Netherlands Enterprise Agency

Geotechnical Report / Investigation Data

Laboratory Test Data
Wind Farm Sites I & II
Hollandse Kust (zuid) Wind Farm Zone

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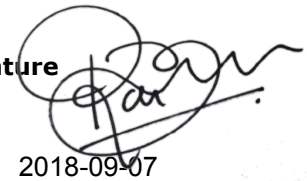
Netherlands Enterprise Agency

RVO.nl distribution

Document title: Geotechnical Report – Laboratory Test Data

Document subtitle: Wind Farm Sites I & II
Hollandse Kust (zuid) Wind Farm Zone

Author (s): Fugro Engineers B.V.
Contract manager RVO.nl: Ruud de Bruijne
Project ID RVO.nl: WOZ1600020
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Version	**Approved for public disclosure by contract manager RVO.nl**	**Approved for public disclosure by project manager offshore wind RVO.nl**
Final	**Name: Ruud de Bruijne** **Signature**  **Date** 2018-09-07	**Name: Matté Brijder** **Signature**  **Date** 2018-09-11

DNV·GL

HOLLANDSE KUST (ZUID) WIND FARM ZONE

Certification Report Site Conditions Geotechnical Investigations and Geological Ground Model

Netherlands Enterprise Agency

Report No.: CR-SC-DNVGL-SE-0190-02453-4_Geotechnical
Date: 2018-09-03



Project name:	Hollandse Kust (zuid) Wind Farm Zone	DNV GL
Report title:	Certification Report Site Conditions Geotechnical Investigations and Geological Ground Model	Renewables Certification Tuborg Parkvej 8 2900 Hellerup Denmark
Customer:	Netherlands Enterprise Agency Croeselaan 15 3521 BJ Utrecht The Netherlands	
Contact person:	Ruud de Bruijne (RVO)	
Date of issue:	2018-09-03	
Project No.:	10016925	
Report No.:	CR-SC-DNVGL-SE-0190-02453-4_Geotechnical	

Applicable contract(s) governing the provision of this Report:

Objective: To confirm that the geotechnical and geological investigations at Hollandse Kust (Zuid) Wind Farm Zone (here: Wind Farm Sites (WFS) I and II) are in accordance with DNVGL-ST-0437 and DNVGL-ST-0126 and can be used within a Design Basis.

Prepared by:	Verified by:	Approved by:
		
Jana Gehrmann-Vorbau Principal Engineer	Dr. Michael Hauschildt Senior Principal Engineer	Erik Asp Senior Principal Engineer

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3	2017-02-09	Update revision of document	Michael Wagner	Dr. Michael Hauschildt	Erik Asp
4	2018-09-03	Update revision of document	Jana Gehrmann-Vorbau	Dr. Michael Hauschildt	Erik Asp

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1 EXECUTIVE SUMMARY

The Hollandse Kust (zuid) WFZ is located in the Dutch Sector of the North Sea, approximately 22 km from the coastline. As part of the tender preparations, the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO) requested a geotechnical site investigation of wind farm sites (WFS) I and II of the Hollandse Kust (zuid) Wind Farm Zone (WFZ) which was based on previously performed geophysical site investigations. Further to the on-site investigations a corresponding laboratory test program was conducted.

DNV GL was assigned to validate the suitability of the conducted investigations and tests for the implementation of a geological ground model and their use within a Design Basis for Offshore Wind Turbine Structures in accordance DNVGL-ST-0437 and DNVGL-ST-0126.

The comprehensive geotechnical campaign and the advanced laboratory test program was defined as a joint effort between multiple parties and reviewed by DNV GL with the objective to reduce the need for boreholes and additional laboratory tests in later stages of development. With a proper CPT calibration and additional CPTs at each planned turbine location it is likely that additional boreholes may be omitted.

However, it is the responsibility of the designer to make the final decision, if additional boreholes or laboratory tests can be omitted to enable an economic and safe foundation design. Further, it is the responsibility of the designer to verify the applicability of the reported test results for the foundation design.

2 CERTIFICATION SCHEME

Document No.	Title
DNVGL-SE-0190:2015-12	Project certification of wind power plants

This report covers the geological survey, geotechnical in-situ testing and soil sampling with static laboratory testing in accordance with section 2.3.2 “Site assessment” of the given Service Specification.

3 LIST OF REPORTS

The appendices to this report comprise the detailed DNV GL certification reports which normally include reference standards/documents, list of design documentation as well as summary and conclusion of the DNV GL evaluation.

APPENDIX	Revision	Subject
A	0	Geotechnical Investigations and Geological Ground Model

4 CONDITIONS

The conditions identified during the technical evaluation are listed in the appendices. The conditions are assigned to the certification phases in which they need to be considered and evaluated.

The conditions listed in the following shall be addressed as part of the certification process.

For the Design Basis phase the following conditions shall be addressed:

- For the final layout of the wind farm zones the detailed geotechnical investigations need to be performed at at each specific (e.g. turbine) location.

5 OUTSTANDING ISSUES

No outstanding issues have been identified.

6 CONCLUSION

Under consideration of the conditions listed in section 4, the geotechnical investigation reports and the geological ground model fulfil the requirements as given in the evaluation criteria listed in section 2 of this report.

APPENDIX A
Geotechnical Investigations and Geological Ground Model

Evaluation of Geotechnical Investigations and Geological Ground Model for Hollandse Kust (zuid) Wind Farm Zone, Wind Farm Sites I and II

A1 Description of verified component, system or item

Within the wind farm area geotechnical and geological investigations have been performed. The results and the found site conditions are documented by the customer and build the basis for the verification of the current report.

A2 Interface to other systems/components

Knowledge obtained from the Geophysical Site Conditions has been considered during the assessment of the Geotechnical Investigations and the Geological Ground Model.

A3 Basis for the evaluation

Applied codes and standards:

Document No.	Revision	Title
DNVGL-ST-0437	November 2016	Loads and site conditions for wind turbines
DNVGL-ST-0126	April 2016	Support structures for wind turbines

A4 Documentation from customer

List of reports:

Document No.	Revision	Title
Fugro Report No.: N6196/02	3 14.10.2016	Geotechnical Report - Investigation Data, Seafloor In Situ Test Locations, Wind Farm Site I, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 562 pages
Fugro Report No.: N6196/04	3 14.10.2016	Geotechnical Report - Investigation Data, Seafloor In Situ Test Locations, Wind Farm Site II, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 507 pages
Fugro Report No.: N6196/01	4 14.11.2016	Geotechnical Report - Investigation Data, Geotechnical Borehole Locations, Wind Farm Site I, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 1501 pages
Fugro Report No.: N6196/03	4 14.11.2016	Geotechnical Report - Investigation Data, Geotechnical Borehole Locations, Wind Farm Site II, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 1433 pages
Fugro Report No.: N6196/09	3 14.11.2016	Geological Ground Model, Wind Farm Site I, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 336 pages

Document No.	Revision	Title
Fugro Report No.: N6196/10	4 02.08.2017	Geological Ground Model, Wind Farm Site II, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 319 pages
Fugro Report No.: N6196/13	4 30.01.2017	Geotechnical Report - Laboratory Test Data, Wind Farm Sites I&II, Hollandse Kust (zuid) Wind Farm Zone, Dutch Sector, North Sea, 1397 pages

A5 Evaluation work

DNV GL has evaluated that the above referenced documents from the customer provide sufficient information to get a good general understanding of the geotechnical and geological conditions in the given wind farm sites WFS I and WFS II.

At each wind farm site eight locations have been investigated by boreholes down to a depth of at least 50 m below mudline, supported by standard cone penetration tests (WFS I: at three locations; WFS II: at two locations) and seismic cone penetration tests (WFS I: at three locations; WFS II: at four locations). The assessment process by DNV GL has been documented in a Verification Comment Sheet (VCS Reference: VCS-08-Rev01-PD-644258).

Furthermore, cone penetration tests at twenty-six and twenty-three locations, respectively, distributed across WFS I and WFS II have been conducted.

The assessment process by DNV GL has been documented in a Verification Comment Sheet (VCS Reference: VCS-07-Rev01-PD-644258).

In addition to initial laboratory tests advanced geotechnical laboratory tests have been conducted for the soil units A, B1, B2, C1, C2 and D using samples from boreholes HKZ1-BH01-SA, HKZ1-BH02-SA, HKZ1-BH07-SA, HKZ1-BH08-SA and HKZ2-BH01-SA, HKZ2-BH03-SA, HKZ2-BH04-SA, HKZ2-BH07A-SA, HKZ2-BH08-SA, HKZ2-BH21-SA for WFS I and WFS II, respectively. The tests include geotechnical index tests, static and cyclic strength tests and dynamic tests. The exact numbers and results can be found in the corresponding report. Further, the test procedures are described and failure conditions are specified where necessary. The assessment process by DNV GL has been documented in a Verification Comment Sheet (VCS Reference: VCS-11-Rev02-PD-644258).

It is evaluated that the used equipment is state-of-the-art in offshore practice and the found results do not deviate from experienced values for parameters of the present soils.

The chosen sites of the conducted investigations are sufficient to develop an illustration of lateral and vertical soil and seabed variations.

It was evaluated that the geological ground model can be relied upon to establish general geological conditions, support discussions on site variability and establish the scope of a future geotechnical investigation campaign, e.g. with respect to park layout studies.

A6 Conditions to be considered in other certification phases

The conditions identified during the technical evaluation are listed in the following. The conditions are assigned to the certification phases in which they need to be considered and evaluated.

For the Design Basis phase the following conditions shall be addressed:

- For the final layout of the wind farm zones the detailed geotechnical investigations need to be performed at at each specific (e.g. turbine) location.

A7 Outstanding issues

No outstanding issues have been identified.

A8 Conclusion

The verification work performed by DNV GL confirms that the “Site assessment” as seen by the documentation from customer related to the Hollandse Kust (zuid) Wind Farm Zone as listed under section A4 fulfils the relevant demands set up in the Certification Scheme DNVGL-SE-0190:2015-12, section 2.3.2 and the related “Basis for the evaluation” listed in section A3 if the condition in chapter A6 is observed.

The geotechnical investigation reports and the geological ground model can be used to support the (preliminary) design of future offshore wind farms in the project area. The data presented in those reports can be used for establishing a Design Basis in accordance with DNVGL-ST-0437 and DNVGL-ST-0126.

About DNV GL

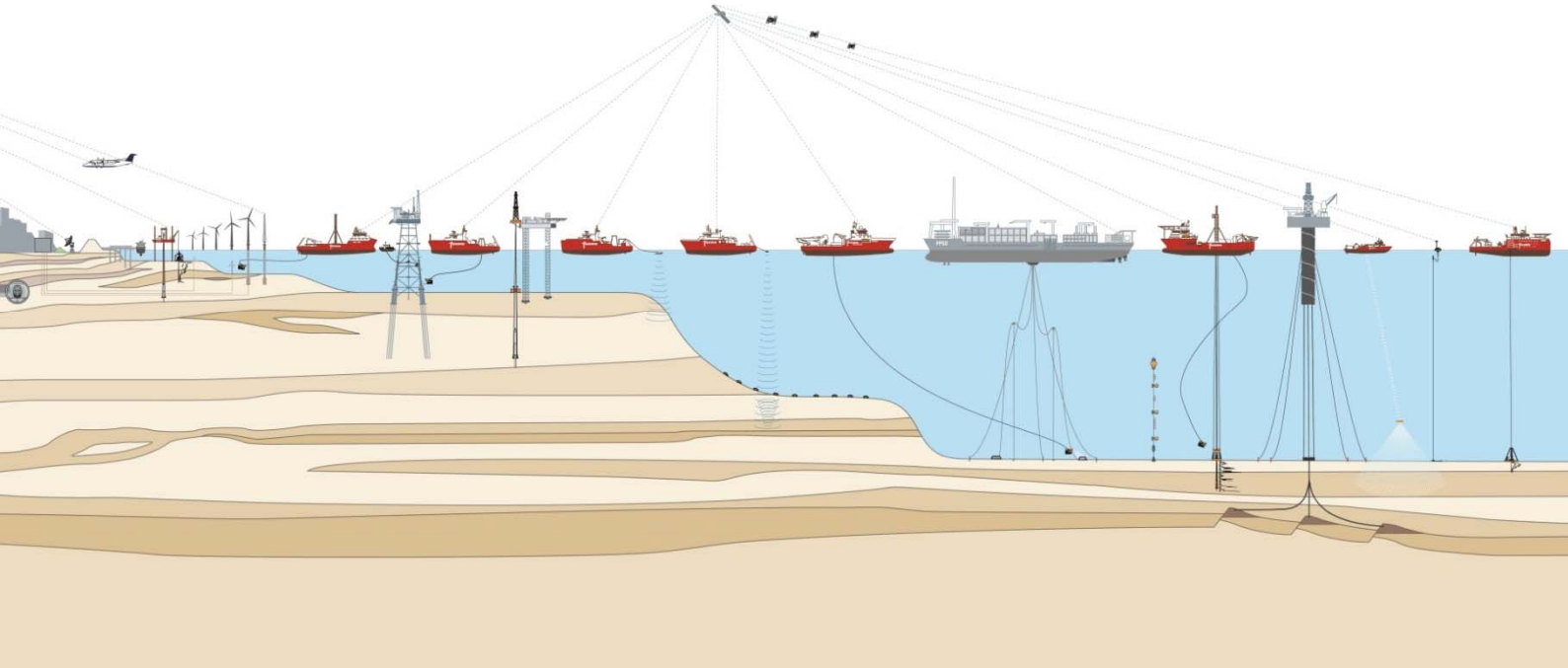
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.

Geotechnical Report
Laboratory Test Data
Wind Farm Sites WFS I&II
Hollandse Kust (zuid) Wind Farm Zone
Dutch Sector, North Sea

Client Reference No. WOZ 1600020
Fugro Report No. N6196/13
Issue 4

Rijksdienst voor Ondernemend Nederland

Rijksdienst voor Ondernemend Nederland (RVO)



Geotechnical Report
Laboratory Test Data
Wind Farm Sites WFS I&II
Hollandse Kust (zuid) Wind Farm Zone
Dutch Sector, North Sea

Client Reference No. WOZ 1600020
Fugro Report No. N6196/13
Issue 4

Client	Rijksdienst voor Ondernemend Nederland (RVO)
Client Contact	R. de Bruijne
Client Address	Croeselaan 15 3521 BJ UTRECHT The Netherlands

Rijksdienst voor Ondernemend Nederland

Fugro Project Lead	E. Schoute - Senior Project Engineer

Issue	Document Status	Date
4	Revised Final	30-Jan-2017
3	Final	20-Jan-2017
2	Fugro Approved Draft	23-Dec-2016
1	Fugro Approved Interim Draft	05-Dec-2016

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SUMMARY

The Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO), henceforth referred to as 'Client', has requested Fugro to perform a geotechnical investigation of wind farm sites (WFS) I to IV of the Hollandse Kust (zuid) Wind Farm Zone (WFZ). The Hollandse Kust (zuid) WFZ is located in the Dutch Sector of the North Sea, approximately 22 km from the coastline (refer to "Vicinity Map" on Page iii and "Detailed Location Plan" on Page iv).

The objective of the geotechnical investigation and associated laboratory testing programme for WFS I to WFS IV is to:

- Improve the geological and geotechnical understanding of Hollandse Kust (zuid) WFZ;
- Update an earlier geological and geophysical model;
- Provide a detailed geological ground model;
- Determine the vertical and lateral variation in seabed conditions;
- Provide relevant geotechnical data to progress the design of wind farm foundation elements, including, but not limited to foundations and cables.

The offshore phase of the geotechnical investigation included seafloor in situ testing, geotechnical borehole drilling with downhole sampling and/or in situ testing and geotechnical laboratory testing. An in-office programme of geotechnical laboratory testing and reporting of results followed the offshore phase.

This report is one of a set of Fugro reports which are delivered as part of this project. This particular report provides laboratory test results for WFS I&II and comprises the following:

- Results of geotechnical index tests;
- Results of static triaxial and direct simple shear tests;
- Results of cyclic triaxial and cyclic simple shear tests;
- Results of dynamic tests;
- Cyclic and static test results plotted on S-N degradation curves;
- Cyclic test results plotted with Drammen Clay Model as background.

The advanced static and cyclic laboratory test programme was prepared in consultation with Client, Client consultants, certifying authority (DNV) and Fugro experts within the context of optimisation of value of data and provision of a sufficiently diverse data set to accommodate different requirements from potential developers and designers. The planned programme was extended with selected test types such as drained cyclic tests and resonant column tests as a result of these initial consultations. The advanced laboratory test programme uses and builds upon the results from the initial laboratory test programme. During the advanced test programme results were used as they became available to further optimize the test programme.

This report is one in a series of reports prepared as part of this project (refer to "List of Project Reports" on Pages v and vi). Companion reports for WFS I&II contain results of geotechnical borehole locations and seafloor in situ test locations and describe a geological ground model for sites WFS I&II including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.

SAMENVATTING

De Rijksdienst voor Ondernemend Nederland (RVO) heeft Fugro gecontracteerd voor een geotechnisch onderzoek in de windgebiedkavels WFS I t/m WFS IV van het Hollandse Kust (zuid) Windgebied. Het Windgebied Hollandse Kust (zuid) ligt in het Nederlandse deel van de Noordzee, ongeveer 22 km voor de kust (zie “Vicinity Map” op Page iii en “Detailed Location Plan” op Page iv).

Het doel van het geotechnisch onderzoek en bijbehorend programma van laboratoriumproeven voor WFS I t/m WFS IV is om:

- Inzicht te verkrijgen in de geologische en geotechnische omstandigheden in Windgebied Hollandse Kust (zuid);
- Het bestaande geofysische en geologische model te verfijnen;
- Een gedetailleerd geologisch grondmodel te genereren;
- De verticale en laterale variabiliteit van de grond te bepalen;
- Relevante geotechnische data voor de ontwikkeling van het ontwerp van windpark funderingsconstructies beschikbaar te stellen, inclusief maar niet gelimiteerd tot funderingen en kabels.

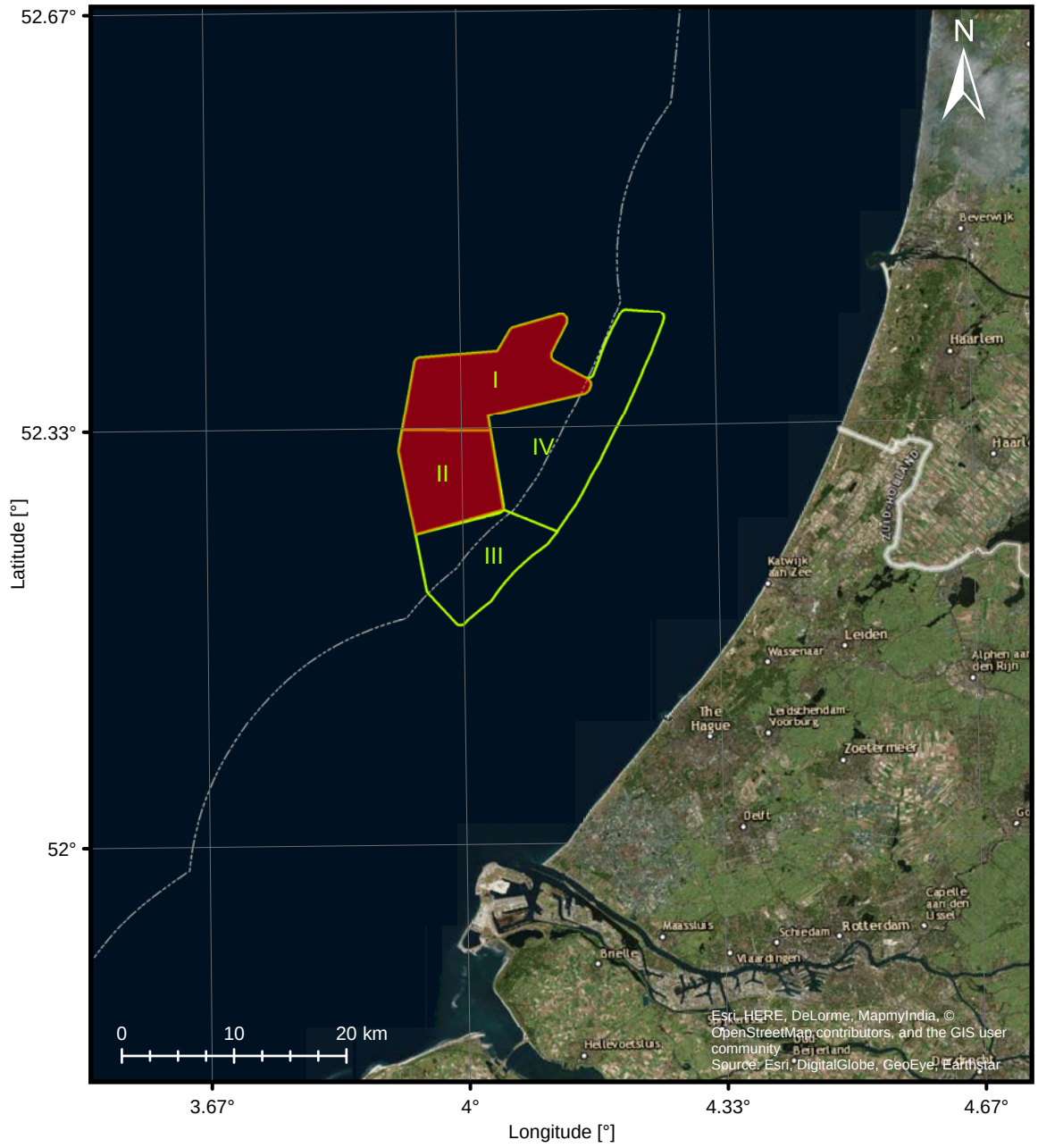
Het geotechnisch onderzoek bestond uit sonderingen vanaf de zeebodem, geotechnische boorgaten met monsternames en/of in situ testen en geotechnische laboratoriumproeven, gevolgd door een geotechnisch laboratorium testprogramma en rapportage van de resultaten.

Dit rapport maakt deel uit van een serie van Fugro rapporten. Dit rapport bevat geotechnische onderzoeks-resultaten voor WFS I&II en omvat het volgende:

- Resultaten van geotechnische classificatie proeven;
- Resultaten van statische triaxiaal proeven en statische schuif proeven;
- Resultaten van cyclische triaxiaal en cyclische schuif proeven;
- Resultaten van dynamische proeven;
- Grafieken van statische en cyclische testresultaten met S-N degradatielijnen als achtergrond;
- Grafieken van cyclische testresultaten met het ‘Drammen Clay’ model als achtergrond.

Het statische en cyclische laboratorium testprogramma is opgezet in samenspraak met RVO, consultants van RVO, certificeringsinstantie (DNV), en Fugro experts met als doel het optimaliseren van de waarde van data en het leveren van een voldoende uitgebreide data set om aan de verschillende eisen van ontwikkelaars en ontwerpers tegemoet te komen. Naar aanleiding van deze initiële consultaties is het geplande programma uitgebreid met bepaalde test types zoals gedraineerde cyclische testen en resonant column testen. Het laboratorium testprogramma gebruikt en bouwt verder op de resultaten van het initiële laboratorium testprogramnma. Gedurende het cyclische testprogramma zijn resultaten die beschikbaar kwamen gebruikt om het programma verder te optimaliseren.

Dit rapport maakt deel uit van een serie van rapporten t.b.v. dit project (zie “List of Project Reports” op Pages v en vi). Zes andere rapporten die WFS I&II behandelen bevatten respectievelijk: de resultaten van de geotechnische boorgatlocaties, in situ testlocaties vanaf de zeebodem, en een geologisch grondmodel voor WFS I&II voorzien van informatie over stratigrafie, laterale variabiliteit, geo-risico’s, geologische analyses, biostratigrafische analyses, algemene geotechnische parameters en een inschatting van de geotechnische geschiktheid van bepaalde constructie types.



Investigation Area I&II (subjects of this report)

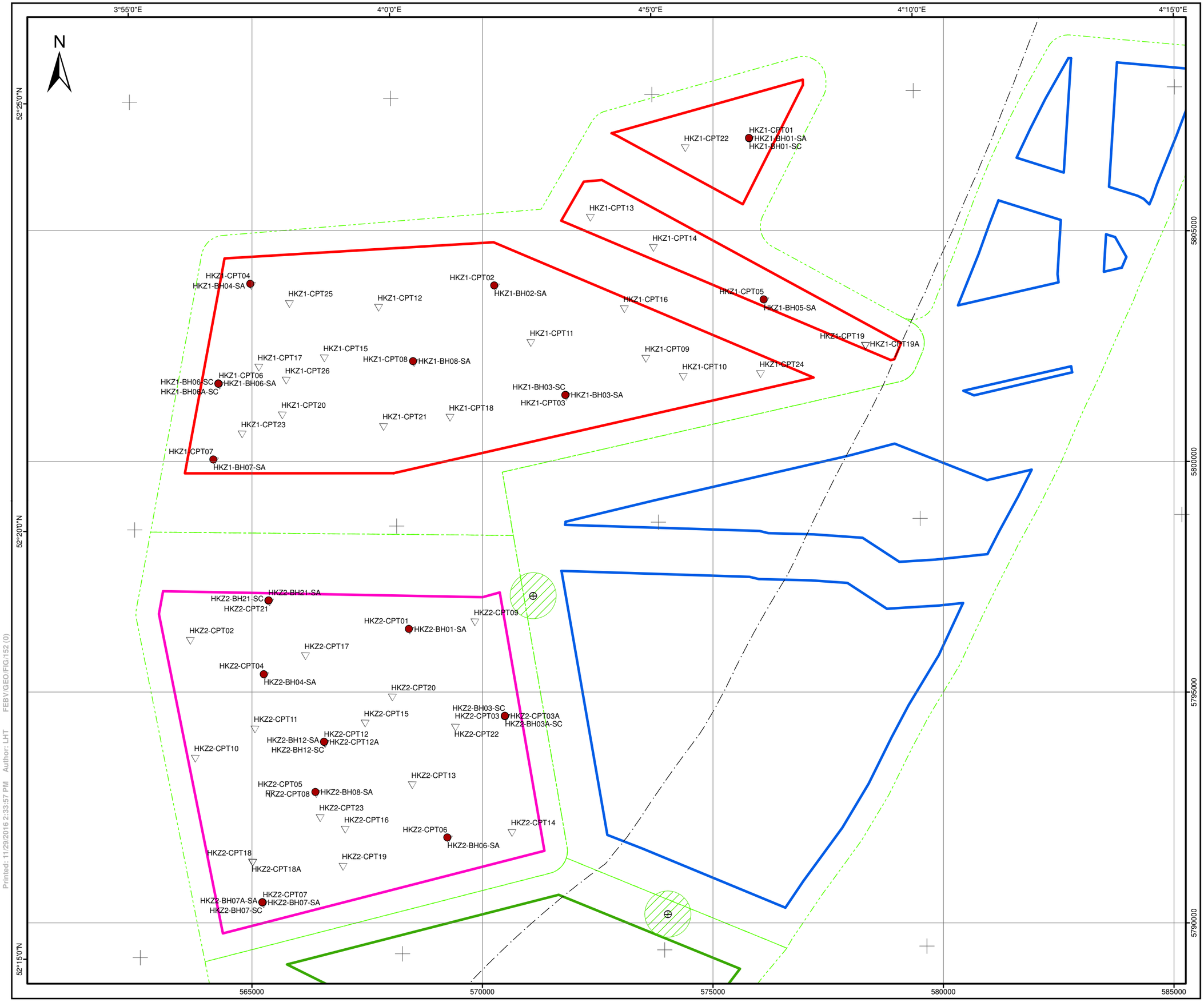
Outline of Hollandse Kust (zuid) Investigation Areas (Roman numeral indicates area number)

12 nautical mile boundary

Datum: ETRS 1989
Ellipsoid: GRS 1980

Printed: 12/23/2016 8:43:22 AM

VICINITY MAP



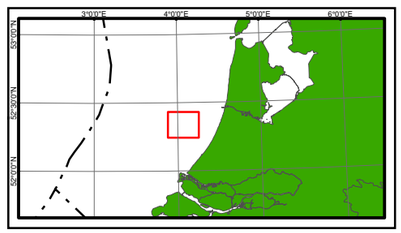
LEGEND:

- Borehole Location - Downhole geotechnical
- Test Point - Seafloor In Situ Test
- 12 nautical mile boundary
- Proposed Platform Locations
- Outline Investigation Areas
- Proposed Platform Exclusion Zone
- Wind Farm Site I
- Wind Farm Site II
- Wind Farm Site III
- Wind Farm Site IV

NOTES:

GEODETIC PARAMETERS:

DATUM	ETRS89
Ellipsoid	GRS80
Semi major axis	a = 6 378 137.000
Inverse flattening	1/f = 298.257222101
PROJECTION	UTM, Zone 31 North
Central Meridian (CM)	3° 00' 00" E
Latitude of Origin	0° 00' 00" N
False Easting	500 000 m
False Northing	000 000 m
Scale factor	0.9996
Units	metres / degrees



Rijksdienst voor Ondernemend Nederland (RVO)
Croeselaan 15, 3521 BJ, Utrecht - THE NETHERLANDS

Fugro
Prismastraat 4, 2631 RT, Nootdorp - THE NETHERLANDS

DETAILED LOCATION PLAN

HOLLANDSE KUST (ZUID) WFZ, WFS I - DUTCH SECTOR, NORTH SEA

Scale 1:76,000
at original A3 page size

0 500 1,000 1,500 metres

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Report Number	Title	Contents
N6196/01	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical laboratory tests.
N6196/02	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/03	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical laboratory tests.
N6196/04	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/05	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical and environmental laboratory tests.
N6196/06	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/07	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical and environmental laboratory tests.
N6196/08	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/09	Geological Ground Model Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/10	Geological Ground Model Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/11	Geological Ground Model Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.

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LIST OF PROJECT REPORTS

Report Number	Title	Contents
N6196/12	Geological Ground Model Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/13	Geotechnical Report - Laboratory Test Data Wind Farm Sites I & II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Results of advanced static and cyclic laboratory tests.
N6196/14	Geotechnical Report - Laboratory Test Data Wind Farm Sites III & IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Results of advanced static and cyclic laboratory tests.
N6196/15	Geotechnical Report - Investigation Data - Substation Alpha Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor and downhole cone penetration tests and results from geotechnical laboratory tests.
N6196/16	Geotechnical Report - Investigation Data - Substation Beta Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor and downhole cone penetration tests, pore pressure dissipation tests and results from geotechnical laboratory tests.

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LIST OF PROJECT REPORTS

1. OVERVIEW

1.1 Purpose of Report

In 2013 more than 40 organisations and the Dutch government entered into the Energy Agreement for Sustainable Growth ('Energieakkoord voor Duurzame Groei'). An important part of this agreement includes scaling up of offshore wind power development. The Ministry of Economic Affairs presented a road map outlining how the Government plans to achieve its offshore wind goals in accordance with the time line agreed upon in the Energy Agreement.

The road map sets out a schedule of tenders offering 700 MW of development each year in the period 2015 to 2019. The Dutch Government has developed a systematic framework under which offshore wind farm zones are designated. Any location outside these wind farm zones is not eligible to receive a permit. Within the designated wind farm zones the government decides the specific sites where wind farms can be constructed using a so-called Wind Farm Site Decision ('Kavelbesluit'). This contains conditions for building and operating a wind farm on a specific site. The Dutch transmission system operator TenneT will be responsible for grid connection.

Winners of the site development tenders will be granted a permit to build a wind farm according to the Offshore Wind Energy Act ('Wet Windenergie op Zee'), a SDE+ grant and offered a grid connection to the main land. The Ministry provides all relevant site data, which can be used for the preparation of bids for these tenders.

As part of the tender preparations, the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO), henceforth referred to as 'Client', has requested Fugro to perform a geotechnical site investigation of wind farm sites (WFS) I to IV of the Hollandse Kust (zuid) Wind Farm Zone (WFZ). The Hollandse Kust (zuid) WFZ is located in the Dutch Sector of the North Sea, approximately 22 km from the coastline (refer to "Vicinity Map" on Plate 1 and "Detailed Location Plan" on Plate 2).

The objective of the geotechnical investigation and associated laboratory test programme for WFS I to WFS IV is to:

- Improve the geological and geotechnical understanding of Hollandse Kust (zuid) WFZ;
- Update an earlier geological and geophysical model;
- Provide a detailed geological ground model;
- Determine the vertical and lateral variation in seabed conditions;
- Provide relevant geotechnical data to progress the design of windfarm foundation elements, including, but not limited to foundations and cables.

The offshore phase of the geotechnical investigation included seafloor in situ testing, geotechnical borehole drilling with downhole sampling and in situ testing and geotechnical laboratory testing. An office programme of geotechnical laboratory testing and reporting of results followed the offshore phase.

1.2 Scope of Report

This report is one of a set of Fugro reports which are delivered as part of this project. This particular report provides laboratory test results for WFS I&II and comprises the following:

- Results of geotechnical index tests;
- Results of static triaxial and direct simple shear tests;
- Results of cyclic triaxial and cyclic simple shear tests;
- Results of dynamic tests;
- Selected cyclic test results plotted with S-N degradation curves as background;
- Selected cyclic test results plotted with Drammen Clay Model as background.

Results presented in this report are for an area demarcated as Investigation Areas I and II (Plates 1 and 2).

1.3 Report Format

This report is one in a series of reports prepared as part of this project (refer to “List of Project Reports” on Plates 3 and 4). Companion reports for WFS I&II contain results of geotechnical borehole locations and seafloor in situ test locations and describe a geological ground model for sites WFS I&II including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.

This report uses and summarises information from sources listed in Section 3. The reader should consult the source information for details. Understanding of site conditions improves upon further data acquisition and interpretation. This means that some of the source interpretations may be superseded by information presented in this report. Similarly, interpretations given in this report may require updating in the future.

The principal sections of this report are the Summary, Main Text, Plates following Main Text, and Section A. Comments are as follows:

- The Summary section allows a quick-scan management overview. It includes a selection of plates. The selected plates are duplicates from a larger set of Plates following Main Text;
- Section 2 of the Main Text focuses on methodology;
- Section A provides the principal information as described in Section 1.2 “Scope of Report”. This section should be read in conjunction with the Plates following Main Text, where applicable;
- Section A starts with primary information, which may consist of links to Plates following Main Text. Plate numbering starts with a section number, e.g. Plate A1-1 belongs to Section A1.

1.4 Project Responsibilities and Use of Report

This report presents information according to a project specification determined and monitored by the Client. The Main Text section titled “Sources of Information and References” provides further details. Particularly, the Client selected and approved borehole locations and sample and test depths, monitored and approved data acquisition and supplied information for geotechnical project use.

The report was prepared in accordance with Contract WOZ 1600020 between Rijksdienst voor Ondernemend Nederland and Fugro Engineers B.V., dated 15 June 2016.

This report must be read in conjunction with Section B, “Use of Report”. This section includes information about report issue control.

Fugro understands that this report will be used for the purpose described in this Main Text section. That purpose was a significant factor in determining the scope and level of the services. Results must not be used if the purpose for which the report was prepared or the Client’s proposed development or activity changes. Results may possibly suit alternative use. Suitability must be verified.

2. LABORATORY TEST PROGRAMME

2.1 Test Results

The geotechnical laboratory test programme comprised (where appropriate) geotechnical index, (cyclic) strength, and dynamic testing, including:

- Particle size distribution (PSD);
- Isotropically and anisotropically consolidated undrained triaxial in compression (CIUc/CAUc);
- Isotropically consolidated undrained triaxial in extension (CIUe);
- Isotropically consolidated drained triaxial in compression (CIDc);
- Resonant column (RC);
- Cyclic triaxial (CTX);
- Direct simple shear (DSS);
- Bender Element (BE) on selected specimens used for DSS testing;
- Cyclic simple shear (CSS).

Laboratory test results are provided in Section A "Geotechnical Laboratory Test Results". Section A further presents details and includes commentary on individual test results where required. The static and cyclic test programme covered specimens of six soil units present across WFS I&II. Refer to Table 2.1 for a general overview and Section A, specifically Table A1.1, for details. For background information regarding different soil units identified across WFS I&II, refer to the companion Geological Ground Model reports (see "List of Project Reports" on Plates 3 and 4).

Table 2.1: Overview of Soil Units and Associated Laboratory Test Programme

Unit	Formation (Member)	Test type(s)
A	Southern Bight (-)	Geotechnical index, (cyclic) strength, and dynamic
B1	Kreftenheye (sand member)	Geotechnical index, (cyclic) strength, and dynamic
B2	Kreftenheye (clay member)	(Cyclic) strength and dynamic
C1	Eem (Brown Bank)	(Cyclic) strength and dynamic
C2	Eem (alternating sand/clay member)	Geotechnical index, (cyclic) strength, and dynamic
D	Yarmouth Roads (-)	Geotechnical index, (cyclic) strength, and dynamic

In this report, soil units will be referred to using a combination of unit and formation name (e.g. "Unit B1 (Kreftenheye)").

Units A (Southern Bight) and B1 (Kreftenheye) consist predominantly of coarse-grained cohesionless soils. Unit B2 (Kreftenheye) and Unit C1 (Eem) consist predominantly of fine-grained cohesive soils. Units C2 (Eem) and D (Yarmouth Roads) consist of both soil types. Spatial variability in soil properties across WFS I&II as well as within the individual formations at specific locations is considerable. The test programme and associated test specimen selection was planned to support assessment of the predominant soil properties of specific formations. Variation in soil conditions within formations may not be fully captured by the test programme, particularly for Units C2 and D. The laboratory test programme is detailed in Section A1.1.

Results of CSS tests are, where appropriate, plotted on so-called S-N graphs (refer to Plates 5 and 6), which show normalized cyclic shear stress (Cyclic Stress Ratio, CSR) versus number of cycles to

failure (N). Cyclic degradation curves and results from static tests are included in the S-N graphs for selected test results. Static results plotted on the S-N graphs were normalized using the same reference strength or reference stress as was used for corresponding cyclic tests.

The cyclic degradation curves presented on the S-N graphs were generated using a best-fit power regression model through data points corresponding to test results of specimens that failed at a number of cycles less than 1500 and only selected test results for specimens that did not show failure before 1500 cycles. In case of multiple tests that did not fail before 1500 cycles, the test performed applying the highest CSR was used for the regression. Even though test results with no clear failure before 1500 cycles at lower CSRs were not considered for the regression lines, the data points are still included on the S-N graphs.

Some data points presented in the S-N graphs have a (nearly) identical combination of number of cycles to failure (N_f) and CSR and plot therefore on top of the other. Details about the individual test results are presented in the summary tables (refer to Plates A1-1 to A1-14).

The S-N graph for CSS tests on coarse-grained cohesionless specimens (Plate 6) includes background degradation curves proposed by Andersen (2009) for CSS tests with symmetrical cyclic loading (τ_{av}=0) on normally consolidated sands and silts with selected relative densities ranging from 40 % to 100 % and consolidation stresses ranging from 85 kPa to 710 kPa. It may be noted that specimens from Unit A (Batch 2) were consolidated at lower stresses than the tests used to derive the background degradation curves.

In the S-N graph for CSS tests on fine-grained cohesive specimens (Plate 5), no degradation curve is presented for Unit C (Eem) due to insufficient data points. In the S-N graph for CSS tests on coarse-grained cohesionless specimens (Plate 6), no degradation curve is presented for Unit A (Southern Bight) as data points are outside the expected range, i.e. specimens show an apparent higher cyclic resistance, for construction of a typical cyclic degradation curve for this soil type.

Presented S-N curves should be used with care. Specific design situations require verification of suitability of the laboratory approach and presented regression lines.

Results of CTX and CSS tests on fine-grained cohesive specimens are plotted with background Drammen Clay Model contours (Andersen et al., 1988), refer to Plates 7 to 10. Results are plotted for Drammen Clay Models with a yield stress ratio (YSR) of 1 and 4. Reference strengths selected for plotting the CSS test results are the same as used for S-N normalization. Details about average shear strain, cyclic shear strain and number of cycles at failure are presented to the right of the data points. Details about test results are presented in the summary tables in Section A1. It is to be noted that the test results do not particularly match with presented Drammen Clay Model contours. The contours were included to provide a cross-reference of the test results with a known model.

2.2 Premises and Assumptions

The advanced static and cyclic laboratory test programme was prepared in consultation with Client, Client consultants, certifying authority (DNV) and Fugro experts within the context of optimisation of value of data and provision of a sufficiently diverse data set to accommodate different requirements

from potential developers and designers. The planned programme was extended with selected test types such as drained cyclic tests and resonant column tests as a result of these initial consultations. The advanced laboratory test programme uses and builds upon the results from an earlier laboratory test programme carried out as part of this project (refer to “List of Project Reports” on Plates 3 and 4). During the advanced test programme results were used as they became available to further optimize the test programme.

The laboratory test programme aims to provide a broad use of acquired test results of (a) the soils predominantly present at WFS I&II, and (b) the soils considered relevant for probable future structure design. The programme was prepared to include a variety of test types, test specimen conditions and different loading conditions. Inevitably not every variation could be accounted for within the test programme. Important considerations for the (cyclic) test programme include:

- Cyclic shear testing was performed to support assessment of soil strength degradation under 2-way cyclic loading, and under undrained conditions. Individual tests targeted specimen failure within 1500 cycles, to allow construction of S-N degradation curves, with specific interest in the zero to 200 number of cycles to failure range;
- Cyclic triaxial testing was performed to primarily support assessment of cyclic soil response under typical foundation, i.e. a monopile, design loads under both drained (where relevant) and undrained conditions. The cyclic load conditions were selected in consultation with Client. Conditions for individual tests are based on previous experience and not on a site or location specific foundation design.

Static and cyclic testing on the fine-grained cohesive soil units use undisturbed specimens. Test conditions, i.e. vertical and radial stresses for re-compression, were selected based on estimated in situ stress conditions.

Static and cyclic testing for the coarse-grained cohesionless soil units use specimens from batch samples. For each coarse-grained cohesionless soil unit, one or two batches were created using a selection of samples from one or two boreholes per batch. For each batch, static and cyclic testing is performed on reconstituted test specimens with similar target (dry) densities and consolidation stresses per batch. Refer to Table A1.2 in Section A1 for composition details of batch samples.

Cyclic testing is performed at a frequency of 0.1 Hz, i.e. a cycle of 10 seconds. Specimens are subjected to stress-controlled cyclic loading under drained or undrained conditions and a sinusoidal loading waveform to determine cyclic strain accumulation and post-cyclic effects on the ultimate resistance. Specimens are tested at selected cyclic stresses (τ_{cy}) and average cyclic stresses (τ_{av}).

Pre-shear (drained) cyclic testing is applied for CSS tests on coarse-grained cohesionless specimens. Pre-shear includes 400 cycles at selected (low) combinations of average and cyclic stresses. CSS testing on fine-grained cohesive specimens also included a cyclic loading stage of 400 cycles under

drained conditions[1]. CSS testing was continued at selected (higher) combinations of average and cyclic stresses up to a maximum of 1500 cycles.

Two cyclic stages are applied for CTX tests on fine-grained cohesive and coarse-grained cohesionless specimens. The first cyclic stage consist of applying a maximum of 1500 load cycles, whereas the second cyclic stage consists of applying a maximum of 400 load cycles at selected (higher) combinations of average and cyclic stresses.

The different pre-shear and/or cyclic load stages were selected considering the objectives for the different test types. The applied number of load cycles are based on a standardized maximum number of load cycles for a pre-shear, a first or a consecutive cyclic load phase. The number of cycles are not based on site specific loading conditions. The cyclic loading regime applied for CSS and CTX triaxial testing are not related. Comments on the different phases include:

- For CSS tests, pre-shear on coarse-grained cohesionless specimens is applied to improve cyclic soil response during the cyclic loading stage. An initial 400-load-cycle stage (i.e. a pre-shear) was not intended on fine-grained cohesive specimens but was applied for consistency reasons, refer for details to above. The main cyclic load stage for CSS testing consisted of loading the specimen to failure within 1500 cycles, or, to a maximum of 1500 cycles;
- For CTX testing, the two different cyclic phases intend to simulate typical actions during the foundation's lifetime, i.e. an initial phase (long duration) with cyclic loading in line with expected design loads for the various limit states, followed by a short-duration phase simulating extreme loads. Selected cyclic load conditions were such that specimen failure was not expected during either one of the cyclic phases. This allowed post-cyclic static strength testing.

Cyclic testing is terminated when failure of the specimen is evident, or at 400/1500 cycles, whichever condition is reached first. Specimen failure is considered to be achieved when one of the following conditions is met:

- The average shear strain exceeds 15 %;
- The cyclic shear strain amplitude exceeds 15 %;
- Excess pore water pressure exceeds 95 % of the effective stress in the specimen at the start of cycling;
- The applied cyclic shear stress drops to less than 90 % of the specified value.

Post-cyclic testing is performed on CSS and CTX specimens subjected to 1500 load cycles (and additional 400 cycles where applicable) without reaching failure. Post-cyclic static shearing is performed up to a nominal axial or shear strain of 20 % to 25 %.

[1] Note that the 400 load cycles stage was initially not planned on fine-grained cohesive specimens. Due to an oversight it was however applied during the first two tests of the CSS test series on fine-grained cohesive specimens. It was decided to continue this approach throughout the test series to allow comparison of results. The information from this stage can be used for assessment of cyclic behaviour under small cyclic loading conditions.

2.3 Test Preparations and Test Conditions

Batch samples were prepared for tests on coarse-grained cohesionless material. A particle size distribution (PSD) has been determined of each batch sample. PSDs are presented on Plates A2-1 and A2-2.

Selection of dry densities for preparation of coarse-grained cohesionless specimens is based on (a) average measured unit weights and water contents, and (b) test conditions used for tests performed previously on specimens from similar soil units.

Consolidation of test specimens was performed either isotropically or anisotropically, following an assessment of expected in situ stress conditions using available laboratory test data and derived cone penetration test (CPT) parameters. Coefficient of earth pressure at rest (K_0) was estimated for fine-grained cohesive specimens using a proposed relation between OCR, plasticity and K_0 (Brooker and Ireland, 1965) and by using Mayne and Kulhawy (1982); Mayne (1995) was used for a K_0 determination using CPT data for coarse-grained cohesionless specimens.

Consolidation stresses for tests on fine-grained cohesive specimens were chosen similar to calculated in situ vertical effective stresses. In situ stress conditions used the unit weight profiles as used in calculation of derived CPT parameters, presented in companion reports (refer to Plates 3 and 4). For coarse-grained cohesionless specimens, selected consolidation and test stresses represent an approximate average of in situ stress levels within the target formation of the batch. For Unit A (Southern Bight), a higher than average level was selected considering the recommended lower limits of the test apparatus (which is around 10 kPa to 15 kPa).

The reference strength used for normalisation of average and cyclic shear stresses of tests on fine-grained cohesive specimens was assessed as follows:

- CSS tests: peak shear stress (τ_{peak}) of static (DSS) tests on nearby samples;
- CTX tests: peak deviator stress (q_{peak}) of static (CIUc, CAUc) tests on nearby samples.

The reference strength used for normalisation of average and cyclic shear stresses of tests on coarse-grained cohesionless specimens was assessed as follows:

- CSS and undrained CTX tests: applied vertical consolidation stress (σ'_{vc});
- Drained CTX tests: peak deviator stress (q_{peak}) or deviator stress at peak principle effective stress ratio ($(\sigma'_1/\sigma'_3)_{peak}$) of static (CIDc) tests on nearby samples.

For this test programme “drained” testing is accommodated by allowing specimen to drain during a loading phase. One-way drainage is applied. The cyclic loading frequency was not adjusted in case pore pressure build-up during the cyclic load phase occurred.

Bender element tests were scheduled to measure shear wave velocity (v_s) and shear modulus at small strain (G_{max}). Bender element tests were performed on some of the DSS tests on fine-grained cohesive and coarse-grained cohesionless specimens. Specimens from all considered soil units were tested.

Resonant column tests were scheduled to determine shear modulus and damping ratio at small shear strain values by torsional vibration. Tests were performed as part of static (CIUc) triaxial tests on fine-grained cohesive specimens, or as part of static (CIDc, CIUc, CAUc) triaxial tests on coarse-grained cohesionless specimens. One resonant column test has been carried out as a standalone test on an undisturbed specimen specifically selected for this test. Resonant column tests were performed prior to static testing, where applicable.

3. SOURCES OF INFORMATION AND REFERENCES

3.1 Client-supplied Information

This report summarises and relies on Client-supplied information:

- Deltares, 2015. *Geological study Hollandse Kust (Zuid) Wind Farm Zone, Final Report, Report No. 1221136-000-BGS-0006, 22 December 2015.* Utrecht: Deltares.
- Fugro Survey B.V., 2016a. *Geophysical Site Investigation Survey. Hollandse Kust (zuid) Wind Farm Development Zone - Wind Farm Site I. Report No. GH176-R1, Rev 01, 13 May 2016.*
- Fugro Survey B.V., 2016b. *Geophysical Site Investigation Survey. Hollandse Kust (zuid) Wind Farm Development Zone - Wind Farm Site II. Report No. GH176-R2, Rev 01, 13 May 2016.*
- Fugro Survey B.V., 2016c. *Geophysical Site Investigation Survey. Hollandse Kust (zuid) Wind Farm Development Zone - Wind Farm Site III. Report No. GH176-R3, Rev 01, 23 May 2016.*
- Fugro Survey B.V., 2016d. *Geophysical Site Investigation Survey. Hollandse Kust (zuid) Wind Farm Development Zone - Wind Farm Site IV. Report No. GH176-R4, Rev 01, 23 May 2016.*
- Periplus Archeomare, 2016. *Desk study archaeological assessment, Final Report (Rev 04), Report No. 15A024-01, 29 January 2016.* Amsterdam: Periplus Archeomare.
- REASeuro, 2016. *Unexploded Ordnance (UXO) - Desk Study, Final Report (Rev 02), 12 February 2016.* Riel: Riel Explosive Advice & Services Europe B.V.
- Rijksdienst voor Ondernemend Nederland, 2016a. *Wind Farm Zone Hollandse Kust (zuid) - Starting points & Assumptions - Part I General, Rev 05, 20 April 2016*.
- Rijksdienst voor Ondernemend Nederland, 2016b. *Soil Investigations Wind Farm Zones - Section IV-d. Scope of Work Geotechnical Survey. Hollandse Kust (zuid) Wind Farm Zone, Final, 13 June 2016.*
- Data from Geophysical Site Investigation Survey in digital file format (e.g. *.SEGY, *.XYZ-format):
  - Multibeam Echo Sounder (MBES) data
  - Sidescan Sonar (SSS) data
  - Magnetometer (MAG) data
  - Sparker data, Multichannel Seismic (MCS)
  - Pinger data, Sub-Bottom Profiler (SBP).

3.2 Fugro Information

This report uses and summarises Fugro-held information:

- Fugro data base:
  - Information about regional geology
  - General geotechnical data
  - Previous geotechnical investigation data applicable to nearby sites.

3.3 References of Main Text

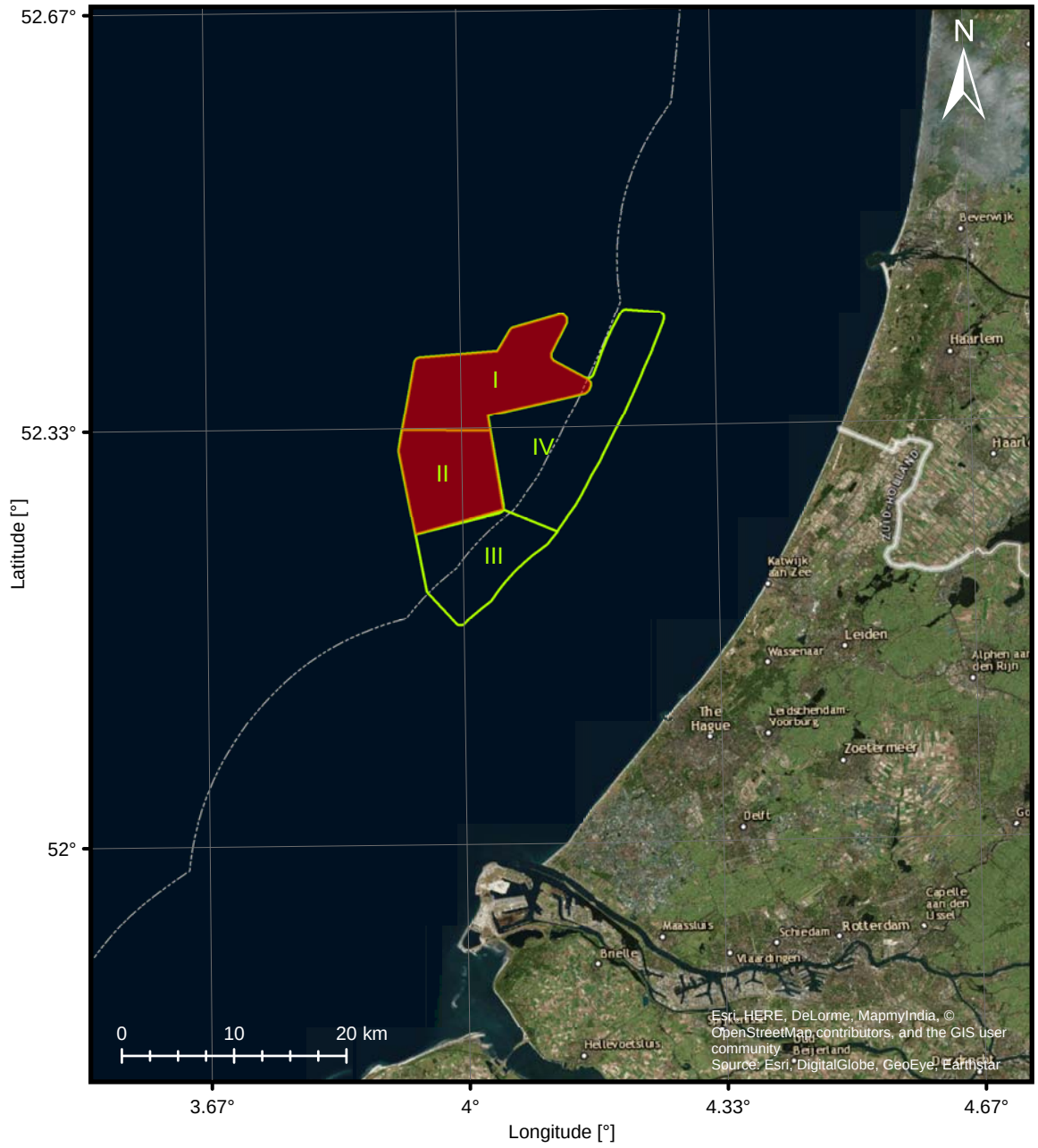
Andersen, K.H., Kleven, A. and Heien, D., 1988. Cyclic Soil Data for Design of Gravity Structures, *Journal of Geotechnical Engineering*, 114 (5), May 1988, pp. 517-539.

Andersen, K.H., 2009. Bearing Capacity under Cyclic Loading - Offshore, along the Coast, and on Land. The 21st Bjerrum Lecture presented in Oslo, 23 November 2007. *Canadian Geotechnical Journal*, Vol. 46, No. 5, pp. 513-535.

Brooker, E.W. and Ireland, H.O., 1965. Earth Pressures at Rest Related to Stress History. *Canadian Geotechnical Journal*, Vol. 2, No. 1, pp. 1-15.

Mayne, P.W. and Kulhawy, F.H., 1982. K_o - OCR Relationships in Soil*. Journal of the Geotechnical Engineering Division,* Vol. 108, No. GT6, pp. 851-872.

Mayne, P.W. 1995. CPT Determination of Overconsolidation Ratio and Lateral Stresses in Clean Quartz Sands. In *International Symposium on Cone Penetration Testing CPT'95, Linköping, Sweden, October 4-5, 1995, Vol. 2,* Linköping: Swedish Geotechnical Society, SGF Report, No. 3:95, pp. 215-220.



Investigation Area I&II (subjects of this report)

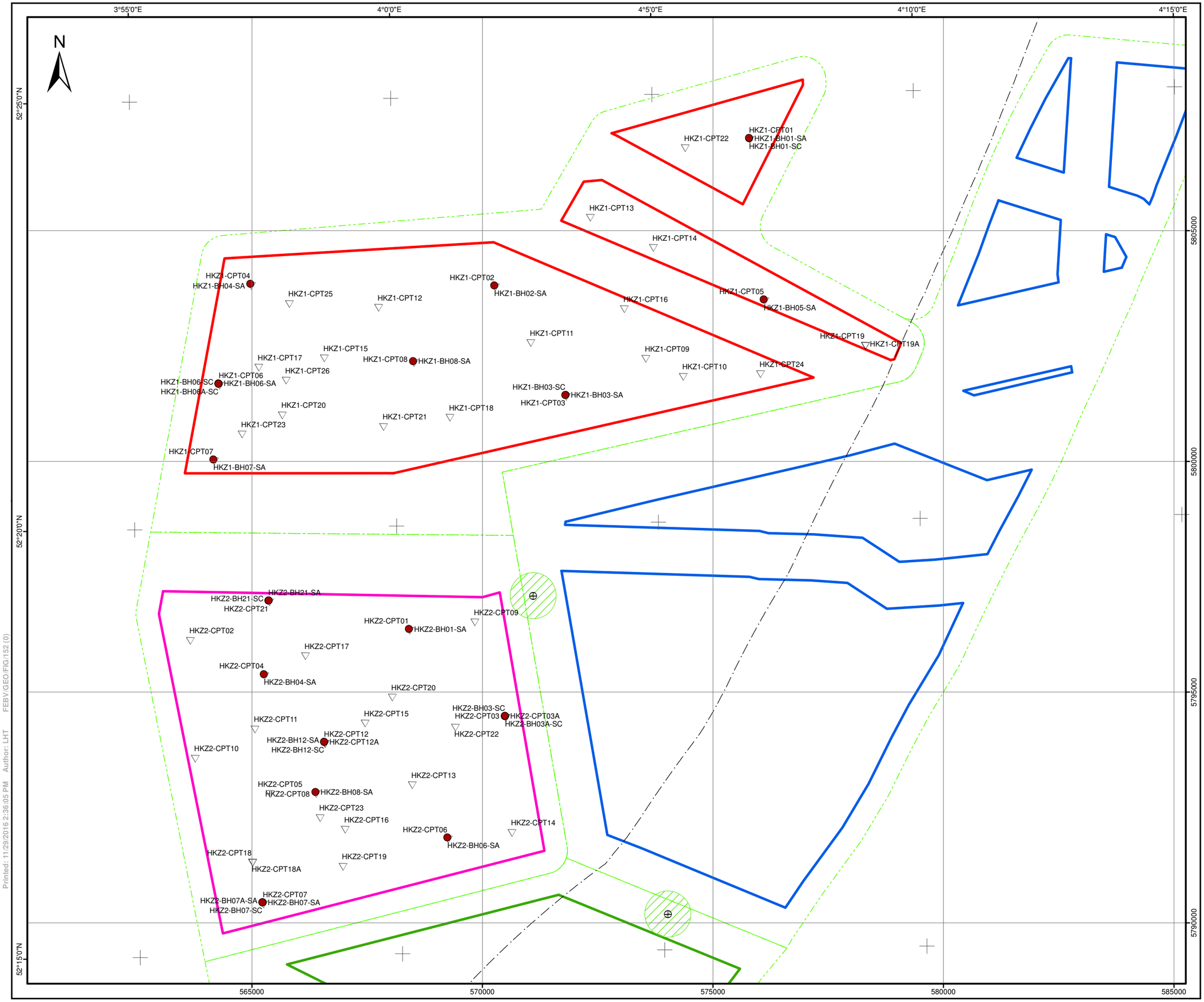
Outline of Hollandse Kust (zuid) Investigation Areas (Roman numeral indicates area number)

12 nautical mile boundary

Datum: ETRS 1989
Ellipsoid: GRS 1980

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VICINITY MAP



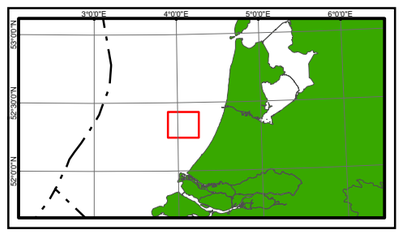
LEGEND:

- Borehole Location - Downhole geotechnical
- Test Point - Seafloor In Situ Test
- 12 nautical mile boundary
- Proposed Platform Locations
- Outline Investigation Areas
- Proposed Platform Exclusion Zone
- Wind Farm Site I
- Wind Farm Site II
- Wind Farm Site III
- Wind Farm Site IV

NOTES:

GEODETIC PARAMETERS:

DATUM	ETRS89
Ellipsoid	GRS80
Semi major axis	a = 6 378 137.000
Inverse flattening	1/f = 298.257222101
PROJECTION	UTM, Zone 31 North
Central Meridian (CM)	3° 00' 00" E
Latitude of Origin	0° 00' 00" N
False Easting	500 000 m
False Northing	000 000 m
Scale factor	0.9996
Units	metres / degrees



Rijksdienst voor Ondernemend Nederland (RVO)
Croeselaan 15, 3521 BJ, Utrecht - THE NETHERLANDS

Fugro
Prismastraat 4, 2631 RT, Nootdorp - THE NETHERLANDS

DETAILED LOCATION PLAN

HOLLANDSE KUST (ZUID) WFZ, WFS I - DUTCH SECTOR, NORTH SEA

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0 500 1,000 1,500 metres

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Report Number	Title	Contents
N6196/01	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical laboratory tests.
N6196/02	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/03	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical laboratory tests.
N6196/04	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/05	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical and environmental laboratory tests.
N6196/06	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/07	Geotechnical Report - Investigation Data - Geotechnical Borehole Locations Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from downhole (seismic) cone penetration tests and results from geotechnical and environmental laboratory tests.
N6196/08	Geotechnical Report - Investigation Data - Seafloor In Situ Test Locations Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor cone penetration tests and pore pressure dissipation tests.
N6196/09	Geological Ground Model Wind Farm Site I Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/10	Geological Ground Model Wind Farm Site II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/11	Geological Ground Model Wind Farm Site III Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.

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LIST OF PROJECT REPORTS

Report Number	Title	Contents
N6196/12	Geological Ground Model Wind Farm Site IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geological ground model including stratigraphy, lateral soil variability, geohazards, geological analyses, biostratigraphic analyses, basic geotechnical parameter values and assessment of geotechnical suitability of selected types of structures.
N6196/13	Geotechnical Report - Laboratory Test Data Wind Farm Sites I & II Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Results of advanced static and cyclic laboratory tests.
N6196/14	Geotechnical Report - Laboratory Test Data Wind Farm Sites III & IV Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Results of advanced static and cyclic laboratory tests.
N6196/15	Geotechnical Report - Investigation Data - Substation Alpha Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor and downhole cone penetration tests and results from geotechnical laboratory tests.
N6196/16	Geotechnical Report - Investigation Data - Substation Beta Hollandse Kust (zuid) Wind Farm Zone - Dutch Sector, North Sea	Geotechnical data including geotechnical logs, results from seafloor and downhole cone penetration tests, pore pressure dissipation tests and results from geotechnical laboratory tests.

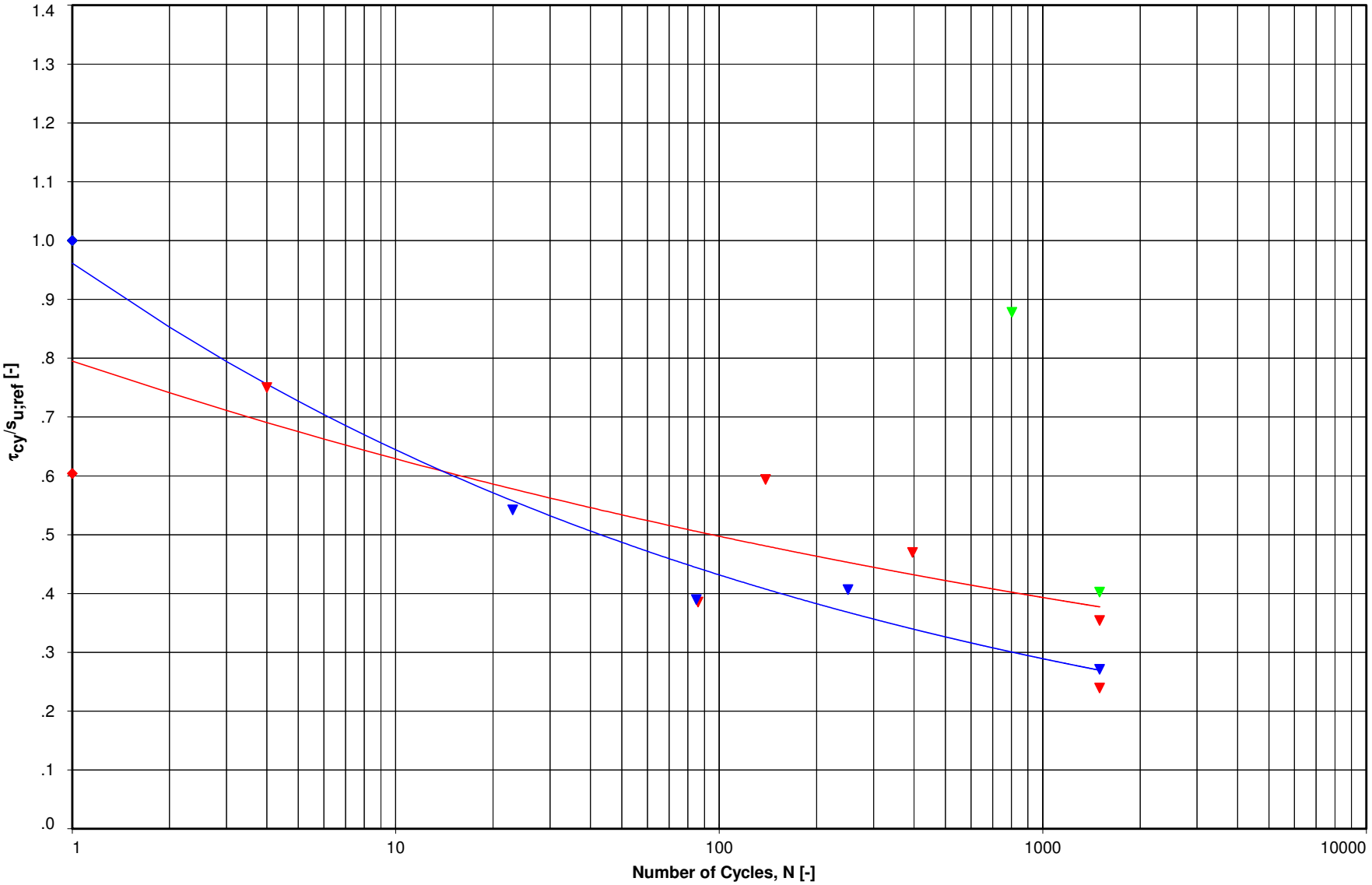
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LIST OF PROJECT REPORTS

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HOLLANDSE KUST (ZUID) WFZ, WFS I&II - DUTCH SECTOR, NORTH SEA

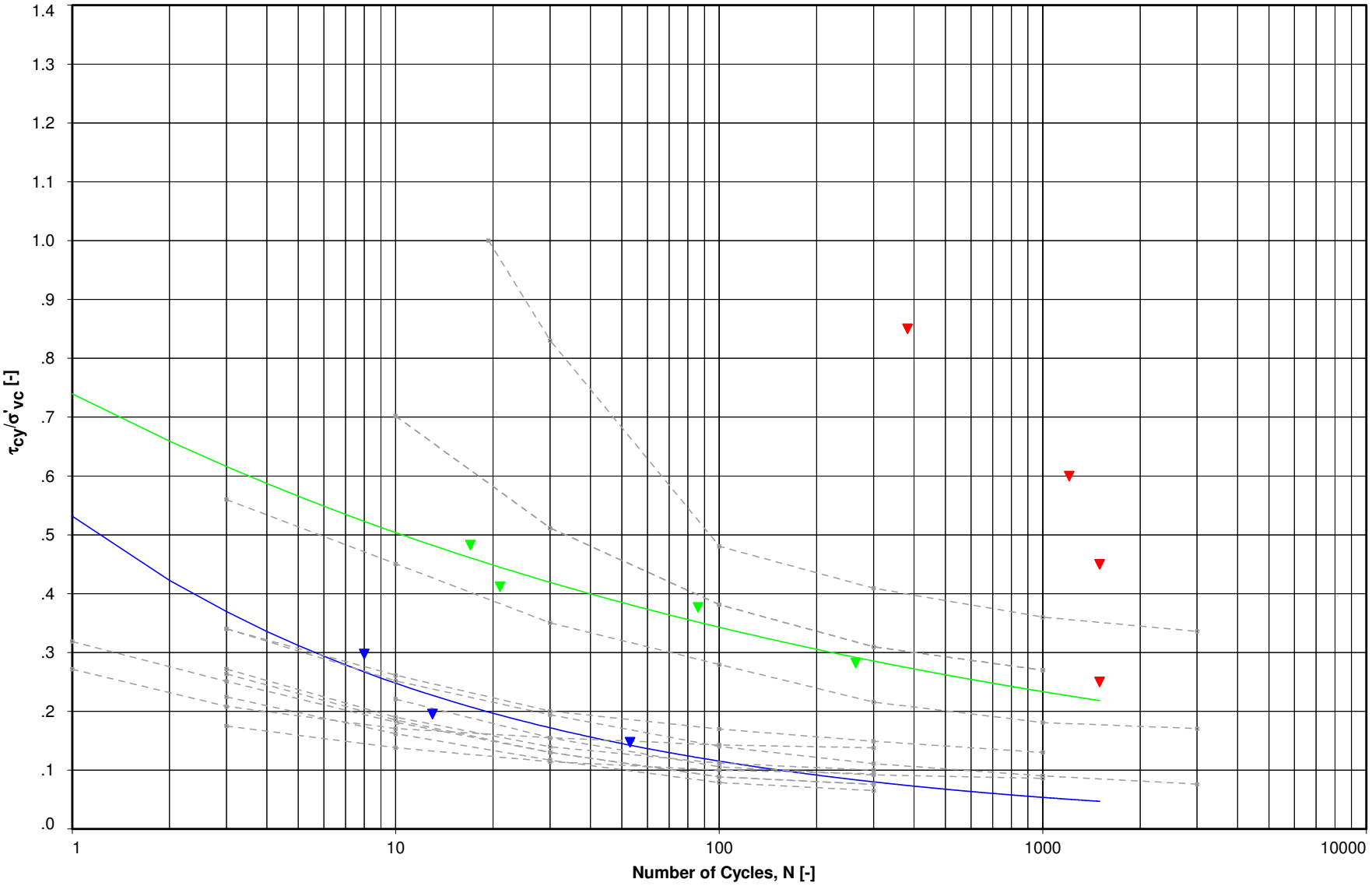
NORMALIZED CYCLIC SHEAR STRESS VERSUS NUMBER OF CYCLES TO FAILURE



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HOLLANDSE KUST (ZUID) WFZ, WFS I&II - DUTCH SECTOR, NORTH SEA

NORMALIZED CYCLIC SHEAR STRESS VERSUS NUMBER OF CYCLES TO FAILURE



▼ CSS - Coarse-grained cohesionless specimens

S-N Degradation curves proposed by Andersen (2009)

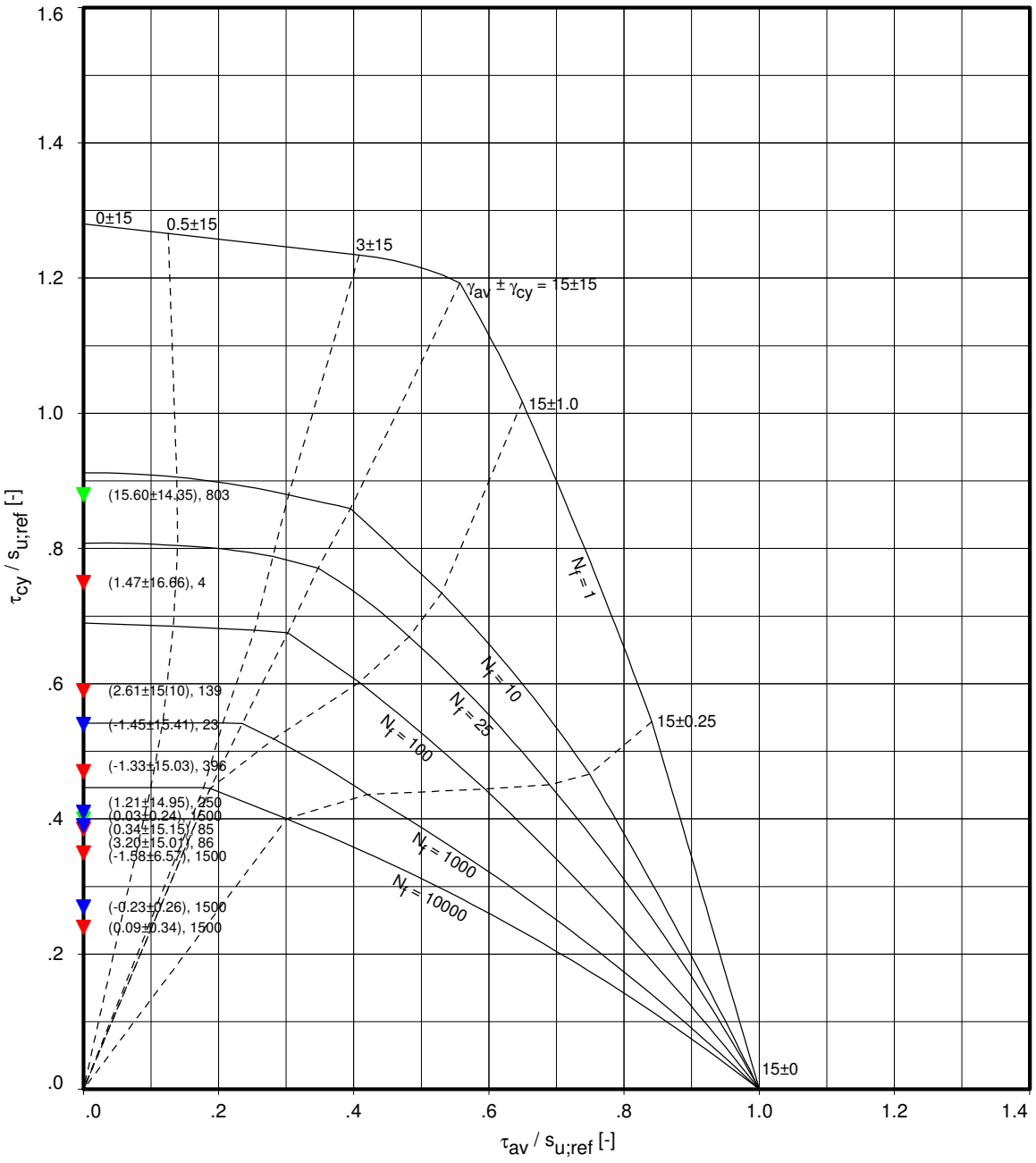
S-N Degradation curve for Unit B1 (Eem) $\tau_{cy}/\sigma'_{vc} = 0.740*N^{-0.167}$

S-N Degradation curve for Unit D (Yarmouth Roads) $\tau_{cy}/\sigma'_{vc} = 0.532*N^{-0.332}$

Test results - Unit A (Southern Bight) at σ'_{vc} = 20 kPa

Test results - Unit B1 (Kreftenheye) at σ'_{vc} = 85 kPa

Test results - Unit D (Yarmouth Roads) at σ'_{vc} = 420 kPa

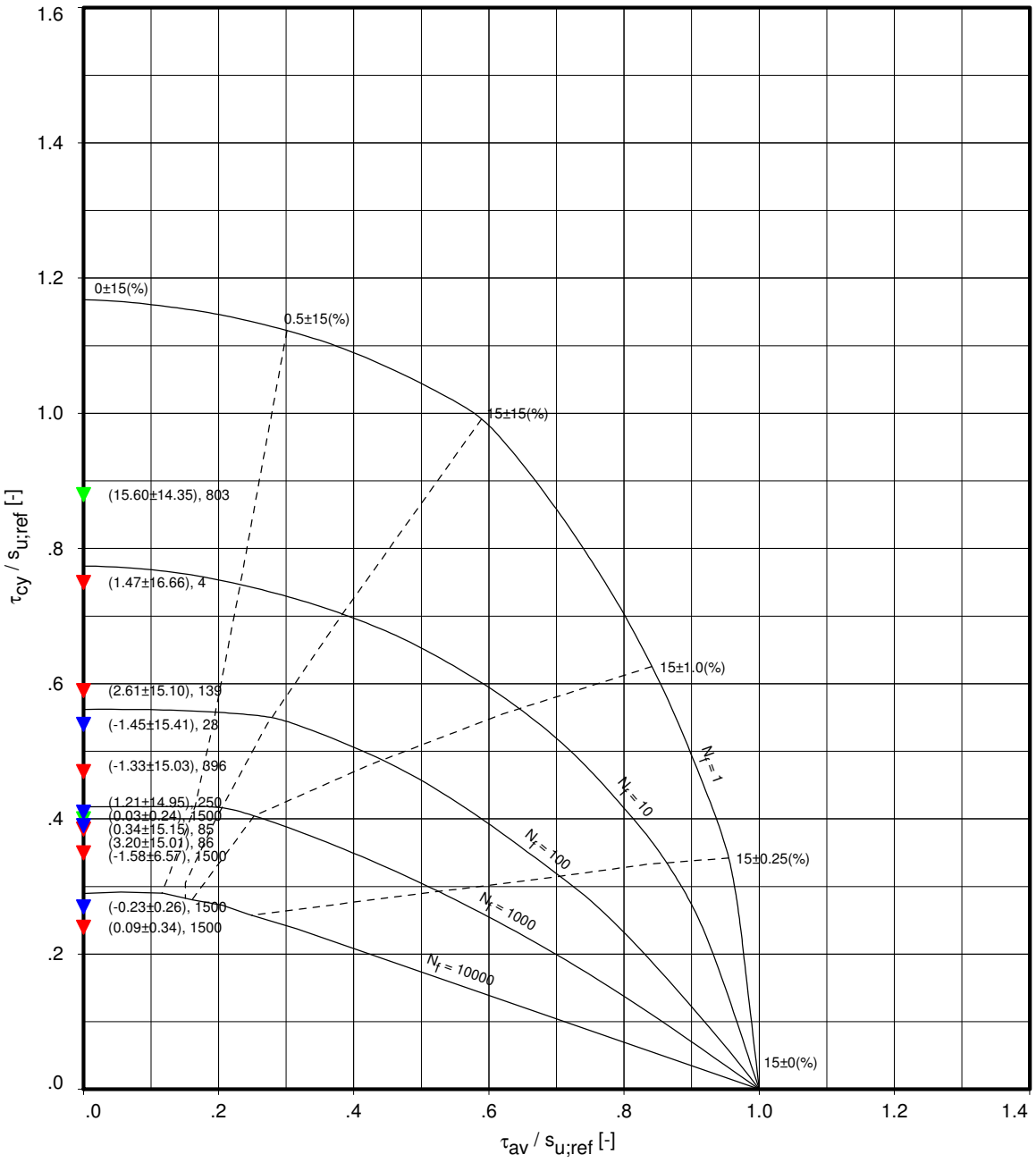


▼ Test results - Unit B2 (Kreftenheye)
▼ Test results - Unit C1 (Eem)
▼ Test results - Unit C2 (Eem)

Notes:
- Comparison of cyclic direct simple shear test results with Drammen clay model at YSR = 1 (Andersen et al., 1988)
- $(\gamma_{av} \pm \gamma_{cy}), N_f$: Average shear strain and cyclic shear strain (%) at final number of cycles

CYCLIC DIRECT SIMPLE SHEAR TESTS - DRAMMEN CLAY COMPARISON (YSR=1)

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▼ Test results - Unit B2 (Kreftenheye)

▼ Test results - Unit C1 (Eem)

▼ Test results - Unit C2 (Eem)

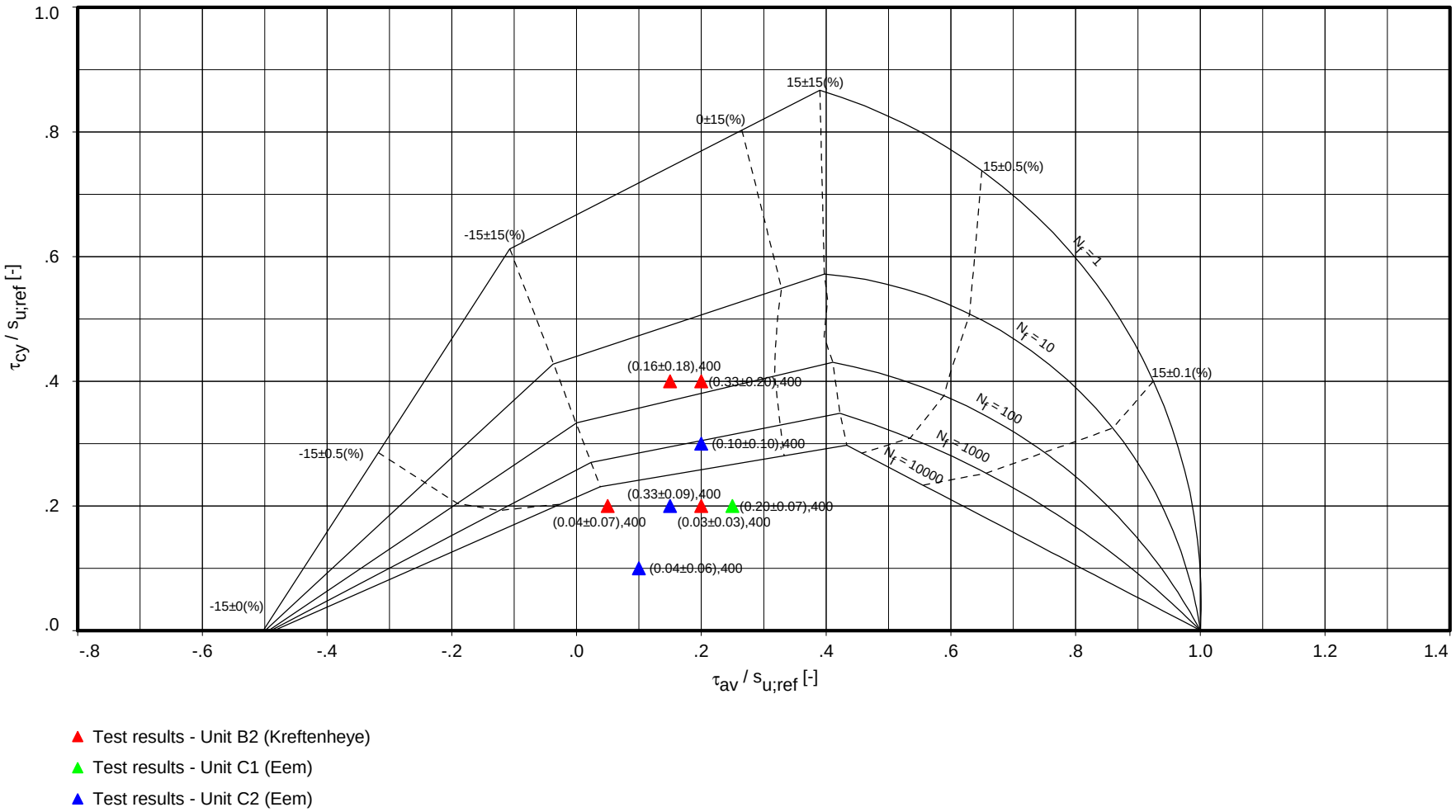
Notes:

- Comparison of cyclic direct simple shear test results with Drammen clay model at YSR = 4 (Andersen et al., 1988)
- $(\gamma_{av} \pm \gamma_{cy}), N_f$: Average shear strain and cyclic shear strain (%) at final number of cycles

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CYCLIC DIRECT SIMPLE SHEAR TESTS - DRAMMEN CLAY COMPARISON (YSR=4)

CYCLIC TRIAXIAL TESTS - DRAMMEN CLAY COMPARISON (YSR=1)



▲ Test results - Unit B2 (Kreftenheye)

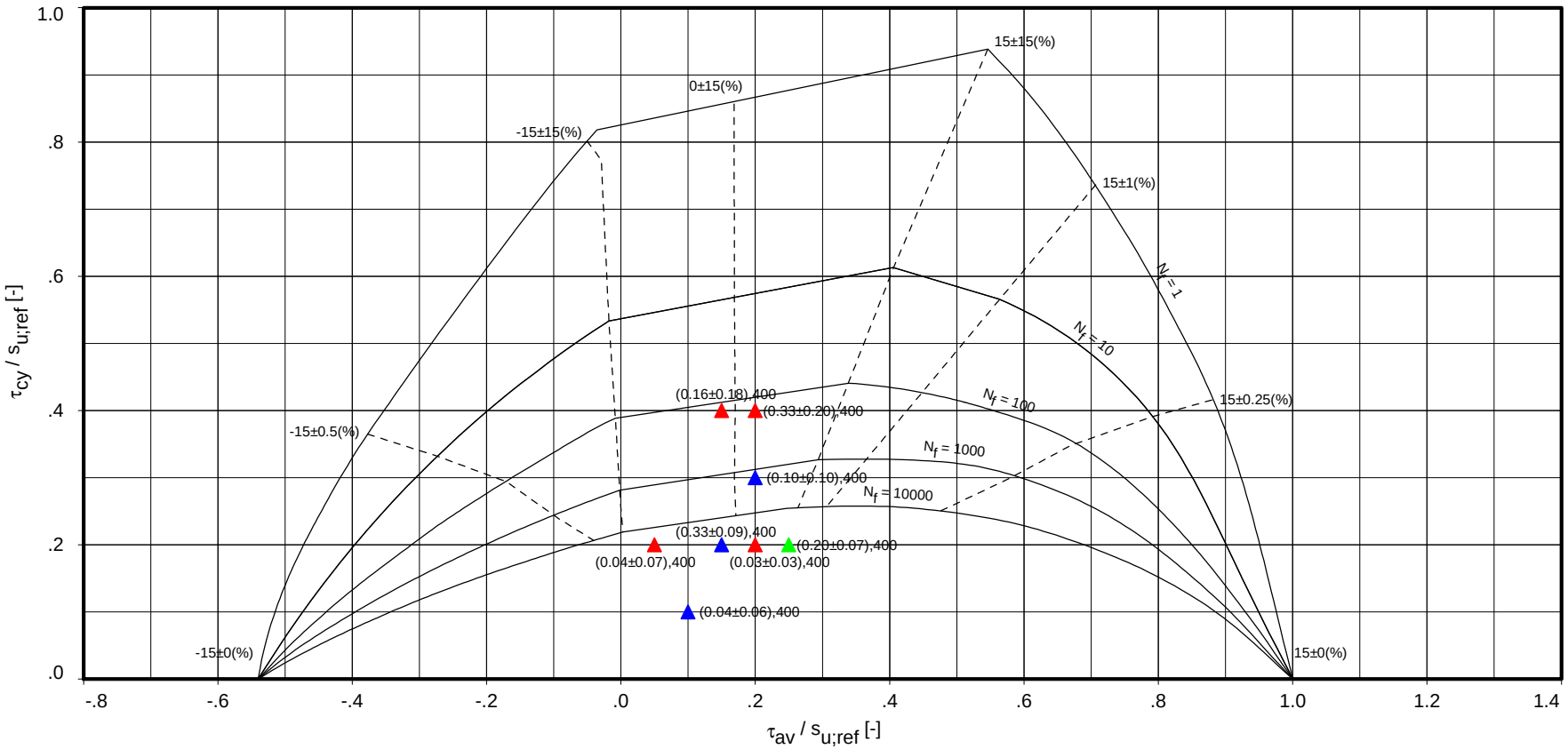
▲ Test results - Unit C1 (Eem)

▲ Test results - Unit C2 (Eem)

Notes:

- Comparison of cyclic triaxial test results with Drammen clay model at YSR = 1 (Andersen et al., 1988)
- $(\varepsilon_{av} \pm \varepsilon_{cy}),N_f$: Average axial strain and cyclic axial strain (%) at final number of cycles

CYCLIC TRIAXIAL TESTS - DRAMMEN CLAY COMPARISON (YSR=4)



▲ Test results - Unit B2 (Kreftenheye)

▲ Test results - Unit C1 (Eem)

▲ Test results - Unit C2 (Eem)

Notes:

- Comparison of cyclic triaxial test results with Drammen clay model at YSR = 4 (Andersen et al., 1988)
- $(\gamma_{av} \pm \gamma_{cy}),N_f$: Average shear strain and cyclic shear strain (%) at final number of cycles

SECTION A: GEOTECHNICAL LABORATORY TEST RESULTS

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SECTION A2: INDEX LABORATORY TESTS
SECTION A3: DIRECT SIMPLE SHEAR TESTS
SECTION A4: TRIAXIAL TESTS
SECTION A5: CYCLIC SIMPLE SHEAR TESTS
SECTION A6: CYCLIC TRIAXIAL TESTS
SECTION A7: RESONANT COLUMN TESTS

SECTION A1: LABORATORY TESTING OVERVIEW

TEXT – SECTION A1: Page

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A1. LABORATORY TESTING OVERVIEW

A1.1 SUMMARY OF LABORATORY TESTS

Main Text Section 2 titled “Laboratory Test Programme” presents an overview of the geotechnical laboratory tests performed including discussion of adopted strategy, premises and assumptions. This section presents test results. Table A1.1 presents a summary of the quantity of each laboratory test completed, along with references to the adopted test procedures.

Table A1.1: Overview of Laboratory Test Programme

	Unit (Formation)							
	Total	A (Southern Bight)	B1 (Kreftenheye)	B2 (Kreftenheye)	C1 (Eem)	C2 (Eem)	D (Yarmouth Roads)	
Test Type	**Number of Tests**							**Test Procedure**
Geotechnical Index								
Particle Size Analysis (sieving and pipette)	7	2	2	-	-	1	2	BS1377:Part 2:1990:Clause 9.2+9.4 (BSI, 1990a) supplemented with Fugro in-house procedures
Strength (Static)								
Direct Simple Shear (DSS)	7	1	1	2	1	1	1	Fugro in-house procedures based on ASTM D6528-07 (ASTM, 2007b)
Isotropically Consolidated Undrained Triaxial compression (CIUc)	4	1	1	2	-	-	-	BS1377:Part 8:1990:Clauses 4+5.4+6+7 (BSI, 1990b) supplemented with Fugro in-house procedures
Isotropically Consolidated Undrained Triaxial extension (CIUe)	1	-	-	1	-	-	-	BS1377:Part 8:1990:Clauses 4+5.4+6+7 (BSI, 1990b) supplemented with Fugro in-house procedures
Anisotropically Consolidated Undrained Triaxial compression (CAUc)	3	-	-	-	-	2	1	BS1377:Part 8:1990:Clauses 4+5.4+6+7 (BSI, 1990b) supplemented with Fugro in-house procedures
Isotropically Consolidated Drained Triaxial compression (CIDc)	2	1	1	-	-	-	-	BS1377:Part 8:1990:Clauses 4+5.3+6+8 (BSI, 1990b) supplemented with Fugro in-house procedures

	Unit (Formation)							
	Total	A (Southern Bight)	B1 (Kreftenheye)	B2 (Kreftenheye)	C1 (Eem)	C2 (Eem)	D (Yarmouth Roads)	
Test Type	**Number of Tests**							**Test Procedure**
Strength (Cyclic)								
Stress-controlled Cyclic Simple Shear (CSS)	23	4	4	6	2	4	3	Fugro in-house procedure based on ASTM D6528-07 (ASTM, 2007b)
Stress-controlled Isotropically Consolidated Undrained Cyclic Triaxial (CTX)	18	2	1	4	1	7	3	ASTM D3999-11 (ASTM, 2011a) and ASTM D5311-11 (ASTM, 2011b) supplemented with Fugro in-house procedures
Stress-controlled Isotropically Consolidated Drained Cyclic Triaxial (CTX)	8	4	4	-	-	-	-	ASTM D3999-11 (ASTM, 2011a) and ASTM D5311-11 (ASTM, 2011b) supplemented with Fugro in-house procedures
Dynamic								
Bender Element (BE)[1)]	6	1	1	1	1	1	1	Fugro in-house procedure
Resonant Column (RC)[2)]	9	2	2	2	-	2	1	ASTM D4015-07 (ASTM, 2007a) supplemented with Fugro in-house procedures

Notes:
[1)] Bender Element tests were performed as part of the DSS tests
[2)] Resonant Column tests were performed as either a stand-alone test or as an additional stage of CIUc/CAUc/CIDc triaxial tests

Testing of coarse-grained cohesionless material was performed on batch samples. For testing on fine-grained cohesive soils, undisturbed wax samples were used. Tables A1.2 and A1.3 present summaries of the selected samples used for batch sample preparation and strength testing.

Table A1.2: Selected Samples for Testing of Coarse-grained Cohesionless Soil Units

Soil Unit	Location	Site	Sample	Sample Depth [m BSF]	Test Types
A (Southern Bight) - Batch 1	HKZ2-BH03-SA	WFS II	01BagB	0.30	CIDc, CIUc, CTX, RC
	HKZ2-BH03-SA	WFS II	02BagA	1.00	
	HKZ2-BH03-SA	WFS II	03BagB	2.20	
	HKZ2-BH03-SA	WFS II	03BagC	2.40	
	HKZ2-BH03-SA	WFS II	04BagA	3.00	
	HKZ2-BH04-SA	WFS II	01BagB	0.25	
	HKZ2-BH04-SA	WFS II	02BagB	1.30	
	HKZ2-BH04-SA	WFS II	03BagA	2.00	

Soil Unit	Location	Site	Sample	Sample Depth [m BSF]	Test Types
A (Southern Bight) - Batch 2	HKZ1-BH07-SA	WFS I	02BagA	1.00	DSS(+BE), CSS
	HKZ1-BH07-SA	WFS I	03BagA	2.00	
	HKZ1-BH07-SA	WFS I	03BagB	2.25	
	HKZ1-BH06-SA	WFS I	02BagA	1.00	
	HKZ1-BH06-SA	WFS I	02BagB	1.30	
B1 (Kreftenheye) - Batch 3	HKZ2-BH03-SA	WFS II	15BagA	12.50	CIDc, CIUc, CTX, RC
	HKZ2-BH03-SA	WFS II	16BagA	13.00	
	HKZ2-BH03-SA	WFS II	17BagA	13.50	
	HKZ2-BH01-SA	WFS II	17BagA	12.50	
	HKZ2-BH01-SA	WFS II	18BagA	13.00	
	HKZ2-BH01-SA	WFS II	18BagB	13.30	
	HKZ2-BH01-SA	WFS II	19BagA	14.00	
B1 (Kreftenheye) - Batch 4	HKZ1-BH07-SA	WFS I	08BagA	6.00	DSS(+BE), CSS
	HKZ1-BH07-SA	WFS I	09BagA	6.50	
	HKZ1-BH08-SA	WFS I	10BagA	8.00	
	HKZ1-BH08-SA	WFS I	10BagB	8.25	
	HKZ1-BH08-SA	WFS I	11BagA	9.00	
C2 (Eem) - Batch 5	HKZ1-BH08-SA	WFS I	35BagA	32.50	CAUc, CTX
	HKZ1-BH08-SA	WFS I	36BagA	33.00	
	HKZ1-BH08-SA	WFS I	36BagB	33.30	
	HKZ1-BH08-SA	WFS I	37BagA	34.00	
	HKZ1-BH08-SA	WFS I	37BagB	34.30	
D (Yarmouth Roads) - Batch 6	HKZ2-BH07A-SA	WFS II	30BagA	39.50	CAUc, CTX, RC
	HKZ2-BH07A-SA	WFS II	30BagB	39.80	
	HKZ2-BH07A-SA	WFS II	31BagA	40.50	
	HKZ2-BH07A-SA	WFS II	31BagB	40.80	
D (Yarmouth Roads) - Batch 7	HKZ2-BH07A-SA	WFS II	32BagB	41.70	DSS(+BE), CSS
	HKZ2-BH21-SA	WFS II	53BagC	44.90	
	HKZ2-BH21-SA	WFS II	54BagA	45.50	
	HKZ2-BH21-SA	WFS II	54BagB	45.75	

Table A1.3: Selected Samples for Testing of Fine-grained Cohesive Soil Units

Soil Unit	Location	Site	Sample	Sample Depth [m BSF]	Test Type(s)
B2 (Kreftenheye)	HKZ1-BH01-SA	WFS I	17WaxB	14.65	CIUc, RC
	HKZ1-BH01-SA	WFS I	17WaxC	14.85	CTX
	HKZ1-BH01-SA	WFS I	17WaxD	15.05	CTX
	HKZ1-BH01-SA	WFS I	20WaxC	17.90	CIUe
	HKZ1-BH01-SA	WFS I	20WaxD	18.10	CIUc, RC
	HKZ1-BH01-SA	WFS I	21WaxC	18.90	CTX
	HKZ1-BH01-SA	WFS I	21WaxD	19.10	CTX
	HKZ1-BH02-SA	WFS I	15WaxB	12.75	DSS(+BE), CSS
	HKZ1-BH02-SA	WFS I	15WaxC	12.95	CSS
	HKZ2-BH04-SA	WFS II	16WaxB	13.20	DSS, CSS

Soil Unit	Location	Site	Sample	Sample Depth [m BSF]	Test Type(s)
C1 (Eem)	HKZ1-BH01-SA	WFS I	25WaxA	22.5	CTX
	HKZ1-BH02-SA	WFS I	24WaxB	21.60	DSS(+BE), CSS
	HKZ1-BH02-SA	WFS I	24WaxB	21.60	CSS
C2 (Eem)	HKZ2-BH21-SA	WFS II	29WaxB	22.15	CAUc
	HKZ2-BH21-SA	WFS II	29WaxD	22.55	CTX
	HKZ2-BH21-SA	WFS II	30WaxB	23.25	CTX
	HKZ2-BH21-SA	WFS II	30WaxC	23.45	CTX
	HKZ2-BH21-SA	WFS II	31WaxD	24.5	RC
	HKZ2-BH08-SA	WFS II	40WaxB	23.70	DSS(+BE), CSS
	HKZ2-BH08-SA	WFS II	40WaxC	23.90	CSS

Table A1.4 presents an overview of the selected dry densities and consolidation pressures for the various batch samples. In general the specified conditions were achieved during specimen preparation.

Table A1.4: Target Test Preparation Conditions for Batch Samples

Soil Unit	Test Types	Target Dry Density [Mg/m^3]	Vertical Consolidation Stress [kPa]	Horizontal Consolidation Stress [kPa]
A (Southern Bight) - Batch 1	CIDc, CIUc, CTX, RC	1.65	20	20
A (Southern Bight) - Batch 2	DSS(+BE), CSS	1.65	20	20
B1 (Kreftenheye) - Batch 3	CIDc, CIUc, CTX, RC	1.64	135	135
B1 (Kreftenheye) - Batch 4	DSS(+BE), CSS	1.66	85	85
C2 (Eem) - Batch 5	CAUc, CTX, RC	1.58	320	225
D (Yarmouth Roads) - Batch 6	CAUc, CTX, RC	1.58	380	250
D (Yarmouth Roads) - Batch 7	DSS(+BE), CSS	1.58	420	420
Note: - Actual dry densities may vary slightly compared to target dry densities				

A1.2 QUALITY OF RESULTS

In general, the laboratory test results are considered to be of good quality. Assessed data quality is according to expectations for used sampling practice and laboratory test methods. Laboratory tests were only performed on suitable soil samples.

Results of geotechnical laboratory tests are generally consistent with the visual descriptions and in situ test interpretations. It is noted that the majority of the strength tests results correlate reasonably well with the shear strength derived from in situ tests reported in companion reports (refer to Plates 3 and 4), although some scatter is noted. This is likely attributed to heterogeneity of the test specimens and to the differences between the various testing techniques used.

According to ISO (2014), an indication of sample quality may be derived from laboratory consolidation test results. The proposed method however is applicable to a limited range of soil conditions.

The normalised sample quality parameter ($\Delta e/e_0$) of CSS and DSS test specimens ranges between 0.024 and 0.168. The undisturbed sample quality indication for these specimens according to ISO (2014) is “very good to excellent” to “very poor” – this indication must be used with caution for soils outside the specified range.

The normalised sample quality parameter ($\Delta e/e_0$) of CIU and CTX test specimens ranges between 0.004 and 0.107. The undisturbed sample quality indication for these specimens according to ISO (2014) is “very good to excellent” to “very poor” – this indication must be used with caution for soils outside the specified range.

The normalised sample quality parameter ($\Delta e/e_0$) of RC test specimens ranges between 0.000 and 0.108. The undisturbed sample quality indication for these specimens according to ISO (2014) is “very good to excellent” to “very poor” – this indication must be used with caution for soils outside the specified range.

A1.3 PRACTICE FOR SAMPLE HANDLING AND LABORATORY TESTING

Practice

Procedure:	According to ISO (2014)
Data Processing and Management:	– Laboratory-specific software and GeODin® software, as applicable – Graphical scales selected to suit general presentation of data – No display of data outside of chart limits, i.e. some values may not be shown – Level of detail and accuracy in geotechnical sample description and interpretation depend on factors such as test data, sample size, quality, coverage, availability of supplementary information, and project requirements
Data Format(s):	PDF for viewing and printing (this primary document)

Office Geotechnical Laboratory

Test Programme:	Geotechnical index, static and cyclic strength and stiffness, dynamic
Programme Adjustment:	– Assessment of feasibility of a test (by sample inspection) prior to start of specimen preparation – Decision by laboratory: (1) to proceed with test, (2) not to proceed with test, (3) to advise adjustments to test procedure – Selection of alternative test specimen by laboratory and/or geotechnical engineer, if applicable in case of decision “not to proceed” or when adequate test completion proves impracticable
Ground Description:	– Geotechnical sample descriptions for individual test specimens – No verification with and correlation with source sample description or nearby in situ and laboratory test data – Geotechnical sample description is an interpretation of processed data available at the time of preparation – Level of detail and accuracy in geotechnical sample description and interpretation depend on factors such as test data, sample size, quality, coverage, availability of supplementary information, and project requirements
Laboratory Air Temperature:	Typically about 20°C
Sample Waxed in Cardboard Tube:	– Removal of sample from tube by cutting – Photography of selected sample section(s) – Static and cyclic strength and stiffness testing, dynamic testing (refer to Table A1.1 for details) – Geotechnical sample description – If applicable, selection and labelling of left-over sample sections for undisturbed preservation and/or disturbed preservation
Sample in Plastic Bags	– Batching of individual bag sample where applicable – Geotechnical index testing and geotechnical sample description – Static and cyclic strength and stiffness testing, dynamic testing (refer to Table A1.1 for details) – If applicable, selection and labelling of left-over sample sections for disturbed preservation)

Sample Storage and Disposition

Sample Storage:	– Storage period of 12 months after arrival of samples in laboratory – Storage temperature within the range +2°C and +35°C – Protection from direct sunlight
Transport:	Not applicable
Final Disposition:	In accordance with office laboratory procedures

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A1.4 INDEX LABORATORY TESTS

Particle size distributions (PSD) were determined of all coarse-grained cohesionless batch samples. PSD curves are presented on Plates A2-1 and A2-2.

A1.5 DIRECT SIMPLE SHEAR TESTS

Four direct simple shear (DSS) tests were performed on fine-grained cohesive specimens and three DSS tests were performed on coarse-grained cohesionless specimens, in order to assess the undrained shear strength in simple shear. Tests results are summarised on Plates A1-1 to A1-4 in Section A1. Individual test results are presented in Section A3.

DSS tests were performed using constant volume test conditions (i.e. undrained), allowing test results to be used as a reference for undrained cyclic simple shear testing. In general, the results from fine-grained cohesive specimens show good correlation with other strength data obtained from laboratory- and in situ testing. The two DSS tests performed on fine-grained cohesive specimens from Unit B2 (Kreftenheye) showed peak shear stress values of 58 kPa and 96 kPa respectively. The higher value has been applied as reference strength for CSS tests on specimens from Unit B2 as this value is more in line with undrained shear strengths derived from other strength tests and results from in situ testing.

A1.6 TRIAXIAL TESTS

Fine-grained cohesive soils

Two isotropically consolidated undrained triaxial compression (CIUc) tests, one isotropically consolidated undrained triaxial extension (CIUe) test, and one anisotropically consolidated undrained triaxial compression (CAUc) test were performed on fine-grained cohesive specimens. Tests results are summarised on Plate A1-5. Individual test results are presented in Section A4.

Results of the two CIUc triaxial tests show a sharp initial increase in deviator stress q, a non-linear p'-q relationship and an initial increase of pore water pressure followed by a decrease proportional to the overconsolidation ratio. The stress paths indicate limited strain hardening, which is expected behaviour for slightly overconsolidated clays.

The stress path of the CIUe triaxial test on Sample 20WaxC (17.95 m) from borehole HKZ1-BH01-SA shows typical behaviour for cohesive soils subjected to extensional loading. The absolute value of the peak deviator stress (172 kPa) of the extension test is lower than the peak deviator stress (208 kPa) of the adjacent triaxial compression test at 18.11 m BSF, which is according to expectations.

The measured deviator stress of triaxial Test CIU03 shows a minor interruption at about 0.3 % axial strain, notable in the stress-strain plot and the stress path, refer to Plates A4.1-8 and A4.1-9. The cause of disturbance is unknown, but is likely to be equipment-related and not soil-related. The interruption appears to have had limited effect on the overall test result.

The base drain was accidentally opened at the end of the consolidation stage of triaxial test CIU05. Specimen quality or final effective consolidation stress was not affected.

Due to operator error, the specimen used for triaxial test CAU01 was isotropically consolidated to an effective pressure of 200 kPa, instead of a requested anisotropic effective radial pressure of 200 kPa and an effective axial pressure of 220 kPa. The application of a slightly lower axial consolidation pressure is not expected to have had significant effect on test behaviour and results.

Coarse-grained cohesionless soils

Two isotropically consolidated undrained triaxial compression (CIUc) tests and two anisotropically consolidated undrained triaxial compression (CAUc) tests were performed on coarse-grained cohesionless specimens. Results of the CIUc and the CAUc triaxial tests are summarised on Plate A1-6. Individual test results are presented in Section A4.

Dilatant soil behaviour was observed during triaxial Tests CIU01, CIUc02 and CAUc02, on specimens from Unit A (Southern Bight), Unit B1 (Kreftenheye) and Unit C2 (Eem) respectively. Note that CIU01 was stopped at approximately 7 % strain after reaching the maximum capacity of the load cell. Stress paths show strain hardening soil behaviour. In contrast, contractive soil behaviour was observed during triaxial test CAUc03 on a specimen from Unit D (Yarmouth Roads). Observed stress strain behaviour is generally in line with expectations for used target dry density, specimens grading and consolidation pressures used.

Two isotropically consolidated drained triaxial compression (CIDc) tests were performed on coarse-grained cohesionless specimens. Results of the CIDc triaxial tests are summarised on Plate A1-6. Individual test results are presented in Section A4.

Both tests show dilative behaviour, which is as expected. However, CID01 shows strain hardening behaviour and a resulting high maximum deviator stress at failure. This could be attributed to negative pore pressure build-up during the shearing stage. However, this should not have occurred as drainage was allowed. Results from CID01 should be used with care.

A1.7 CYCLIC SIMPLE SHEAR TESTS

Stress-controlled cyclic simple shear (CSS) tests were performed on fine-grained cohesive and coarse-grained cohesionless specimens. Tests results are summarised on Plates A1-7 to A1-10. Individual test results are presented in Section A5.

Specimens were subjected to two cyclic test stages. During the first stage, specimens were cyclically loaded to a maximum of 400 cycles at relatively low cyclic stress ratios (CSR). During the main cyclic loading phase, specimens were tested using a maximum of 1500 cycles and slightly higher cyclic stress ratios than applied during the pre-shear stage. Post-cyclic static testing was performed on all specimens. The stress-strain behaviour of the post-cyclic static stage was similar to results of static (DSS) tests.

Fine-grained cohesive soils

Twelve CSS tests were performed on fine-grained cohesive specimens. Graphs presenting shear induced pore water pressure against number of cycles (N) show data spikes, the occurrence of which is related to the measurement tolerance of the used testing equipment in relation to the scale of the plot.

Cyclic shear stress of test CSS10 was not fully controlled between cycle 800 and cycle 950. Cyclic shear stress of test CSS11 was not fully controlled between cycle 170 and cycle 260. This may be attributed to soil conditions, equipment limitations and/or operator settings. The latter two are related to the stress controlled feedback of the system, which is for cyclic direct simple shear testing less delimited than for cyclic triaxial testing. Development of shear strain has not been affected significantly by this partial deviation from target cyclic stress.

The used testing equipment was not able to fully maintain the shear stress of test CSS19 as a result of large rate of strain accumulation after approximately 180 cycles.

A sample photograph for the specimen tested in Test CSS17 is not available due to operator error.

Coarse-grained cohesionless soils

Eleven CSS tests were performed on coarse-grained cohesionless specimens. Test results show a steady build-up of shear-induced pore water pressures (PWP) at low cyclic strain levels up to PWP ratios between 0.6 and 0.8. Thereafter, PWP (ratios) and cyclic strain levels progressively increase until failure occurs. As the vertical stress within the soil approaches zero, the soil dilates in order to sustain an increasing shear stress. The dilation ceases momentarily at the stress reversal point before unloading occurs. This is clearly seen in the temporary drop in pore pressure once the pore pressure ratios are above 0.8 to 0.9.

Graphs presenting shear induced pore water pressure against number of cycles (N) show data spikes, the occurrence of which is related to the measurement tolerance of the used testing equipment in relation to the scale of the plot.

Coarse-grained cohesionless specimens show strain-hardening behaviour during the post-cyclic stage. Stress-strain curves of the post-cyclic static loading stage of Tests CSS10, CSS12, CSS17, CSS06, CSS21, and CSS22 show a (sharp) decrease in pore water pressure and increase in shear stress.

The presented initial shear strain of the pre-cyclic loading stage of CSS03 of approximately 0.3 % was generated during consolidation of the specimen.

Specimen failure was reached at 382 cycles during the cyclic loading stage of CSS03 and at 264 cycles during the cyclic loading stage of CSS06, in both cases cyclic shear strain exceeded 15 %. Both tests were continued running slightly longer. The extra data is included in the test results for completeness.

A1.8 CYCLIC TRIAXIAL TESTS

Stress-controlled cyclic triaxial (CTX) tests were performed on fine-grained cohesive and coarse-grained cohesionless specimens. Tests results are summarised on Plates A1-11 to A1-14. Individual test results are presented in Section A6.

Specimens were tested for a range of average and cyclic stress ratios. The cyclic loading stage consisted of two stages: Phase 1 (1500 cycles) at fairly low average and cyclic stress ratios, Phase 2 (400 cycles) at higher average and cyclic stress ratios, refer to Main Text. Post-cyclic static testing was performed, where possible.

Fine-grained cohesive soils

Eight tests were performed on fine-grained cohesive specimens. All tests were performed under undrained conditions.

The average and cyclic axial strains at the end of the second cyclic loading stage were limited to 0.33 % and 0.18 %, respectively. None of the specimens failed during cyclic loading.

For the soil units where multiple CTX tests were performed on, the observed average and cyclic strains at the end of the cyclic loading Phase 2 were generally higher for tests with higher average and cyclic stress ratios, which is according to expectations.

The stress-strain behaviour during the post-cyclic shearing stage was generally similar to the observed behaviour in static CIU tests. Stress paths (p'/q) show for most tests limited strain-hardening behaviour, as a result of the stress state at start of the post-cyclic static shearing phase. The failure envelope of static triaxial test results presented in companion report and post-cyclic static shearing are generally similar.

The radial and axial stresses at the end of the saturation stage of CTX14, CTX15 and CTX18 were (slightly) higher than the consolidation stresses, which resulted into specimen deformation during consolidation developing in extension (volumetric strain and external axial strain).

The radial stress at the end of the saturation stage of CTX19 was slightly higher than the radial consolidation stress. The volumetric strain during consolidation was in extension (external axial strain was in compression).

The void ratio of the specimen was (slightly) higher at the end of the consolidation stage of tests CTX14, CTX15, CTX18 and CTX19 compared to the initial specimen state. Sample quality index could be determined for these tests, refer to Plate A1-11.

Limited signal fluctuation was observed in the recording of the cyclic loading stress between approximately cycle 1100 and 1400 of stage of CTX17, due to load cell constrains of the triaxial equipment. The data presented between approximately cycle 1100 and cycle 1400 should be used with caution. The data after approximately 1400 cycles was not significantly affected and results were assessed as reliable.

The application of cyclic loading during Phase 1 of CTX15 was not fully controlled between approximately cycle 700 and cycle 900, due to load cell constrains of the triaxial equipment. The data presented between approximately cycle 700 and cycle 900 should be used with caution (e.g. presented shear modulus and damping ratio). The data after approximately 900 cycles was not significantly affected and results were assessed as reliable.

In the test results of CTX12 and CTX16, the value of the consolidation stress reported in the table (Plate A6.1-2 and Plate A6.1-120) is slightly different (1 kPa) compared to the values reported on the page with stress-strain diagrams of the consolidation stage (Plate A6.1-10 and Plate A6.1-128).

A sample photograph for the specimen tested in test CTX16 is not available due to operator error.

Coarse-grained cohesionless soils

Eighteen tests were performed on coarse-grained cohesionless specimens. Ten tests were performed with undrained cyclic loading conditions and are presented in Section A6.2. Eight tests were performed with drained cyclic loading conditions (refer to Section A6.3).

The majority of the specimens subjected to drained cyclic loading did not fail during cyclic loading as was intended. Only during tests CTX02, CTX03 and CTX04 specimen failure occurred during cyclic loading, refer to below for details.

For the specimens subjected to undrained cyclic loading, six tests failed during cyclic loading and four tests did not fail for the average and cyclic stress ratios applied. It should be noted that selected cyclic loading conditions of tests with drained conditions were different than for tests performed with undrained conditions and are therefore not directly comparable.

A post-cyclic static stage was performed on tests CTX02, CTX03, CTX04, CTX05 and CTX21, despite that specimen failure was observed during cyclic loading. Post-cyclic strength parameters of these tests may be less typical and should be used with caution. The specimen state after failure under cyclic loading of tests CTX22, CTX23, CTX25 and CTX26 did not allow for post-cyclic static loading, i.e. the specimens were too liquefied.

In general the peak deviator stress of static consolidated drained (CD) triaxial tests was used as reference deviator strength for the drained cyclic triaxial tests, refer to Main Text. The peak deviator stress of CID01 of 563 kPa was selected as reference deviator strength for CTX02 and CTX03 (Batch 1 on Unit A “Southern Bight”), refer to Plates A1-6 and A1-14. Results of CTX02 and CTX03 indicate failure during the first cyclic loading stage. The reference deviator stress of Batch 1 for the remaining tests was therefore reconsidered. The deviator stress at peak principal effective stress ratio of CID01 of 122 kPa was subsequently selected as reference strength for CTX01 and CTX04.

Test results of CTX05, CTX21, CTX22 and CTX25 show a steady increase of pore pressure at low average and cyclic strain levels up to pore pressure ratio values between 0.6 and 0.8. Thereafter, pore pressure (ratios) and average and cyclic strain levels progressively increase until failure occurs. The measured pore pressure response towards failure is consistent with expectations for medium dense to dense sand. As the effective stress within the soil approaches zero, the soil dilates in order to sustain an increasing deviator stress. The dilation ceases momentarily at the stress reversal point before unloading occurs. This is clearly seen in the temporary drop in pore pressure once the pore pressure ratios are above 0.8 to 0.9.

The post-cyclic static shear stage of CTX01 was performed partially undrained, as a result of apparent blockage of the drainage pipe. The post-cyclic shearing phase was for that reason omitted from the results of this test.

A1.9 DYNAMIC TESTS

Bender Element Tests

Bender element tests were performed to measure shear wave velocity (v_s) and shear modulus at small strain (G_{max}), as part of six DSS tests on fine-grained cohesive specimens (DSS03R, DSS05, and DSS06) and coarse-grained cohesionless specimens (DSS01, DSS02, and DSS07). A bender element test involves triggering a shear wave, conducted at various frequencies, through the specimen. Tests were performed during the post-setup and/or post-consolidation stage using a variety of frequencies, generally in the range of 10 000 Hz to 100 000 Hz in order to find the frequency with optimum coupling from sender to receiver elements, and hence the strongest received signal. The optimum frequency can vary between tests. On plates in Sections A3.1 and A3.2, a range of measured respectively assessed v_s and G_{max} values for the applied frequencies is presented. The highest values for v_s and G_{max} measured post-consolidation are presented in the DSS summary tables in Section A1.

In general, bender element test results with a wavelength ratio >3 (wavelength ratio is defined as the peak-to-peak arrival time over the input wave period) are considered to be of good quality and hence, are presented in Sections A3.1 and A3.2. In some instances, test results with a wavelength ratio between 2 and 3 are also presented, but only when corresponding G_{max} values are comparable to the G_{max} values with wavelength ratio >3. With wavelength ratio <2, values of G_{max} become increasingly inconsistent and are not presented.

Measured shear wave velocities for the test specimens tend to be lower than those inferred for in situ conditions (refer to Plates 3 and 4 for a list of companion reports in which such results are presented). Reasons include:

- Different methods for determination of shear wave velocity: seismic downhole and/or CPT-based correlation versus bender element tests;
- Approximation of specimen density versus in situ soil density has inherent uncertainties;
- Used method for specimen preparation is different than in situ soil deposition;
- In situ soil includes long-term stress history and time effects (aging).

Resonant Column Tests

Isotropically and anisotropically consolidated resonant column tests were performed to determine shear modulus (G), maximum shear modulus (G_{max}) and damping ratio (D) with increasing average shear strain (γ) at small shear strain by torsional resonance. The samples were consolidated prior to torsional resonance. Test results are summarised on plates in Section A1, individual test results are presented in Section A7.

The tests consist of a primary torsional resonance stage (titled ‘initial loading’), after which the torque level is reduced to the initial level and an additional torsional resonance stage (titled ‘repeat loading’) is performed. The comparison of the results of the ‘initial loading’ and ‘repeat loading’ stages provides an indication of the specimen degradation due to resonance at higher strain levels.

Results of three isotropically consolidated resonant column tests on fine-grained cohesive specimens show expected behaviour for soils tested. The maximum value of shear modulus G was observed at lowest shear strain measured. The tests were terminated after a significant excess pore water pressure was observed.

Drained and undrained resonant column tests on coarse-grained cohesionless material from Unit B1 (Kreftenheye) have been performed on one specimen. Therefore, test results include results for a drained and an undrained torsional resonance stage. Resonant column tests performed on specimens from Batch 5 (Unit C2, Eem) and Batch 6 (Unit D, Yarmouth Roads) were performed undrained. Results of the four (an-)isotropically consolidated resonant column tests on coarse-grained cohesionless specimens show expected behaviour for soils tested. The maximum value of shear modulus G was observed at lowest shear strain measured. The tests were terminated after a significant excess pore water pressure (undrained tests) or a substantial reduction in shear modulus (drained tests) was observed.

Sample photographs for the specimen tested in test RC03 on Unit B1 (Kreftenheye) are not available due to operator error.

A1.10 REFERENCES

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British Standards Institution, 1990a. *BS 1377: Part 2:1990 British Standard Methods of Test for Soils for Civil Engineering Purposes. Part 2: Classification Tests.* London: BSI.

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SUMMARY OF DIRECT SIMPLE SHEAR TEST RESULTS – CONSOLIDATION STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage					$\Delta e/e_o$
						w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]	[-]
HKZ1-BH02-SA	15WaxB	12.87	B1 (Kreftenheye)	DSS	DSS03R	34.3	17.9	0.993	30.5	18.2	120	0.890	5.18	0.104
HKZ2-BH04-SA	16WaxB	13.21		DSS	DSS04	24.1	19.8	0.662	23.0	19.9	125	0.634	1.70	0.042
HKZ1-BH02-SA	24WaxB	21.61	C1 (Eem)	DSS	DSS05	31.3	19.5	0.778	29.6	19.8	210	0.734	2.45	0.057
HKZ2-BH08-SA	40WaxB	23.82	C2 (Eem)	DSS	DSS06	27.2	19.7	0.706	24.4	20.2	190	0.631	4.42	0.106

Key:

$w_{i\,/\,pc}$ = initial / post-consolidation water content
$\gamma_{i\,/\,pc}$ = initial / post-consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = post-consolidation void ratio
$\varepsilon_{v;pc}$ = post-consolidation vertical strain
Δe = change of void ratio from initial conditions to post-consolidation conditions

SUMMARY OF DIRECT SIMPLE SHEAR TEST RESULTS – TEST STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	At Peak Shear Stress					Post-Consolidation*	
						σ'_{vc} [kPa]	s_u [kPa]	s_u/σ'_{vc} [-]	γ_c [%]	Δu [kPa]	v_s [m/s]	G_{max} [MPa]
HKZ1-BH02-SA	15WaxB	12.87	B1 (Kreftenheye)	DSS	DSS03R	120	58	0.48	14.24	36	188	66
HKZ2-BH04-SA	16WaxB	13.21		DSS	DSS04	125	96	0.77	29.91	26	-	-
HKZ1-BH02-SA	24WaxB	21.61	C1 (Eem)	DSS	DSS05	210	82	0.39	19.66	64	211	90
HKZ2-BH08-SA	40WaxB	23.82	C2 (Eem)	DSS	DSS06	190	59	0.31	29.43	88	186	71

Notes:
* : v_s and G_{max} values represent the maximum values for the tested range of frequencies

Key:

σ'_{vc}	=	vertical effective consolidation stress	Δu	=	change in inferred pore water pressure
s_u	=	undrained shear strength	v_s	=	shear wave velocity
γ_c	=	shear strain at peak shear stress	G_{max}	=	shear modulus at small strain

SUMMARY OF DIRECT SIMPLE SHEAR TEST RESULTS – CONSOLIDATION STAGE

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage				
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
2	A (Southern Bight)	DSS	DSS01	10.0	17.9	0.606	22.2	19.9	20	0.587	1.17
4	B1 (Kreftenheye)	DSS	DSS02	9.6	18.0	0.590	21.8	20.1	85	0.576	0.88
7	D (Yarmouth Roads)	DSS	DSS07	8.6	17.1	0.656	23.9	19.7	420	0.634	1.31

Key:

$w_{i\,/\,pc}$ = initial / after consolidation water content
$\gamma_{i\,/\,pc}$ = initial / after consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = void ratio at end of consolidation
$\varepsilon_{v;pc}$ = vertical strain at end of consolidation

SUMMARY OF DIRECT SIMPLE SHEAR TEST RESULTS – TEST STAGE

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID		At Peak Shear Stress (Static)			Post-Consolidation*	
				σ'_{vc} [kPa]	τ [kPa]	γ_c [%]	Δu [kPa]	v_s [m/s]	G_{max} [MPa]
2	A (Southern Bight)	DSS	DSS01	20	629	29.67	-1063	126	32
4	B1 (Kreftenheye)	DSS	DSS02	85	739	21.26	-1209	204	85
7	D (Yarmouth Roads)	DSS	DSS07	420	702	29.67	-842	251	127

Notes:

* : v_s and G_{max} values represent the maximum values for the tested range of frequencies

Key:

σ'_{vc}	=	vertical effective consolidation stress	Δu	=	change in inferred pore water pressure
τ	=	peak shear stress	v_s	=	shear wave velocity
γ_c	=	shear strain at peak shear stress	G_{max}	=	shear modulus at small strain

SUMMARY OF ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage							Δe/e$_o$
						w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	σ'_{rc} [kPa]	e_{pc} [-]	$\varepsilon_{vol;pc}$ [%]	$\varepsilon_{v;pc}$ [%]	[-]
HKZ1-BH01-SA	17WAXB	14.67	B1 (Kreftenheye)	CIUc	CIU03	30.8	19.1	0.807	30.6	19.2	145	145	0.804	0.19	0.09	0.004
HKZ1-BH01-SA	20WAXC	17.95		CIUe	CIUe04	30.9	18.7	0.851	27.5	19.2	165	165	0.760	4.95	1.99	0.107
HKZ1-BH01-SA	20WAXD	18.11		CIUc	CIU05	30.1	18.5	0.857	29.4	18.6	165	165	0.838	0.99	0.50	0.022
HKZ2-BH21-SA	29WAXB	22.20	C2 (Eem)	CAU	CAU01	27.7	19.3	0.763	26.8	19.5	200	200	0.730	1.89	0.75	0.043

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	At Peak Deviator Stress					At Maximum Stress Ratio		
						s_u [kPa]	s_u/σ'_{vc} [-]	ε_a [%]	ε_{50} [%]	E_{50} [MPa]	s_u [kPa]	s_u/σ'_{vc} [-]	ε_a [%]
HKZ1-BH01-SA	17WAXB	14.67	B1 (Kreftenheye)	CIUc	CIU03	118	0.81	19.92	0.51	23.0	86	0.59	2.82
HKZ1-BH01-SA	20WAXC	17.95		CIUe	CIUe04	86	0.52	-6.30	-0.67	12.9	84	0.51	-5.39
HKZ1-BH01-SA	20WAXD	18.11		CIUc	CIU05	104	0.63	14.18	0.40	25.7	94	0.57	3.50
HKZ2-BH21-SA	29WAXB	22.20	C2 (Eem)	CAU	CAU01	144	0.72	12.49	0.90	15.9	133	0.66	5.40

Key:

$w_{i\,/\,pc}$	=	initial / after consolidation water content
$\gamma_{i\,/\,pc}$	=	initial / after consolidation unit weight
e_0	=	initial void ratio
$\sigma'_{vc\,/\,rc}$	=	vertical / radial effective stress at end of consolidation
e_{pc}	=	void ratio at end of consolidation
$\varepsilon_{vol;pc}$	=	volumetric strain at end of consolidation
$\varepsilon_{v;pc}$	=	vertical strain at end of consolidation
Δe	=	change of void ratio from initial conditions to estimated in-situ stress conditions
s_u	=	undrained shear strength
ε_a	=	axial strain at peak deviator stress or maximum stress ratio
ε_{50}	=	axial strain at 50% of peak deviator stress
E_{50}	=	Young's modulus at 50% of peak deviator stress

SUMMARY OF (AN)ISOTROPICALLY CONSOLIDATED (UN)DRAINED TRIAXIAL TEST RESULTS

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage					
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{rc} [kPa]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
1	A (Southern Bight)	CIU	CIU01	10.0	17.9	0.604	22.8	19.9	15	15	0.603	0.00
3	B1 (Kreftenheye)	CIU	CIUc02	10.2	17.7	0.622	23.1	19.8	135	135	0.612	0.17
5	C2 (Eem)	CAU	CAUc02	10.6	17.1	0.684	25.1	19.5	225	320	0.666	0.46
6	D (Yarmouth Roads)	CAU	CAUc03	10.1	17.1	0.677	24.9	19.5	250	380	0.659	0.74
1	A (Southern Bight)	CID	CID01	10.4	17.8	0.614	23.2	19.8	15	15	0.614	-
3	B1 (Kreftenheye)	CID	CID02	10.7	17.7	0.625	23.2	19.8	135	135	0.615	-

Batch	Unit (Formation)	Test Type	Test ID	At Peak Deviator Stress					At Peak Principal Effective Stress Ratio		
				q [kPa]	q/σ'_{vc} [-]	ε_a [%]	ε_{50} [%]	E_{50} [MPa]	q [kPa]	q/σ'_{vc} [-]	ε_a [%]
1	A (Southern Bight)	CIU	CIU01	2258	150.53	6.99	3.67	30.72	120	8.00	0.75
3	B1 (Kreftenheye)	CIU	CIU02	1906	14.12	20.00	6.84	13.93	440	3.26	2.46
5	C2 (Eem)	CAU	CAUc02	1325	4.14	20.01	3.84	16.01	581	1.82	2.59
6	D (Yarmouth Roads)	CAU	CAUc03	258	0.68	20.00	6.05	1.05	208	0.55	9.74
1	A (Southern Bight)	CID	CID01	563	37.53	9.11	3.08	9.13	122	8.13	1.11
3	B1 (Kreftenheye)	CID	CID02	448	3.32	3.69	0.37	60.39	443	3.28	2.40

Key:

$w_{i\,/\,pc}$	=	initial / after consolidation water content
$\gamma_{i\,/\,pc}$	=	initial / after consolidation unit weight
e_0	=	initial void ratio
$\sigma'_{vc\,/\,rc}$	=	vertical / radial effective stress at end of consolidation
e_{pc}	=	void ratio at end of consolidation
$\varepsilon_{vol;pc}$	=	volumetric strain at end of consolidation
$\varepsilon_{v;pc}$	=	vertical strain at end of consolidation
Δe	=	change of void ratio from initial conditions to estimated in-situ stress conditions
q	=	corrected deviator stress
ε_a	=	axial strain at peak deviator stress or maximum stress ratio
ε_{50}	=	axial strain at 50% of peak deviator stress
E_{50}	=	Young's modulus at 50% of peak deviator stress

SUMMARY OF CYCLIC SIMPLE SHEAR TEST RESULTS – CONSOLIDATION STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage					$\Delta e/e_o$ [-]
						w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]	
HKZ1-BH02-SA	15WaxB	12.80	B1 (Kreftenheye)	CSS	CSS09	33.9	17.8	1.003	30.4	18.2	120	0.907	4.75	0.096
HKZ1-BH02-SA	15WaxB	12.84		CSS	CSS10	34.0	17.9	0.985	31.2	18.2	120	0.911	3.70	0.075
HKZ1-BH02-SA	15WaxC	12.96		CSS	CSS11	36.1	17.8	1.027	34.7	18.0	120	0.987	1.97	0.039
HKZ1-BH02-SA	15WaxC	13.01		CSS	CSS12	35.4	18.1	0.971	34.4	18.3	120	0.946	1.29	0.026
HKZ2-BH04-SA	16WaxB	13.24		CSS	CSS13	25.3	19.5	0.697	24.7	19.6	125	0.680	0.98	0.024
HKZ2-BH04-SA	16WaxB	13.28		CSS	CSS14	25.3	20.2	0.647	24.3	20.3	125	0.620	1.65	0.042
HKZ1-BH02-SA	24WaxB	21.69	C1 (Eem)	CSS	CSS15	26.8	19.7	0.704	25.2	20.0	210	0.661	2.52	0.061
HKZ1-BH02-SA	24WaxB	21.65		CSS	CSS16	26.5	19.9	0.686	25.1	20.1	210	0.649	2.21	0.054
HKZ2-BH08-SA	40WaxB	23.86	C2 (Eem)	CSS	CSS17	26.0	19.9	0.678	22.7	20.5	190	0.589	5.33	0.131
HKZ2-BH08-SA	40WaxC	23.92		CSS	CSS18	27.7	19.3	0.721	23.1	20.0	190	0.601	7.03	0.166
HKZ2-BH08-SA	40WaxC	23.97		CSS	CSS19	28.1	19.1	0.773	25.0	19.6	190	0.689	4.77	0.109
HKZ2-BH08-SA	40WaxC	24.03		CSS	CSS23	25.9	19.9	0.678	23.2	20.3	190	0.604	4.36	0.109

Key:

$w_{i\,/\,pc}$ = initial / post-consolidation water content
$\gamma_{i\,/\,pc}$ = initial / post-consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = post-consolidation void ratio
$\varepsilon_{v;pc}$ = post-consolidation vertical strain
Δe = change of void ratio from initial conditions to post-consolidation conditions

SUMMARY OF CYCLIC SIMPLE SHEAR TEST RESULTS – TEST STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth	Unit	Test Type	Test ID			Pre-Cyclic Loading Stage						Cyclic Loading Stage						Post-Cyclic Static Loading Stage		
						σ'_{vc}	$s_{u;ref}$	$\tau_{av}/s_{u;ref}$	$\tau_{cy}/s_{u;ref}$	N_f	γ_{av}	γ_{cy}	u_a	$\tau_{av}/s_{u;ref}$	$\tau_{cy}/s_{u;ref}$	N_f	γ_{av}	γ_{cy}	u_a	s_u	γ_f	u_f
		[m]				[kPa]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[kPa]	[%]	[kPa]
HKZ1-BH02-SA	15WaxB	12.80	B2	CSS	CSS09	120	96	0.00	0.06	400	1.84	0.03	0	0.00	0.24	1500	0.09	0.34	54	83	20.55	36
HKZ1-BH02-SA	15WaxB	12.84		CSS	CSS10	120	96	0.00	0.06	400	0.02	0.03	0	0.00	0.35	1500	-1.58	6.57	96	68	13.24	42
HKZ1-BH02-SA	15WaxC	12.96		CSS	CSS11	120	96	0.00	0.06	400	0.10	0.03	0	-0.02	0.47	396	-1.33	15.03	92	63	26.54	54
HKZ1-BH02-SA	15WaxC	13.01		CSS	CSS12	120	96	0.00	0.06	400	0.74	0.03	0	0.00	0.59	139	2.61	15.10	88	64	25.78	54
HKZ2-BH04-SA	16WaxB	13.24		CSS	CSS13	125	96	0.00	0.10	400	0.38	0.07	0	0.00	0.39	86	3.20	15.01	90	48	30.01	48
HKZ2-BH04-SA	16WaxB	13.28		CSS	CSS14	125	96	0.00	0.09	400	1.95	0.07	0	0.00	0.75	4	1.47	16.66	69	62	29.95	56
HKZ1-BH02-SA	24WaxB	21.69	C1	CSS	CSS15	210	82	0.00	0.10	400	0.27	0.03	0	0.00	0.40	1500	0.03	0.24	41	124	20.75	55
HKZ1-BH02-SA	24WaxB	21.65		CSS	CSS16	210	82	0.00	0.10	400	0.33	0.03	0	0.00	0.88	803	15.60	14.35	132	49	29.96	127
HKZ2-BH08-SA	40WaxB	23.86	C2	CSS	CSS17	190	59	0.00	0.10	400	-0.43	0.03	-7	0.00	0.39	85	0.34	15.15	166	38	28.73	138
HKZ2-BH08-SA	40WaxC	23.92		CSS	CSS18	190	59	0.00	0.10	400	-1.08	0.03	0	0.00	0.27	1500	-0.23	0.26	80	61	21.13	88
HKZ2-BH08-SA	40WaxC	23.97		CSS	CSS19	190	59	0.00	0.10	400	0.27	0.03	0	0.00	0.41	250	1.21	14.95	172	34	29.98	146
HKZ2-BH08-SA	40WaxC	24.03		CSS	CSS23	190	59	-0.02	0.05	400	0.31	0.01	0	0.00	0.54	23	-1.45	15.41	168	44	22.61	127

Key:

σ'_{vc}	=	vertical effective stress at end of consolidation
$s_{u;ref}$	=	reference undrained shear strength
τ_{av}	=	average shear stress
τ_{cy}	=	cyclic shear stress
N_f	=	number of cycles to failure
γ_{av}	=	average shear strain at N_f
γ_{cy}	=	cyclic shear strain at N_f
u_a	=	inferred pore water pressure at N_f
s_u	=	undrained shear strength
γ_f	=	shear strain at failure
u_f	=	inferred pore water pressure at failure
$s_{u;ref}$	=	reference undrained shear strength

SUMMARY OF CYCLIC SIMPLE SHEAR TEST RESULTS – CONSOLIDATION STAGE

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage				
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
2	A (Southern Bight)	CSS	CSS01	10.3	17.9	0.610	22.6	19.9	20	0.598	0.75
		CSS	CSS02	10.2	17.9	0.609	22.9	19.9	20	0.607	0.16
		CSS	CSS03	10.6	17.9	0.615	22.2	20.0	20	0.588	1.67
		CSS	CSS04	10.5	17.8	0.614	22.9	19.9	20	0.608	0.36
4	B1 (Kreftenheye)	CSS	CSS05	10.0	18.0	0.597	22.3	20.0	85	0.591	0.33
		CSS	CSS06	10.1	18.0	0.598	22.2	20.0	85	0.588	0.65
		CSS	CSS07	8.7	18.0	0.578	21.4	20.1	85	0.568	0.61
		CSS	CSS08	9.9	18.0	0.595	21.3	20.2	85	0.563	1.99
7	D (Yarmouth Roads)	CSS	CSS20	10.5	17.1	0.685	24.8	19.6	420	0.658	1.61
		CSS	CSS21	11.9	17.1	0.706	25.0	19.5	420	0.664	2.47
		CSS	CSS22	11.3	17.1	0.698	25.6	19.4	420	0.678	1.14

Key:

$w_{i\,/\,pc}$ = initial / after consolidation water content
$\gamma_{i\,/\,pc}$ = initial / after consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = void ratio at end of consolidation
$\varepsilon_{v;pc}$ = vertical strain at end of consolidation

SUMMARY OF CYCLIC SIMPLE SHEAR TEST RESULTS – TEST STAGE

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID		Pre-Cyclic Loading Stage						Cyclic Loading Stage						Post-Cyclic Static Loading Stage		
				σ'_{vc}	τ_{av}/σ'_{vc}	τ_{cy}/σ'_{vc}	N_f	γ_{av}	γ_{cy}	u_a	τ_{av}/σ'_{vc}	τ_{cy}/σ'_{vc}	N_f	γ_{av}	γ_{cy}	u_a	τ_f	γ_f	u_f
				[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[kPa]	[%]	[kPa]
2	A (Southern Bight)	CSS	CSS01	20	0.00	0.05	400	-0.67	0.01	0	0.00	0.60	1208	15.05	11.78	9	199	40.78	-283
		CSS	CSS02	20	0.00	0.05	400	0.73	0.02	0	0.00	0.25	1500	6.76	5.22	9	242	24.97	-1411
		CSS	CSS03	20	0.00	0.05	400	0.29	0.01	0	0.00	0.85	382	-3.68	15.03	5	378	29.99	-573
		CSS	CSS04	20	-0.05	0.05	400	0.18	0.01	0	0.00	0.45	1500	-4.33	10.53	12	711	29.98	-1119
4	B1 (Kreftenheye)	CSS	CSS05	85	0.00	0.05	400	-0.31	0.05	0	0.00	0.38	86	2.35	15.02	12	249	28.33	-1346
		CSS	CSS06	85	0.00	0.05	400	0.03	0.02	0	0.00	0.28	264	-2.63	15.02	67	466	29.98	-638
		CSS	CSS07	85	0.00	0.05	400	-0.02	0.02	0	0.00	0.41	21	-1.55	15.11	57	307	39.84	-433
		CSS	CSS08	85	0.00	0.05	400	2.36	0.03	0	0.00	0.48	17	-3.14	15.04	50	420	30.00	-575
7	D (Yarmouth Roads)	CSS	CSS20	420	0.00	0.05	400	0.25	0.07	0	0.00	0.15	53	-0.40	15.05	370	161	18.88	187
		CSS	CSS21	420	0.00	0.05	400	0.25	0.07	0	0.00	0.20	13	0.69	15.67	350	359	29.97	-178
		CSS	CSS22	420	0.00	0.05	400	0.35	0.06	0	0.00	0.30	8	-0.45	16.15	316	467	29.99	-337

Key:

σ'_{vc}	=	vertical effective stress at end of consolidation
τ_{av}	=	average shear stress
τ_{cy}	=	cyclic shear stress
N_f	=	number of cycles to failure
γ_{av}	=	average shear strain at N_f
γ_{cy}	=	cyclic shear strain at N_f
u_a	=	inferred pore water pressure at N_f
τ_f	=	shear stress at failure
γ_f	=	shear strain at failure
u_f	=	inferred pore water pressure at failure

SUMMARY OF CYCLIC TRIAXIAL TEST RESULTS – CONSOLIDATION STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage					$\Delta e/e_o$
						w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]	[-]
HKZ1-BH01-SA	17WaxC	14.86	B2 (Kreftenheye)	CTX	CTX12	29.1	18.9	0.806	27.3	19.2	148	0.757	1.34	0.061
HKZ1-BH01-SA	17WaxD	15.08		CTX	CTX13	29.3	19.2	0.782	27.1	19.5	145	0.725	1.62	0.073
HKZ1-BH01-SA	21WaxC	18.92		CTX	CTX14	30.5	18.5	0.862	30.6	18.5	166	0.867	-0.05	-
HKZ1-BH01-SA	21WaxD	19.10		CTX	CTX15	31.1	18.4	0.878	31.3	18.4	165	0.883	-0.17	-
HKZ1-BH01-SA	25WaxA	22.55	C1 (Eem)	CTX	CTX16	31.8	18.7	0.862	31.5	18.8	211	0.852	0.30	0.012
HKZ1-BH21-SA	29WaxD	22.56	C2 (Eem)	CTX	CTX17	30.2	19.3	0.780	28.5	19.6	220	0.735	1.35	0.058
HKZ1-BH21-SA	30WaxB	23.28		CTX	CTX18	31.3	19.3	0.798	31.4	19.3	220	0.801	-0.04	-
HKZ1-BH21-SA	30WaxC	23.46		CTX	CTX19	30.8	18.8	0.836	30.8	18.8	220	0.837	0.01	-

Key:

$w_{i\,/\,pc}$ = initial / post-consolidation water content
$\gamma_{i\,/\,pc}$ = initial / post-consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = post-consolidation void ratio
$\varepsilon_{v;pc}$ = post-consolidation vertical strain
Δe = change of void ratio from initial conditions to post-consolidation conditions

SUMMARY OF CYCLIC TRIAXIAL TEST RESULTS – TEST STAGE

COHESIVE SPECIMENS

Location	Sample No.	Depth	Unit	Test Type	Test ID			Cyclic Loading Stage 1						Cyclic Loading Stage 2						Post-Cyclic Static Loading Stage			
						σ'_{vc}	q_{ref}	q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	u_a	q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	u_a	q	ε_a	ε_{50}	u_f
		[m]				[kPa]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[kPa]	[%]	[%]	[kPa]
HKZ1-BH01-SA	17WaxC	14.86	B2	CTX	CTX12	148	233	0.05	0.10	1500	0.03	0.02	24	0.05	0.20	400	0.04	0.07	44	216	12.9	0.51	63
HKZ1-BH01-SA	17WaxD	15.08		CTX	CTX13	145	233	0.10	0.10	1500	0.03	0.04	17	0.20	0.20	400	0.33	0.09	74	235	10.0	0.94	58
HKZ1-BH01-SA	21WaxC	18.92		CTX	CTX14	166	208	0.15	0.15	1500	0.04	0.03	26	0.15	0.40	400	0.16	0.18	60	222	2.71	0.28	80
HKZ1-BH01-SA	21WaxD	19.10		CTX	CTX15	165	208	0.10	0.10	1500	0.02	0.02	17	0.20	0.40	400	0.33	0.20	75	230	2.63	0.60	88
HKZ1-BH01-SA	25WaxA	22.55	C1	CTX	CTX16	211	215	0.10	0.15	1500	0.07	0.04	25	0.25	0.20	400	0.20	0.07	44	212	3.90	0.24	95
HKZ1-BH21-SA	29WaxD	22.56	C2	CTX	CTX17	220	287	0.10	0.10	1500	-0.01	0.04	8	0.15	0.15	400	0.04	0.06	11	313	3.17	0.58	73
HKZ1-BH21-SA	30WaxB	23.28		CTX	CTX18	220	287	0.15	0.10	1500	0.02	0.01	16	0.15	0.20	400	0.03	0.03	16	244	4.98	0.20	67
HKZ1-BH21-SA	30WaxC	23.46		CTX	CTX19	220	287	0.15	0.15	1500	0.04	0.03	17	0.20	0.30	400	0.10	0.10	31	235	2.43	0.24	88

Key:

σ'_{vc}	=	vertical effective stress at end of consolidation
q_{ref}	=	reference deviator stress
q_{av}	=	average deviator stress
q_{cy}	=	cyclic deviator stress
N_f	=	number of cycles to failure
ε_{av}	=	average axial strain at N_f
ε_{cy}	=	cyclic axial strain at N_f
u_a	=	inferred pore water pressure at N_f
q	=	deviator stress
ε_a	=	axial strain at peak deviator stress
ε_{50}	=	axial strain at 50% of peak deviator stress
u_f	=	inferred pore water pressure at failure

SUMMARY OF CYCLIC TRIAXIAL TEST RESULTS – CONSOLIDATION STAGE
COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage				
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
1	A (Southern Bight)	CTX	CTX05	9.2	17.9	0.592	22.4	20.0	20	0.594	0.02
		CTX	CTX06	11.2	17.8	0.624	23.5	19.8	20	0.622	0.03
3	B1 (Kreftenheye)	CTX	CTX11	10.0	17.7	0.616	22.9	19.9	135	0.607	0.15
5	C2 (Eem)	CTX	CTX20	10.2	17.1	0.680	24.9	19.5	320	0.661	0.46
		CTX	CTX21	9.5	17.1	0.669	24.6	19.6	320	0.652	0.44
		CTX	CTX22	9.9	17.1	0.677	25.0	19.5	320	0.662	0.52
		CTX	CTX23	10.4	17.1	0.685	24.9	19.55	320	0.659	1.12
6	D (Yarmouth Roads)	CTX	CTX24	10.2	17.1	0.674	24.8	19.6	380	0.657	0.67
		CTX	CTX25	9.5	17.1	0.669	24.7	19.6	380	0.653	0.62
		CTX	CTX26	9.7	17.1	0.674	24.7	19.6	379	0.655	0.67

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage				
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
1	A (Southern Bight)	CTX	CTX01	9.7	17.9	0.600	22.9	19.9	20	0.607	-0.02
		CTX	CTX02	10.1	17.8	0.609	23.0	19.8	20	0.610	0.01
		CTX	CTX03	10.3	17.9	0.609	23.0	19.8	20	0.610	0.01
		CTX	CTX04	10.5	17.8	0.614	23.1	19.8	20	0.611	0.03
3	B1 (Kreftenheye)	CTX	CTX07	9.1	17.7	0.604	22.4	19.9	135	0.594	0.18
		CTX	CTX08	10.2	17.8	0.614	22.8	19.9	135	0.604	0.24
		CTX	CTX09	10.9	17.7	0.630	23.5	19.8	135	0.623	0.12
		CTX	CTX10	10.4	17.7	0.622	23.1	19.8	135	0.611	0.23

Key:

$w_{i\,/\,pc}$ = initial / after consolidation water content
$\gamma_{i\,/\,pc}$ = initial / after consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = void ratio at end of consolidation
$\varepsilon_{v;pc}$ = vertical strain at end of consolidation

SUMMARY OF CYCLIC TRIAXIAL TEST RESULTS – TEST STAGE
COHESIONLESS SPECIMENS

Batch	Unit	Test Type	Test ID	σ'_{vc}	q_{ref}	Undrained															
						Cyclic Loading Stage 1						Cyclic Loading Stage 2						Post-Cyclic Static Loading Stage			
						q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	u_a	q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	u_a	q	ε_a	ε_{50}	u_f
				[kPa]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[-]	[-]	[-]	[%]	[%]	[kPa]	[kPa]	[%]	[%]	[kPa]
1	A	CTX	CTX05	20	40	0.00	0.05	1500	0.01	0.01	2	0.00	0.25	19	-1.02	3.36	12	-	-	-	-
		CTX	CTX06	20	40	0.15	0.10	1500	0.99	0.01	0	0.20	0.13	400	1.03	0.01	1	2380	14.10	5.95	-973
3	B1	CTX	CTX11	135	270	0.00	0.10	1500	0.02	0.02	13	0.00	0.17	400	0.03	0.05	36	1950	18.60	4.59	-736
5	C2	CTX	CTX20	320	640	0.05	0.10	1500	-0.01	0.06	96	0.10	0.15	400	0.02	0.07	55	1870	20.34	4.19	-640
		CTX	CTX21	320	640	0.10	0.10	1500	0.00	0.06	52	0.15	0.20	96	8.98	11.34	185	3	14.29	-2.18	218
		CTX	CTX22	320	640	0.10	0.15	74	9.68	15.30	197	-	-	-	-	-	-	-	-	-	-
		CTX	CTX23	320	640	0.15	0.15	371	15.01	0.22	190	-	-	-	-	-	-	1435	22.10	18.42	-376
6	D	CTX	CTX24	320	760	0.05	0.05	1500	-0.07	0.02	73	0.10	0.05	400	0.04	0.02	17	392	18.54	0.26	83
		CTX	CTX25	380	760	0.10	0.15	54	18.05	12.89	232	-	-	-	-	-	-	-	-	-	-
		CTX	CTX26	379	760	0.15	0.15	28	17.19	7.12	208	-	-	-	-	-	-	-	-	-	-

Batch	Unit	Test Type	Test ID	σ'_{vc}	q_{ref}	Drained													
						Cyclic Loading Stage 1					Cyclic Loading Stage 2					Post-Cyclic Static Loading Stage		
						q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	q_{av}/q_{ref}	q_{cy}/q_{ref}	N_f	ε_{av}	ε_{cy}	q	ε_a	ε_{50}
				[kPa]	[kPa]	[-]	[-]	[-]	[%]	[%]	[-]	[-]	[-]	[%]	[%]	[kPa]	[%]	[%]
1	A	CTX	CTX01	20	122	0.10	0.10	1500	0.89	0.02	0.25	0.30	400	3.49	0.06	-	-	-
		CTX	CTX02	20	563	0.20	0.10	220	15.02	0.07	-	-	-	-	-	-	-	-
		CTX	CTX03	20	563	0.10	0.20	9	-7.09	17.41	-	-	-	-	-	-	-	-
		CTX	CTX04	20	122	0.20	0.20	1491	5.45	0.03	0.35	0.35	163	20.51	0.10	57	21.06	22.98
3	B1	CTX	CTX07	135	448	0.10	0.10	1500	0.36	0.03	0.25	0.25	400	0.80	0.07	460	3.12	0.94
		CTX	CTX08	135	448	0.20	0.10	1500	0.79	0.03	0.35	0.25	400	2.01	0.06	398	4.20	2.09
		CTX	CTX09	135	448	0.10	0.15	1500	0.30	0.05	0.25	0.40	400	1.91	0.12	445	4.14	2.03
		CTX	CTX10	135	448	0.20	0.15	1500	1.27	0.05	0.35	0.35	400	3.51	0.11	420	4.89	3.61

Key:

σ'_{vc}	=	vertical effective stress at end of consolidation
q_{ref}	=	reference deviator stress
q_{av}	=	average deviator stress
q_{cy}	=	cyclic deviator stress
N_f	=	number of cycles to failure
ε_{av}	=	average axial strain at N_f
ε_{cy}	=	cyclic axial strain at N_f
u_a	=	inferred pore water pressure at N_f
q	=	deviator stress
ε_a	=	axial strain at peak deviator stress
ε_{50}	=	axial strain at 50% of peak deviator stress
u_f	=	inferred pore water pressure at failure

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST RESULTS

COHESIVE SPECIMENS

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage							$\Delta e/e_o$
						w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{vc} [kPa]	σ'_{rc} [kPa]	e_{pc} [-]	$\varepsilon_{vol;pc}$ [%]	$\varepsilon_{v;pc}$ [%]	[-]
HKZ1-BH01-SA	17WAXB	14.67	B1 (Kreftenheye)	RC	RC07	30.8	19.1	0.814	27.5	19.5	145	145	0.726	4.87	1.43	0.108
HKZ1-BH01-SA	20WAXD	18.11		RC	RC08	30.8	18.6	0.863	29.9	18.8	165	165	0.838	1.31	0.73	0.029
HKZ2-BH21-SA	31WaxD	24.52	C2 (Eem)	RC	RC09	32.5	18.6	0.881	32.5	18.6	200	200	0.881	0.04	0.01	0.000

Location	Sample No.	Depth [m]	Unit (Formation)	Test Type	Test ID	Torsional Resonance Stage – Initial Loading			Torsional Resonance Stage – Repeat Loading		
						G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]	G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]
HKZ1-BH01-SA	17WAXB	14.67	B1 (Kreftenheye)	RC	RC07	69.13	$4.81*10^{-4}$	1.42	68.27	$4.57*10^{-4}$	1.25
HKZ1-BH01-SA	20WAXD	18.11		RC	RC08	61.52	$6.71*10^{-4}$	0.34	62.62	$4.88*10^{-4}$	0.07
HKZ2-BH21-SA	31WaxD	24.52	C2 (Eem)	RC	RC09	93.05	$3.38*10^{-4}$	0.79	91.89	$1.80*10^{-4}$	1.54

Key:

$w_{i\,/\,pc}$	=	initial / after consolidation water content
$\gamma_{i\,/\,pc}$	=	initial / after consolidation unit weight
e_0	=	initial void ratio
$\sigma'_{vc\,/\,rc}$	=	vertical / radial effective stress at end of consolidation
e_{pc}	=	void ratio at end of consolidation
$\varepsilon_{vol;pc}$	=	volumetric strain at end of consolidation
$\varepsilon_{v;pc}$	=	vertical strain at end of consolidation
Δe	=	change of void ratio from initial conditions to estimated in-situ stress conditions
G_{max}	=	maximum shear modulus
γ	=	average shear strain
D	=	damping ratio

SUMMARY OF CYCLIC SIMPLE SHEAR TEST RESULTS – CONSOLIDATION STAGE

COHESIONLESS SPECIMENS

Batch	Unit (Formation)	Test Type	Test ID	Initial			Consolidation Stage					
				w_i [%]	γ_i [kN/m³]	e_0 [-]	w_{pc} [%]	γ_{pc} [kN/m³]	σ'_{rc} [kPa]	σ'_{vc} [kPa]	e_{pc} [-]	$\varepsilon_{v;pc}$ [%]
1	A (Southern Bight)	RC	RC01	10.9	17.8	0.619	23.4	19.8	20	20	0.619	0.01
3	B1 (Kreftenheye)	RC	RC03	9.5	17.7	0.609	23.0	19.9	135	135	0.609	0.13
5	C2 (Eem)	RC	RC05	10.0	17.1	0.676	24.9	19.5	225	320	0.660	0.48
6	D (Yarmouth Roads)	RC	RC06	9.5	17.1	0.672	24.5	19.6	250	380	0.650	0.81

Batch	Unit (Formation)	Test Type	Test ID	Drained – Torsional Resonance Stage						Undrained – Torsional Resonance Stage					
				Initial Loading			Repeat Loading			Initial Loading			Repeat Loading		
				G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]	G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]	G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]	G_{max} [MPa]	γ at G_{max} [%]	D at G_{max} [%]
1	A (Southern Bight)	RC	RC01	37.65	$3.07*10^{-4}$	1.38	32.28	$5.97*10^{-4}$	1.13	32.28	$4.79*10^{-4}$	0.94	32.39	$2.67*10^{-4}$	1.22
3	B1 (Kreftenheye)	RC	RC03	106.83	$4.55*10^{-4}$	0.07	98.77	$4.99*10^{-4}$	0.18	96.35	$5.04*10^{-4}$	0.19	93.18	$5.01*10^{-4}$	0.16
5	C2 (Eem)	RC	RC05	-	-	-	-	-	-	130.74	$1.33*10^{-4}$	1.41	128.03	$1.43*10^{-4}$	1.34
6	D (Yarmouth Roads)	RC	RC06	-	-	-	-	-	-	117.23	$1.02*10^{-4}$	0.65	115.66	$1.05*10^{-4}$	0.66

Key:

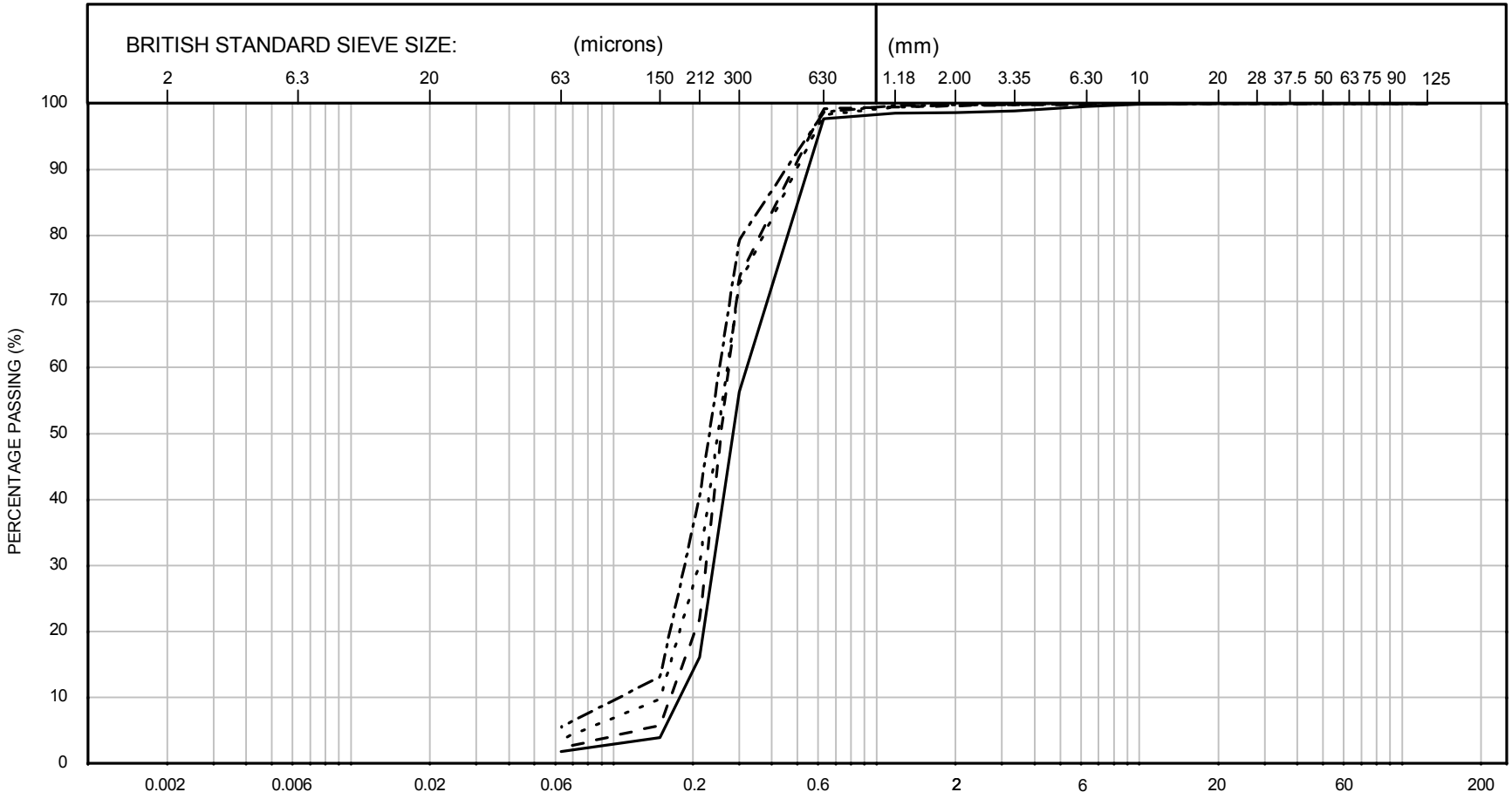
$w_{i\,/\,pc}$ = initial / after consolidation water content
$\gamma_{i\,/\,pc}$ = initial / after consolidation unit weight
e_0 = initial void ratio
σ'_{vc} = vertical effective consolidation stress
e_{pc} = void ratio at end of consolidation
$\varepsilon_{v;pc}$ = vertical strain at end of consolidation
G_{max} = maximum shear modulus
γ = average shear strain
D = damping ratio

SECTION A2: INDEX LABORATORY TESTS

LIST OF PLATES IN SECTION A2: Plate

Particle Size Distribution Results A2-1 to A2-2

PARTICLE SIZE DISTRIBUTION TEST RESULTS



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

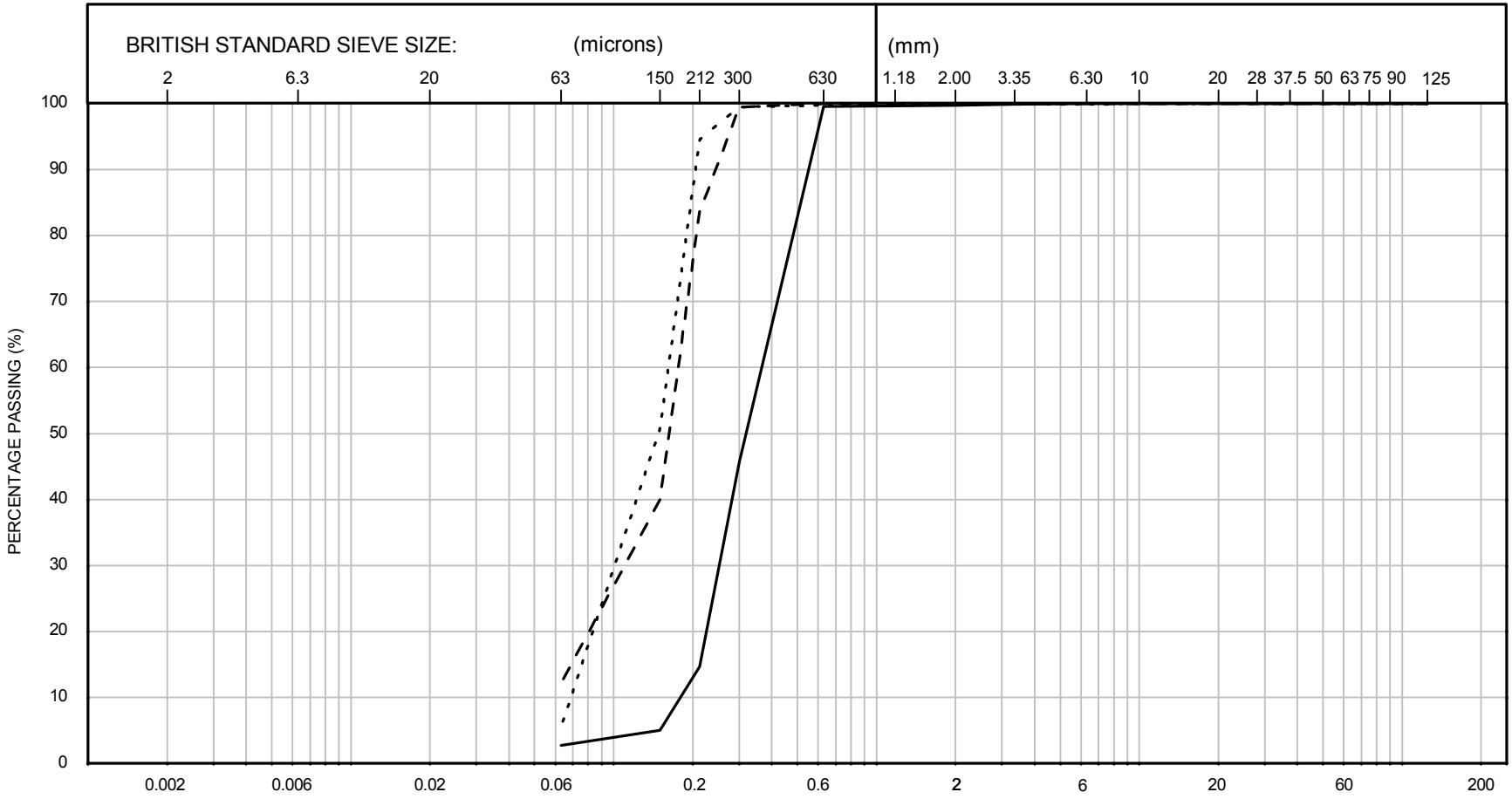
Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt†	Sand	Gravel	Cobbles
——	Various	Batch 1	-	9.2	N/A	0	1	98	1	0
– –	Various	Batch 2	-	9.2	N/A	0	2	98	0	0
- - -	Various	Batch 3	-	9.2	N/A	0	3	97	0	0
—– –	Various	Batch 4	-	9.2	N/A	0	5	95	0	0

* Tested in accordance with the following clauses of BS 1377: Part 2: 1990:

9.2	Wet sieve
9.3	Dry sieve
9.4	Sedimentation by pipette
9.5	Sedimentation by hydrometer

† Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

PARTICLE SIZE DISTRIBUTION TEST RESULTS



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt†	Sand	Gravel	Cobbles
———	HKZ1-BH08-SA	Batch 5	-	9.2	N/A	0	2	98	0	0
– – –	HKZ2-BH07A-SA	Batch 6	-	9.2	N/A	0	12	88	0	0
- - -	HKZ2-BH21-SA	Batch 7	-	9.2	N/A	0	5	95	0	0

† Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

* Tested in accordance with the following clauses of BS 1377: Part 2: 1990:

9.2	Wet sieve
9.3	Dry sieve
9.4	Sedimentation by pipette
9.5	Sedimentation by hydrometer

SECTION A3: DIRECT SIMPLE SHEAR TESTS

LIST OF PLATES IN SECTION A3: Plate

Direct Simple Shear Test – Cohesive Specimens	A3.1-1 to A3.1-39
Direct Simple Shear Test – Cohesionless Specimens	A3.2-1 to A3.2-33

VISUAL DESCRIPTION
Very dark brown CLAY with organic matter

GENERAL	
Date test started	17/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.9
Water content	[%]	34.3
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.35
Void ratio	[-]	0.993
Degree of saturation	[%]	93
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_15B_DSS03R
Template issue	1.4
Processed by Date	EJC 19/10/2016
Checked by Date	PH 11/11/2016
Approved by Date	PH 11/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.87
Test number	DSS03R

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

CONSOLIDATION		
σ_{vc}	[kPa]	120
Vertical strain	[%]	5.18
Bulk density	[Mg/m^3]	1.86
Dry density	[Mg/m^3]	1.43
Void ratio	[-]	0.890
Water content	[%]	30.5

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION				
Bulk density	[Mg/m^3]	1.86		
Dry density	[Mg/m^3]	1.43		
Void ratio	[-]	0.890		
Distance	[mm]	23.88		
Vertical stress	[kPa]	120		
Input Wave Period	Peak-to-Peak Arrival Time	Wavelength Ratio	Velocity	G_{max}
[ms]	[ms]	[-]	[m/s]	[MPa]
0.03	0.1270	4.23	188.02	65.89
0.04	0.1300	3.25	183.69	62.89
0.05	0.1335	2.67	178.87	59.63
0.06	0.1360	2.27	175.58	57.46
0.07	0.1400	2.00	170.57	54.23

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	58
Shear strain	[%]	14.24
Shear induced -$\Delta\sigma_v$	[kPa]	36
Vertical stress	[kPa]	84
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	58
Shear induced -$\Delta\sigma_v$	[kPa]	36
Vertical stress	[kPa]	83
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.87
Test number	DSS03R

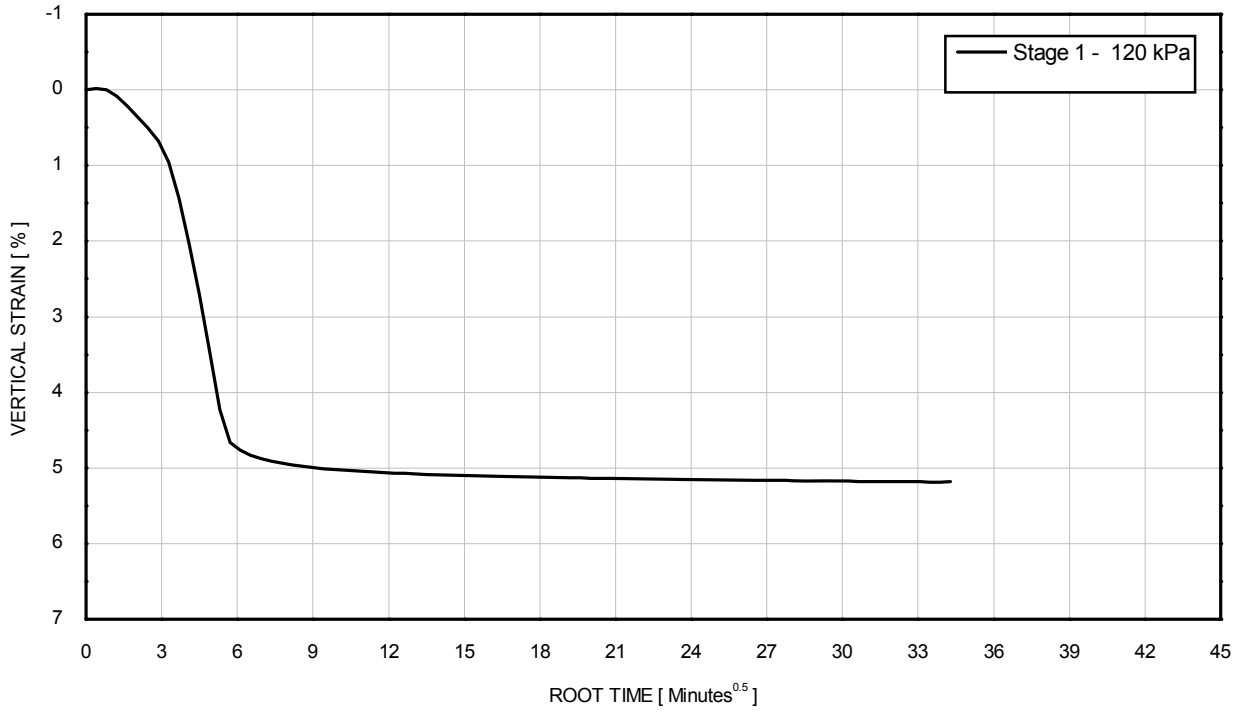
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

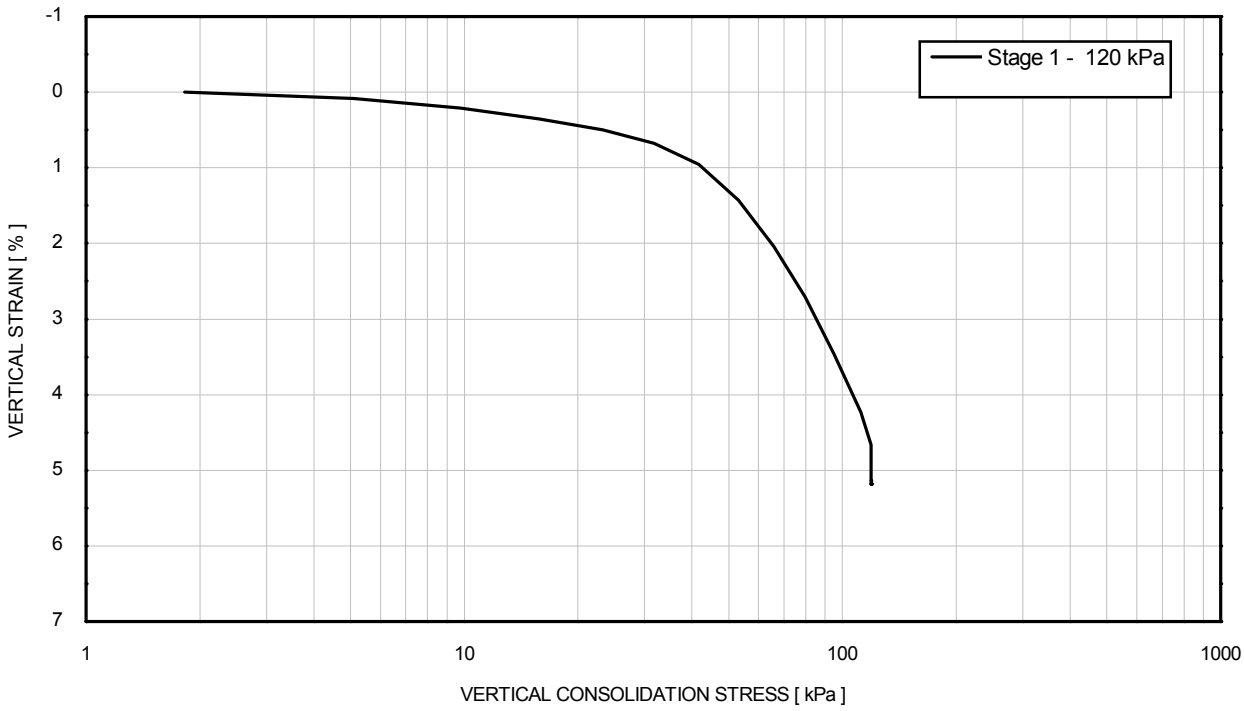
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.87
Test number	DSS03R

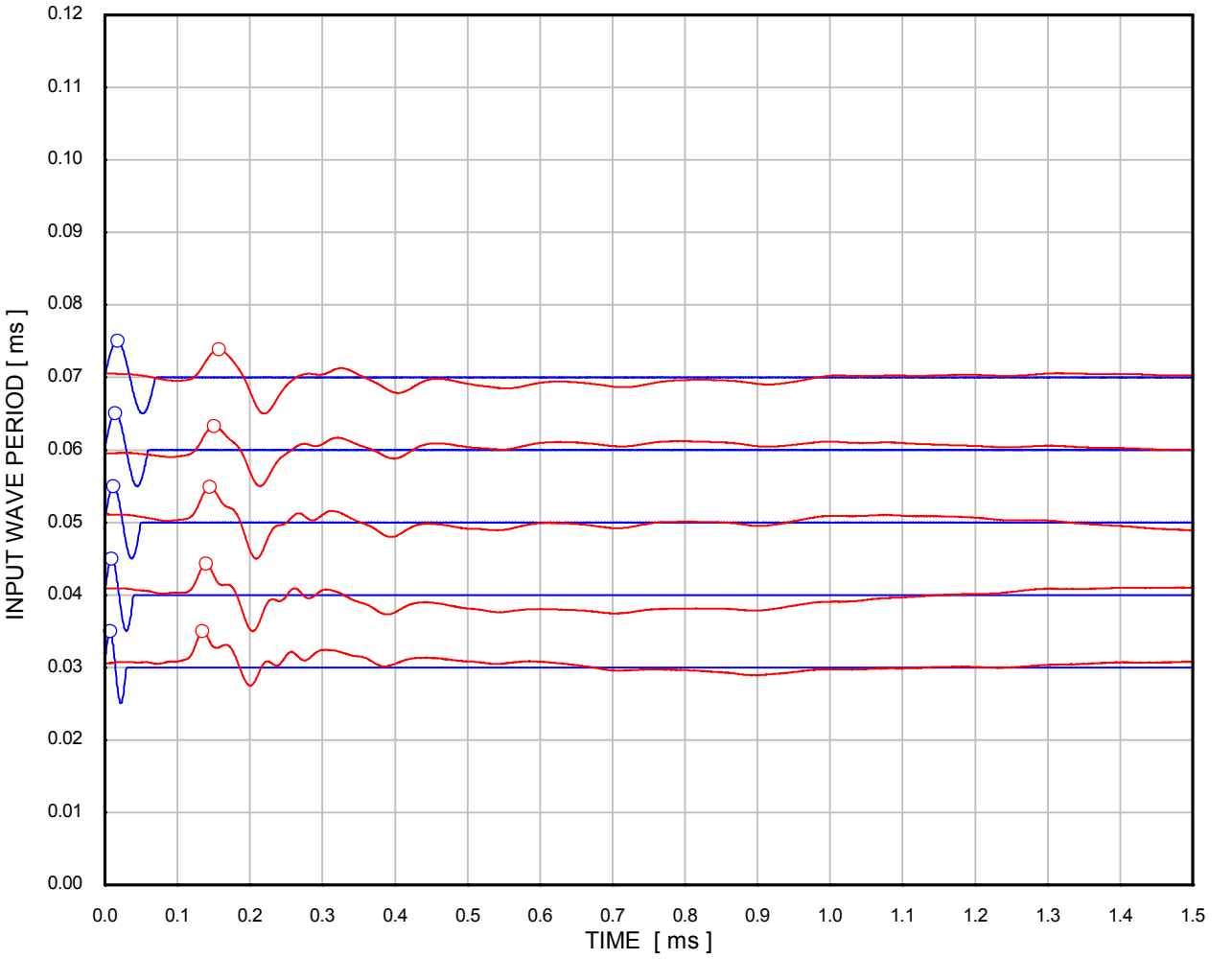
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

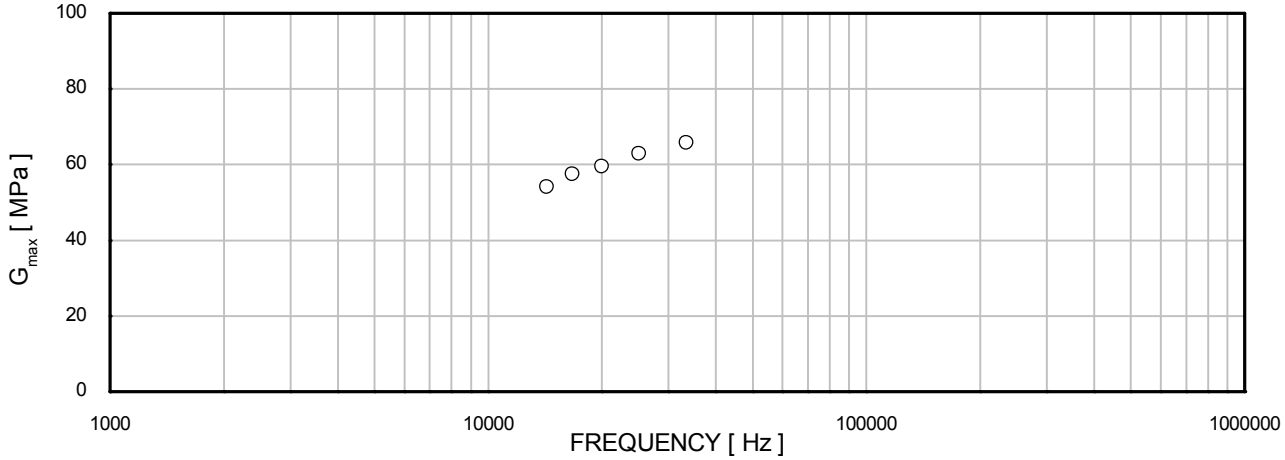




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 15WaxB
		Depth [m]	: 12.87
		Test No.	: DSS03R

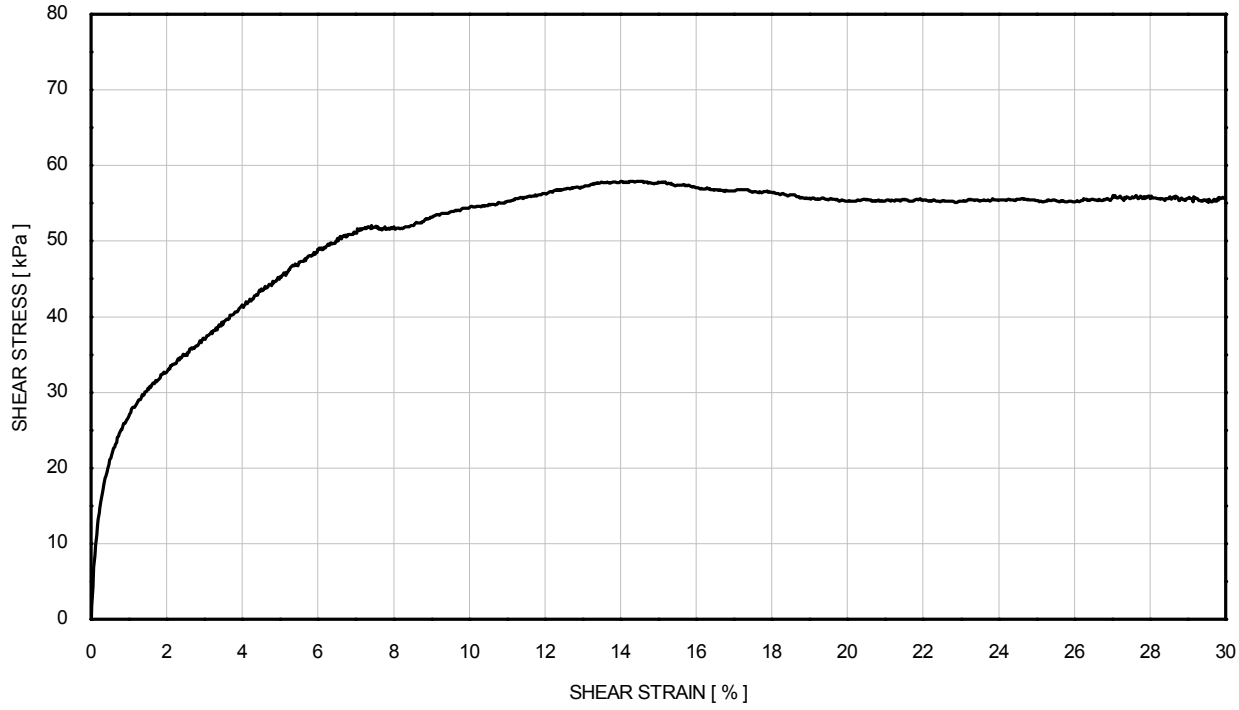
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE

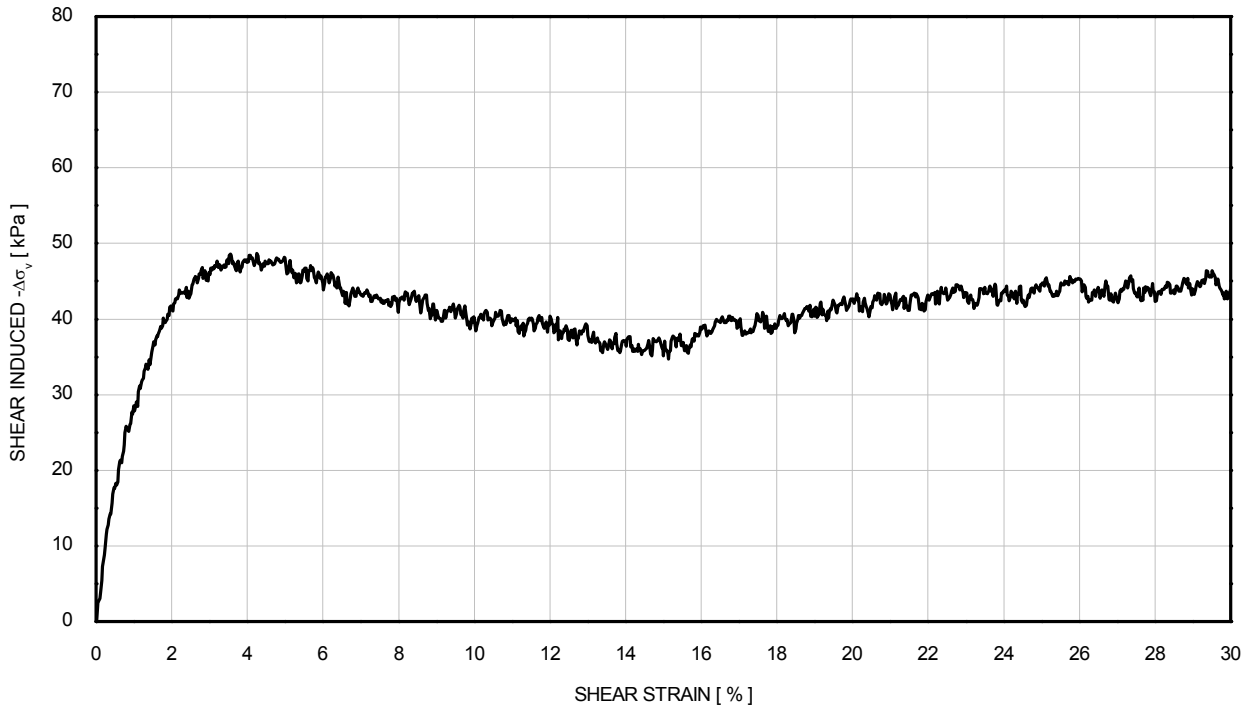




σ'_{rc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
	Source signal	Sample	: 15WaxB
	Received signal	Depth [m]	: 12.87
○ / ○	Selected peak values	Test No.	: DSS03R

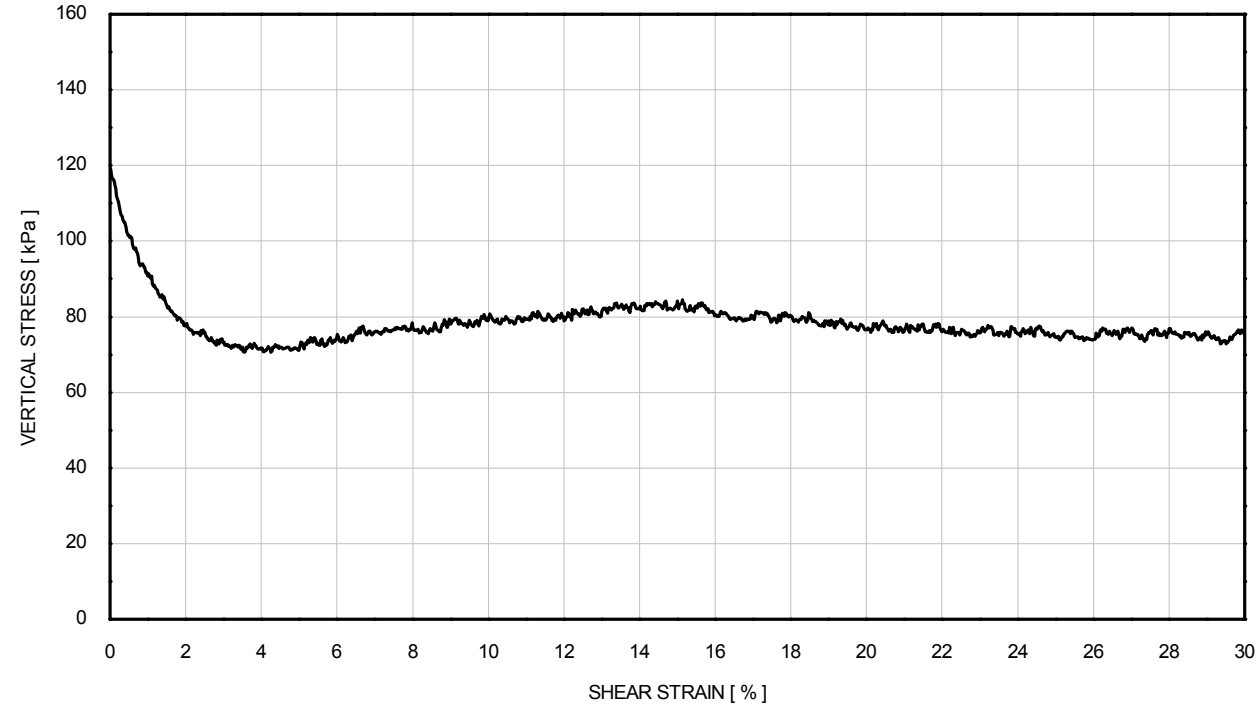
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

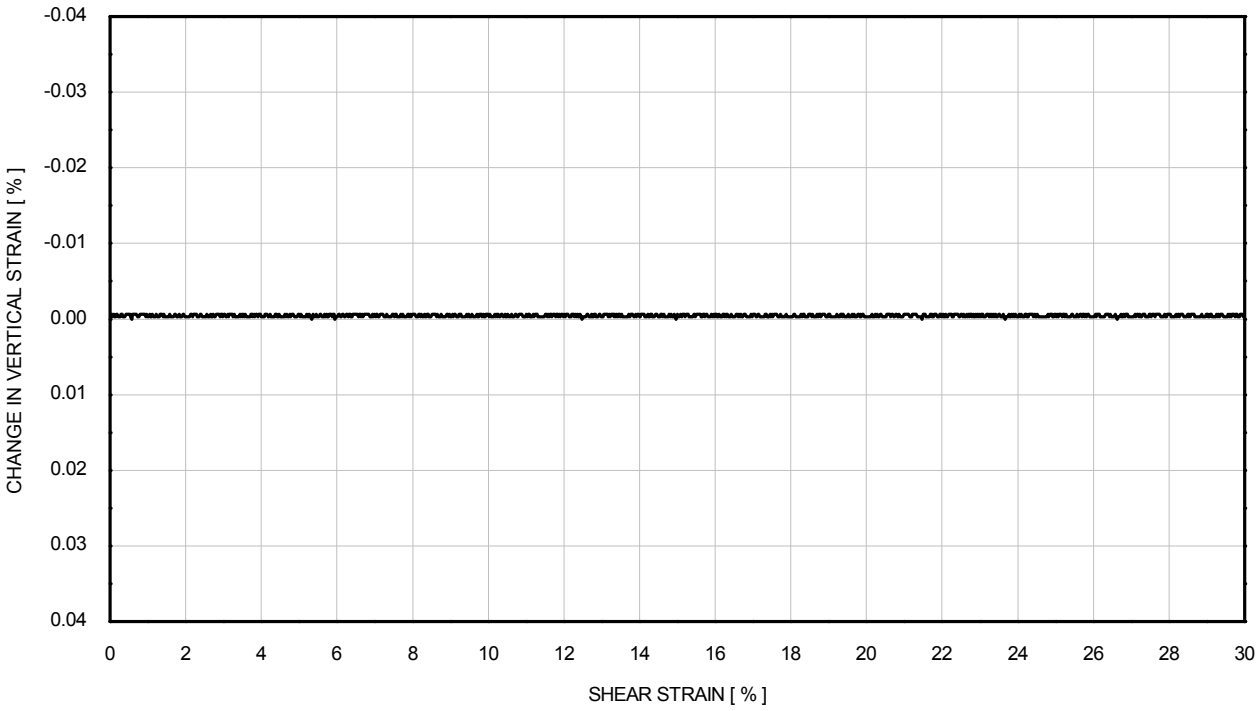




σ_{vc}	: 119 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 58 kPa	Sample	: 15WaxB
γ at τ_{peak}	: 14.24 %	Depth [m]	: 12.87
Rate of strain	: 2.99 %/hour	Test No.	: DSS03R

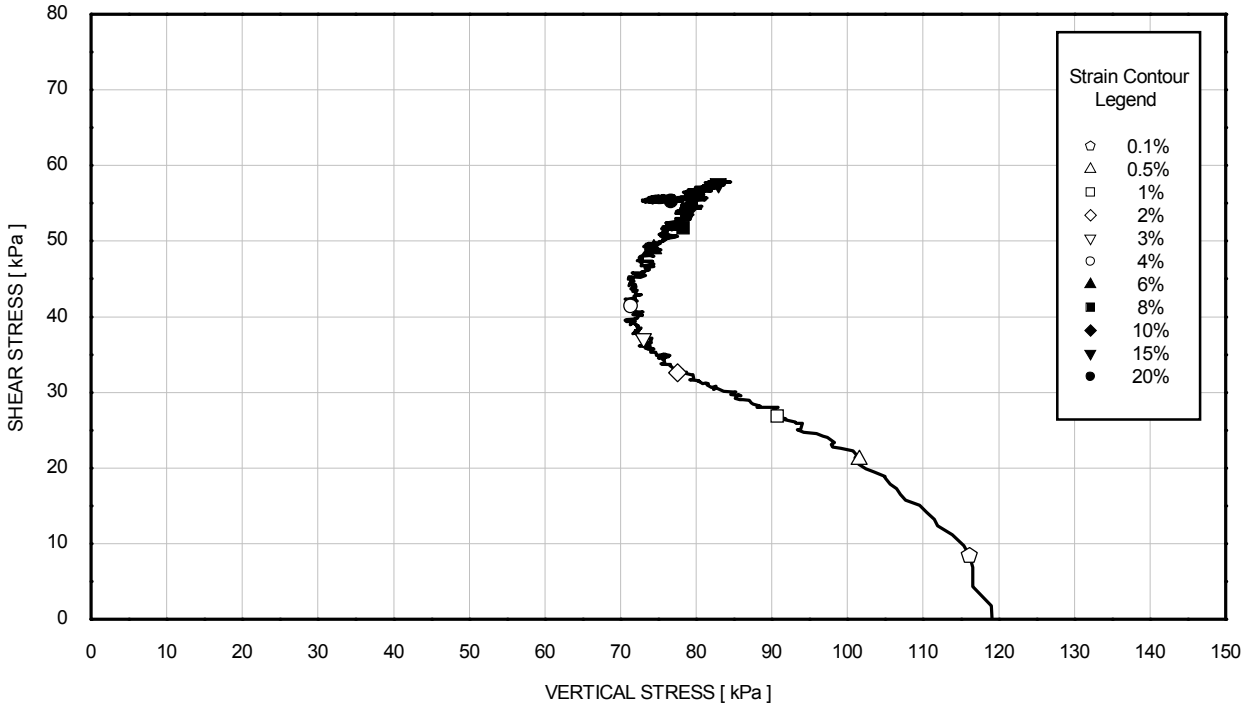
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

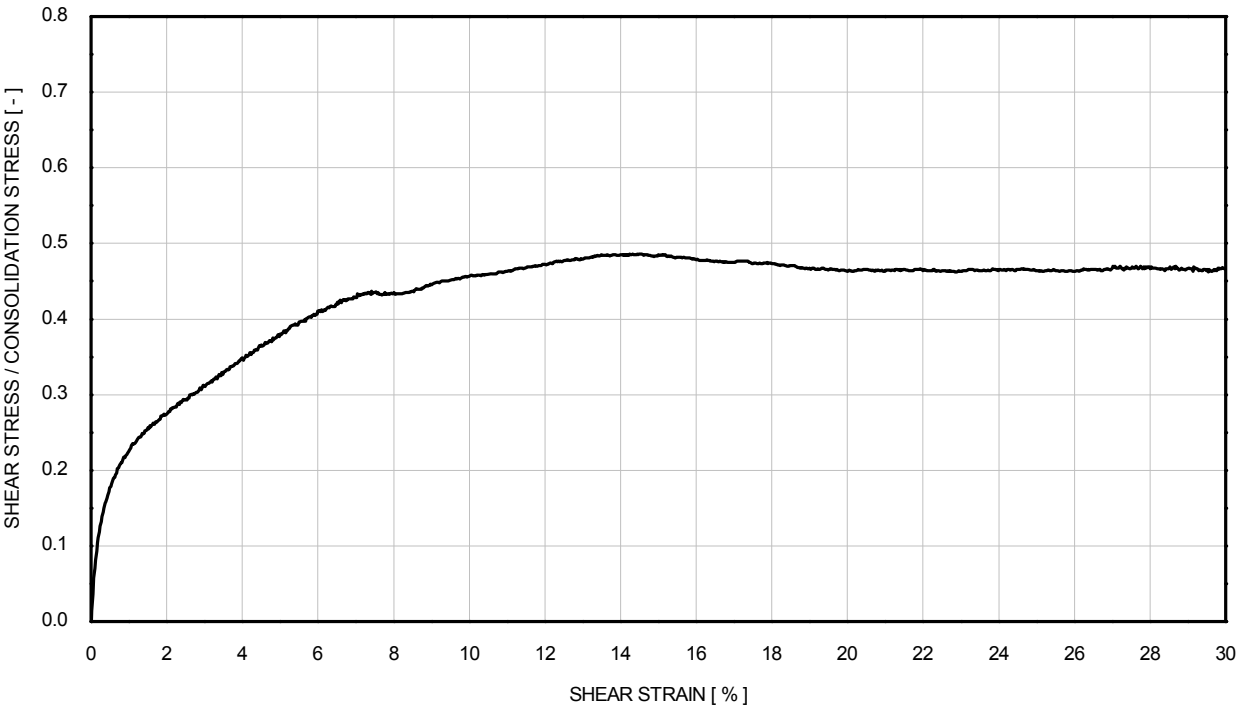




σ_{vc}	:	119 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	58 kPa	Sample	: 15WaxB
γ at τ_{peak}	:	14.24 %	Depth [m]	: 12.87
Rate of strain	:	2.99 %/hour	Test No.	: DSS03R

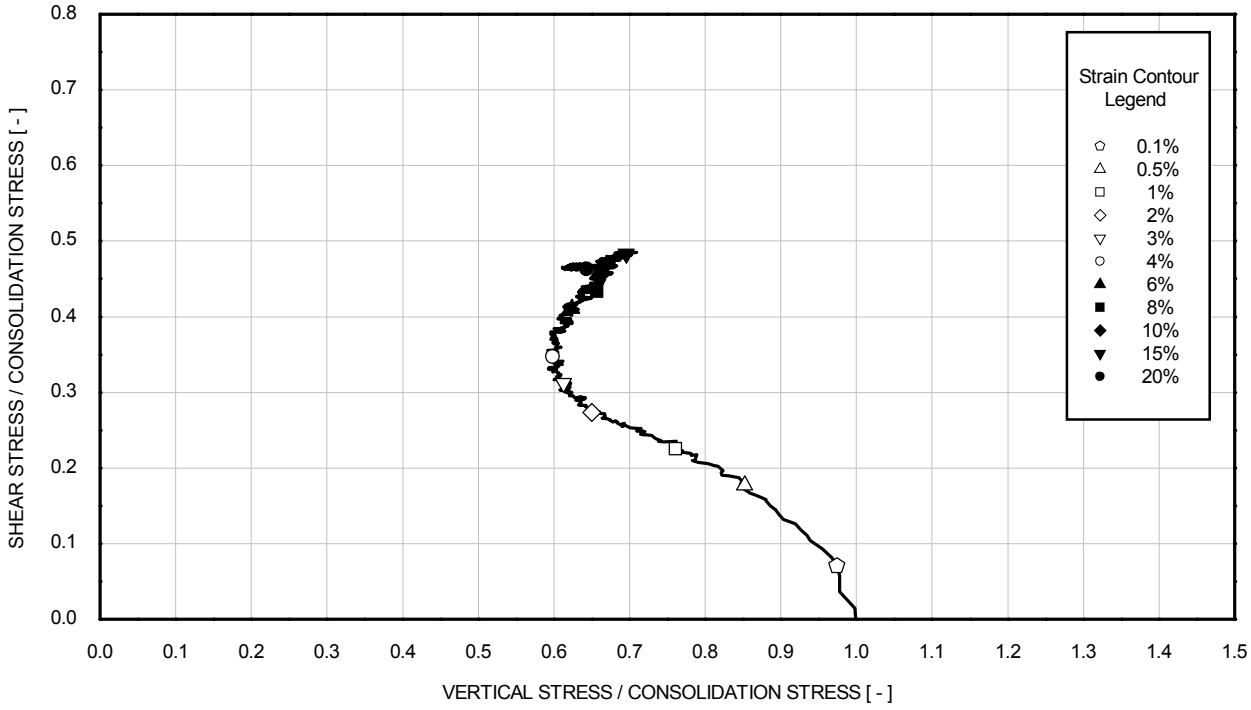
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

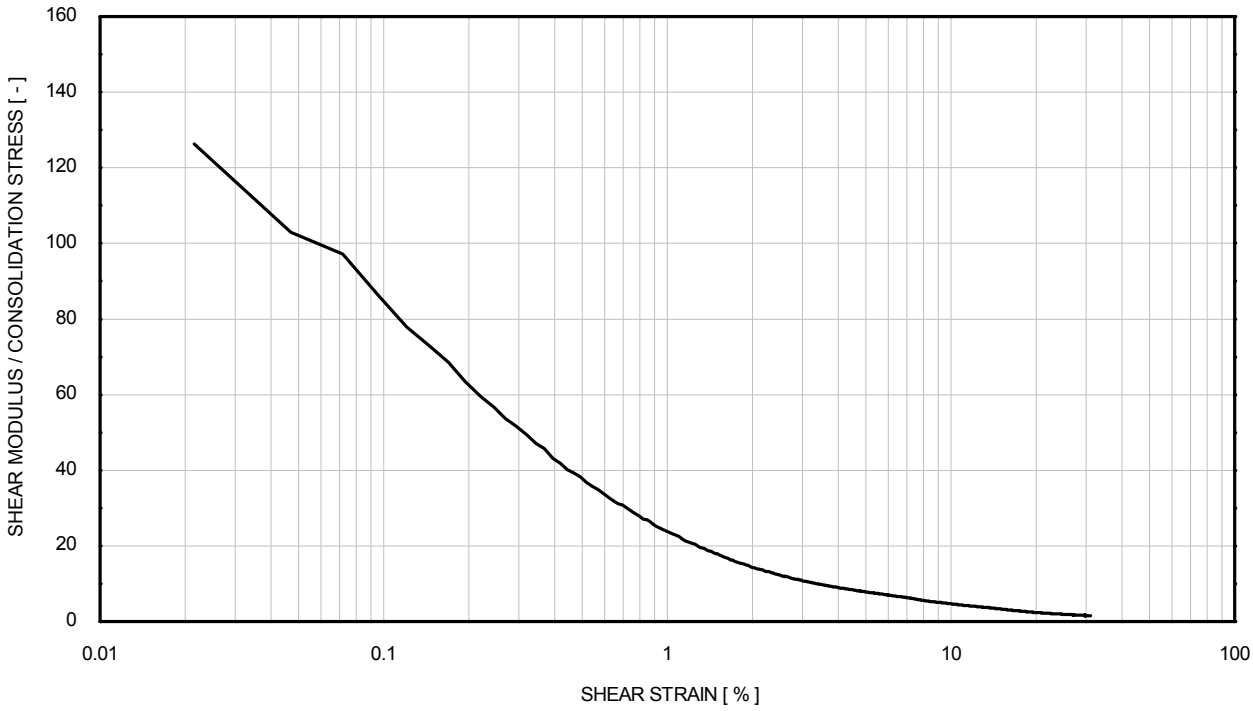




σ_{vc}	:	119 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	58 kPa	Sample	: 15WaxB
γ at τ_{peak}	:	14.24 %	Depth [m]	: 12.87
Rate of strain	:	2.99 %/hour	Test No.	: DSS03R

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	119 kPa	Borehole	:	HKZ1-BH02-SA
τ_{peak}	:	58 kPa	Sample	:	15WaxB
γ at τ_{peak}	:	14.24 %	Depth [m]	:	12.87
Rate of strain	:	2.99 %/hour	Test No.	:	DSS03R

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Grey CLAY

GENERAL	
Date test started	13/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	30.3
Water content	[%]	24.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.62
Void ratio	[-]	0.662
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH04-SA_16B_DSS04
Template issue	1.4
Processed by Date	EJC 18/10/2016
Checked by Date	PH 11/11/2016
Approved by Date	PH 11/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.21
Test number	DSS04

SUMMARY OF CONSOLIDATED DSS TEST

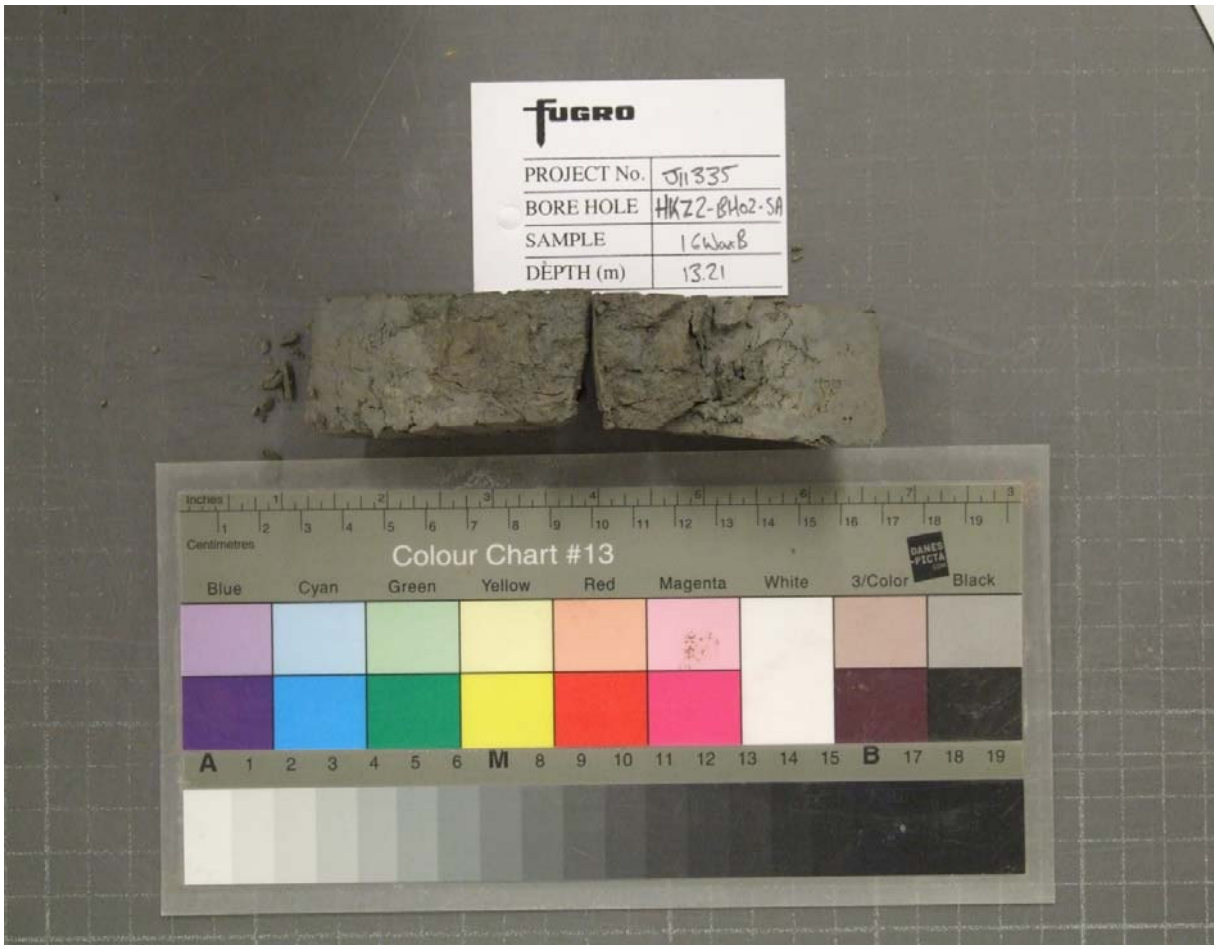
CONSOLIDATION		
σ_{vc}	[kPa]	125
Vertical strain	[%]	1.70
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.634
Water content	[%]	23.0

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	96
Shear strain	[%]	29.91
Shear induced -$\Delta\sigma_v$	[kPa]	26
Vertical stress	[kPa]	99
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.97
At 15 % shear strain		
Shear stress	[kPa]	85
Shear induced -$\Delta\sigma_v$	[kPa]	32
Vertical stress	[kPa]	94
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.21
Test number	DSS04

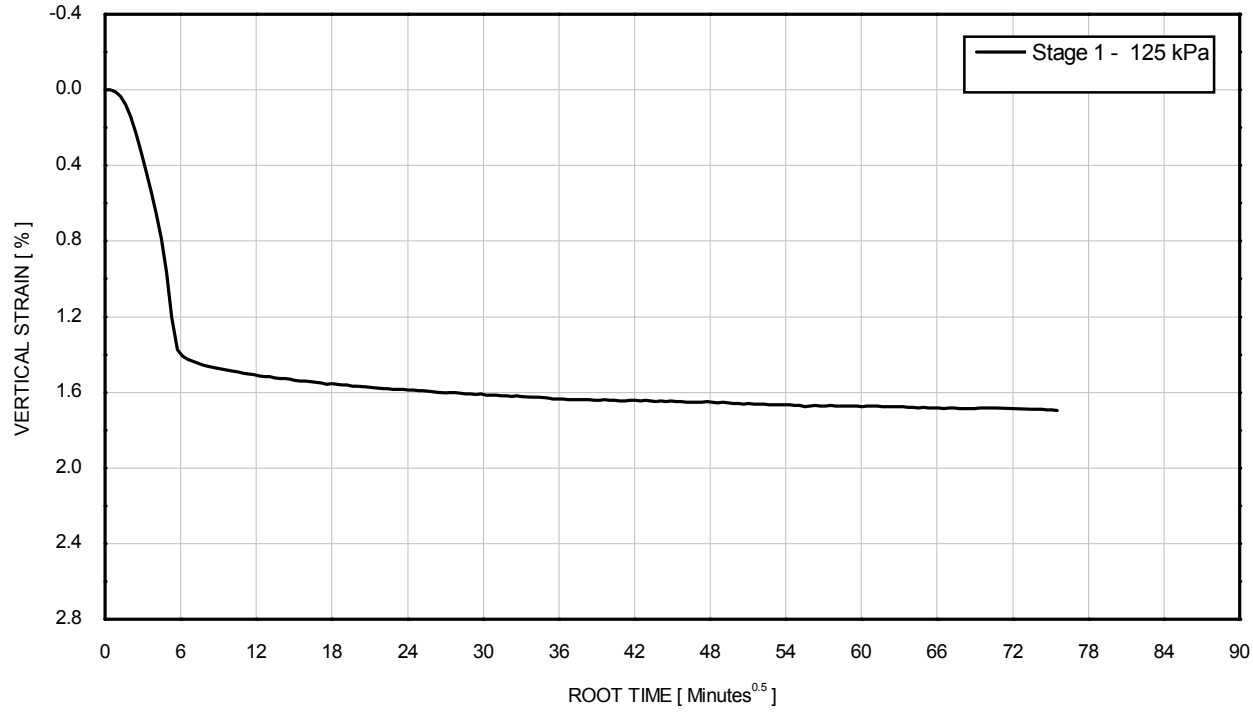
SUMMARY OF CONSOLIDATED DSS TEST

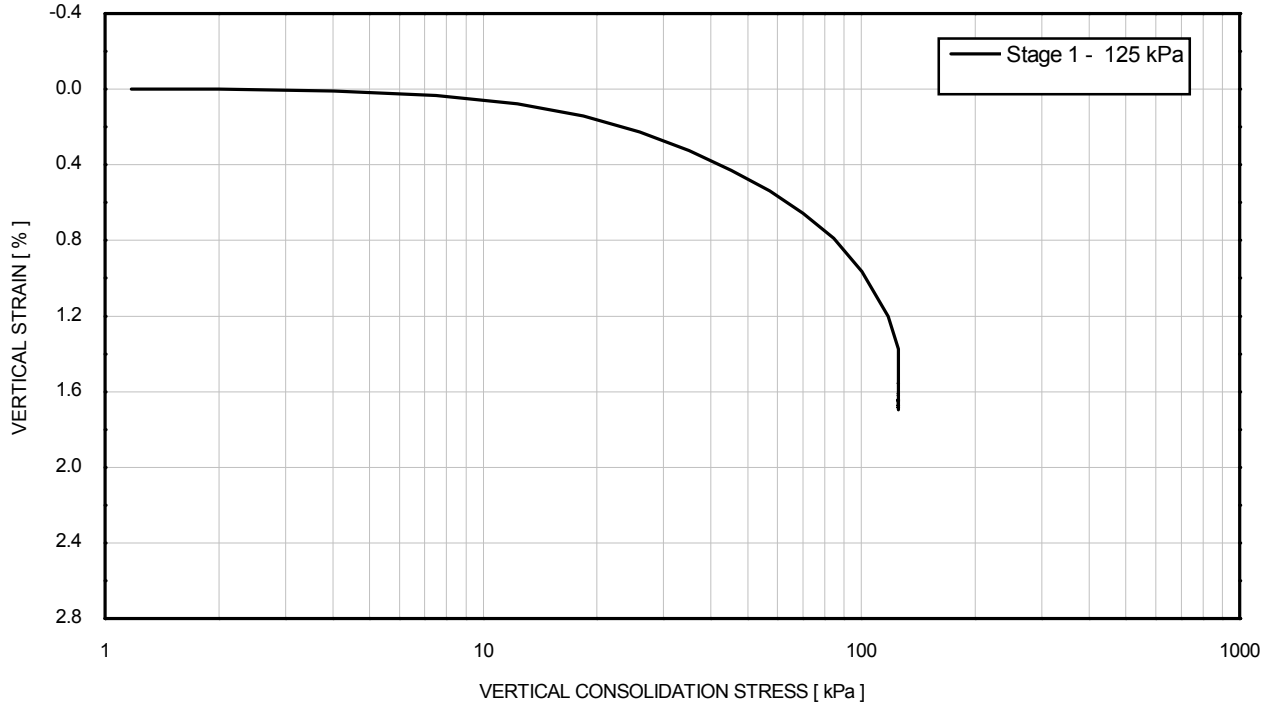
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.21
Test number	DSS04

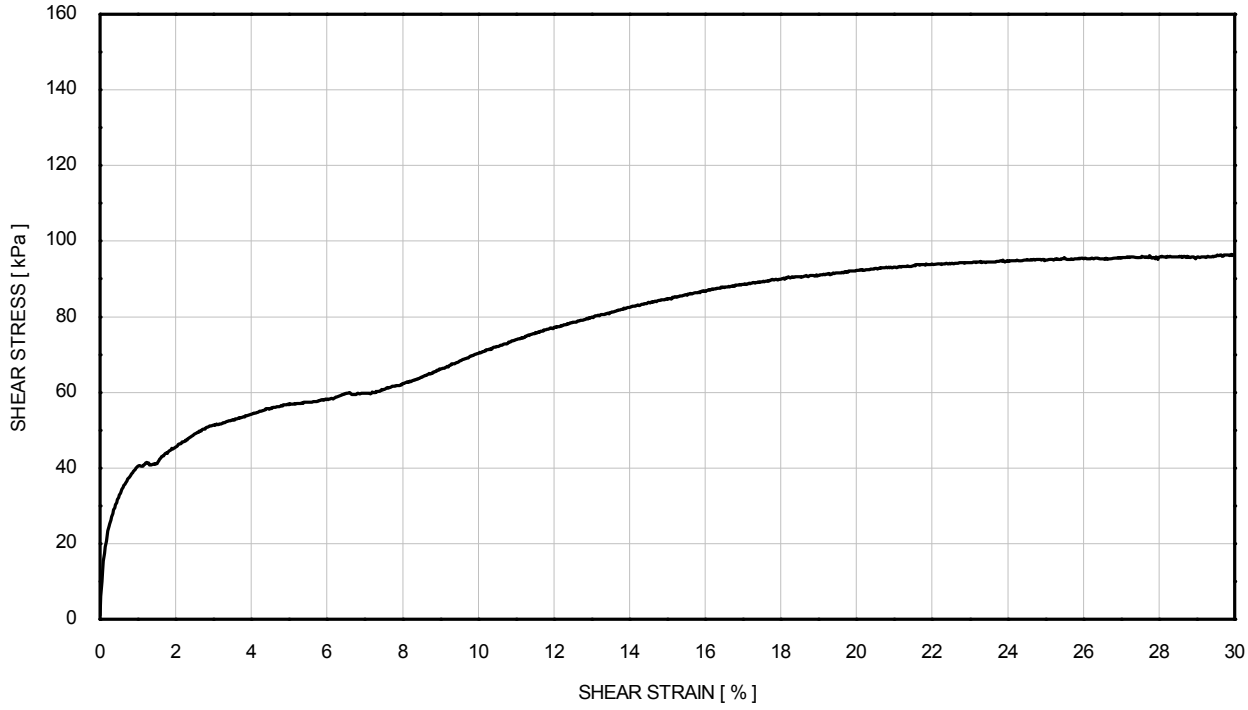
SUMMARY OF CONSOLIDATED DSS TEST

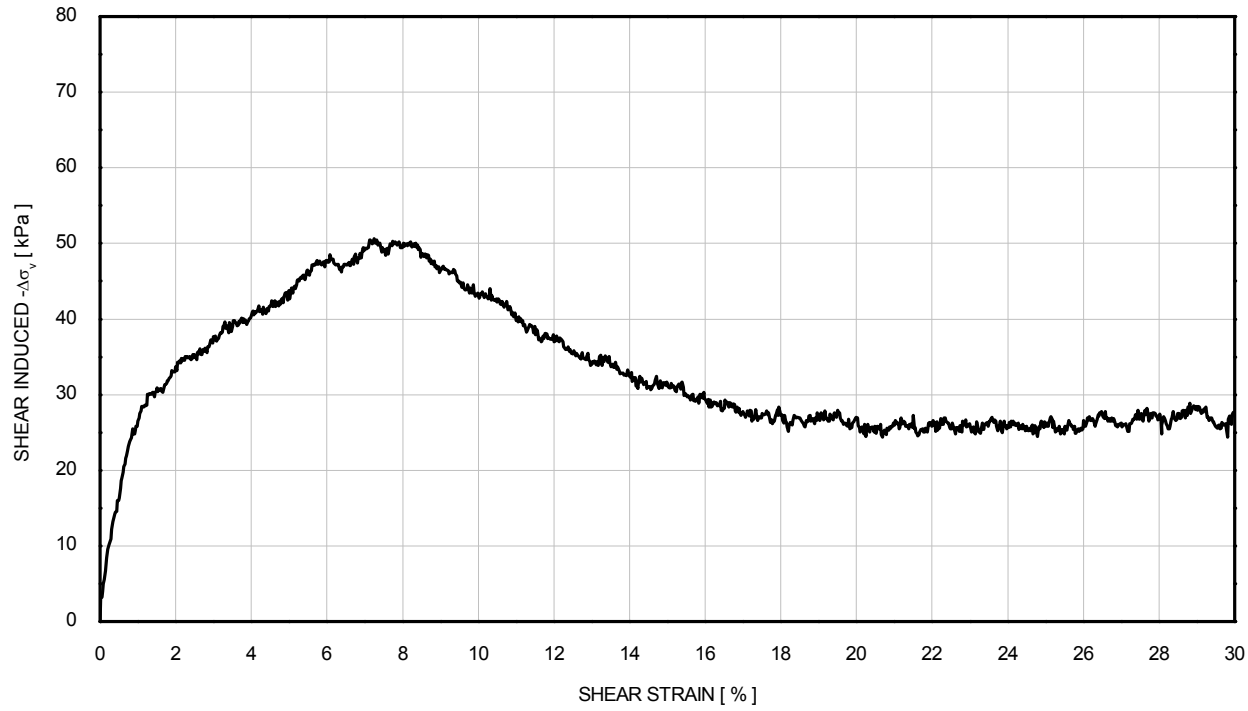




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
		Sample	: 16WaxB
		Depth [m]	: 13.21
		Test No.	: DSS04

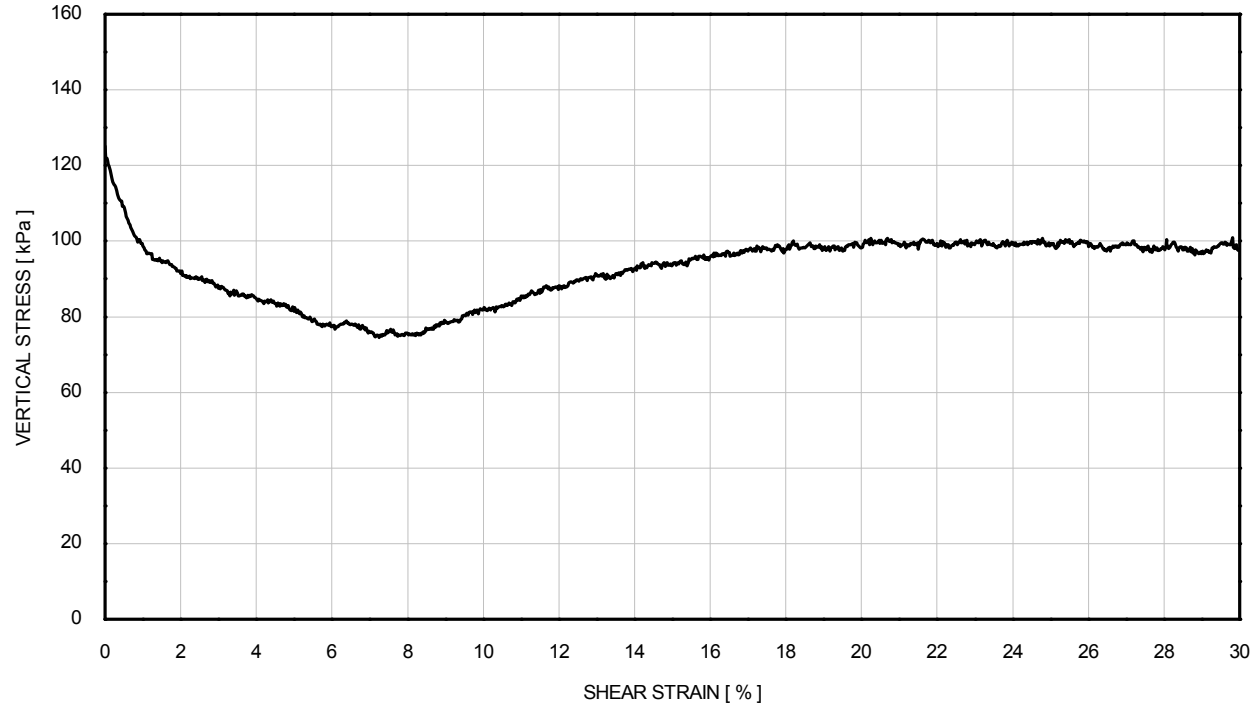
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE

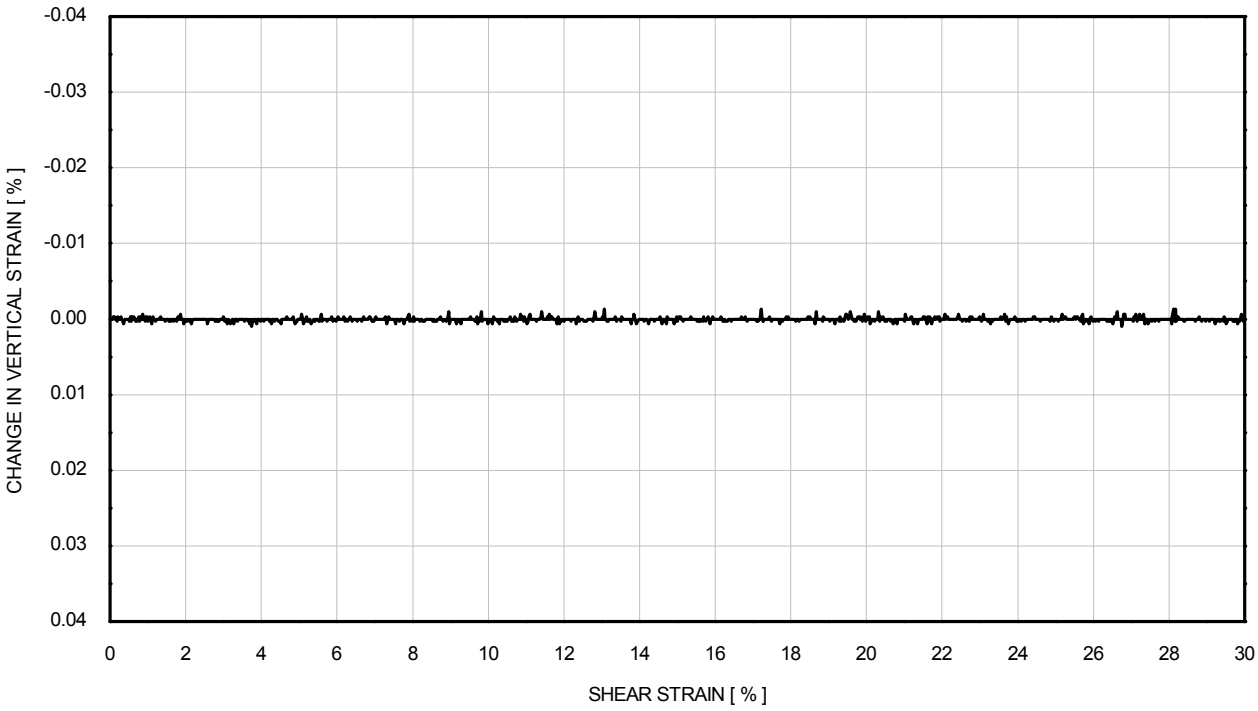




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 96 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.91 %	Depth [m]	: 13.21
Rate of strain	: 2.97 %/hour	Test No.	: DSS04

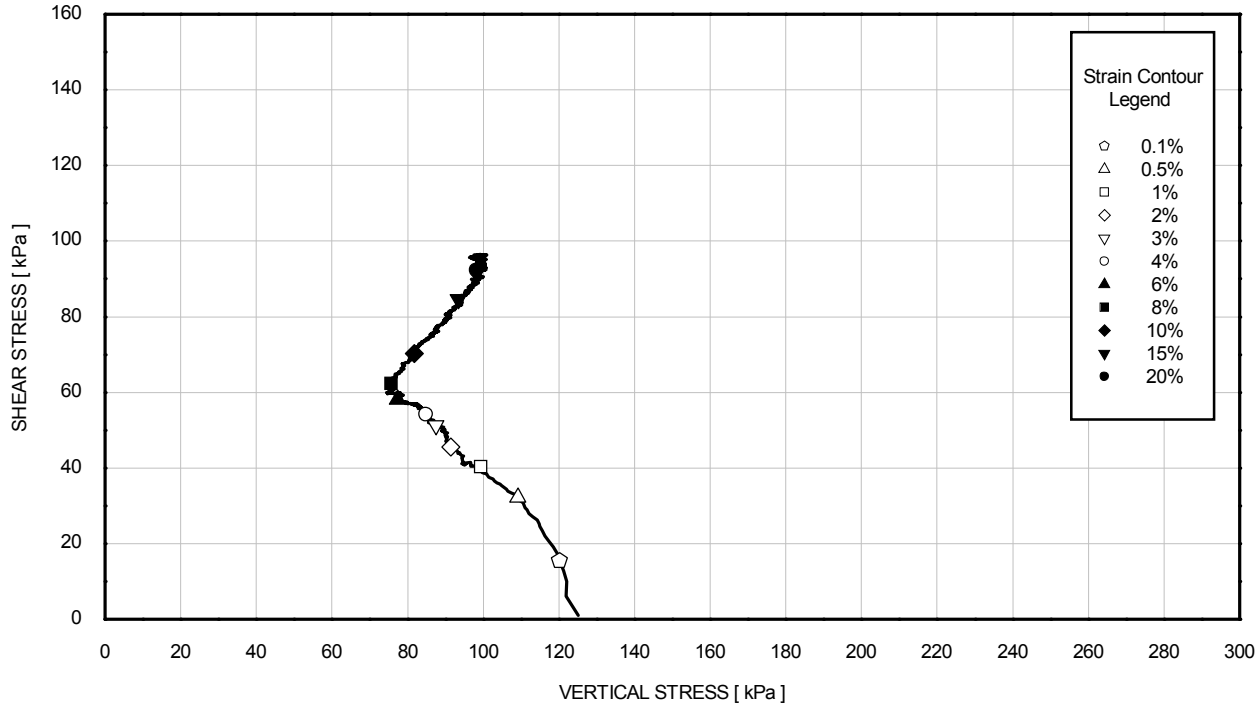
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

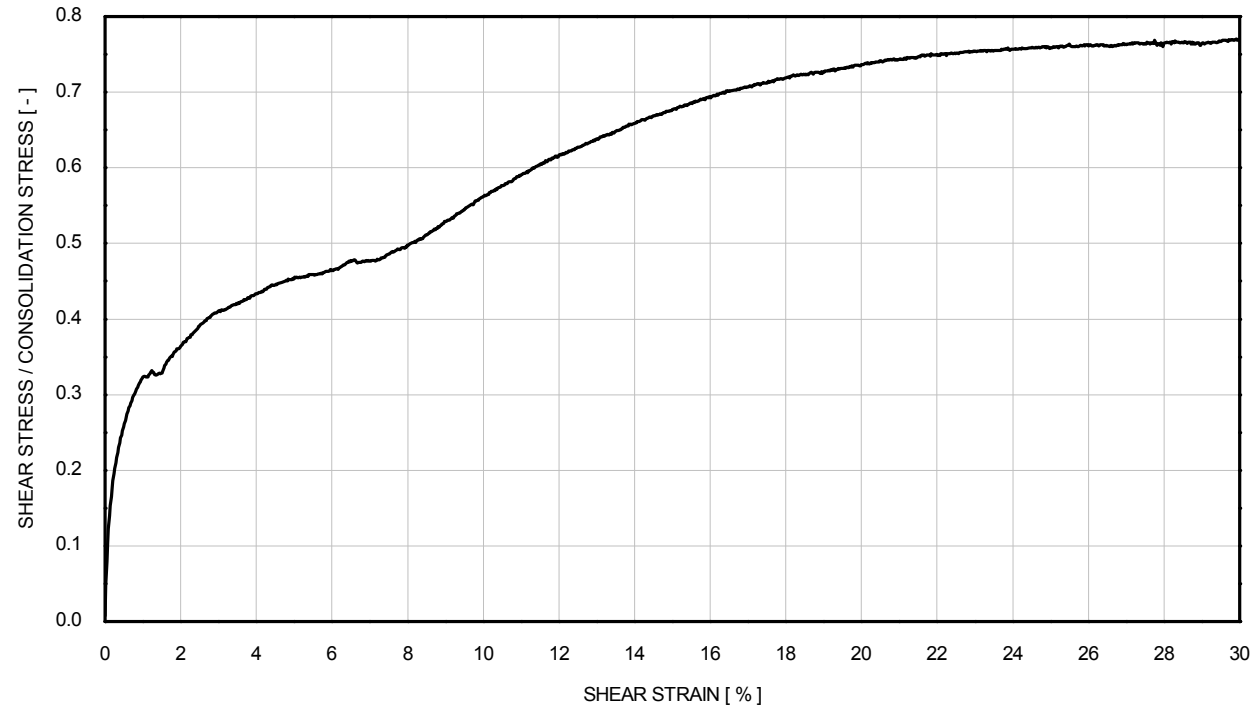




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 96 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.91 %	Depth [m]	: 13.21
Rate of strain	: 2.97 %/hour	Test No.	: DSS04

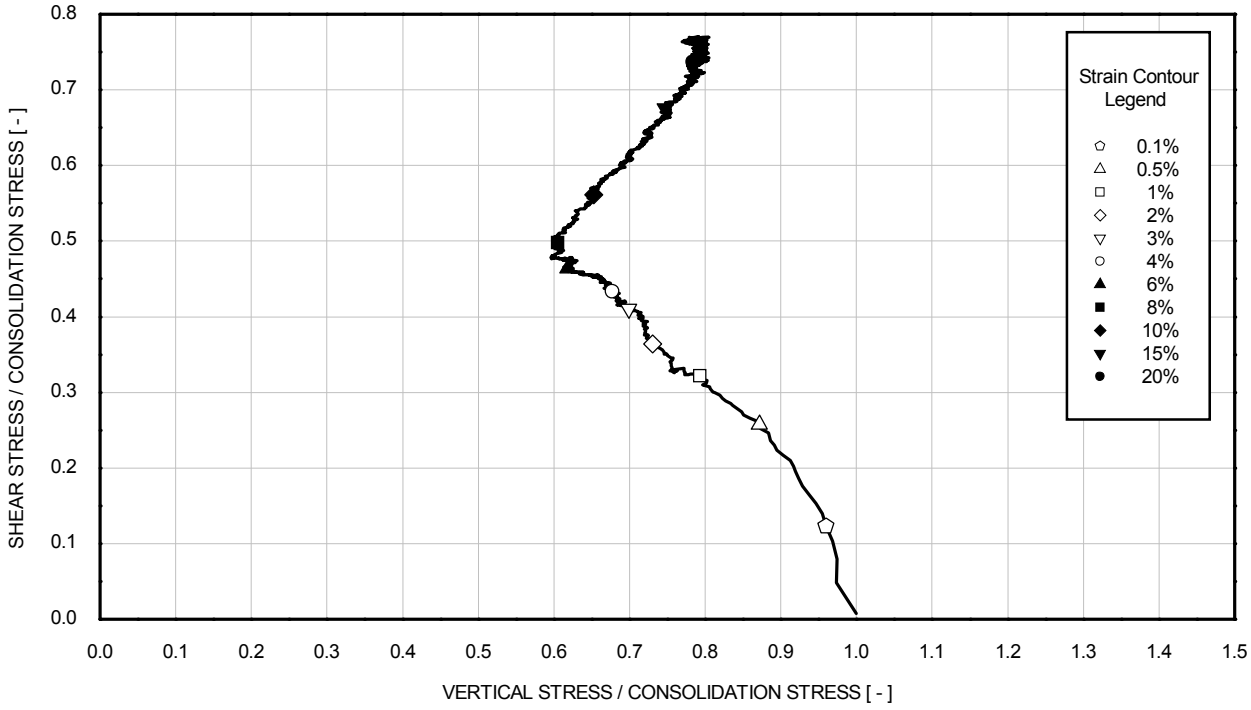
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

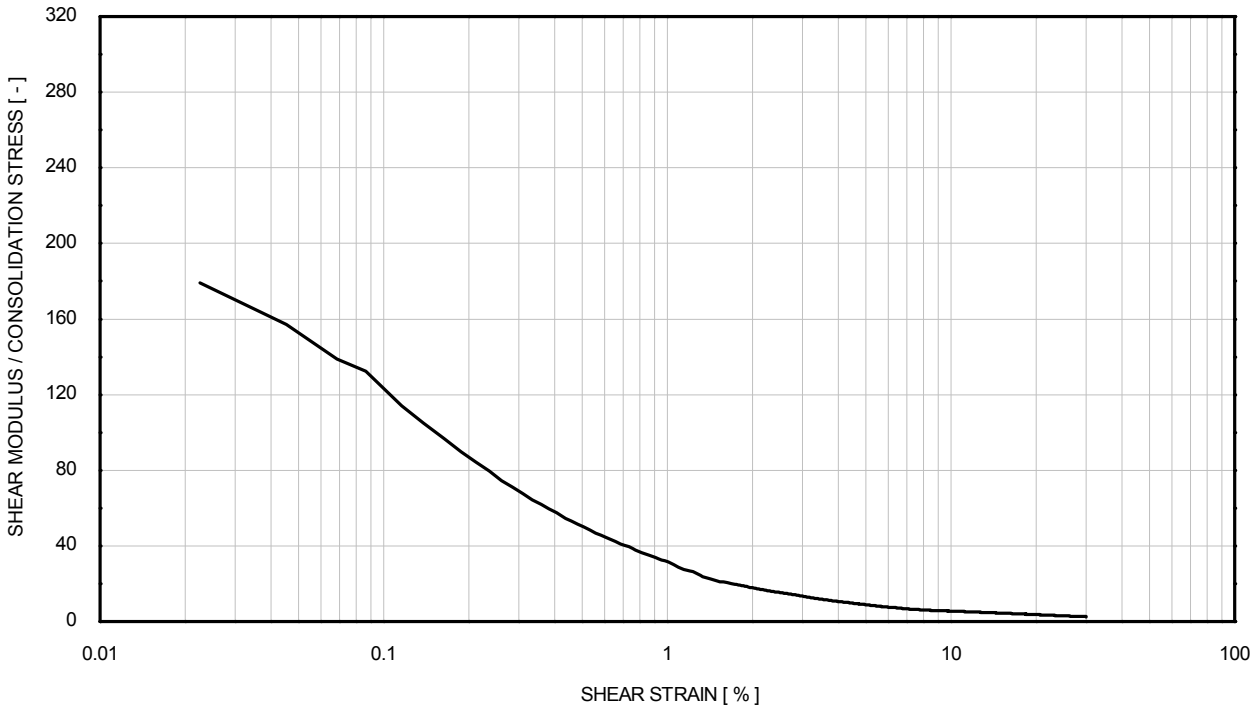




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 96 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.91 %	Depth [m]	: 13.21
Rate of strain	: 2.97 %/hour	Test No.	: DSS04

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
τ_{peak}	:	96 kPa	Sample	:	16WaxB
γ at τ_{peak}	:	29.91 %	Depth [m]	:	13.21
Rate of strain	:	2.97 %/hour	Test No.	:	DSS04

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Dark grey CLAY with closely spaced thin laminae of silt

GENERAL	
Date test started	19/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.6
Length	[mm]	29.9
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.52
Void ratio	[-]	0.778
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA 24B_DSS05
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 11/11/2016
Approved by Date	PH 11/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.61
Test number	DSS05

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-SETUP		
Bulk density	[Mg/m^3]	1.99
Dry density	[Mg/m^3]	1.52
Void ratio	[-]	0.778
Distance	[mm]	25.42
Vertical stress	[kPa]	1

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.1985	19.85	128.06	32.69
0.02	0.1805	9.03	140.83	39.54
0.03	0.1715	5.72	148.22	43.79
0.04	0.1655	4.14	153.60	47.03
0.05	0.1730	3.46	146.94	43.04
0.06	0.1735	2.89	146.51	42.79
0.07	0.1805	2.58	140.83	39.54
0.08	0.1785	2.23	142.41	40.43
0.09	0.1830	2.03	138.91	38.46

CONSOLIDATION		
σ_{vc}	[kPa]	210
Vertical strain	[%]	2.45
Bulk density	[Mg/m^3]	2.02
Dry density	[Mg/m^3]	1.56
Void ratio	[-]	0.734
Water content	[%]	29.6

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.61
Test number	DSS05

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION		
Bulk density	[Mg/m^3]	2.02
Dry density	[Mg/m^3]	1.56
Void ratio	[-]	0.734
Distance	[mm]	24.69
Vertical stress	[kPa]	210

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.1235	12.35	199.89	80.64
0.02	0.1170	5.85	210.99	89.85
0.03	0.1175	3.92	210.10	89.09
0.04	0.1195	2.99	206.58	86.13
0.05	0.1225	2.45	201.52	81.97
0.06	0.1245	2.08	198.28	79.35

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	82
Shear strain	[%]	19.66
Shear induced -$\Delta\sigma_v$	[kPa]	64
Vertical stress	[kPa]	146
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.01
At 15 % shear strain		
Shear stress	[kPa]	81
Shear induced -$\Delta\sigma_v$	[kPa]	70
Vertical stress	[kPa]	140
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.61
Test number	DSS05

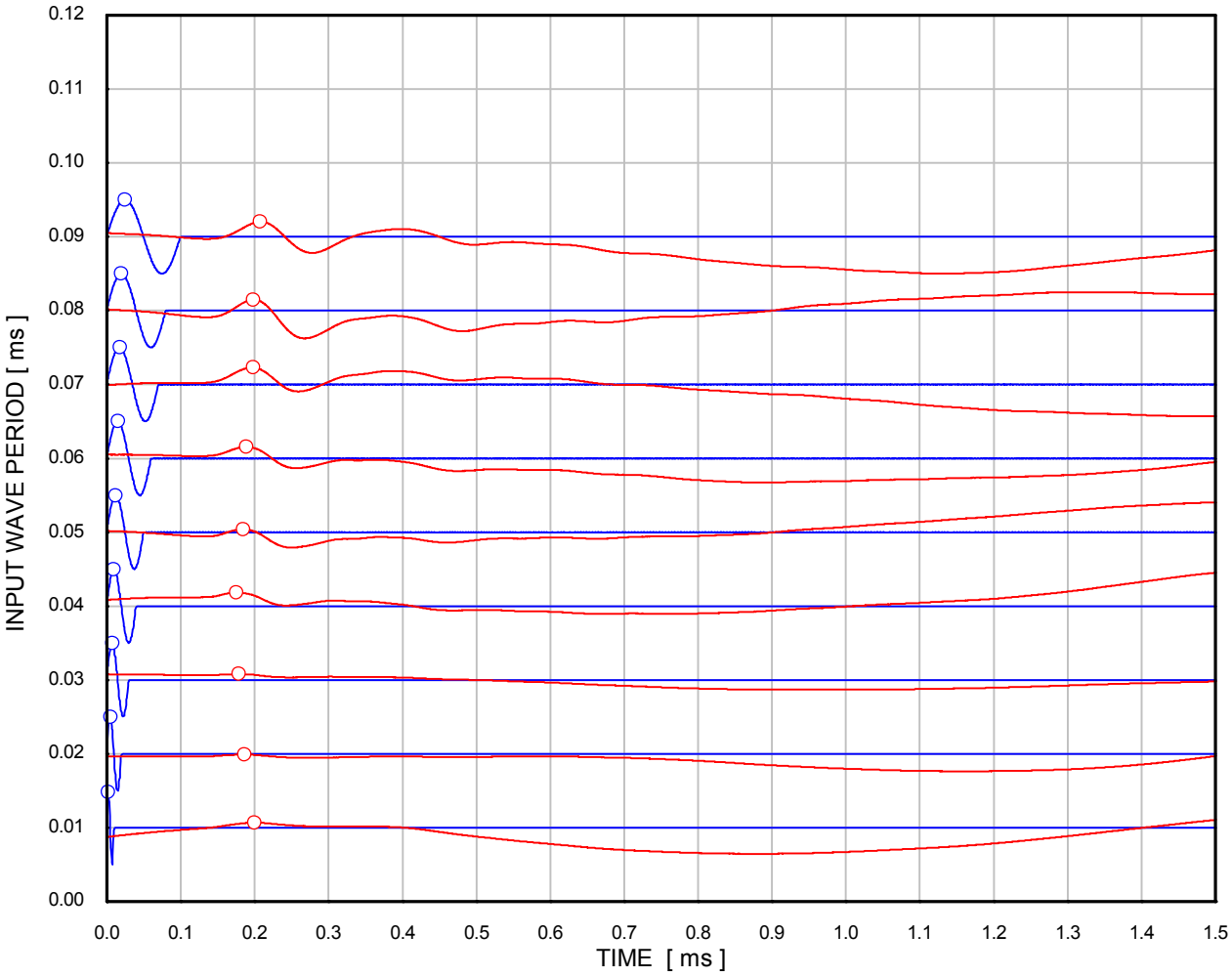
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

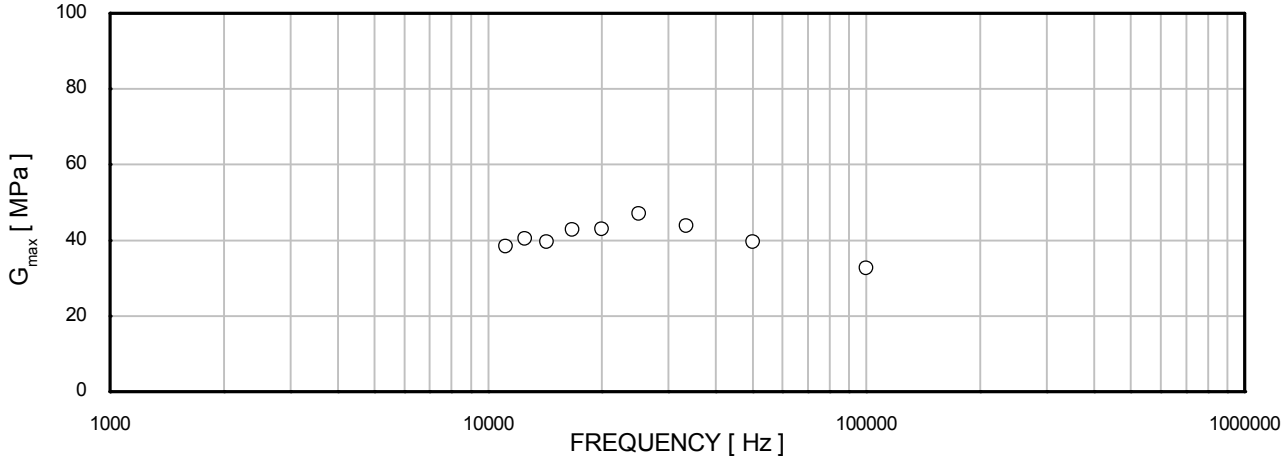
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.61
Test number	DSS05

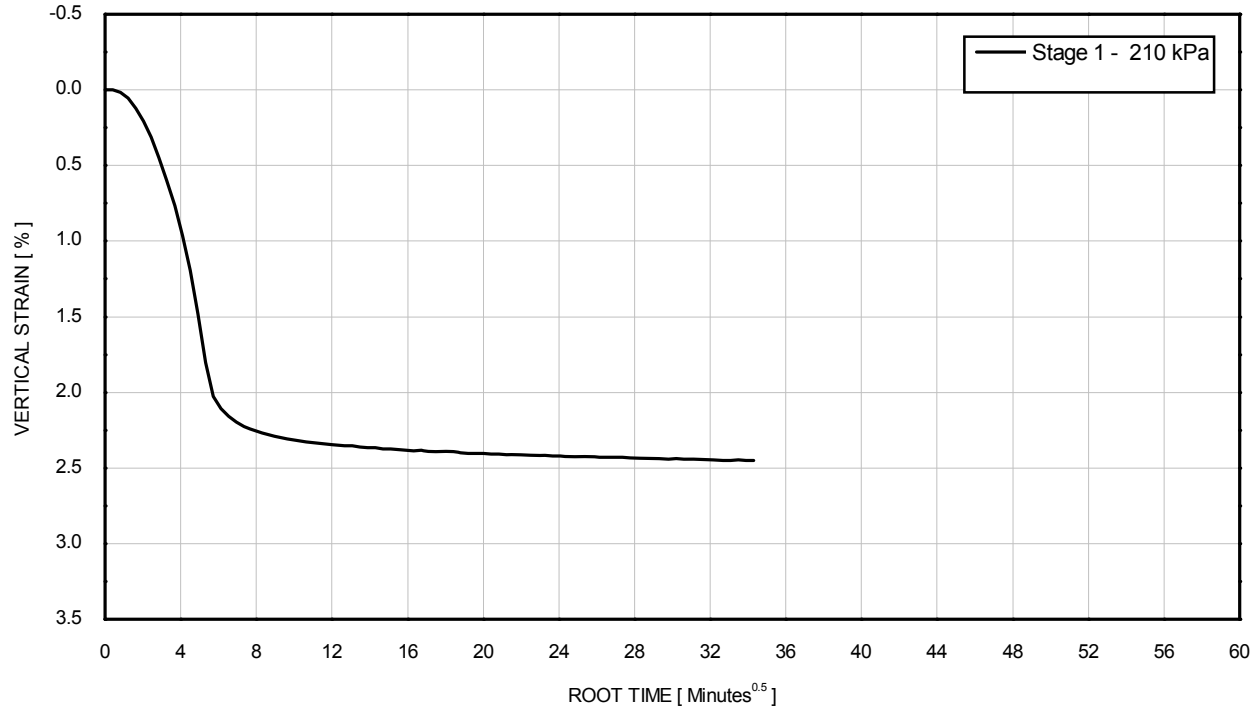
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

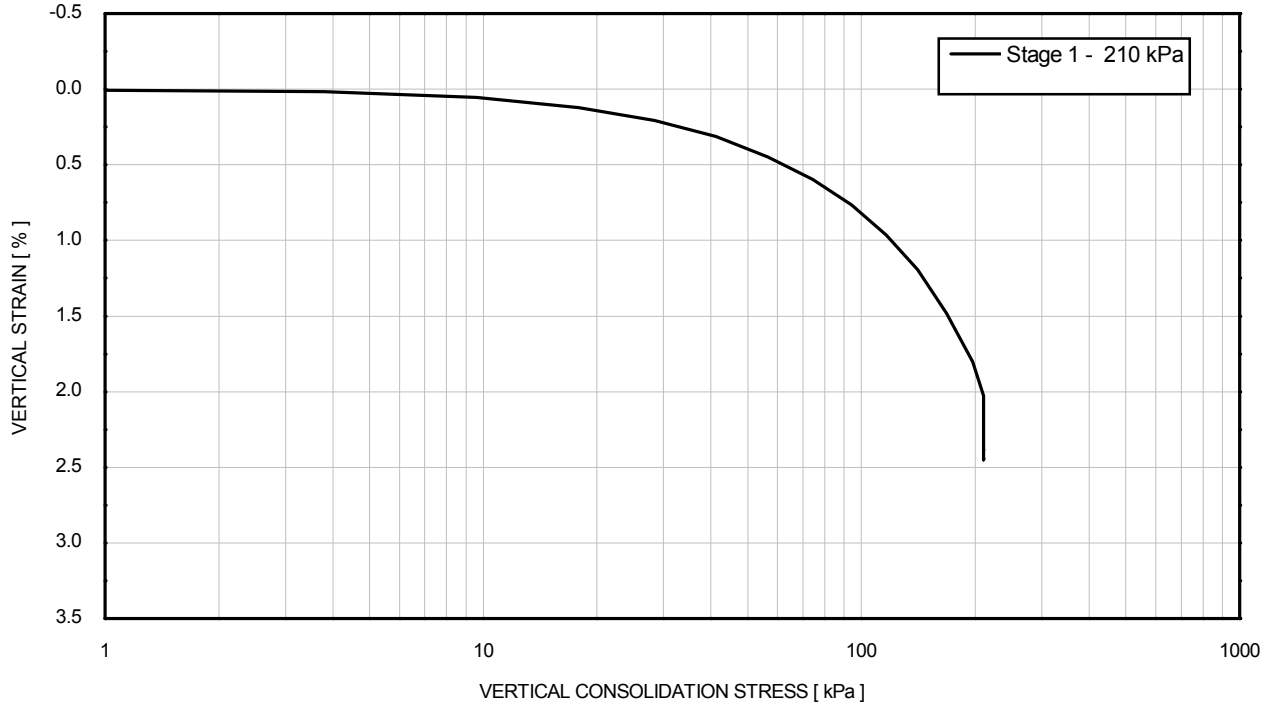




σ'_{rc}	: 1 kPa	Borehole	: HKZ1-BH02-SA
	Source signal	Sample	: 24WaxB
	Received signal	Depth [m]	: 21.61
○ / ○	Selected peak values	Test No.	: DSS05

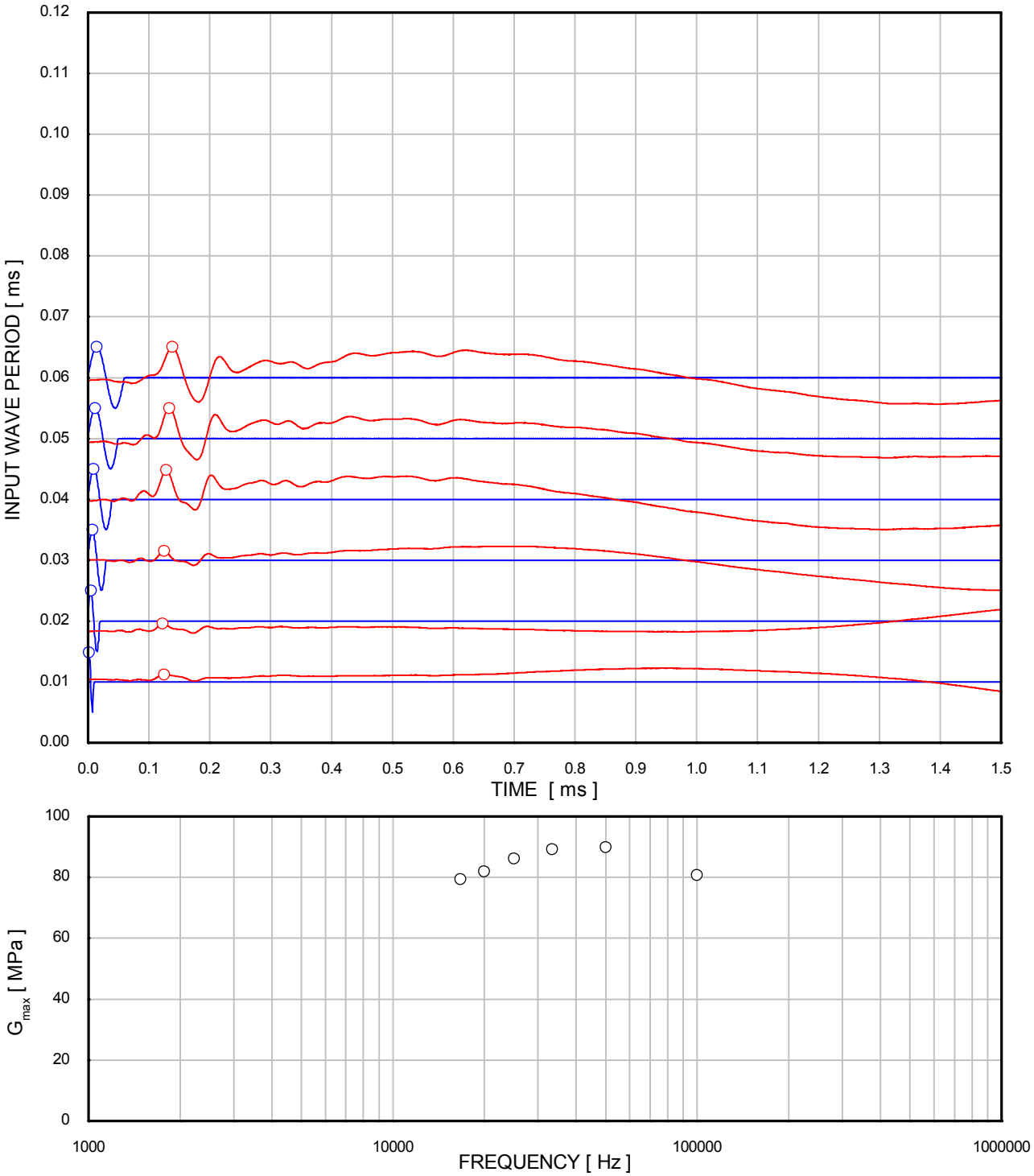
CONSOLIDATED DSS TEST
POST-SETUP S_{VH} BENDER ELEMENT DETERMINATIONS





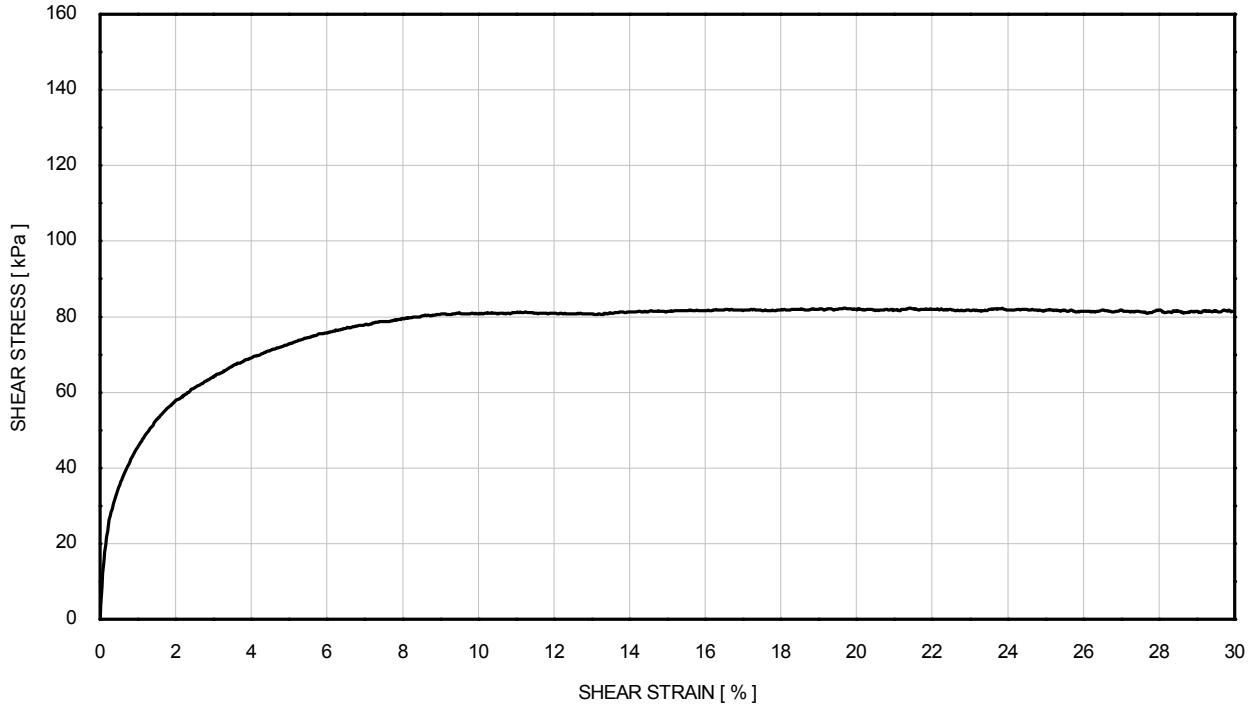
σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 24WaxB
		Depth [m]	: 21.61
		Test No.	: DSS05

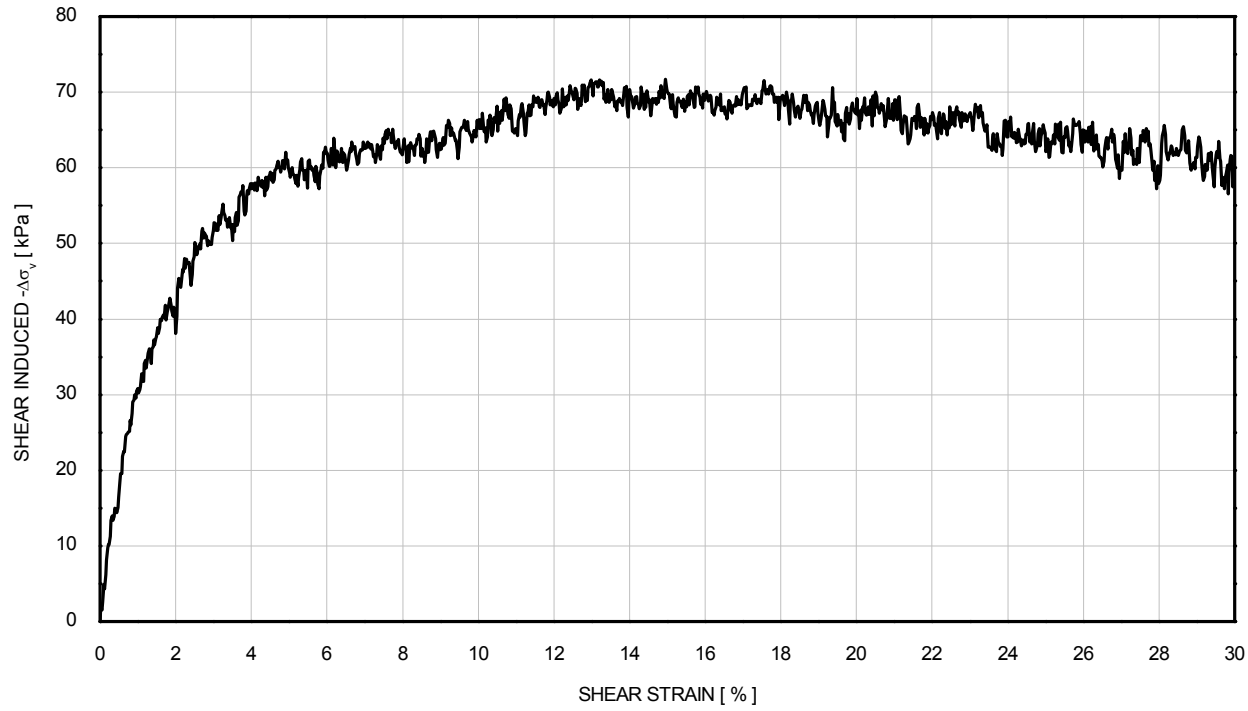
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE



σ'_{rc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
	Source signal	Sample	: 24WaxB
	Received signal	Depth [m]	: 21.61
○ / ○	Selected peak values	Test No.	: DSS05

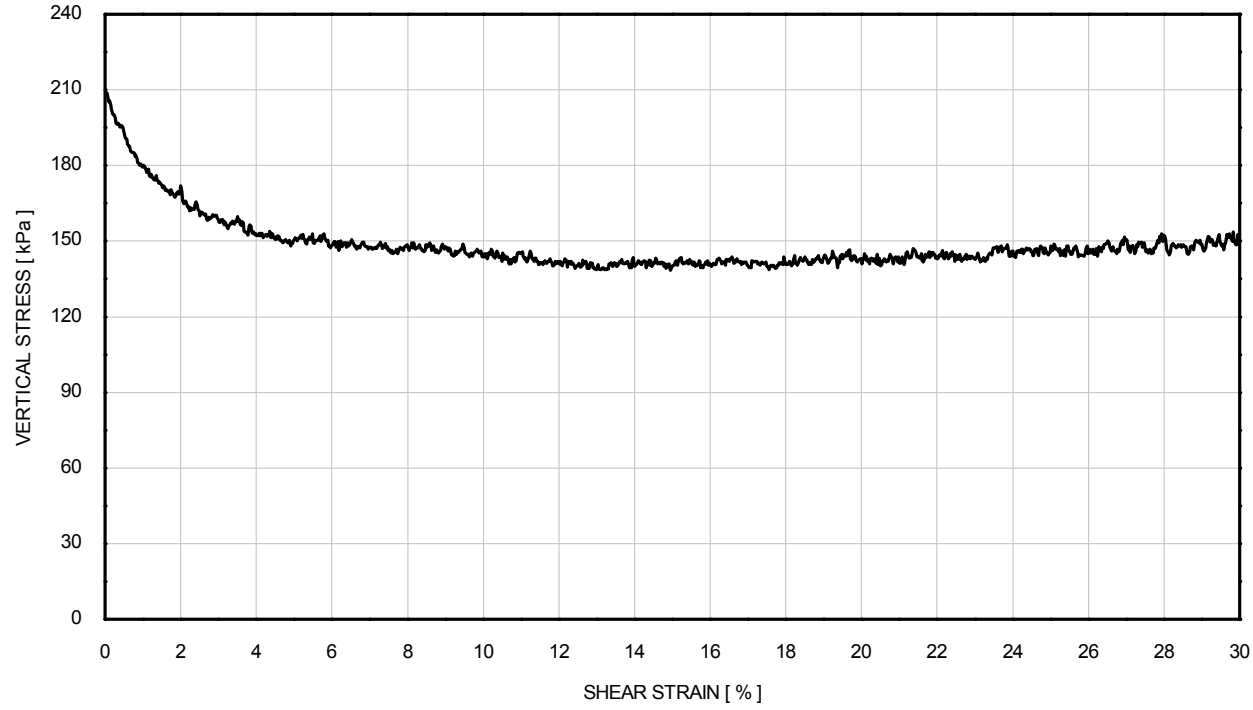
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

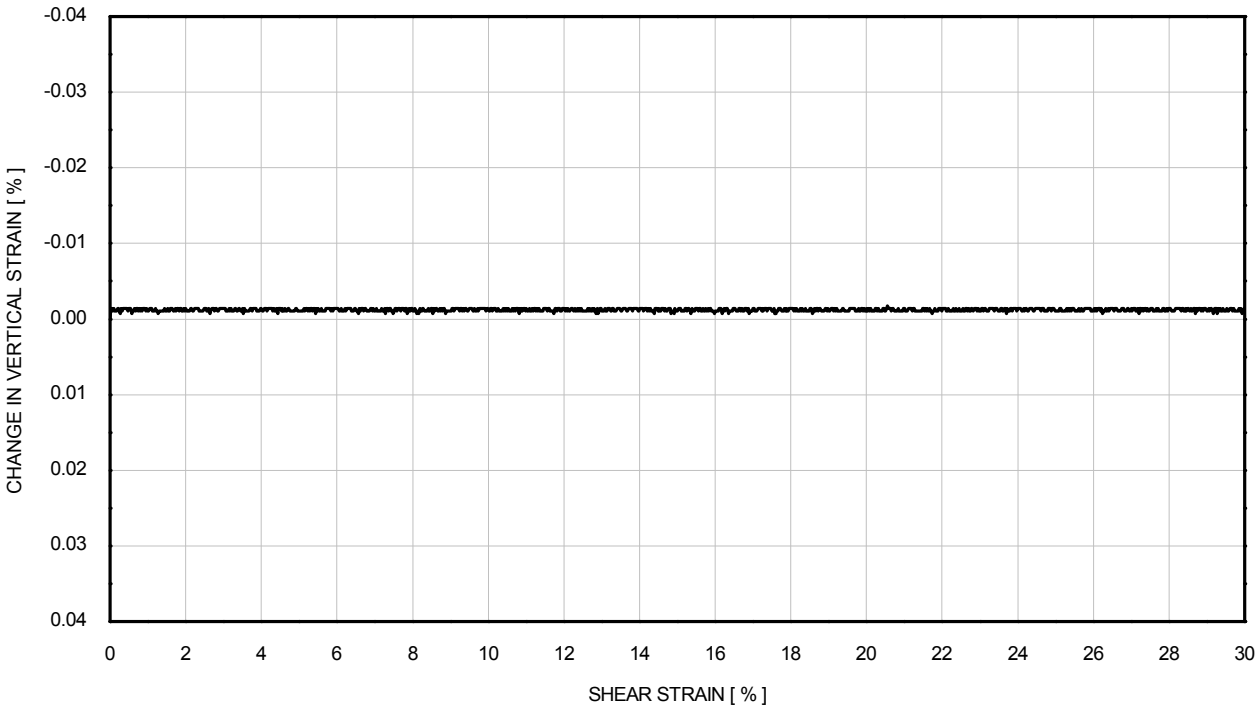




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 82 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 19.66 %	Depth [m]	: 21.61
Rate of strain	: 3.01 %/hour	Test No.	: DSS05

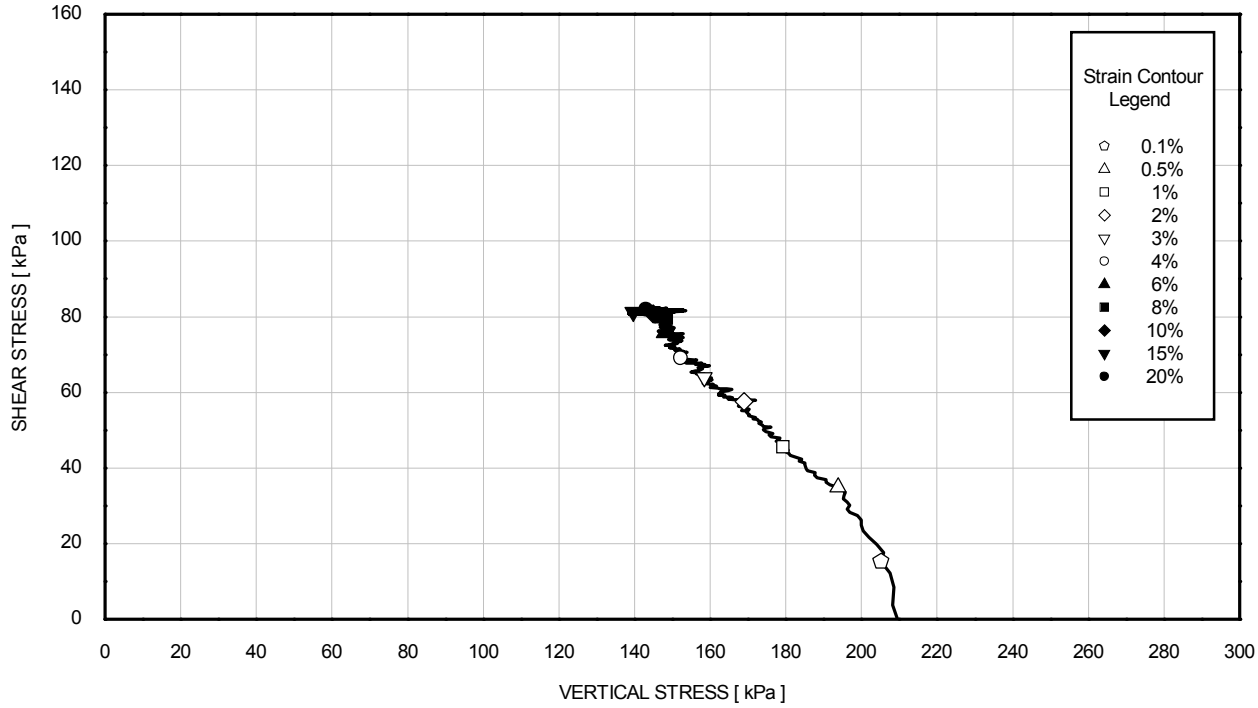
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

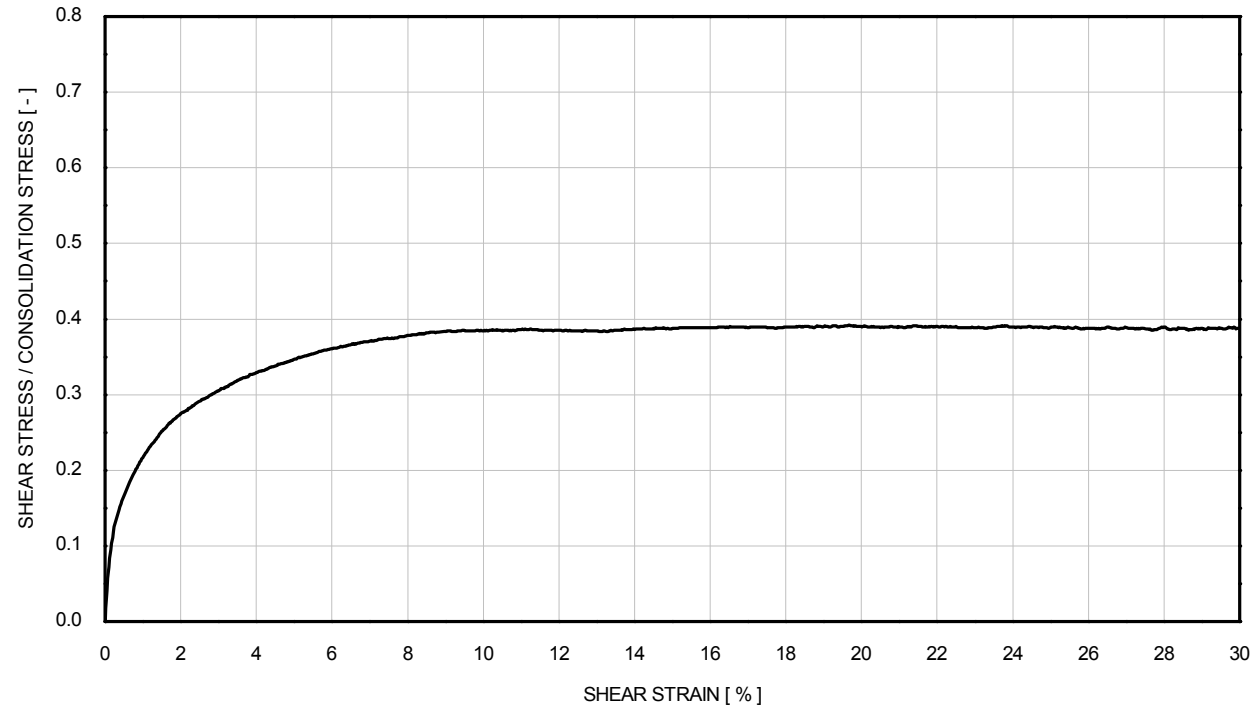




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 82 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 19.66 %	Depth [m]	: 21.61
Rate of strain	: 3.01 %/hour	Test No.	: DSS05

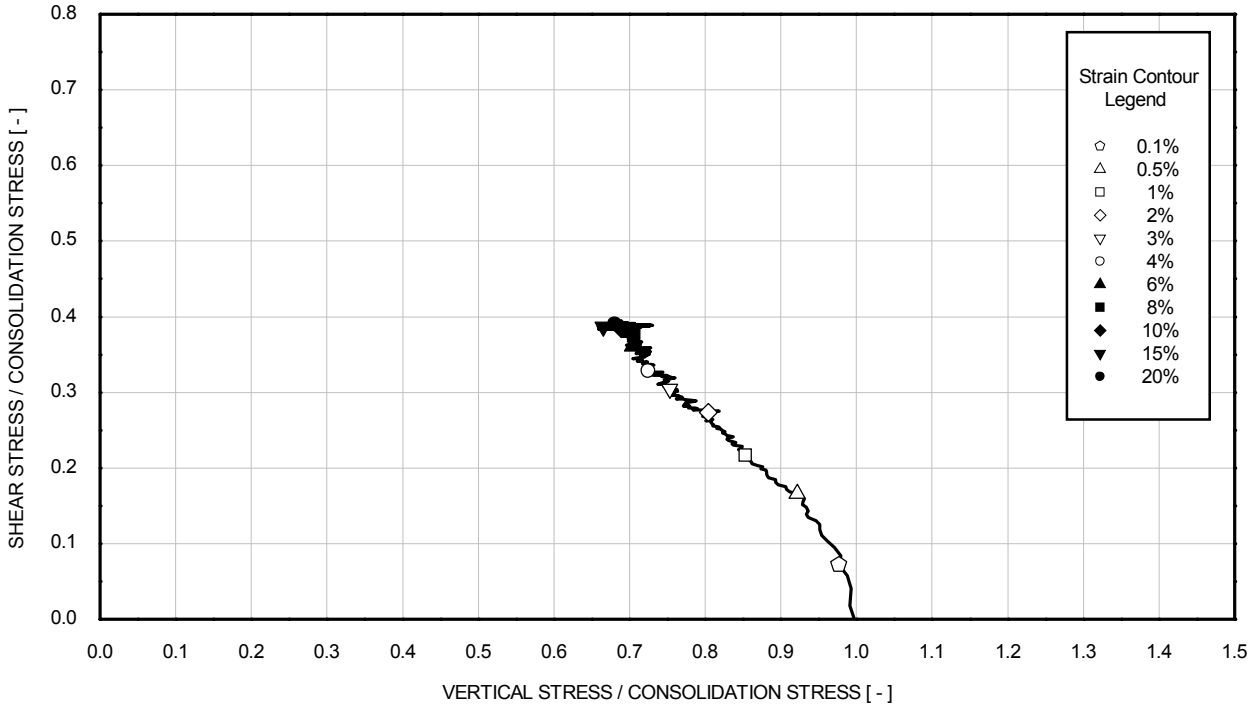
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

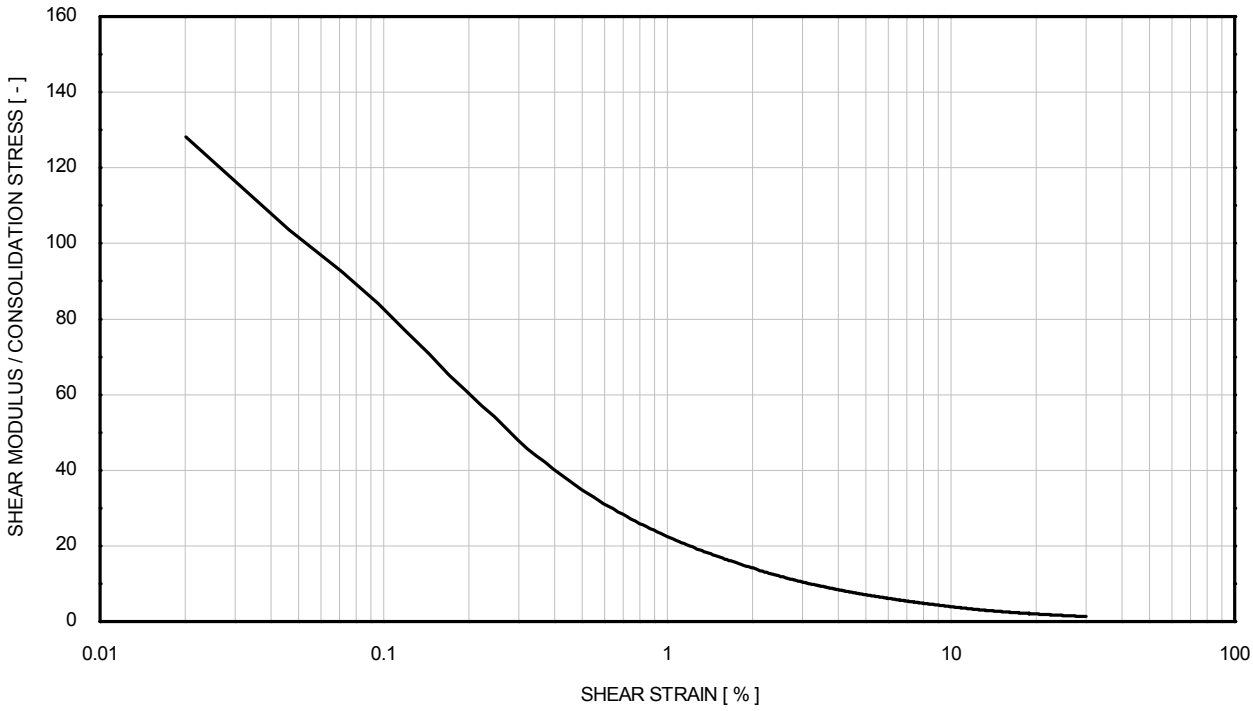




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 82 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 19.66 %	Depth [m]	: 21.61
Rate of strain	: 3.01 %/hour	Test No.	: DSS05

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
τ_{peak}	:	82 kPa	Sample	:	24WaxB
γ at τ_{peak}	:	19.66 %	Depth [m]	:	21.61
Rate of strain	:	3.01 %/hour	Test No.	:	DSS05

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive grey CLAY

GENERAL	
Date test started	24/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.5
Water content	[%]	27.2
Bulk density	[Mg/m³]	2.01
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.706
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH08-SA_40B_DSS06
Template issue	1.4
Processed by Date	EJC 19/10/2016
Checked by Date	PH 18/11/2016
Approved by Date	PH 18/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.82
Test number	DSS06

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-SETUP		
Bulk density	[Mg/m^3]	2.01
Dry density	[Mg/m^3]	1.58
Void ratio	[-]	0.706
Distance	[mm]	25.00
Vertical stress	[kPa]	0

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.04	0.3870	9.68	64.60	8.40
0.06	0.3945	6.58	63.37	8.09
0.08	0.3955	4.94	63.21	8.04
0.10	0.3980	3.98	62.81	7.94
0.12	0.4045	3.37	61.80	7.69

CONSOLIDATION		
σ_{vc}	[kPa]	190
Vertical strain	[%]	4.42
Bulk density	[Mg/m^3]	2.06
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.631
Water content	[%]	24.4

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.82
Test number	DSS06

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION		
Bulk density	[Mg/m^3]	2.06
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.631
Distance	[mm]	23.69
Vertical stress	[kPa]	190

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.1320	13.20	179.51	66.39
0.02	0.1295	6.48	182.97	68.98
0.03	0.1285	4.28	184.40	70.05
0.04	0.1290	3.23	183.68	69.51
0.05	0.1285	2.57	184.40	70.05
0.06	0.1275	2.13	185.84	71.16

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	59
Shear strain	[%]	29.43
Shear induced -$\Delta\sigma_v$	[kPa]	88
Vertical stress	[kPa]	102
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	49
Shear induced -$\Delta\sigma_v$	[kPa]	87
Vertical stress	[kPa]	103
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.82
Test number	DSS06

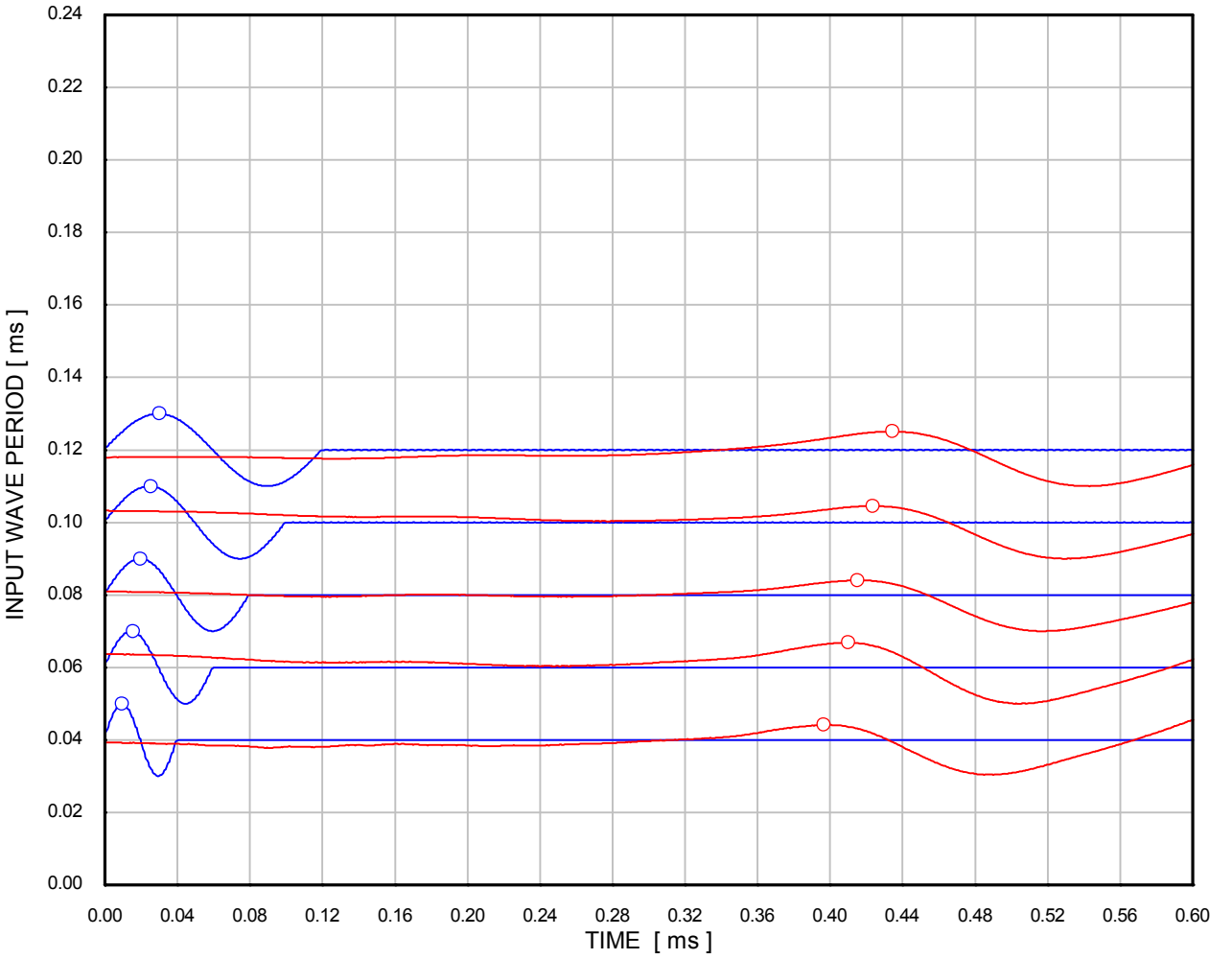
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

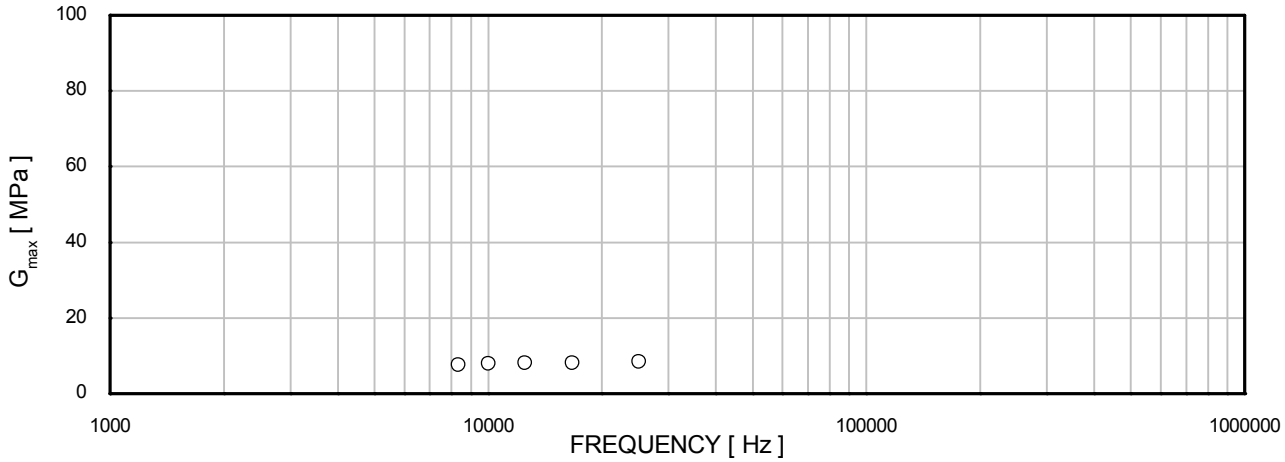
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.82
Test number	DSS06

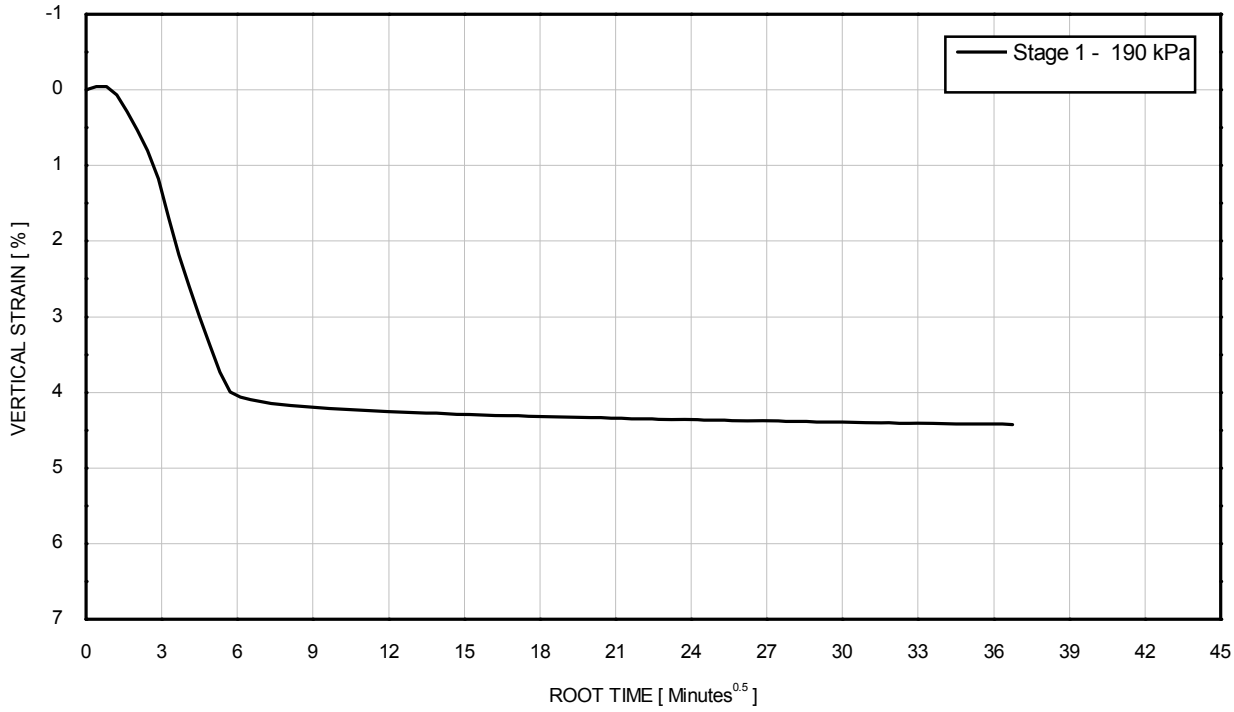
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

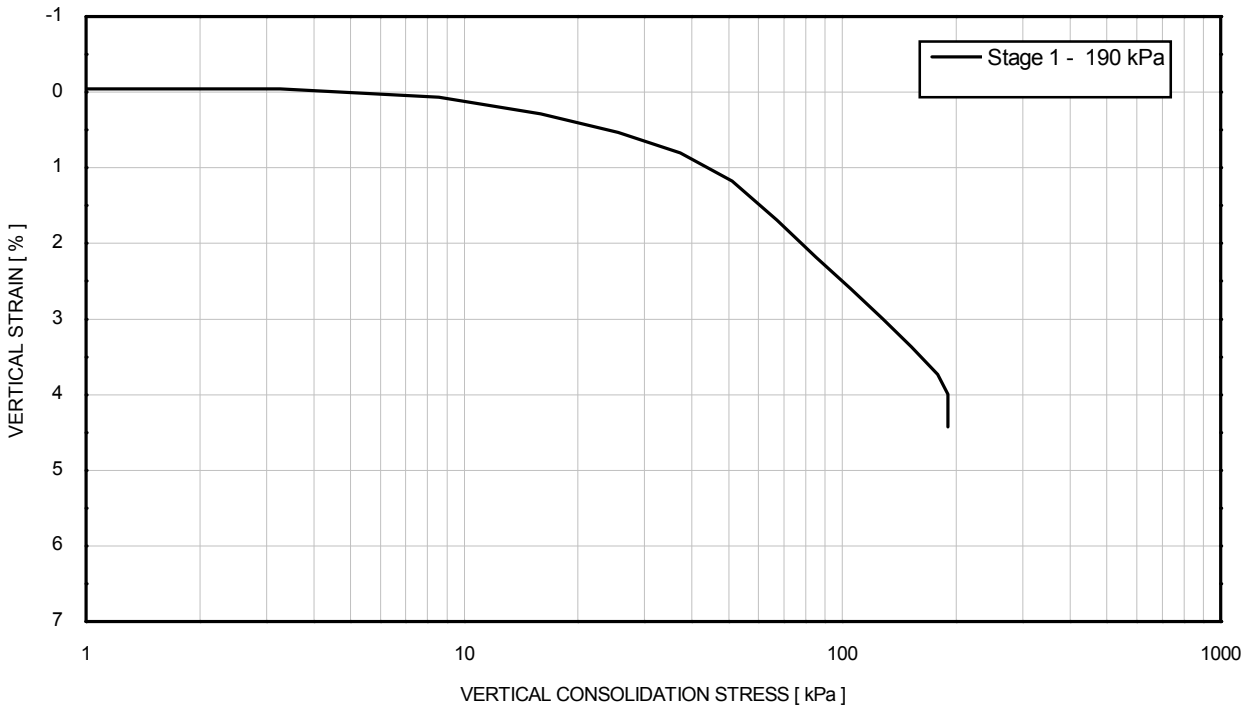




σ'_{vc}	: 0 kPa	Borehole	: HKZ2-BH08-SA
	Source signal	Sample	: 40WaxB
	Received signal	Depth [m]	: 23.82
○ / ○	Selected peak values	Test No.	: DSS06

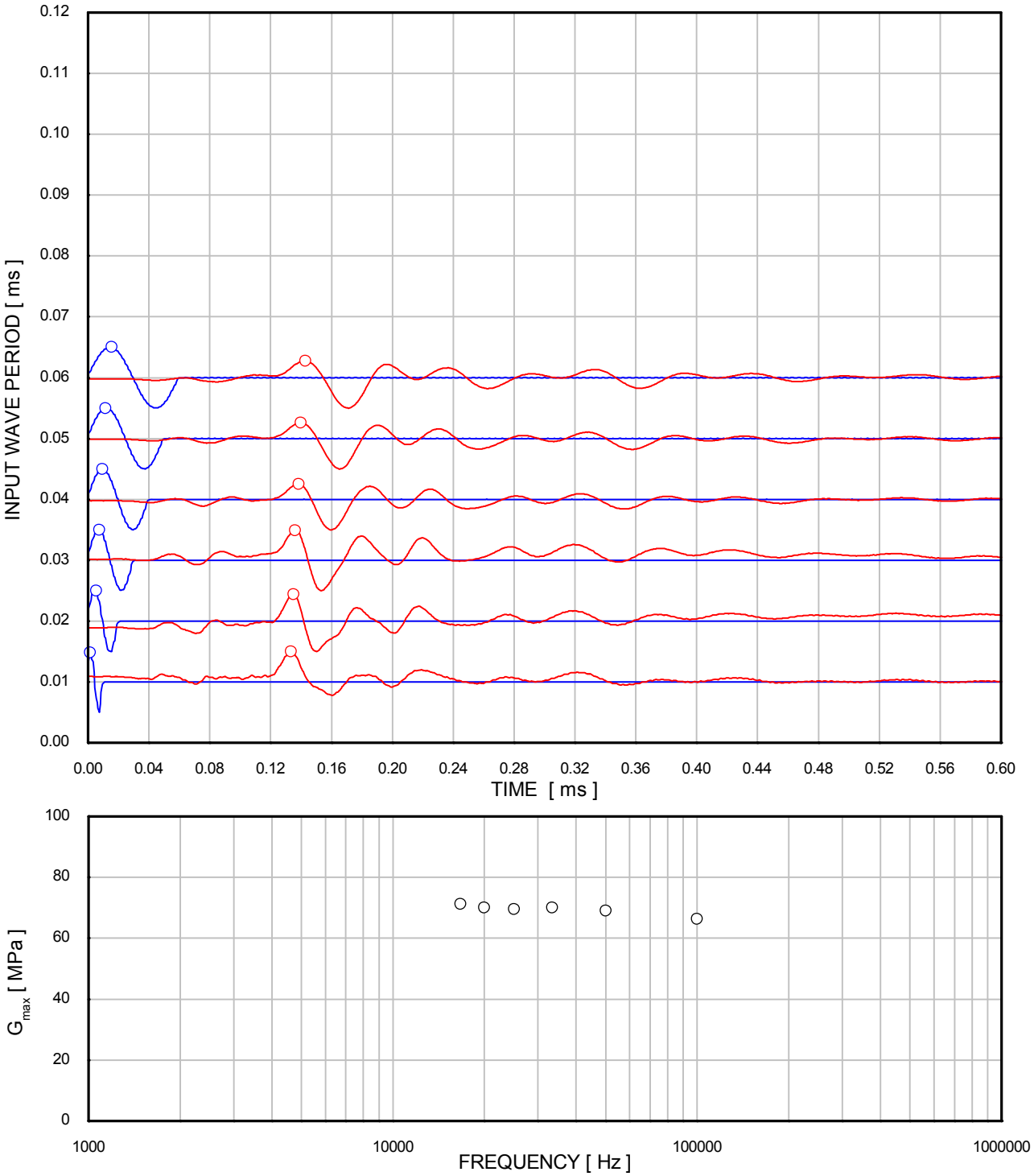
CONSOLIDATED DSS TEST
POST-SETUP S_{VH} BENDER ELEMENT DETERMINATIONS





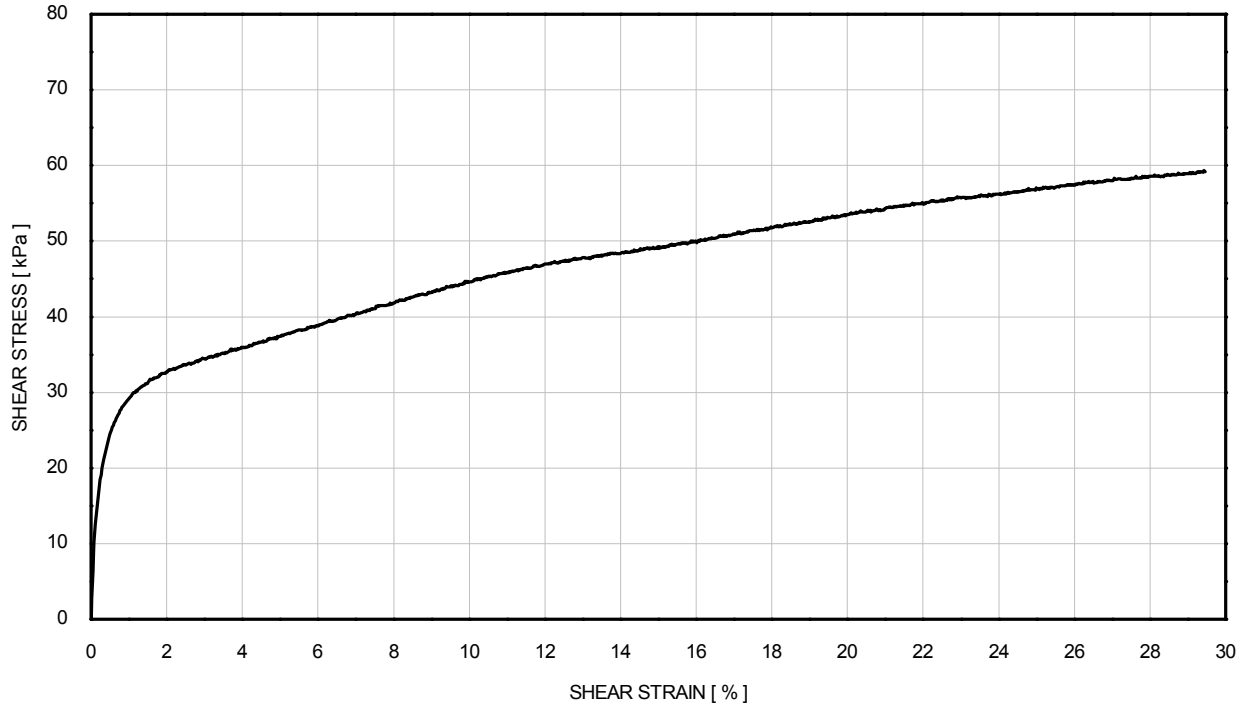
σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
		Sample	: 40WaxB
		Depth [m]	: 23.82
		Test No.	: DSS06

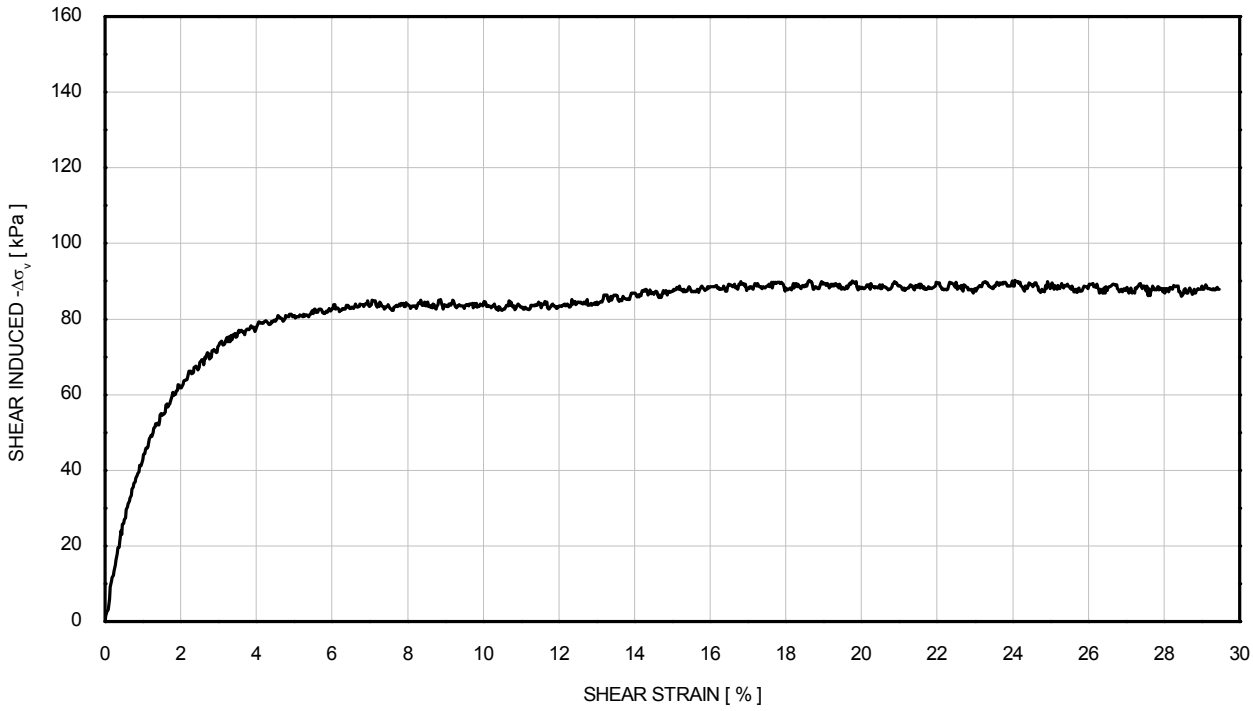
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE



σ'_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
	Source signal	Sample	: 40WaxB
	Received signal	Depth [m]	: 23.82
○ / ○	Selected peak values	Test No.	: DSS06

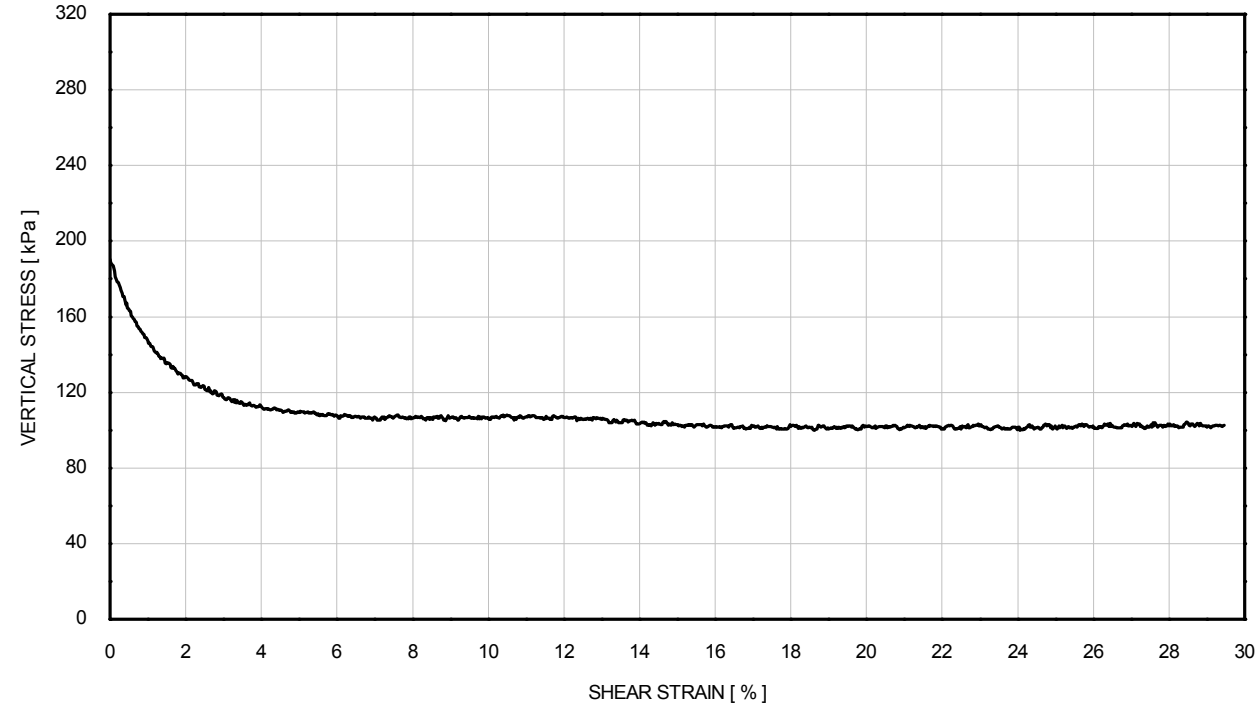
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

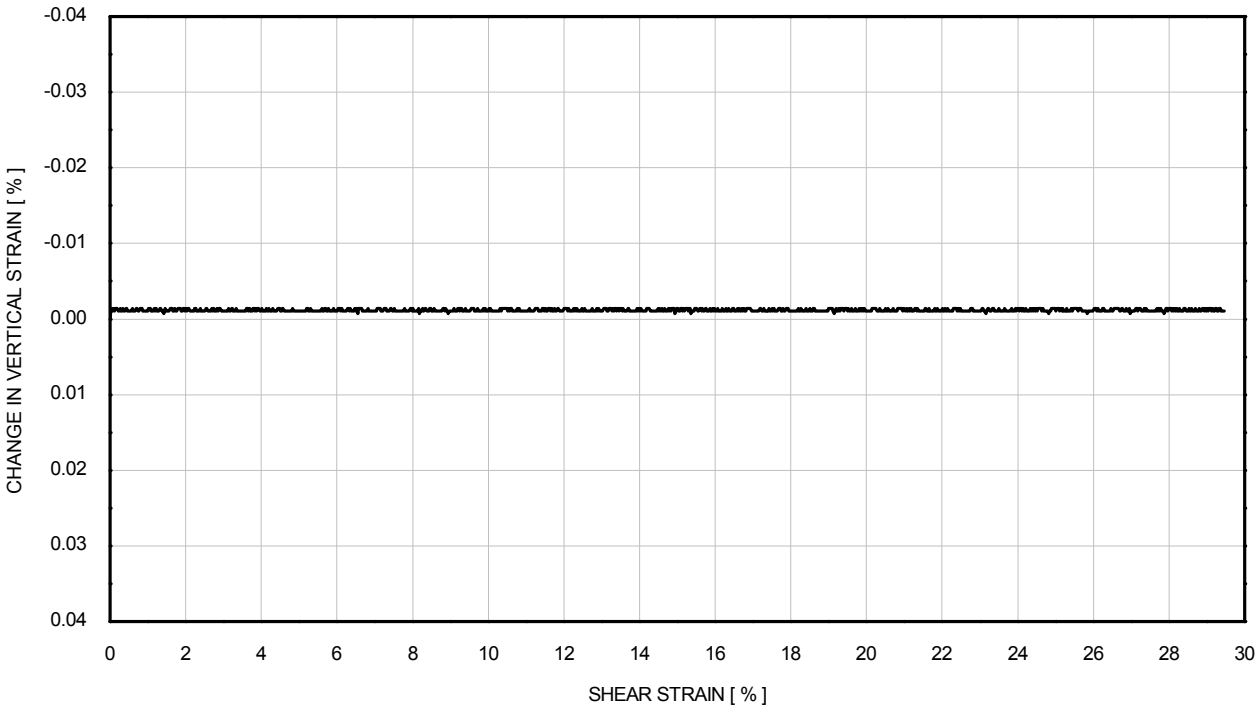




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 59 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 29.43 %	Depth [m]	: 23.82
Rate of strain	: 2.99 %/hour	Test No.	: DSS06

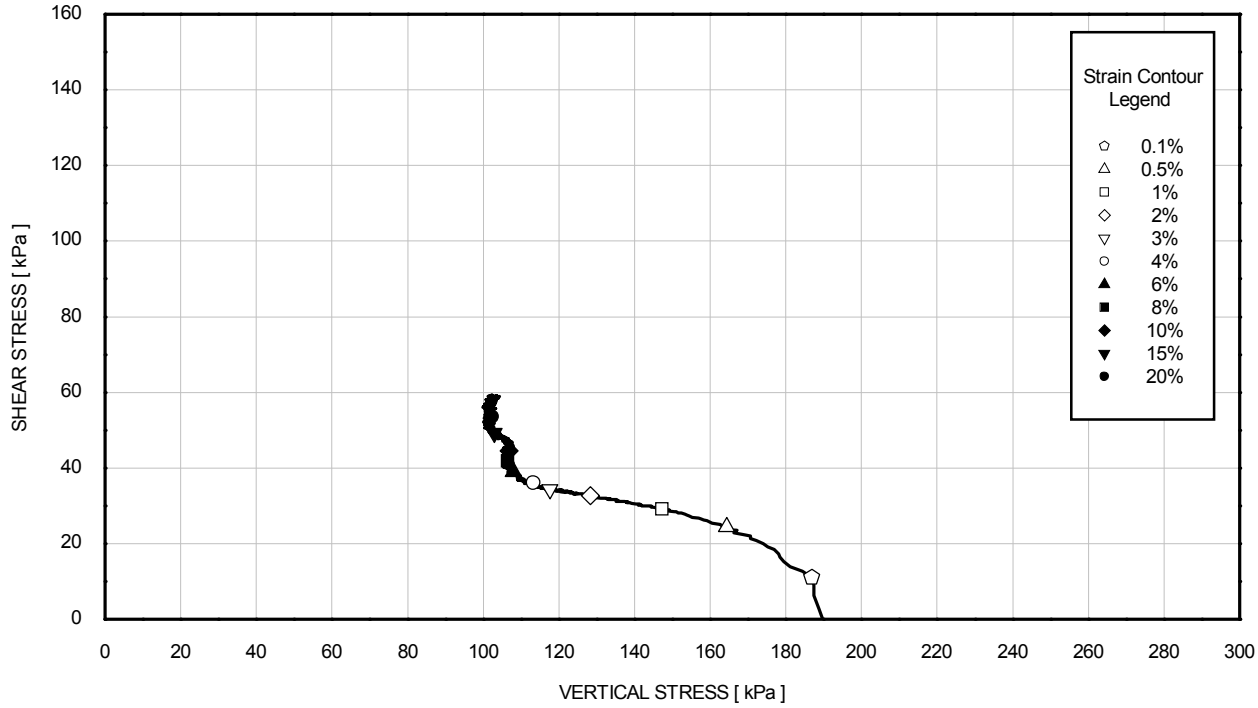
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

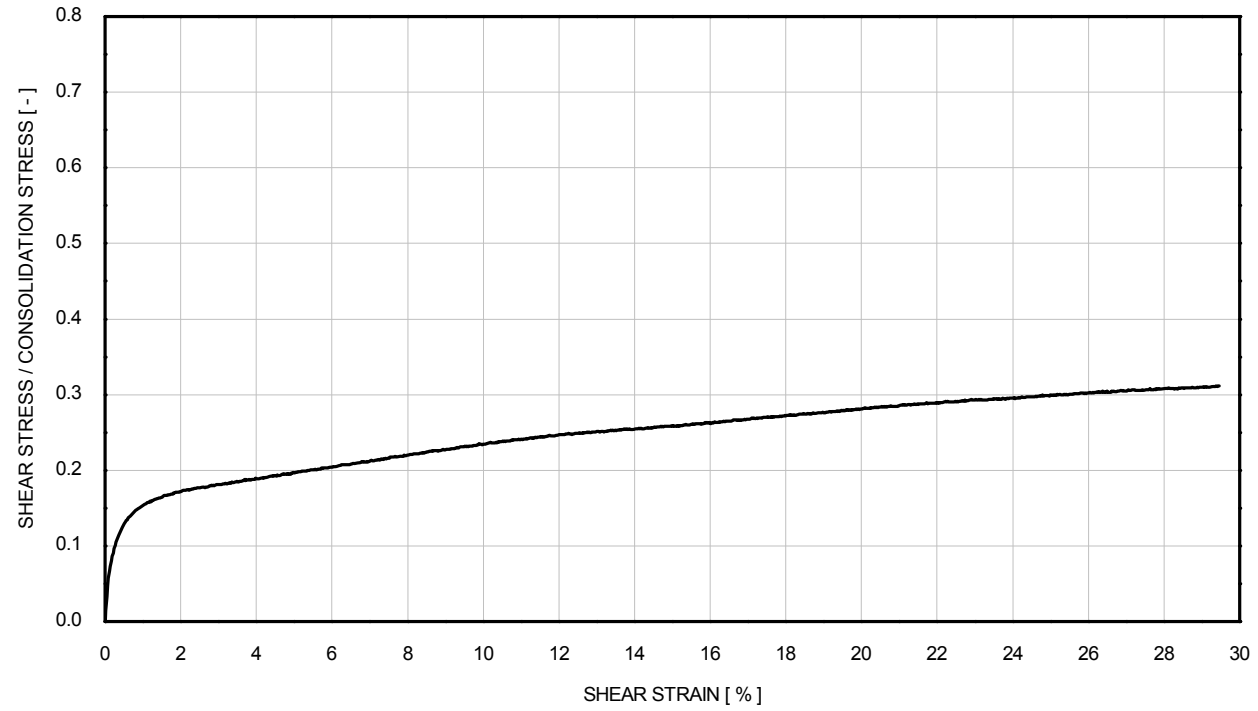




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 59 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 29.43 %	Depth [m]	: 23.82
Rate of strain	: 2.99 %/hour	Test No.	: DSS06

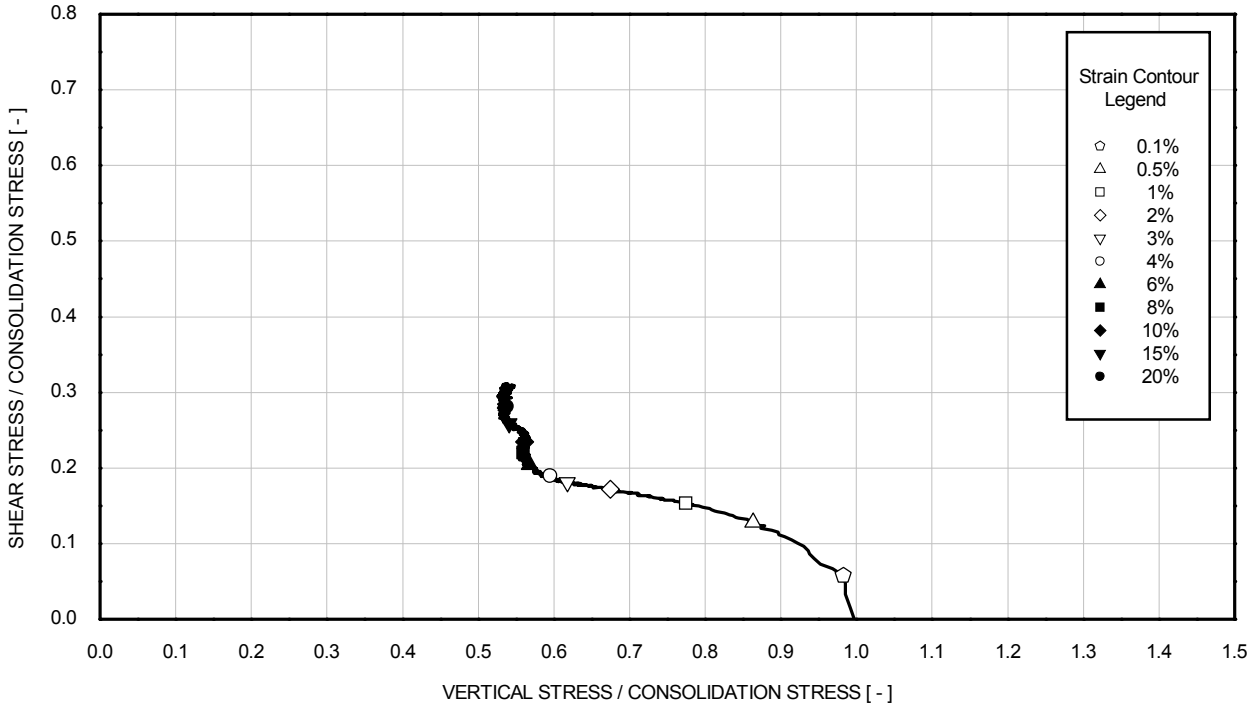
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

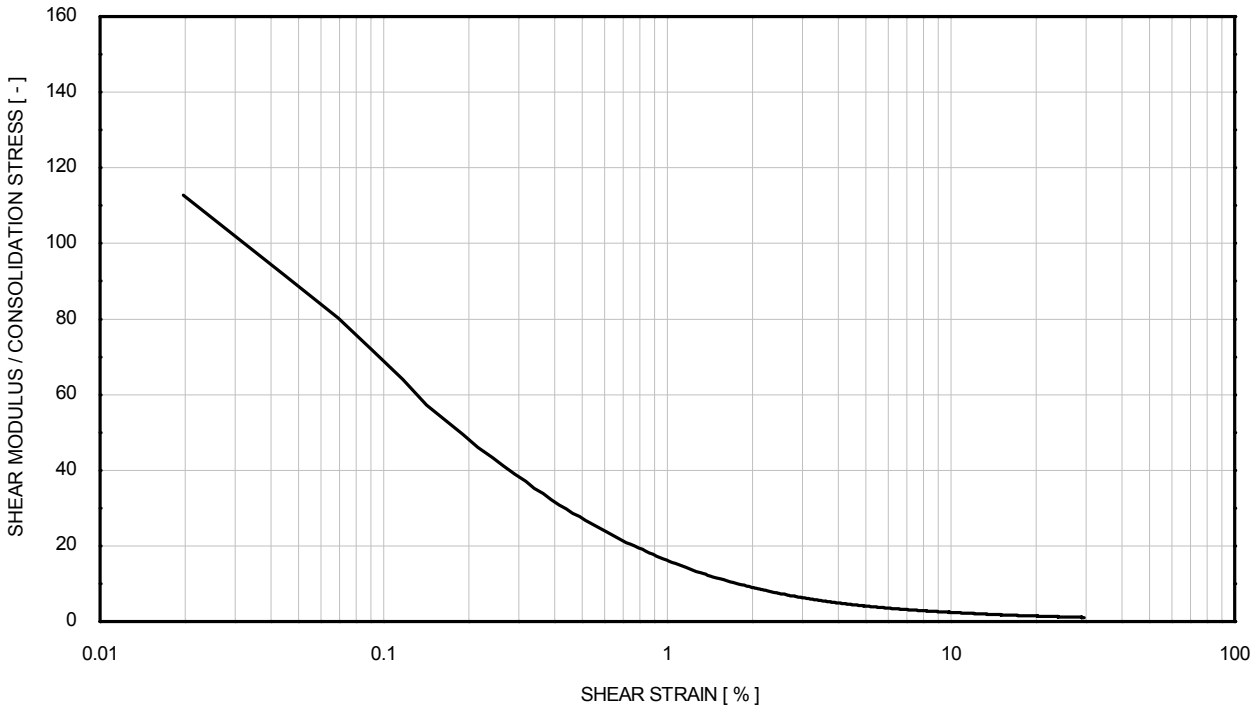




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 59 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 29.43 %	Depth [m]	: 23.82
Rate of strain	: 2.99 %/hour	Test No.	: DSS06

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
τ_{peak}	:	59 kPa	Sample	:	40WaxB
γ at τ_{peak}	:	29.43 %	Depth [m]	:	23.82
Rate of strain	:	2.99 %/hour	Test No.	:	DSS06

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Light brown fine to coarse SAND with few shells and shell fragments

GENERAL	
Date test started	26/10/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.8
Length	[mm]	30.0
Water content after compaction	[%]	10.0
Bulk density after compaction	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.606
Degree of saturation after compaction	[%]	44
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	22.9
Bulk density at start of test	[Mg/m³]	2.03
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 2 - DSS01
Template issue	1.4
Processed by Date	JLS 26/10/2016
Checked by Date	PH 11/11/2016
Approved by Date	PH 11/11/2016

TEST IDENTIFICATION	
Batch	2
Sample	DSS_2-1
Unit	Unit A (Southern Bight)
Test number	DSS01

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-SETUP		
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.606
Distance	[mm]	25.50
Vertical stress	[kPa]	20

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.6410	64.10	39.78	3.21
0.02	0.6350	31.75	40.16	3.27
0.03	0.6280	20.93	40.61	3.34
0.04	0.6345	15.86	40.19	3.27
0.05	0.6205	12.41	41.10	3.42
0.06	0.6375	10.63	40.00	3.24
0.07	0.6410	9.16	39.78	3.21
0.08	0.6415	8.02	39.75	3.20
0.09	0.6490	7.21	39.29	3.13
0.10	0.6485	6.49	39.32	3.13

CONSOLIDATION		
σ_{vc}	[kPa]	20
Vertical strain	[%]	1.17
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.587
Water content	[%]	22.2

TEST IDENTIFICATION	
Batch	2
Sample	DSS_2-1
Unit	Unit A (Southern Bight)
Test number	DSS01

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION		
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.587
Distance	[mm]	25.20
Vertical stress	[kPa]	20

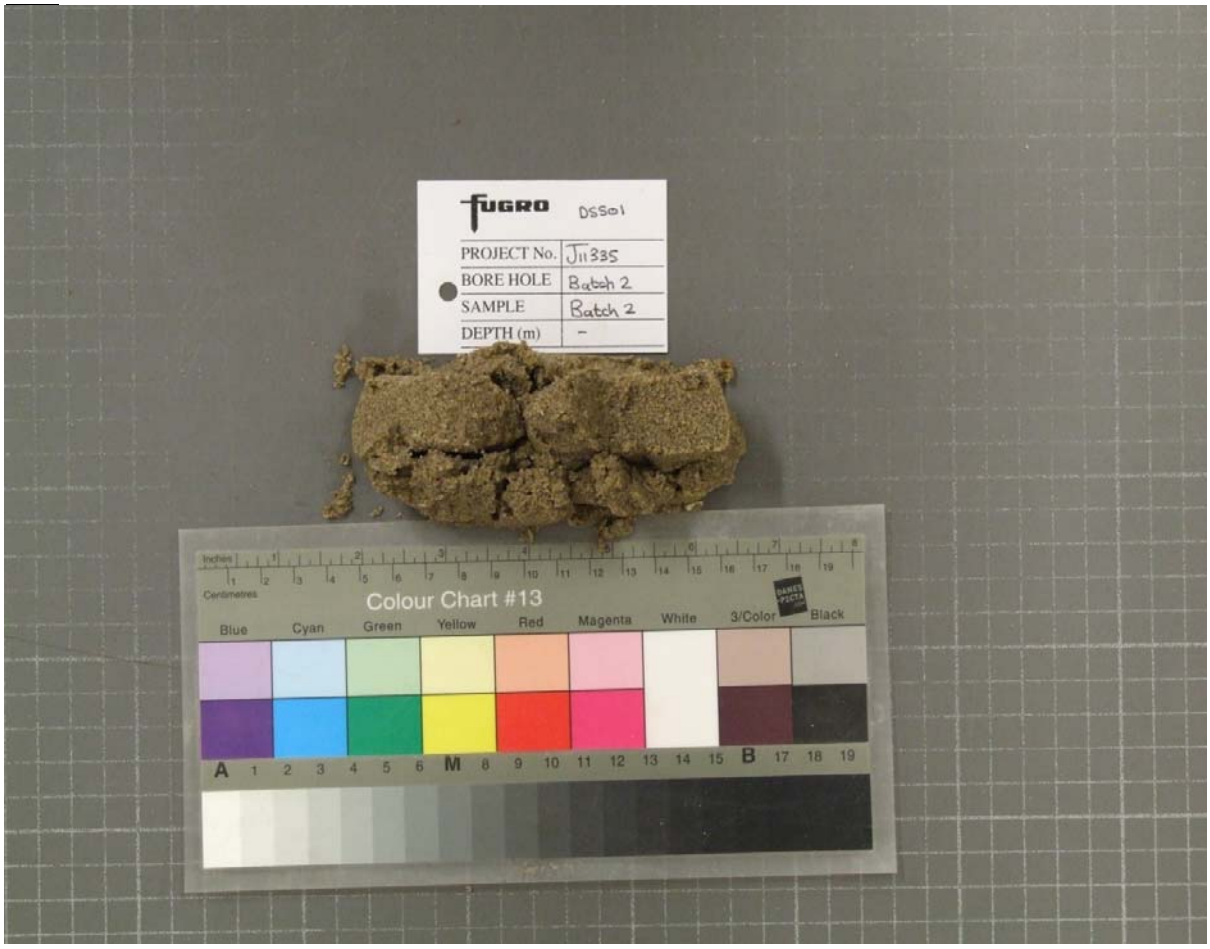
Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.2075	20.75	122.89	30.62
0.02	0.2040	10.20	125.00	31.68
0.03	0.2025	6.75	125.93	32.15
0.04	0.2035	5.09	125.31	31.83
0.05	0.2055	4.11	124.09	31.22
0.06	0.2070	3.45	123.19	30.77
0.07	0.2075	2.96	122.89	30.62
0.08	0.2110	2.64	120.85	29.61
0.09	0.2140	2.38	119.16	28.79
0.10	0.2155	2.16	118.33	28.39

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	629
Shear strain	[%]	29.67
Shear induced -$\Delta\sigma_v$	[kPa]	-1063
Vertical stress	[kPa]	1083
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.97
At 15 % shear strain		
Shear stress	[kPa]	153
Shear induced -$\Delta\sigma_v$	[kPa]	-241
Vertical stress	[kPa]	260
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	2
Sample	DSS_2-1
Unit	Unit A (Southern Bight)
Test number	DSS01

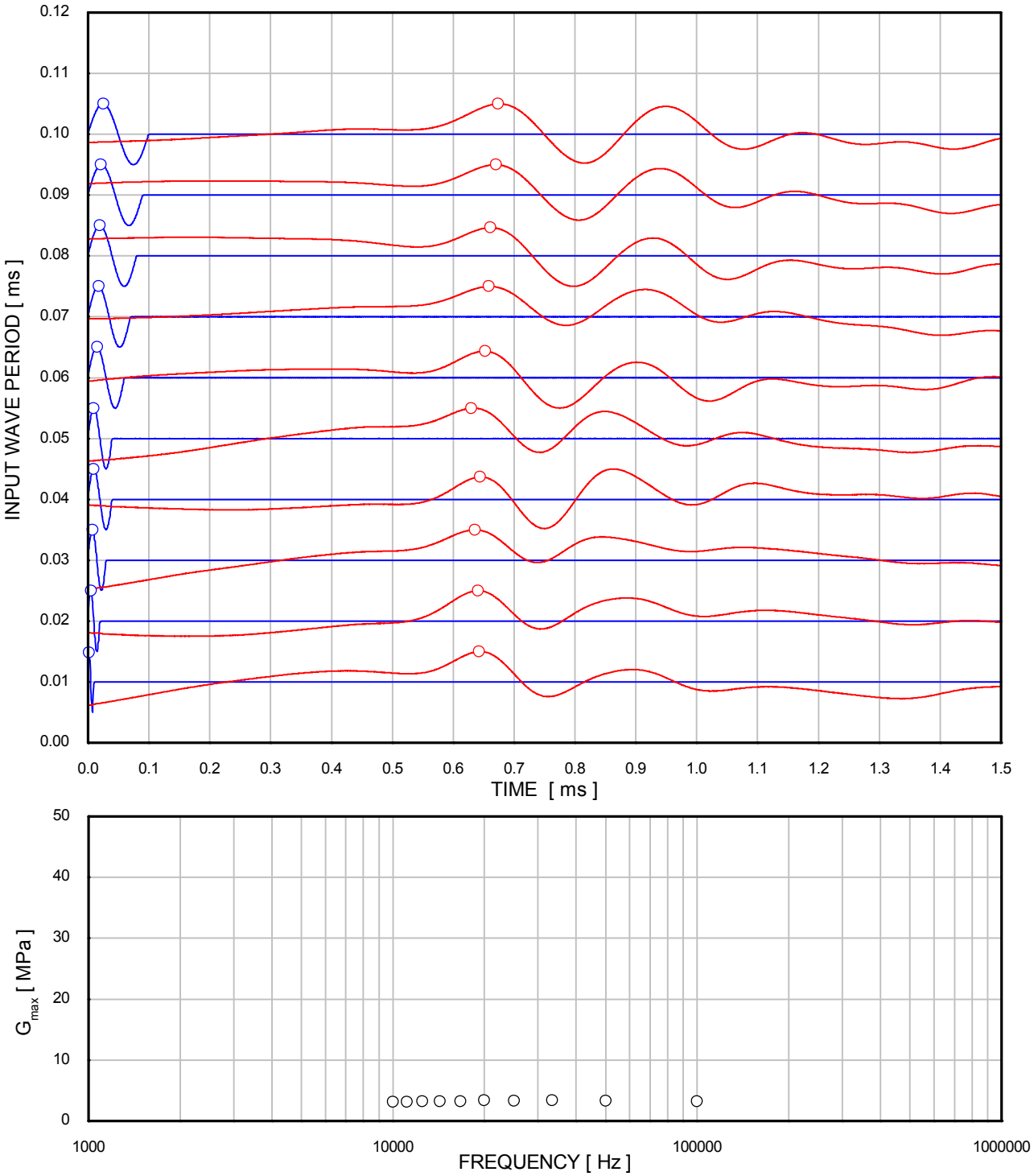
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

SPECIMEN PHOTOGRAPH



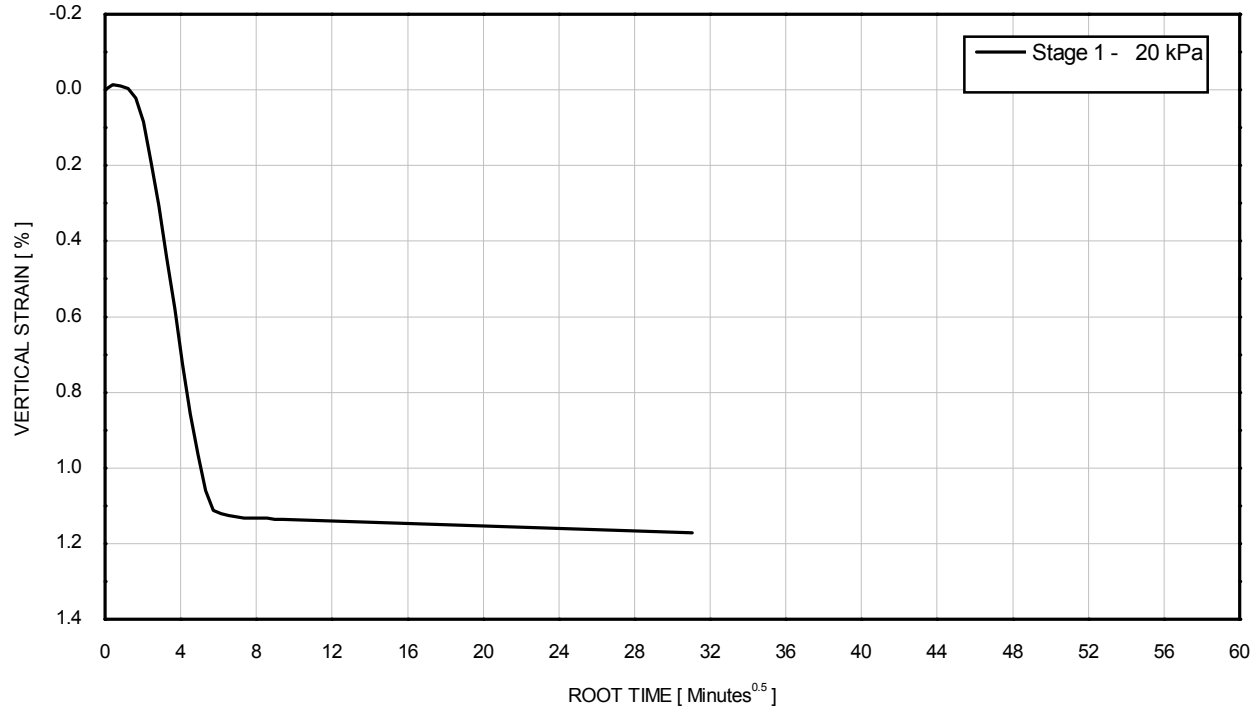
TEST IDENTIFICATION	
Batch	2
Sample	DSS_2-1
Unit	Unit A (Southern Bight)
Test number	DSS01

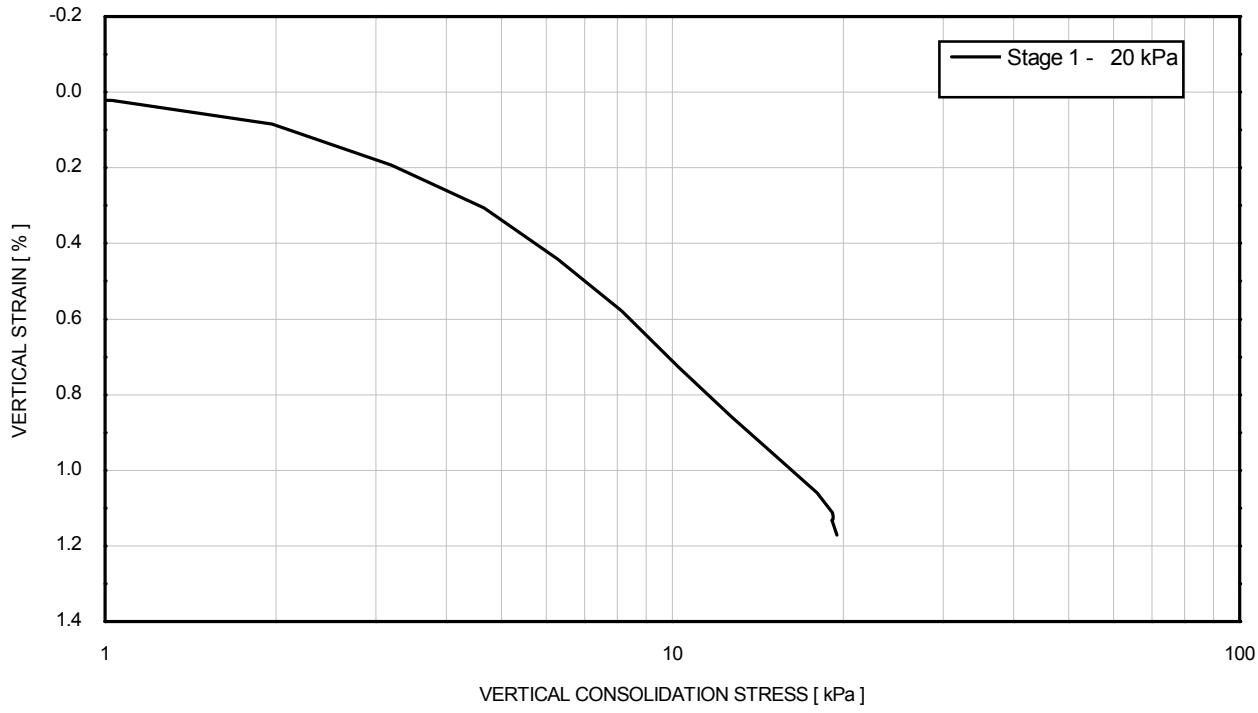
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS



σ'_{rc}	: 20 kPa	Batch	: 2
	Source signal	Sample	: DSS_2-1
	Received signal	Unit	: Unit A (Southern Bight)
○ / ○	Selected peak values	Test No.	: DSS01

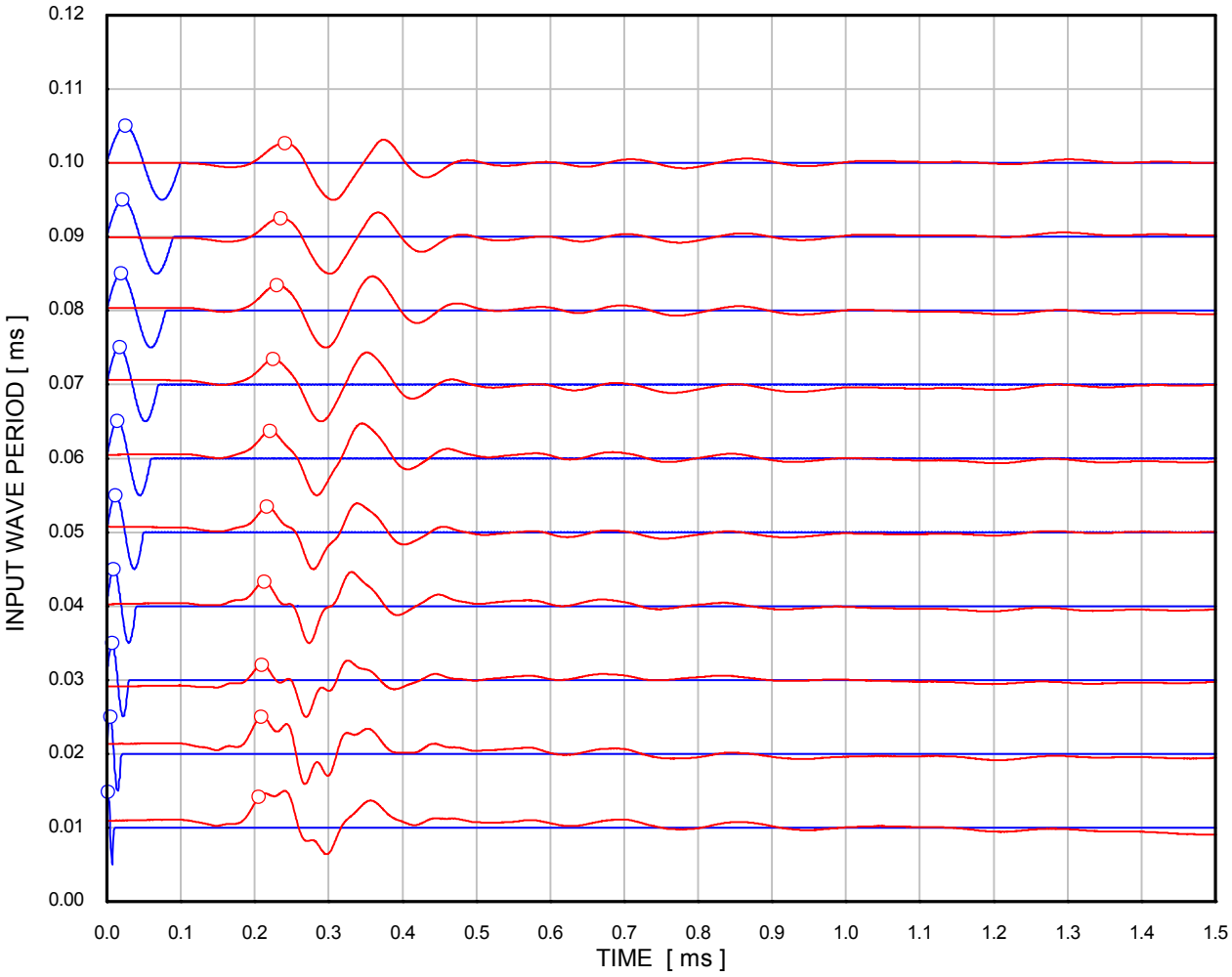
CONSOLIDATED DSS TEST
POST-SETUP S_{VH} BENDER ELEMENT DETERMINATIONS

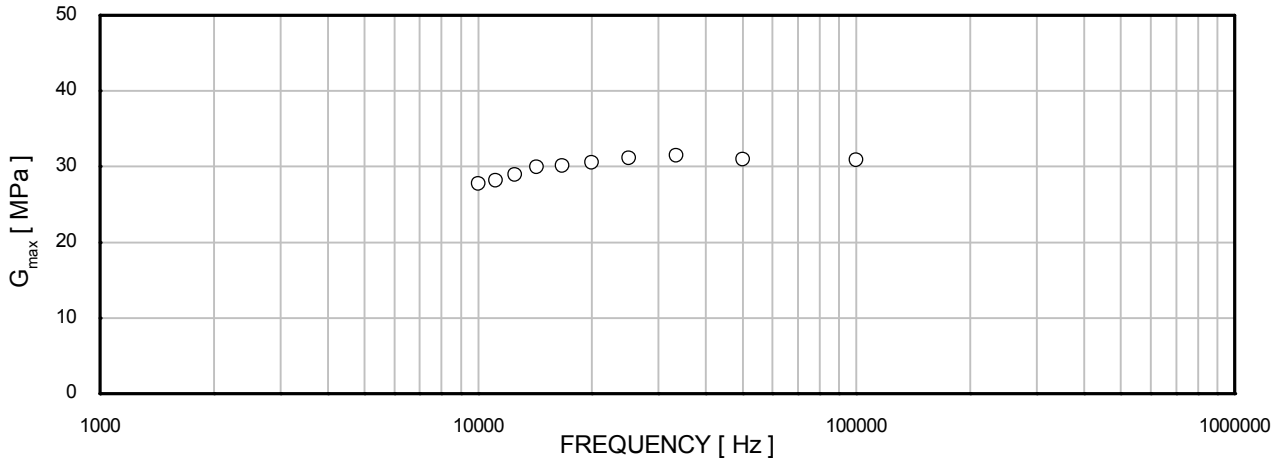




σ_{vc}	: 20 kPa	Batch	: 2
		Sample	: DSS_2-1
		Unit	: Unit A (Southern Bight)
		Test No.	: DSS01

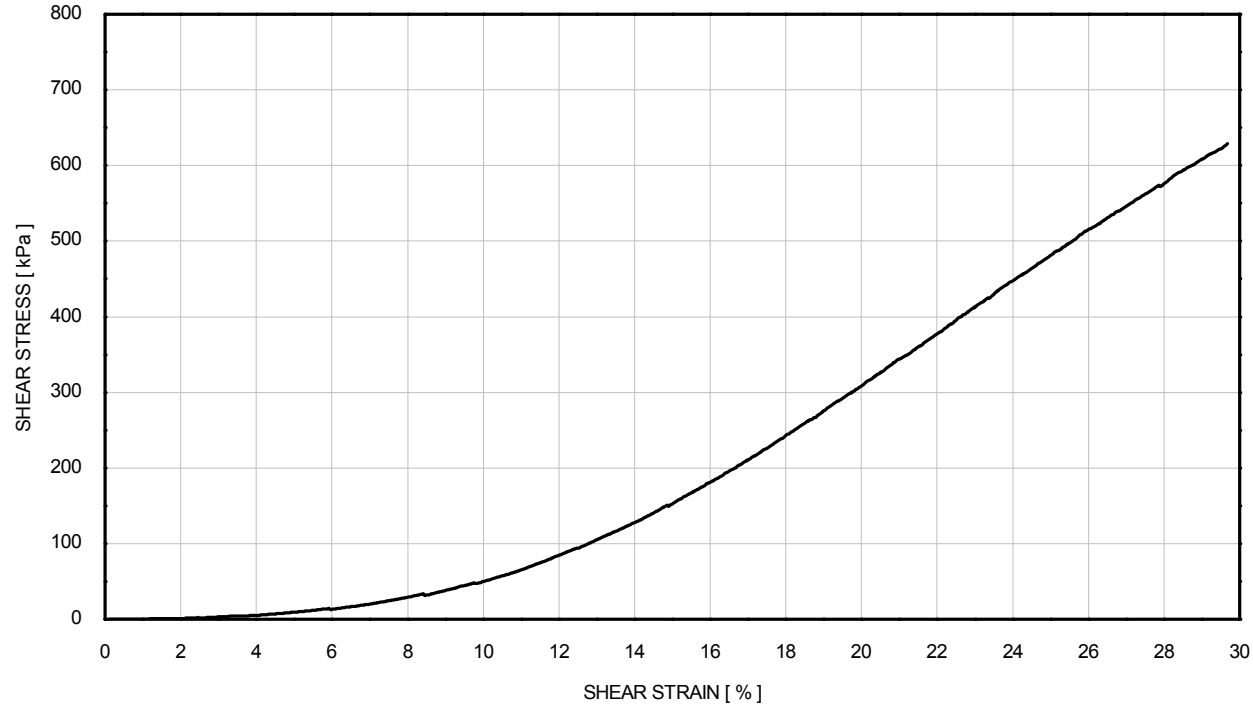
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE

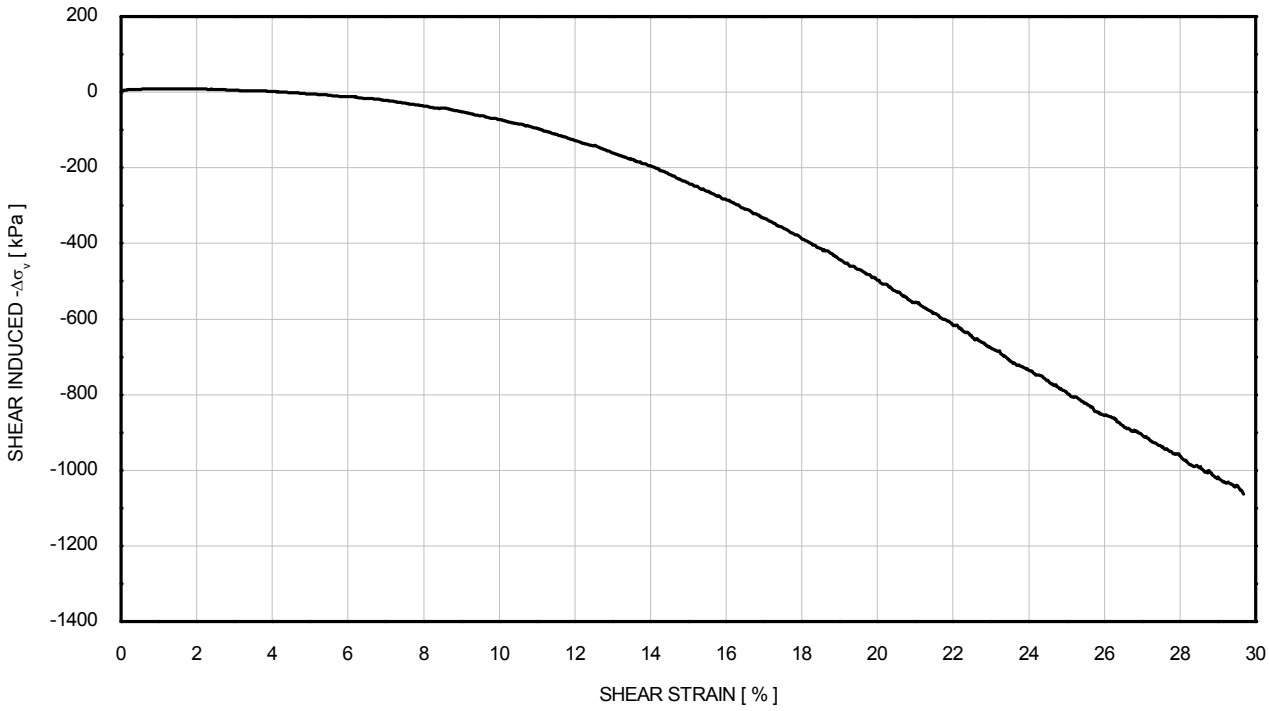




σ'_{rc}	: 20 kPa	Batch	: 2
	Source signal	Sample	: DSS_2-1
	Received signal	Unit	: Unit A (Southern Bight)
○ / ○	Selected peak values	Test No.	: DSS01

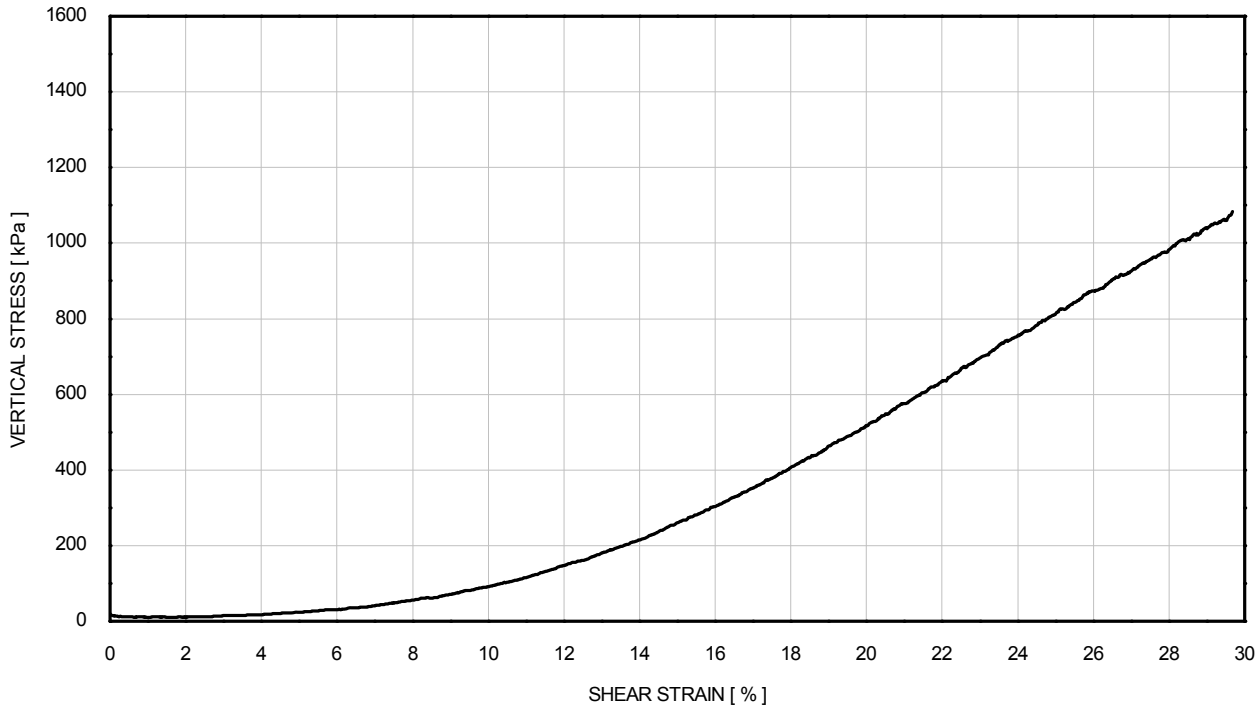
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

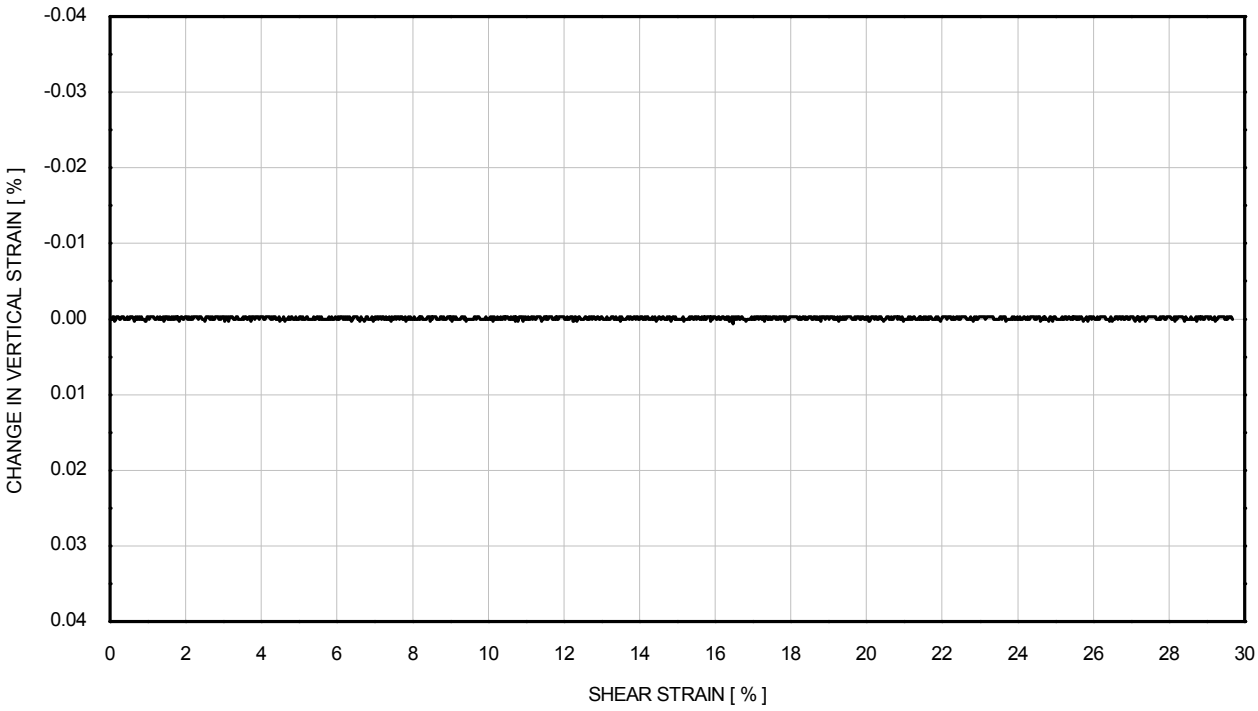




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 629 kPa	Sample	: DSS_2-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97 %/hour	Test No.	: DSS01

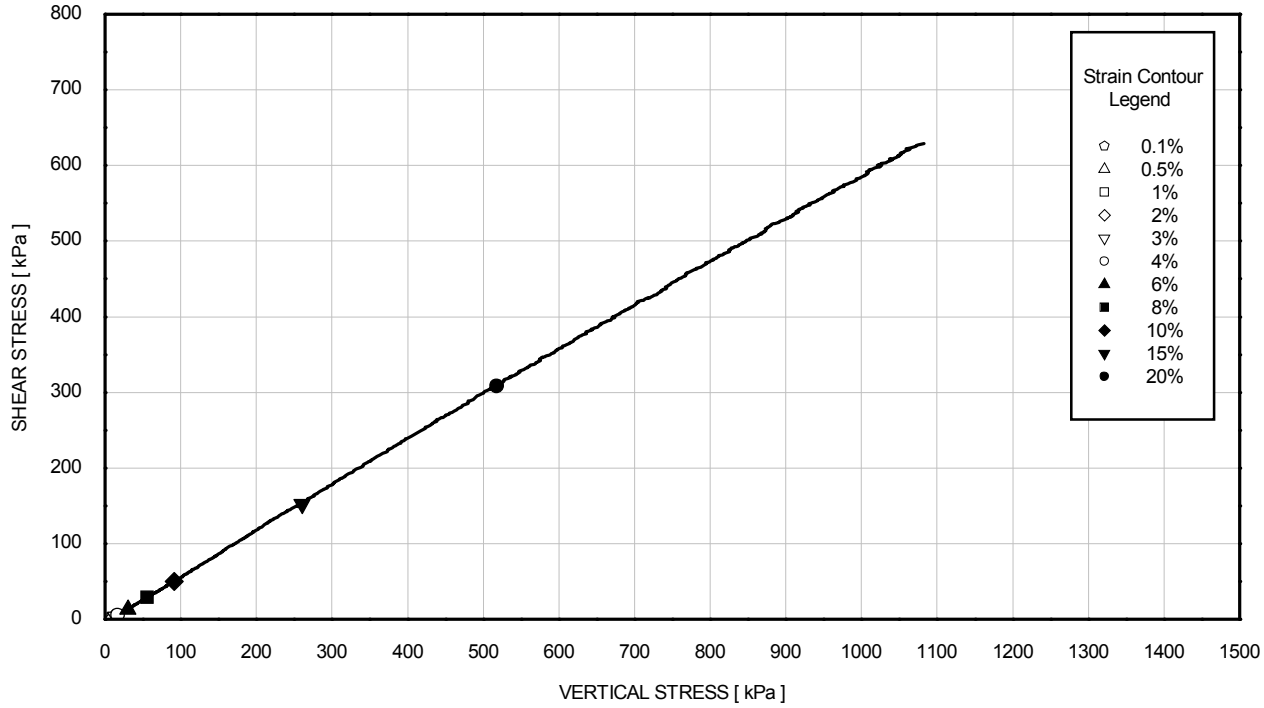
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

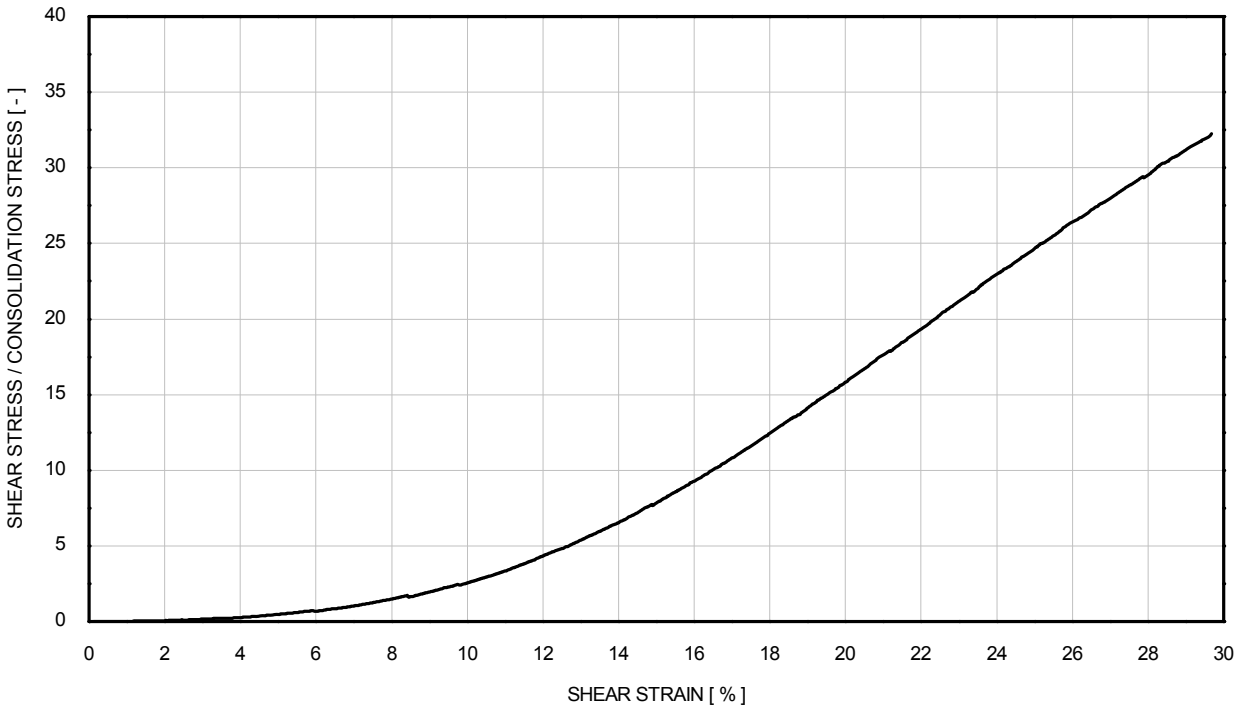




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 629 kPa	Sample	: DSS_2-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97 %/hour	Test No.	: DSS01

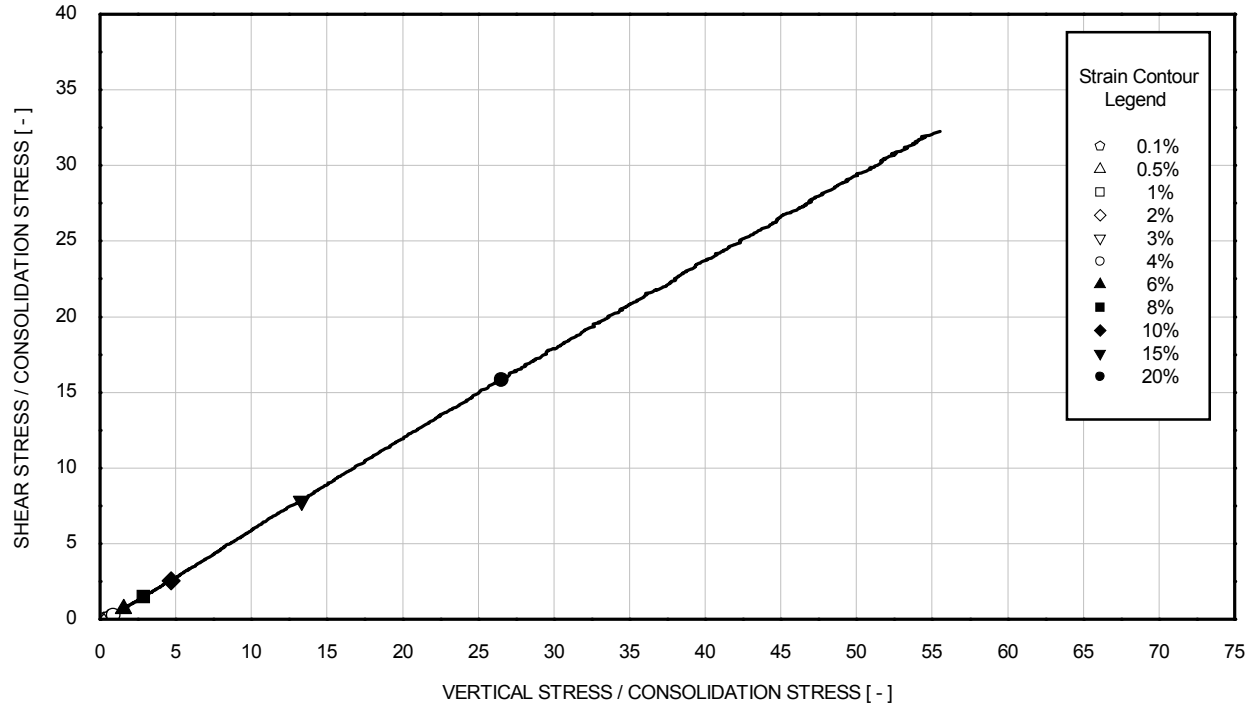
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

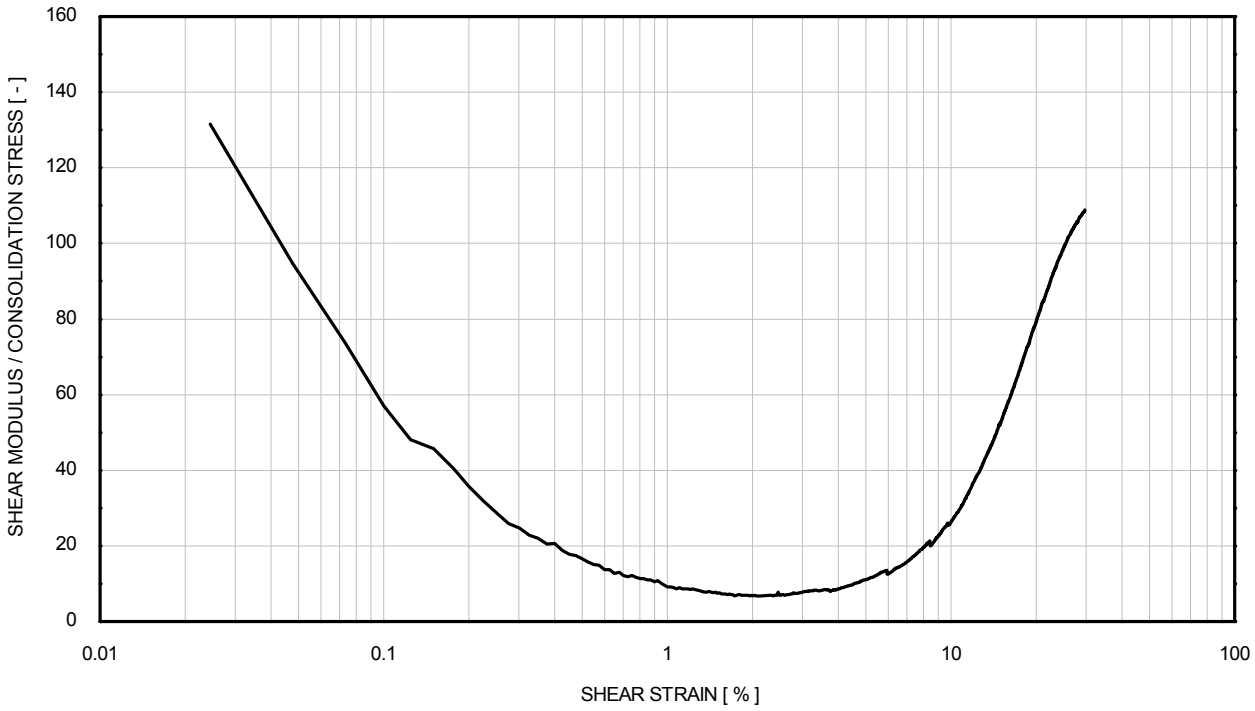




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 629 kPa	Sample	: DSS_2-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97 %/hour	Test No.	: DSS01

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 629 kPa	Sample	: DSS_2-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97 %/hour	Test No.	: DSS01

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown fine to coarse SAND with organic matter

GENERAL	
Date test started	31/10/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.4
Length	[mm]	30.0
Water content after compaction	[%]	9.6
Bulk density after compaction	[Mg/m³]	1.83
Dry density	[Mg/m³]	1.67
Void ratio	[-]	0.590
Degree of saturation after compaction	[%]	43
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	22.3
Bulk density at start of test	[Mg/m³]	2.04
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 4 - DSS02
Template issue	1.4
Processed by Date	JLS 02/11/2016
Checked by Date	PH 11/11/2016
Approved by Date	PH 11/11/2016

TEST IDENTIFICATION	
Batch	4
Sample	DSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	DSS02

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-SETUP		
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.590
Distance	[mm]	25.50
Vertical stress	[kPa]	1

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.4705	47.05	54.20	5.98
0.02	0.4595	22.98	55.50	6.27
0.03	0.4510	15.03	56.54	6.51
0.04	0.4520	11.30	56.42	6.48
0.05	0.4570	9.14	55.80	6.34
0.06	0.4580	7.63	55.68	6.32
0.07	0.4595	6.56	55.50	6.27
0.08	0.4630	5.79	55.08	6.18
0.09	0.4675	5.19	54.55	6.06
0.10	0.4690	4.69	54.37	6.02

CONSOLIDATION		
σ_{vc}	[kPa]	85
Vertical strain	[%]	0.88
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.68
Void ratio	[-]	0.576
Water content	[%]	21.8

TEST IDENTIFICATION	
Batch	4
Sample	DSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	DSS02

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION		
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.68
Void ratio	[-]	0.576
Distance	[mm]	25.24
Vertical stress	[kPa]	85

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.01	0.1245	12.45	202.70	84.09
0.02	0.1250	6.25	201.88	83.42
0.03	0.1245	4.15	202.70	84.09
0.04	0.1240	3.10	203.51	84.77
0.05	0.1245	2.49	202.70	84.09
0.06	0.1240	2.07	203.51	84.77

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	739
Shear strain	[%]	21.26
Shear induced -$\Delta\sigma_v$	[kPa]	-1209
Vertical stress	[kPa]	1294
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.97
At 15 % shear strain		
Shear stress	[kPa]	441
Shear induced -$\Delta\sigma_v$	[kPa]	-676
Vertical stress	[kPa]	761
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	4
Sample	DSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	DSS02

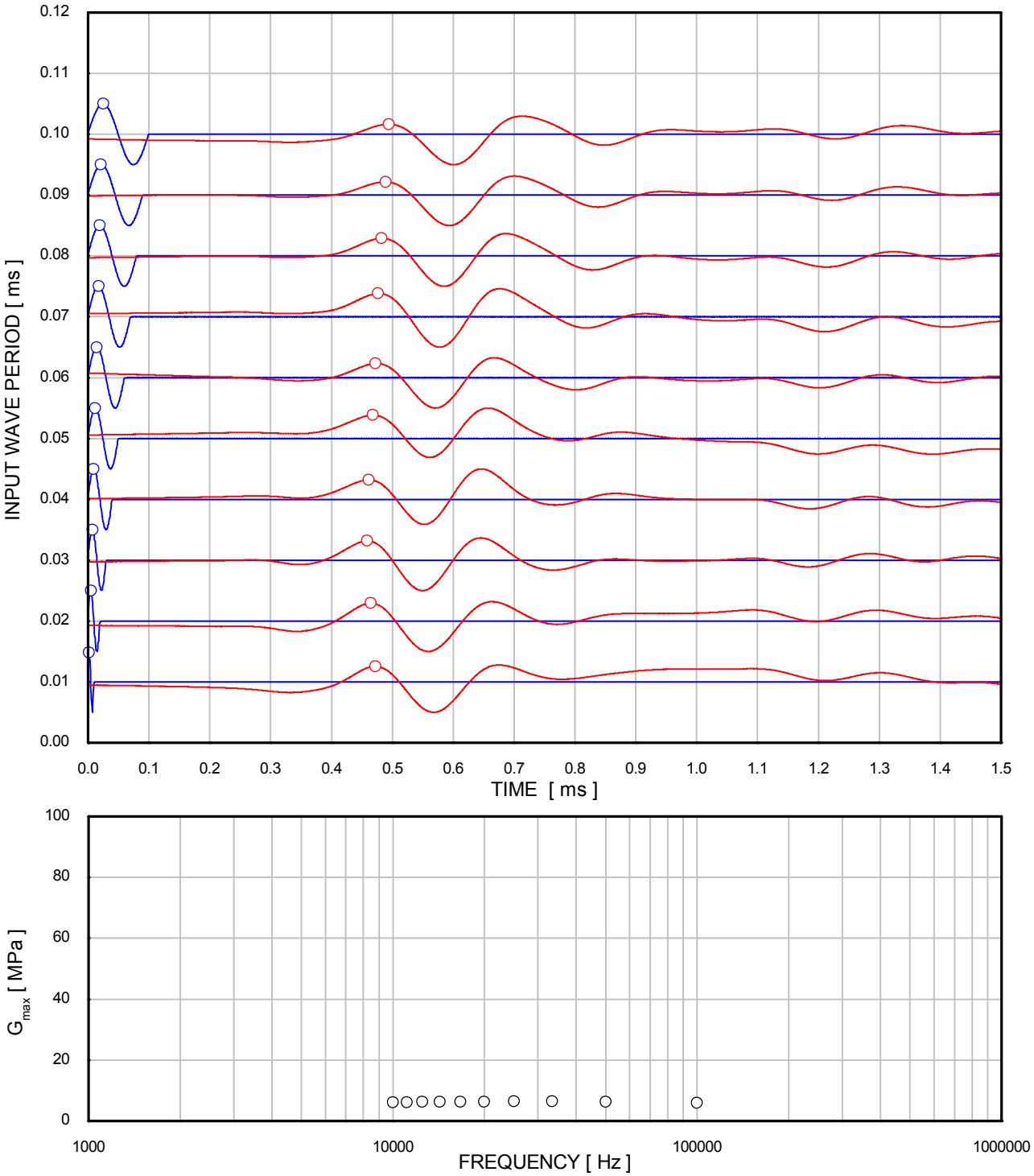
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

SPECIMEN PHOTOGRAPH



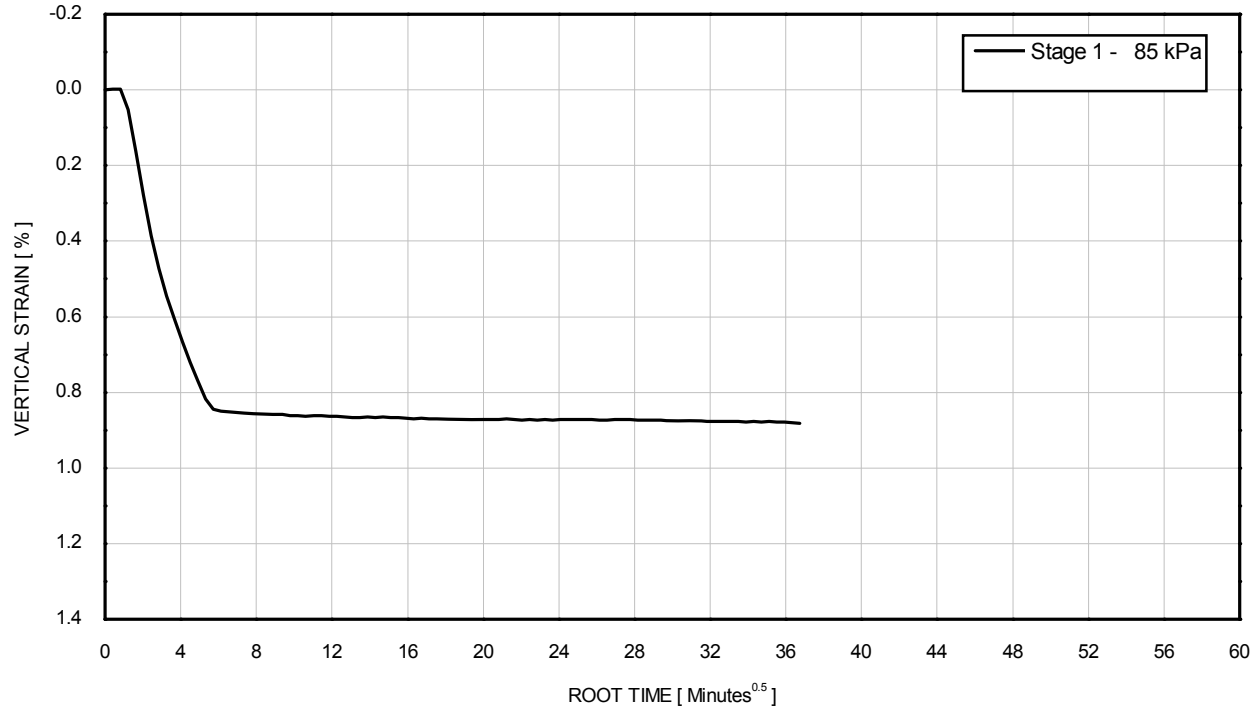
TEST IDENTIFICATION	
Batch	4
Sample	DSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	DSS02

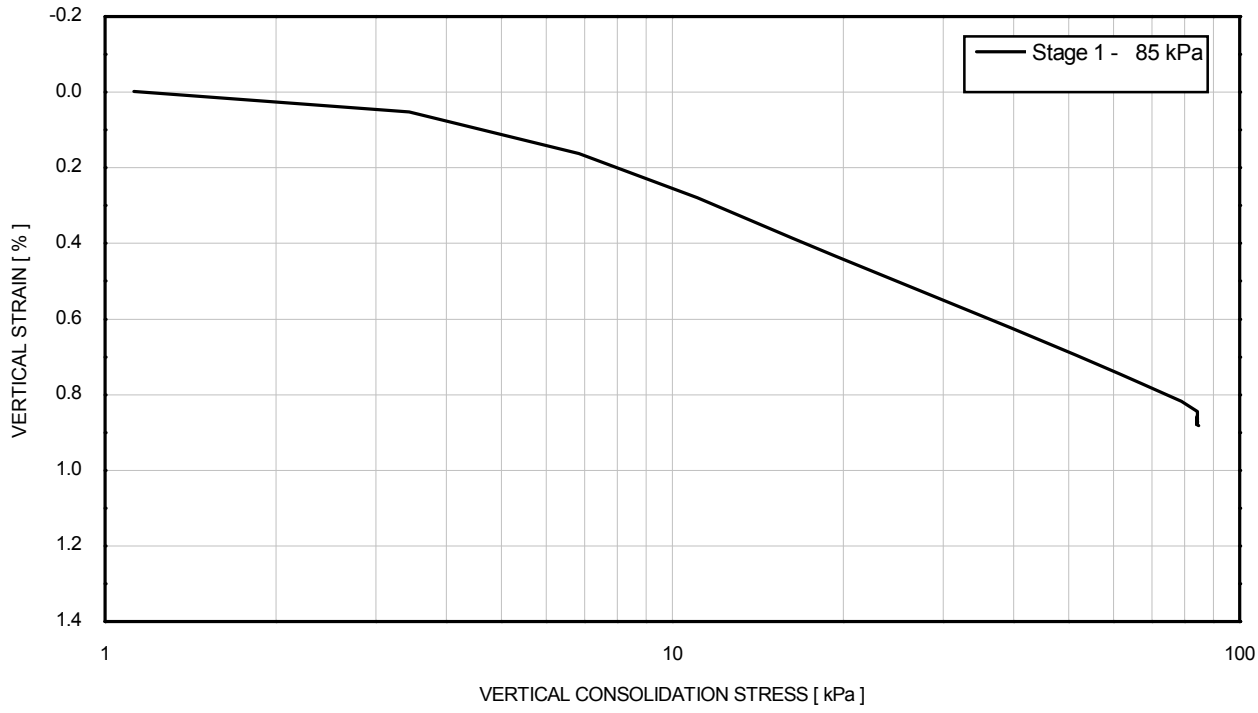
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS



σ'_{rc}	: 1 kPa	Batch	: 4
	Source signal	Sample	: DSS_4-1
	Received signal	Unit	: Unit B1 (Kreftenheye)
○ / ○	Selected peak values	Test No.	: DSS02

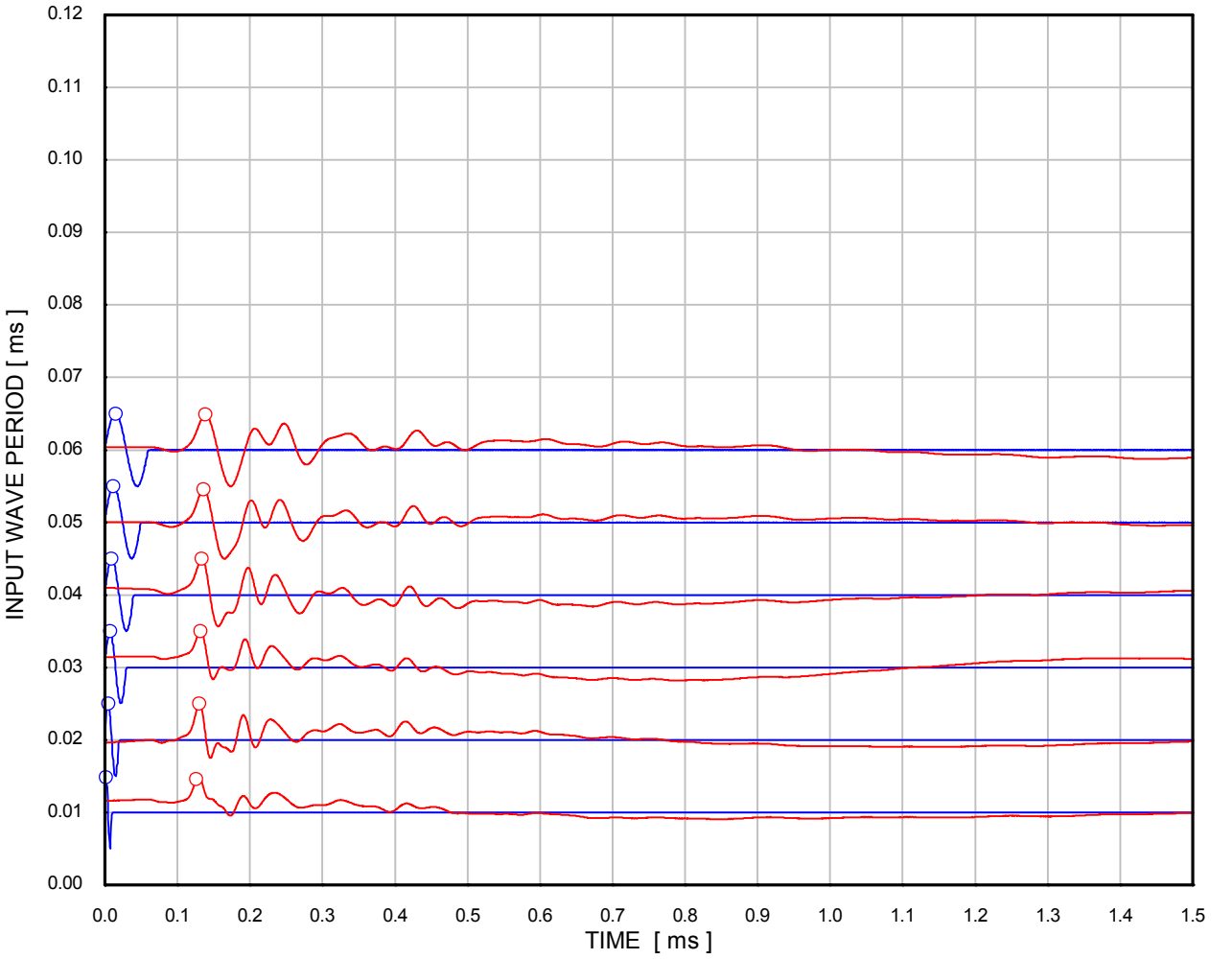
CONSOLIDATED DSS TEST
POST-SETUP S_{VH} BENDER ELEMENT DETERMINATIONS

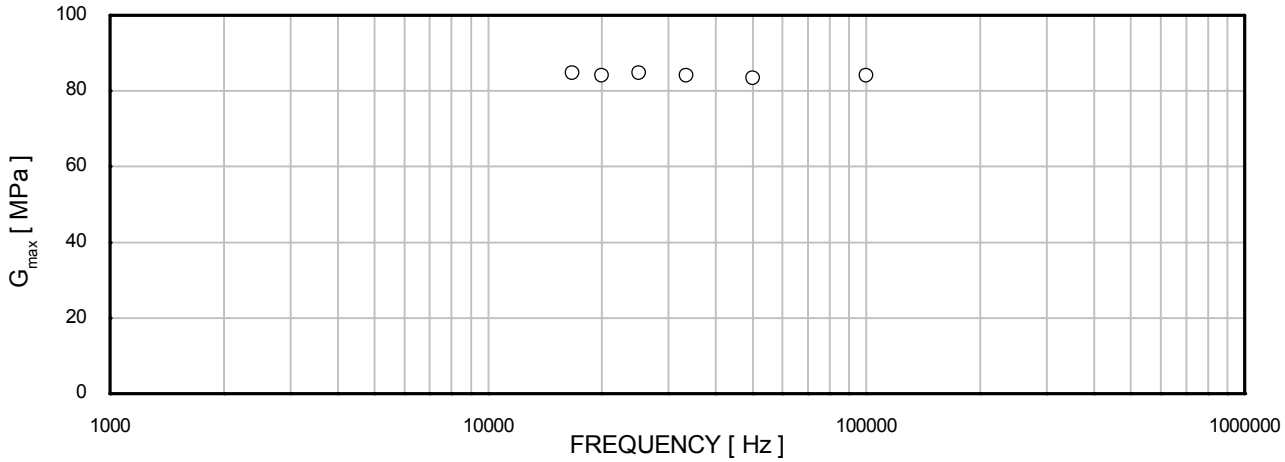




σ_{vc}	: 85 kPa	Batch	: 4
		Sample	: DSS_4-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: DSS02

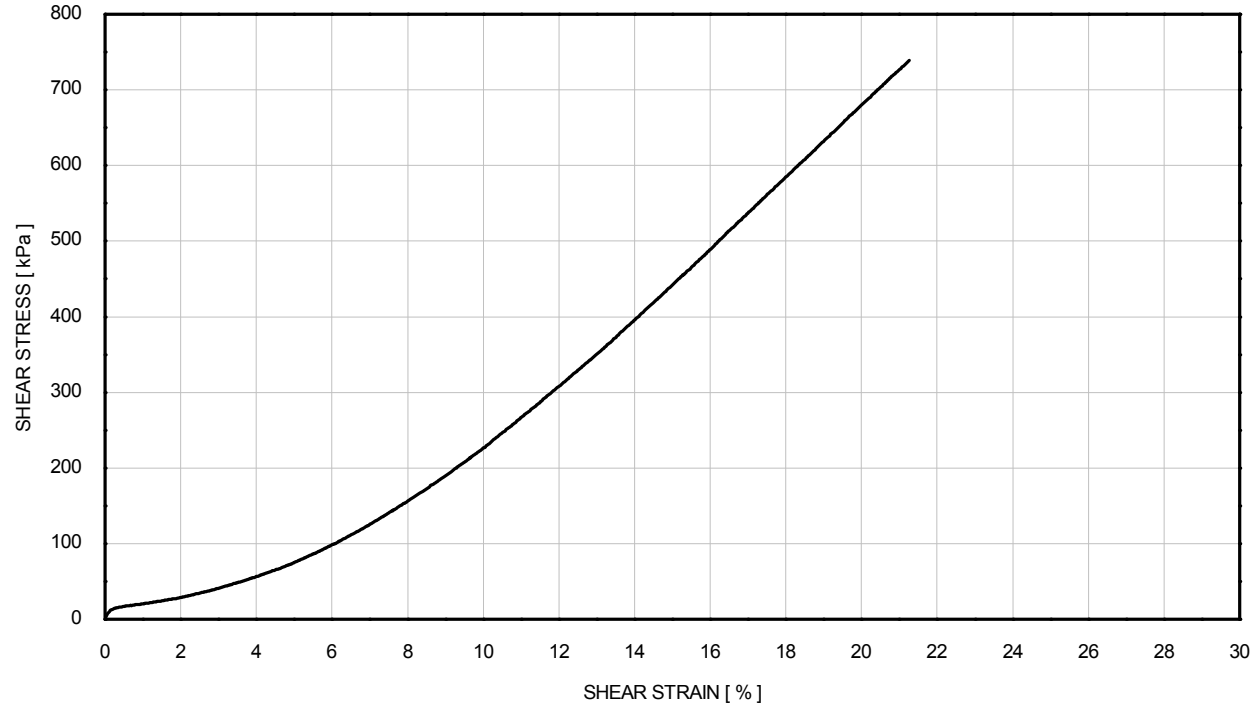
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE

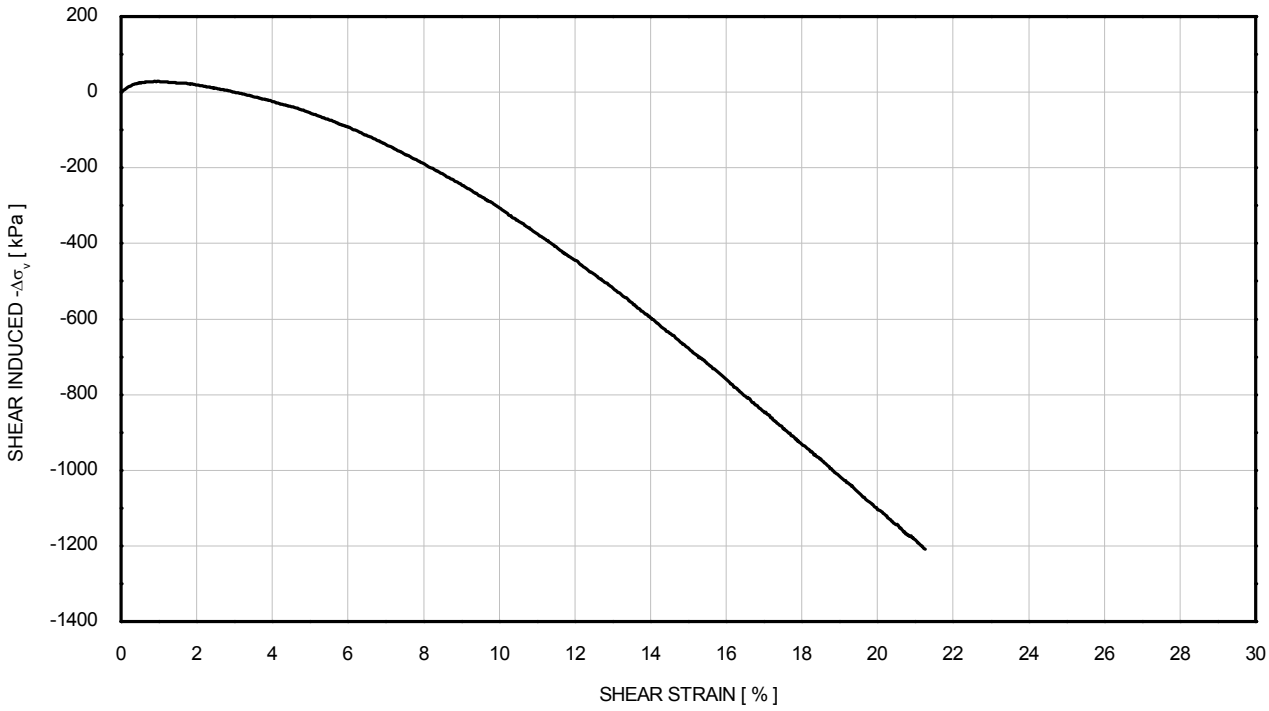




σ'_{rc}	: 85 kPa	Batch	: 4
	Source signal	Sample	: DSS_4-1
	Received signal	Unit	: Unit B1 (Kreftenheye)
○ / ○	Selected peak values	Test No.	: DSS02

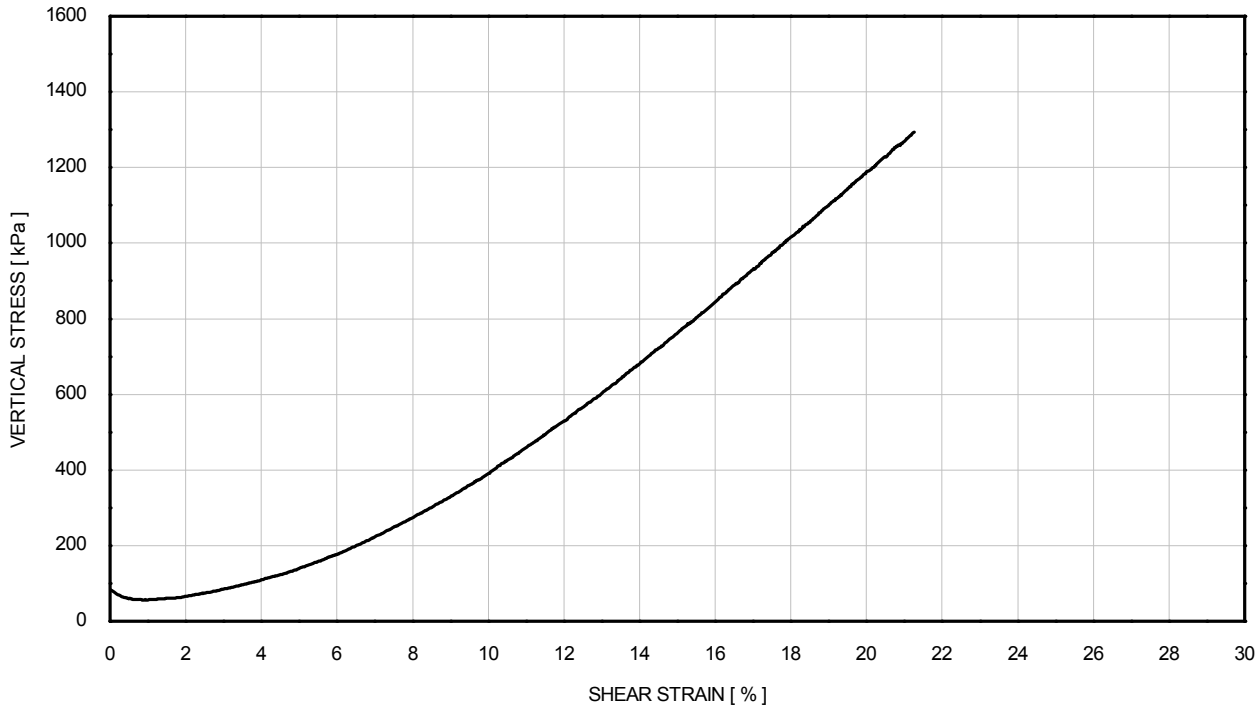
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

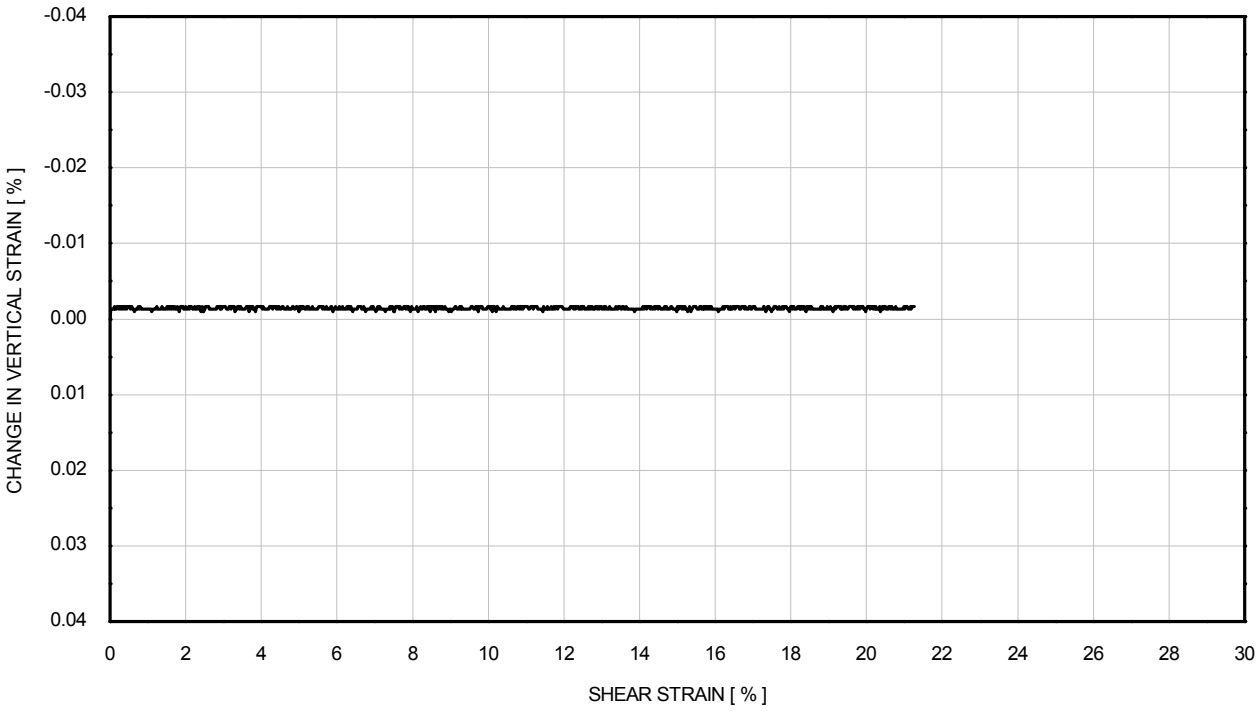




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 739 kPa	Sample	: DSS_4-1
γ at τ_{peak}	: 21.26 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.97 %/hour	Test No.	: DSS02

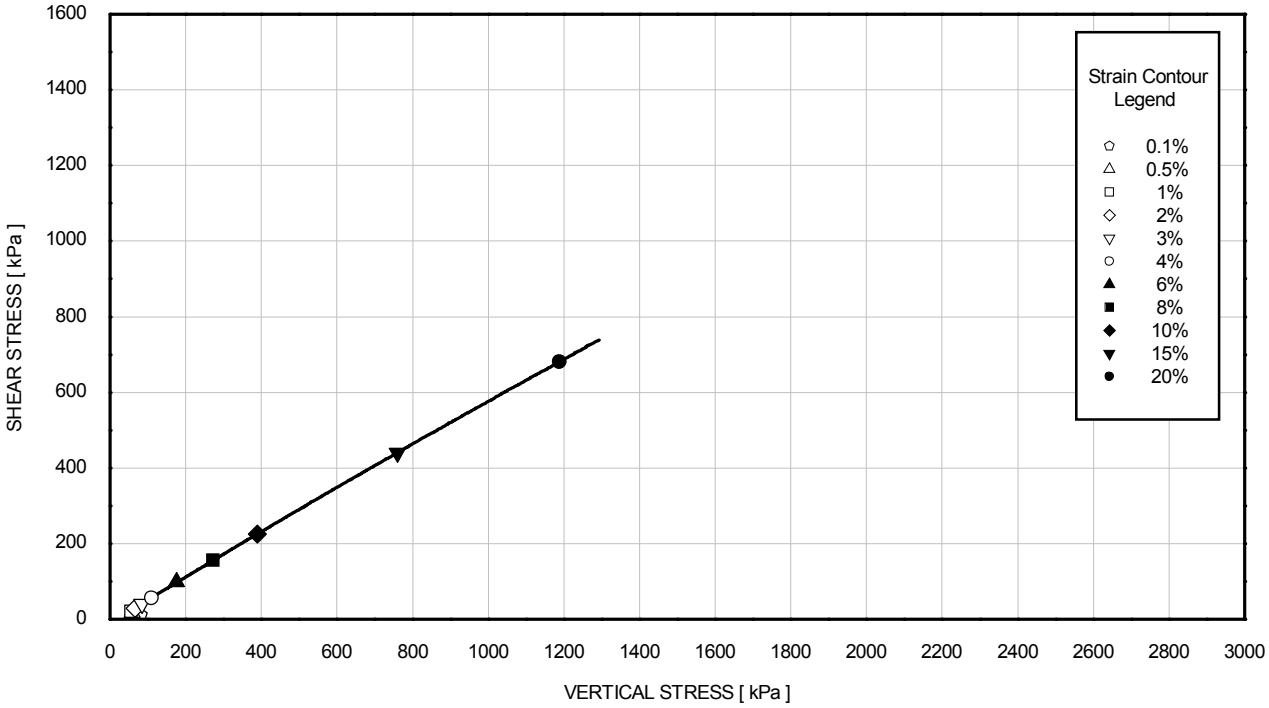
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

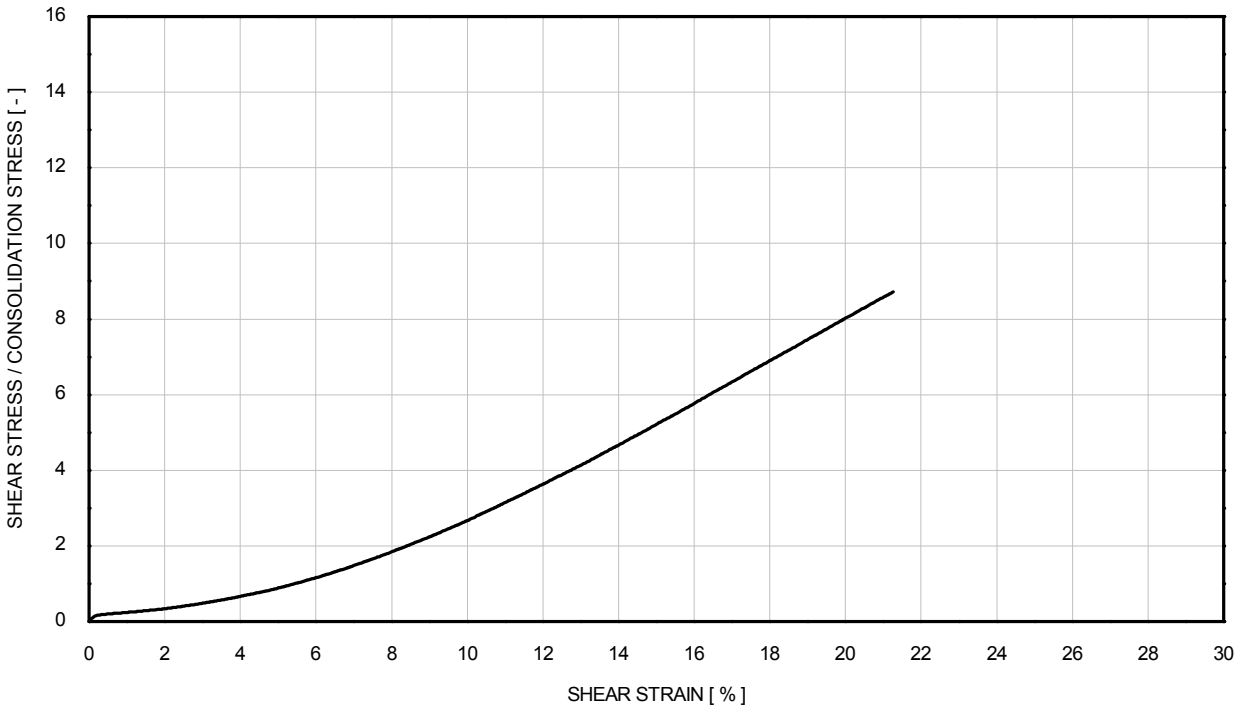




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 739 kPa	Sample	: DSS_4-1
γ at τ_{peak}	: 21.26 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.97 %/hour	Test No.	: DSS02

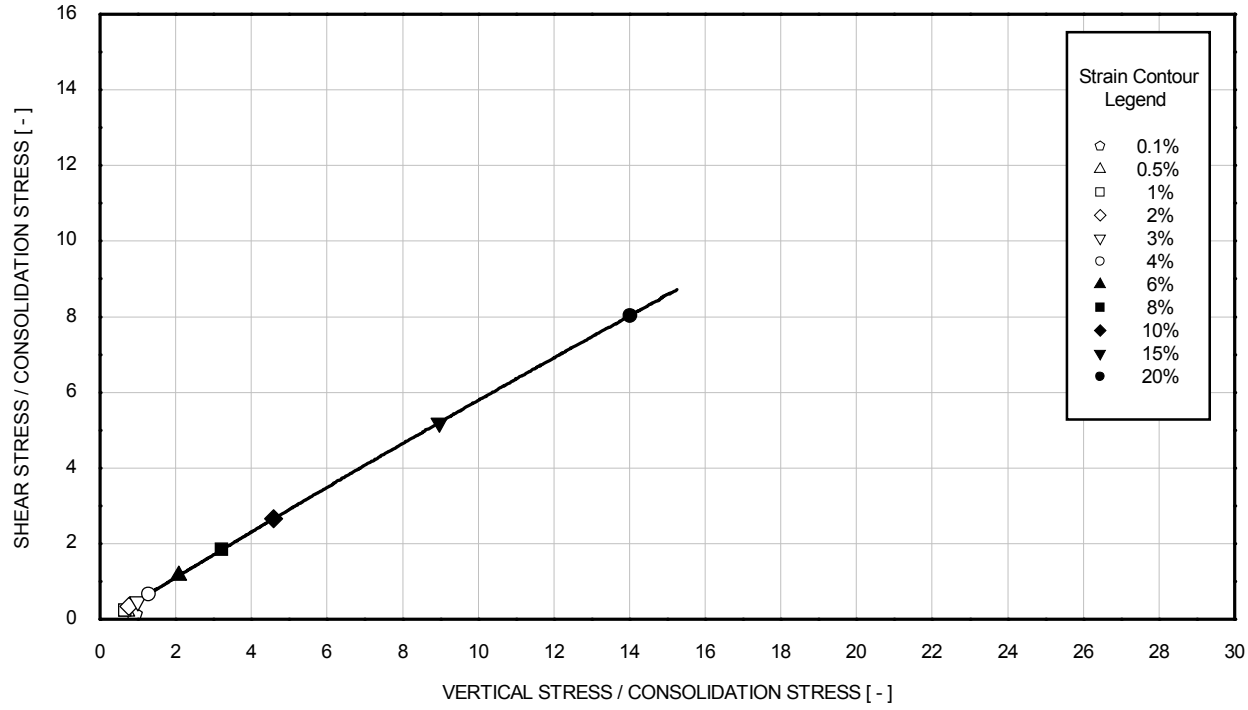
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

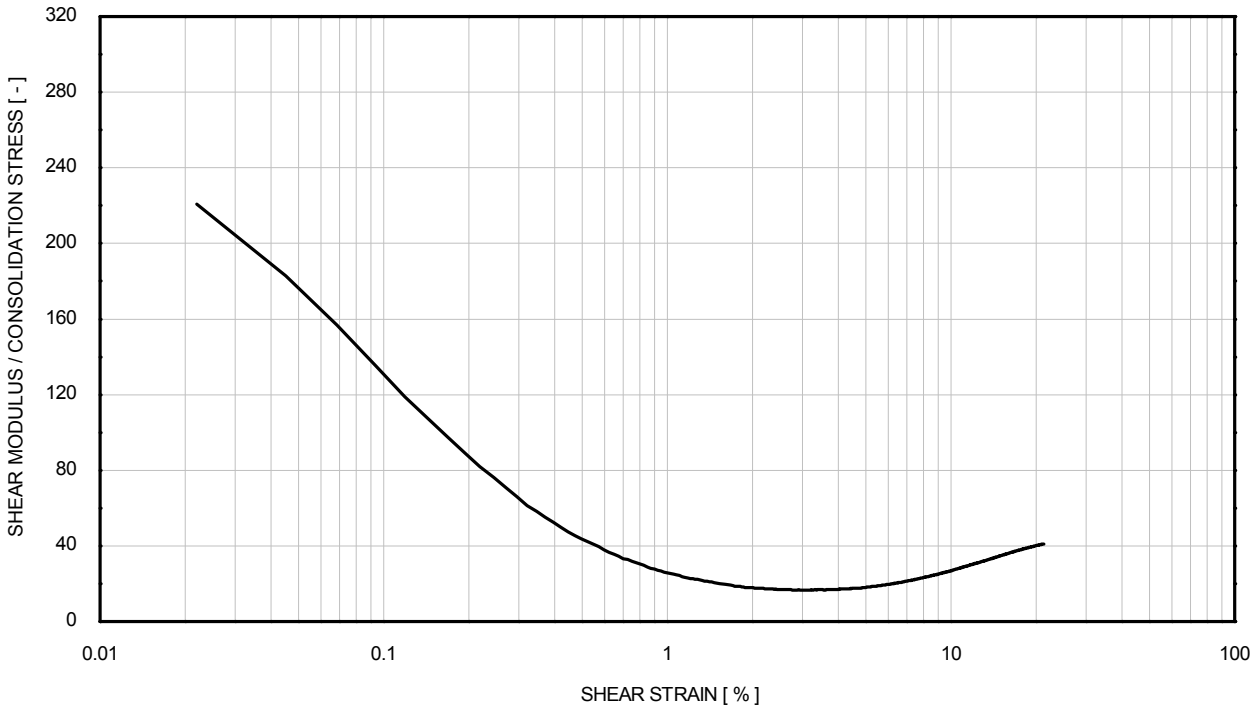




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 739 kPa	Sample	: DSS_4-1
γ at τ_{peak}	: 21.26 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.97 %/hour	Test No.	: DSS02

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	85 kPa	Batch	:	4
τ_{peak}	:	739 kPa	Sample	:	DSS_4-1
γ at τ_{peak}	:	21.26 %	Unit	:	Unit B1 (Kreftenheye)
Rate of strain	:	2.97 %/hour	Test No.	:	DSS02

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Light olive brown slightly silty fine SAND

GENERAL	
Date test started	11/02/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	8.6
Bulk density after compaction	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.656
Degree of saturation after compaction	[%]	35
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	24.7
Bulk density at start of test	[Mg/m³]	2.00
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 7_DSS07
Template issue	1.4
Processed by	JLS
Date	04/11/2016
Checked by	PH
Date	18/11/2016
Approved by	PH
Date	18/11/2016

TEST IDENTIFICATION	
Batch	7
Sample	DSS_7-1
Unit	Unit D (Yarmouth Roads)
Test number	DSS07

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-SETUP		
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.60
Void ratio	[-]	0.656
Distance	[mm]	25.50
Vertical stress	[kPa]	1

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.02	0.3410	17.05	74.78	11.17
0.03	0.3365	11.22	75.78	11.47
0.04	0.3380	8.45	75.44	11.36
0.05	0.3390	6.78	75.22	11.30
0.06	0.3405	5.68	74.89	11.20
0.07	0.3430	4.90	74.34	11.04

CONSOLIDATION		
σ_{vc}	[kPa]	420
Vertical strain	[%]	1.31
Bulk density	[Mg/m^3]	2.01
Dry density	[Mg/m^3]	1.62
Void ratio	[-]	0.634
Water content	[%]	23.9

TEST IDENTIFICATION	
Batch	7
Sample	DSS_7-1
Unit	Unit D (Yarmouth Roads)
Test number	DSS07

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

S_{VH} BENDER ELEMENT DETERMINATIONS - POST-CONSOLIDATION		
Bulk density	[Mg/m^3]	2.01
Dry density	[Mg/m^3]	1.62
Void ratio	[-]	0.634
Distance	[mm]	25.11
Vertical stress	[kPa]	420

Input Wave Period [ms]	Peak-to-Peak Arrival Time [ms]	Wavelength Ratio [-]	Velocity [m/s]	G_{max} [MPa]
0.02	0.1000	5.00	251.06	126.69
0.03	0.1015	3.38	247.35	122.97
0.04	0.1075	2.69	233.55	109.63
0.05	0.1095	2.19	229.28	105.66

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	702
Shear strain	[%]	29.67
Shear induced -$\Delta\sigma_v$	[kPa]	-842
Vertical stress	[kPa]	1261
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.97
At 15 % shear strain		
Shear stress	[kPa]	421
Shear induced -$\Delta\sigma_v$	[kPa]	-353
Vertical stress	[kPa]	773
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	7
Sample	DSS_7-1
Unit	Unit D (Yarmouth Roads)
Test number	DSS07

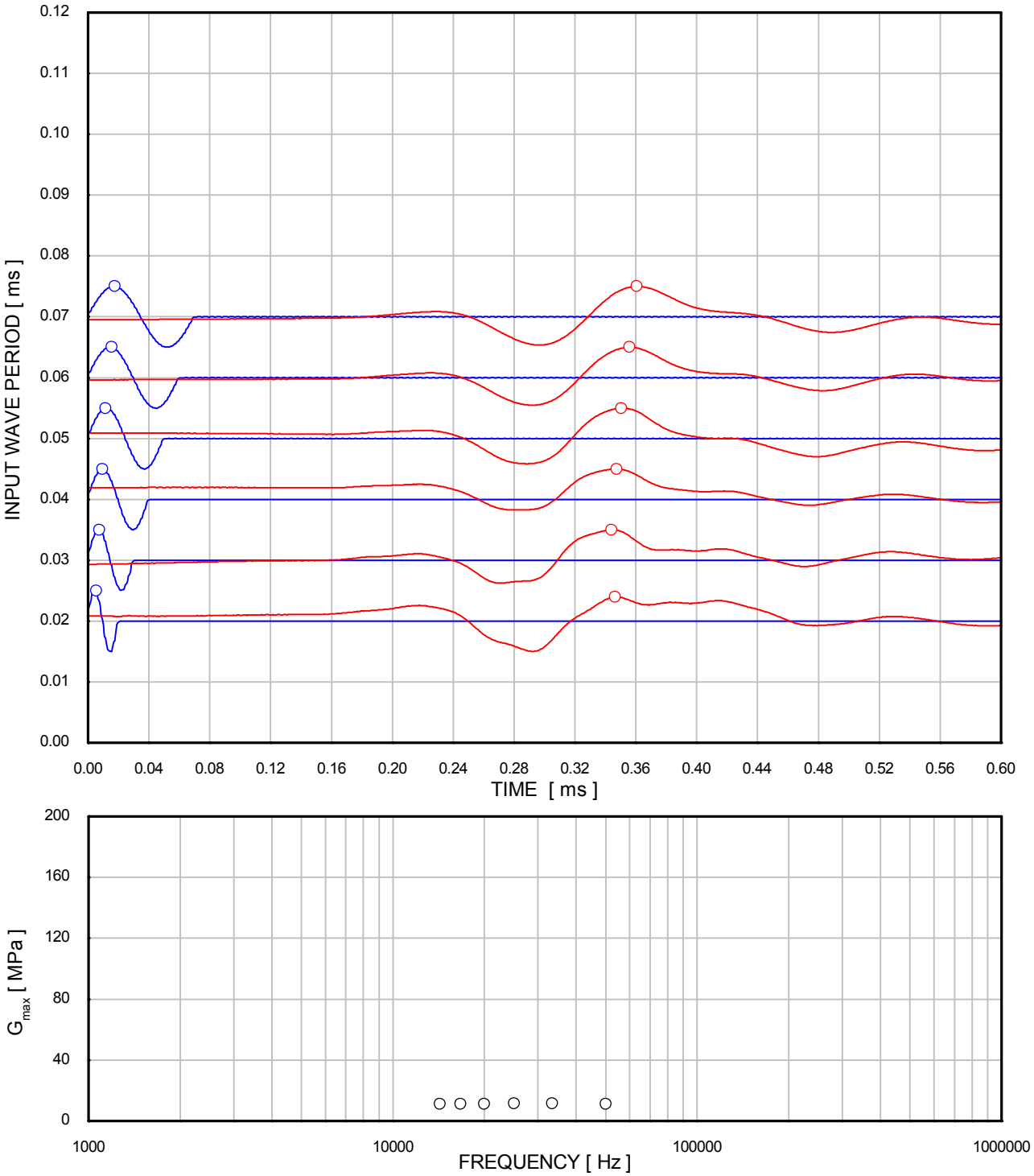
SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS

SPECIMEN PHOTOGRAPH

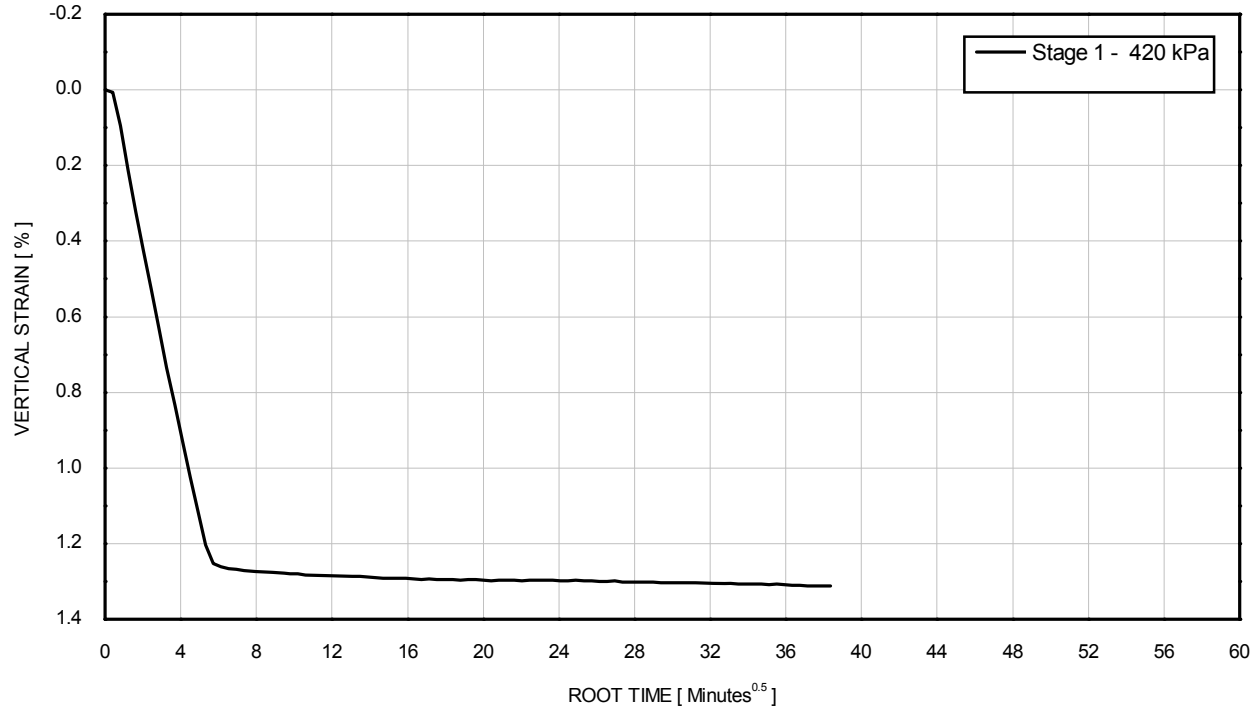


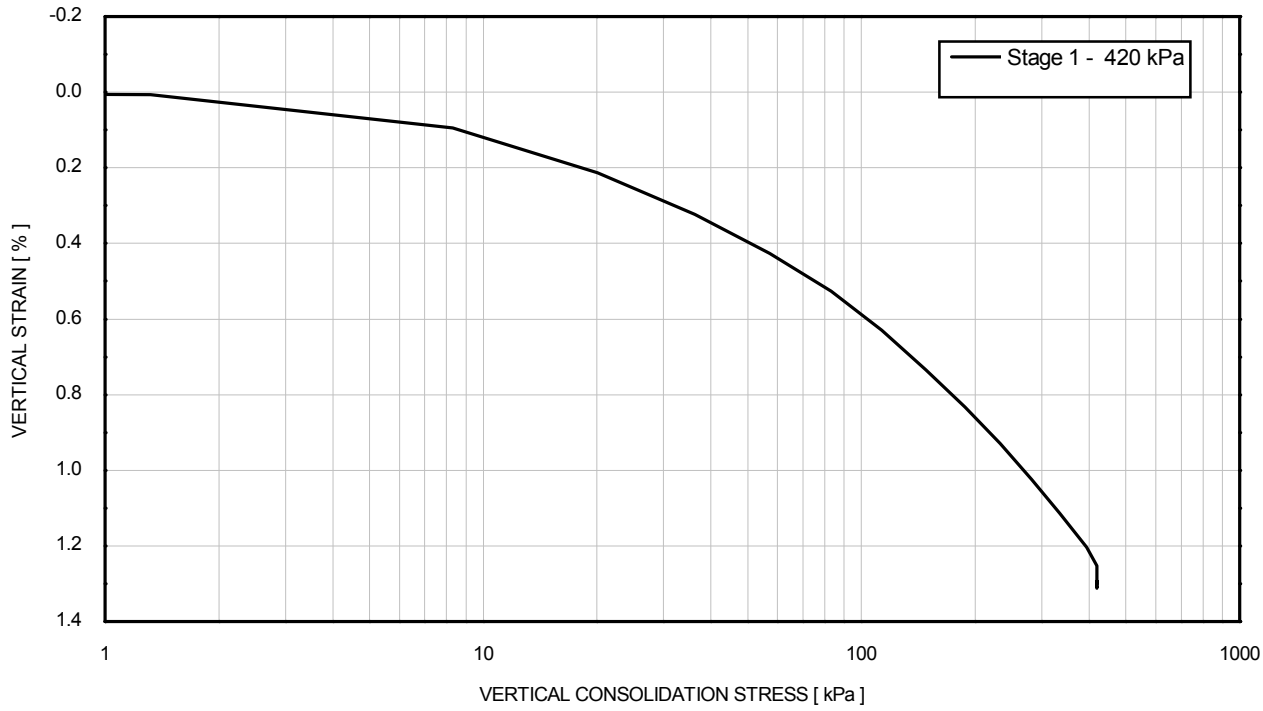
TEST IDENTIFICATION	
Batch	7
Sample	DSS_7-1
Unit	Unit D (Yarmouth Roads)
Test number	DSS07

SUMMARY OF CONSOLIDATED DSS TEST WITH BENDER ELEMENT DETERMINATIONS



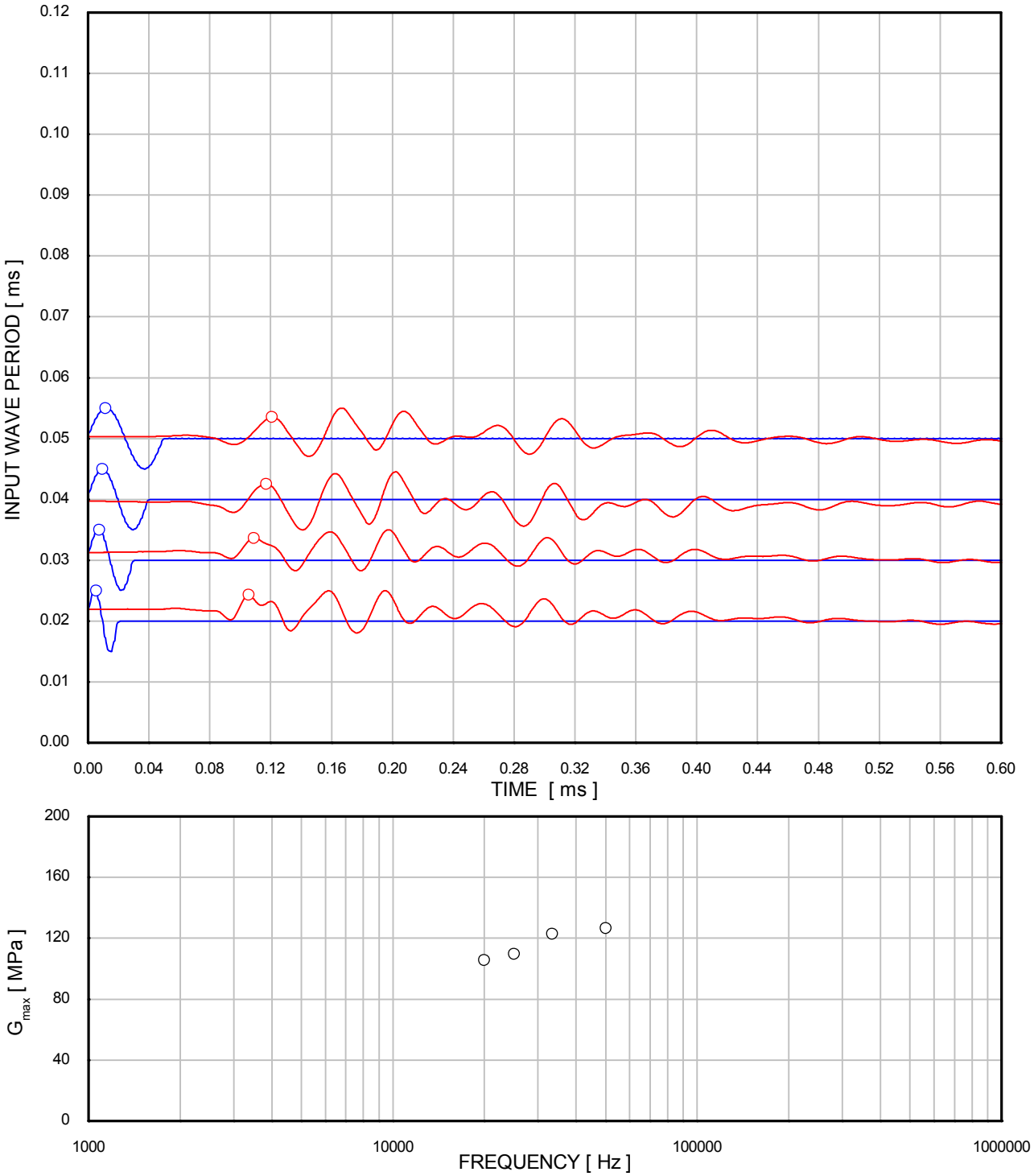
CONSOLIDATED DSS TEST
POST-SETUP S_{VH} BENDER ELEMENT DETERMINATIONS





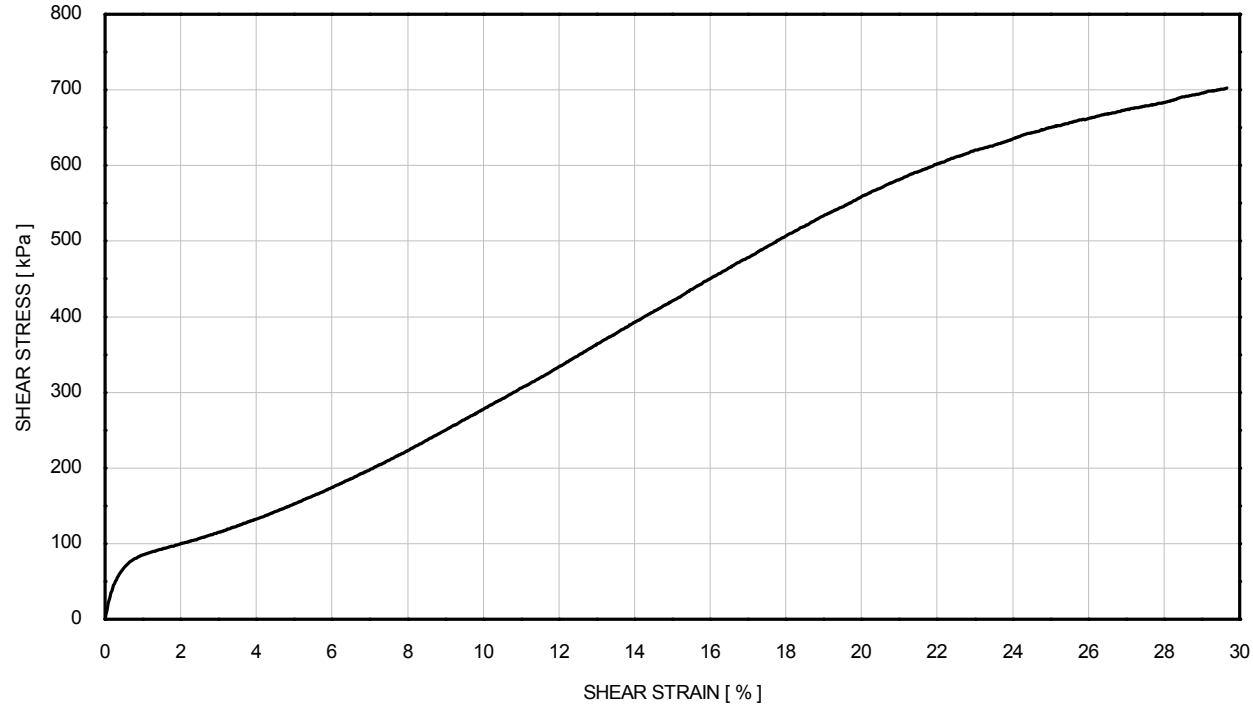
σ_{vc}	: 420 kPa	Batch	: 7
		Sample	: DSS_7-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: DSS07

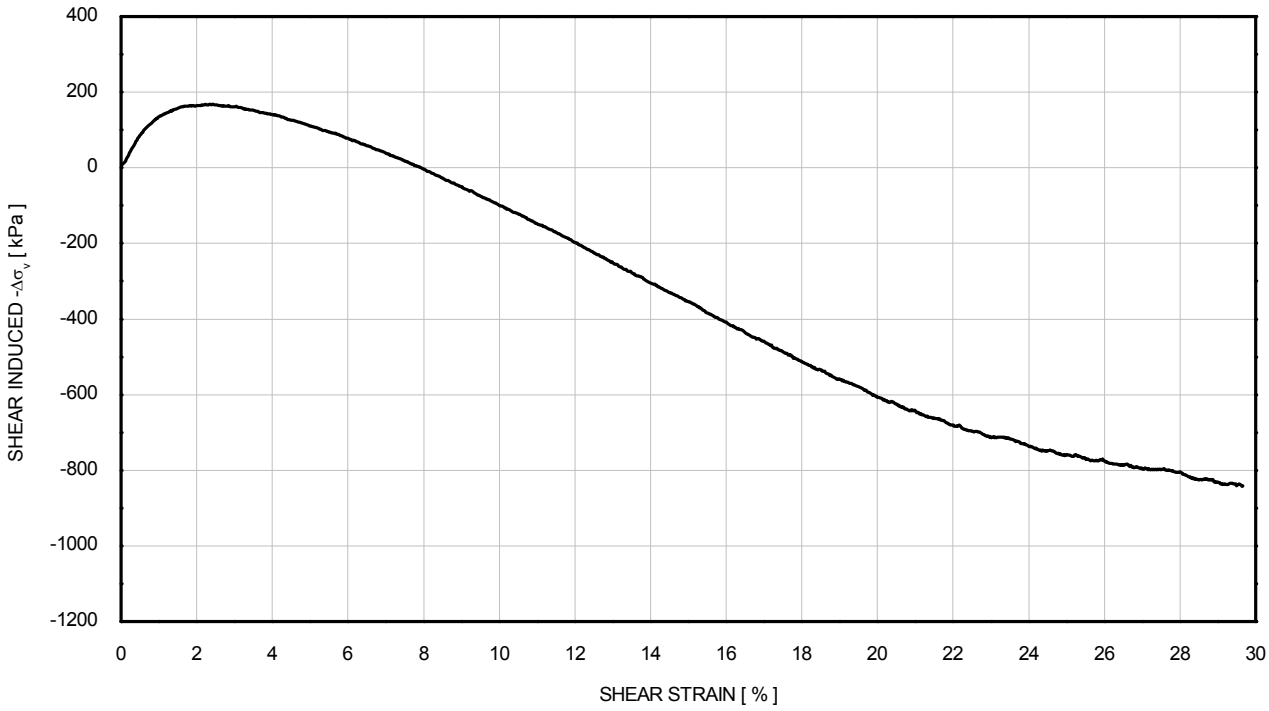
CONSOLIDATED DSS TEST
CONSOLIDATION STAGE



σ'_{rc}	: 420 kPa	Batch	: 7
	Source signal	Sample	: DSS_7-1
	Received signal	Unit	: Unit D (Yarmouth Roads)
○ / ○	Selected peak values	Test No.	: DSS07

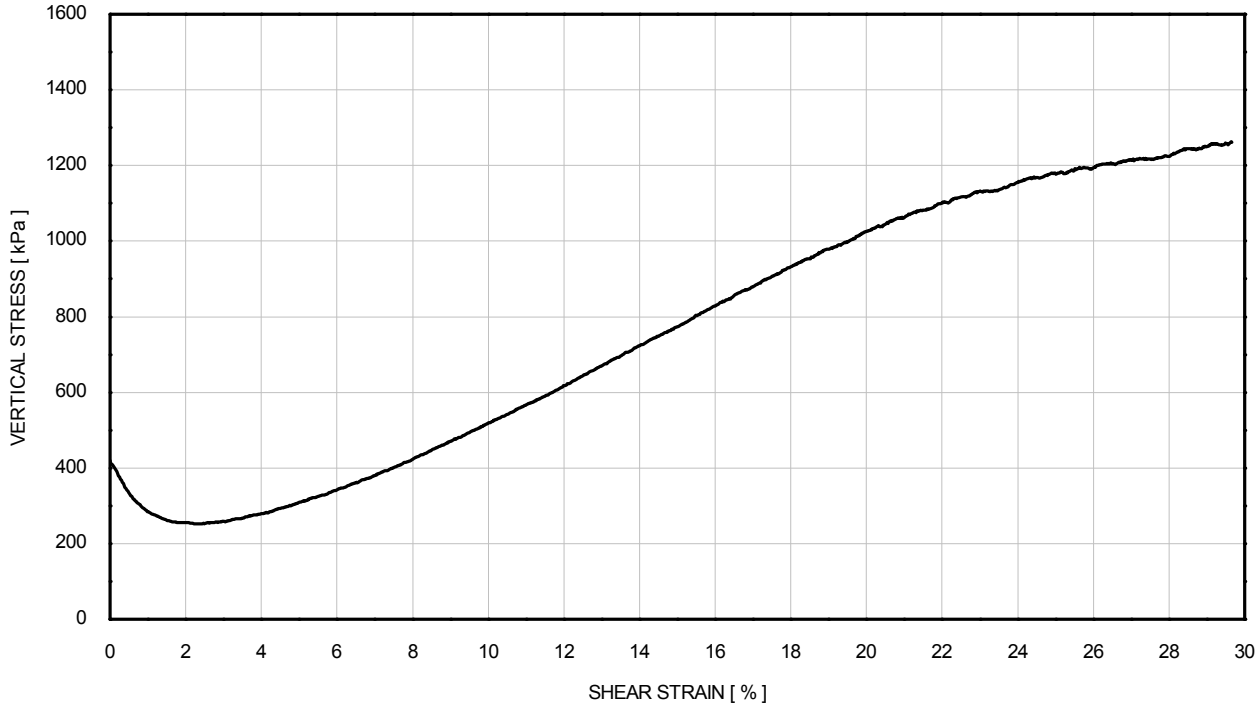
CONSOLIDATED DSS TEST
POST-CONSOLIDATION S_{VH} BENDER ELEMENT DETERMINATIONS

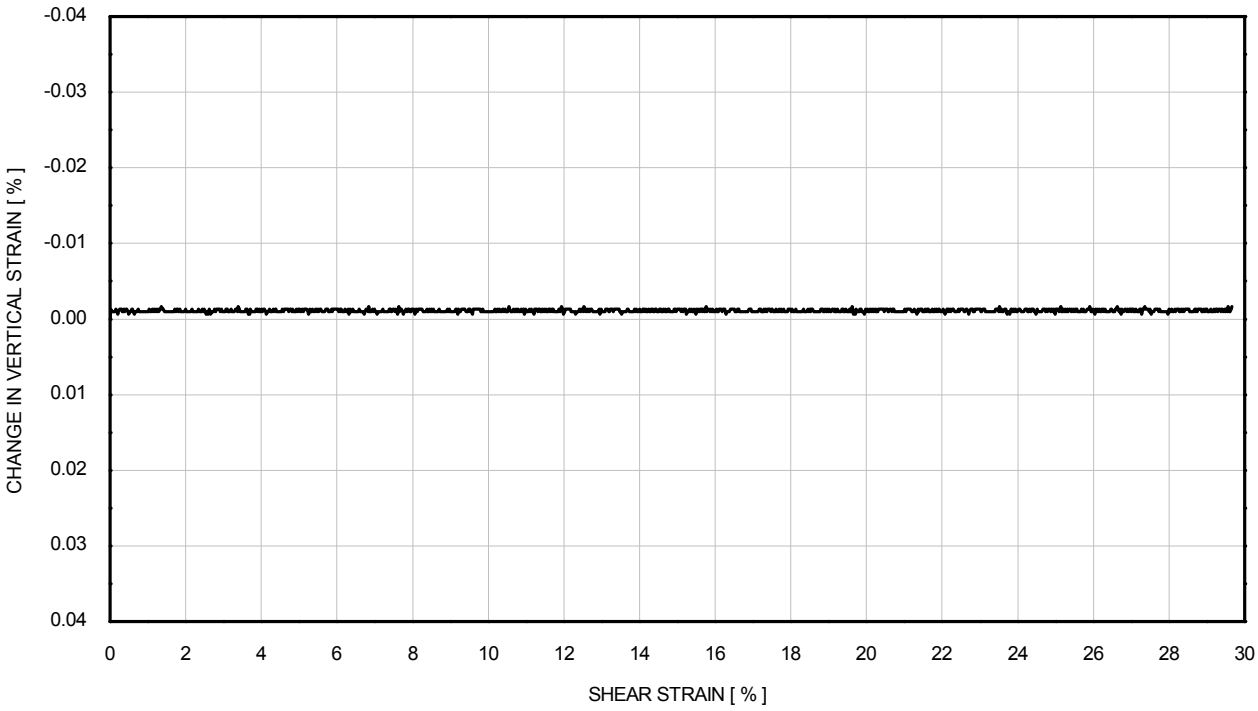




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 702 kPa	Sample	: DSS_7-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.97 %/hour	Test No.	: DSS07

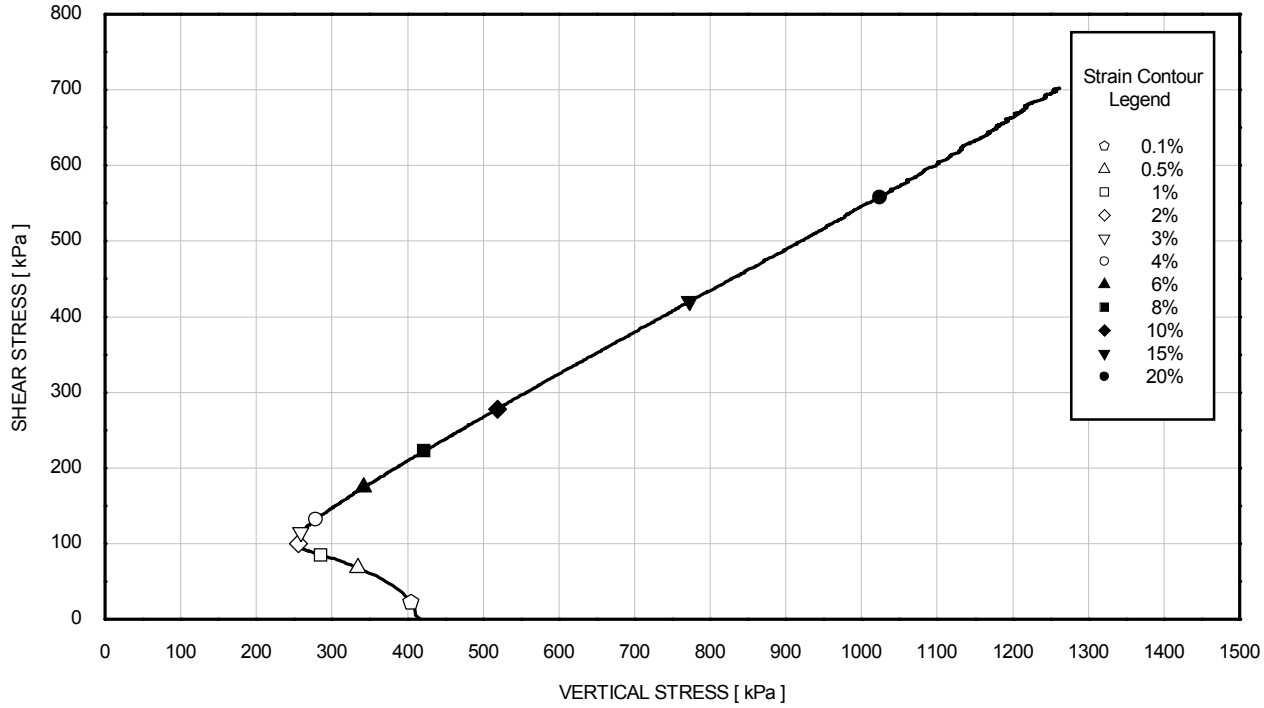
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

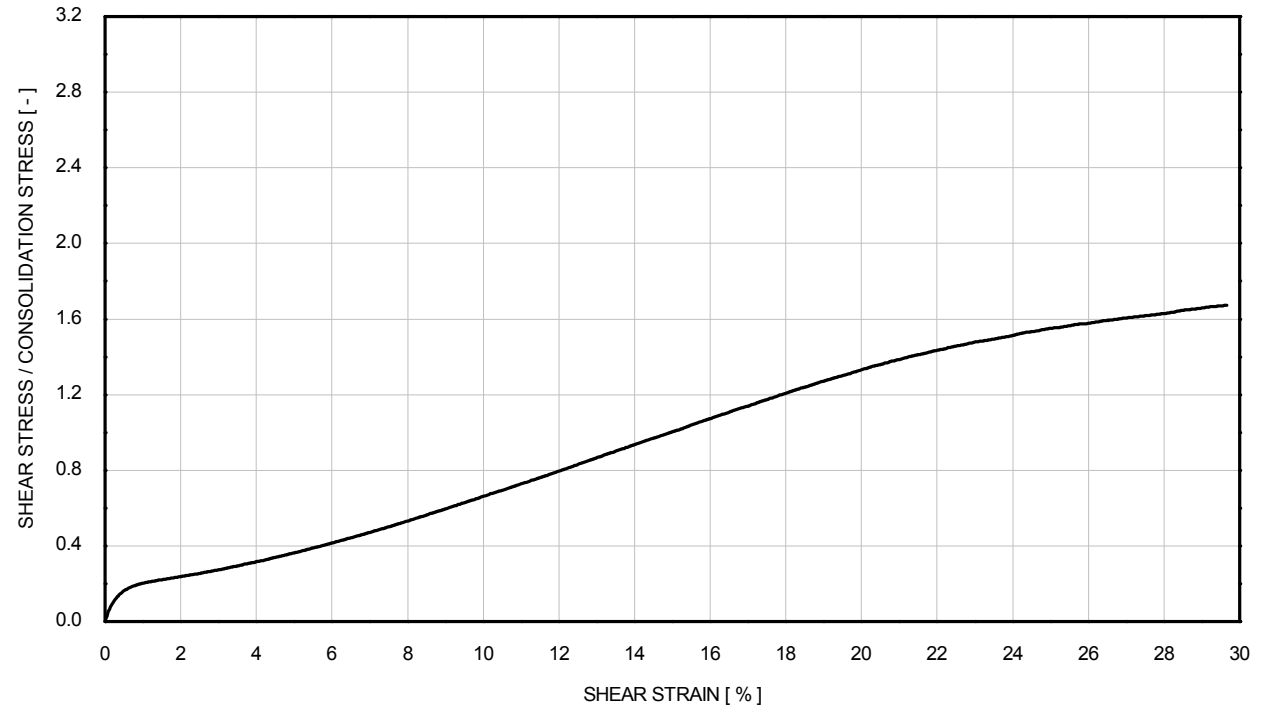




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 702 kPa	Sample	: DSS_7-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.97 %/hour	Test No.	: DSS07

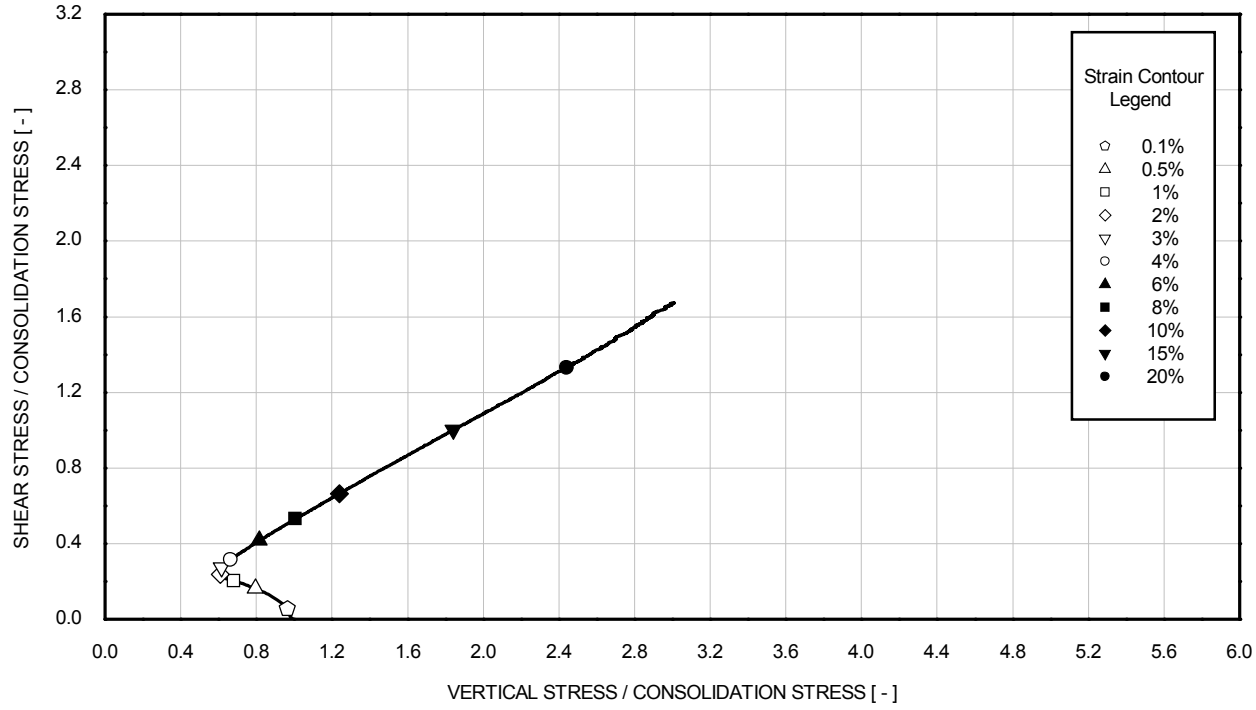
CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

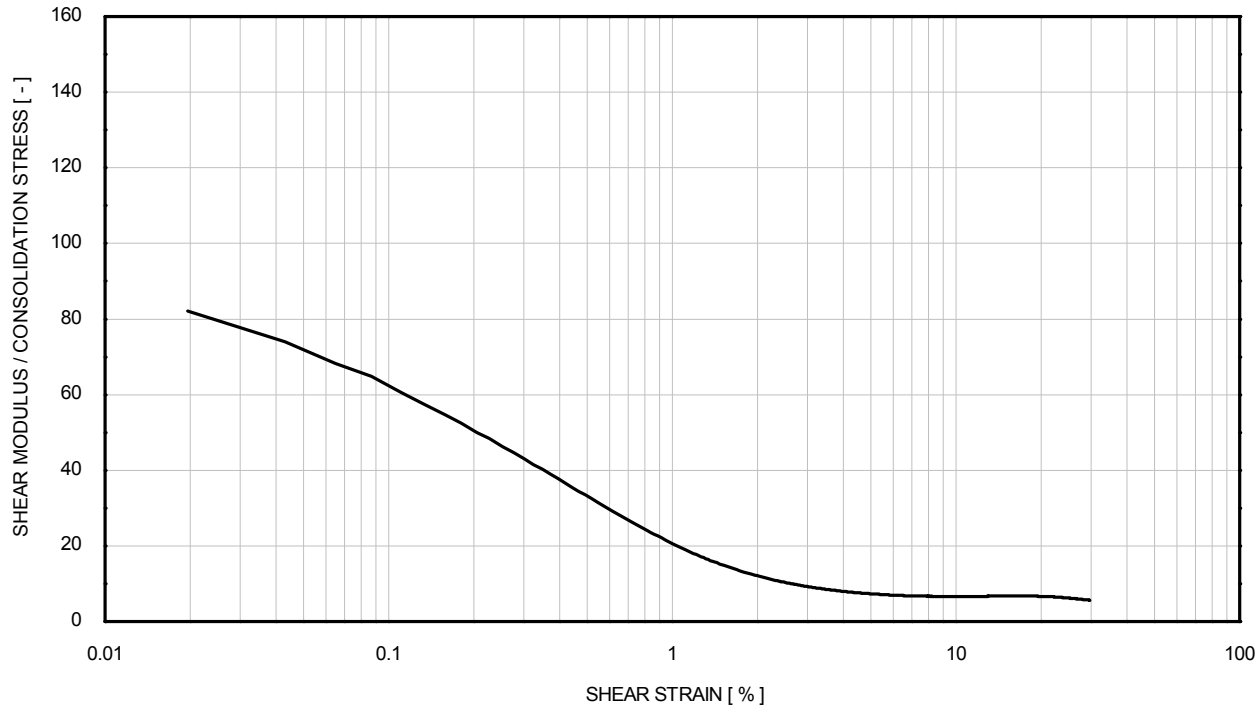




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 702 kPa	Sample	: DSS_7-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.97 %/hour	Test No.	: DSS07

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 702 kPa	Sample	: DSS_7-1
γ at τ_{peak}	: 29.67 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.97 %/hour	Test No.	: DSS07

CONSOLIDATED DSS TEST
SHEARING STAGE - CONSTANT VOLUME

SECTION A4: TRIAXIAL TESTS

LIST OF PLATES IN SECTION A4:

	Plate
Isotropically Consolidated Undrained Triaxial Test – Cohesive Specimens	A4.1-1 to A4.1-27
Anisotropically Consolidated Undrained Triaxial Test – Cohesive Specimens	A4.2-1 to A4.2-9
Isotropically Consolidated Undrained Triaxial Test – Cohesionless Specimens	A4.3-1 to A4.3-18
Anisotropically Consolidated Undrained Triaxial Test – Cohesionless Specimens	A4.4-1 to A4.4-20
Isotropically Consolidated Drained Triaxial Test – Cohesionless Specimens	A4.5-1 to A4.5-18

VISUAL DESCRIPTION
Dark grey silty CLAY with laminae of fine sand

GENERAL	
Date test started	04/11/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	69.4
Length	[mm]	138.6
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.95
Dry density	[Mg/m³]	1.49
Void ratio	[-]	0.807
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_17WAXB_CIU03
Processed by	MSR
Date	21/11/2016
Checked by	AR
Date	06/12/2016
Approved by	PH
Date	07/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	CIU03

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	780
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	925
Back pressure	[kPa]	780
Base PWP	[kPa]	780
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	145
Effective axial pressure	[kPa]	145
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.19
External axial strain	[%]	0.09
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.804
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	CIU03

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	145
Initial effective axial pressure	[kPa]	145
Rate of strain	[%/hour]	0.30
At peak deviator stress		
Corrected deviator stress	[kPa]	236
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	19.92
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	40
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	105
Effective axial pressure	[kPa]	341
Principal effective stress ratio	[-]	3.25
ε_{50}	[%]	0.51
Secant modulus (E_{50}) at ε_{50}	[kPa]	23042
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	173
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.82
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	83
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	63
Effective axial pressure	[kPa]	235
Principal effective stress ratio	[-]	3.77
At 15% external axial strain		
Corrected deviator stress	[kPa]	232
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	48
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	98
Effective axial pressure	[kPa]	329
Principal effective stress ratio	[-]	3.37

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	CIU03

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





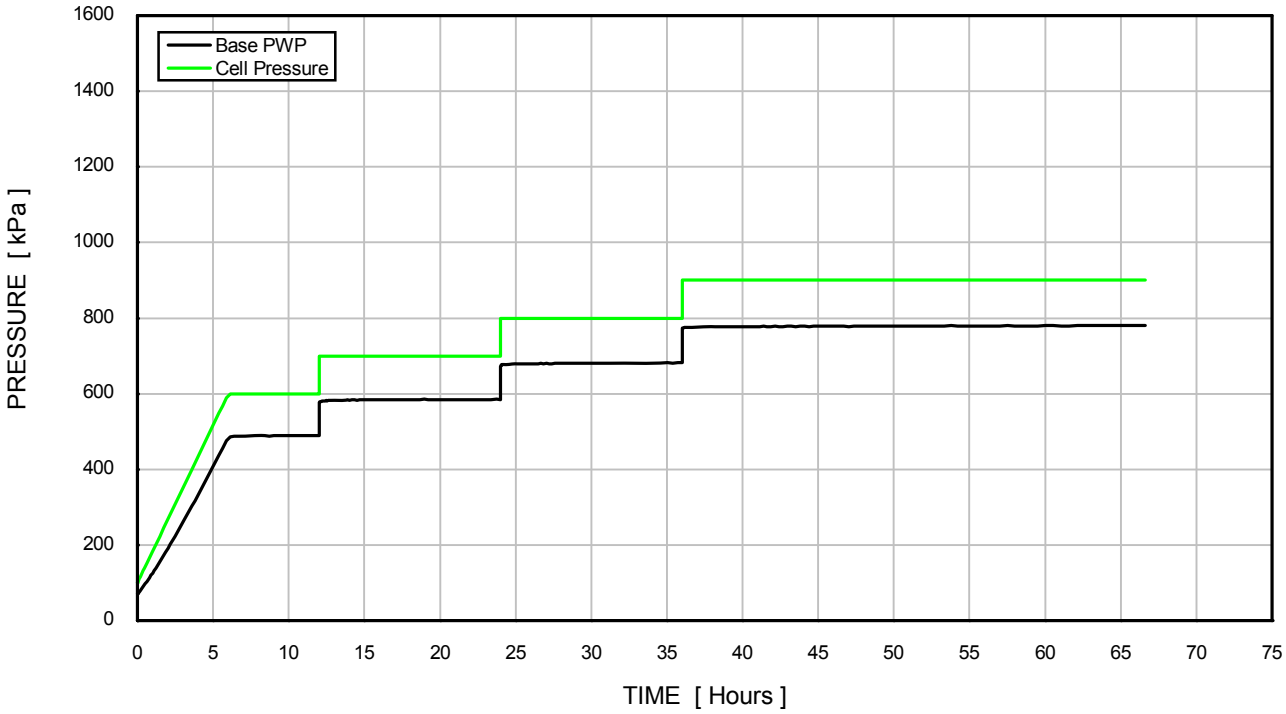
FINAL CONDITIONS

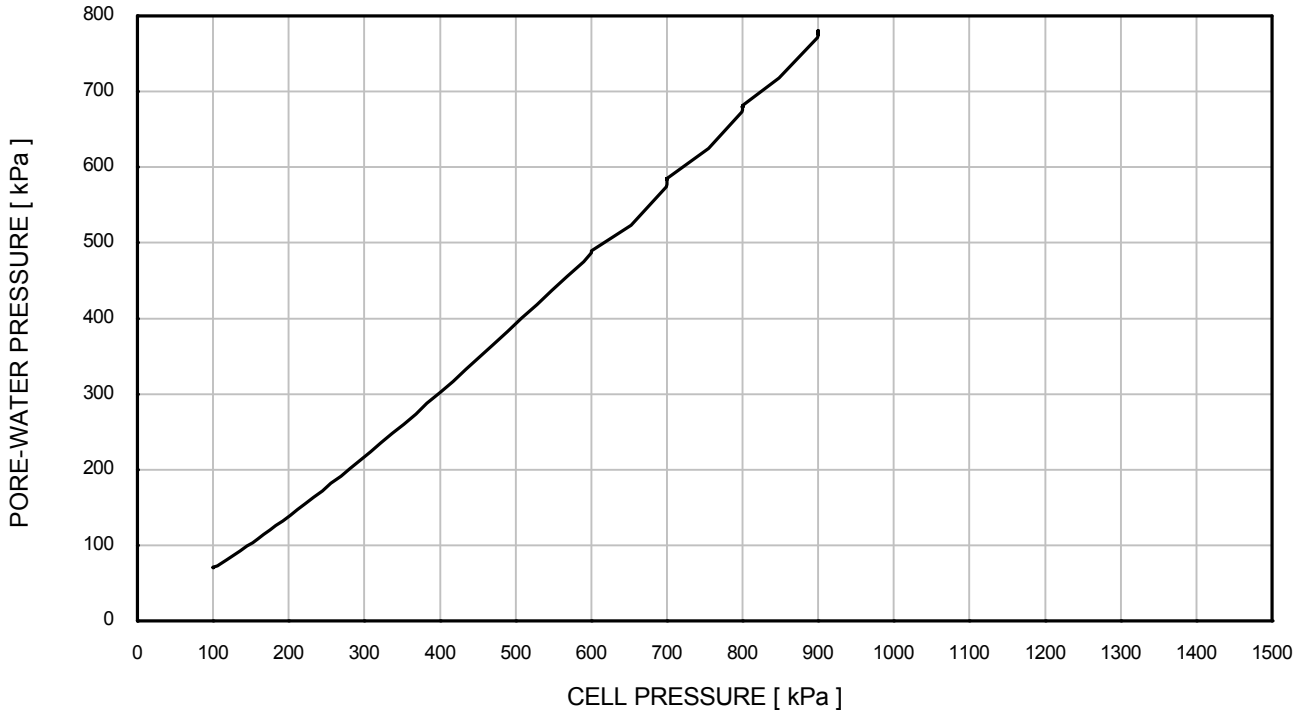
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.50

TEST IDENTIFICATION

Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	CIU03

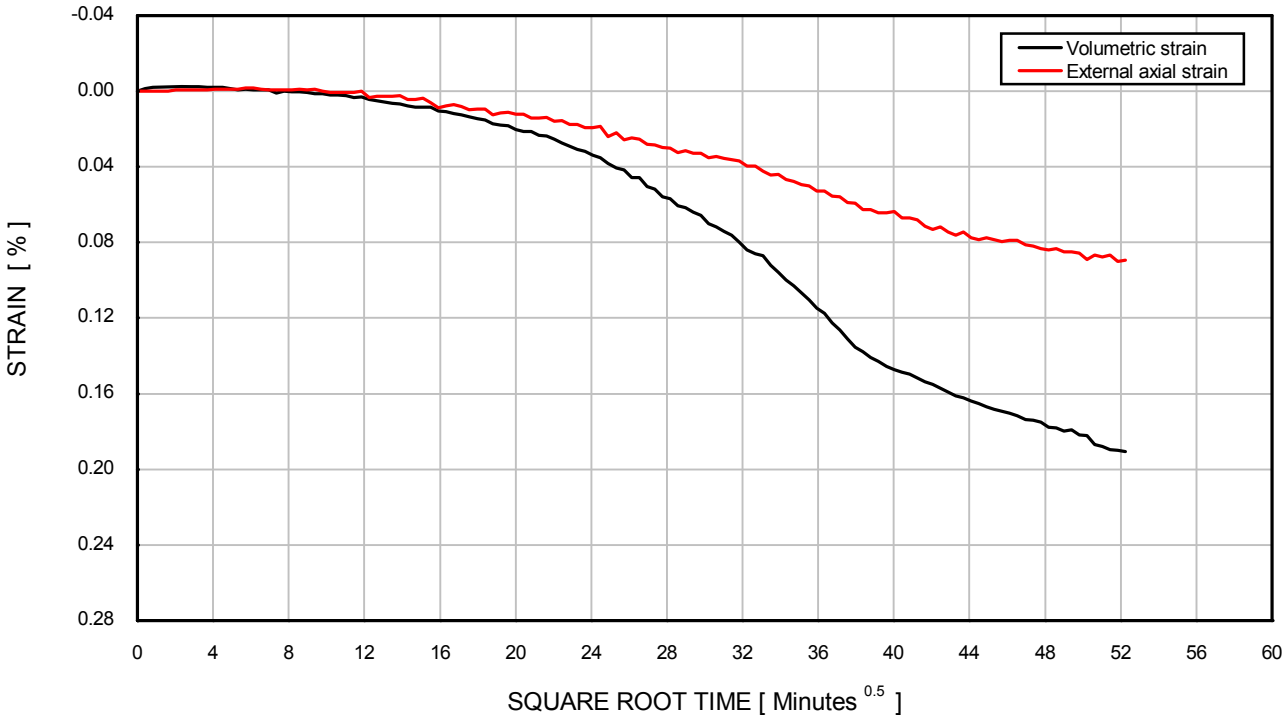
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

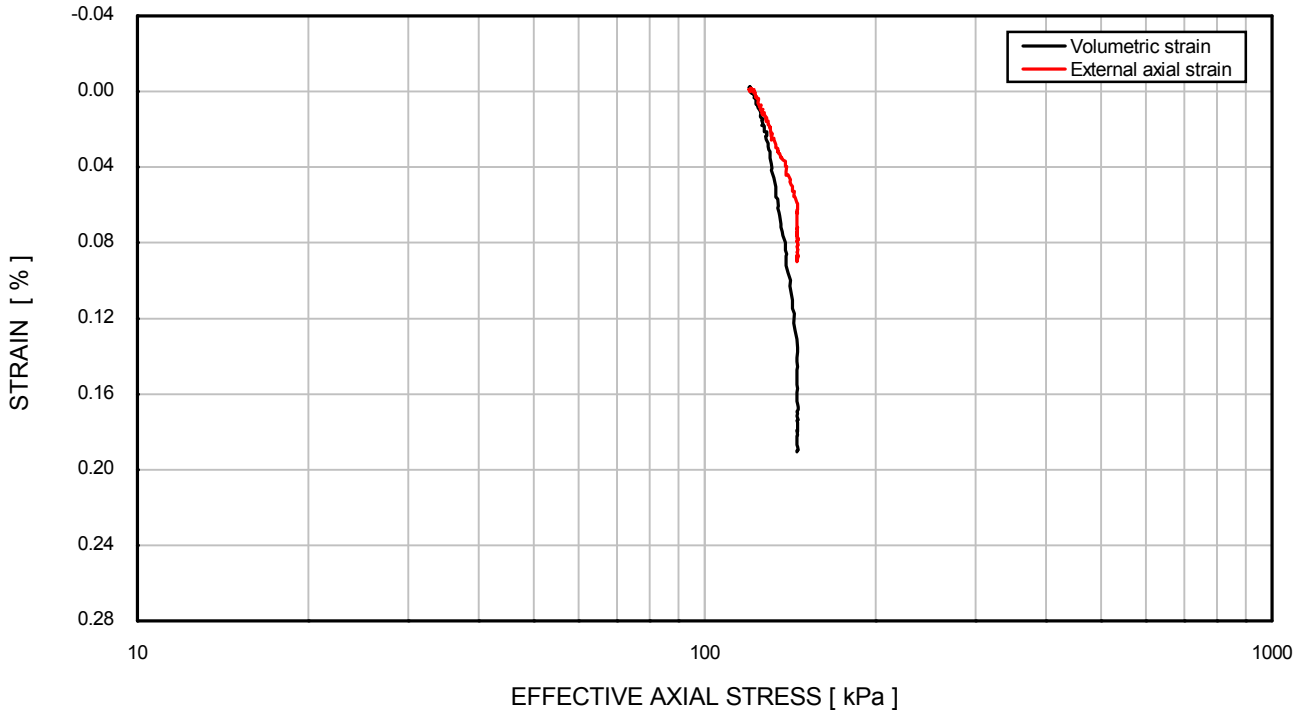




B value	: 0.99	Borehole	: HKZ1-BH01-SA
Initial σ'_r	: 30 kPa	Sample	: 17WaxB
Initial σ'_a	: 30 kPa	Depth [m]	: 14.67
Final σ'_r	: 120 kPa	Test No.	: CIU03
Final σ'_a	: 120 kPa		

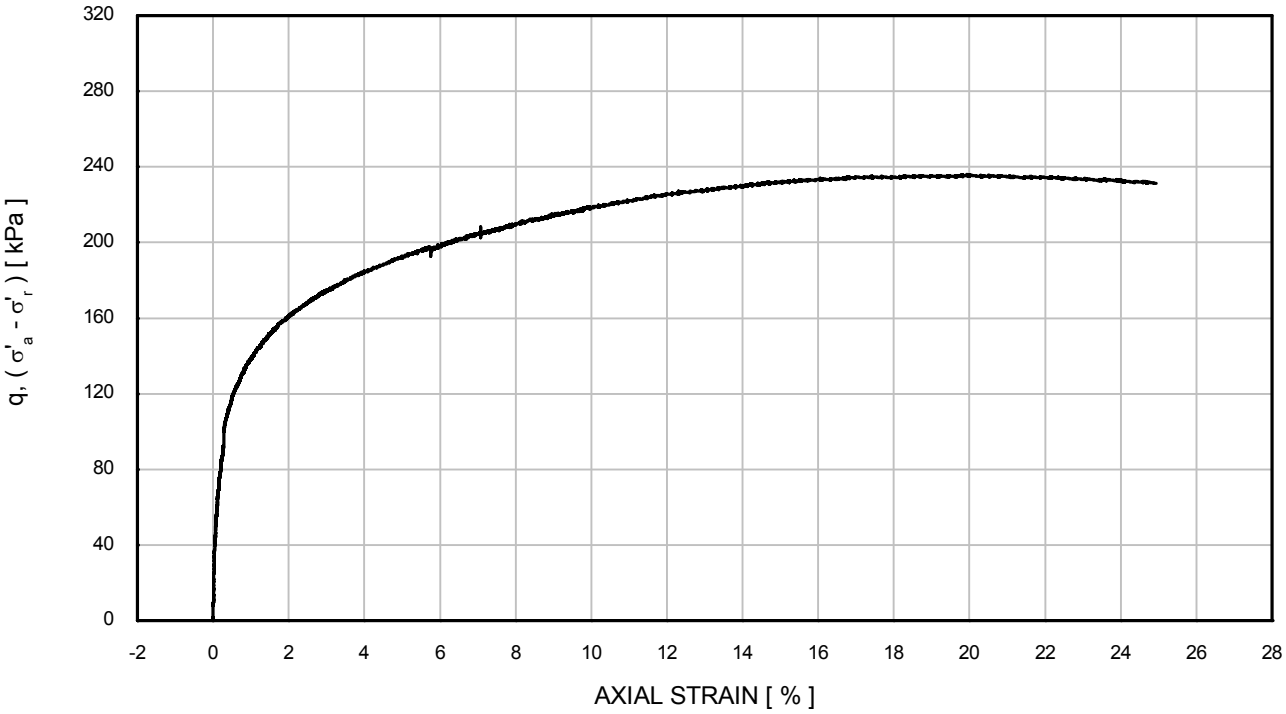
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

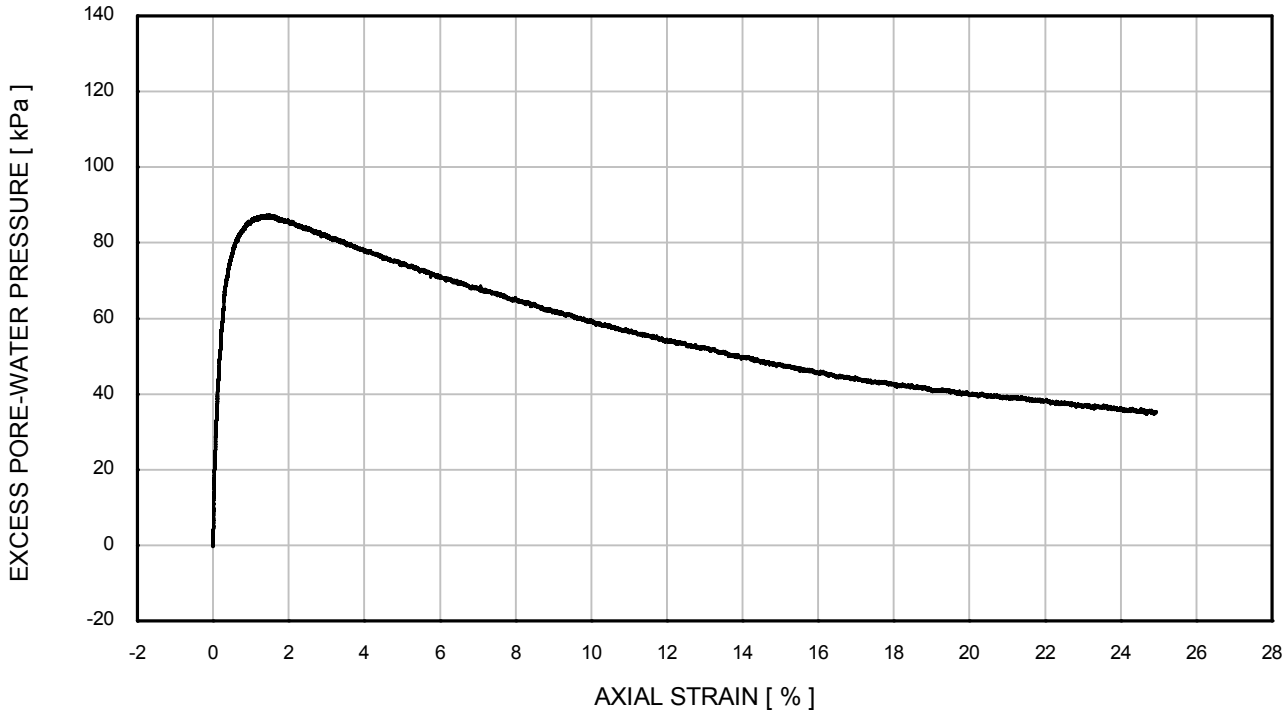




Stage 1 σ'_{rc}	: 145 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 145 kPa	Sample	: 17WaxB
		Depth [m]	: 14.67
		Test No.	: CIU03

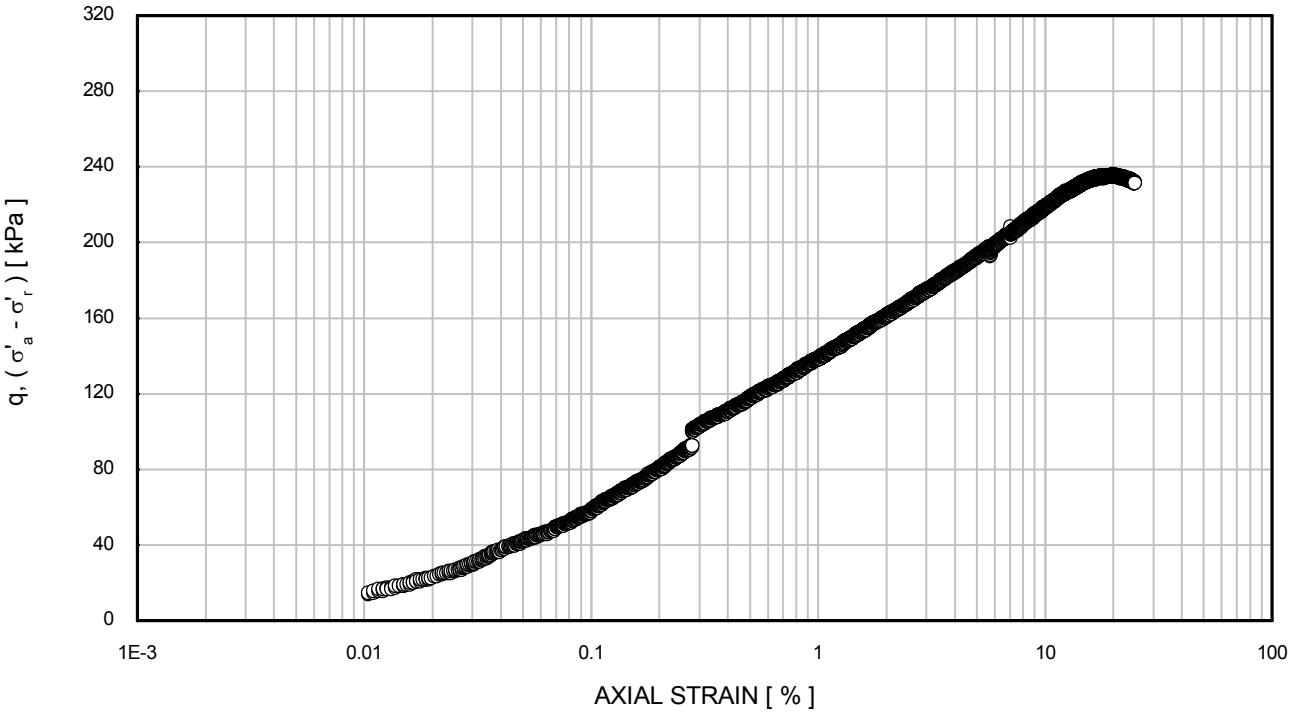
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

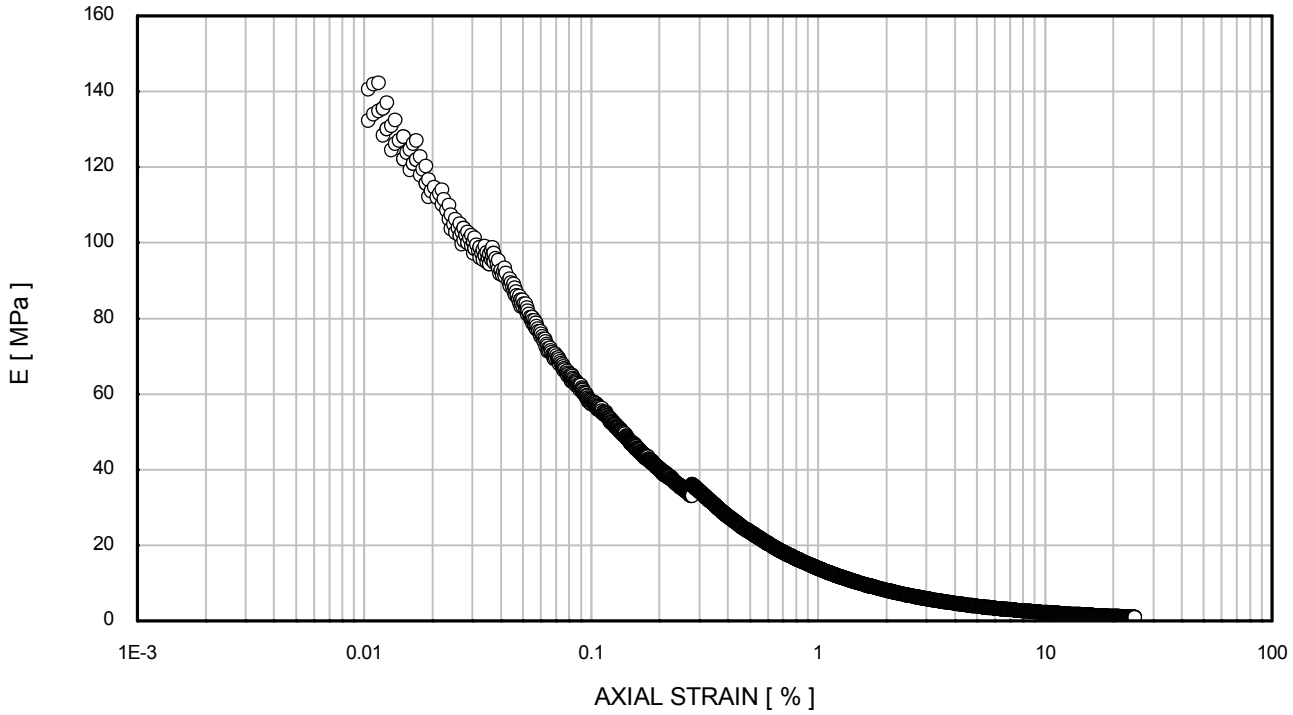




Initial σ'_r	: 145 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 145 kPa	Sample	: 17WaxB
q_{peak}	: 236 kPa	Depth [m]	: 14.67
Ext. ε at q_{peak}	: 19.92 %	Test No.	: CIU03
Rate of strain	: 0.30 %/hour		

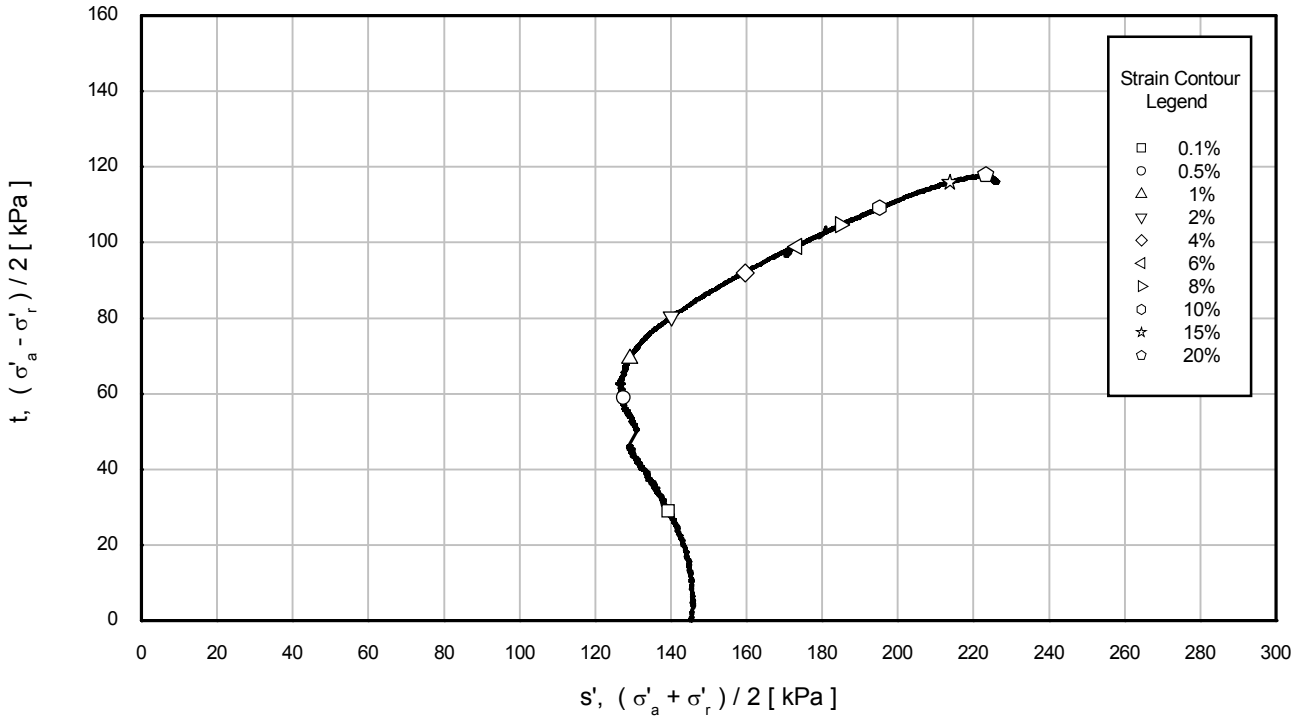
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

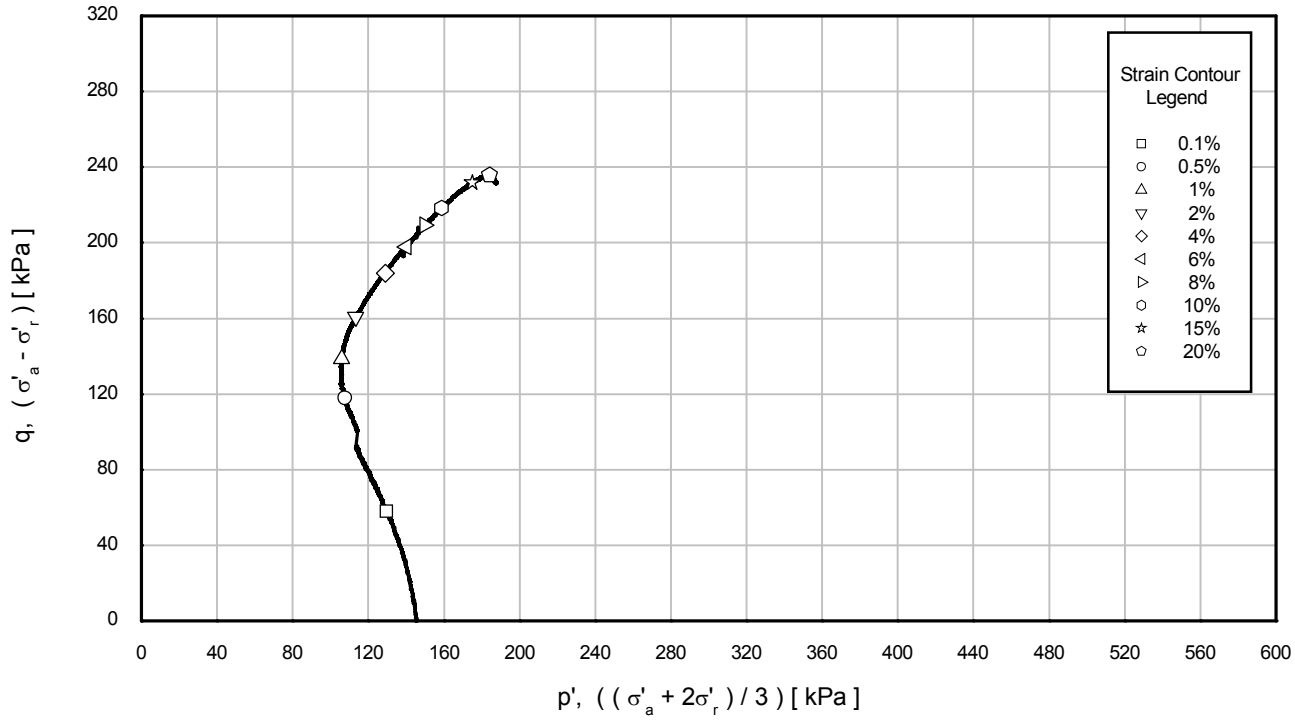




Initial σ'_r	: 145 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 145 kPa	Sample	: 17WaxB
q_{peak}	: 236 kPa	Depth [m]	: 14.67
Ext. ε at q_{peak}	: 19.92 %	Test No.	: CIU03
Rate of strain	: 0.30 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	: 145 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 145 kPa	Sample	: 17WaxB
q_{peak}	: 236 kPa	Depth [m]	: 14.67
Ext. ε at q_{peak}	: 19.92 %	Test No.	: CIU03
Rate of strain	: 0.30 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark grey sandy CLAY

GENERAL	
Date test started	17/10/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	69.5
Length	[mm]	139.9
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.91
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.851
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	32
Pocket penetrometer	[kPa]	78

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_20WAXC_CIUe04
Processed by	MSR
Date	06/12/2016
Checked by	PH
Date	07/12/2016
Approved by	PH
Date	07/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxC
Depth [m]	17.95
Test number	CIUe04

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	500
Base PWP	[kPa]	494
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	659
Back pressure	[kPa]	494
Base PWP	[kPa]	494
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	165
Effective axial pressure	[kPa]	165
Deviator stress	[kPa]	0
Volumetric strain	[%]	4.95
External axial strain	[%]	1.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.5
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.53
Void ratio	[-]	0.760
Degree of saturation	[%]	98

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxC
Depth [m]	17.95
Test number	CIUe04

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	165
Initial effective axial pressure	[kPa]	165
Rate of strain	[%/hour]	0.29
At peak deviator stress		
Corrected deviator stress	[kPa]	-172
Membrane correction applied	[kPa]	-1
Drain correction applied	[kPa]	0
External axial strain	[%]	-6.30
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-70
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	235
Effective axial pressure	[kPa]	62
Principal effective stress ratio	[-]	3.76
ε_{50}	[%]	-0.67
Secant modulus (E_{50}) at ε_{50}	[kPa]	12871
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	-168
Membrane correction applied	[kPa]	-1
Drain correction applied	[kPa]	0
External axial strain	[%]	-5.39
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-61
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	225
Effective axial pressure	[kPa]	57
Principal effective stress ratio	[-]	3.95
At -15% external axial strain		
Corrected deviator stress	[kPa]	-92
Membrane correction applied	[kPa]	-2
Drain correction applied	[kPa]	0
External axial strain	[%]	-15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-13
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	178
Effective axial pressure	[kPa]	86
Principal effective stress ratio	[-]	2.06

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxC
Depth [m]	17.95
Test number	CIUe04

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





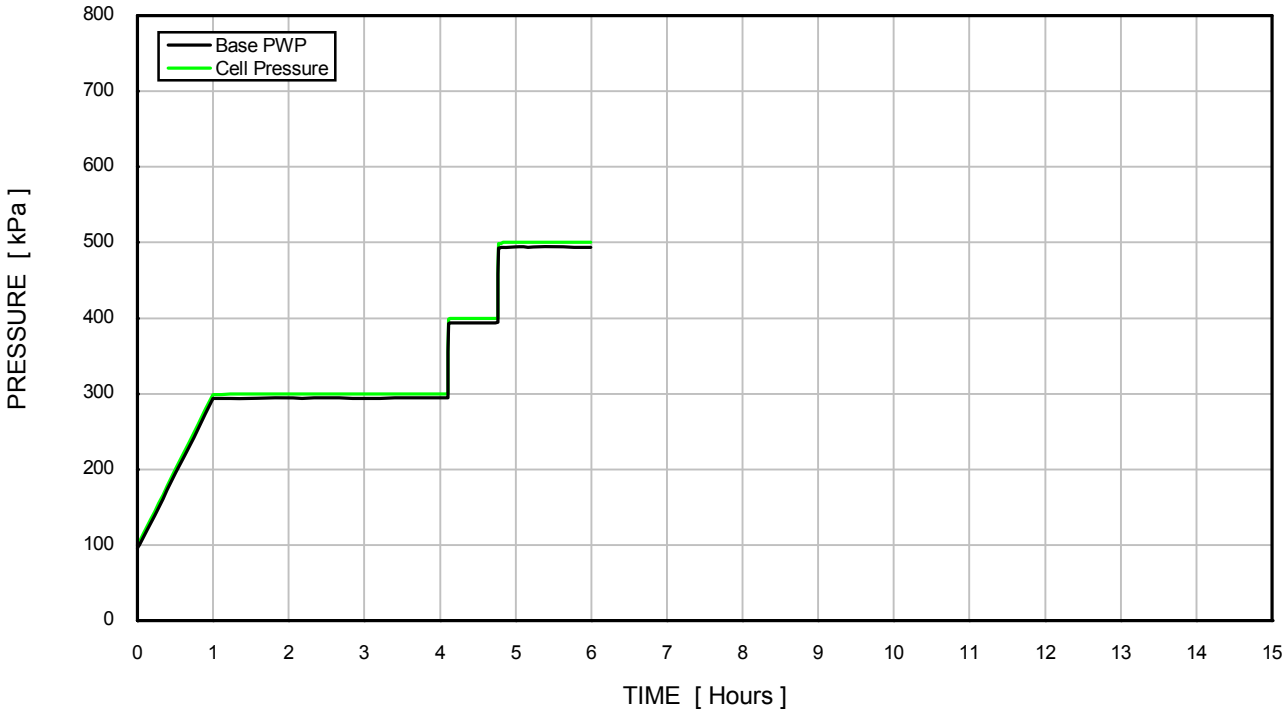
FINAL CONDITIONS

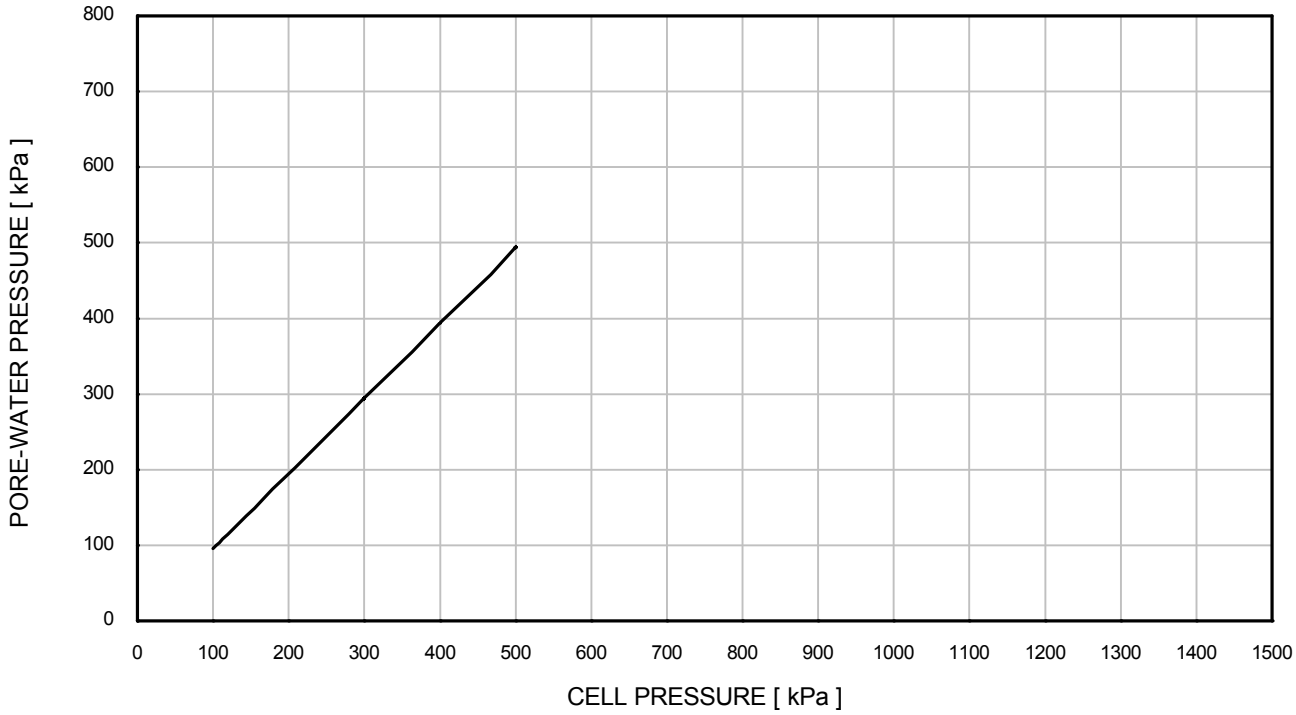
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.91
Dry density	[Mg/m³]	1.46

TEST IDENTIFICATION

Borehole	HKZ1-BH01-SA
Sample	20WaxC
Depth [m]	17.95
Test number	CIUe04

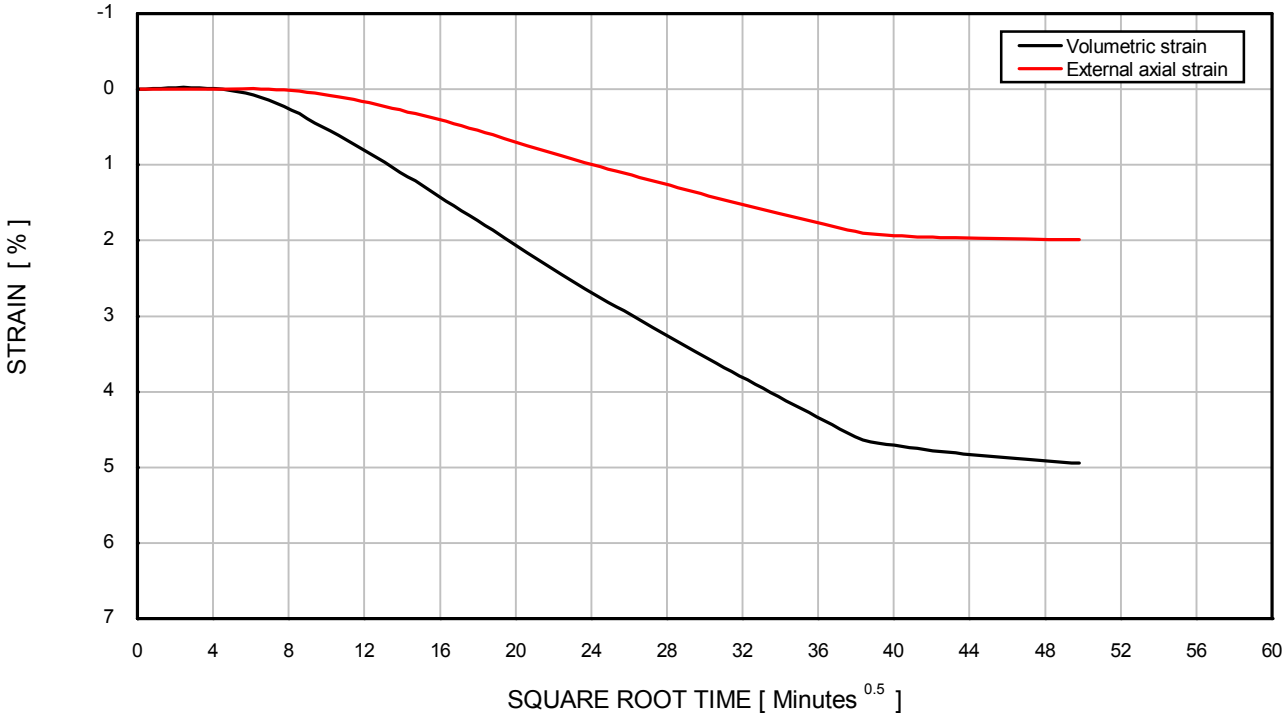
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

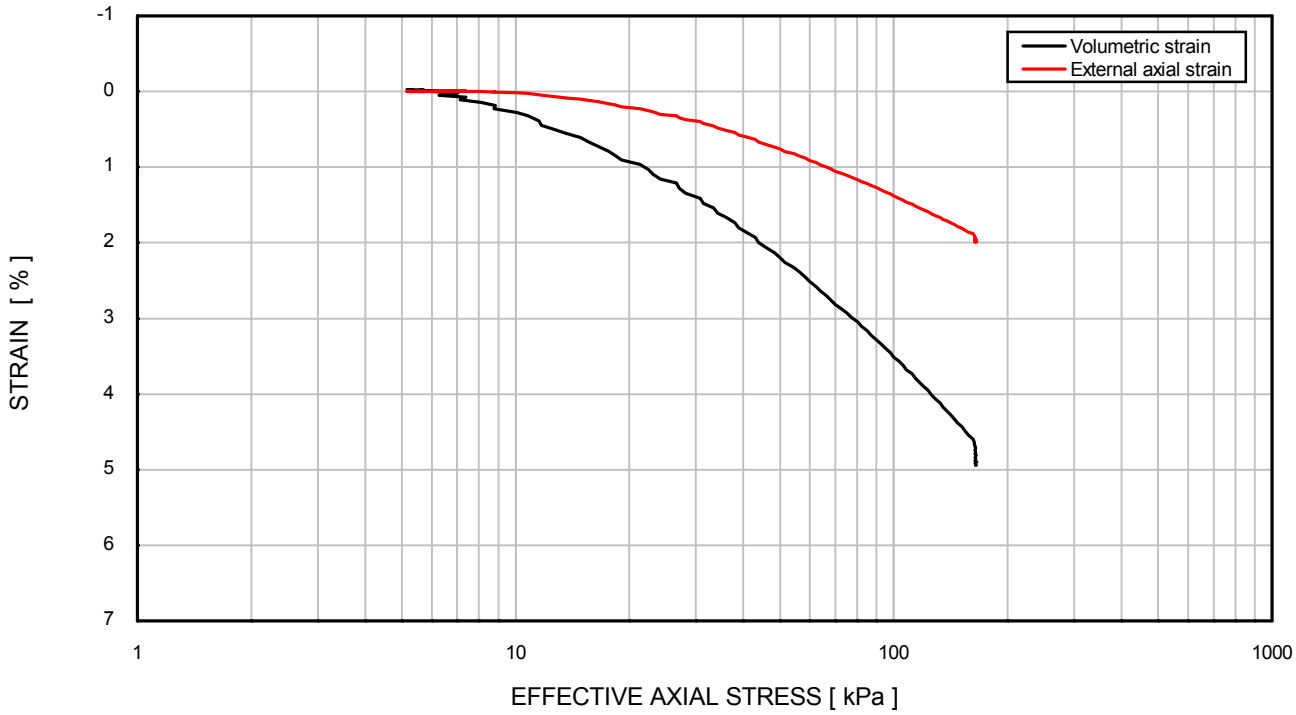




B value	:	1.00			
Initial σ'_r	:	5	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	5	kPa	Sample	: 20WaxC
Final σ'_r	:	6	kPa	Depth [m]	: 17.95
Final σ'_a	:	6	kPa	Test No.	: CIUe04

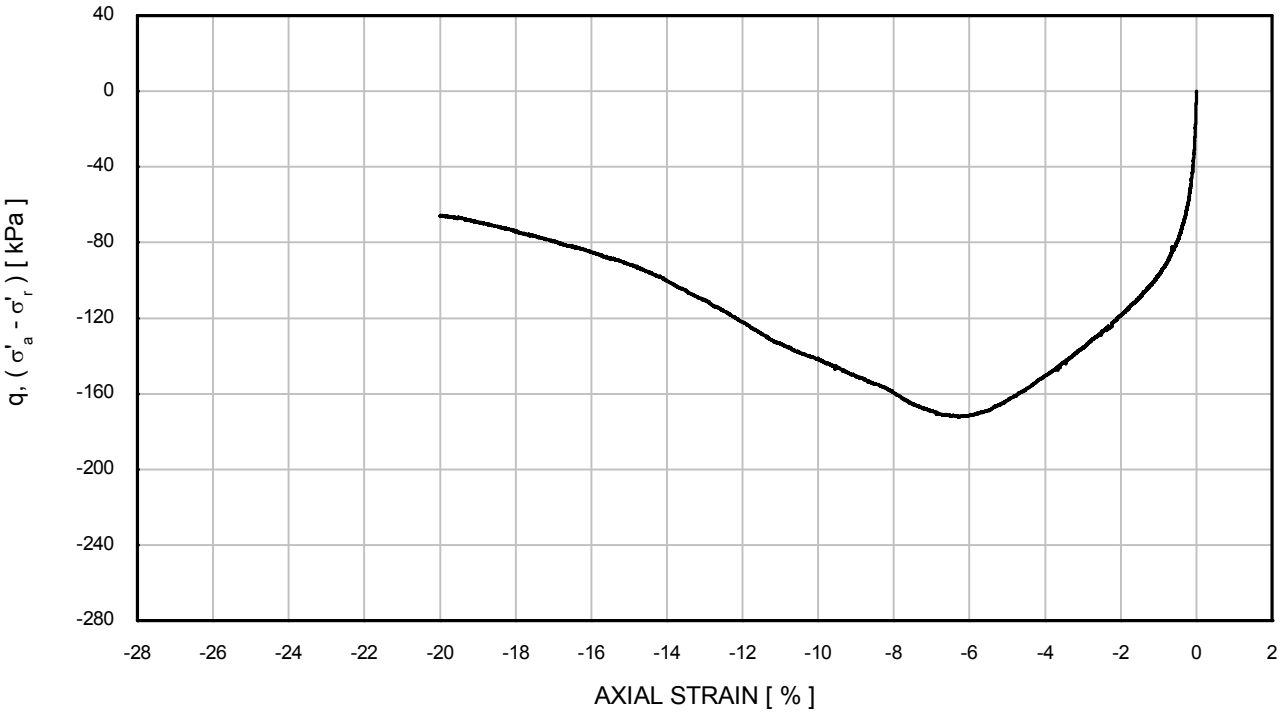
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

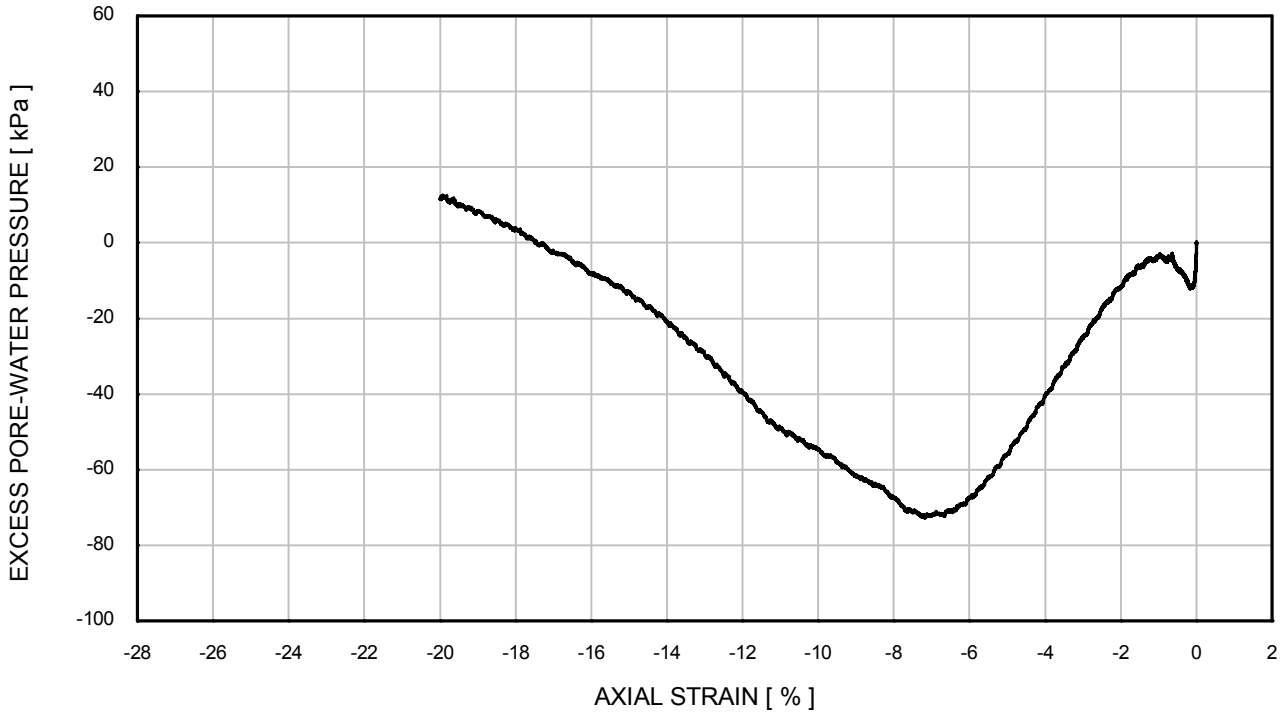




Stage 1 σ'_{rc}	: 165 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 165 kPa	Sample	: 20WaxC
		Depth [m]	: 17.95
		Test No.	: CIUe04

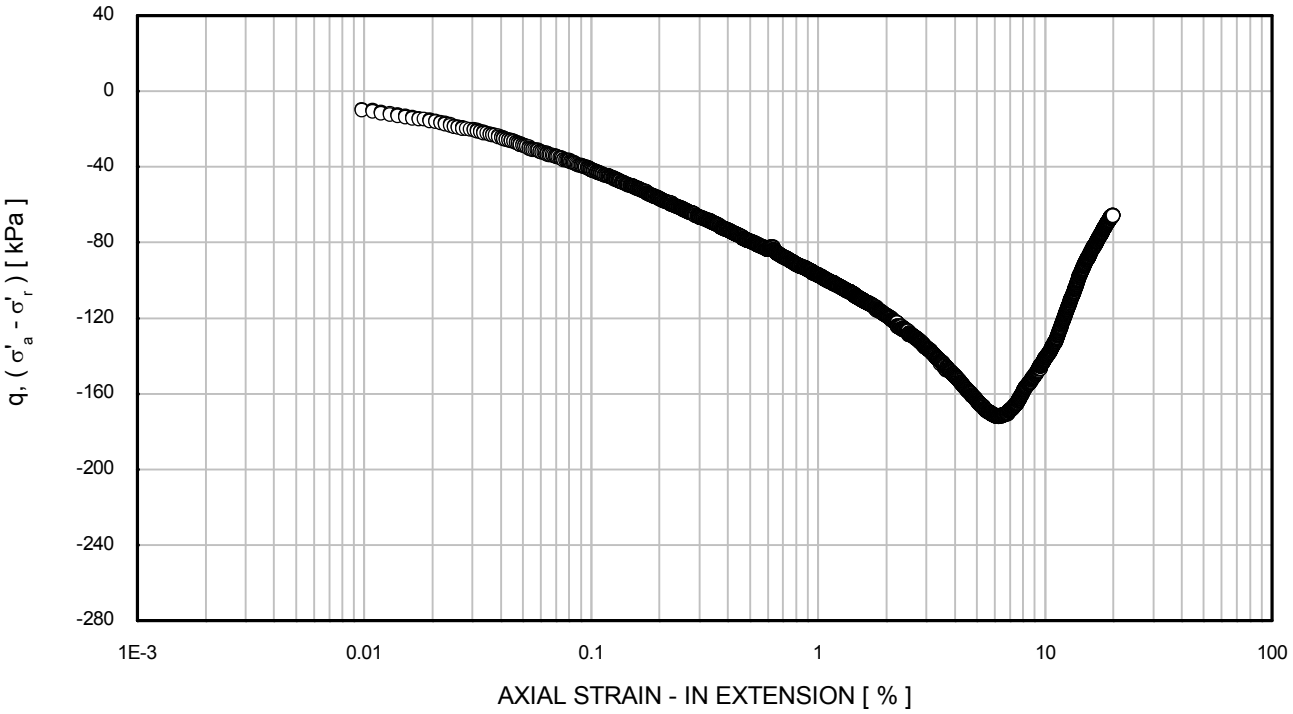
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

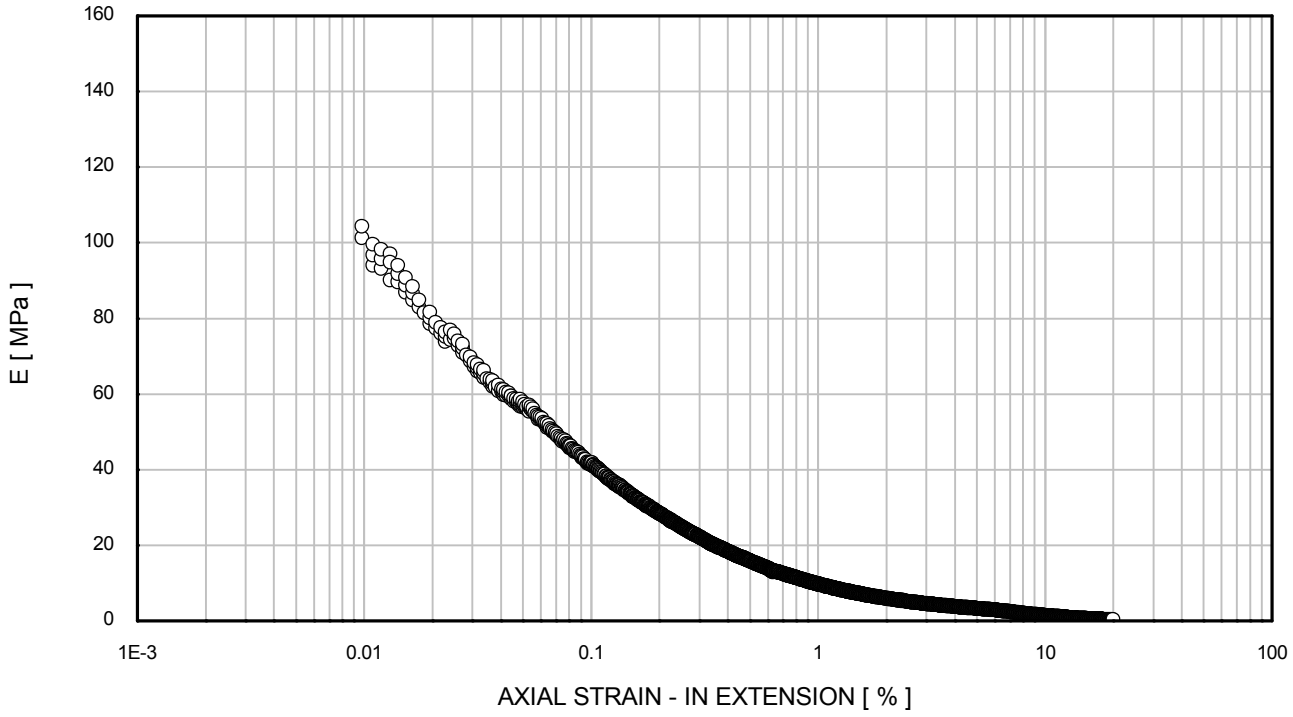




Initial σ'_r	:	165 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	165 kPa	Sample	:	20WaxC
q_{peak}	:	-172 kPa	Depth [m]	:	17.95
Ext. ε at q_{peak}	:	-6.30 %	Test No.	:	CIUe04
Rate of strain	:	0.29 %/hour			

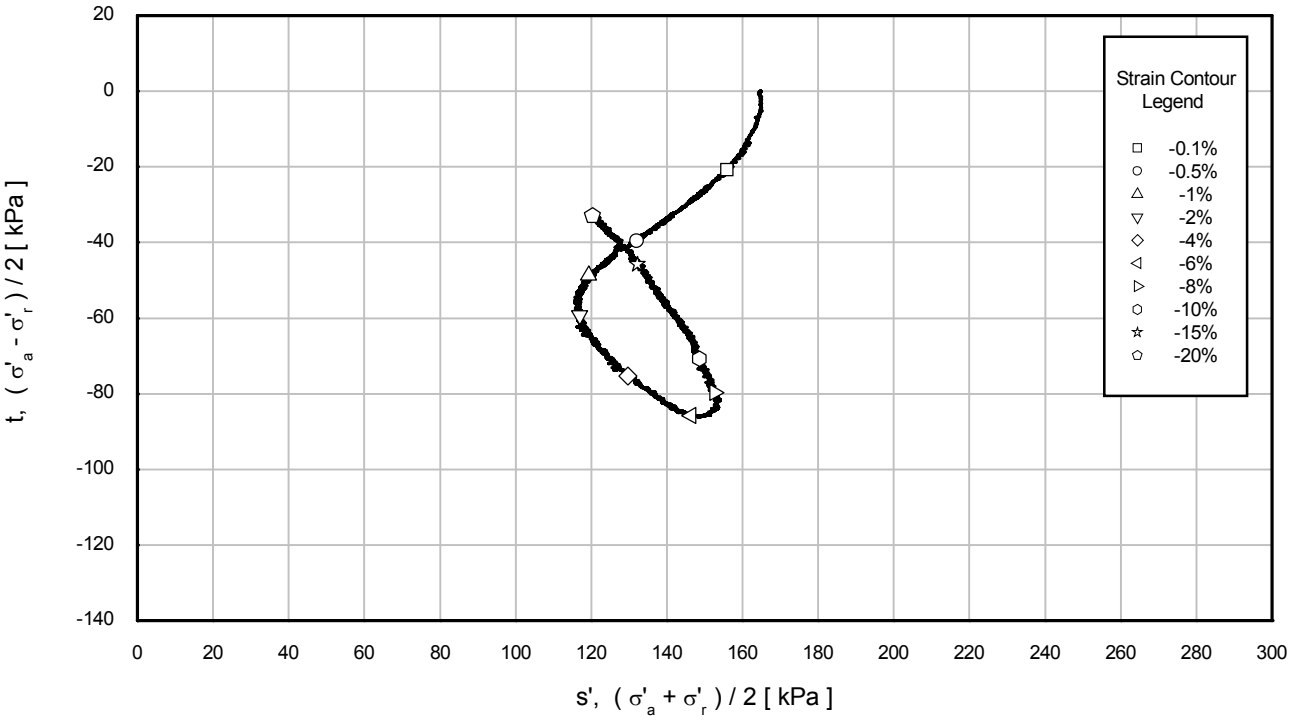
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

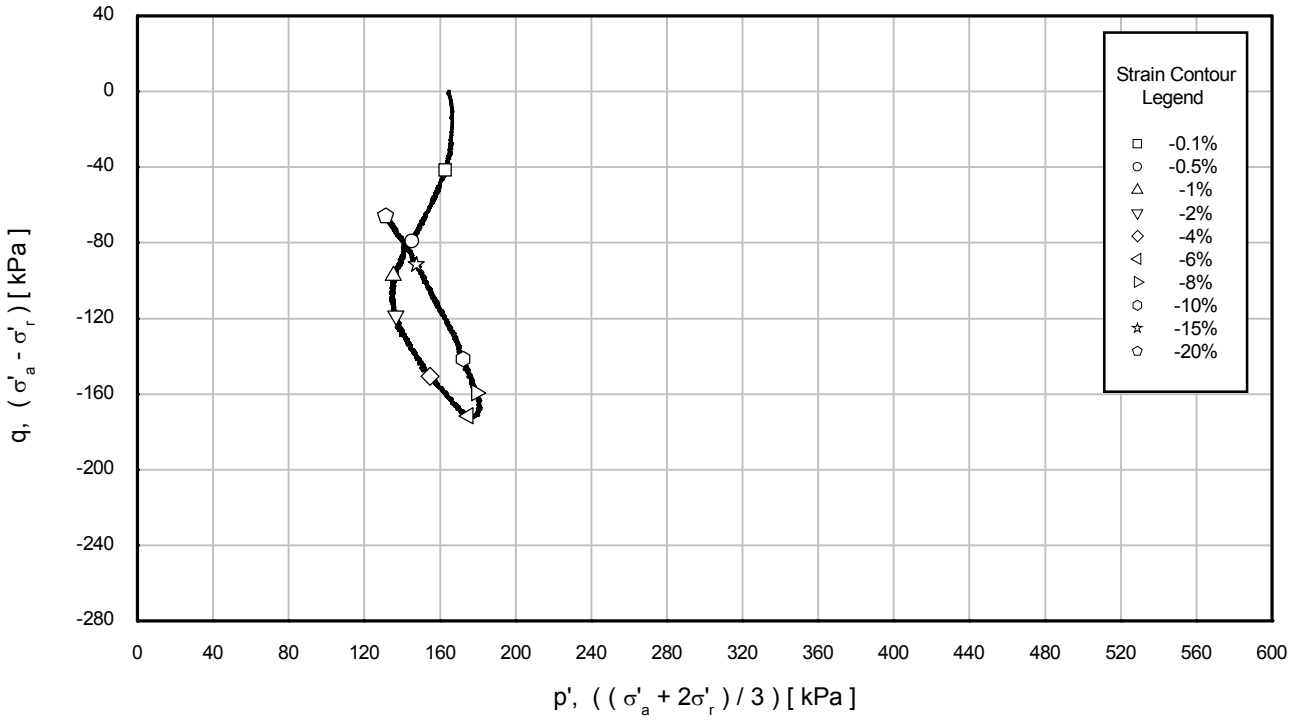




Initial σ'_r	: 165 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 165 kPa	Sample	: 20WaxC
q_{peak}	: -172 kPa	Depth [m]	: 17.95
Ext. ε at q_{peak}	: -6.30 %	Test No.	: CIUe04
Rate of strain	: 0.29 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	165 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	165 kPa	Sample	:	20WaxC
q_{peak}	:	-172 kPa	Depth [m]	:	17.95
Ext. ε at q_{peak}	:	-6.30 %	Test No.	:	CIUe04
Rate of strain	:	0.29 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark grey slightly silty CLAY with extremely closely to closely spaced thin laminea of silt

GENERAL	
Date test started	17/11/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	51.4
Length	[mm]	100.2
Water content	[%]	30.1
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.857
Degree of saturation	[%]	95
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	50
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_20WaxD
Processed by Date	MSR 21/11/2016
Checked by Date	AR 06/12/2016
Approved by Date	PH 07/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	CIU05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	799
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	963
Back pressure	[kPa]	798
Base PWP	[kPa]	798
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	165
Effective axial pressure	[kPa]	165
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.99
External axial strain	[%]	0.50
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	29.4
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.838
Degree of saturation	[%]	95

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	CIU05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	165
Initial effective axial pressure	[kPa]	165
Rate of strain	[%/hour]	0.30
At peak deviator stress		
Corrected deviator stress	[kPa]	208
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	14.18
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	76
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	89
Effective axial pressure	[kPa]	297
Principal effective stress ratio	[-]	3.34
ε_{50}	[%]	0.40
Secant modulus (E_{50}) at ε_{50}	[kPa]	25707
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	187
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	3.50
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	101
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	63
Effective axial pressure	[kPa]	250
Principal effective stress ratio	[-]	3.95
At 15% external axial strain		
Corrected deviator stress	[kPa]	207
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	75
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	90
Effective axial pressure	[kPa]	297
Principal effective stress ratio	[-]	3.30

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	CIU05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





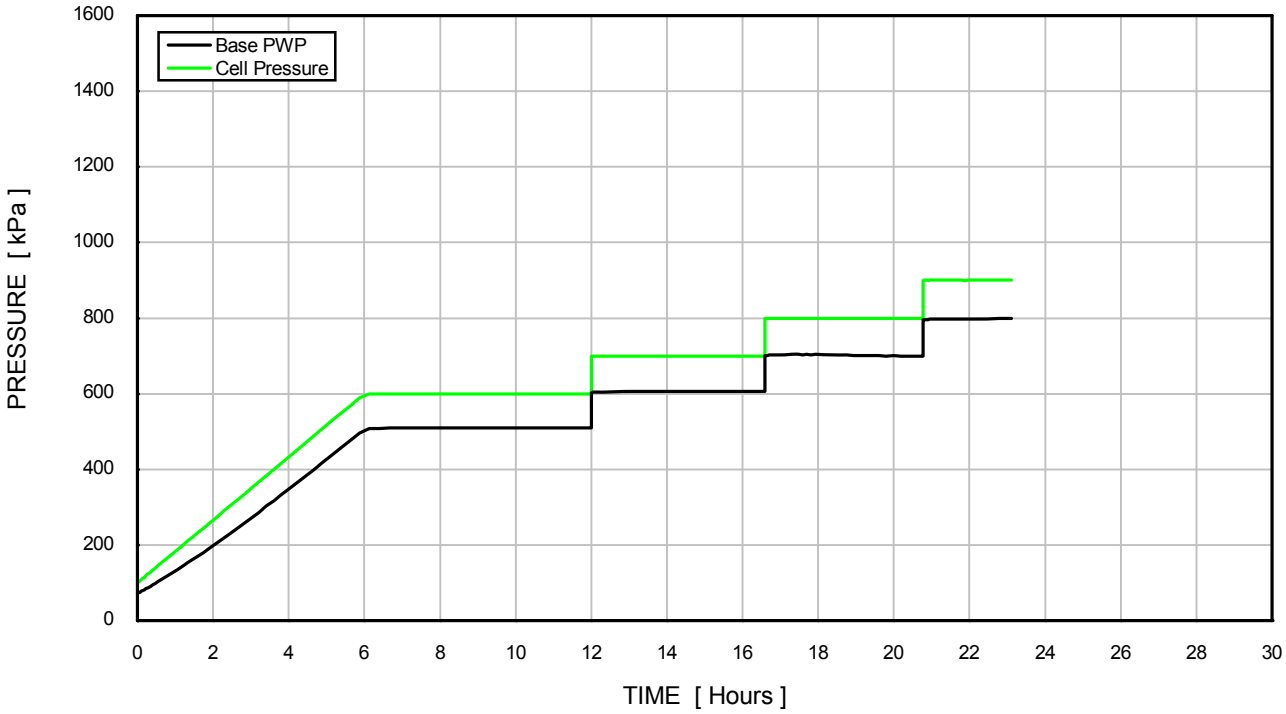
FINAL CONDITIONS

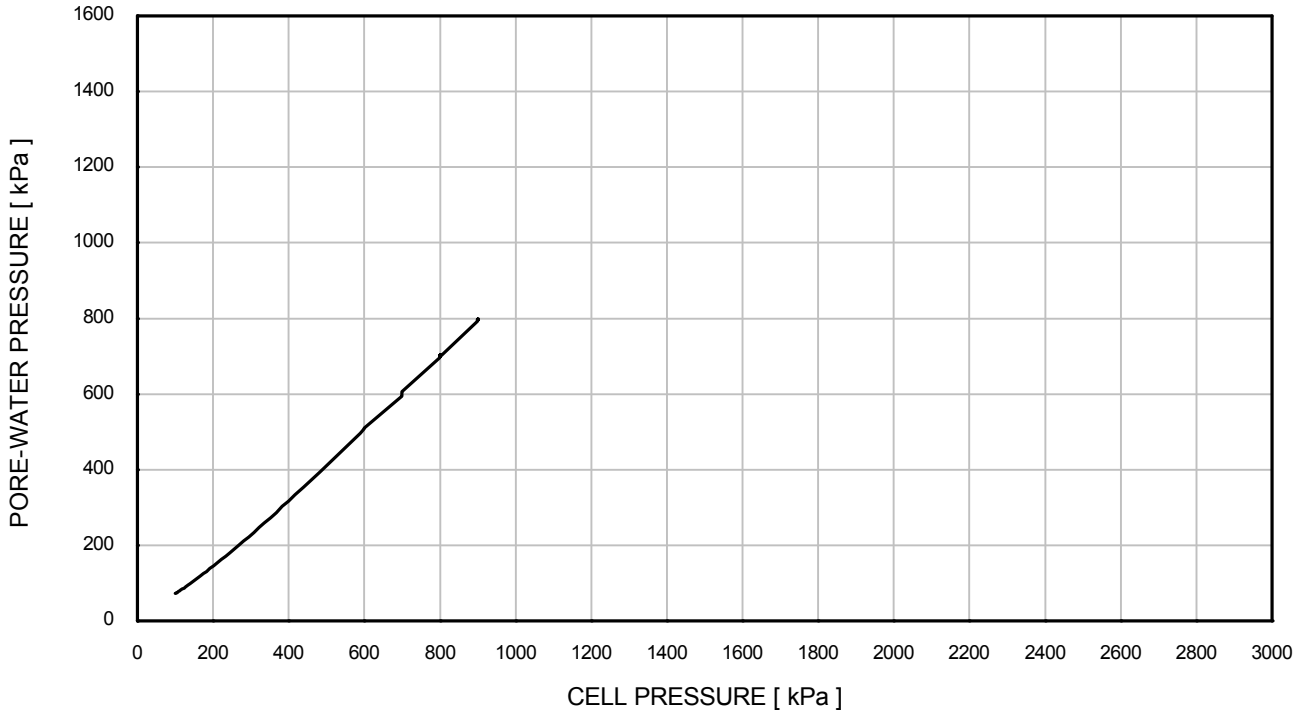
Water content	[%]	29.4
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.47

TEST IDENTIFICATION

Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	CIU05

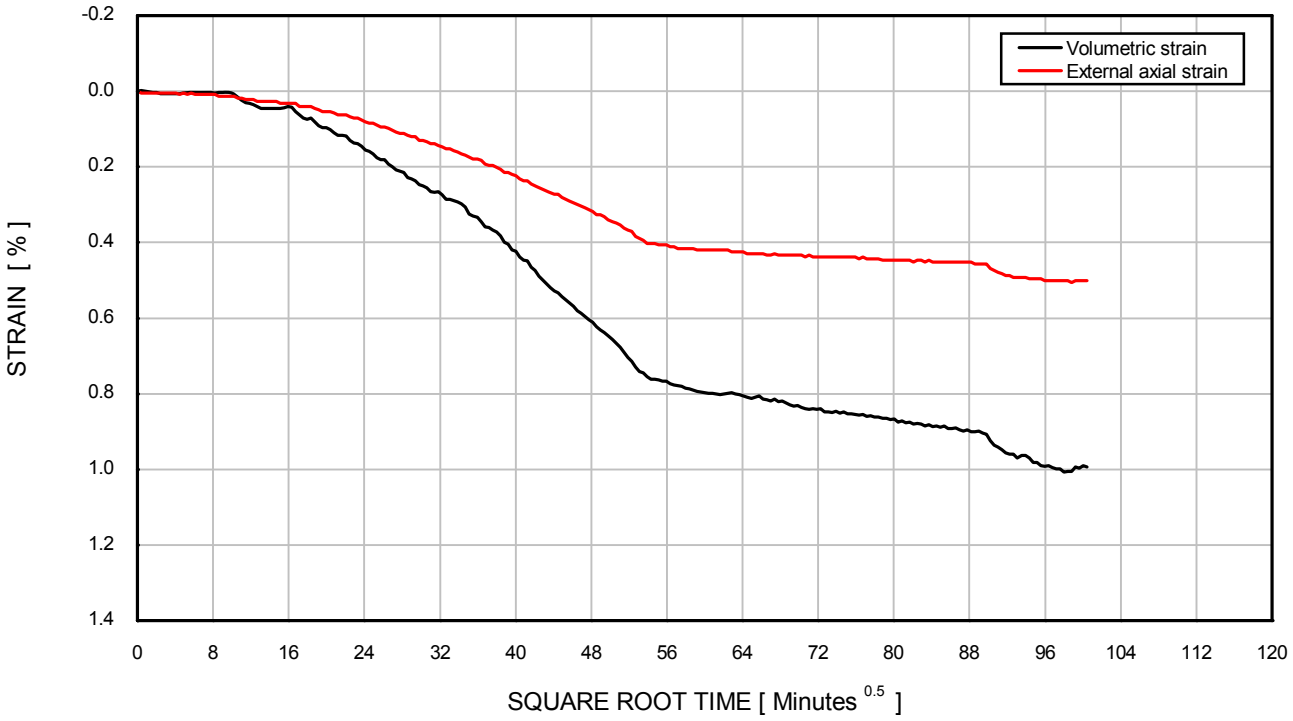
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

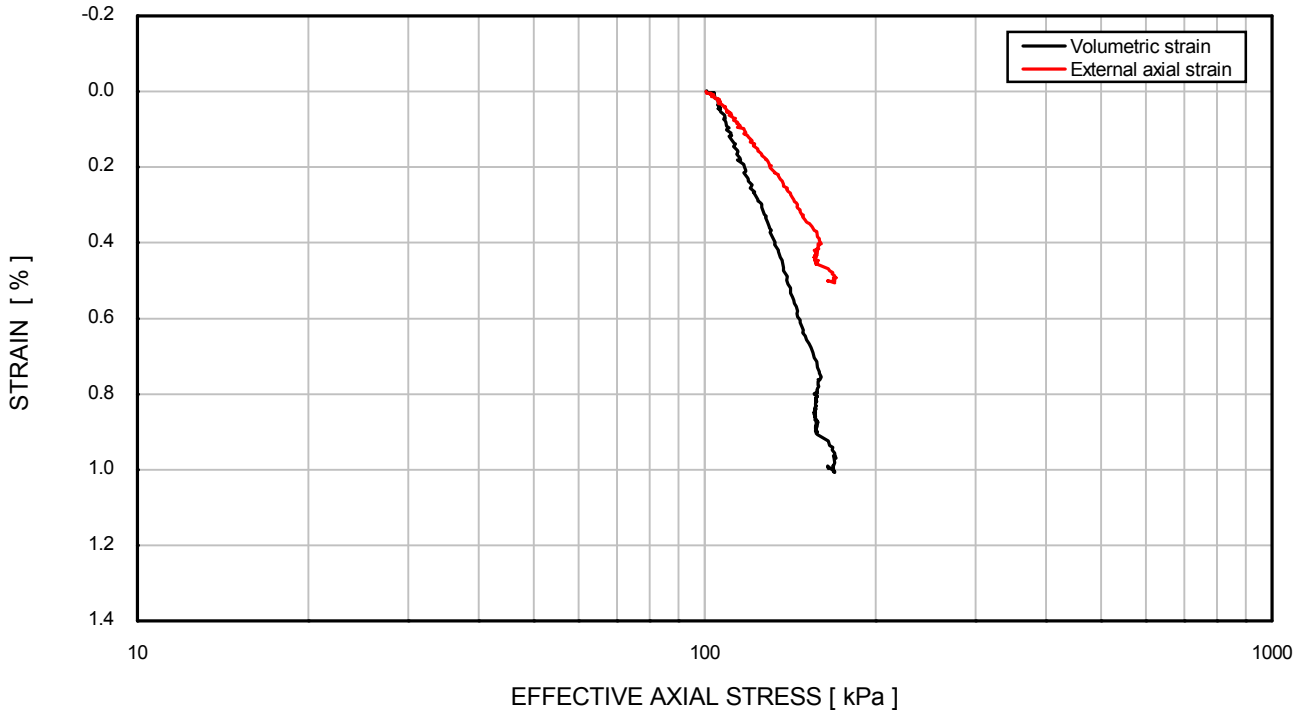




B value	: 0.99	Borehole	: HKZ1-BH01-SA
Initial σ'_r	: 27 kPa	Sample	: 20WaxD
Initial σ'_a	: 27 kPa	Depth [m]	: 18.11
Final σ'_r	: 101 kPa	Test No.	: CIU05
Final σ'_a	: 101 kPa		

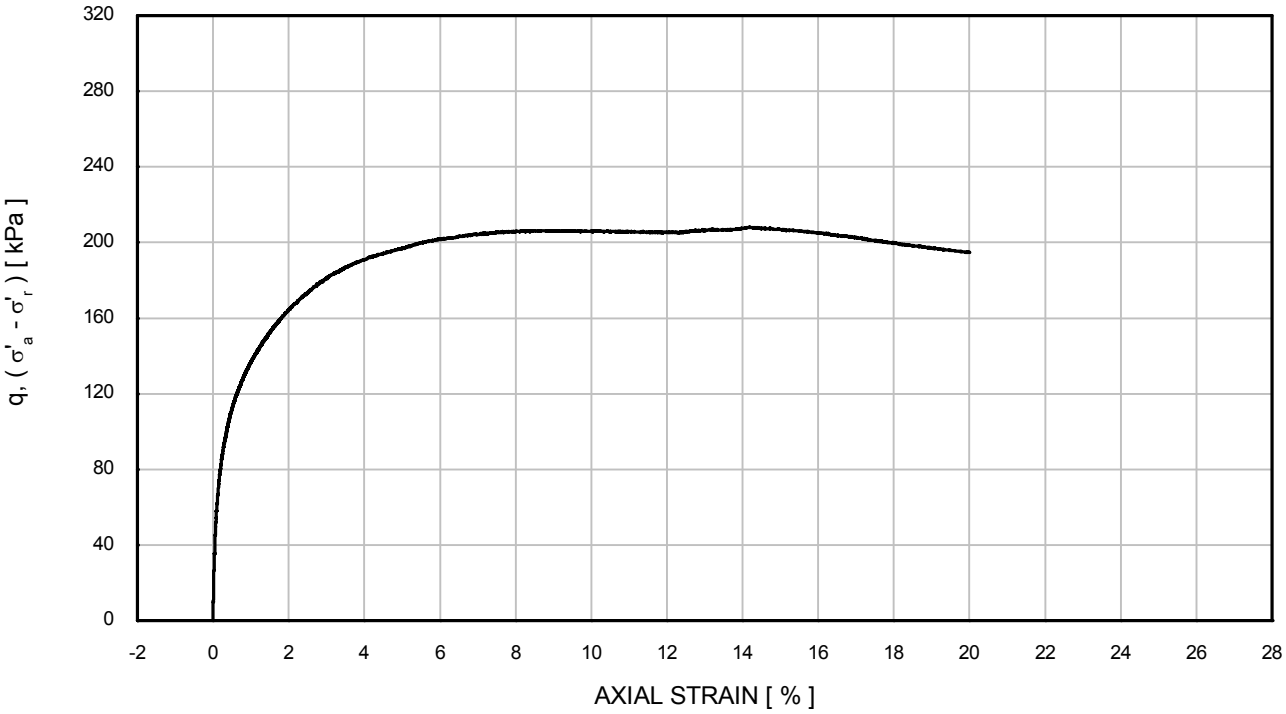
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

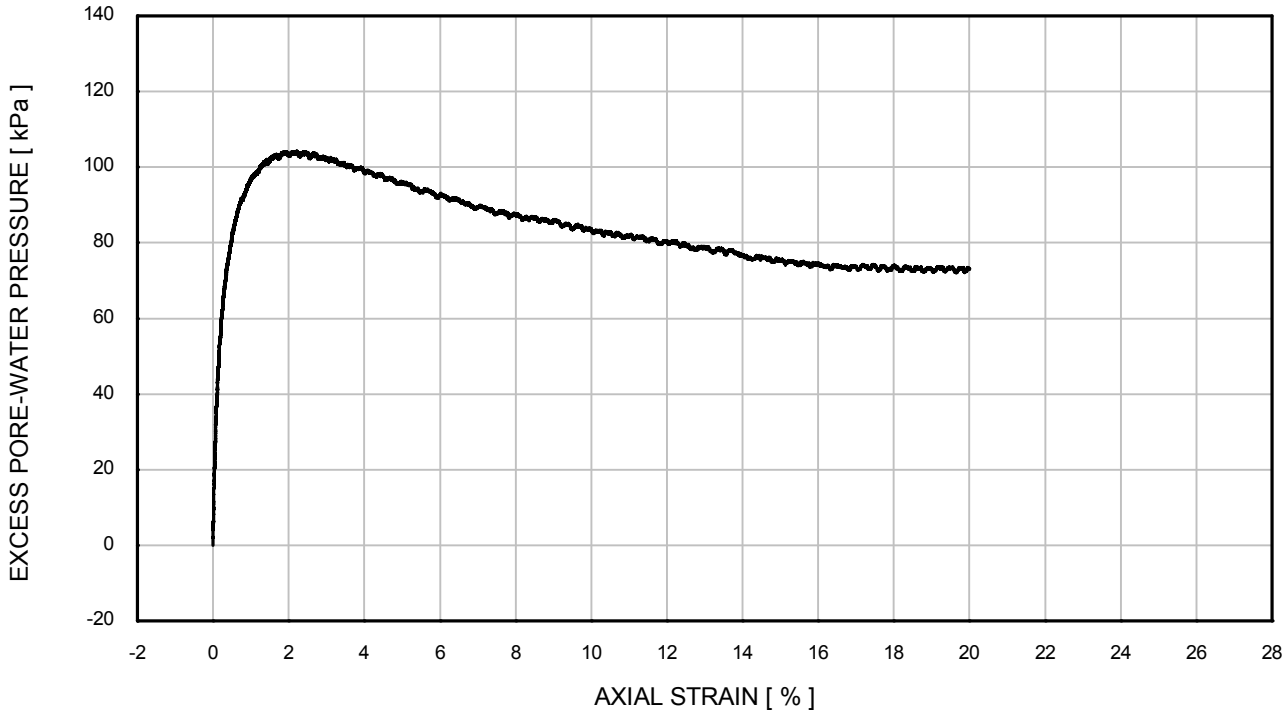




Stage 1 σ'_{rc}	: 165 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 165 kPa	Sample	: 20WaxD
		Depth [m]	: 18.11
		Test No.	: CIU05

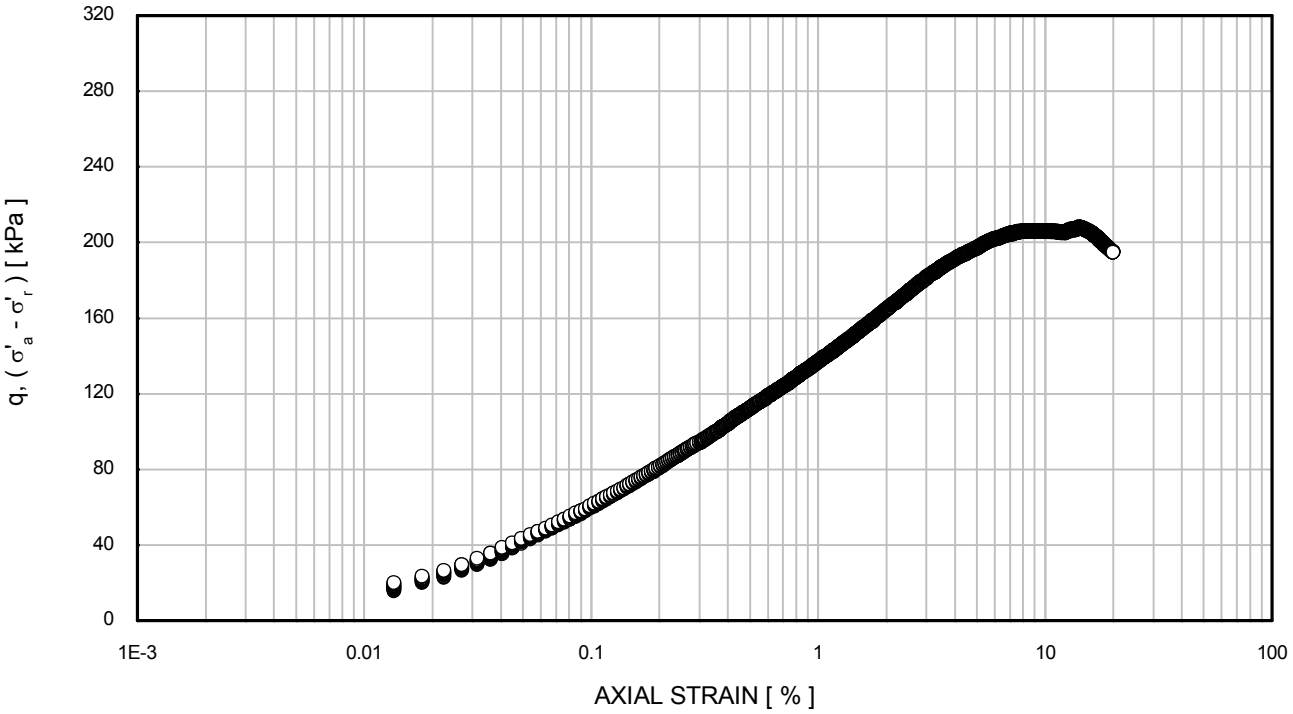
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

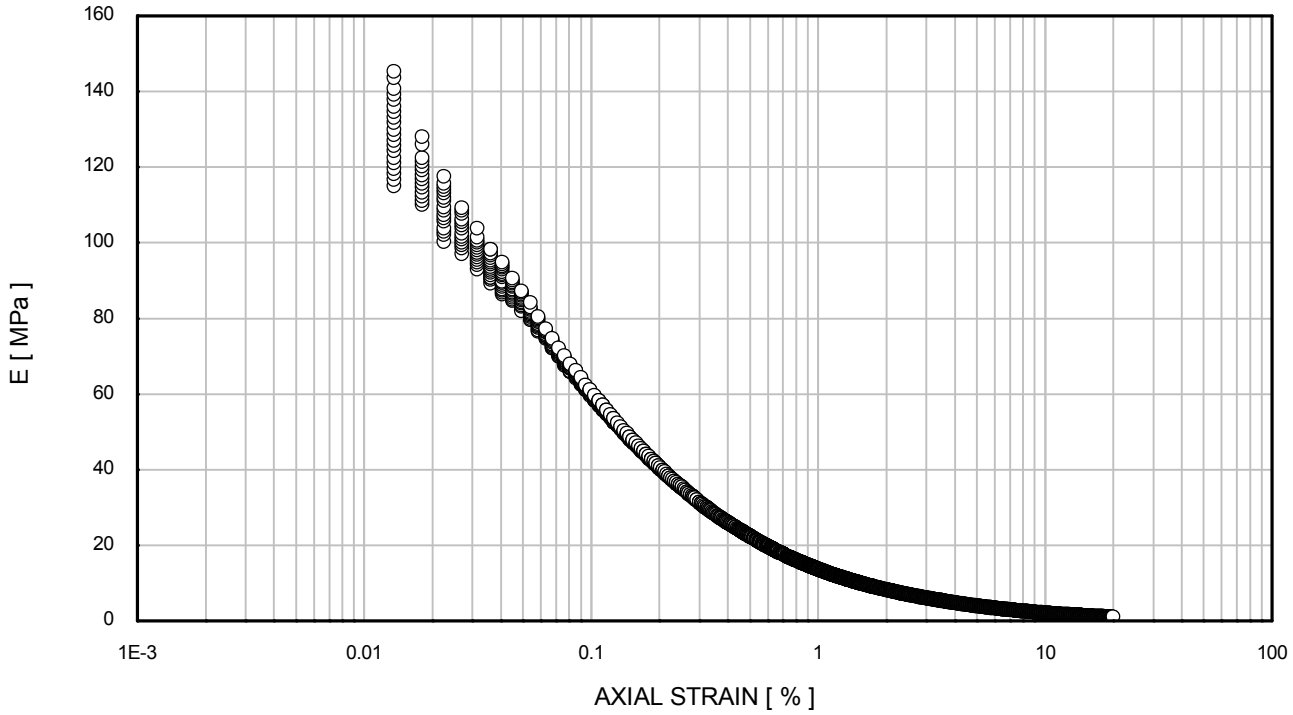




Initial σ'_r	: 165 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 165 kPa	Sample	: 20WaxD
q_{peak}	: 208 kPa	Depth [m]	: 18.11
Ext. ε at q_{peak}	: 14.18 %	Test No.	: CIU05
Rate of strain	: 0.30 %/hour		

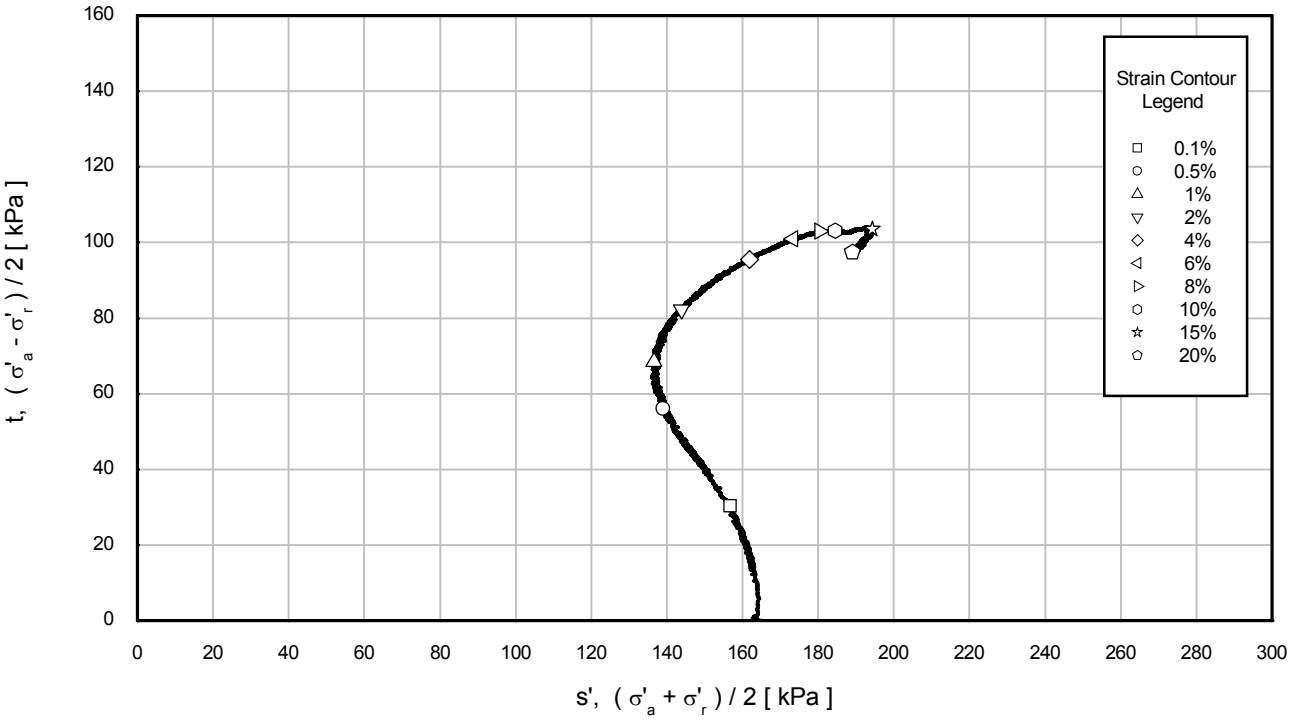
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

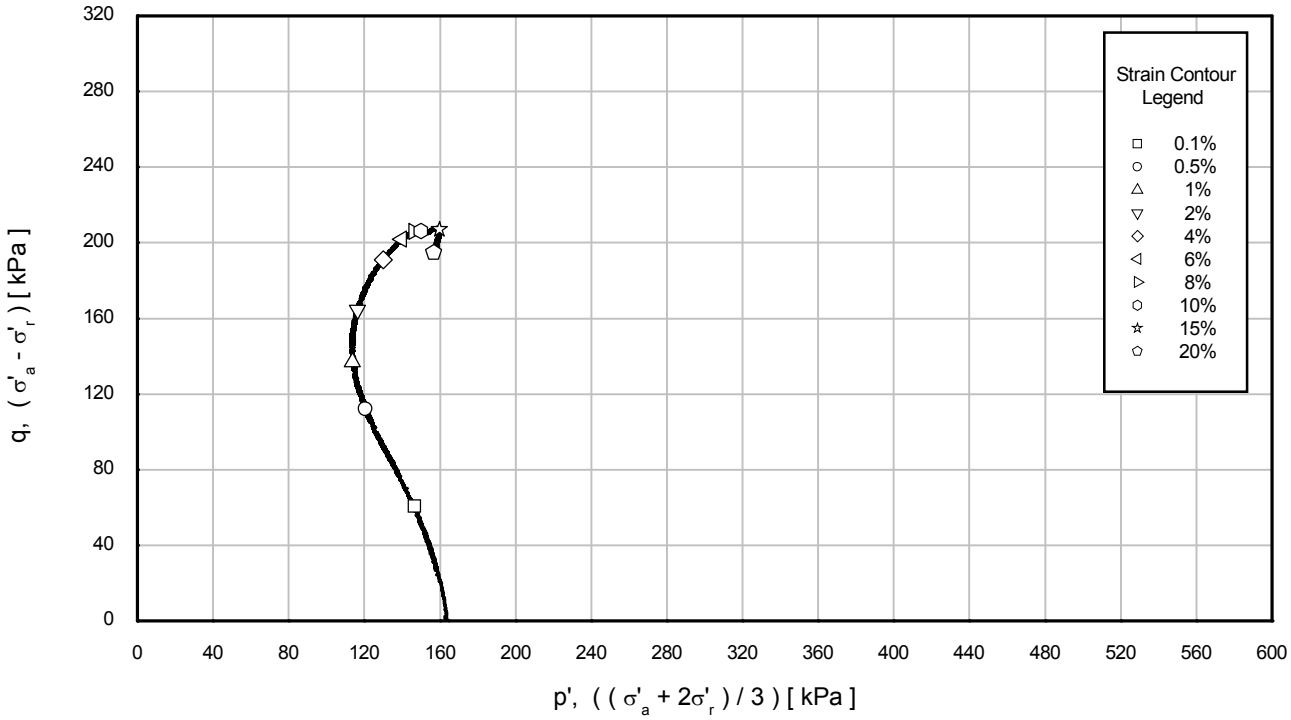




Initial σ'_r	: 165 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 165 kPa	Sample	: 20WaxD
q_{peak}	: 208 kPa	Depth [m]	: 18.11
Ext. ε at q_{peak}	: 14.18 %	Test No.	: CIU05
Rate of strain	: 0.30 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	165 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	165 kPa	Sample	:	20WaxD
q_{peak}	:	208 kPa	Depth [m]	:	18.11
Ext. ε at q_{peak}	:	14.18 %	Test No.	:	CIU05
Rate of strain	:	0.30 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Bluish grey CLAY

GENERAL	
Date test started	31/10/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	50.1
Length	[mm]	99.8
Water content	[%]	27.7
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.763
Degree of saturation	[%]	99
Assumed particle density	[Mg/m³]	2.72
Torvane	[kPa]	75
Pocket penetrometer	[kPa]	70

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ2-BH21-SA_29WaxB_CAU01
Processed by	MSR
Date	08/11/2016
Checked by	PH
Date	14/12/2016
Approved by	PH
Date	14/12/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	29WaxB
Depth [m]	22.20
Test number	CAU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	829
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1029
Back pressure	[kPa]	829
Base PWP	[kPa]	829
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	200
Effective axial pressure	[kPa]	200
Deviator stress	[kPa]	0
Volumetric strain	[%]	1.89
External axial strain	[%]	0.75
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	26.8
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.730
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	29WaxB
Depth [m]	22.20
Test number	CAU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	200
Initial effective axial pressure	[kPa]	200
Rate of strain	[%/hour]	0.30
At peak deviator stress		
Corrected deviator stress	[kPa]	287
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	12.49
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	86
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	114
Effective axial pressure	[kPa]	400
Principal effective stress ratio	[-]	3.52
ε_{50}	[%]	0.90
Secant modulus (E_{50}) at ε_{50}	[kPa]	15850
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	265
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	5.40
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	99
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	101
Effective axial pressure	[kPa]	366
Principal effective stress ratio	[-]	3.62
At 15% external axial strain		
Corrected deviator stress	[kPa]	285
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	85
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	115
Effective axial pressure	[kPa]	400
Principal effective stress ratio	[-]	3.49

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	29WaxB
Depth [m]	22.20
Test number	CAU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





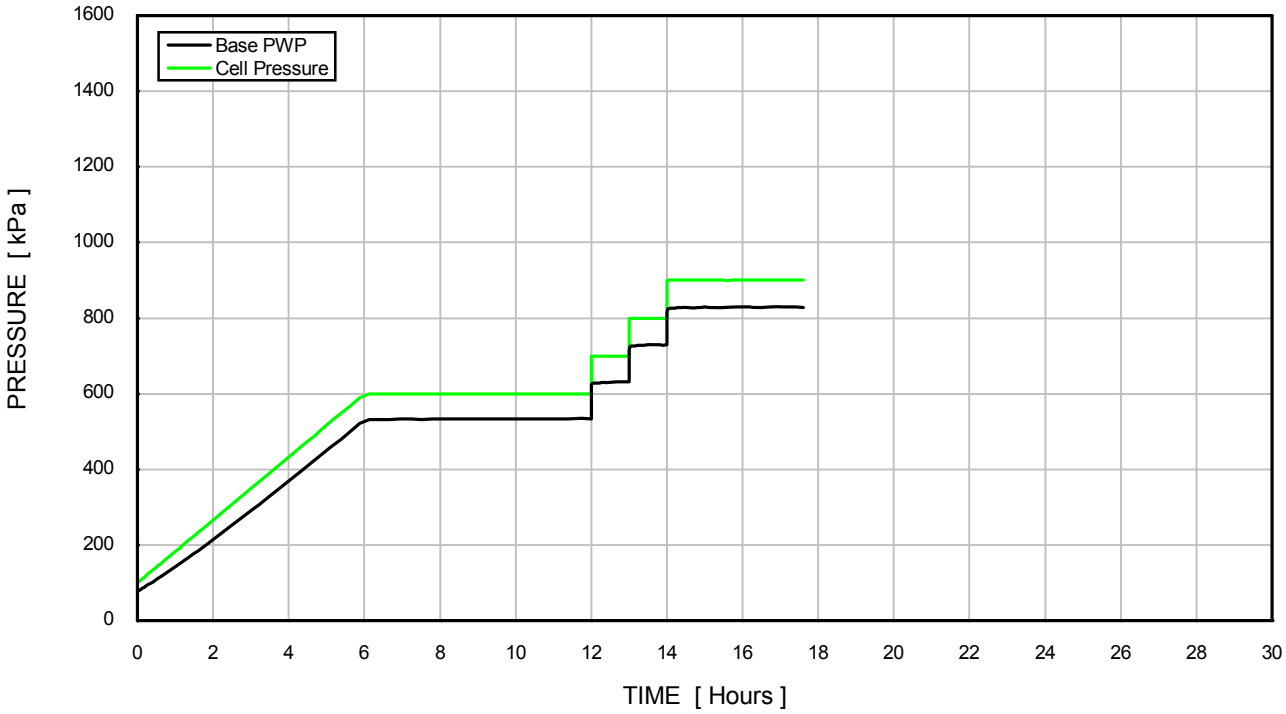
FINAL CONDITIONS

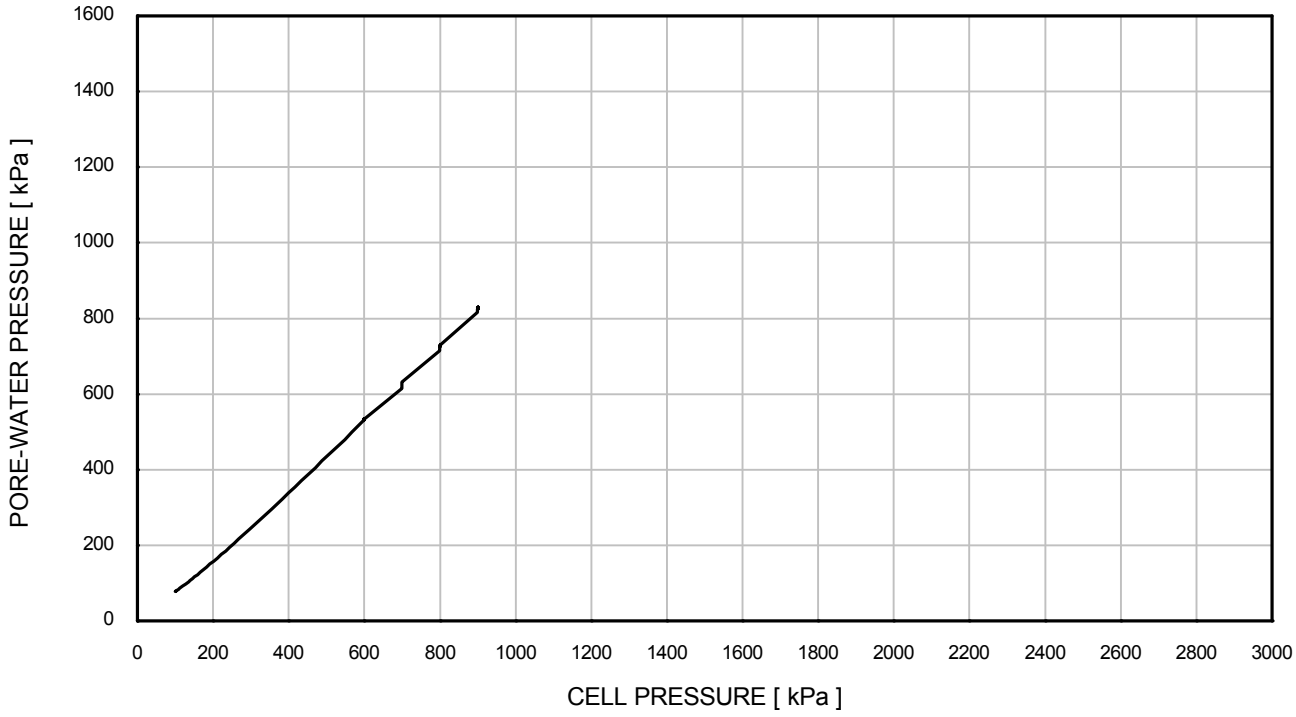
Water content	[%]	26.8
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57

TEST IDENTIFICATION

Borehole	HKZ2-BH21-SA
Sample	29WaxB
Depth [m]	22.20
Test number	CAU01

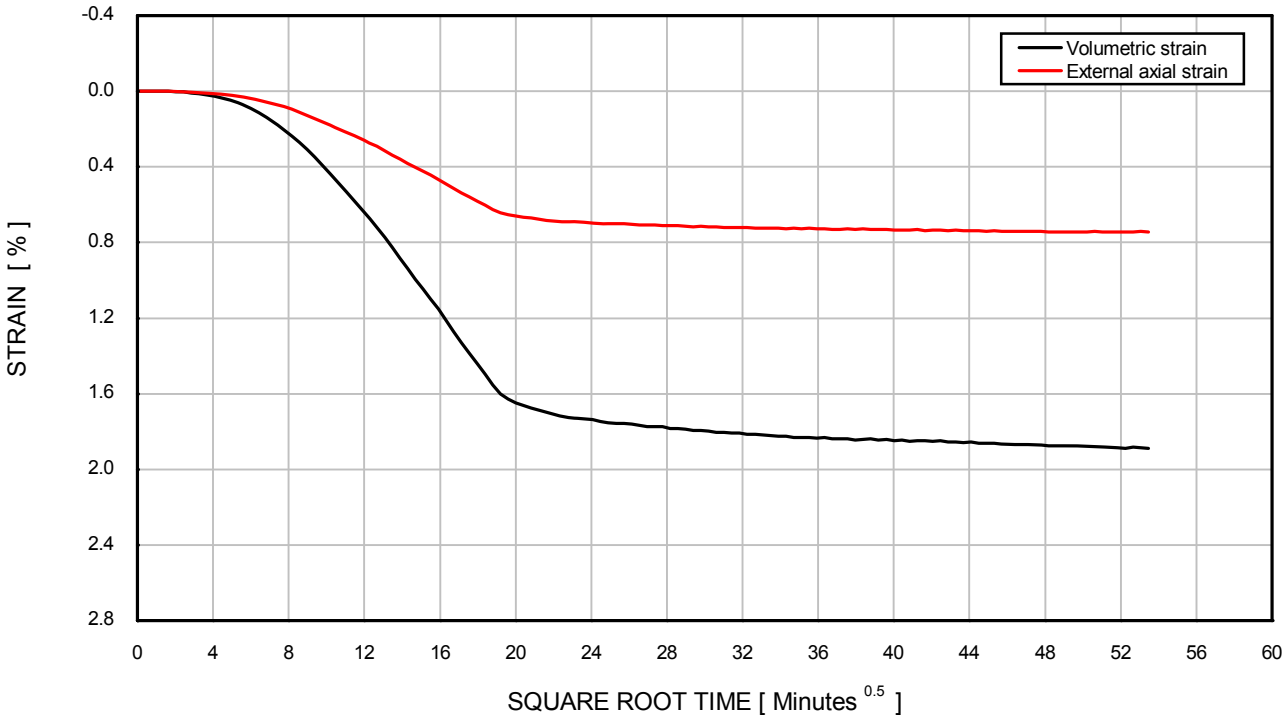
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

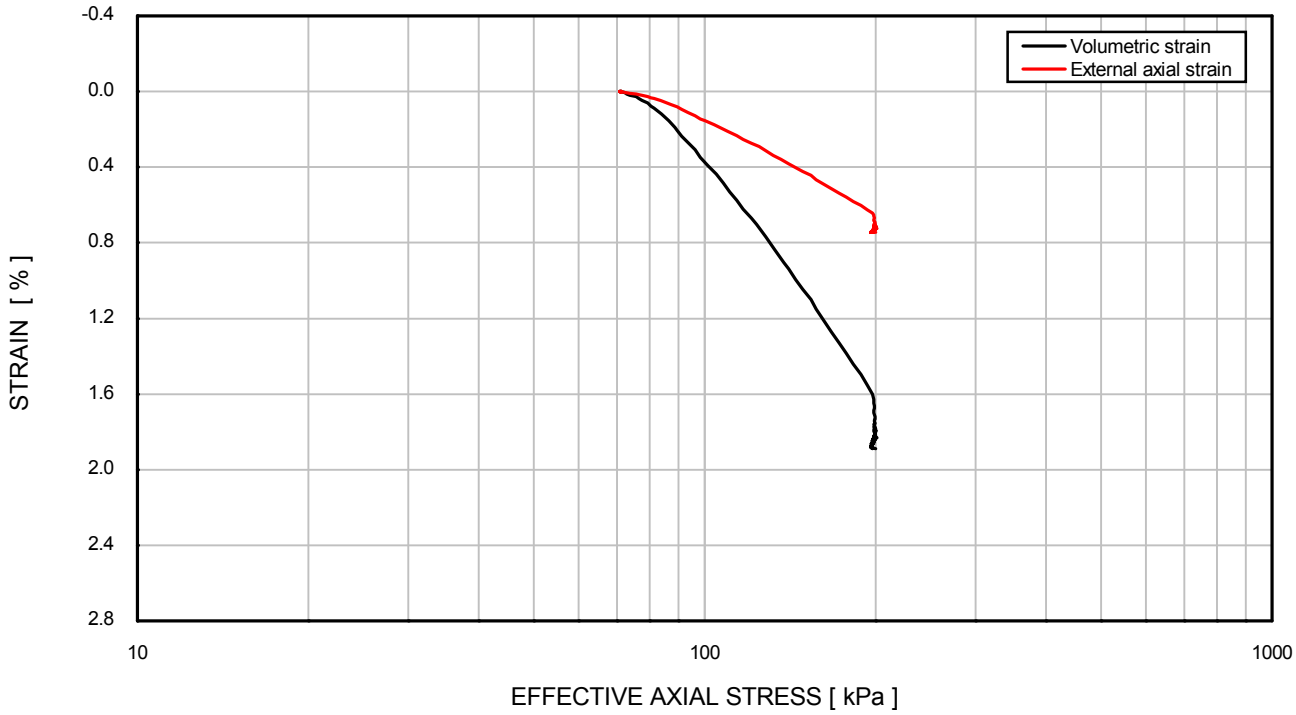




B value	: 1.00	Borehole	: HKZ2-BH21-SA
Initial σ'_r	: 23 kPa	Sample	: 29WaxB
Initial σ'_a	: 23 kPa	Depth [m]	: 22.20
Final σ'_r	: 71 kPa	Test No.	: CAU01
Final σ'_a	: 71 kPa		

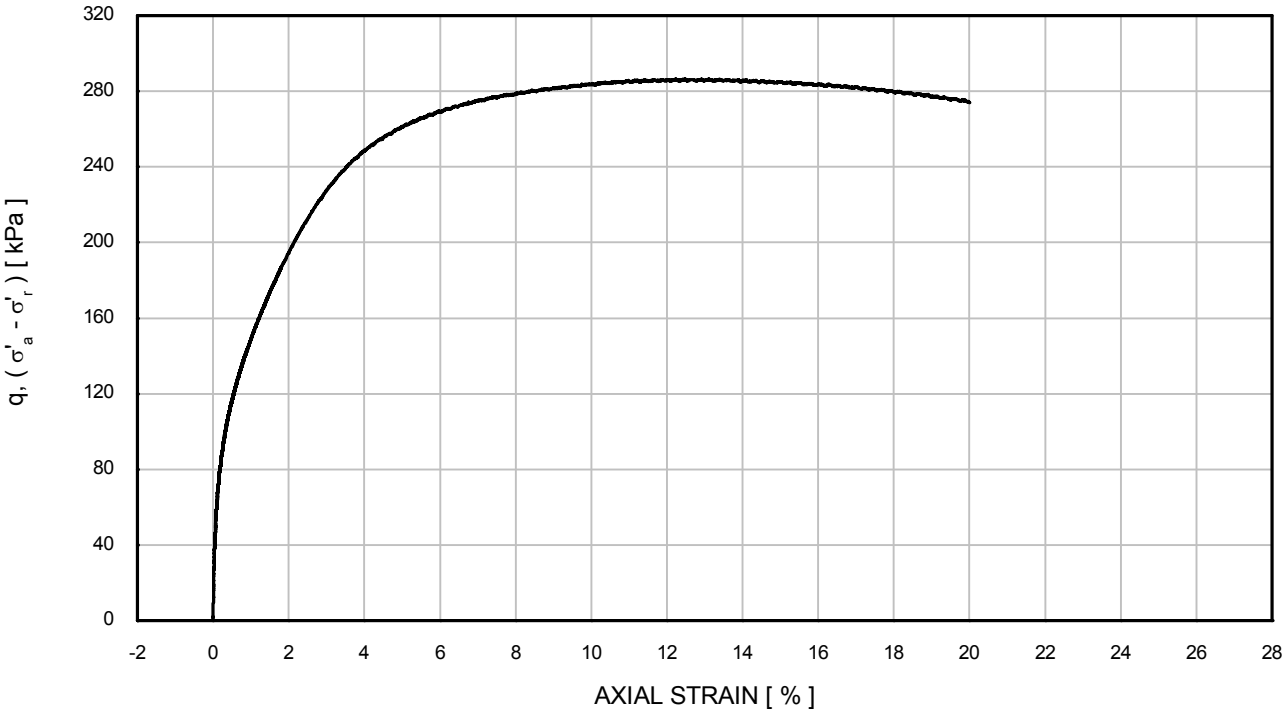
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

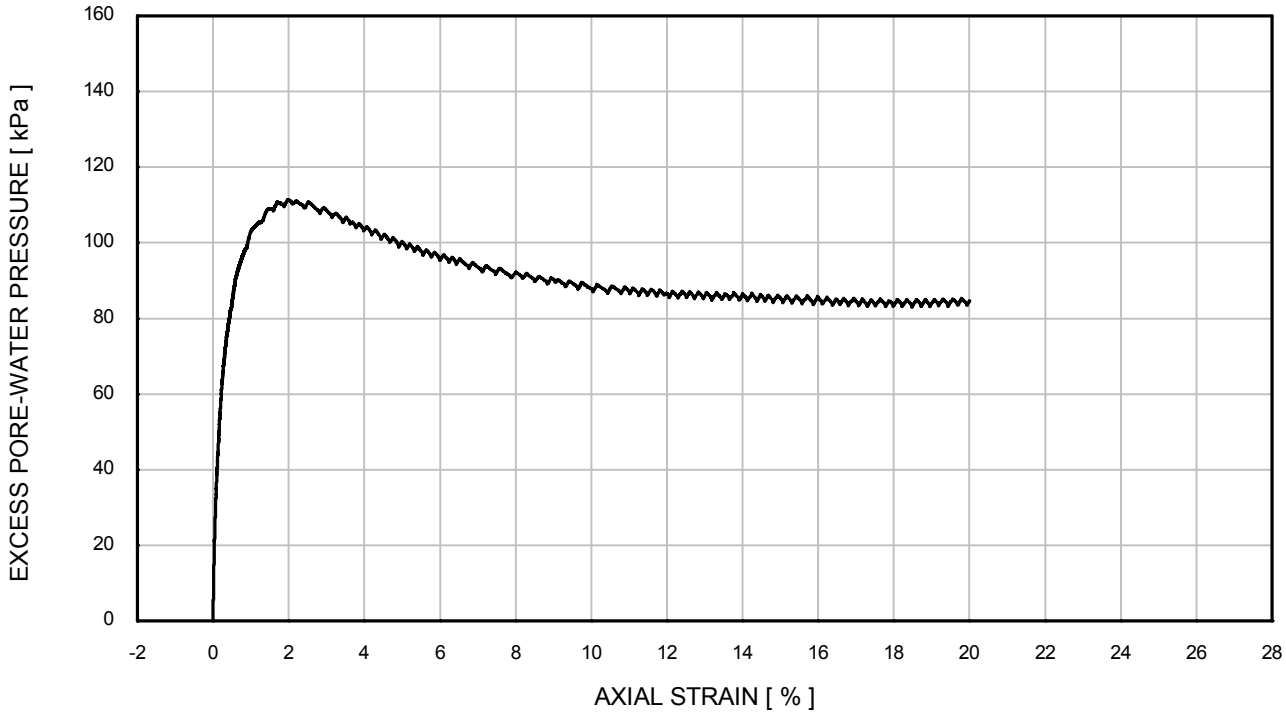




Stage 1 σ'_{rc}	: 200 kPa	Batch	: HKZ2-BH21-SA
Stage 1 σ'_{ac}	: 200 kPa	Sample	: 29WaxB
		Unit	: 22.2
		Test No.	: CAU01

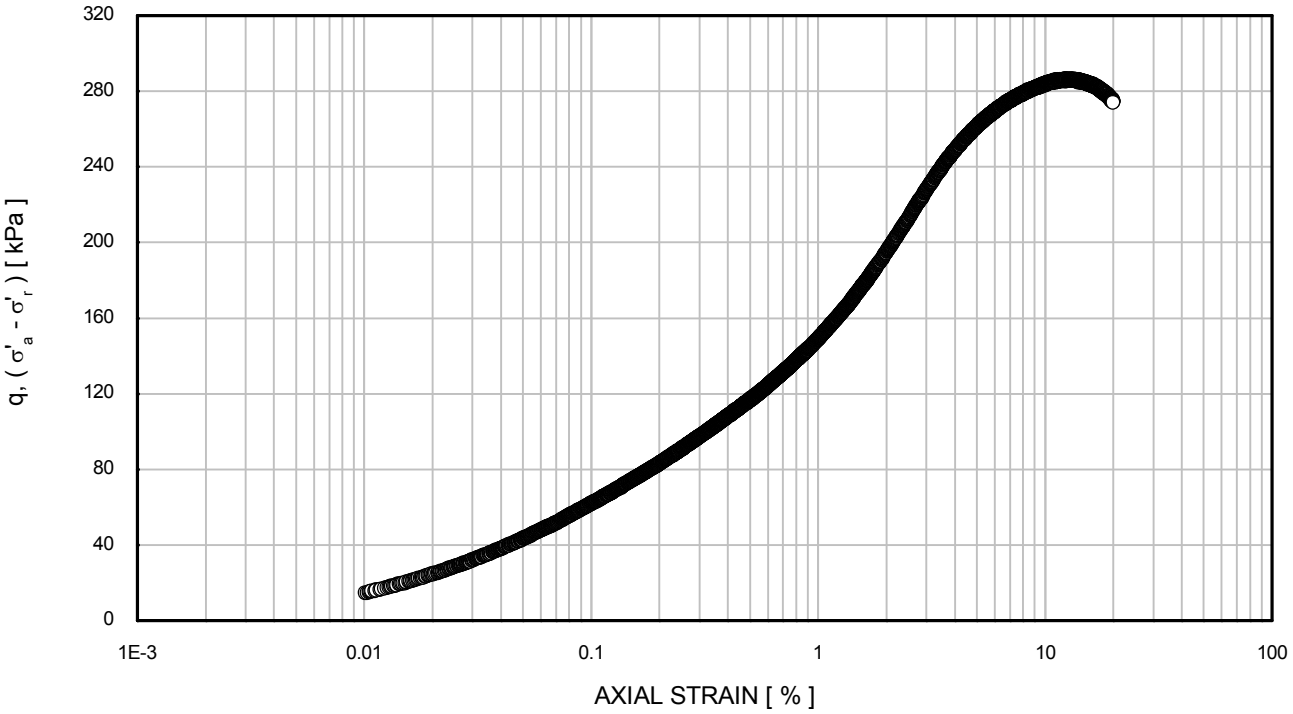
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

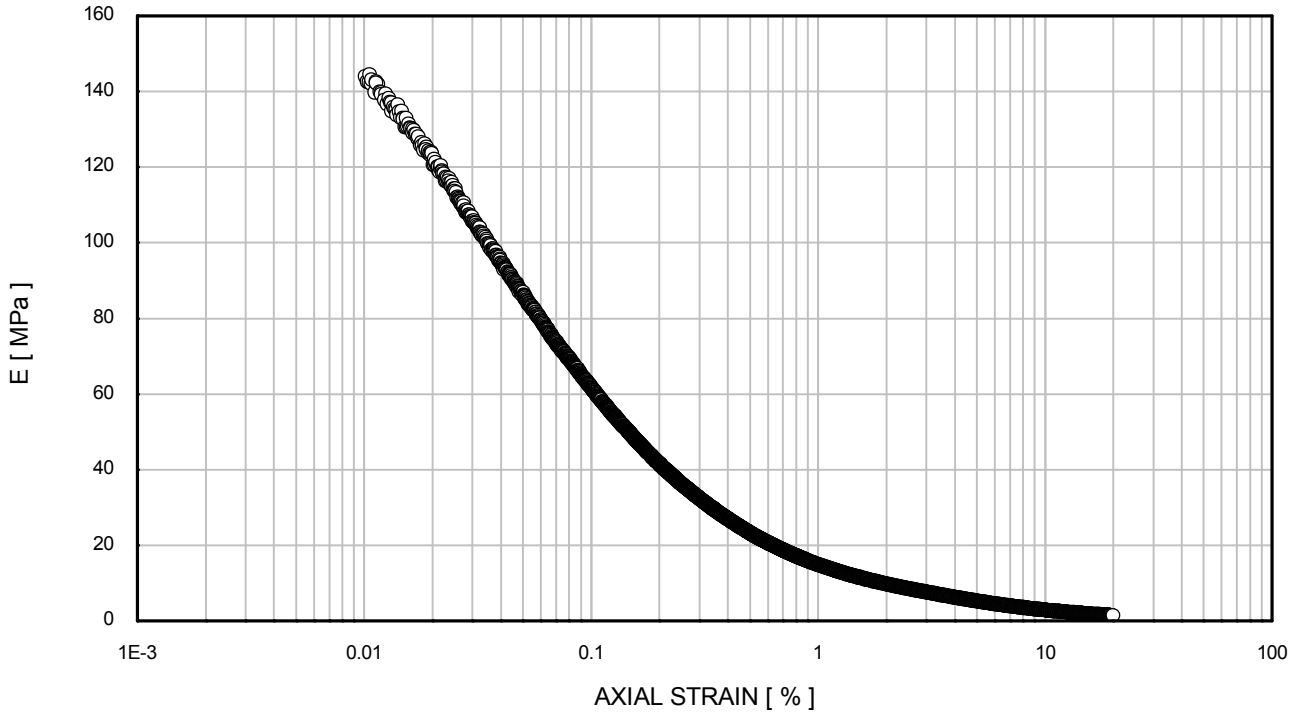




Initial σ'_r	: 200 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 200 kPa	Sample	: 29WaxB
q_{peak}	: 287 kPa	Depth [m]	: 22.20
Ext. ε at q_{peak}	: 12.49 %	Test No.	: CAU01
Rate of strain	: 0.30 %/hour		

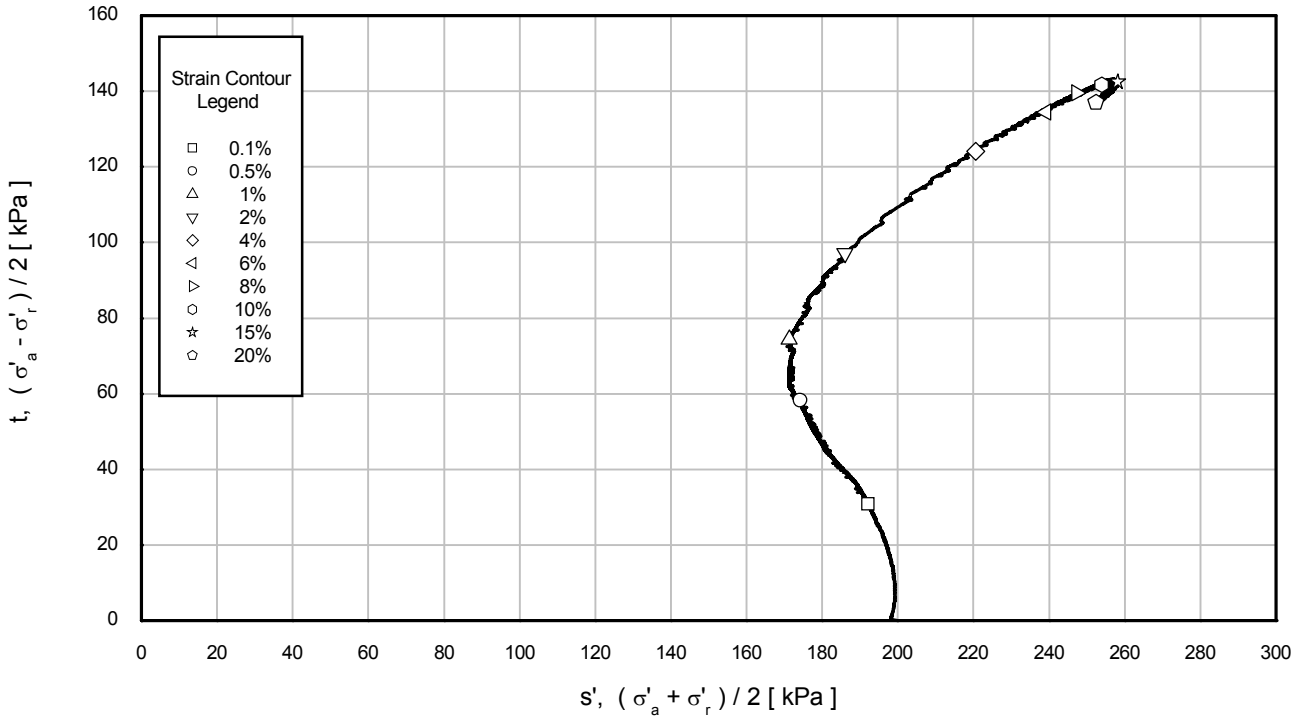
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

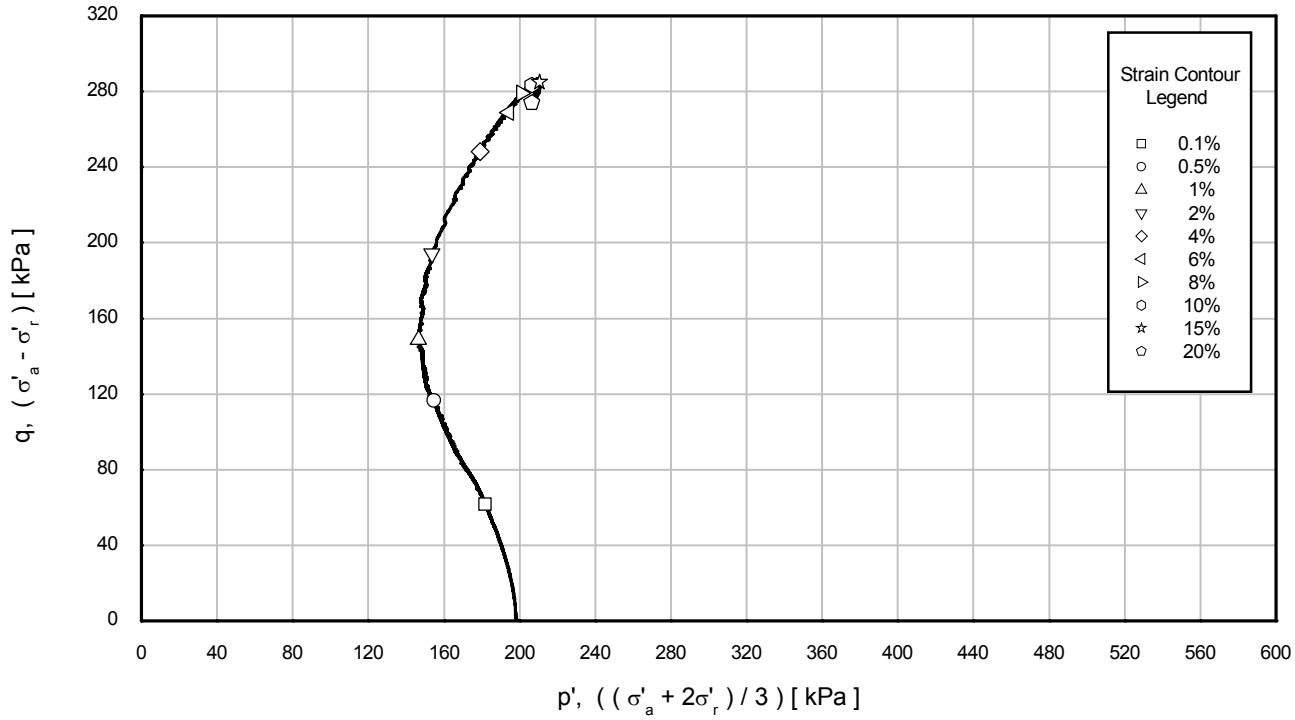




Initial σ'_r	: 200 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 200 kPa	Sample	: 29WaxB
q_{peak}	: 287 kPa	Depth [m]	: 22.20
Ext. ε at q_{peak}	: 12.49 %	Test No.	: CAU01
Rate of strain	: 0.30 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	200 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	200 kPa	Sample	:	29WaxB
q_{peak}	:	287 kPa	Depth [m]	:	22.20
Ext. ε at q_{peak}	:	12.49 %	Test No.	:	CAU01
Rate of strain	:	0.30 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND with fine to medium gravel sized shell fragments

GENERAL	
Date test started	29/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.0
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.604
Degree of saturation	[%]	44
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 01_CIU01
Processed by Date	MSR 06/12/2016
Checked by Date	PH 07/12/2016
Approved by Date	PH 07/12/2016

TEST IDENTIFICATION	
Batch	1
Sample	-
Unit	Unit A (Southern Bight)
Test number	CIU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	800
Base PWP	[kPa]	789
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	804
Back pressure	[kPa]	789
Base PWP	[kPa]	789
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	15
Effective axial pressure	[kPa]	15
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.05
External axial strain	[%]	0.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.8
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.603
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	-
Unit	Unit A (Southern Bight)
Test number	CIU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	15
Initial effective axial pressure	[kPa]	15
Rate of strain	[%/hour]	0.96
At peak deviator stress		
Corrected deviator stress	[kPa]	2258
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	6.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-800
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	816
Effective axial pressure	[kPa]	3073
Principal effective stress ratio	[-]	3.77
ε_{50}	[%]	3.67
Secant modulus (E_{50}) at ε_{50}	[kPa]	30722
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	120
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	0.75
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-17
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	32
Effective axial pressure	[kPa]	152
Principal effective stress ratio	[-]	4.75
At 15% external axial strain		
Corrected deviator stress	[kPa]	-
Membrane correction applied	[kPa]	-
Drain correction applied	[kPa]	-
External axial strain	[%]	-
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	-
Effective axial pressure	[kPa]	-
Principal effective stress ratio	[-]	-

TEST IDENTIFICATION	
Batch	1
Sample	-
Unit	Unit A (Southern Bight)
Test number	CIU01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





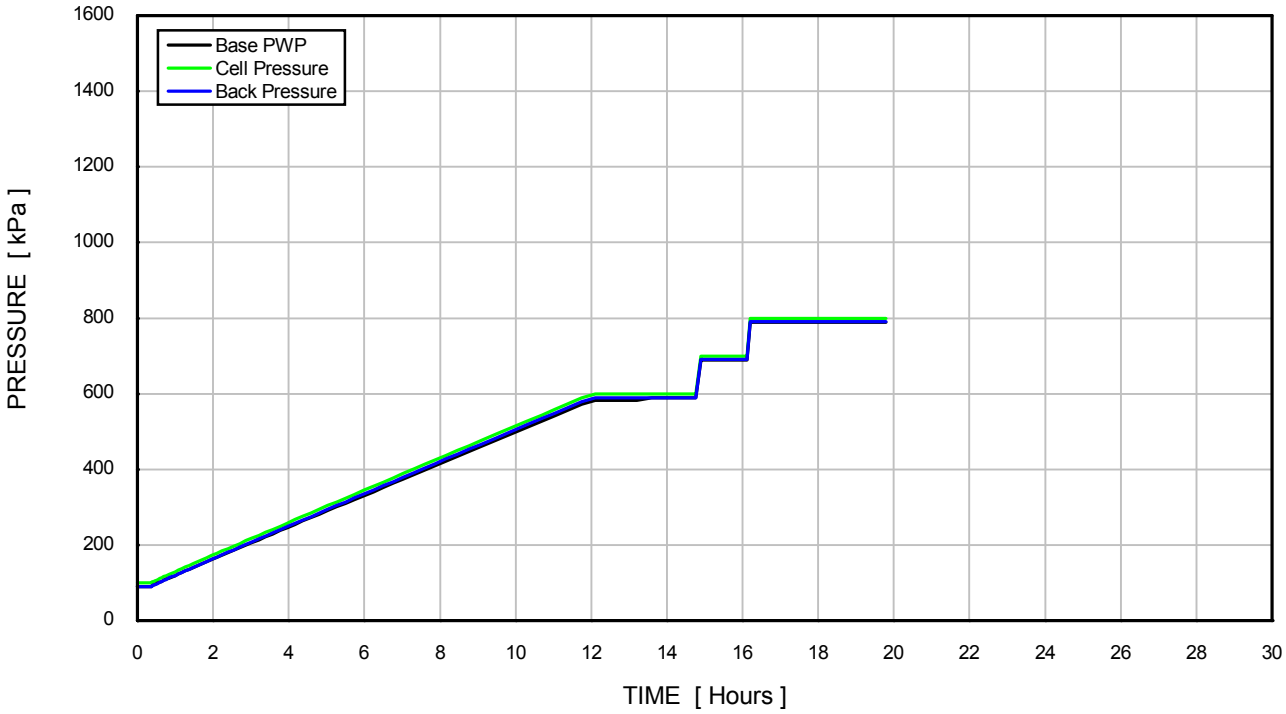
FINAL CONDITIONS

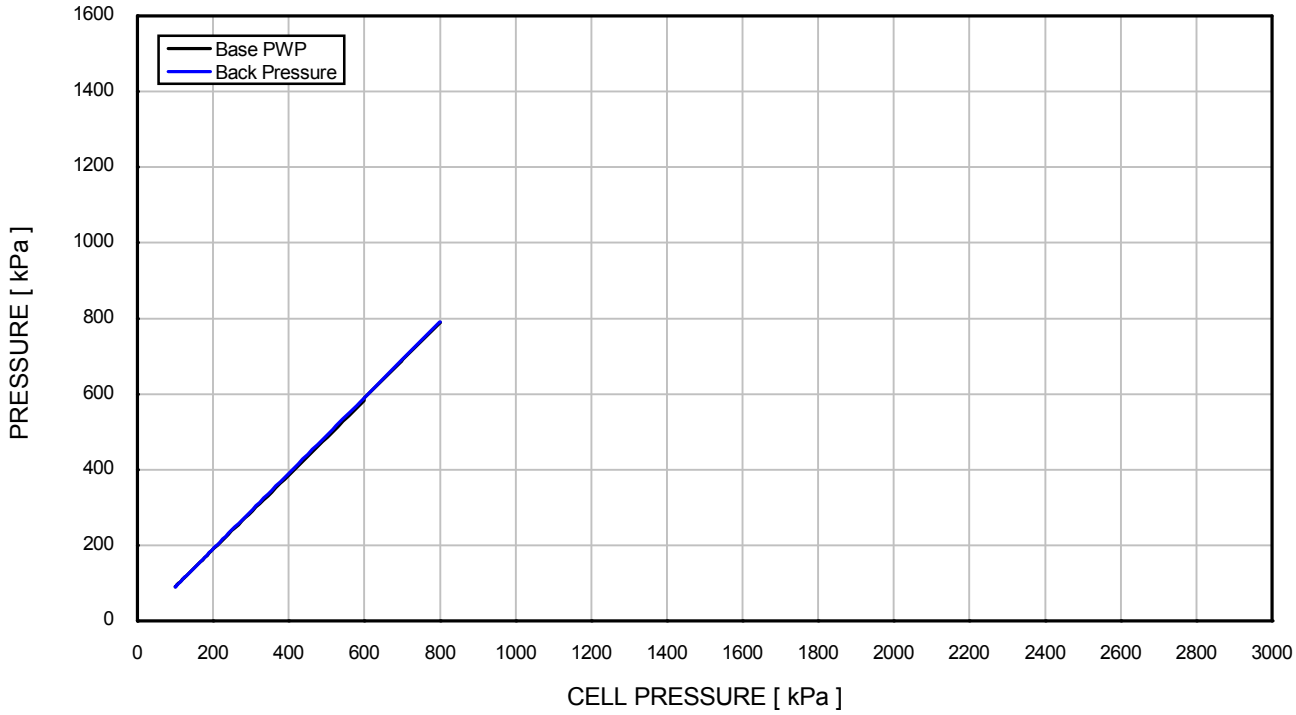
Water content	[%]	22.8
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65

TEST IDENTIFICATION

Batch	1
Sample	-
Unit	Unit A (Southern Bight)
Test number	CIU01

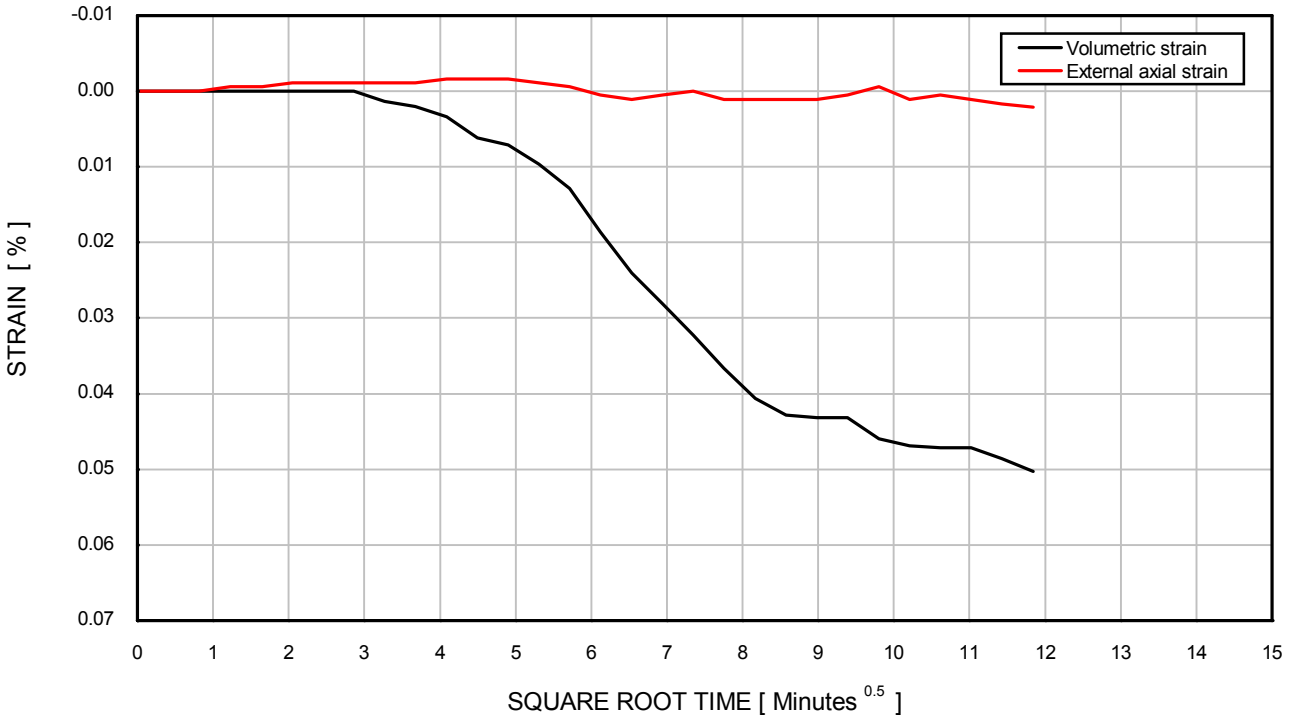
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST





B value	:	1.00			
Initial σ'_r	:	9	kPa	Batch	: 1
Initial σ'_a	:	9	kPa	Sample	: -
Final σ'_r	:	11	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	11	kPa	Test No.	: CIU01

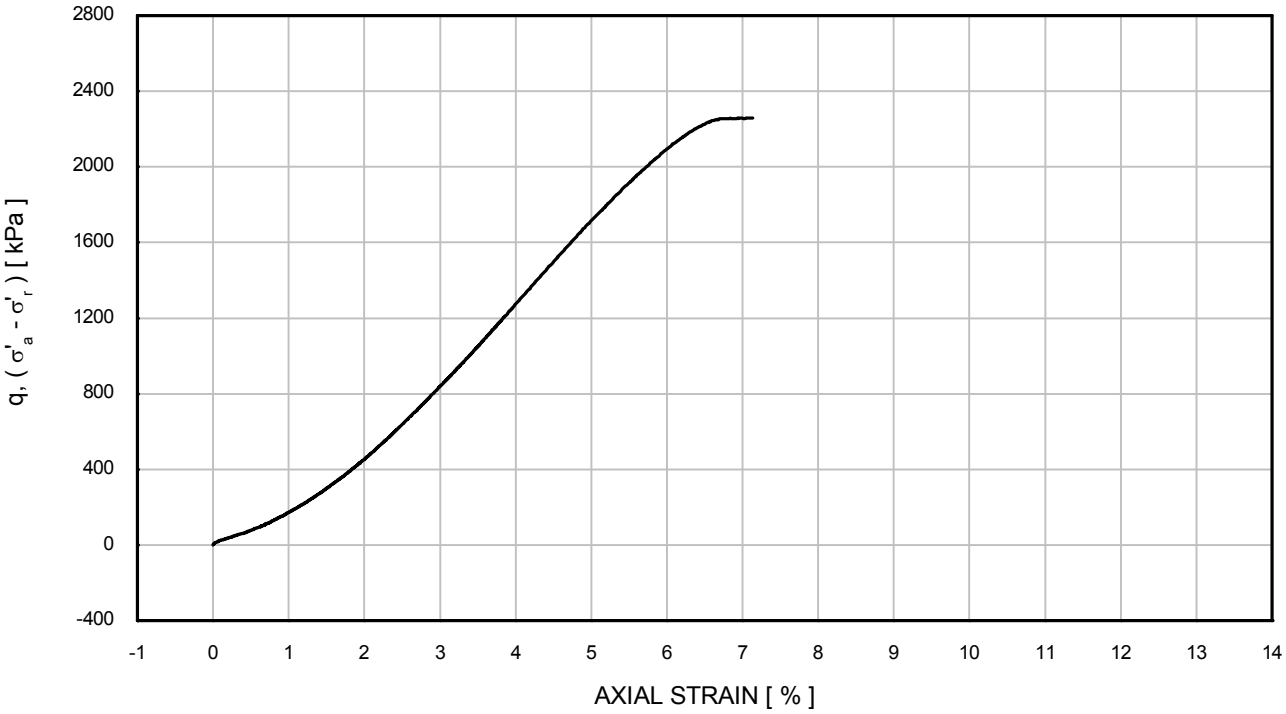
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

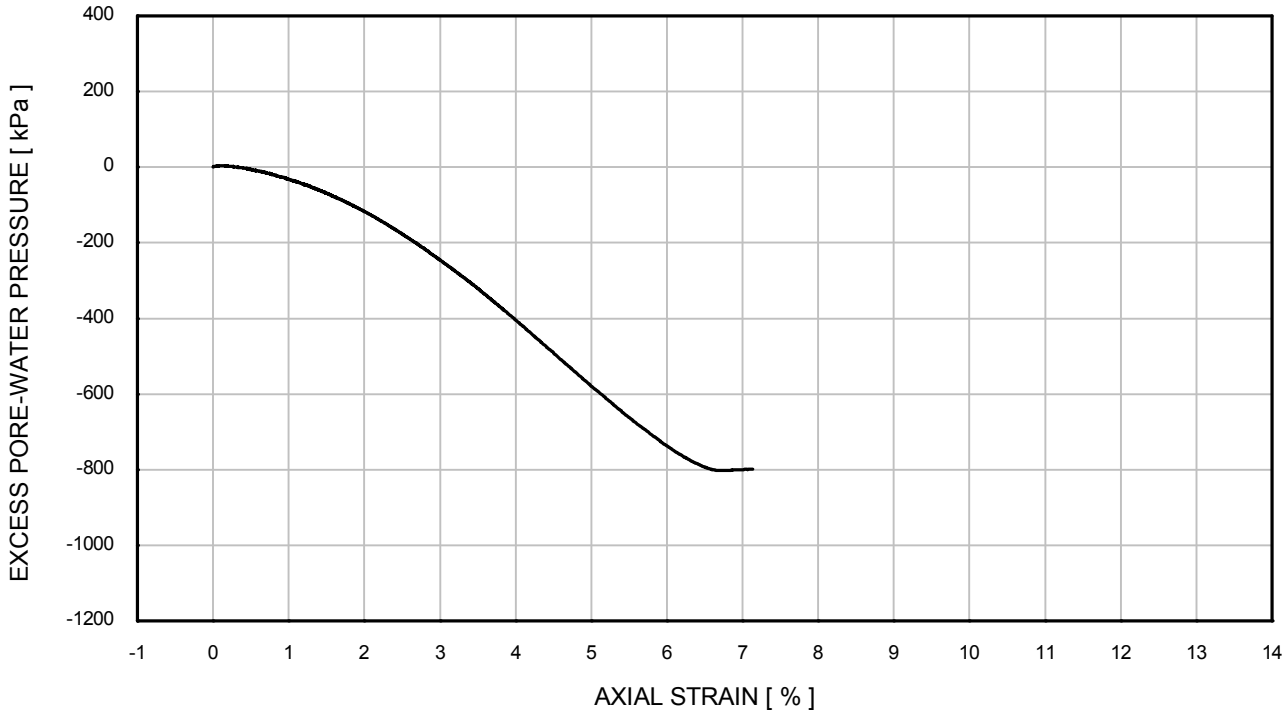




Stage 1 σ'_{rc}	:	15 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	15 kPa	Sample	:	-
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CIU01

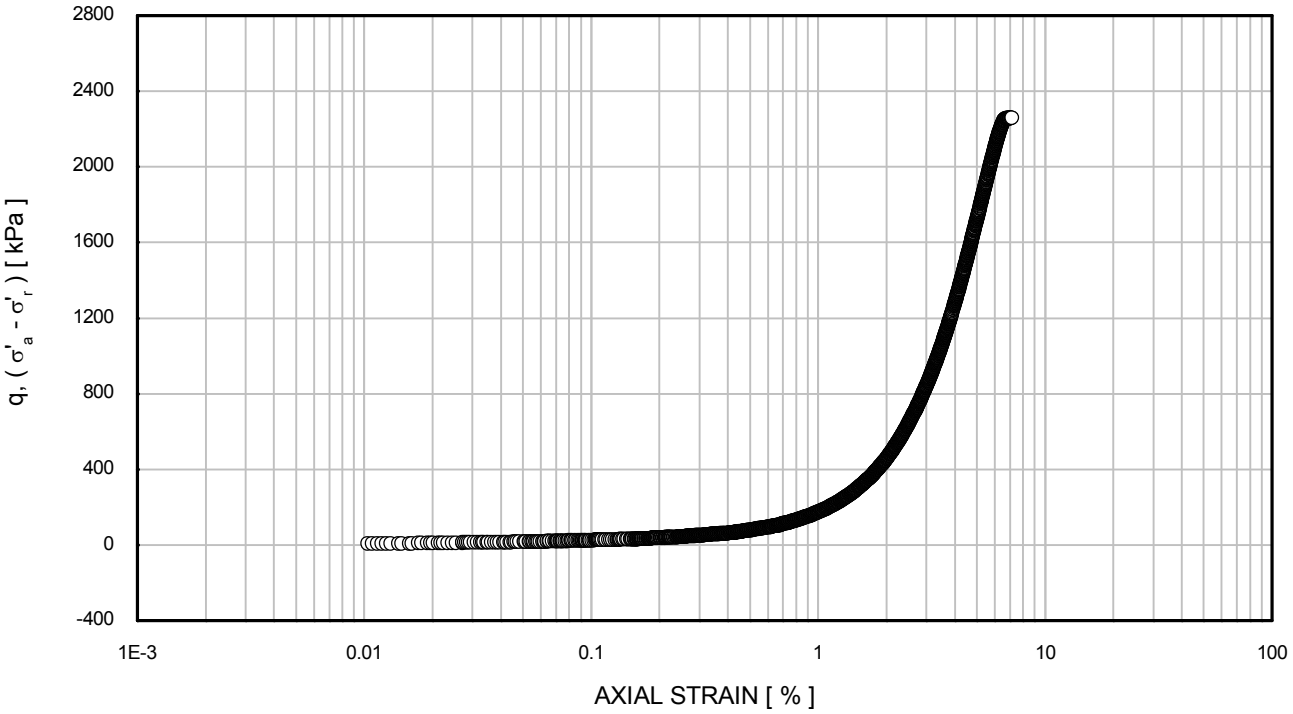
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

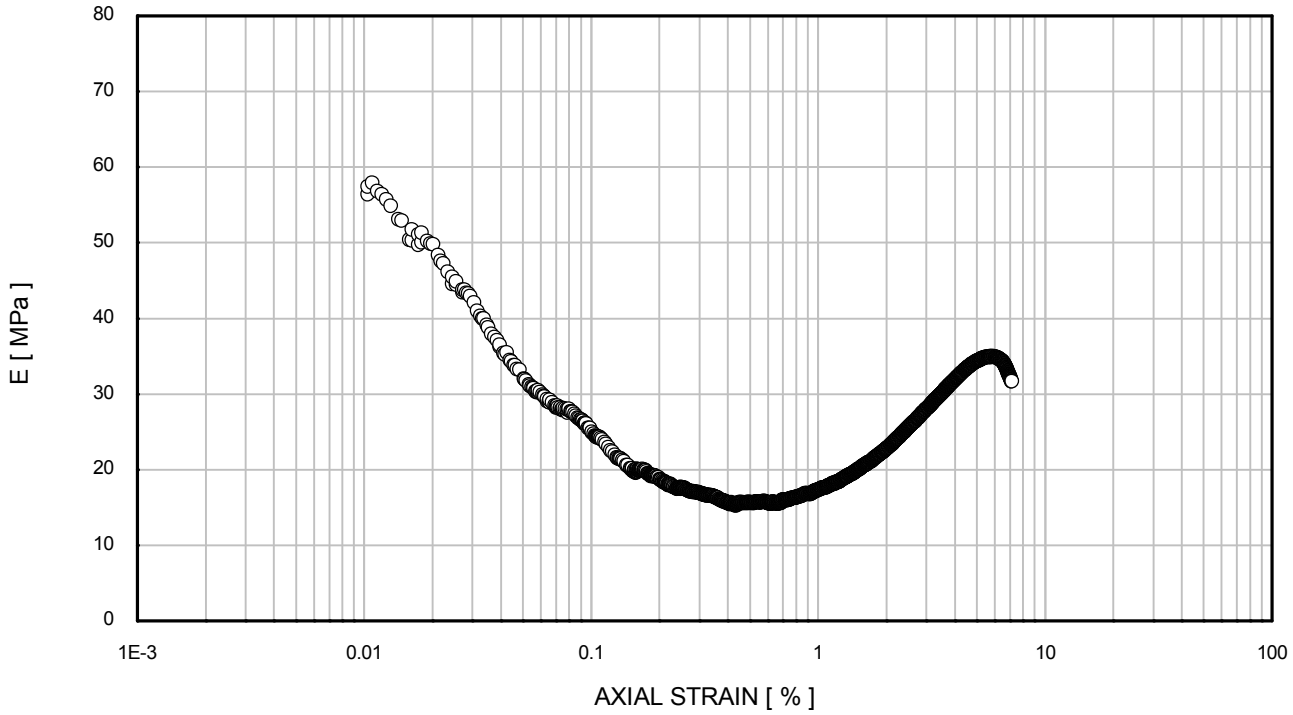




Initial σ'_r	:	15 kPa	Batch	:	1
Initial σ'_a	:	15 kPa	Sample	:	-
q_{peak}	:	2258 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	6.99 %	Test No.	:	CIU01
Rate of strain	:	0.96 %/hour			

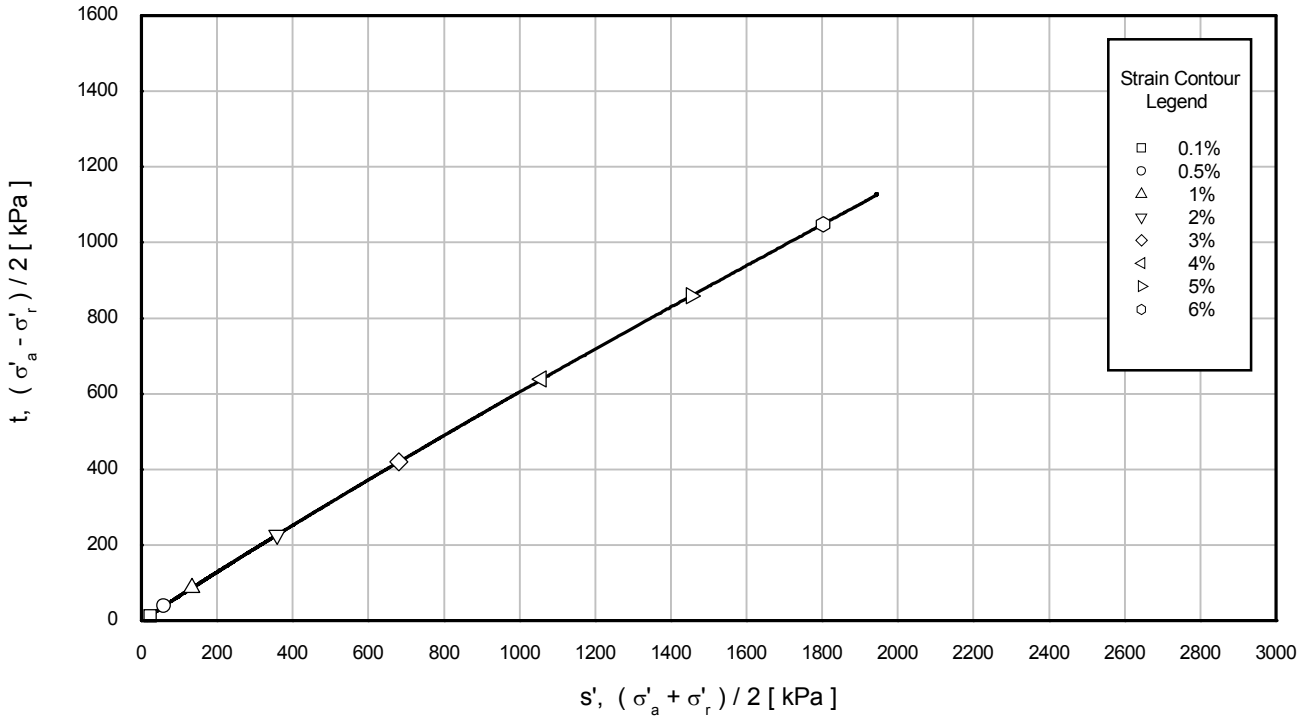
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

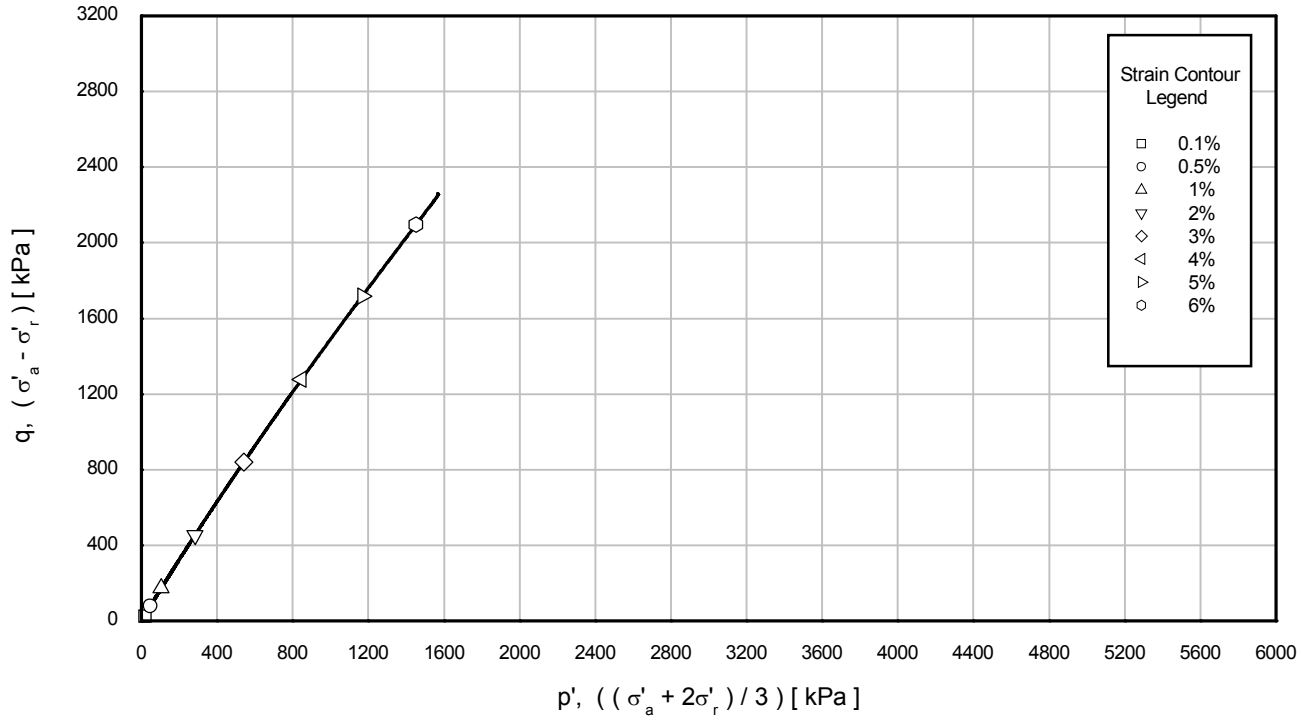




Initial σ'_r	:	15 kPa	Batch	:	1
Initial σ'_a	:	15 kPa	Sample	:	-
q_{peak}	:	2258 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	6.99 %	Test No.	:	CIU01
Rate of strain	:	0.96 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	15 kPa	Batch	:	1
Initial σ'_a	:	15 kPa	Sample	:	-
q_{peak}	:	2258 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	6.99 %	Test No.	:	CIU01
Rate of strain	:	0.96 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Light yellowish brown fine to medium SAND

GENERAL	
Date test started	15/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.2
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	44
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 3_CIUc02
Processed by Date	MSR 24/11/2016
Checked by Date	PH 28/11/2016
Approved by Date	PH 28/11/2016

TEST IDENTIFICATION	
Batch	3
Sample	-
Unit	Unit B1 (Kreftenheye)
Test number	CIUc02

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1000
Base PWP	[kPa]	980
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1115
Back pressure	[kPa]	980
Base PWP	[kPa]	980
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.58
External axial strain	[%]	0.17
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.612
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	-
Unit	Unit B1 (Kreftenheye)
Test number	CIUc02

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	135
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	1906
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	20.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-707
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	842
Effective axial pressure	[kPa]	2747
Principal effective stress ratio	[-]	3.26
ε_{50}	[%]	6.84
Secant modulus (E_{50}) at ε_{50}	[kPa]	13929
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	440
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.46
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-27
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	162
Effective axial pressure	[kPa]	601
Principal effective stress ratio	[-]	3.72
At 15% external axial strain		
Corrected deviator stress	[kPa]	1701
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-572
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	707
Effective axial pressure	[kPa]	2409
Principal effective stress ratio	[-]	3.40

TEST IDENTIFICATION	
Batch	3
Sample	-
Unit	Unit B1 (Kreftenheye)
Test number	CIUc02

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





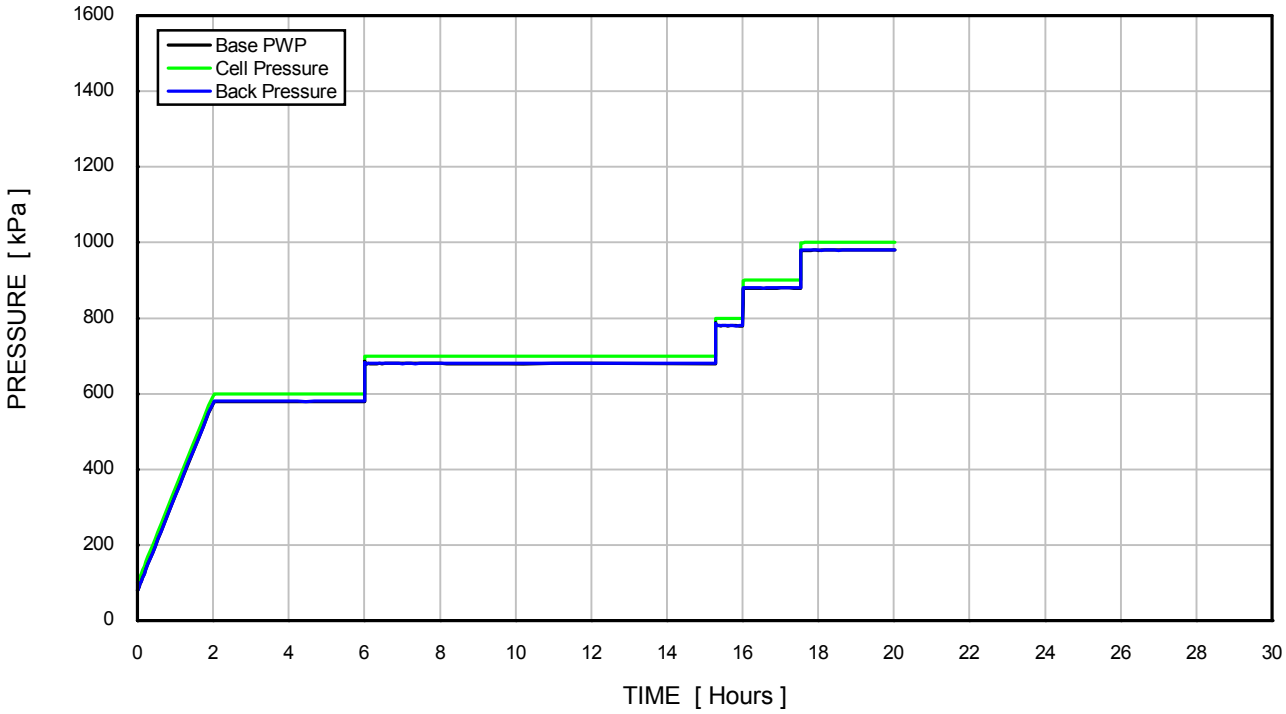
FINAL CONDITIONS

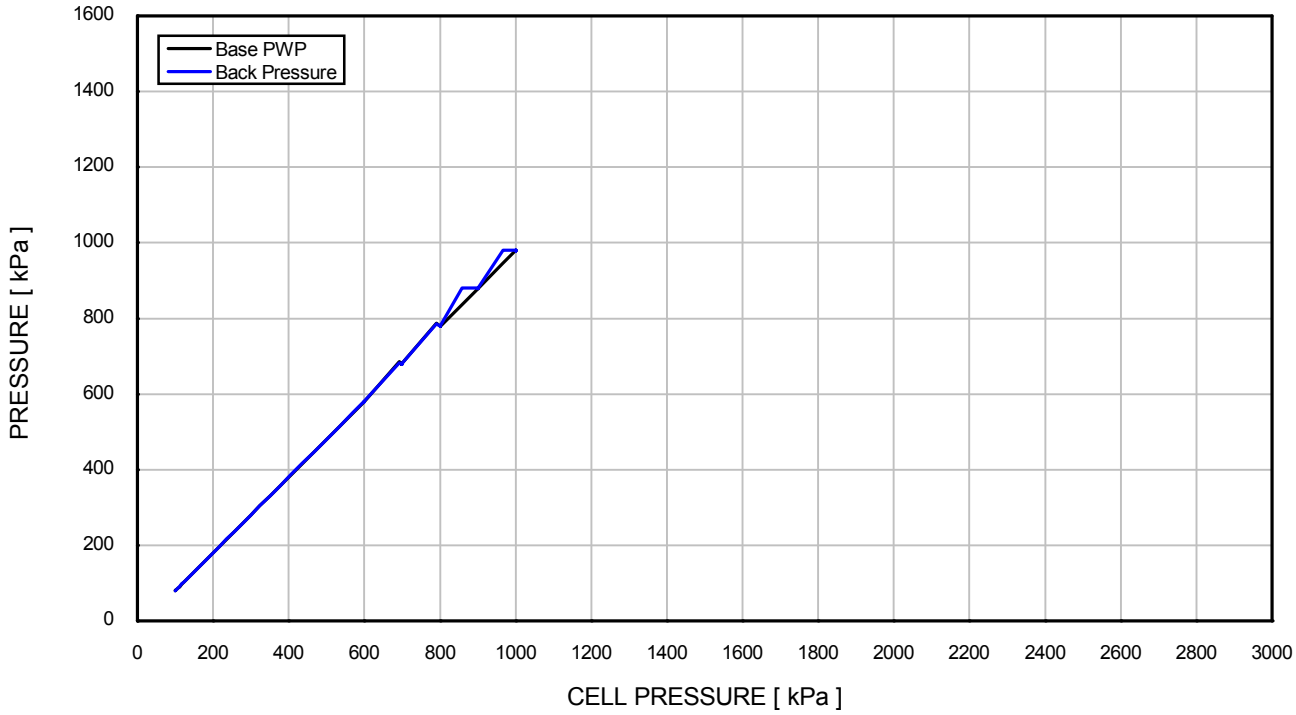
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64

TEST IDENTIFICATION

Batch	3
Sample	-
Unit	Unit B1 (Kreftenheye)
Test number	CIUc02

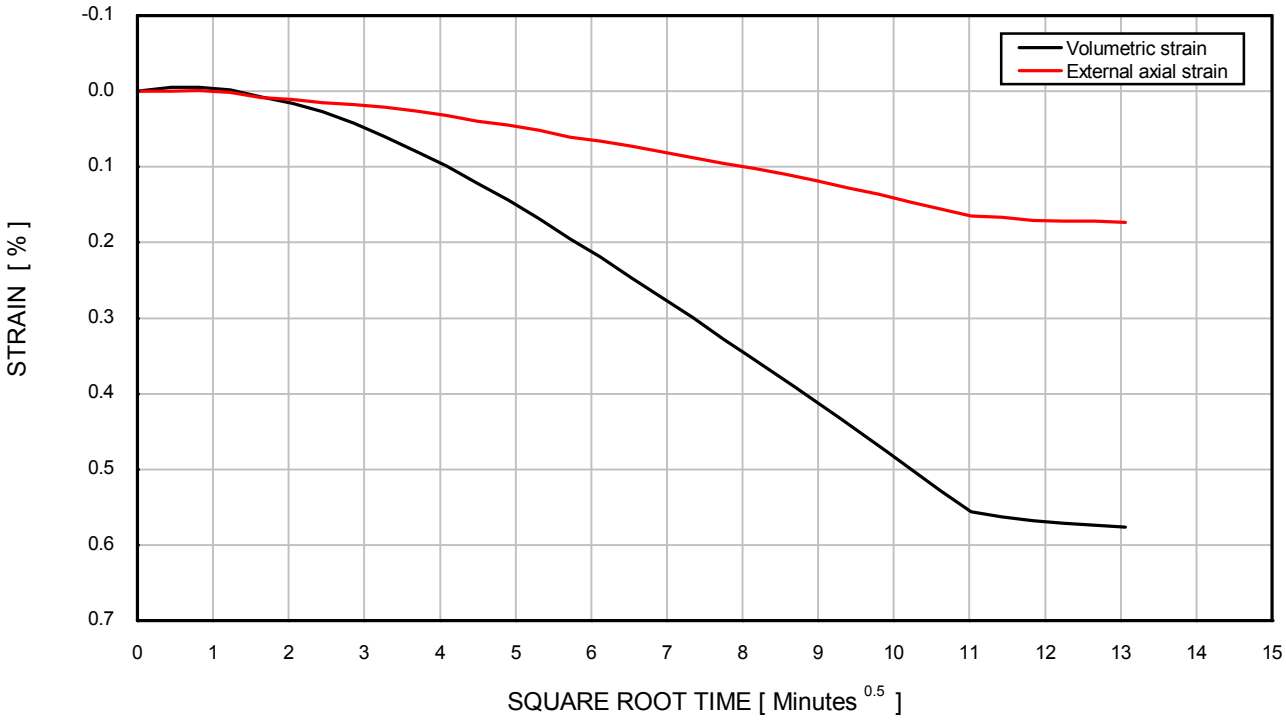
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

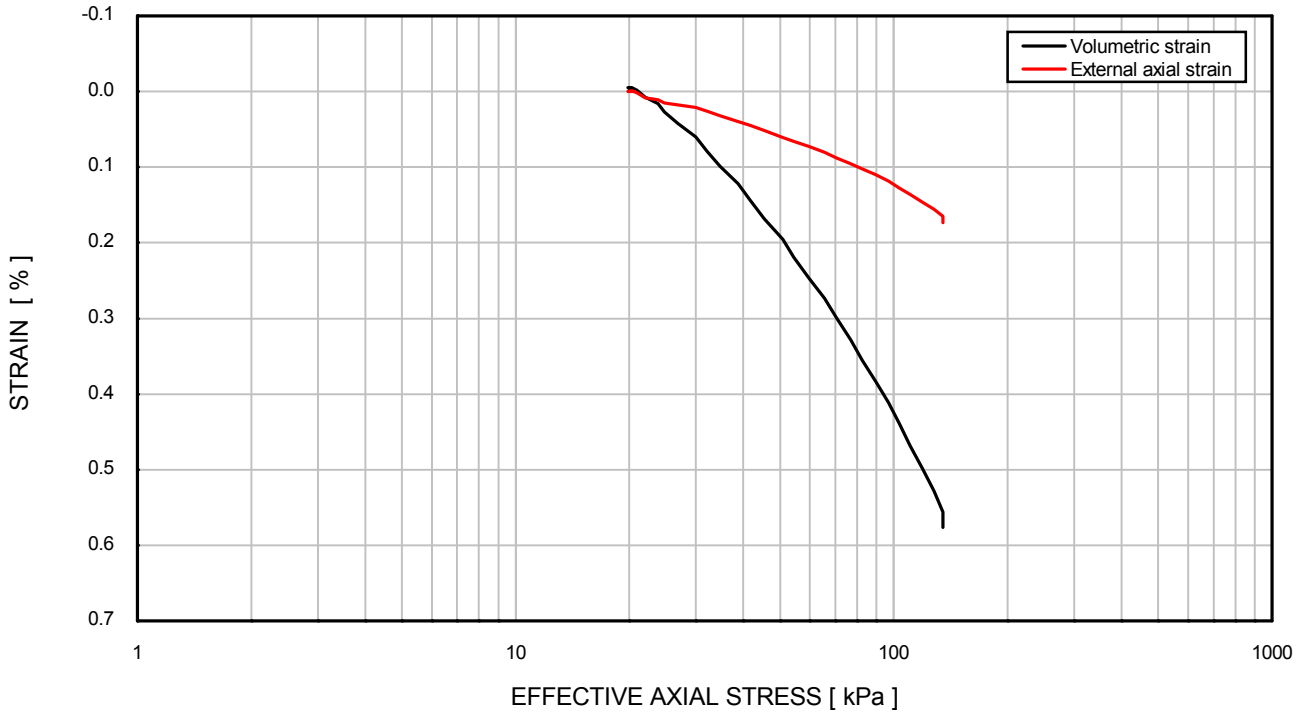




B value	:	1.00	Batch	:	3
Initial σ'_r	:	20 kPa	Sample	:	-
Initial σ'_a	:	20 kPa	Unit	:	Unit B1 (Kreftenheye)
Final σ'_r	:	20 kPa	Test No.	:	CIUc02
Final σ'_a	:	20 kPa			

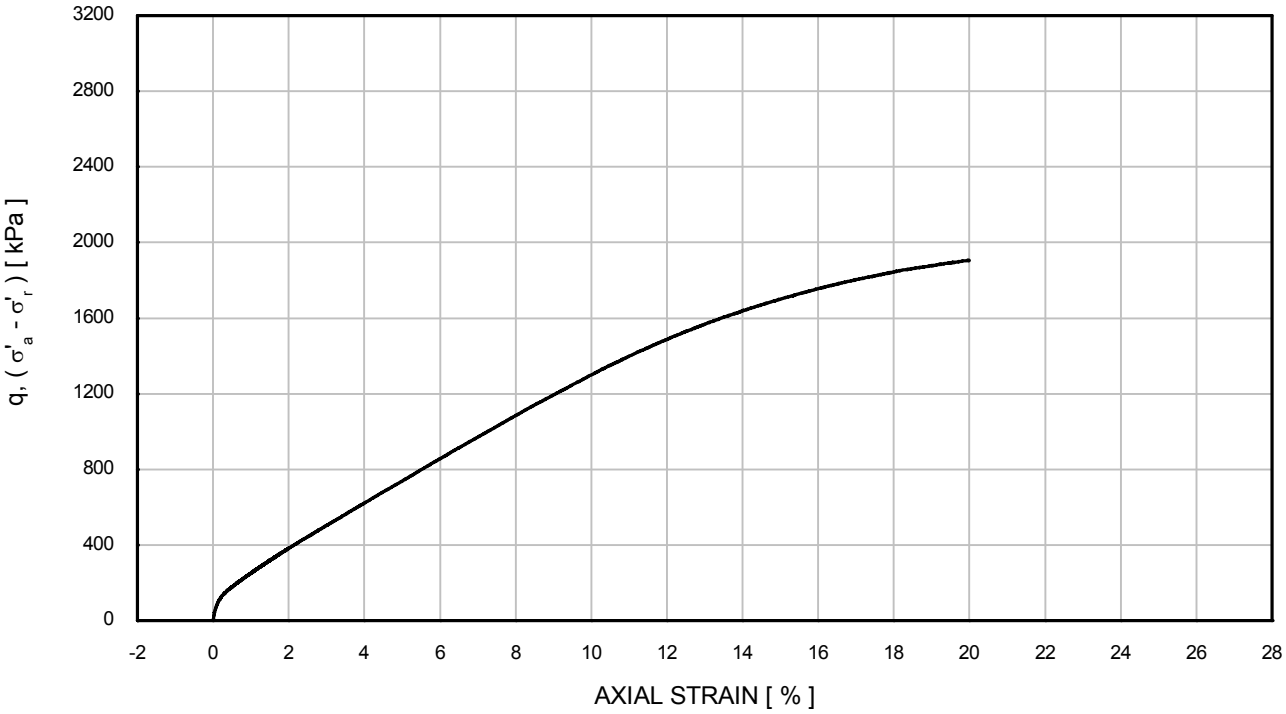
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

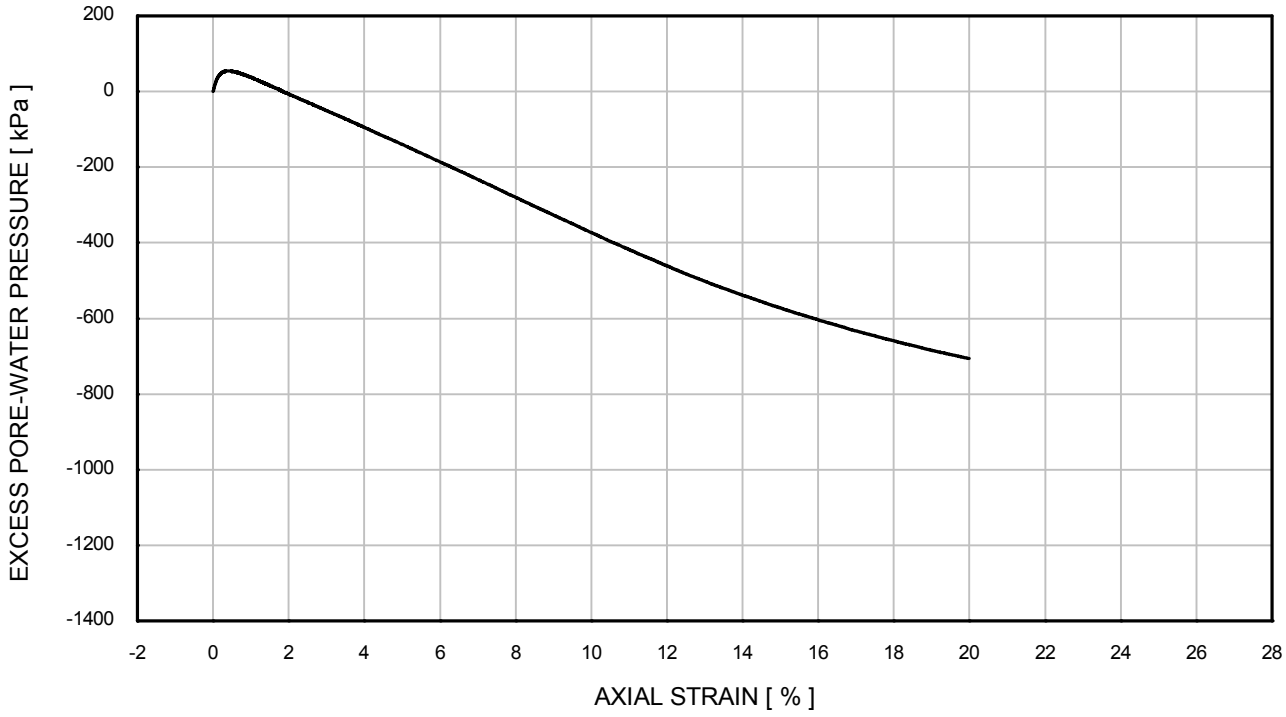




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: -
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CIUc02

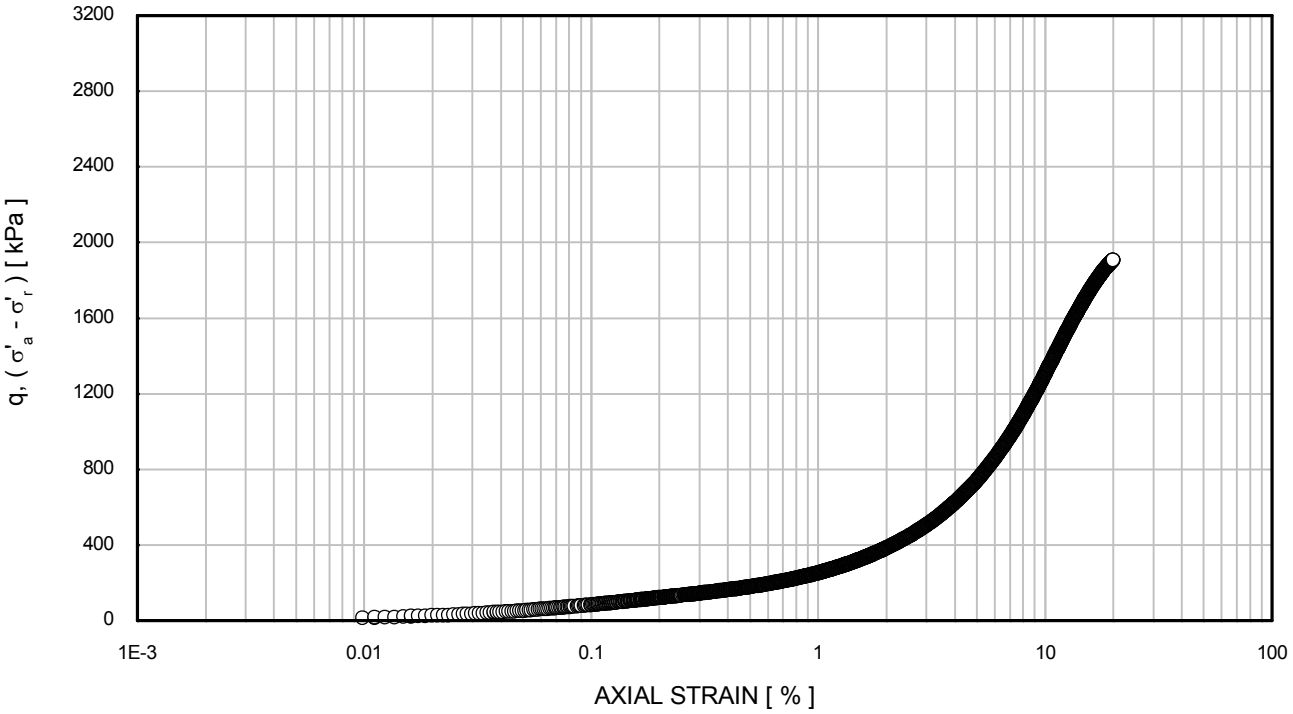
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

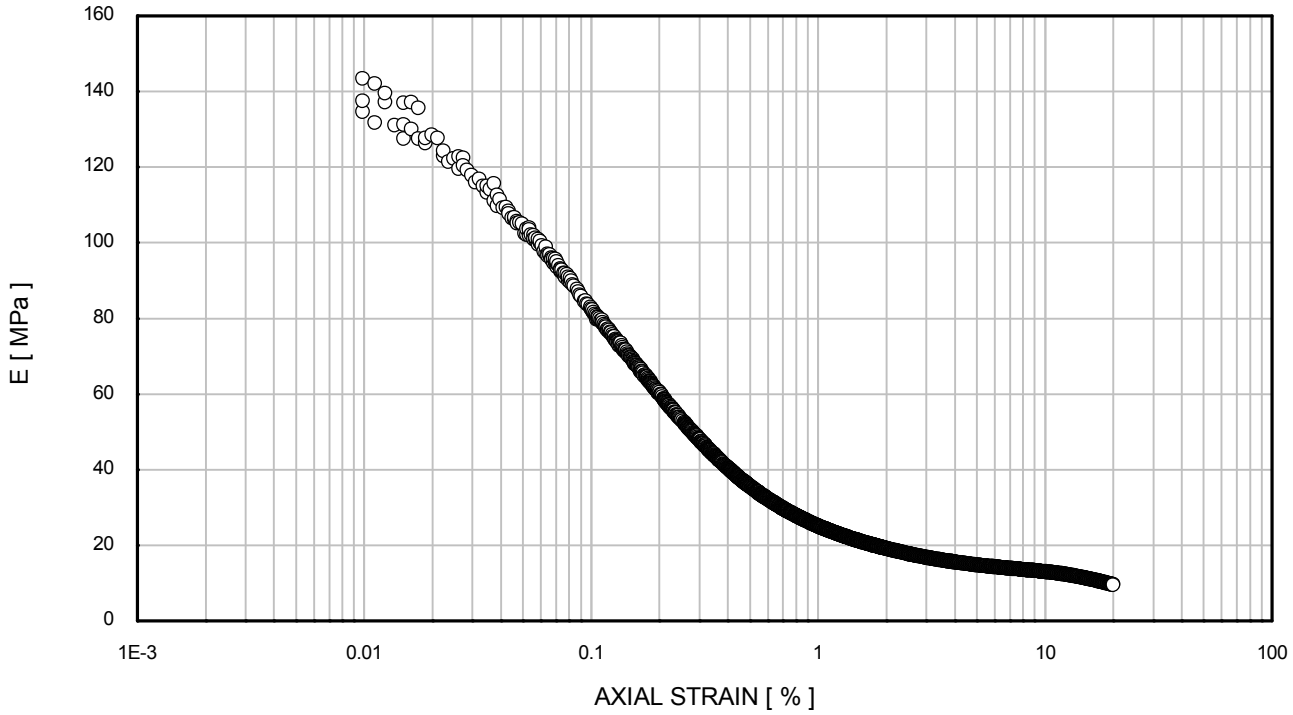




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 135 kPa	Sample	: -
q_{peak}	: 1906 kPa	Unit	: Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	: 20.00 %	Test No.	: CIUc02
Rate of strain	: 1.00 %/hour		

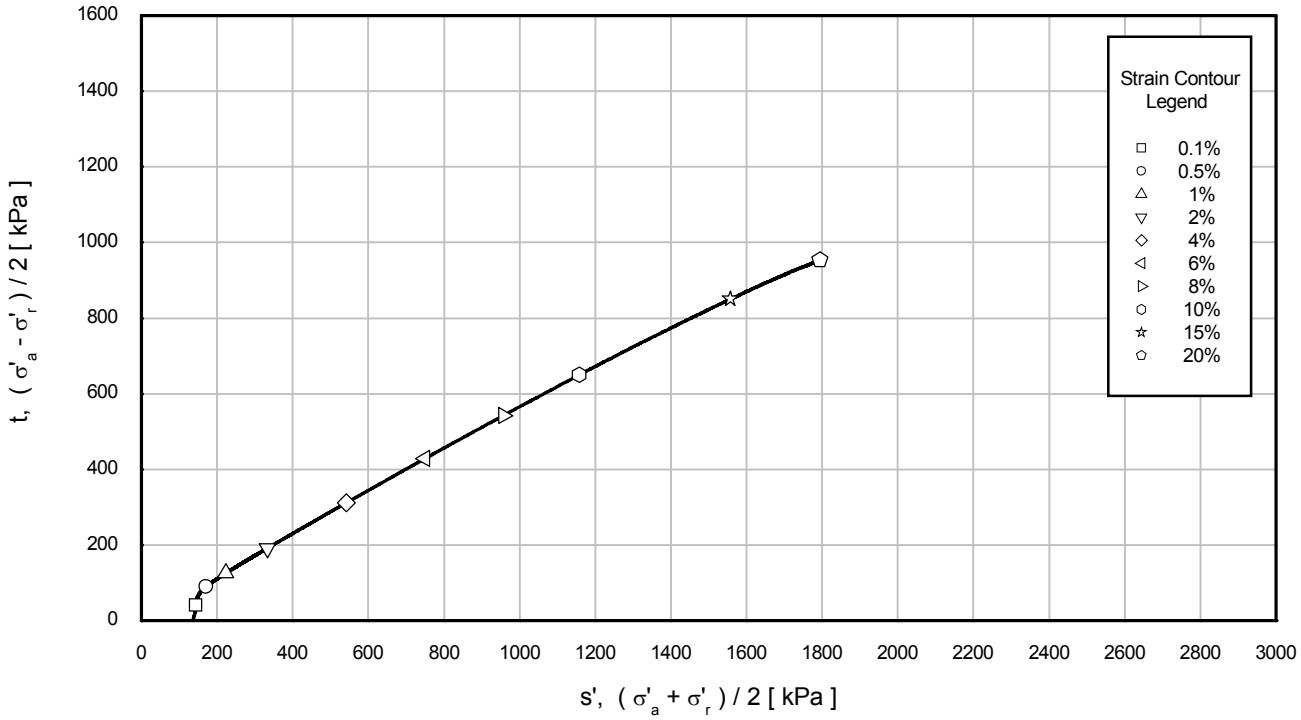
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

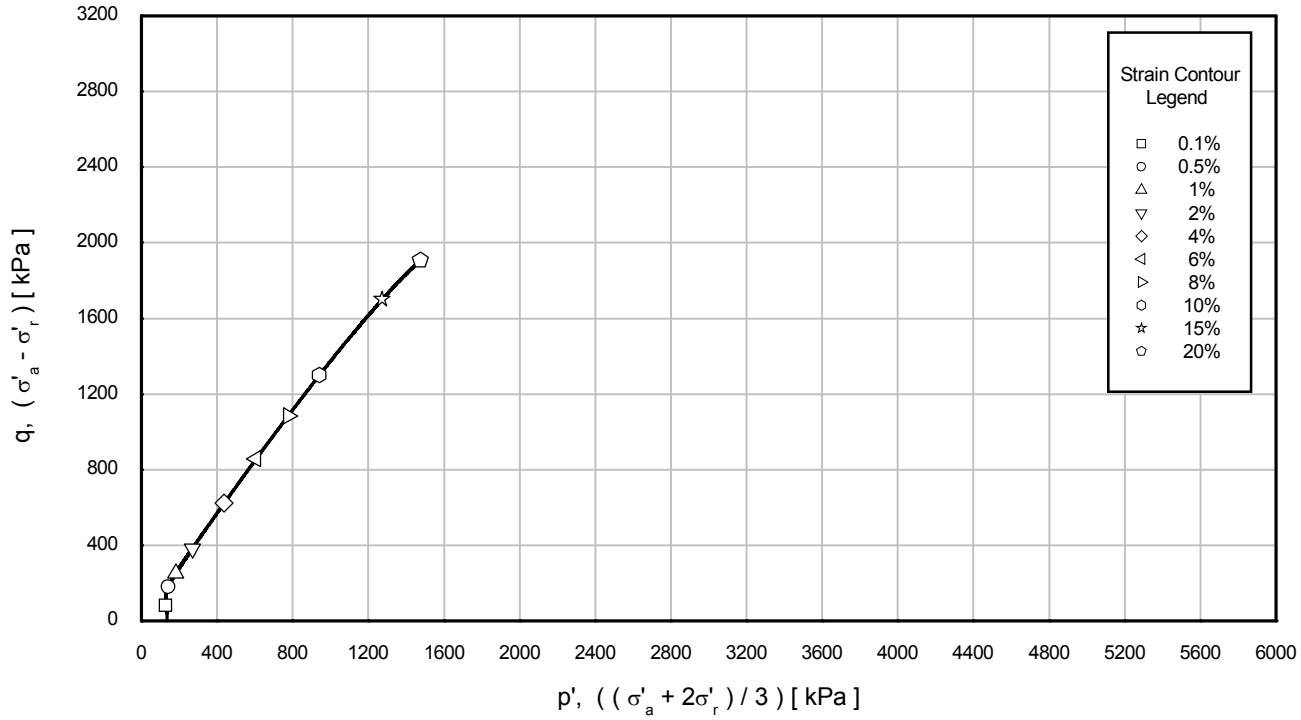




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 135 kPa	Sample	: -
q_{peak}	: 1906 kPa	Unit	: Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	: 20.00 %	Test No.	: CIUc02
Rate of strain	: 1.00 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 135 kPa	Sample	: -
q_{peak}	: 1906 kPa	Unit	: Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	: 20.00 %	Test No.	: CIUc02
Rate of strain	: 1.00 %/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark yellowish brown fine SAND

GENERAL	
Date test started	06/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	71.7
Length	[mm]	144.0
Water content	[%]	10.6
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.684
Degree of saturation	[%]	41
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic Consolidation - Anisotropic	Not applicable Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 05_CAU02_TXL
Processed by Date	EJC 09/12/2016
Checked by Date	MSR 12/12/2016
Approved by Date	PH 14/12/2016

TEST IDENTIFICATION	
Batch	5
Sample	-
Unit	Unit C2 (Eem)
Test number	CAUc02

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	800
Base PWP	[kPa]	787
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1012
Back pressure	[kPa]	787
Base PWP	[kPa]	787
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	225
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	1.08
External axial strain	[%]	0.46
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	25.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.666
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	-
Unit	Unit C2 (Eem)
Test number	CAUc02

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	225
Initial effective axial pressure	[kPa]	320
Rate of strain	[%/hour]	0.98
At peak deviator stress		
Corrected deviator stress	[kPa]	1325
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	20.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-398
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	623
Effective axial pressure	[kPa]	1948
Principal effective stress ratio	[-]	3.13
ε_{50}	[%]	3.84
Secant modulus (E_{50}) at ε_{50}	[kPa]	16010
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	581
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.59
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-12
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	237
Effective axial pressure	[kPa]	819
Principal effective stress ratio	[-]	3.45
At 15% external axial strain		
Corrected deviator stress	[kPa]	1255
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-337
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	562
Effective axial pressure	[kPa]	1817
Principal effective stress ratio	[-]	3.23

TEST IDENTIFICATION	
Batch	5
Sample	-
Unit	Unit C2 (Eem)
Test number	CAUc02

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

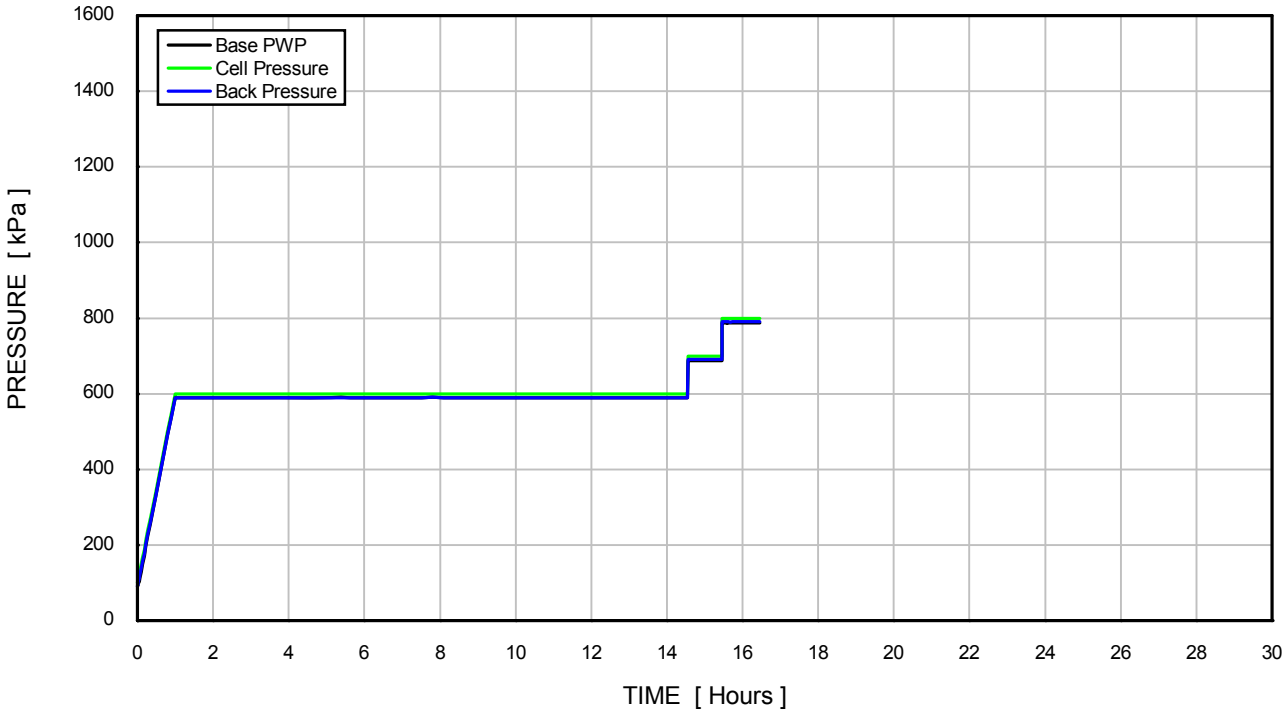


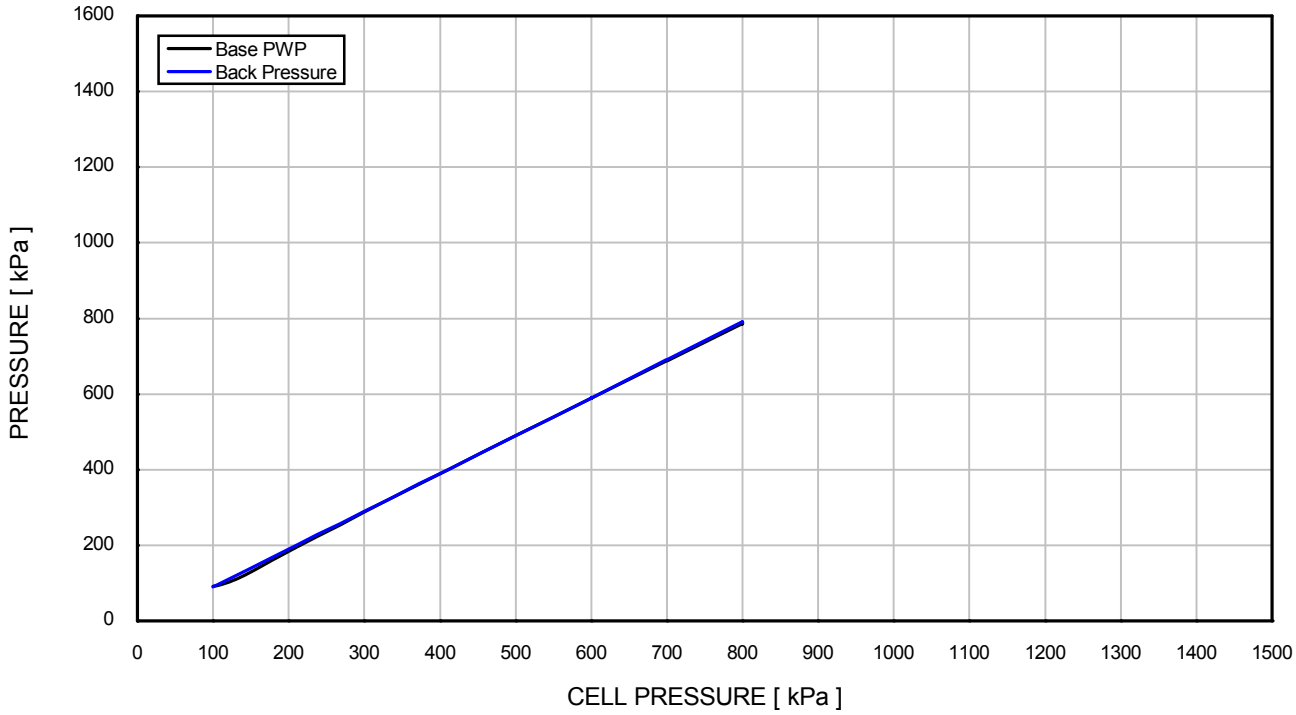


FINAL CONDITIONS		
Water content	[%]	25.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59

TEST IDENTIFICATION	
Batch	5
Sample	-
Unit	Unit C2 (Eem)
Test number	CAUc02

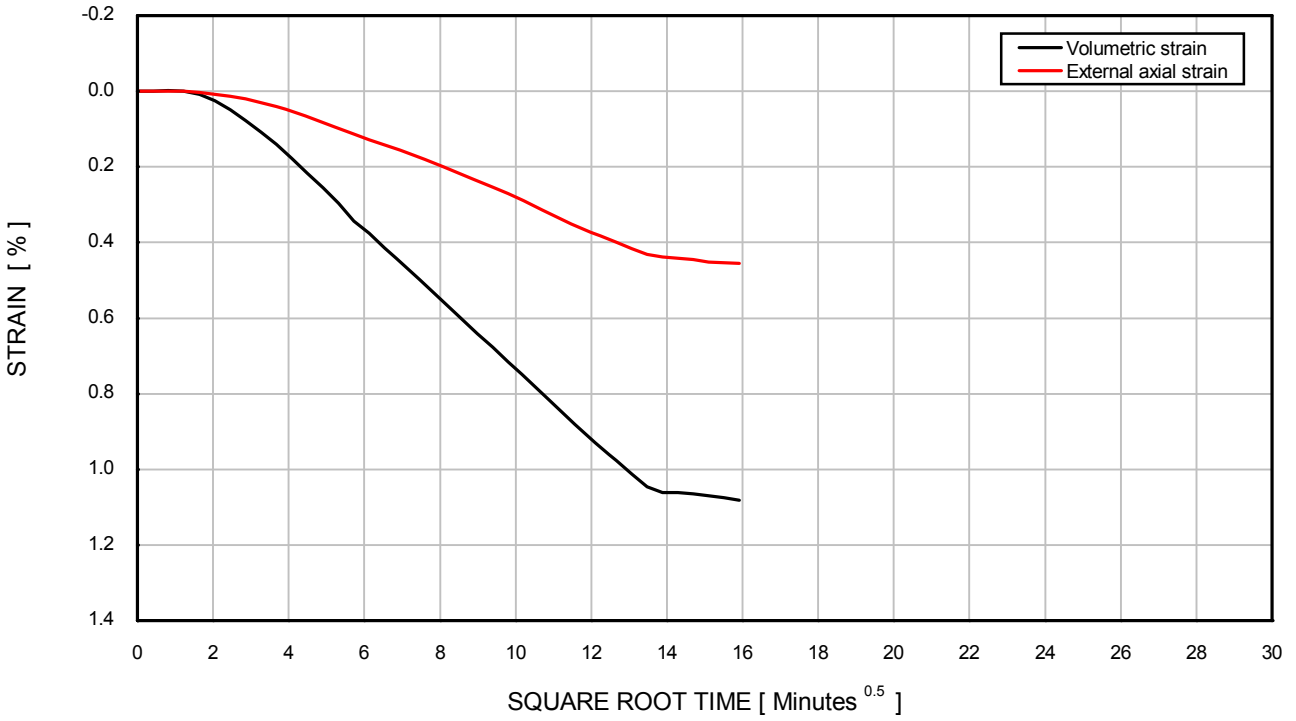
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

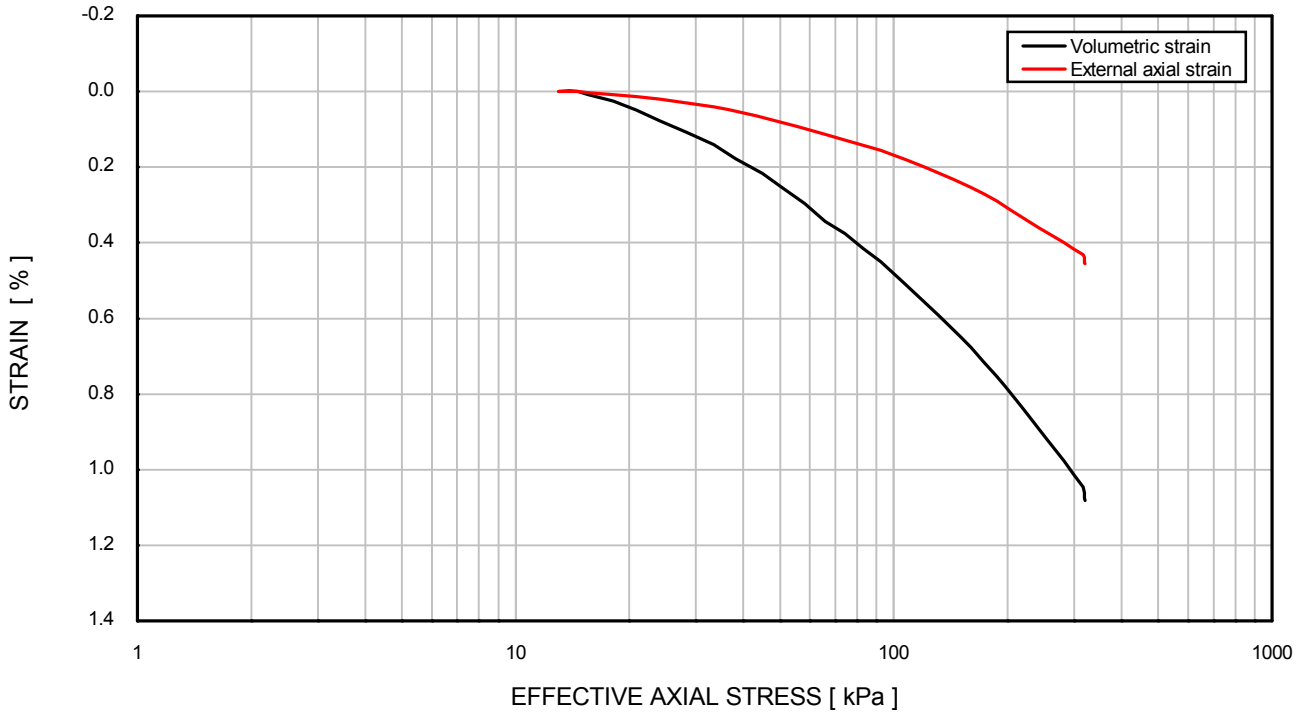




B value	:	0.99			
Initial σ'_r	:	9	kPa	Batch	: 5
Initial σ'_a	:	9	kPa	Sample	: -
Final σ'_r	:	13	kPa	Unit	: Unit C2 (Eem)
Final σ'_a	:	13	kPa	Test No.	: CAUc02

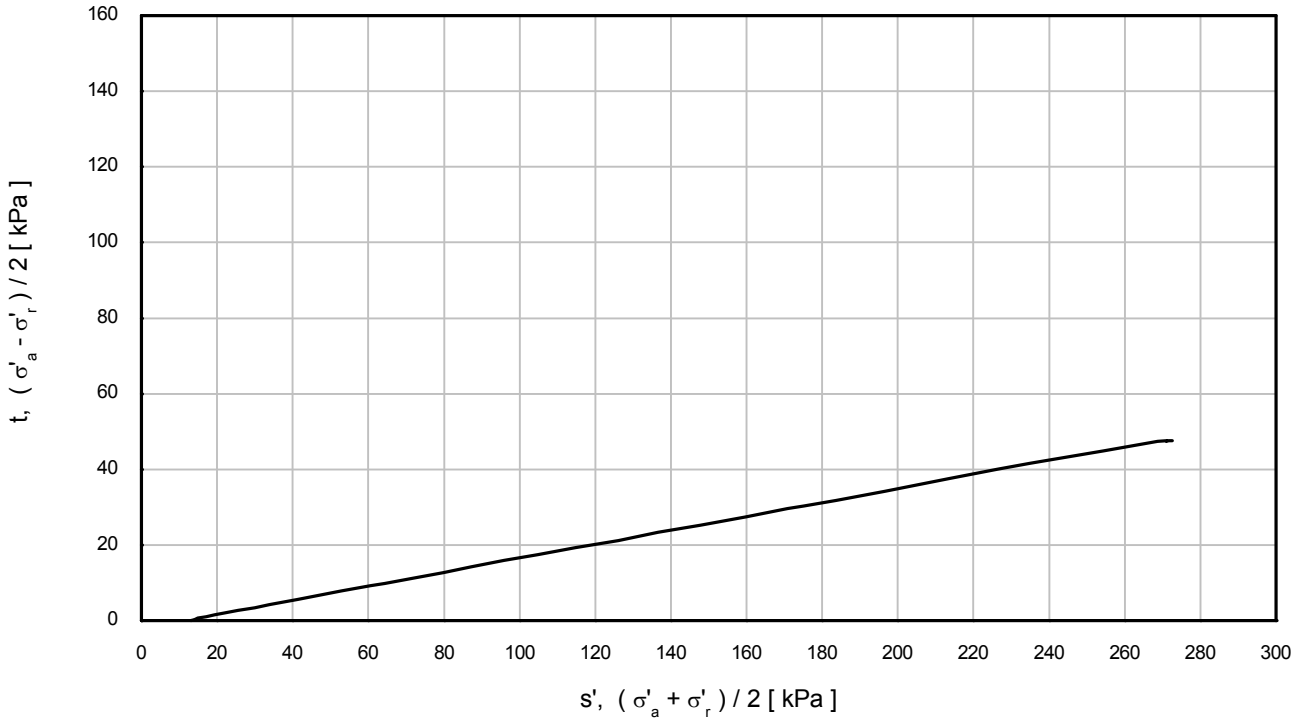
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

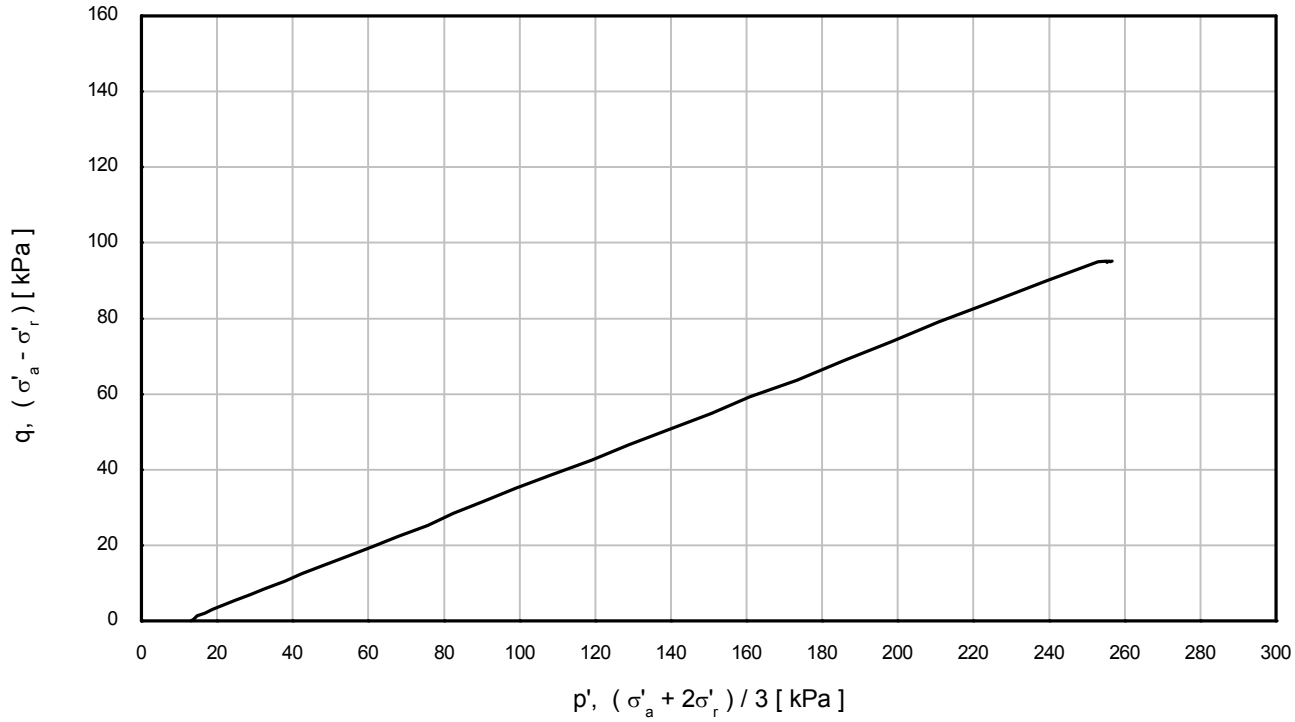




Stage 1 σ'_{rc}	: 225 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: -
		Unit	: Unit C2 (Eem)
		Test No.	: CAUc02

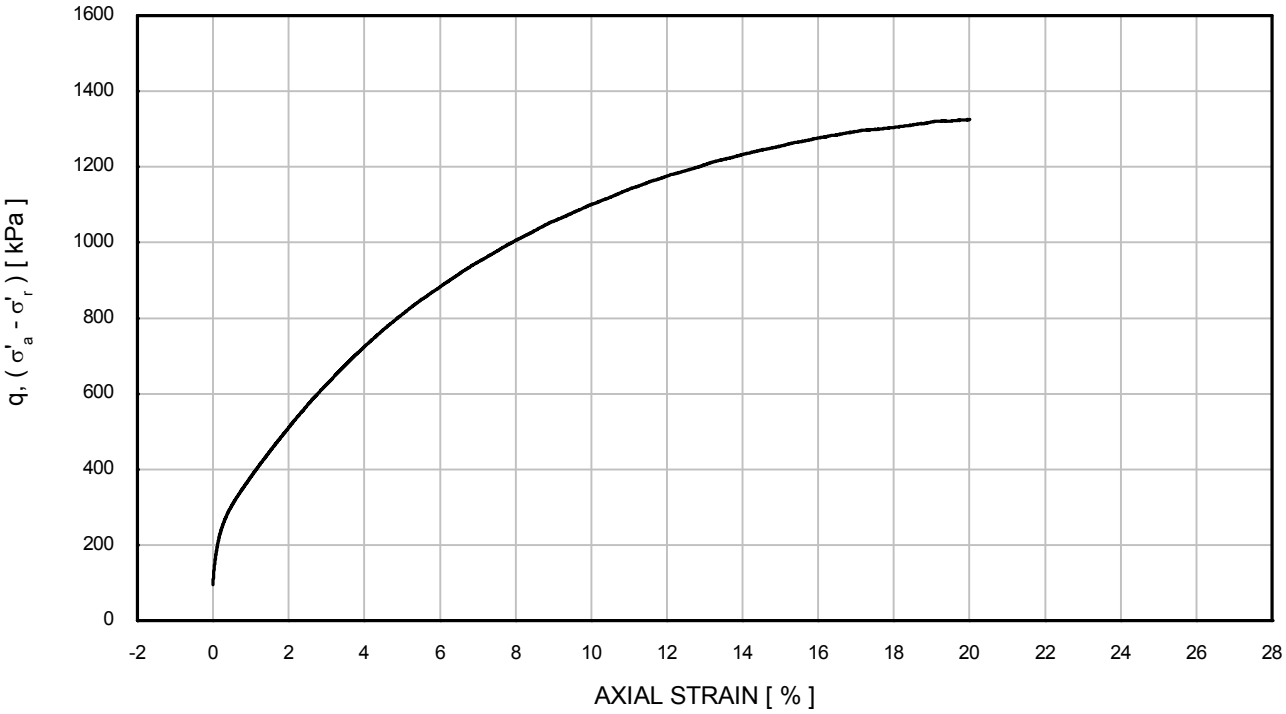
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

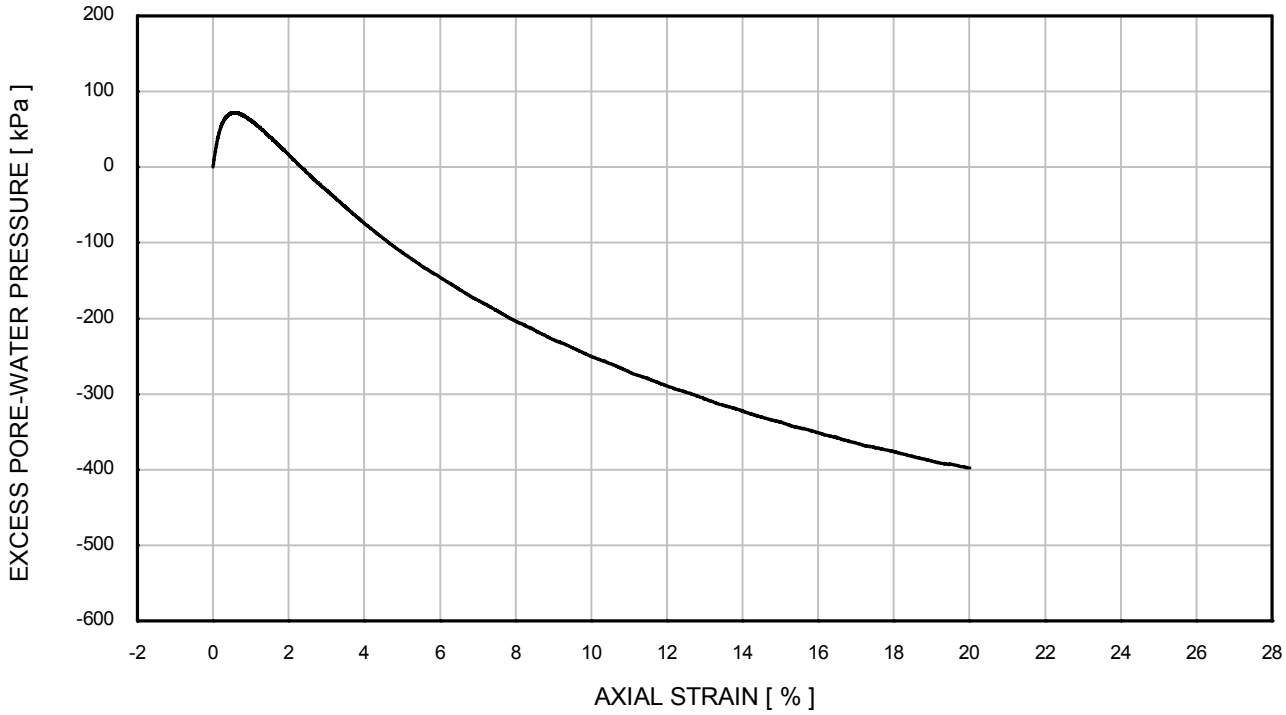




Stage 1 σ'_{rc}	: 225 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: -
		Unit	: Unit C2 (Eem)
		Test No.	: CAUc02

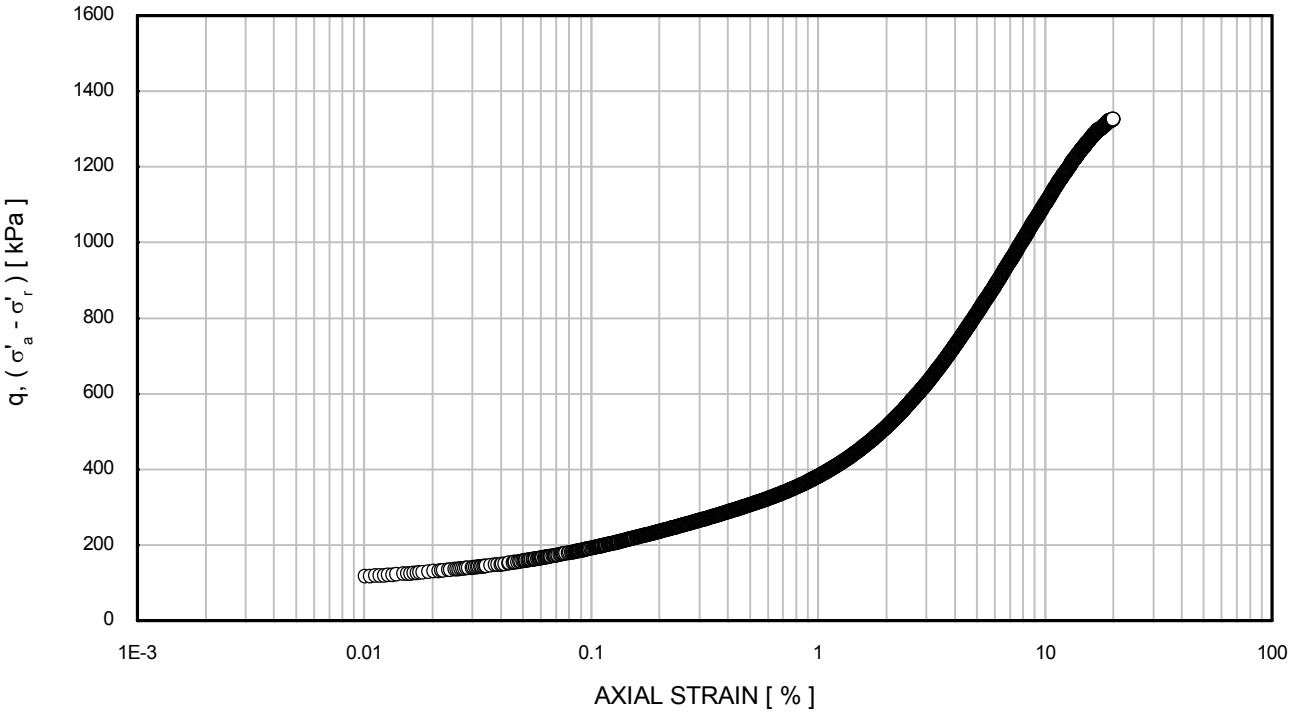
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

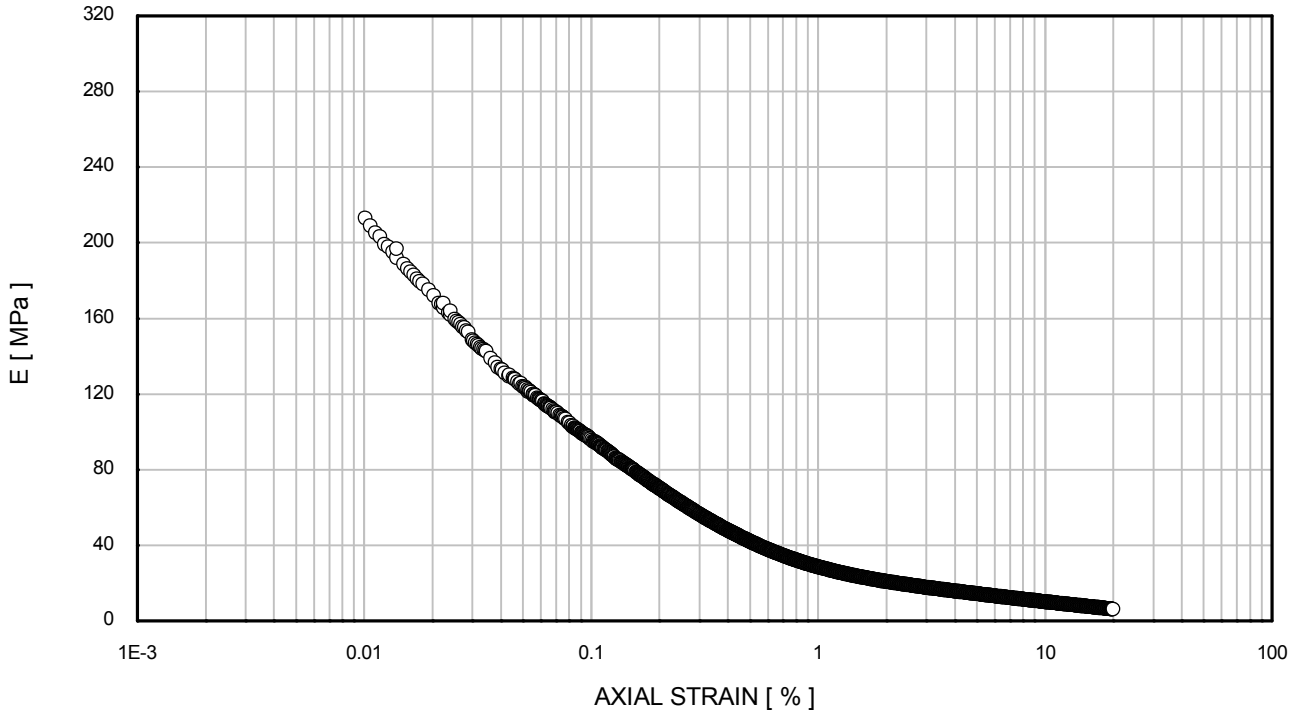




Initial σ'_r	: 225 kPa	Batch	: 5
Initial σ'_a	: 320 kPa	Sample	: -
q_{peak}	: 1325 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 20.01 %	Test No.	: CAUc02
Rate of strain	: 0.98 %/hour		

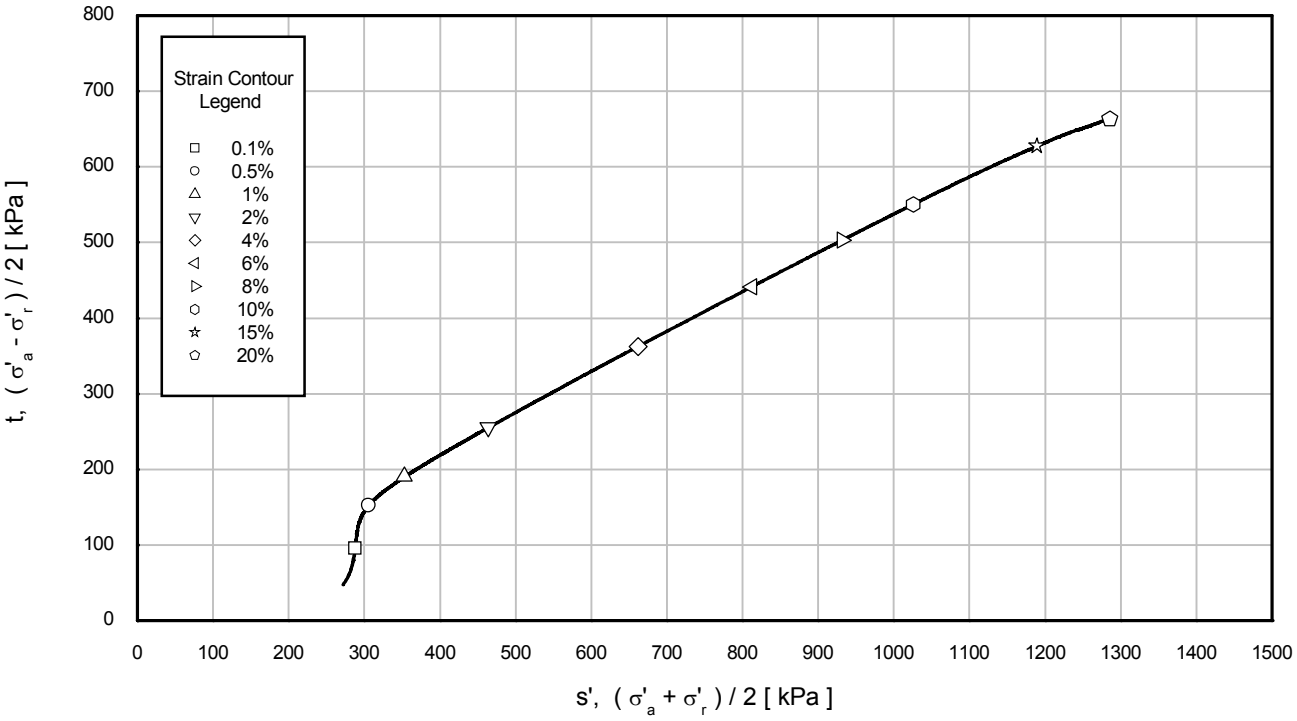
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

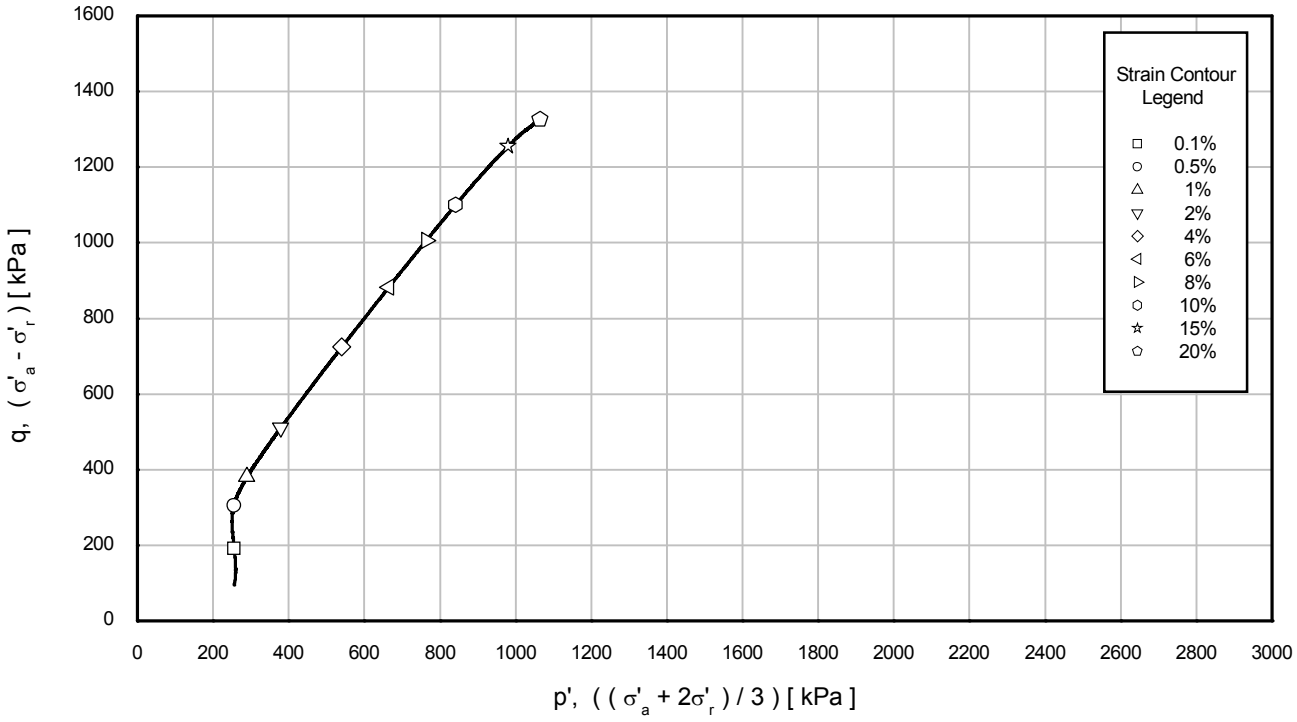




Initial σ'_r	: 225 kPa	Batch	: 5
Initial σ'_a	: 320 kPa	Sample	: -
q_{peak}	: 1325 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 20.01 %	Test No.	: CAUc02
Rate of strain	: 0.98 %/hour		

ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	225 kPa	Batch	:	5
Initial σ'_a	:	320 kPa	Sample	:	-
q_{peak}	:	1325 kPa	Unit	:	Unit C2 (Eem)
Ext. ε at q_{peak}	:	20.01 %	Test No.	:	CAUc02
Rate of strain	:	0.98 %/hour			

ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Light yellowish brown fine to medium SAND

GENERAL	
Date test started	22/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.1
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.677
Degree of saturation	[%]	40
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 06_CAUc03
Processed by Date	RN 02/12/2016
Checked by Date	AR 06/12/2016
Approved by Date	PH 07/12/2016

TEST IDENTIFICATION	
Batch	6
Sample	-
Unit	Unit D (Yarmouth Roads)
Test number	CAUc03

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	870
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1120
Back pressure	[kPa]	870
Base PWP	[kPa]	870
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	250
Effective axial pressure	[kPa]	380
Deviator stress	[kPa]	130
Volumetric strain	[%]	1.05
External axial strain	[%]	0.74
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.659
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	6
Sample	-
Depth [m]	Unit D (Yarmouth Roads)
Test number	CAUc03

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	250
Initial effective axial pressure	[kPa]	380
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	258
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	20.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	147
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	103
Effective axial pressure	[kPa]	361
Principal effective stress ratio	[-]	3.50
ε_{50}	[%]	6.05
Secant modulus (E_{50}) at ε_{50}	[kPa]	1054
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	208
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.74
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	171
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	79
Effective axial pressure	[kPa]	287
Principal effective stress ratio	[-]	3.62
At 15% external axial strain		
Corrected deviator stress	[kPa]	231
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	14.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	159
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	91
Effective axial pressure	[kPa]	322
Principal effective stress ratio	[-]	3.54

TEST IDENTIFICATION	
Borehole	6
Sample	-
Depth [m]	Unit D (Yarmouth Roads)
Test number	CAUc03

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

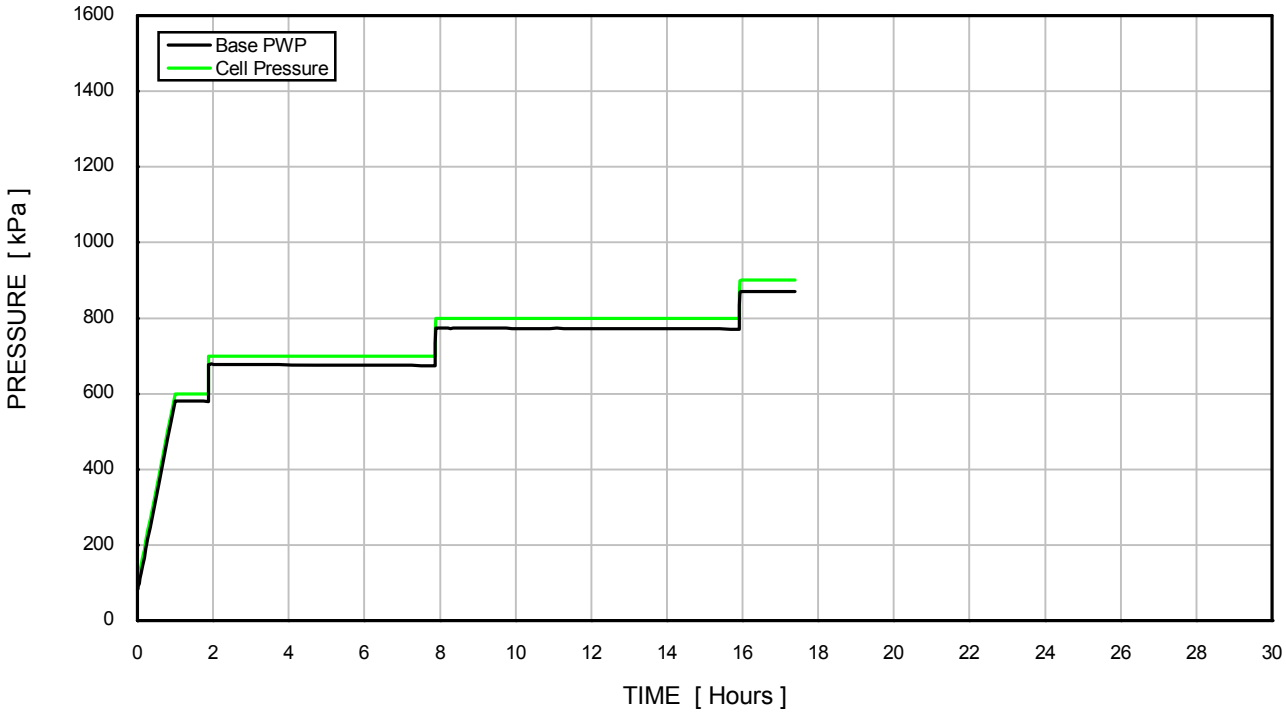


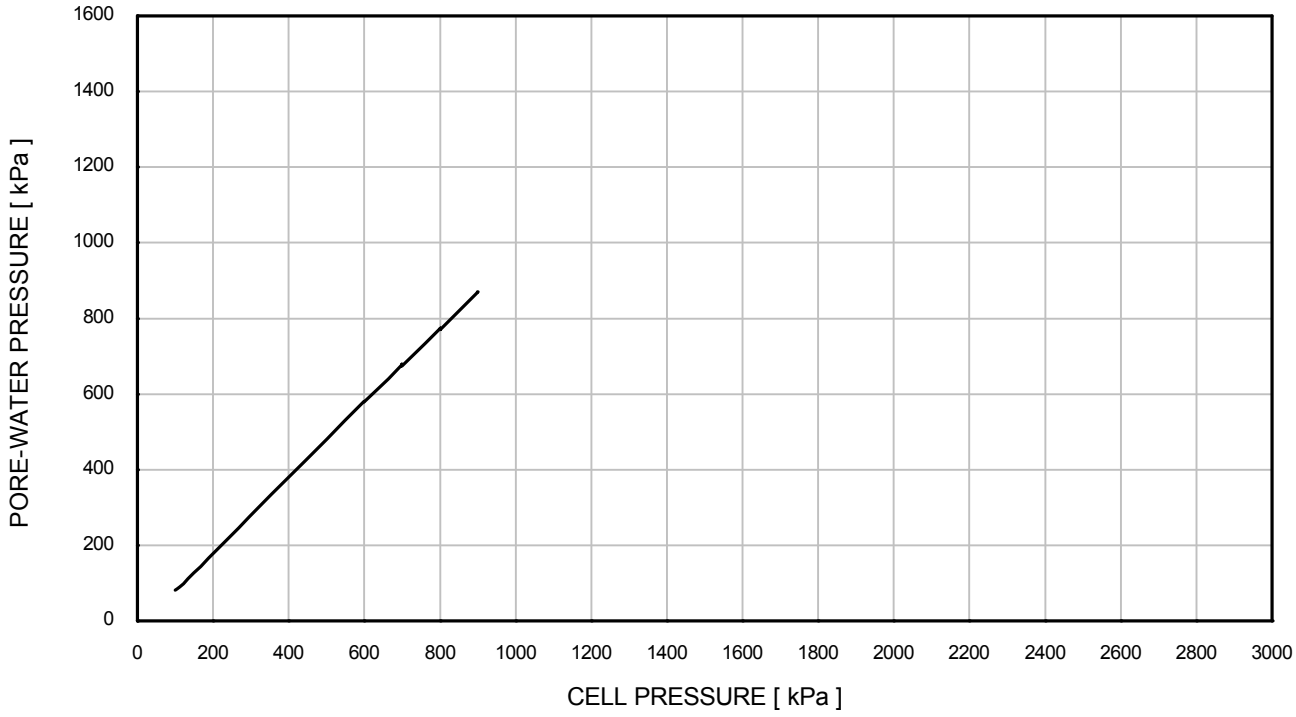


FINAL CONDITIONS		
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION	
Borehole	6
Sample	-
Depth [m]	Unit D (Yarmouth Roads)
Test number	CAUc03

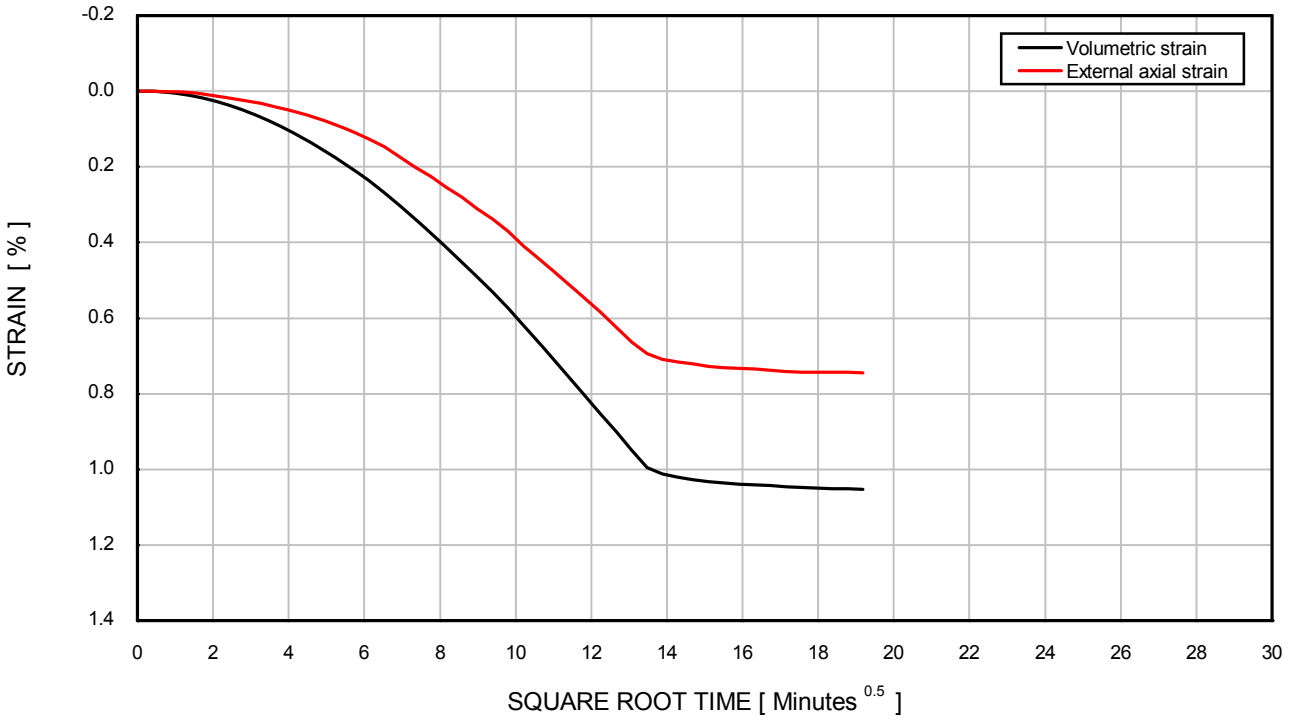
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

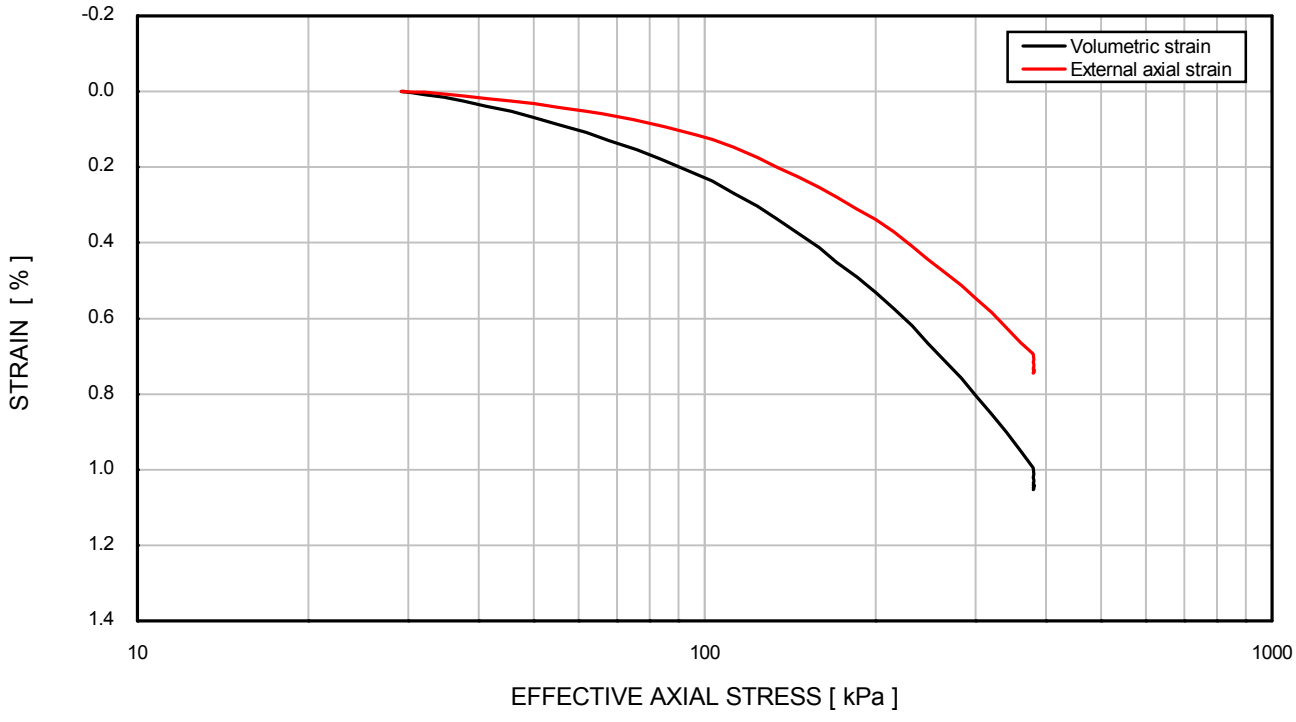




B value	:	0.99	Batch	:	6
Initial σ'_r	:	19 kPa	Sample	:	-
Initial σ'_a	:	19 kPa	Unit	:	Unit D (Yarmouth Roads)
Final σ'_r	:	30 kPa	Test No.	:	CAUc03
Final σ'_a	:	30 kPa			

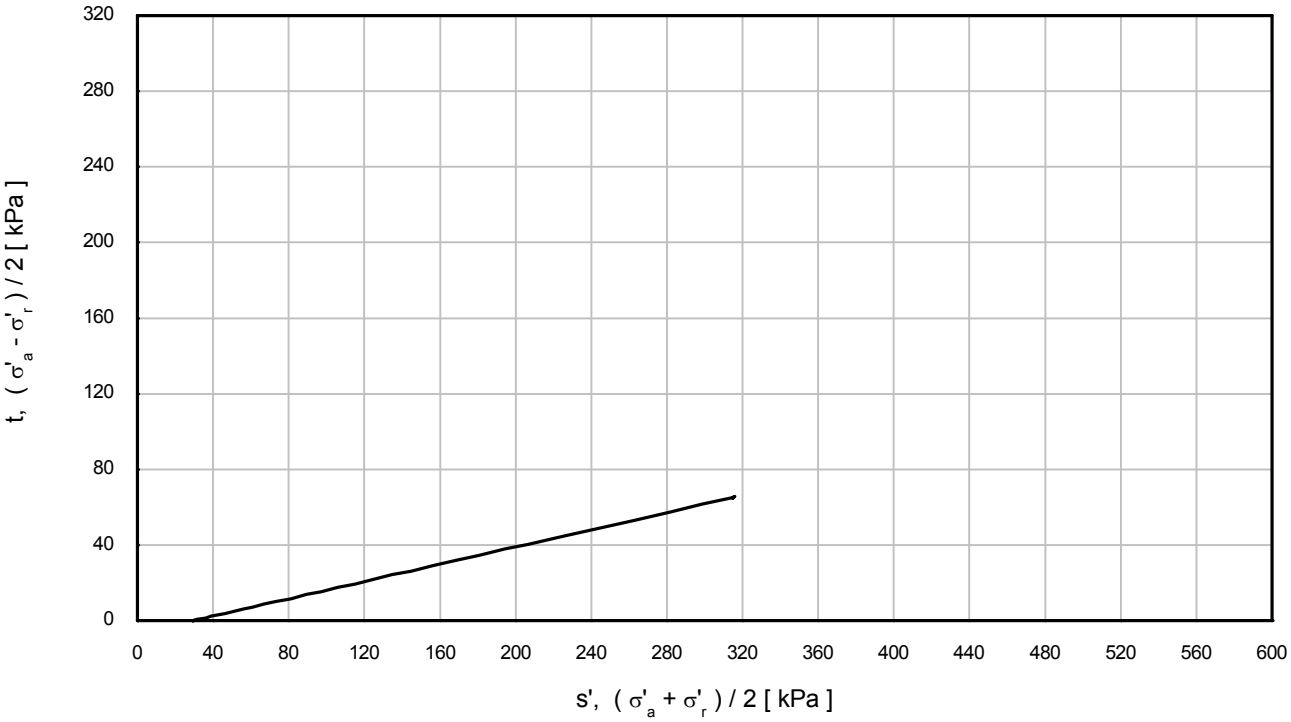
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

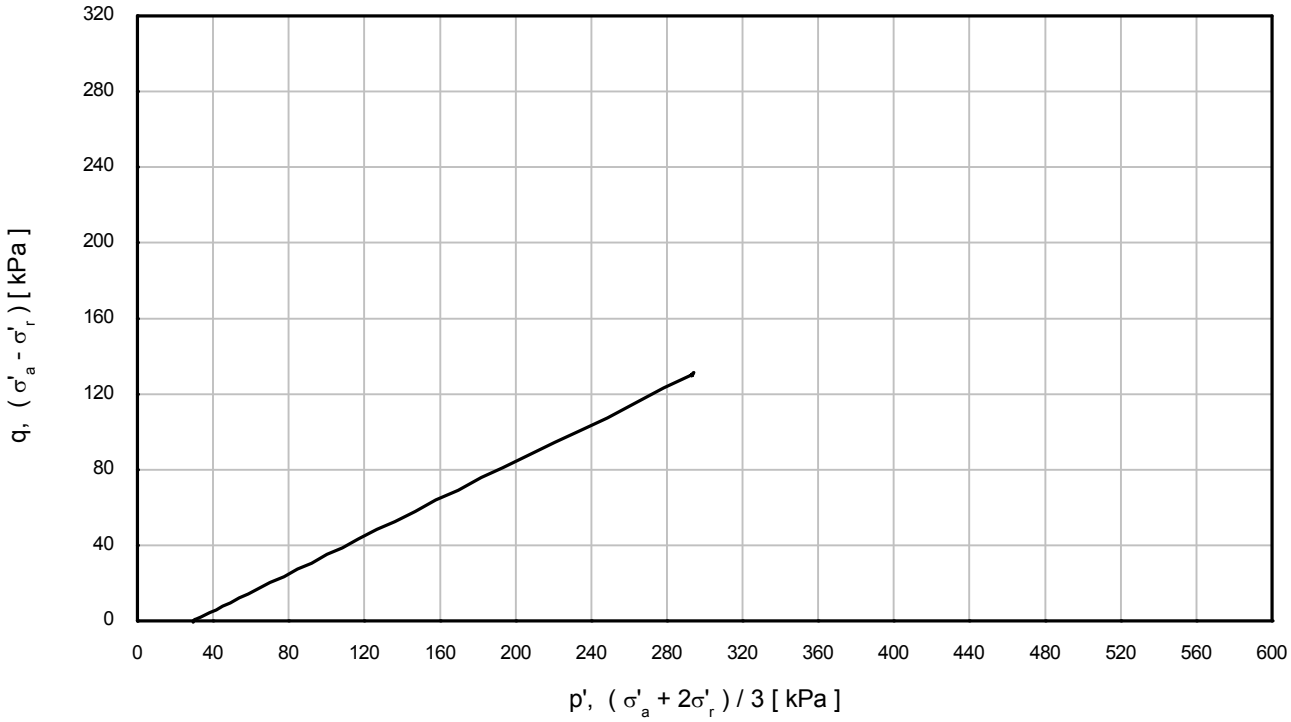




Stage 1 σ'_{rc}	:	250 kPa	Batch	:	6
Stage 1 σ'_{ac}	:	380 kPa	Sample	:	-
			Unit	:	Unit D (Yarmouth Roads)
			Test No.	:	CAUc03

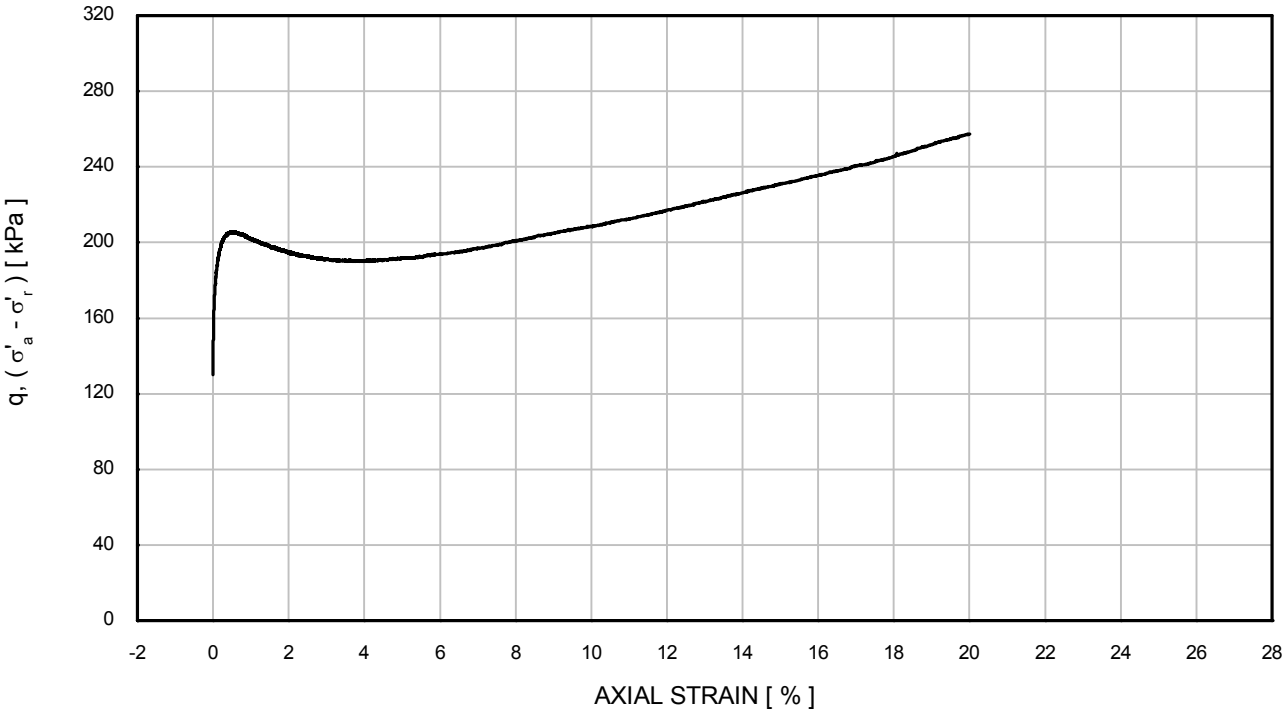
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

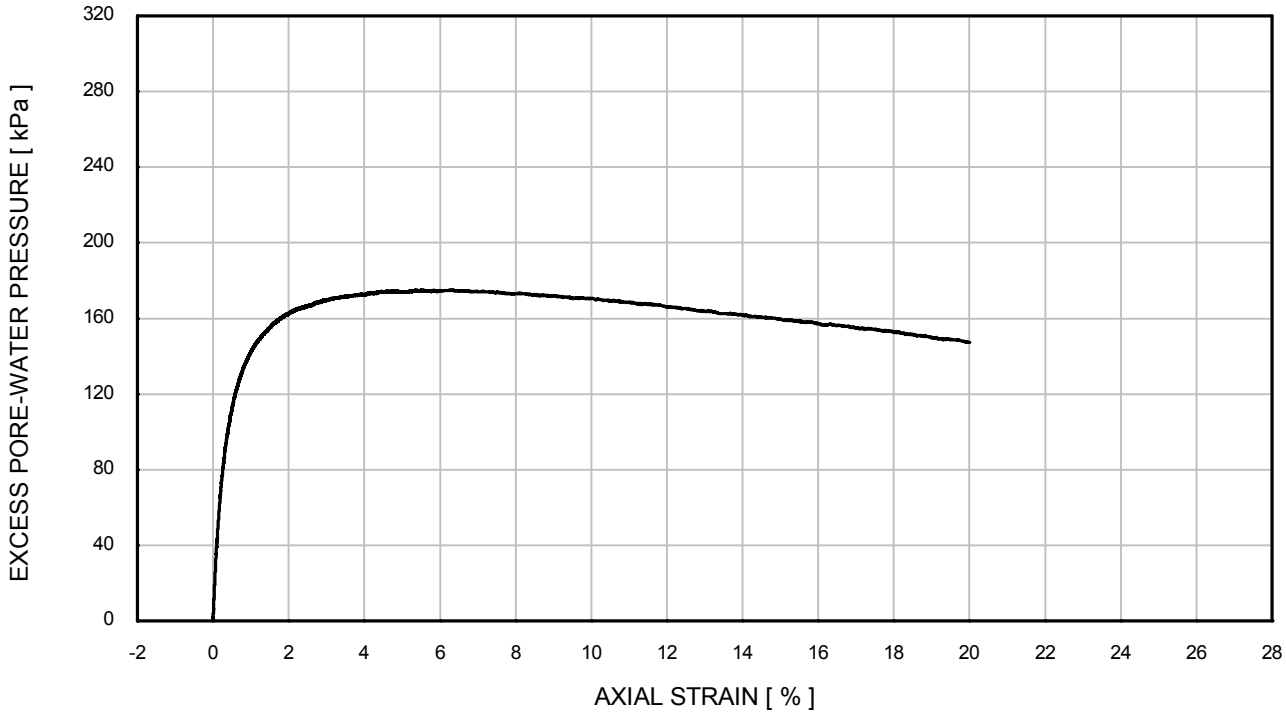




Stage 1 σ'_{rc}	: 250 kPa	Batch	: 6
Stage 1 σ'_{ac}	: 380 kPa	Sample	: -
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CAUc03

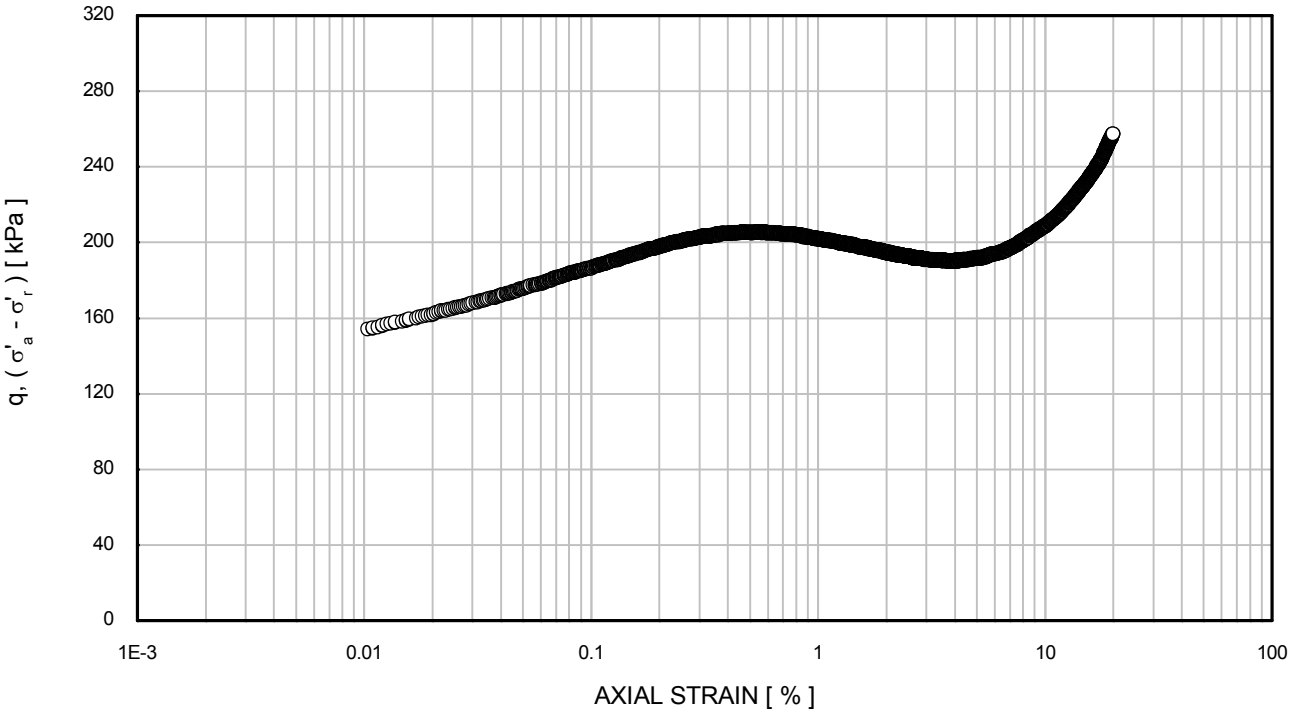
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

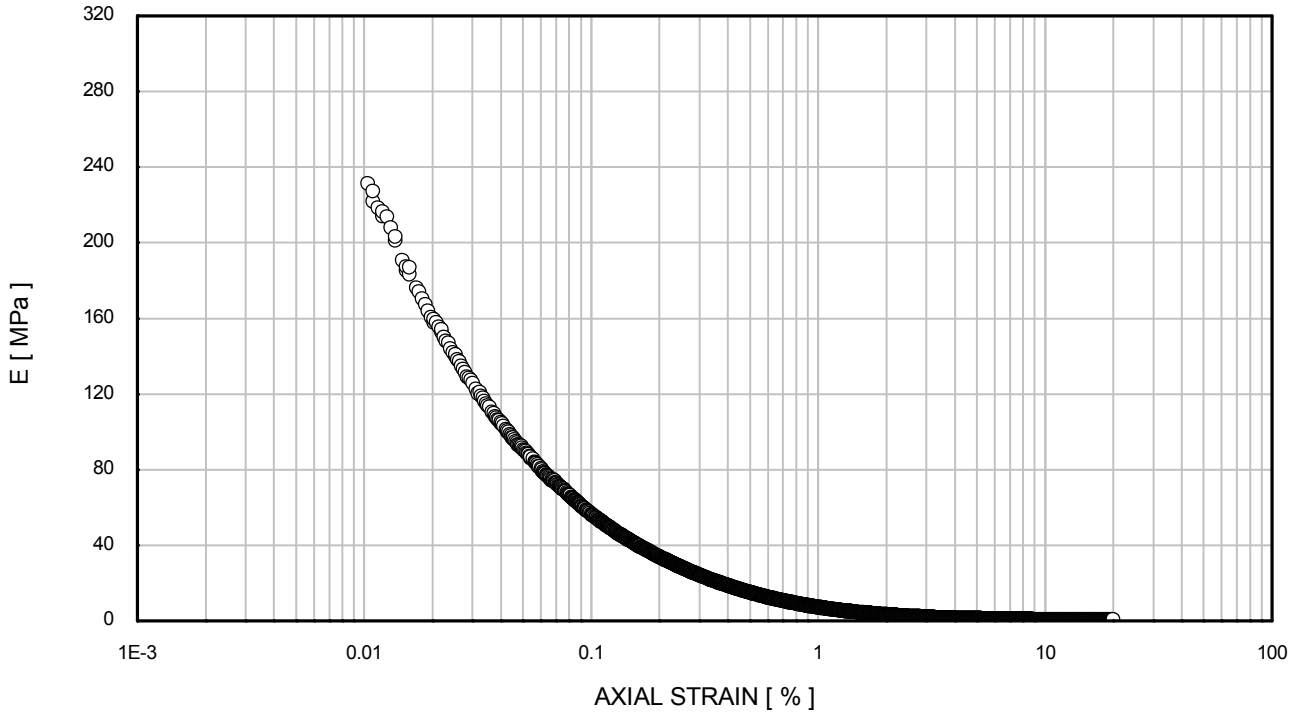




Initial σ'_r	:	250 kPa	Batch	:	6
Initial σ'_a	:	380 kPa	Sample	:	-
q_{peak}	:	258 kPa	Unit	:	Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	:	20.00 %	Test No.	:	CAUc03
Rate of strain	:	1.00 %/hour			

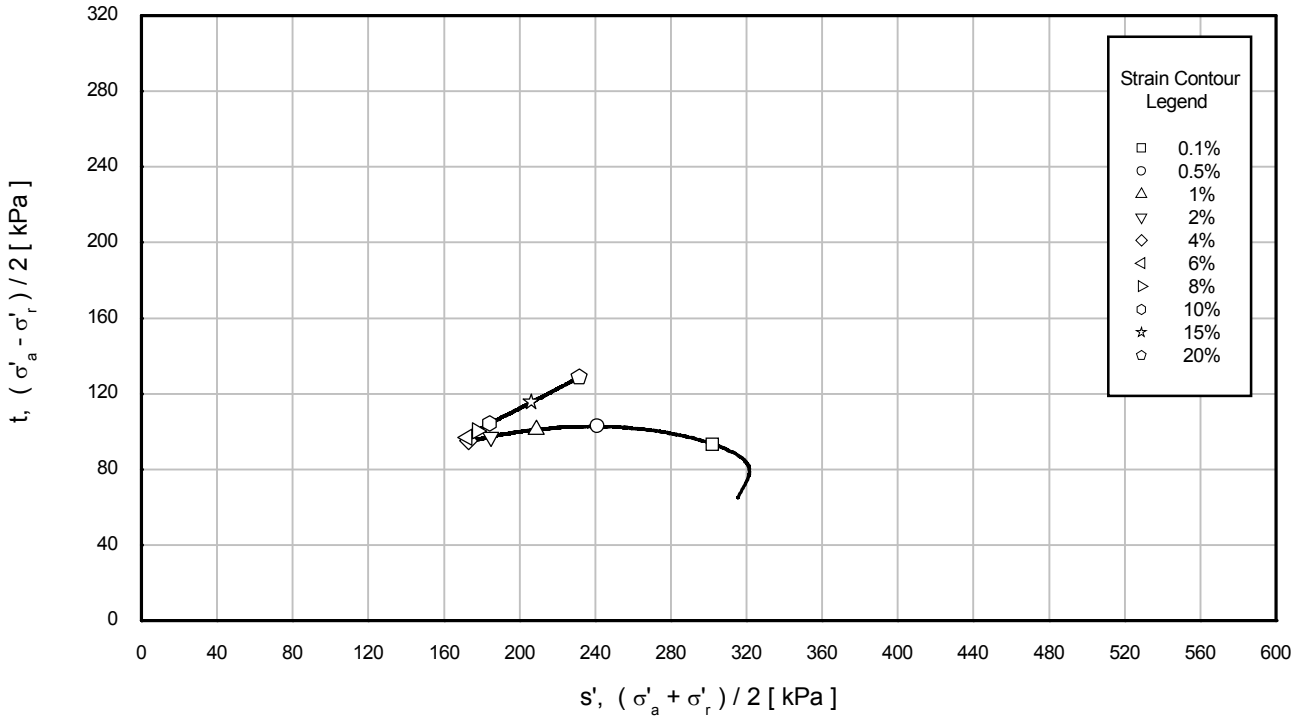
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

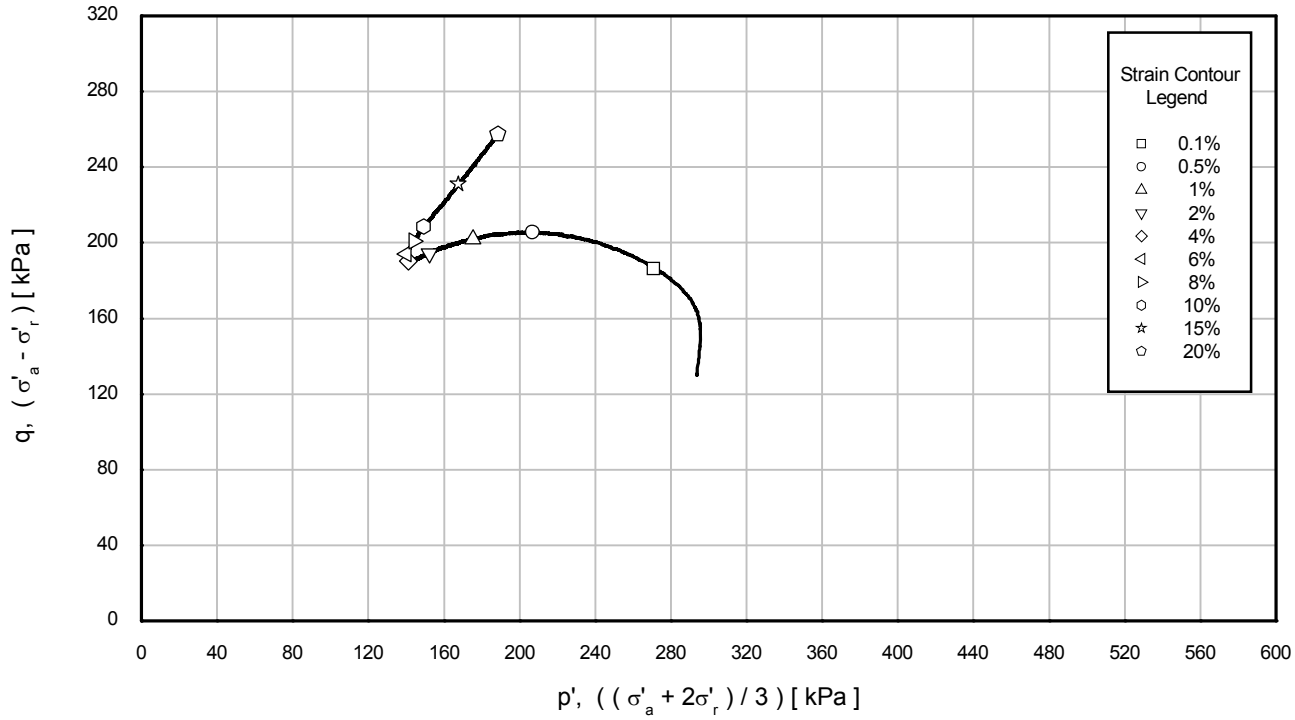




Initial σ'_r	:	250 kPa	Batch	:	6
Initial σ'_a	:	380 kPa	Sample	:	-
q_{peak}	:	258 kPa	Unit	:	Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	:	20.00 %	Test No.	:	CAUc03
Rate of strain	:	1.00 %/hour			

ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	250 kPa	Batch	:	6
Initial σ'_a	:	380 kPa	Sample	:	-
q_{peak}	:	258 kPa	Unit	:	Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	:	20.00 %	Test No.	:	CAUc03
Rate of strain	:	1.00 %/hour			

ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	07/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	71.7
Length	[mm]	144.0
Water content	[%]	10.4
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.614
Degree of saturation	[%]	45
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 01_CID01r
Processed by Date	RN 09/12/2016
Checked by Date	MSR 12/12/2016
Approved by Date	PH 13/12/2016

TEST IDENTIFICATION	
Batch	1
Sample	CID_1-1
Unit	Unit A (Southern Bight)
Test number	CID01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	800
Base PWP	[kPa]	786
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	801
Back pressure	[kPa]	786
Base PWP	[kPa]	786
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	15
Effective axial pressure	[kPa]	15
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.02
External axial strain	[%]	0.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.2
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.614
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CID_1-1
Unit	Unit A (Southern Bight)
Test number	CID01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	15
Initial effective axial pressure	[kPa]	15
Rate of strain	[%/hour]	0.99
At peak deviator stress		
Corrected deviator stress	[kPa]	563
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.11
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-2.48
Local Volumetric strain	[%]	-
Effective radial pressure	[kPa]	206
Effective axial pressure	[kPa]	768
Principal effective stress ratio	[-]	3.74
ε_{50}	[%]	3.08
Secant modulus (E_{50}) at ε_{50}	[kPa]	9130
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	122
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.11
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.29
Local Volumetric strain	[%]	-
Effective radial pressure	[kPa]	31
Effective axial pressure	[kPa]	153
Principal effective stress ratio	[-]	4.95
At 15% external axial strain		
Corrected deviator stress	[kPa]	527
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-3.32
Local Volumetric strain	[%]	
Effective radial pressure	[kPa]	215
Effective axial pressure	[kPa]	742
Principal effective stress ratio	[-]	3.46

TEST IDENTIFICATION	
Batch	1
Sample	CID_1-1
Unit	Unit A (Southern Bight)
Test number	CID01

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





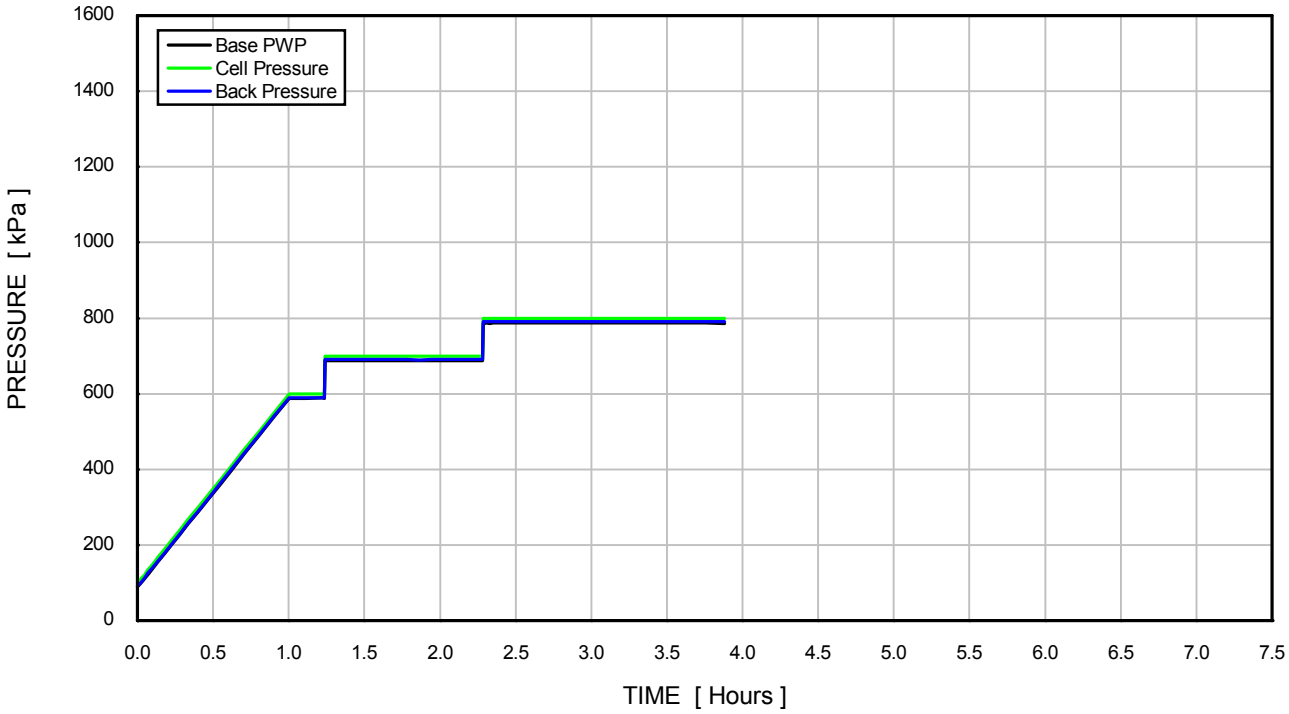
FINAL CONDITIONS

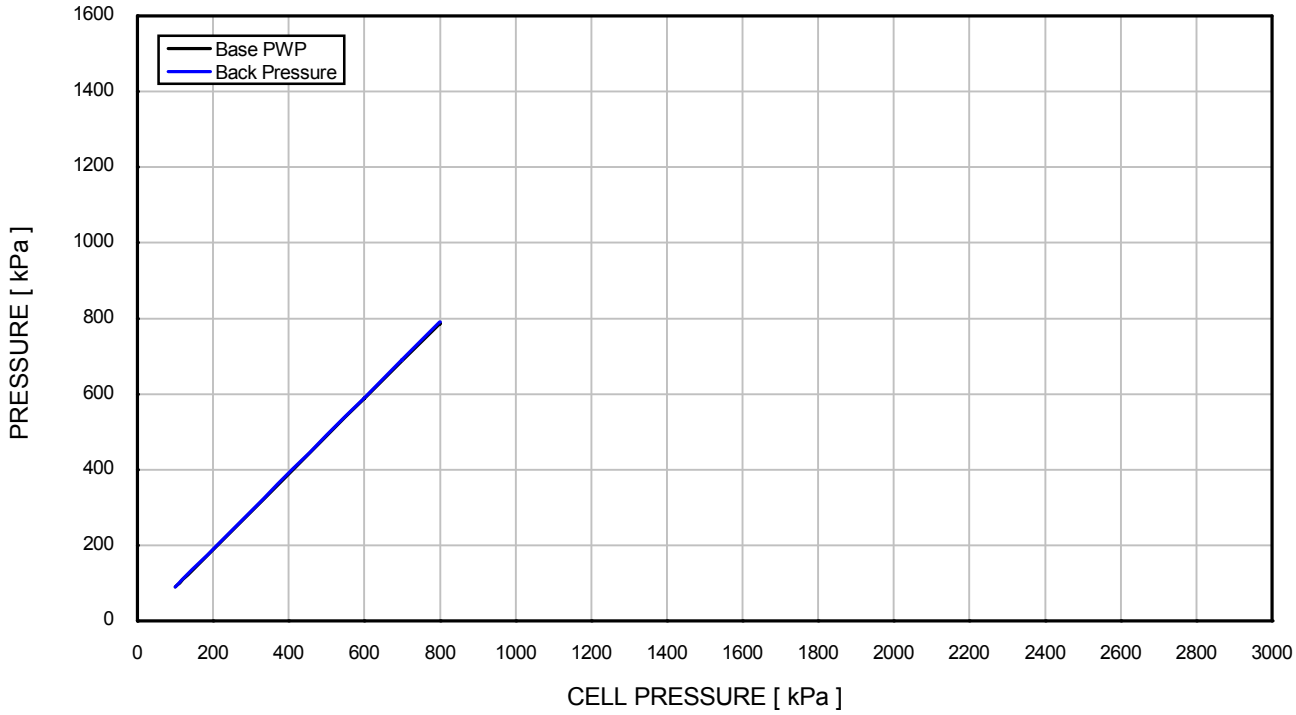
Water content	[%]	25.4
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.58

TEST IDENTIFICATION

Batch	1
Sample	CID_1-1
Unit	Unit A (Southern Bight)
Test number	CID01

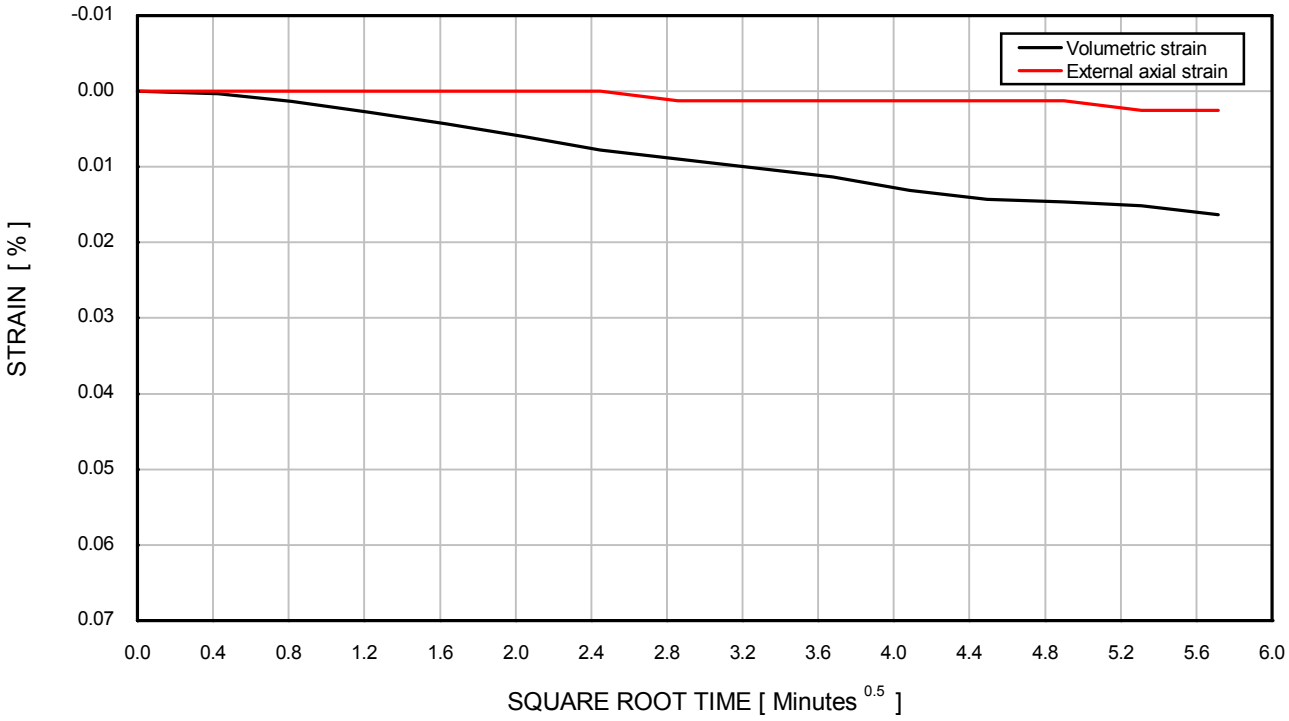
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST





B value	:	0.99			
Initial σ'_r	:	10	kPa	Batch	: 1
Initial σ'_a	:	10	kPa	Sample	: CID_1-1
Final σ'_r	:	14	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	14	kPa	Test No.	: CID01

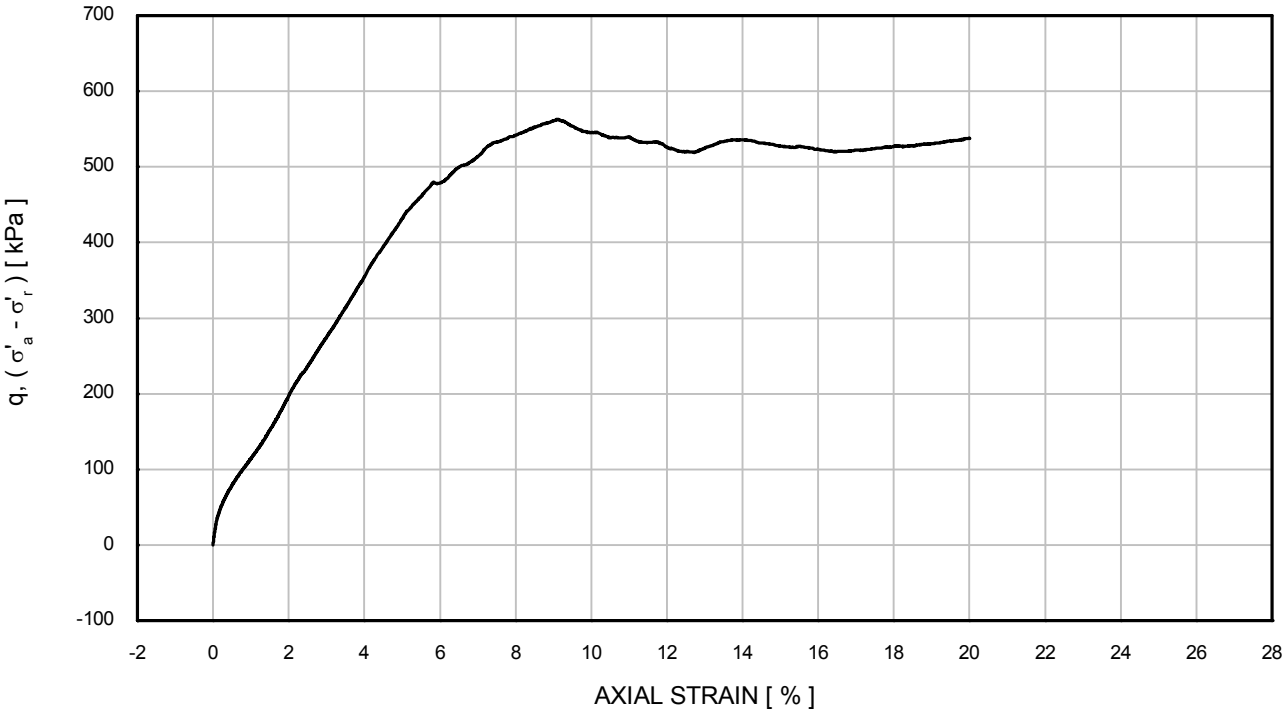
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

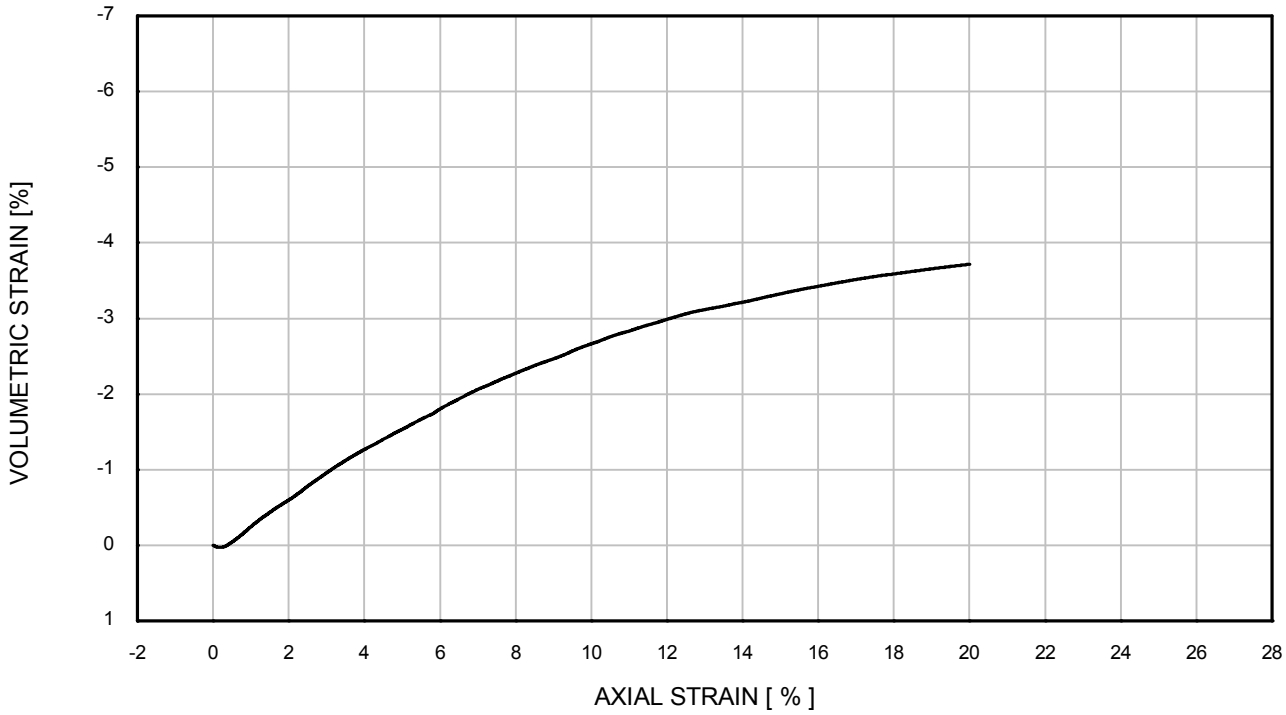




Stage 1 σ'_{rc}	:	15 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	15 kPa	Sample	:	CID_1-1
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CID01

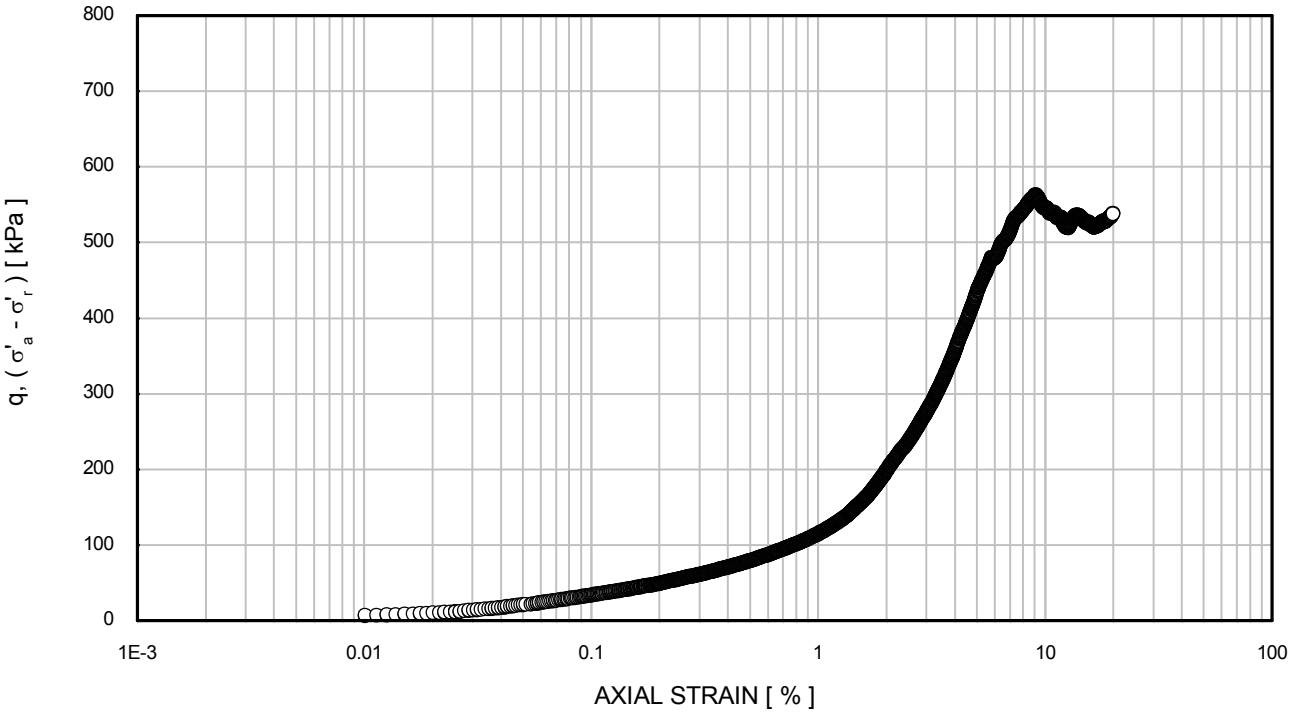
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

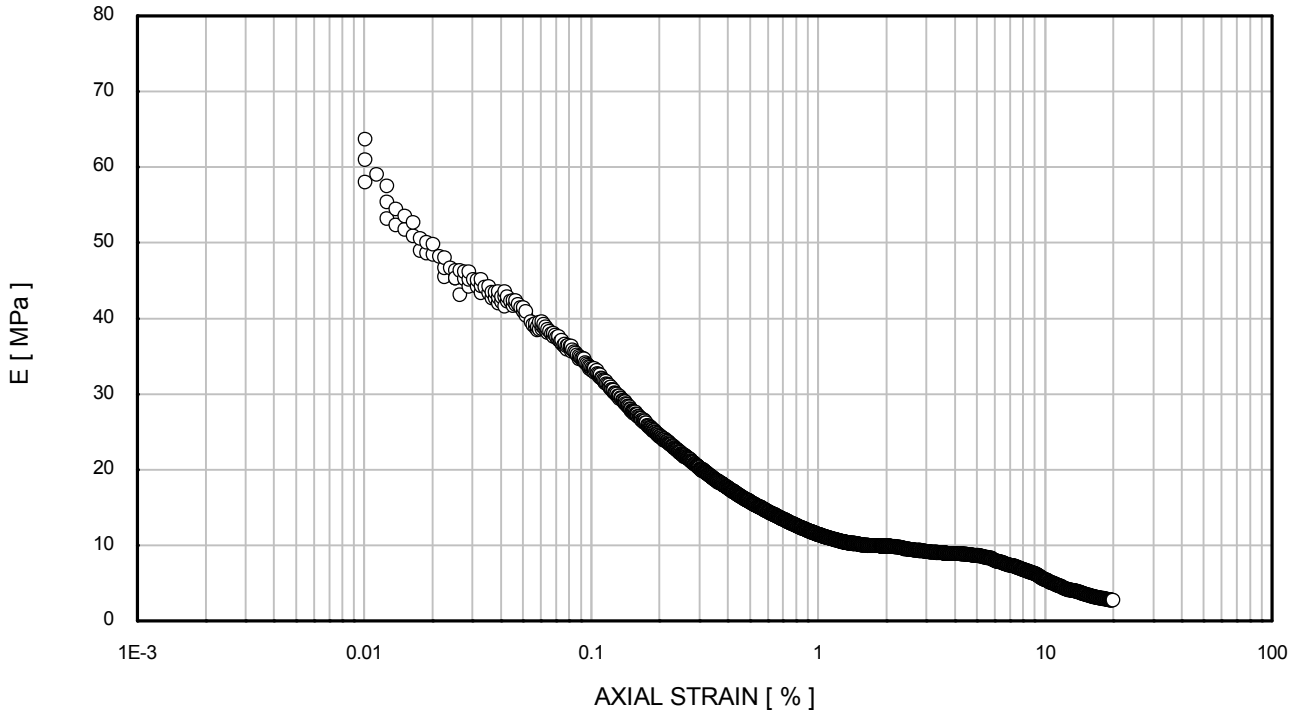




Initial σ'_r	:	15 kPa	Batch	:	1
Initial σ'_a	:	15 kPa	Sample	:	CID_1-1
q_{peak}	:	563 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	9.11 %	Test No.	:	CID01
Rate of strain	:	0.99 %/hour			

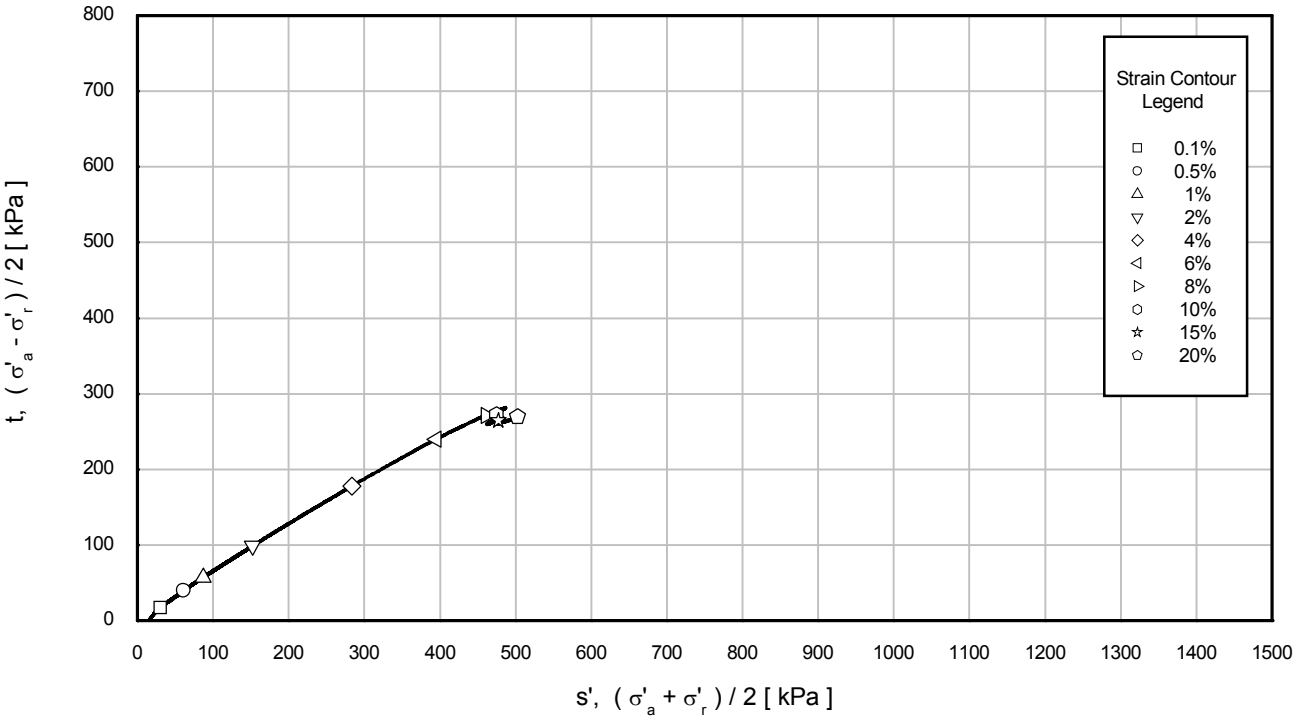
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED

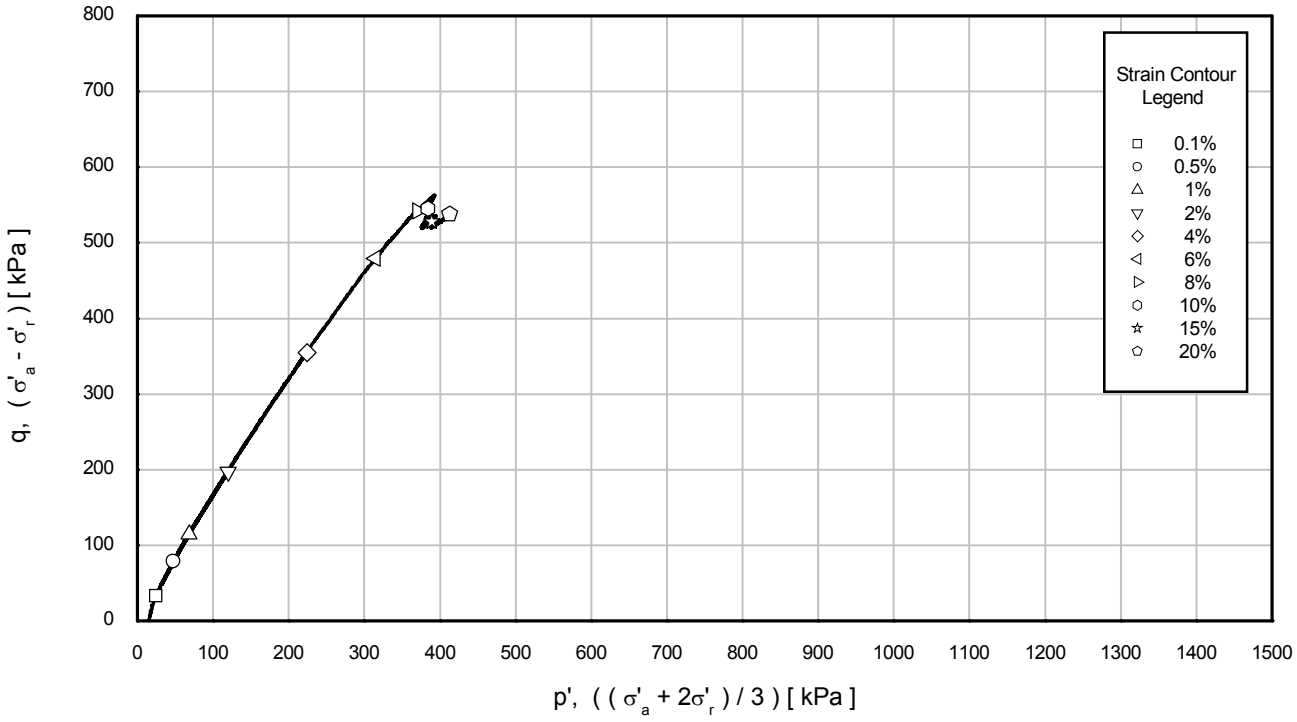




Initial σ'_r	:	15 kPa	Batch	:	1
Initial σ'_a	:	15 kPa	Sample	:	CID_1-1
q_{peak}	:	563 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	9.11 %	Test No.	:	CID01
Rate of strain	:	0.99 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	15	kPa	Batch	: 1
Initial σ'_a	:	15	kPa	Sample	: CID_1-1
q_{peak}	:	563	kPa	Unit	: Unit A (Southern Bight)
Ext. ε at q_{peak}	:	9.11	%	Test No.	: CID01
Rate of strain	:	0.99	%/hour		

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED

VISUAL DESCRIPTION
Light brown fine to medium SAND with traces of fine to medium gravel sized shell fragments

GENERAL	
Date test started	06/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	71.7
Length	[mm]	144.0
Water content	[%]	10.7
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.625
Degree of saturation	[%]	45
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 03_CID02
Processed by	RN
Date	09/12/2016
Checked by	PH
Date	13/12/2016
Approved by	PH
Date	13/12/2016

TEST IDENTIFICATION	
Batch	3
Sample	CID_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CID02

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	800
Base PWP	[kPa]	787
Mid height PWP	[kPa]	-
B value achieved	[-]	0.98

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	922
Back pressure	[kPa]	787
Base PWP	[kPa]	787
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.63
External axial strain	[%]	0.13
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.2
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.615
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CID_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CID02

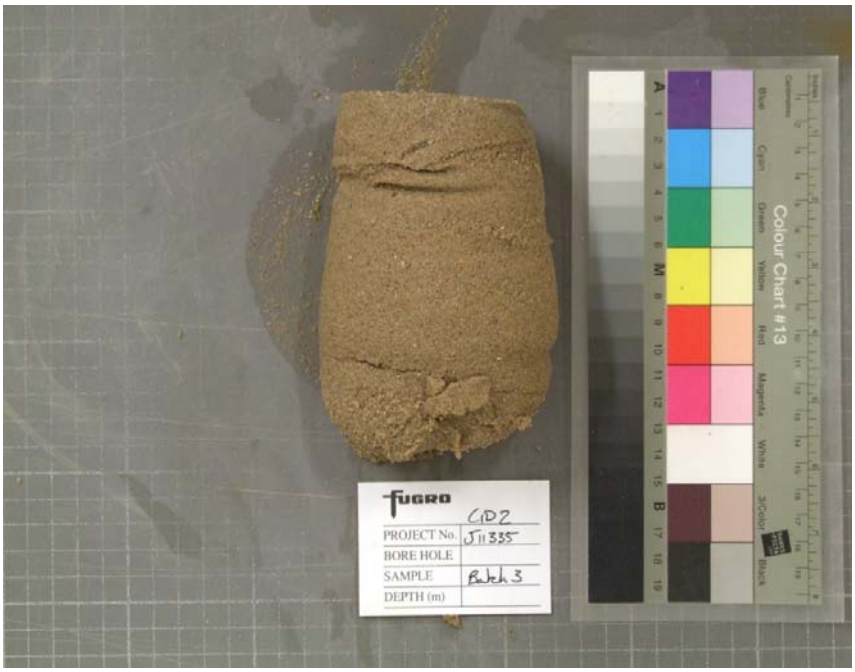
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	135
Rate of strain	[%/hour]	0.99
At peak deviator stress		
Corrected deviator stress	[kPa]	448
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.69
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.90
Local Volumetric strain	[%]	-
Effective radial pressure	[kPa]	144
Effective axial pressure	[kPa]	591
Principal effective stress ratio	[-]	4.12
ε_{50}	[%]	0.37
Secant modulus (E_{50}) at ε_{50}	[kPa]	60390
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	443
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.40
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.41
Local Volumetric strain	[%]	-
Effective radial pressure	[kPa]	139
Effective axial pressure	[kPa]	581
Principal effective stress ratio	[-]	4.19
At 15% external axial strain		
Corrected deviator stress	[kPa]	369
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-2.64
Local Volumetric strain	[%]	
Effective radial pressure	[kPa]	152
Effective axial pressure	[kPa]	521
Principal effective stress ratio	[-]	3.42

TEST IDENTIFICATION	
Batch	3
Sample	CID_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CID02

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





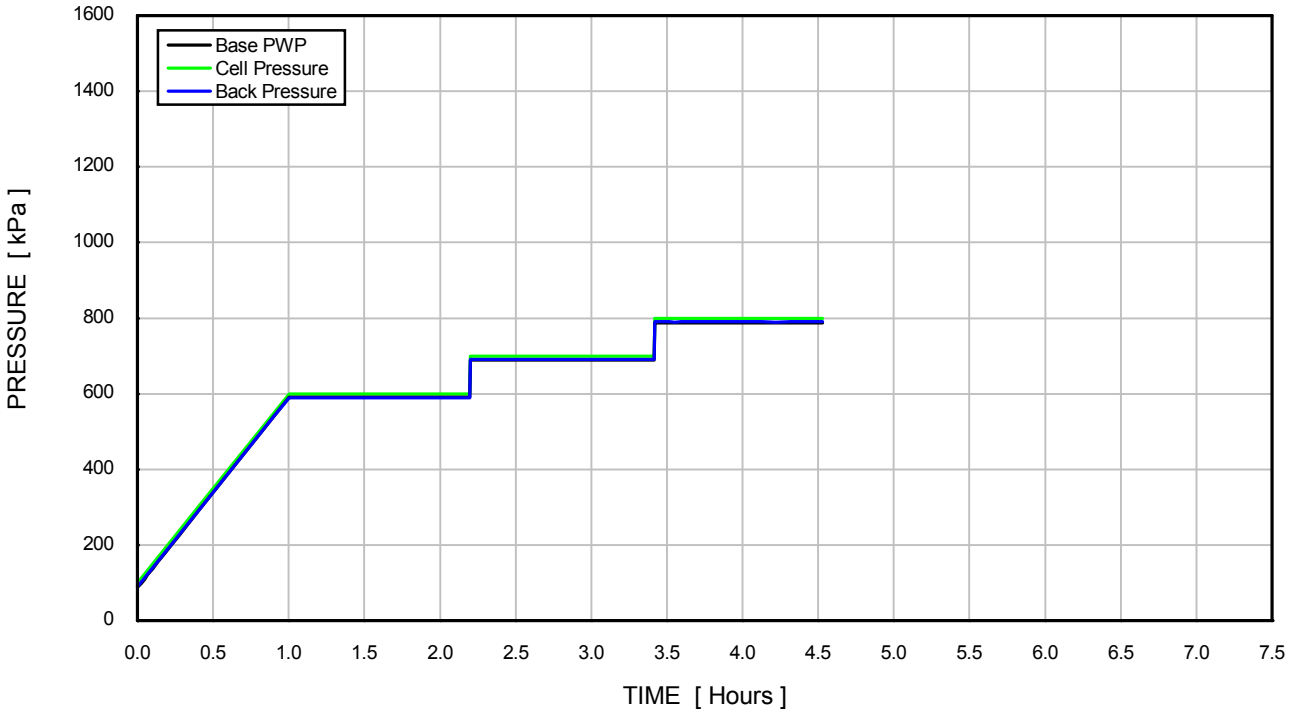
FINAL CONDITIONS

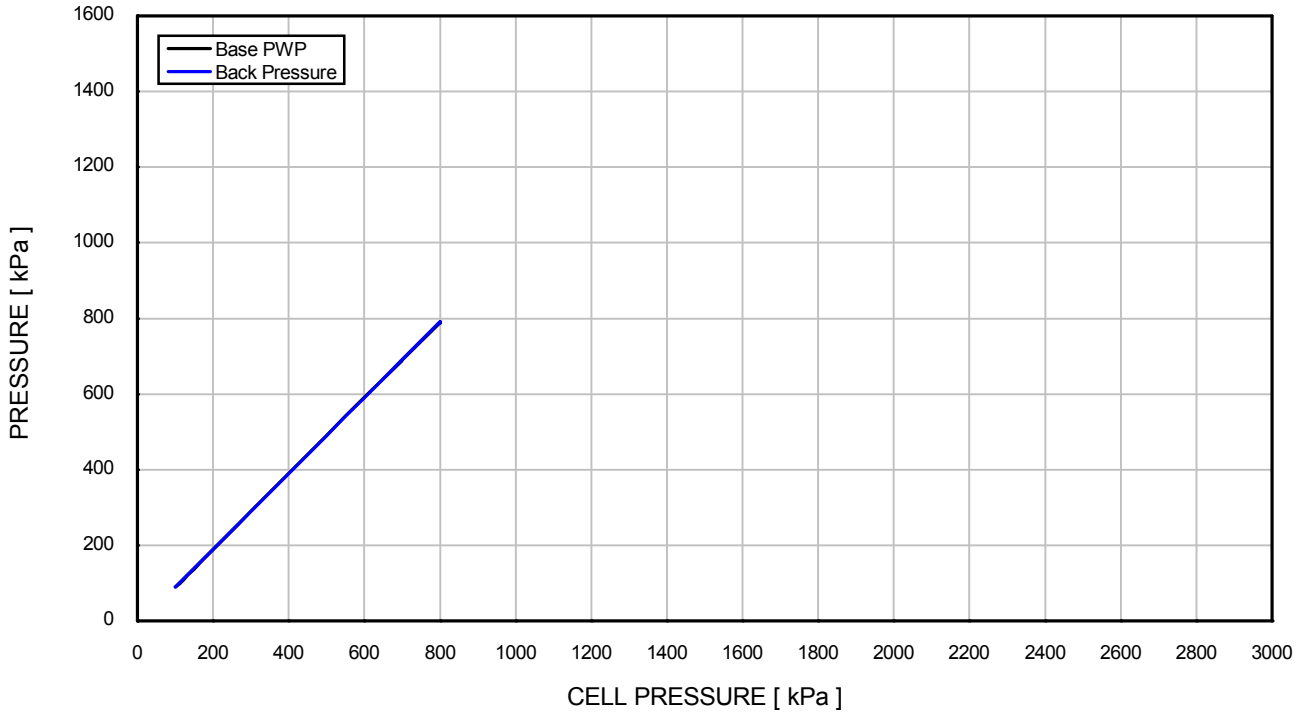
Water content	[%]	25.0
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59

TEST IDENTIFICATION

Batch	3
Sample	CID_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CID02

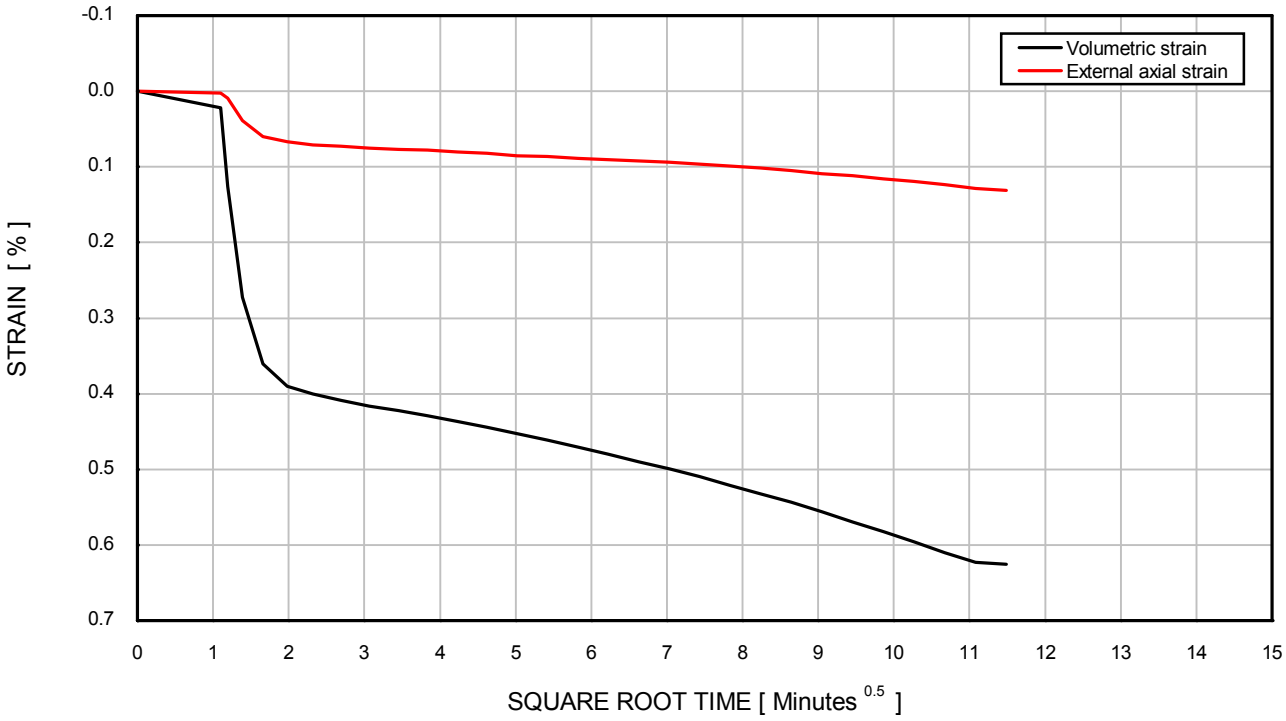
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

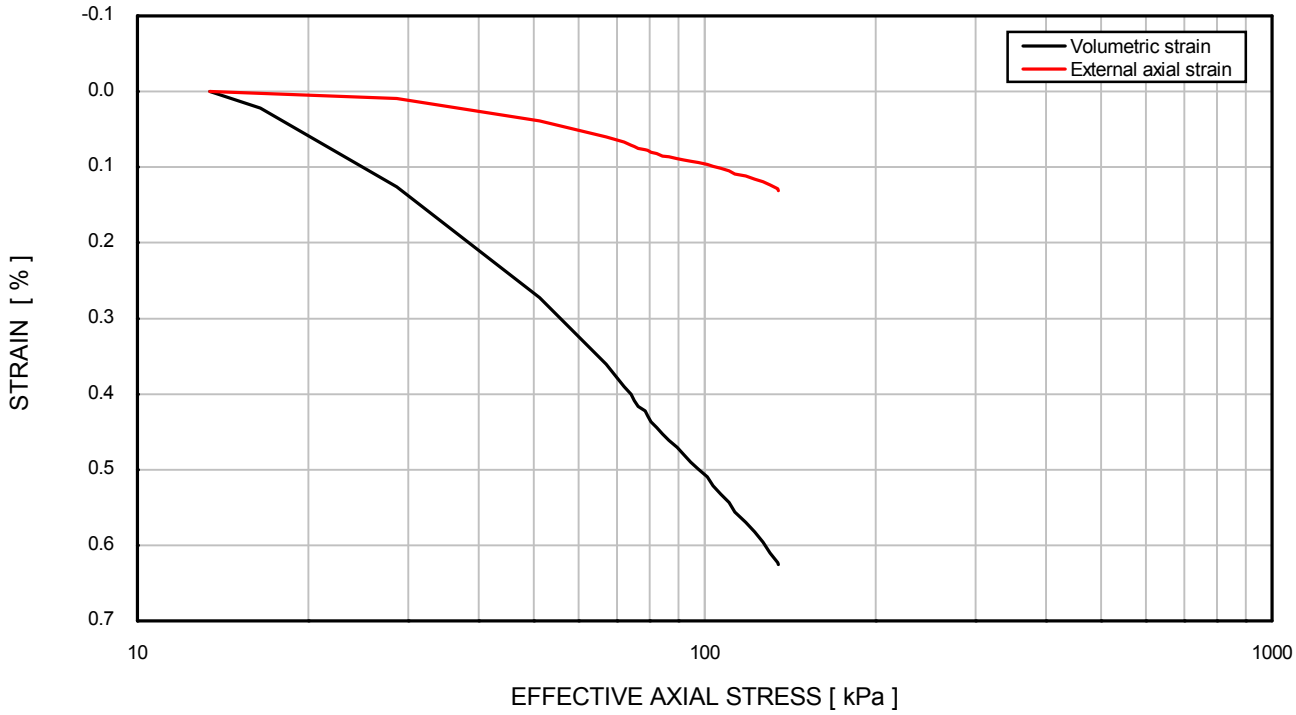




B value	:	0.98			
Initial σ'_r	:	10	kPa	Batch	: 3
Initial σ'_a	:	10	kPa	Sample	: CID_3-1
Final σ'_r	:	13	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	13	kPa	Test No.	: CID02

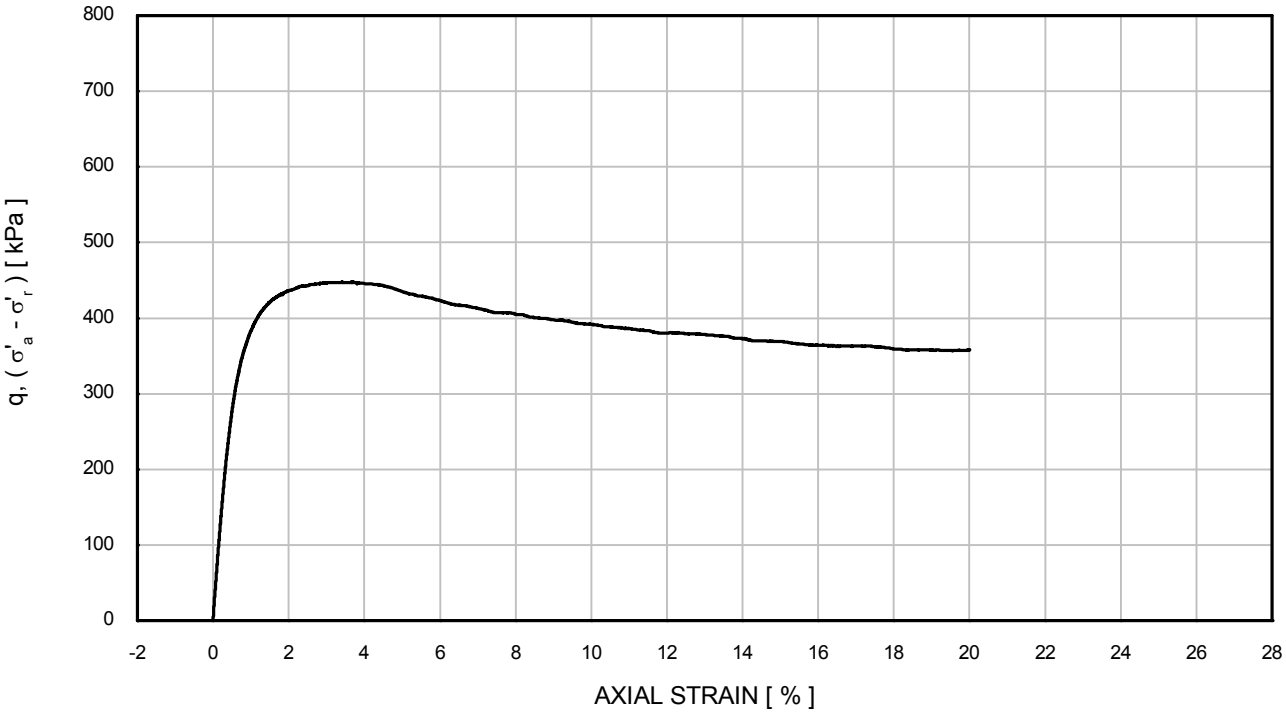
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SATURATION STAGE - DRAINED

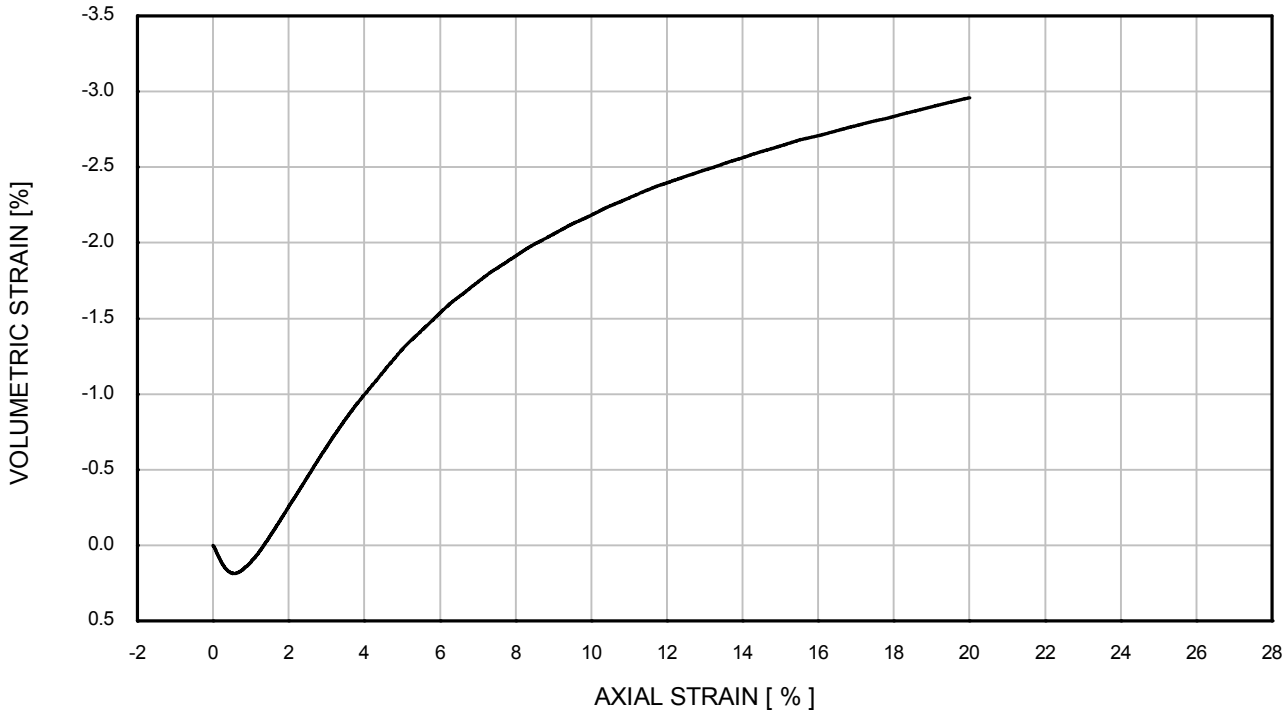




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CID_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CID02

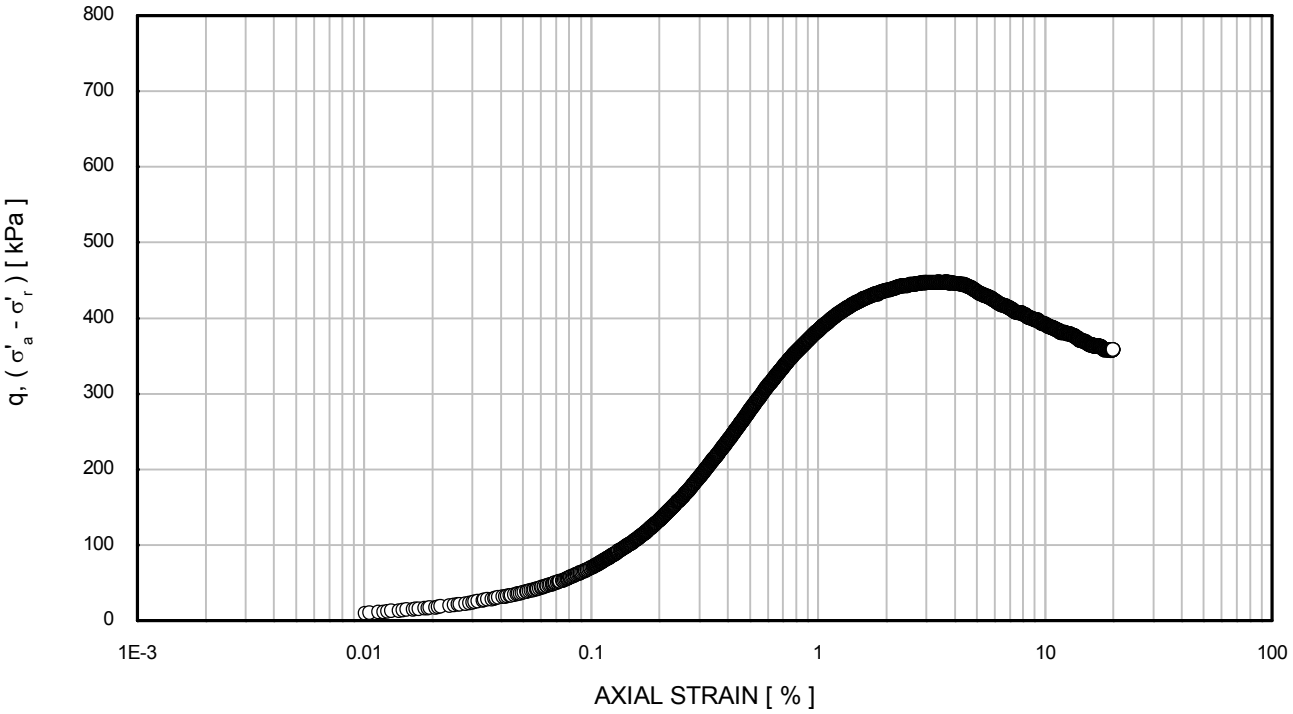
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

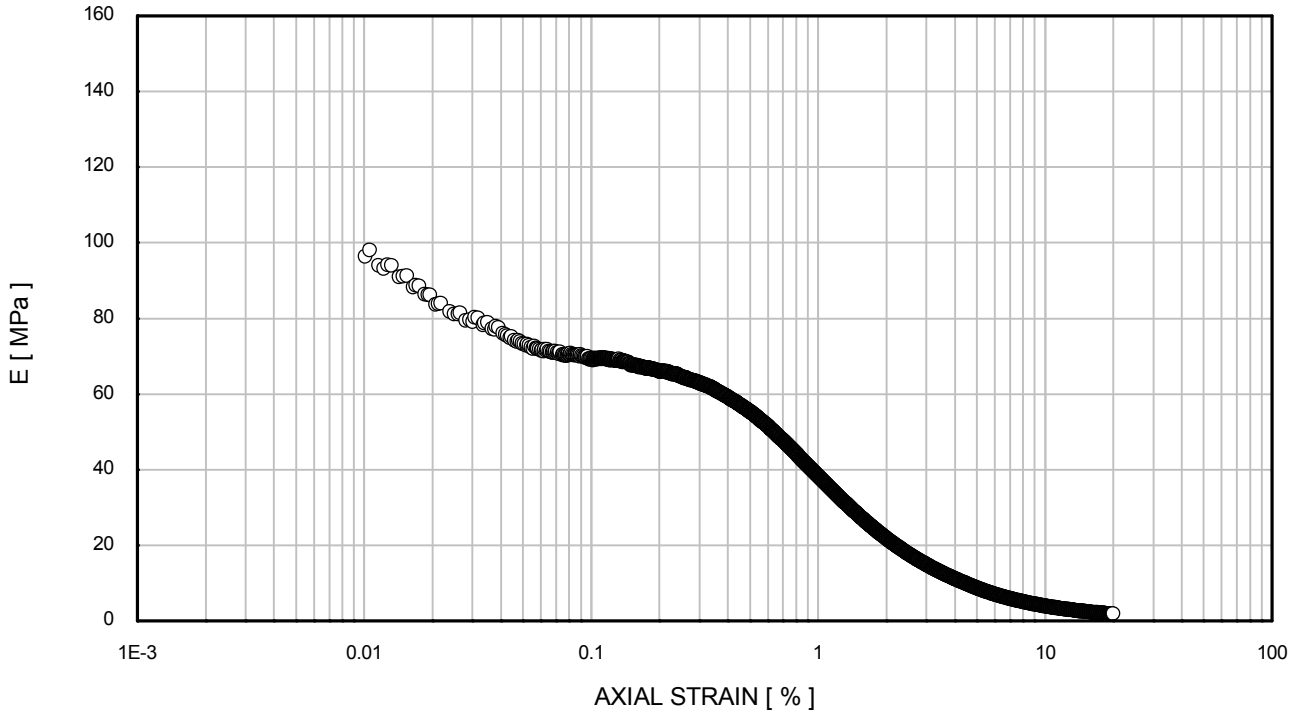




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CID_3-1
q_{peak}	:	448 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.69 %	Test No.	:	CID02
Rate of strain	:	0.99 %/hour			

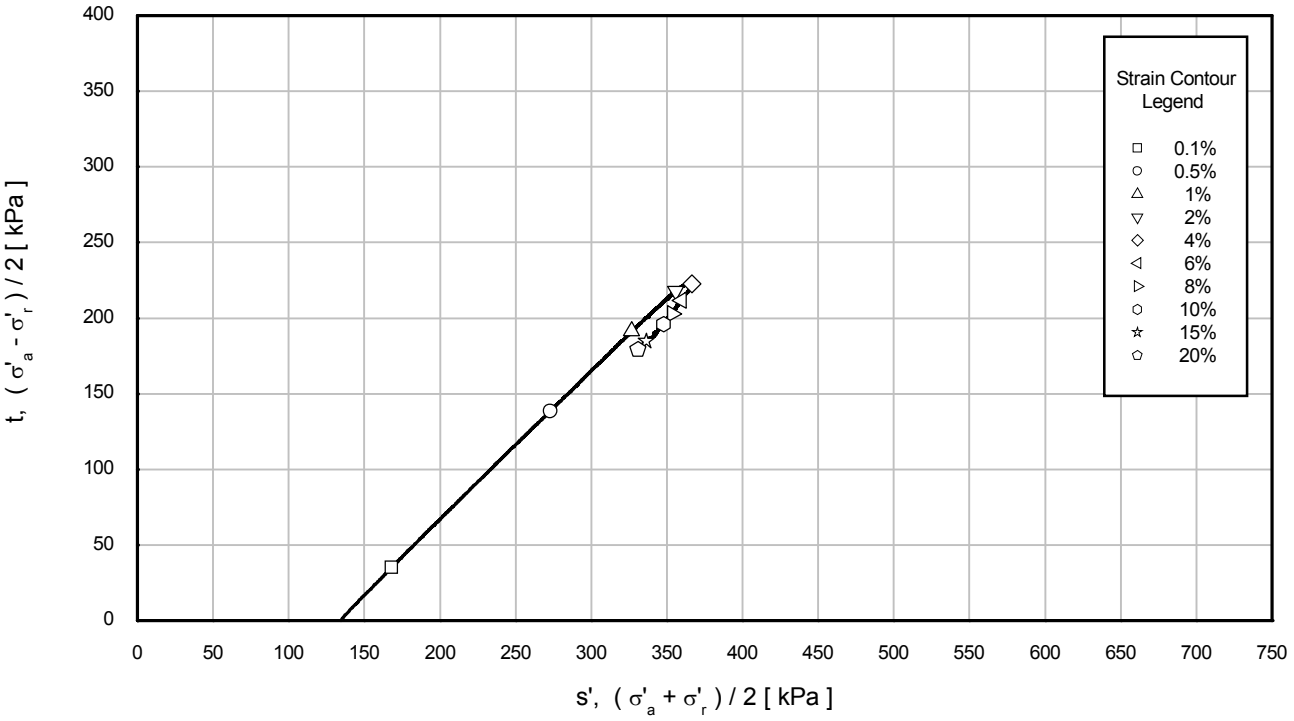
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED

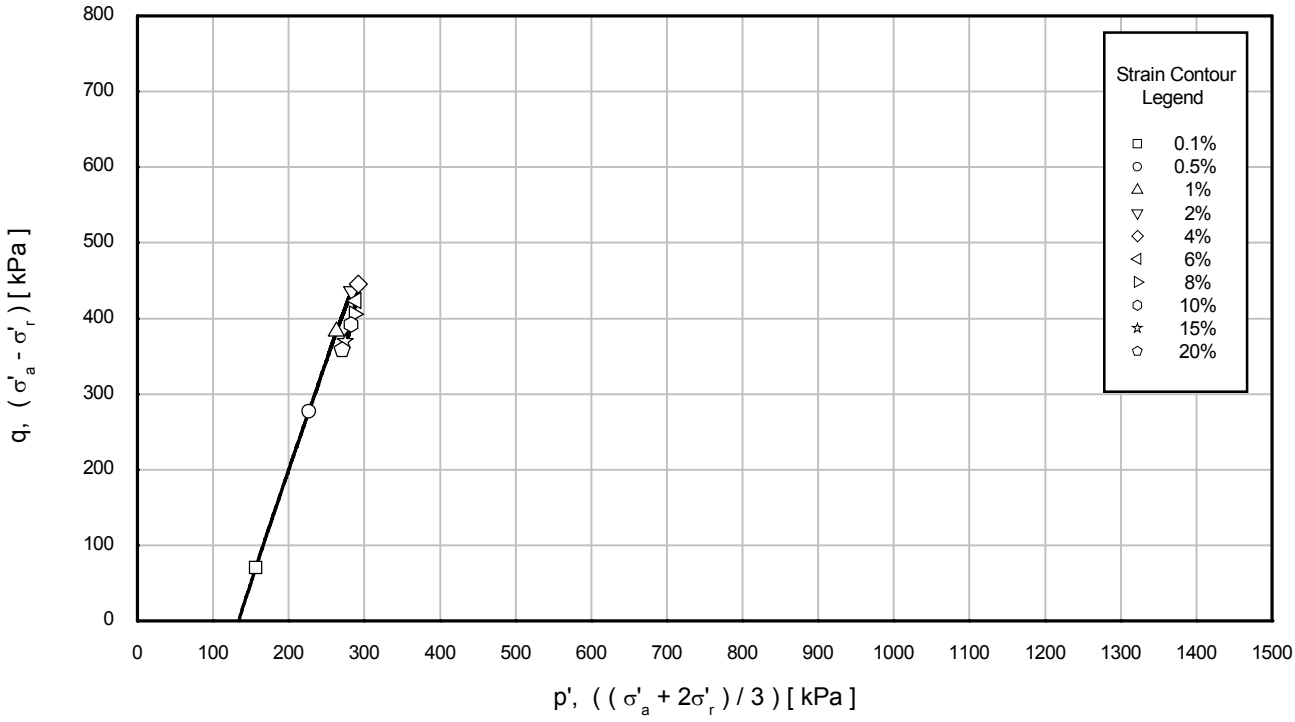




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CID_3-1
q_{peak}	:	448 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.69 %	Test No.	:	CID02
Rate of strain	:	0.99 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CID_3-1
q_{peak}	:	448 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.69 %	Test No.	:	CID02
Rate of strain	:	0.99 %/hour			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
SHEARING STAGE - DRAINED

SECTION A5: CYCLIC SIMPLE SHEAR TESTS

LIST OF PLATES IN SECTION A5: Plate

Cyclic Simple Shear Test – Cohesive Specimens	A5.1-1 to A5.1-228
Cyclic Simple Shear Test – Cohesionless Specimens	A5.2-1 to A5.2-209

VISUAL DESCRIPTION
Very dark brown CLAY with organic matter

GENERAL	
Date test started	10/12/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.9
Water content	[%]	33.9
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.35
Void ratio	[-]	1.003
Degree of saturation	[%]	91
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_15B_CSS09
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 18/11/2016
Approved by Date	PH 18/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.80
Test number	CSS09

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	120
Vertical strain	[%]	4.75
Bulk density	[Mg/m^3]	1.85
Dry density	[Mg/m^3]	1.42
Void ratio	[-]	0.907
Water content	[%]	30.4

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	120
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	4.76
Bulk density	[Mg/m^3]	1.85
Dry density	[Mg/m^3]	1.42
Void ratio	[-]	0.907

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	1.84	0.03	18.75	3.93
2	1.84	0.03	18.19	3.50
5	1.84	0.03	18.28	3.20
10	1.84	0.03	18.19	3.16
20	1.84	0.03	18.09	2.80
30	1.84	0.03	18.09	3.24
40	1.84	0.03	17.79	2.51
50	1.84	0.03	17.70	2.90
100	1.84	0.03	18.09	2.86
200	1.84	0.03	17.74	3.08
300	1.84	0.03	17.66	2.66
400	1.84	0.03	17.66	3.22

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.80
Test number	CSS09

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	23
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
γ_{av} at N_f	[%]	0.09
γ_{cy} at N_f	[%]	0.34
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	54
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.01	0.20	11.44	11.44
2	0.01	0.20	11.20	10.80
5	0.01	0.21	10.81	9.94
10	0.01	0.22	10.51	9.50
20	0.02	0.23	10.19	9.18
30	0.02	0.23	9.93	9.04
40	0.02	0.24	9.74	8.89
50	0.03	0.24	9.56	8.78
100	0.03	0.25	9.03	8.72
500	0.06	0.30	7.69	8.54
1000	0.08	0.32	7.13	8.58
1500	0.09	0.34	6.83	8.61

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	83
Shear strain	[%]	20.55
Shear induced $-\Delta\sigma_v$	[kPa]	36
Vertical stress	[kPa]	83
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.02
At 15 % shear strain		
Shear stress	[kPa]	78
Shear induced $-\Delta\sigma_v$	[kPa]	39
Vertical stress	[kPa]	81
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.80
Test number	CSS09

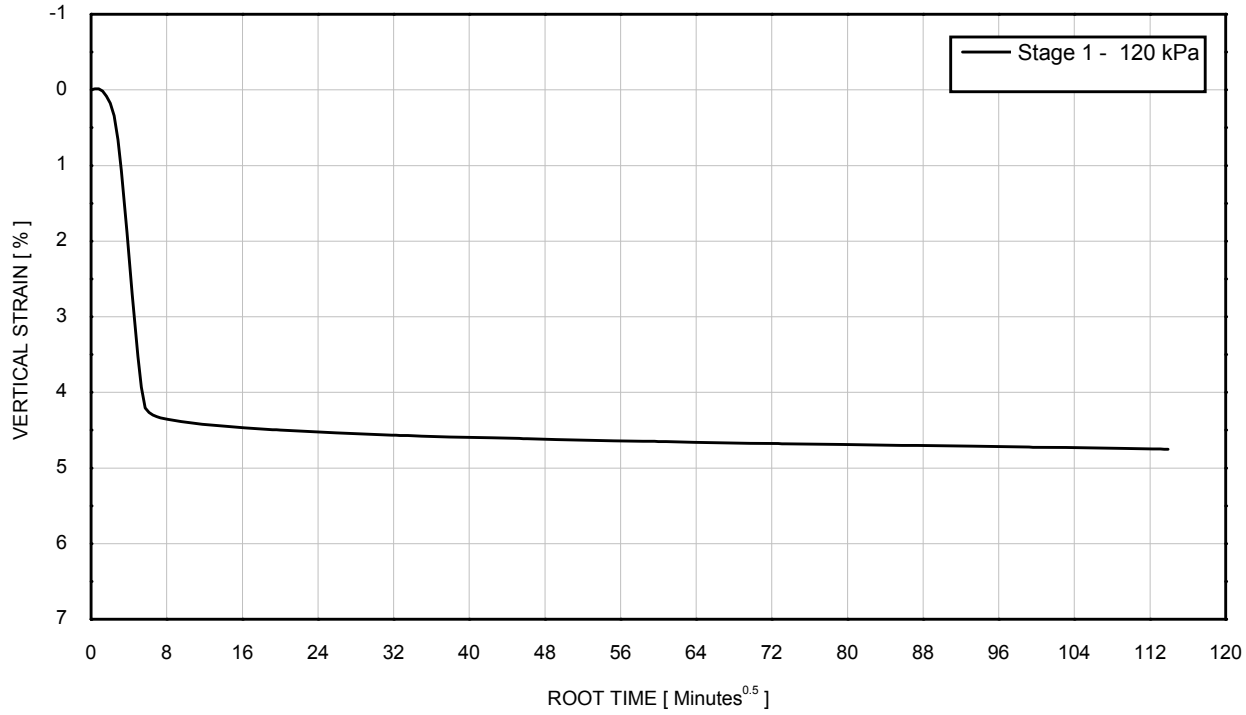
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

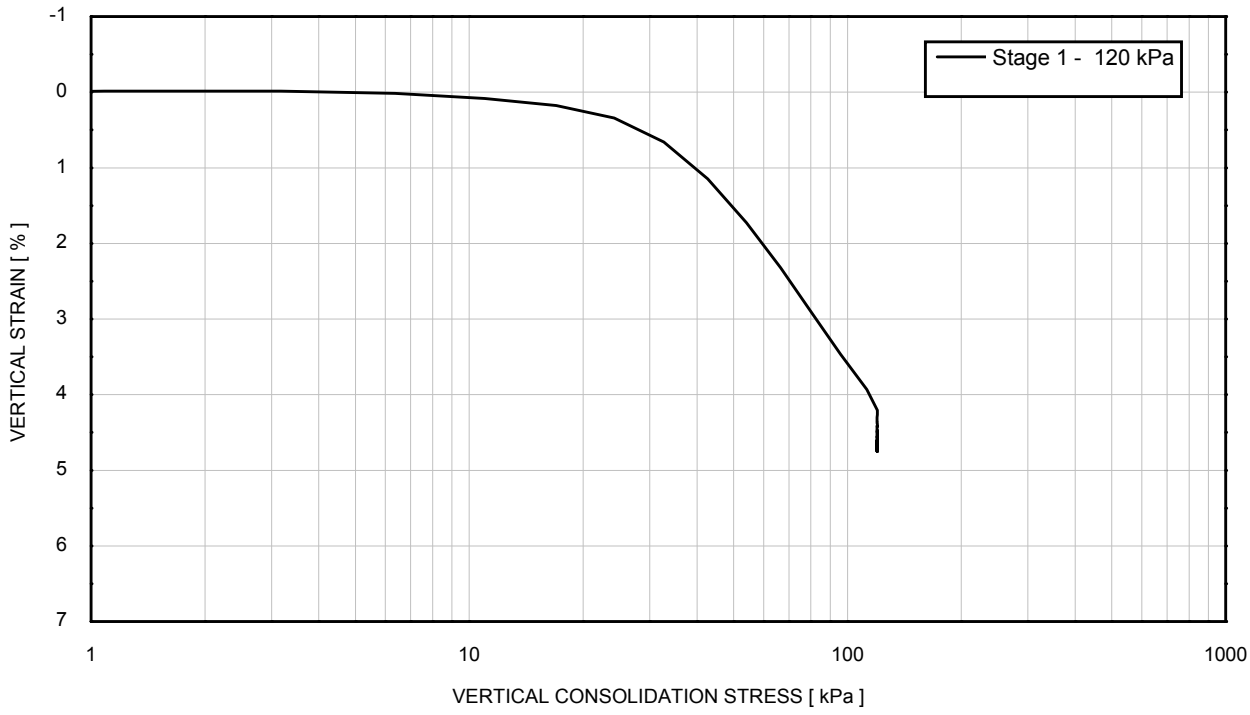
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.80
Test number	CSS09

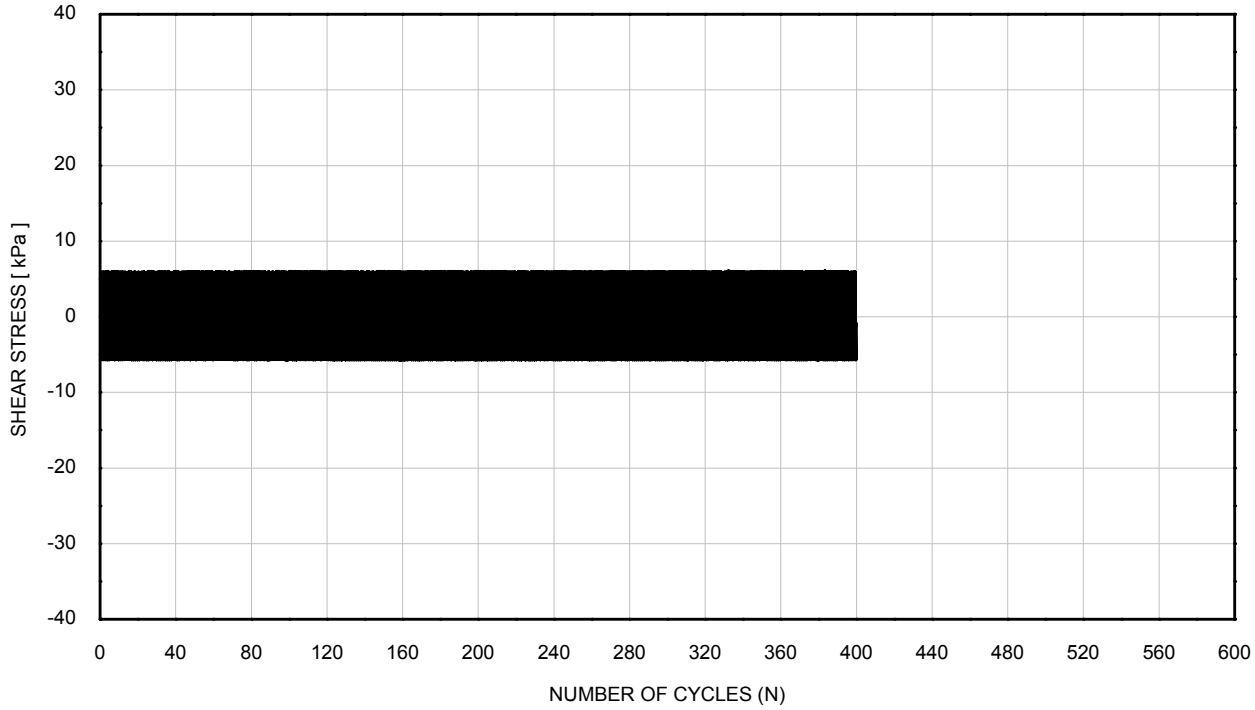
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

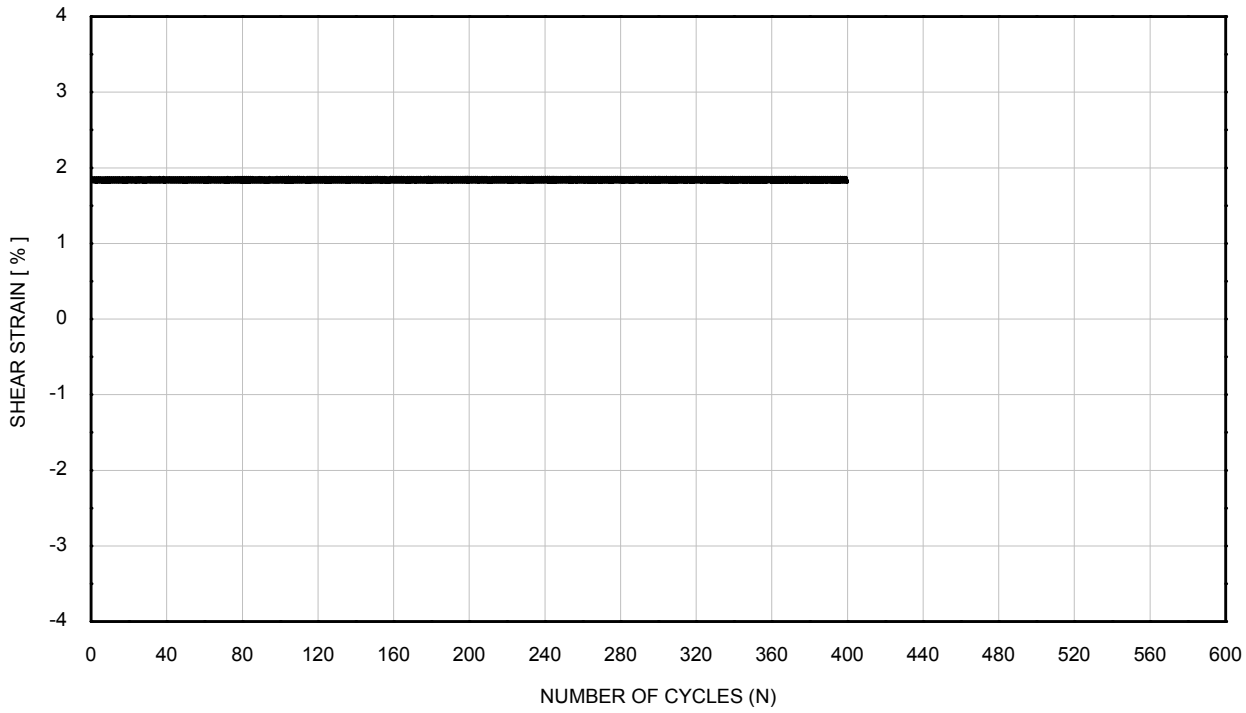




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 15WaxB
		Depth [m]	: 12.80
		Test No.	: CSS09

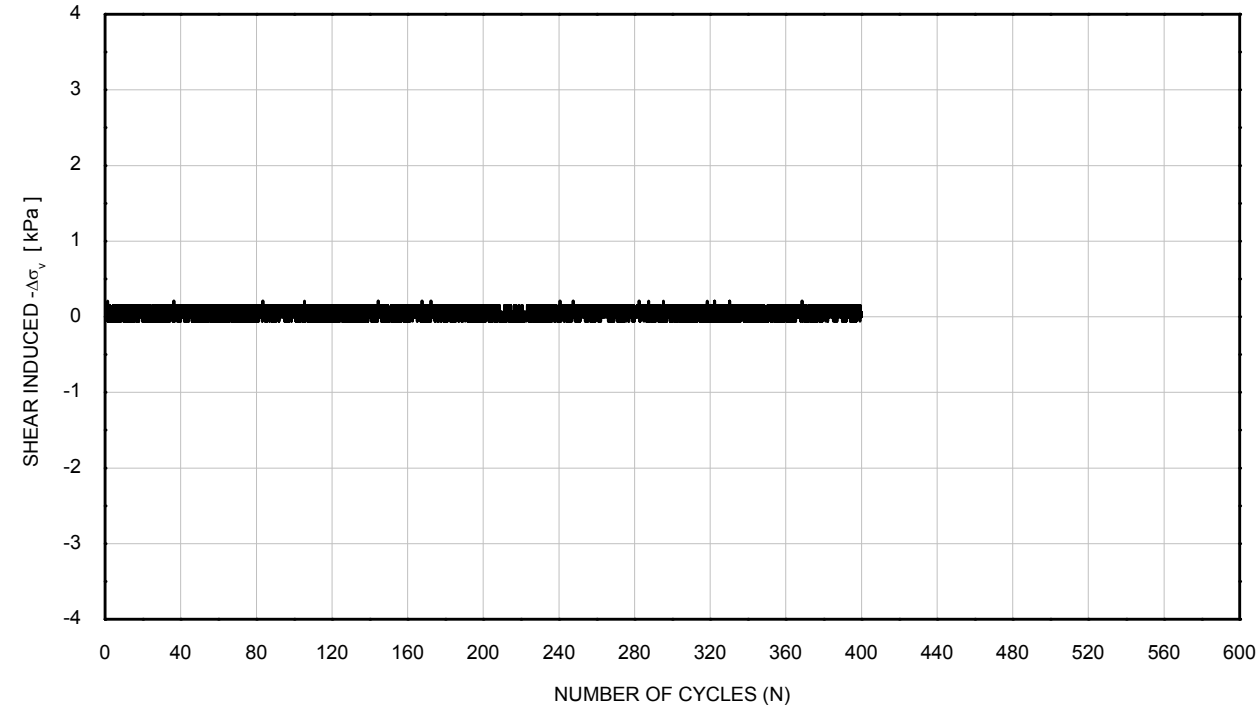
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

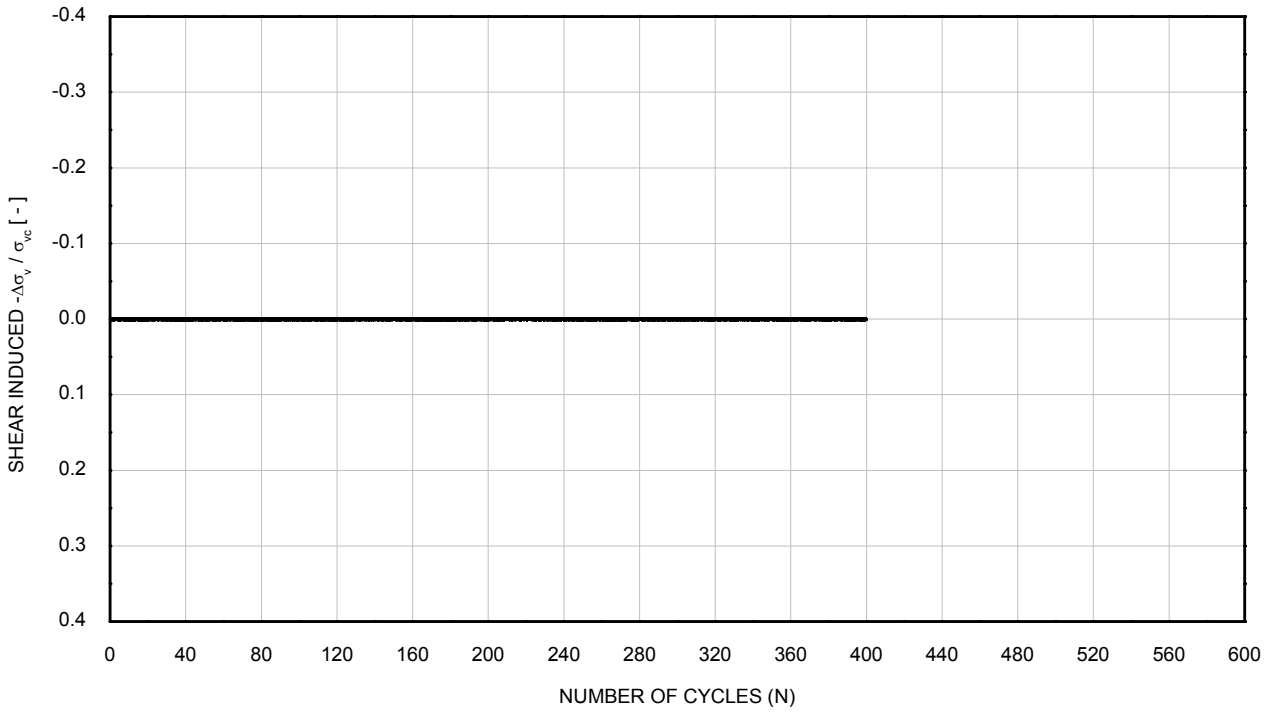




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

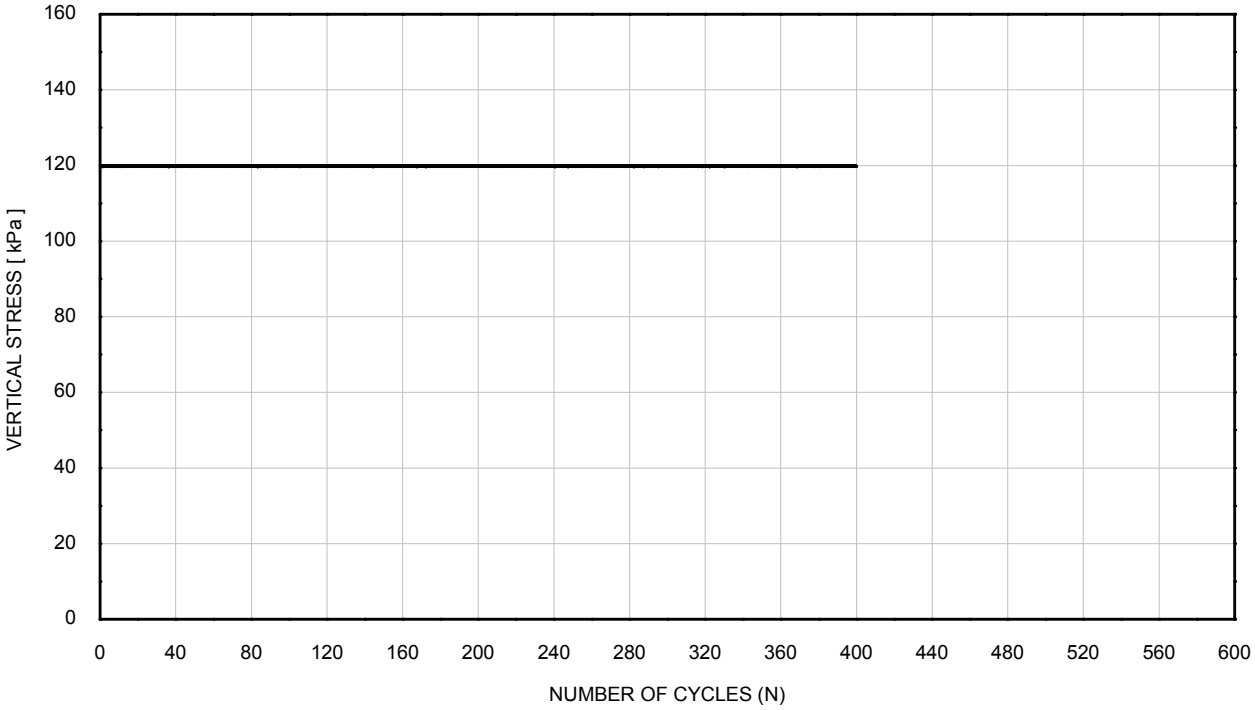
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

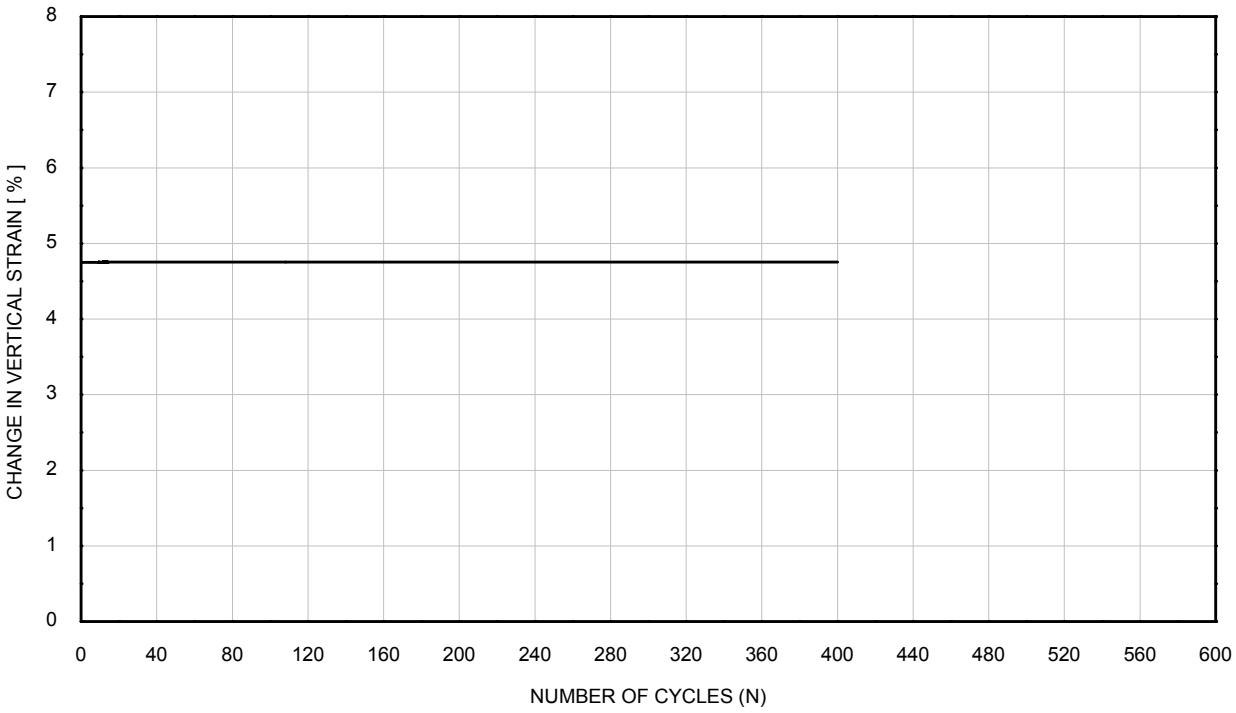




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 15WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	: 12.80
Frequency	:	0.10 Hz	Test No.	: CSS09

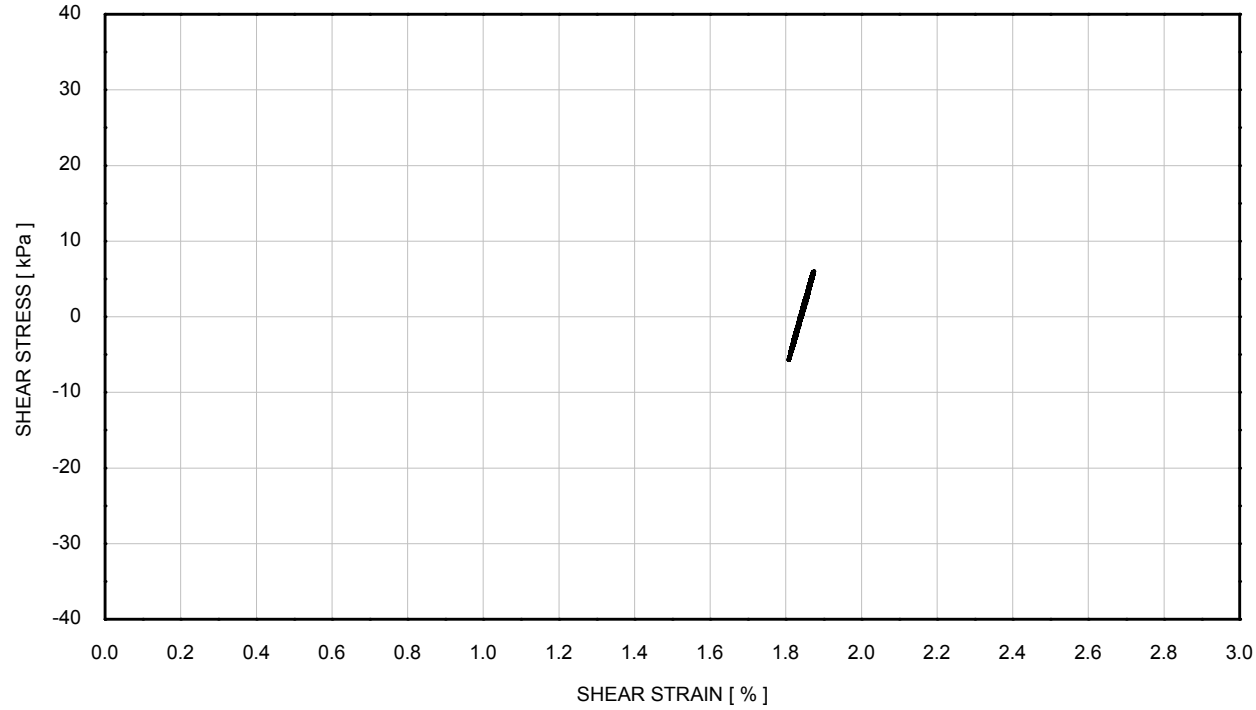
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

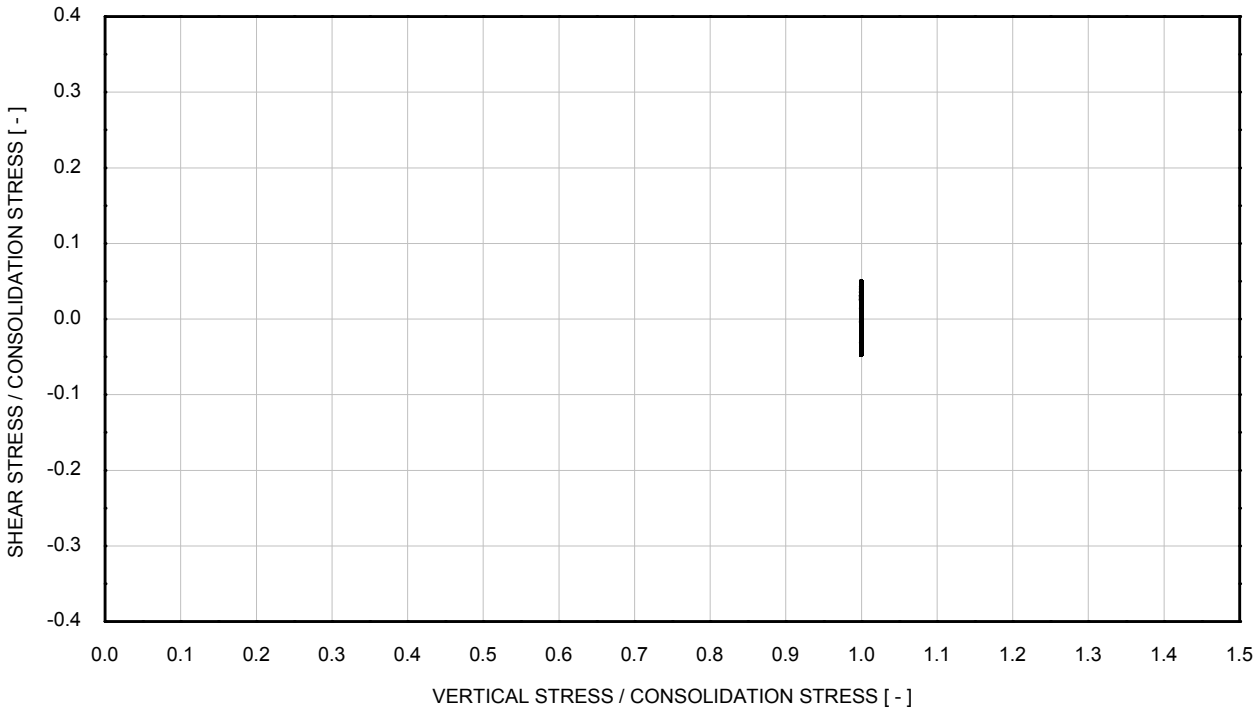




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

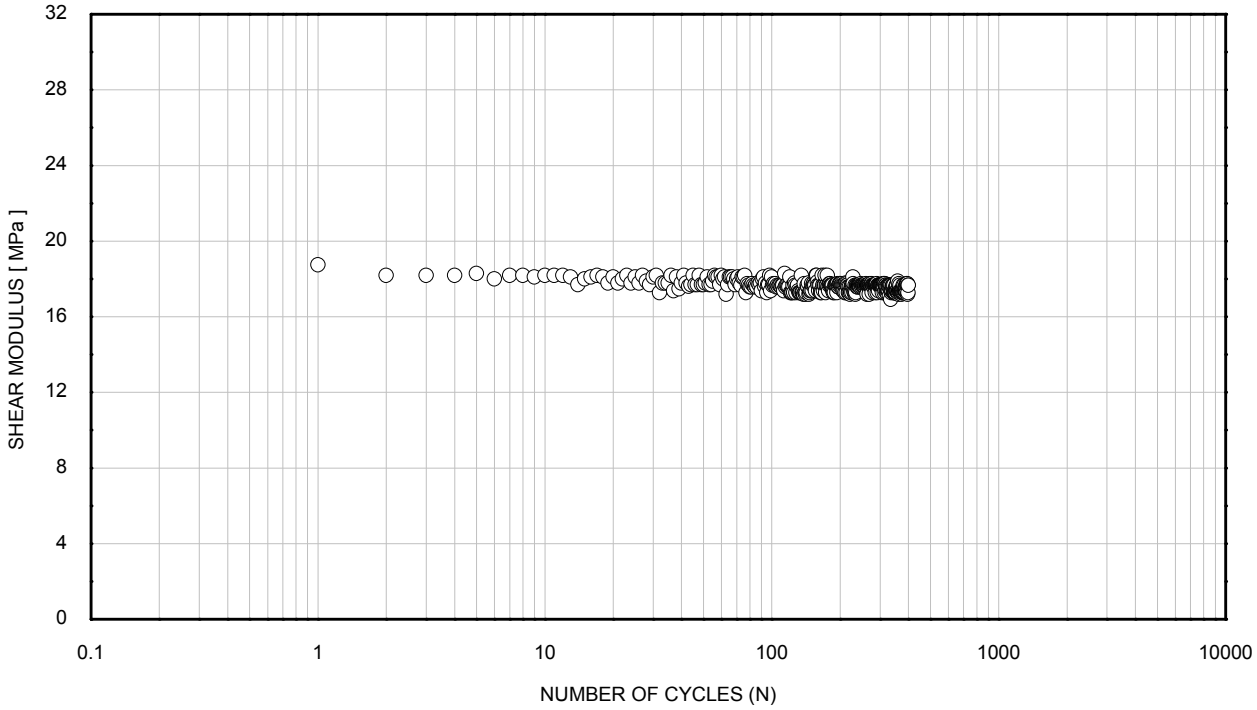
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

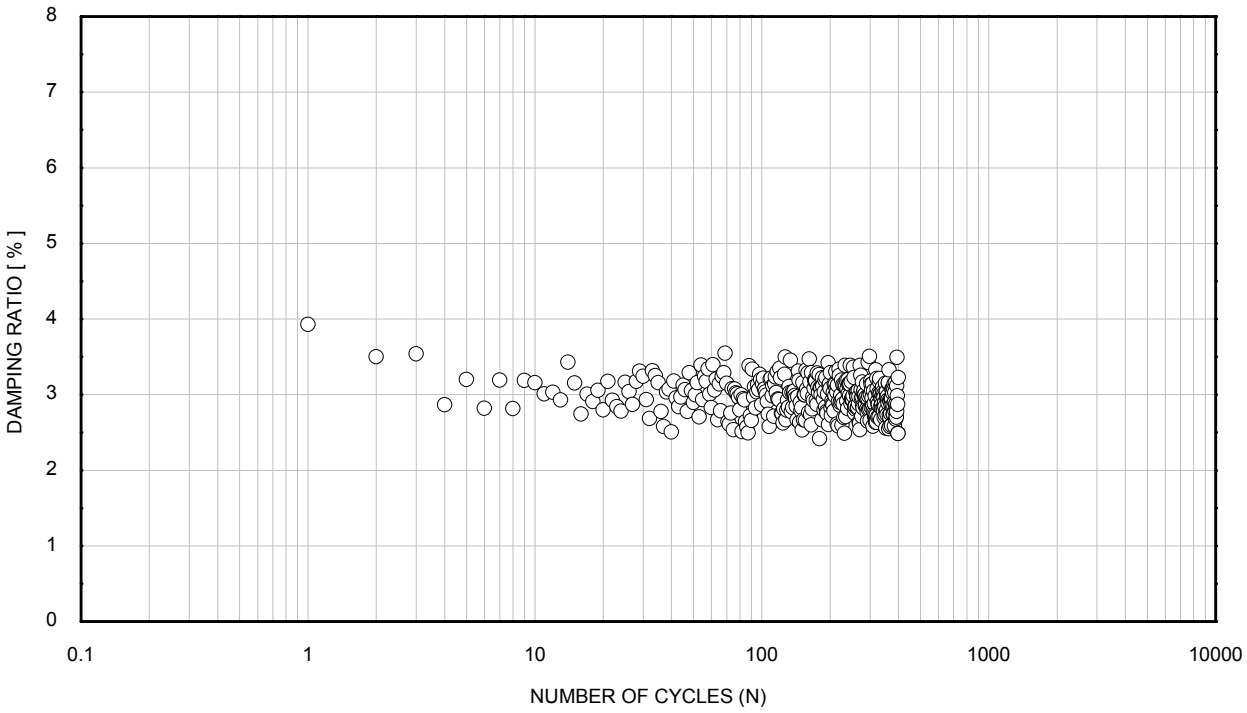




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

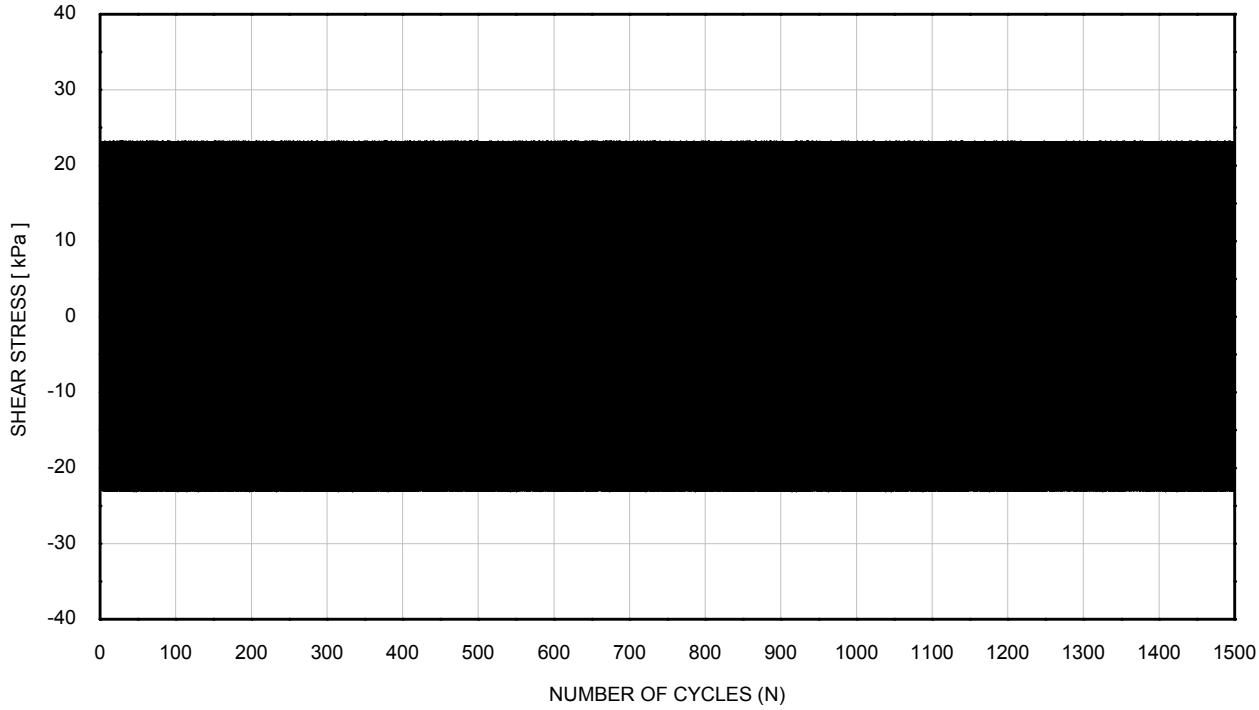
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

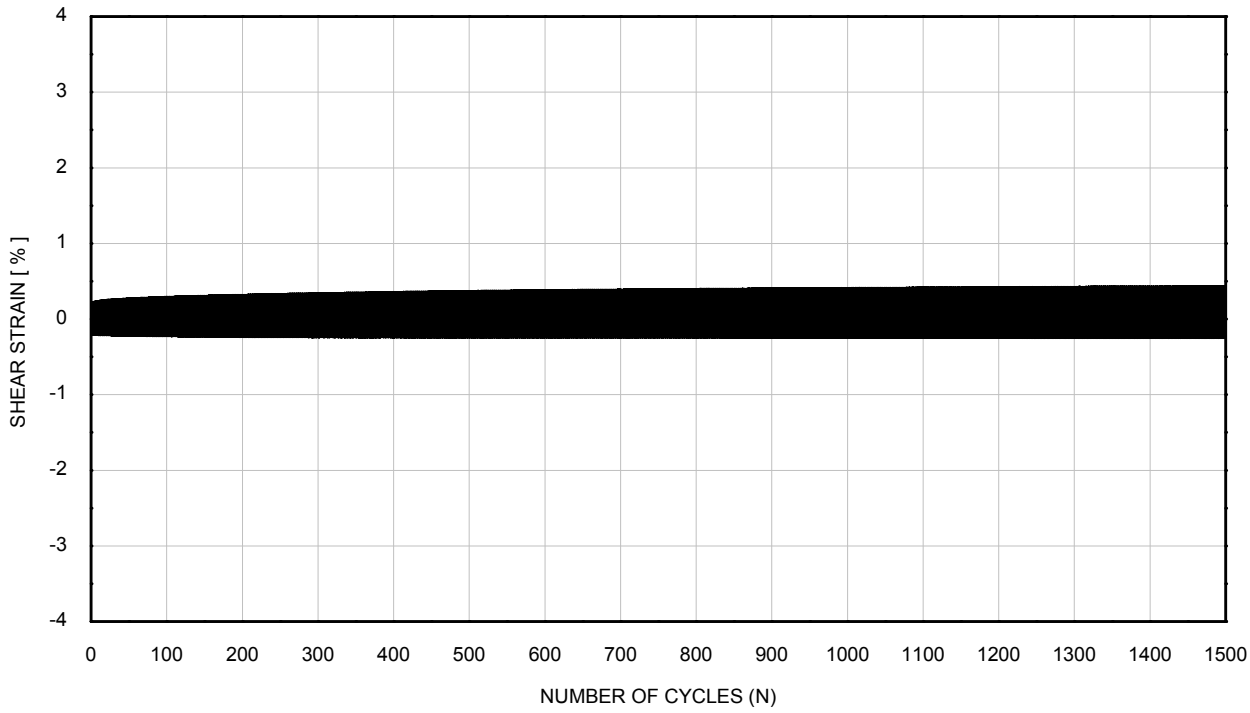




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

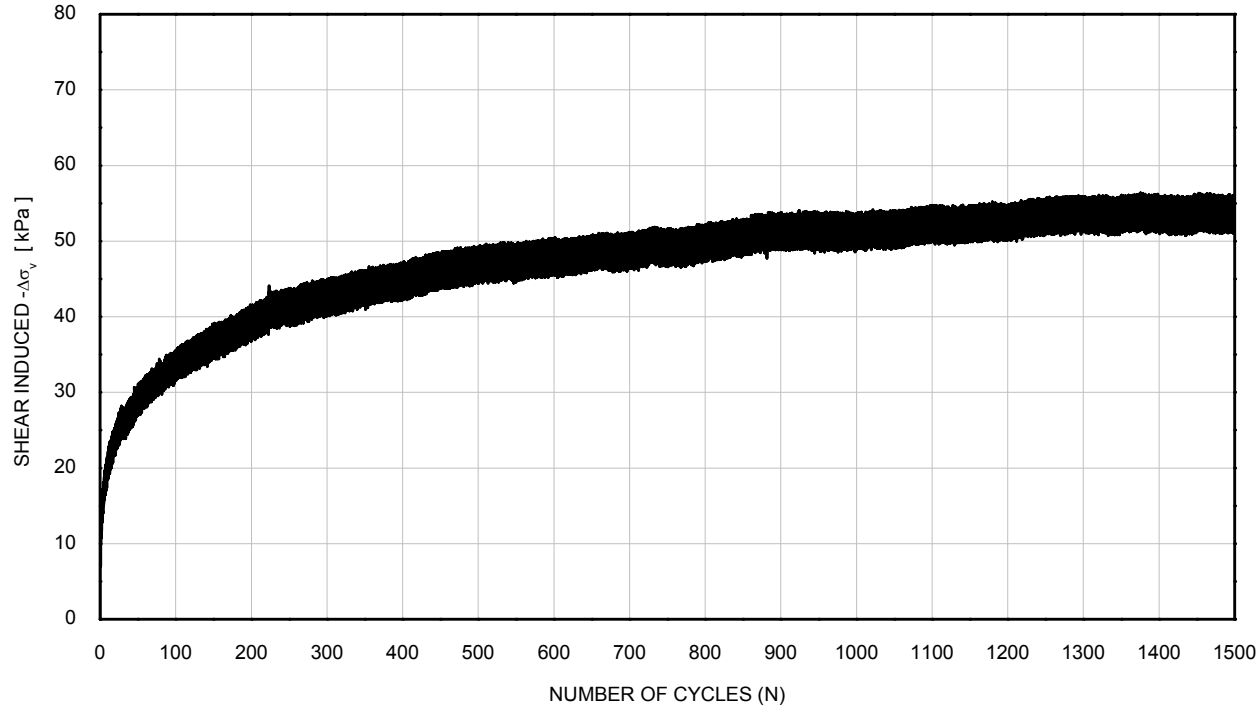
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

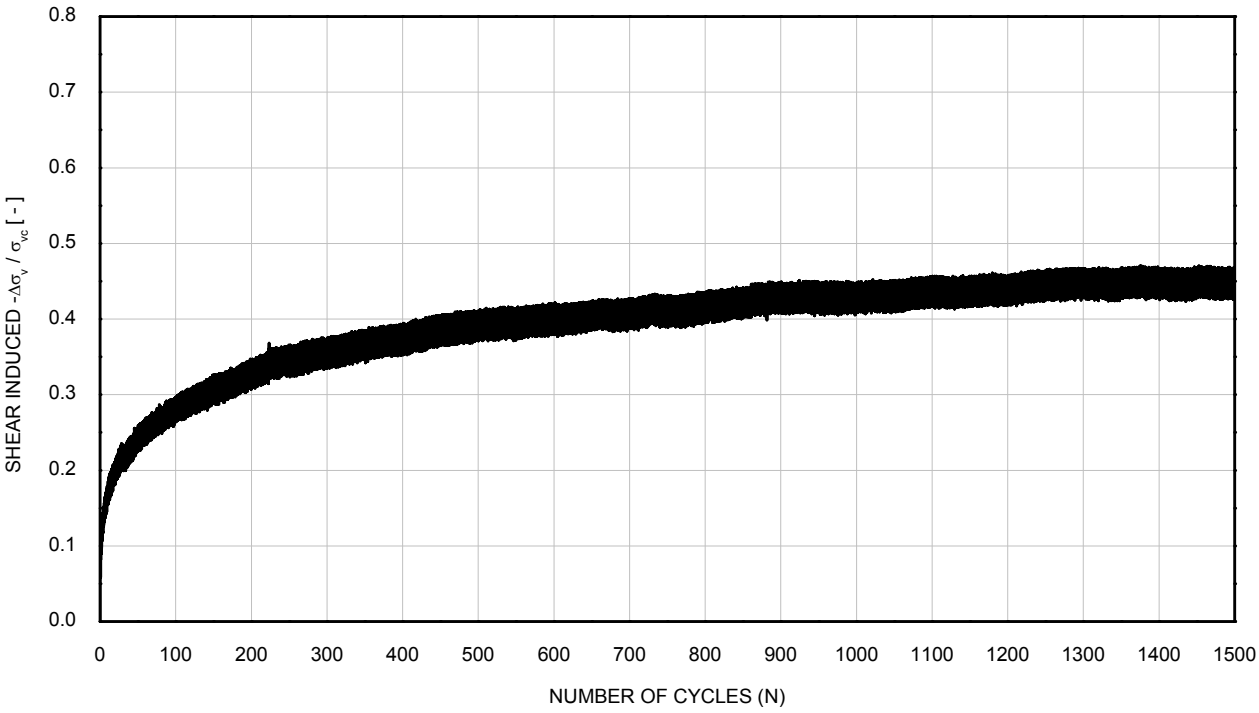




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

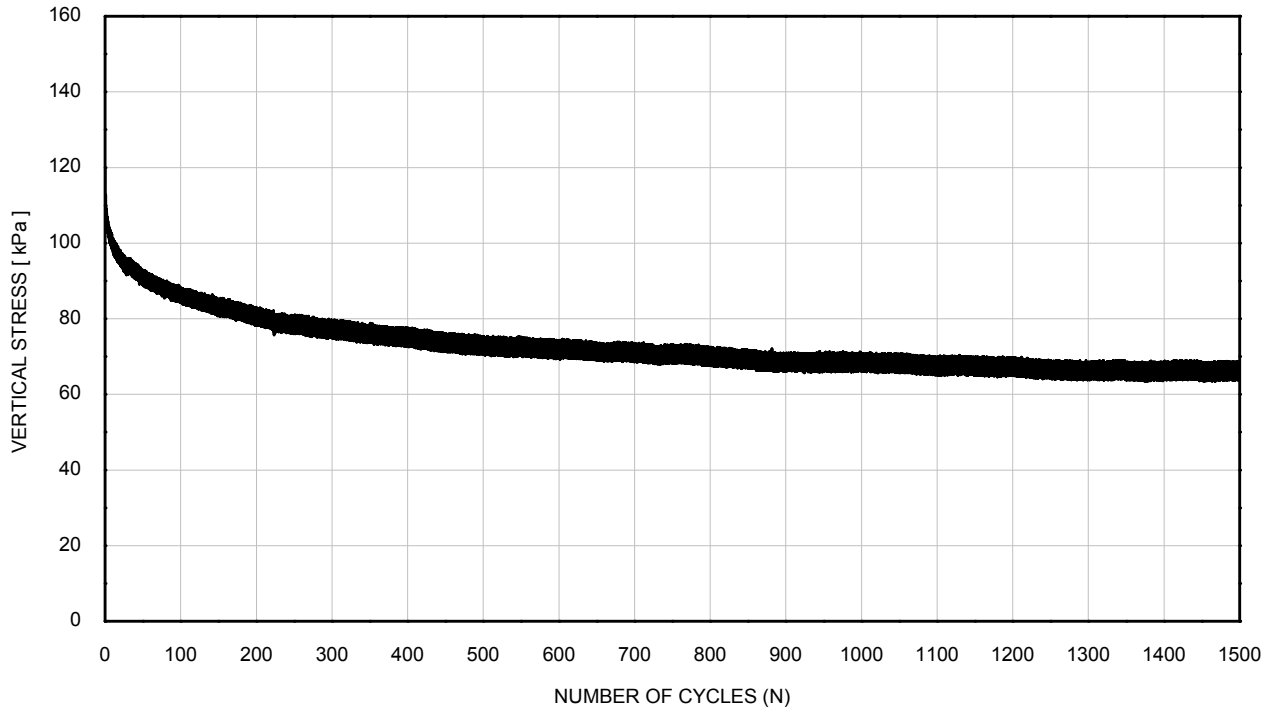
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

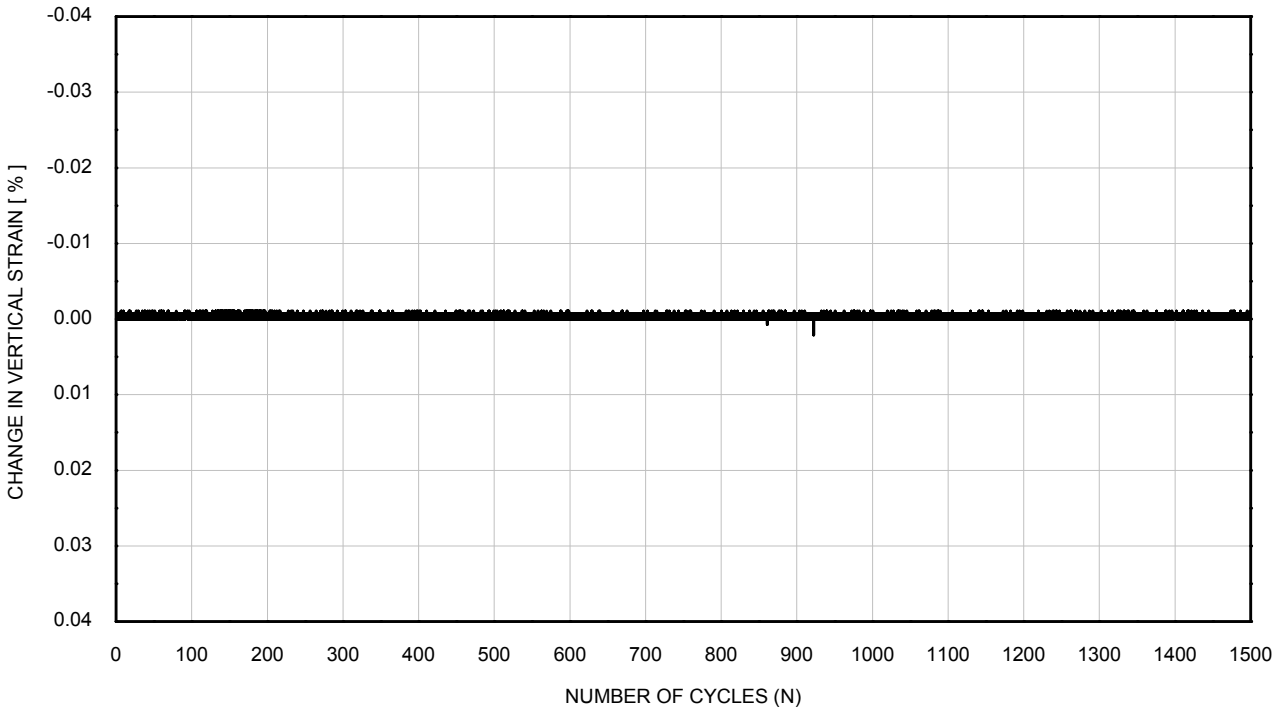




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 15WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	: 12.80
Frequency	:	0.10 Hz	Test No.	: CSS09

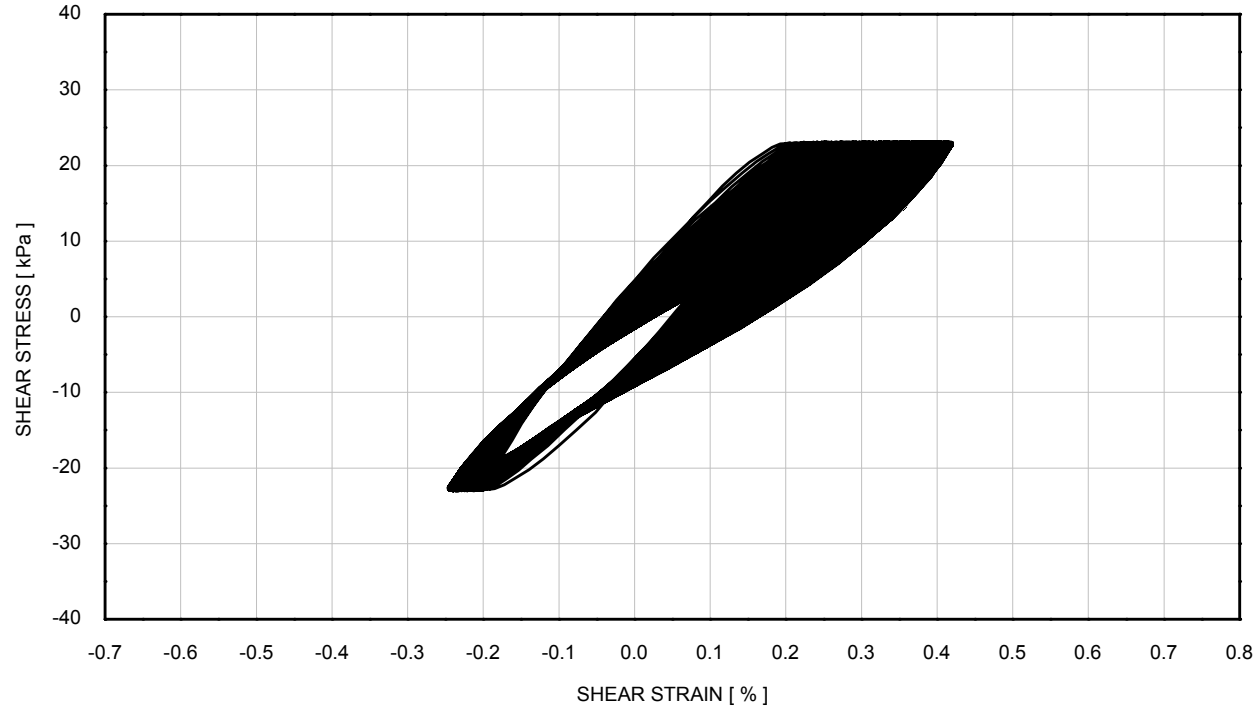
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

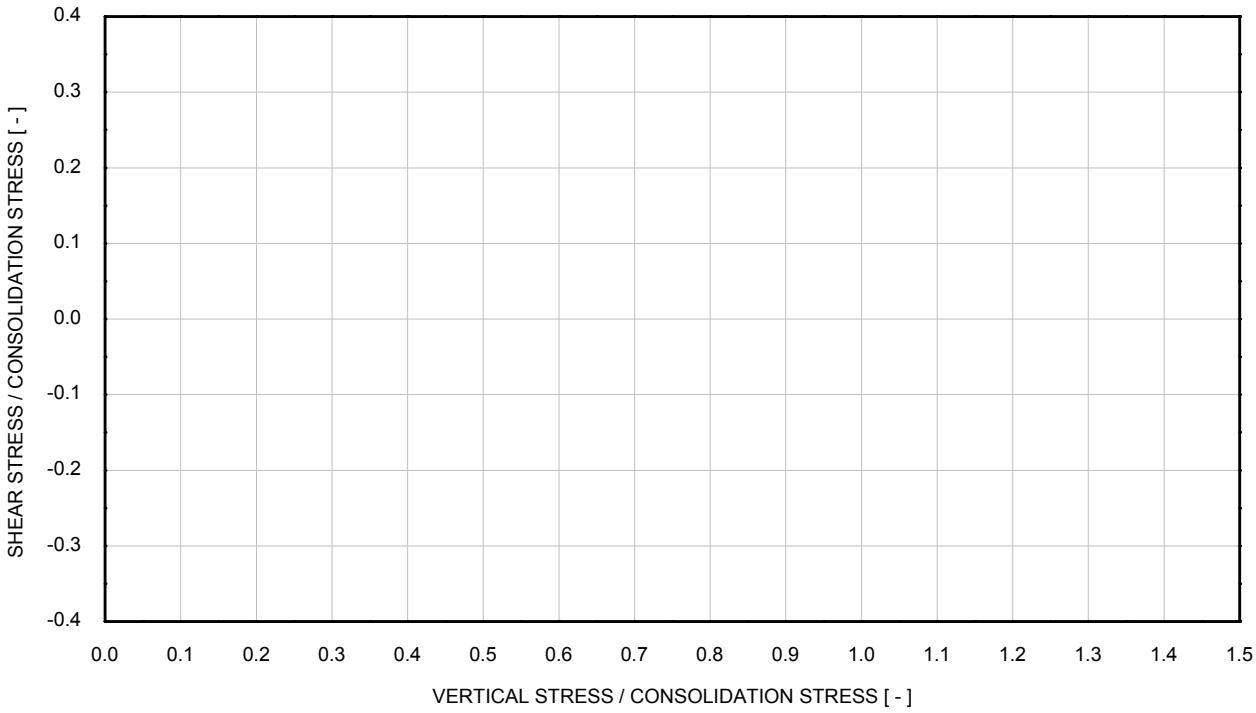




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

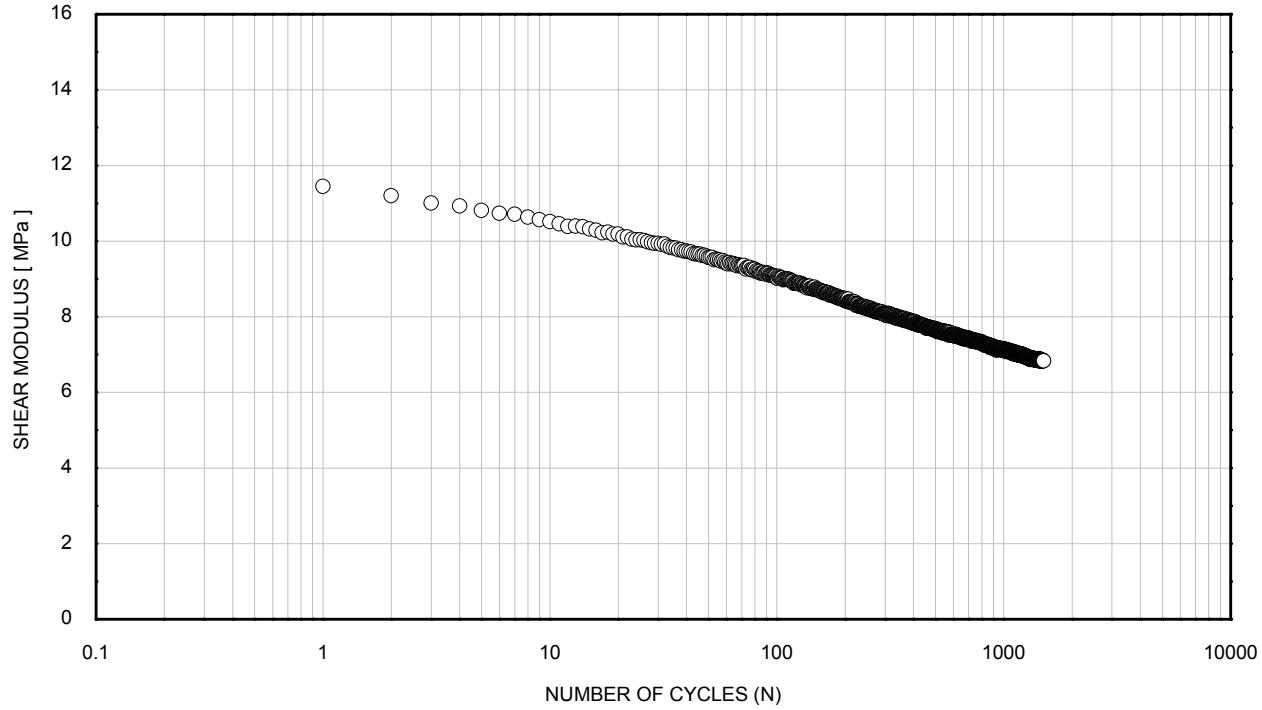
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

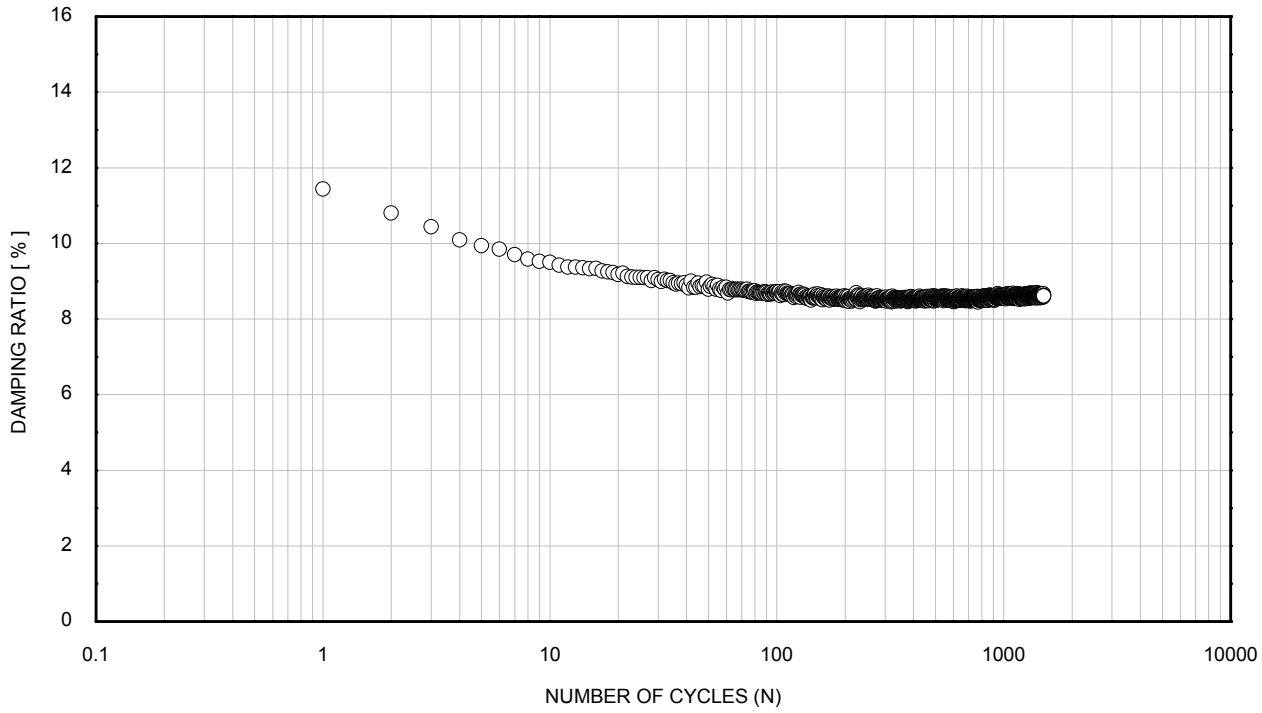




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

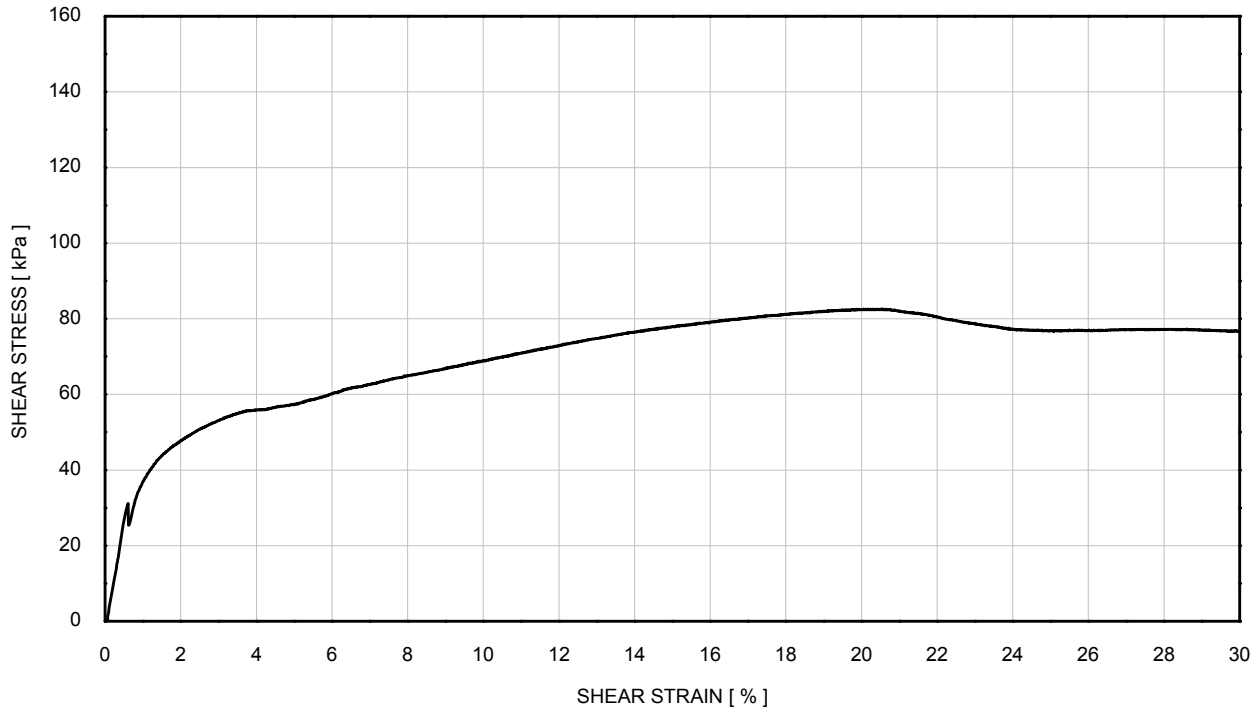
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

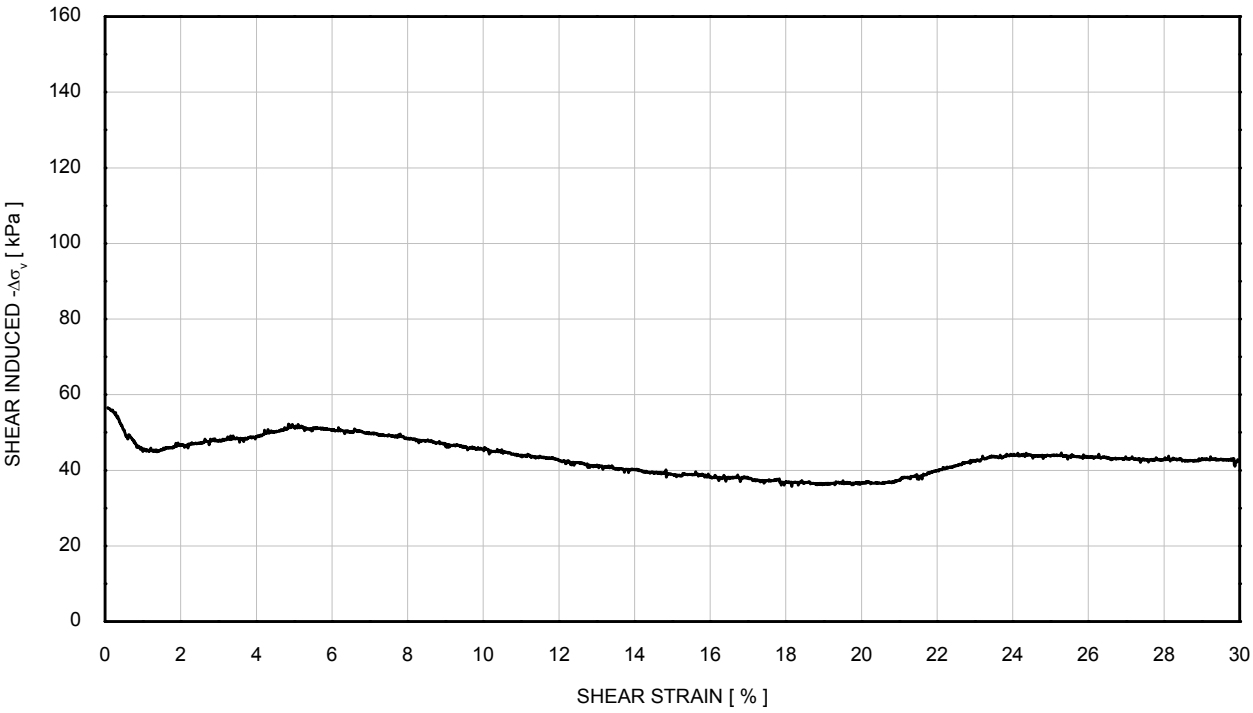




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	12.80
Frequency	:	0.10 Hz	Test No.	:	CSS09

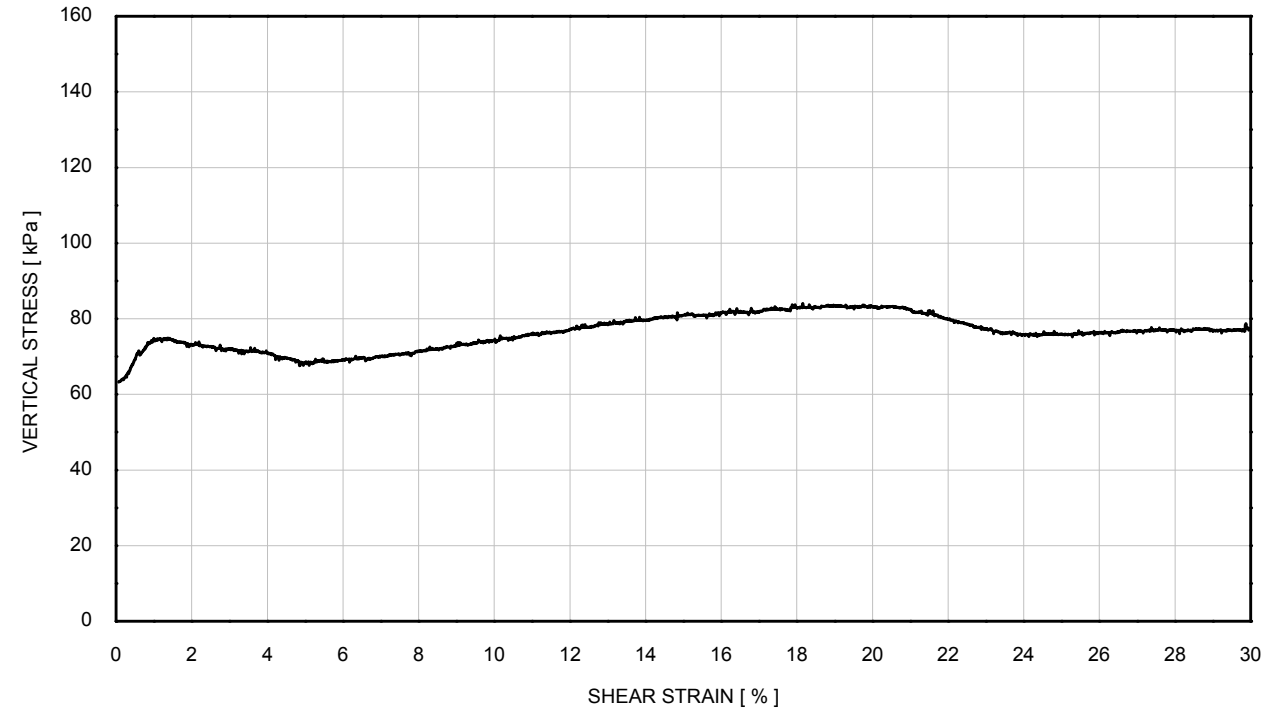
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

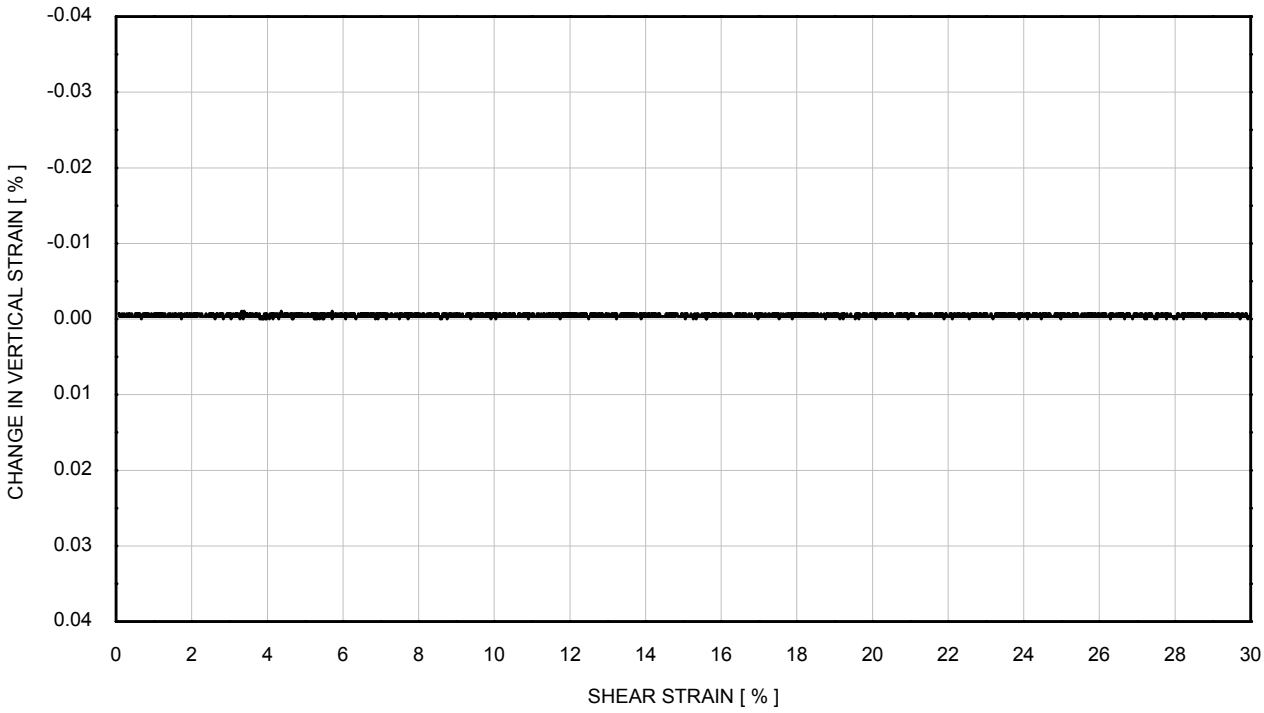




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 83 kPa	Sample	: 15WaxB
γ at τ_{peak}	: 20.55 %	Depth [m]	: 12.80
Rate of strain	: 3.02 %/hour	Test No.	: CSS09

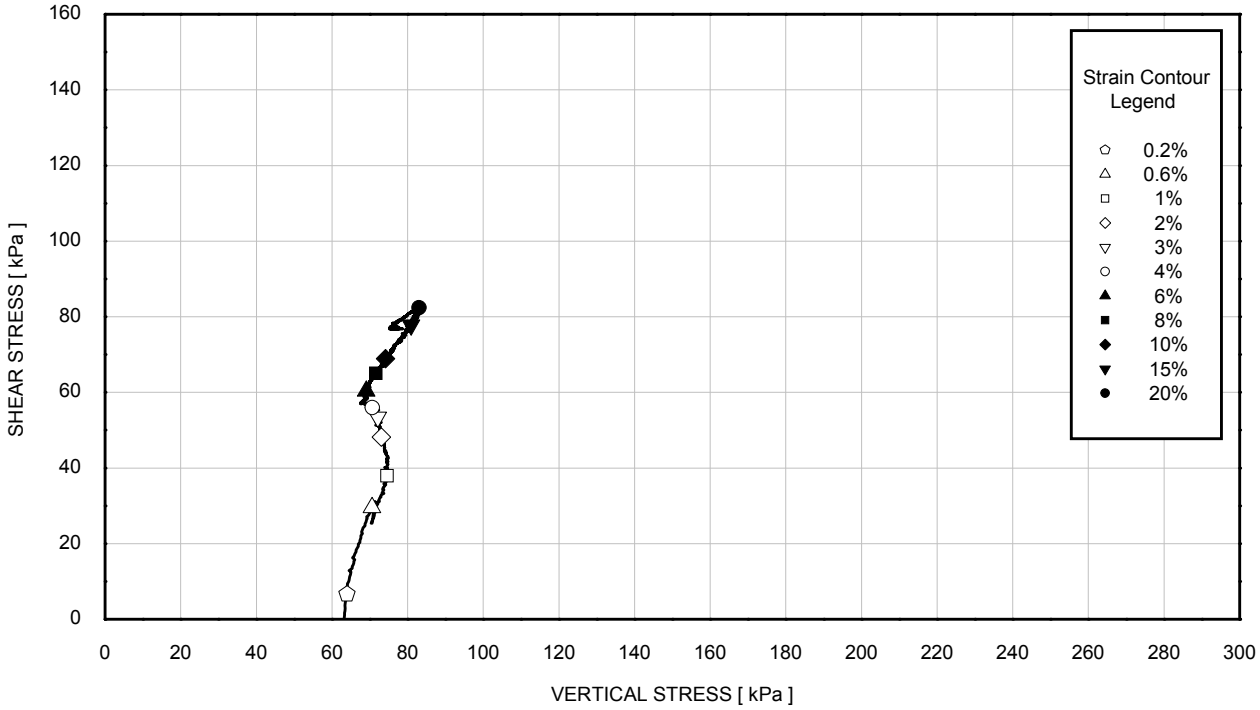
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

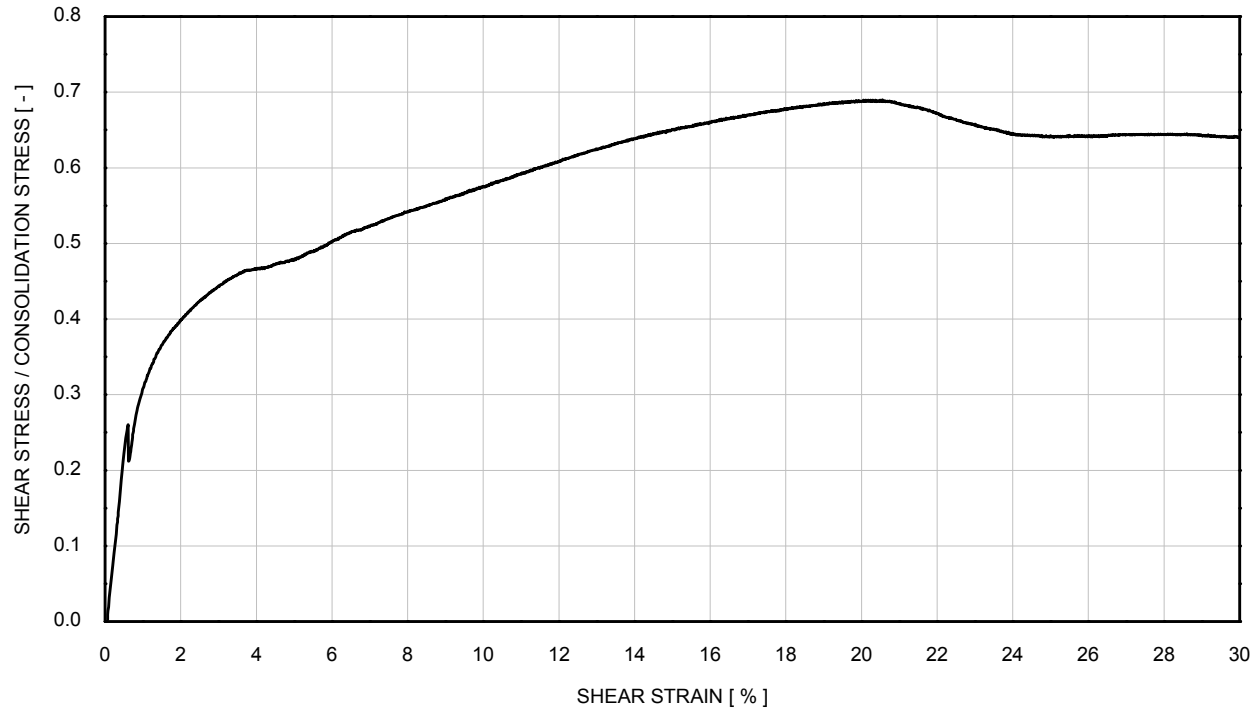




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 83 kPa	Sample	: 15WaxB
γ at τ_{peak}	: 20.55 %	Depth [m]	: 12.80
Rate of strain	: 3.02 %/hour	Test No.	: CSS09

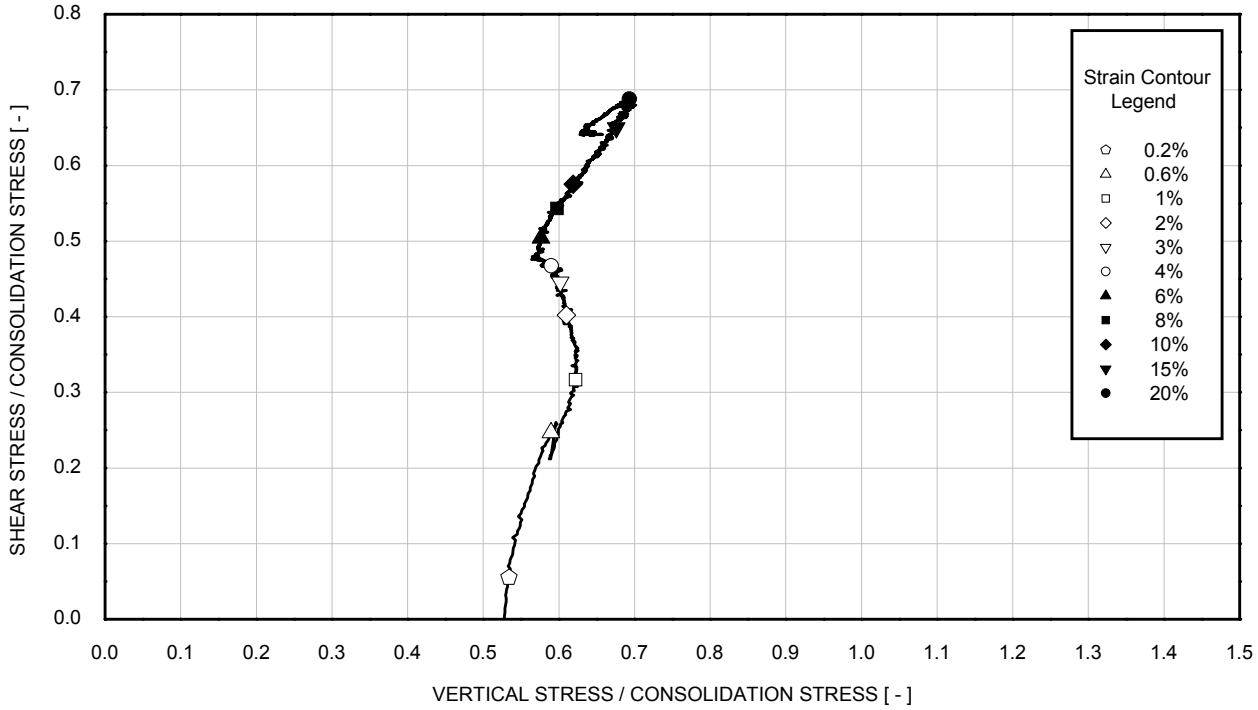
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

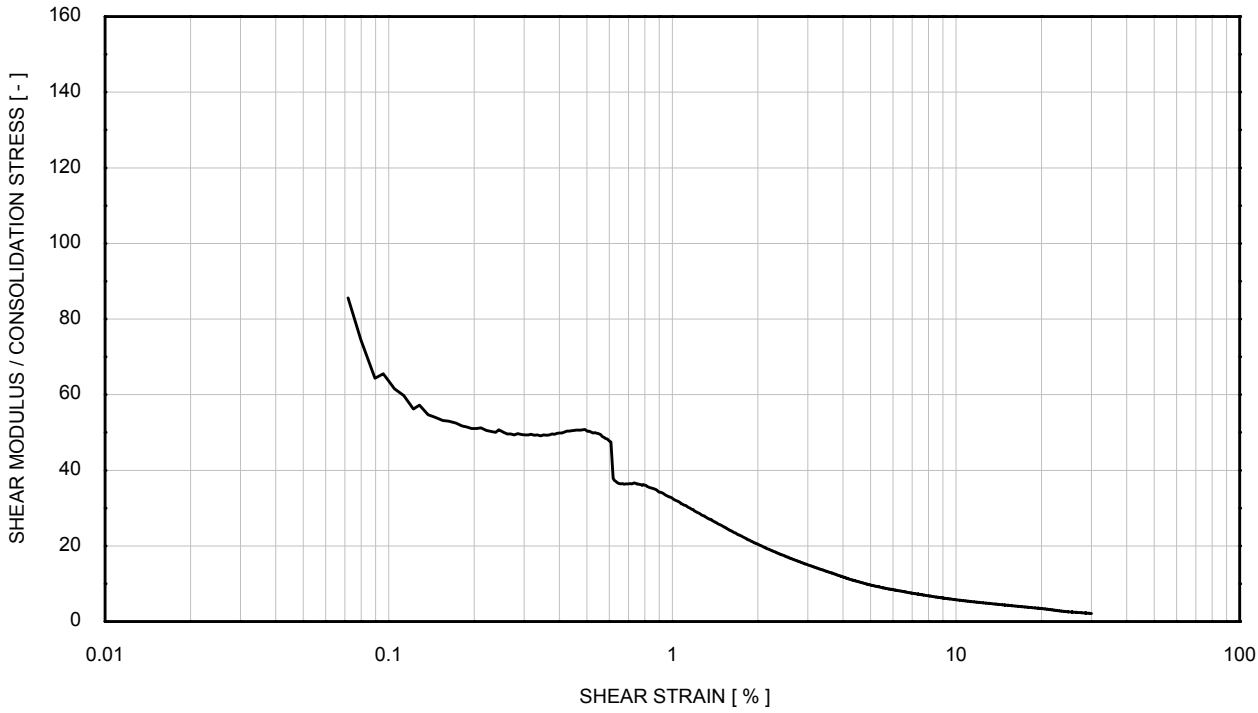




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	83 kPa	Sample	: 15WaxB
γ at τ_{peak}	:	20.55 %	Depth [m]	: 12.80
Rate of strain	:	3.02 %/hour	Test No.	: CSS09

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 120	kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 83	kPa	Sample	: 15WaxB
γ at τ_{peak}	: 20.55	%	Depth [m]	: 12.80
Rate of strain	: 3.02	%/hour	Test No.	: CSS09

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Very dark brown CLAY with organic matter

GENERAL	
Date test started	10/12/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.7
Water content	[%]	34.0
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.36
Void ratio	[-]	0.985
Degree of saturation	[%]	93
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_15B_CSS10
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 18/11/2016
Approved by Date	PH 18/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.84
Test number	CSS10

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	120
Vertical strain	[%]	3.70
Bulk density	[Mg/m^3]	1.85
Dry density	[Mg/m^3]	1.41
Void ratio	[-]	0.911
Water content	[%]	31.2

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	120
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	3.70
Bulk density	[Mg/m^3]	1.85
Dry density	[Mg/m^3]	1.41
Void ratio	[-]	0.911

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.02	0.03	18.79	3.21
2	0.02	0.03	18.70	2.50
5	0.02	0.03	19.19	2.61
10	0.02	0.03	19.03	2.26
20	0.02	0.03	19.03	2.37
30	0.02	0.03	18.37	2.65
40	0.02	0.03	18.37	2.18
50	0.02	0.03	18.37	2.46
100	0.02	0.03	18.37	2.21
200	0.02	0.03	18.46	2.46
300	0.02	0.03	18.18	2.62
400	0.02	0.03	17.87	2.45

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.84
Test number	CSS10

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	34
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
γ_{av} at N_f	[%]	-1.58
γ_{cy} at N_f	[%]	6.57
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	96
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.15	0.80	4.10	26.34
2	-0.55	1.41	2.39	29.28
5	-0.50	1.65	2.06	30.85
10	-0.60	1.91	1.78	27.96
20	-0.61	2.08	1.64	25.32
30	-0.62	2.17	1.57	23.06
40	-0.62	2.24	1.52	22.20
50	-0.62	2.31	1.48	21.54
100	-0.69	2.57	1.33	18.02
500	-0.74	4.13	0.83	11.55
1000	-1.38	5.71	0.59	13.93
1500	-1.58	6.57	0.52	14.11

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	68
Shear strain	[%]	13.24
Shear induced $-\Delta\sigma_v$	[kPa]	42
Vertical stress	[kPa]	78
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.98
At 15 % shear strain		
Shear stress	[kPa]	59
Shear induced $-\Delta\sigma_v$	[kPa]	57
Vertical stress	[kPa]	63
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.84
Test number	CSS10

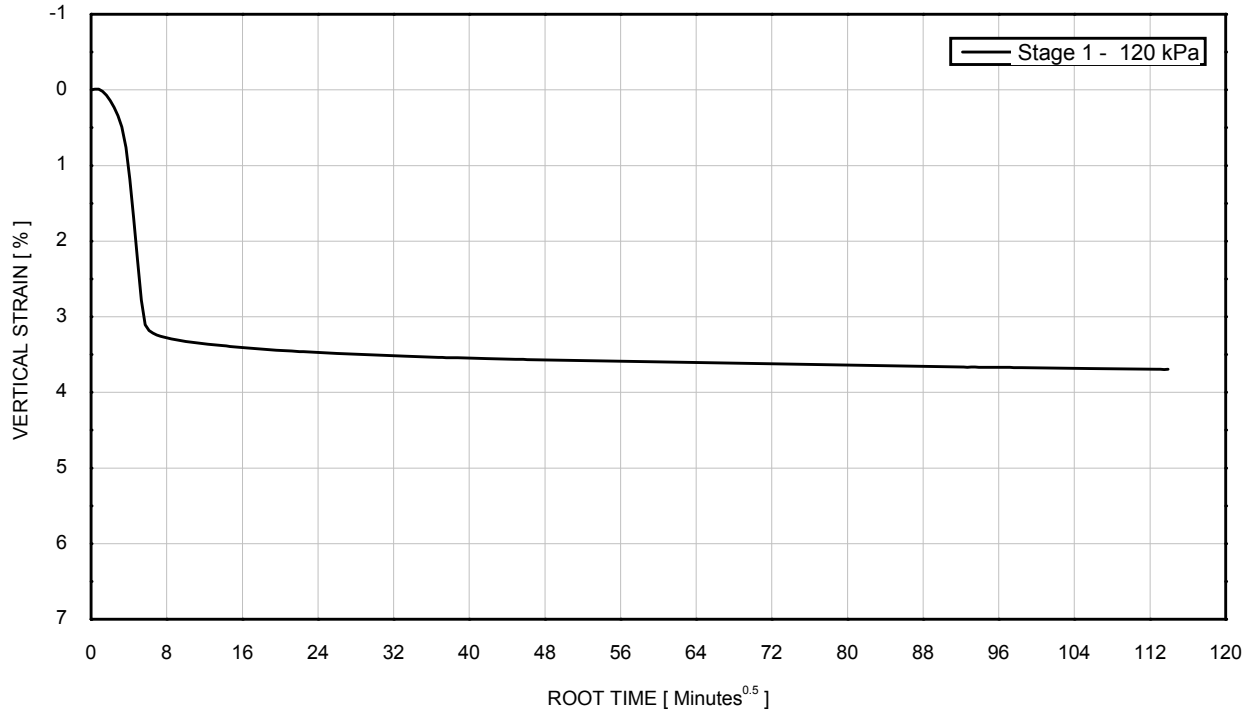
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

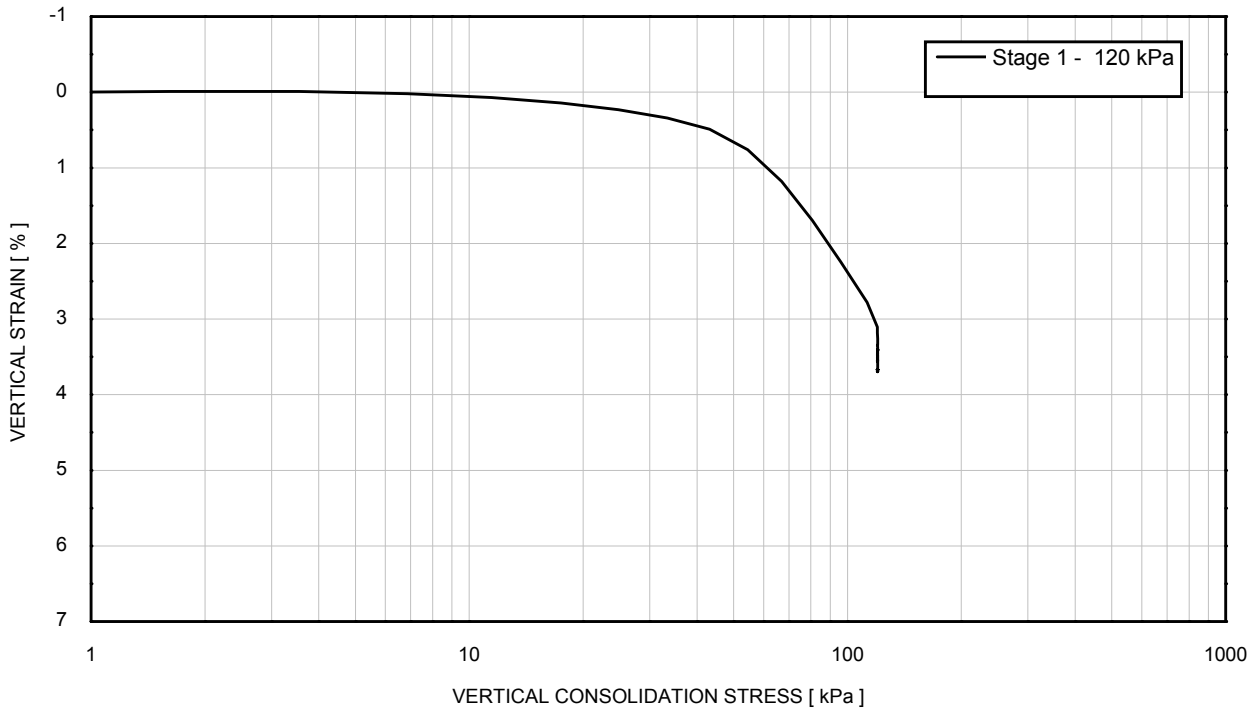
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxB
Depth [m]	12.84
Test number	CSS10

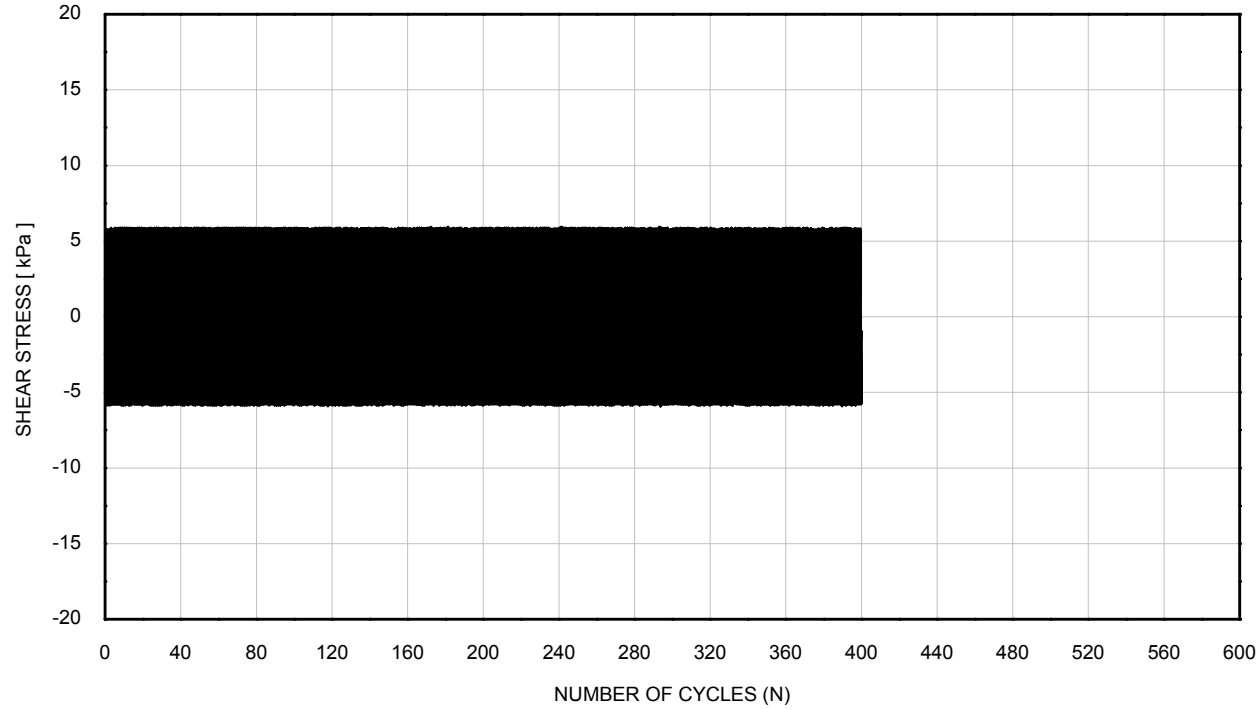
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

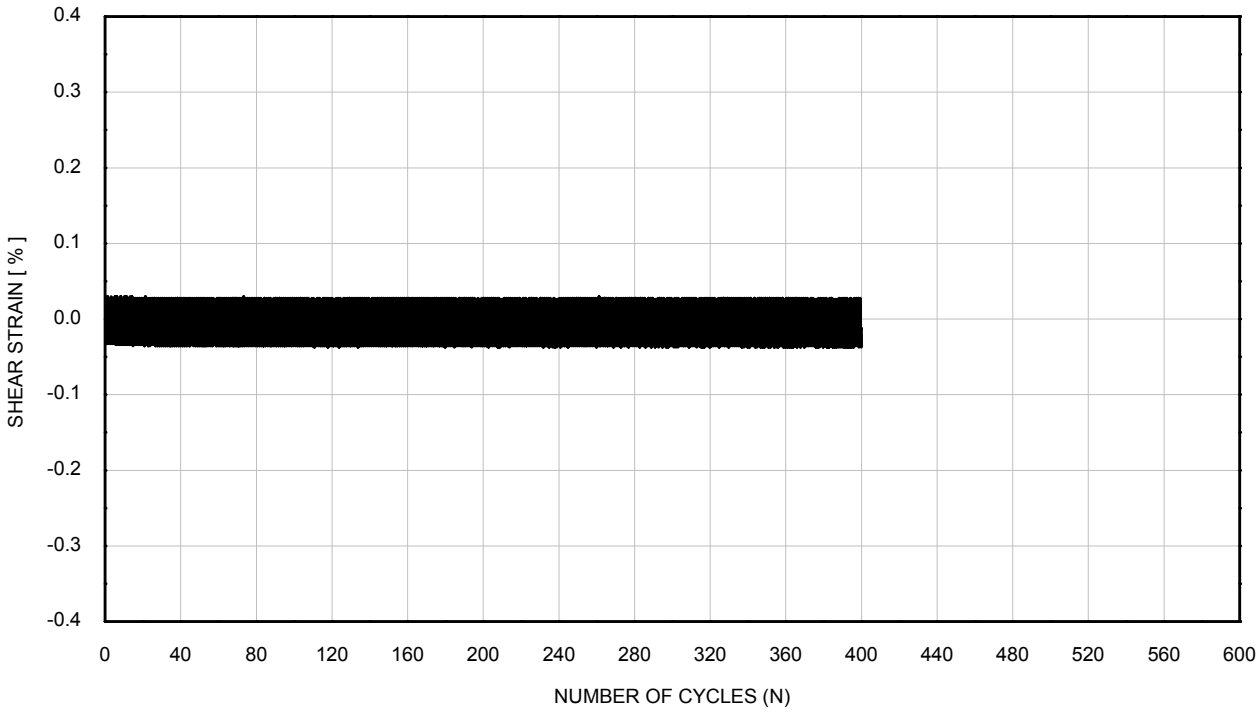




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 15WAXB
		Depth [m]	: 12.84
		Test No.	: CSS10

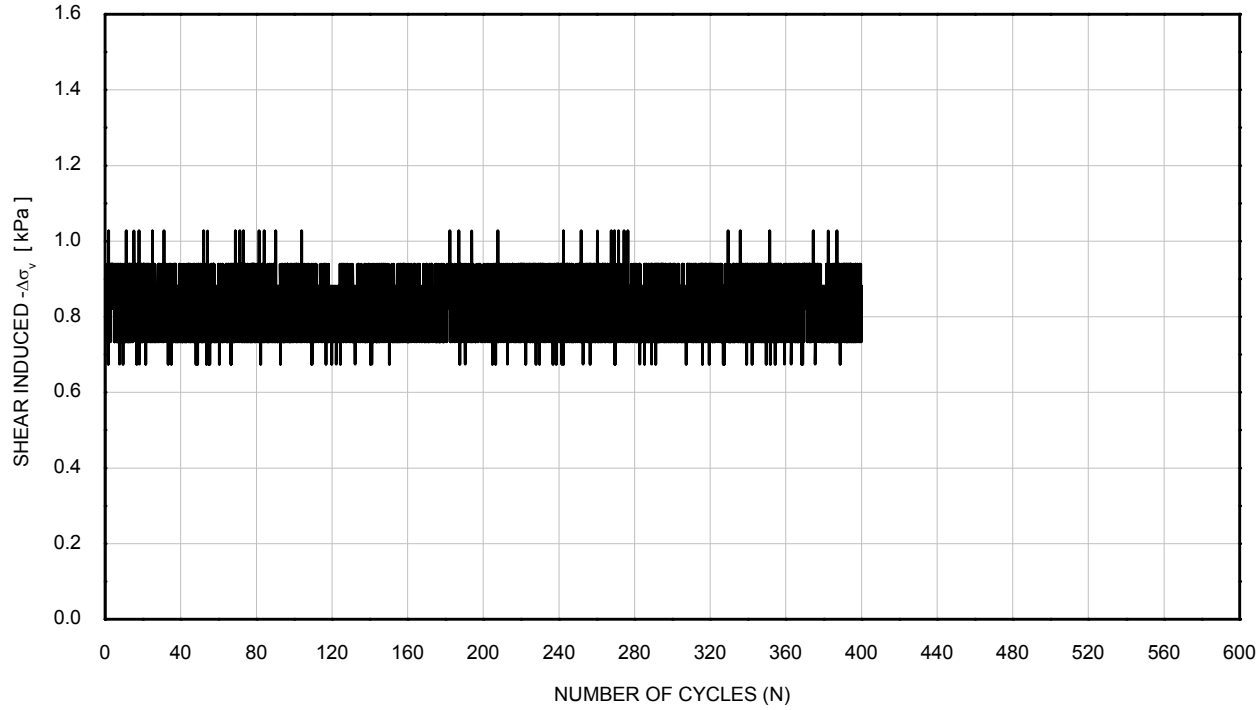
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

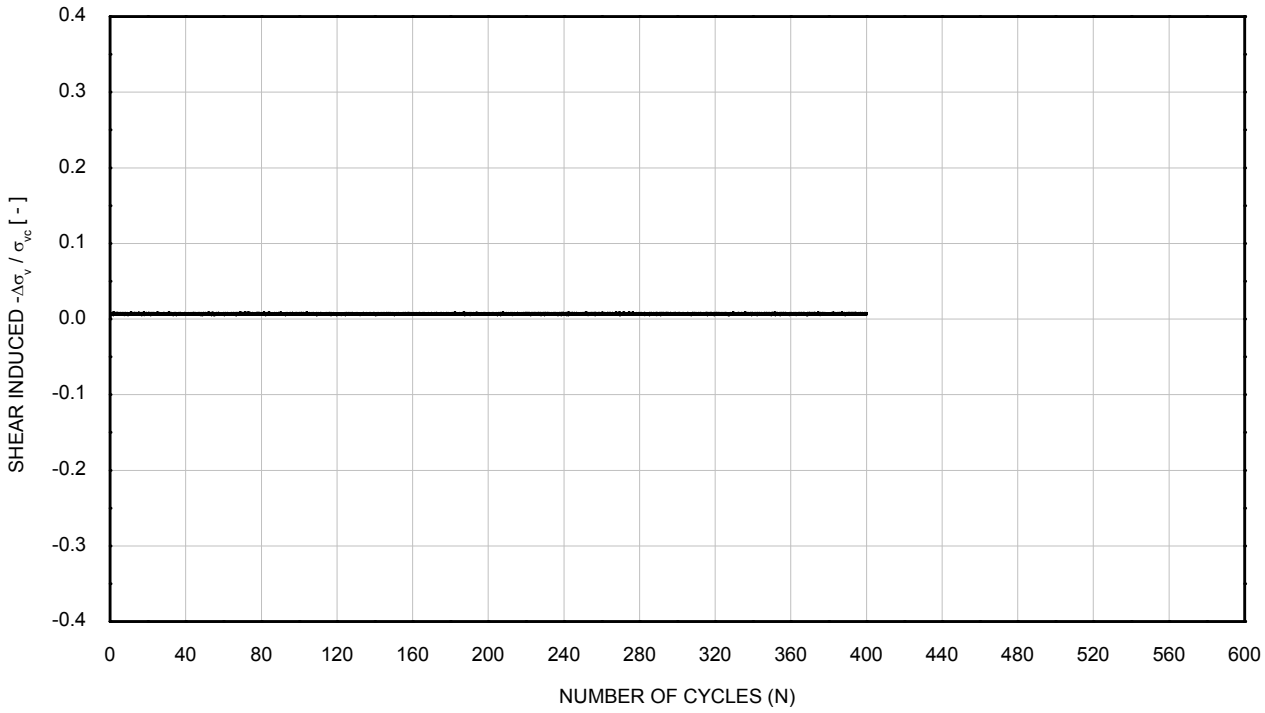




σ_{vc}	:	121 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

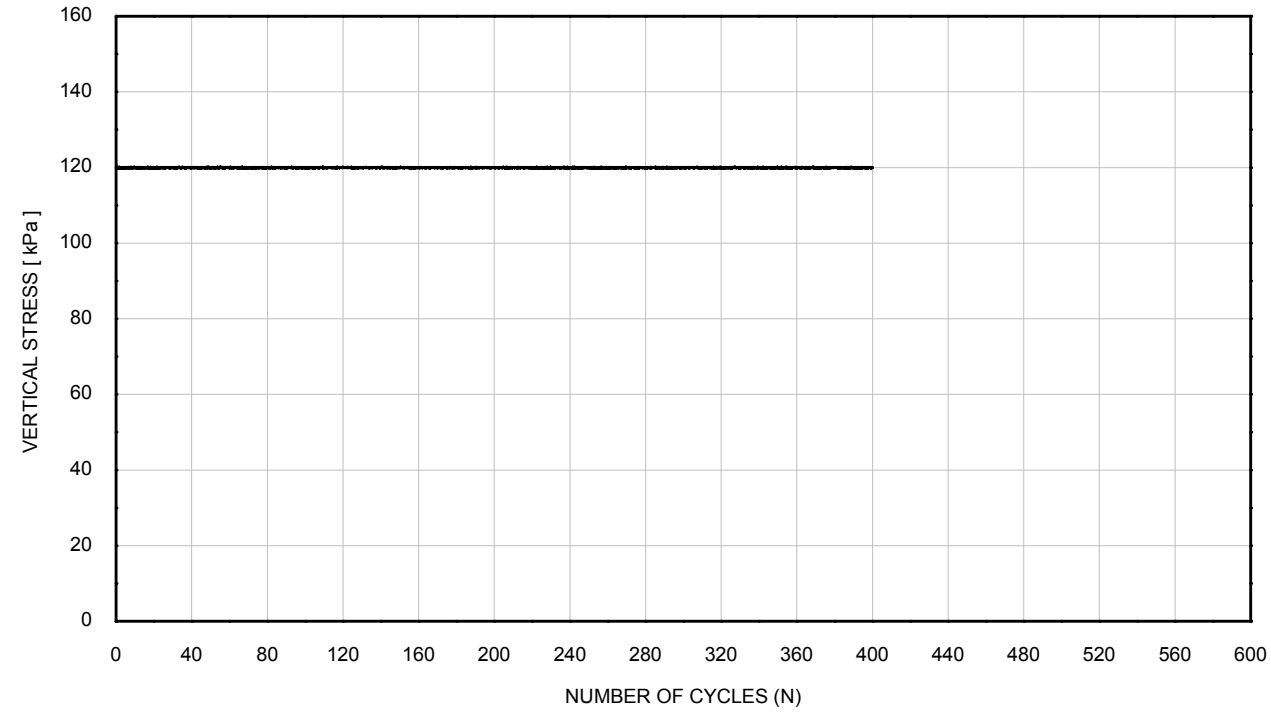
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

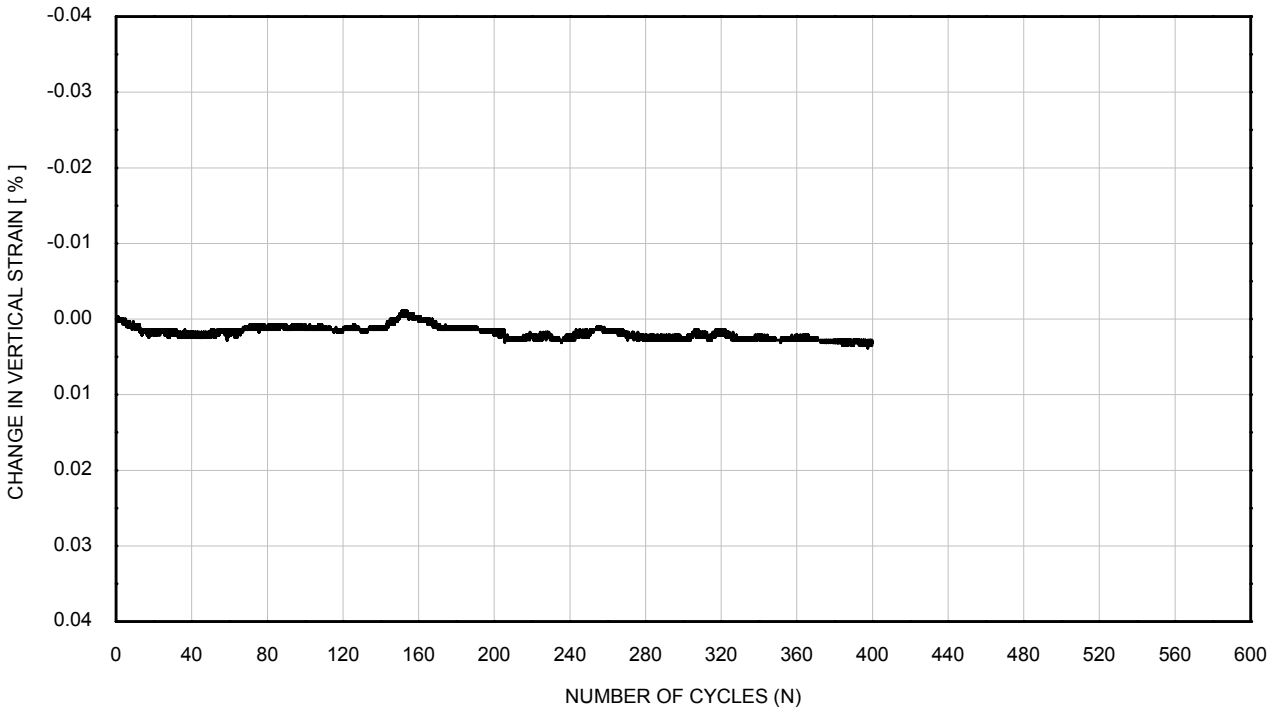




σ_{vc}	:	121 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

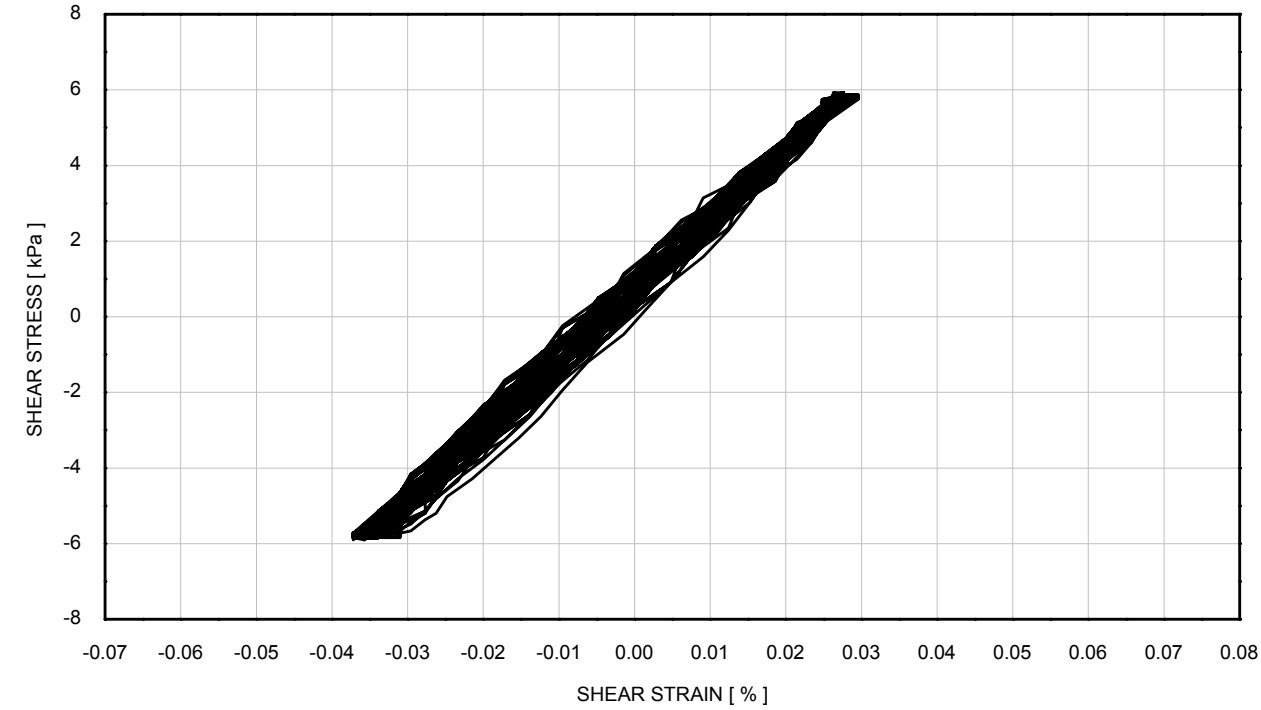
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

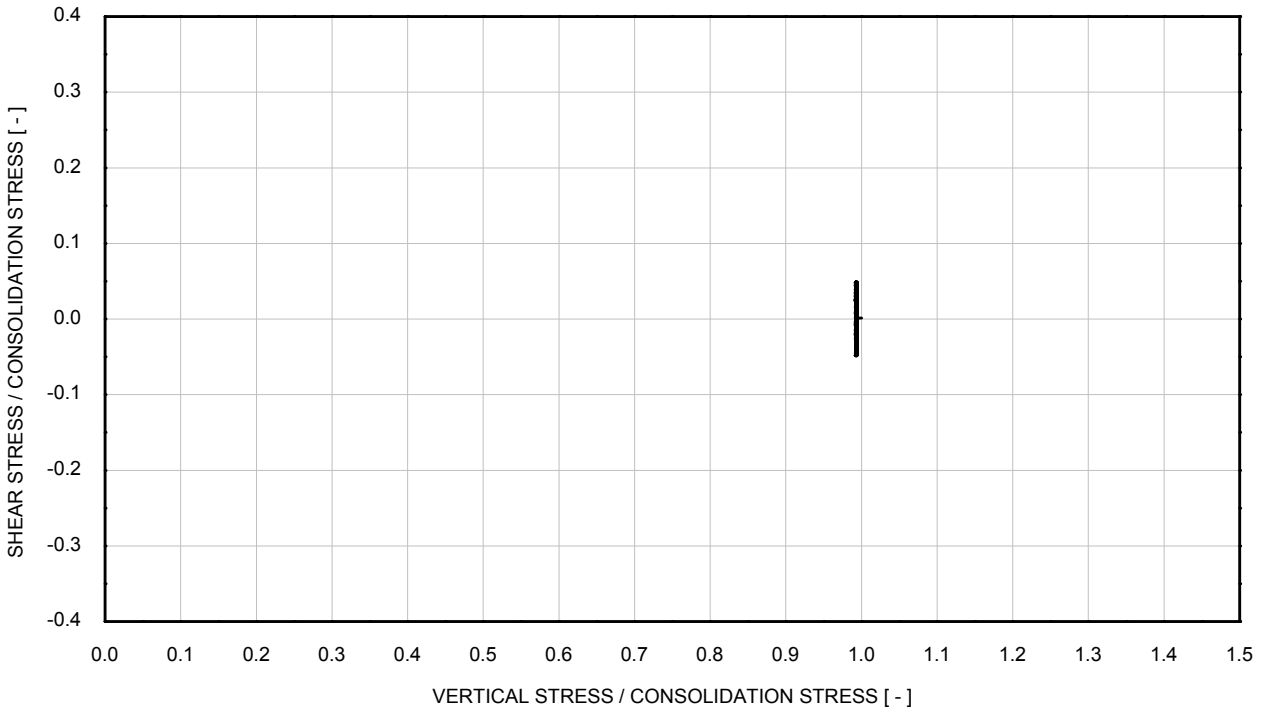




σ_{vc}	:	121 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

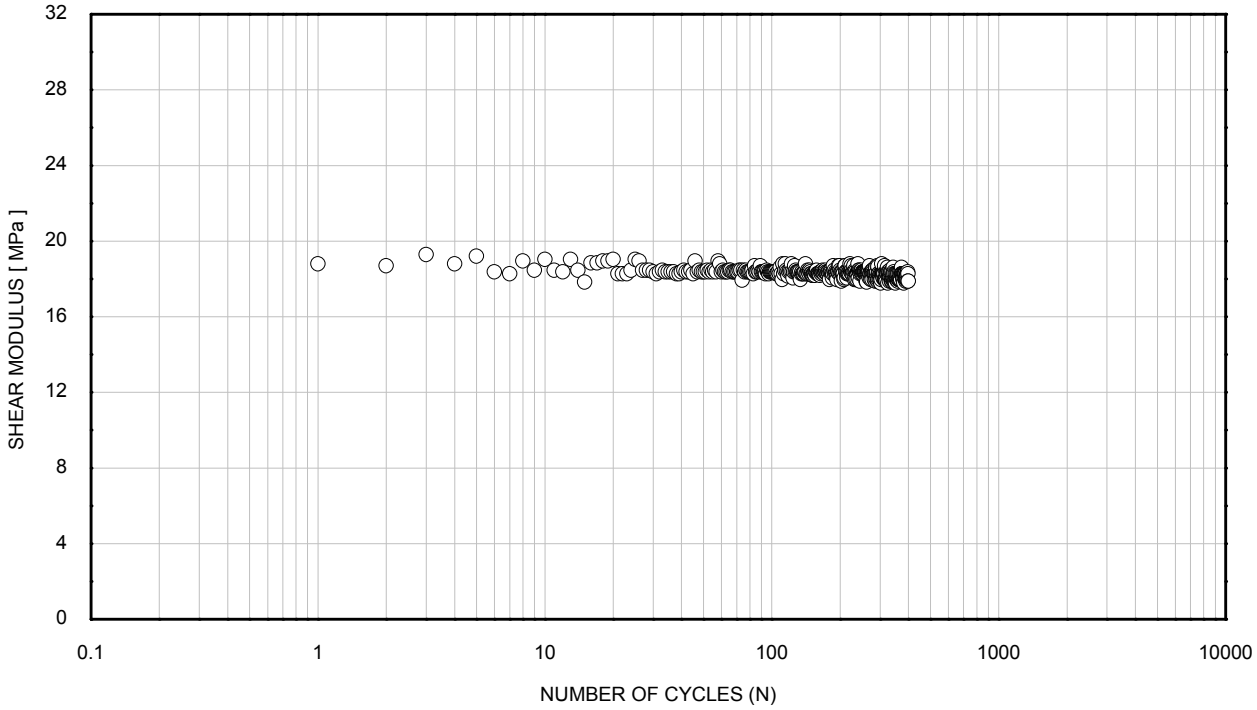
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

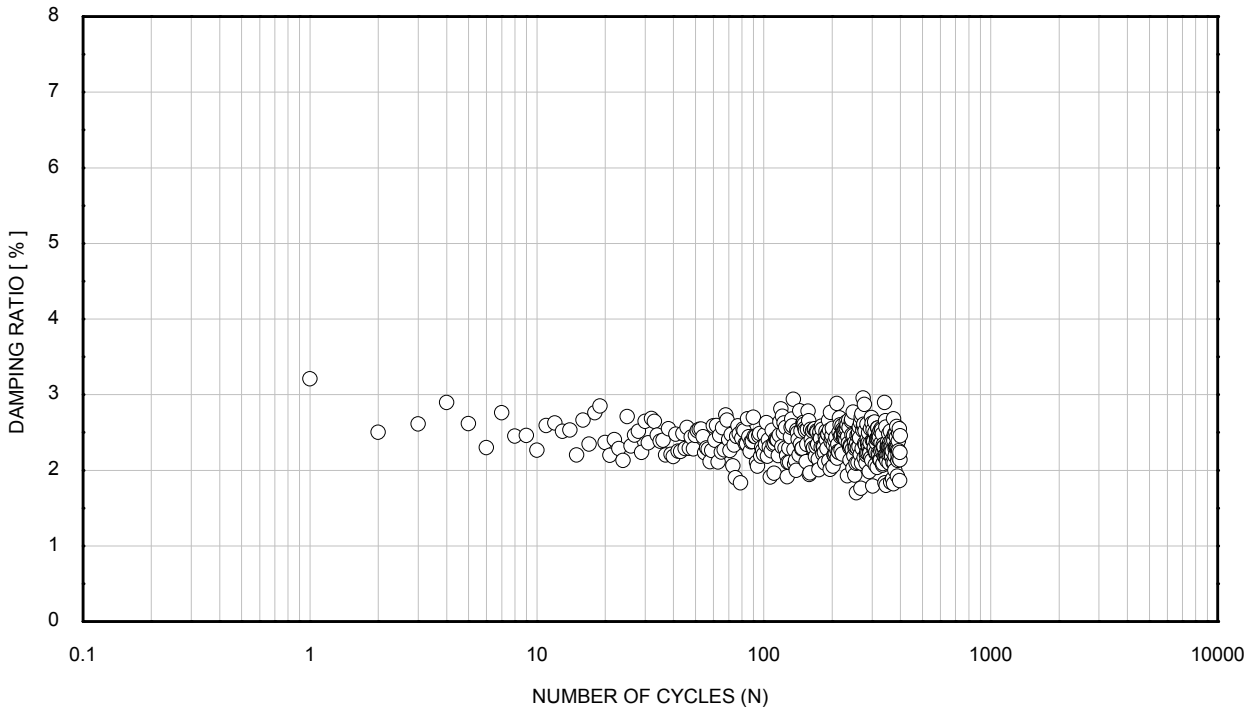




σ_{vc}	:	121 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 15WAXB
Mean τ_{cy}	:	6 kPa	Depth [m]	: 12.84
Frequency	:	0.10 Hz	Test No.	: CSS10

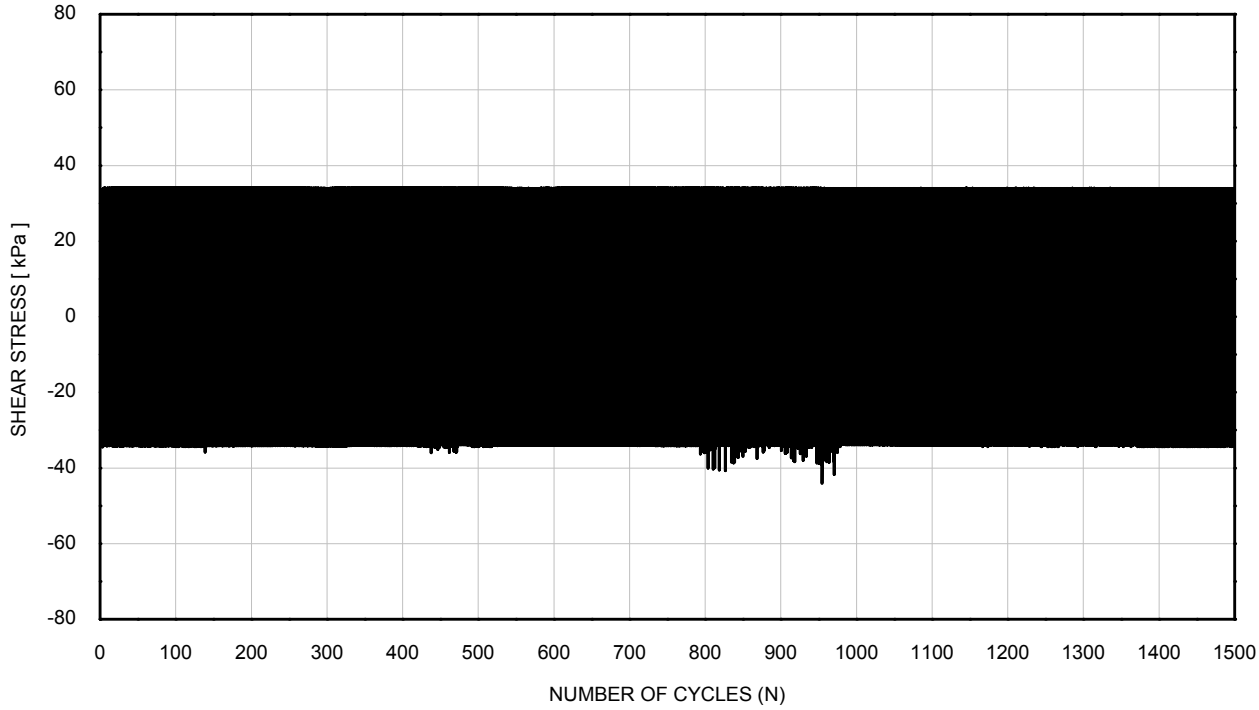
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

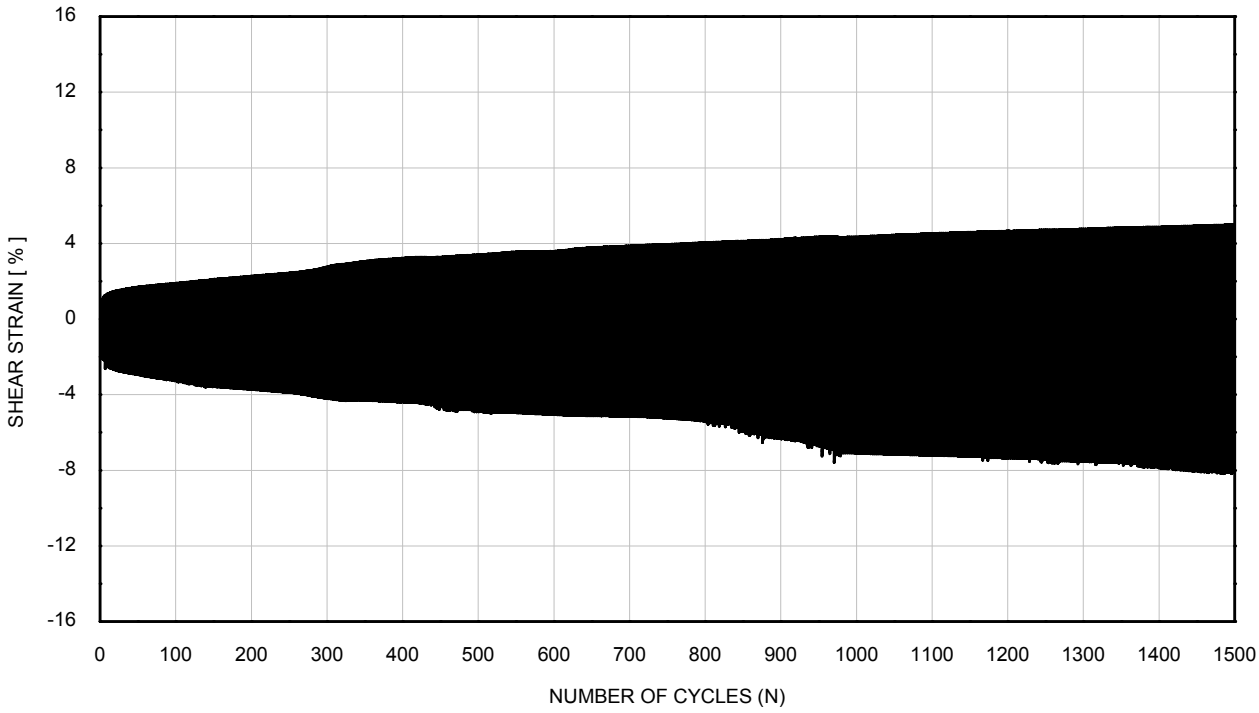




σ_{vc}	:	121 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

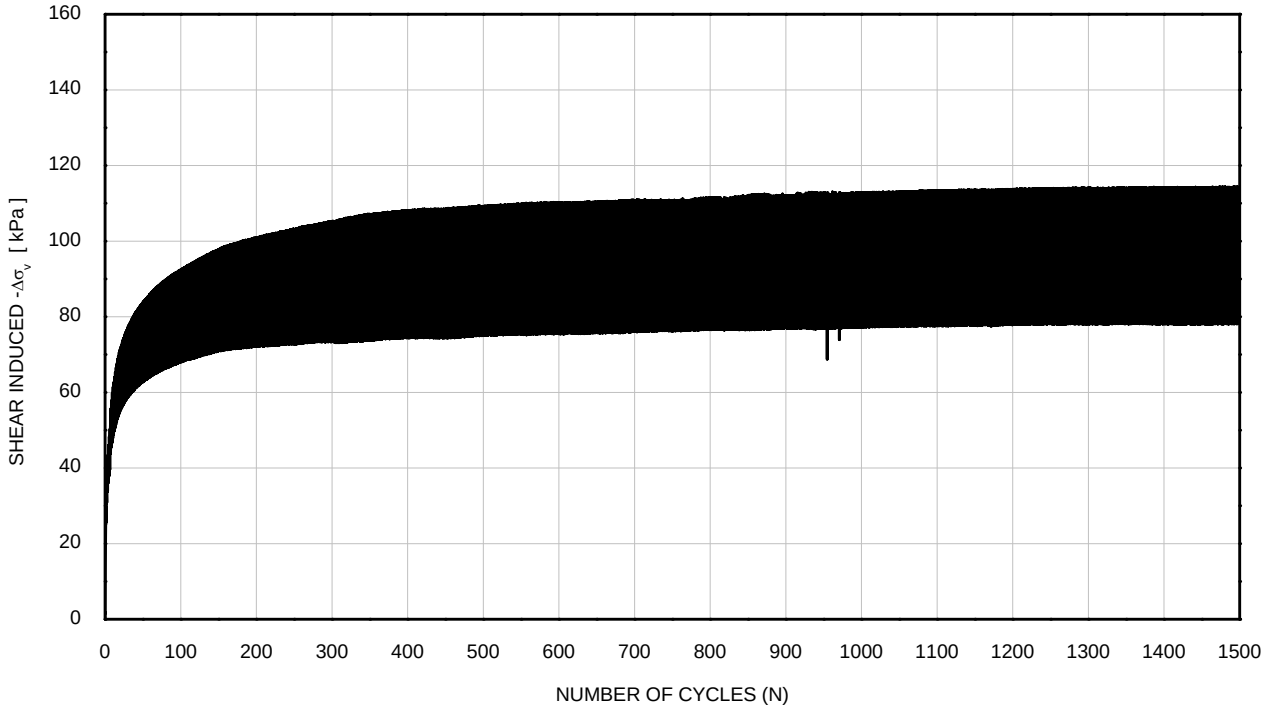
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

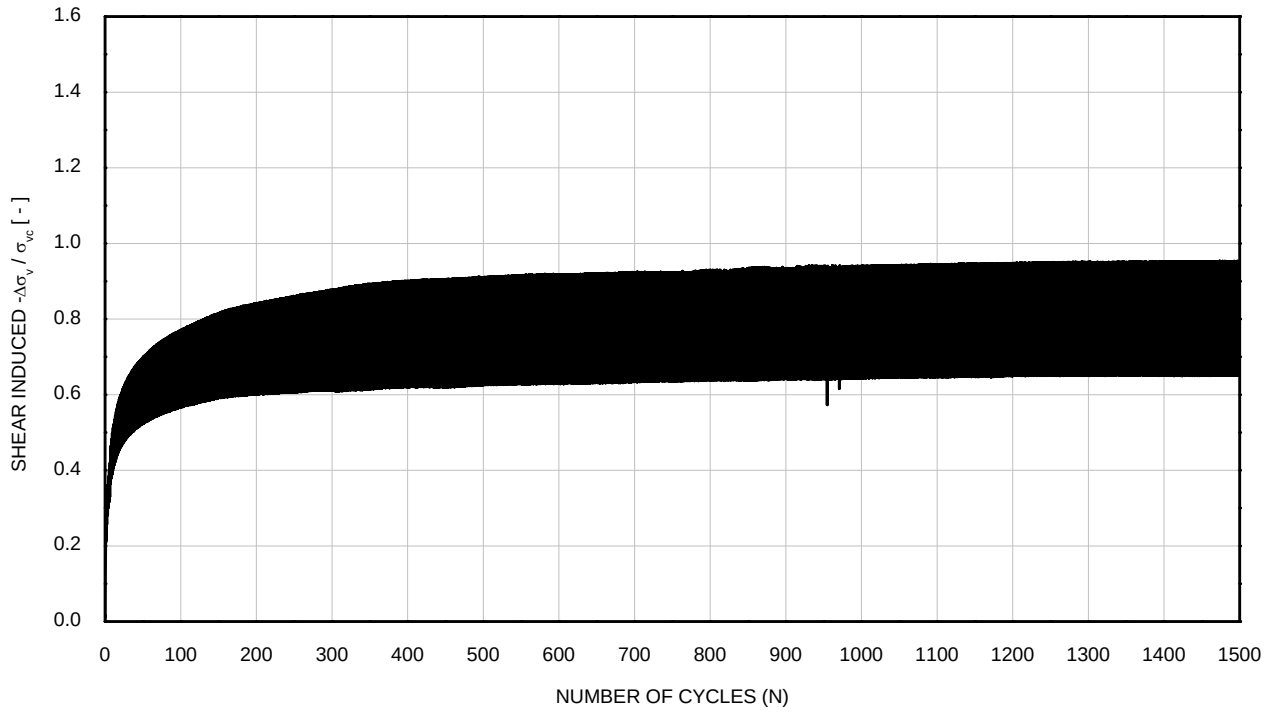




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	34 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

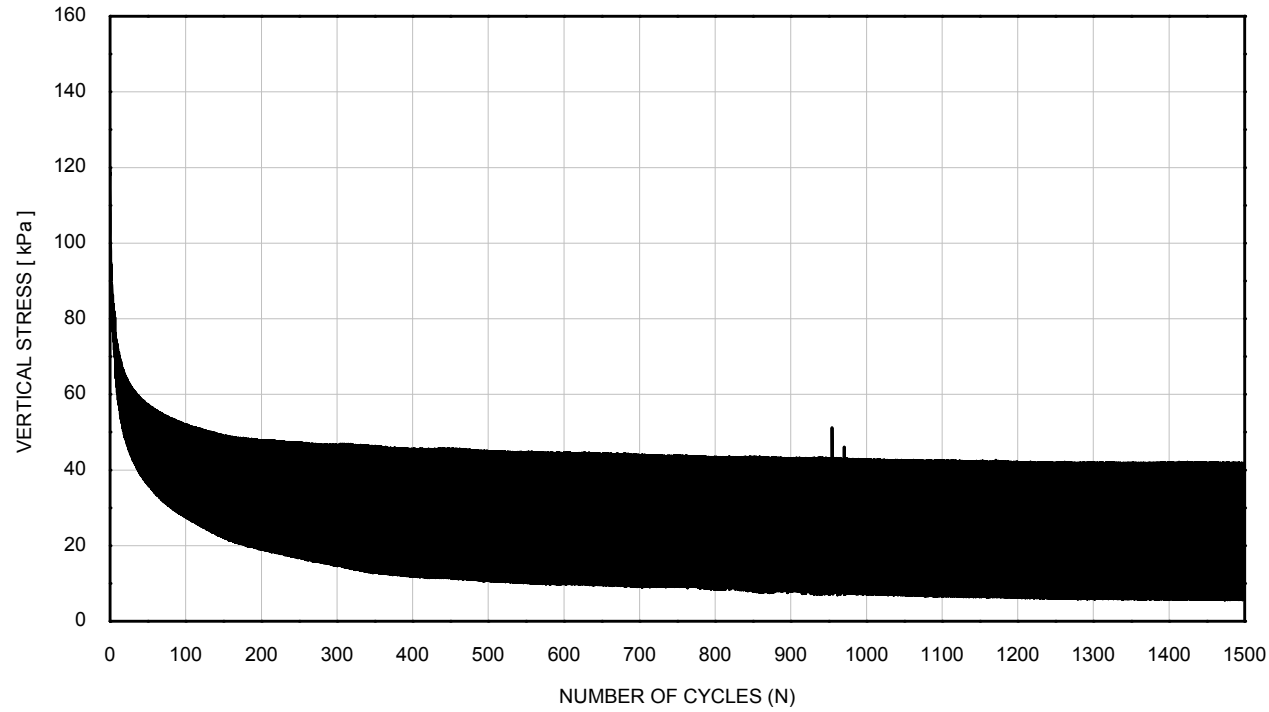
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

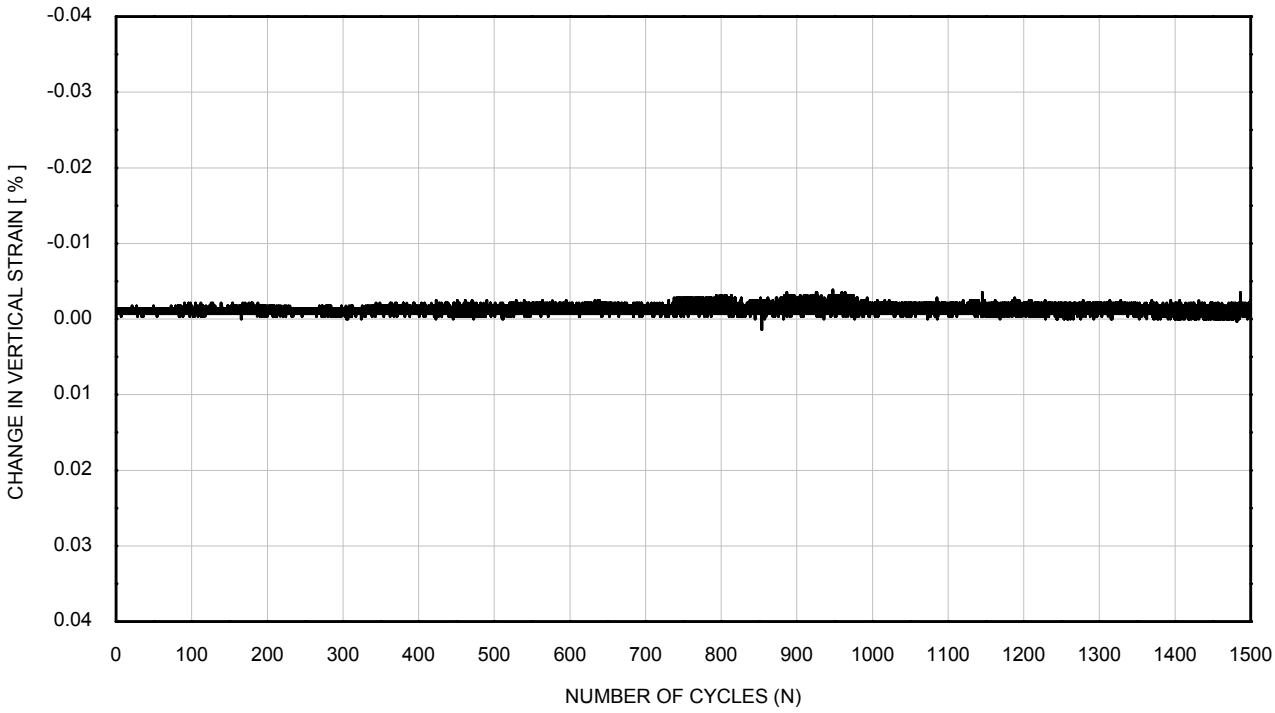




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	34 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

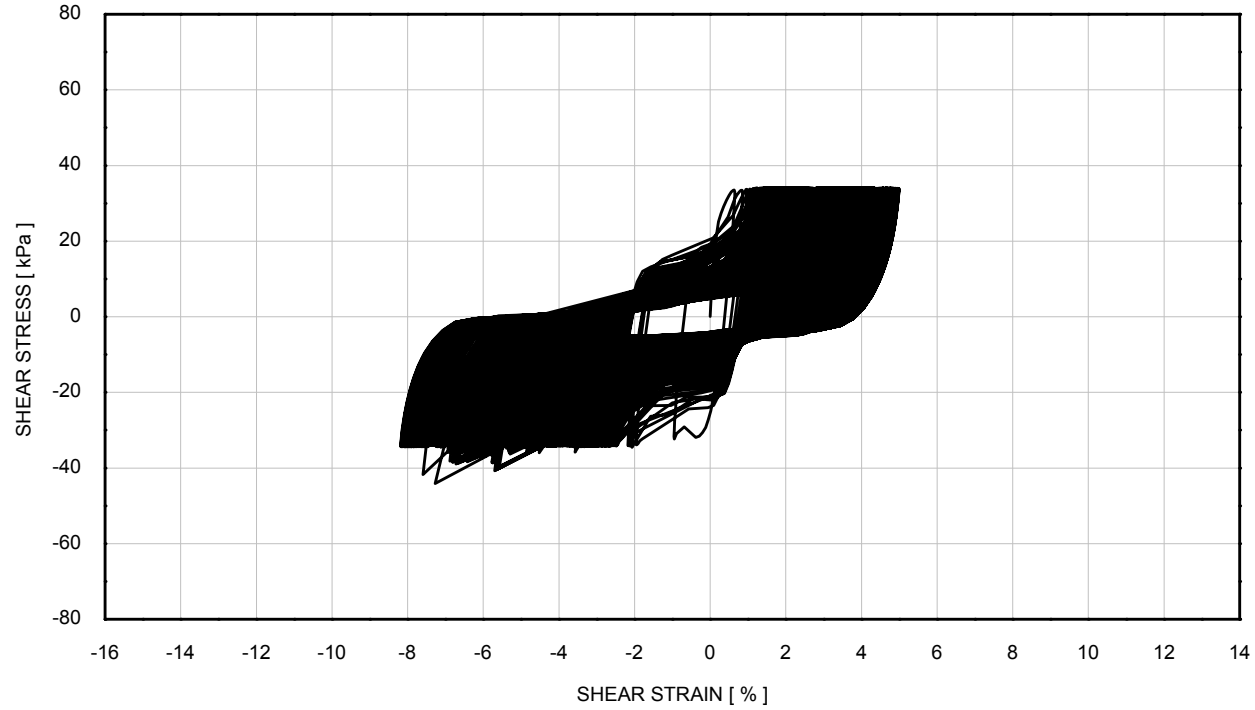
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

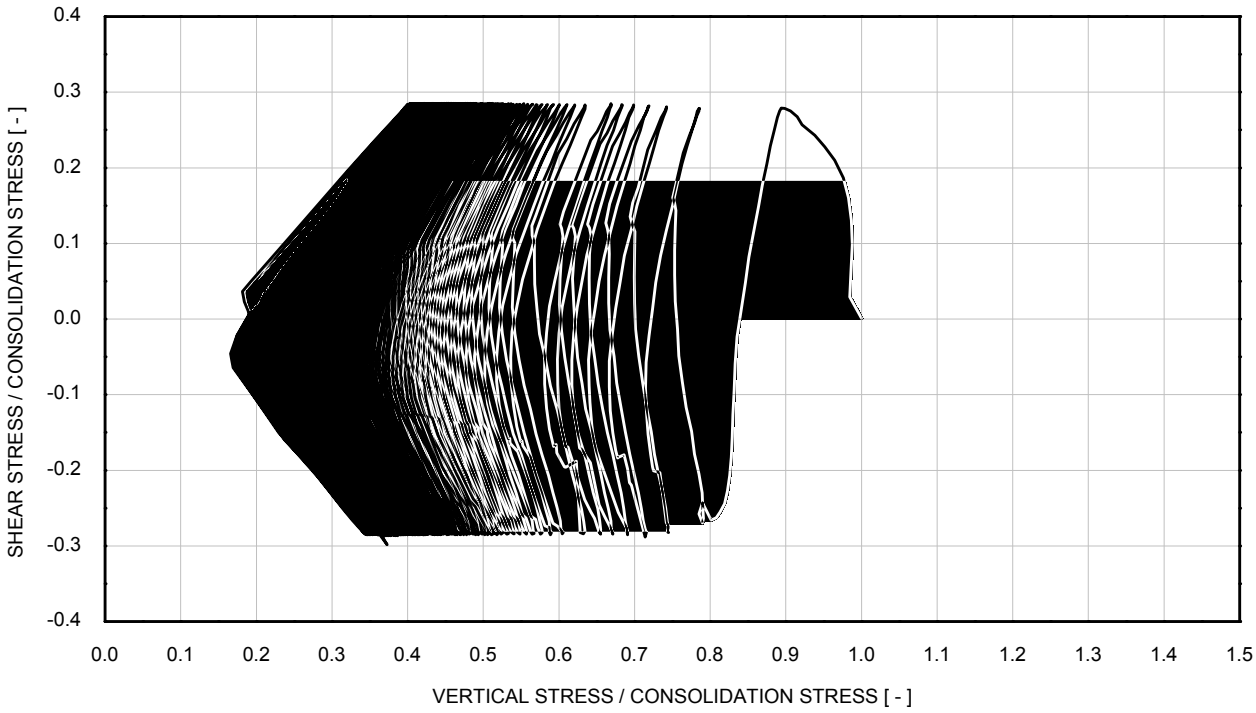




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	34 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

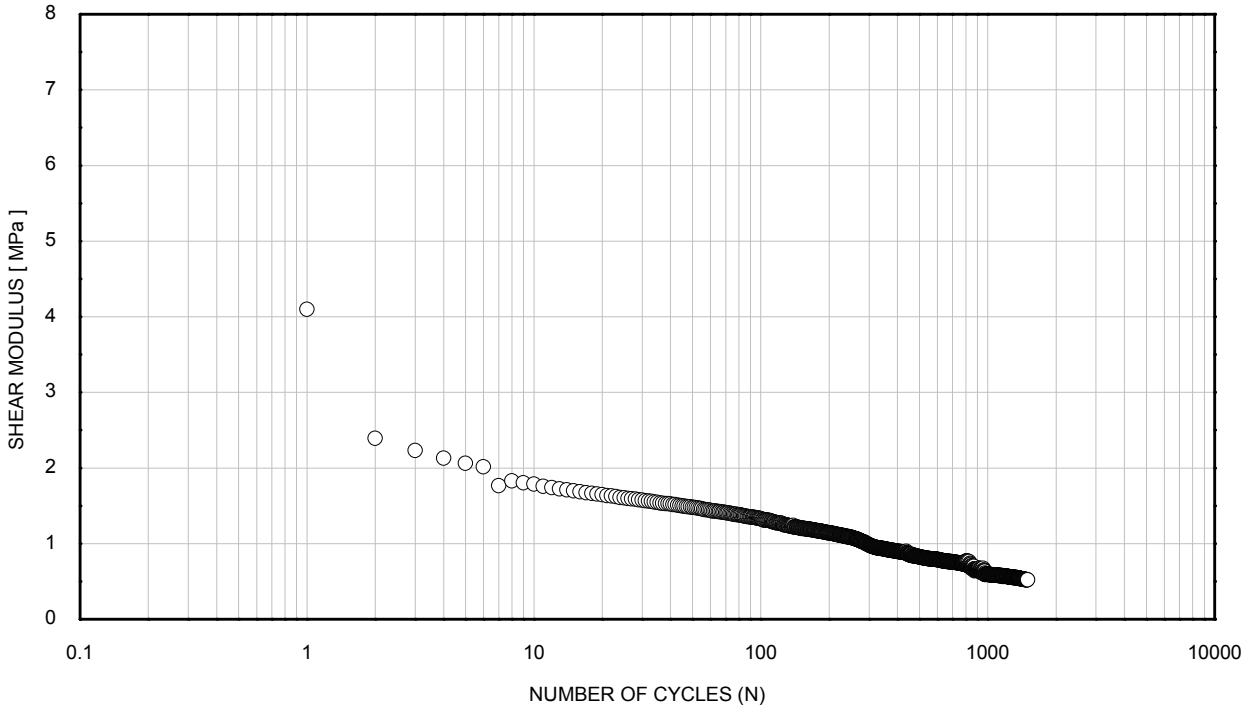
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

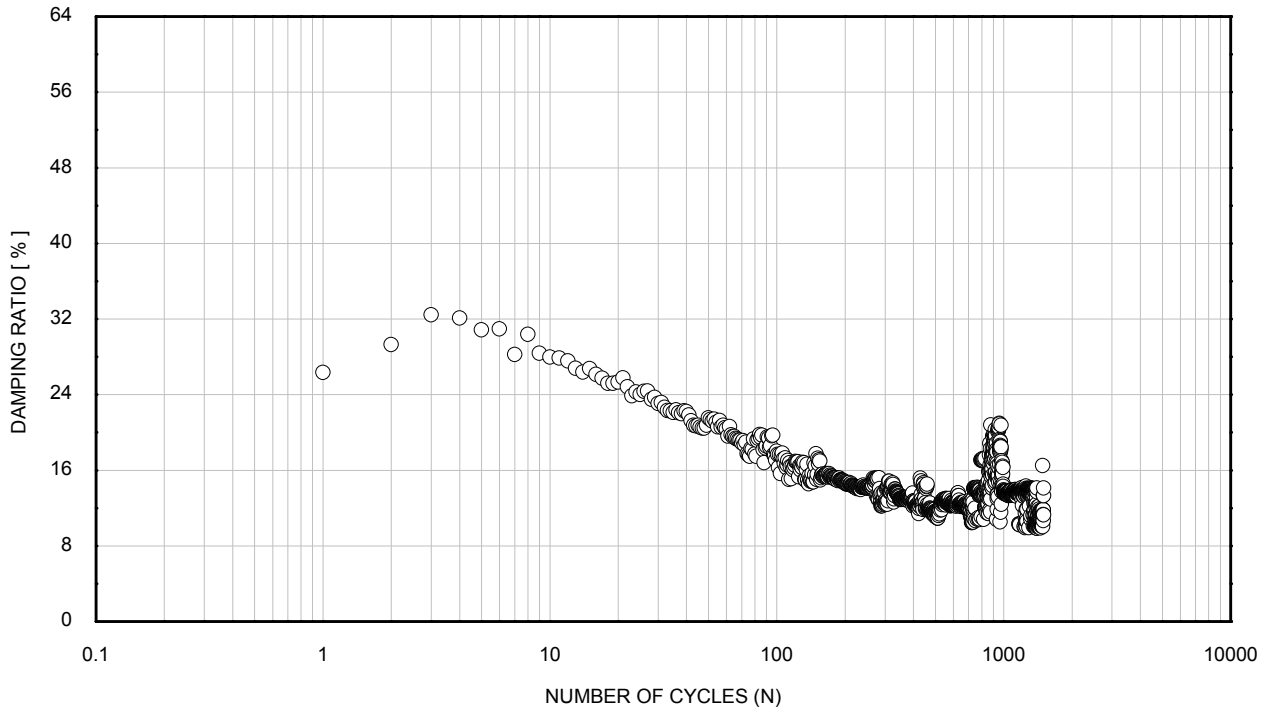




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	34 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

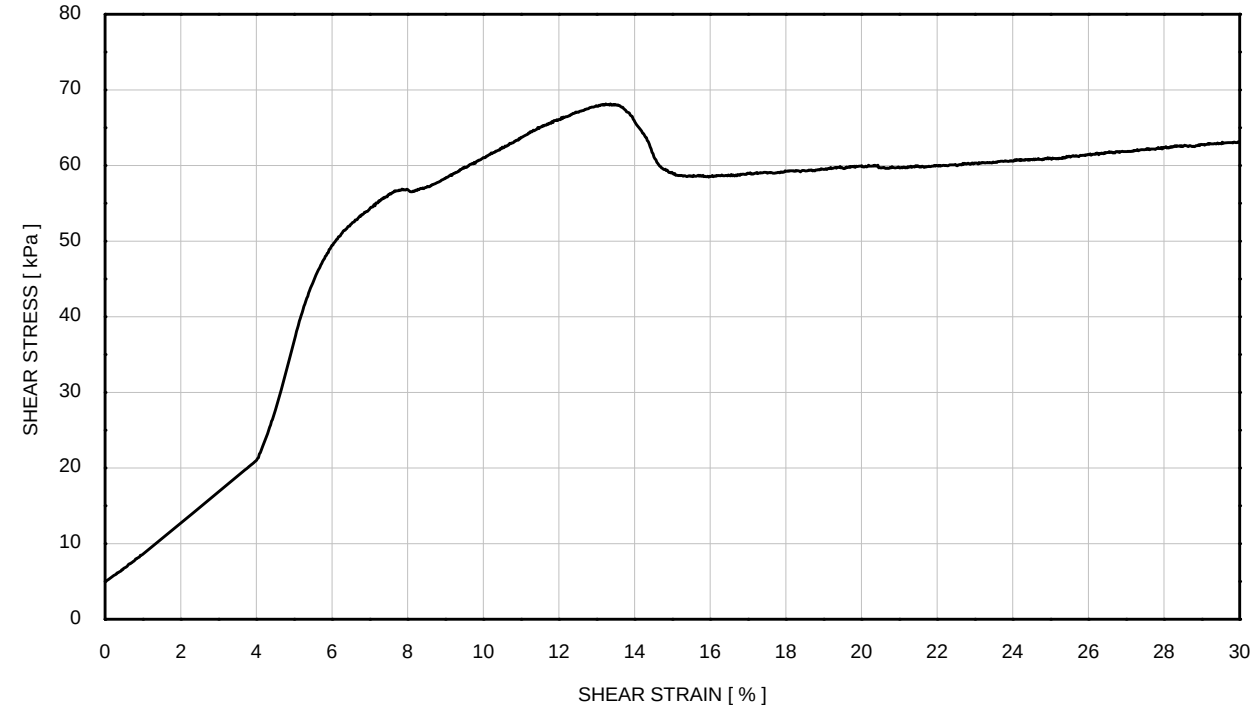
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

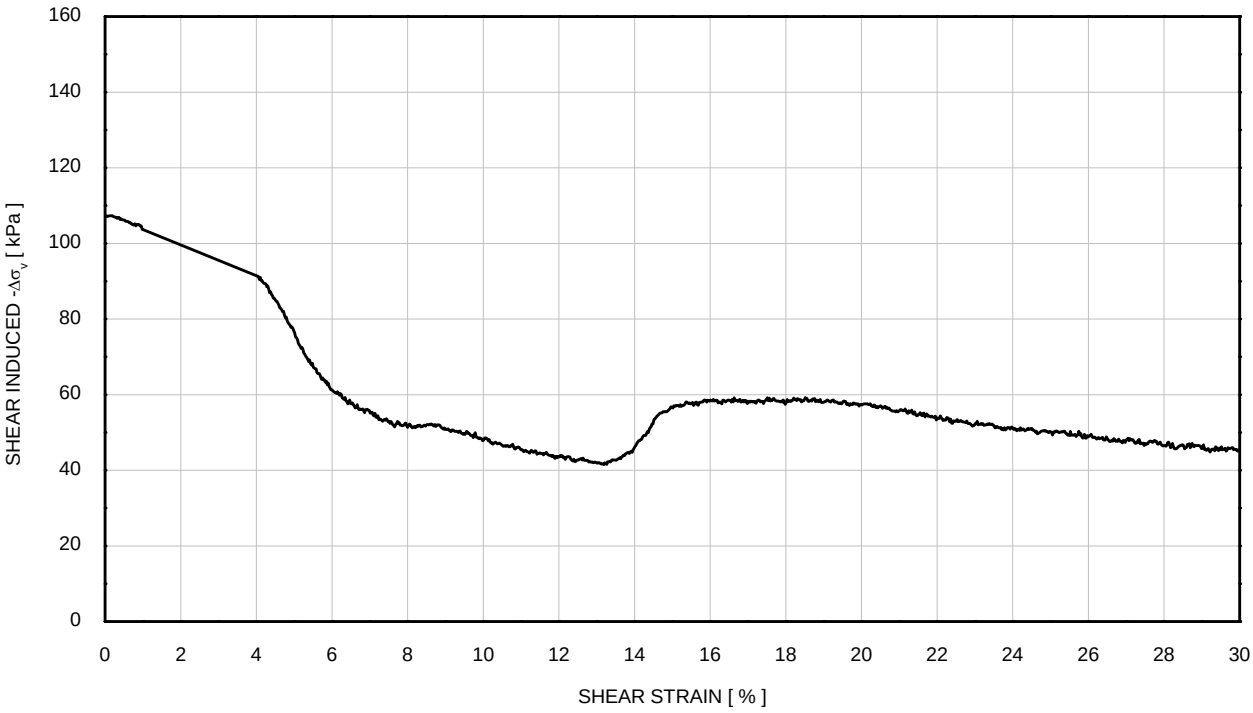




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WAXB
Mean τ_{cy}	:	34 kPa	Depth [m]	:	12.84
Frequency	:	0.10 Hz	Test No.	:	CSS10

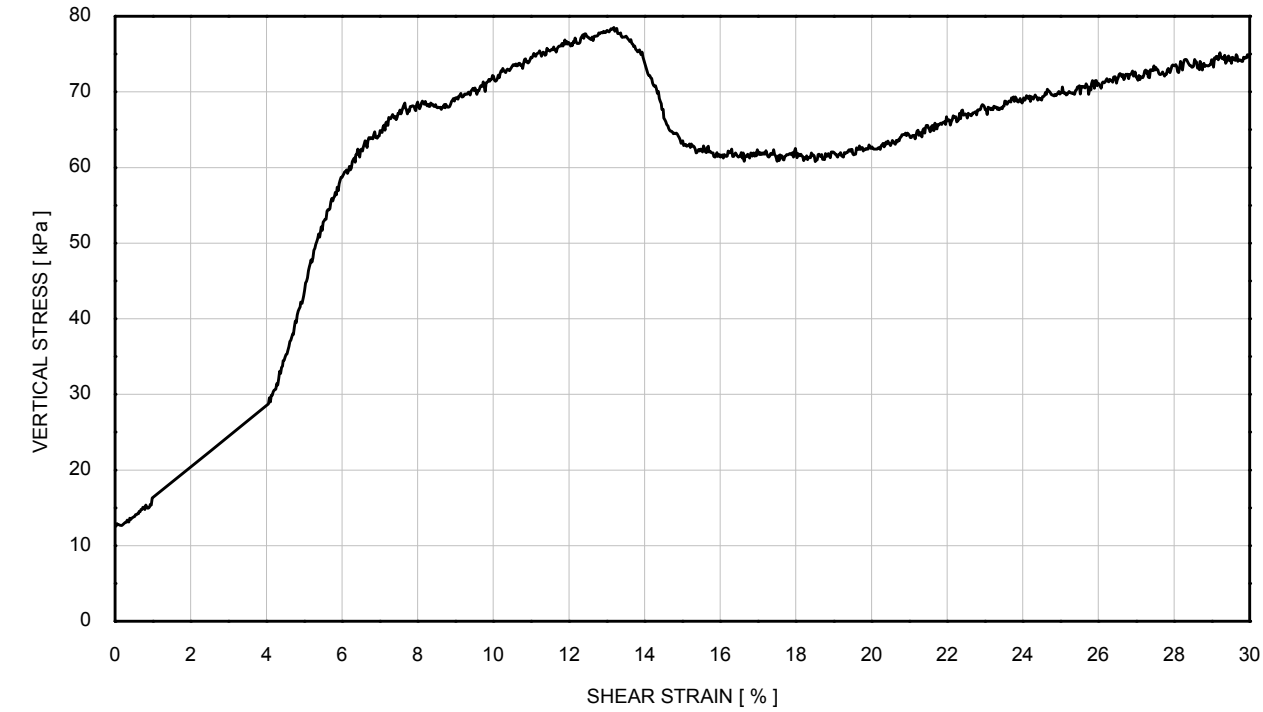
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

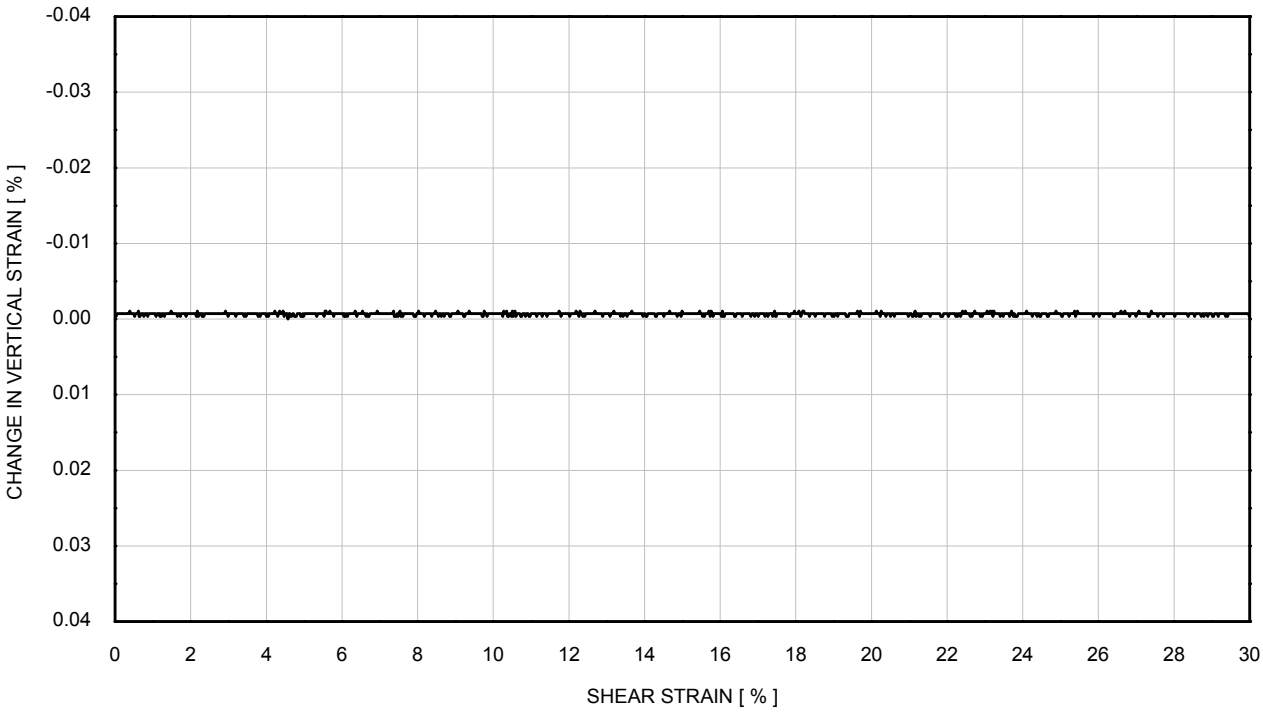




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 68 kPa	Sample	: 15WAXB
γ at τ_{peak}	: 13.24 %	Depth [m]	: 12.84
Rate of strain	: 2.98 %/hour	Test No.	: CSS10

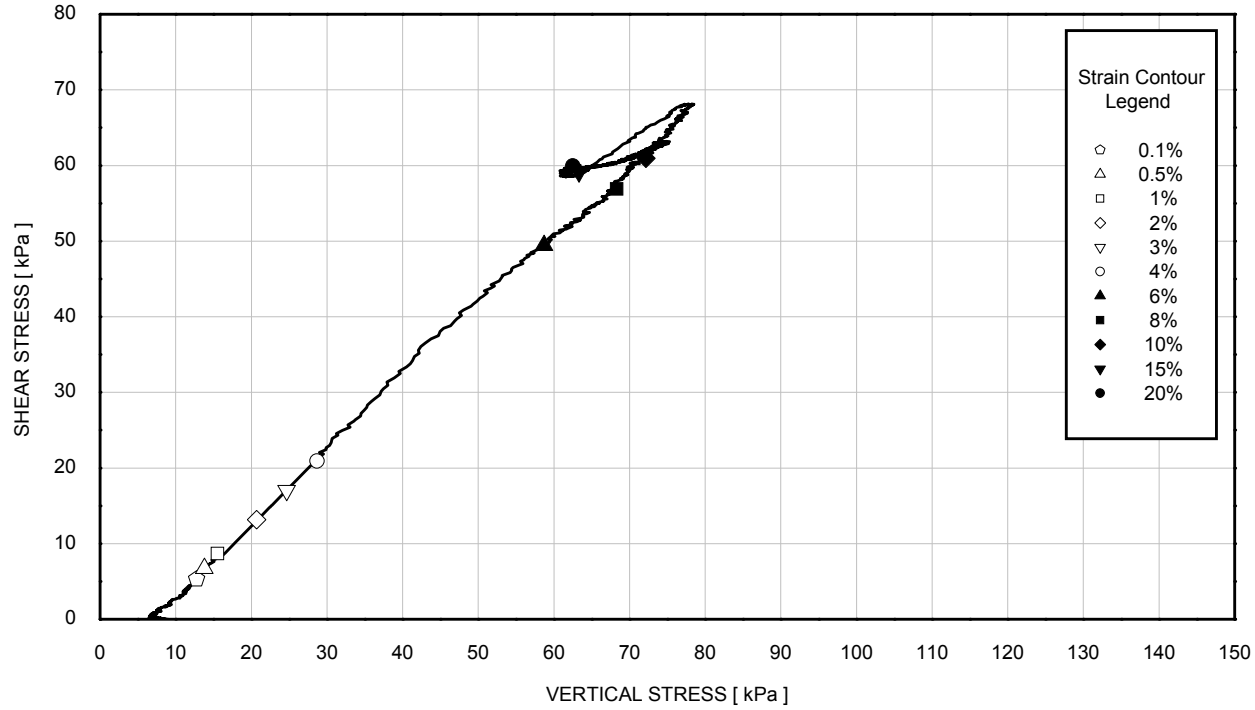
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

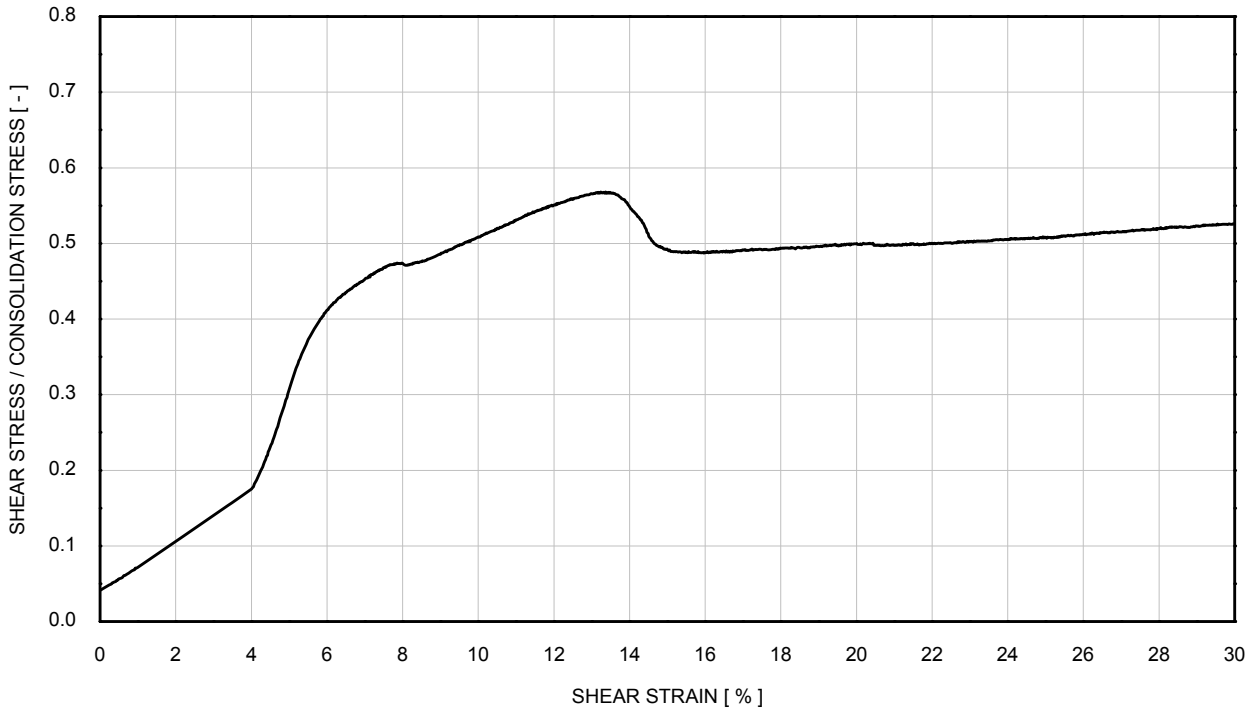




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 68 kPa	Sample	: 15WAXB
γ at τ_{peak}	: 13.24 %	Depth [m]	: 12.84
Rate of strain	: 2.98 %/hour	Test No.	: CSS10

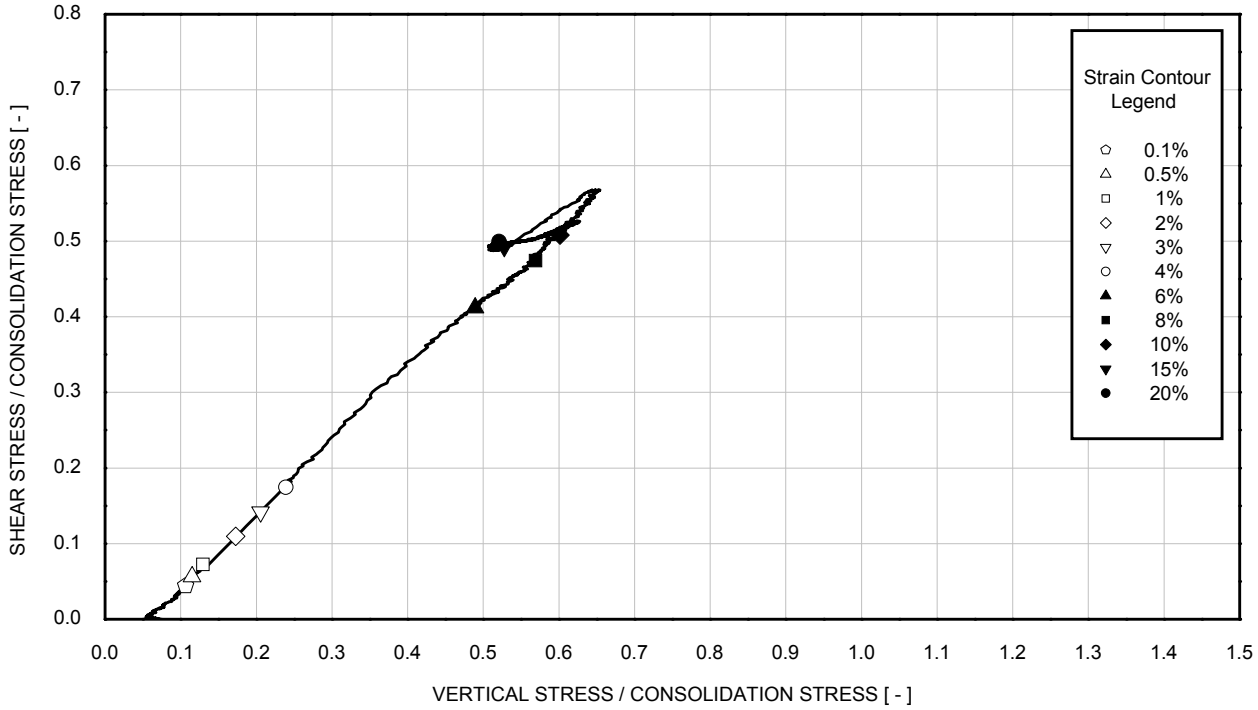
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

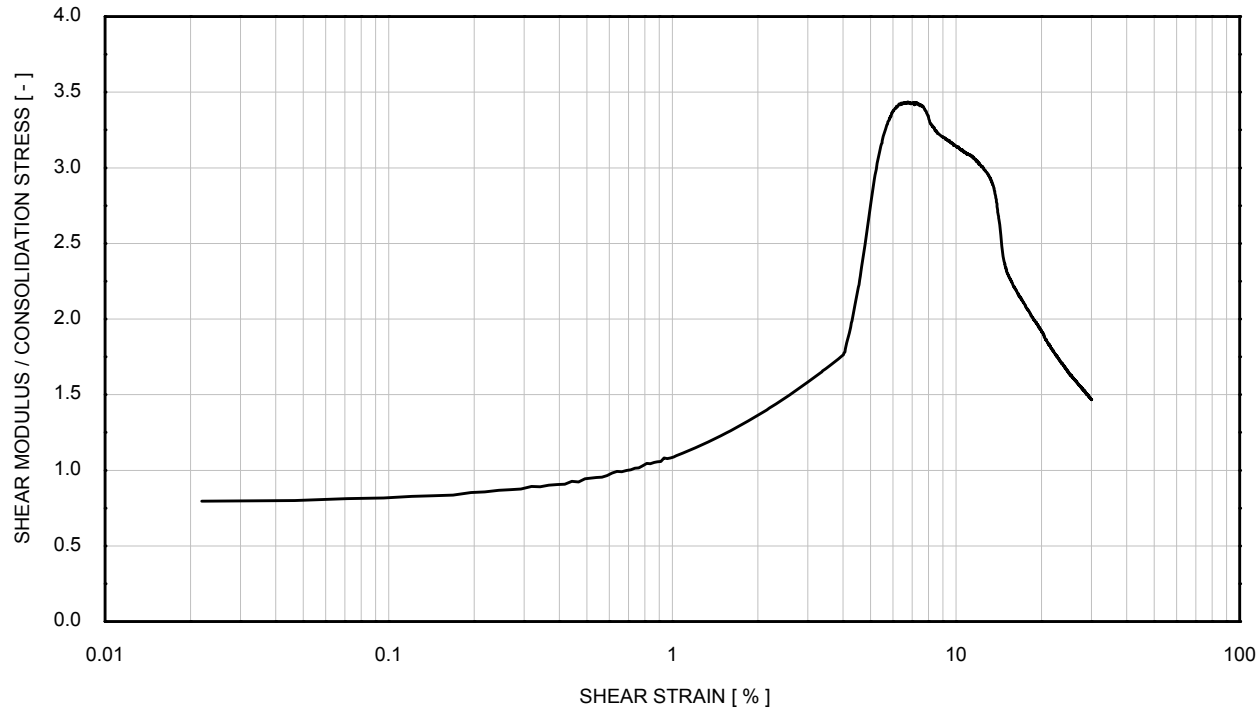




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	68 kPa	Sample	: 15WAXB
γ at τ_{peak}	:	13.24 %	Depth [m]	: 12.84
Rate of strain	:	2.98 %/hour	Test No.	: CSS10

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	68 kPa	Sample	: 15WAXB
γ at τ_{peak}	:	13.24 %	Depth [m]	: 12.84
Rate of strain	:	2.98 %/hour	Test No.	: CSS10

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Very dark brown CLAY with organic mattter

GENERAL	
Date test started	10/12/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	30.0
Water content	[%]	36.1
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.33
Void ratio	[-]	1.027
Degree of saturation	[%]	95
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_15C_CSS11
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 21/11/2016
Approved by Date	AR 12/01/2017

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	12.96
Test number	CSS11

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	120
Vertical strain	[%]	1.97
Bulk density	[Mg/m^3]	1.83
Dry density	[Mg/m^3]	1.36
Void ratio	[-]	0.987
Water content	[%]	34.7

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	120
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.97
Bulk density	[Mg/m^3]	1.83
Dry density	[Mg/m^3]	1.36
Void ratio	[-]	0.987

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.10	0.03	19.05	2.57
2	0.09	0.03	18.27	2.80
5	0.10	0.03	19.25	3.42
10	0.10	0.03	18.79	2.59
20	0.10	0.03	18.98	1.99
30	0.10	0.03	19.34	2.26
40	0.09	0.03	19.05	3.04
50	0.10	0.03	18.98	2.59
100	0.10	0.03	18.27	2.45
200	0.10	0.03	17.95	2.55
300	0.10	0.03	18.27	3.15
400	0.10	0.03	18.89	2.06

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	12.96
Test number	CSS11

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	45
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	396
γ_{av} at N_f	[%]	-1.33
γ_{cy} at N_f	[%]	15.03
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	92
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.25	1.86	2.39	25.39
2	-0.23	2.11	2.14	25.23
5	-0.23	2.45	1.85	19.11
10	-0.27	2.73	1.66	16.01
20	-0.26	3.07	1.48	14.55
30	-0.24	3.32	1.37	13.94
40	-0.23	3.53	1.29	14.17
50	-0.21	3.73	1.22	14.09
100	-0.11	4.79	0.95	13.24
200	-2.60	8.62	0.53	7.19
300	-2.27	10.48	0.43	14.20
396	-1.33	15.03	0.29	14.73

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	63
Shear strain	[%]	26.54
Shear induced $-\Delta\sigma_v$	[kPa]	54
Vertical stress	[kPa]	66
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.02
At 15 % shear strain		
Shear stress	[kPa]	44
Shear induced $-\Delta\sigma_v$	[kPa]	70
Vertical stress	[kPa]	50
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	12.96
Test number	CSS11

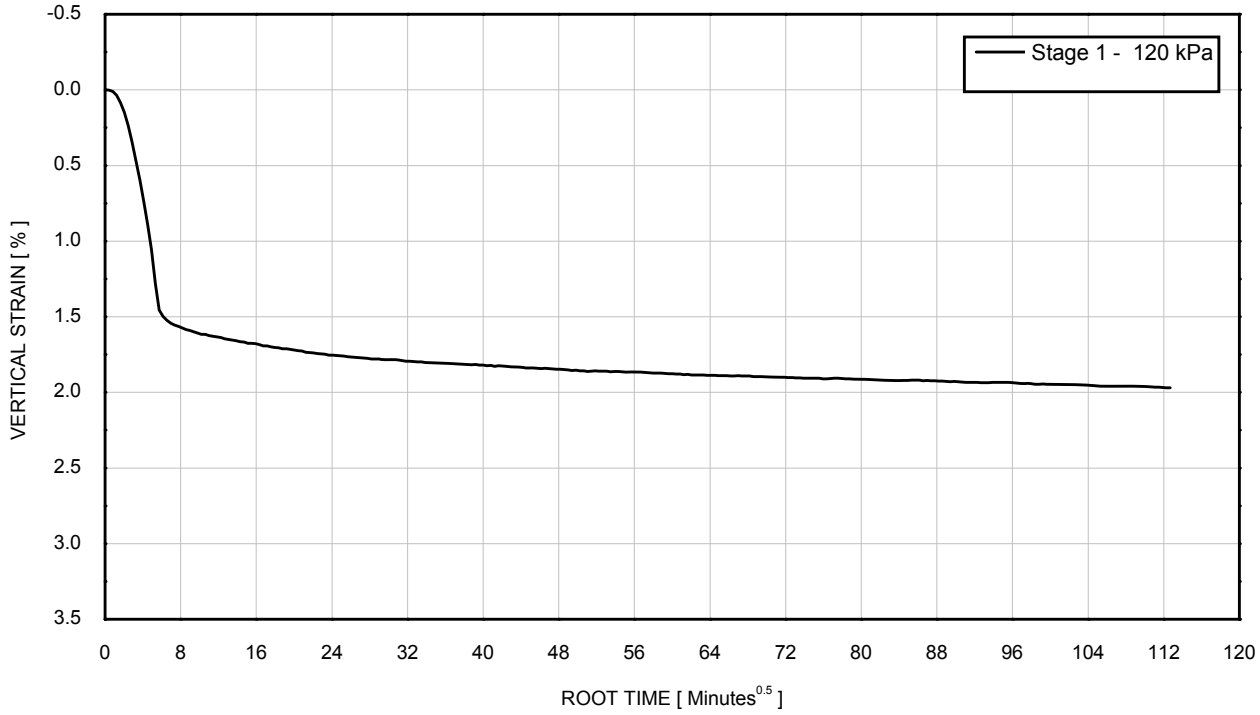
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

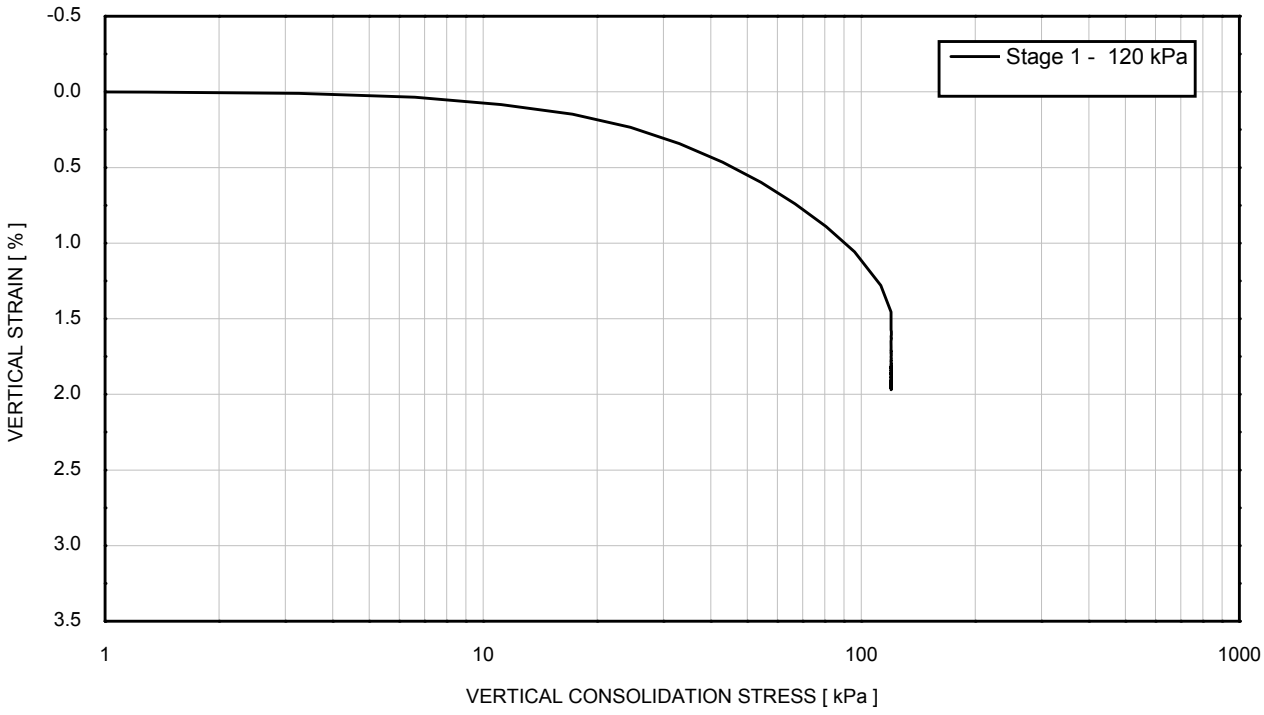
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	12.96
Test number	CSS11

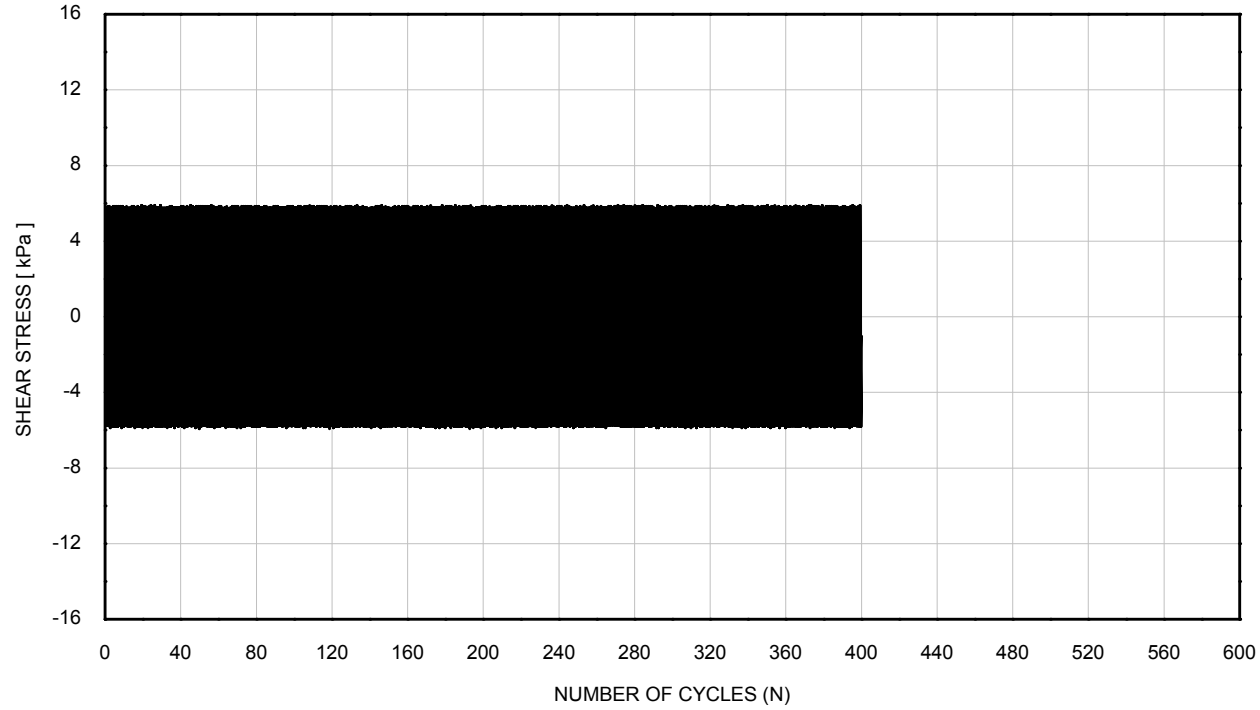
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

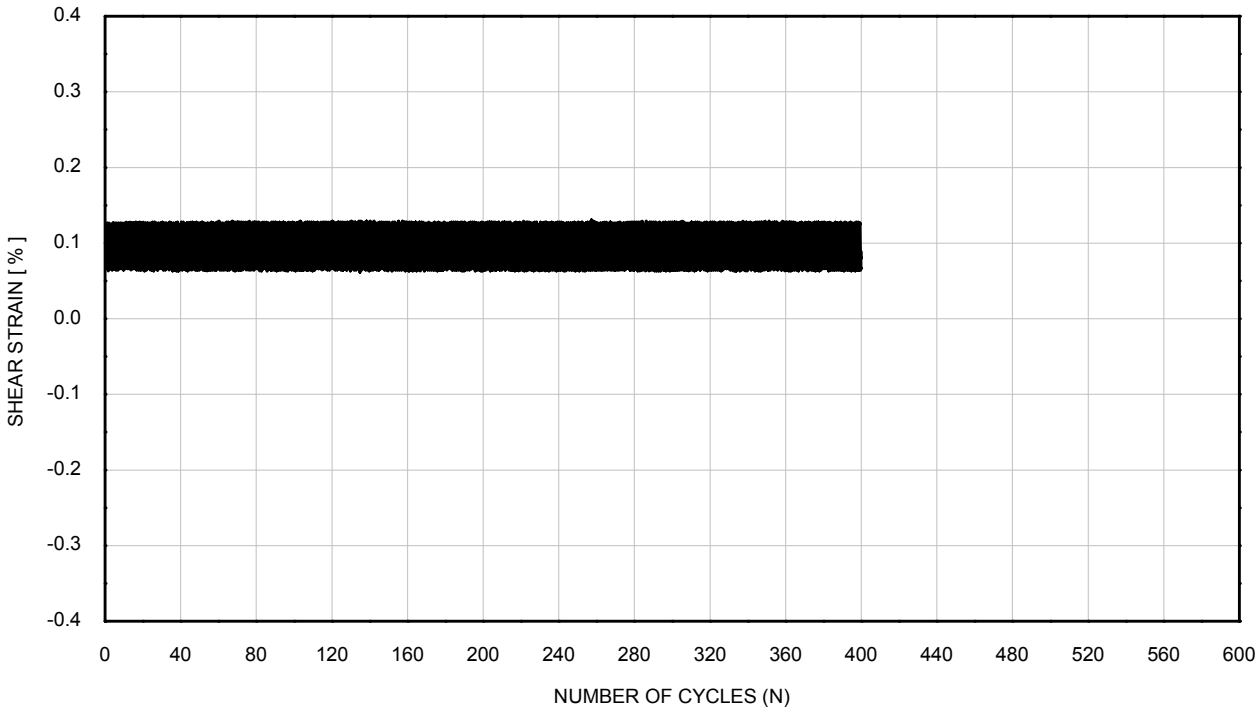




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 15WaxC
		Depth [m]	: 12.96
		Test No.	: CSS11

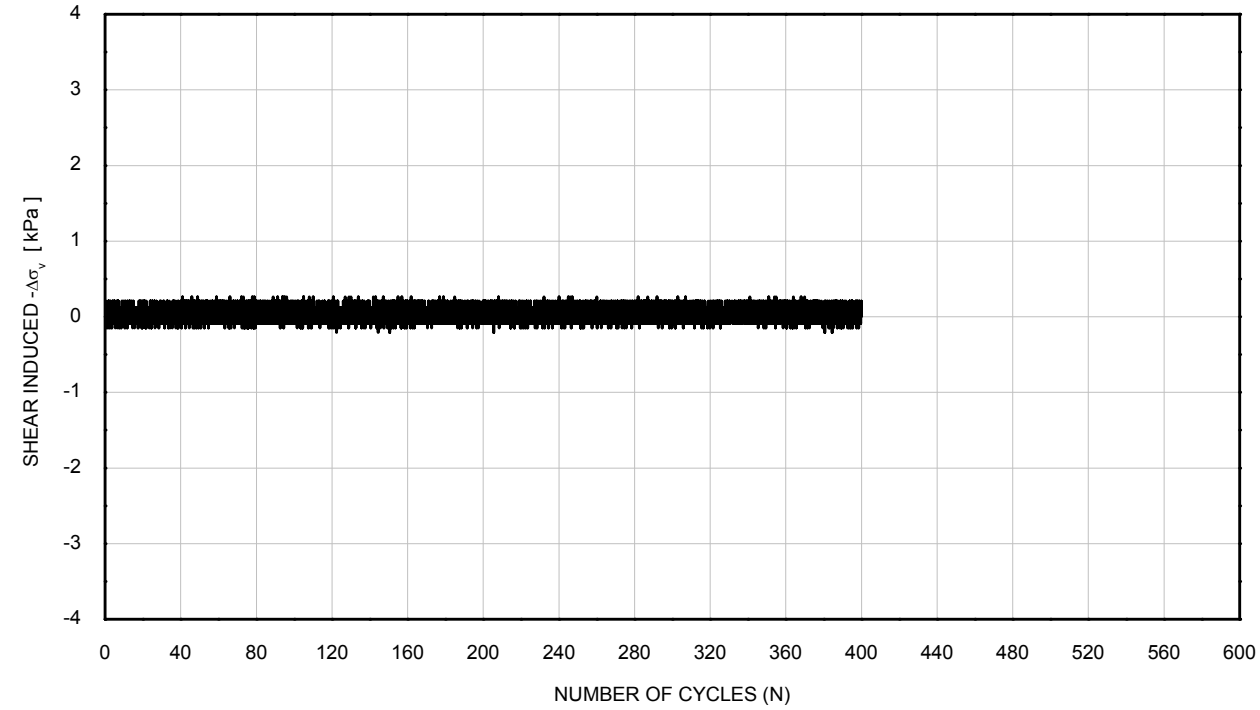
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

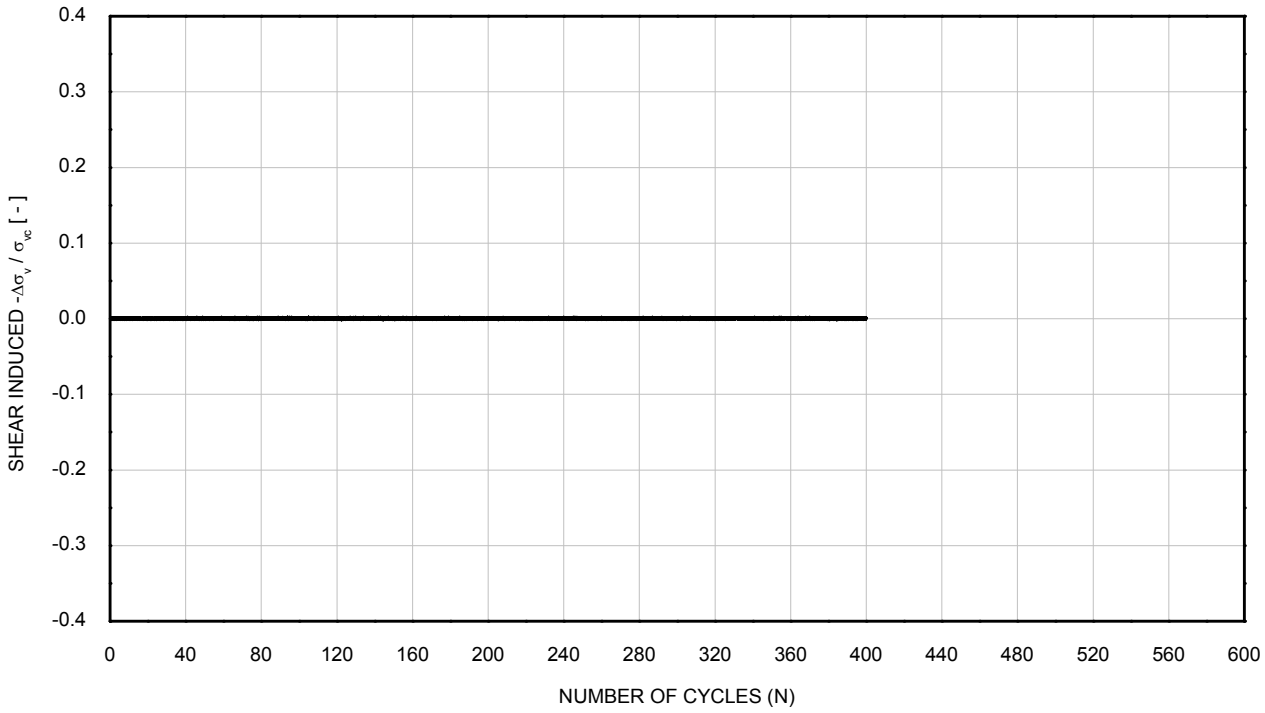




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	: 12.96
Frequency	:	0.10 Hz	Test No.	: CSS11

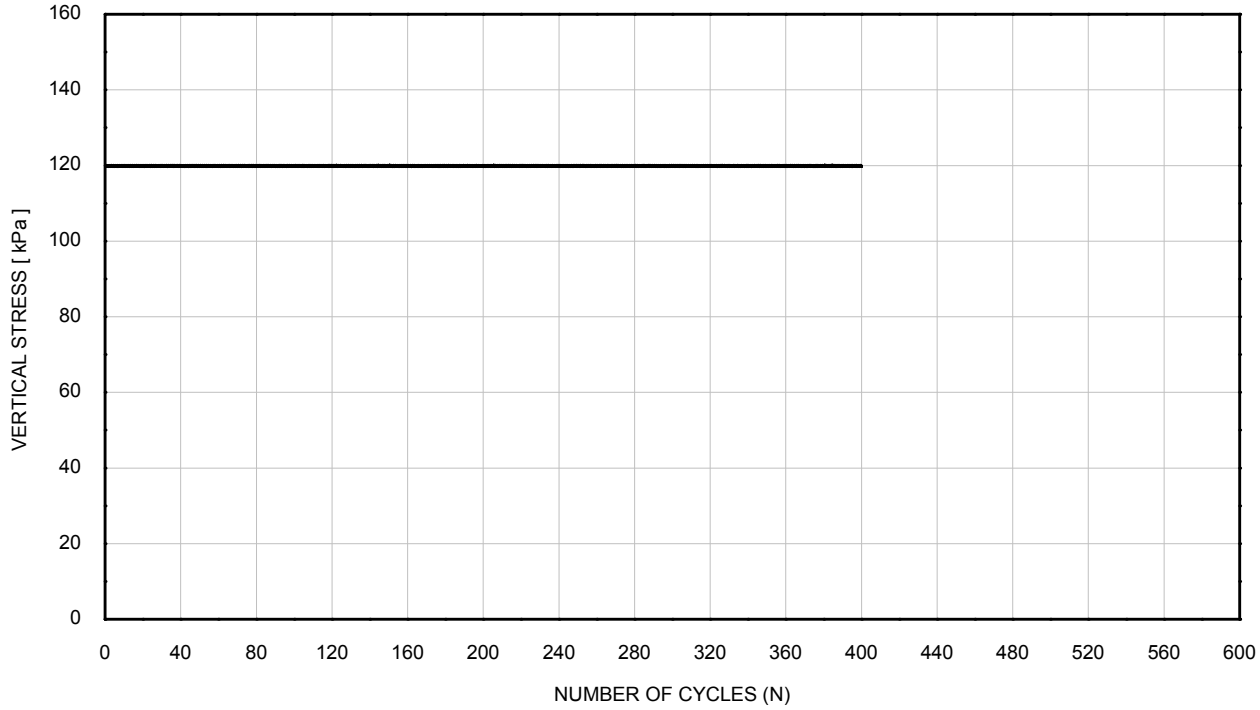
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

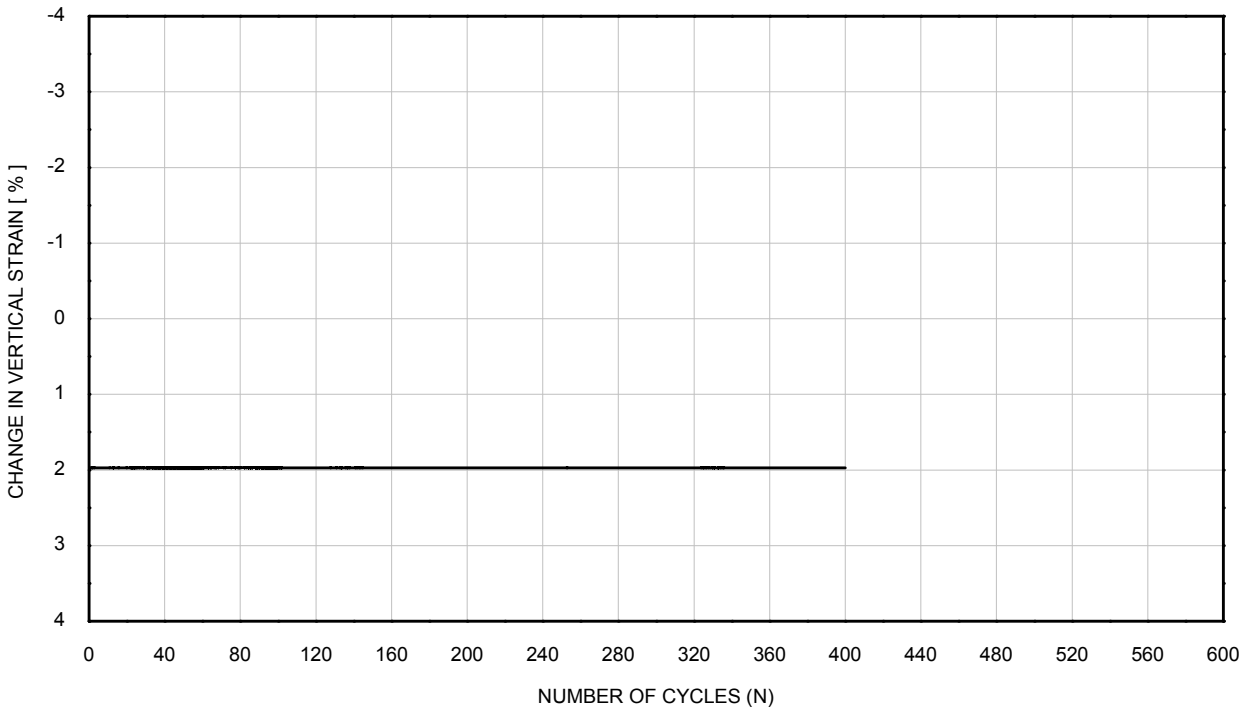




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

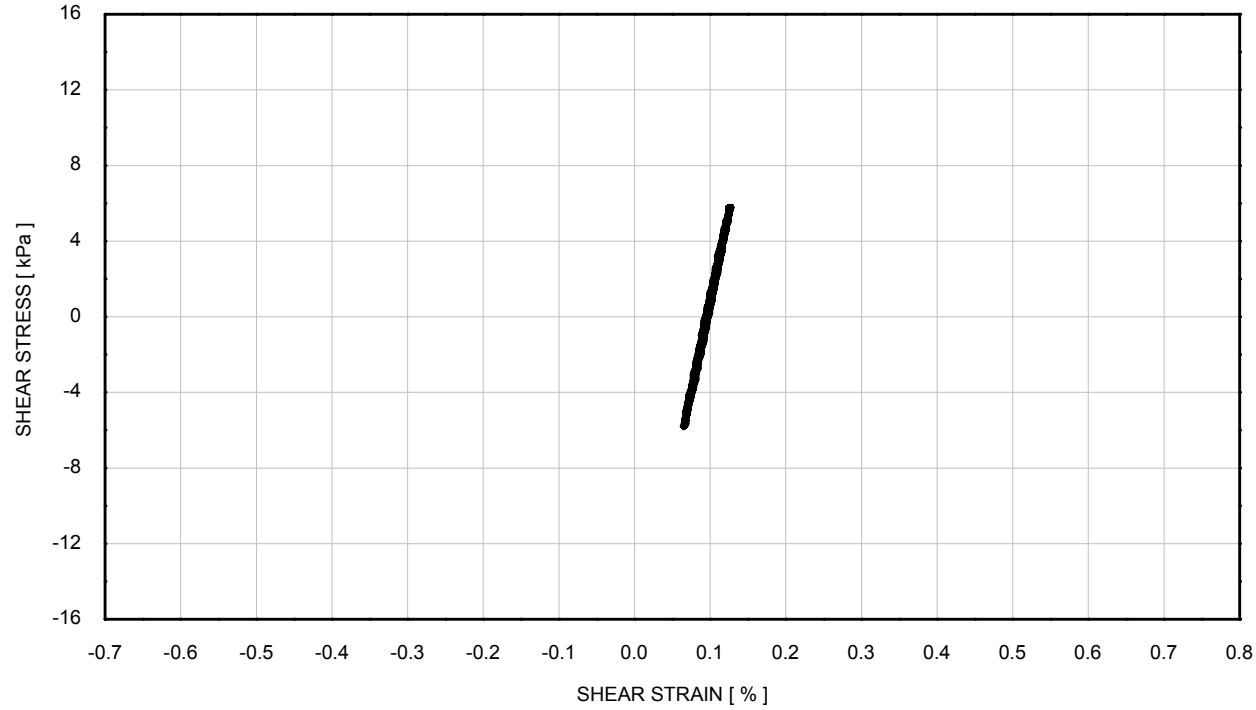
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

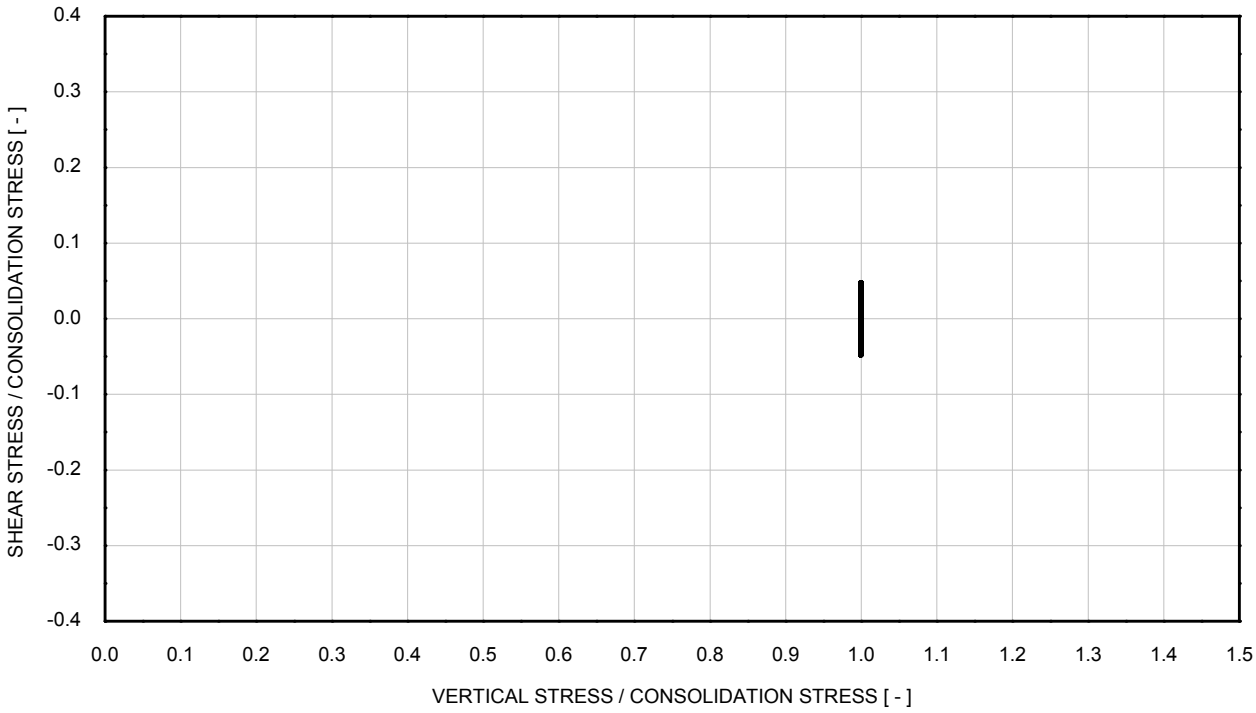




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

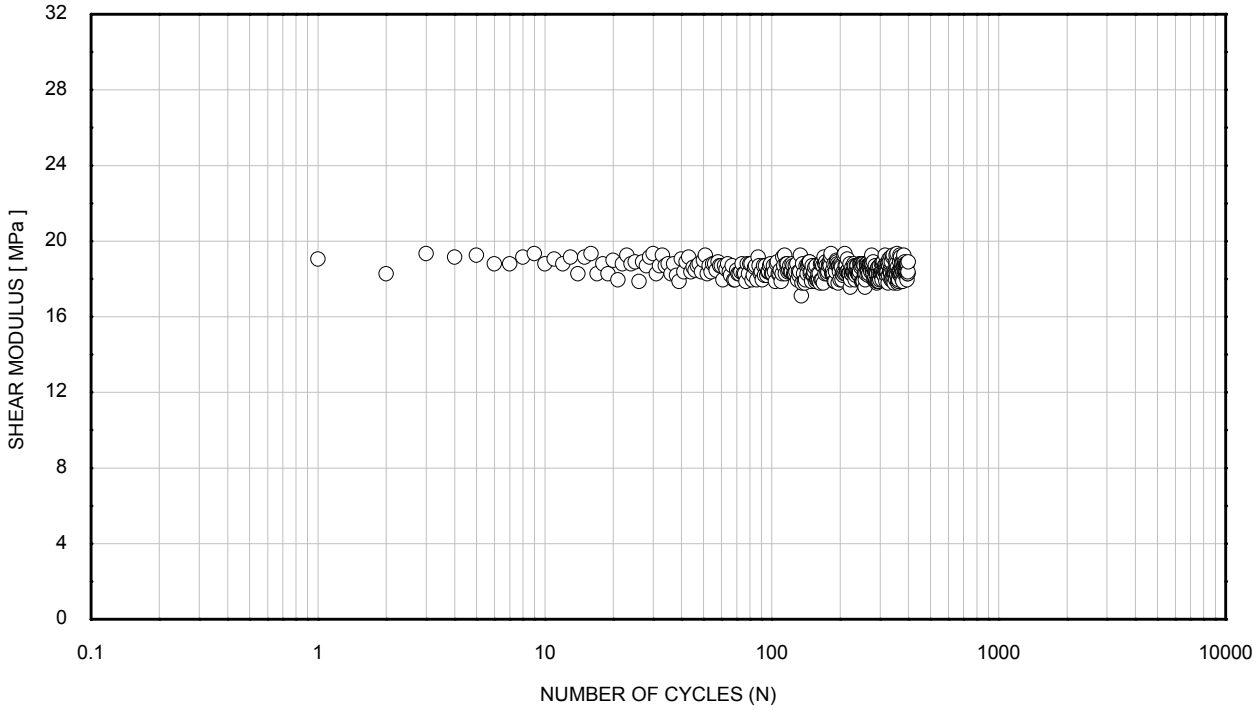
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

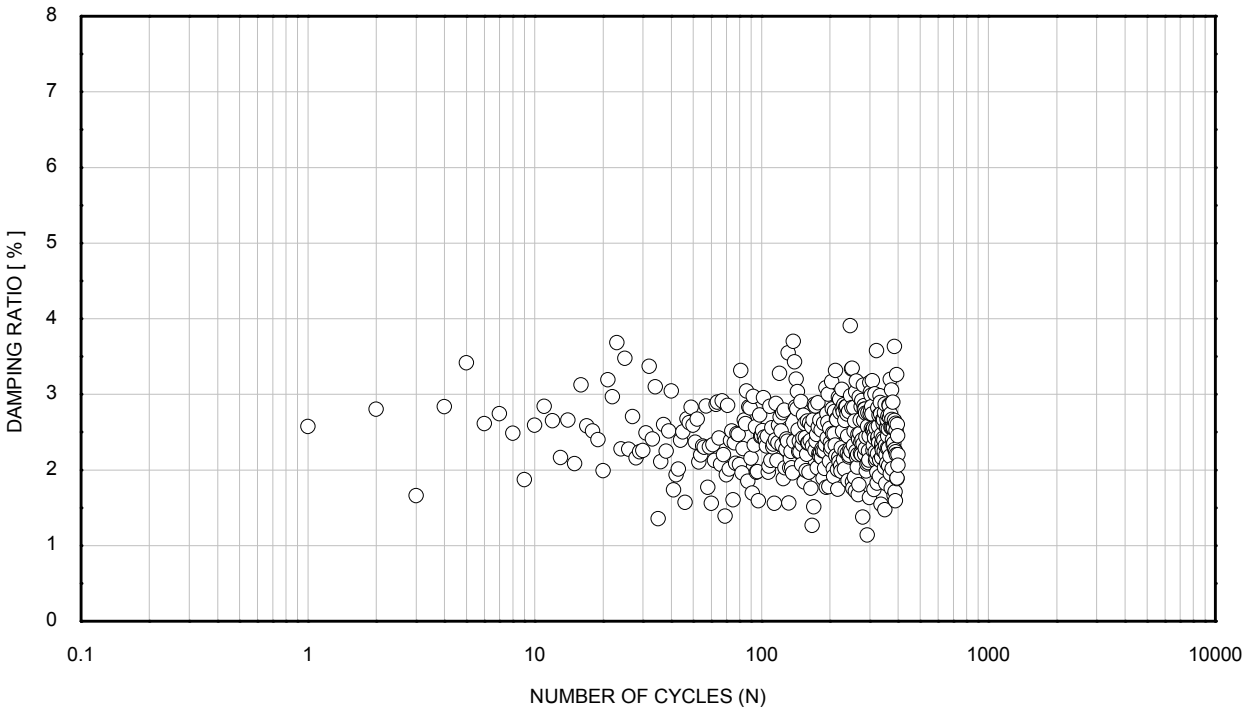




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

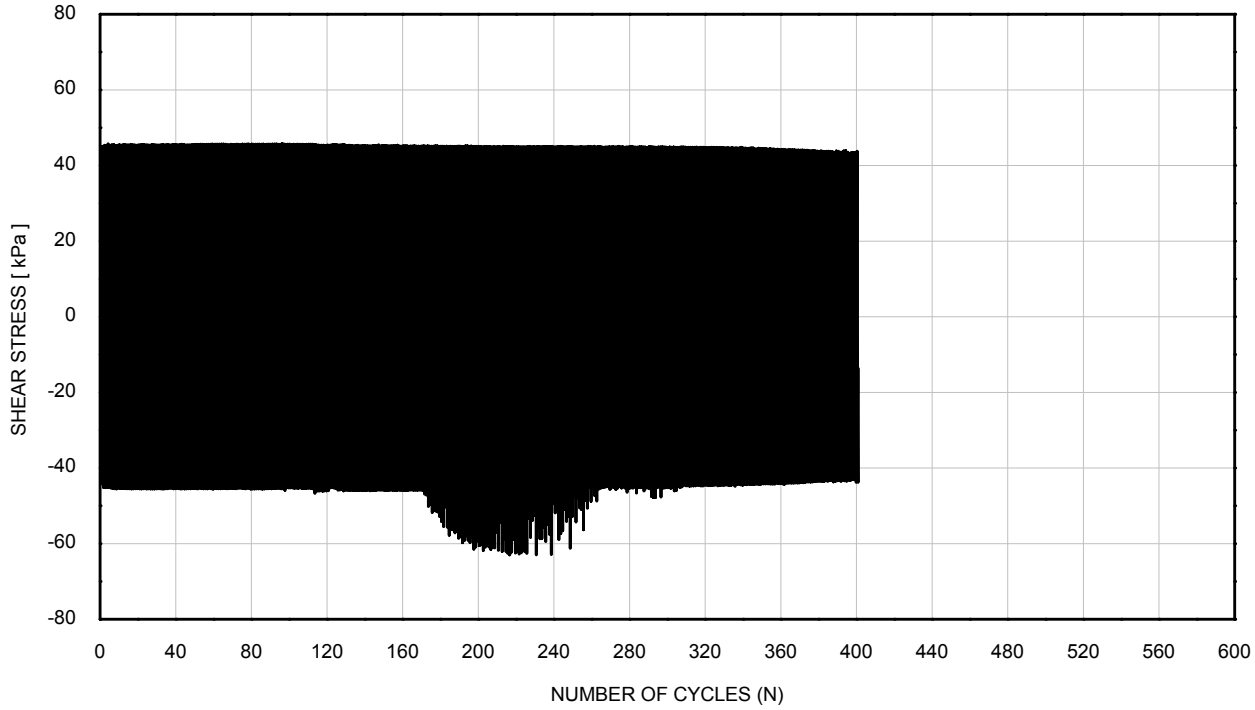
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

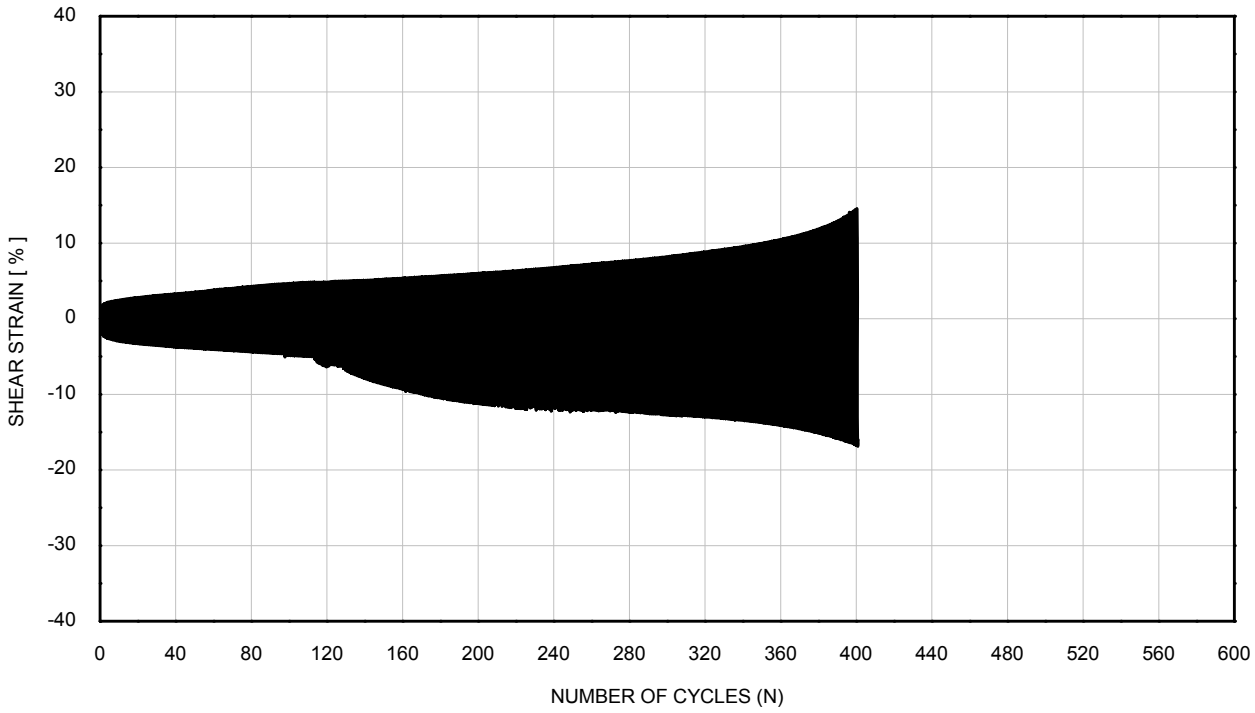




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

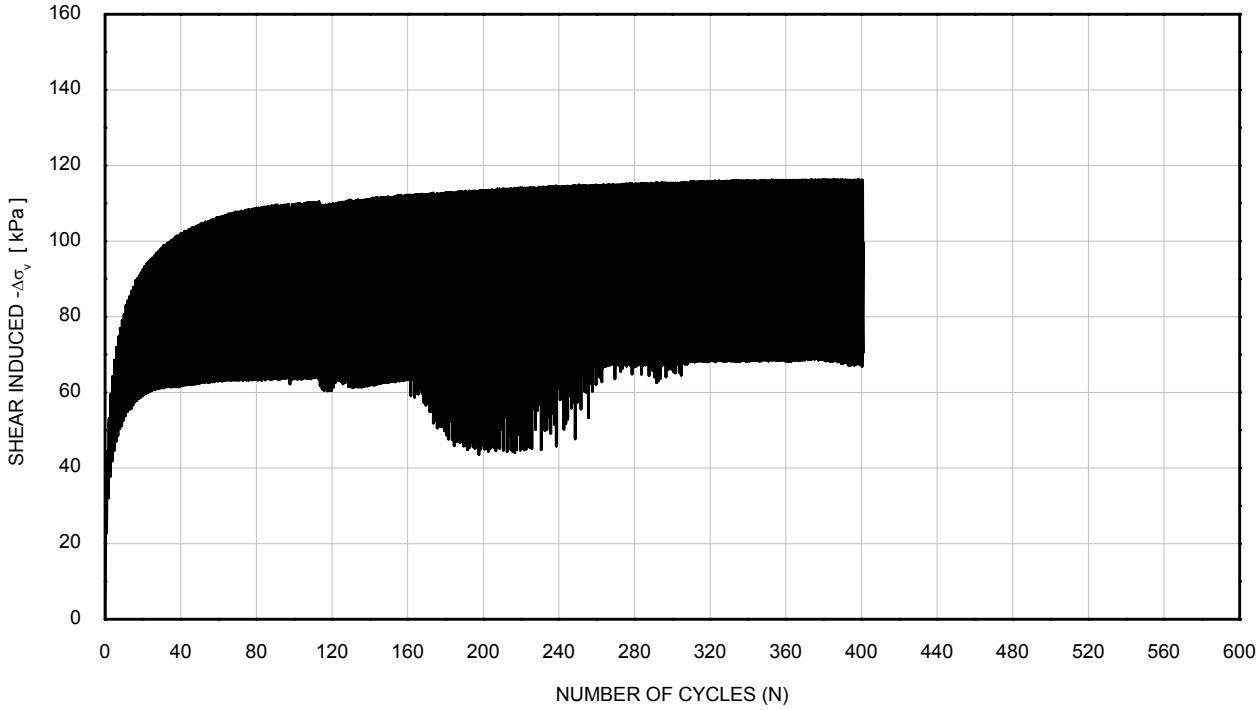
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

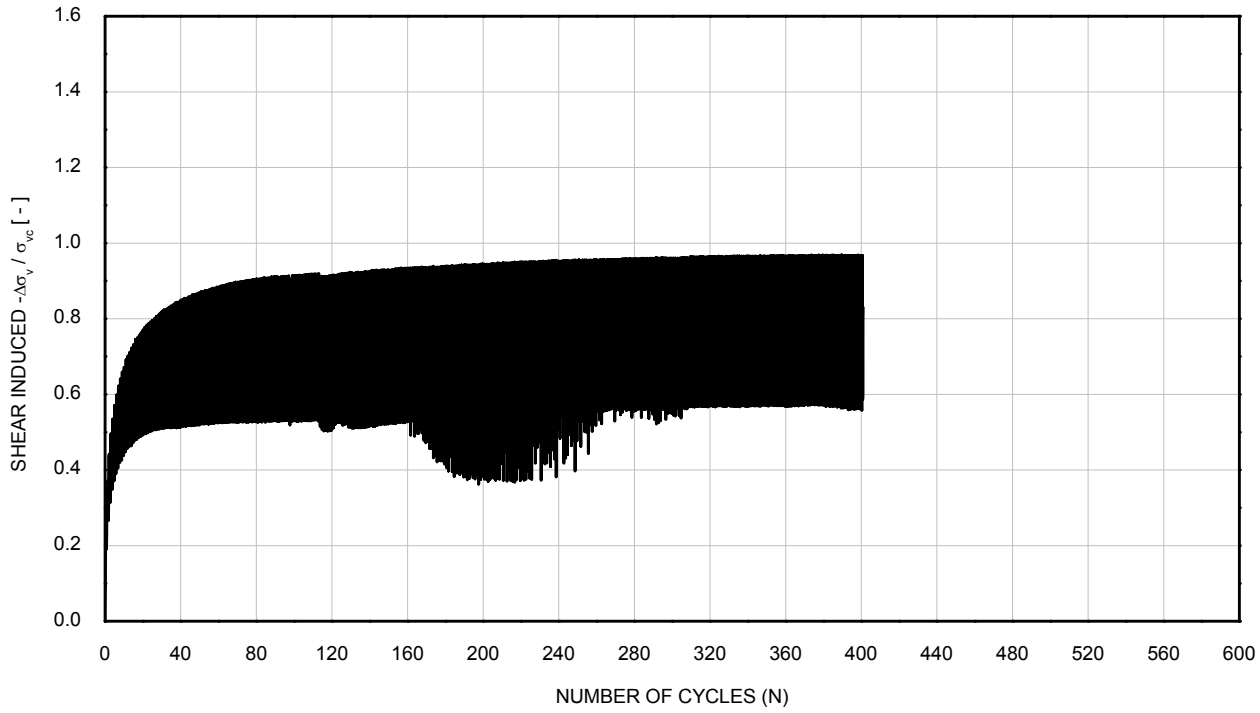




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	-1 kPa	Sample	:	15WAXC
Mean τ_{cy}	:	46 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

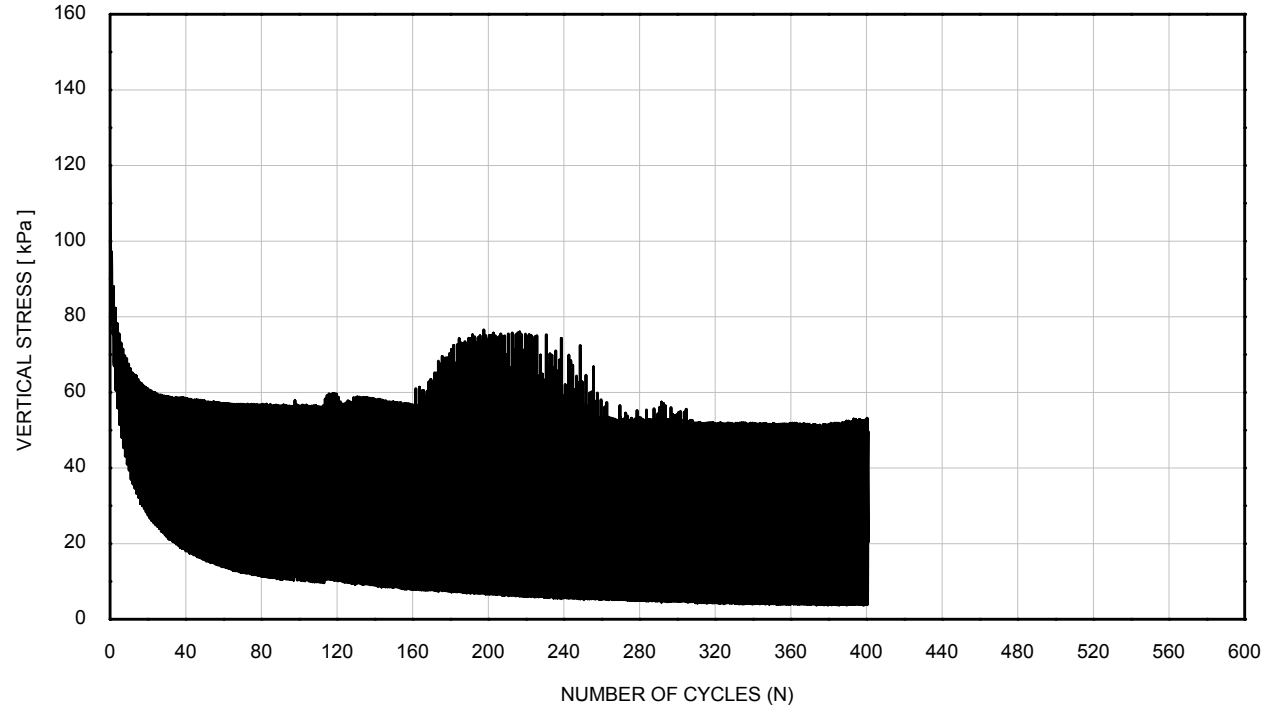
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

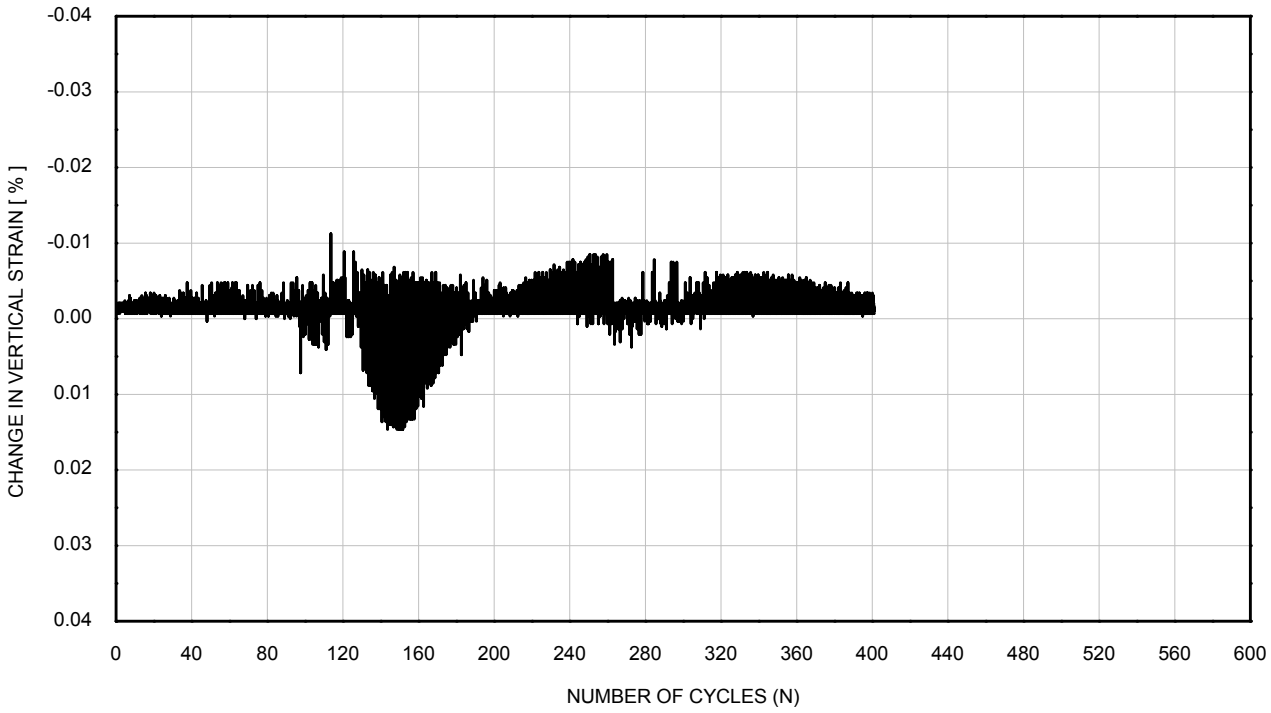




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	-1 kPa	Sample	:	15WAXC
Mean τ_{cy}	:	46 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

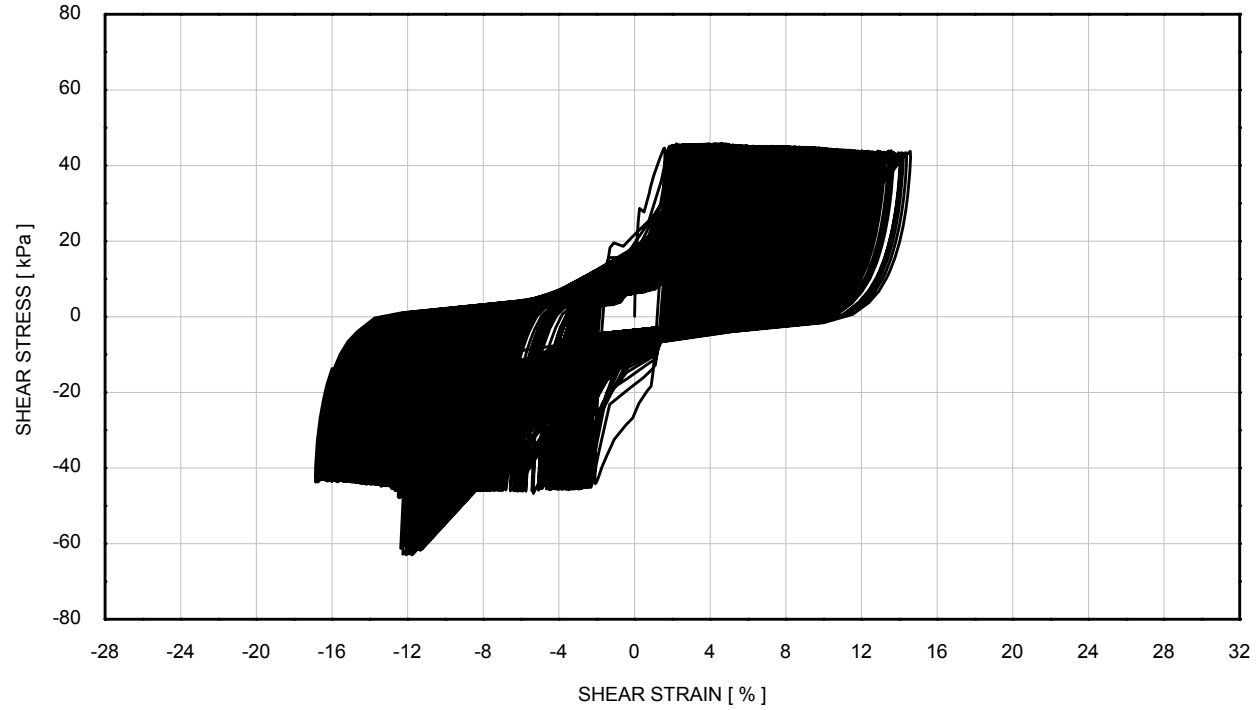
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

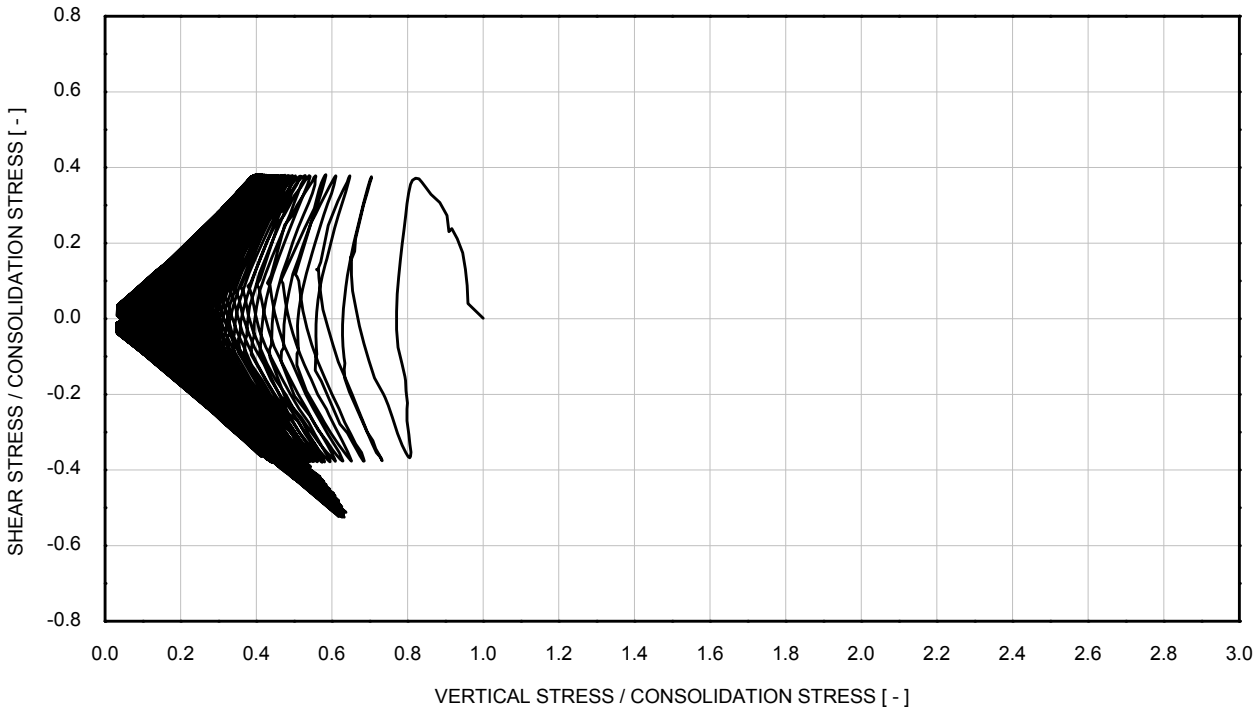




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	-1 kPa	Sample	:	15WAXC
Mean τ_{cy}	:	46 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

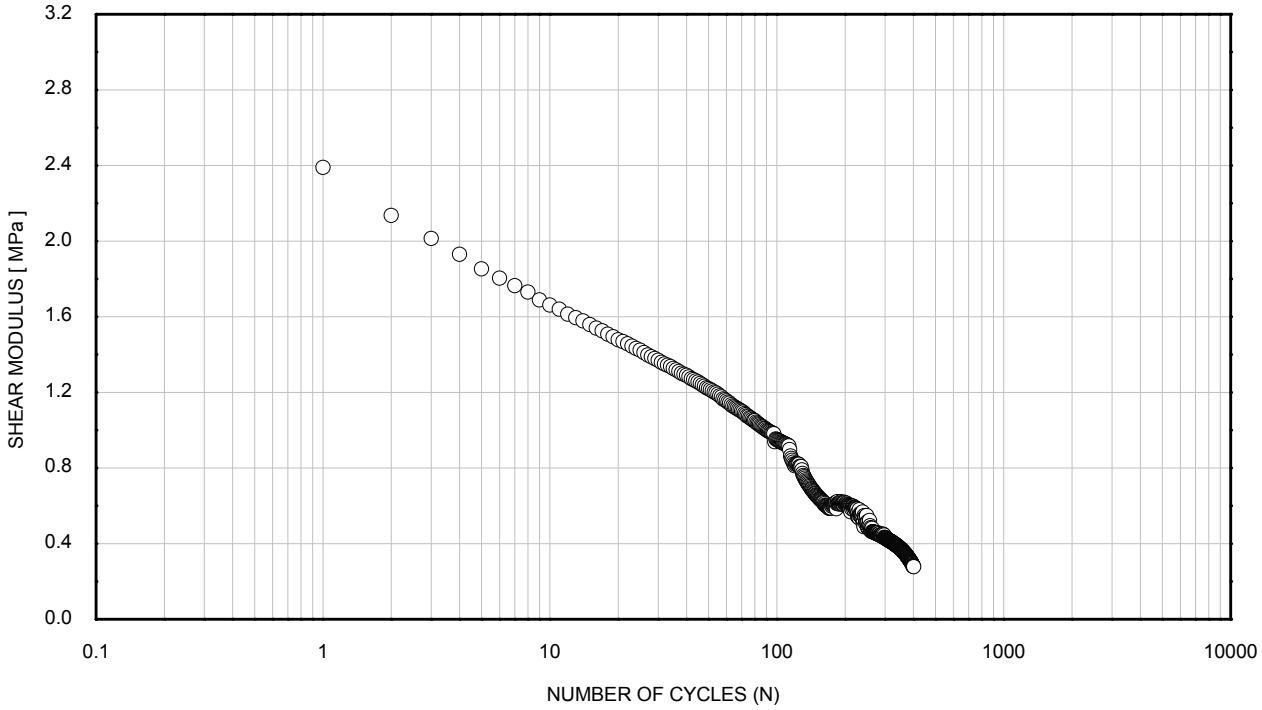
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

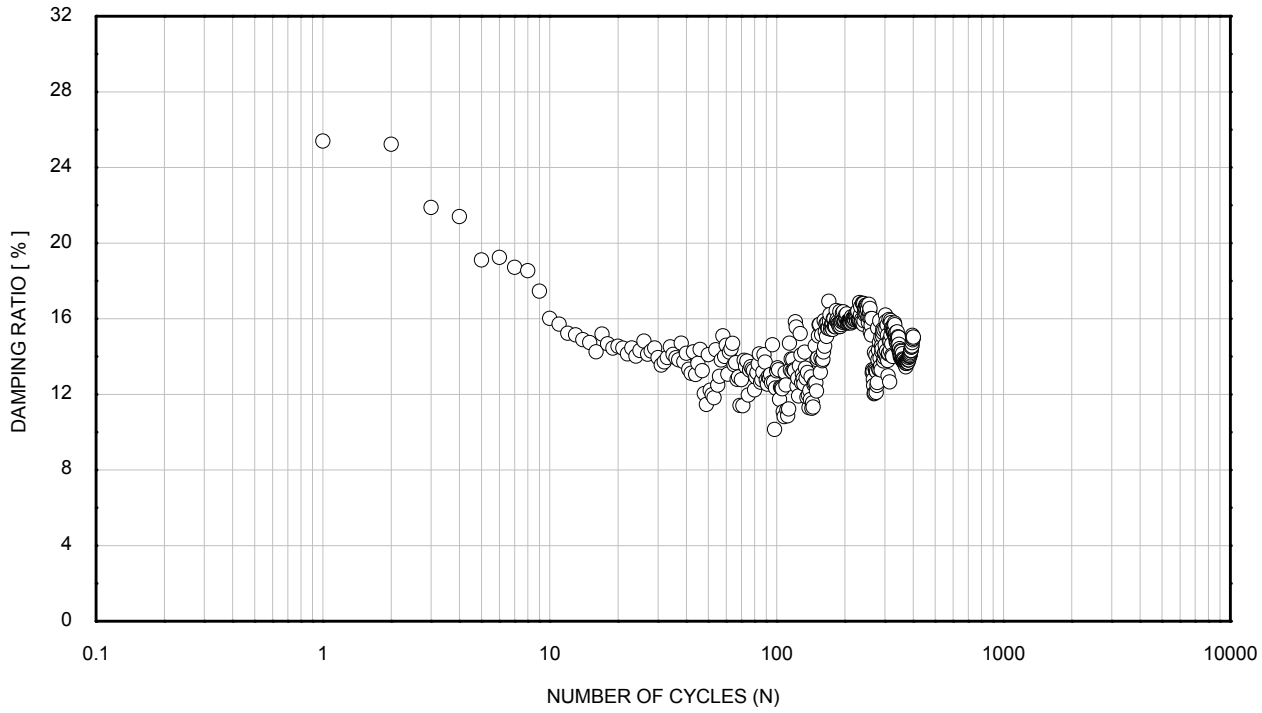




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	-1 kPa	Sample	:	15WAXC
Mean τ_{cy}	:	46 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

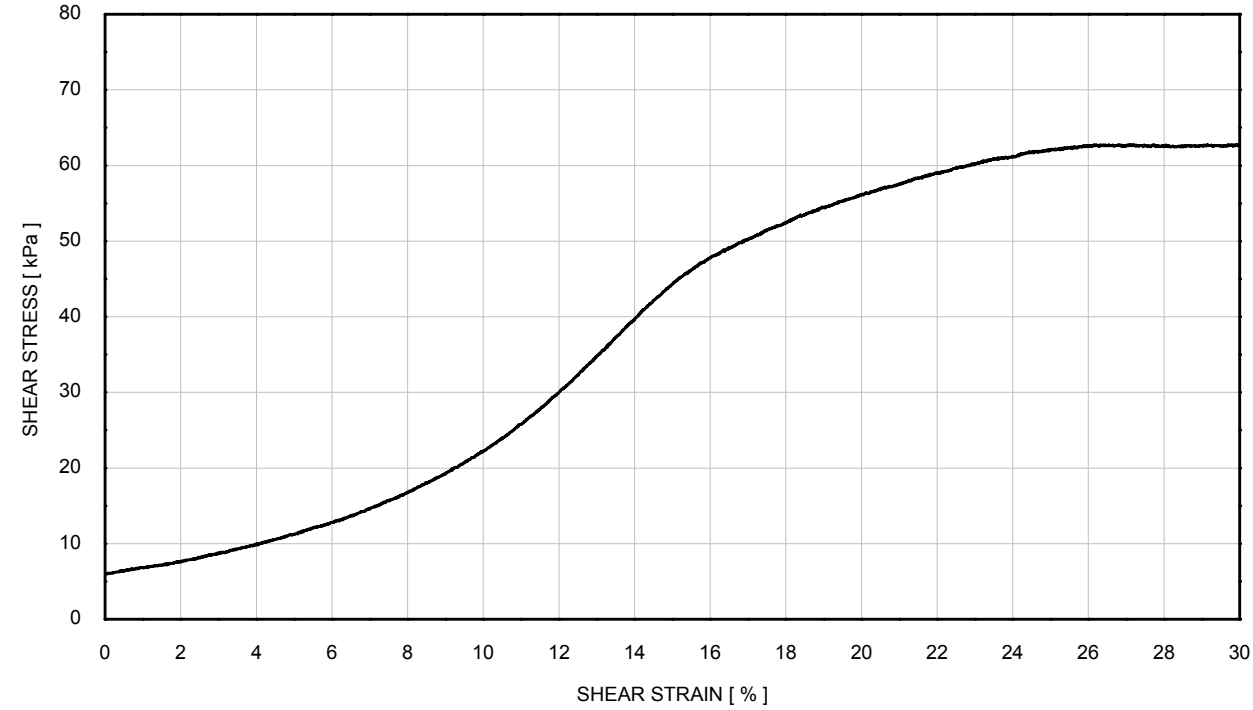
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

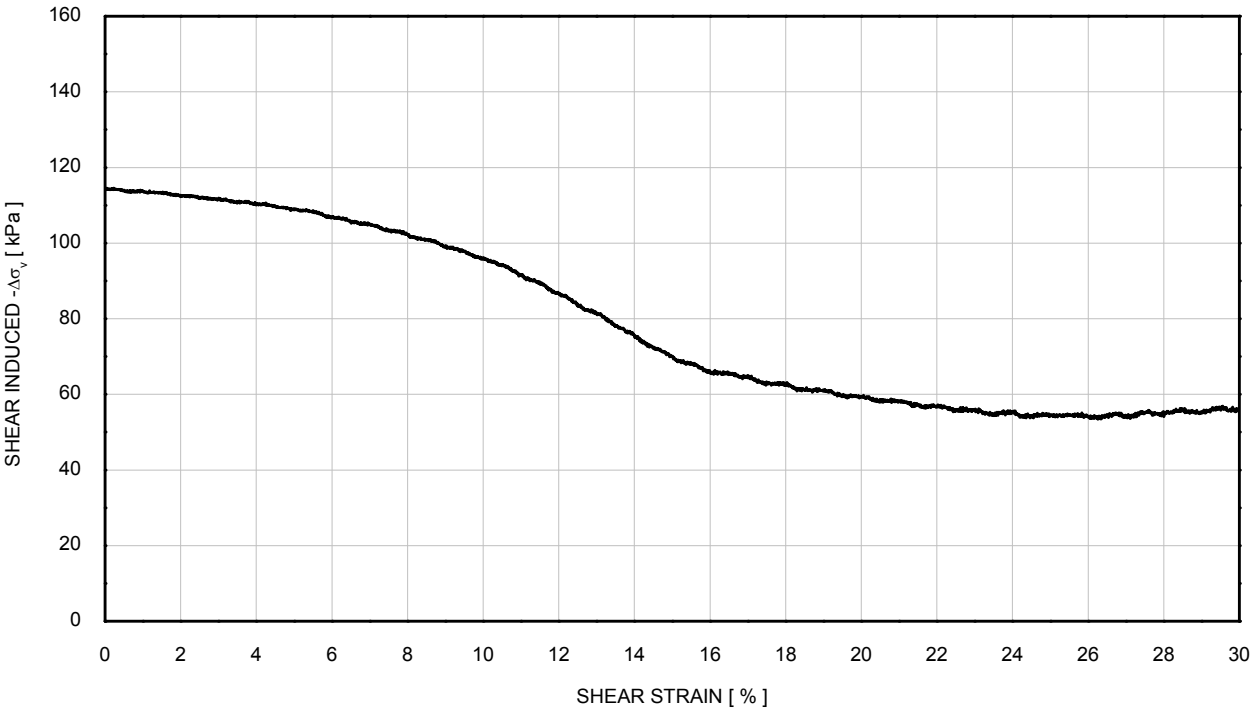




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	-1 kPa	Sample	:	15WAXC
Mean τ_{cy}	:	46 kPa	Depth [m]	:	12.96
Frequency	:	0.10 Hz	Test No.	:	CSS11

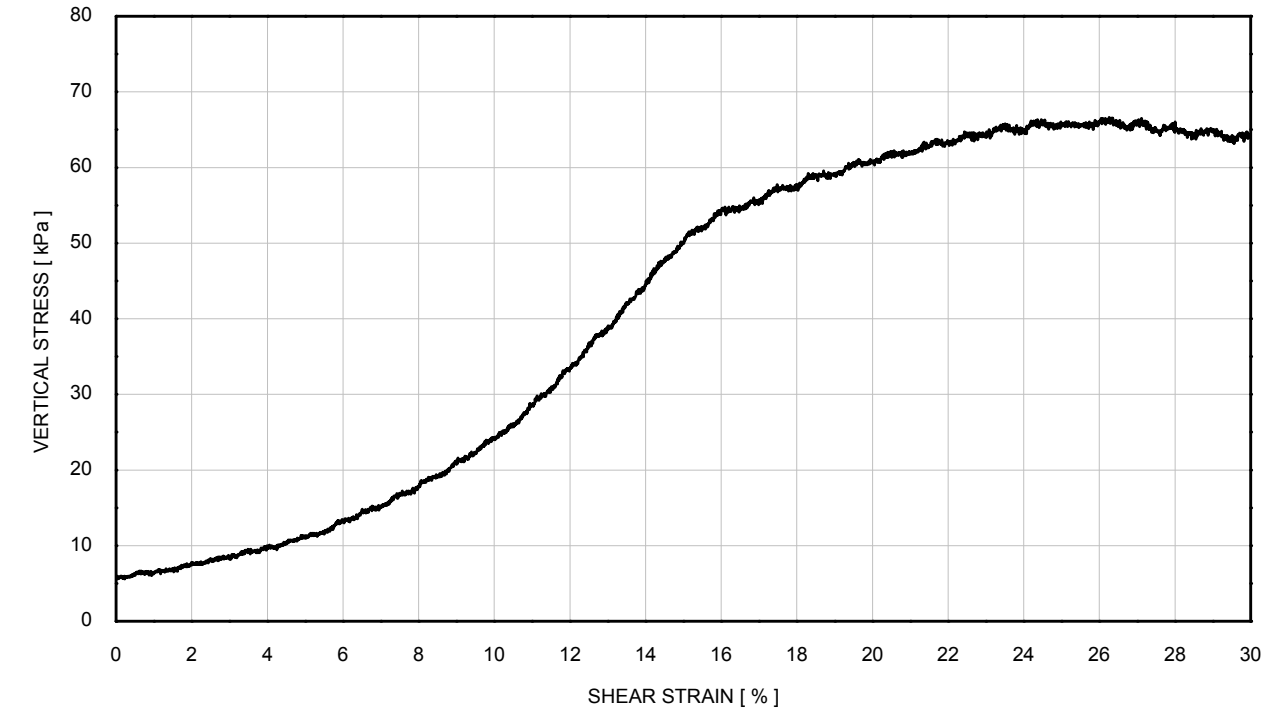
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

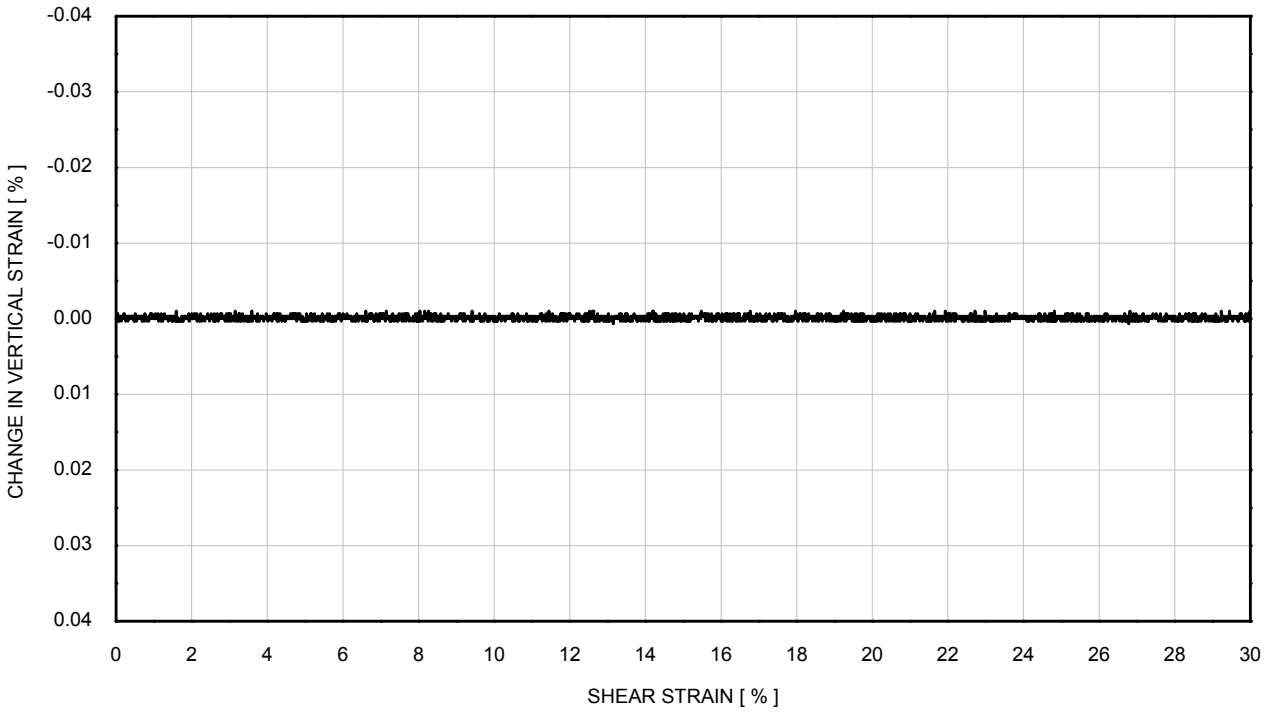




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 63 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 26.54 %	Depth [m]	: 12.96
Rate of strain	: 3.02 %/hour	Test No.	: CSS11

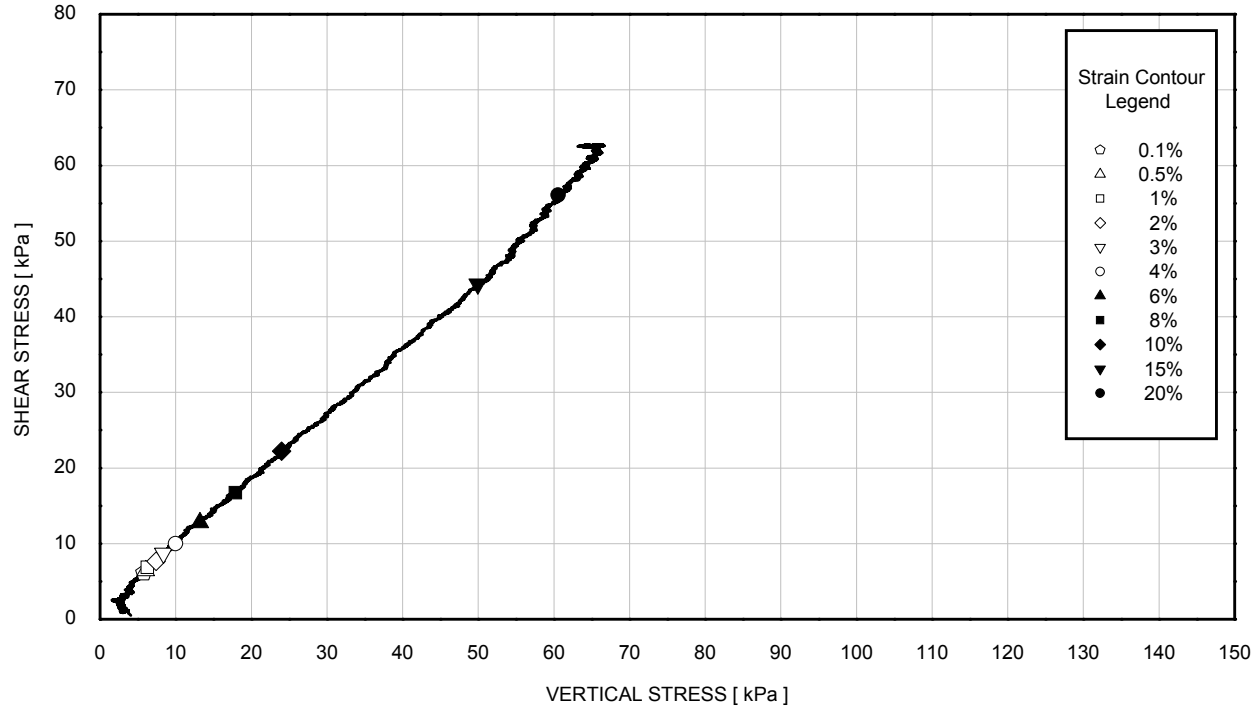
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

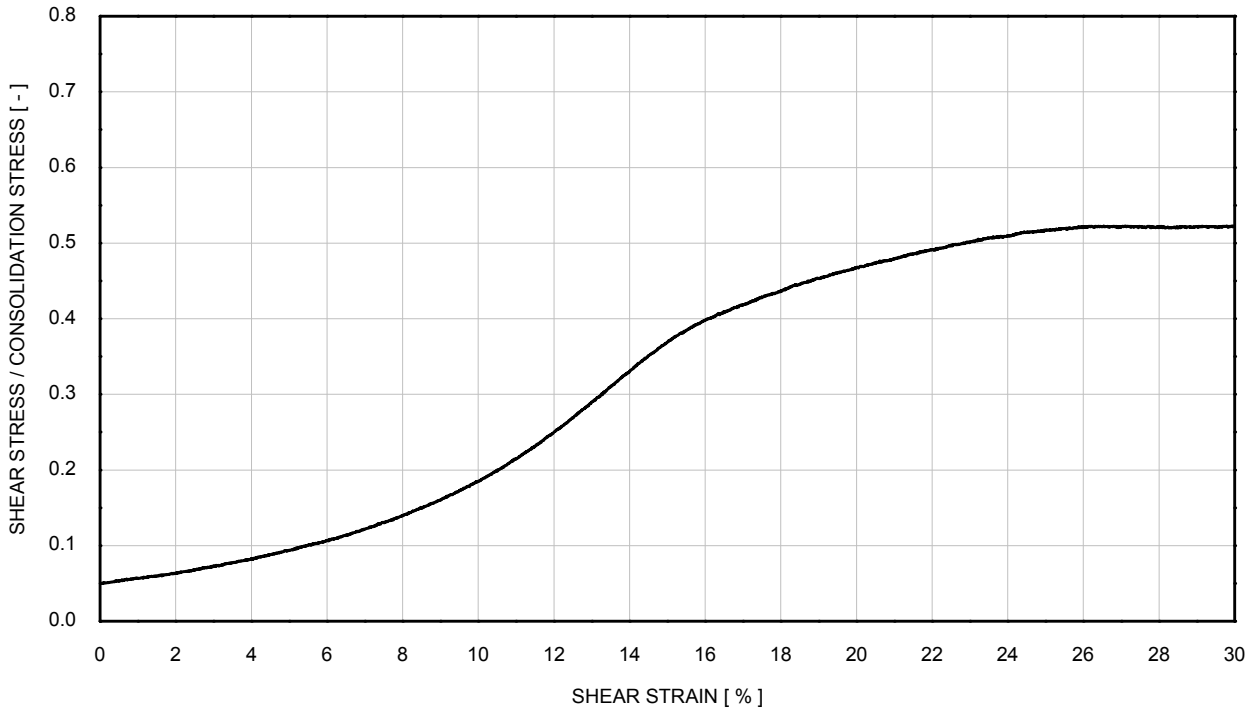




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 63 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 26.54 %	Depth [m]	: 12.96
Rate of strain	: 3.02 %/hour	Test No.	: CSS11

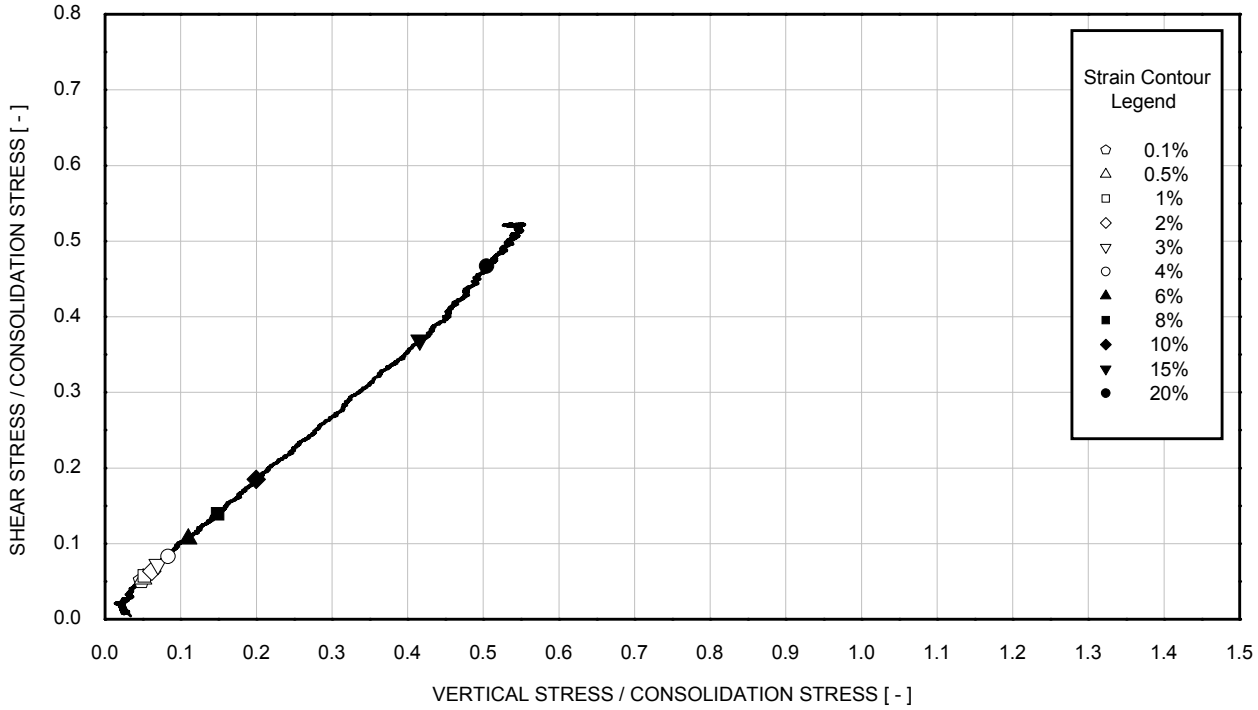
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

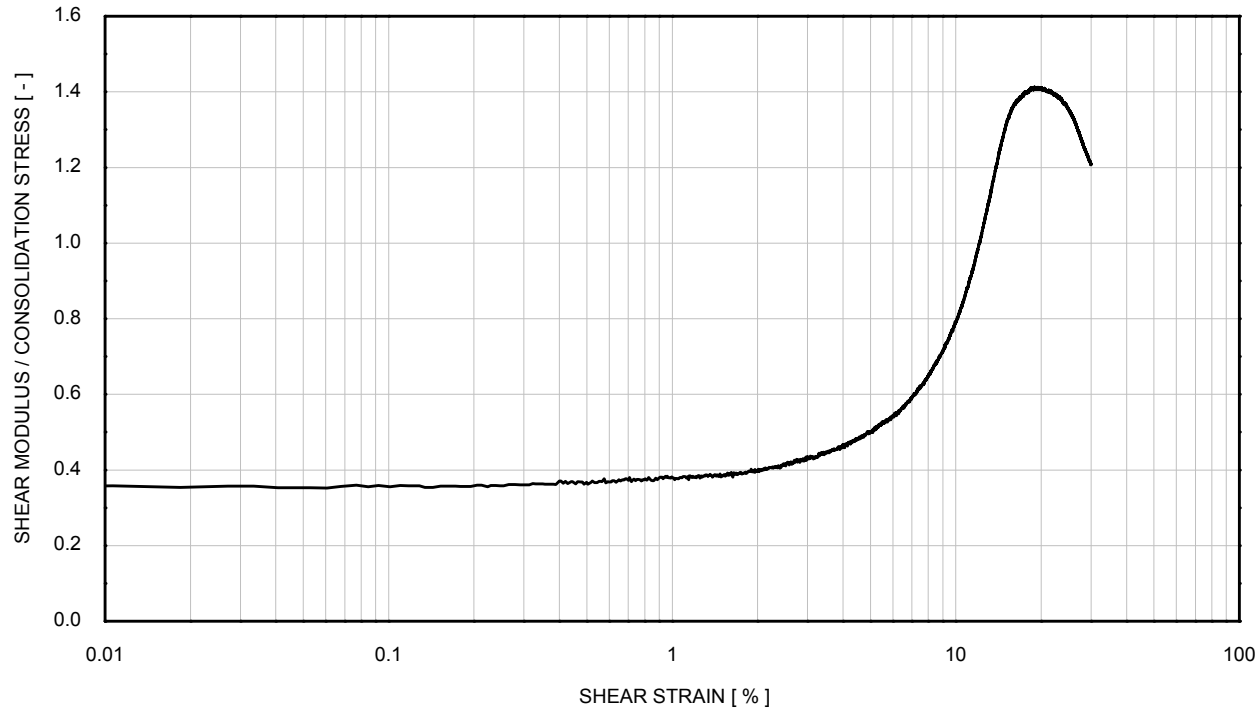




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 63 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 26.54 %	Depth [m]	: 12.96
Rate of strain	: 3.02 %/hour	Test No.	: CSS11

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 63 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 26.54 %	Depth [m]	: 12.96
Rate of strain	: 3.02 %/hour	Test No.	: CSS11

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Very dark brown CLAY with organic matter

GENERAL	
Date test started	12/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.8
Water content	[%]	35.4
Bulk density	[Mg/m³]	1.85
Dry density	[Mg/m³]	1.37
Void ratio	[-]	0.971
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_15C_CSS12
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 21/11/2016
Approved by Date	DT 12/01/2017

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	13.01
Test number	CSS12

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	120
Vertical strain	[%]	1.29
Bulk density	[Mg/m^3]	1.87
Dry density	[Mg/m^3]	1.39
Void ratio	[-]	0.946
Water content	[%]	34.4

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	120
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.29
Bulk density	[Mg/m^3]	1.87
Dry density	[Mg/m^3]	1.39
Void ratio	[-]	0.946

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.74	0.03	21.18	2.92
2	0.74	0.03	21.65	2.85
5	0.74	0.03	21.18	2.12
10	0.75	0.03	22.25	2.37
20	0.74	0.03	22.25	1.70
30	0.74	0.03	21.76	1.69
40	0.74	0.03	21.65	2.75
50	0.74	0.03	21.07	2.43
100	0.74	0.03	22.14	3.27
200	0.74	0.03	20.42	1.79
300	0.75	0.03	20.78	2.75
400	0.74	0.03	20.63	2.55

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	13.01
Test number	CSS12

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	57
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	139
γ_{av} at N_f	[%]	2.61
γ_{cy} at N_f	[%]	15.10
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	88
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.76	2.54	2.22	21.40
2	-0.74	2.90	2.00	23.27
5	-0.37	3.57	1.59	16.10
10	-0.48	3.92	1.44	14.53
20	-0.53	4.74	1.19	15.24
30	-0.47	5.44	1.04	13.90
40	-0.31	6.38	0.89	19.49
50	-0.26	6.97	0.81	20.90
100	0.60	9.81	0.61	16.90
139	2.61	15.10	0.37	16.09

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	64
Shear strain	[%]	25.78
Shear induced $-\Delta\sigma_v$	[kPa]	54
Vertical stress	[kPa]	66
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.06
At 15 % shear strain		
Shear stress	[kPa]	31
Shear induced $-\Delta\sigma_v$	[kPa]	90
Vertical stress	[kPa]	30
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	13.01
Test number	CSS12

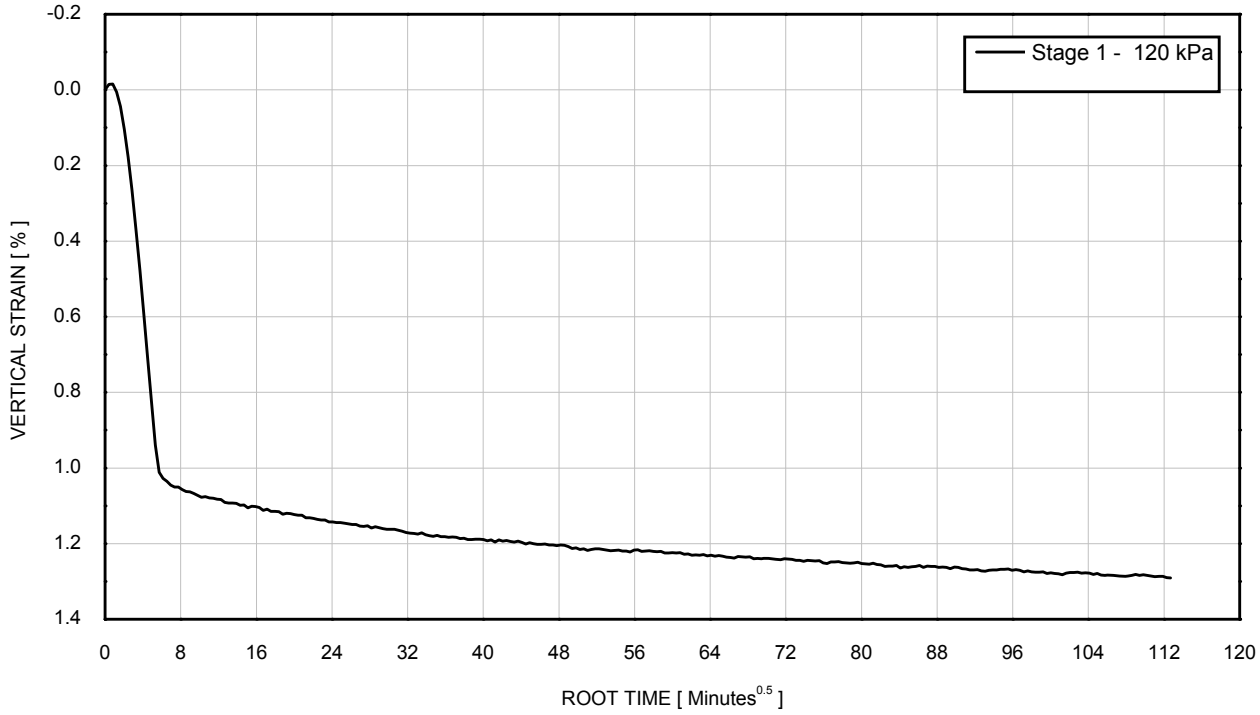
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

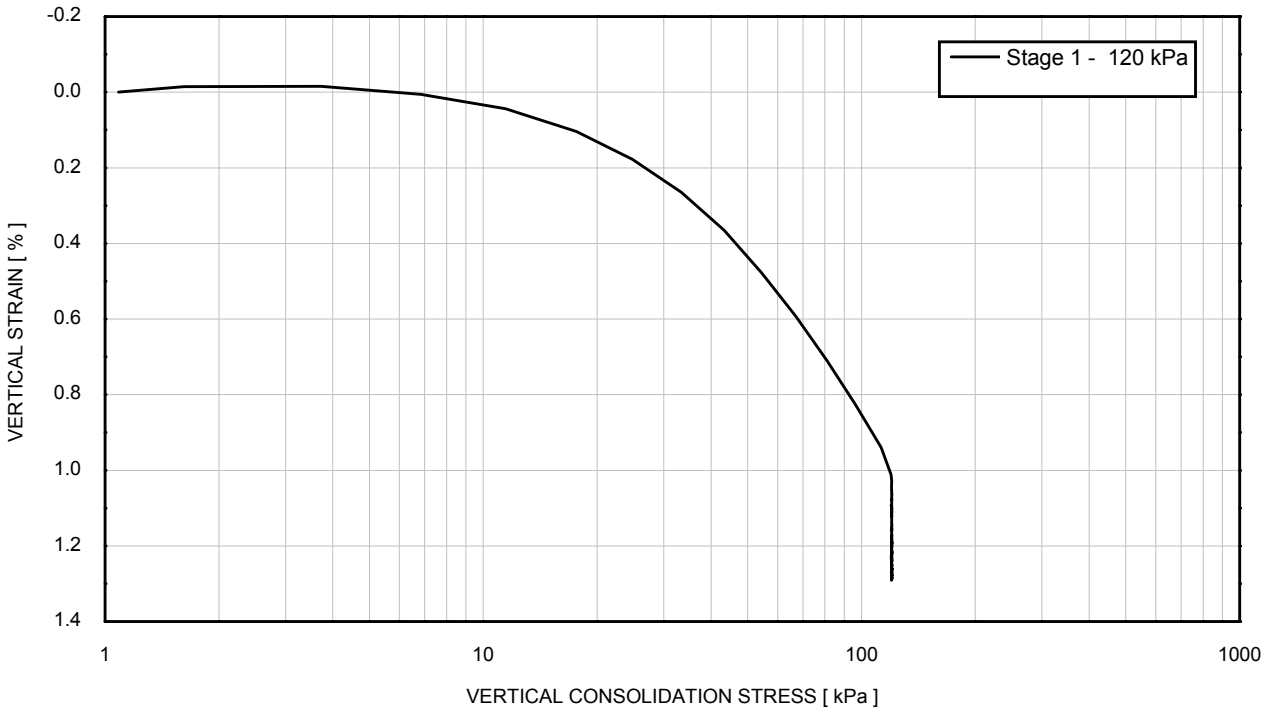
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	15WaxC
Depth [m]	13.01
Test number	CSS12

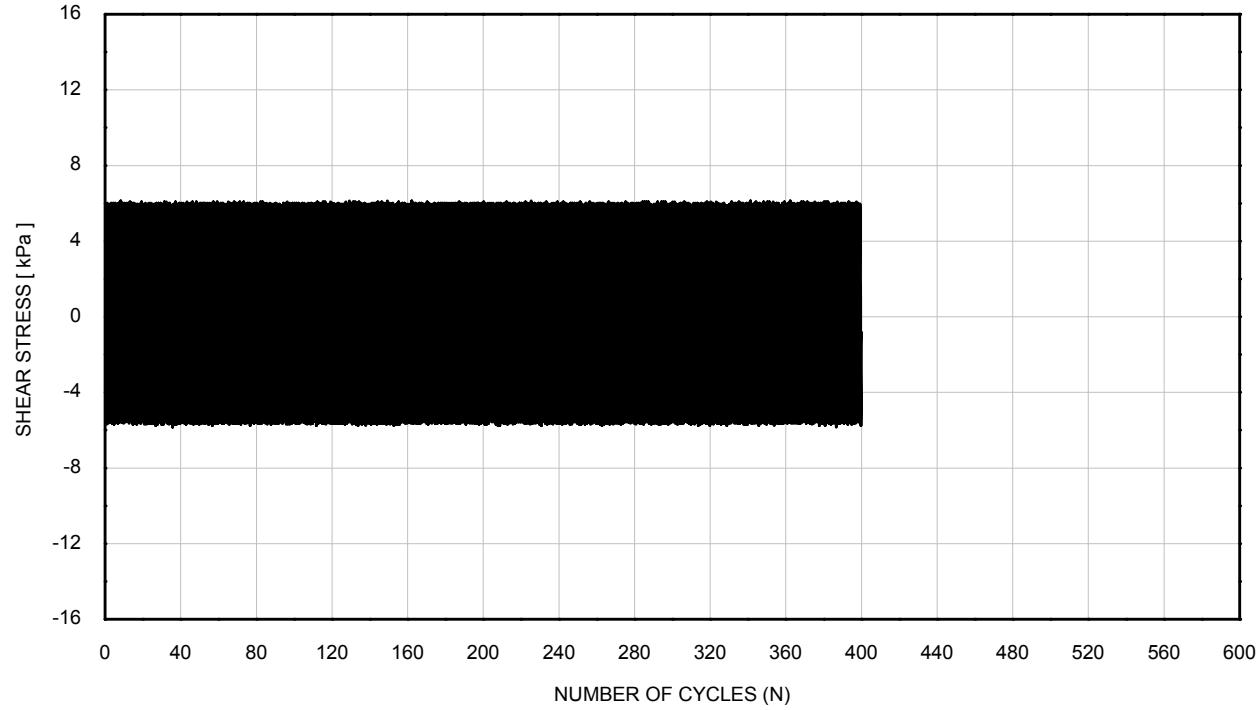
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

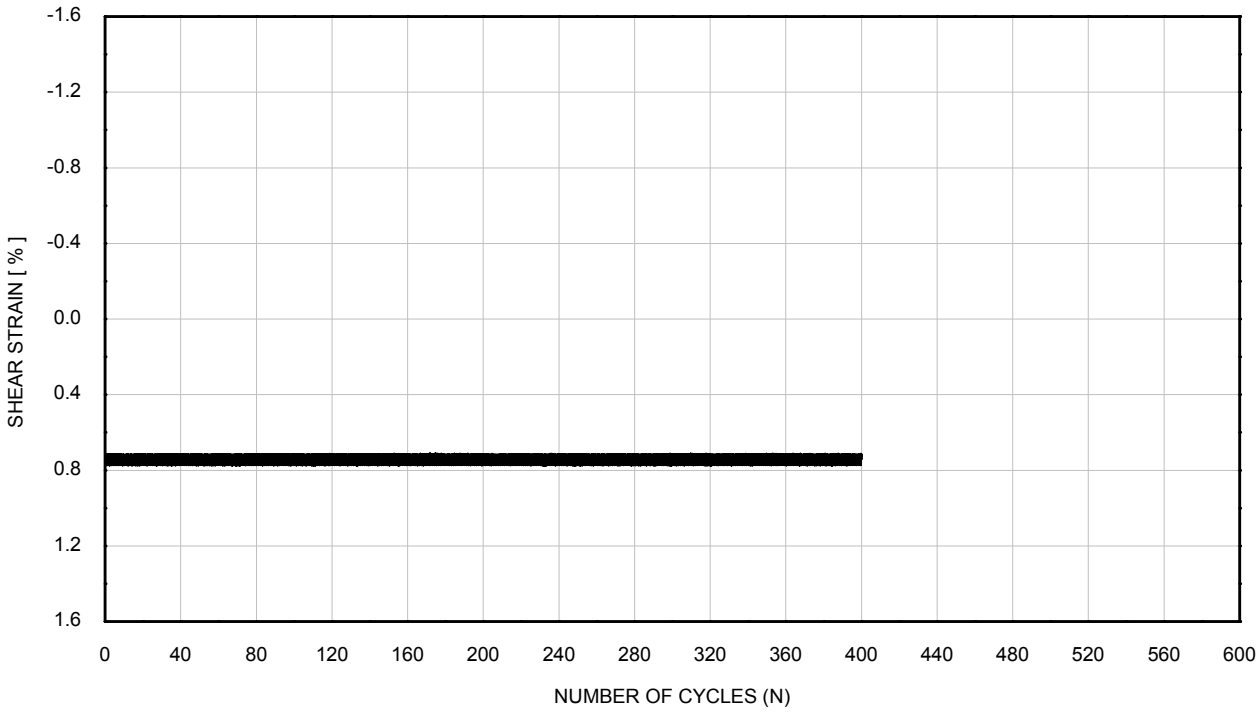




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 15WaxC
		Depth [m]	: 13.01
		Test No.	: CSS12

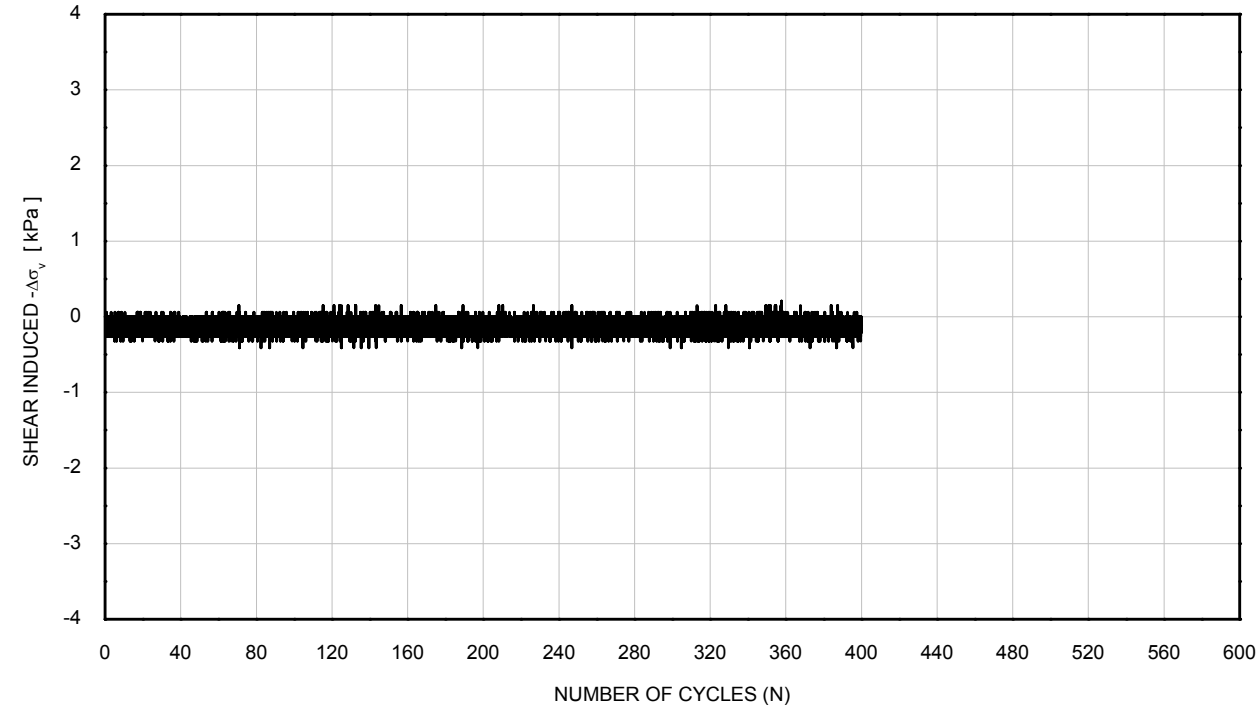
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

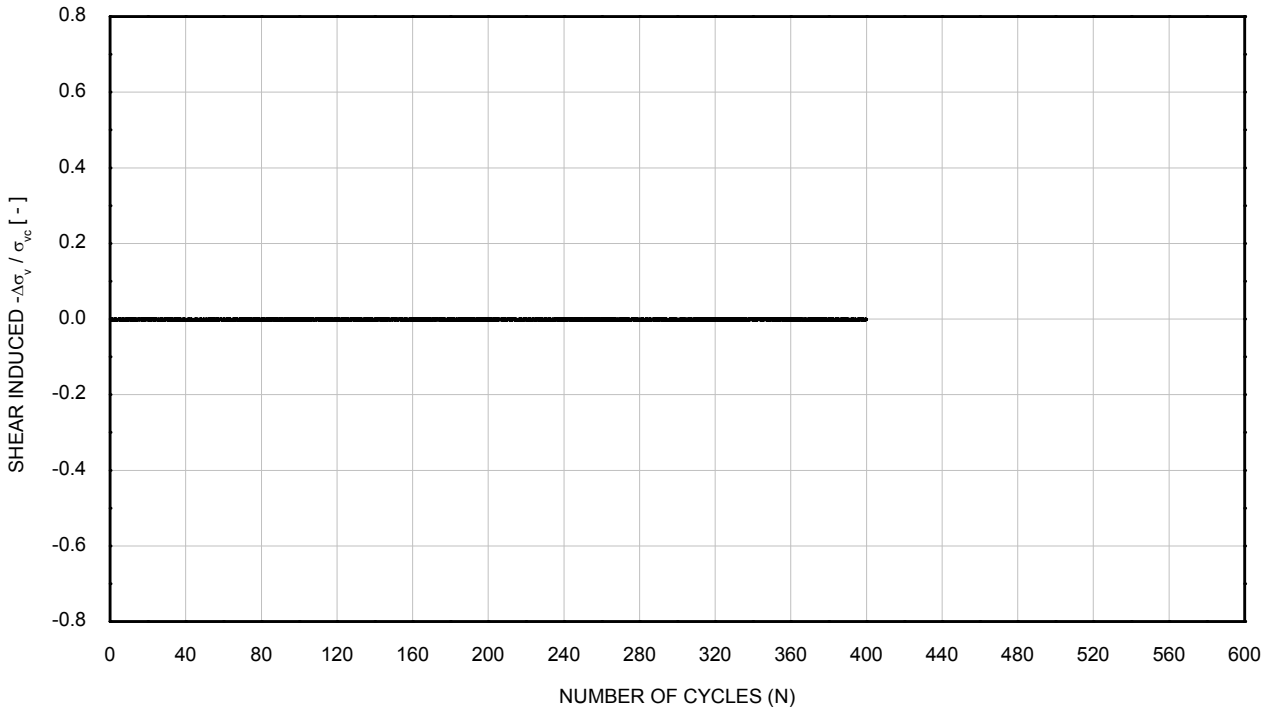




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

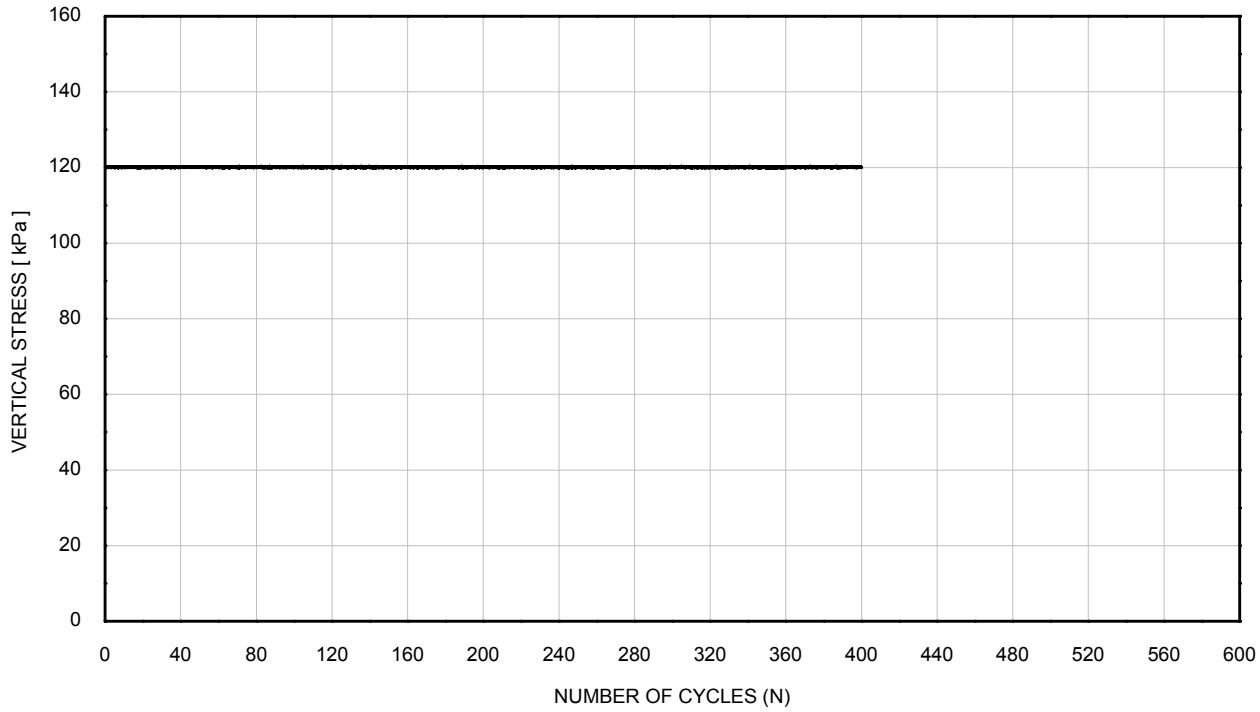
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

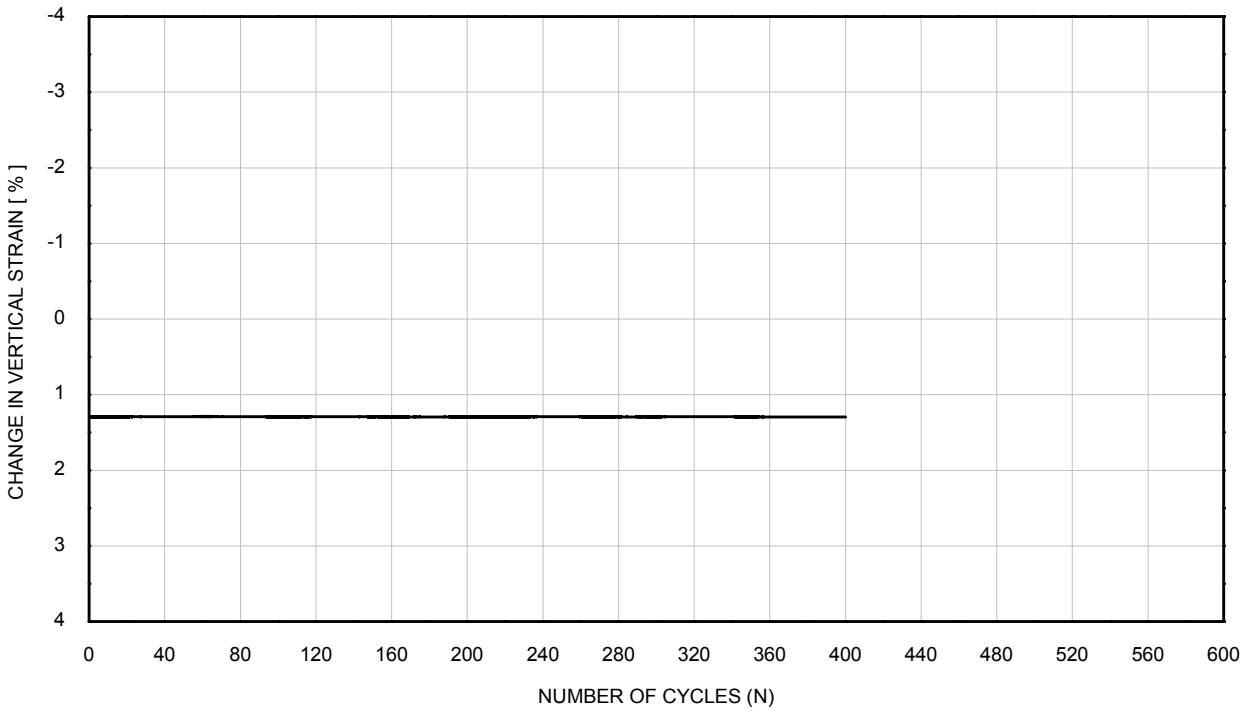




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	: 13.01
Frequency	:	0.10 Hz	Test No.	: CSS12

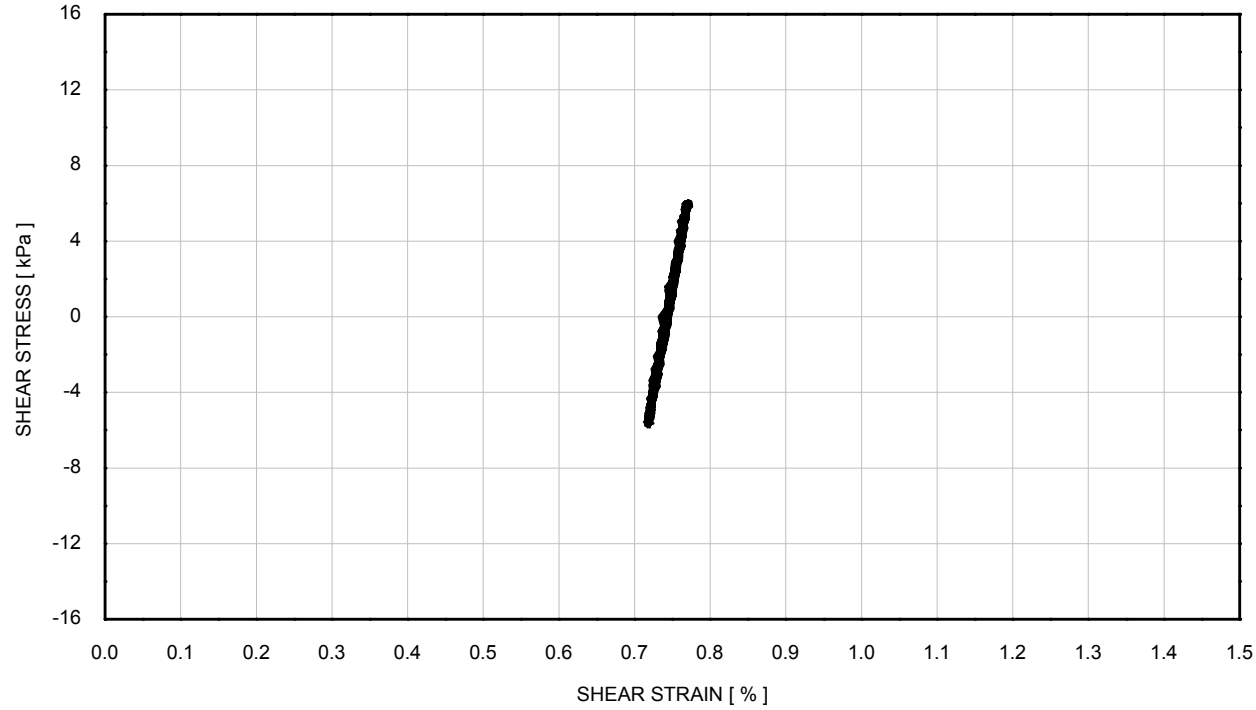
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

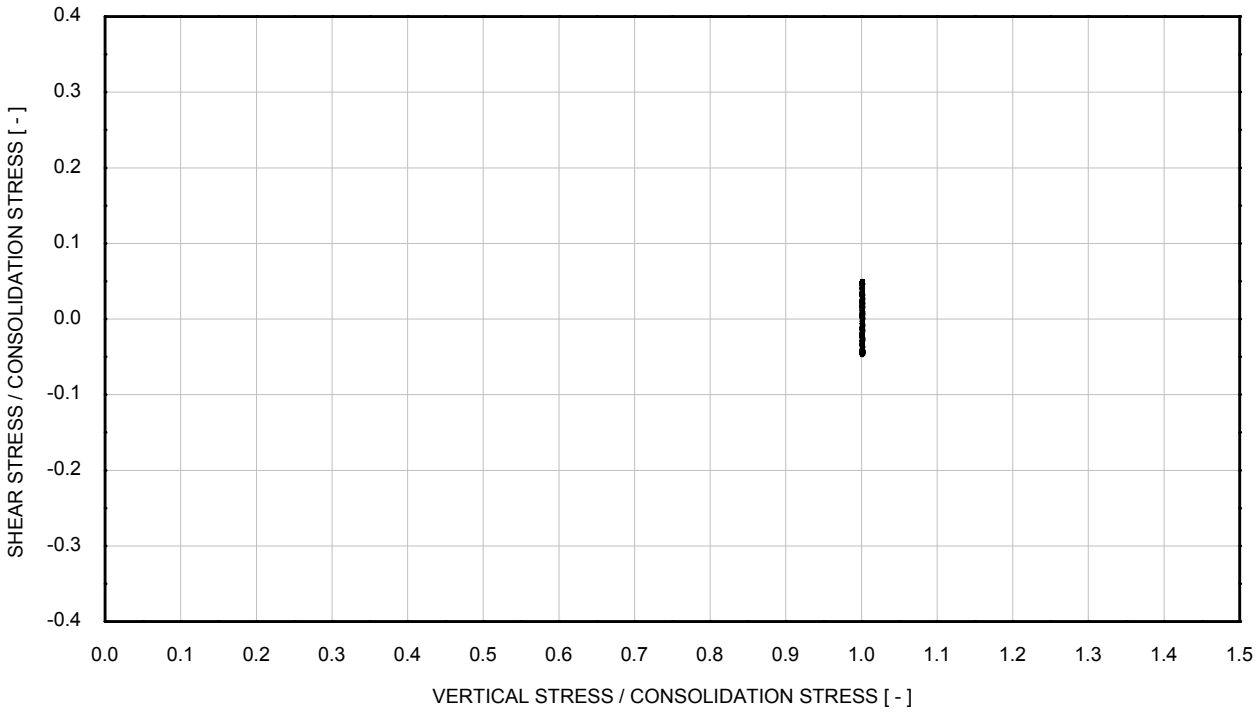




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

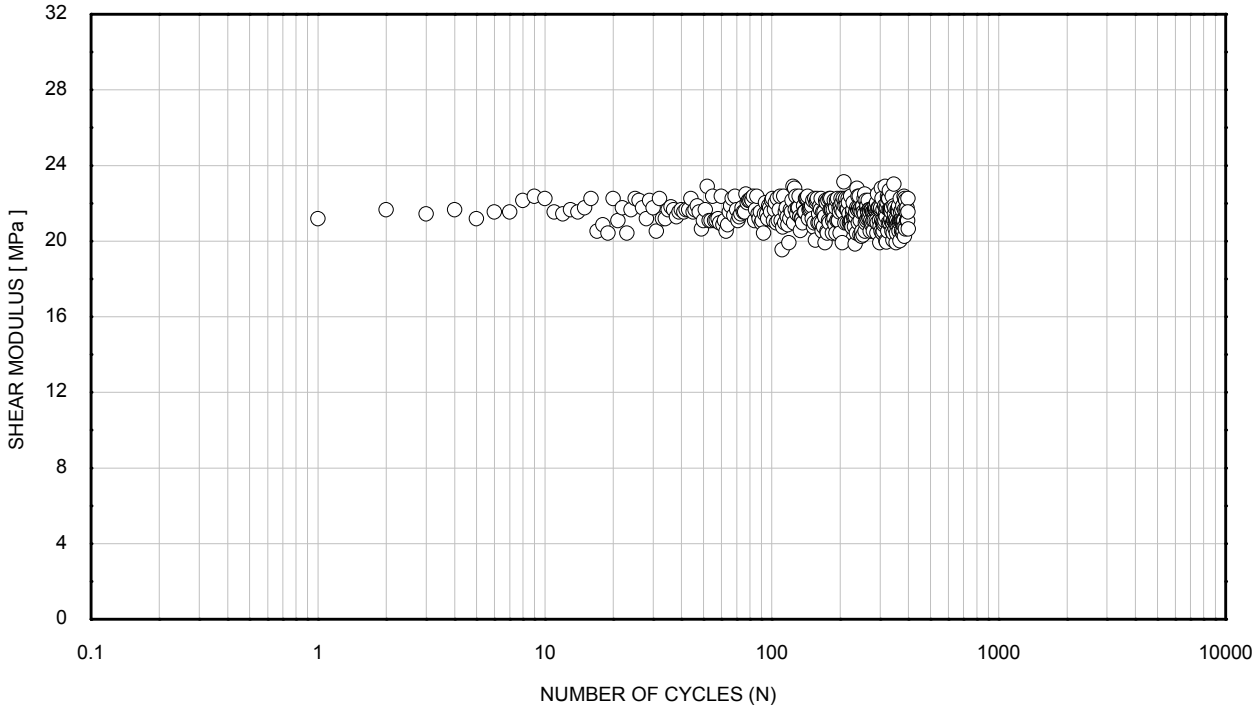
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

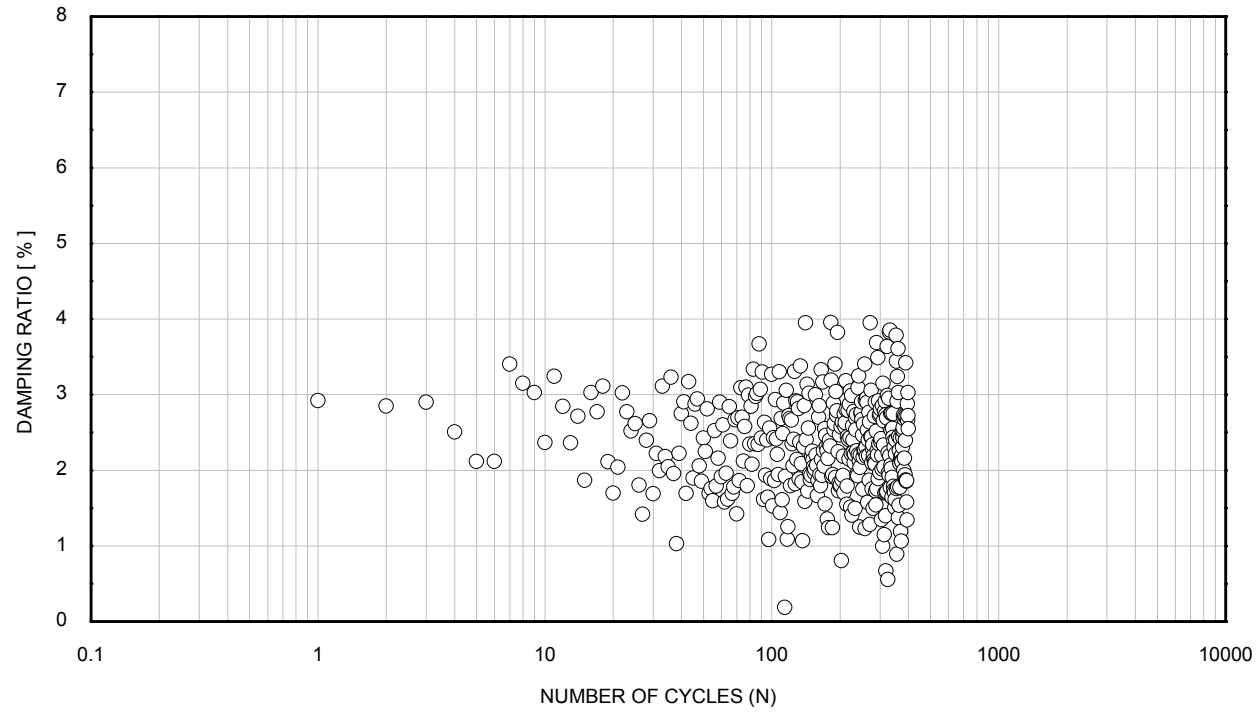




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

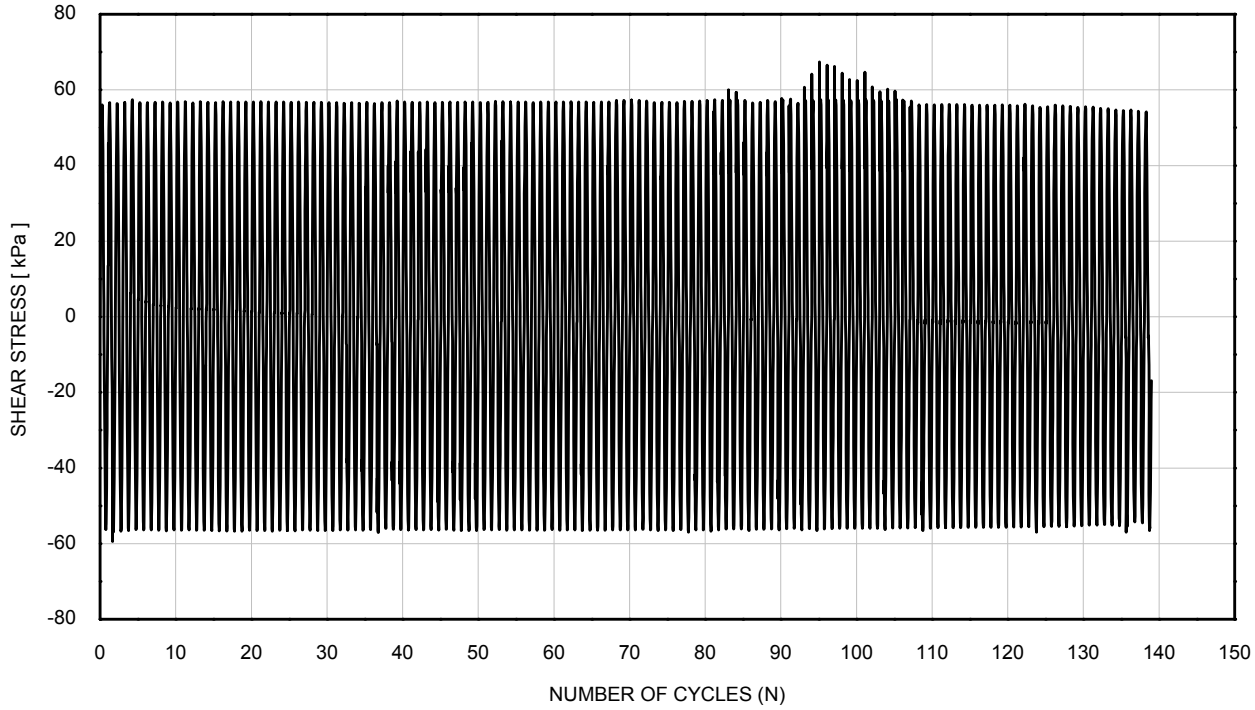
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

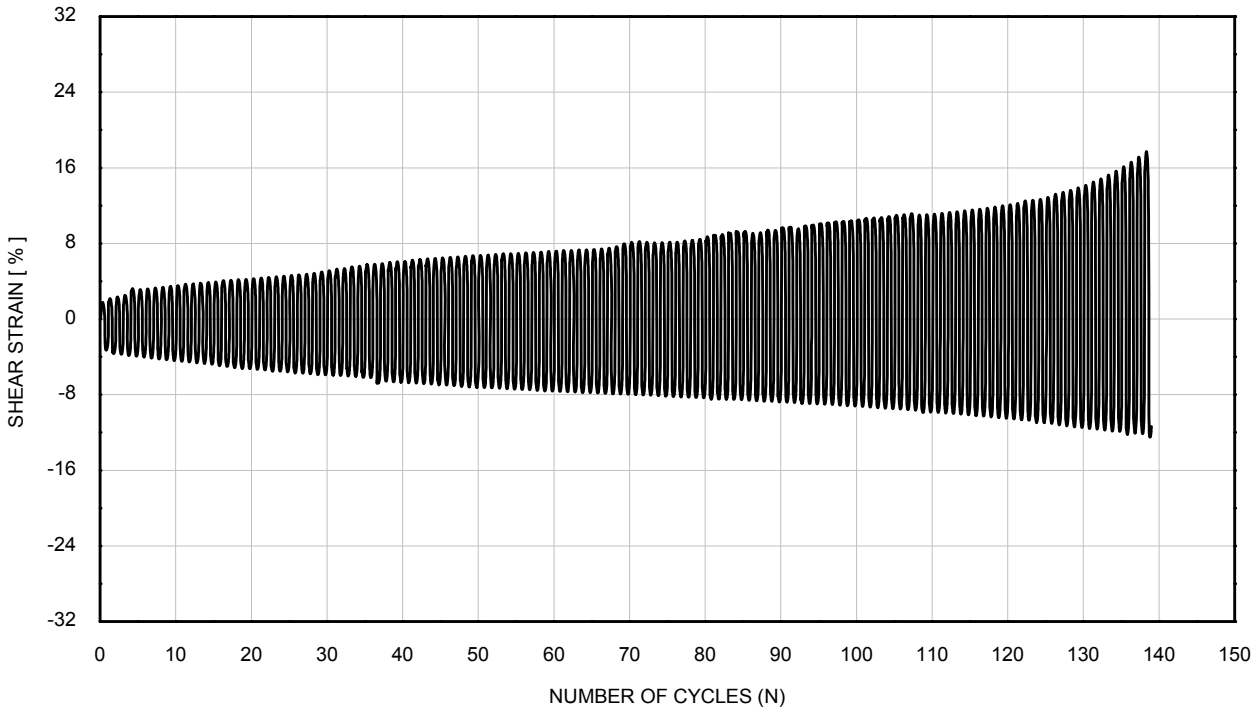




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

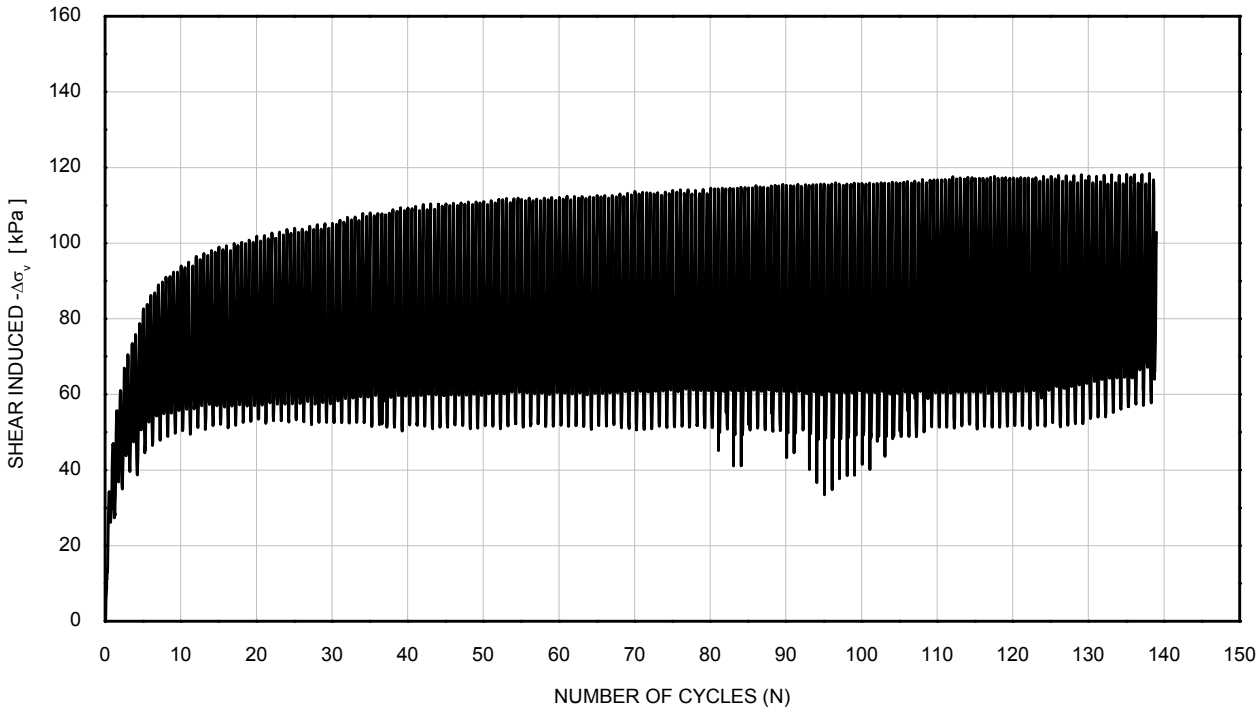
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

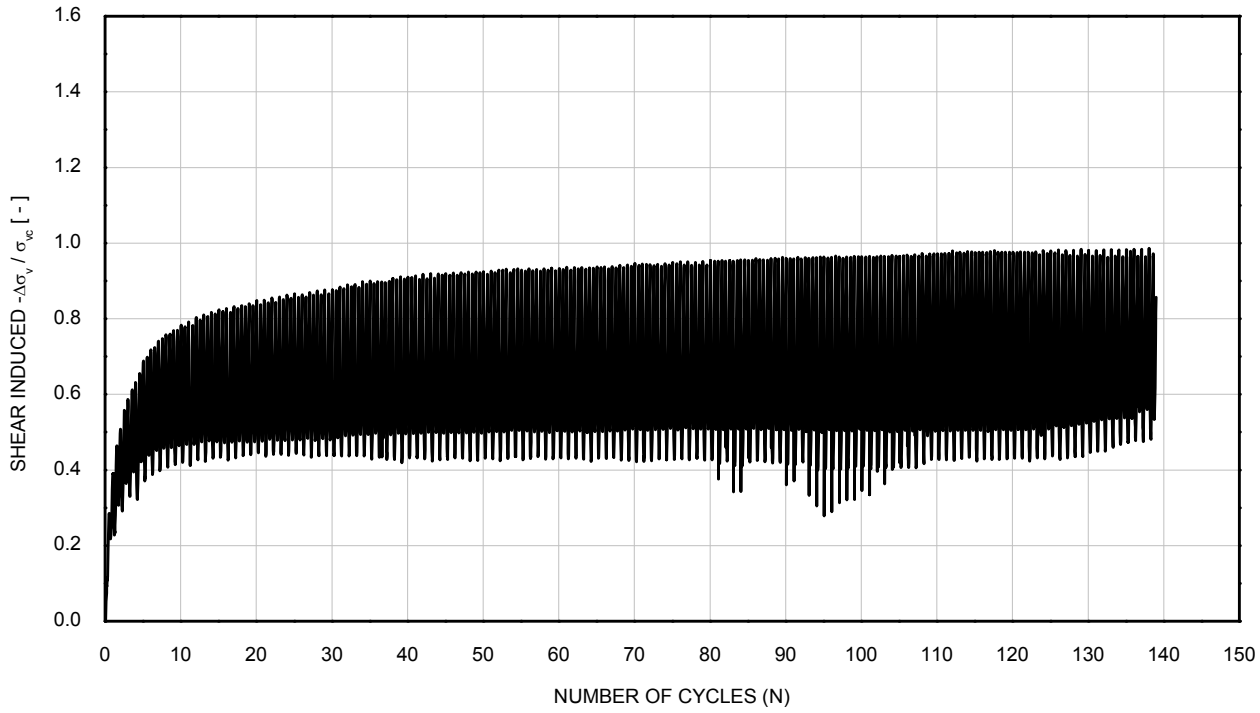




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	57 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

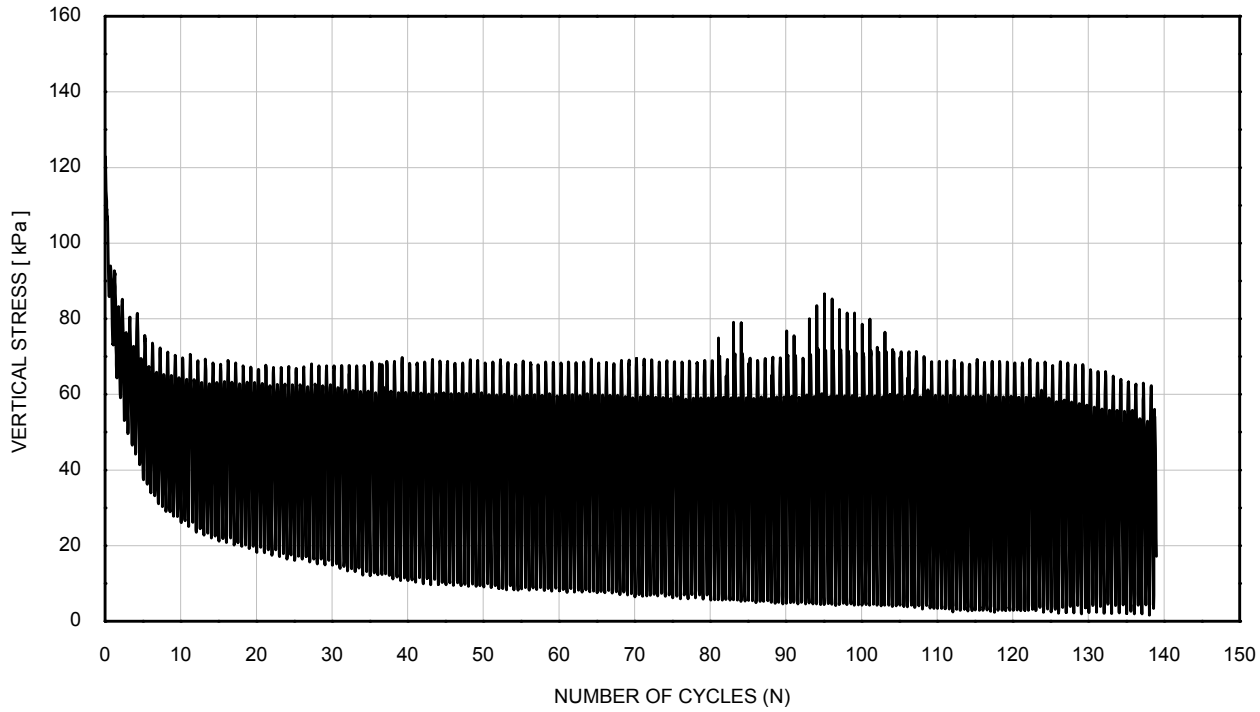
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

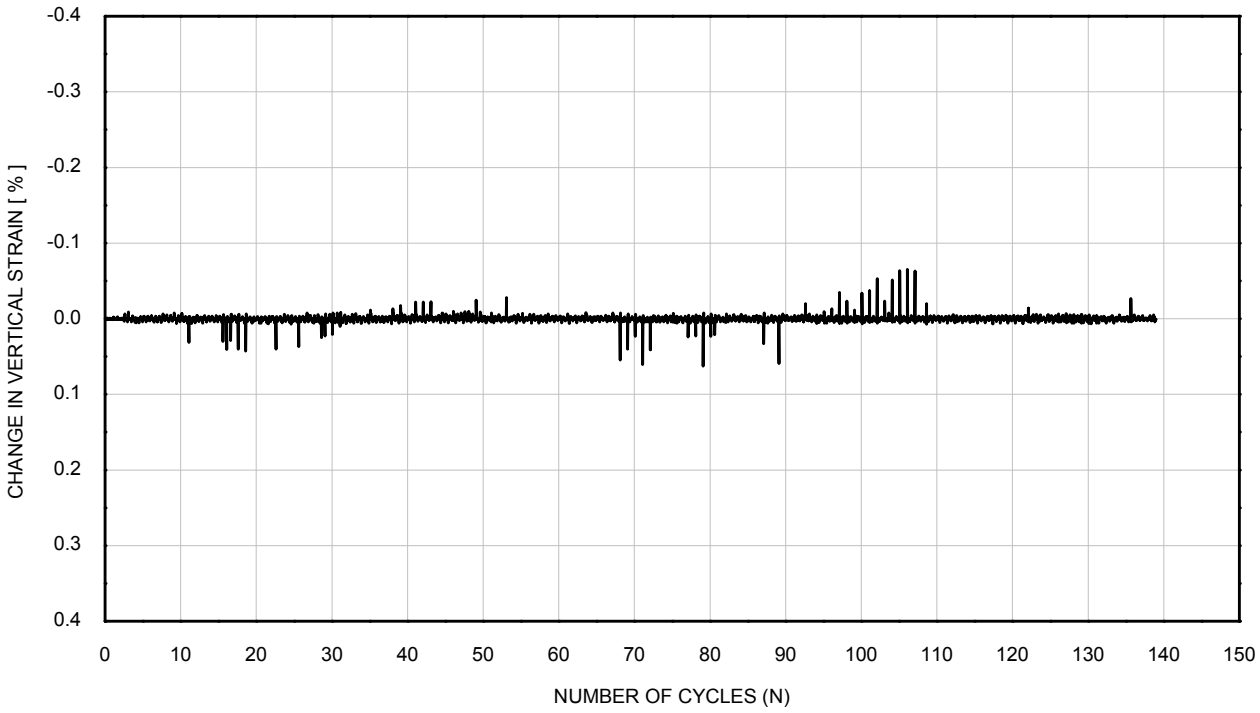




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	57 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

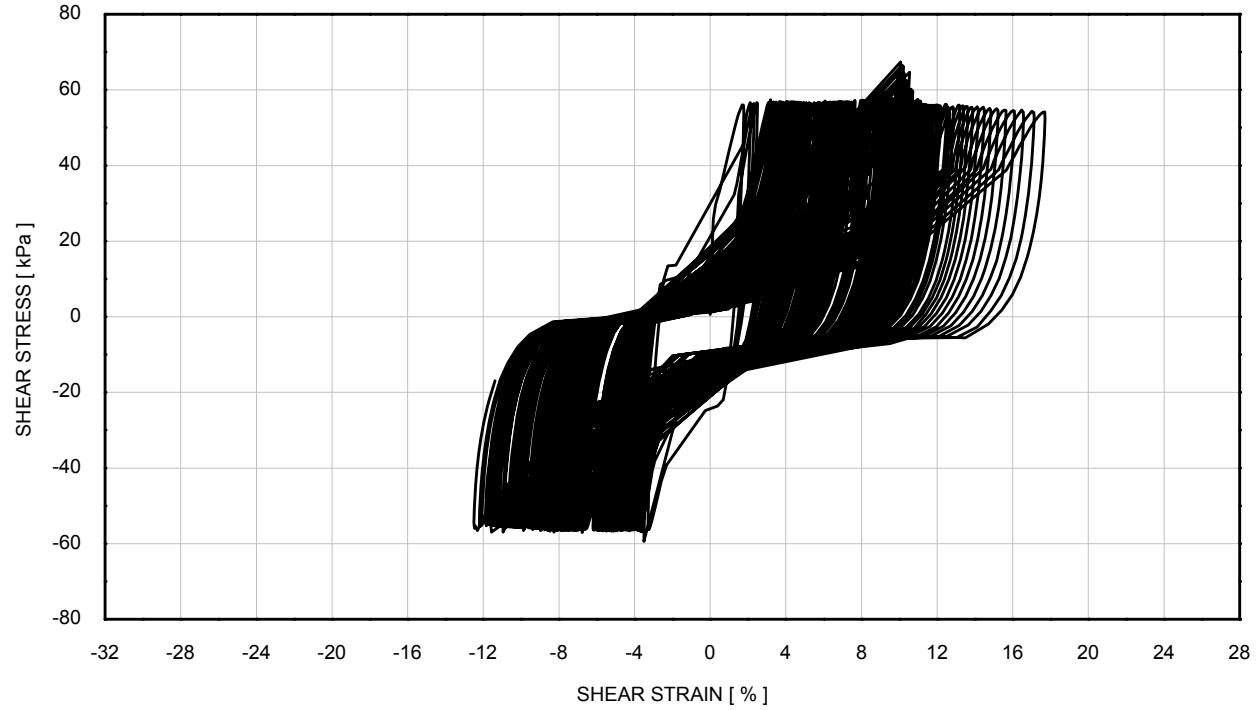
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

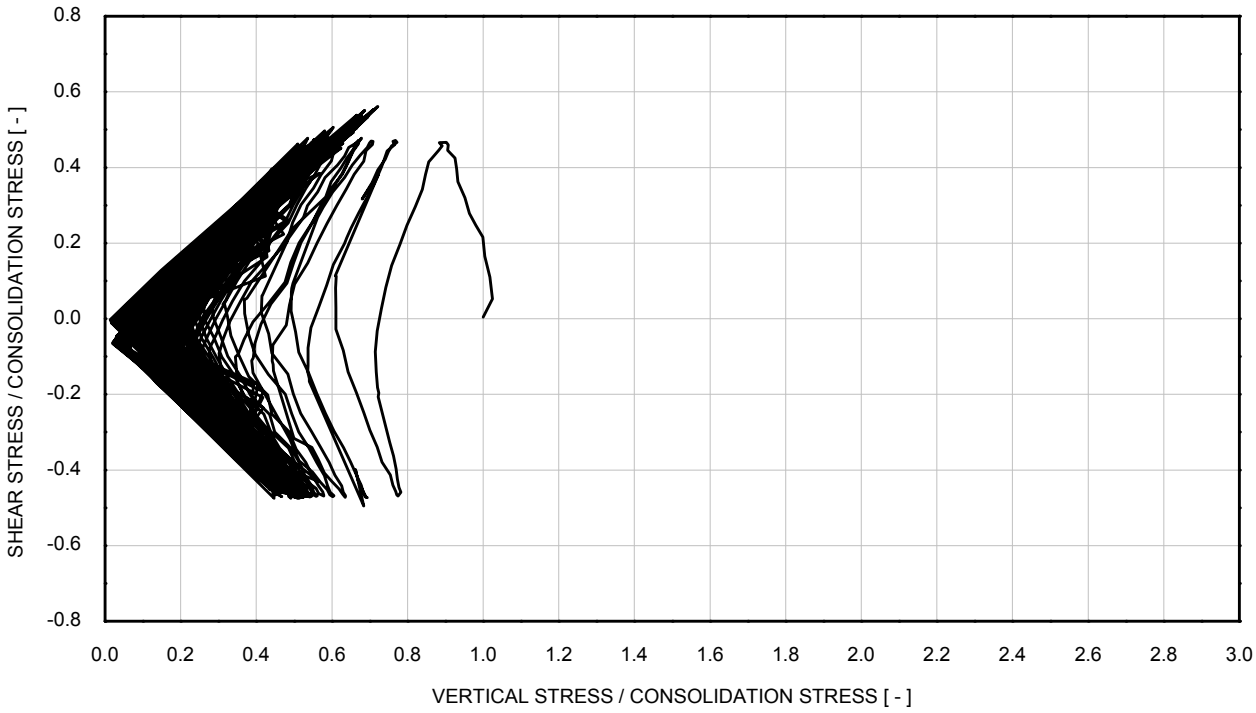




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	57 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

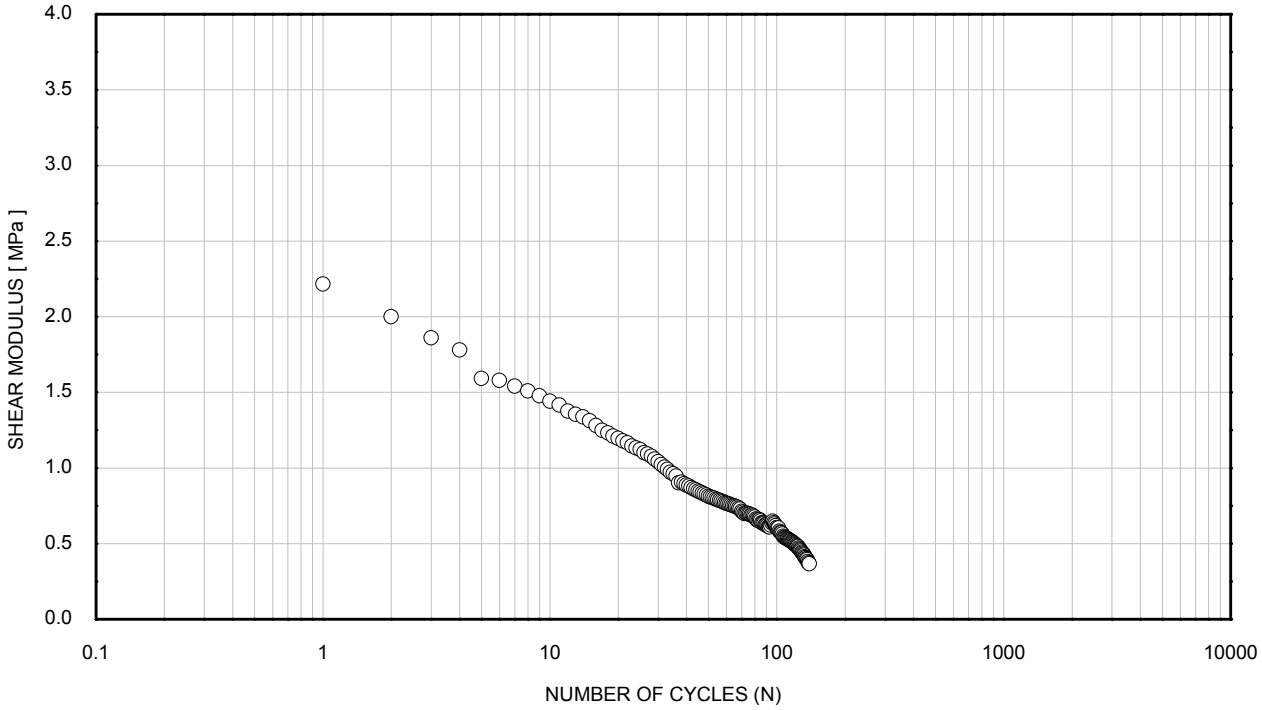
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

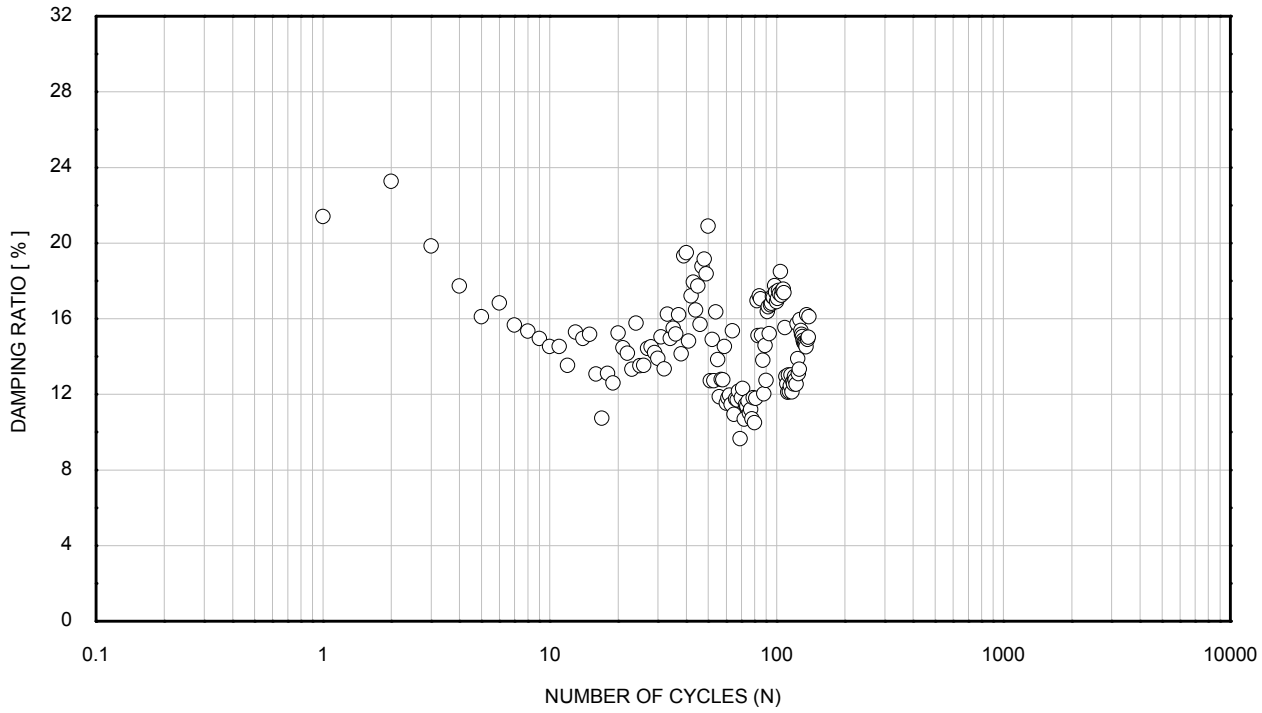




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	57 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

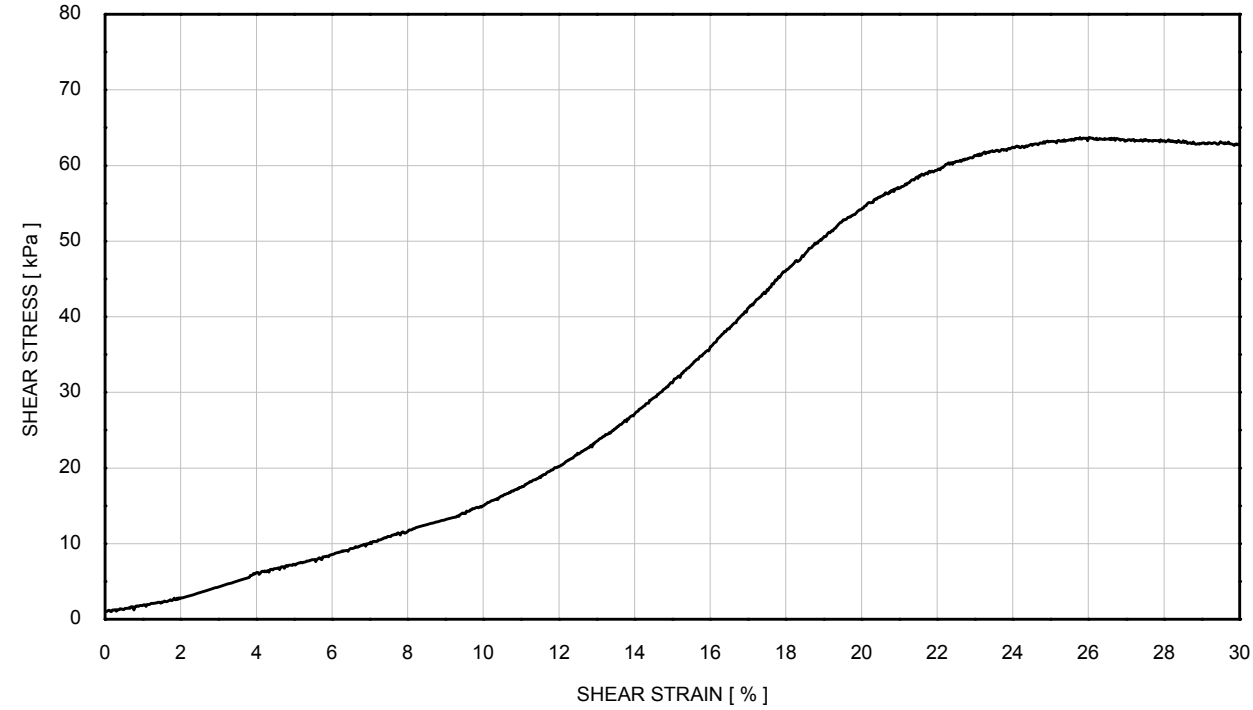
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

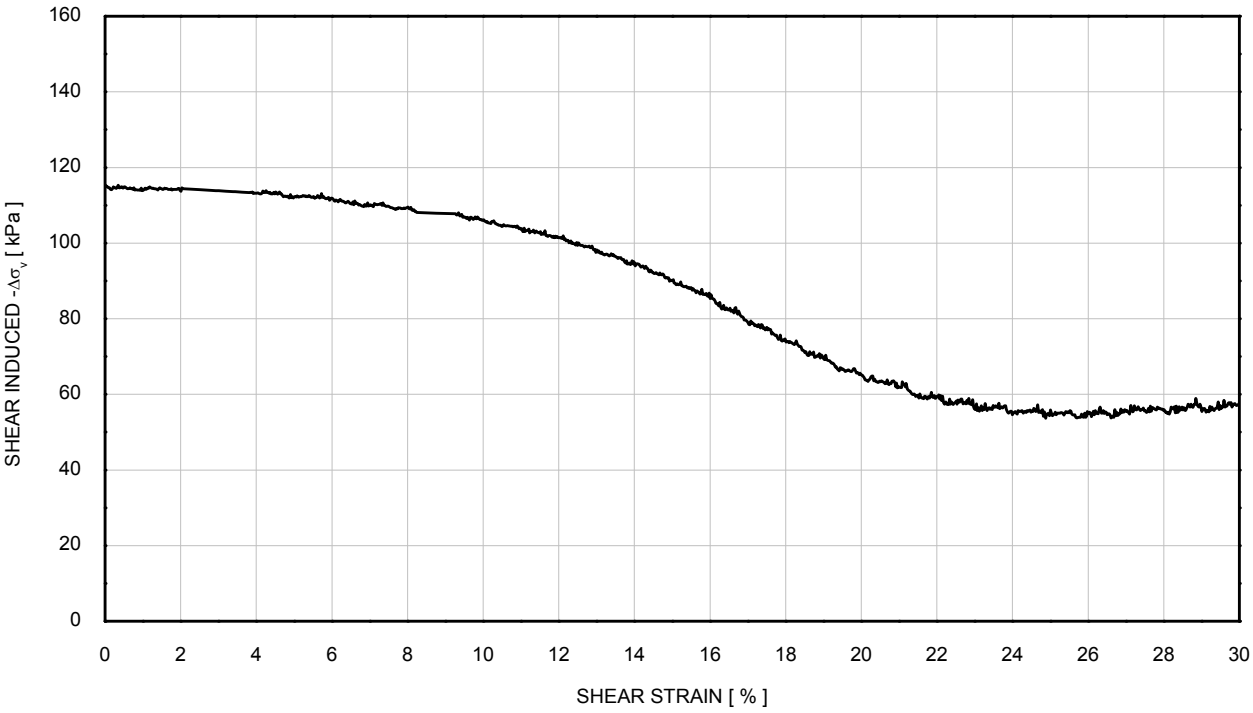




σ_{vc}	:	120 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	15WaxC
Mean τ_{cy}	:	57 kPa	Depth [m]	:	13.01
Frequency	:	0.10 Hz	Test No.	:	CSS12

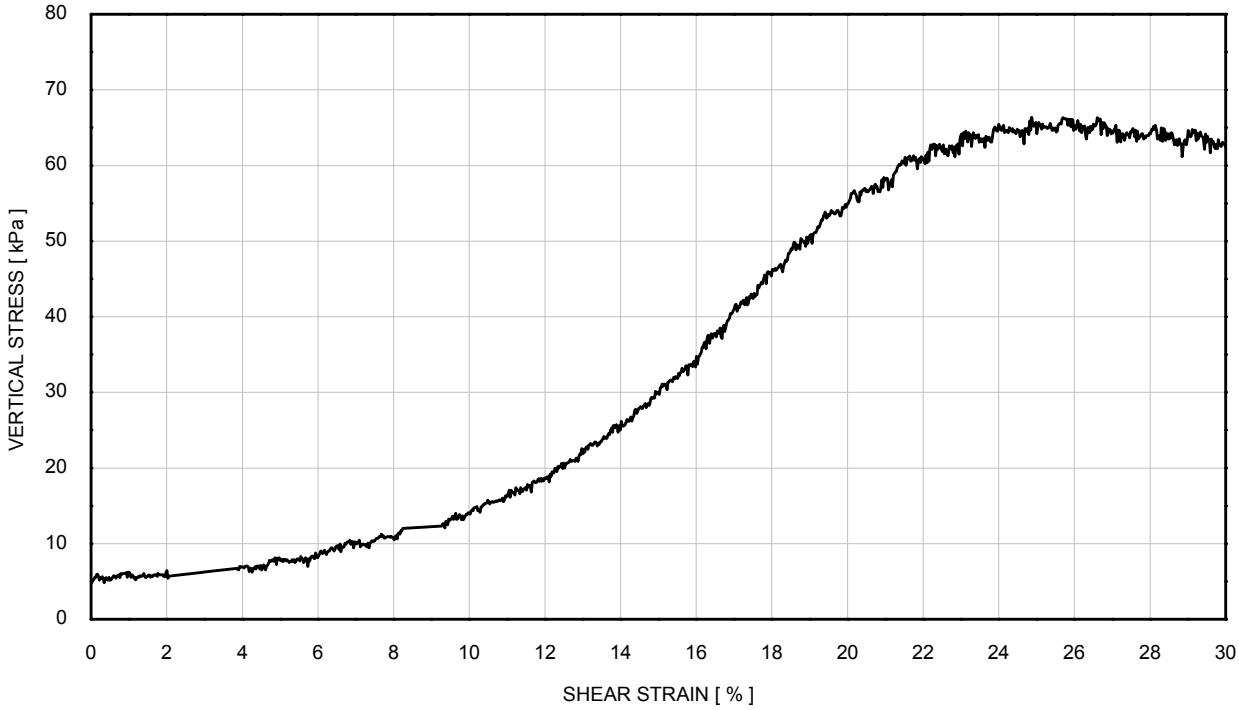
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

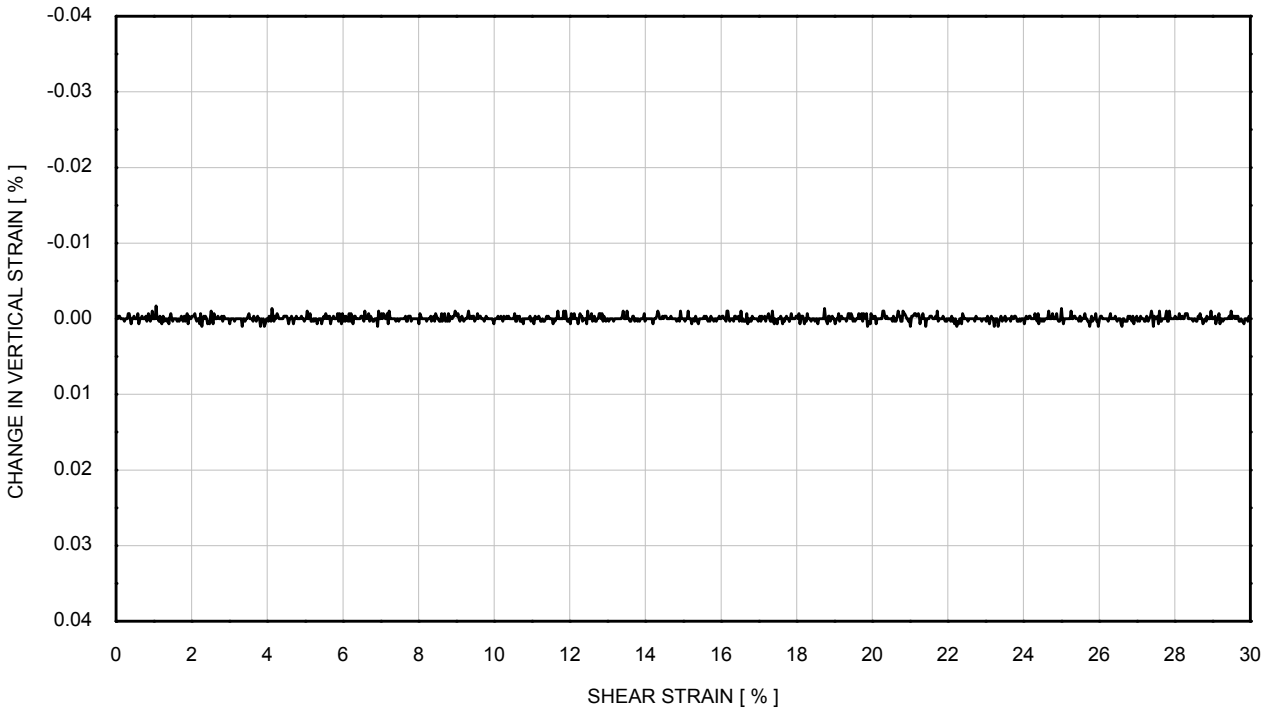




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 64 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 25.78 %	Depth [m]	: 13.01
Rate of strain	: 3.06 %/hour	Test No.	: CSS12

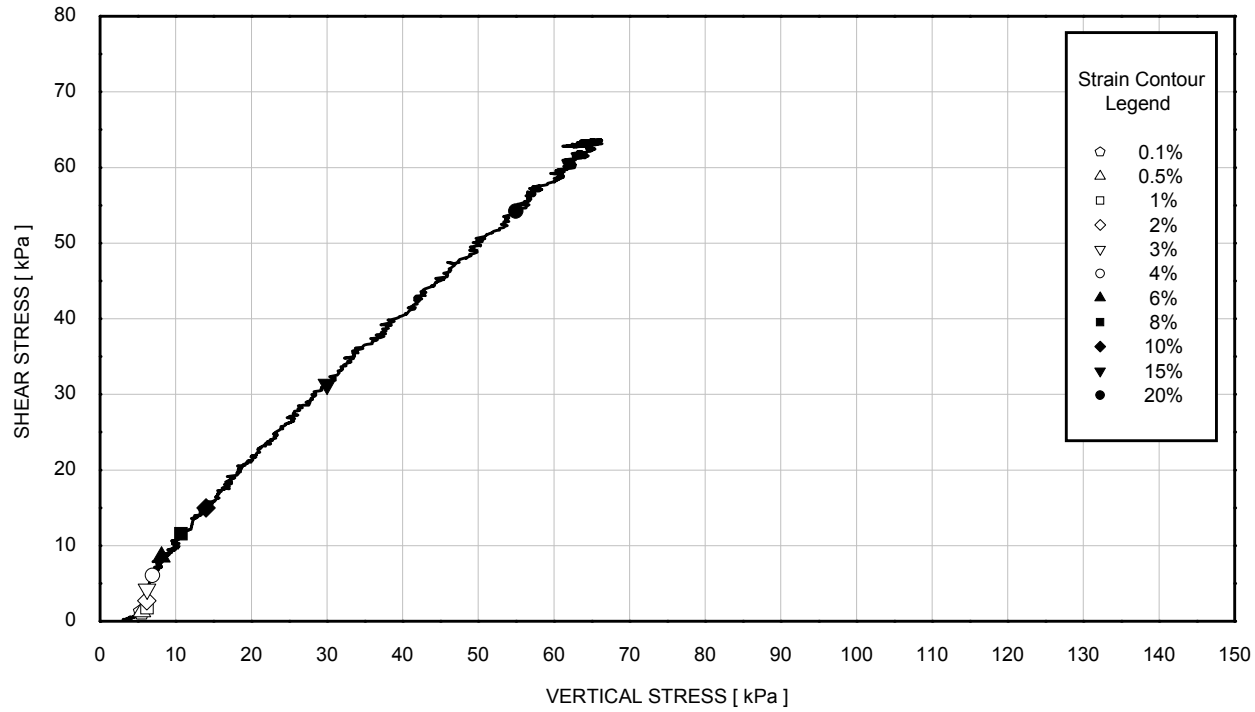
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

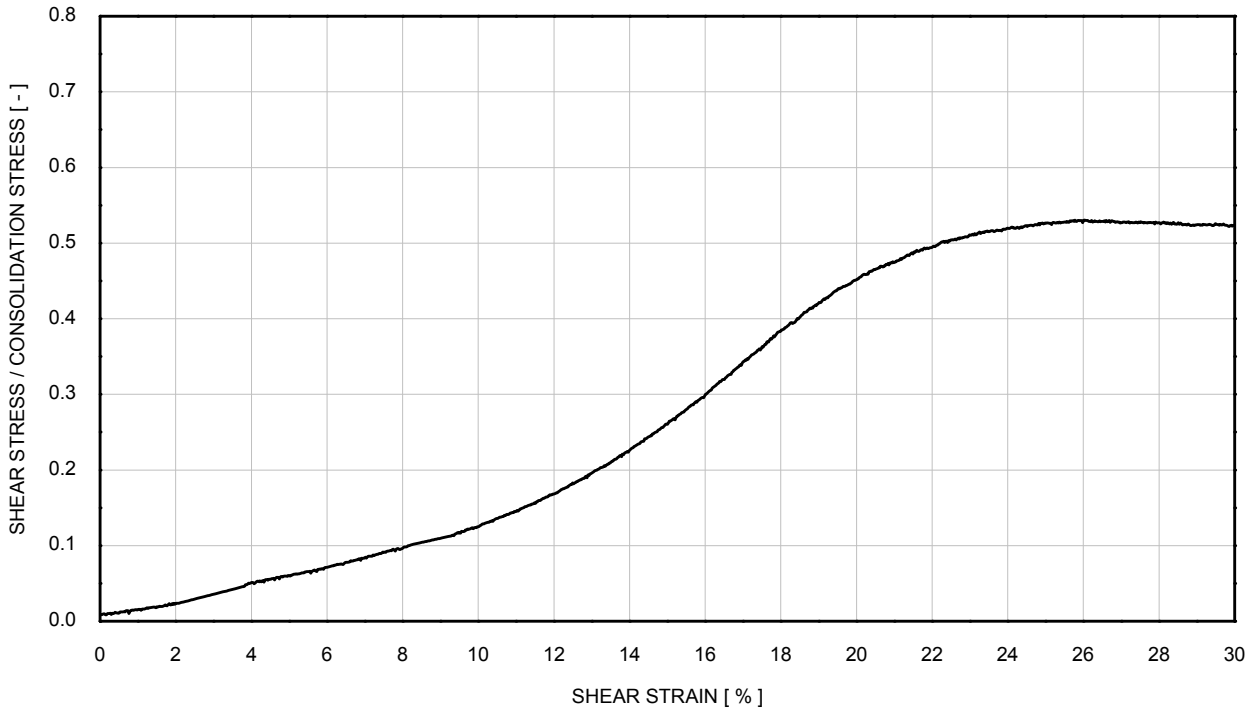




σ_{vc}	: 120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 64 kPa	Sample	: 15WaxC
γ at τ_{peak}	: 25.78 %	Depth [m]	: 13.01
Rate of strain	: 3.06 %/hour	Test No.	: CSS12

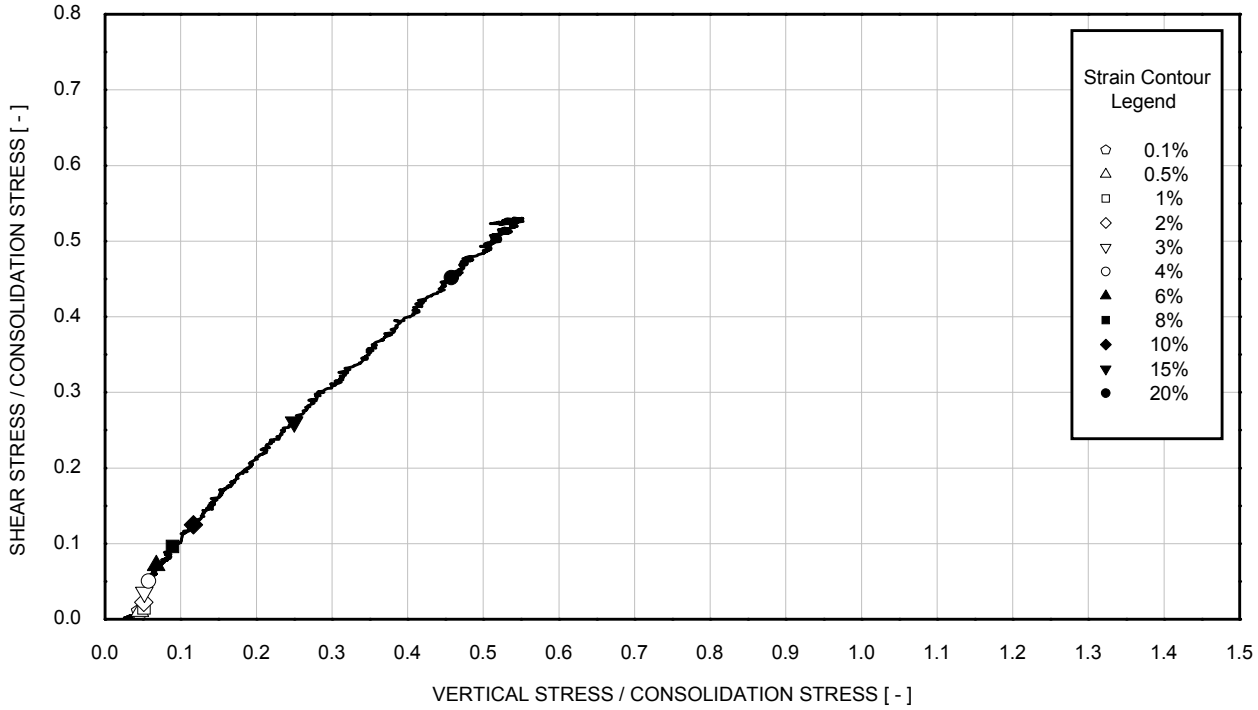
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

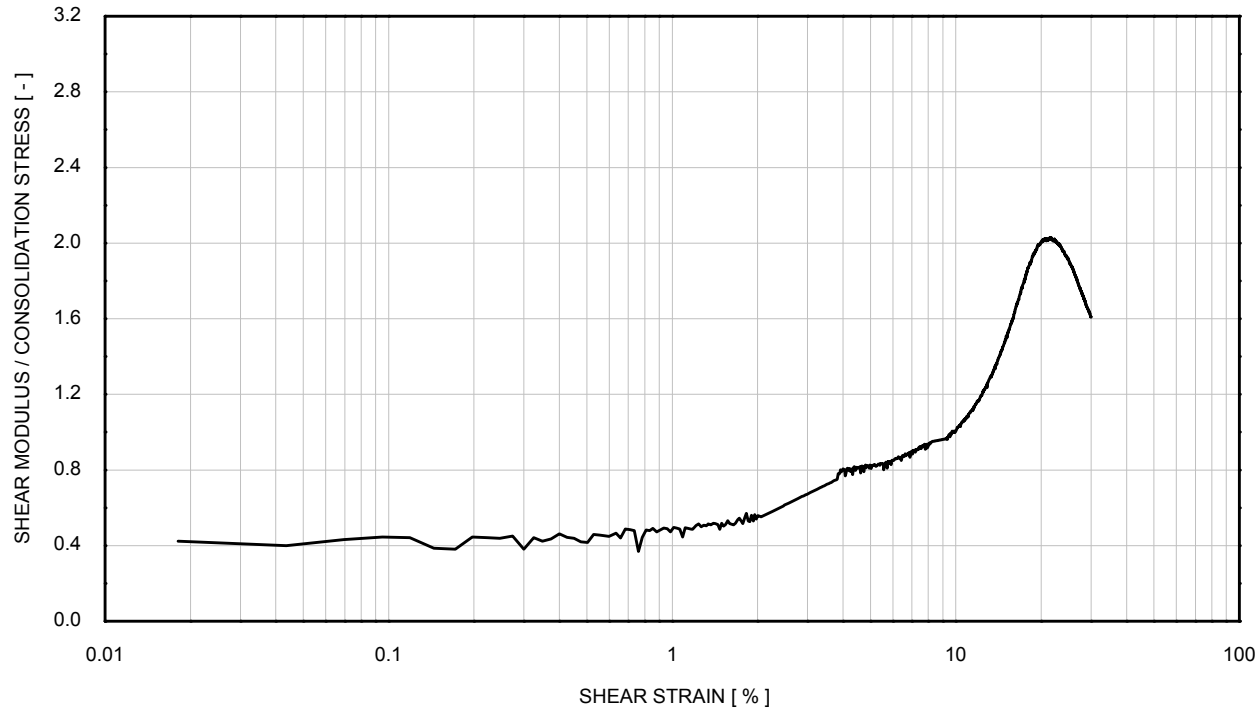




σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	64 kPa	Sample	: 15WaxC
γ at τ_{peak}	:	25.78 %	Depth [m]	: 13.01
Rate of strain	:	3.06 %/hour	Test No.	: CSS12

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	120 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	:	64 kPa	Sample	: 15WaxC
γ at τ_{peak}	:	25.78 %	Depth [m]	: 13.01
Rate of strain	:	3.06 %/hour	Test No.	: CSS12

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive grey silty CLAY

GENERAL	
Date test started	24/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.7
Length	[mm]	29.8
Water content	[%]	25.3
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.697
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH04-SA_CSS13
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 25/11/2016
Approved by Date	PH 25/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.24
Test number	CSS13

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	125
Vertical strain	[%]	0.98
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.61
Void ratio	[-]	0.680
Water content	[%]	24.7

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	125
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	10
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.02
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.61
Void ratio	[-]	0.680

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.40	0.07	14.12	7.49
2	0.40	0.07	14.30	7.22
5	0.40	0.07	14.34	5.79
10	0.40	0.07	14.25	5.76
20	0.39	0.07	14.10	5.74
30	0.39	0.07	13.99	5.18
40	0.39	0.07	14.14	5.87
50	0.39	0.07	14.08	5.57
100	0.39	0.07	13.99	4.40
200	0.39	0.07	13.93	4.53
300	0.38	0.07	13.89	4.88
400	0.38	0.07	13.80	4.62

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.24
Test number	CSS13

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	37
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	86
γ_{av} at N_f	[%]	3.20
γ_{cy} at N_f	[%]	15.01
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	90
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.11	1.91	1.98	31.19
2	-0.05	2.16	1.75	32.17
5	-0.04	2.54	1.50	24.35
10	-0.02	2.87	1.32	21.14
20	0.02	3.35	1.13	18.98
30	0.03	3.74	1.01	15.32
40	0.06	4.17	0.91	13.35
50	0.19	4.72	0.79	13.39
60	0.31	5.62	0.67	12.65
70	0.66	7.20	0.51	13.76
80	1.76	10.81	0.33	16.29
86	3.20	15.01	0.24	18.54

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	48
Shear strain	[%]	30.01
Shear induced $-\Delta\sigma_v$	[kPa]	48
Vertical stress	[kPa]	77
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.02
At 15 % shear strain		
Shear stress	[kPa]	18
Shear induced $-\Delta\sigma_v$	[kPa]	90
Vertical stress	[kPa]	35
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.24
Test number	CSS13

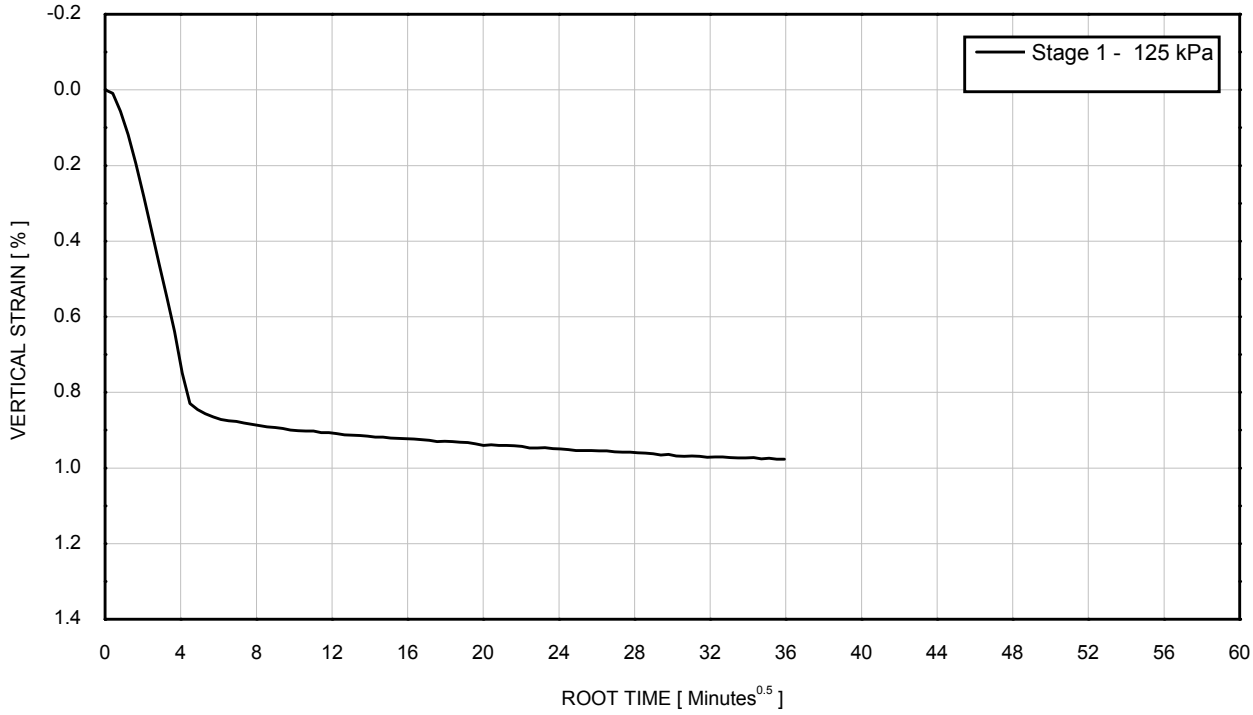
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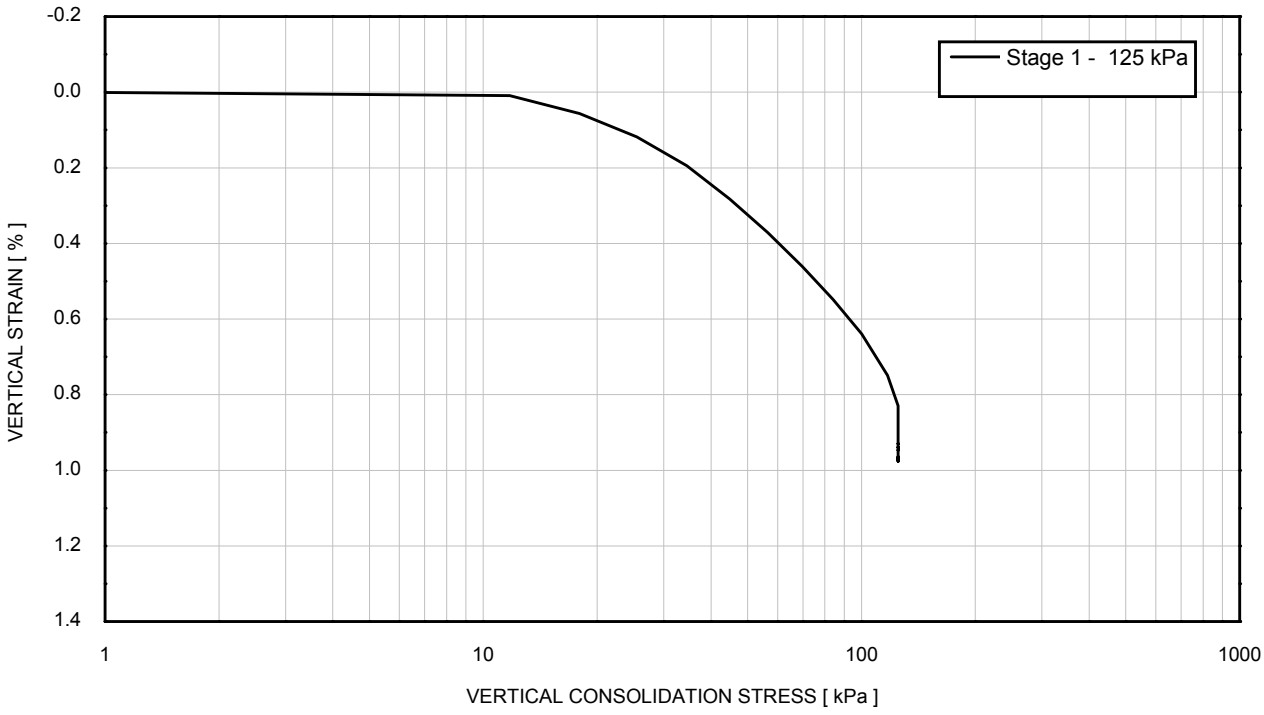
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.24
Test number	CSS13

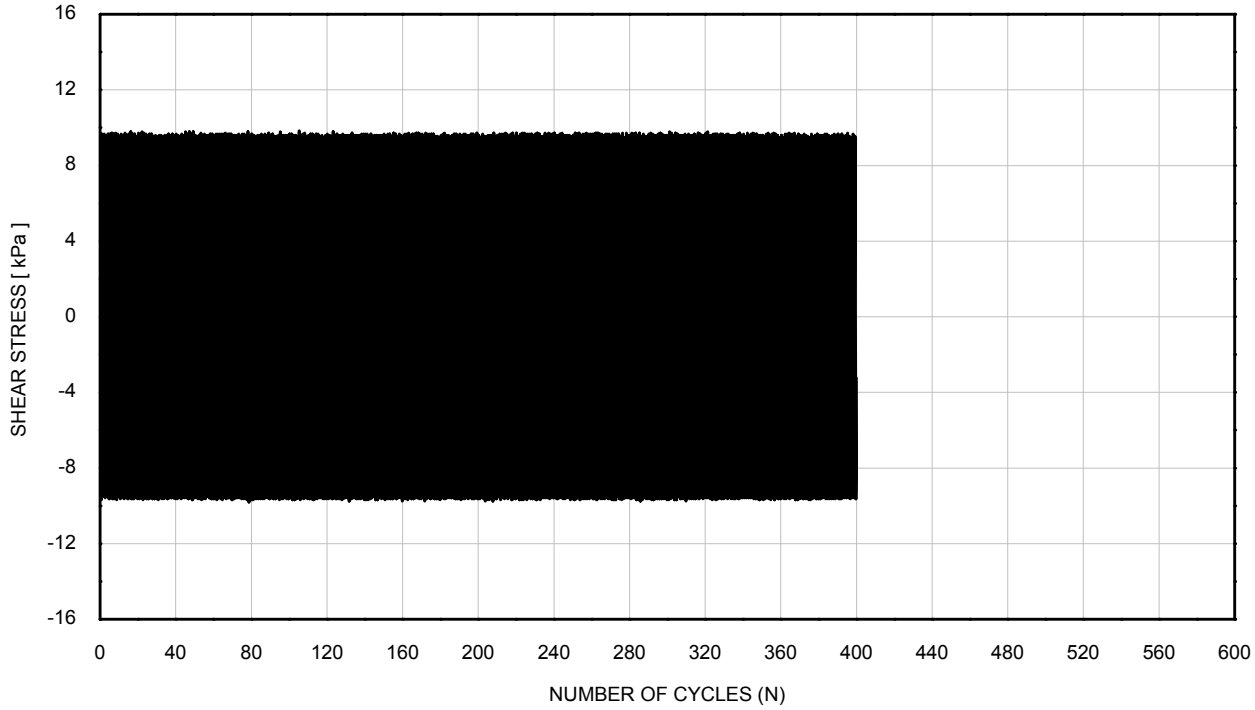
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

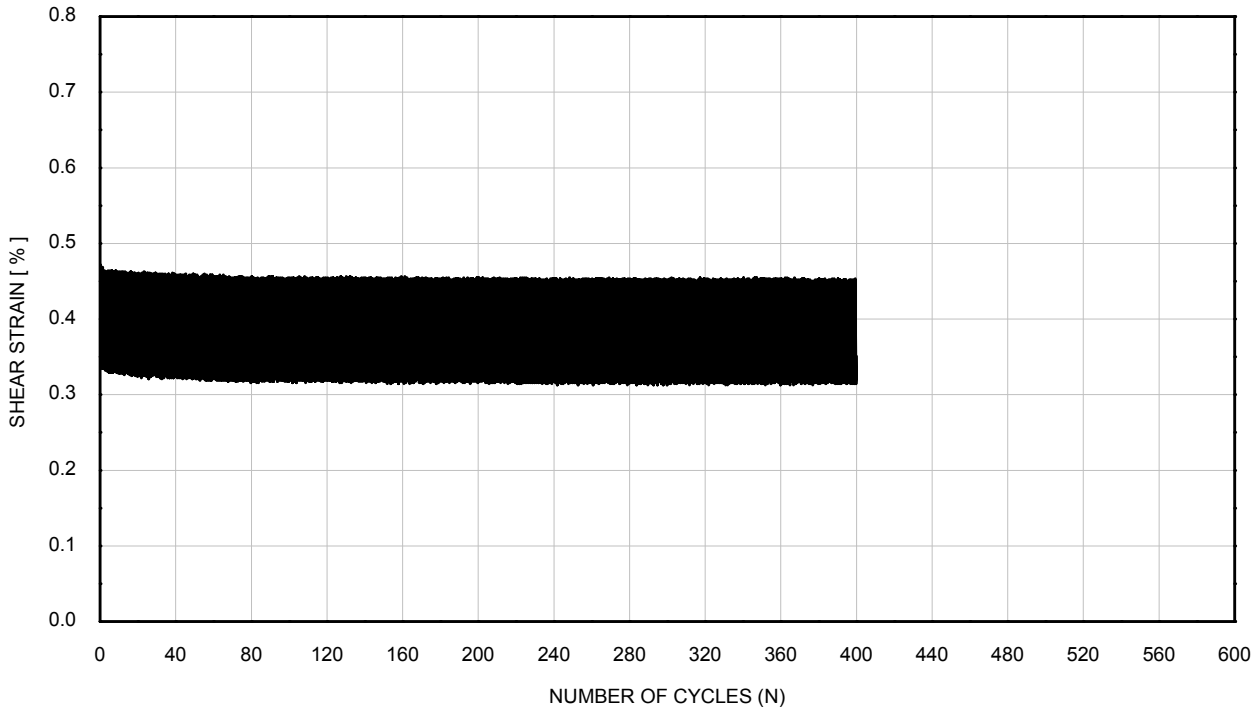




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
		Sample	: 16WaxB
		Depth [m]	: 13.24
		Test No.	: CSS13

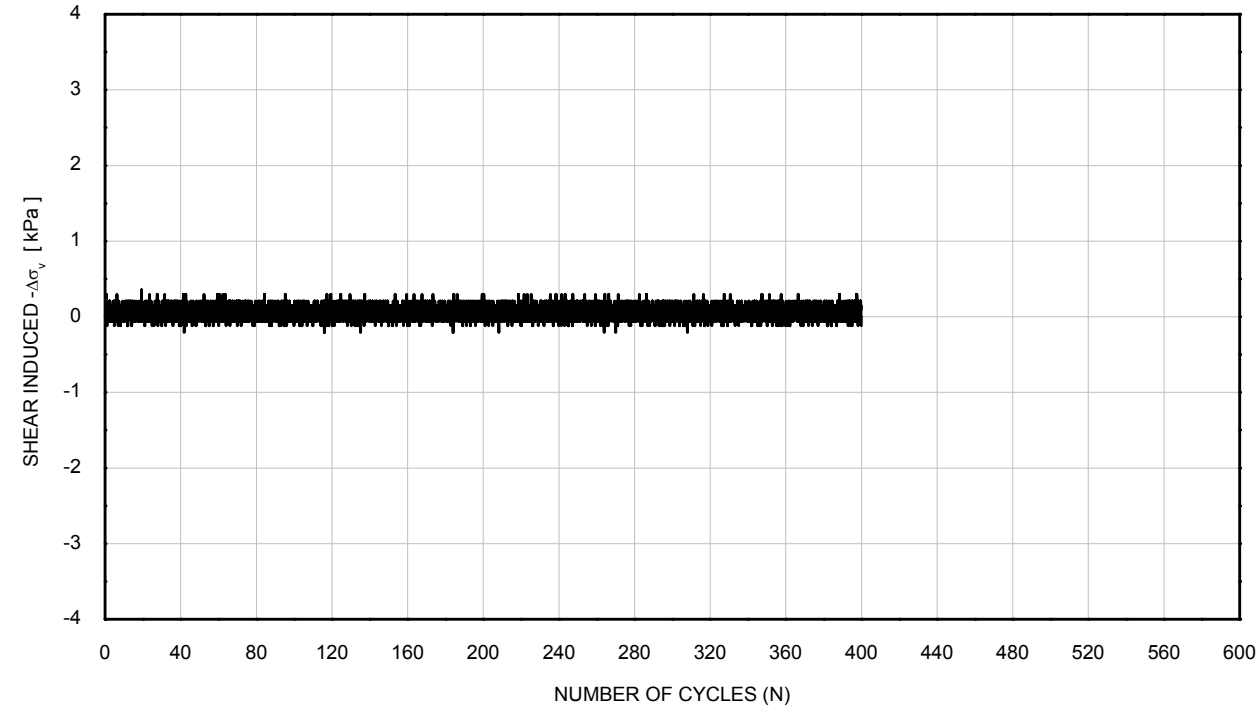
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

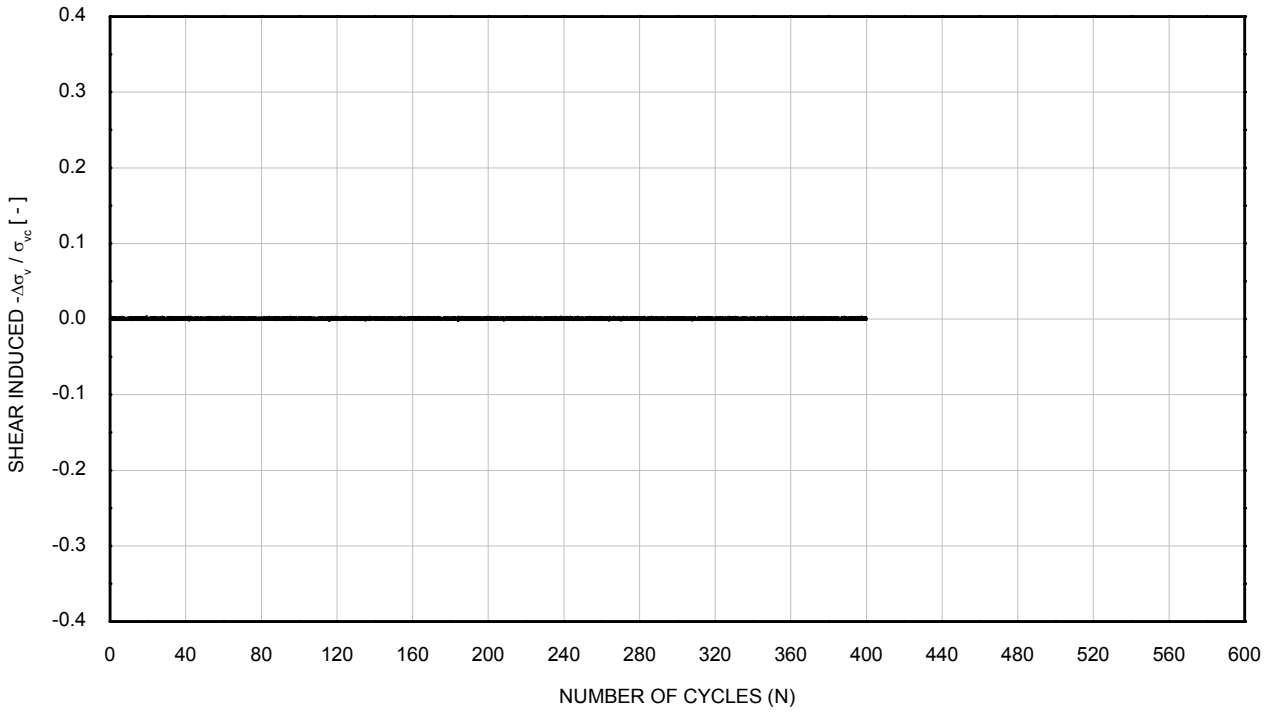




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	10 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

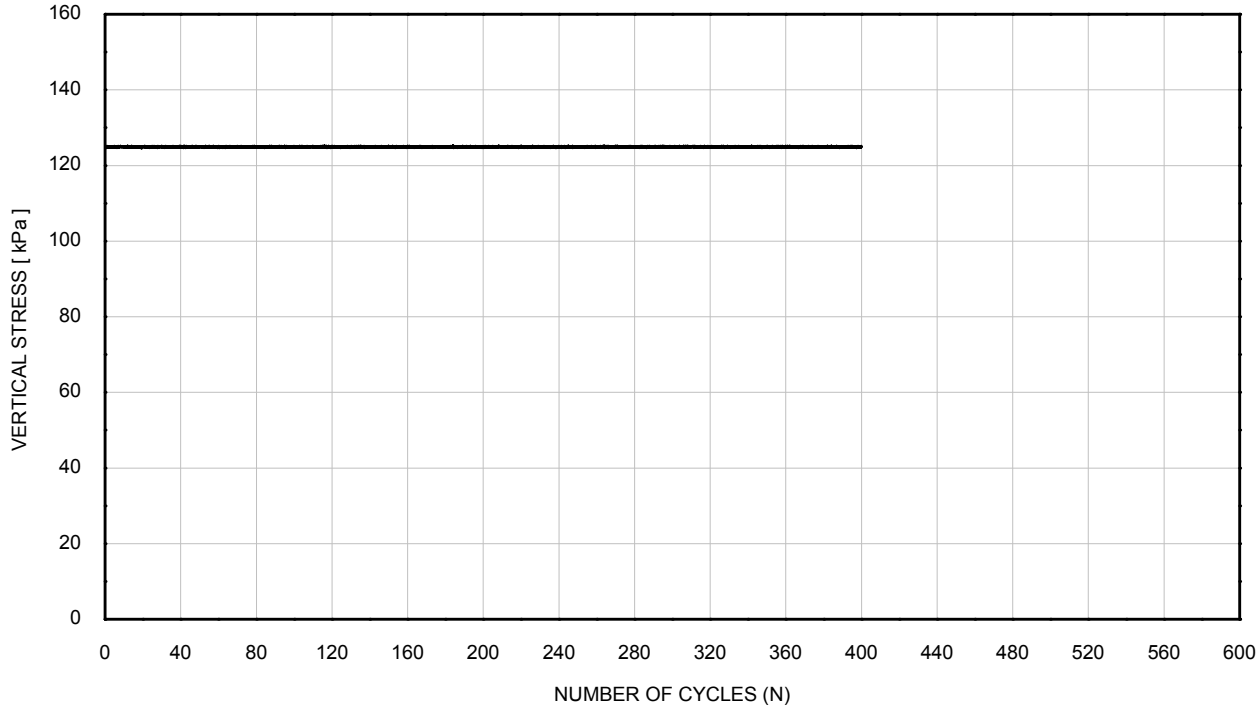
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

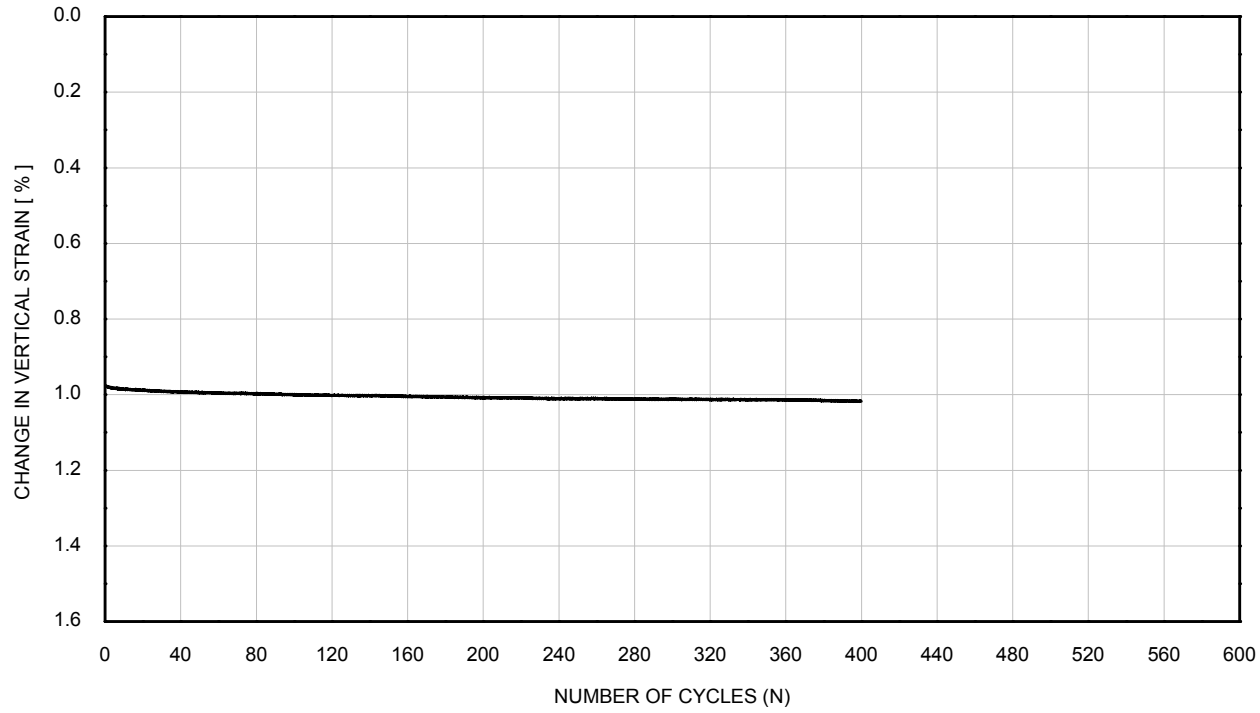




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	10 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

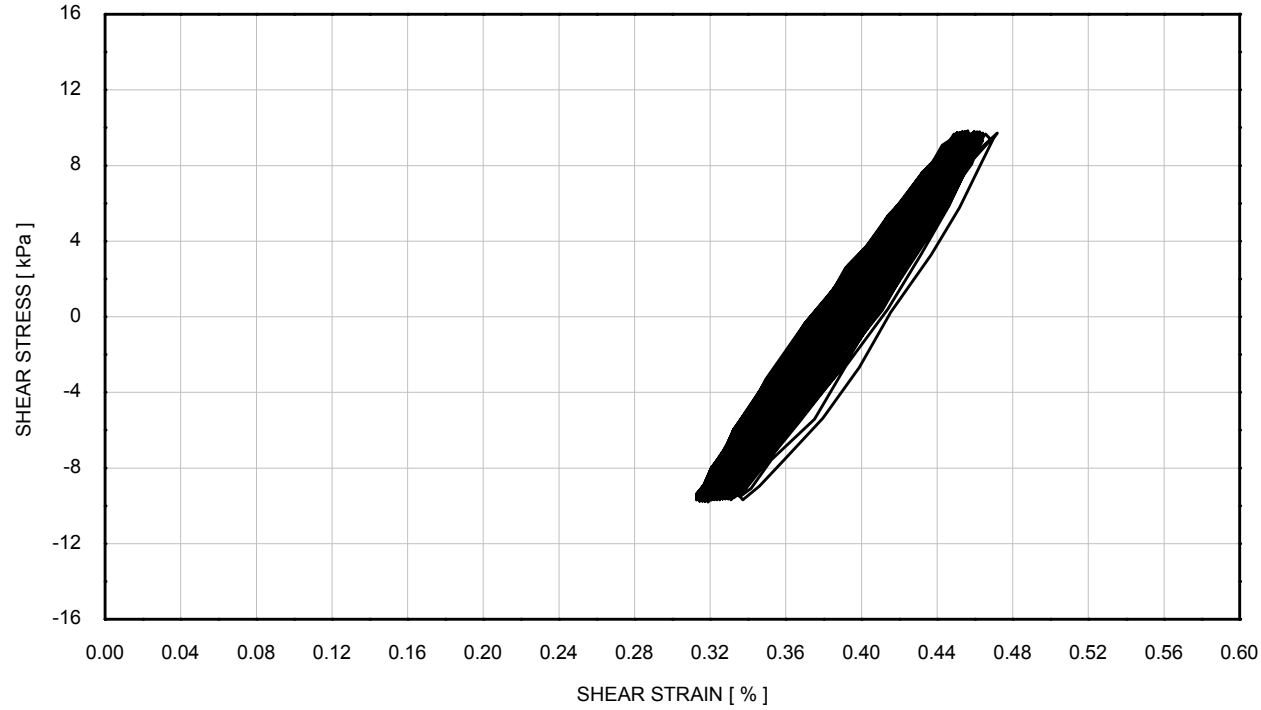
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

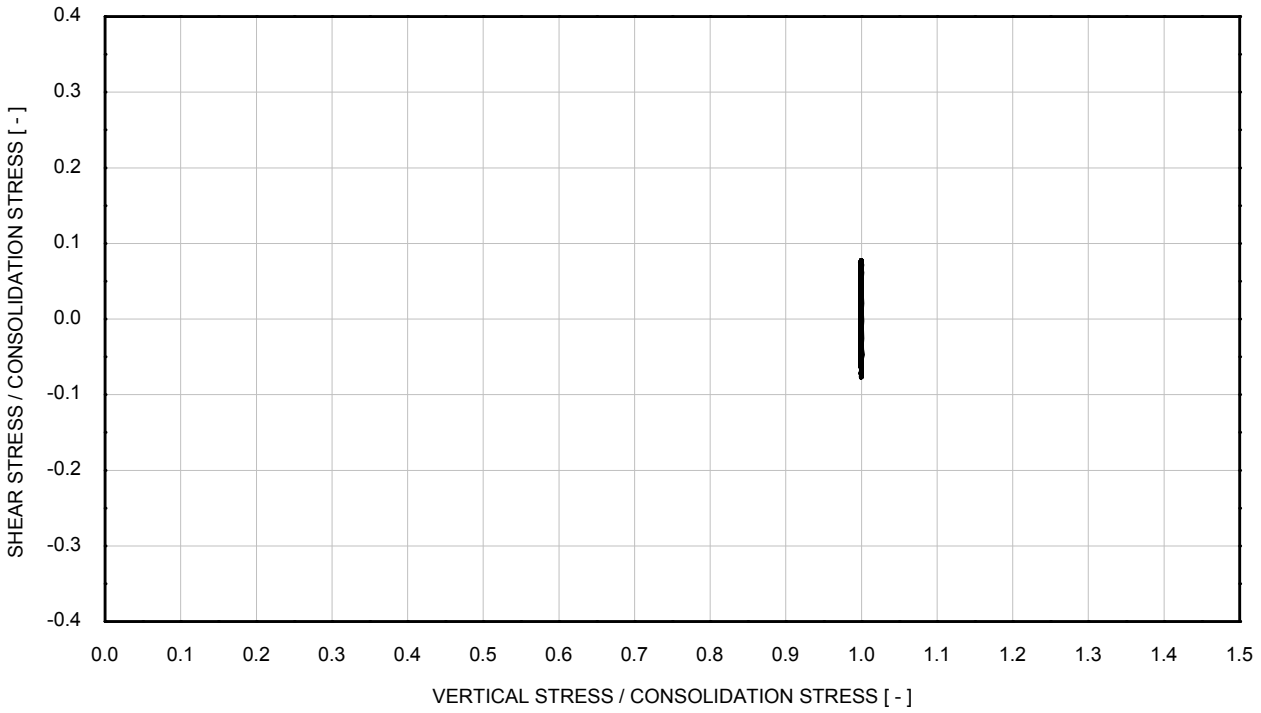




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	10 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

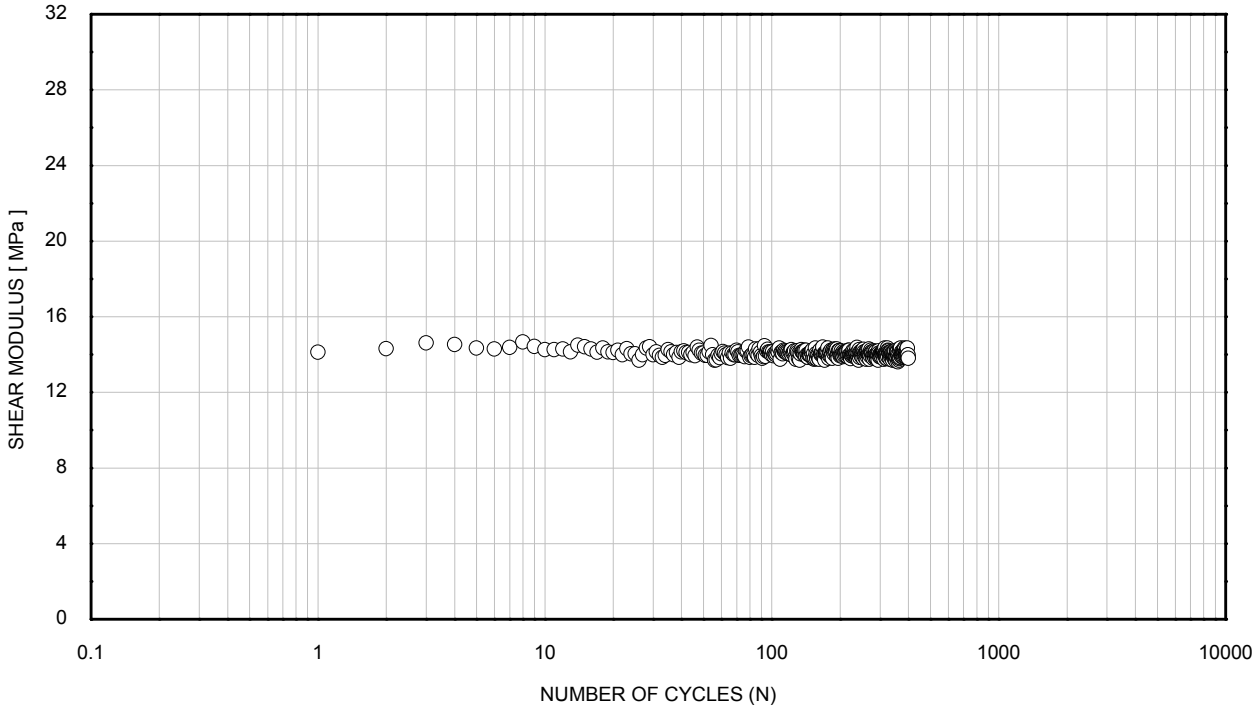
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

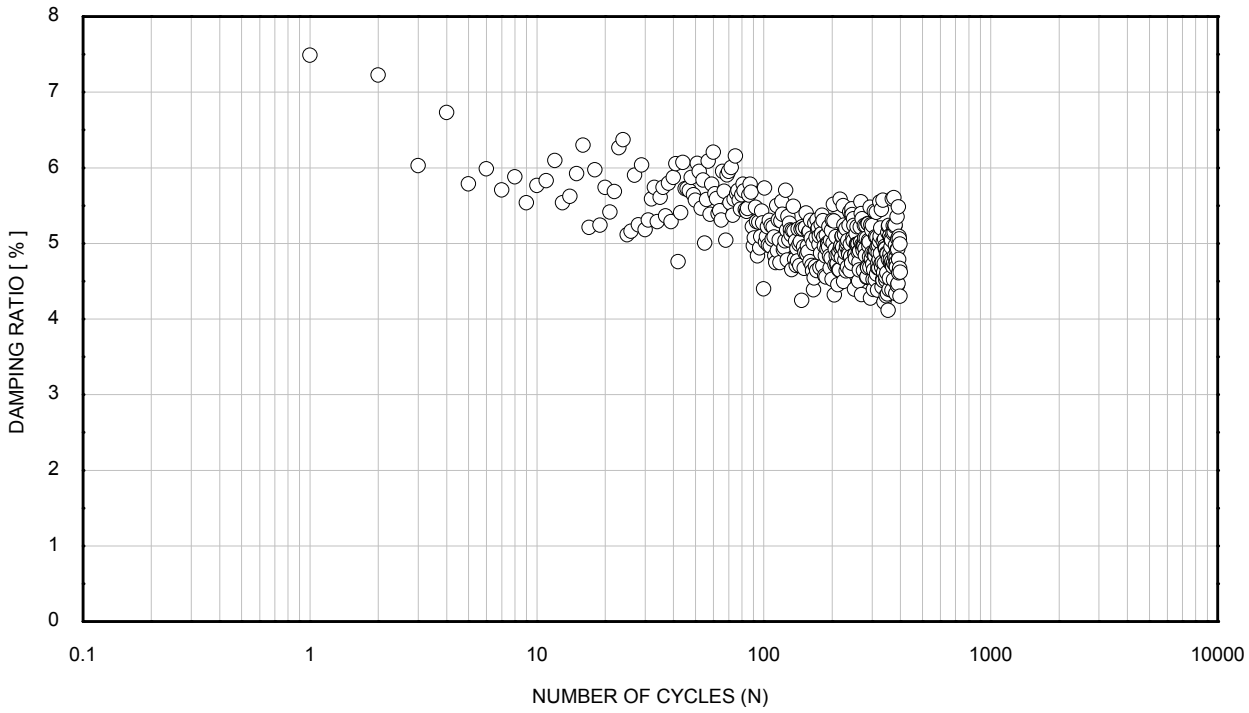




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	10 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

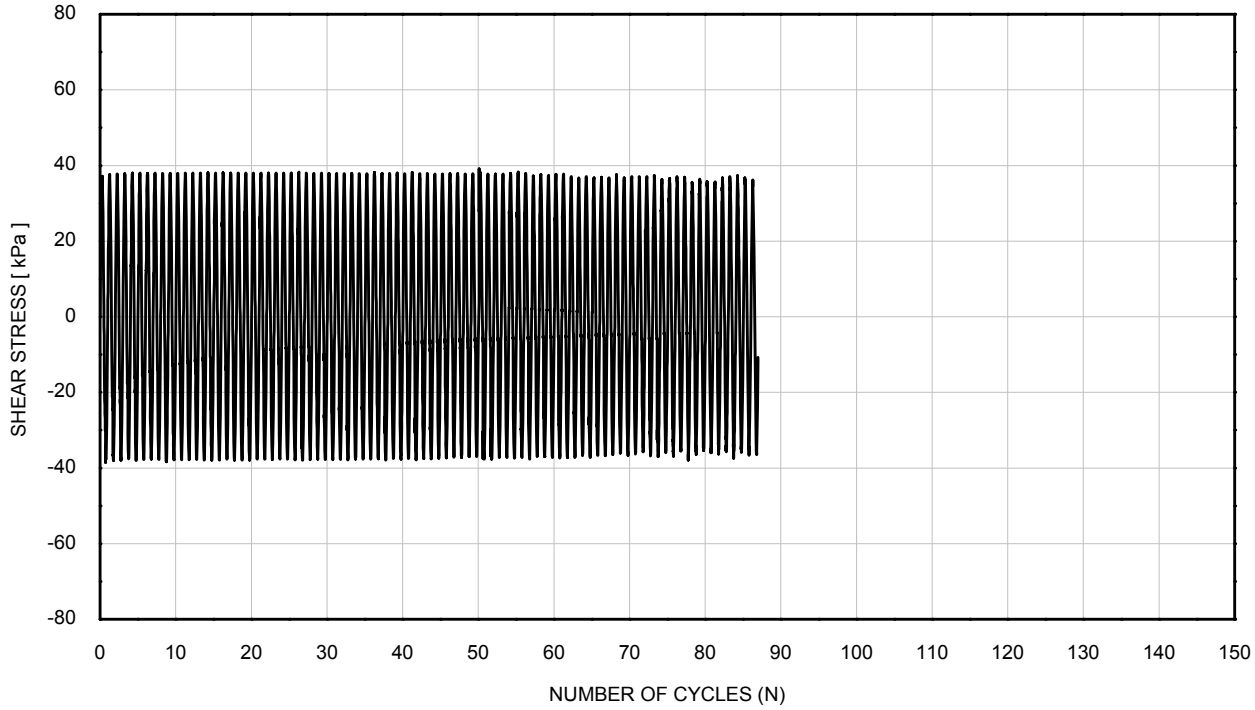
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

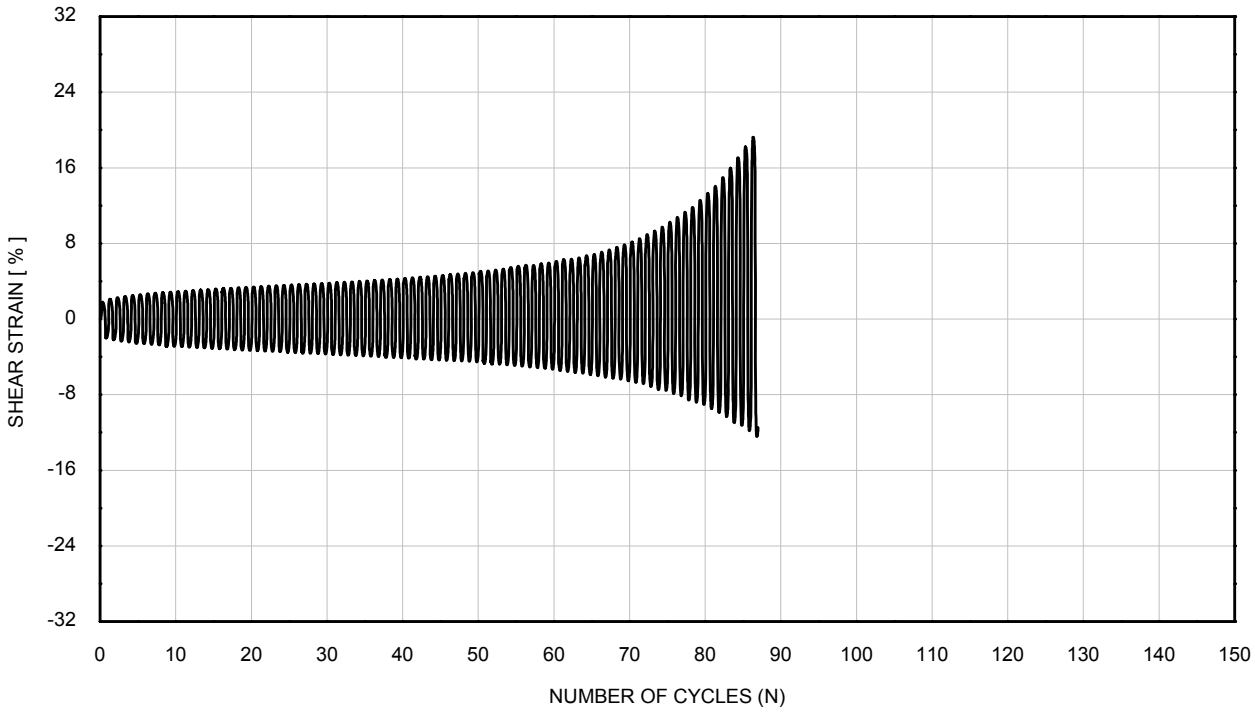




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	10 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

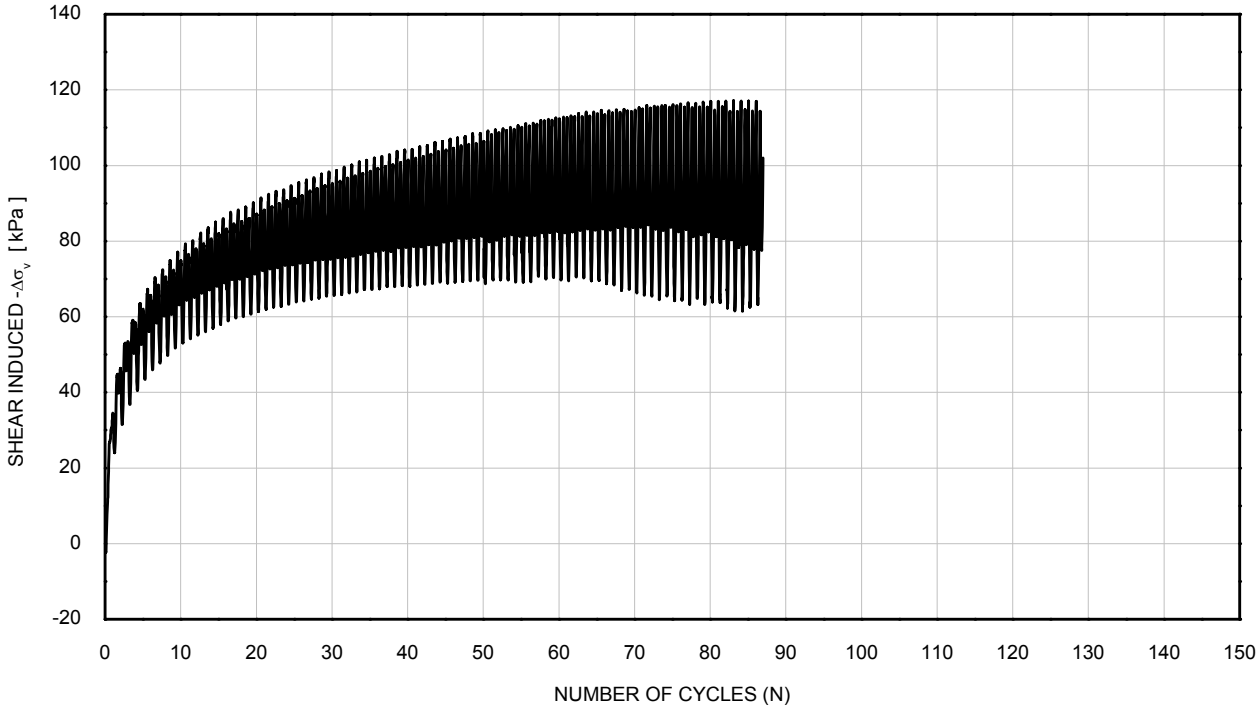
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

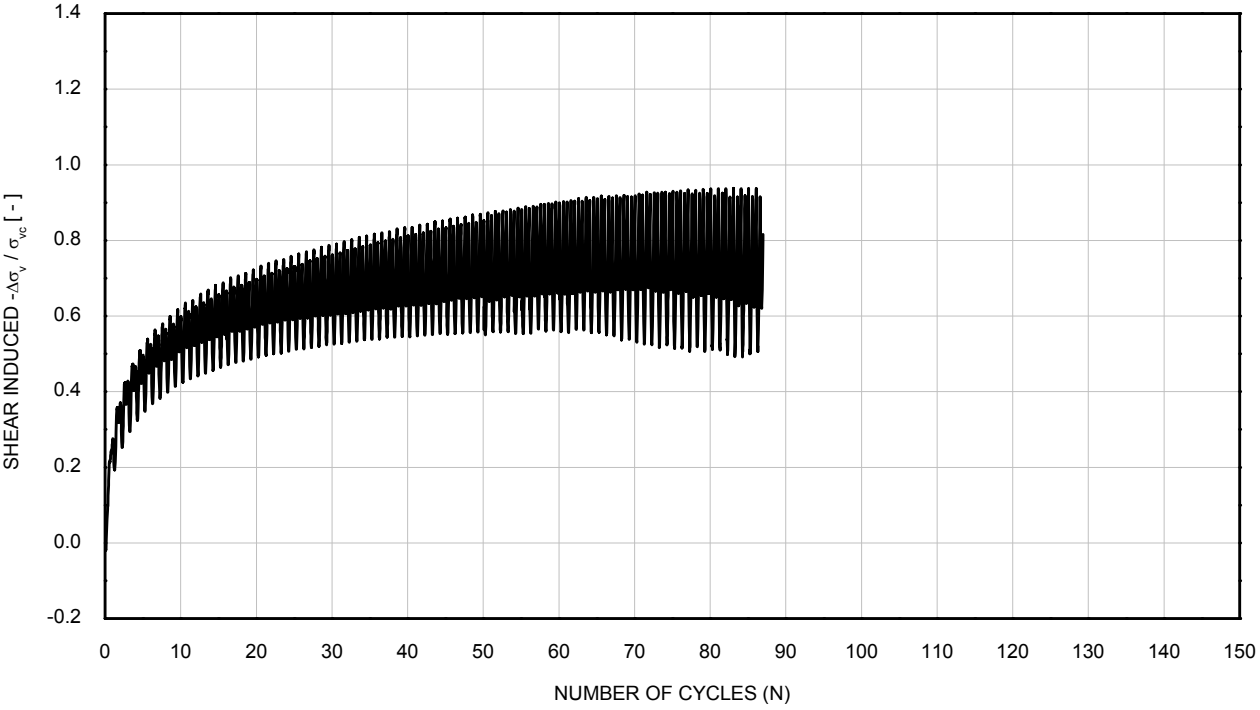




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	37 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

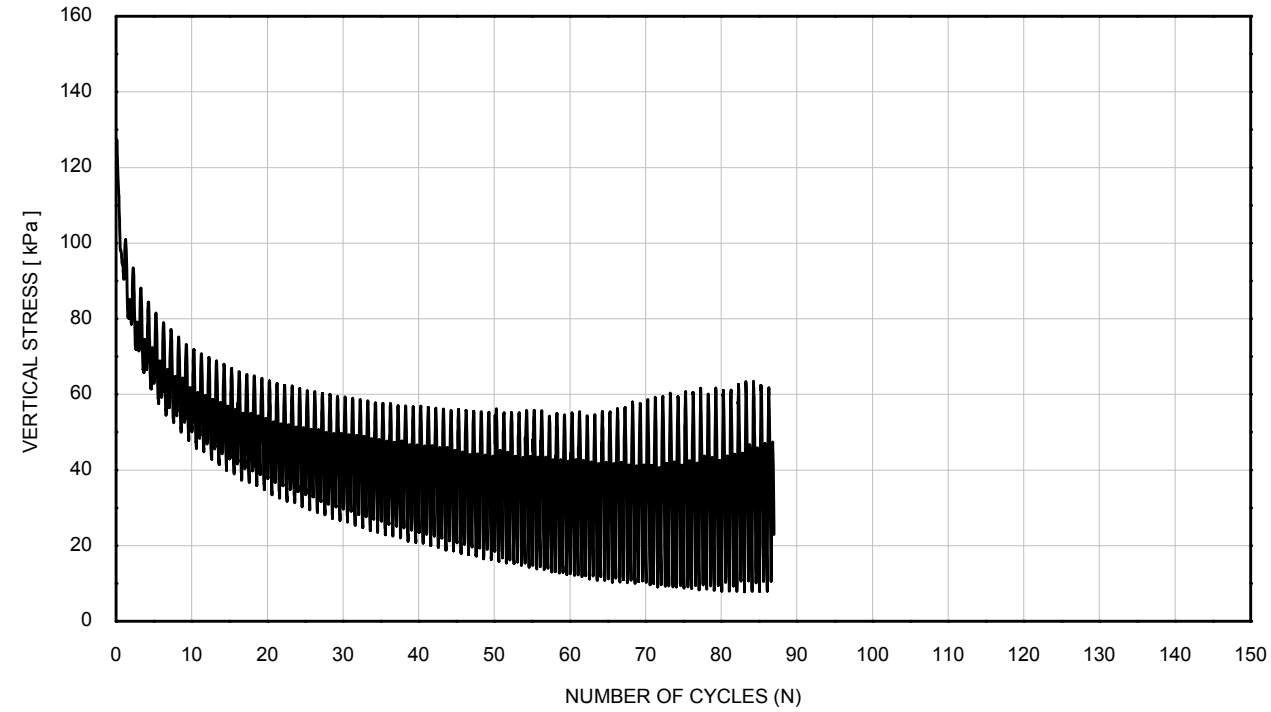
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

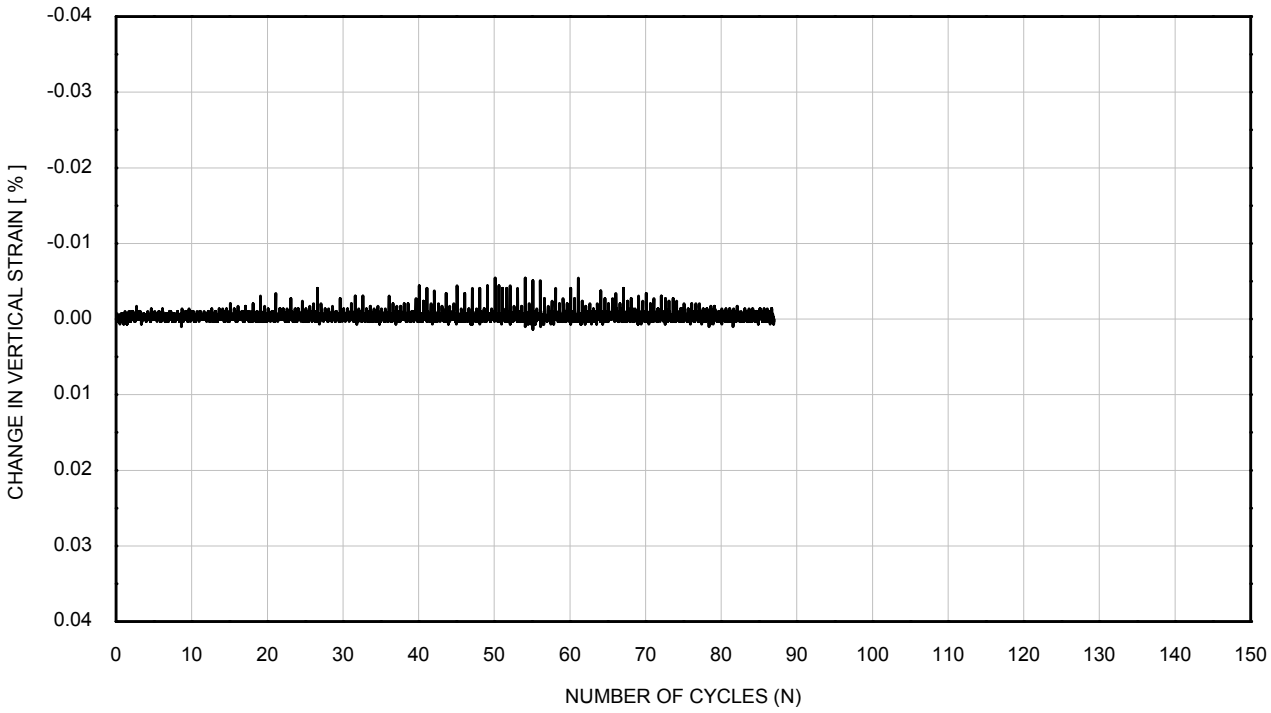




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	37 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

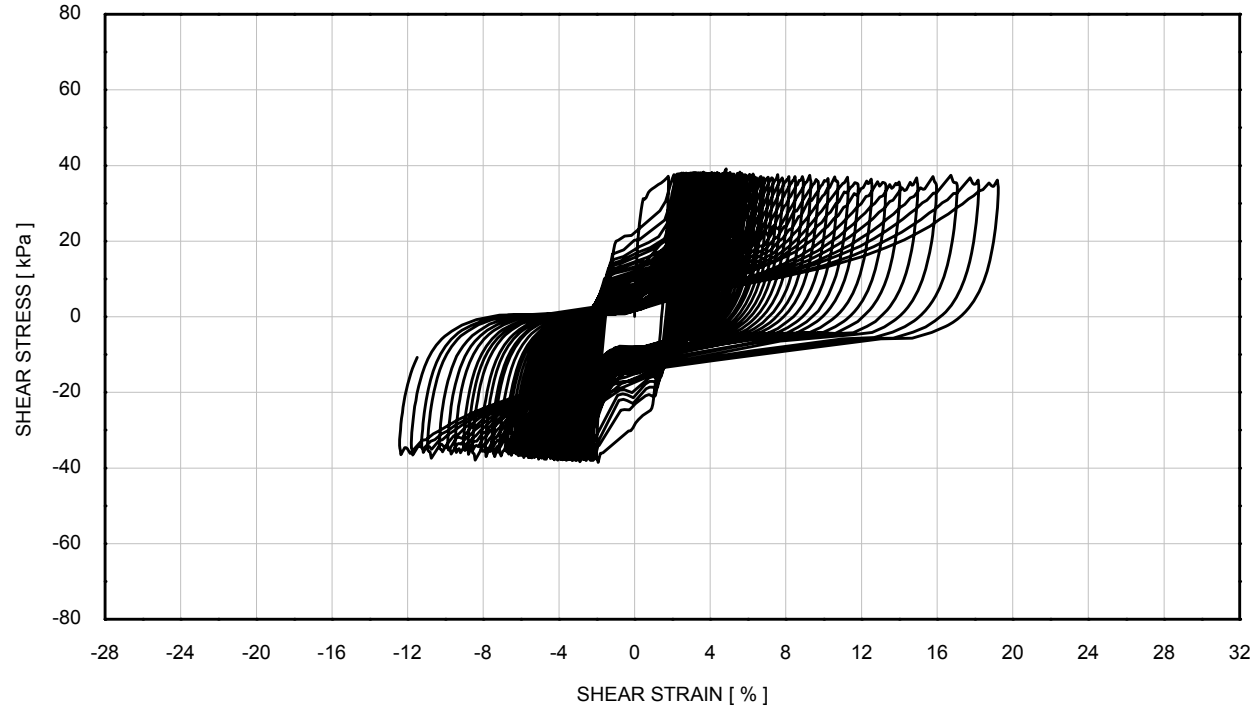
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

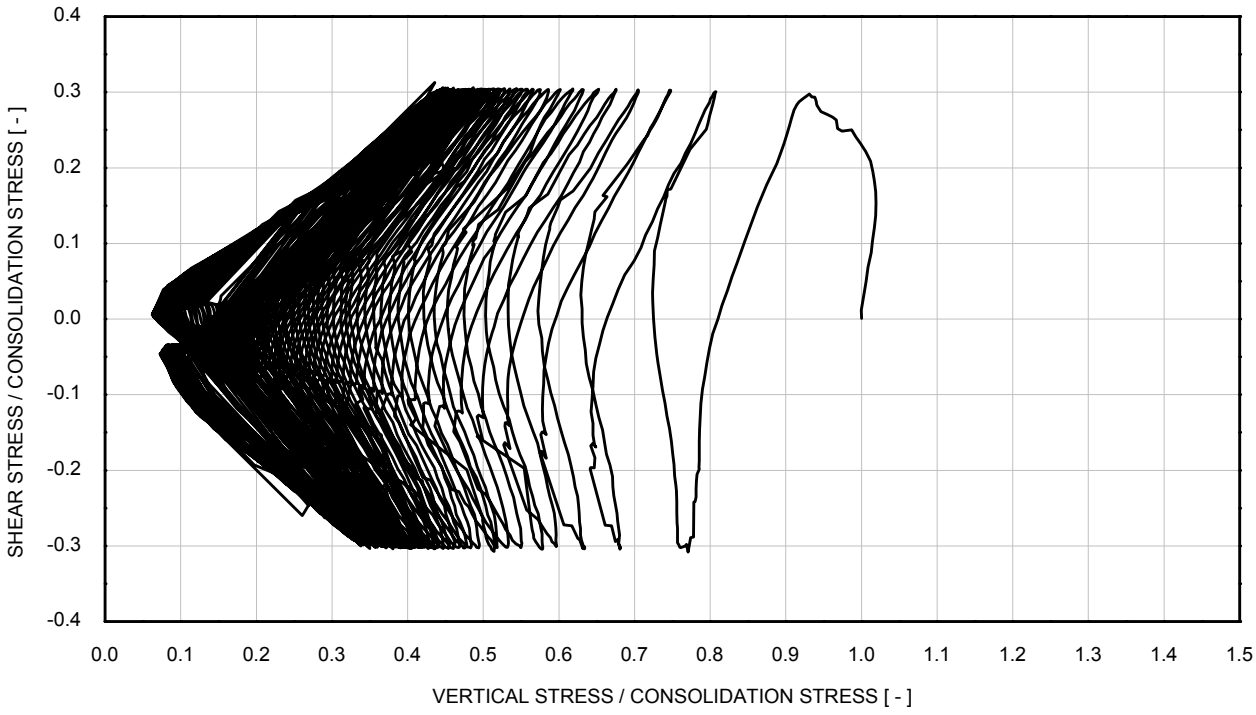




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	37 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

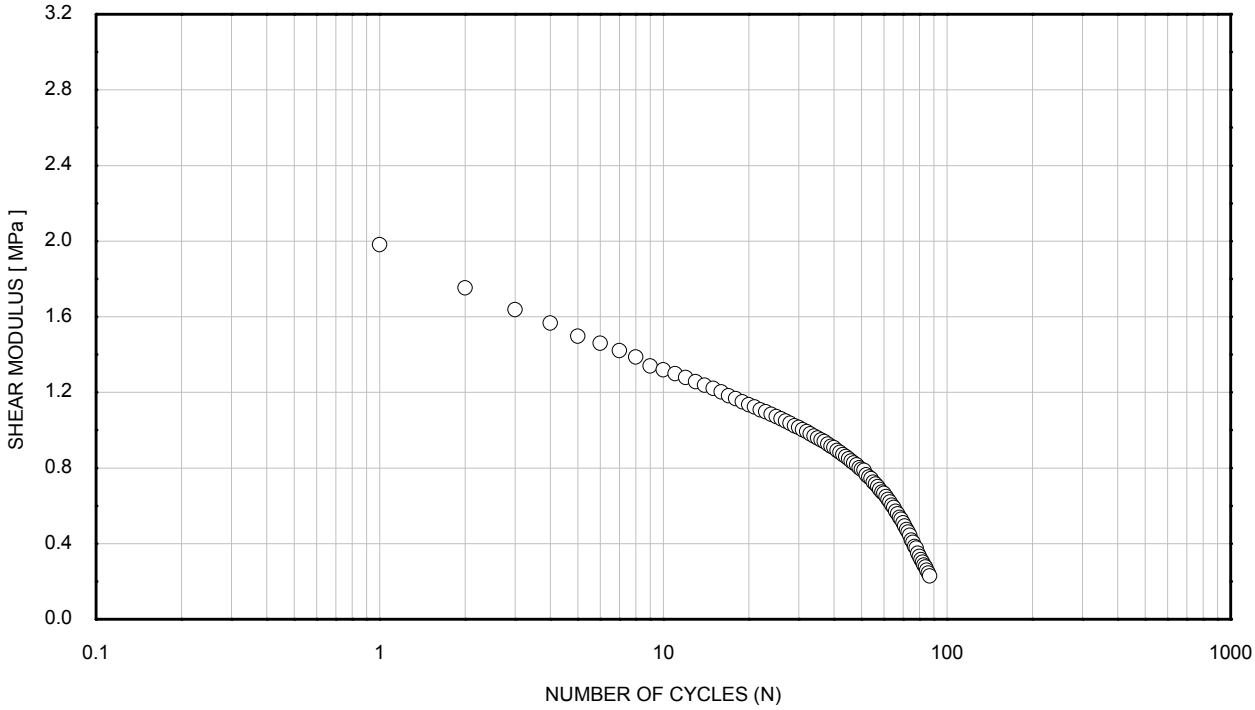
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

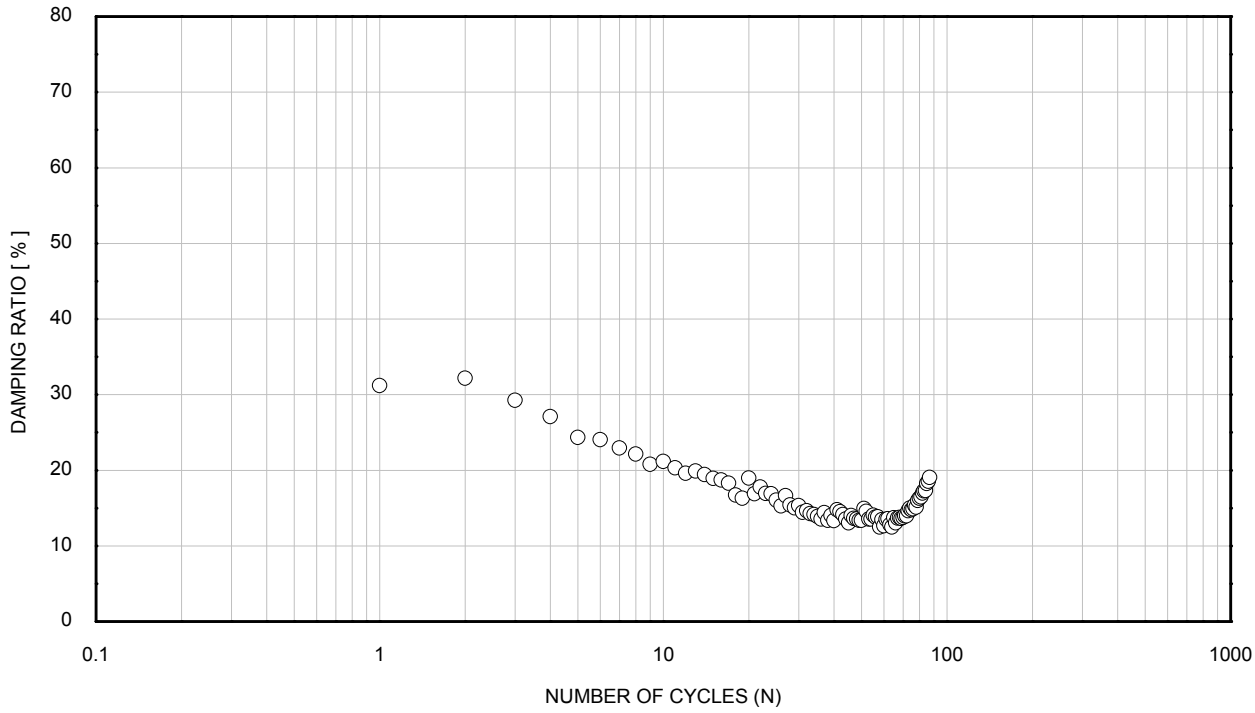




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	37 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

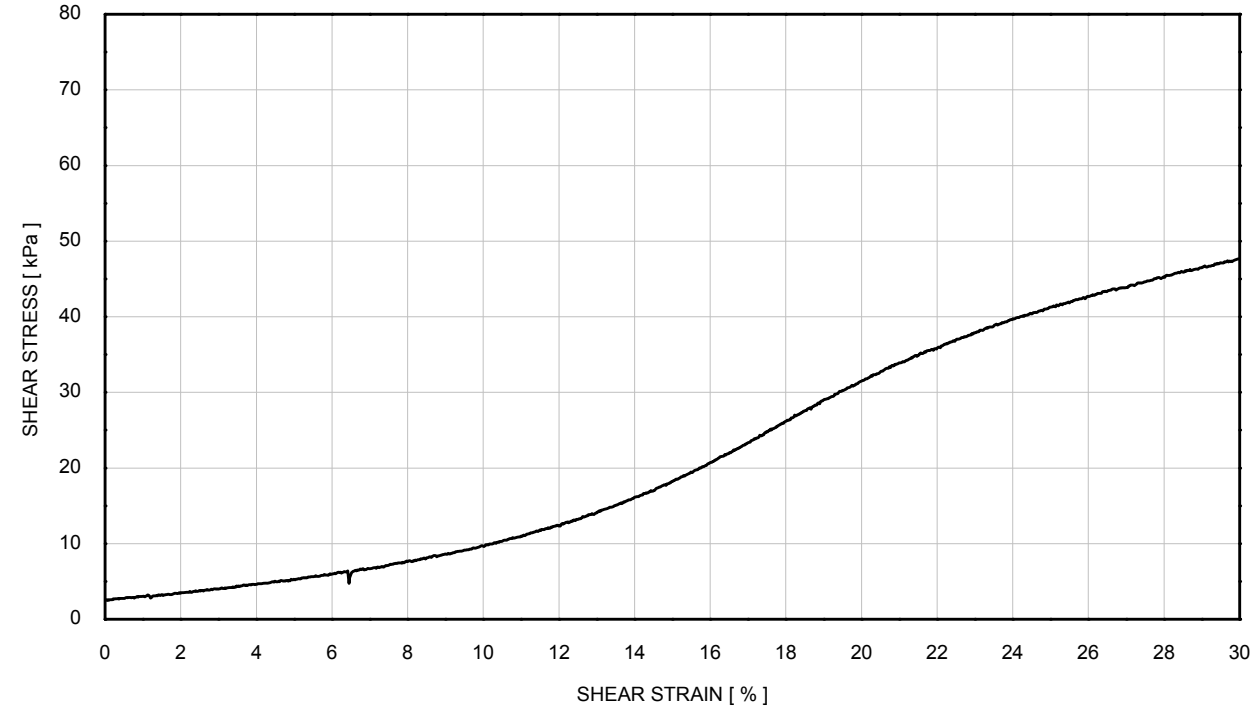
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

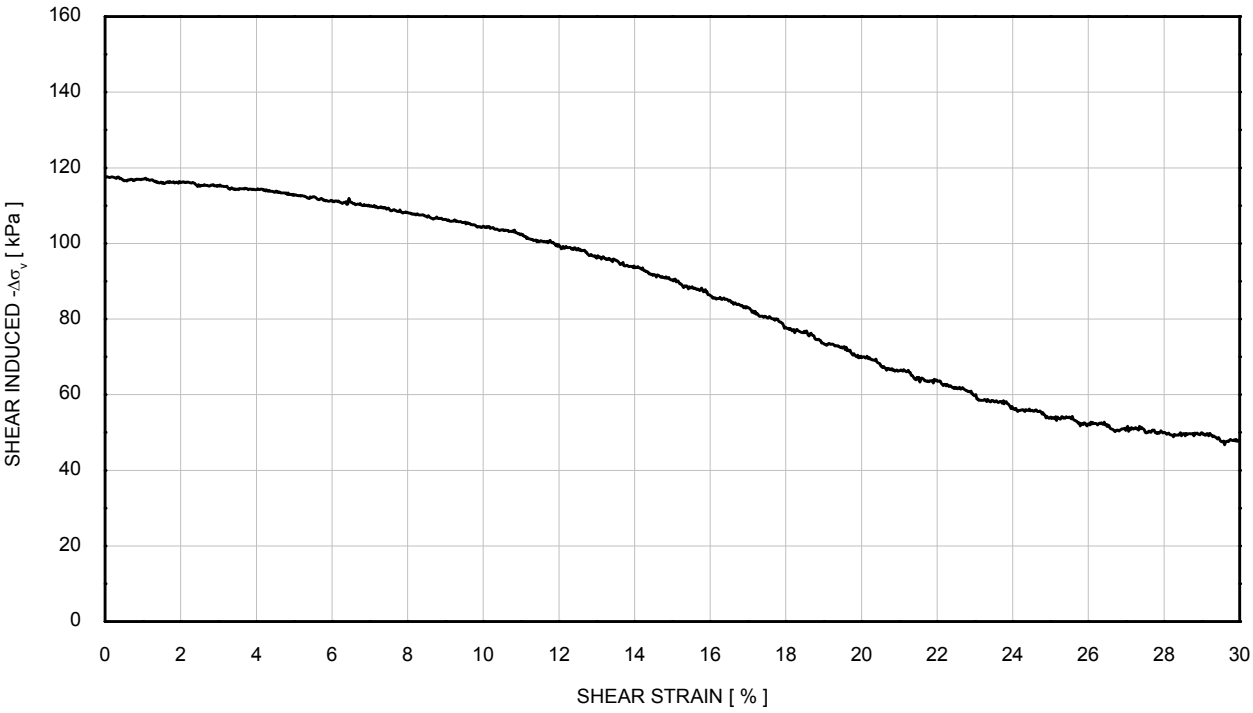




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	37 kPa	Depth [m]	:	13.24
Frequency	:	0.10 Hz	Test No.	:	CSS13

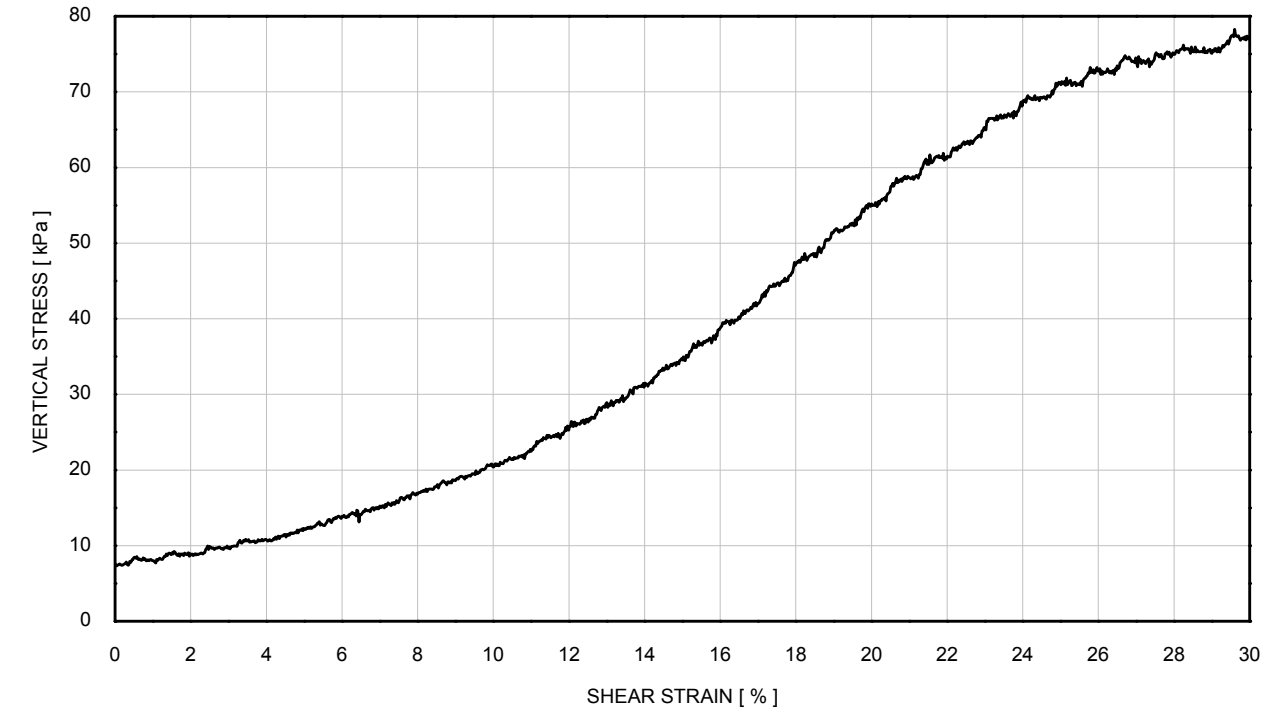
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

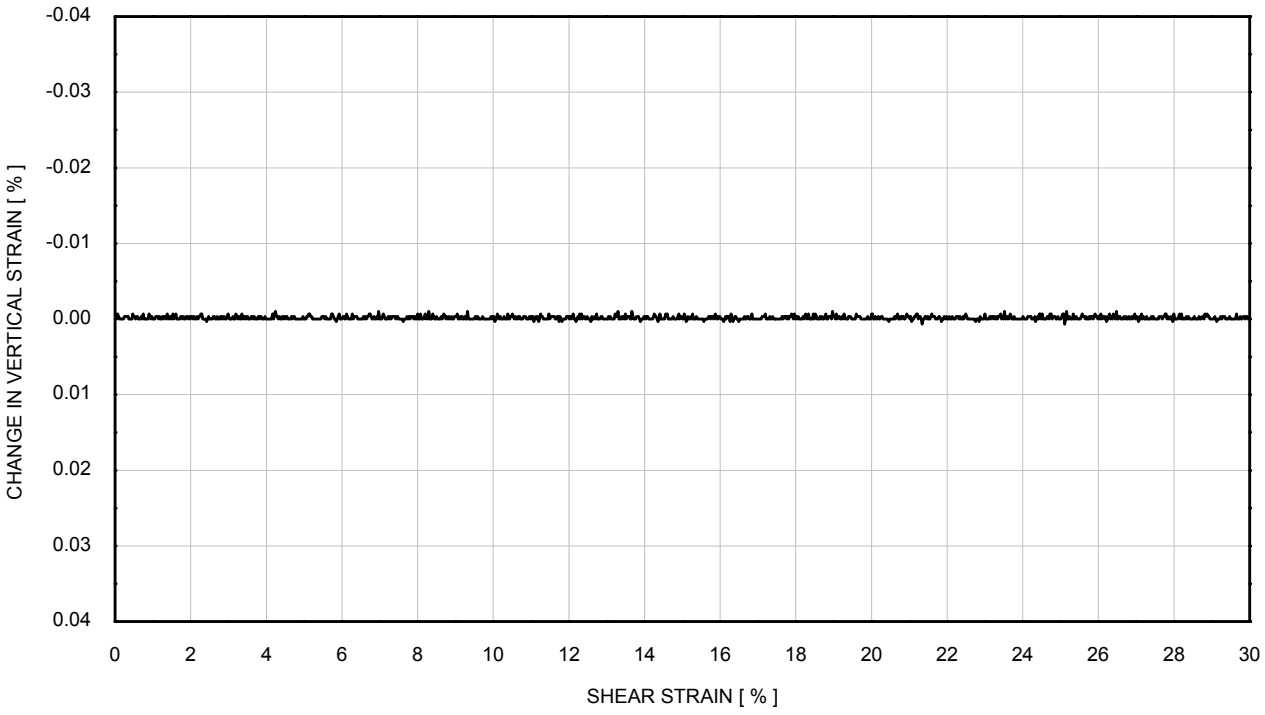




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 48 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 30.01 %	Depth [m]	: 13.24
Rate of strain	: 3.02 %/hour	Test No.	: CSS13

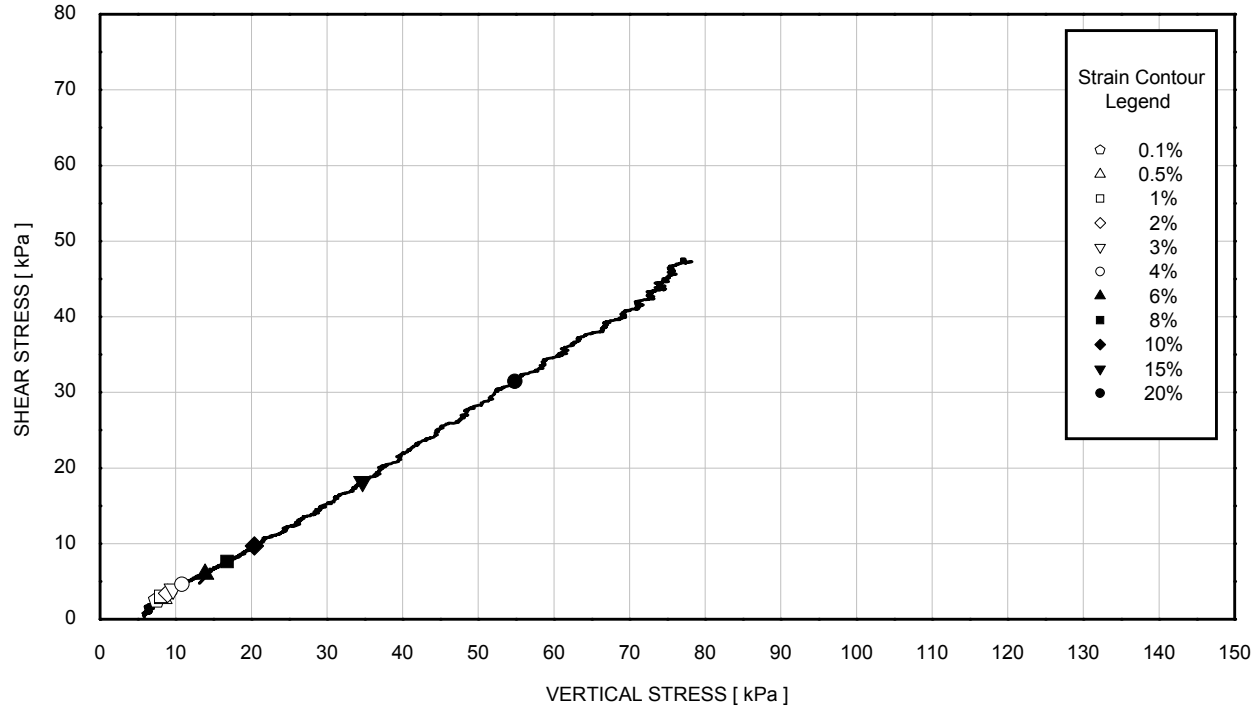
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

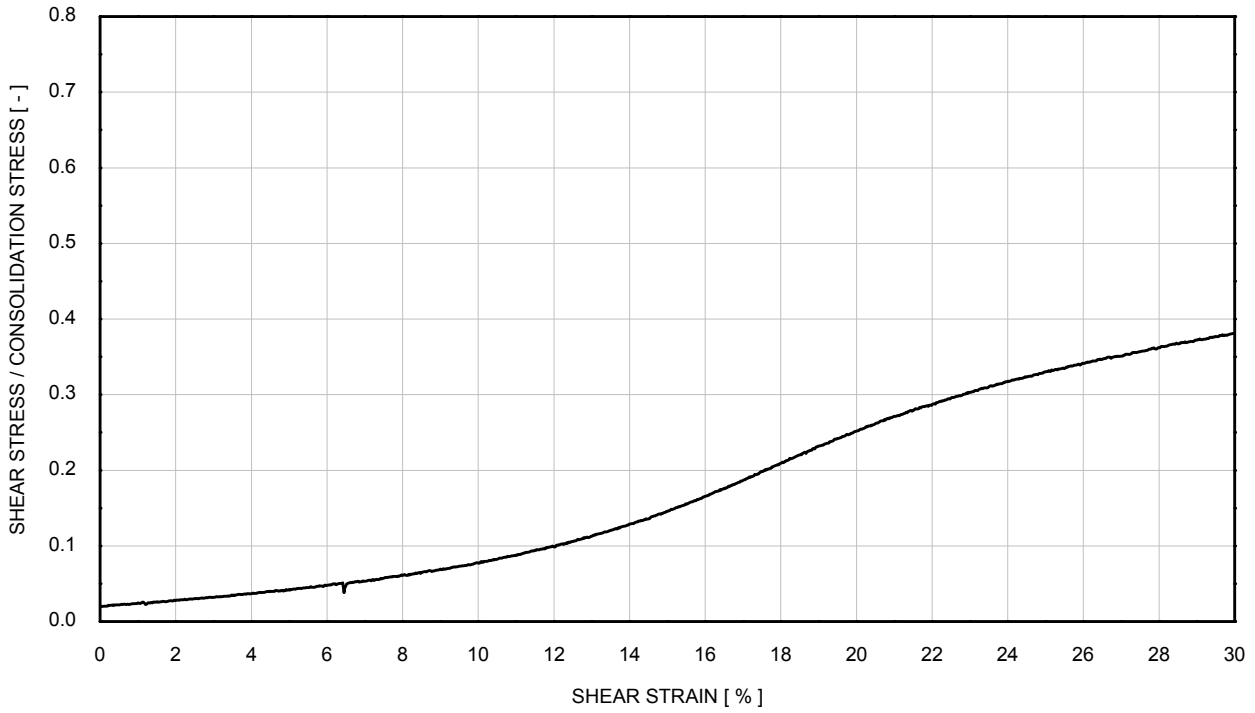




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 48 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 30.01 %	Depth [m]	: 13.24
Rate of strain	: 3.02 %/hour	Test No.	: CSS13

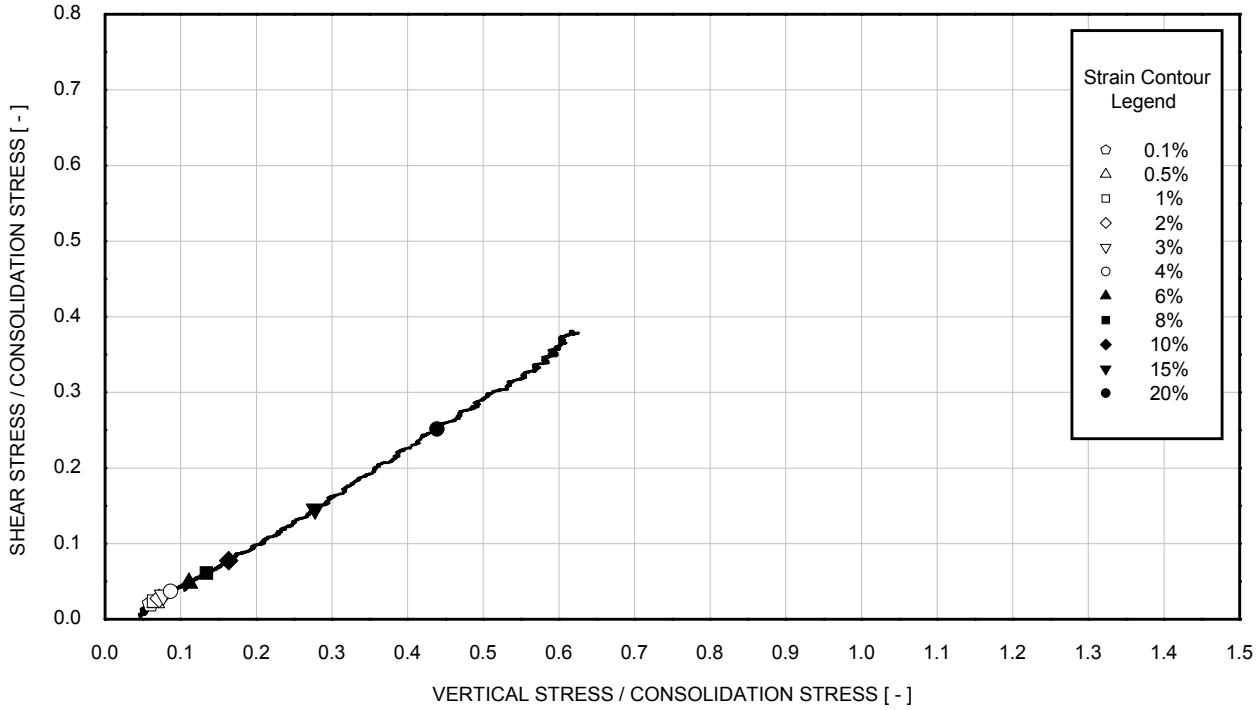
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

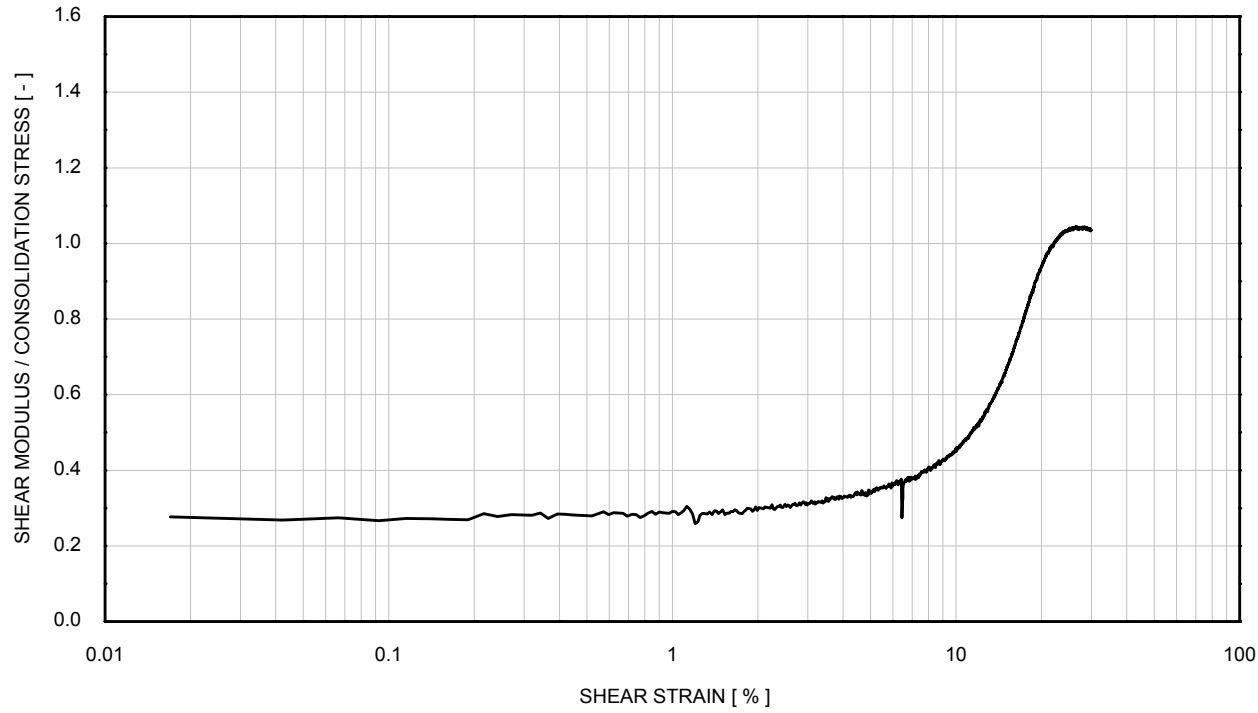




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 48 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 30.01 %	Depth [m]	: 13.24
Rate of strain	: 3.02 %/hour	Test No.	: CSS13

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 125	kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 48	kPa	Sample	: 16WaxB
γ at τ_{peak}	: 30.01	%	Depth [m]	: 13.24
Rate of strain	: 3.02	%/hour	Test No.	: CSS13

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive grey silty CLAY

GENERAL	
Date test started	24/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.5
Length	[mm]	29.8
Water content	[%]	25.3
Bulk density	[Mg/m³]	2.06
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.647
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH04-SA_CSS14
Template issue	1.4
Processed by Date	JLS 25/10/2016
Checked by Date	PH 28/11/2016
Approved by Date	PH 28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.28
Test number	CSS14

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	125
Vertical strain	[%]	1.65
Bulk density	[Mg/m^3]	2.07
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.620
Water content	[%]	24.3

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	125
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	9
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.71
Bulk density	[Mg/m^3]	2.07
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.619

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	1.90	0.07	14.02	13.59
2	1.90	0.07	14.09	9.70
5	1.91	0.07	12.98	8.43
10	1.91	0.07	12.72	8.99
20	1.92	0.07	12.76	8.26
30	1.92	0.07	12.76	9.12
40	1.93	0.07	12.64	7.99
50	1.93	0.07	12.72	8.04
100	1.93	0.07	13.11	7.12
200	1.94	0.07	13.25	7.39
300	1.94	0.07	12.98	7.95
400	1.95	0.07	13.11	7.13

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.28
Test number	CSS14

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	96
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	72
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	4
γ_{av} at N_f	[%]	1.47
γ_{cy} at N_f	[%]	16.66
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	69
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.69	8.10	0.87	23.15
2	0.18	10.90	0.66	19.48
3	0.77	13.67	0.53	21.77
4	1.47	16.66	0.45	19.75

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	62
Shear strain	[%]	29.95
Shear induced $-\Delta\sigma_v$	[kPa]	56
Vertical stress	[kPa]	69
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.00
At 15 % shear strain		
Shear stress	[kPa]	37
Shear induced $-\Delta\sigma_v$	[kPa]	75
Vertical stress	[kPa]	50
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.28
Test number	CSS14

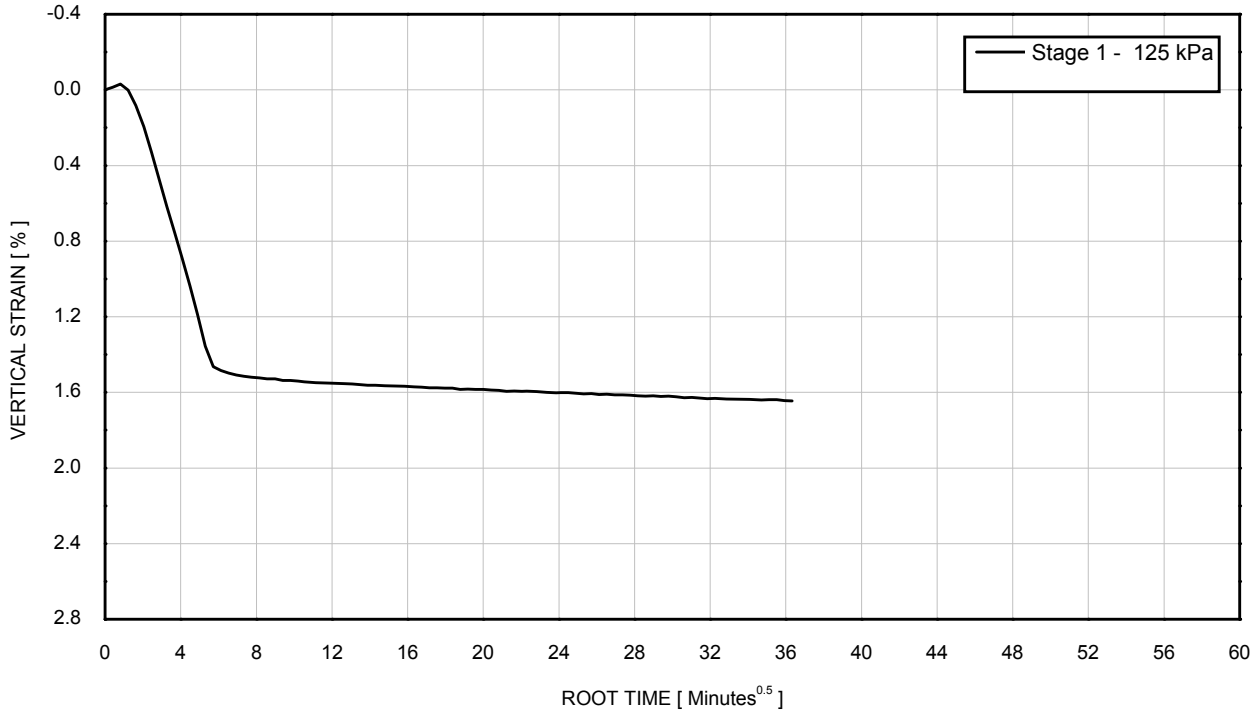
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

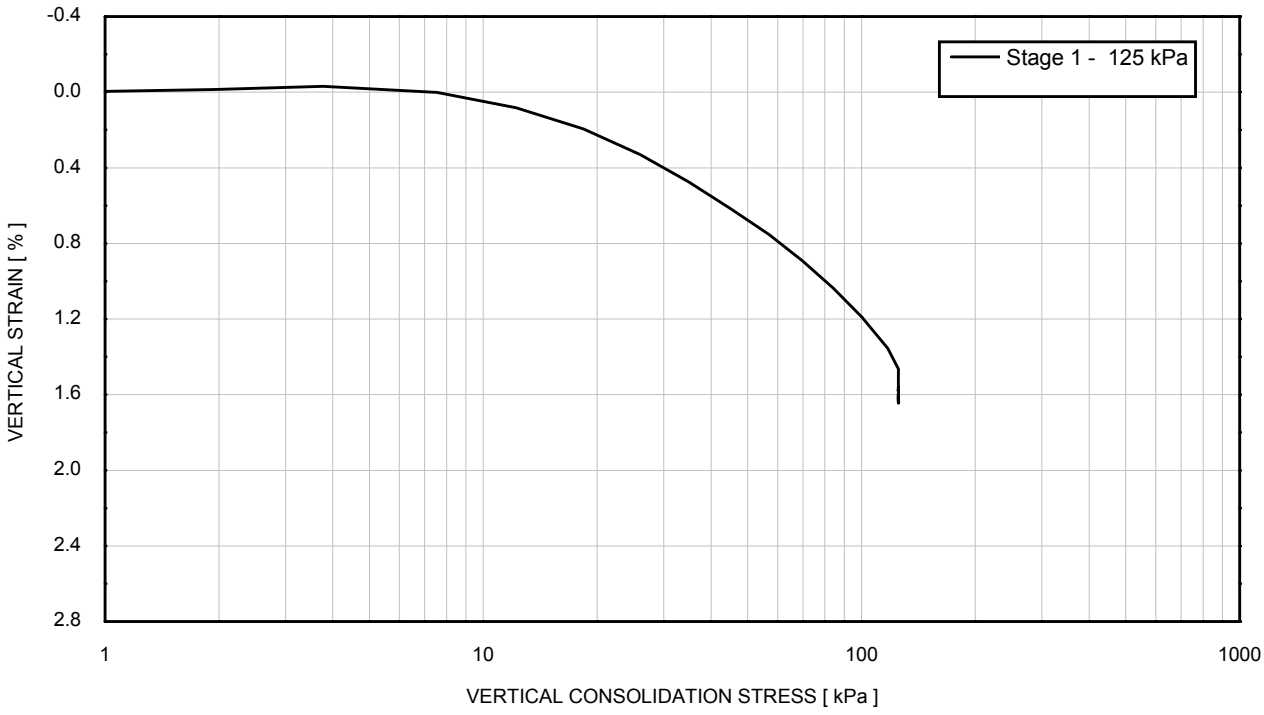
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH04-SA
Sample	16WaxB
Depth [m]	13.28
Test number	CSS14

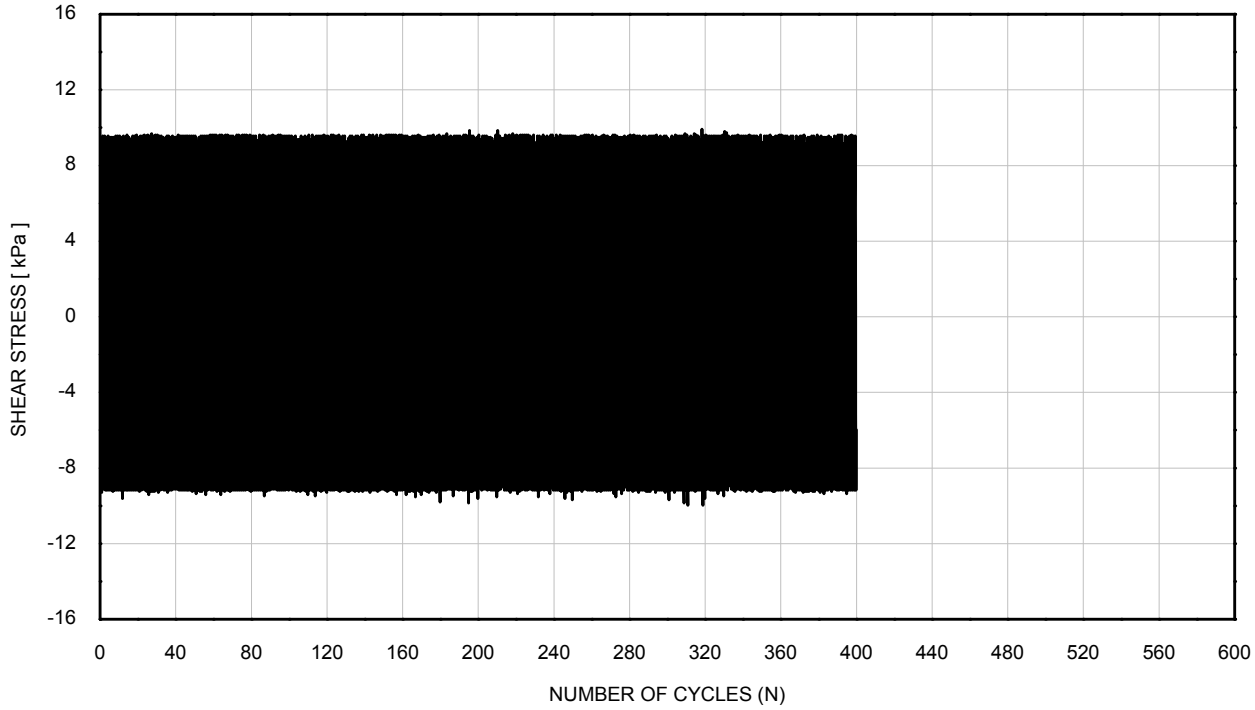
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

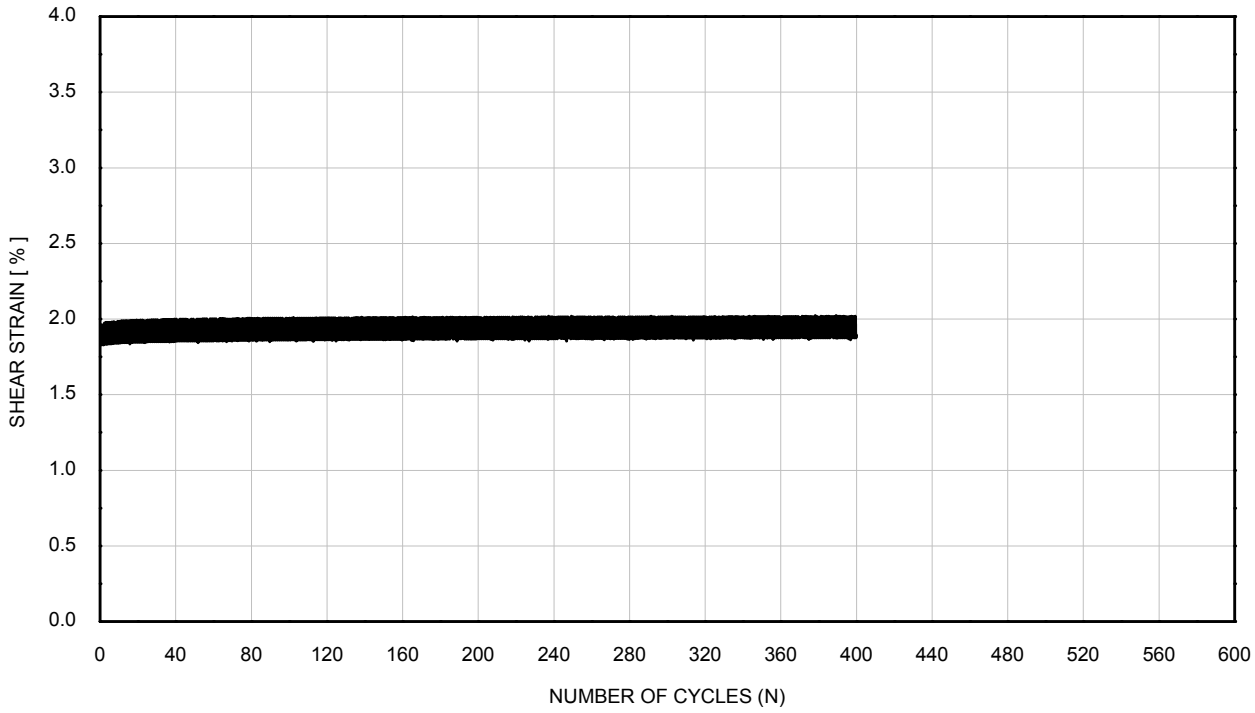




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
		Sample	: 16WaxB
		Depth [m]	: 13.28
		Test No.	: CSS14

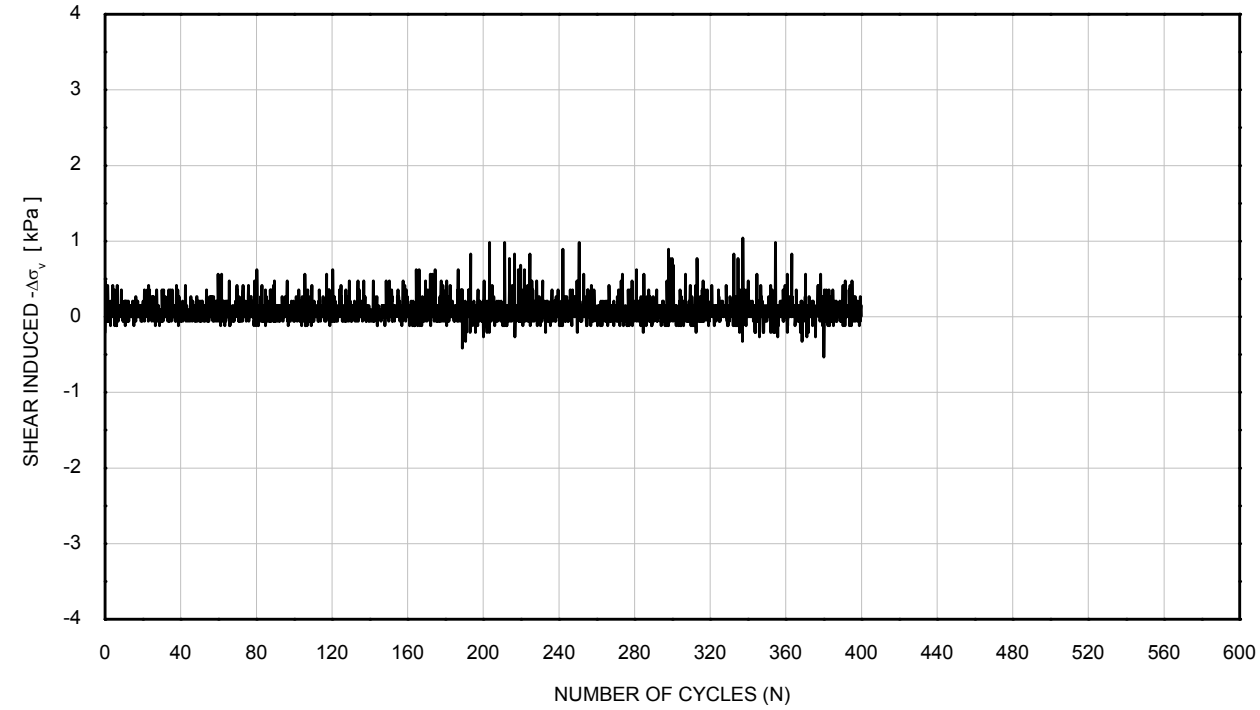
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

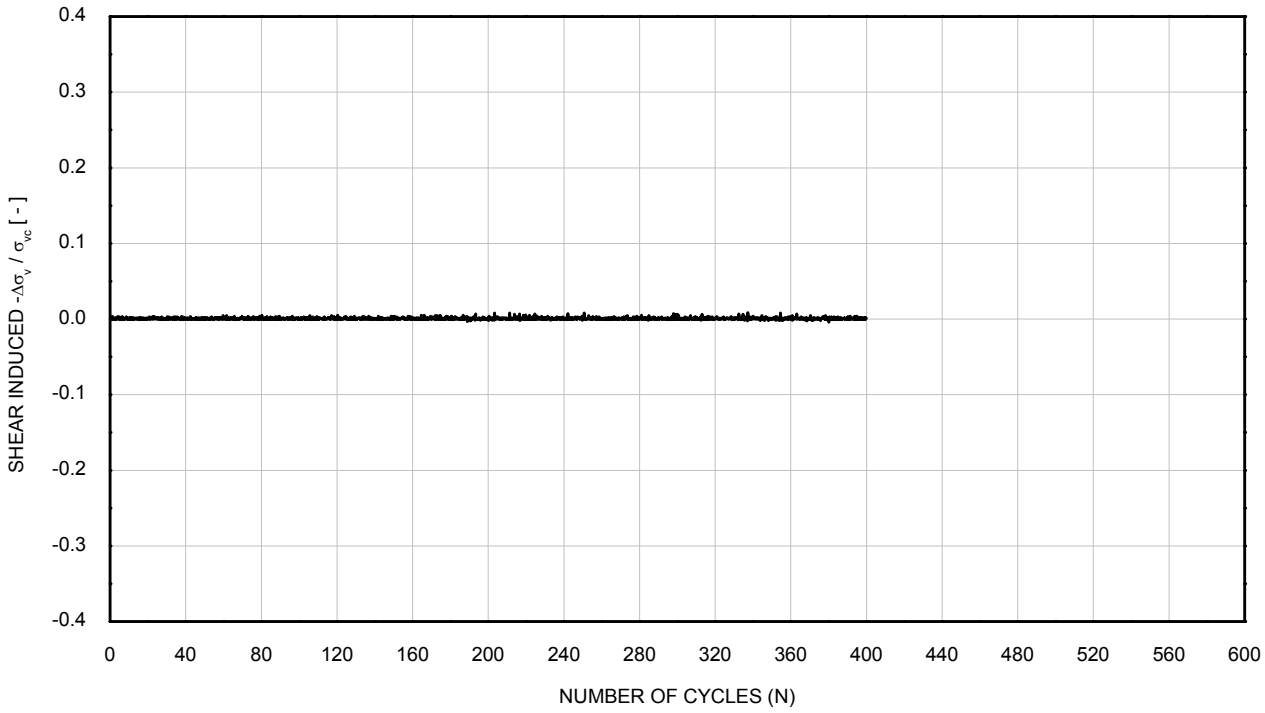




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	9 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

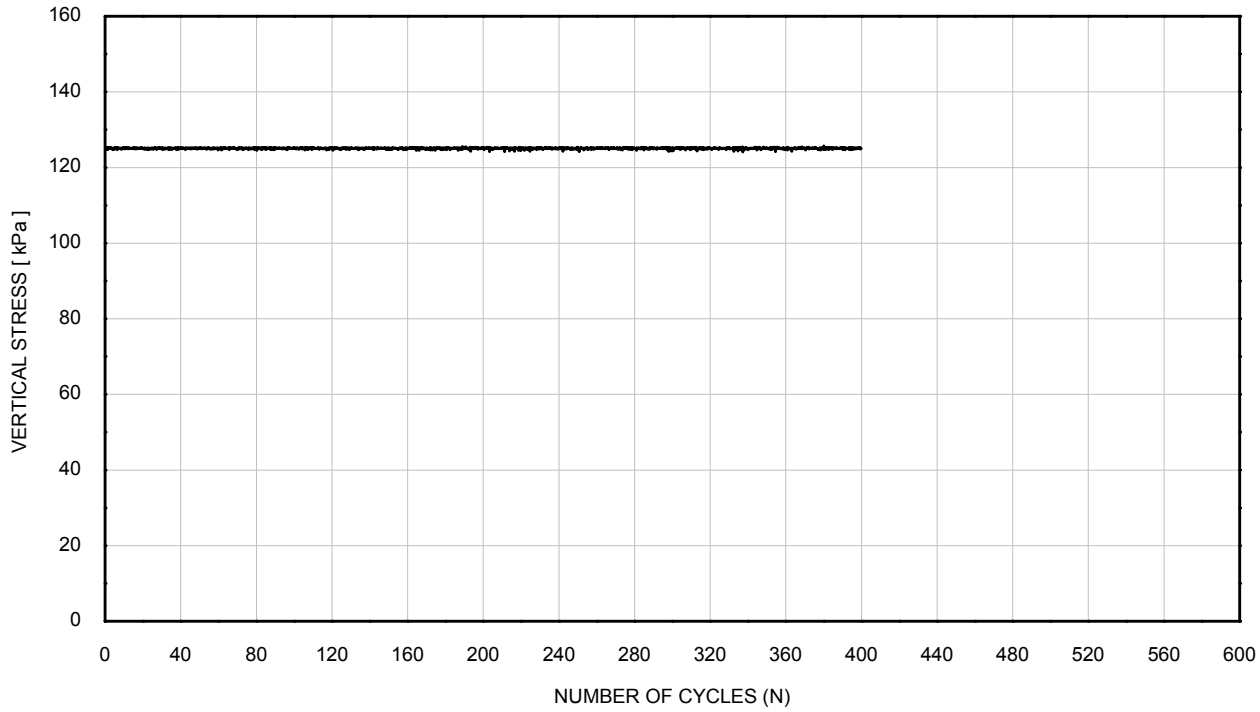
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

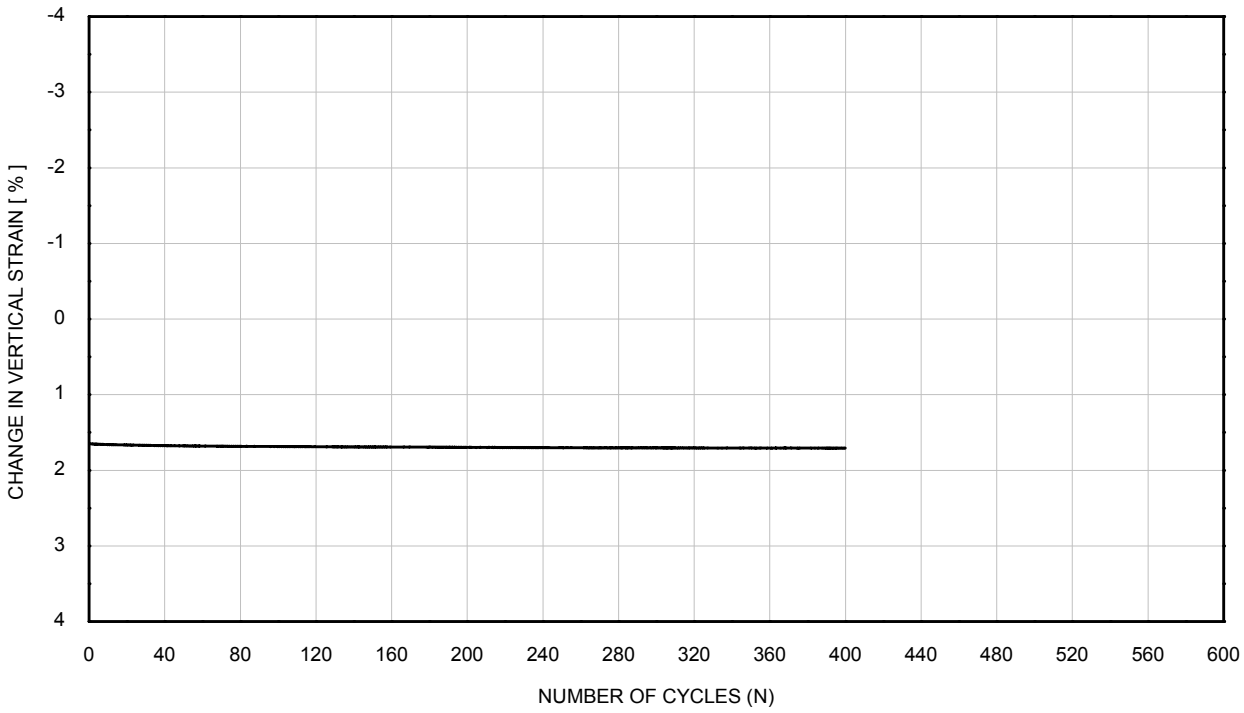




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	9 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

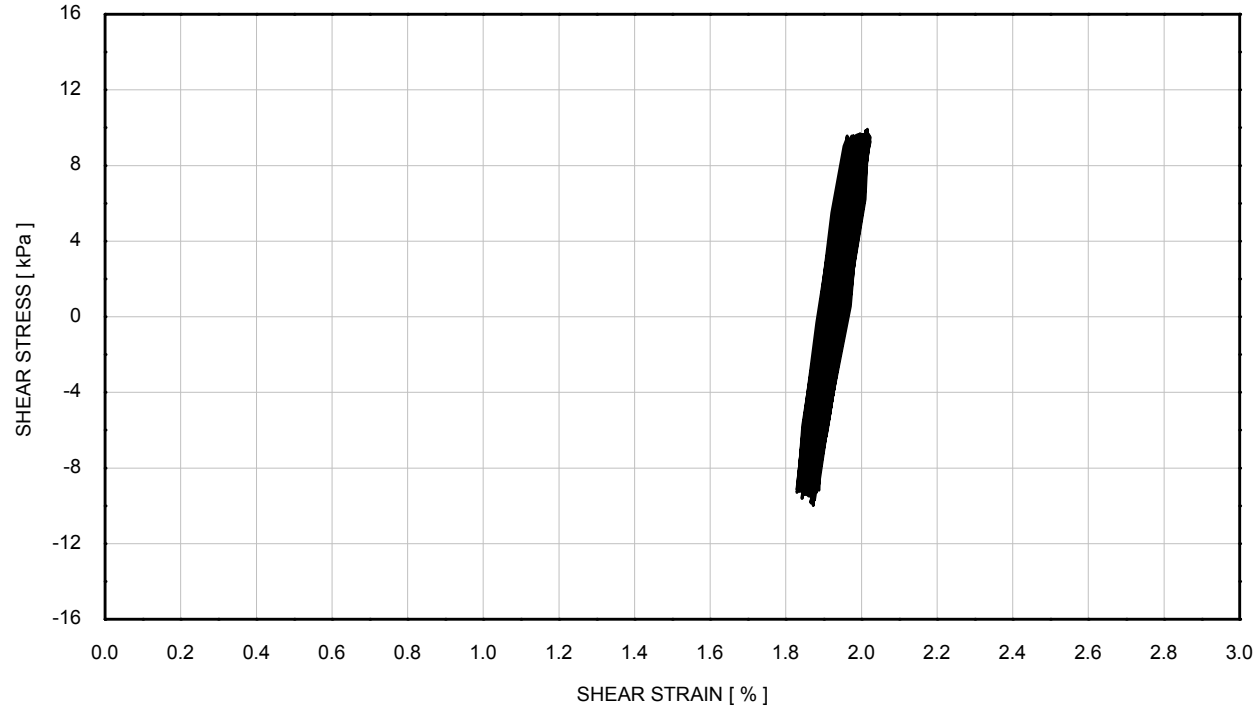
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

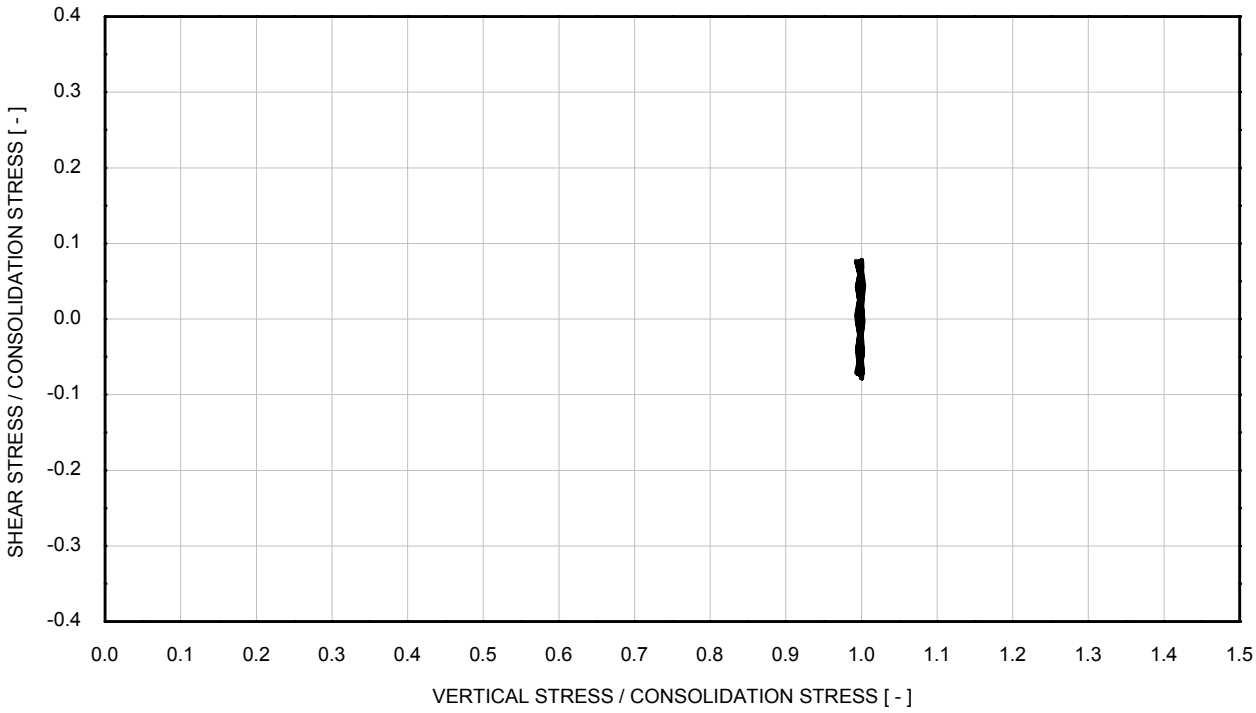




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	9 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

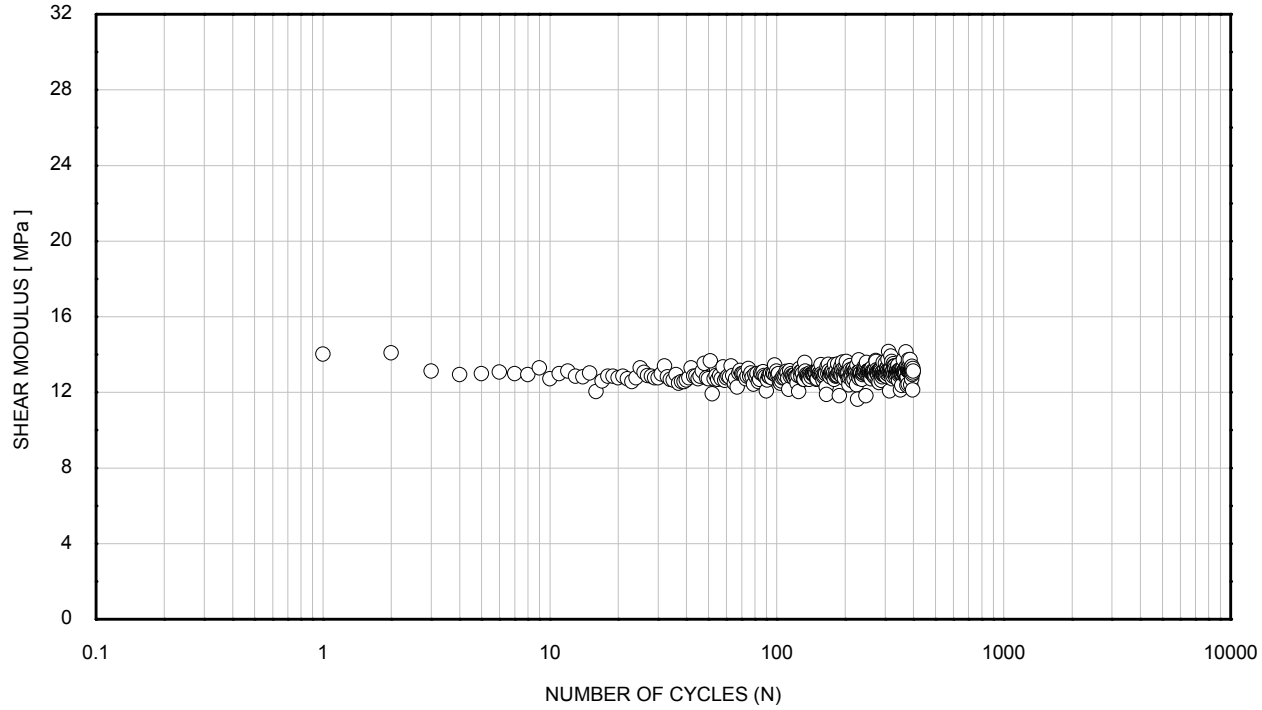
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

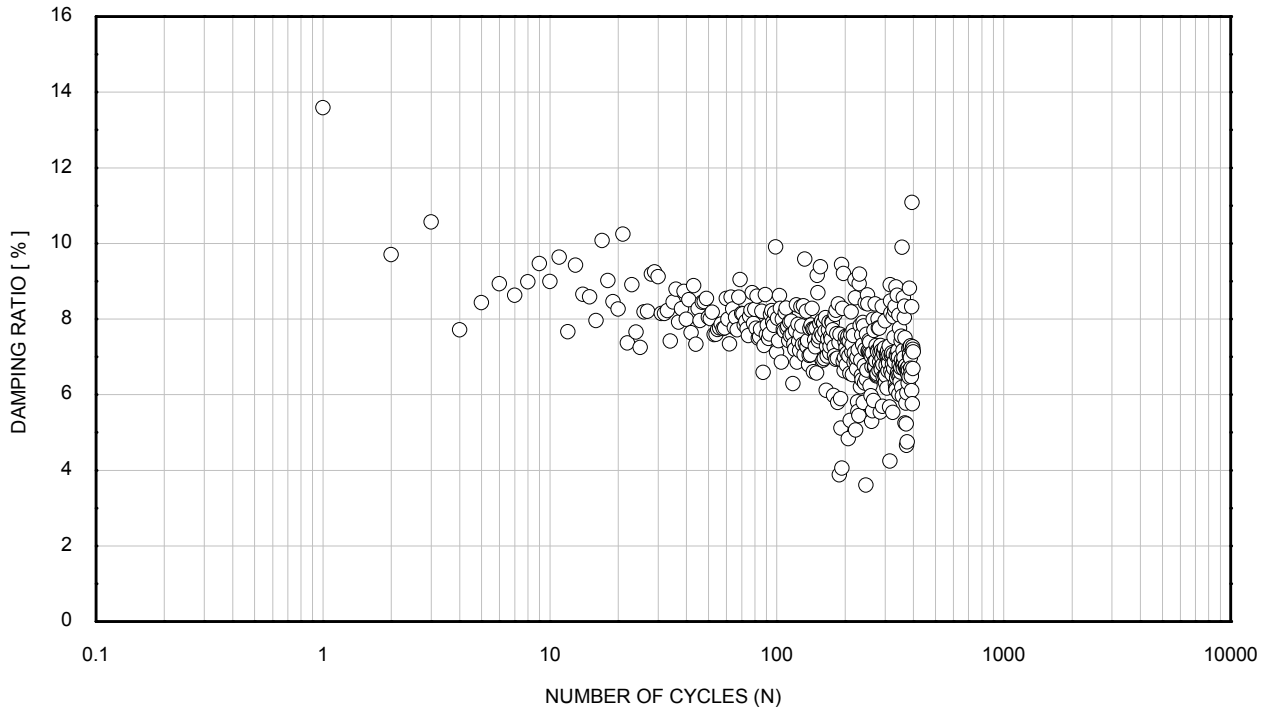




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	9 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

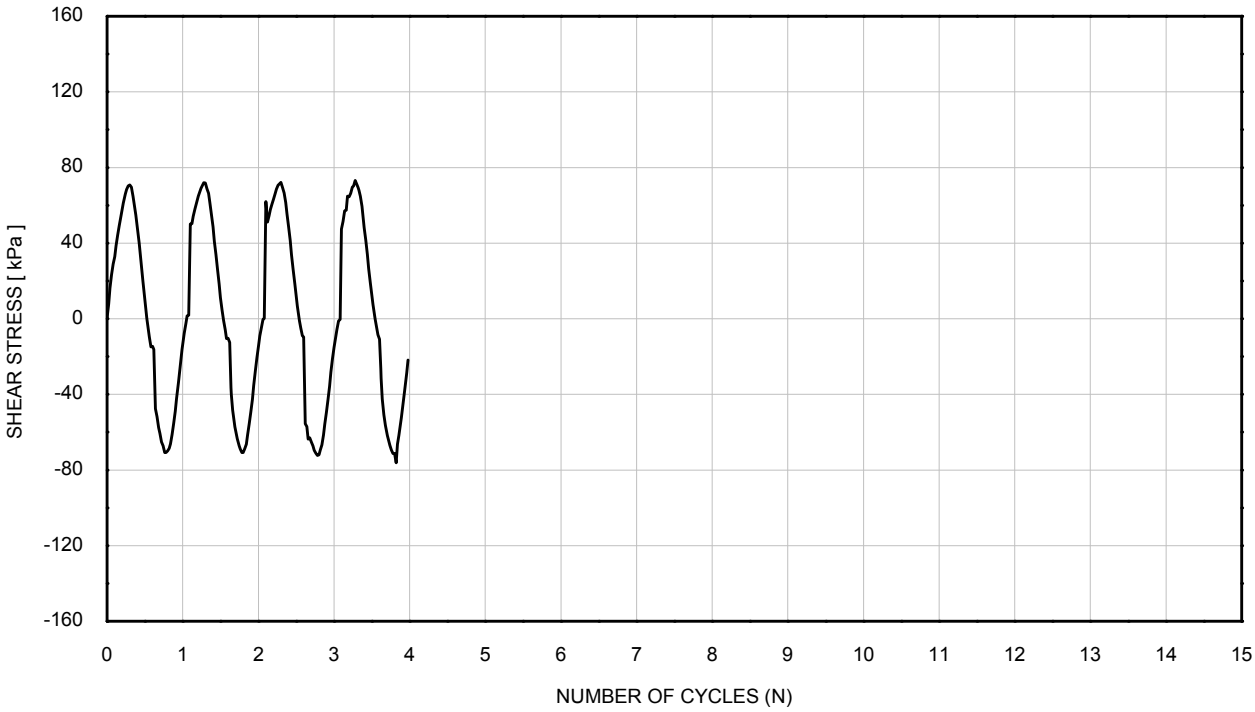
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

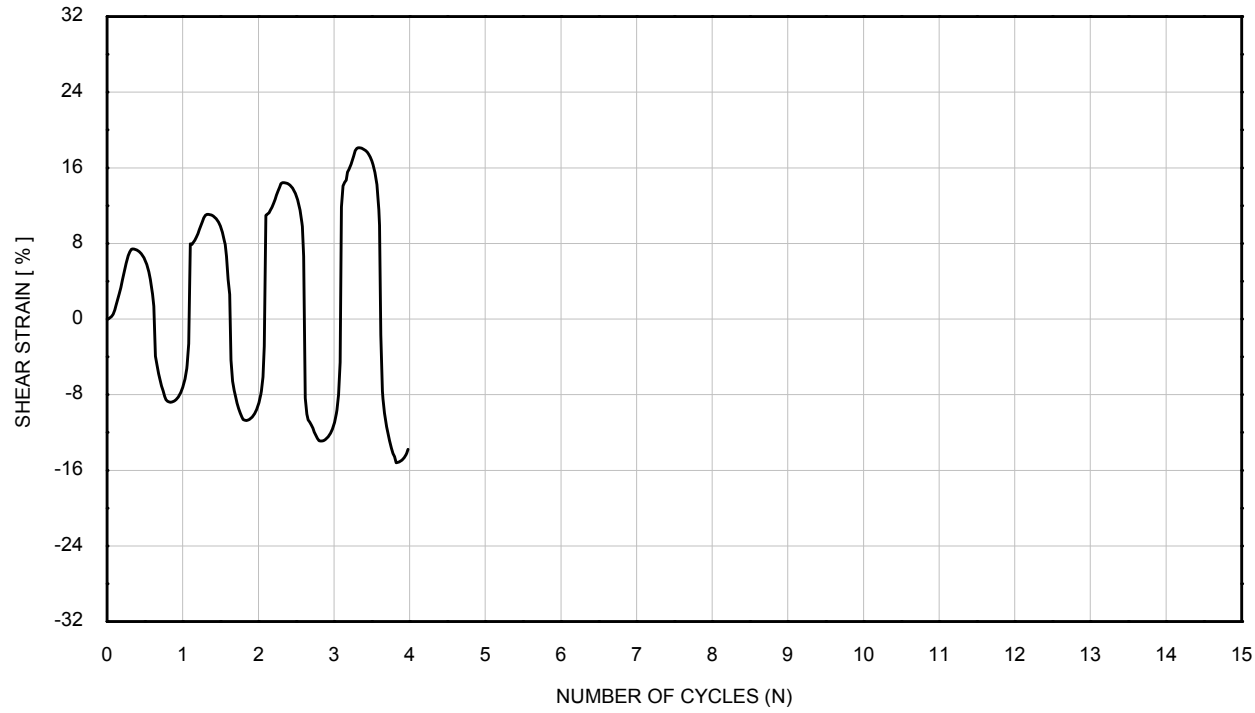




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	9 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

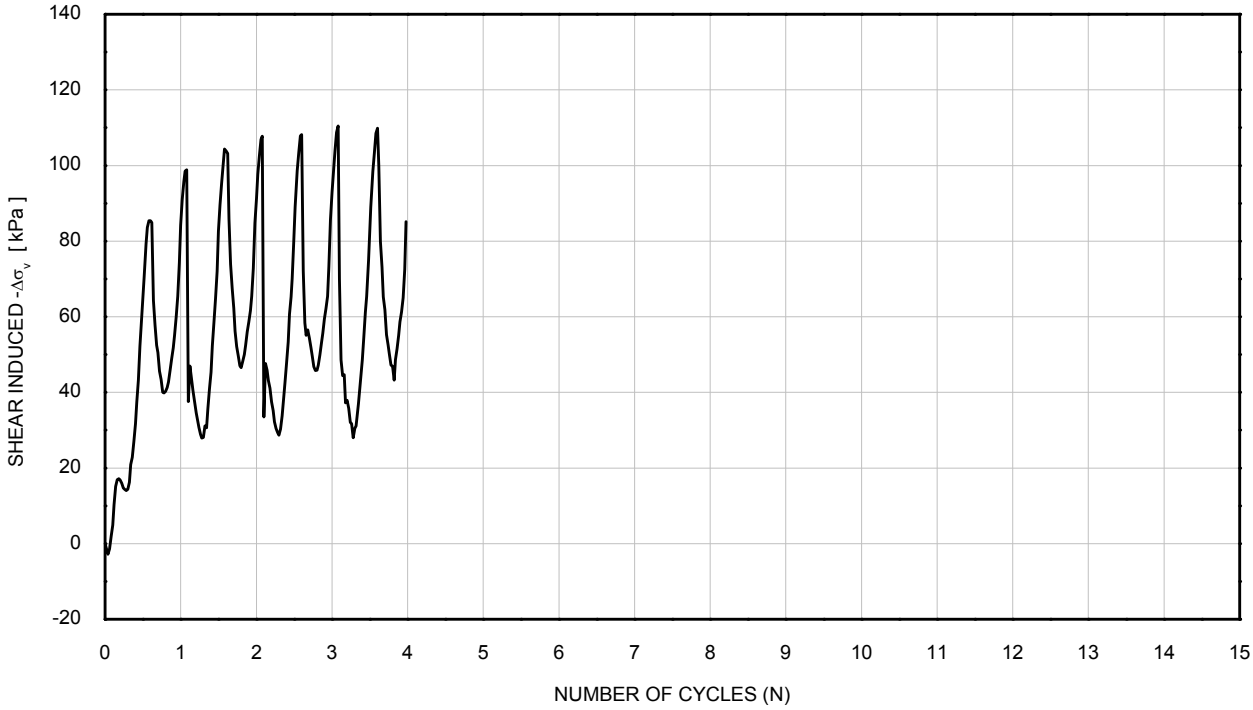
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

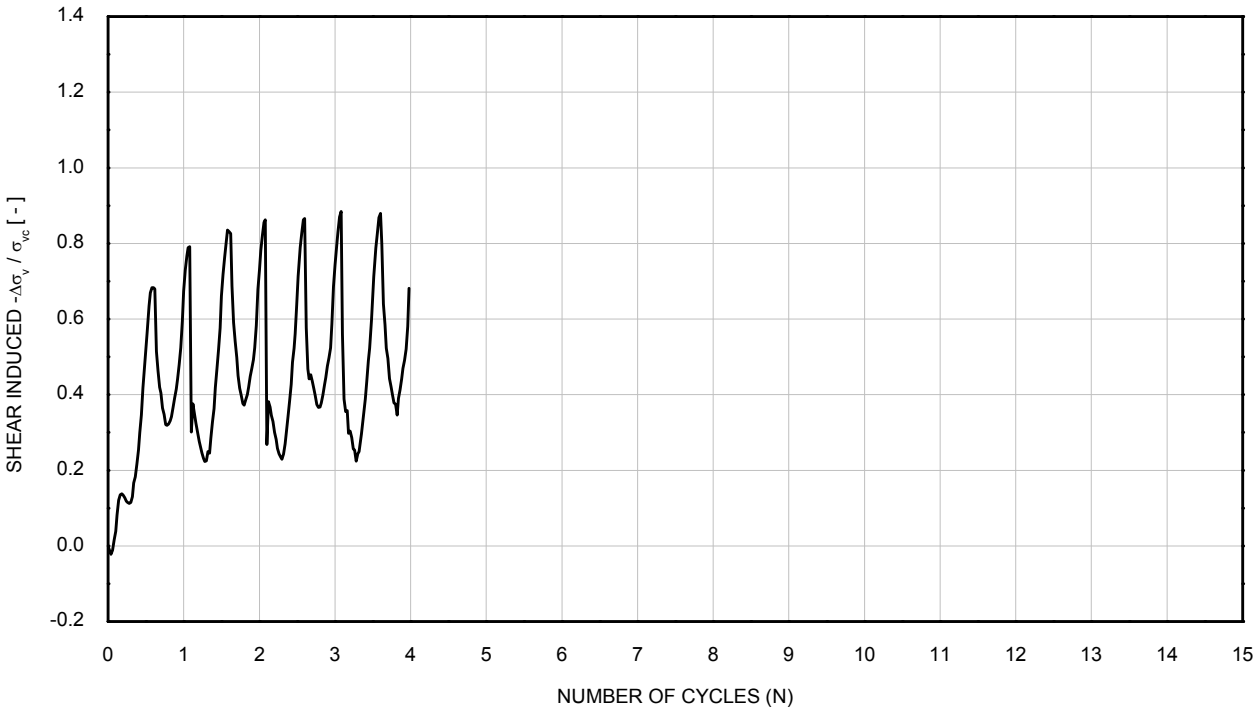




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

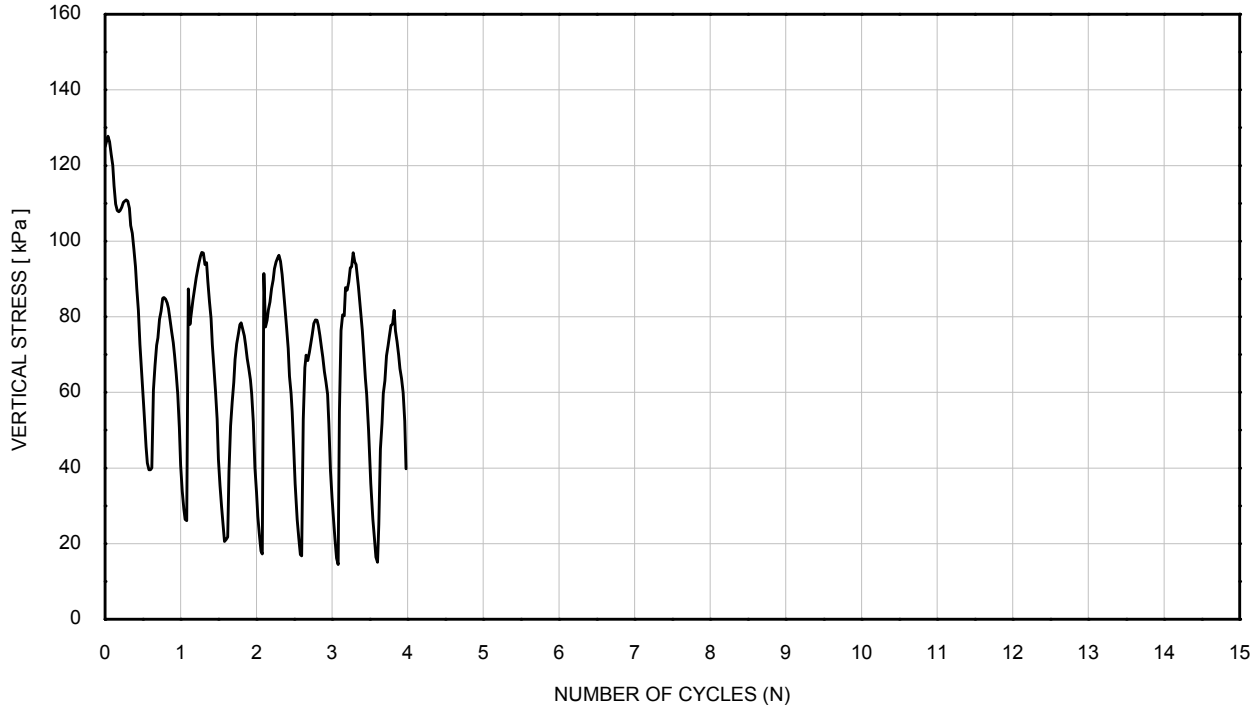
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

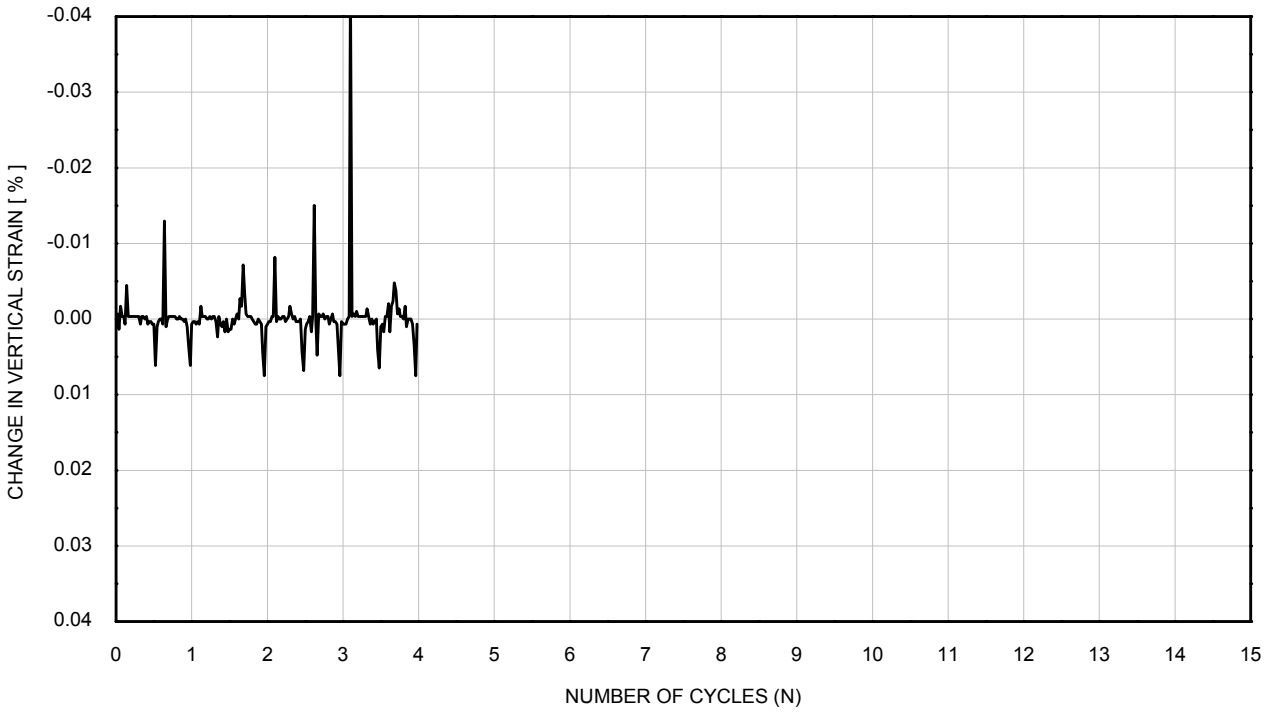




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

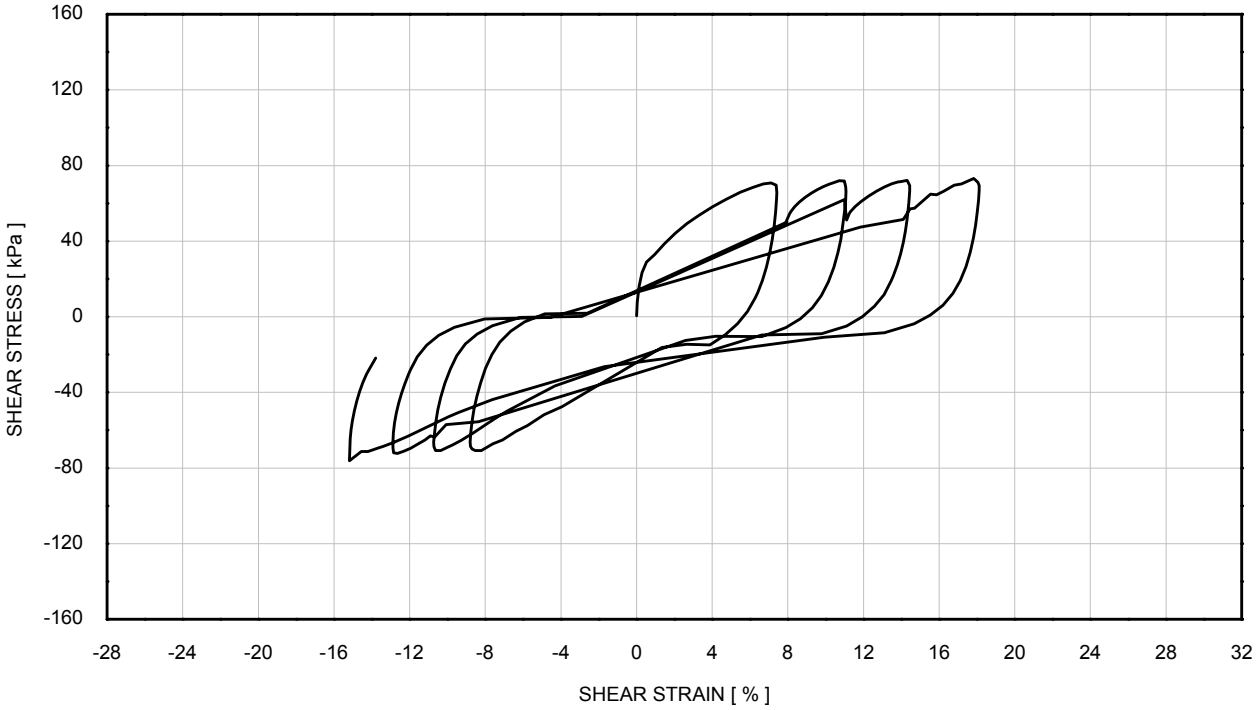
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

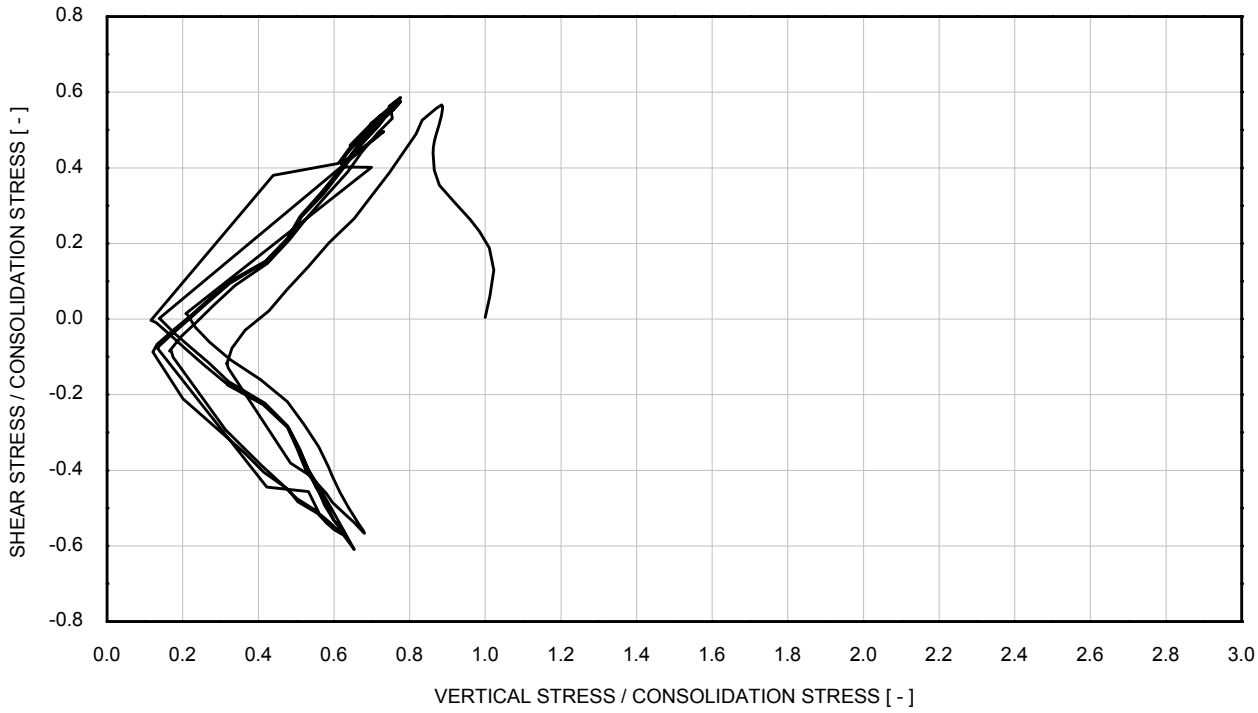




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

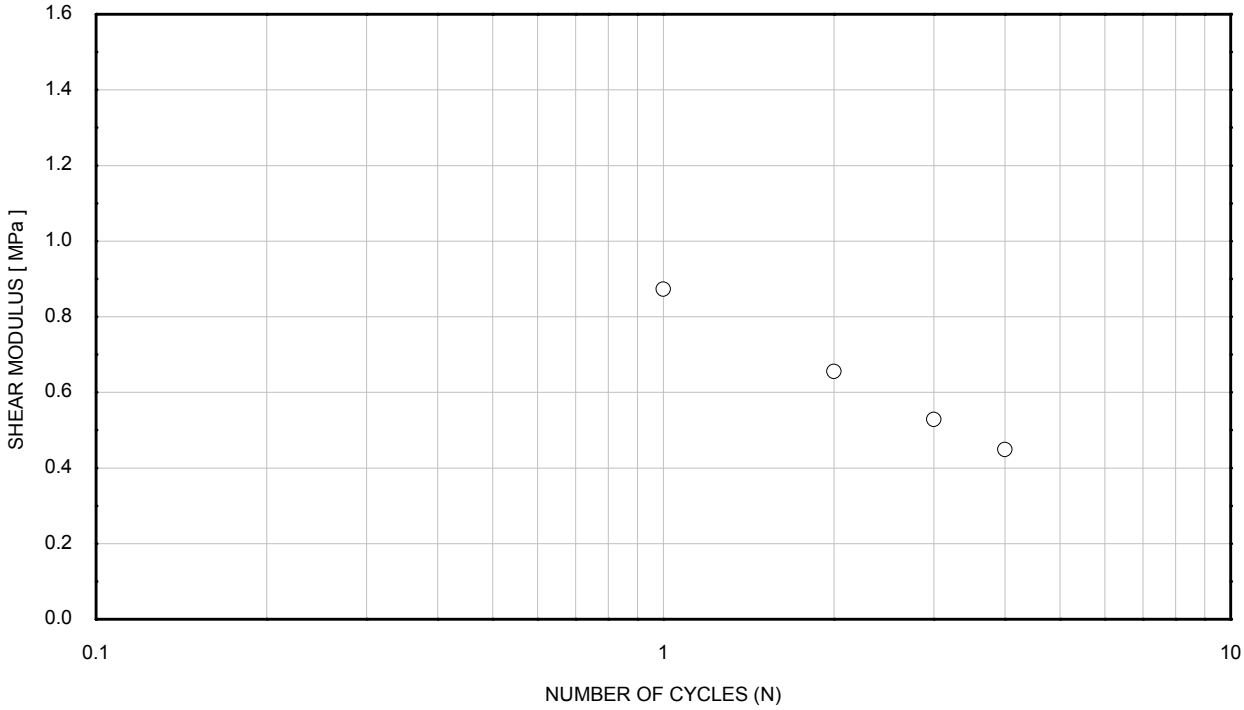
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

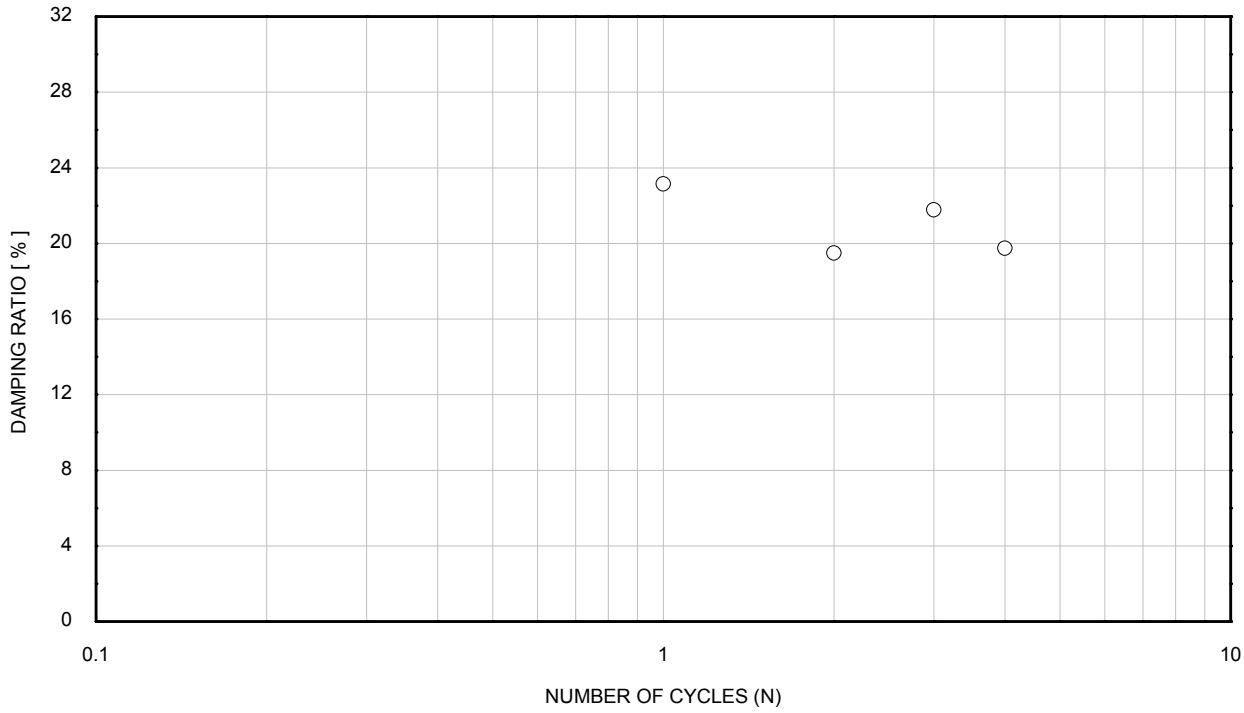




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

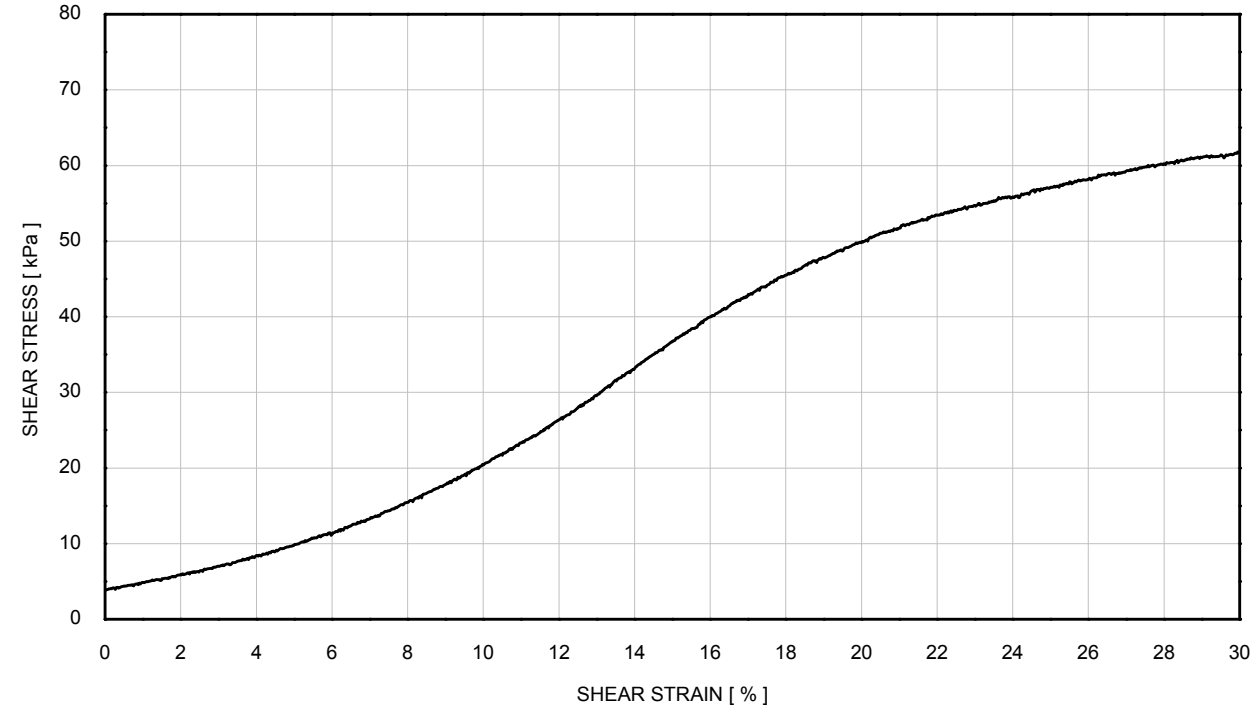
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

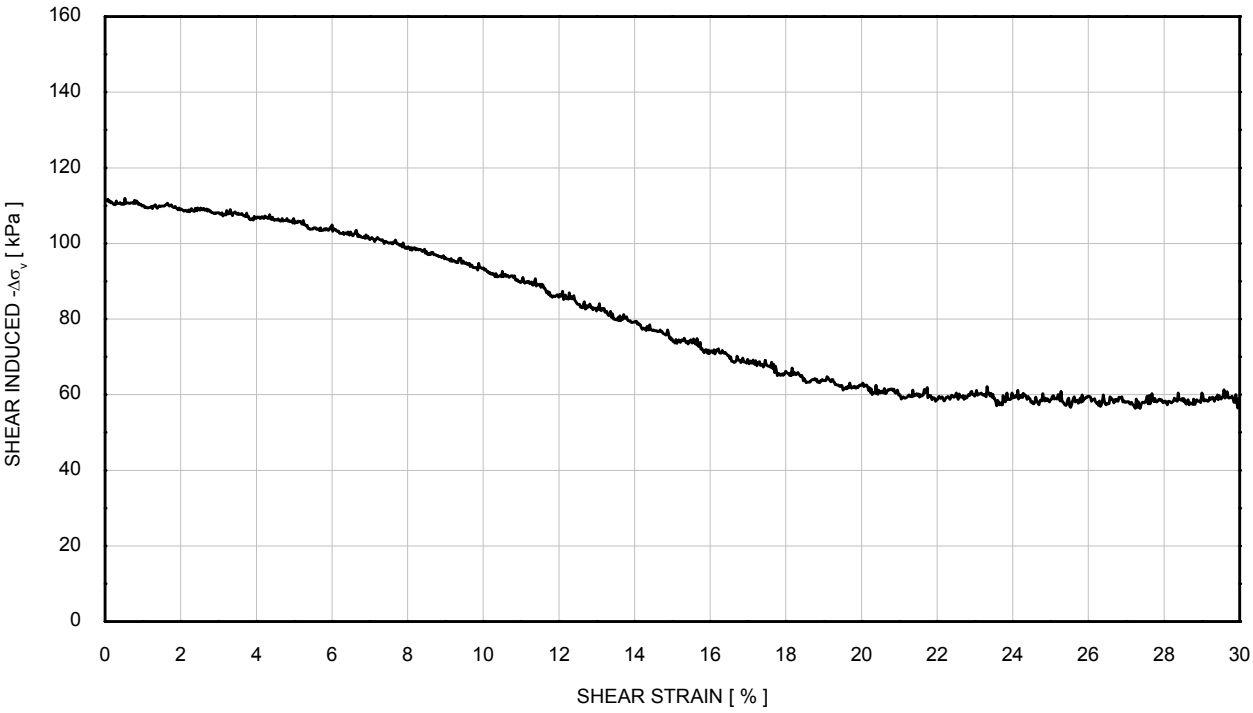




σ_{vc}	:	125 kPa	Borehole	:	HKZ2-BH04-SA
Mean τ_{av}	:	0 kPa	Sample	:	16WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	13.28
Frequency	:	0.10 Hz	Test No.	:	CSS14

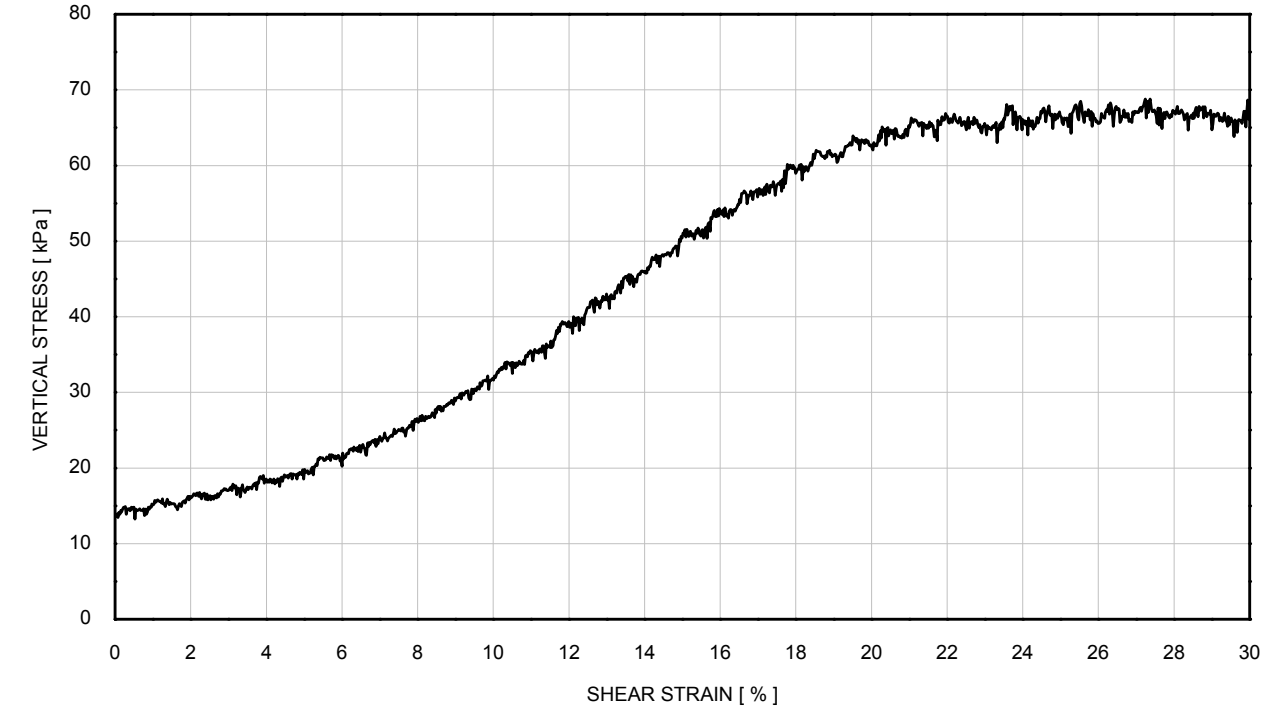
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

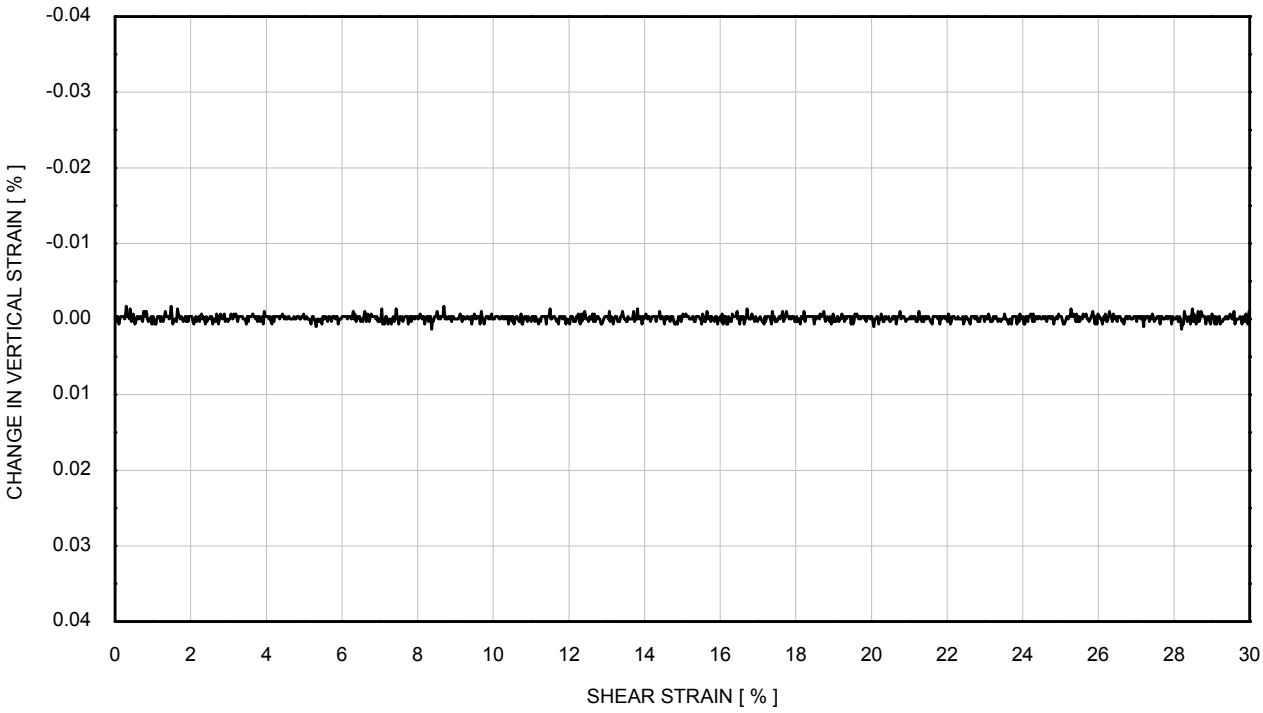




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 62 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.95 %	Depth [m]	: 13.28
Rate of strain	: 3.00 %/hour	Test No.	: CSS14

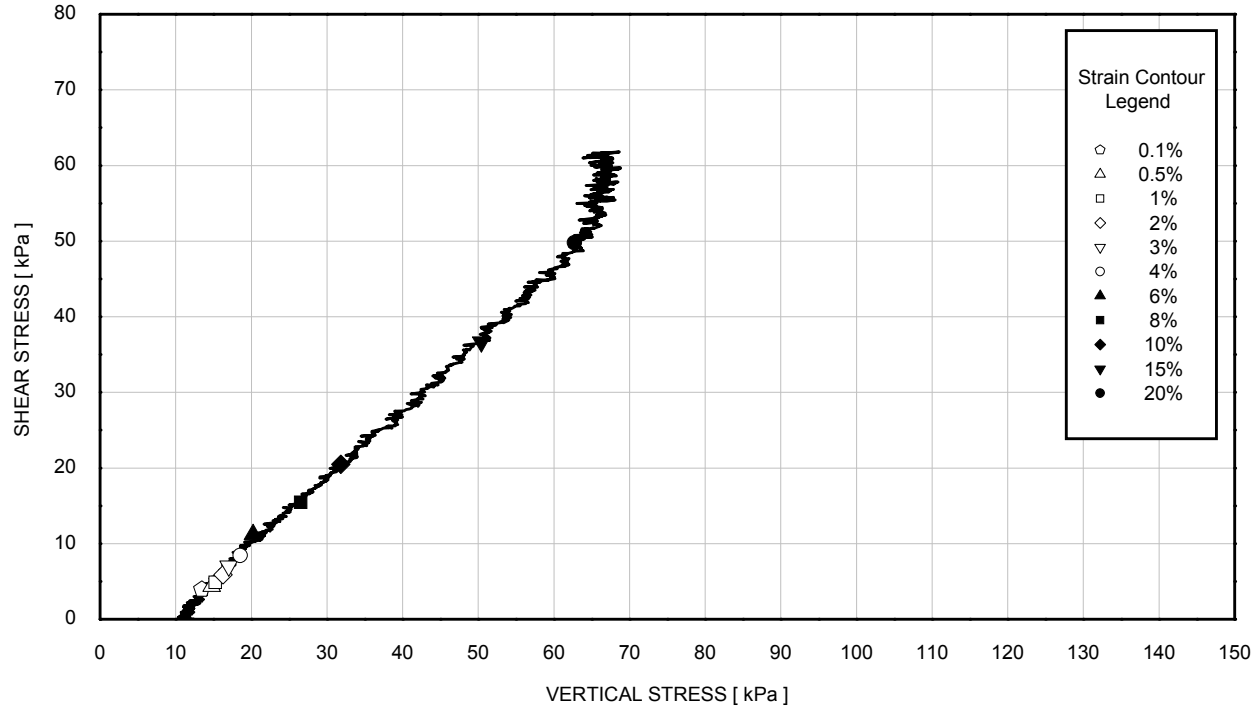
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

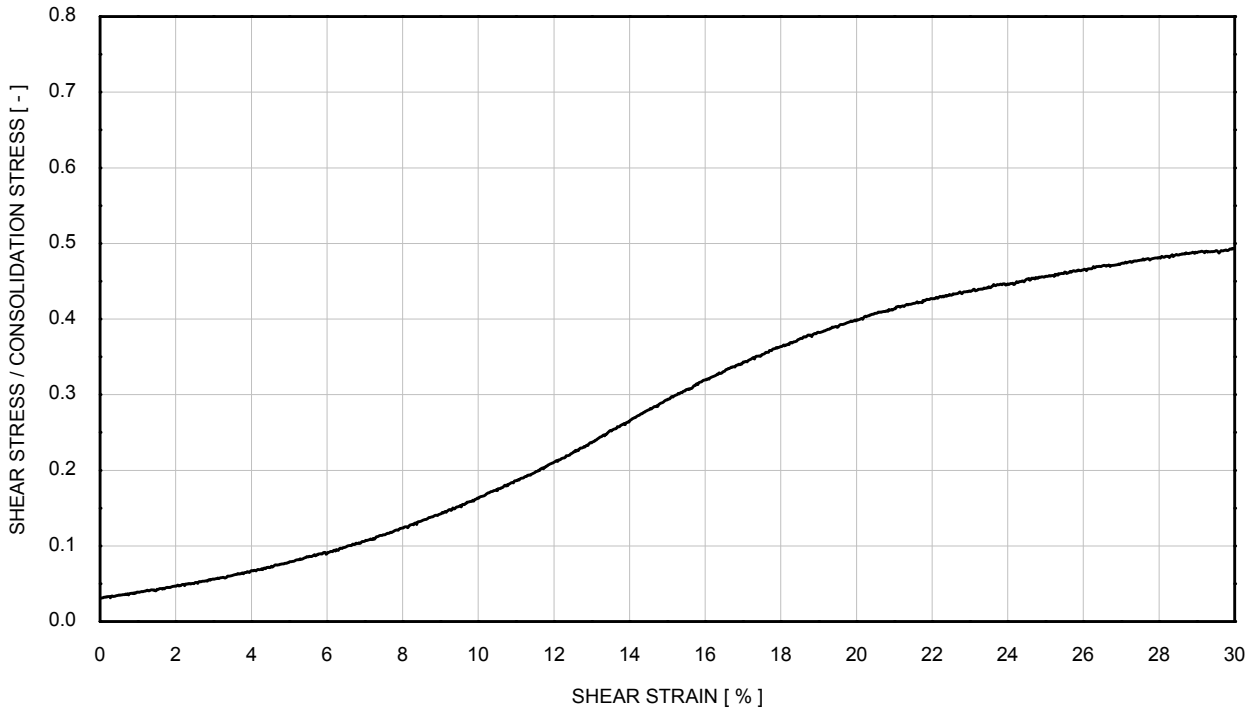




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 62 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.95 %	Depth [m]	: 13.28
Rate of strain	: 3.00 %/hour	Test No.	: CSS14

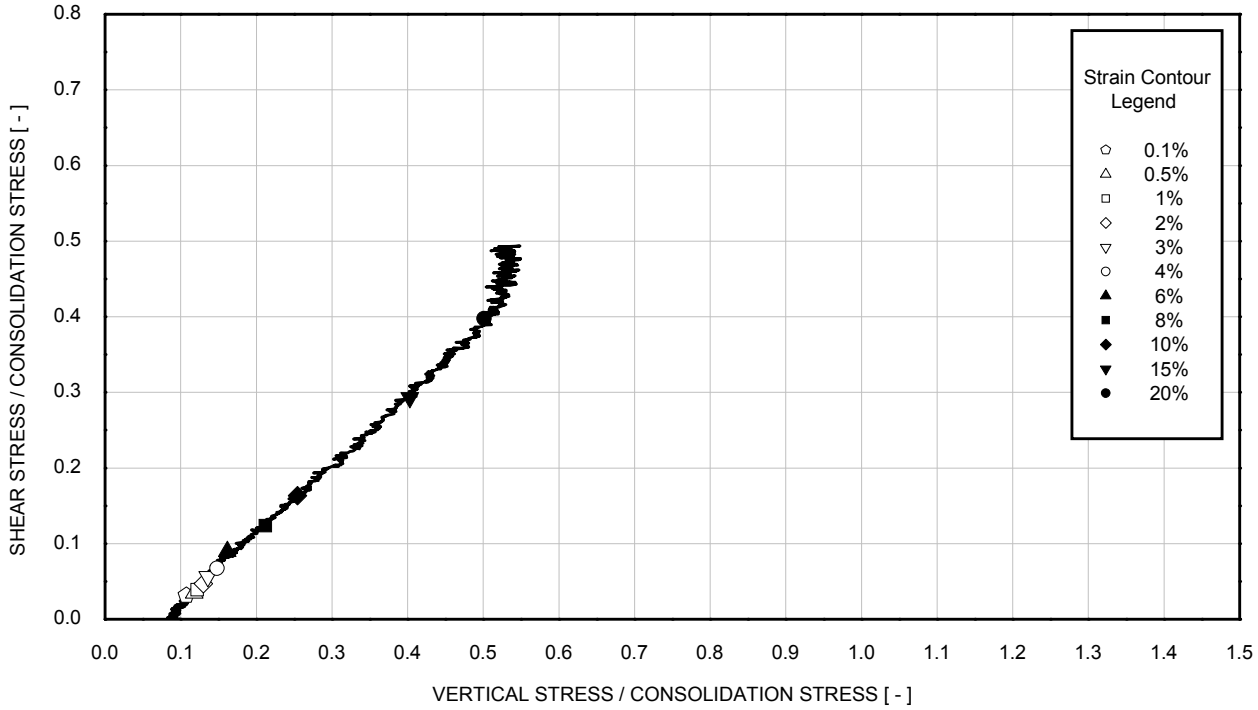
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

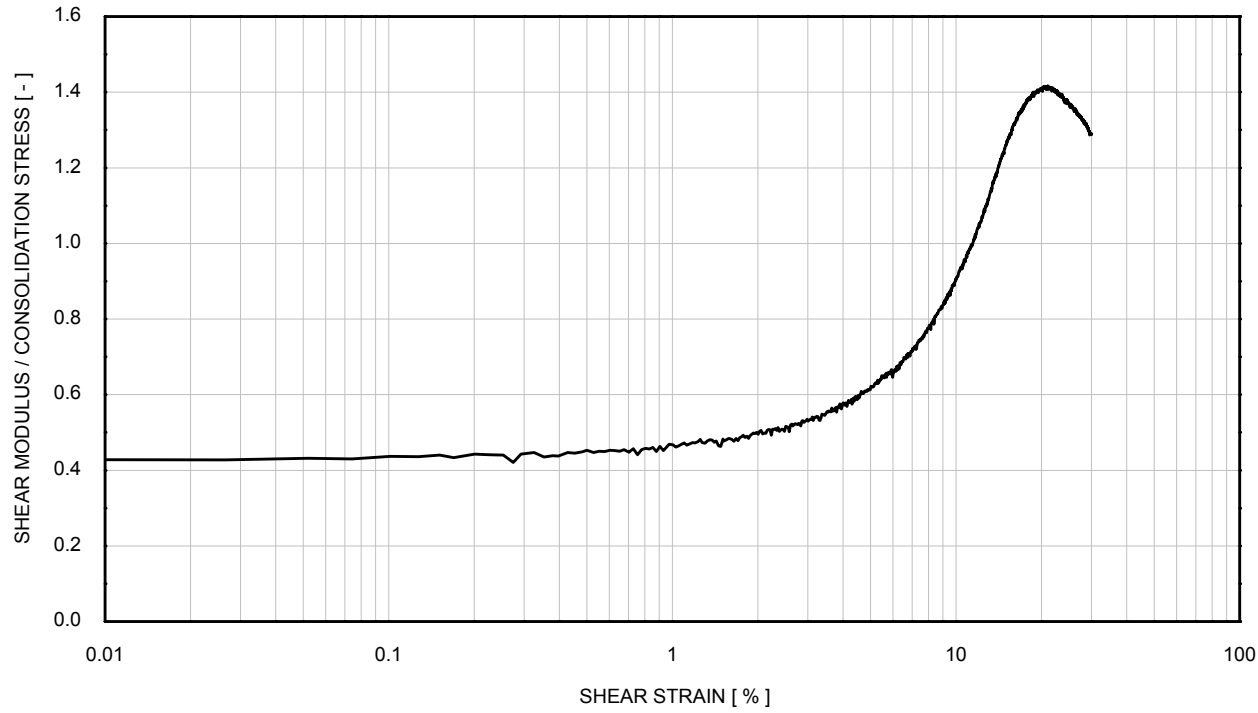




σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 62 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.95 %	Depth [m]	: 13.28
Rate of strain	: 3.00 %/hour	Test No.	: CSS14

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 125 kPa	Borehole	: HKZ2-BH04-SA
τ_{peak}	: 62 kPa	Sample	: 16WaxB
γ at τ_{peak}	: 29.95 %	Depth [m]	: 13.28
Rate of strain	: 3.00 %/hour	Test No.	: CSS14

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Dark grey CLAY

GENERAL	
Date test started	24/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.7
Length	[mm]	30.0
Water content	[%]	26.8
Bulk density	[Mg/m³]	2.01
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.704
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	142
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_24B_CSS15
Template issue	1.4
Processed by	JLS
Date	25/10/2016
Checked by	PH
Date	21/11/2016
Approved by	PH
Date	21/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.69
Test number	CSS15

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	210
Vertical strain	[%]	2.52
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.63
Void ratio	[-]	0.661
Water content	[%]	25.2

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	210
Reference stress	[kPa]	82
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	8
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	2.52
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.63
Void ratio	[-]	0.661

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.26	0.03	25.78	4.16
2	0.26	0.03	24.49	2.47
5	0.26	0.03	25.07	2.37
10	0.26	0.03	25.11	0.72
20	0.26	0.03	25.55	2.22
30	0.26	0.03	26.37	2.52
40	0.26	0.03	26.28	1.77
50	0.26	0.03	26.28	2.03
100	0.26	0.03	25.49	1.93
200	0.26	0.03	25.20	1.37
300	0.27	0.03	25.02	2.23
400	0.27	0.03	25.11	0.61

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.69
Test number	CSS15

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	82
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	33
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
γ_{av} at N_f	[%]	0.03
γ_{cy} at N_f	[%]	0.24
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	41
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.01	0.18	18.64	8.29
2	0.01	0.18	18.00	7.56
5	0.01	0.19	17.42	7.27
10	0.01	0.19	16.97	7.21
20	0.01	0.20	16.36	7.20
30	0.01	0.20	16.17	7.15
40	0.01	0.21	15.88	7.22
50	0.01	0.21	15.63	7.22
100	0.01	0.21	15.24	7.39
500	0.02	0.23	14.15	7.59
1000	0.02	0.24	13.72	7.64
1500	0.03	0.24	13.59	7.78

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	124
Shear strain	[%]	20.75
Shear induced $-\Delta\sigma_v$	[kPa]	55
Vertical stress	[kPa]	155
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.98
At 15 % shear strain		
Shear stress	[kPa]	122
Shear induced $-\Delta\sigma_v$	[kPa]	68
Vertical stress	[kPa]	142
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.69
Test number	CSS15

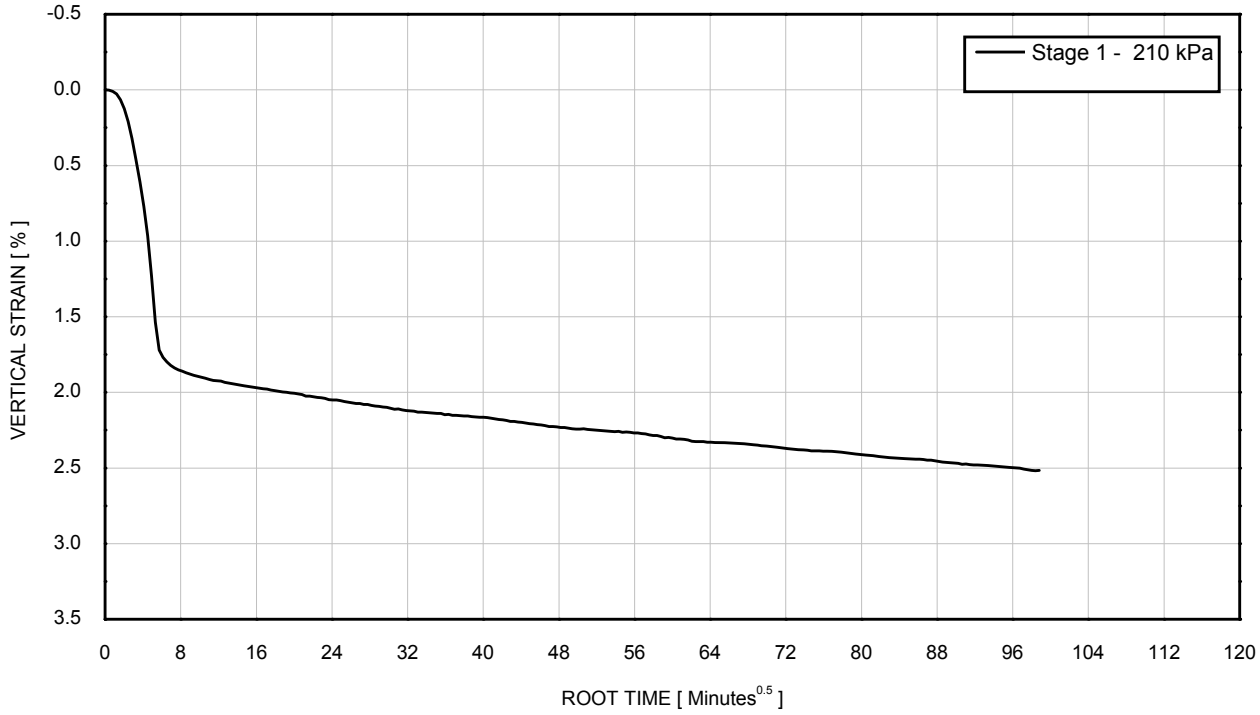
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

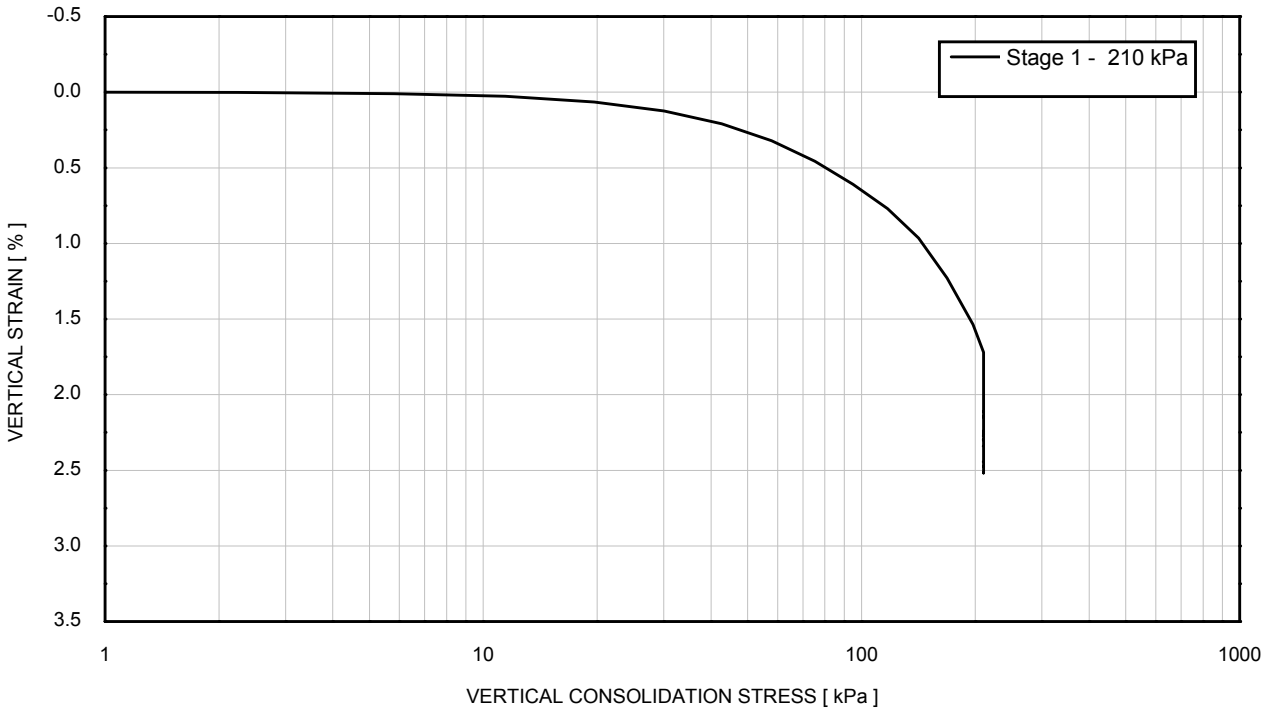
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.69
Test number	CSS15

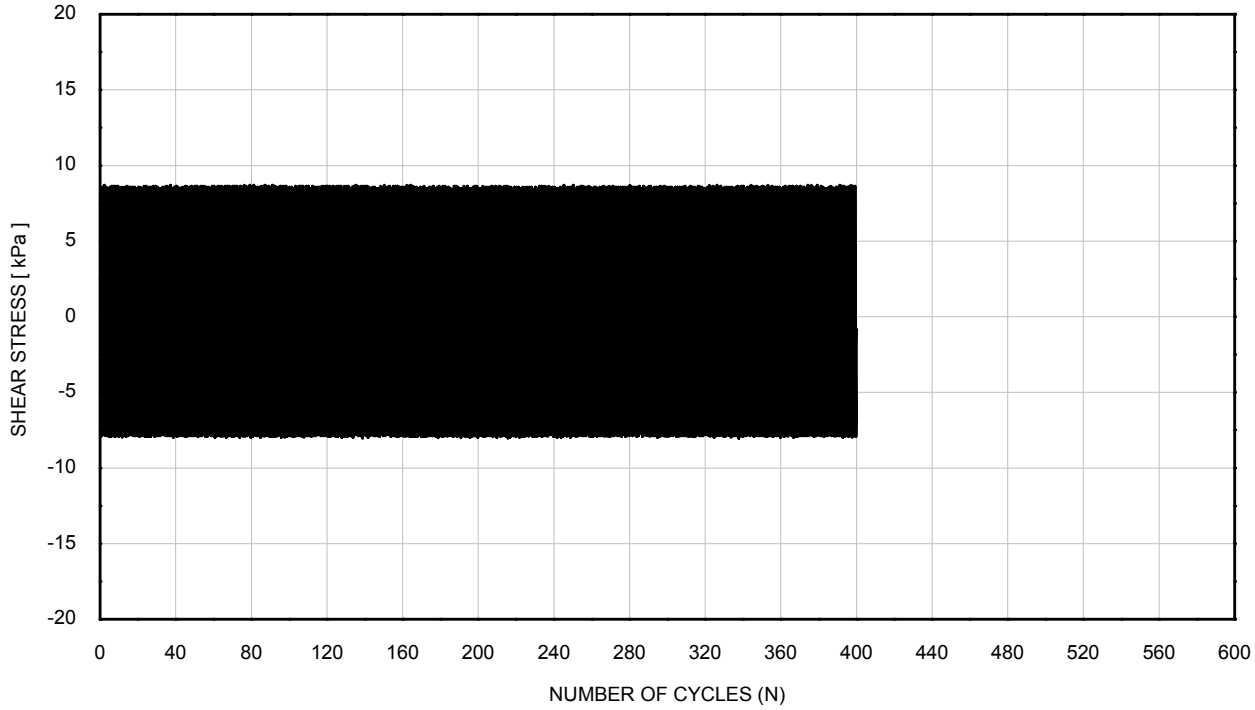
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

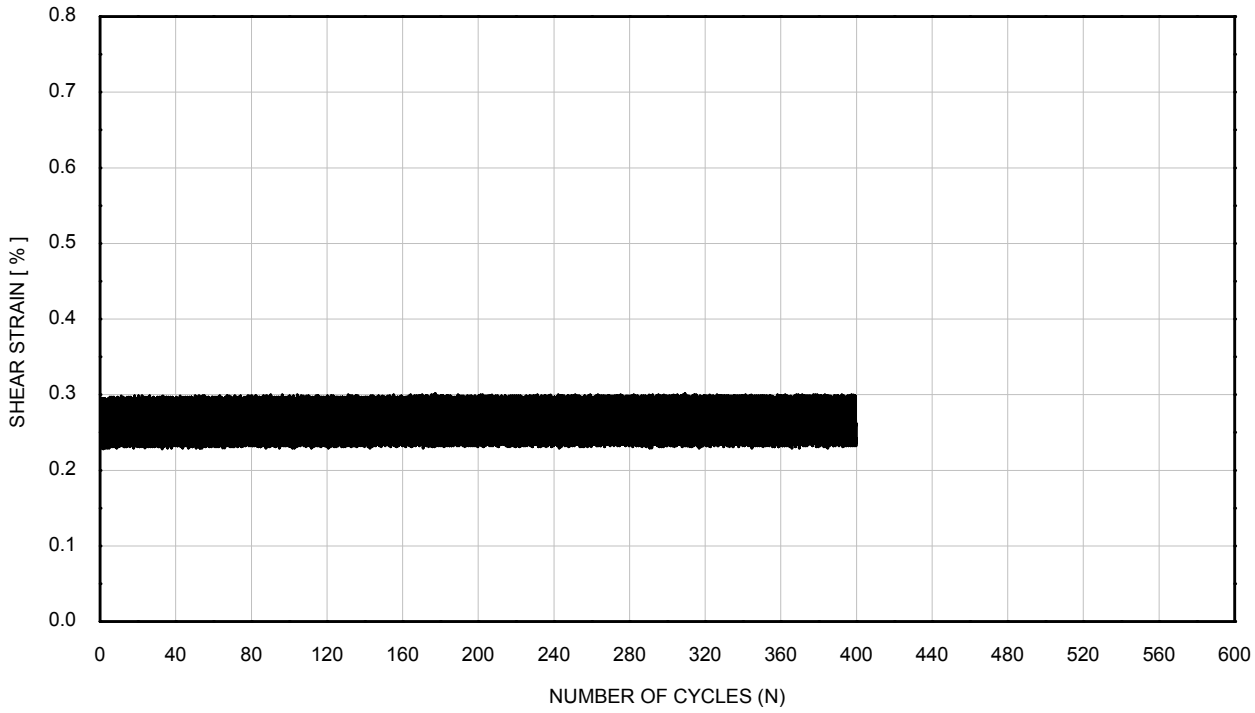




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 24WaxB
		Depth [m]	: 21.69
		Test No.	: CSS15

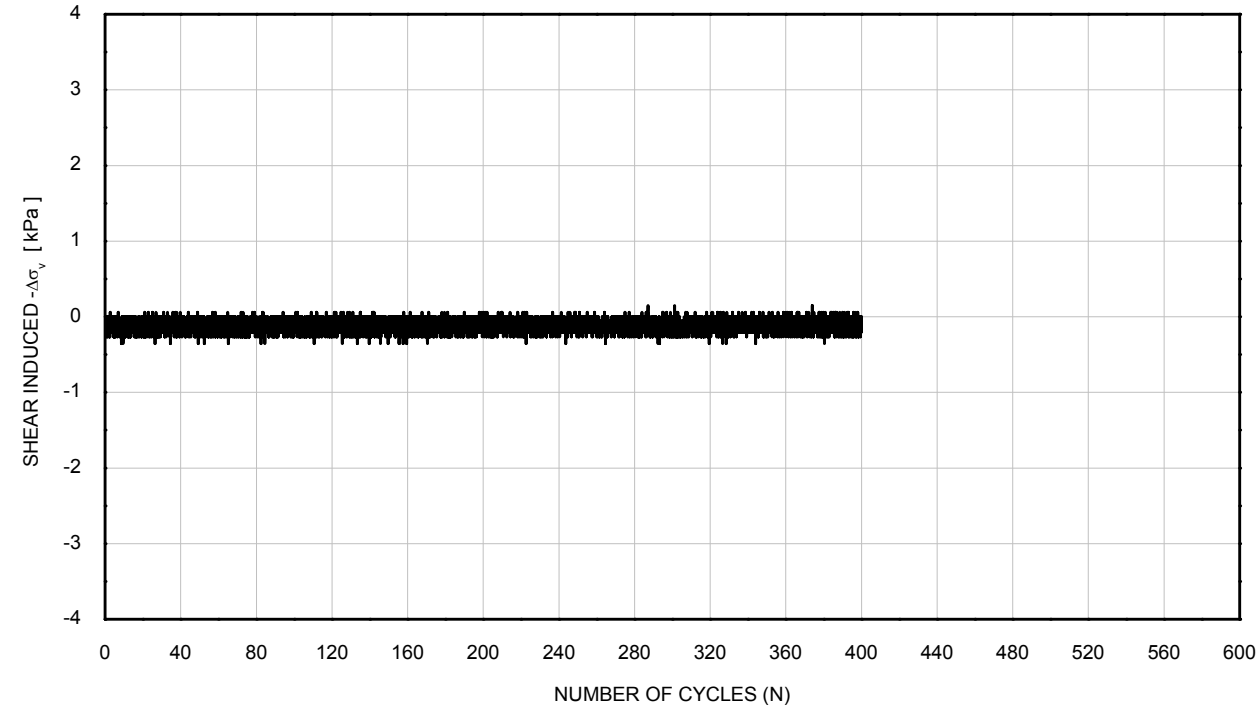
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

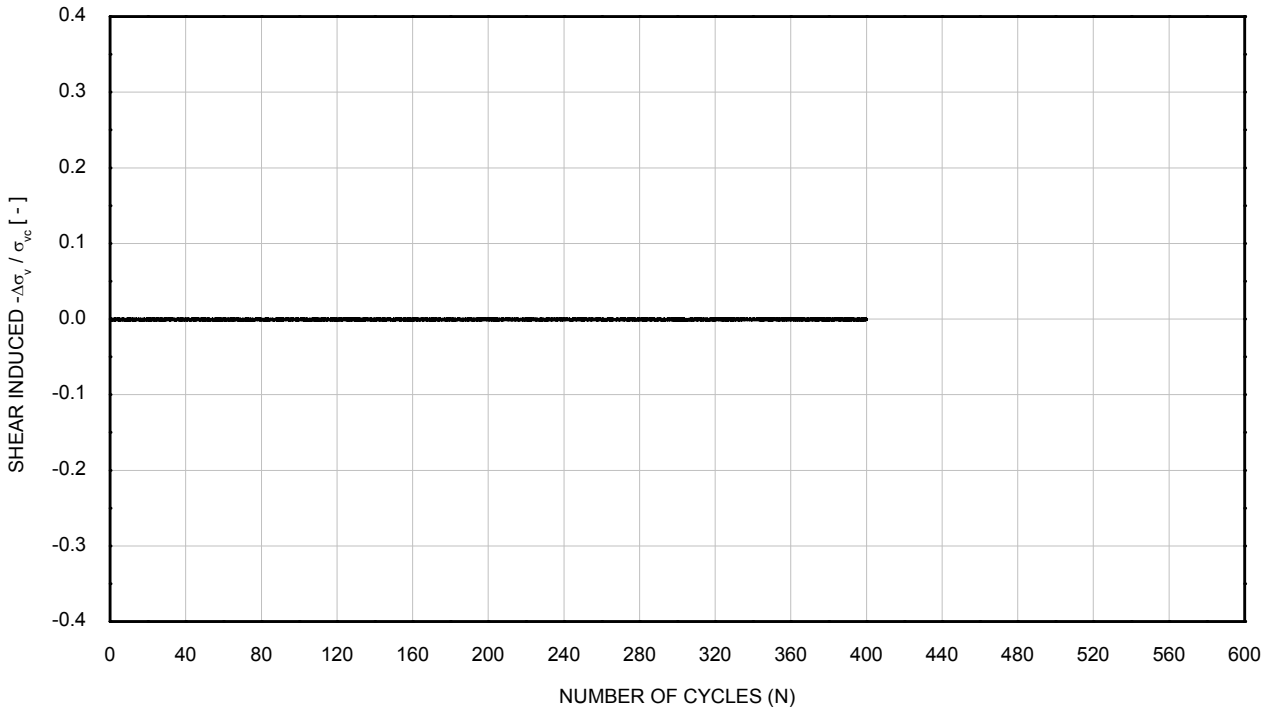




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

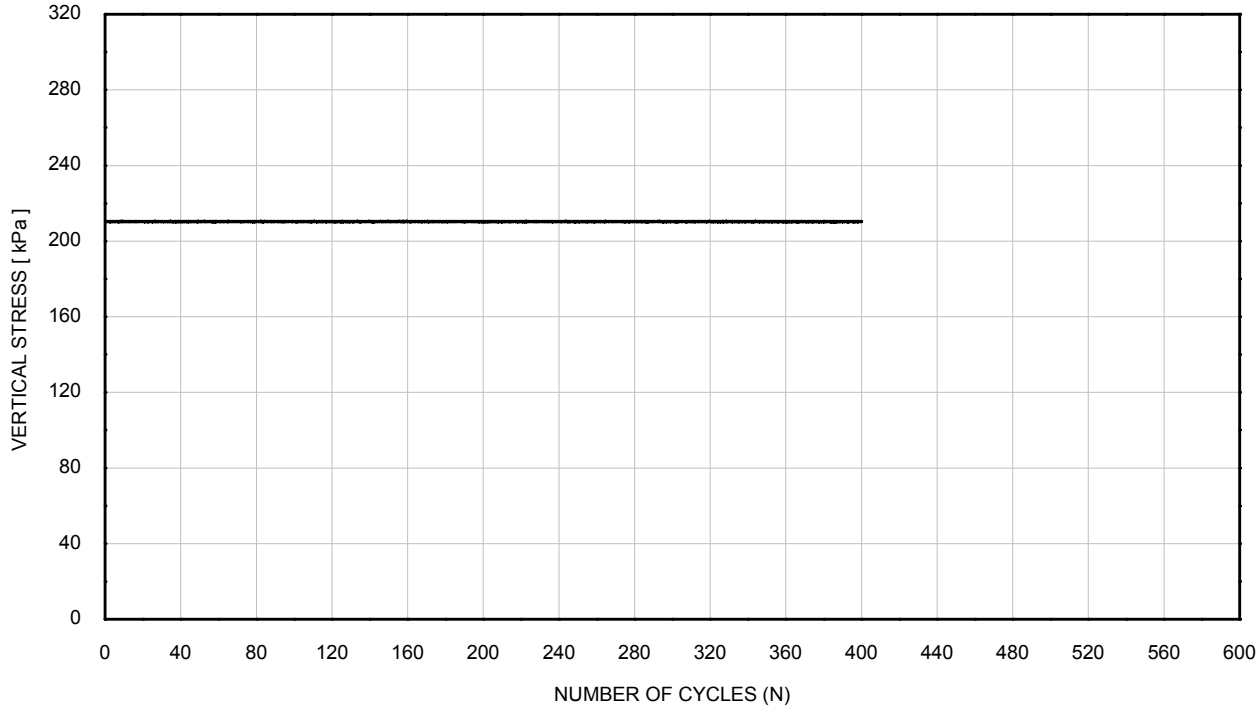
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

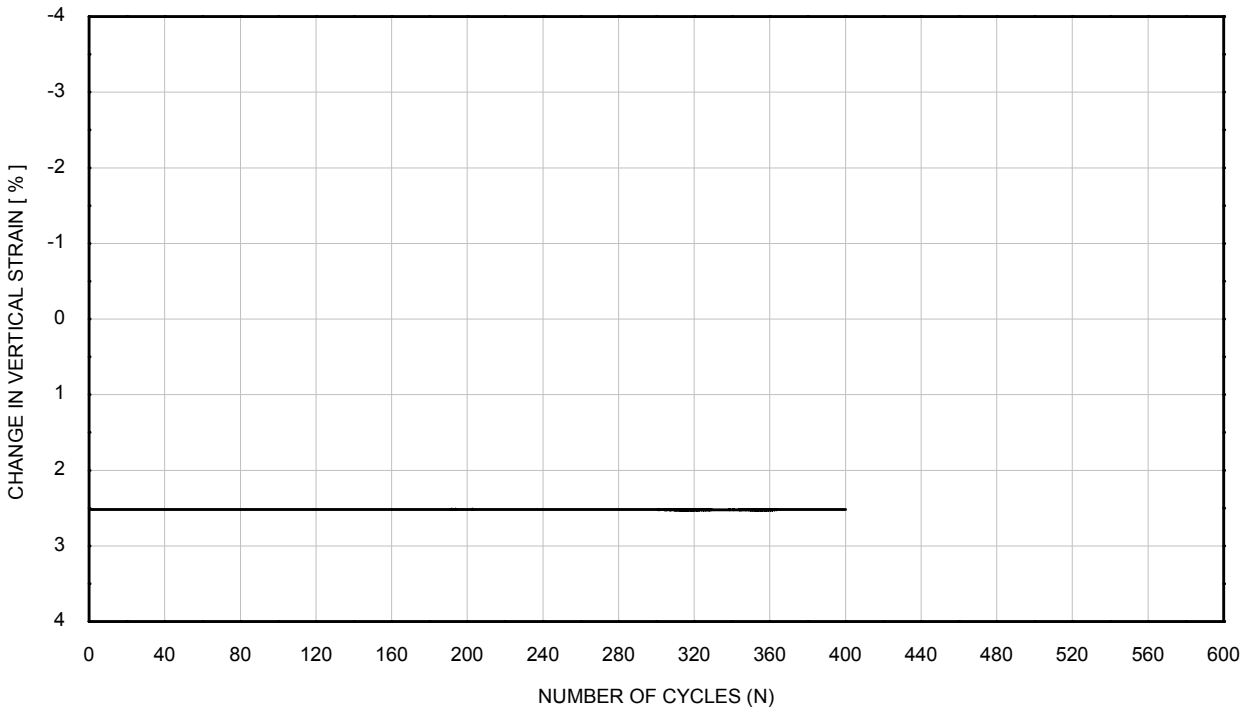




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

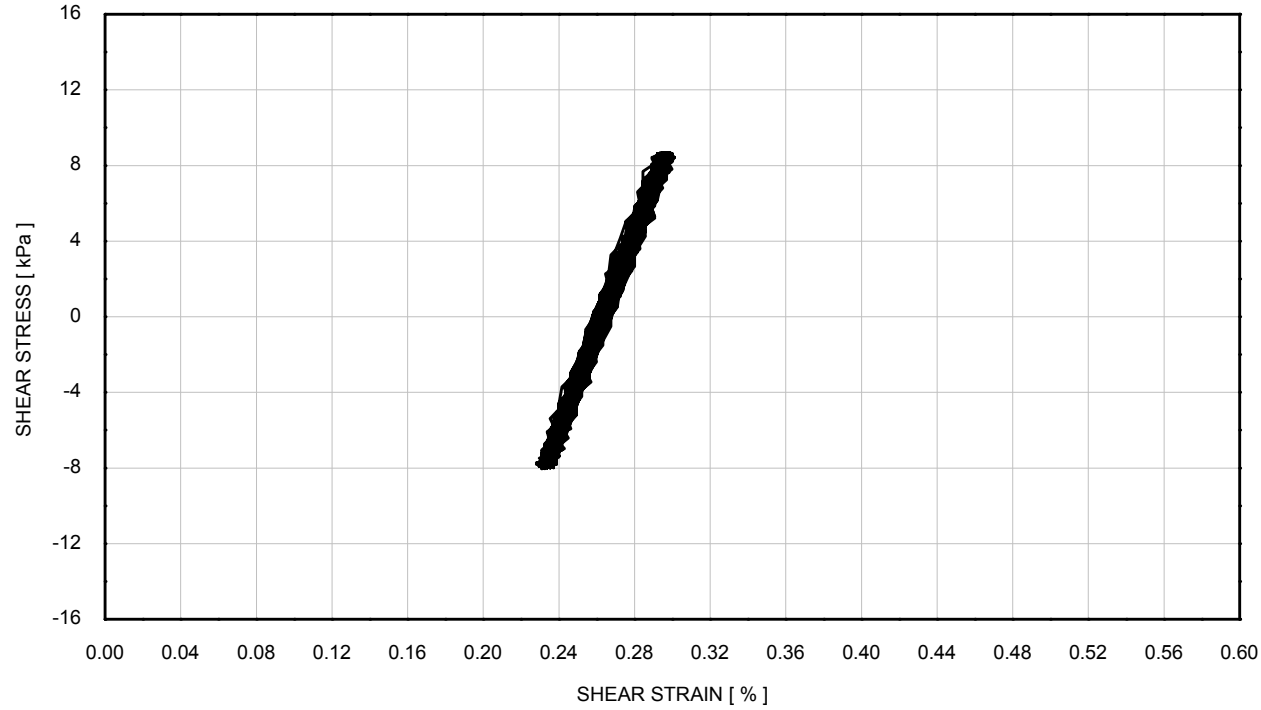
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

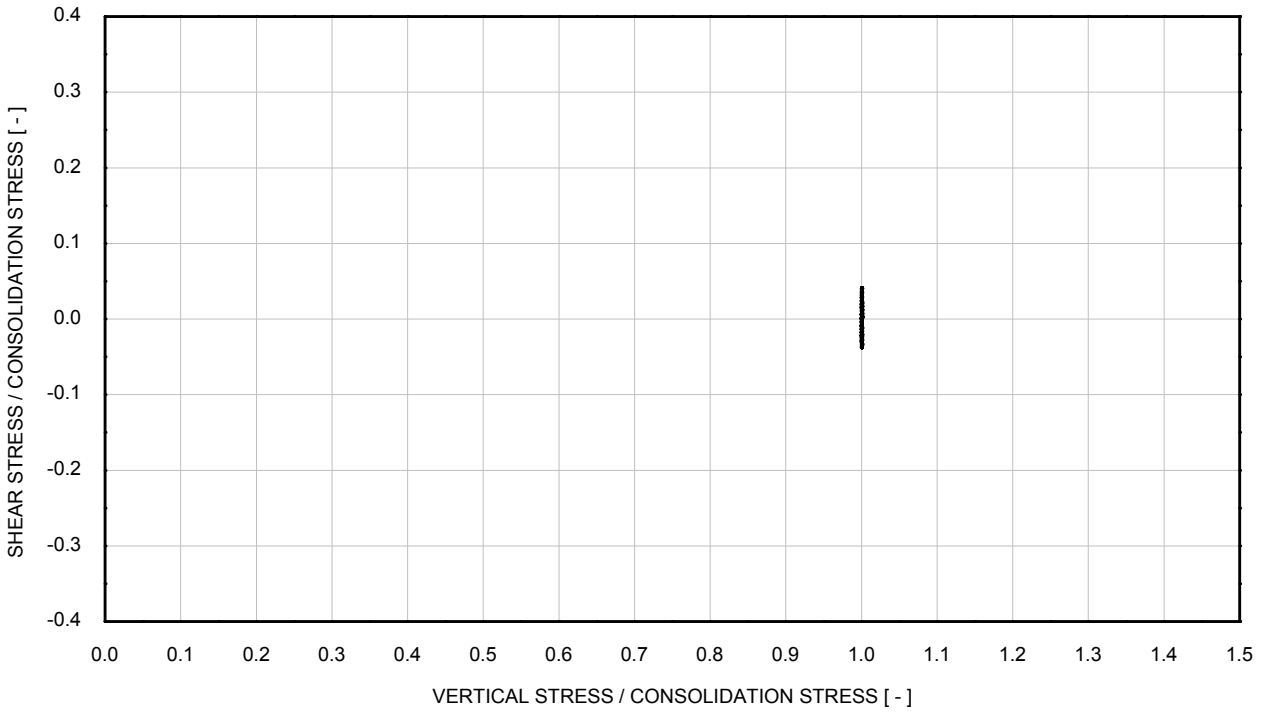




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

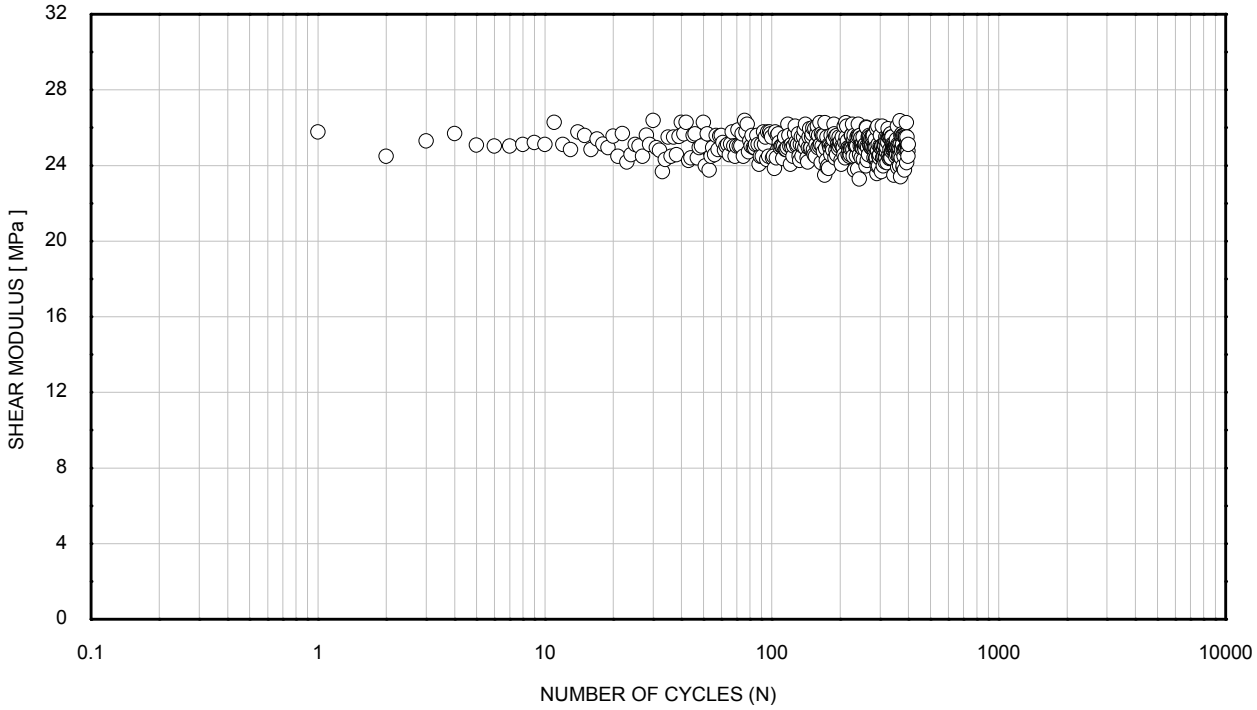
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

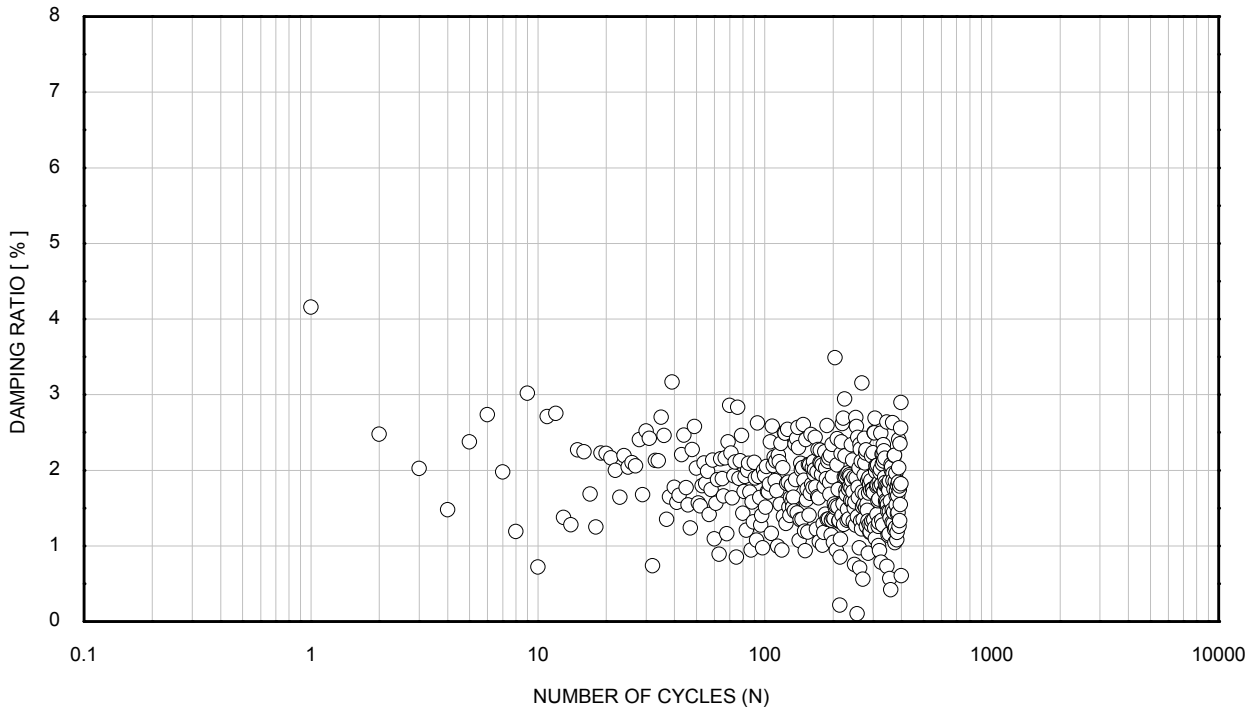




σ_{vc}	:	210 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	: 21.69
Frequency	:	0.10 Hz	Test No.	: CSS15

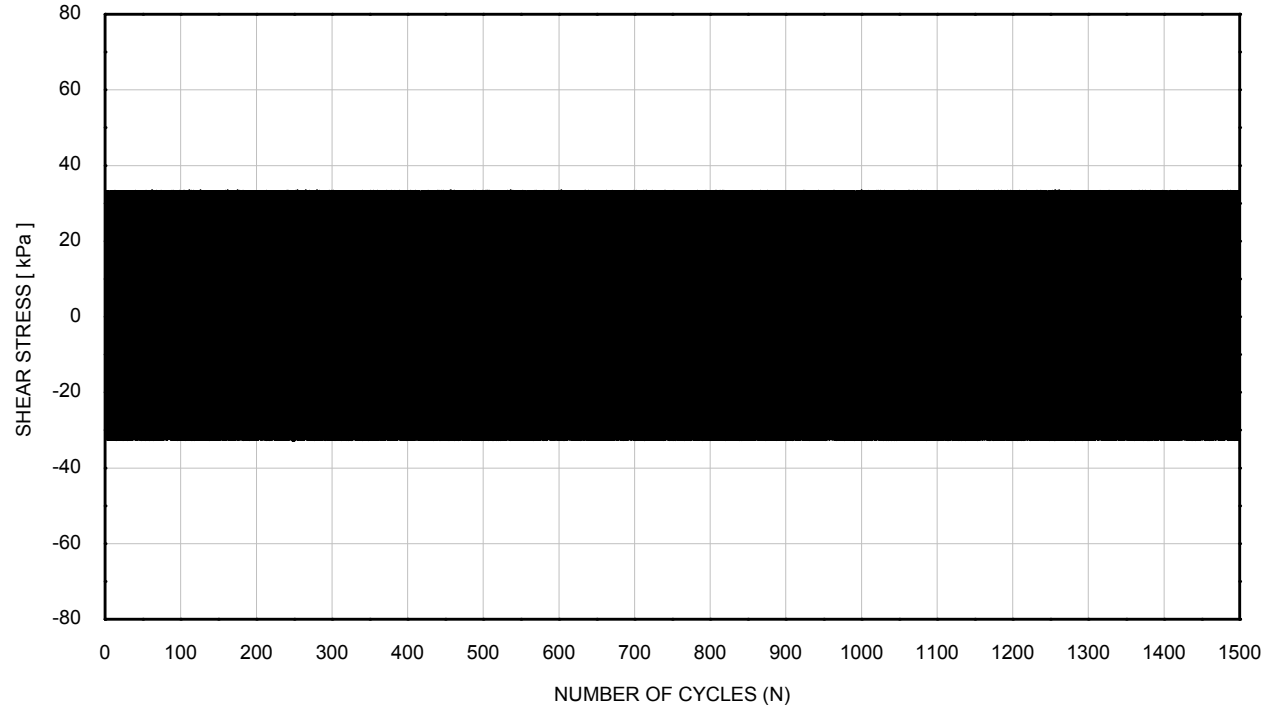
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

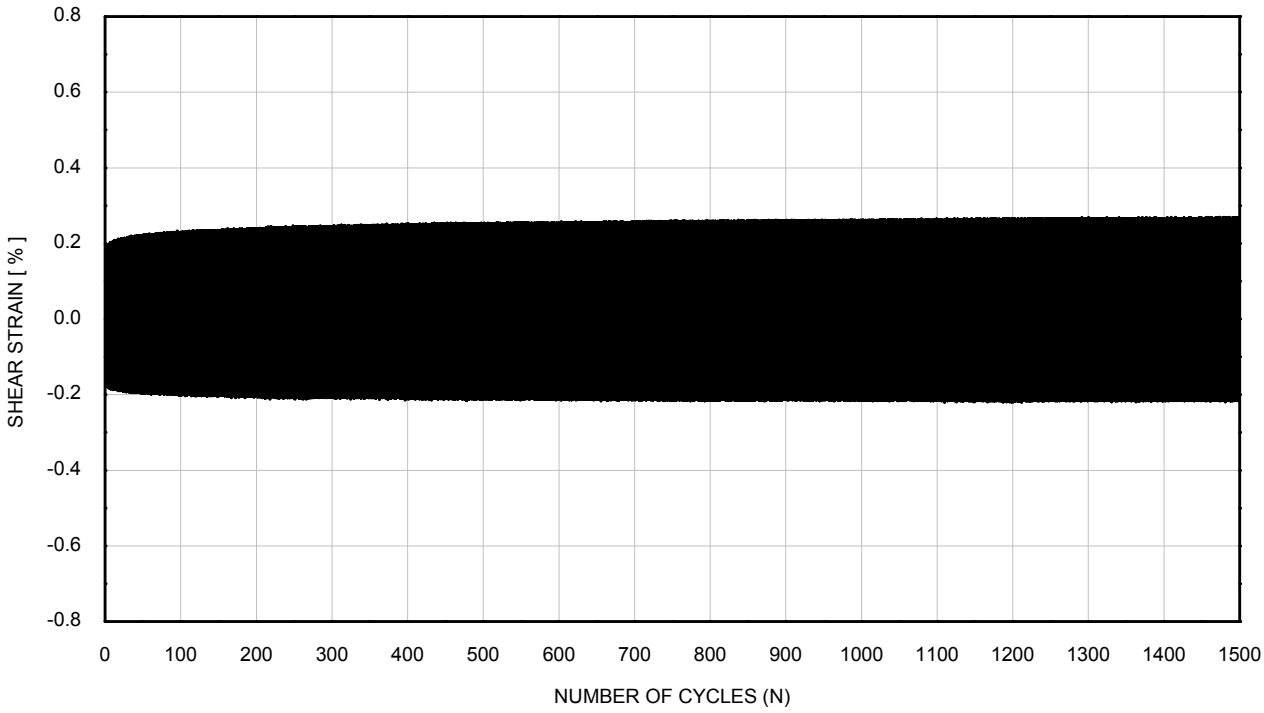




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

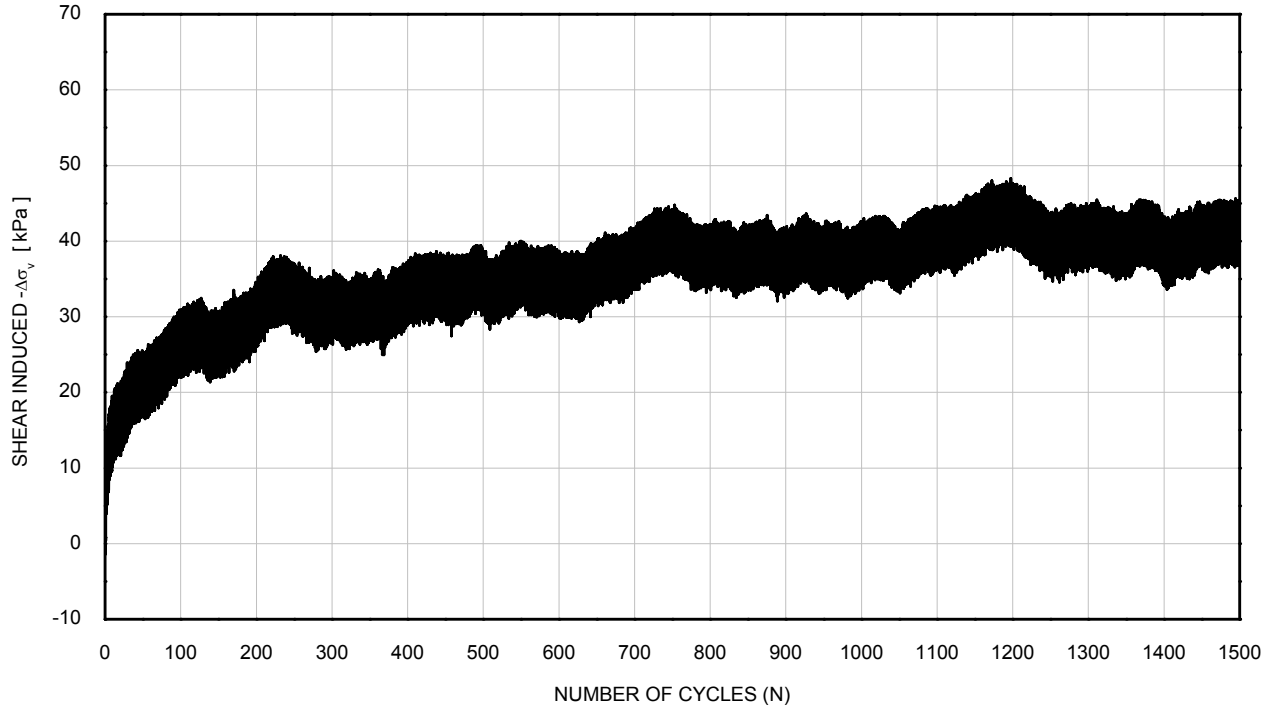
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

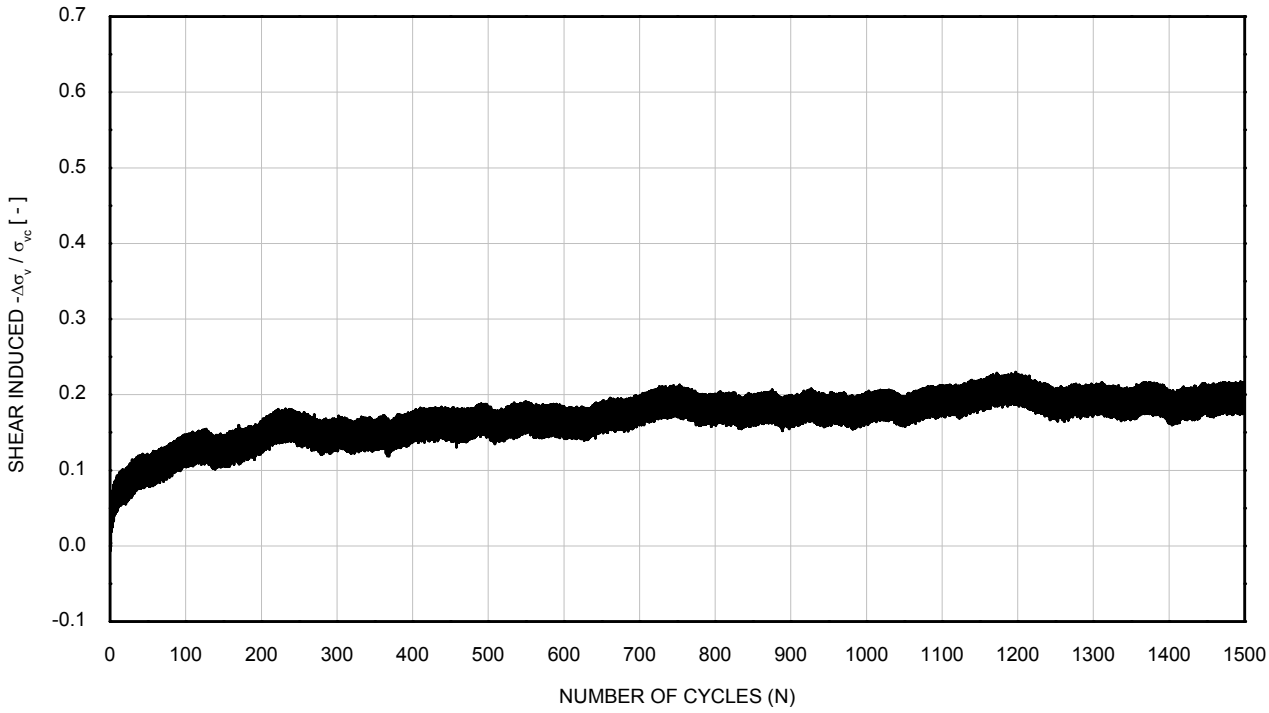




σ_{vc}	:	210 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 24WaxB
Mean τ_{cy}	:	33 kPa	Depth [m]	: 21.69
Frequency	:	0.10 Hz	Test No.	: CSS15

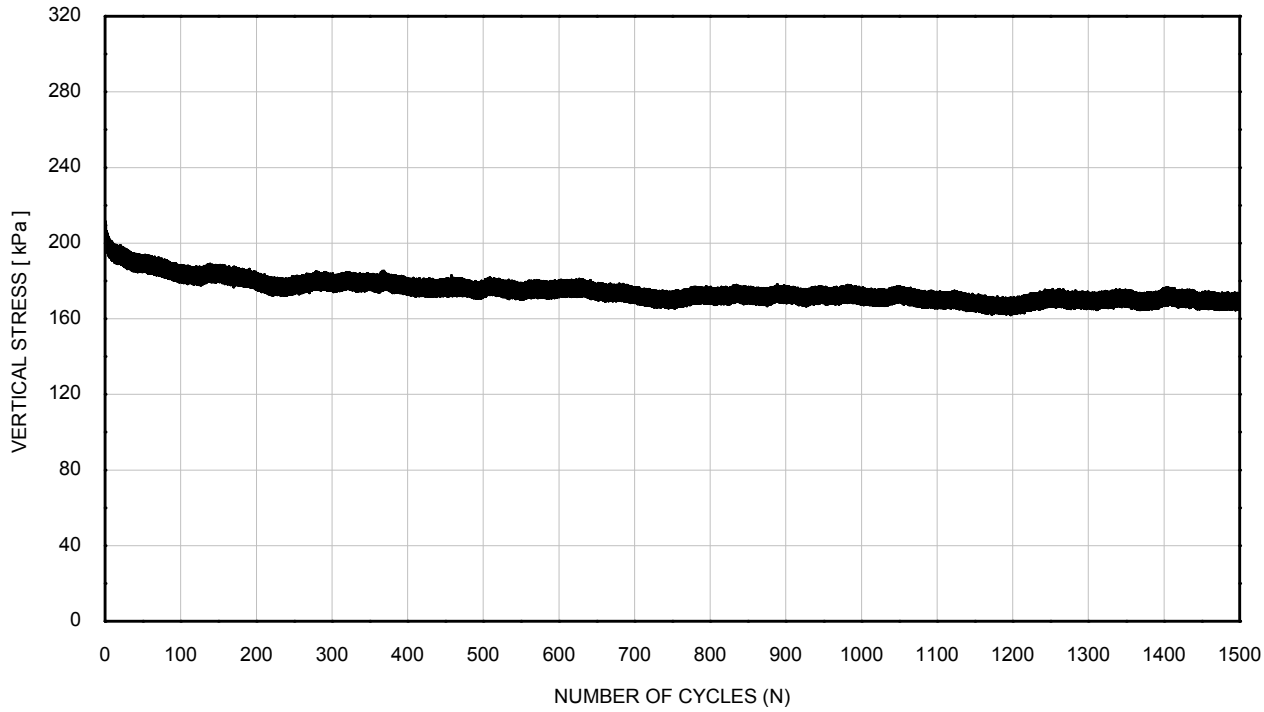
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

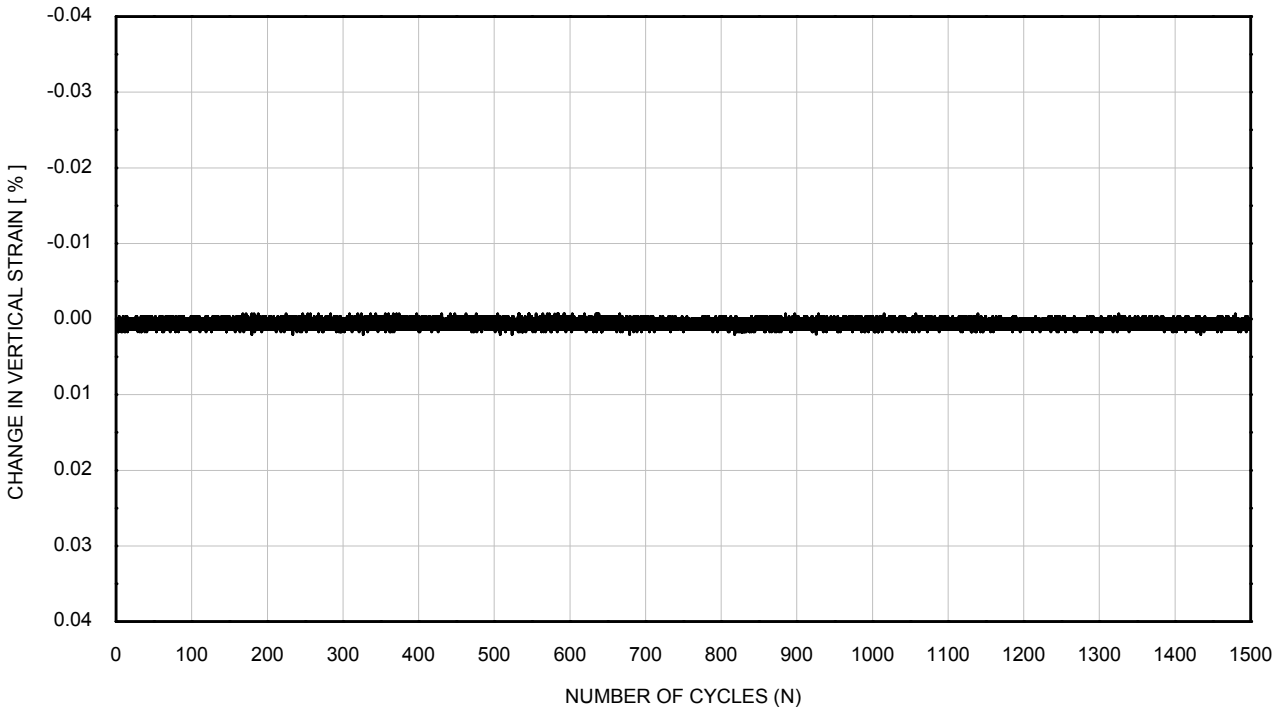




σ_{vc}	:	210 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 24WaxB
Mean τ_{cy}	:	33 kPa	Depth [m]	: 21.69
Frequency	:	0.10 Hz	Test No.	: CSS15

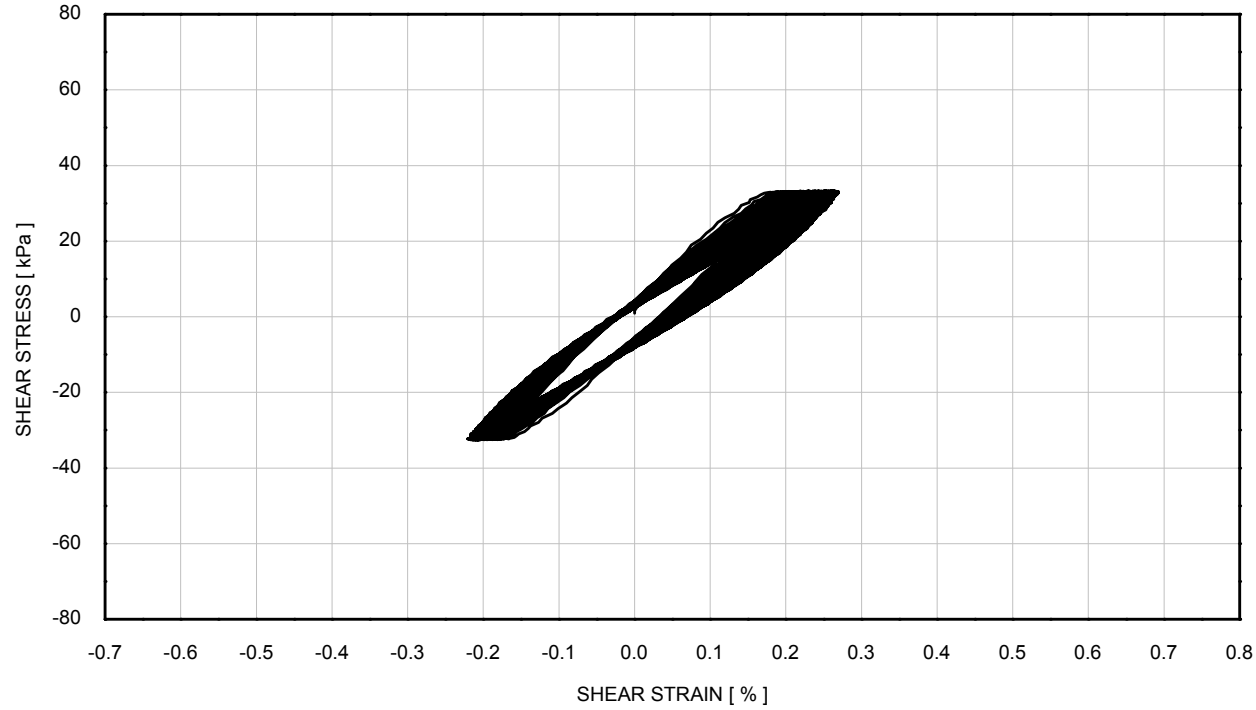
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

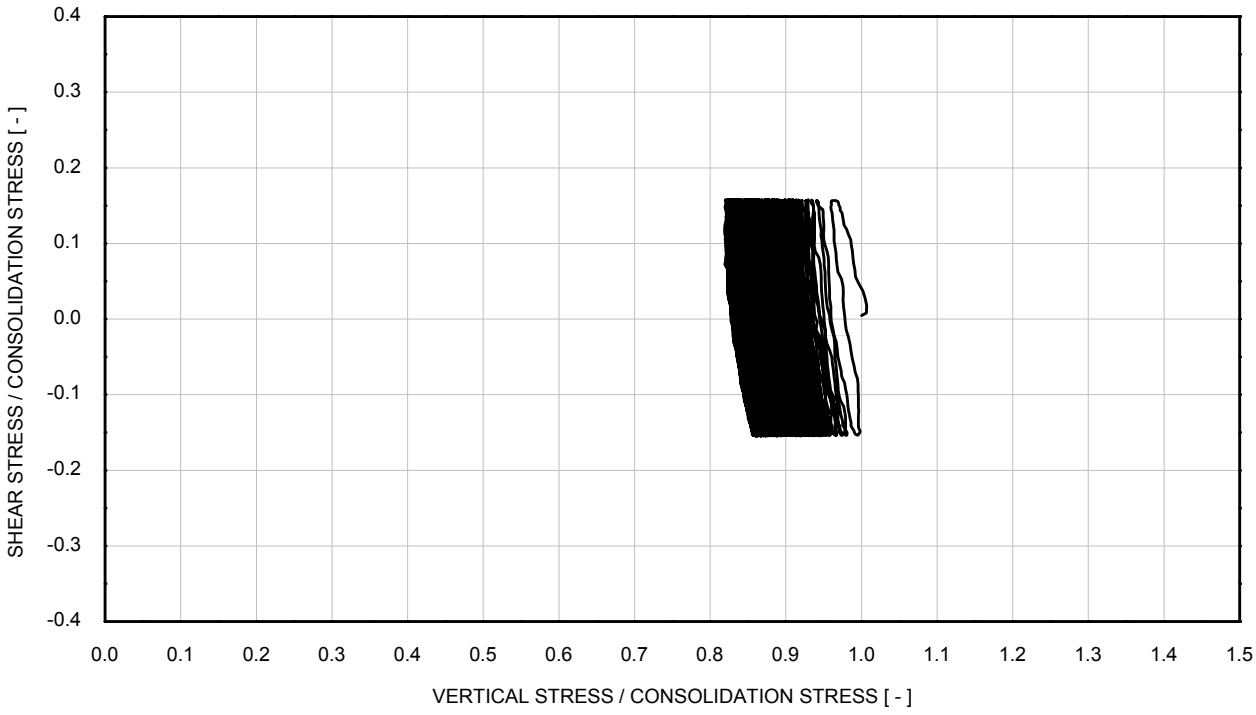




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	33 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

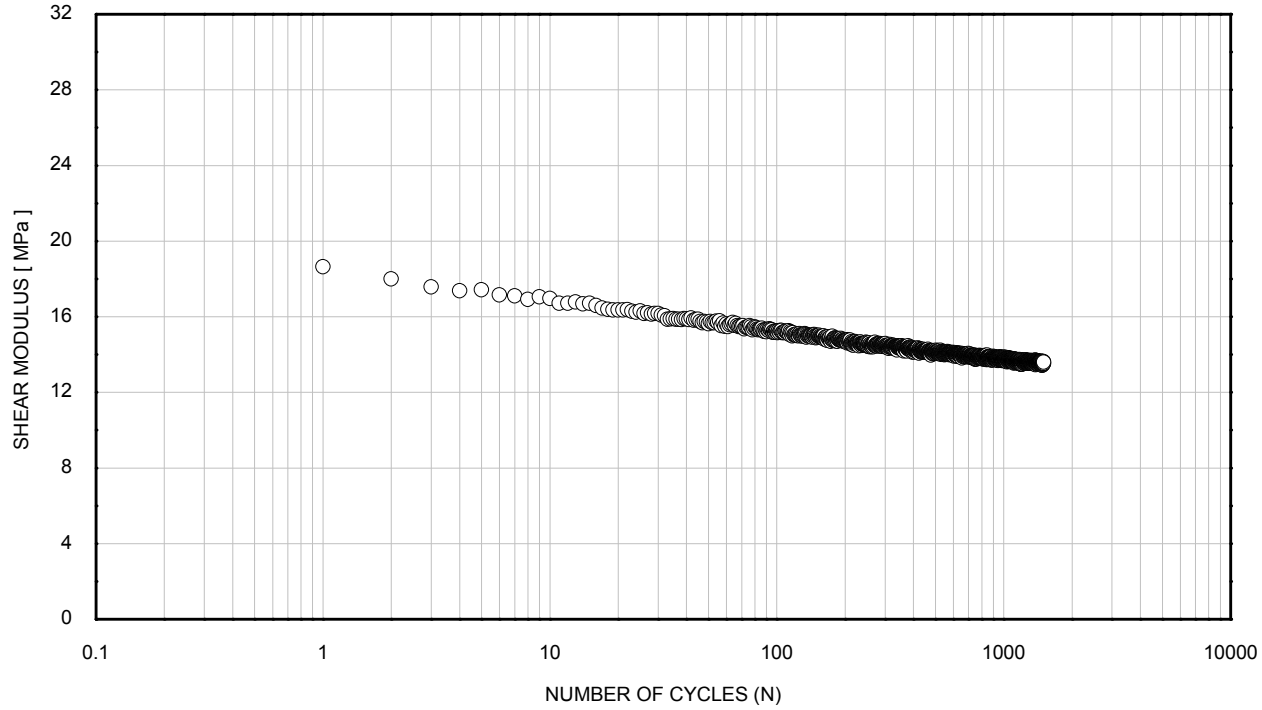
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

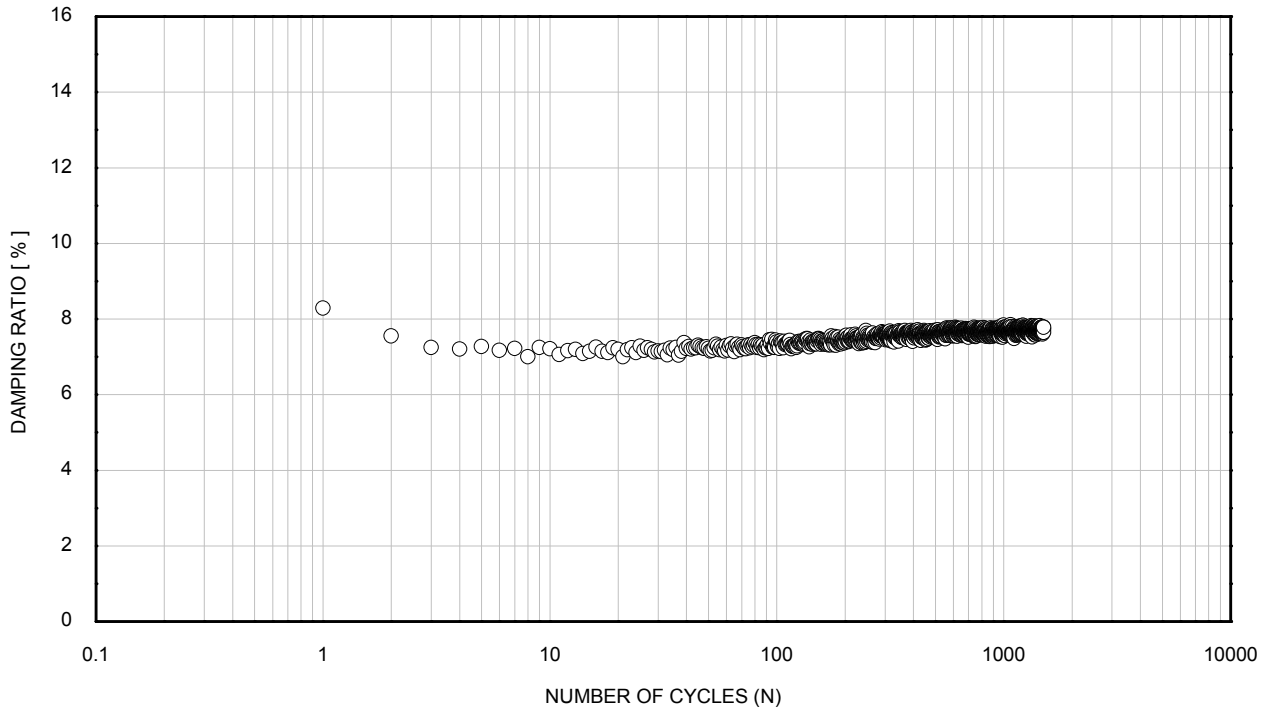




σ_{vc}	:	210 kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	: 24WaxB
Mean τ_{cy}	:	33 kPa	Depth [m]	: 21.69
Frequency	:	0.10 Hz	Test No.	: CSS15

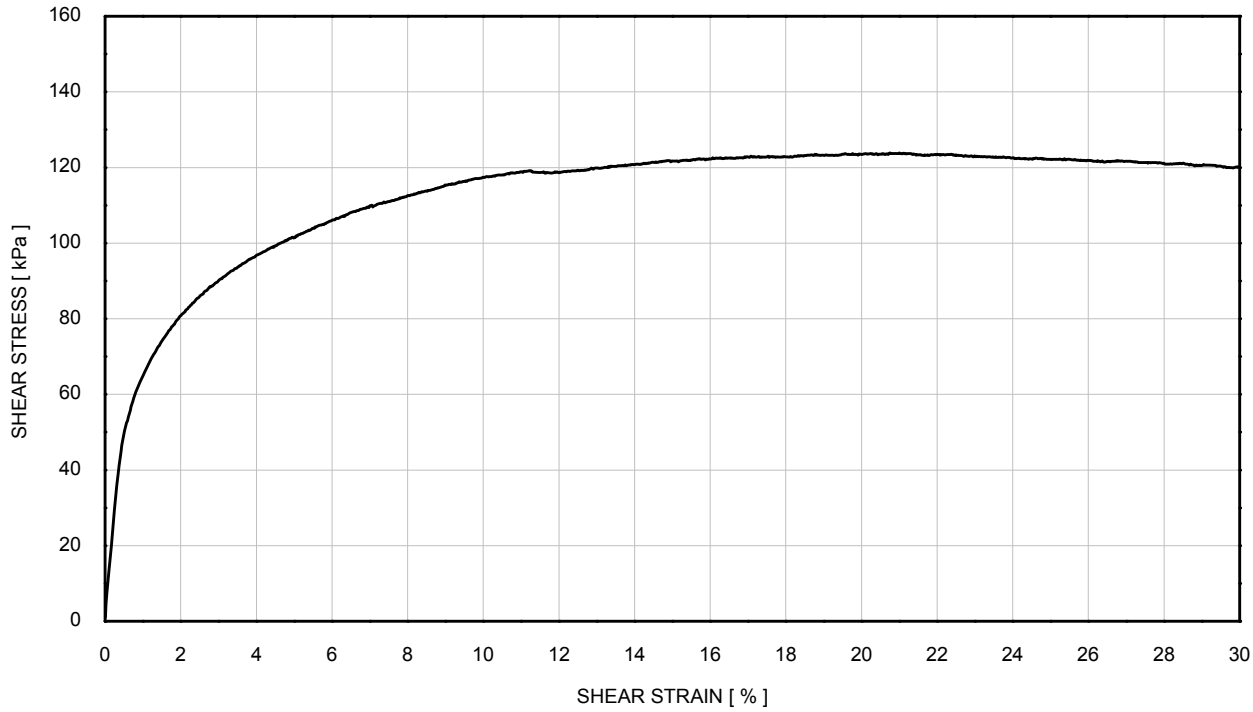
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

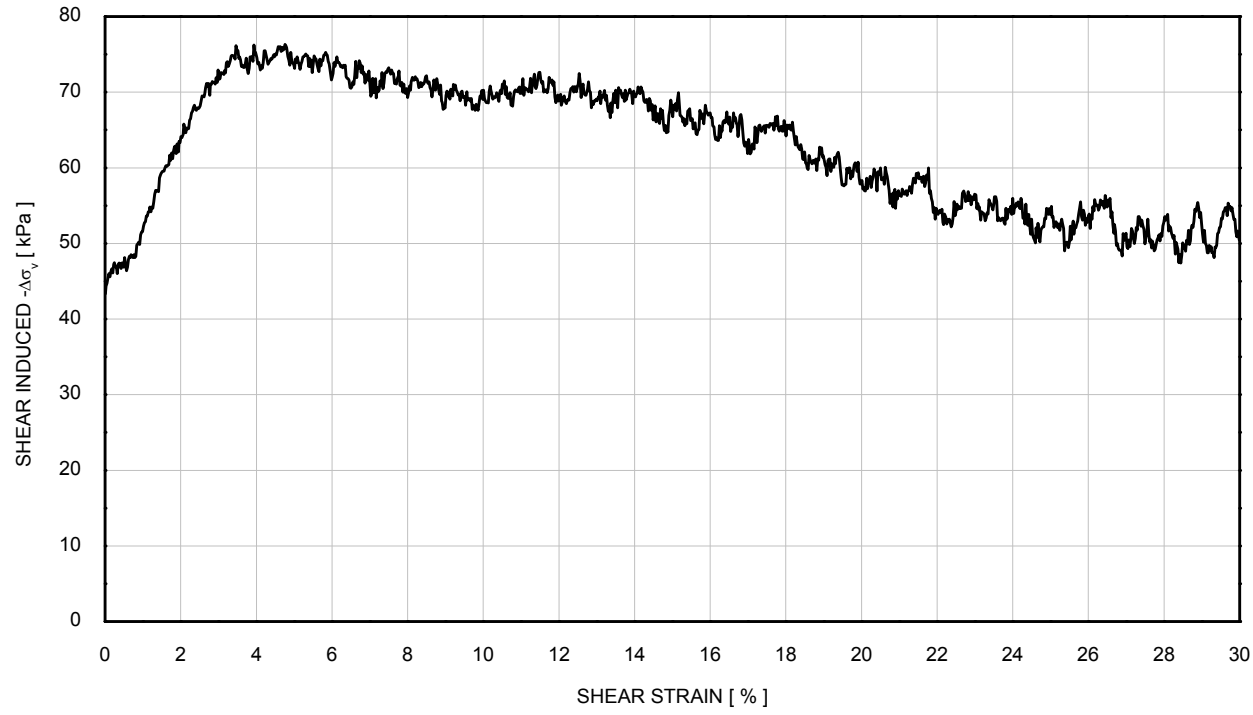




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	33 kPa	Depth [m]	:	21.69
Frequency	:	0.10 Hz	Test No.	:	CSS15

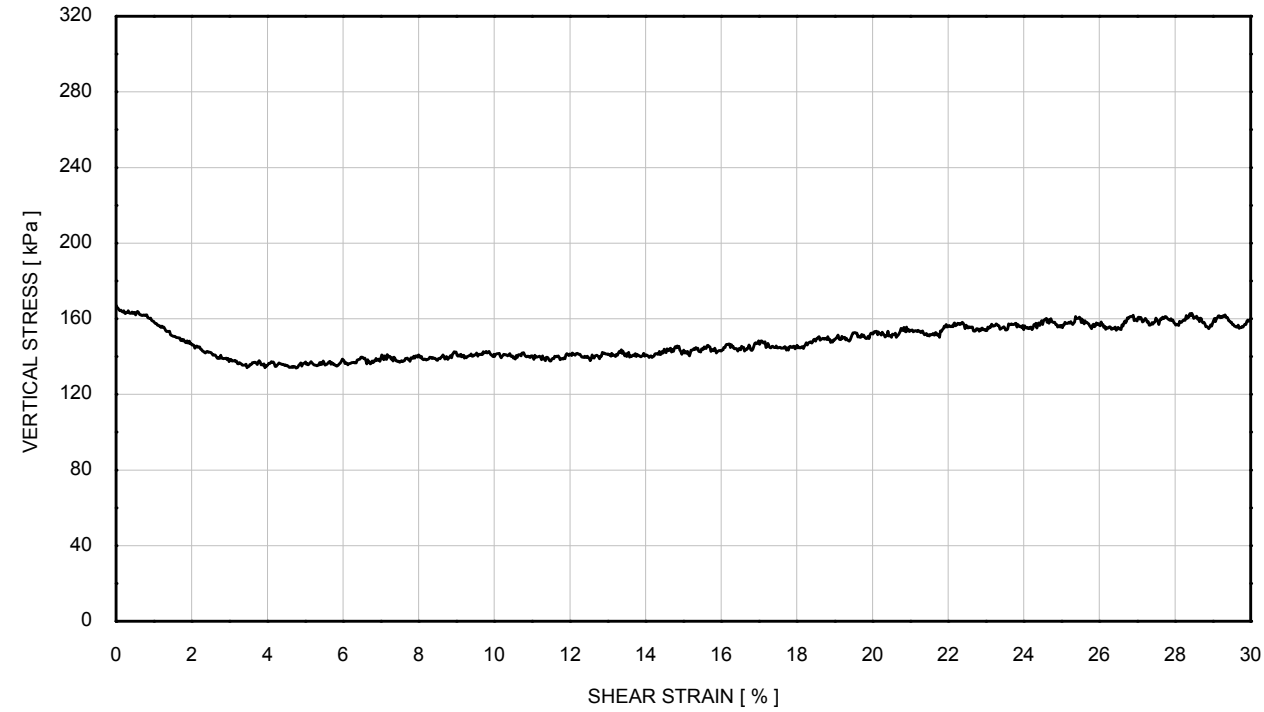
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

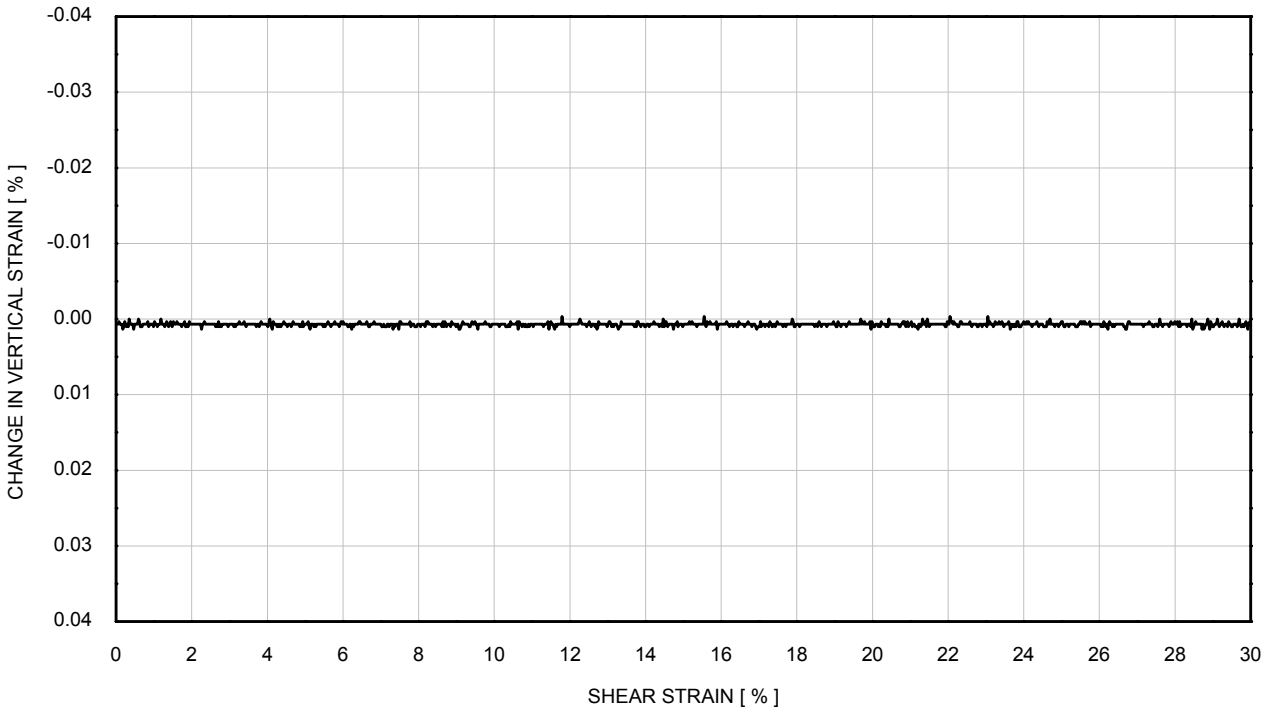




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 124 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 20.75 %	Depth [m]	: 21.69
Rate of strain	: 2.98 %/hour	Test No.	: CSS15

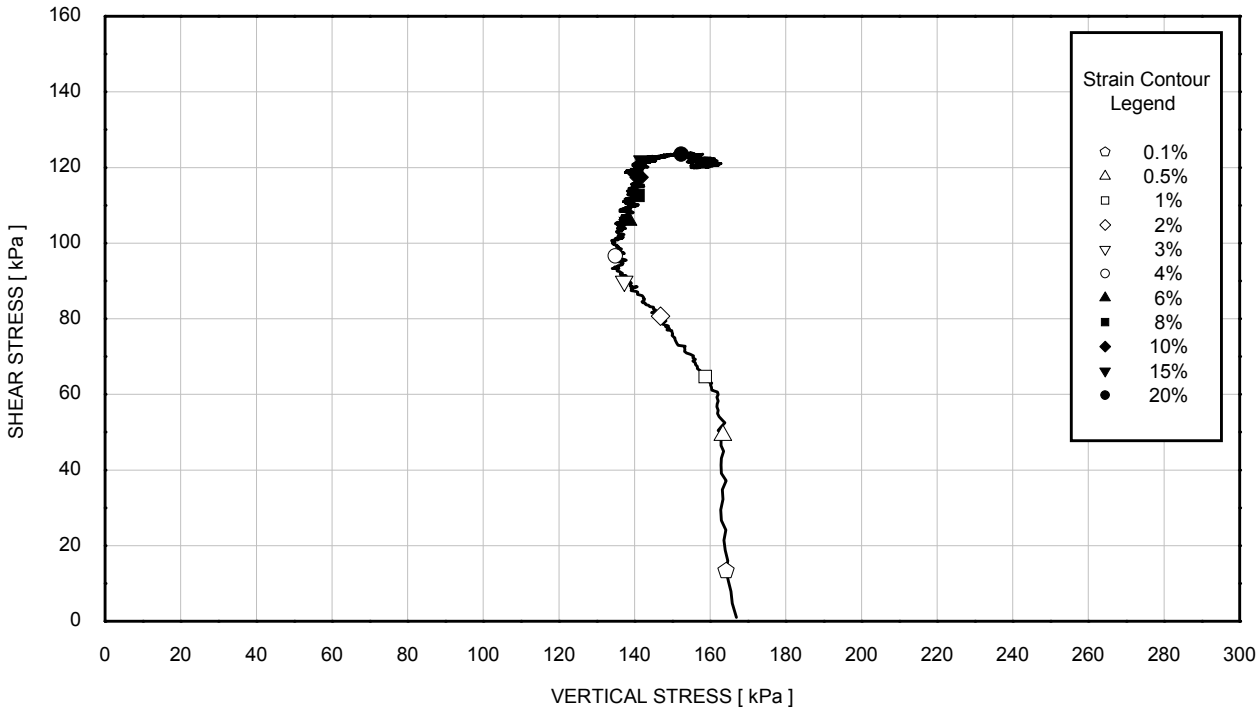
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

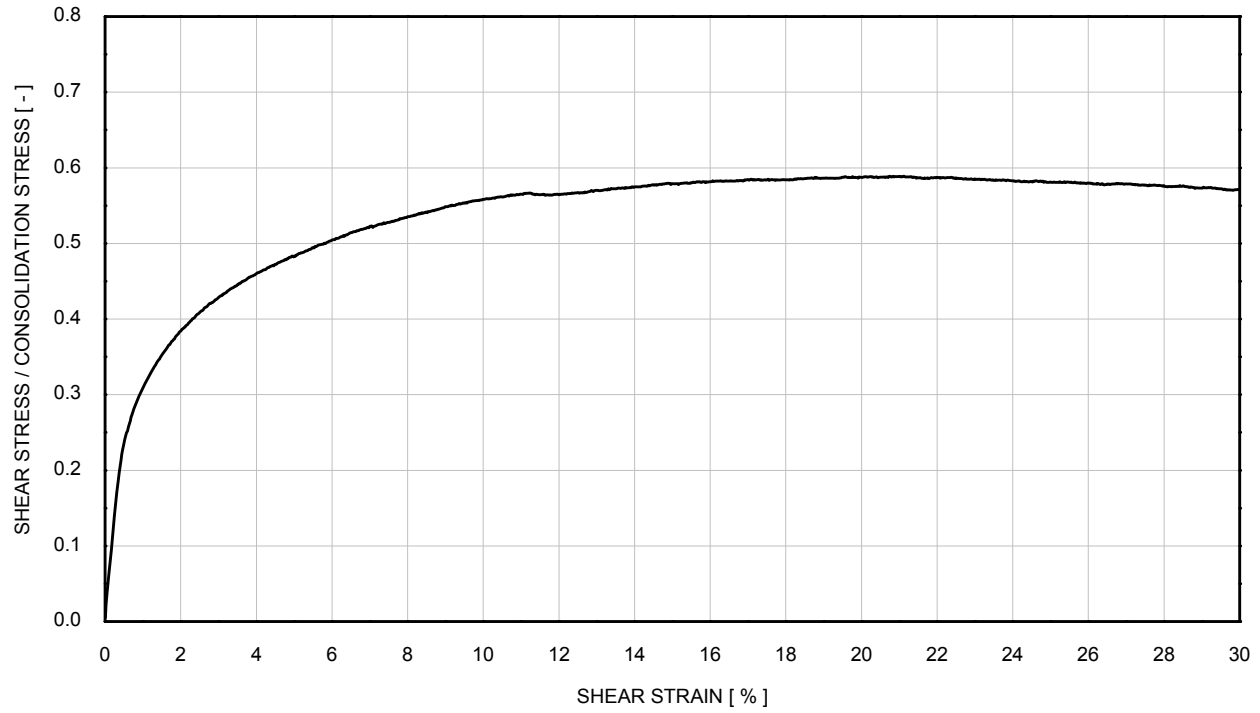




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 124 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 20.75 %	Depth [m]	: 21.69
Rate of strain	: 2.98 %/hour	Test No.	: CSS15

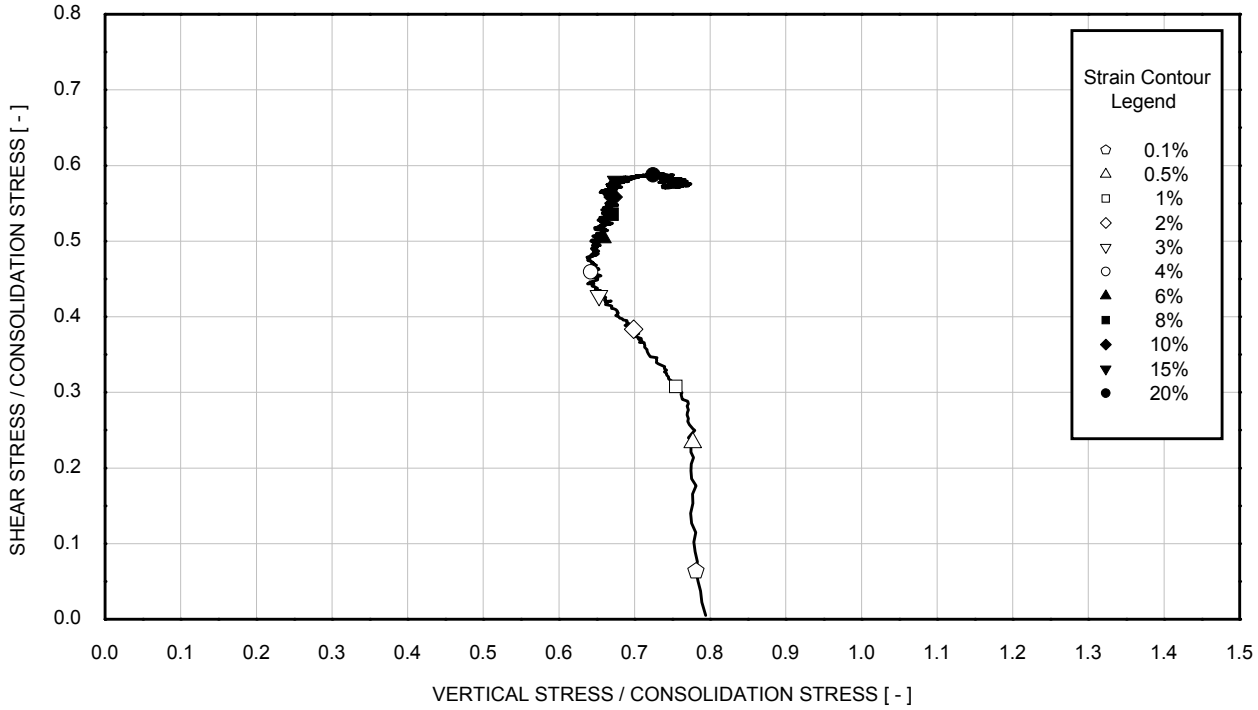
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

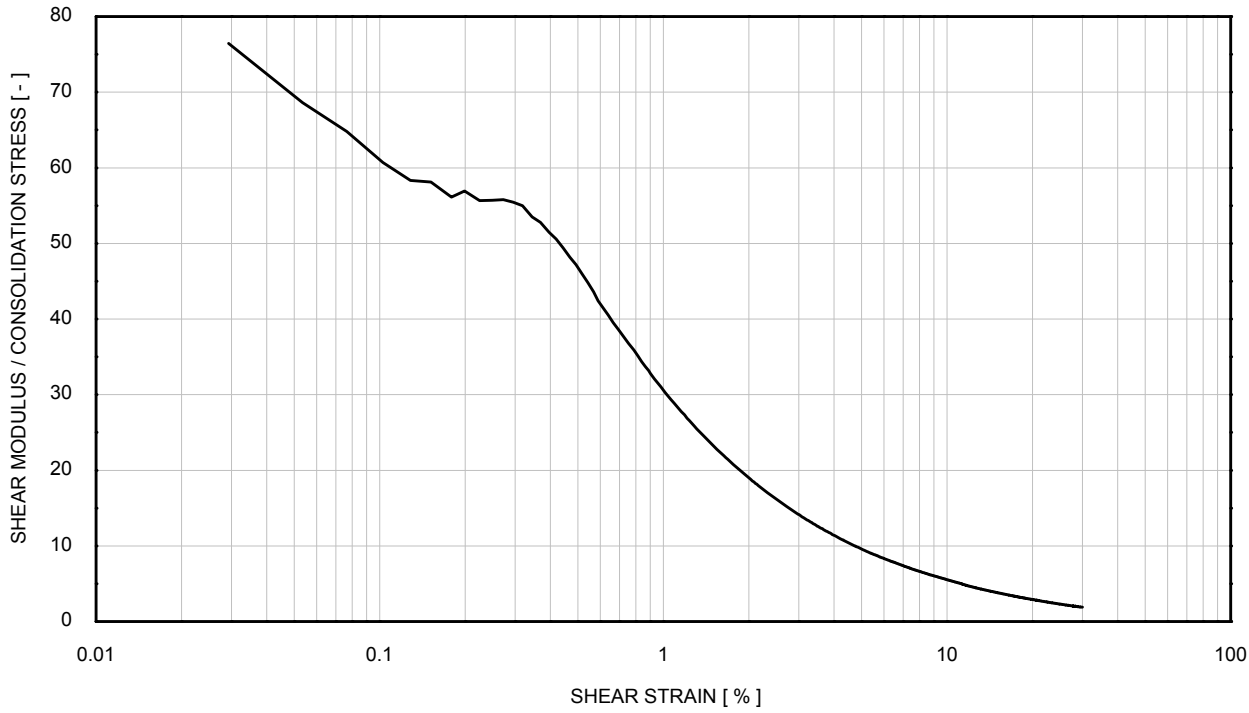




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 124 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 20.75 %	Depth [m]	: 21.69
Rate of strain	: 2.98 %/hour	Test No.	: CSS15

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 124 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 20.75 %	Depth [m]	: 21.69
Rate of strain	: 2.98 %/hour	Test No.	: CSS15

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Dark grey CLAY

GENERAL	
Date test started	24/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.7
Length	[mm]	30.1
Water content	[%]	26.5
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.686
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ1-BH02-SA_24B_CSS16
Template issue	1.4
Processed by Date	JLS 04/11/2016
Checked by Date	PH 25/11/2016
Approved by Date	PH 25/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.65
Test number	CSS16

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	210
Vertical strain	[%]	2.21
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.64
Void ratio	[-]	0.649
Water content	[%]	25.1

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	210
Reference stress	[kPa]	82
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	8
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	2.20
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.64
Void ratio	[-]	0.649

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.32	0.03	29.13	5.07
2	0.32	0.03	29.34	3.22
5	0.32	0.03	30.49	2.75
10	0.32	0.03	29.55	2.94
20	0.32	0.03	29.55	2.49
50	0.32	0.03	29.45	2.32
100	0.32	0.03	29.49	1.84
200	0.32	0.03	29.60	1.89
300	0.33	0.03	29.34	2.50
400	0.33	0.03	30.49	2.56

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.65
Test number	CSS16

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	82
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	72
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	803
γ_{av} at N_f	[%]	15.60
γ_{cy} at N_f	[%]	14.35
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	132
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.07	0.76	9.63	17.70
2	0.10	0.85	8.54	16.80
5	0.13	0.99	7.38	15.94
10	0.16	1.11	6.57	15.56
20	0.18	1.25	5.82	15.18
50	0.22	1.50	4.86	14.81
100	0.27	1.77	4.12	14.69
200	0.35	2.19	3.32	14.91
500	0.76	3.97	1.81	18.84
803	15.60	14.35	0.45	39.49

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	49
Shear strain	[%]	29.96
Shear induced $-\Delta\sigma_v$	[kPa]	127
Vertical stress	[kPa]	83
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.01
At 15 % shear strain		
Shear stress	[kPa]	27
Shear induced $-\Delta\sigma_v$	[kPa]	168
Vertical stress	[kPa]	42
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.65
Test number	CSS16

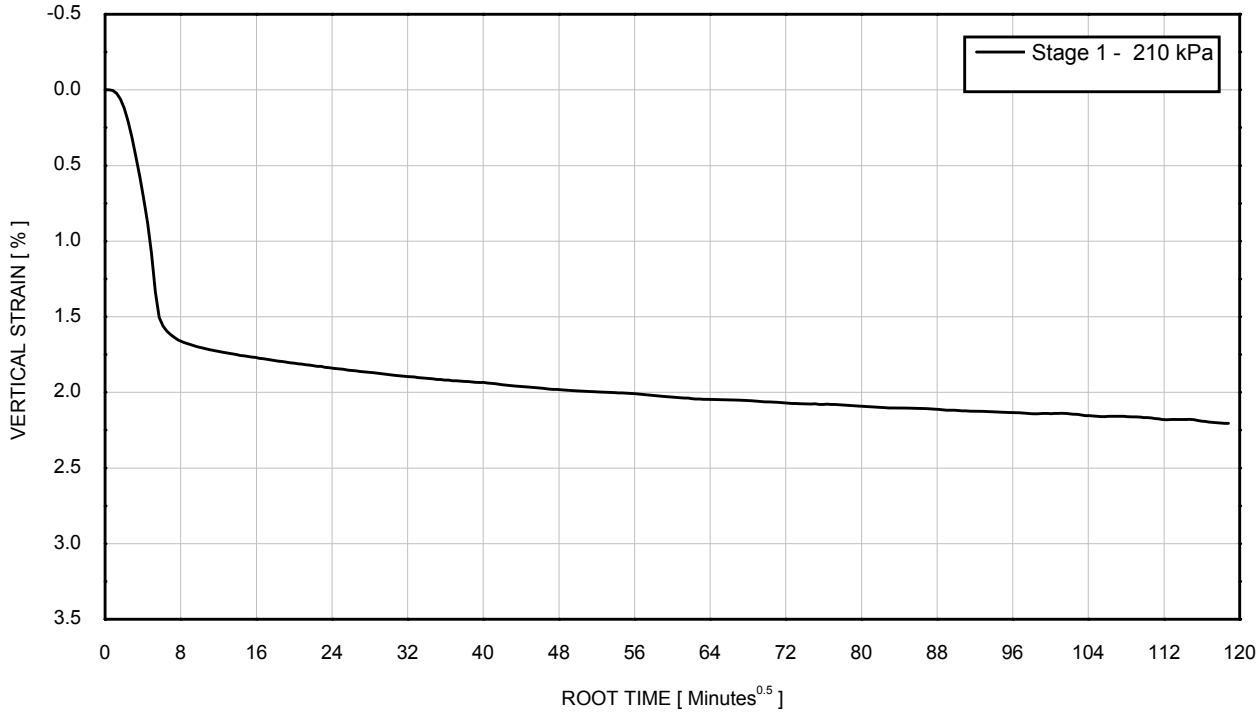
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

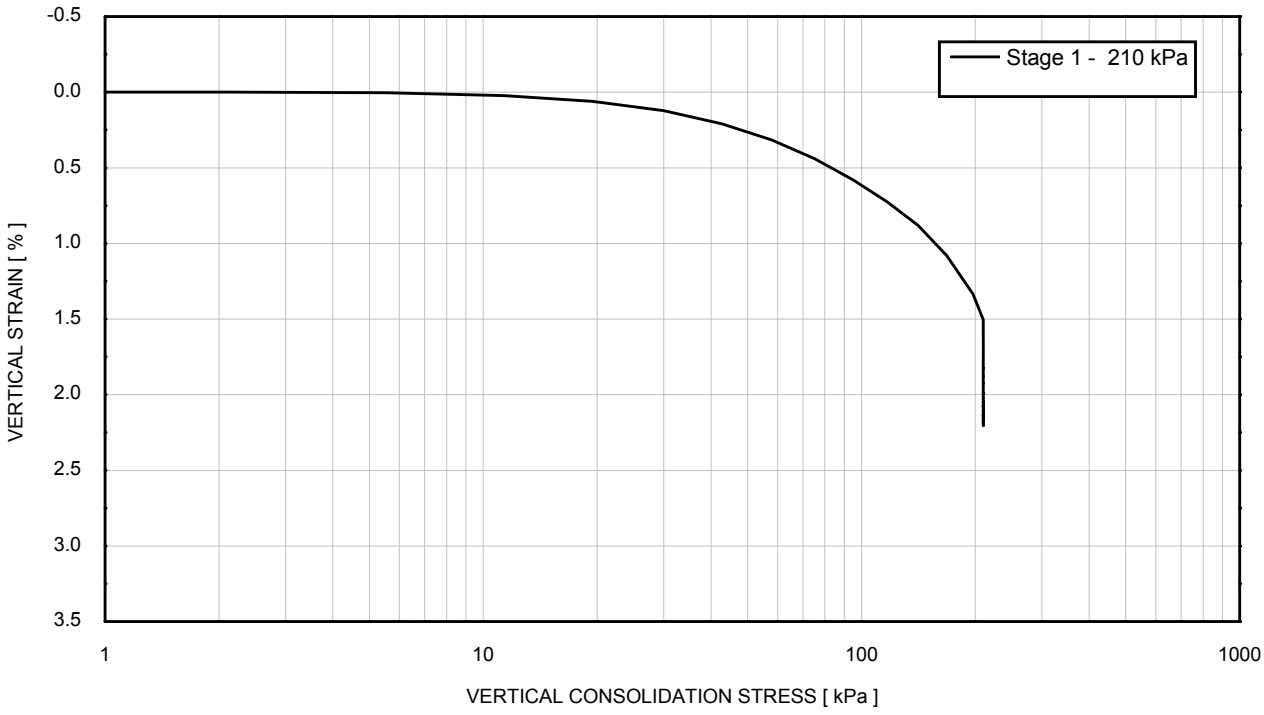
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ1-BH02-SA
Sample	24WaxB
Depth [m]	21.65
Test number	CSS16

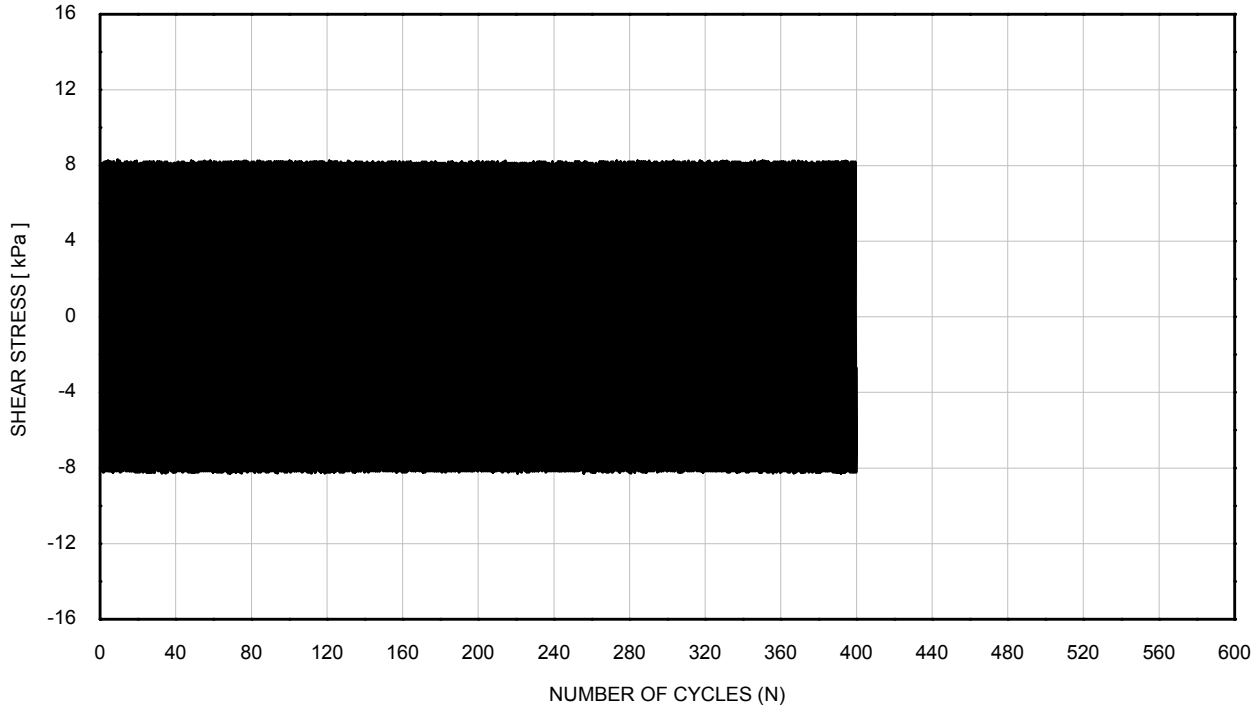
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

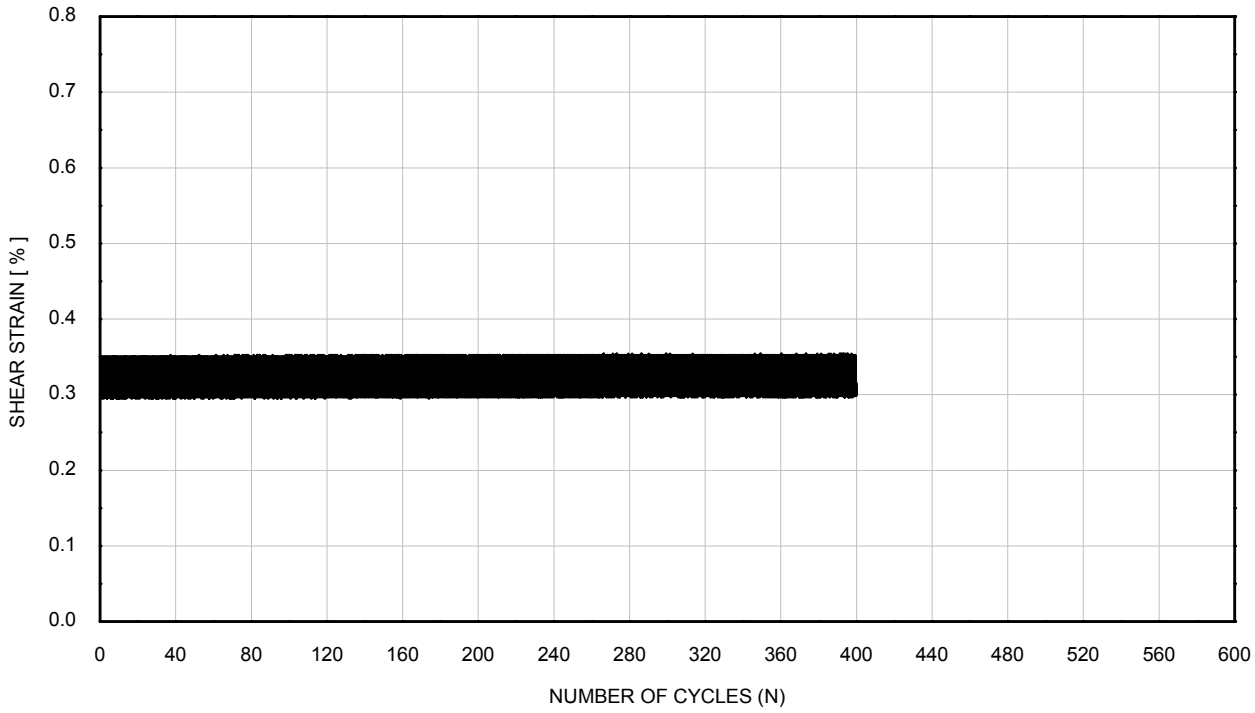




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
		Sample	: 24WaxB
		Depth [m]	: 21.65
		Test No.	: CSS16

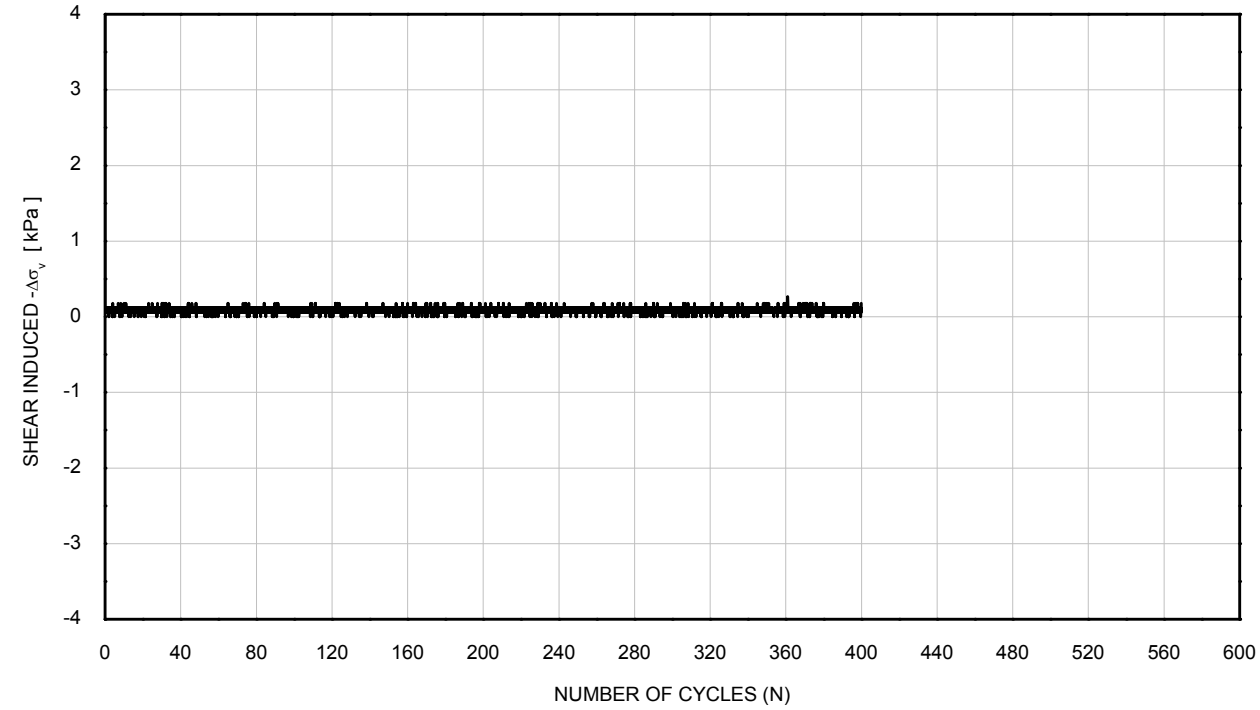
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

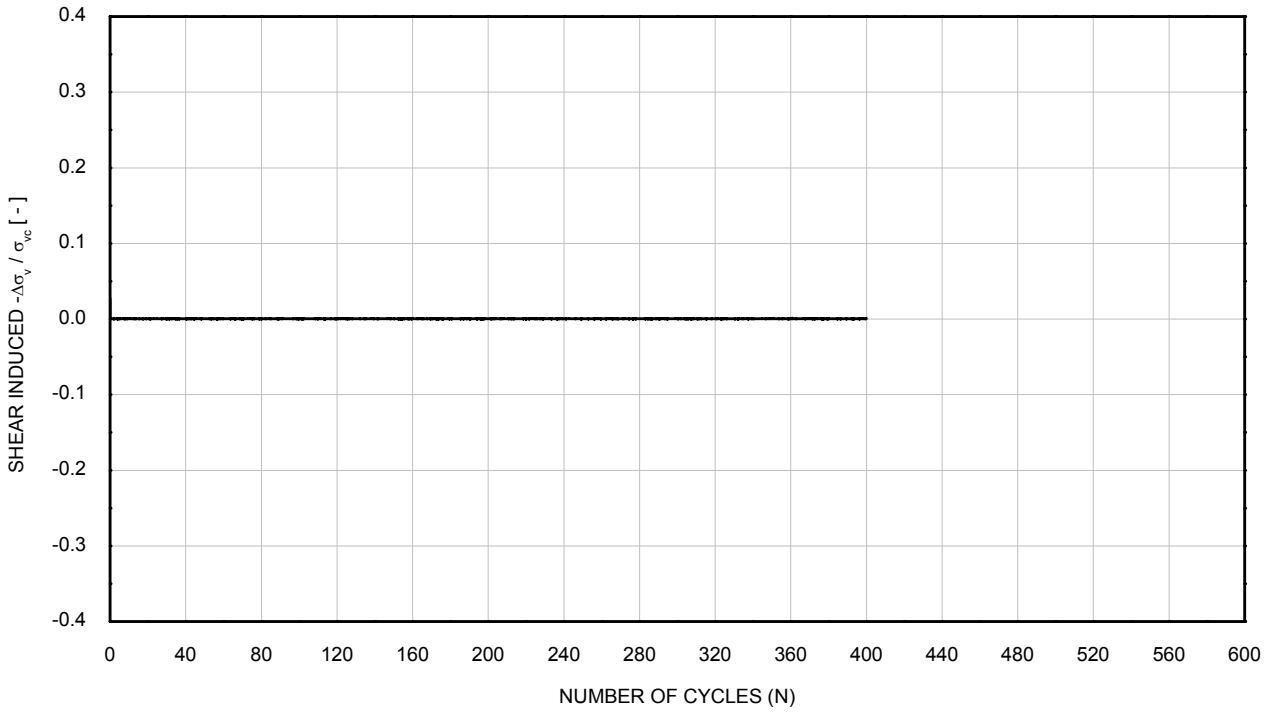




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

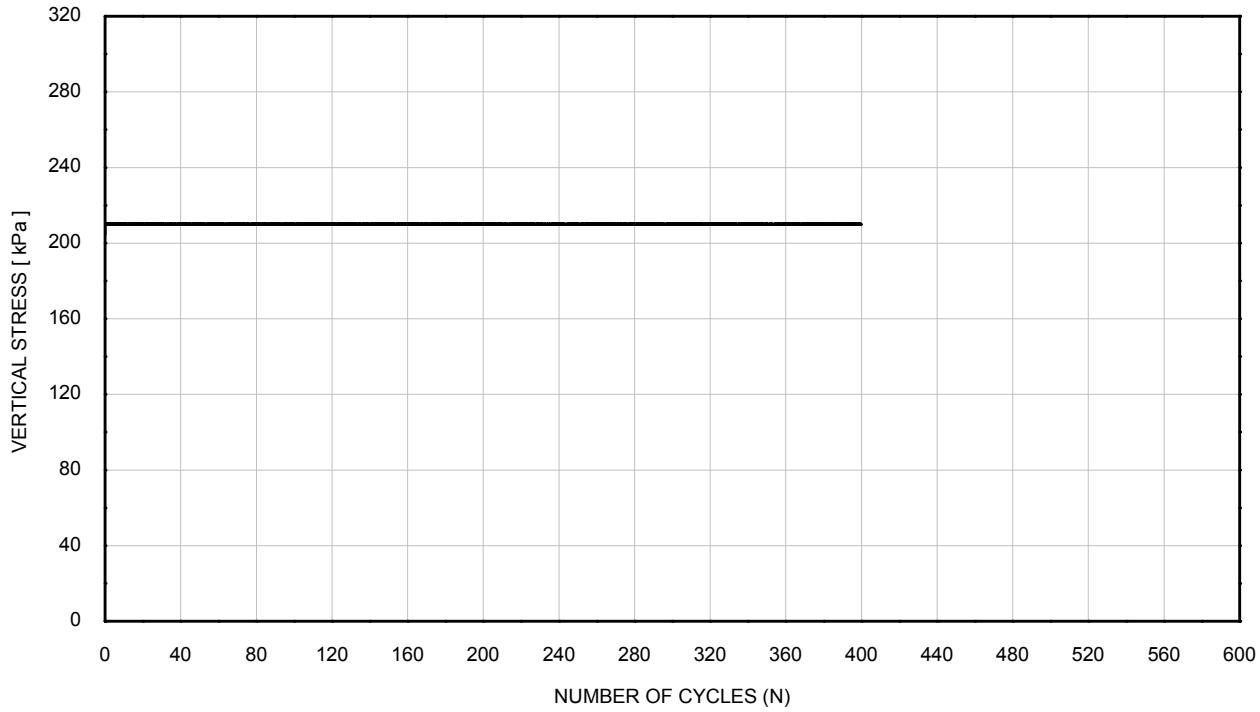
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

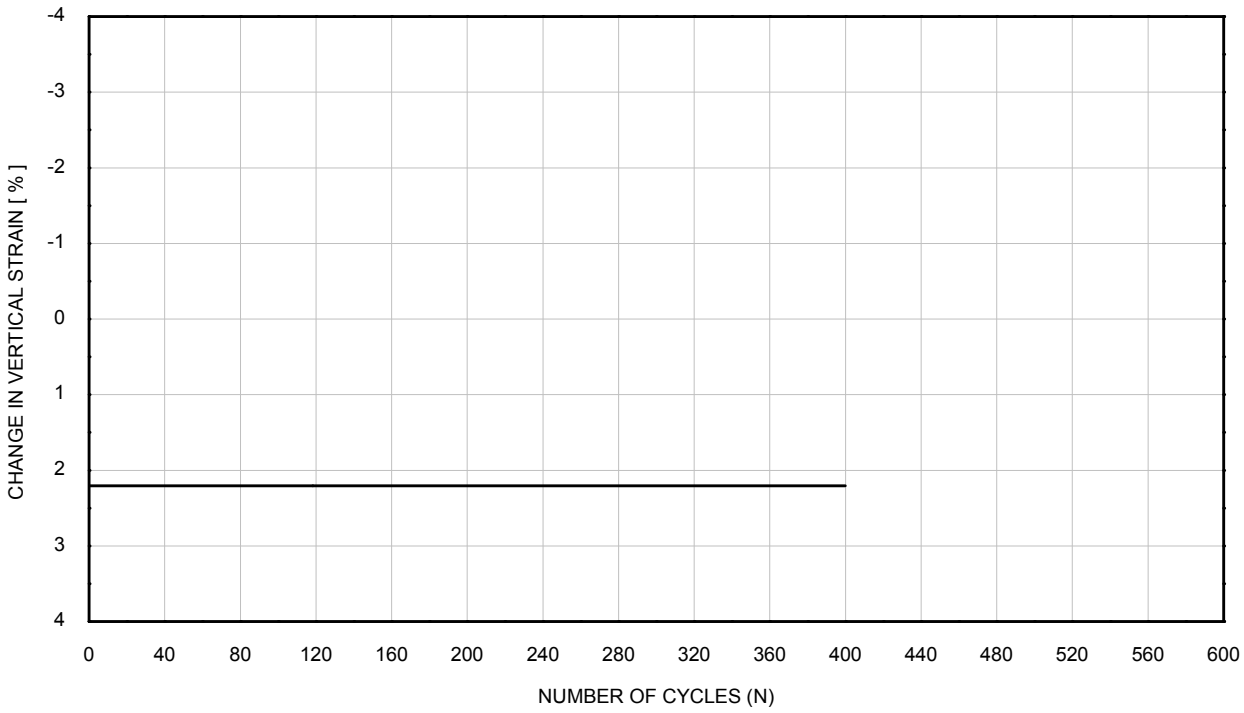




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

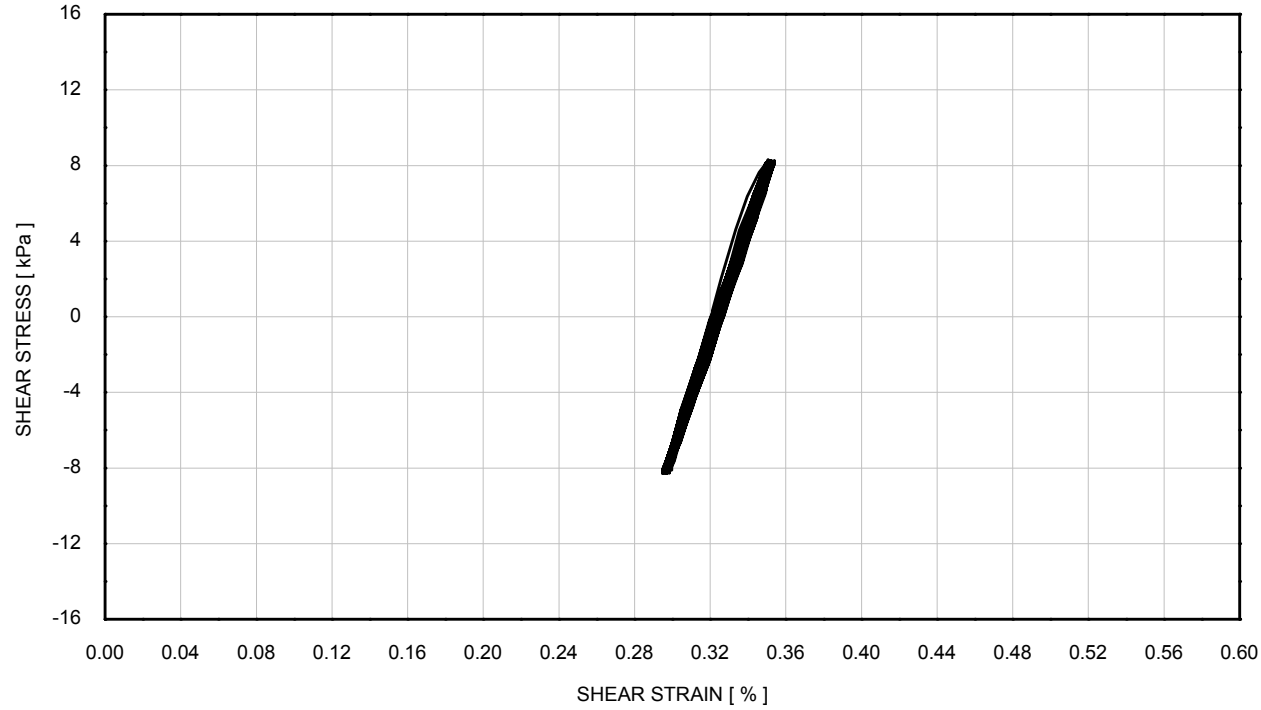
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

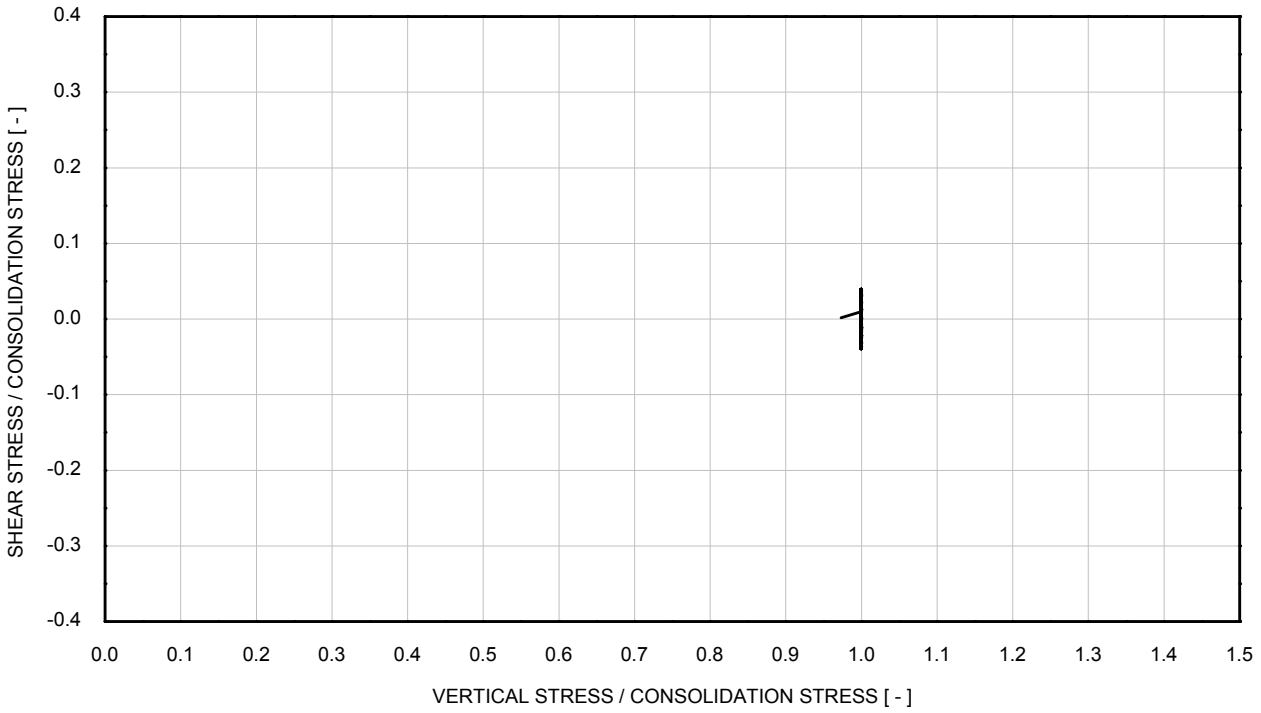




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

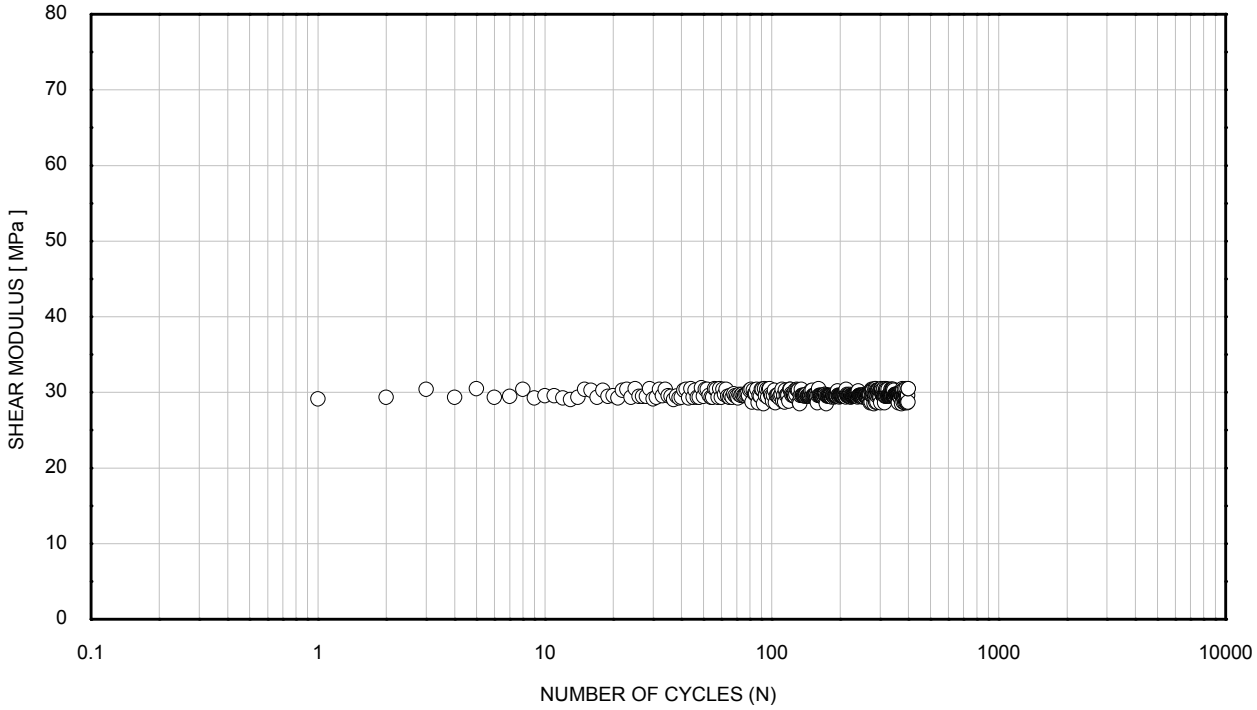
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

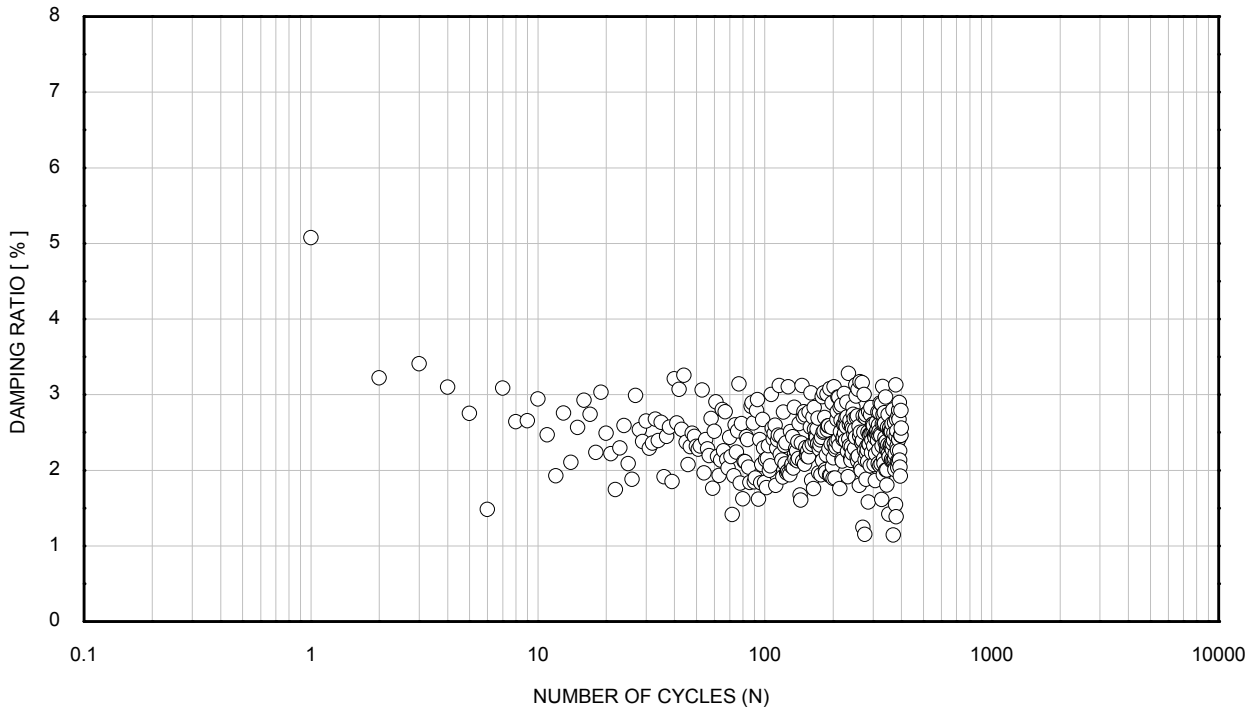




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

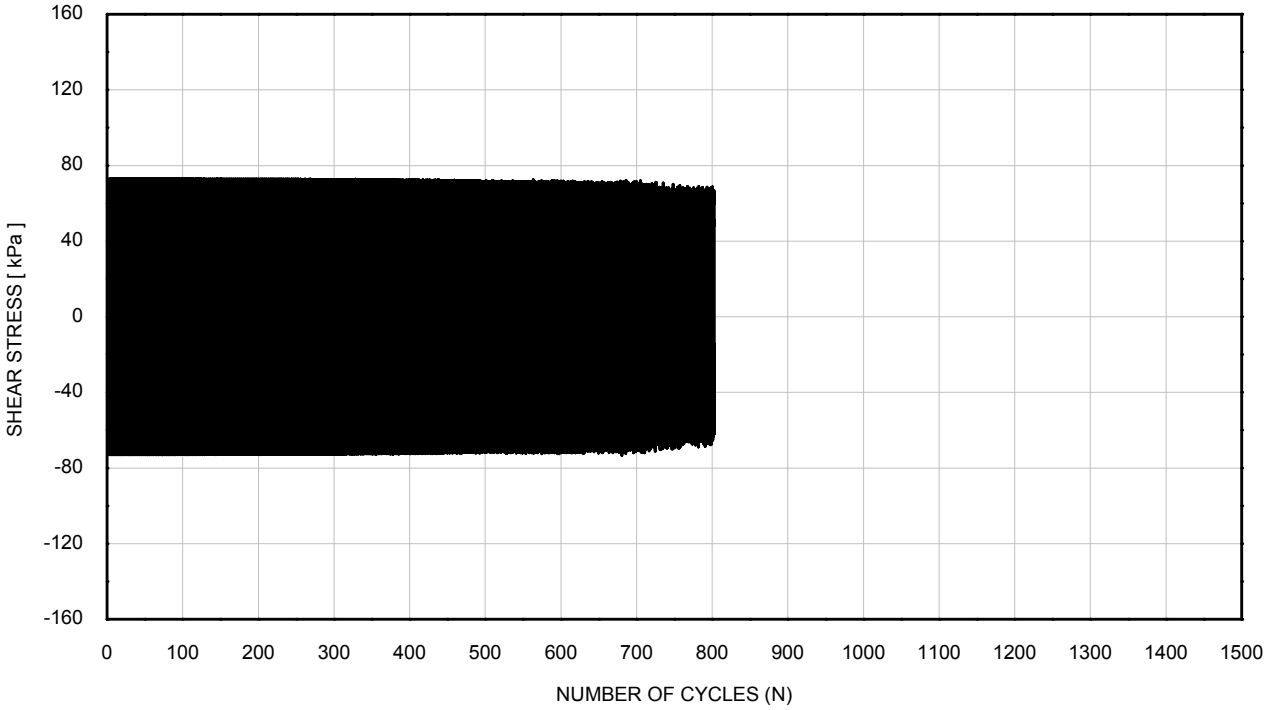
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

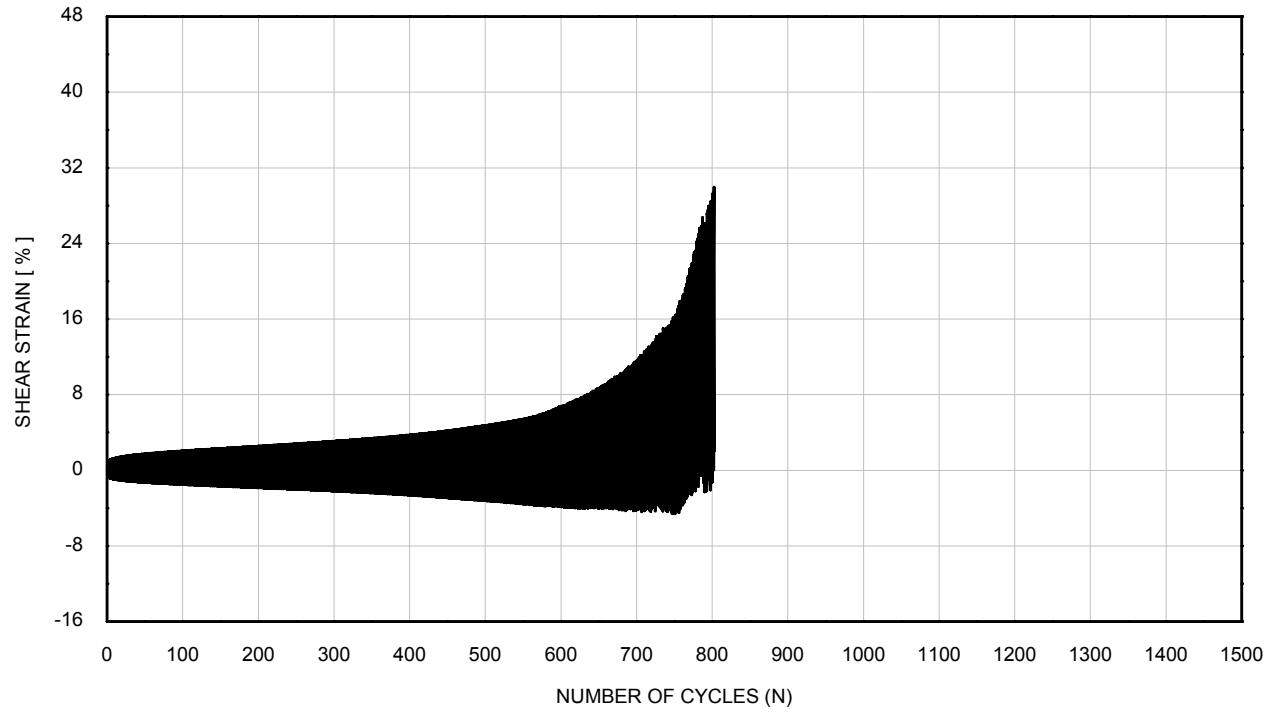




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	8 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

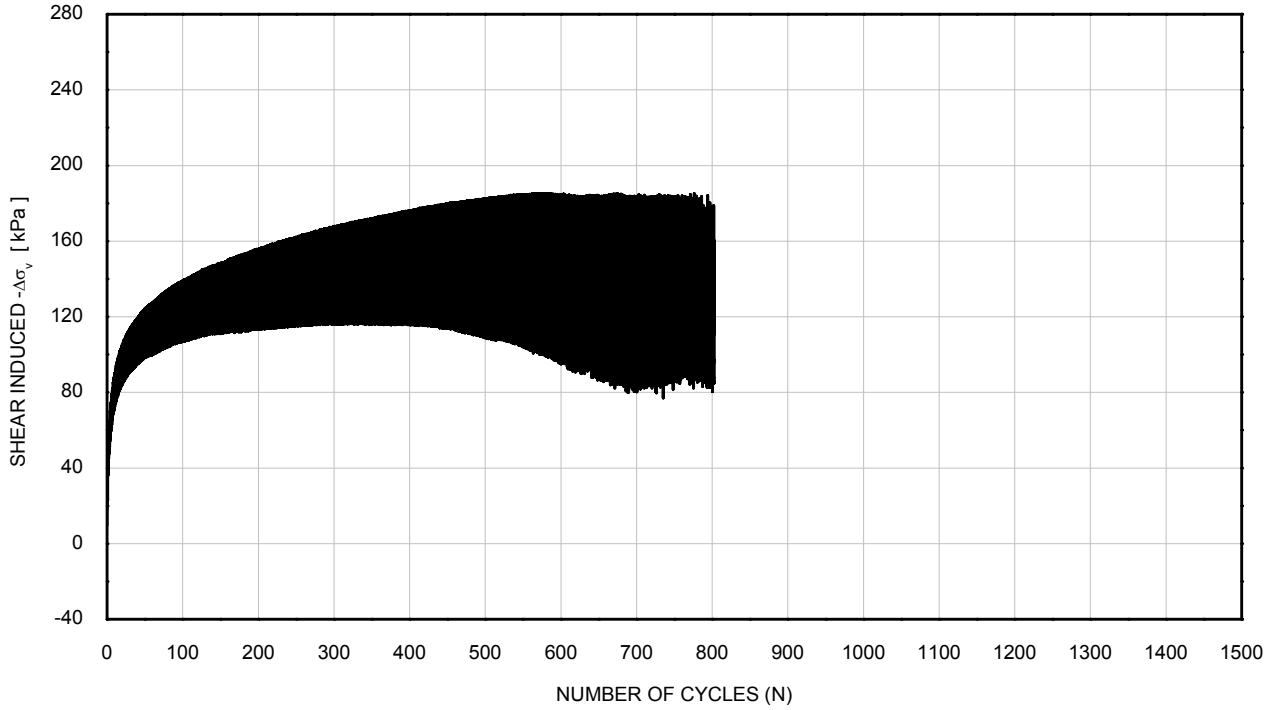
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

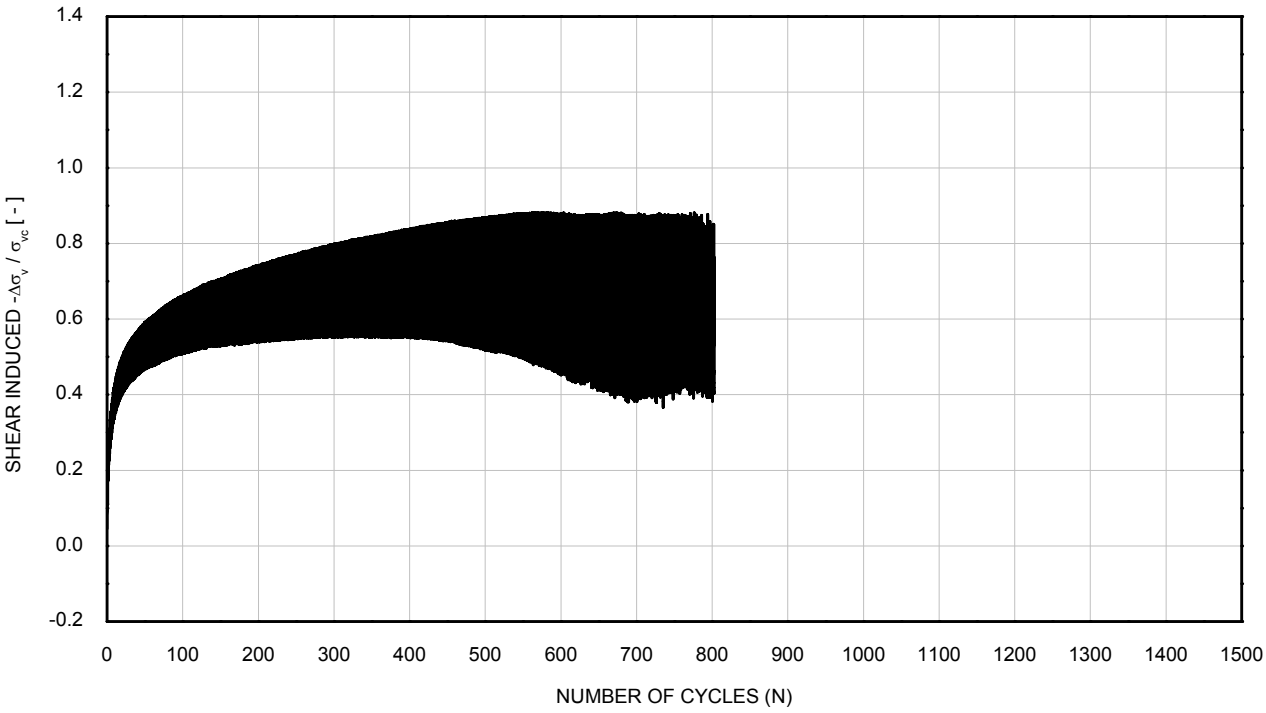




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

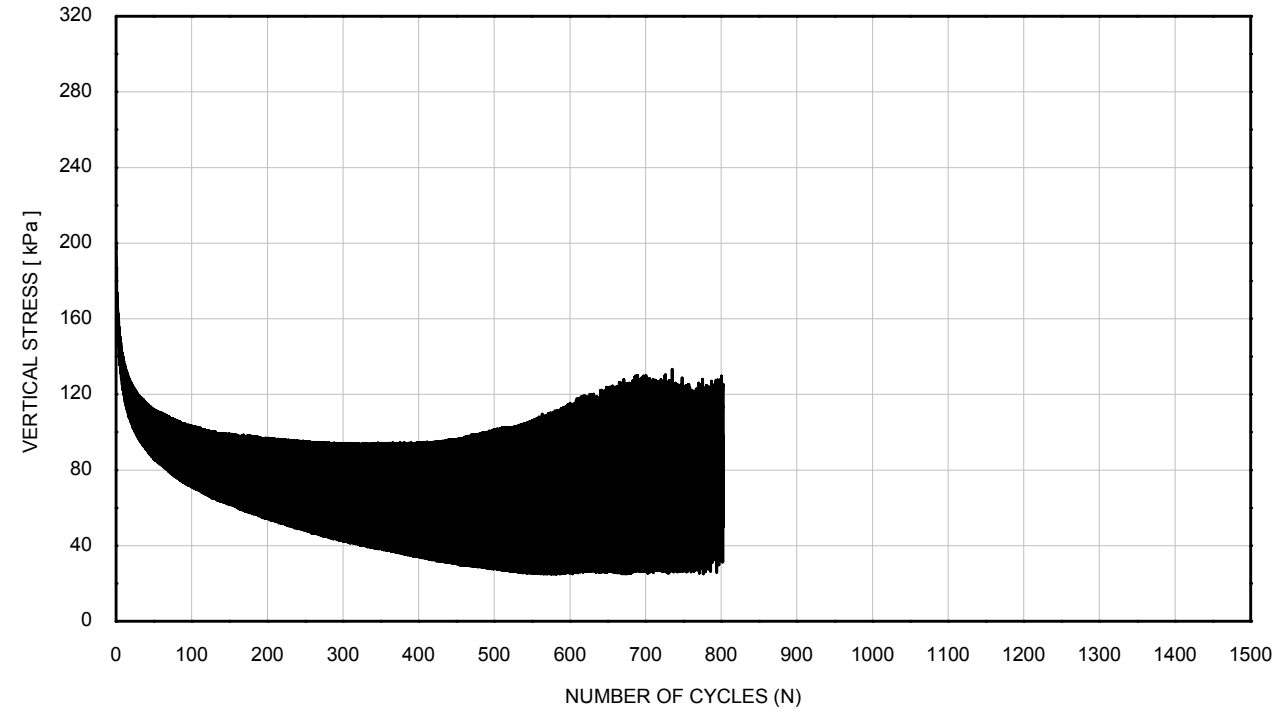
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

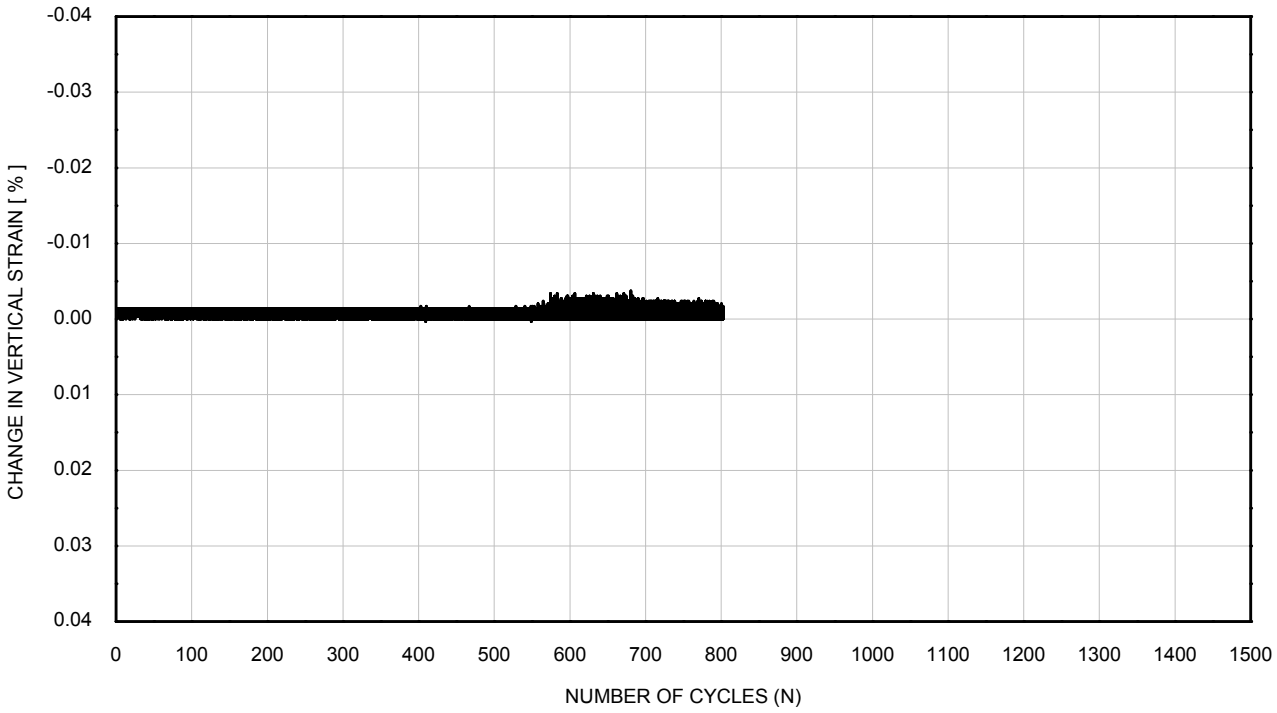




σ_{vc}	: 210	kPa	Borehole	: HKZ1-BH02-SA
Mean τ_{av}	: 0	kPa	Sample	: 24WaxB
Mean τ_{cy}	: 72	kPa	Depth [m]	: 21.65
Frequency	: 0.10	Hz	Test No.	: CSS16

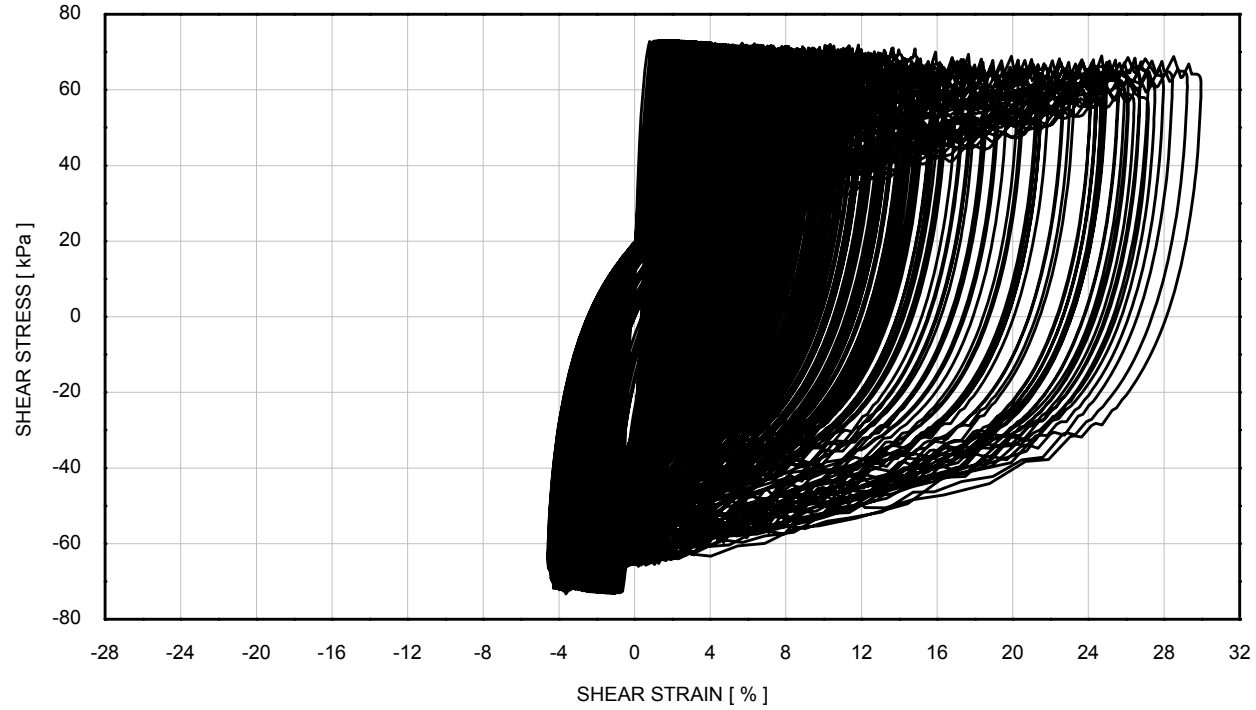
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

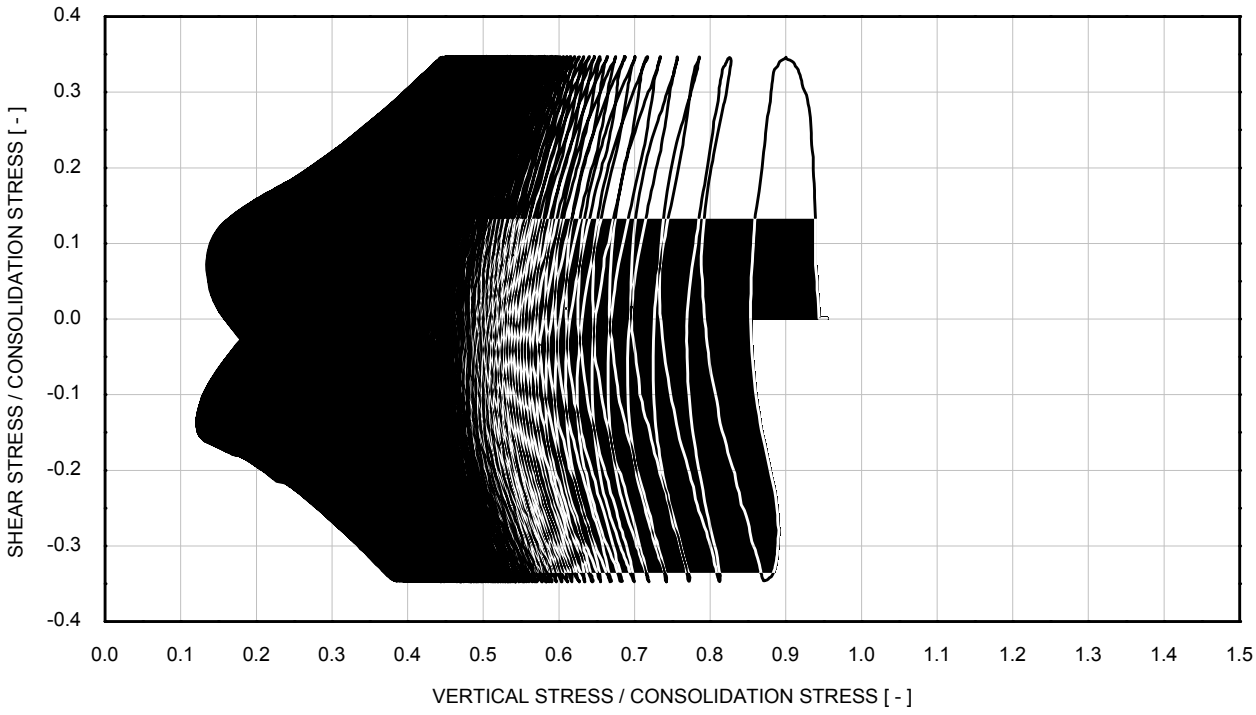




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

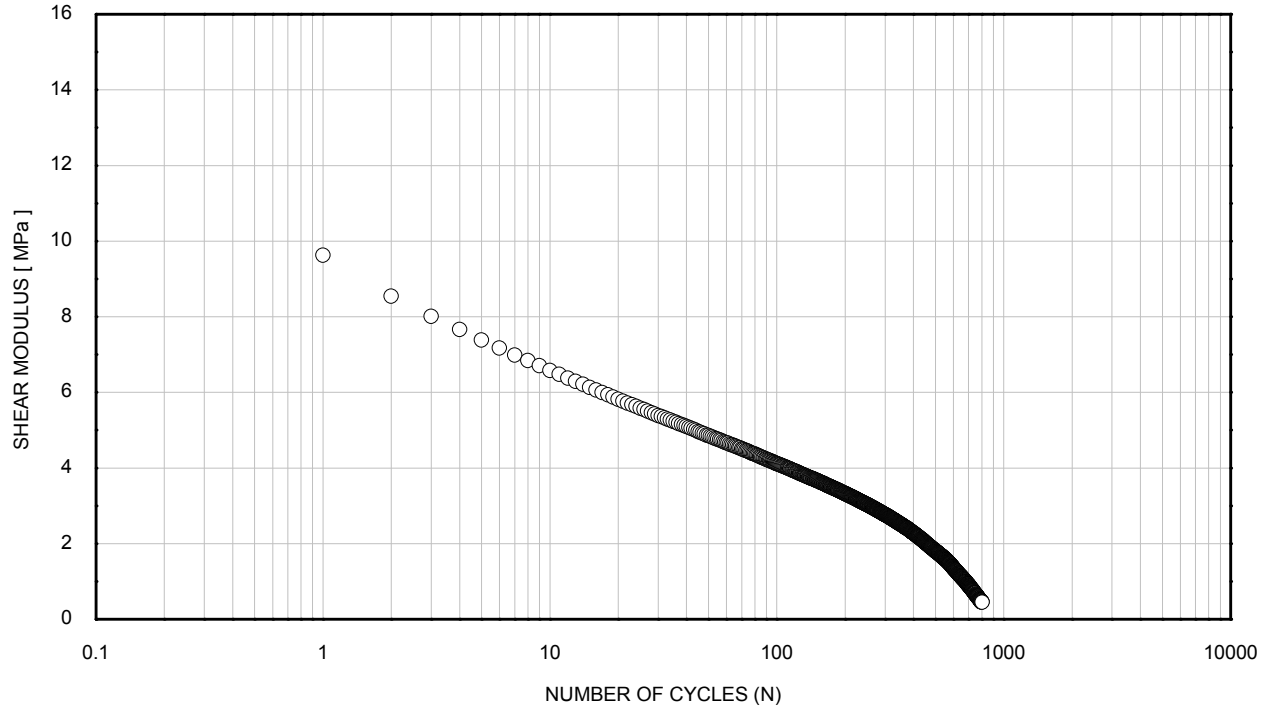
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

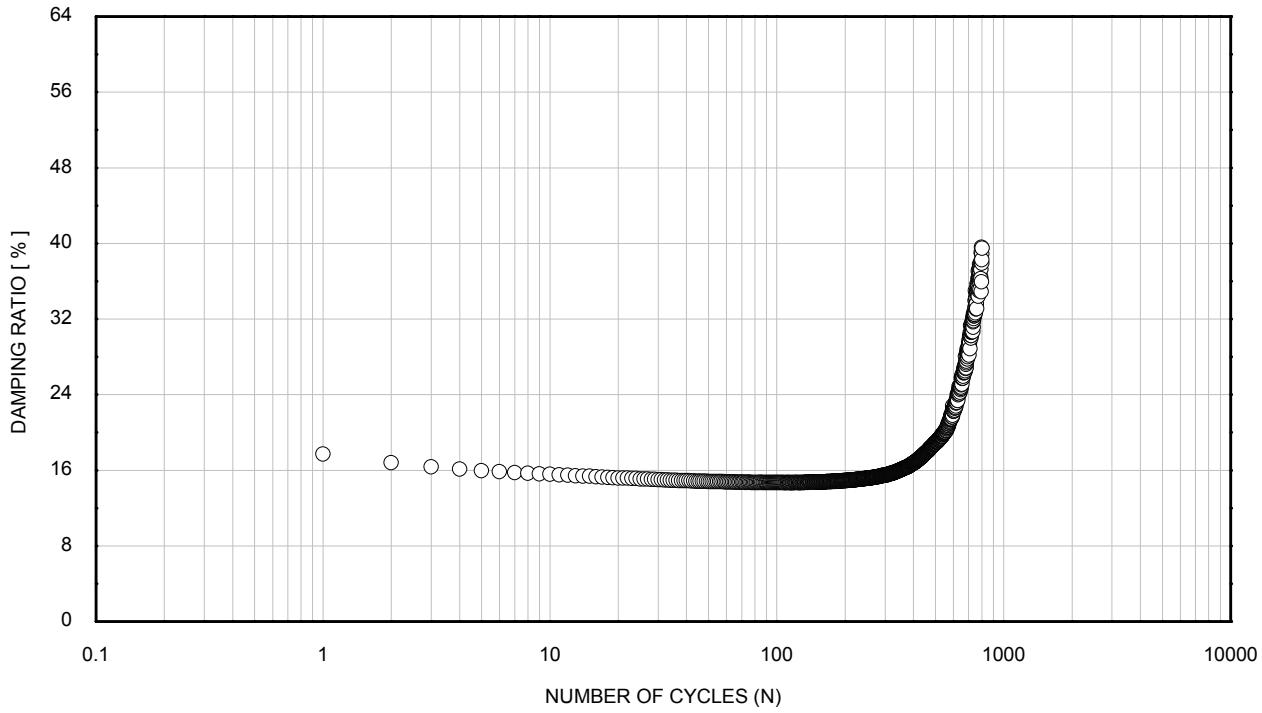




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

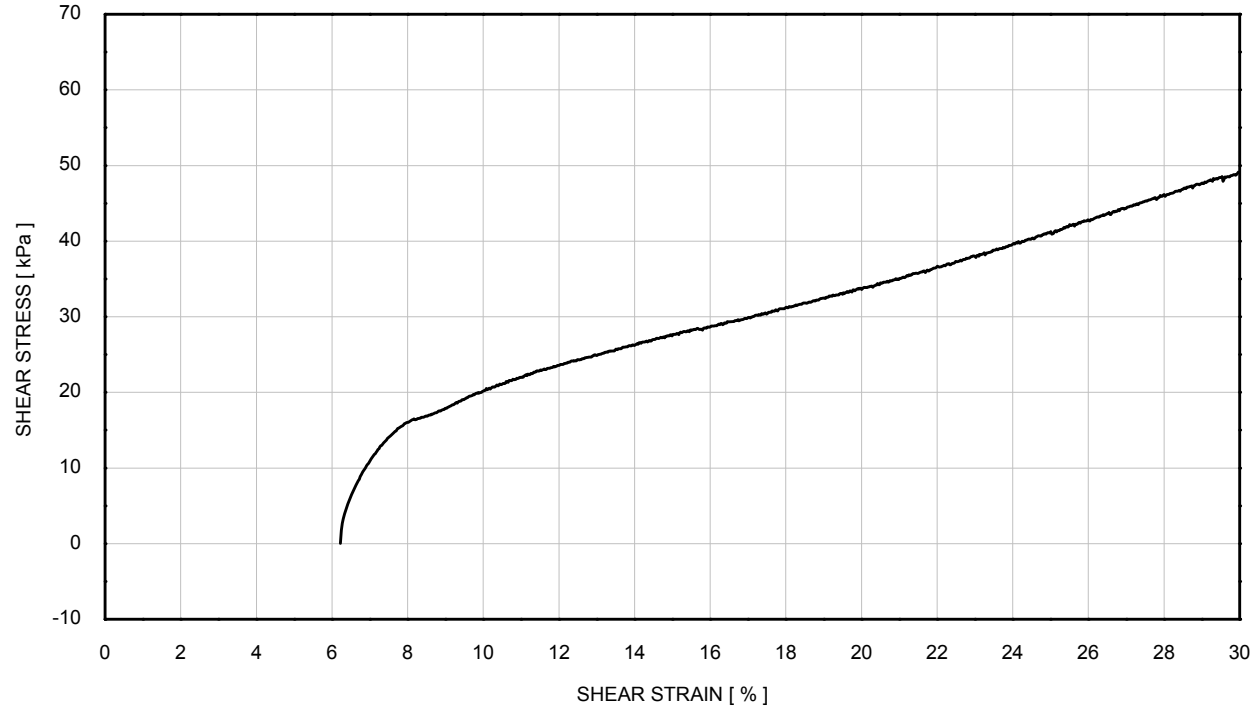
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

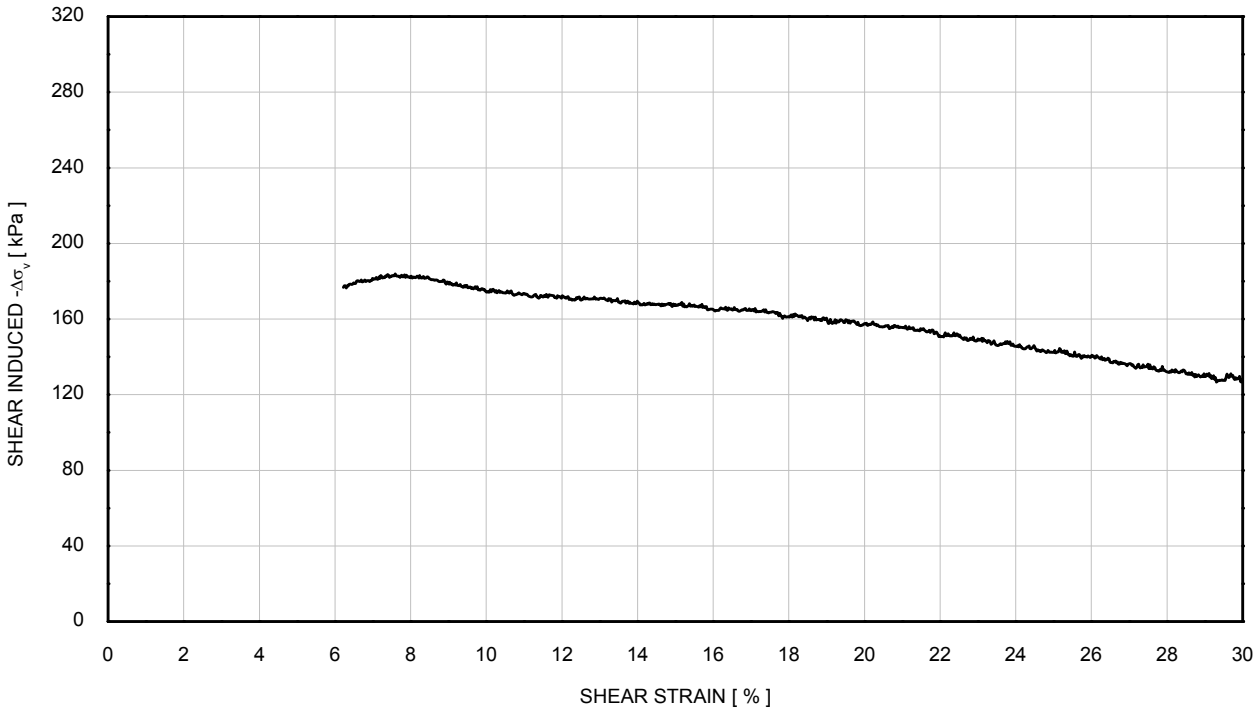




σ_{vc}	:	210 kPa	Borehole	:	HKZ1-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	24WaxB
Mean τ_{cy}	:	72 kPa	Depth [m]	:	21.65
Frequency	:	0.10 Hz	Test No.	:	CSS16

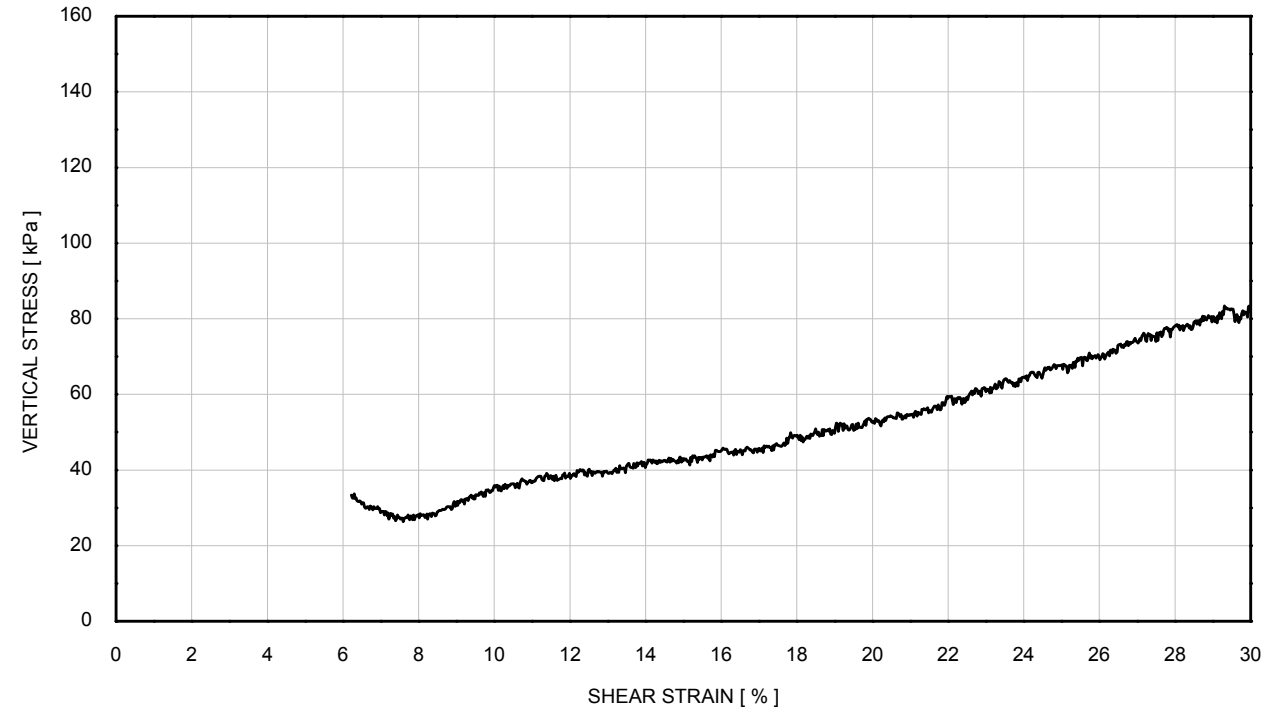
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

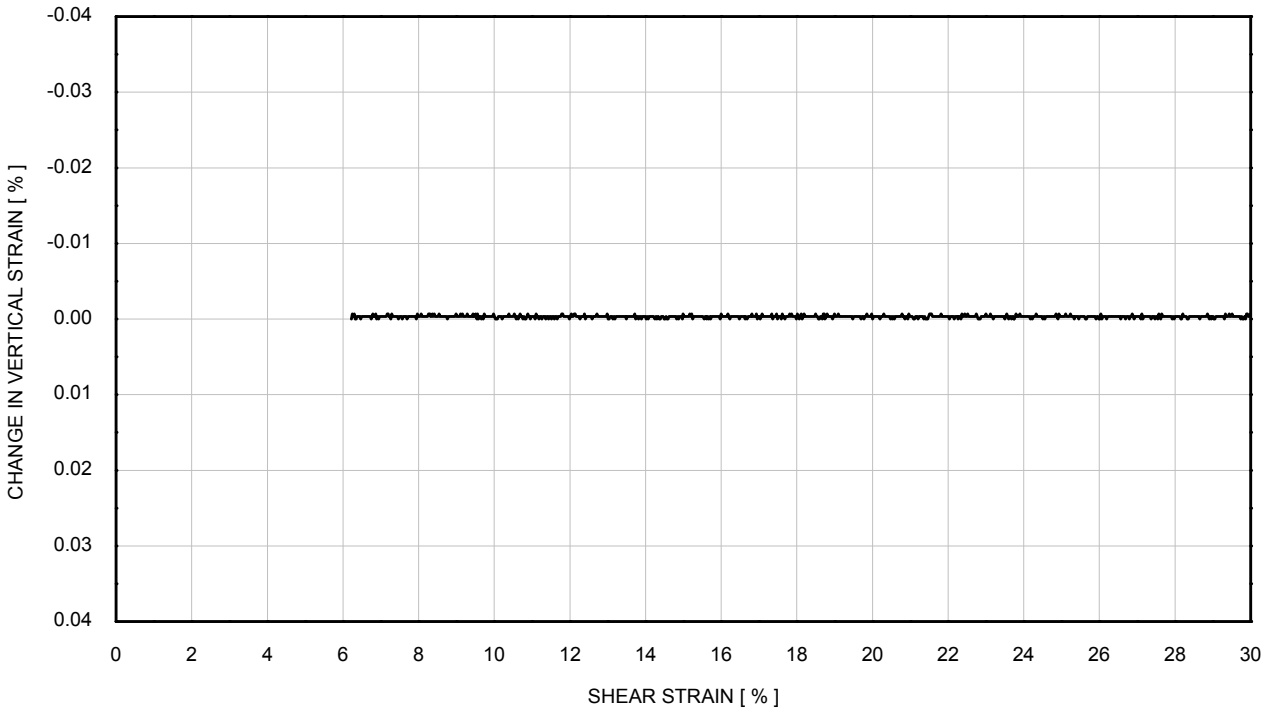




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 49 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 29.96 %	Depth [m]	: 21.65
Rate of strain	: 3.01 %/hour	Test No.	: CSS16

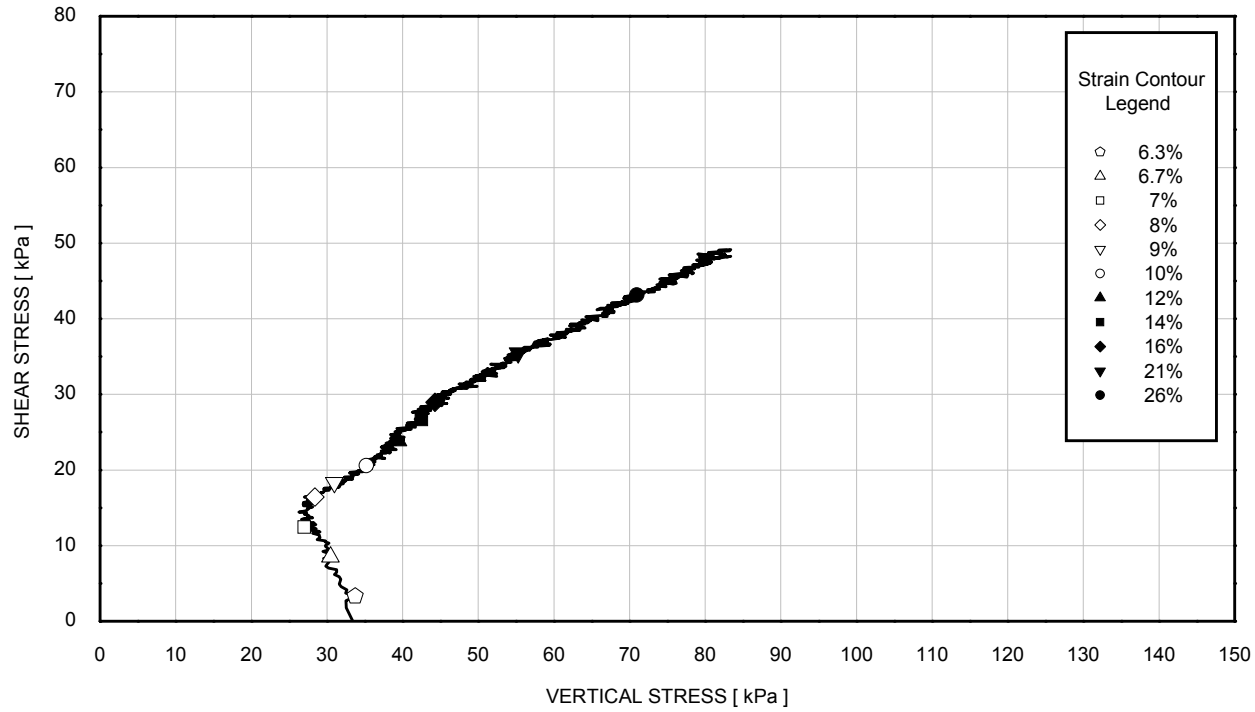
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

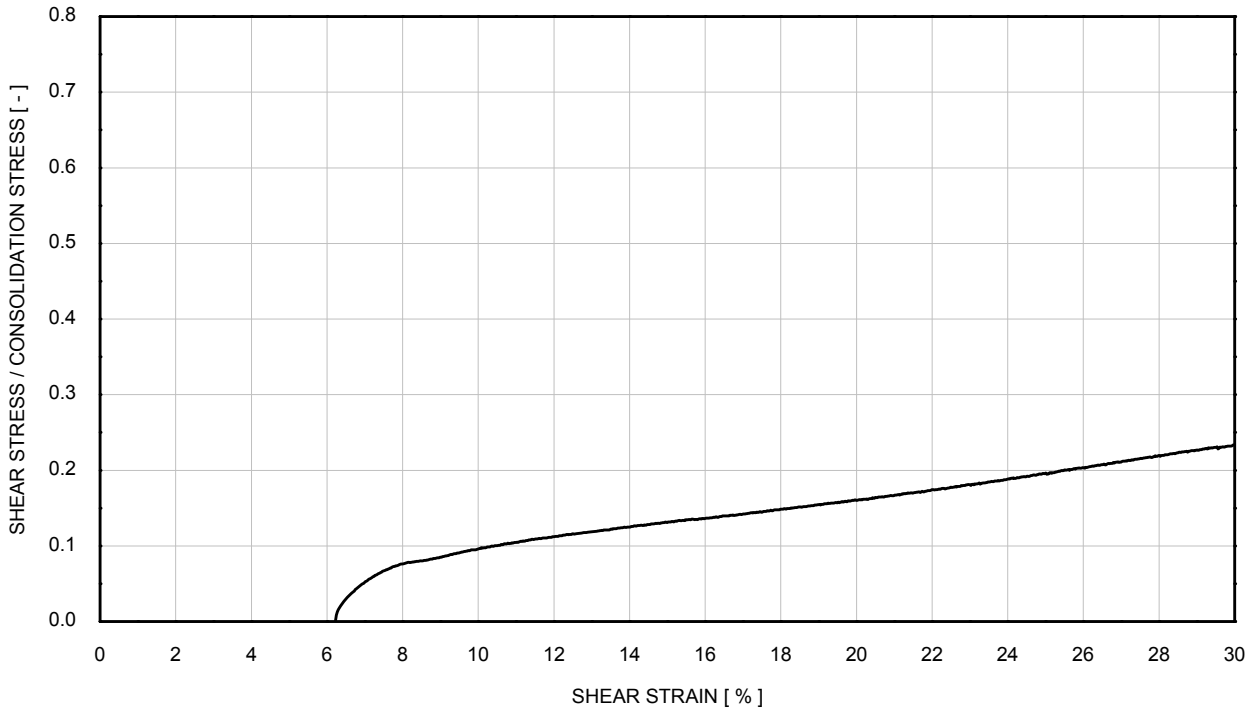




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 49 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 29.96 %	Depth [m]	: 21.65
Rate of strain	: 3.01 %/hour	Test No.	: CSS16

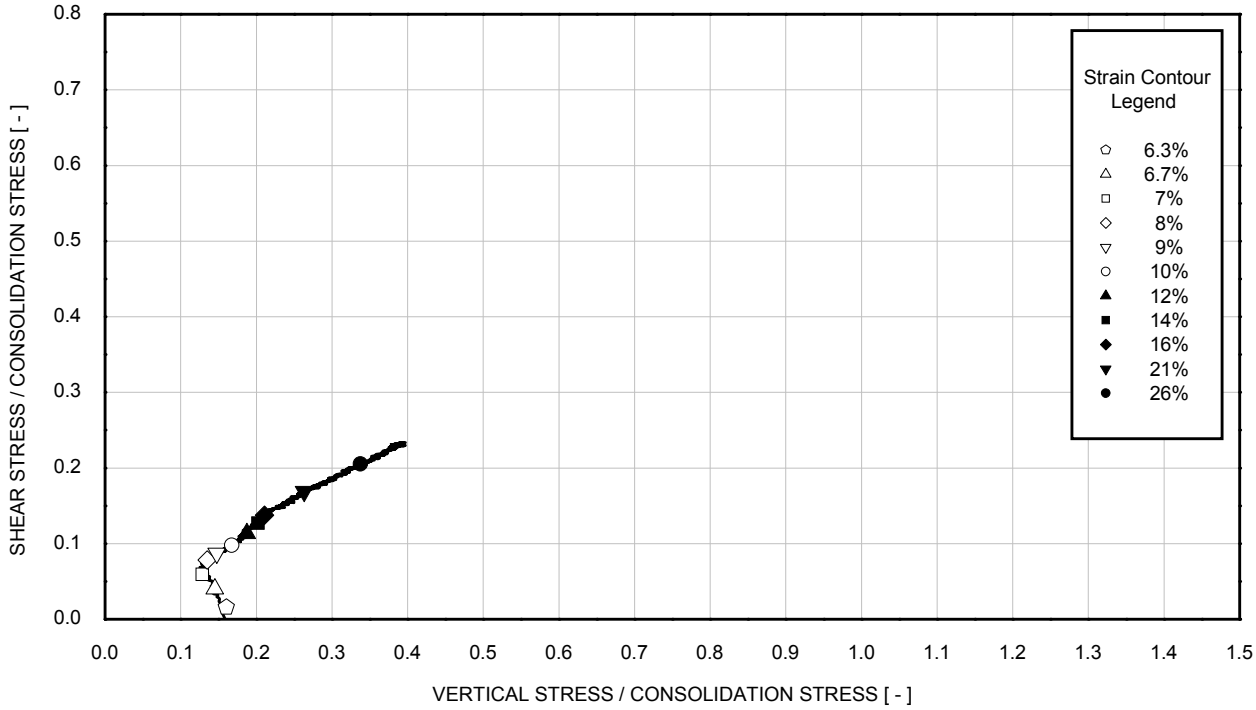
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

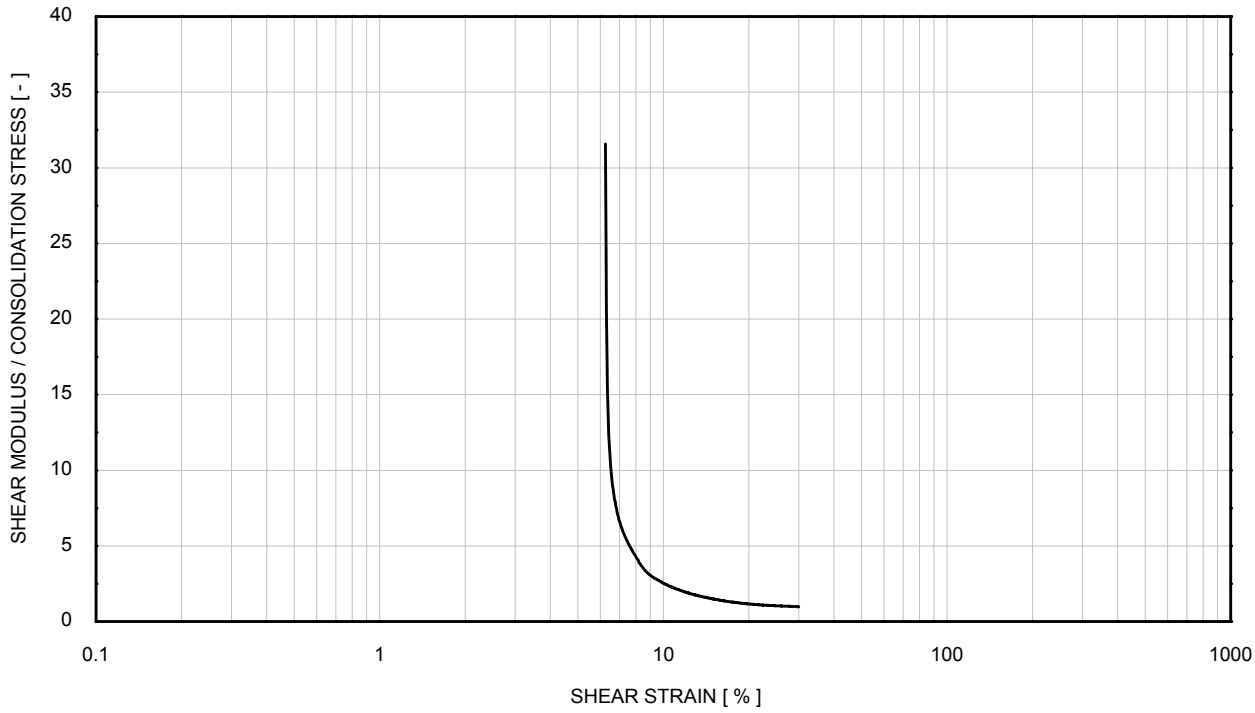




σ_{vc}	: 210 kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 49 kPa	Sample	: 24WaxB
γ at τ_{peak}	: 29.96 %	Depth [m]	: 21.65
Rate of strain	: 3.01 %/hour	Test No.	: CSS16

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 210	kPa	Borehole	: HKZ1-BH02-SA
τ_{peak}	: 49	kPa	Sample	: 24WaxB
γ at τ_{peak}	: 29.96	%	Depth [m]	: 21.65
Rate of strain	: 3.01	%/hour	Test No.	: CSS16

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive grey silty CLAY with traces of organic matter

GENERAL	
Date test started	31/10/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.2
Length	[mm]	29.6
Water content	[%]	26.0
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.61
Void ratio	[-]	0.678
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	142
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH08-SA_CSS17
Template issue	1.4
Processed by	JLS
Date	25/10/2016
Checked by	PH
Date	28/11/2016
Approved by	PH
Date	28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.86
Test number	CSS17

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	190
Vertical strain	[%]	5.33
Bulk density	[Mg/m^3]	2.09
Dry density	[Mg/m^3]	1.70
Void ratio	[-]	0.589
Water content	[%]	22.7

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
γ_{av} at N_f	[%]	-0.43
γ_{cy} at N_f	[%]	0.03
Shear induced -$\Delta\sigma_v$ at N_f	[kPa]	-7
Vertical strain	[%]	5.38

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.42	0.03	20.98	7.26
2	-0.42	0.03	21.79	4.92
5	-0.42	0.03	24.01	5.00
10	-0.42	0.03	23.59	4.55
20	-0.42	0.03	20.88	3.88
30	-0.42	0.03	23.78	3.64
40	-0.42	0.03	22.64	4.38
50	-0.42	0.03	23.89	5.23
100	-0.42	0.03	23.89	2.91
200	-0.43	0.03	21.73	3.00
400	-0.43	0.03	22.84	2.85

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.86
Test number	CSS17

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	23
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	85
γ_{av} at N_f	[%]	0.34
γ_{cy} at N_f	[%]	15.15
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	166
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.01	0.21	11.33	17.71
2	0.00	0.22	11.20	17.15
5	0.00	0.24	9.98	16.26
10	0.00	0.28	8.55	16.00
20	0.00	0.36	6.64	16.35
30	0.00	0.47	5.10	17.22
40	0.00	0.66	3.61	18.06
50	0.00	1.04	2.25	19.05
60	-0.01	2.29	0.98	20.49
70	0.03	6.01	0.37	16.81
80	0.19	12.00	0.18	13.83
85	0.34	15.15	0.14	13.49

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	38
Shear strain	[%]	28.73
Shear induced $-\Delta\sigma_v$	[kPa]	138
Vertical stress	[kPa]	52
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.93
At 15 % shear strain		
Shear stress	[kPa]	17
Shear induced $-\Delta\sigma_v$	[kPa]	163
Vertical stress	[kPa]	27
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.86
Test number	CSS17

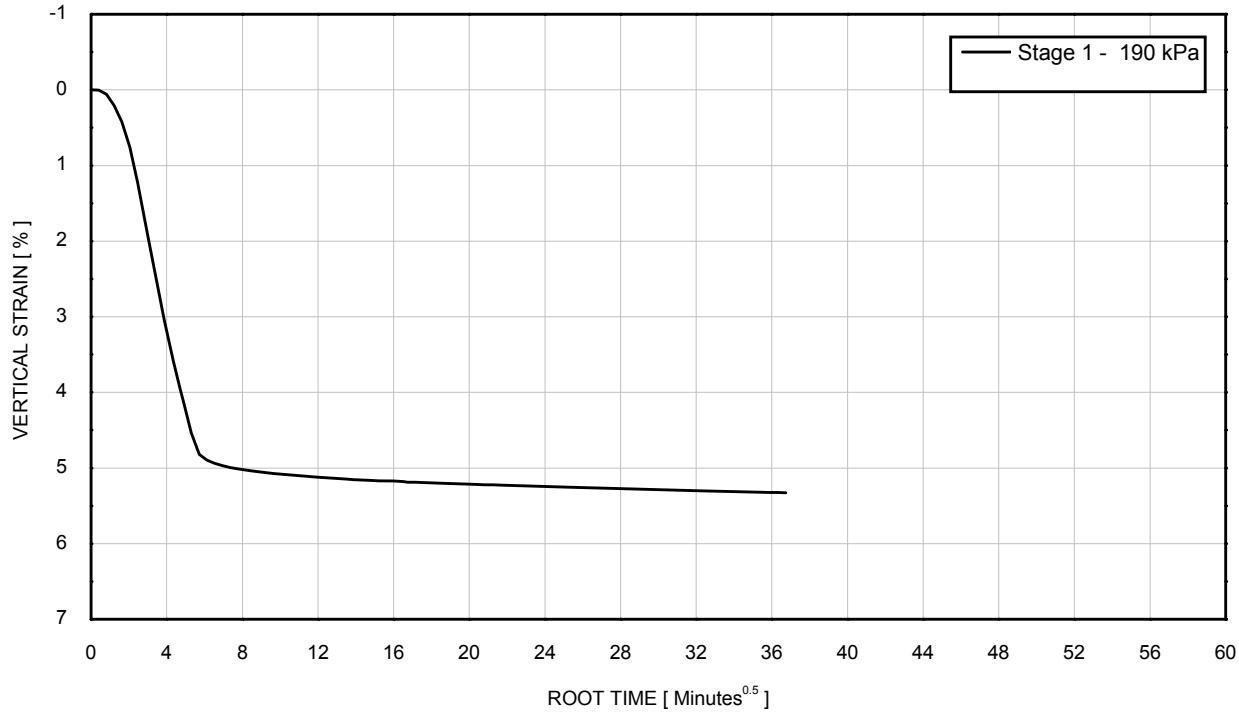
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

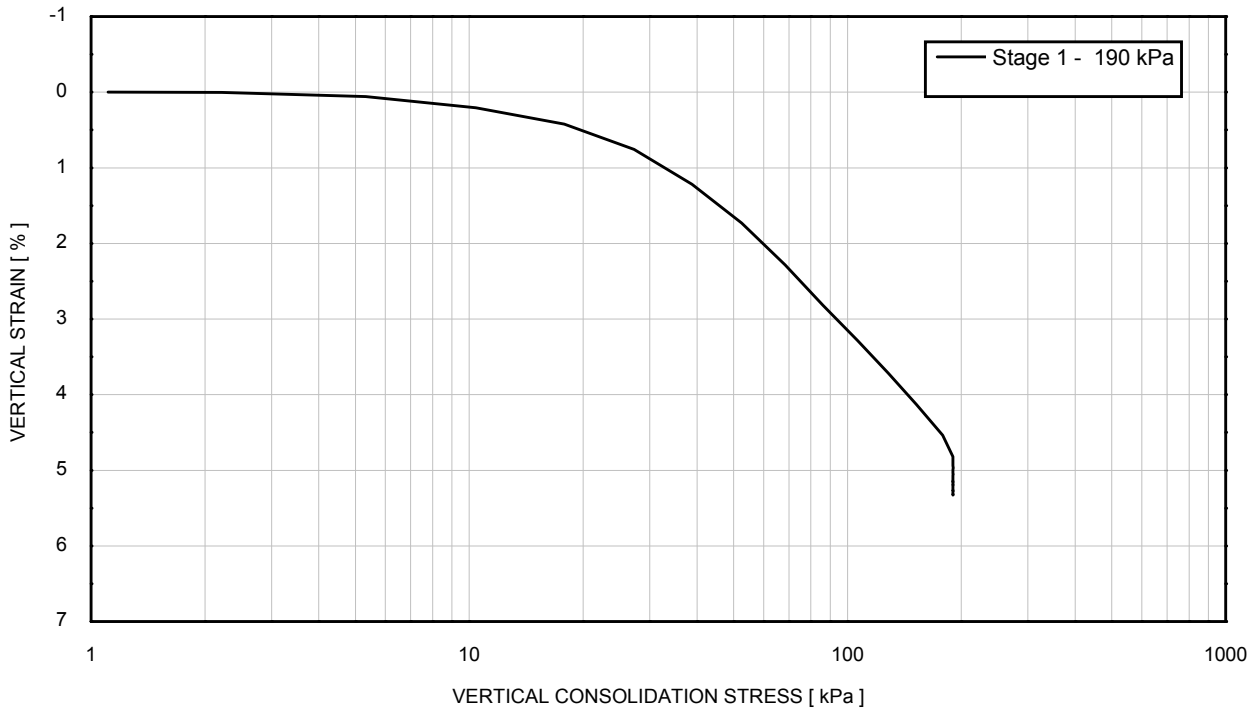
SPECIMEN PHOTOGRAPH

No photograph available

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxB
Depth [m]	23.86
Test number	CSS17

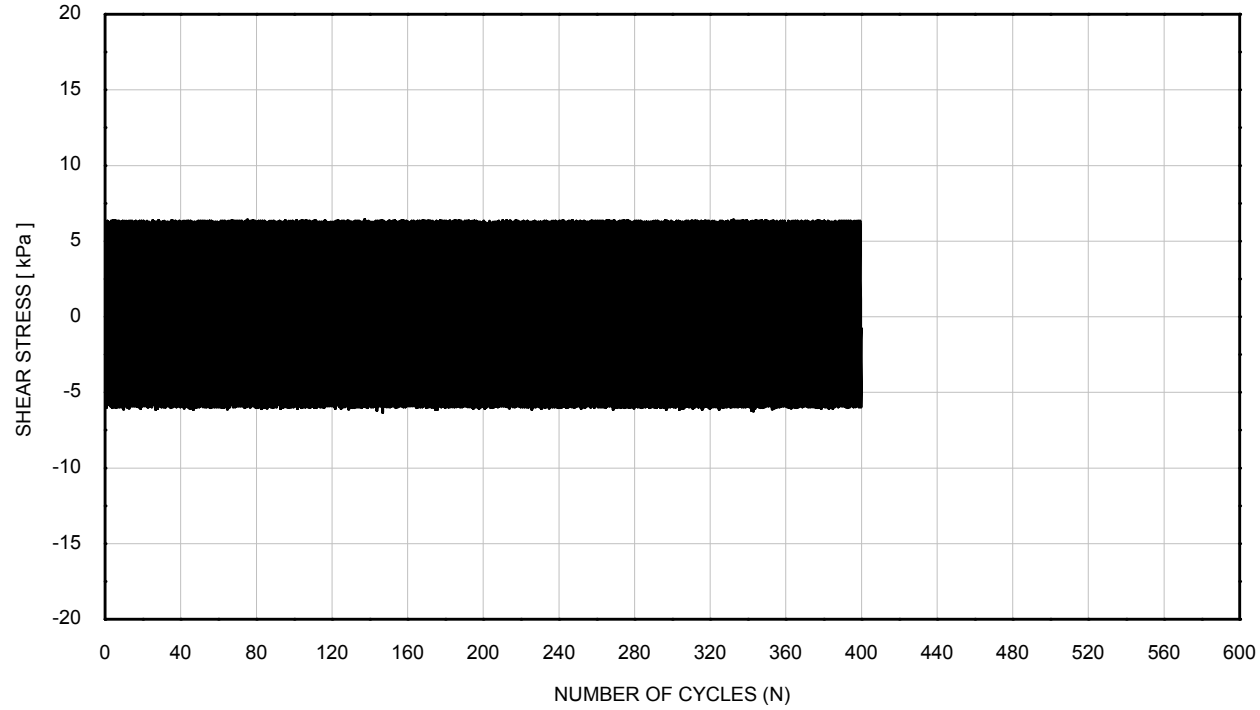
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

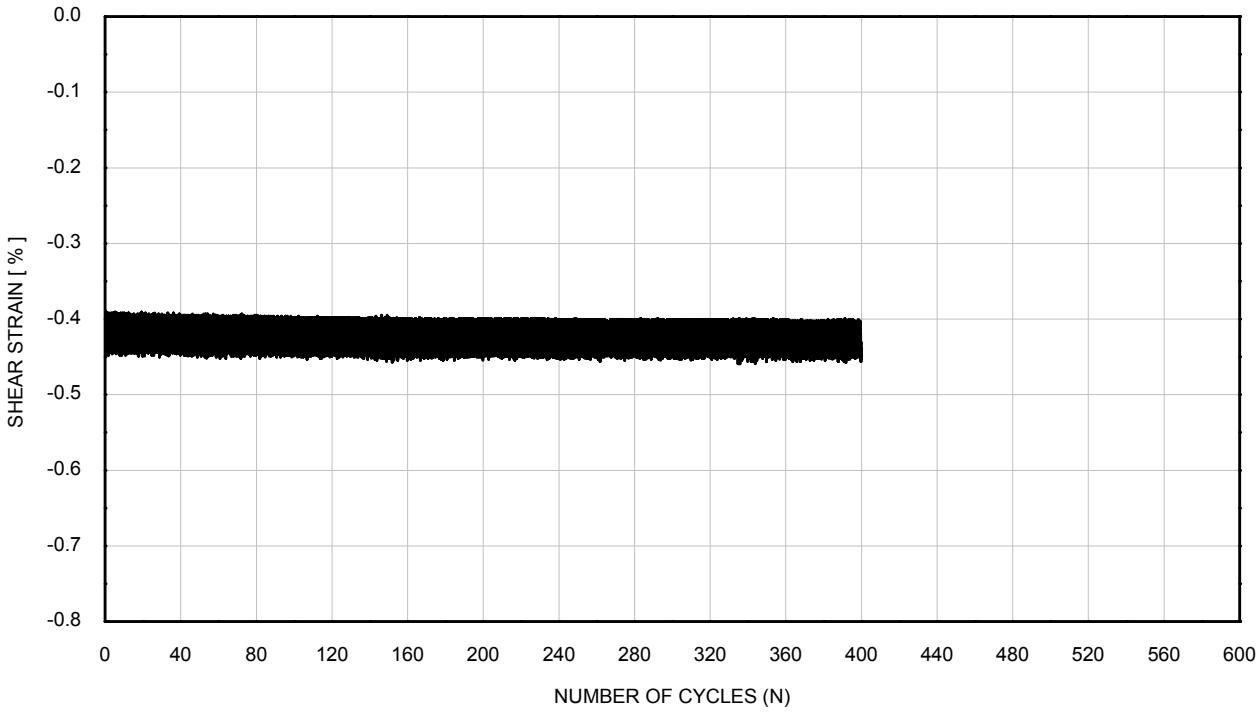




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
		Sample	: 40WaxB
		Depth [m]	: 23.86
		Test No.	: CSS17

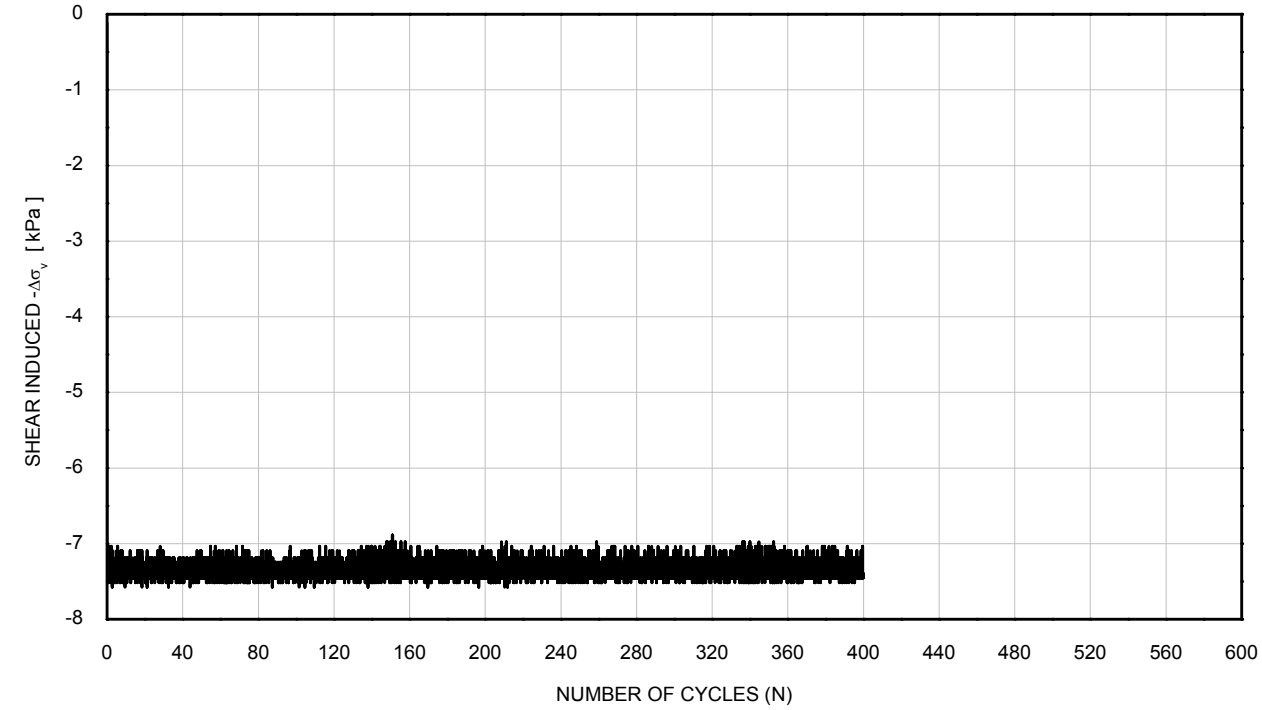
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

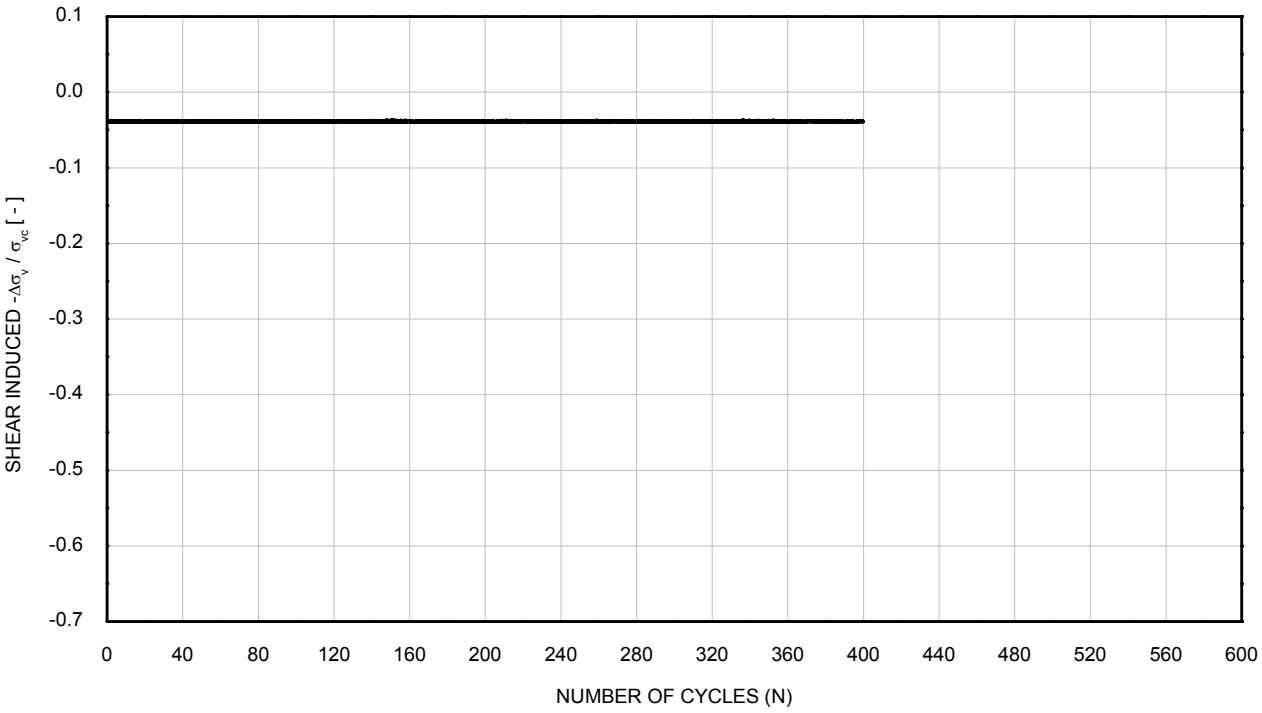




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

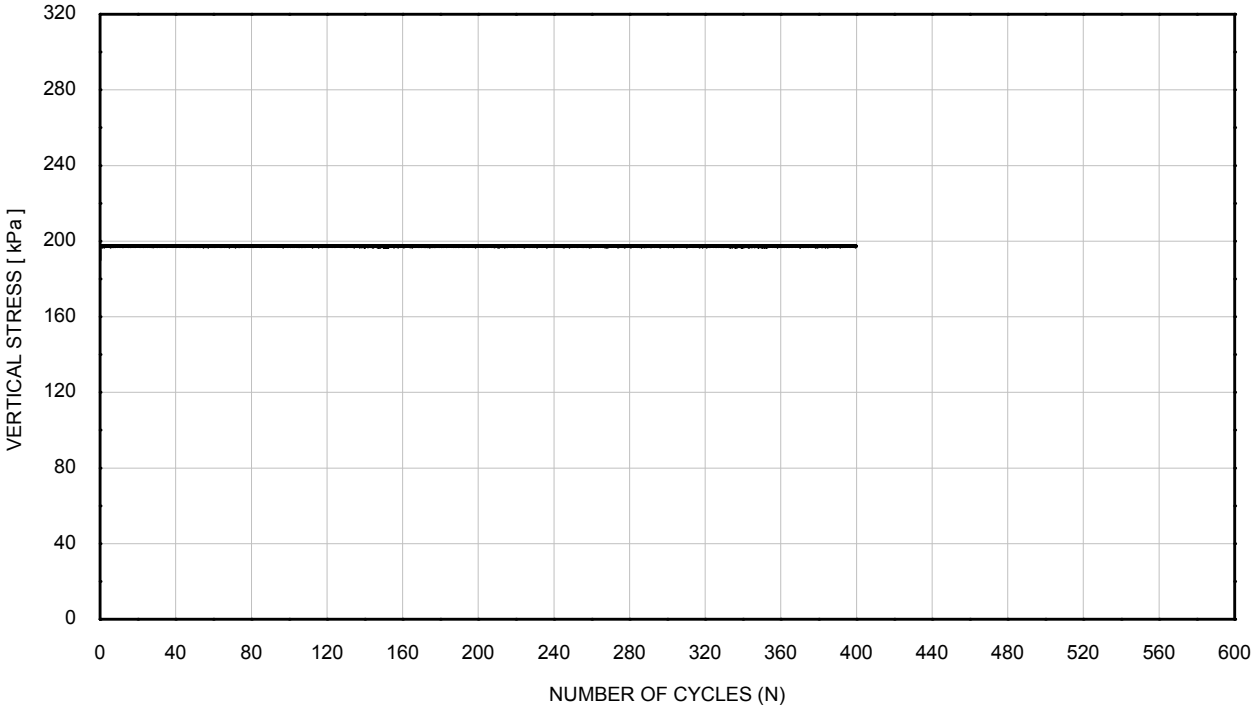
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

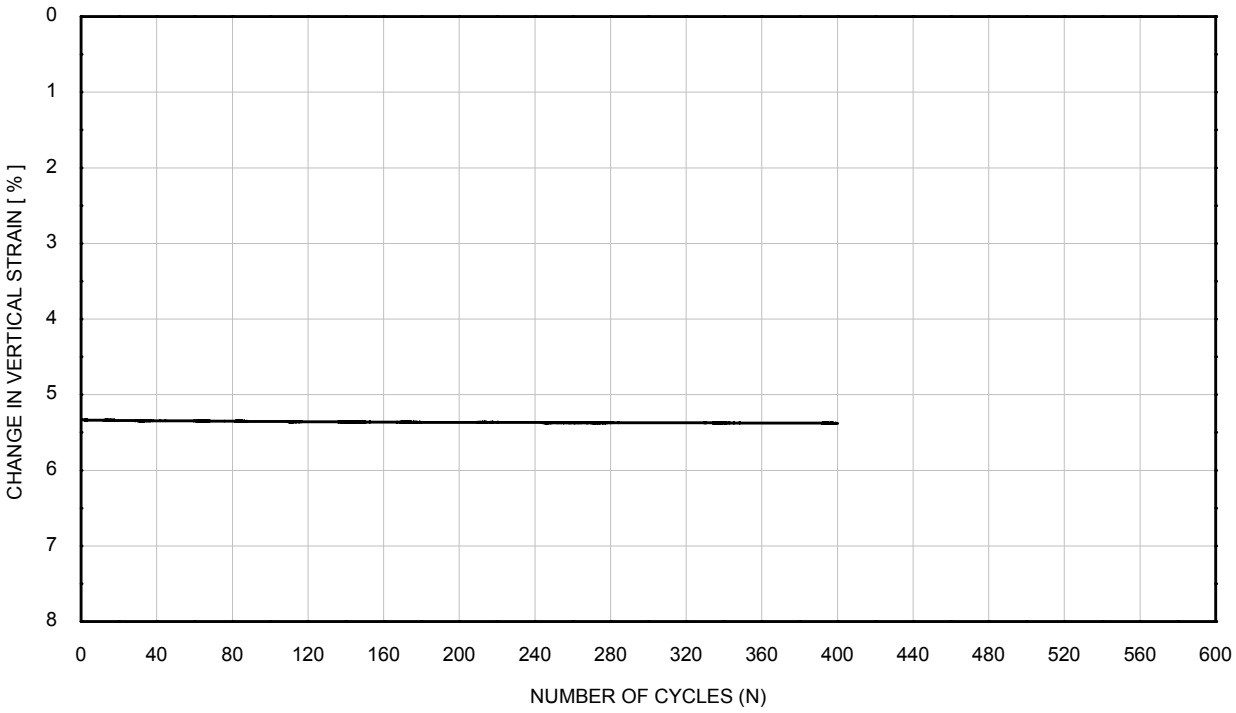




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

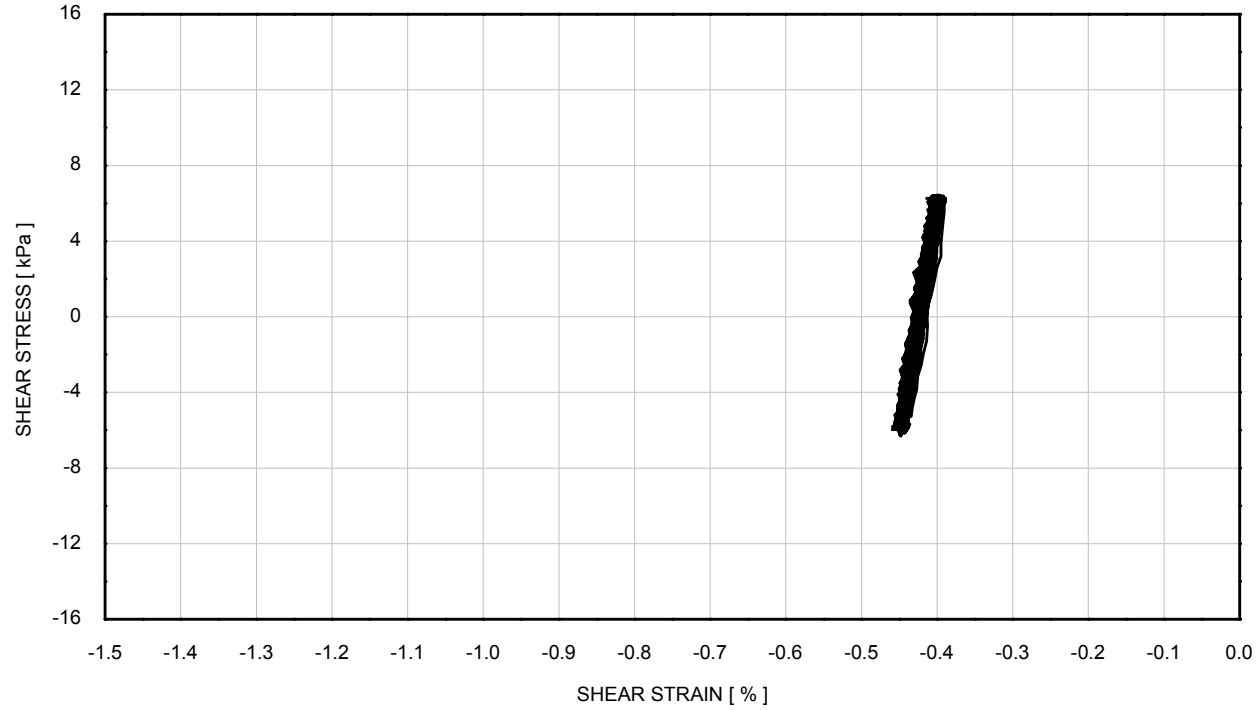
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

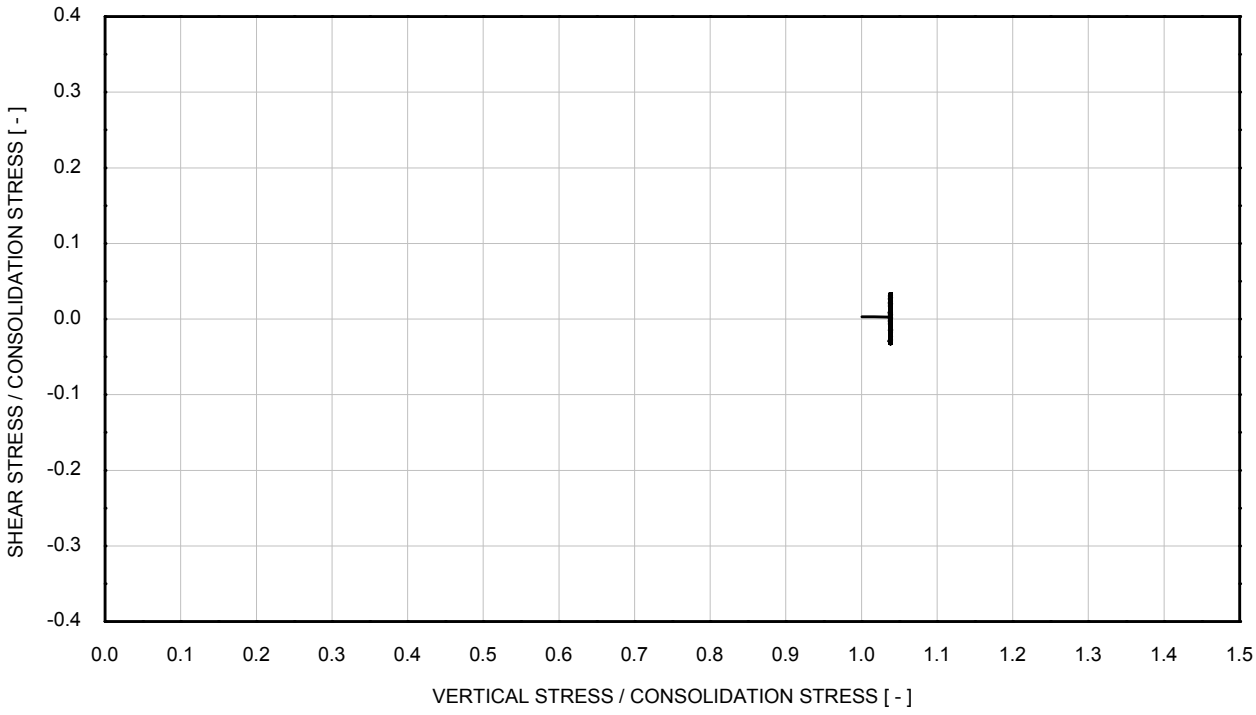




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

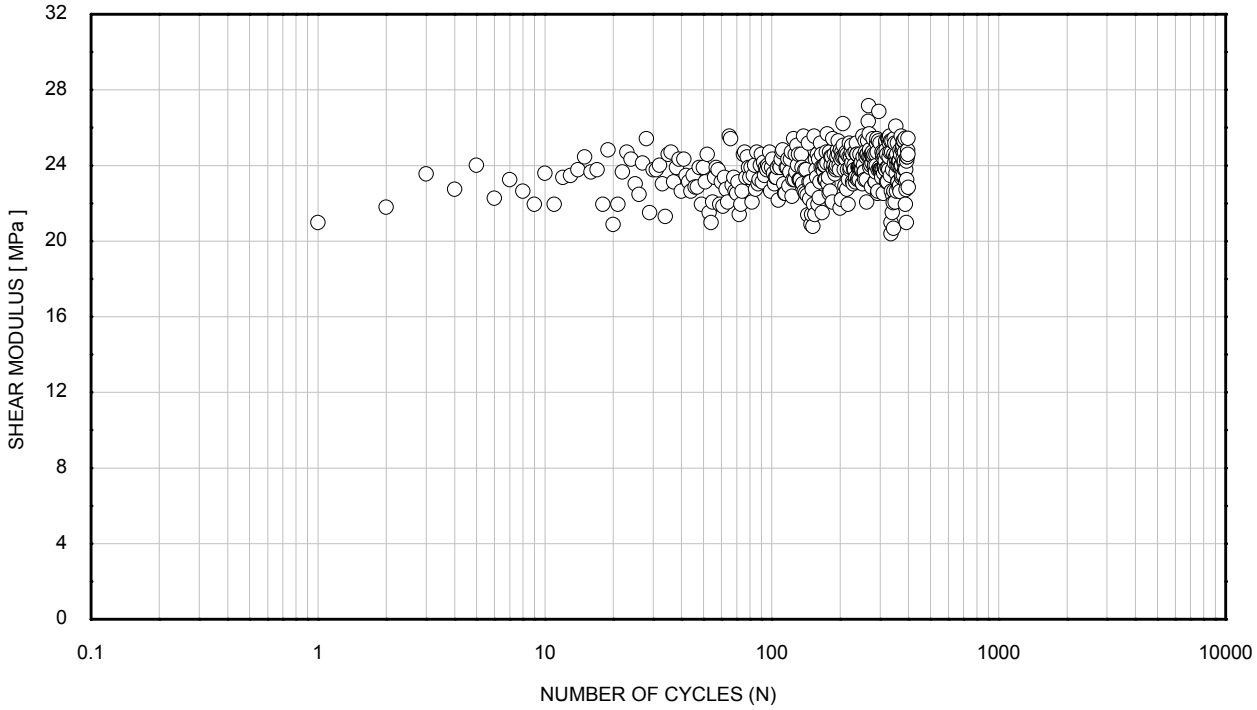
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

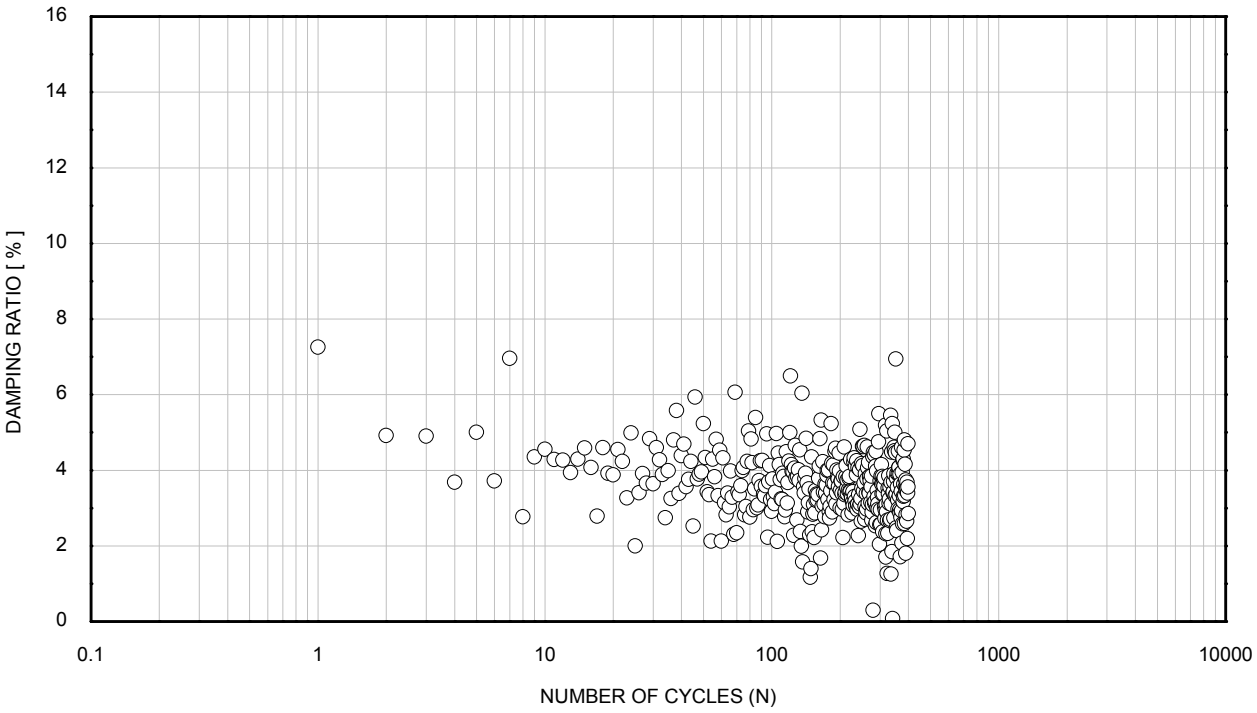




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

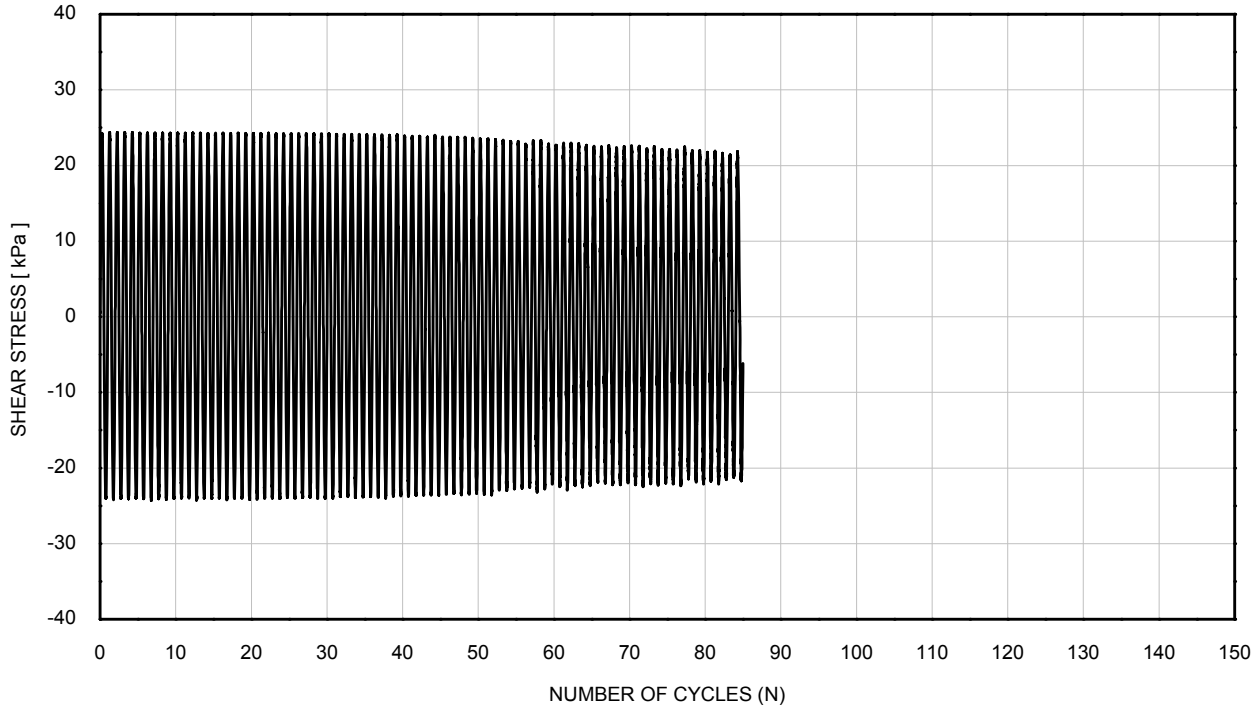
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

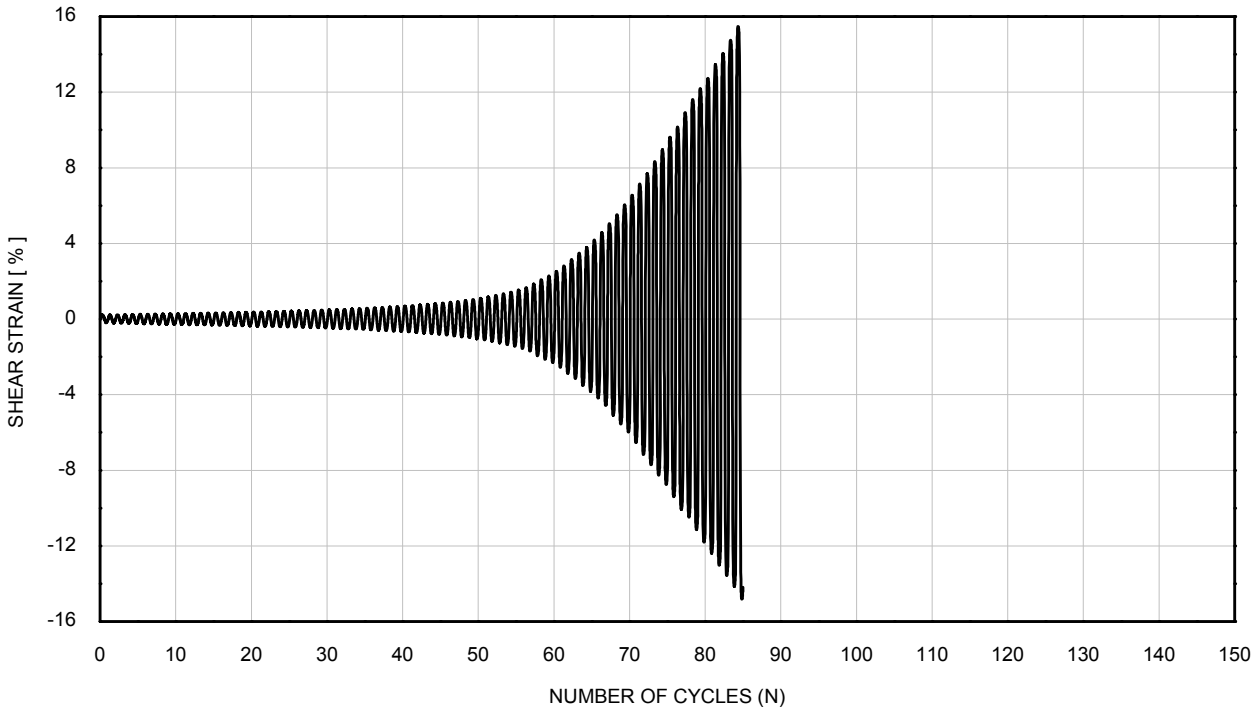




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
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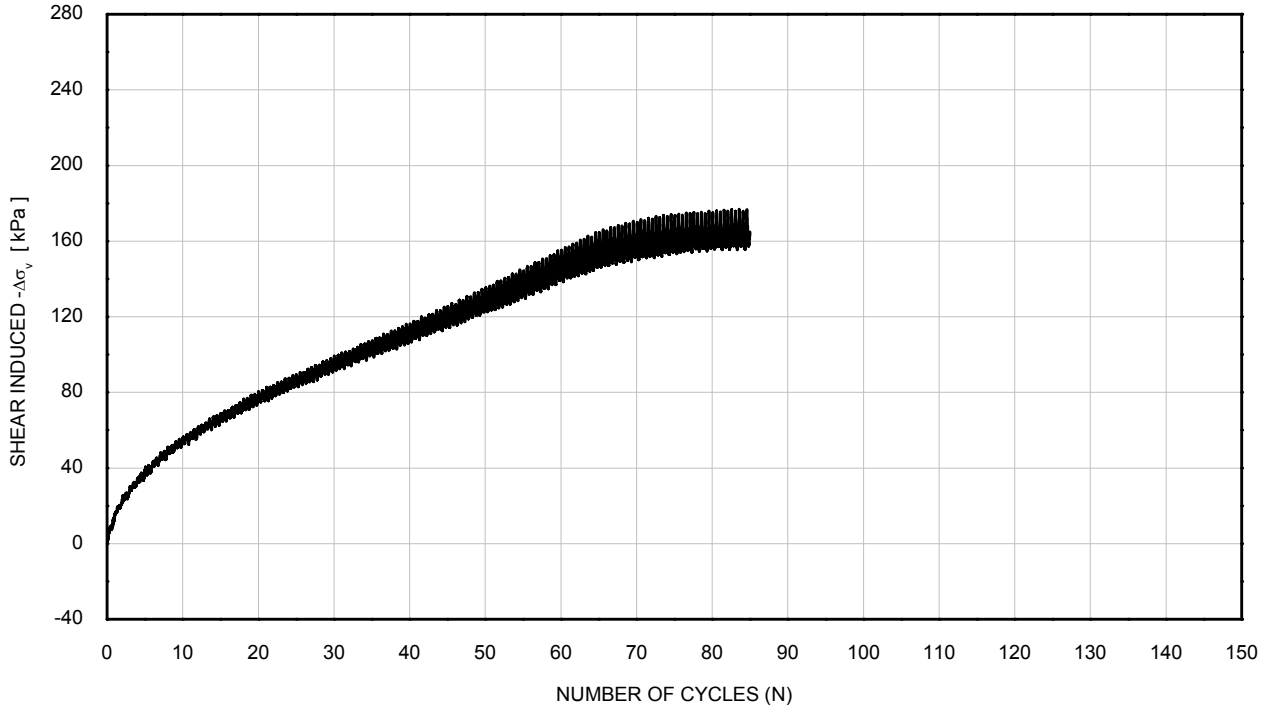
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

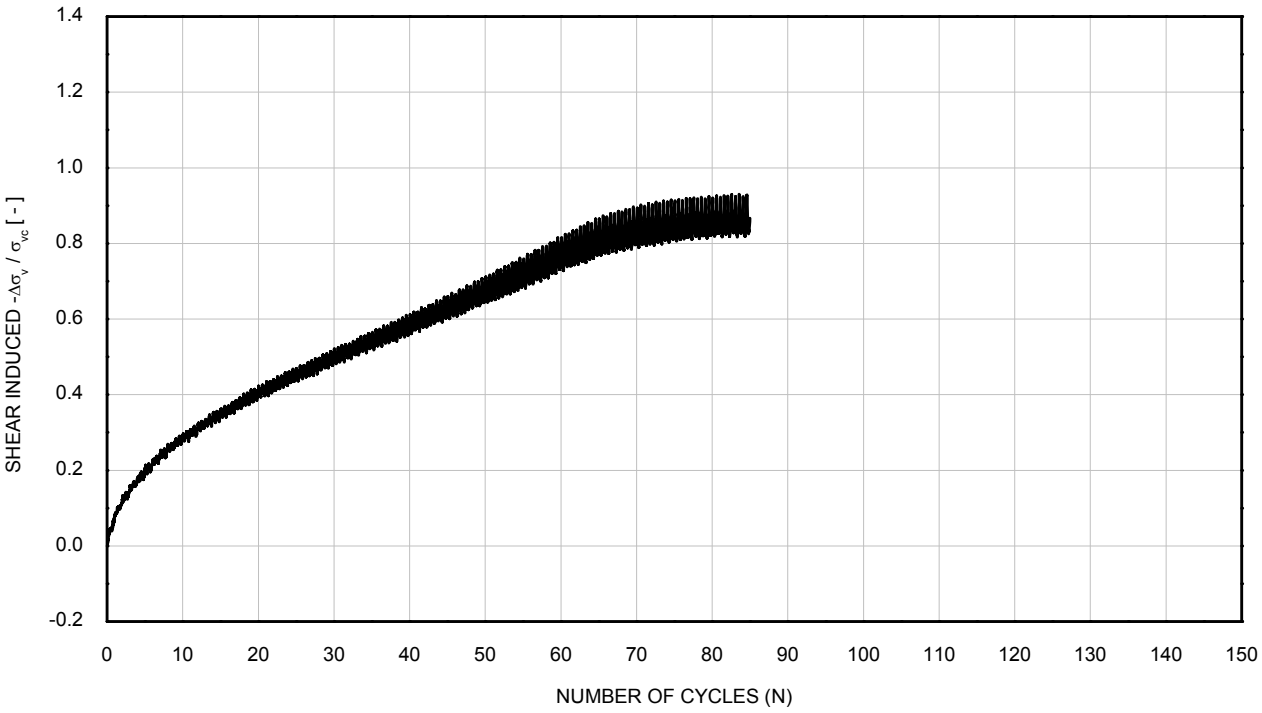




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

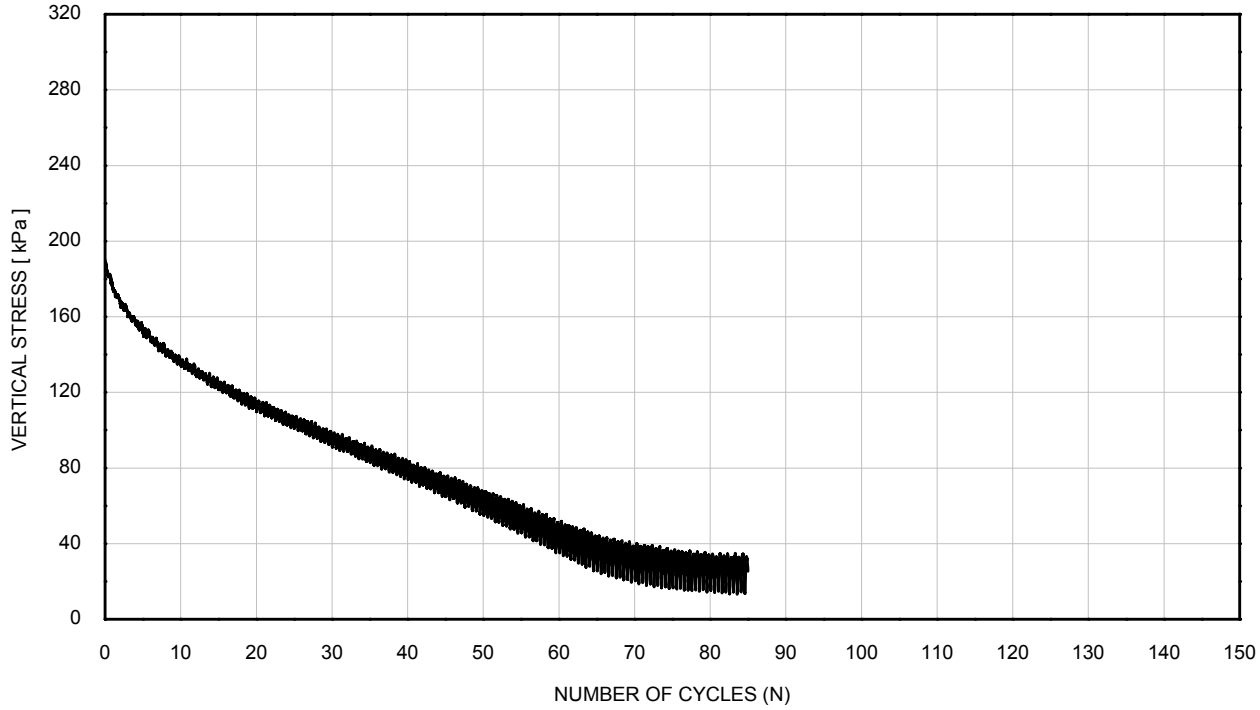
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

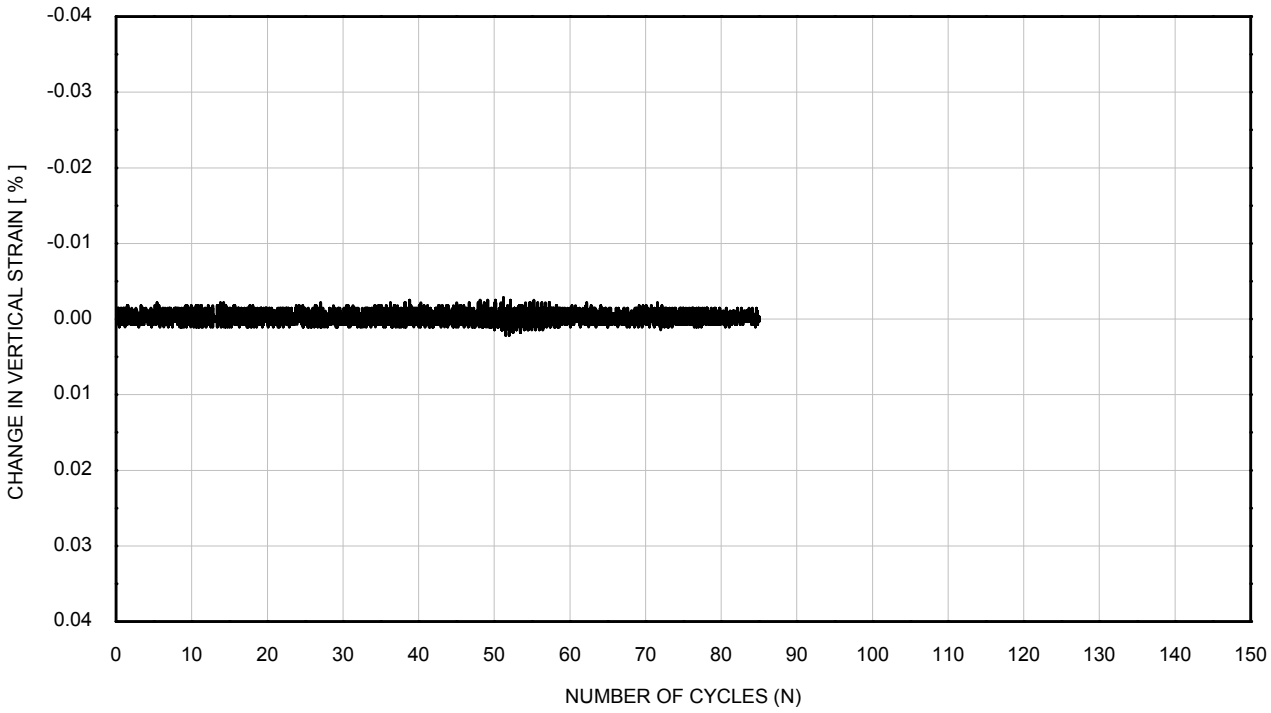




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

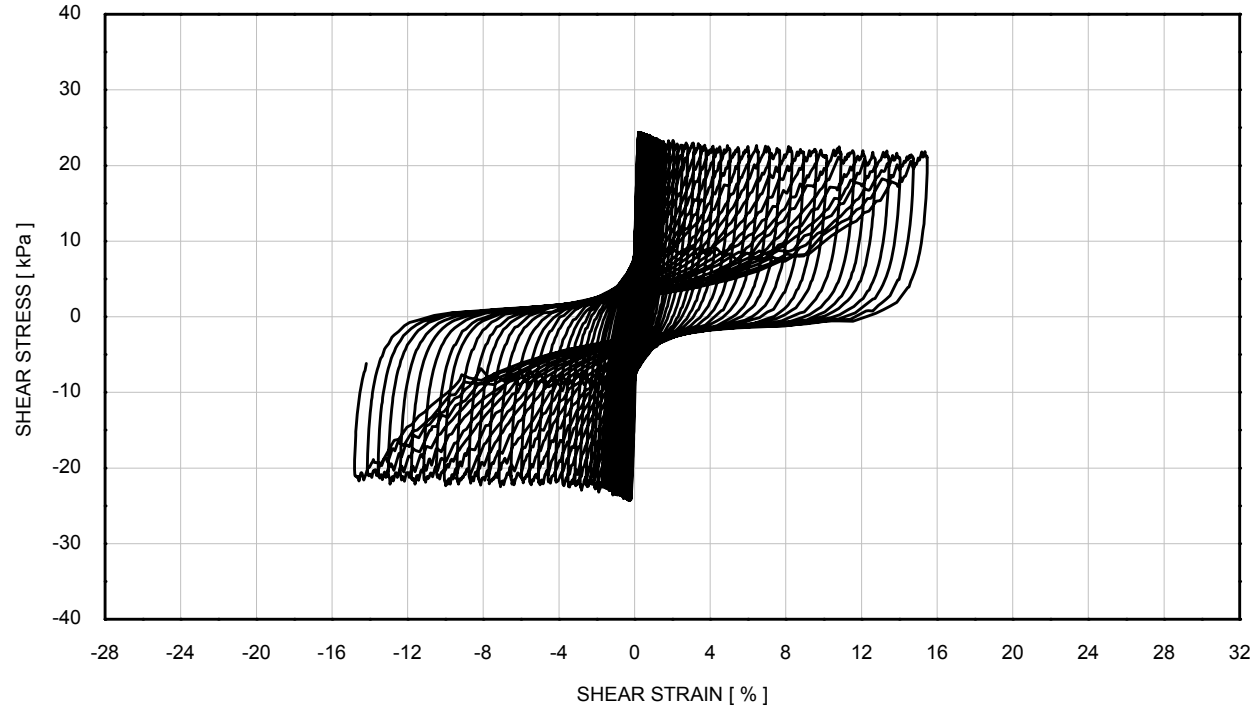
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

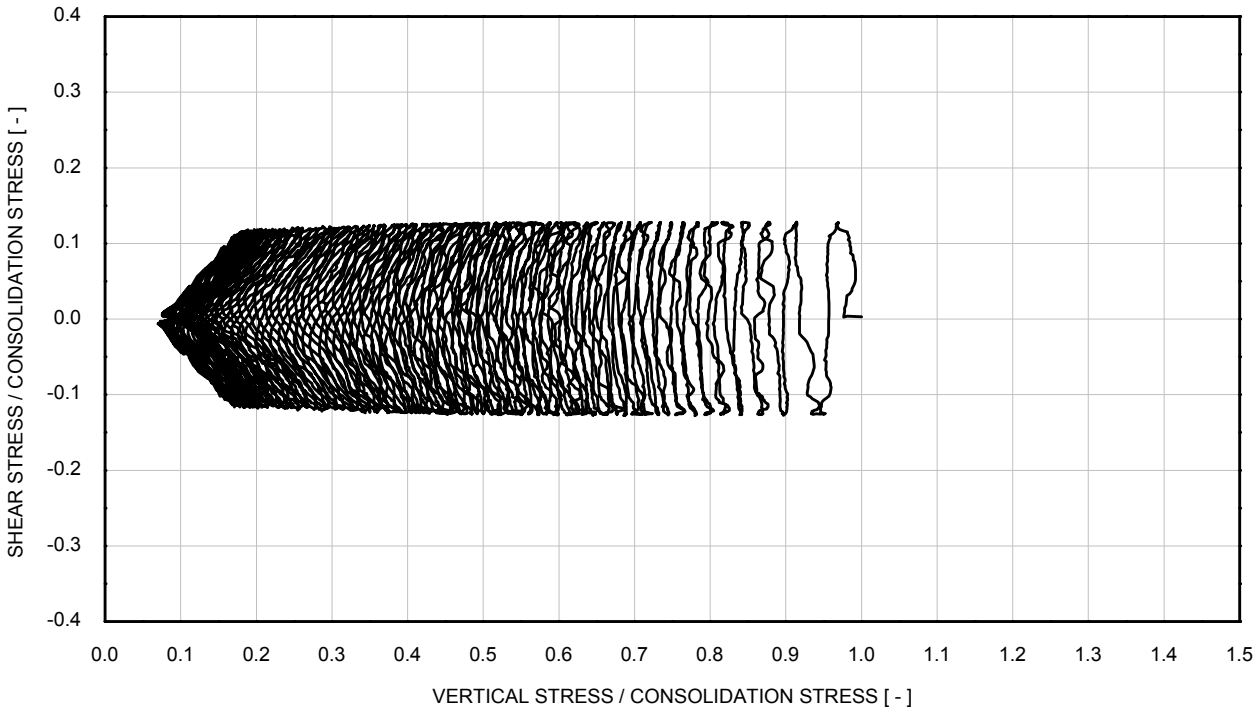




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

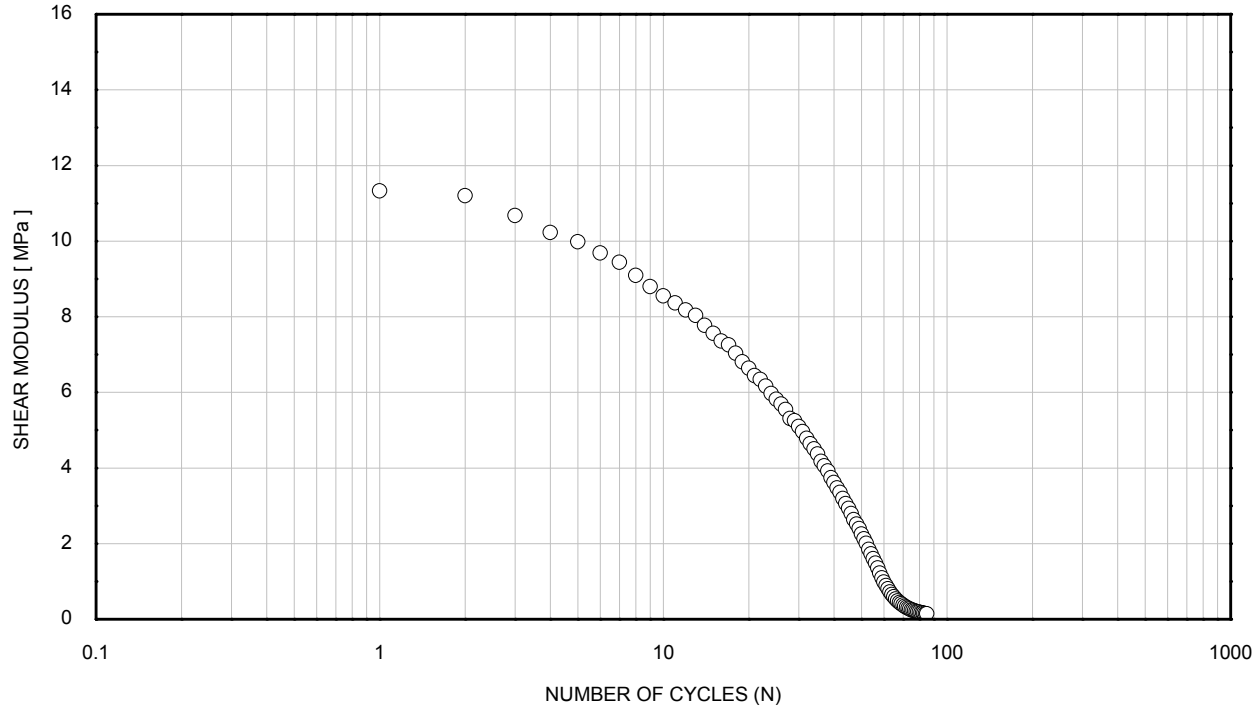
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

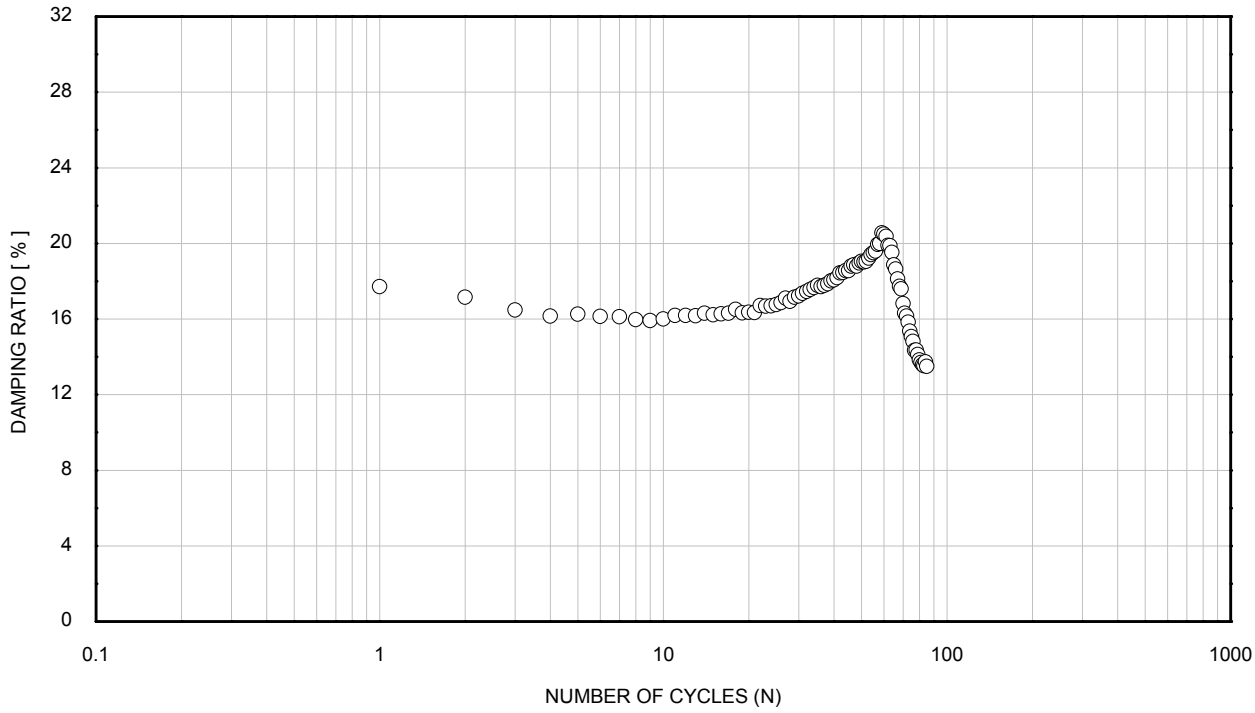




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	:	23.86
Frequency	:	0.10 Hz	Test No.	:	CSS17

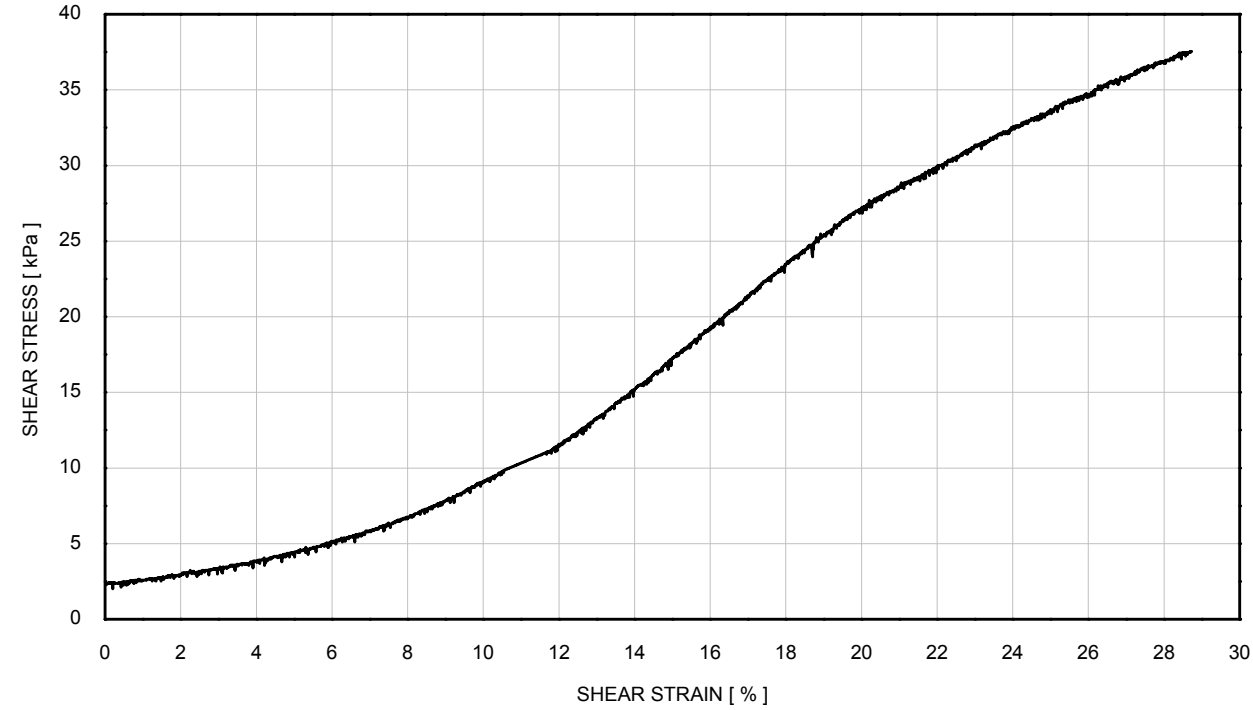
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

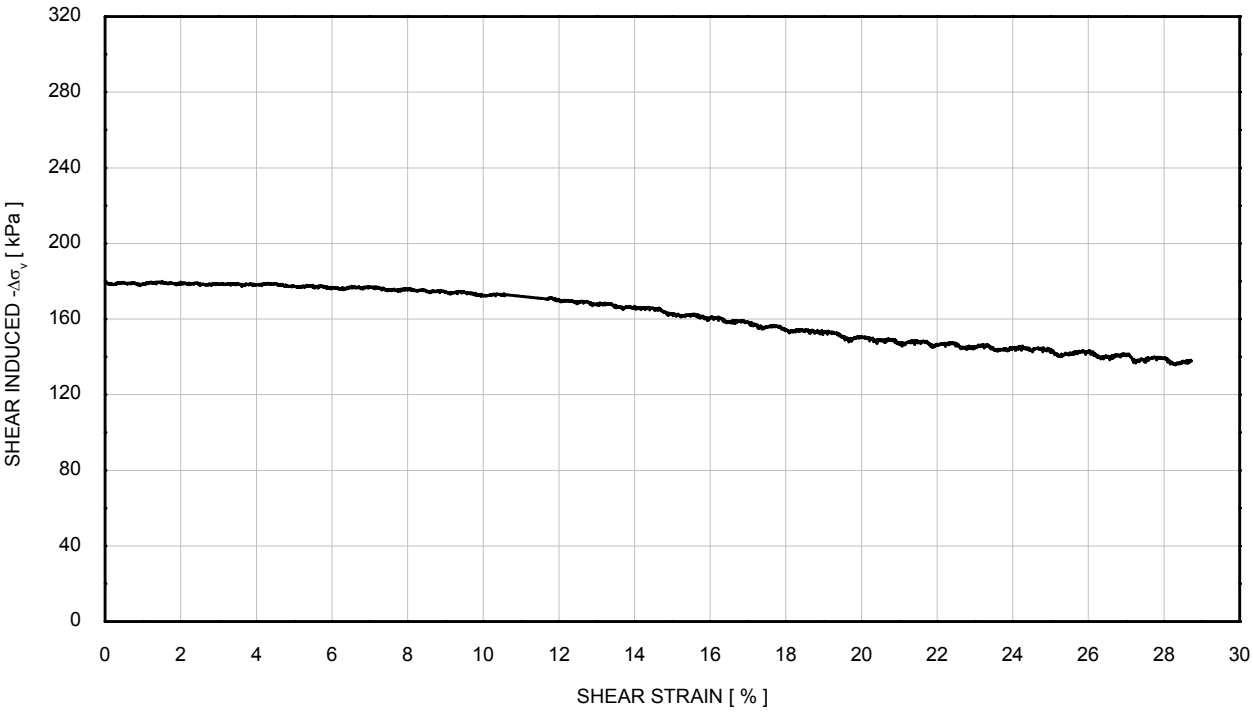




σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	: 40WaxB
Mean τ_{cy}	:	23 kPa	Depth [m]	: 23.86
Frequency	:	0.10 Hz	Test No.	: CSS17

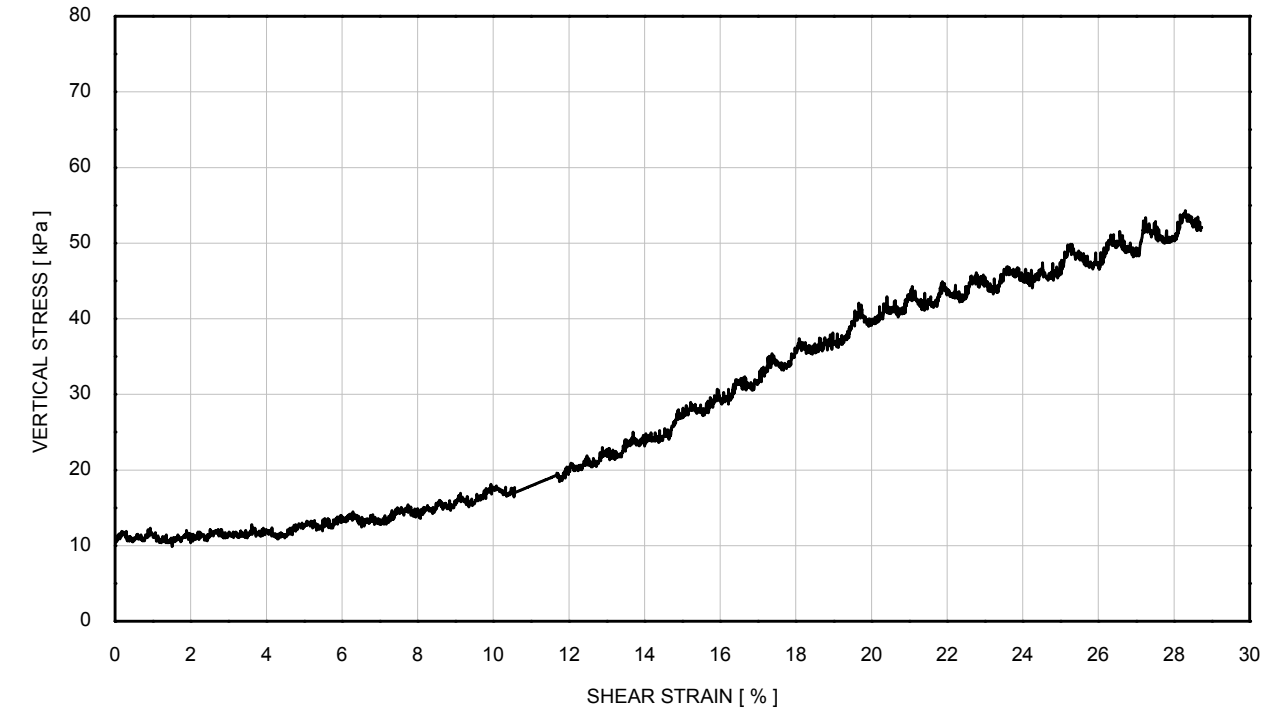
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

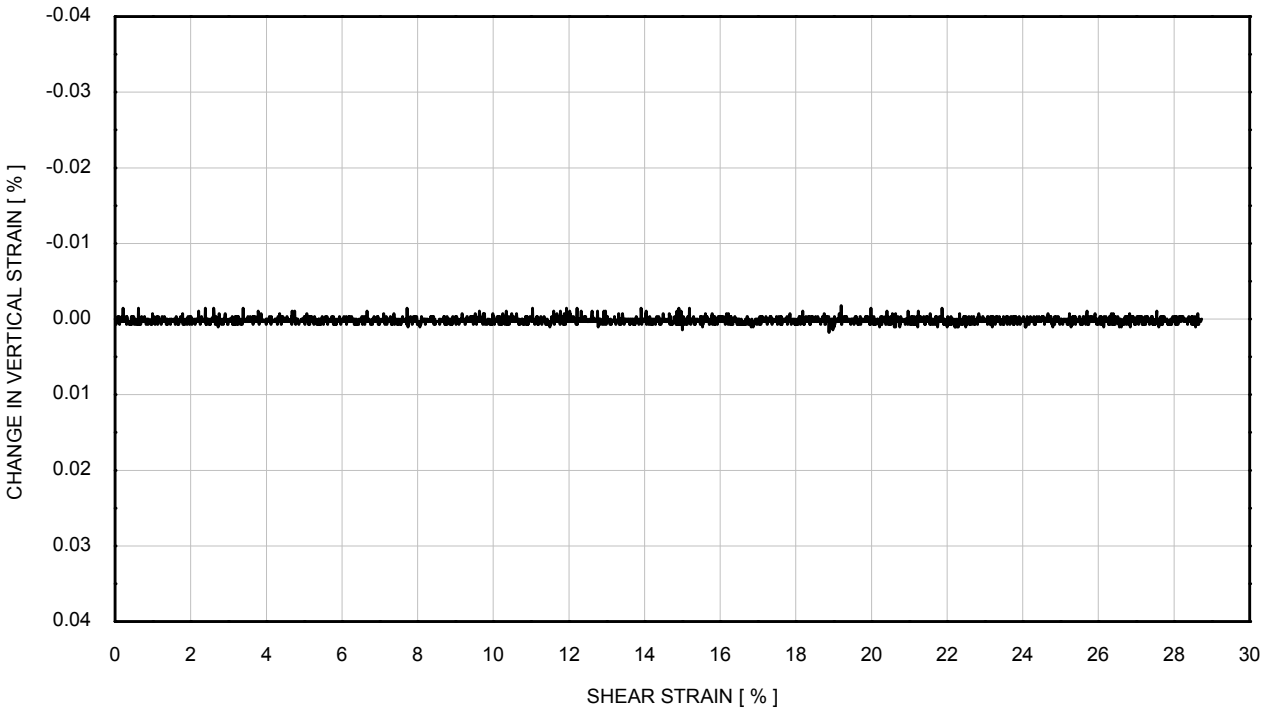




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 38 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 28.73 %	Depth [m]	: 23.86
Rate of strain	: 2.93 %/hour	Test No.	: CSS17

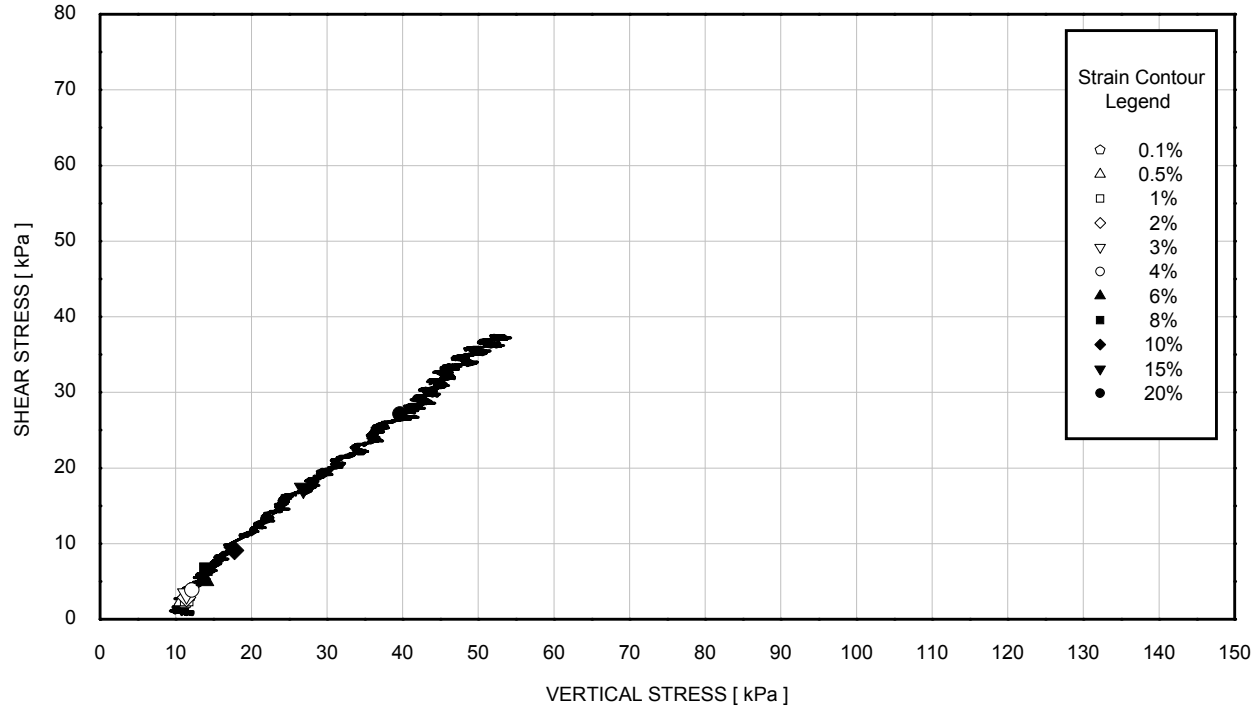
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

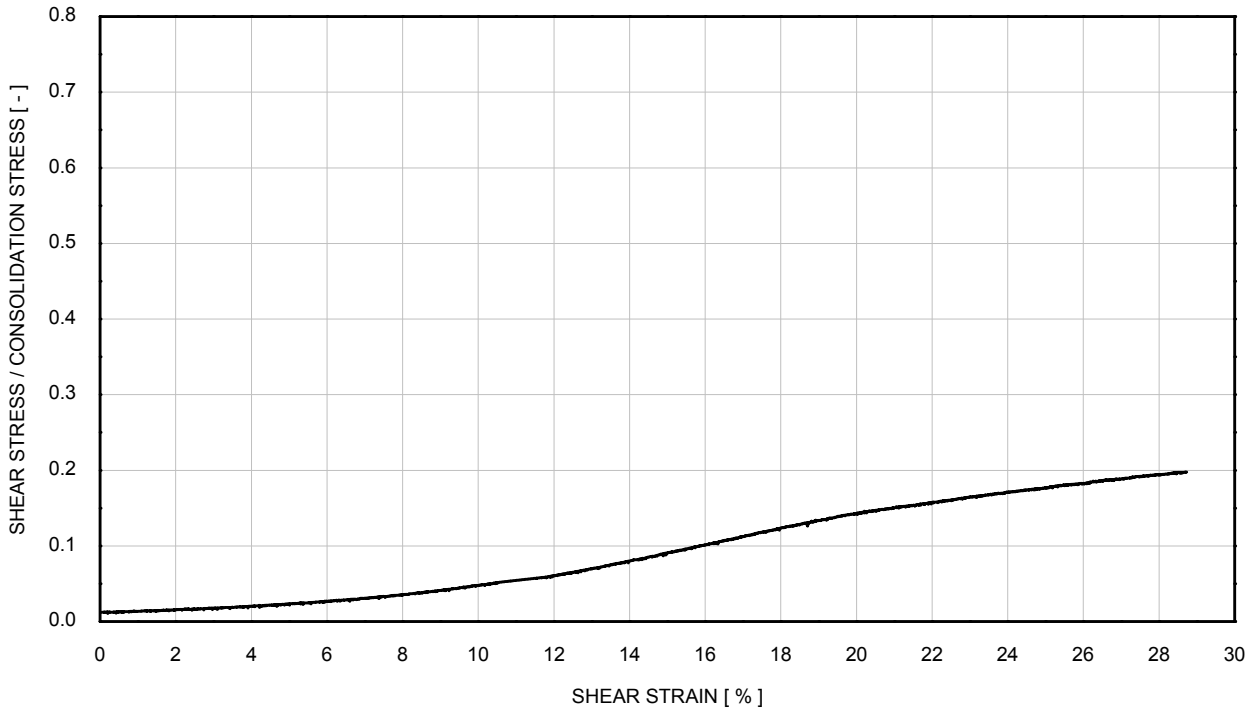




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 38 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 28.73 %	Depth [m]	: 23.86
Rate of strain	: 2.93 %/hour	Test No.	: CSS17

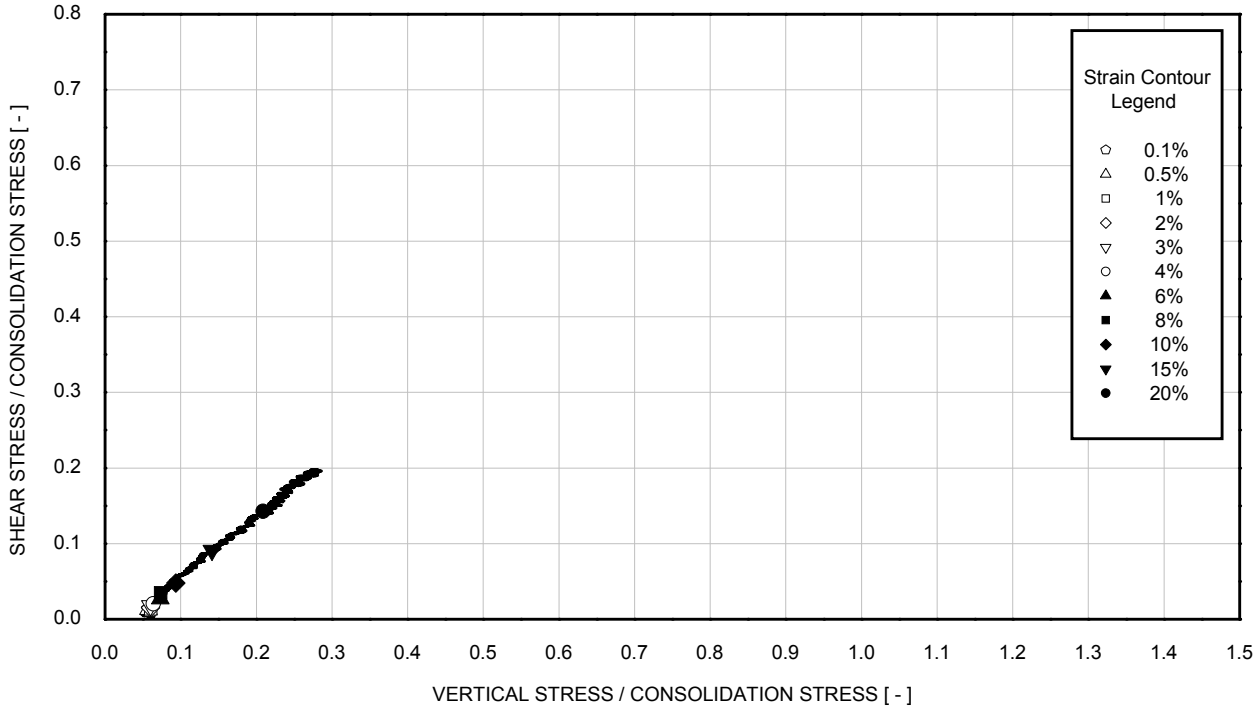
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

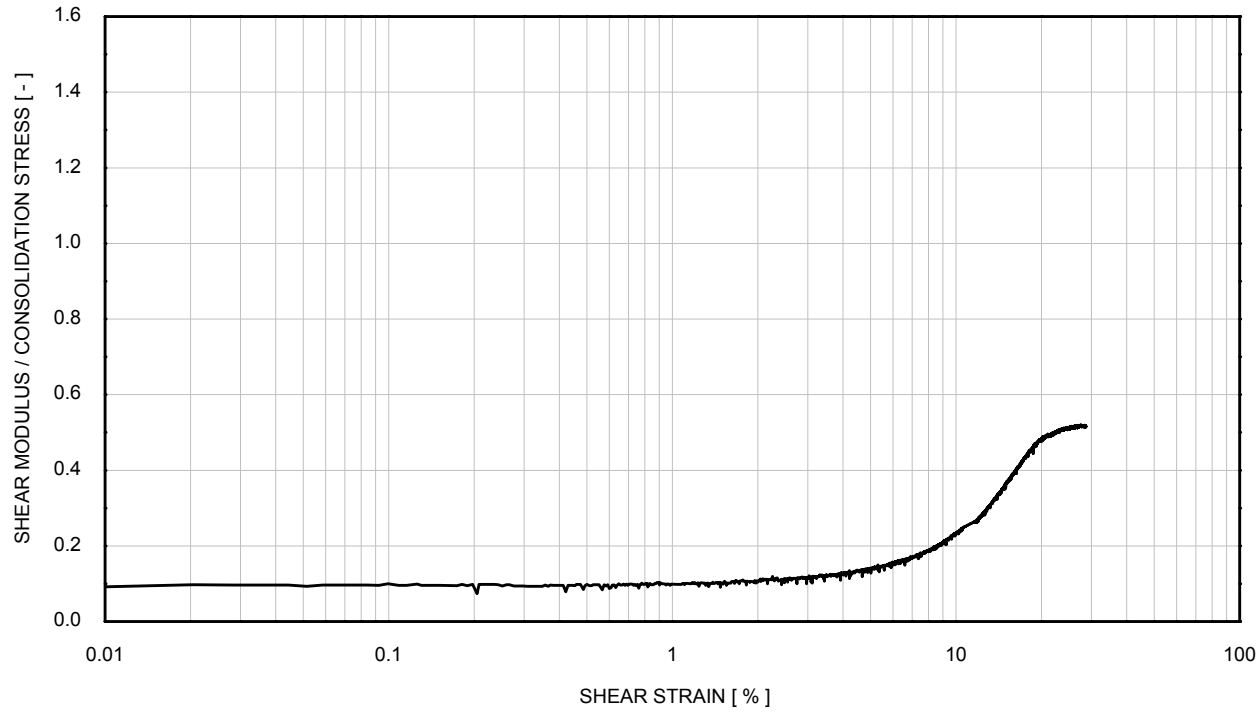




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 38 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 28.73 %	Depth [m]	: 23.86
Rate of strain	: 2.93 %/hour	Test No.	: CSS17

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 38 kPa	Sample	: 40WaxB
γ at τ_{peak}	: 28.73 %	Depth [m]	: 23.86
Rate of strain	: 2.93 %/hour	Test No.	: CSS17

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Very dark grey silty CLAY

GENERAL	
Date test started	11/03/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.8
Length	[mm]	29.7
Water content	[%]	27.7
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.721
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	46
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH08-SA_CSS18
Template issue	1.4
Processed by Date	JLS 07/11/2016
Checked by Date	PH 28/11/2016
Approved by Date	PH 28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH02-SA
Sample	40WaxC
Depth [m]	23.92
Test number	CSS18

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	190
Vertical strain	[%]	7.03
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.601
Water content	[%]	23.1

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	190
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	7.05
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.600

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-1.06	0.03	18.47	6.85
2	-1.06	0.03	19.69	4.20
5	-1.07	0.03	19.87	3.36
10	-1.07	0.03	20.43	3.66
20	-1.07	0.03	20.56	3.23
50	-1.07	0.03	20.56	3.26
100	-1.08	0.03	20.46	2.94
200	-1.08	0.03	20.36	3.17
300	-1.08	0.03	19.04	1.78
400	-1.08	0.03	20.88	2.38

TEST IDENTIFICATION	
Borehole	HKZ2-BH02-SA
Sample	40WaxC
Depth [m]	23.92
Test number	CSS18

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	16
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
γ_{av} at N_f	[%]	-0.23
γ_{cy} at N_f	[%]	0.26
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	80
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.02	0.13	13.09	12.61
2	-0.04	0.12	13.80	11.61
5	-0.05	0.12	13.33	10.33
10	-0.06	0.13	12.83	9.81
20	-0.08	0.13	12.27	10.08
50	-0.11	0.16	10.56	9.96
100	-0.13	0.18	9.29	10.50
200	-0.16	0.20	8.30	10.75
500	-0.19	0.22	7.39	10.73
1000	-0.22	0.25	6.59	10.85
1500	-0.23	0.26	6.19	10.81

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	61
Shear strain	[%]	21.13
Shear induced $-\Delta\sigma_v$	[kPa]	88
Vertical stress	[kPa]	102
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	60
Shear induced $-\Delta\sigma_v$	[kPa]	79
Vertical stress	[kPa]	111
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH02-SA
Sample	40WaxC
Depth [m]	23.92
Test number	CSS18

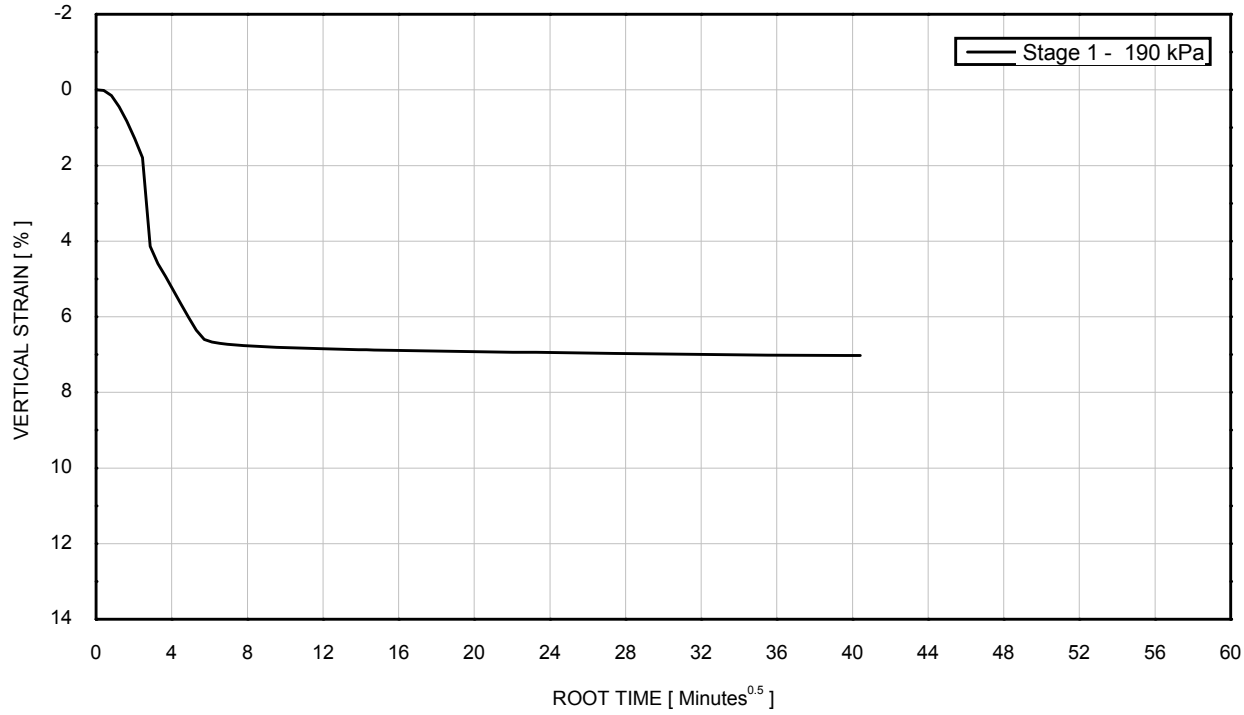
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

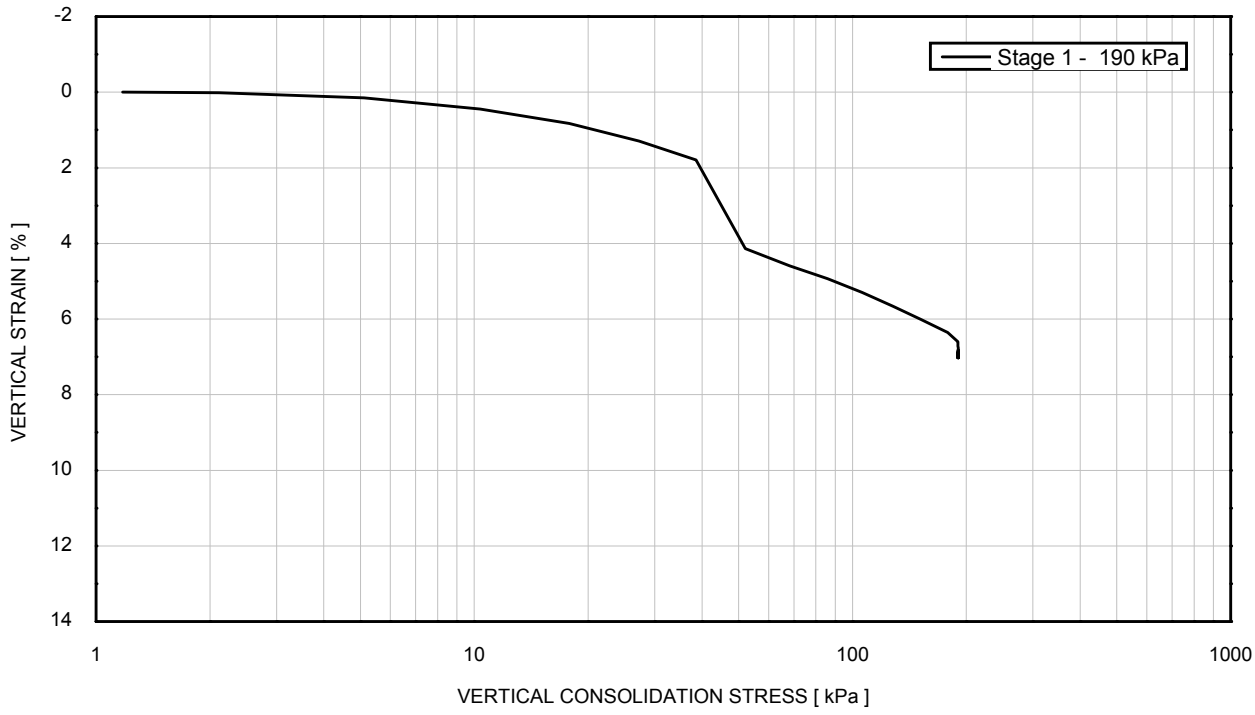
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH02-SA
Sample	40WaxC
Depth [m]	23.92
Test number	CSS18

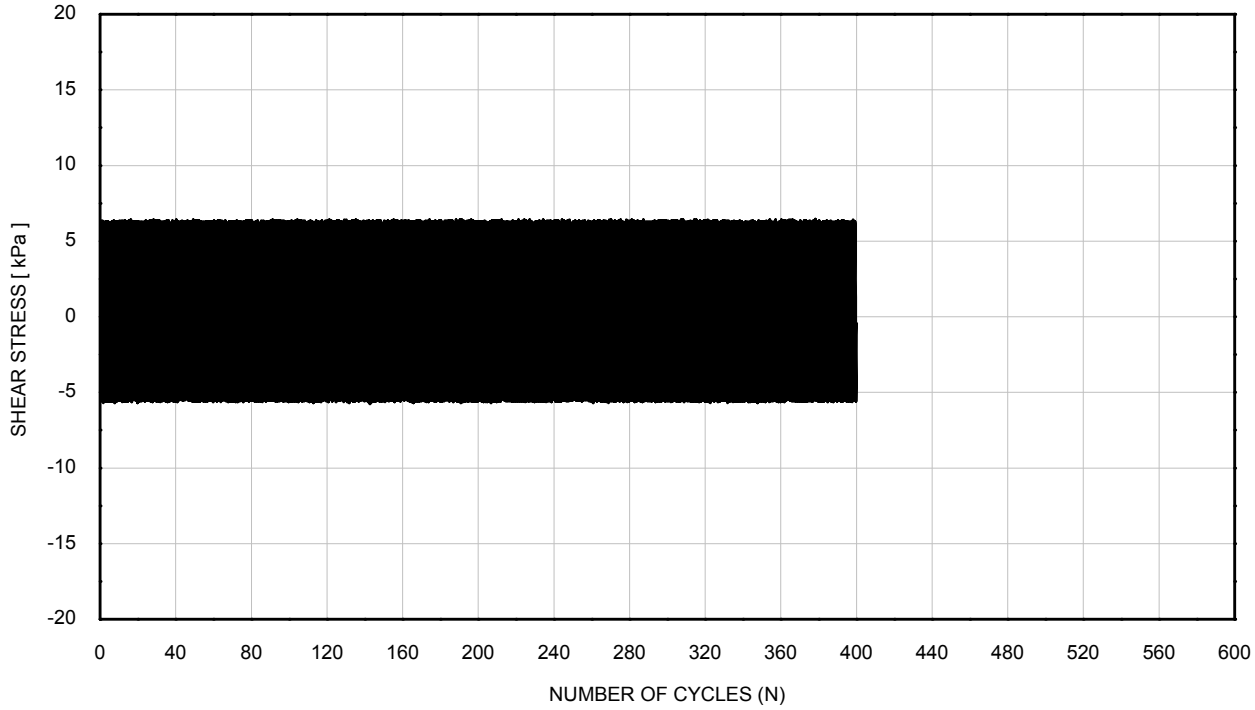
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

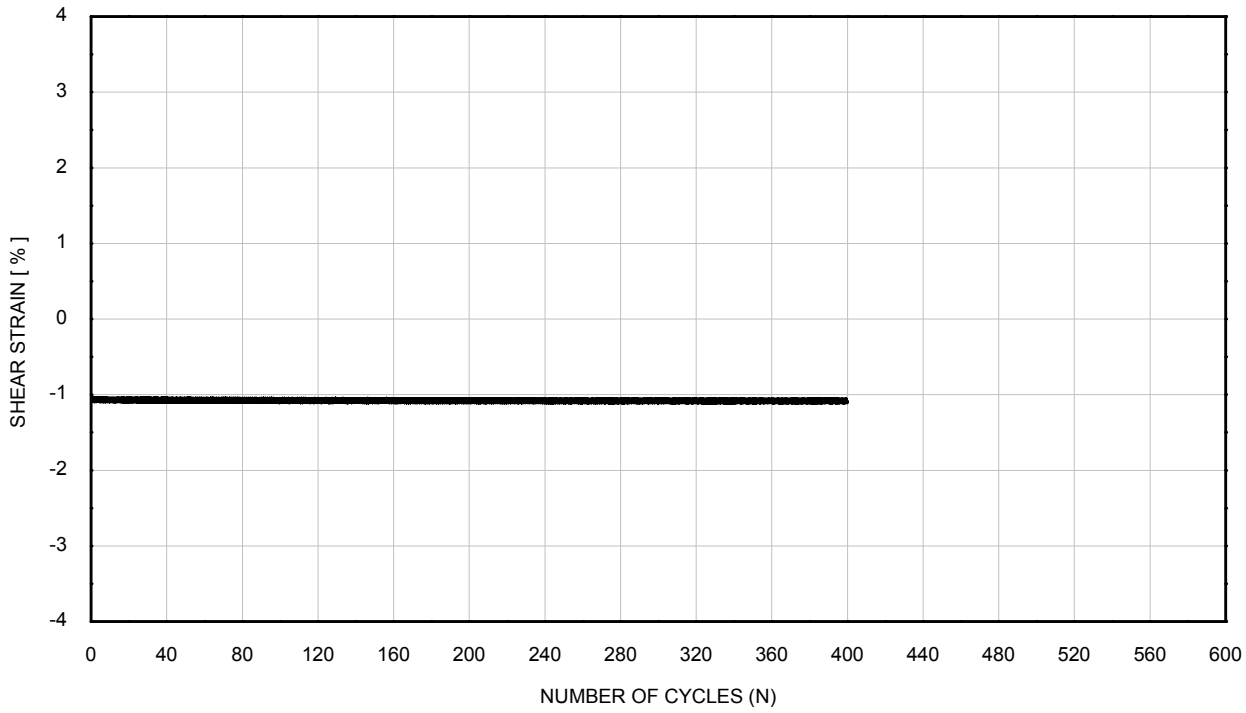




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH02-SA
		Sample	: 40WaxC
		Depth [m]	: 23.92
		Test No.	: CSS18

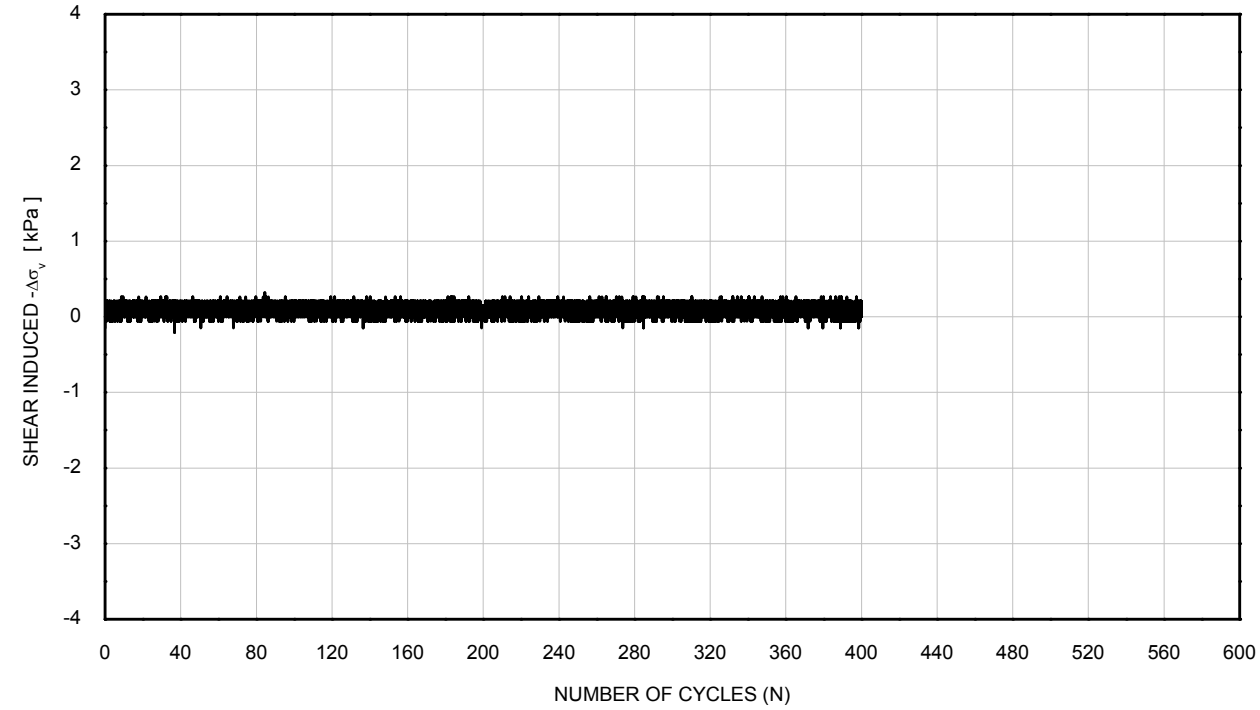
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

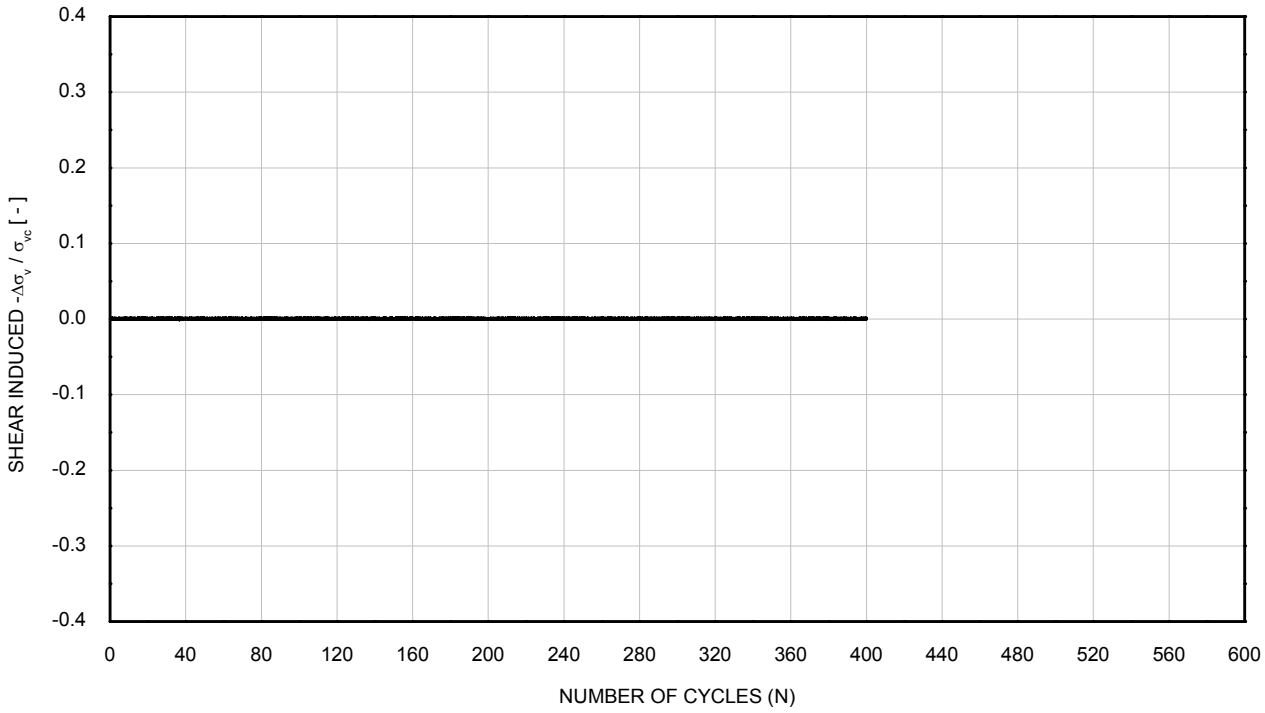




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

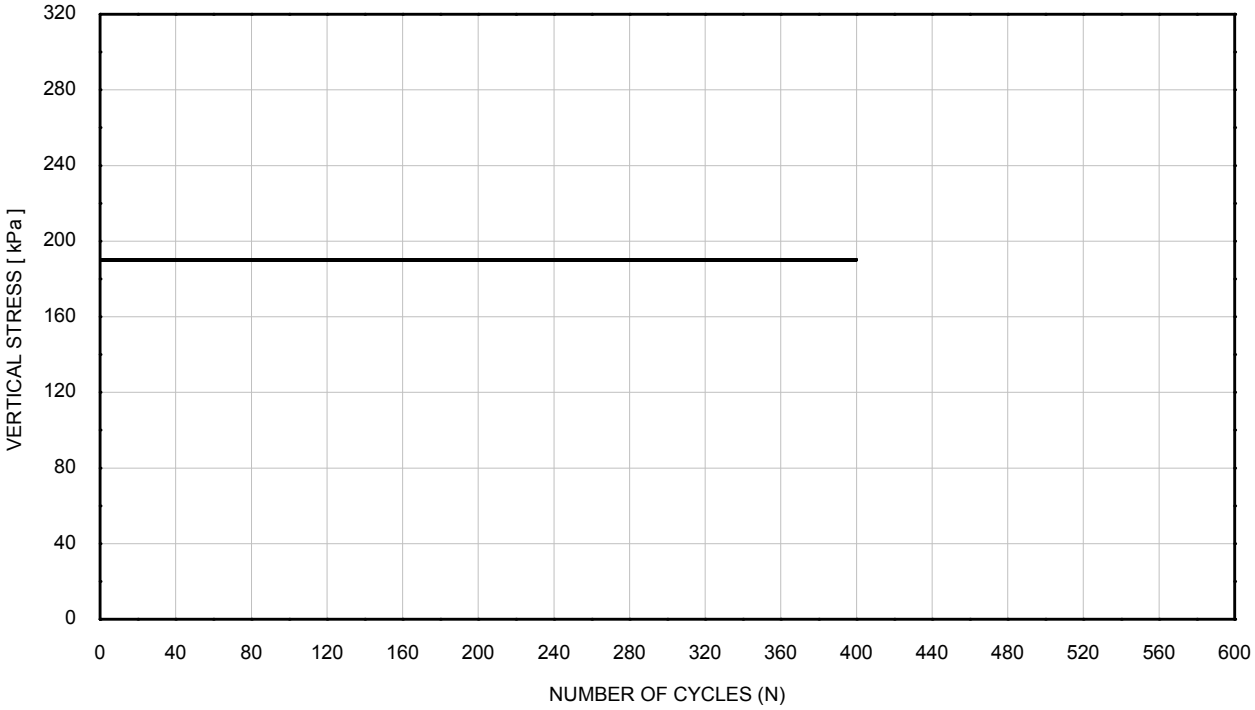
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

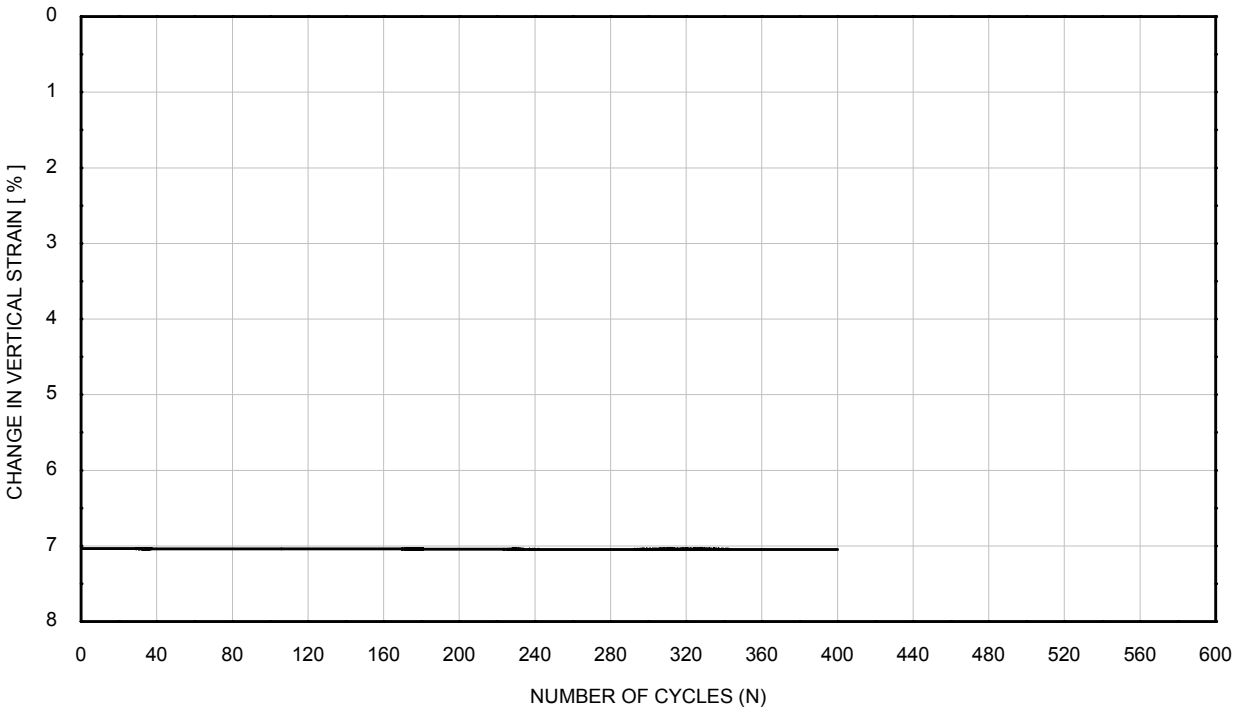




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

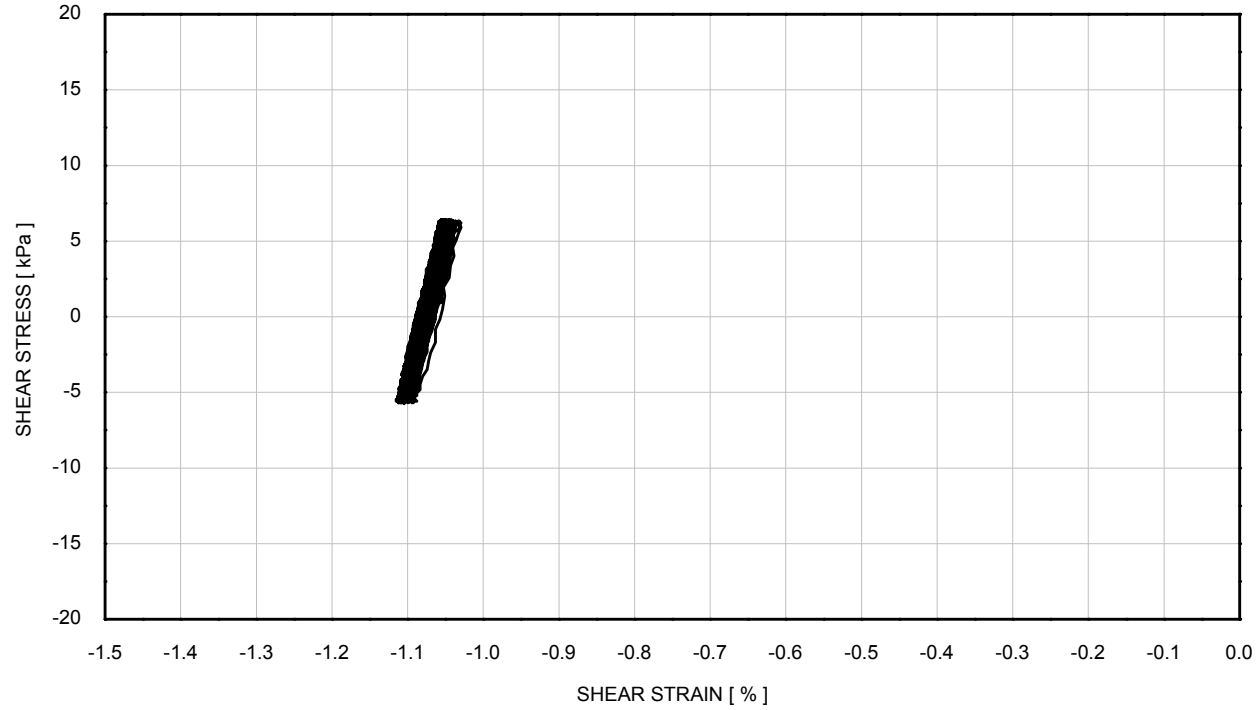
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

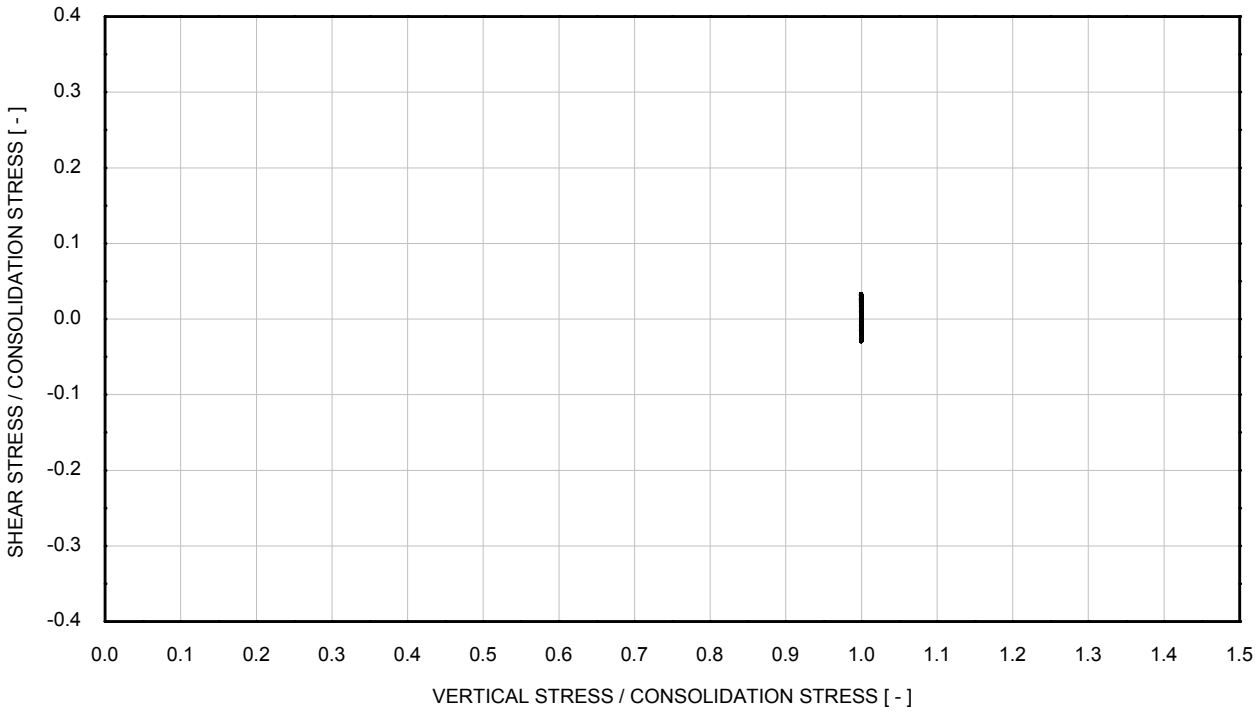




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

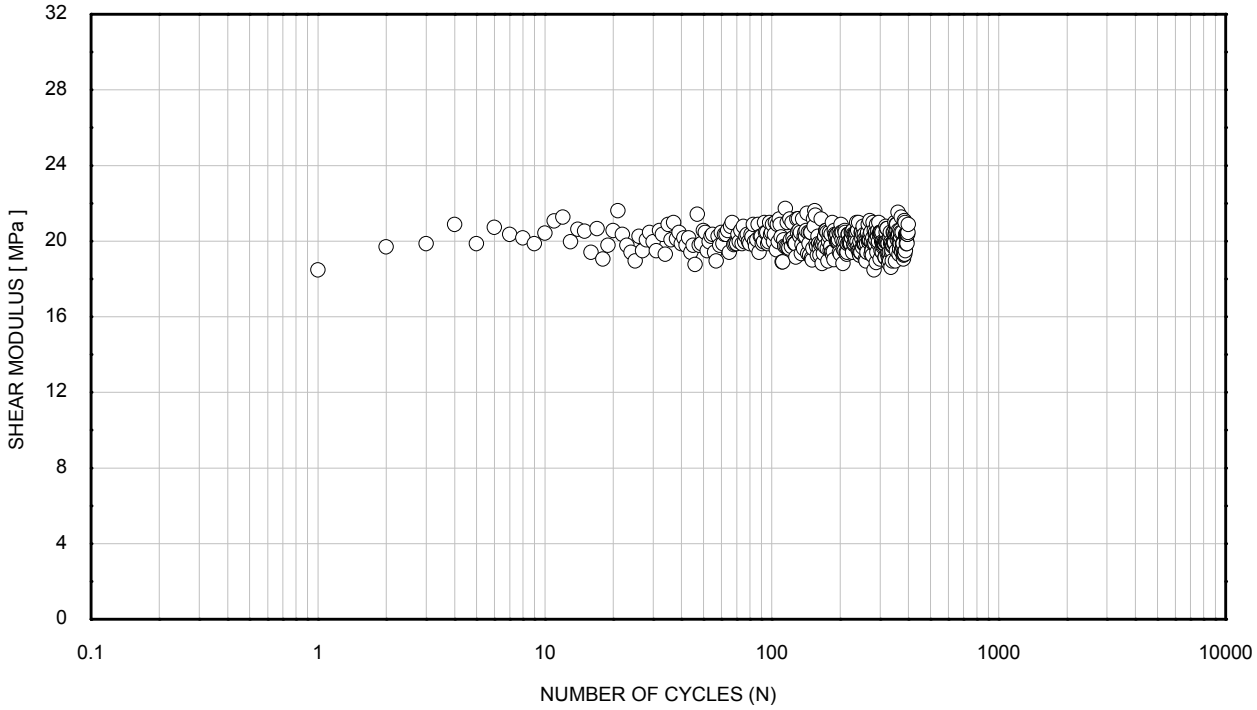
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

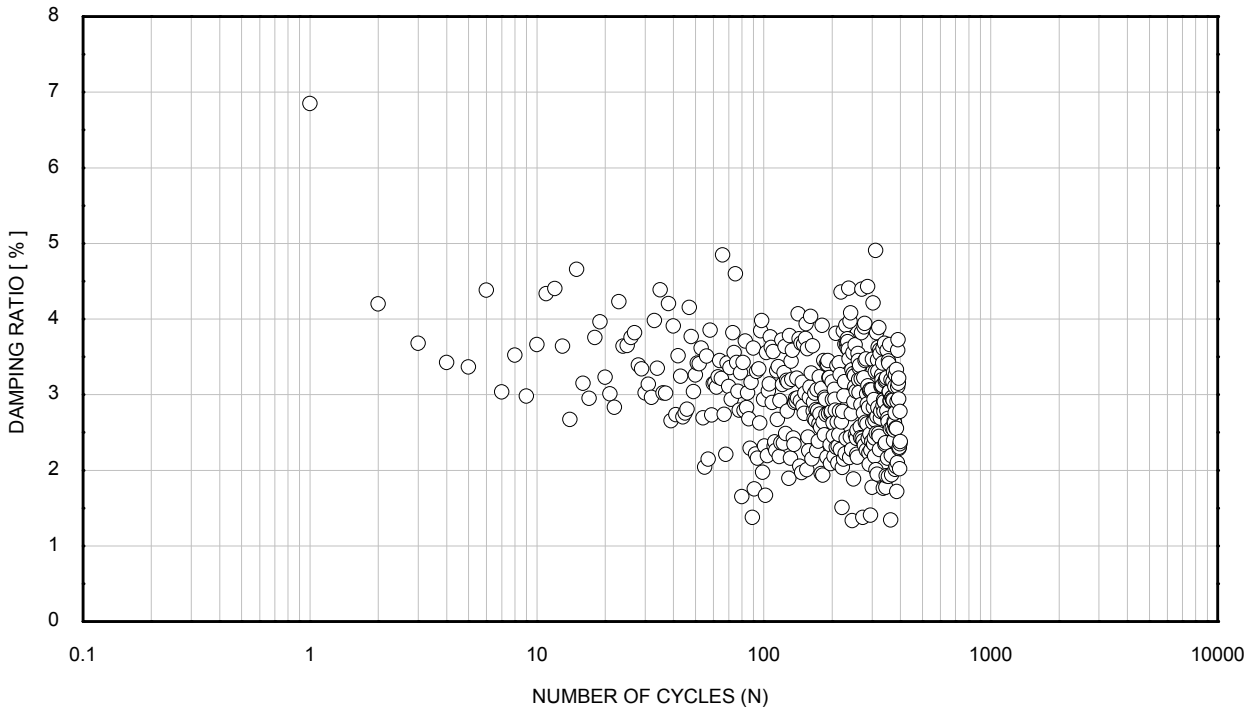




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

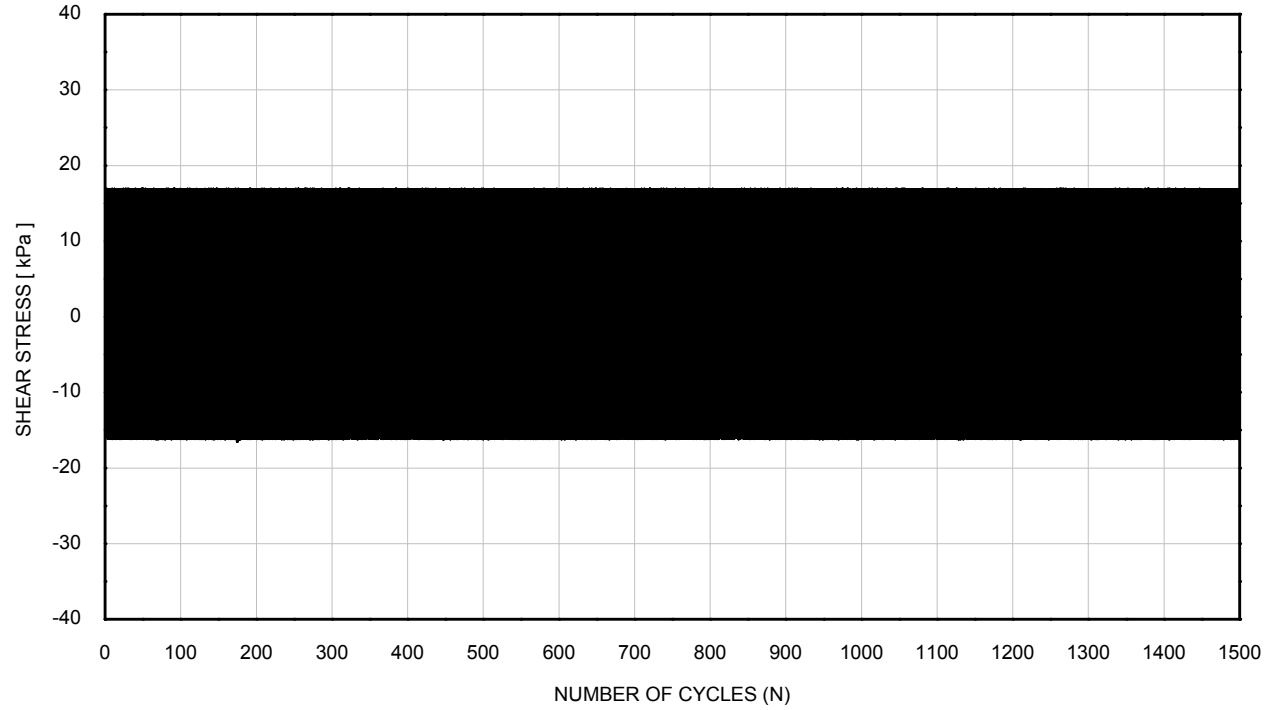
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

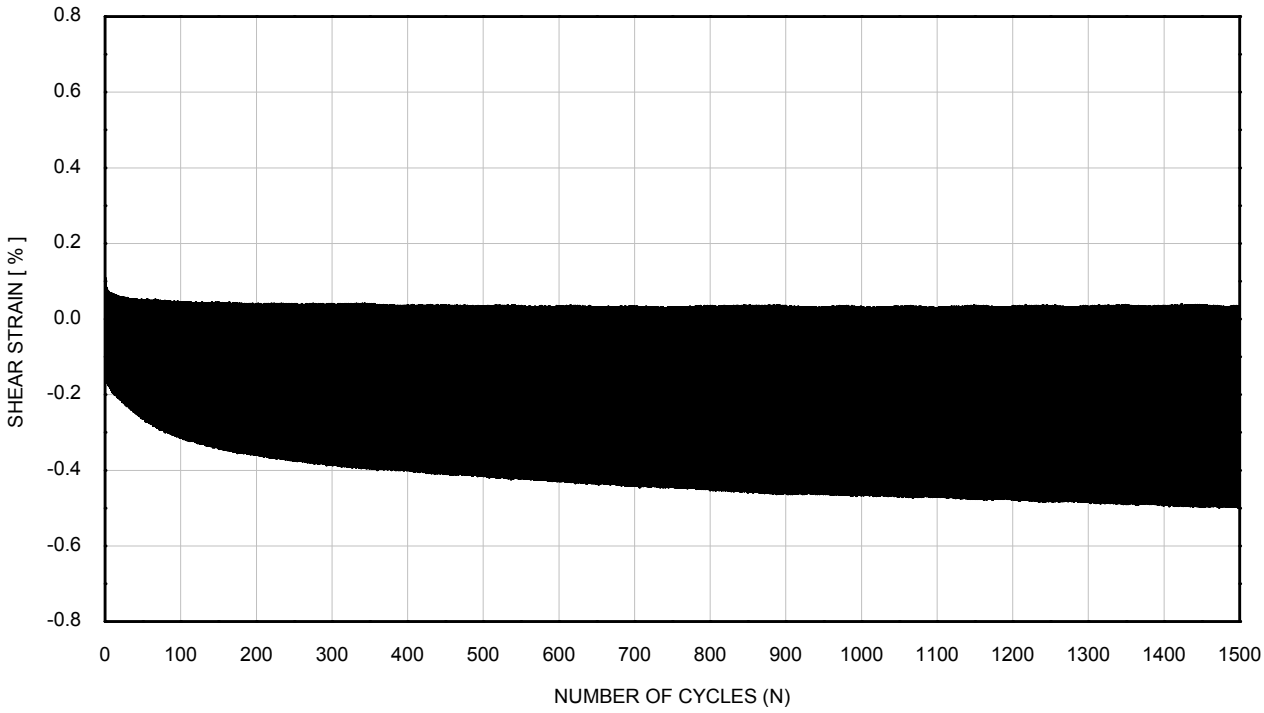




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

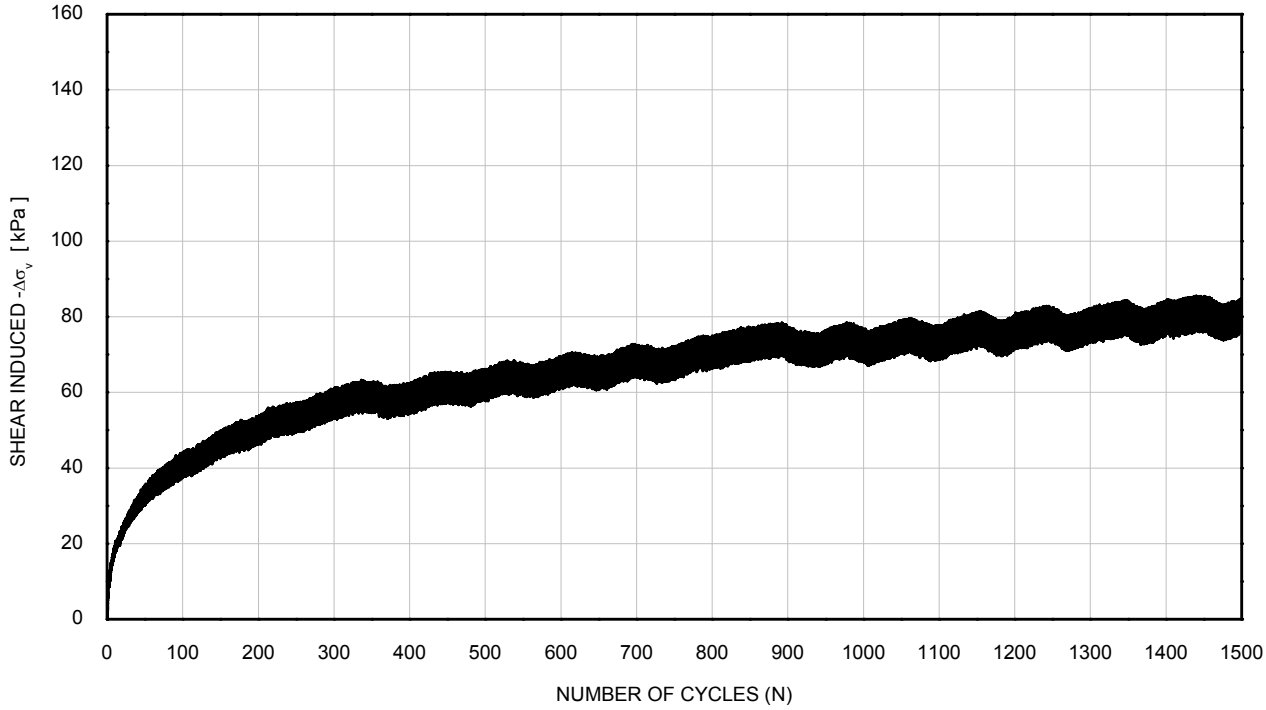
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

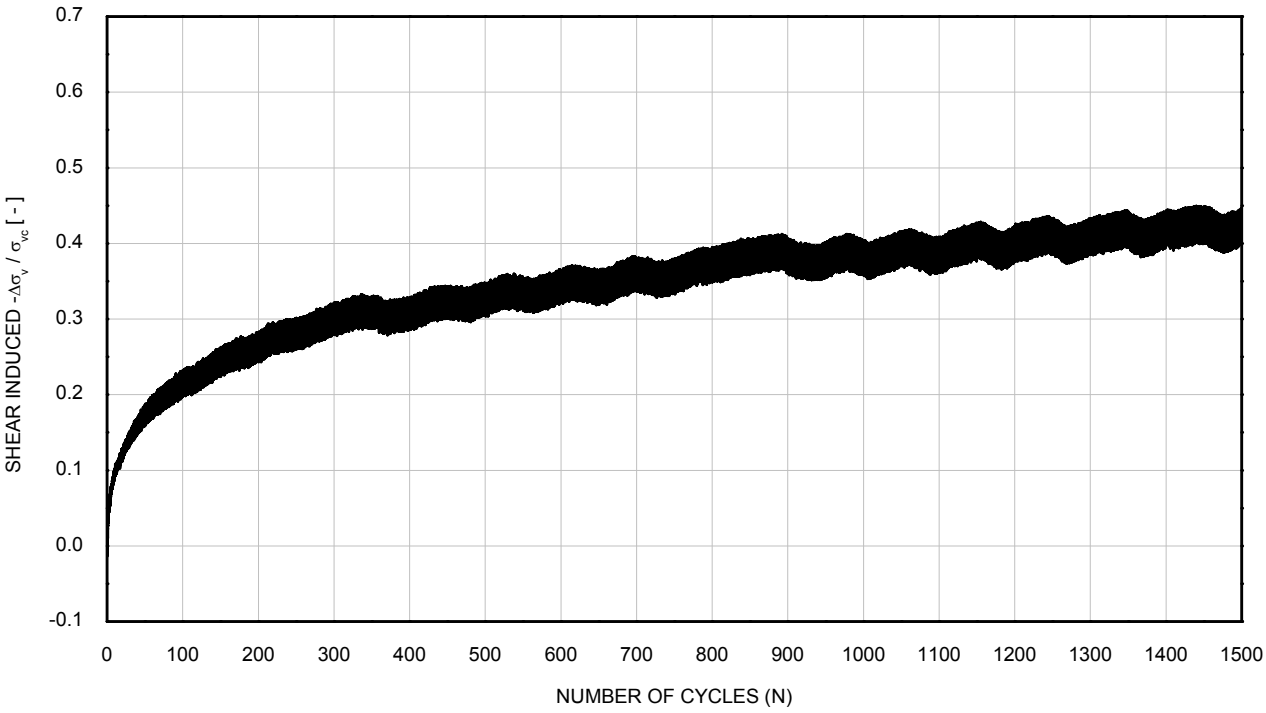




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	16 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

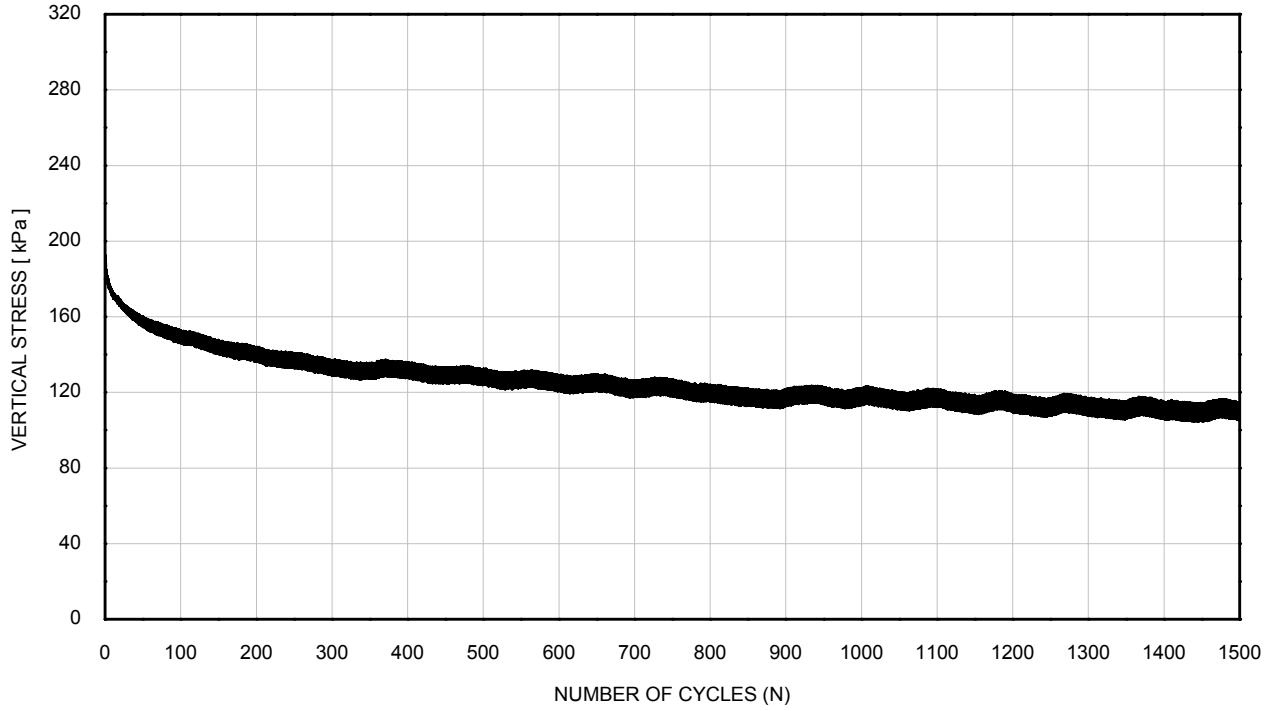
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

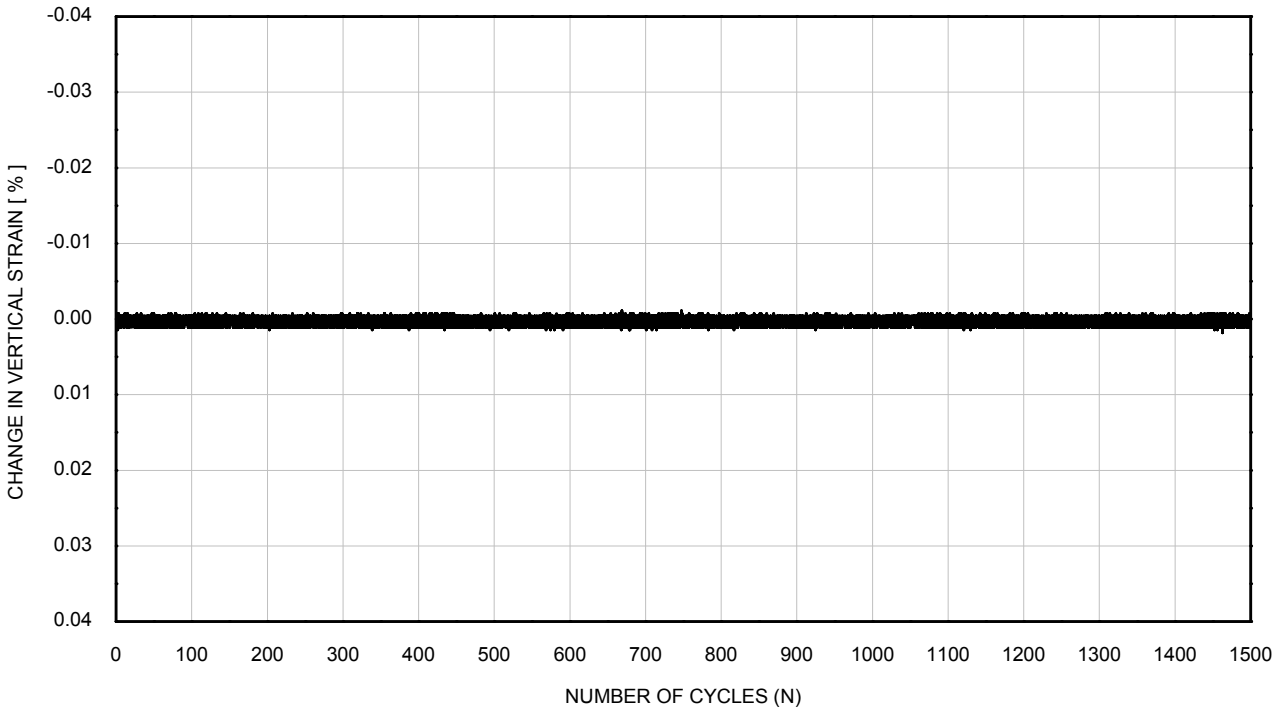




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	16 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

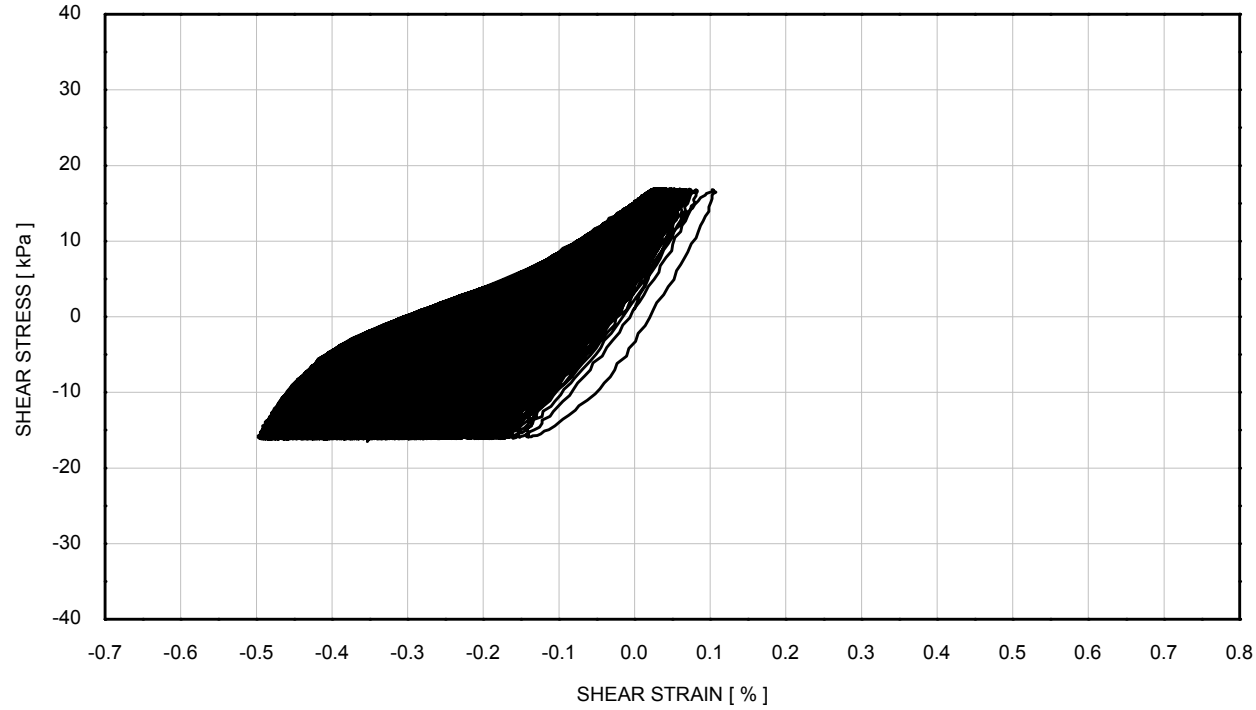
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

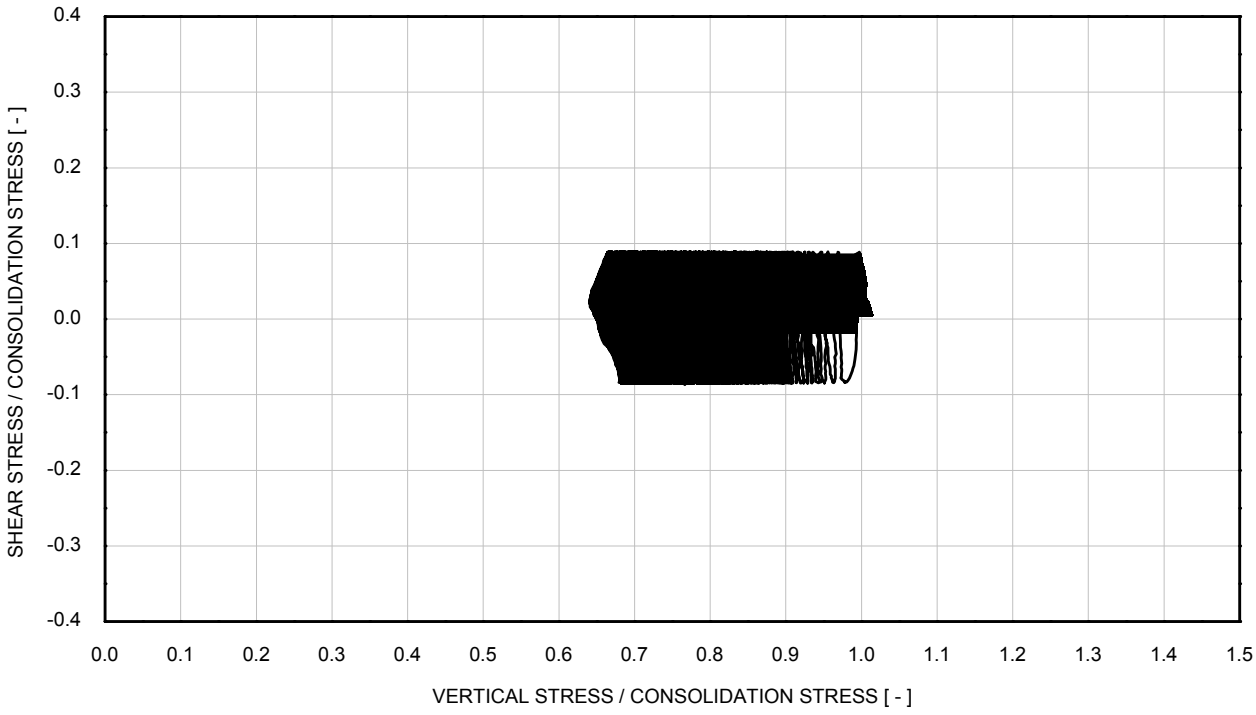




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	16 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

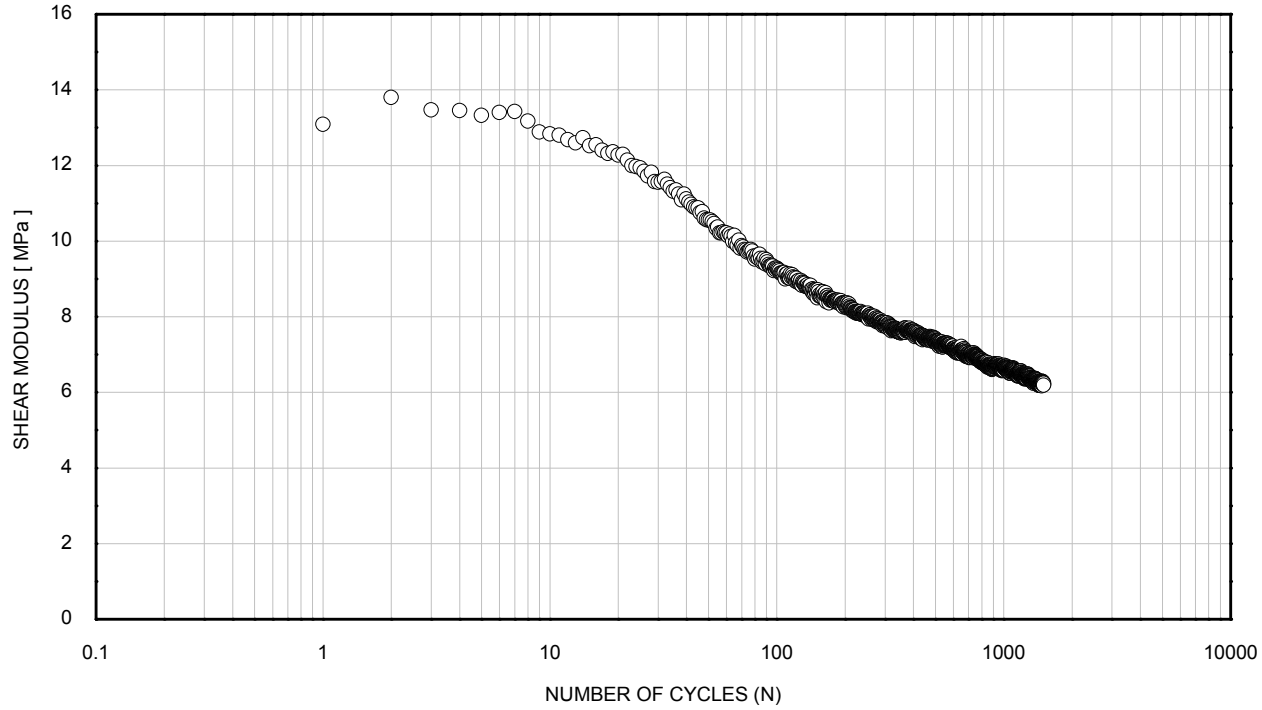
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

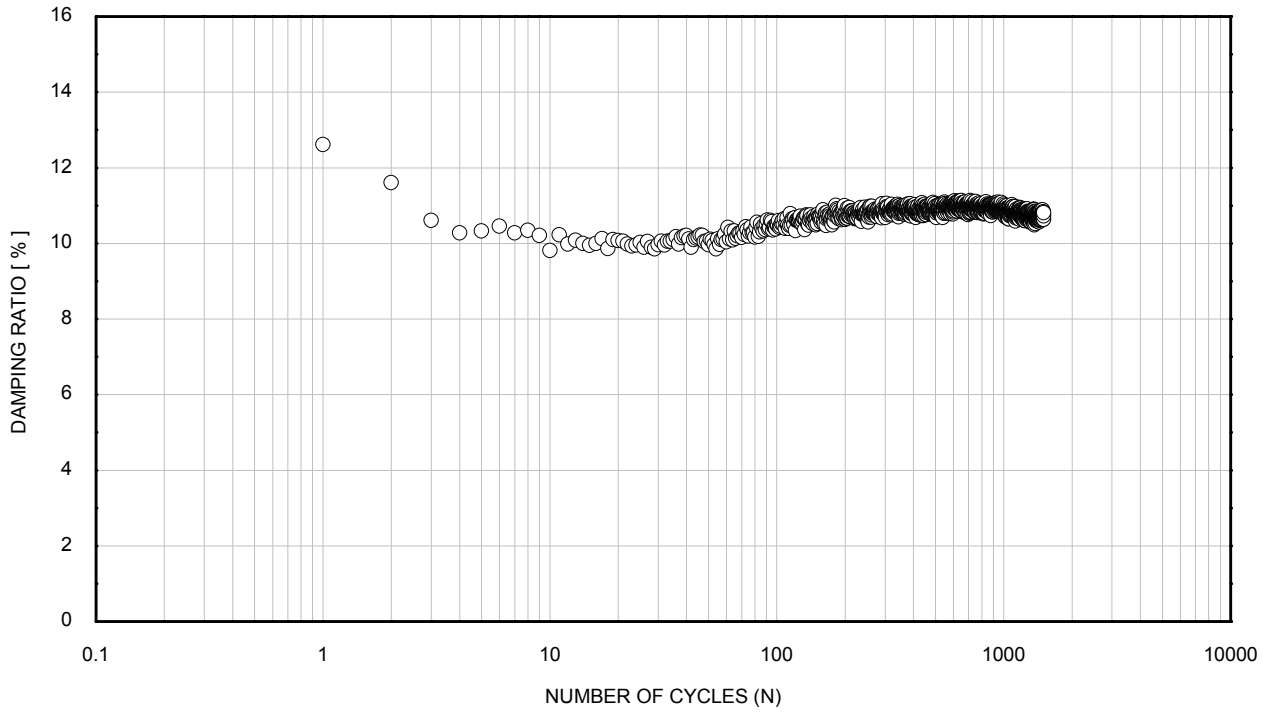




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	16 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

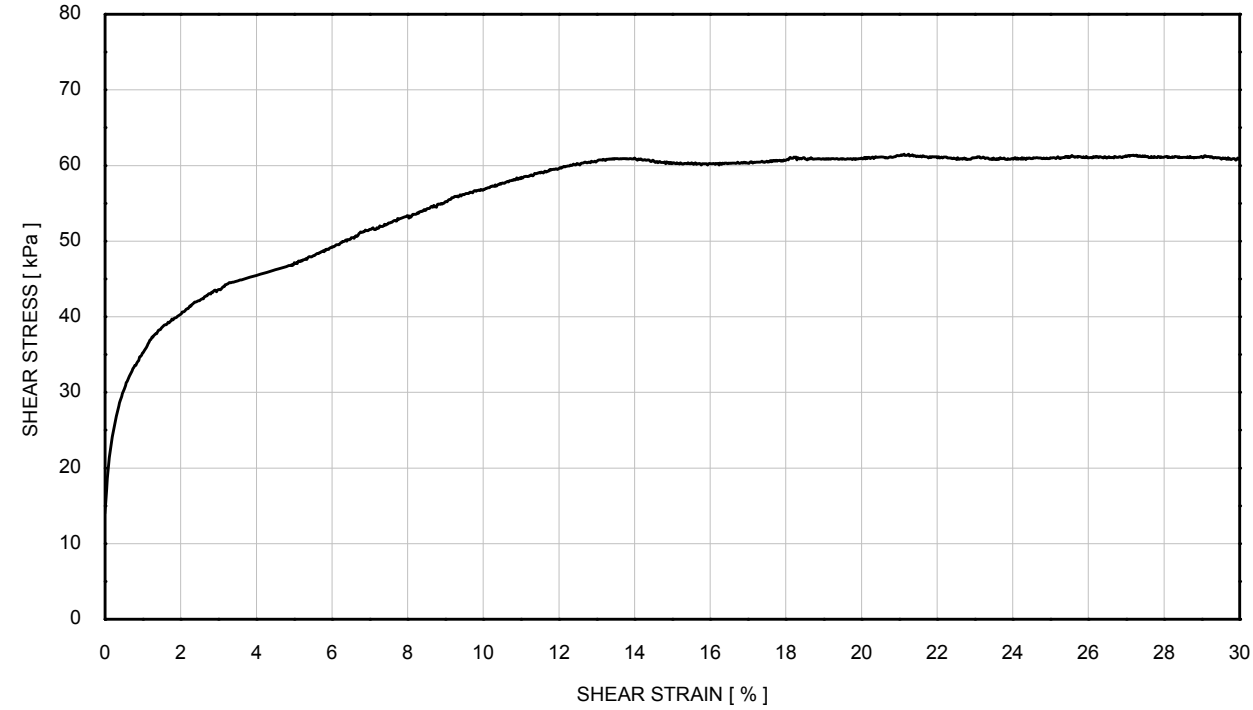
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

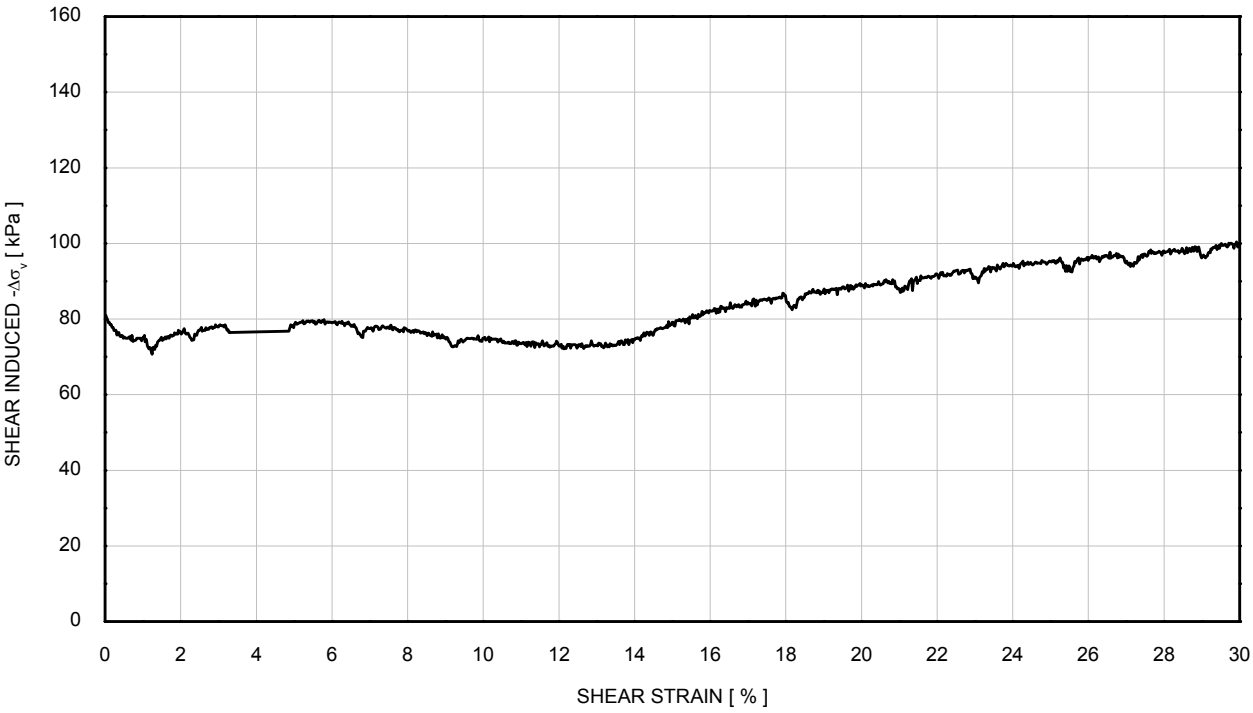




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH02-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	16 kPa	Depth [m]	:	23.92
Frequency	:	0.10 Hz	Test No.	:	CSS18

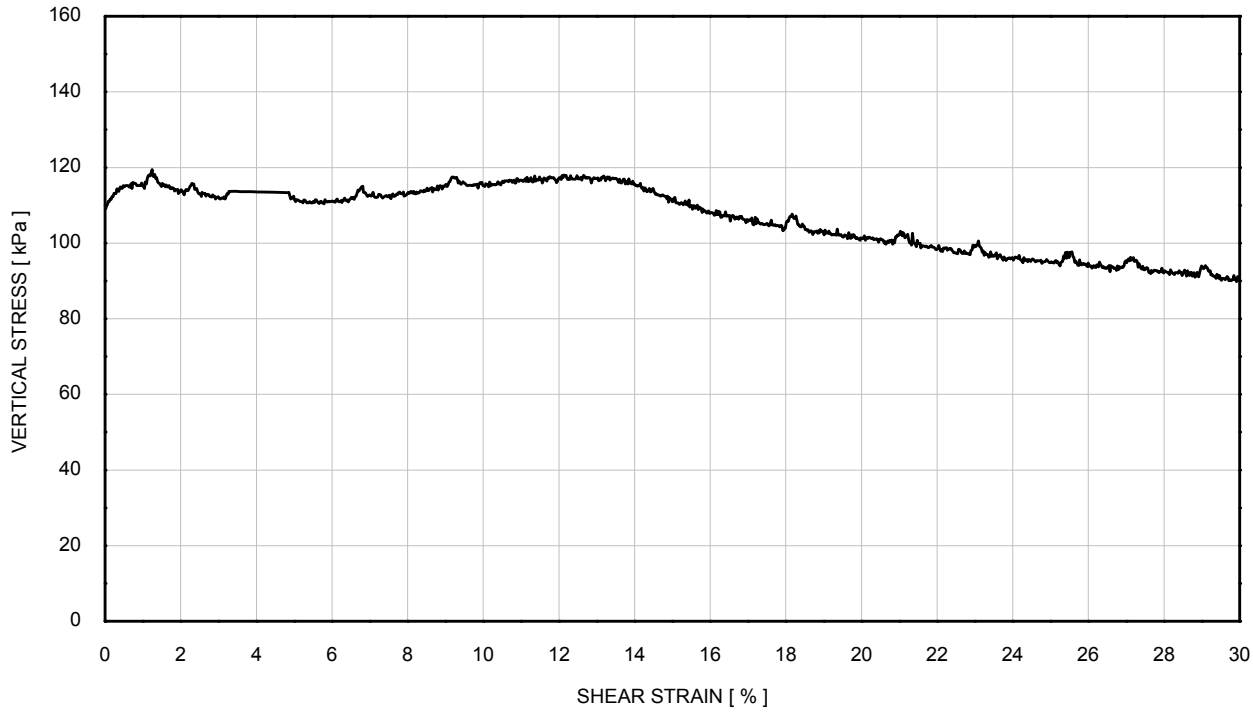
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

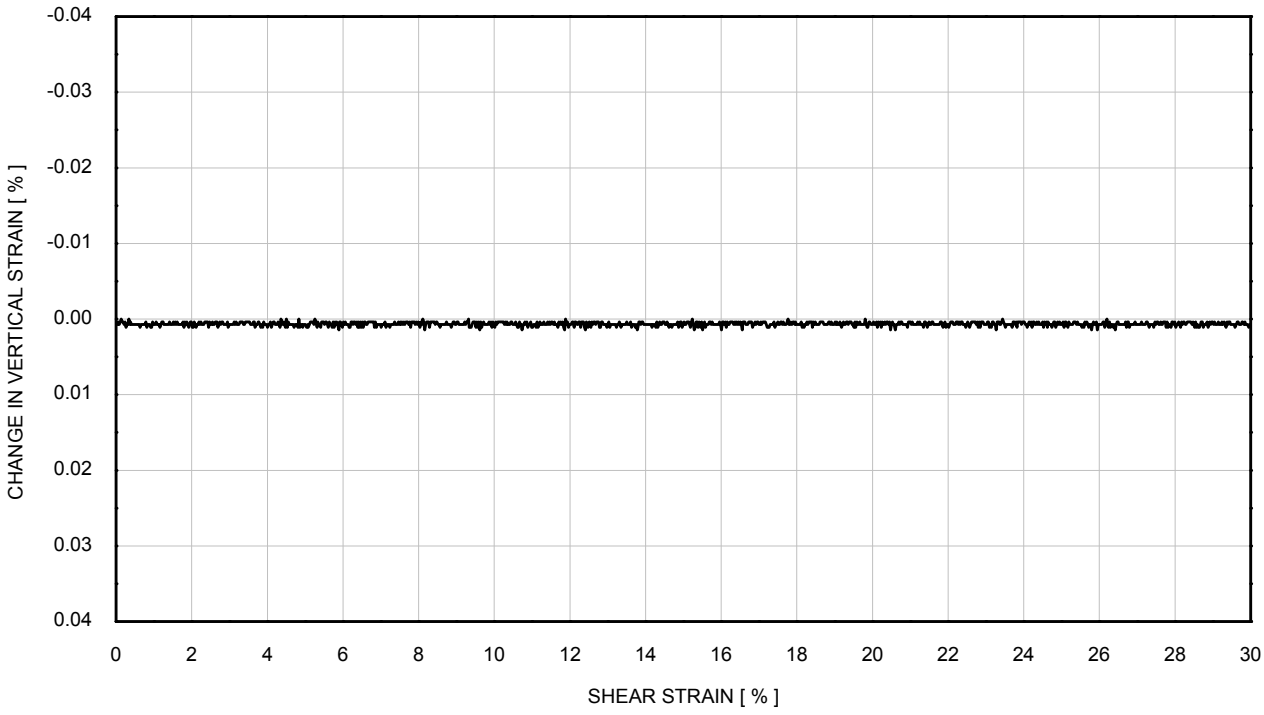




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH02-SA
τ_{peak}	: 61 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 21.13 %	Depth [m]	: 23.92
Rate of strain	: 2.99 %/hour	Test No.	: CSS18

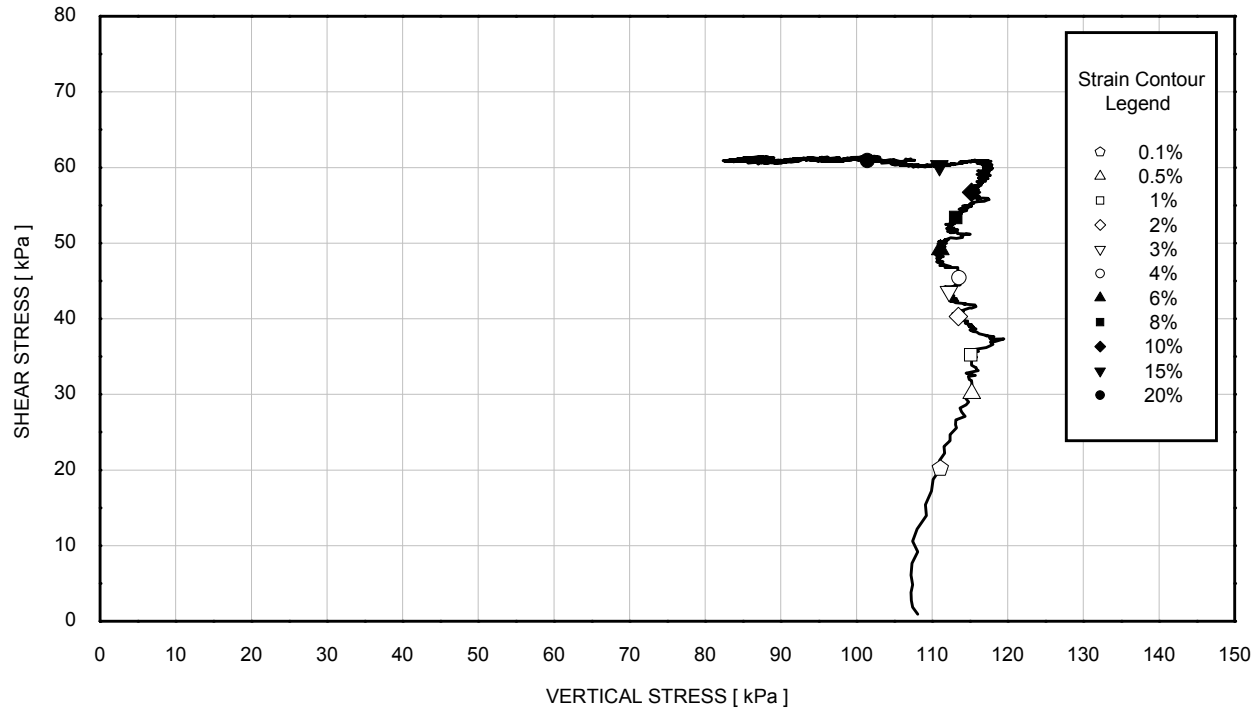
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

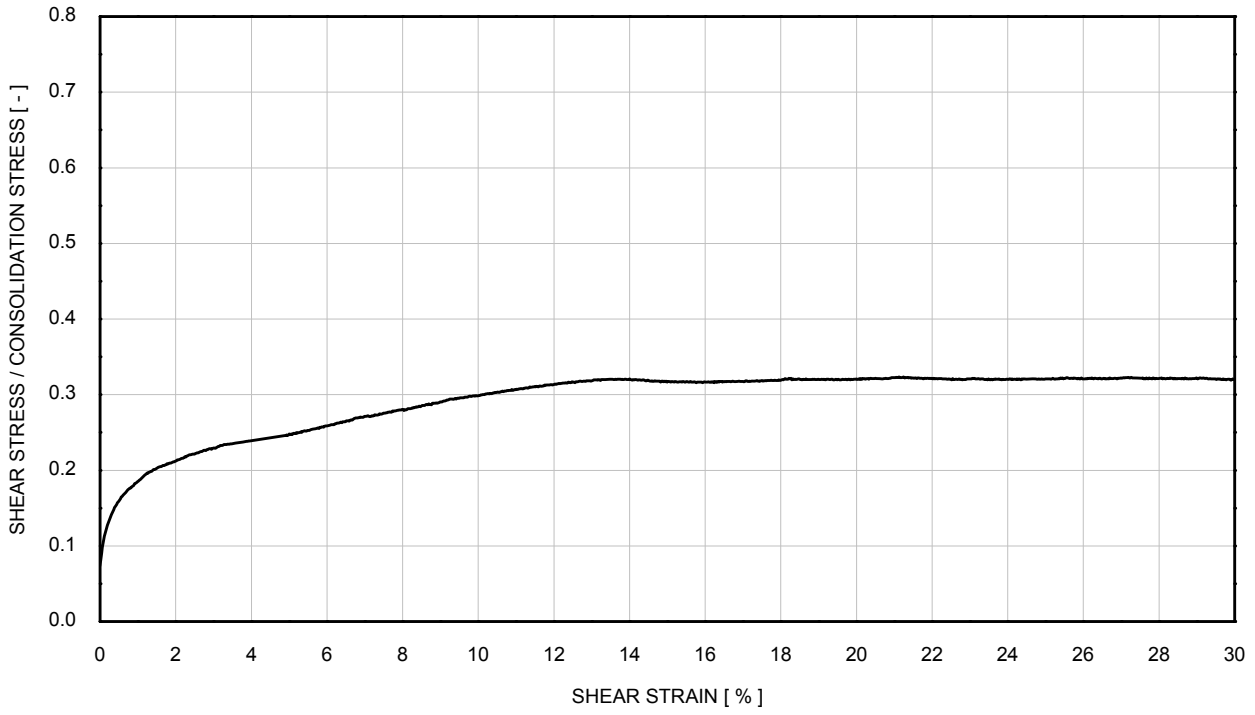




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH02-SA
τ_{peak}	: 61 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 21.13 %	Depth [m]	: 23.92
Rate of strain	: 2.99 %/hour	Test No.	: CSS18

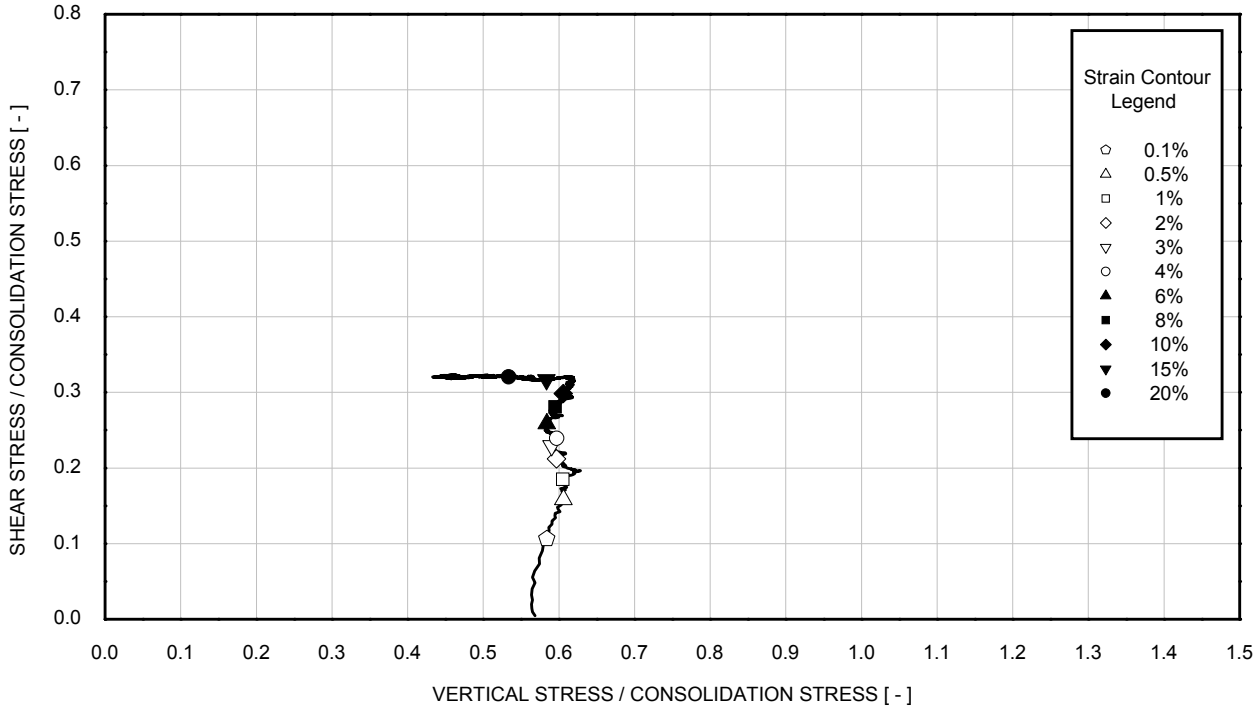
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

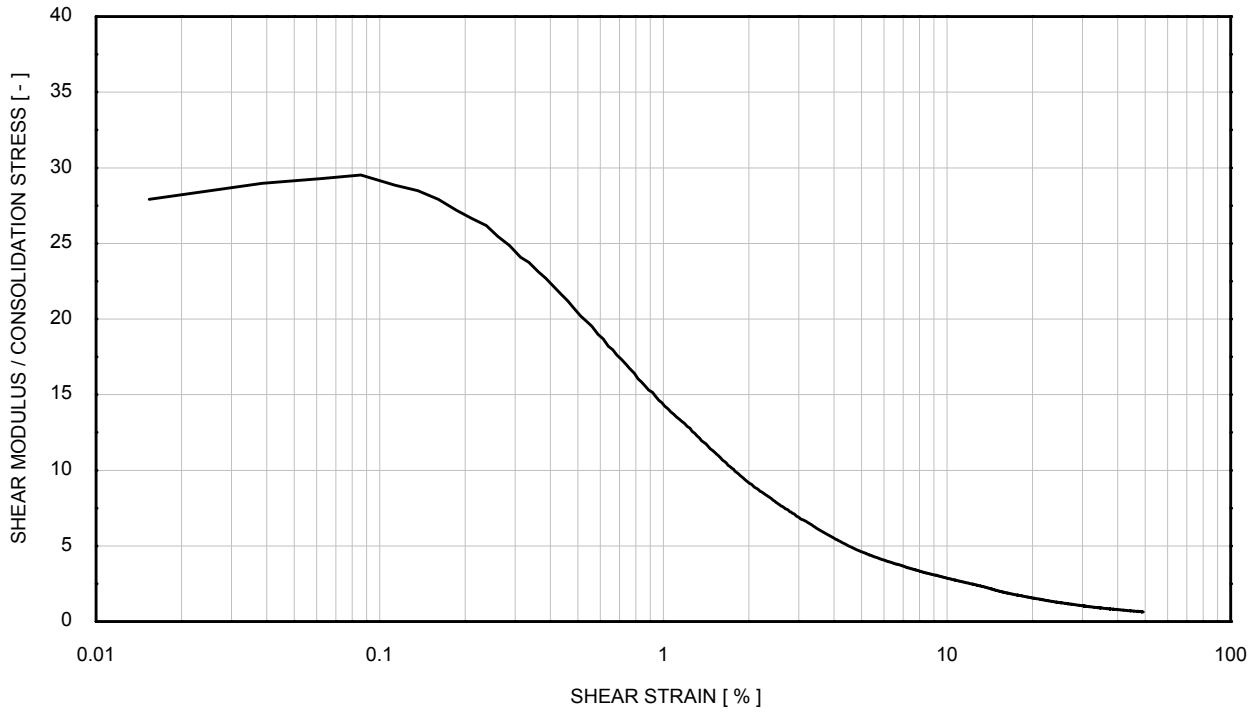




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH02-SA
τ_{peak}	: 61 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 21.13 %	Depth [m]	: 23.92
Rate of strain	: 2.99 %/hour	Test No.	: CSS18

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH02-SA
τ_{peak}	:	61 kPa	Sample	: 40WaxC
γ at τ_{peak}	:	21.13 %	Depth [m]	: 23.92
Rate of strain	:	2.99 %/hour	Test No.	: CSS18

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Very dark grey CLAY

GENERAL	
Date test started	11/09/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.8
Length	[mm]	29.6
Water content	[%]	28.1
Bulk density	[Mg/m³]	1.95
Dry density	[Mg/m³]	1.52
Void ratio	[-]	0.773
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	46
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH08-SA_CSS19
Template issue	1.4
Processed by Date	JLS 07/11/2016
Checked by Date	PH 28/11/2016
Approved by Date	PH 28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	23.97
Test number	CSS19

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	190
Vertical strain	[%]	4.77
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.60
Void ratio	[-]	0.689
Water content	[%]	25.0

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	190
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	6
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	4.78
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.60
Void ratio	[-]	0.689

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.27	0.03	21.02	6.01
2	0.27	0.03	22.25	5.91
5	0.27	0.03	22.47	4.81
10	0.27	0.03	22.36	4.27
20	0.27	0.03	21.76	4.17
50	0.27	0.03	21.87	3.75
100	0.27	0.03	21.87	4.04
200	0.27	0.03	21.76	4.11
300	0.27	0.03	21.76	3.45
400	0.27	0.03	21.98	3.66

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	23.97
Test number	CSS19

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	24
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	250
γ_{av} at N_f	[%]	1.21
γ_{cy} at N_f	[%]	14.95
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	172
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.03	0.24	10.16	18.88
2	0.03	0.25	9.80	17.65
5	0.05	0.27	8.93	16.16
10	0.06	0.30	8.08	15.71
20	0.07	0.34	7.09	15.63
30	0.08	0.38	6.40	15.76
40	0.09	0.42	5.87	15.86
50	0.09	0.45	5.44	15.96
100	0.11	0.63	3.84	16.60
200	0.27	2.48	0.93	17.89
250	1.21	14.95	0.15	15.02

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	34
Shear strain	[%]	29.98
Shear induced $-\Delta\sigma_v$	[kPa]	146
Vertical stress	[kPa]	44
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	15
Shear induced $-\Delta\sigma_v$	[kPa]	173
Vertical stress	[kPa]	17
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	23.97
Test number	CSS19

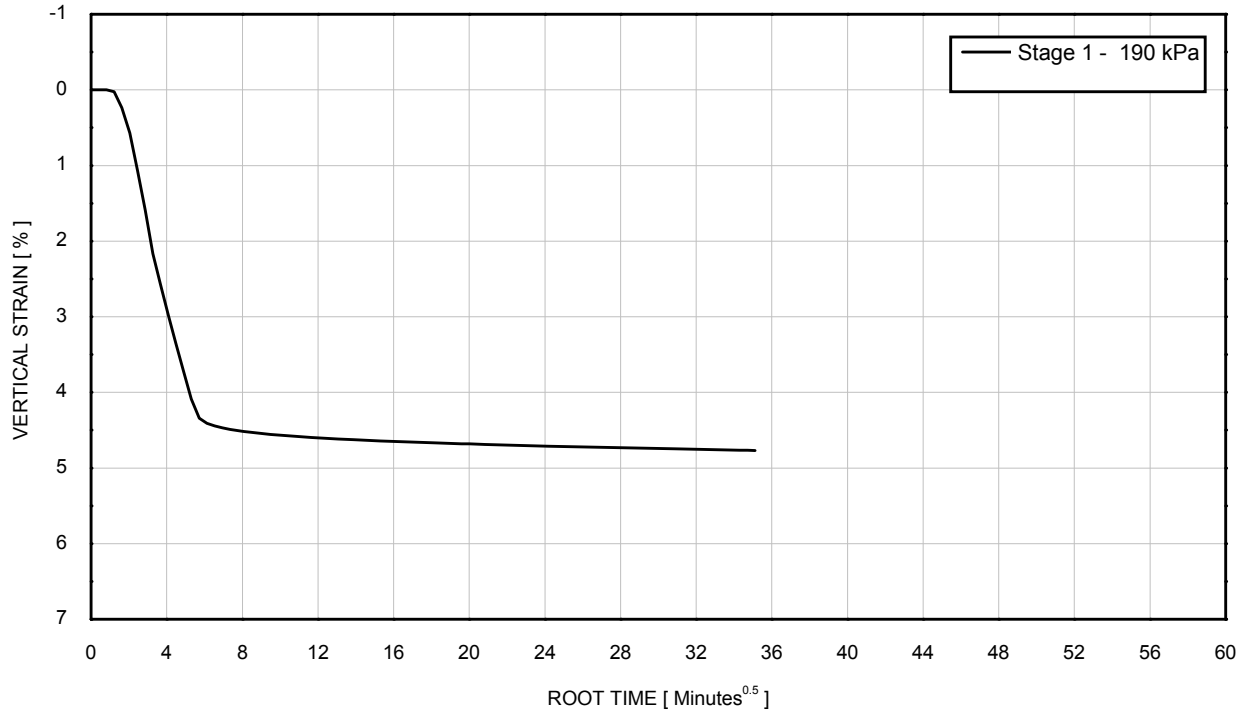
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

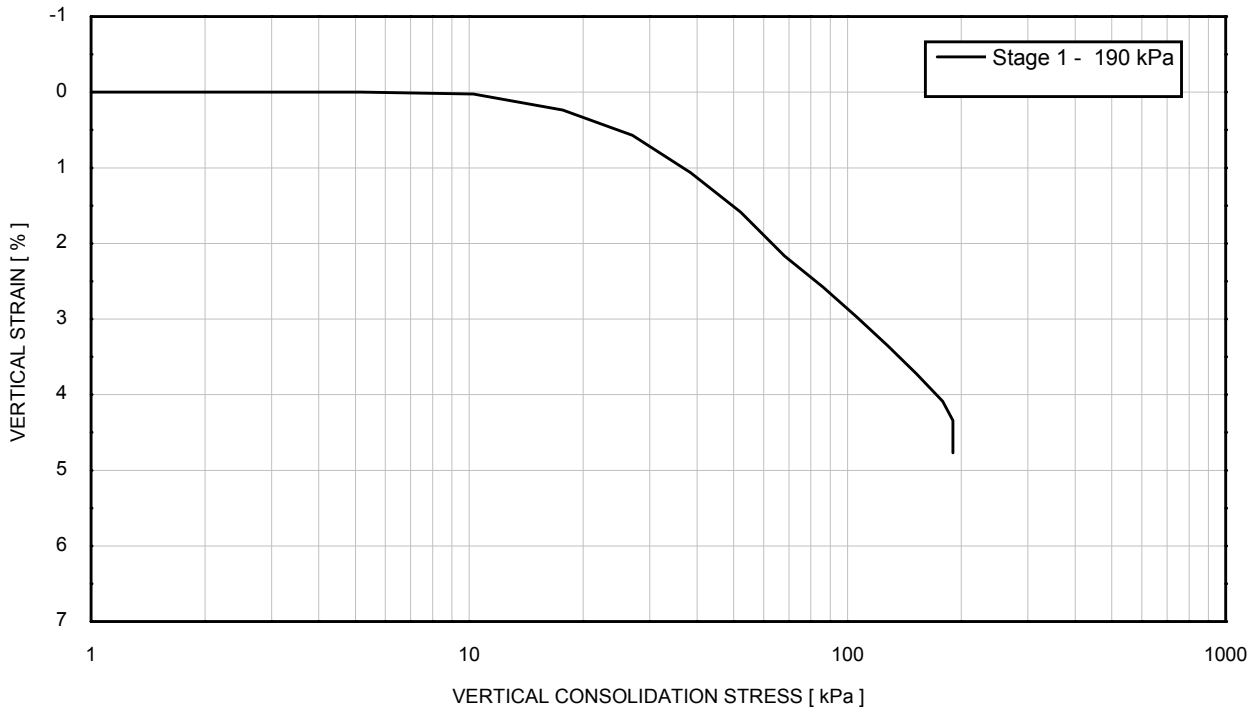
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	23.97
Test number	CSS19

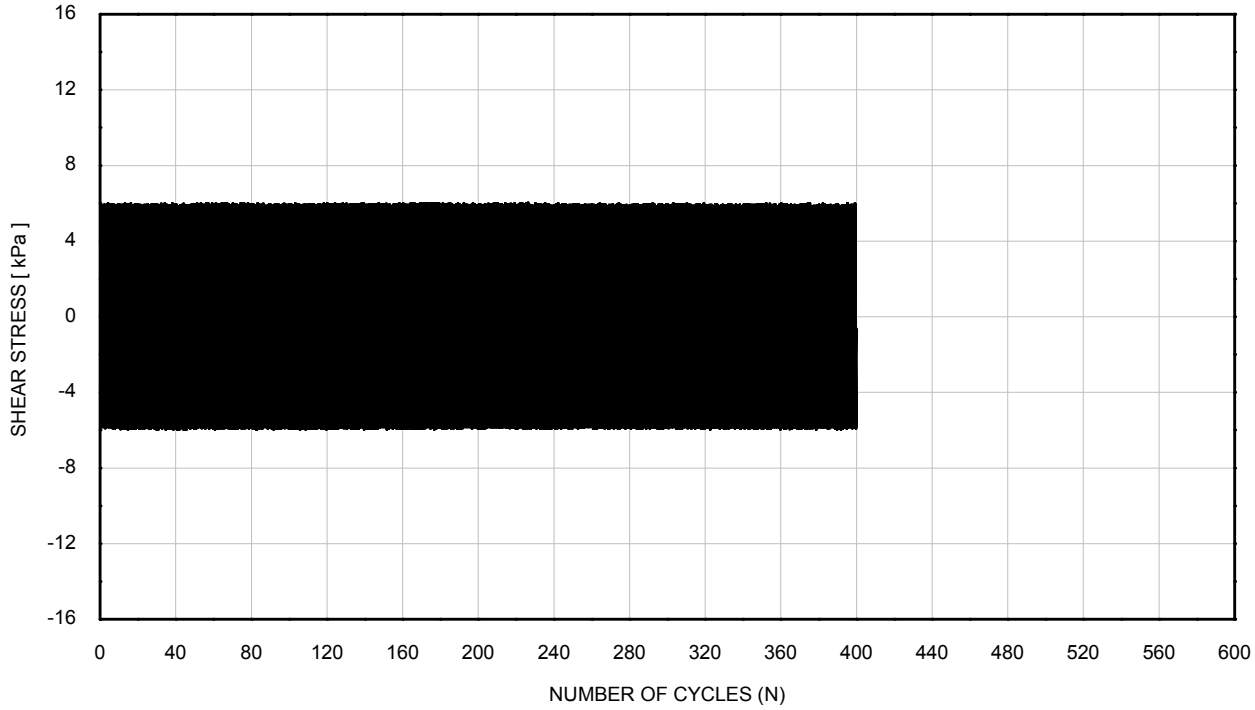
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

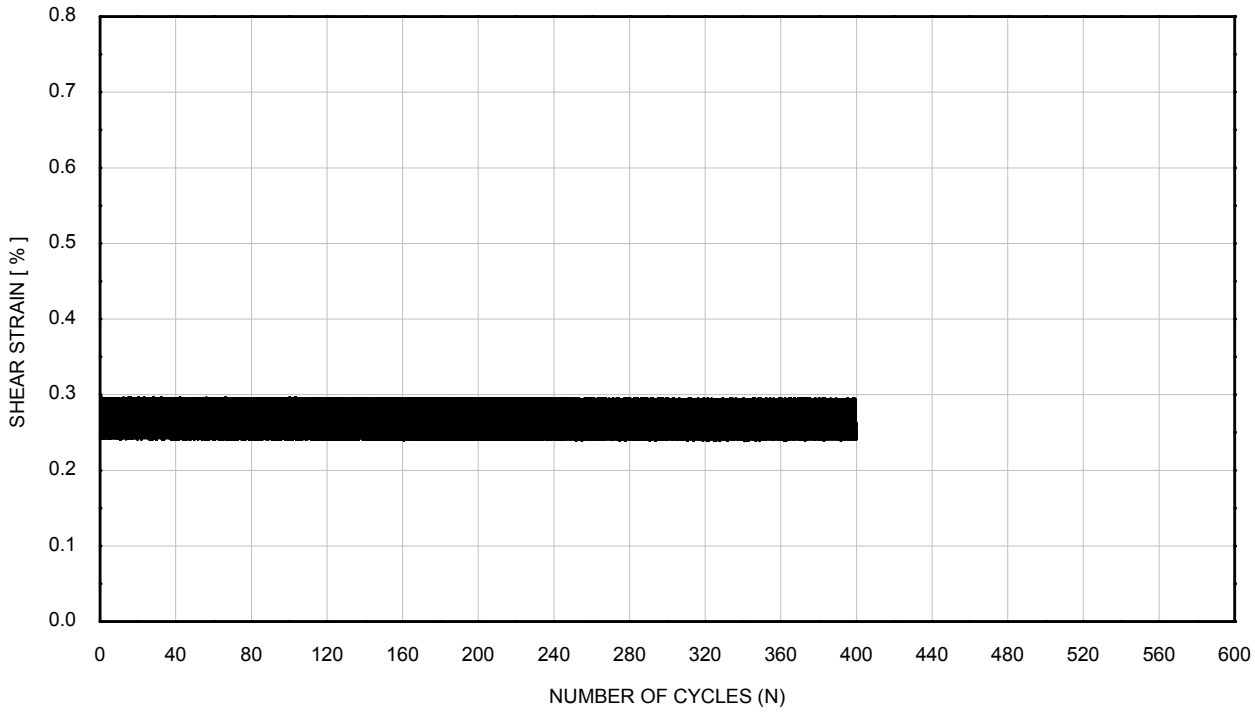




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
		Sample	: 40WaxC
		Depth [m]	: 23.97
		Test No.	: CSS19

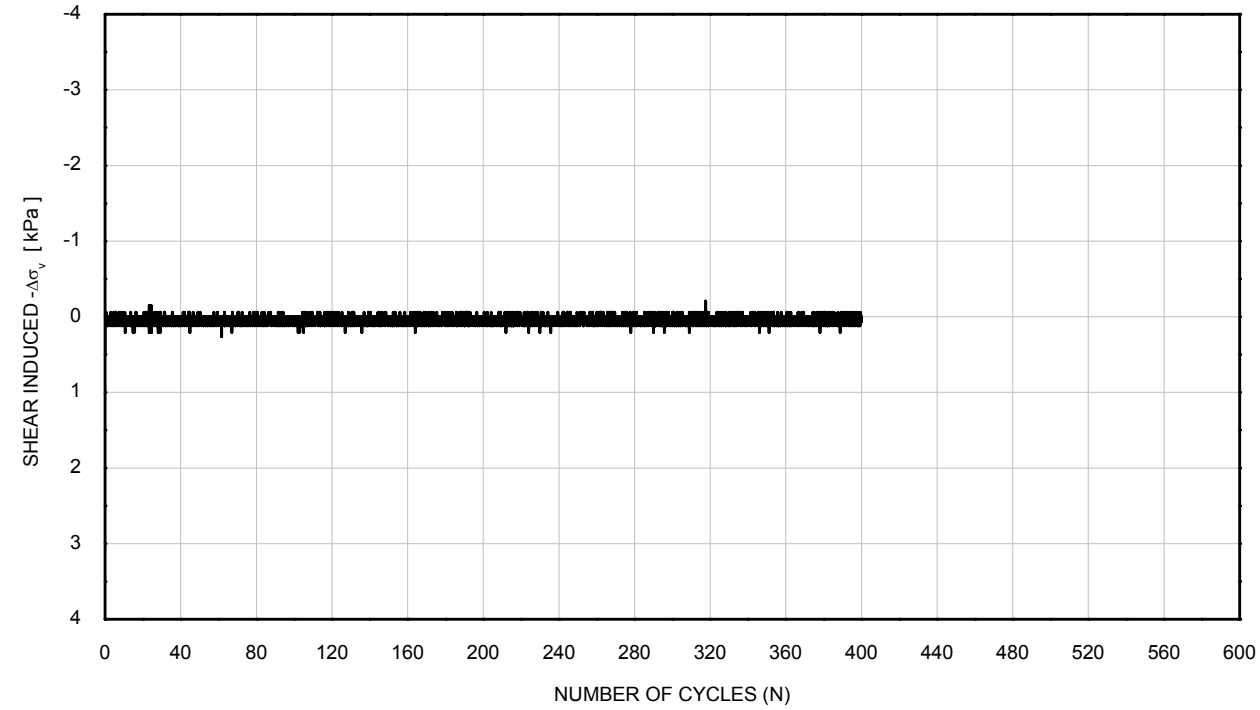
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

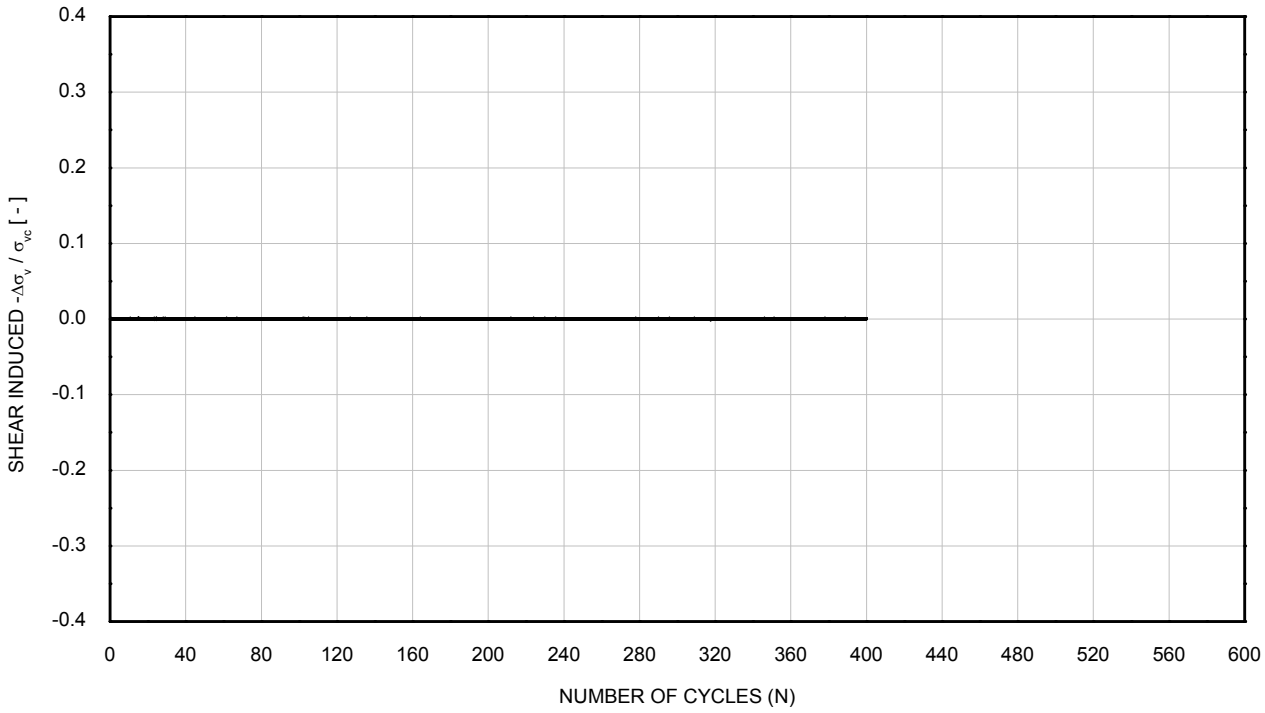




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

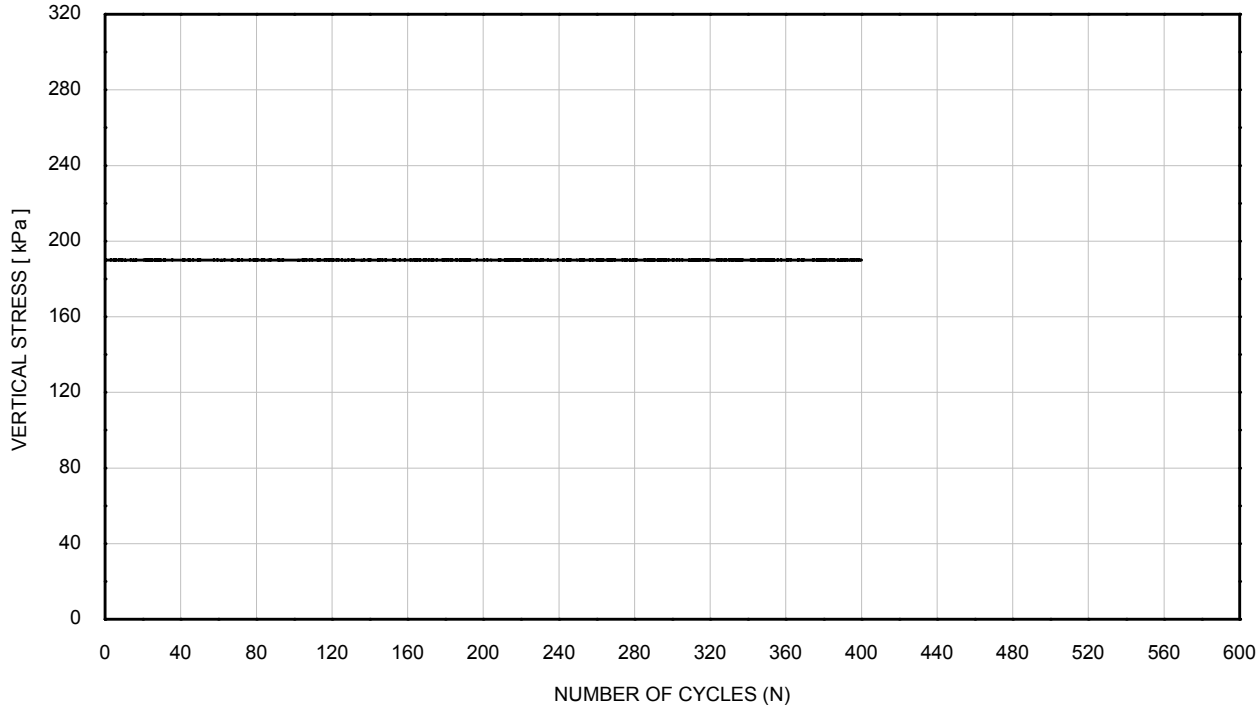
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

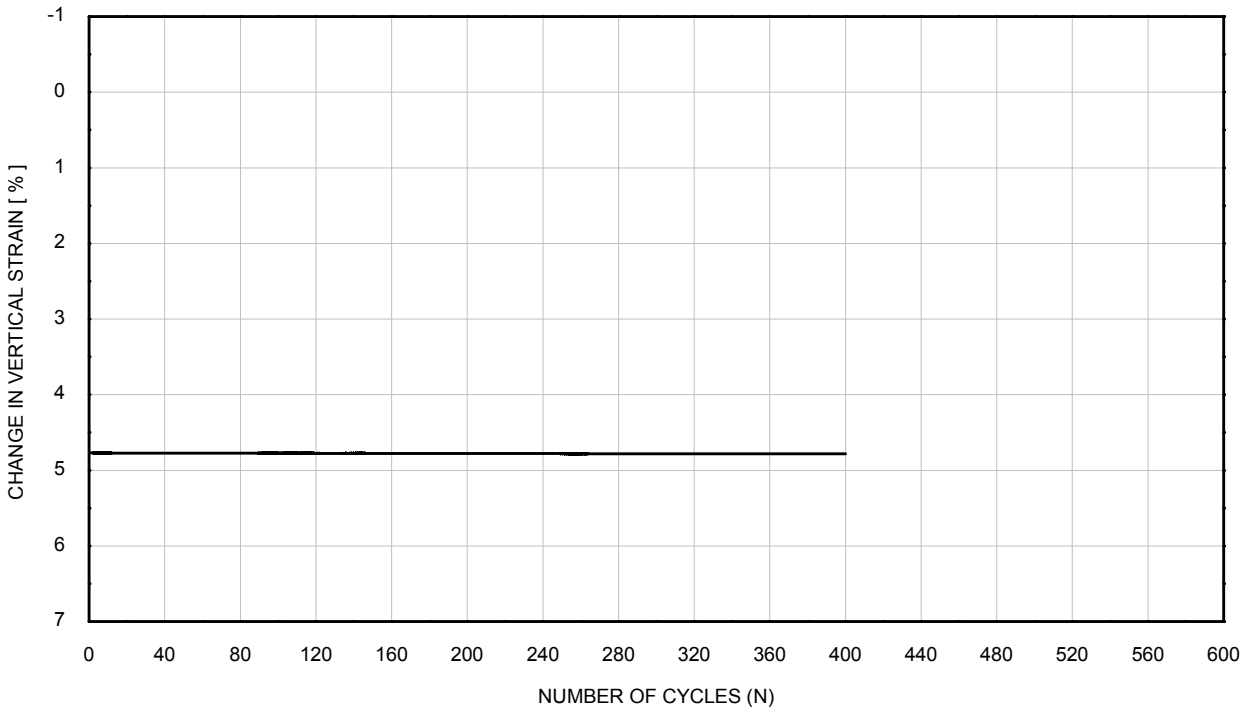




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

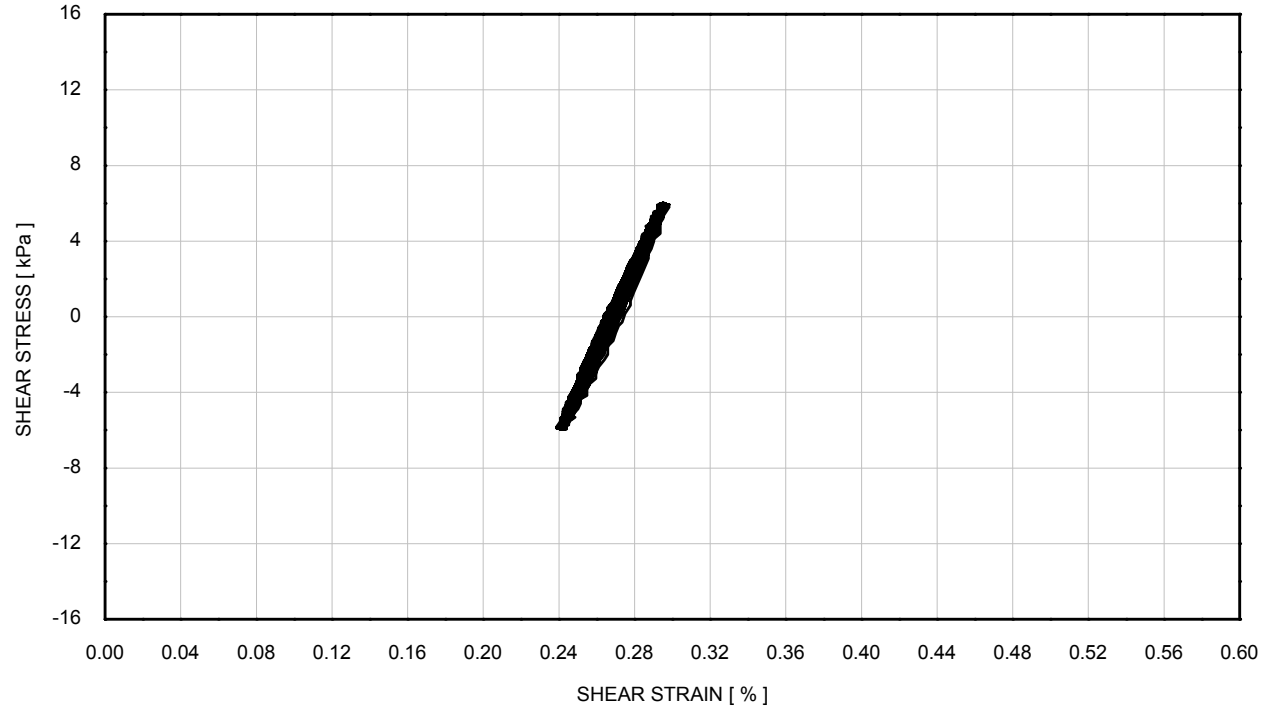
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

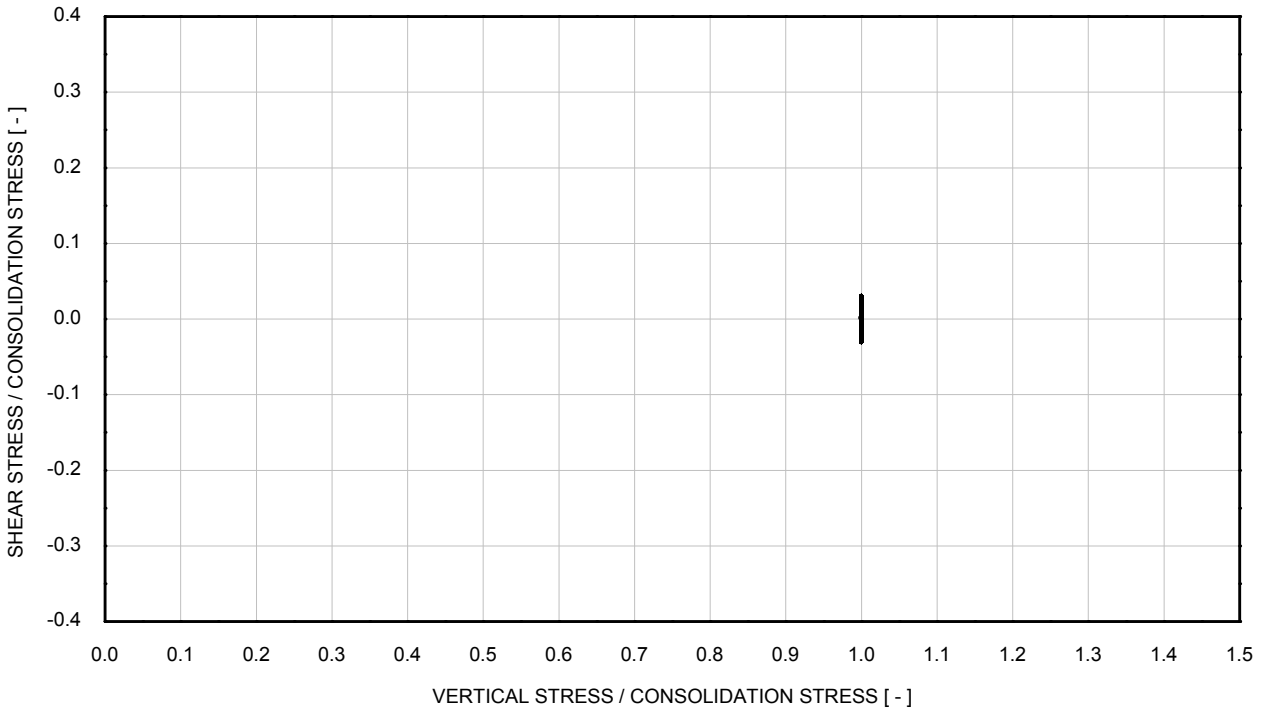




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

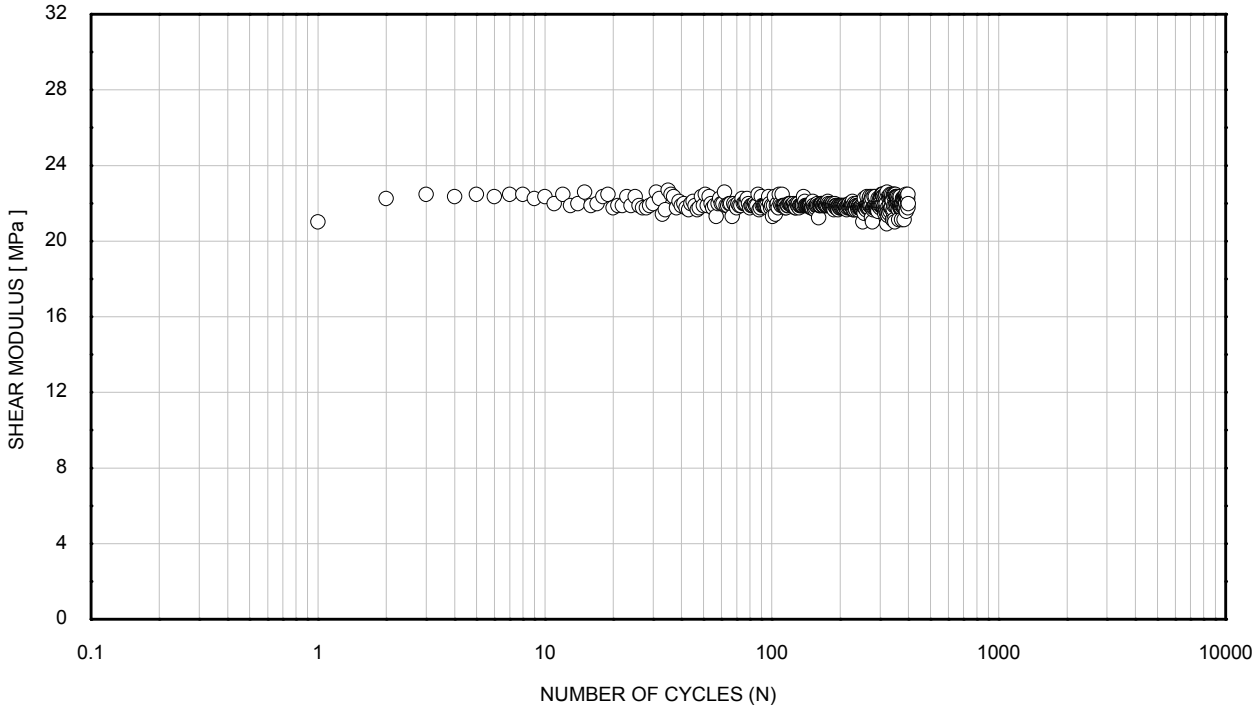
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

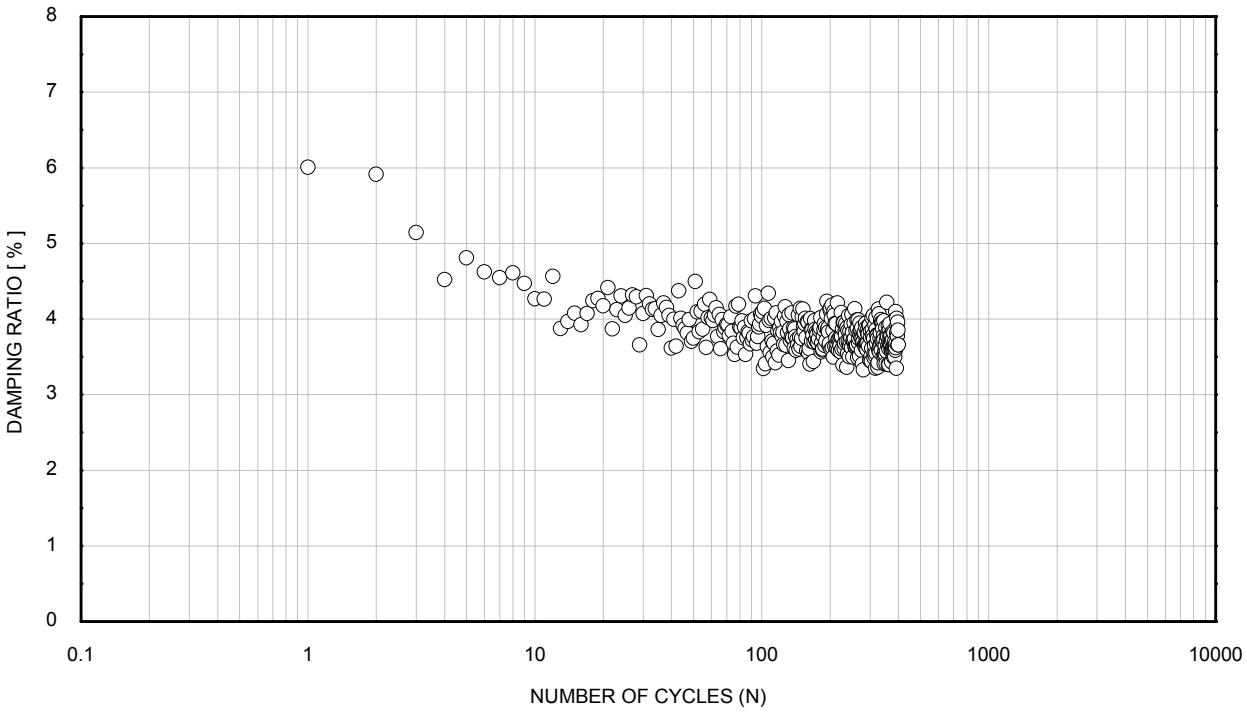




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

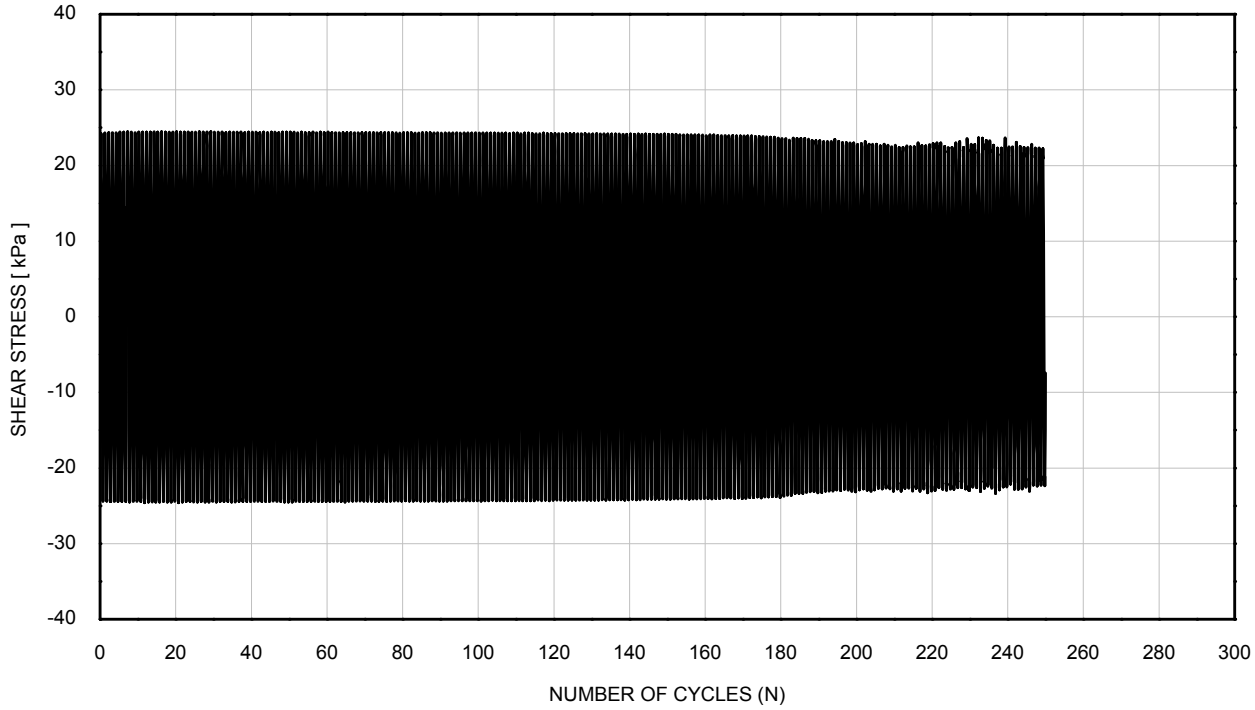
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

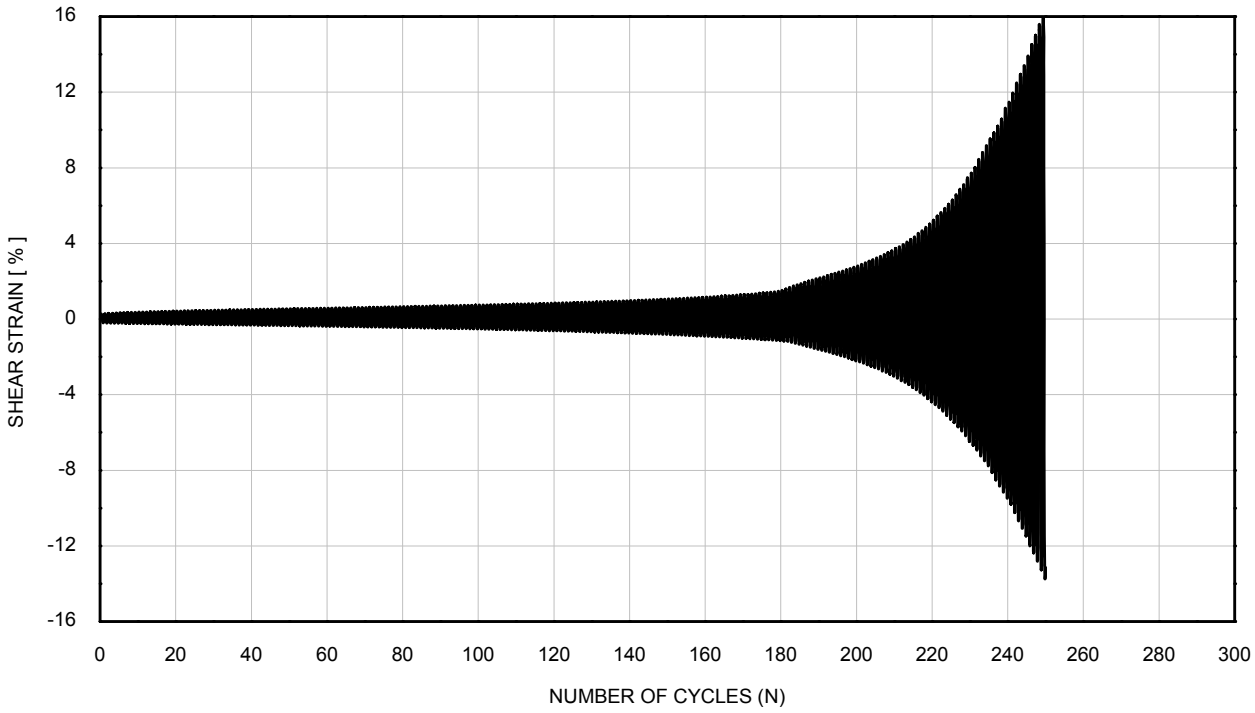




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	6 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

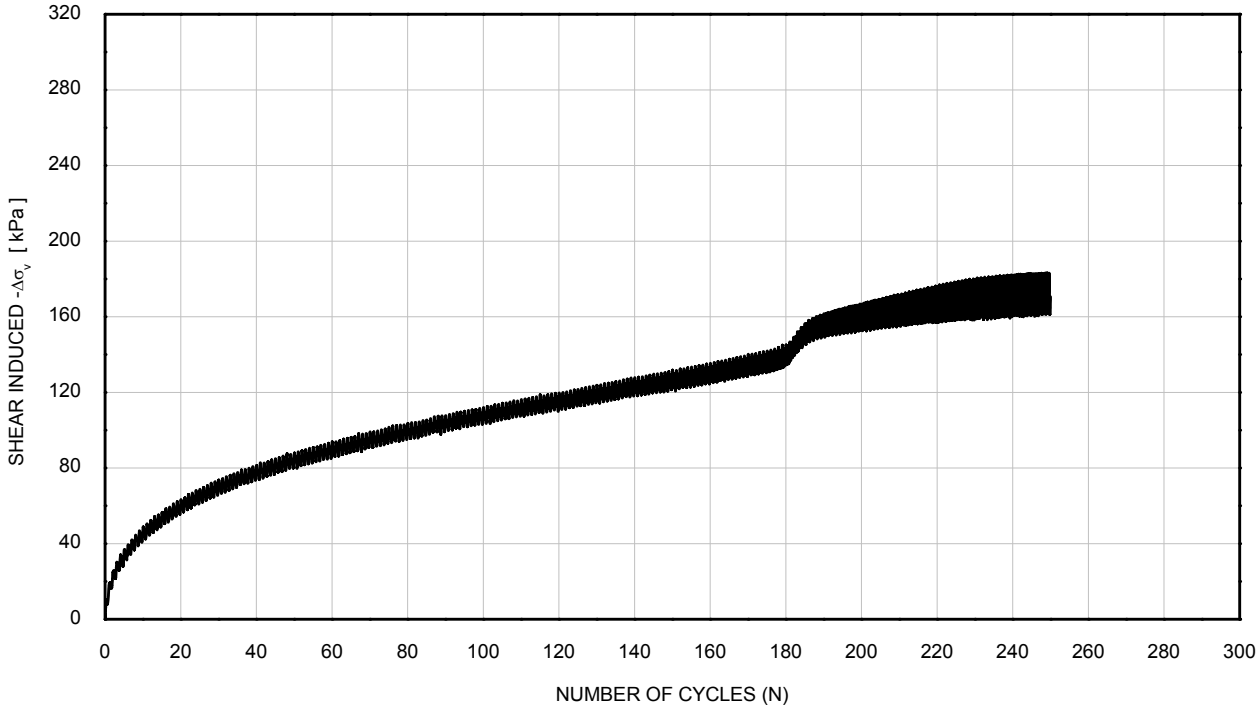
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

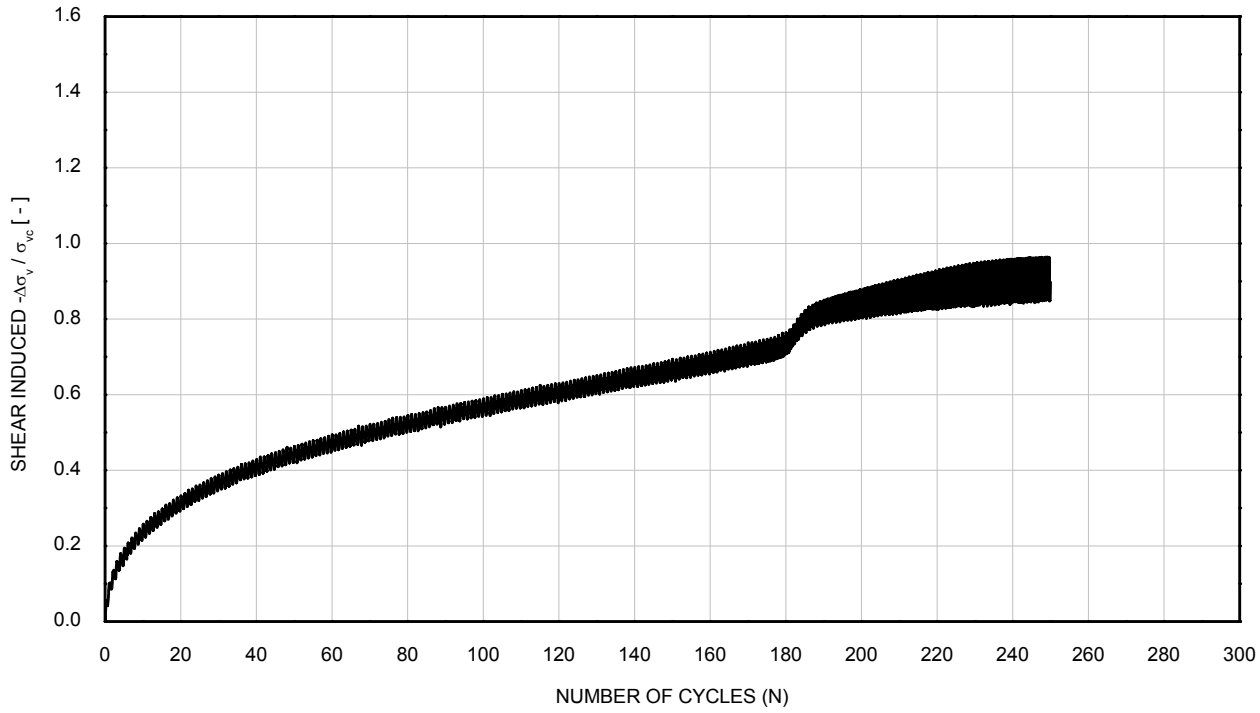




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	24 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

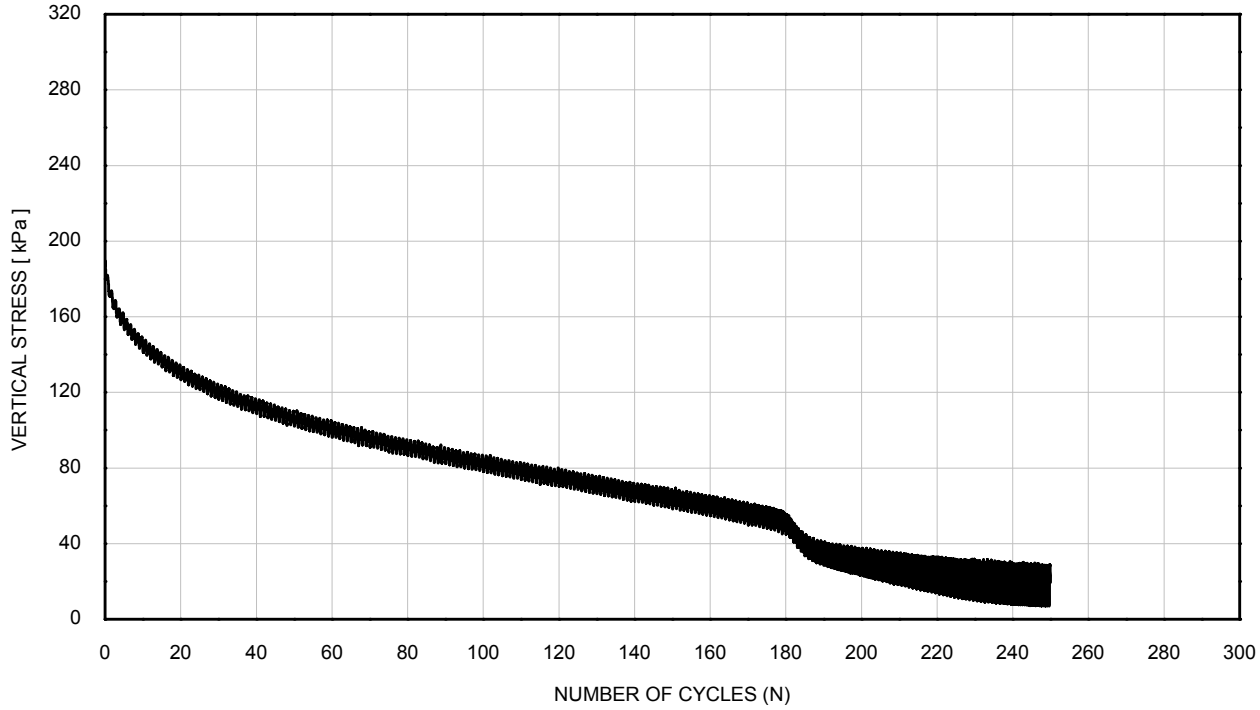
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

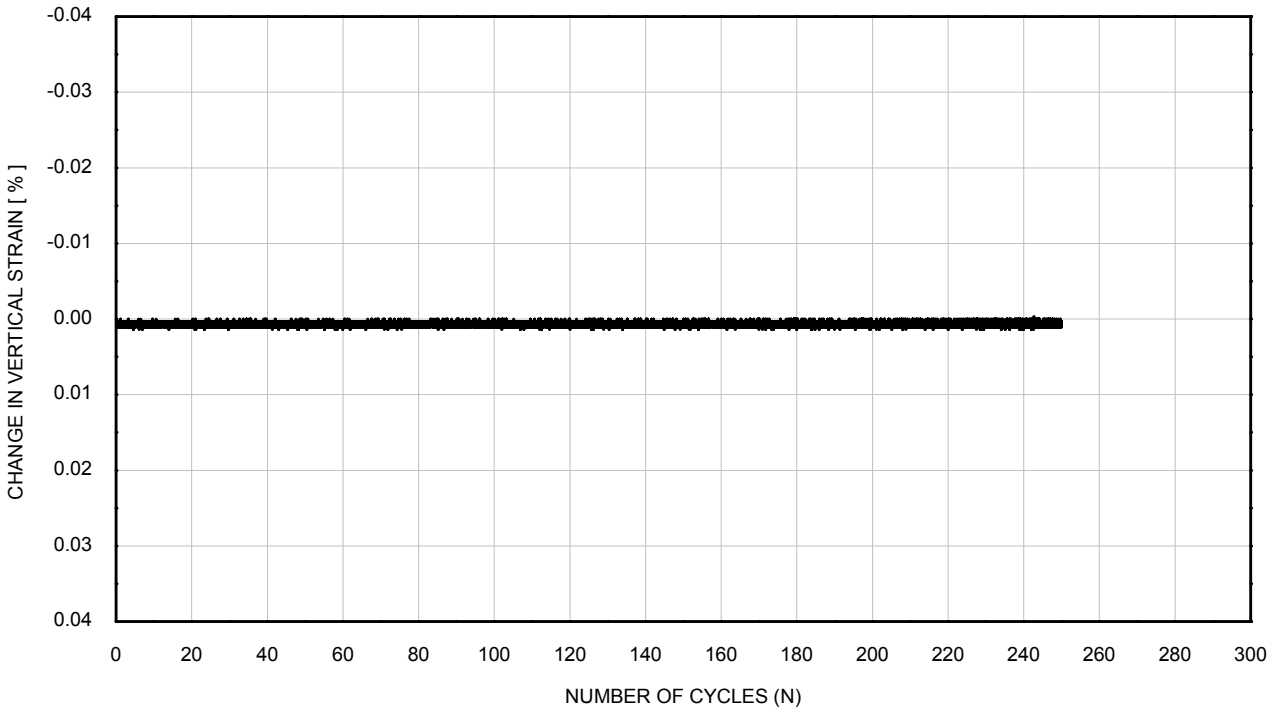




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	24 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

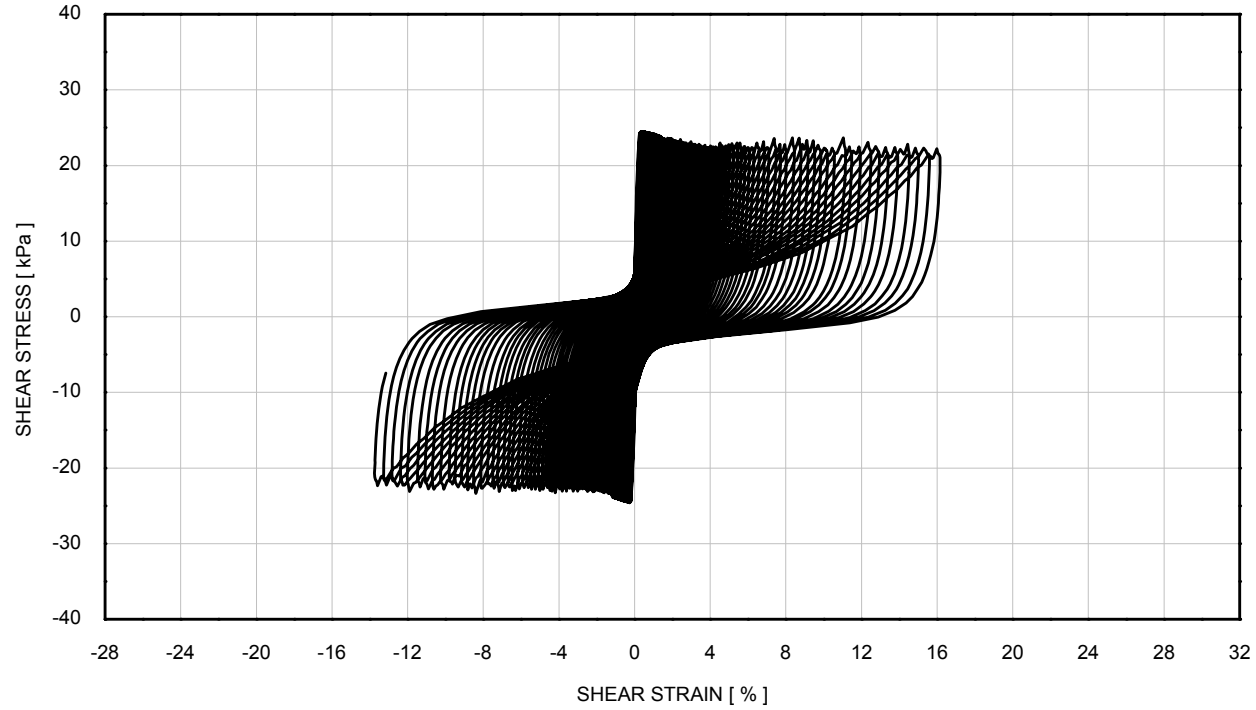
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

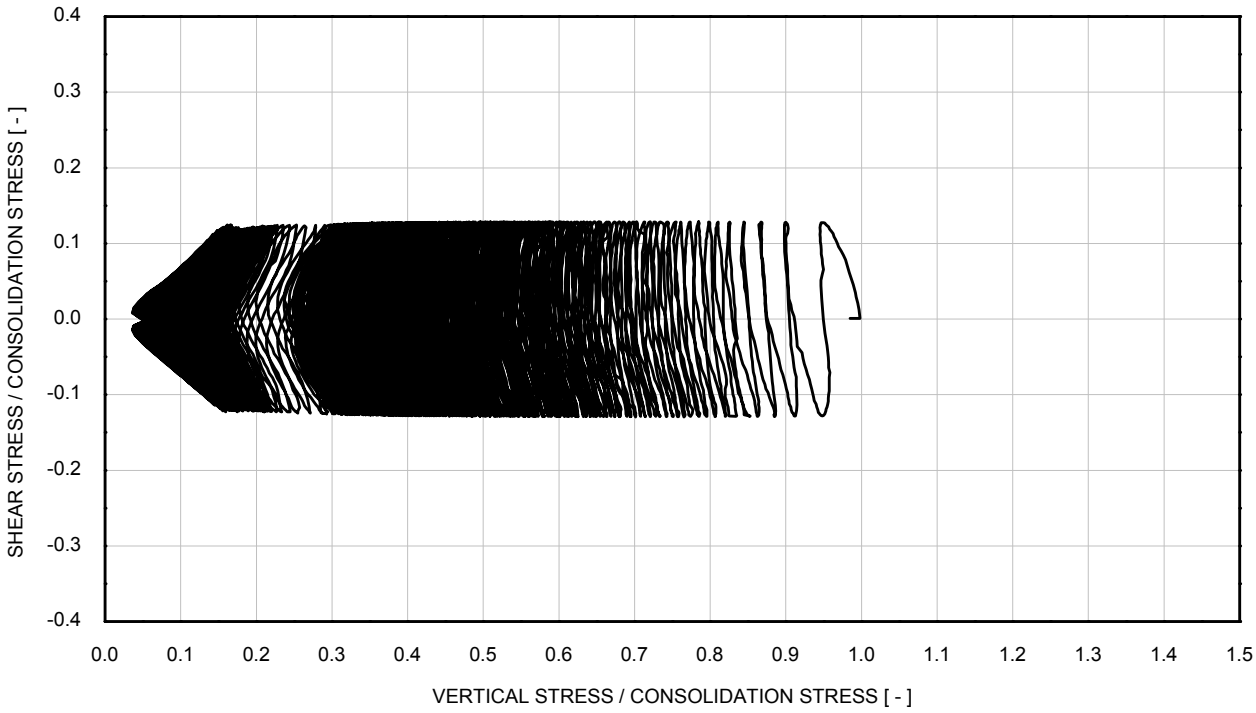




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	24 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

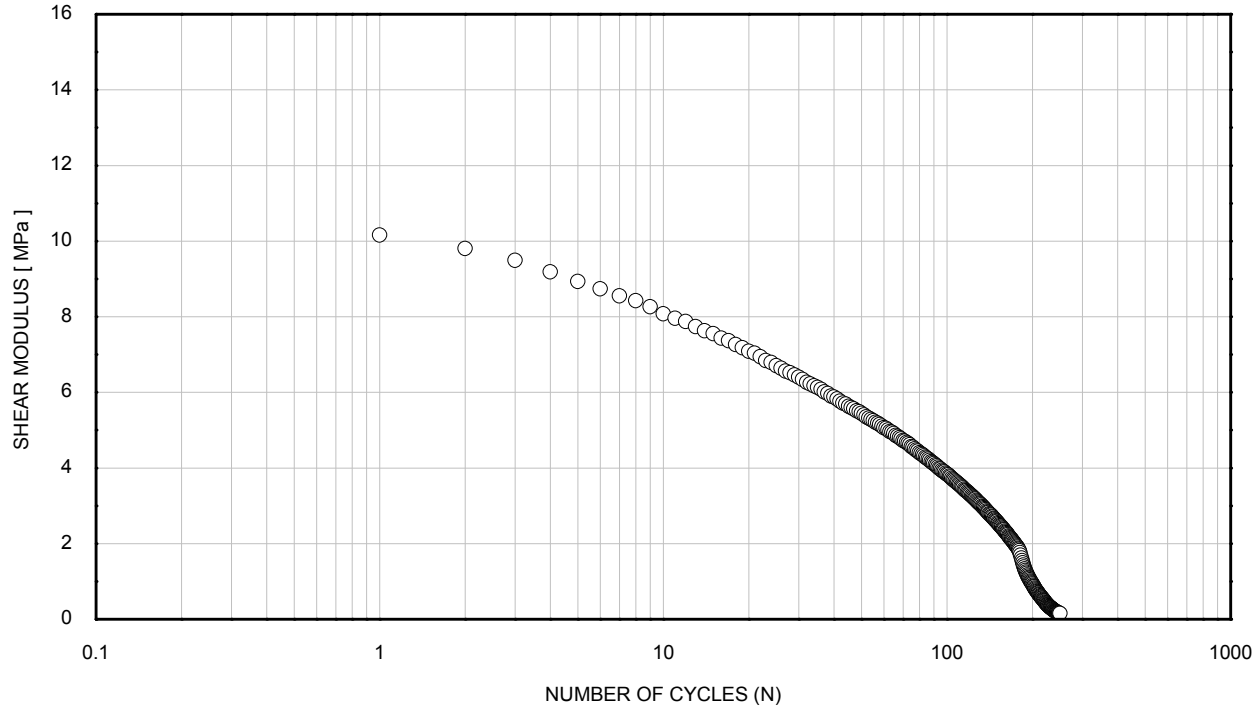
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

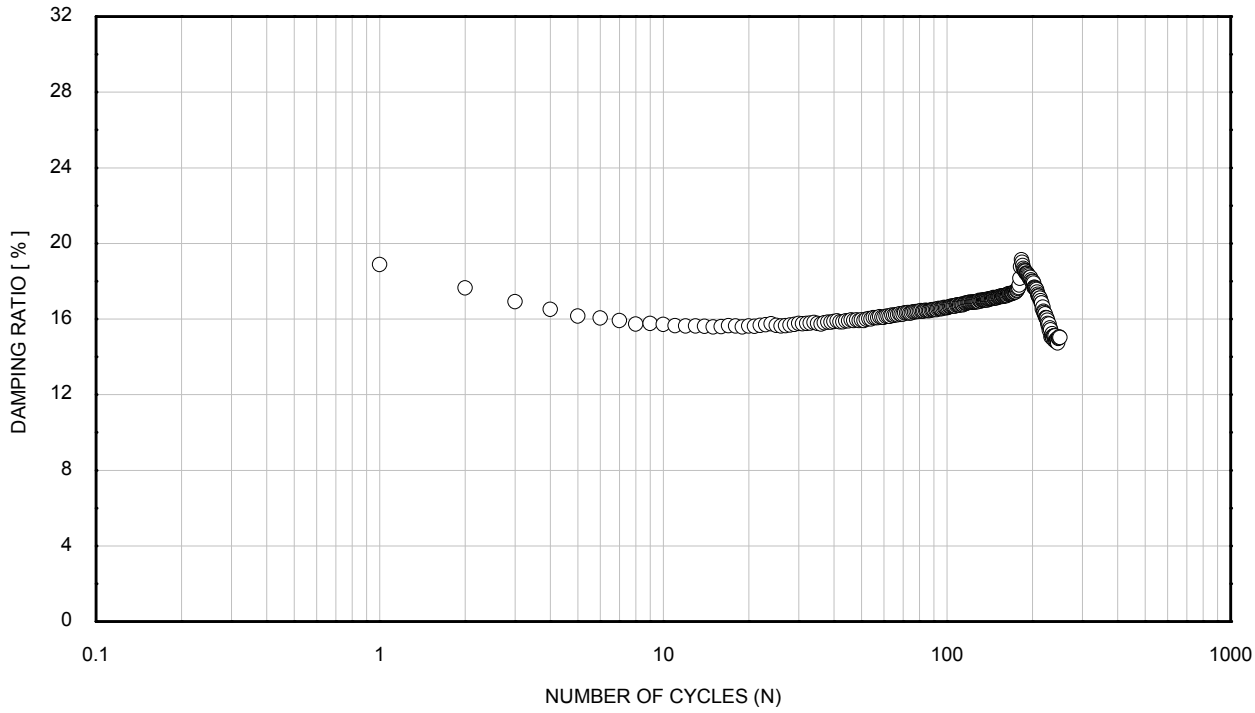




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	24 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

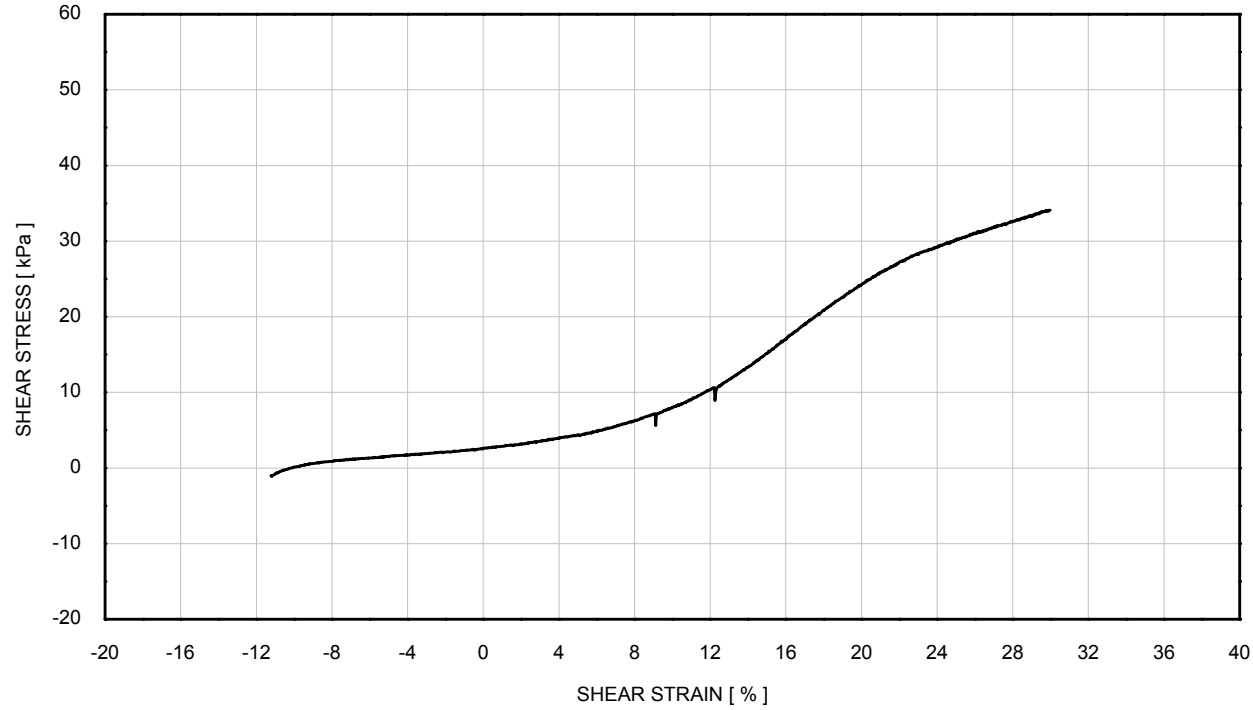
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

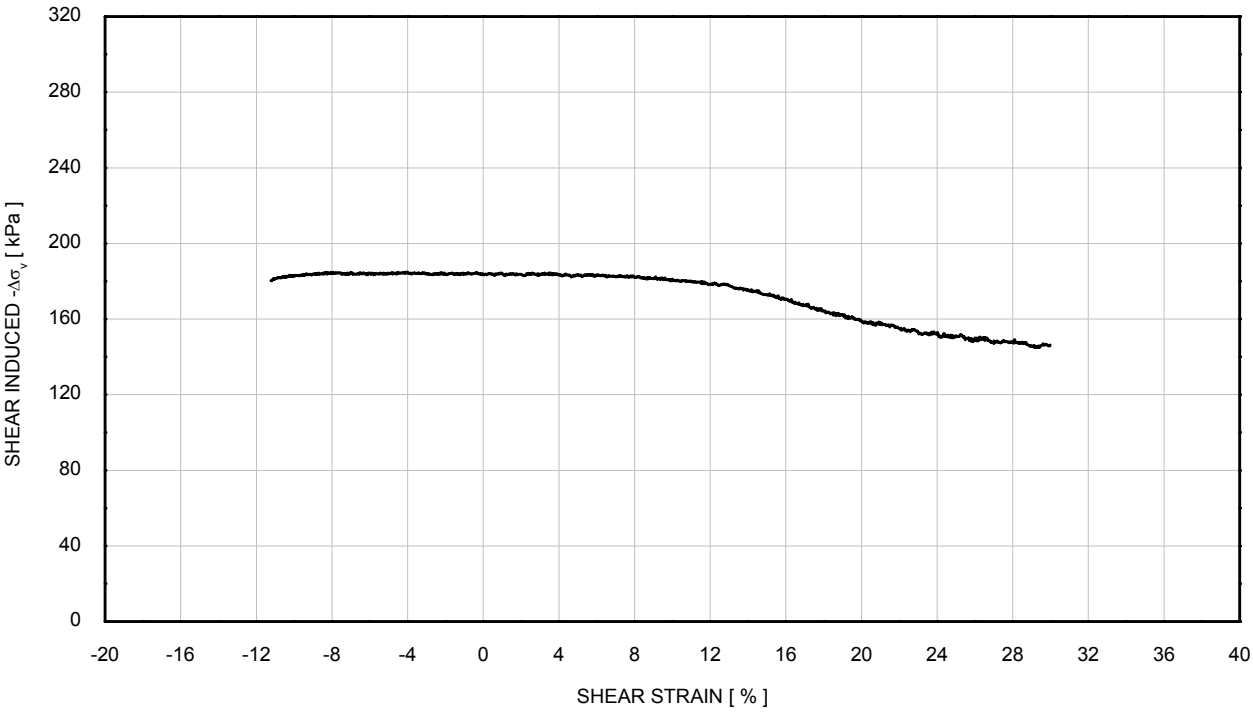




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	24 kPa	Depth [m]	:	23.97
Frequency	:	0.10 Hz	Test No.	:	CSS19

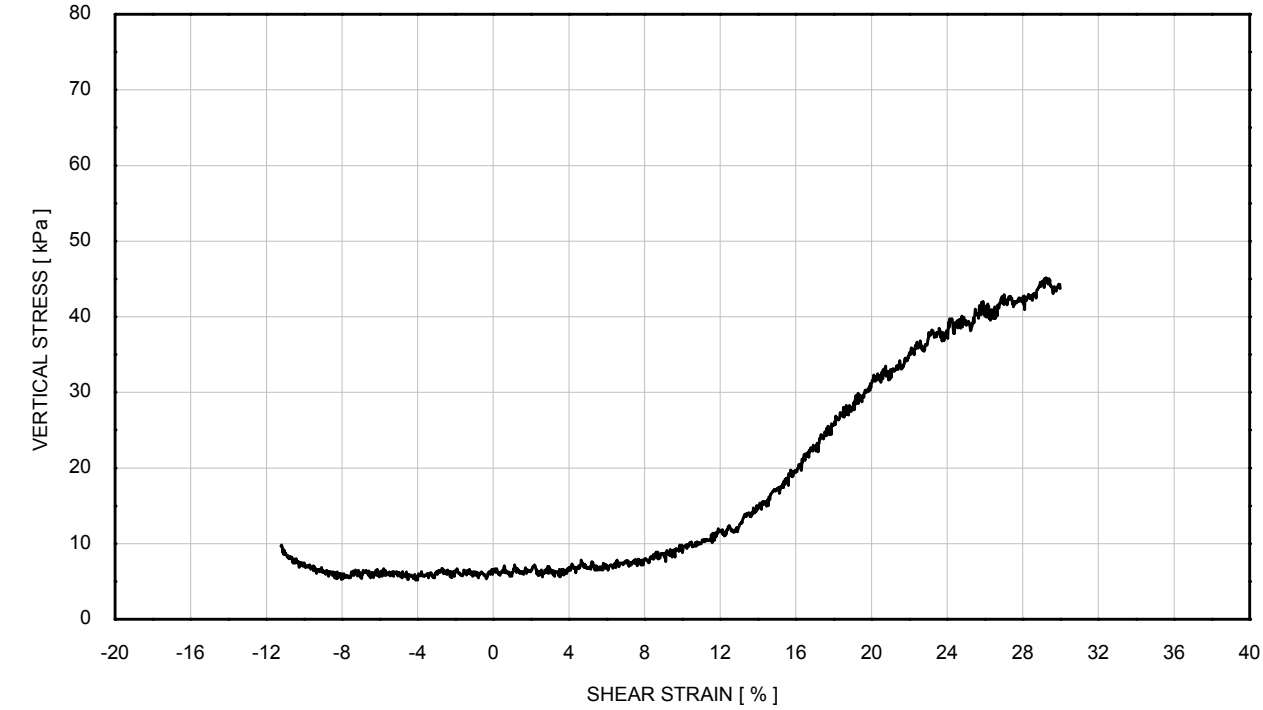
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

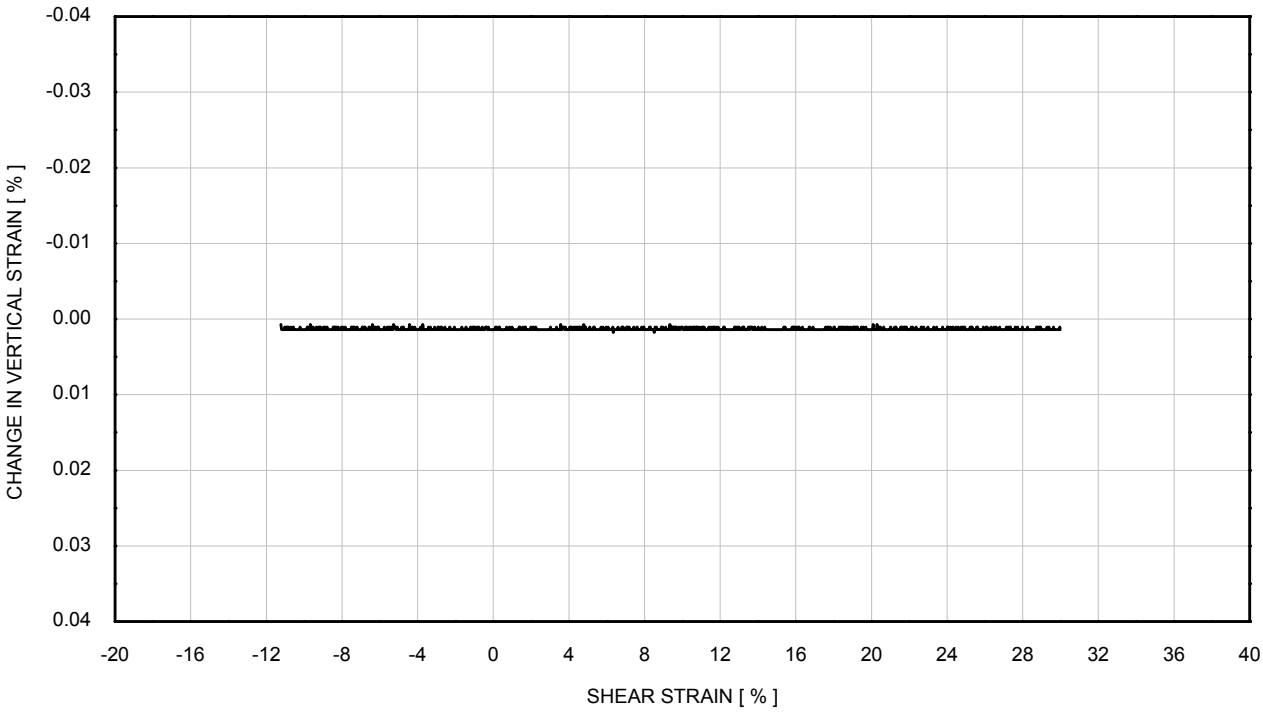




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 34 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 29.98 %	Depth [m]	: 23.97
Rate of strain	: 2.99 %/hour	Test No.	: CSS19

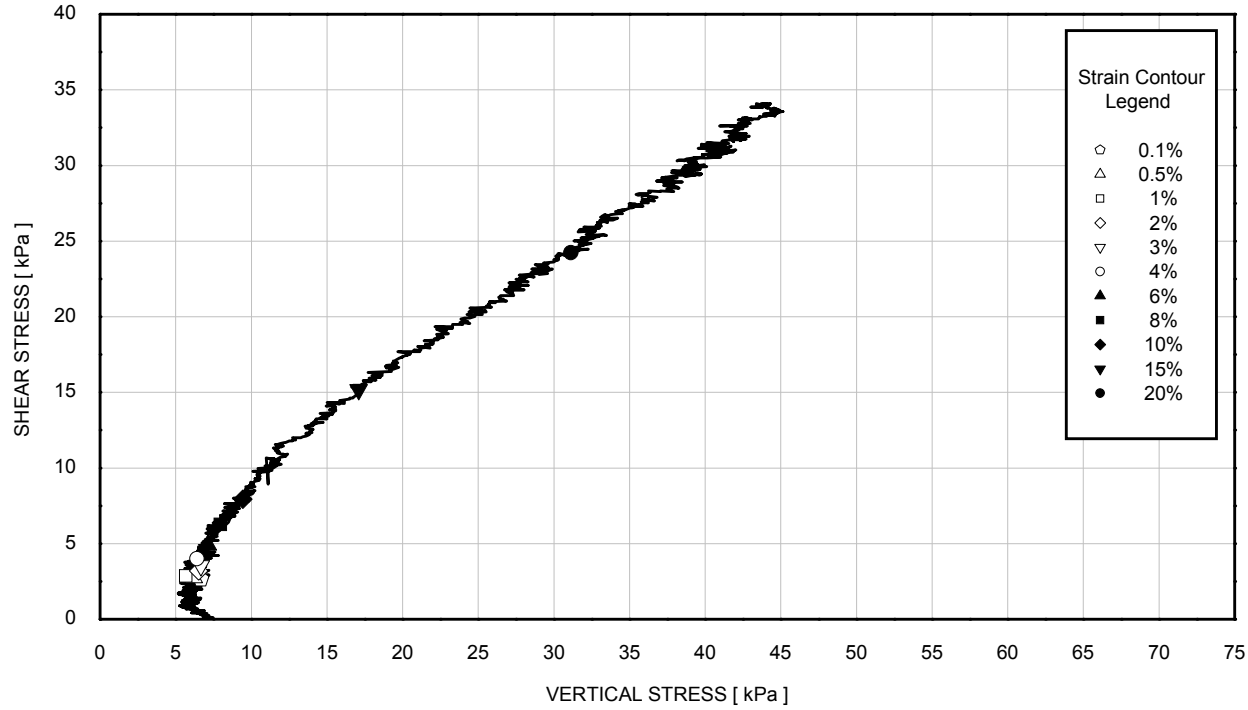
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

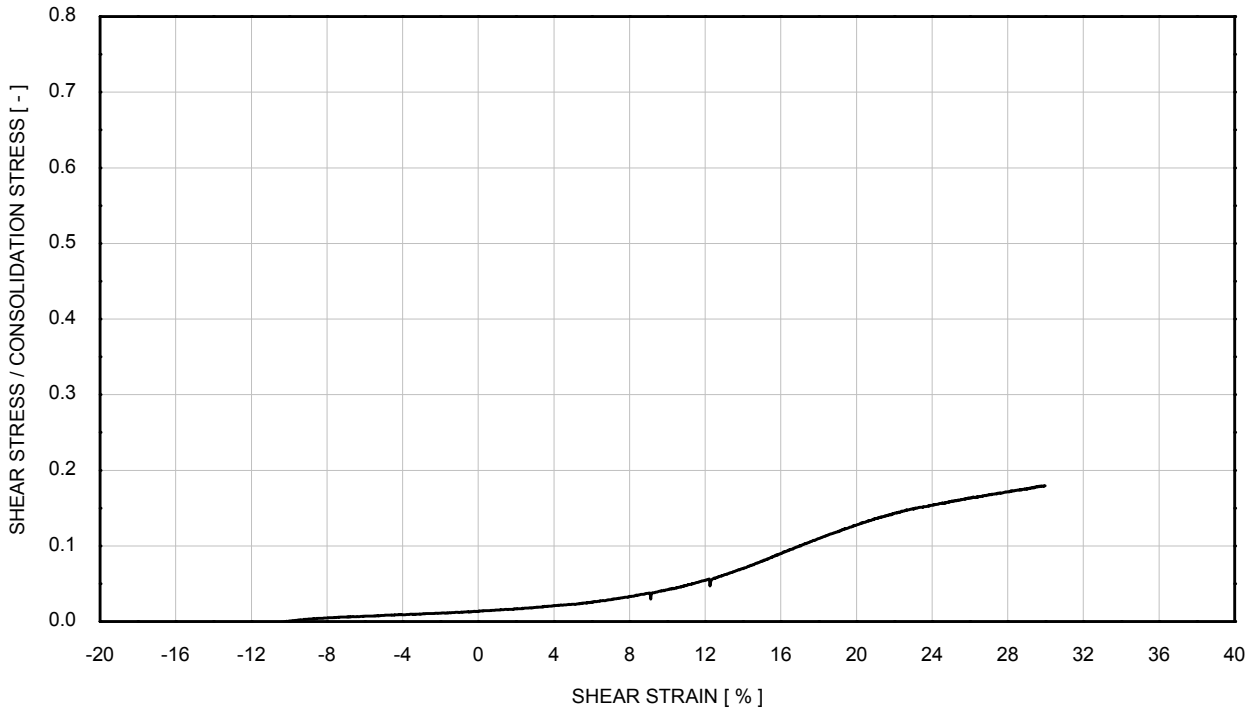




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 34 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 29.98 %	Depth [m]	: 23.97
Rate of strain	: 2.99 %/hour	Test No.	: CSS19

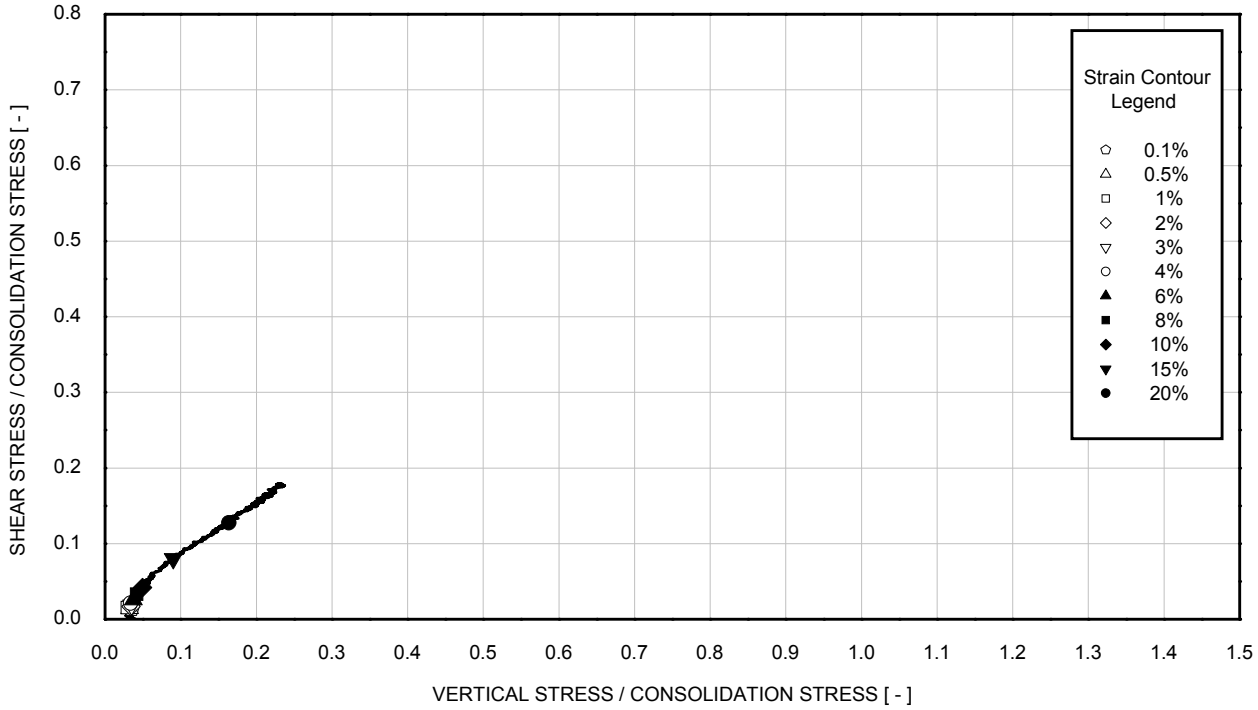
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

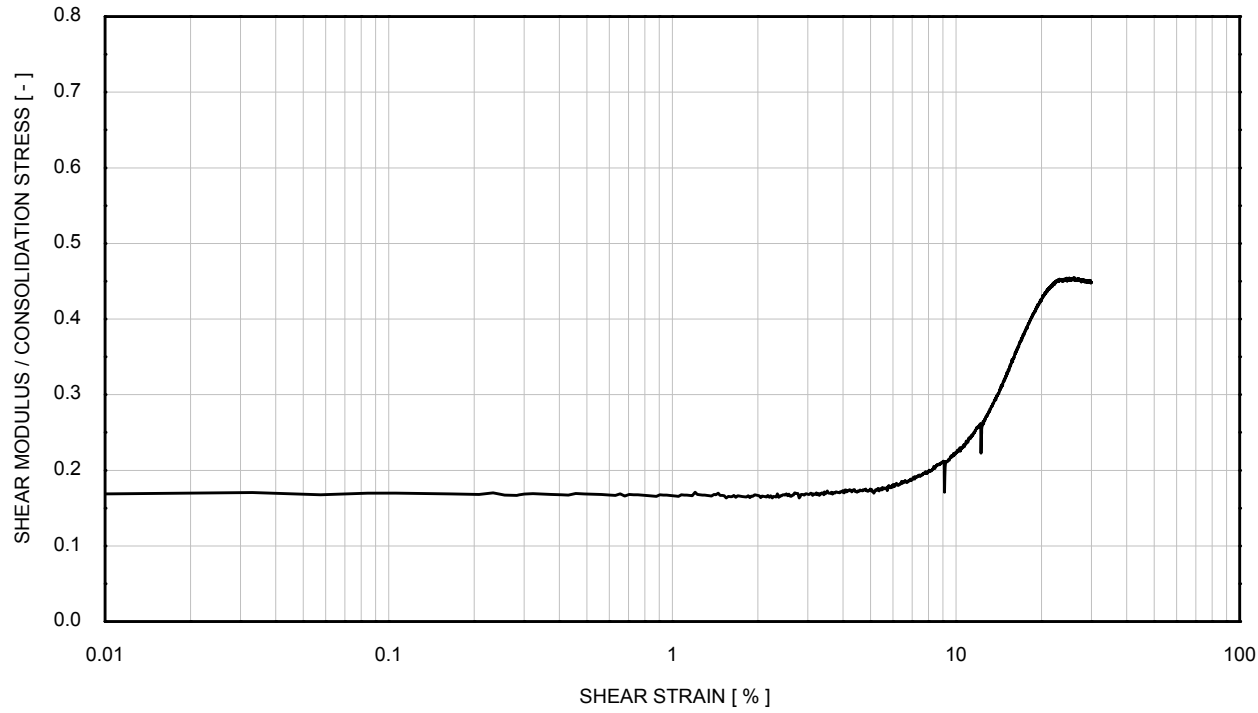




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 34 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 29.98 %	Depth [m]	: 23.97
Rate of strain	: 2.99 %/hour	Test No.	: CSS19

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 34 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 29.98 %	Depth [m]	: 23.97
Rate of strain	: 2.99 %/hour	Test No.	: CSS19

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Dark grey silty CLAY

GENERAL	
Date test started	28/11/2016
Type of sample	Undisturbed
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	65.9
Length	[mm]	29.7
Water content	[%]	25.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.61
Void ratio	[-]	0.678
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	46
Pocket penetrometer	[kPa]	-
Torvane 90°	[kPa]	-
Pocket penetrometer 90°	[kPa]	-

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ HKZ2-BH08-SA_CSS23
Template issue	1.4
Processed by Date	JLS 30/11/2016
Checked by Date	PH 13/12/2016
Approved by Date	PH 13/12/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	24.03
Test number	CSS23

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	190
Vertical strain	[%]	4.36
Bulk density	[Mg/m^3]	2.07
Dry density	[Mg/m^3]	1.68
Void ratio	[-]	0.604
Water content	[%]	23.2

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	190
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	-1
Mean τ_{cy}	[kPa]	3
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	4.37
Bulk density	[Mg/m^3]	2.07
Dry density	[Mg/m^3]	1.68
Void ratio	[-]	0.604

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.30	0.01	22.65	1.78
2	0.30	0.01	22.47	6.87
5	0.30	0.01	23.09	4.28
10	0.30	0.01	24.11	0.49
20	0.30	0.01	22.65	2.81
30	0.30	0.01	21.86	2.57
40	0.30	0.01	24.01	3.06
50	0.30	0.01	27.15	3.89
100	0.30	0.01	26.55	7.58
200	0.31	0.01	27.15	3.81
300	0.31	0.01	25.46	5.24
400	0.31	0.01	24.54	1.07

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	24.03
Test number	CSS23

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	59
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	32
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	23
γ_{av} at N_f	[%]	-1.45
γ_{cy} at N_f	[%]	15.41
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	168
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.06	0.49	6.76	22.05
2	0.03	0.63	5.39	21.75
4	0.04	0.98	3.33	21.64
6	0.00	1.56	2.06	21.04
8	-0.07	2.57	1.26	20.18
10	-0.10	3.88	0.81	18.51
12	-0.19	5.47	0.58	16.53
14	-0.34	7.20	0.44	14.80
16	-0.49	9.06	0.36	13.61
18	-0.70	10.81	0.30	13.20
20	-0.84	12.70	0.26	12.16
23	-1.45	15.41	0.21	12.45

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	44
Shear strain	[%]	22.61
Shear induced $-\Delta\sigma_v$	[kPa]	127
Vertical stress	[kPa]	63
Vertical strain	[%]	-0.02
Rate of strain	[%/hour]	3.00
At 15 % shear strain		
Shear stress	[kPa]	28
Shear induced $-\Delta\sigma_v$	[kPa]	152
Vertical stress	[kPa]	38
Vertical strain	[%]	-0.02

TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	24.03
Test number	CSS23

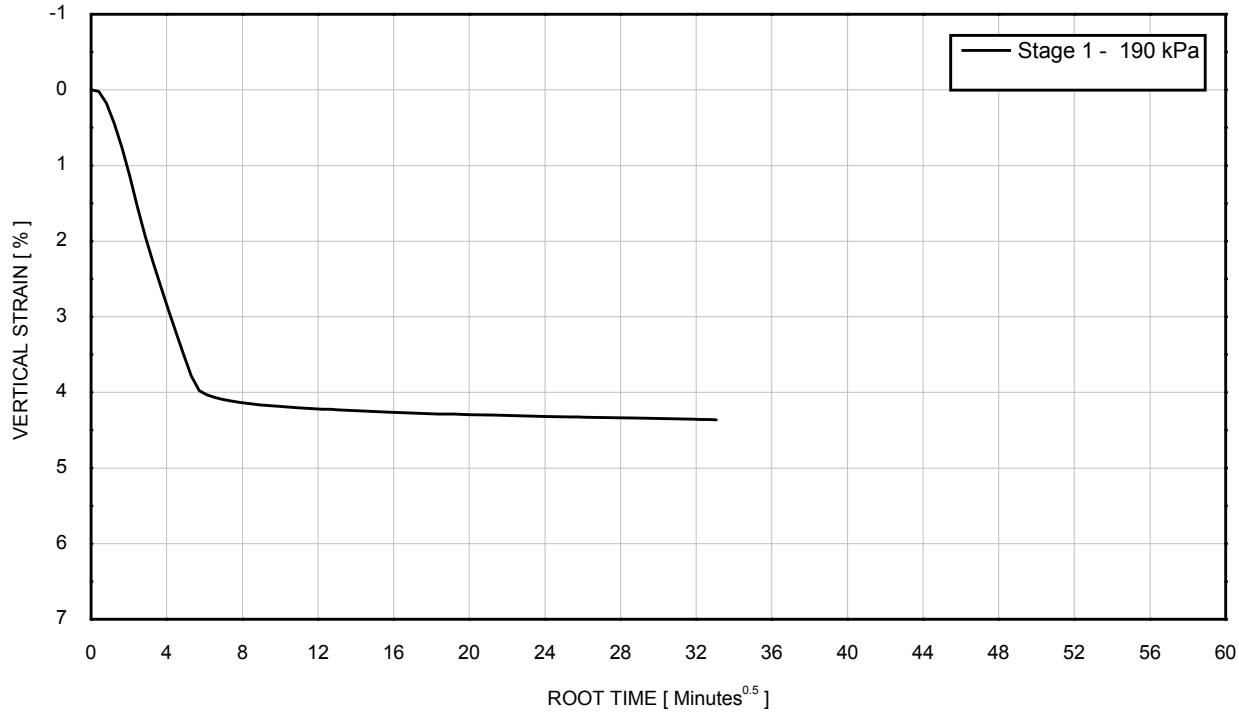
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

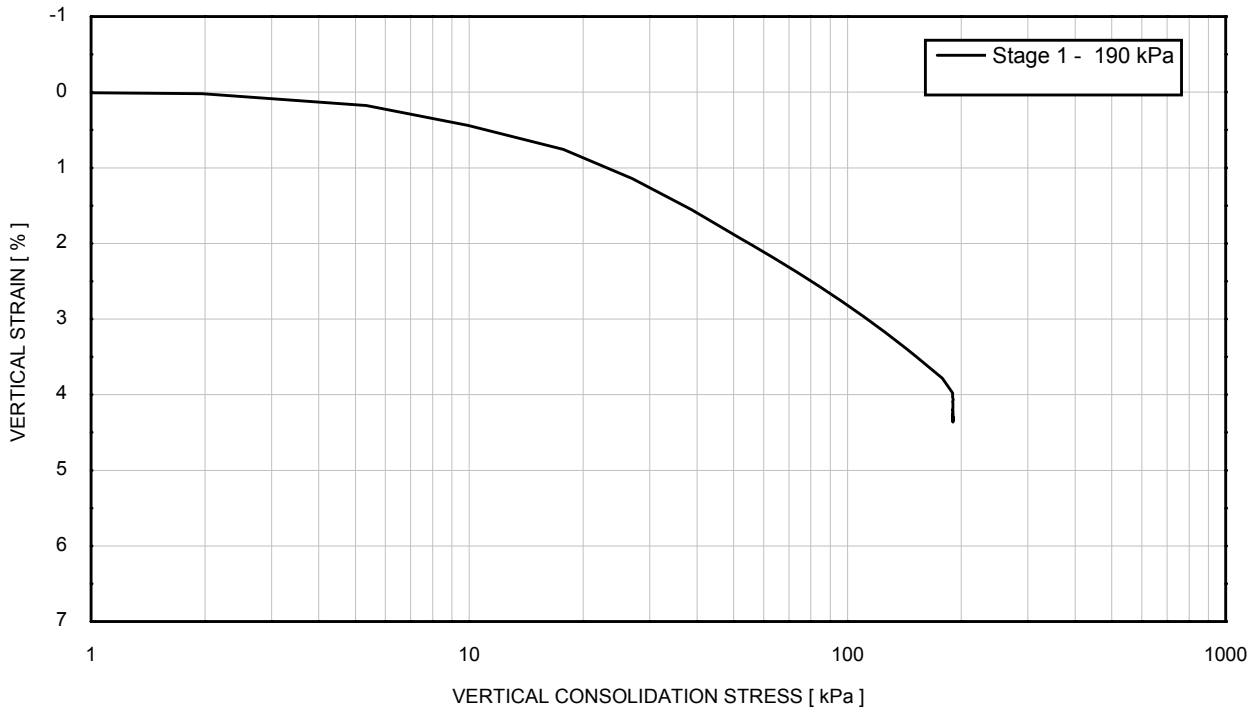
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	HKZ2-BH08-SA
Sample	40WaxC
Depth [m]	24.03
Test number	CSS23

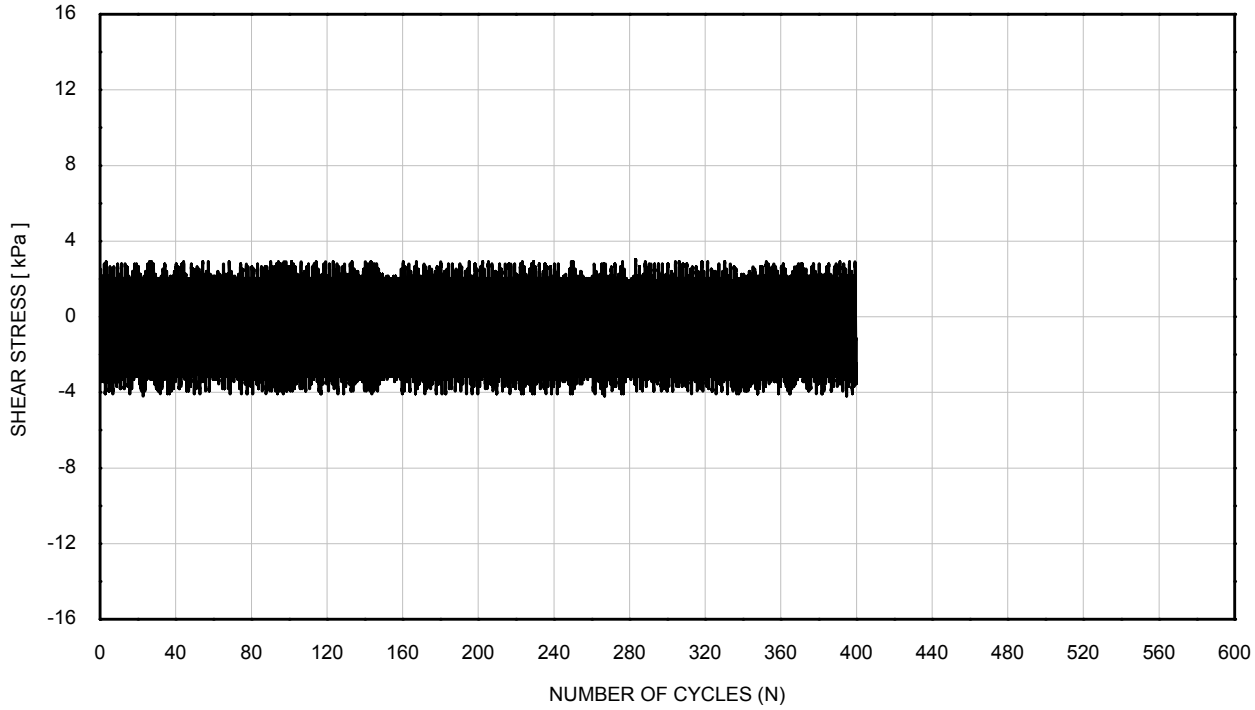
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

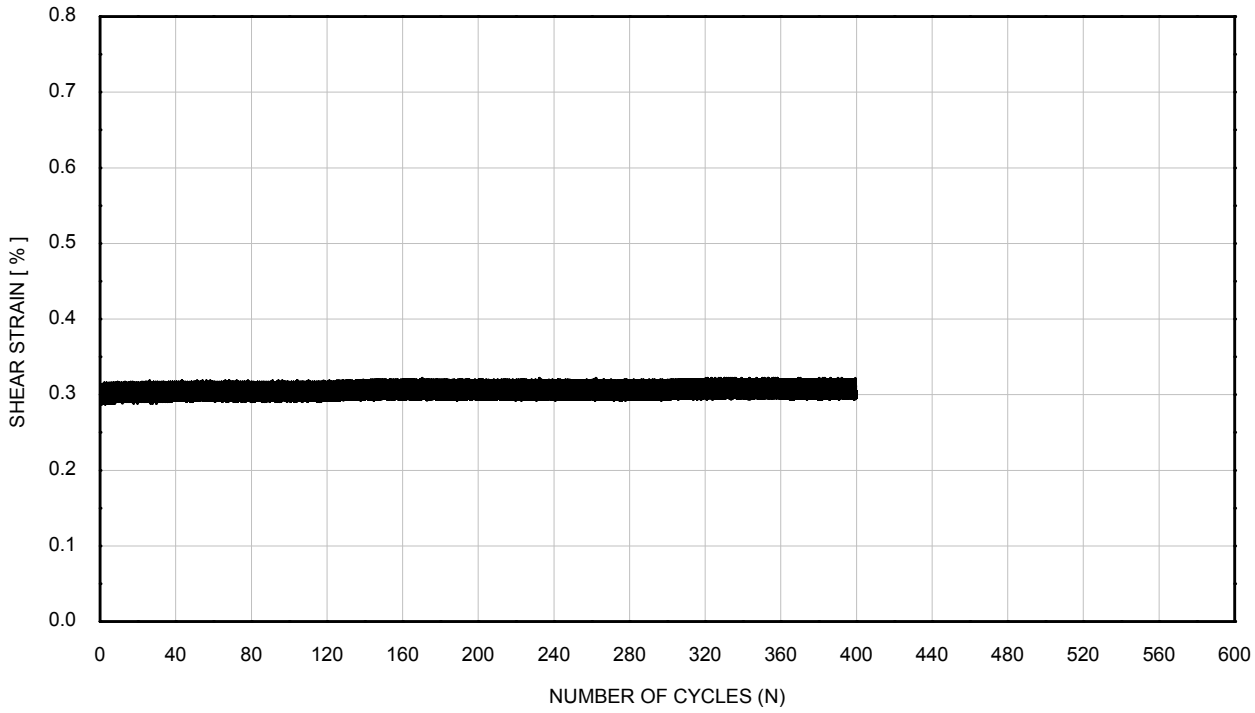




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
		Sample	: 40WaxC
		Depth [m]	: 24.03
		Test No.	: CSS23

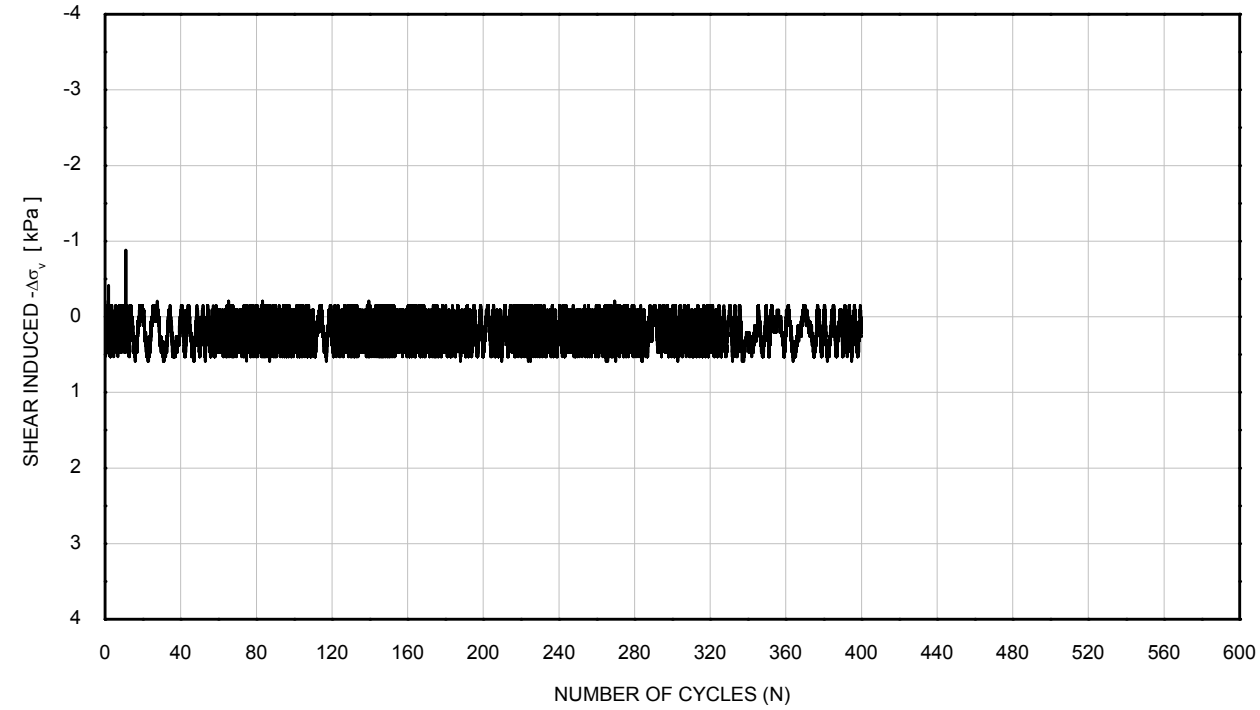
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

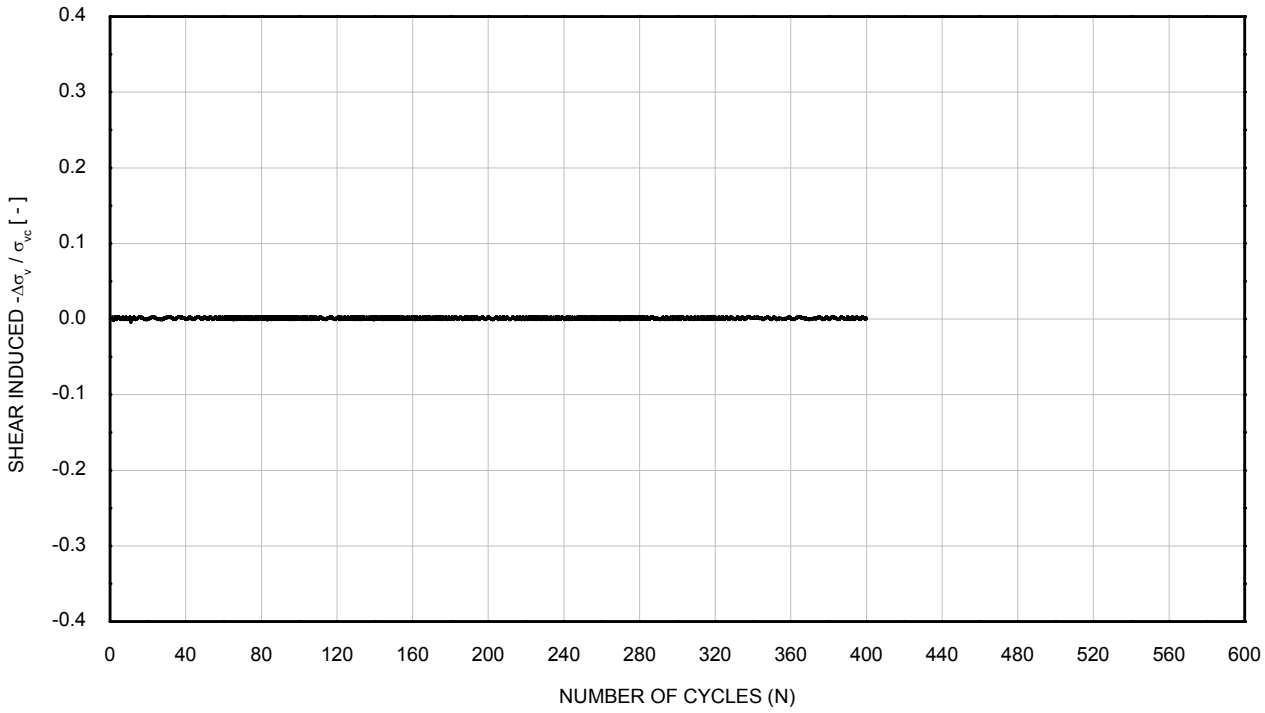




σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH08-SA
Mean τ_{av}	:	-1 kPa	Sample	: 40WaxC
Mean τ_{cy}	:	3 kPa	Depth [m]	: 24.03
Frequency	:	0.10 Hz	Test No.	: CSS23

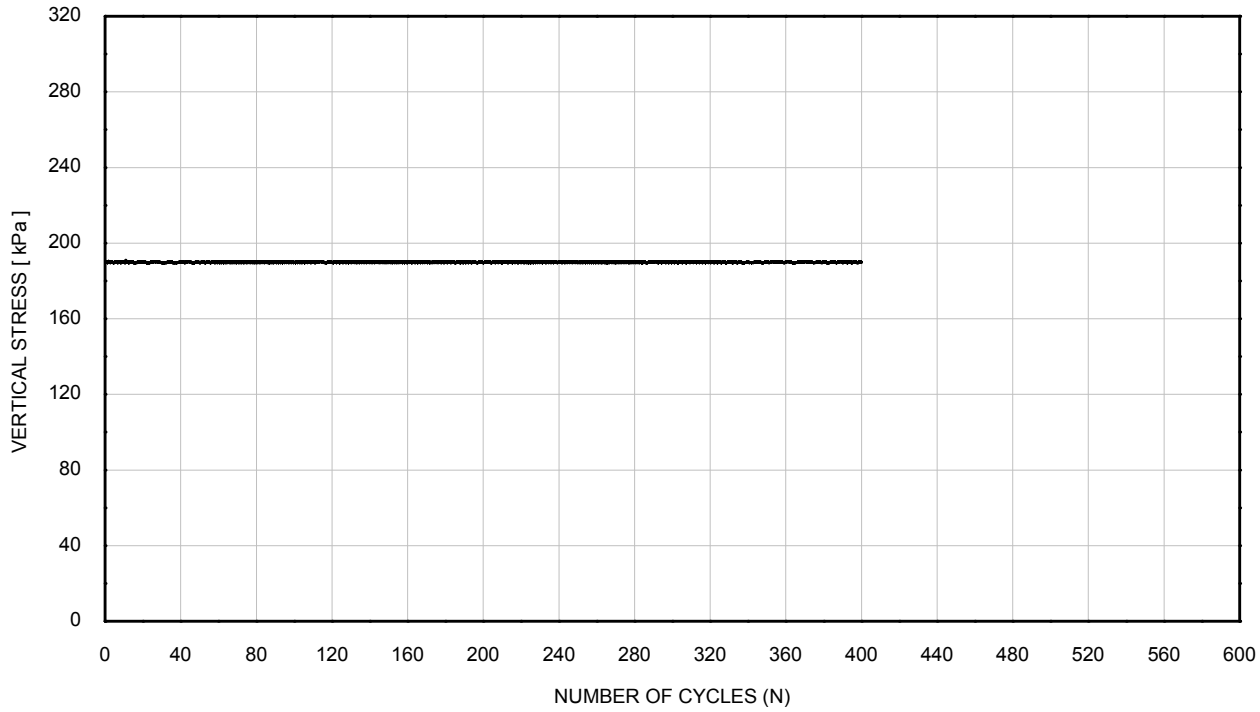
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

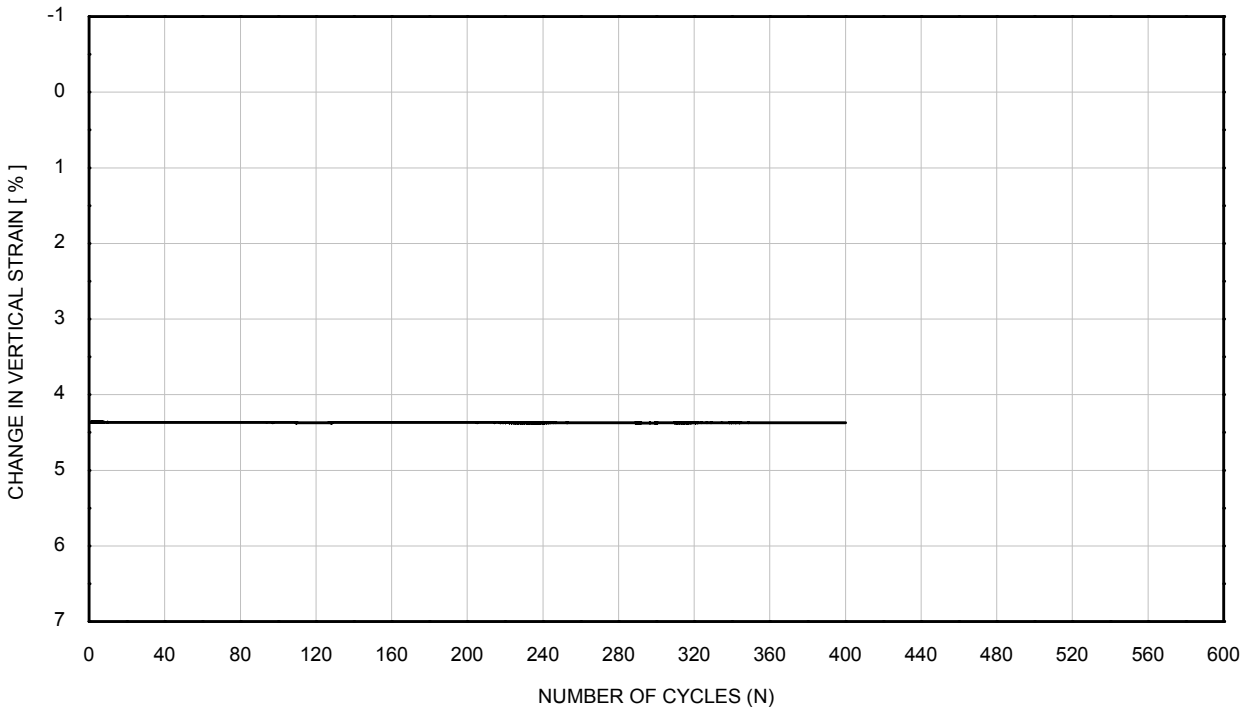




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	-1 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	3 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

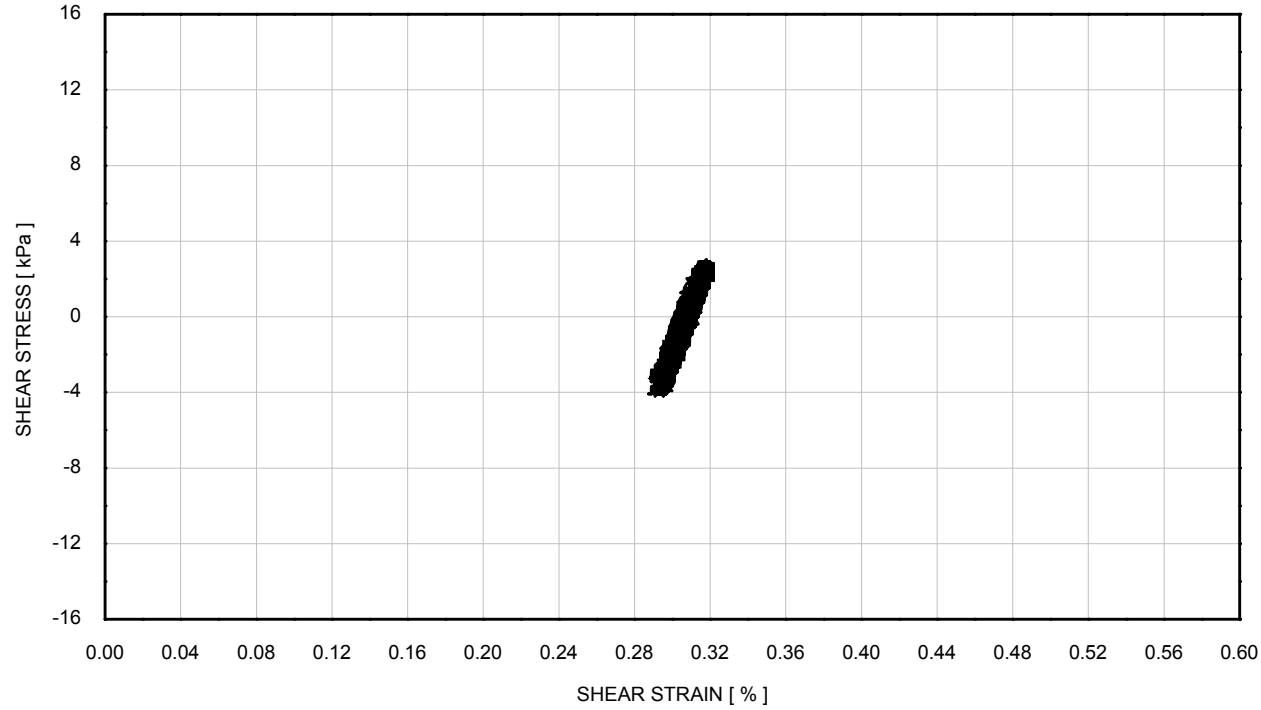
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

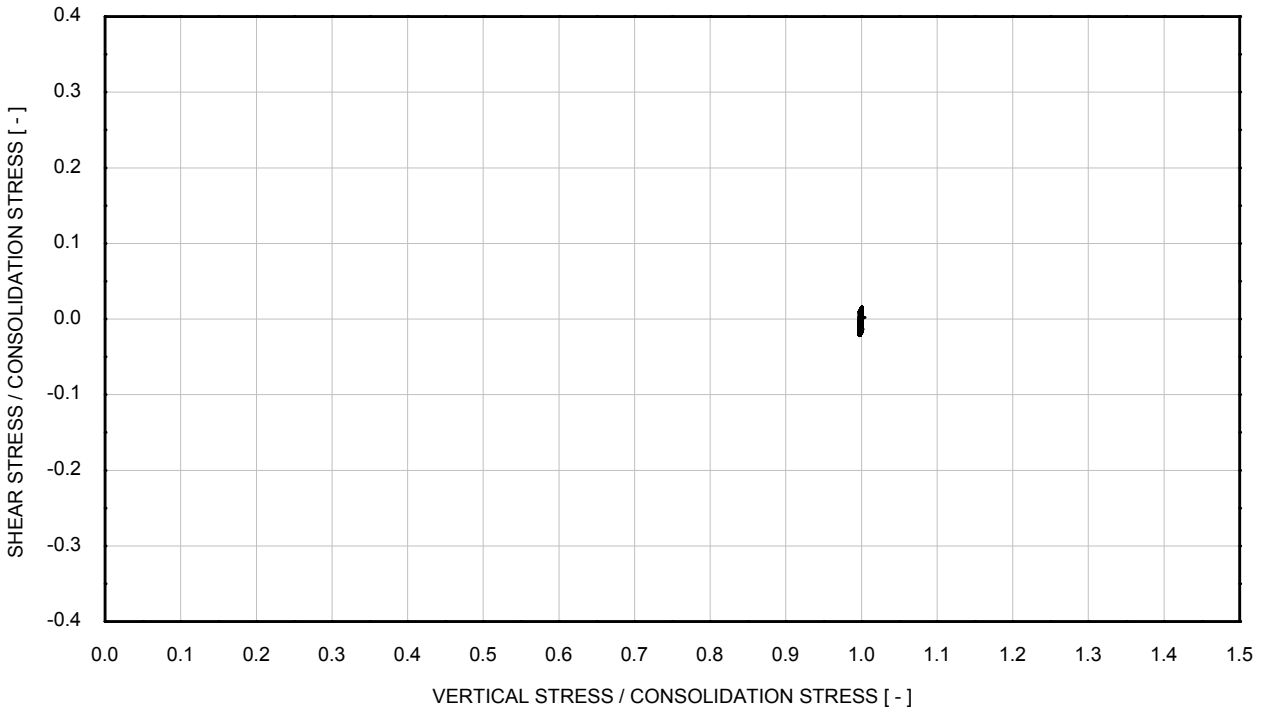




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	-1 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	3 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

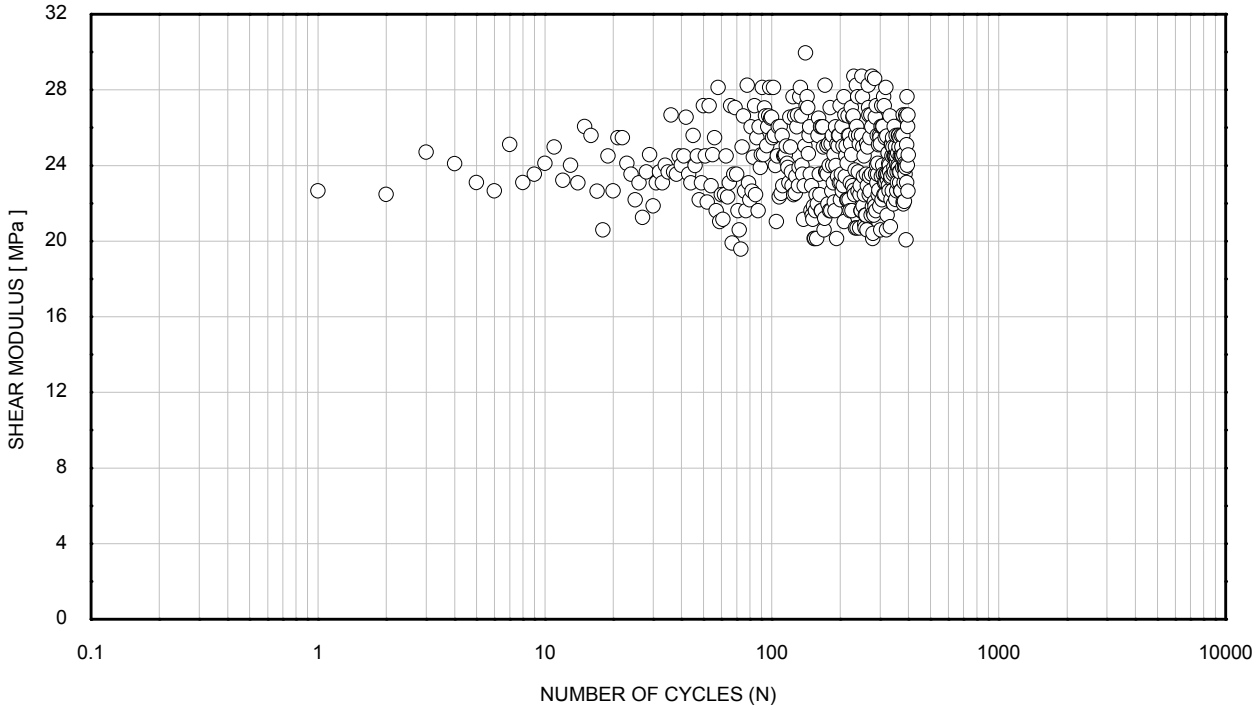
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

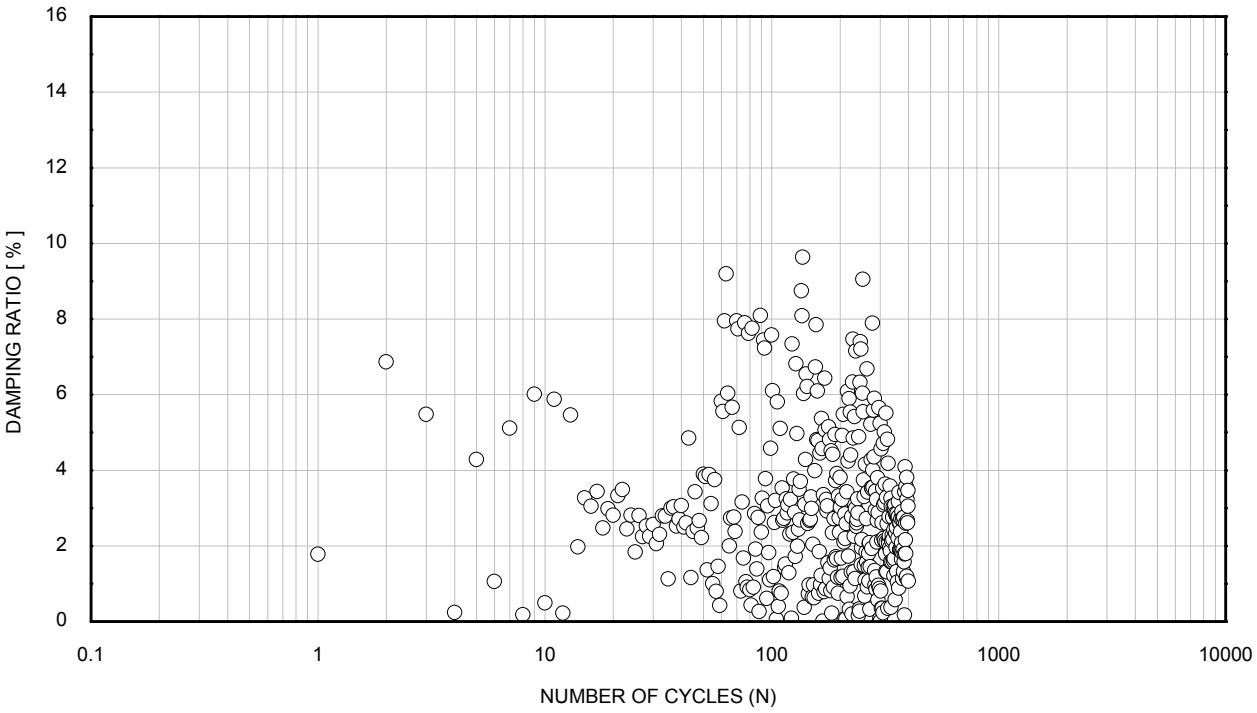




σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH08-SA
Mean τ_{av}	:	-1 kPa	Sample	: 40WaxC
Mean τ_{cy}	:	3 kPa	Depth [m]	: 24.03
Frequency	:	0.10 Hz	Test No.	: CSS23

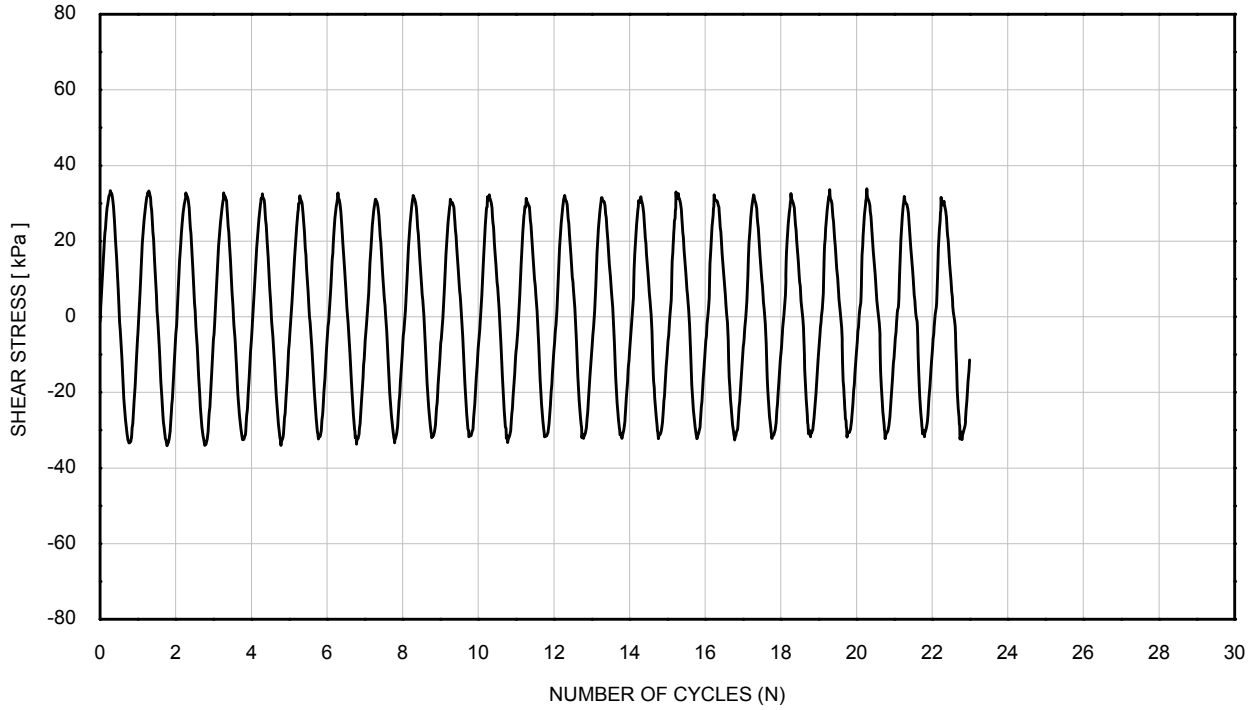
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

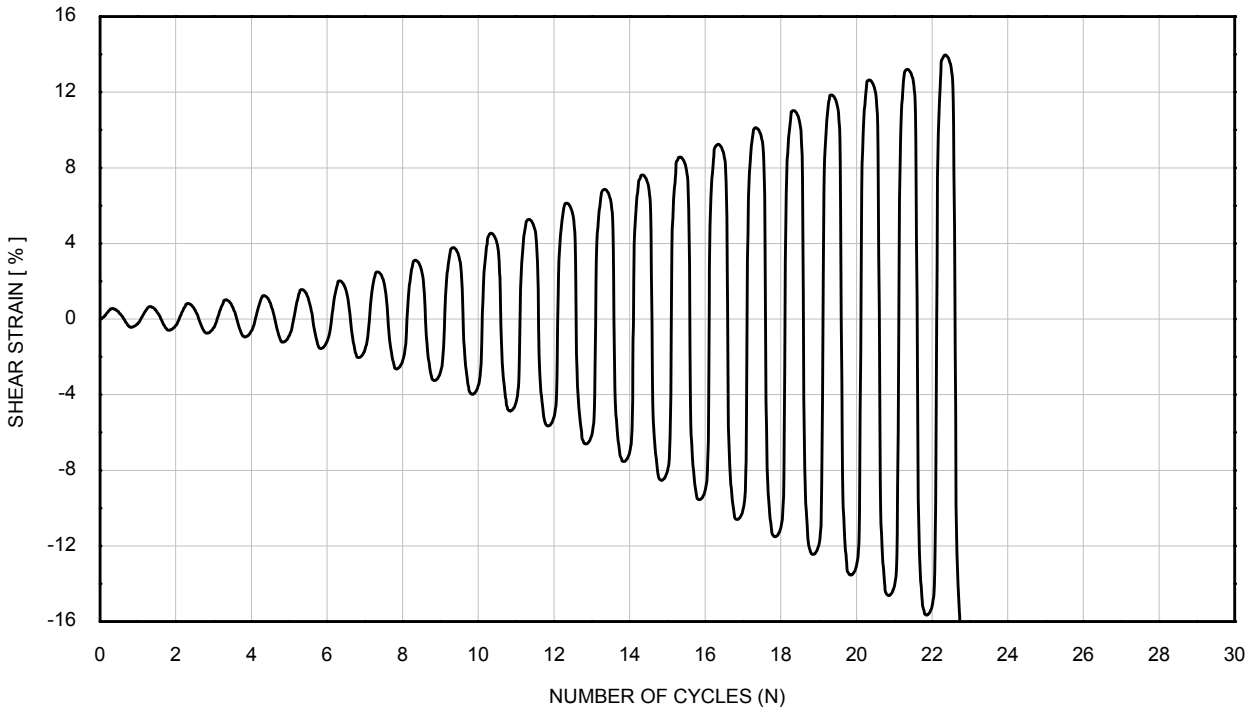




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	-1 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	3 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

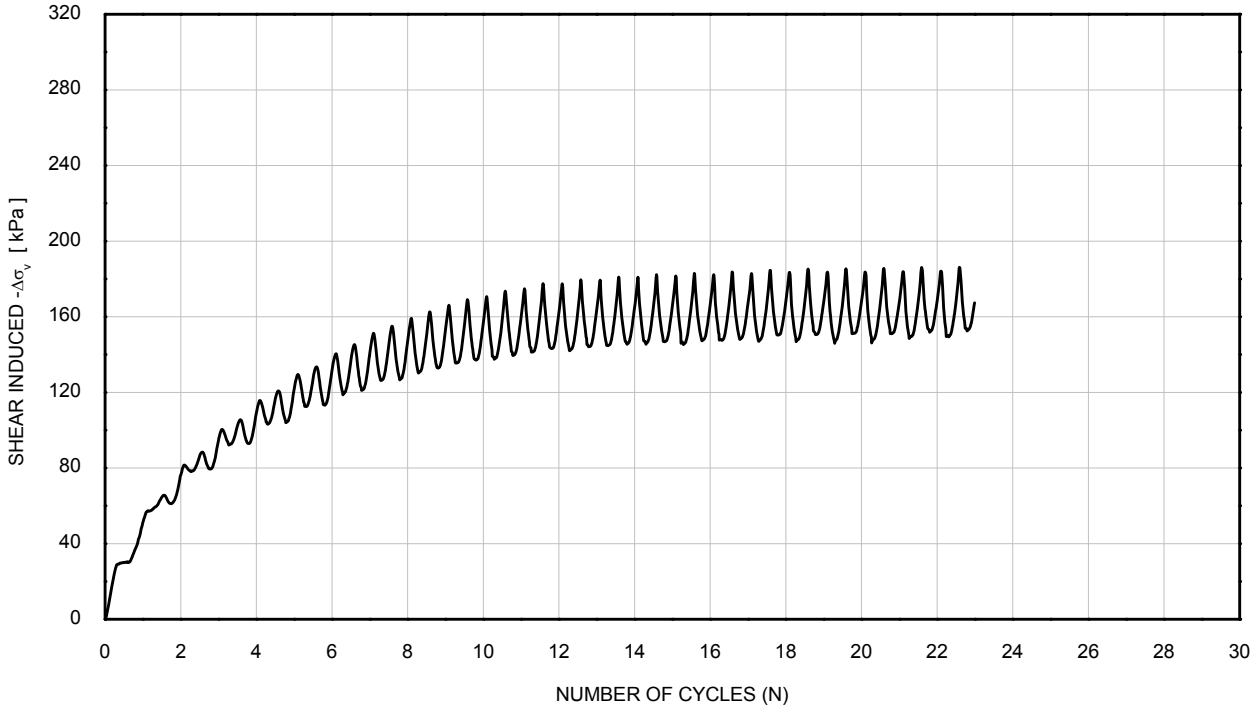
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

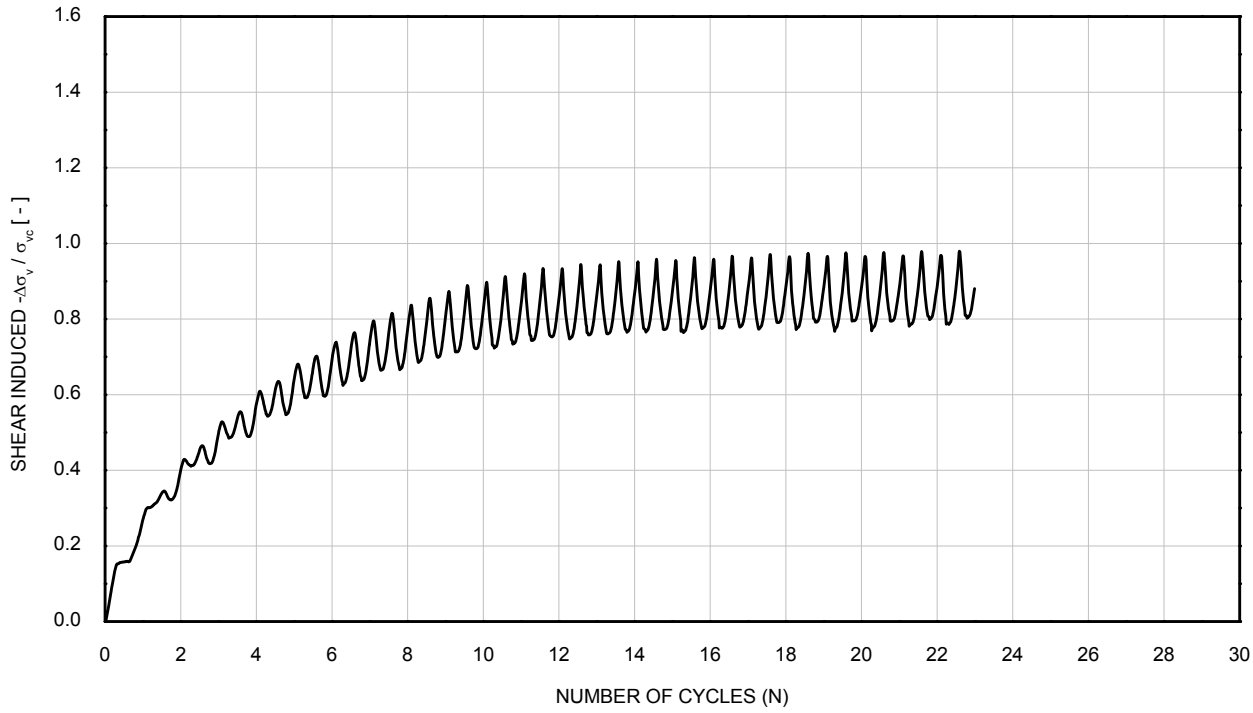




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	32 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

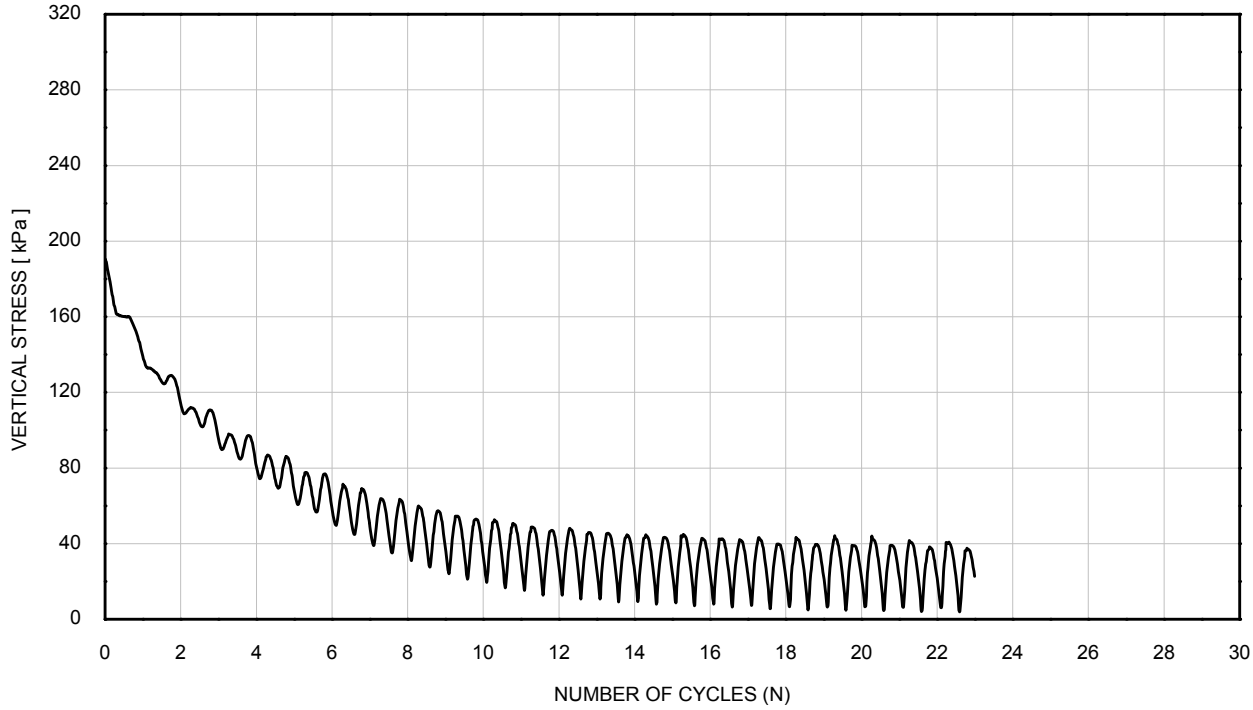
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

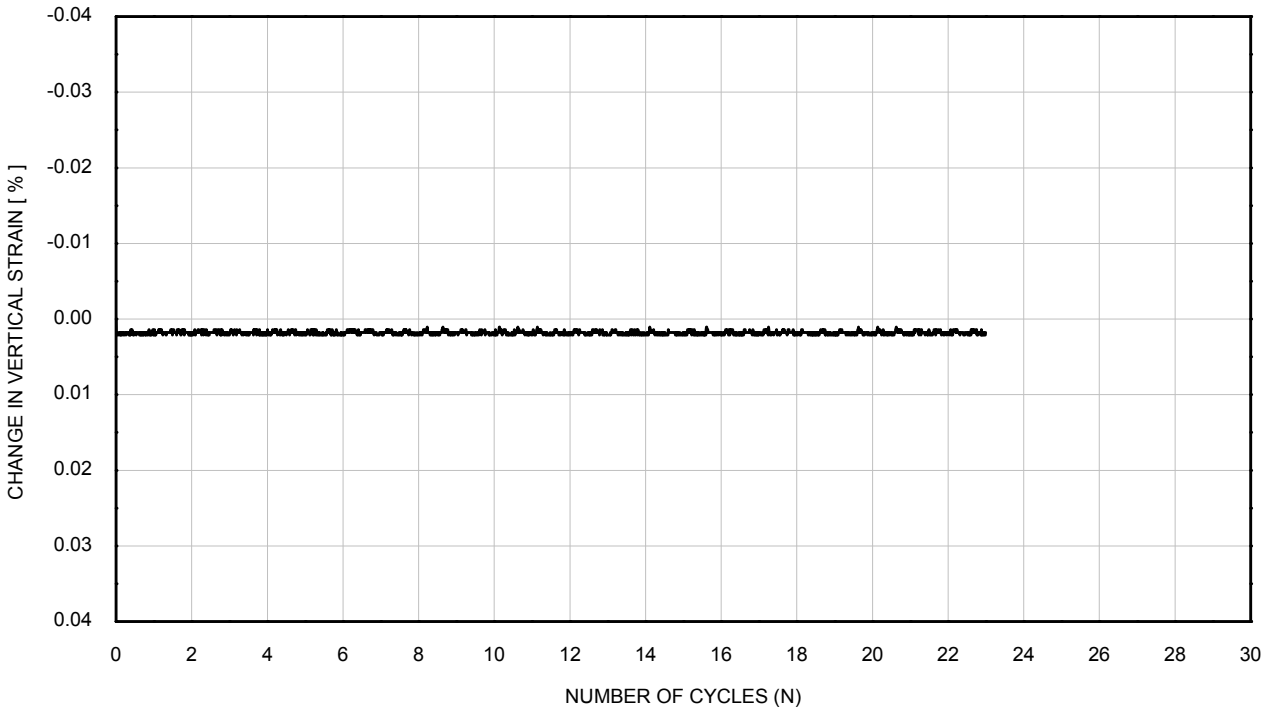




σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	: 40WaxC
Mean τ_{cy}	:	32 kPa	Depth [m]	: 24.03
Frequency	:	0.10 Hz	Test No.	: CSS23

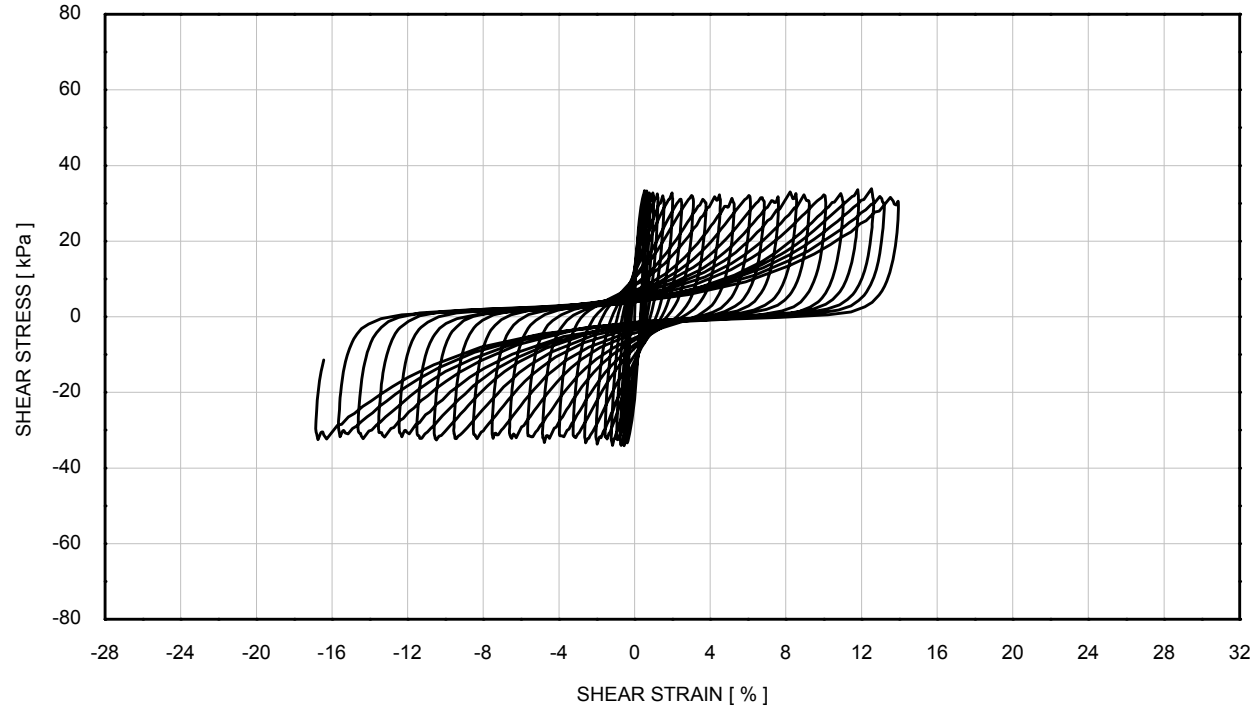
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

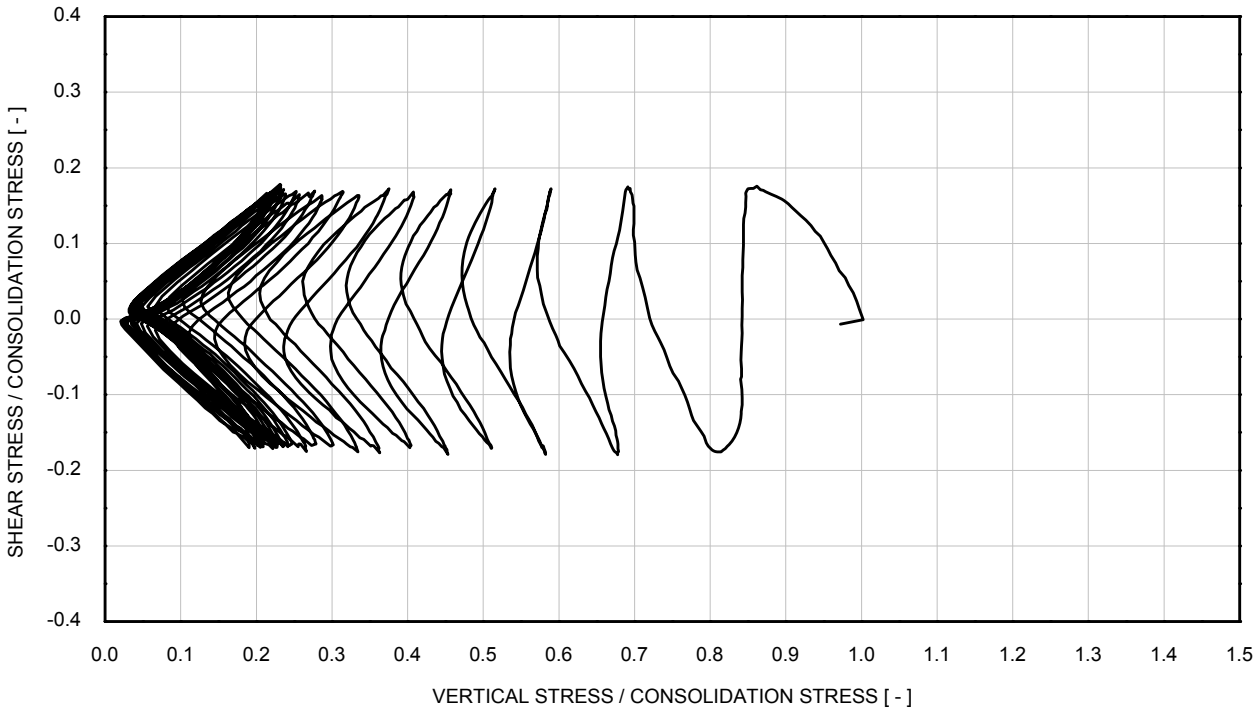




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	32 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

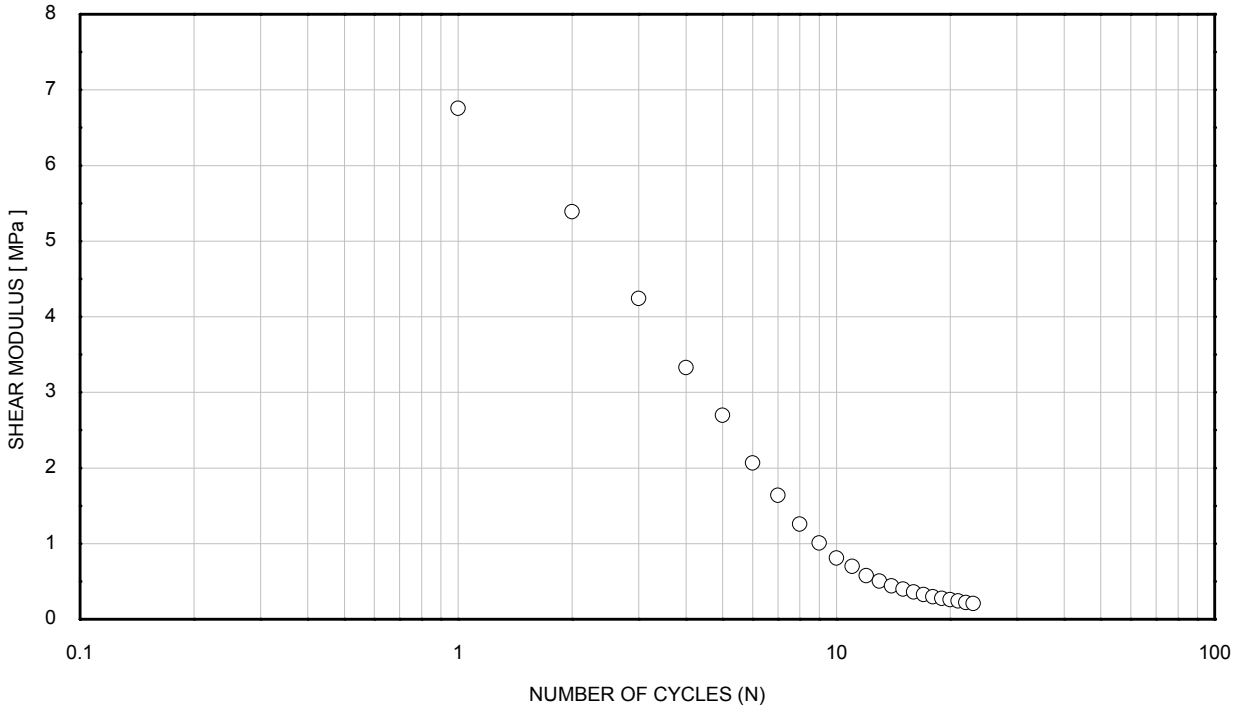
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

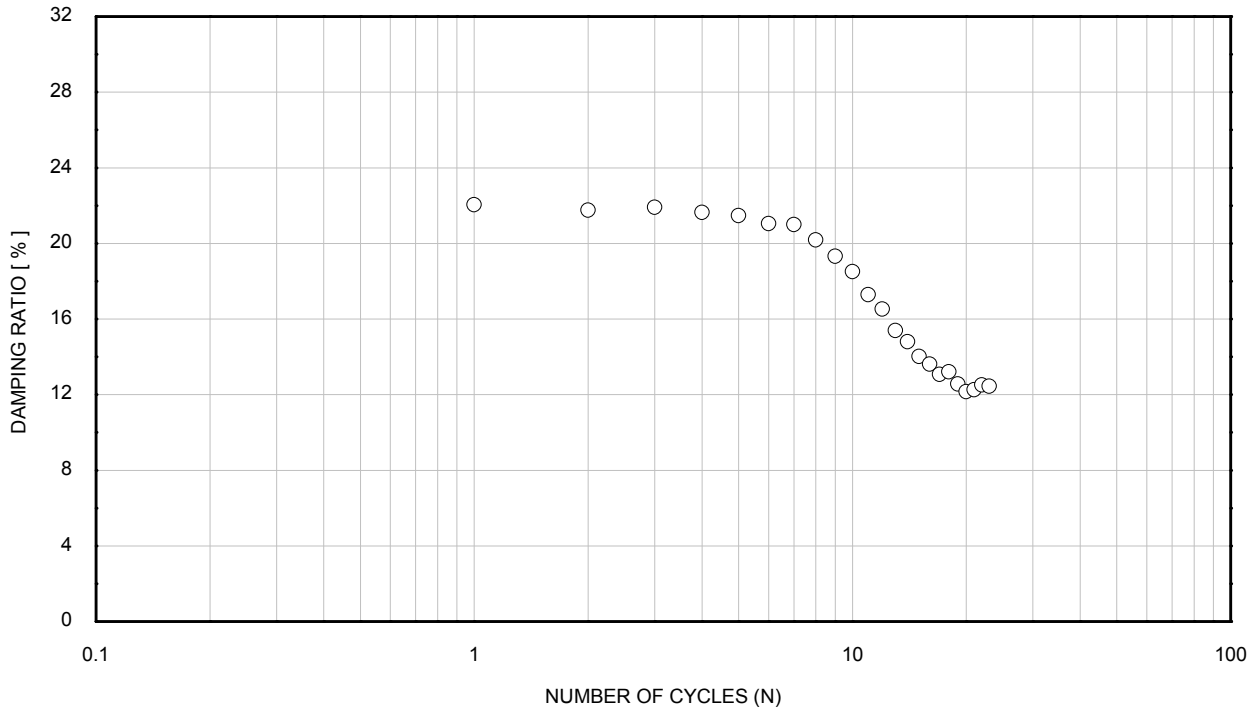




σ_{vc}	:	190 kPa	Borehole	: HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	: 40WaxC
Mean τ_{cy}	:	32 kPa	Depth [m]	: 24.03
Frequency	:	0.10 Hz	Test No.	: CSS23

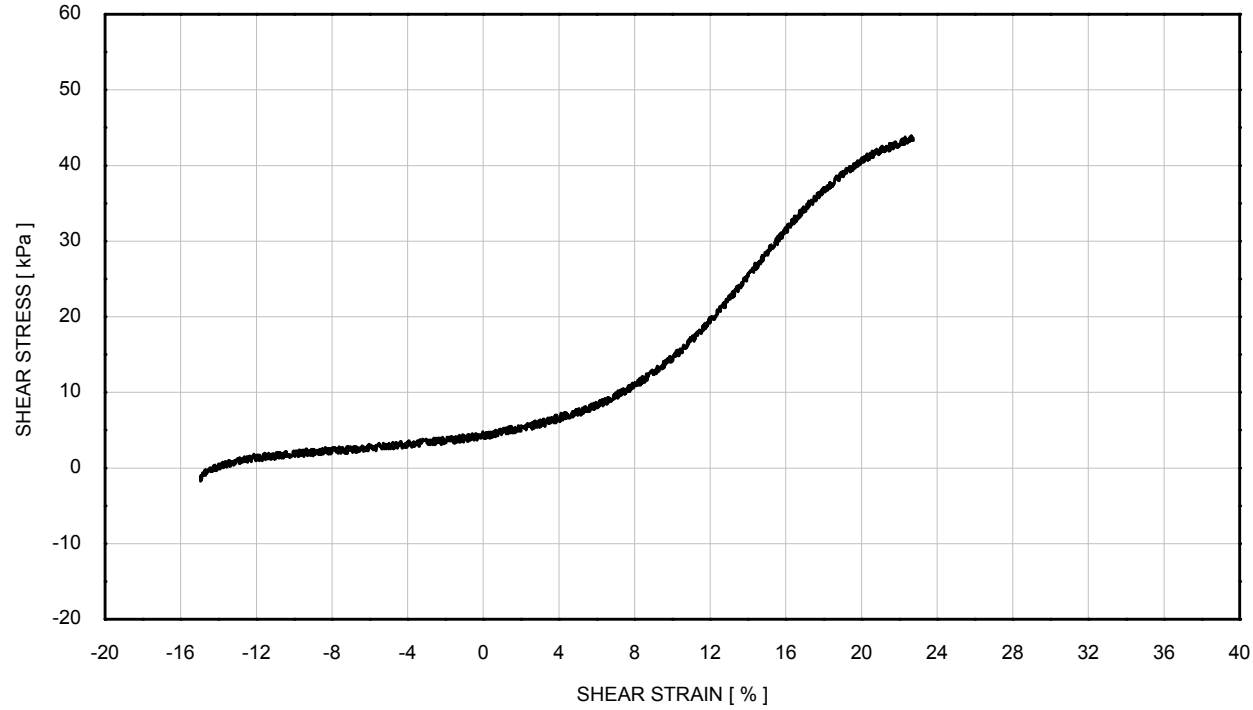
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

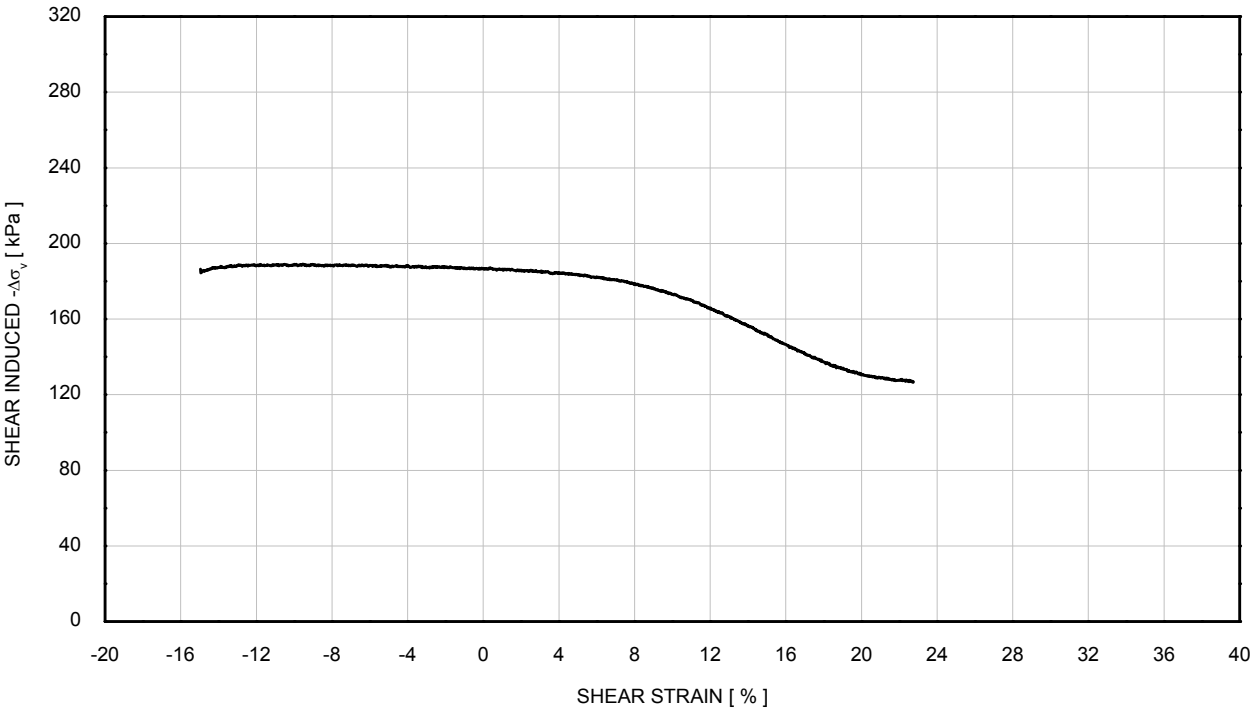




σ_{vc}	:	190 kPa	Borehole	:	HKZ2-BH08-SA
Mean τ_{av}	:	0 kPa	Sample	:	40WaxC
Mean τ_{cy}	:	32 kPa	Depth [m]	:	24.03
Frequency	:	0.10 Hz	Test No.	:	CSS23

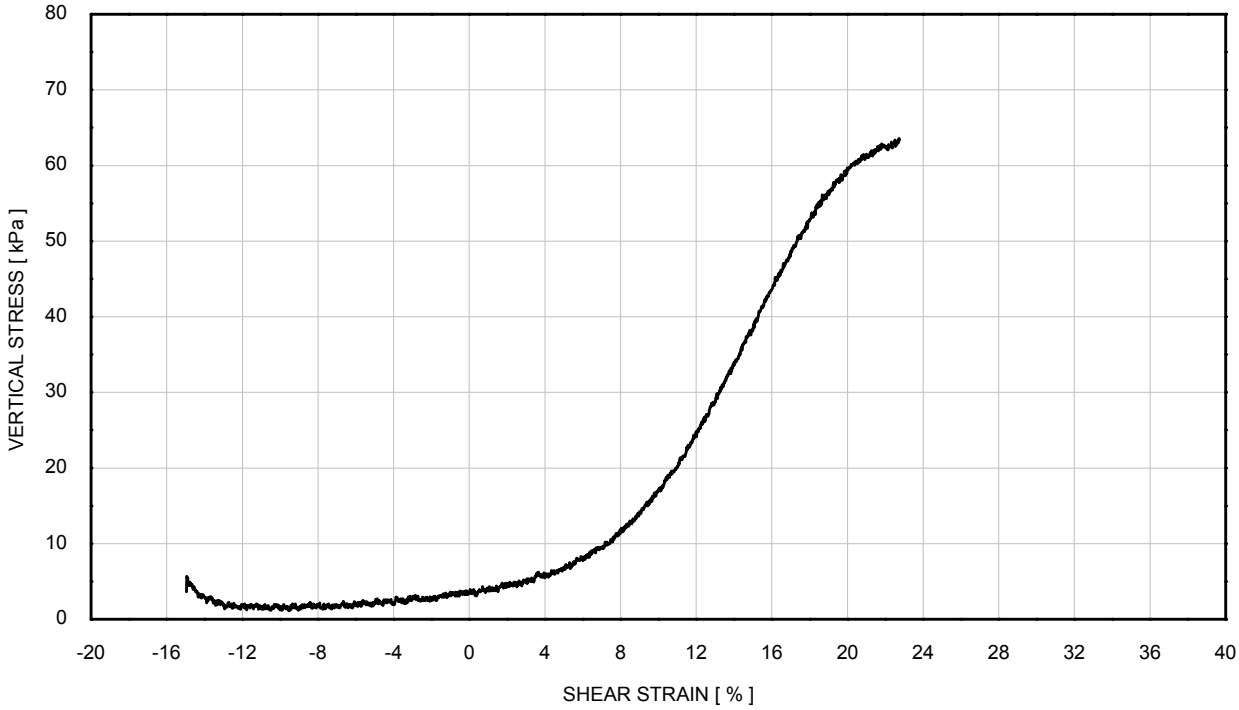
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

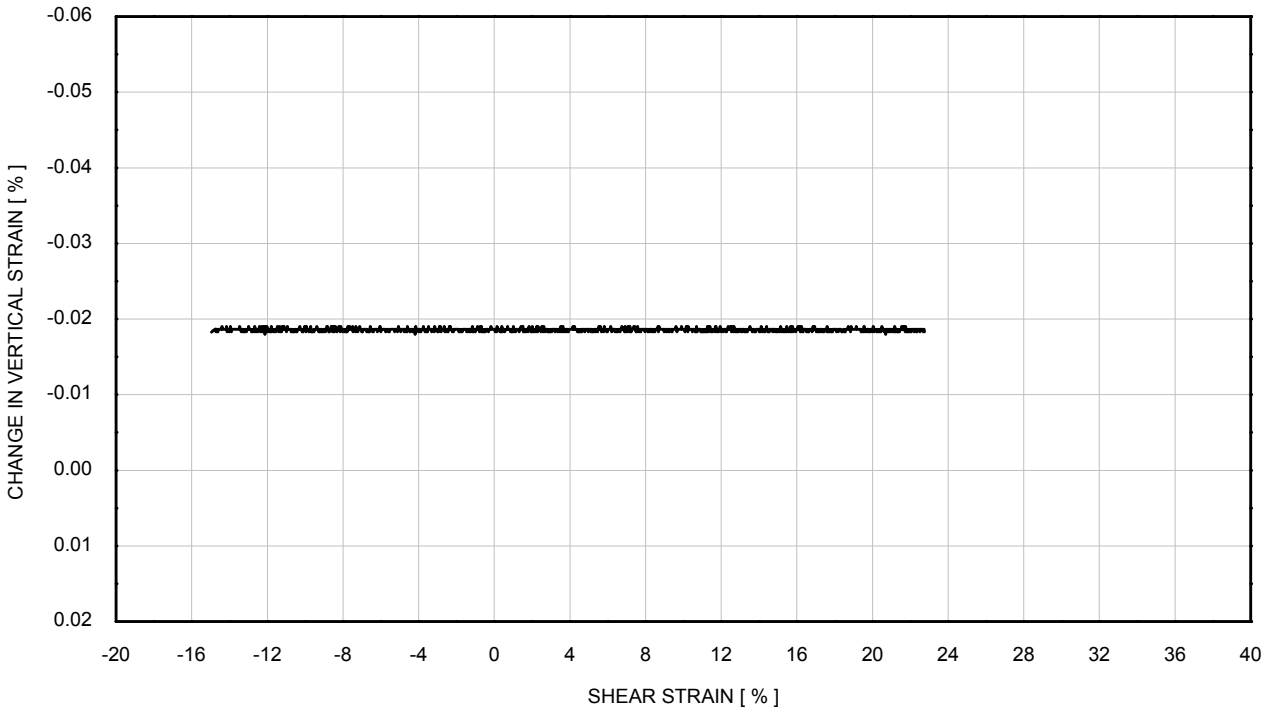




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 49 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 28.17 %	Depth [m]	: 24.03
Rate of strain	: 1.88 %/hour	Test No.	: CSS23

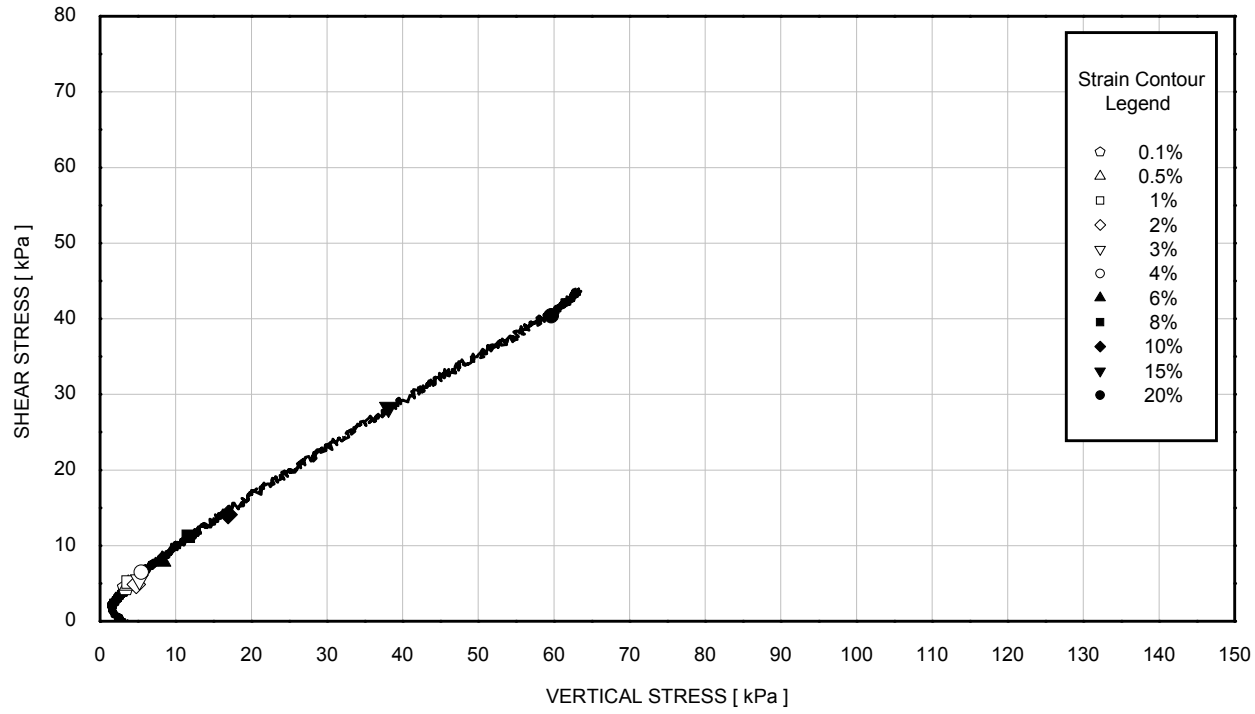
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

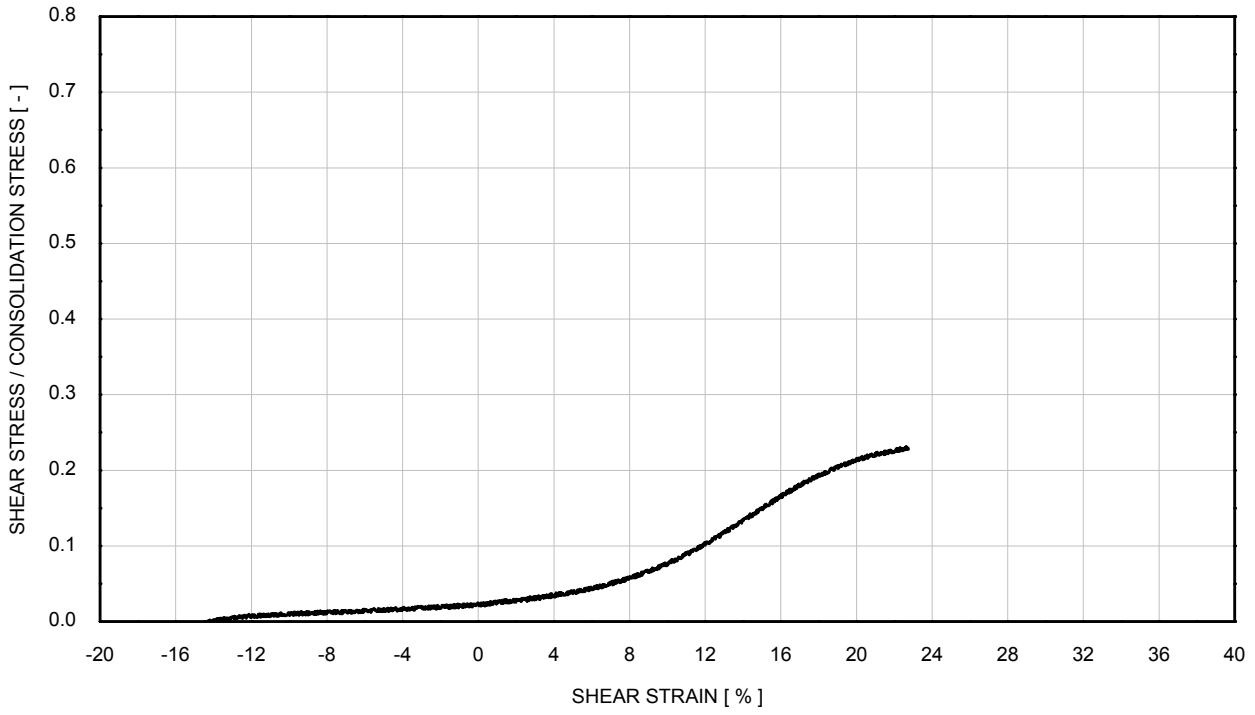




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 49 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 28.17 %	Depth [m]	: 24.03
Rate of strain	: 1.88 %/hour	Test No.	: CSS23

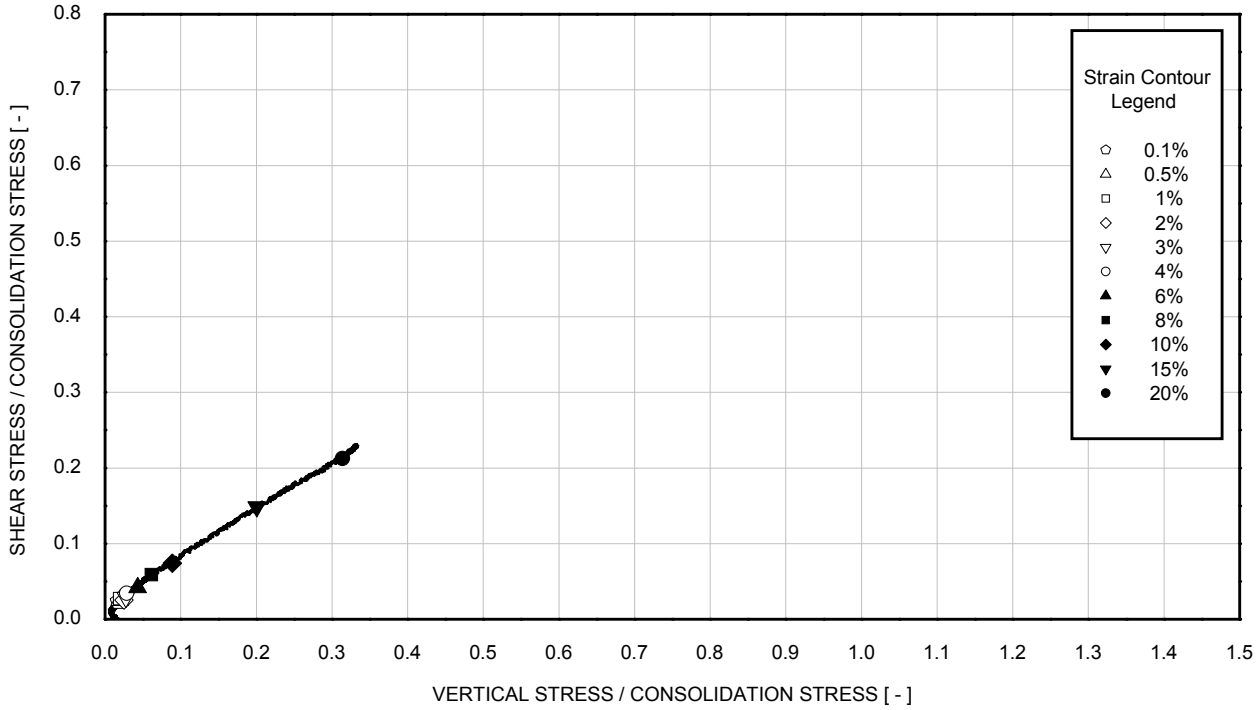
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

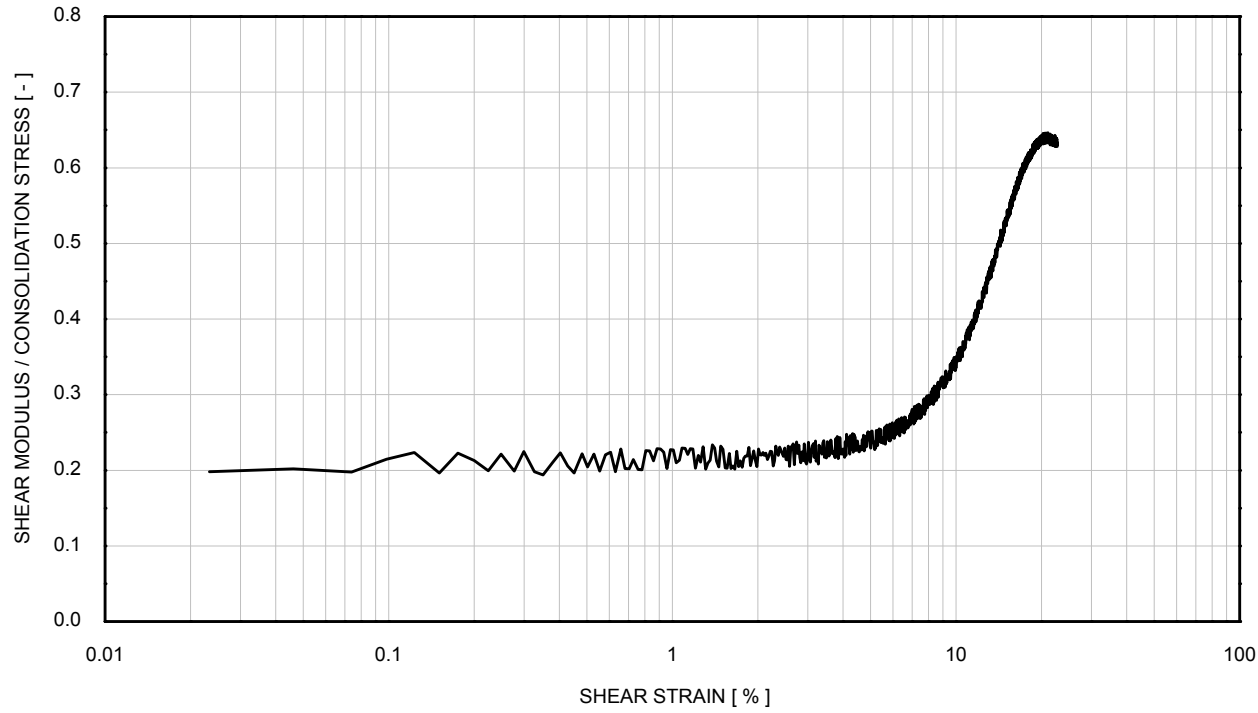




σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 49 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 28.17 %	Depth [m]	: 24.03
Rate of strain	: 1.88 %/hour	Test No.	: CSS23

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 190 kPa	Borehole	: HKZ2-BH08-SA
τ_{peak}	: 49 kPa	Sample	: 40WaxC
γ at τ_{peak}	: 28.17 %	Depth [m]	: 24.03
Rate of strain	: 1.88 %/hour	Test No.	: CSS23

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive grey fine to medium SAND

GENERAL	
Date test started	15/11/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	10.3
Bulk density after compaction	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation after compaction	[%]	45
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	23.0
Bulk density at start of test	[Mg/m³]	2.02
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 2_CSS01
Template issue	1.4
Processed by Date	JLS 23/11/2016
Checked by Date	PH 25/11/2016
Approved by Date	DT 12/01/2017

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-1
Unit	Unit A (Southern Bight)
Test number	CSS01

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	20
Vertical strain	[%]	0.75
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.598
Water content	[%]	22.6

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	20
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	1
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	0.85
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.66
Void ratio	[-]	0.597

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.52	0.03	3.34	25.54
2	-0.55	0.02	4.93	17.32
5	-0.57	0.02	6.40	11.42
10	-0.58	0.02	6.82	6.81
20	-0.60	0.02	6.82	7.77
50	-0.62	0.01	7.47	5.42
100	-0.65	0.02	6.92	5.53
200	-0.66	0.01	8.52	2.83
300	-0.67	0.01	7.65	2.29
400	-0.67	0.01	7.86	3.51

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-1
Unit	Unit A (Southern Bight)
Test number	CSS01

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	12
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1208
γ_{av} at N_f	[%]	15.05
γ_{cy} at N_f	[%]	11.78
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	9
Vertical strain	[%]	0.00

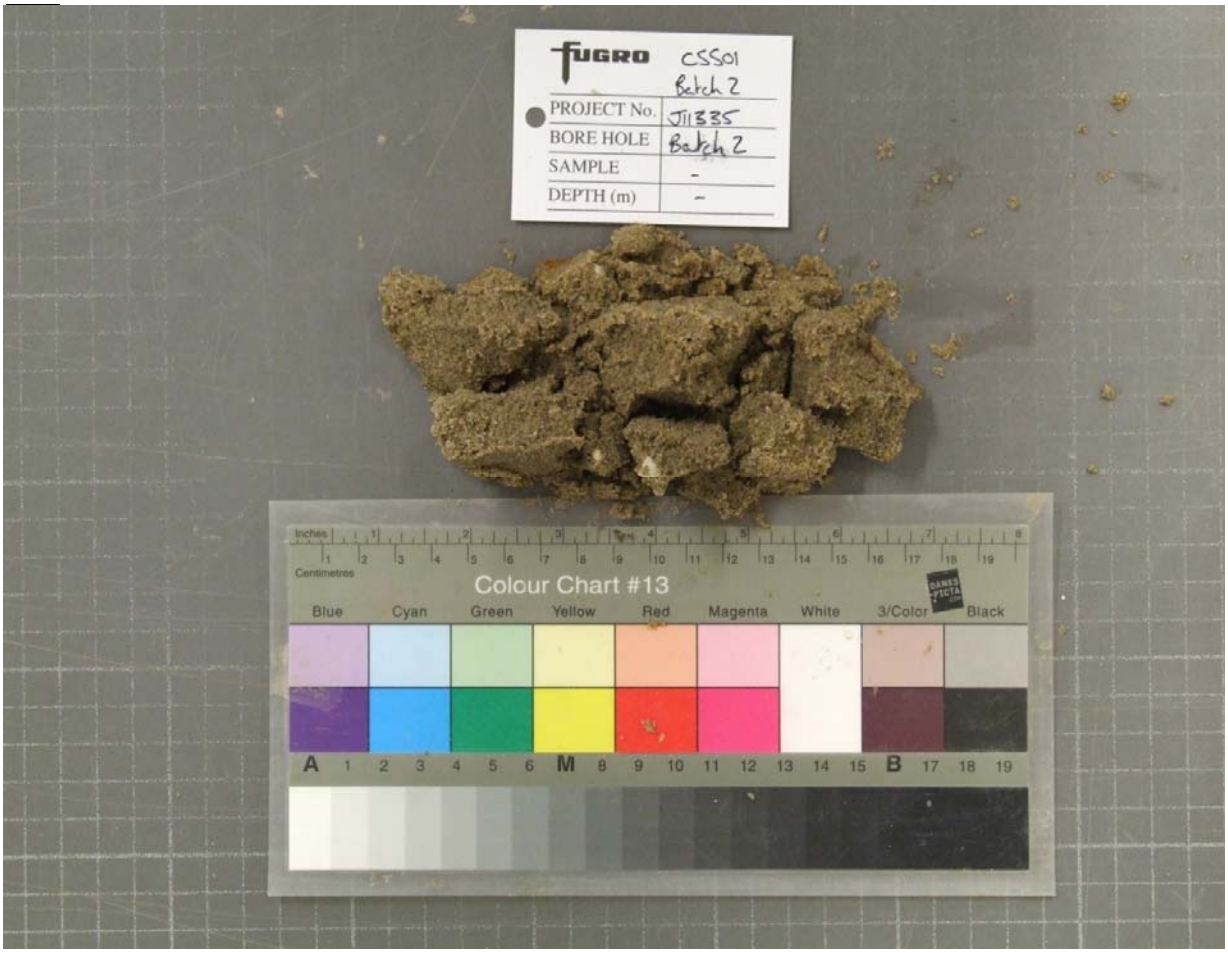
Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-5.92	6.80	0.18	17.25
2	-6.16	7.39	0.16	12.99
5	-6.02	8.50	0.14	10.93
10	-5.41	9.85	0.12	9.58
20	-4.48	10.85	0.11	8.56
30	-3.76	11.43	0.10	8.51
40	-3.13	11.42	0.10	8.84
50	-2.79	11.81	0.10	7.99
100	-0.94	12.67	0.09	7.54
500	7.10	13.48	0.09	6.97
1000	12.64	12.11	0.10	7.77
1208	15.05	11.78	0.10	7.67

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	199
Shear strain	[%]	40.78
Shear induced $-\Delta\sigma_v$	[kPa]	-283
Vertical stress	[kPa]	303
Vertical strain	[%]	0.02
Rate of strain	[%/hour]	2.96
At 15 % shear strain		
Shear stress	[kPa]	-
Shear induced $-\Delta\sigma_v$	[kPa]	-
Vertical stress	[kPa]	-
Vertical strain	[%]	-

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-1
Unit	Unit A (Southern Bight)
Test number	CSS01

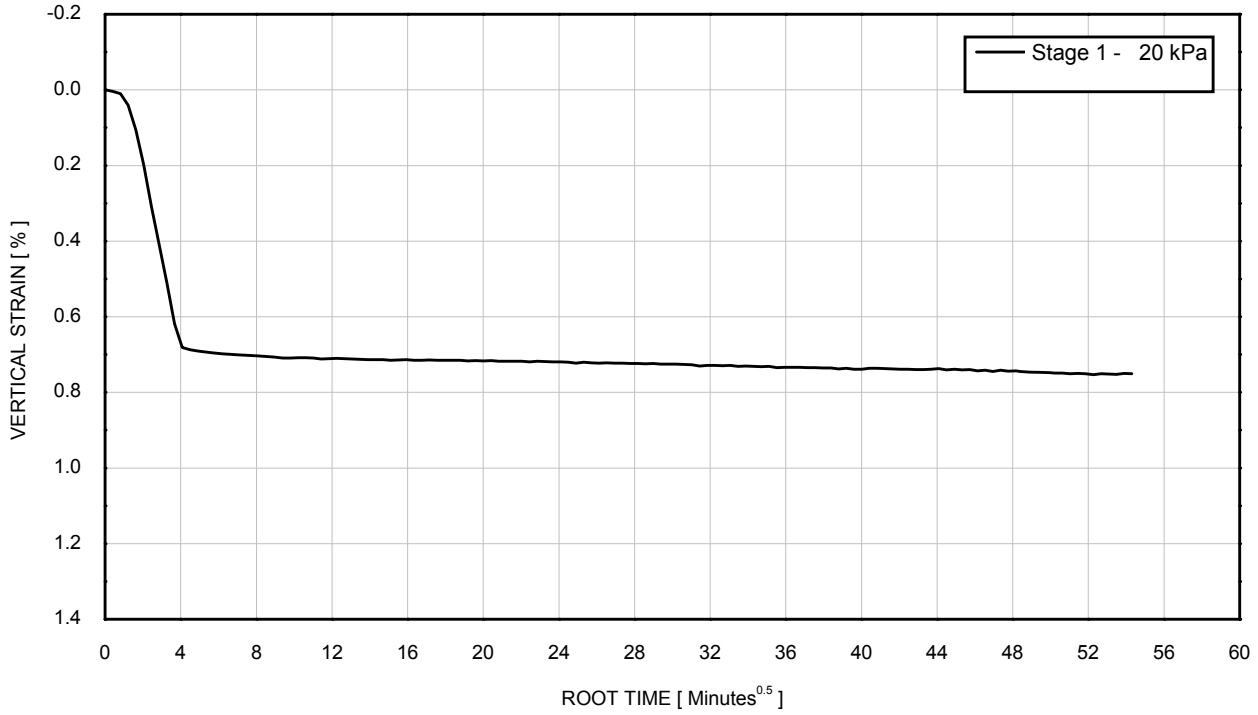
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

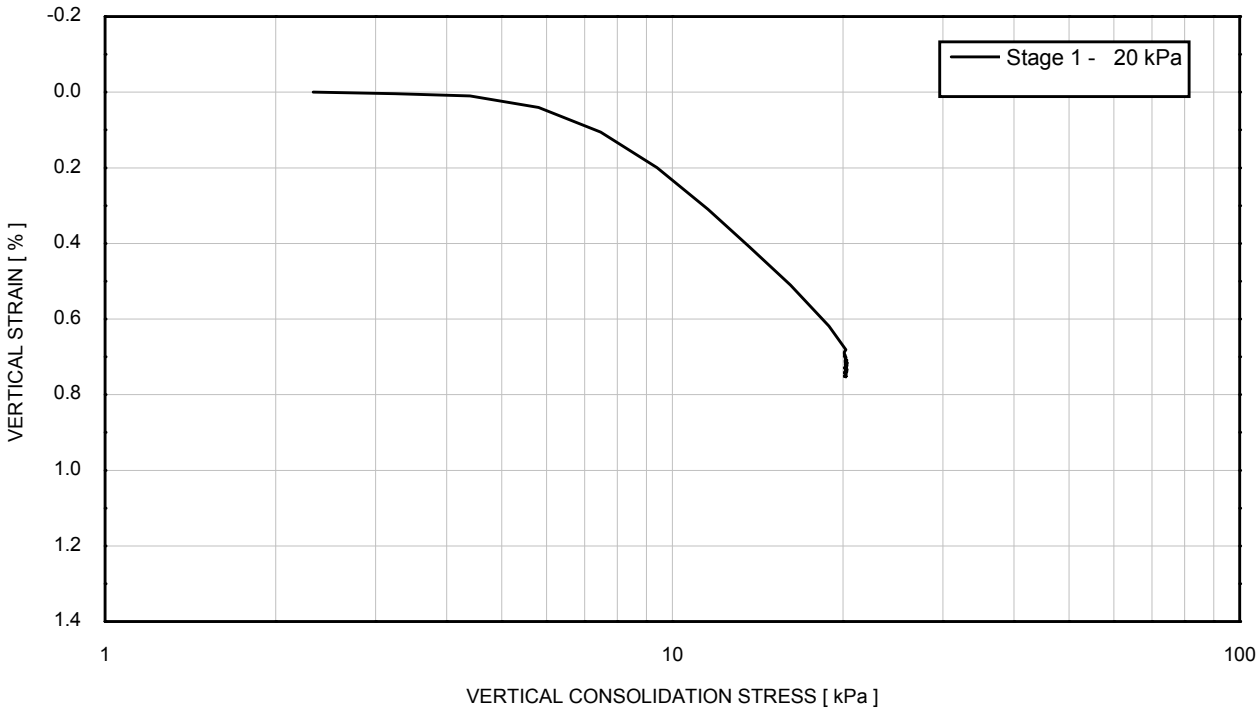
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-1
Unit	Unit A (Southern Bight)
Test number	CSS01

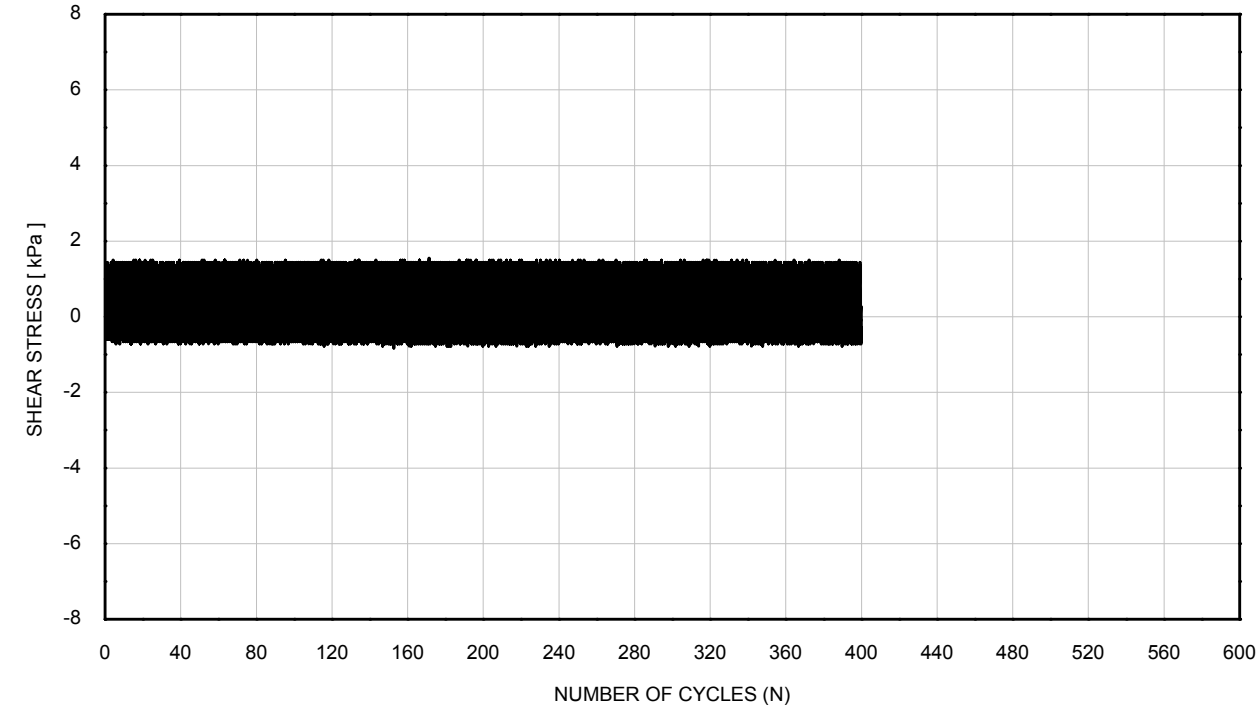
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

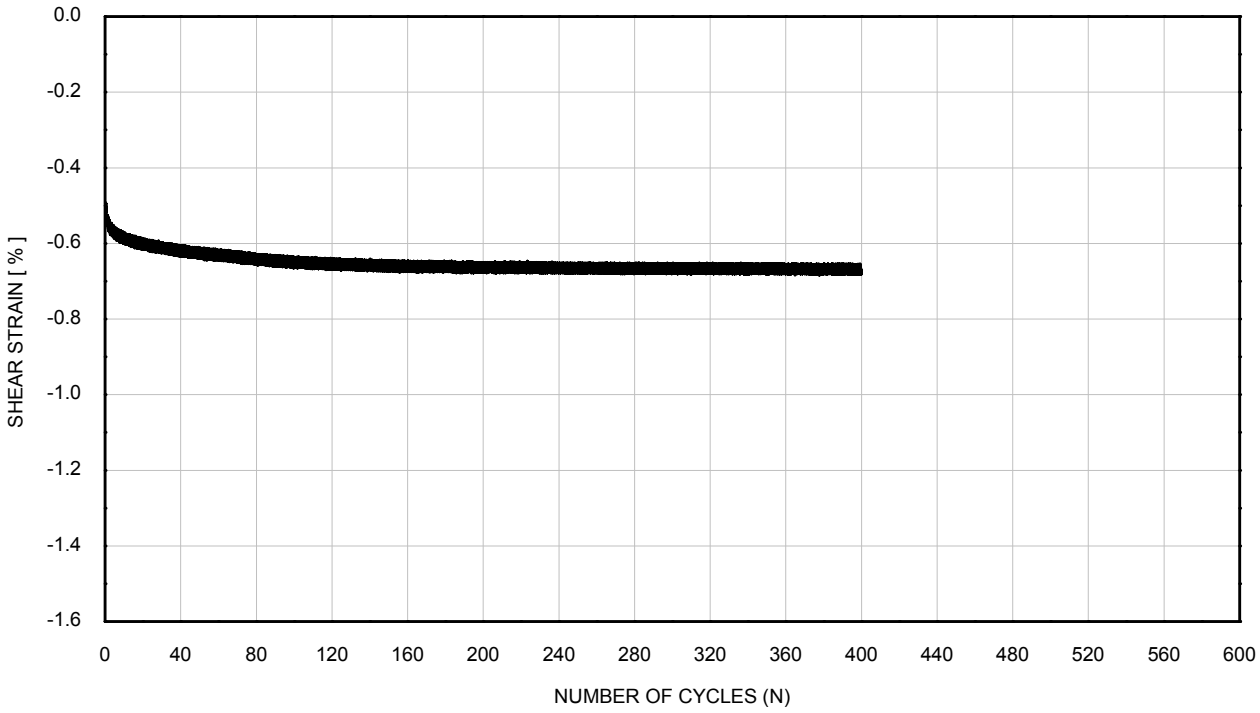




σ_{vc}	: 20 kPa	Batch	: 2
		Sample	: CSS_2-1
		Unit	: Unit A (Southern Bight)
		Test No.	: CSS01

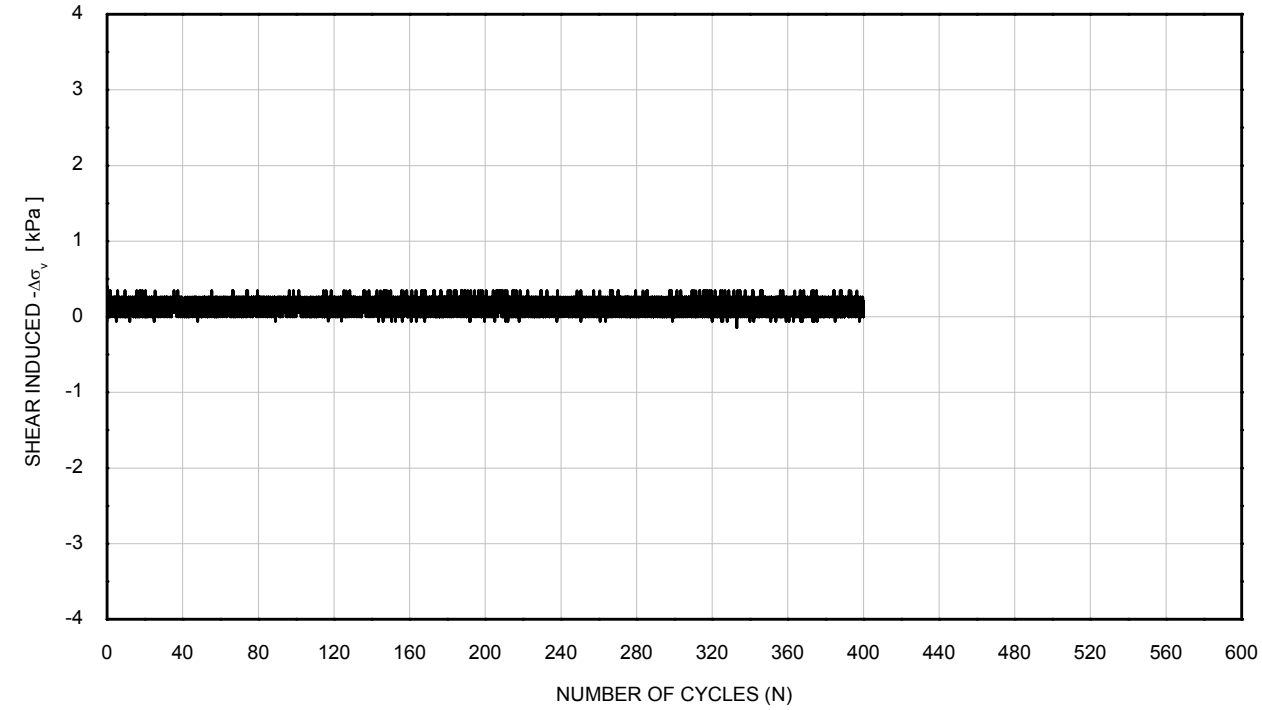
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

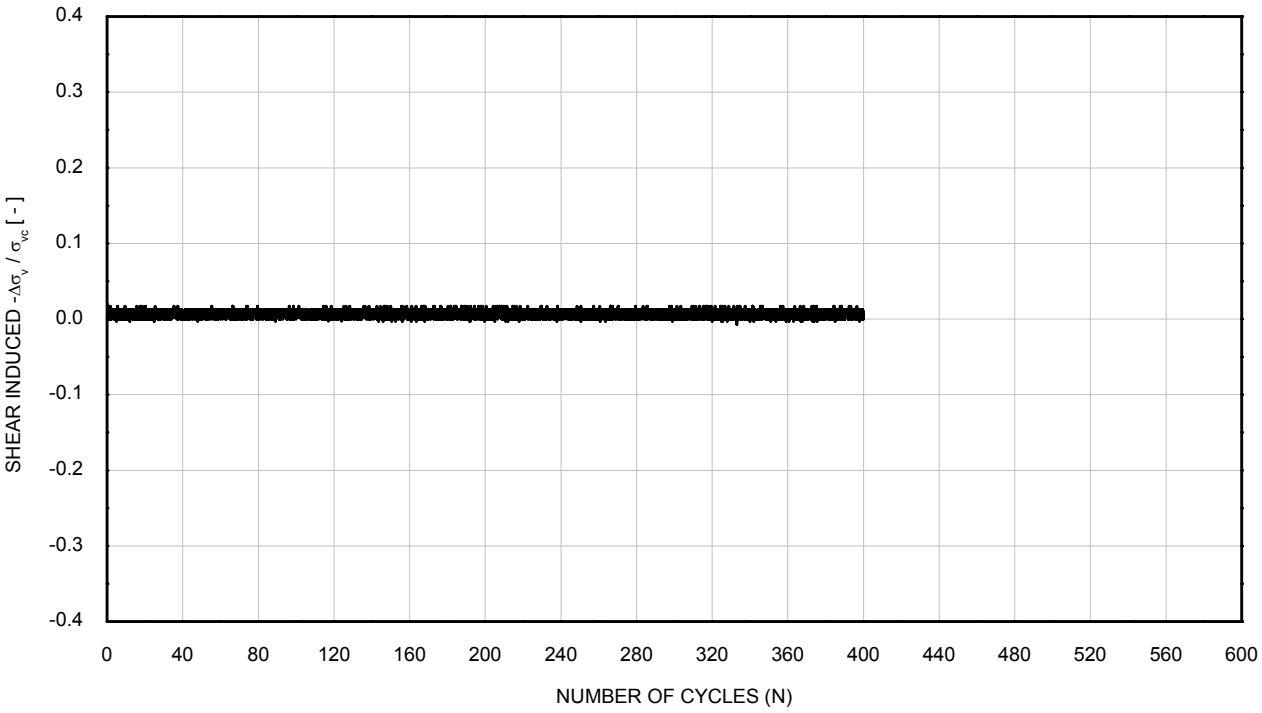




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

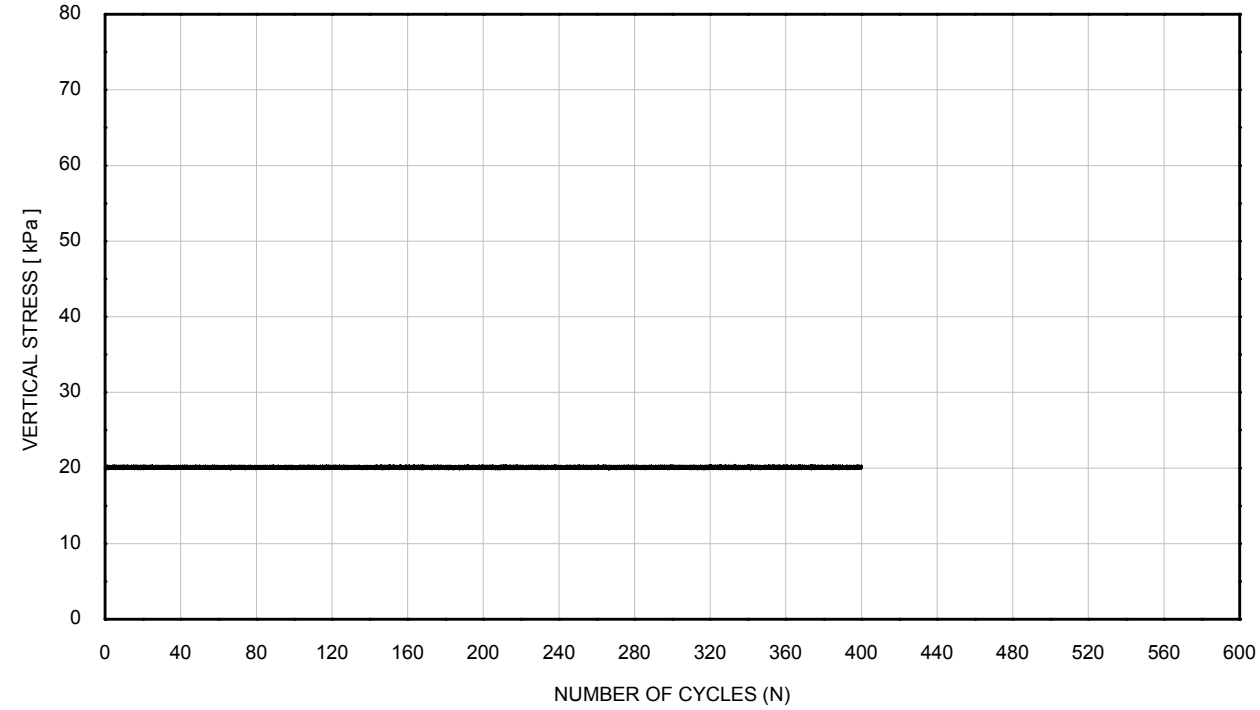
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

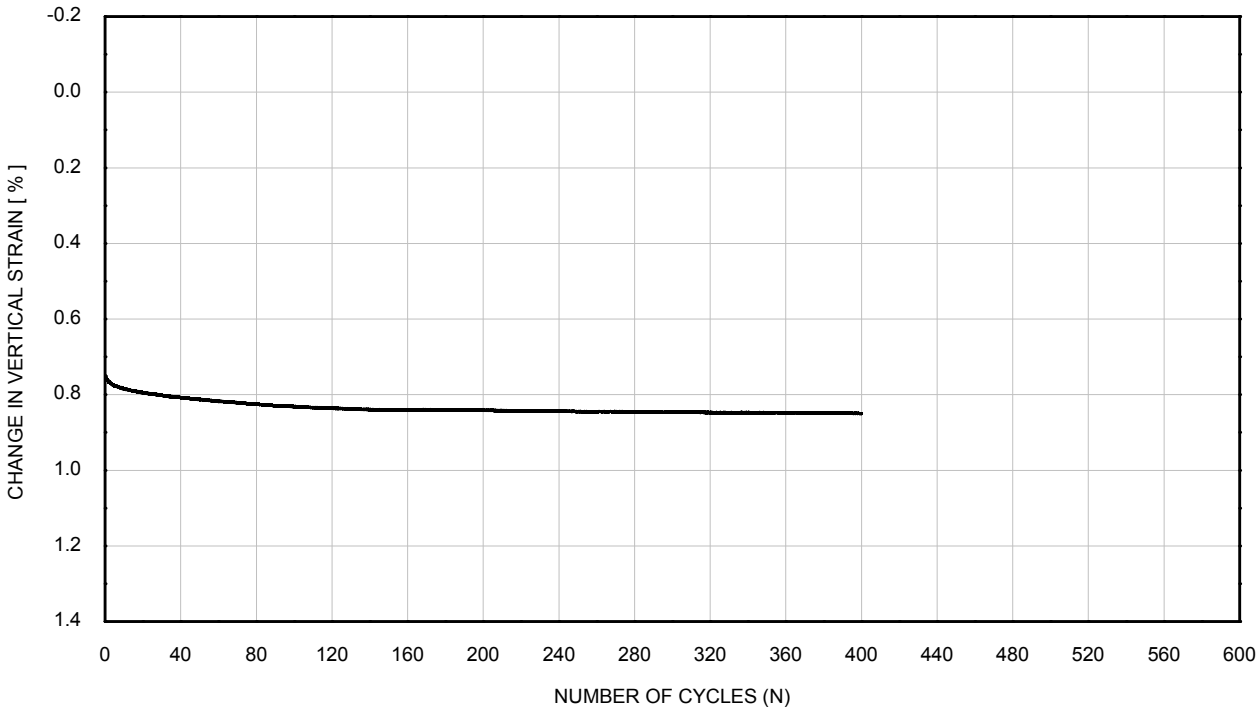




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

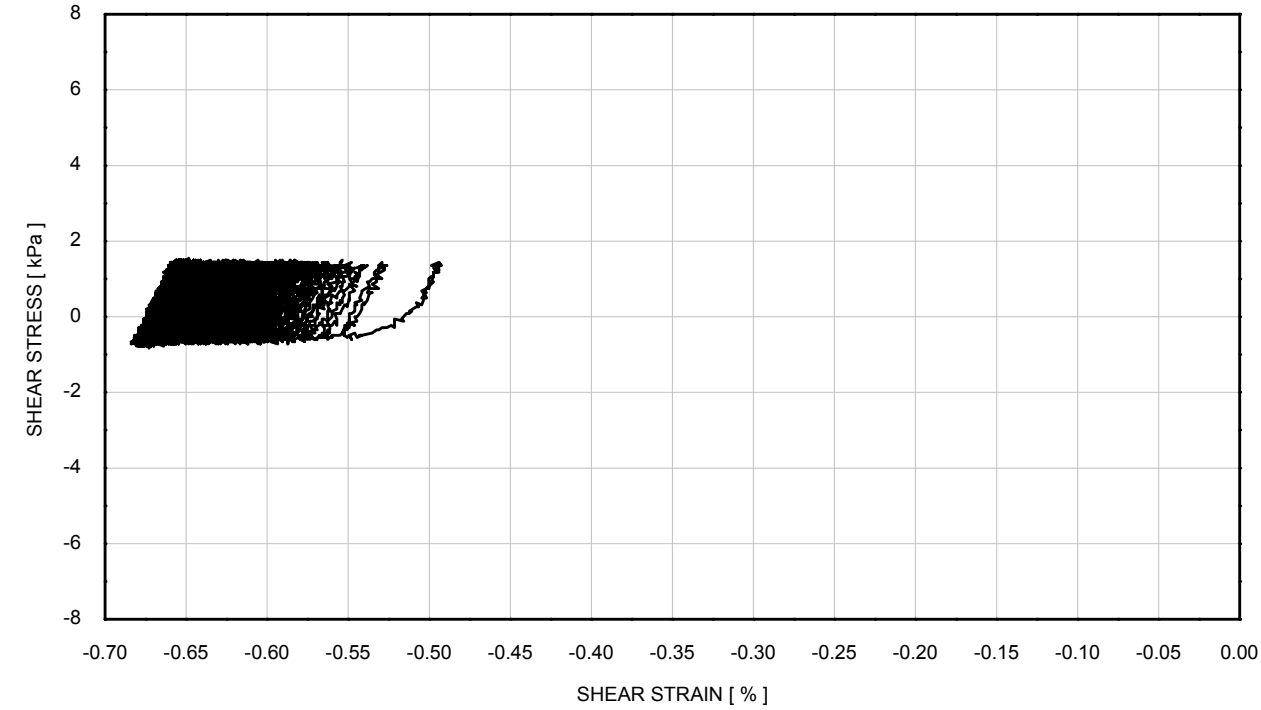
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

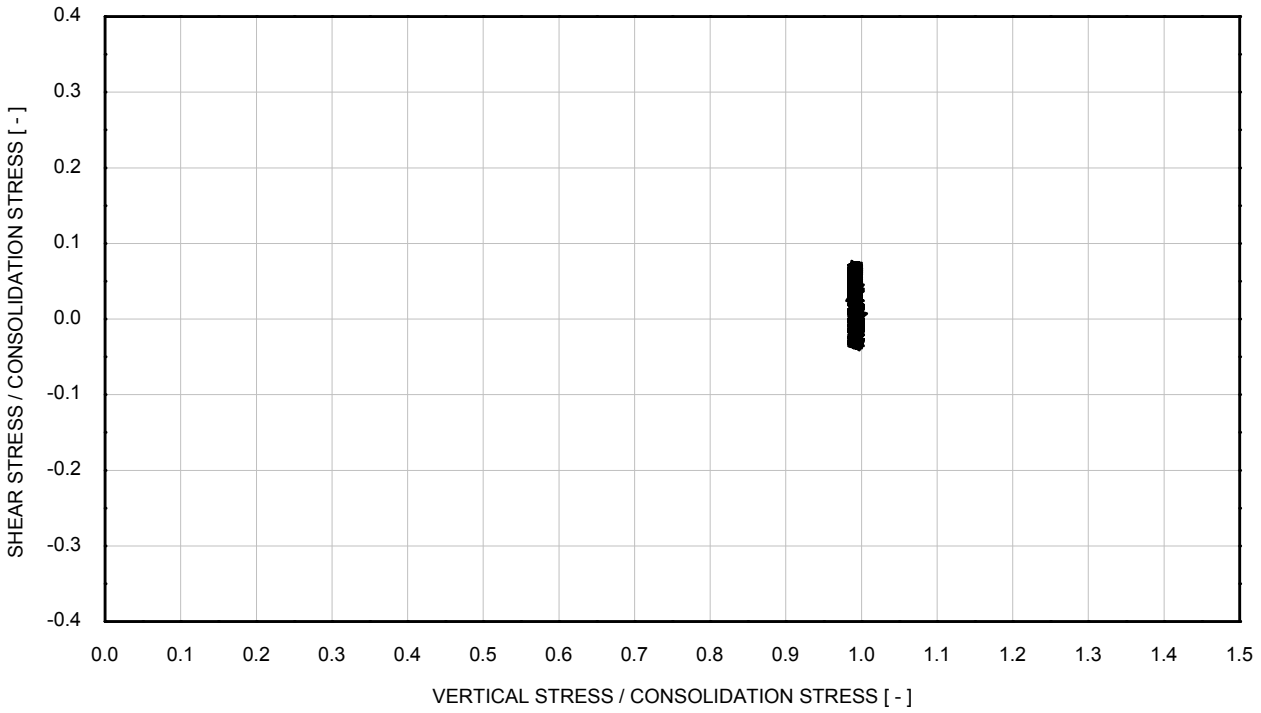




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

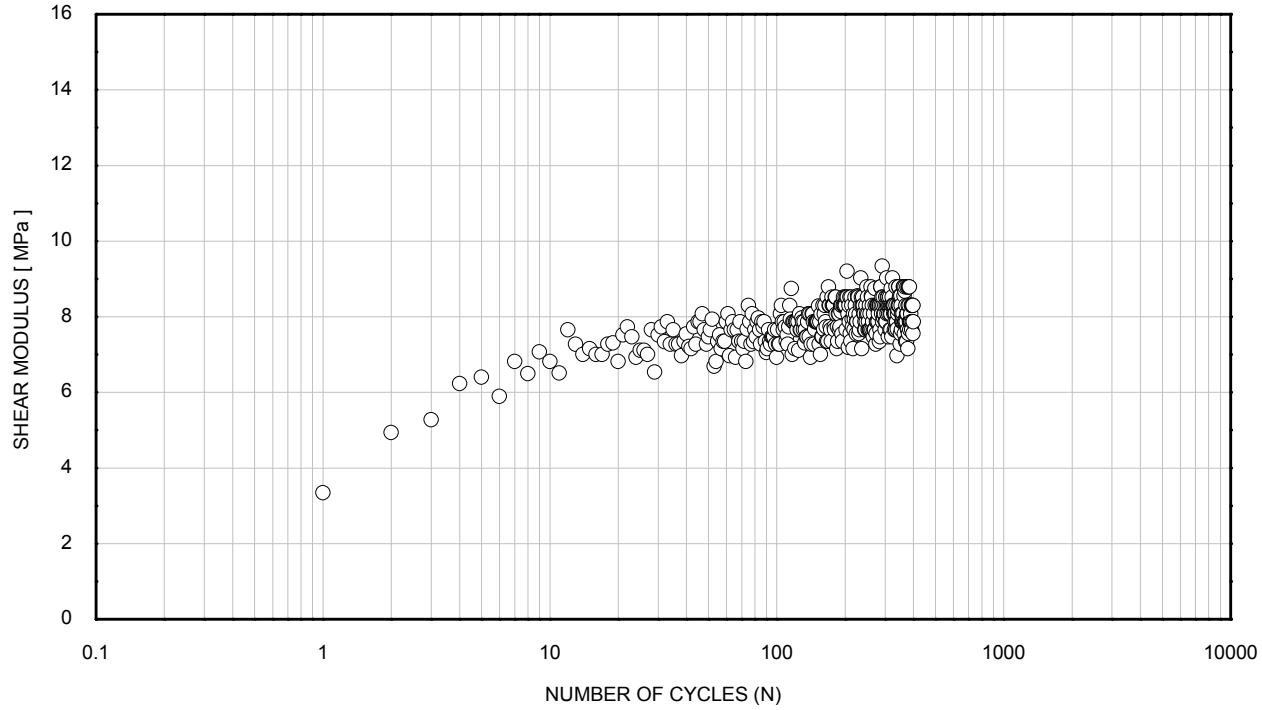
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

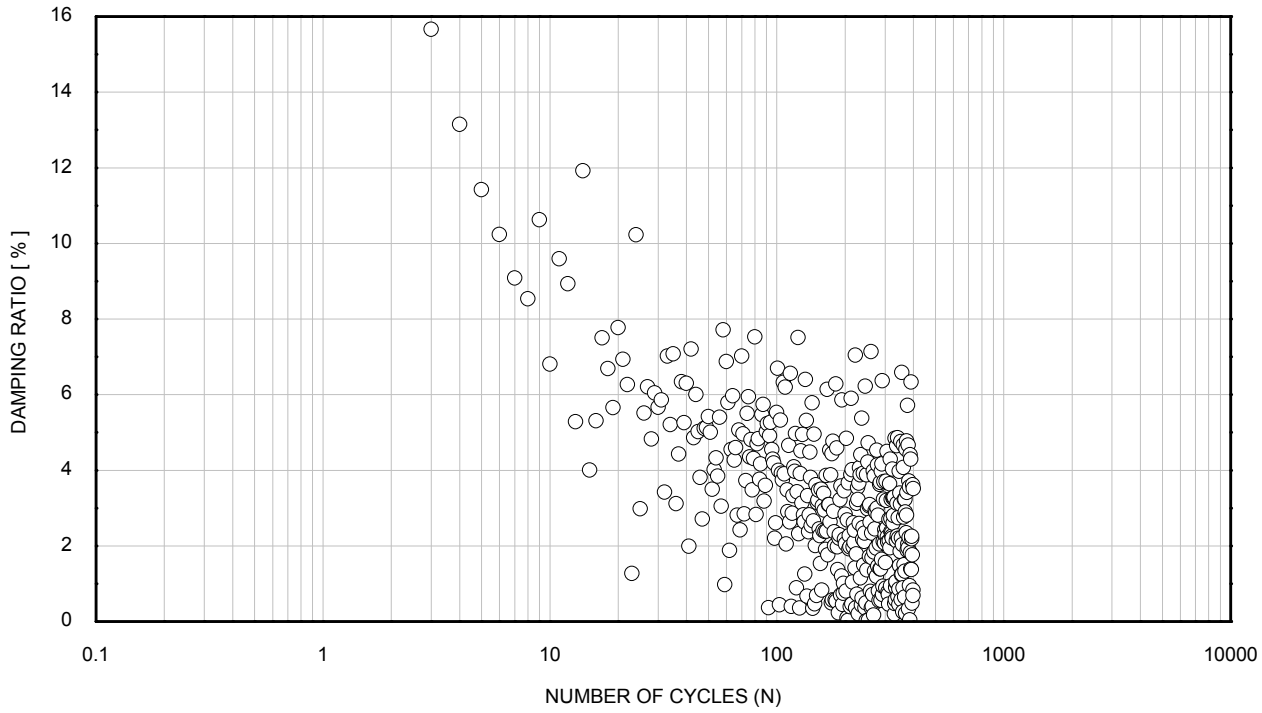




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

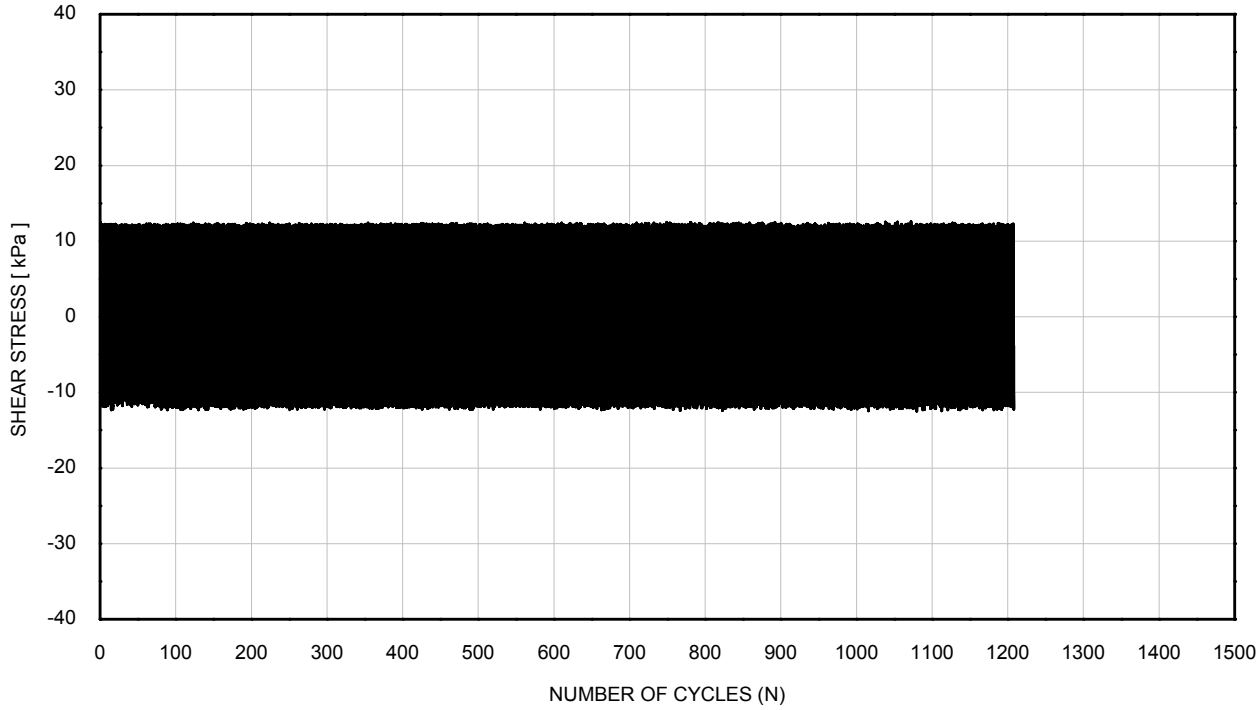
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

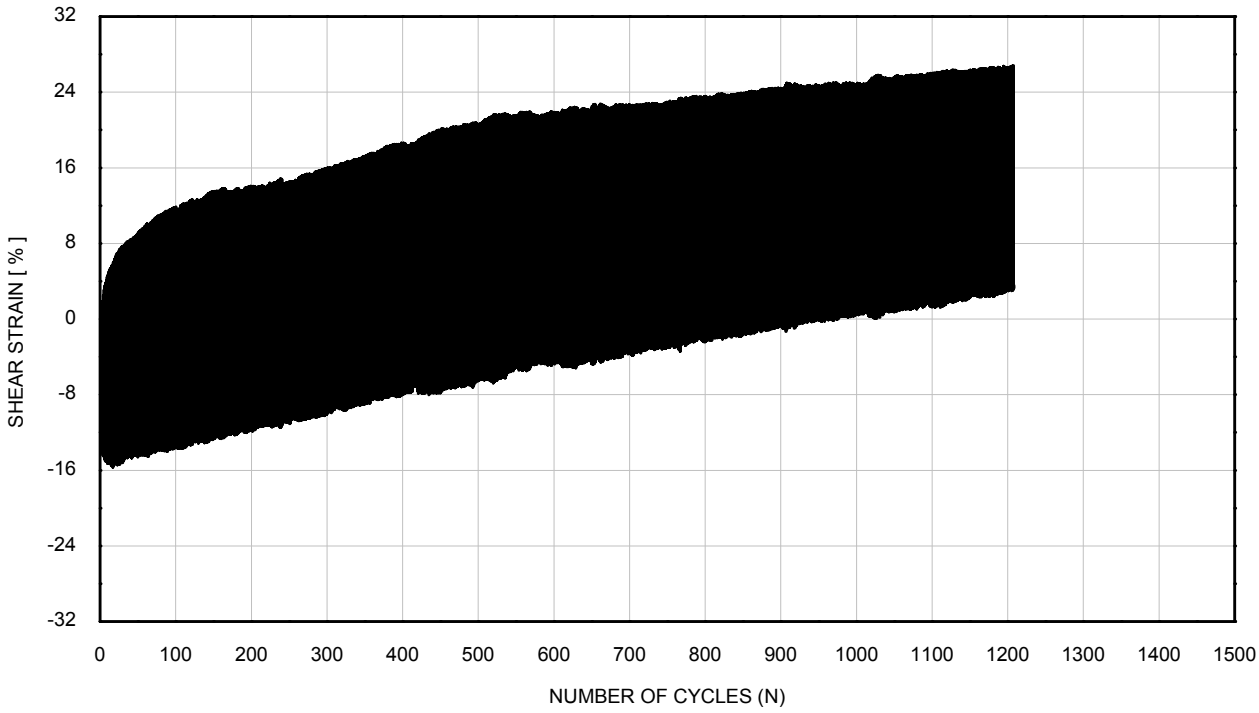




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

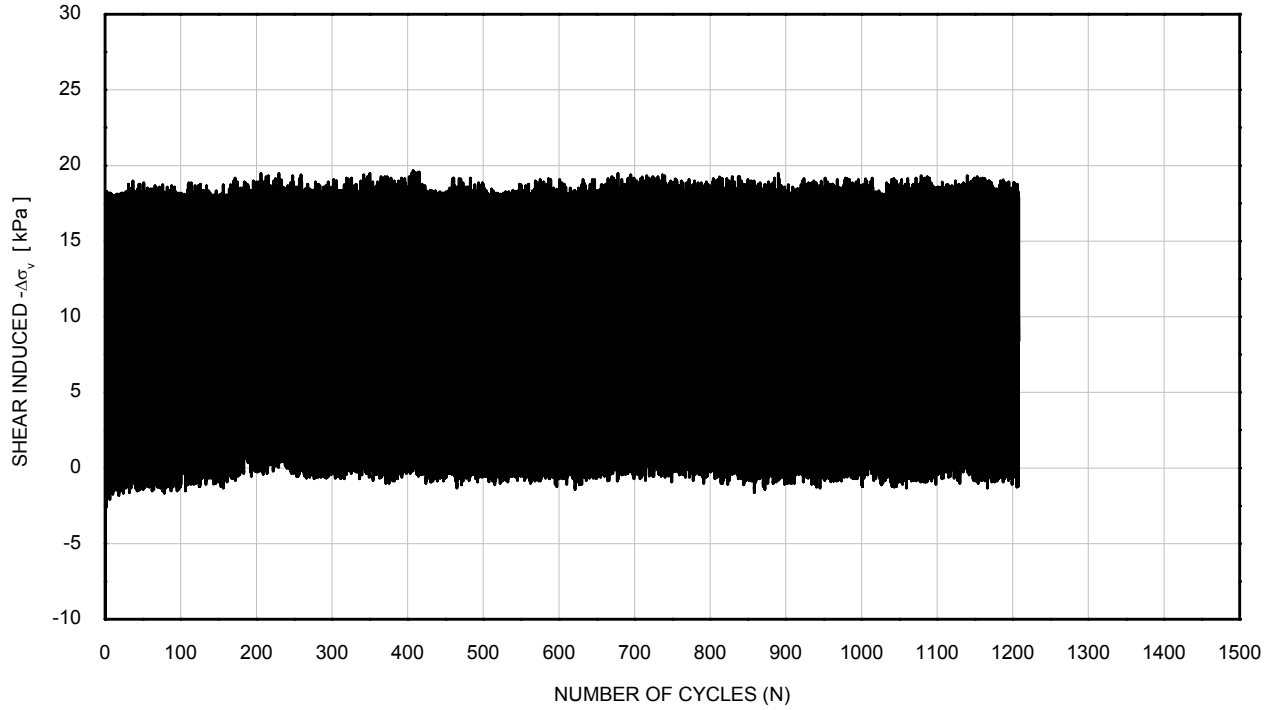
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

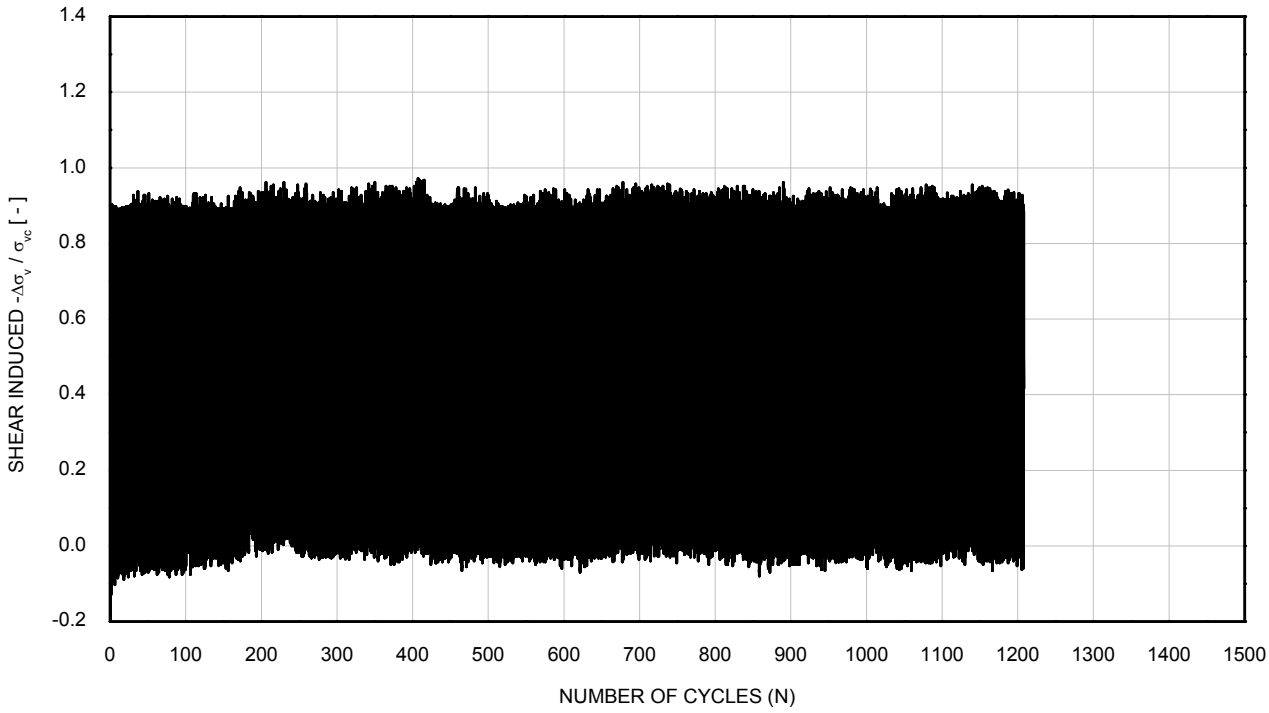




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	12 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

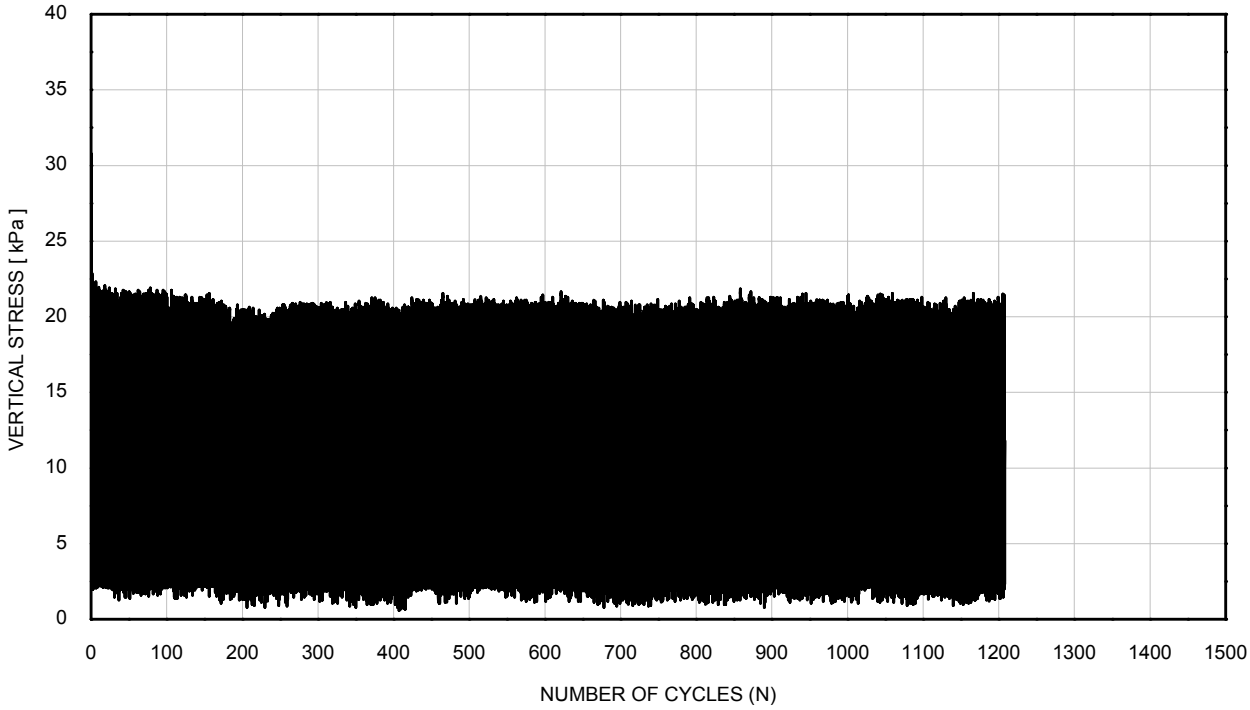
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

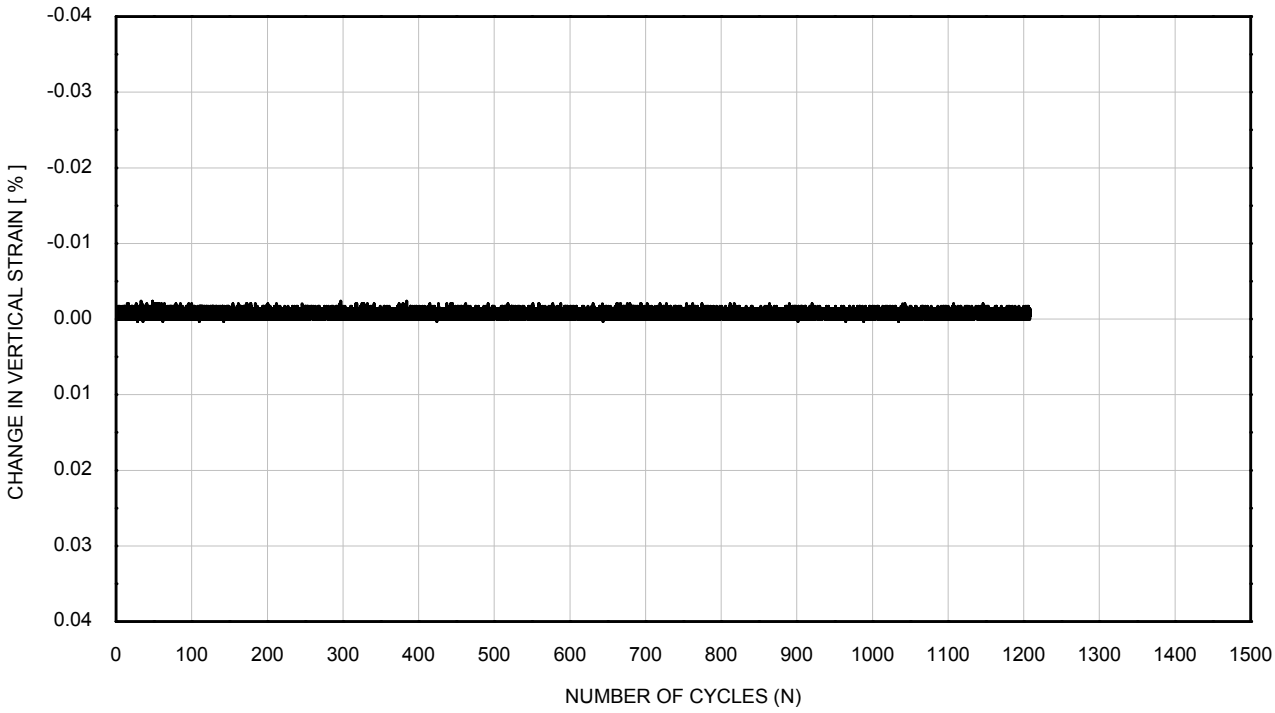




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	12 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

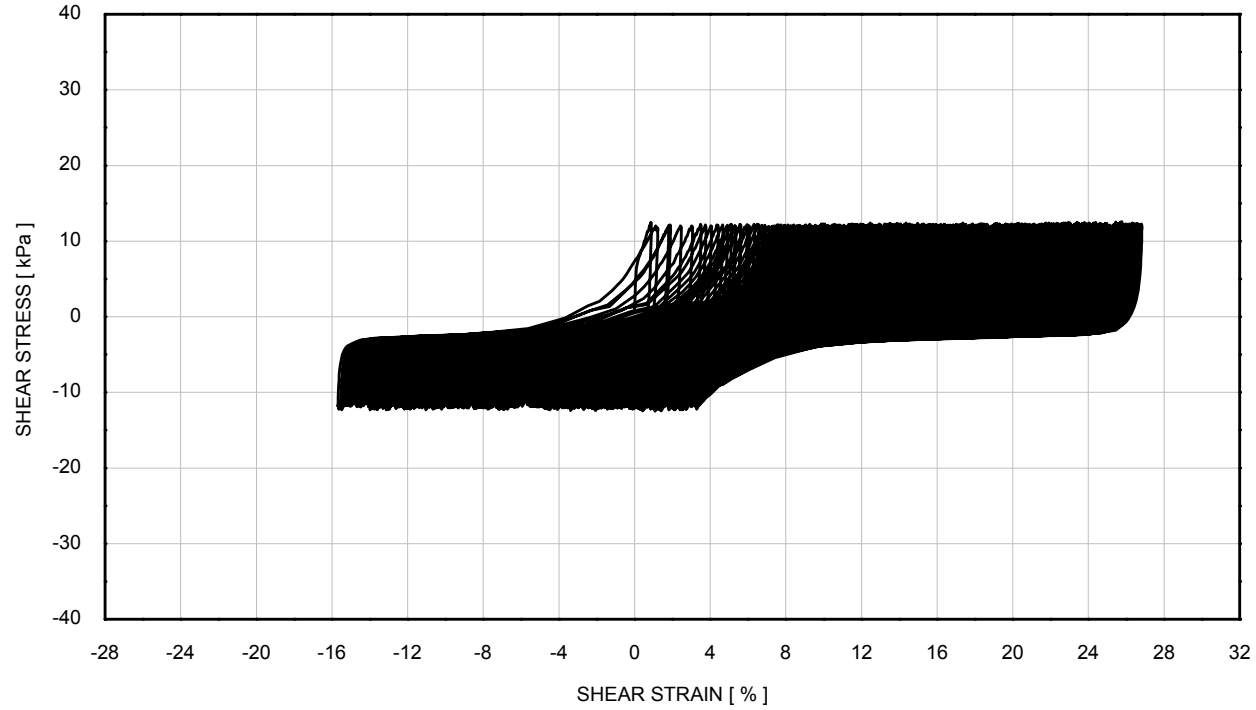
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

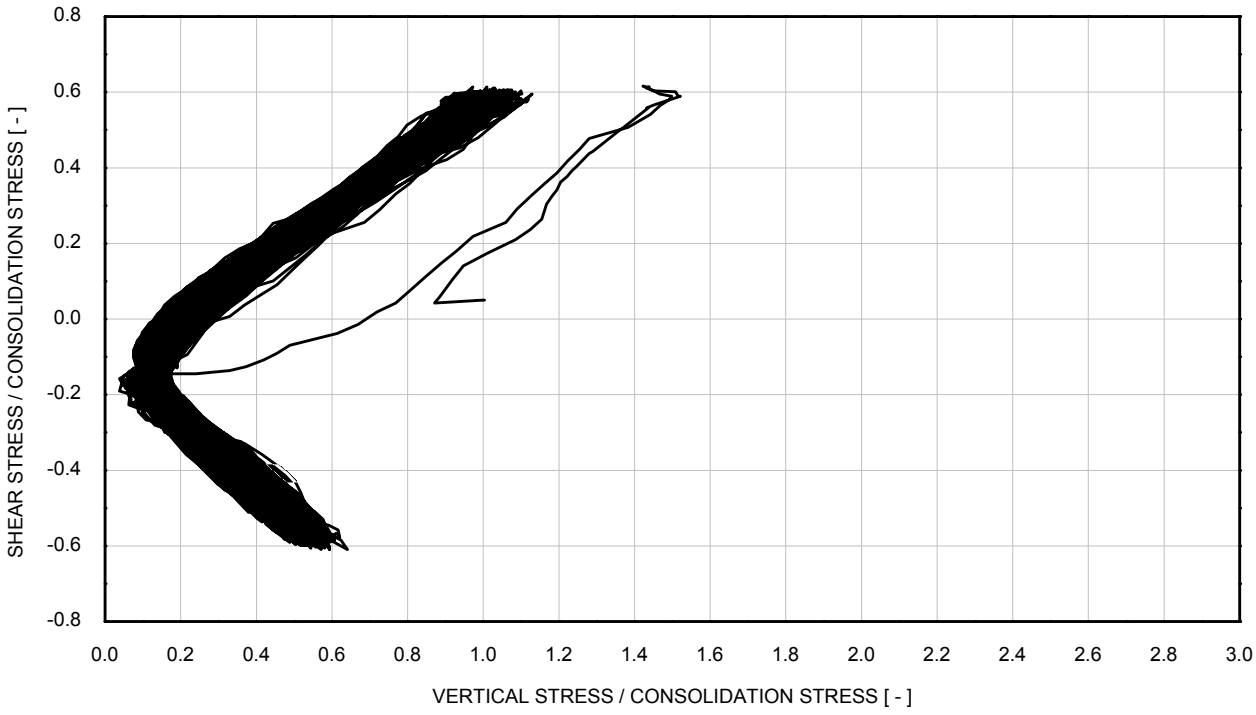




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	12 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

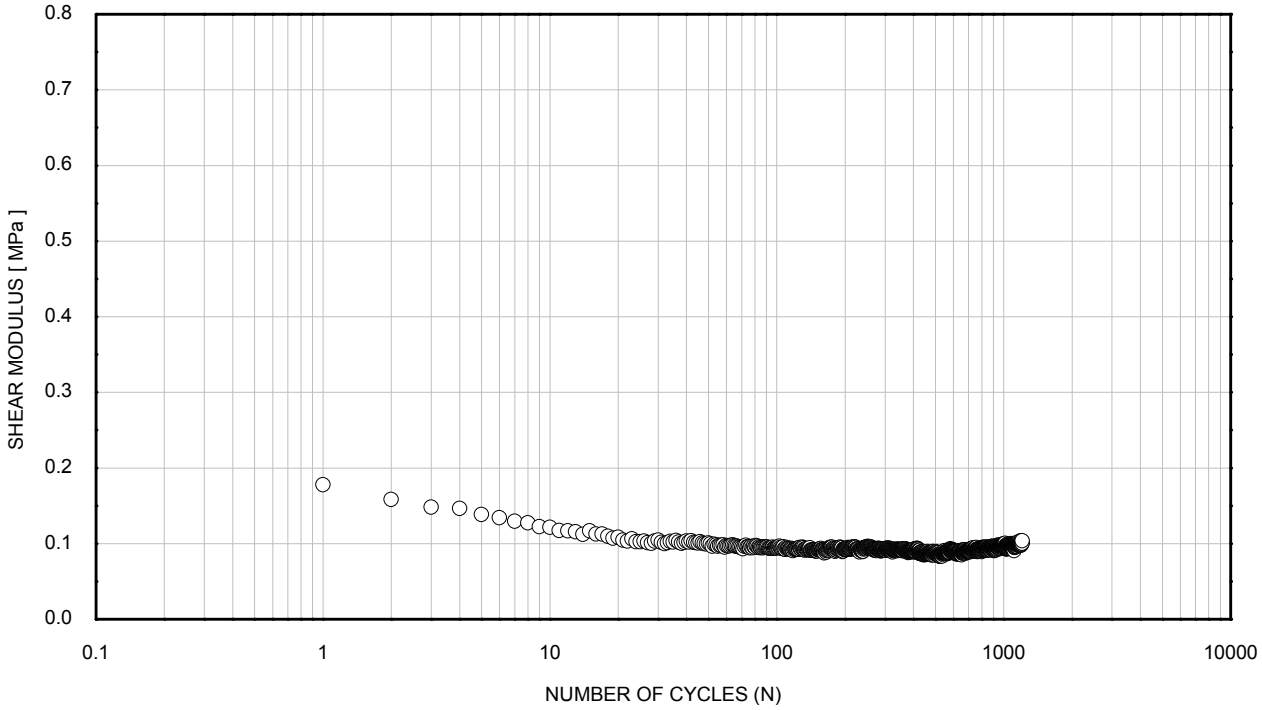
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

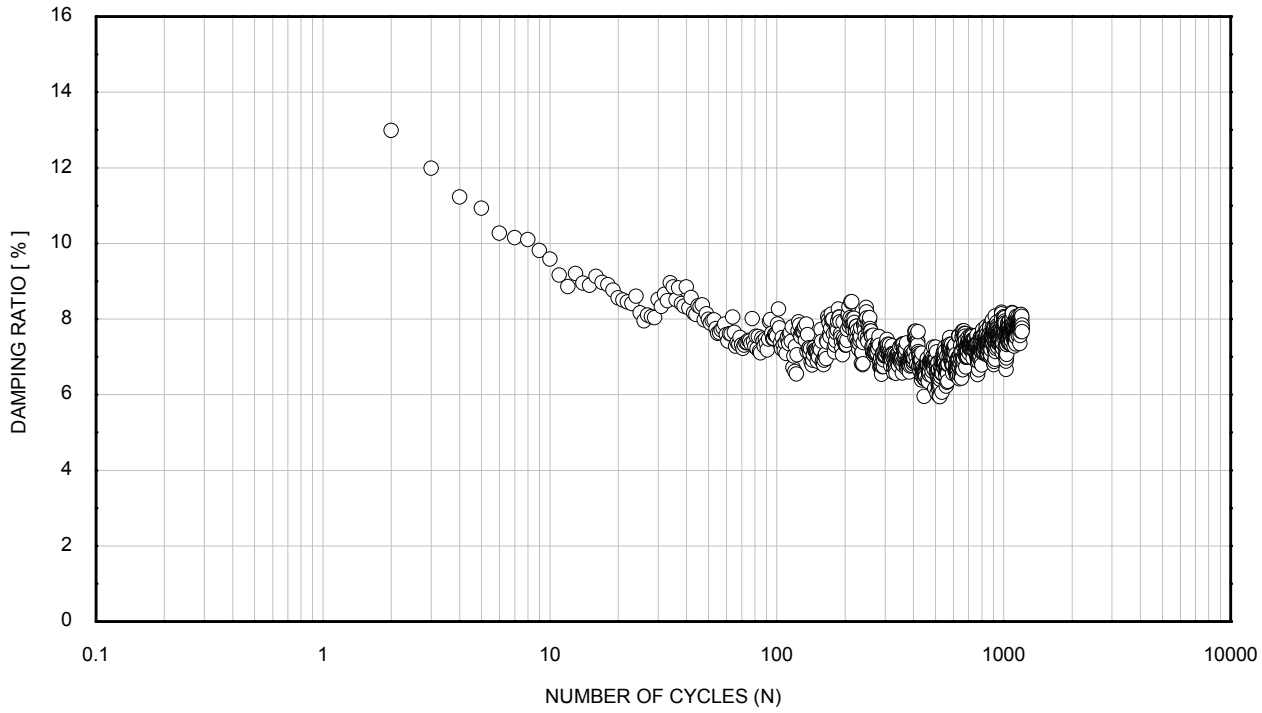




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	12 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS01

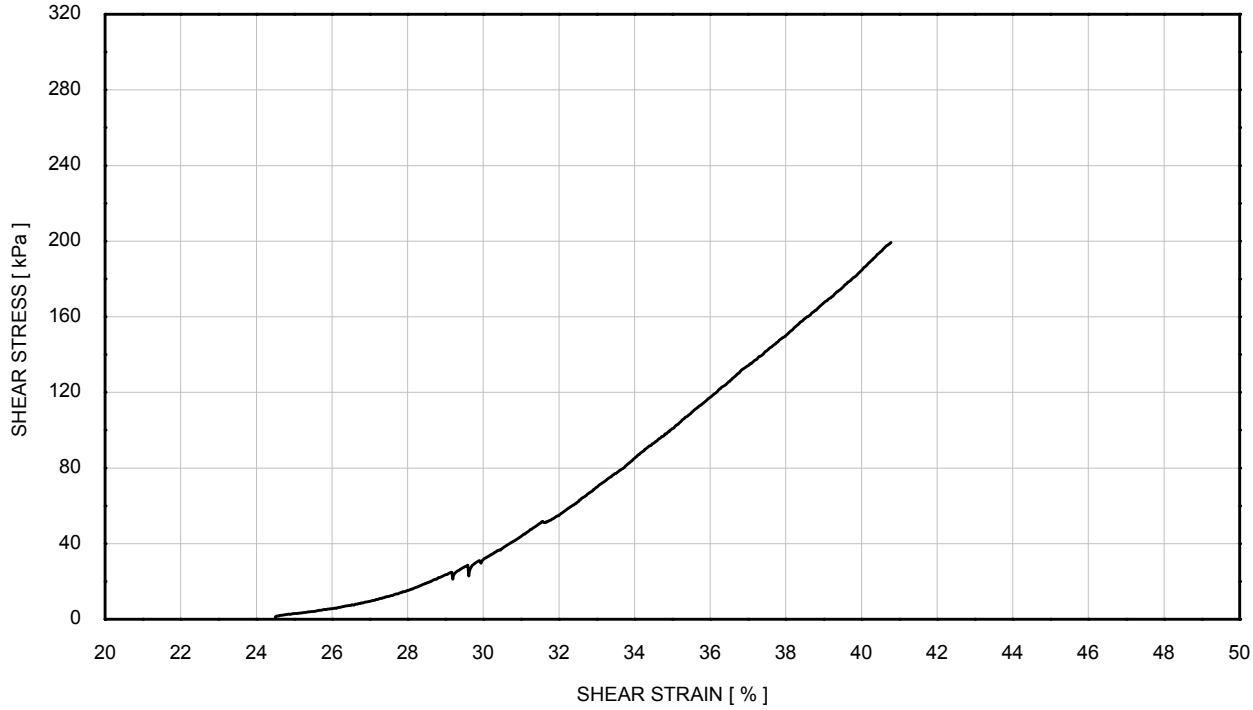
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

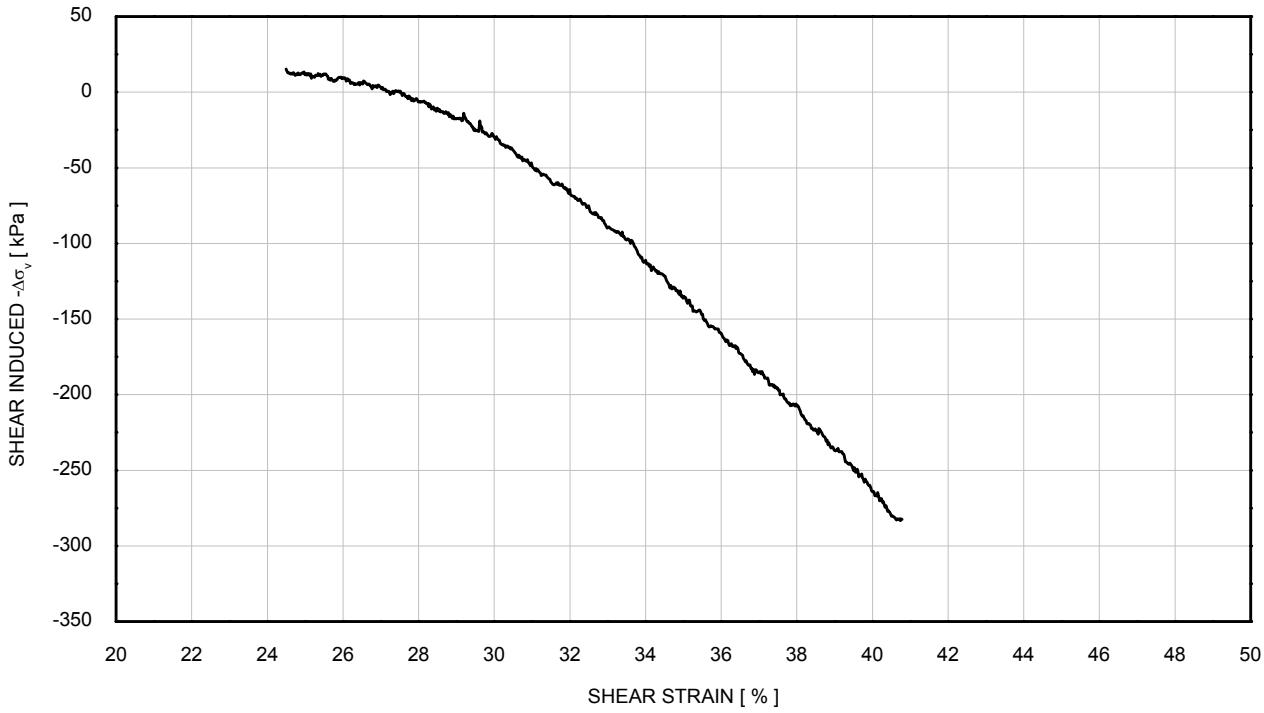




σ_{vc}	:	20 kPa	Borehole	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-1
Mean τ_{cy}	:	12 kPa	Depth [m]	:	--
Frequency	:	0.10 Hz	Test No.	:	CSS01

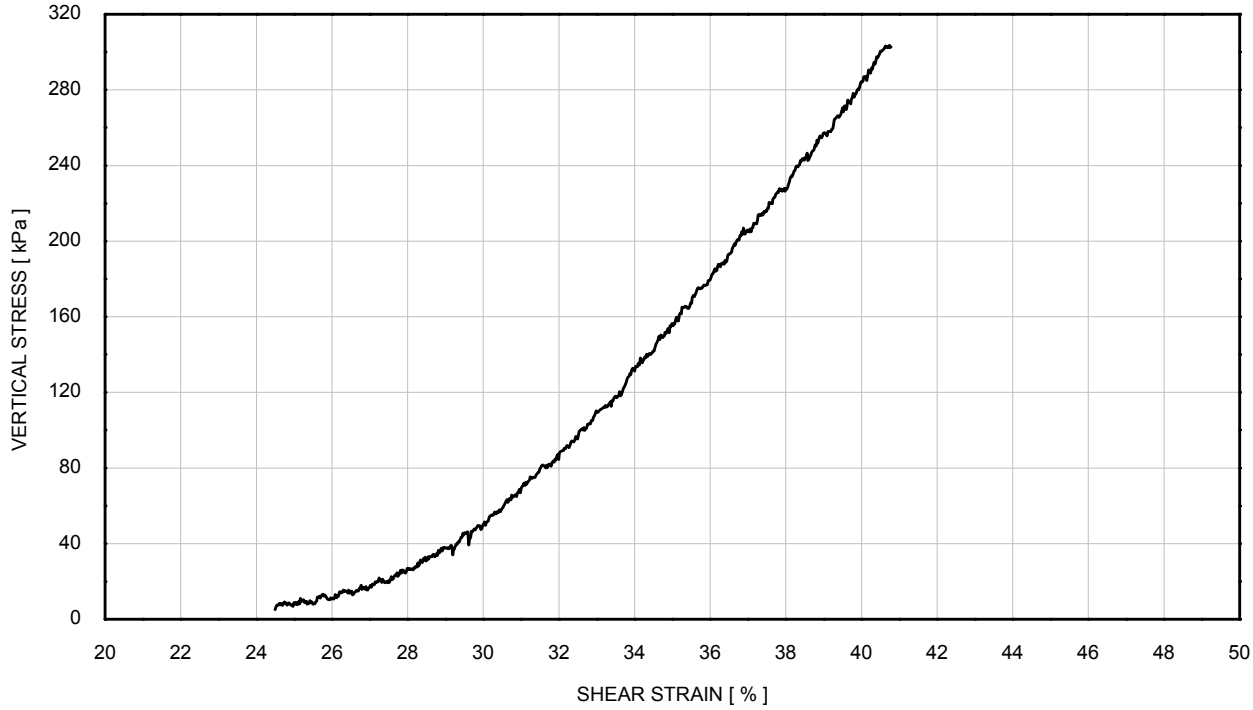
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

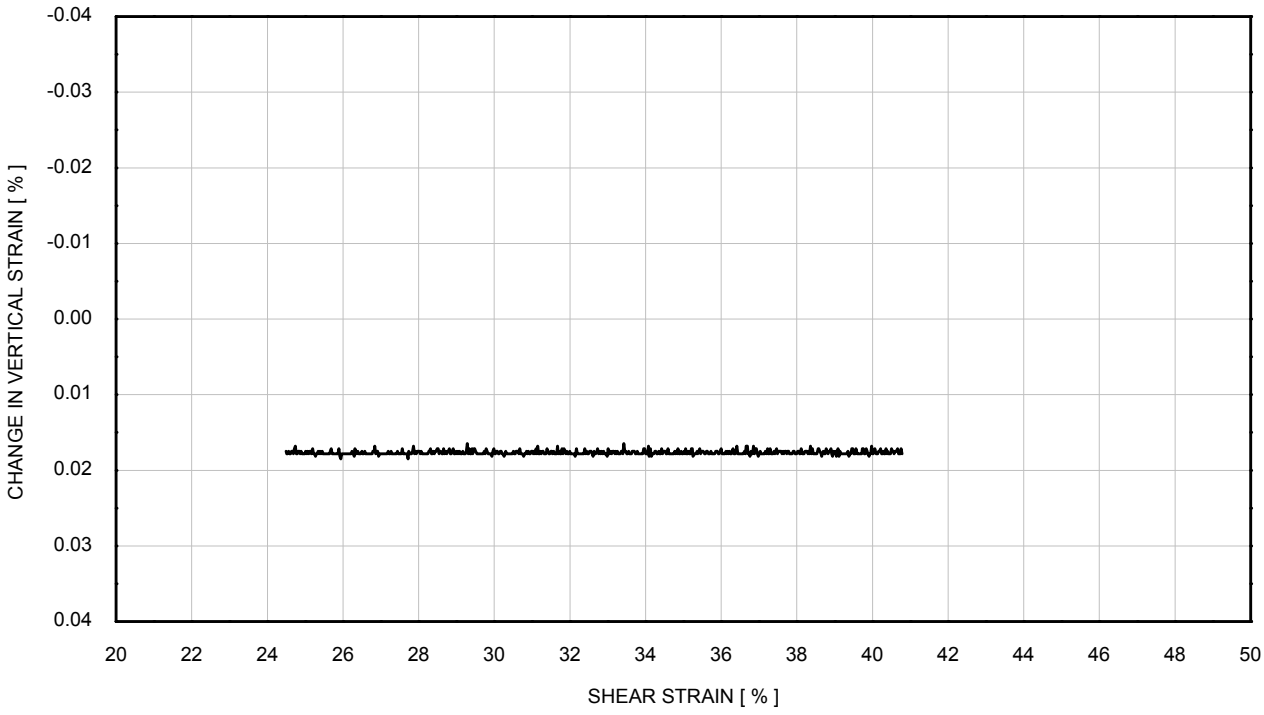




σ_{vc}	:	20 kPa	Batch	: 2
τ_{peak}	:	199 kPa	Sample	: CSS_2-1
γ at τ_{peak}	:	40.78 %	Unit	: Unit A (Southern Bight)
Rate of strain	:	2.96 %/hour	Test No.	: CSS01

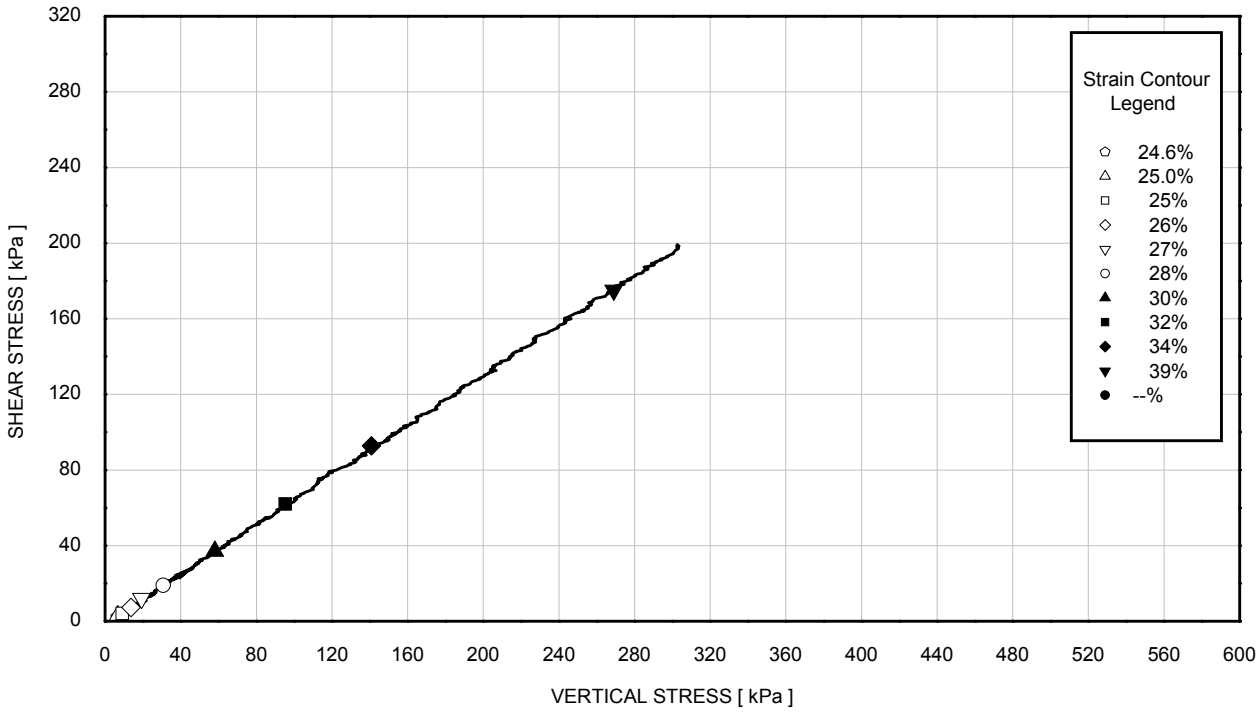
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

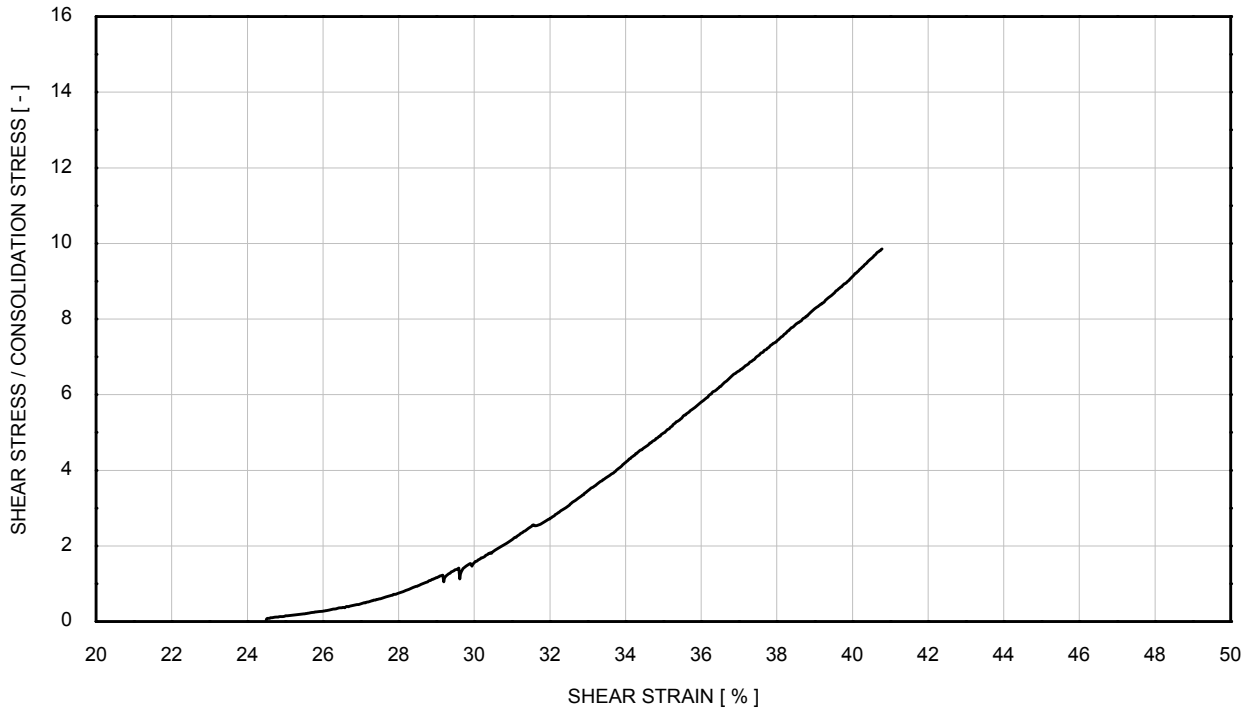




σ_{vc}	:	20 kPa	Batch	:	2
τ_{peak}	:	199 kPa	Sample	:	CSS_2-1
γ at τ_{peak}	:	40.78 %	Unit	:	Unit A (Southern Bight)
Rate of strain	:	2.96 %/hour	Test No.	:	CSS01

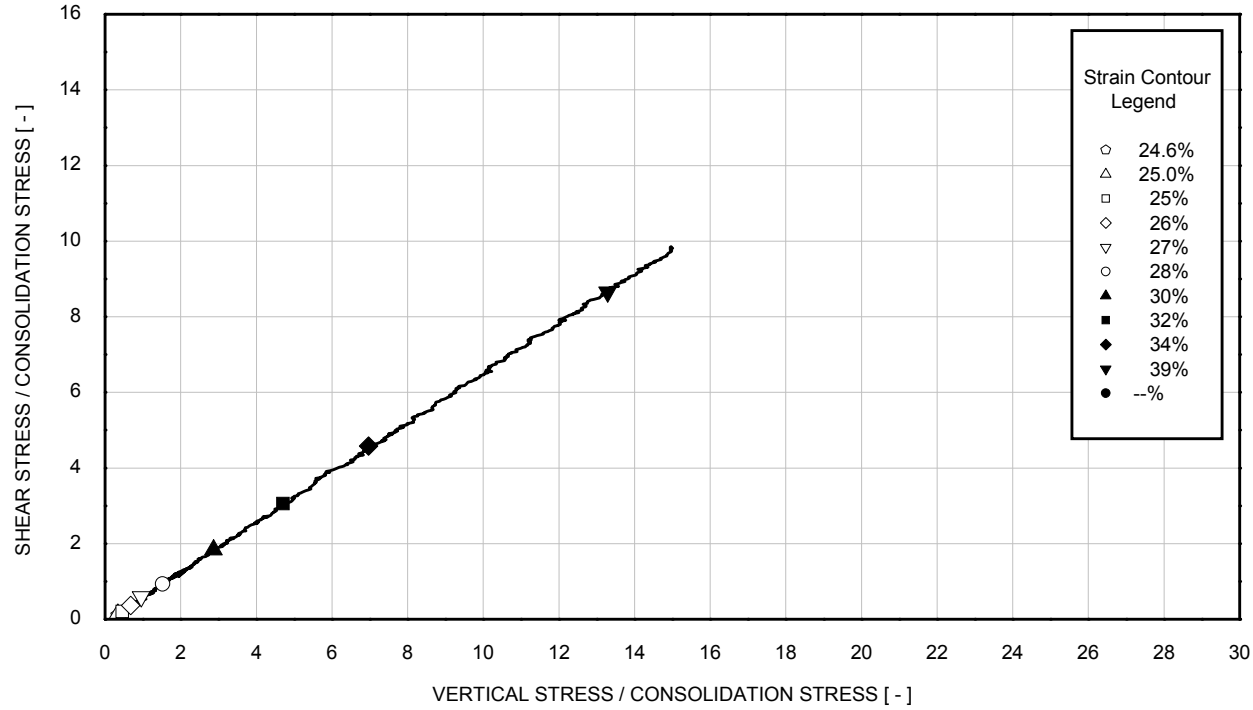
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

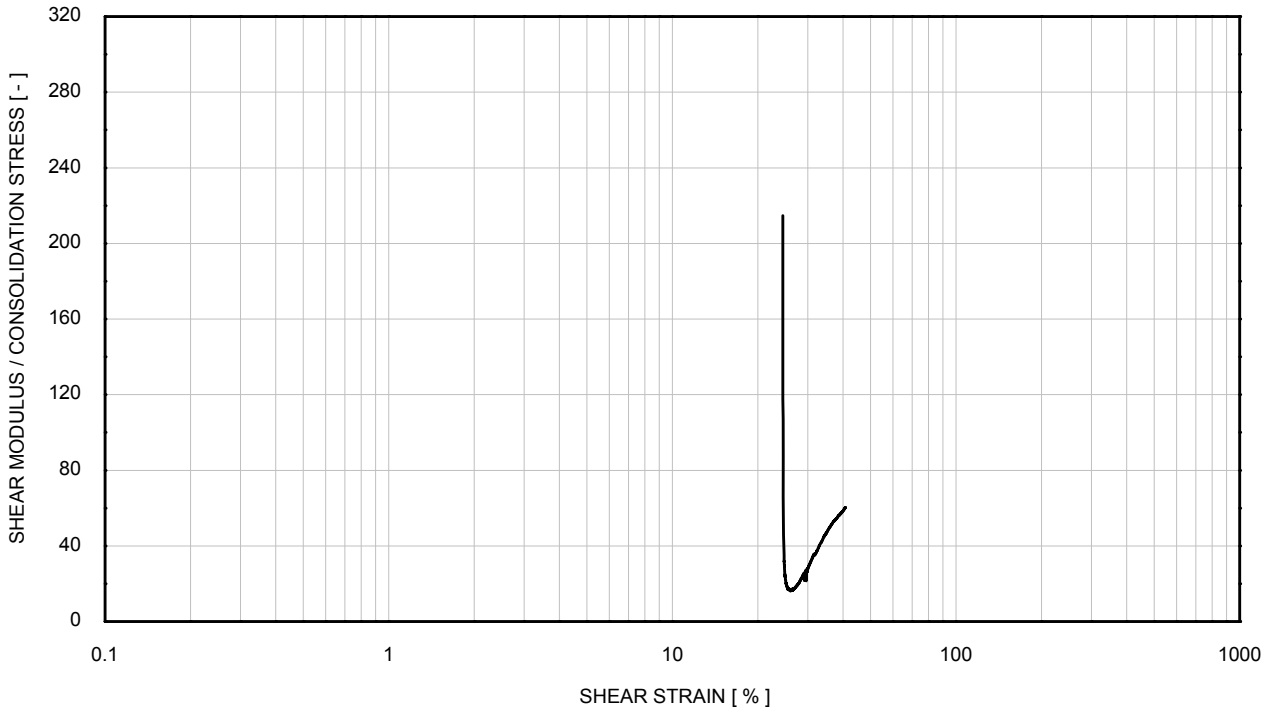




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 199 kPa	Sample	: CSS_2-1
γ at τ_{peak}	: 40.78 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.96 %/hour	Test No.	: CSS01

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 199 kPa	Sample	: CSS_2-1
γ at τ_{peak}	: 40.78 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.96 %/hour	Test No.	: CSS01

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown fine to coarse SAND with shell fragments

GENERAL	
Date test started	07/11/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	10.2
Bulk density after compaction	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.609
Degree of saturation after compaction	[%]	44
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	23.0
Bulk density at start of test	[Mg/m³]	2.03
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 2_CSS02
Template issue	1.4
Processed by Date	JLS 07/11/2016
Checked by Date	PH 21/11/2016
Approved by Date	PH 21/11/2016

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-2
Unit	Unit A (Southern Bight)
Test number	CSS02

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	20
Vertical strain	[%]	0.16
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.607
Water content	[%]	22.9

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	20
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	1
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	0.24
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.606

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.66	0.03	3.94	23.63
2	0.67	0.02	4.62	17.42
5	0.68	0.02	4.83	12.85
10	0.69	0.02	4.77	10.99
20	0.70	0.02	5.40	8.26
50	0.71	0.02	5.08	8.31
100	0.72	0.02	4.99	8.10
200	0.72	0.02	5.08	6.94
300	0.73	0.02	4.75	5.57
400	0.73	0.02	5.13	7.29

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-2
Unit	Unit A (Southern Bight)
Test number	CSS02

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	5
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
γ_{av} at N_f	[%]	6.76
γ_{cy} at N_f	[%]	5.22
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	9
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.68	2.40	0.22	24.30
2	1.09	3.11	0.17	18.42
5	1.61	3.79	0.14	15.32
10	1.95	4.16	0.13	14.29
20	2.27	4.44	0.12	13.28
50	2.67	4.58	0.12	12.96
100	3.09	4.66	0.11	12.64
200	3.90	4.57	0.11	12.30
500	4.82	4.66	0.12	11.36
1000	6.17	4.90	0.11	11.31
1500	6.76	5.22	0.10	11.04

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	242
Shear strain	[%]	24.97
Shear induced $-\Delta\sigma_v$	[kPa]	-1411
Vertical stress	[kPa]	1431
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.98
At 15 % shear strain		
Shear stress	[kPa]	20
Shear induced $-\Delta\sigma_v$	[kPa]	-94
Vertical stress	[kPa]	114
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-2
Unit	Unit A (Southern Bight)
Test number	CSS02

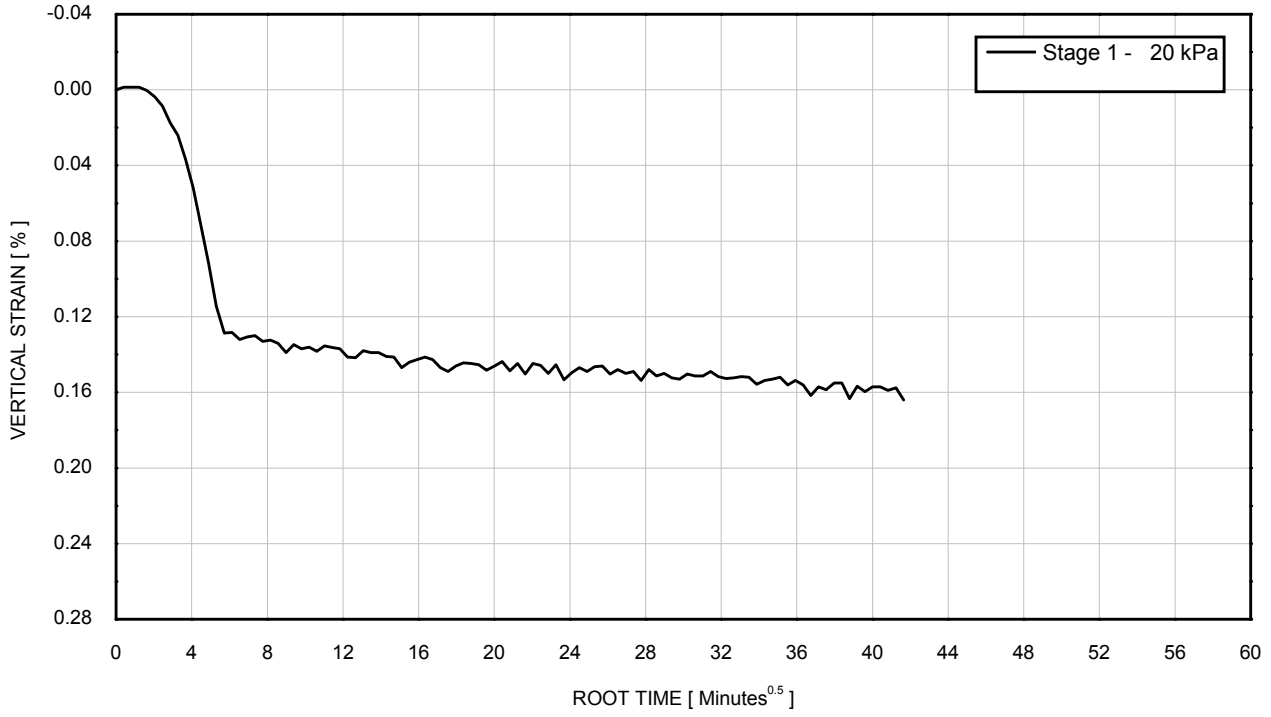
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

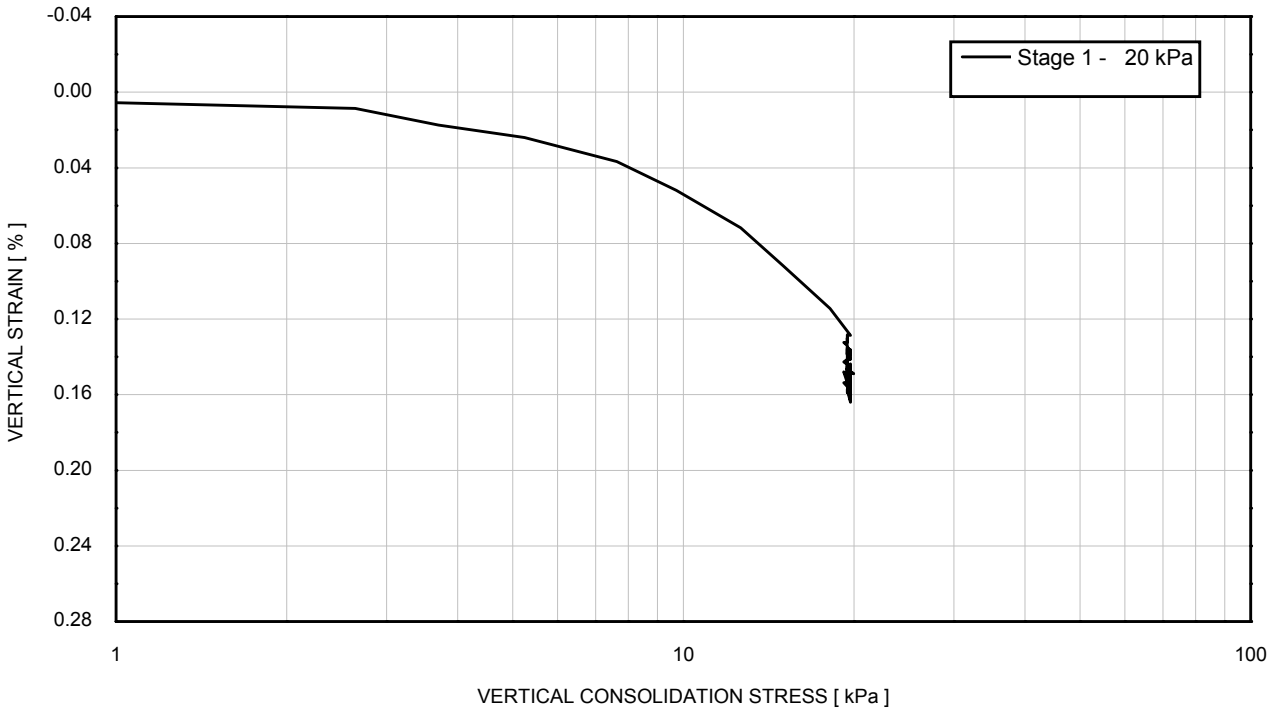
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-2
Unit	Unit A (Southern Bight)
Test number	CSS02

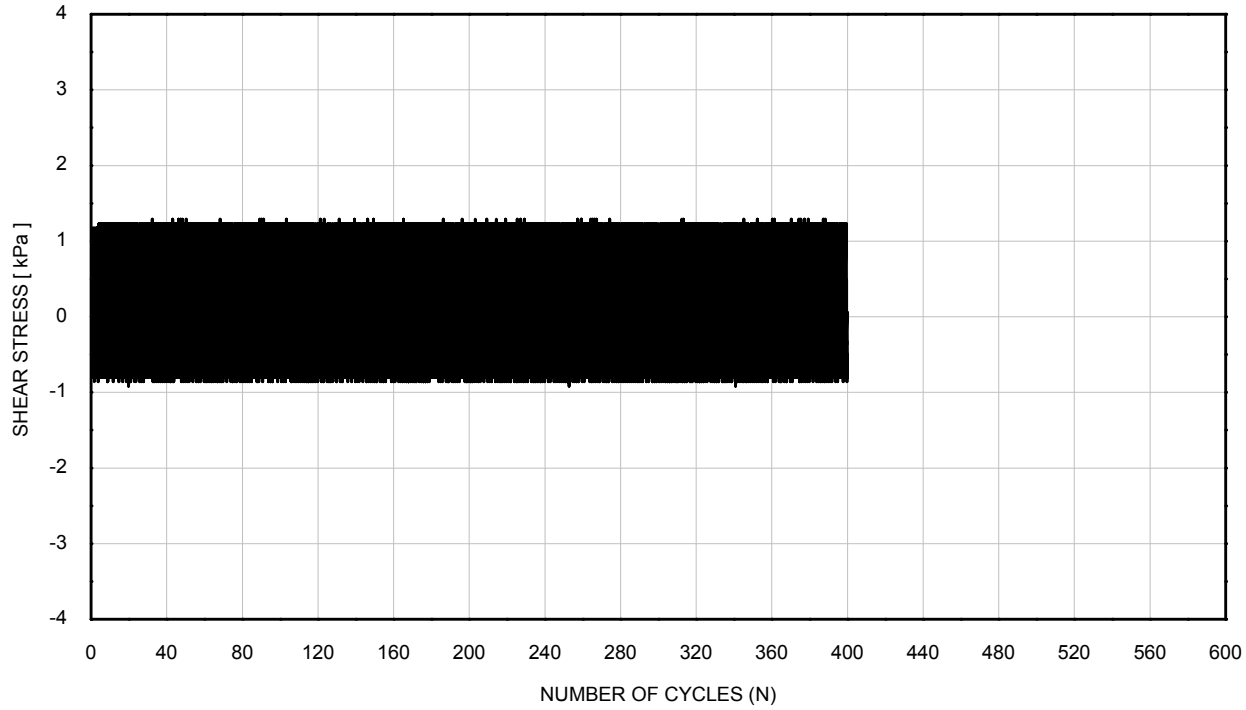
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

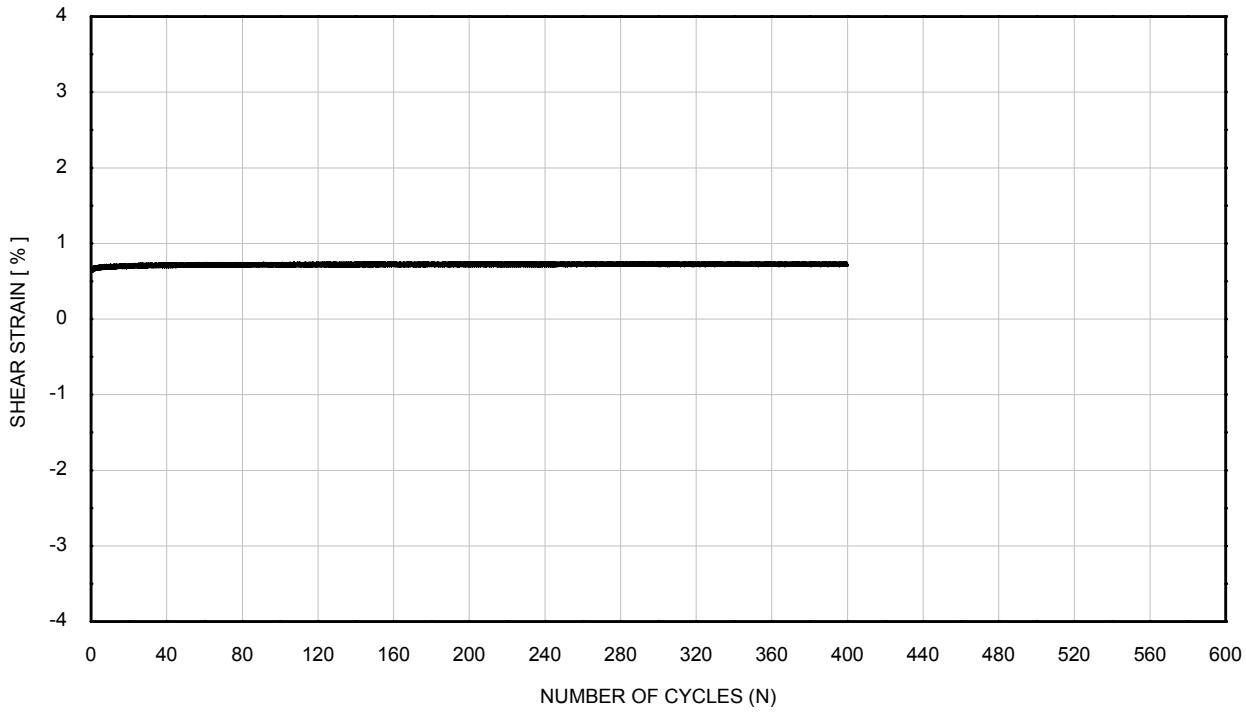




σ_{vc}	: 20 kPa	Batch	: 2
		Sample	: CSS_2-2
		Unit	: Unit A (Southern Bight)
		Test No.	: CSS02

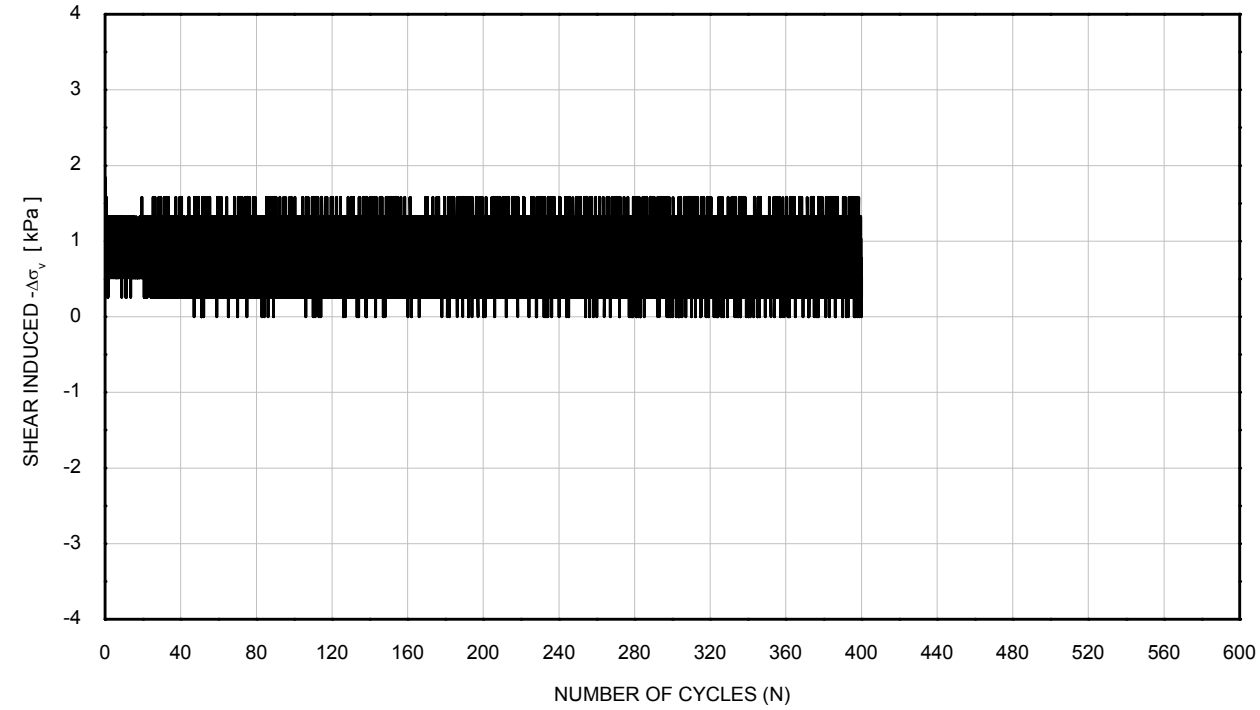
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

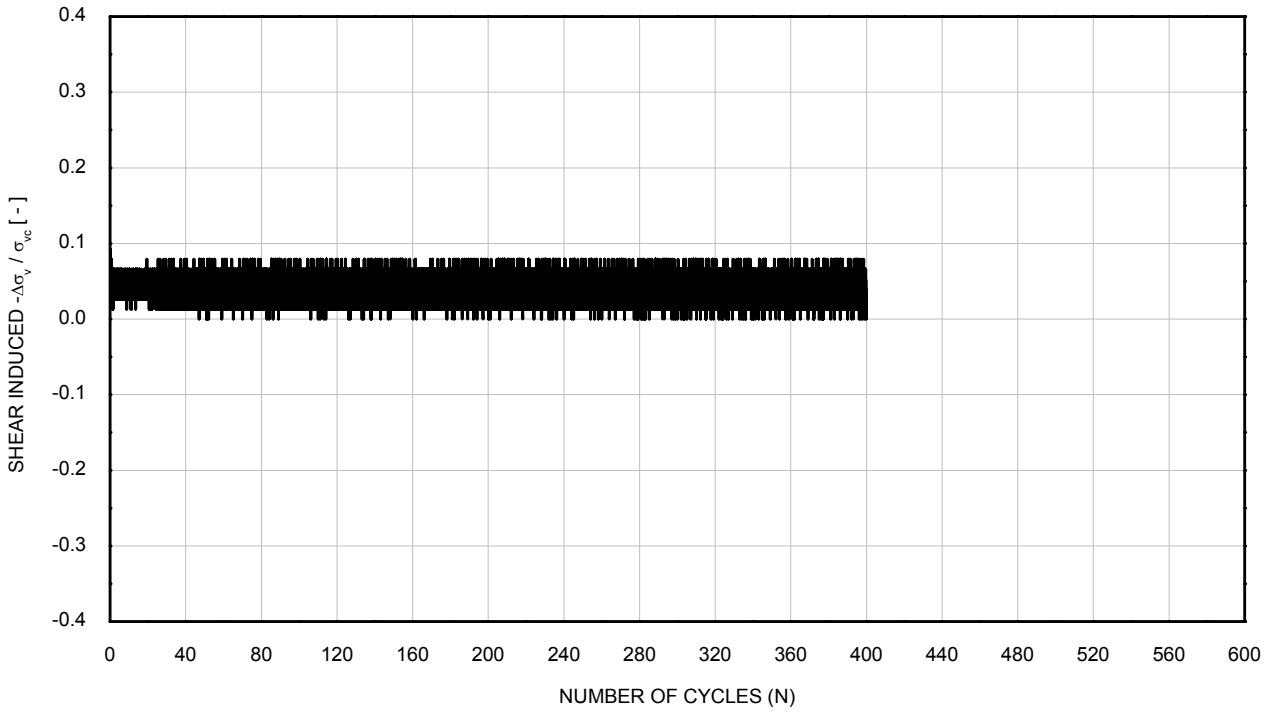




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

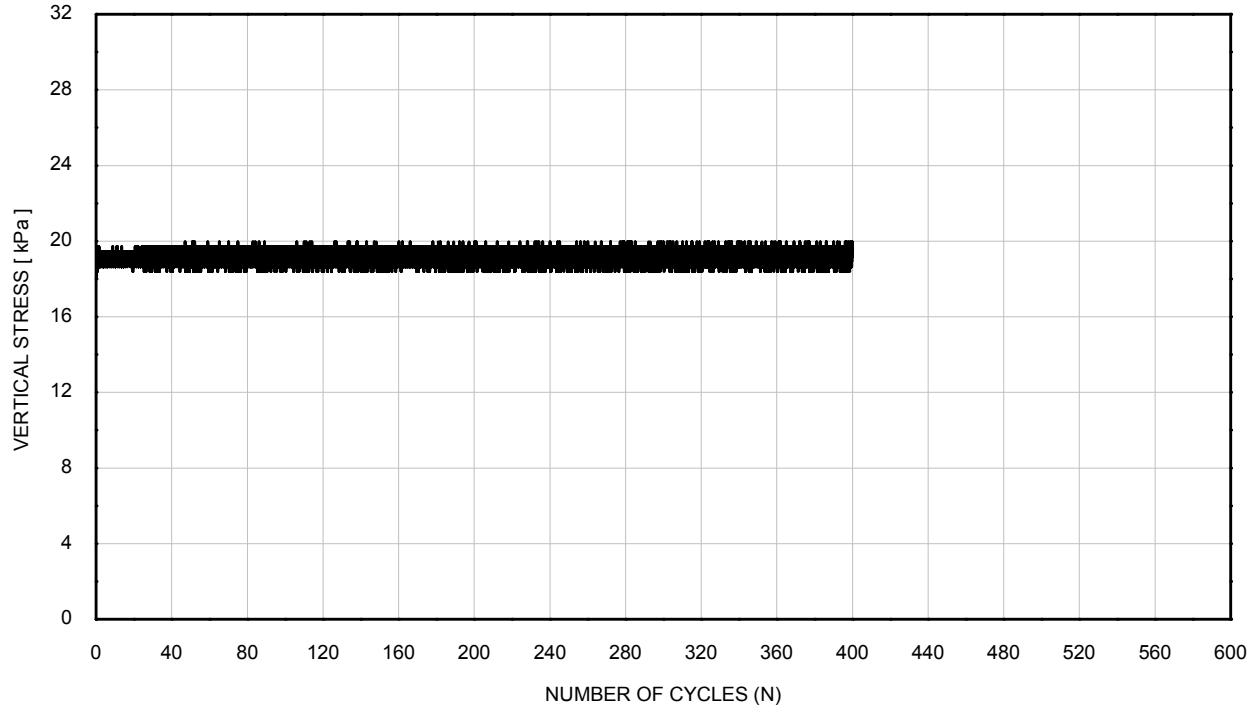
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

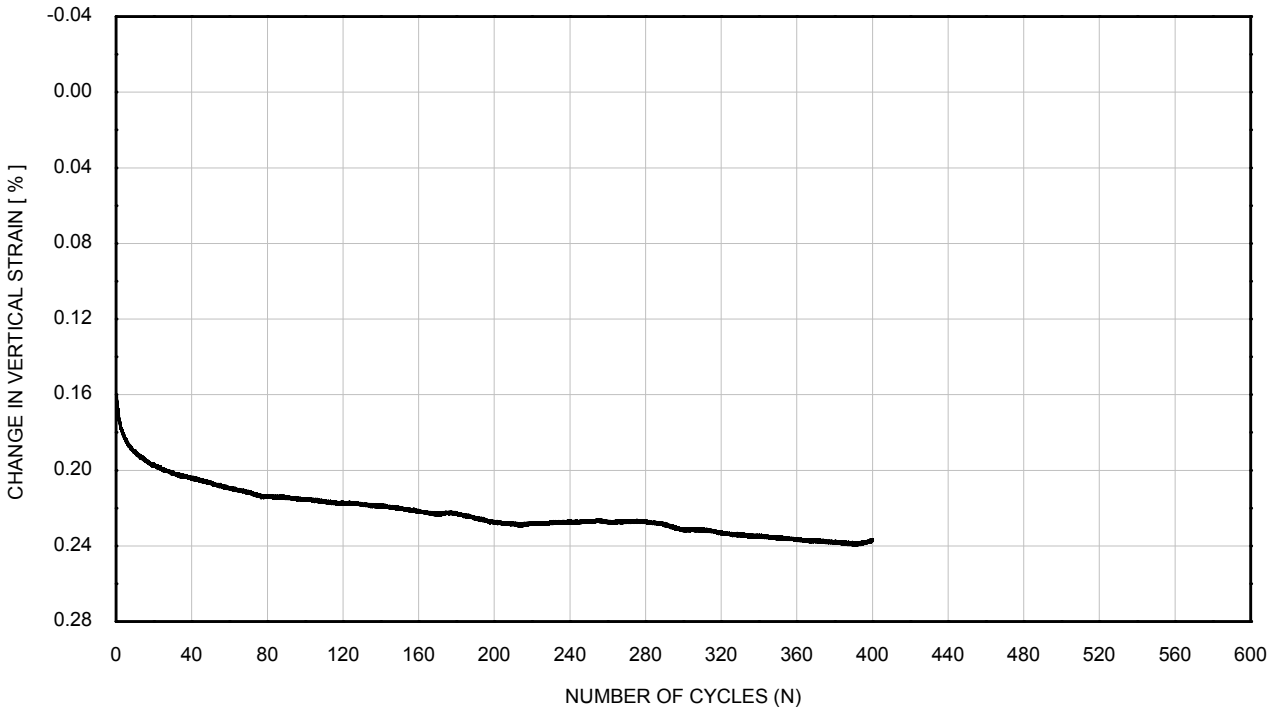




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

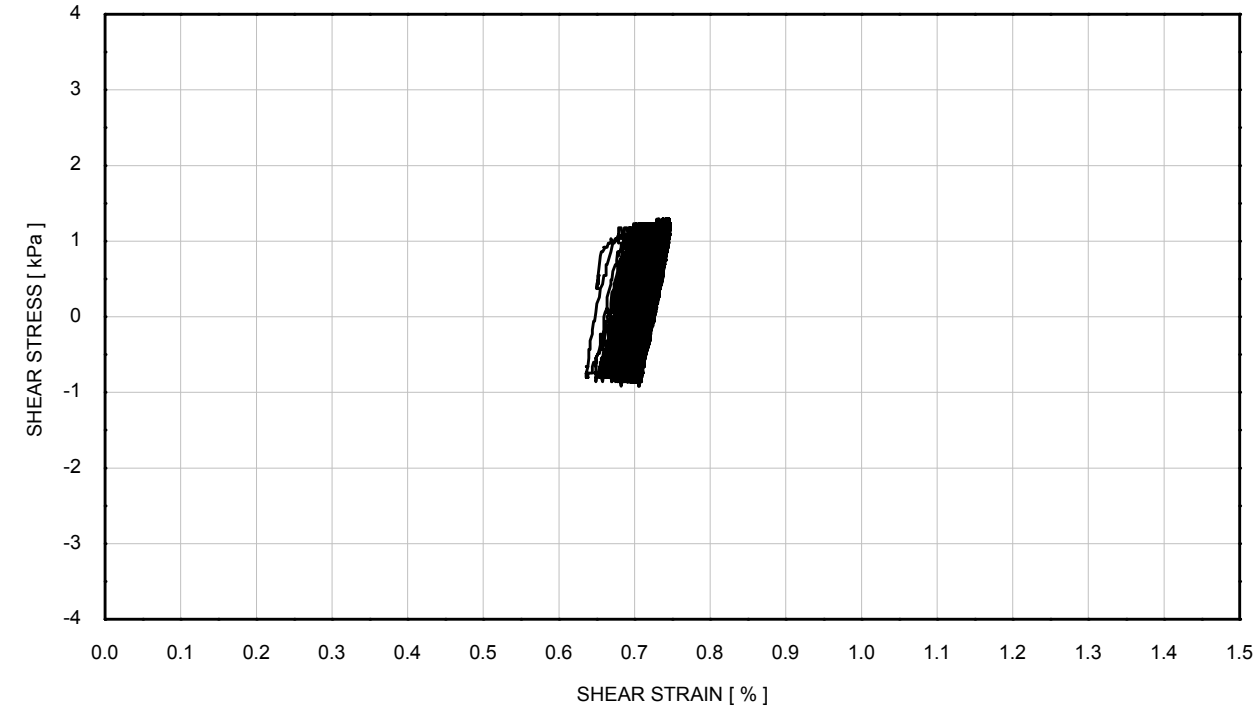
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

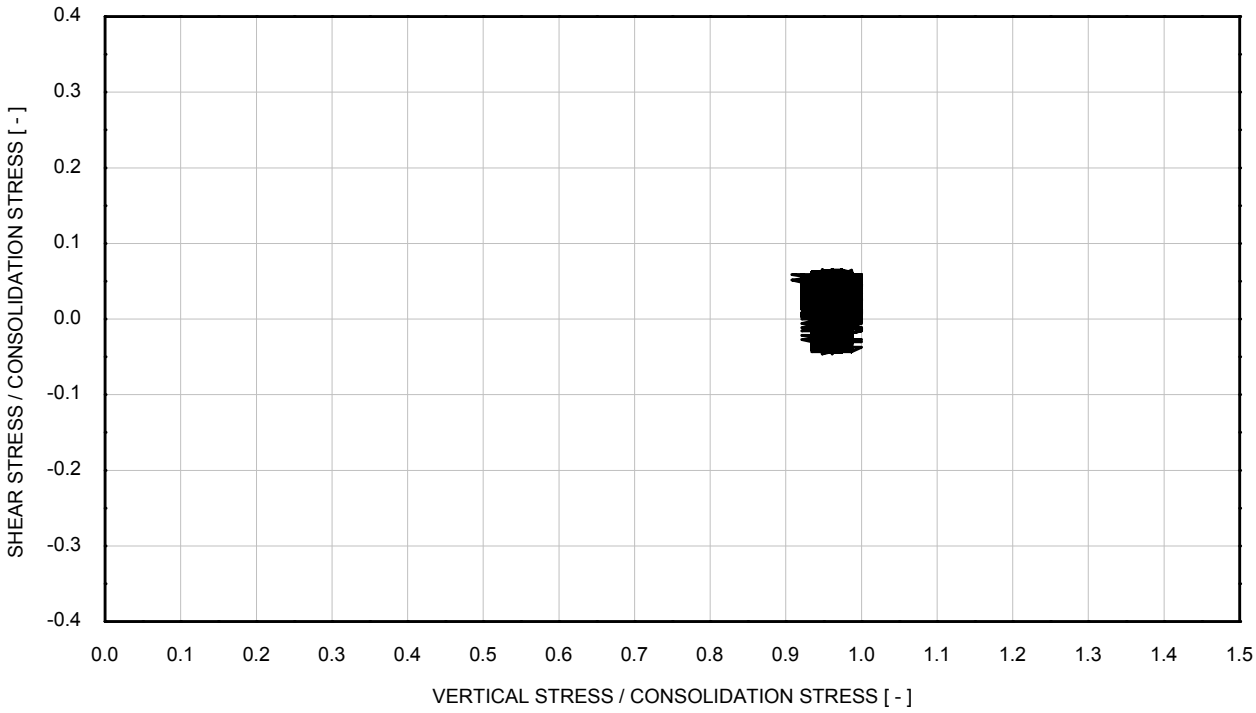




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

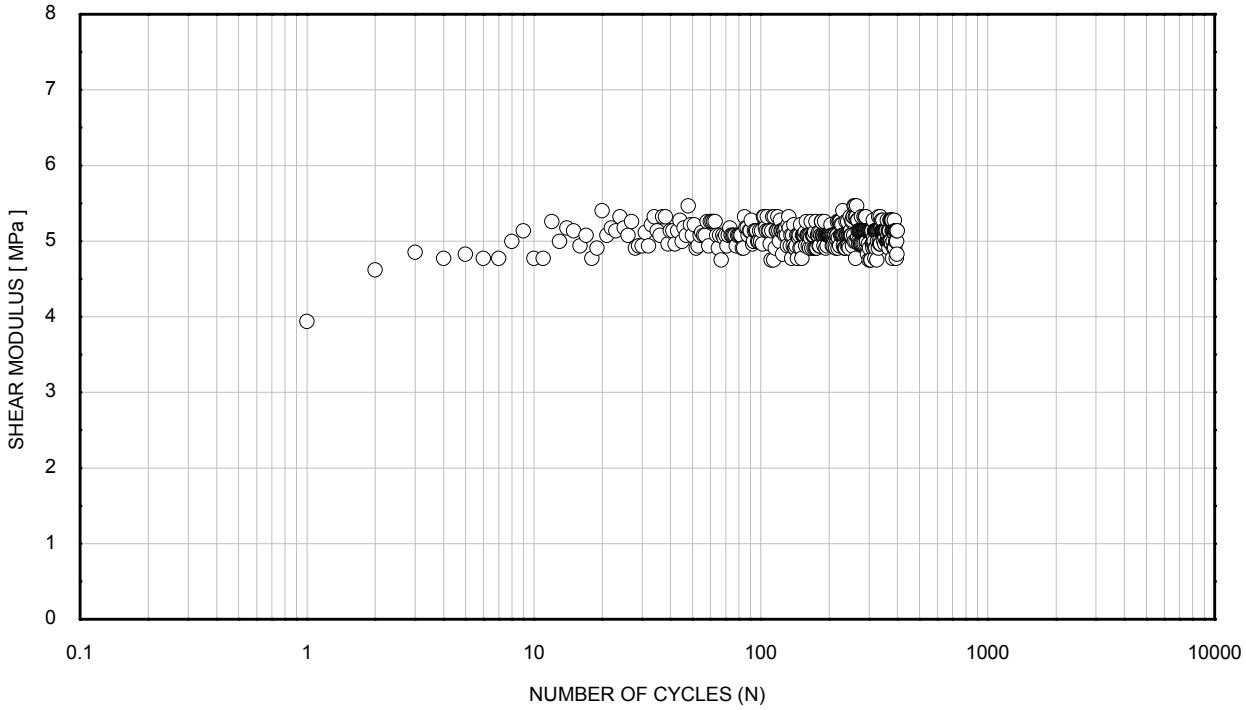
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

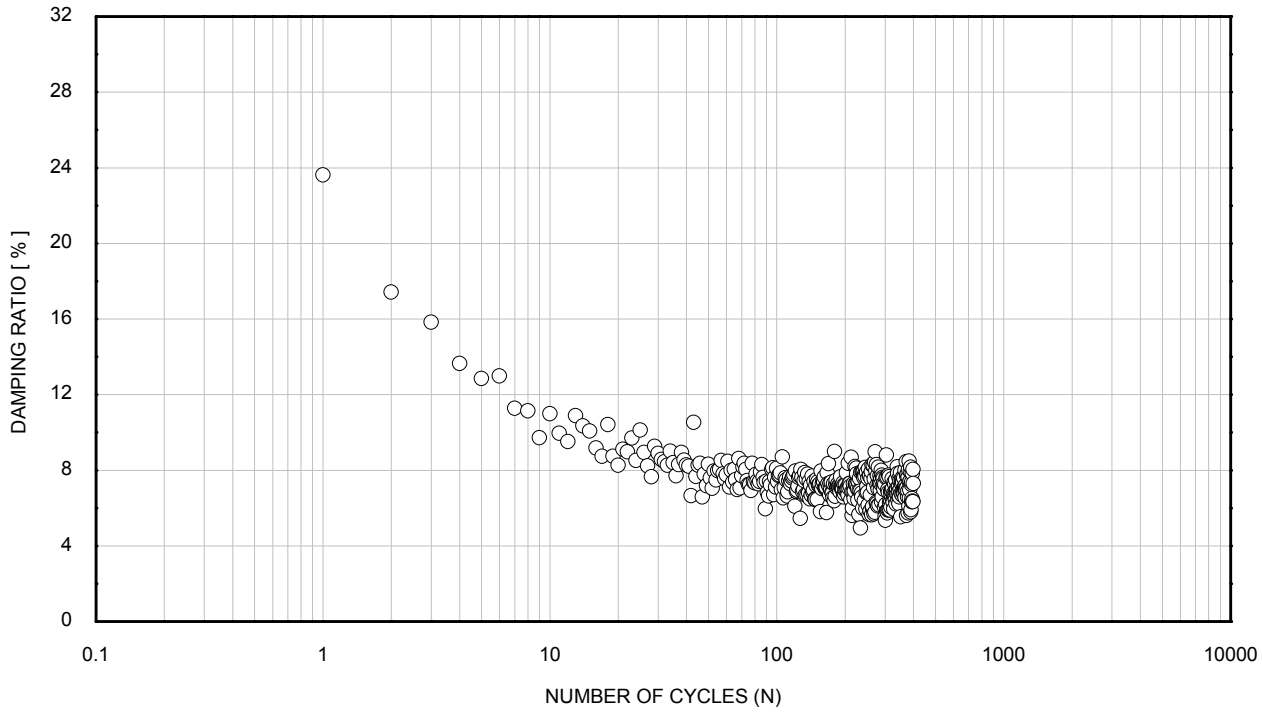




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

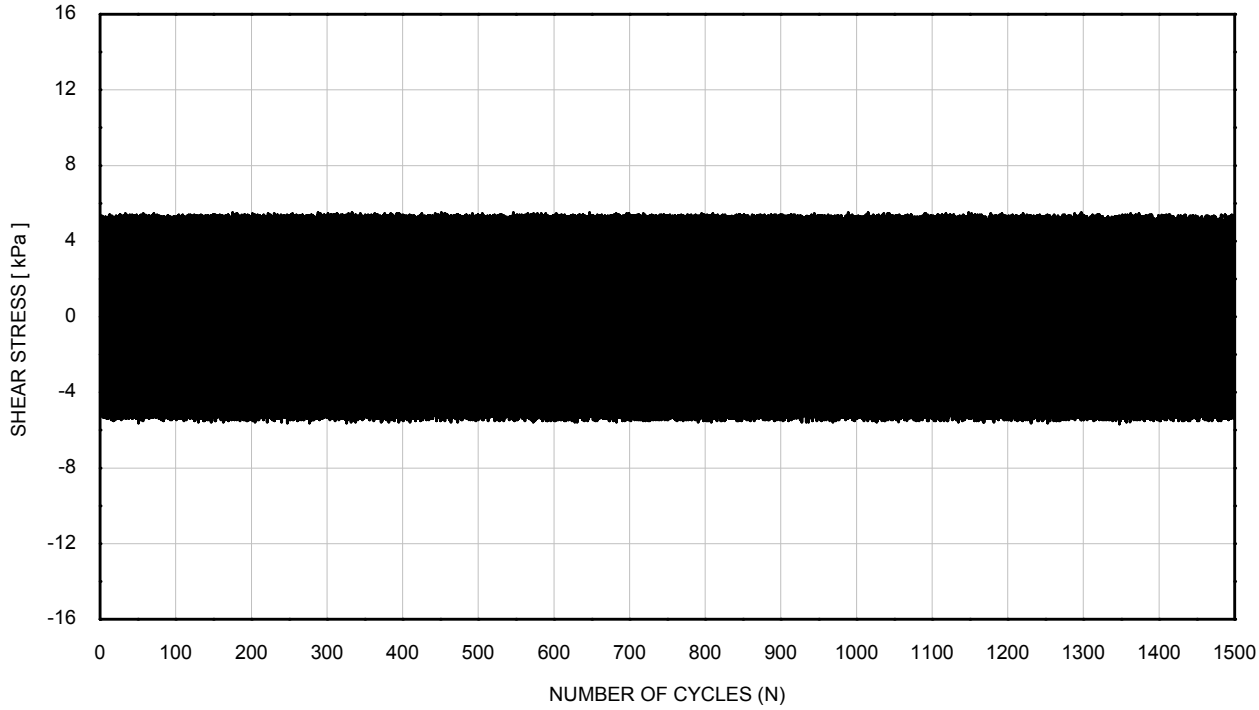
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

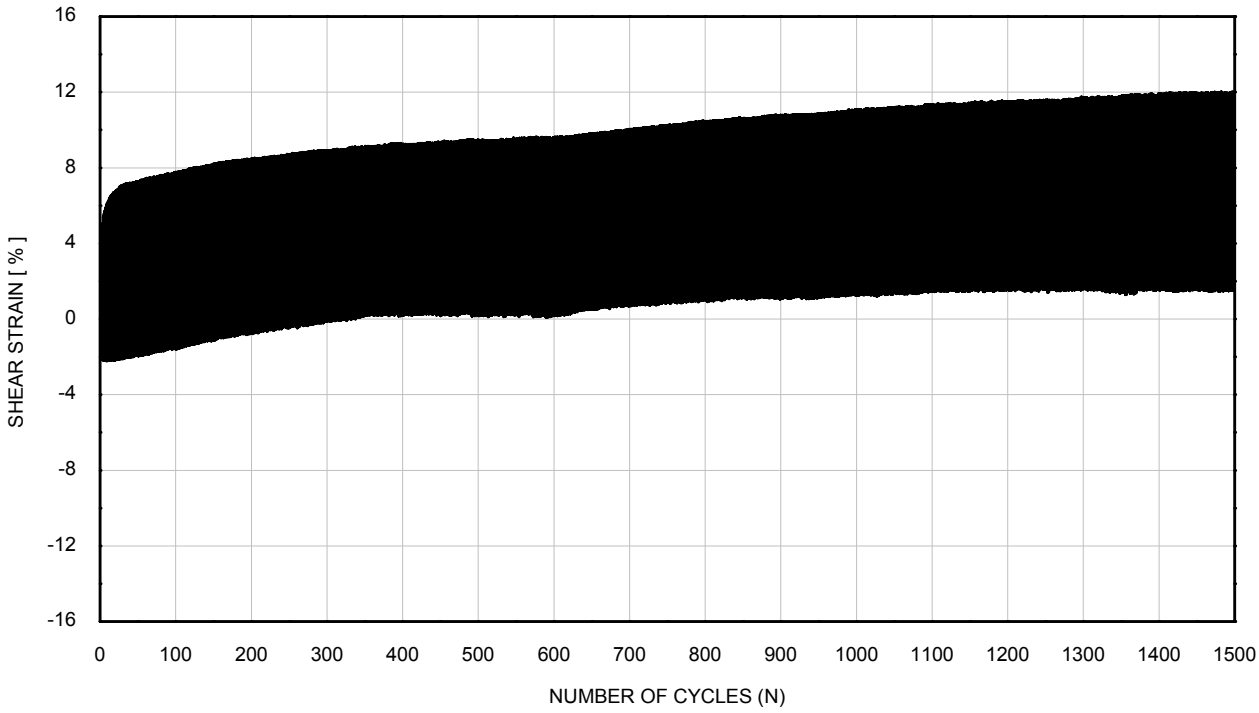




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

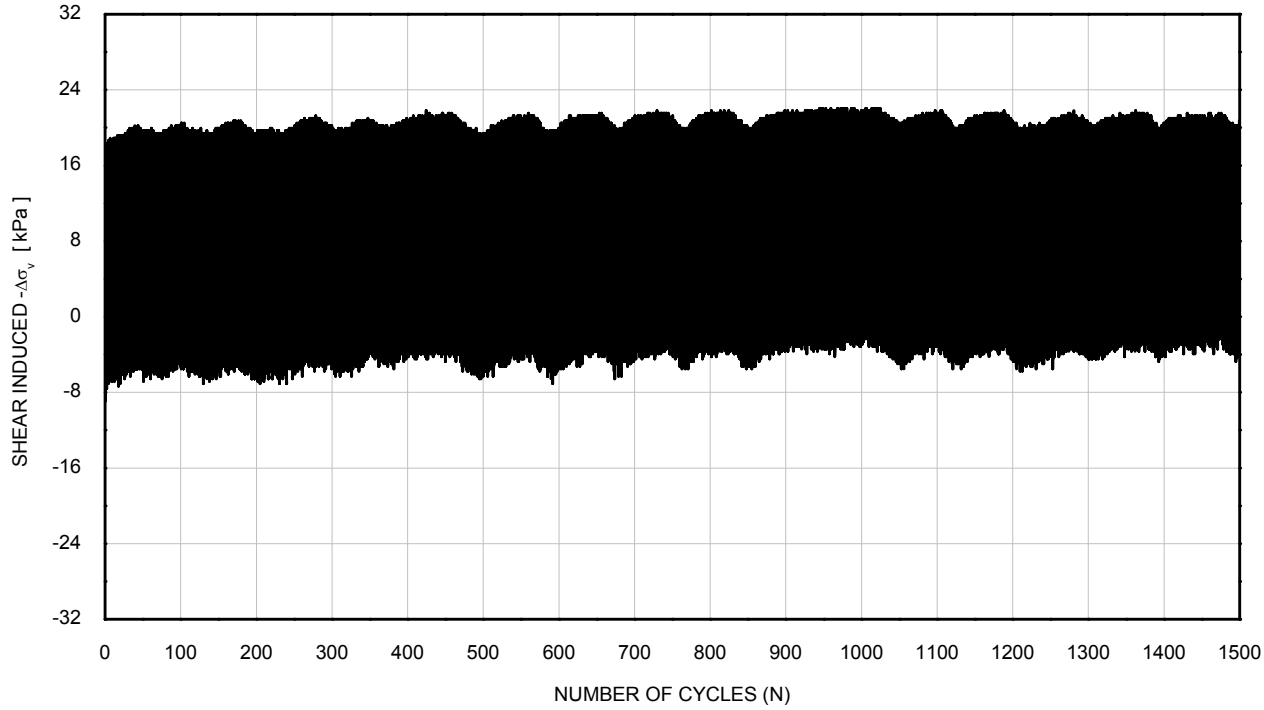
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

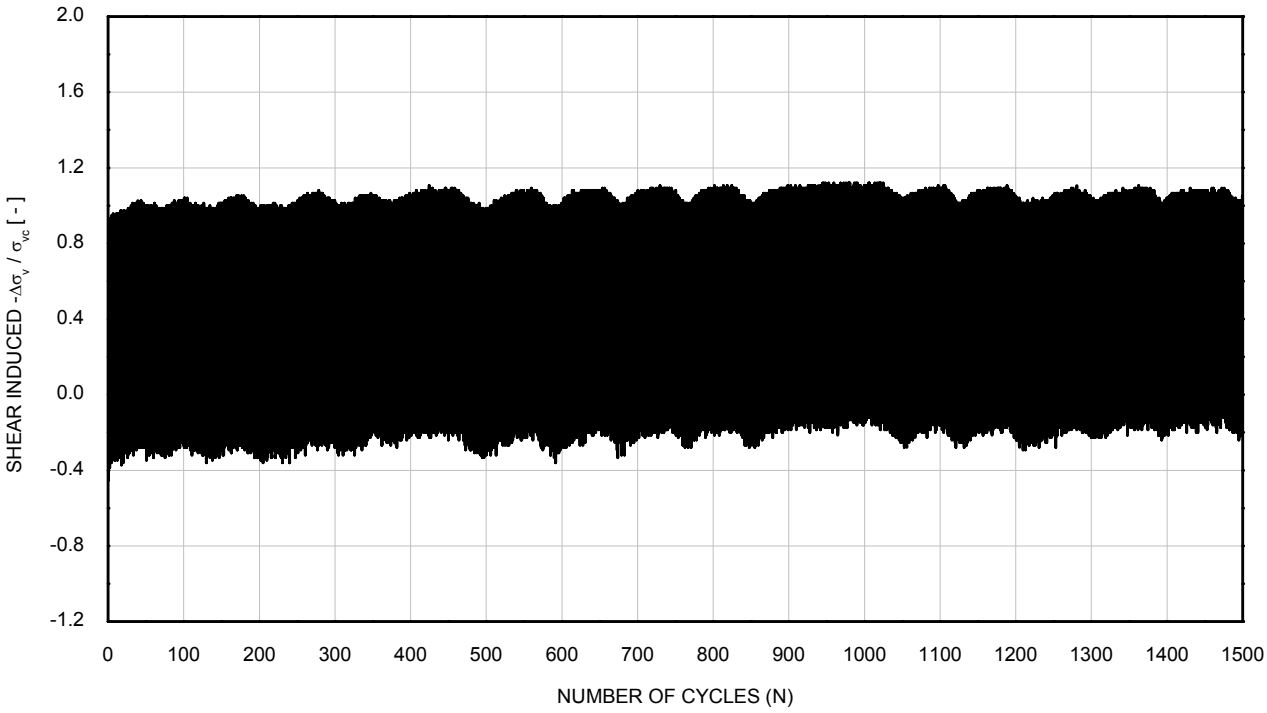




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	5 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

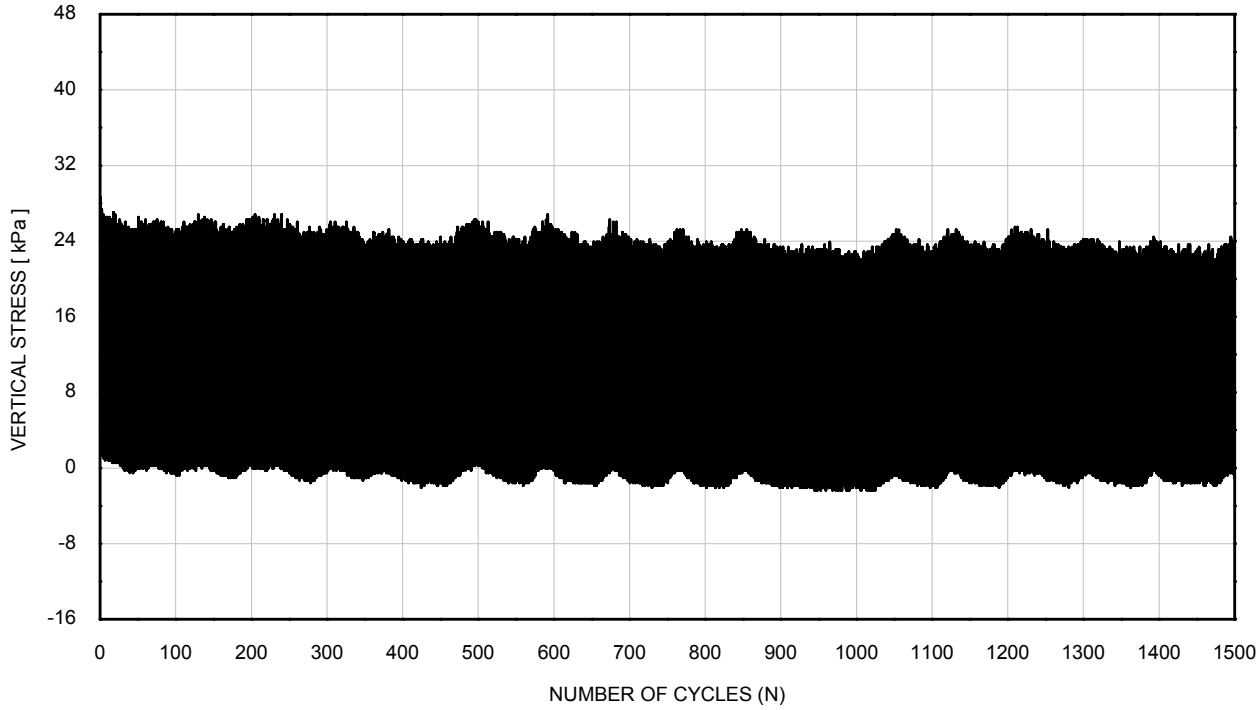
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

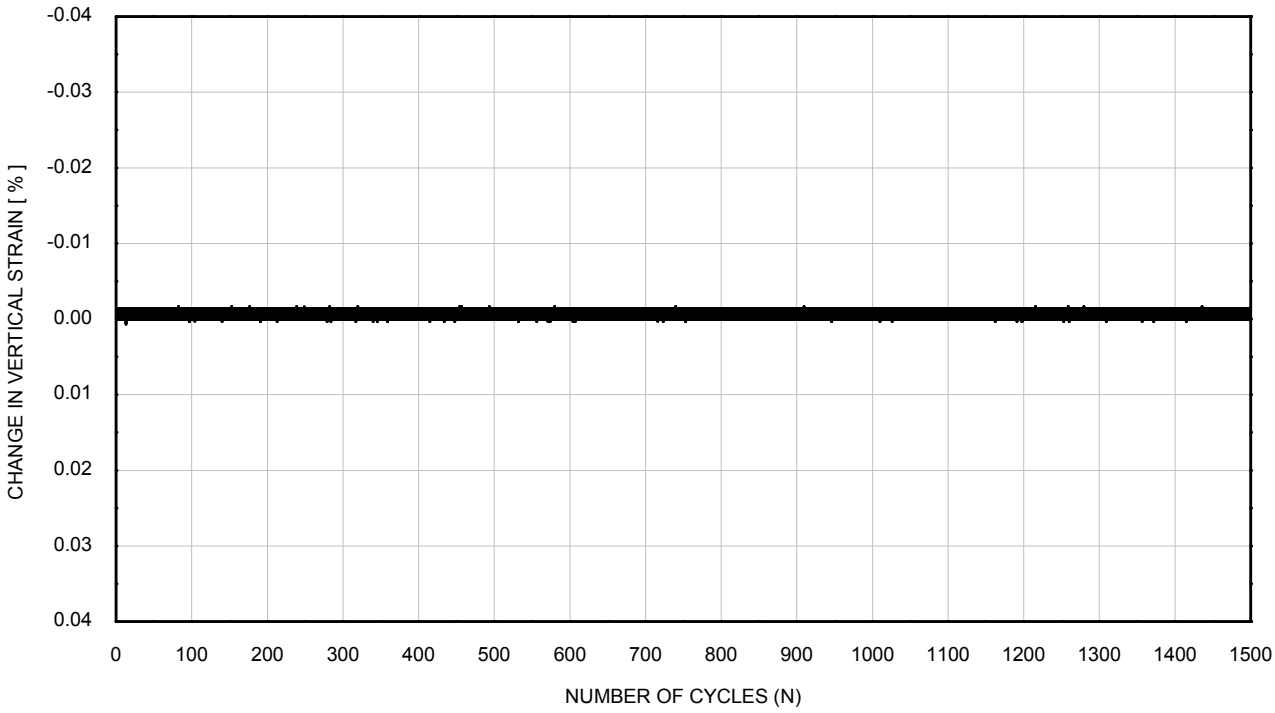




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	5 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

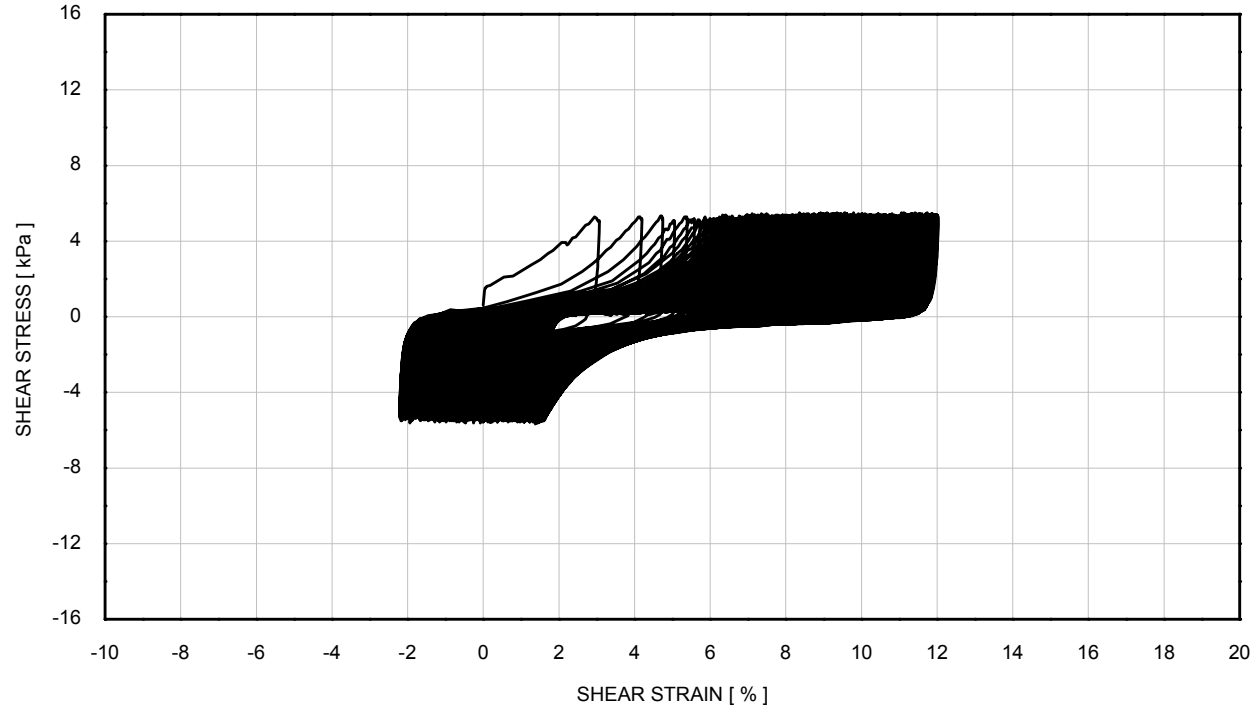
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

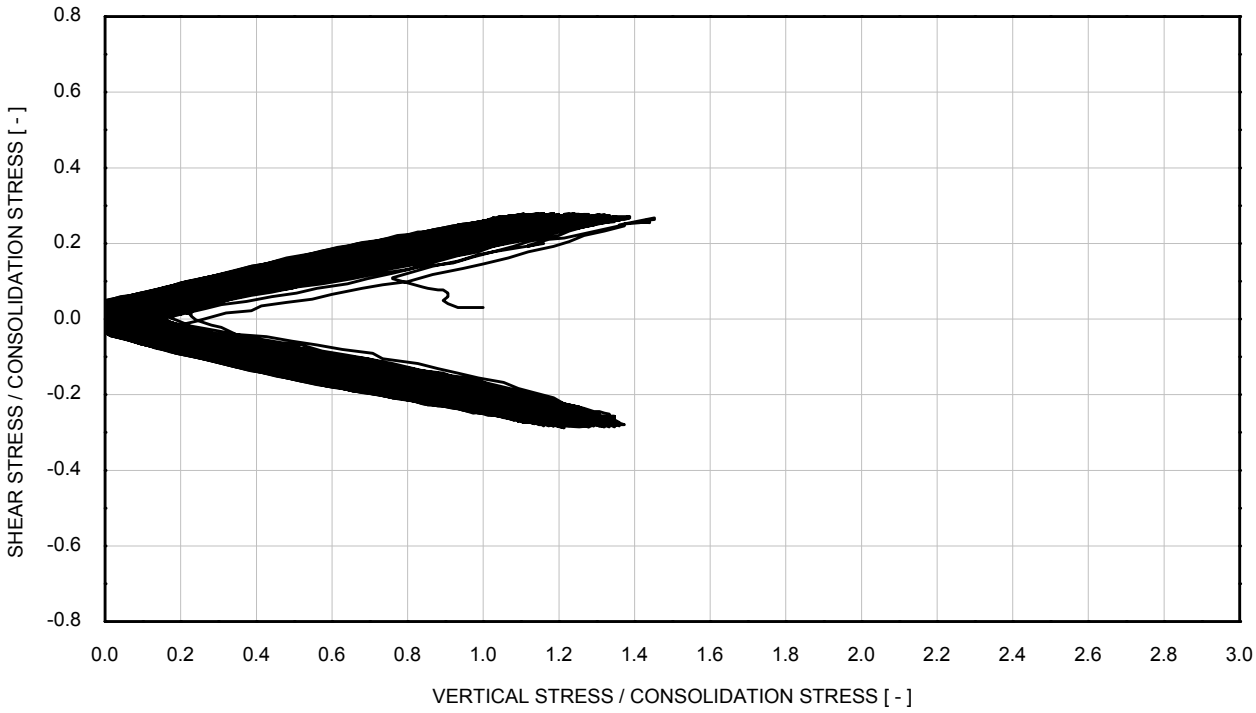




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	5 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

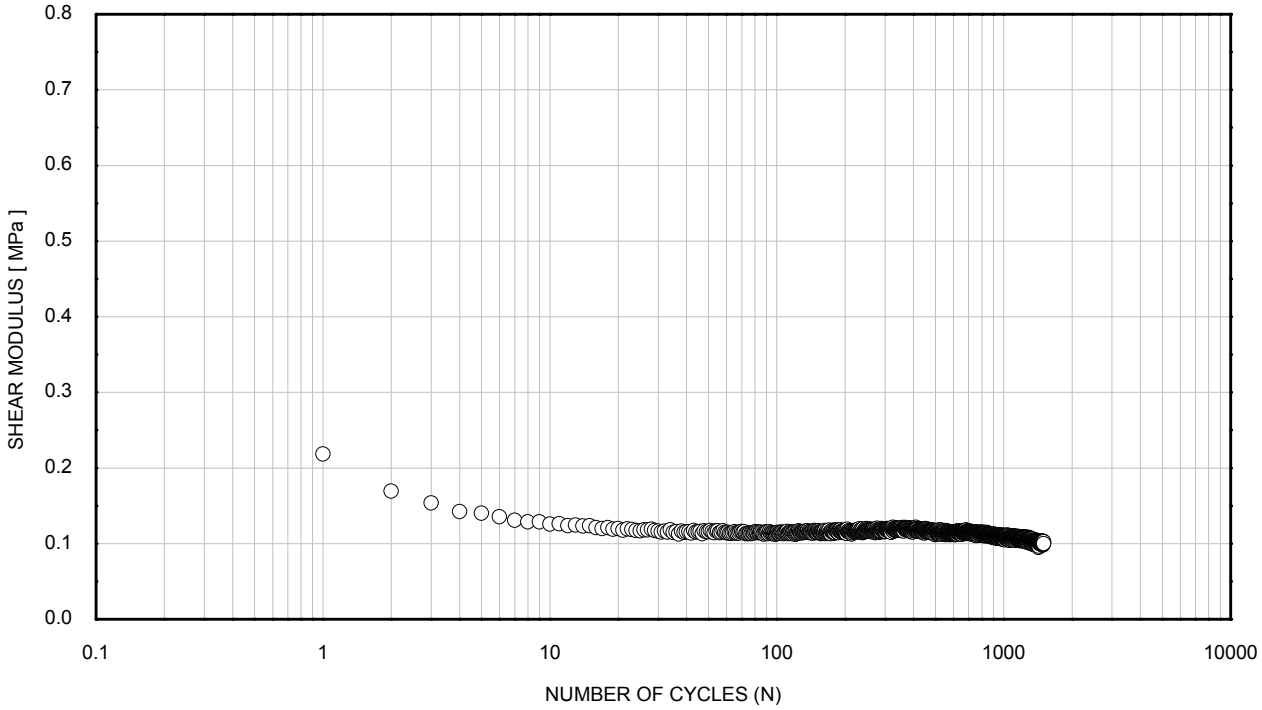
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

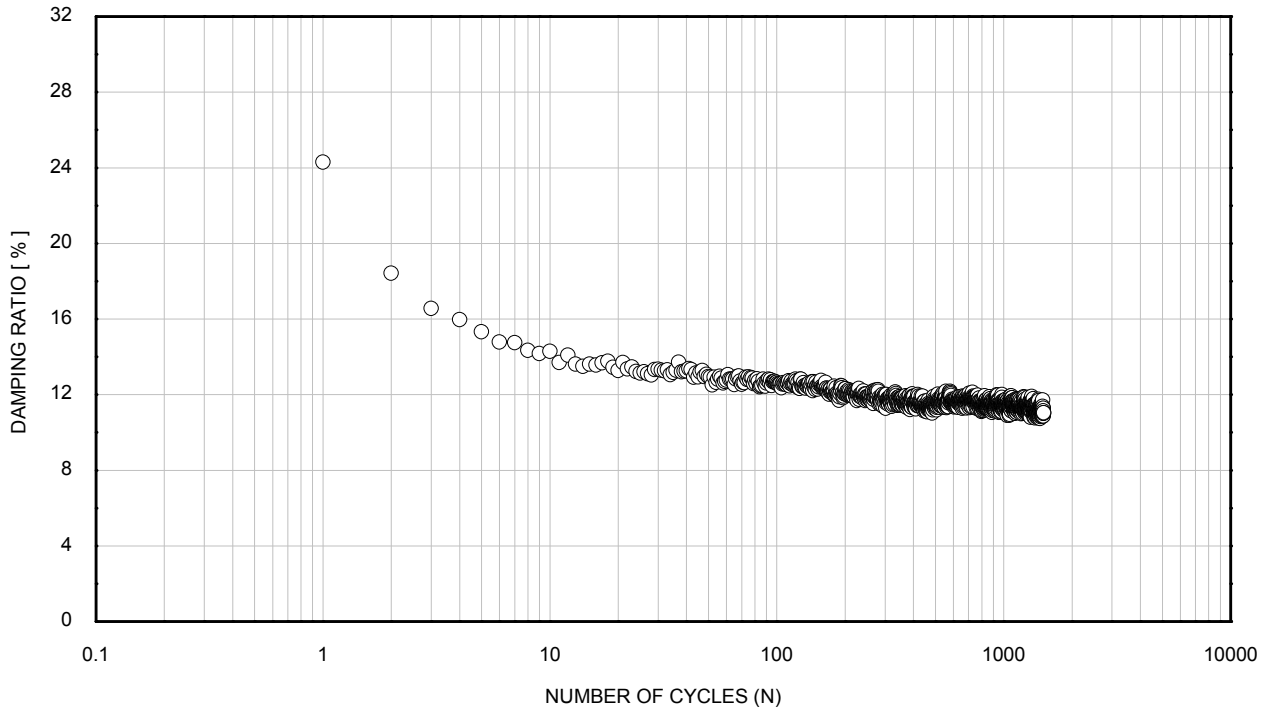




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	5 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

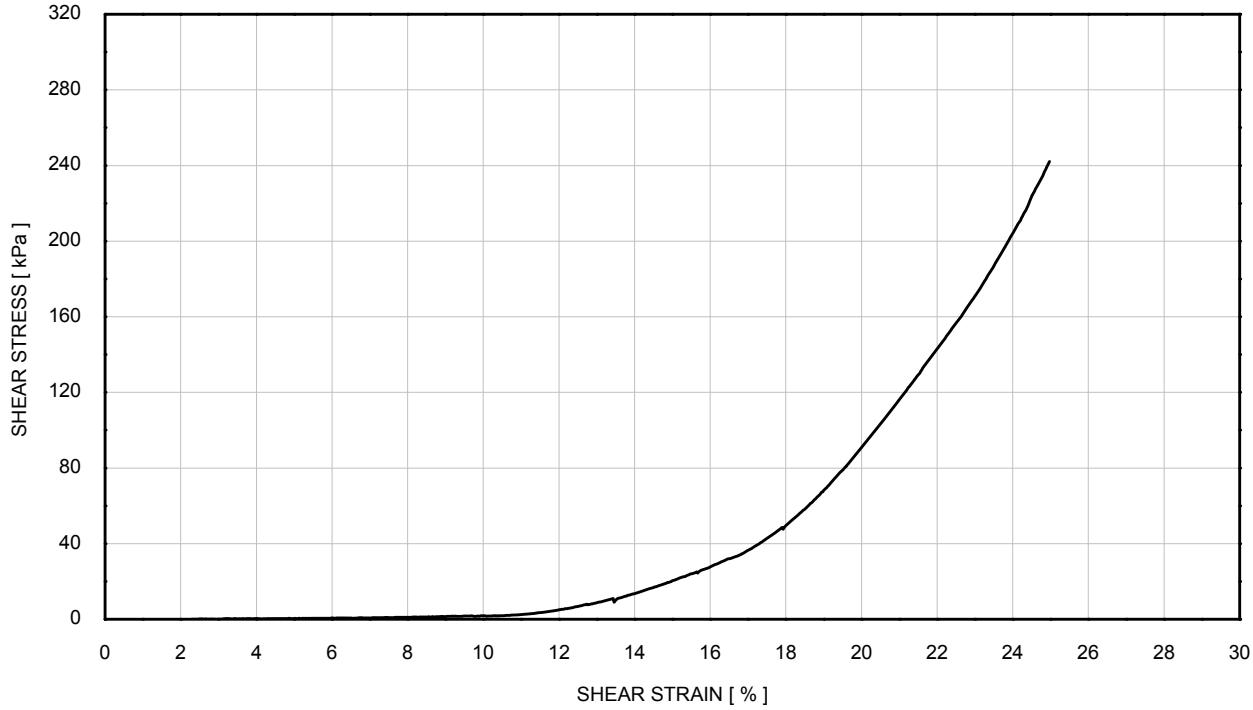
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

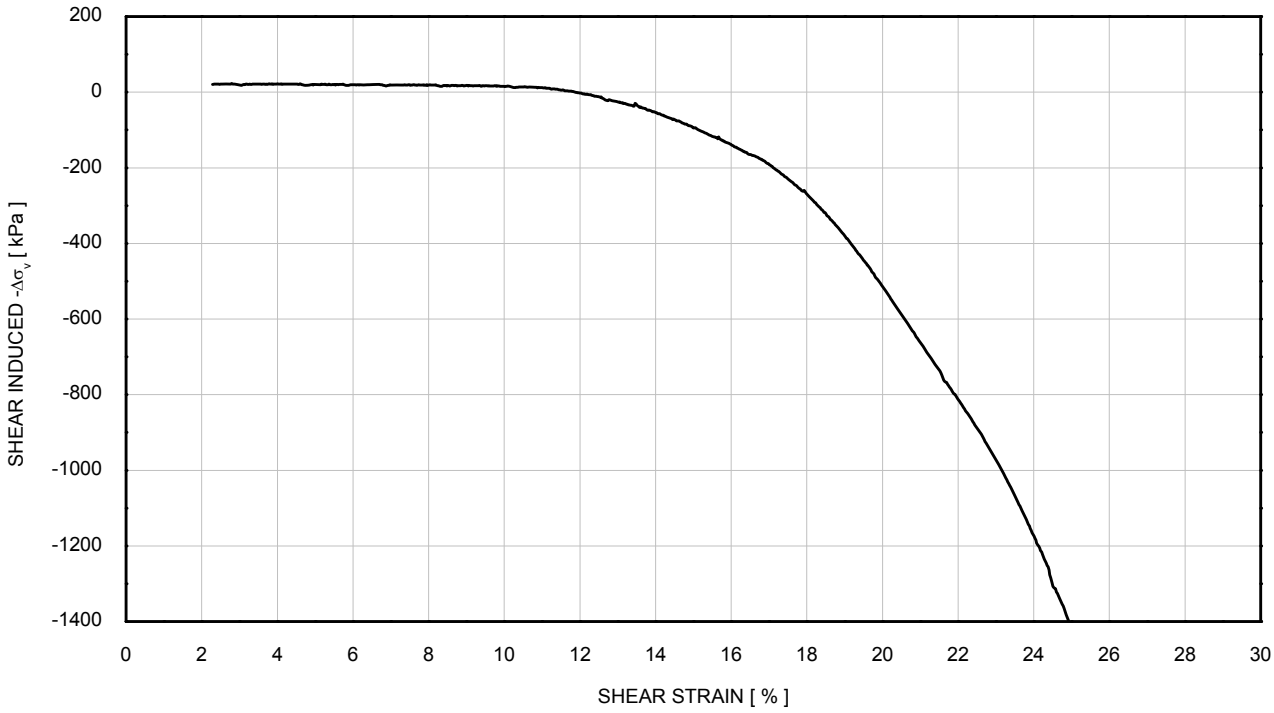




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-2
Mean τ_{cy}	:	5 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS02

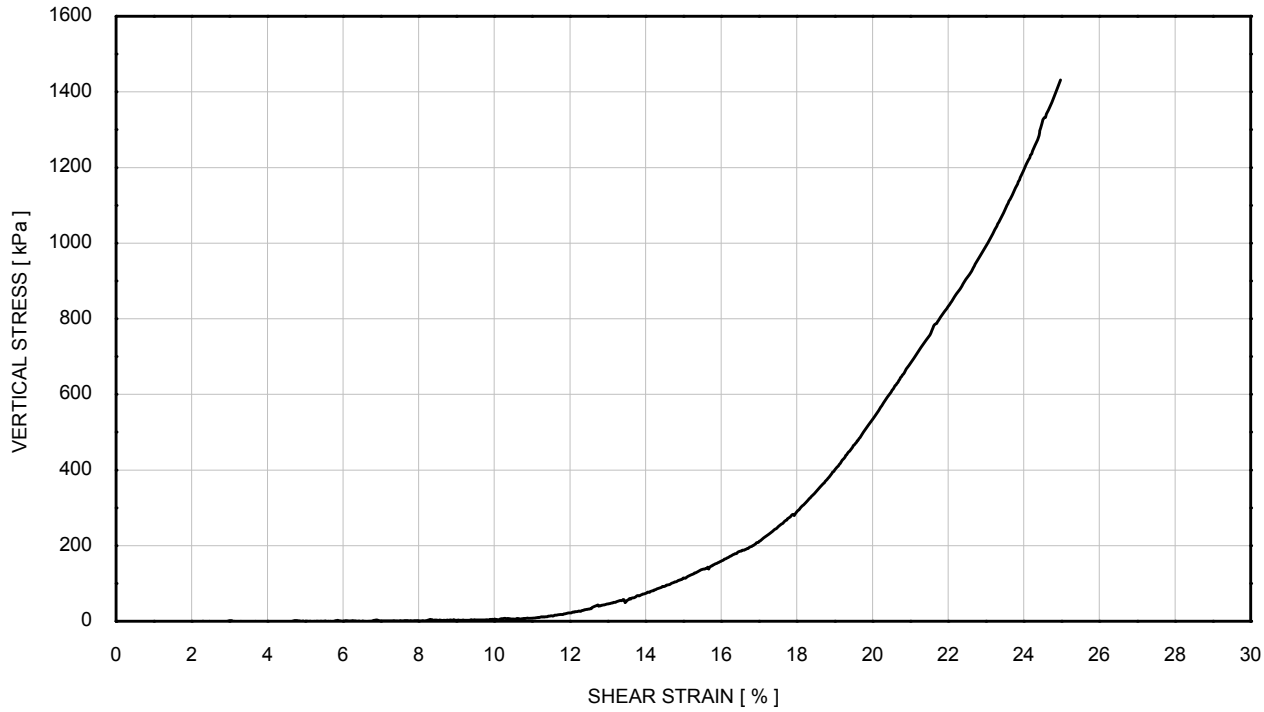
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

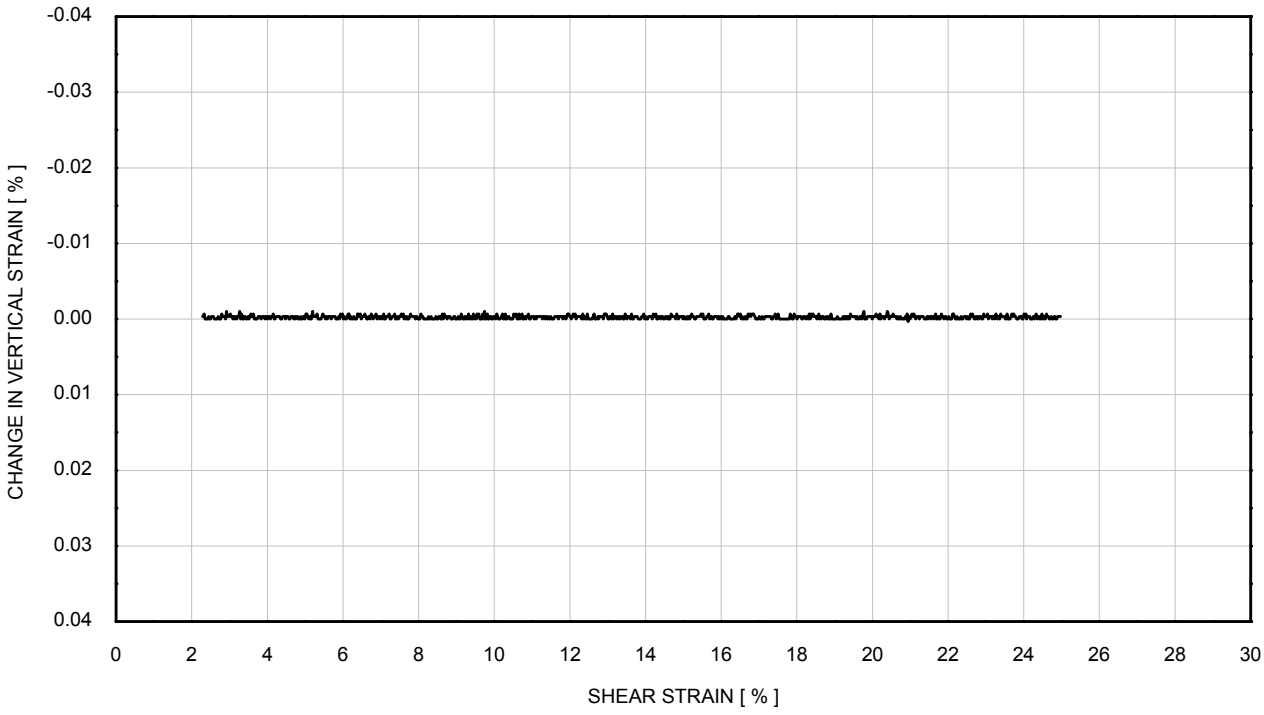




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 242 kPa	Sample	: CSS_2-2
γ at τ_{peak}	: 24.97 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.98 %/hour	Test No.	: CSS02

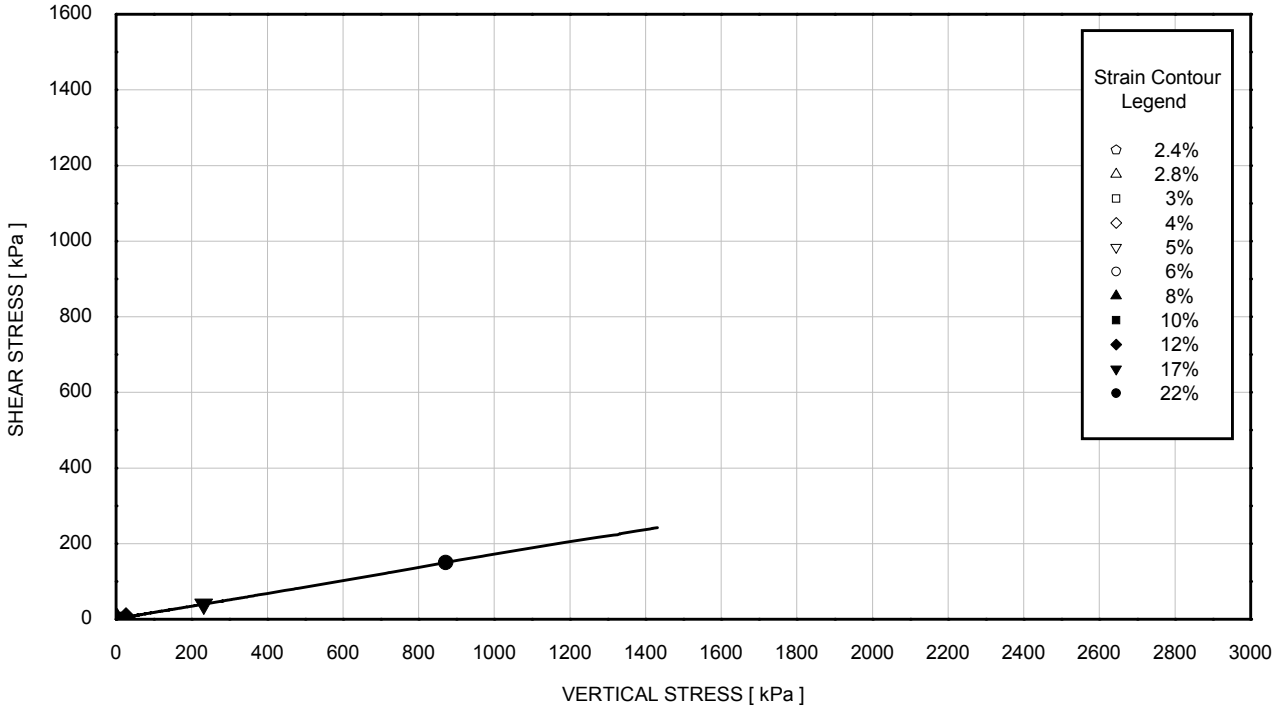
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

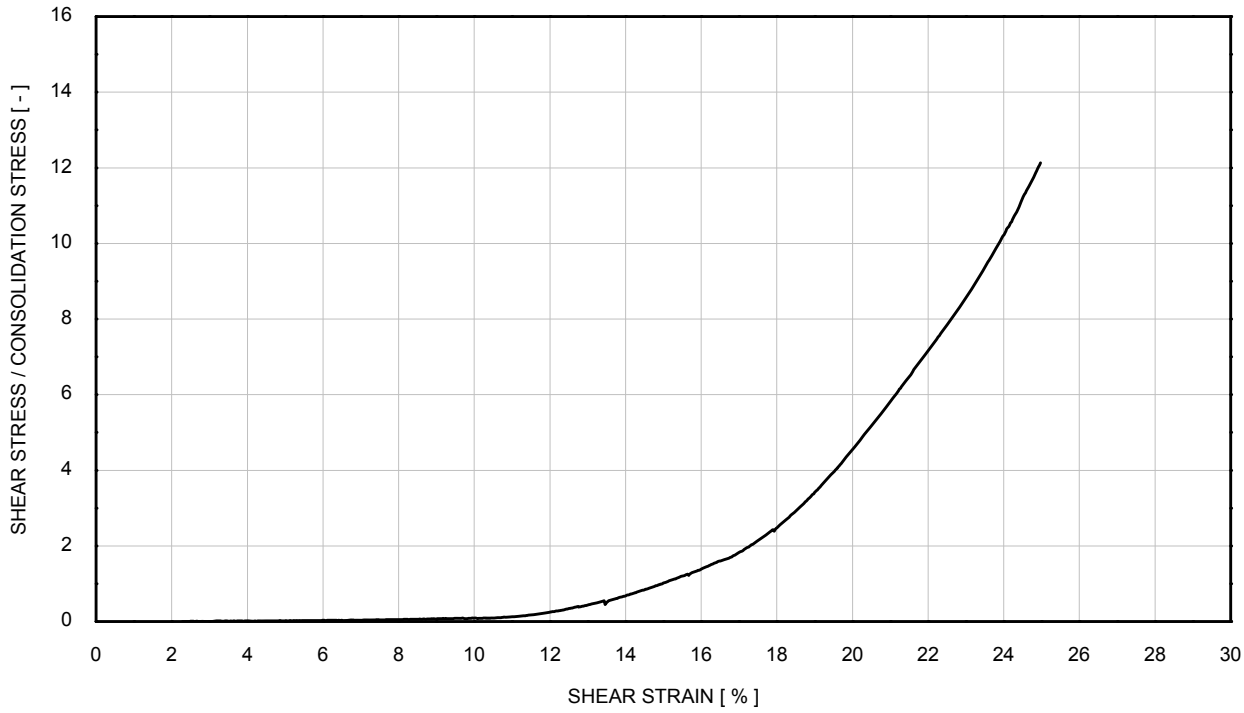




σ_{vc}	:	20 kPa	Batch	:	2
τ_{peak}	:	242 kPa	Sample	:	CSS_2-2
γ at τ_{peak}	:	24.97 %	Unit	:	Unit A (Southern Bight)
Rate of strain	:	2.98 %/hour	Test No.	:	CSS02

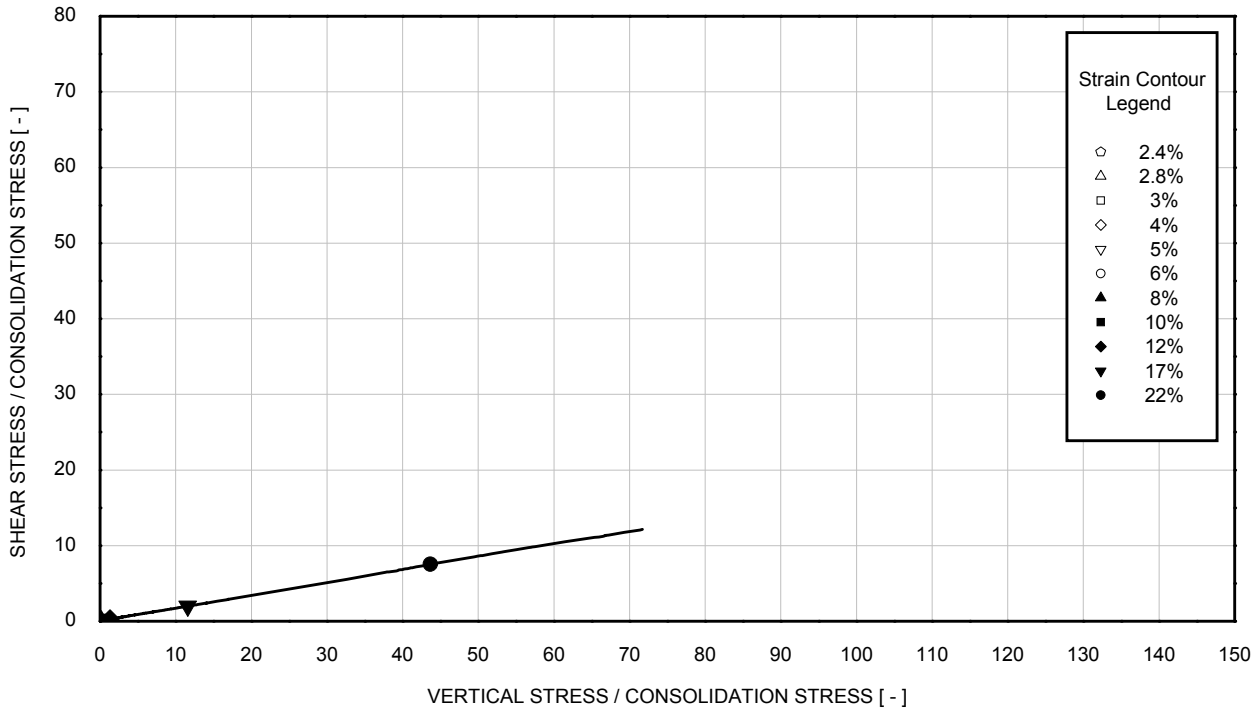
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

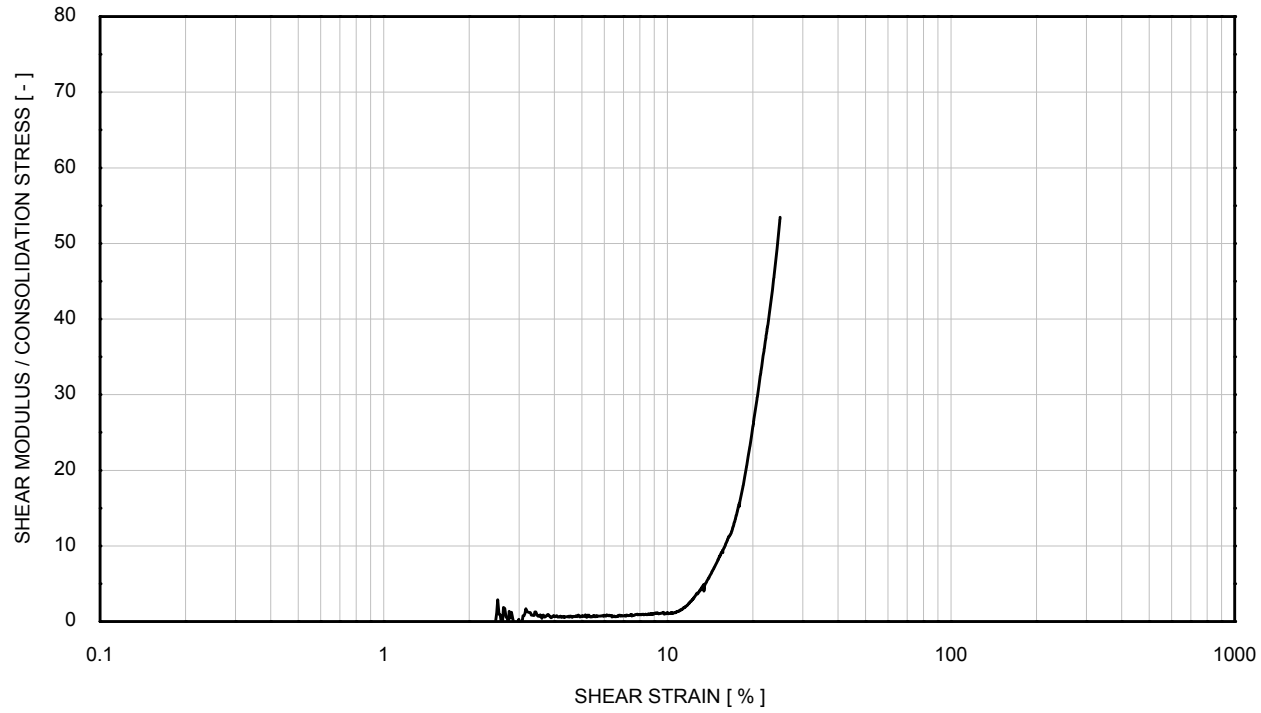




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 242 kPa	Sample	: CSS_2-2
γ at τ_{peak}	: 24.97 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.98 %/hour	Test No.	: CSS02

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 20	kPa	Batch	: 2
τ_{peak}	: 242	kPa	Sample	: CSS_2-2
γ at τ_{peak}	: 24.97	%	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.98	%/hour	Test No.	: CSS02

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown silty fine SAND with few shell fragments

GENERAL	
Date test started	28/11/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.2
Length	[mm]	30.0
Water content after compaction	[%]	10.6
Bulk density after compaction	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.615
Degree of saturation after compaction	[%]	46
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	23.2
Bulk density at start of test	[Mg/m³]	2.02
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 2_CSS03
Template issue	1.4
Processed by Date	JLS 30/11/2016
Checked by Date	PH 01/12/2016
Approved by Date	PH 01/12/2016

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-3
Unit	Unit A (Southern Bight)
Test number	CSS03

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	20
Vertical strain	[%]	1.67
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.588
Water content	[%]	22.2

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	20
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	1
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.72
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.588

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.33	0.01	7.37	9.38
2	0.33	0.01	7.87	7.00
5	0.33	0.01	8.22	6.24
10	0.32	0.01	8.38	5.33
20	0.32	0.01	7.98	4.64
50	0.31	0.01	8.52	4.38
100	0.30	0.01	8.52	2.74
200	0.30	0.01	8.72	3.67
300	0.29	0.01	8.72	2.82
400	0.29	0.01	8.72	2.90

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-3
Unit	Unit A (Southern Bight)
Test number	CSS03

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	17
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	382
γ_{av} at N_f	[%]	-3.68
γ_{cy} at N_f	[%]	15.03
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	5
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-2.36	7.13	0.23	13.21
2	-2.53	8.15	0.20	10.28
5	-2.77	9.40	0.18	8.92
10	-2.90	10.49	0.16	8.51
20	-2.93	11.78	0.14	7.04
50	-3.03	13.37	0.12	6.98
100	-3.44	14.19	0.12	6.52
200	-3.50	14.65	0.11	6.90
300	-3.78	14.86	0.11	6.68
382	-3.68	15.03	0.11	6.87

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	378
Shear strain	[%]	29.99
Shear induced $-\Delta\sigma_v$	[kPa]	-573
Vertical stress	[kPa]	593
Vertical strain	[%]	-0.01
Rate of strain	[%/hour]	3.01
At 15 % shear strain		
Shear stress	[kPa]	45
Shear induced $-\Delta\sigma_v$	[kPa]	-50
Vertical stress	[kPa]	70
Vertical strain	[%]	-0.01

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-3
Unit	Unit A (Southern Bight)
Test number	CSS03

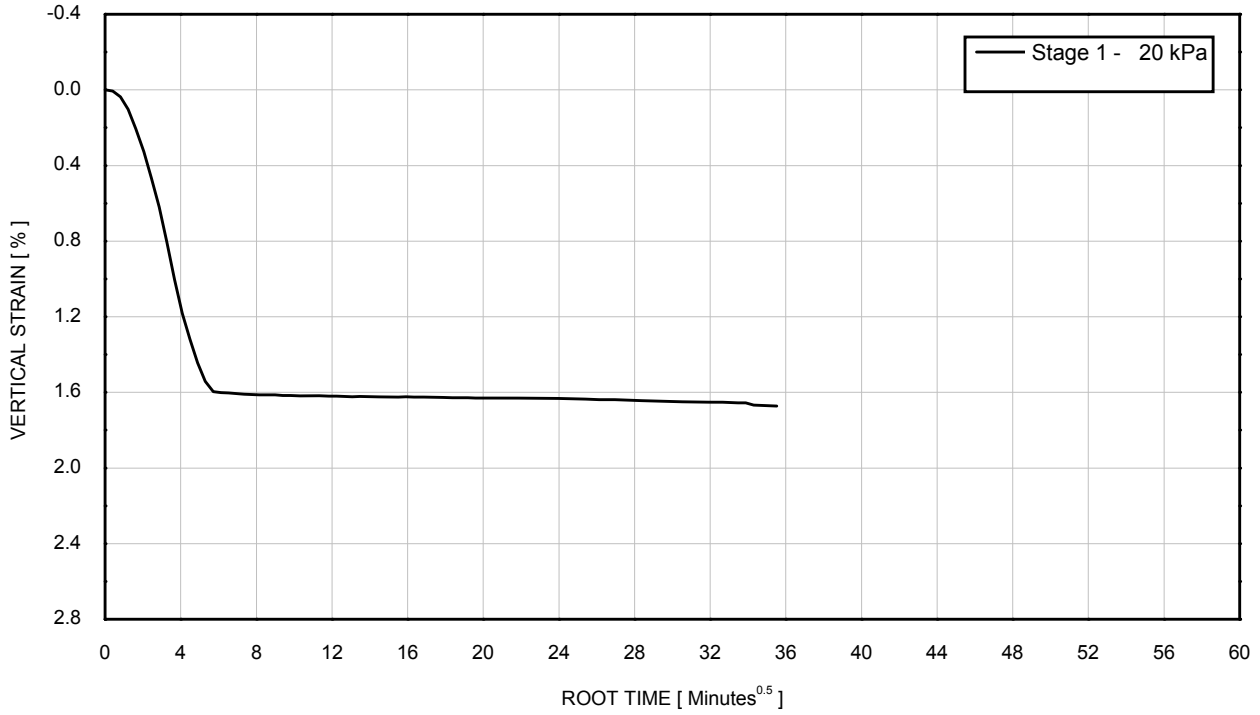
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

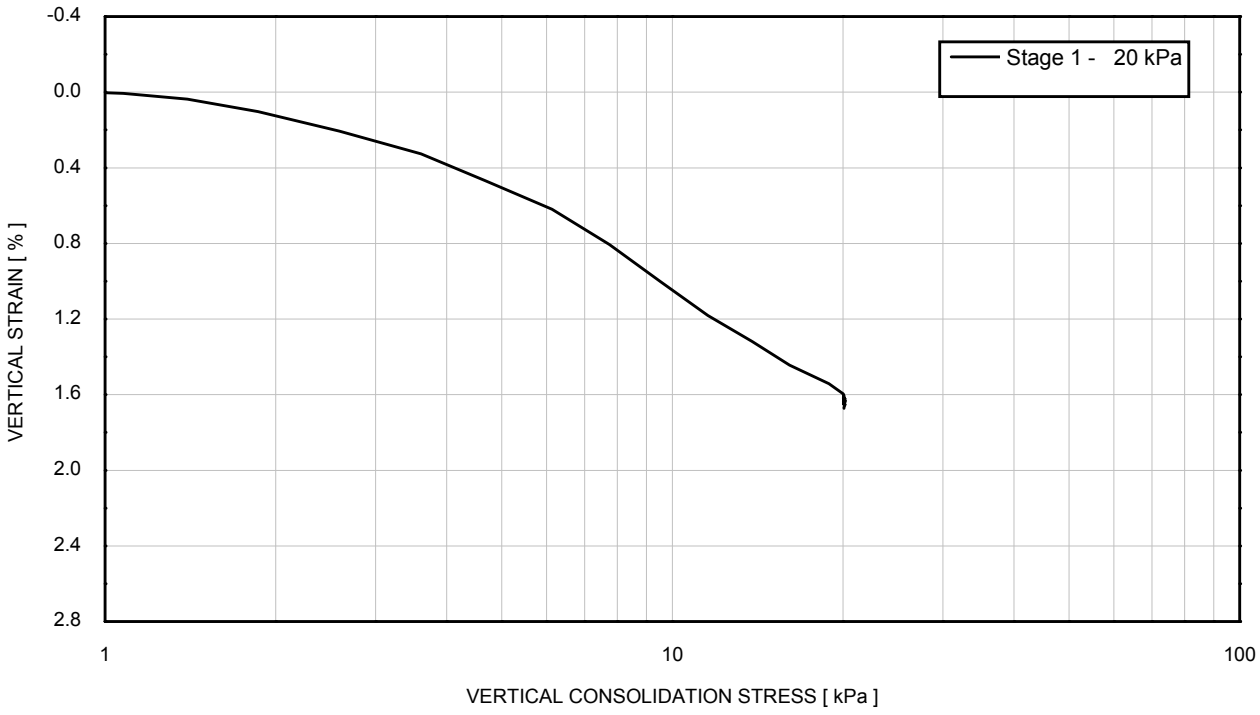
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-3
Unit	Unit A (Southern Bight)
Test number	CSS03

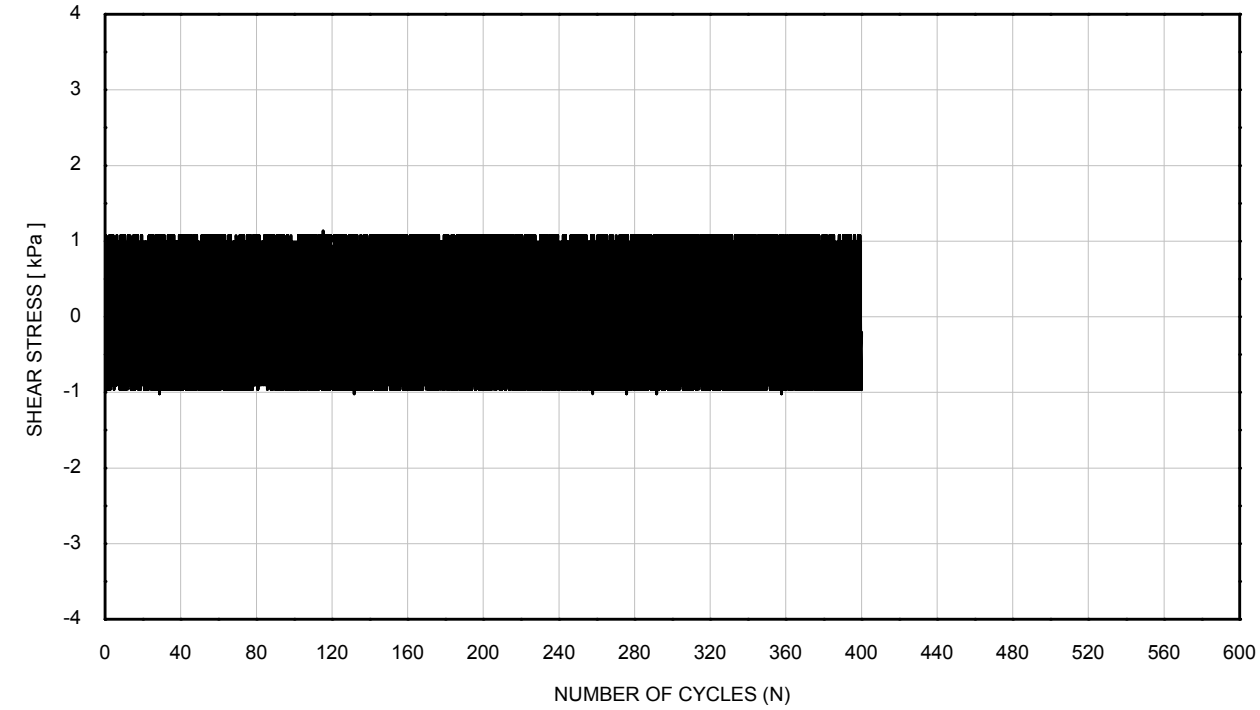
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

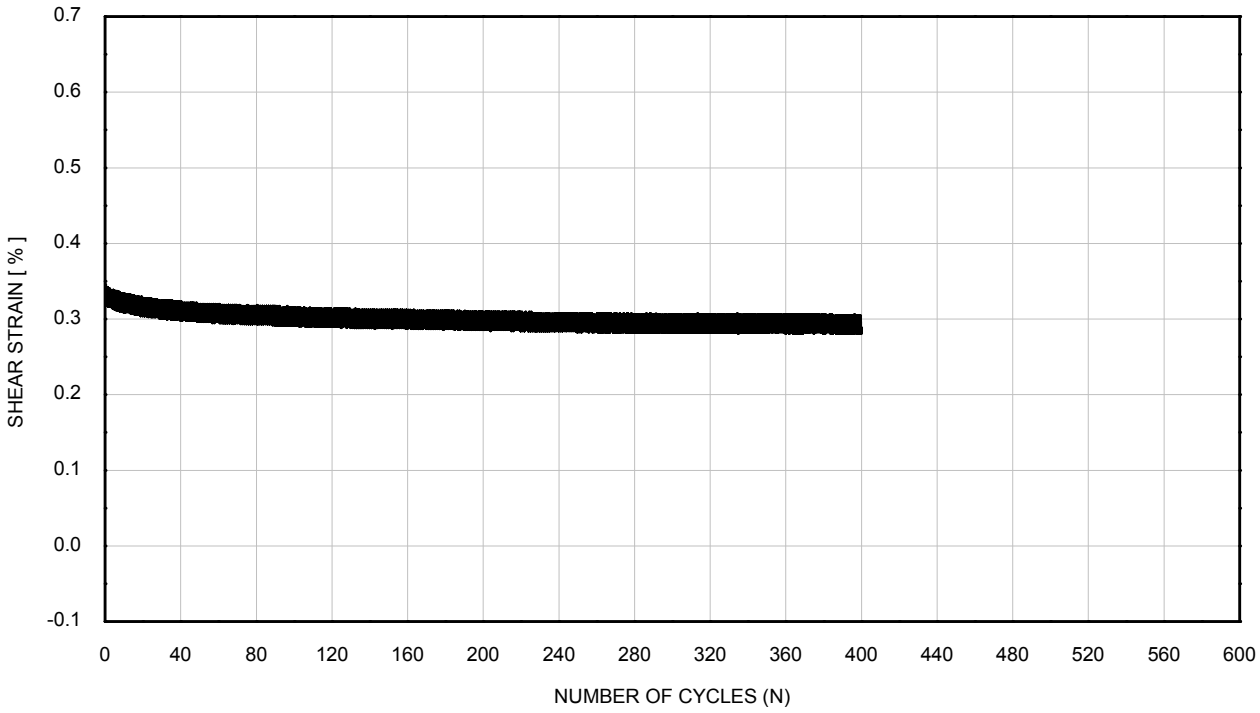




σ_{vc}	: 20 kPa	Batch	: 2
		Sample	: CSS_2-3
		Unit	: Unit A (Southern Bight)
		Test No.	: CSS03

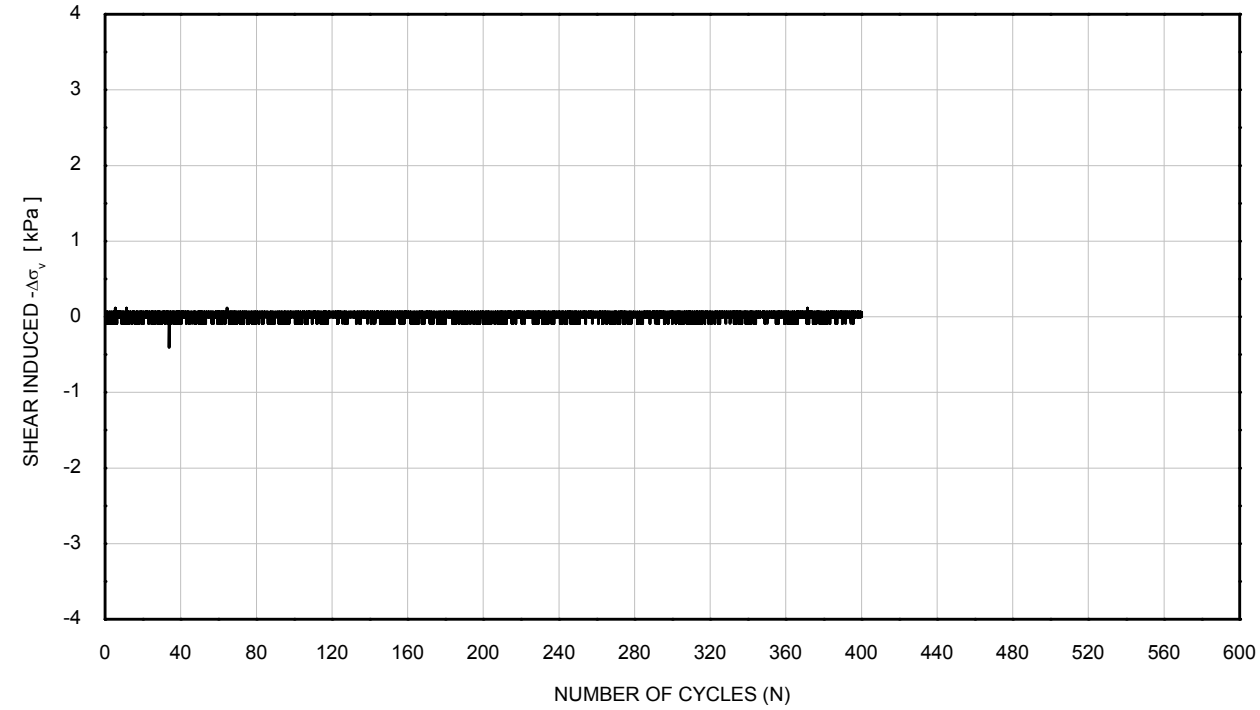
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

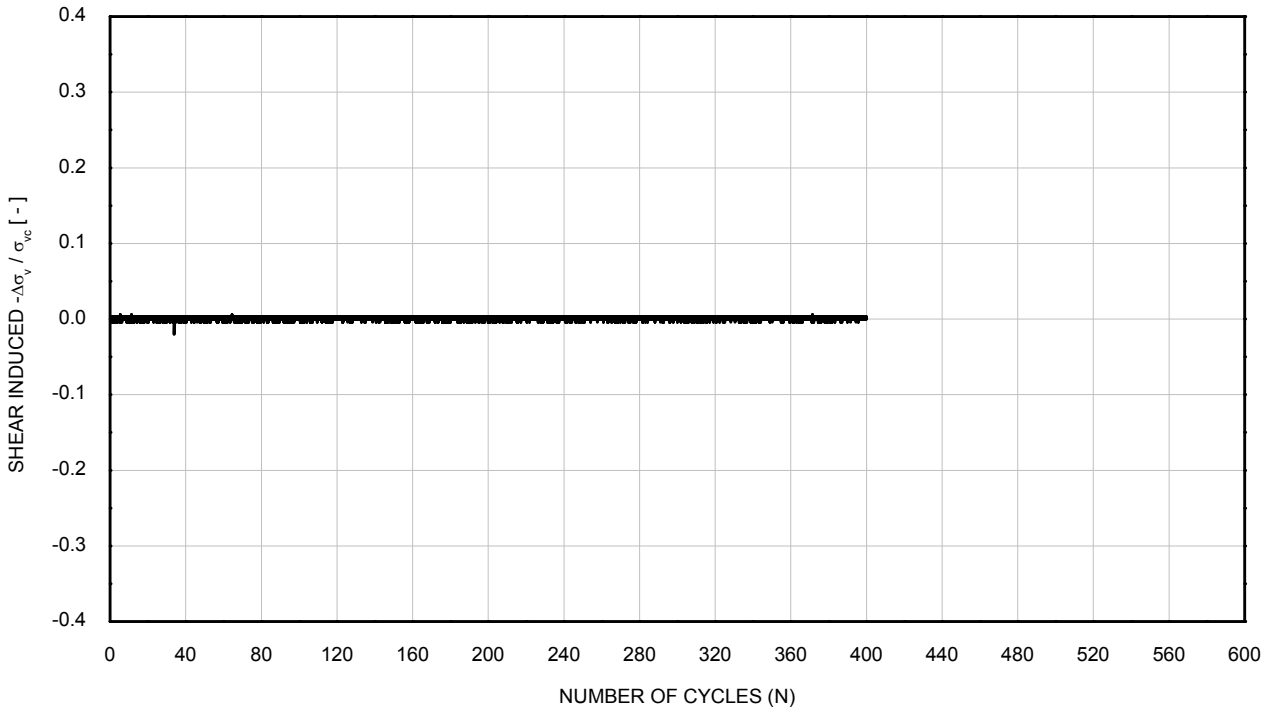




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

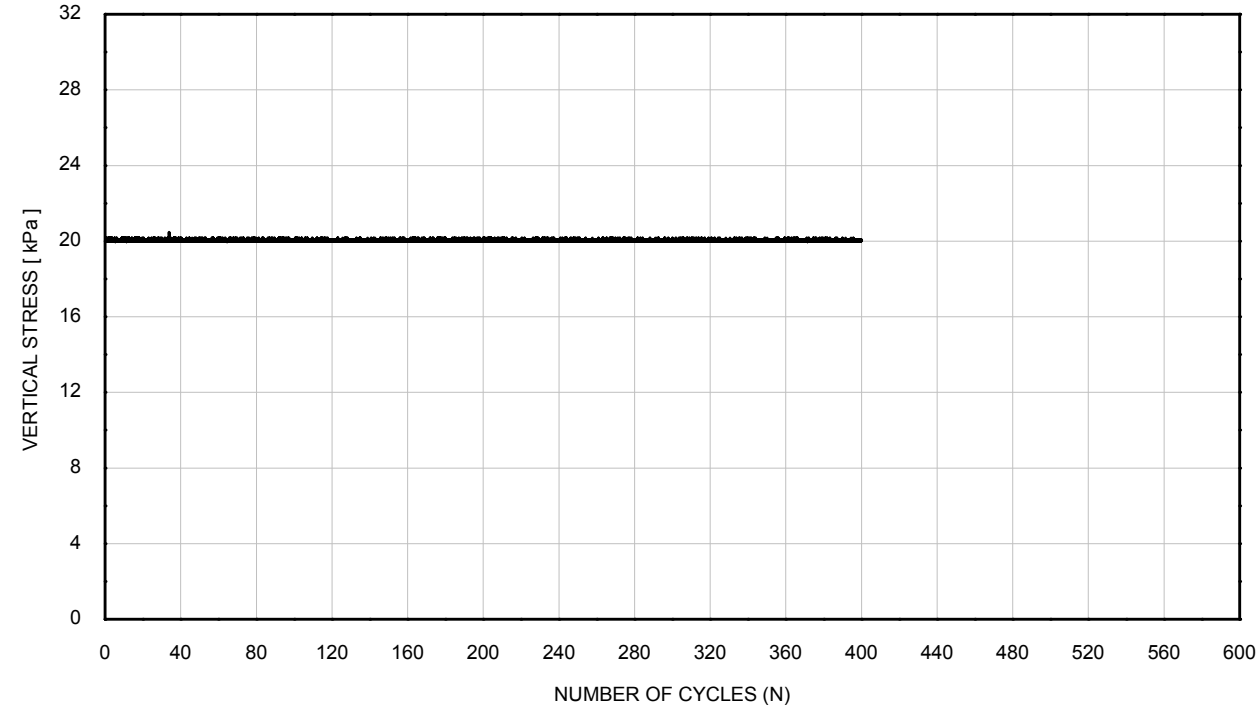
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

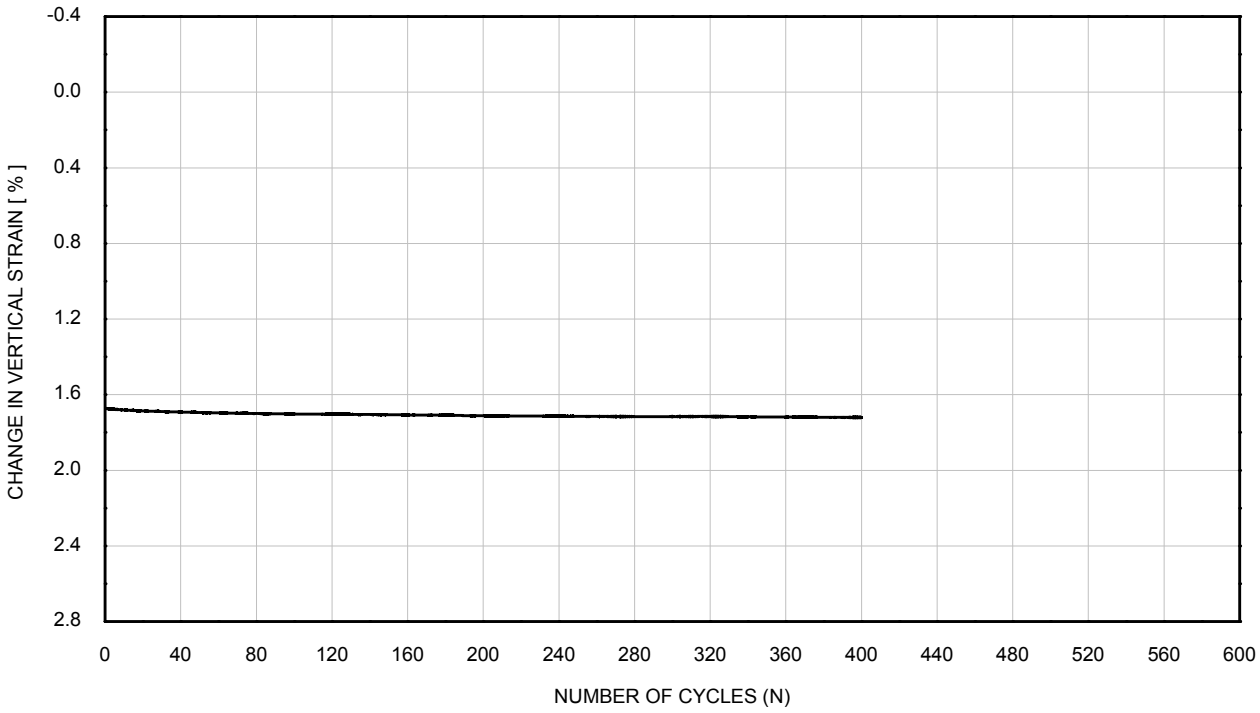




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

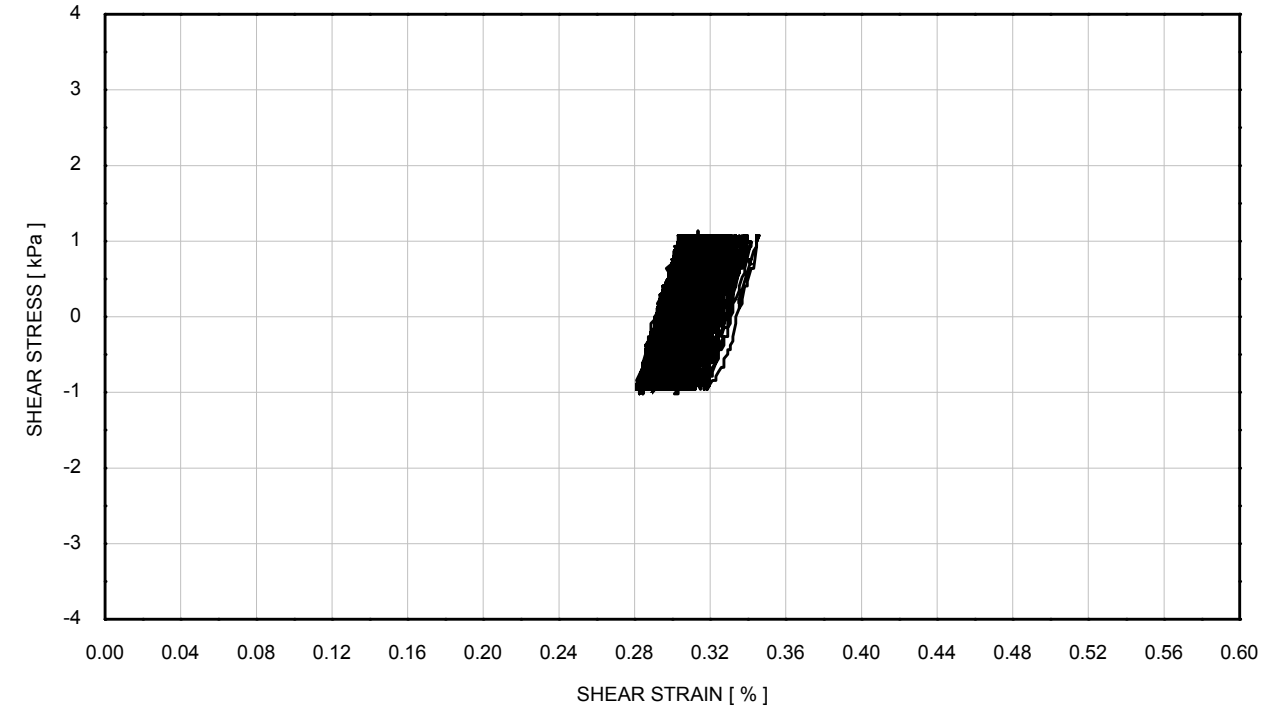
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

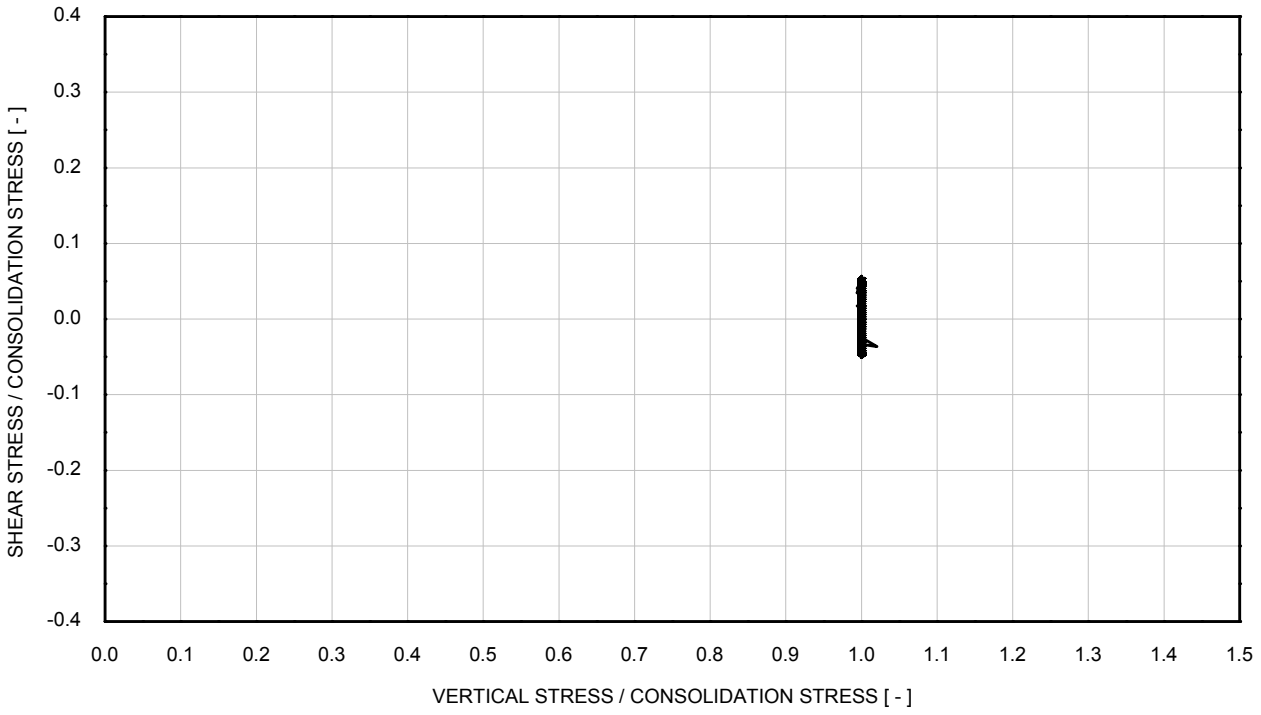




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

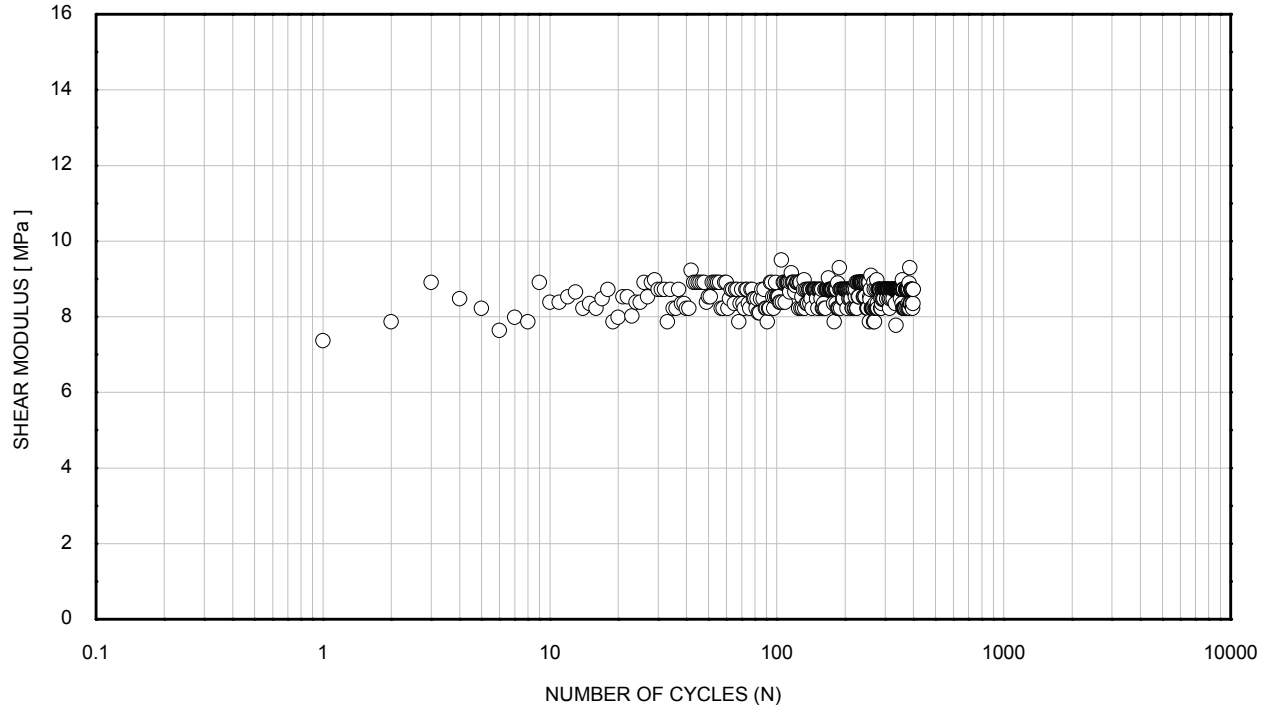
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

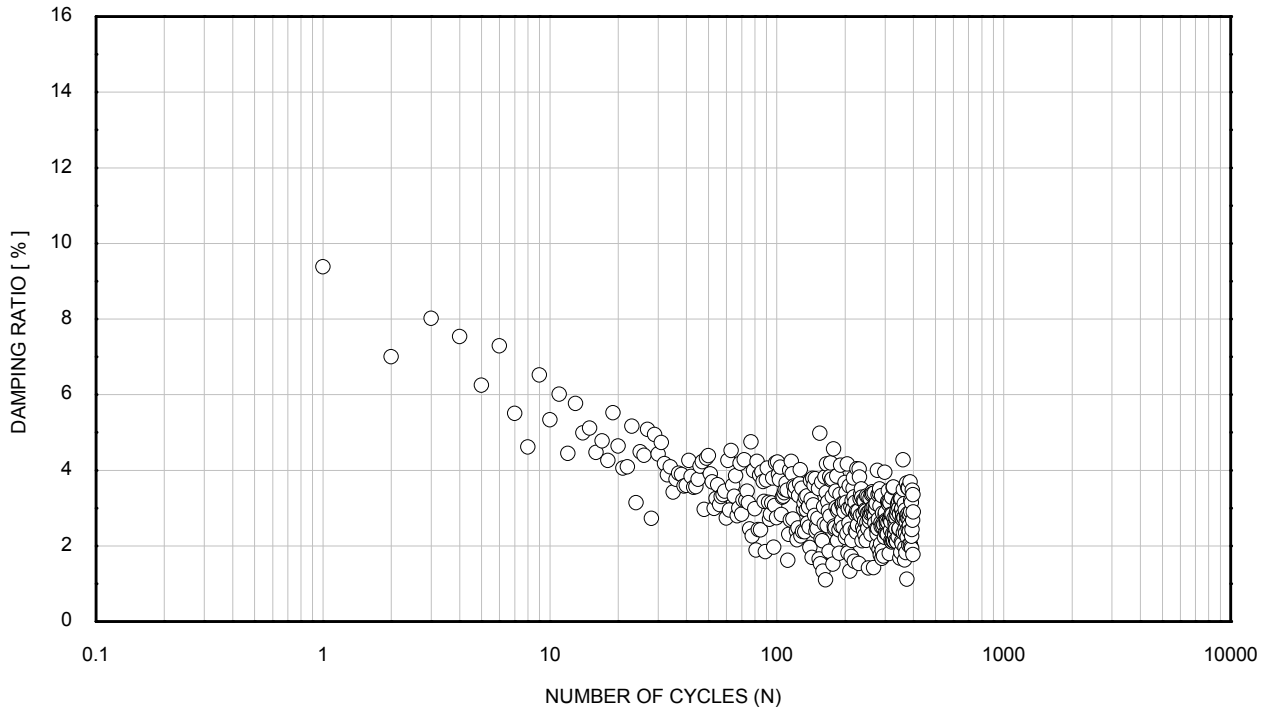




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

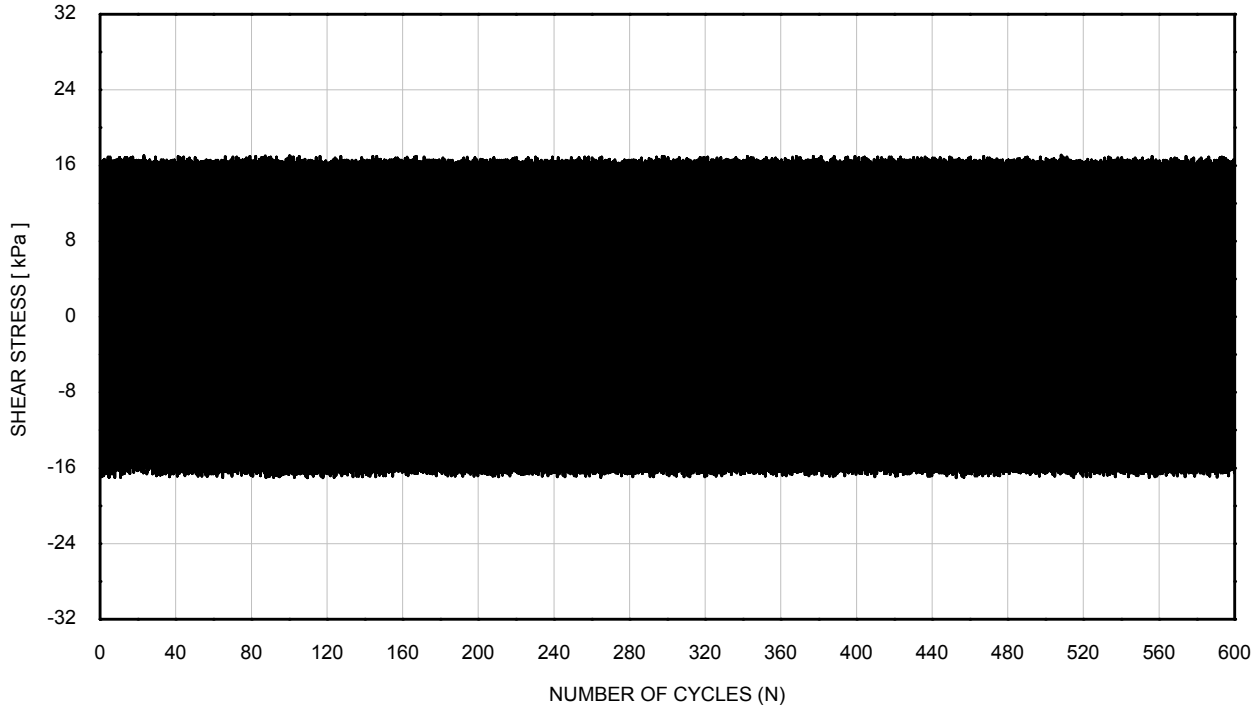
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

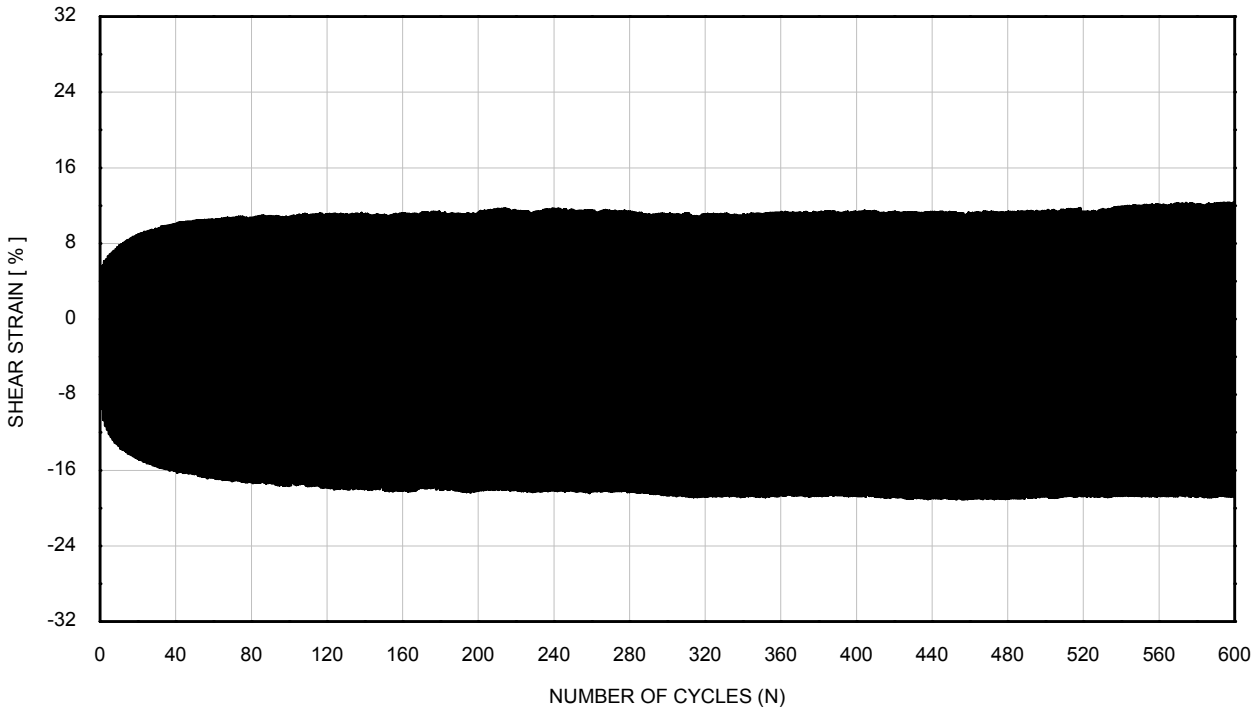




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

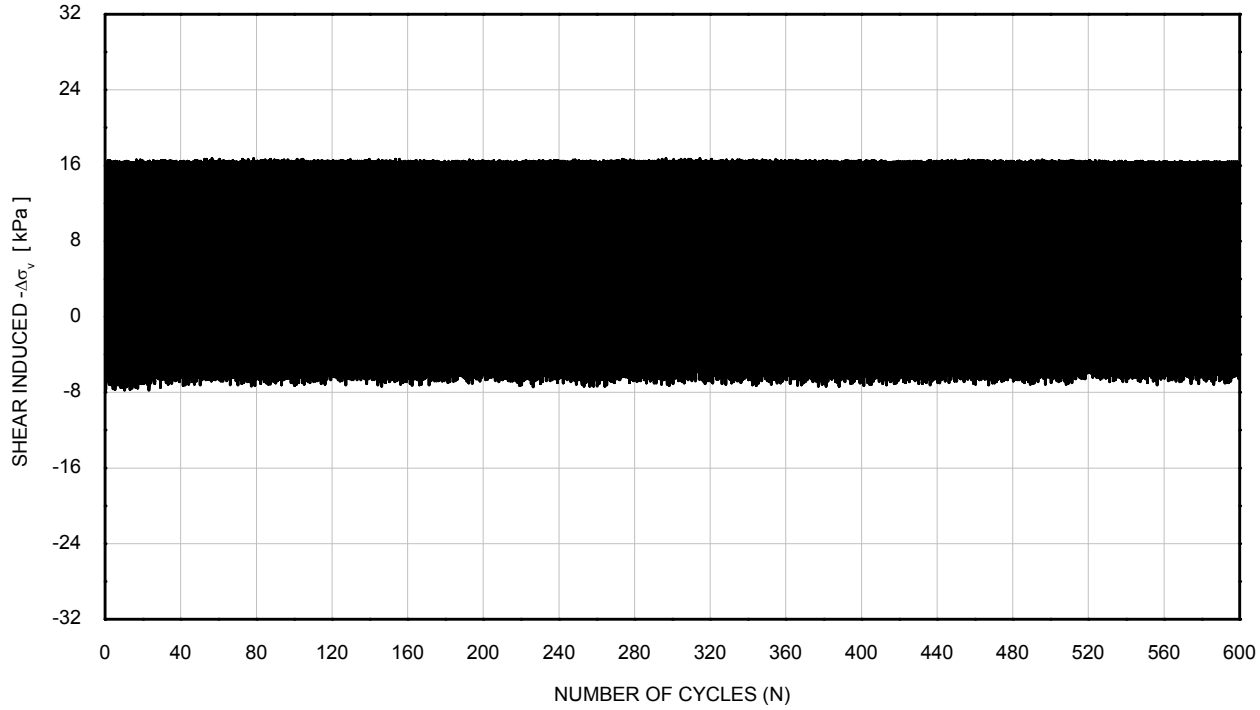
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

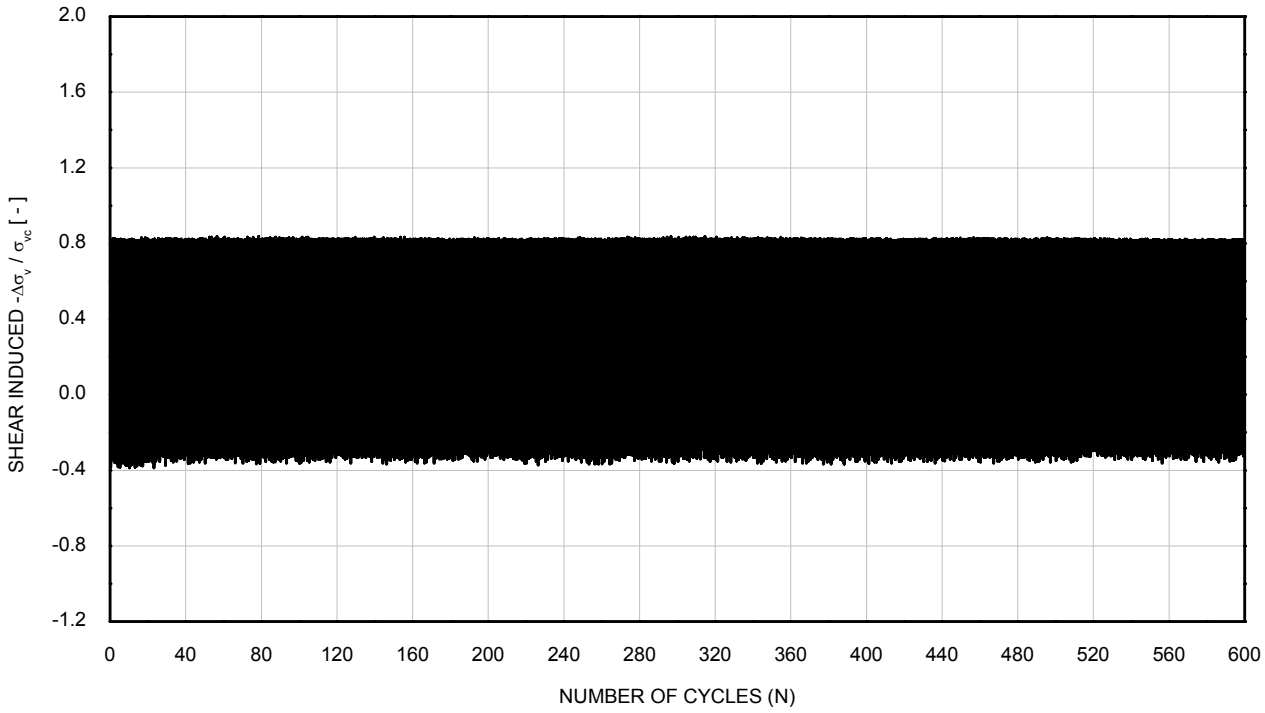




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	17 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

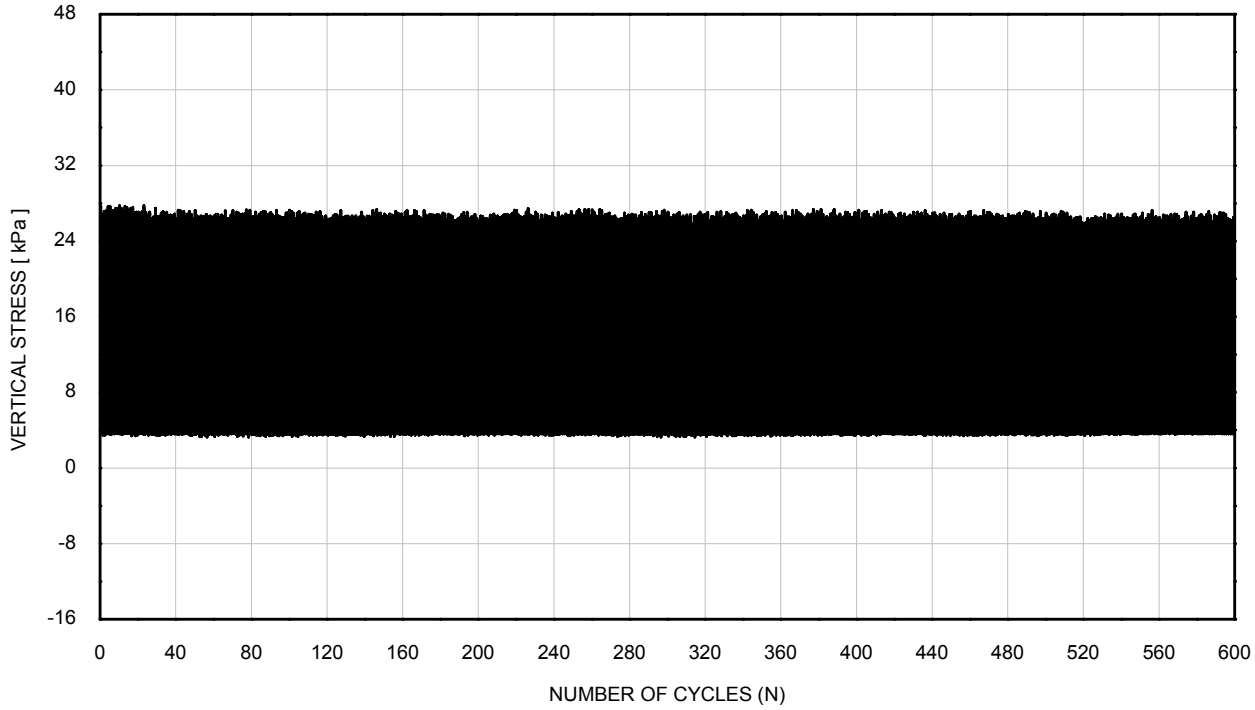
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

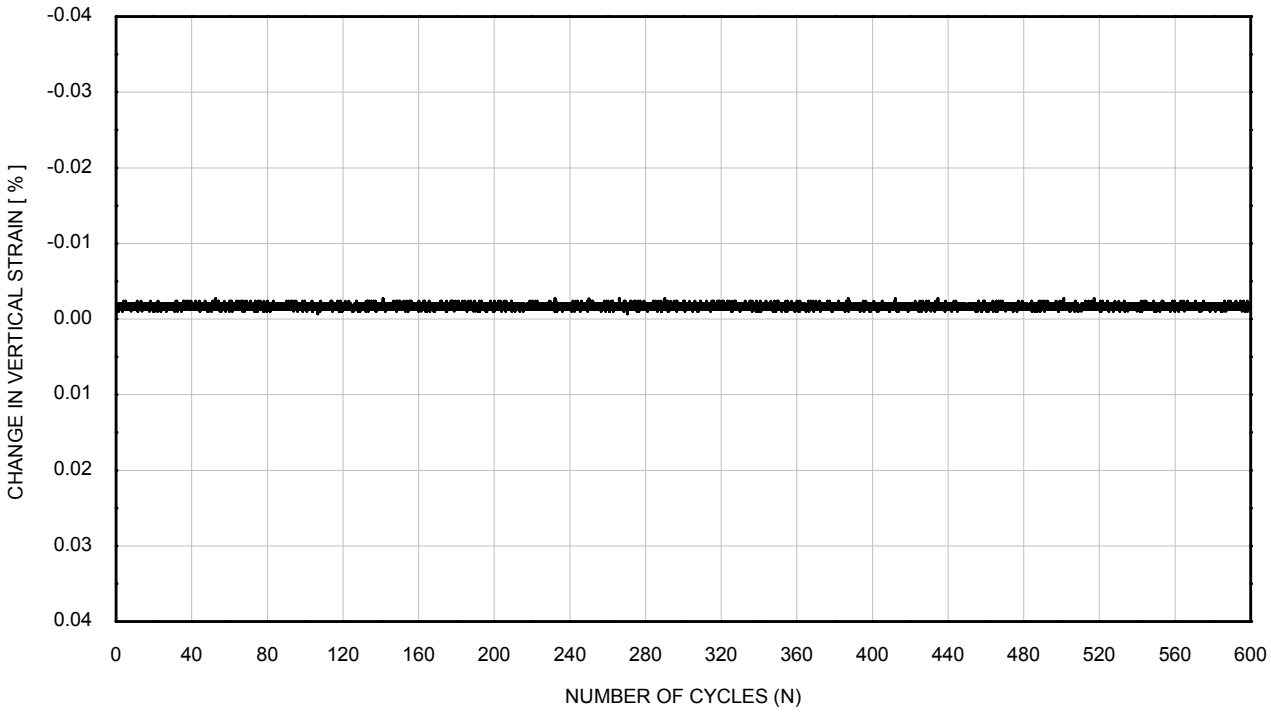




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	17 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

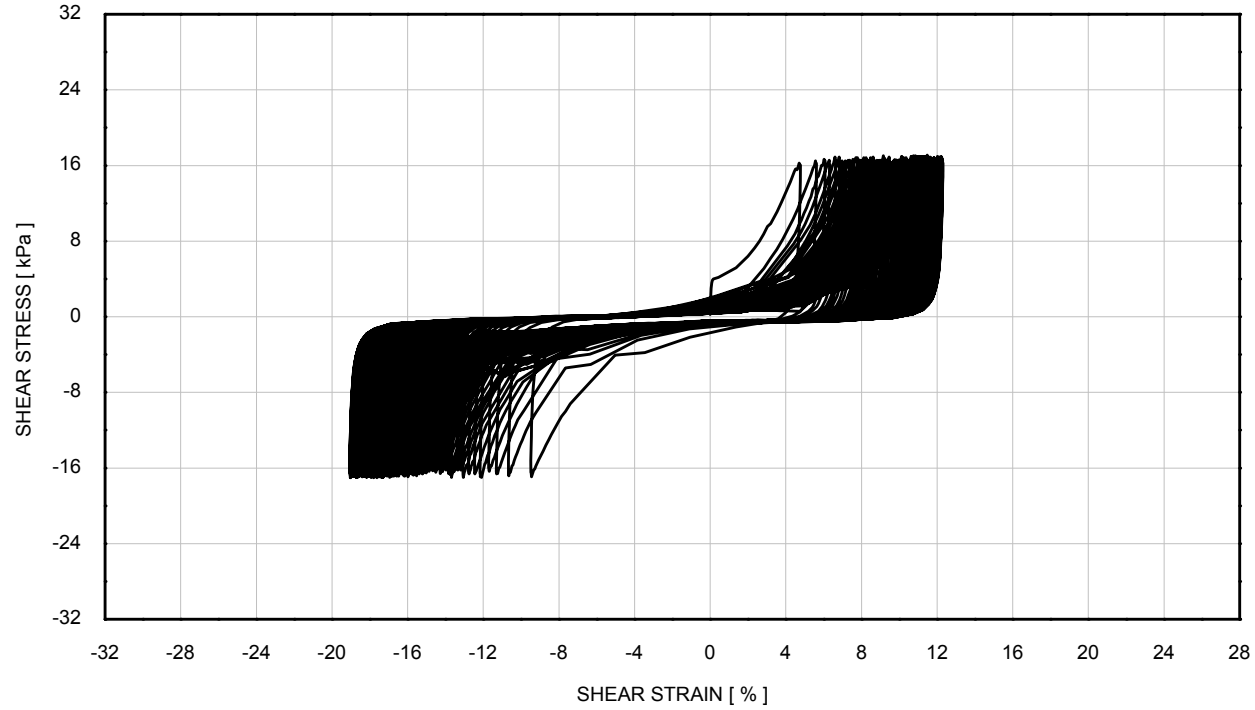
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

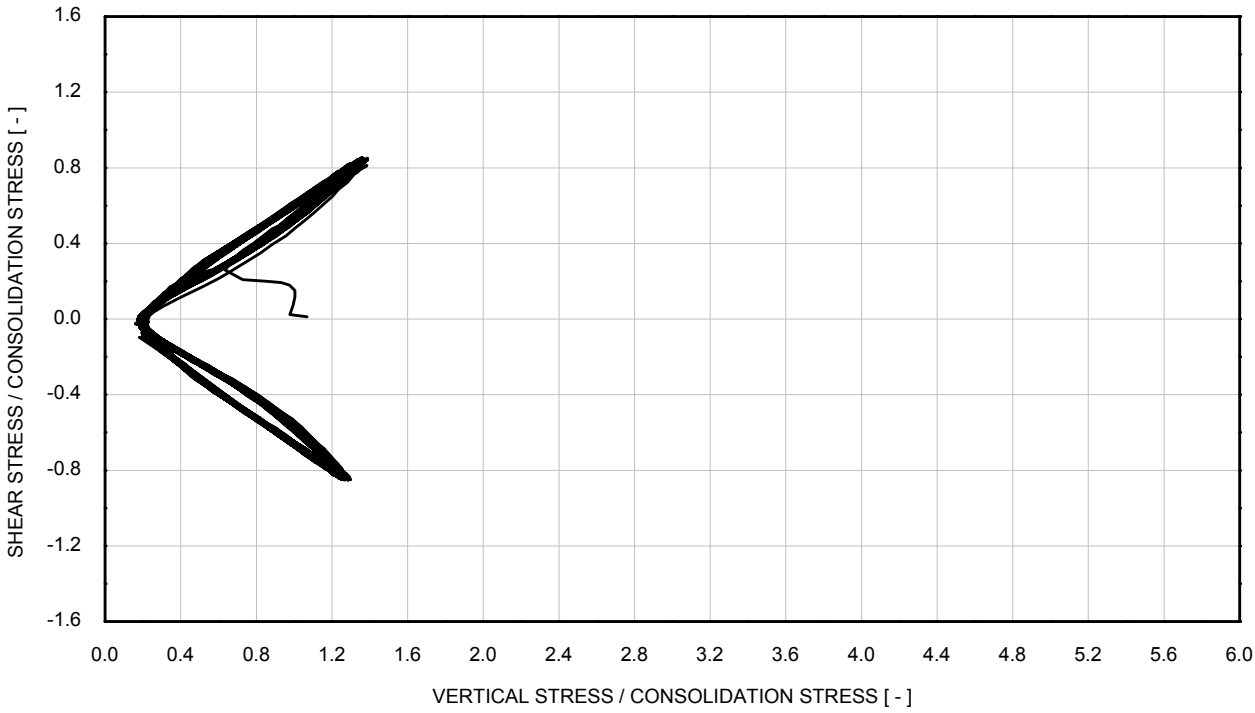




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	17 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

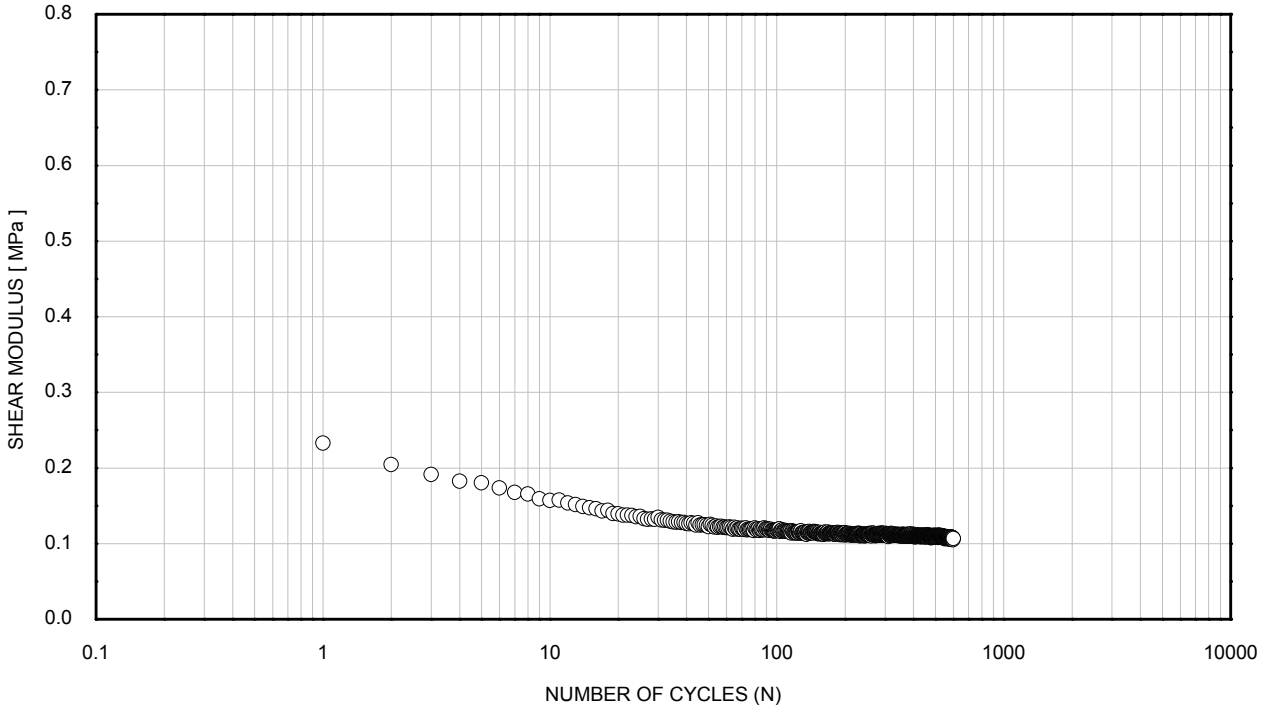
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

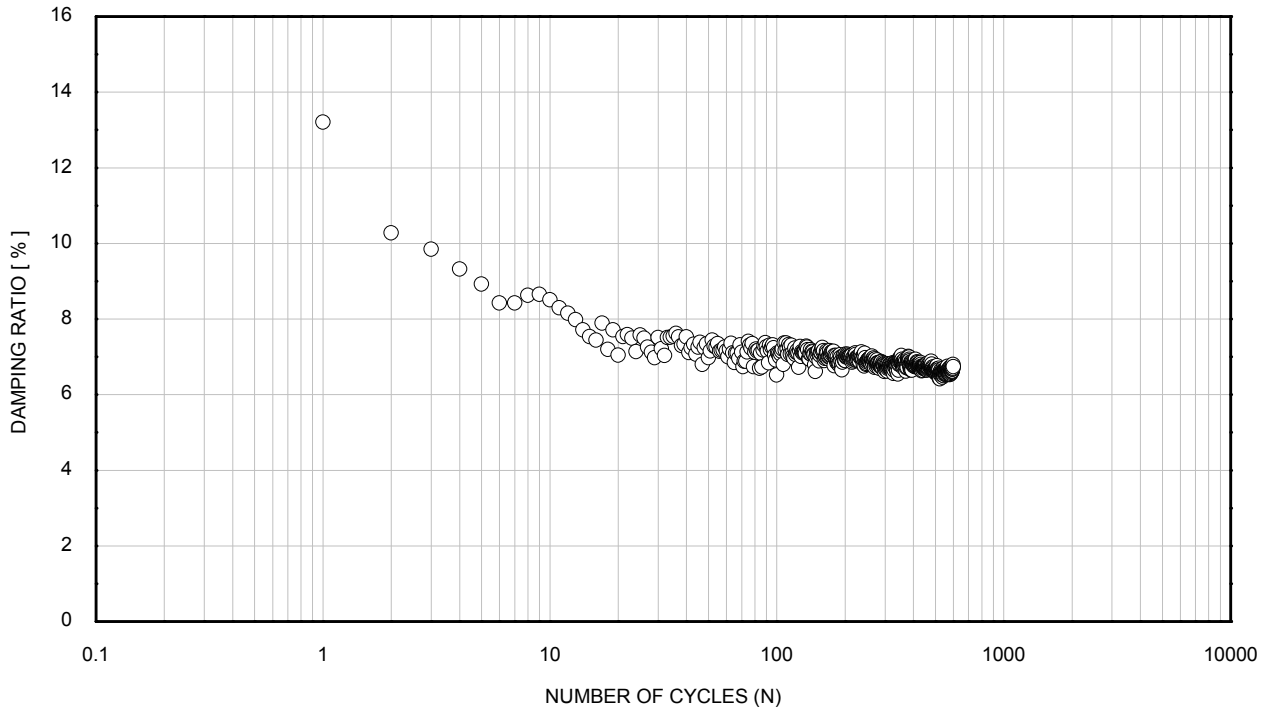




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	17 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

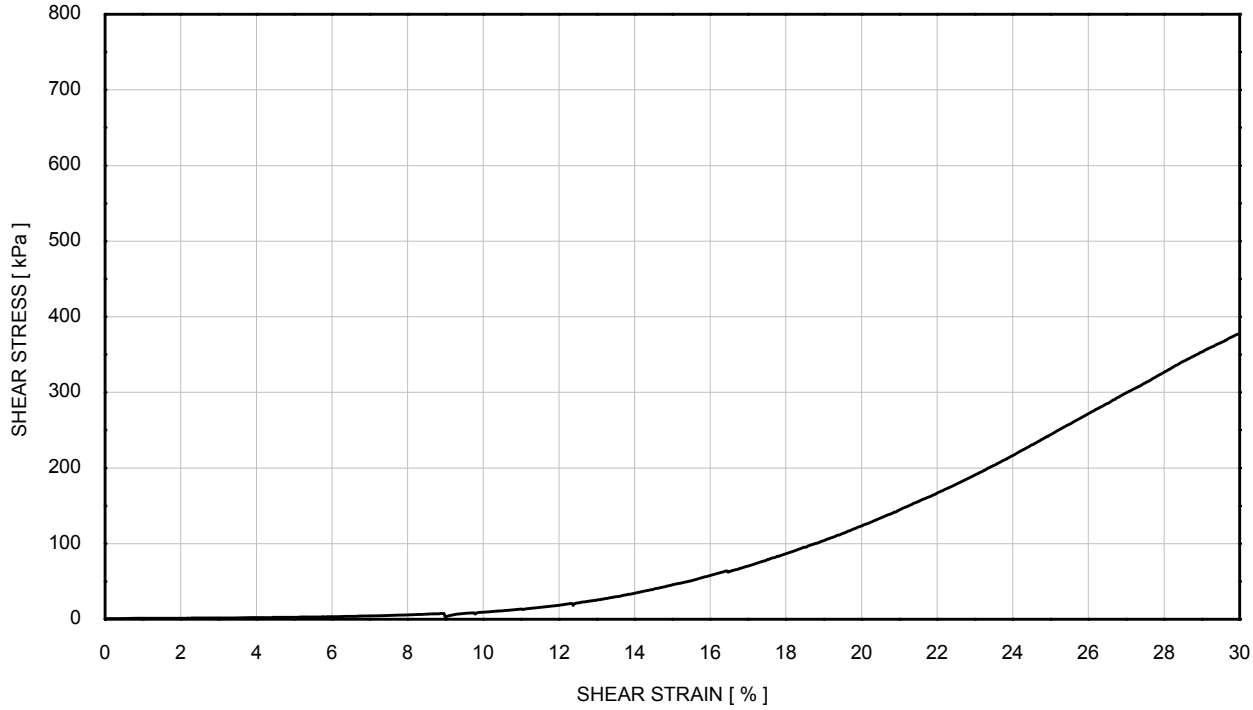
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

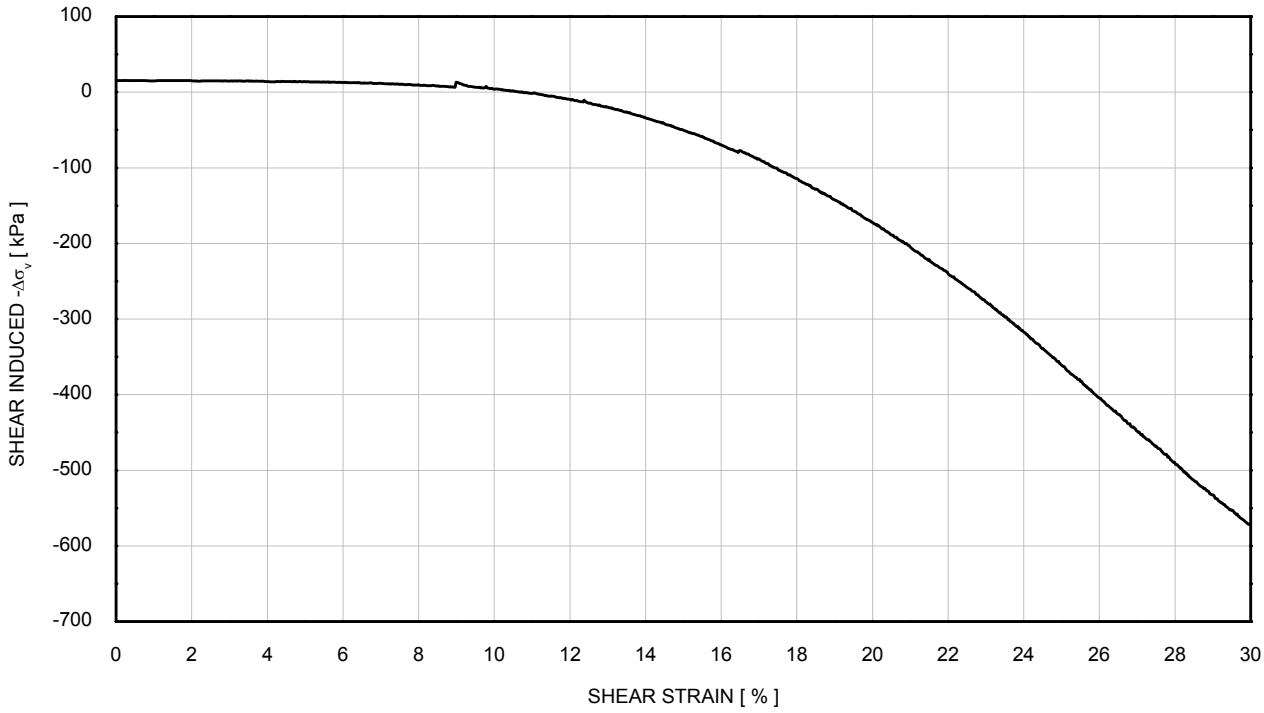




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Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-3
Mean τ_{cy}	:	17 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS03

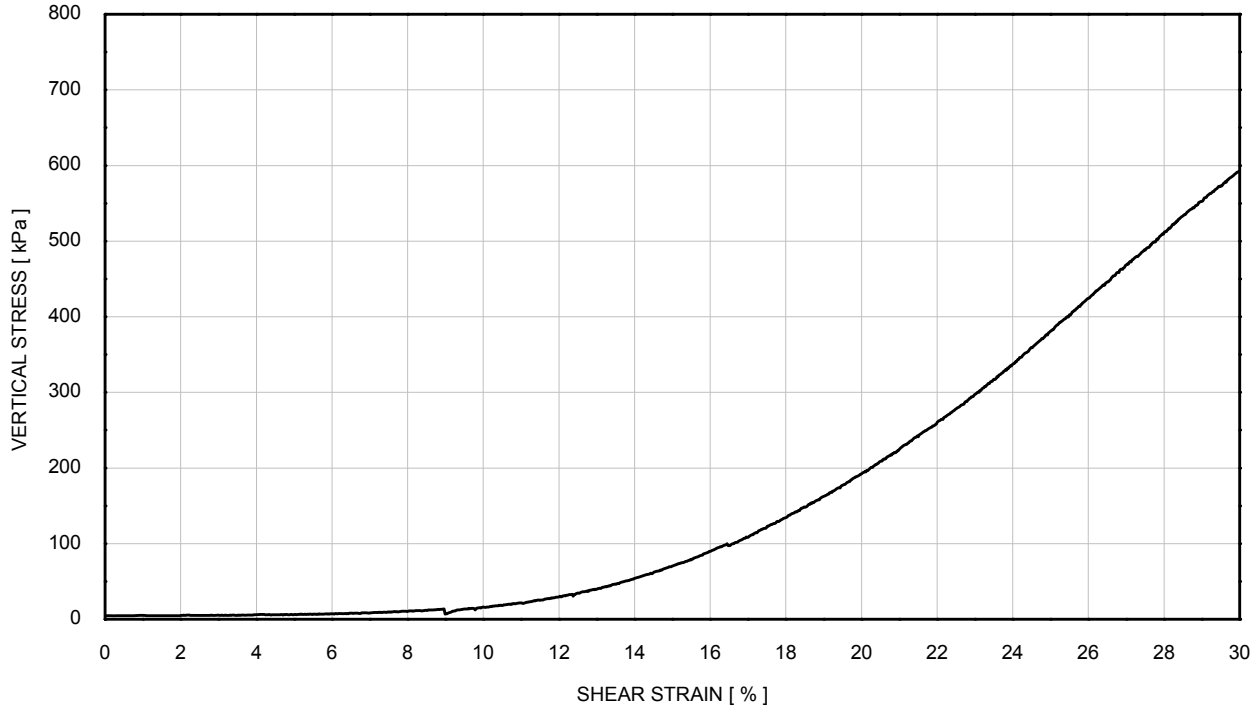
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

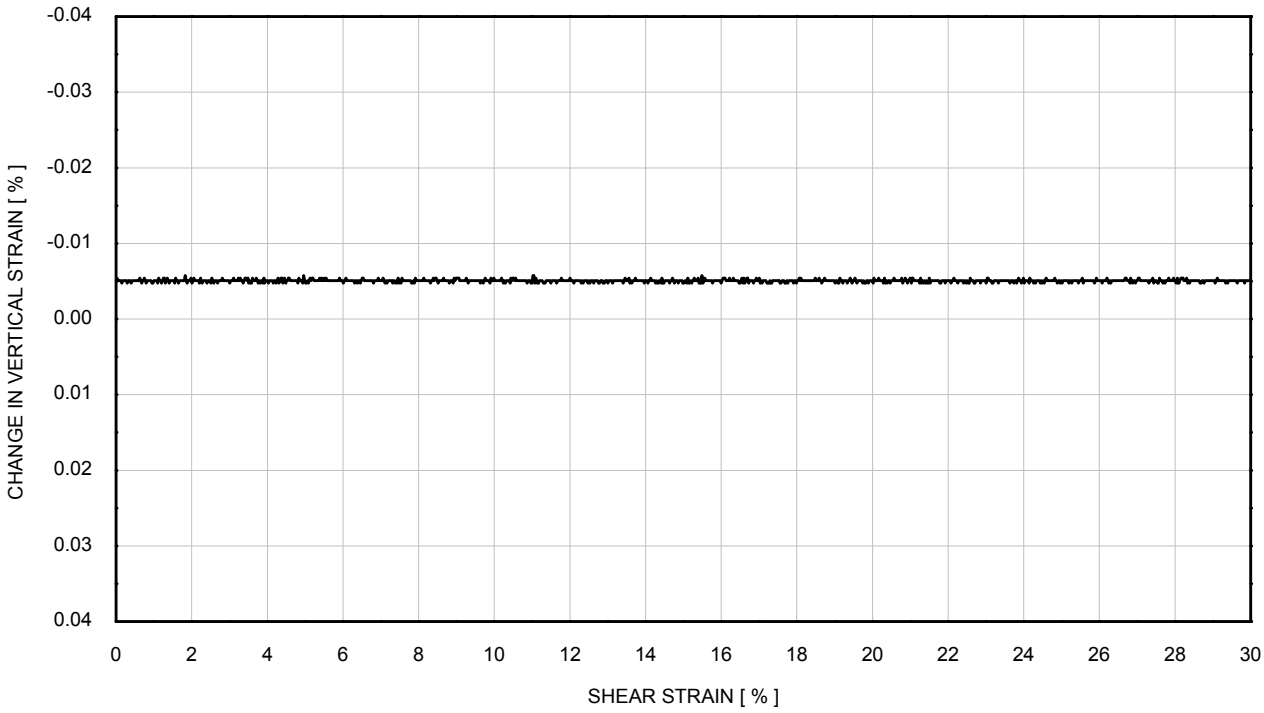




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 378 kPa	Sample	: CSS_2-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 3.01 %/hour	Test No.	: CSS03

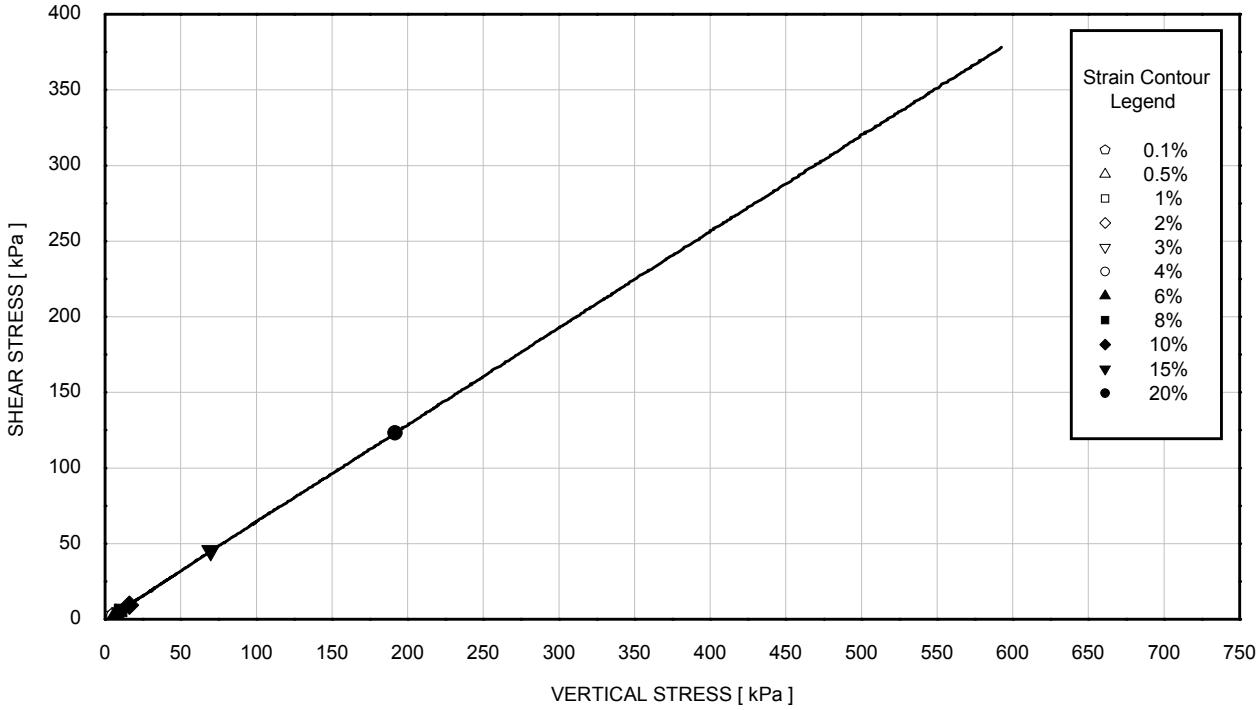
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

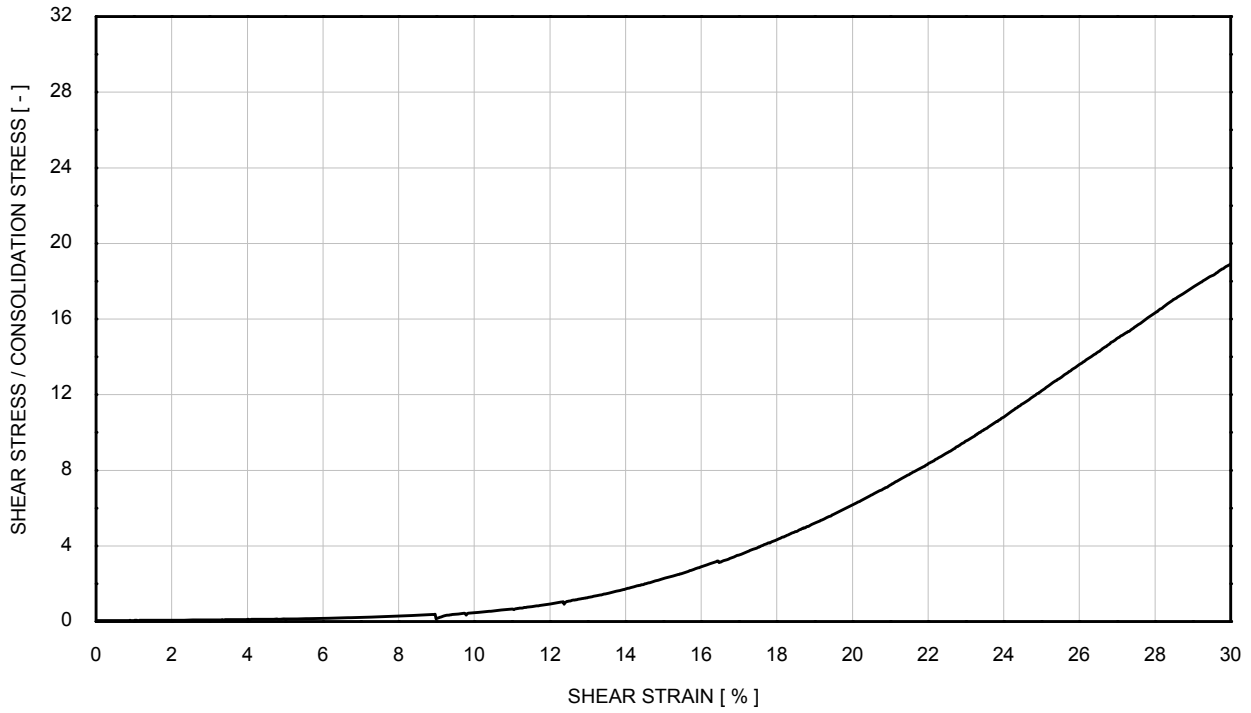




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 378 kPa	Sample	: CSS_2-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 3.01 %/hour	Test No.	: CSS03

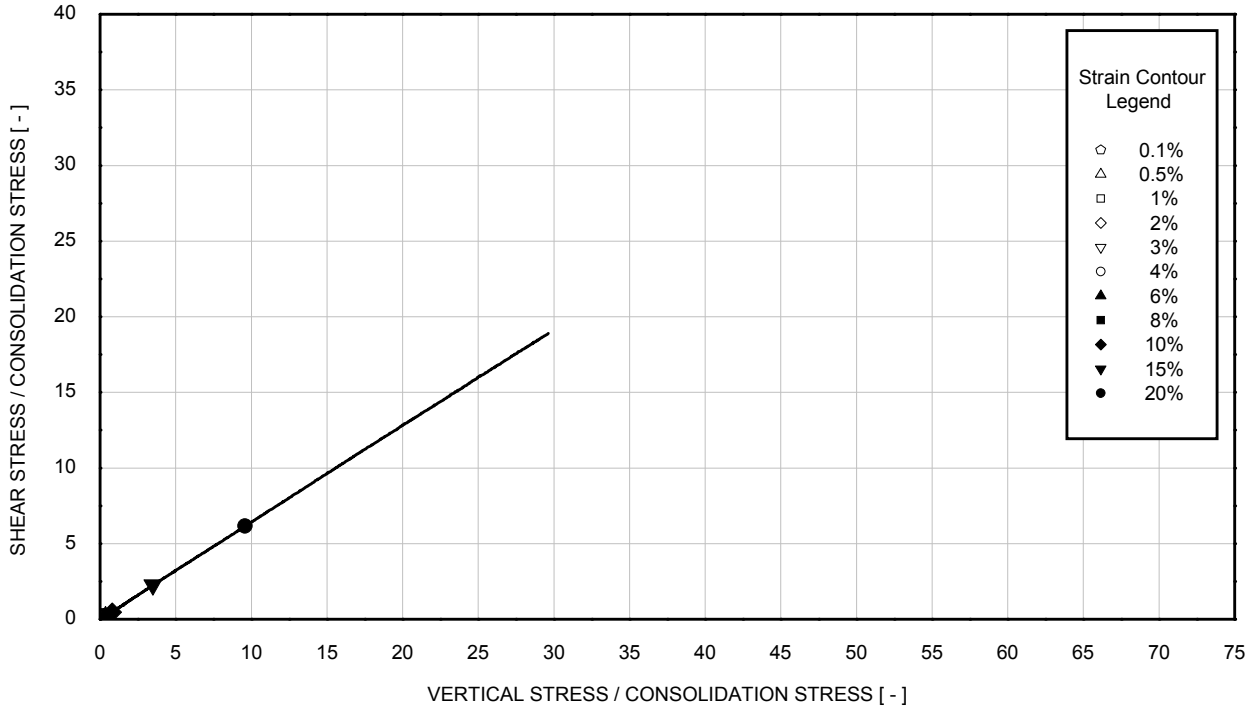
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

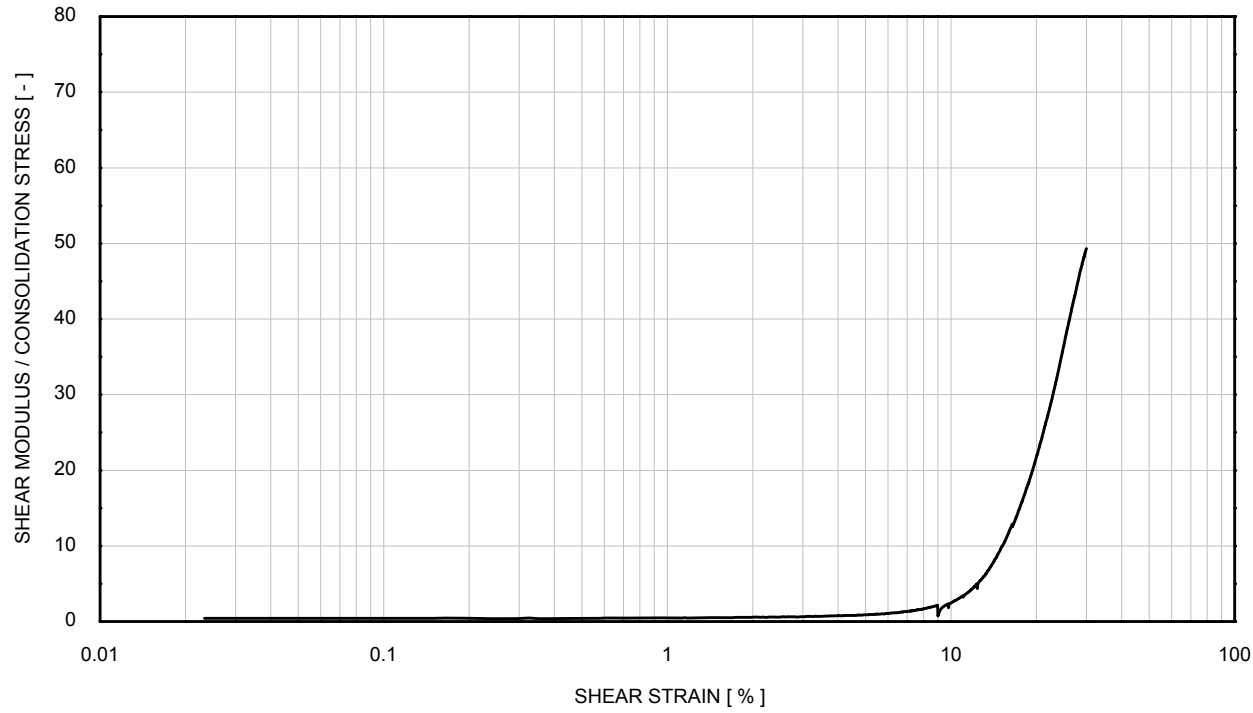




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 378 kPa	Sample	: CSS_2-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 3.01 %/hour	Test No.	: CSS03

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 20	kPa	Batch	: 2
τ_{peak}	: 378	kPa	Sample	: CSS_2-3
γ at τ_{peak}	: 29.99	%	Unit	: Unit A (Southern Bight)
Rate of strain	: 3.01	%/hour	Test No.	: CSS03

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown slightly silty fine SAND

GENERAL	
Date test started	11/09/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.5
Length	[mm]	30.0
Water content after compaction	[%]	10.5
Bulk density after compaction	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.614
Degree of saturation after compaction	[%]	45
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	23.2
Bulk density at start of test	[Mg/m³]	2.02
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 2_CSS04
Template issue	1.4
Processed by Date	JLS 09/11/2016
Checked by Date	PH 21/11/2016
Approved by Date	PH 21/11/2016

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-4
Unit	Unit A (Southern Bight)
Test number	CSS04

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	20
Vertical strain	[%]	0.36
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.608
Water content	[%]	22.9

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	20
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	-1
Mean τ_{cy}	[kPa]	1
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	0.38
Bulk density	[Mg/m^3]	2.03
Dry density	[Mg/m^3]	1.65
Void ratio	[-]	0.607

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.14	0.02	5.07	30.97
2	0.15	0.01	9.94	15.23
5	0.16	0.01	10.22	7.65
10	0.16	0.01	9.94	5.90
20	0.16	0.01	10.18	4.18
50	0.17	0.01	10.18	3.54
100	0.17	0.01	10.40	2.71
200	0.17	0.01	9.94	2.34
300	0.18	0.01	10.99	4.05
400	0.18	0.01	10.18	2.91

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-4
Unit	Unit A (Southern Bight)
Test number	CSS04

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	20
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	9
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
γ_{av} at N_f	[%]	-4.33
γ_{cy} at N_f	[%]	10.53
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	12
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.92	1.71	0.55	19.87
2	1.05	2.08	0.45	15.42
5	1.11	2.54	0.37	13.43
10	1.08	2.91	0.32	12.63
20	0.99	3.47	0.27	11.71
50	0.70	4.89	0.19	9.60
100	0.27	6.17	0.15	8.48
200	-0.49	7.22	0.13	7.82
500	-1.95	8.66	0.11	7.28
1000	-3.29	9.77	0.09	7.42
1500	-4.33	10.53	0.09	7.59

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	711
Shear strain	[%]	29.98
Shear induced $-\Delta\sigma_v$	[kPa]	-1119
Vertical stress	[kPa]	1139
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.97
At 15 % shear strain		
Shear stress	[kPa]	133
Shear induced $-\Delta\sigma_v$	[kPa]	-182
Vertical stress	[kPa]	202
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-4
Unit	Unit A (Southern Bight)
Test number	CSS04

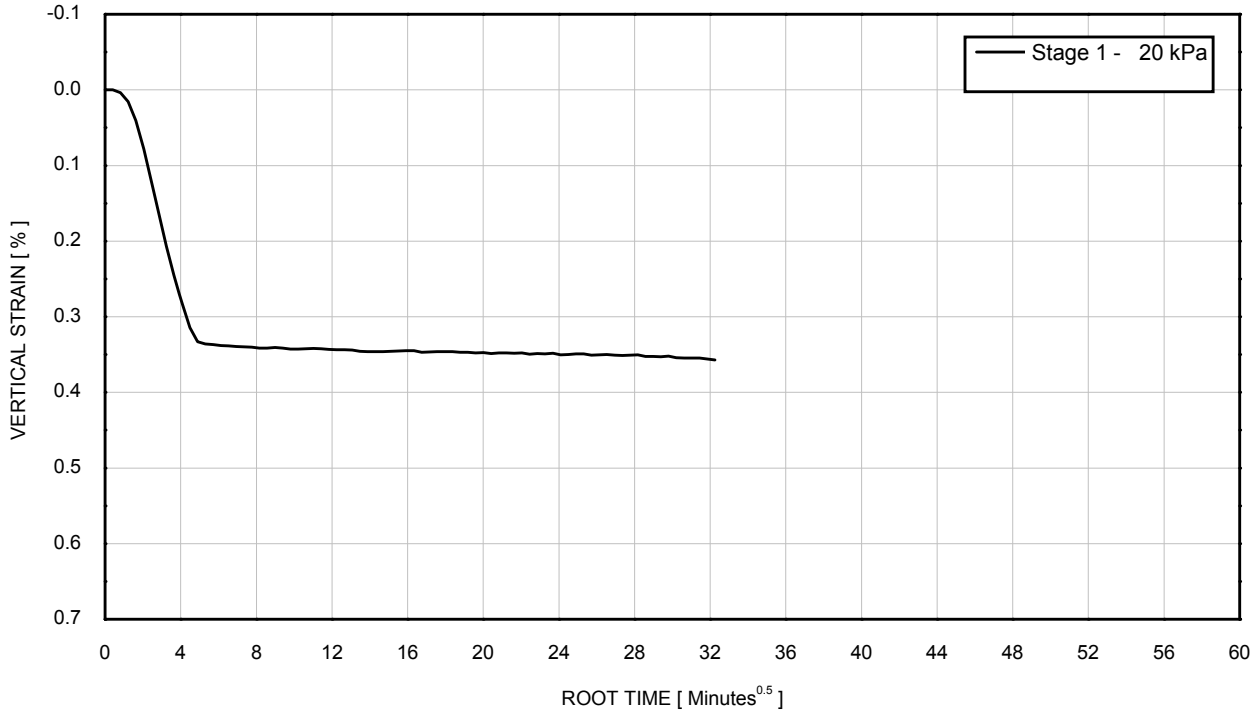
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

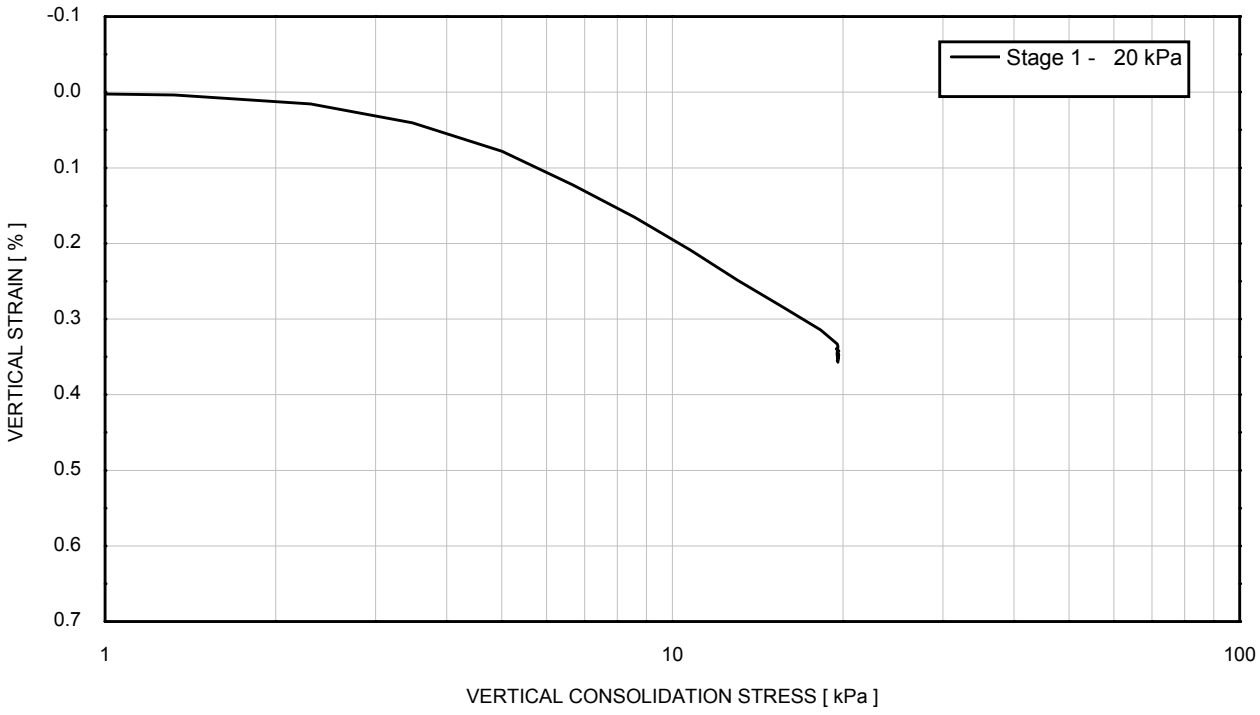
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	2
Sample	CSS_2-4
Unit	Unit A (Southern Bight)
Test number	CSS04

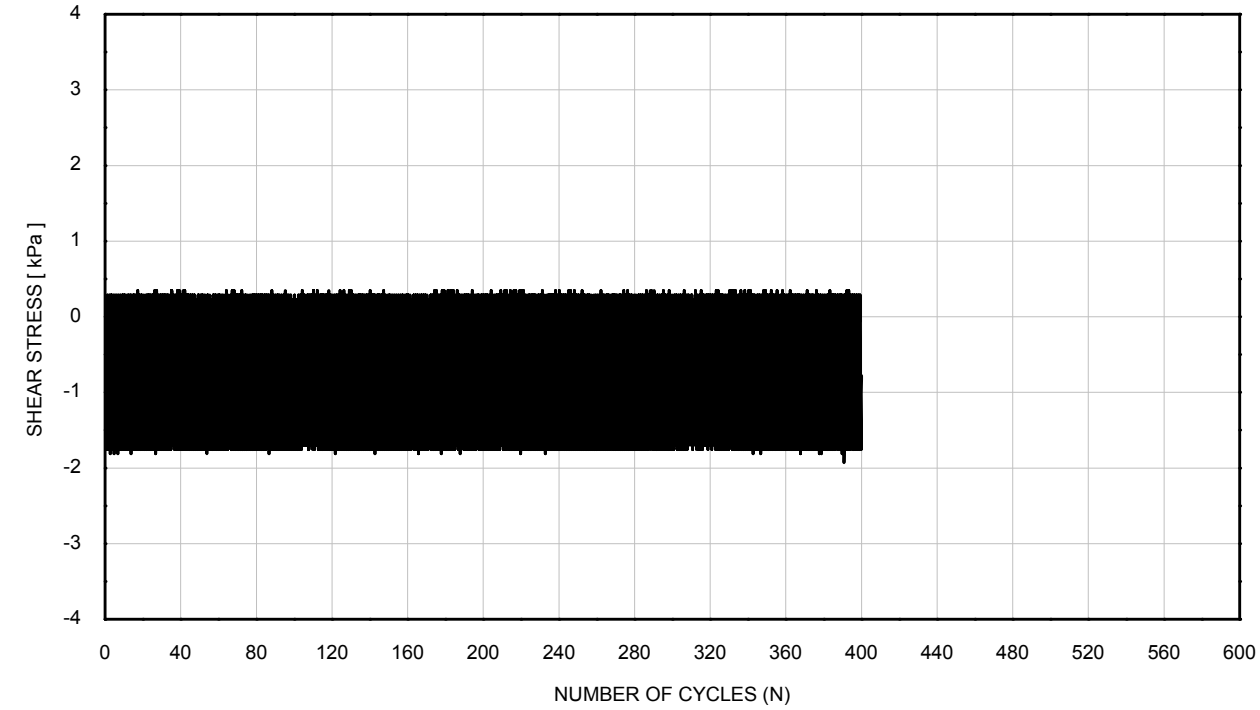
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

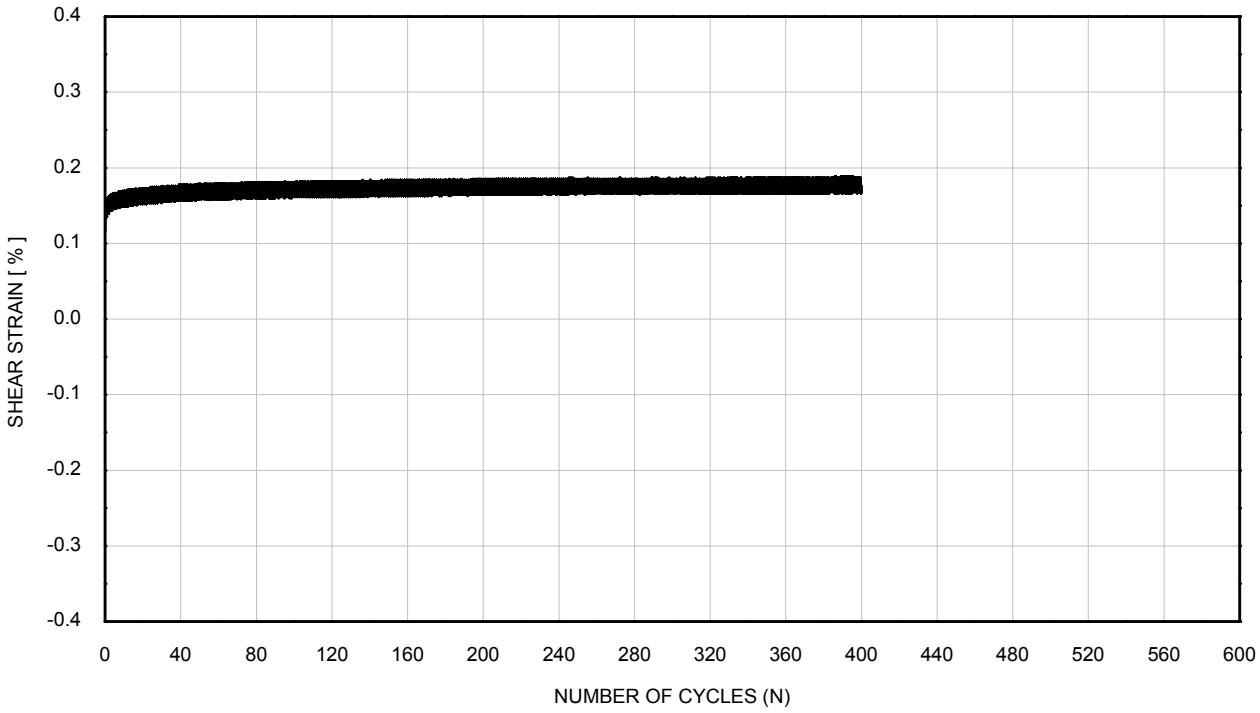




σ_{vc}	: 20 kPa	Batch	: 2
		Sample	: CSS_2-4
		Unit	: Unit A (Southern Bight)
		Test No.	: CSS04

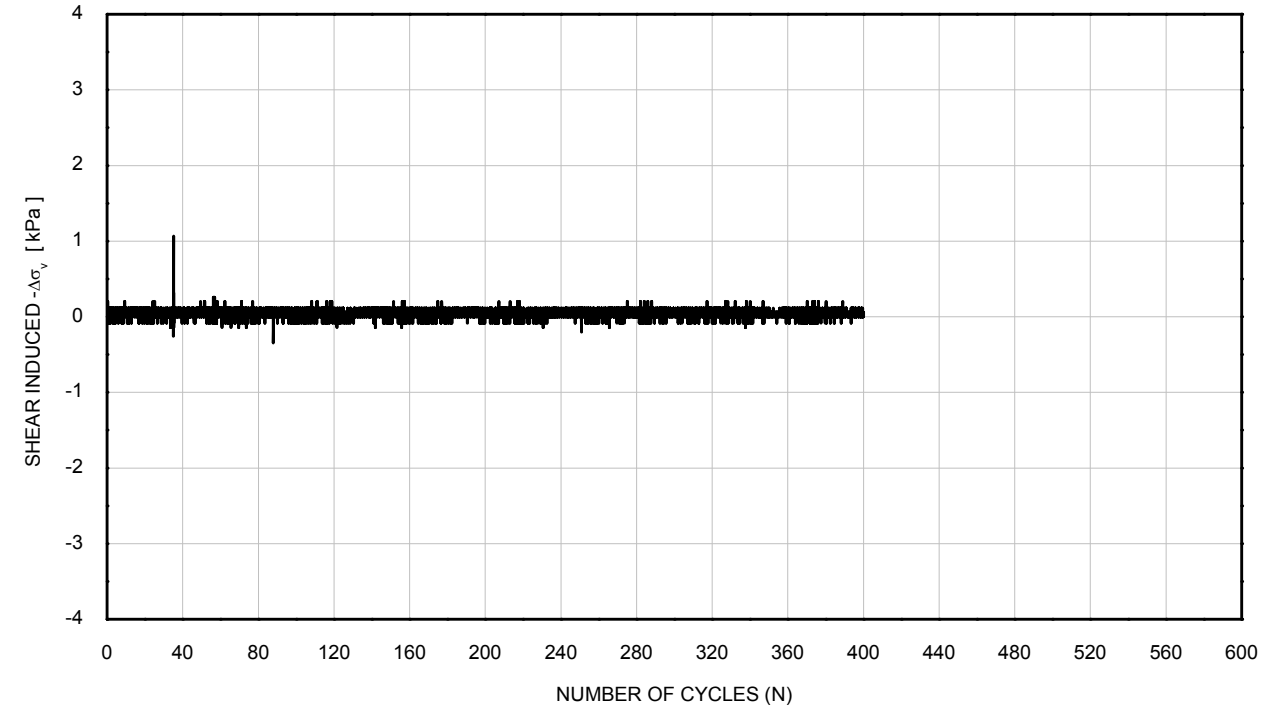
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

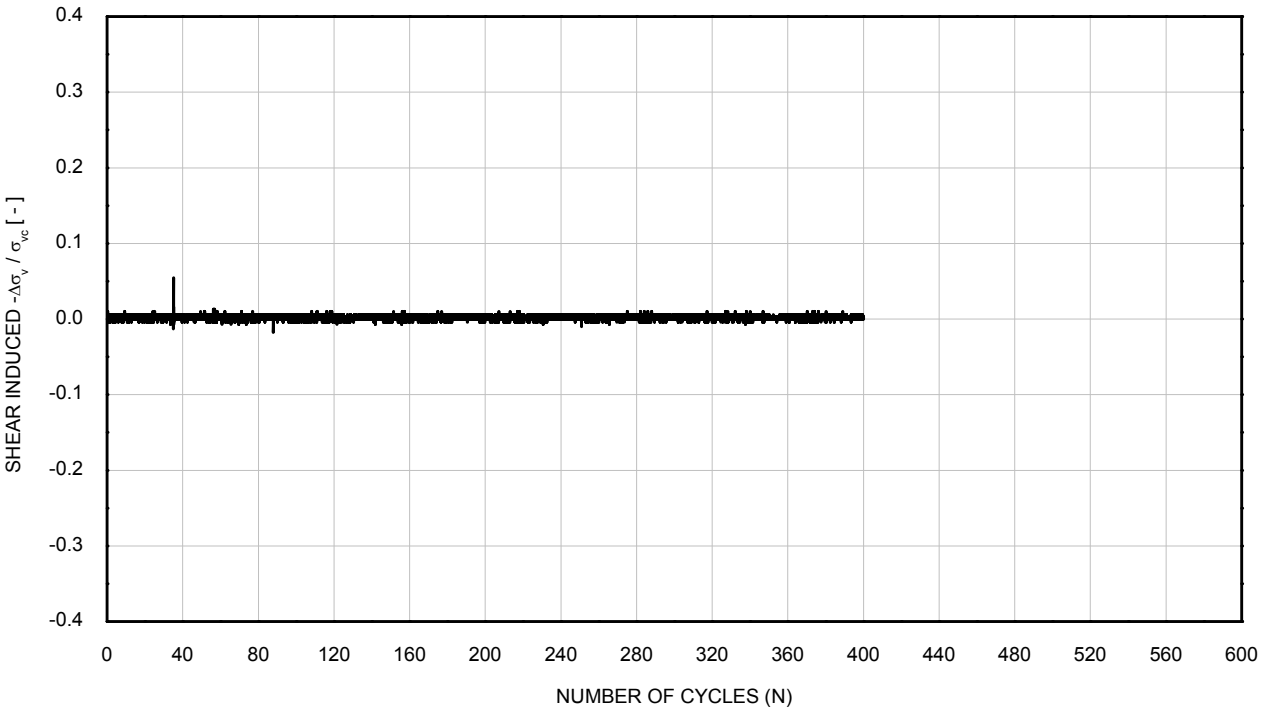




σ_{vc}	:	20 kPa	Batch	: 2
Mean τ_{av}	:	-1 kPa	Sample	: CSS_2-4
Mean τ_{cy}	:	1 kPa	Unit	: Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	: CSS04

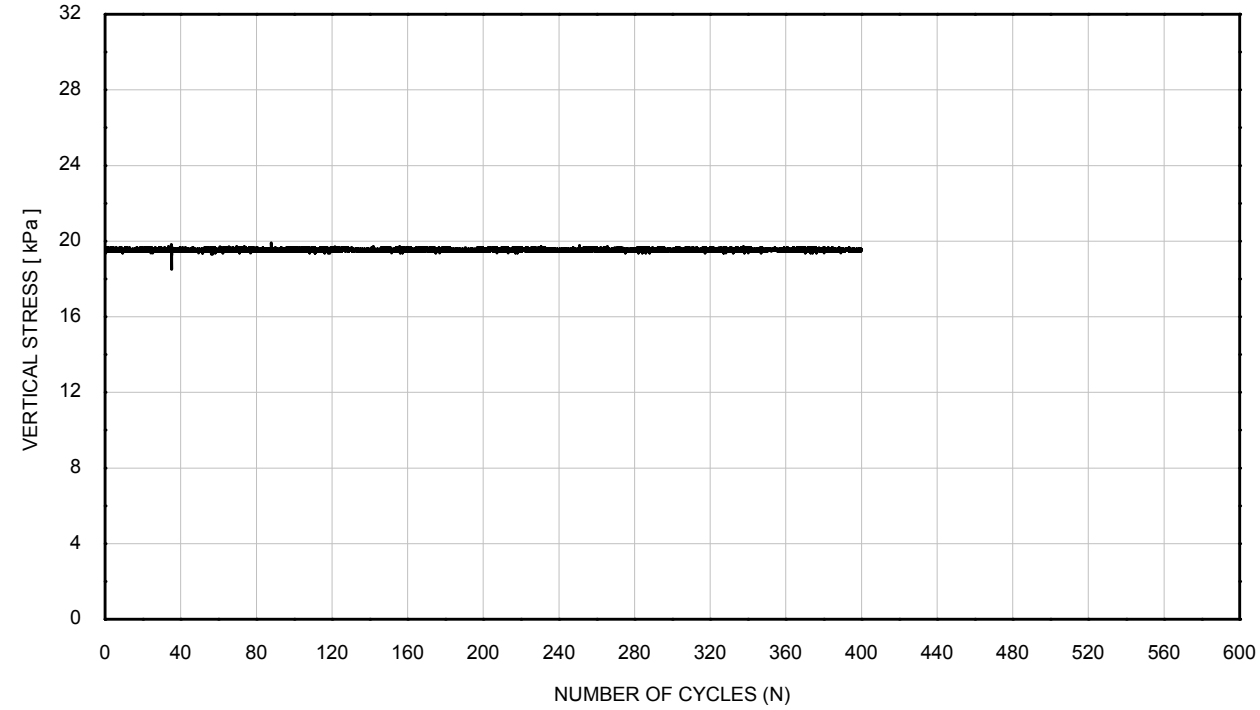
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

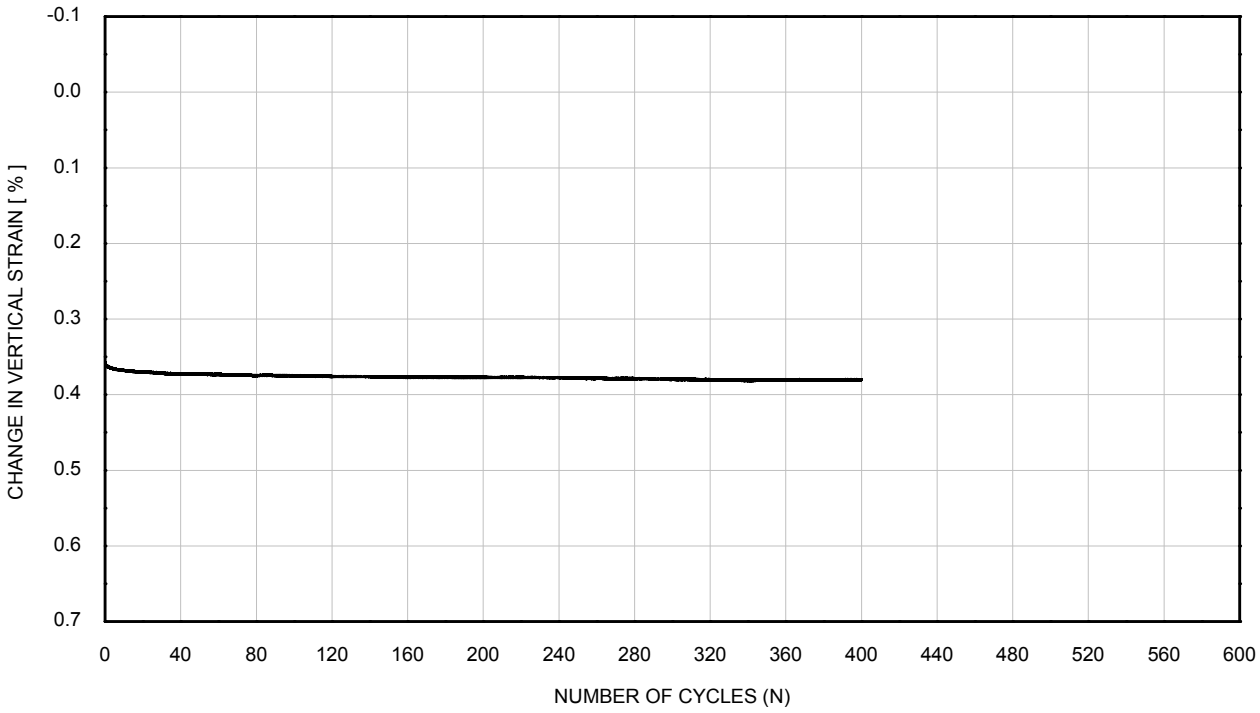




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	-1 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

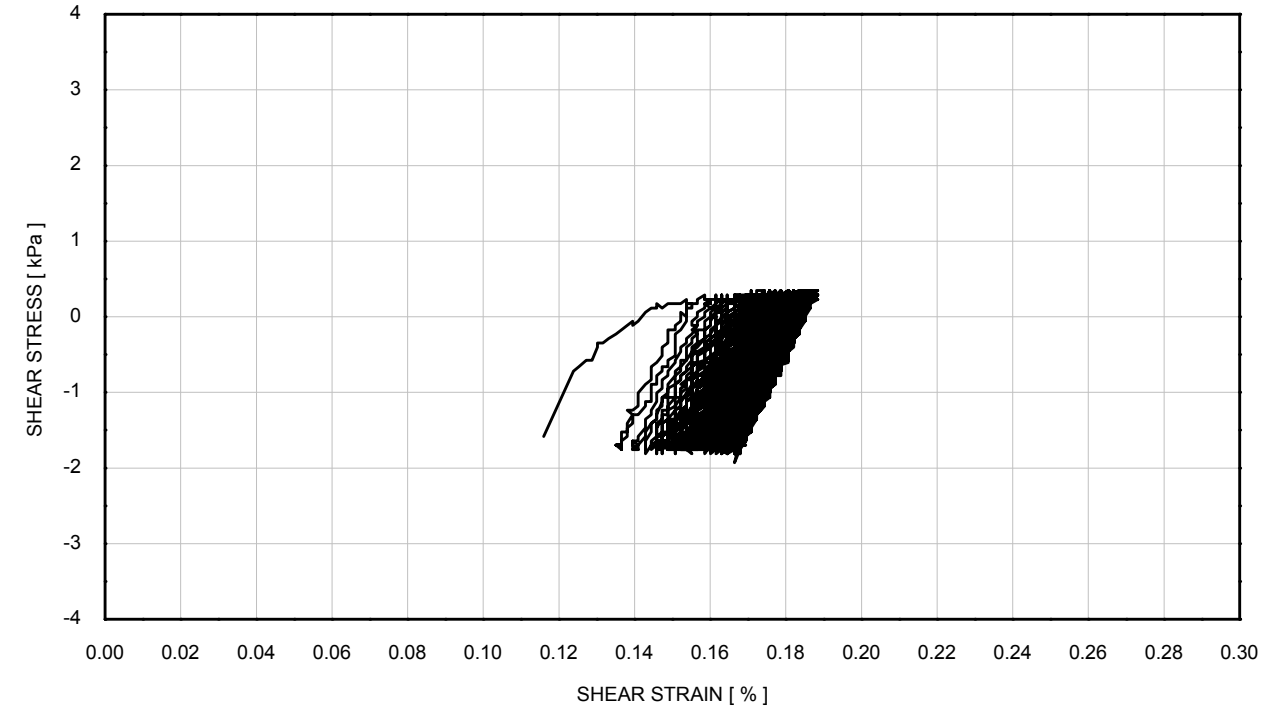
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

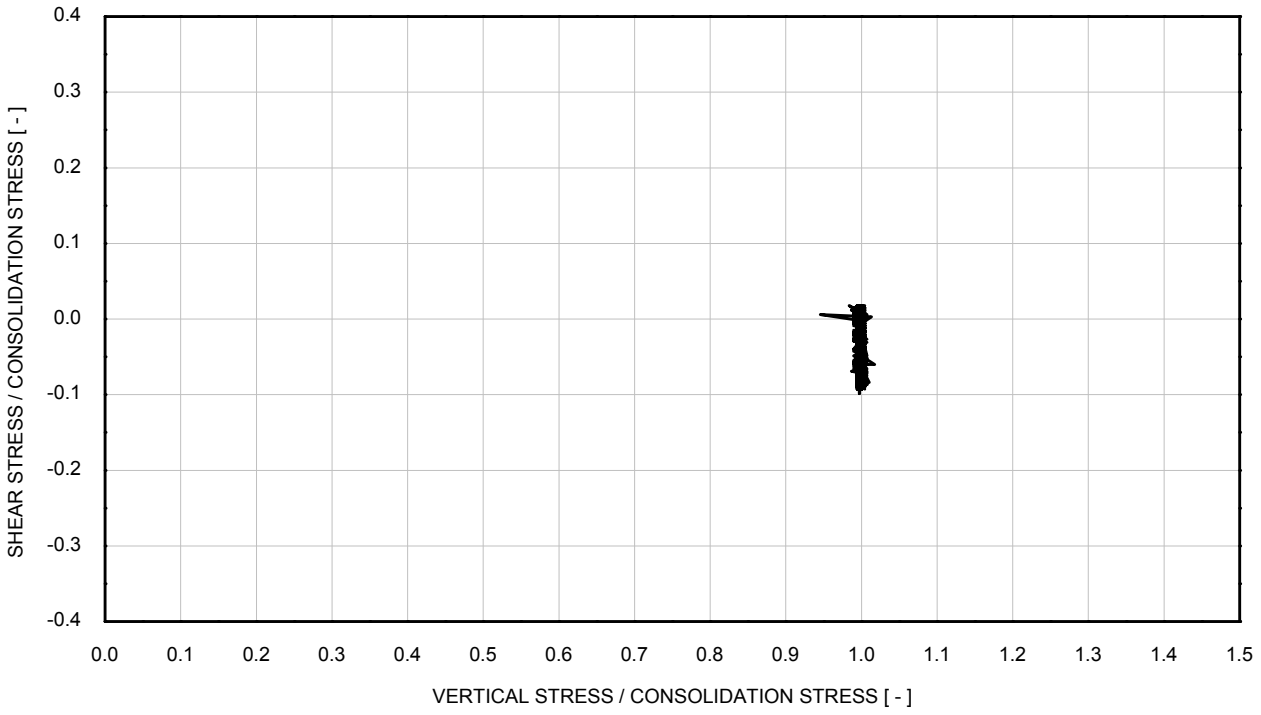




σ_{vc}	:	20 kPa	Batch	: 2
Mean τ_{av}	:	-1 kPa	Sample	: CSS_2-4
Mean τ_{cy}	:	1 kPa	Unit	: Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	: CSS04

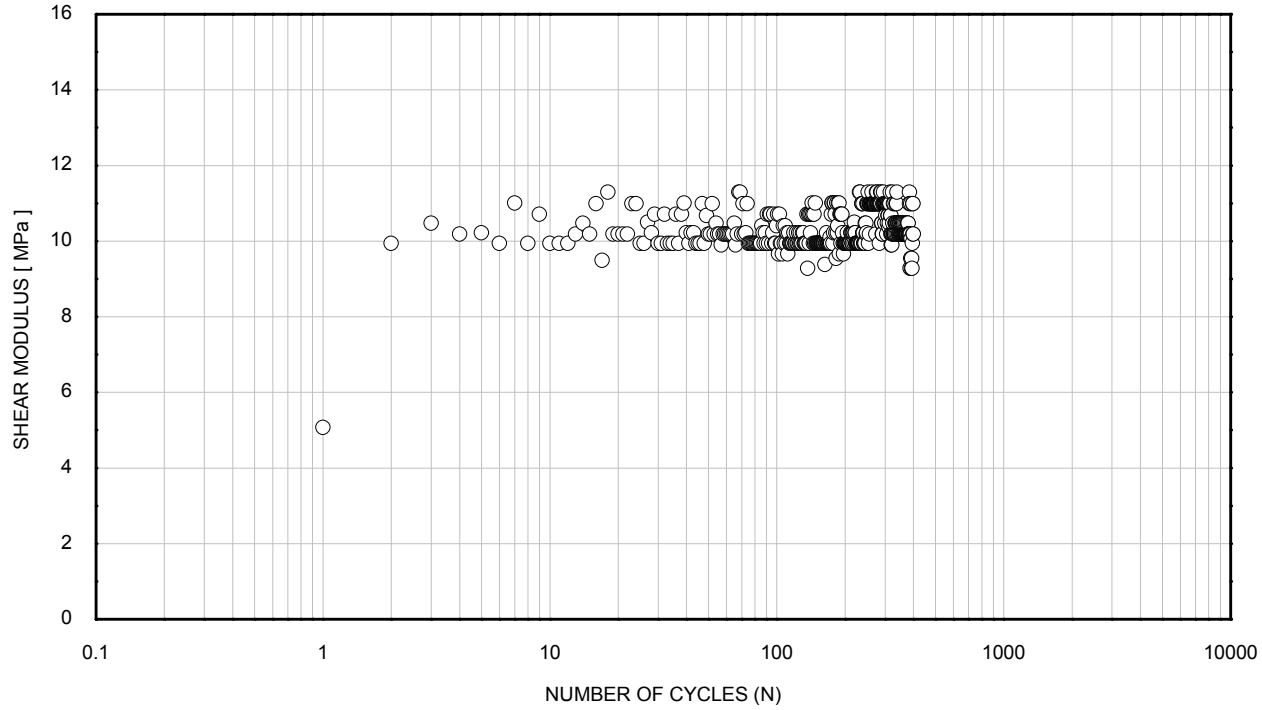
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

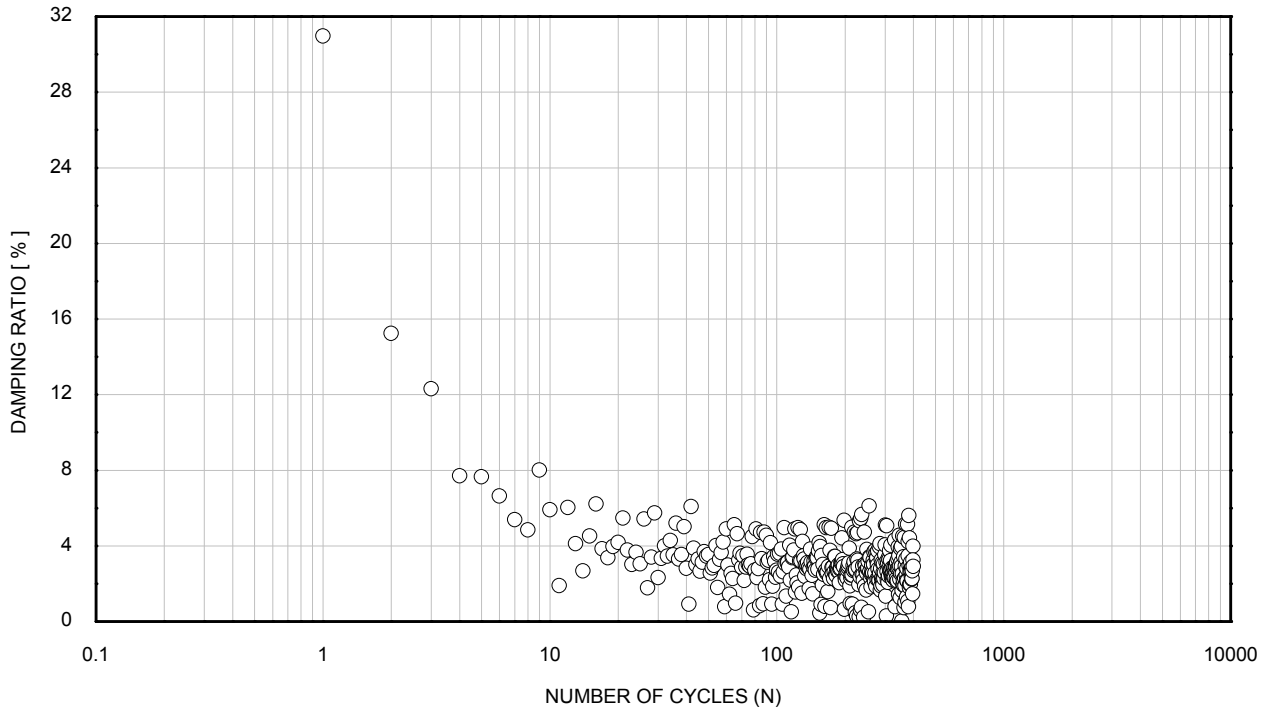




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	-1 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

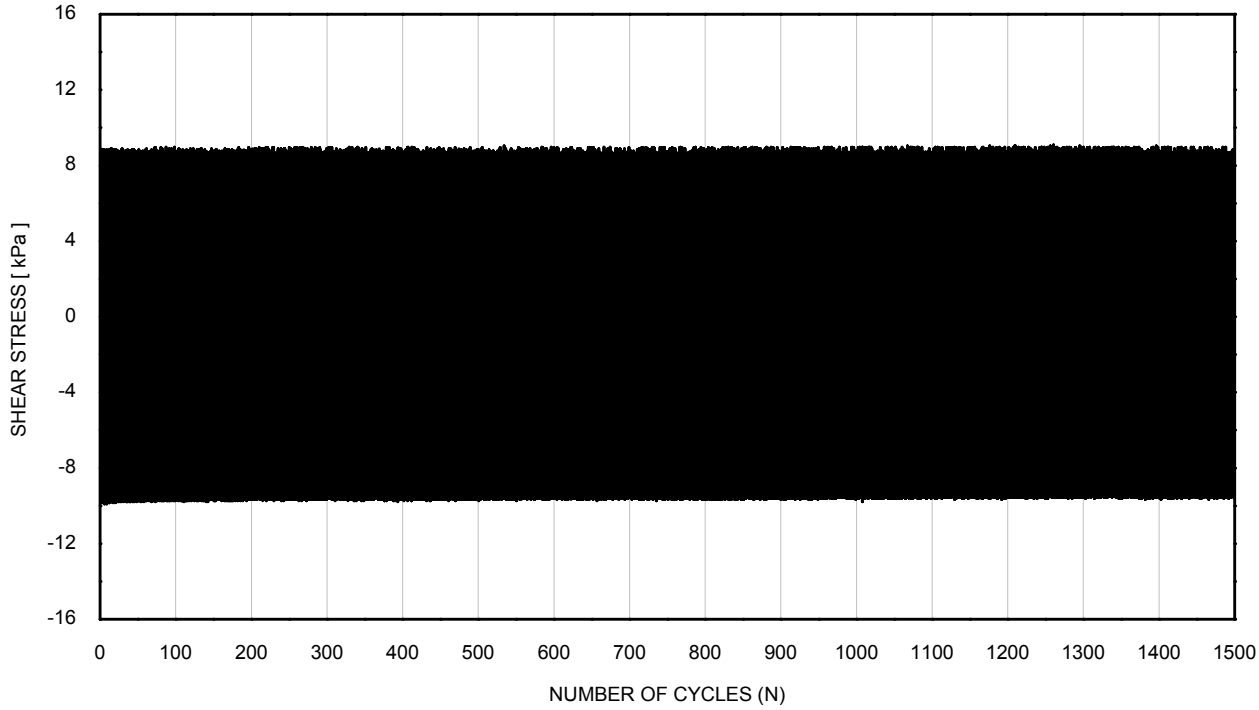
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

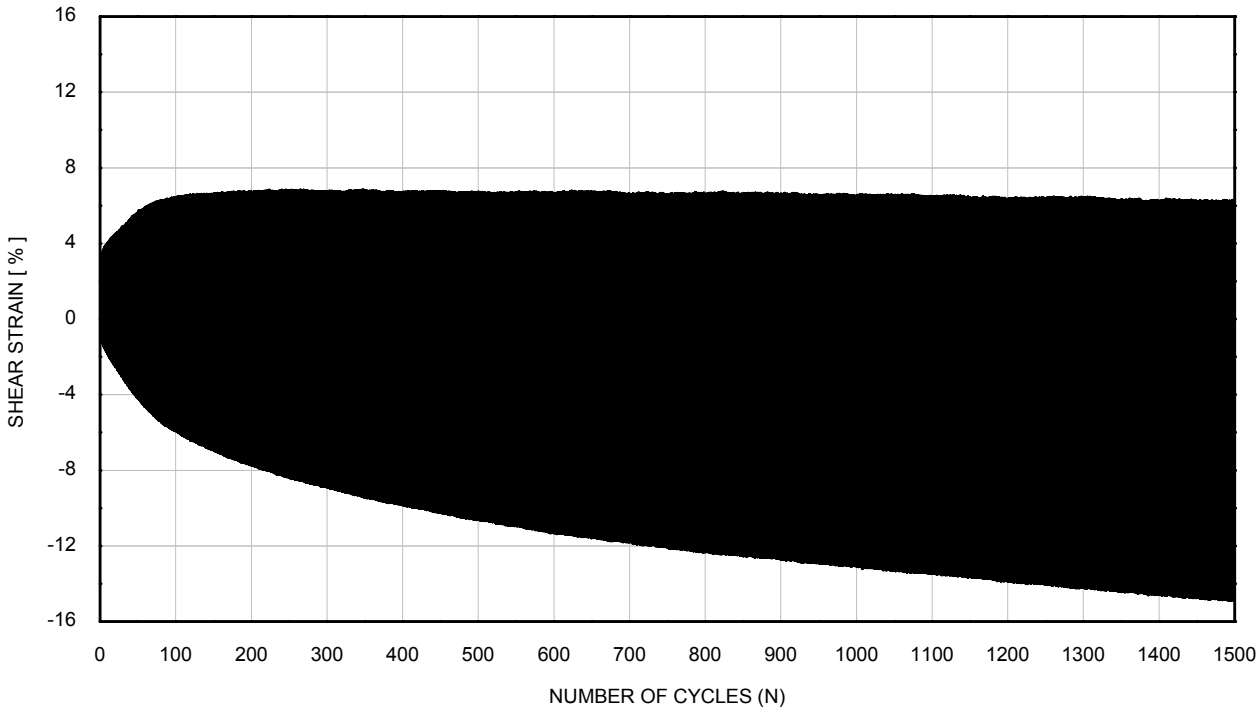




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	-1 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	1 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

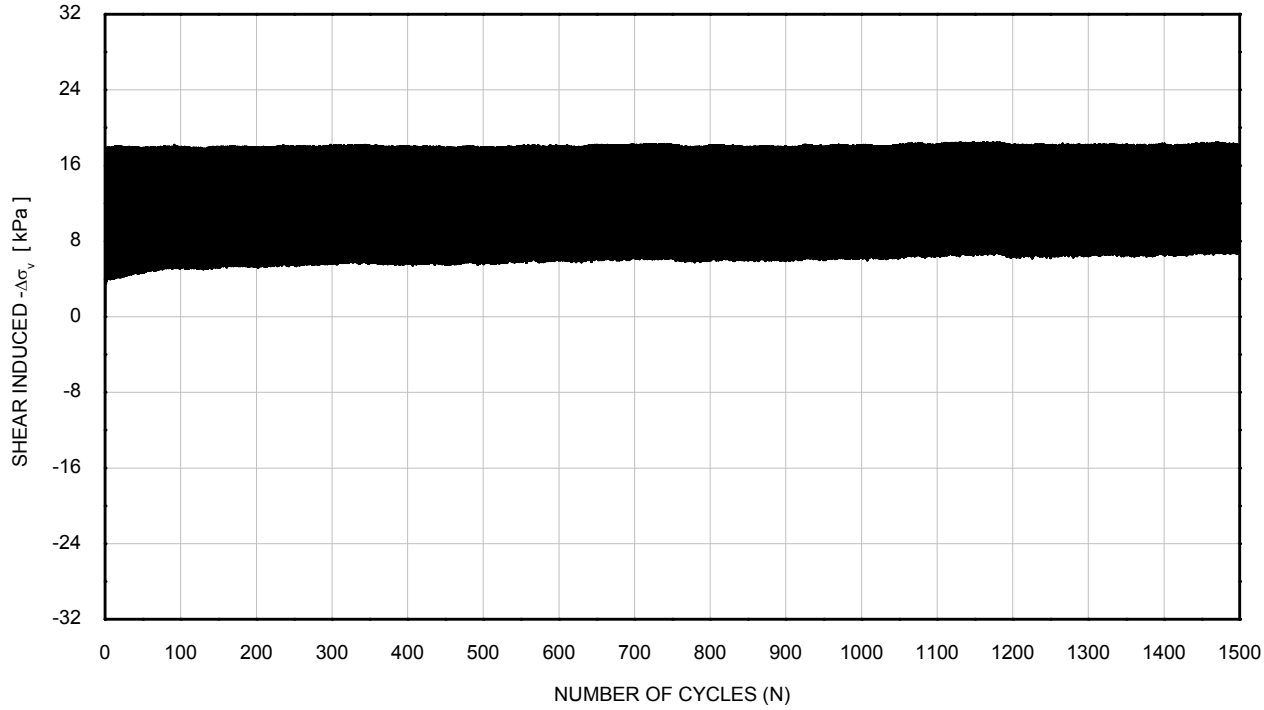
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

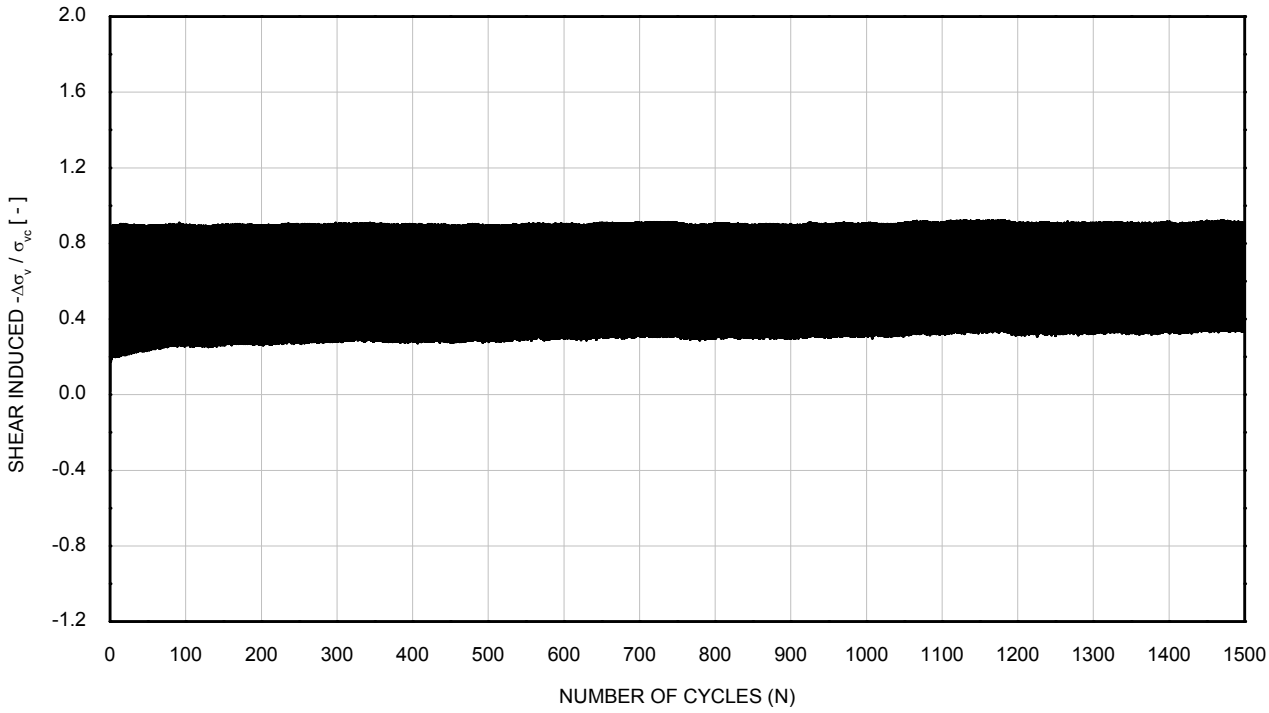




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	9 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

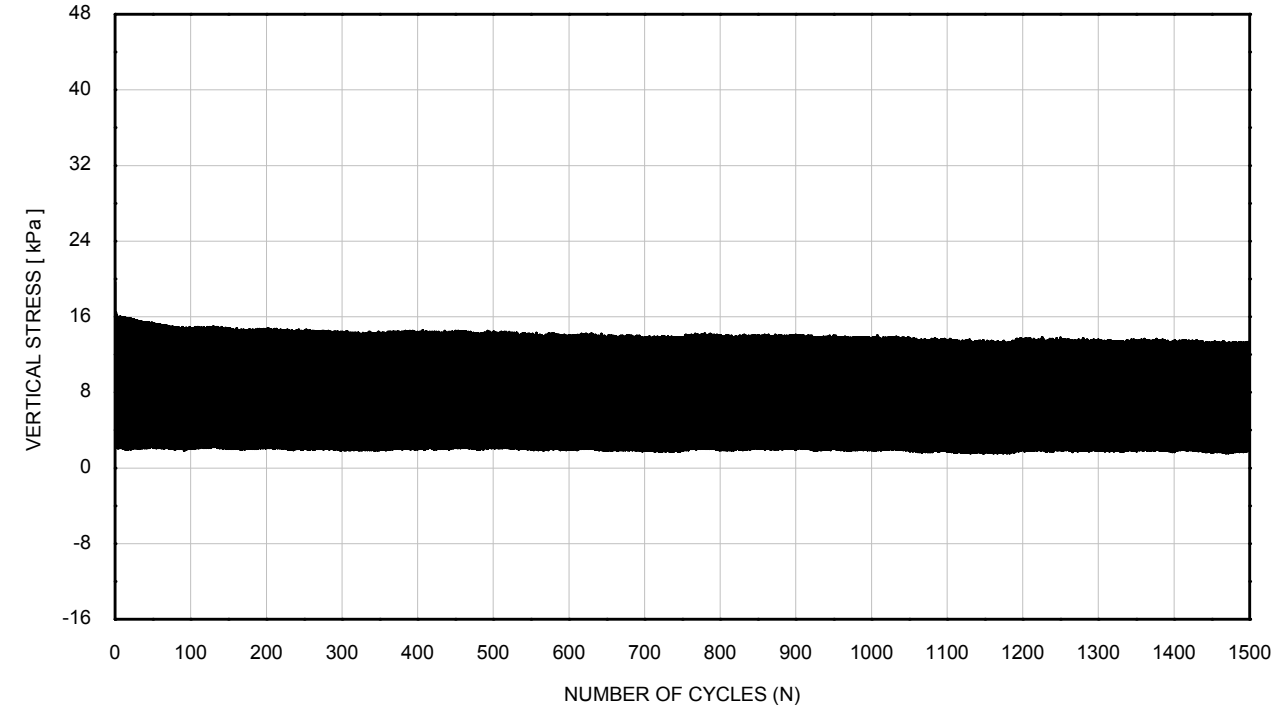
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

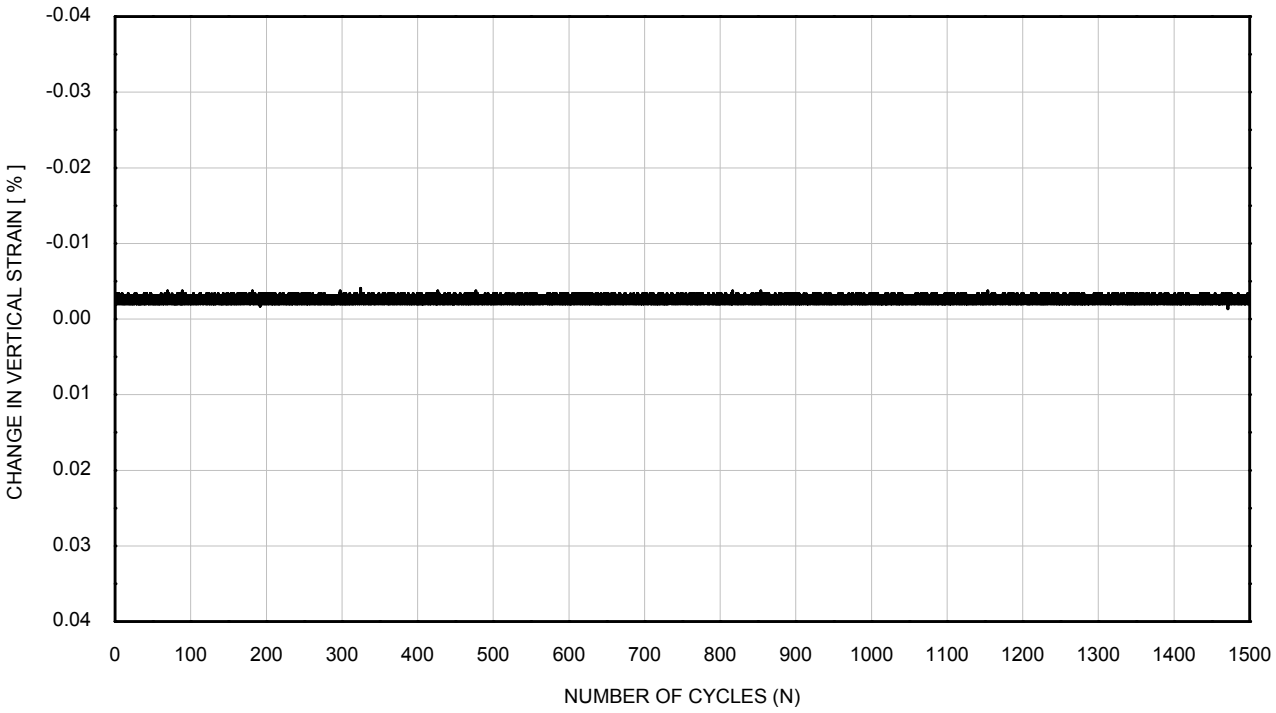




σ_{vc}	:	20 kPa	Batch	: 2
Mean τ_{av}	:	0 kPa	Sample	: CSS_2-4
Mean τ_{cy}	:	9 kPa	Unit	: Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	: CSS04

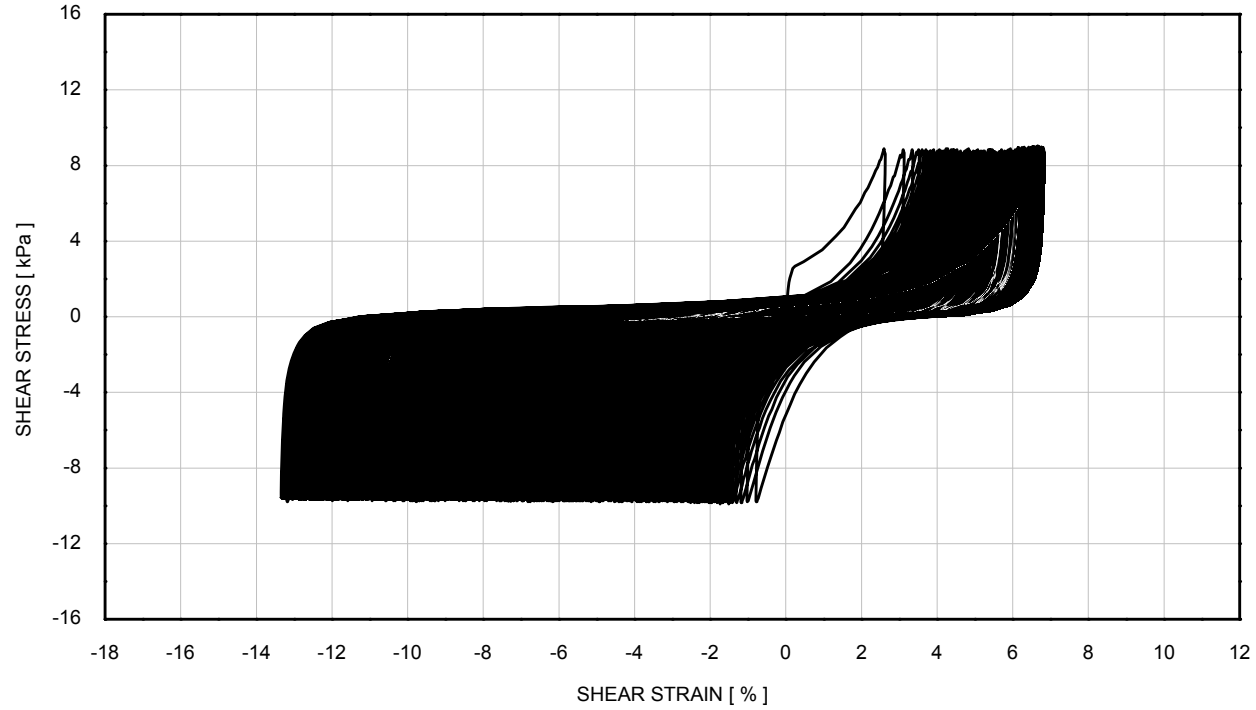
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

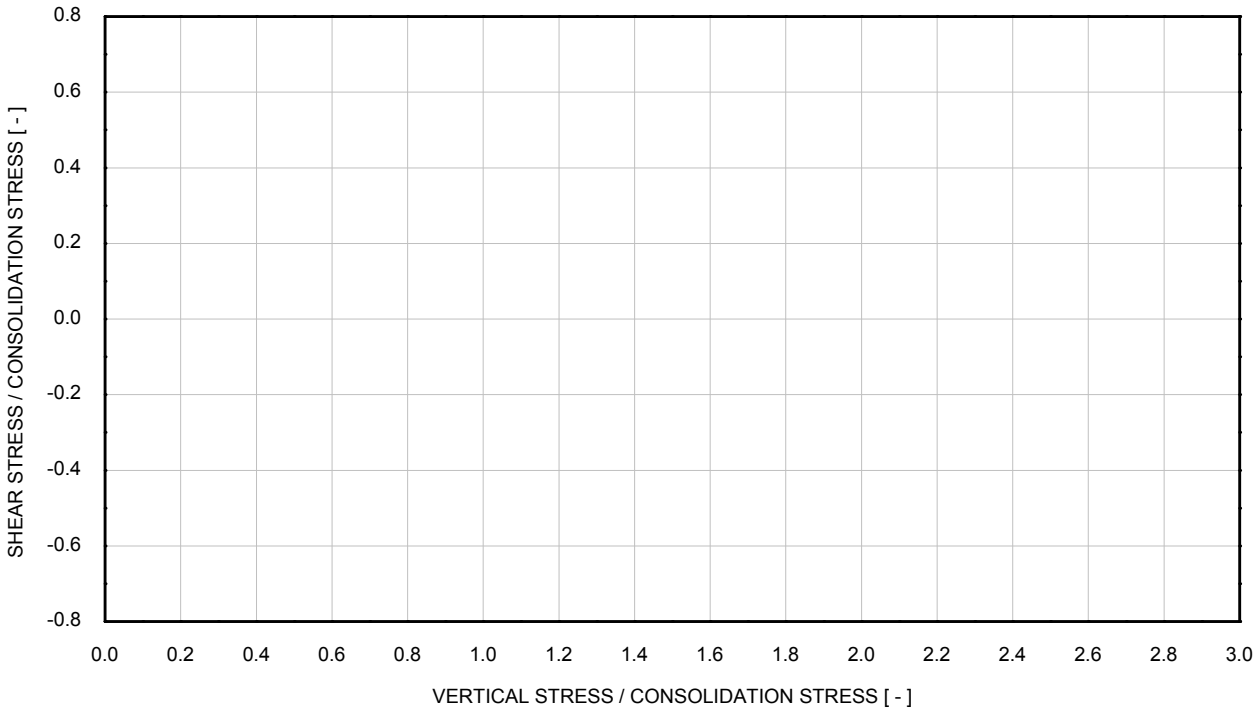




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	9 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

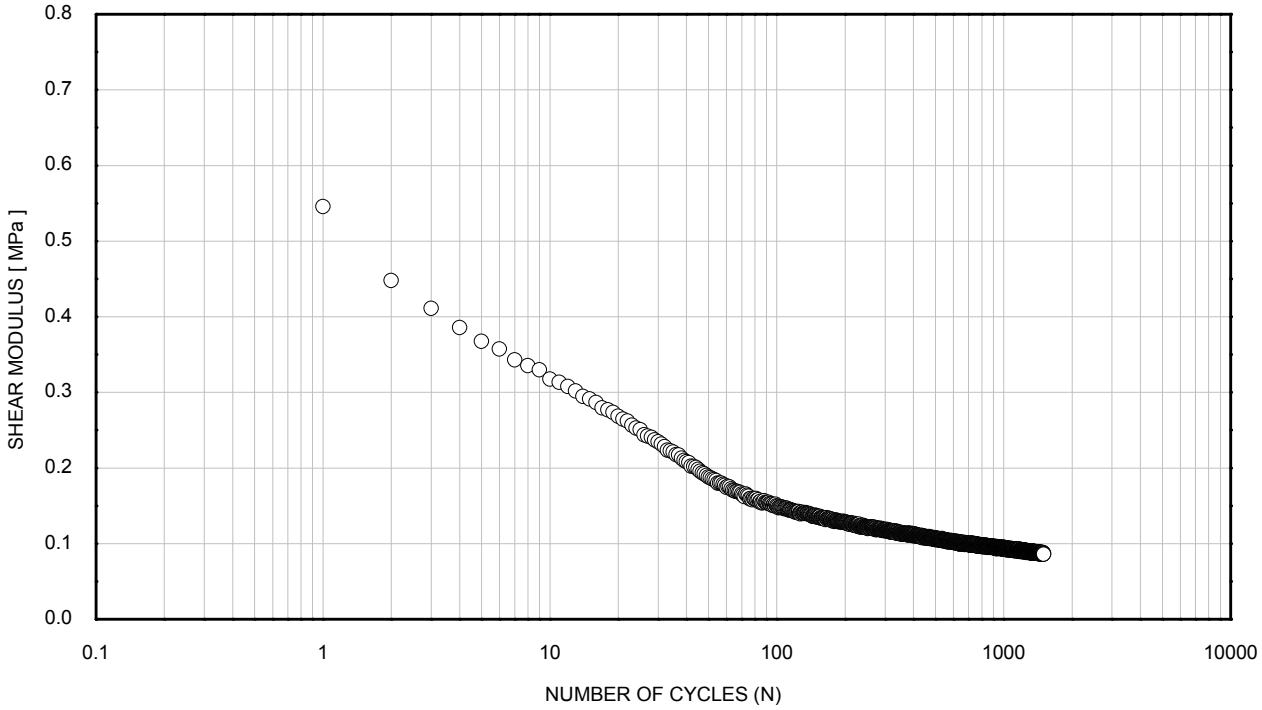
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

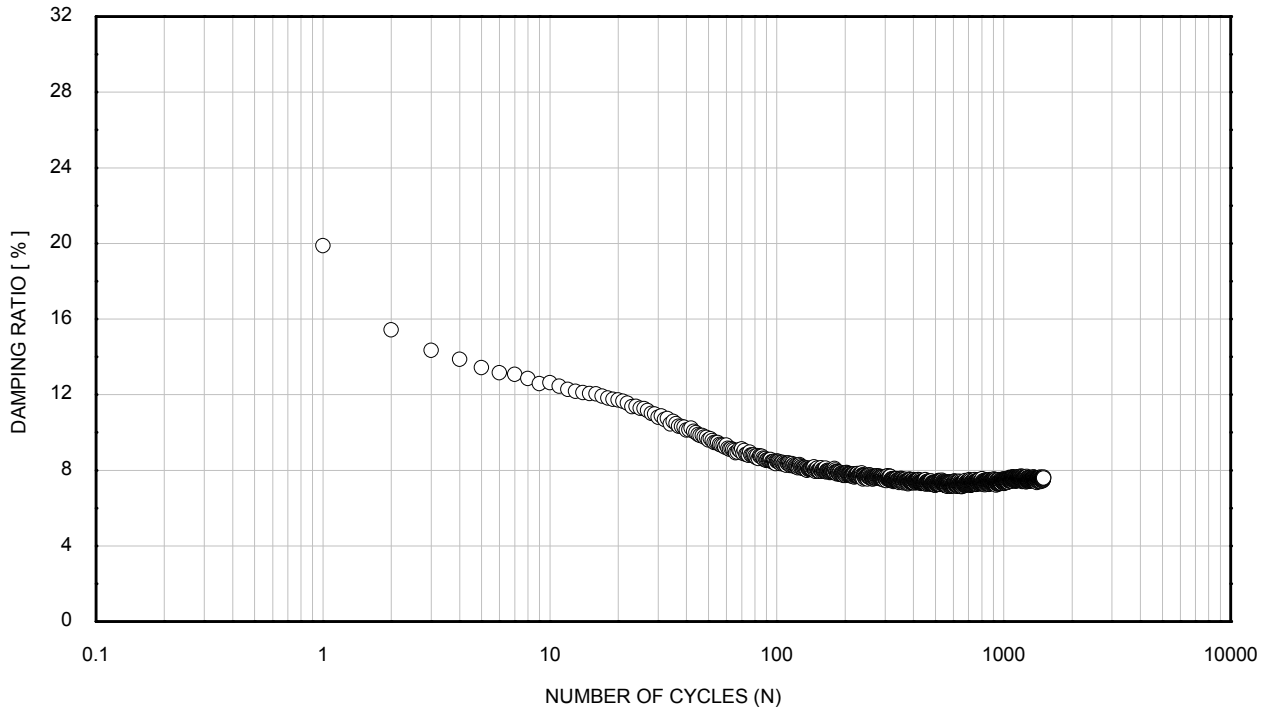




σ_{vc}	:	20 kPa	Batch	: 2
Mean τ_{av}	:	0 kPa	Sample	: CSS_2-4
Mean τ_{cy}	:	9 kPa	Unit	: Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	: CSS04

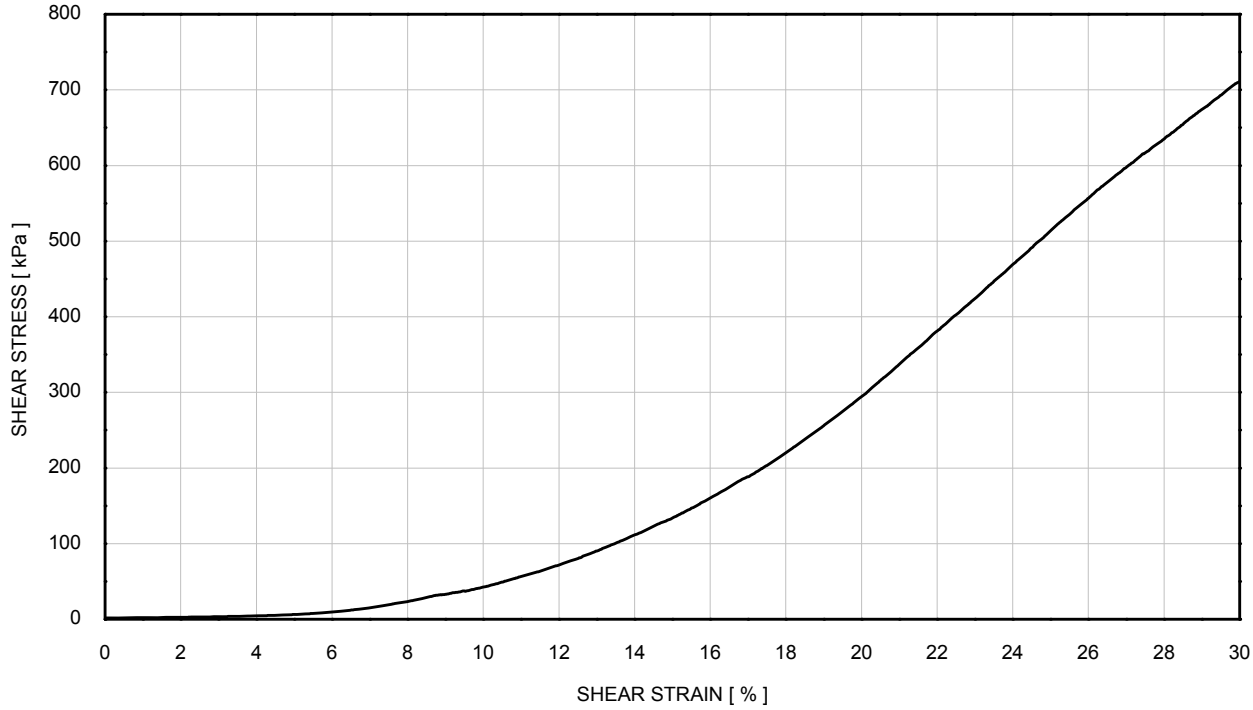
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

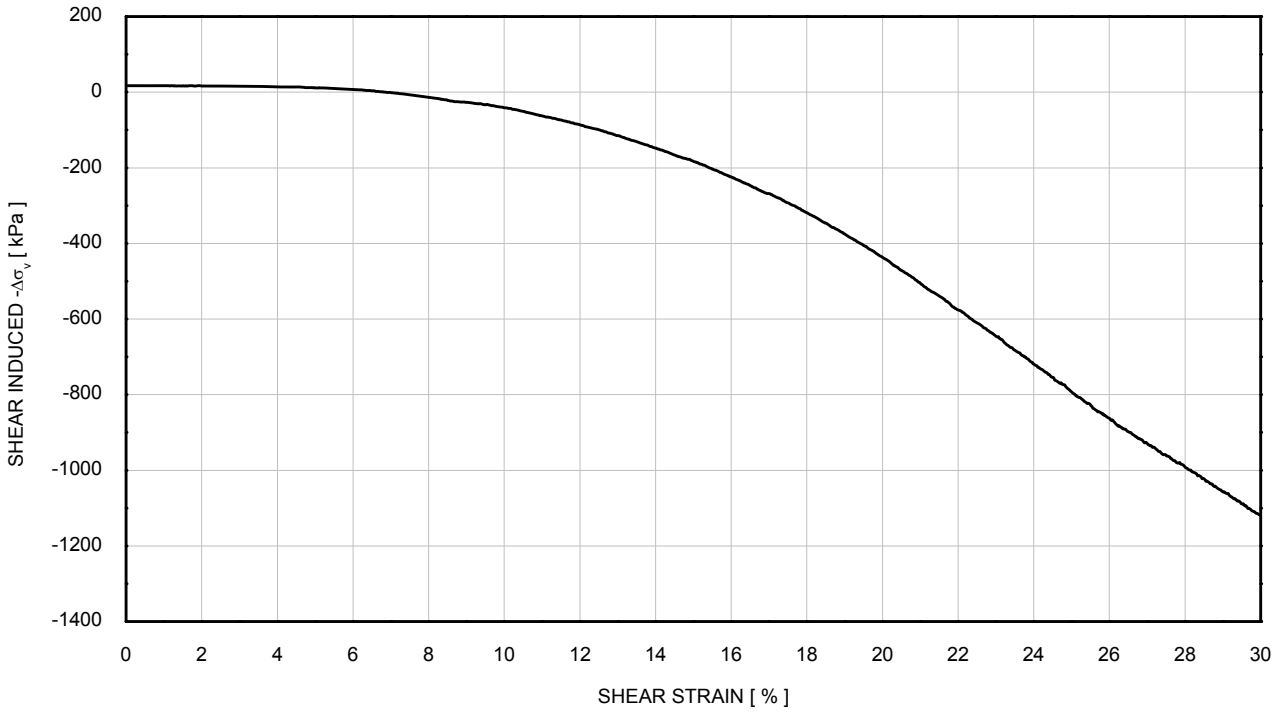




σ_{vc}	:	20 kPa	Batch	:	2
Mean τ_{av}	:	0 kPa	Sample	:	CSS_2-4
Mean τ_{cy}	:	9 kPa	Unit	:	Unit A (Southern Bight)
Frequency	:	0.10 Hz	Test No.	:	CSS04

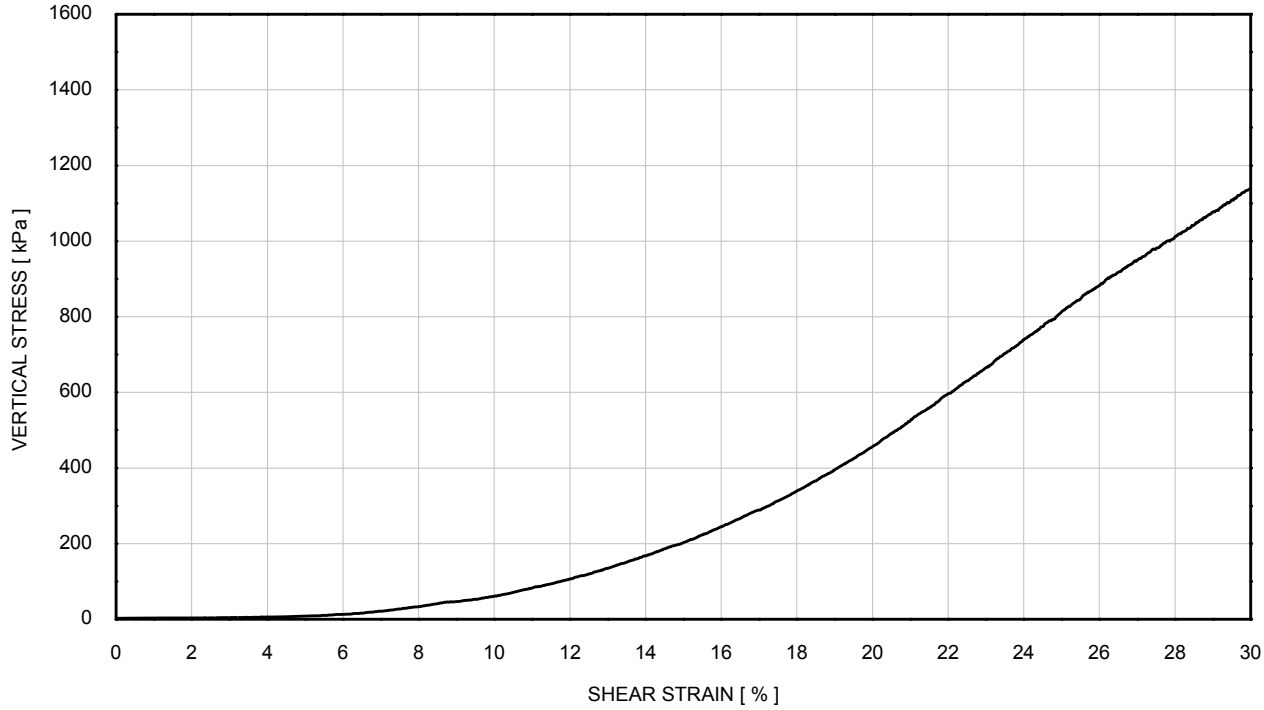
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

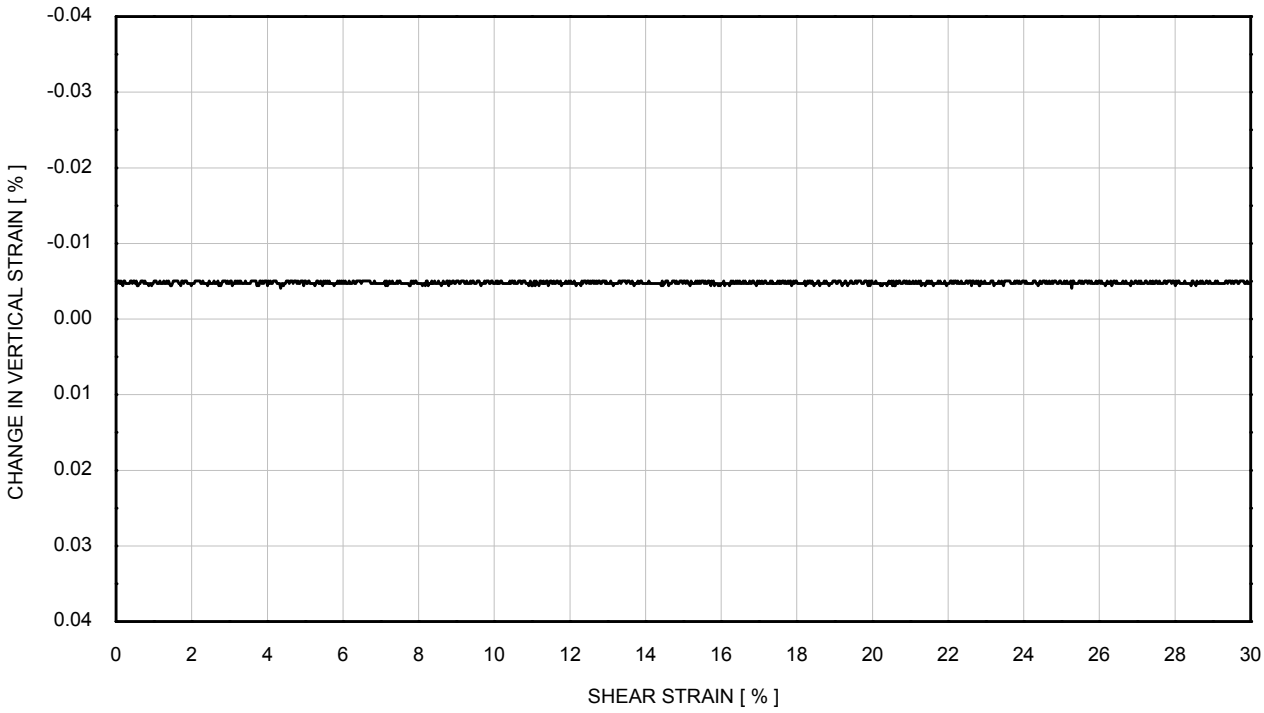




σ_{vc}	: 20 kPa	Batch	: 2
τ_{peak}	: 711 kPa	Sample	: CSS_2-4
γ at τ_{peak}	: 29.98 %	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97 %/hour	Test No.	: CSS04

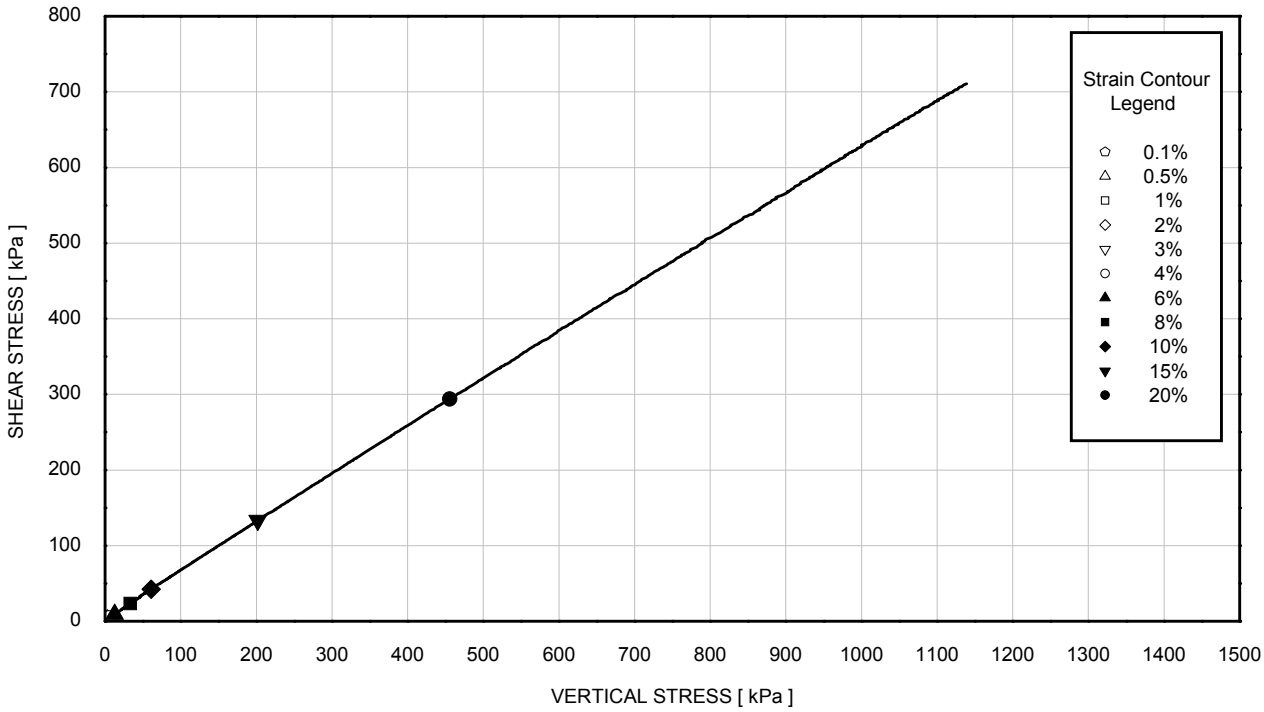
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

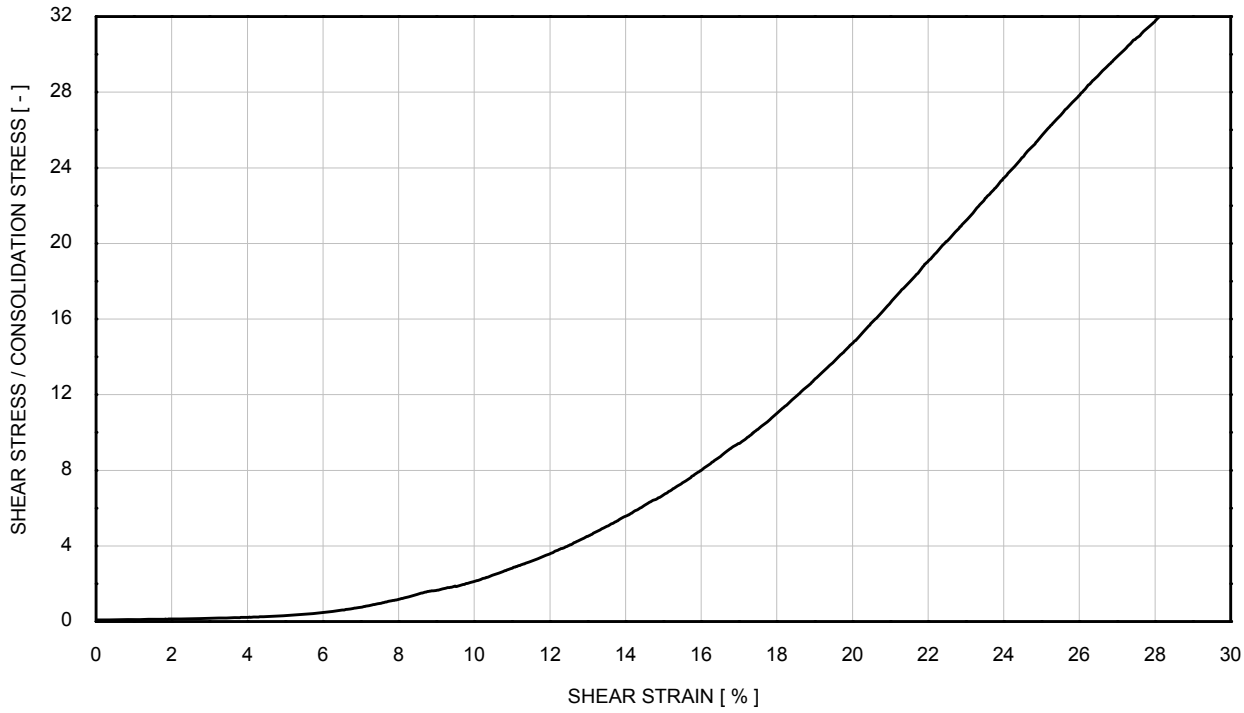




σ_{vc}	:	20 kPa	Batch	:	2
τ_{peak}	:	711 kPa	Sample	:	CSS_2-4
γ at τ_{peak}	:	29.98 %	Unit	:	Unit A (Southern Bight)
Rate of strain	:	2.97 %/hour	Test No.	:	CSS04

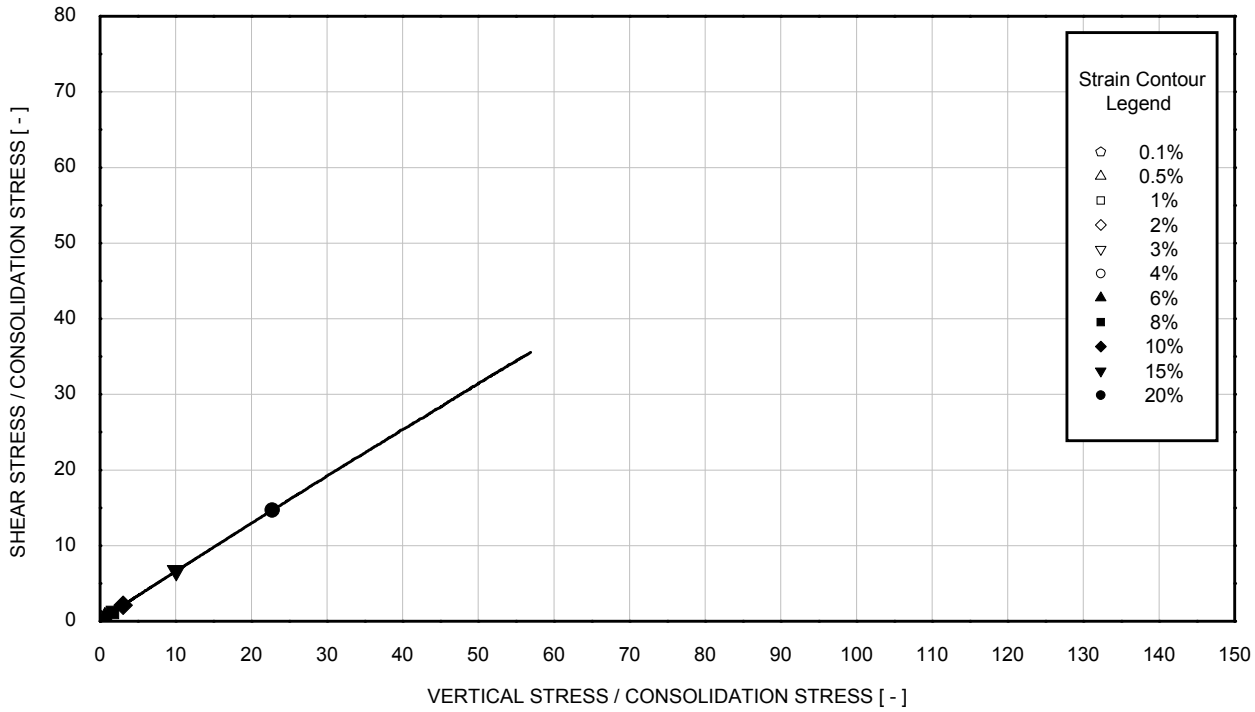
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

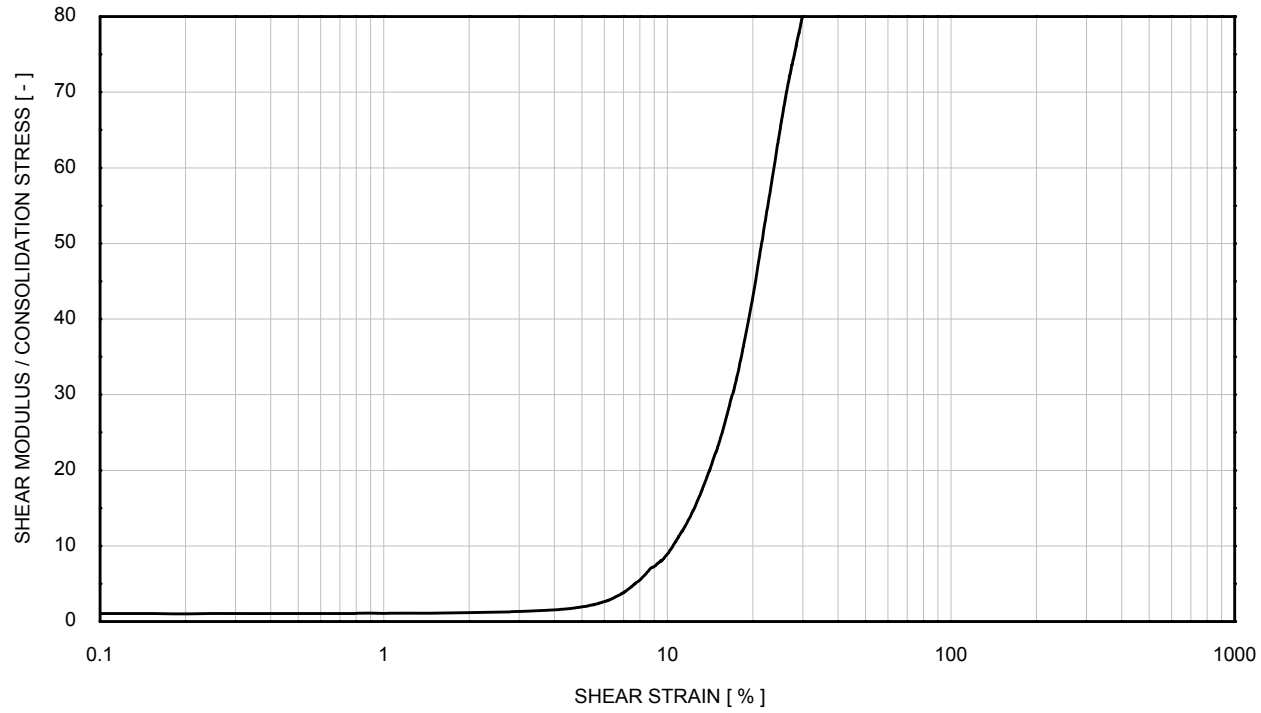




σ_{vc}	: 20	kPa	Batch	: 2
τ_{peak}	: 711	kPa	Sample	: CSS_2-4
γ at τ_{peak}	: 29.98	%	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97	%/hour	Test No.	: CSS04

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 20	kPa	Batch	: 2
τ_{peak}	: 711	kPa	Sample	: CSS_2-4
γ at τ_{peak}	: 29.98	%	Unit	: Unit A (Southern Bight)
Rate of strain	: 2.97	%/hour	Test No.	: CSS04

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown slightly silty fine SAND with few shell fragments

GENERAL	
Date test started	05/12/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	10.0
Bulk density after compaction	[Mg/m³]	1.83
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.597
Degree of saturation after compaction	[%]	44
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	22.5
Bulk density at start of test	[Mg/m³]	2.03
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 4_CSS05
Template issue	1.4
Processed by Date	JLS 07/12/2016
Checked by Date	PH 13/12/2016
Approved by Date	PH 13/12/2016

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	CSS05

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	85
Vertical strain	[%]	0.33
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.591
Water content	[%]	22.3

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	85
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	4
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	0.51
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.588

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.28	0.11	3.64	20.60
2	-0.31	0.07	5.84	19.21
5	-0.32	0.06	7.31	13.46
10	-0.32	0.05	7.85	10.41
20	-0.32	0.05	8.66	9.47
30	-0.32	0.05	8.60	8.64
40	-0.32	0.05	8.66	8.31
50	-0.32	0.05	8.73	8.06
100	-0.32	0.05	9.04	7.43
200	-0.31	0.05	9.11	7.28
400	-0.31	0.05	8.99	7.04

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	CSS05

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	32
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	86
γ_{av} at N_f	[%]	2.35
γ_{cy} at N_f	[%]	15.02
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	-12
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.81	4.13	0.75	18.65
2	-0.57	5.19	0.61	13.92
5	-0.29	6.61	0.49	11.65
10	0.01	7.96	0.41	9.37
20	0.31	9.80	0.33	9.52
30	0.55	11.15	0.29	9.21
40	0.89	12.29	0.26	7.20
50	1.14	13.11	0.24	7.63
60	1.53	13.70	0.23	7.88
70	1.79	14.36	0.22	8.01
80	2.16	14.77	0.22	7.56
86	2.35	15.02	0.21	7.36

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	249
Shear strain	[%]	28.33
Shear induced $-\Delta\sigma_v$	[kPa]	-1346
Vertical stress	[kPa]	1431
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.00
At 15 % shear strain		
Shear stress	[kPa]	16
Shear induced $-\Delta\sigma_v$	[kPa]	-10
Vertical stress	[kPa]	95
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	CSS05

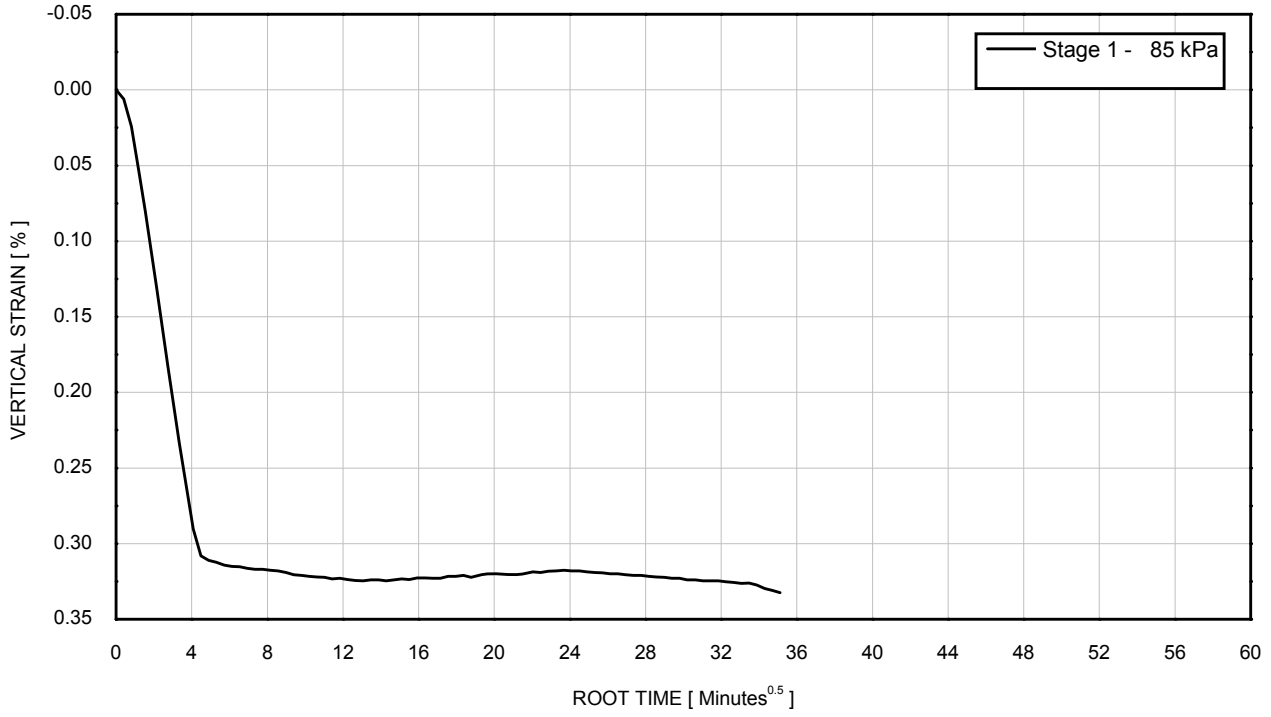
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

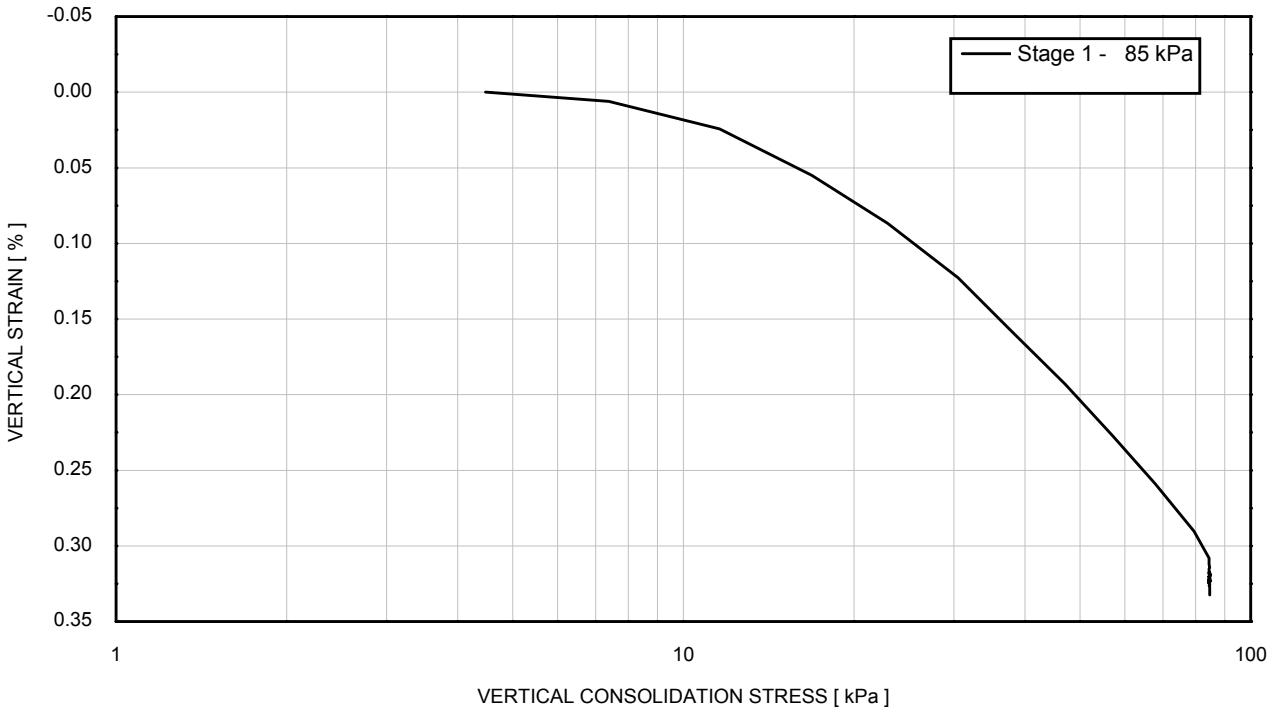
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-1
Unit	Unit B1 (Kreftenheye)
Test number	CSS05

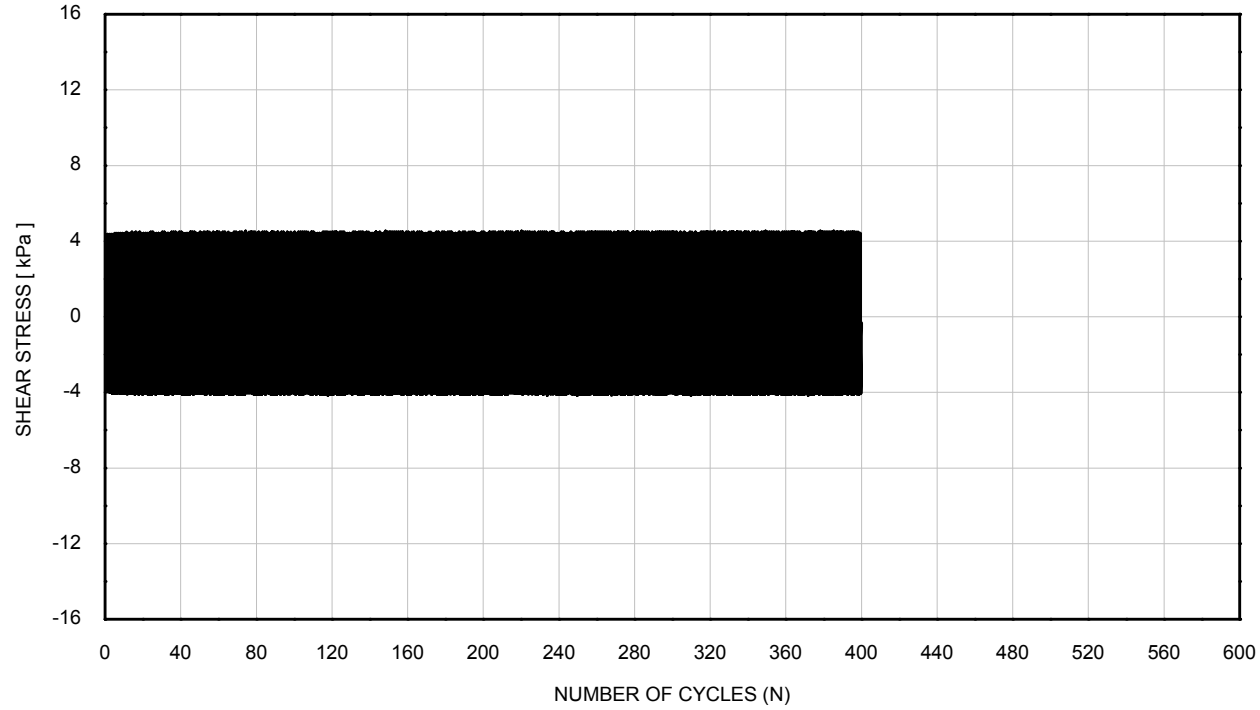
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

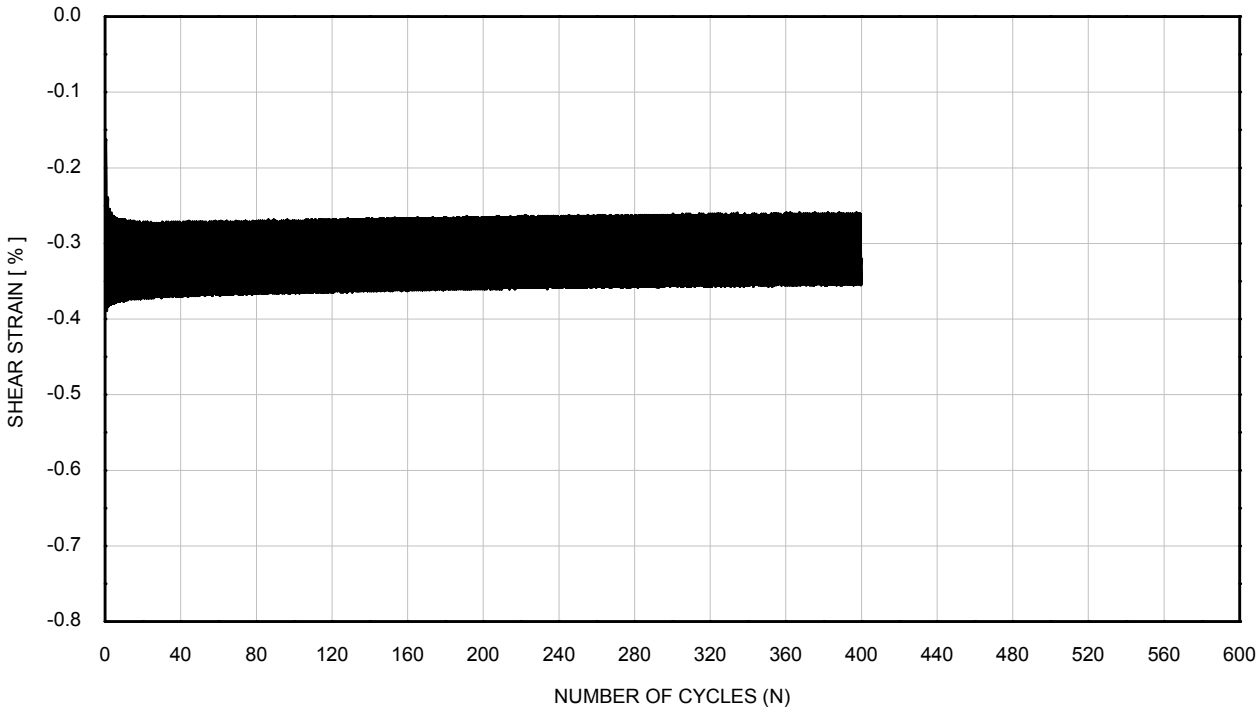




σ_{vc}	: 85 kPa	Batch	: 4
		Sample	: CSS_4-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CSS05

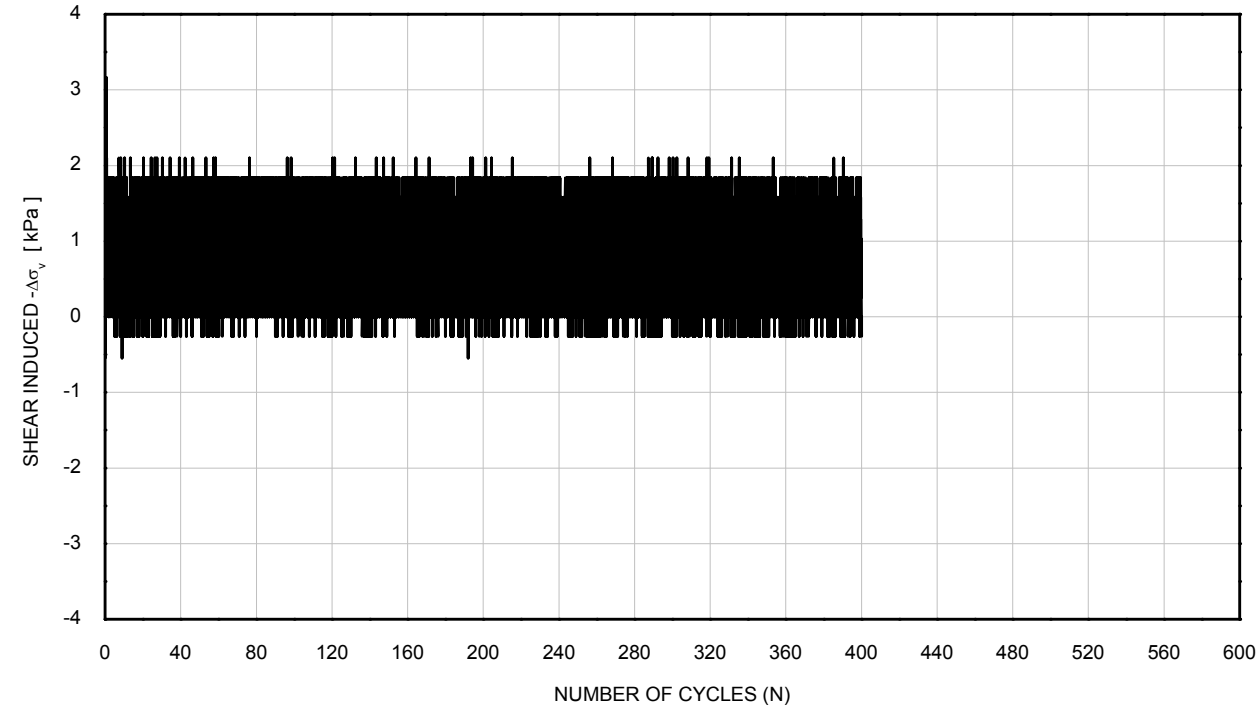
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

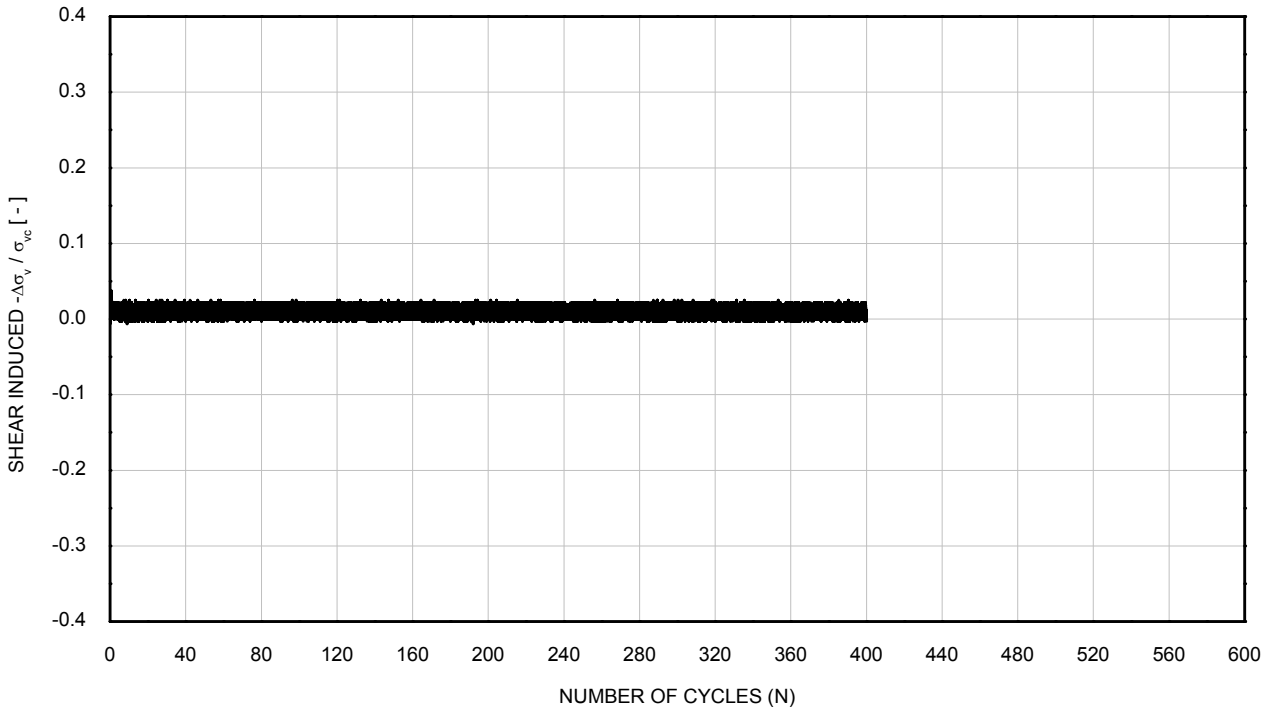




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

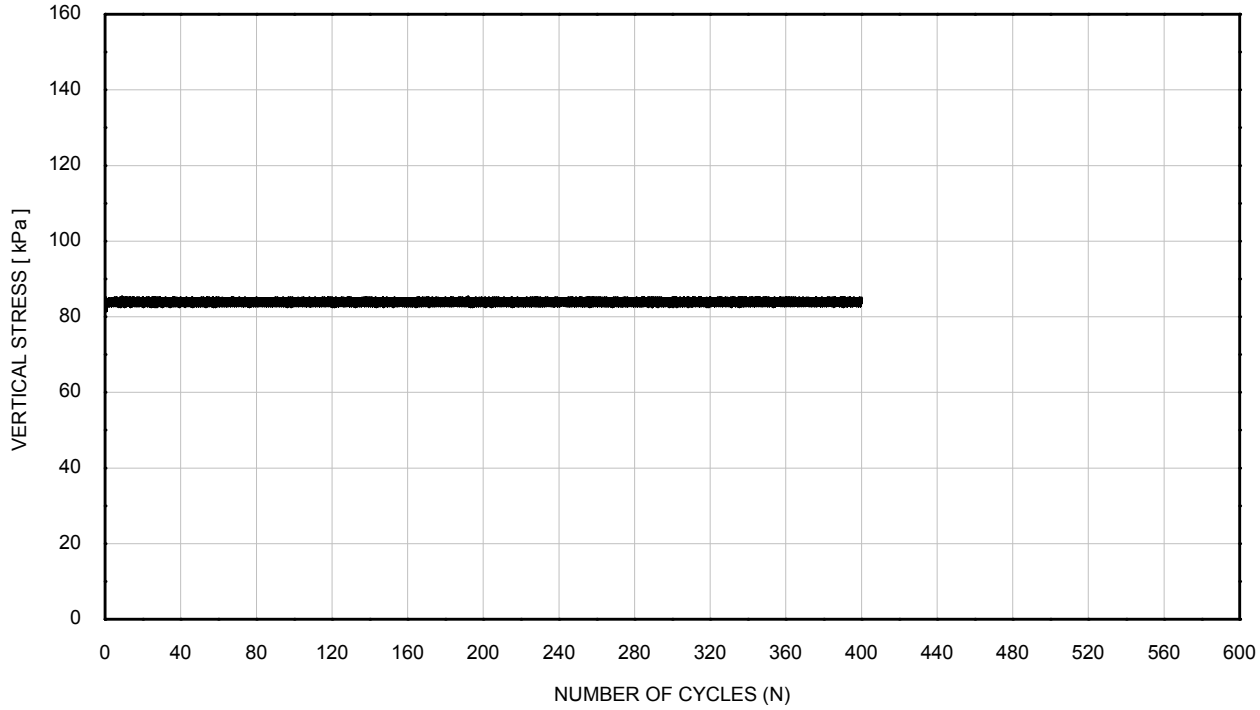
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

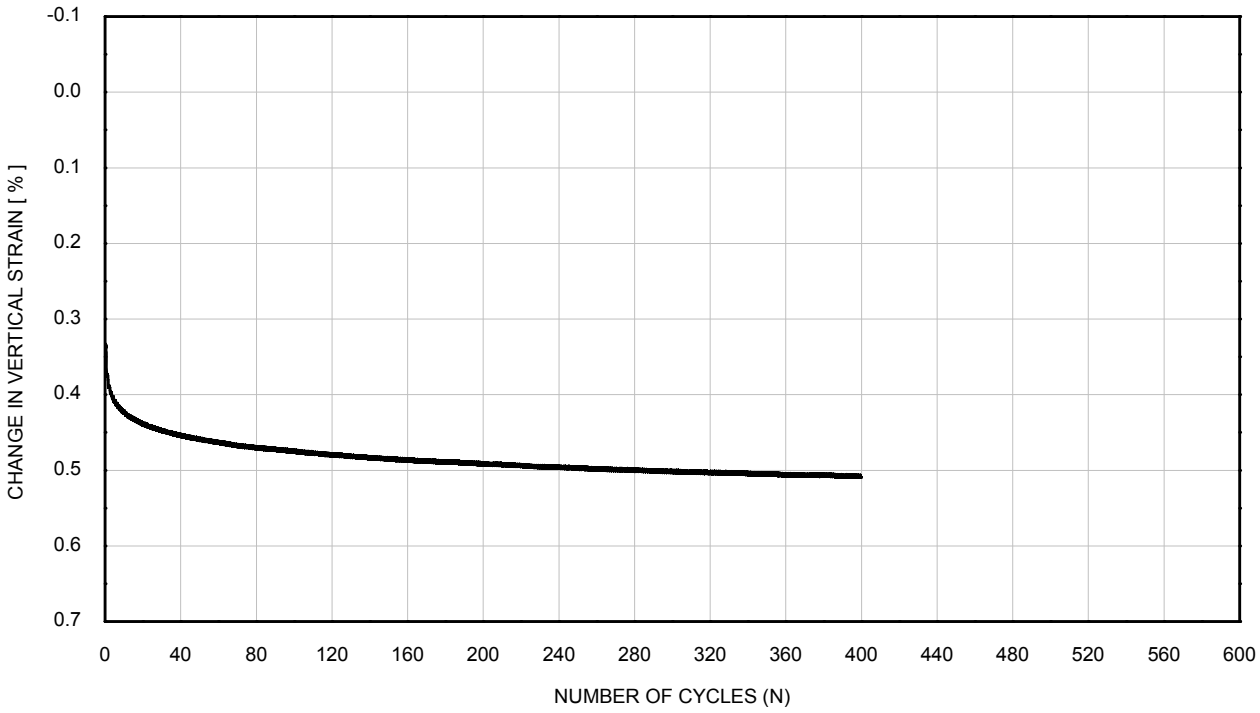




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

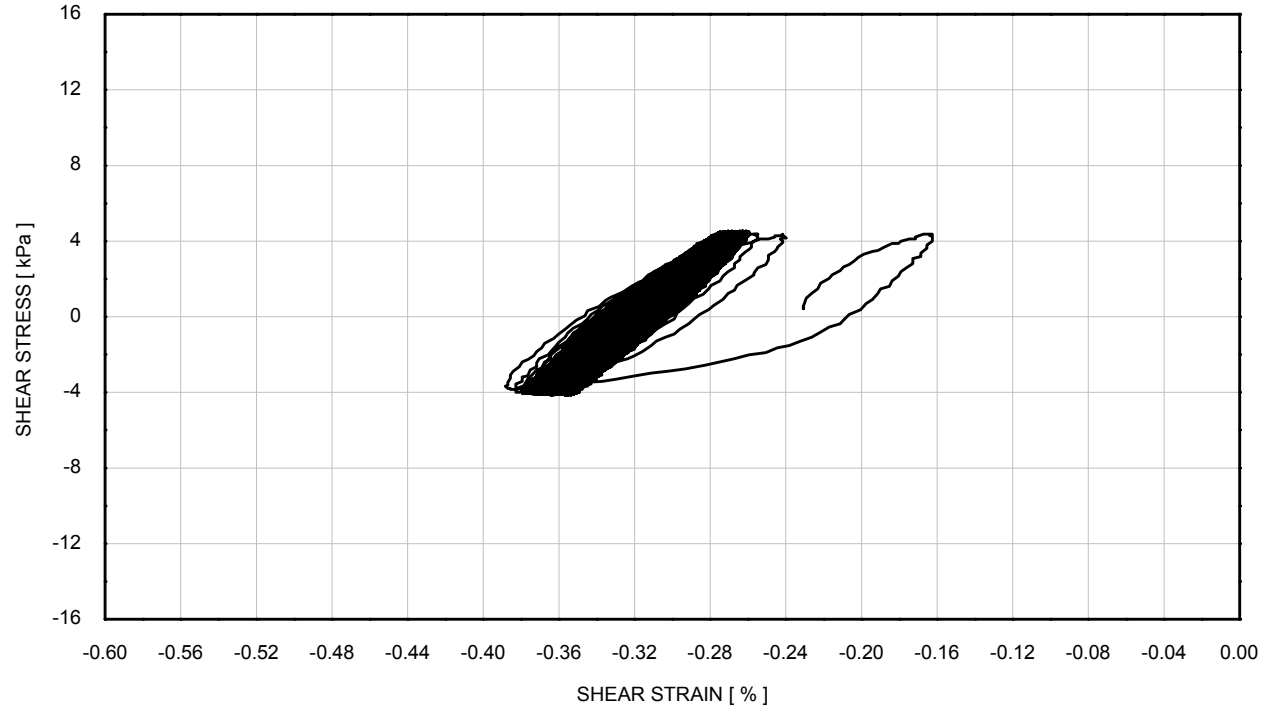
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

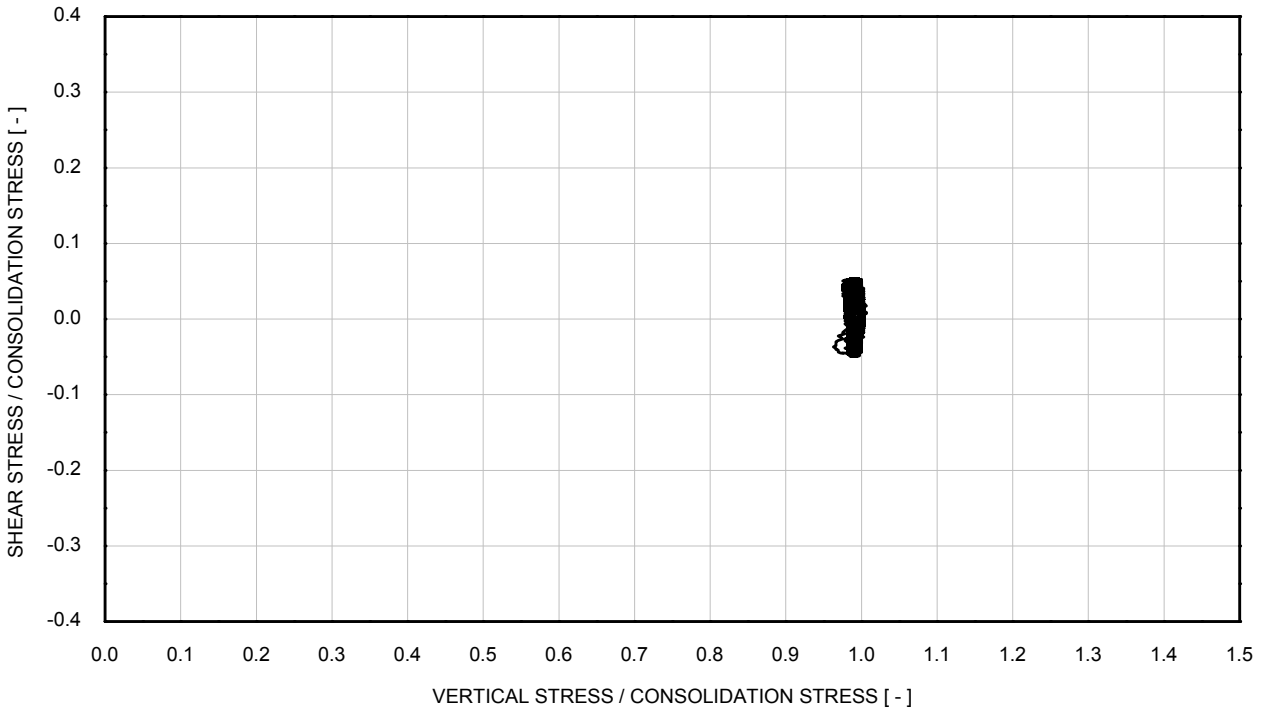




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

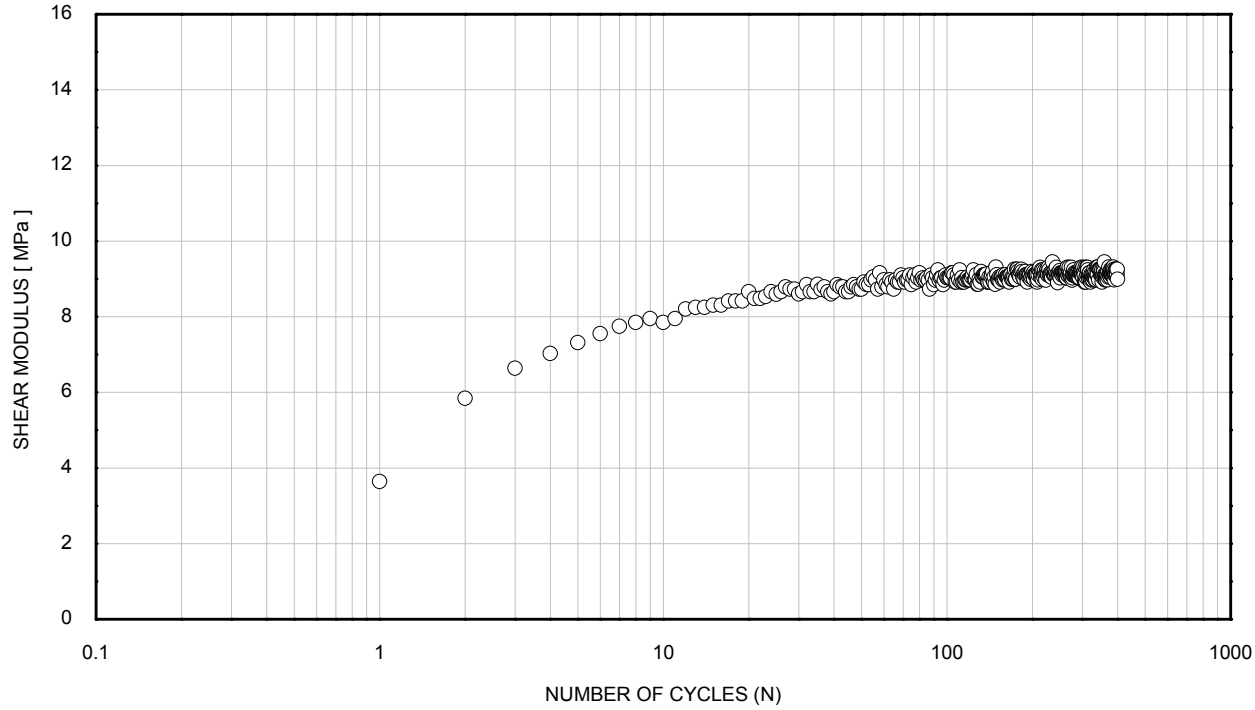
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

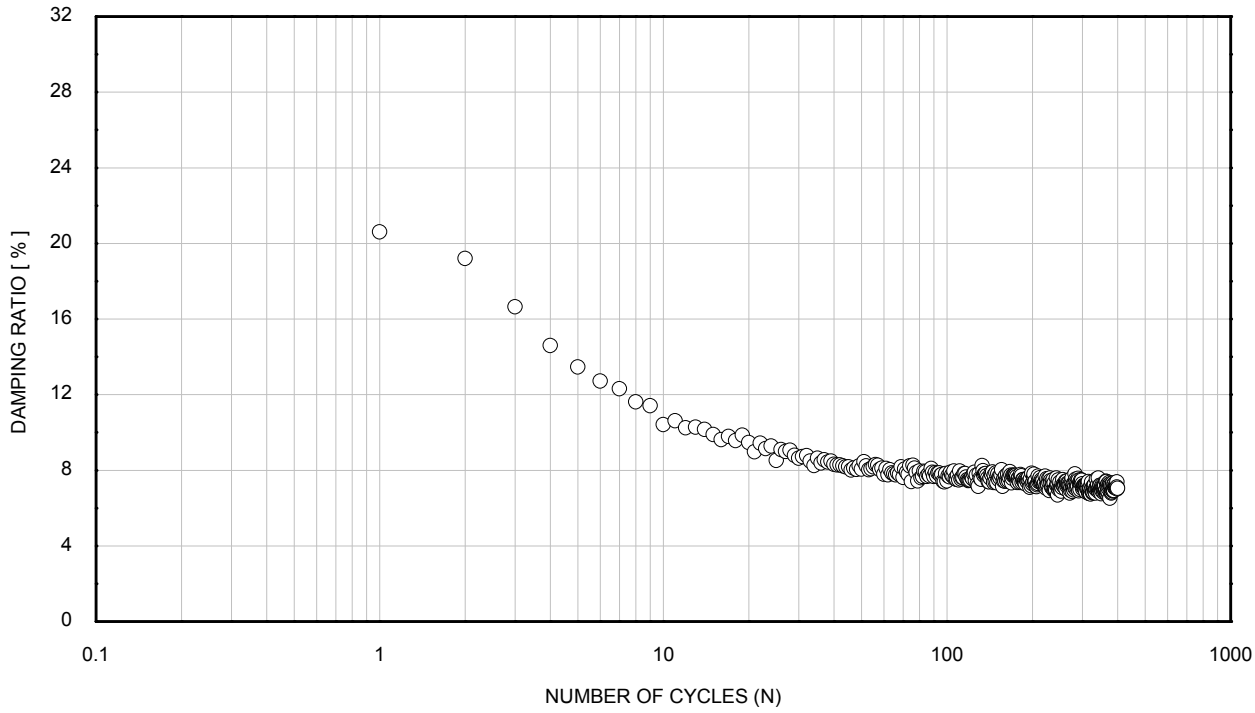




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

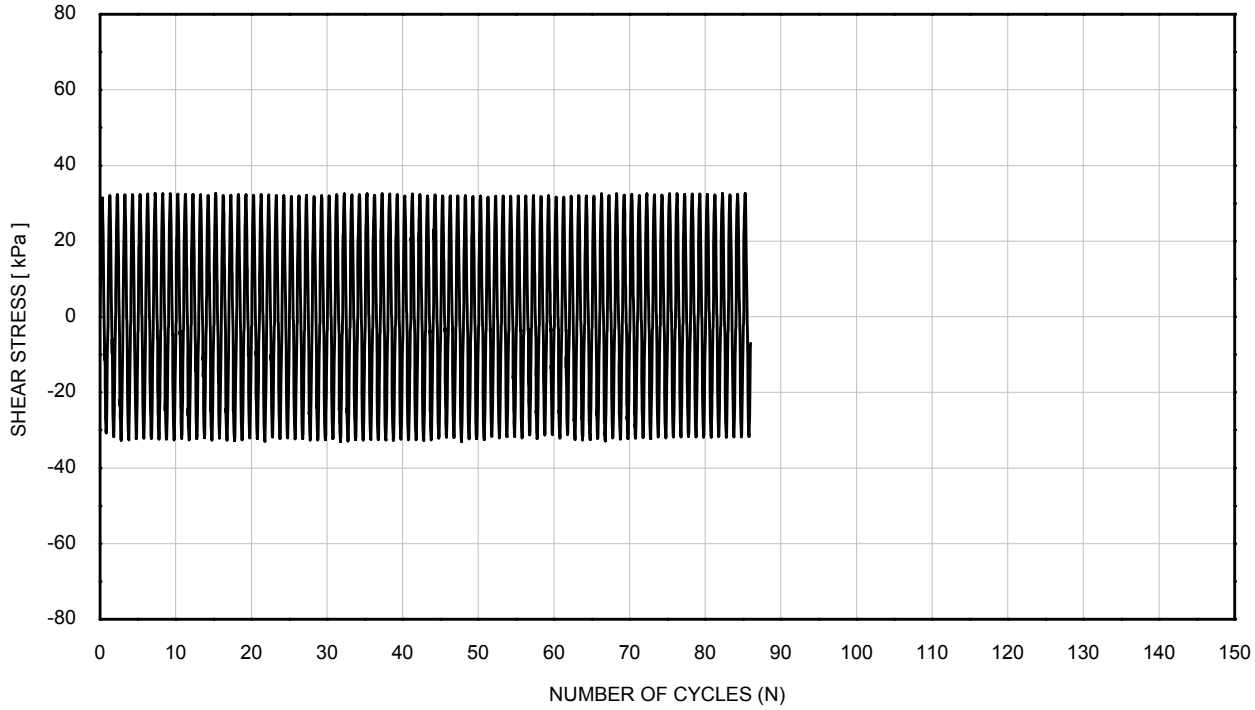
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

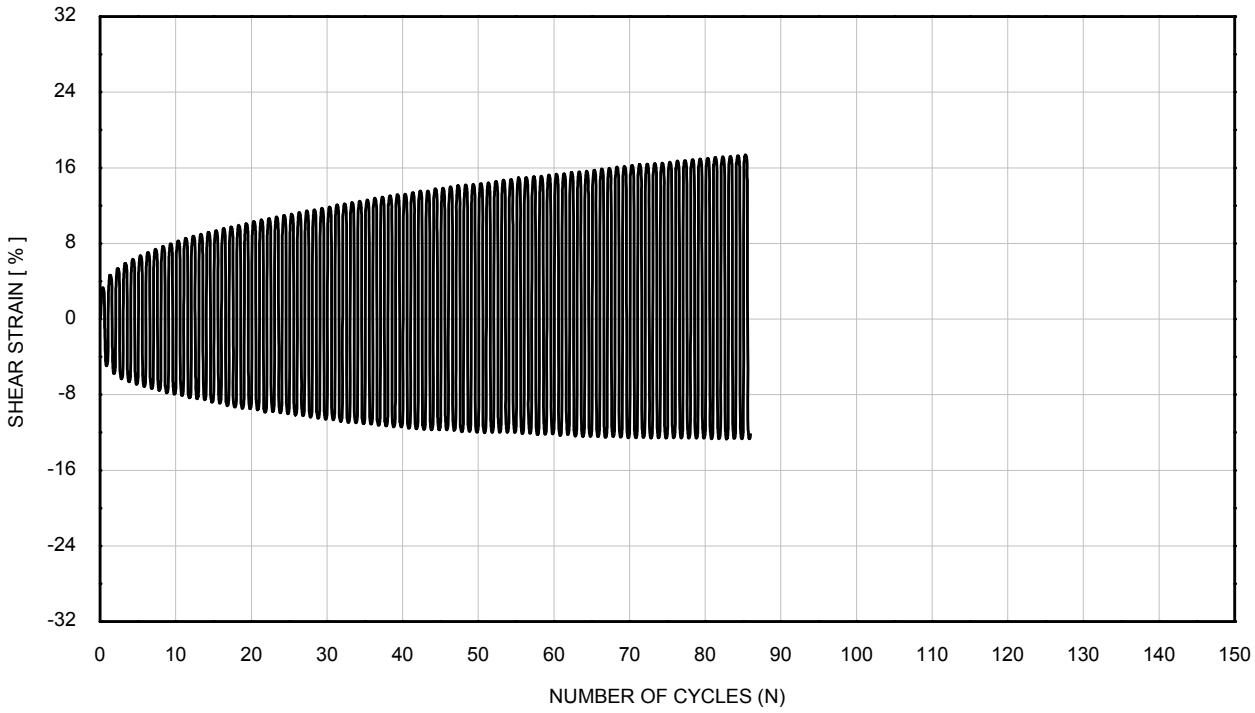




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

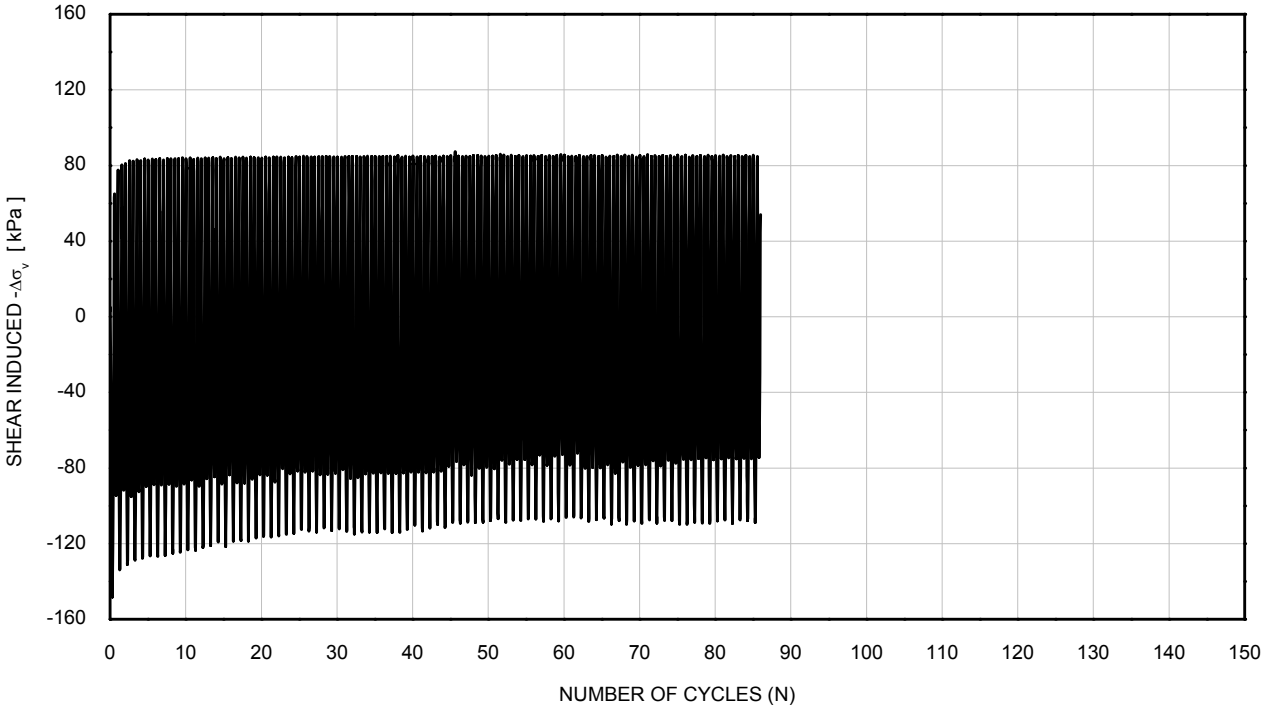
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

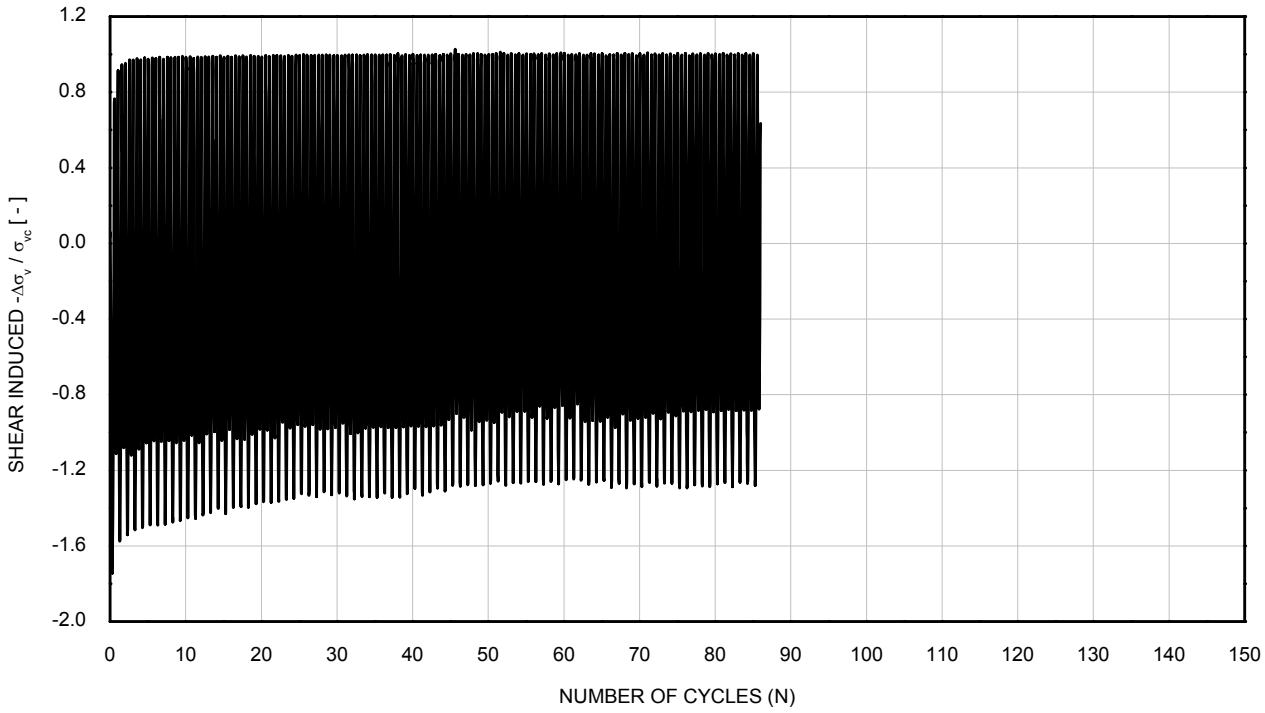




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	32 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

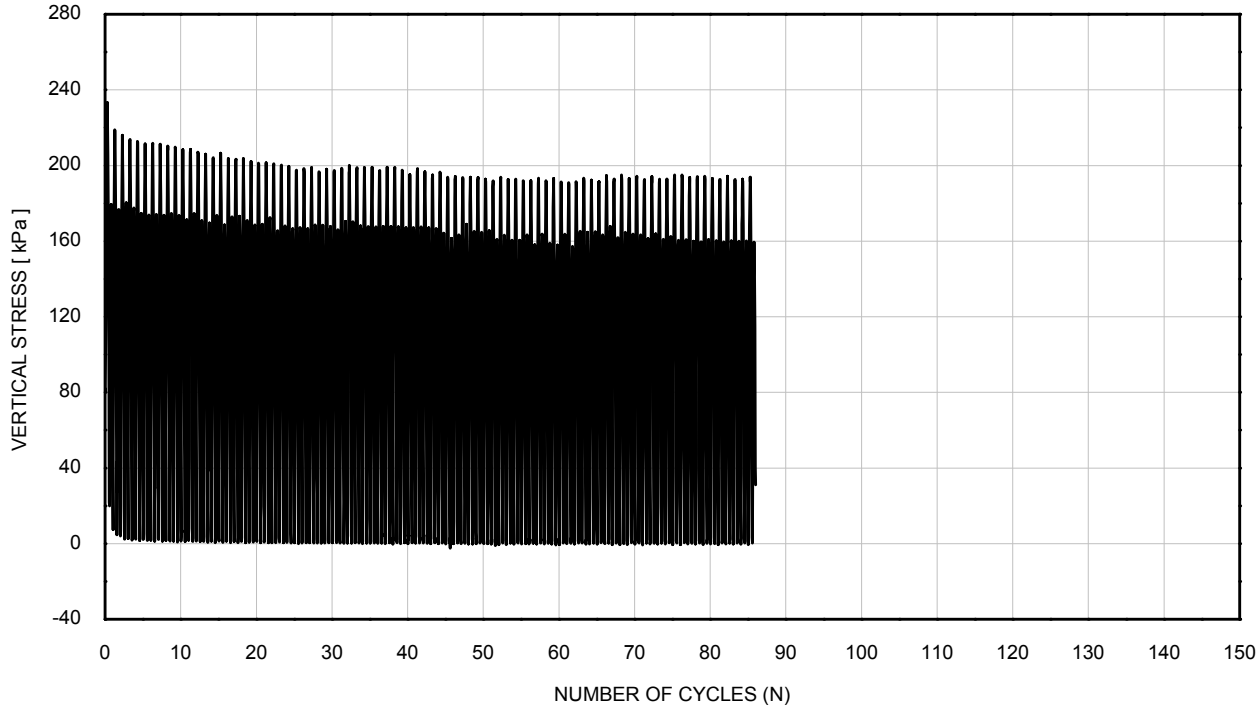
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

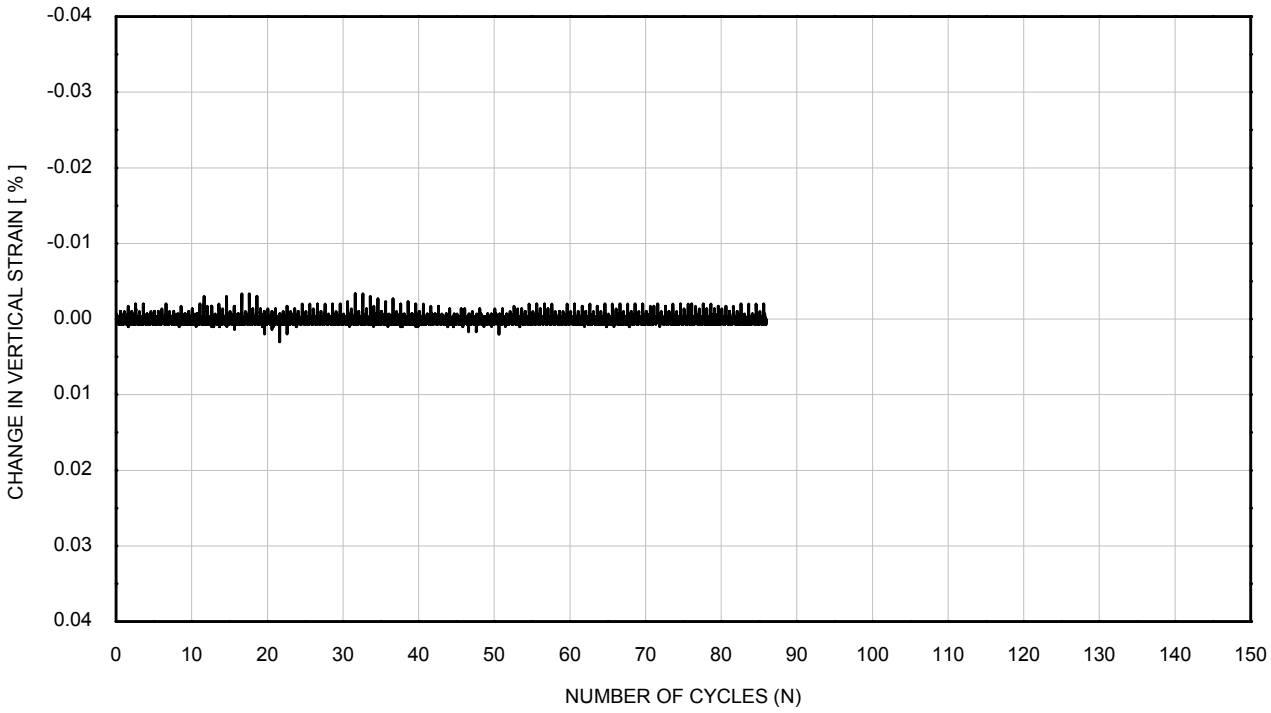




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	32 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

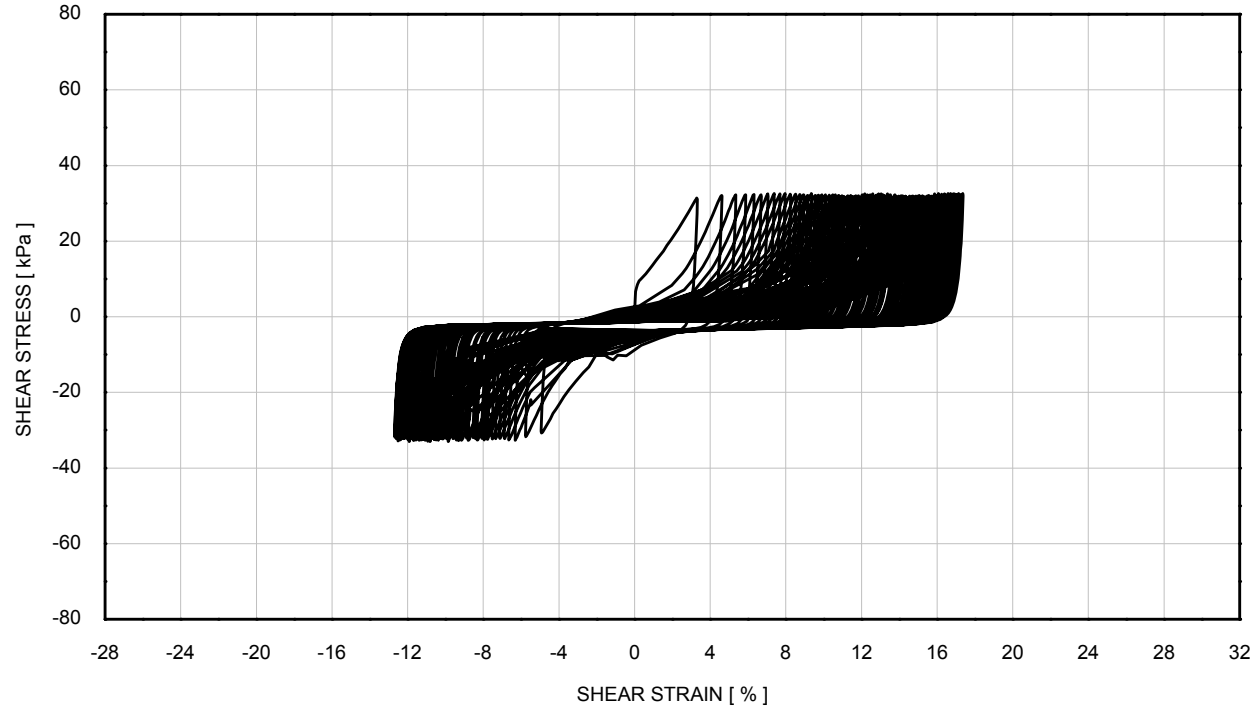
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

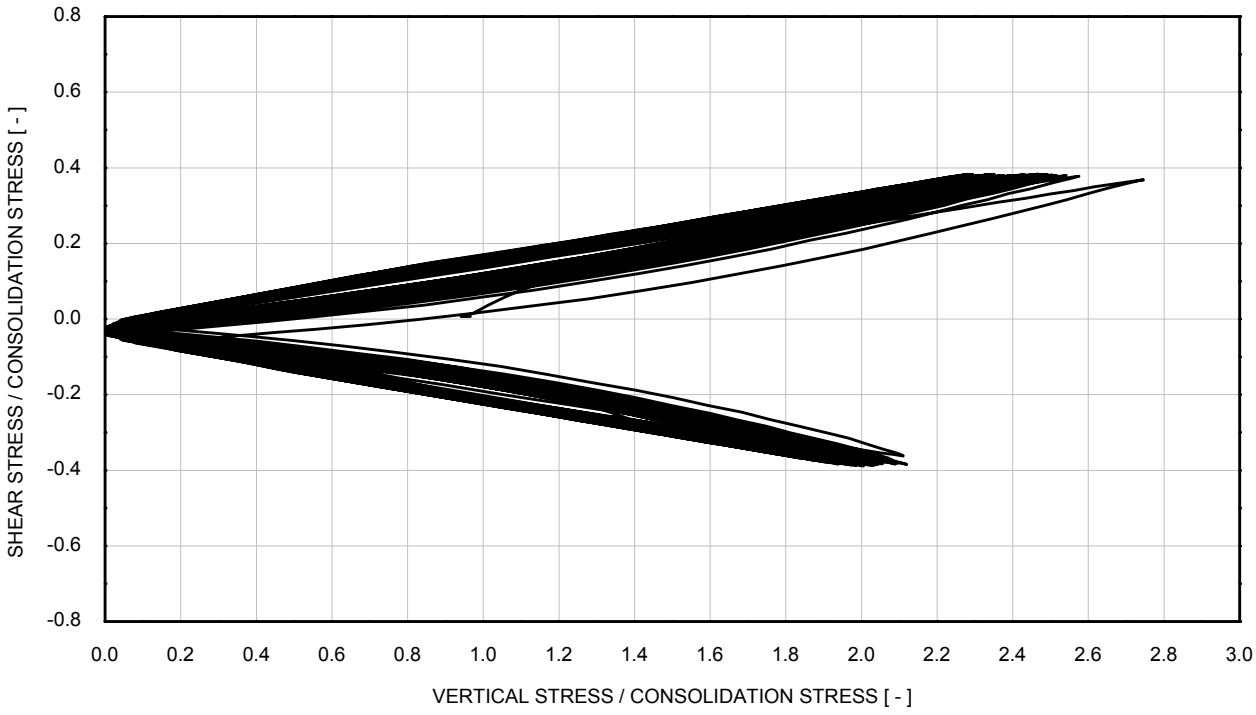




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	32 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

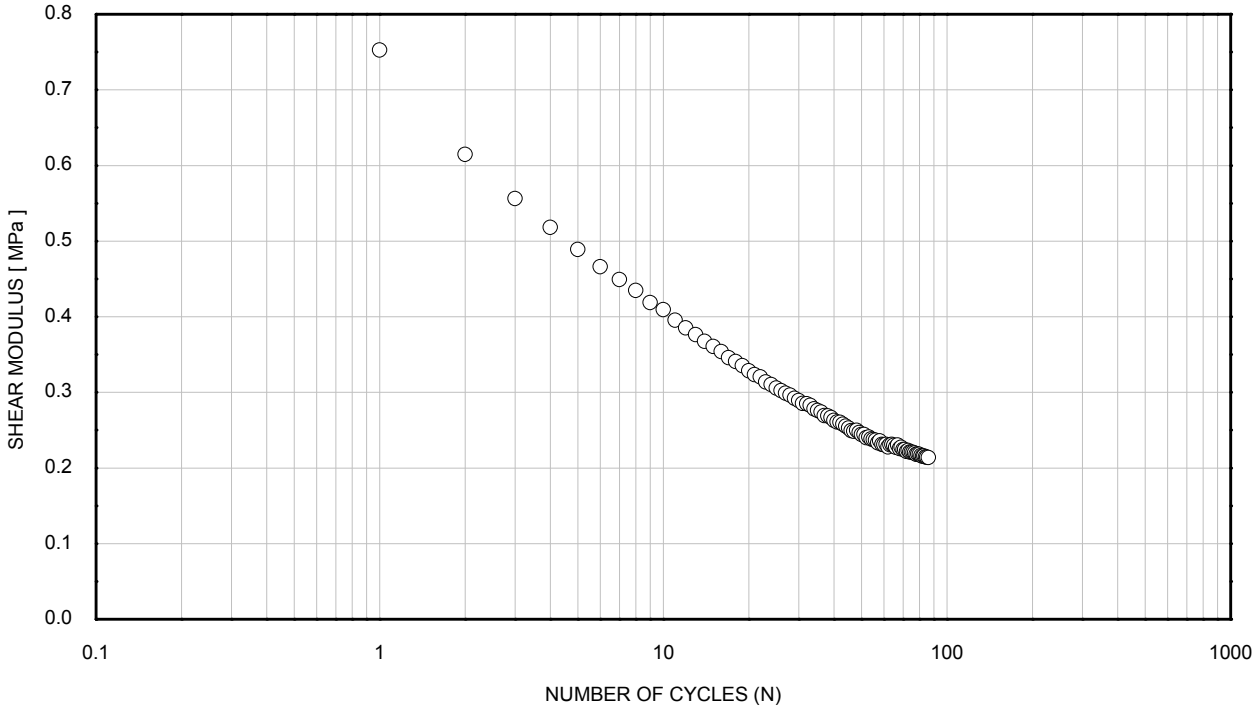
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

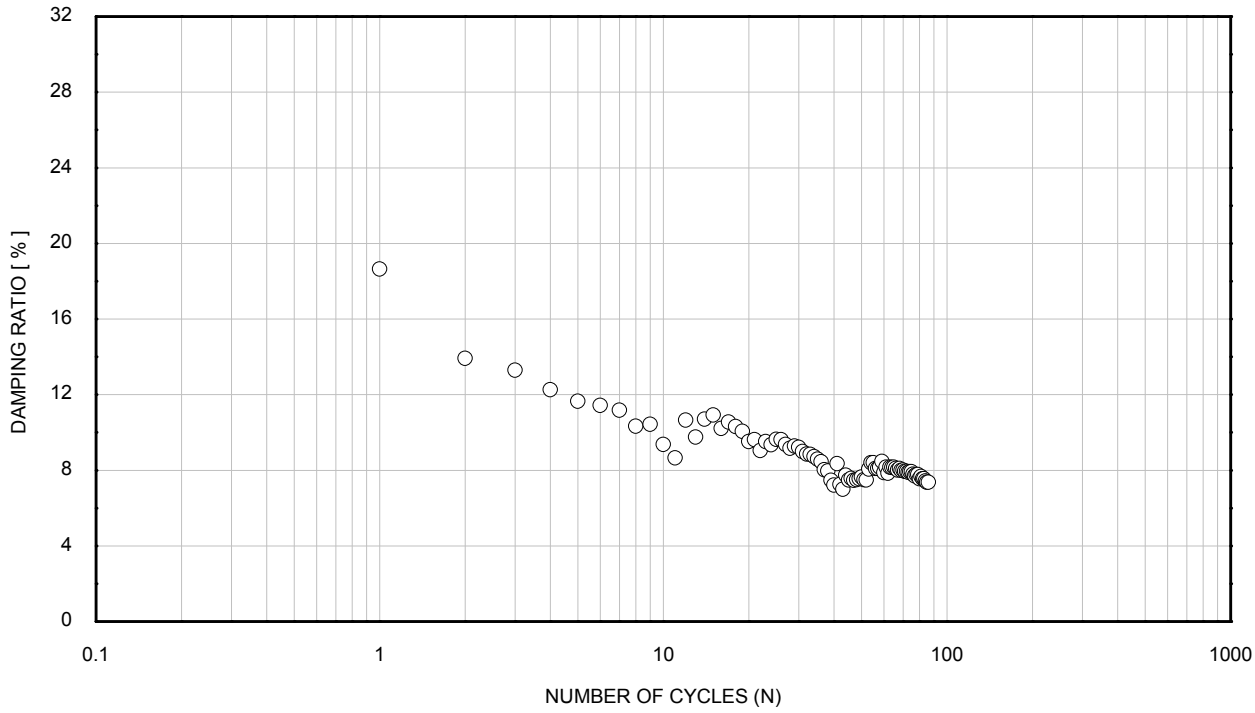




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	32 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

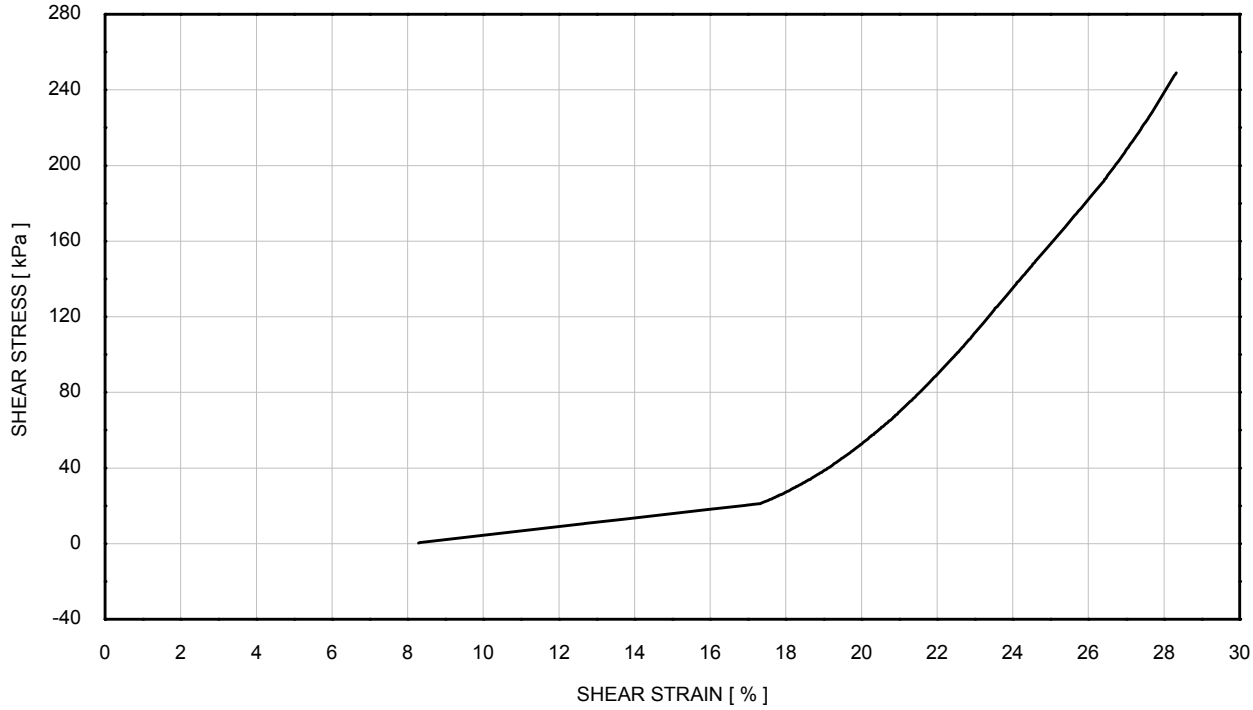
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

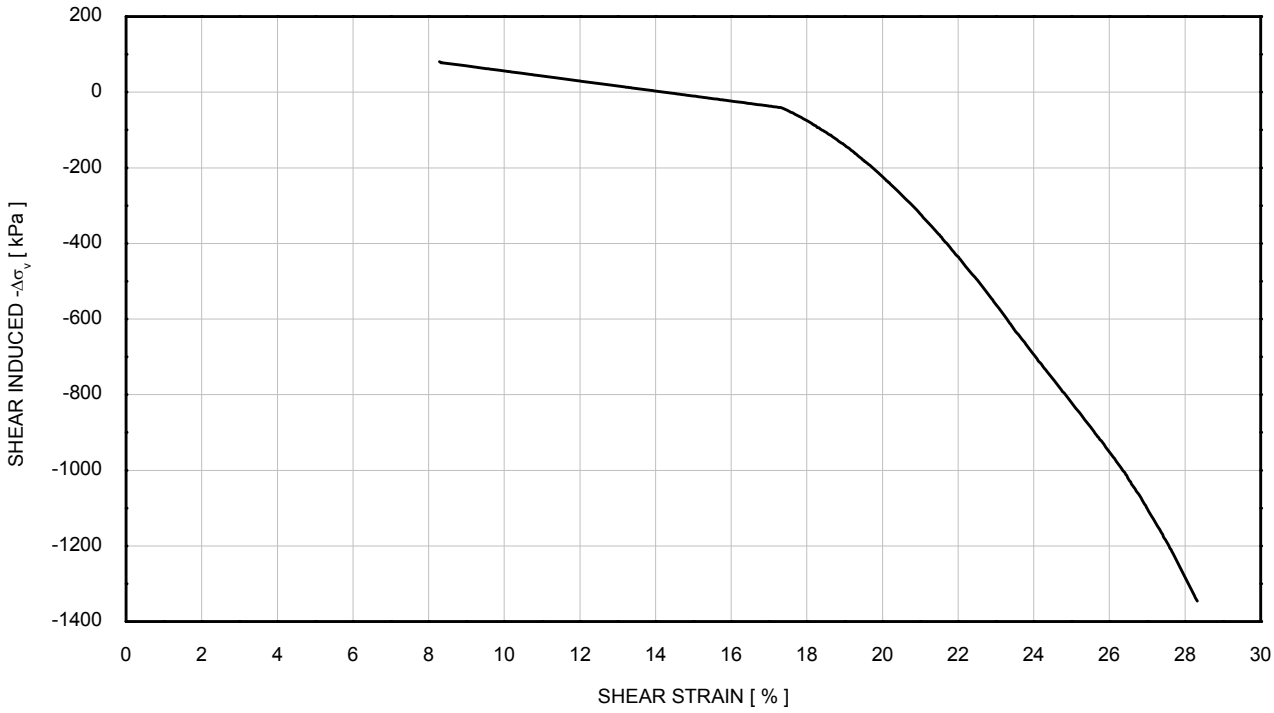




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-1
Mean τ_{cy}	:	32 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS05

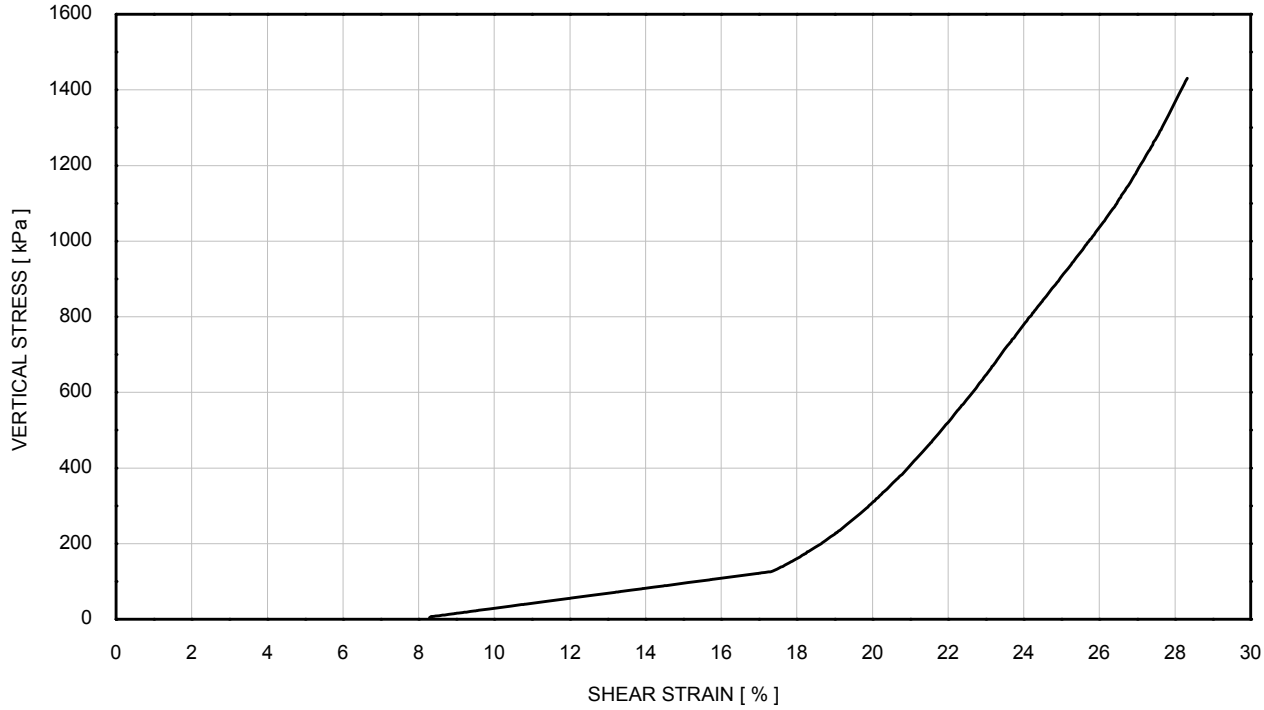
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

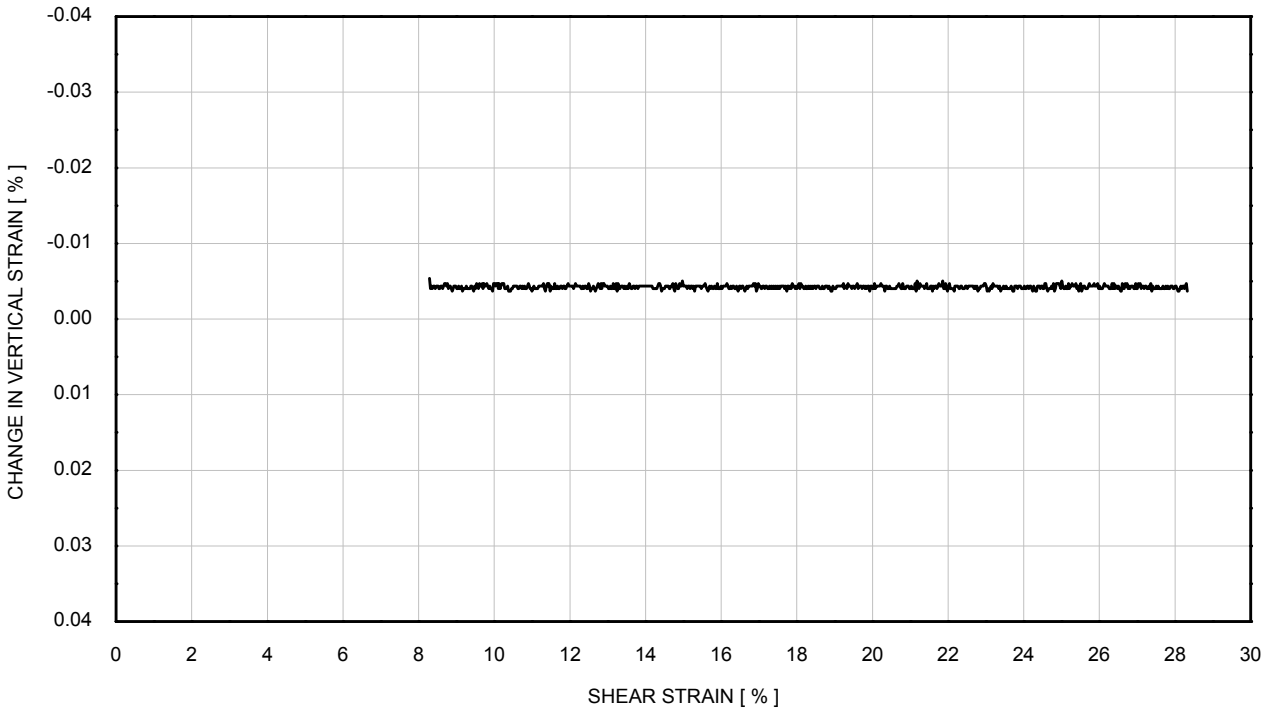




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 249 kPa	Sample	: CSS_4-1
γ at τ_{peak}	: 28.33 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 3.00 %/hour	Test No.	: CSS05

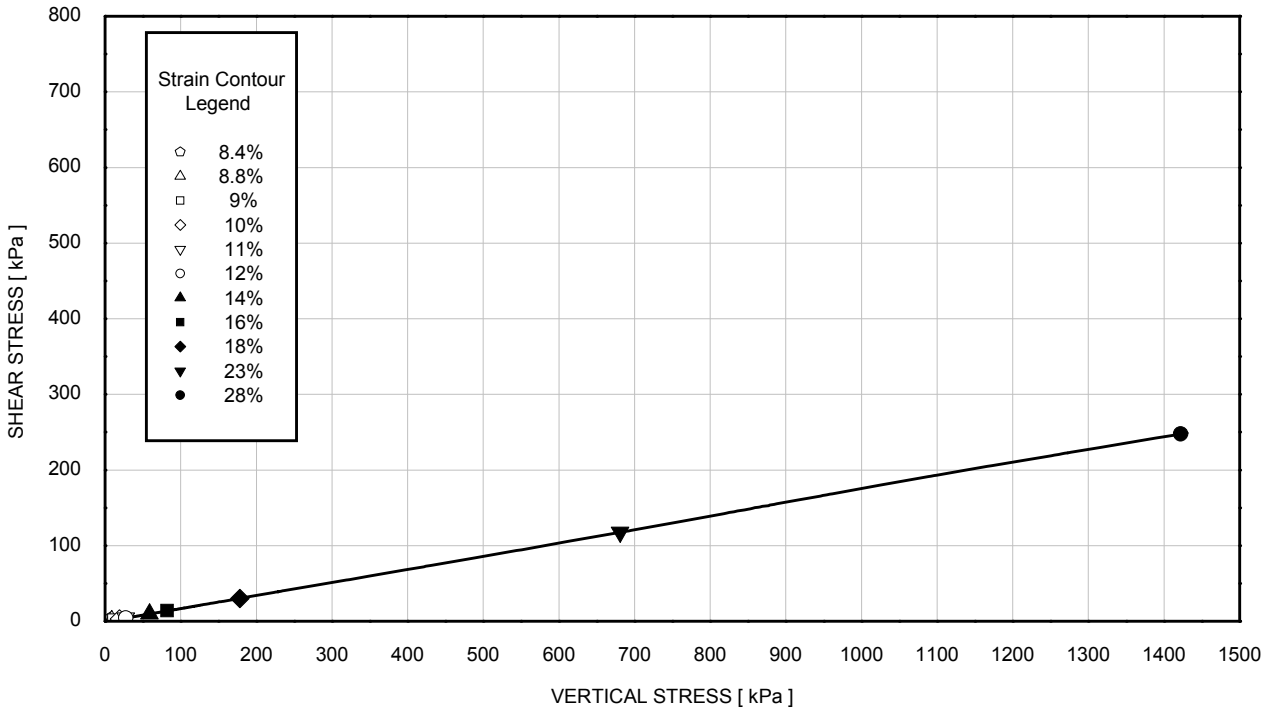
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

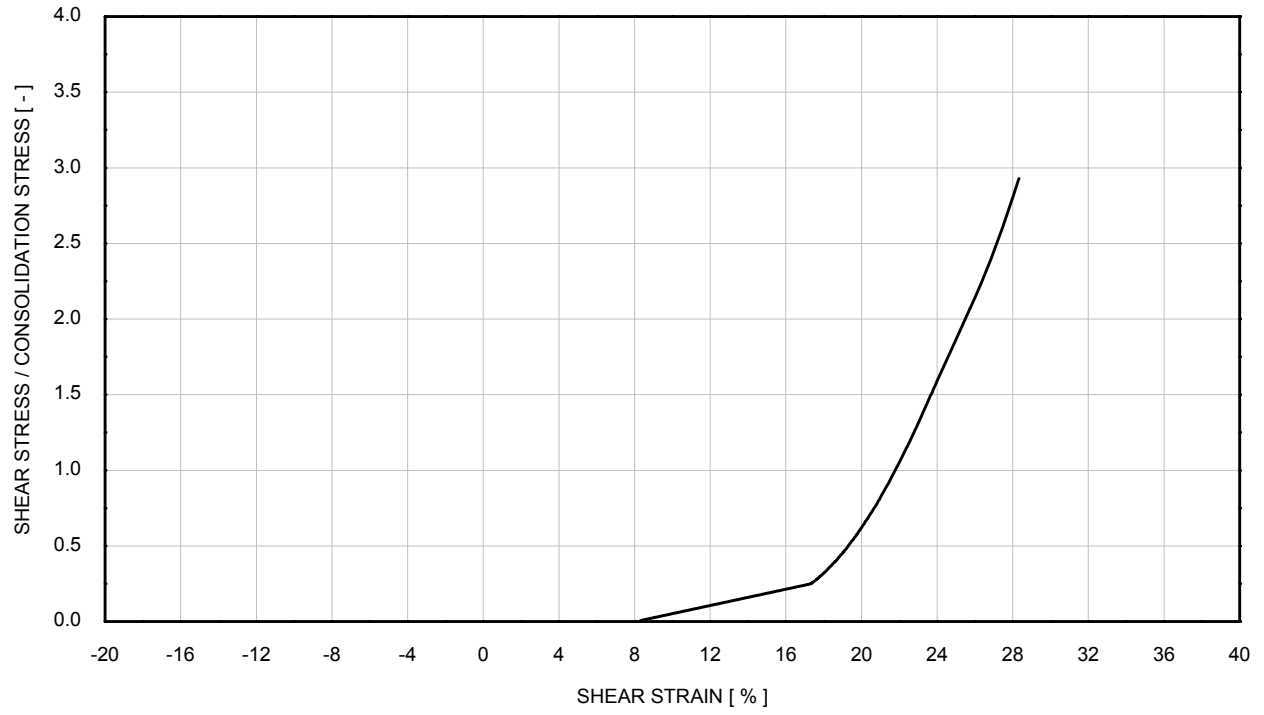




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 249 kPa	Sample	: CSS_4-1
γ at τ_{peak}	: 28.33 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 3.00 %/hour	Test No.	: CSS05

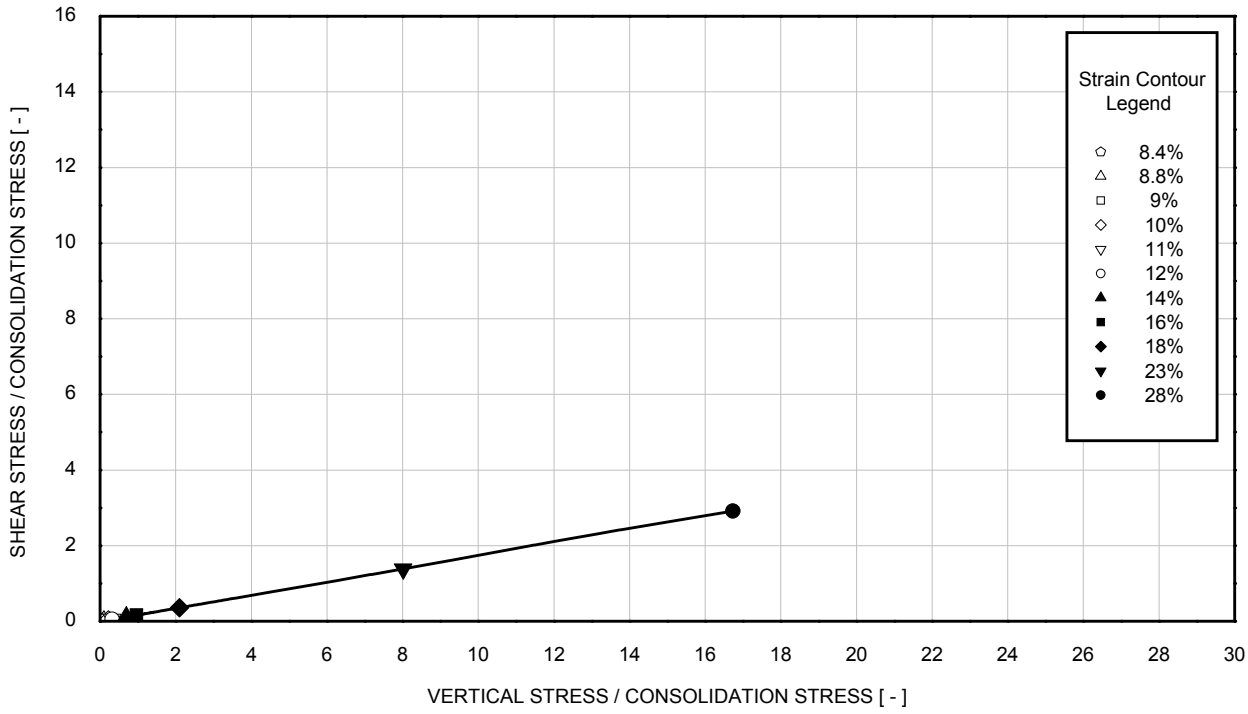
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

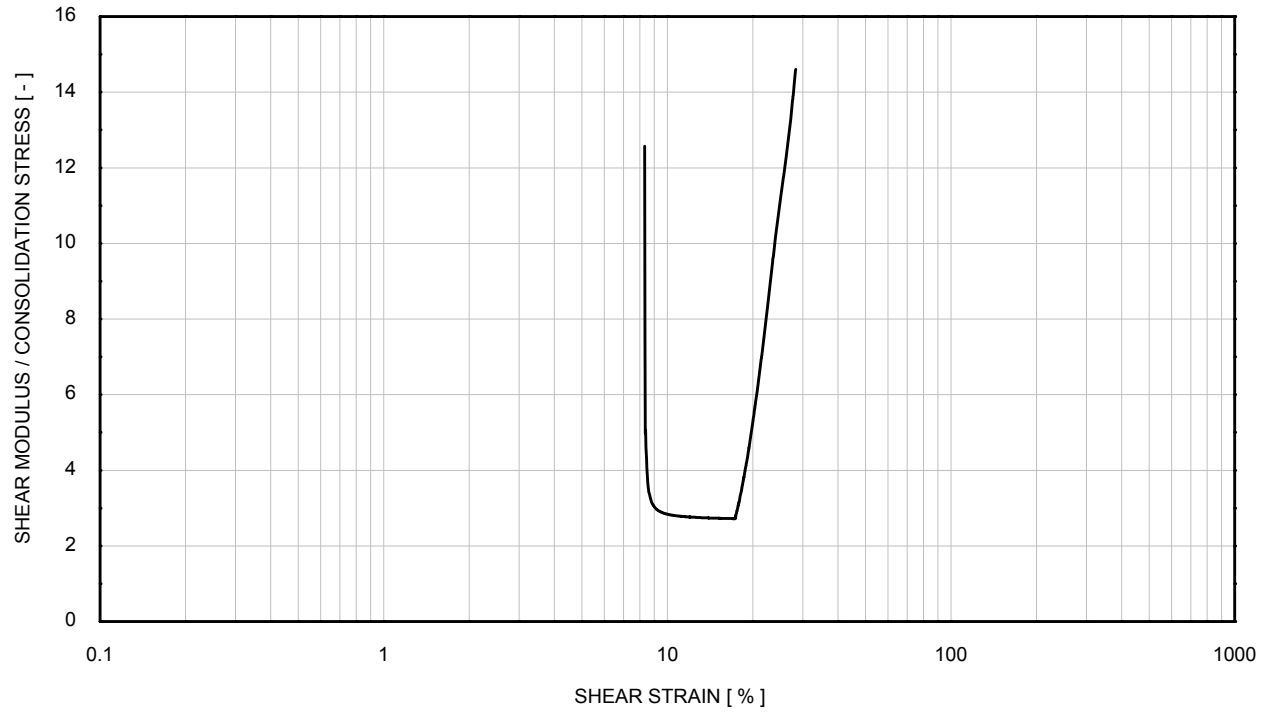




σ_{vc}	:	85 kPa	Batch	: 4
τ_{peak}	:	249 kPa	Sample	: CSS_4-1
γ at τ_{peak}	:	28.33 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	:	3.00 %/hour	Test No.	: CSS05

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	:	85 kPa	Batch	: 4
τ_{peak}	:	249 kPa	Sample	: CSS_4-1
γ at τ_{peak}	:	28.33 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	:	3.00 %/hour	Test No.	: CSS05

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown slightly silty fine to medium SAND with few shell fragments

GENERAL	
Date test started	11/03/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	10.1
Bulk density after compaction	[Mg/m³]	1.83
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.598
Degree of saturation after compaction	[%]	45
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	22.6
Bulk density at start of test	[Mg/m³]	2.03
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 4_CSS06
Template issue	1.4
Processed by	JLS
Date	09/11/2016
Checked by	PH
Date	21/11/2016
Approved by	PH
Date	21/11/2016

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-2
Unit	Unit B1 (Kreftenheye)
Test number	CSS06

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	85
Vertical strain	[%]	0.65
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.588
Water content	[%]	22.2

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	85
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	4
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	0.68
Bulk density	[Mg/m^3]	2.04
Dry density	[Mg/m^3]	1.67
Void ratio	[-]	0.588

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.04	0.02	17.94	6.49
2	0.04	0.02	18.18	3.84
5	0.04	0.02	18.18	2.04
10	0.03	0.03	16.11	2.19
20	0.03	0.02	17.41	2.59
50	0.03	0.03	17.03	1.17
100	0.03	0.02	18.18	0.91
200	0.03	0.03	16.11	1.55
300	0.03	0.02	17.41	0.67
400	0.03	0.02	18.75	1.45

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-2
Unit	Unit B1 (Kreftenheye)
Test number	CSS06

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	24
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	264
γ_{av} at N_f	[%]	-2.63
γ_{cy} at N_f	[%]	15.02
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	67
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.40	1.13	2.15	25.33
2	-0.44	1.85	1.29	26.44
5	-0.47	3.40	0.71	16.36
10	-0.80	4.90	0.49	11.95
20	-1.60	7.05	0.34	9.98
50	-2.39	10.41	0.23	8.68
100	-2.47	12.57	0.19	7.84
200	-2.43	14.30	0.17	7.51
264	-2.63	15.02	0.16	6.95

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	466
Shear strain	[%]	29.98
Shear induced $-\Delta\sigma_v$	[kPa]	-638
Vertical stress	[kPa]	723
Vertical strain	[%]	0.01
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	52
Shear induced $-\Delta\sigma_v$	[kPa]	13
Vertical stress	[kPa]	72
Vertical strain	[%]	0.01

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-2
Unit	Unit B1 (Kreftenheye)
Test number	CSS06

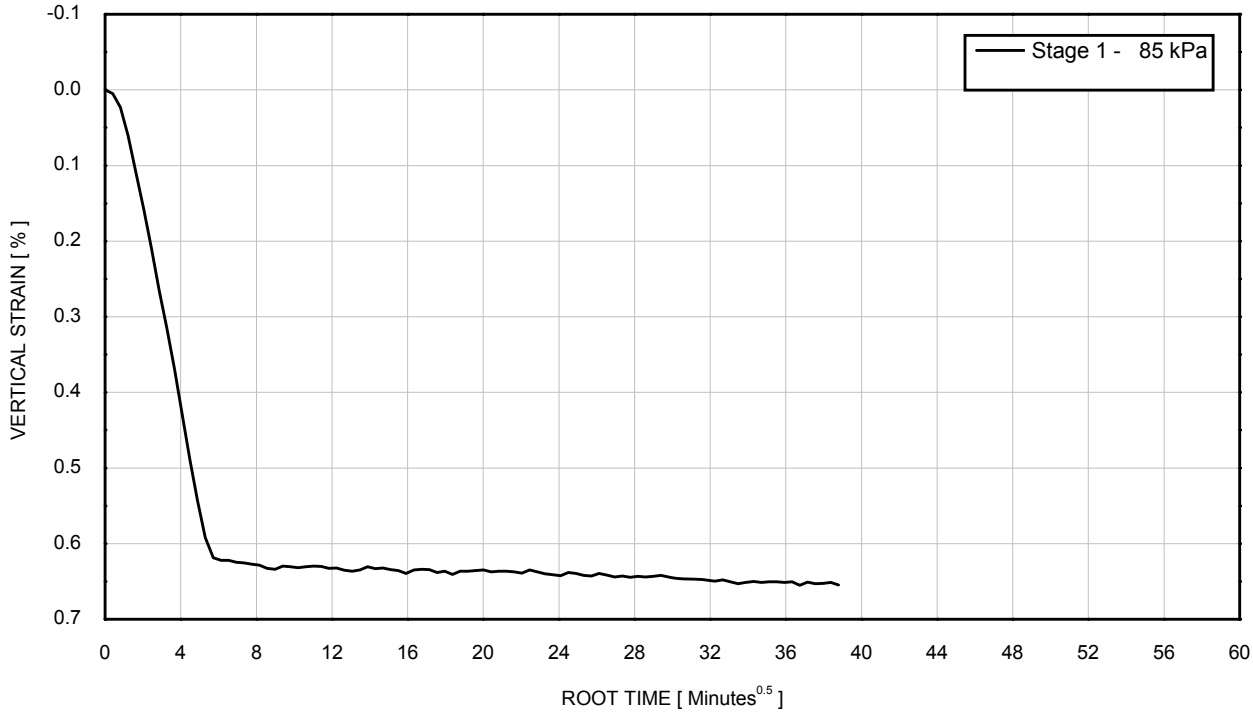
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

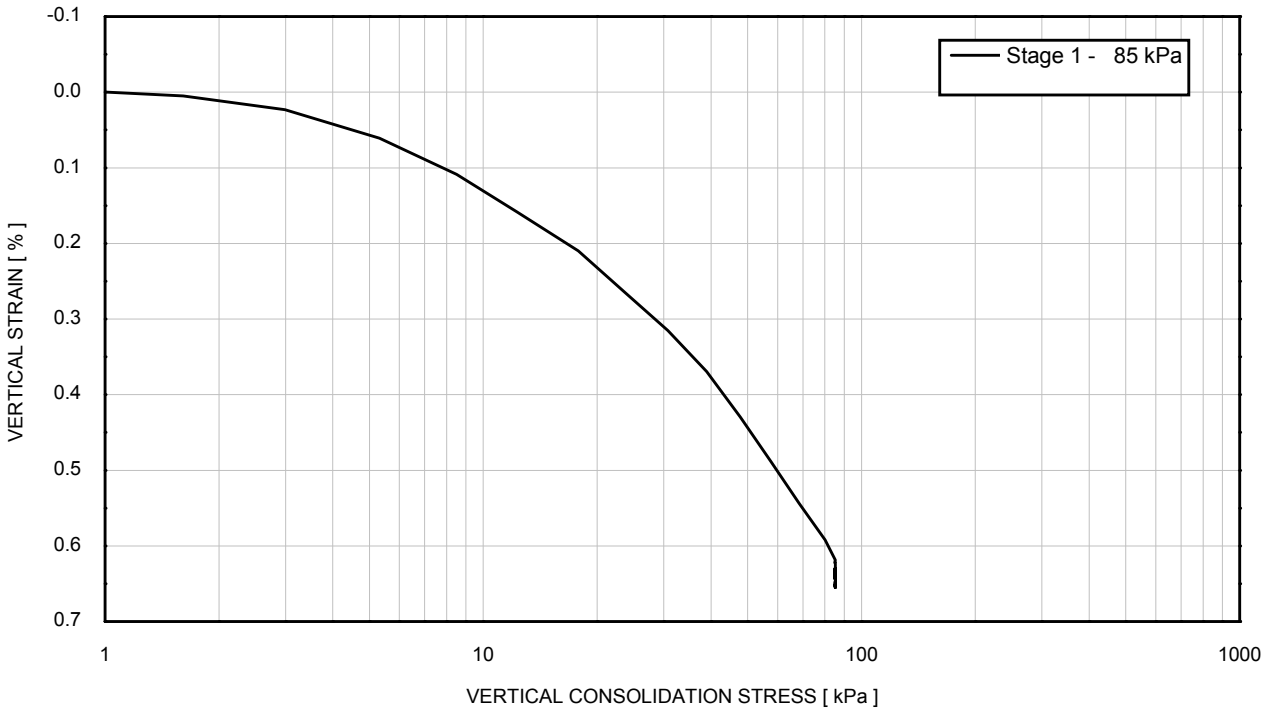
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-2
Unit	Unit B1 (Kreftenheye)
Test number	CSS06

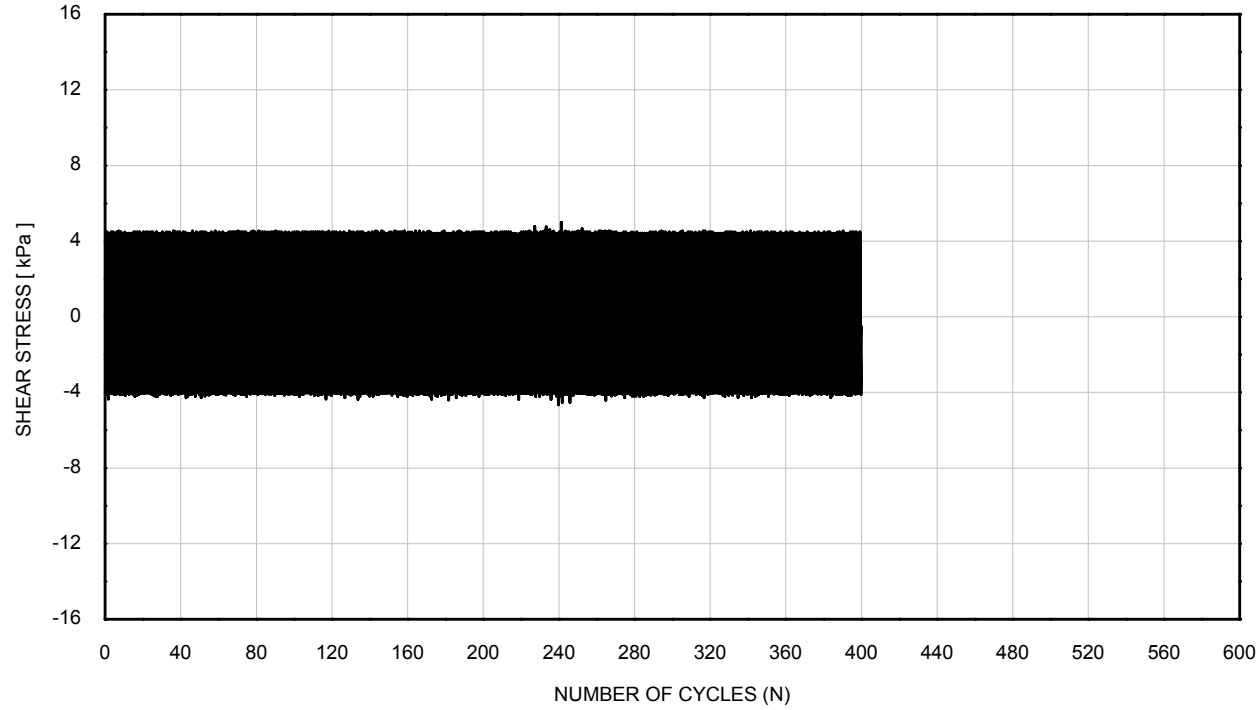
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

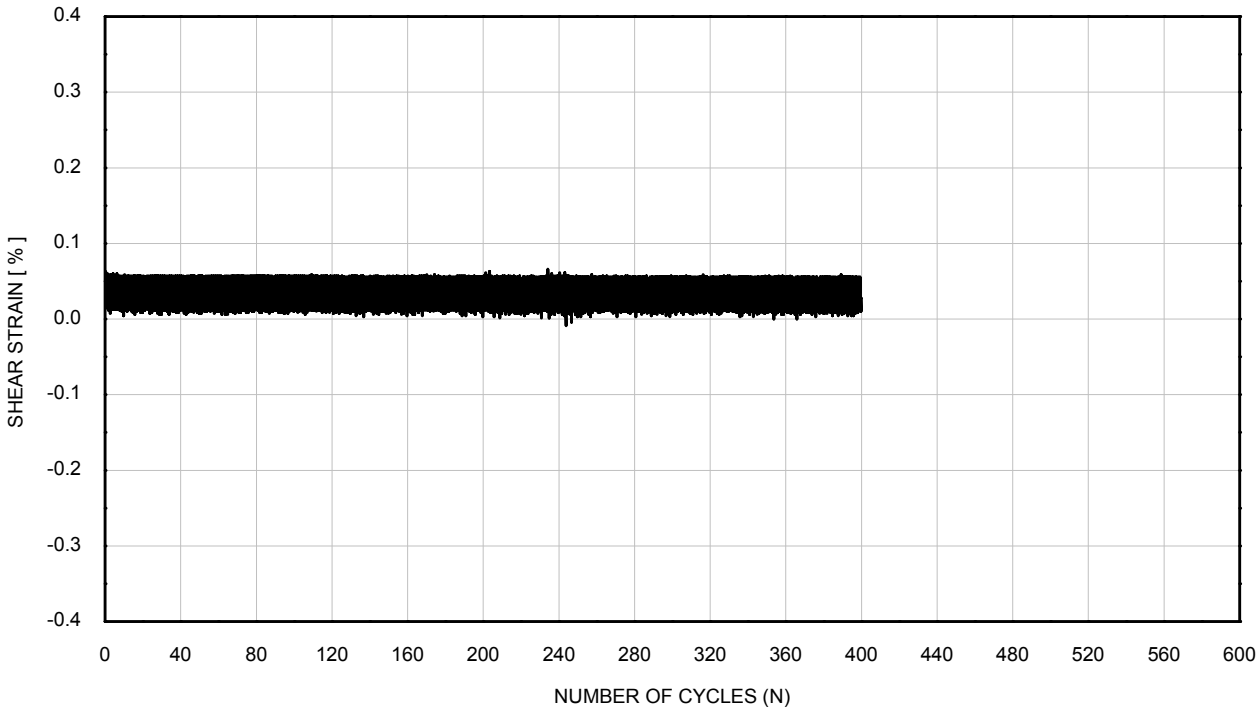




σ_{vc}	: 85 kPa	Batch	: 4
		Sample	: CSS_4-2
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CSS06

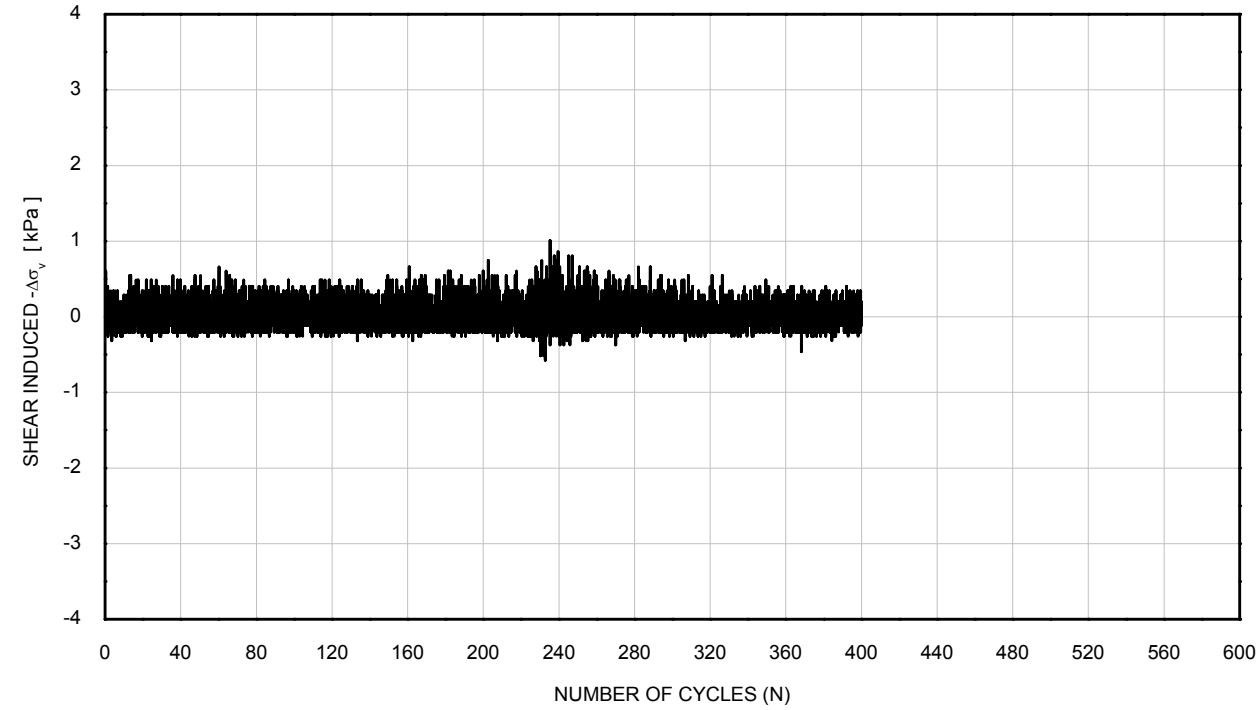
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

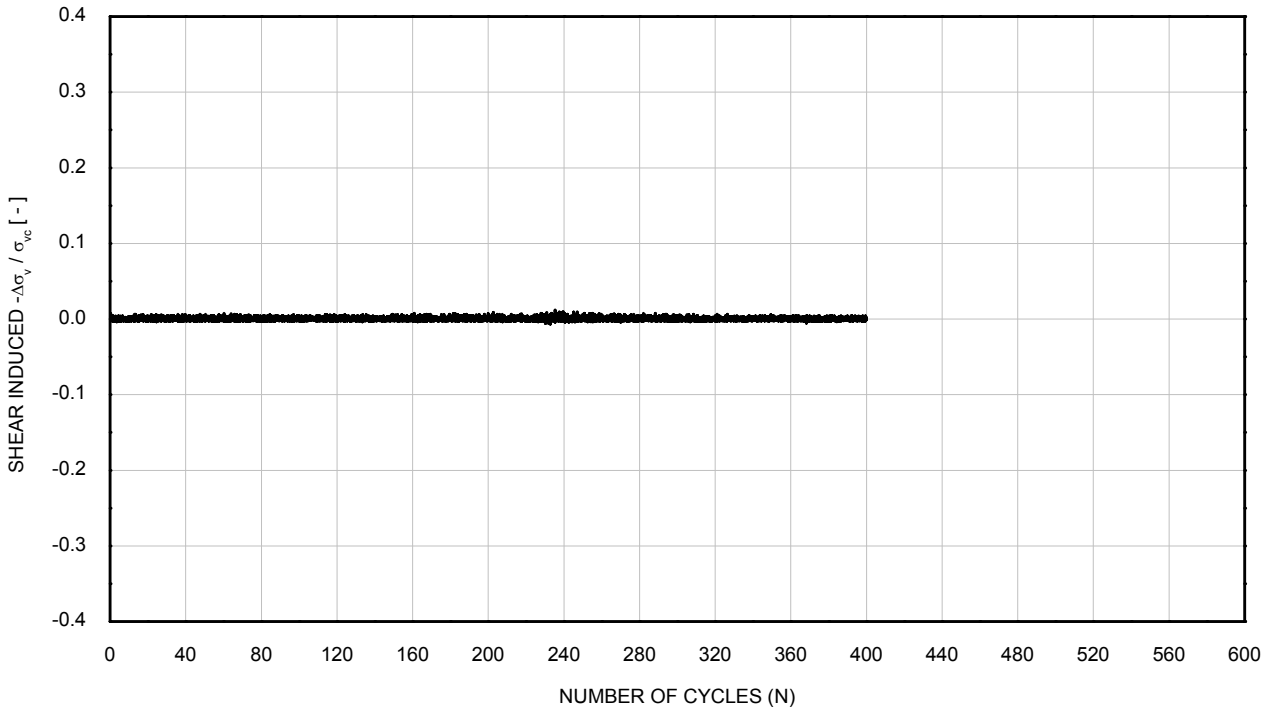




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

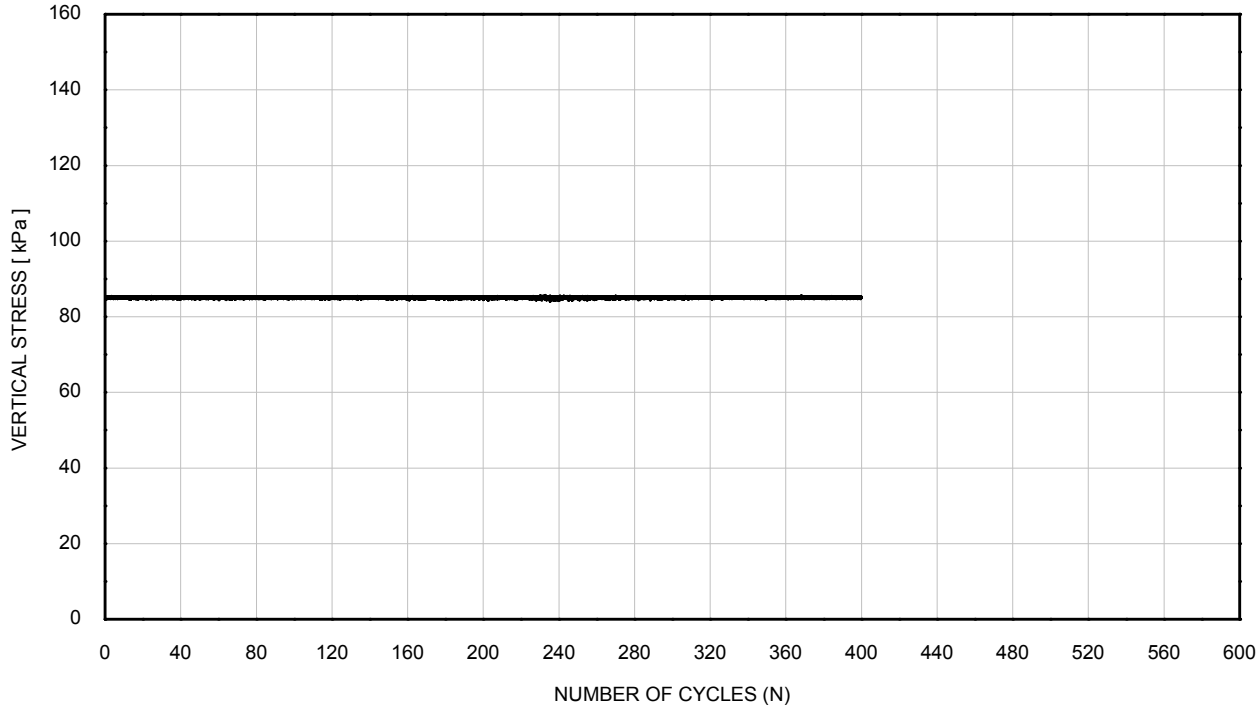
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

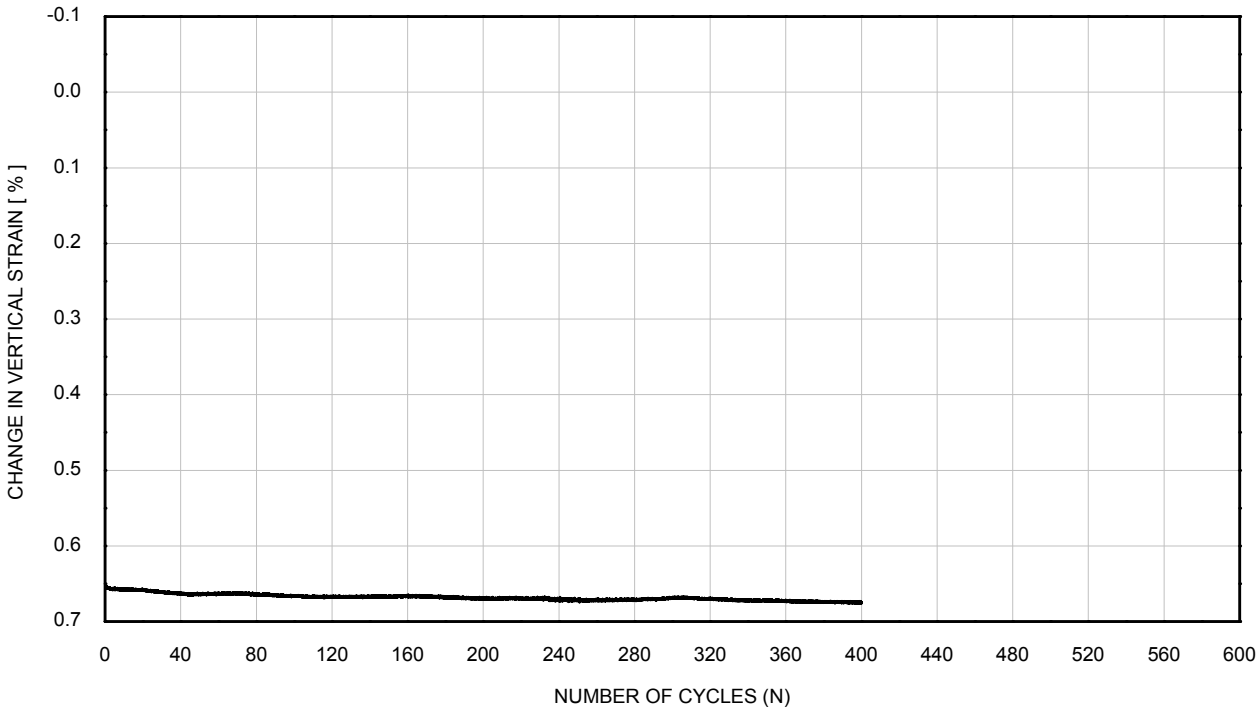




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

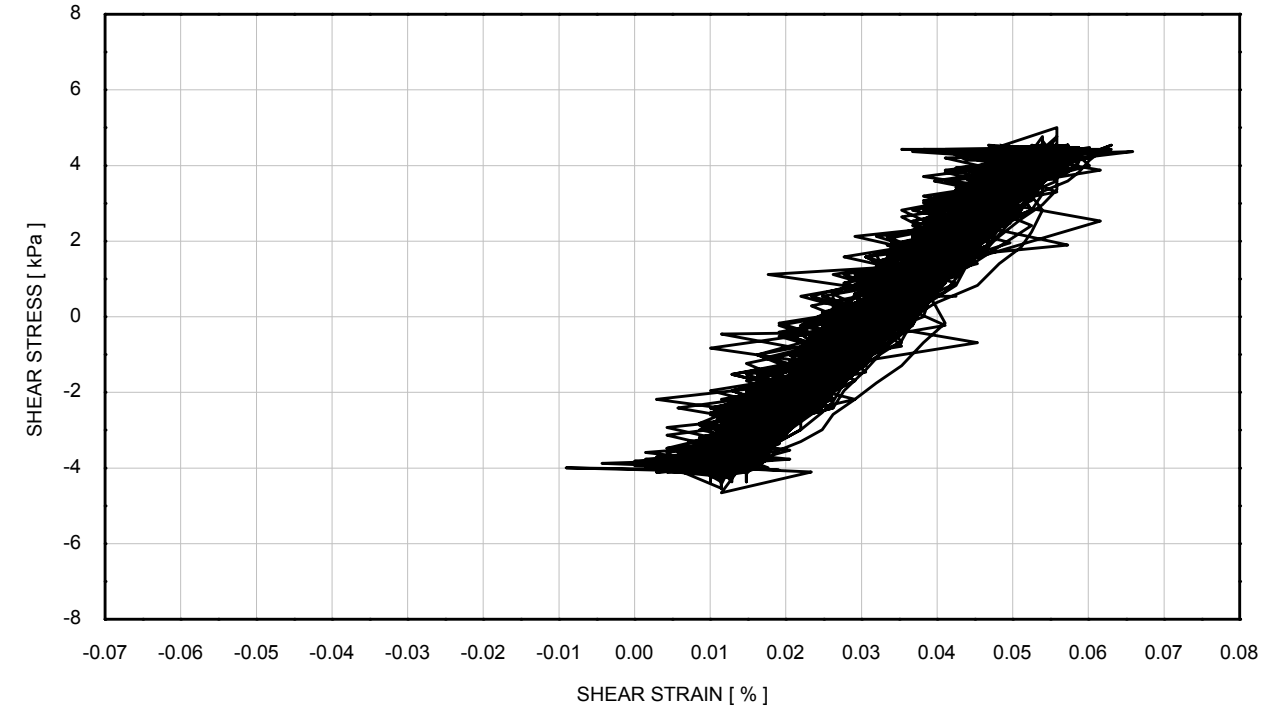
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

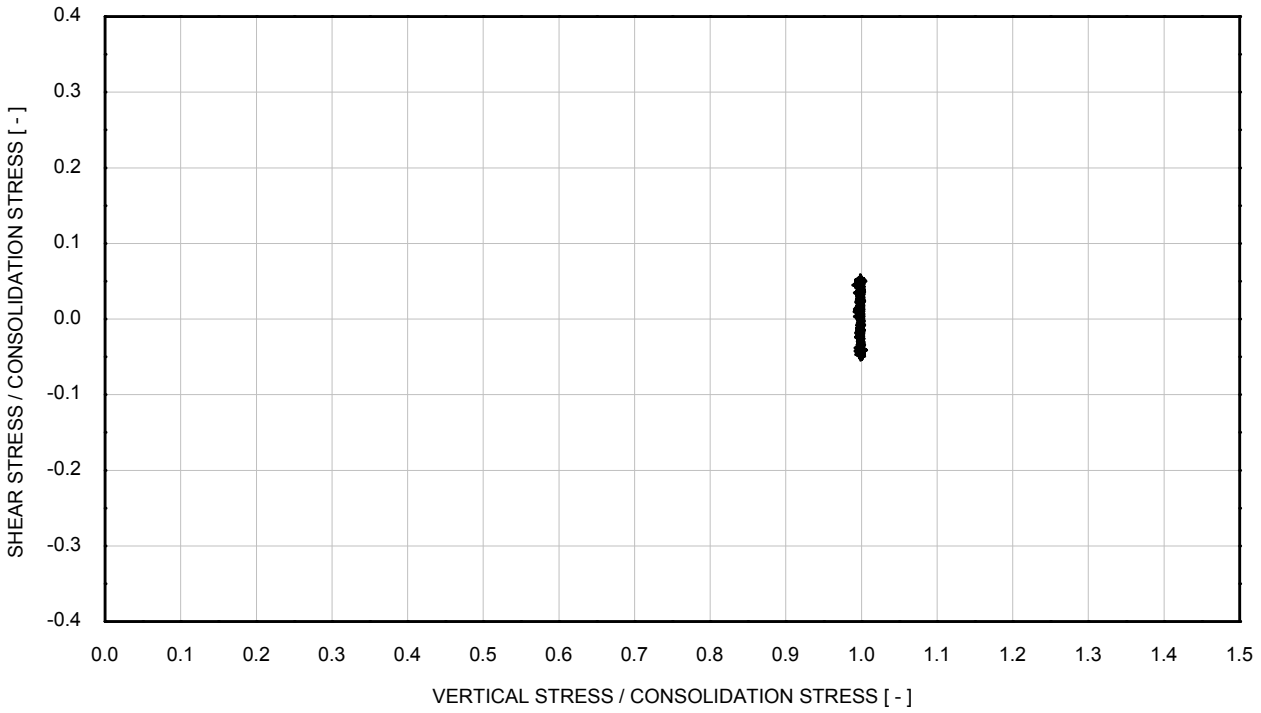




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

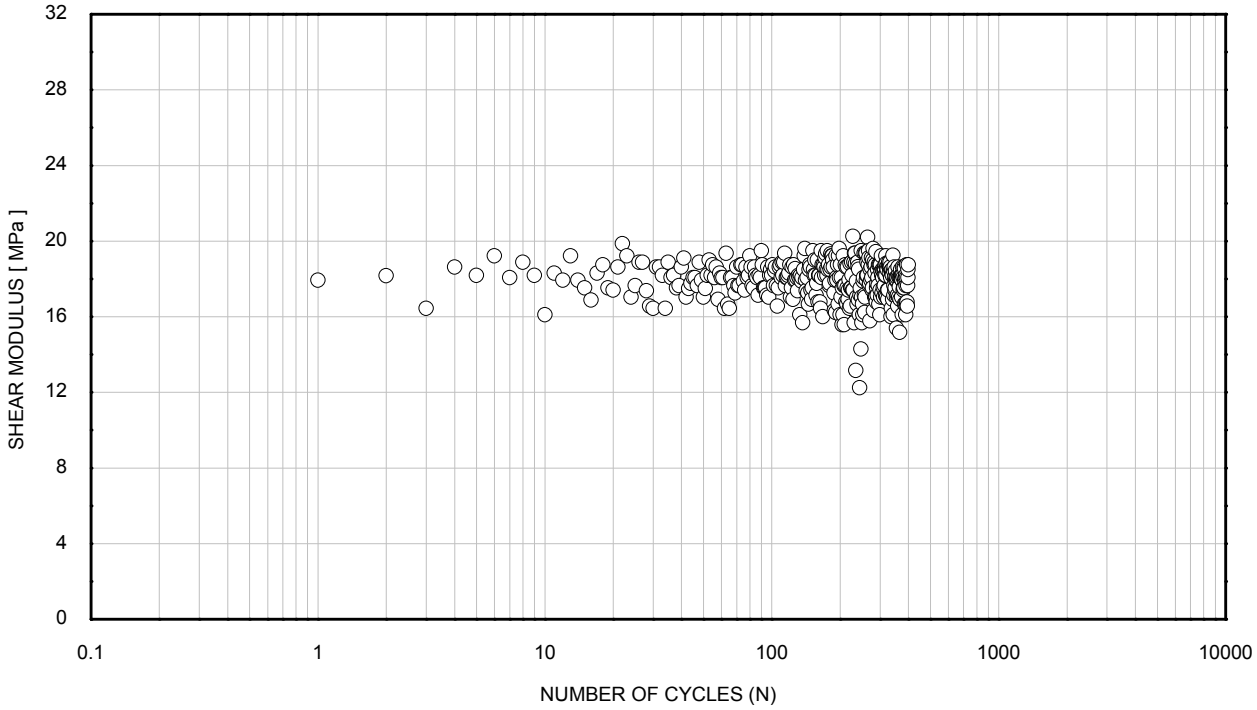
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

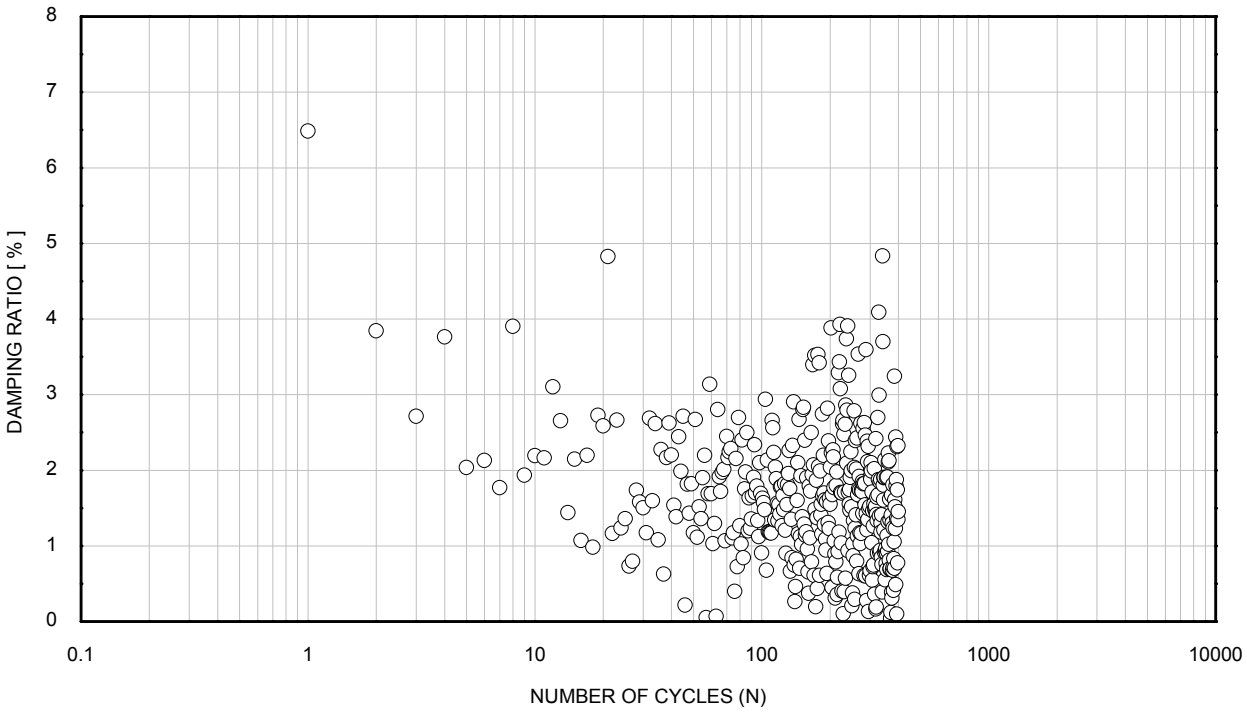




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

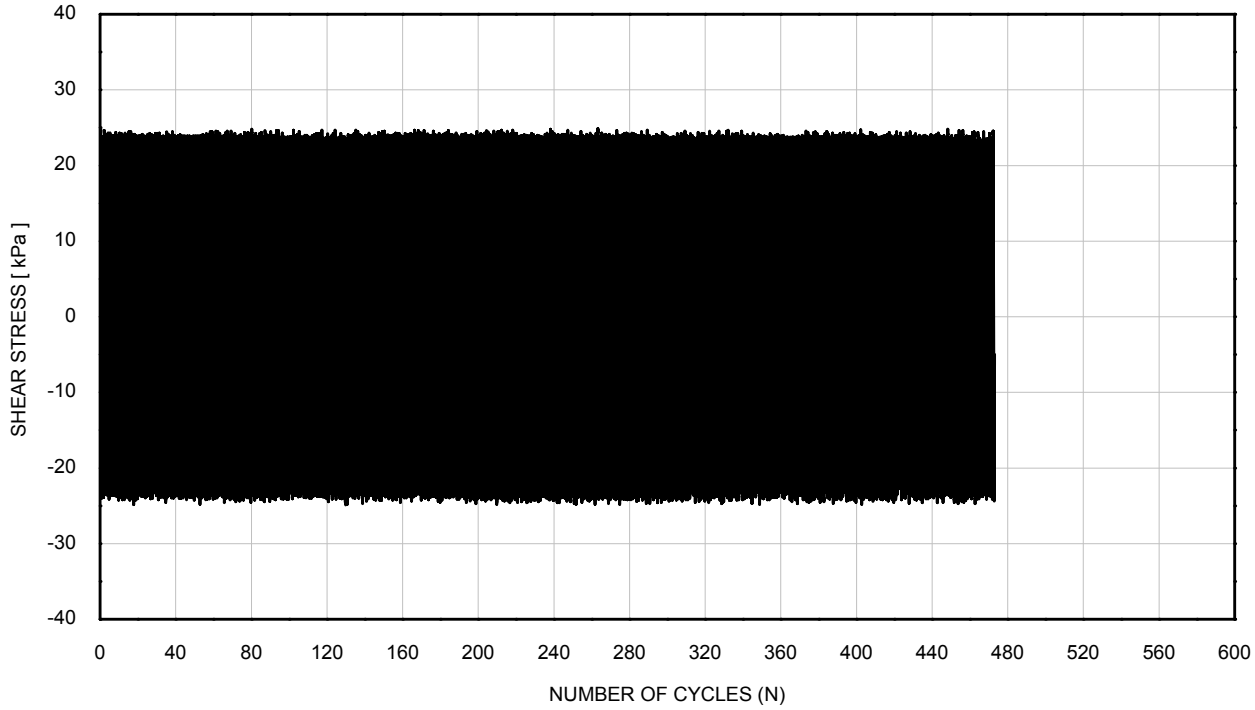
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

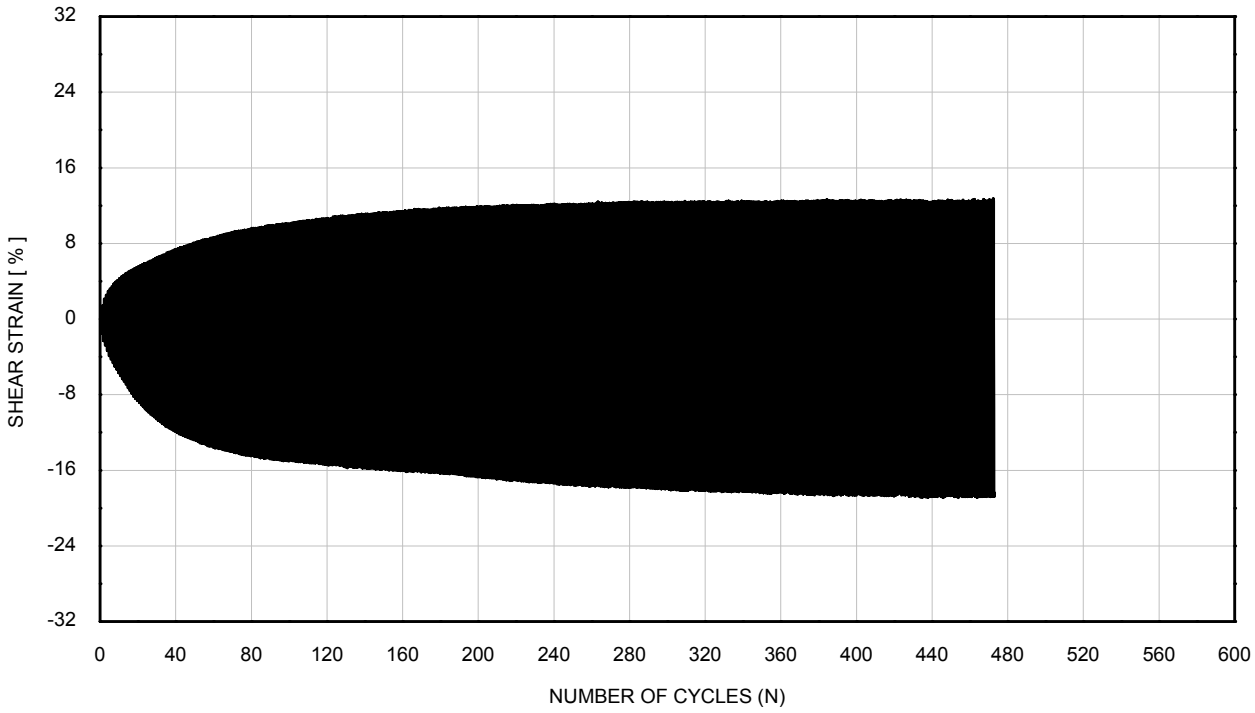




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

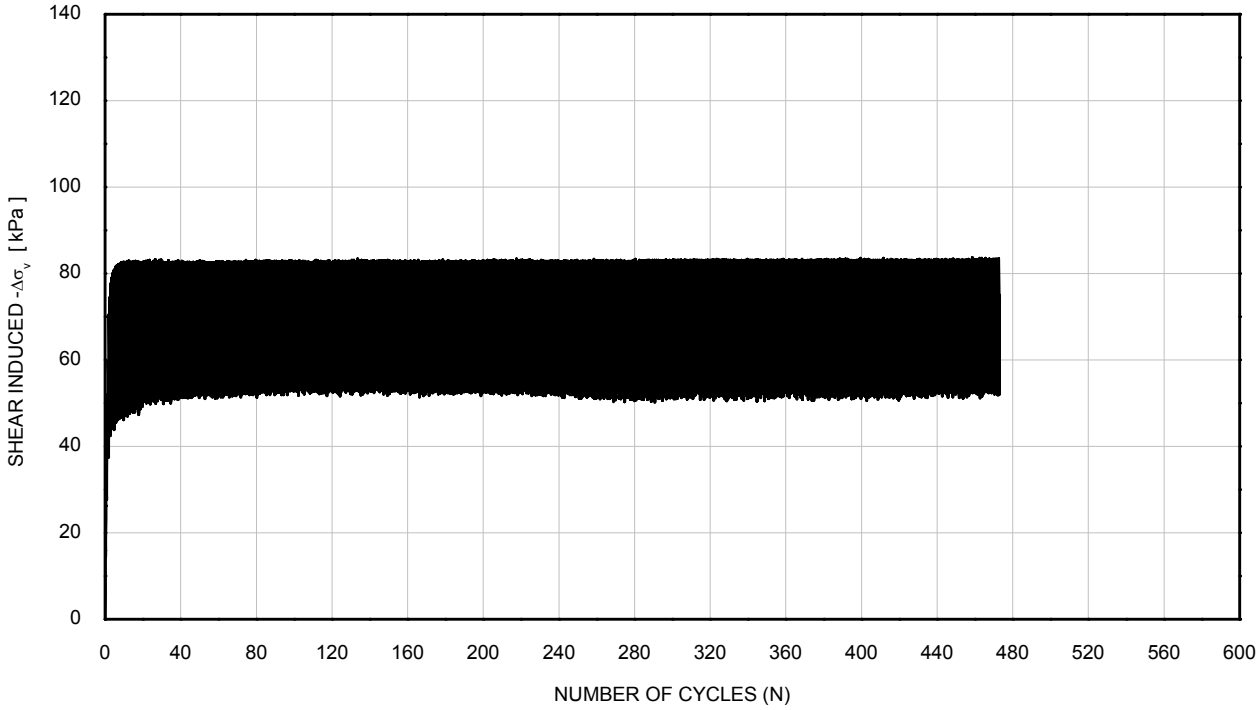
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

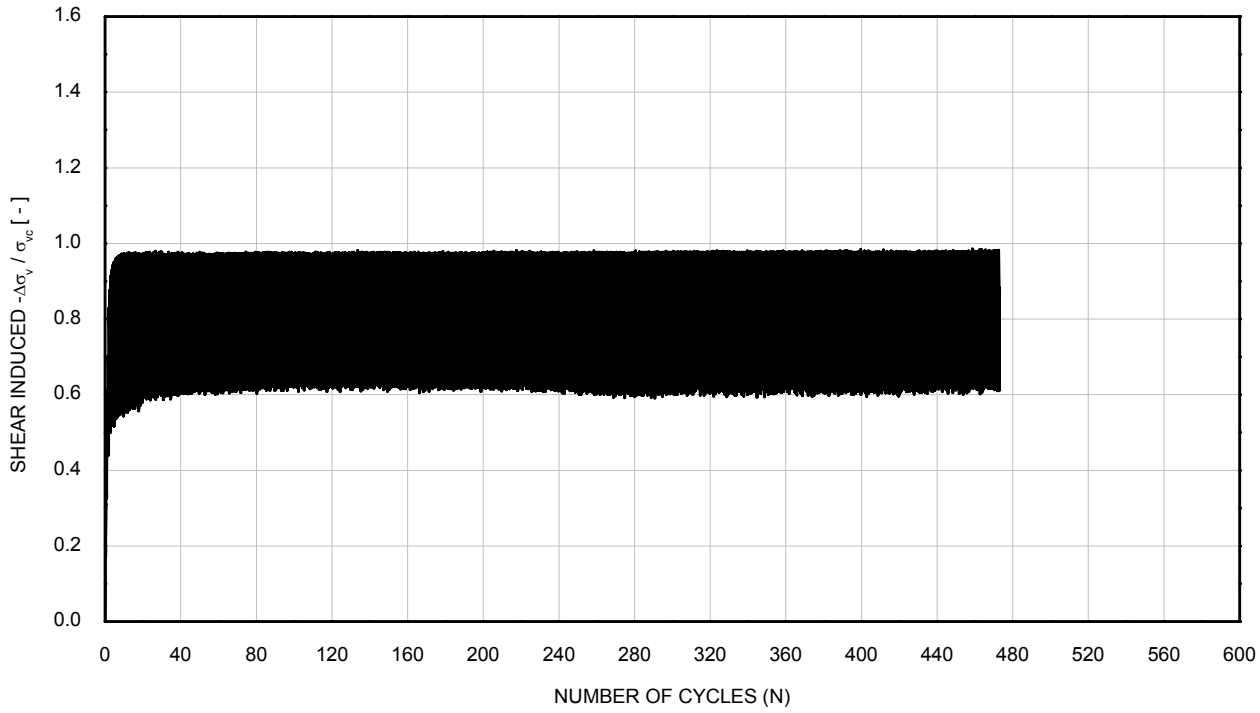




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	24 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

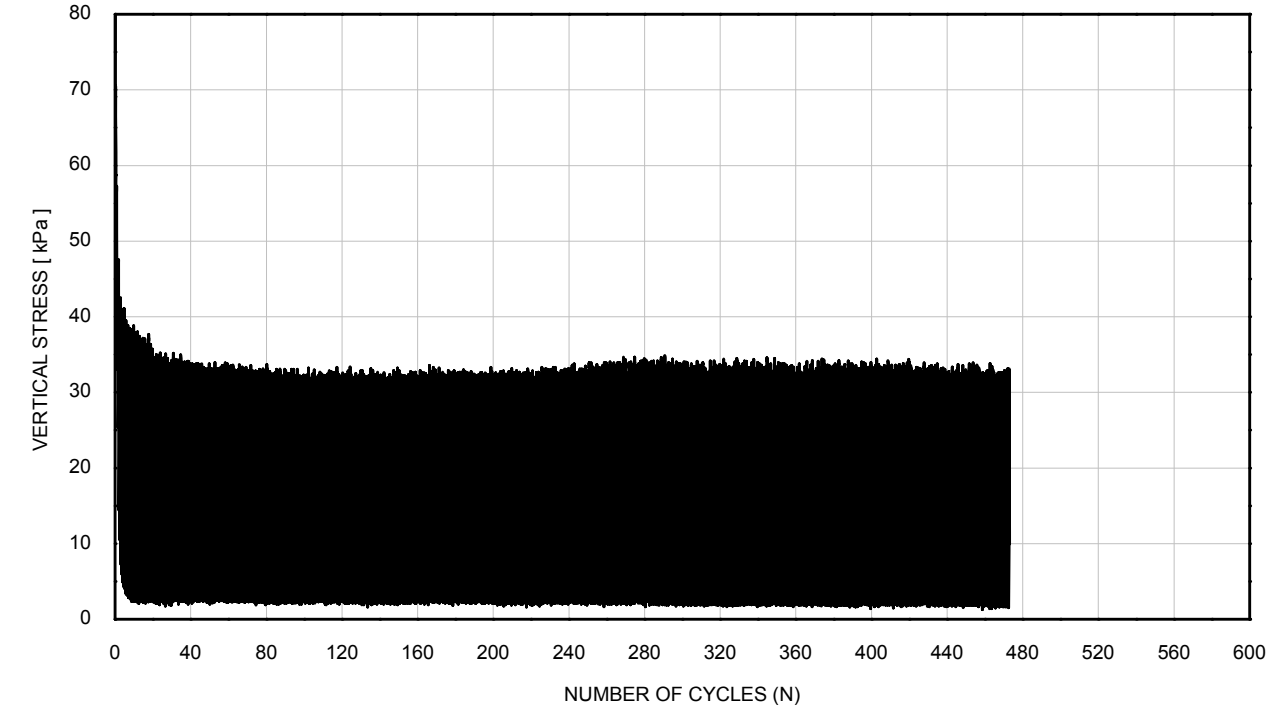
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

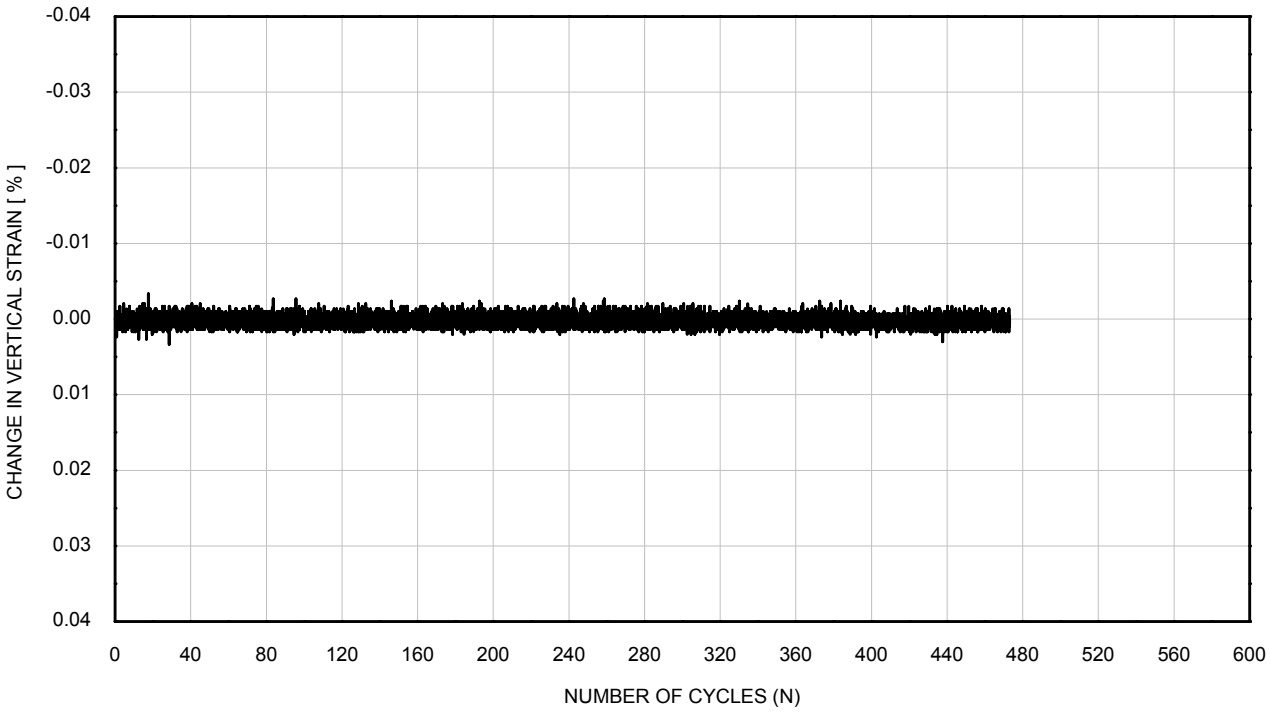




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	24 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

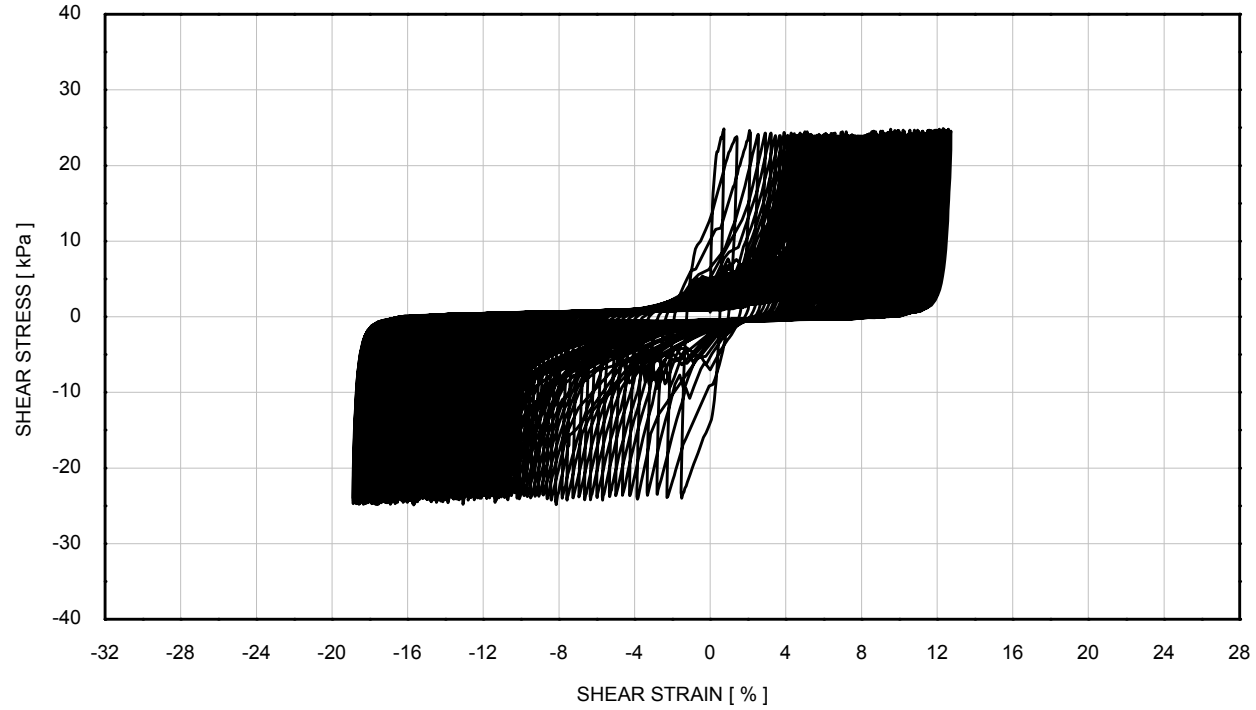
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

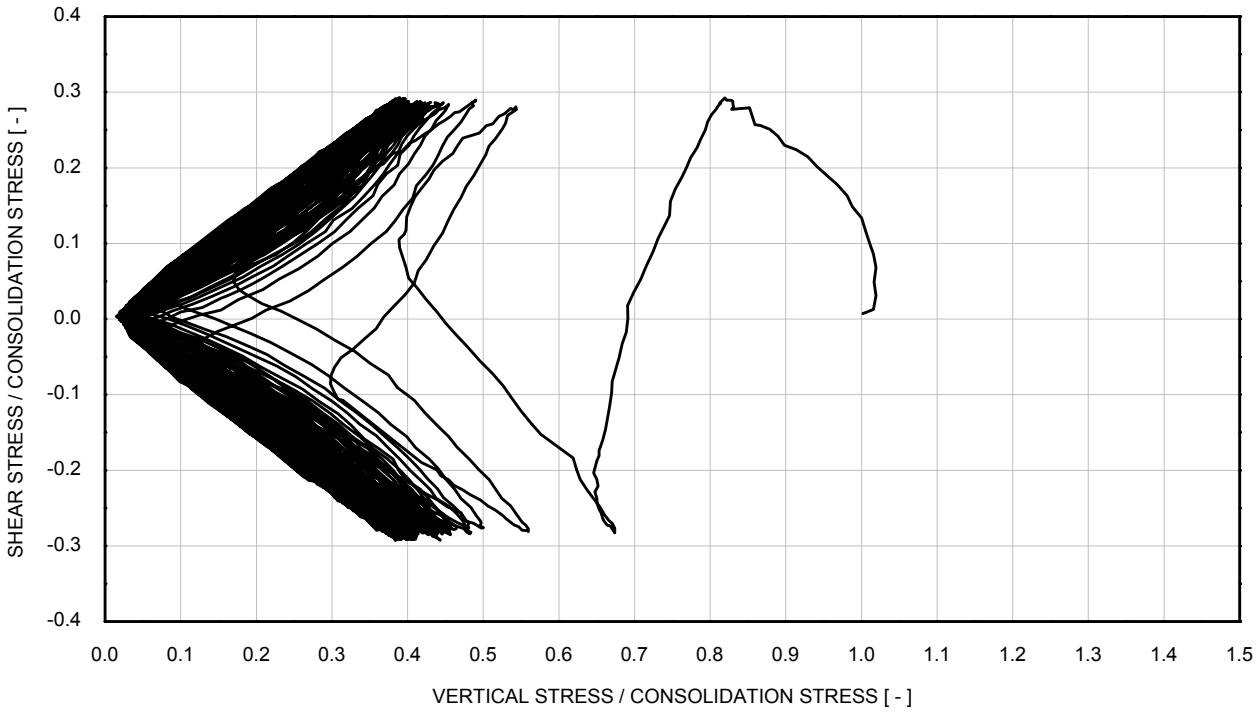




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	24 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

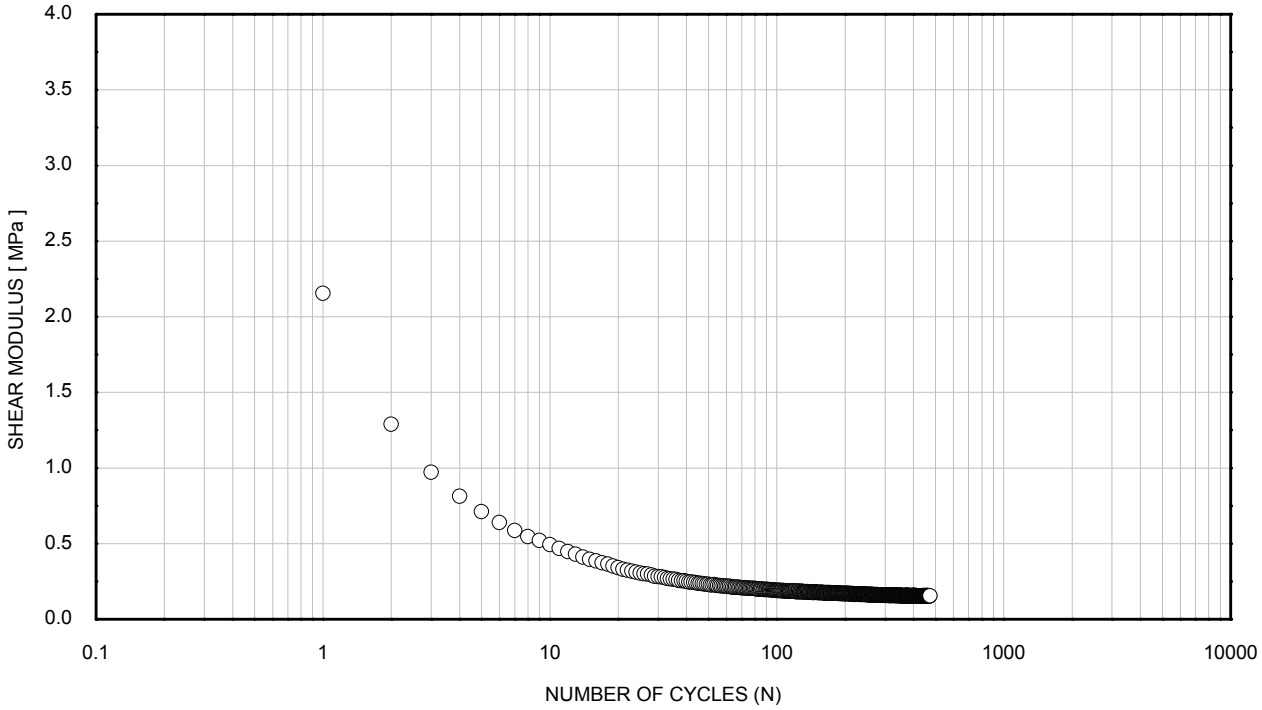
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

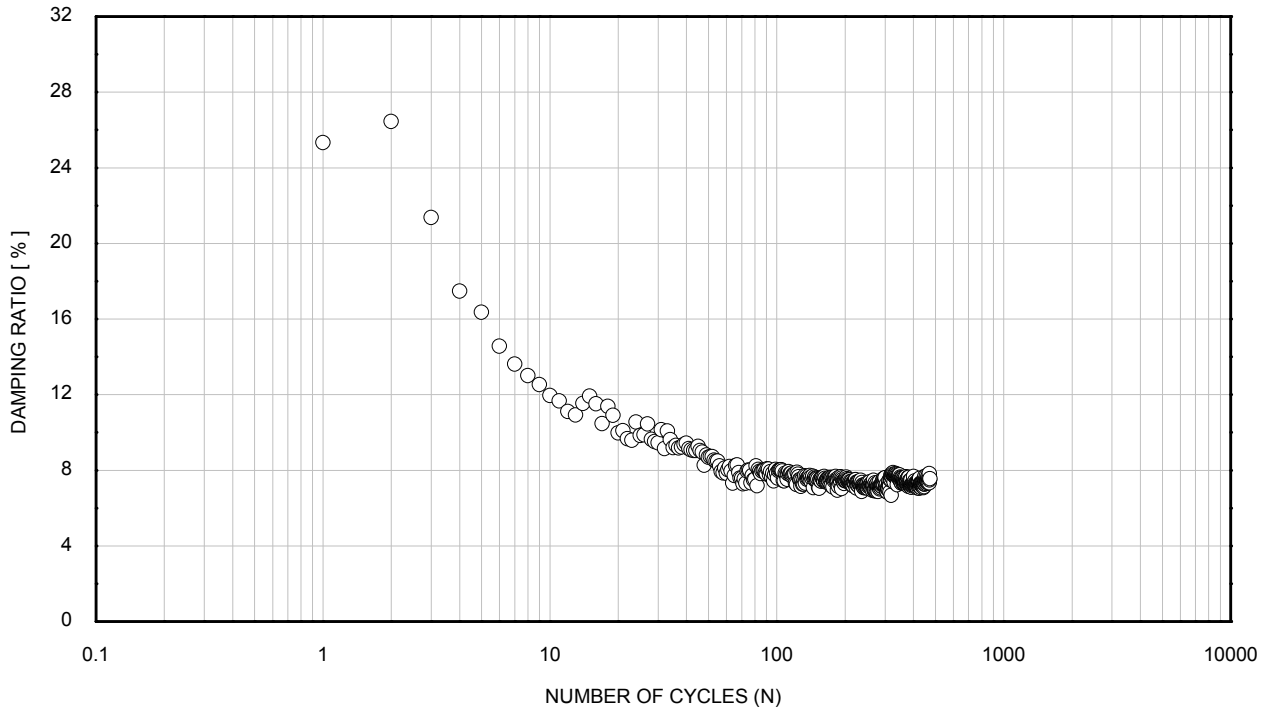




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	24 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

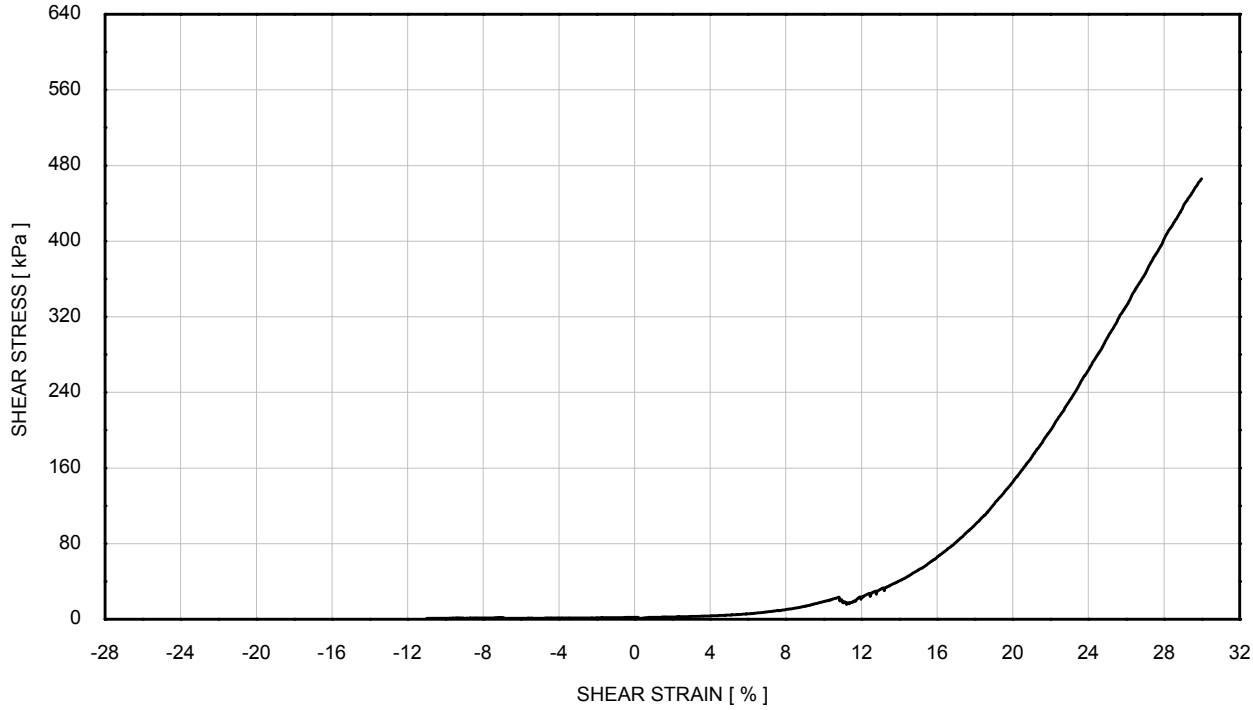
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

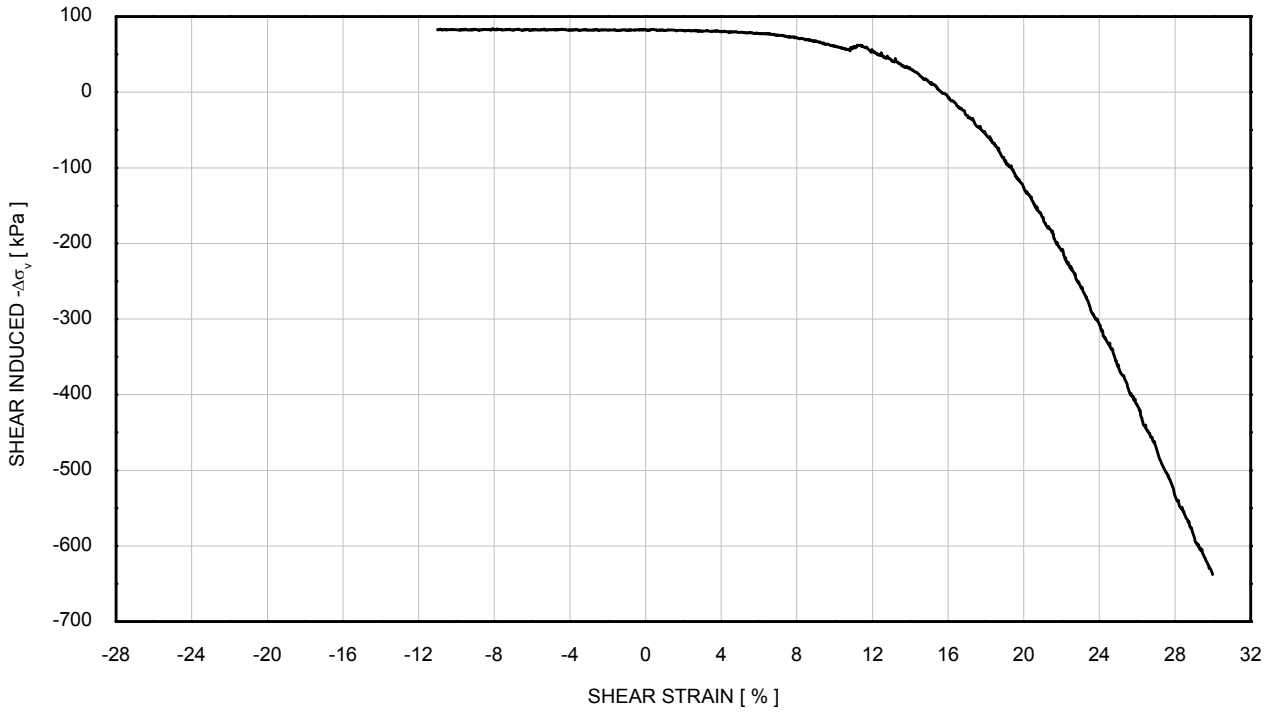




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-2
Mean τ_{cy}	:	24 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS06

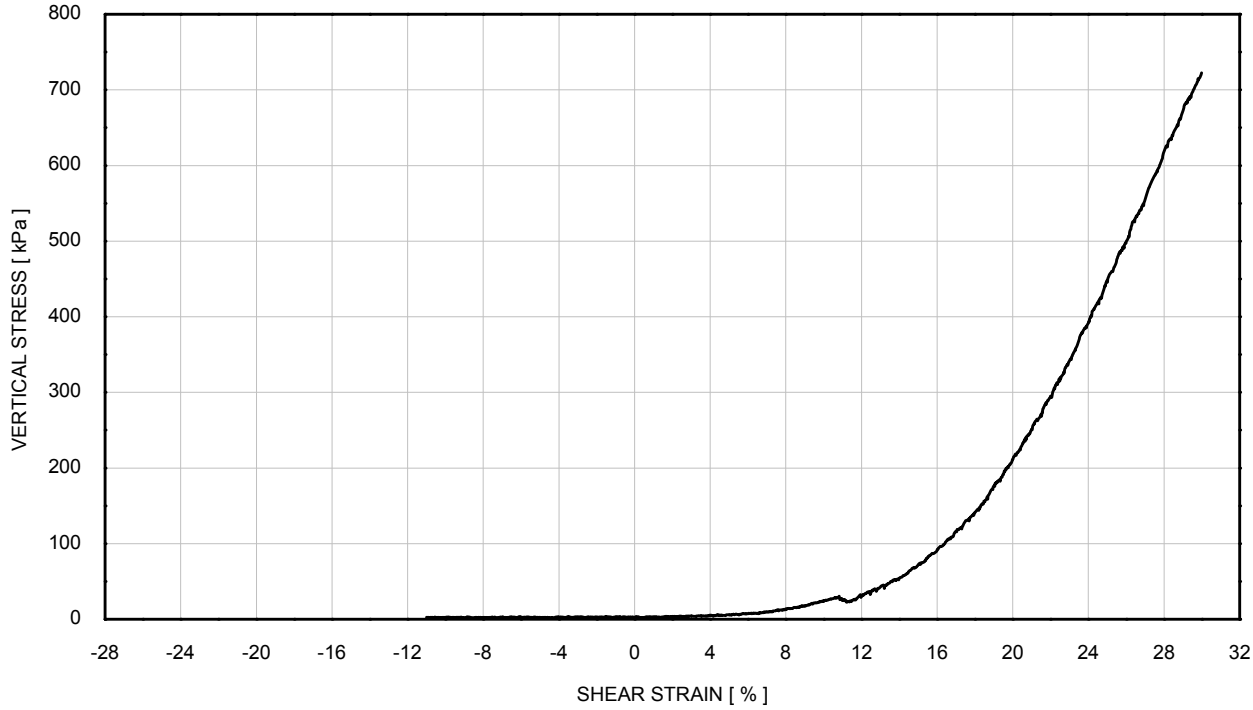
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

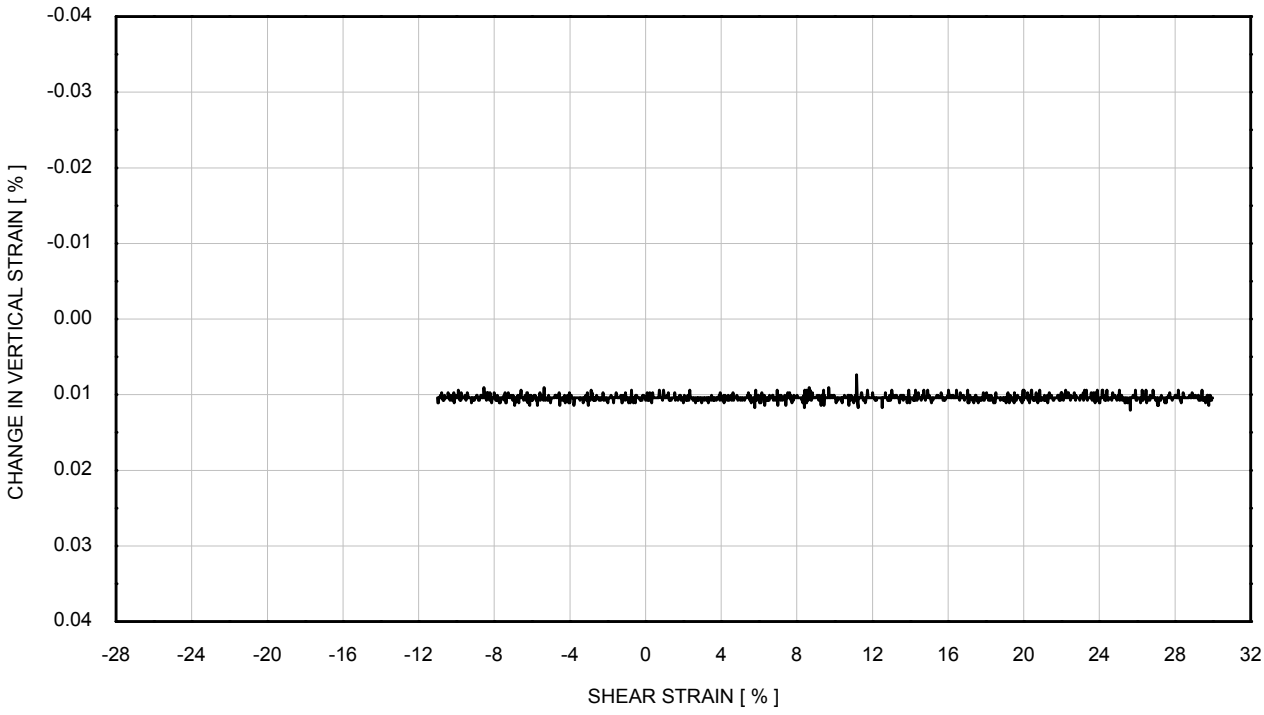




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 466 kPa	Sample	: CSS_4-2
γ at τ_{peak}	: 29.98 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS06

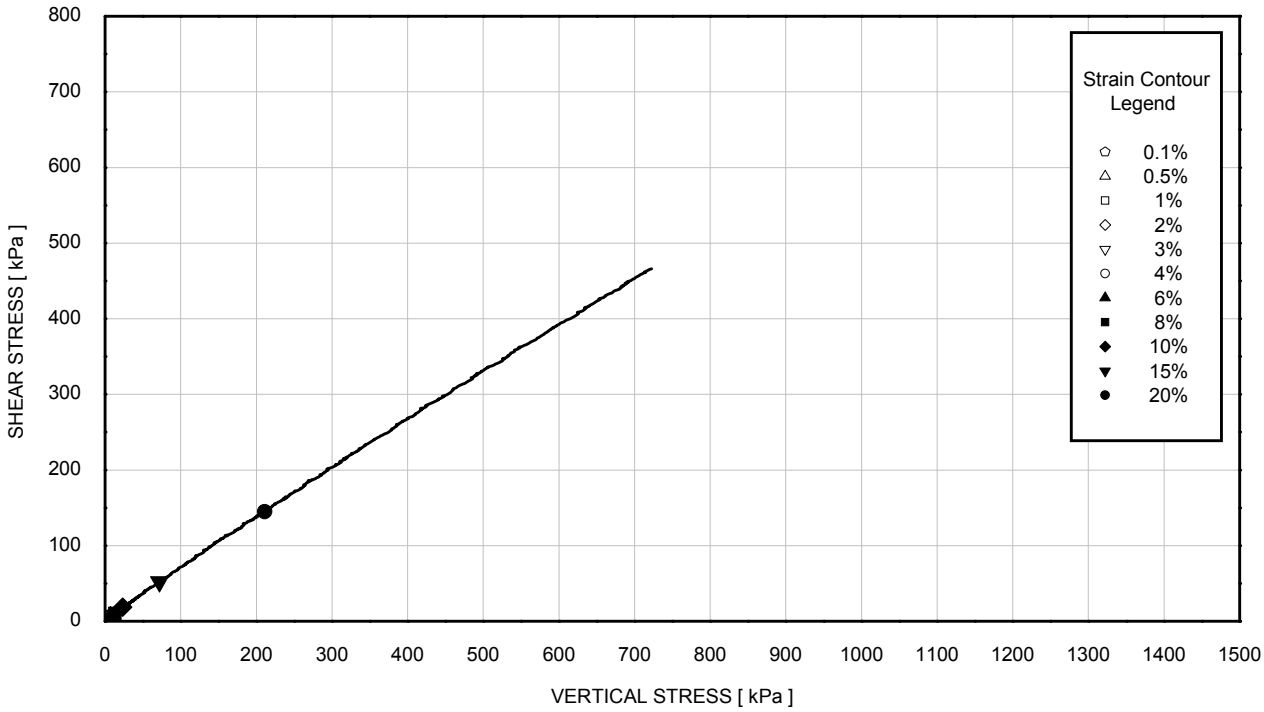
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

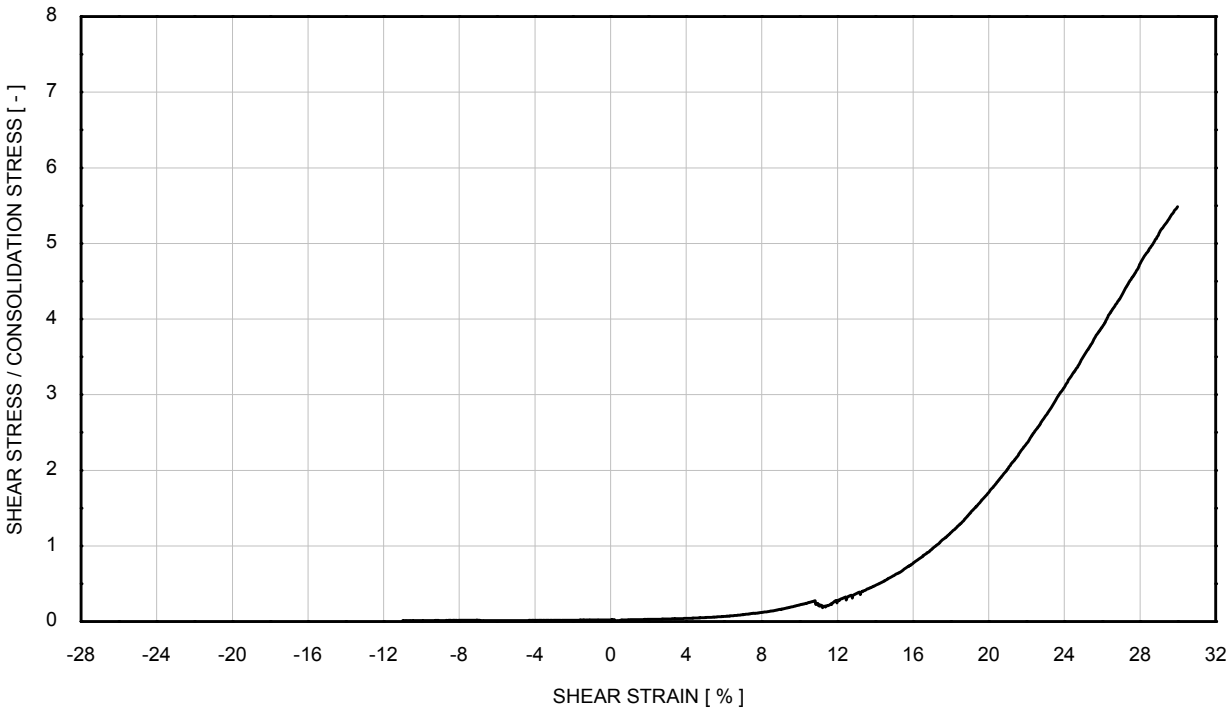




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 466 kPa	Sample	: CSS_4-2
γ at τ_{peak}	: 29.98 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS06

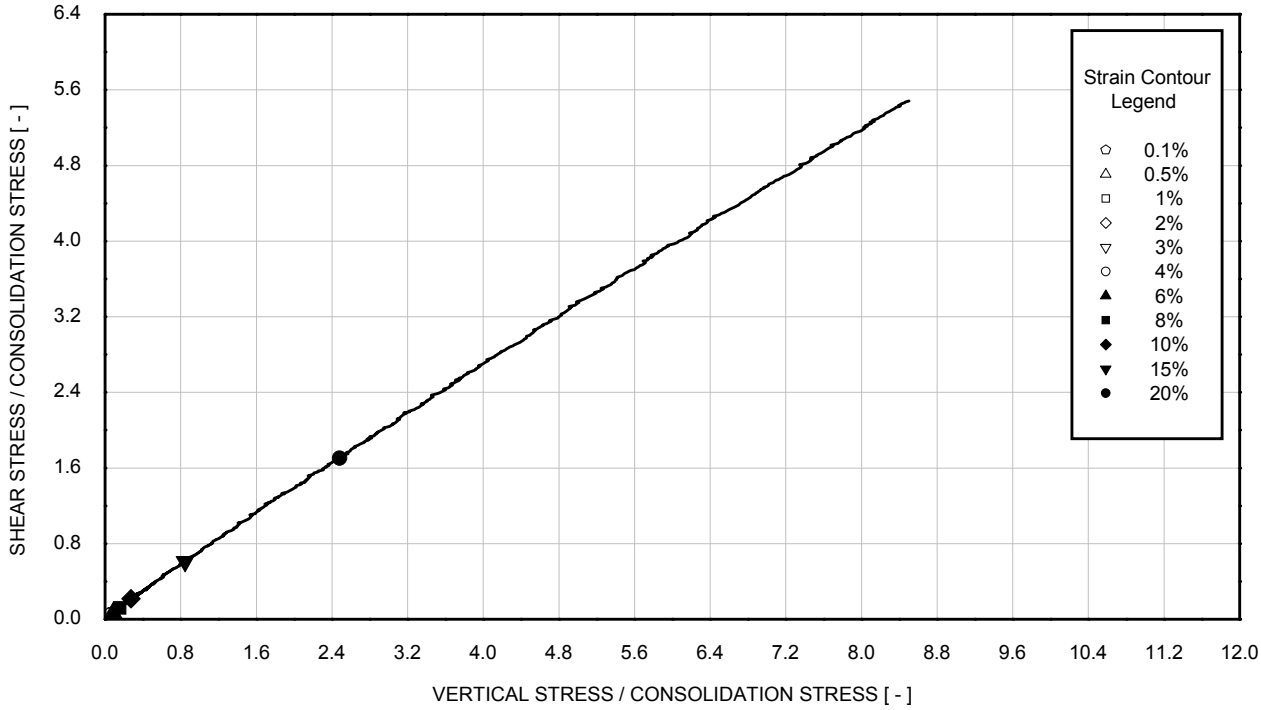
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

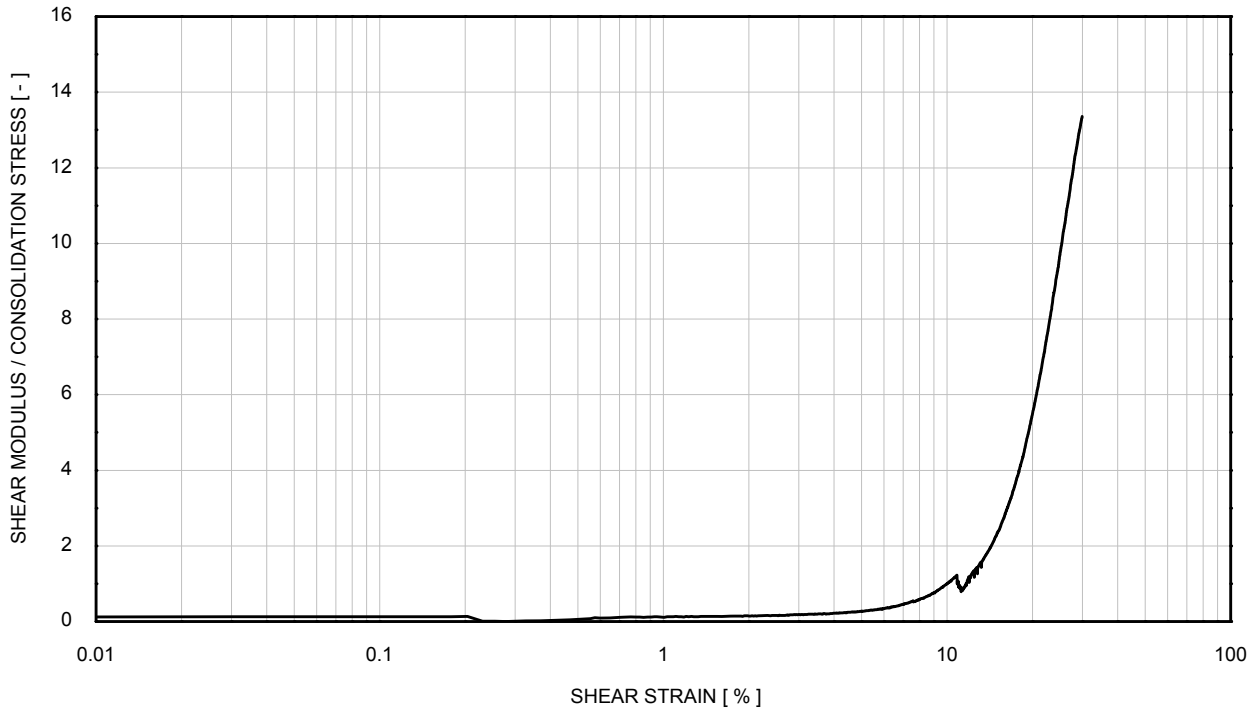




σ_{vc}	: 85	kPa	Batch	: 4
τ_{peak}	: 466	kPa	Sample	: CSS_4-2
γ at τ_{peak}	: 29.98	%	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99	%/hour	Test No.	: CSS06

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 466 kPa	Sample	: CSS_4-2
γ at τ_{peak}	: 29.98 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS06

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Brownish grey fine SAND

GENERAL	
Date test started	16/12/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.4
Length	[mm]	30.0
Water content after compaction	[%]	8.7
Bulk density after compaction	[Mg/m³]	1.83
Dry density	[Mg/m³]	1.68
Void ratio	[-]	0.578
Degree of saturation after compaction	[%]	40
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	21.8
Bulk density at start of test	[Mg/m³]	2.05
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 4_CSS07
Template issue	1.4
Processed by Date	MG 19/12/2016
Checked by Date	JLS 20/12/2016
Approved by Date	DT 12/01/2017

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-3
Unit	Unit B1 (Kreftenheye)
Test number	CSS07

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	85
Vertical strain	[%]	0.61
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.69
Void ratio	[-]	0.568
Water content	[%]	21.4

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	85
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	4
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	0.06
Bulk density	[Mg/m^3]	2.05
Dry density	[Mg/m^3]	1.69
Void ratio	[-]	0.567

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.00	0.03	15.60	9.99
2	-0.01	0.02	18.00	5.54
5	-0.01	0.02	18.75	4.41
10	-0.01	0.02	19.23	3.04
20	-0.01	0.02	19.50	2.84
30	-0.01	0.02	19.35	1.90
40	-0.02	0.02	20.02	2.01
50	-0.02	0.02	19.50	3.58
100	-0.02	0.02	20.02	1.60
200	-0.02	0.02	19.56	1.54
300	-0.02	0.02	19.69	3.48
400	-0.02	0.02	18.30	0.37

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-3
Unit	Unit B1 (Kreftenheye)
Test number	CSS07

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	35
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	21
γ_{av} at N_f	[%]	-1.55
γ_{cy} at N_f	[%]	15.11
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	57
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.64	2.79	1.27	19.65
2	-0.78	4.35	0.82	13.17
4	-1.10	6.88	0.52	10.15
6	-1.32	8.90	0.40	9.09
8	-1.46	10.45	0.34	8.55
10	-1.54	11.69	0.30	8.22
12	-1.62	12.63	0.28	8.00
14	-1.67	13.42	0.26	7.92
16	-1.69	14.03	0.25	7.93
18	-1.69	14.54	0.24	7.75
20	-1.60	14.95	0.24	7.71
21	-1.55	15.11	0.23	7.70

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	307
Shear strain	[%]	39.84
Shear induced $-\Delta\sigma_v$	[kPa]	-433
Vertical stress	[kPa]	518
Vertical strain	[%]	0.01
Rate of strain	[%/hour]	2.98
At 15 % shear strain		
Shear stress	[kPa]	45
Shear induced $-\Delta\sigma_v$	[kPa]	17
Vertical stress	[kPa]	68
Vertical strain	[%]	0.01

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-3
Unit	Unit B1 (Kreftenheye)
Test number	CSS07

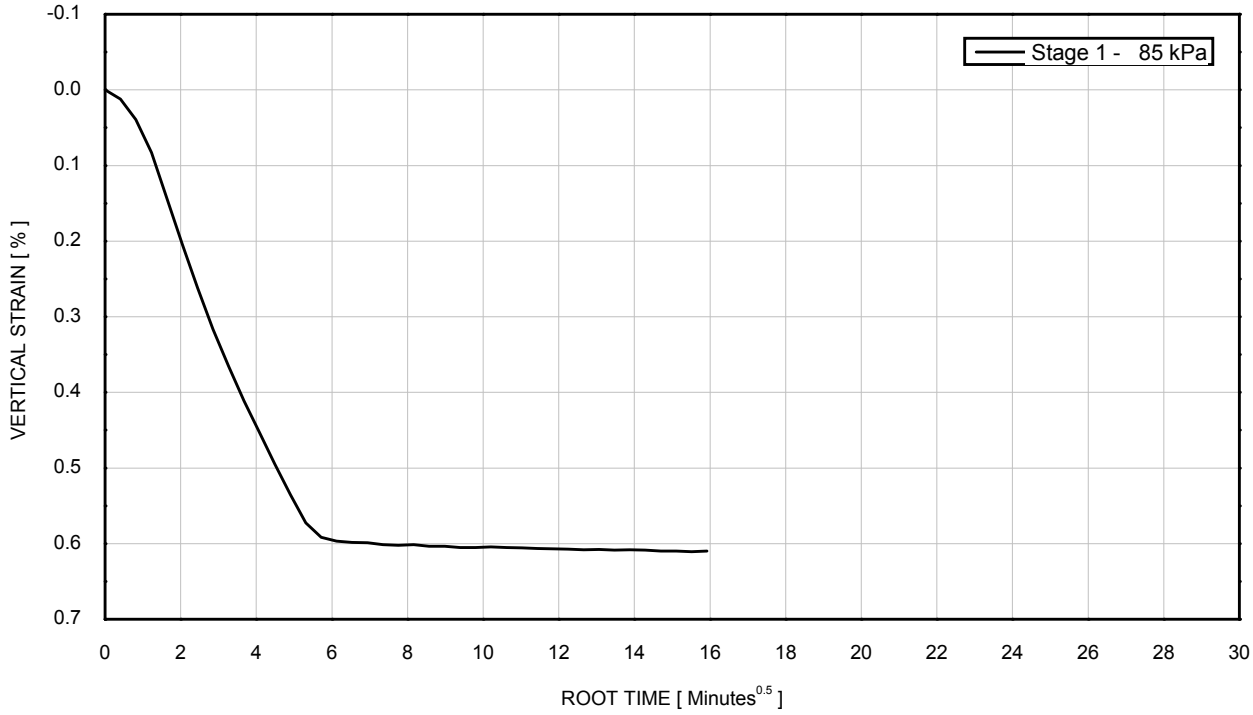
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

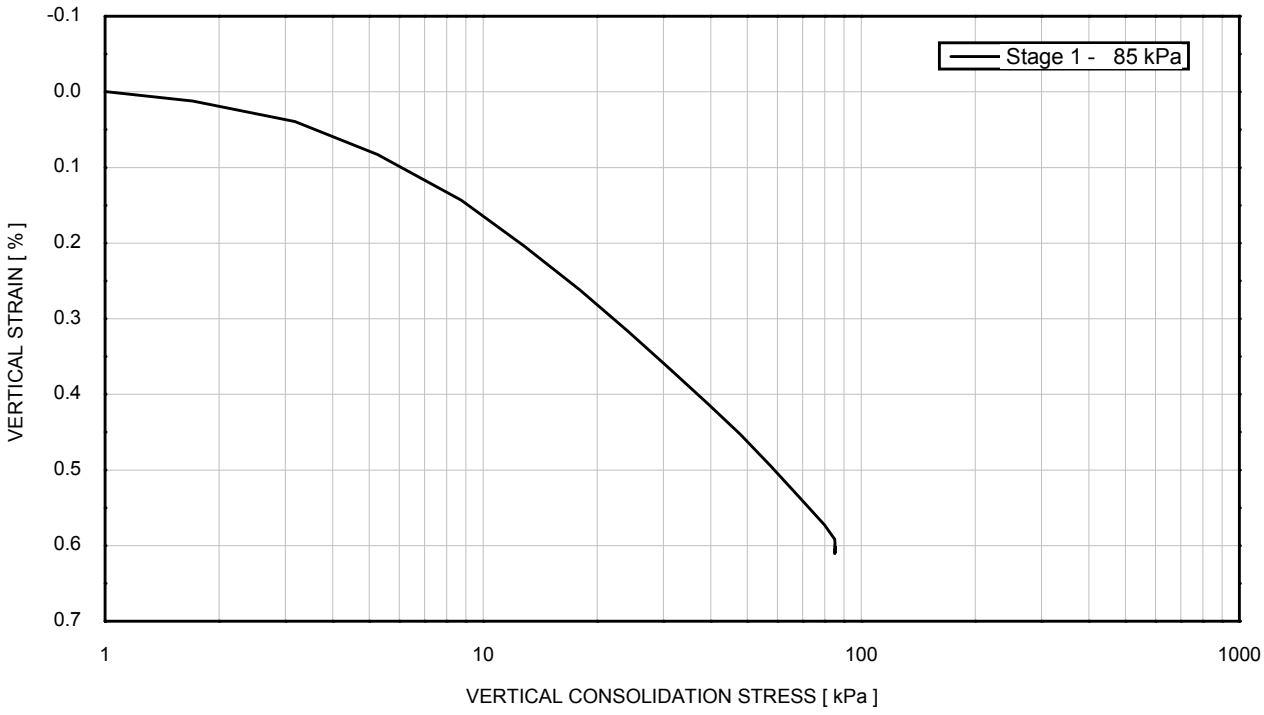
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-3
Unit	Unit B1 (Kreftenheye)
Test number	CSS07

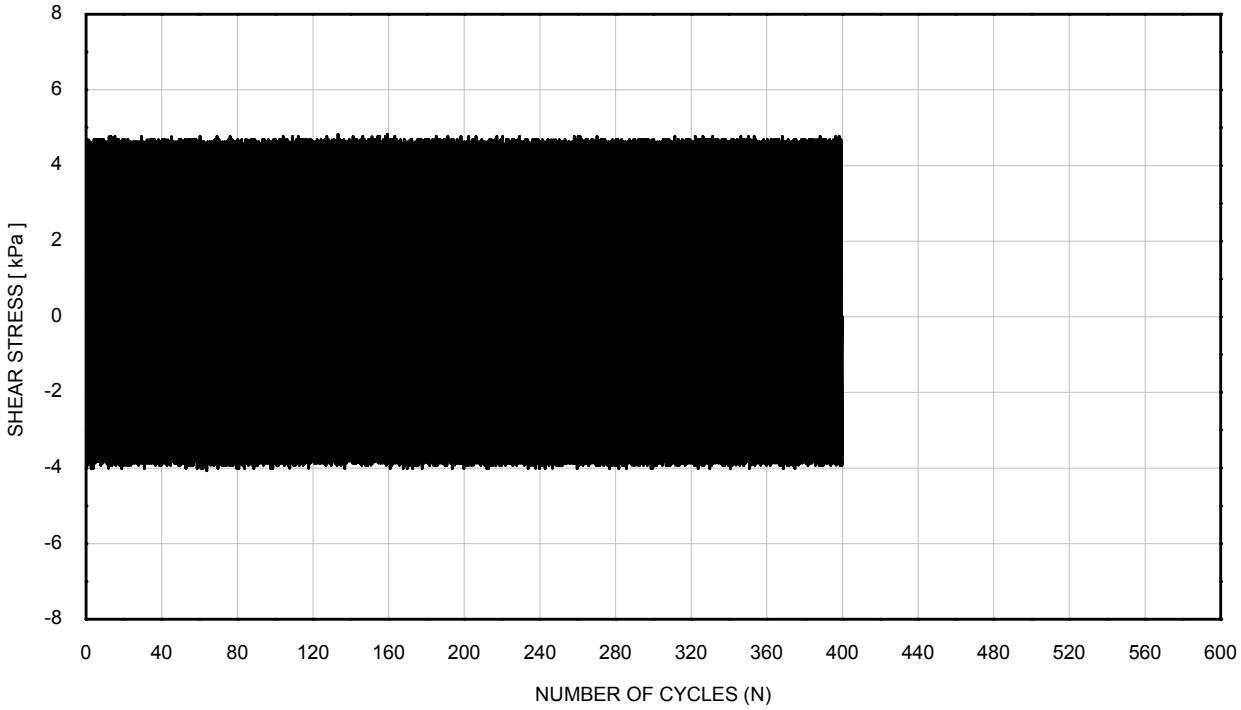
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

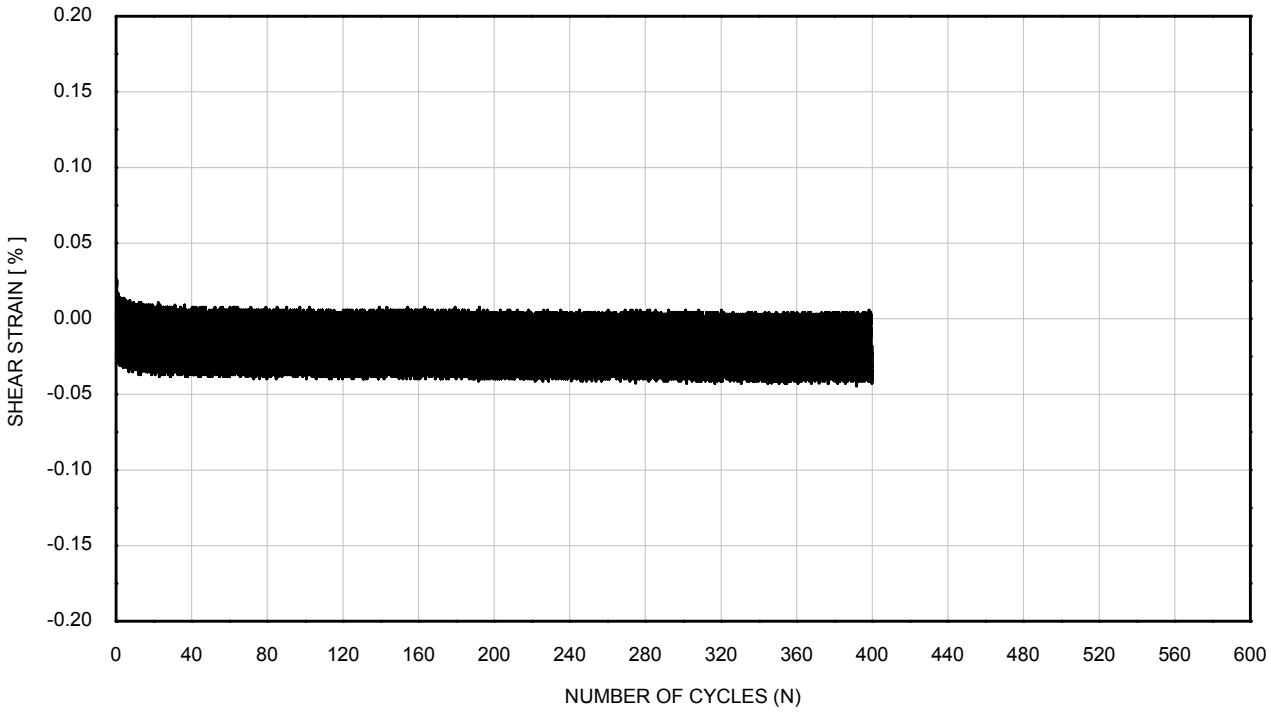




σ_{vc}	: 85 kPa	Batch	: 4
		Sample	: CSS_4-3
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CSS07

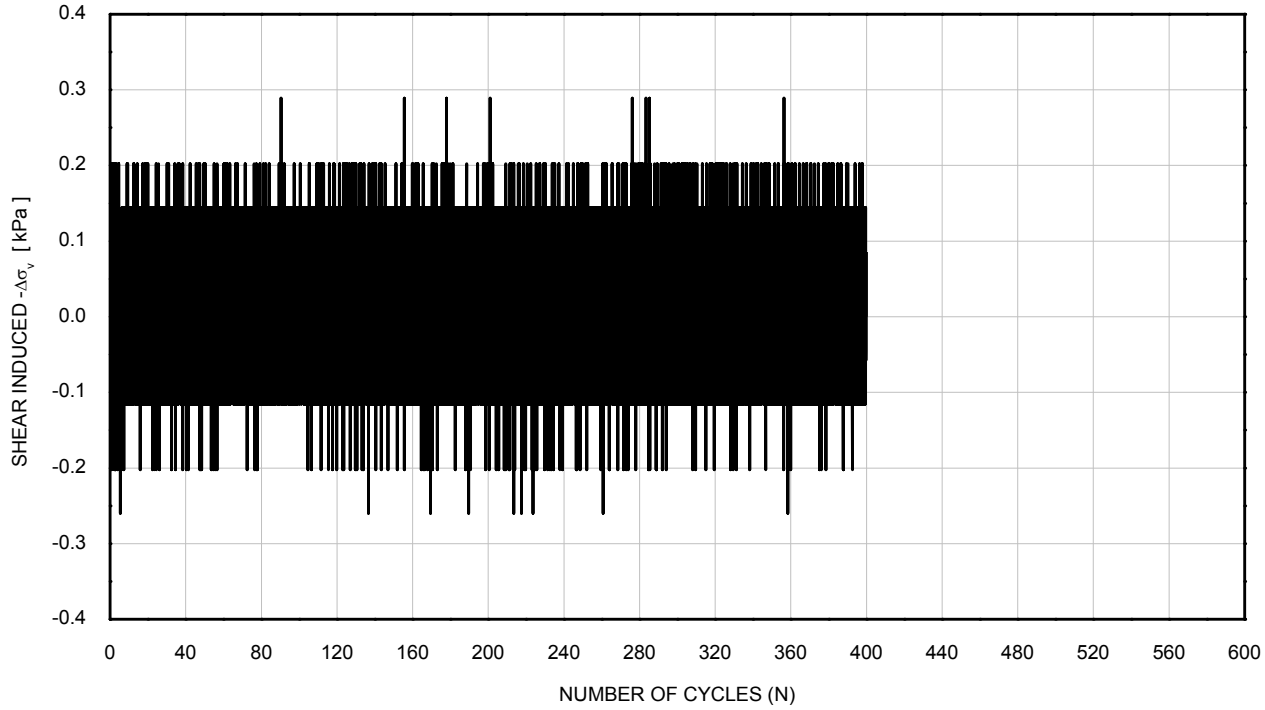
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

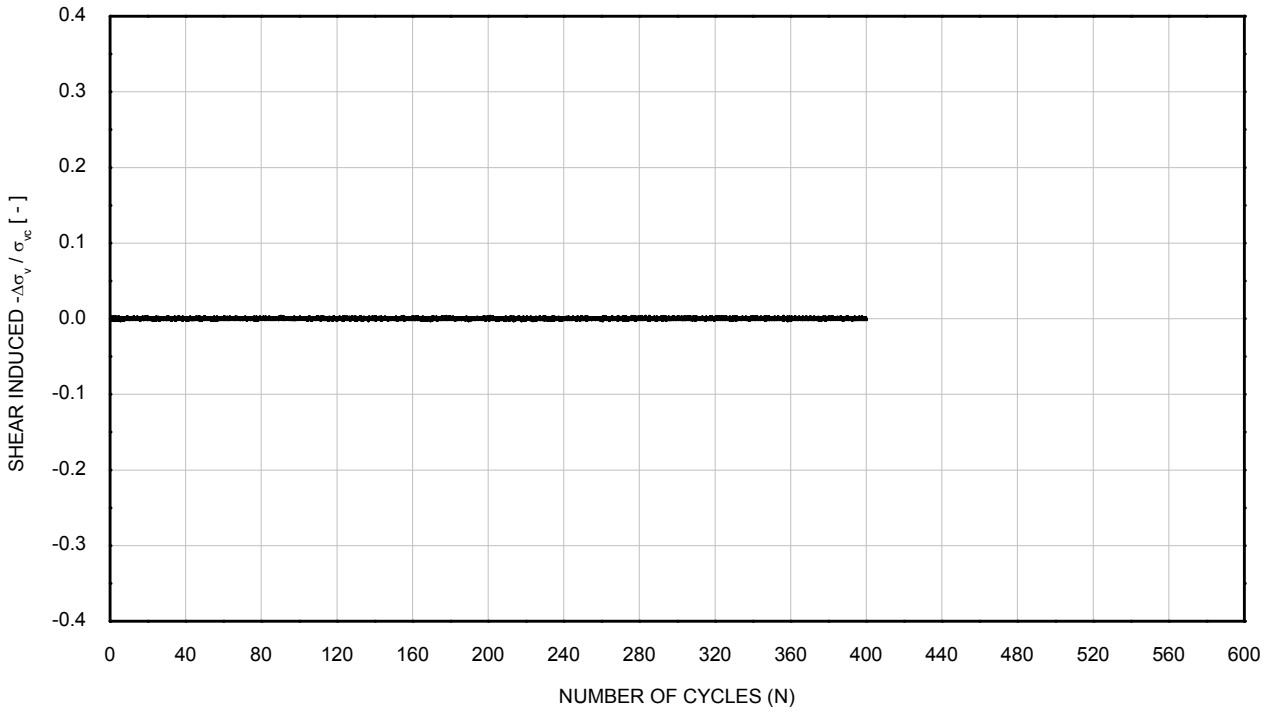




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-3
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS07

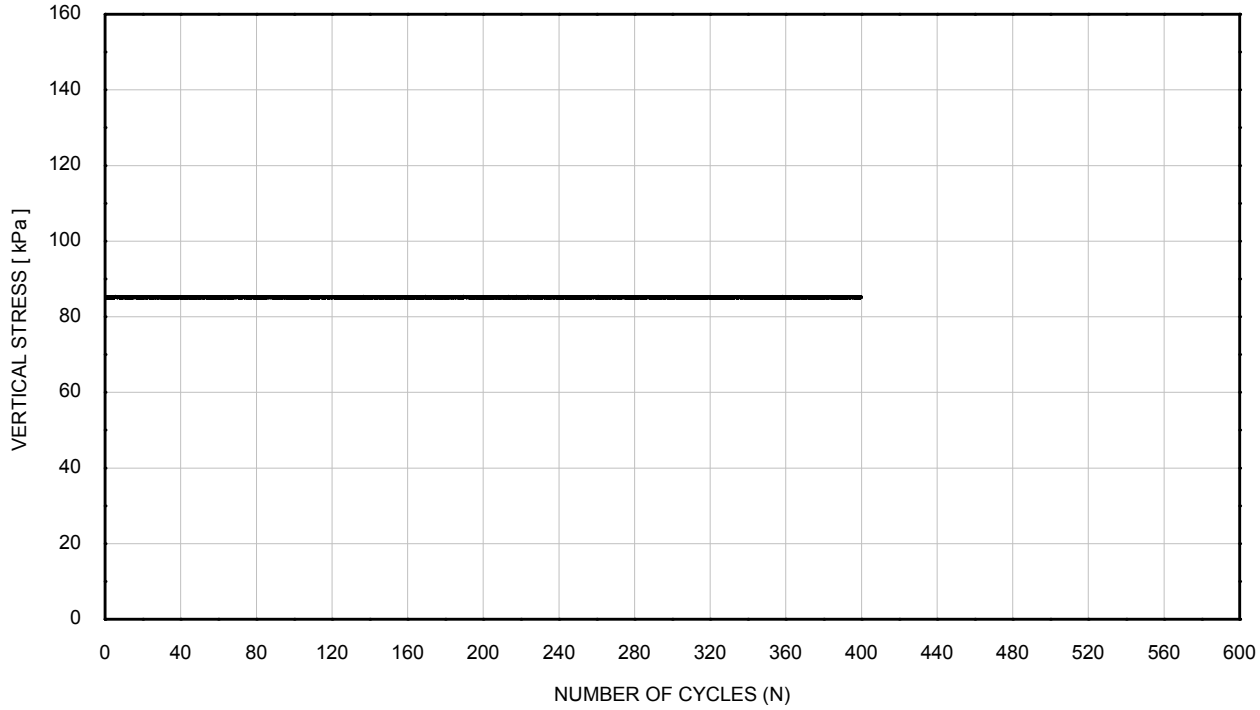
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

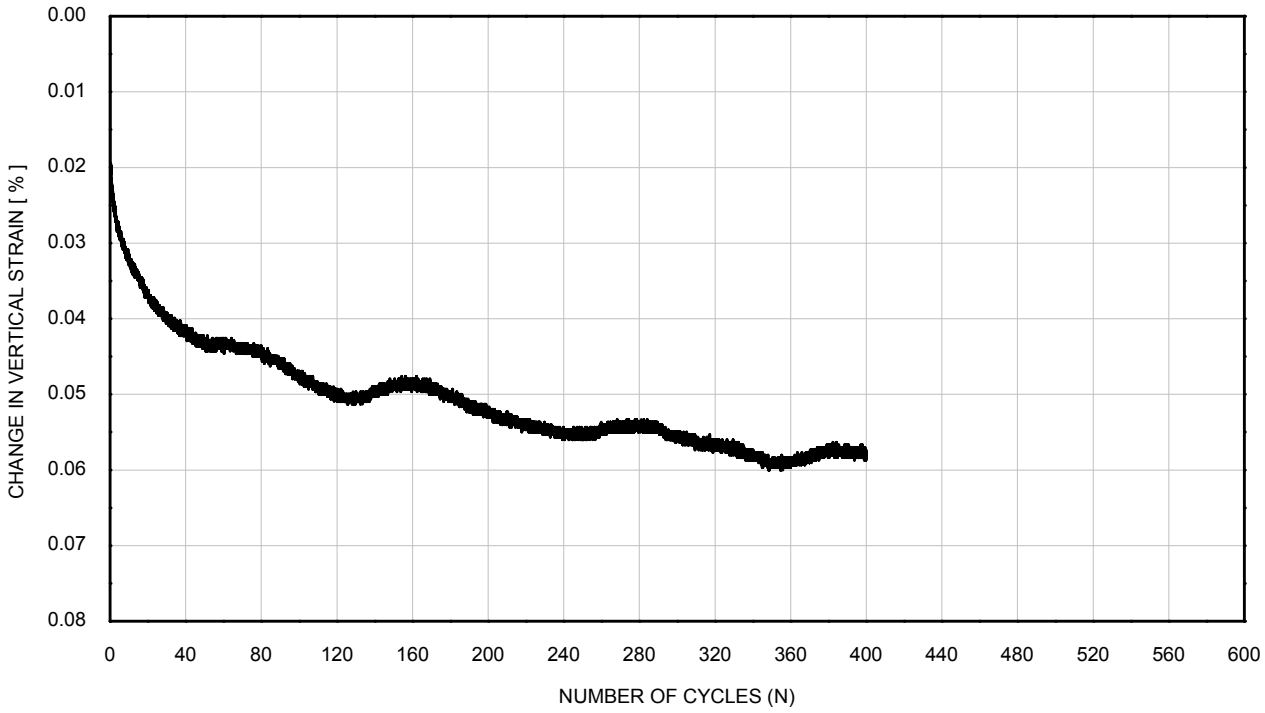




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-3
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS07

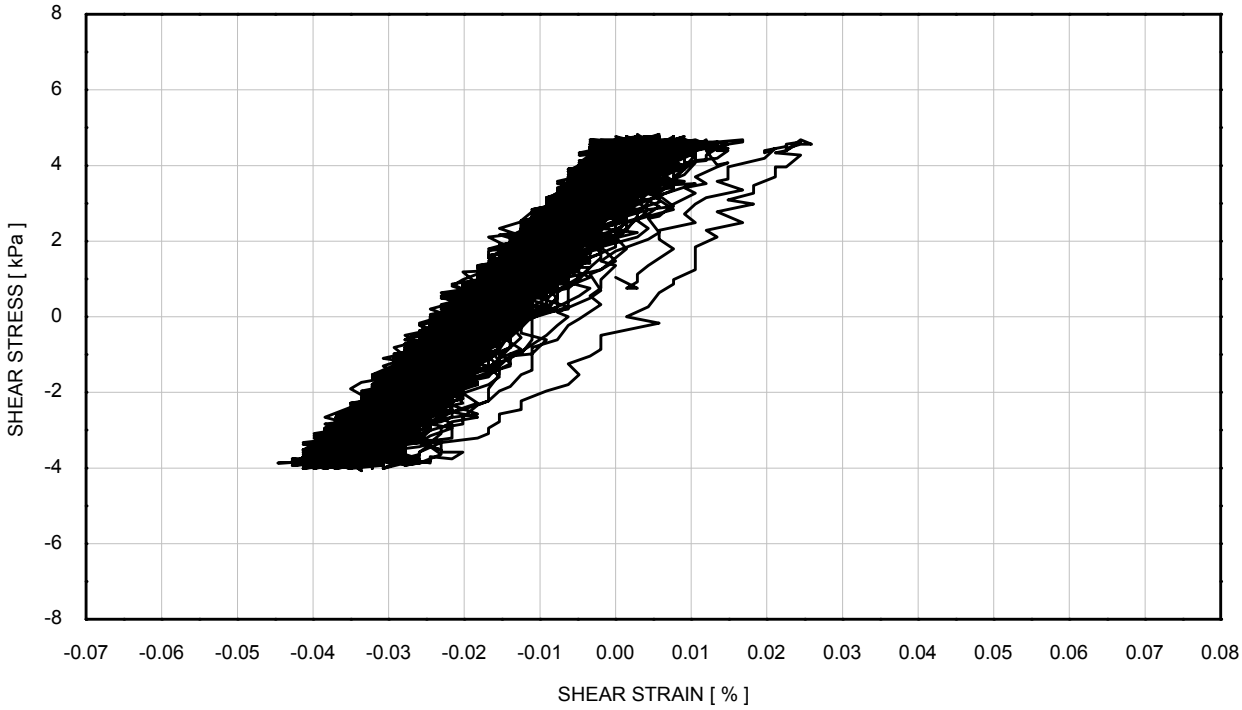
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

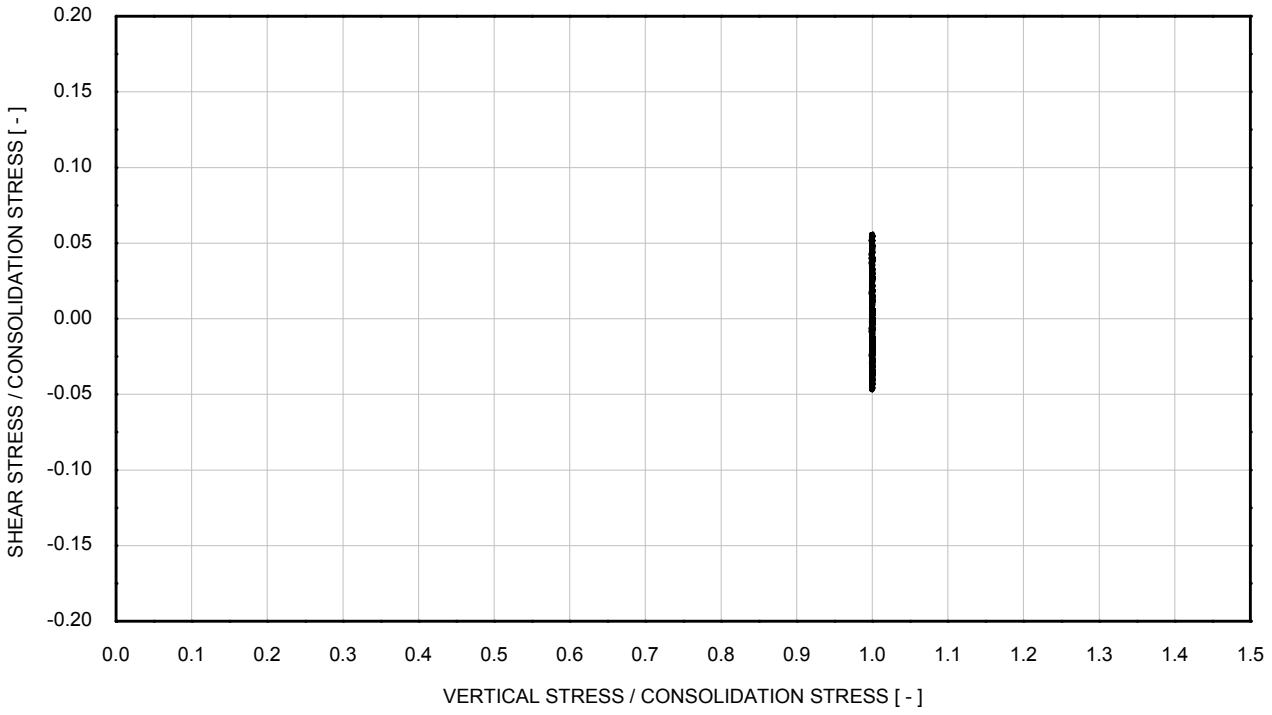




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-3
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS07

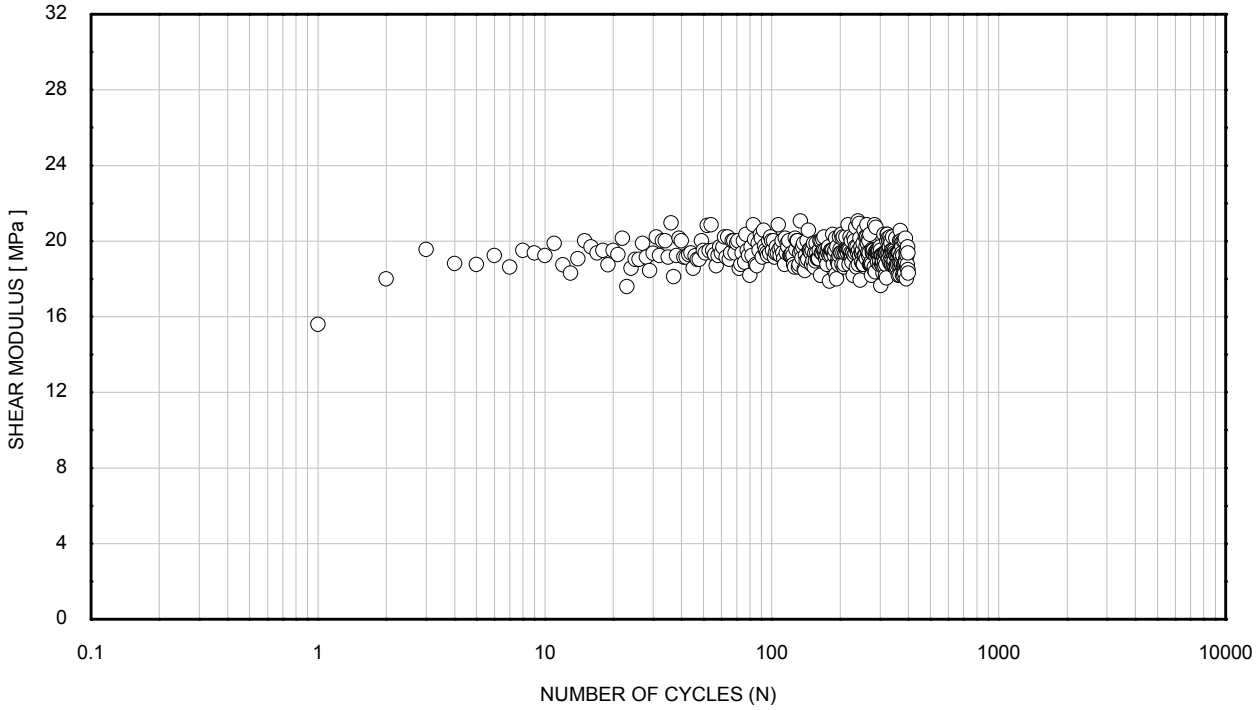
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

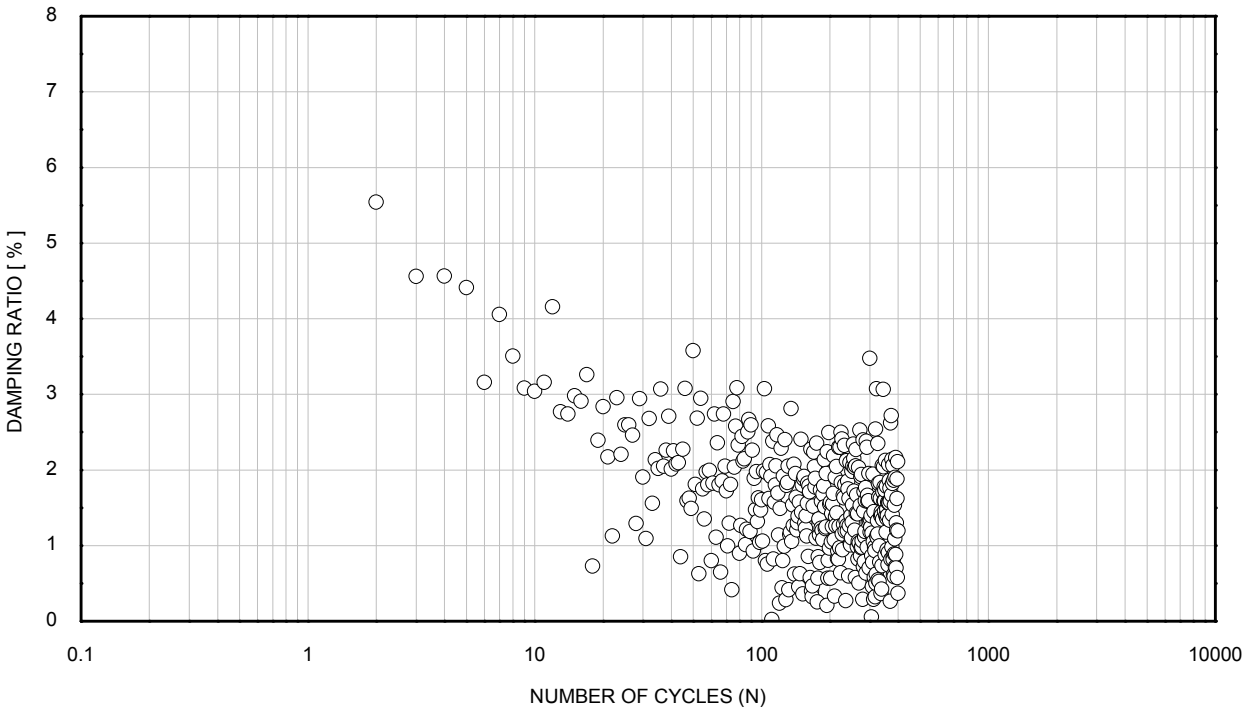




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-3
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS07

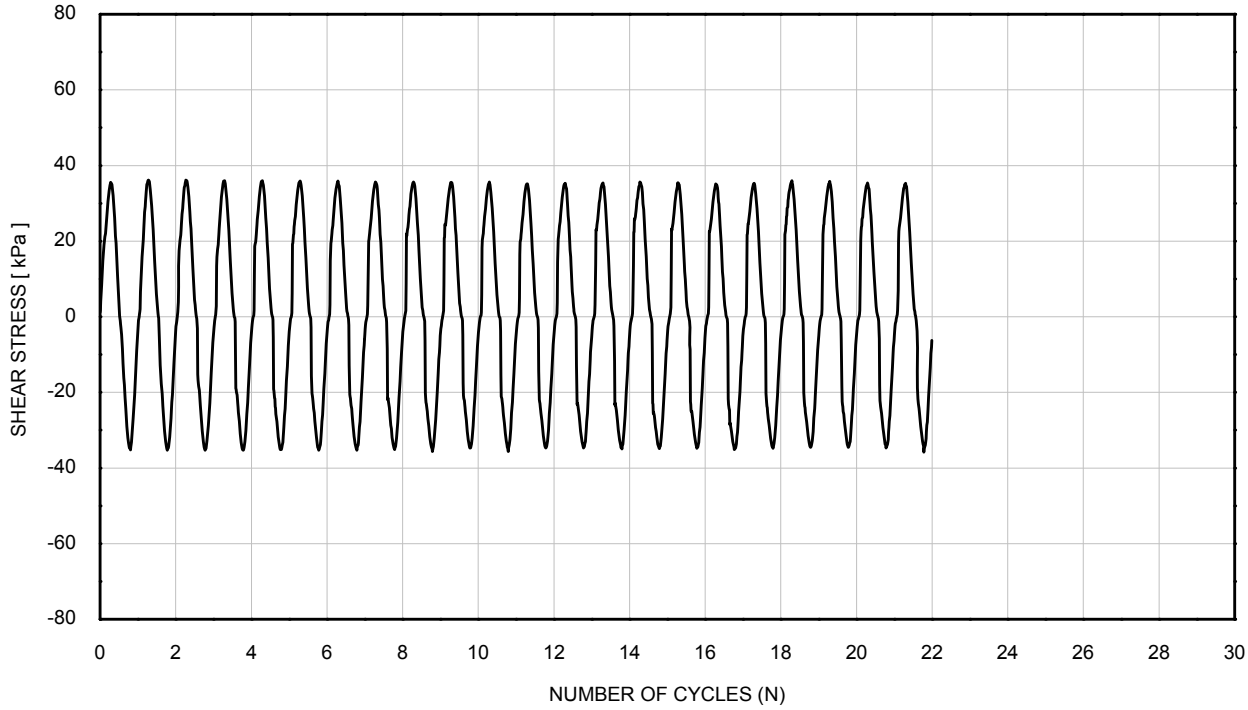
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

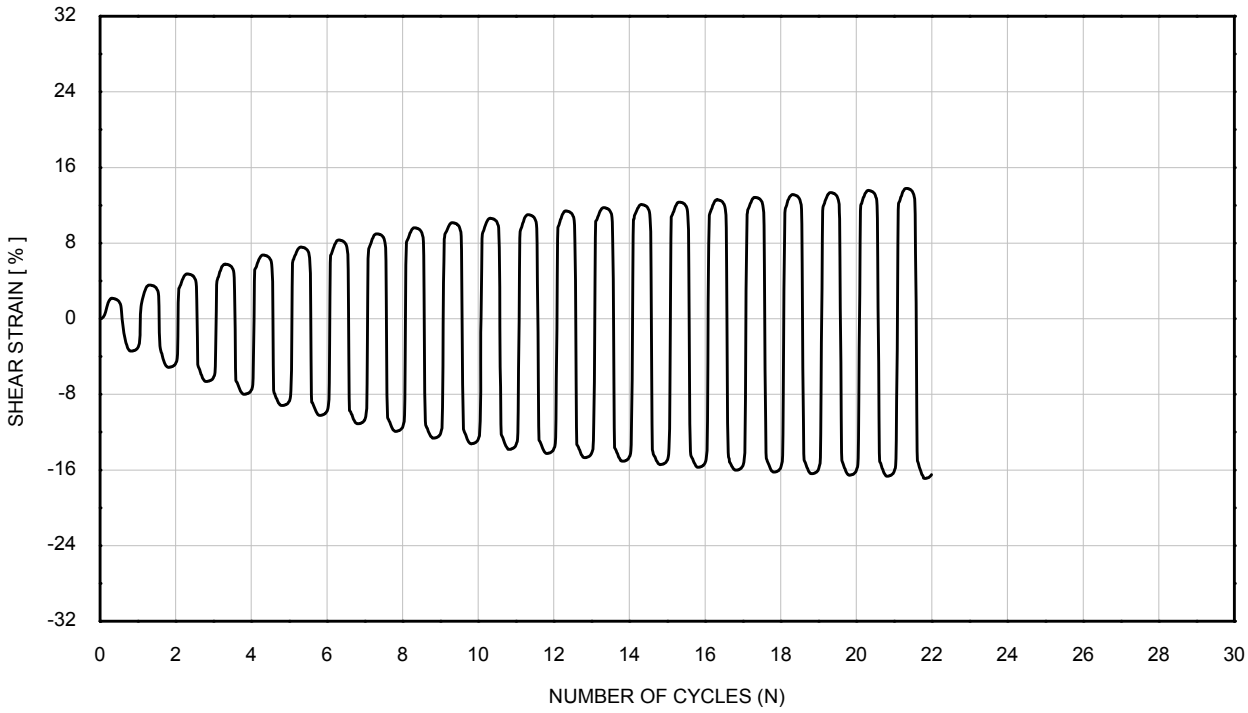




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-3
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS07

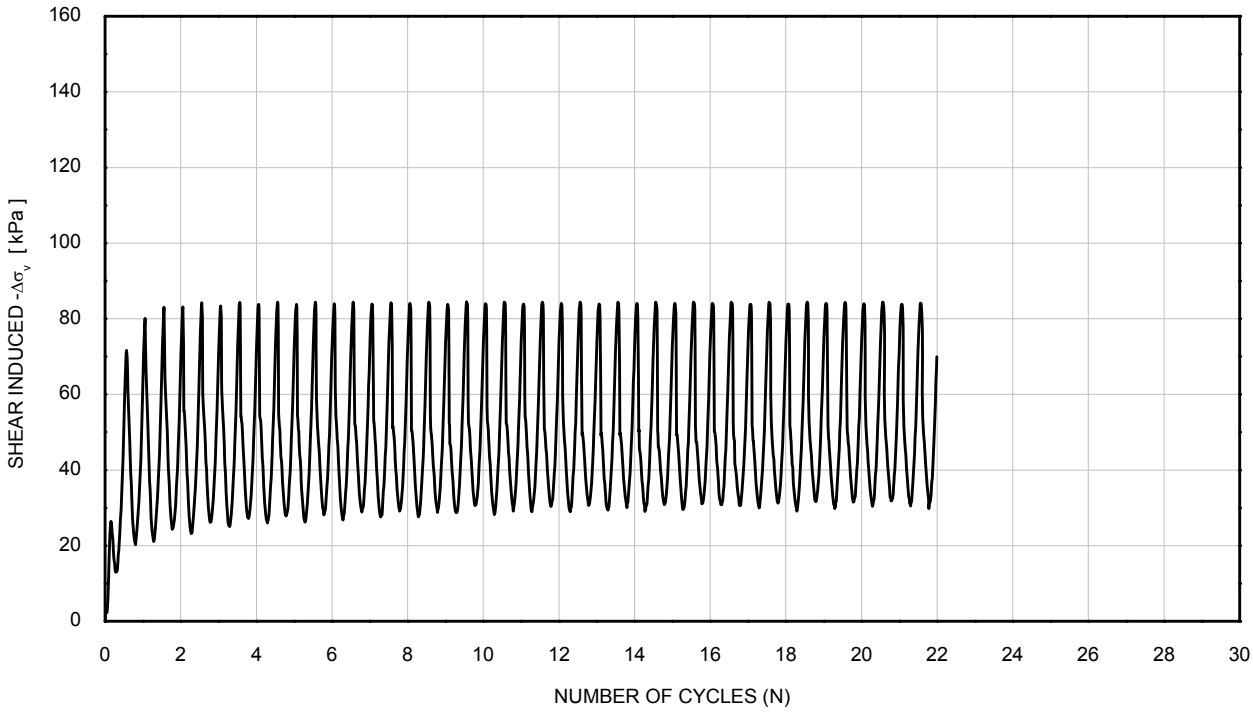
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

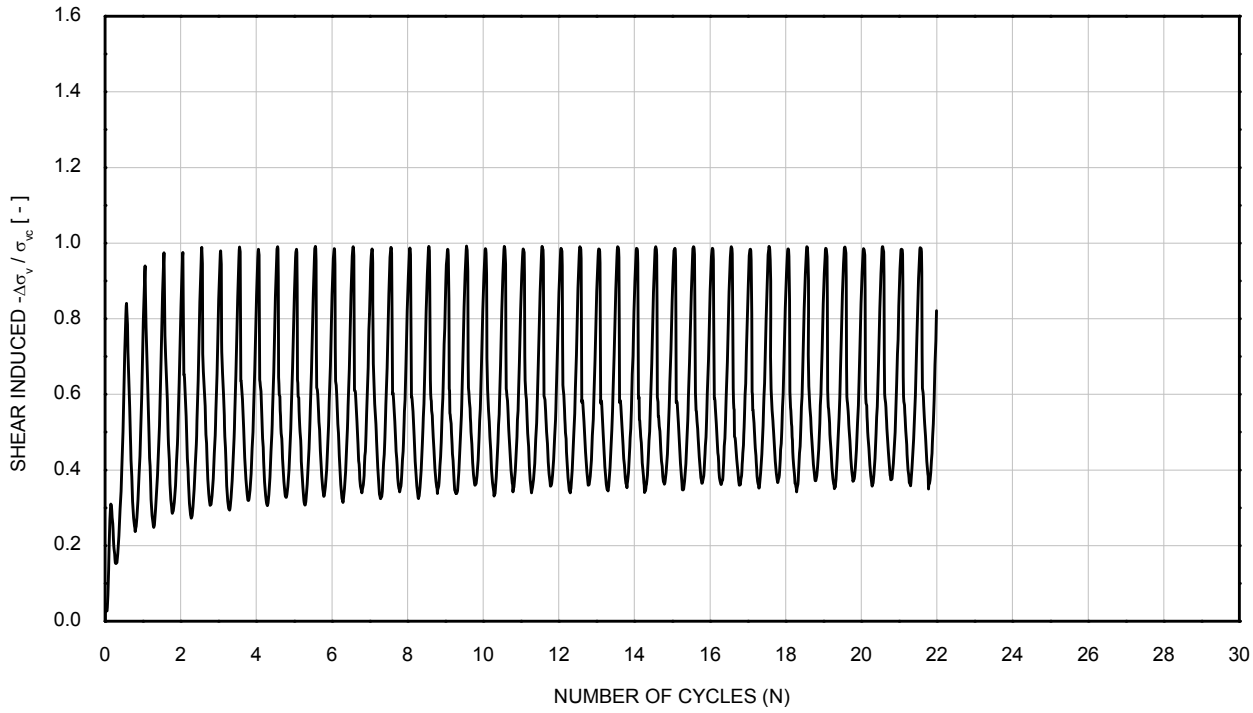




σ_{vc}	: 85	kPa	Batch	: 4
Mean τ_{av}	: --	kPa	Sample	: CSS_4-3
Mean τ_{cy}	: 35	kPa	Unit	: Unit B1 (Kreftenheye)
Frequency	: 0.10	Hz	Test No.	: CSS07

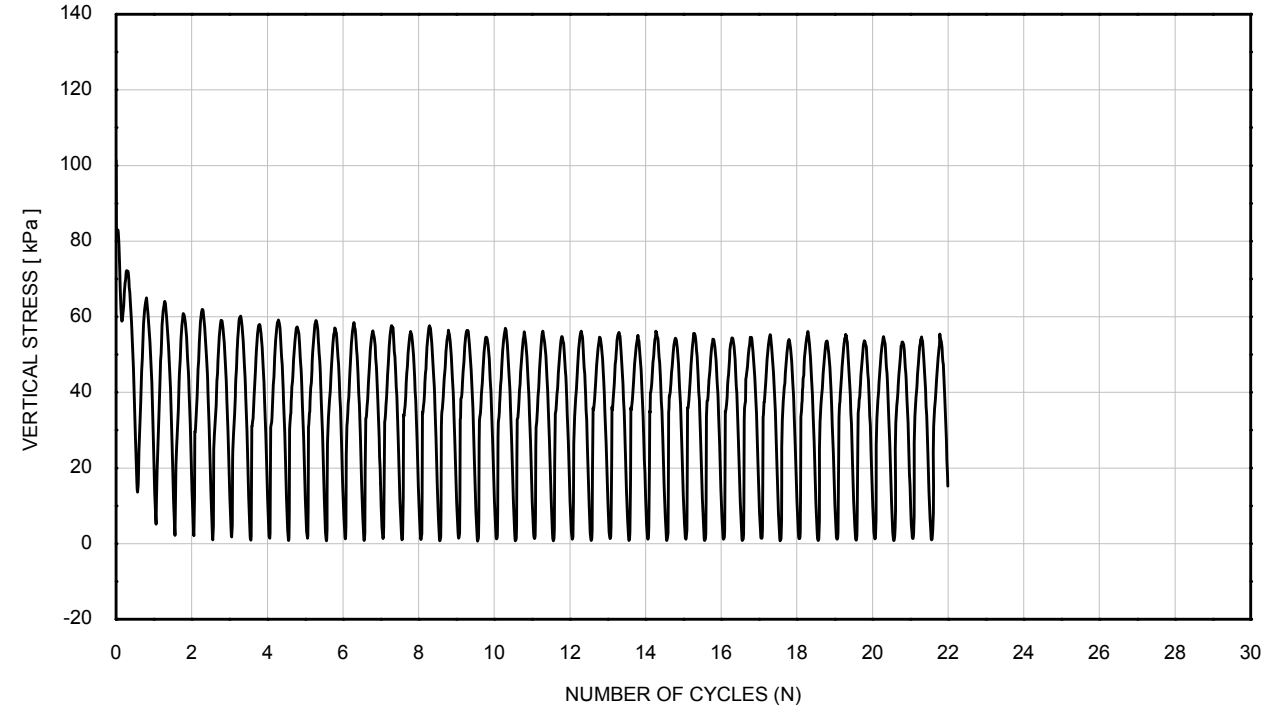
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

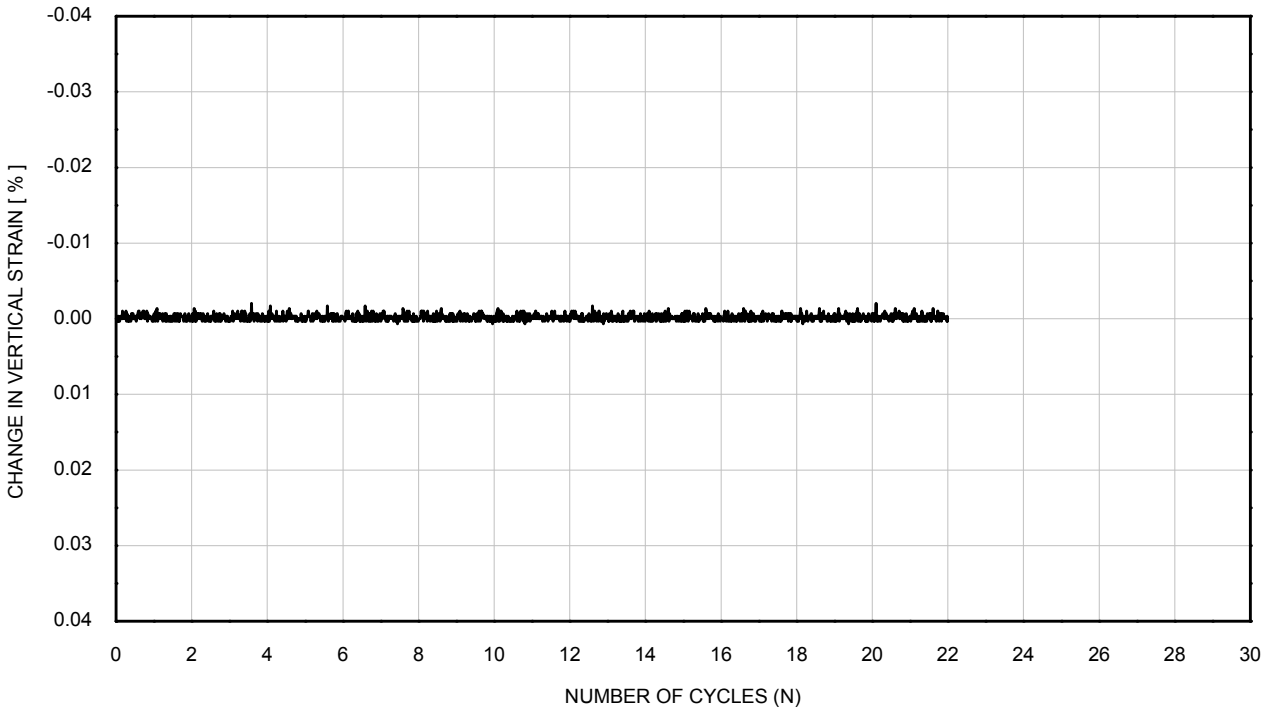




σ_{vc}	: 85	kPa	Batch	: 4
Mean τ_{av}	: --	kPa	Sample	: CSS_4-3
Mean τ_{cy}	: 35	kPa	Unit	: Unit B1 (Kreftenheye)
Frequency	: 0.10	Hz	Test No.	: CSS07

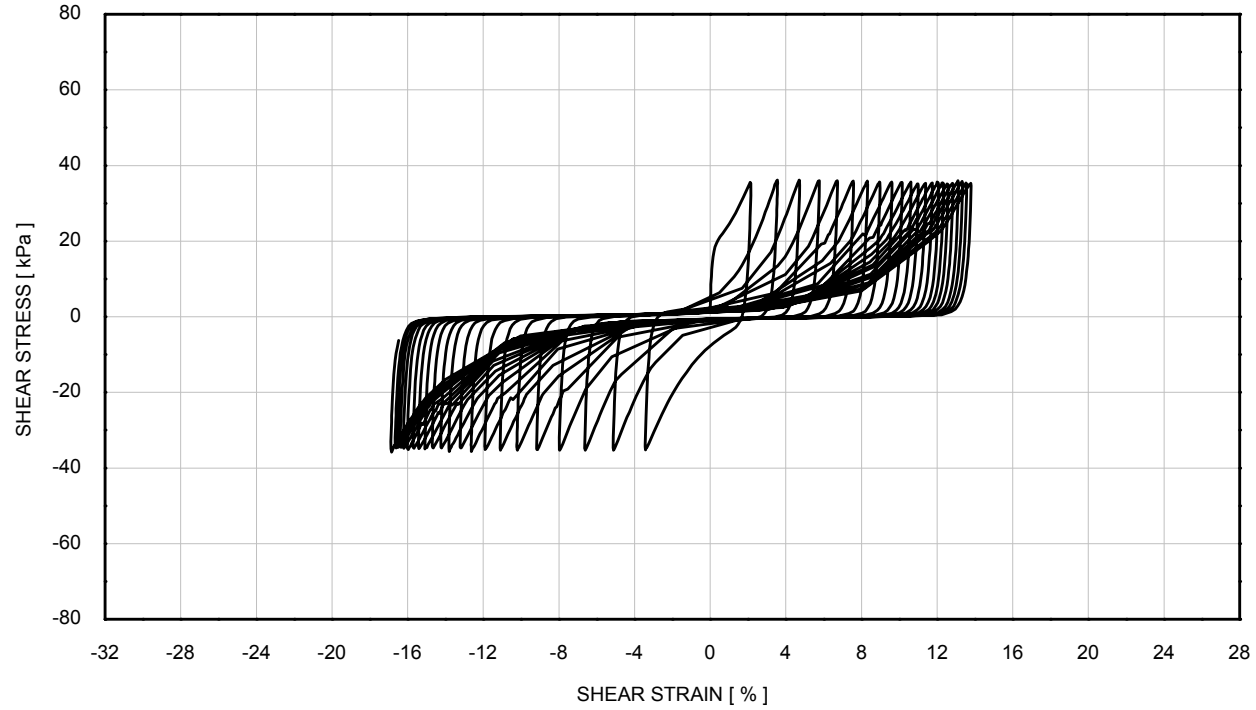
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

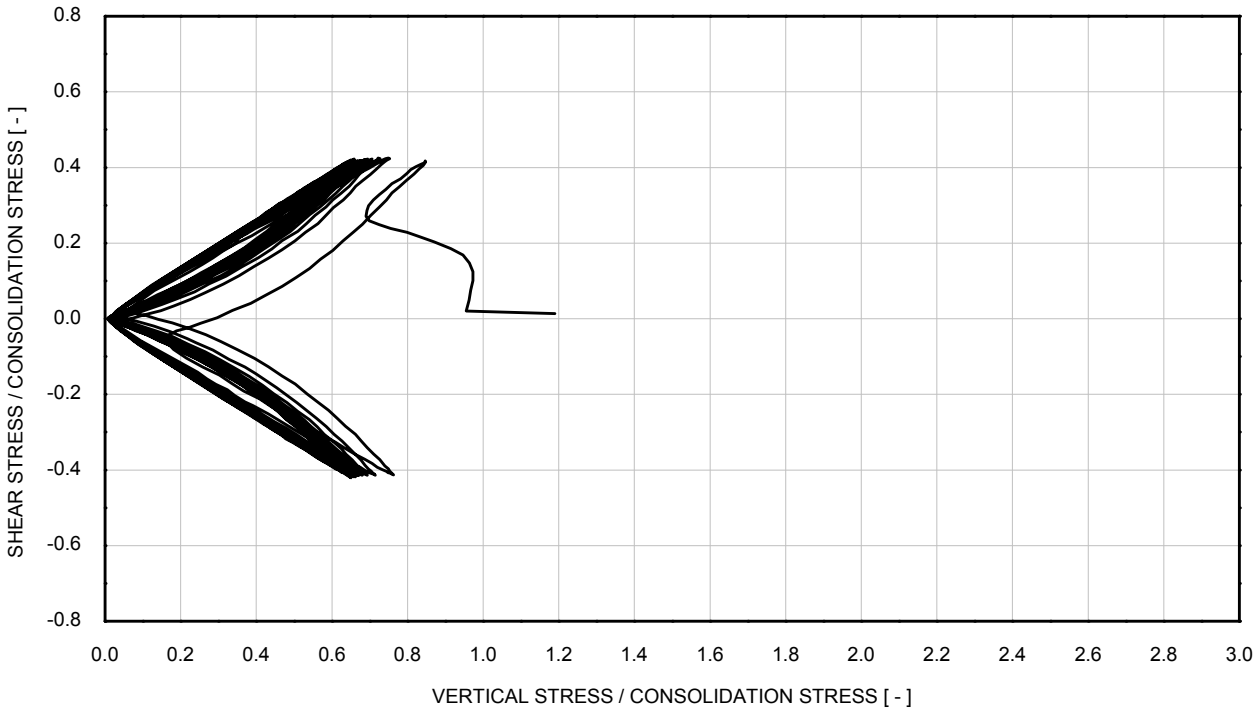




σ_{vc}	: 85	kPa	Batch	: 4
Mean τ_{av}	: --	kPa	Sample	: CSS_4-3
Mean τ_{cy}	: 35	kPa	Unit	: Unit B1 (Kreftenheye)
Frequency	: 0.10	Hz	Test No.	: CSS07

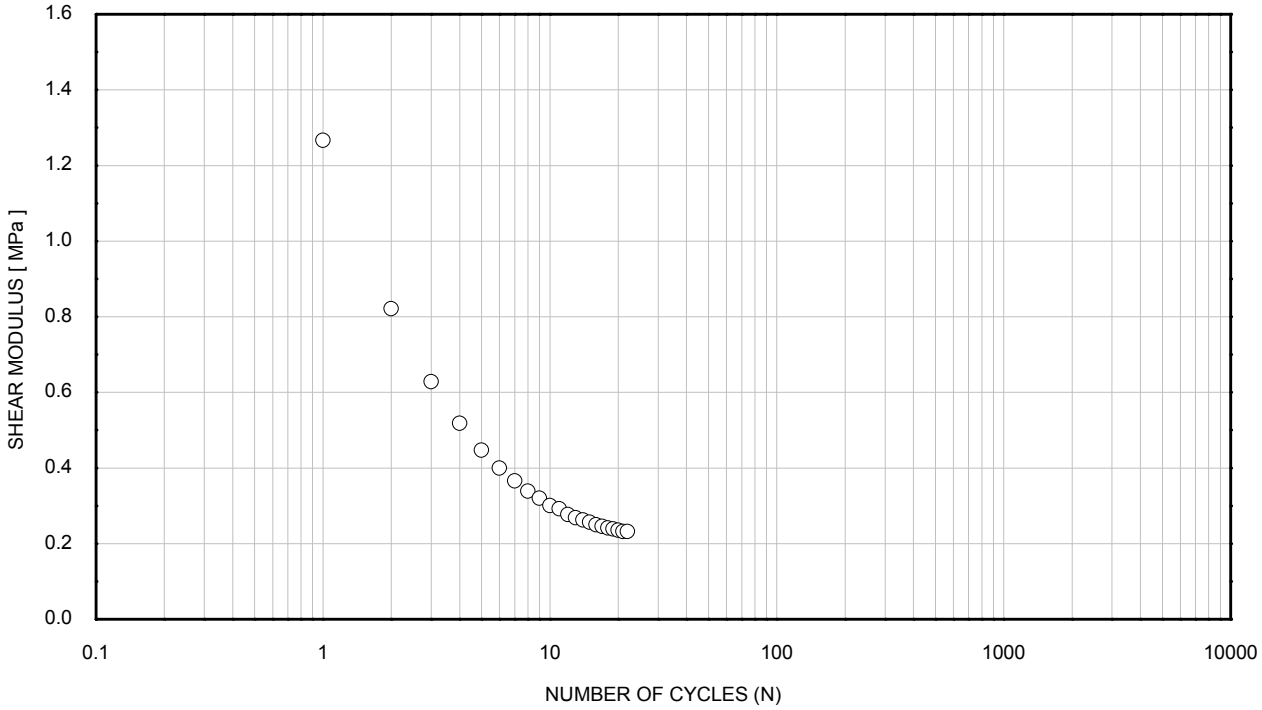
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

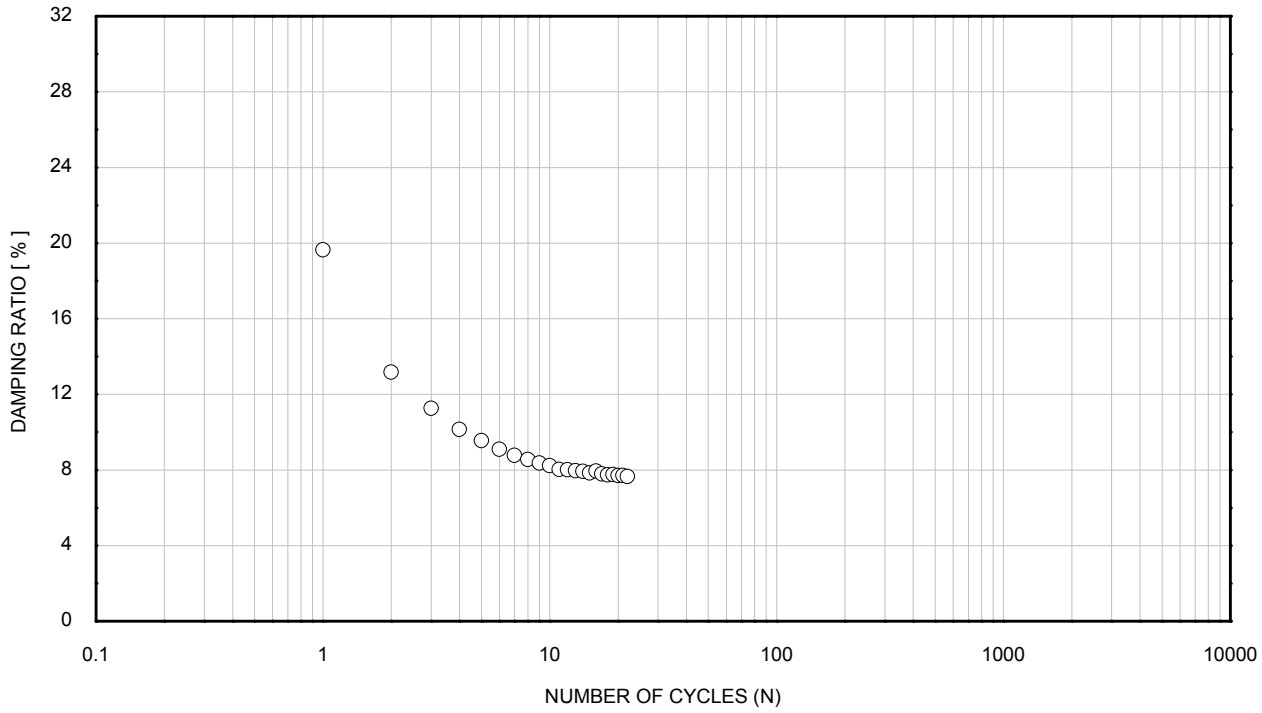




σ_{vc}	:	85 kPa	Batch	: 4
Mean τ_{av}	:	-- kPa	Sample	: CSS_4-3
Mean τ_{cy}	:	35 kPa	Unit	: Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	: CSS07

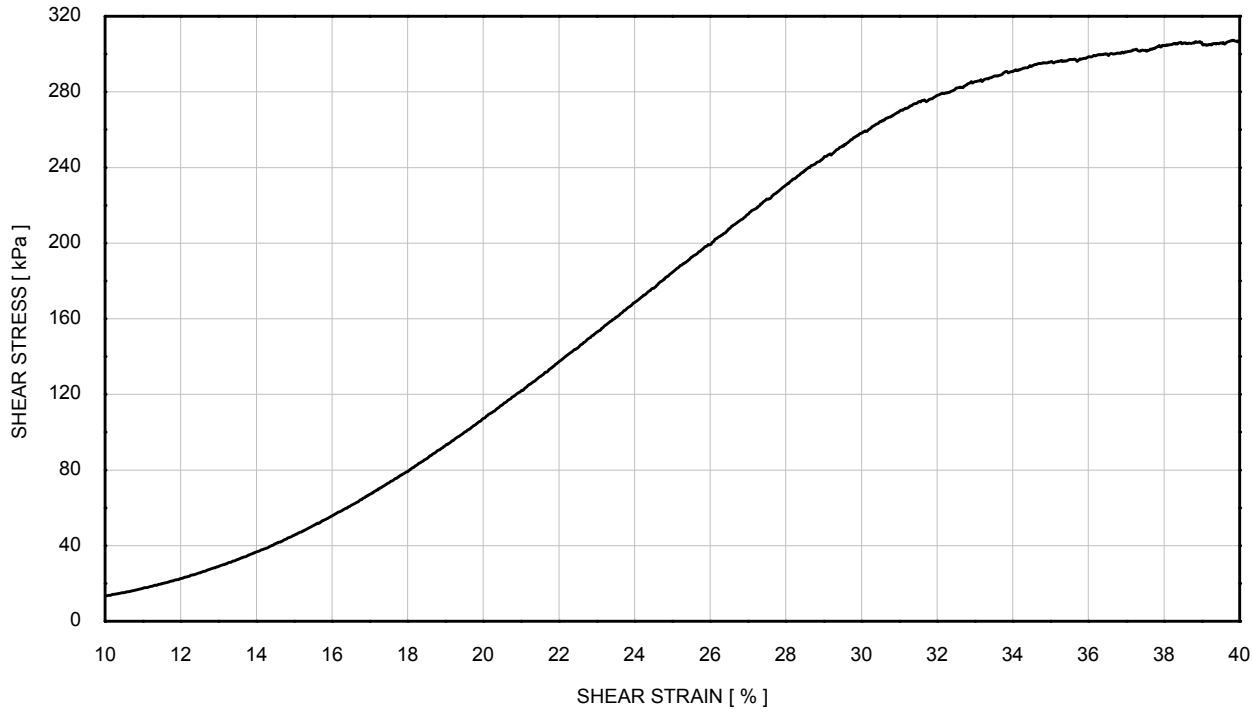
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

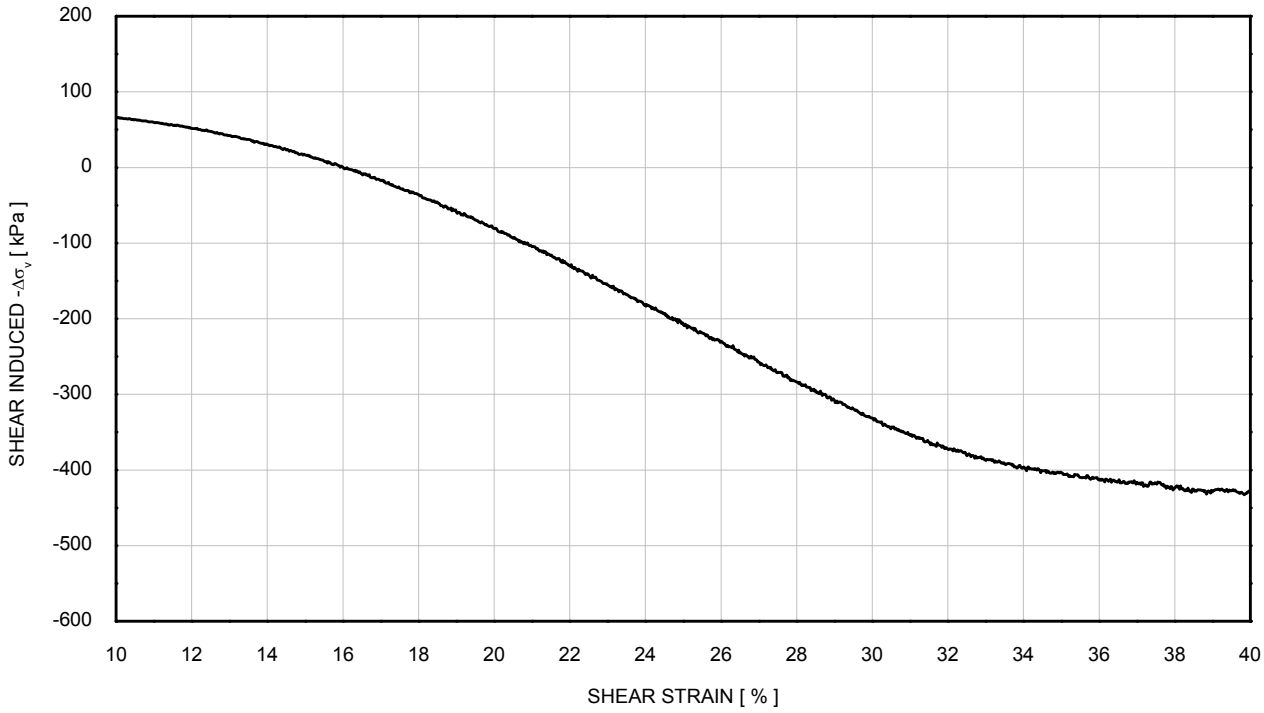




σ_{vc}	: 85	kPa	Batch	: 4
Mean τ_{av}	: --	kPa	Sample	: CSS_4-3
Mean τ_{cy}	: 35	kPa	Unit	: Unit B1 (Kreftenheye)
Frequency	: 0.10	Hz	Test No.	: CSS07

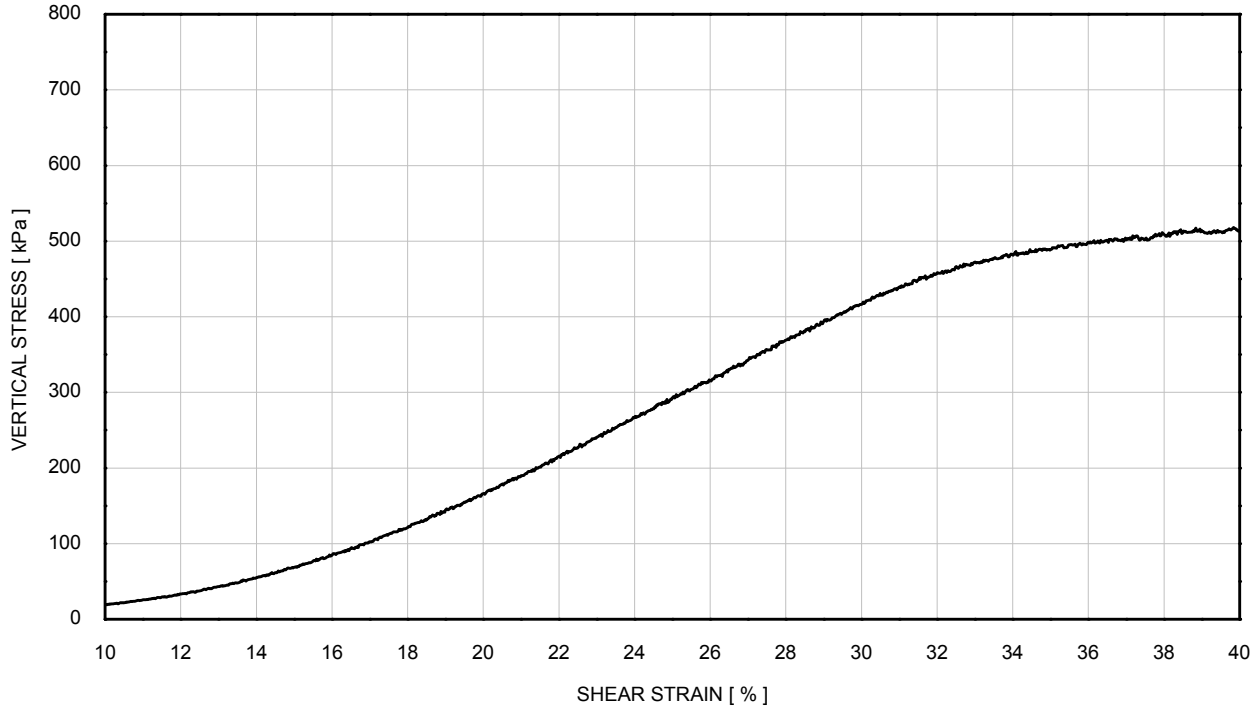
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

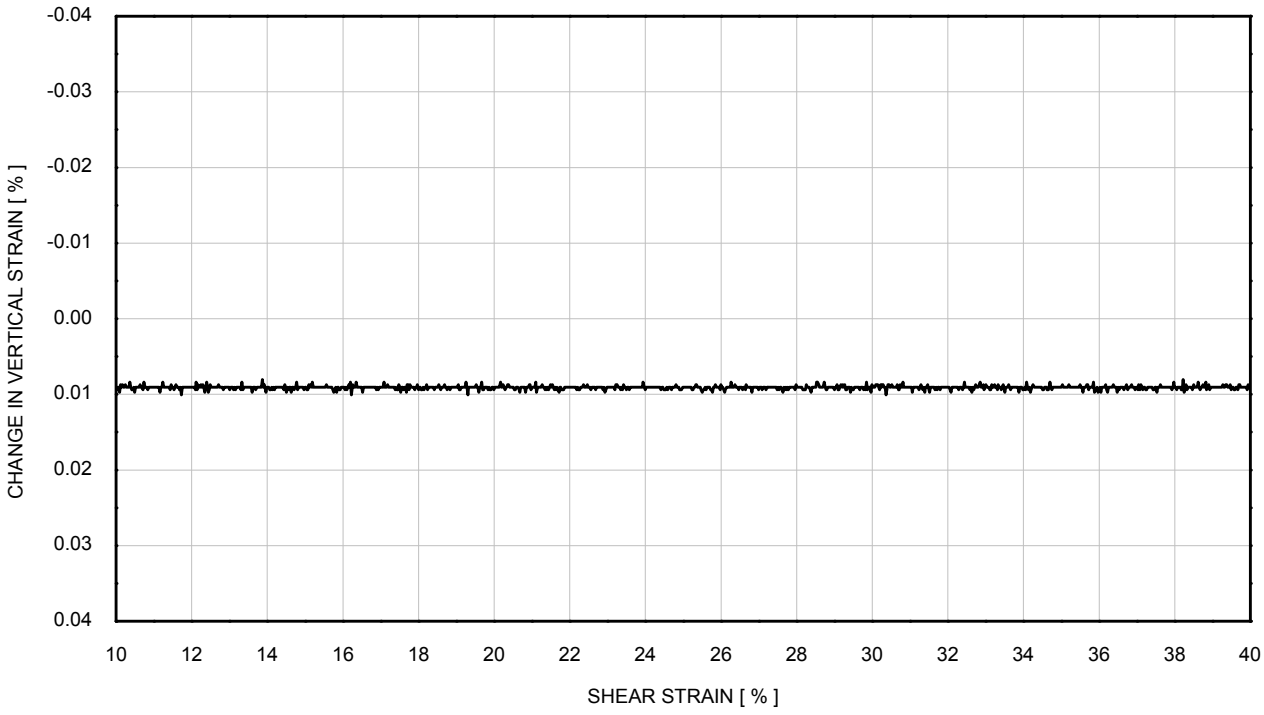




σ_{vc}	: 85	kPa	Batch	: 4
τ_{peak}	: 307	kPa	Sample	: CSS_4-3
γ at τ_{peak}	: 39.84	%	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.98	%/hour	Test No.	: CSS07

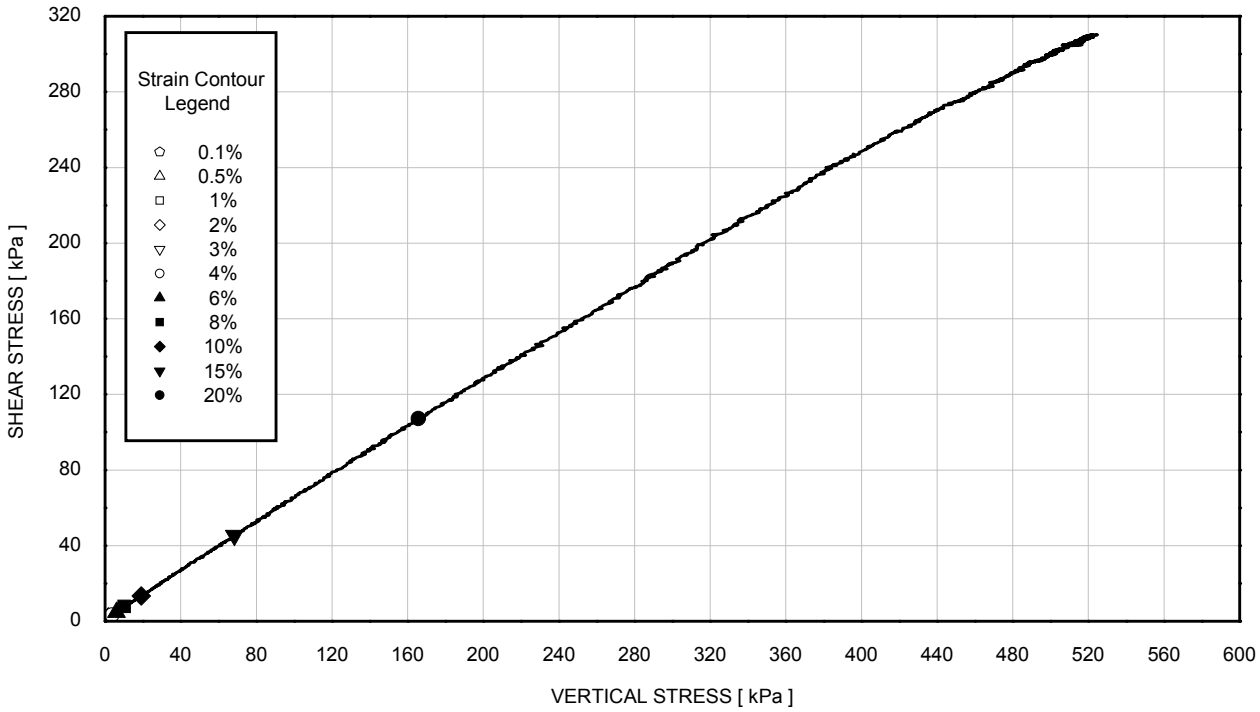
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

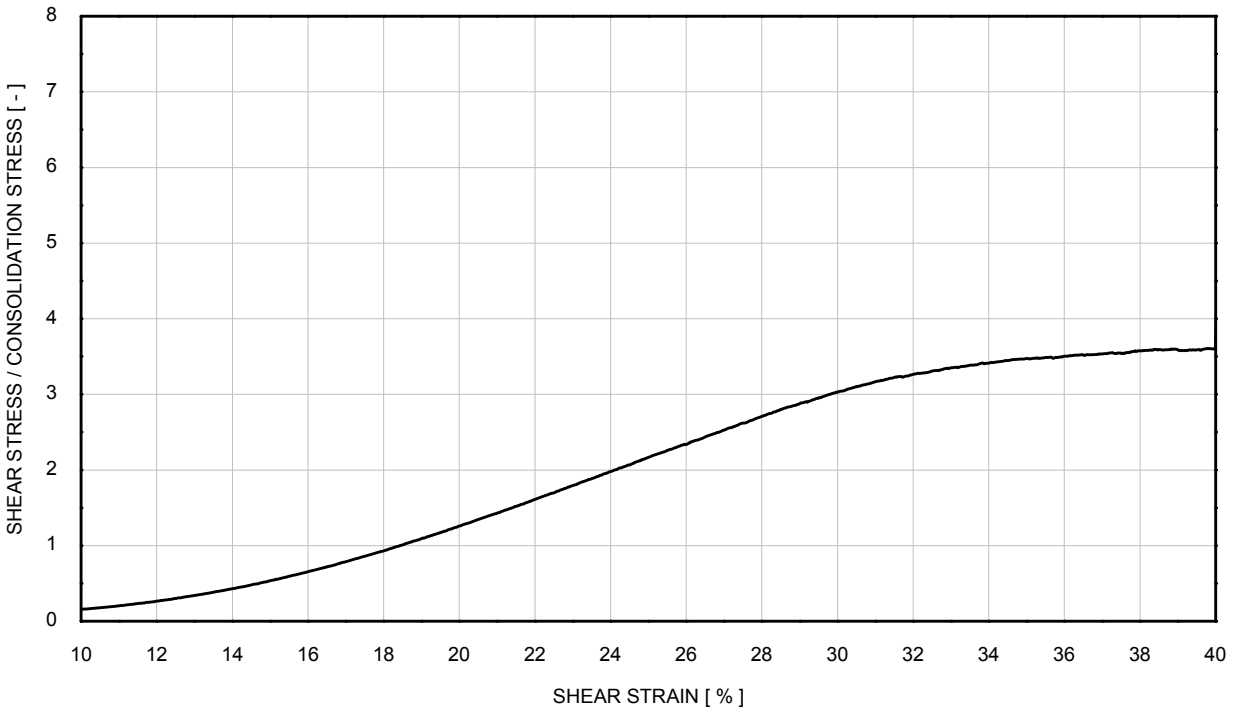




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 307 kPa	Sample	: CSS_4-3
γ at τ_{peak}	: 39.84 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.98 %/hour	Test No.	: CSS07

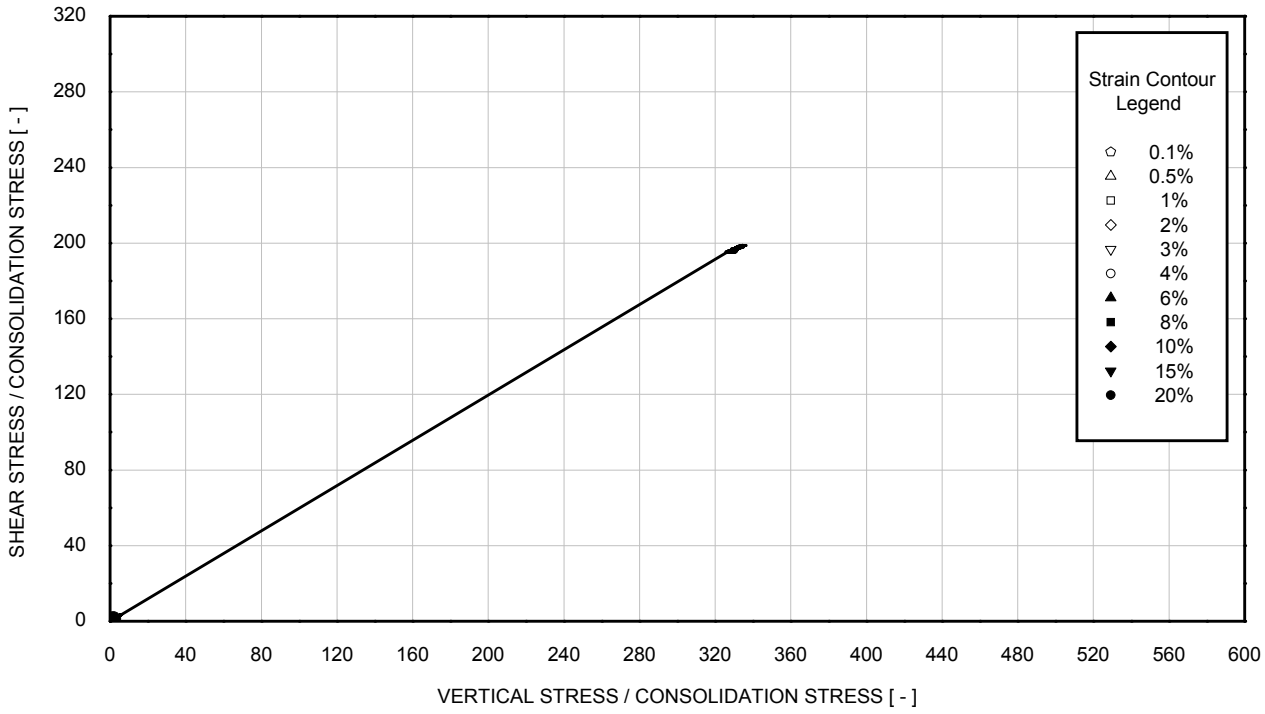
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

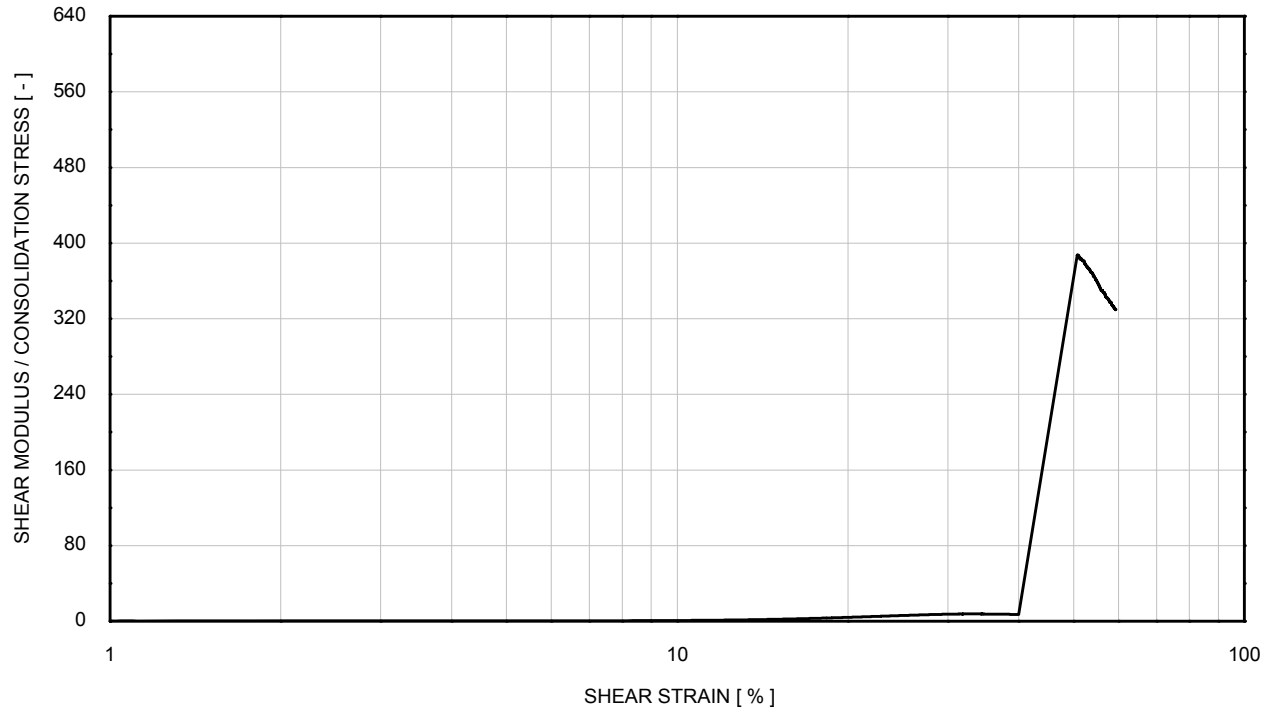




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 307 kPa	Sample	: CSS_4-3
γ at τ_{peak}	: 39.84 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.98 %/hour	Test No.	: CSS07

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 85	kPa	Batch	: 4
τ_{peak}	: 307	kPa	Sample	: CSS_4-3
γ at τ_{peak}	: 39.84	%	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.98	%/hour	Test No.	: CSS07

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown slightly silty fine to medium SAND with few shell fragments

GENERAL	
Date test started	11/11/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.4
Length	[mm]	30.0
Water content after compaction	[%]	9.9
Bulk density after compaction	[Mg/m³]	1.83
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.595
Degree of saturation after compaction	[%]	44
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	22.5
Bulk density at start of test	[Mg/m³]	2.03
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 4_CSS08
Template issue	1.4
Processed by Date	JLS 17/11/2016
Checked by Date	PH 21/11/2016
Approved by Date	PH 21/11/2016

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-4
Unit	Unit B1 (Kreftenheye)
Test number	CSS08

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	85
Vertical strain	[%]	1.99
Bulk density	[Mg/m^3]	2.06
Dry density	[Mg/m^3]	1.70
Void ratio	[-]	0.563
Water content	[%]	21.3

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	85
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	4
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	2.03
Bulk density	[Mg/m^3]	2.06
Dry density	[Mg/m^3]	1.70
Void ratio	[-]	0.563

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	2.41	0.03	15.22	7.21
2	2.41	0.03	16.74	5.29
5	2.40	0.03	16.74	3.97
10	2.39	0.02	17.11	3.76
20	2.39	0.02	17.34	3.24
50	2.38	0.02	17.34	2.51
100	2.37	0.02	17.23	2.02
200	2.37	0.03	16.74	1.99
300	2.36	0.02	17.23	1.72
400	2.36	0.03	16.63	1.65

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-4
Unit	Unit B1 (Kreftenheye)
Test number	CSS08

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	85
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	41
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	17
γ_{av} at N_f	[%]	-3.14
γ_{cy} at N_f	[%]	15.04
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	50
Vertical strain	[%]	0.00

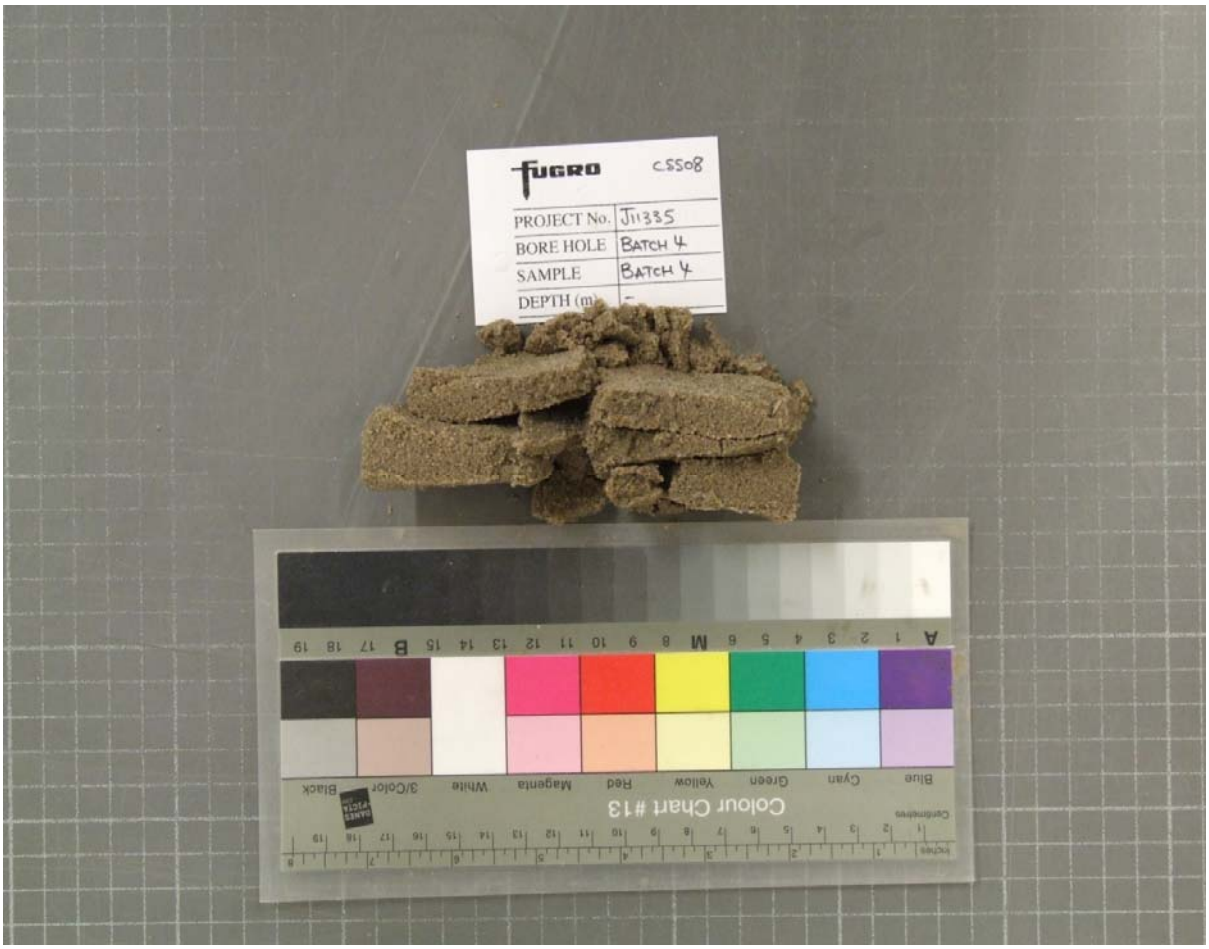
Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-3.05	7.07	0.57	15.52
2	-3.30	8.58	0.47	10.97
4	-3.55	10.06	0.40	10.03
6	-3.58	11.20	0.36	9.35
8	-3.47	12.16	0.34	9.34
10	-3.40	12.99	0.31	9.11
12	-3.25	13.67	0.30	8.99
16	-3.15	14.76	0.27	9.02
17	-3.14	15.04	0.27	8.96

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	420
Shear strain	[%]	30.00
Shear induced $-\Delta\sigma_v$	[kPa]	-575
Vertical stress	[kPa]	660
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	83
Shear induced $-\Delta\sigma_v$	[kPa]	-45
Vertical stress	[kPa]	130
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-4
Unit	Unit B1 (Kreftenheye)
Test number	CSS08

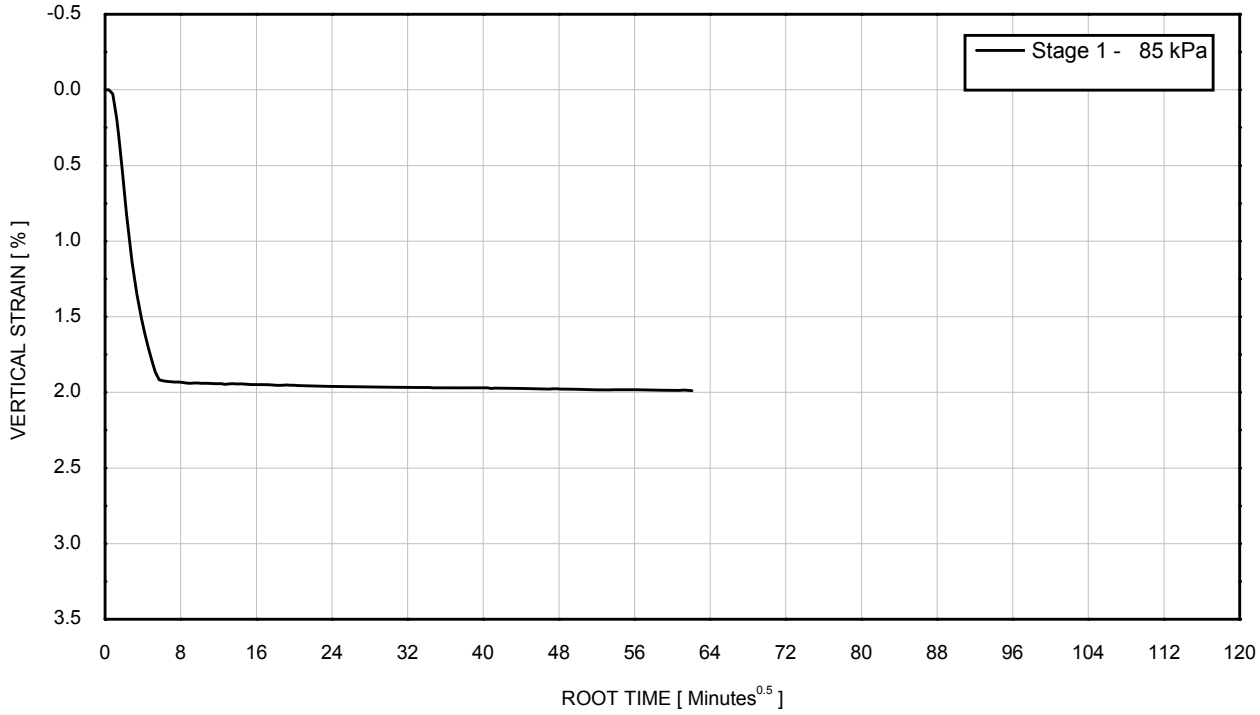
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

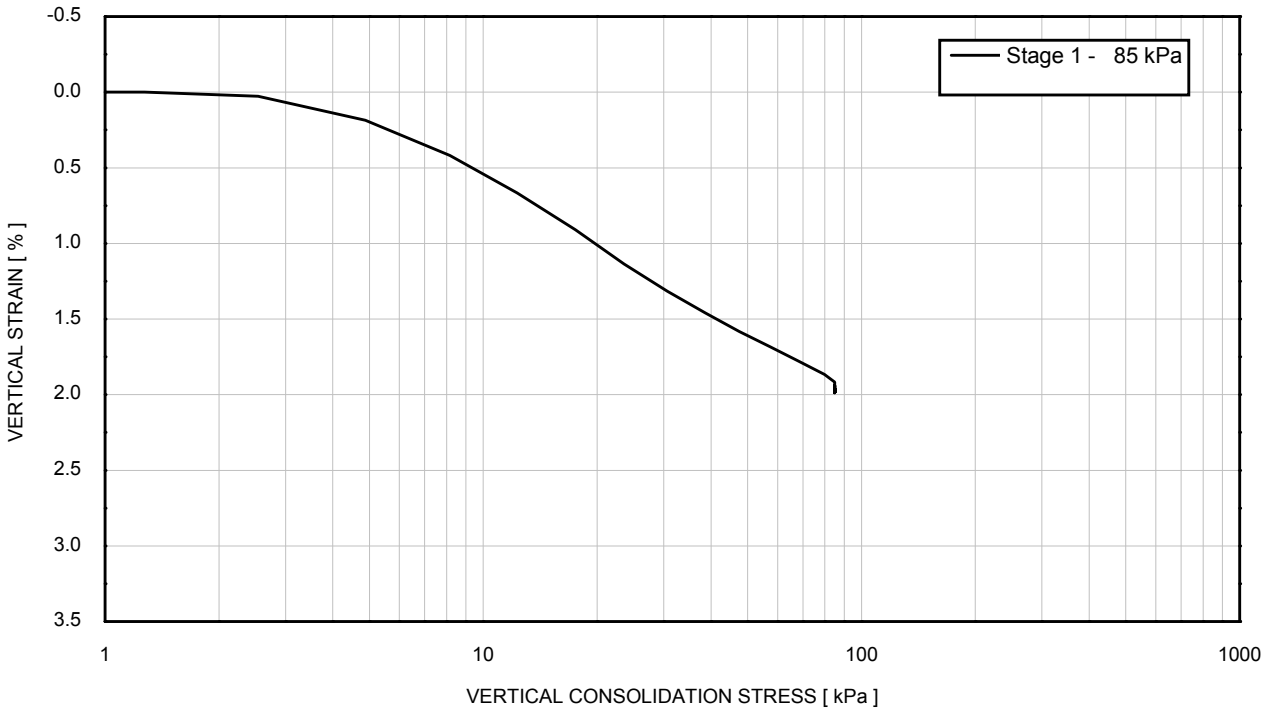
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	4
Sample	CSS_4-4
Unit	Unit B1 (Kreftenheye)
Test number	CSS08

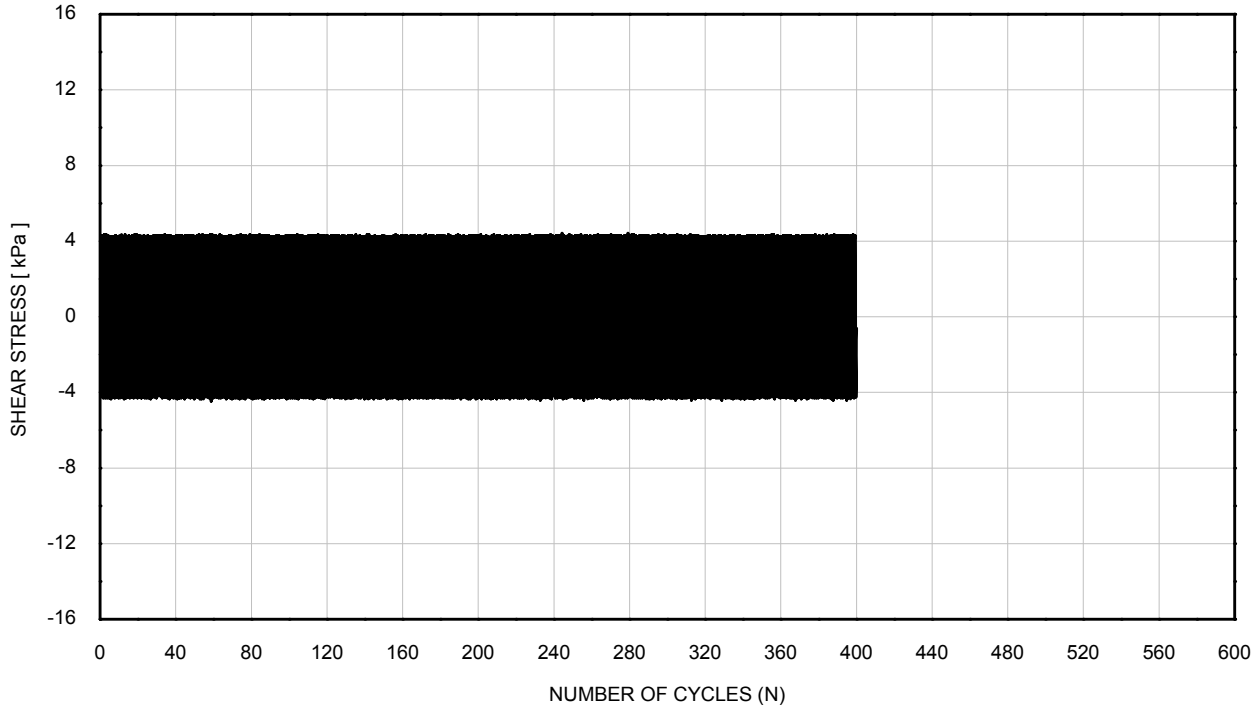
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

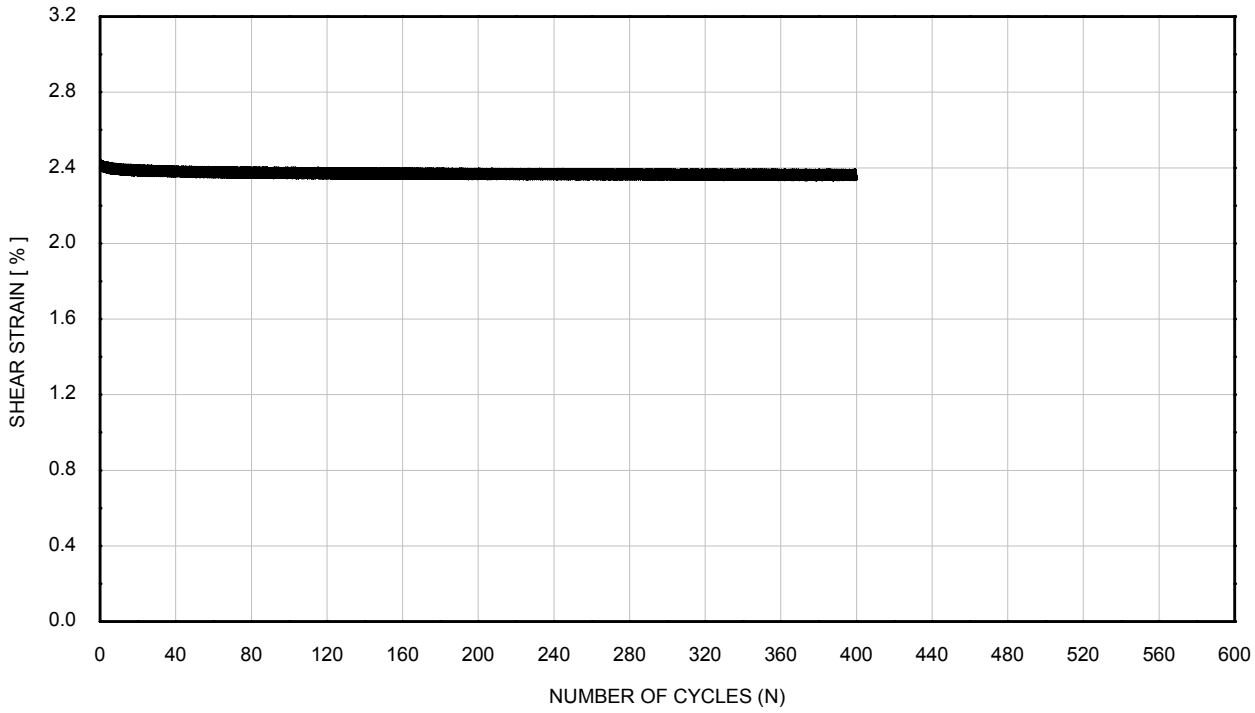




σ_{vc}	: 85 kPa	Batch	: 4
		Sample	: CSS_4-4
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CSS08

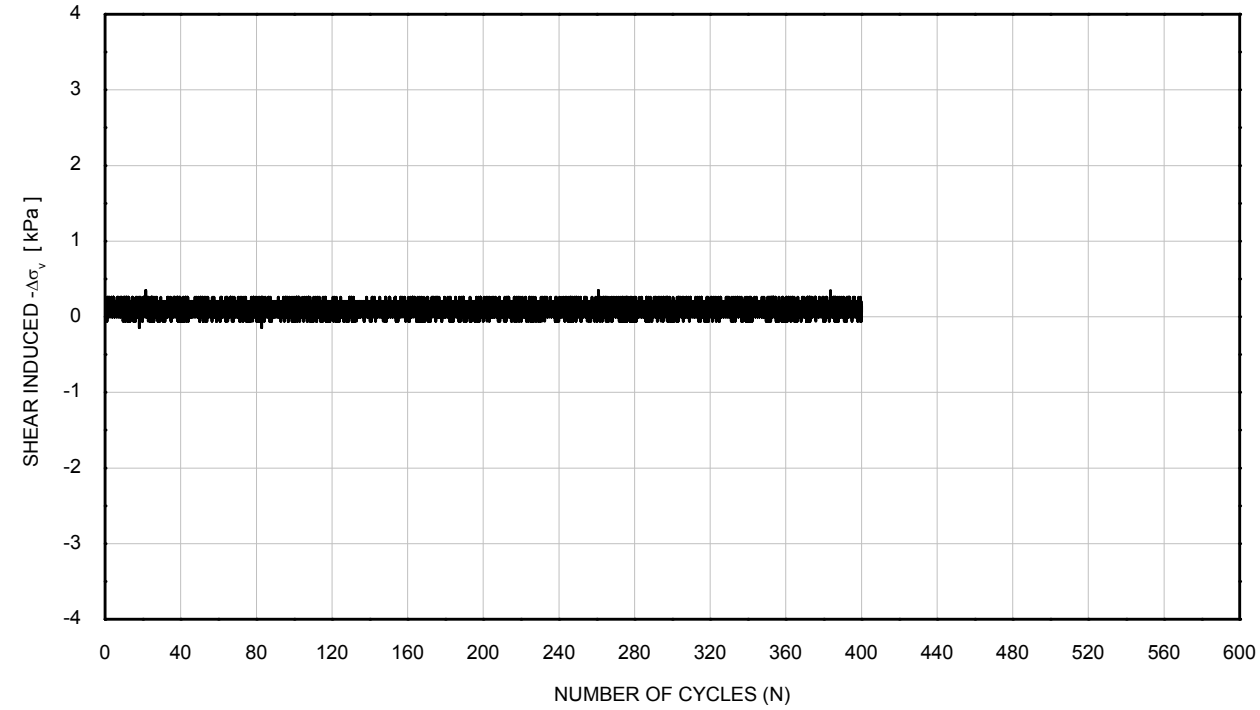
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

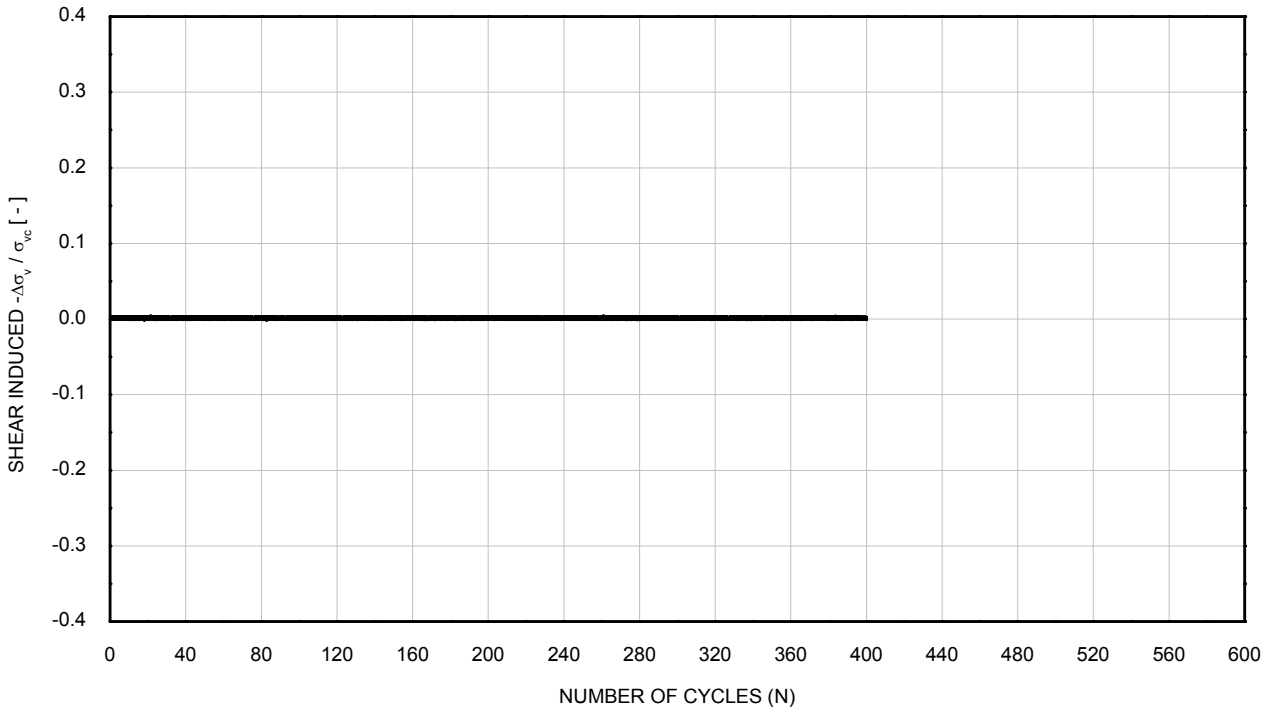




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

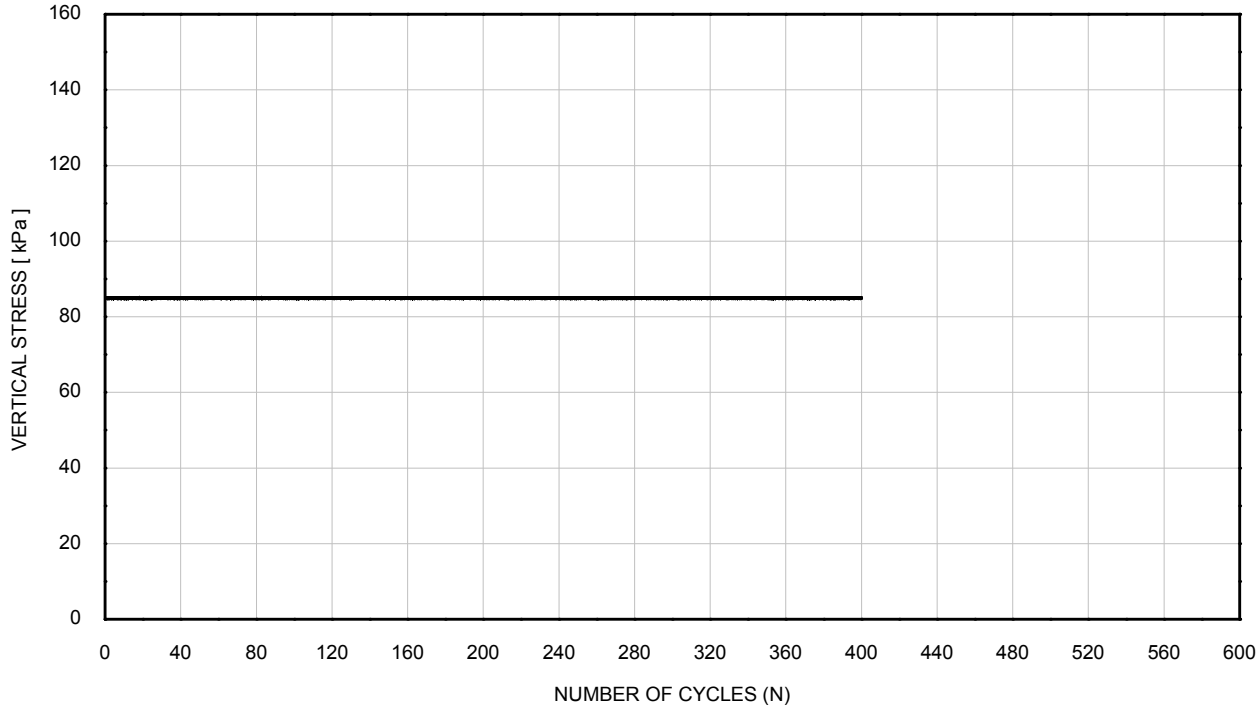
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

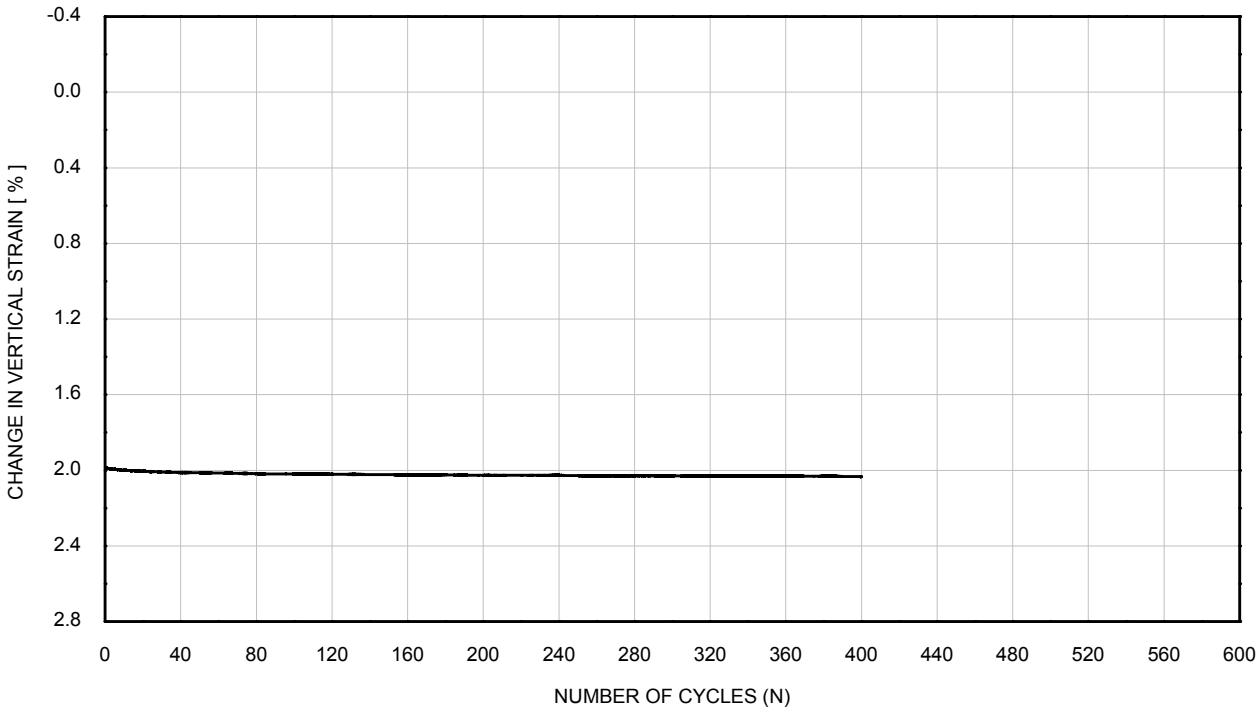




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

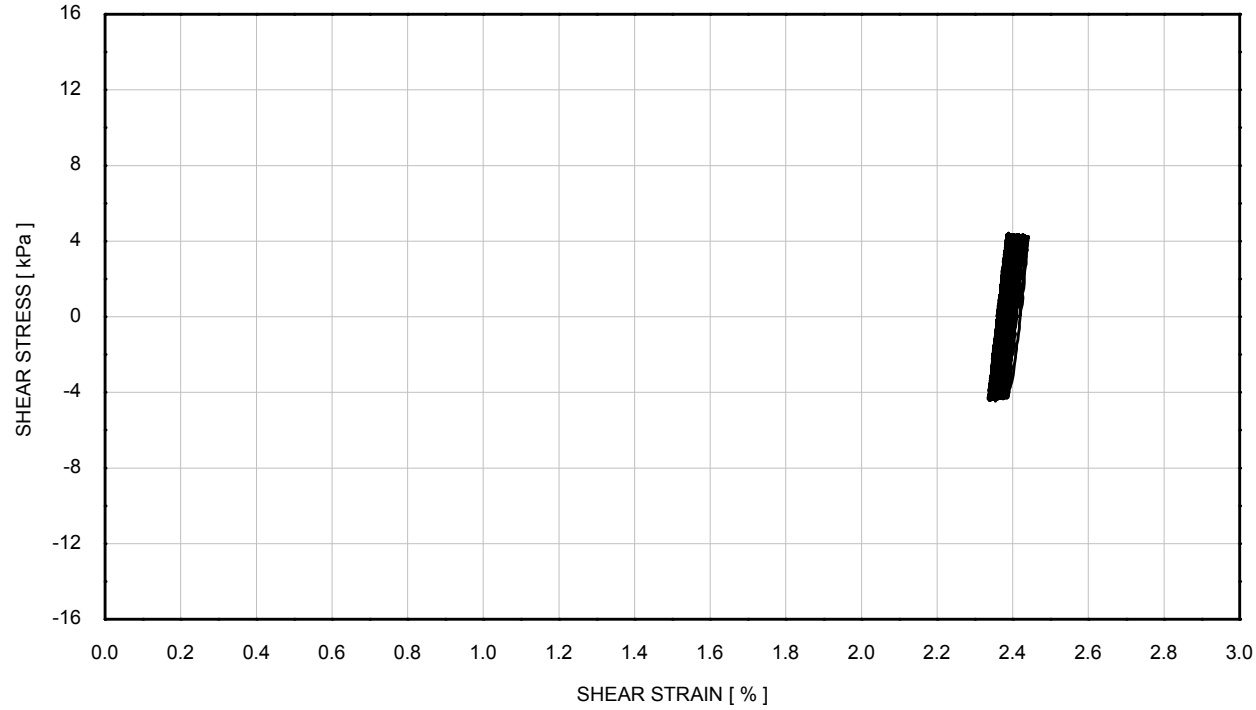
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

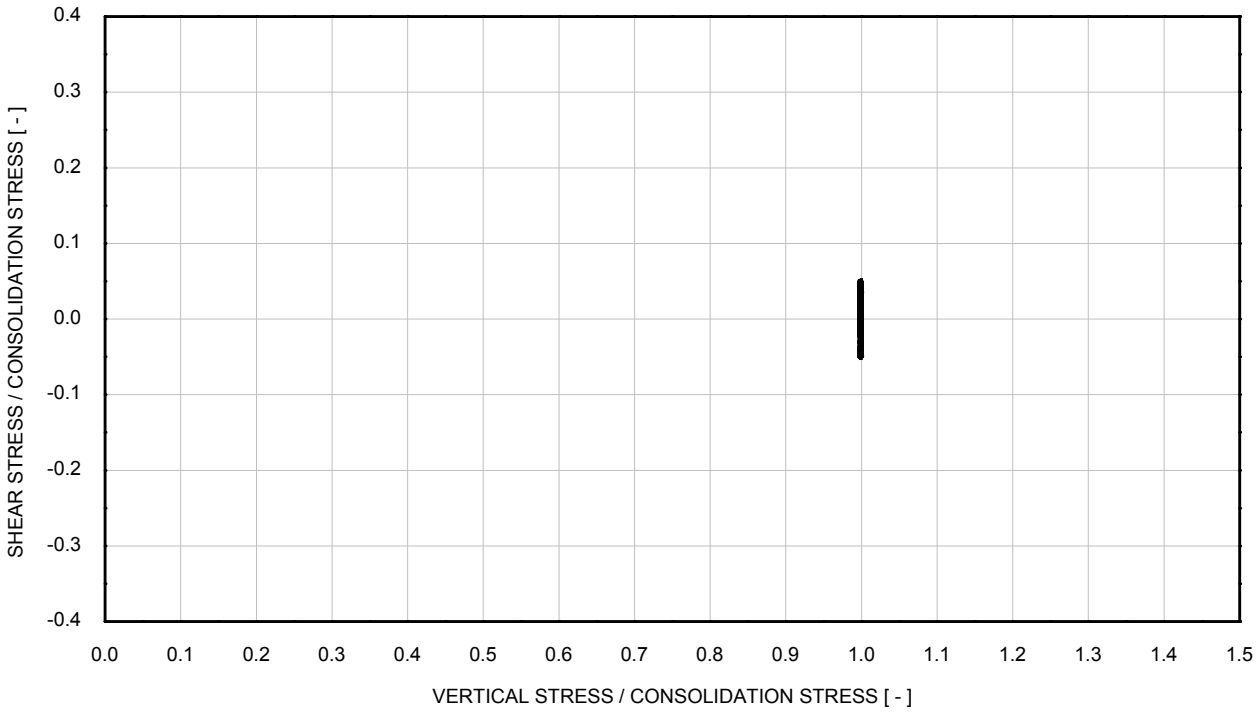




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

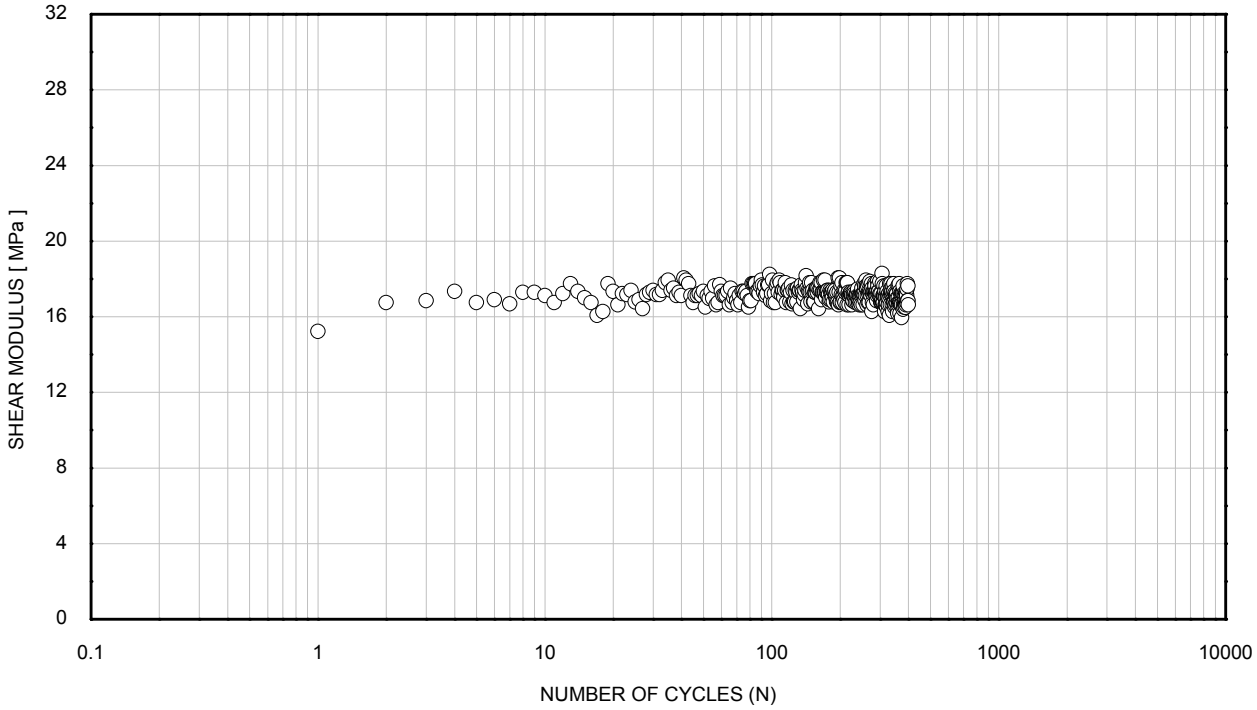
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

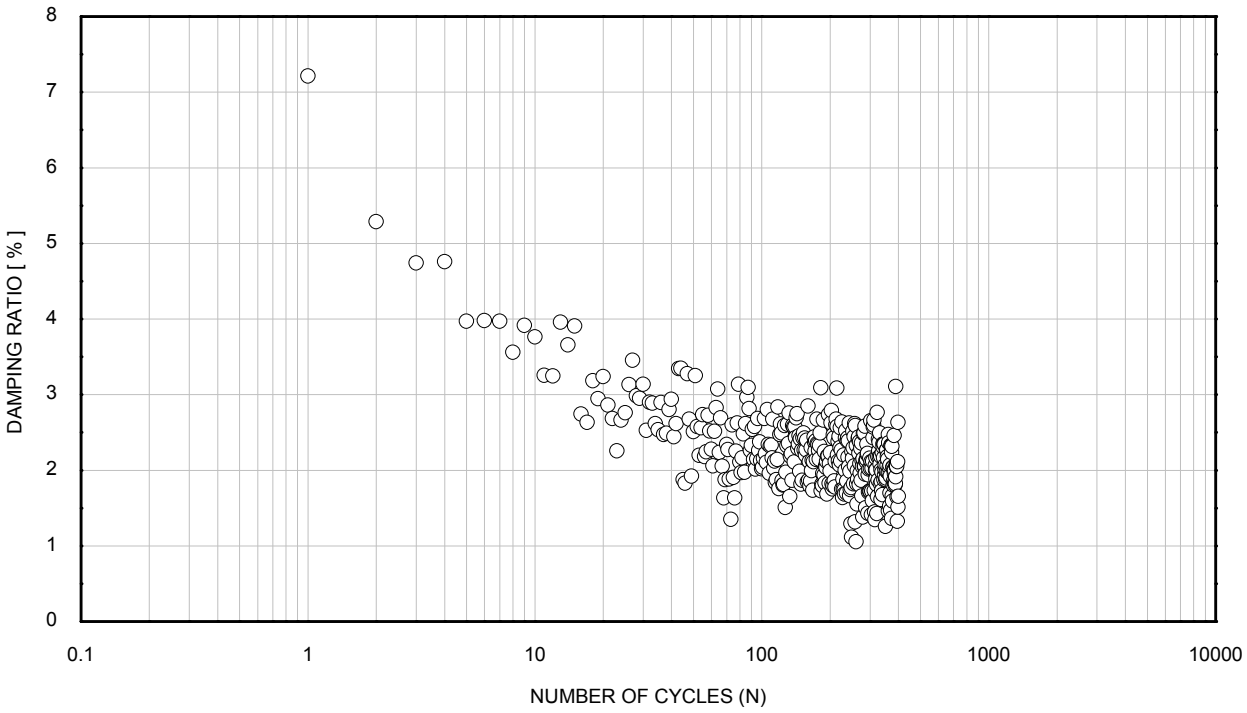




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

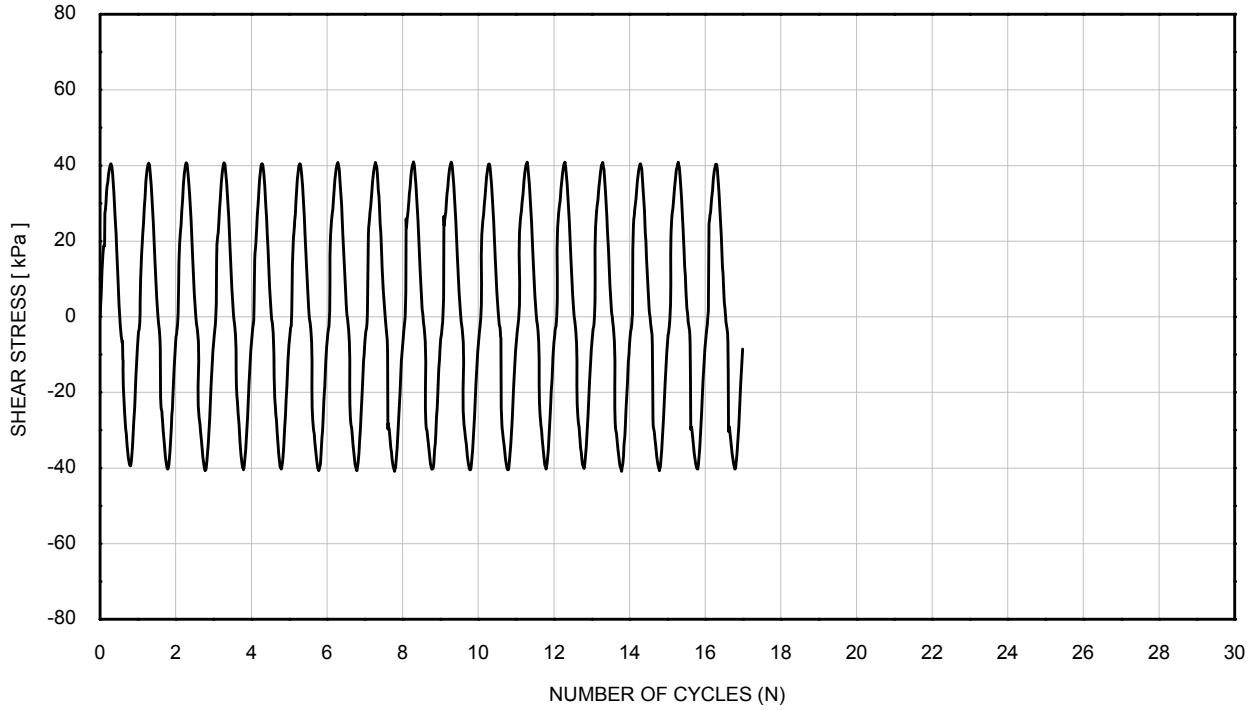
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

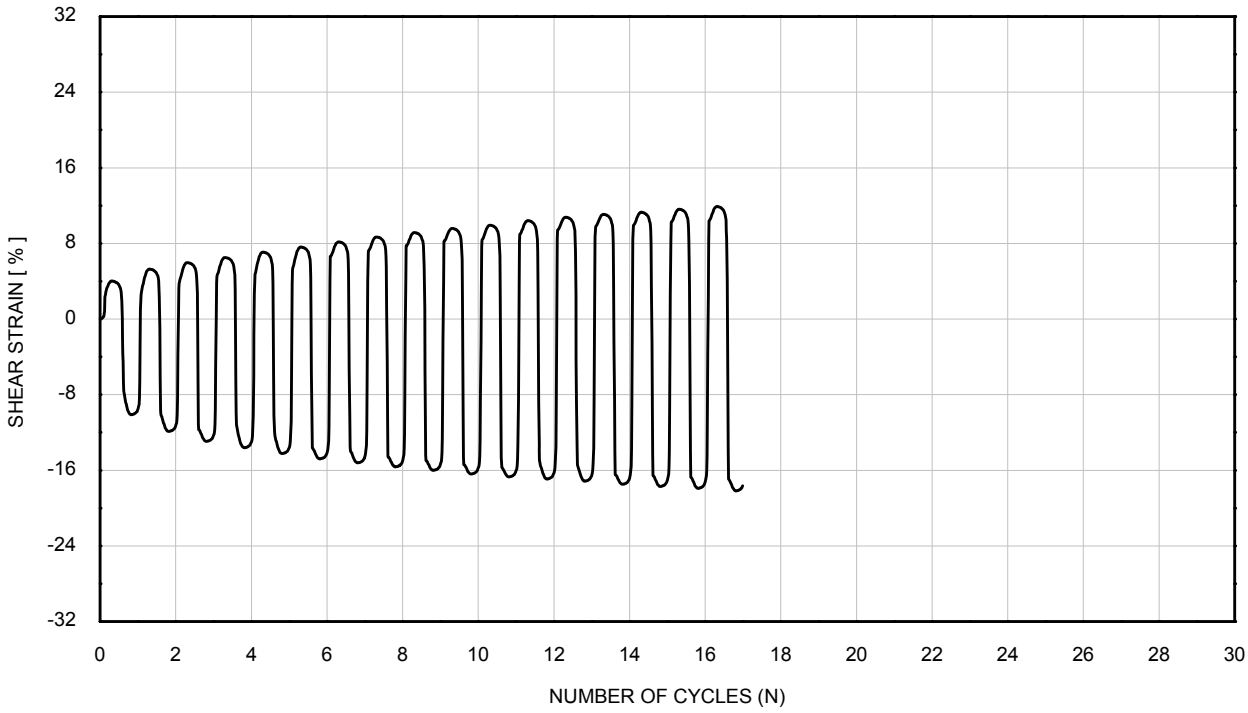




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	4 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

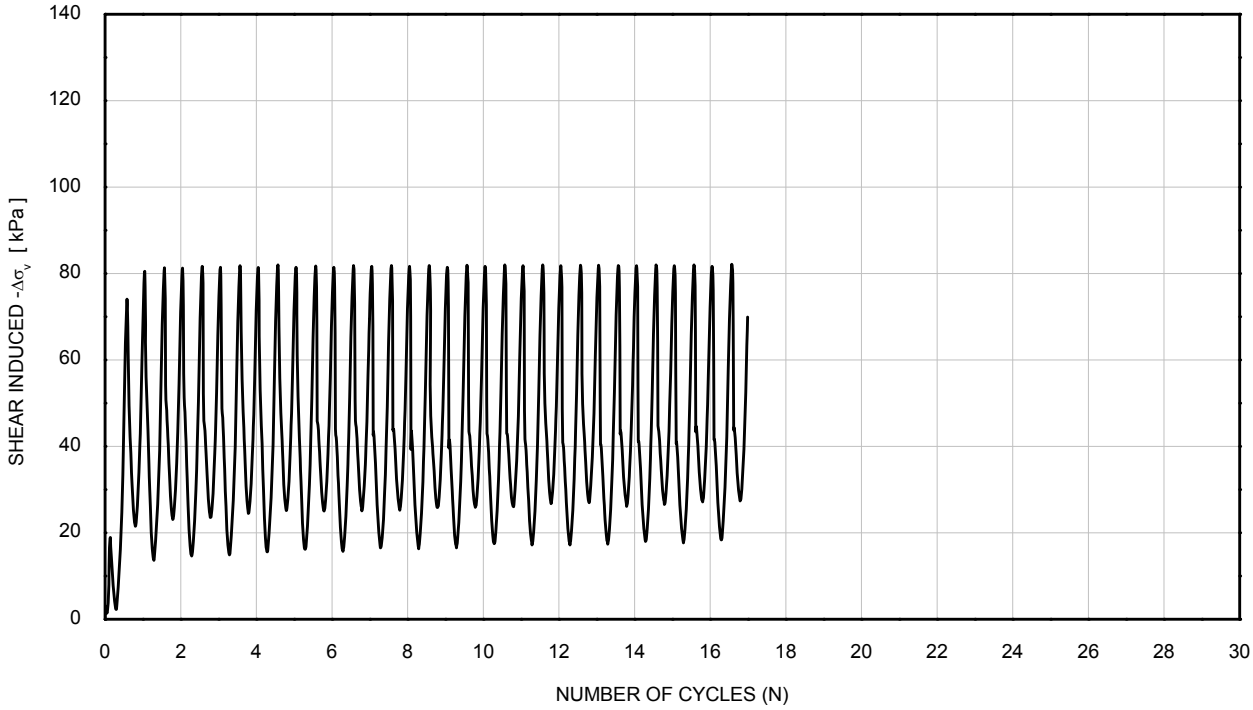
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

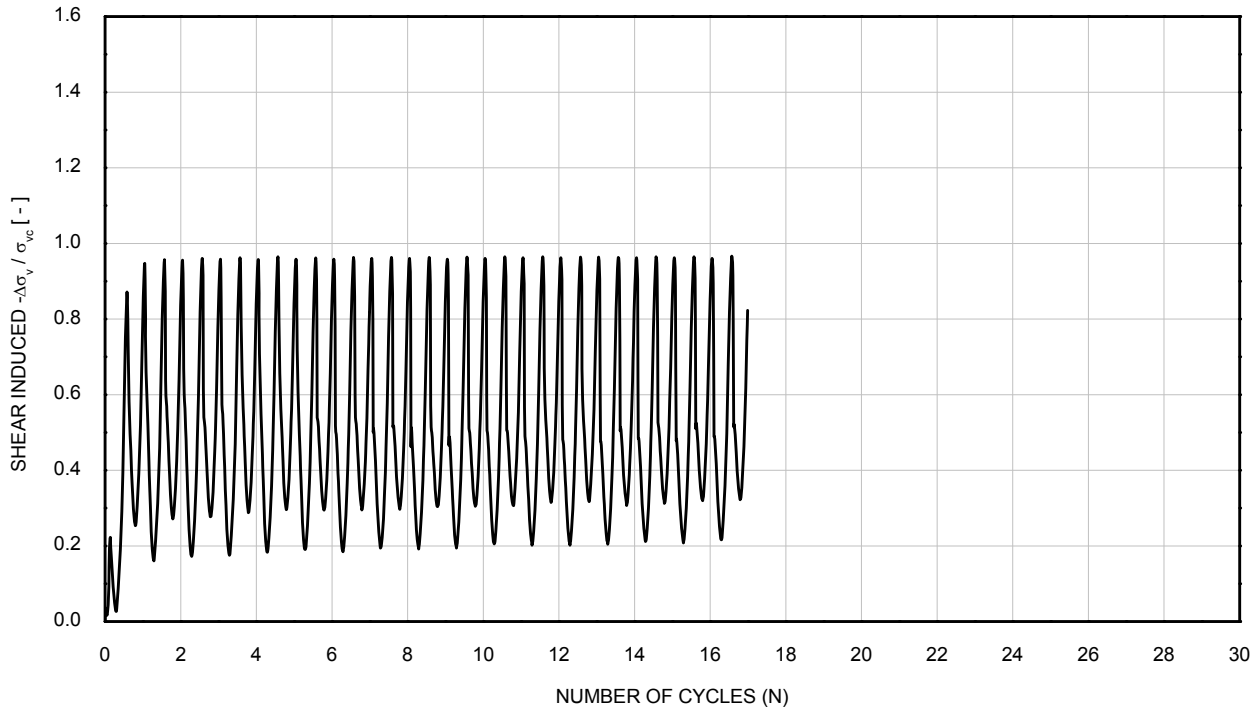




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	41 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

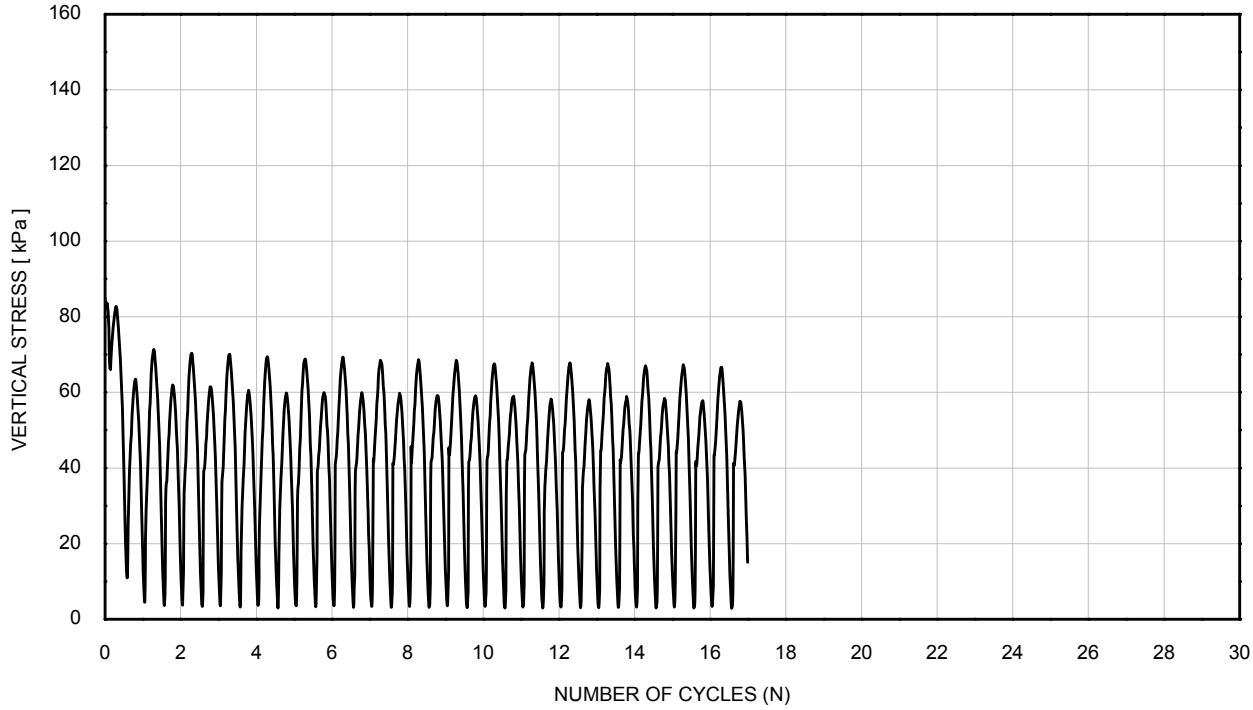
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

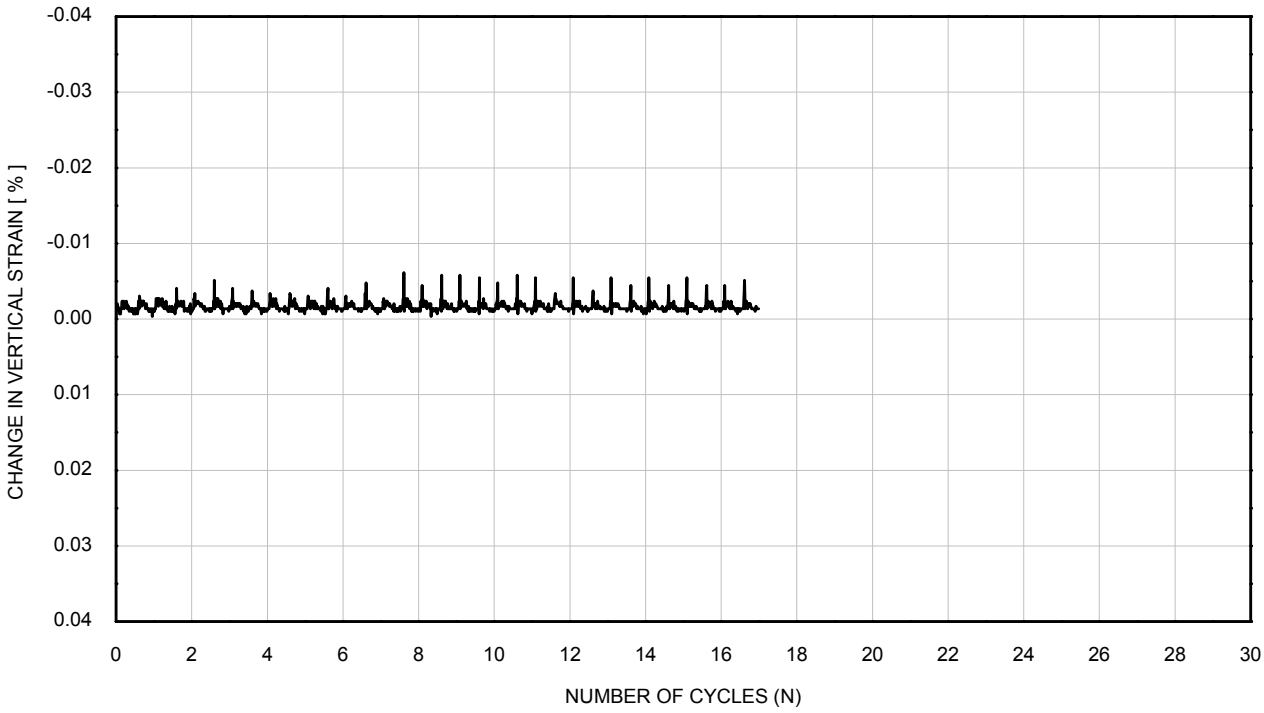




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	41 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

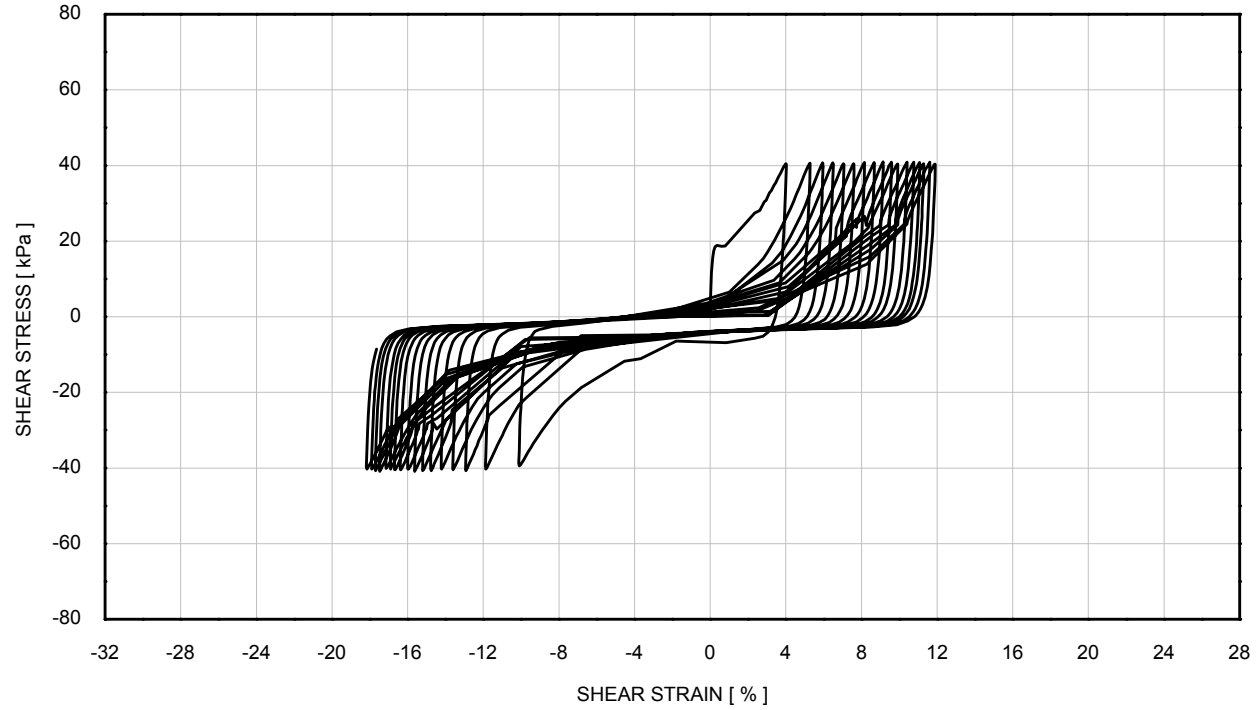
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

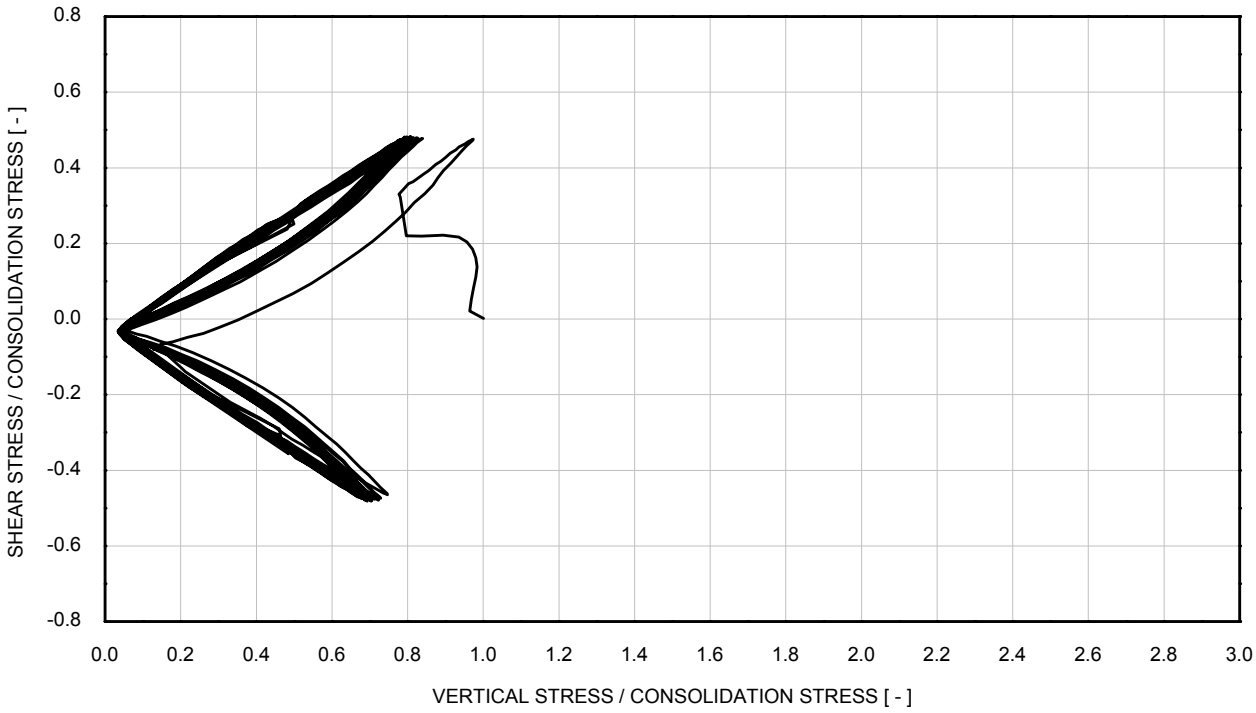




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	41 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

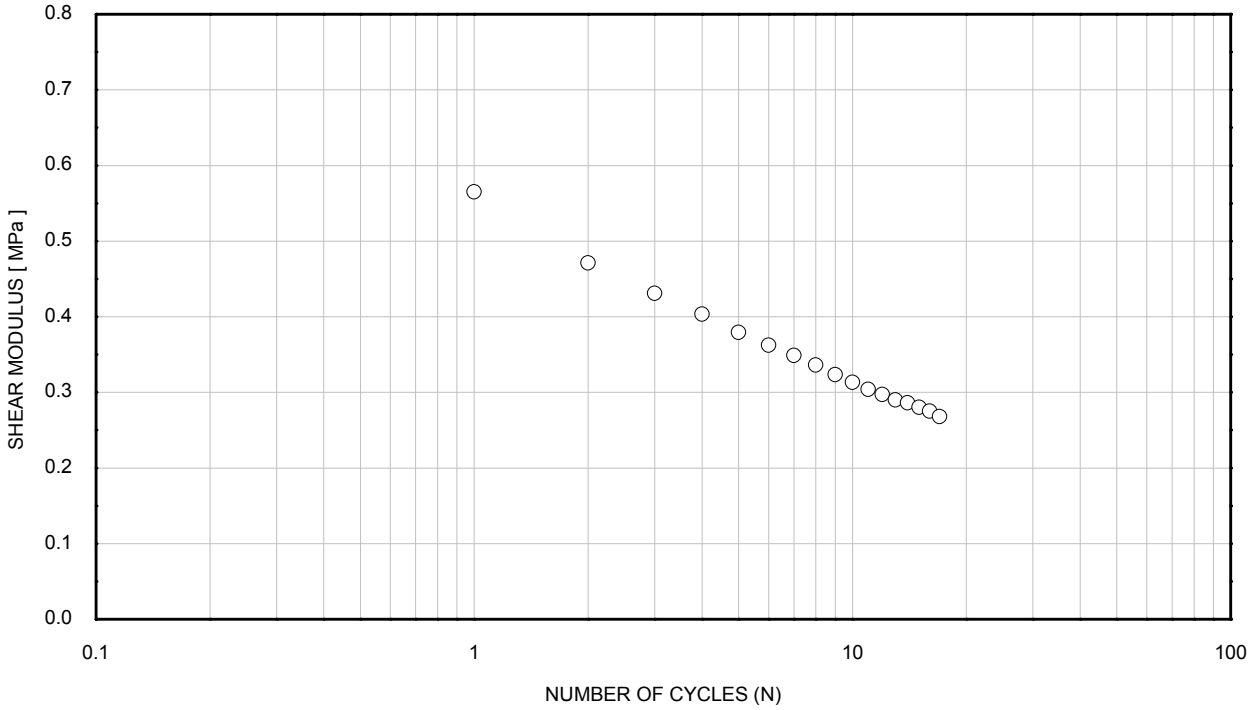
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

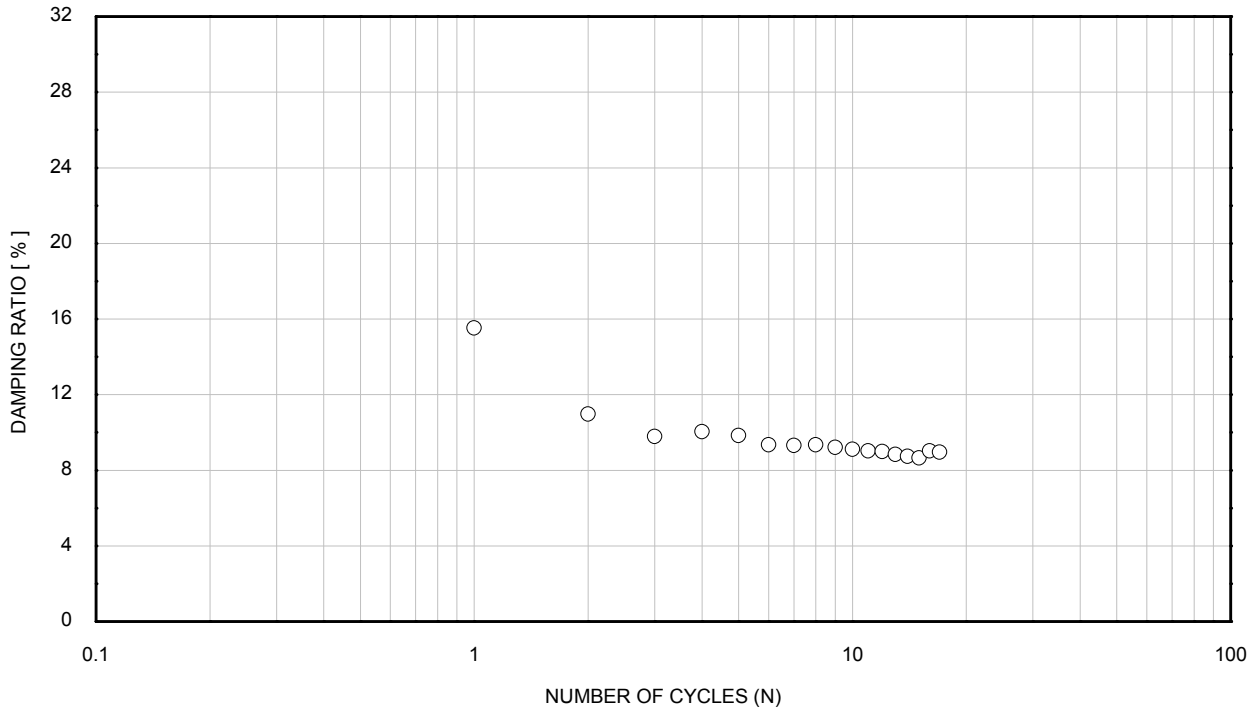




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	41 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

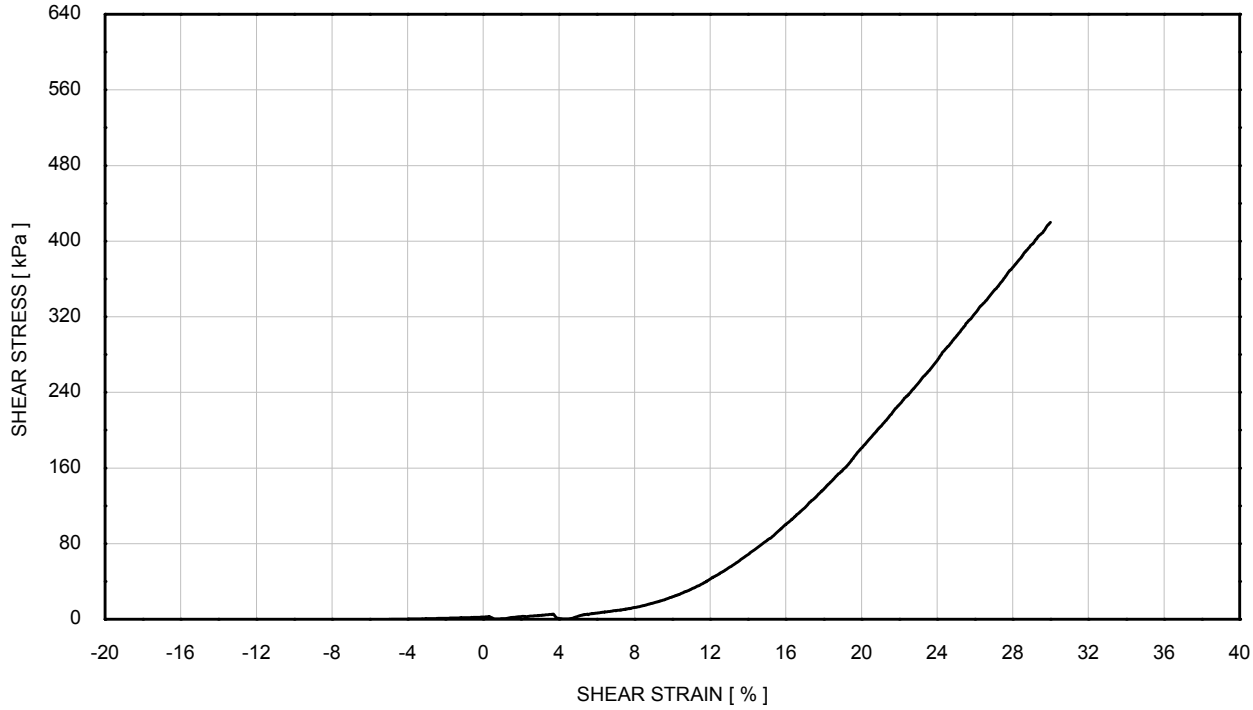
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

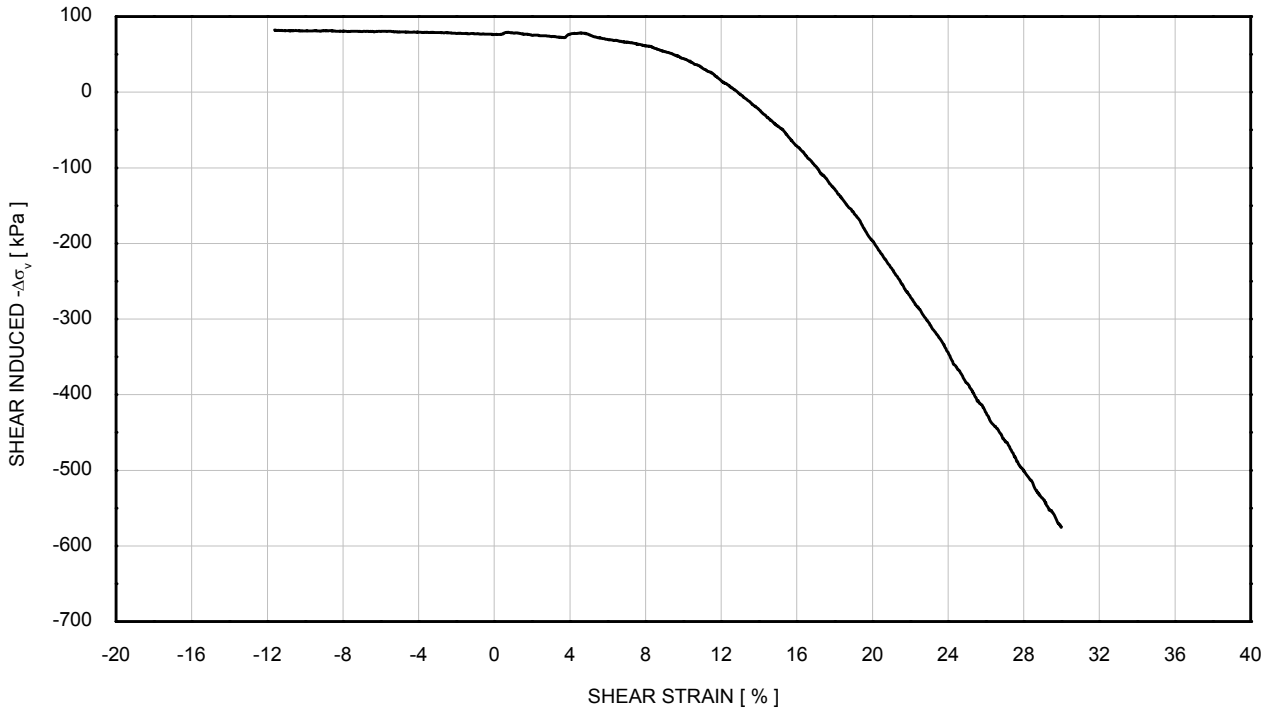




σ_{vc}	:	85 kPa	Batch	:	4
Mean τ_{av}	:	0 kPa	Sample	:	CSS_4-4
Mean τ_{cy}	:	41 kPa	Unit	:	Unit B1 (Kreftenheye)
Frequency	:	0.10 Hz	Test No.	:	CSS08

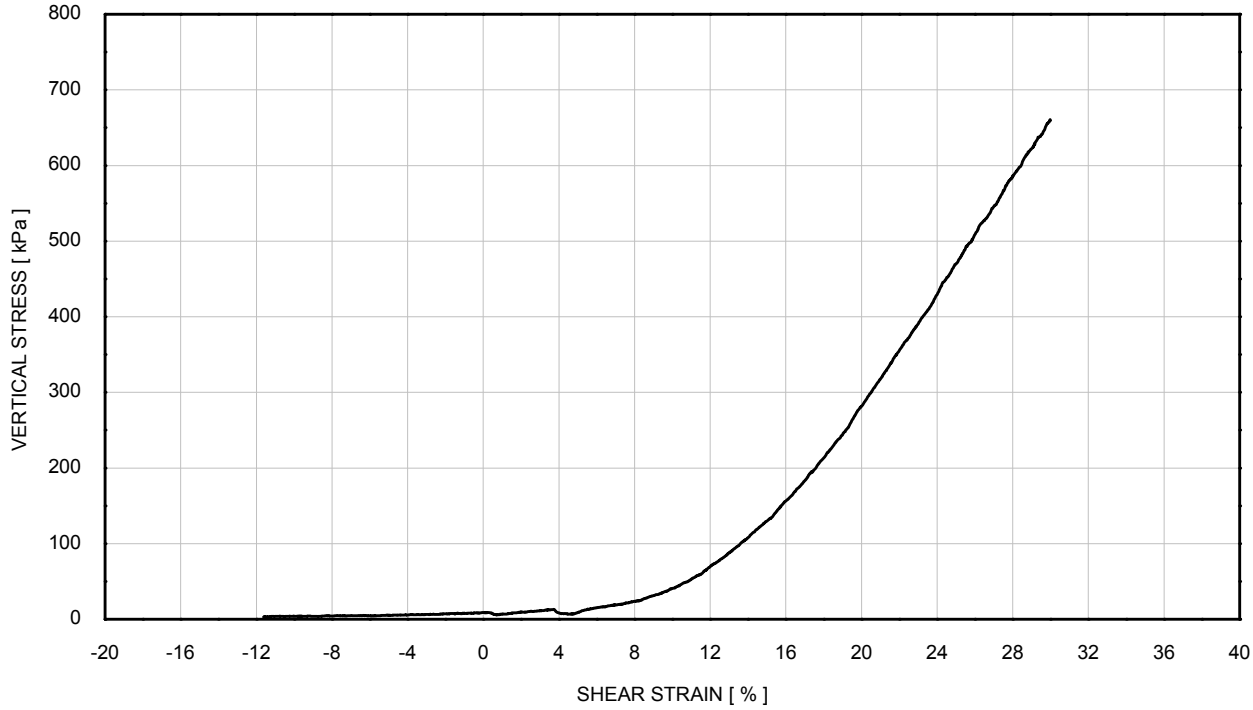
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

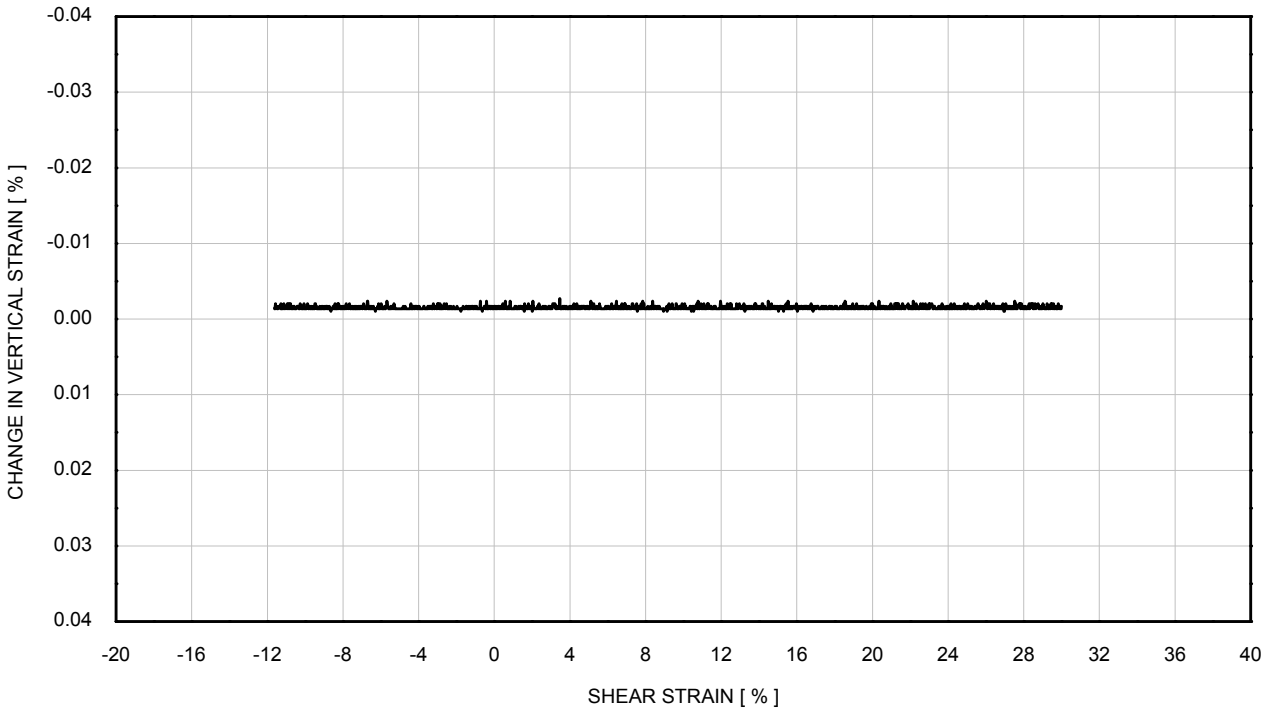




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 420 kPa	Sample	: CSS_4-4
γ at τ_{peak}	: 30.00 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS08

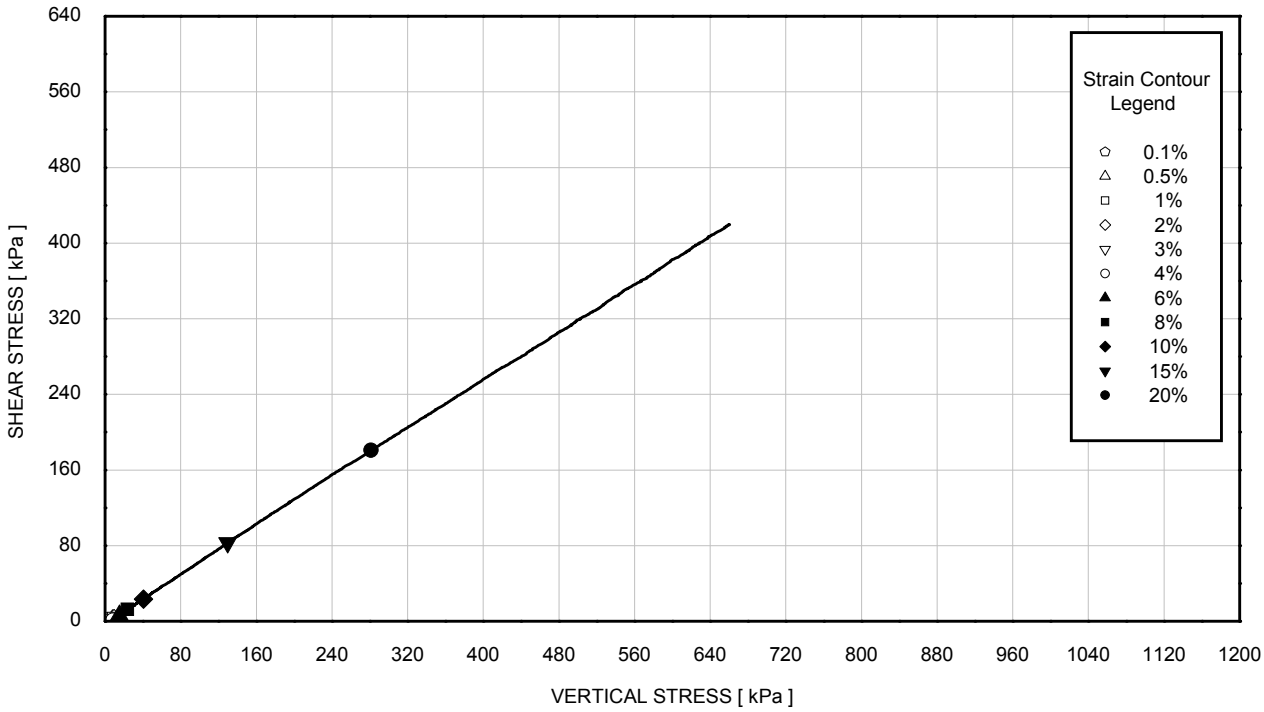
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

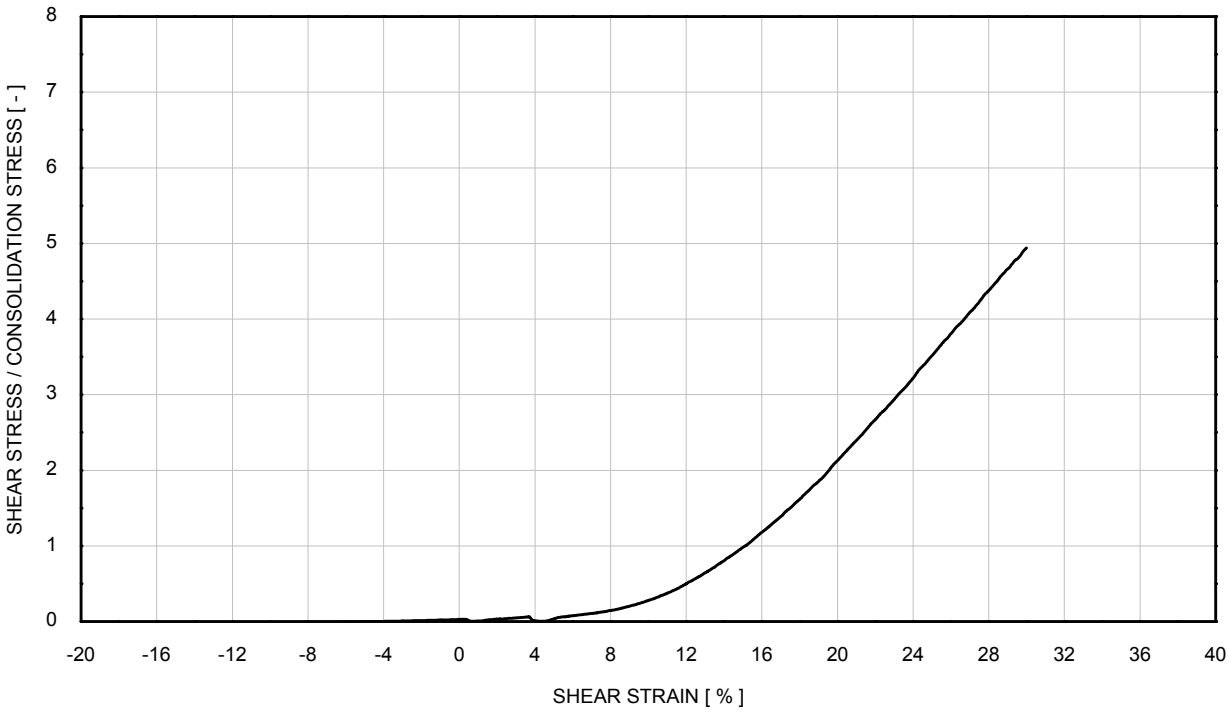




σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 420 kPa	Sample	: CSS_4-4
γ at τ_{peak}	: 30.00 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS08

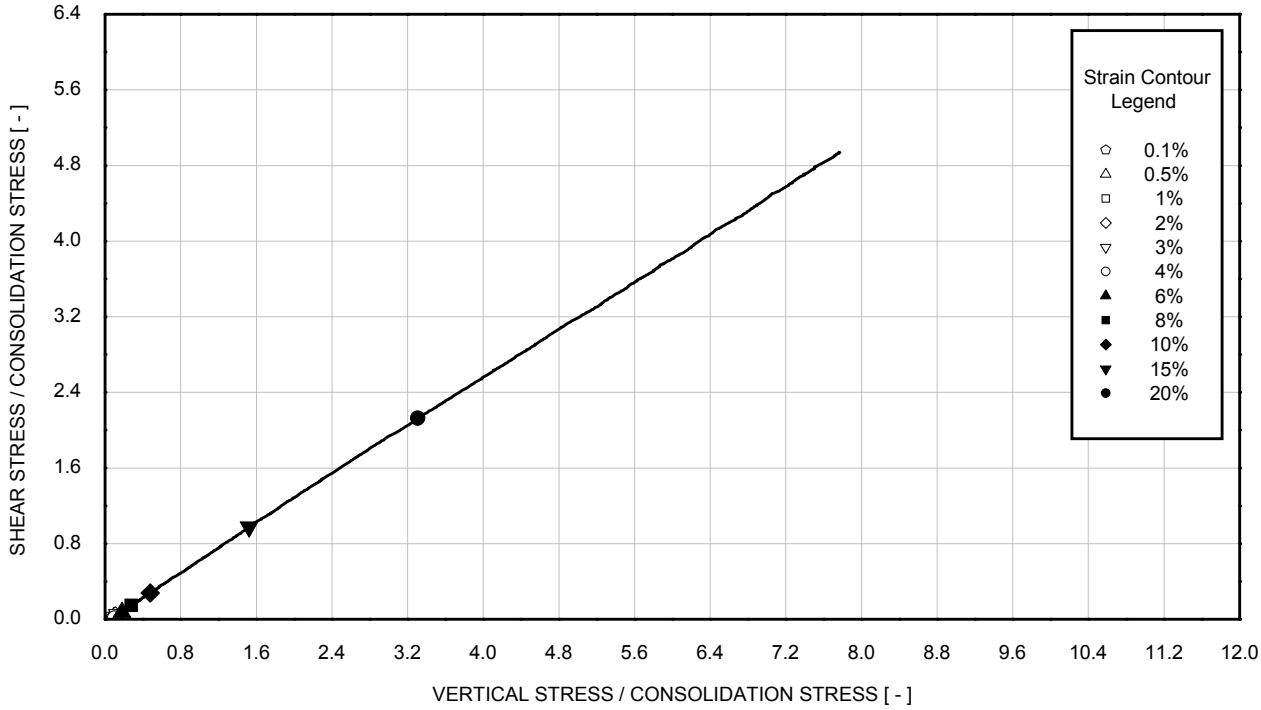
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

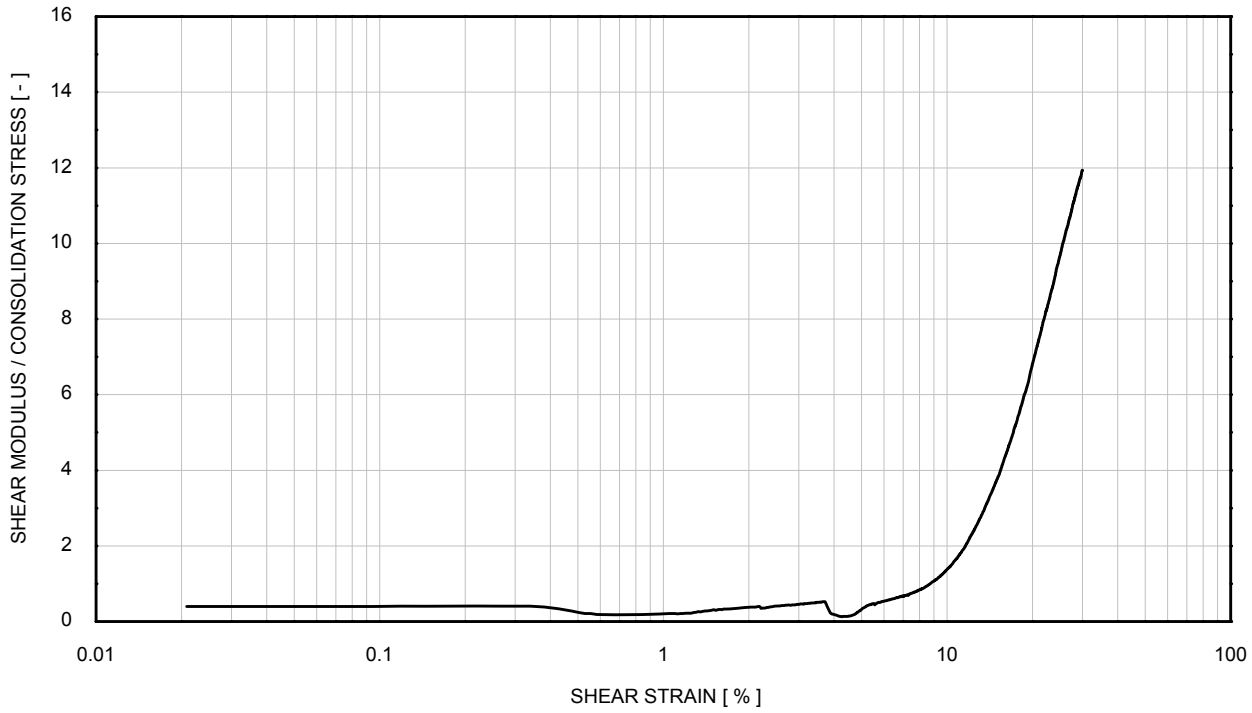




σ_{vc}	: 85	kPa	Batch	: 4
τ_{peak}	: 420	kPa	Sample	: CSS_4-4
γ at τ_{peak}	: 30.00	%	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99	%/hour	Test No.	: CSS08

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 85 kPa	Batch	: 4
τ_{peak}	: 420 kPa	Sample	: CSS_4-4
γ at τ_{peak}	: 30.00 %	Unit	: Unit B1 (Kreftenheye)
Rate of strain	: 2.99 %/hour	Test No.	: CSS08

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown silty fine SAND

GENERAL	
Date test started	05/12/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	10.5
Bulk density after compaction	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.685
Degree of saturation after compaction	[%]	41
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	25.8
Bulk density at start of test	[Mg/m³]	1.98
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07
Note: Vertical stress / vertical strain refers to the directionality of load application within the equipment	

QUALITY ASSURANCE	
Filename	J11335 \ Batch 7_CSS20
Template issue	1.4
Processed by Date	MG 07/12/2016
Checked by Date	PH 13/12/2016
Approved by Date	PH 13/12/2016

TEST IDENTIFICATION	
Borehole	7
Sample	CSS_7-1
Depth [m]	Unit D (Yarmouth Roads)
Test number	CSS20

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	420
Vertical strain	[%]	1.61
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.60
Void ratio	[-]	0.658
Water content	[%]	24.8

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	420
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	21
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
Vertical strain	[%]	1.67
Bulk density	[Mg/m^3]	2.00
Dry density	[Mg/m^3]	1.60
Void ratio	[-]	0.657

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.23	0.07	28.82	5.67
2	0.23	0.07	29.88	3.93
5	0.23	0.07	29.92	2.98
10	0.23	0.07	29.92	2.62
20	0.23	0.07	29.92	2.49
50	0.24	0.07	29.27	2.19
100	0.24	0.07	29.58	1.87
200	0.24	0.07	29.62	1.96
300	0.24	0.07	29.36	1.75
400	0.25	0.07	29.36	1.80

TEST IDENTIFICATION	
Borehole	7
Sample	CSS_7-1
Depth [m]	Unit D (Yarmouth Roads)
Test number	CSS20

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	62
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	53
γ_{av} at N_f	[%]	-0.40
γ_{cy} at N_f	[%]	15.05
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	370
Vertical strain	[%]	0.00

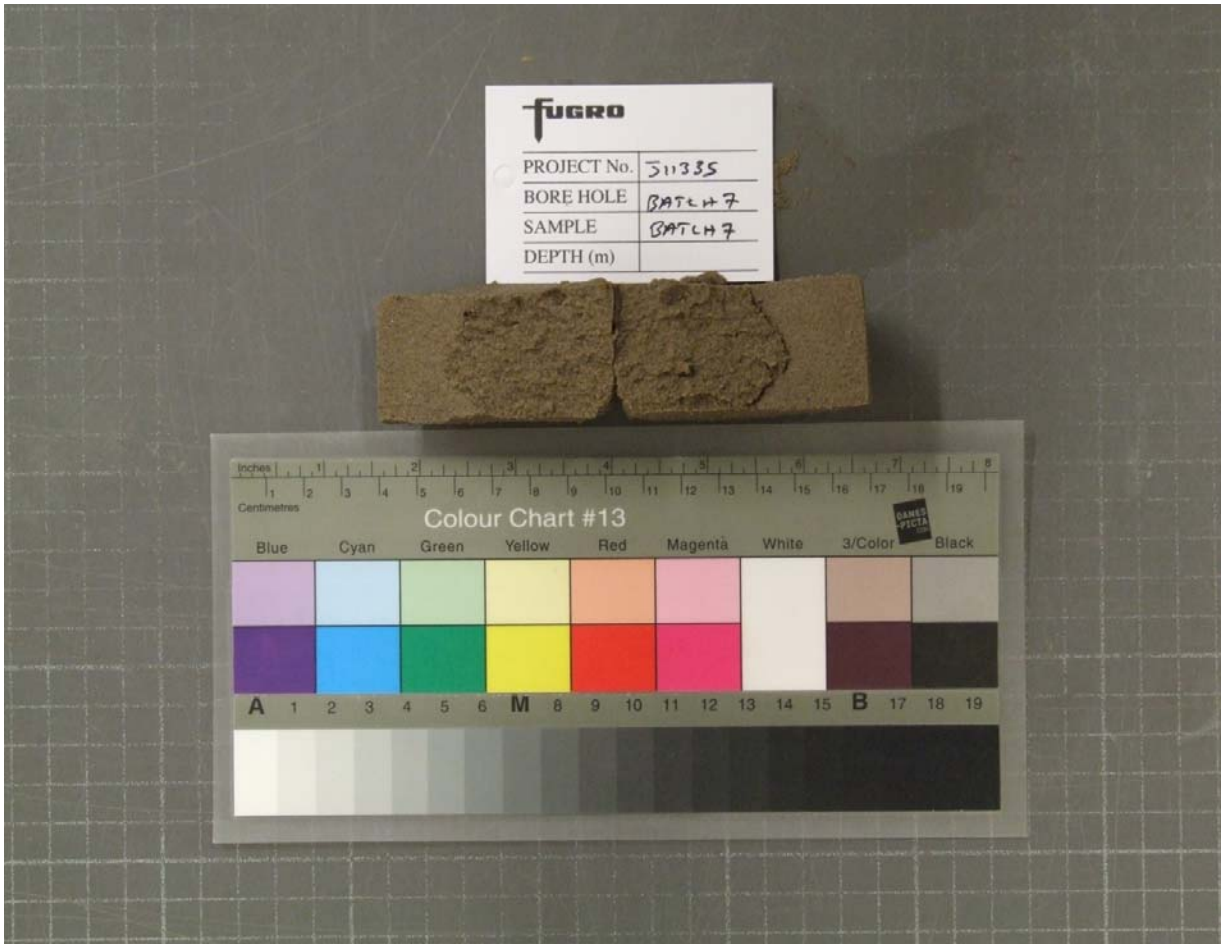
Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.03	0.30	20.86	11.26
2	0.02	0.29	21.31	9.41
5	0.01	0.31	19.91	8.84
10	0.01	0.36	17.49	9.84
20	0.01	0.55	11.44	14.38
30	-0.52	2.89	2.12	18.82
40	-0.59	9.65	0.63	8.81
50	-0.37	14.21	0.43	8.66
53	-0.40	15.05	0.40	7.81

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	161
Shear strain	[%]	18.88
Shear induced $-\Delta\sigma_v$	[kPa]	187
Vertical stress	[kPa]	233
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	3.00
At 15 % shear strain		
Shear stress	[kPa]	81
Shear induced $-\Delta\sigma_v$	[kPa]	301
Vertical stress	[kPa]	119
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Borehole	7
Sample	CSS_7-1
Depth [m]	Unit D (Yarmouth Roads)
Test number	CSS20

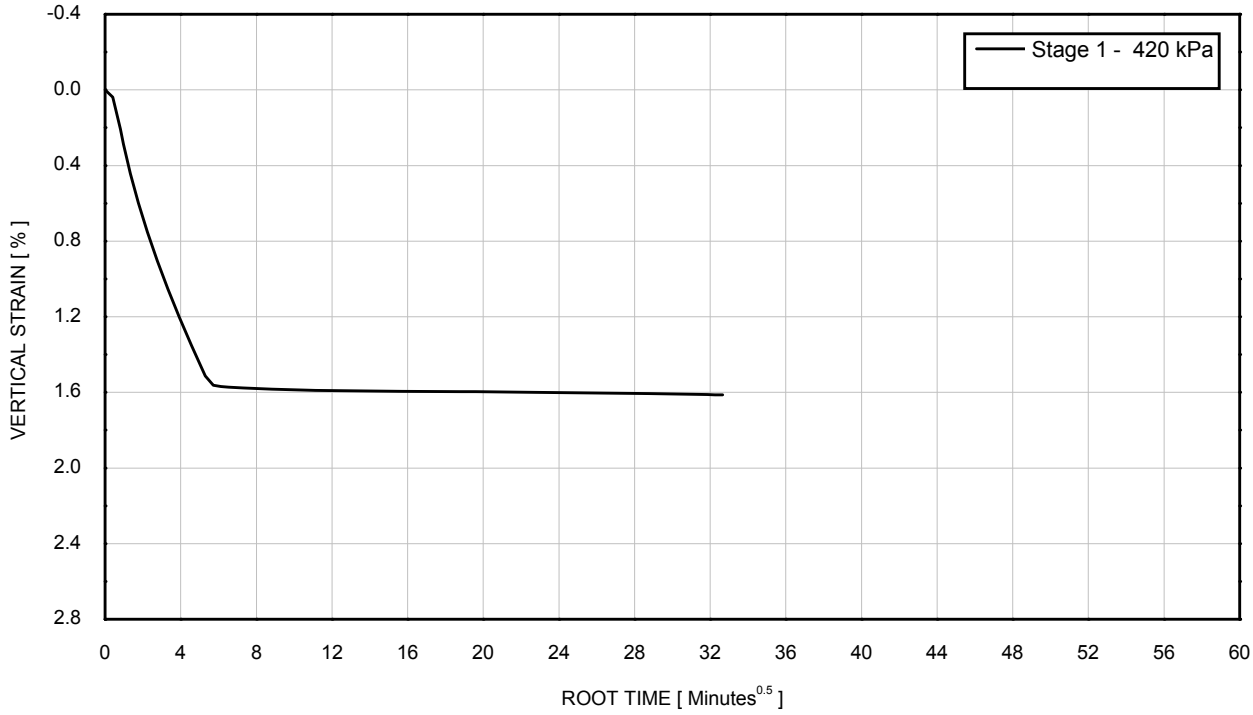
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

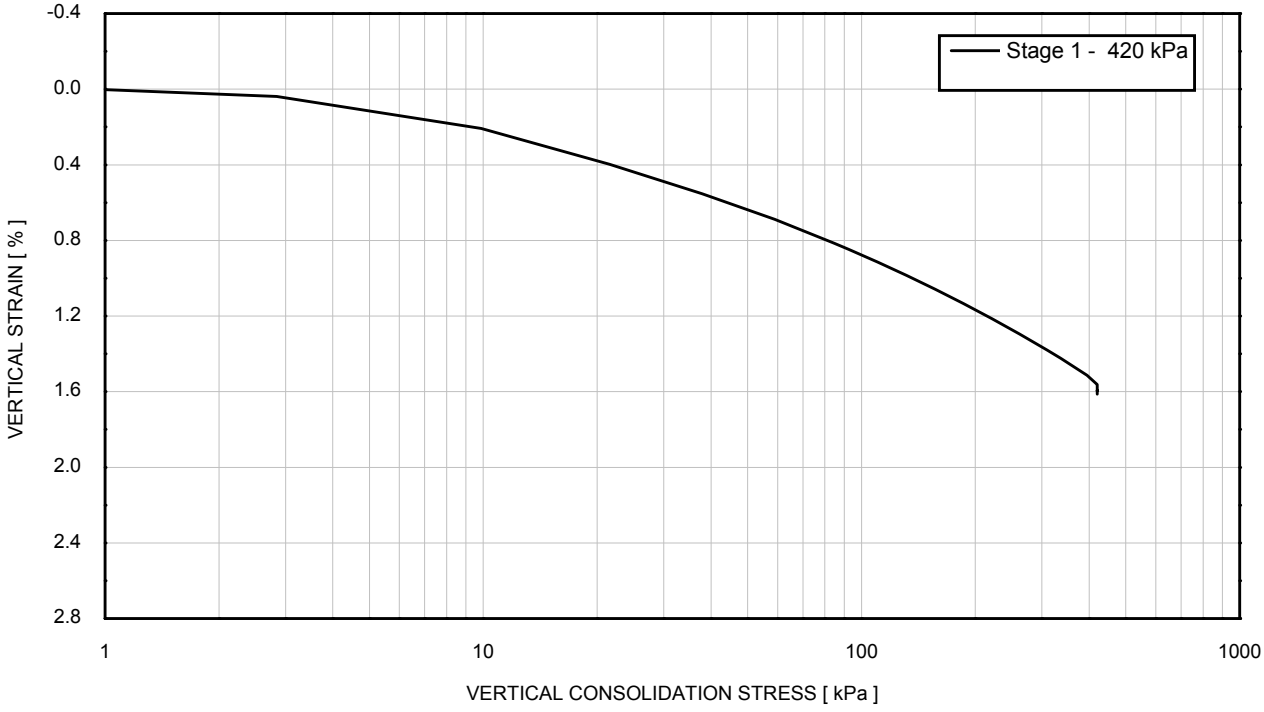
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Borehole	7
Sample	CSS_7-1
Depth [m]	Unit D (Yarmouth Roads)
Test number	CSS20

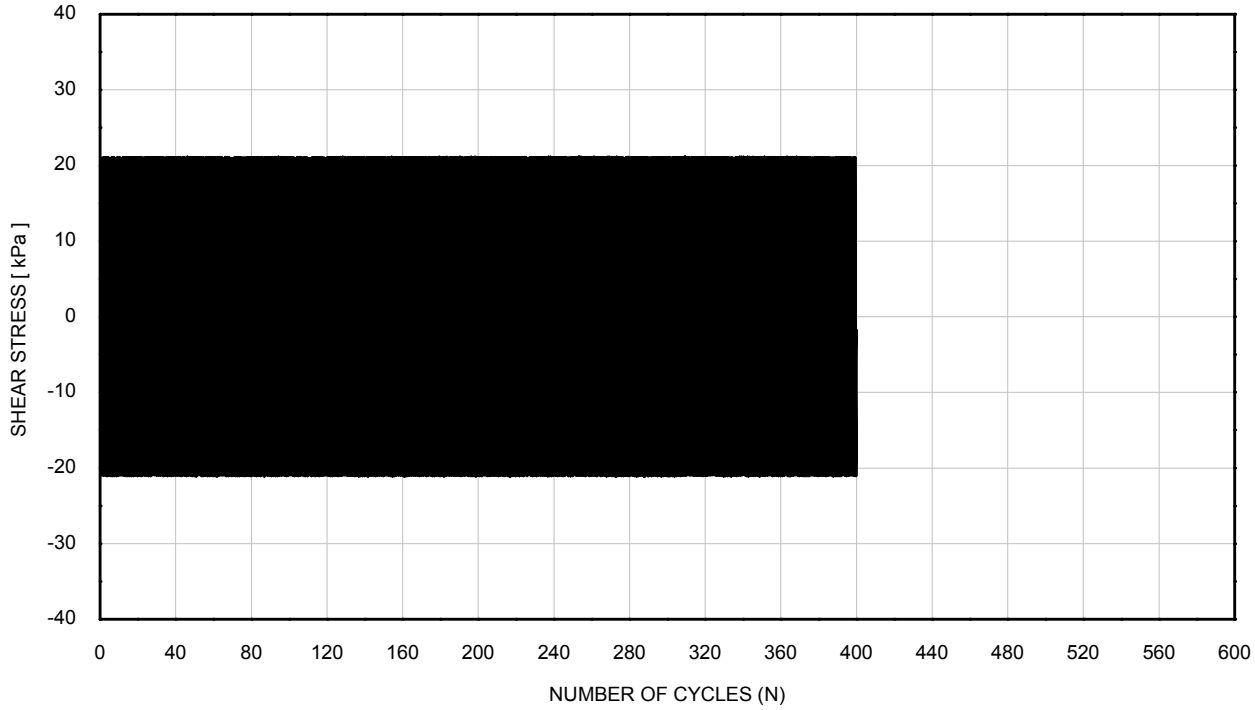
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

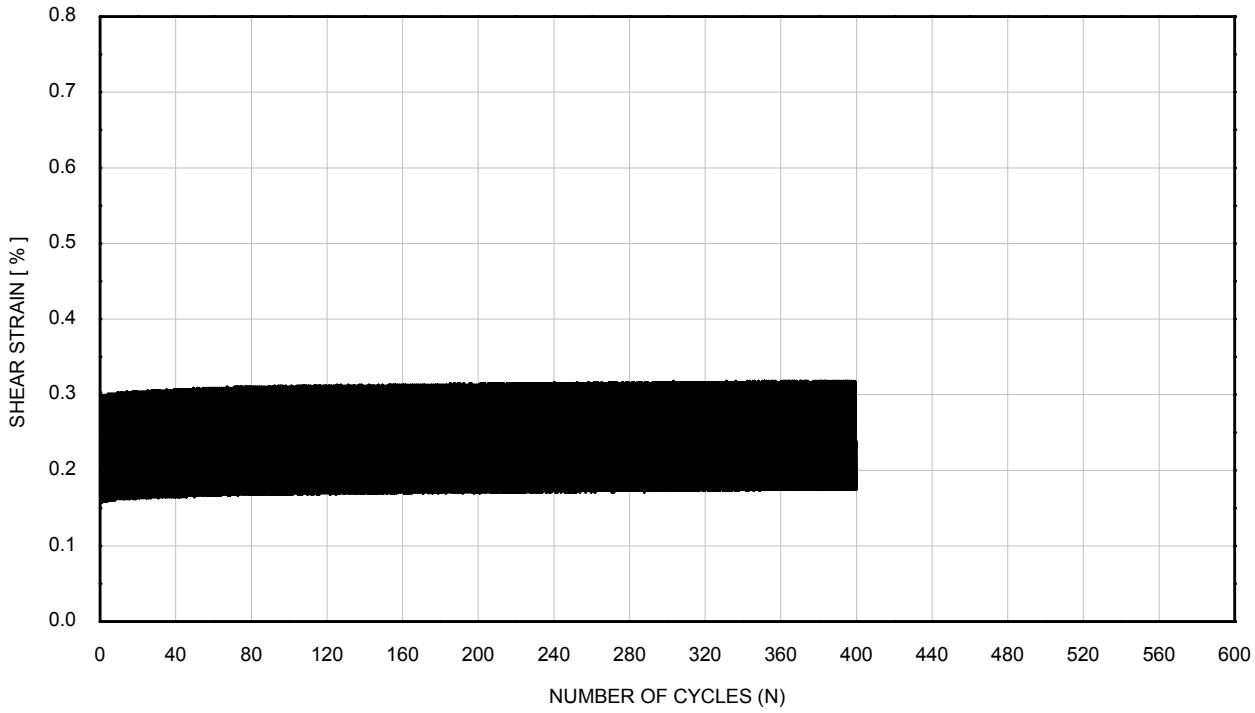




σ_{vc}	: 420 kPa	Batch	: 7
		Sample	: CSS_7-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CSS20

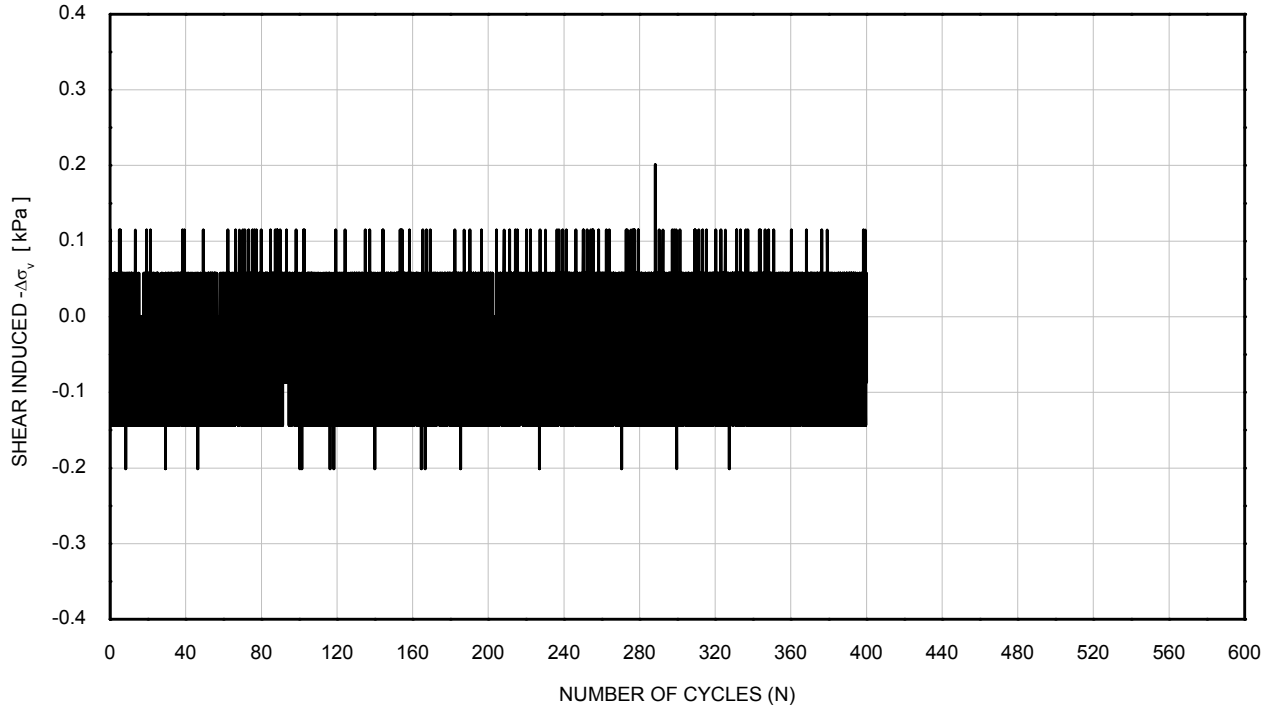
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

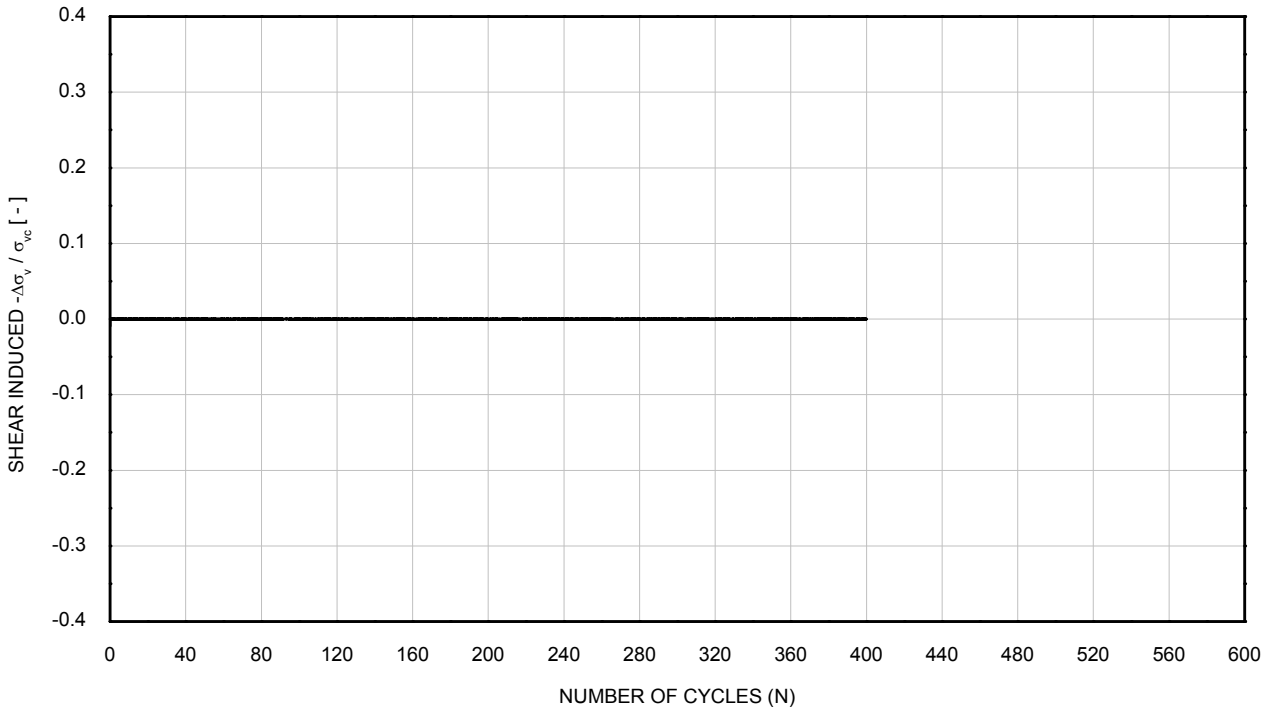




σ_{vc}	: 420	kPa	Batch	: 7	
Mean τ_{av}	: 0	kPa	Sample	: CSS_7-1	
Mean τ_{cy}	: 21	kPa	Unit	: Unit D (Yarmouth Roads)	
Frequency	: 0.10	Hz	Test No.	: CSS20	

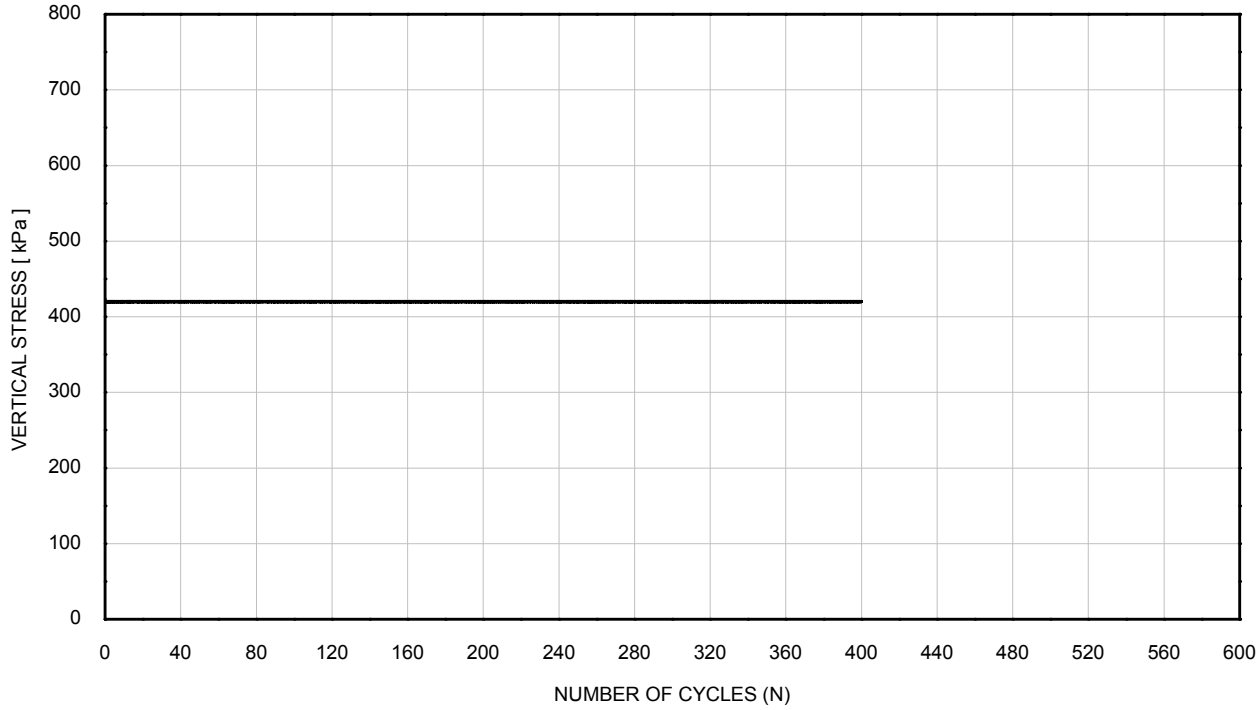
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

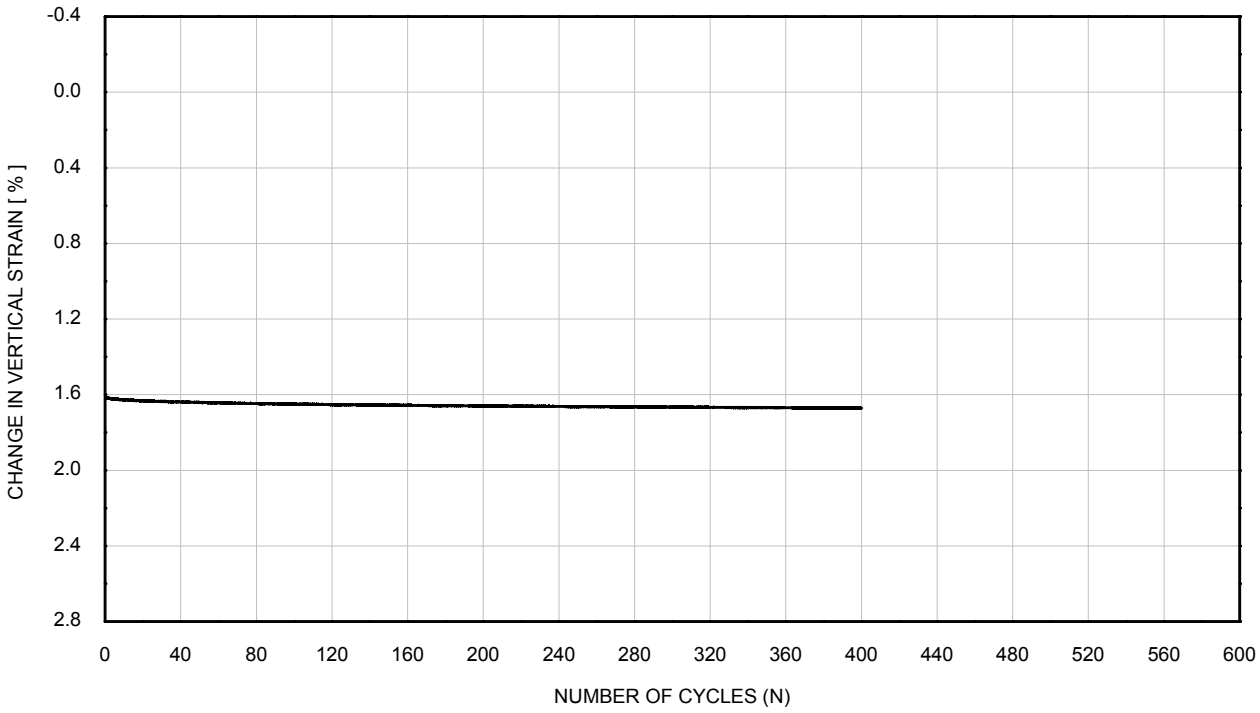




σ_{vc}	: 420	kPa	Batch	: 7
Mean τ_{av}	: 0	kPa	Sample	: CSS_7-1
Mean τ_{cy}	: 21	kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	: 0.10	Hz	Test No.	: CSS20

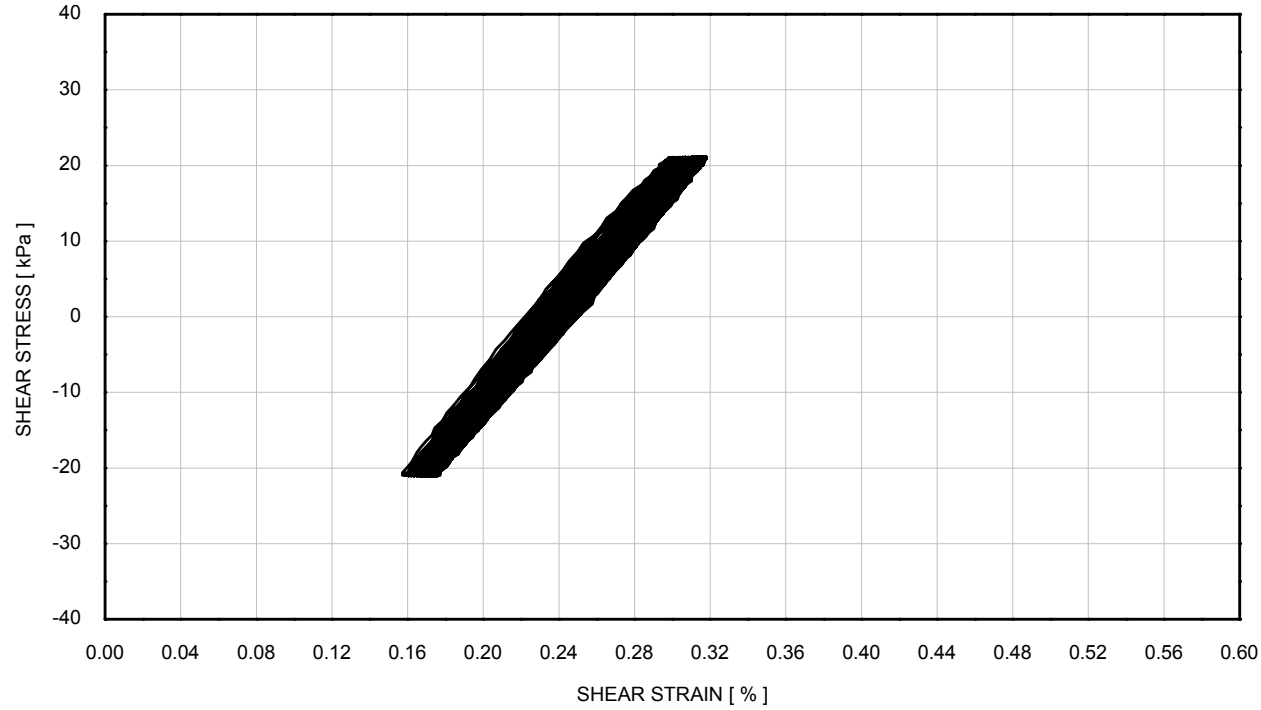
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

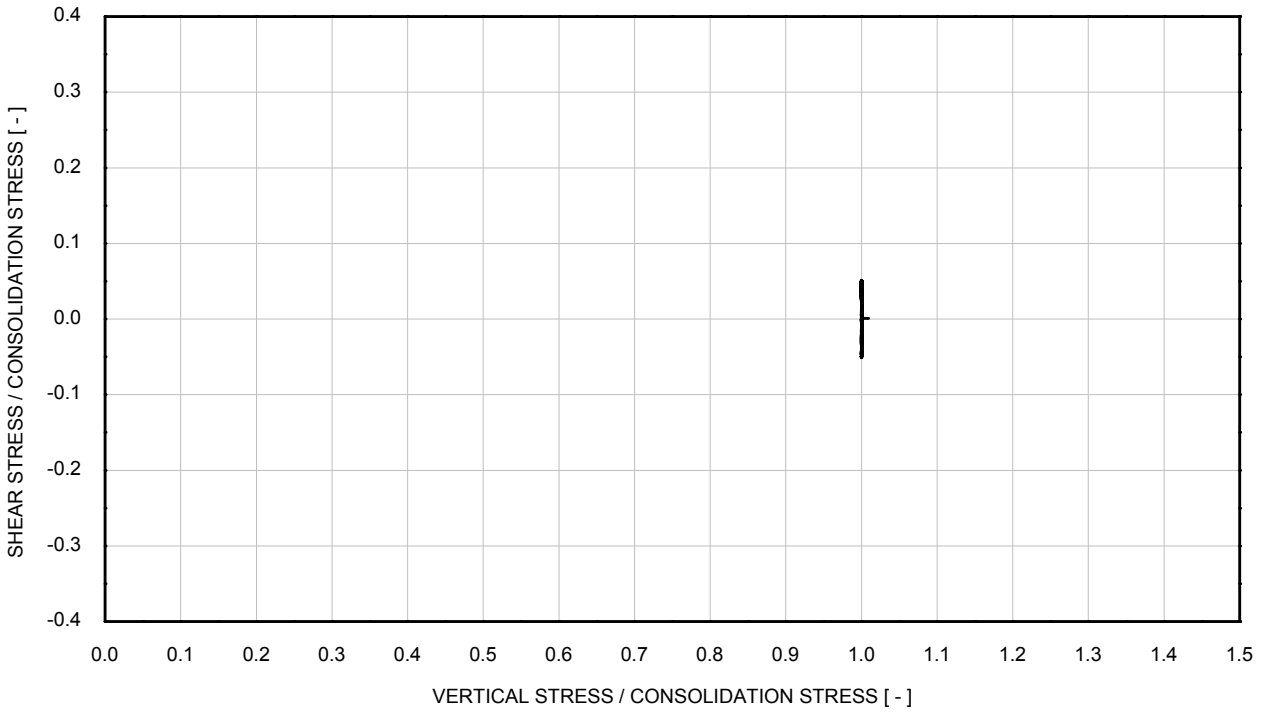




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-1
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS20

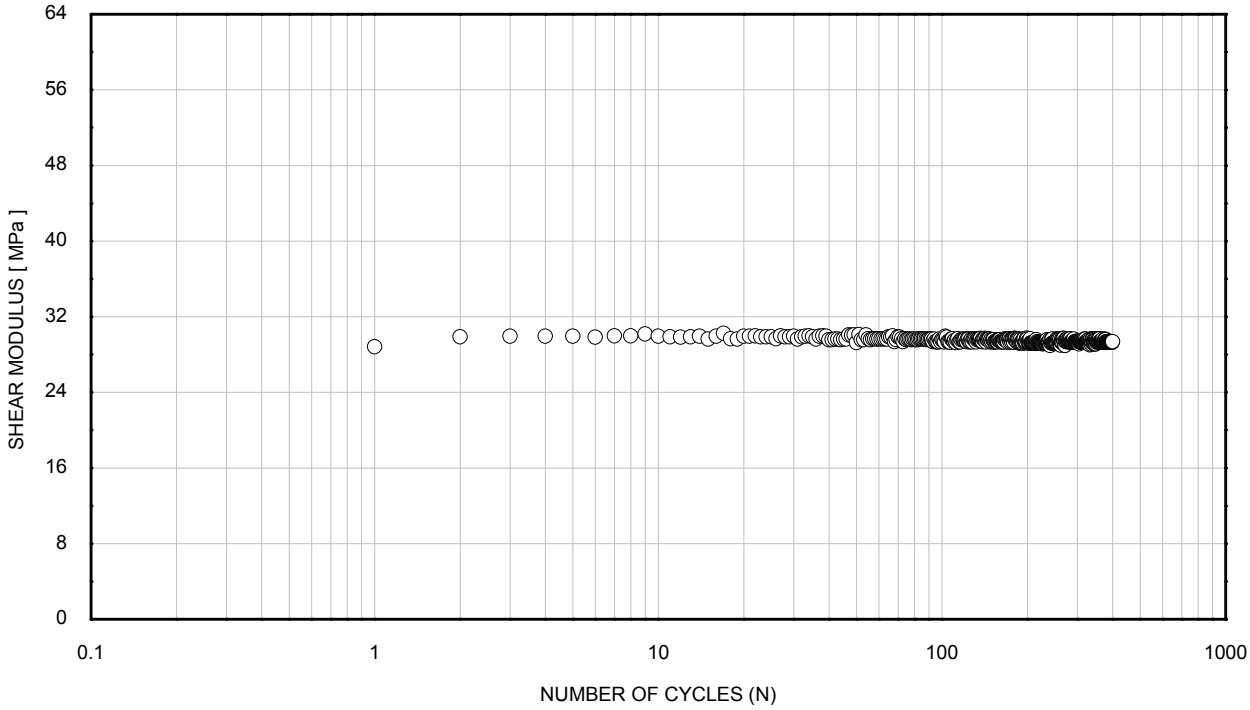
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

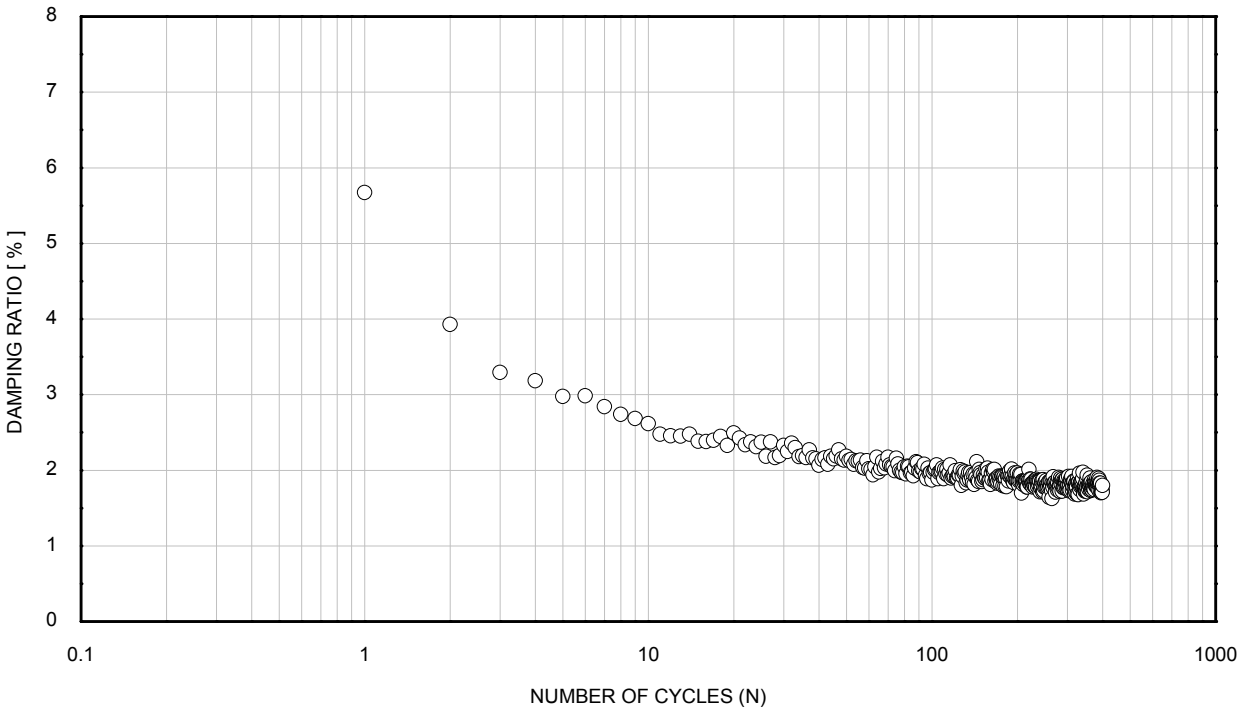




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-1
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS20

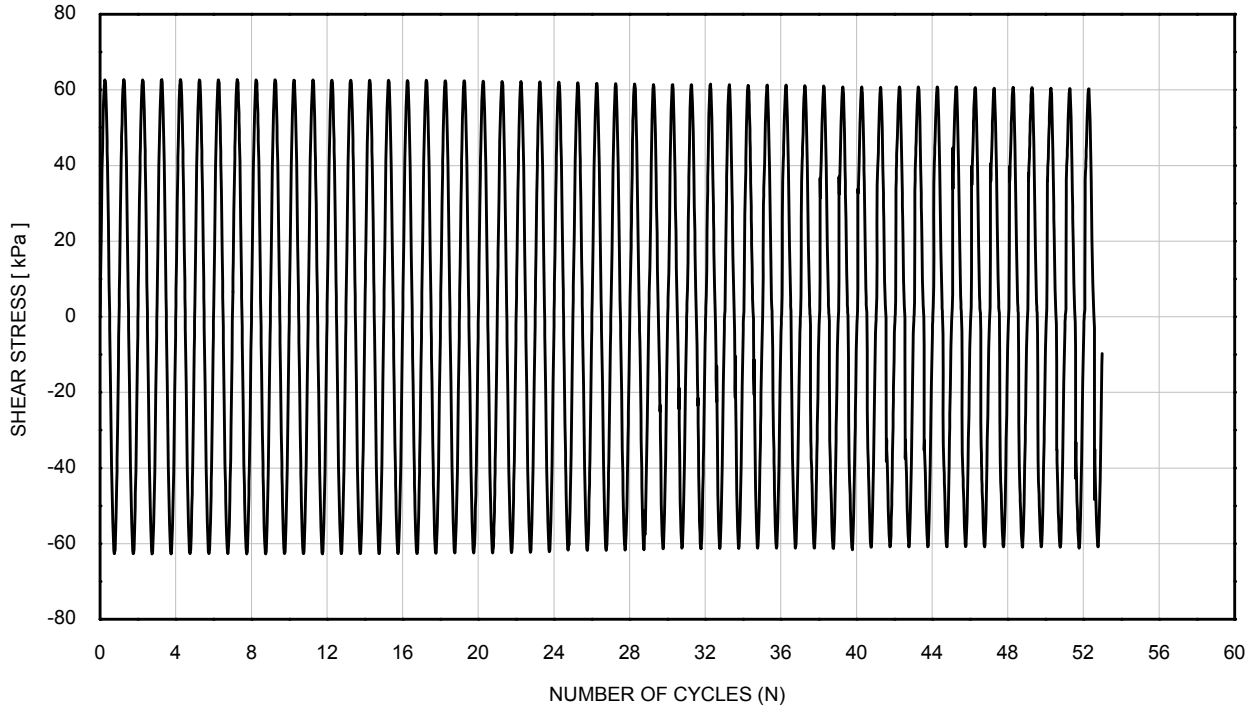
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

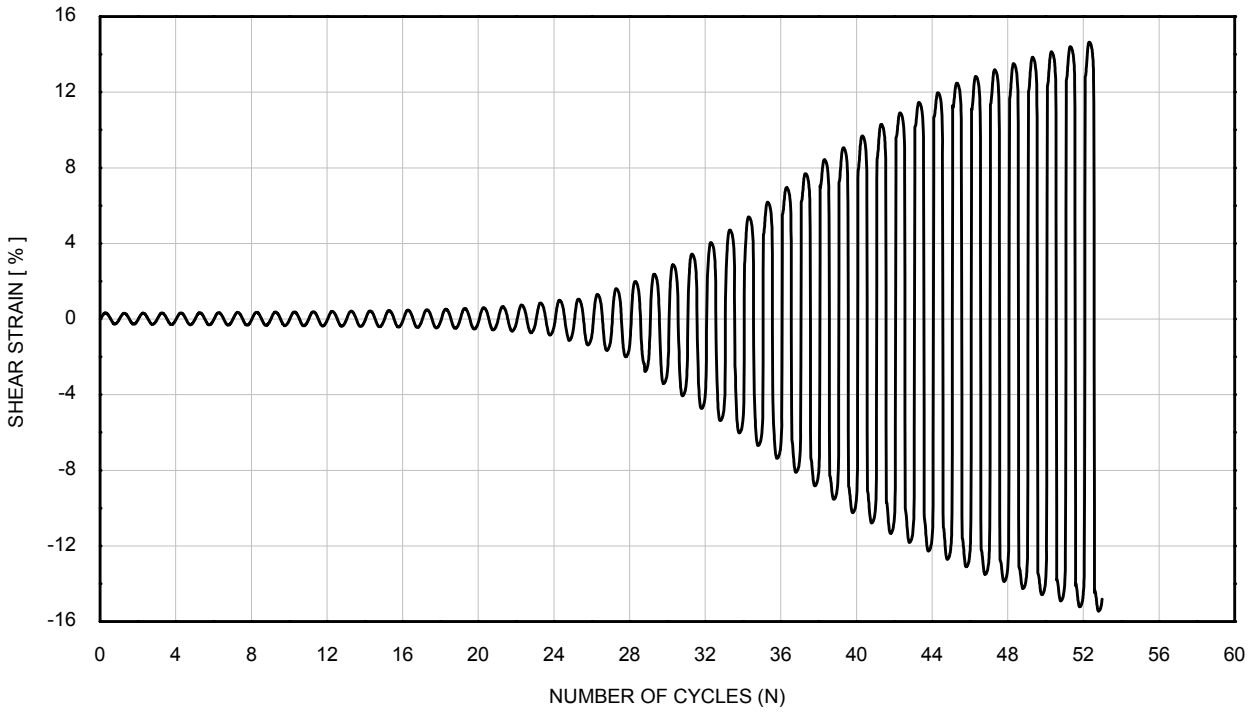




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-1
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS20

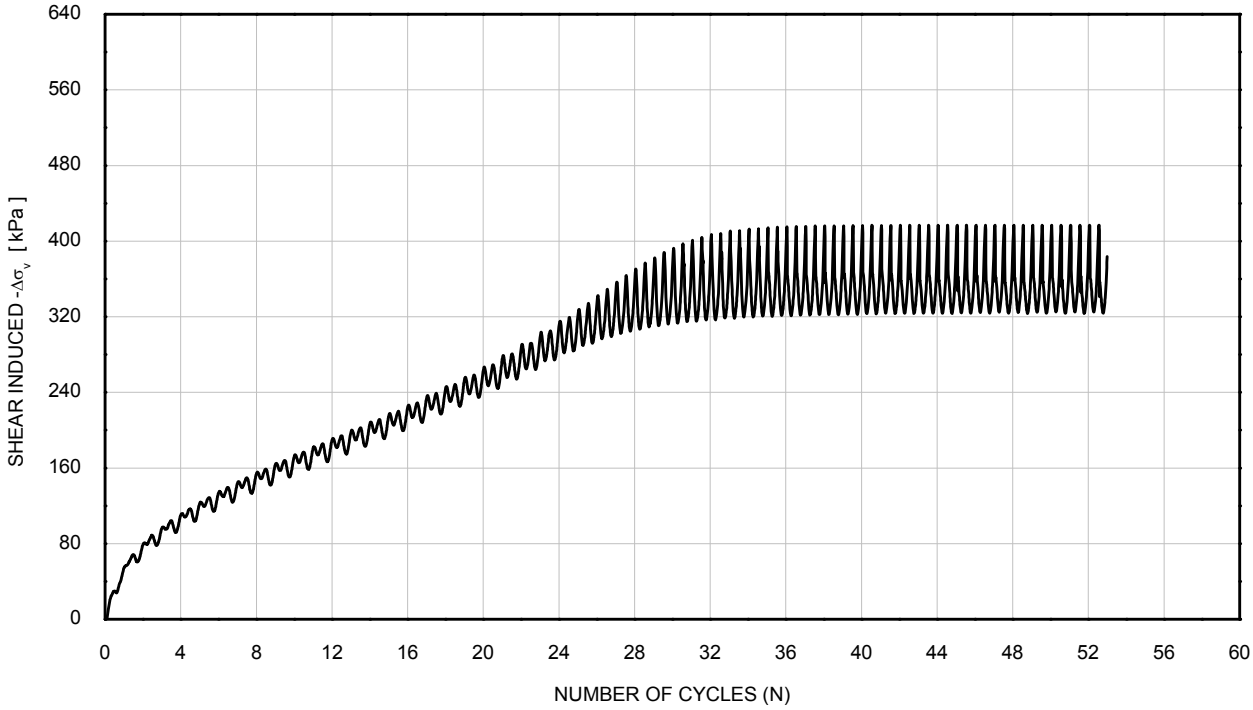
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

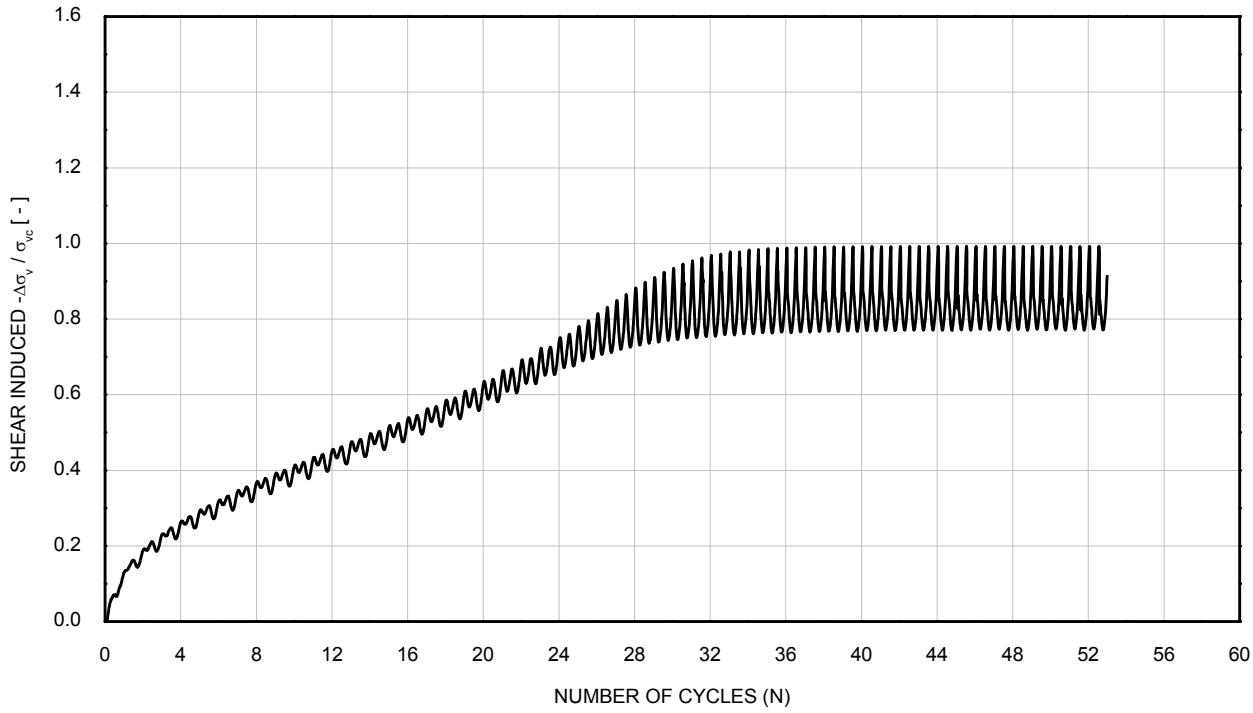




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-1
Mean τ_{cy}	:	62 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS20

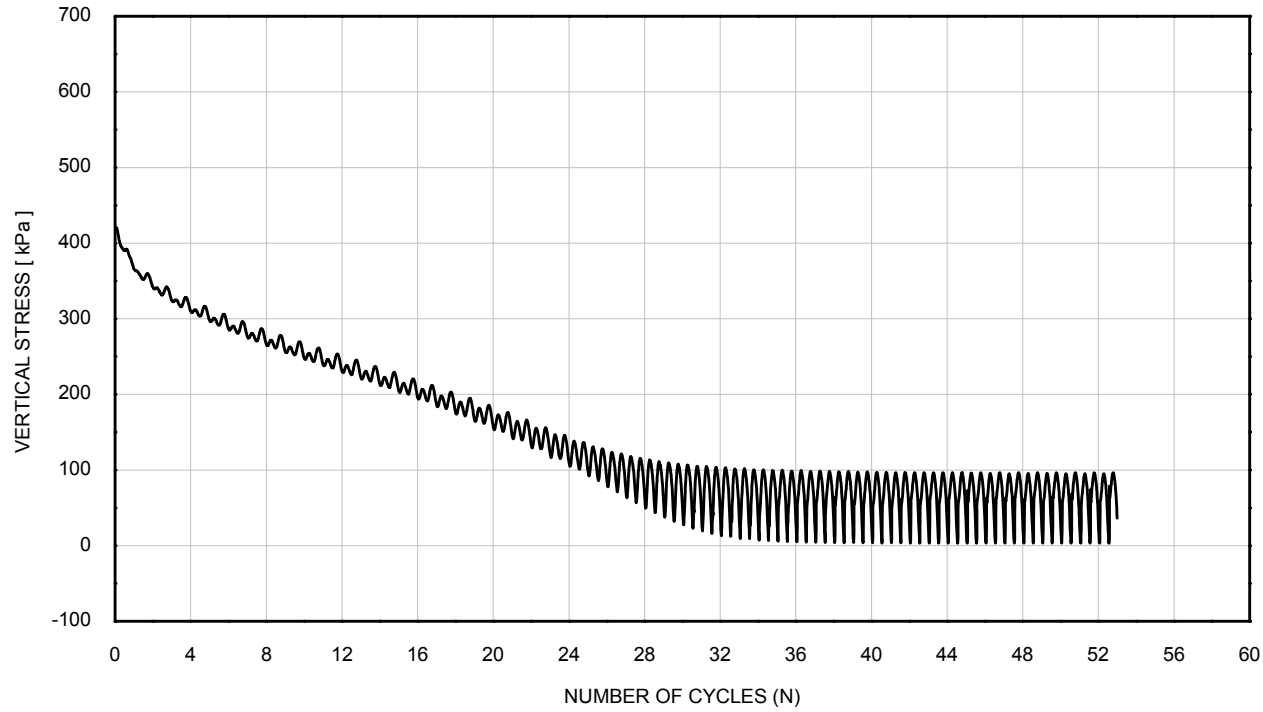
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

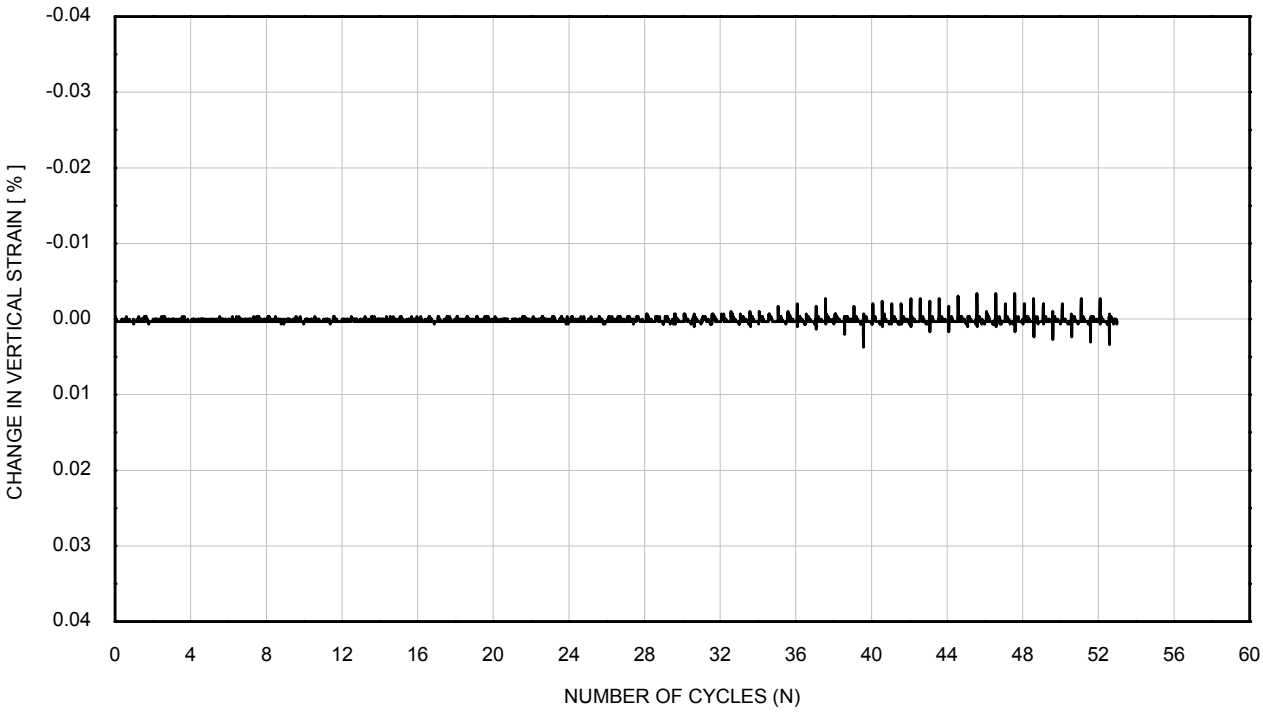




σ_{vc}	:	420 kPa	Batch	: 7
Mean τ_{av}	:	0 kPa	Sample	: CSS_7-1
Mean τ_{cy}	:	62 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	: CSS20

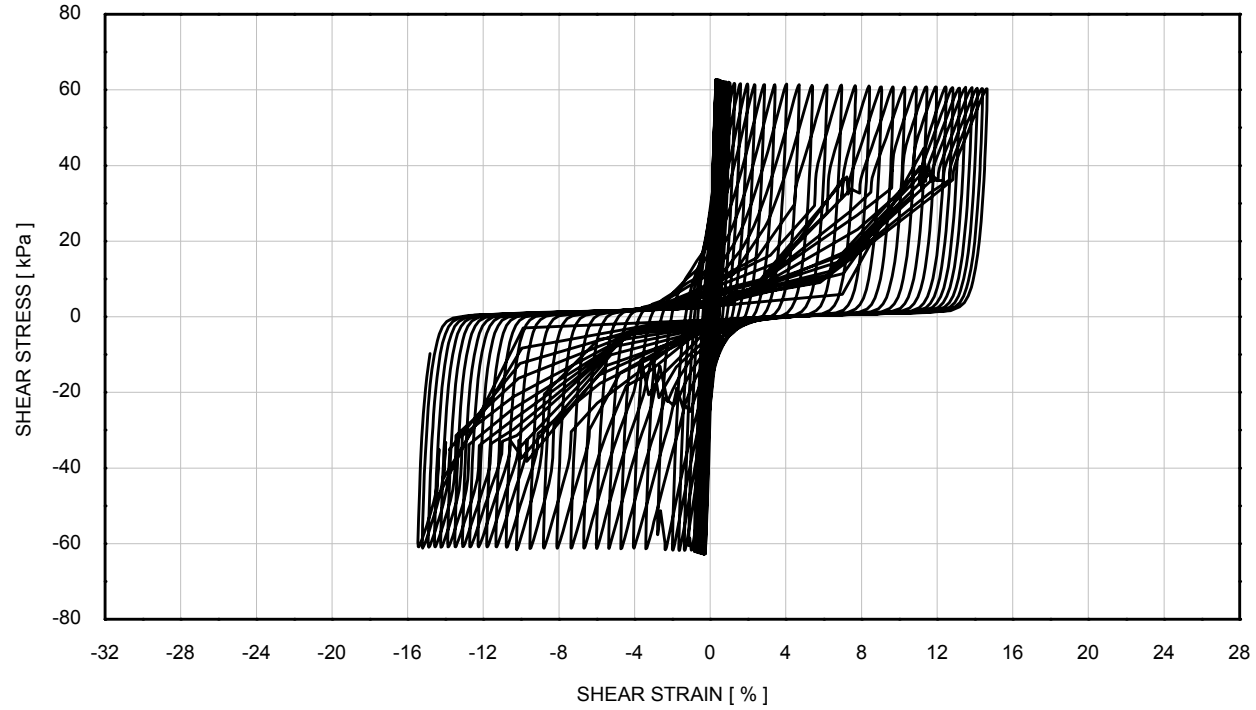
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

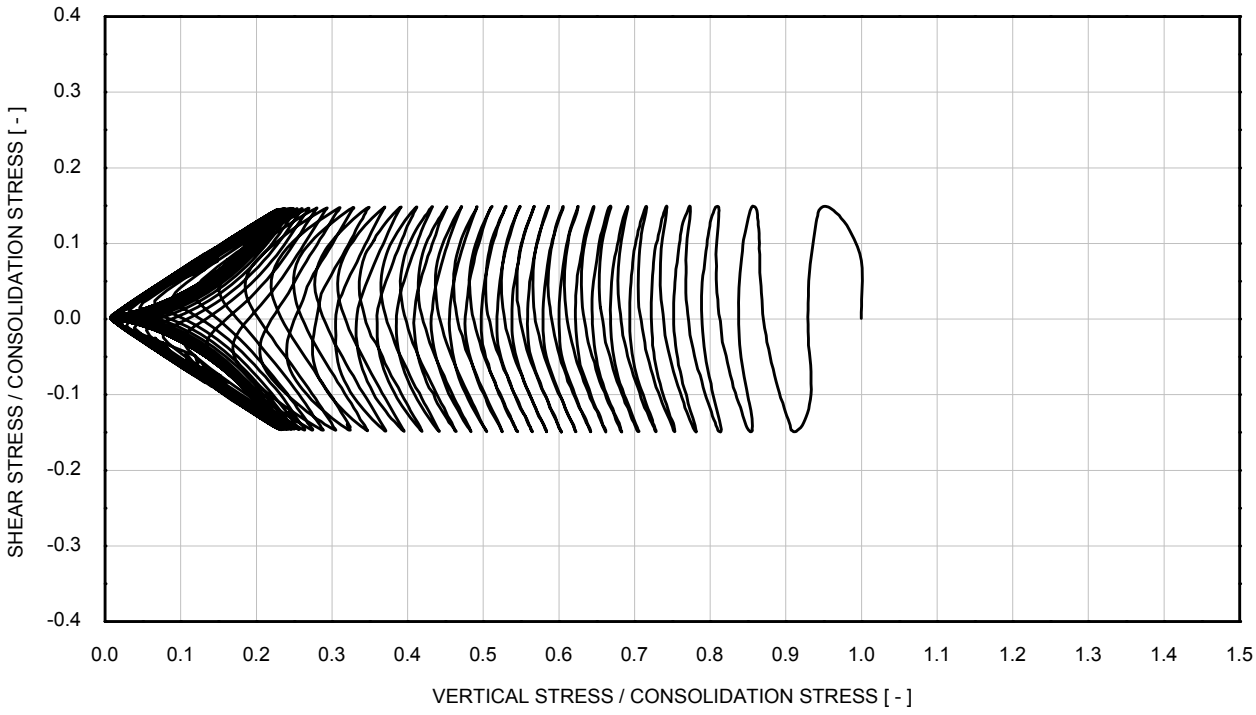




σ_{vc}	:	420 kPa	Batch	: 7
Mean τ_{av}	:	0 kPa	Sample	: CSS_7-1
Mean τ_{cy}	:	62 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	: CSS20

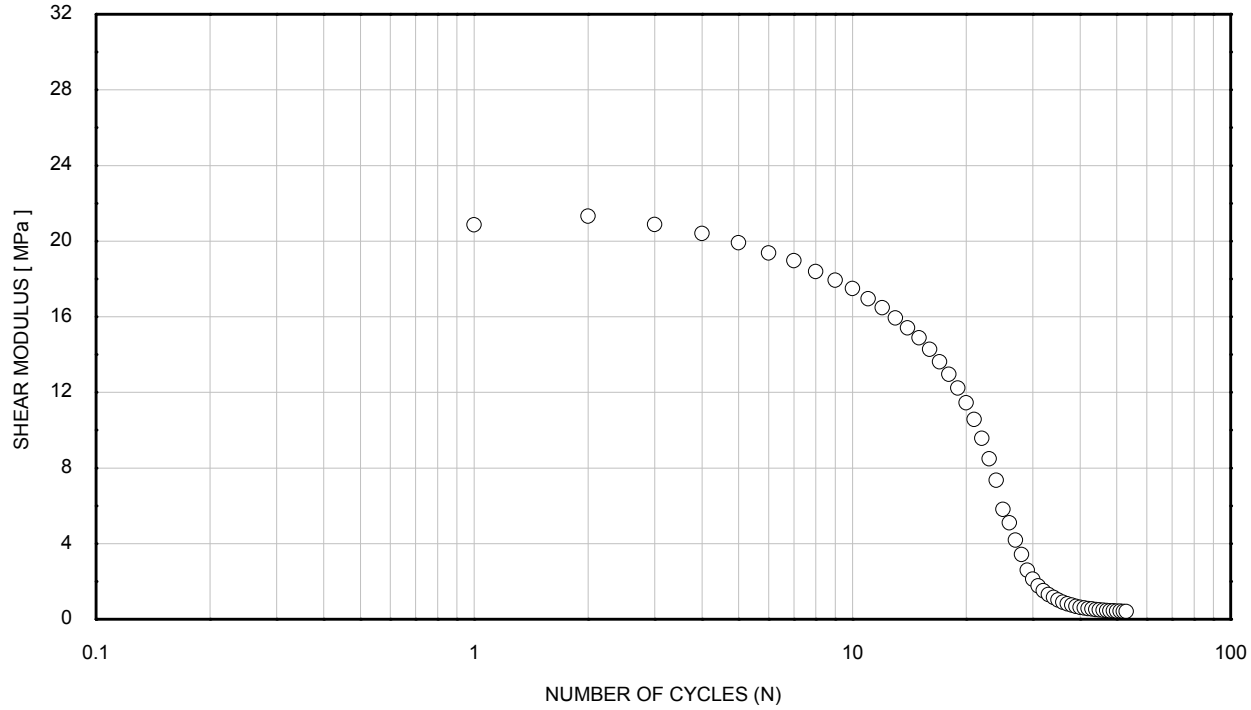
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

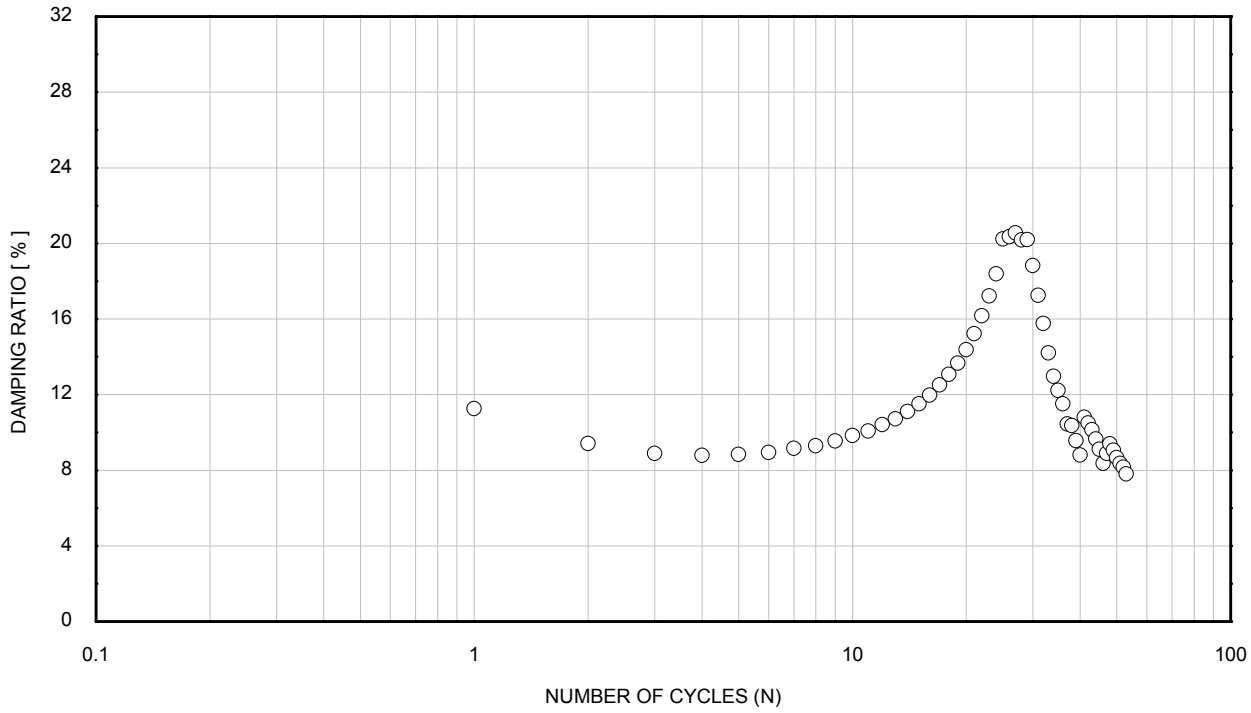




σ_{vc}	:	420 kPa	Batch	: 7
Mean τ_{av}	:	0 kPa	Sample	: CSS_7-1
Mean τ_{cy}	:	62 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	: CSS20

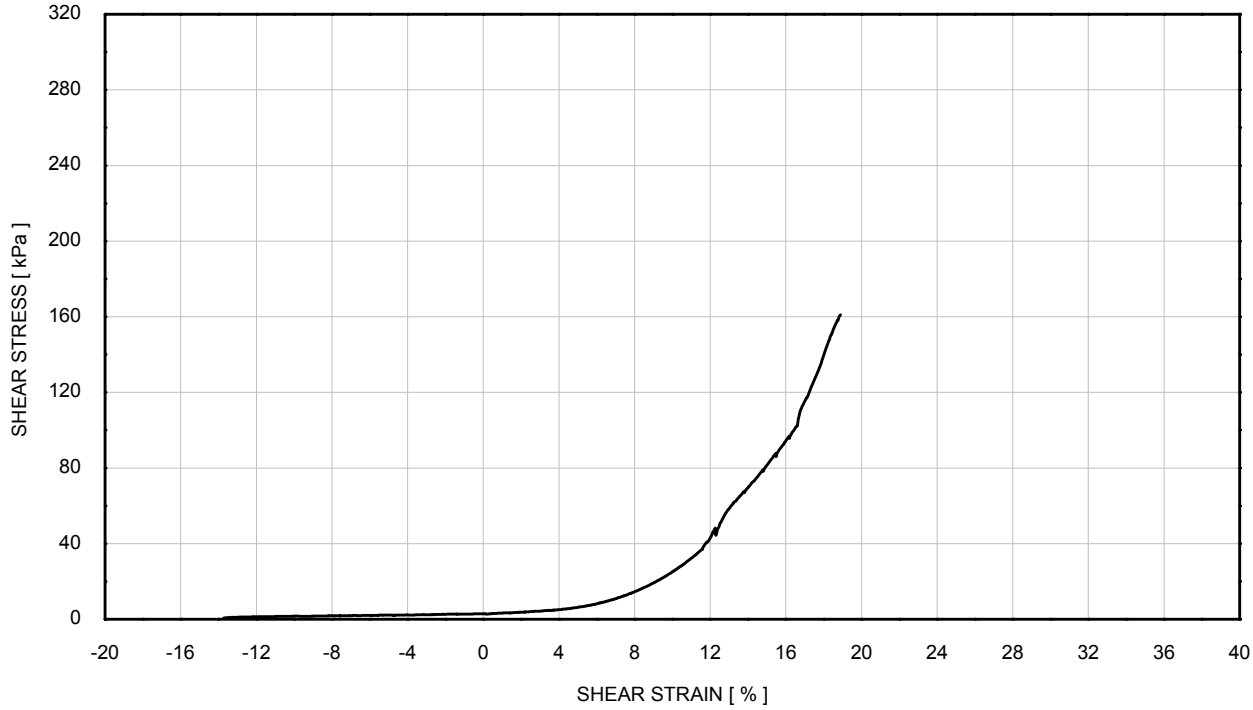
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

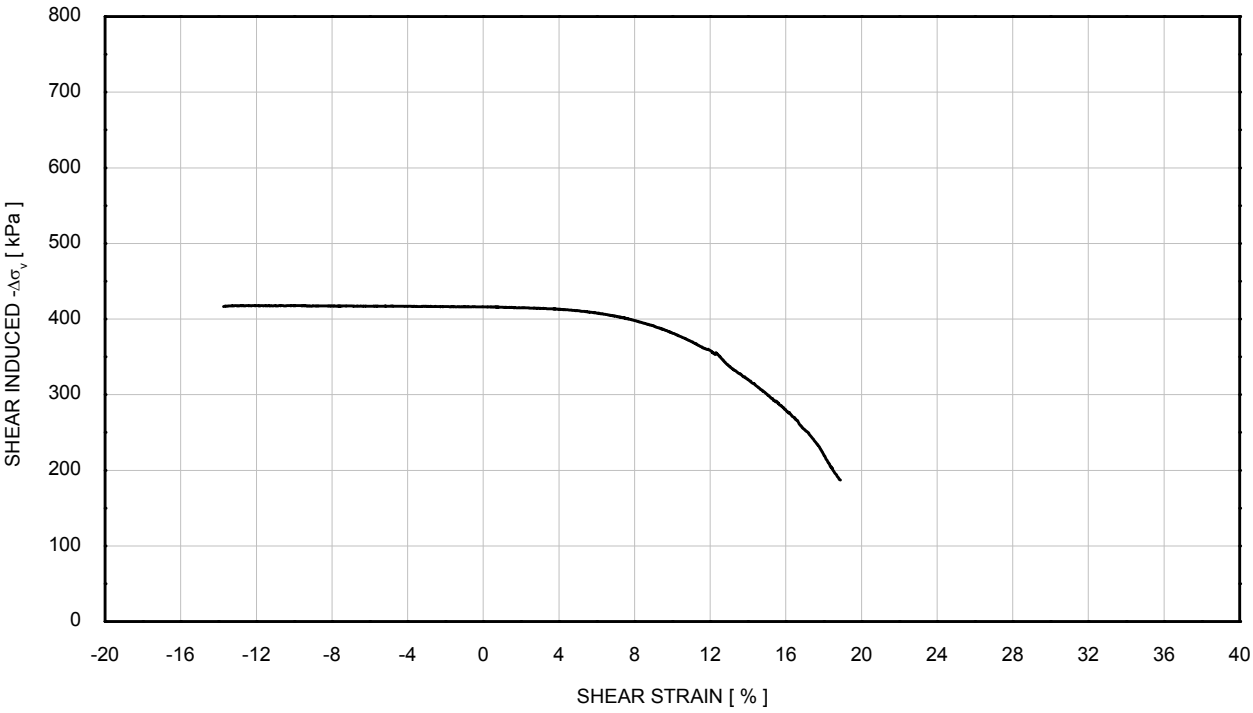




σ_{vc}	: 420 kPa	Batch	: 7
Mean τ_{av}	: 0 kPa	Sample	: CSS_7-1
Mean τ_{cy}	: 62 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	: 0.10 Hz	Test No.	: CSS20

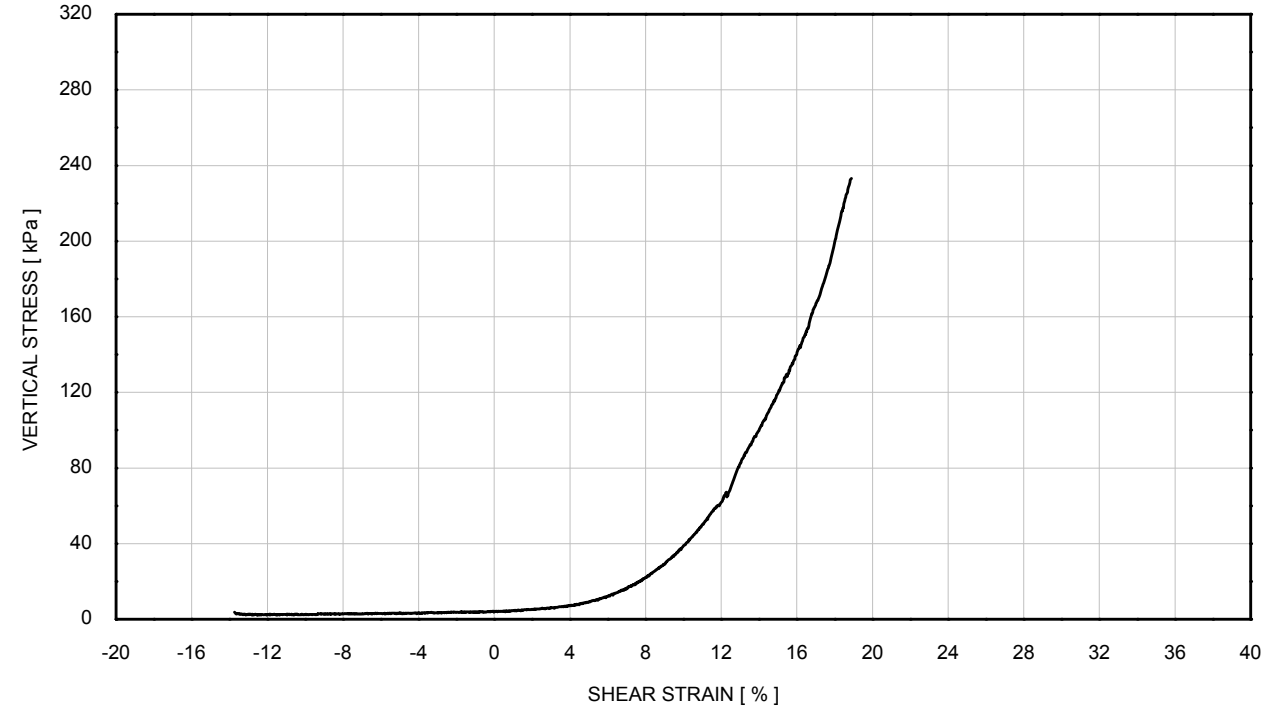
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

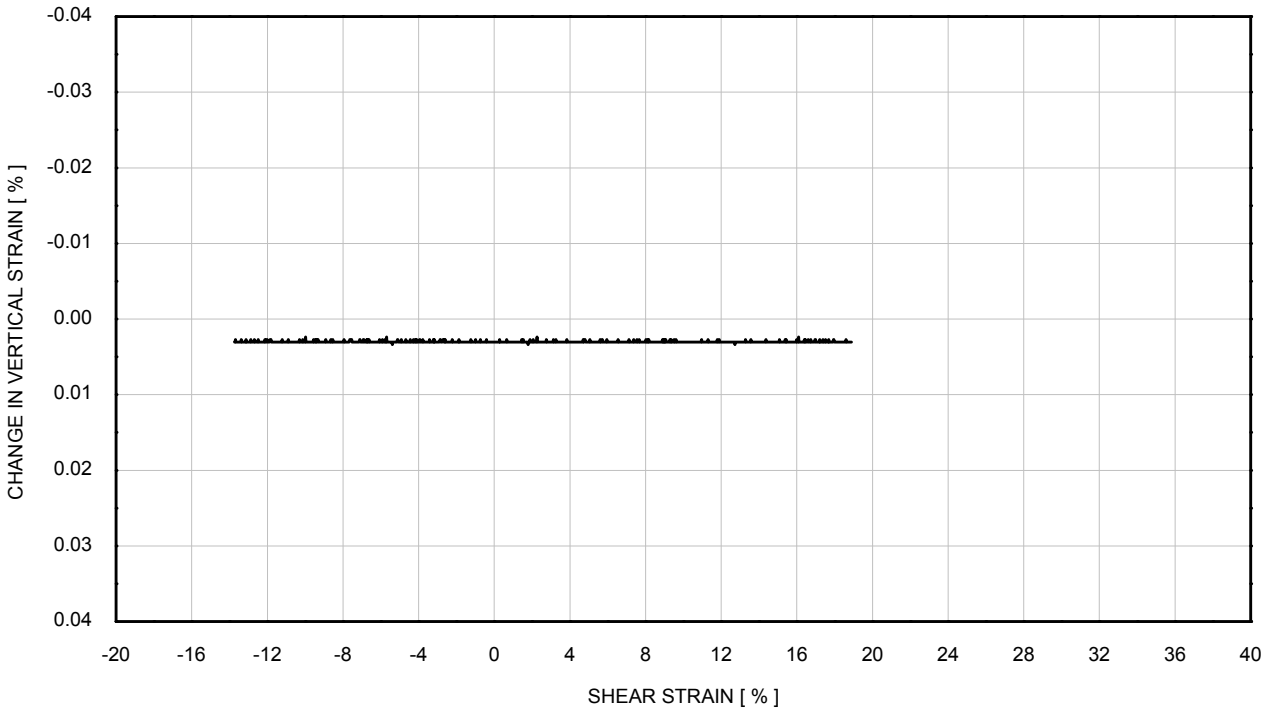




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 161 kPa	Sample	: CSS_7-1
γ at τ_{peak}	: 18.88 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 3.00 %/hour	Test No.	: CSS20

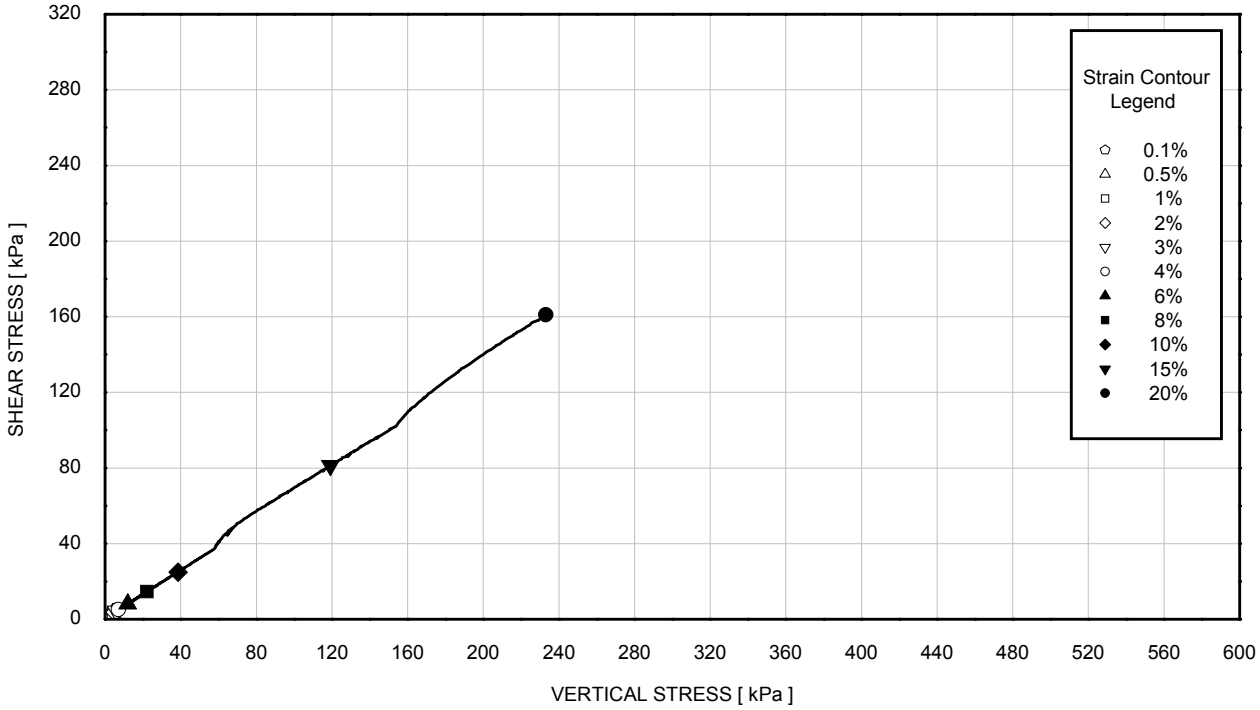
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

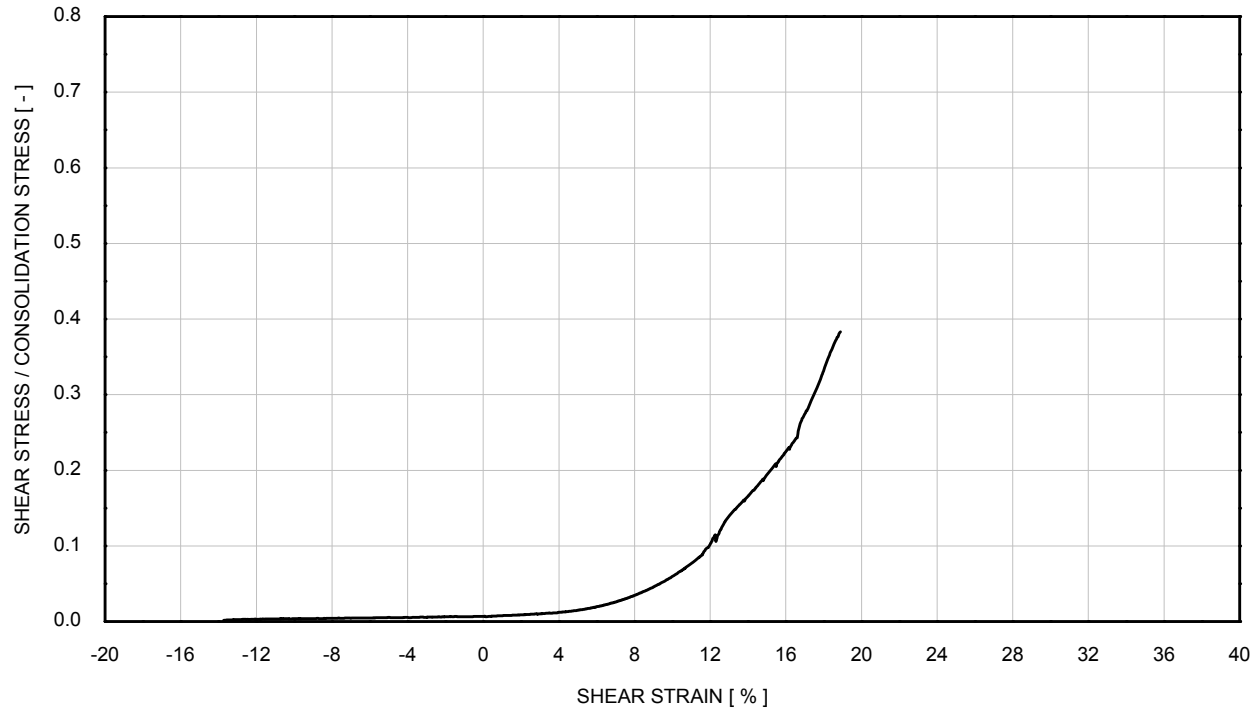




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 161 kPa	Sample	: CSS_7-1
γ at τ_{peak}	: 18.88 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 3.00 %/hour	Test No.	: CSS20

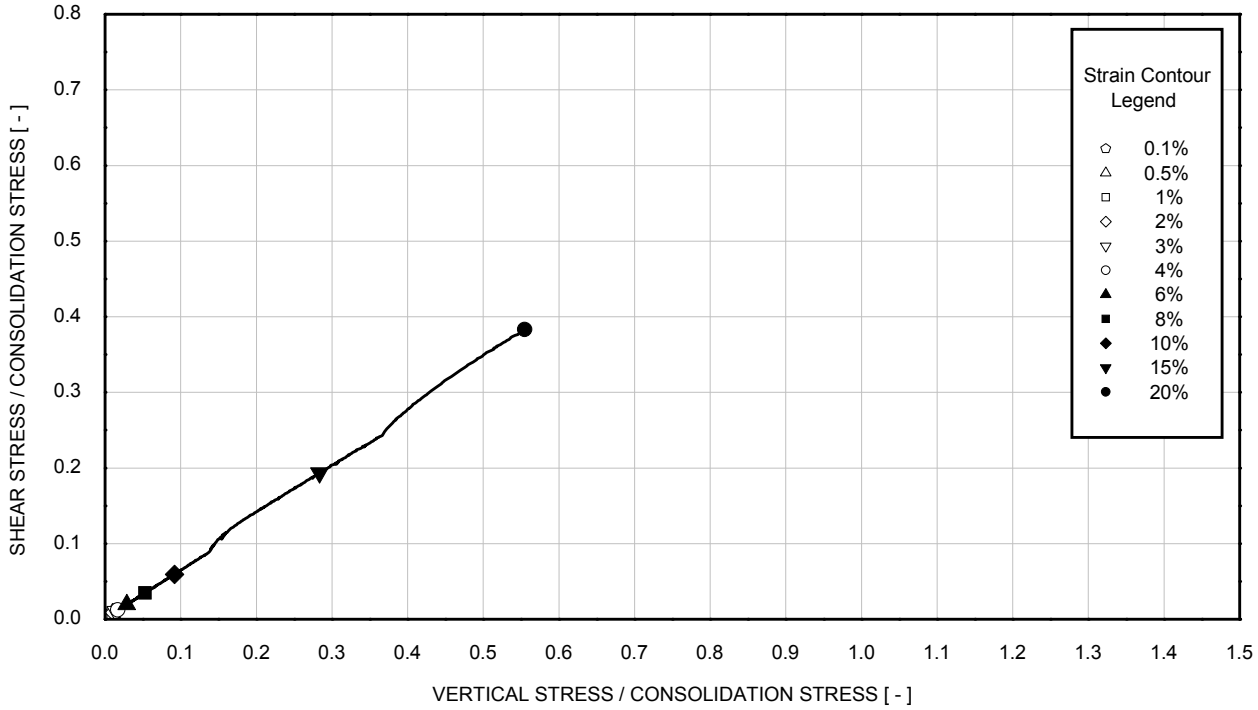
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

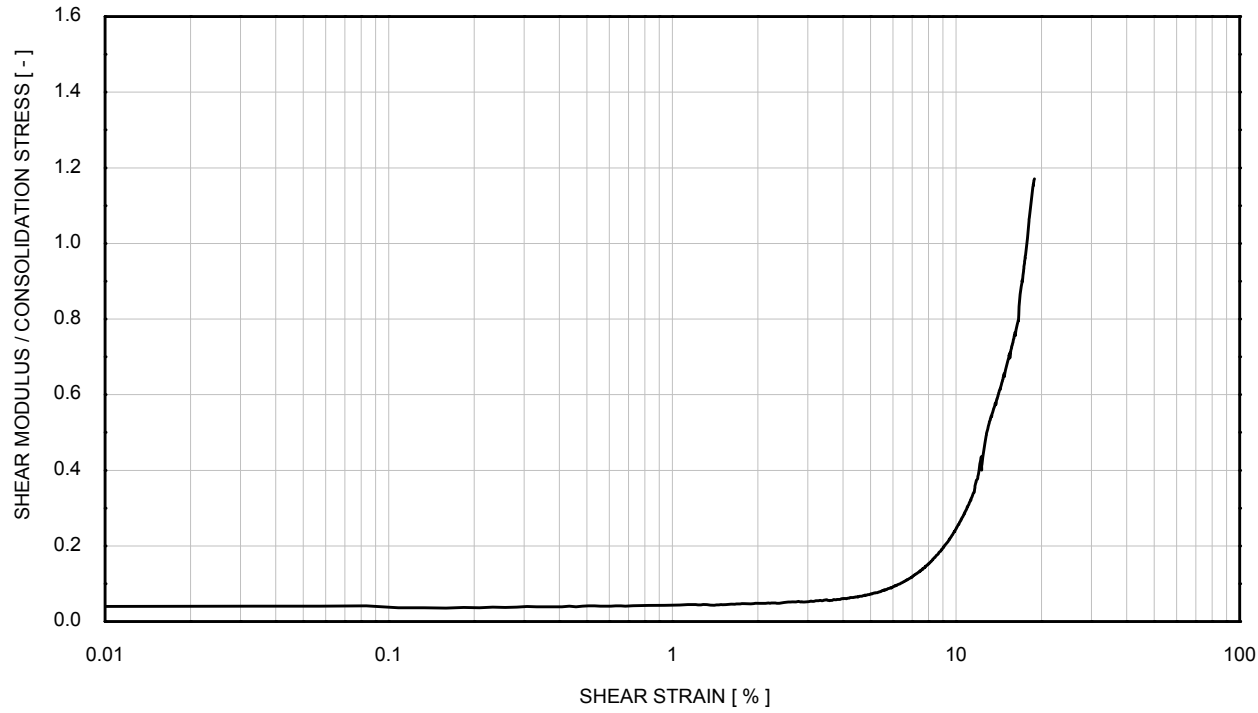




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 161 kPa	Sample	: CSS_7-1
γ at τ_{peak}	: 18.88 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 3.00 %/hour	Test No.	: CSS20

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 161 kPa	Sample	: CSS_7-1
γ at τ_{peak}	: 18.88 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 3.00 %/hour	Test No.	: CSS20

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown silty fine SAND

GENERAL	
Date test started	18/11/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.6
Length	[mm]	30.0
Water content after compaction	[%]	11.9
Bulk density after compaction	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.55
Void ratio	[-]	0.706
Degree of saturation after compaction	[%]	45
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	26.6
Bulk density at start of test	[Mg/m³]	1.97
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 7_CSS21
Template issue	1.4
Processed by	JLS
Date	29/11/2016
Checked by	PH
Date	01/12/2016
Approved by	PH
Date	01/12/2016

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-2
Unit	Unit D (Yarmouth Roads)
Test number	CSS21

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	420
Vertical strain	[%]	2.47
Bulk density	[Mg/m^3]	1.99
Dry density	[Mg/m^3]	1.59
Void ratio	[-]	0.664
Water content	[%]	25.0

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	420
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	21
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	2.51
Bulk density	[Mg/m^3]	1.99
Dry density	[Mg/m^3]	1.59
Void ratio	[-]	0.663

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.26	0.07	29.27	4.92
2	0.26	0.07	30.76	3.48
5	0.26	0.07	30.95	2.89
10	0.26	0.07	30.99	2.54
20	0.25	0.07	30.63	2.38
50	0.25	0.07	30.17	2.24
100	0.25	0.07	30.17	2.03
200	0.25	0.07	30.17	1.90
300	0.25	0.07	29.94	1.93
400	0.25	0.07	30.17	1.87

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-2
Unit	Unit D (Yarmouth Roads)
Test number	CSS21

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	82
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	13
γ_{av} at N_f	[%]	0.69
γ_{cy} at N_f	[%]	15.67
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	350
Vertical strain	[%]	0.00

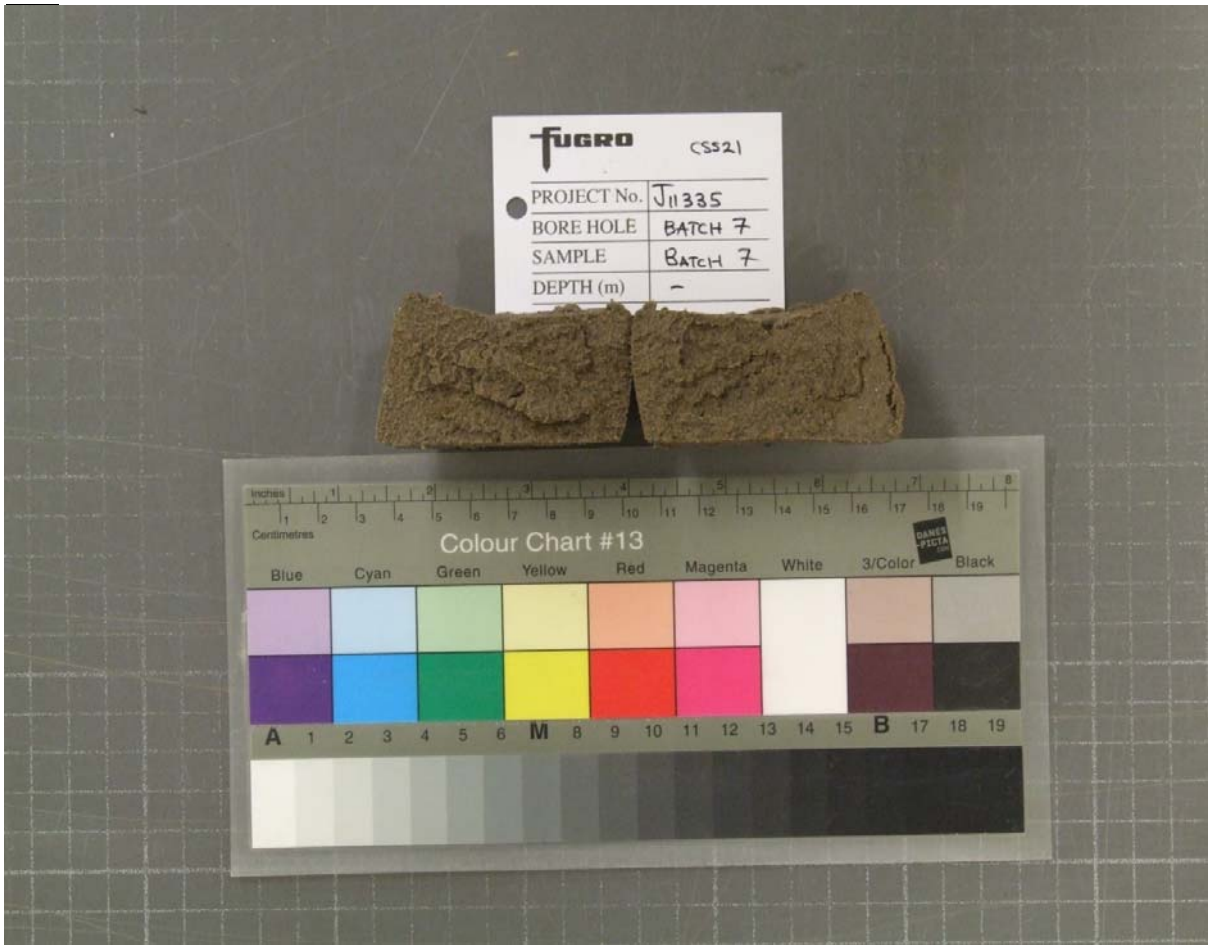
Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.65	1.25	6.58	23.31
2	-1.00	1.83	4.47	27.44
4	-0.28	5.16	1.59	17.24
6	-0.18	7.87	1.04	14.54
8	-0.02	10.38	0.79	11.04
10	0.29	12.87	0.64	11.00
12	0.50	14.84	0.55	11.00
13	0.69	15.67	0.52	9.87

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	359
Shear strain	[%]	29.97
Shear induced $-\Delta\sigma_v$	[kPa]	-178
Vertical stress	[kPa]	598
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.99
At 15 % shear strain		
Shear stress	[kPa]	35
Shear induced $-\Delta\sigma_v$	[kPa]	362
Vertical stress	[kPa]	58
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-2
Unit	Unit D (Yarmouth Roads)
Test number	CSS21

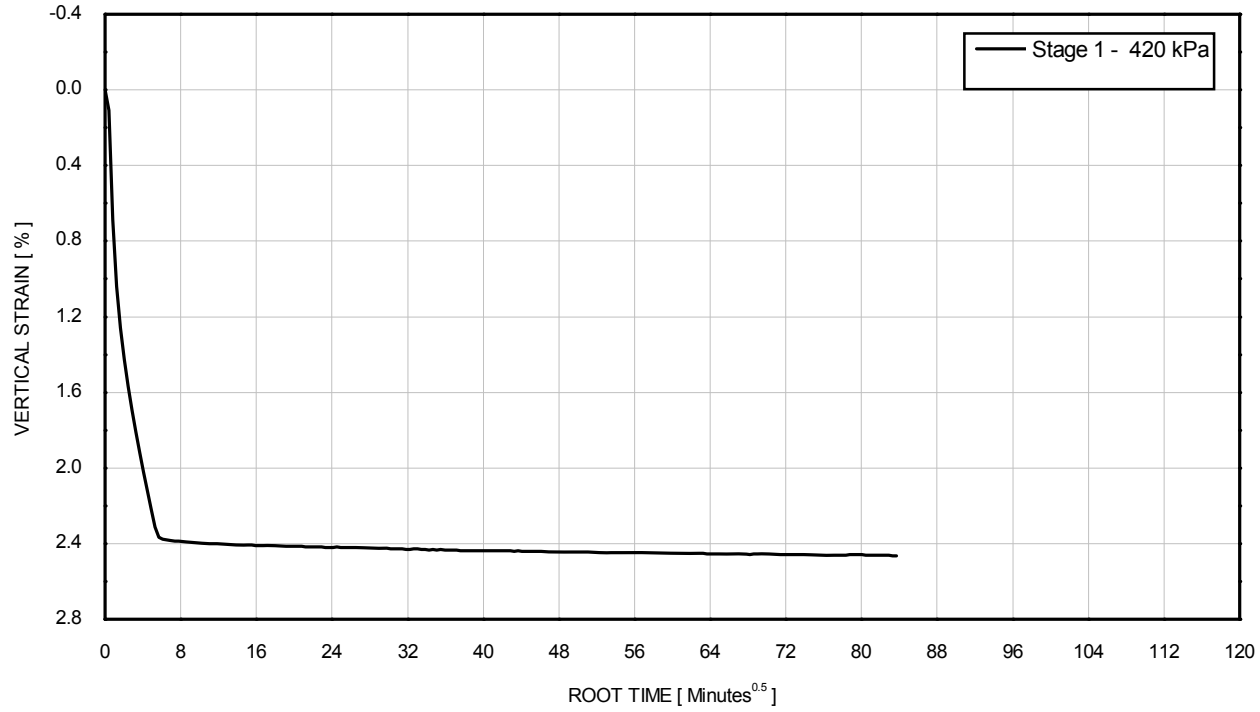
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

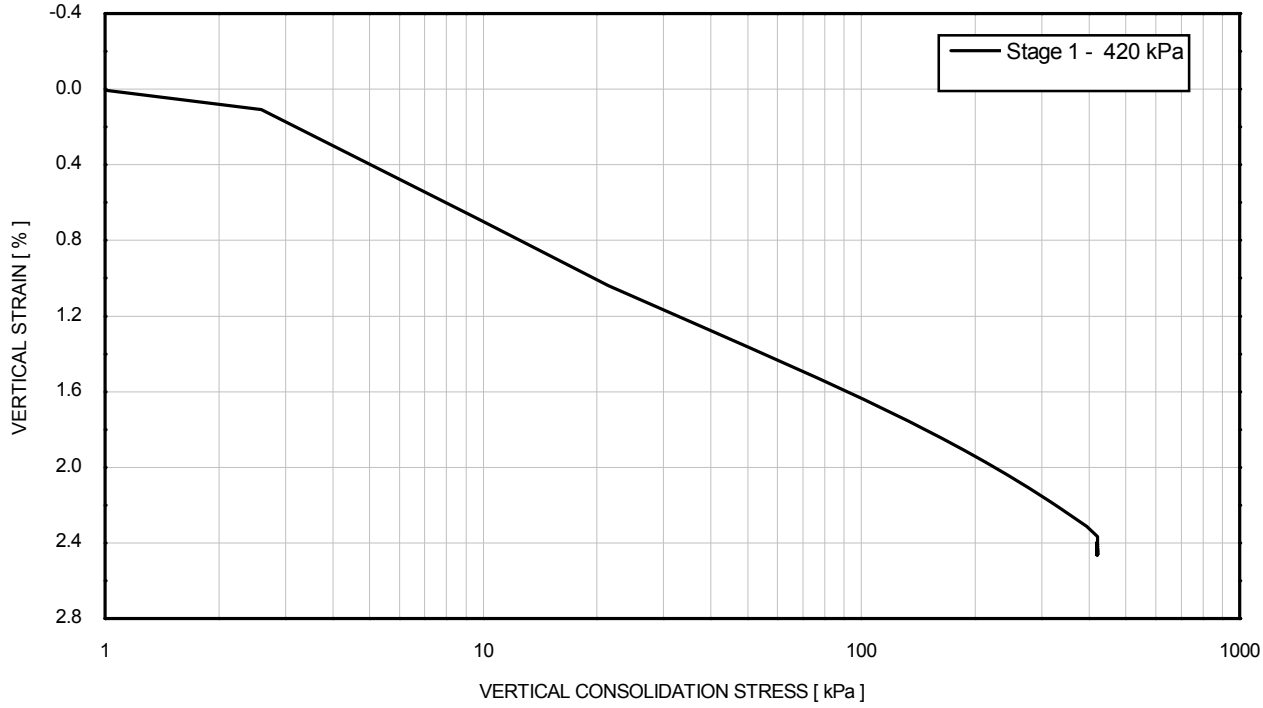
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-2
Unit	Unit D (Yarmouth Roads)
Test number	CSS21

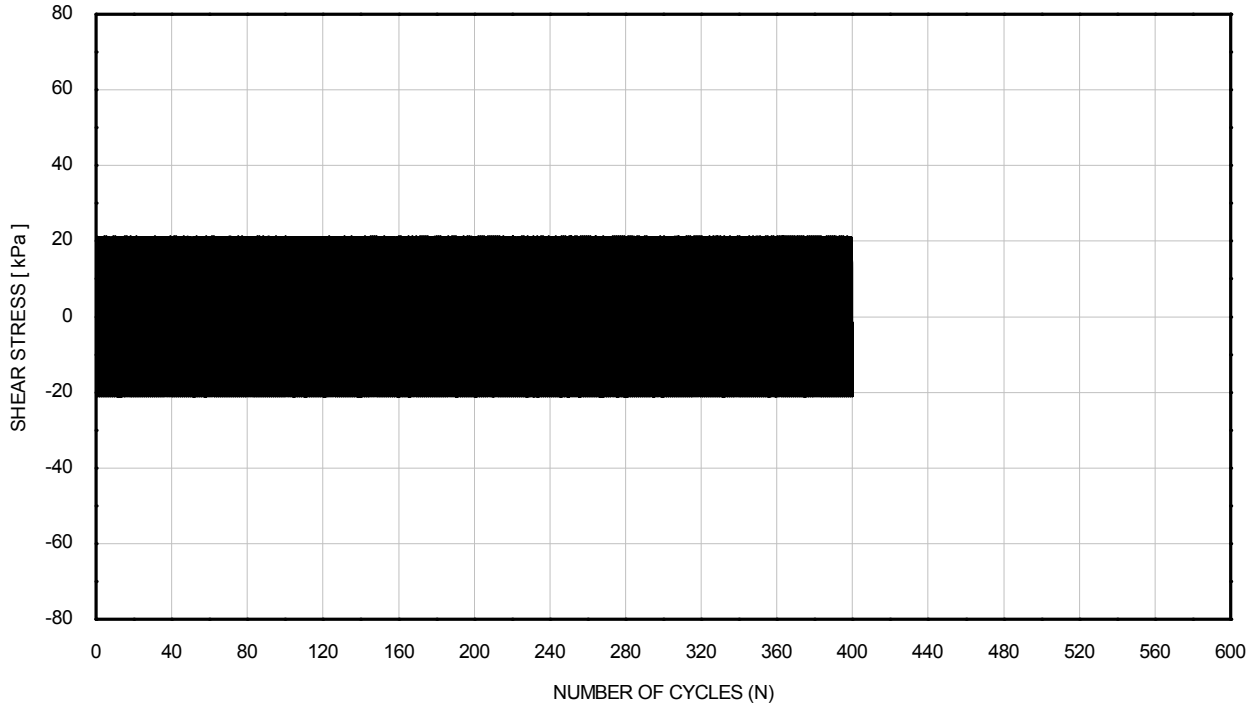
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

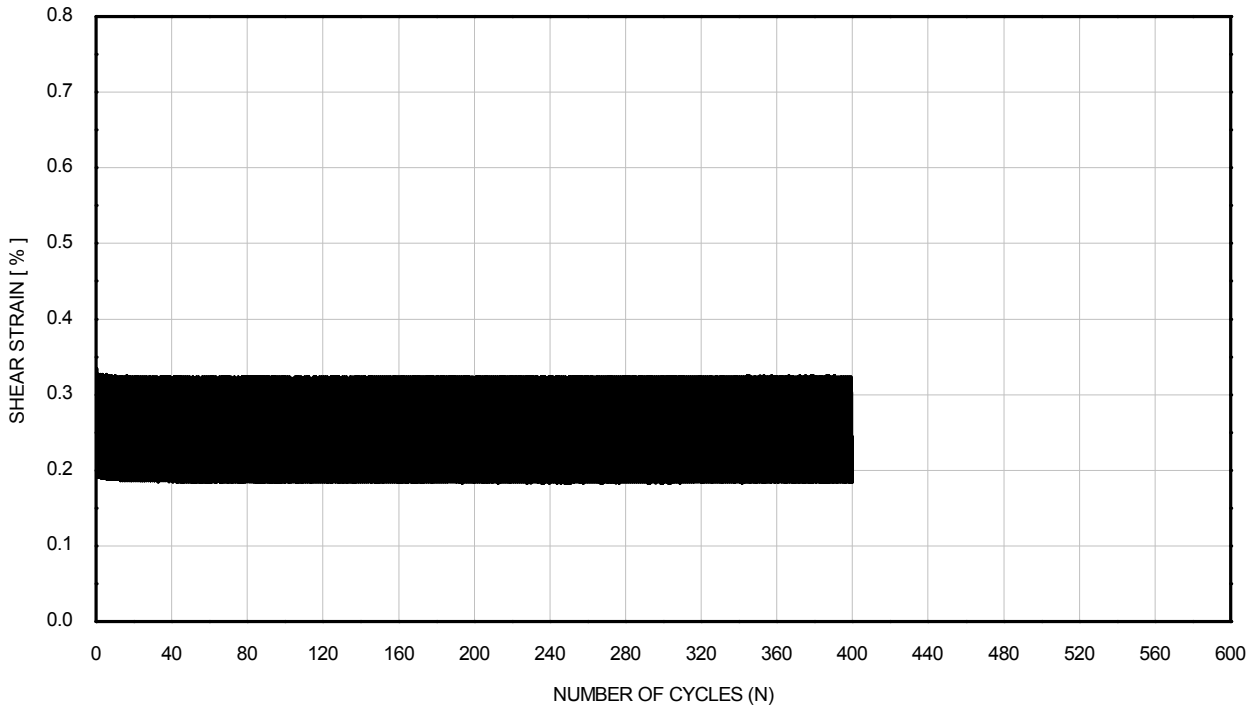




σ_{vc}	: 420 kPa	Batch	: 7
		Sample	: CSS_7-2
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CSS21

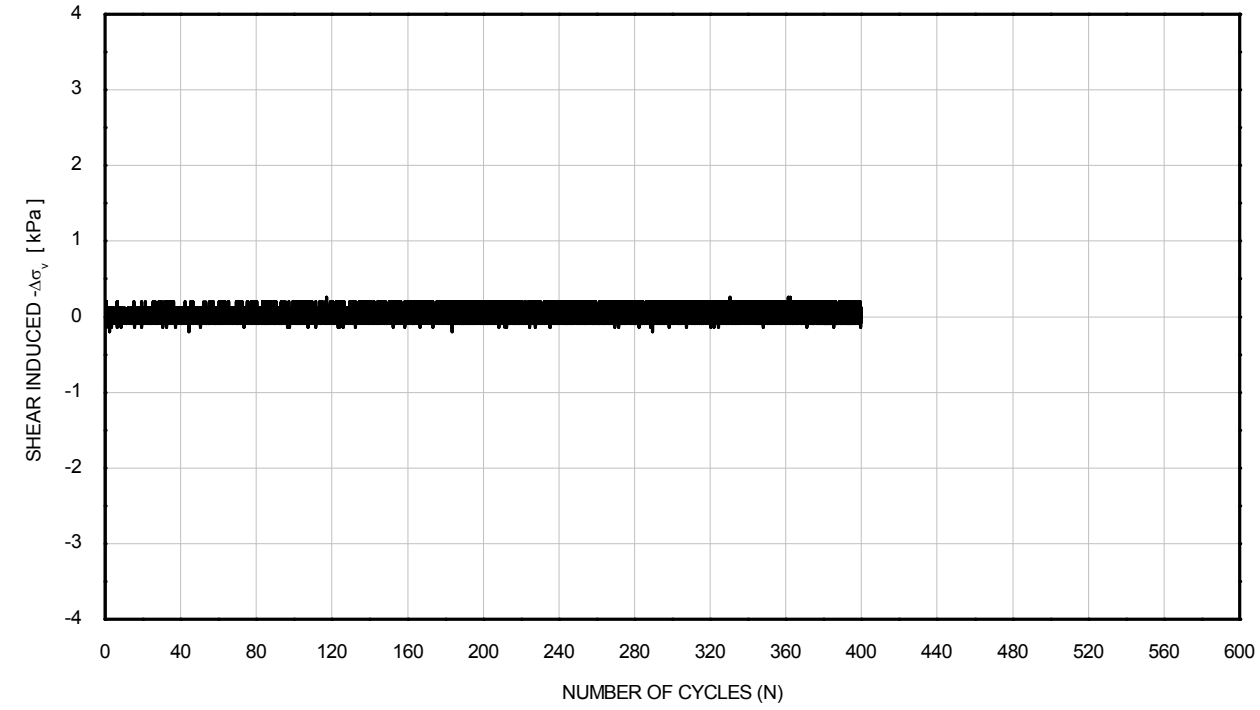
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

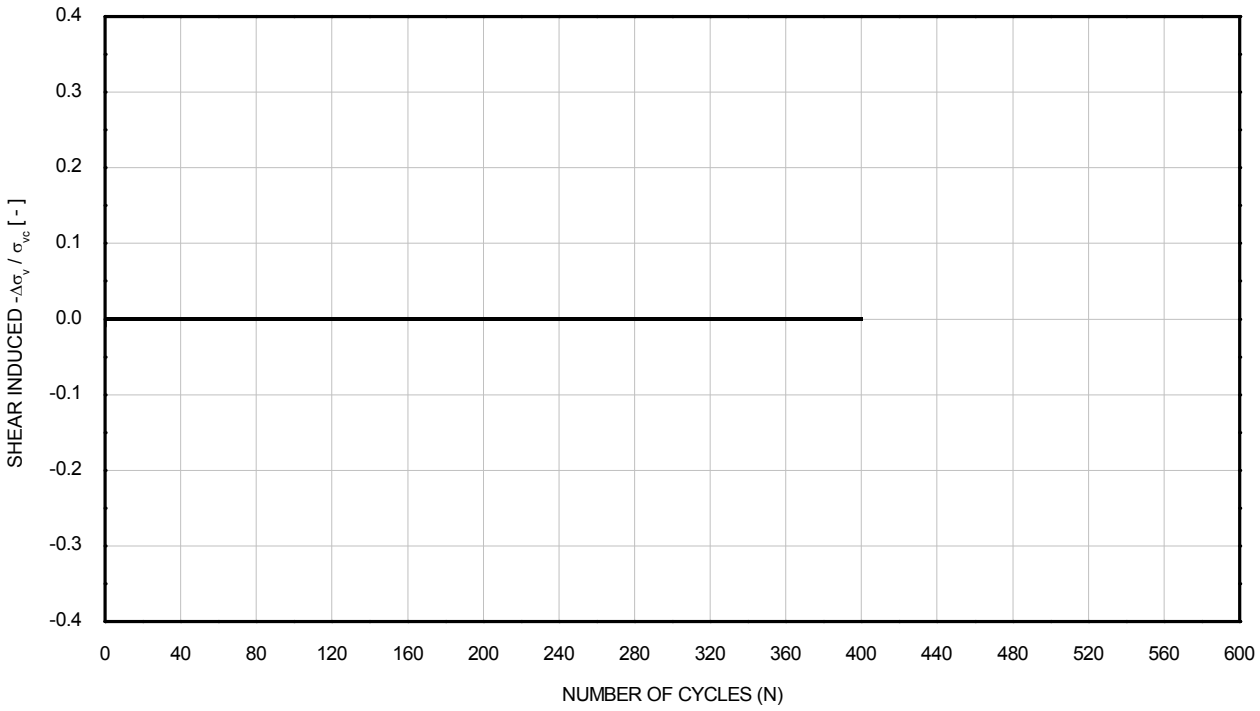




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

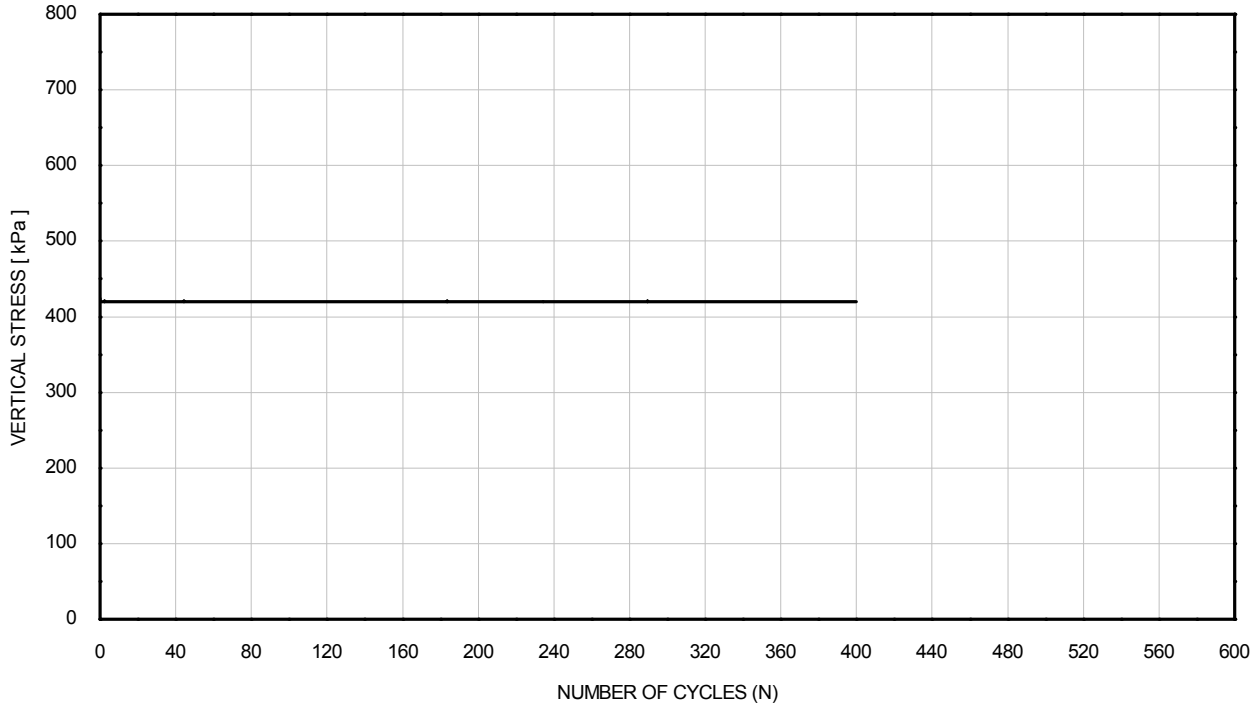
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

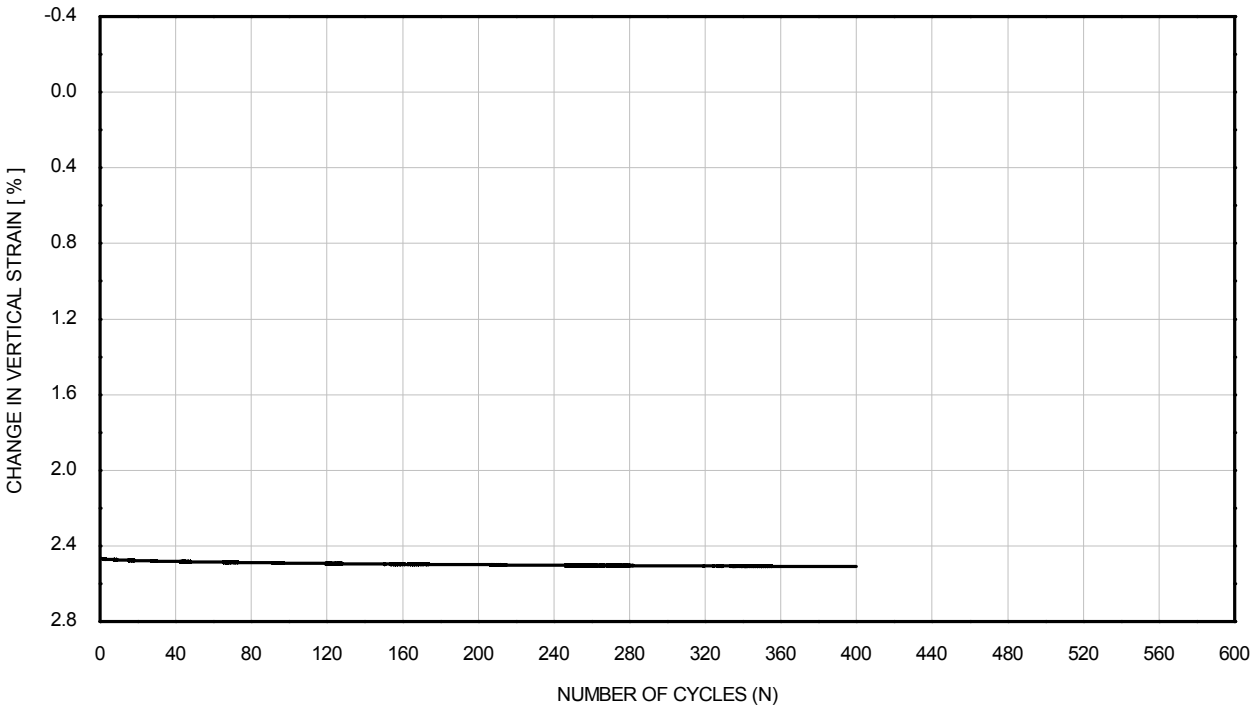




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

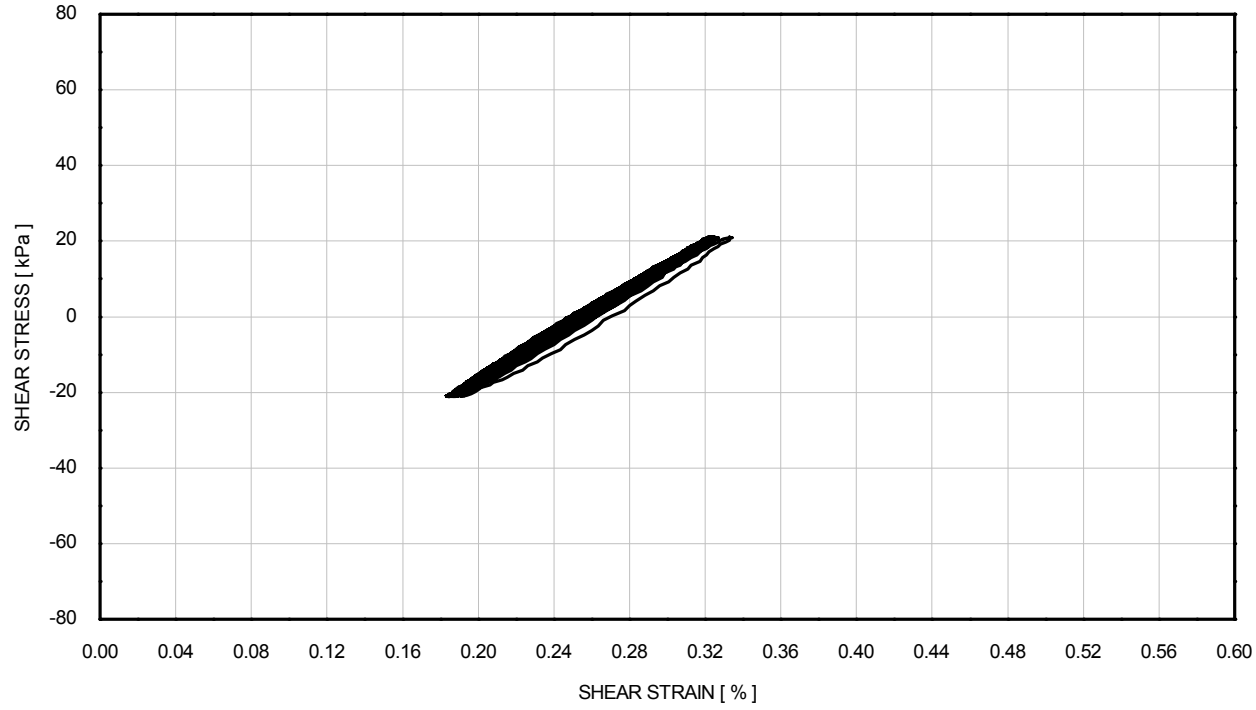
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

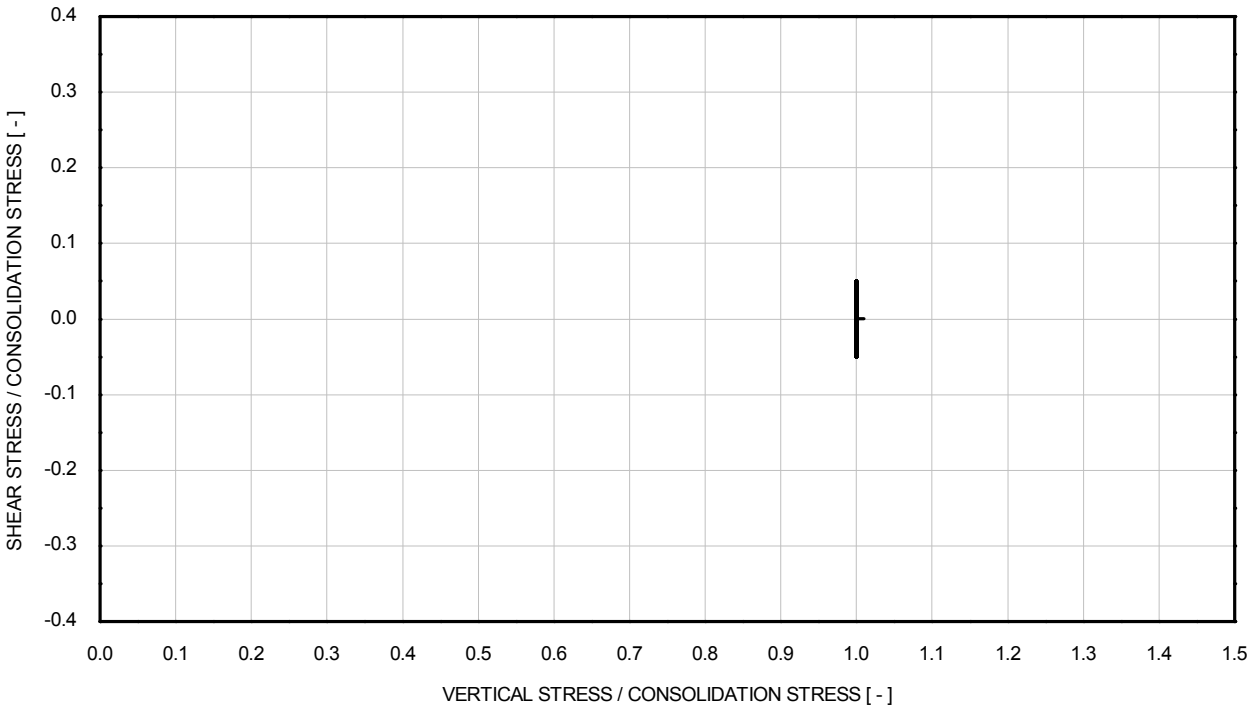




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

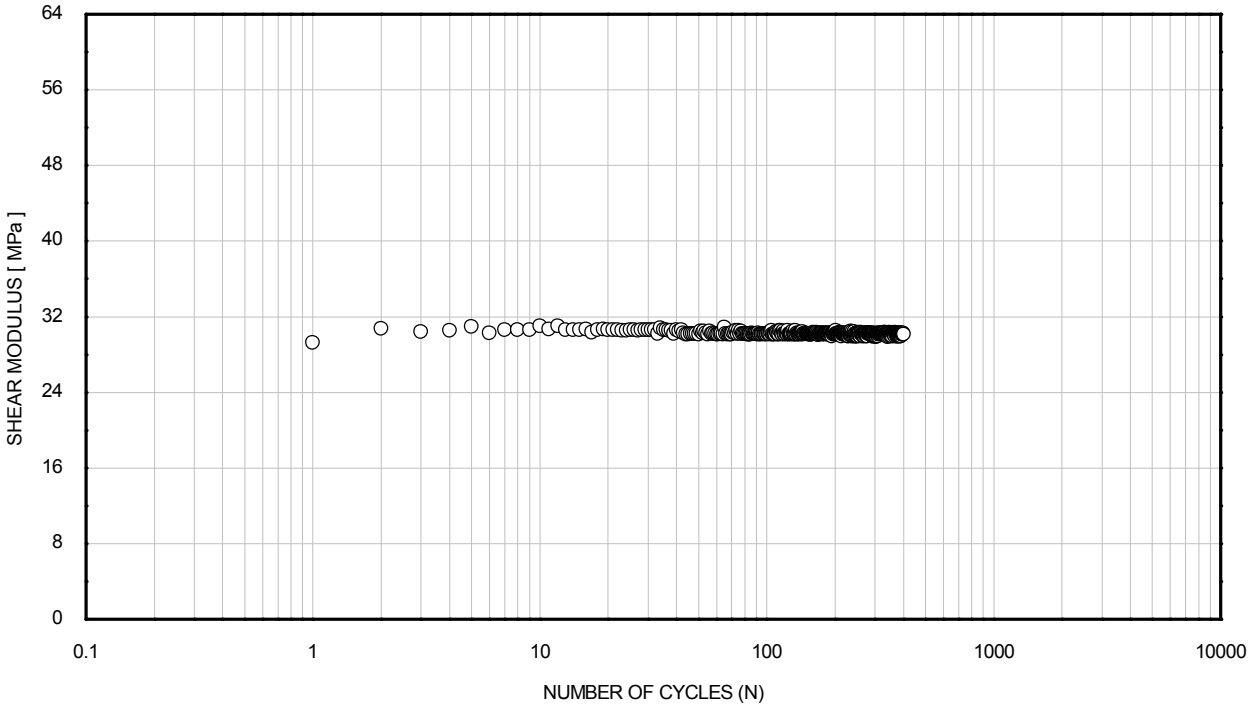
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

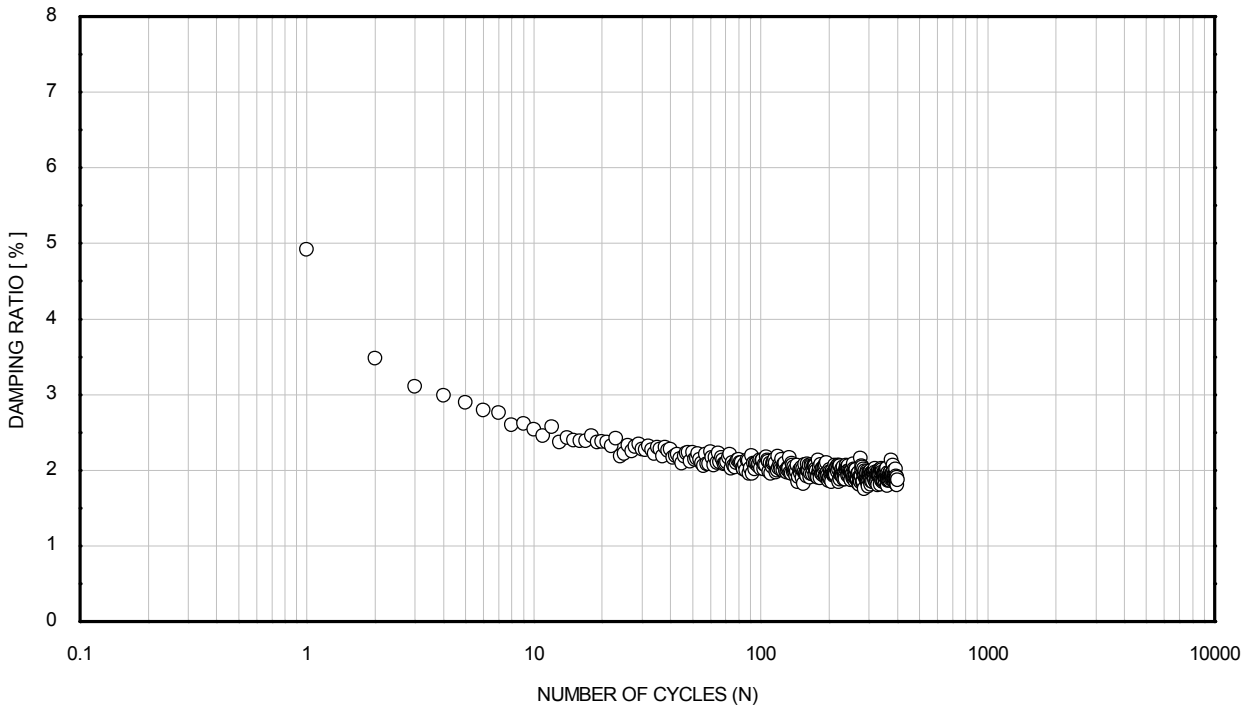




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

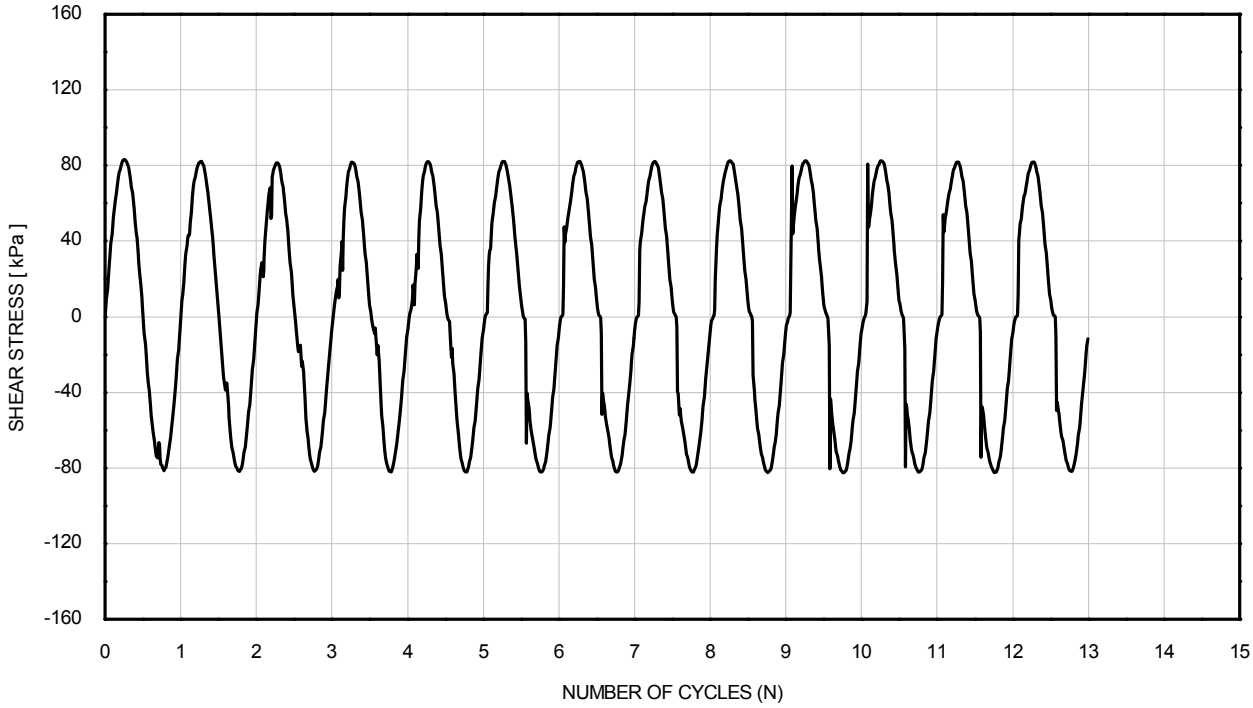
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

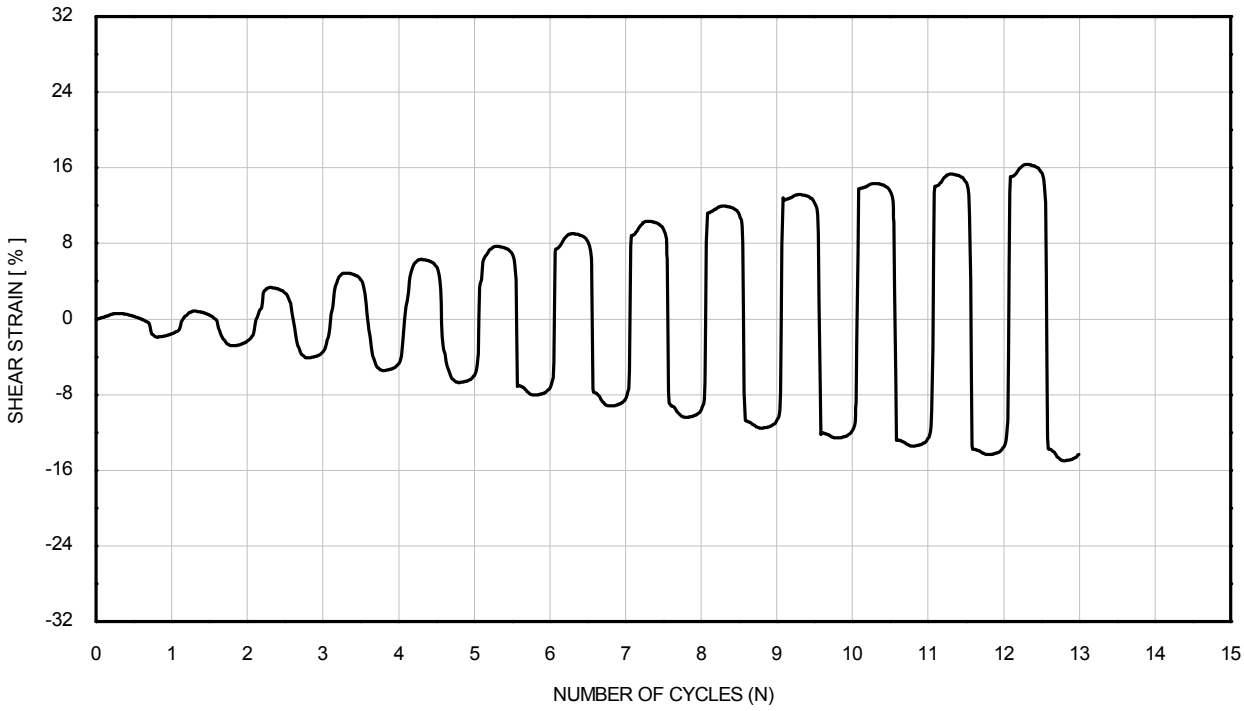




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

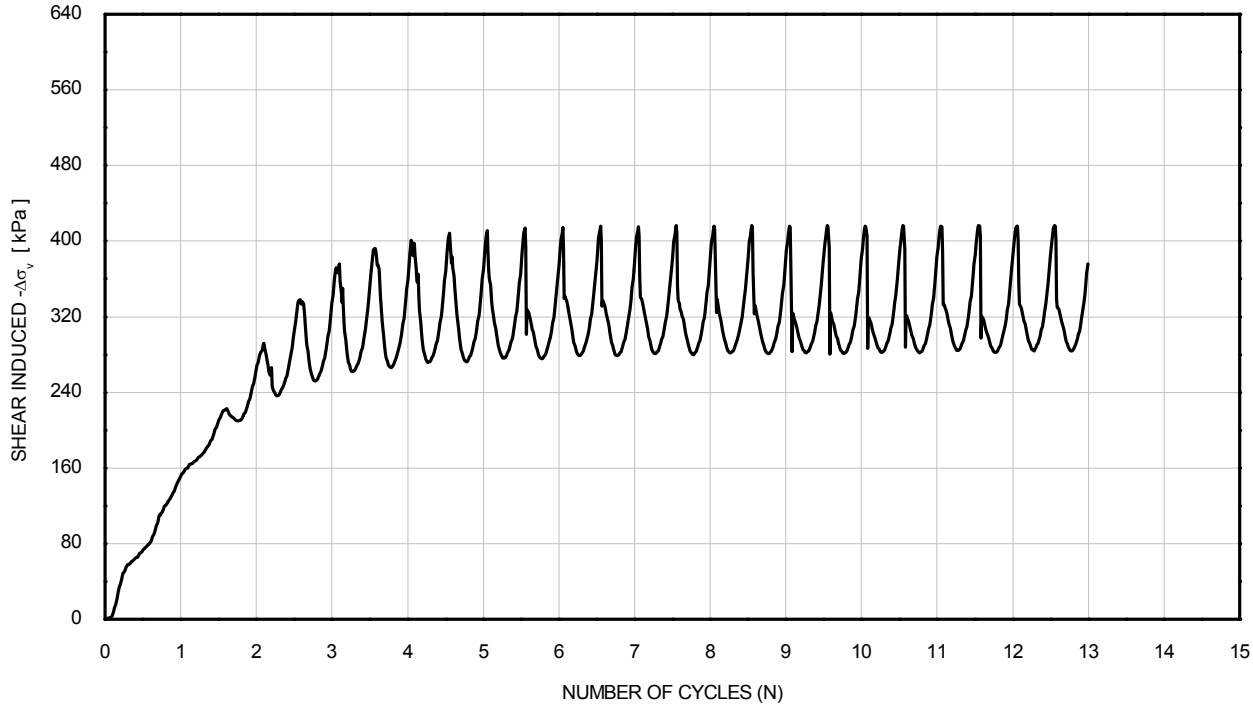
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

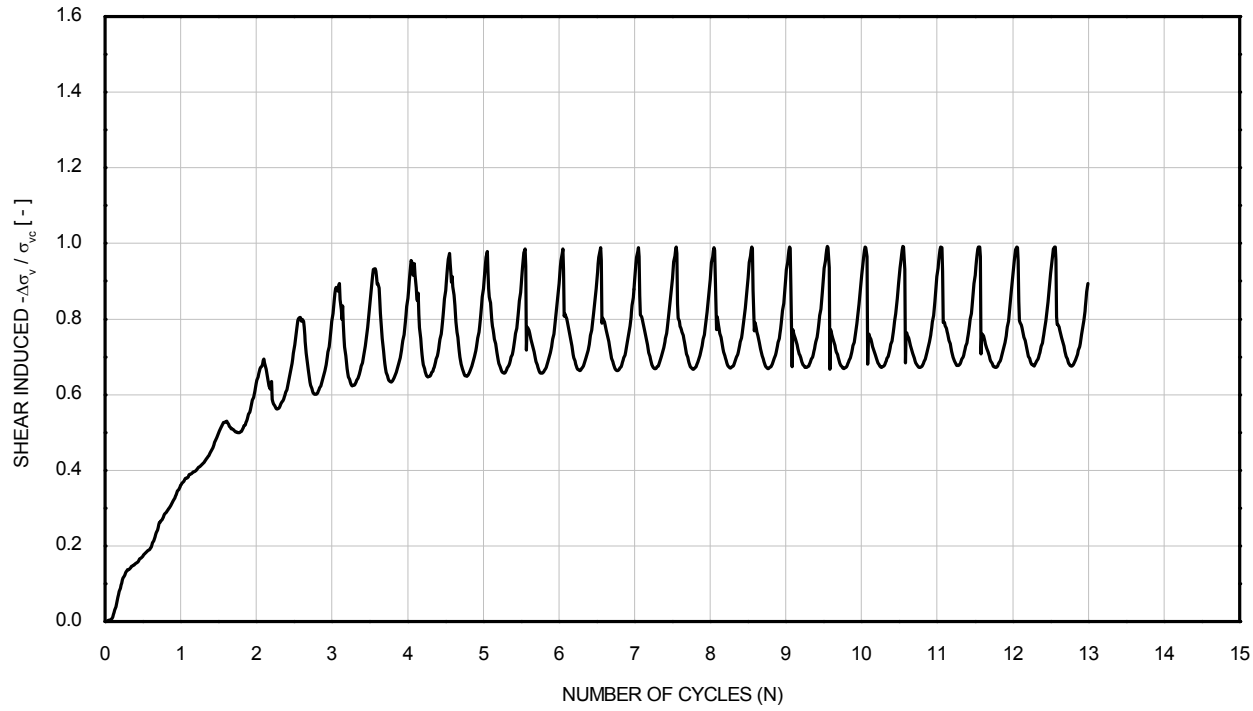




σ_{vc}	: 420	kPa	Batch	: 7
Mean τ_{av}	: 0	kPa	Sample	: CSS_7-2
Mean τ_{cy}	: 82	kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	: 0.10	Hz	Test No.	: CSS21

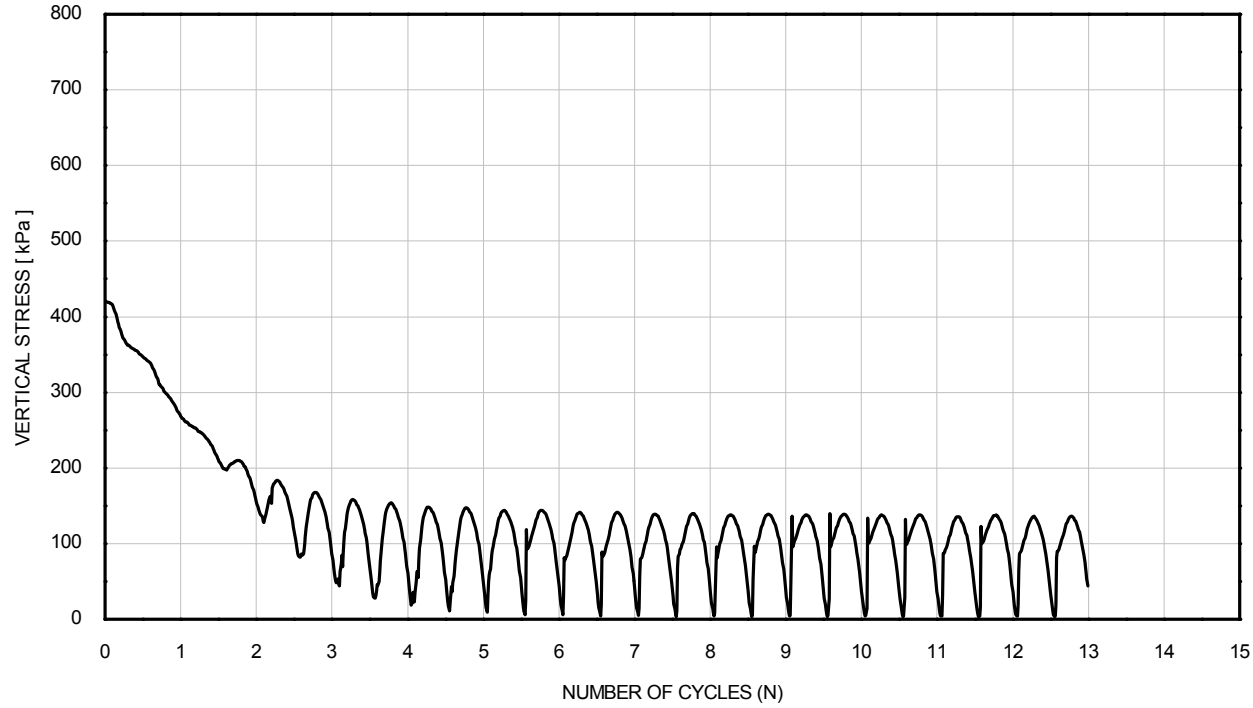
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

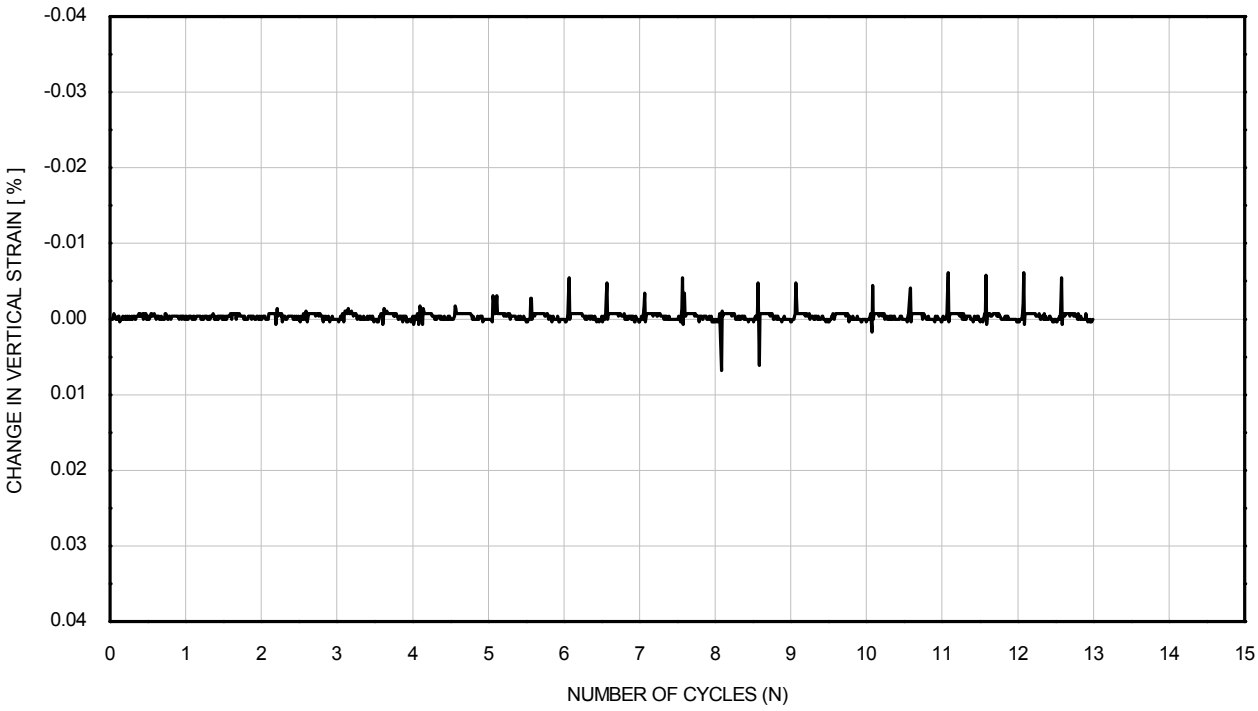




σ_{vc}	:	420 kPa	Batch	: 7
Mean τ_{av}	:	0 kPa	Sample	: CSS_7-2
Mean τ_{cy}	:	82 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	: CSS21

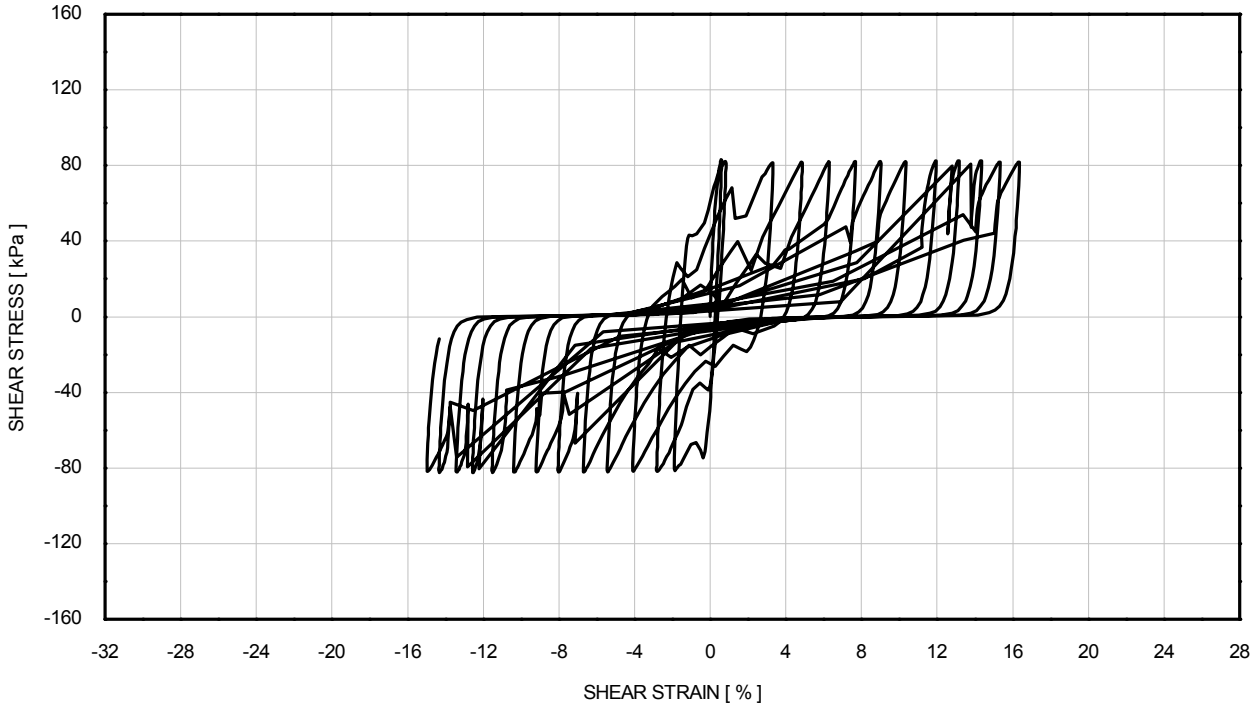
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

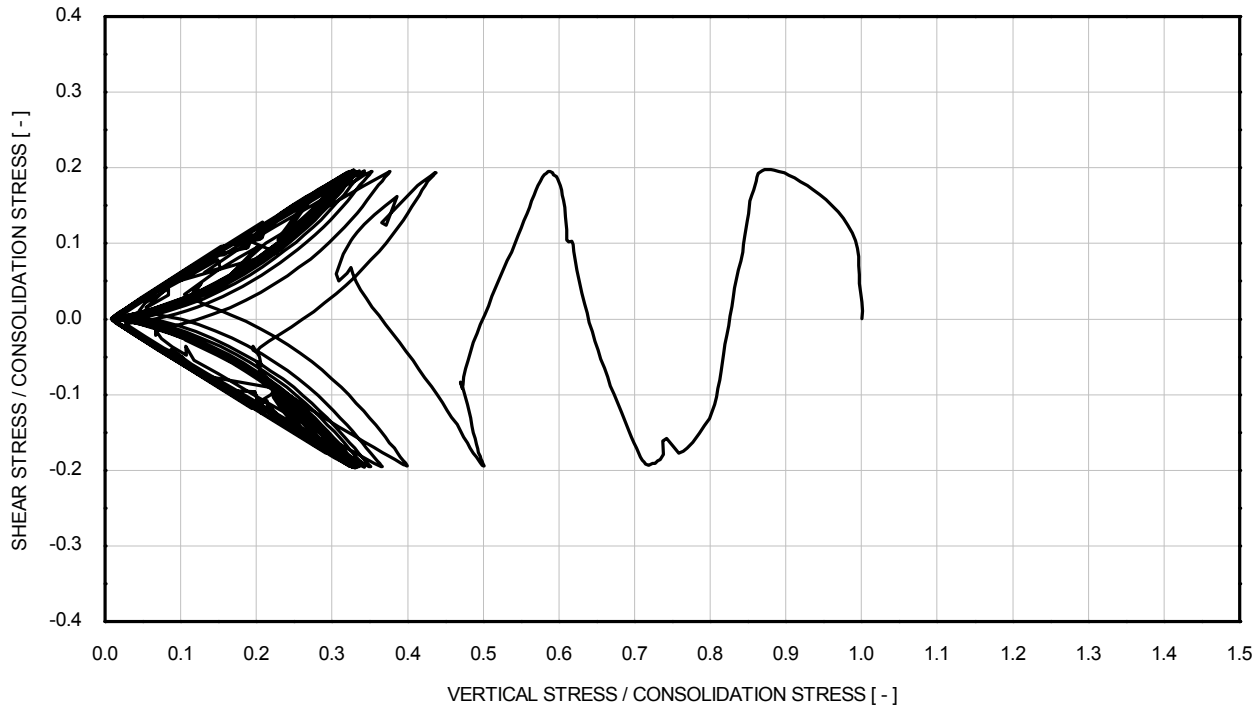




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	82 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

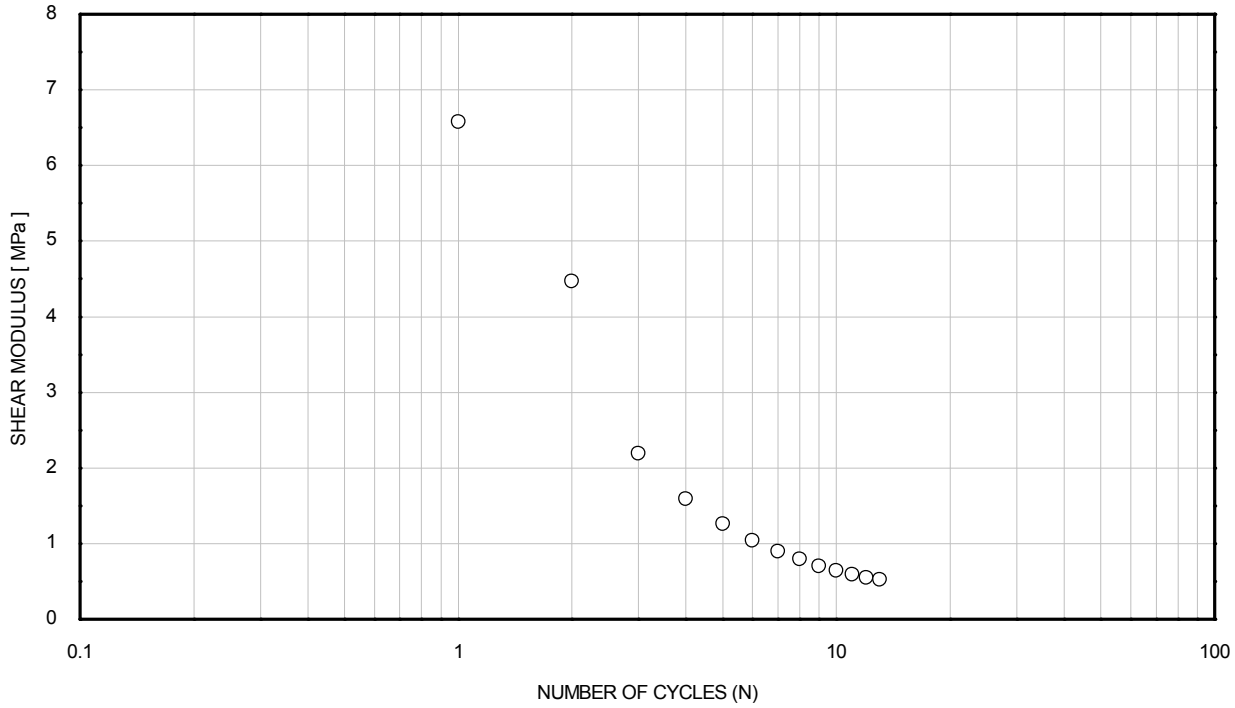
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

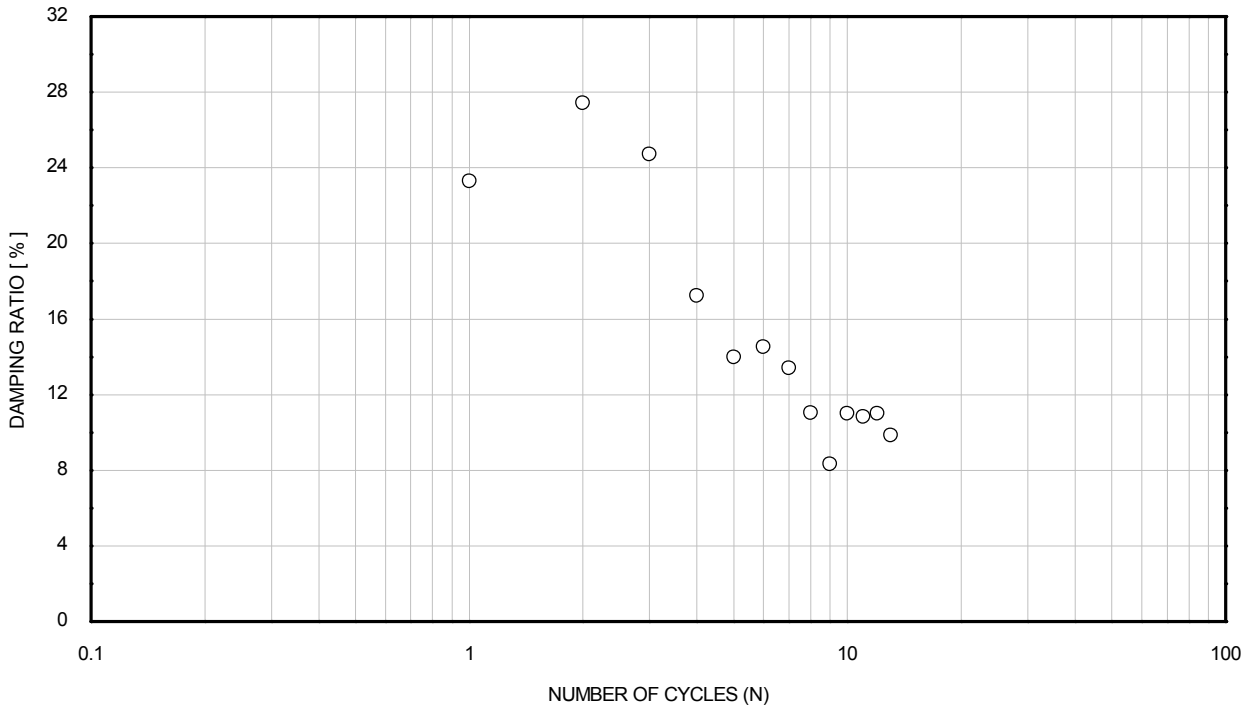




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-2
Mean τ_{cy}	:	82 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS21

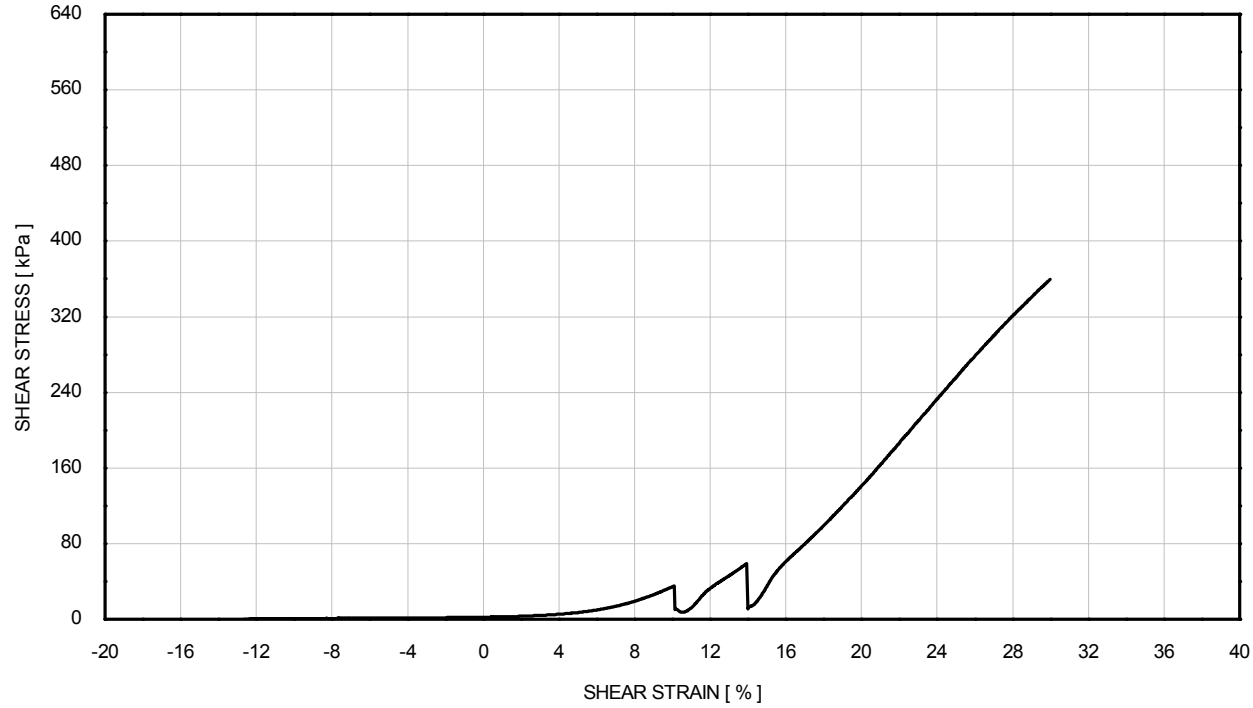
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

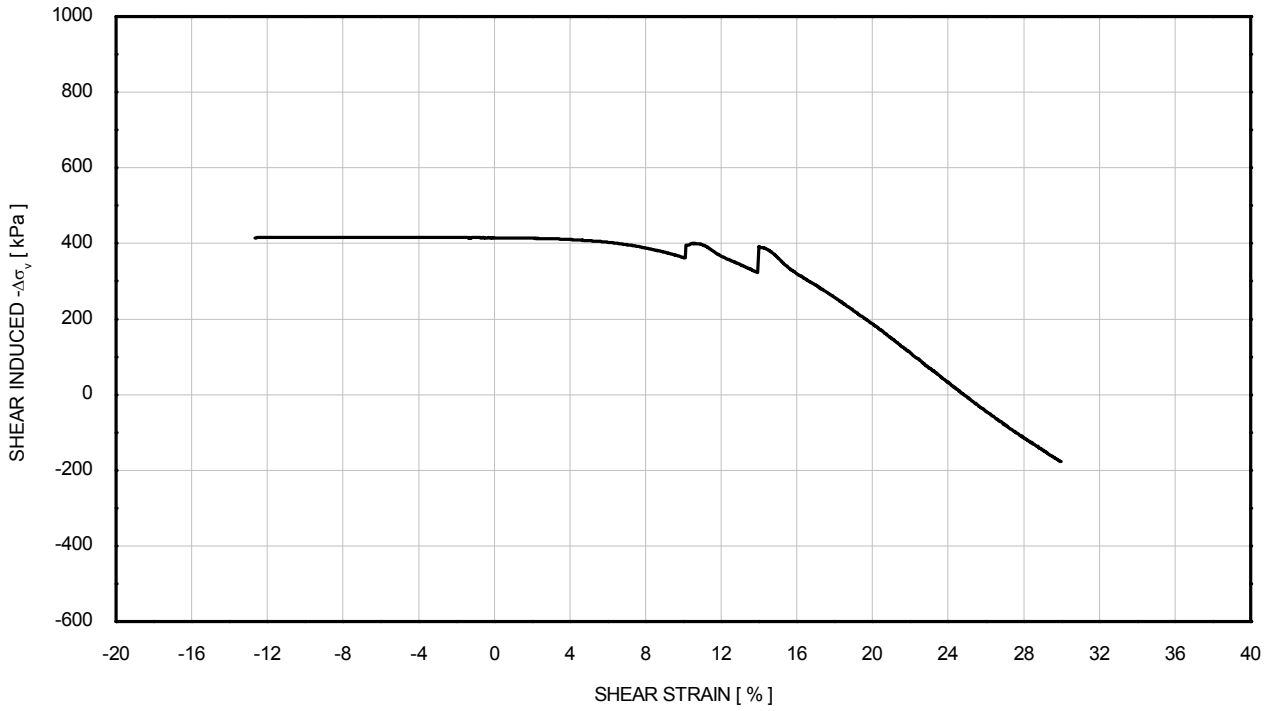




σ_{vc}	:	420 kPa	Batch	: 7
Mean τ_{av}	:	0 kPa	Sample	: CSS_7-2
Mean τ_{cy}	:	82 kPa	Unit	: Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	: CSS21

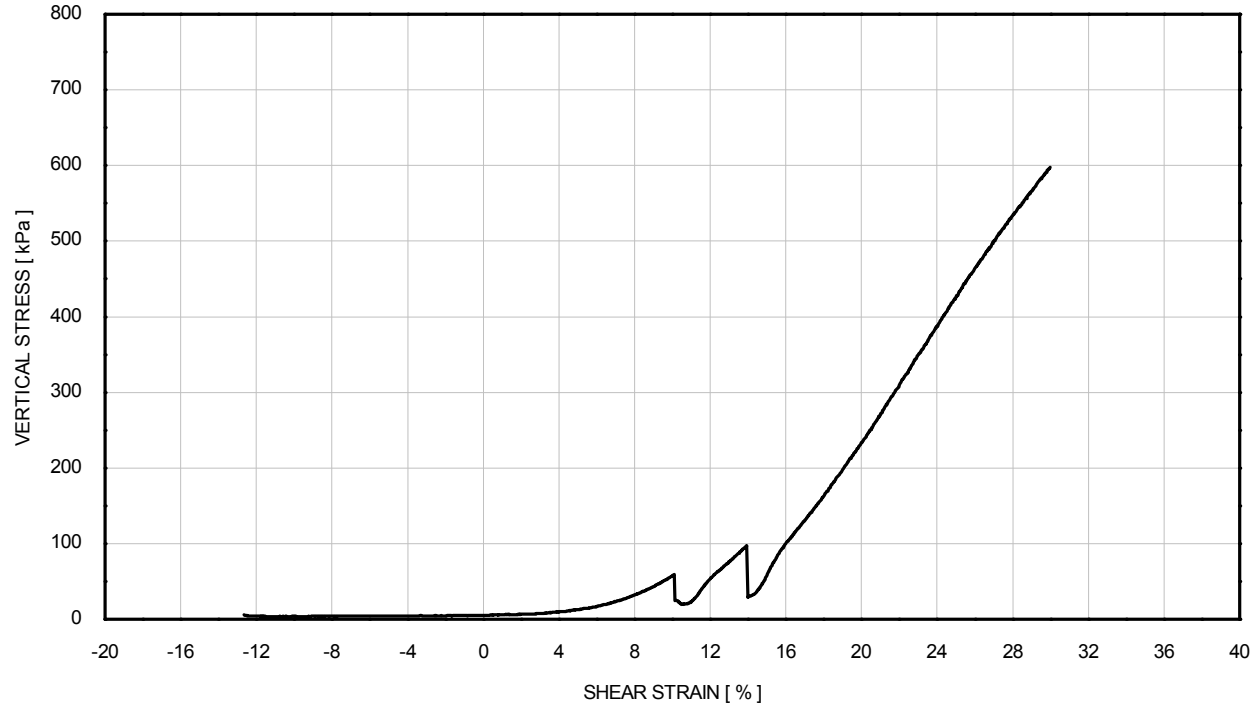
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

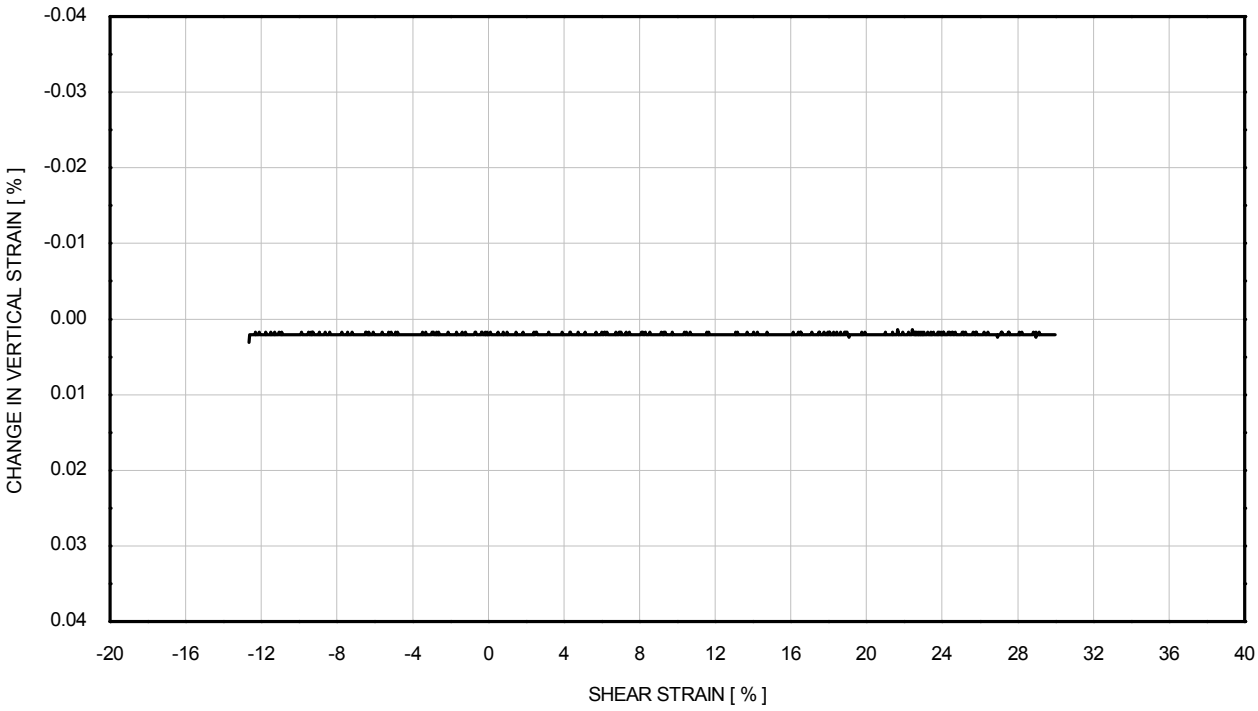




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 359 kPa	Sample	: CSS_7-2
γ at τ_{peak}	: 29.97 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.99 %/hour	Test No.	: CSS21

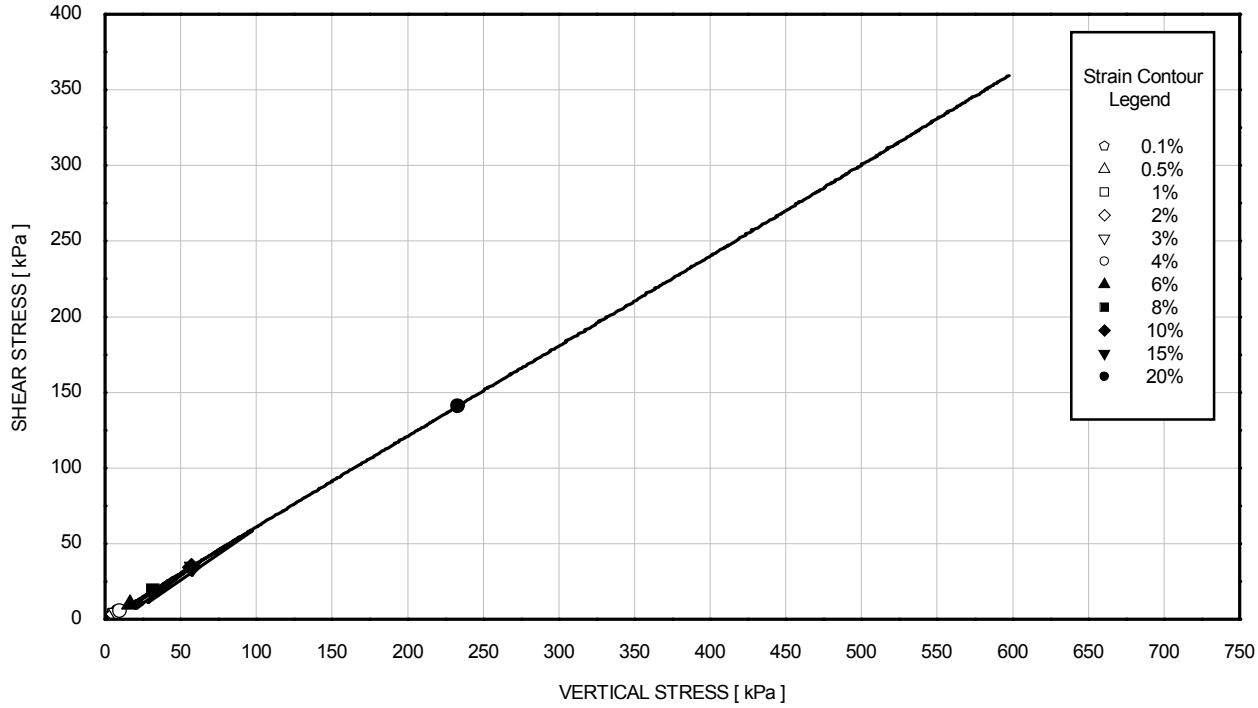
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

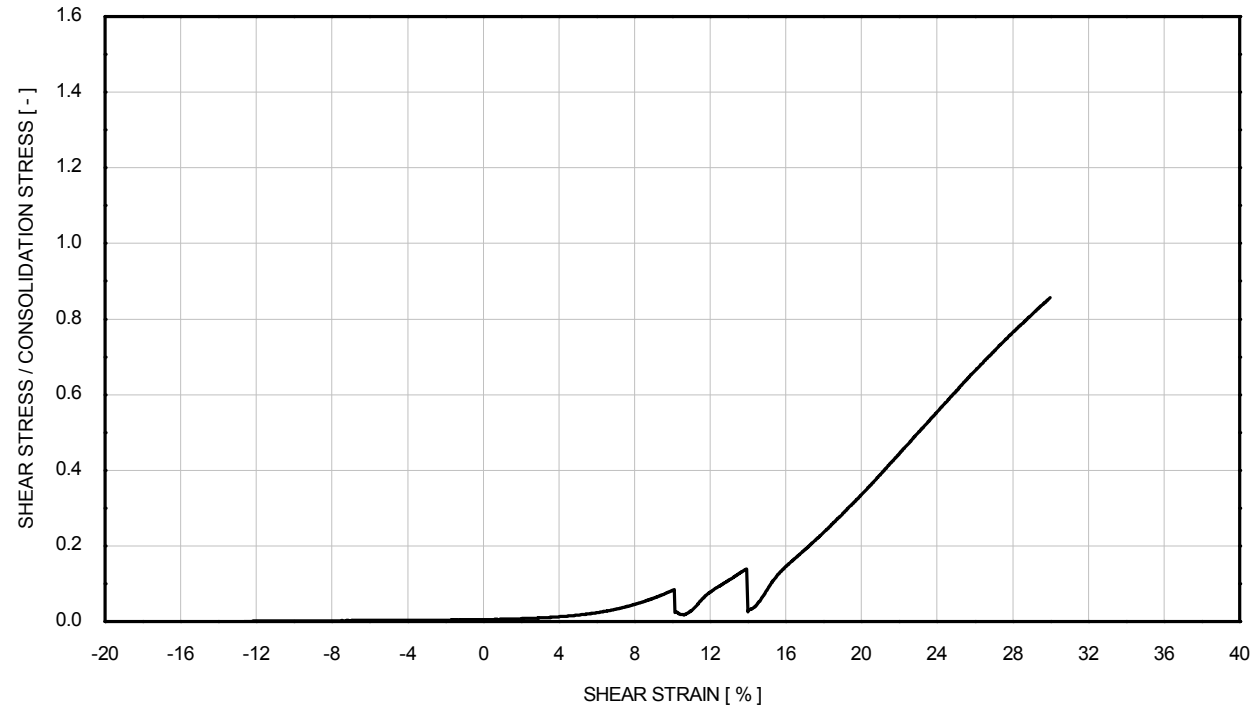




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 359 kPa	Sample	: CSS_7-2
γ at τ_{peak}	: 29.97 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.99 %/hour	Test No.	: CSS21

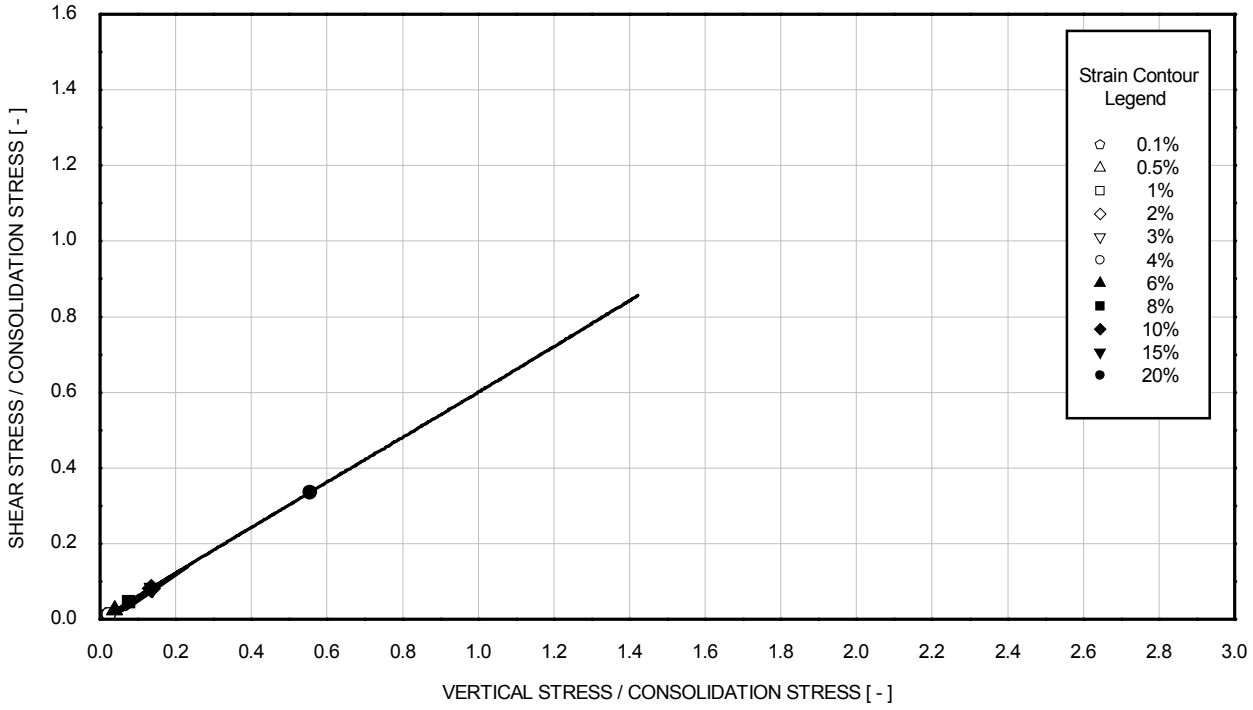
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

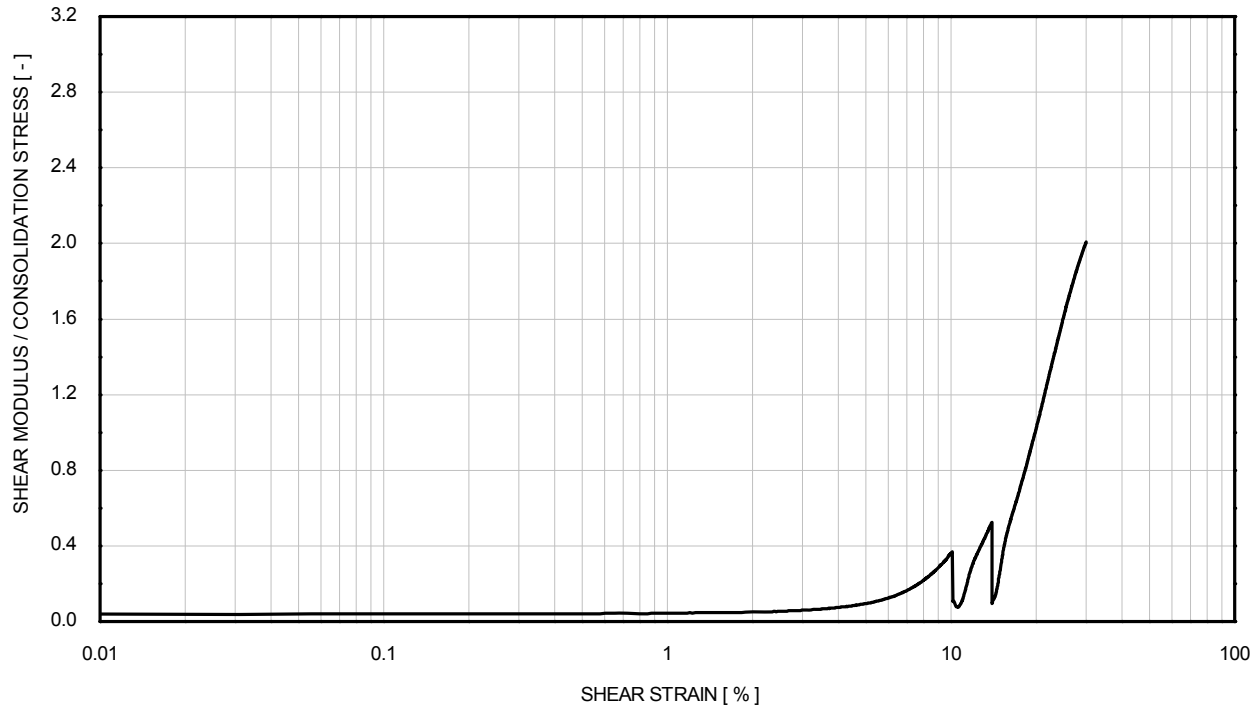




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 359 kPa	Sample	: CSS_7-2
γ at τ_{peak}	: 29.97 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.99 %/hour	Test No.	: CSS21

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 359 kPa	Sample	: CSS_7-2
γ at τ_{peak}	: 29.97 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.99 %/hour	Test No.	: CSS21

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

VISUAL DESCRIPTION
Olive brown silty fine SAND

GENERAL	
Date test started	11/10/2016
Type of sample	Re-compacted
Specimen orientation	Vertical

INITIAL		
Diameter	[mm]	66.5
Length	[mm]	30.0
Water content after compaction	[%]	11.3
Bulk density after compaction	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.698
Degree of saturation after compaction	[%]	43
Assumed particle density	[Mg/m³]	2.65
Water content at start of test	[%]	26.3
Bulk density at start of test	[Mg/m³]	1.97
Degree of saturation at start of test	[%]	100

TESTING PROCEDURES USED	
Specimen set-up	Fugro in house procedure (available upon request) based on ASTM D6528-07
Consolidation	Fugro in house procedure (available upon request) based on ASTM D6528-07
Shearing	Fugro in house procedure (available upon request) based on ASTM D6528-07

Note:
Vertical stress / vertical strain refers to the directionality of load application within the equipment

QUALITY ASSURANCE	
Filename	J11335 \ Batch 7_CSS22
Template issue	1.4
Processed by Date	JLS 14/11/2016
Checked by Date	PH 28/11/2016
Approved by Date	PH 28/11/2016

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-3
Unit	Unit D (Yarmouth Roads)
Test number	CSS22

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

CONSOLIDATION		
σ_{vc}	[kPa]	420
Vertical strain	[%]	1.14
Bulk density	[Mg/m^3]	1.98
Dry density	[Mg/m^3]	1.58
Void ratio	[-]	0.678
Water content	[%]	25.6

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VERTICAL STRESS		
σ_v	[kPa]	420
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	21
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
Vertical strain	[%]	1.18
Bulk density	[Mg/m^3]	1.98
Dry density	[Mg/m^3]	1.58
Void ratio	[-]	0.678

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	0.37	0.07	30.60	4.72
2	0.36	0.07	32.15	3.46
5	0.36	0.06	32.83	2.67
10	0.36	0.06	32.78	2.39
20	0.36	0.06	32.42	2.29
50	0.35	0.06	32.42	1.73
100	0.35	0.06	32.42	1.95
200	0.35	0.06	32.46	1.51
300	0.35	0.07	31.60	1.54
400	0.35	0.06	32.87	1.55

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-3
Unit	Unit D (Yarmouth Roads)
Test number	CSS22

SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

STRESS-CONTROLLED CYCLIC LOADING – CONSTANT VOLUME		
Reference stress	[kPa]	420
Mean τ_{av}	[kPa]	0
Mean τ_{cy}	[kPa]	125
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	8
γ_{av} at N_f	[%]	-0.45
γ_{cy} at N_f	[%]	16.15
Shear induced $-\Delta\sigma_v$ at N_f	[kPa]	316
Vertical strain	[%]	0.00

Cycle (N)	γ_{av} [%]	γ_{cy} [%]	G [MPa]	λ [%]
1	-0.72	3.61	3.42	24.64
2	-0.74	5.16	2.40	18.64
3	-0.77	6.60	1.88	14.14
4	-0.73	8.07	1.54	11.32
5	-0.39	9.85	1.27	13.24
6	-0.89	11.78	1.06	6.54
7	-0.90	14.00	0.90	8.83
8	-0.45	16.15	0.78	10.51

SHEARING – CONSTANT VOLUME		
At peak shear stress		
Shear stress	[kPa]	467
Shear strain	[%]	29.99
Shear induced $-\Delta\sigma_v$	[kPa]	-337
Vertical stress	[kPa]	757
Vertical strain	[%]	0.00
Rate of strain	[%/hour]	2.98
At 15 % shear strain		
Shear stress	[kPa]	119
Shear induced $-\Delta\sigma_v$	[kPa]	239
Vertical stress	[kPa]	181
Vertical strain	[%]	0.00

TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-3
Unit	Unit D (Yarmouth Roads)
Test number	CSS22

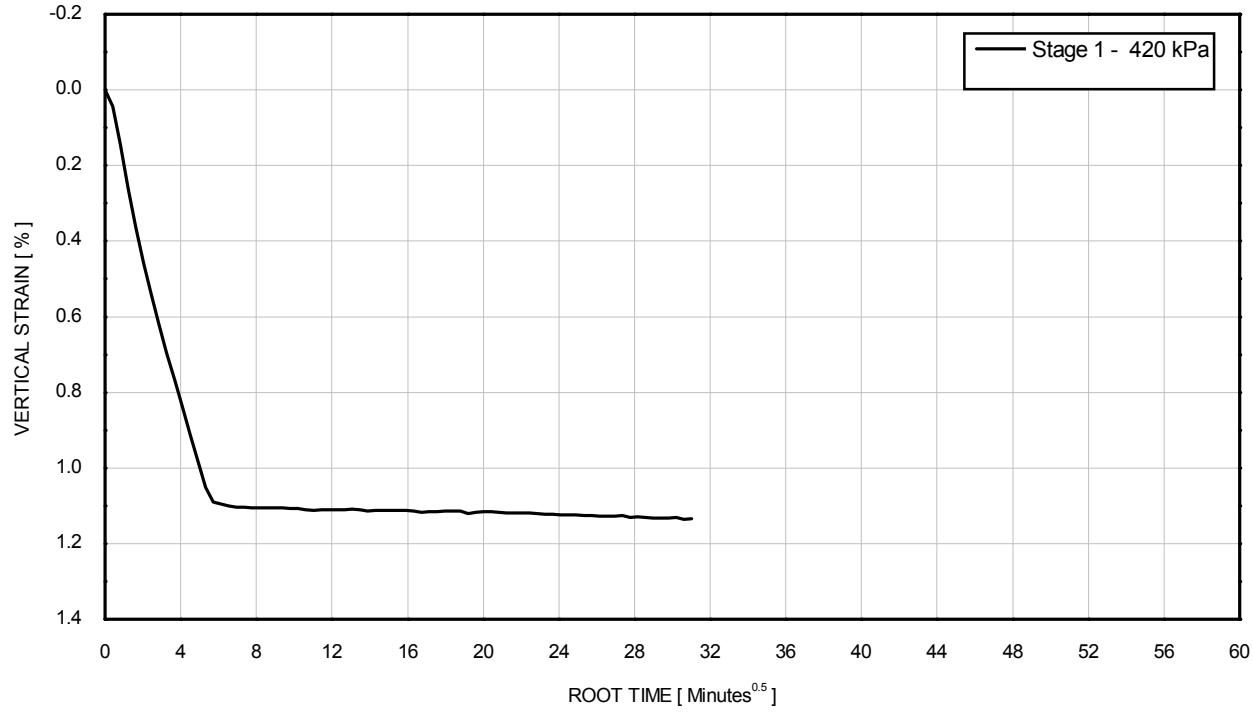
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

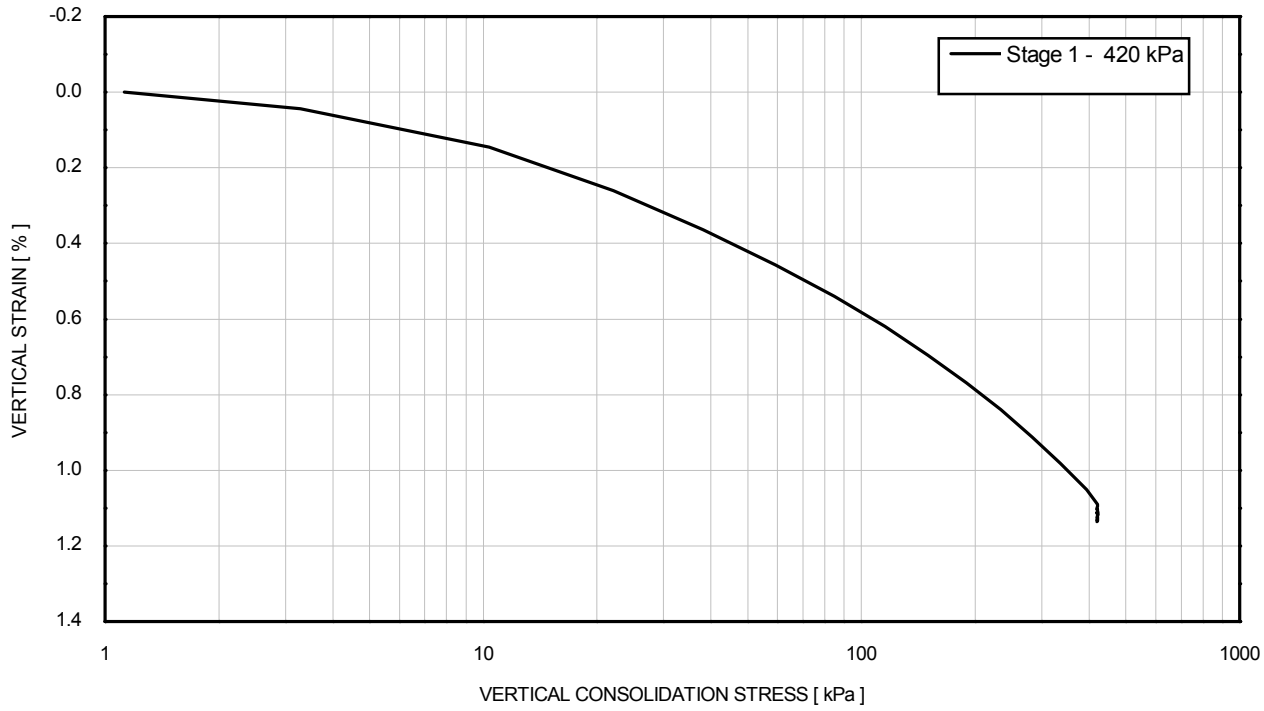
SPECIMEN PHOTOGRAPH



TEST IDENTIFICATION	
Batch	7
Sample	CSS_7-3
Unit	Unit D (Yarmouth Roads)
Test number	CSS22

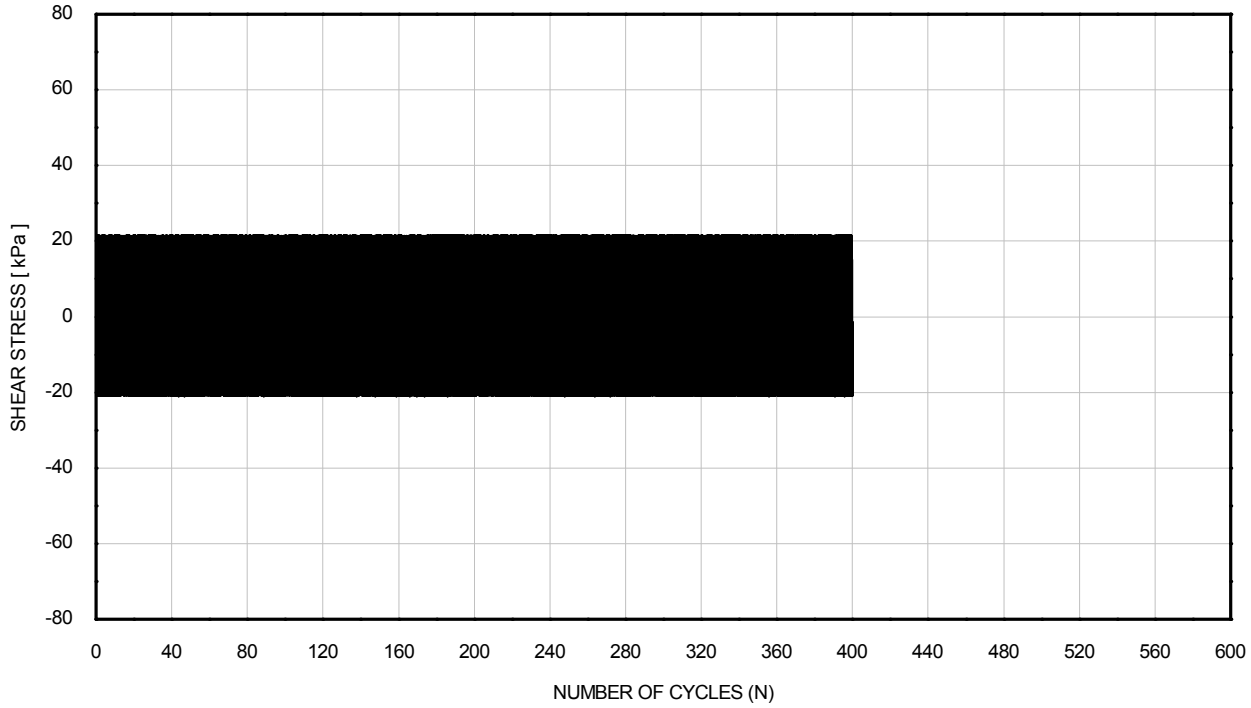
SUMMARY OF CONSOLIDATED CYCLIC DSS TEST

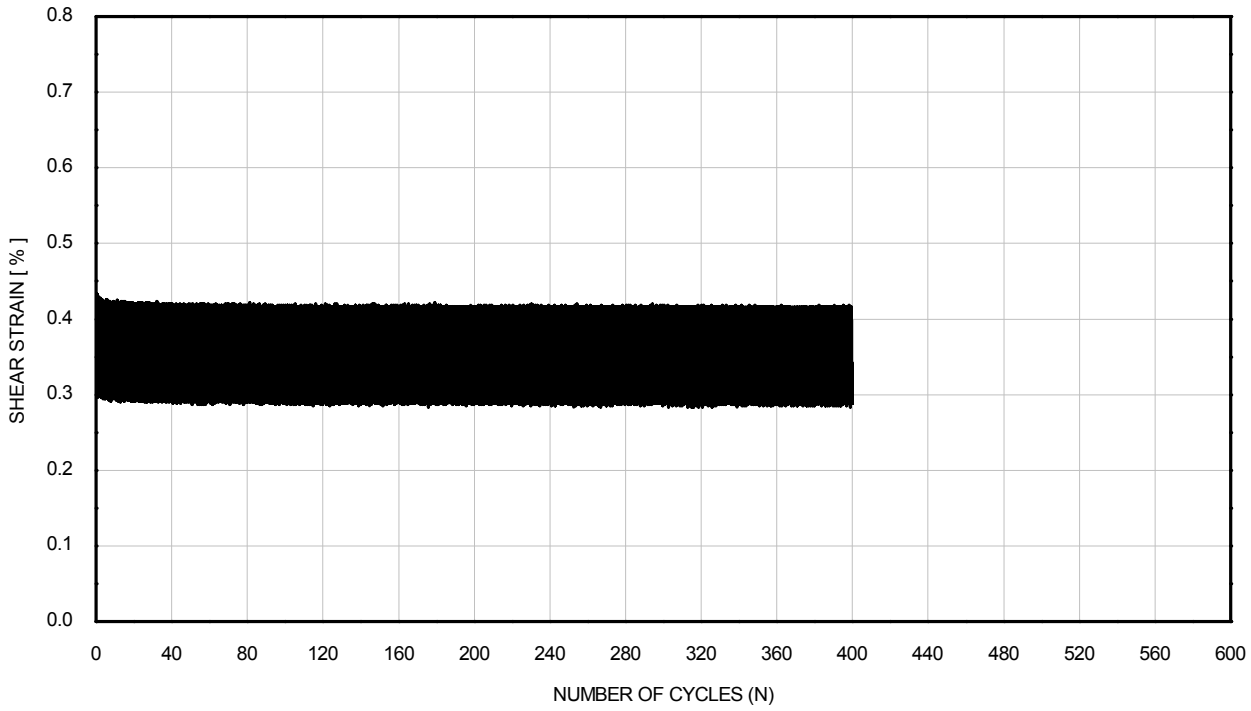




σ_{vc}	: 420 kPa	Batch	: 7
		Sample	: CSS_7-3
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CSS22

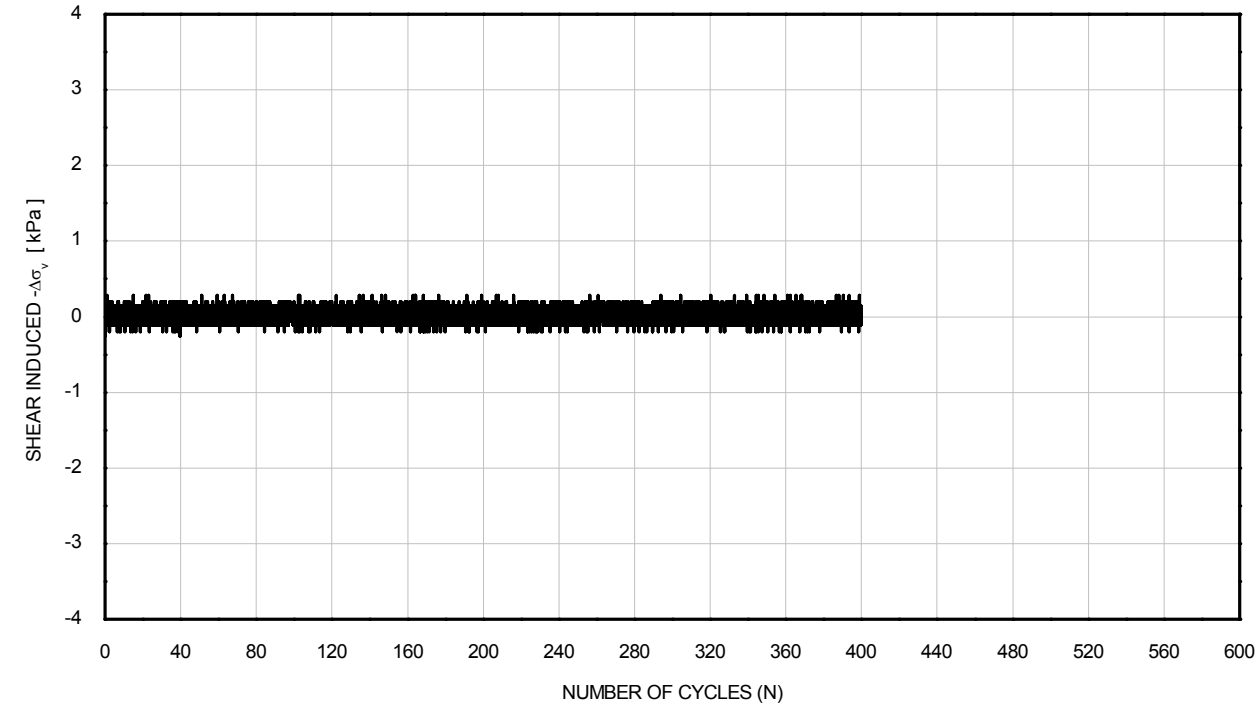
CONSOLIDATED CYCLIC DSS TEST
CONSOLIDATION STAGE

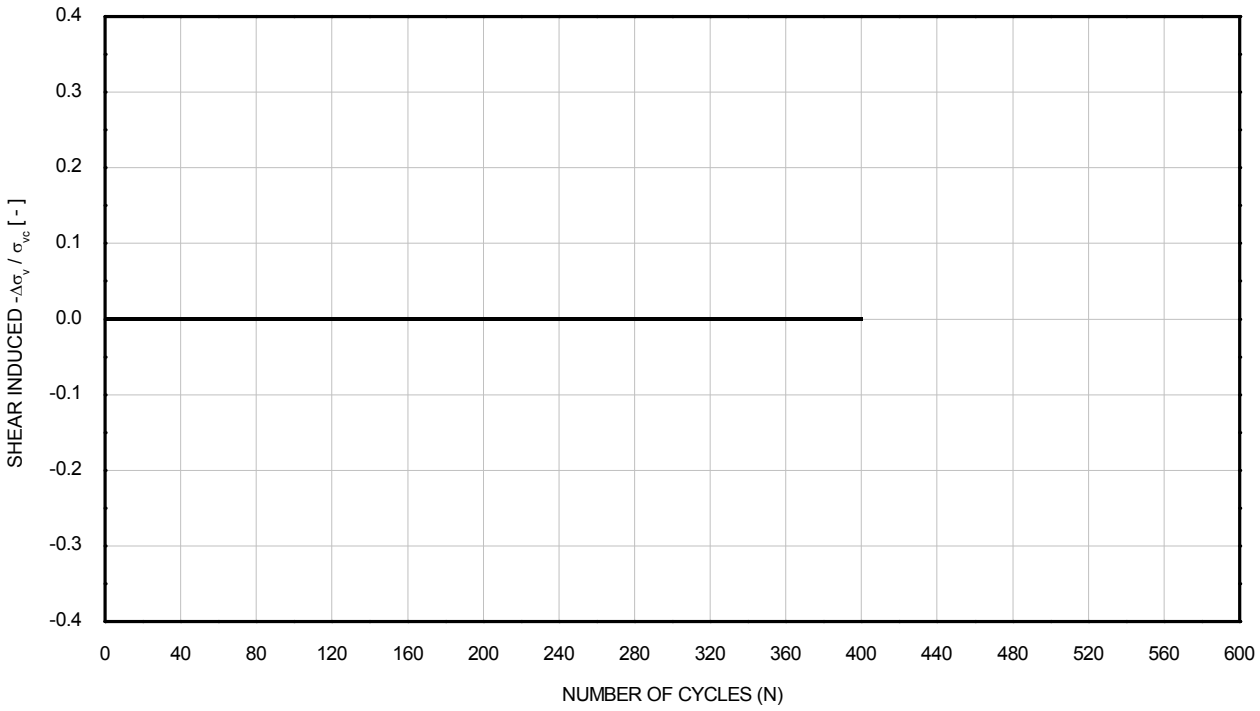




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

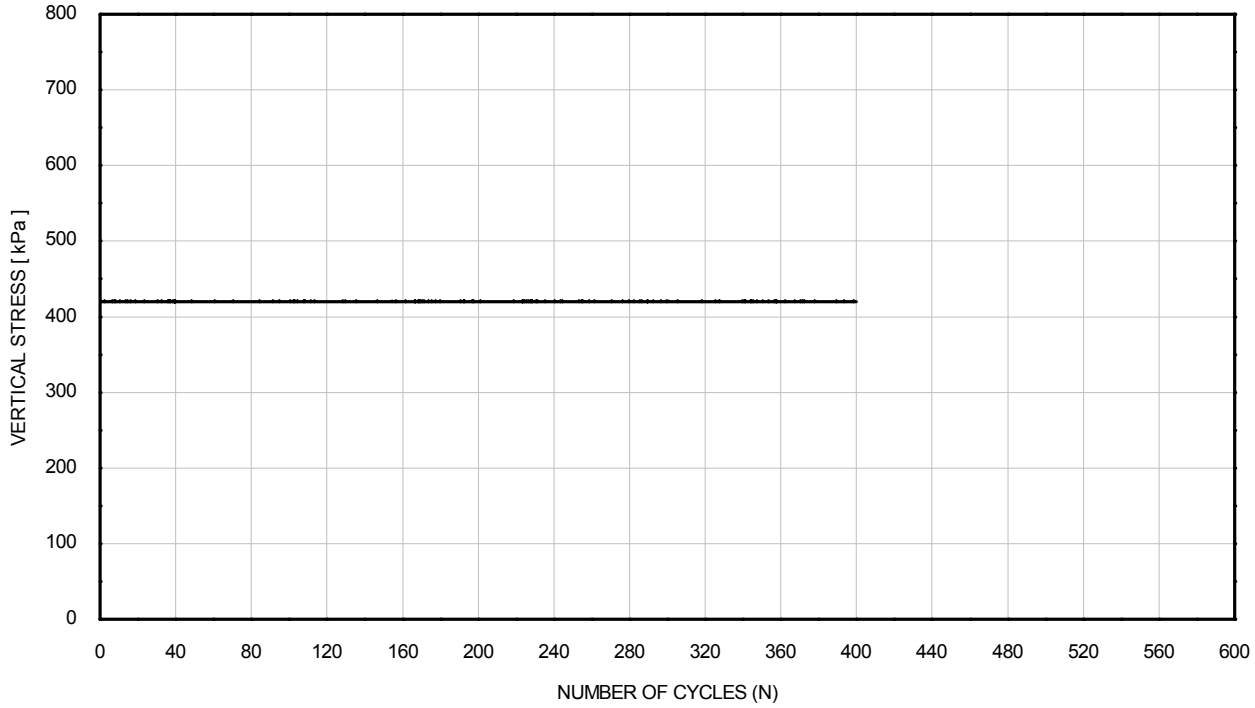
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

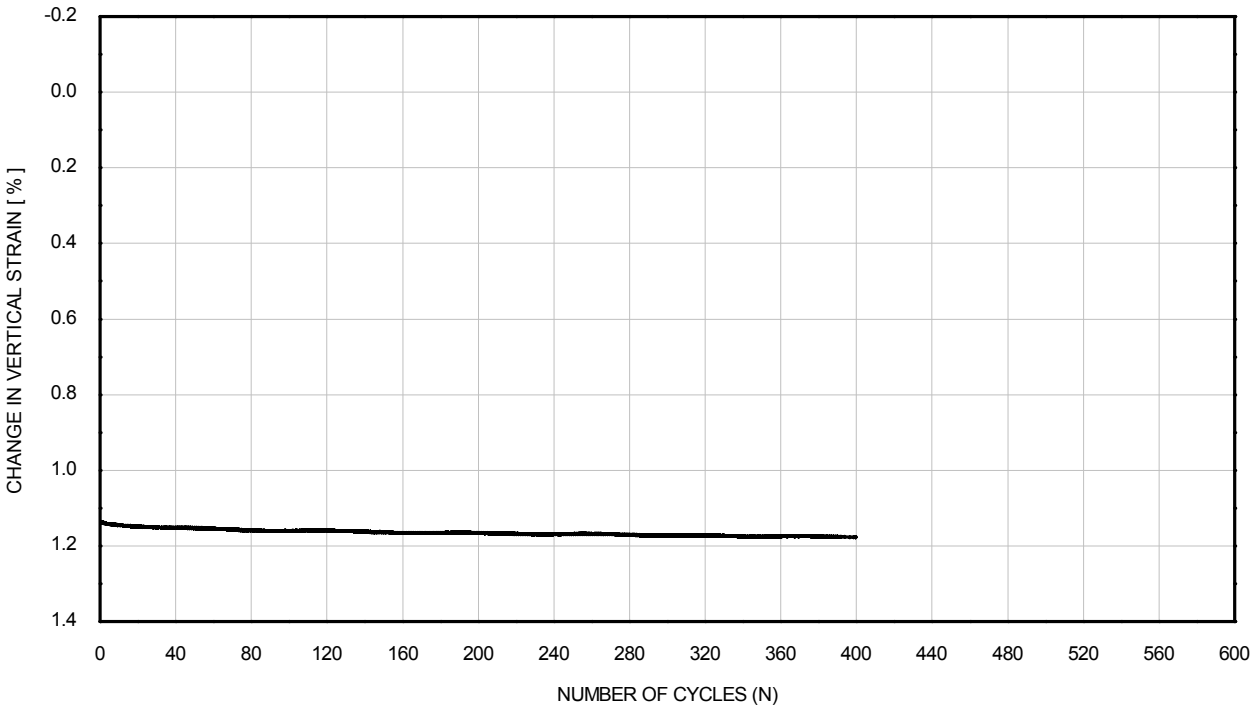




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

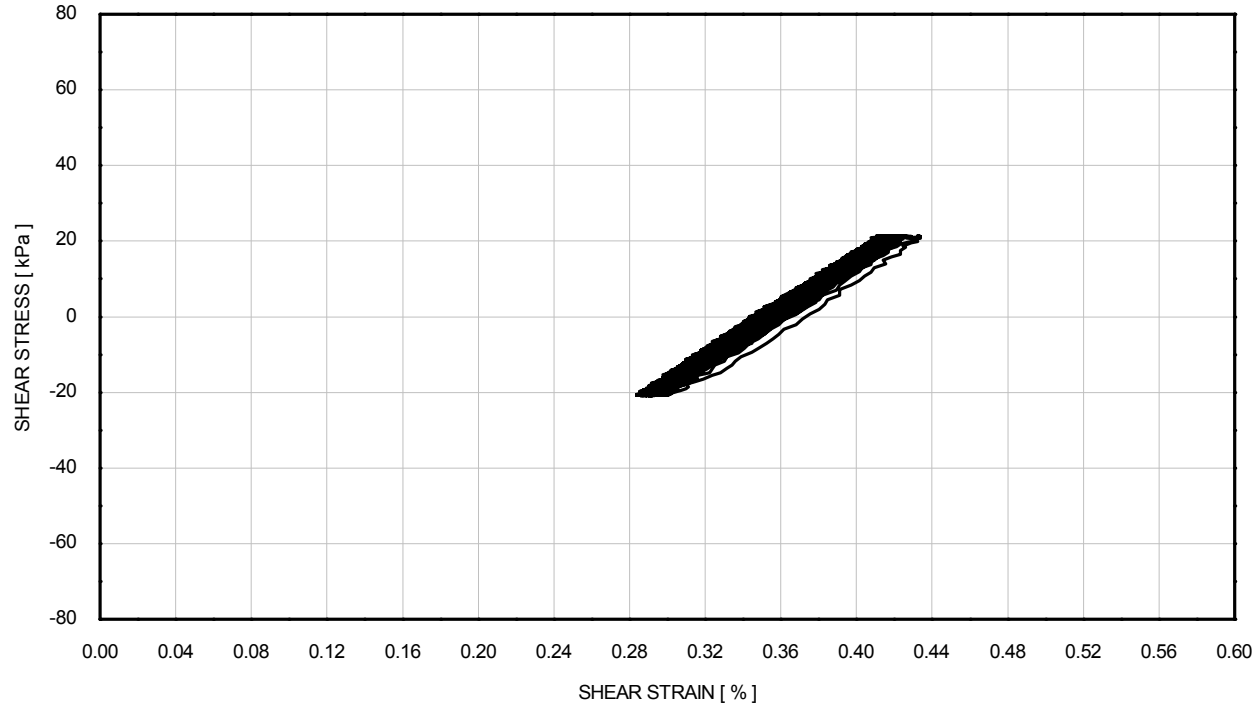
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

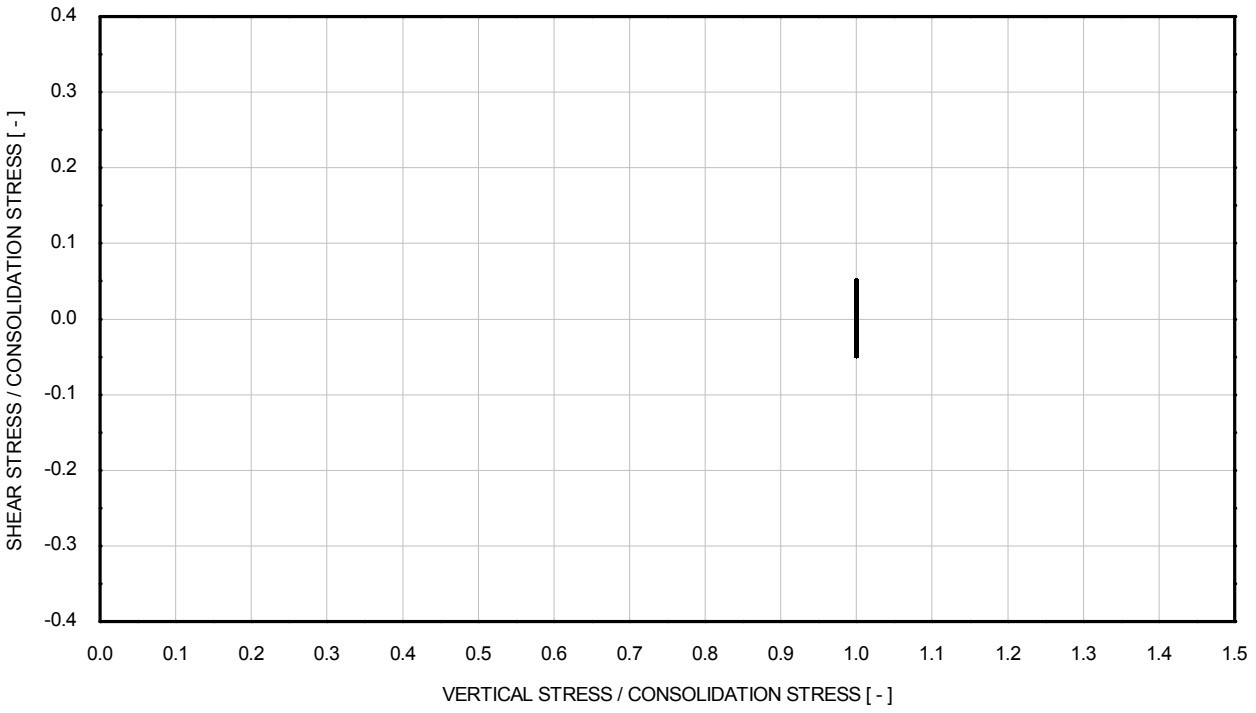




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

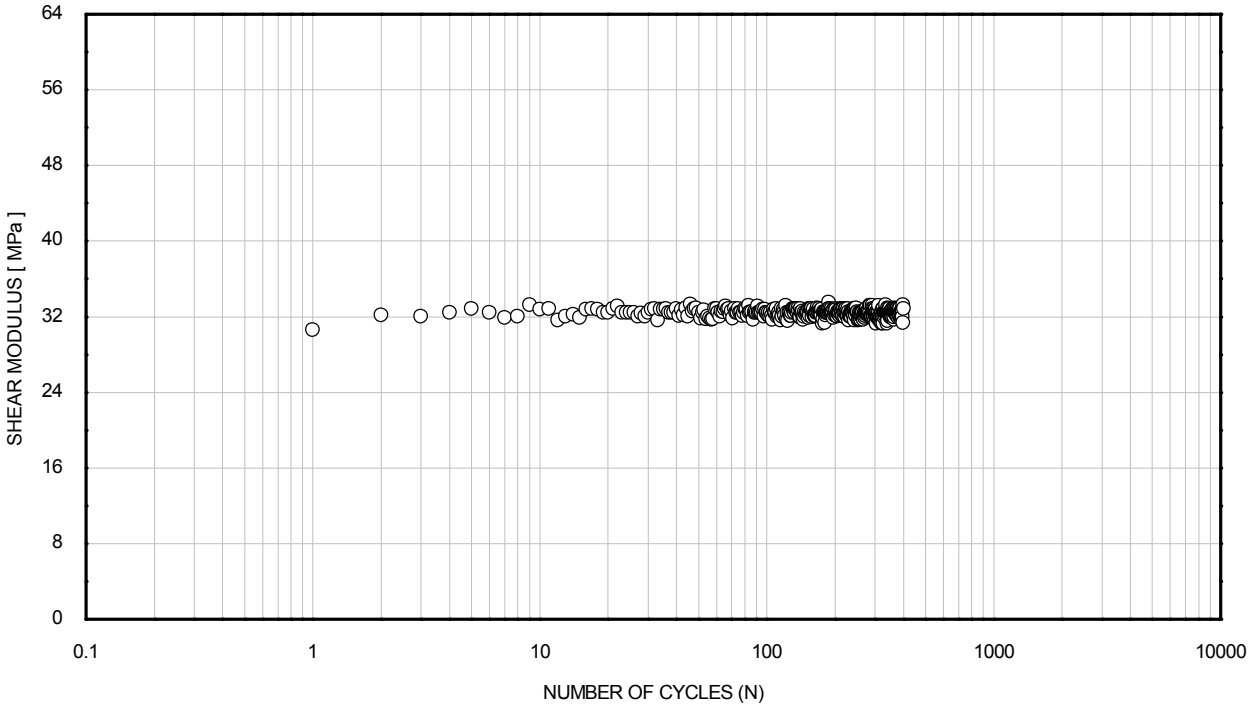
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

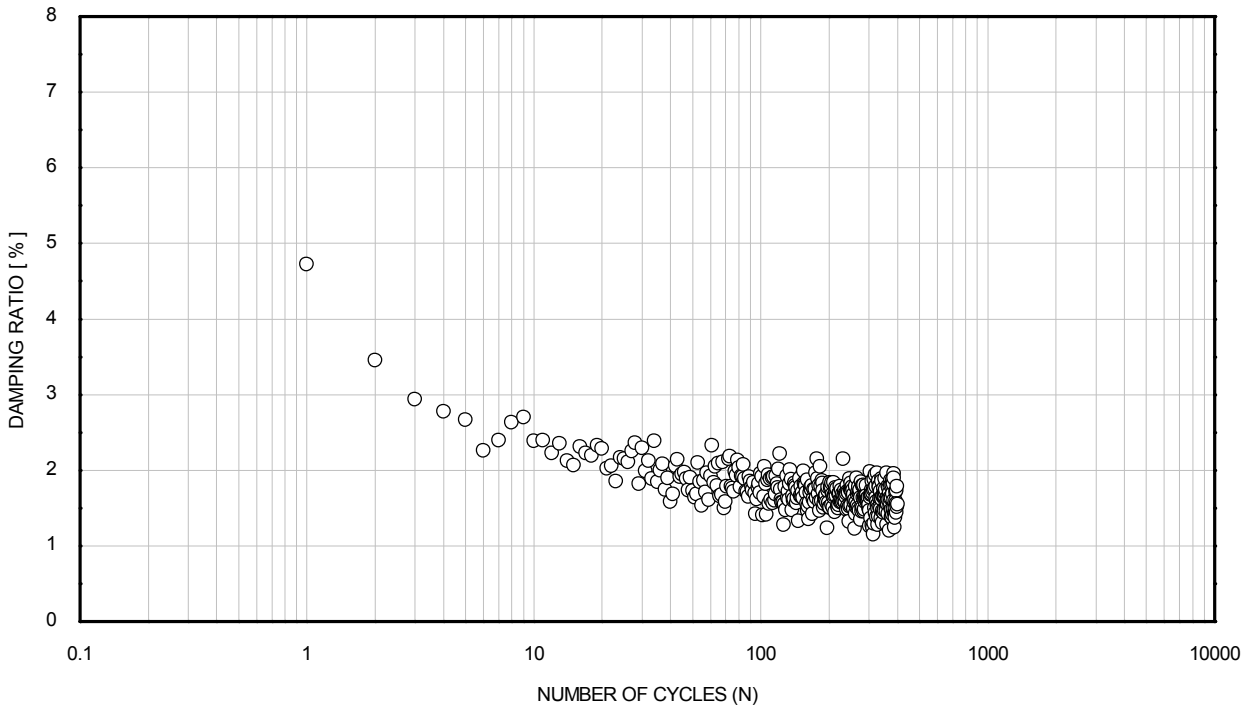




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

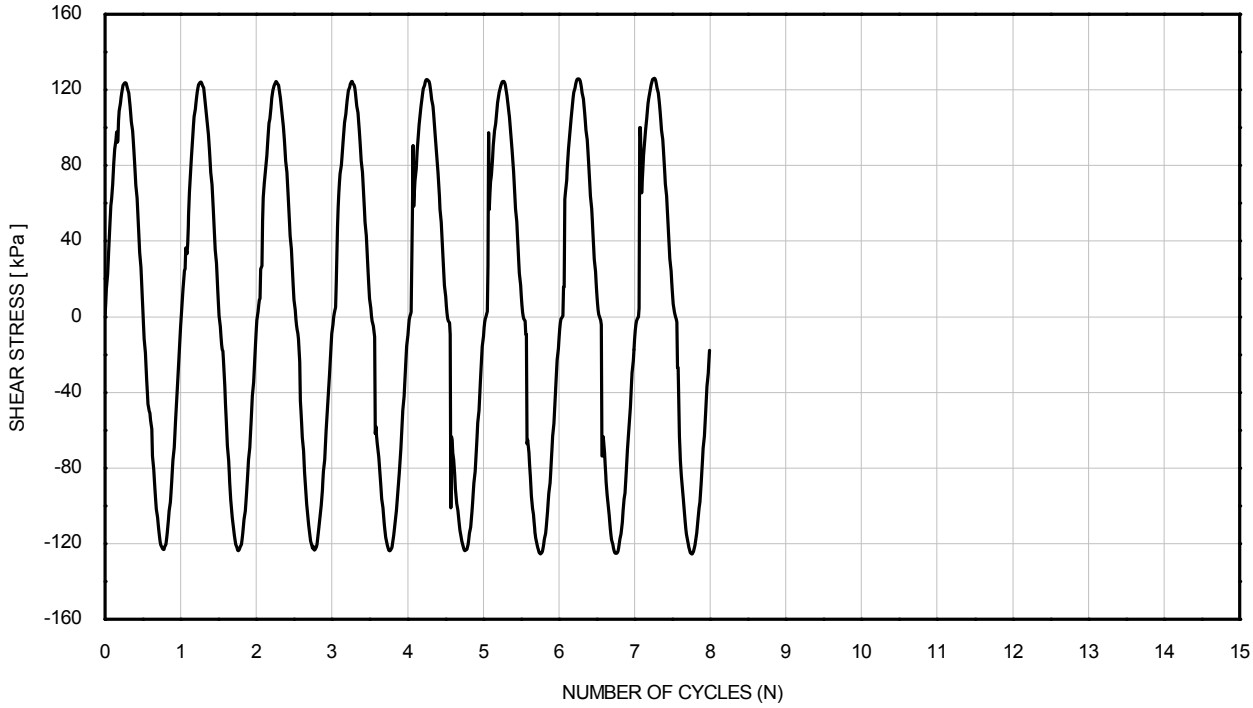
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

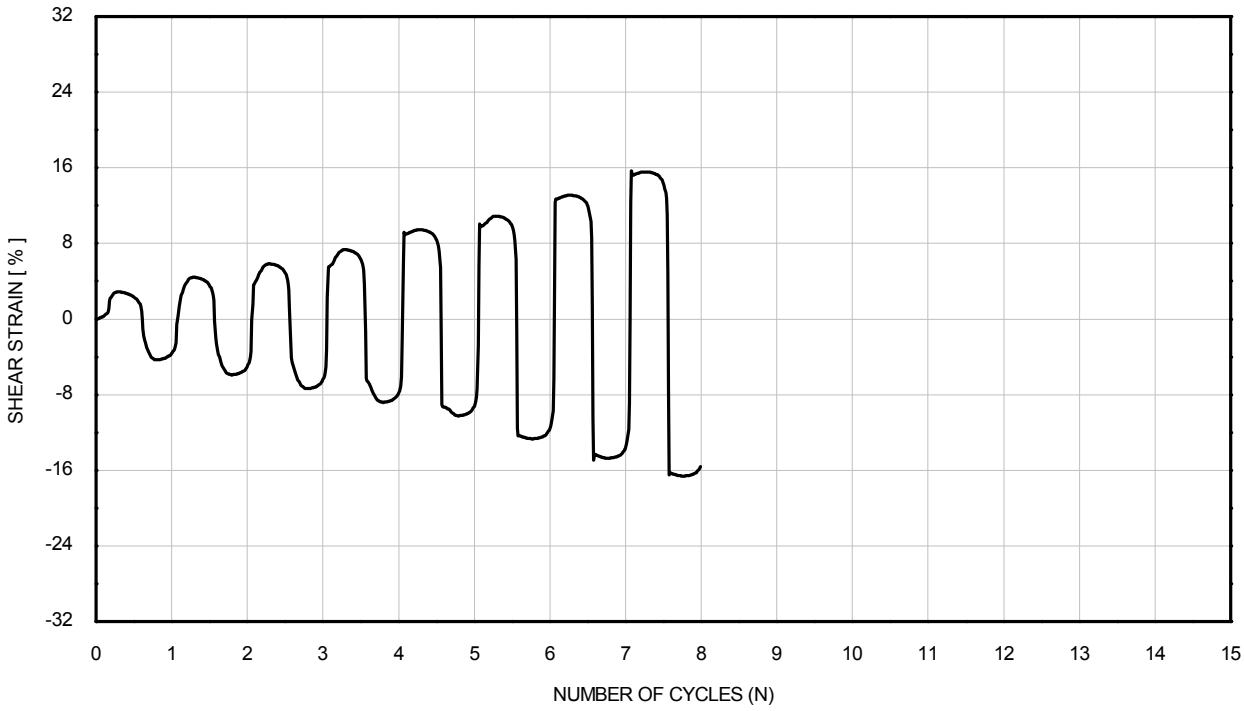




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	21 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

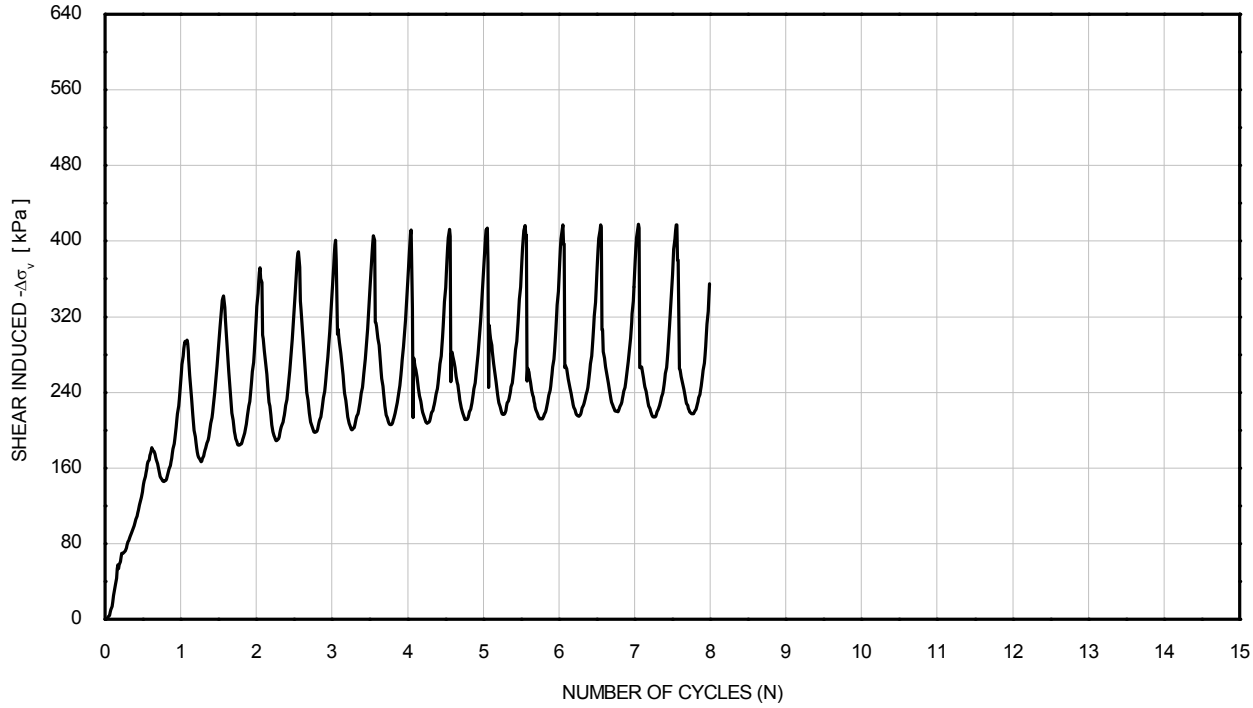
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VERTICAL STRESS

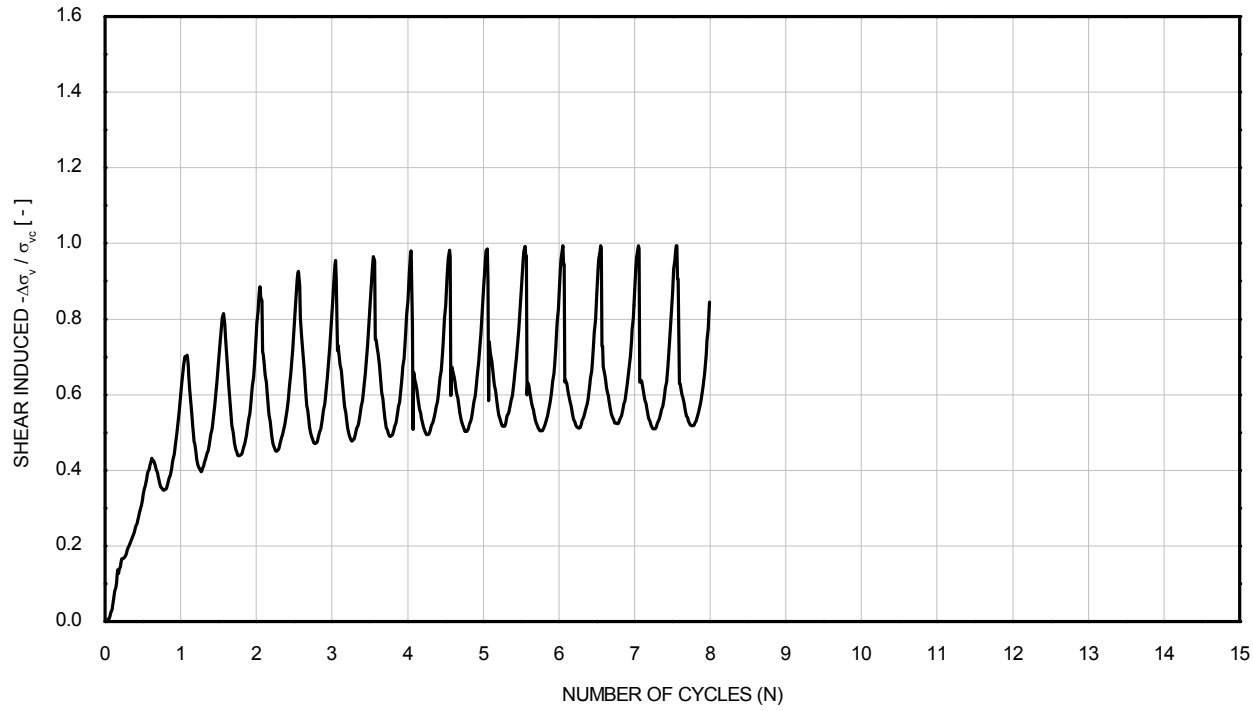




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	125 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

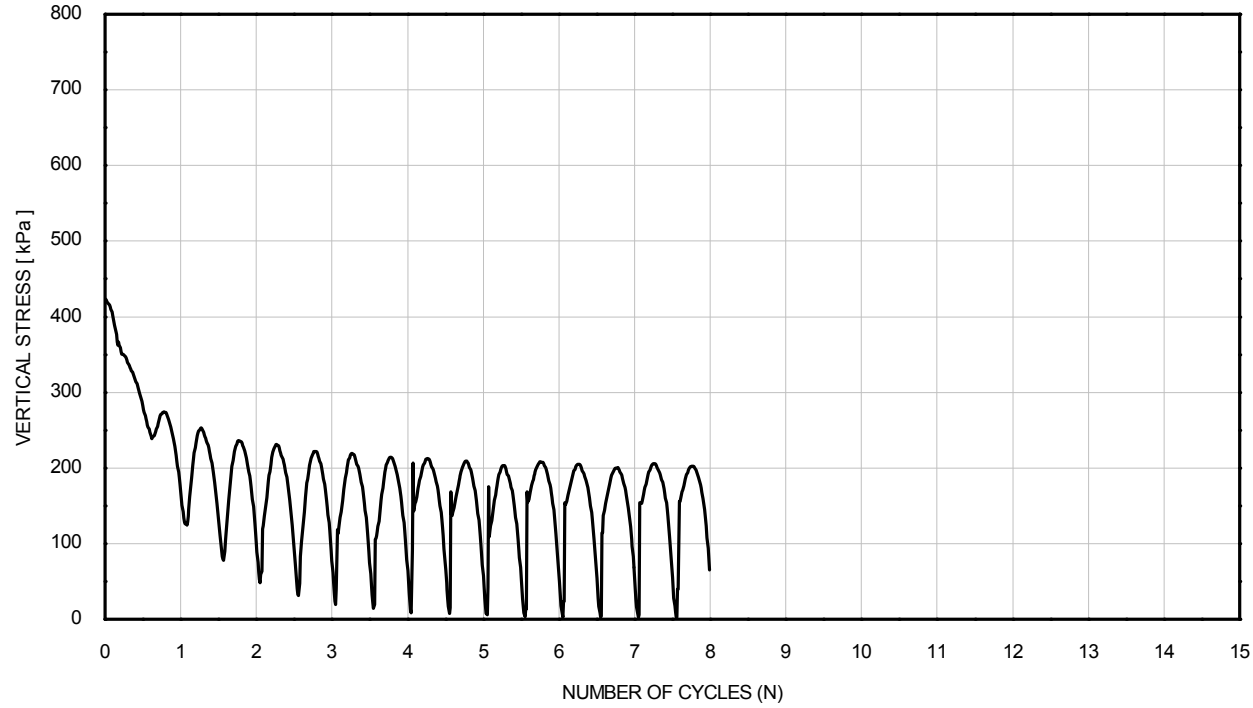
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

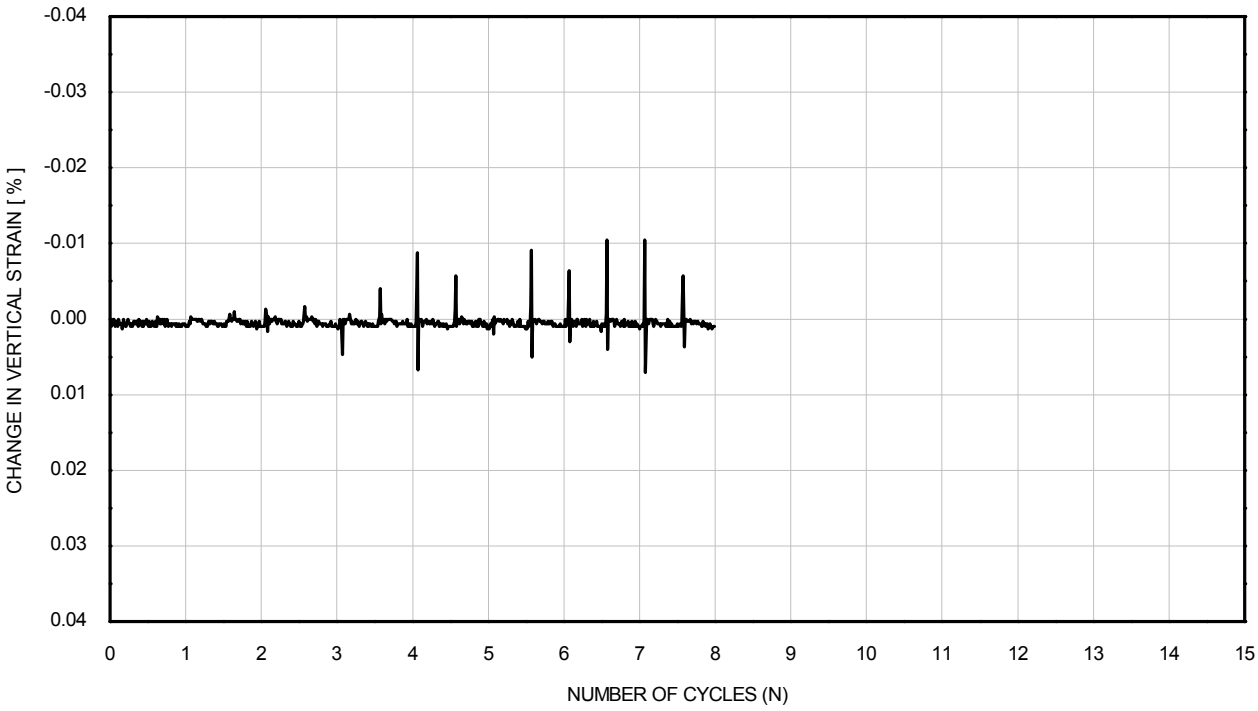




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	125 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

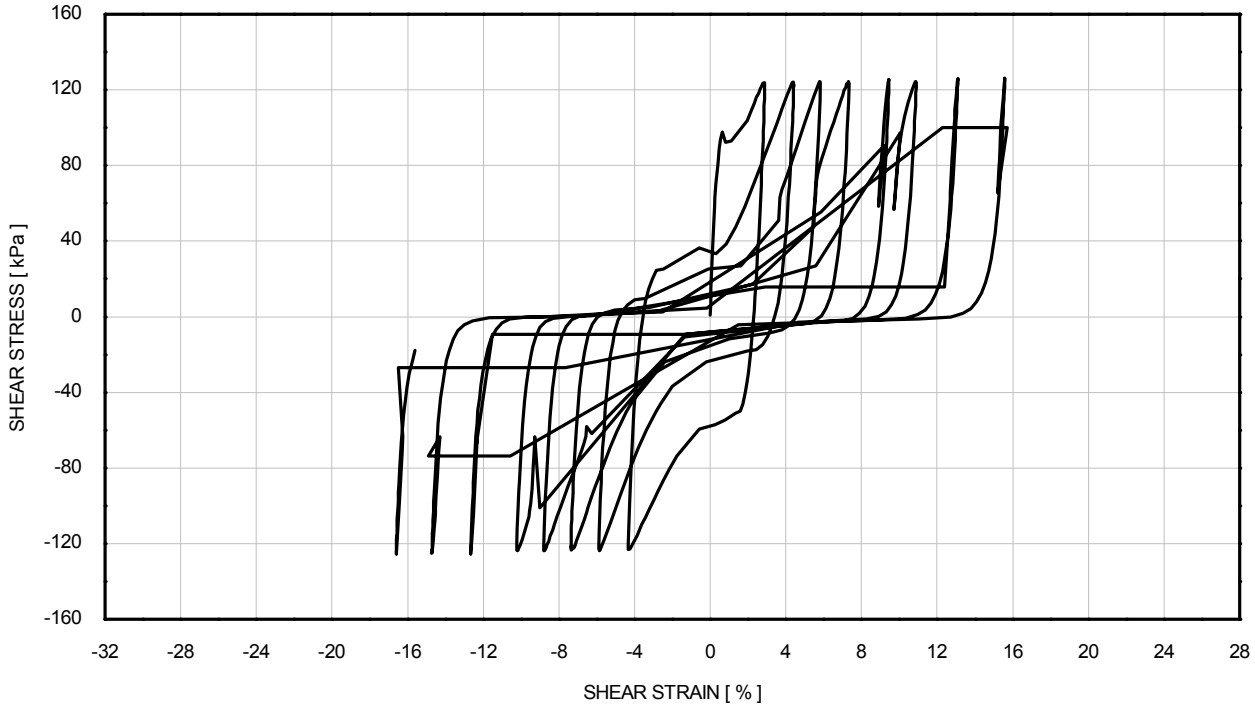
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STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

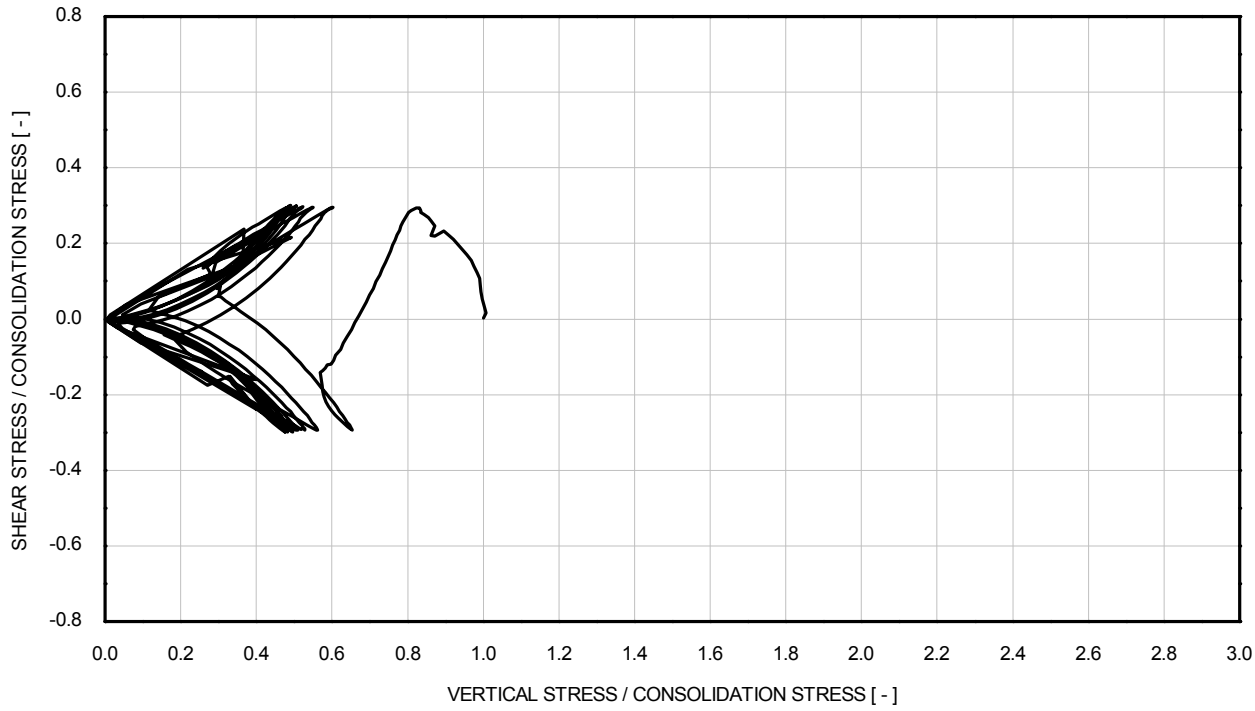




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	125 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

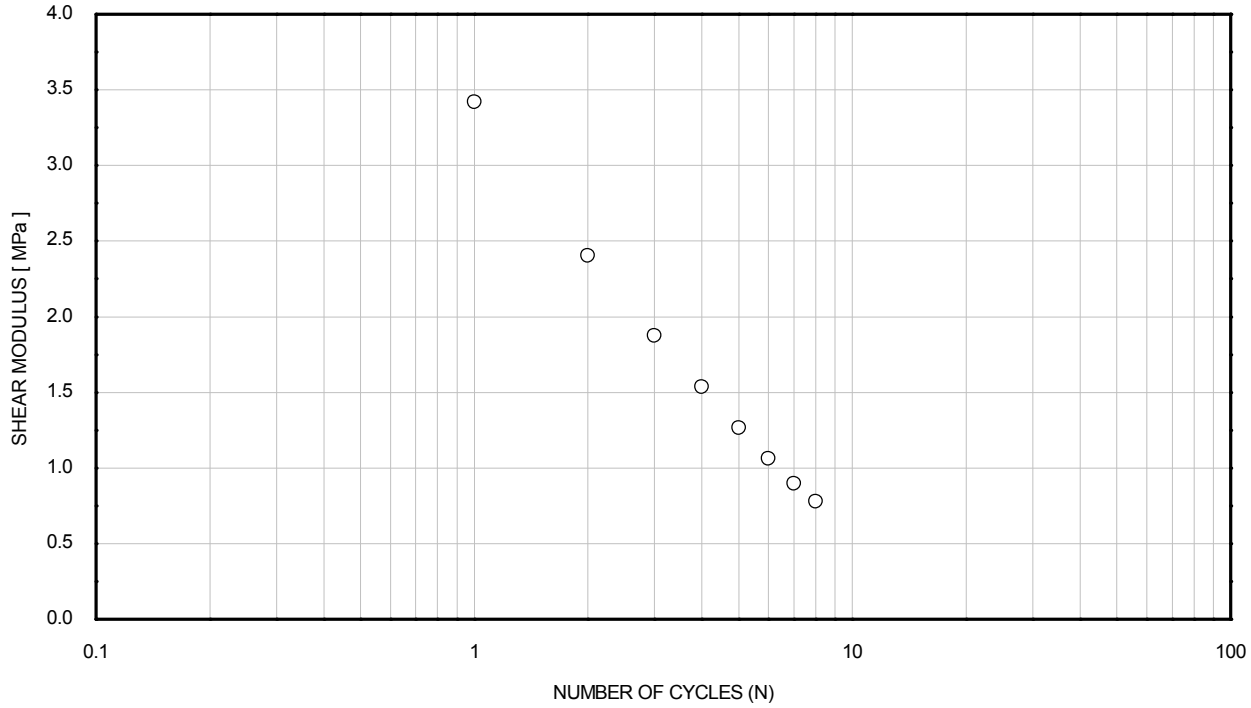
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

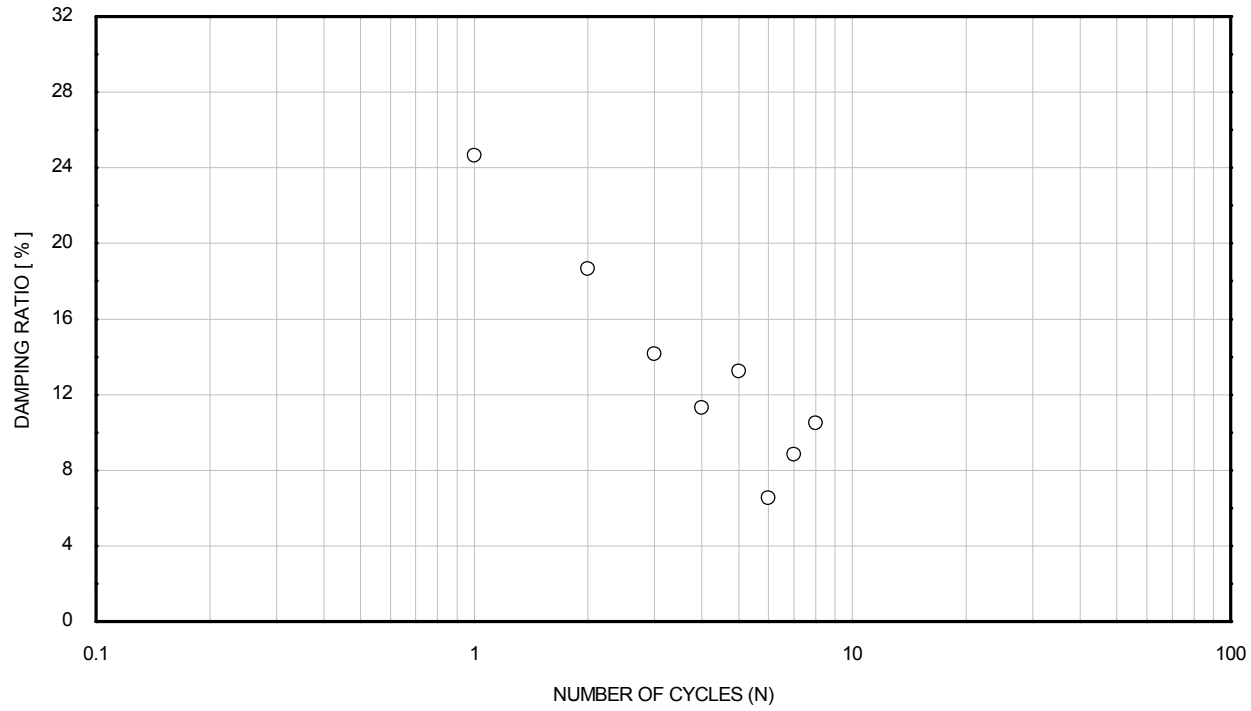




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	125 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

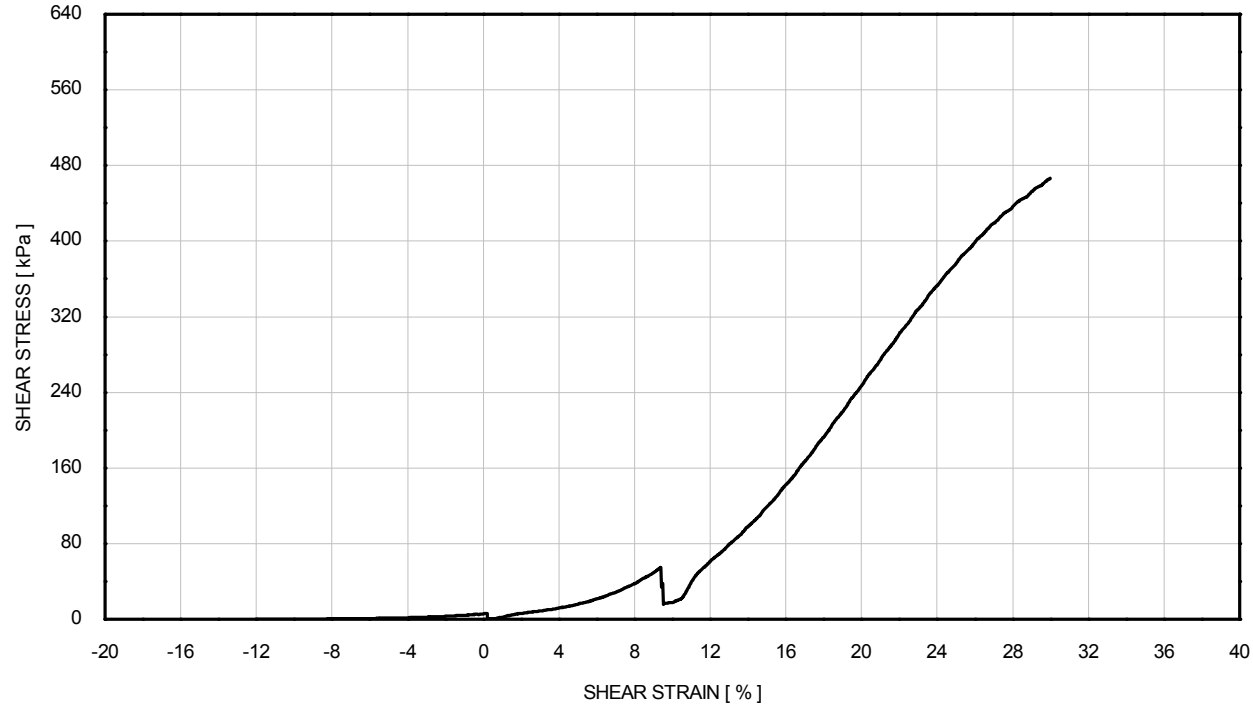
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

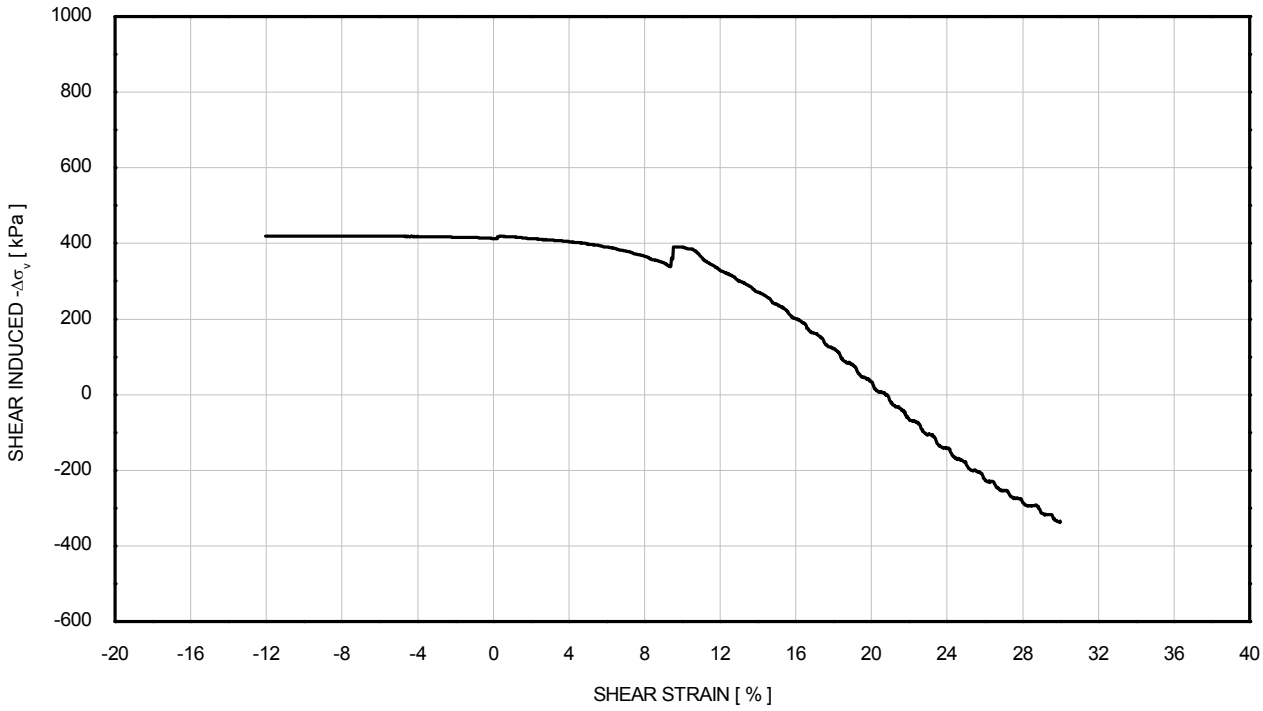




σ_{vc}	:	420 kPa	Batch	:	7
Mean τ_{av}	:	0 kPa	Sample	:	CSS_7-3
Mean τ_{cy}	:	125 kPa	Unit	:	Unit D (Yarmouth Roads)
Frequency	:	0.10 Hz	Test No.	:	CSS22

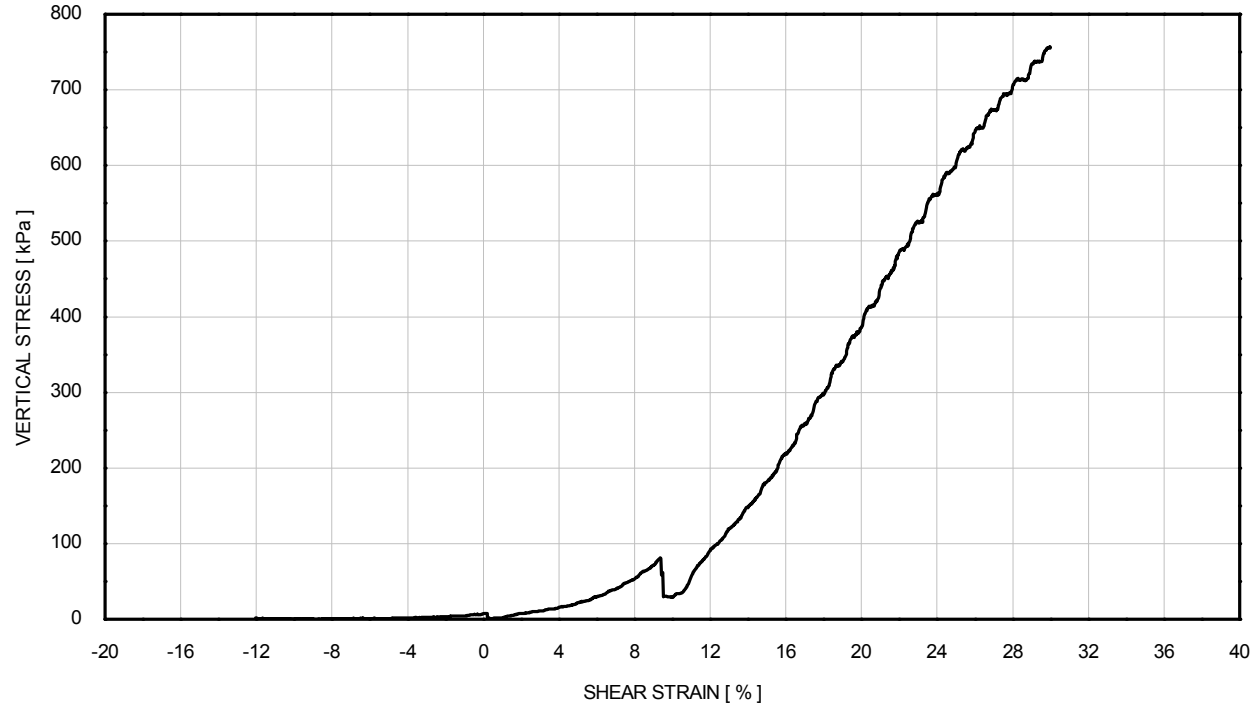
CONSOLIDATED CYCLIC DSS TEST
STRESS-CONTROLLED CYCLIC LOADING STAGE - CONSTANT VOLUME

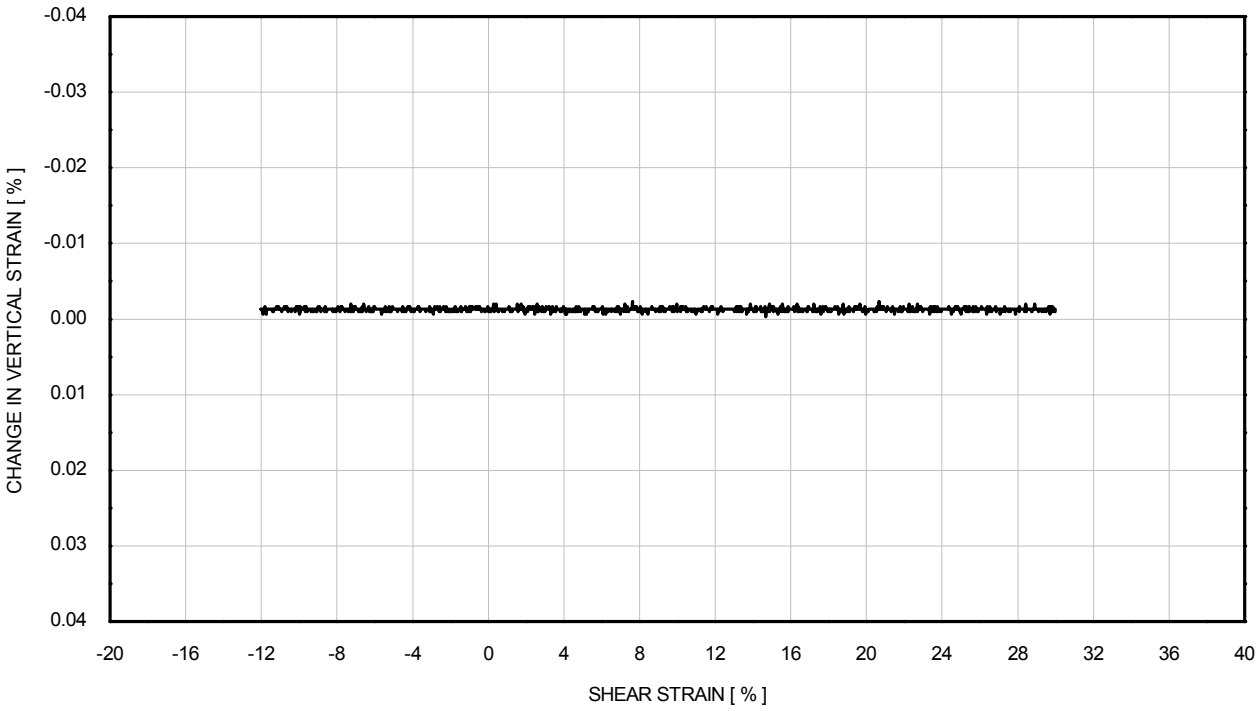




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 467 kPa	Sample	: CSS_7-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.98 %/hour	Test No.	: CSS22

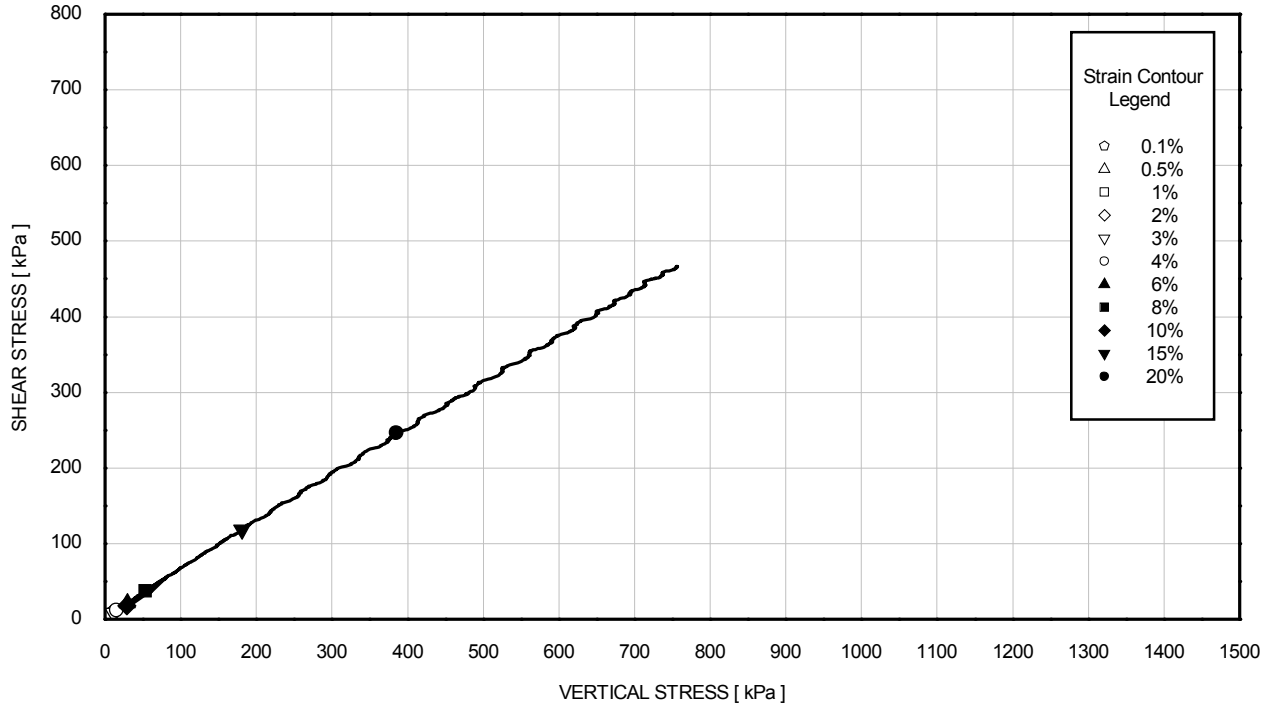
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

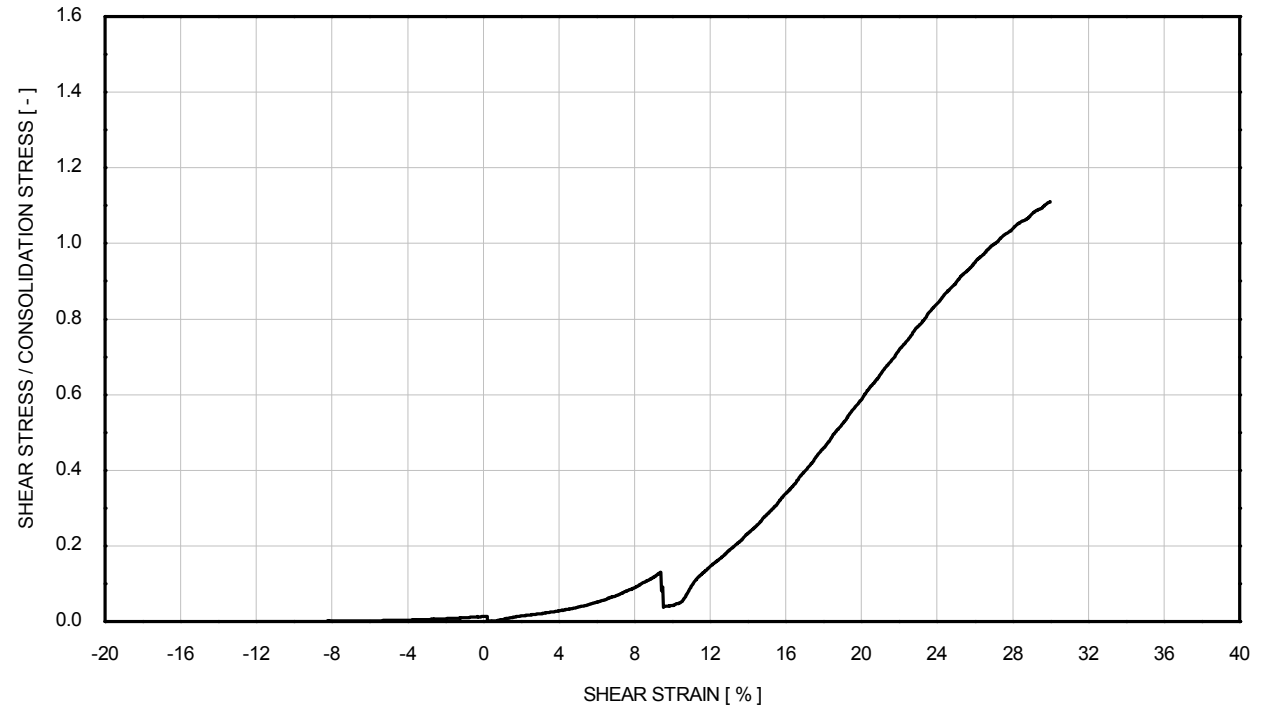




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 467 kPa	Sample	: CSS_7-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.98 %/hour	Test No.	: CSS22

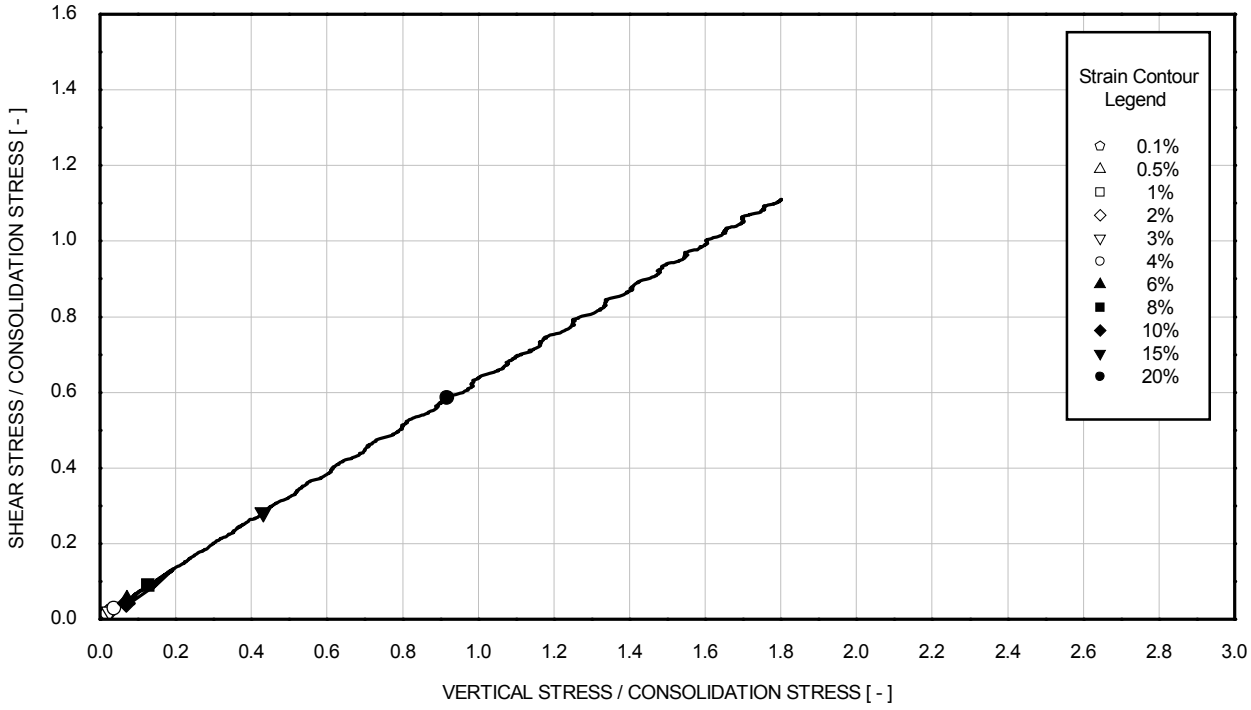
CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

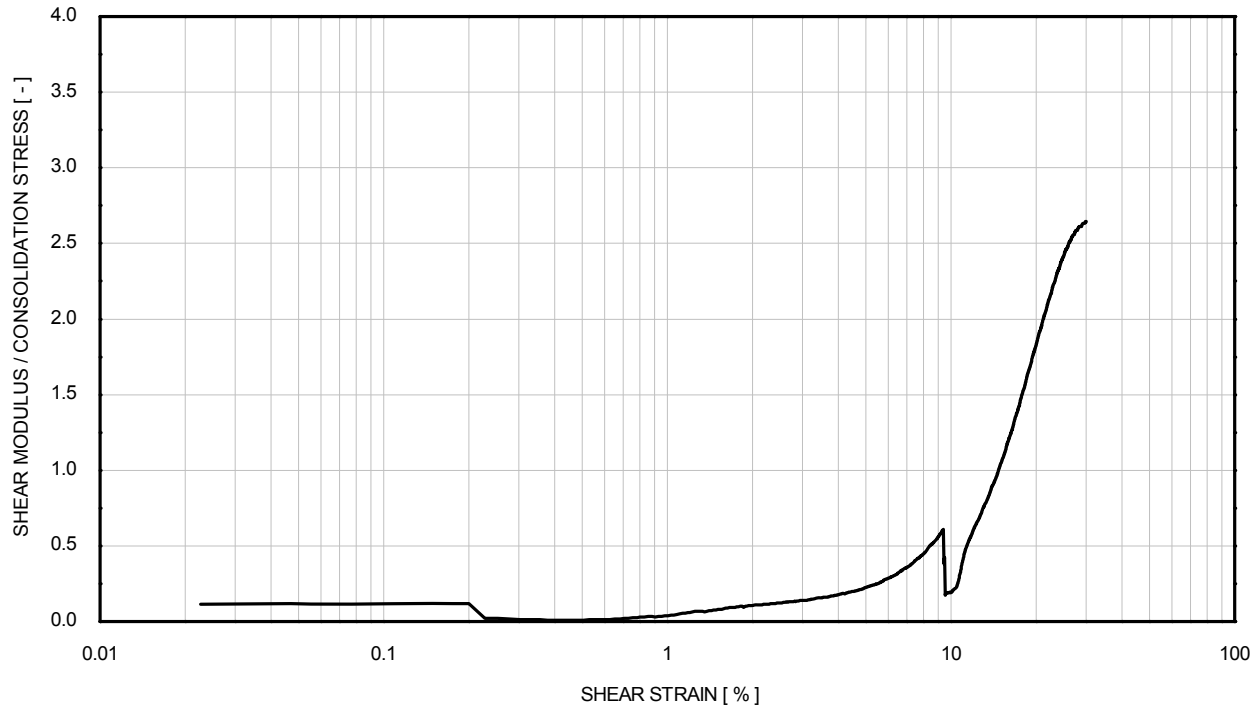




σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 467 kPa	Sample	: CSS_7-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.98 %/hour	Test No.	: CSS22

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME





σ_{vc}	: 420 kPa	Batch	: 7
τ_{peak}	: 467 kPa	Sample	: CSS_7-3
γ at τ_{peak}	: 29.99 %	Unit	: Unit D (Yarmouth Roads)
Rate of strain	: 2.98 %/hour	Test No.	: CSS22

CONSOLIDATED CYCLIC DSS TEST
SHEARING STAGE - CONSTANT VOLUME

SECTION A6: CYCLIC TRIAXIAL TESTS

LIST OF PLATES IN SECTION A6: Plate

Cyclic Triaxial Test – Cohesive Specimens	A6.1-1 to A6.1-231
Cyclic Triaxial Test – Cohesionless Specimens (undrained)	A6.2-1 to A6.2-232
Cyclic Triaxial Test – Cohesionless Specimens (drained)	A6.3-1 to A6.3-196

VISUAL DESCRIPTION
Grey CLAY with thick laminae of silt

GENERAL	
Date test started	06/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	70.2
Length	[mm]	140.0
Water content	[%]	29.1
Bulk density	[Mg/m³]	1.93
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.806
Degree of saturation	[%]	98
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	35
Pocket penetrometer	[kPa]	79

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_17WaxC_CTXL12
Processed by Date	MSR 14/12/2016
Checked by Date	JLS 15/12/2016
Approved by Date	AR 15/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	882
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1029
Back pressure	[kPa]	881
Base PWP	[kPa]	881
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	148
Effective axial pressure	[kPa]	148
Deviator stress	[kPa]	0
Volumetric strain	[%]	2.68
External axial strain	[%]	1.34
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.757
Degree of saturation	[%]	97

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1029
Back pressure	[kPa]	881
Base PWP	[kPa]	888
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	141
Effective axial pressure	[kPa]	153
Deviator stress	[kPa]	12
Volumetric strain	[%]	0.00
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.757
Degree of saturation	[%]	97

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	233
Mean q_{av}	[kPa]	12
Mean q_{cy}	[kPa]	23
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.03
External ε_{cy} at N_f	[%]	0.02
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	24
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.758
Degree of saturation	[%]	97

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.02	111	-	7.01	-
2	0.01	0.02	109	-	4.42	-
5	0.01	0.02	108	-	3.77	-
10	0.01	0.02	107	-	3.51	-
20	0.01	0.02	106	-	3.30	-
30	0.01	0.02	105	-	3.28	-
40	0.01	0.02	104	-	3.21	-
50	0.01	0.02	104	-	3.24	-
100	0.02	0.02	103	-	3.09	-
500	0.02	0.02	99	-	2.87	-
1000	0.02	0.02	96	-	2.84	-
1500	0.03	0.02	95	-	2.82	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1029
Back pressure	[kPa]	881
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	142
Effective axial pressure	[kPa]	154
Deviator stress	[kPa]	12
Volumetric strain	[%]	0.00
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.758
Degree of saturation	[%]	97

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	233
Mean q_{av}	[kPa]	12
Mean q_{cy}	[kPa]	47
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.04
External ε_{cy} at N_f	[%]	0.07
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	44
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54
Void ratio	[-]	0.758
Degree of saturation	[%]	97

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.05	93	-	9.35	-
2	0.01	0.05	92	-	7.69	-
5	0.01	0.05	90	-	7.05	-
10	0.01	0.05	88	-	6.87	-
20	0.02	0.06	85	-	6.82	-
30	0.02	0.06	83	-	6.82	-
40	0.02	0.06	82	-	6.82	-
50	0.02	0.06	80	-	6.85	-
100	0.03	0.06	76	-	6.94	-
200	0.03	0.07	71	-	7.09	-
300	0.04	0.07	68	-	7.17	-
400	0.04	0.07	66	-	7.24	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	102
Initial effective axial pressure	[kPa]	114
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	216
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	12.90
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	63
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	85
Effective axial pressure	[kPa]	301
Principal effective stress ratio	[-]	3.55
ε_{50}	[%]	0.51
Secant modulus (E_{50}) at ε_{50}	[kPa]	20178
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	181
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.16
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	92
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	55
Effective axial pressure	[kPa]	236
Principal effective stress ratio	[-]	4.28
At 10% external axial strain		
Corrected deviator stress	[kPa]	214
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	67
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	81
Effective axial pressure	[kPa]	295
Principal effective stress ratio	[-]	3.64

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





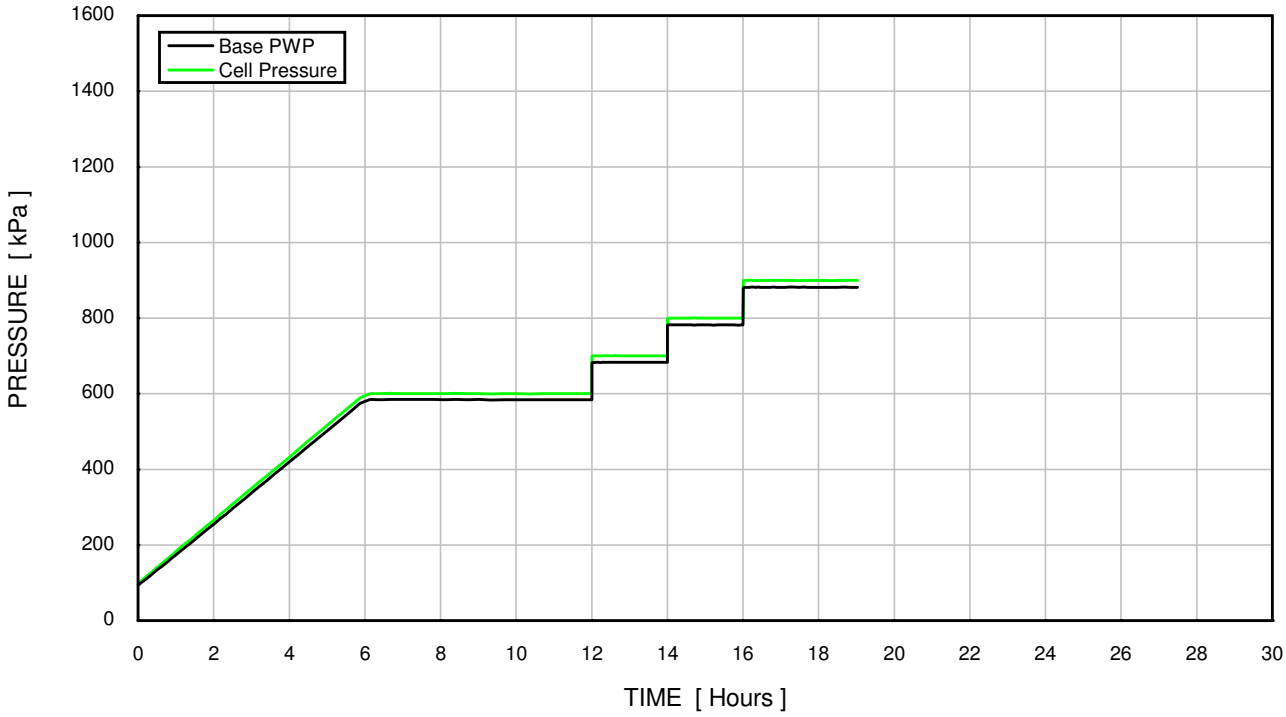
FINAL CONDITIONS

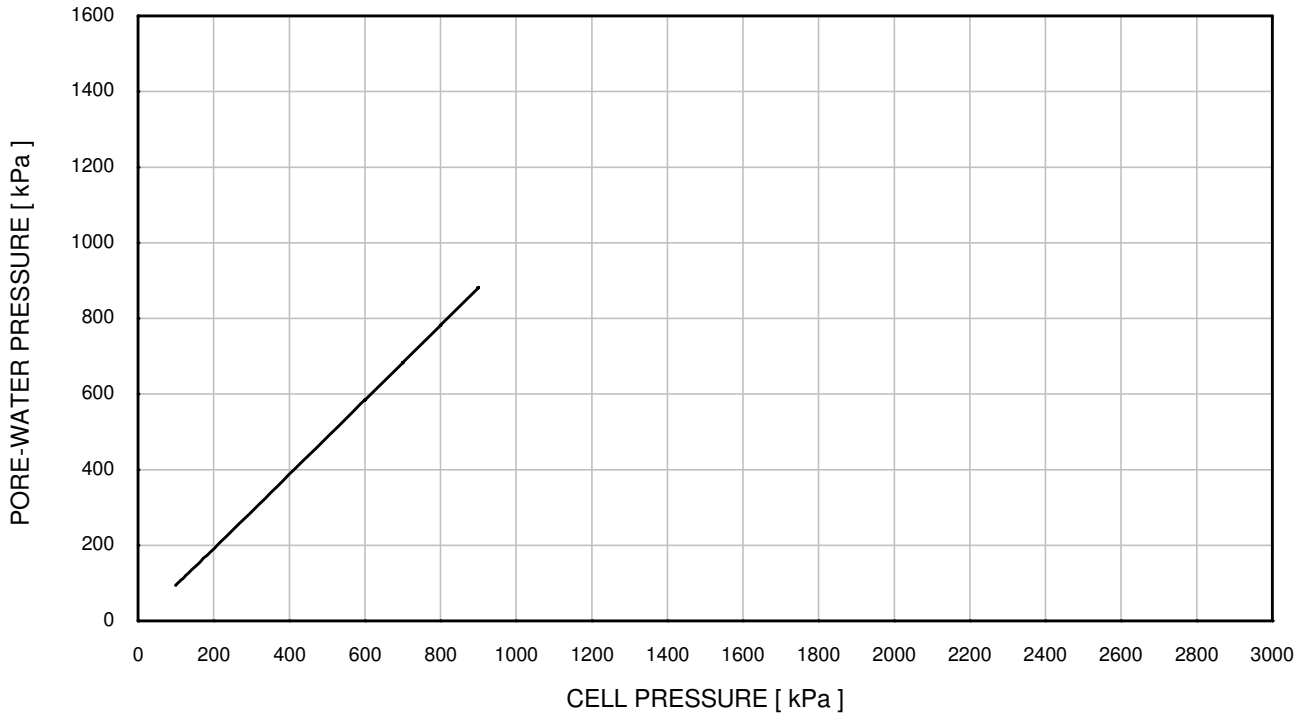
Water content	[%]	27.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.54

TEST IDENTIFICATION

Borehole	HKZ1-BH01-SA
Sample	17WAXC
Depth [m]	14.86
Test number	CTX12

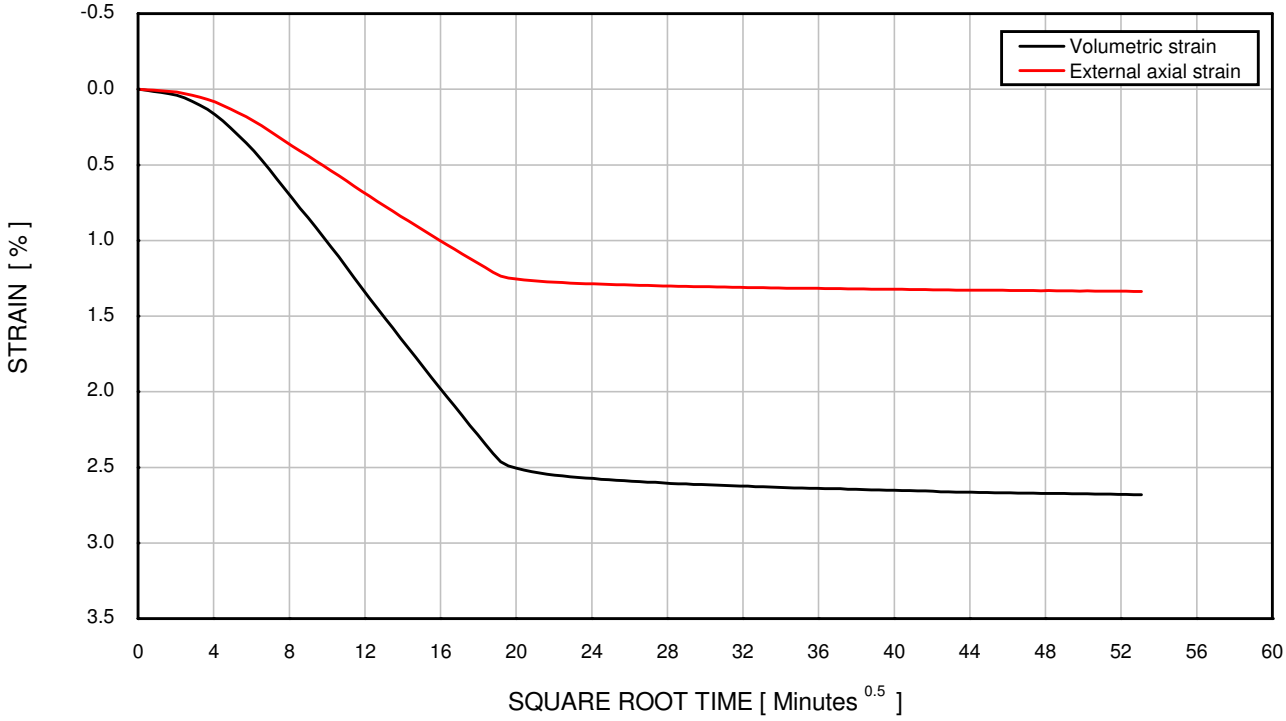
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

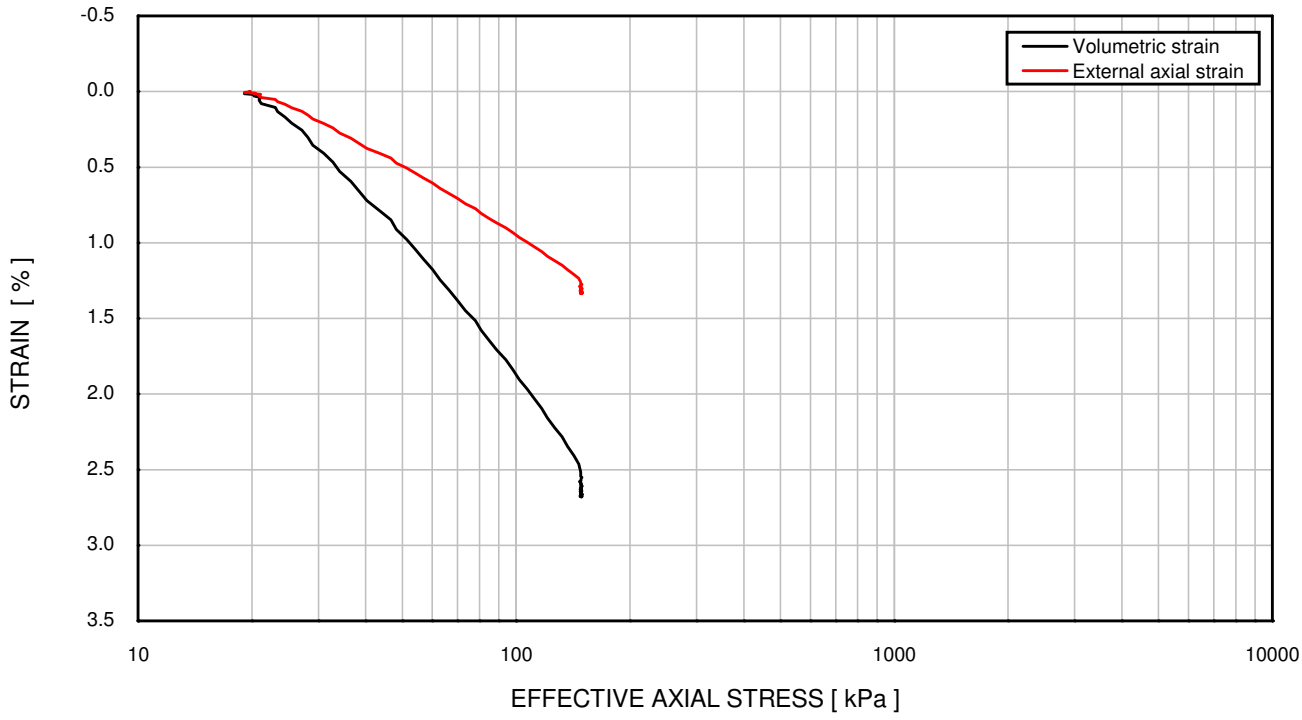




B value	:	1.00			
Initial σ'_r	:	6	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	6	kPa	Sample	: 17WAXC
Final σ'_r	:	18	kPa	Depth [m]	: 14.86
Final σ'_a	:	18	kPa	Test No.	: CTX12

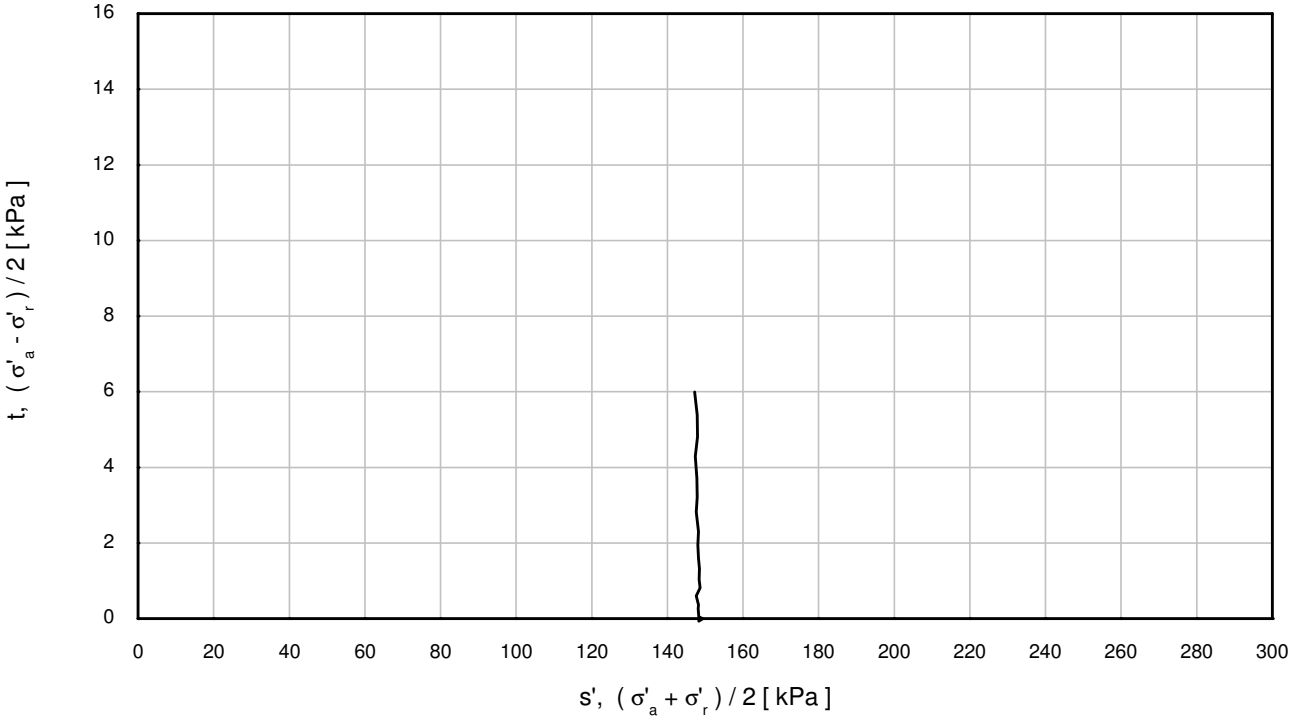
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

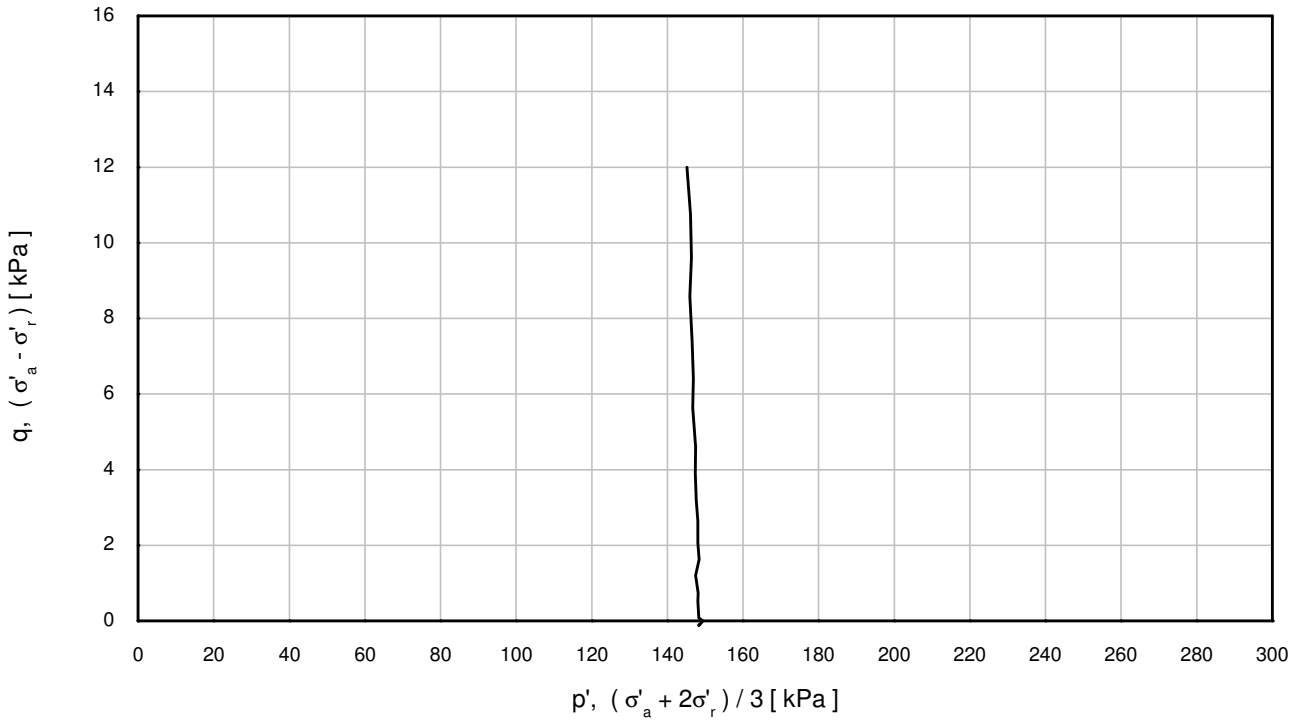




Stage 1 σ'_{rc}	: 149 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 149 kPa	Sample	: 17WAXC
		Depth [m]	: 14.86
		Test No.	: CTX12

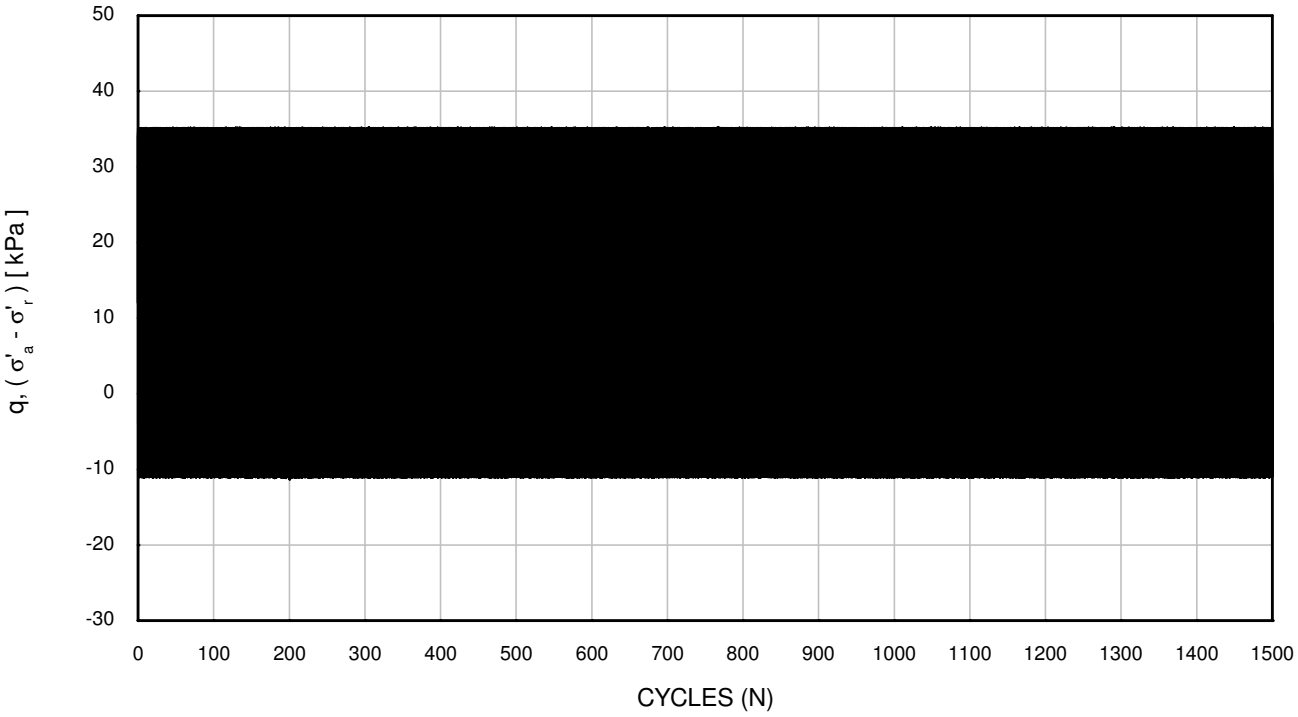
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

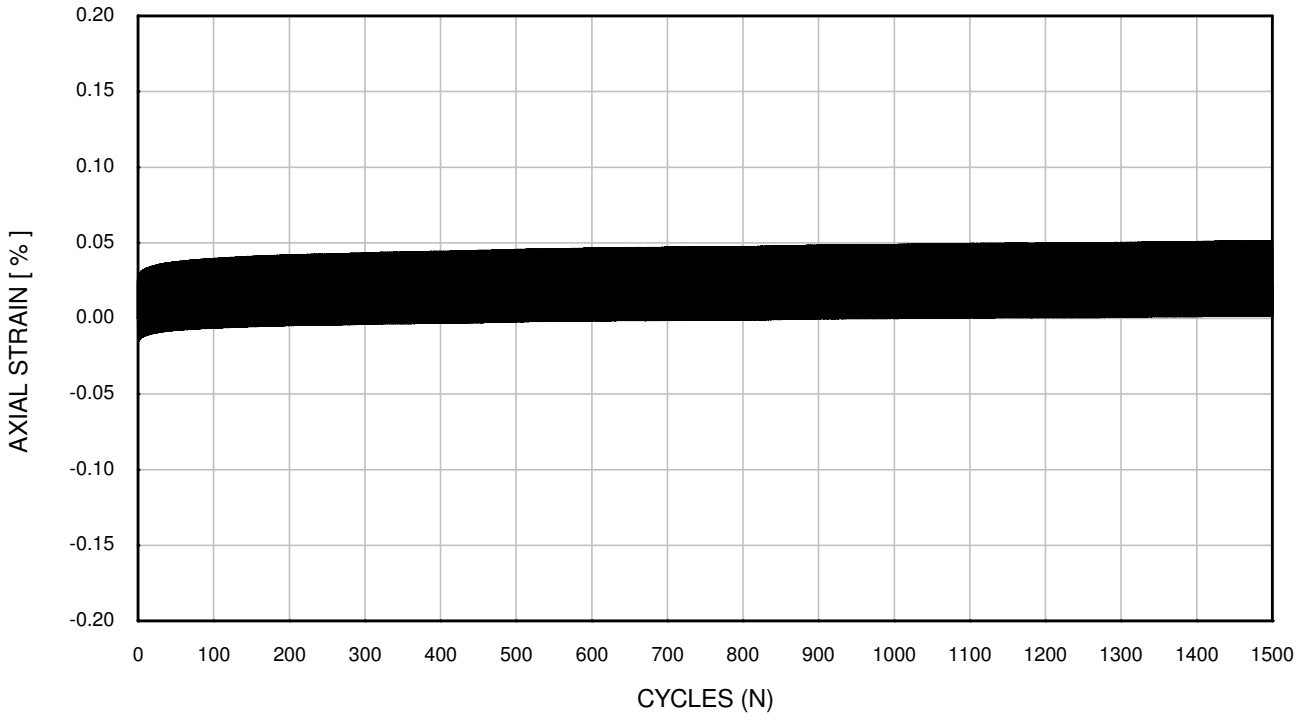




Stage 1 σ'_{rc}	: 141 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 153 kPa	Sample	: 17WAXC
		Depth [m]	: 14.86
		Test No.	: CTX12

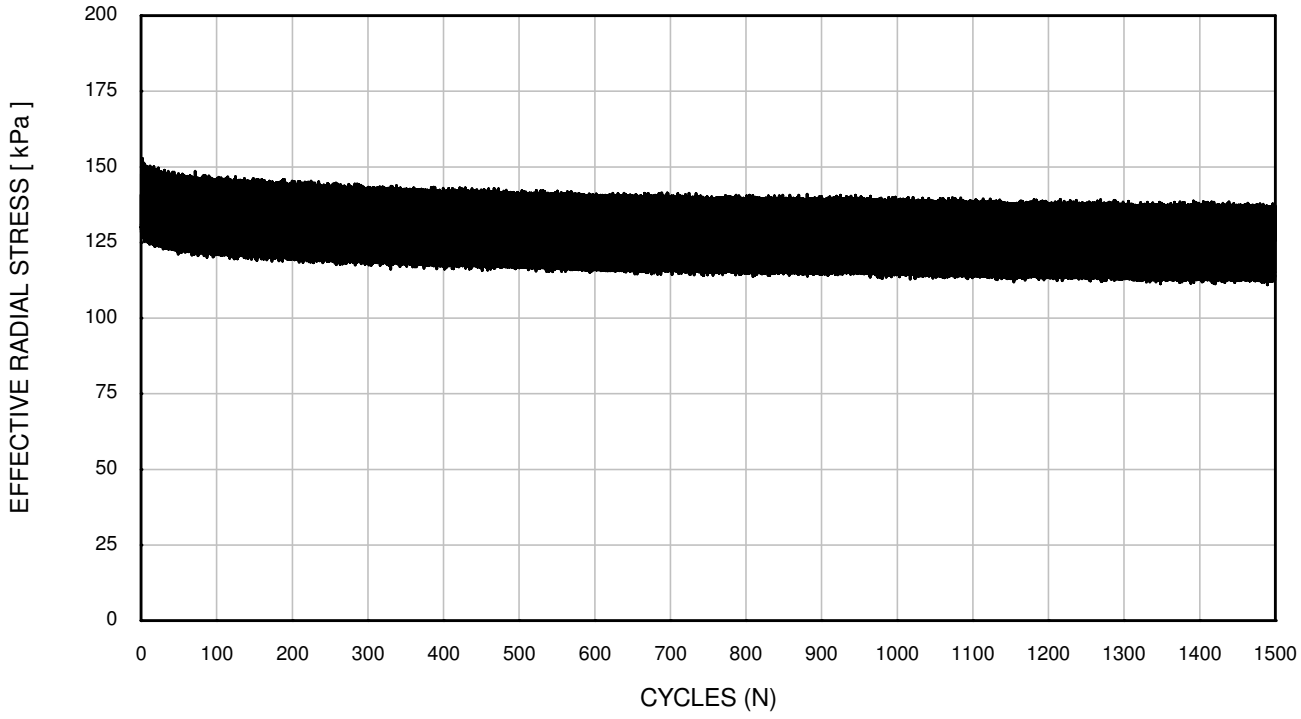
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

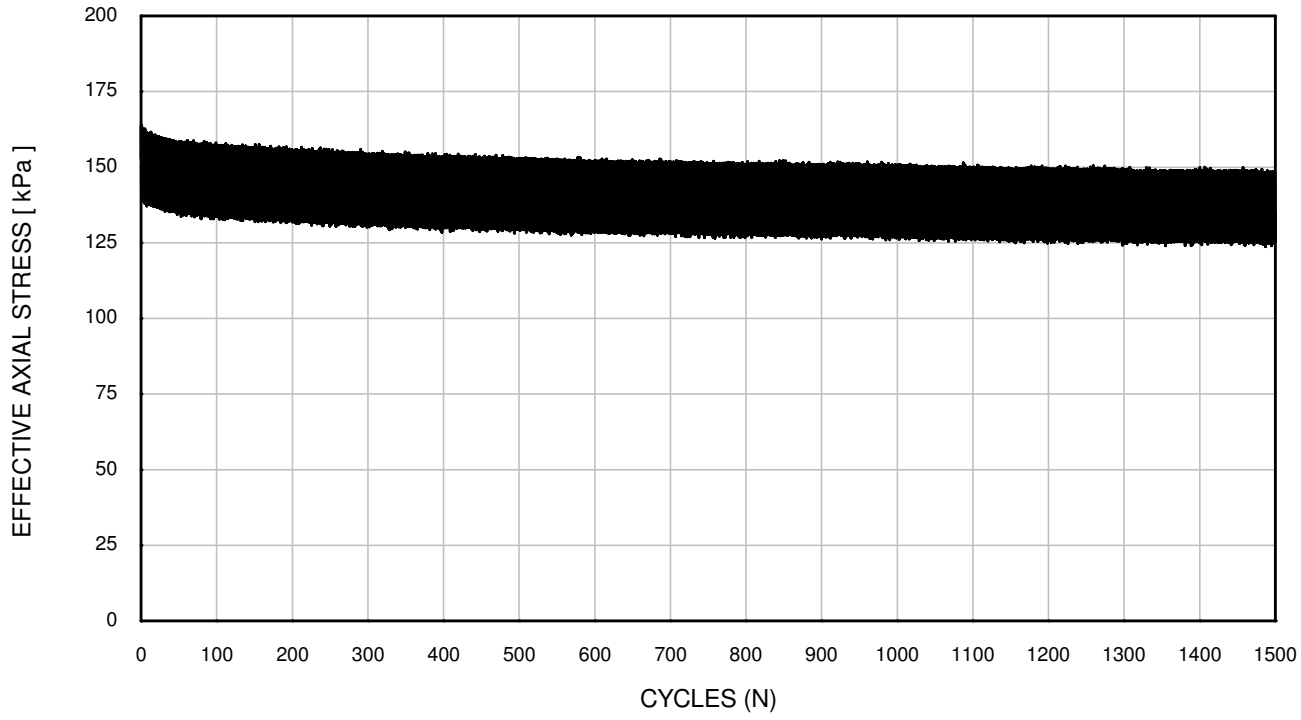




Initial σ'_r	: 141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 153 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 23 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

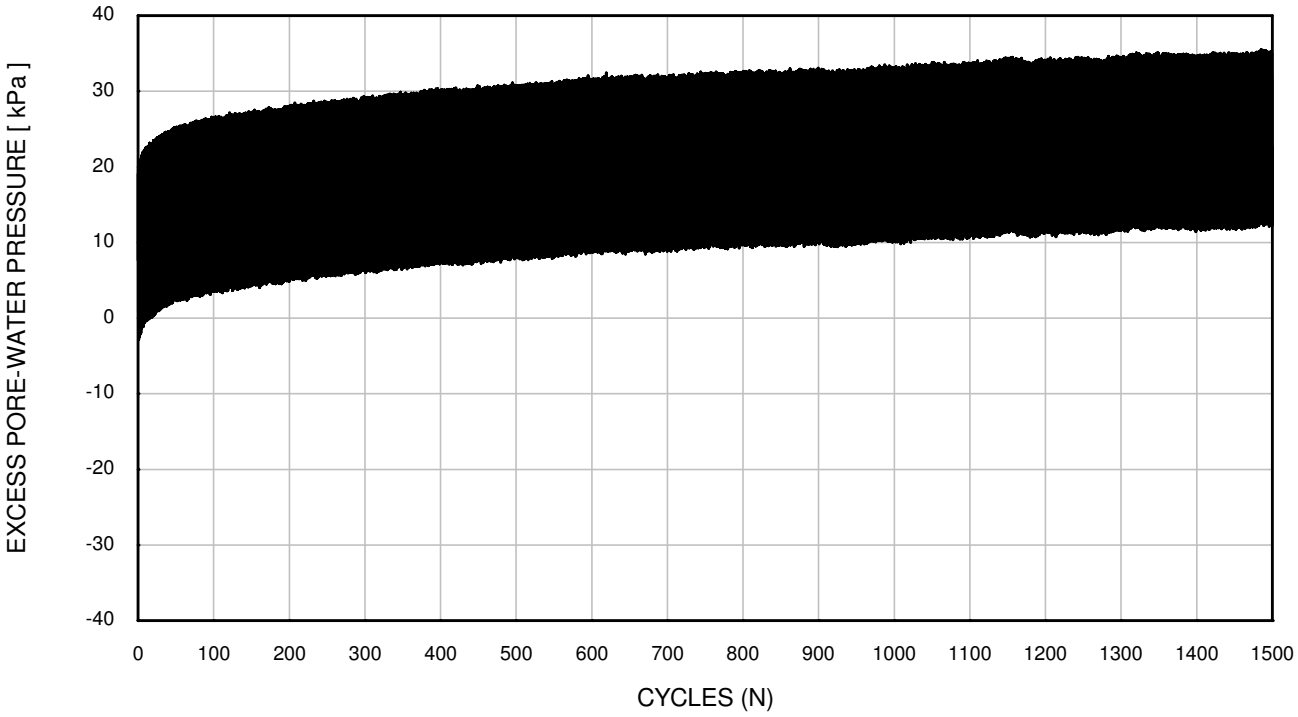
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

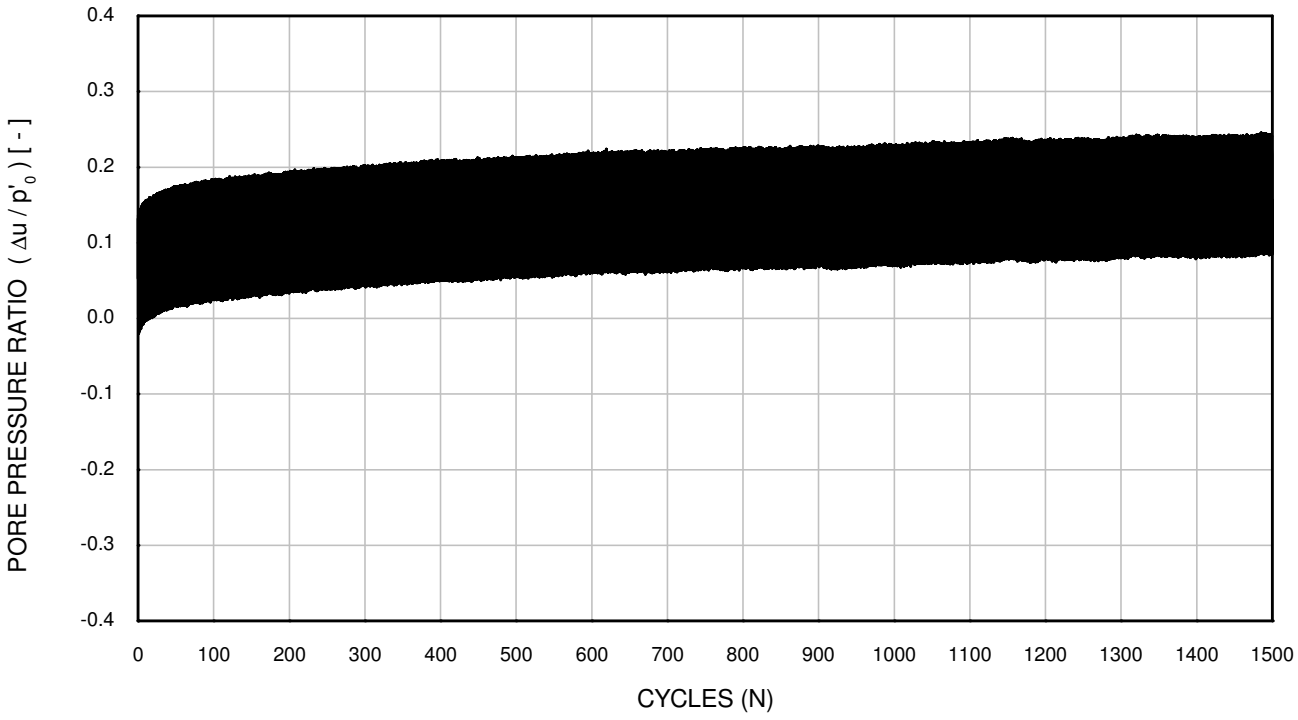




Initial σ'_r	: 141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 153 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 23 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

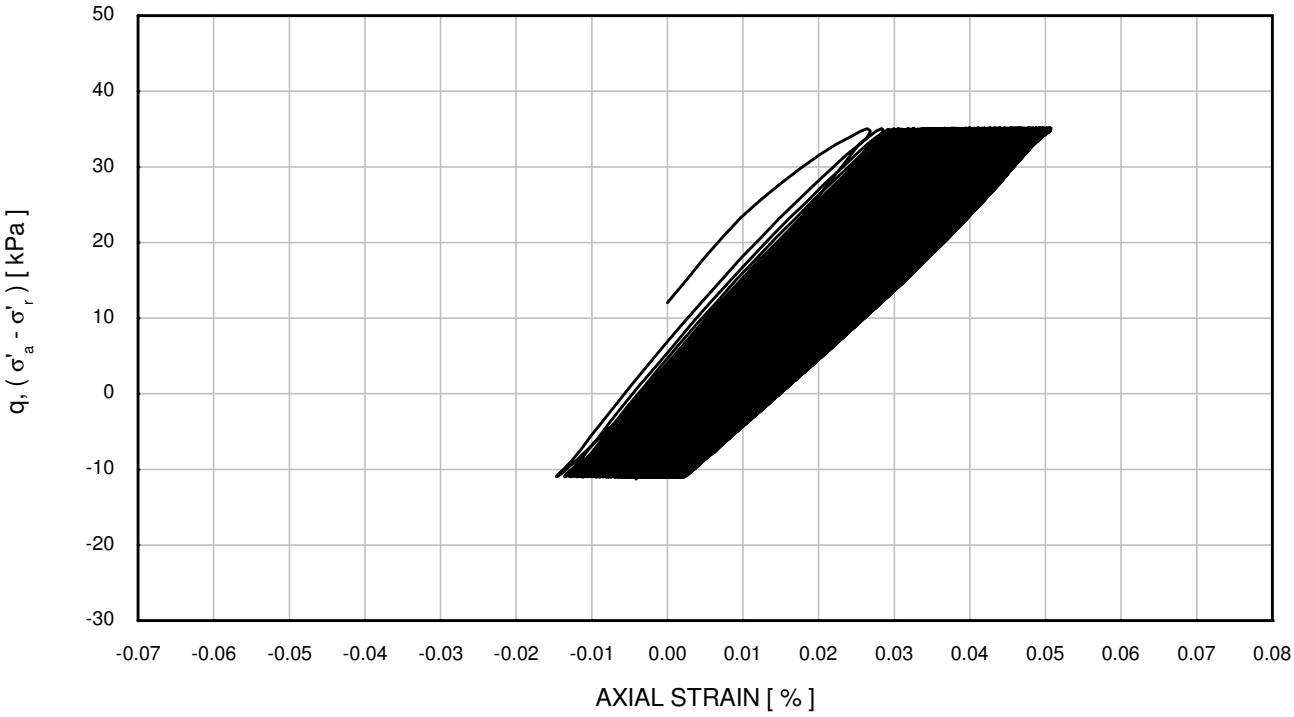
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

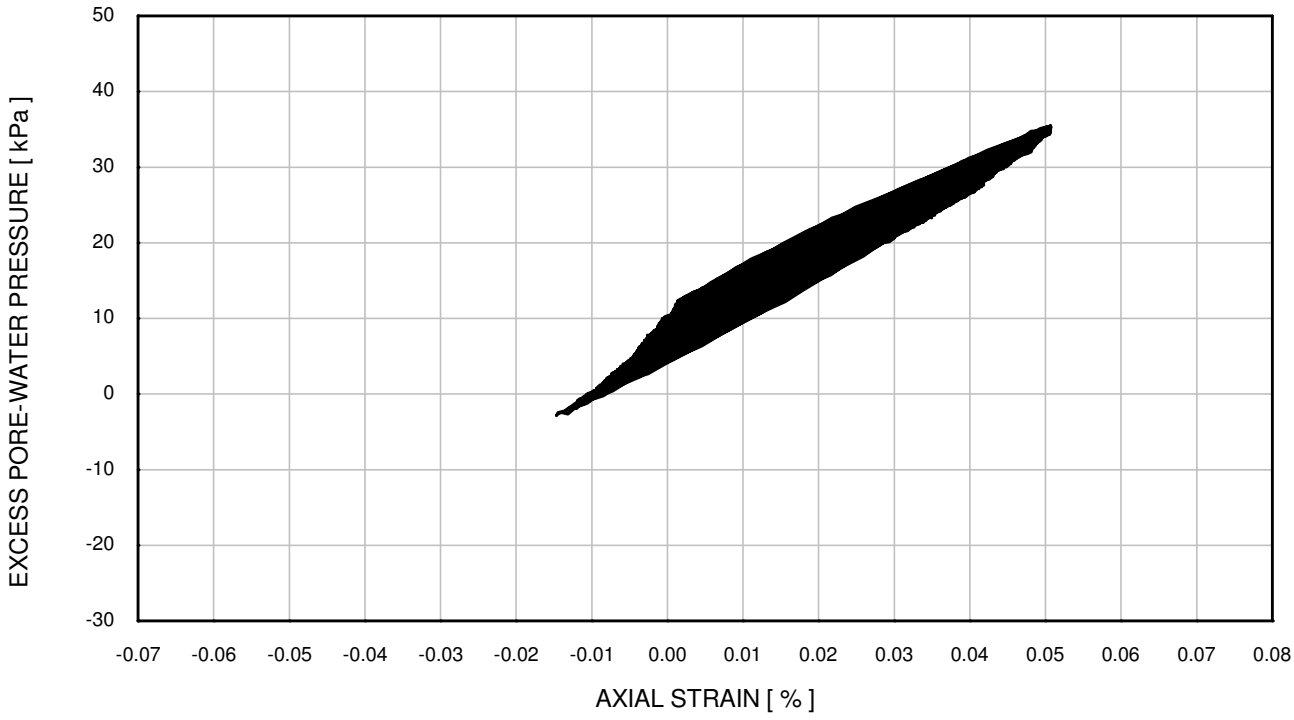




Initial σ'_r	: 141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 153 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 23 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

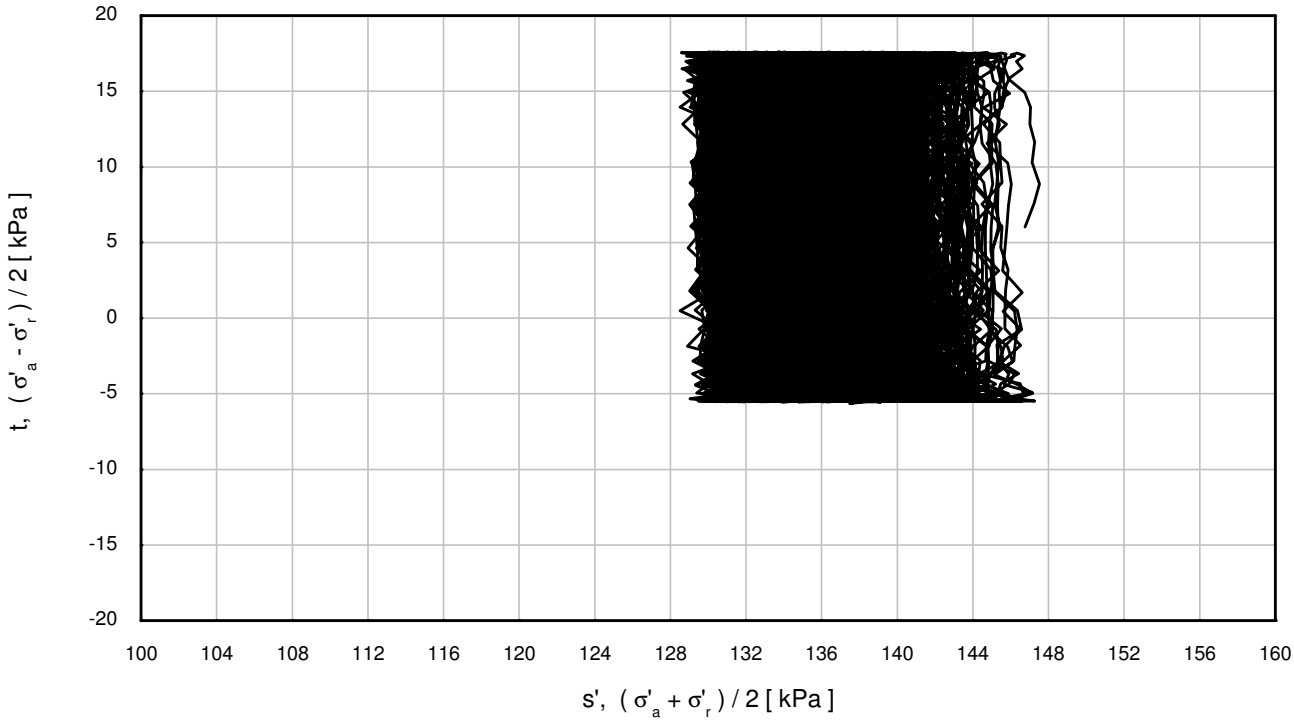
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

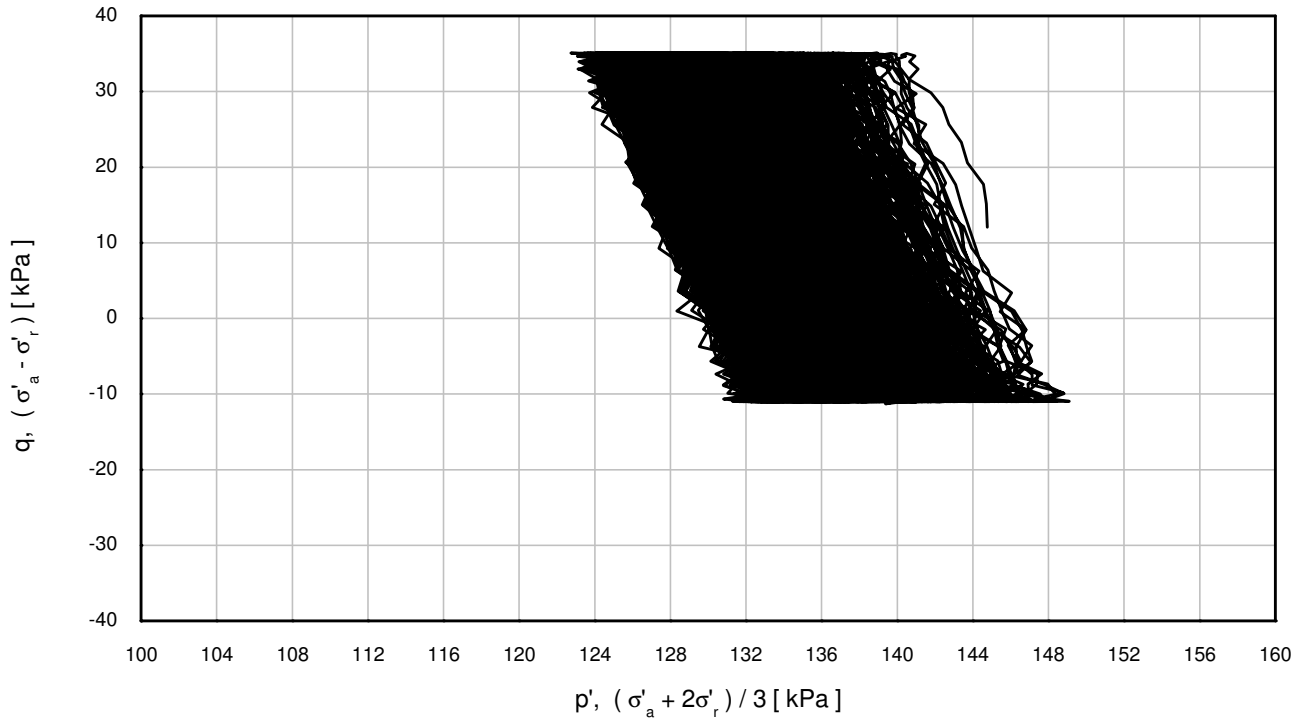




Initial σ'_r	:	141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	153 kPa	Sample	: 17WAXC
q_{av}	:	12 kPa	Depth [m]	: 14.86
q_{cy}	:	23 kPa	Test No.	: CTX12
Frequency	:	0.10 Hz		

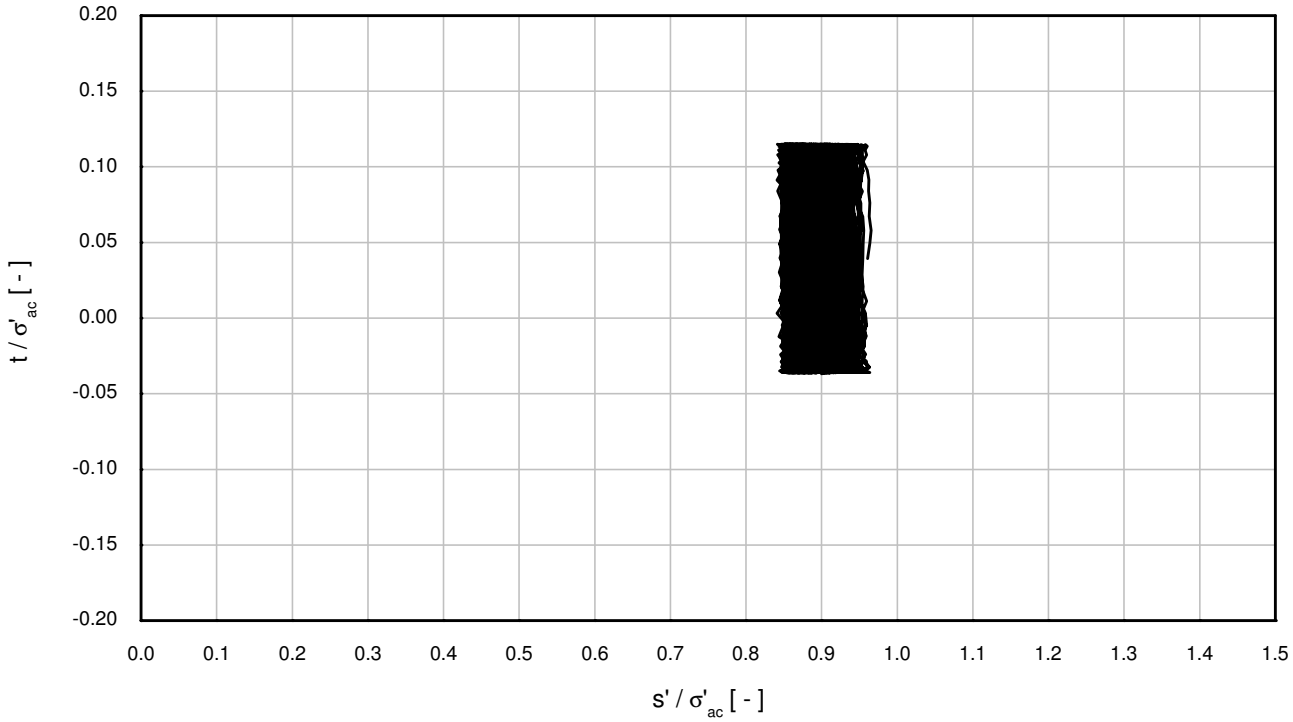
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

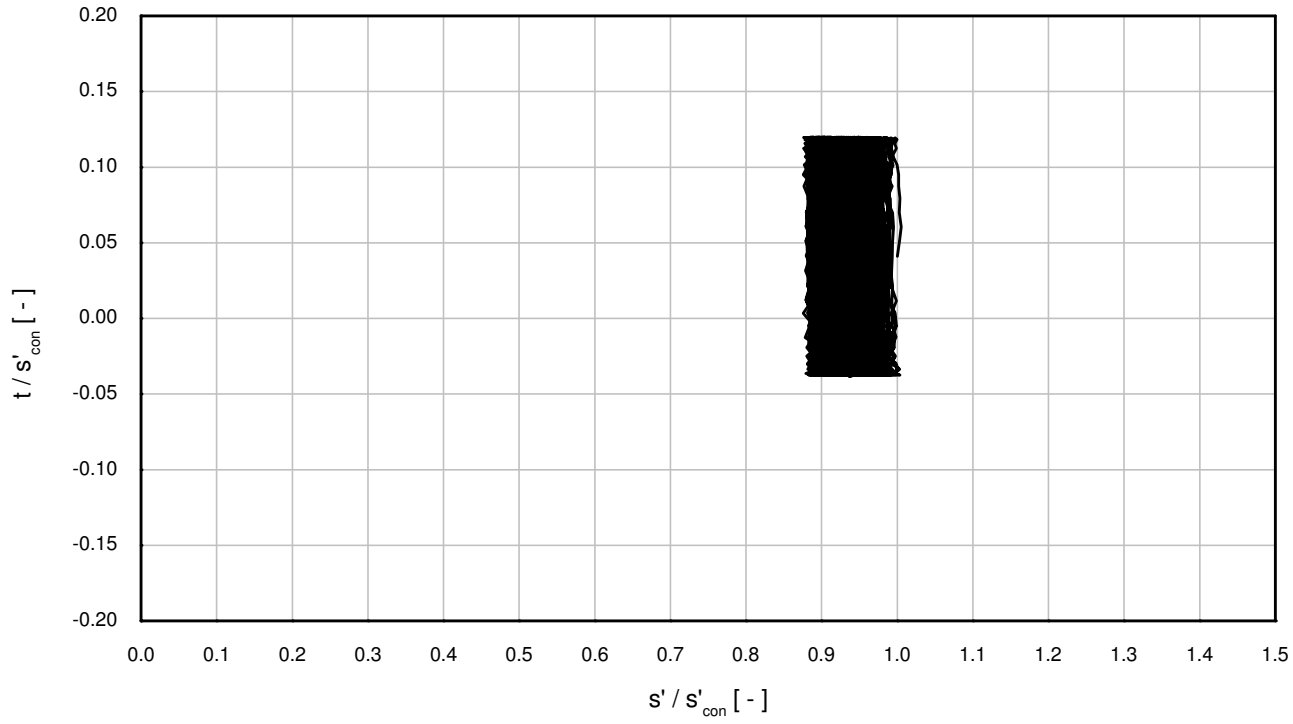




Initial σ'_r	:	141 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	153 kPa	Sample	:	17WAXC
q_{av}	:	12 kPa	Depth [m]	:	14.86
q_{cy}	:	23 kPa	Test No.	:	CTX12
Frequency	:	0.10 Hz			

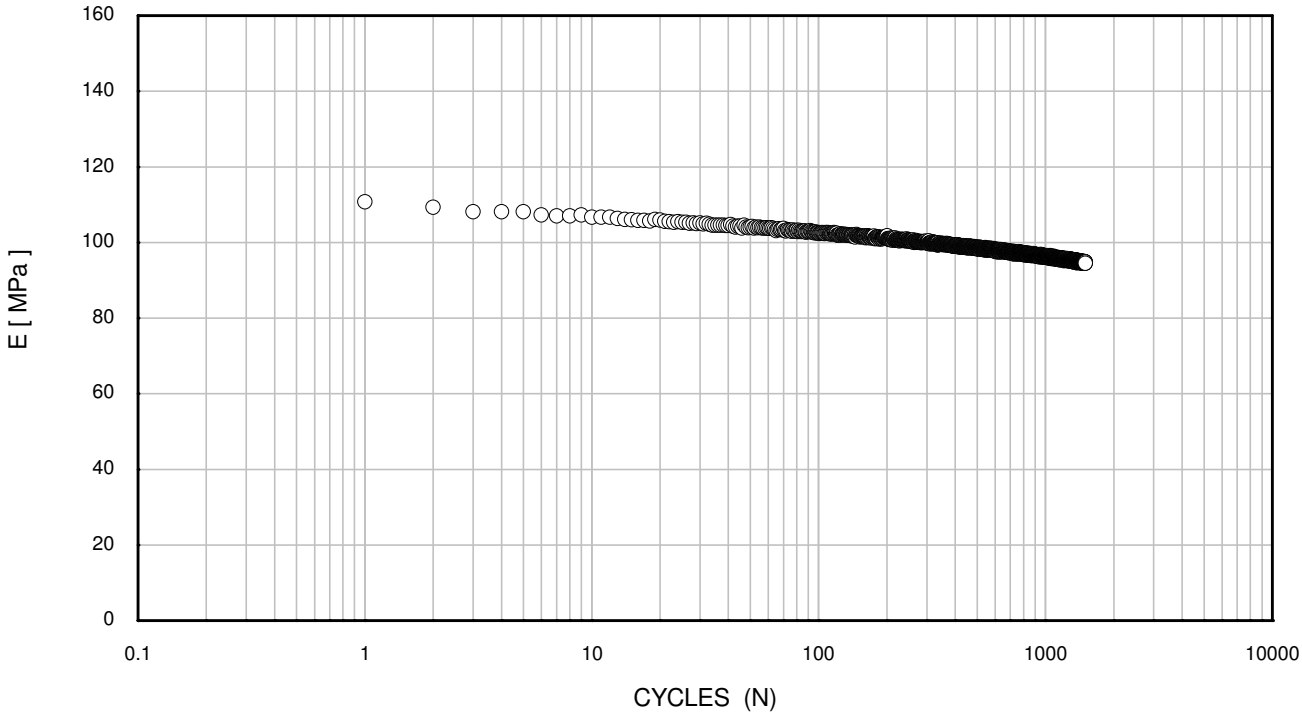
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

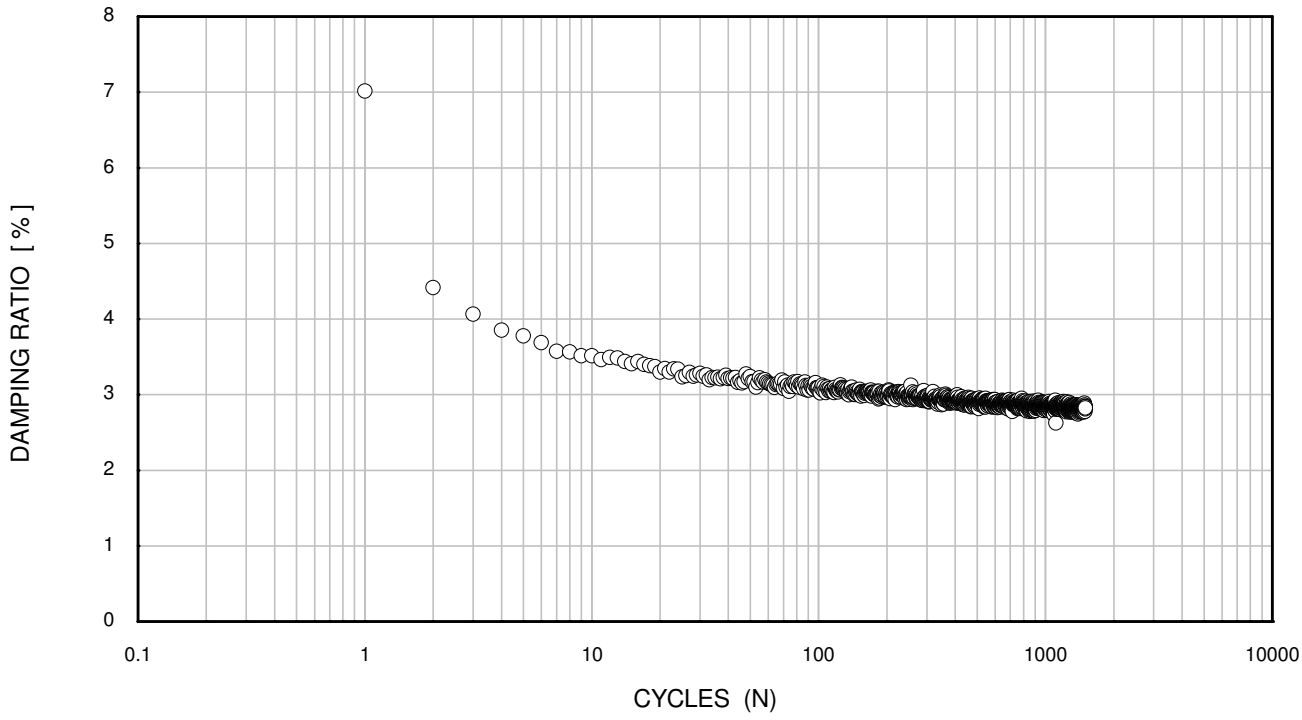




Initial σ'_r	:	141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	153 kPa	Sample	: 17WAXC
q_{av}	:	12 kPa	Depth [m]	: 14.86
q_{cy}	:	23 kPa	Test No.	: CTX12
Frequency	:	0.10 Hz		

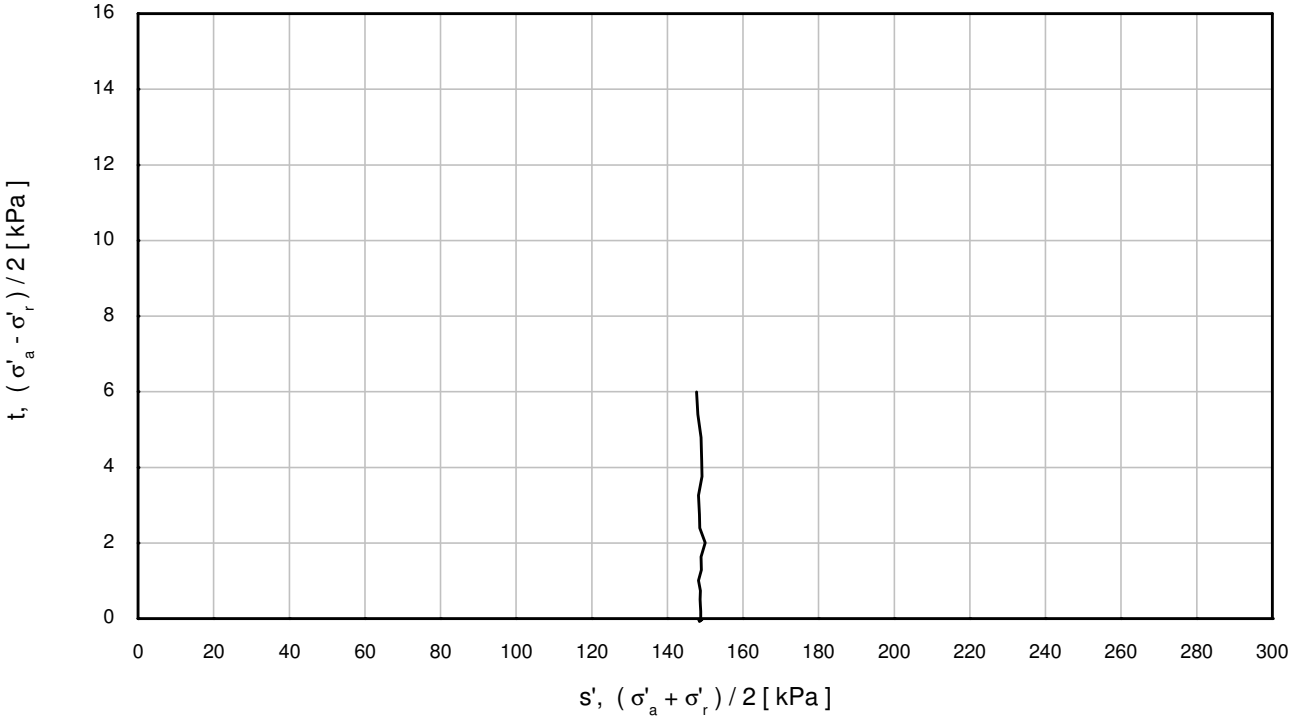
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

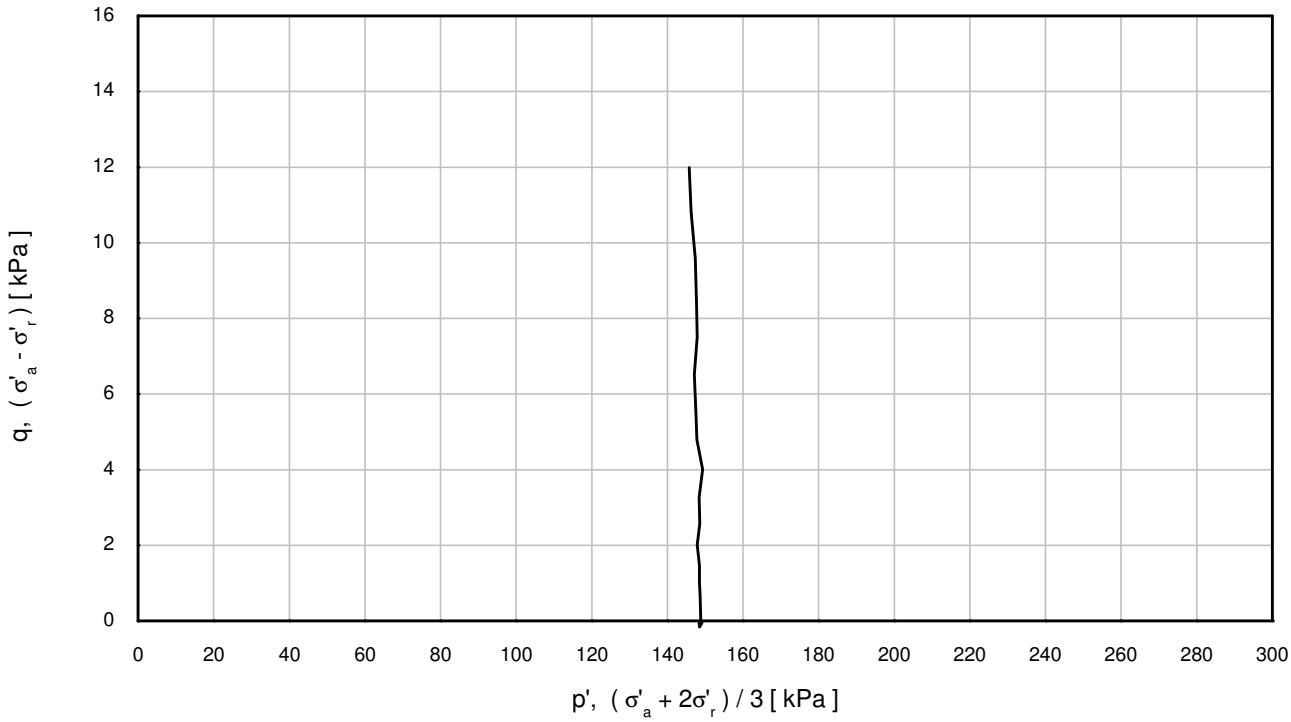




Initial σ'_r	: 141 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 153 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 23 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

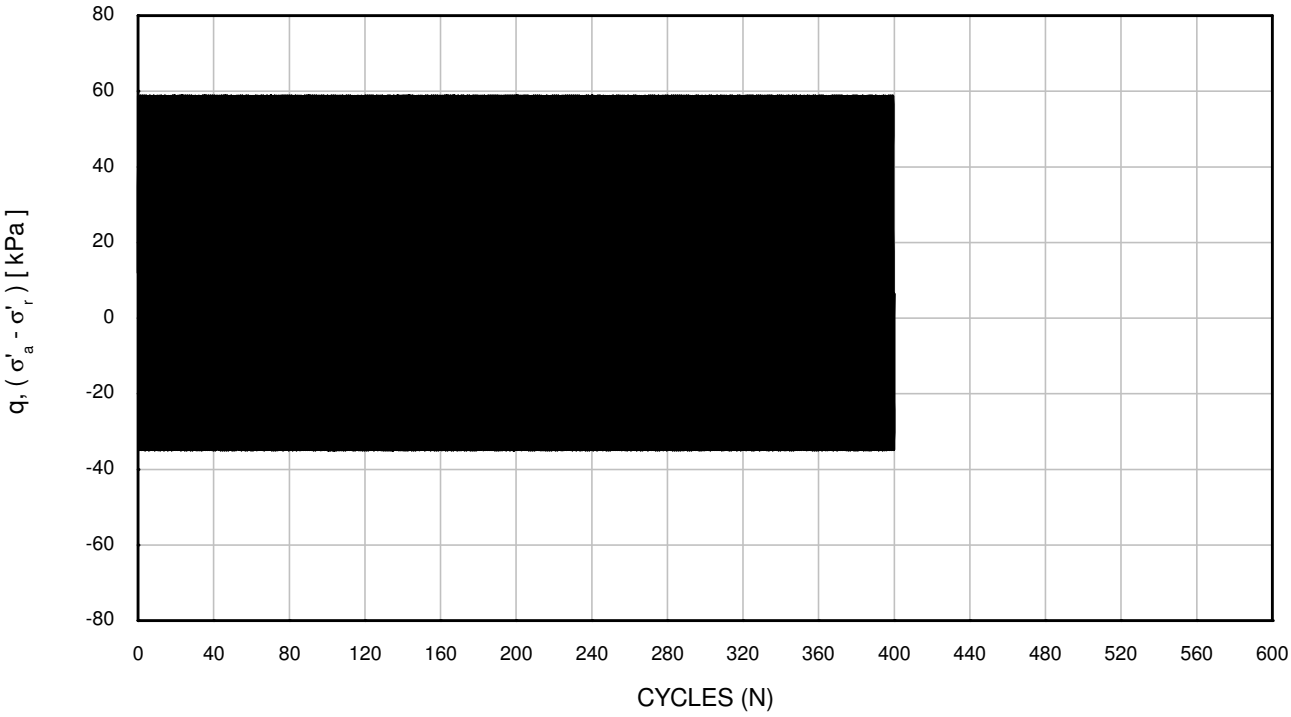
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

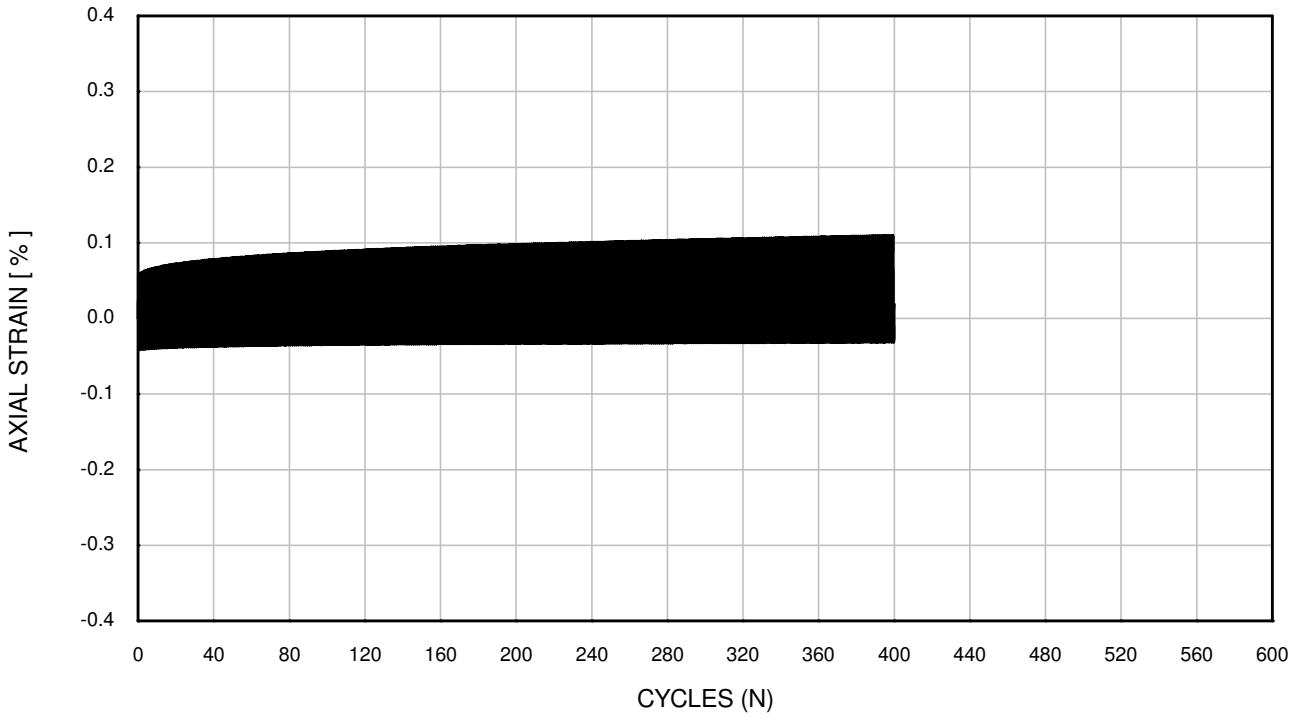




Stage 1 σ'_{rc}	: 142 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 154 kPa	Sample	: 17WAXC
		Depth [m]	: 14.86
		Test No.	: CTX12

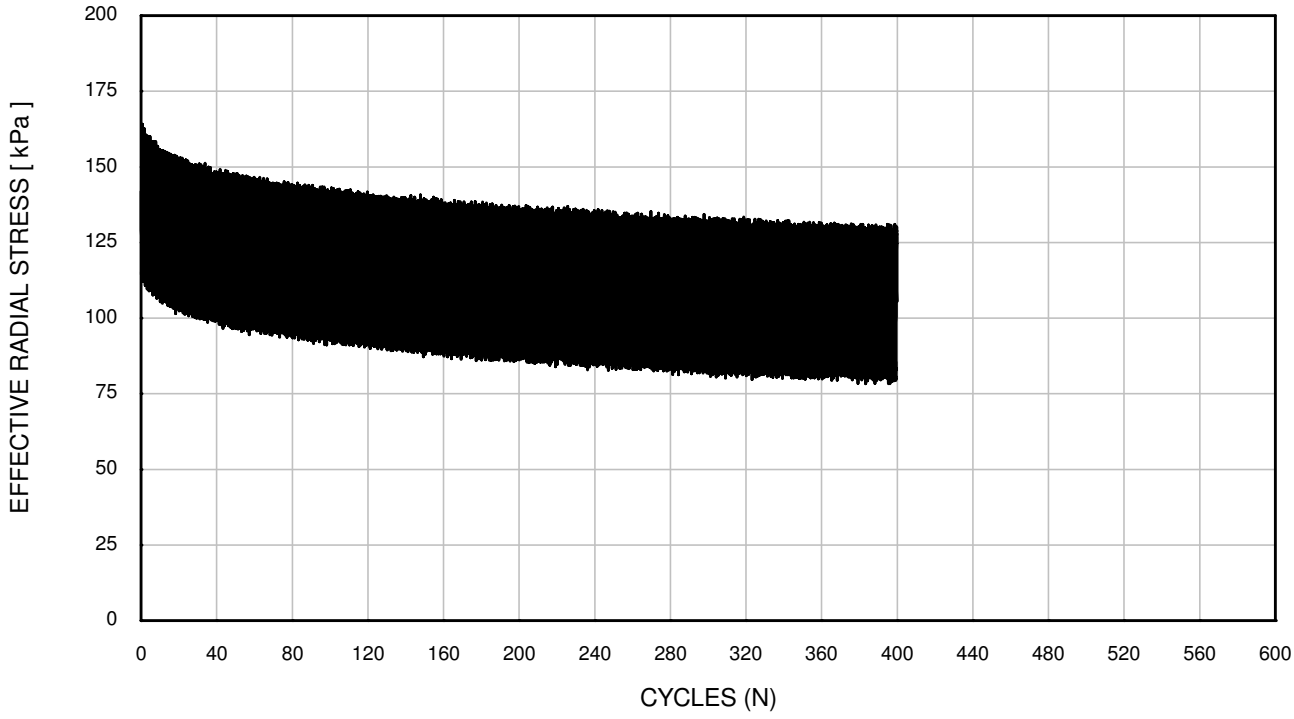
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

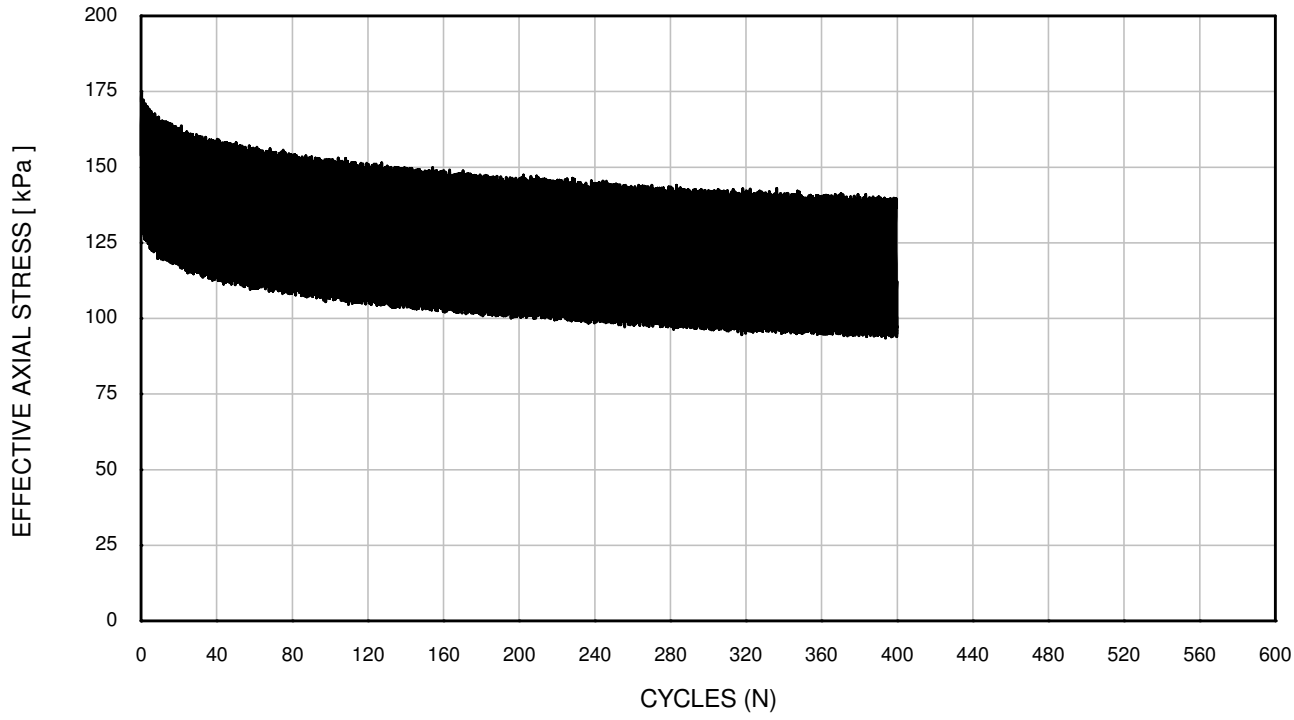




Initial σ'_r	:	142 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	154 kPa	Sample	:	17WAXC
q_{av}	:	12 kPa	Depth [m]	:	14.86
q_{cy}	:	47 kPa	Test No.	:	CTX12
Frequency	:	0.10 Hz			

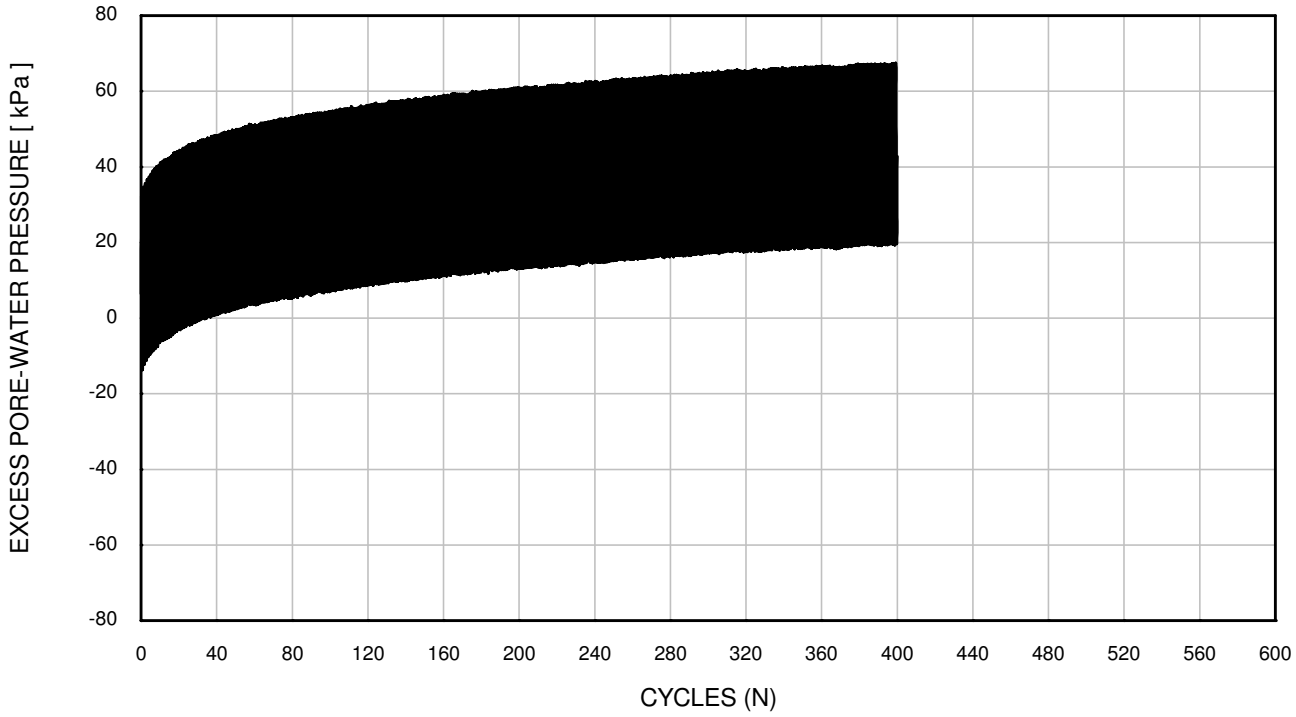
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

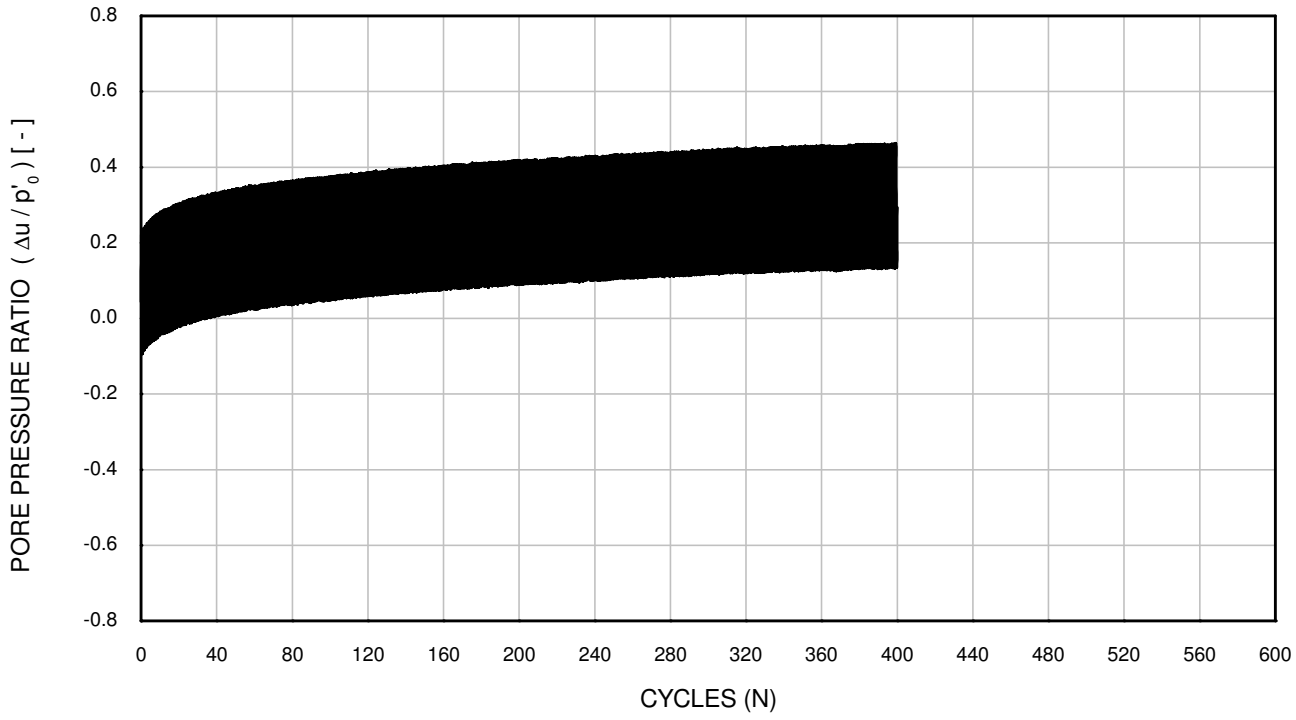




Initial σ'_r	:	142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	154 kPa	Sample	: 17WAXC
q_{av}	:	12 kPa	Depth [m]	: 14.86
q_{cy}	:	47 kPa	Test No.	: CTX12
Frequency	:	0.10 Hz		

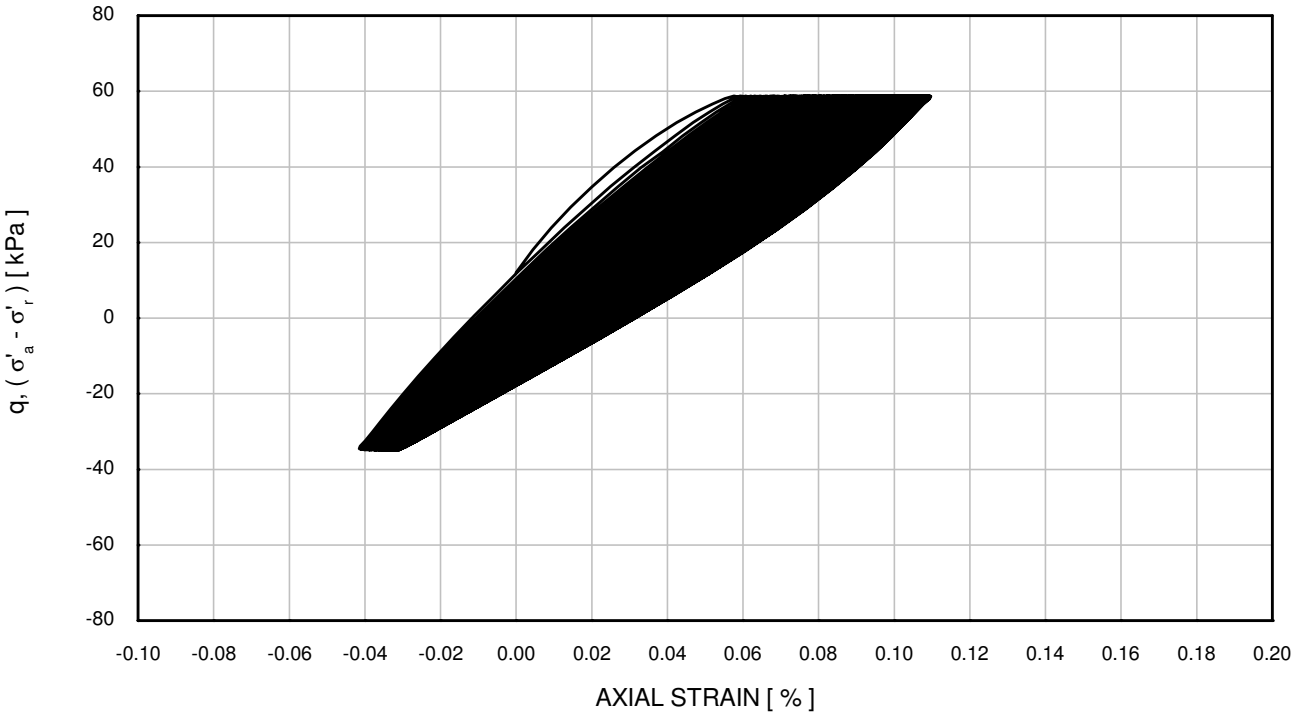
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

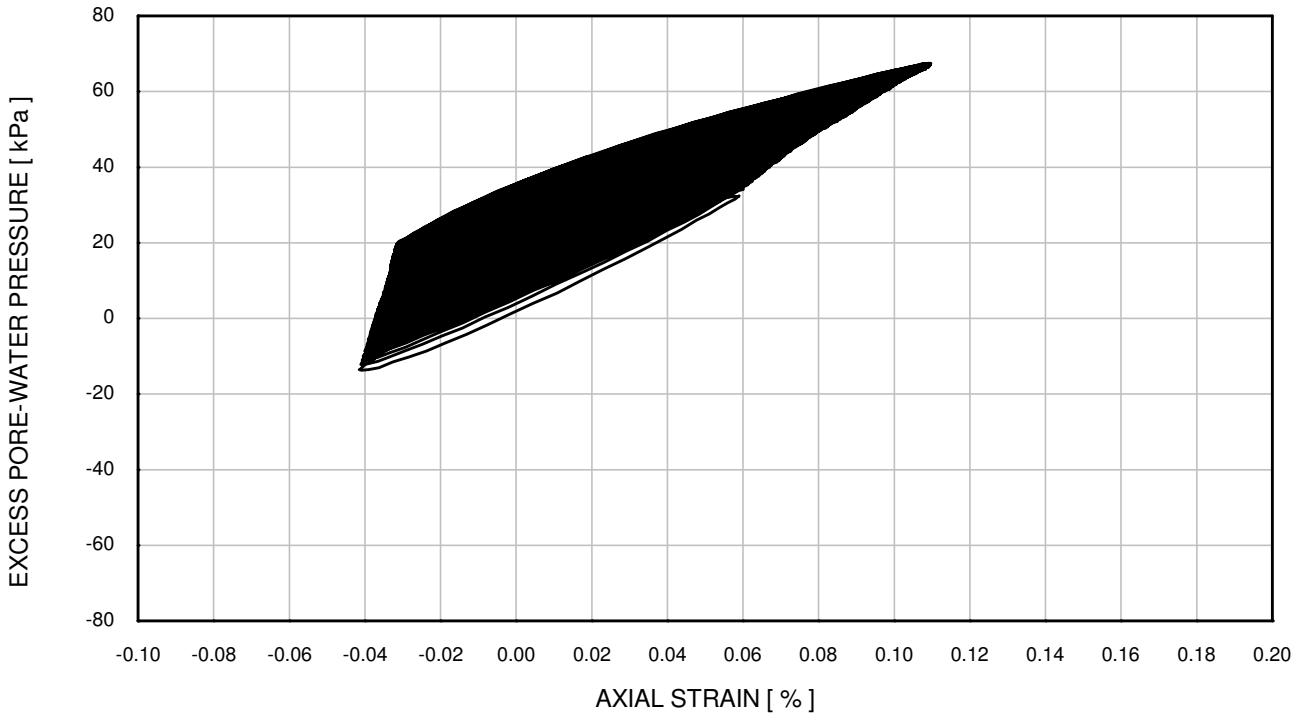




Initial σ'_r	: 142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 154 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 47 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

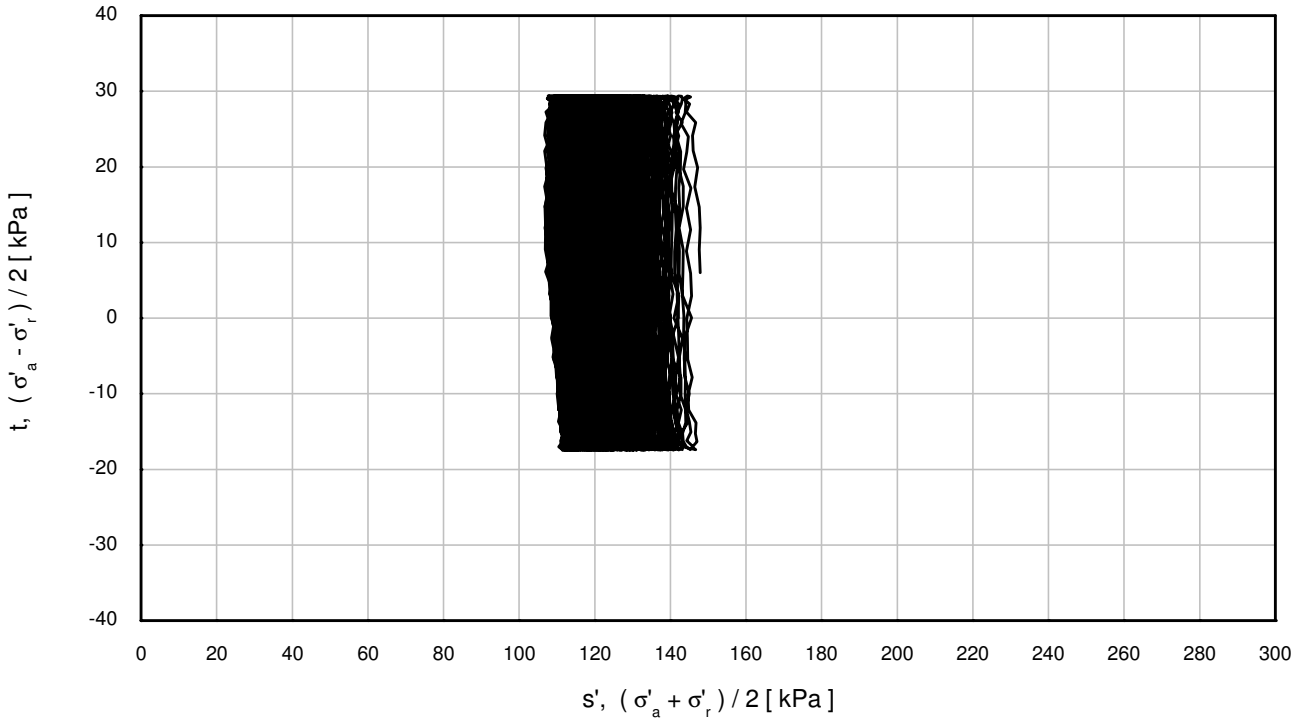
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

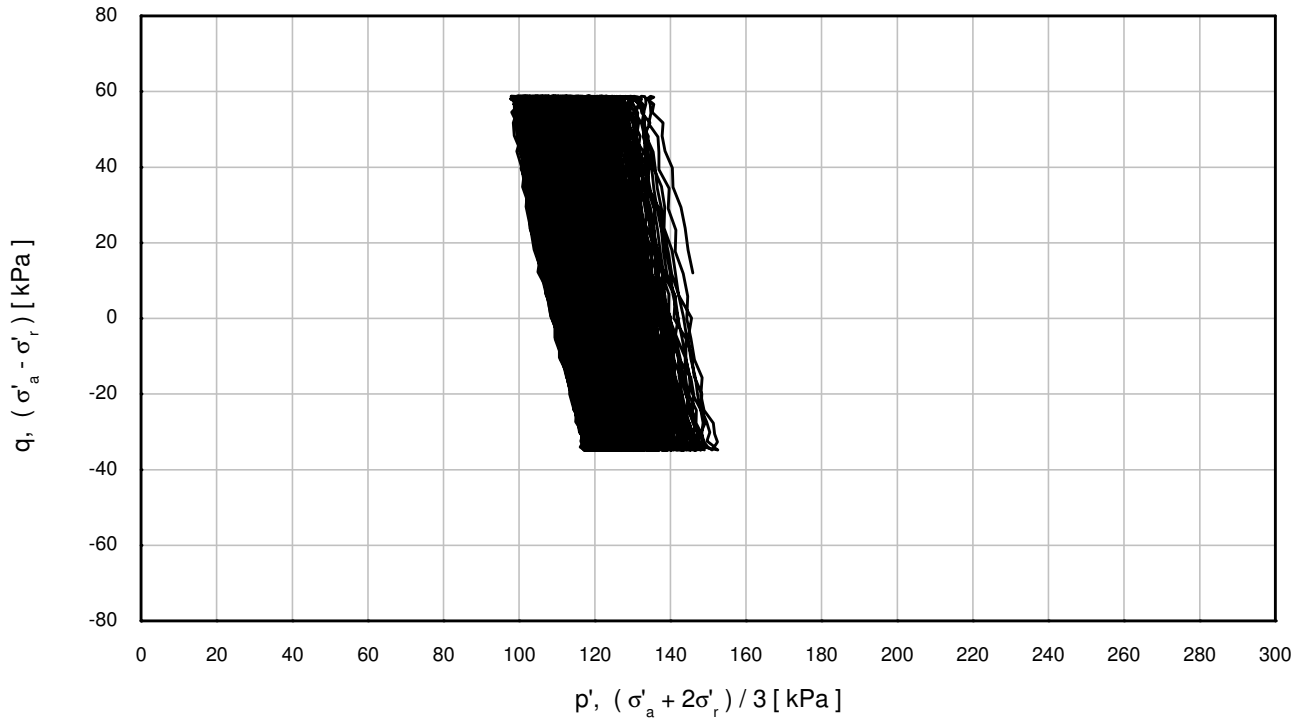




Initial σ'_r	: 142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 154 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 47 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

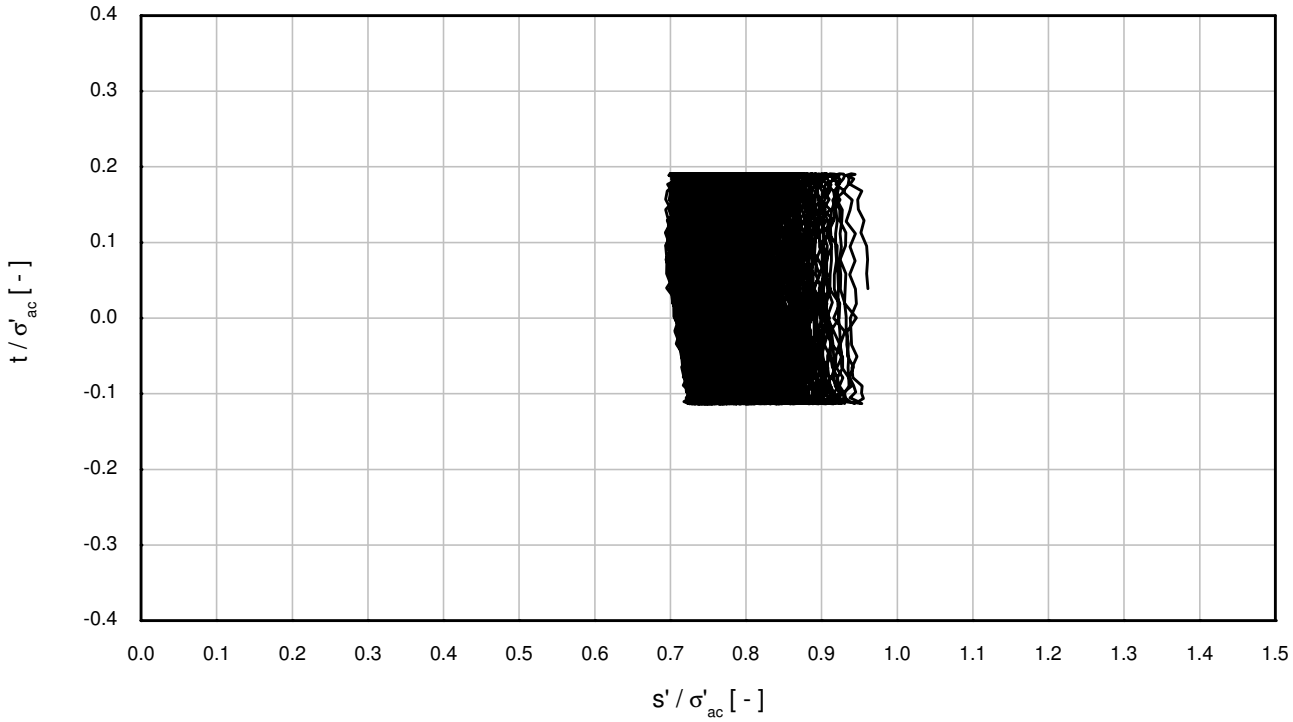
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

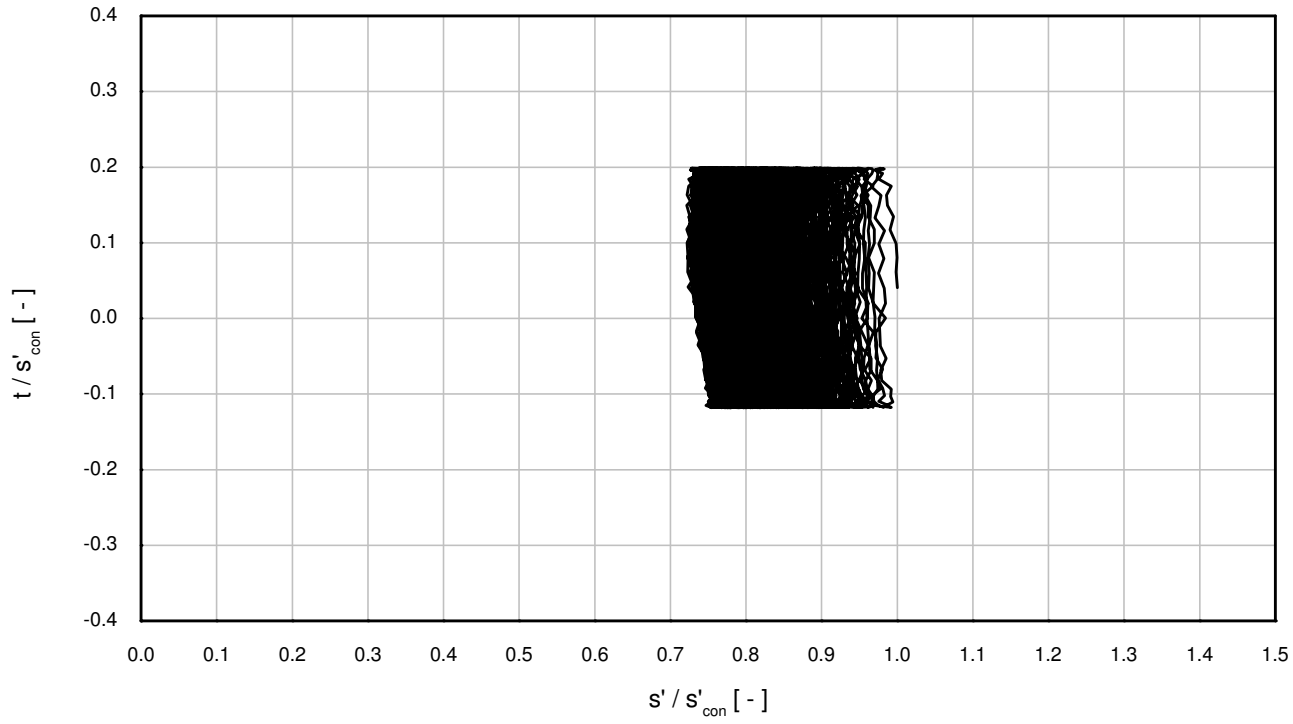




Initial σ'_r	:	142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	154 kPa	Sample	: 17WAXC
q_{av}	:	12 kPa	Depth [m]	: 14.86
q_{cy}	:	47 kPa	Test No.	: CTX12
Frequency	:	0.10 Hz		

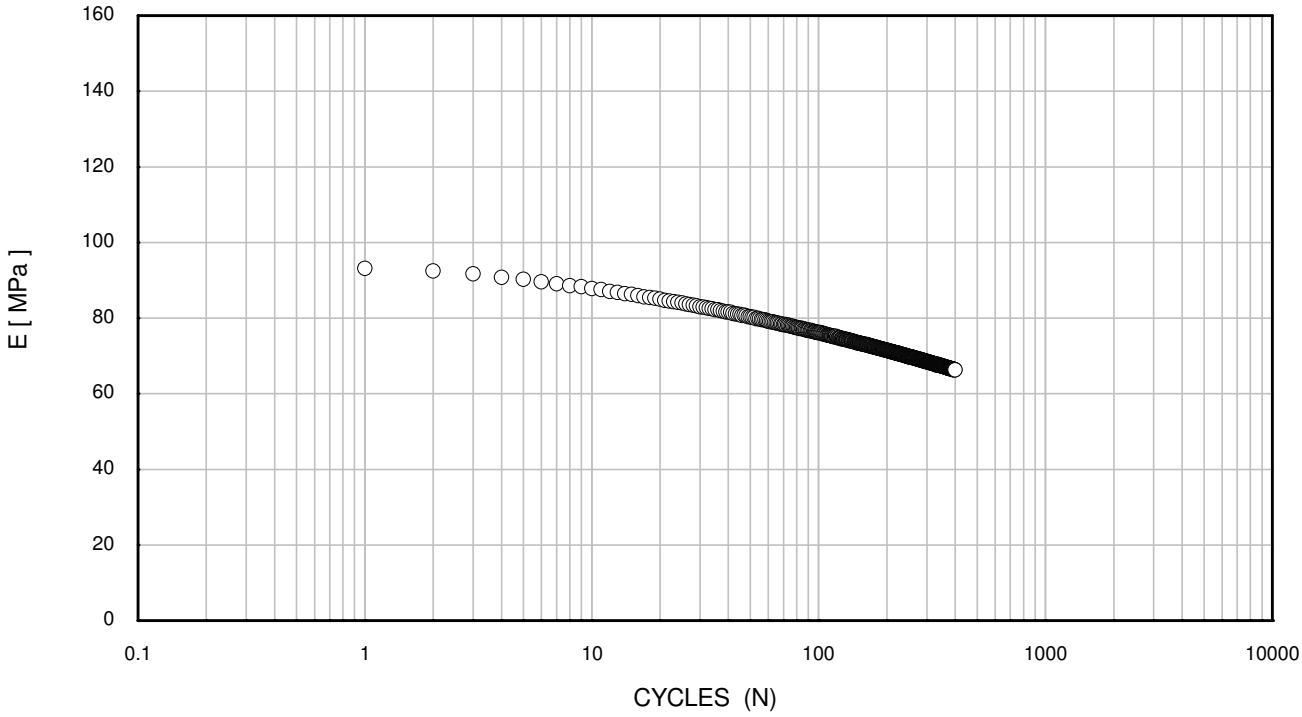
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

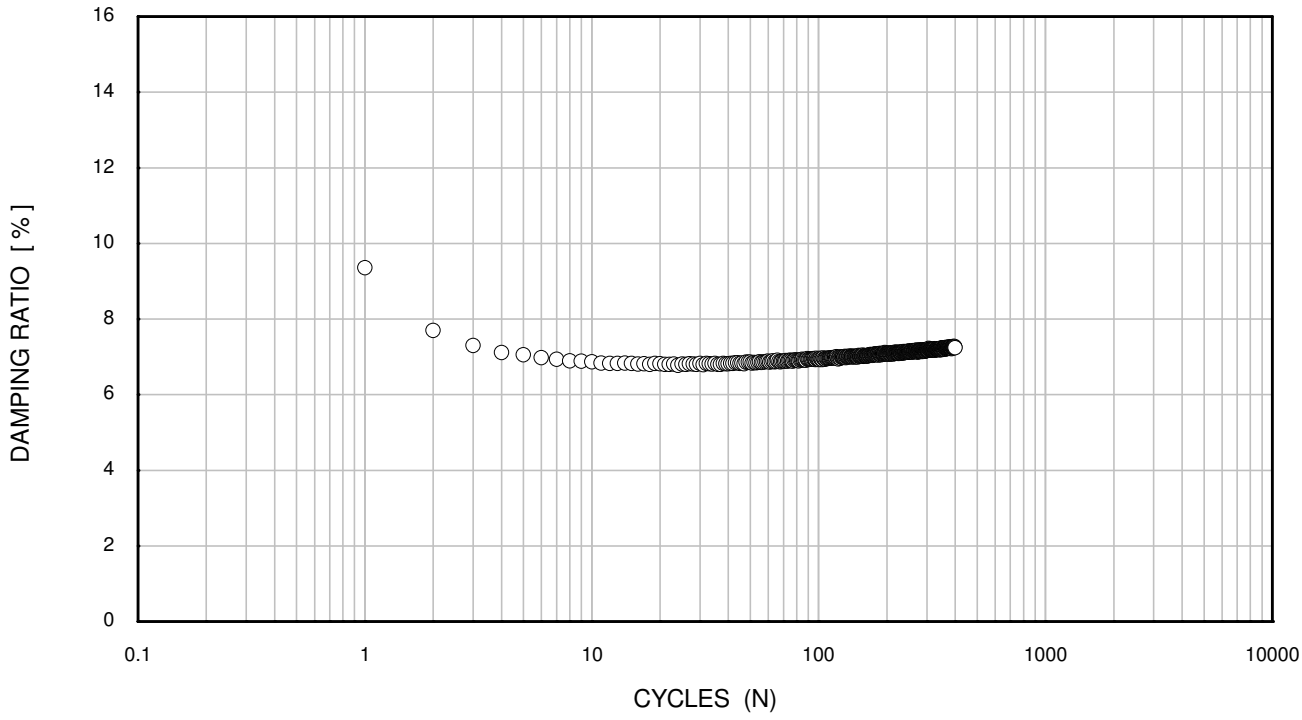




Initial σ'_r	: 142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 154 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 47 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

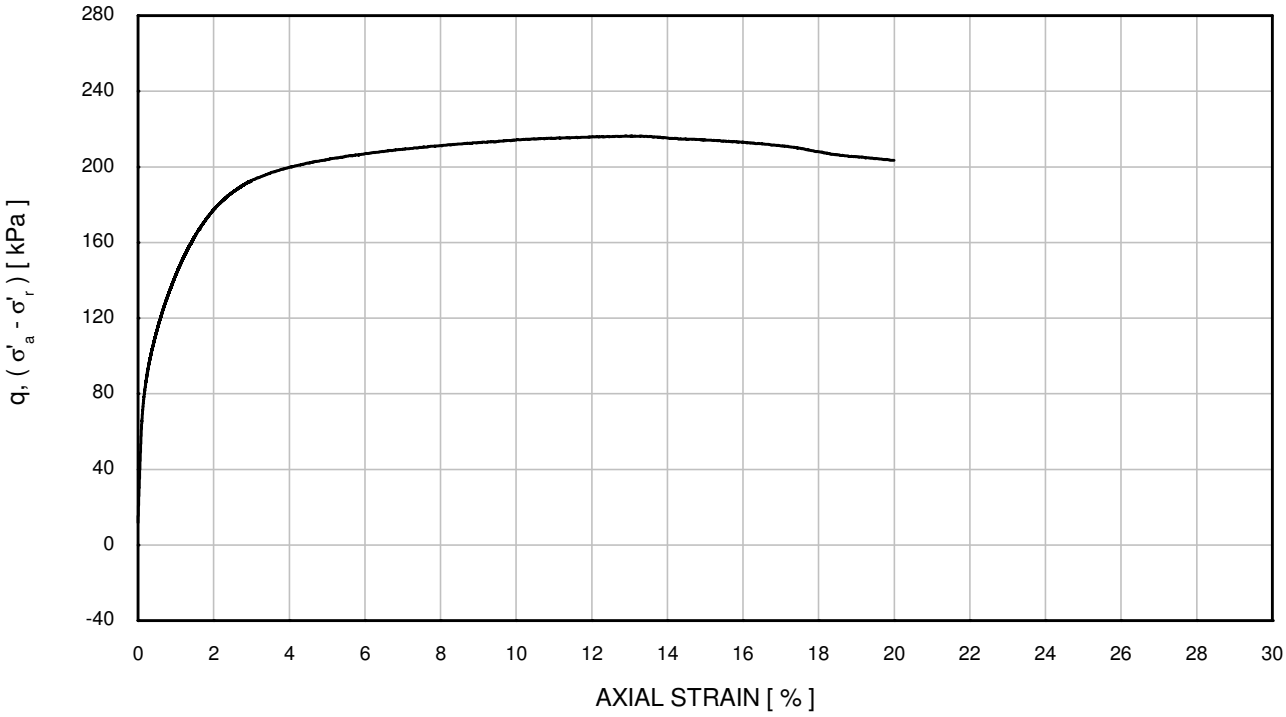
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

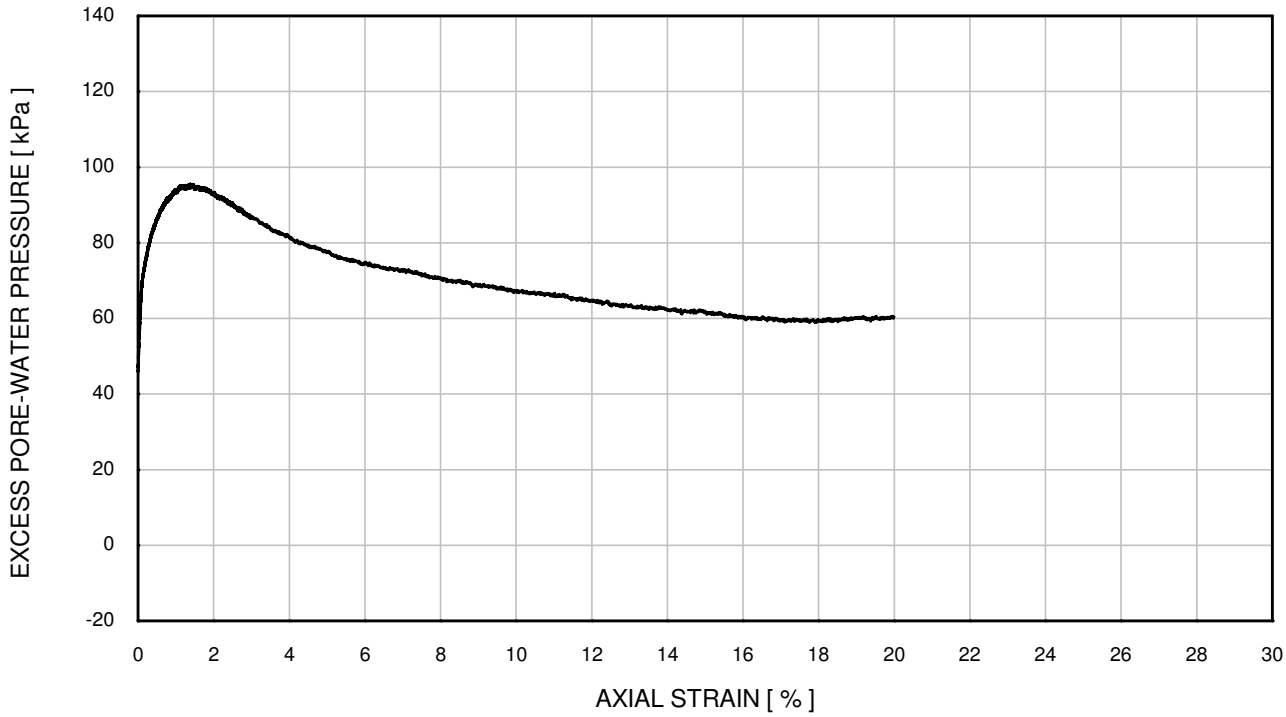




Initial σ'_r	: 142 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 154 kPa	Sample	: 17WAXC
q_{av}	: 12 kPa	Depth [m]	: 14.86
q_{cy}	: 47 kPa	Test No.	: CTX12
Frequency	: 0.10 Hz		

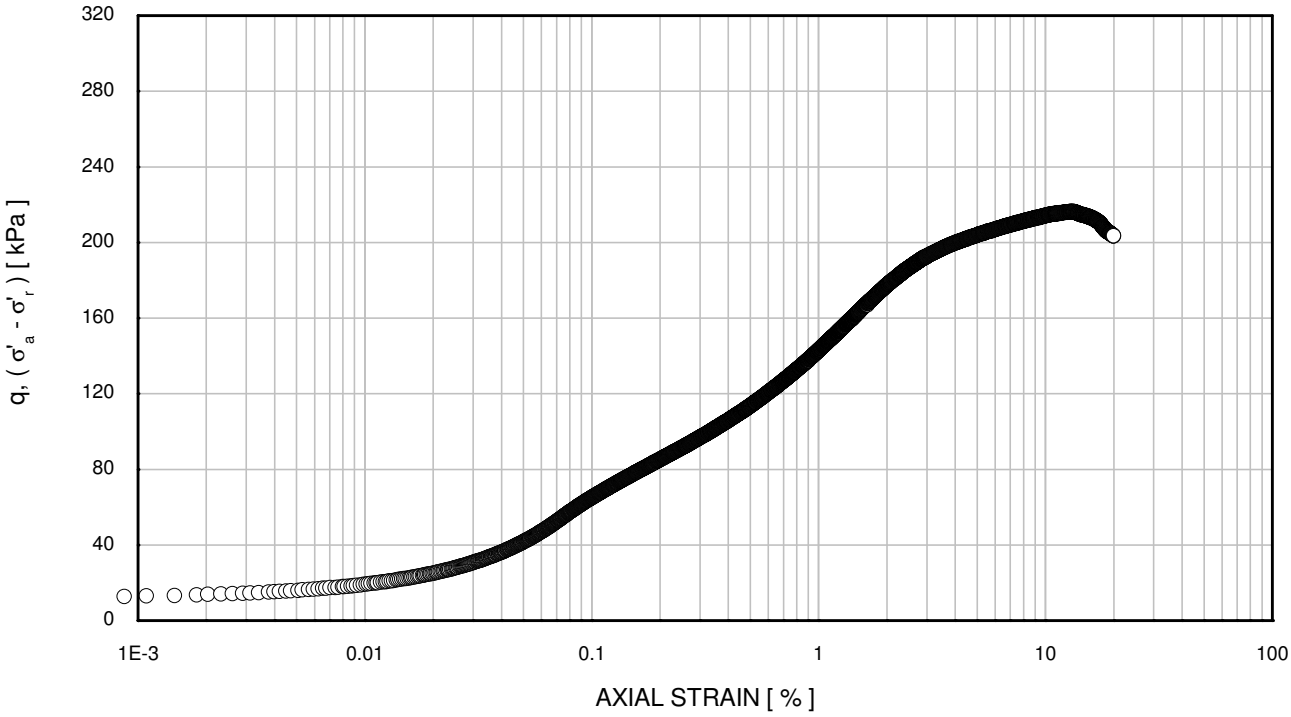
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

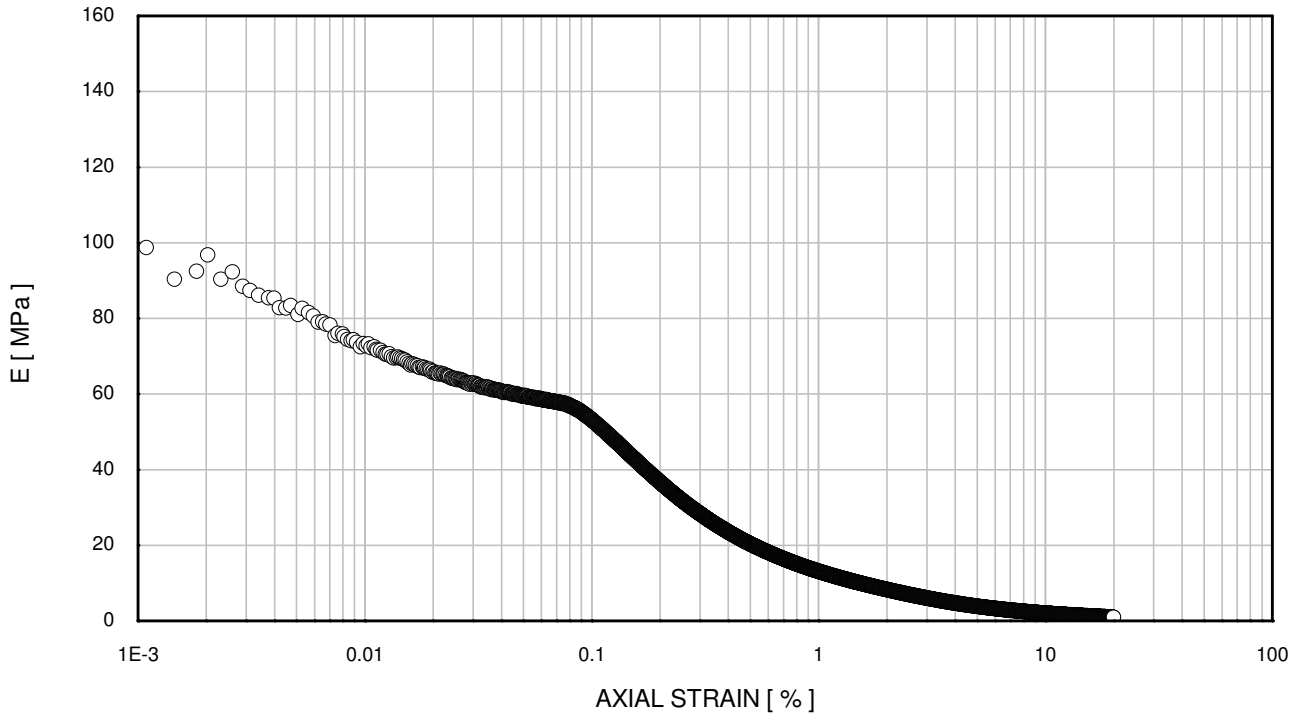




Initial σ'_r	: 102 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 114 kPa	Sample	: 17WAXC
q_{peak}	: 216 kPa	Depth [m]	: 14.86
Ext. ε at q_{peak}	: 12.90 %	Test No.	: CTX12
Rate of strain	: 0.50 %/hour		

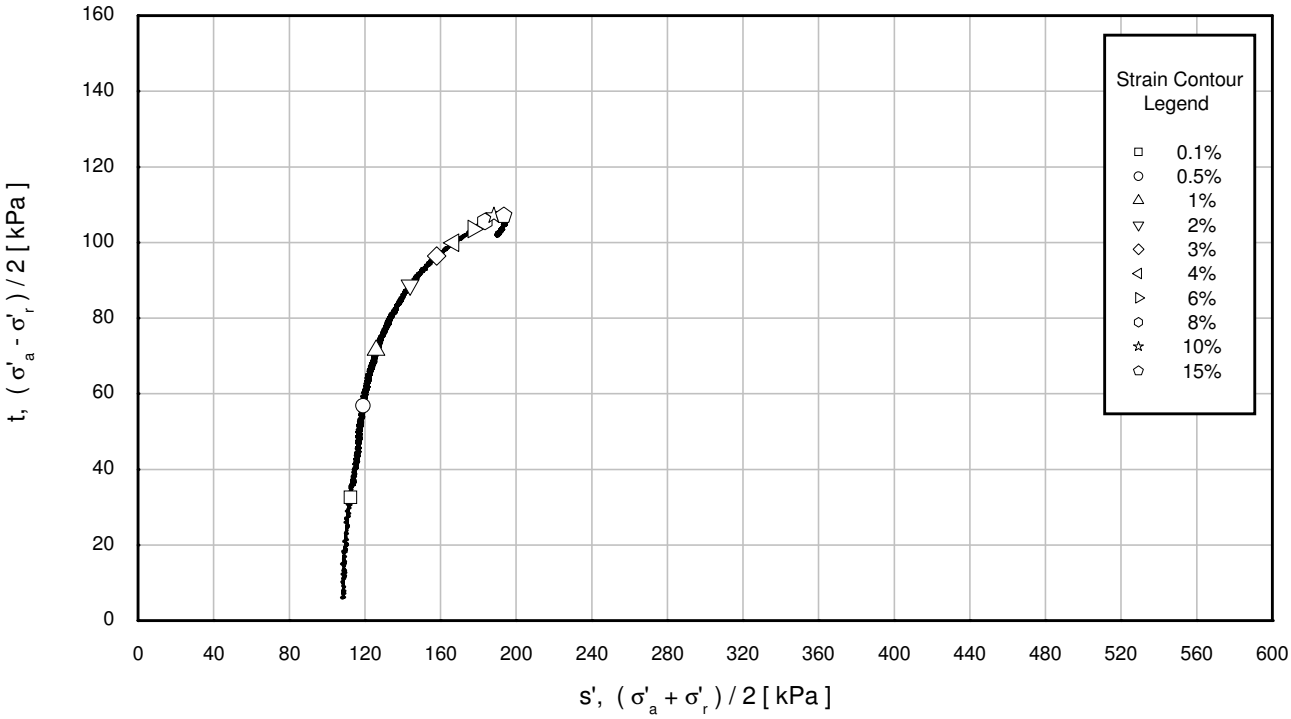
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

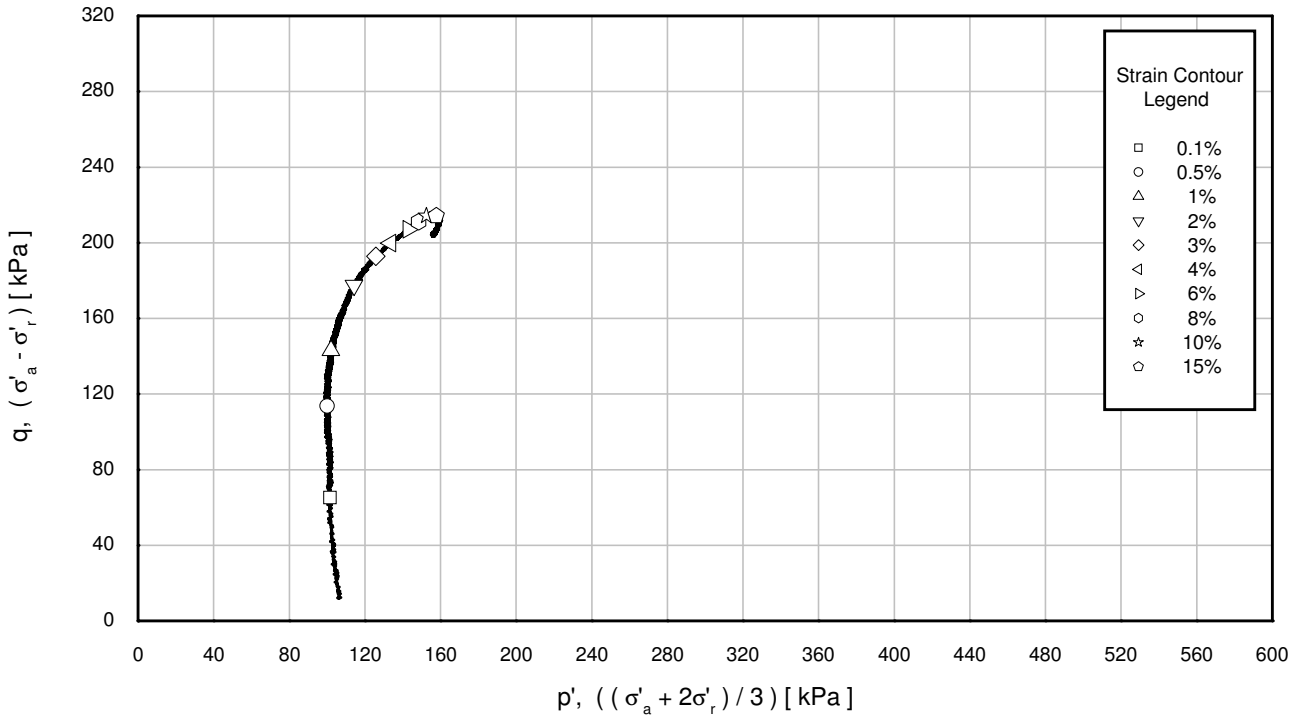




Initial σ'_r	: 102 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 114 kPa	Sample	: 17WAXC
q_{peak}	: 216 kPa	Depth [m]	: 14.86
Ext. ε at q_{peak}	: 12.90 %	Test No.	: CTX12
Rate of strain	: 0.50 %/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	102 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	114 kPa	Sample	:	17WAXC
q_{peak}	:	216 kPa	Depth [m]	:	14.86
Ext. ε at q_{peak}	:	12.90 %	Test No.	:	CTX12
Rate of strain	:	0.50 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Olive grey slightly silty sandy CLAY

GENERAL	
Date test started	08/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	72.0
Length	[mm]	144.1
Water content	[%]	29.3
Bulk density	[Mg/m³]	1.96
Dry density	[Mg/m³]	1.52
Void ratio	[-]	0.782
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	35
Pocket penetrometer	[kPa]	29

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_17D_CTX13
Processed by Date	JLS 03/01/2016
Checked by Date	PH 04/01/2017
Approved by Date	PH 04/01/2017

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	892
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1038
Back pressure	[kPa]	893
Base PWP	[kPa]	893
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	145
Effective axial pressure	[kPa]	145
Deviator stress	[kPa]	0
Volumetric strain	[%]	3.20
External axial strain	[%]	1.62
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.725
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 1		
Cell pressure	[kPa]	1038
Back pressure	[kPa]	893
Base PWP	[kPa]	905
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	133
Effective axial pressure	[kPa]	156
Deviator stress	[kPa]	23
Volumetric strain	[%]	0.00
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.725
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	233
Mean q_{av}	[kPa]	23
Mean q_{cy}	[kPa]	23
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.03
External ε_{cy} at N_f	[%]	0.04
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	17
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.725
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.00	0.03	73.18	-	4.64	-
2	0.00	0.03	70.64	-	8.23	-
5	0.00	0.03	70.03	-	8.50	-
10	0.00	0.03	69.31	-	8.30	-
20	0.00	0.03	68.49	-	8.99	-
30	0.01	0.03	68.57	-	8.56	-
40	0.01	0.03	68.07	-	8.90	-
50	0.01	0.03	67.52	-	8.95	-
100	0.01	0.03	66.96	-	9.33	-
500	0.02	0.03	66.53	-	7.63	-
1000	0.02	0.03	64.97	-	7.62	-
1500	0.03	0.04	64.44	-	7.62	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 2		
Cell pressure	[kPa]	1038
Back pressure	[kPa]	893
Base PWP	[kPa]	918
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	120
Effective axial pressure	[kPa]	167
Deviator stress	[kPa]	47
Volumetric strain	[%]	0.00
External axial strain	[%]	0.05
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.725
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	233
Mean q_{av}	[kPa]	46
Mean q_{cy}	[kPa]	46
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.33
External ε_{cy} at N_f	[%]	0.09
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	74
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.725
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.09	0.07	70.06	-	12.65	-
2	0.10	0.07	68.74	-	5.43	-
5	0.13	0.07	67.67	-	3.94	-
10	0.15	0.07	65.77	-	3.49	-
20	0.17	0.07	64.07	-	3.00	-
30	0.19	0.07	62.78	-	2.80	-
40	0.20	0.07	62.08	-	2.76	-
50	0.21	0.07	61.34	-	2.90	-
100	0.24	0.08	58.74	-	2.88	-
200	0.29	0.08	56.19	-	2.96	-
300	0.31	0.08	54.49	-	3.16	-
400	0.33	0.09	53.36	-	3.31	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

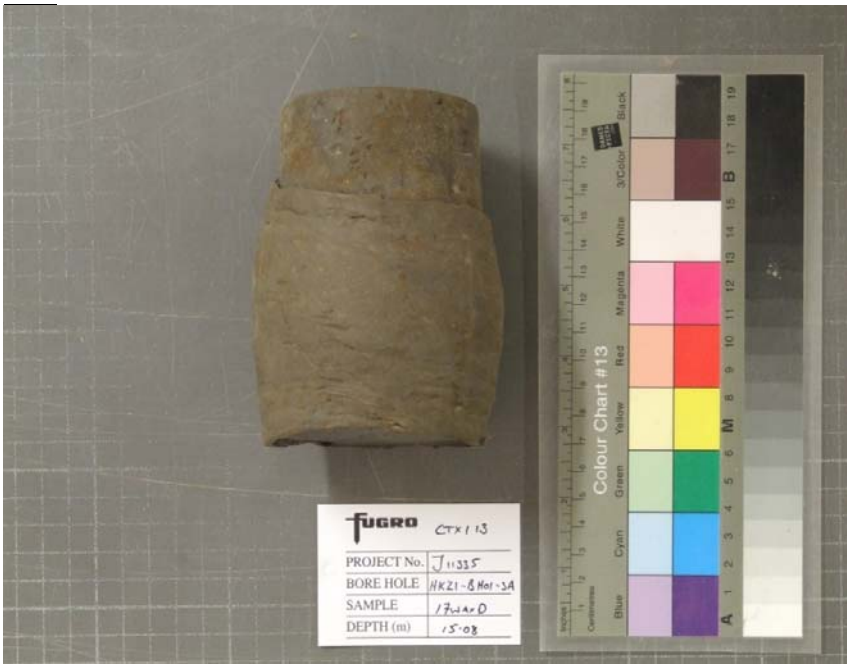
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	69
Initial effective axial pressure	[kPa]	115
Rate of strain	[%/hour]	0.51
At peak deviator stress		
Corrected deviator stress	[kPa]	235
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	58
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	87
Effective axial pressure	[kPa]	322
Principal effective stress ratio	[-]	3.69
ε_{50}	[%]	0.94
Secant modulus (E_{50}) at ε_{50}	[kPa]	15914
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	206
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.73
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	89
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	57
Effective axial pressure	[kPa]	263
Principal effective stress ratio	[-]	4.64
At 15% external axial strain		
Corrected deviator stress	[kPa]	224
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	56
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	90
Effective axial pressure	[kPa]	314
Principal effective stress ratio	[-]	3.49

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

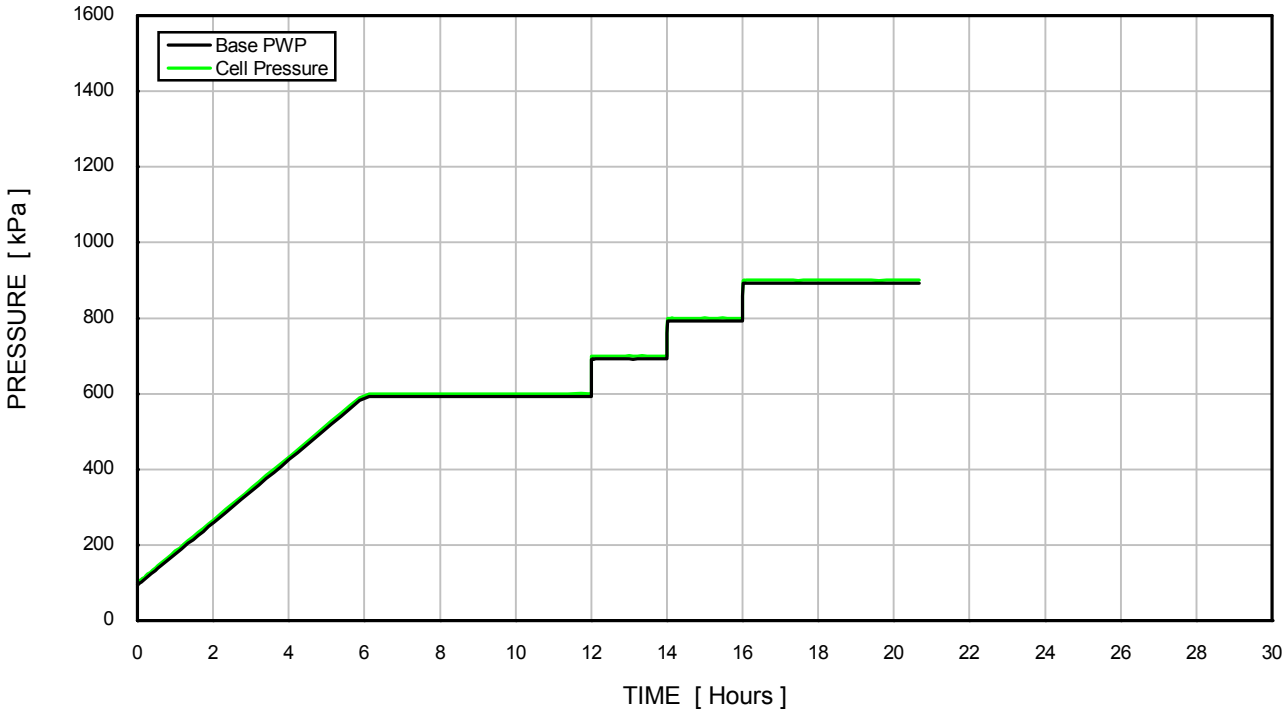


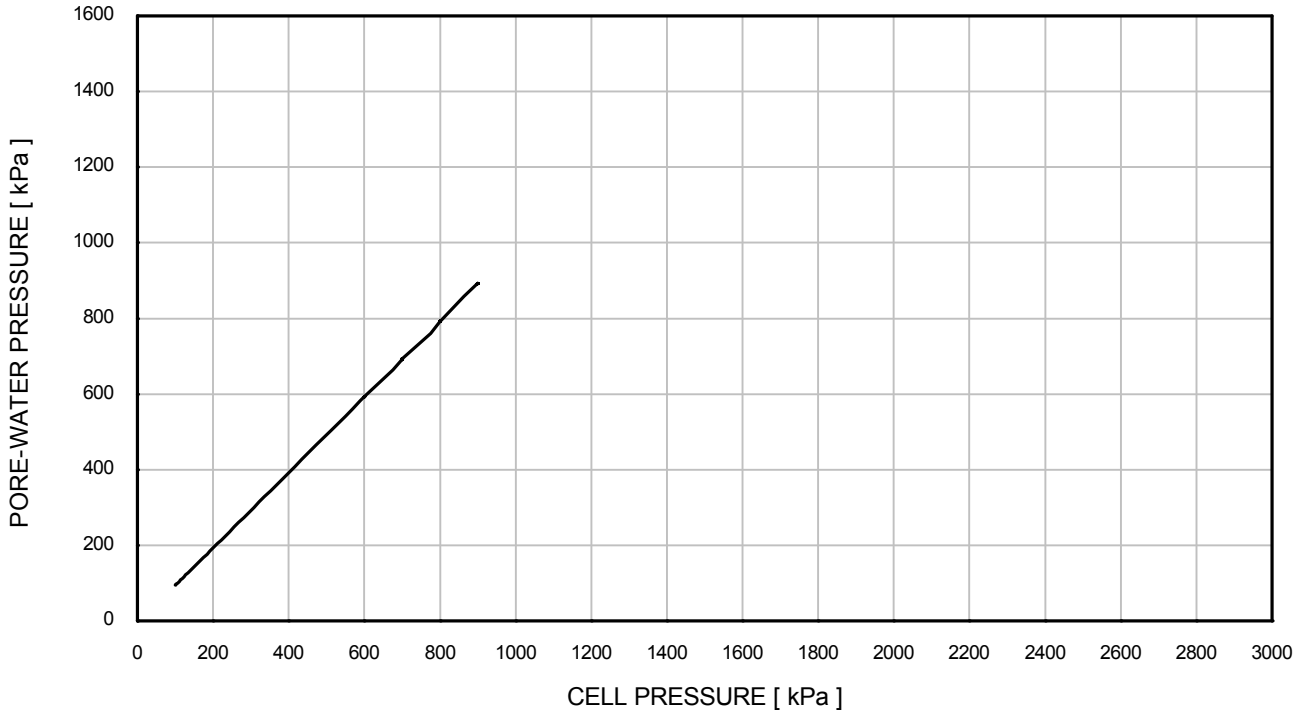


FINAL CONDITIONS		
Water content	[%]	27.1
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.57

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxD
Depth [m]	15.08
Test number	CTX13

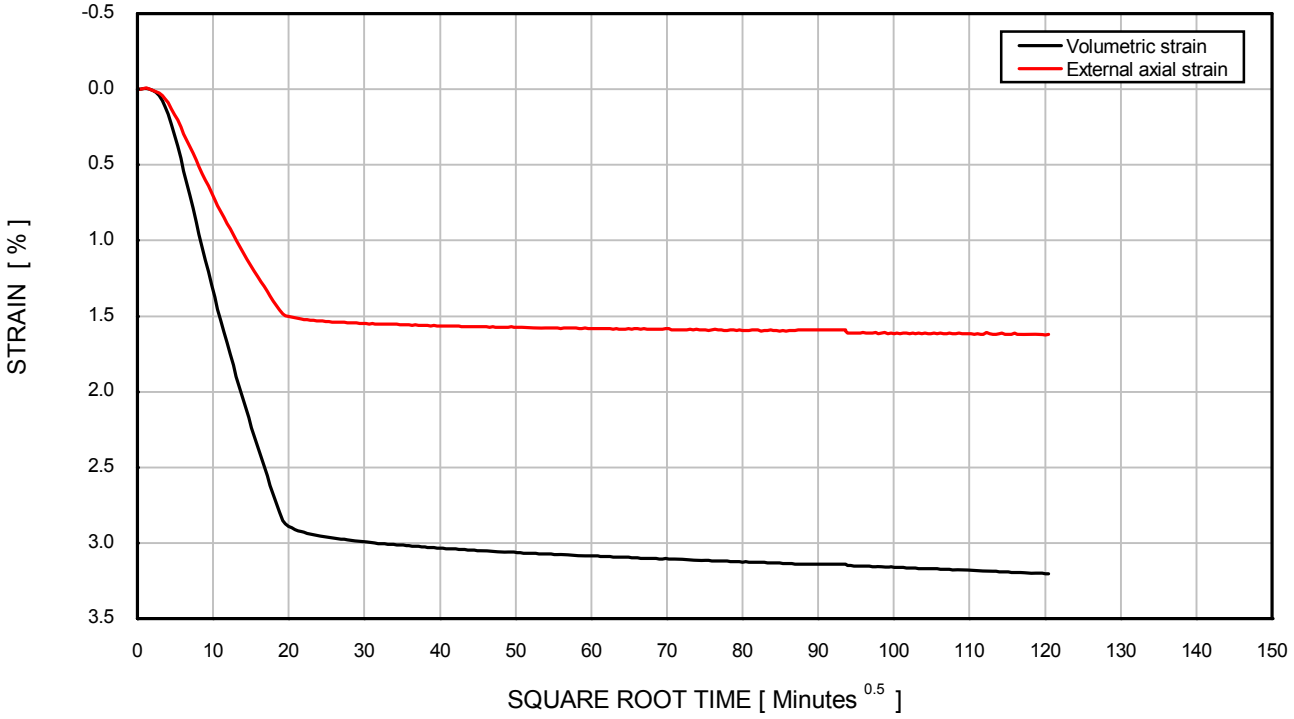
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

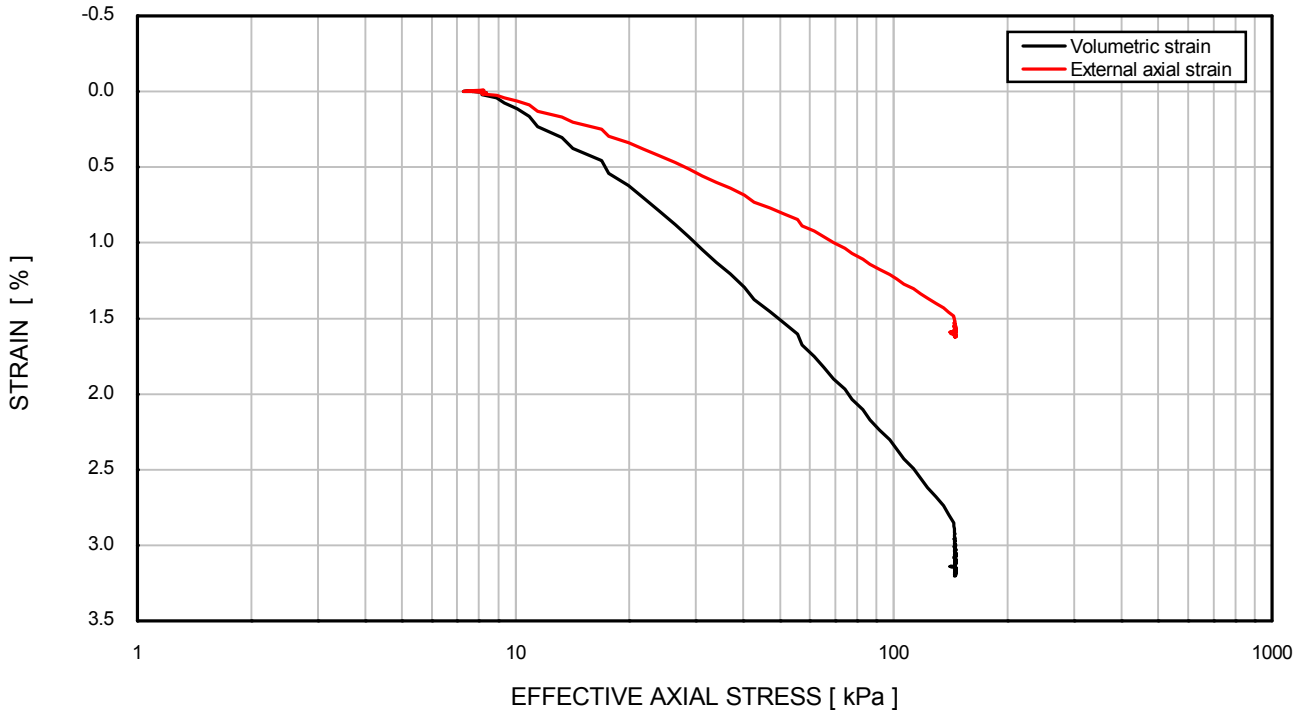




B value	:	1.00			
Initial σ'_r	:	5	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	5	kPa	Sample	: 17WaxD
Final σ'_r	:	8	kPa	Depth [m]	: 15.08
Final σ'_a	:	8	kPa	Test No.	: CTX13

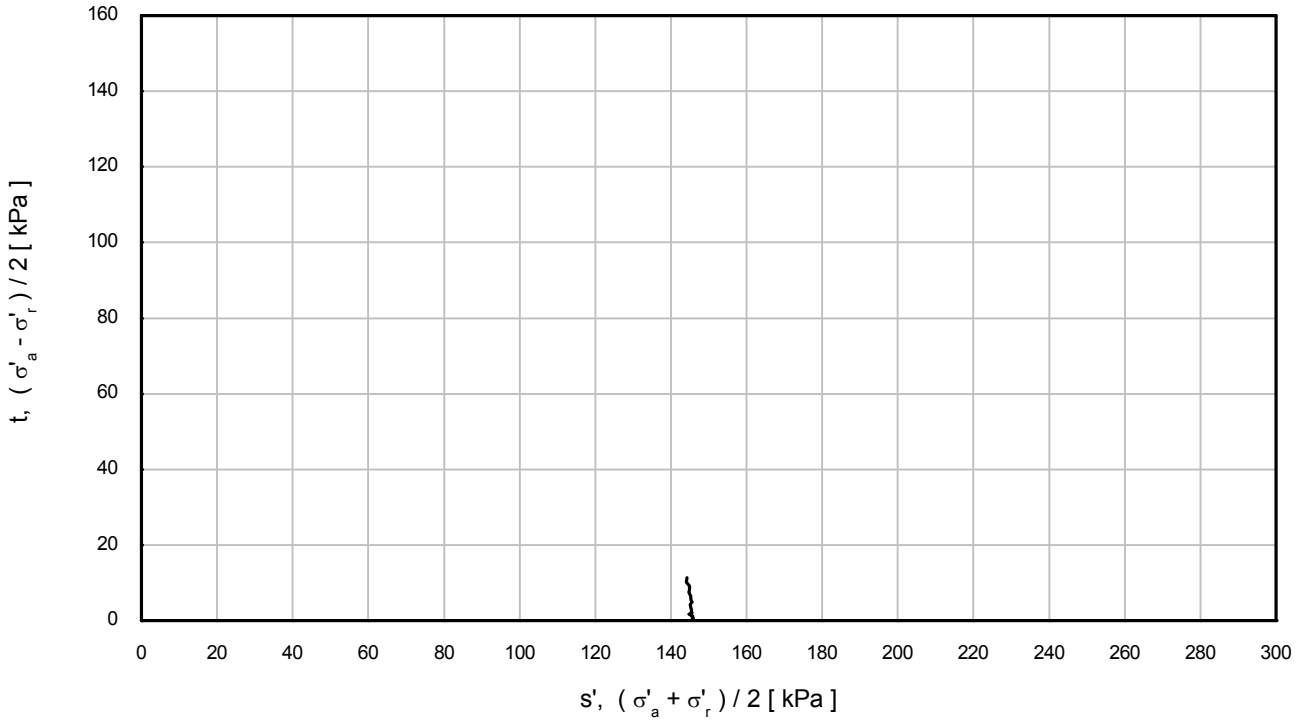
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

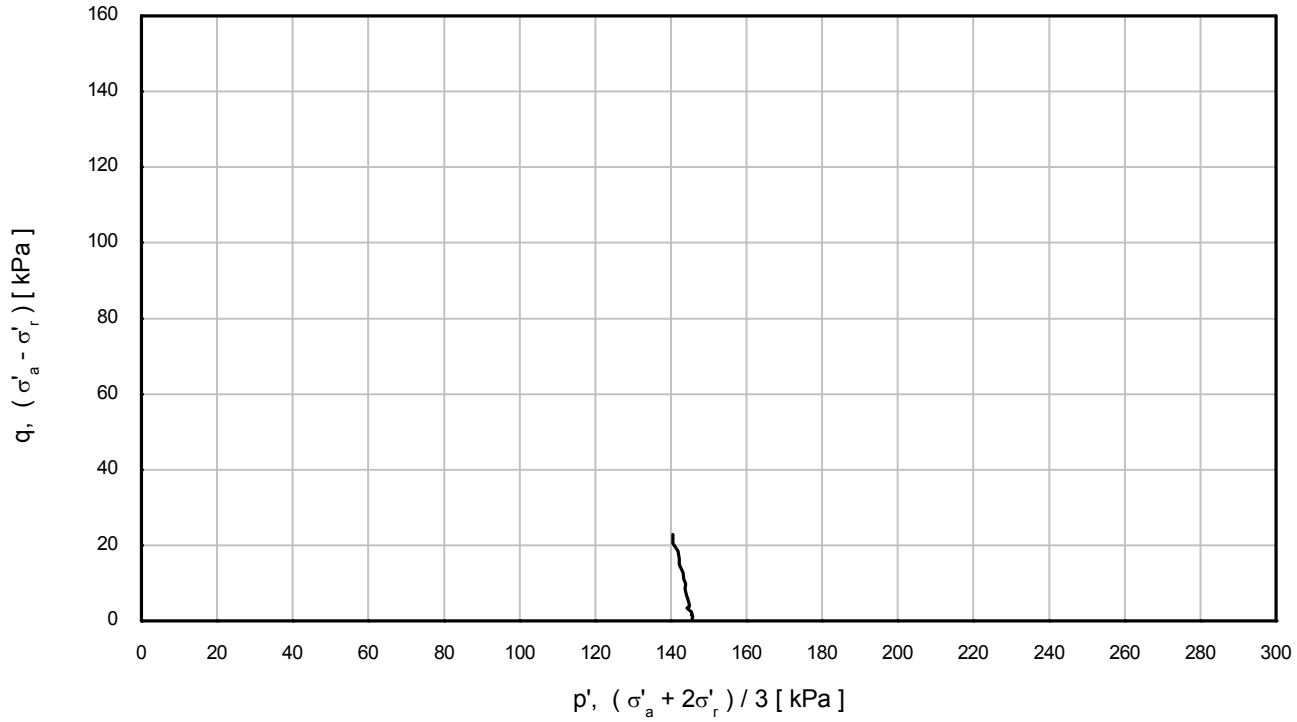




Stage 1 σ'_{rc}	: 145 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 145 kPa	Sample	: 17WaxD
		Depth [m]	: 15.08
		Test No.	: CTX13

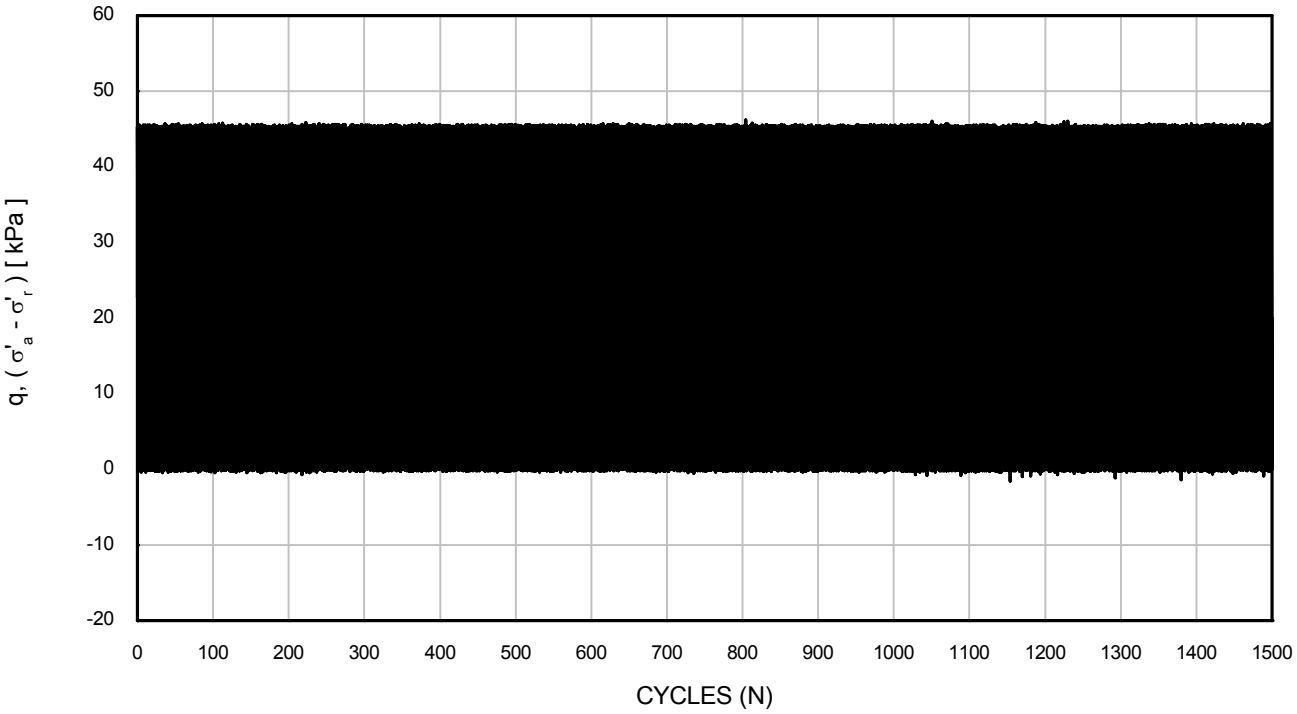
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

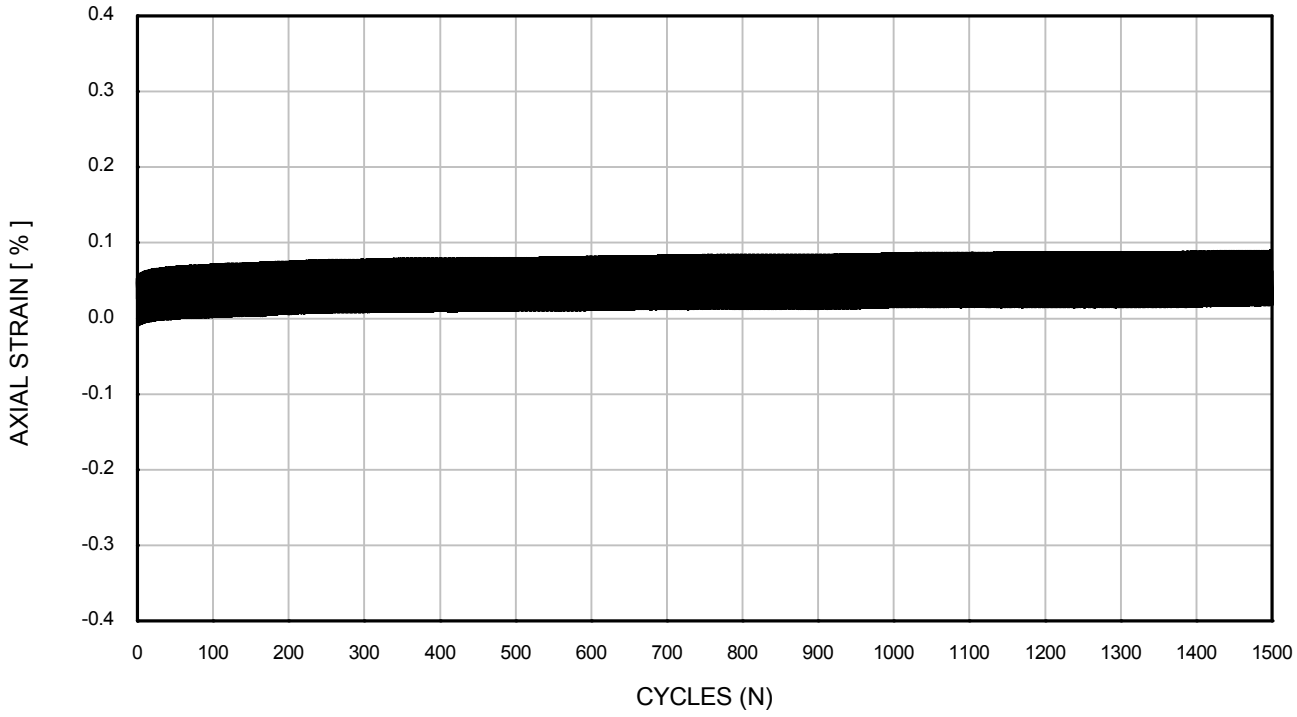




σ'_{rc}	: 133 kPa	Borehole	: HKZ1-BH01-SA
σ'_{ac}	: 156 kPa	Sample	: 17WaxD
		Depth [m]	: 15.08
		Test No.	: CTX13

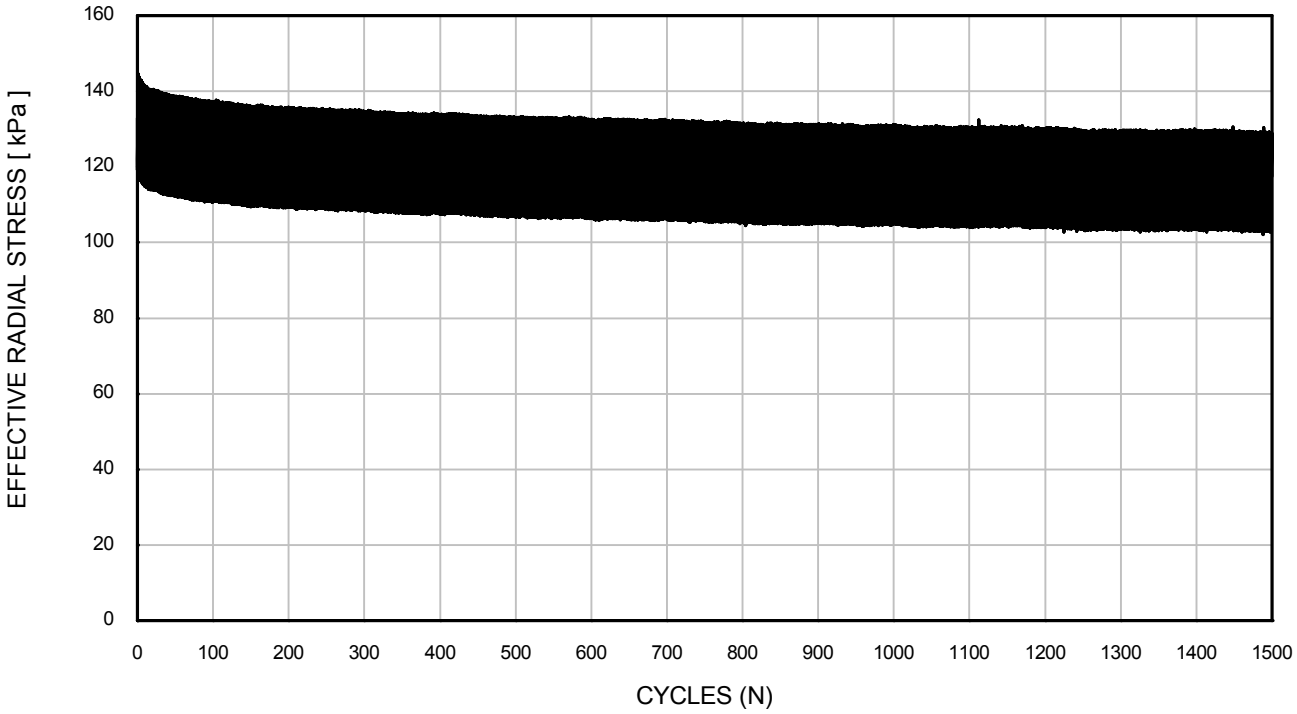
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 1 - UNDRAINED

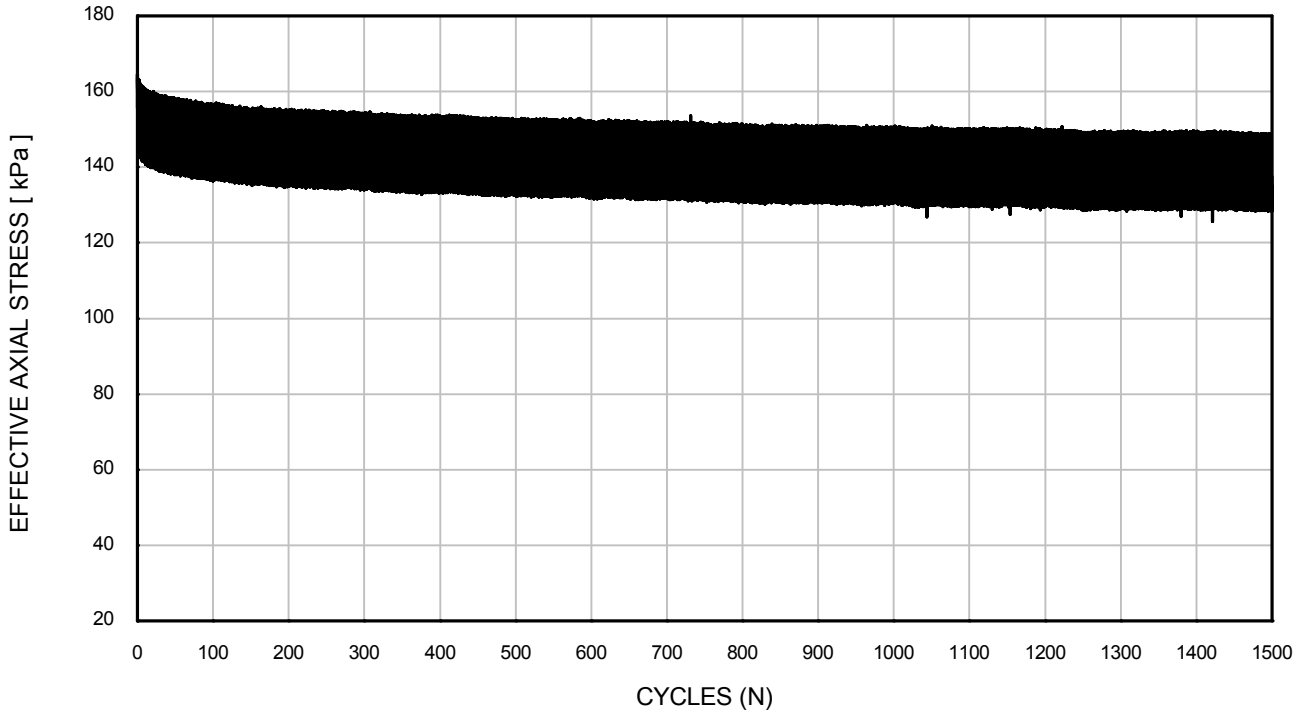




Initial σ'_r	:	133 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	156 kPa	Sample	:	17WaxD
q_{av}	:	23 kPa	Depth [m]	:	15.08
q_{cy}	:	23 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

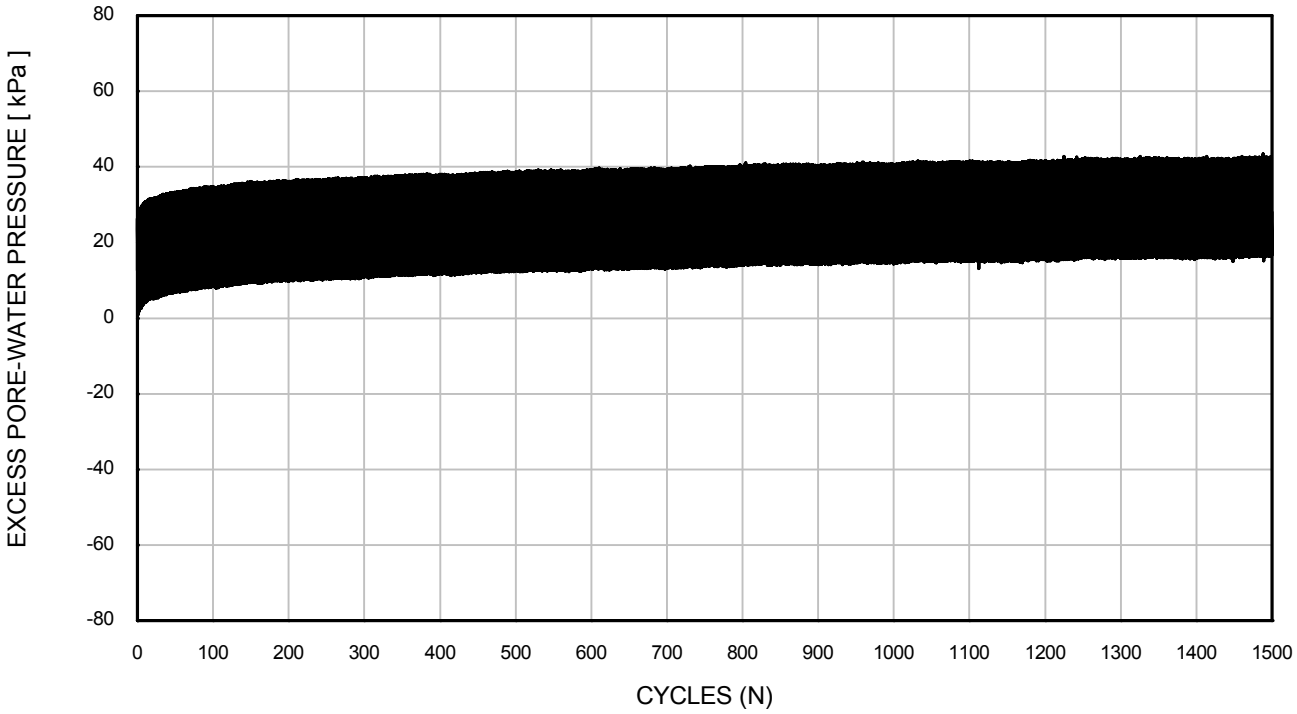
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

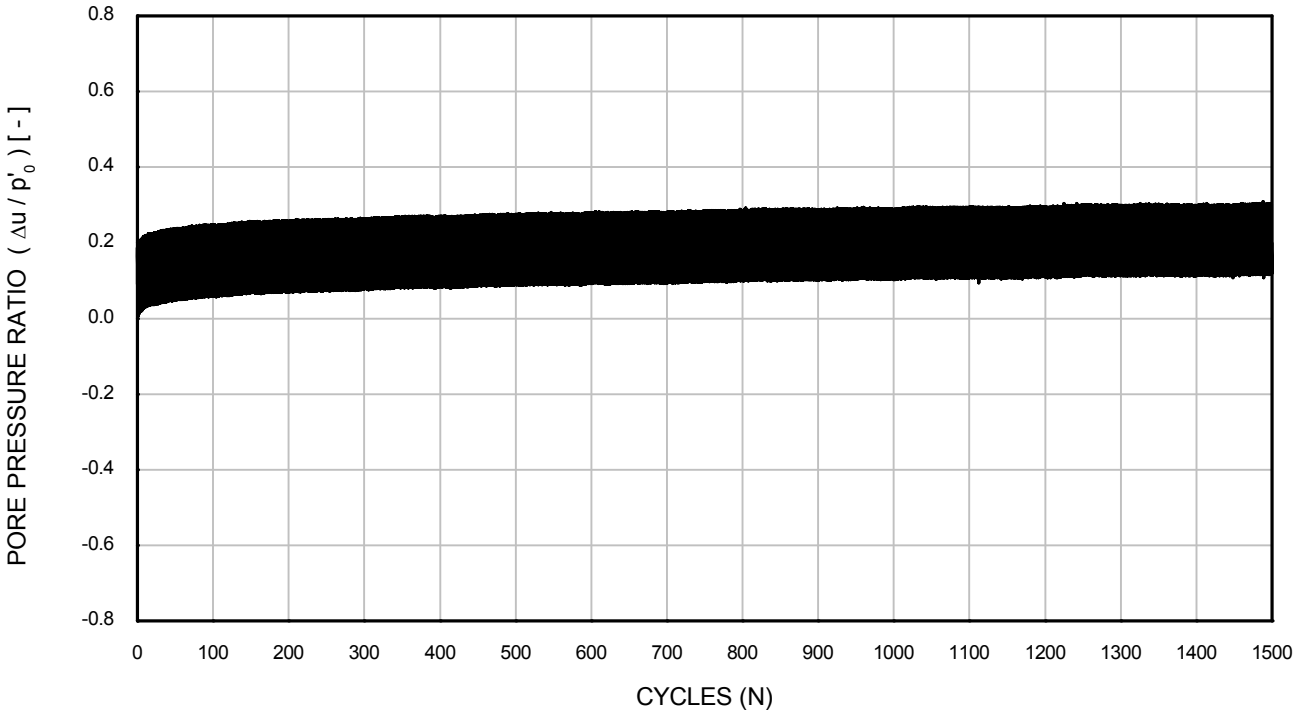




Initial σ'_r	: 133 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 156 kPa	Sample	: 17WaxD
q_{av}	: 23 kPa	Depth [m]	: 15.08
q_{cy}	: 23 kPa	Test No.	: CTX13
Frequency	: 0.10 Hz		

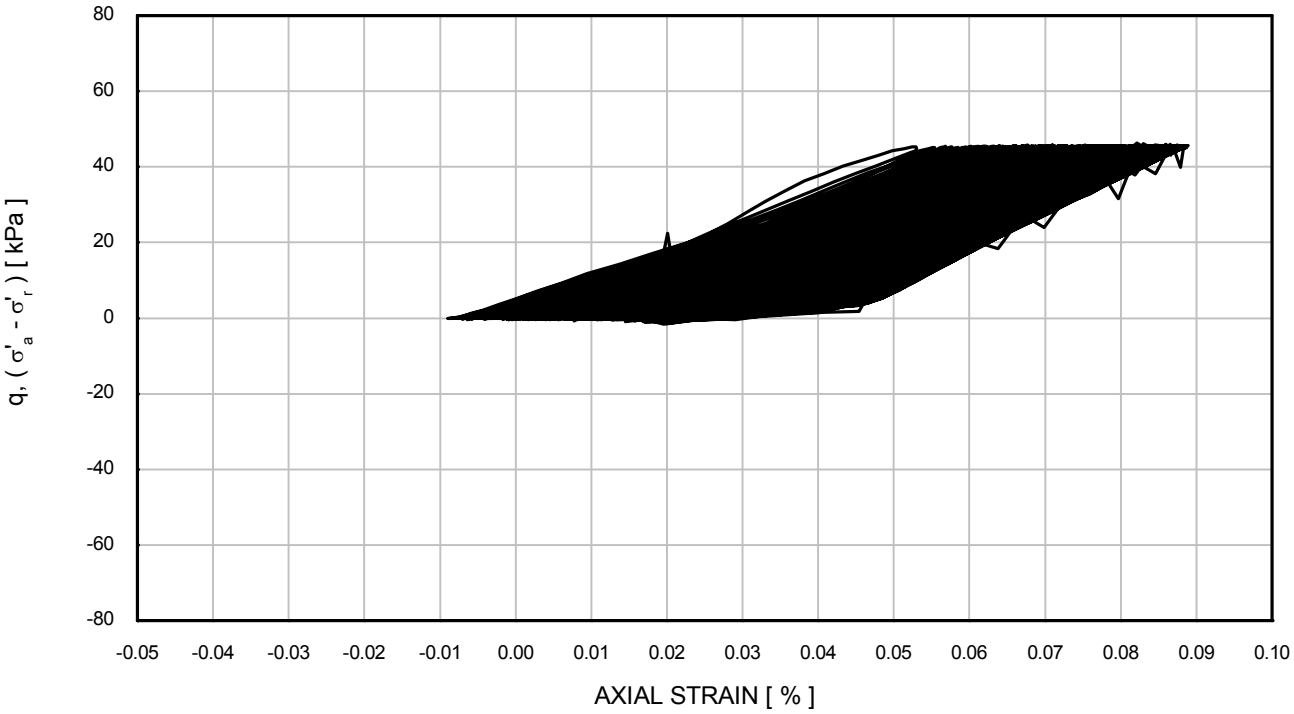
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

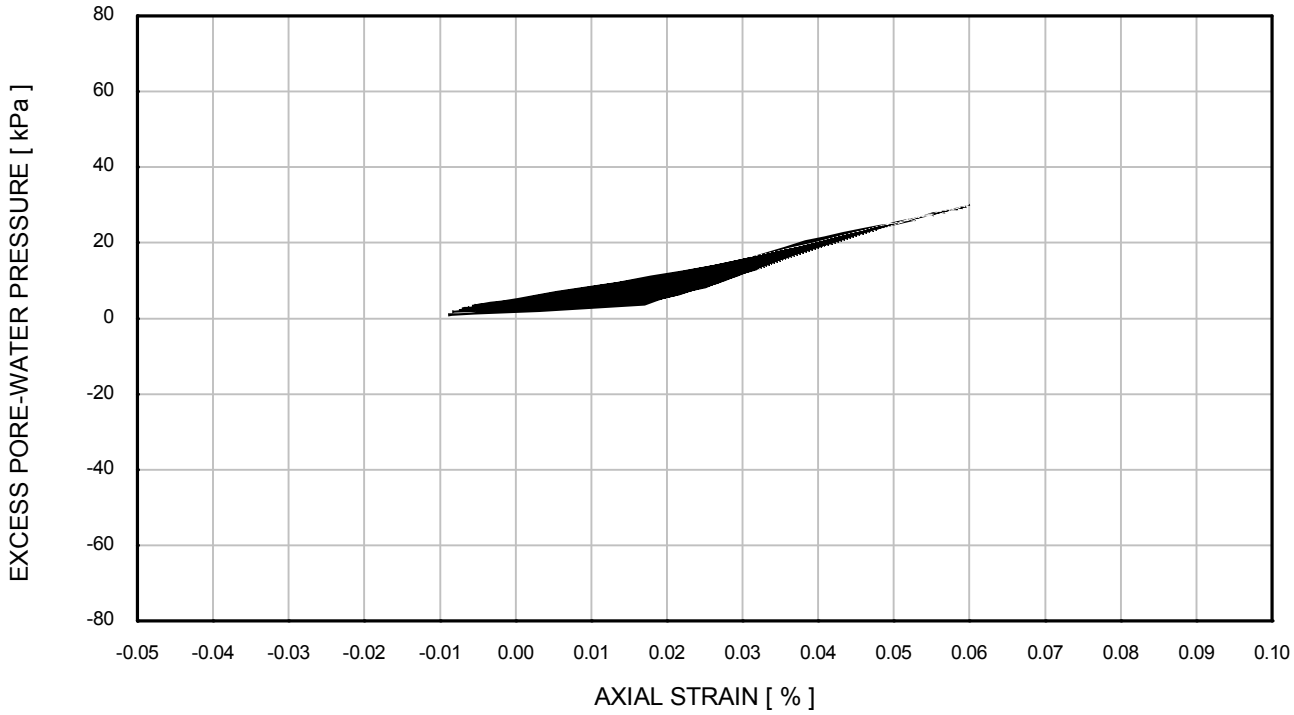




Initial σ'_r	: 133 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 156 kPa	Sample	: 17WaxD
q_{av}	: 23 kPa	Depth [m]	: 15.08
q_{cy}	: 23 kPa	Test No.	: CTX13
Frequency	: 0.10 Hz		

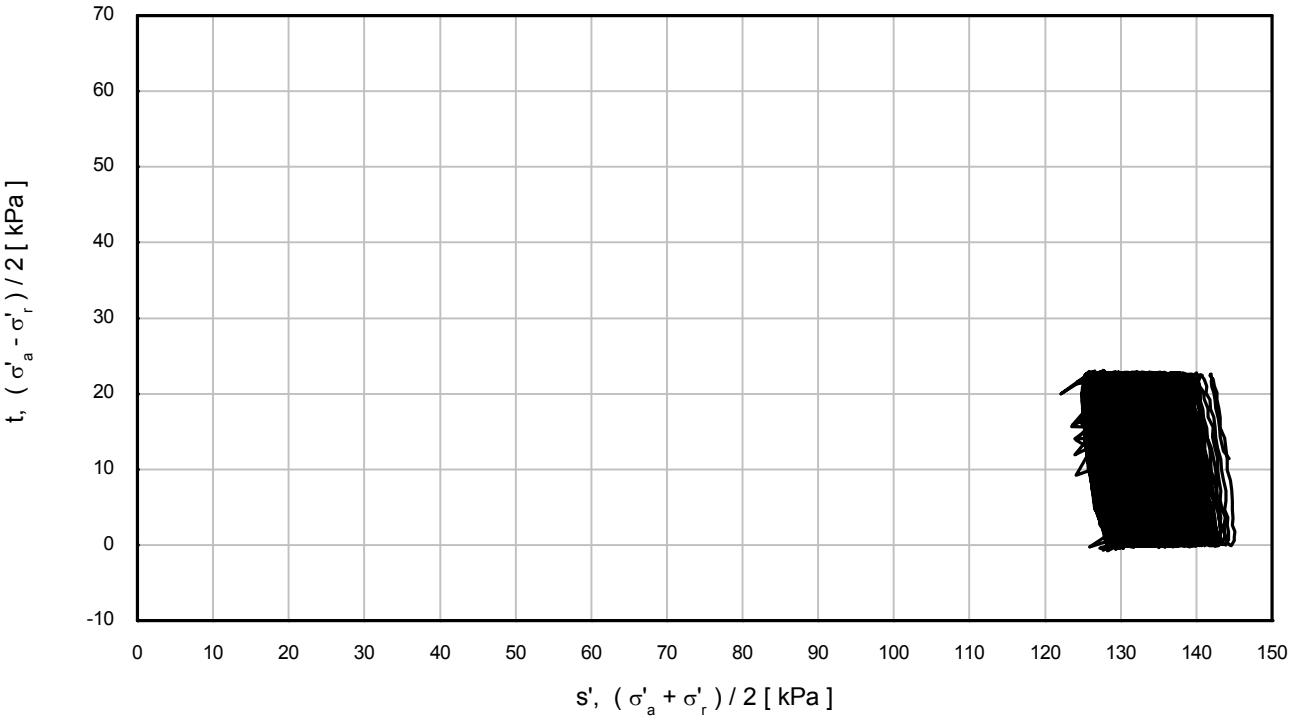
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

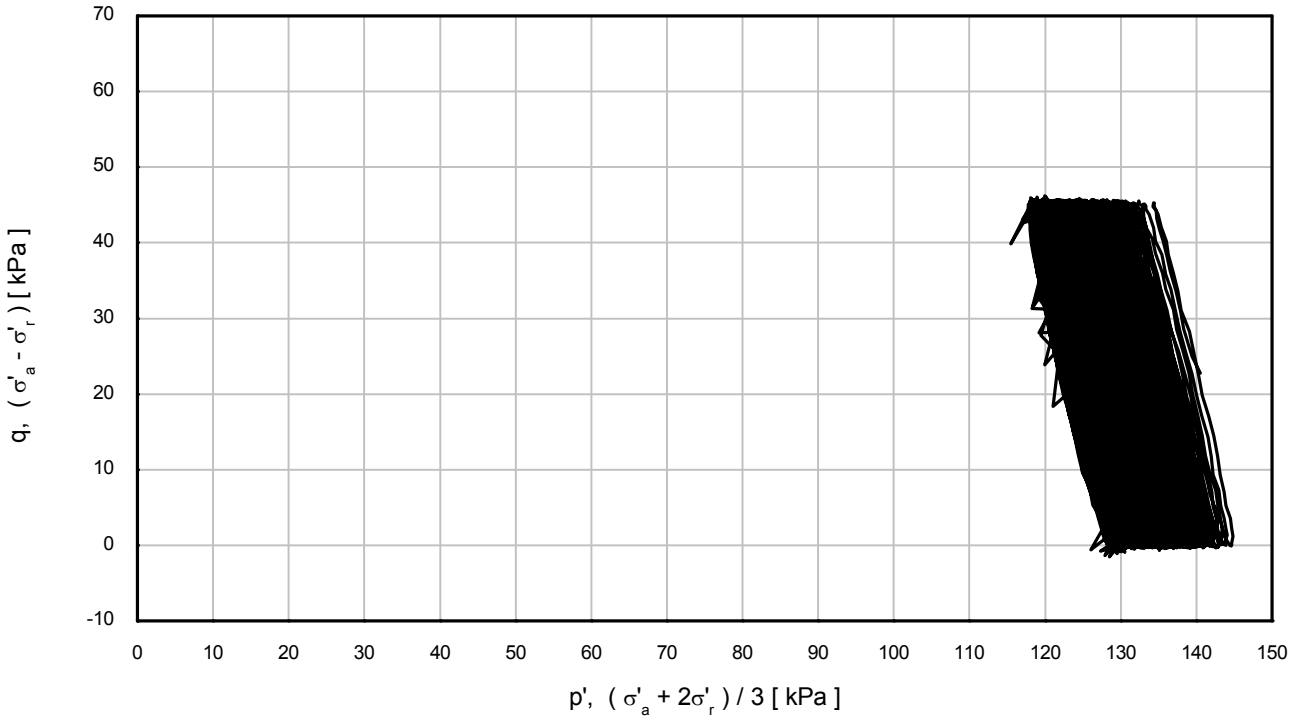




Initial σ'_r	:	133 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	156 kPa	Sample	:	17WaxD
q_{av}	:	23 kPa	Depth [m]	:	15.08
q_{cy}	:	23 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

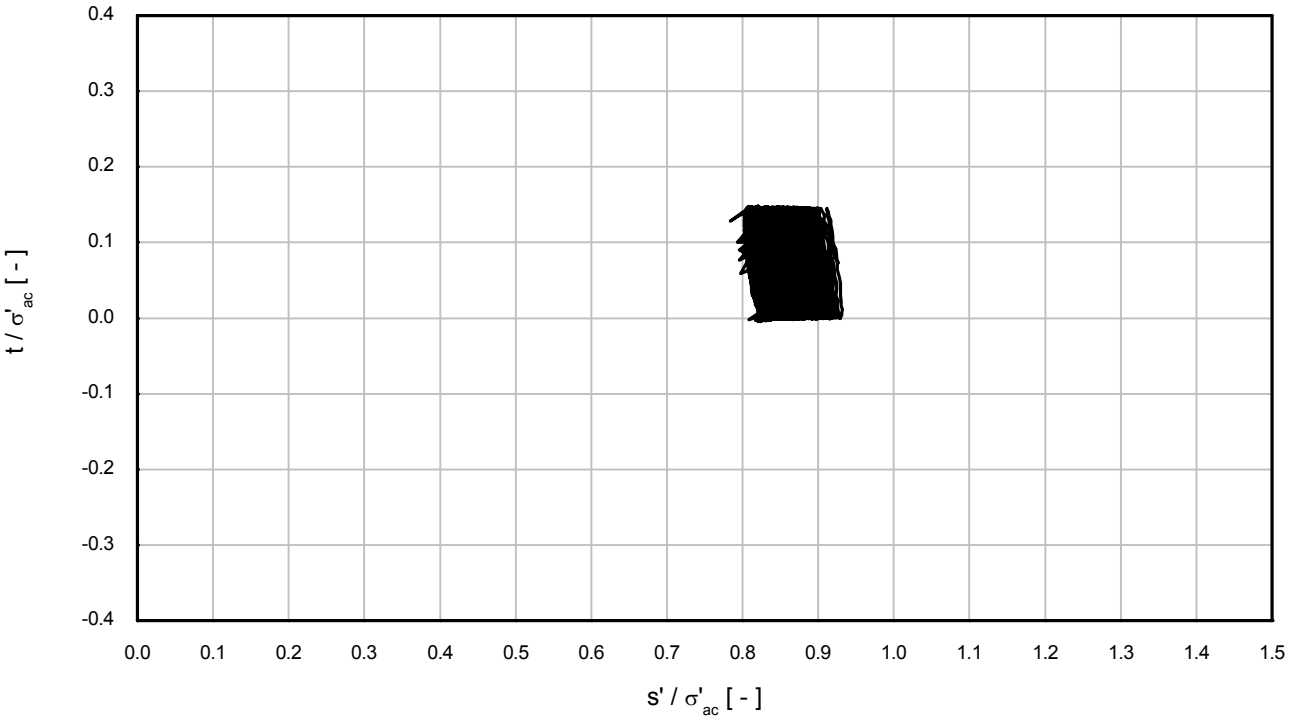
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

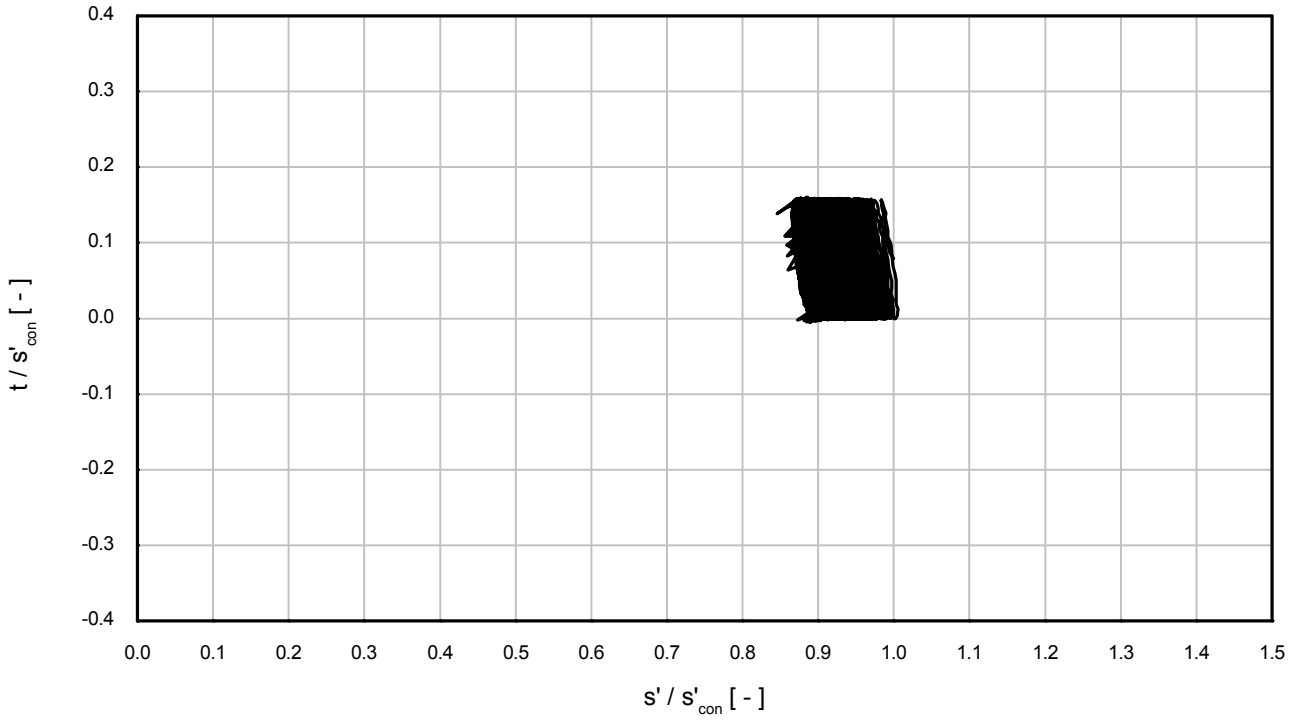




Initial σ'_r	:	133 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	156 kPa	Sample	:	17WaxD
q_{av}	:	23 kPa	Depth [m]	:	15.08
q_{cy}	:	23 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

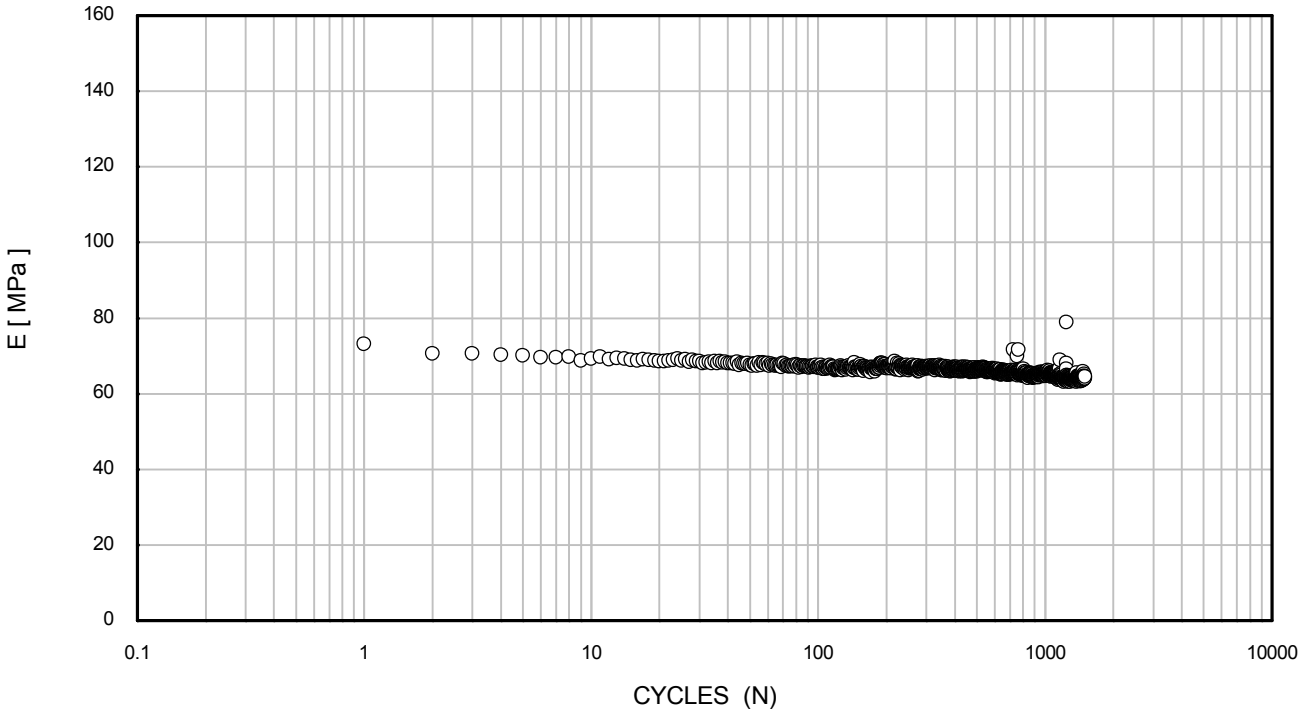
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

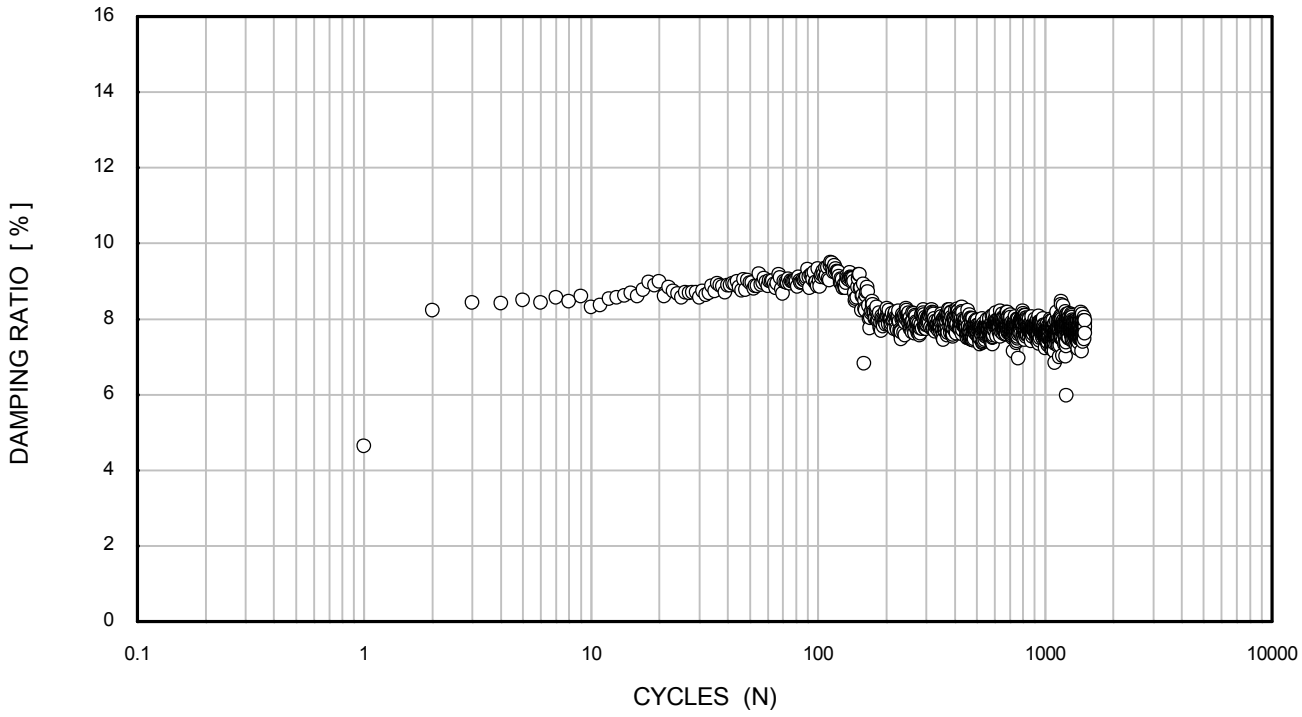




Initial σ'_r	:	133 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	156 kPa	Sample	:	17WaxD
q_{av}	:	23 kPa	Depth [m]	:	15.08
q_{cy}	:	23 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

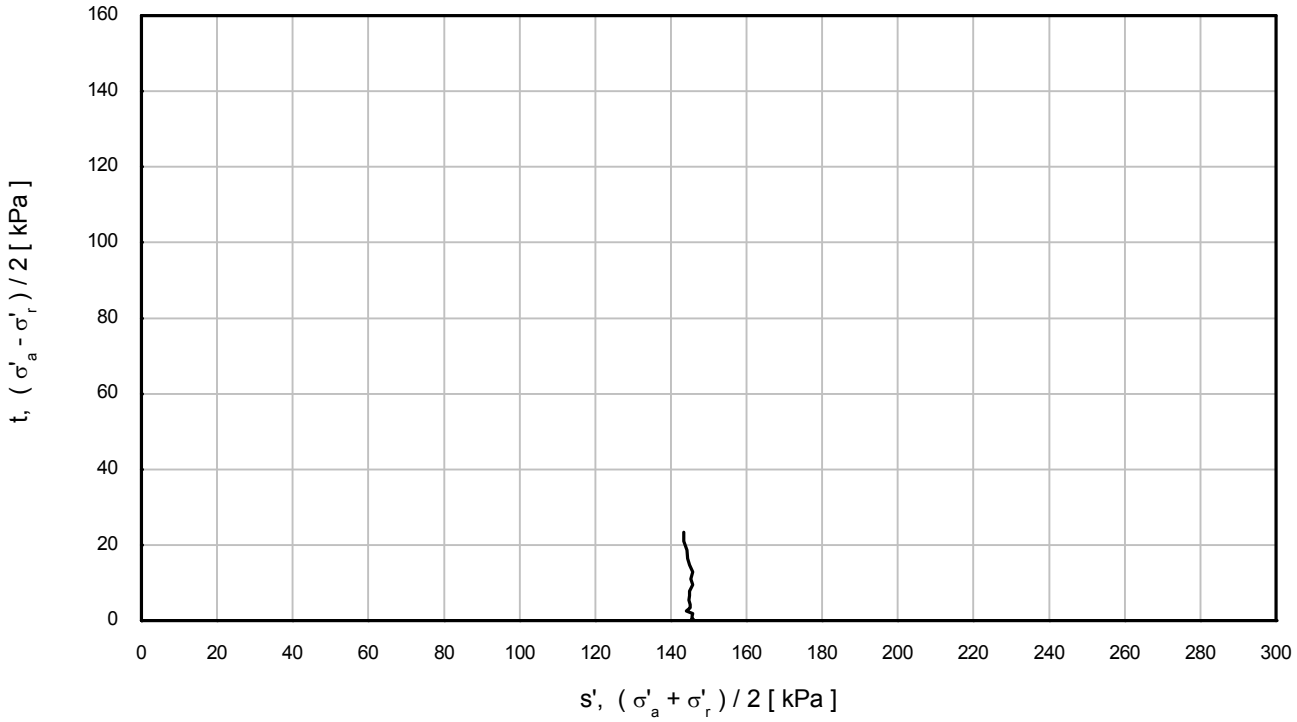
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

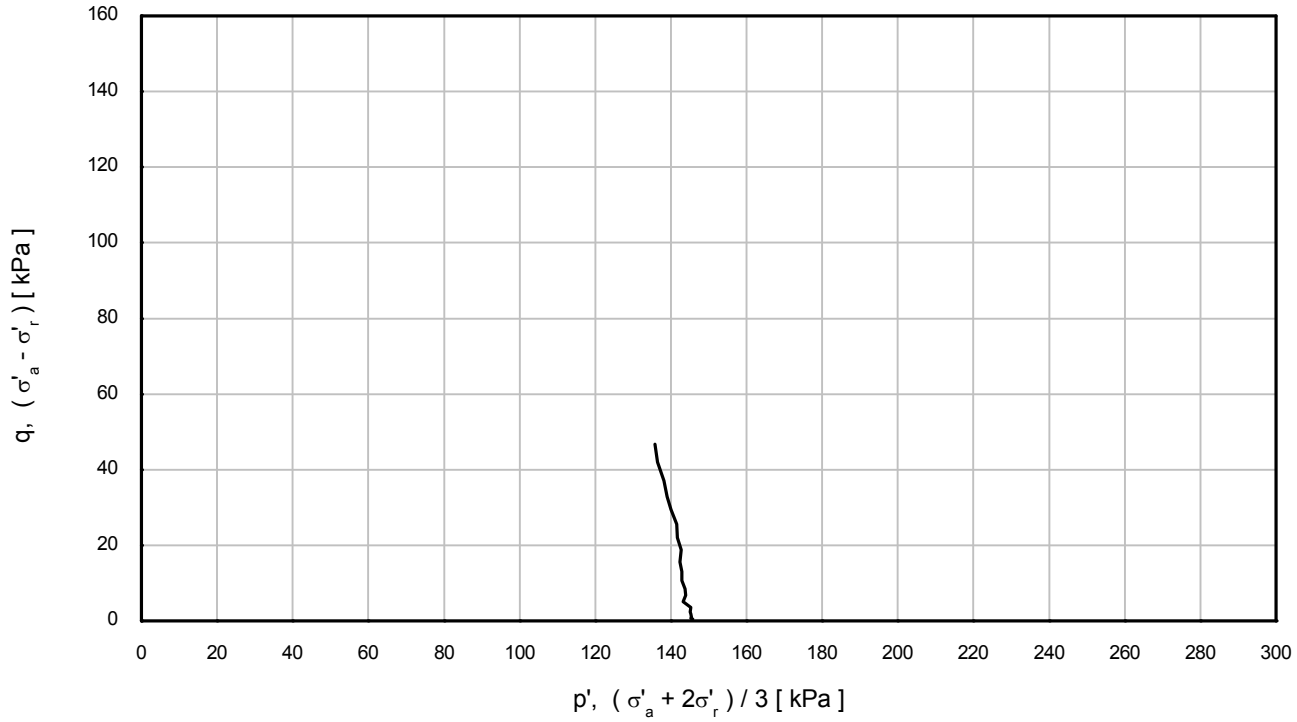




Initial σ'_r	: 133 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 156 kPa	Sample	: 17WaxD
q_{av}	: 23 kPa	Depth [m]	: 15.08
q_{cy}	: 23 kPa	Test No.	: CTX13
Frequency	: 0.10 Hz		

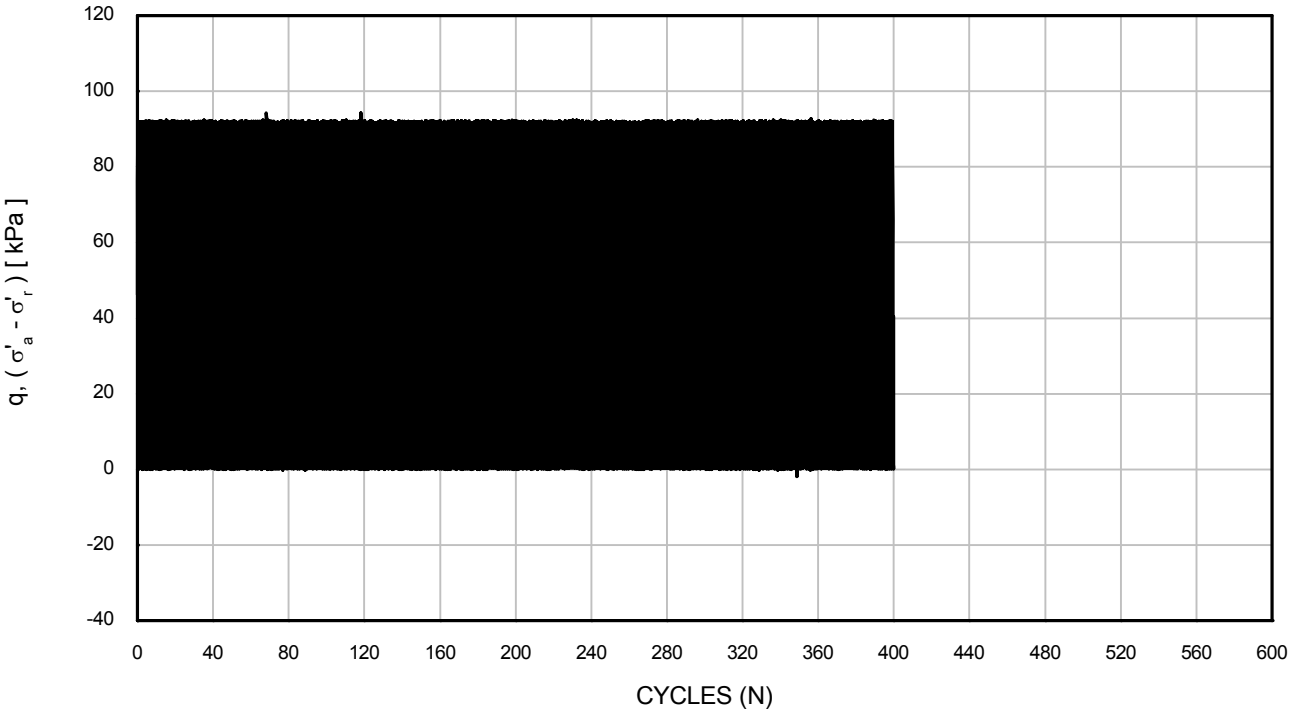
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

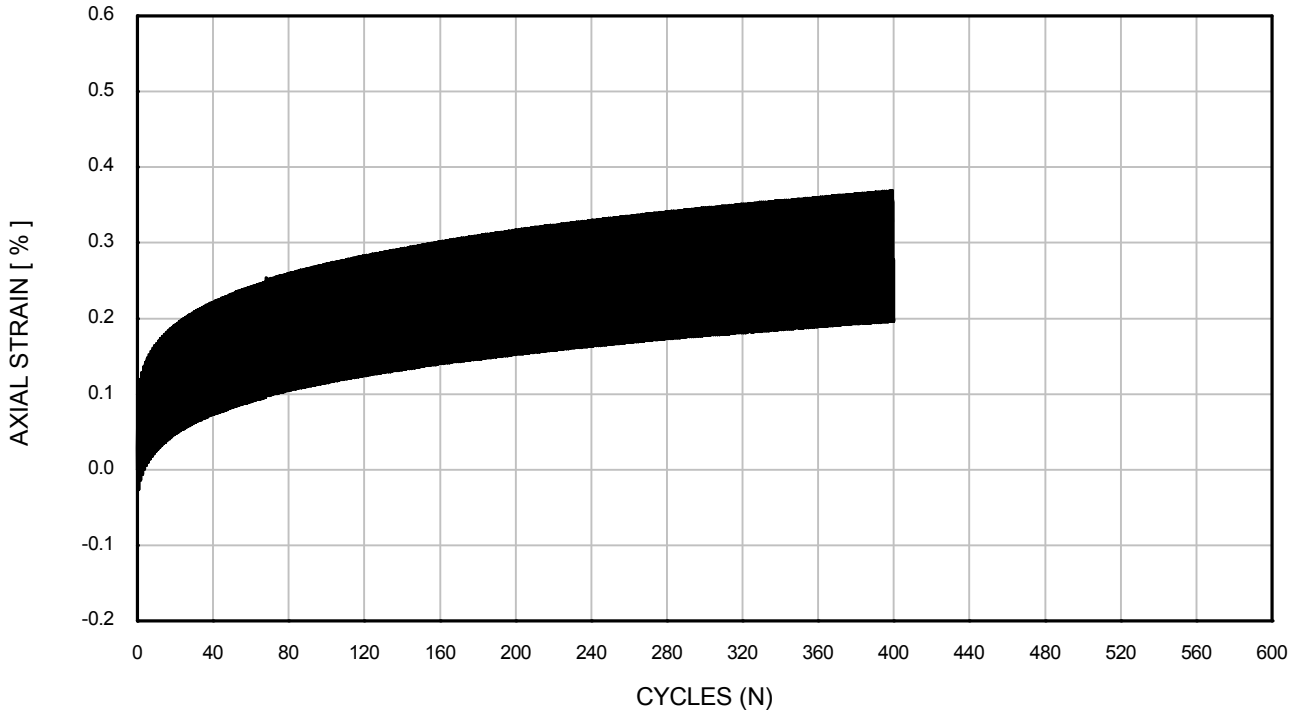




σ'_{rc}	: 120 kPa	Borehole	: HKZ1-BH01-SA
σ'_{ac}	: 167 kPa	Sample	: 17WaxD
		Depth [m]	: 15.08
		Test No.	: CTX13

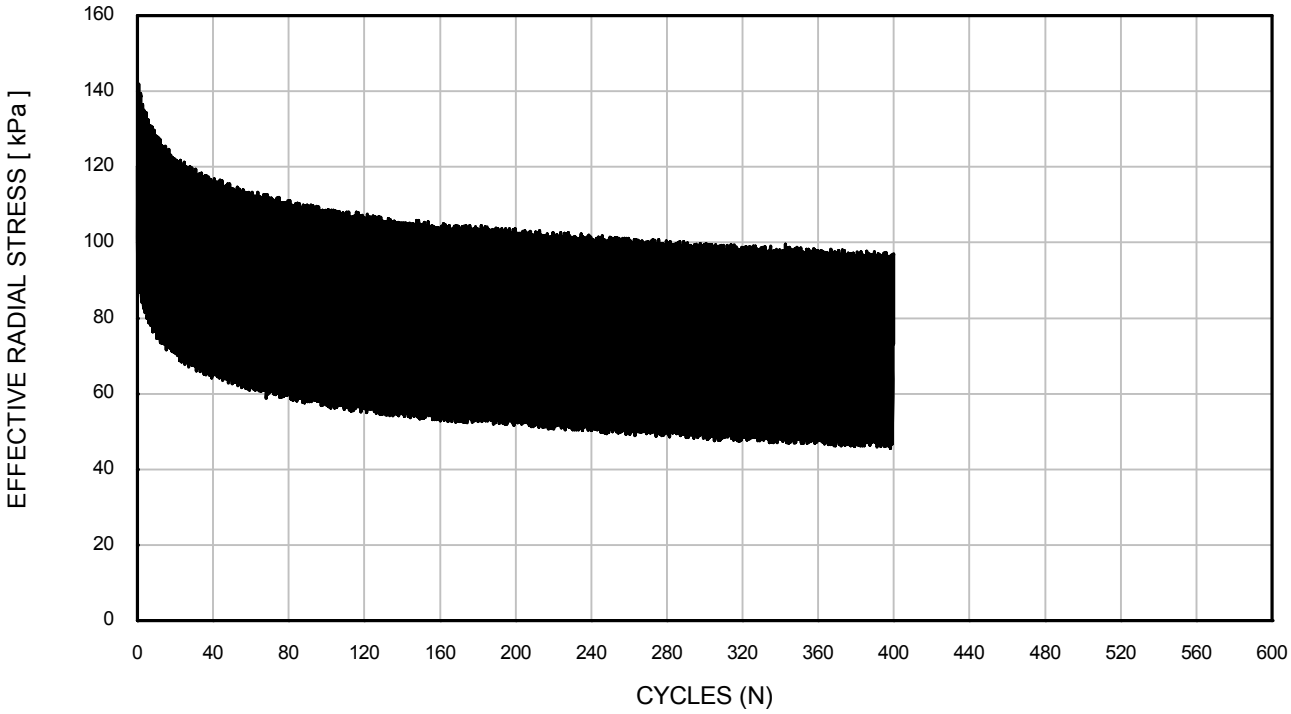
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 2 - UNDRAINED

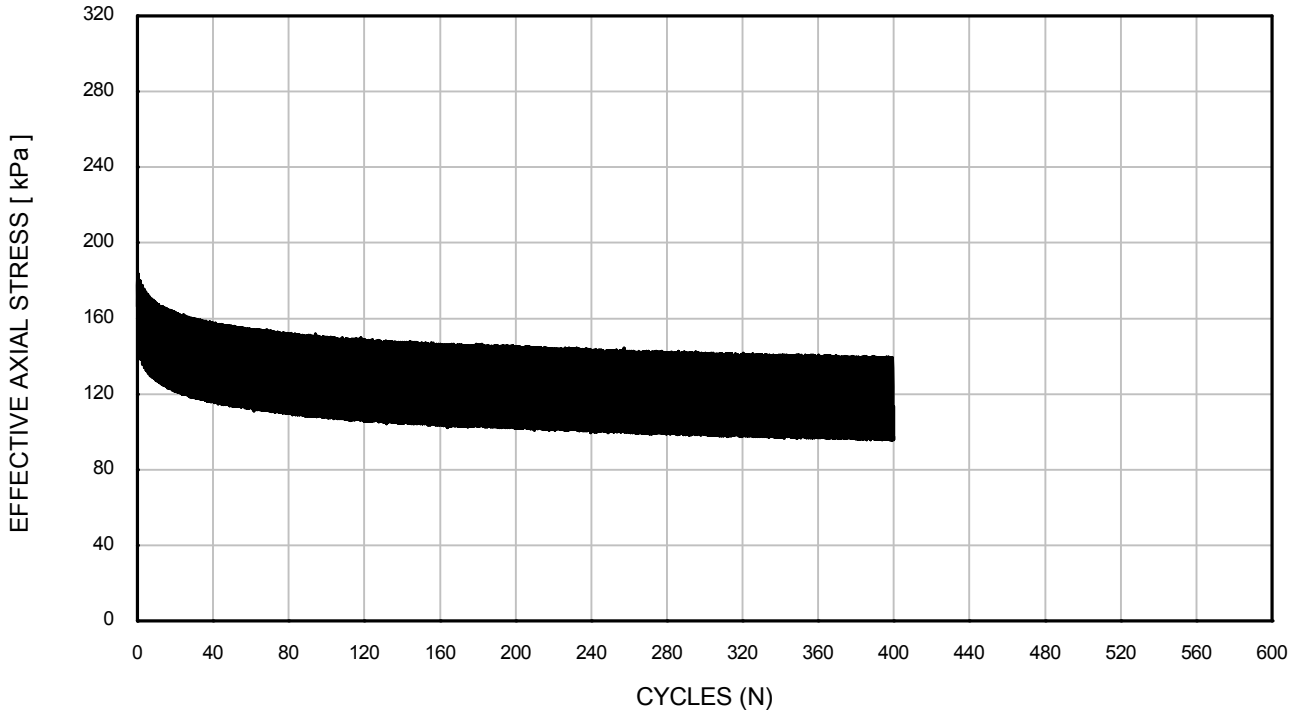




Initial σ'_r	:	120 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	166 kPa	Sample	: 17WaxD
q_{av}	:	46 kPa	Depth [m]	: 15.08
q_{cy}	:	46 kPa	Test No.	: CTX13
Frequency	:	0.10 Hz		

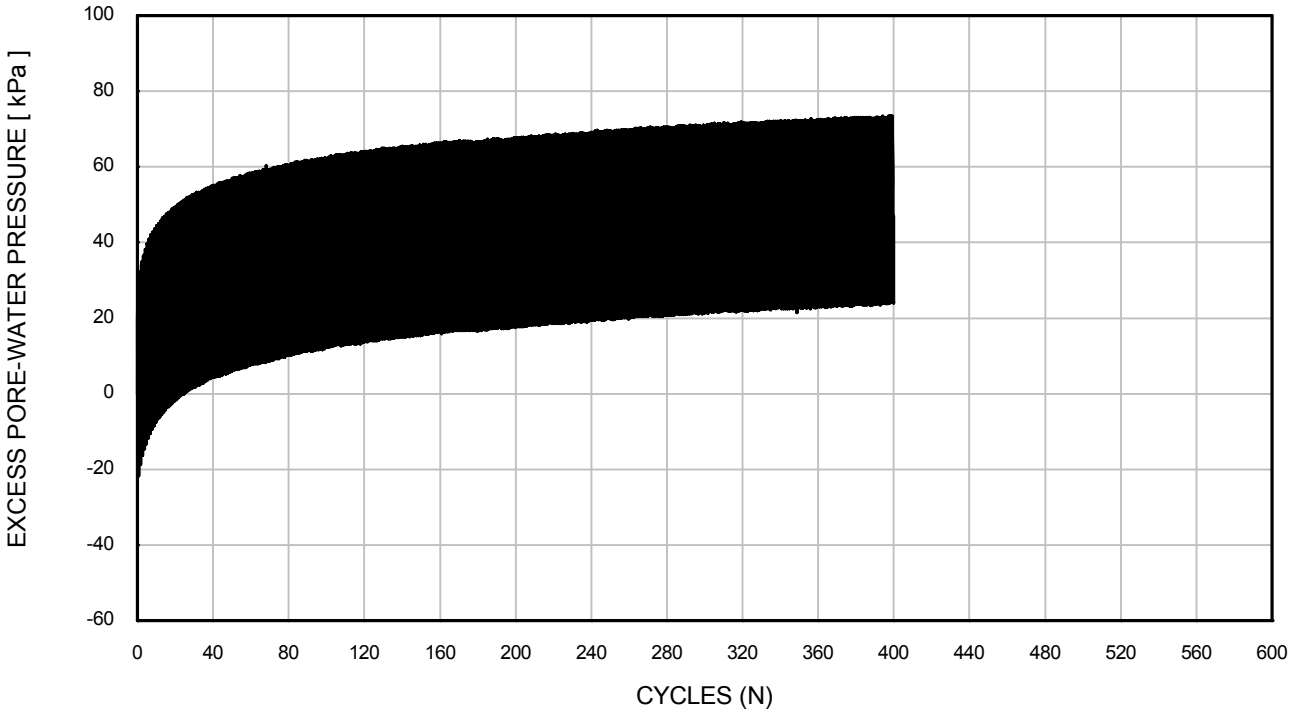
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

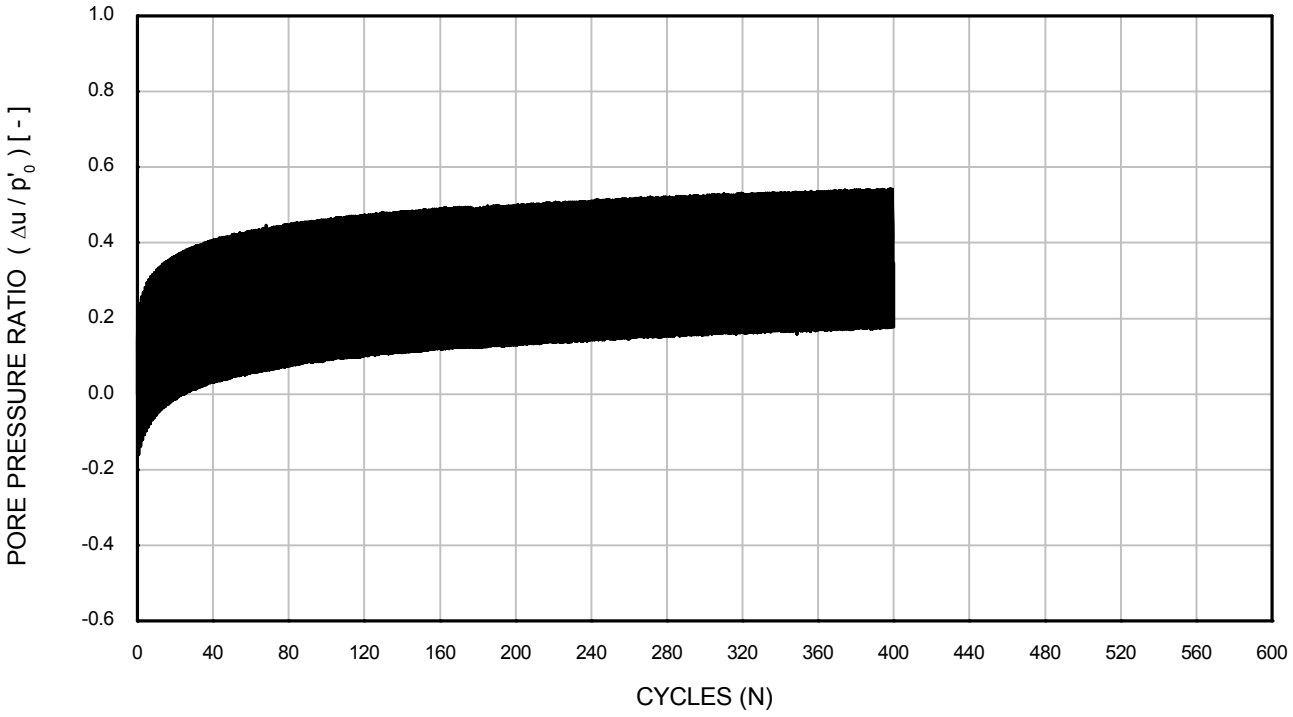




Initial σ'_r	:	120 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	166 kPa	Sample	:	17WaxD
q_{av}	:	46 kPa	Depth [m]	:	15.08
q_{cy}	:	46 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

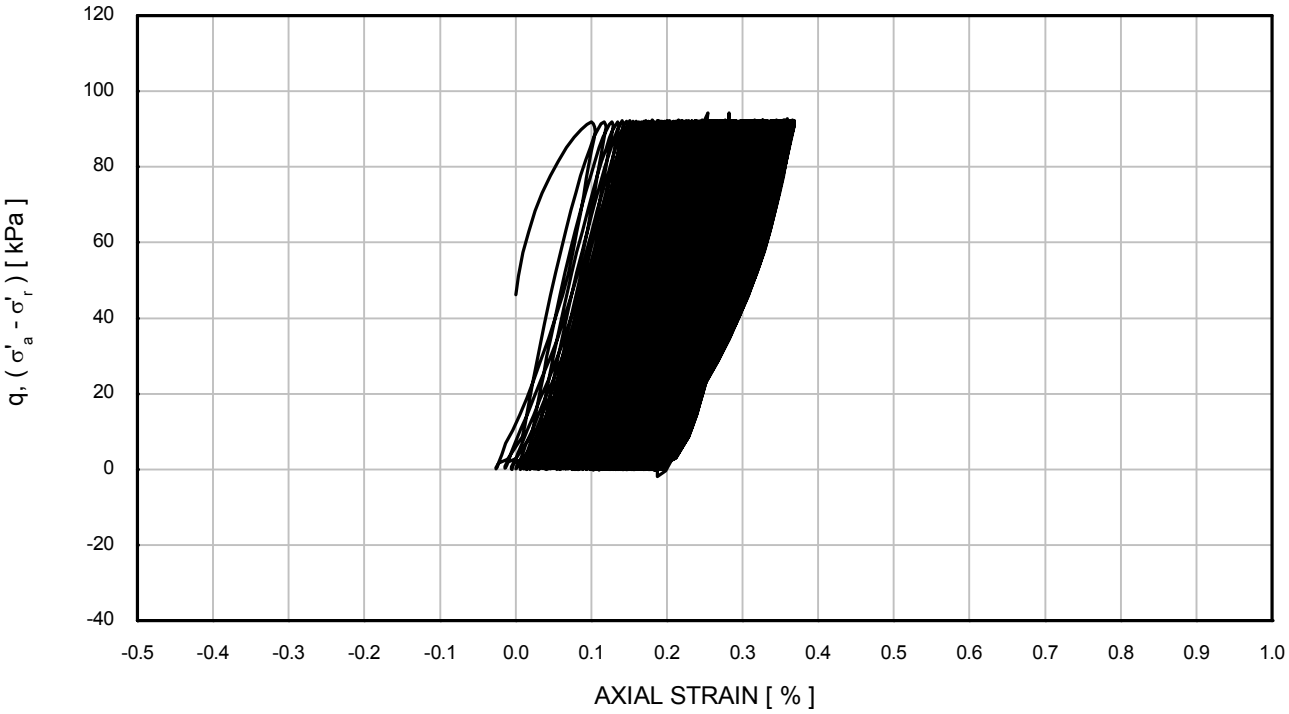
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CYCLIC LOADING STAGE 2 - UNDRAINED

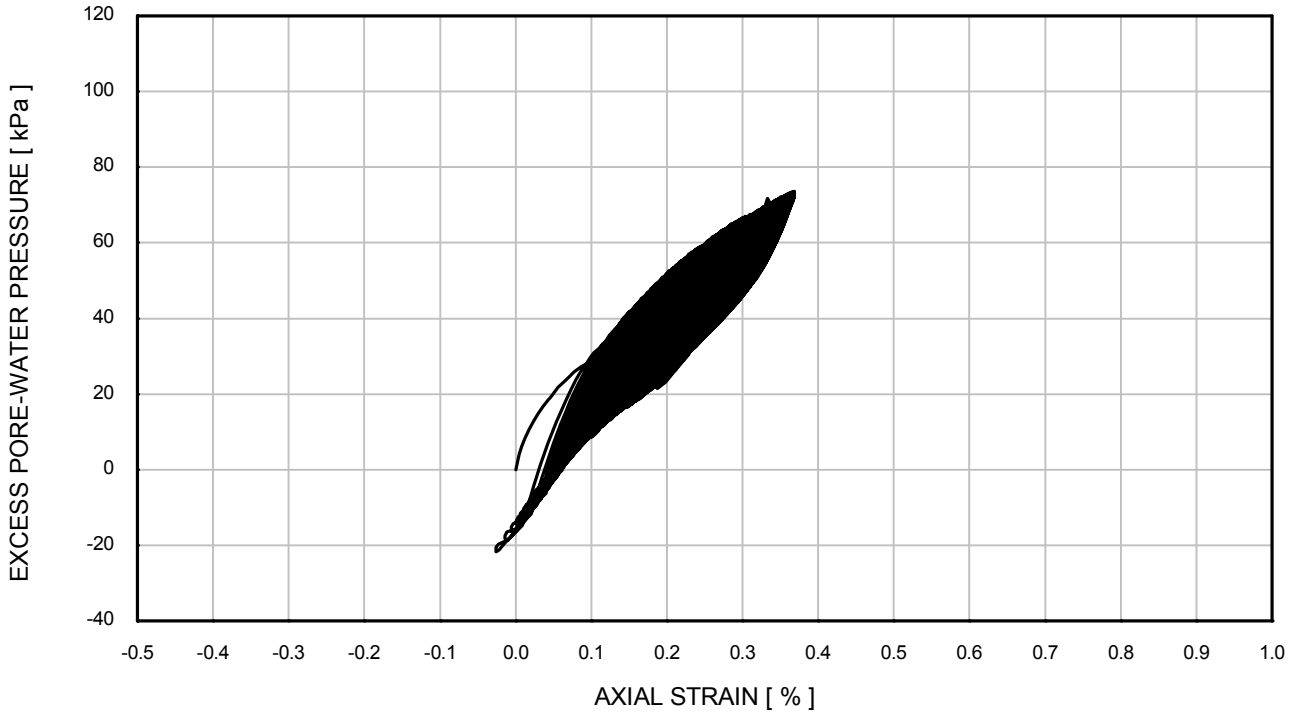




Initial σ'_r	:	120 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	166 kPa	Sample	:	17WaxD
q_{av}	:	46 kPa	Depth [m]	:	15.08
q_{cy}	:	46 kPa	Test No.	:	CTX13
Frequency	:	0.10 Hz			

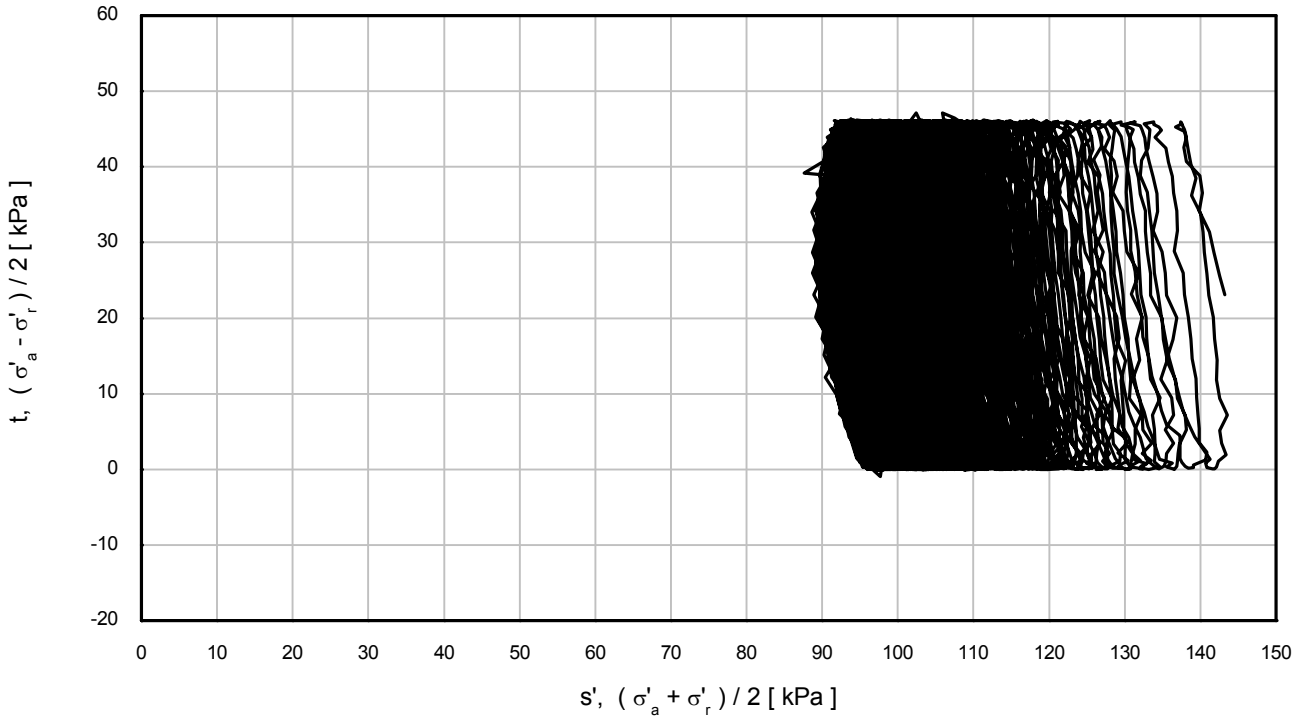
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

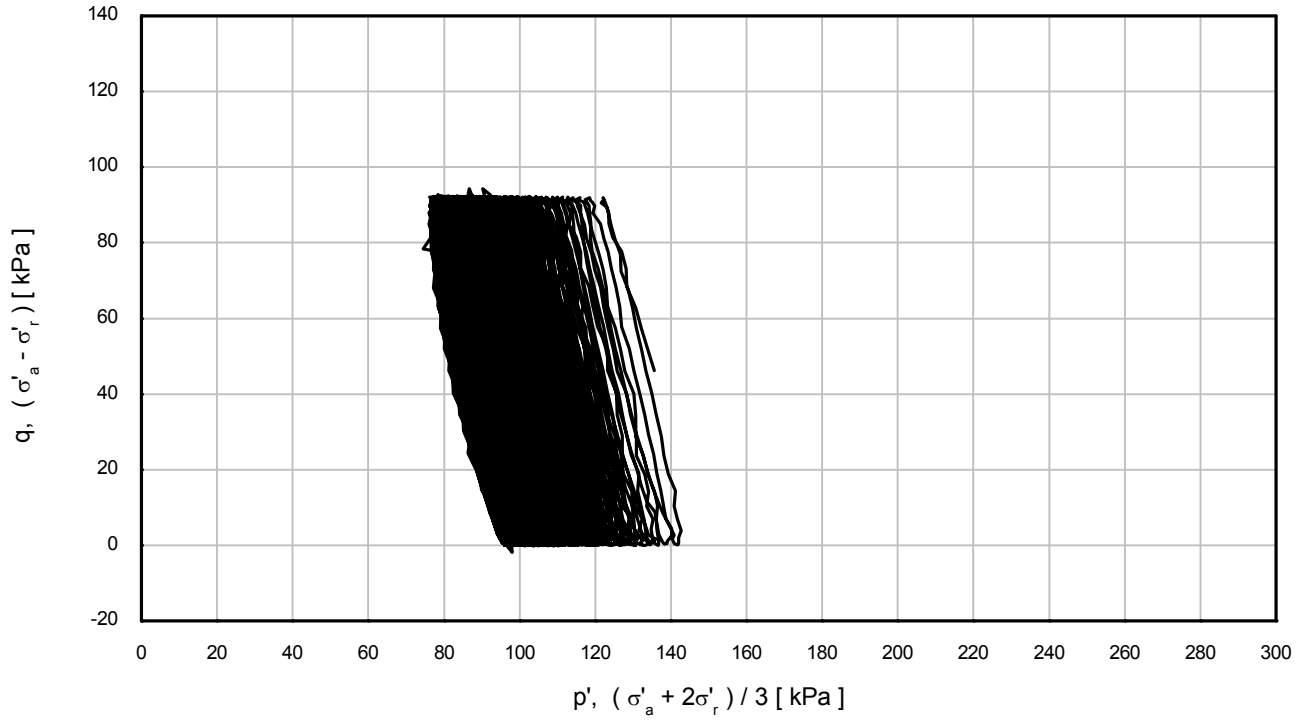




Initial σ'_r	: 120 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 166 kPa	Sample	: 17WaxD
q_{av}	: 46 kPa	Depth [m]	: 15.08
q_{cy}	: 46 kPa	Test No.	: CTX13
Frequency	: 0.10 Hz		

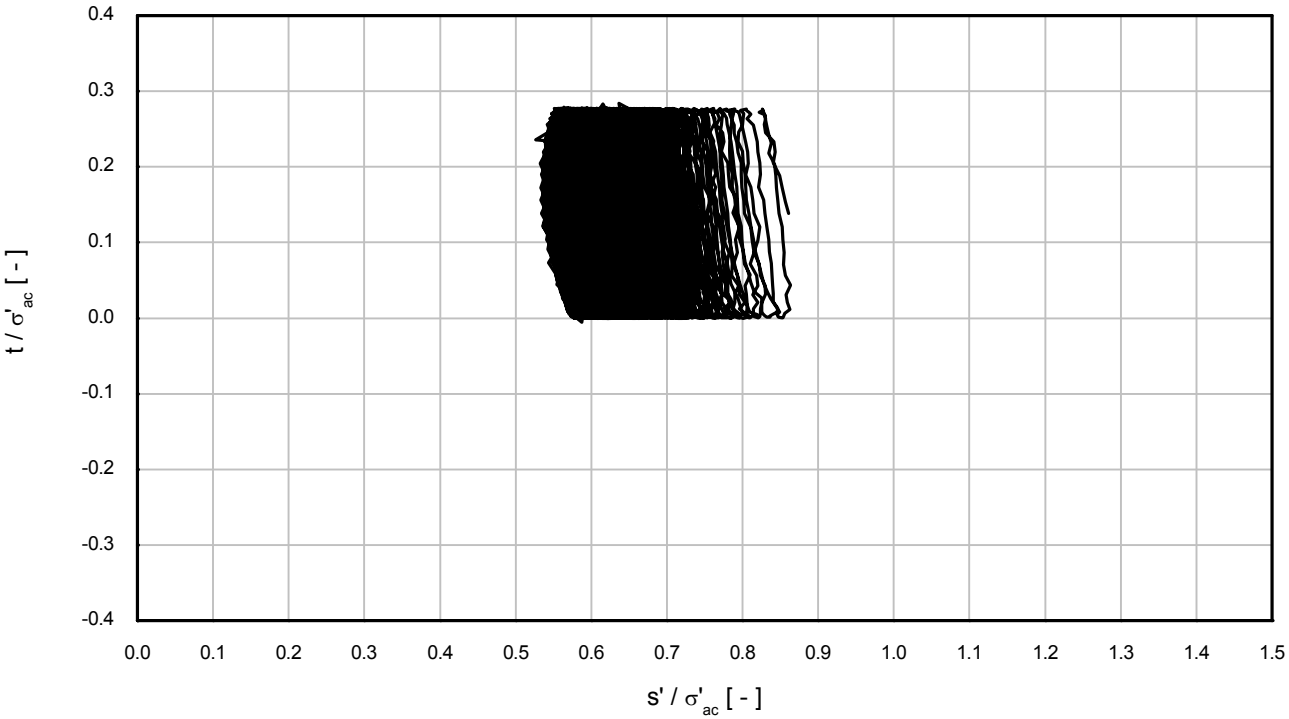
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

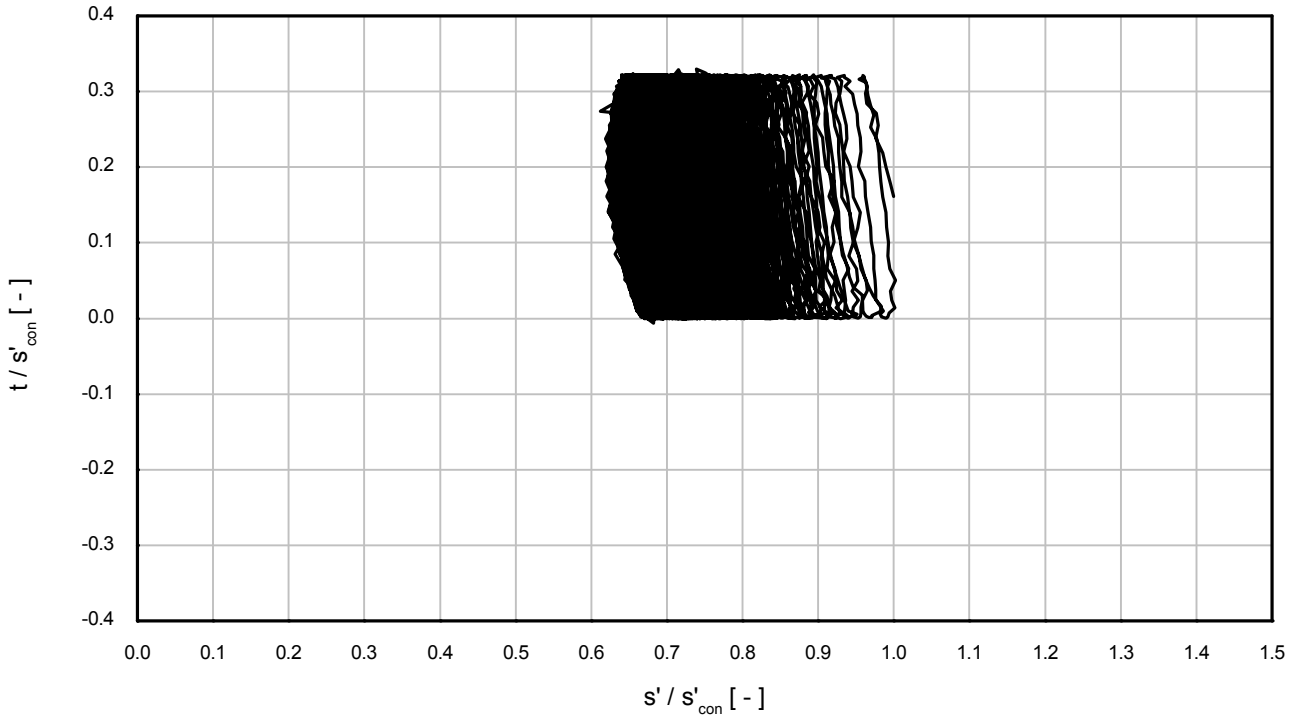




Initial σ'_r	:	120 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	166 kPa	Sample	: 17WaxD
q_{av}	:	46 kPa	Depth [m]	: 15.08
q_{cy}	:	46 kPa	Test No.	: CTX13
Frequency	:	0.10 Hz		

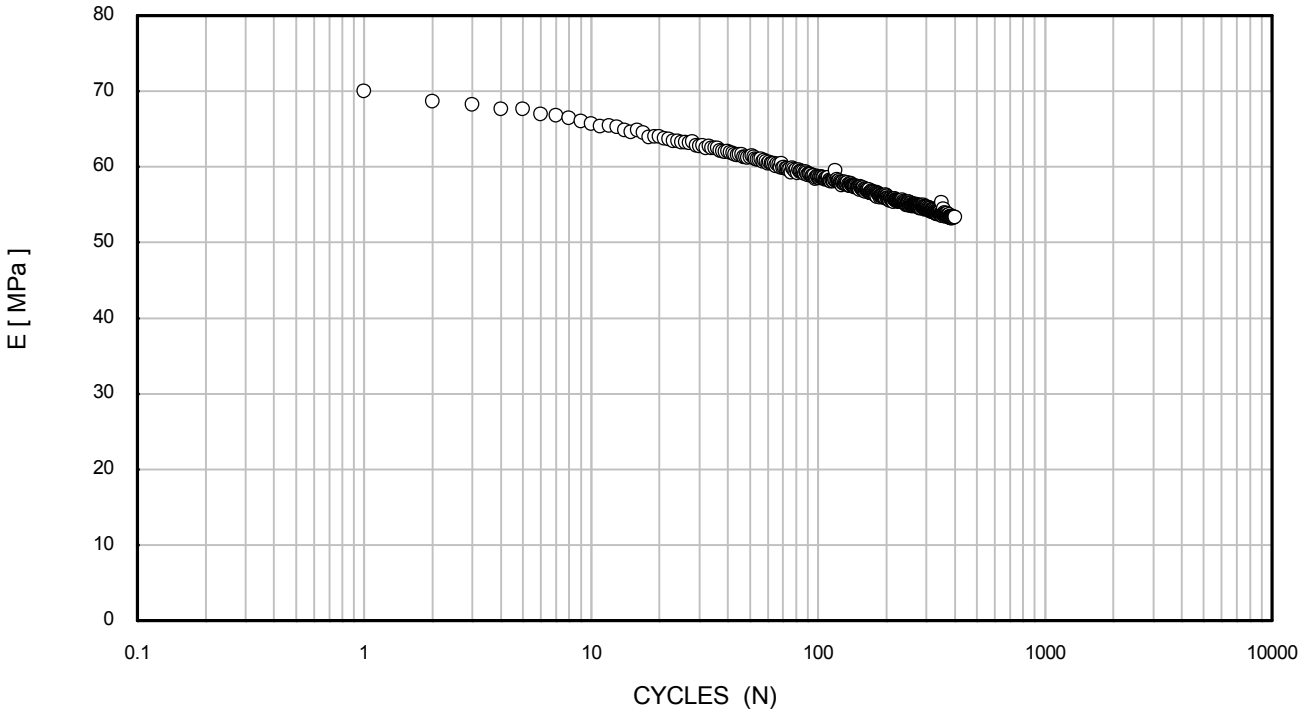
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

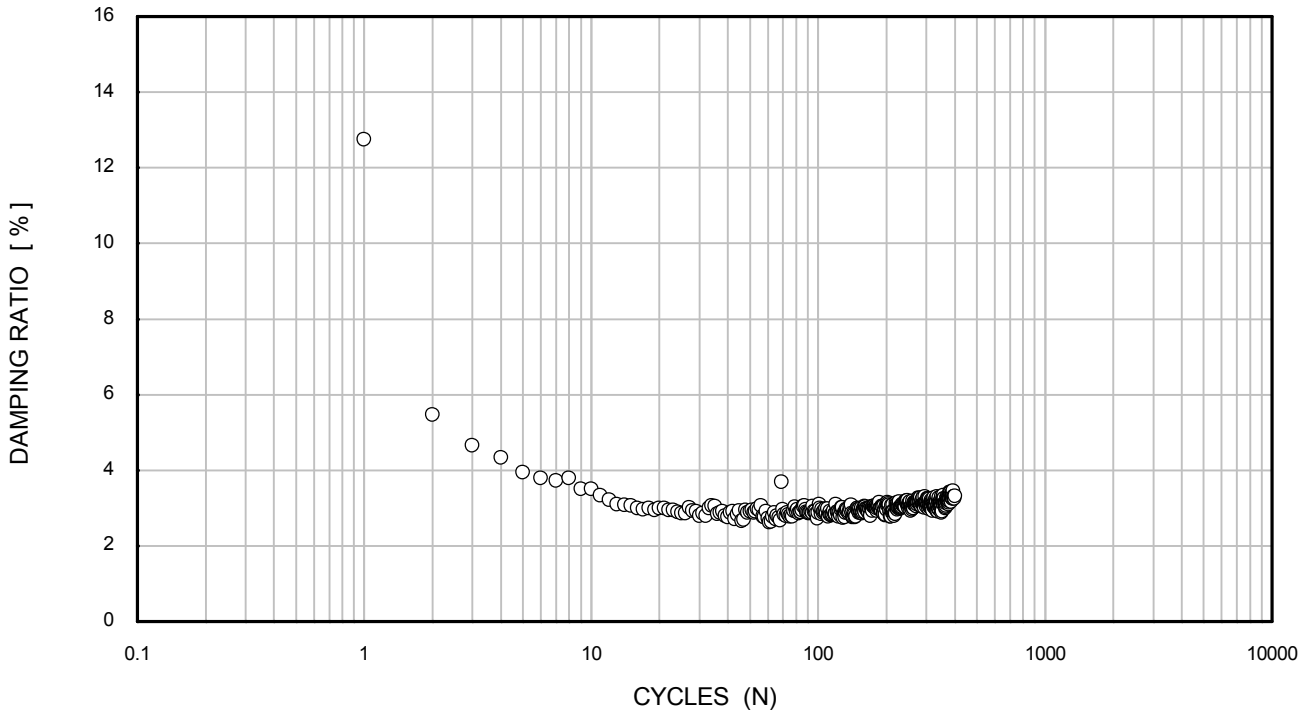




Initial σ'_r	:	120 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	166 kPa	Sample	: 17WaxD
q_{av}	:	46 kPa	Depth [m]	: 15.08
q_{cy}	:	46 kPa	Test No.	: CTX13
Frequency	:	0.10 Hz		

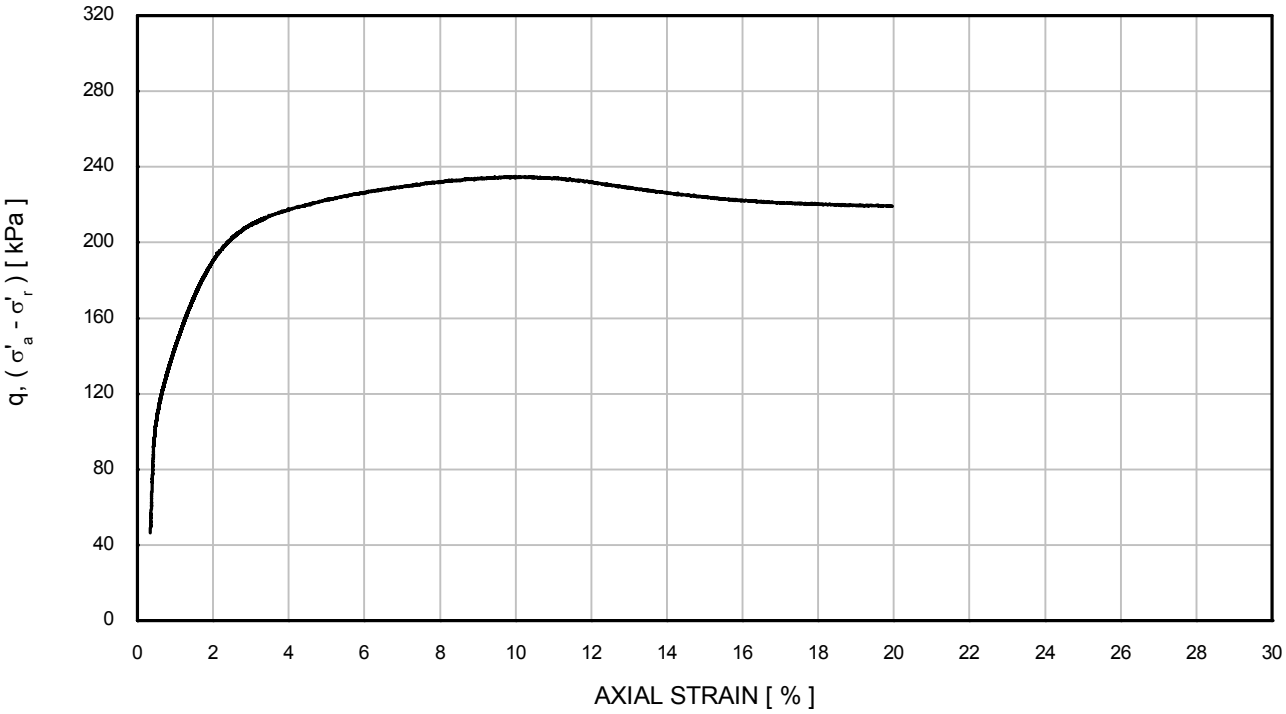
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

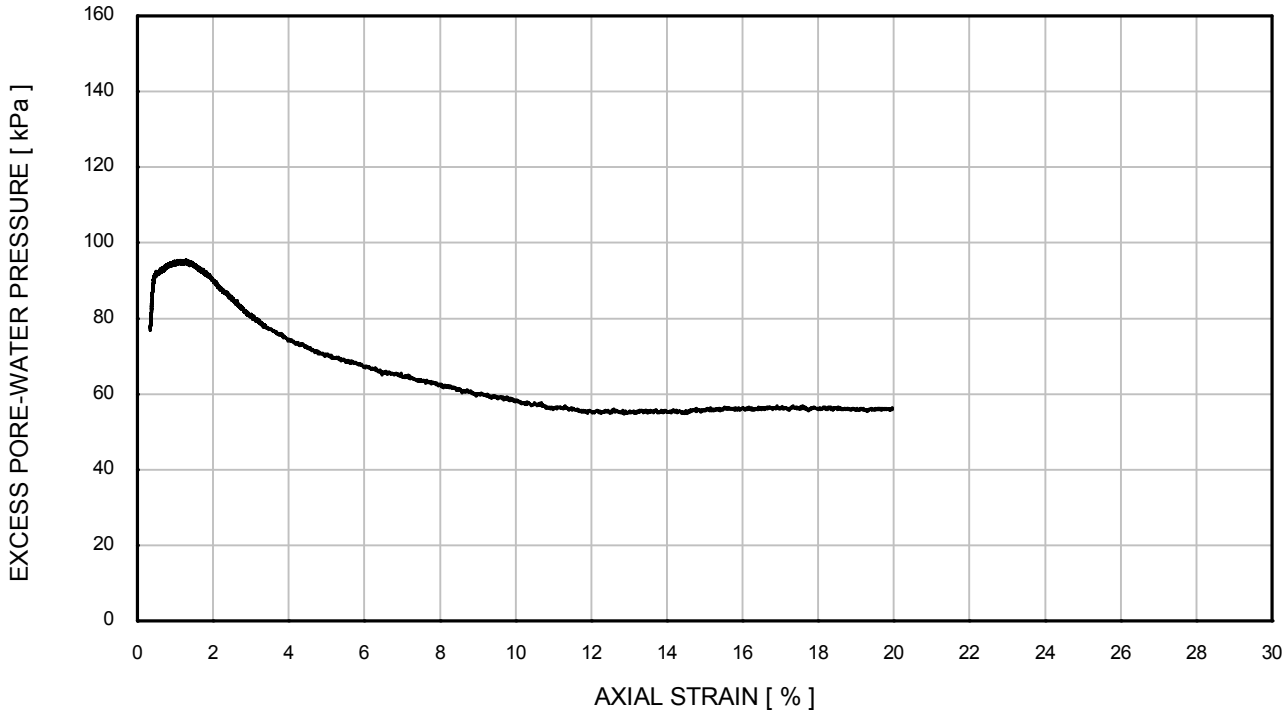




Initial σ'_r	: 120 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 166 kPa	Sample	: 17WaxD
q_{av}	: 46 kPa	Depth [m]	: 15.08
q_{cy}	: 46 kPa	Test No.	: CTX13
Frequency	: 0.10 Hz		

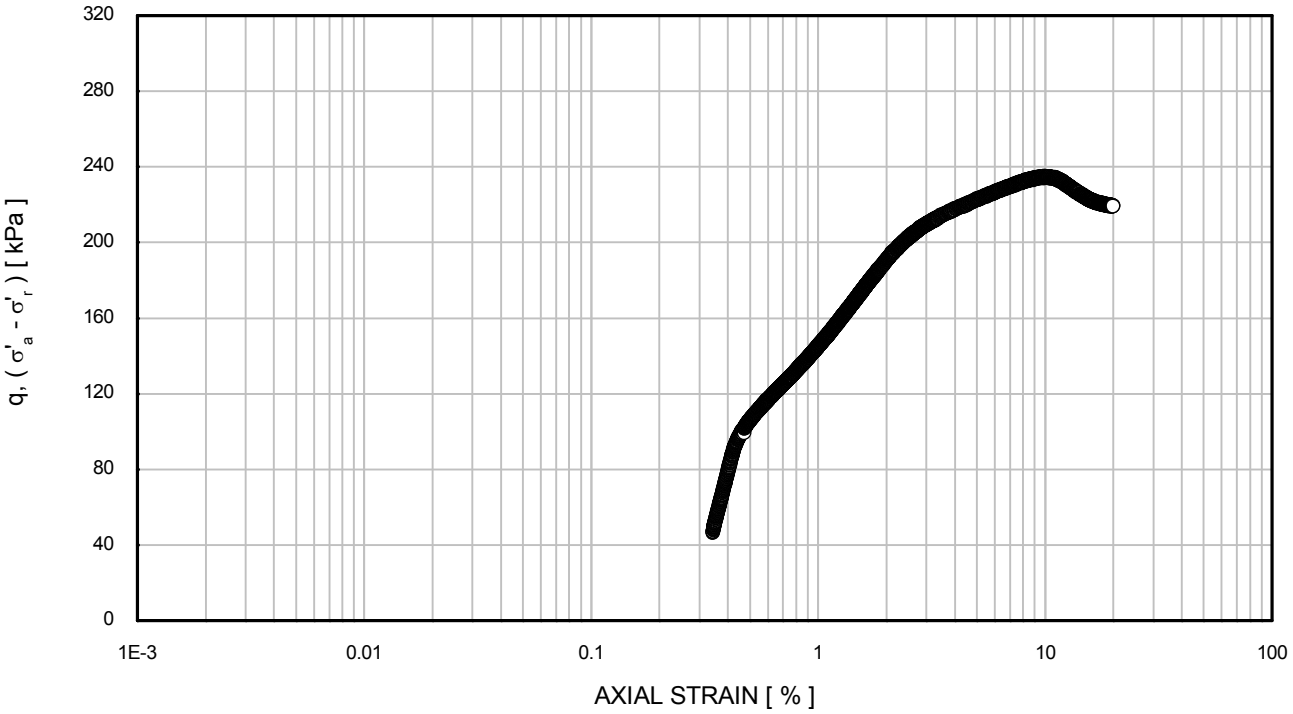
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

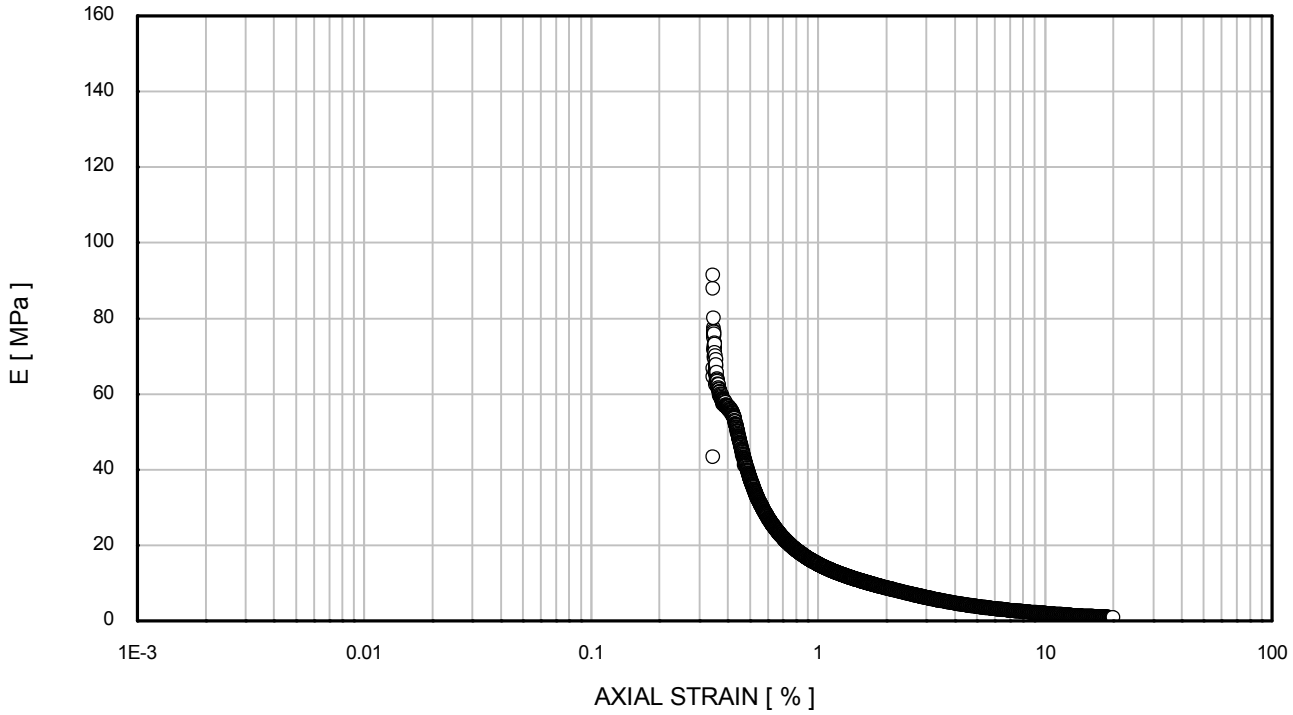




Initial σ'_r	:	69	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	115	kPa	Sample	: 17WaxD
q_{peak}	:	235	kPa	Depth [m]	: 15.08
Ext. ε at q_{peak}	:	9.99	%	Test No.	: CTX13
Rate of strain	:	0.51	%/hour		

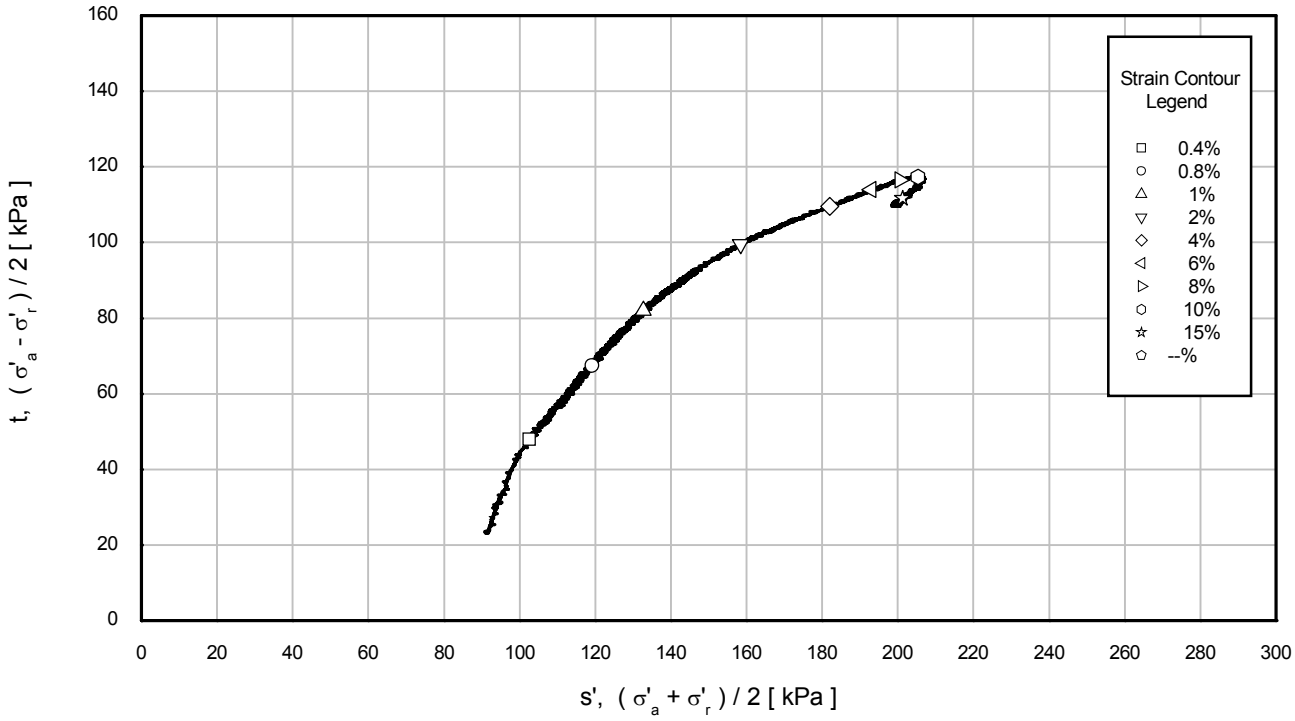
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

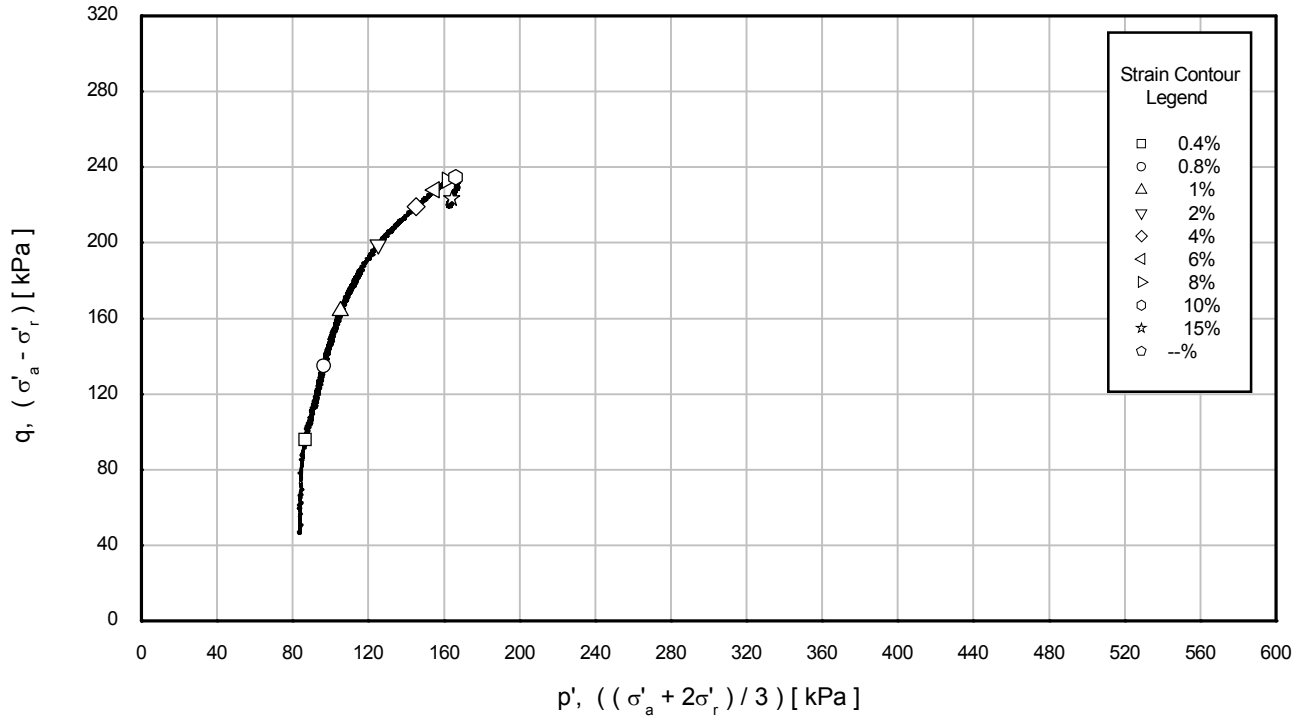




Initial σ'_r	:	69	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	115	kPa	Sample	: 17WaxD
q_{peak}	:	235	kPa	Depth [m]	: 15.08
Ext. ε at q_{peak}	:	9.99	%	Test No.	: CTX13
Rate of strain	:	0.51	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	69	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	115	kPa	Sample	: 17WaxD
q_{peak}	:	235	kPa	Depth [m]	: 15.08
Ext. ε at q_{peak}	:	9.99	%	Test No.	: CTX13
Rate of strain	:	0.51	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Grey CLAY with laminae of fine sand

GENERAL	
Date test started	06/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	70.2
Length	[mm]	139.9
Water content	[%]	30.5
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.862
Degree of saturation	[%]	95
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	41
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_21A_CTX14
Processed by Date	MSR 14/12/2016
Checked by Date	JLS 15/12/2016
Approved by Date	AR 15/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	706
Mid height PWP	[kPa]	-
B value achieved	[-]	0.97

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	871
Back pressure	[kPa]	706
Base PWP	[kPa]	705
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	166
Effective axial pressure	[kPa]	166
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.23
External axial strain	[%]	-0.05
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.867
Degree of saturation	[%]	95

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	871
Back pressure	[kPa]	706
Base PWP	[kPa]	721
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	150
Effective axial pressure	[kPa]	181
Deviator stress	[kPa]	31
Volumetric strain	[%]	-0.01
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.867
Degree of saturation	[%]	95

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	208
Mean q_{av}	[kPa]	31
Mean q_{cy}	[kPa]	31
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.04
External ε_{cy} at N_f	[%]	0.03
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	26
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.867
Degree of saturation	[%]	95

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.03	114	-	7.65	-
2	0.01	0.03	115	-	5.31	-
5	0.01	0.03	115	-	5.00	-
10	0.01	0.03	112	-	5.00	-
20	0.01	0.03	111	-	4.77	-
30	0.02	0.03	110	-	4.86	-
40	0.02	0.03	109	-	4.76	-
50	0.02	0.03	108	-	4.63	-
100	0.02	0.03	107	-	4.82	-
500	0.03	0.03	104	-	4.88	-
1000	0.04	0.03	102	-	4.82	-
1500	0.04	0.03	103	-	4.55	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	871
Back pressure	[kPa]	705
Base PWP	[kPa]	724
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	147
Effective axial pressure	[kPa]	177
Deviator stress	[kPa]	30
Volumetric strain	[%]	0.00
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.867
Degree of saturation	[%]	95

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	208
Mean q_{av}	[kPa]	31
Mean q_{cy}	[kPa]	83
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.16
External ε_{cy} at N_f	[%]	0.18
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	60
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.867
Degree of saturation	[%]	95

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.02	0.10	86	-	11.09	-
2	0.02	0.10	83	-	10.17	-
5	0.03	0.11	78	-	10.18	-
10	0.04	0.11	74	-	10.09	-
20	0.05	0.12	70	-	10.08	-
30	0.06	0.12	68	-	10.25	-
40	0.06	0.13	66	-	10.22	-
50	0.07	0.13	64	-	10.24	-
100	0.09	0.14	59	-	10.44	-
200	0.12	0.15	54	-	10.55	-
300	0.14	0.17	50	-	10.75	-
400	0.16	0.18	47	-	10.94	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	99
Initial effective axial pressure	[kPa]	130
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	222
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.71
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	80
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	85
Effective axial pressure	[kPa]	307
Principal effective stress ratio	[-]	3.61
ε_{50}	[%]	0.28
Secant modulus (E_{50}) at ε_{50}	[kPa]	34693
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	200
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.05
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	105
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	59
Effective axial pressure	[kPa]	259
Principal effective stress ratio	[-]	4.39
At 10% external axial strain		
Corrected deviator stress	[kPa]	205
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	52
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	113
Effective axial pressure	[kPa]	318
Principal effective stress ratio	[-]	2.82

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





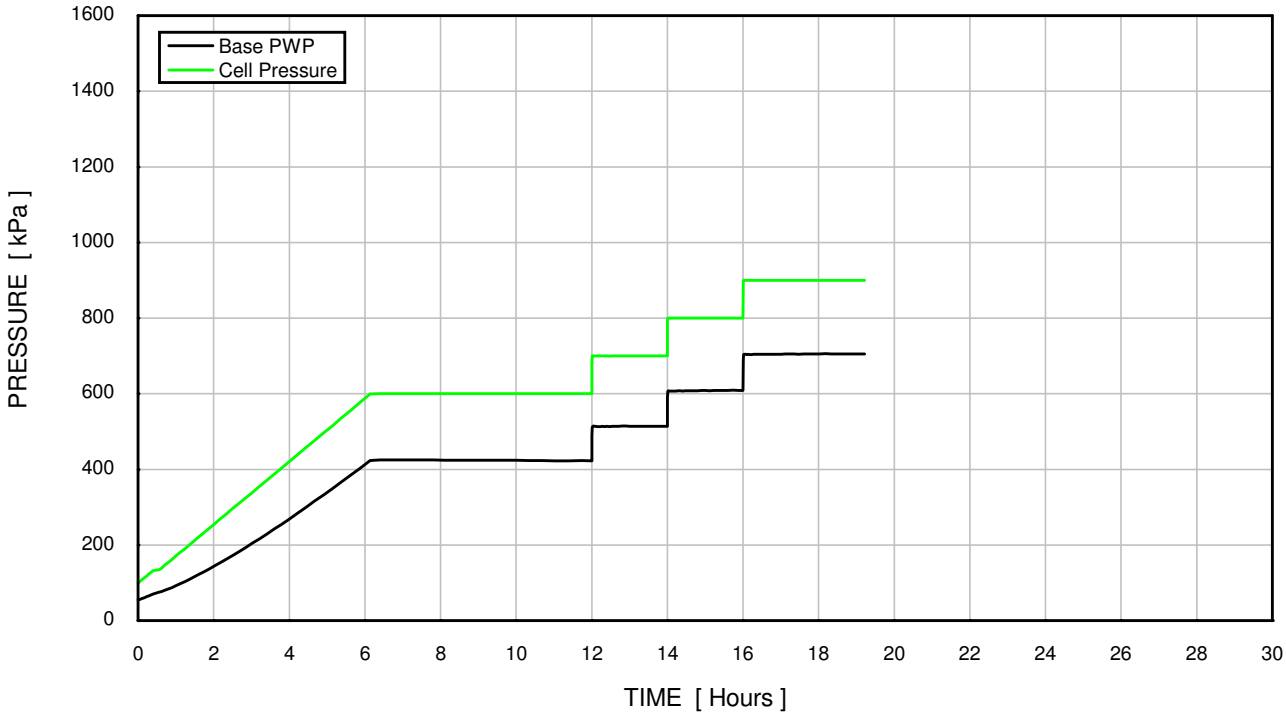
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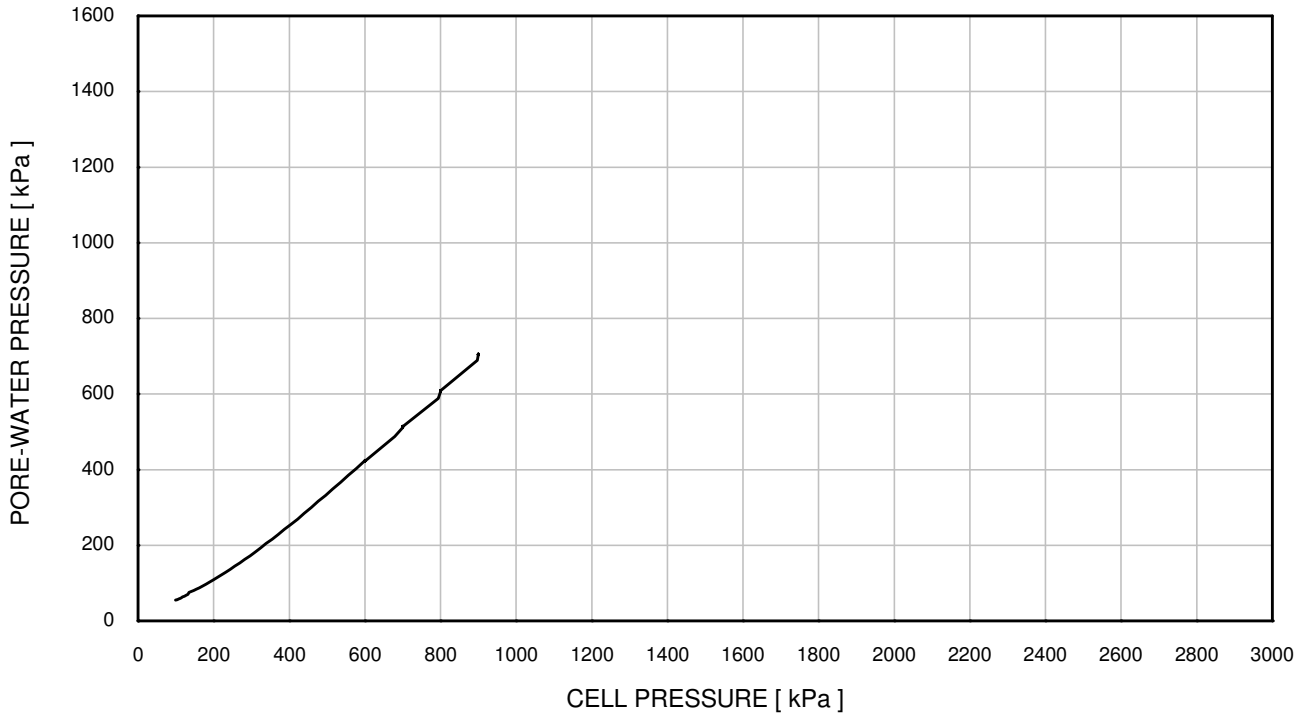
Water content	[%]	30.6
Bulk density	[Mg/m³]	1.89
Dry density	[Mg/m³]	1.45

TEST IDENTIFICATION

Borehole	HKZ1-BH01-SA
Sample	21WAXC
Depth [m]	18.92
Test number	CTX14

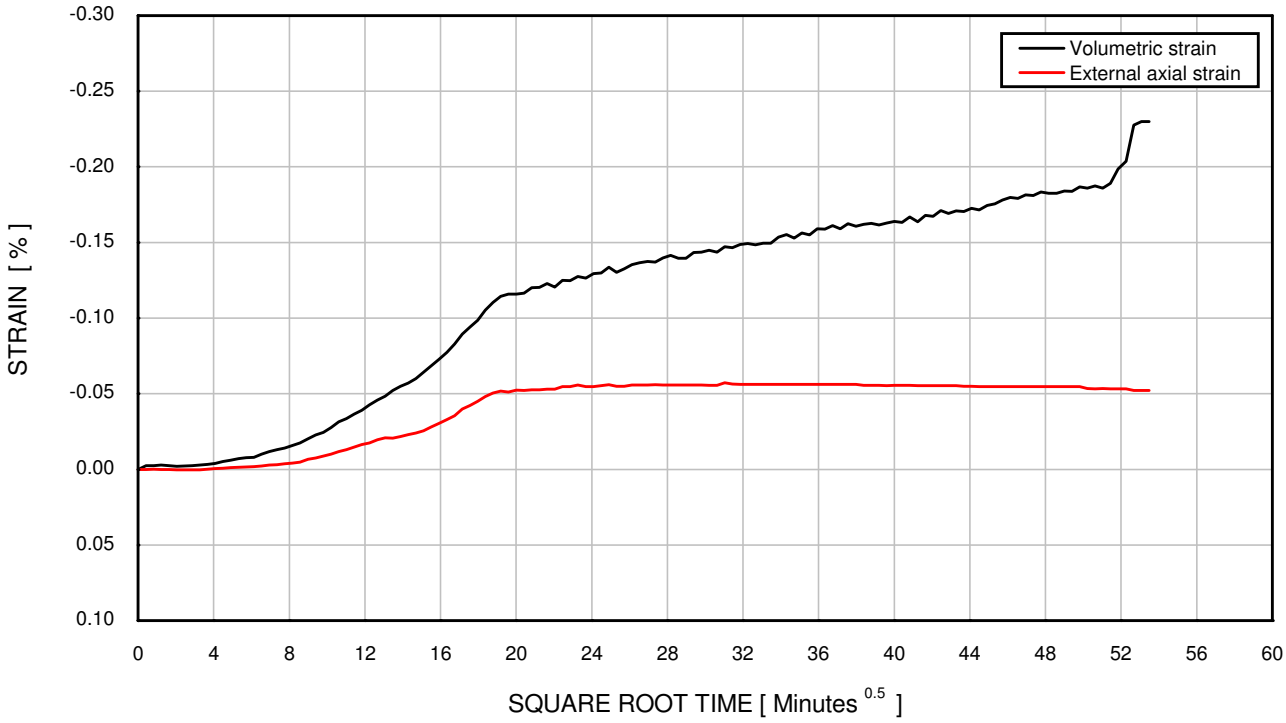
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

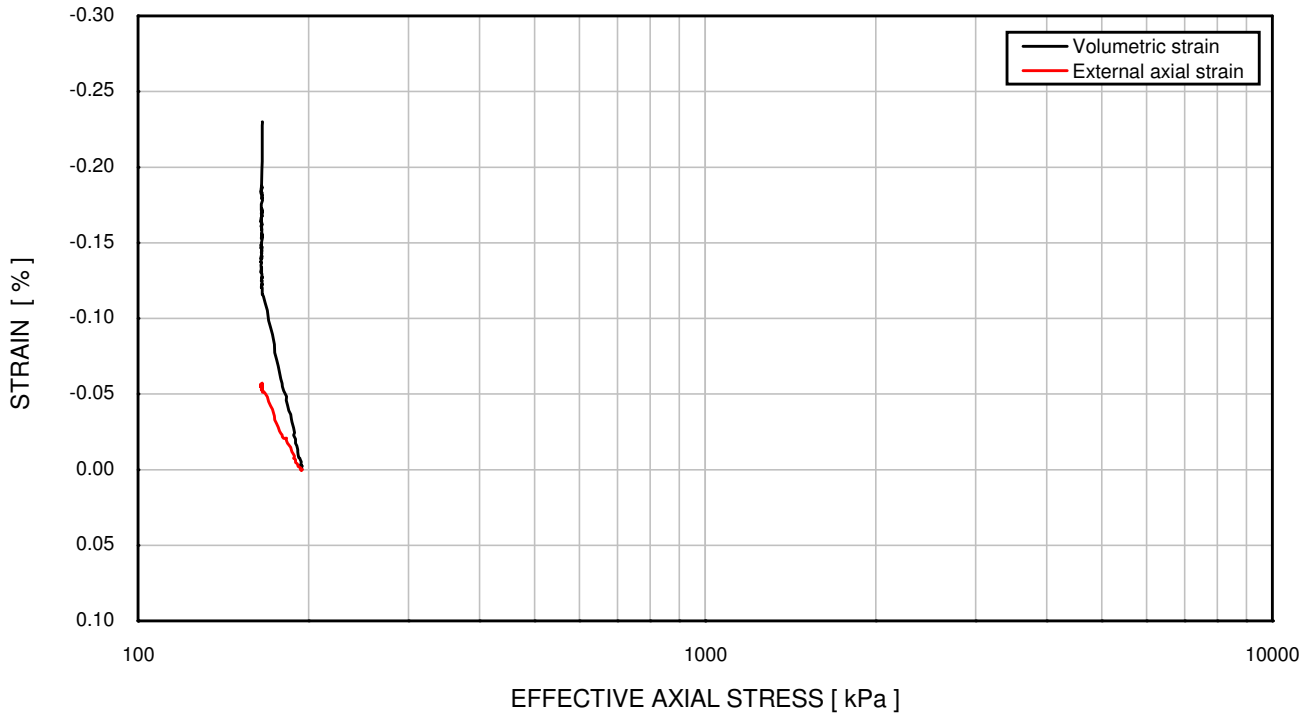




B value	: 0.97	Borehole	: HKZ1-BH01-SA
Initial σ'_r	: 44 kPa	Sample	: 21WAXC
Initial σ'_a	: 44 kPa	Depth [m]	: 18.92
Final σ'_r	: 194 kPa	Test No.	: CTX14
Final σ'_a	: 194 kPa		

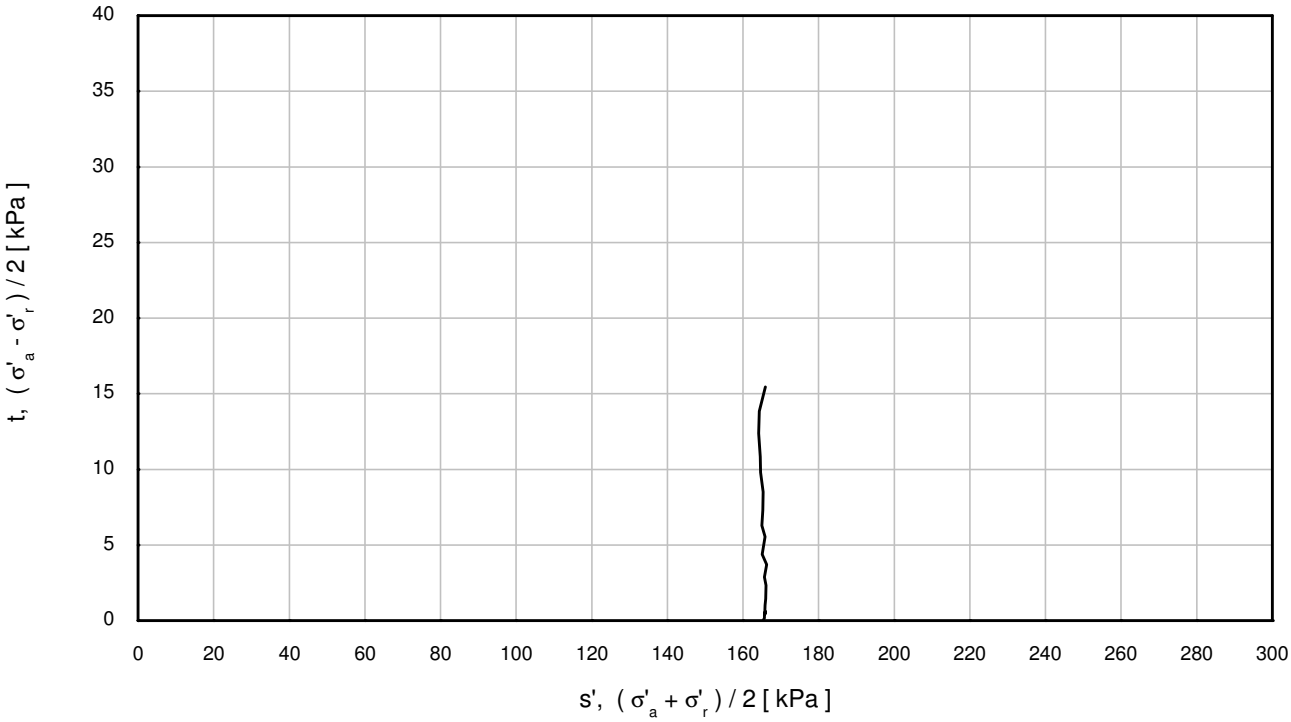
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

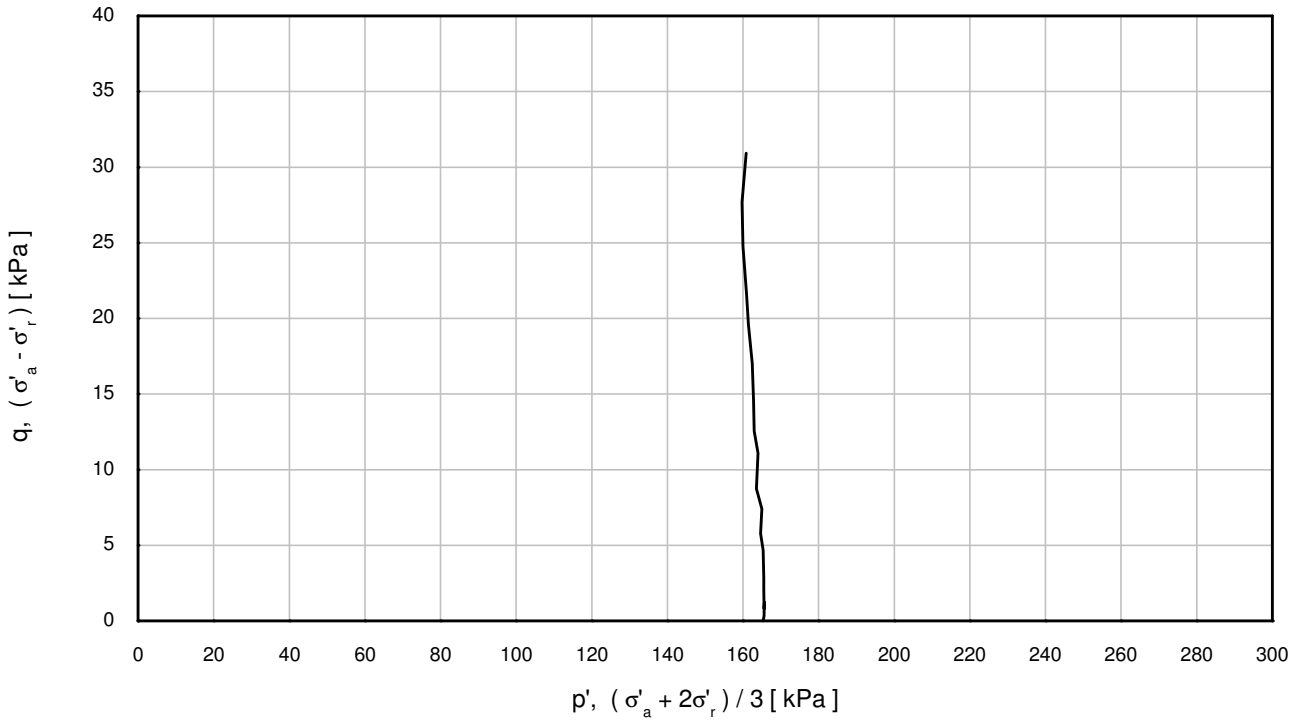




Stage 1 σ'_{rc}	: 166 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 166 kPa	Sample	: 21WAXC
		Depth [m]	: 18.92
		Test No.	: CTX14

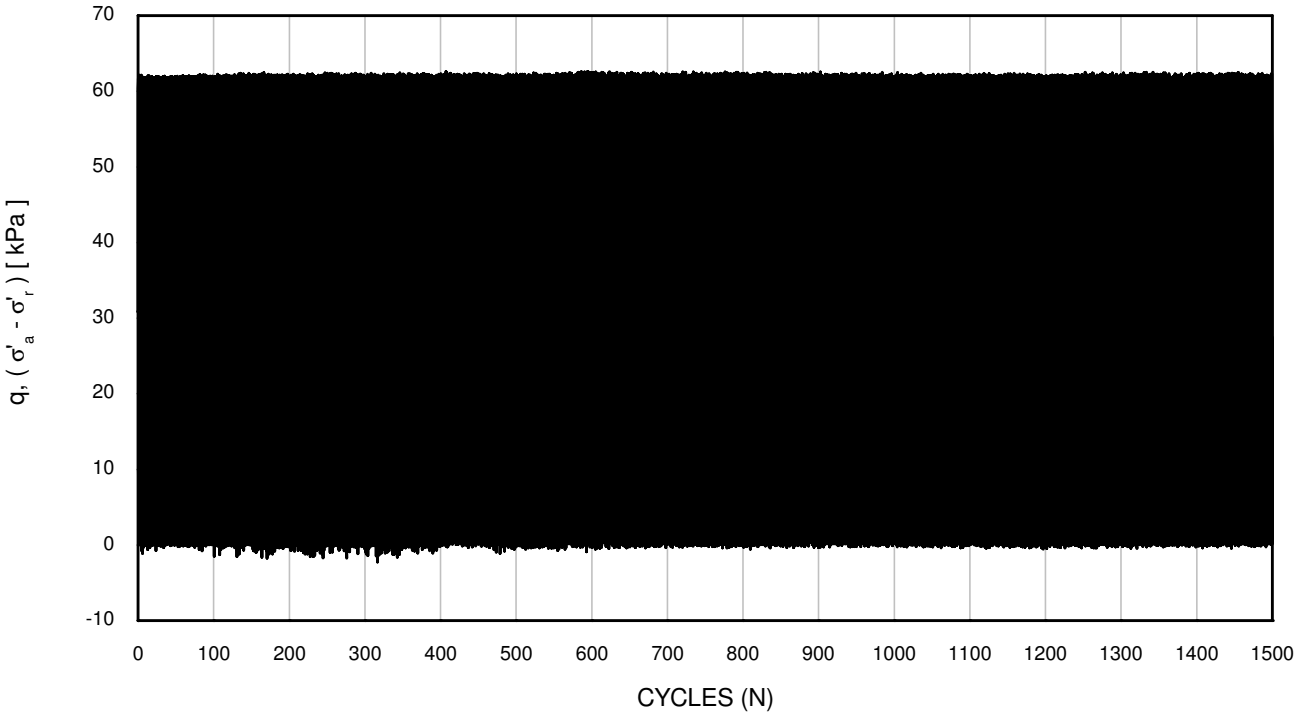
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

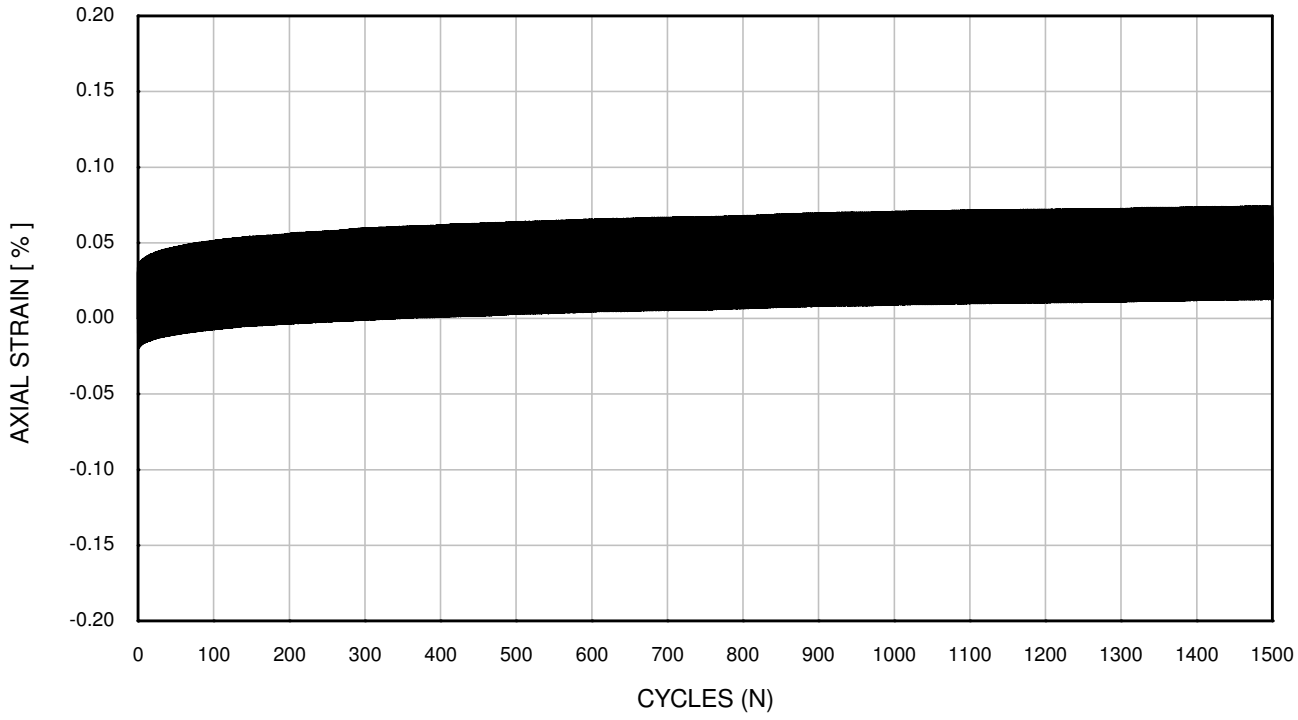




Stage 1 σ'_{rc}	: 150 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 181 kPa	Sample	: 21WAXC
		Depth [m]	: 18.92
		Test No.	: CTX14

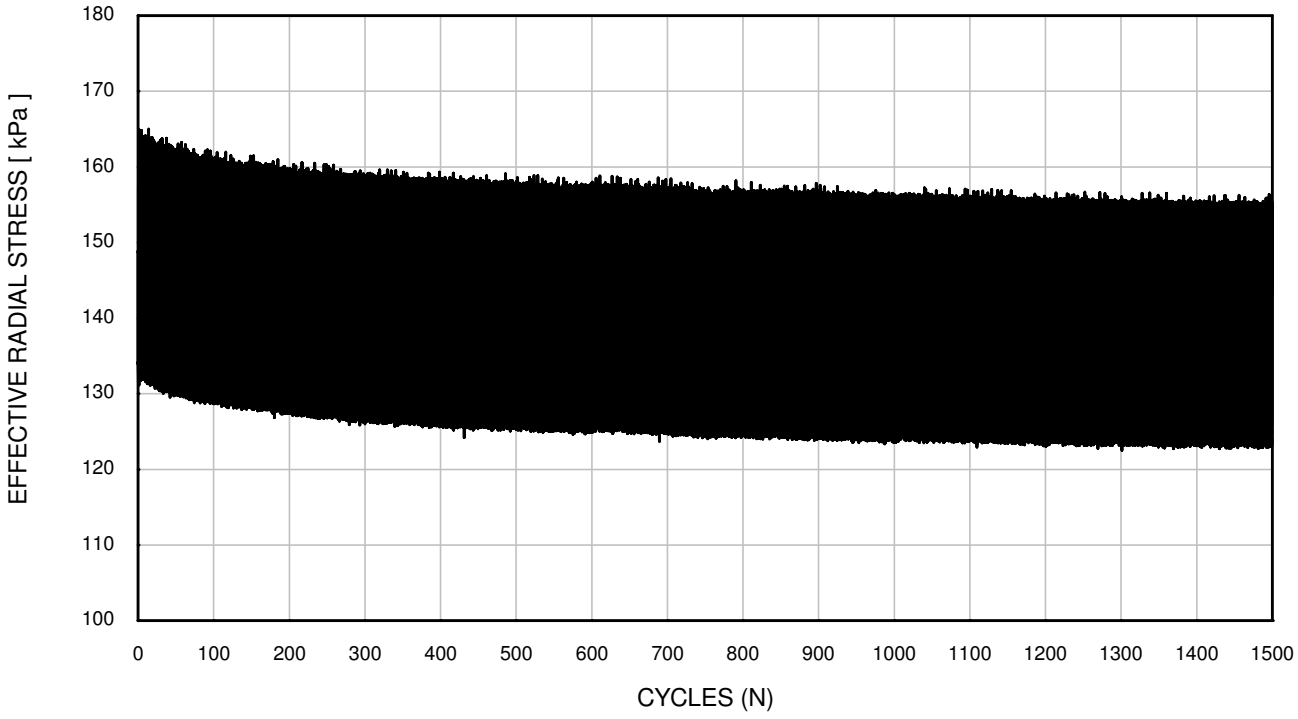
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

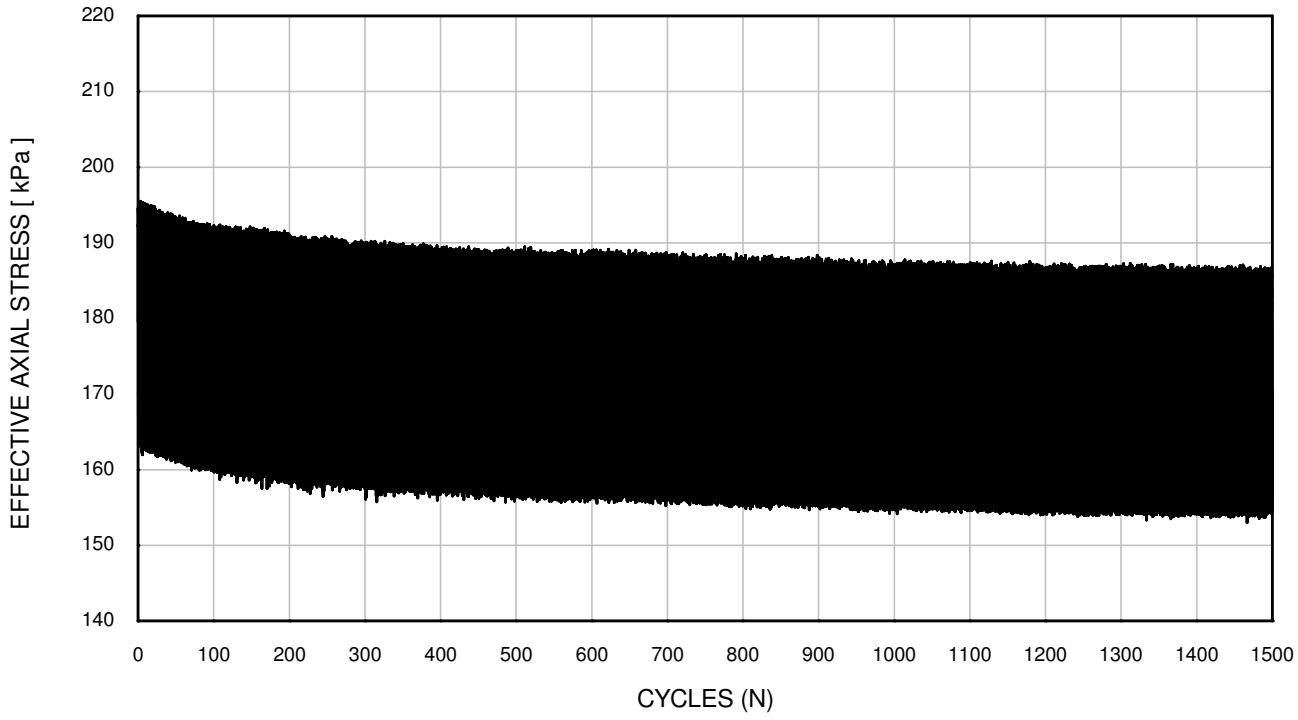




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

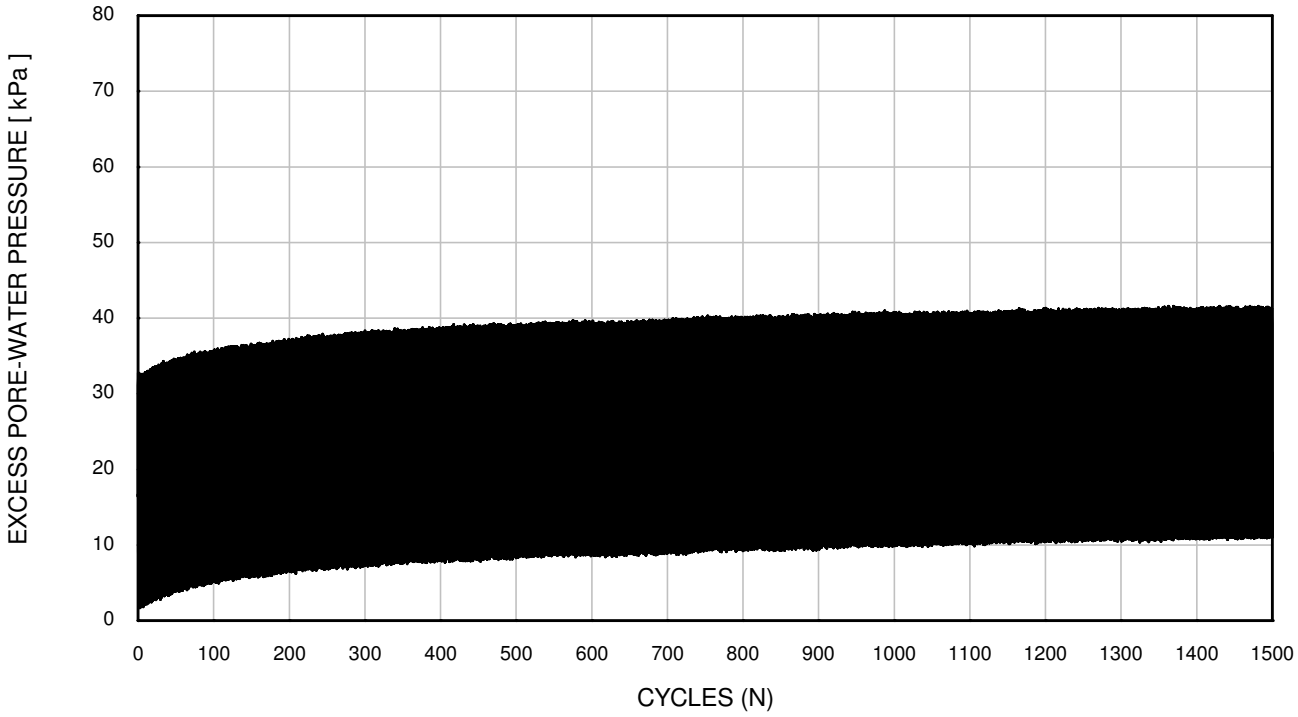
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

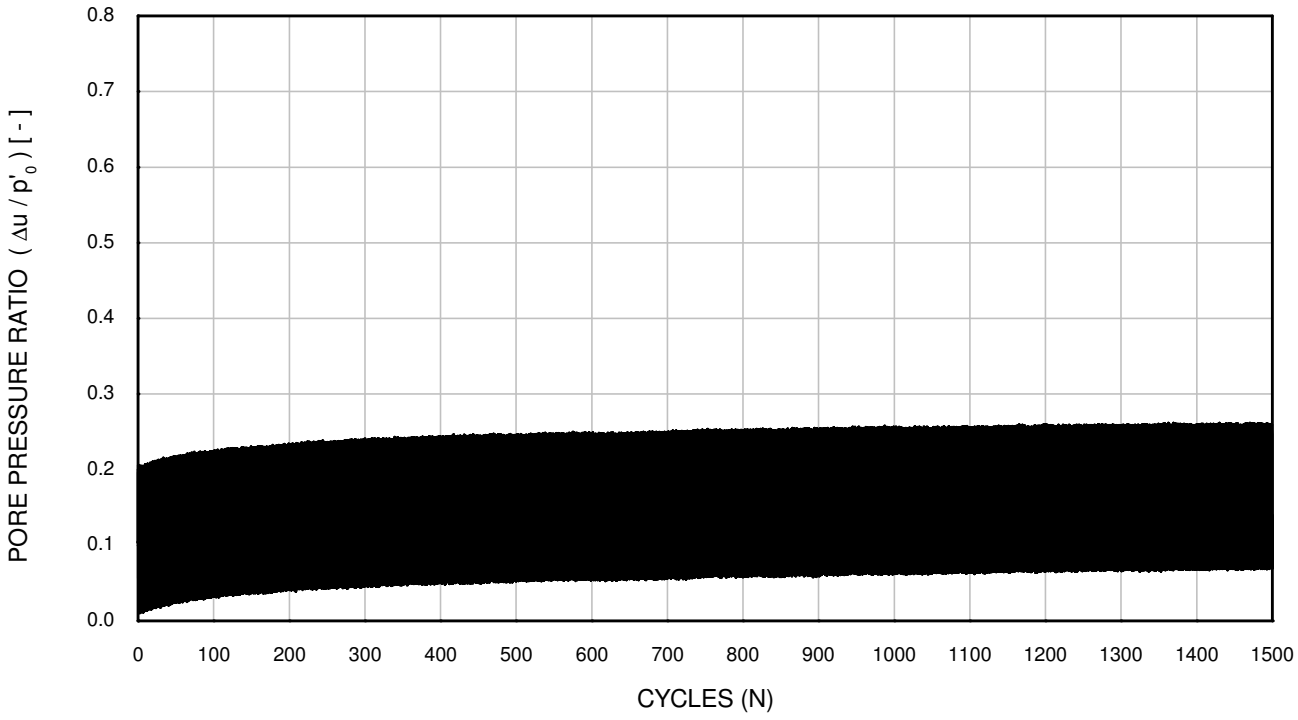




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

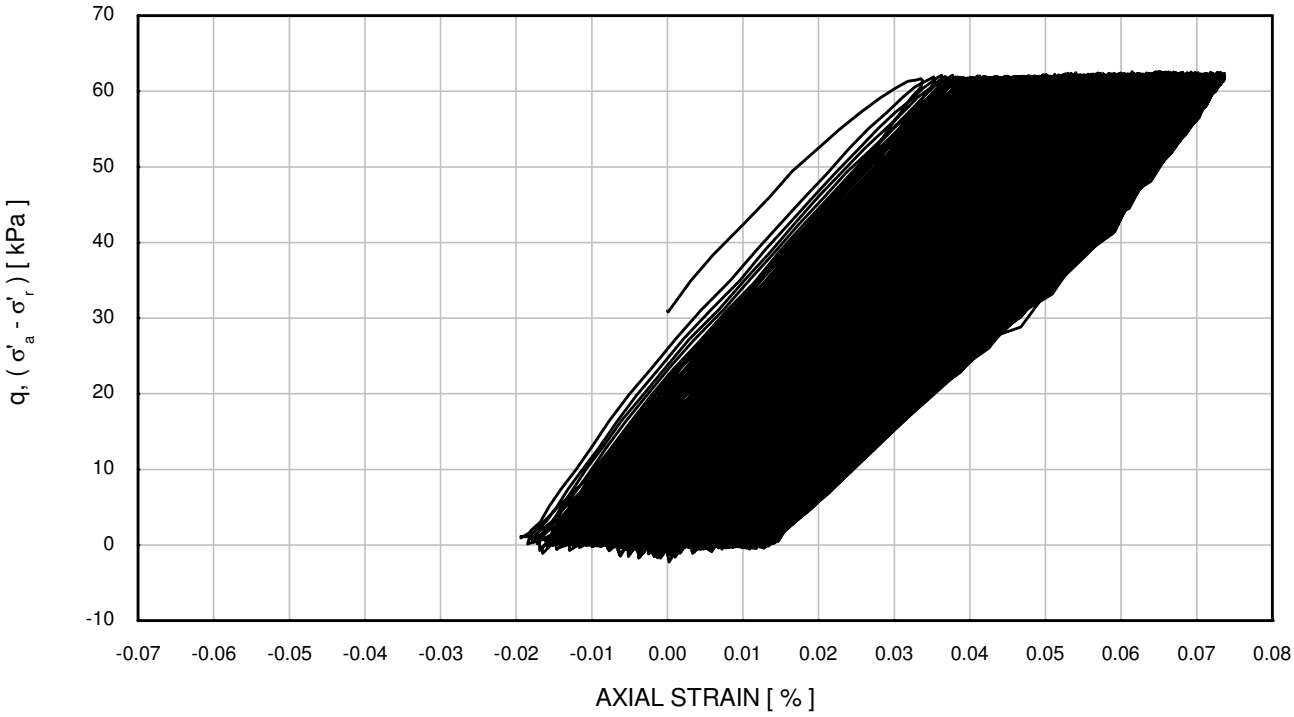
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

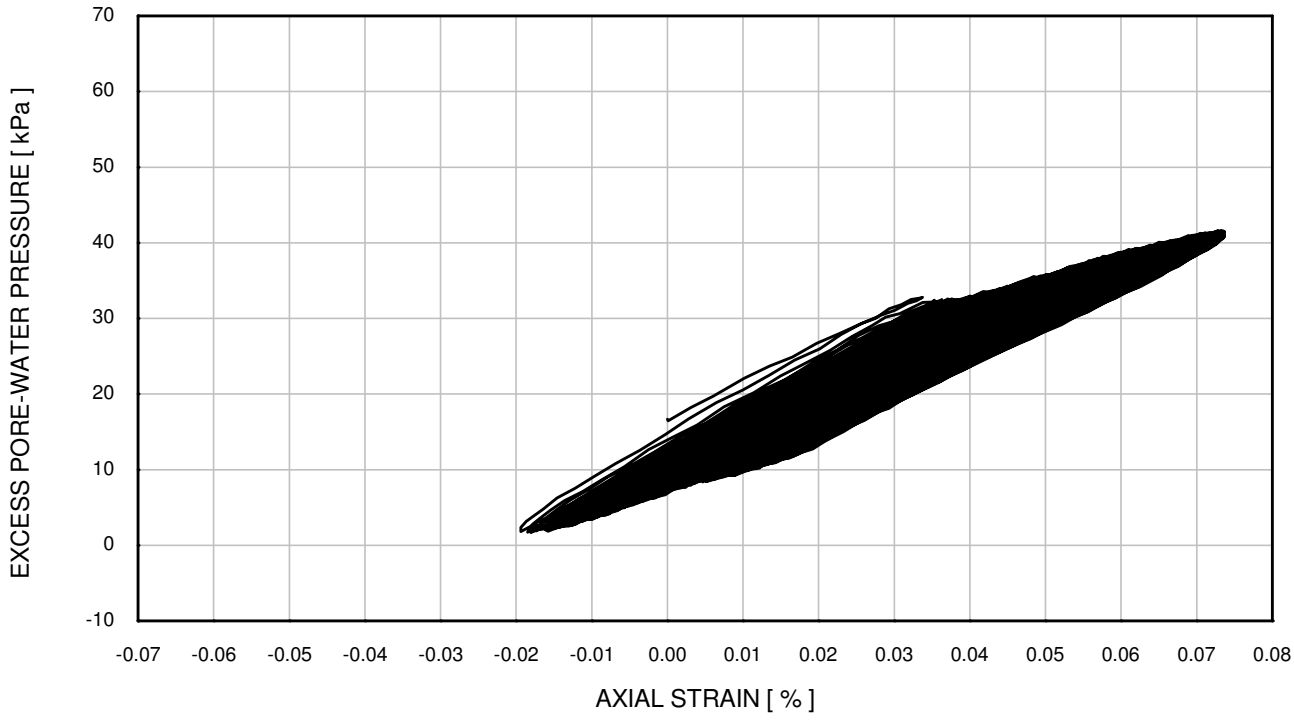




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

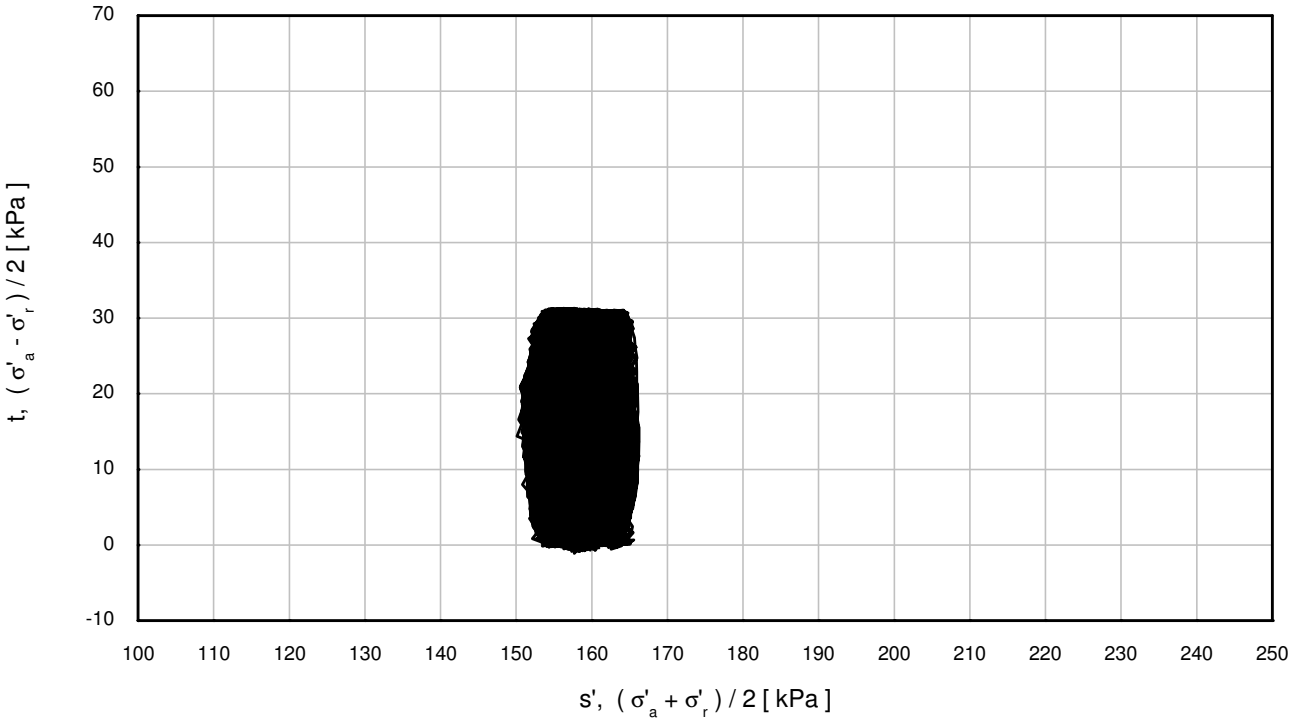
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

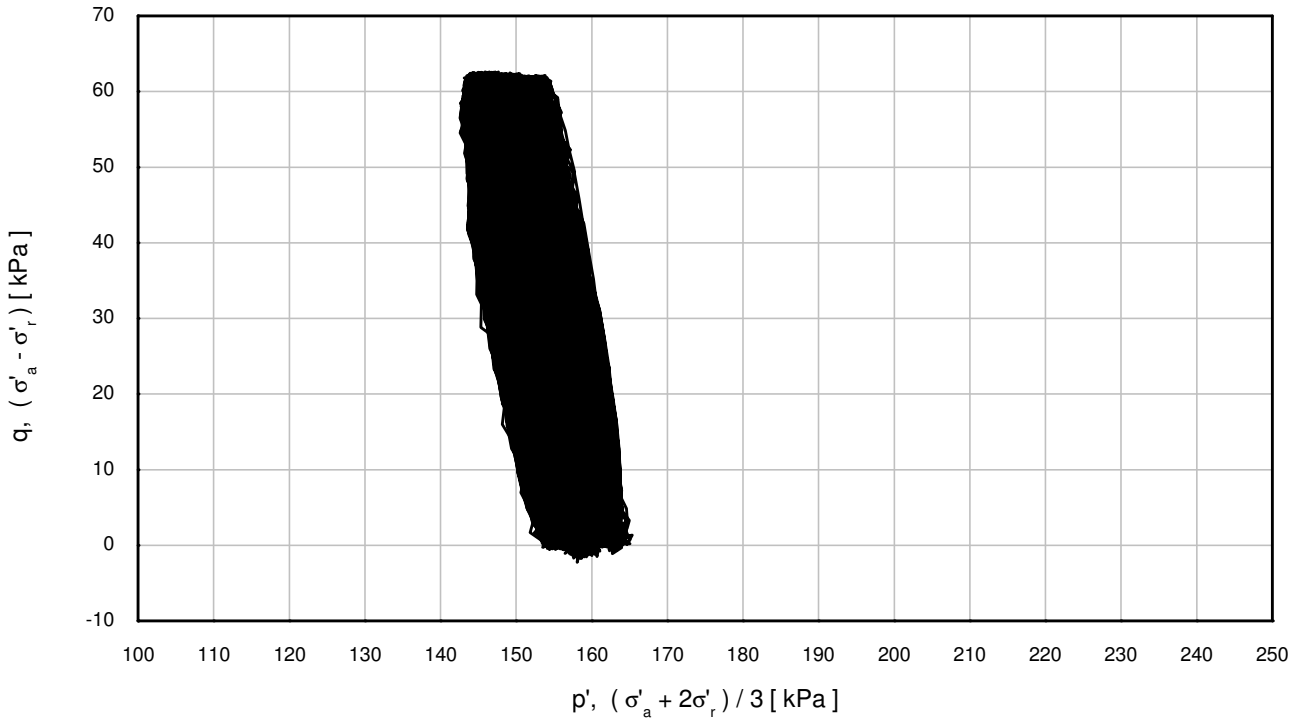




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

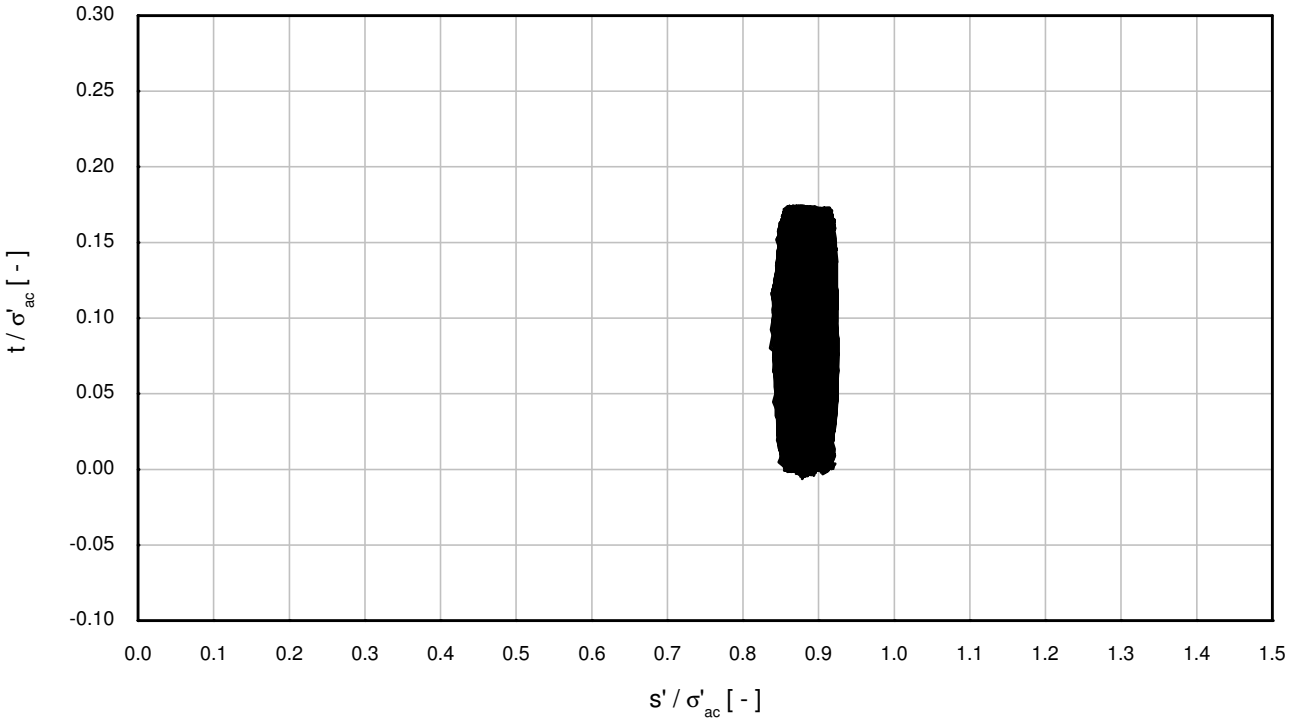
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

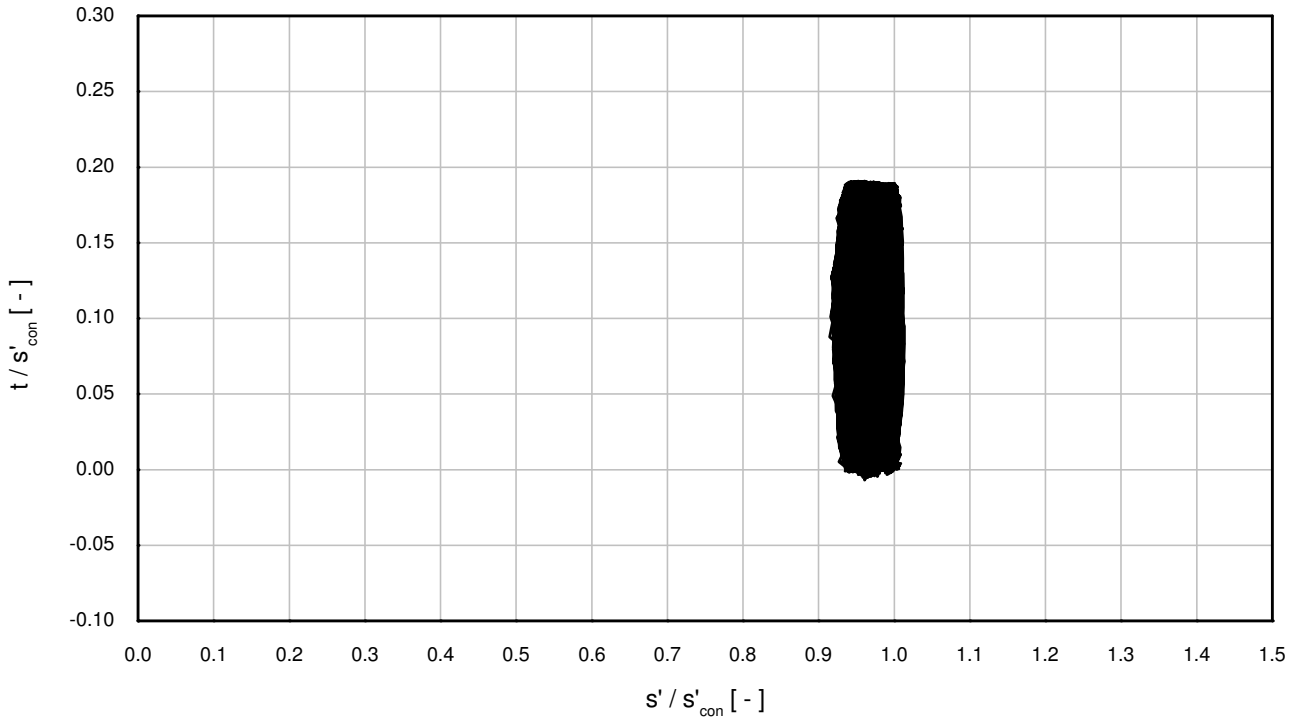




Initial σ'_r	:	149 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	180 kPa	Sample	:	21WAXC
q_{av}	:	31 kPa	Depth [m]	:	18.92
q_{cy}	:	31 kPa	Test No.	:	CTX14
Frequency	:	0.10 Hz			

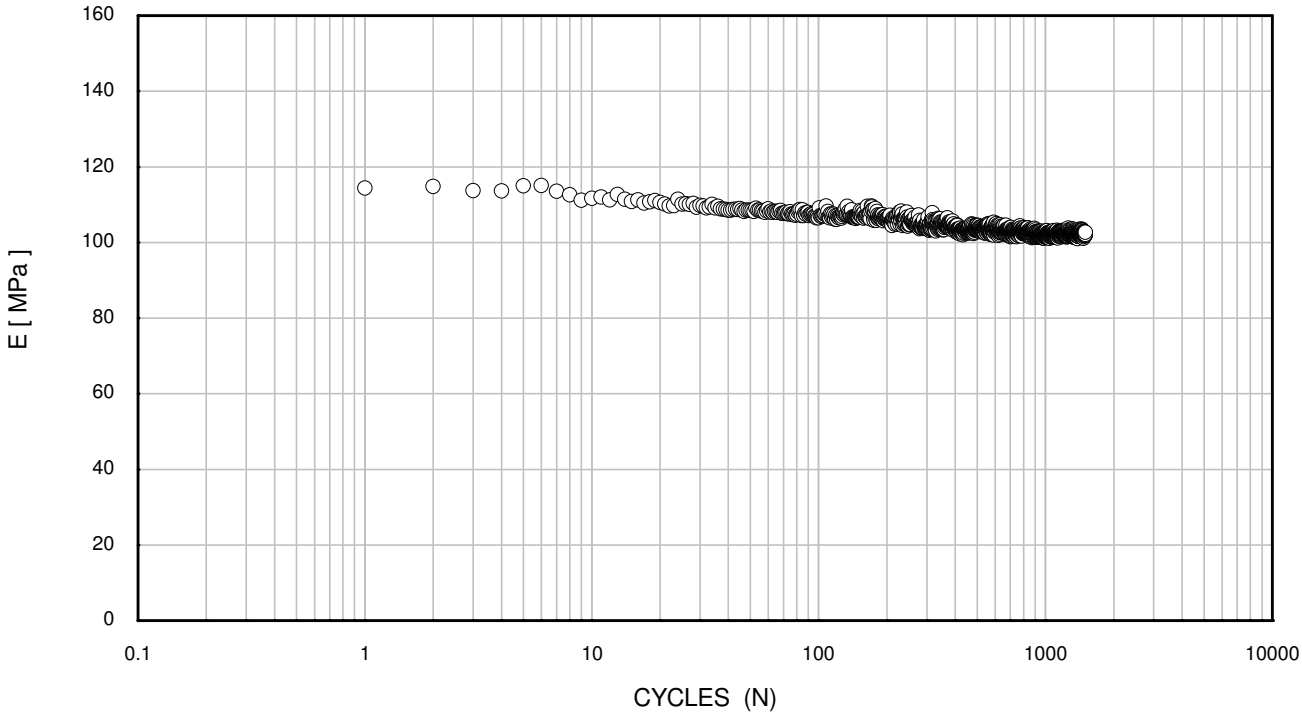
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

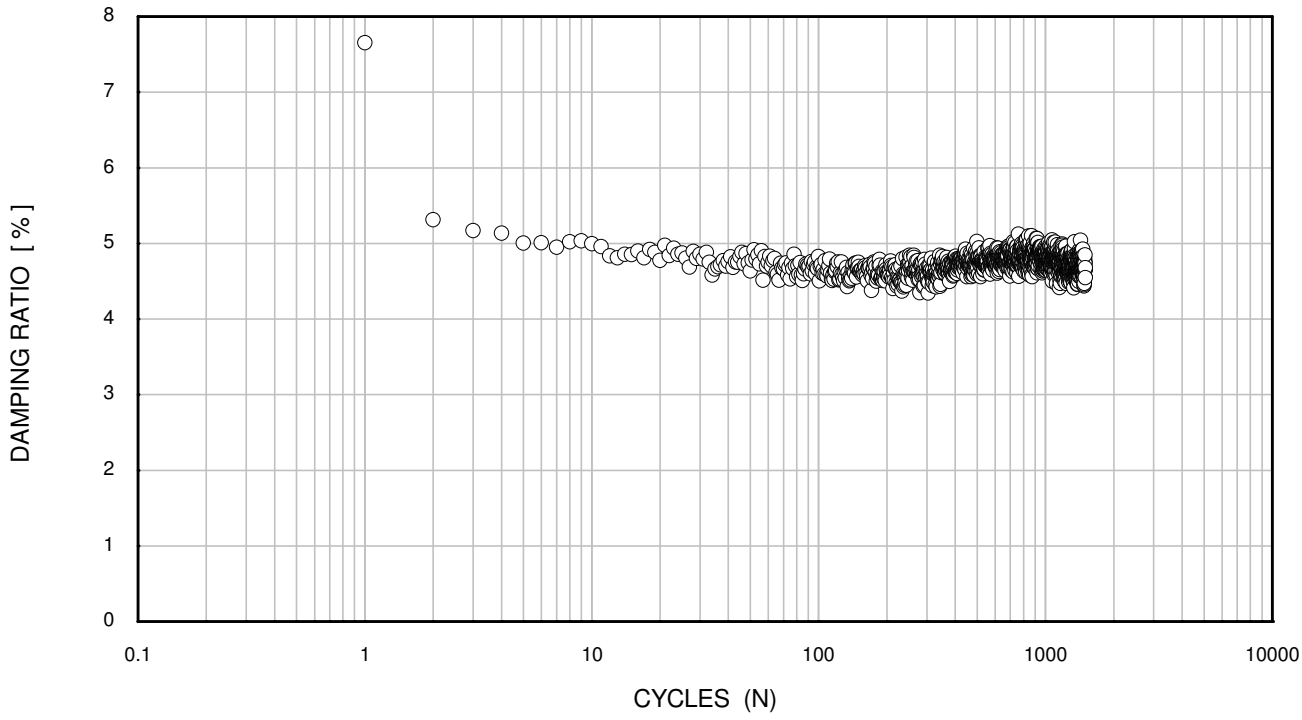




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

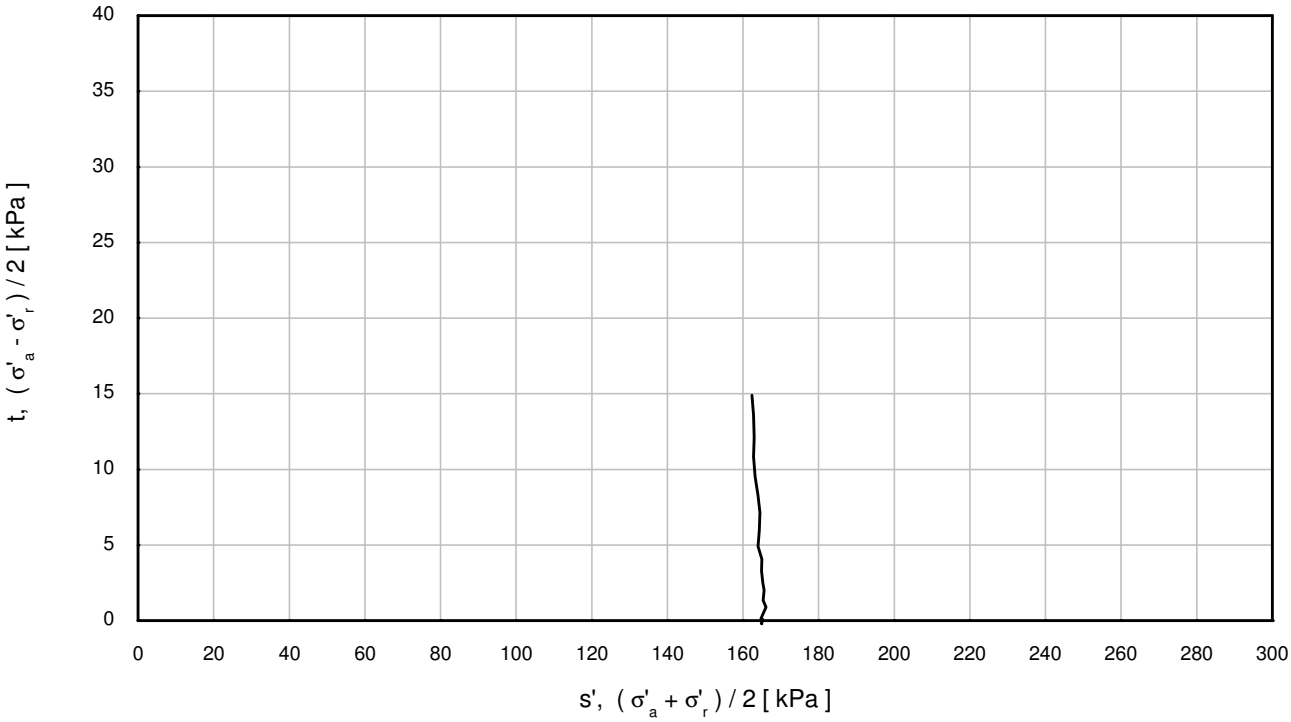
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

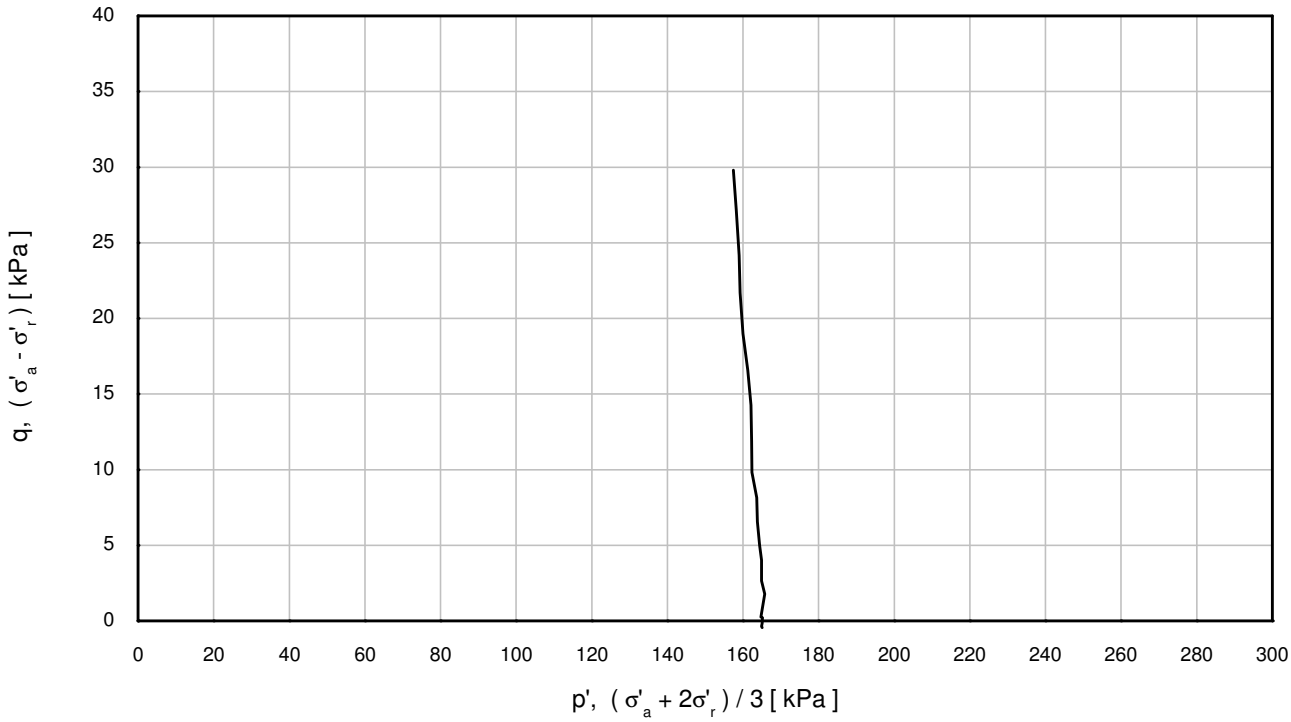




Initial σ'_r	: 149 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 180 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 31 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

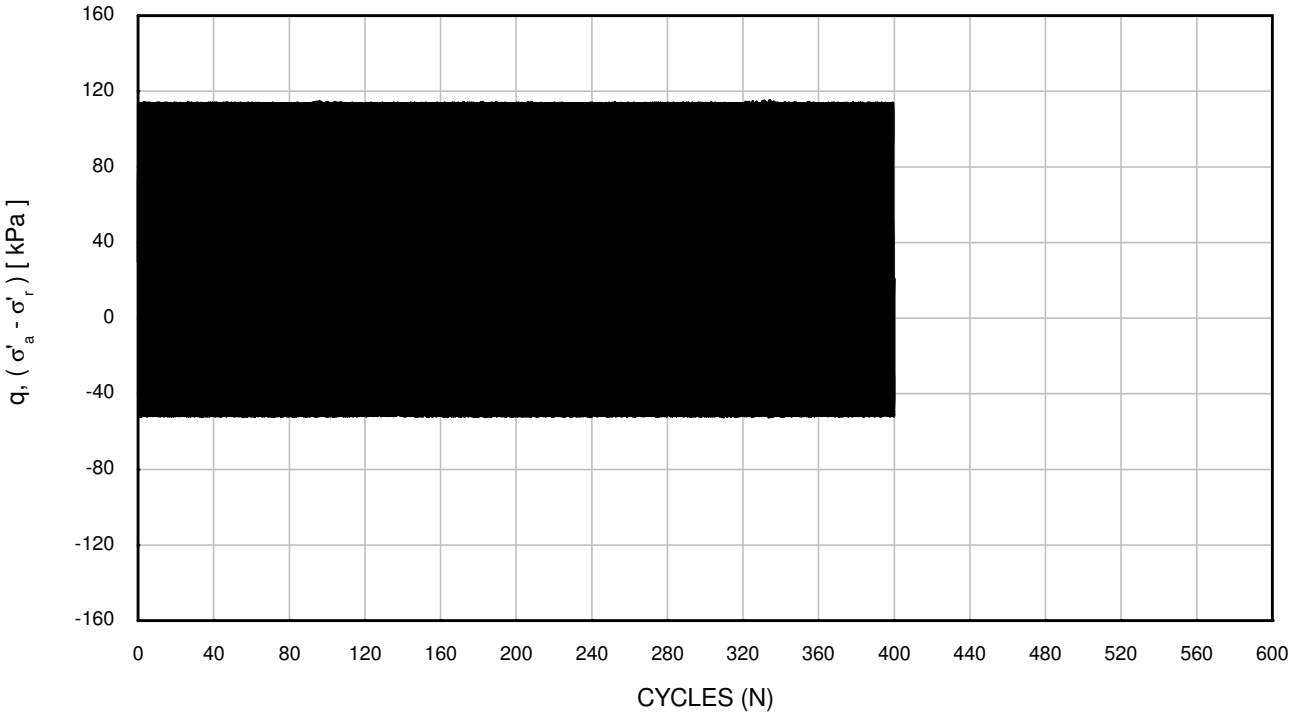
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

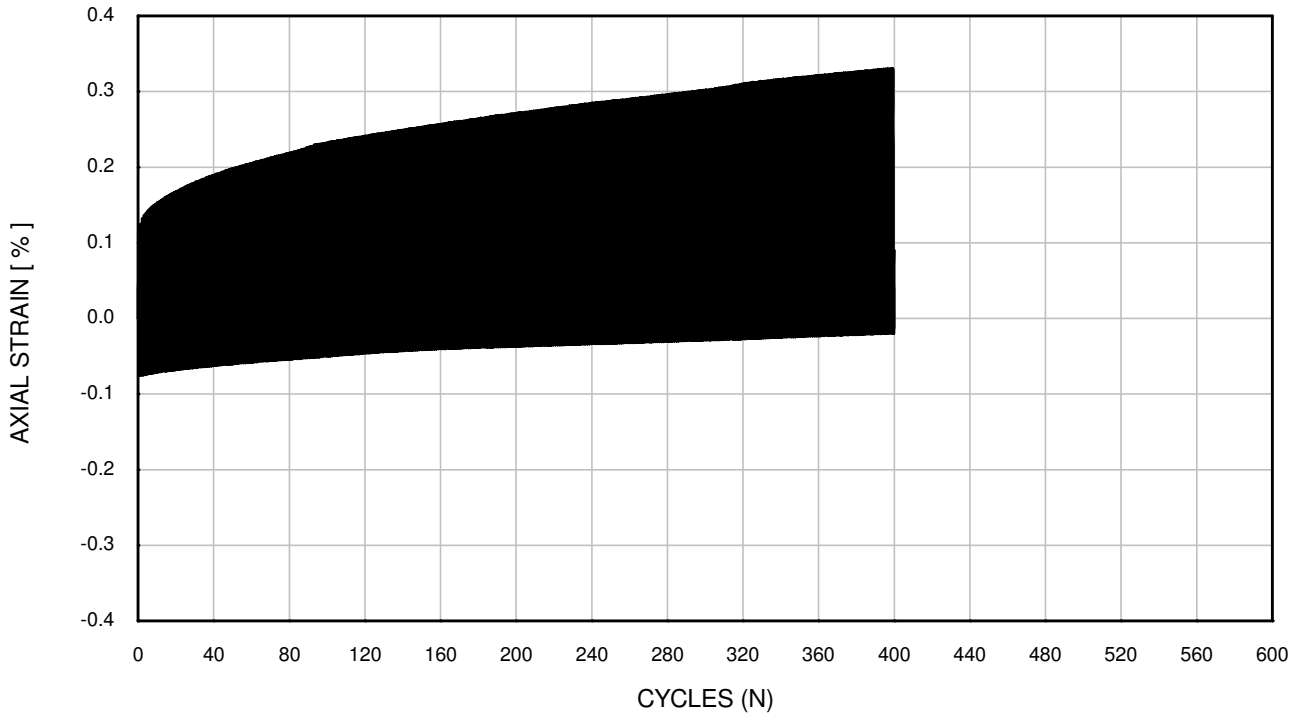




Stage 1 σ'_{rc}	: 147 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 177 kPa	Sample	: 21WAXC
		Depth [m]	: 18.92
		Test No.	: CTX14

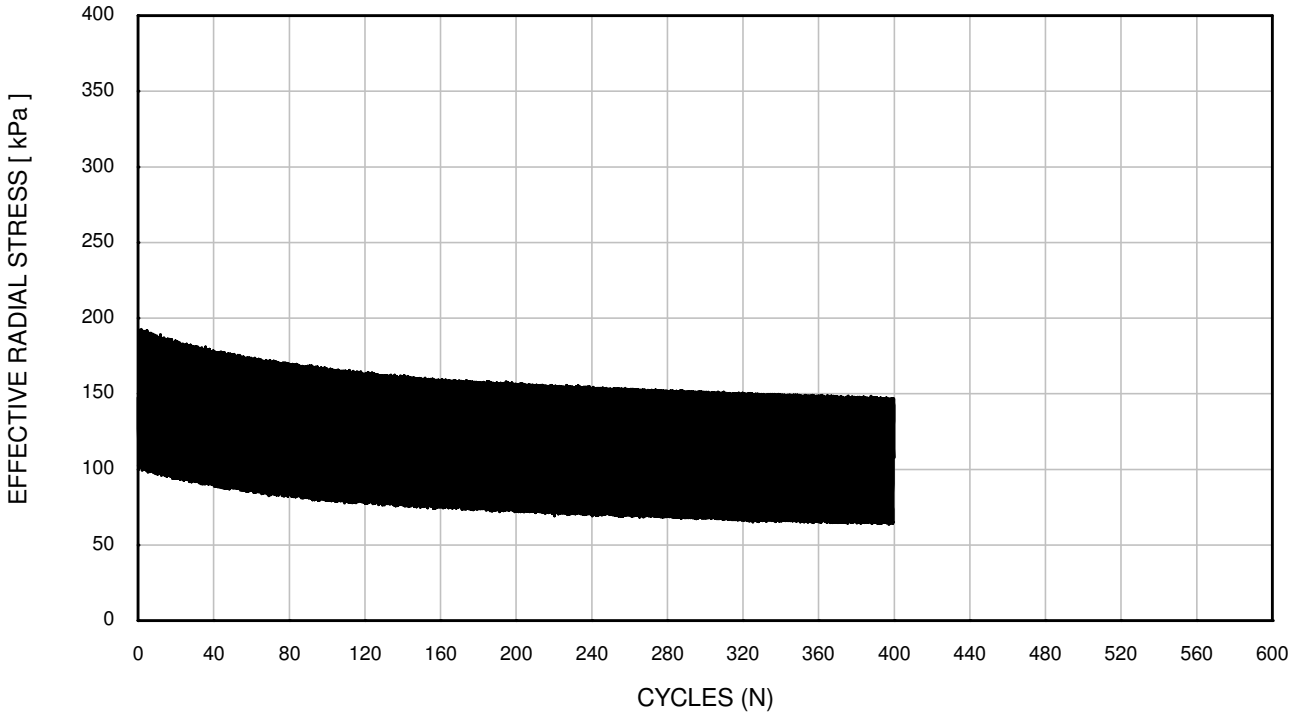
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

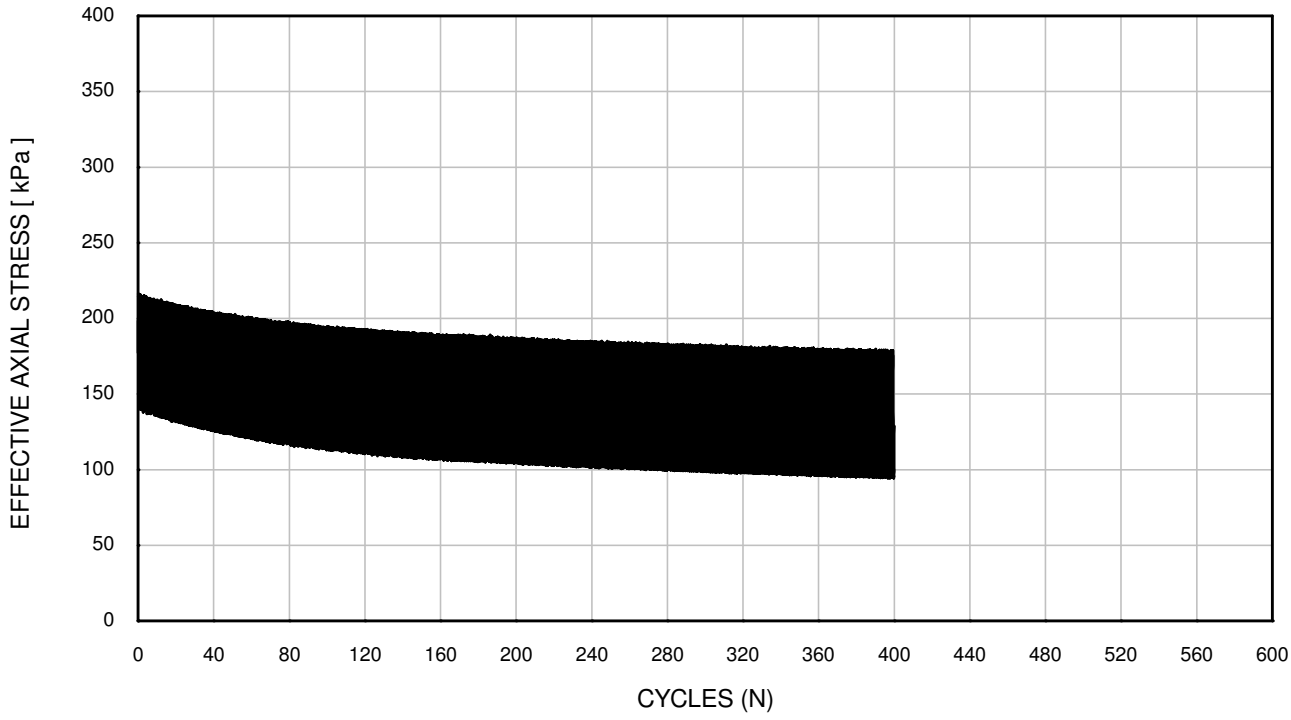




Initial σ'_r	: 147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

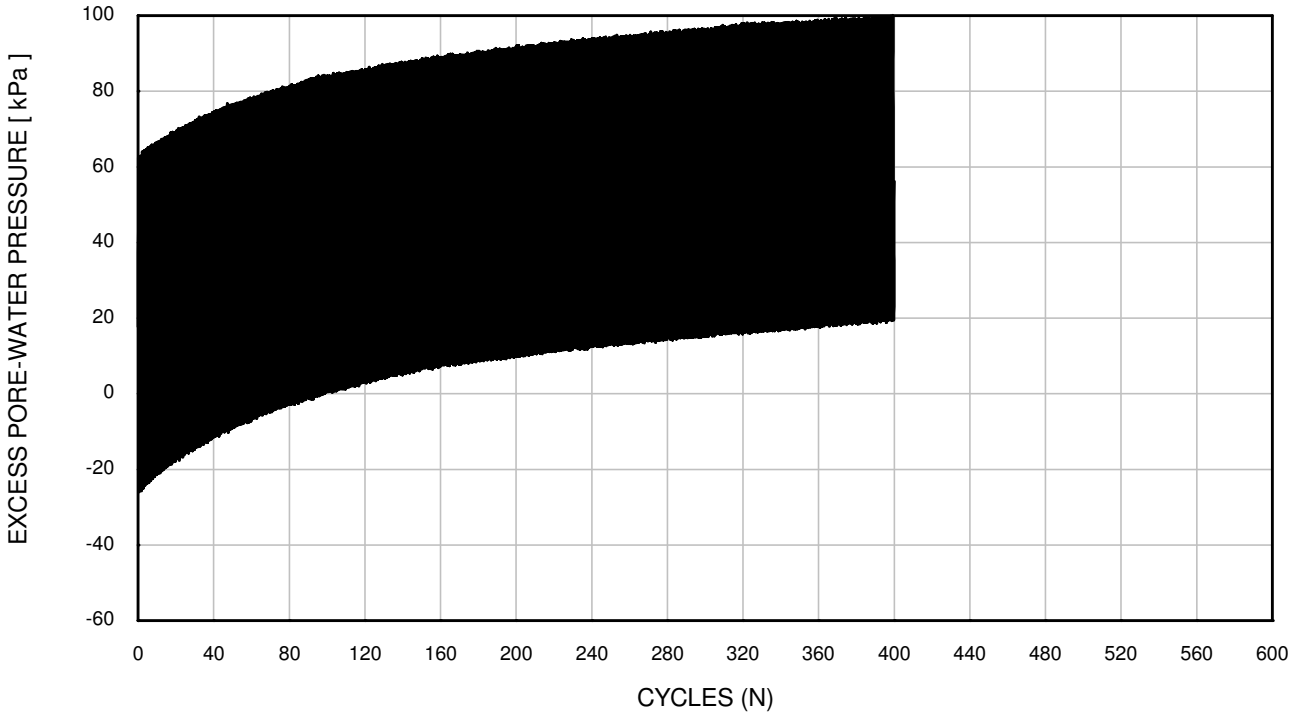
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

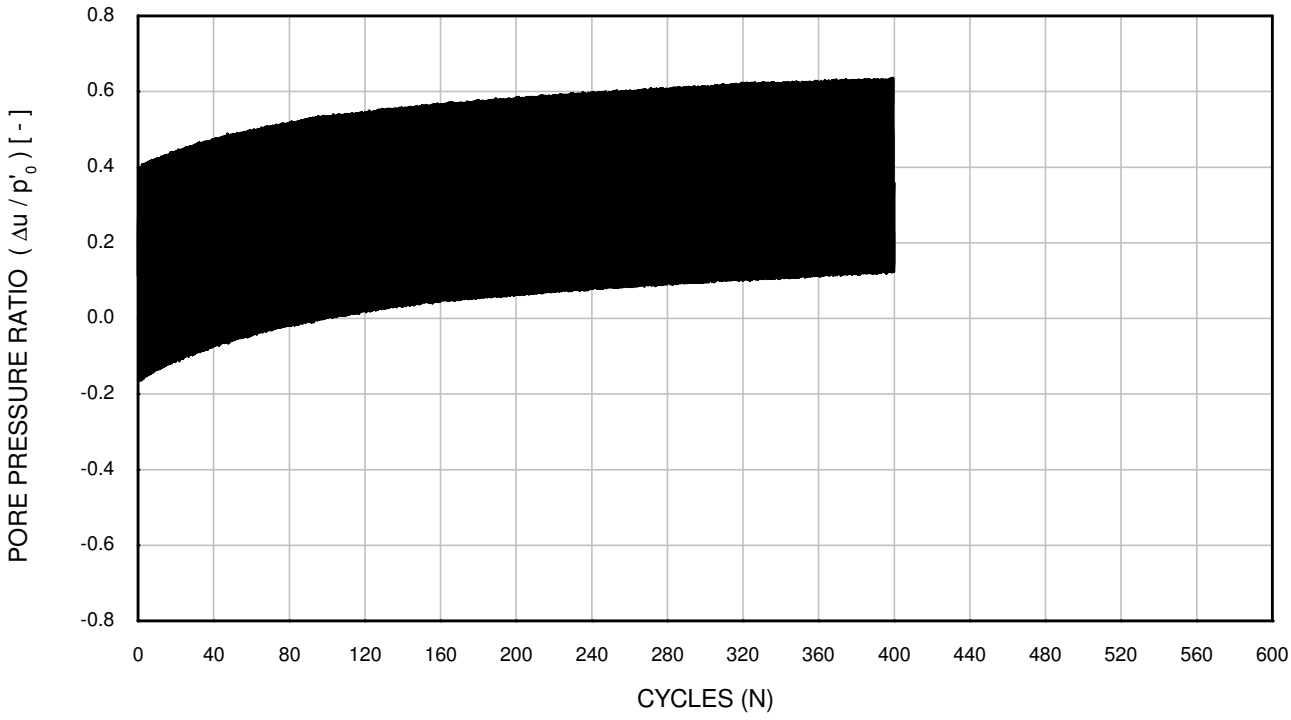




Initial σ'_r	: 147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

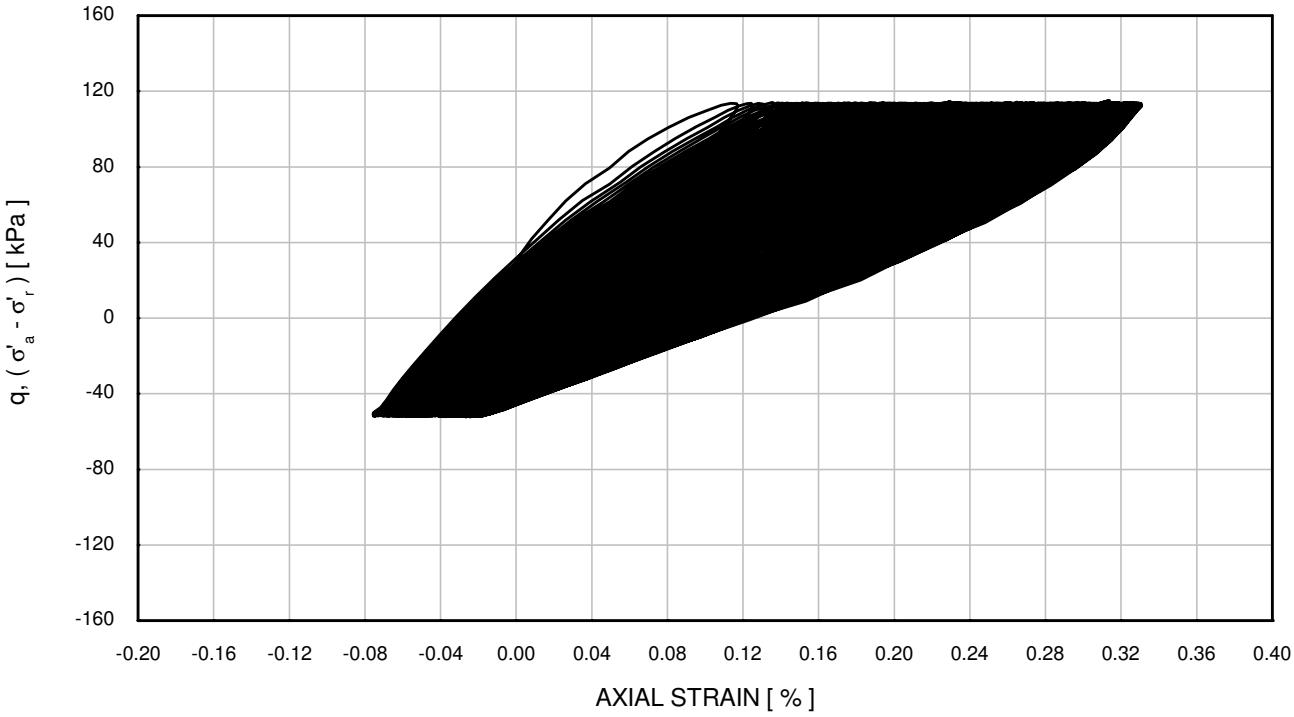
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

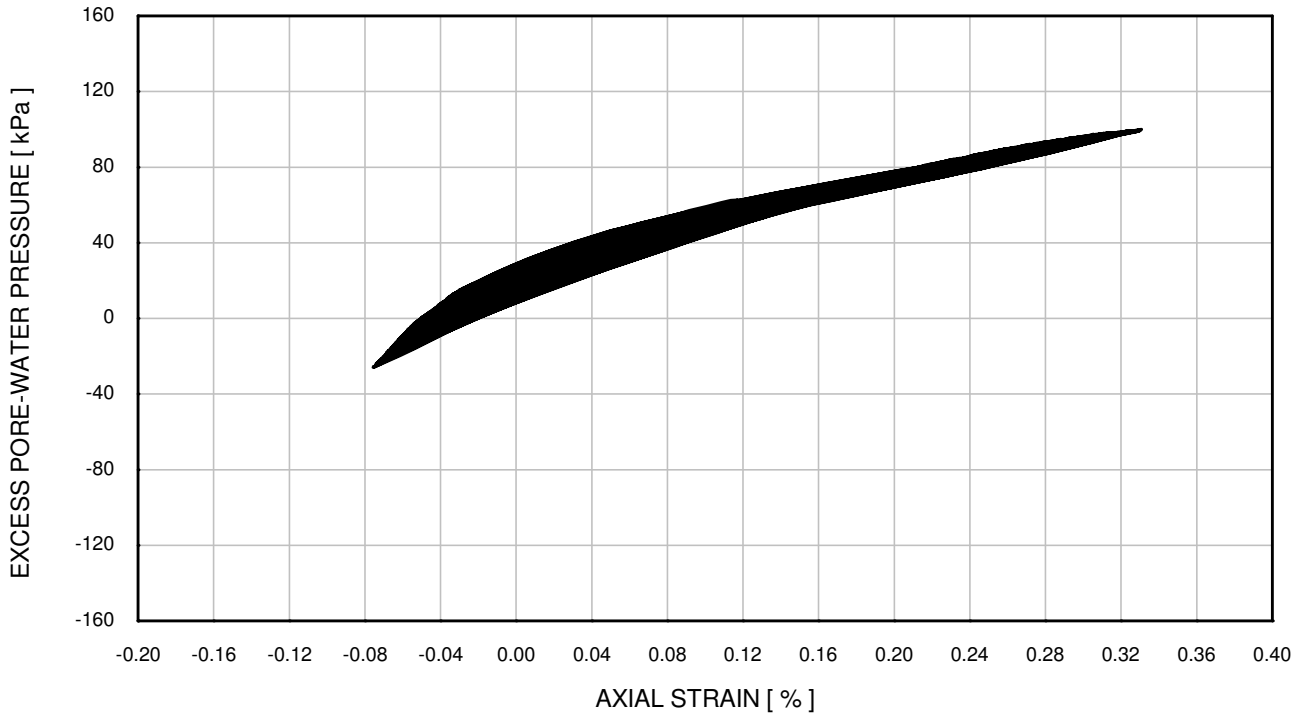




Initial σ'_r	: 147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

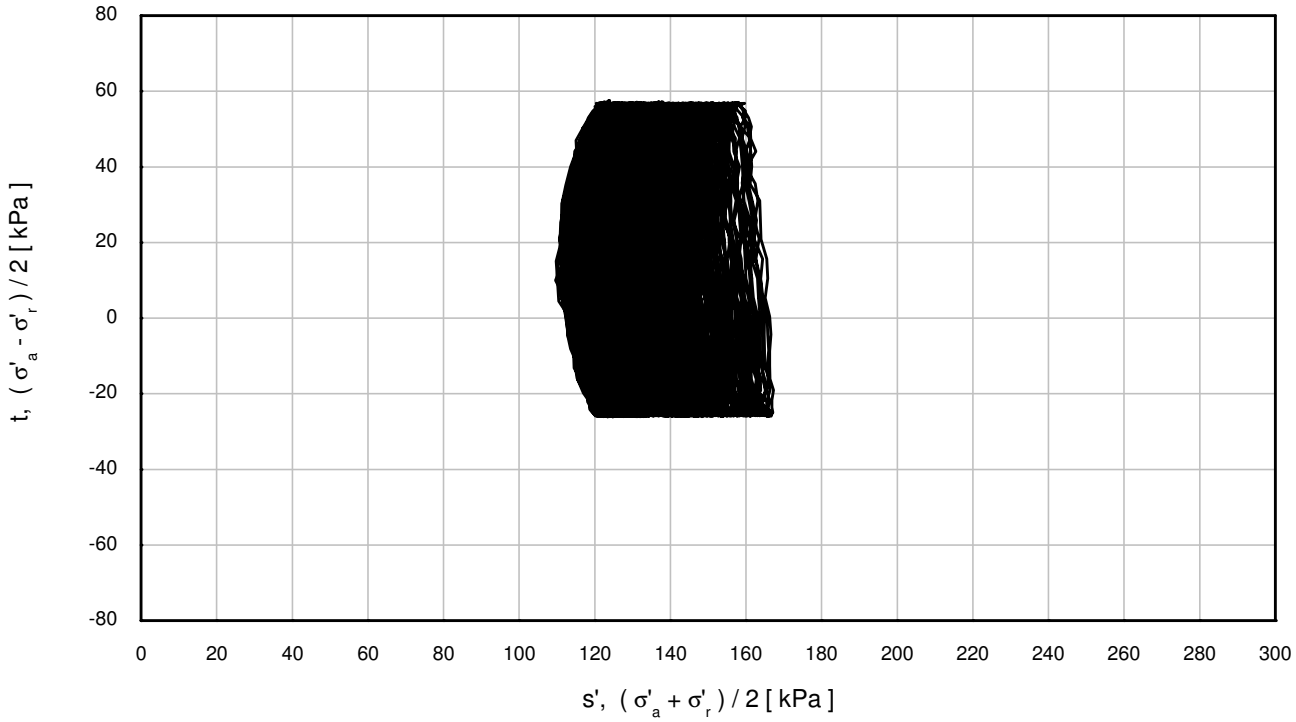
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

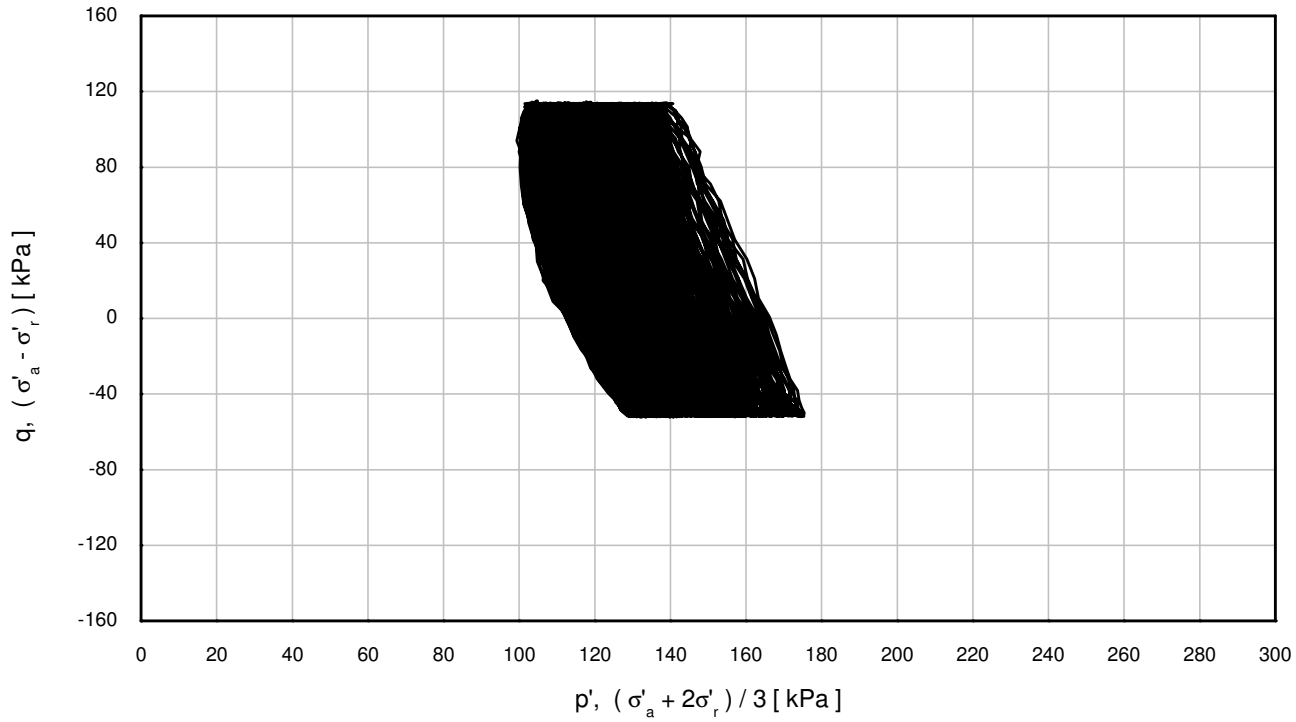




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Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

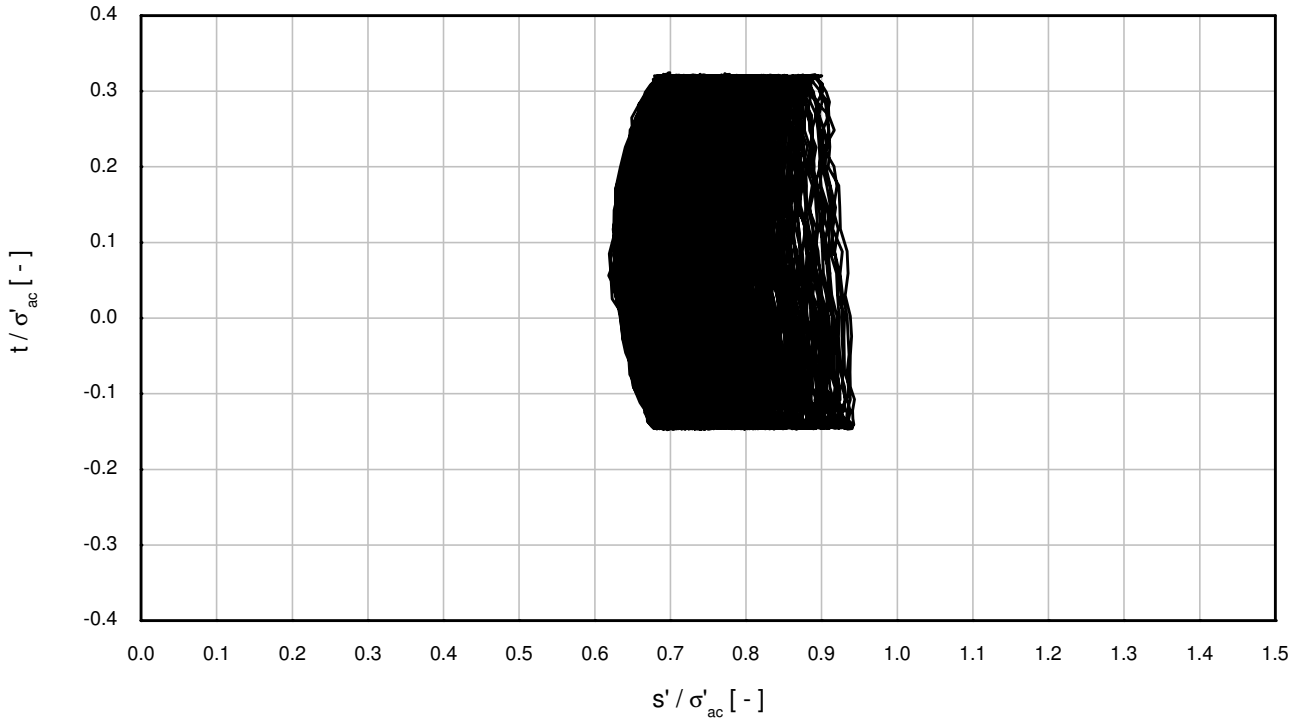
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

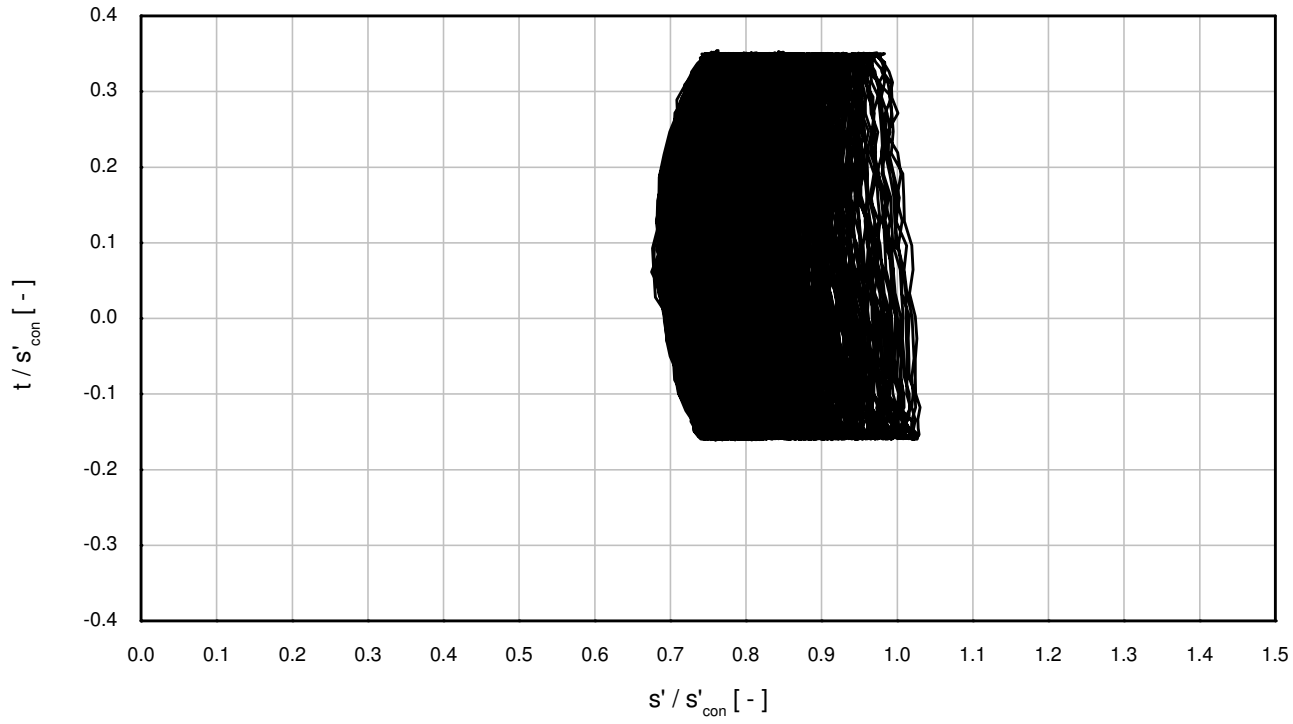




Initial σ'_r	:	147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	177 kPa	Sample	: 21WAXC
q_{av}	:	31 kPa	Depth [m]	: 18.92
q_{cy}	:	83 kPa	Test No.	: CTX14
Frequency	:	0.10 Hz		

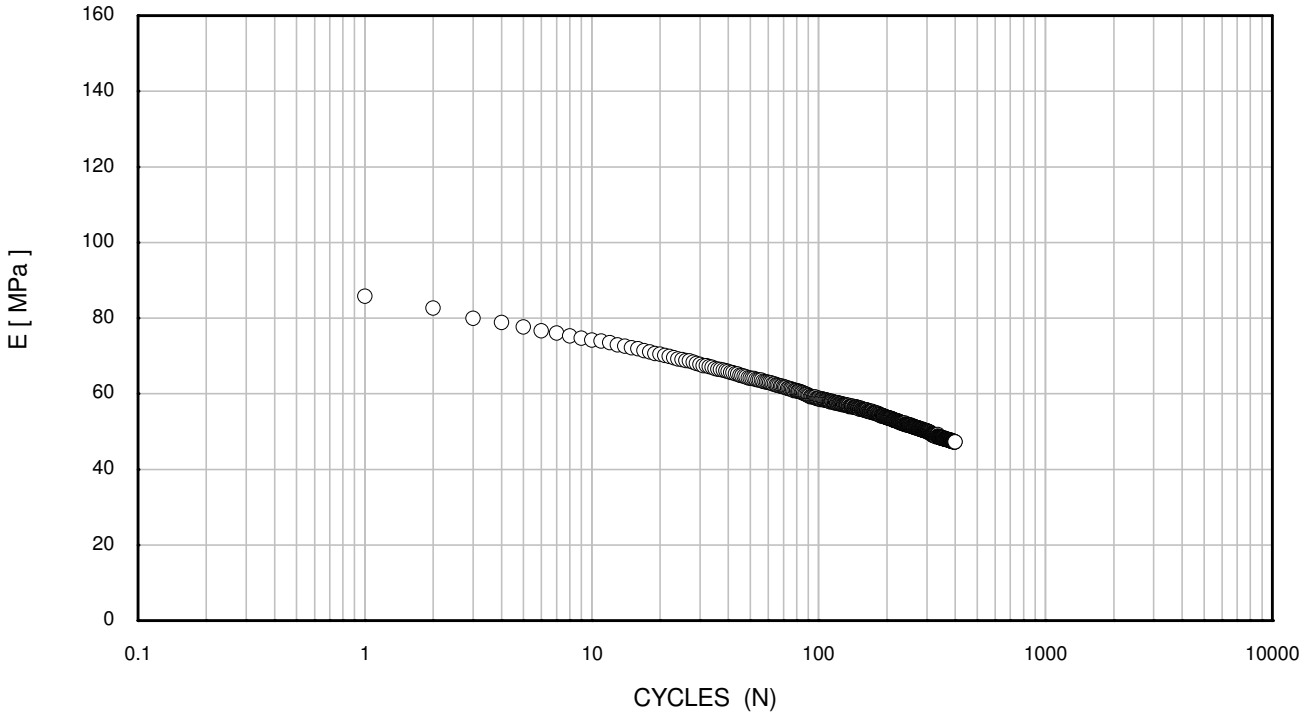
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

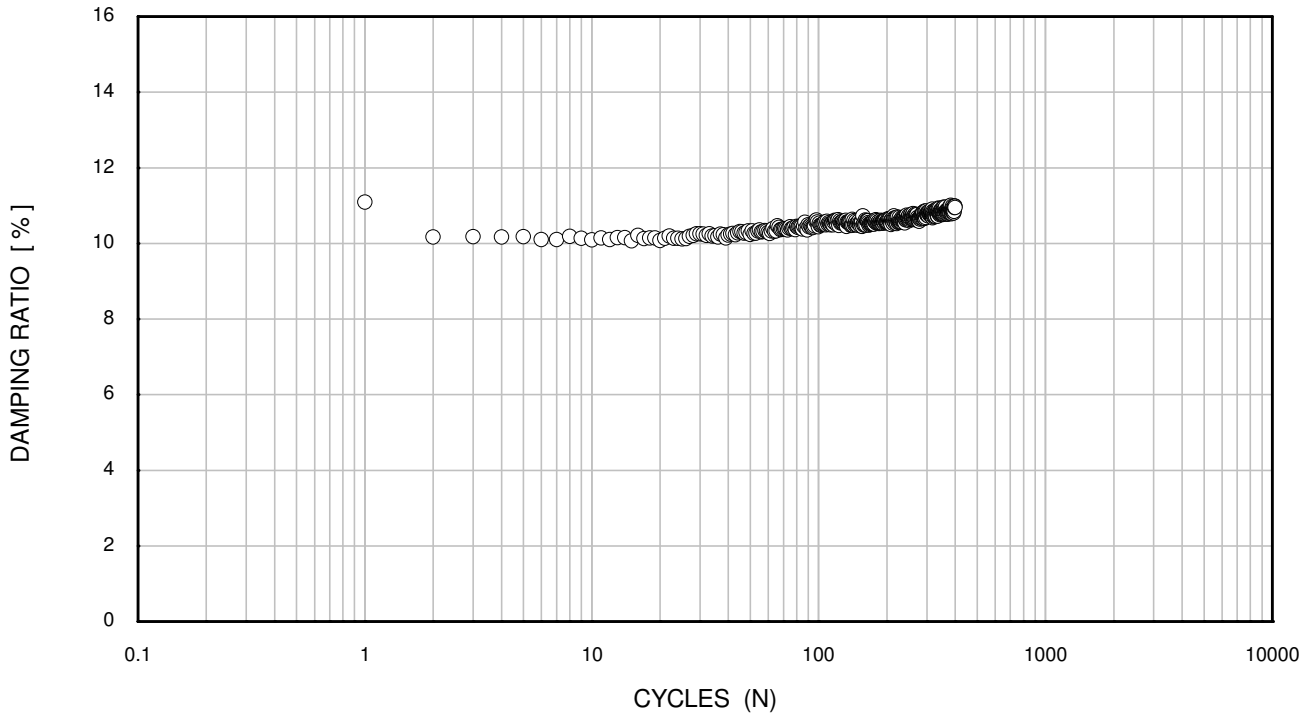




Initial σ'_r	: 147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

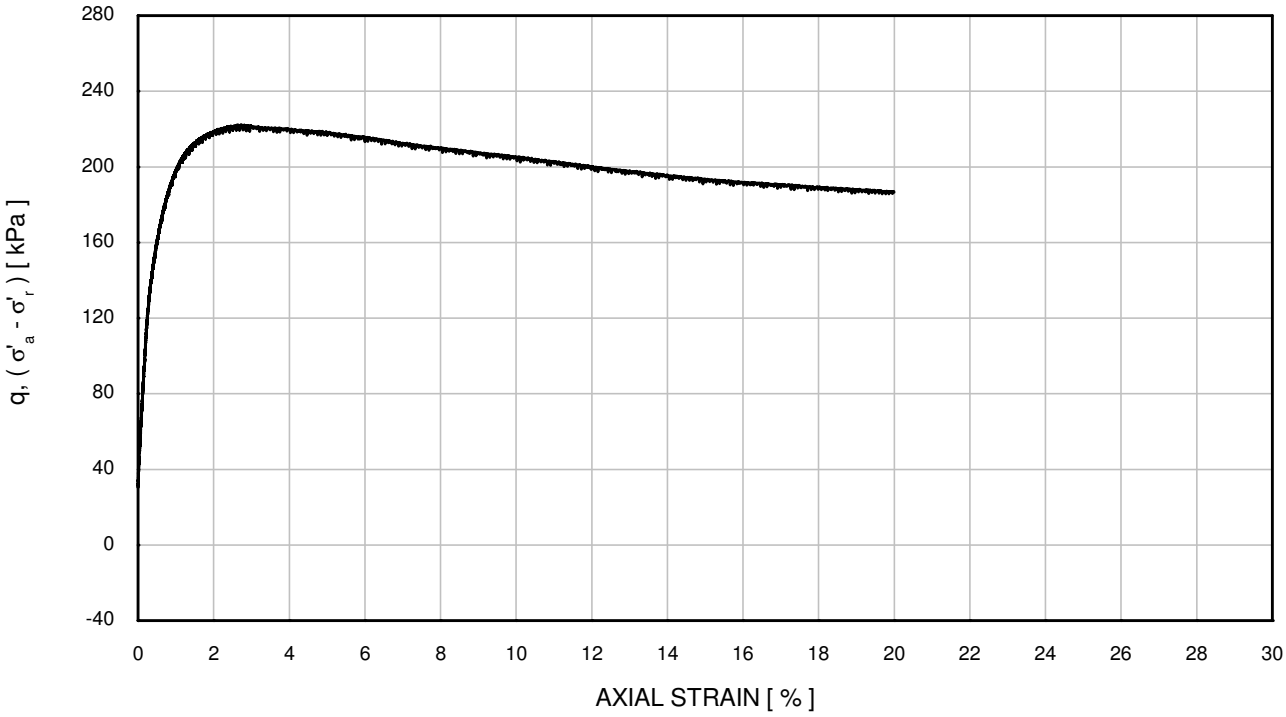
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

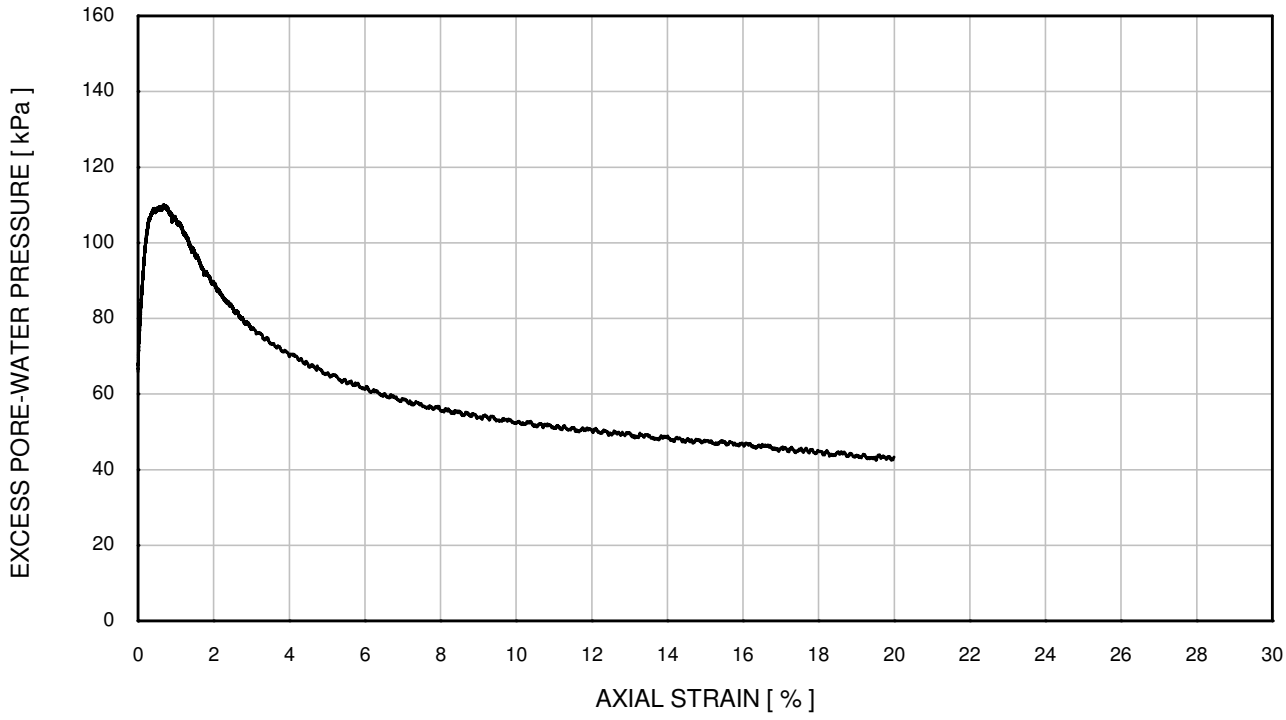




Initial σ'_r	: 147 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 177 kPa	Sample	: 21WAXC
q_{av}	: 31 kPa	Depth [m]	: 18.92
q_{cy}	: 83 kPa	Test No.	: CTX14
Frequency	: 0.10 Hz		

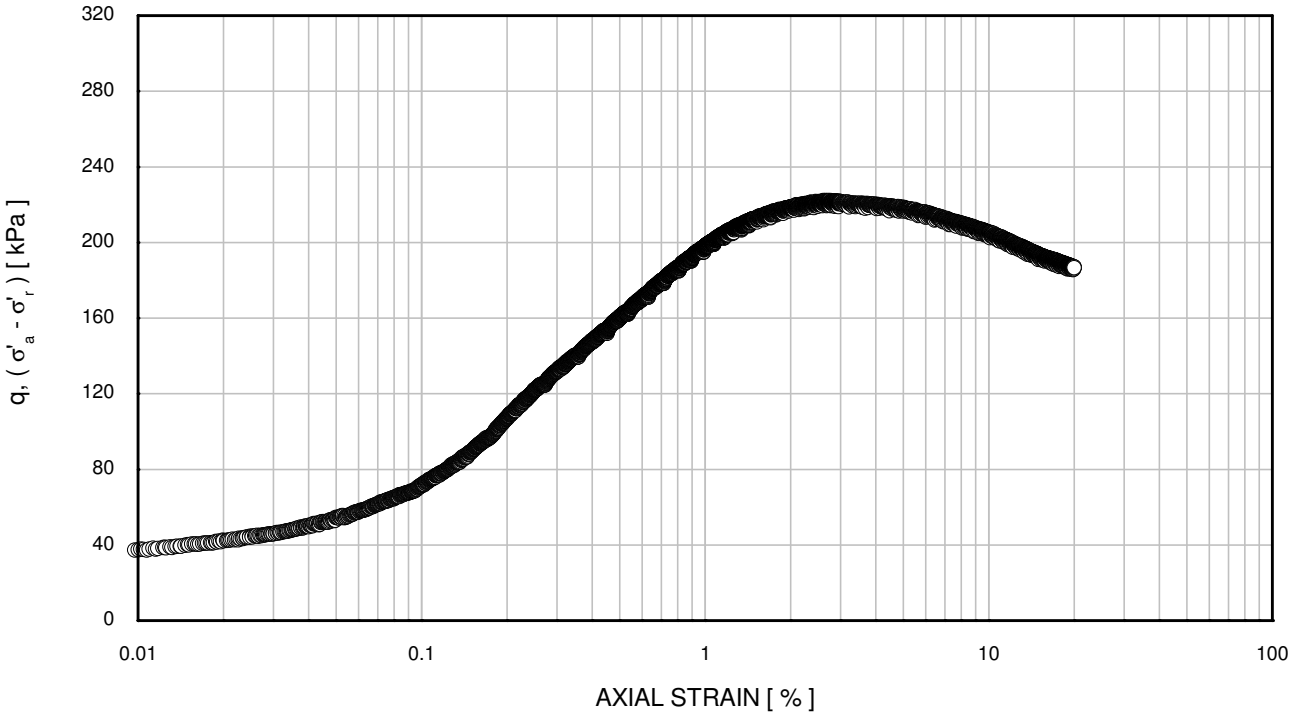
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

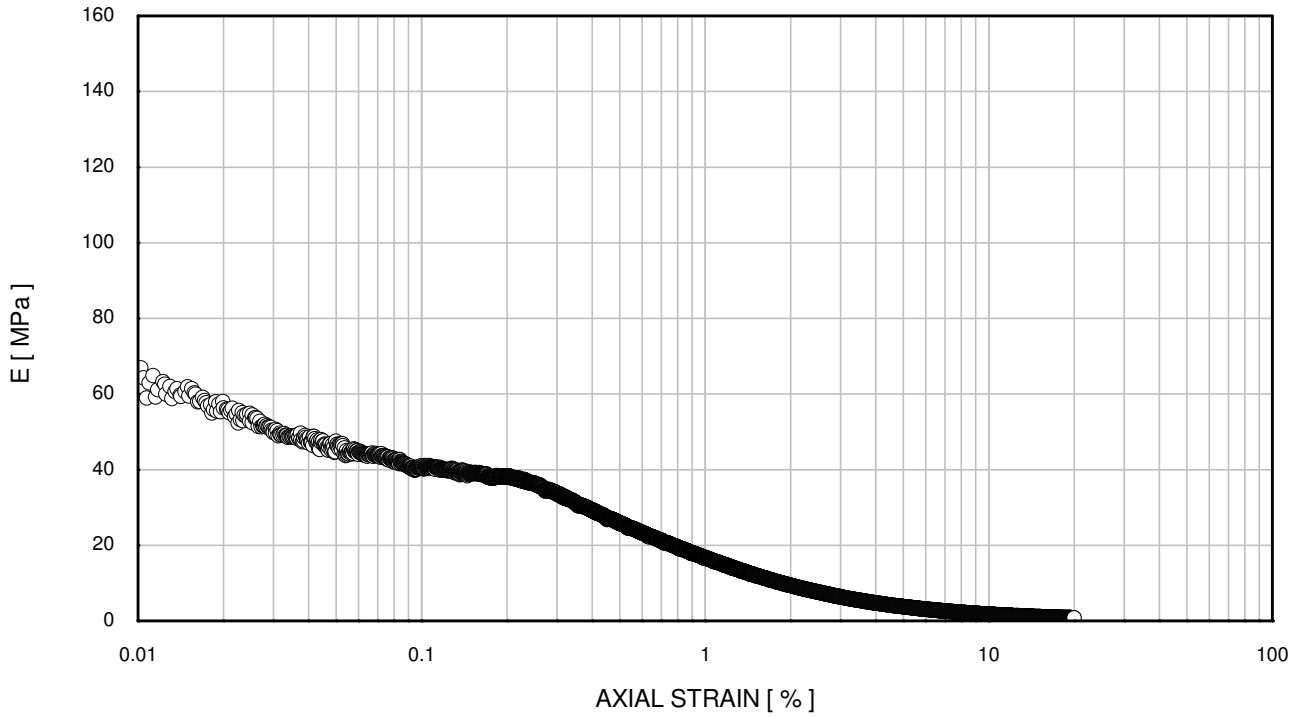




Initial σ'_r	:	99	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	130	kPa	Sample	: 21WAXC
q_{peak}	:	222	kPa	Depth [m]	: 18.92
Ext. ε at q_{peak}	:	2.71	%	Test No.	: CTX14
Rate of strain	:	0.50	%/hour		

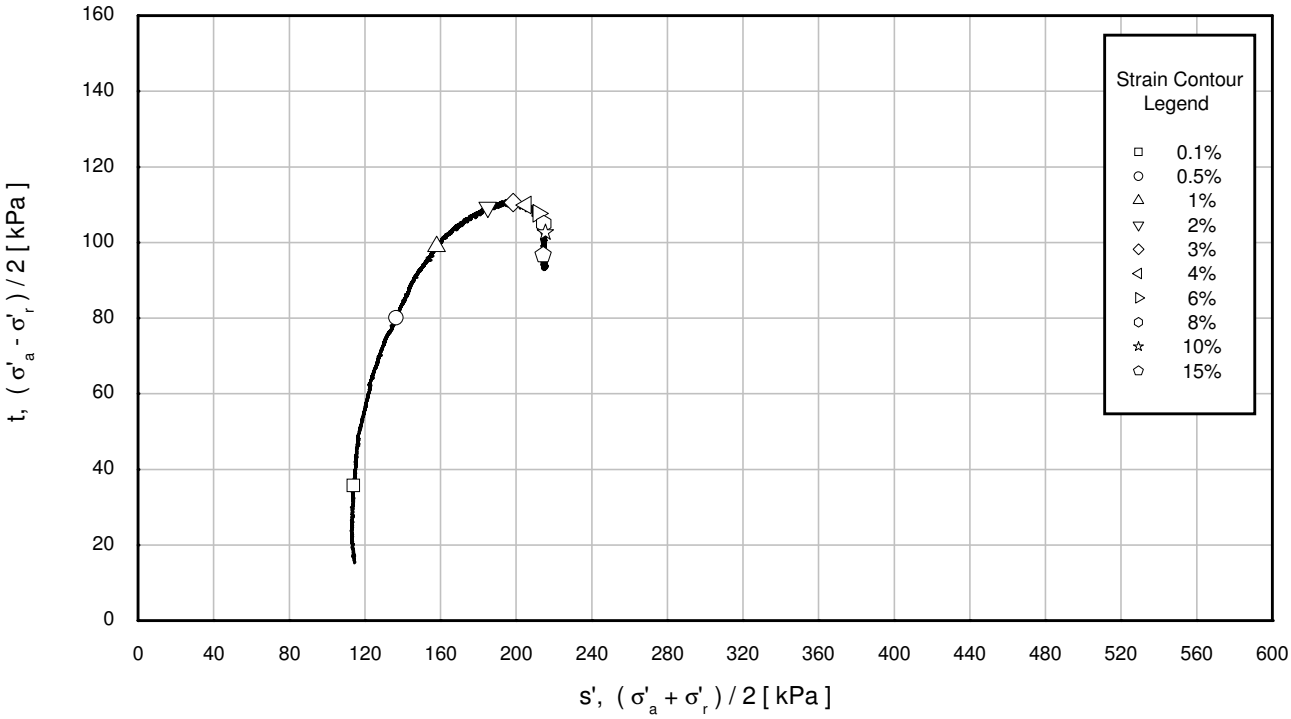
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

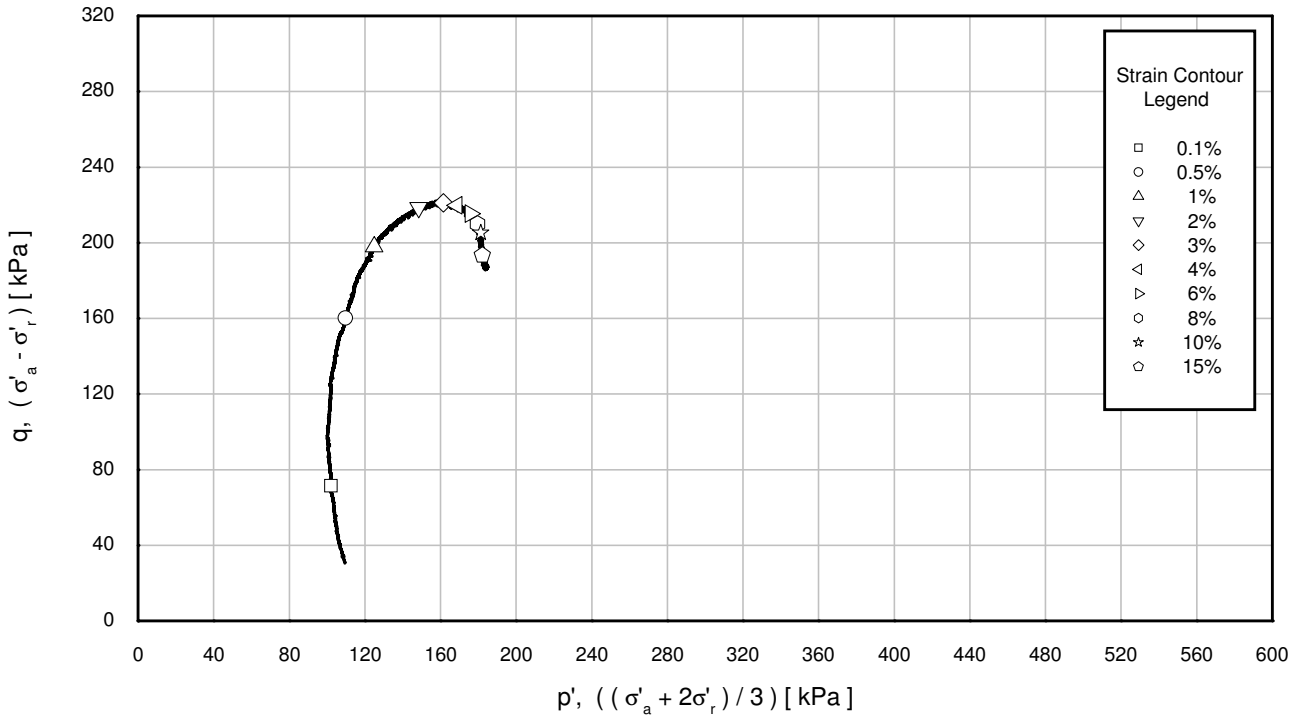




Initial σ'_r	:	99	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	130	kPa	Sample	: 21WAXC
q_{peak}	:	222	kPa	Depth [m]	: 18.92
Ext. ε at q_{peak}	:	2.71	%	Test No.	: CTX14
Rate of strain	:	0.50	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	99	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	130	kPa	Sample	: 21WAXC
q_{peak}	:	222	kPa	Depth [m]	: 18.92
Ext. ε at q_{peak}	:	2.71	%	Test No.	: CTX14
Rate of strain	:	0.50	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
High strength dark grey slightly sandy CLAY with extremely closely to very closely spaced partings to thin laminae of fine sand

GENERAL	
Date test started	16/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	72.1
Length	[mm]	139.4
Water content	[%]	31.1
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.44
Void ratio	[-]	0.878
Degree of saturation	[%]	96
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	50
Pocket penetrometer	[kPa]	50

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_21WaxD_CTX15
Processed by	JLS
Date	04/01/2016
Checked by	PH
Date	11/01/2017
Approved by	PH
Date	11/01/2017

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	653
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	818
Back pressure	[kPa]	653
Base PWP	[kPa]	653
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	165
Effective axial pressure	[kPa]	165
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.28
External axial strain	[%]	-0.17
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43
Void ratio	[-]	0.883
Degree of saturation	[%]	96

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 1		
Cell pressure	[kPa]	818
Back pressure	[kPa]	653
Base PWP	[kPa]	666
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	152
Effective axial pressure	[kPa]	173
Deviator stress	[kPa]	21
Volumetric strain	[%]	0.00
External axial strain	[%]	0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43
Void ratio	[-]	0.883
Degree of saturation	[%]	96

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	208
Mean q_{av}	[kPa]	21
Mean q_{cy}	[kPa]	21
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.02
External ε_{cy} at N_f	[%]	0.02
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	17
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43
Void ratio	[-]	0.883
Degree of saturation	[%]	96

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.02	0.02	105.14	-	6.21	-
2	0.02	0.02	104.89	-	7.02	-
5	0.02	0.02	104.09	-	7.06	-
10	0.02	0.02	103.85	-	7.11	-
20	0.02	0.02	103.00	-	7.06	-
30	0.02	0.02	103.18	-	6.99	-
40	0.03	0.02	102.40	-	7.01	-
50	0.03	0.02	103.18	-	7.02	-
100	0.03	0.02	101.82	-	7.20	-
500	0.03	0.02	97.94	-	8.17	-
1000	0.02	0.02	95.36	-	8.58	-
1500	0.02	0.02	93.65	-	9.19	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 2		
Cell pressure	[kPa]	819
Back pressure	[kPa]	653
Base PWP	[kPa]	675
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	144
Effective axial pressure	[kPa]	186
Deviator stress	[kPa]	42
Volumetric strain	[%]	0.00
External axial strain	[%]	0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43
Void ratio	[-]	0.883
Degree of saturation	[%]	96

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	208
Mean q_{av}	[kPa]	42
Mean q_{cy}	[kPa]	83
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.33
External ε_{cy} at N_f	[%]	0.20
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	75
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43
Void ratio	[-]	0.883
Degree of saturation	[%]	96

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.08	0.11	78.10	-	11.29	-
2	0.09	0.11	75.64	-	9.14	-
5	0.10	0.11	72.35	-	8.76	-
10	0.11	0.12	69.58	-	8.73	-
20	0.13	0.13	65.92	-	8.80	-
30	0.14	0.13	63.55	-	8.90	-
40	0.15	0.13	61.67	-	8.99	-
50	0.16	0.14	60.11	-	9.08	-
100	0.20	0.15	54.89	-	9.38	-
200	0.25	0.17	49.07	-	9.73	-
300	0.29	0.18	45.40	-	9.99	-
400	0.33	0.20	42.46	-	10.24	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	83
Initial effective axial pressure	[kPa]	125
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	230
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.63
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	88
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	79
Effective axial pressure	[kPa]	309
Principal effective stress ratio	[-]	3.92
ε_{50}	[%]	0.60
Secant modulus (E_{50}) at ε_{50}	[kPa]	31385
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	207
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.44
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	106
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	60
Effective axial pressure	[kPa]	267
Principal effective stress ratio	[-]	4.46
At 15% external axial strain		
Corrected deviator stress	[kPa]	189
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	72
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	95
Effective axial pressure	[kPa]	284
Principal effective stress ratio	[-]	2.99

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

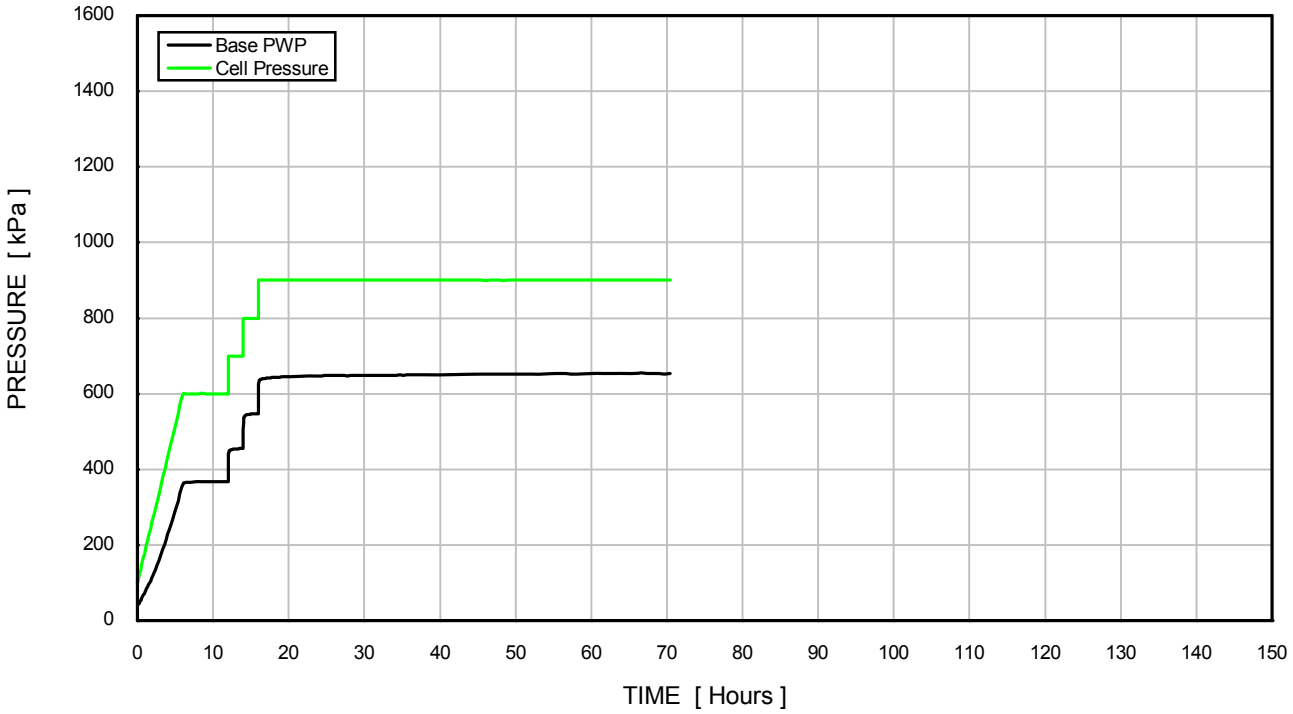


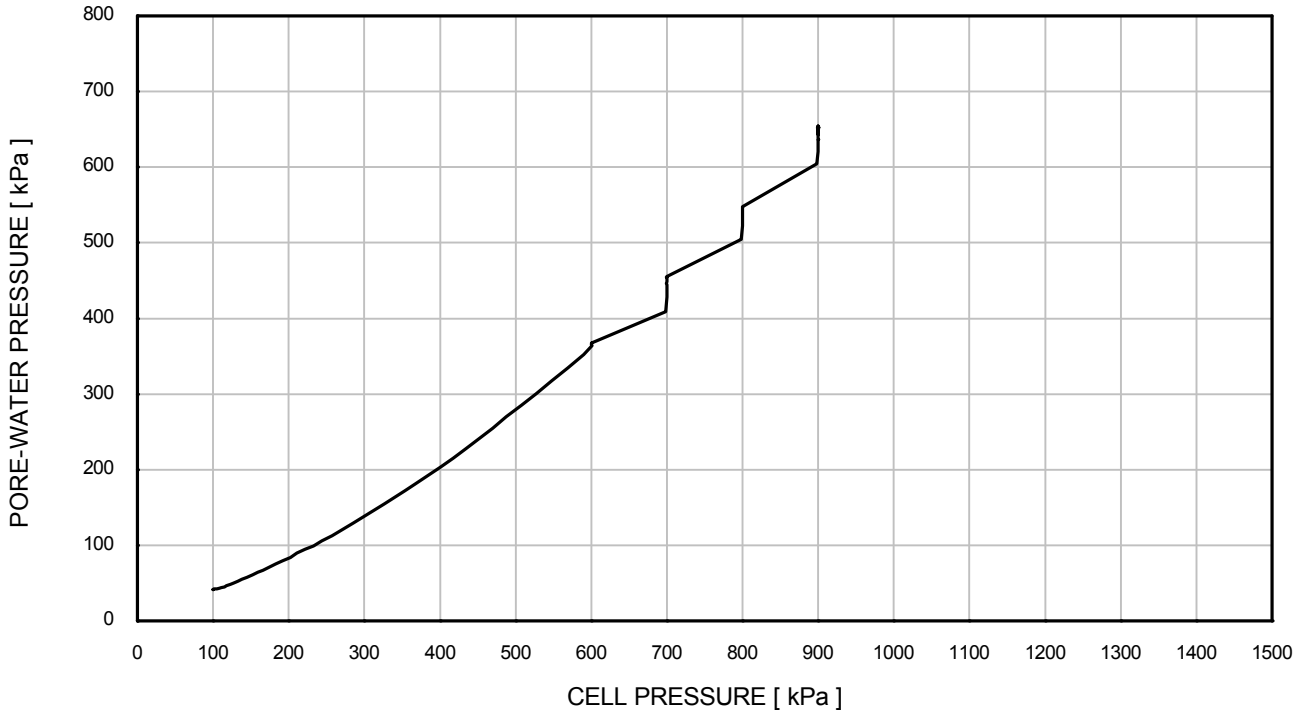


FINAL CONDITIONS		
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.88
Dry density	[Mg/m³]	1.43

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	21WaxD
Depth [m]	19.10
Test number	CTX15

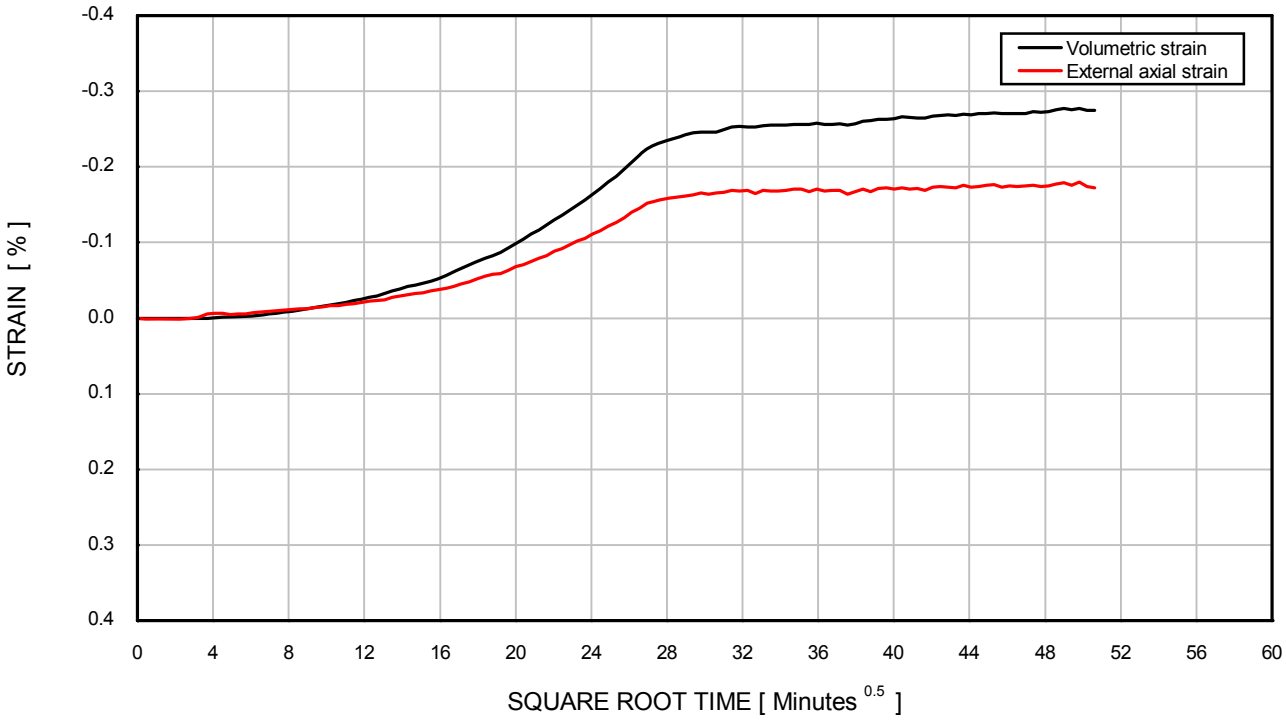
SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

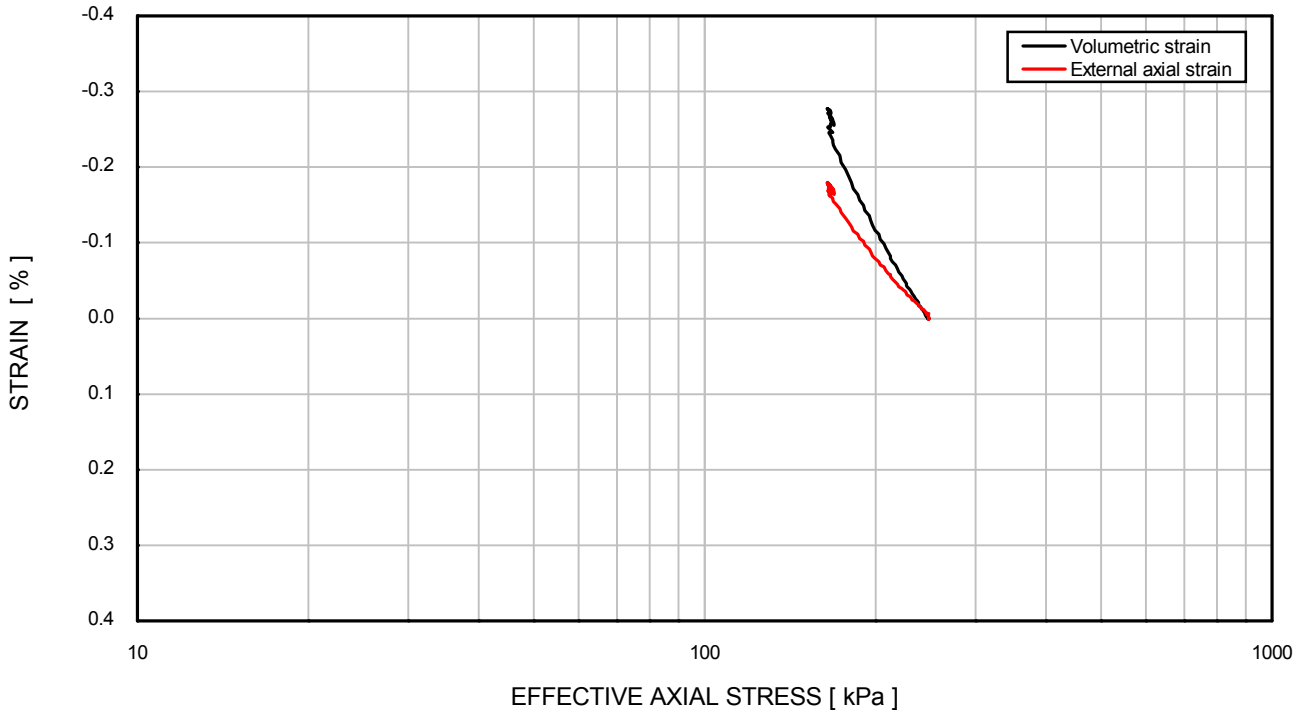




B value	: 1.00	Borehole	: HKZ1-BH01-SA
Initial σ'_r	: 58 kPa	Sample	: 21WaxD
Initial σ'_a	: 58 kPa	Depth [m]	: 19.10
Final σ'_r	: 247 kPa	Test No.	: CTX15
Final σ'_a	: 247 kPa		

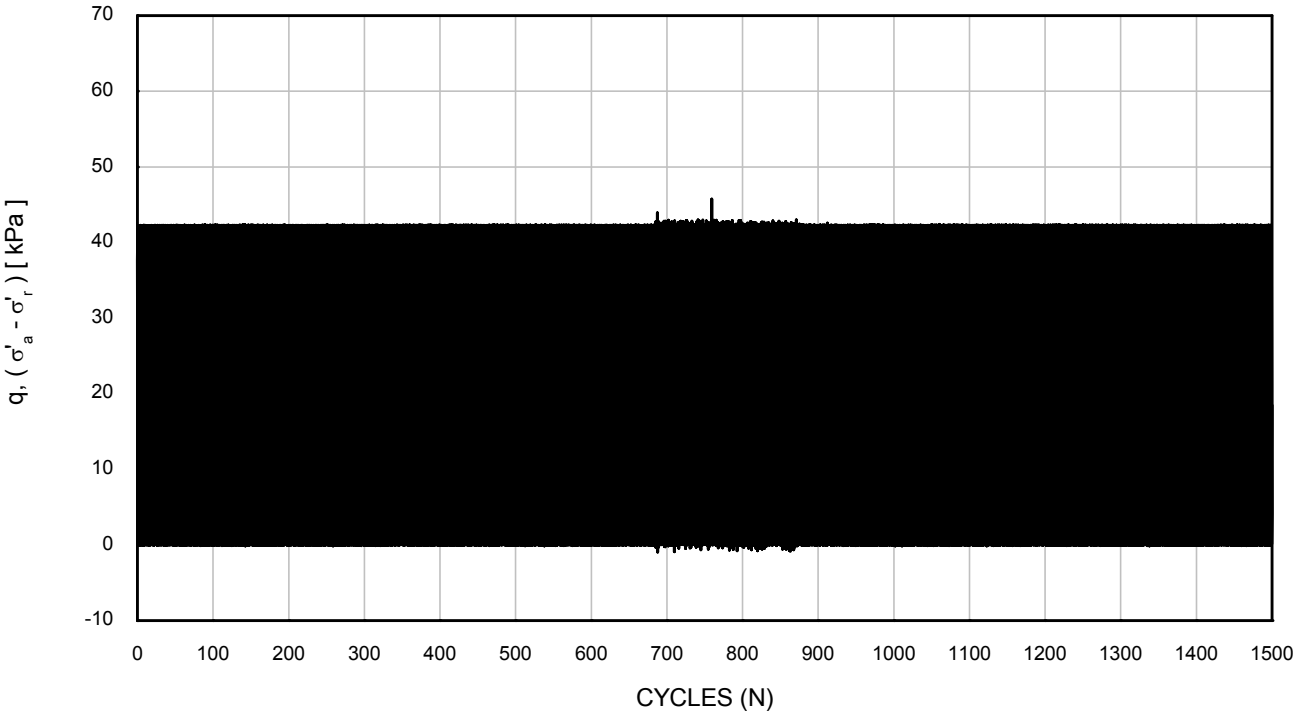
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

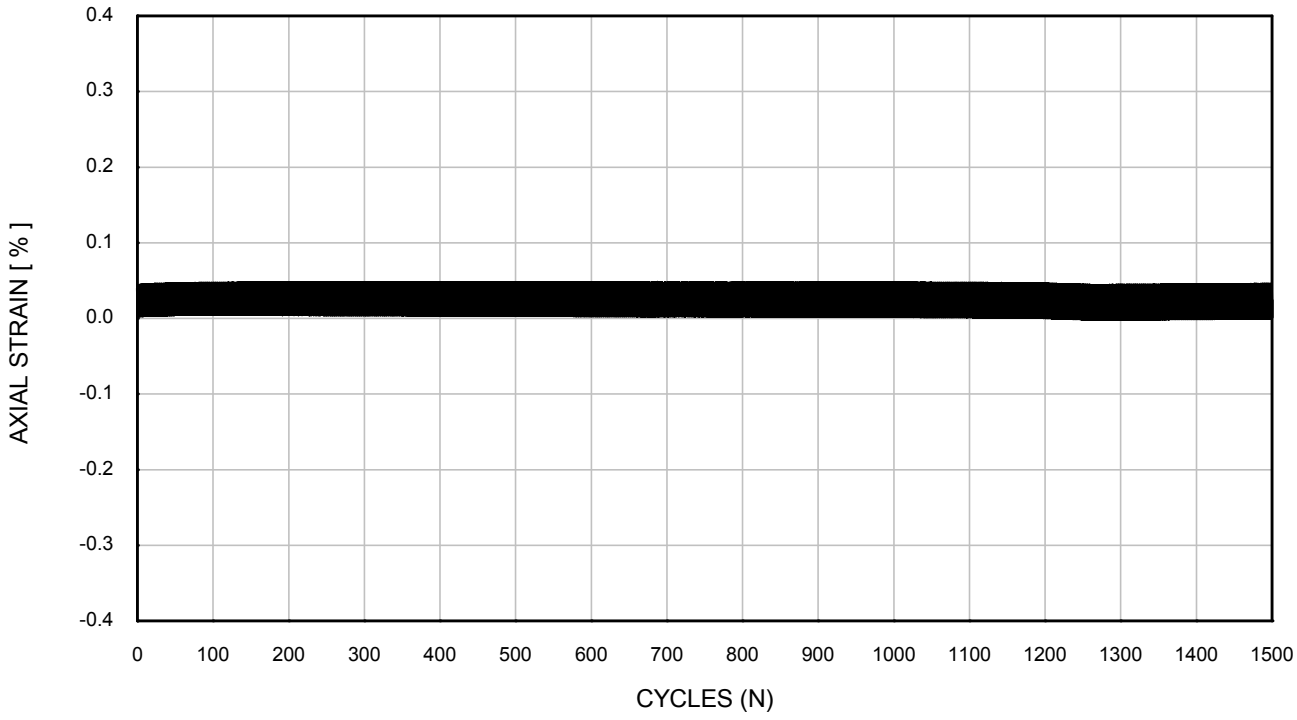




Stage 1 σ'_{rc}	: 165 kPa	Batch	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 165 kPa	Sample	: 21WaxD
		Unit	: 19.1
		Test No.	: CTX15

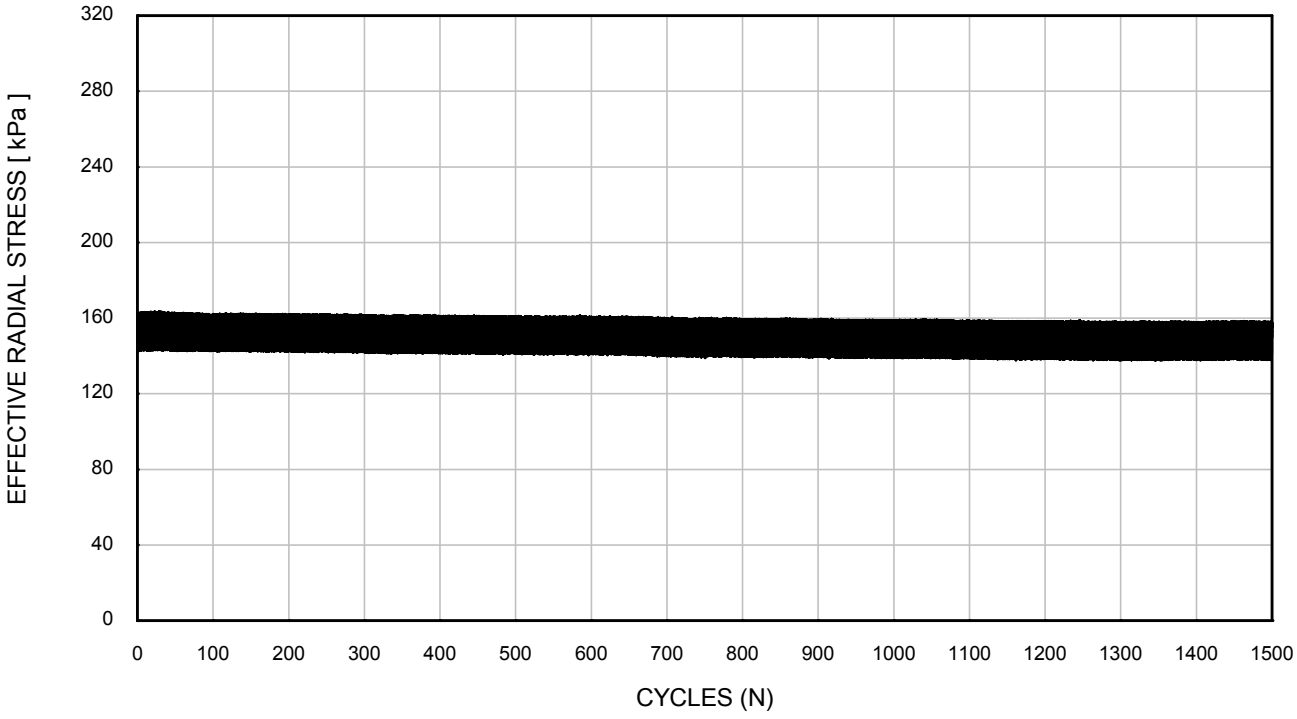
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

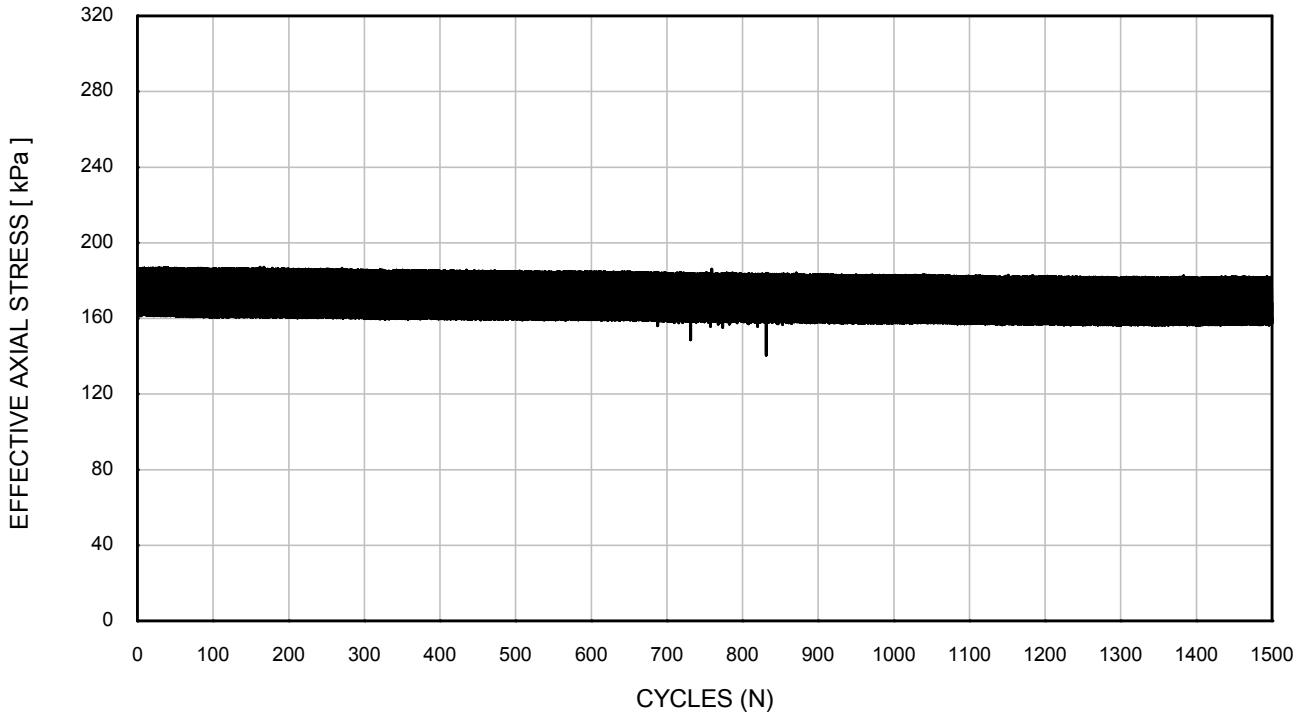




Initial σ'_r	: 152 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 173 kPa	Sample	: 21WaxD
q_{av}	: 21 kPa	Depth [m]	: 19.10
q_{cy}	: 21 kPa	Test No.	: CTX15
Frequency	: 0.10 Hz		

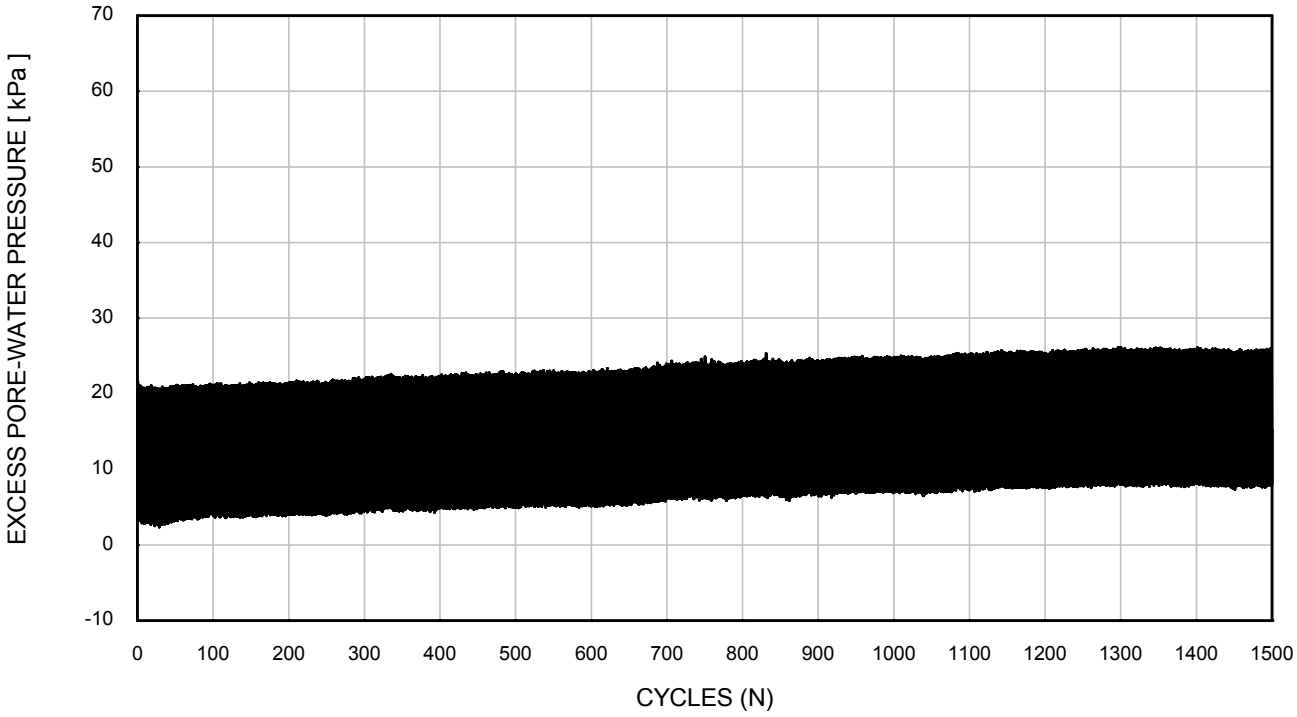
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

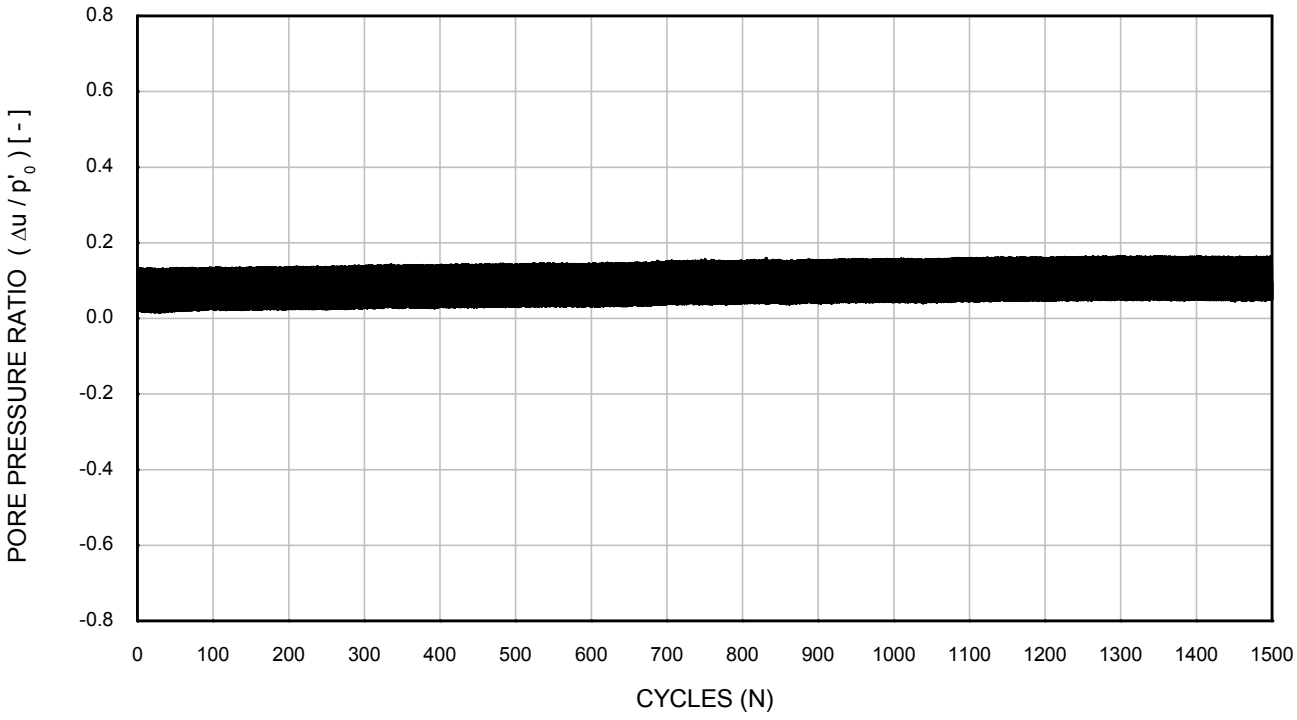




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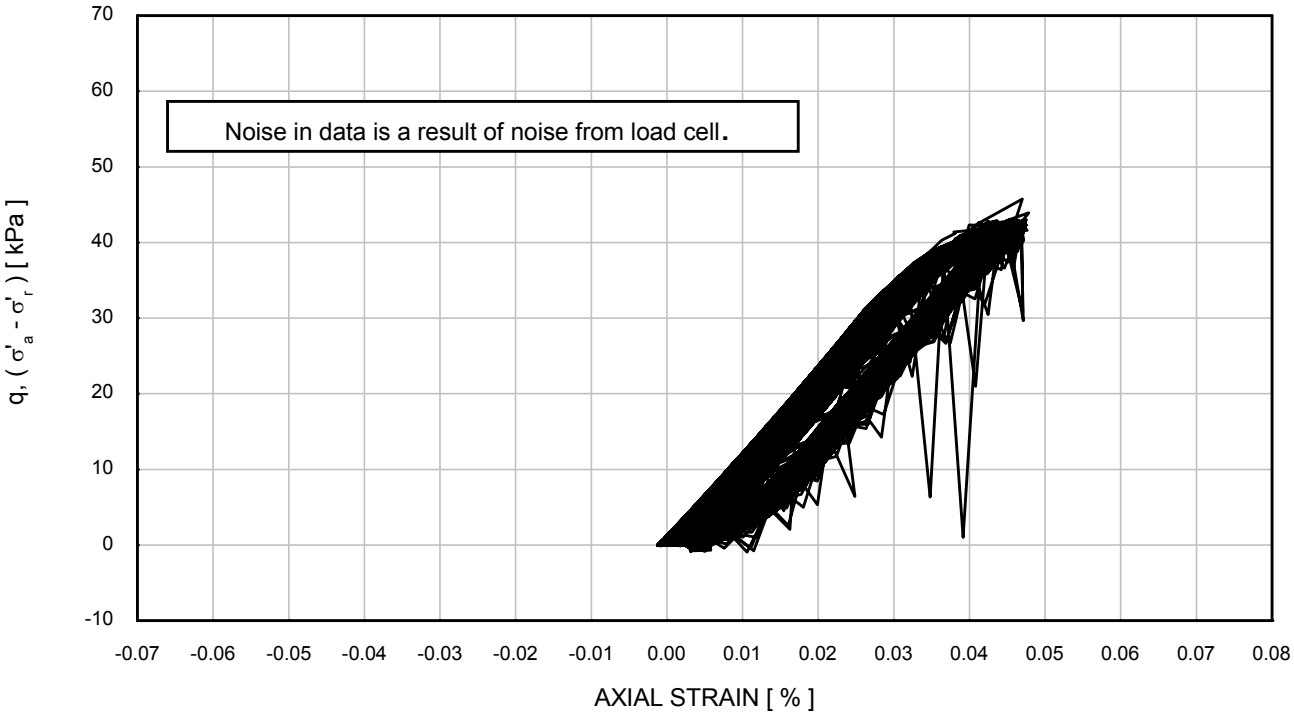
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

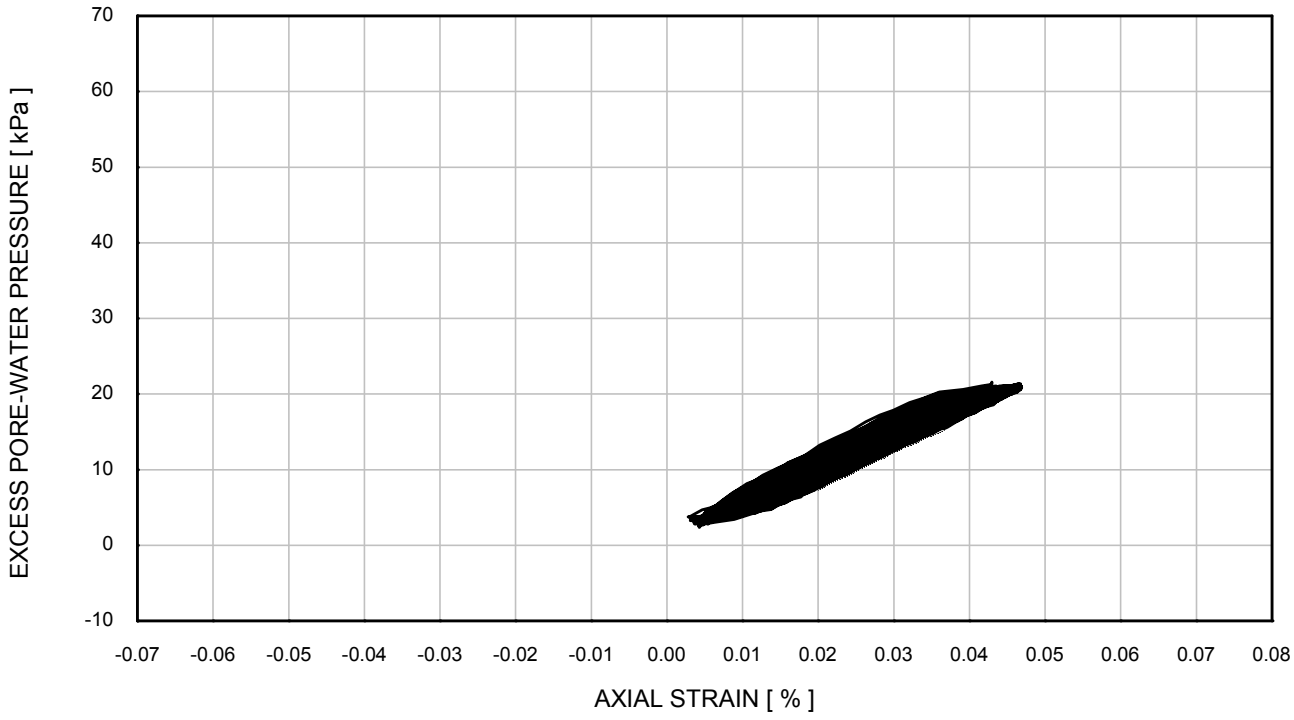




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q_{cy}	: 21 kPa	Test No.	: CTX15
Frequency	: 0.10 Hz		

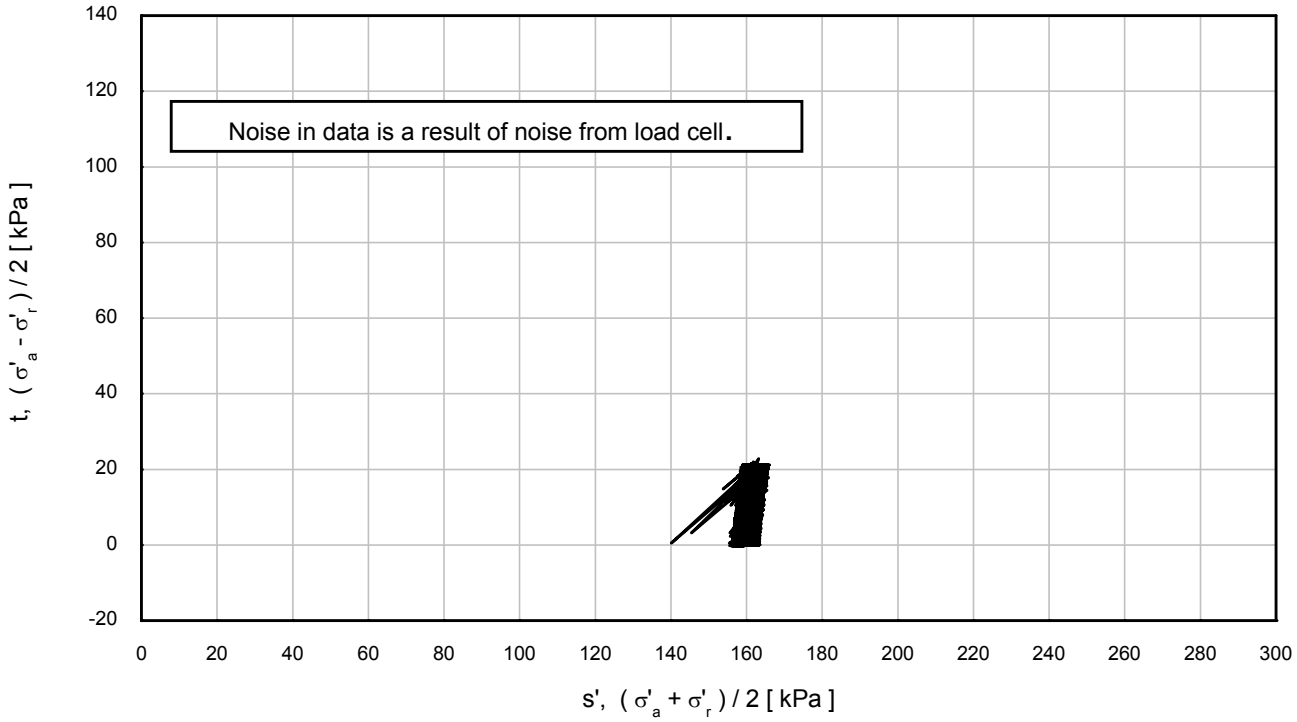
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

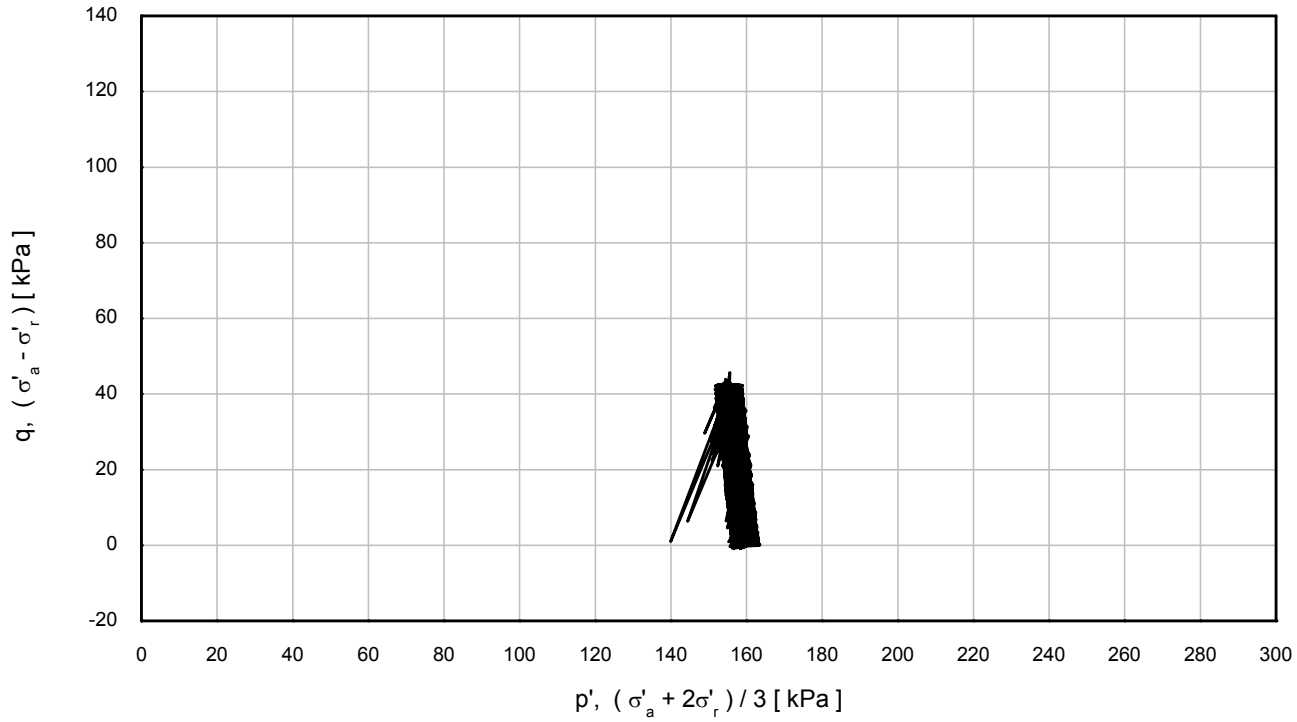




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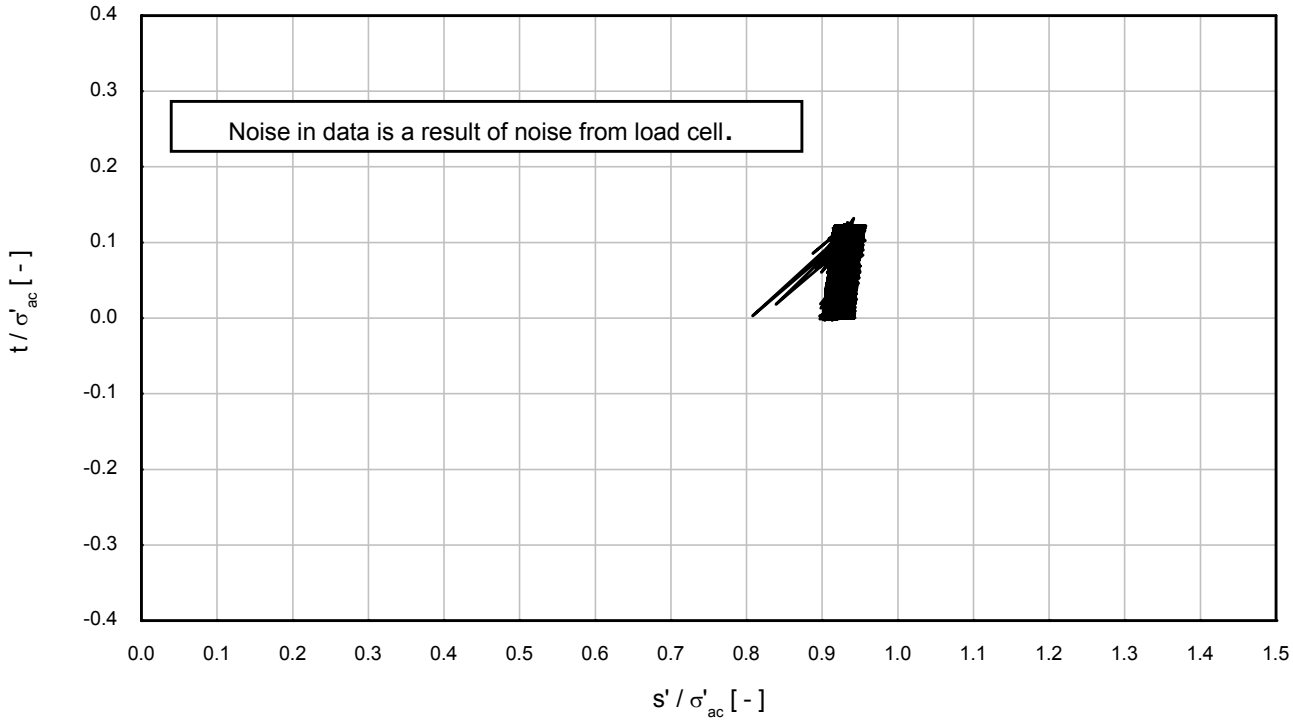
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

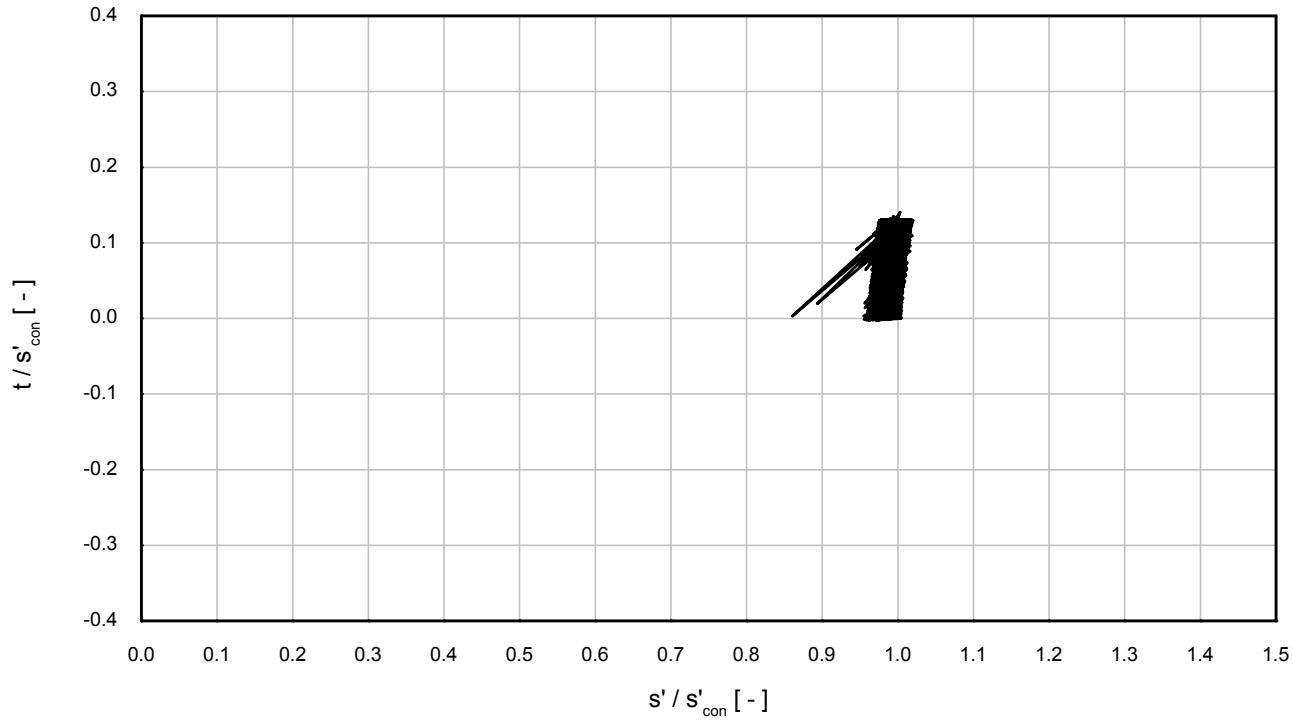




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Initial σ'_a	:	173 kPa	Sample	: 21WaxD
q_{av}	:	21 kPa	Depth [m]	: 19.10
q_{cy}	:	21 kPa	Test No.	: CTX15
Frequency	:	0.10 Hz		

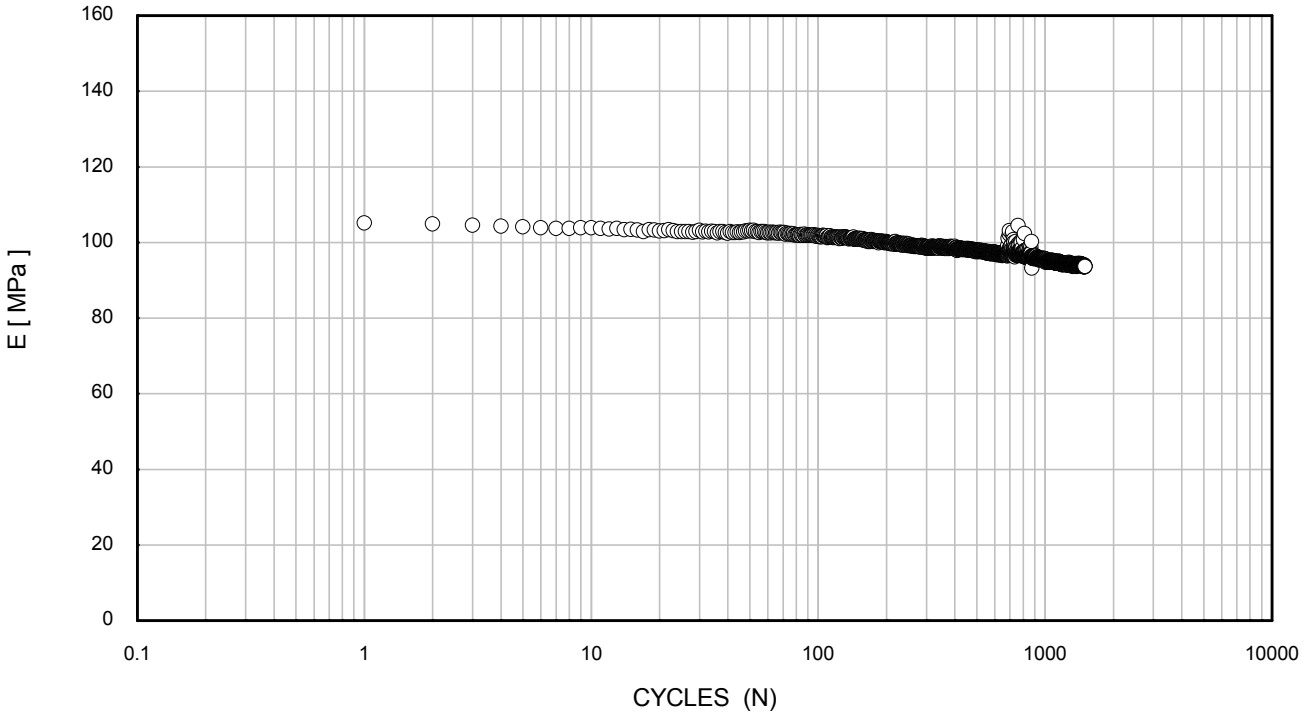
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

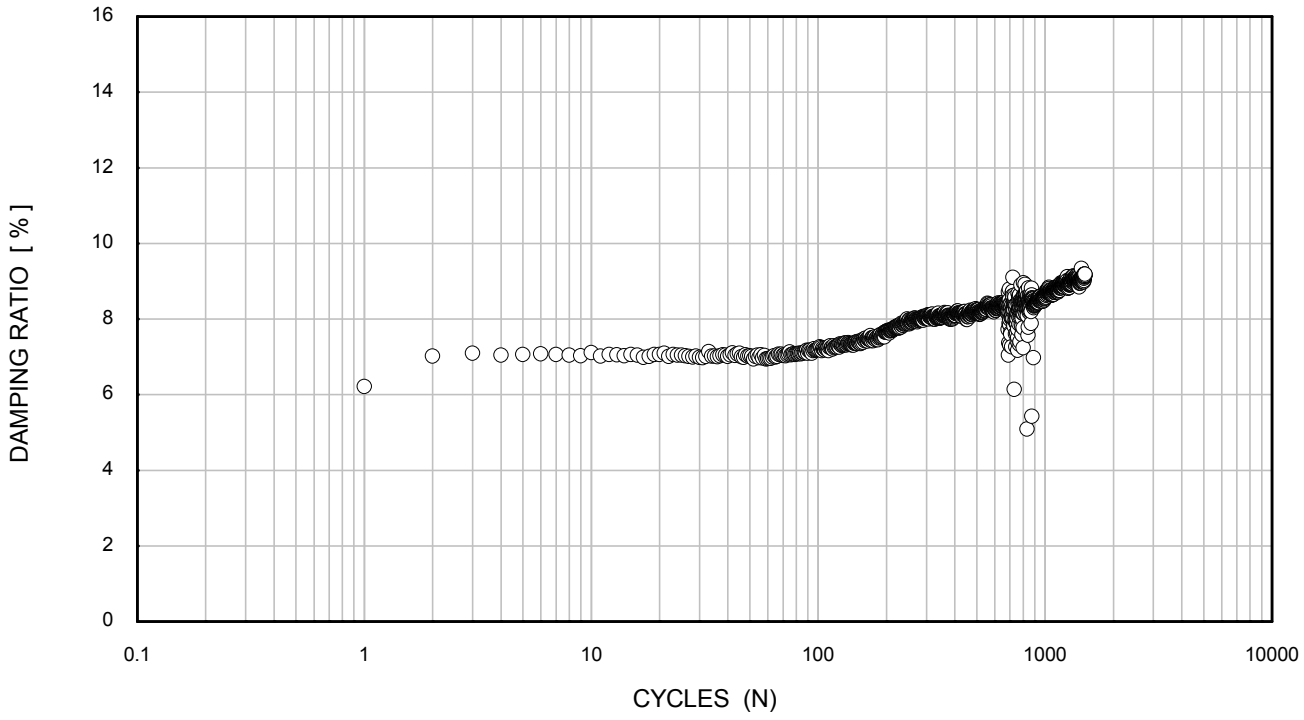




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Initial σ'_a	: 173 kPa	Sample	: 21WaxD
q_{av}	: 21 kPa	Depth [m]	: 19.10
q_{cy}	: 21 kPa	Test No.	: CTX15
Frequency	: 0.10 Hz		

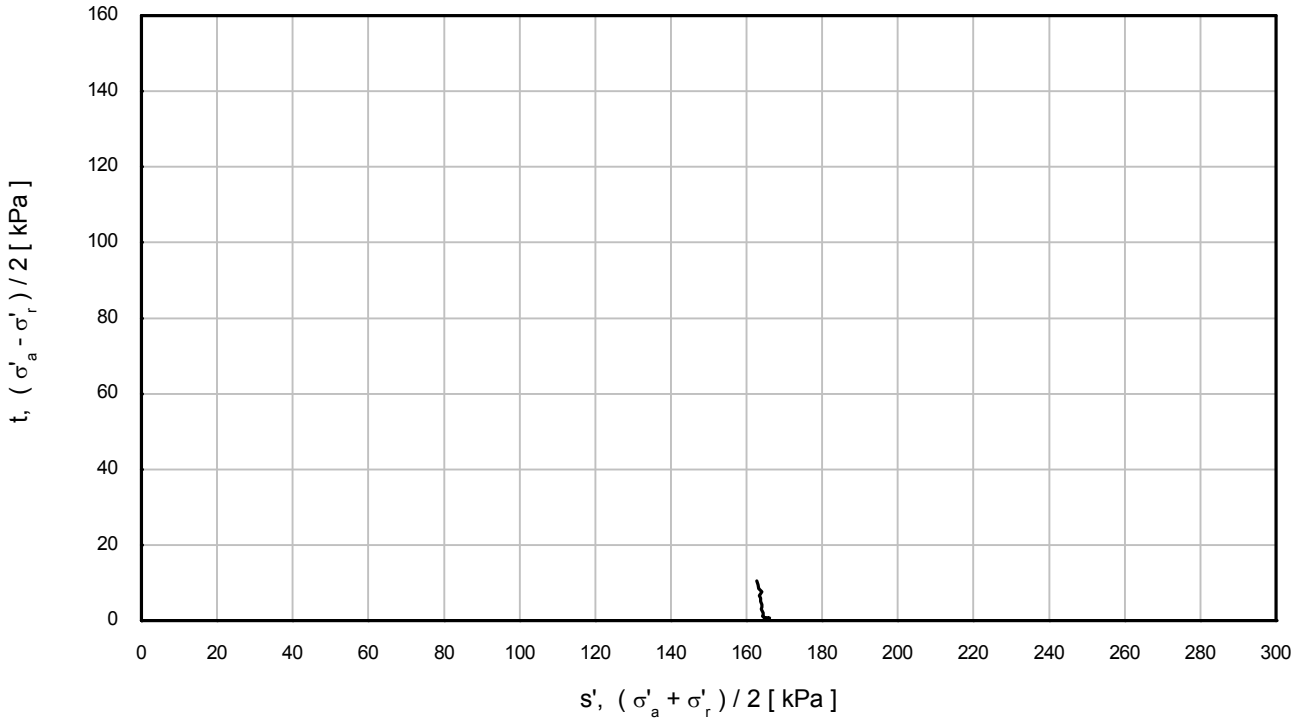
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

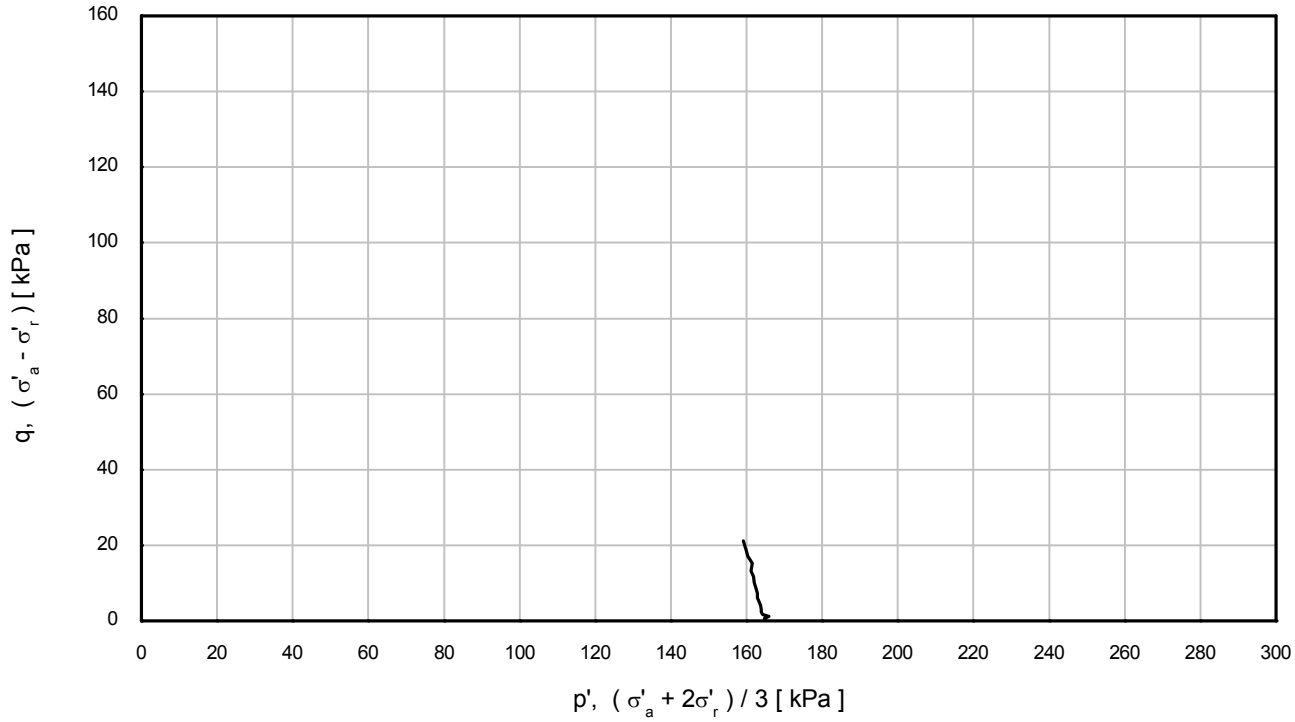




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Initial σ'_a	: 173 kPa	Sample	: 21WaxD
q_{av}	: 21 kPa	Depth [m]	: 19.10
q_{cy}	: 21 kPa	Test No.	: CTX15
Frequency	: 0.10 Hz		

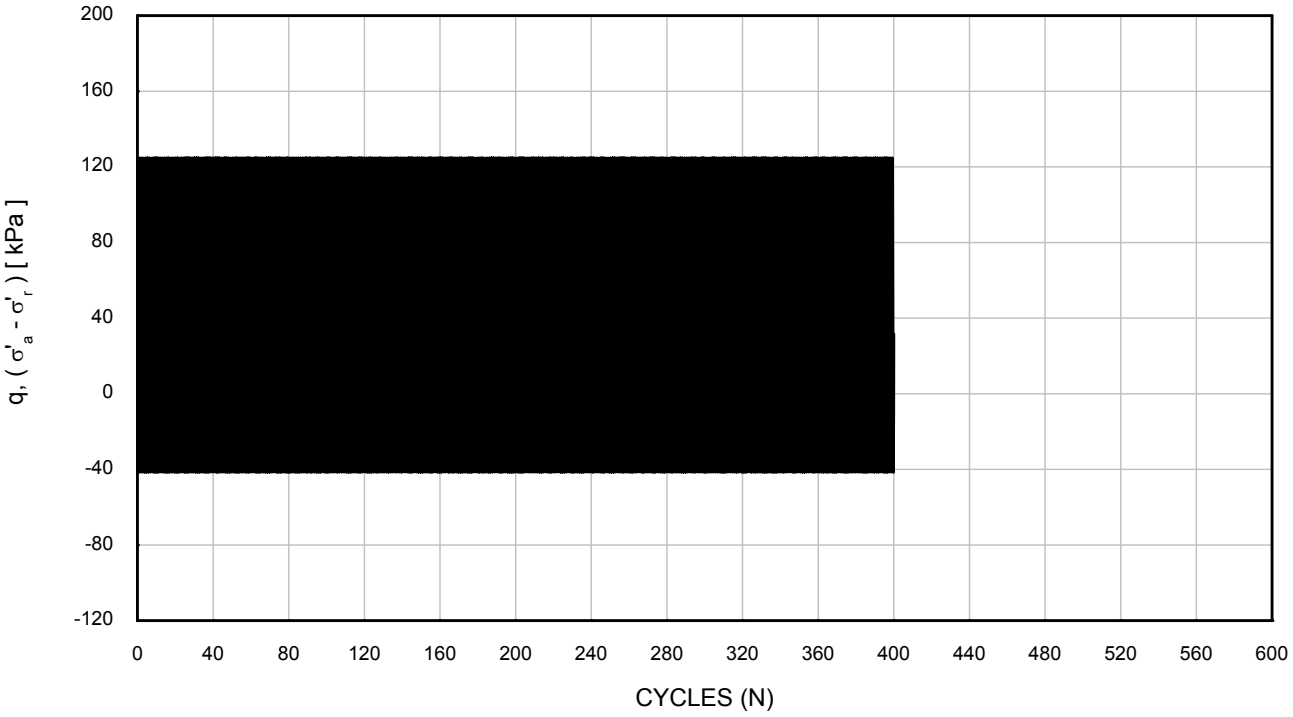
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

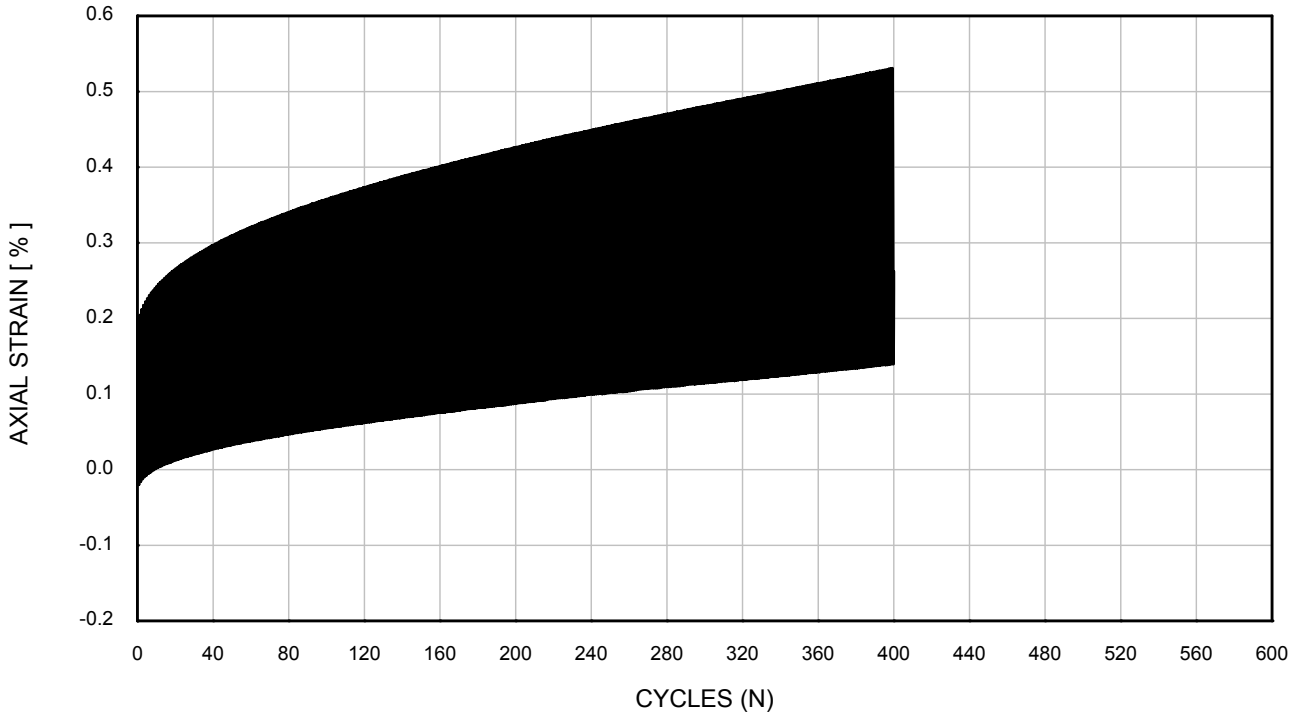




σ'_{rc}	: 152 kPa	Borehole	: HKZ1-BH01-SA
σ'_{ac}	: 173 kPa	Sample	: 21WaxD
		Depth [m]	: 19.10
		Test No.	: CTX15

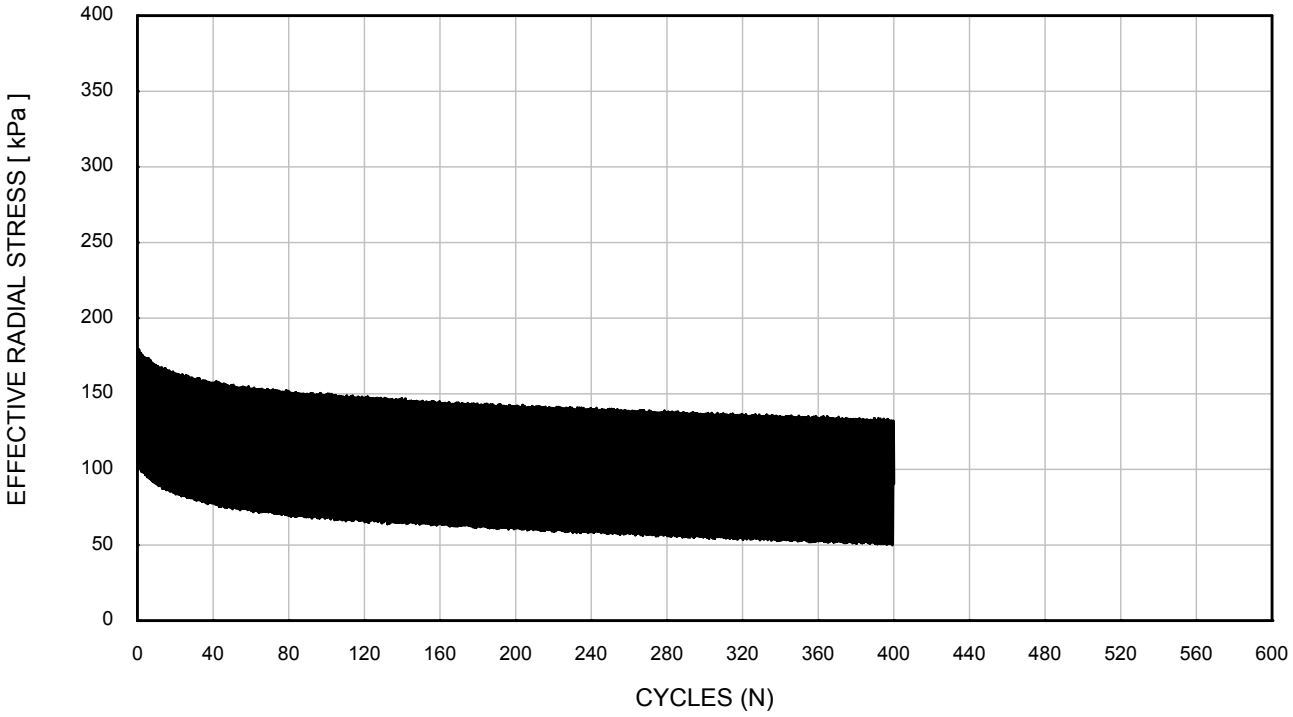
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

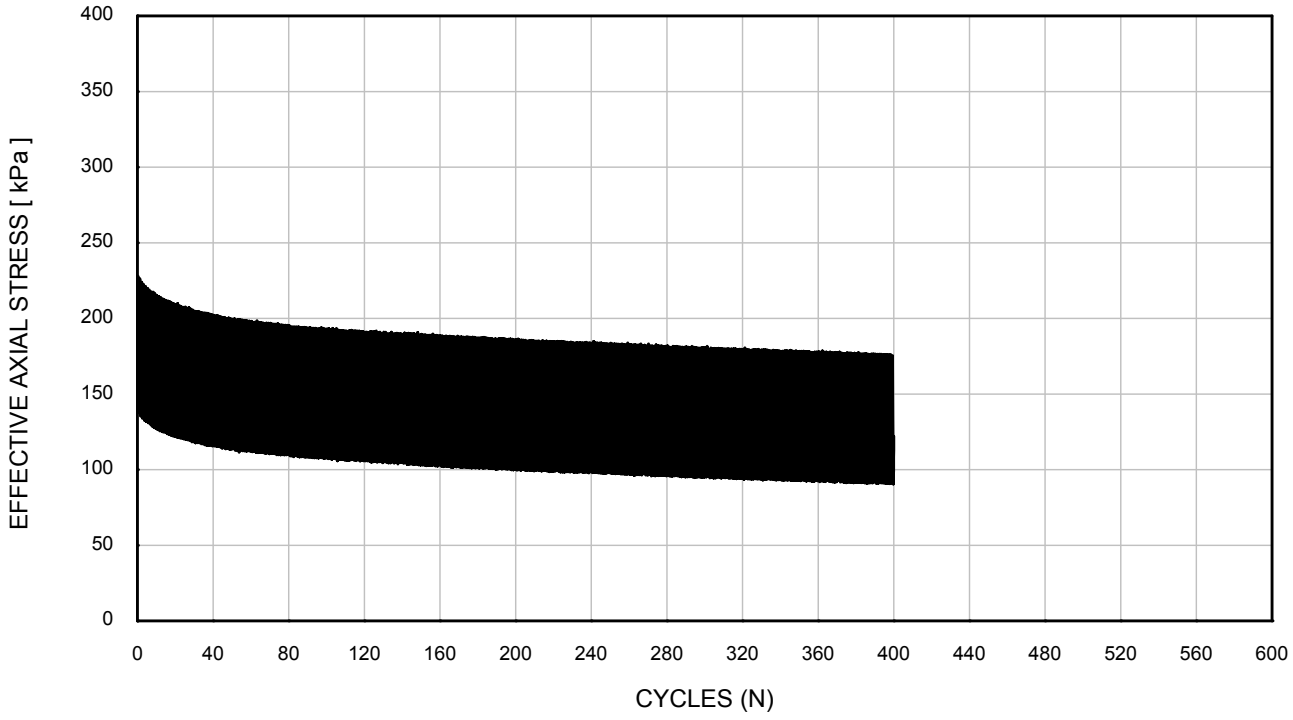




Initial σ'_r	:	144 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	186 kPa	Sample	: 21WAXD
q_{av}	:	42 kPa	Depth [m]	: 19.05
q_{cy}	:	83 kPa	Test No.	: CTX15
Frequency	:	0.10 Hz		

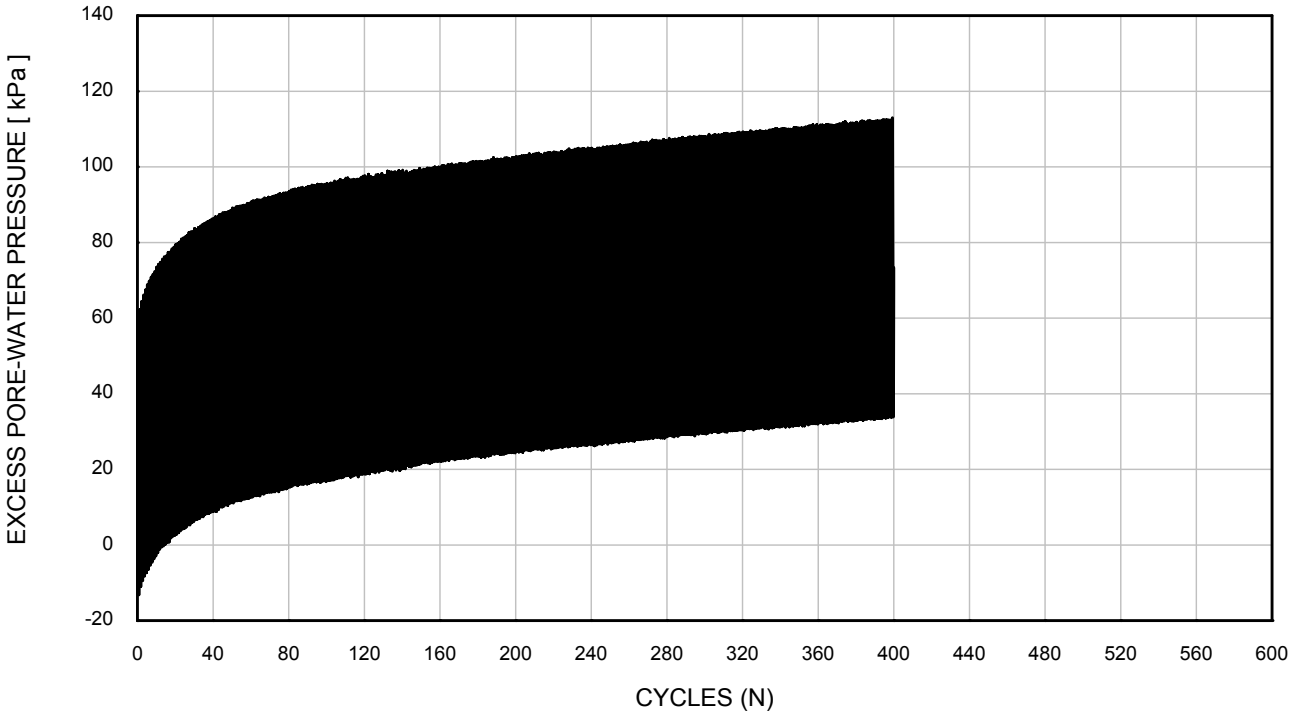
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

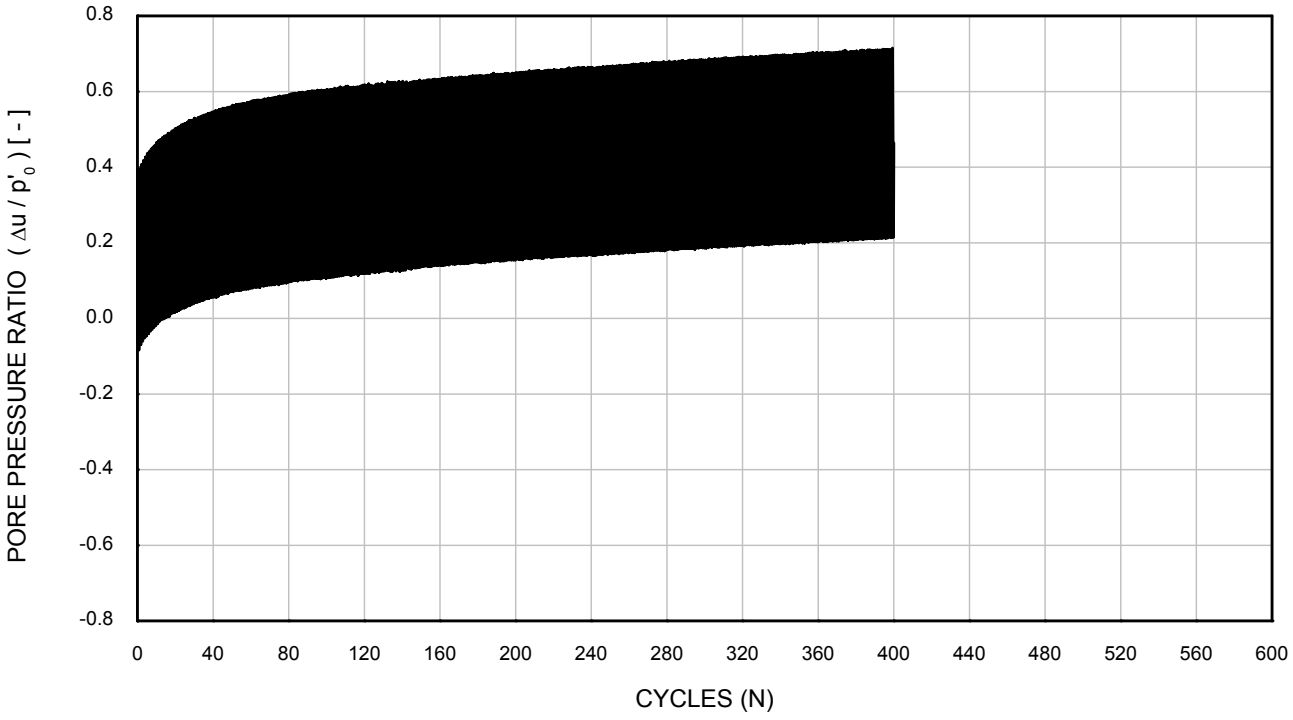




Initial σ'_r	:	144 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	186 kPa	Sample	:	21WAXD
q_{av}	:	42 kPa	Depth [m]	:	19.05
q_{cy}	:	83 kPa	Test No.	:	CTX15
Frequency	:	0.10 Hz			

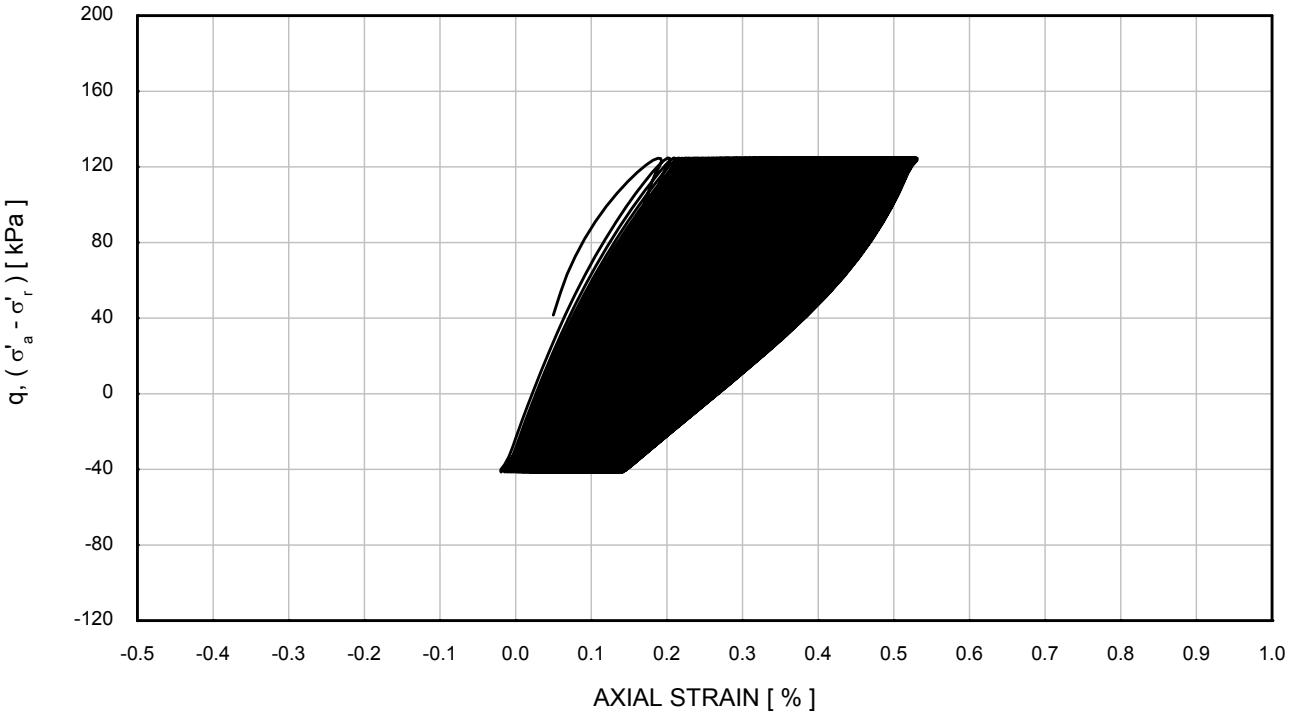
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

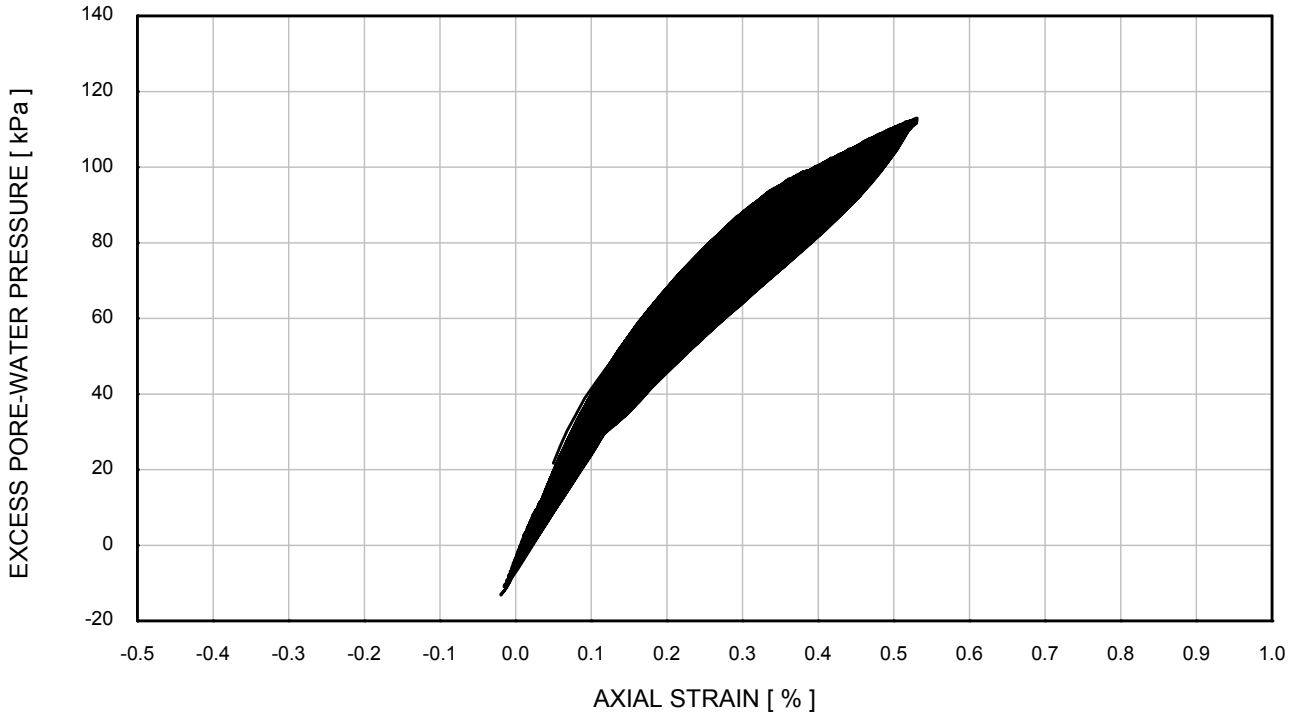




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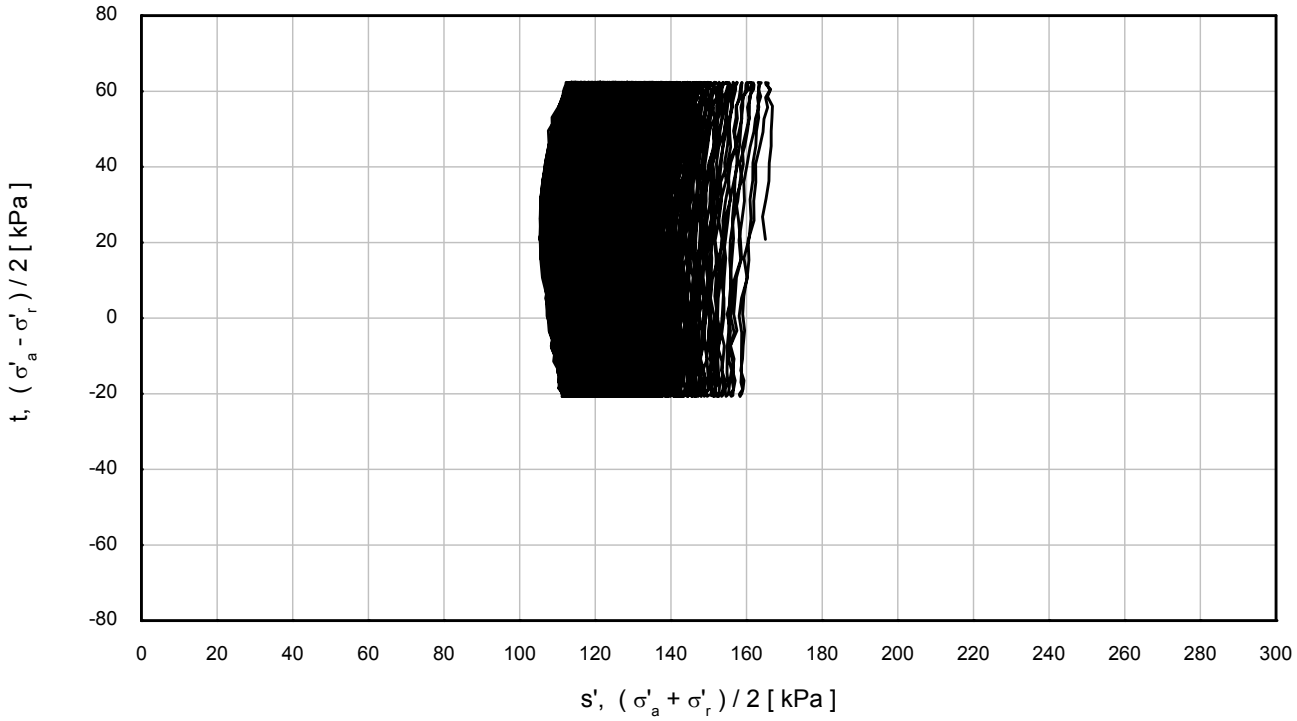
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SECOND CYCLIC LOADING STAGE - UNDRAINED

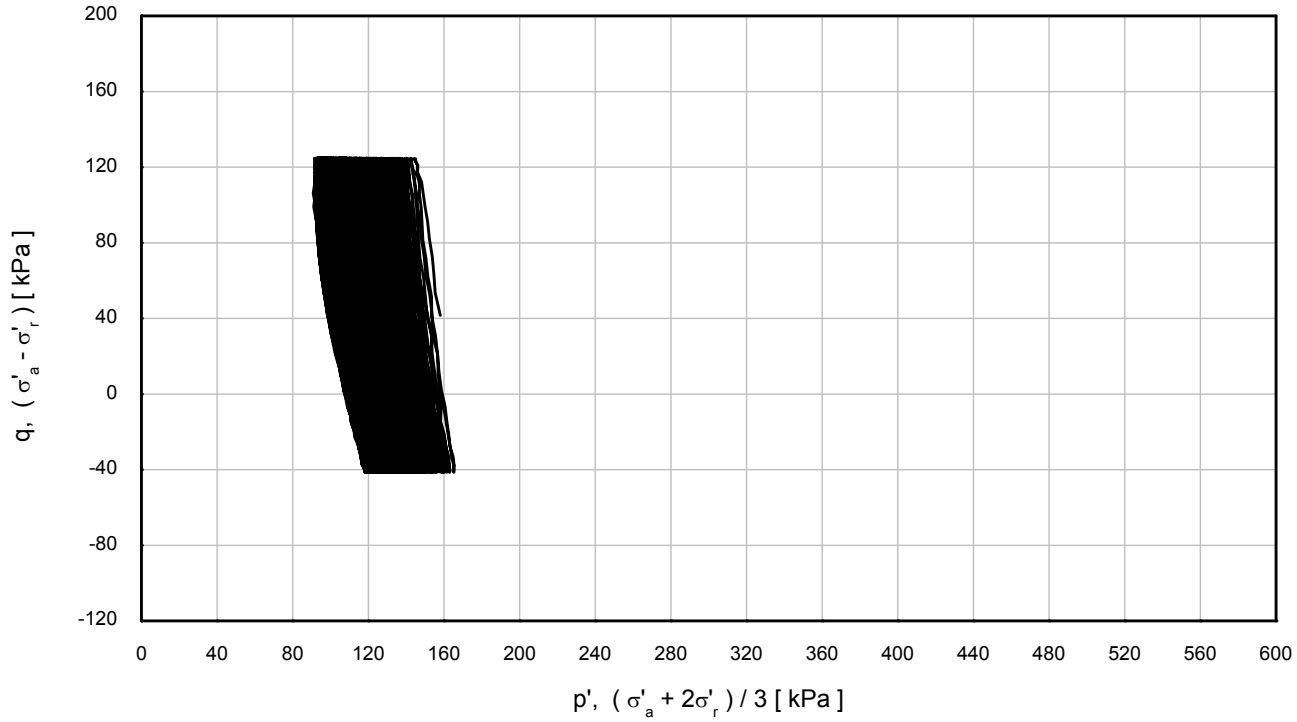




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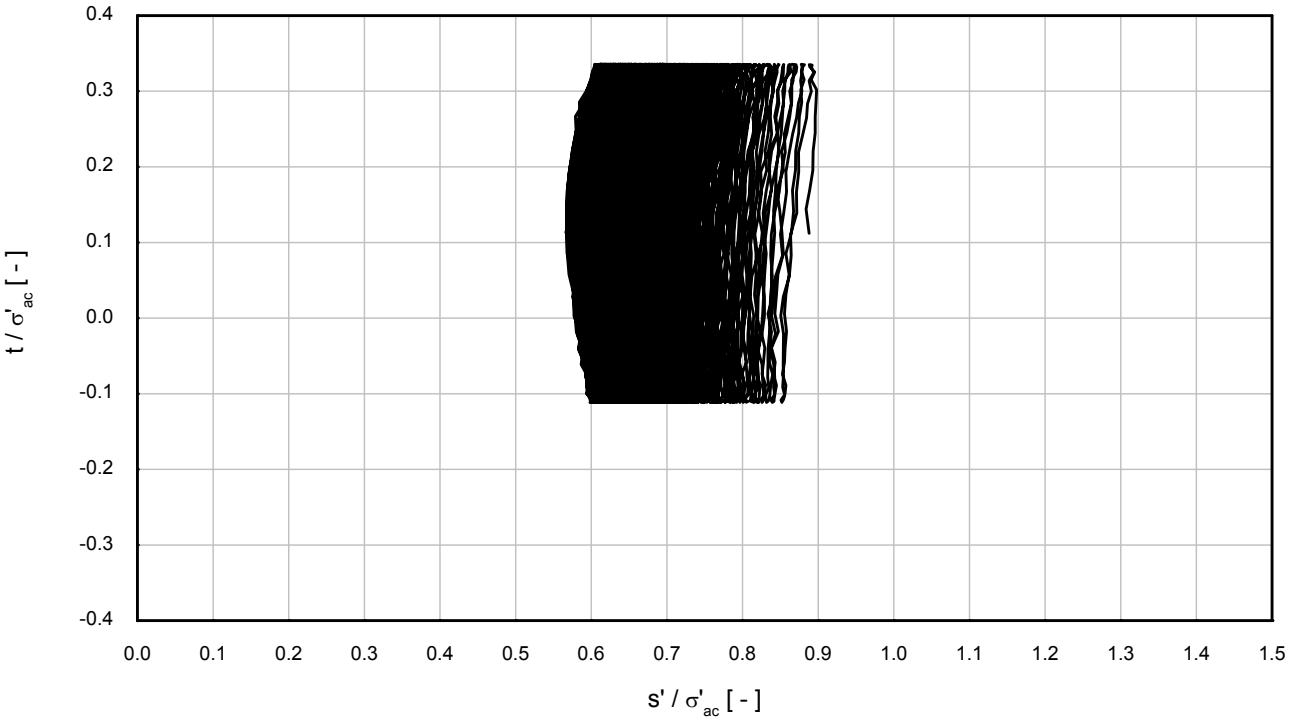
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

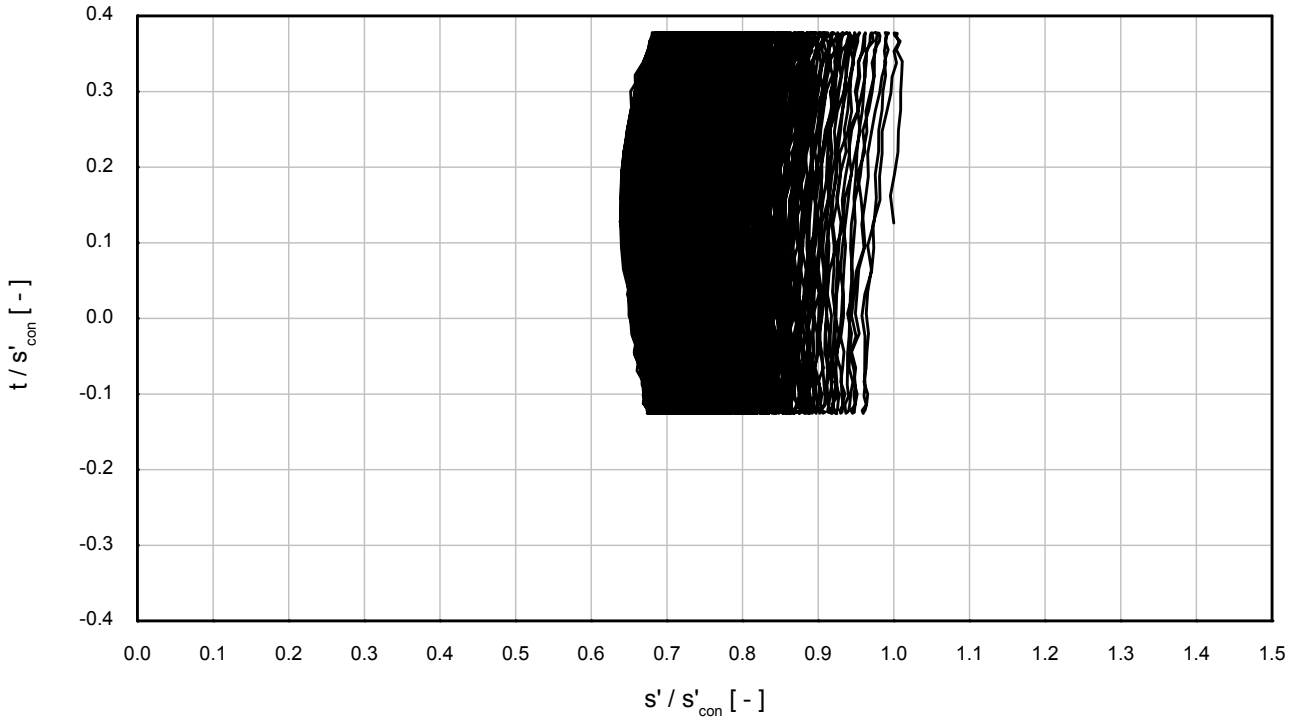




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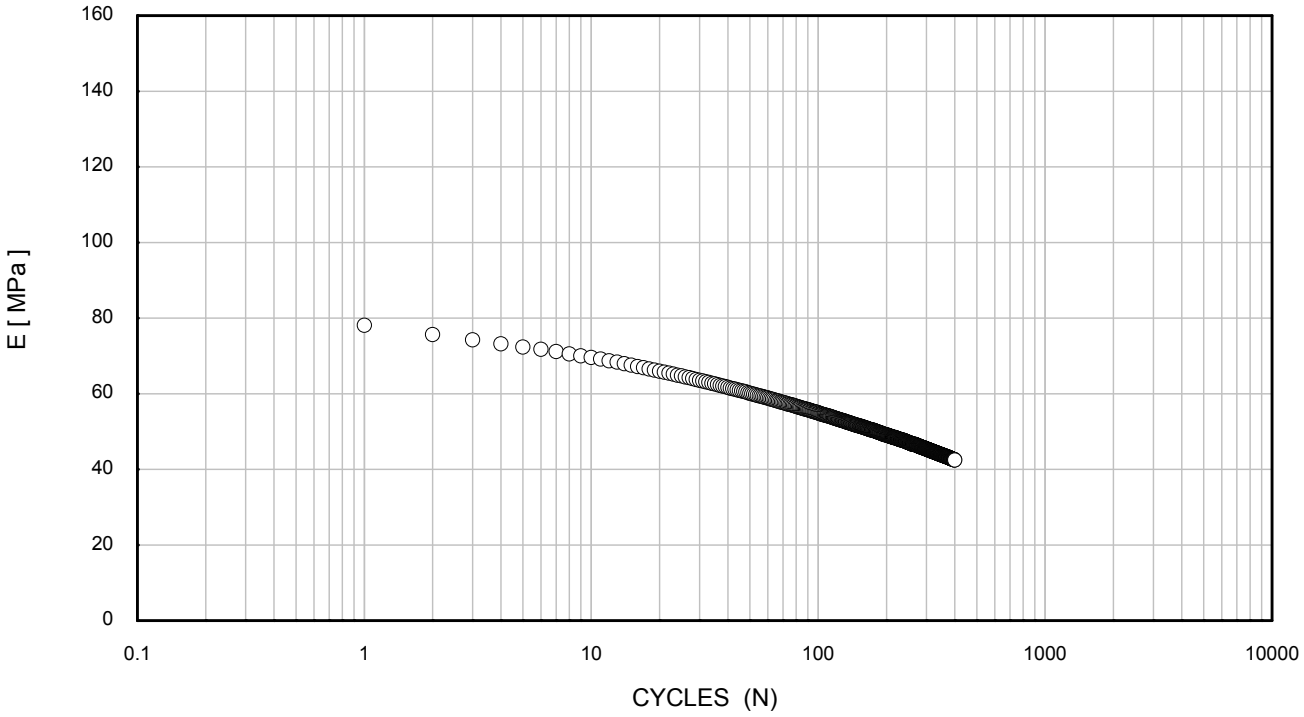
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

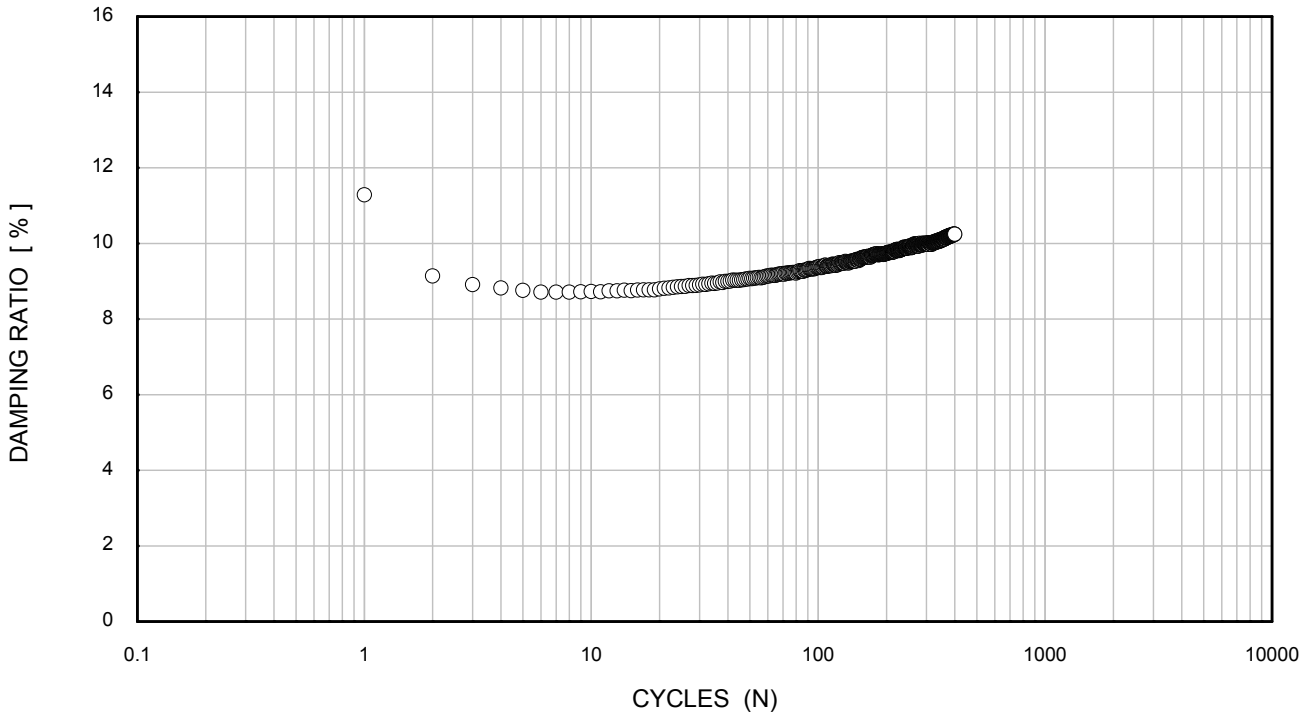




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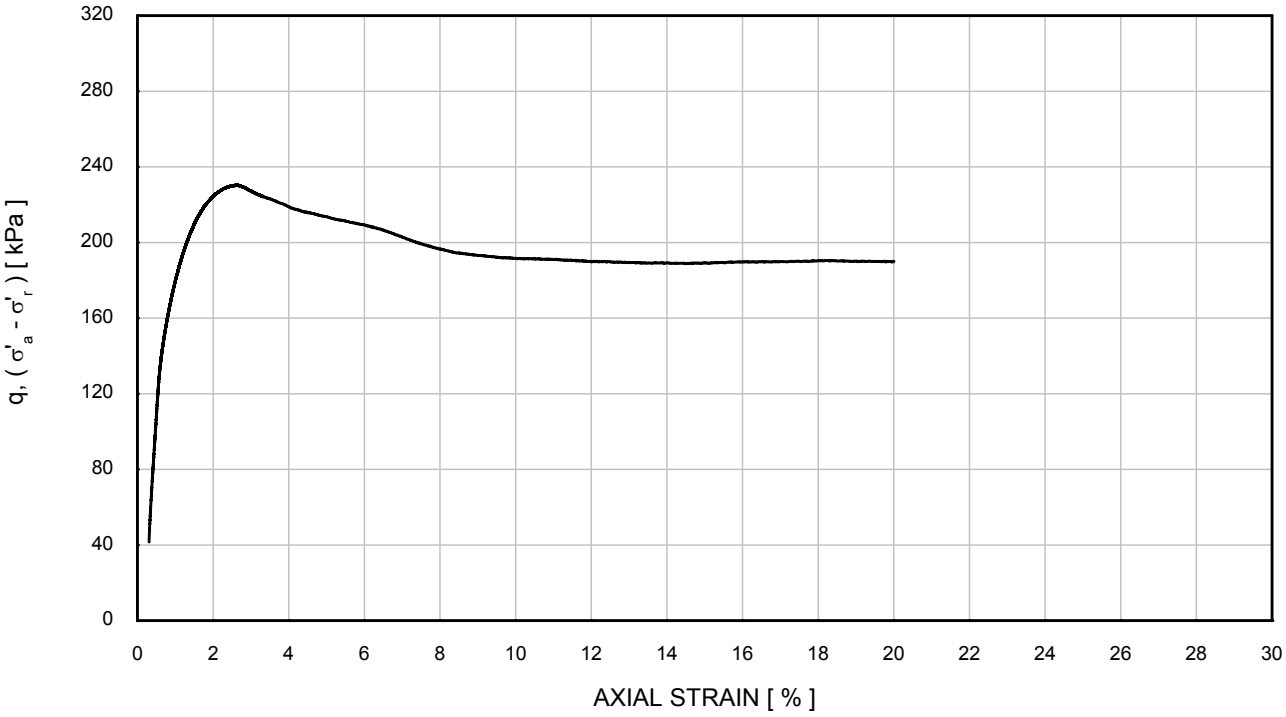
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

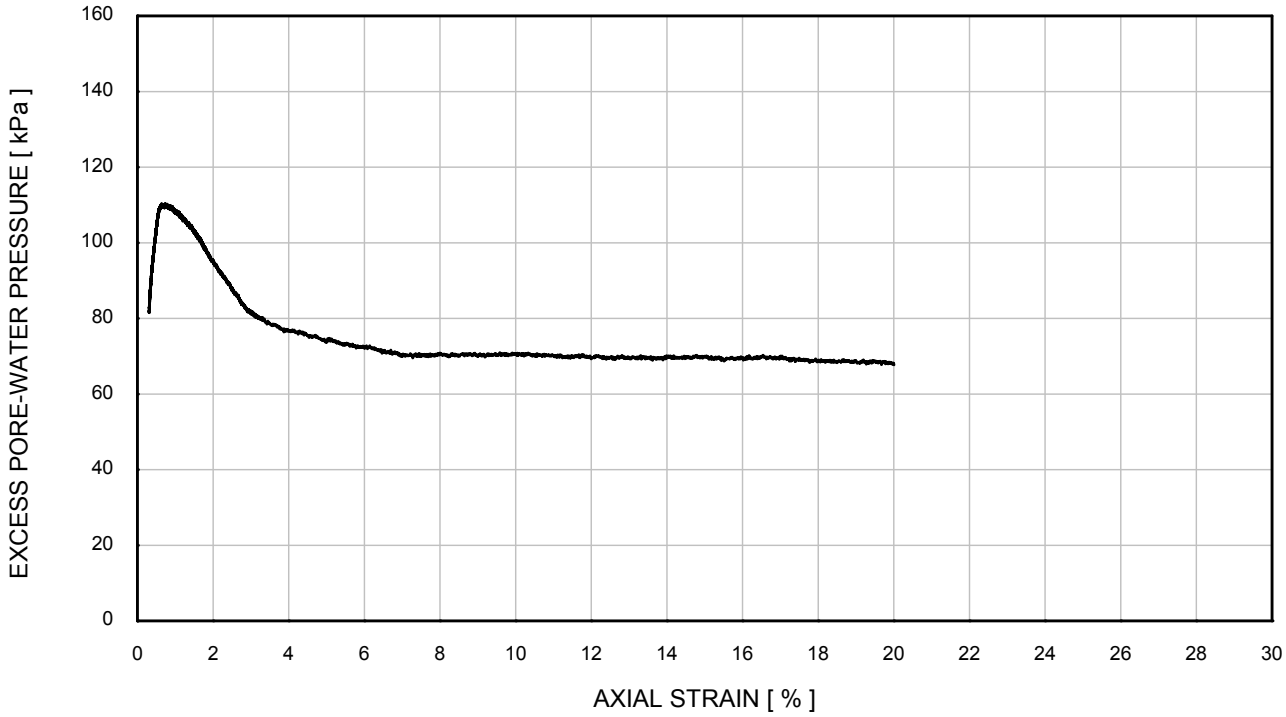




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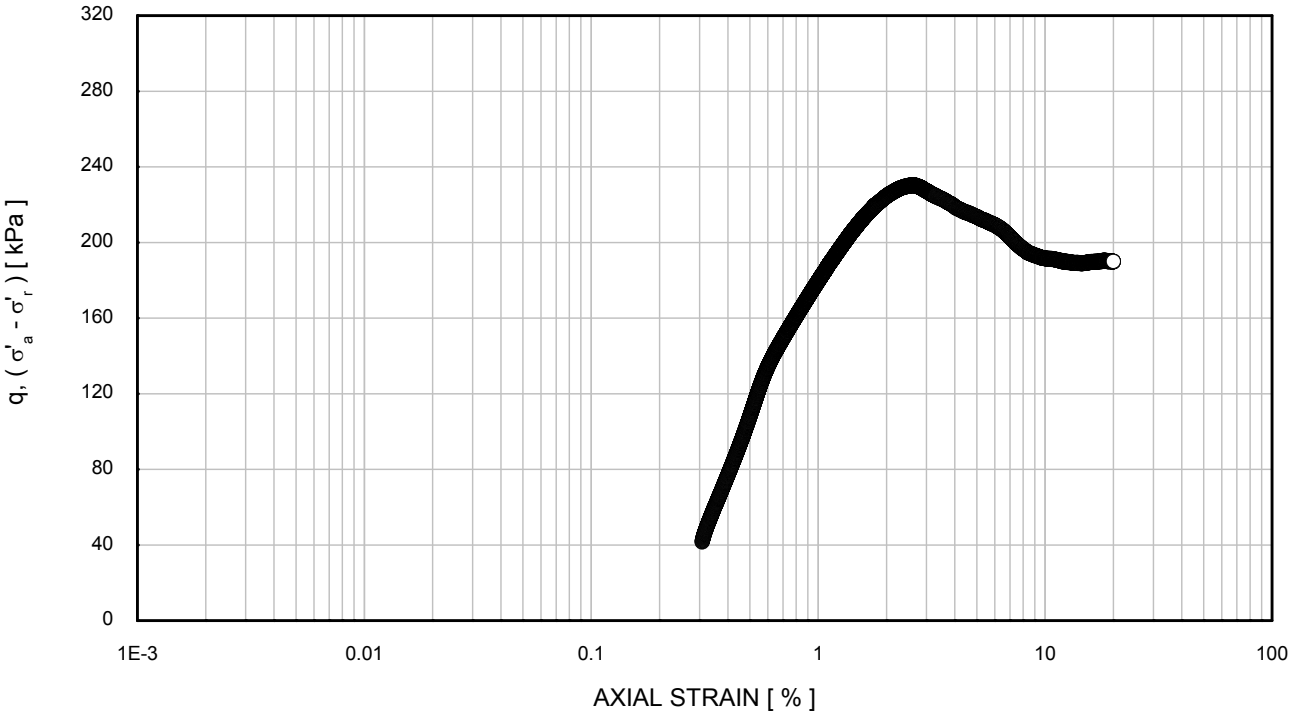
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

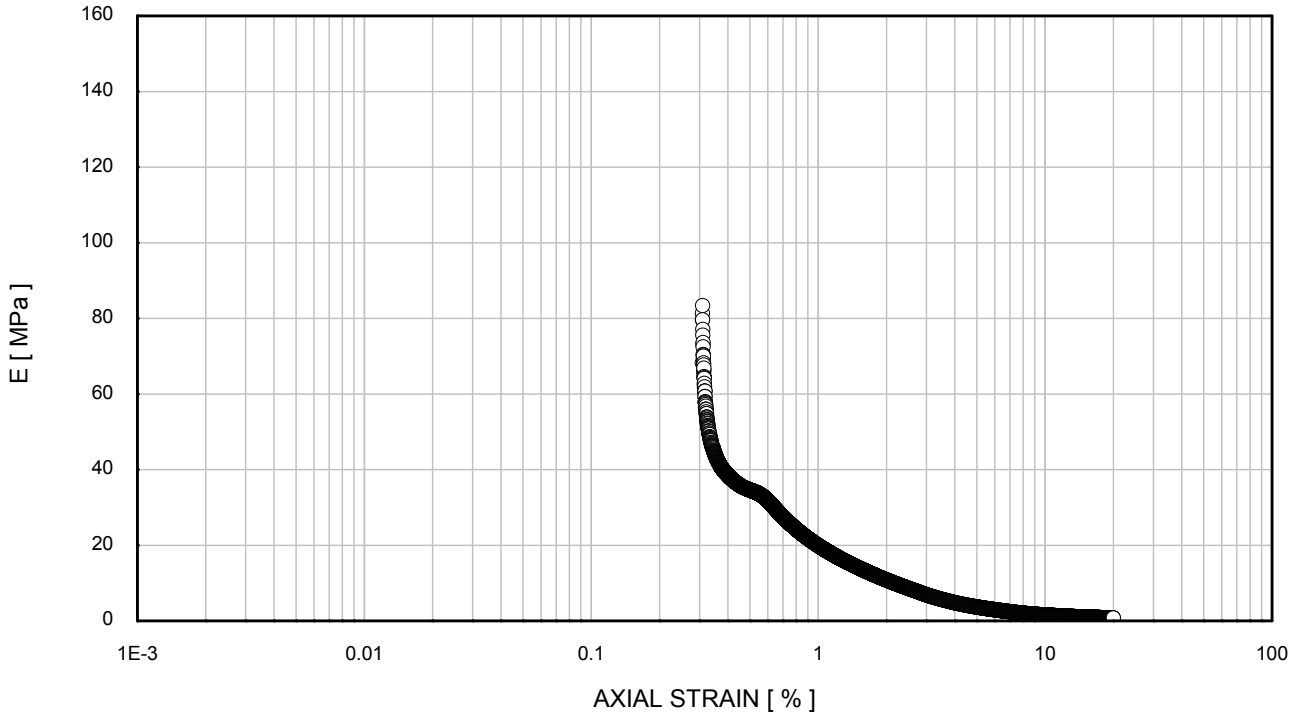




Initial σ'_r	:	83	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	125	kPa	Sample	: 21WAXD
q_{peak}	:	230	kPa	Depth [m]	: 19.05
Ext. ε at q_{peak}	:	2.64	%	Test No.	: CTX15
Rate of strain	:	0.50	%/hour		

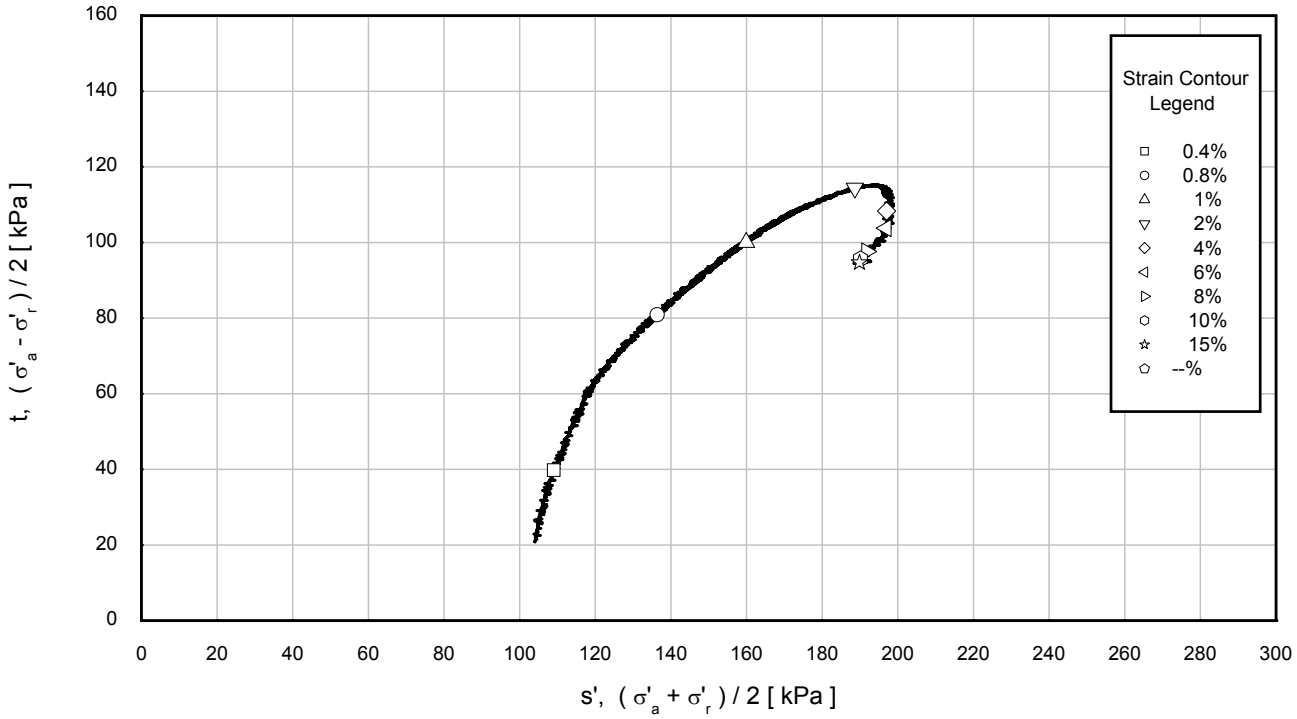
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

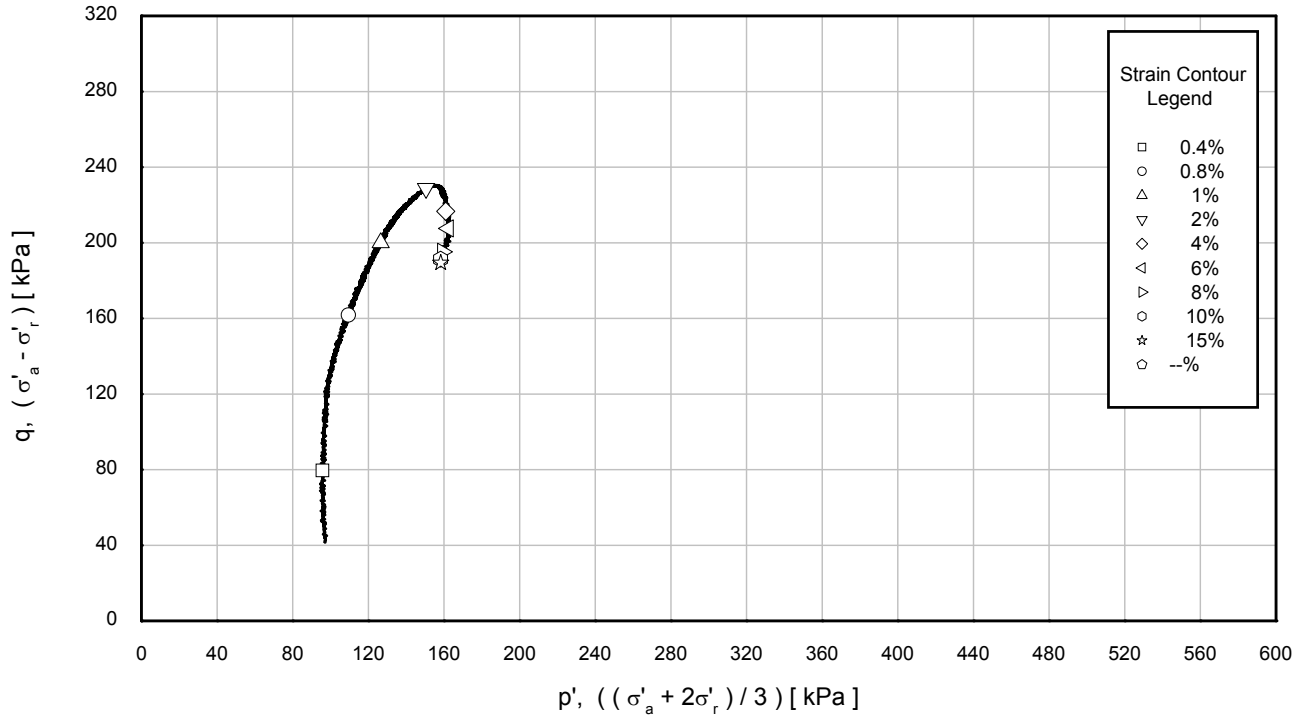




Initial σ'_r	:	83	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	125	kPa	Sample	: 21WAXD
q_{peak}	:	230	kPa	Depth [m]	: 19.05
Ext. ε at q_{peak}	:	2.64	%	Test No.	: CTX15
Rate of strain	:	0.50	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	83	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	125	kPa	Sample	: 21WAXD
q_{peak}	:	230	kPa	Depth [m]	: 19.05
Ext. ε at q_{peak}	:	2.64	%	Test No.	: CTX15
Rate of strain	:	0.50	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark grey slightly sandy CLAY with closely spaced thin laminae of olive grey silt with a thick laminae of grey silty clay

GENERAL	
Date test started	08/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	51.1
Length	[mm]	100.9
Water content	[%]	31.8
Bulk density	[Mg/m³]	1.91
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.862
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	40
Pocket penetrometer	[kPa]	100

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH01-SA_25WaxA_CTX16
Processed by Date	MSR 15/12/2016
Checked by Date	AR 21/12/2016
Approved by Date	AR 22/12/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1099
Base PWP	[kPa]	933
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1142
Back pressure	[kPa]	932
Base PWP	[kPa]	931
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	211
Effective axial pressure	[kPa]	211
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.56
External axial strain	[%]	0.30
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.852
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1142
Back pressure	[kPa]	932
Base PWP	[kPa]	944
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	198
Effective axial pressure	[kPa]	220
Deviator stress	[kPa]	22
Volumetric strain	[%]	0.00
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.852
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

First STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	215
Mean q_{av}	[kPa]	22
Mean q_{cy}	[kPa]	32
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.07
External ε_{cy} at N_f	[%]	0.04
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	25
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.852
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.04	88	-	4.38	-
2	0.01	0.04	87	-	2.56	-
5	0.01	0.04	85	-	1.99	-
10	0.02	0.04	84	-	1.91	-
20	0.02	0.04	82	-	1.72	-
30	0.02	0.04	81	-	1.66	-
40	0.02	0.04	81	-	1.67	-
50	0.03	0.04	81	-	1.60	-
100	0.03	0.04	79	-	1.59	-
1000	0.06	0.04	75	-	0.77	-
1400	0.07	0.04	74	-	0.59	-
1500	0.07	0.04	74	-	0.90	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1142
Back pressure	[kPa]	932
Base PWP	[kPa]	962
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	180
Effective axial pressure	[kPa]	234
Deviator stress	[kPa]	54
Volumetric strain	[%]	0.00
External axial strain	[%]	0.09
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.852
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	215
Mean q_{av}	[kPa]	54
Mean q_{cy}	[kPa]	43
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.20
External ε_{cy} at N_f	[%]	0.07
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	44
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46
Void ratio	[-]	0.852
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.03	0.06	71	-	13.01	-
2	0.04	0.06	69	-	8.51	-
5	0.06	0.06	66	-	7.29	-
10	0.07	0.07	65	-	6.77	-
20	0.09	0.07	64	-	6.45	-
30	0.10	0.07	64	-	6.29	-
40	0.11	0.07	63	-	6.21	-
50	0.12	0.07	63	-	6.08	-
100	0.14	0.07	62	-	5.90	-
200	0.17	0.07	61	-	5.73	-
300	0.19	0.07	60	-	5.55	-
400	0.20	0.07	60	-	5.38	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	183
Initial effective axial pressure	[kPa]	185
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	212
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	3.90
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	95
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	114
Effective axial pressure	[kPa]	326
Principal effective stress ratio	[-]	2.86
ε_{50}	[%]	0.24
Secant modulus (E_{50}) at ε_{50}	[kPa]	42965
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	207
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	101
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	107
Effective axial pressure	[kPa]	314
Principal effective stress ratio	[-]	2.94
At 10% external axial strain		
Corrected deviator stress	[kPa]	184
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	10.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	71
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	137
Effective axial pressure	[kPa]	321
Principal effective stress ratio	[-]	2.34

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

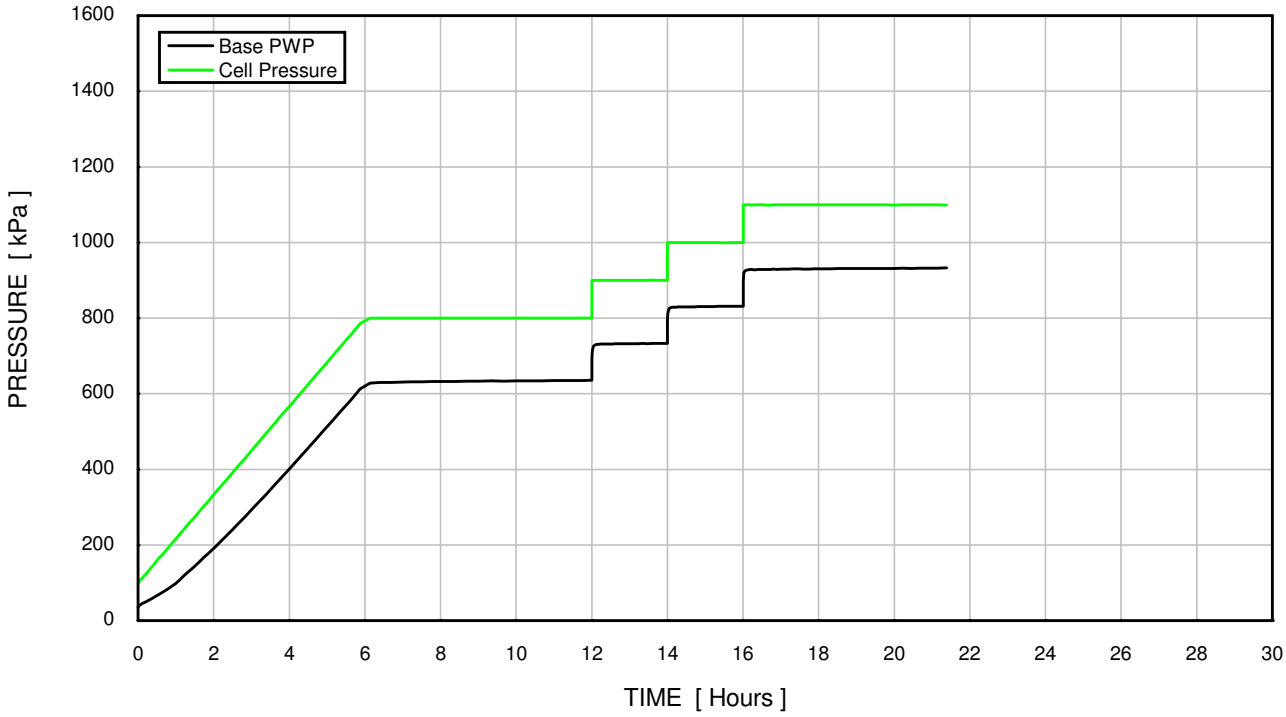
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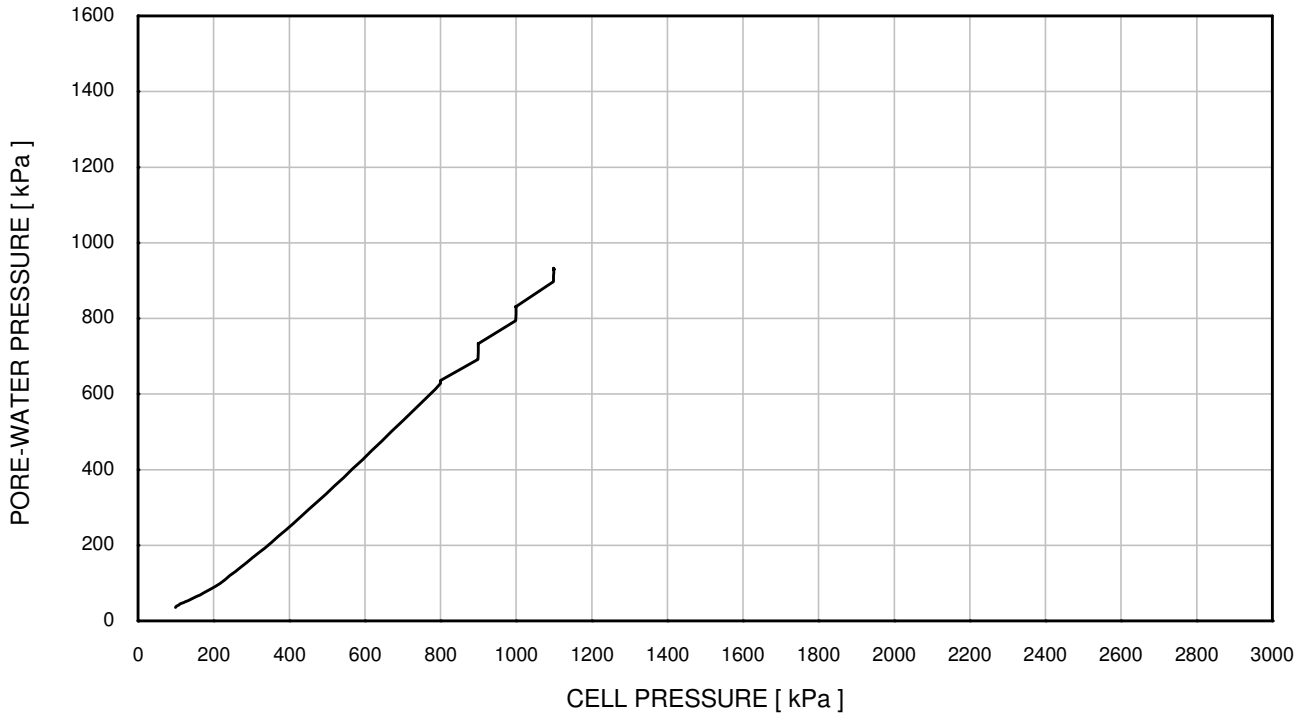
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FINAL CONDITIONS		
Water content	[%]	31.5
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.46

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	25WAXA
Depth [m]	22.55
Test number	CTX16

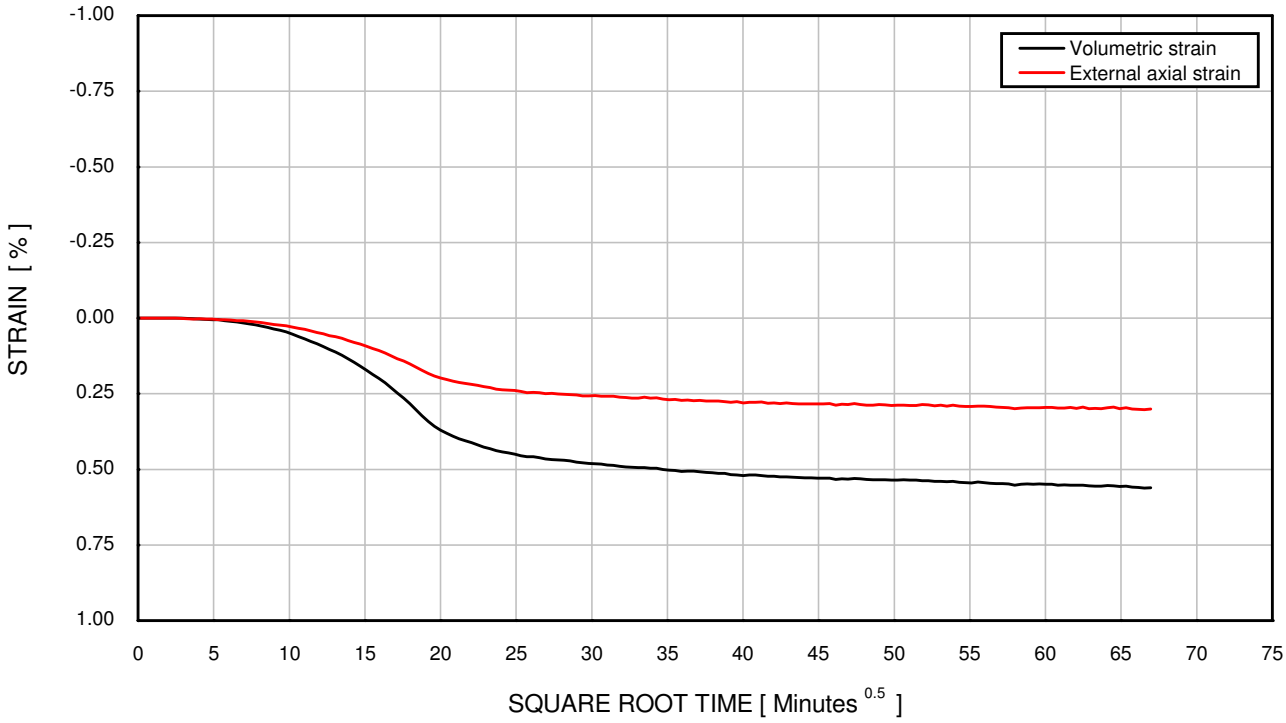
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

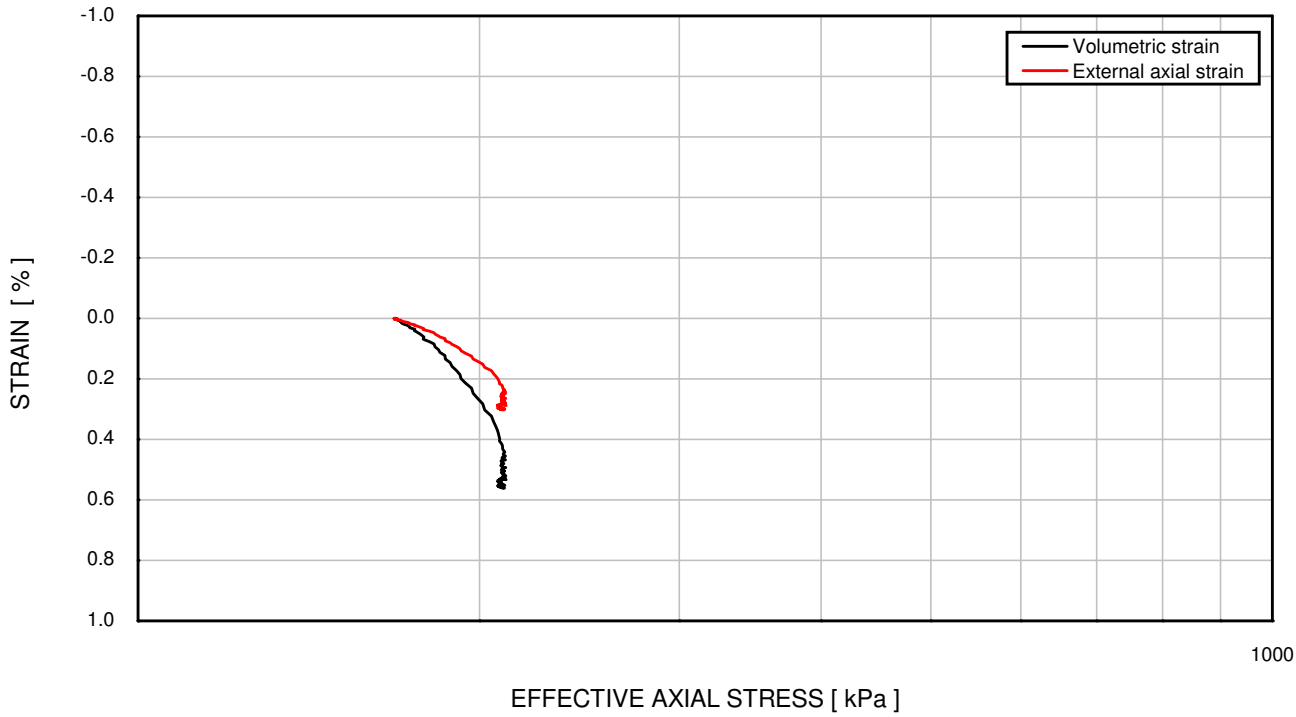




B value	: 1.00	Borehole	: HKZ1-BH01-SA
Initial σ'_r	: 63 kPa	Sample	: 25WAXA
Initial σ'_a	: 63 kPa	Depth [m]	: 22.55
Final σ'_r	: 166 kPa	Test No.	: CTX16
Final σ'_a	: 166 kPa		

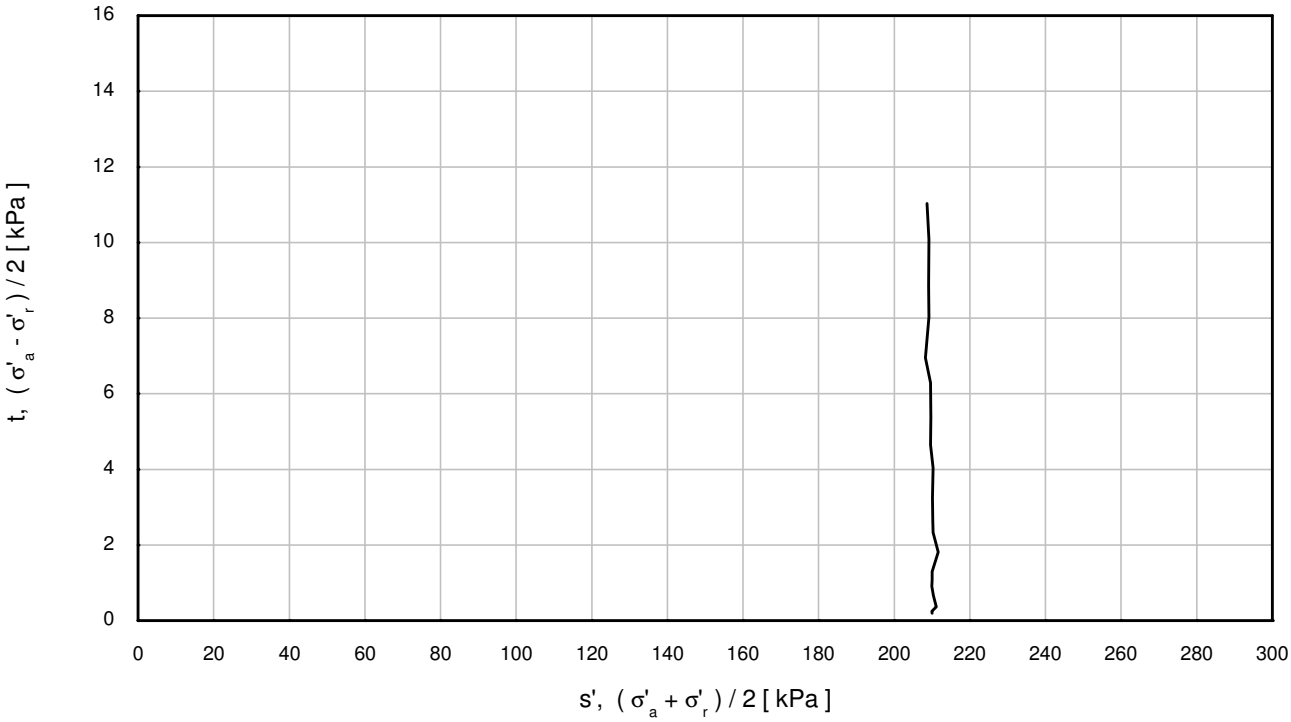
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

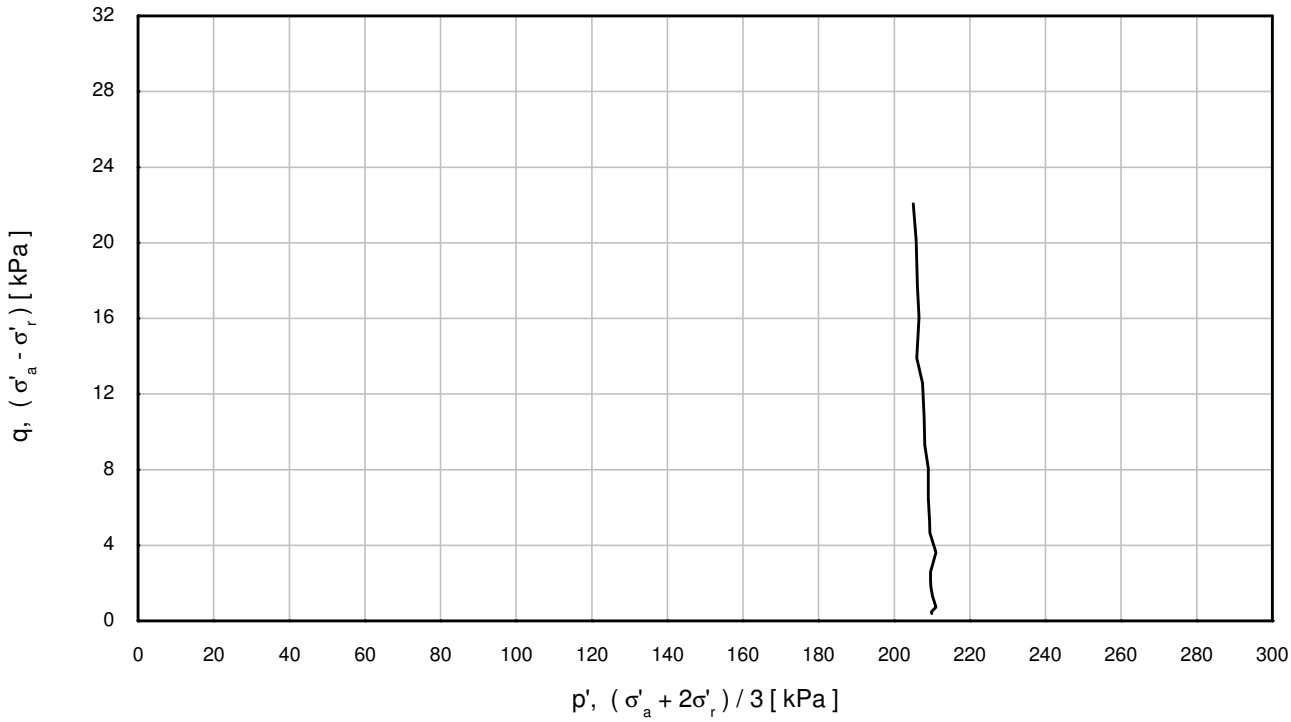




Stage 1 σ'_{rc}	: 210 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 210 kPa	Sample	: 25WAXA
		Depth [m]	: 22.55
		Test No.	: CTX16

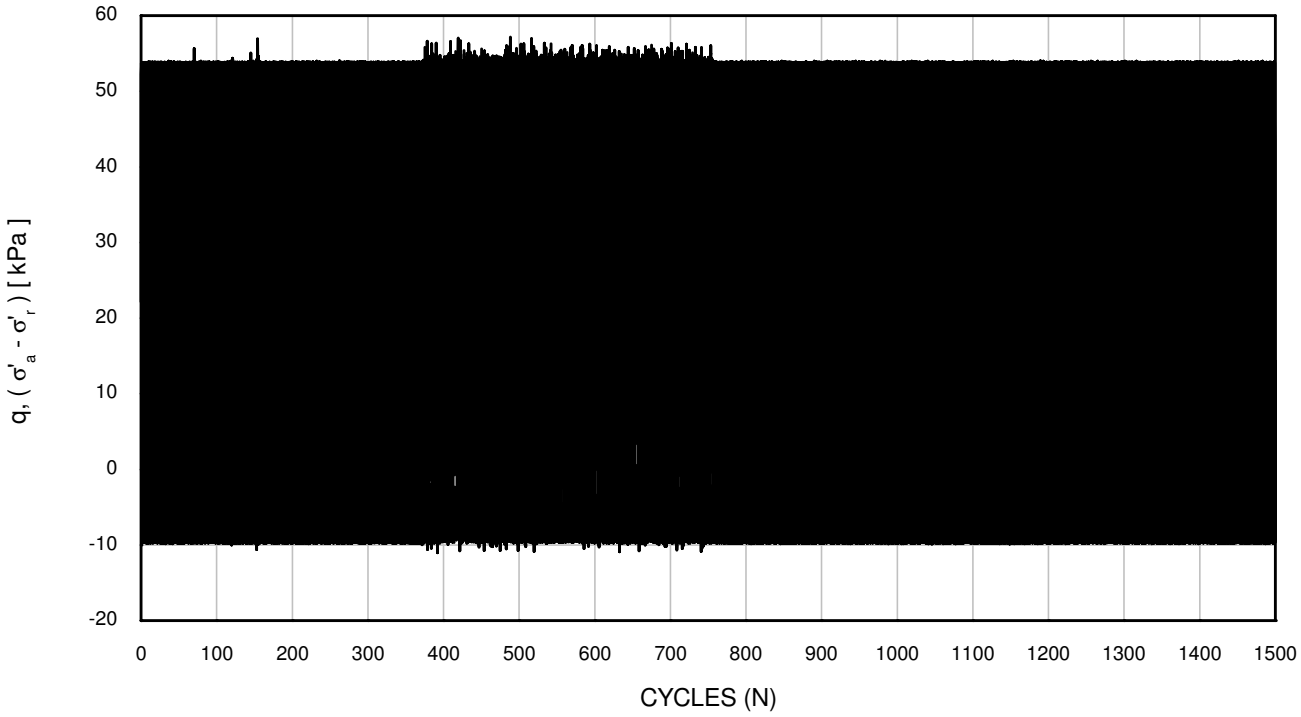
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

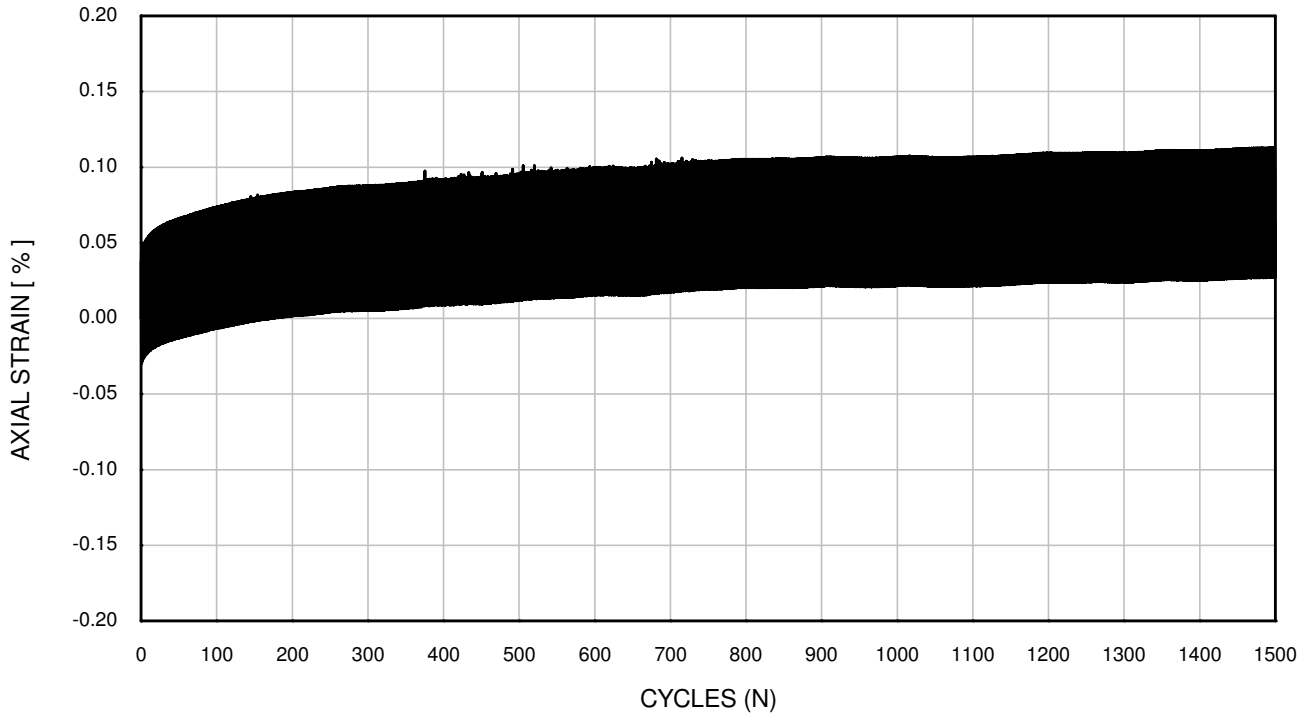




Stage 1 σ'_{rc}	: 198 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 220 kPa	Sample	: 25WAXA
		Depth [m]	: 22.55
		Test No.	: CTX16

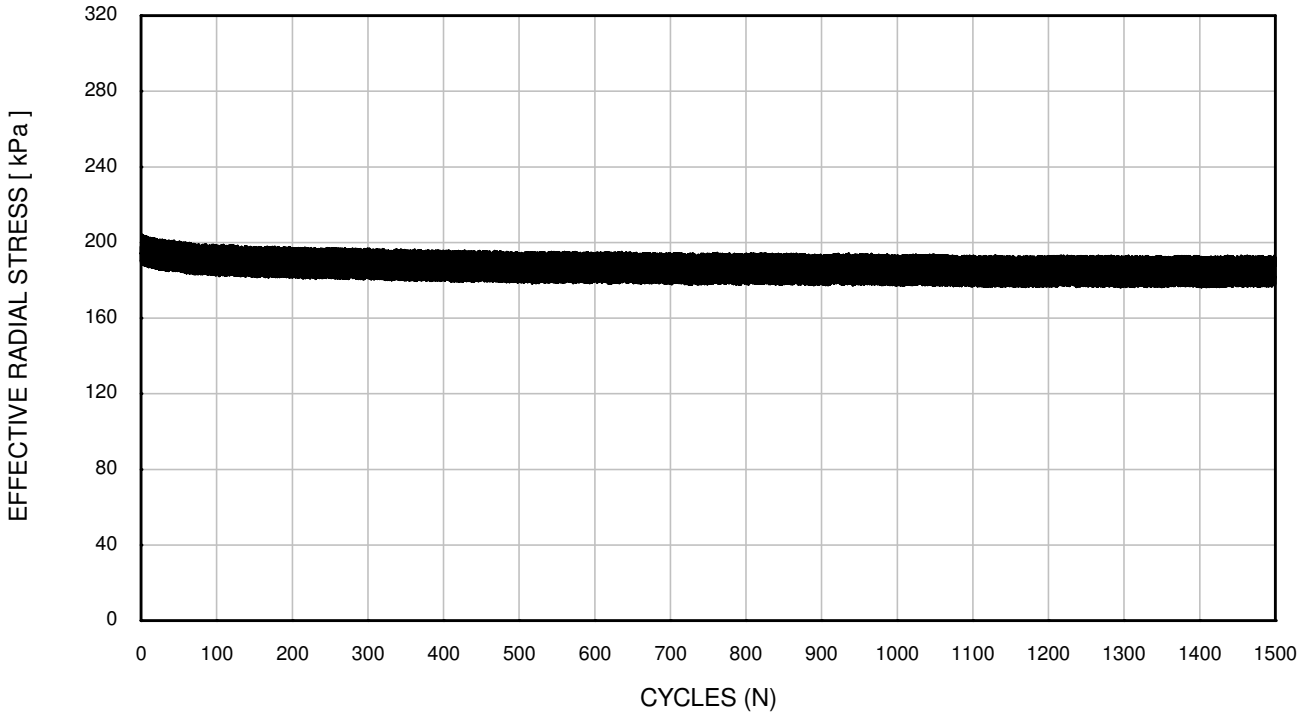
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

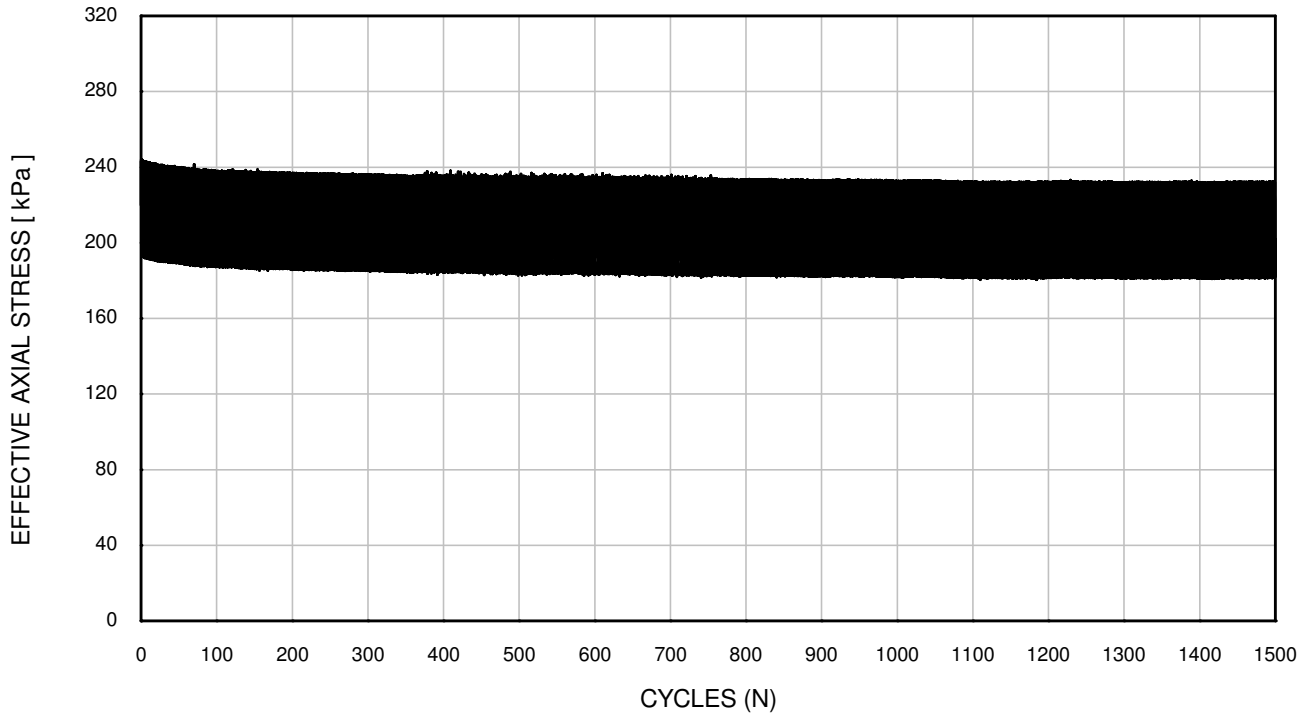




Initial σ'_r	:	198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	220 kPa	Sample	: 25WAXA
q_{av}	:	22 kPa	Depth [m]	: 22.55
q_{cy}	:	32 kPa	Test No.	: CTX16
Frequency	:	0.10 Hz		

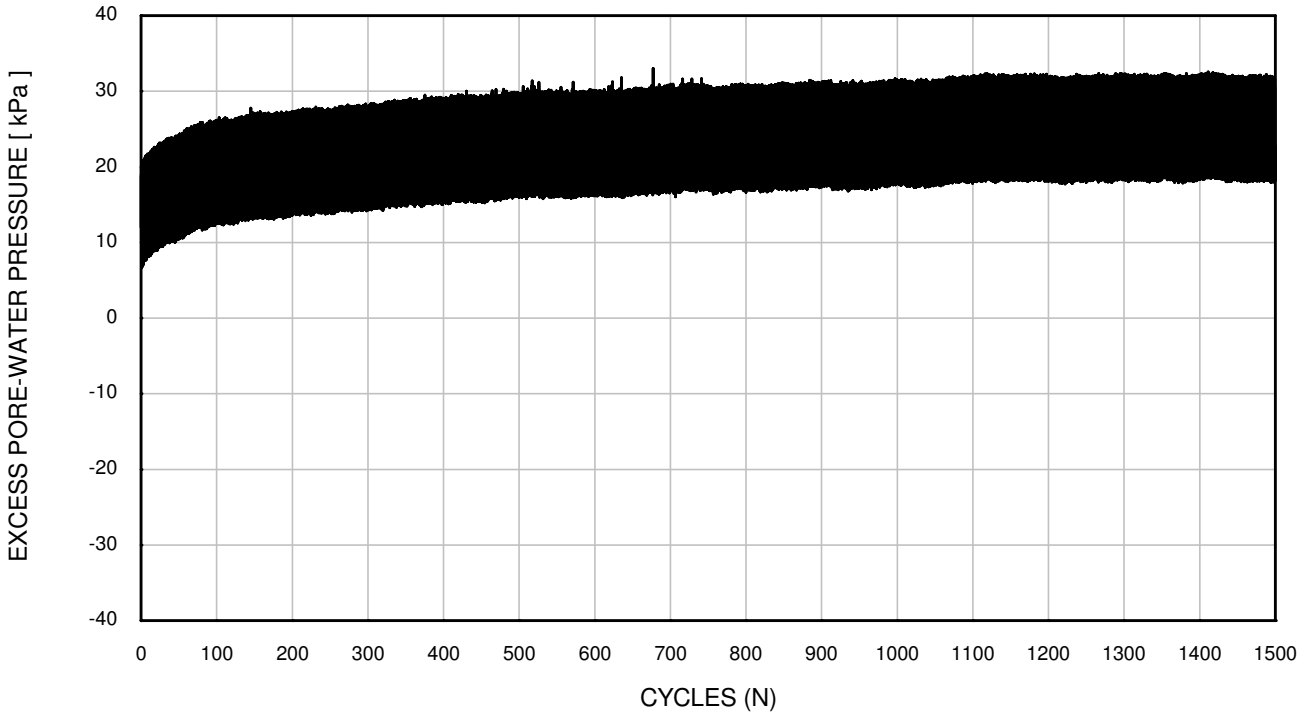
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

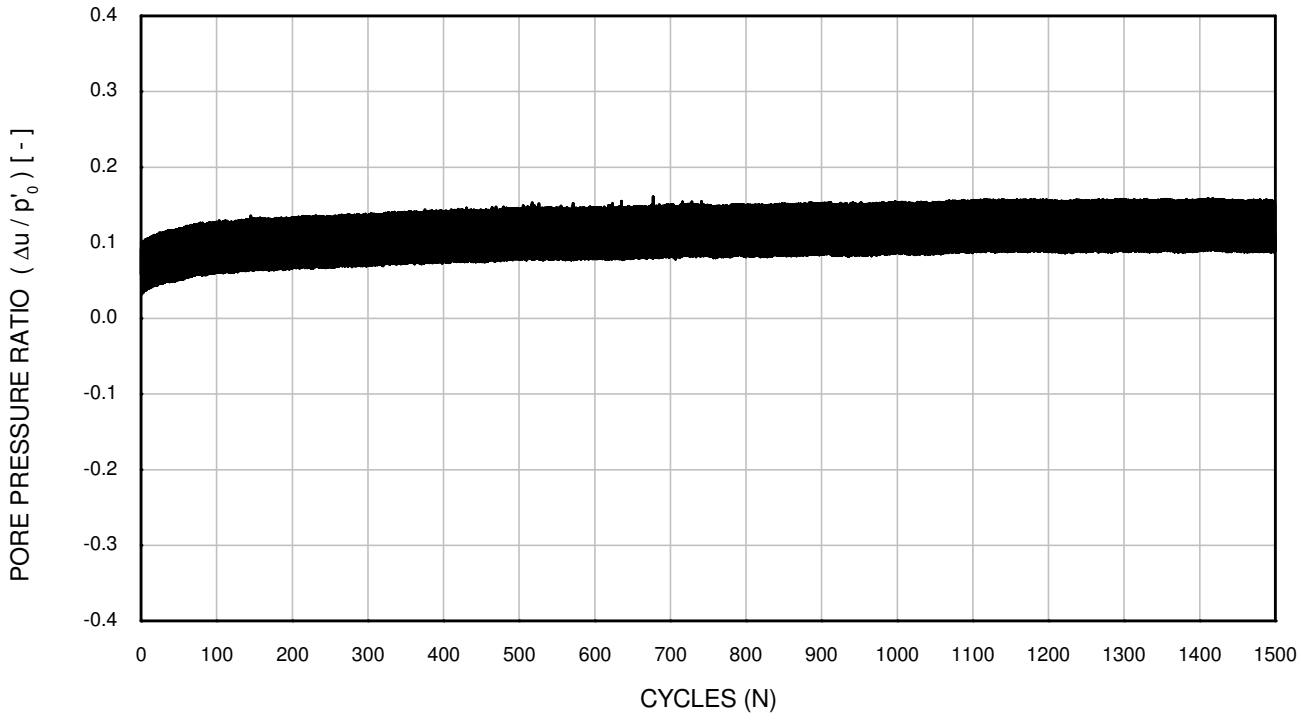




Initial σ'_r	: 198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 220 kPa	Sample	: 25WAXA
q_{av}	: 22 kPa	Depth [m]	: 22.55
q_{cy}	: 32 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

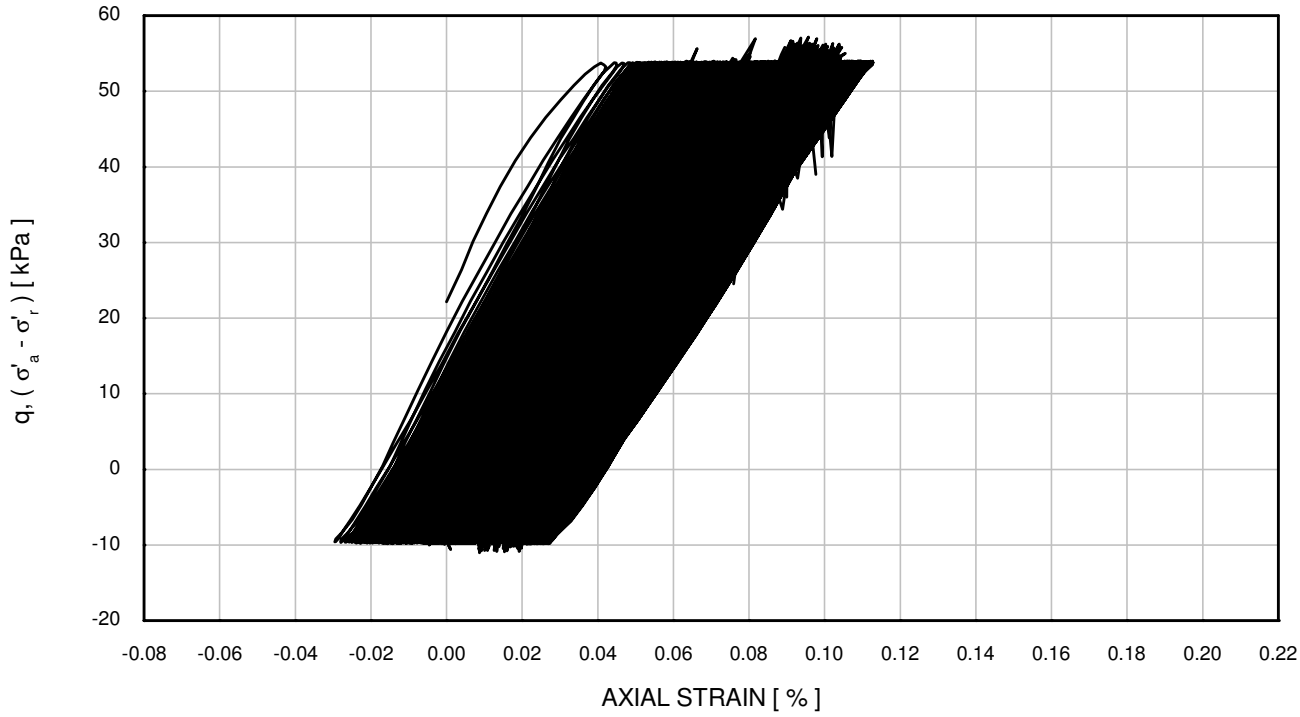
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

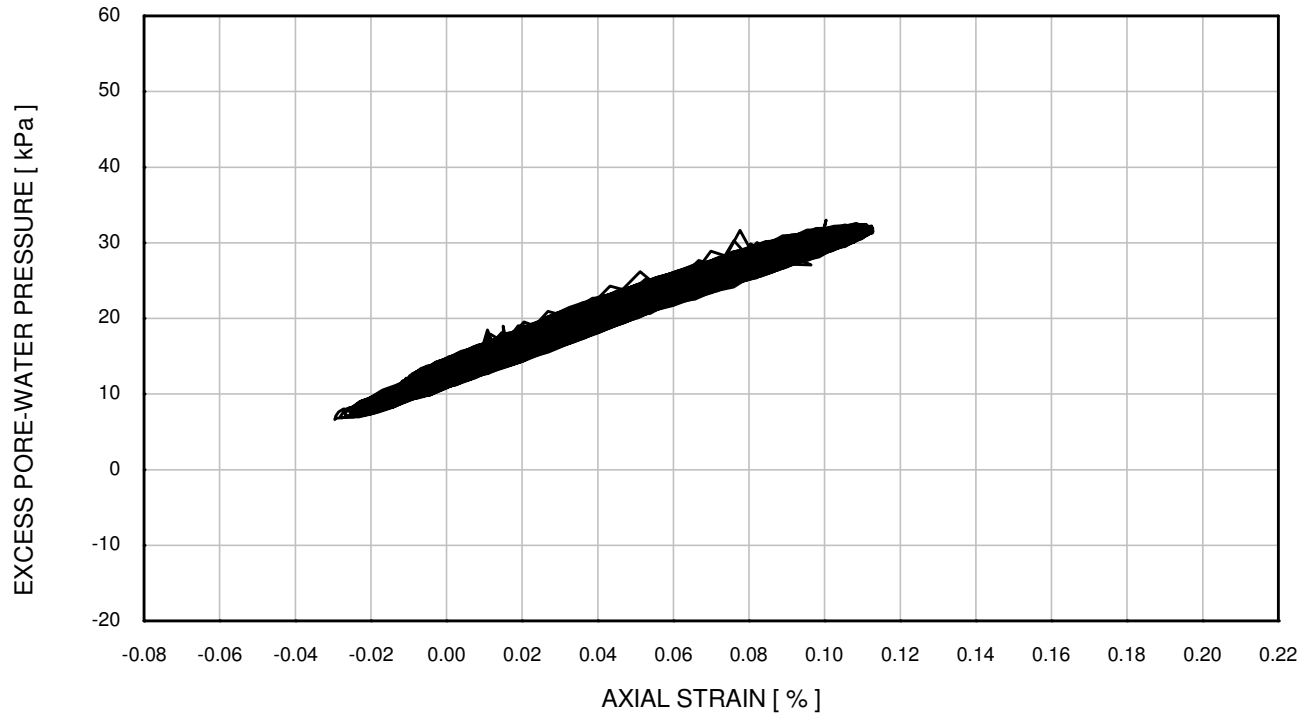




Initial σ'_r	: 198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 220 kPa	Sample	: 25WAXA
q_{av}	: 22 kPa	Depth [m]	: 22.55
q_{cy}	: 32 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

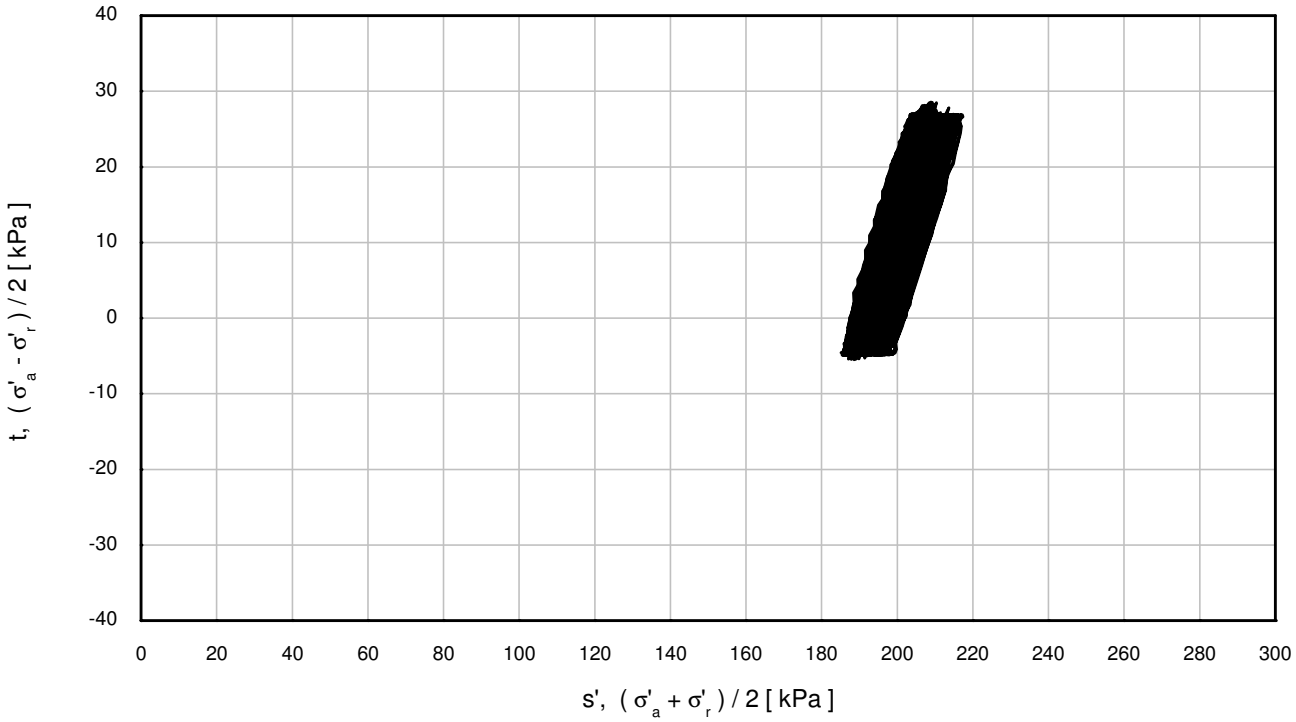
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

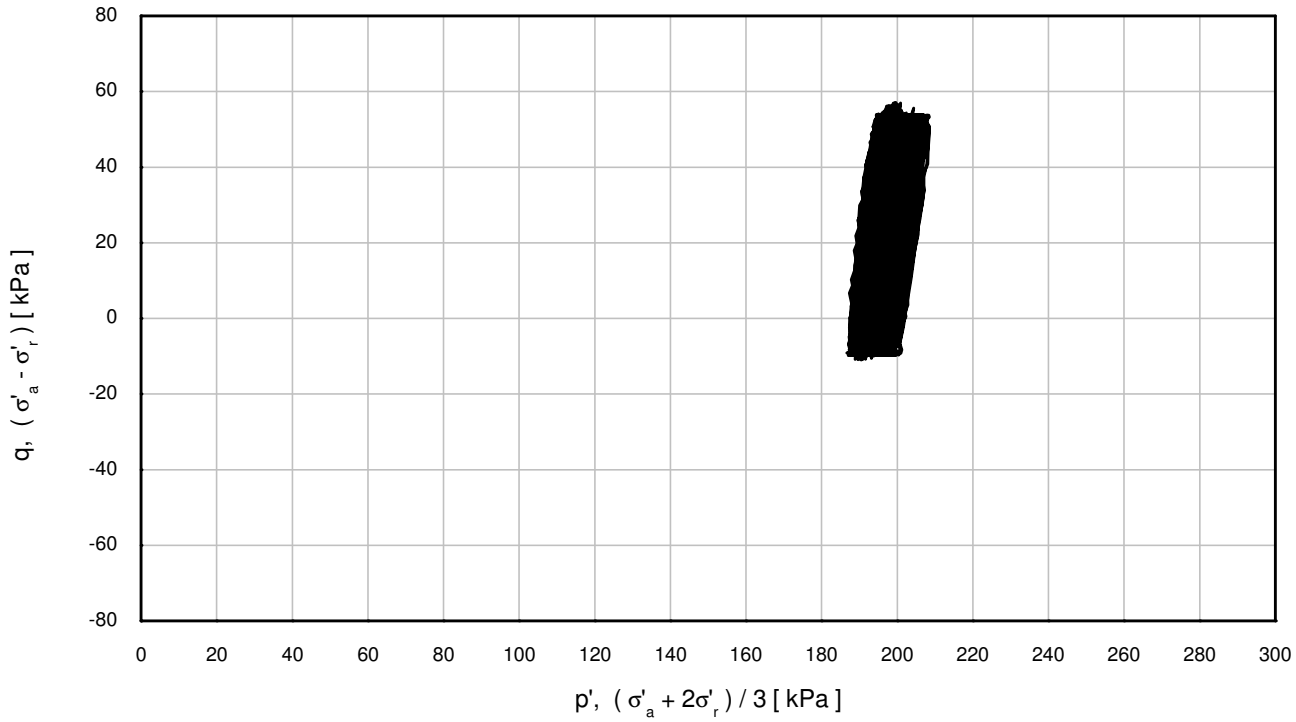




Initial σ'_r	: 198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 220 kPa	Sample	: 25WAXA
q_{av}	: 22 kPa	Depth [m]	: 22.55
q_{cy}	: 32 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

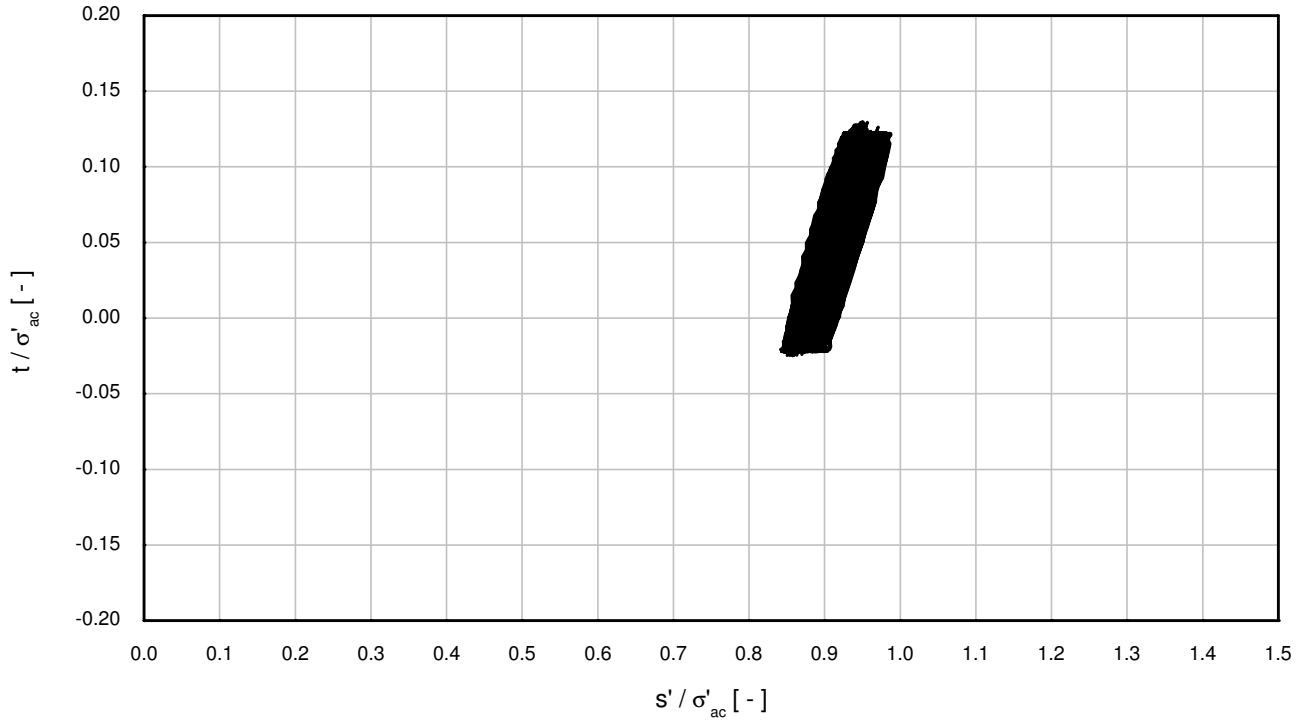
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FIRST CYCLIC LOADING STAGE - UNDRAINED

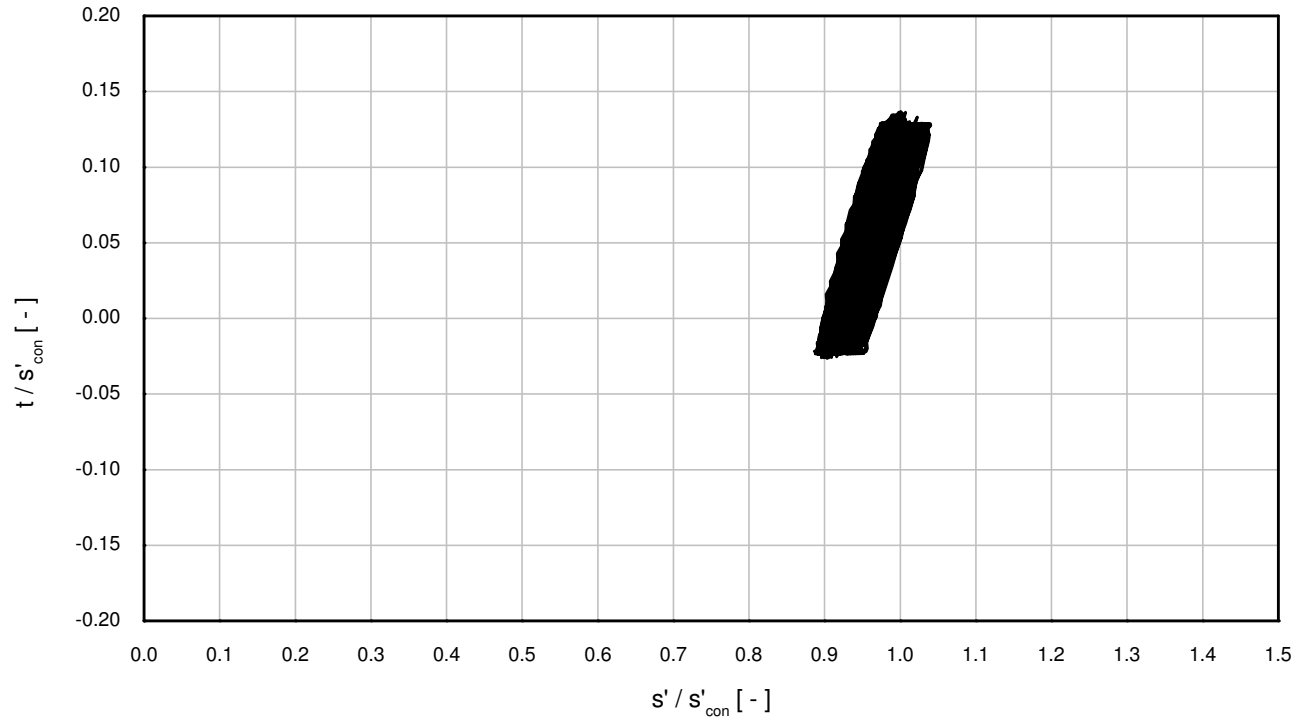




Initial σ'_r	:	198 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	220 kPa	Sample	:	25WAXA
q_{av}	:	22 kPa	Depth [m]	:	22.55
q_{cy}	:	32 kPa	Test No.	:	CTX16
Frequency	:	0.10 Hz			

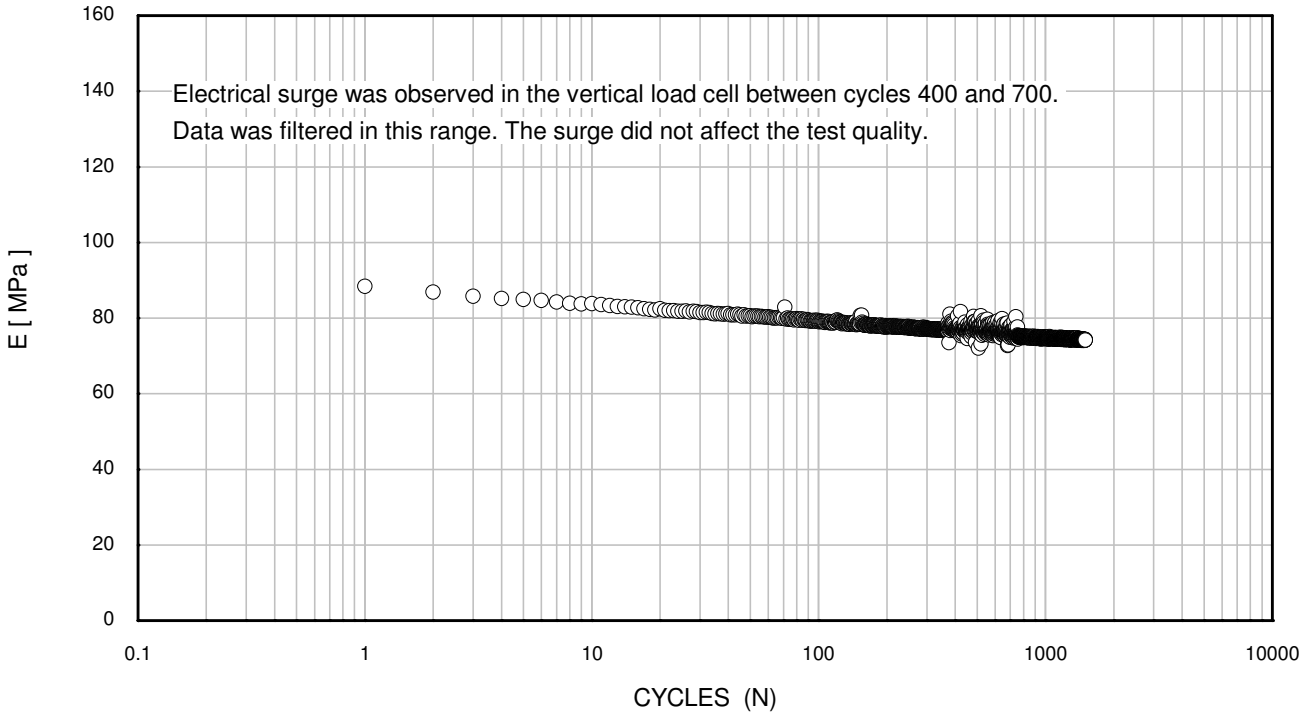
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

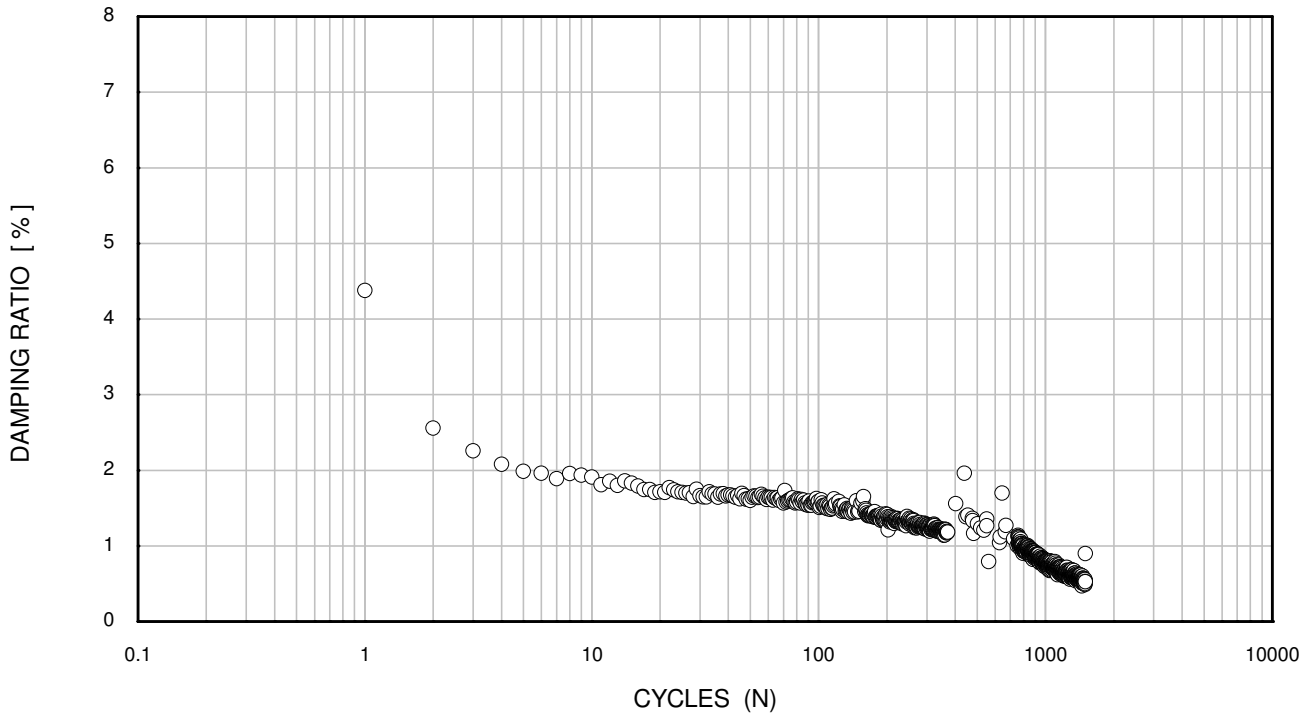




Initial σ'_r	: 198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 220 kPa	Sample	: 25WAXA
q_{av}	: 22 kPa	Depth [m]	: 22.55
q_{cy}	: 32 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

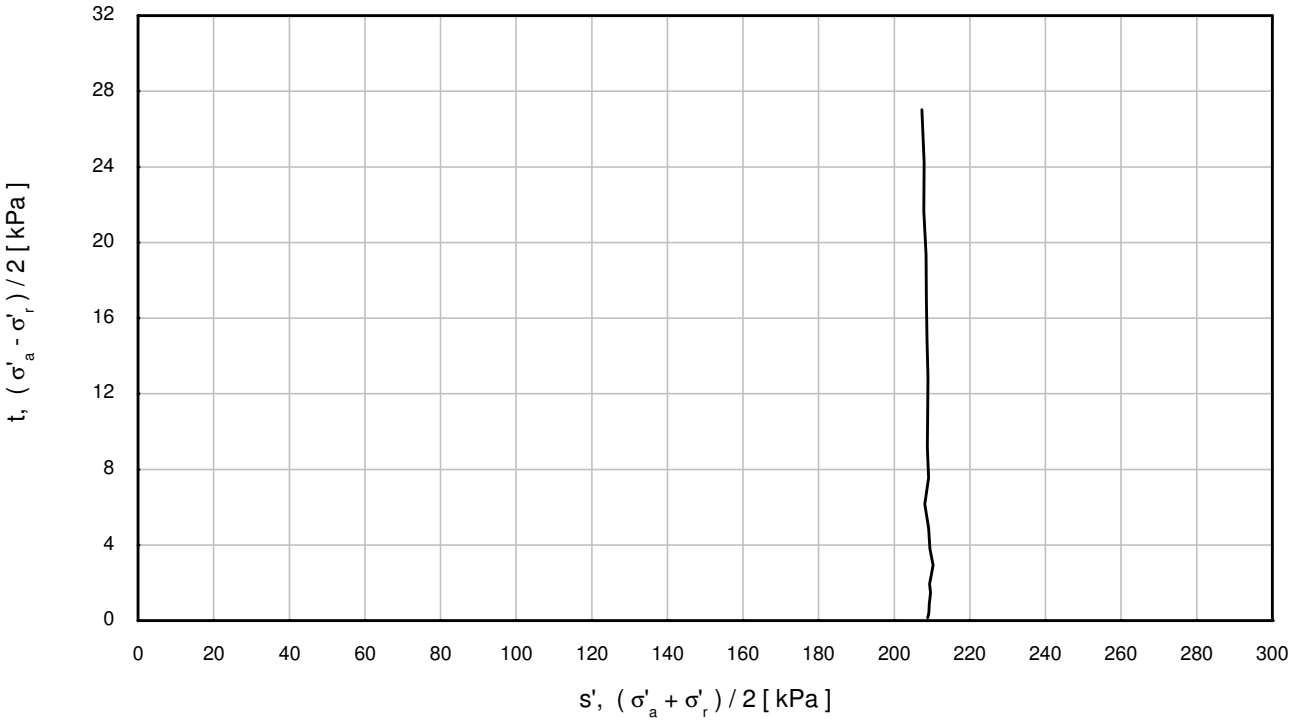
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

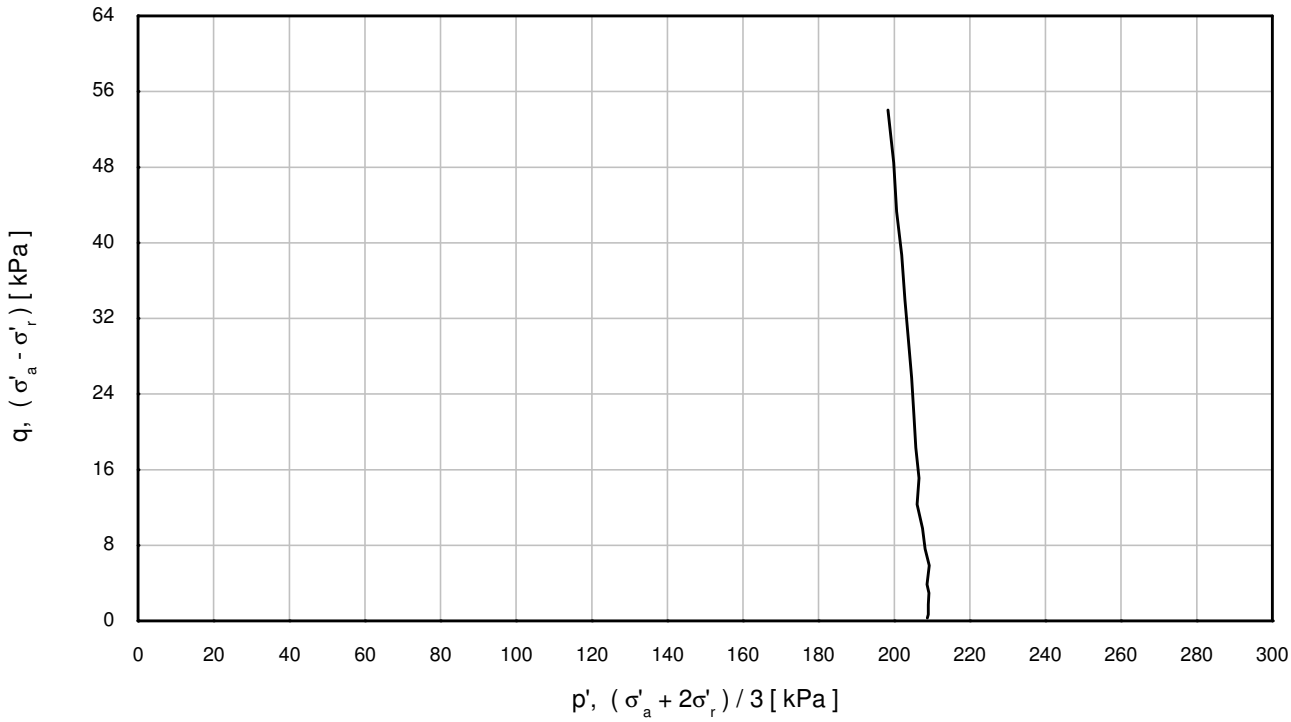




Initial σ'_r	: 198 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 220 kPa	Sample	: 25WAXA
q_{av}	: 22 kPa	Depth [m]	: 22.55
q_{cy}	: 32 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

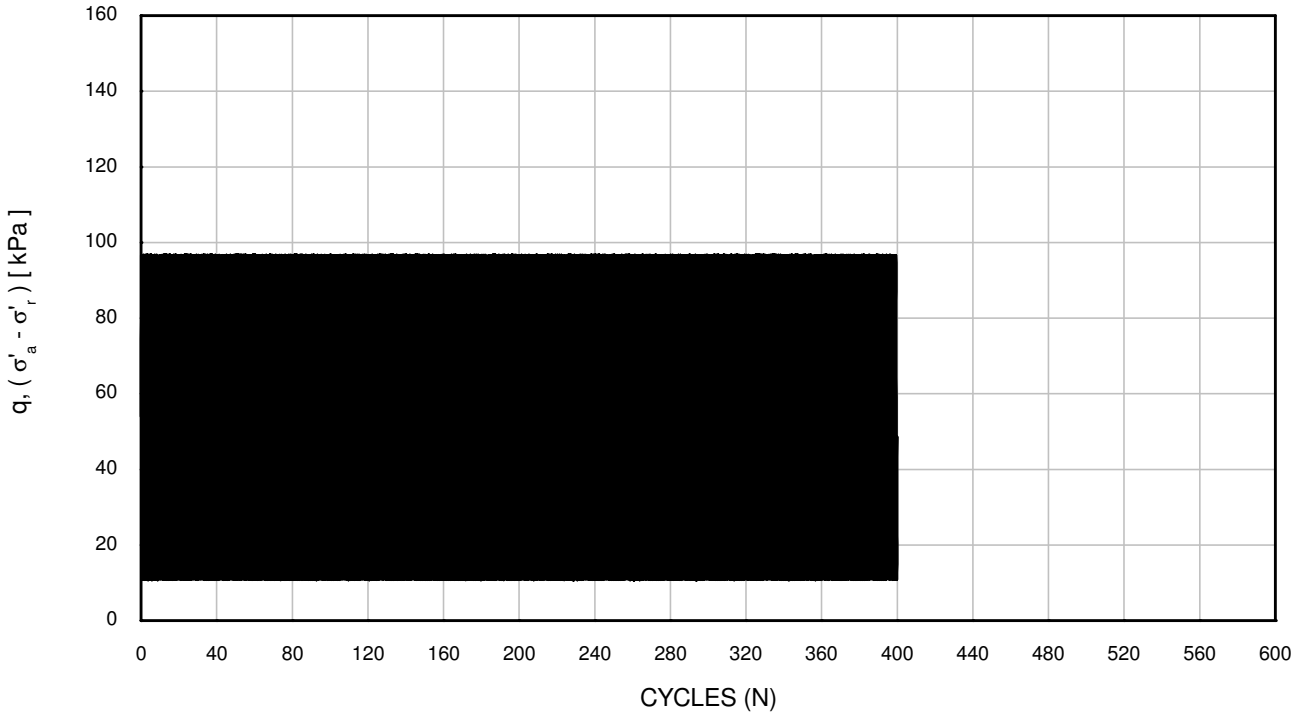
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

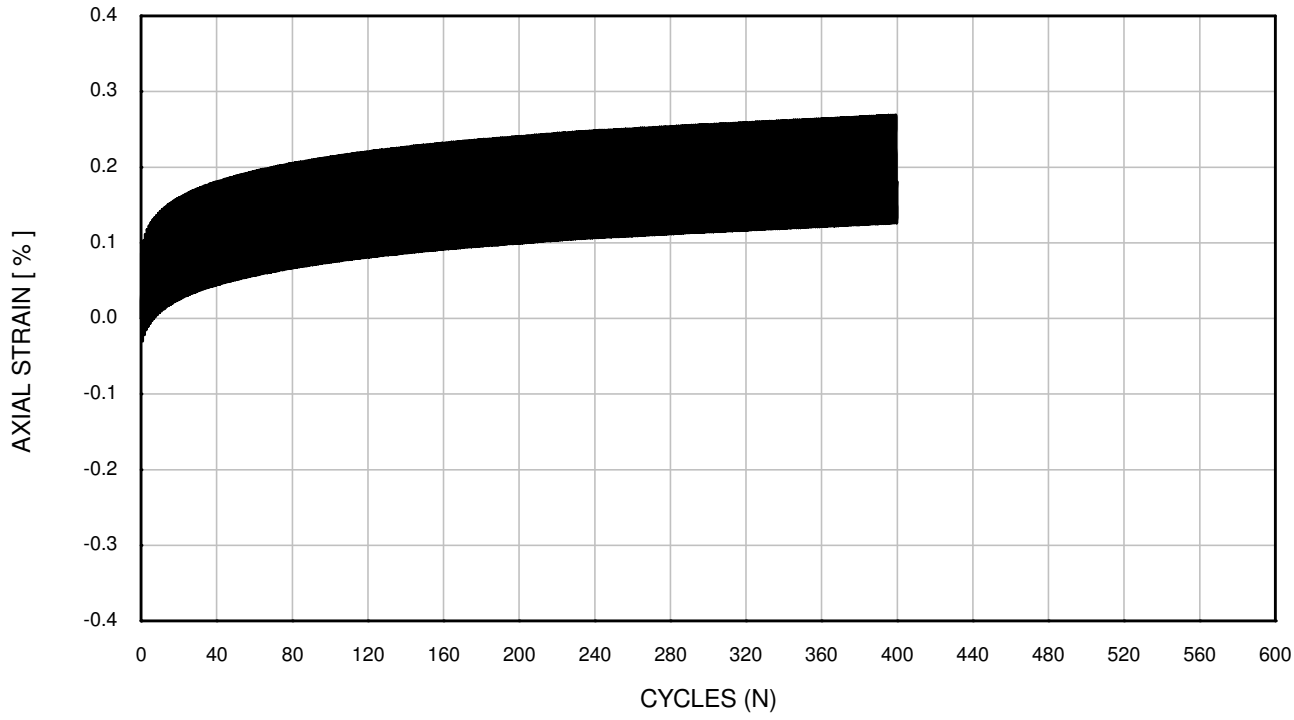




Stage 1 σ'_{rc}	: 180 kPa	Borehole	: HKZ1-BH01-SA
Stage 1 σ'_{ac}	: 234 kPa	Sample	: 25WAXA
		Depth [m]	: 22.55
		Test No.	: CTX16

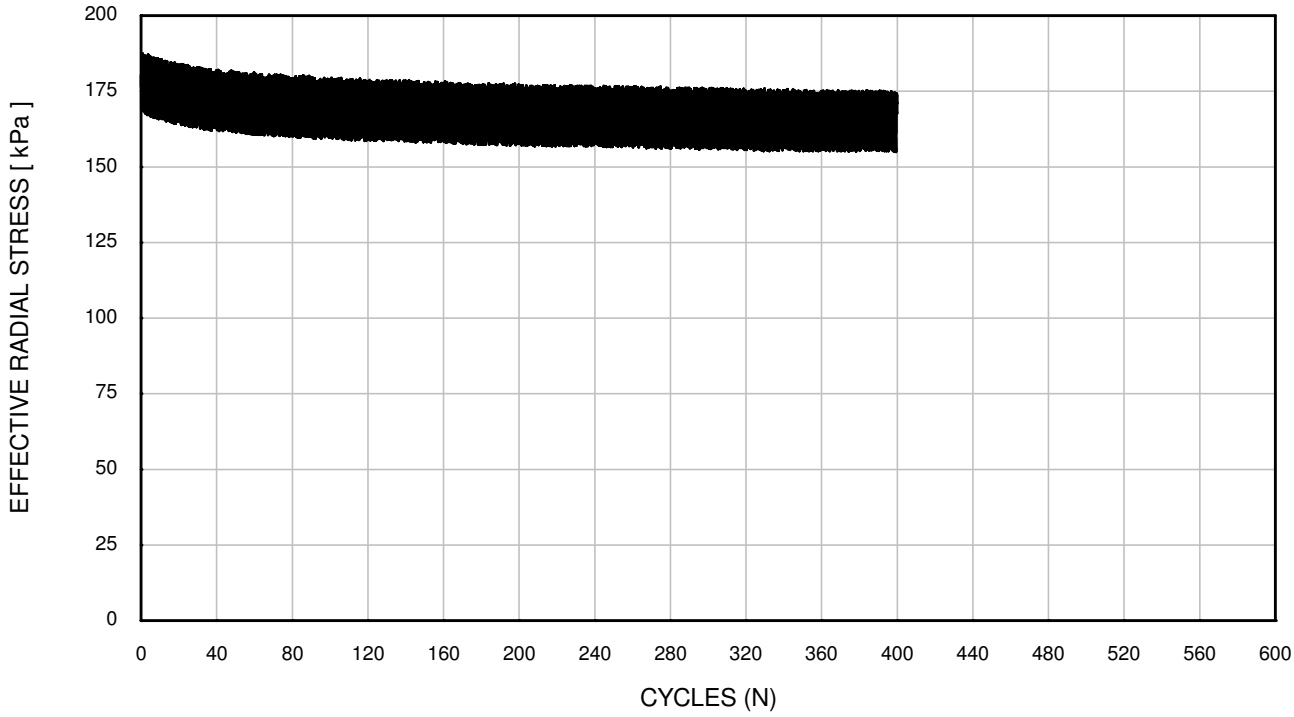
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

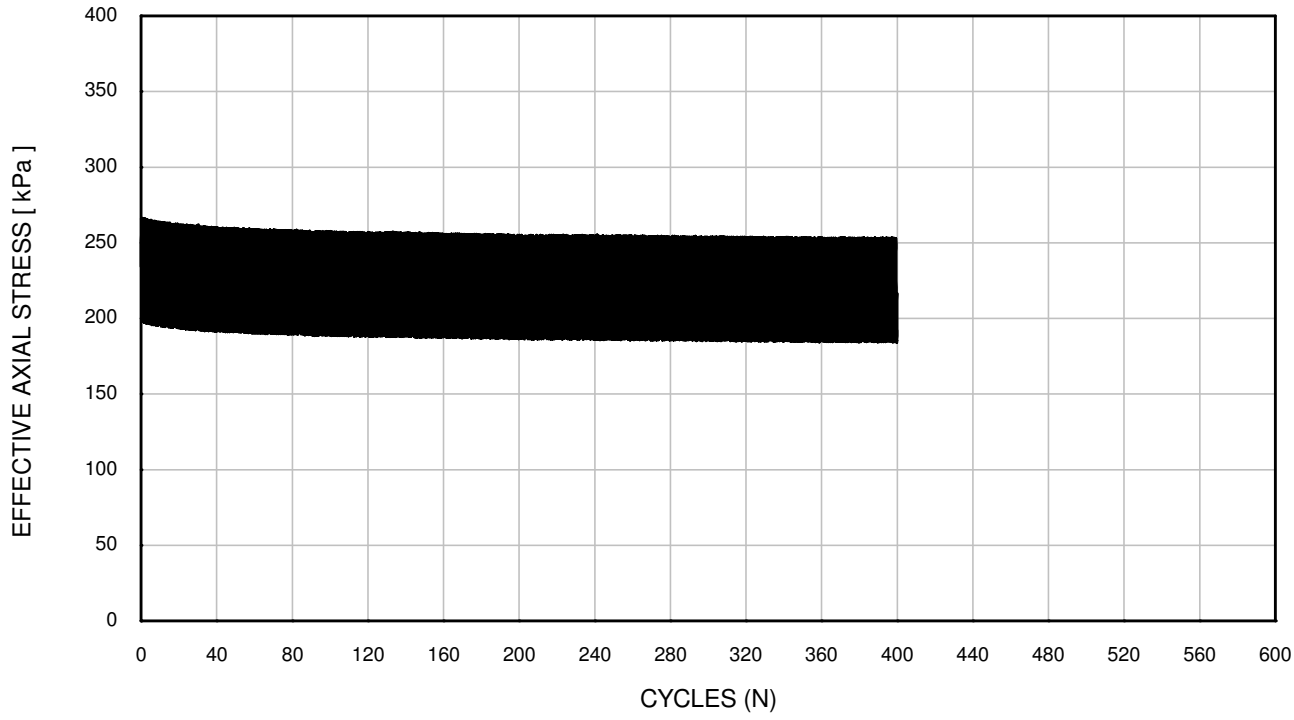




Initial σ'_r	: 180 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 234 kPa	Sample	: 25WAXA
q_{av}	: 54 kPa	Depth [m]	: 22.55
q_{cy}	: 43 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

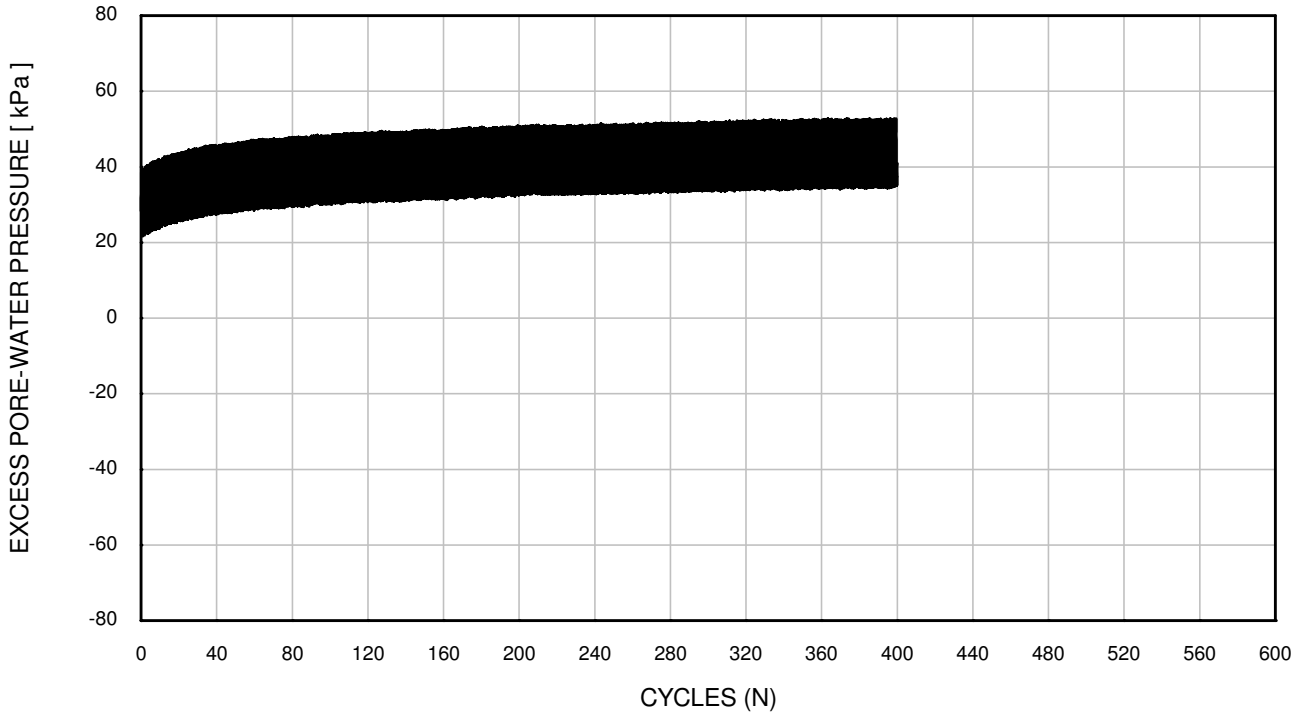
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

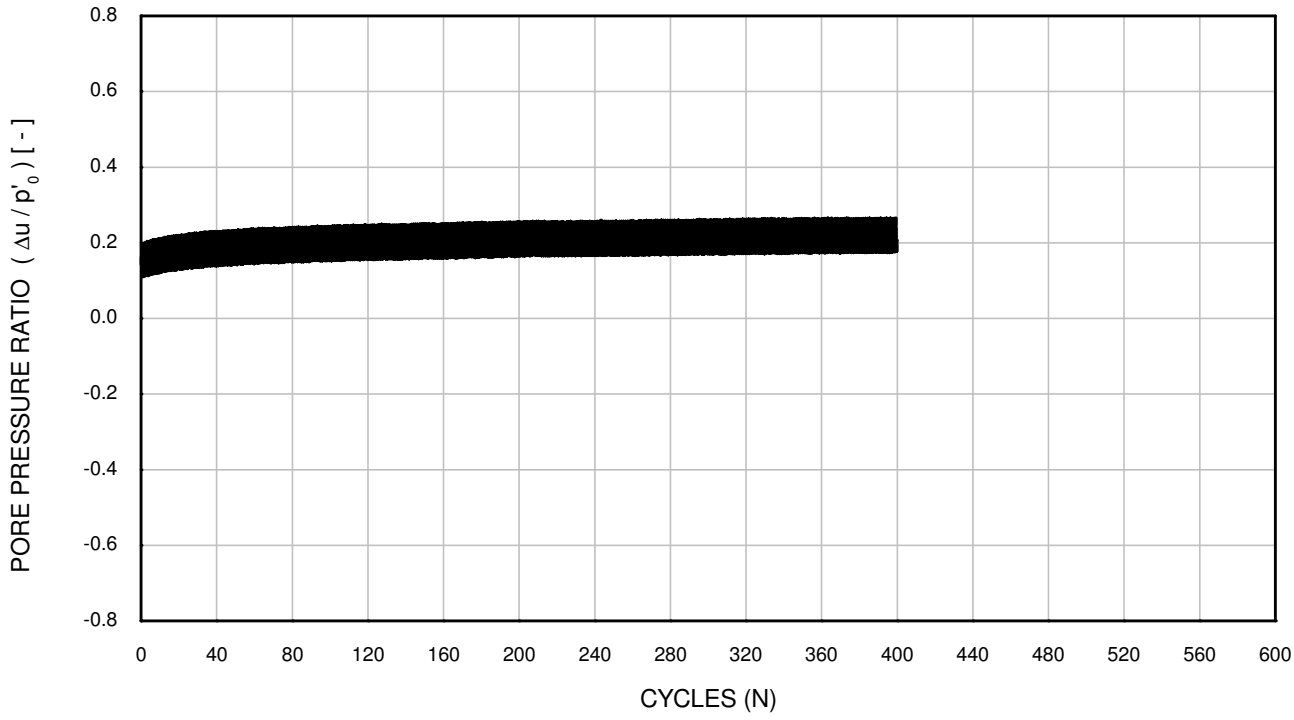




Initial σ'_r	:	180 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	234 kPa	Sample	:	25WAXA
q_{av}	:	54 kPa	Depth [m]	:	22.55
q_{cy}	:	43 kPa	Test No.	:	CTX16
Frequency	:	0.10 Hz			

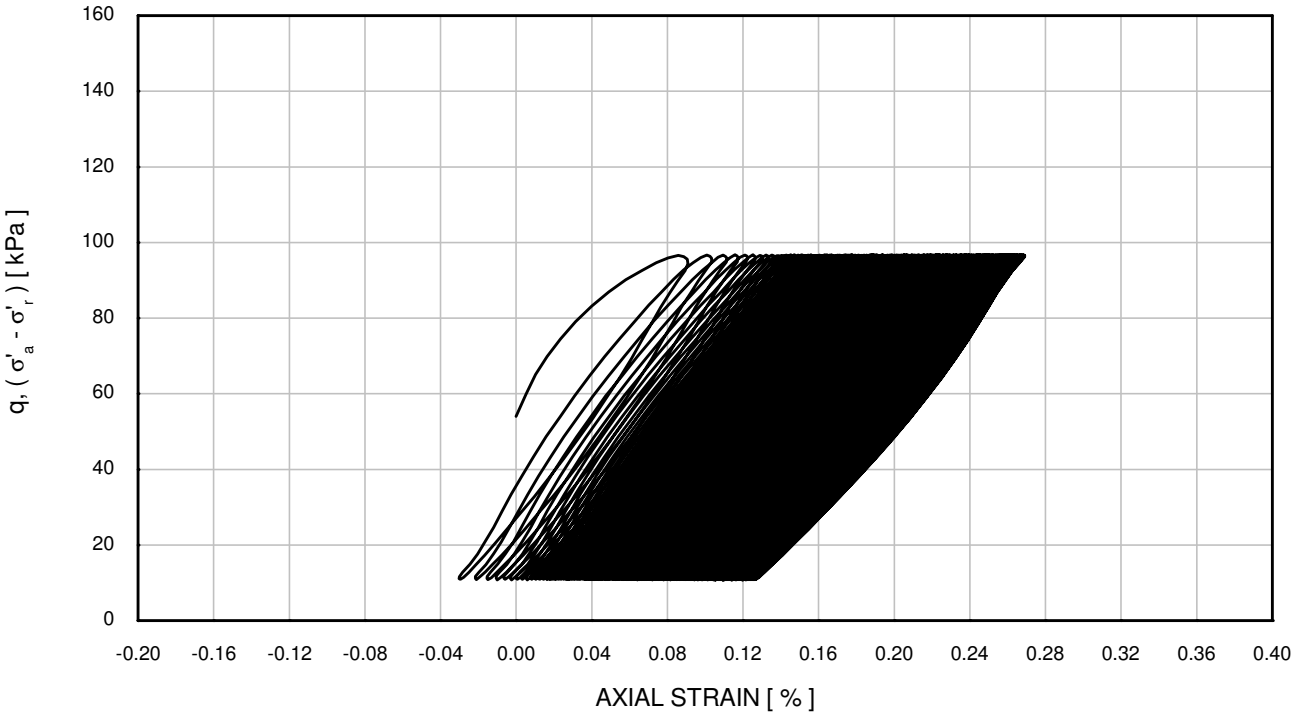
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

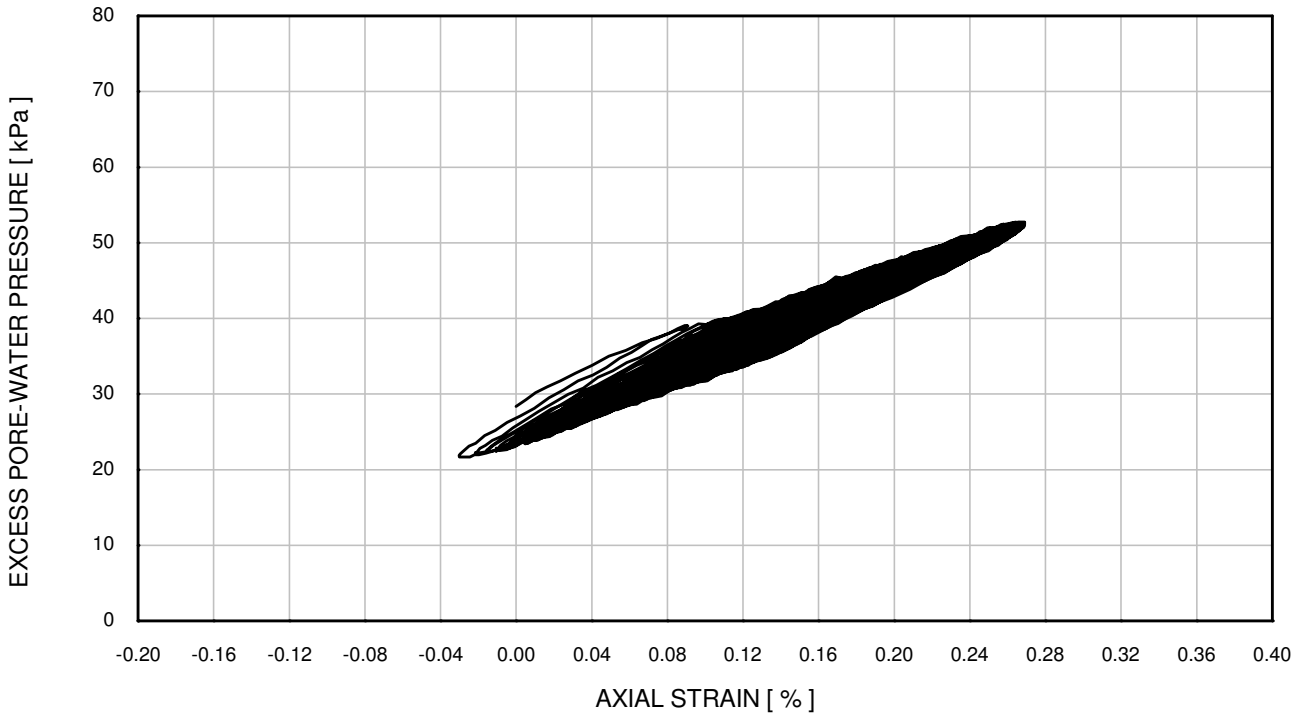




Initial σ'_r	: 180 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 234 kPa	Sample	: 25WAXA
q_{av}	: 54 kPa	Depth [m]	: 22.55
q_{cy}	: 43 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

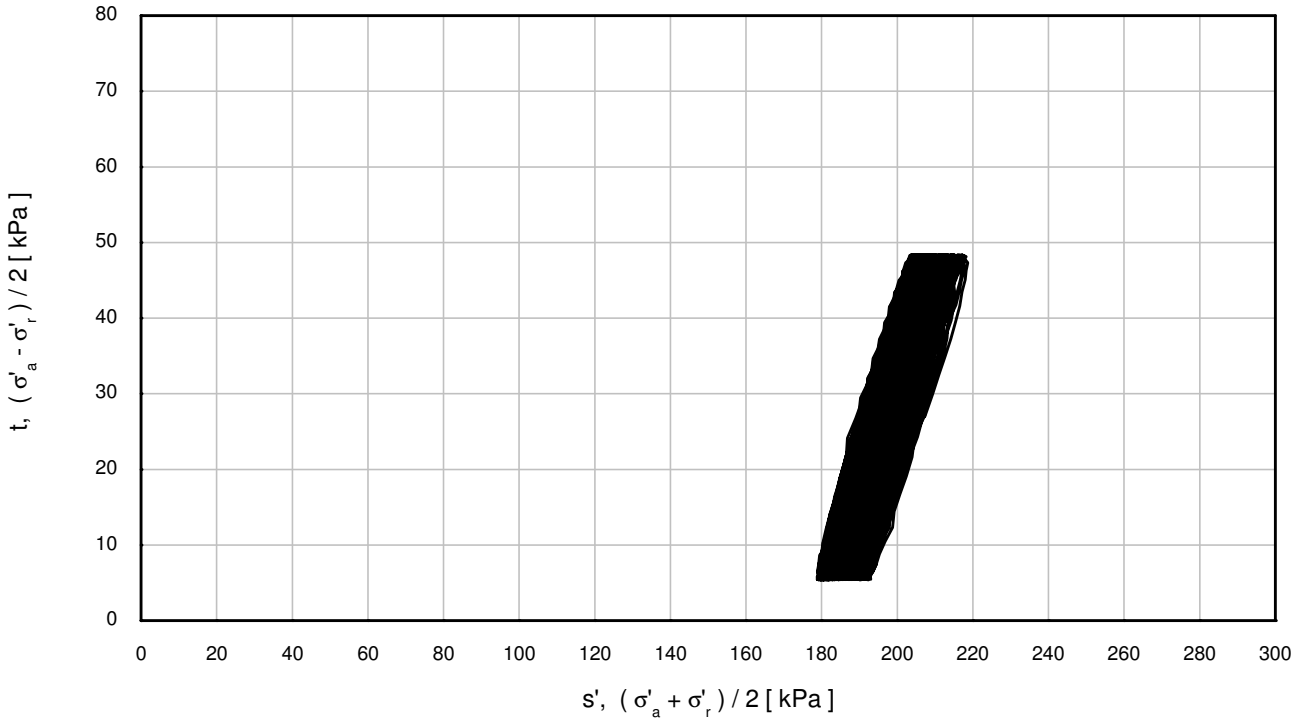
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

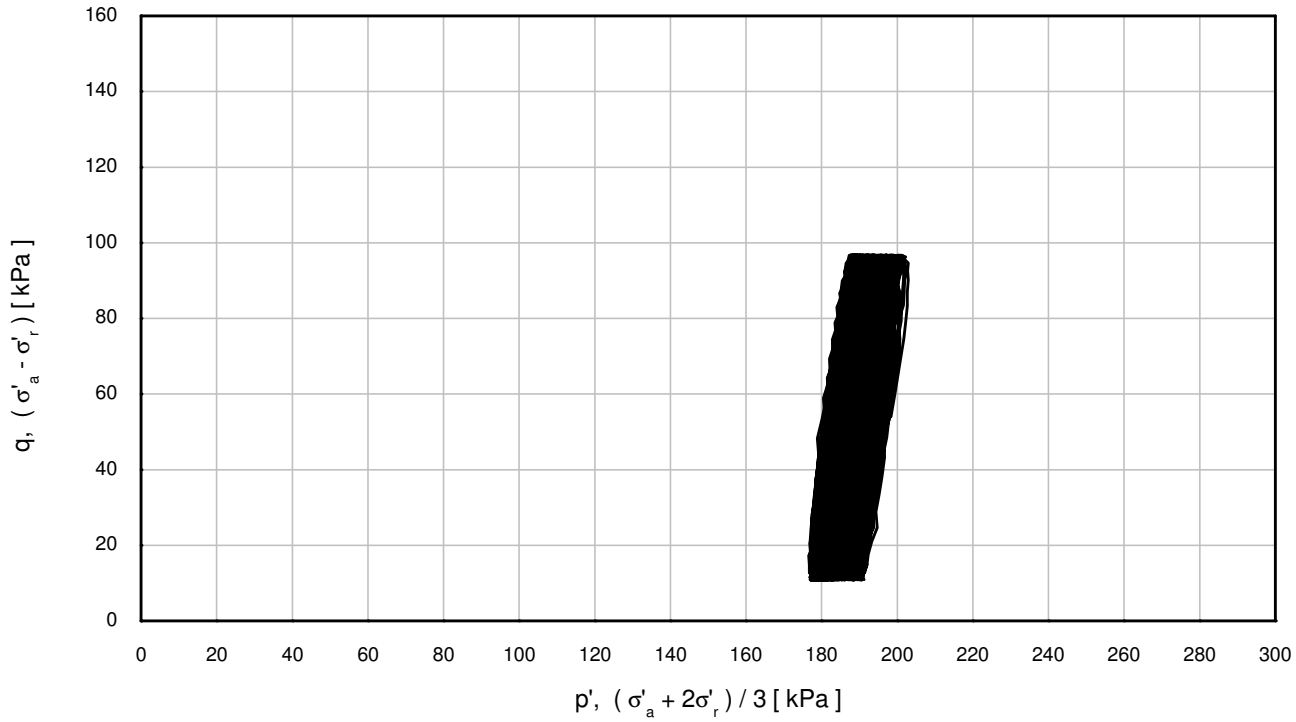




Initial σ'_r	: 180 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 234 kPa	Sample	: 25WAXA
q_{av}	: 54 kPa	Depth [m]	: 22.55
q_{cy}	: 43 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

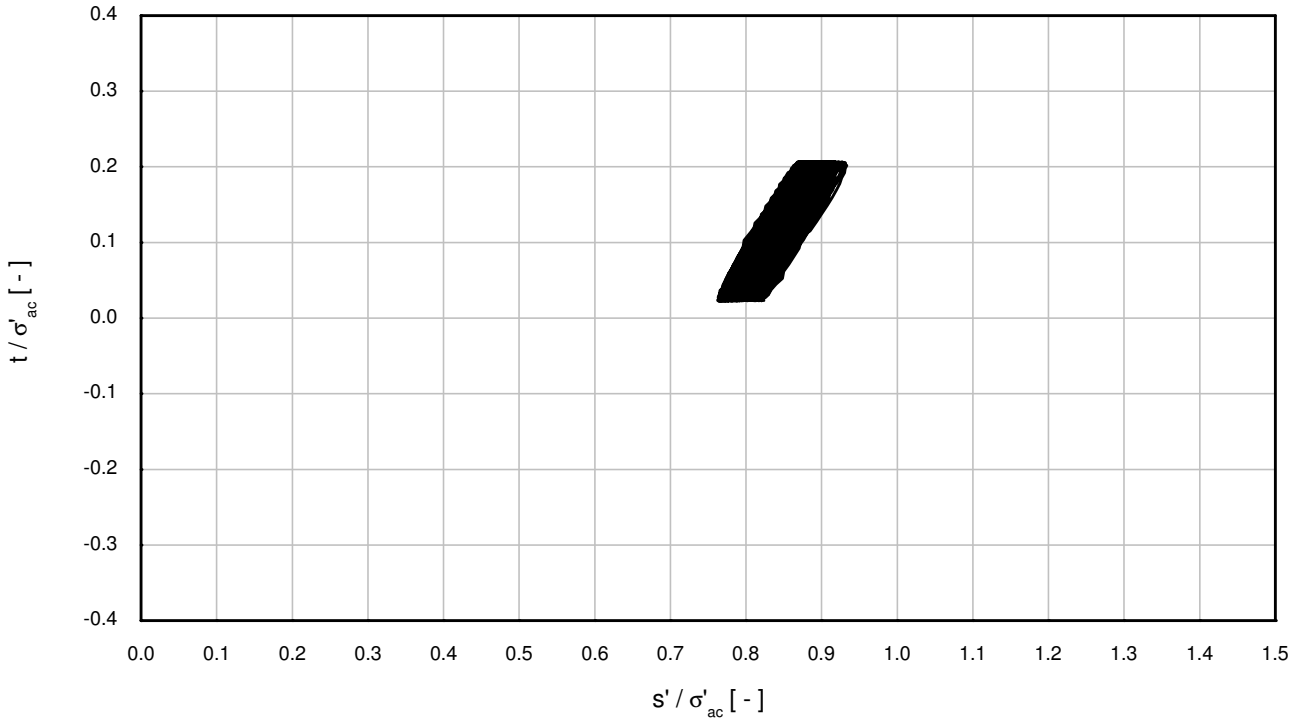
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

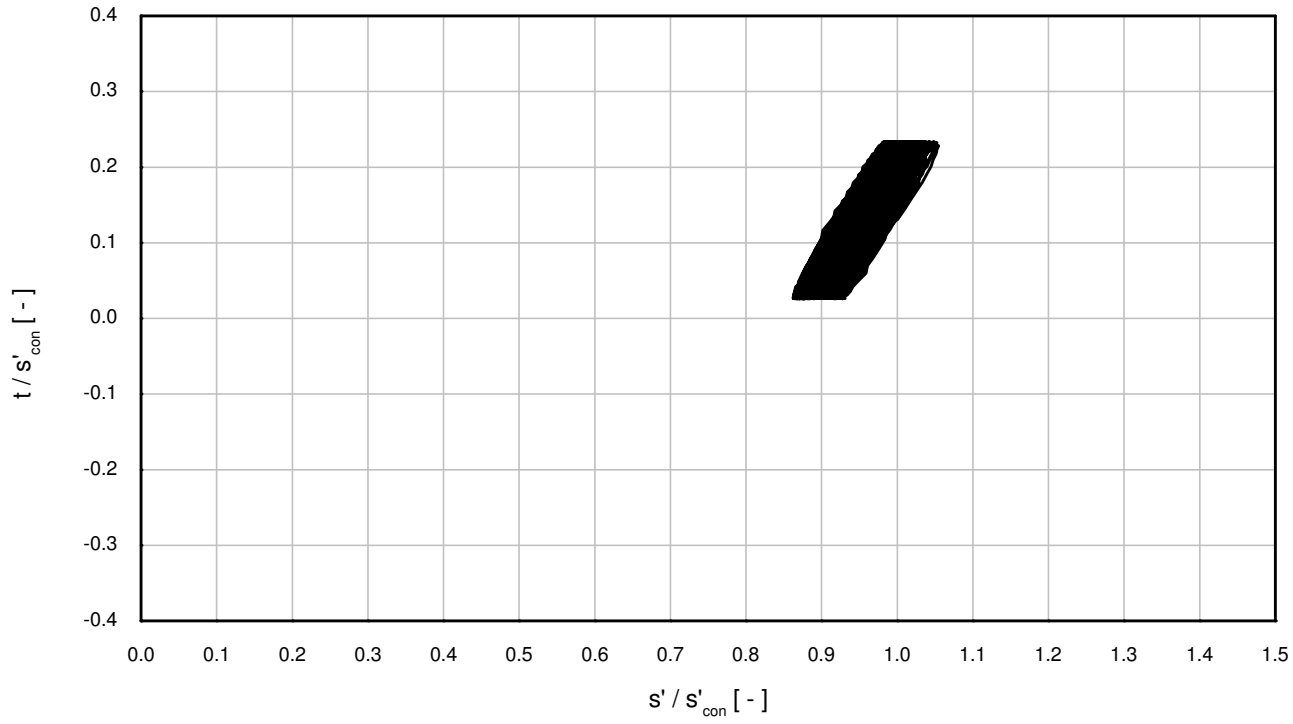




Initial σ'_r	:	180 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	234 kPa	Sample	: 25WAXA
q_{av}	:	54 kPa	Depth [m]	: 22.55
q_{cy}	:	43 kPa	Test No.	: CTX16
Frequency	:	0.10 Hz		

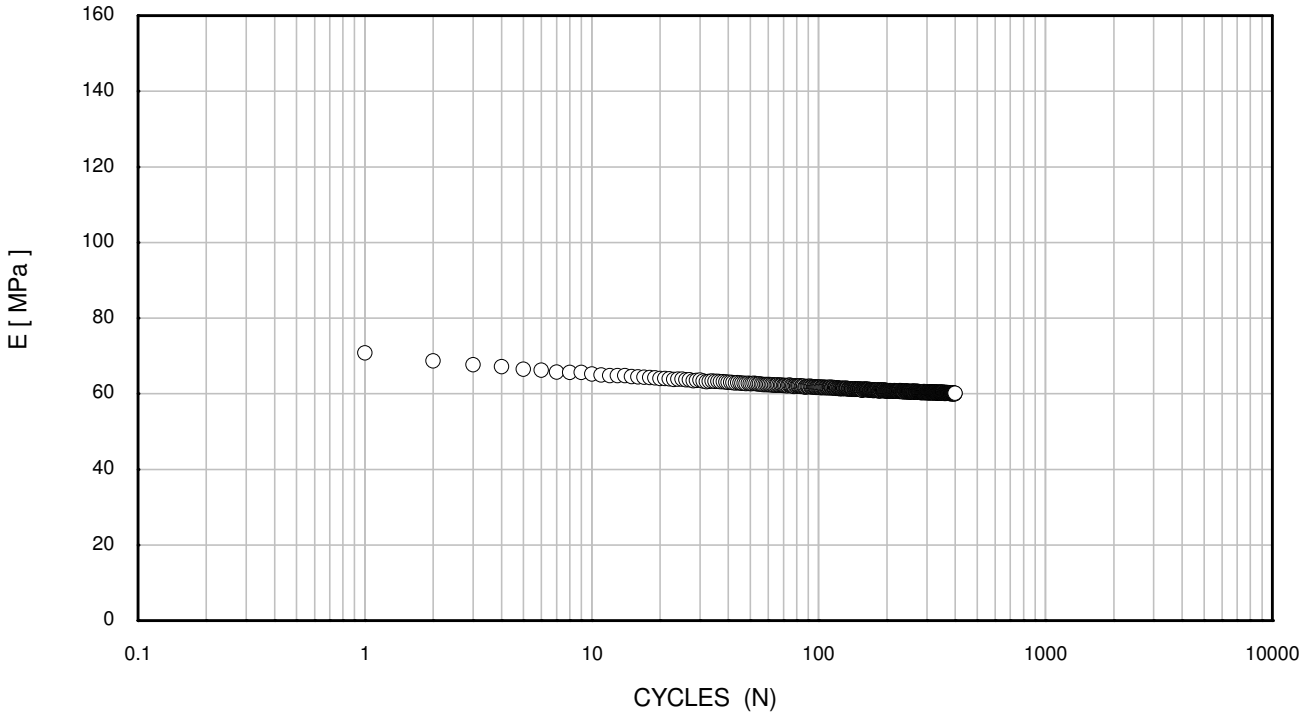
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

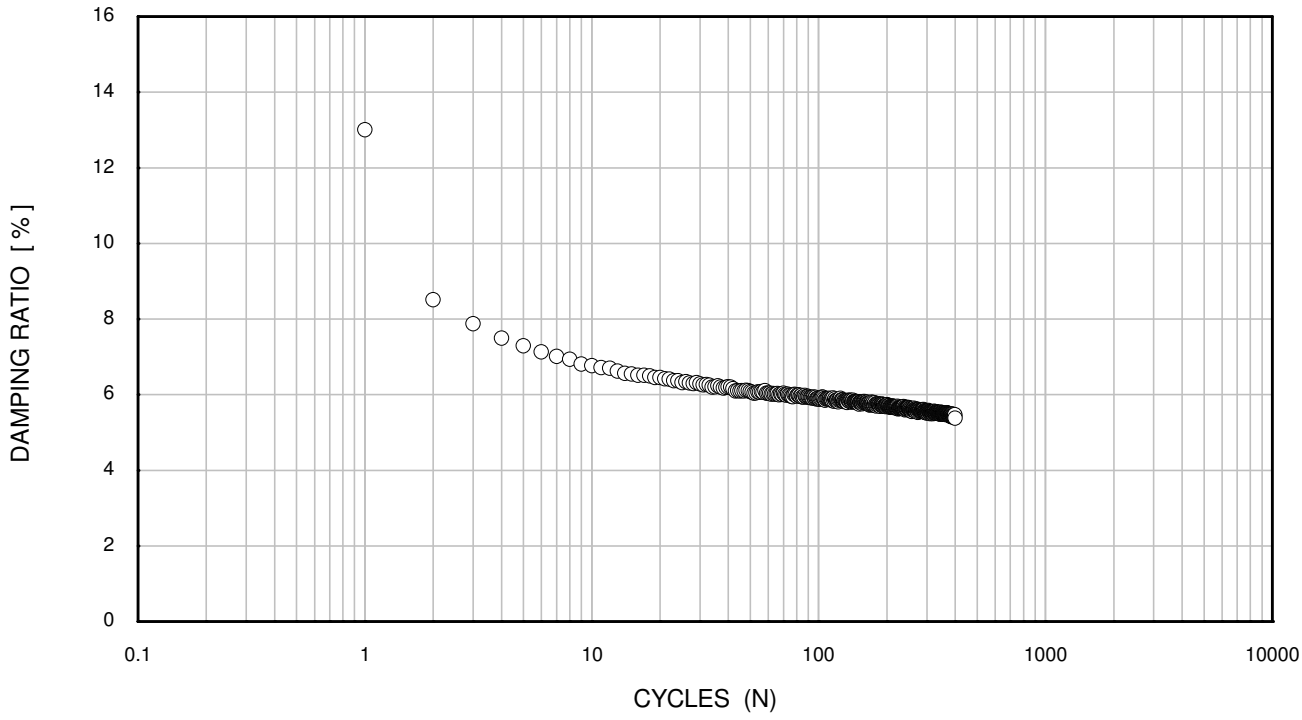




Initial σ'_r	:	180 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	234 kPa	Sample	:	25WAXA
q_{av}	:	54 kPa	Depth [m]	:	22.55
q_{cy}	:	43 kPa	Test No.	:	CTX16
Frequency	:	0.10 Hz			

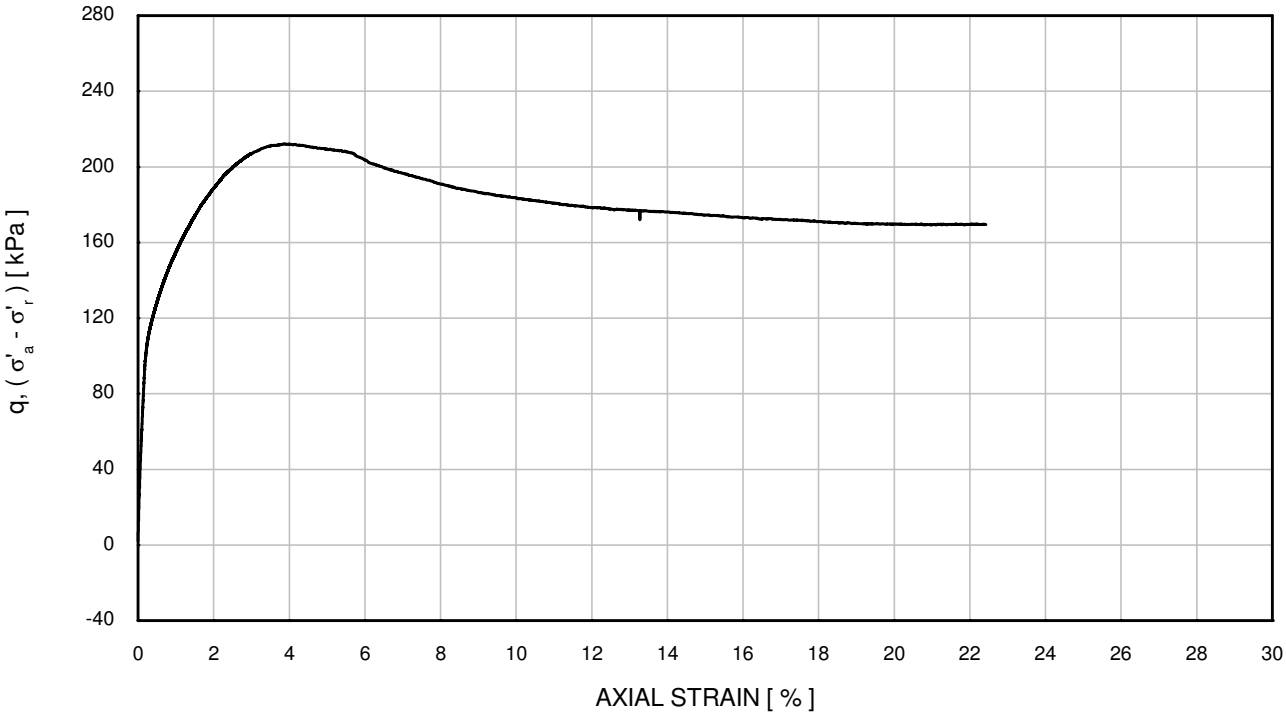
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

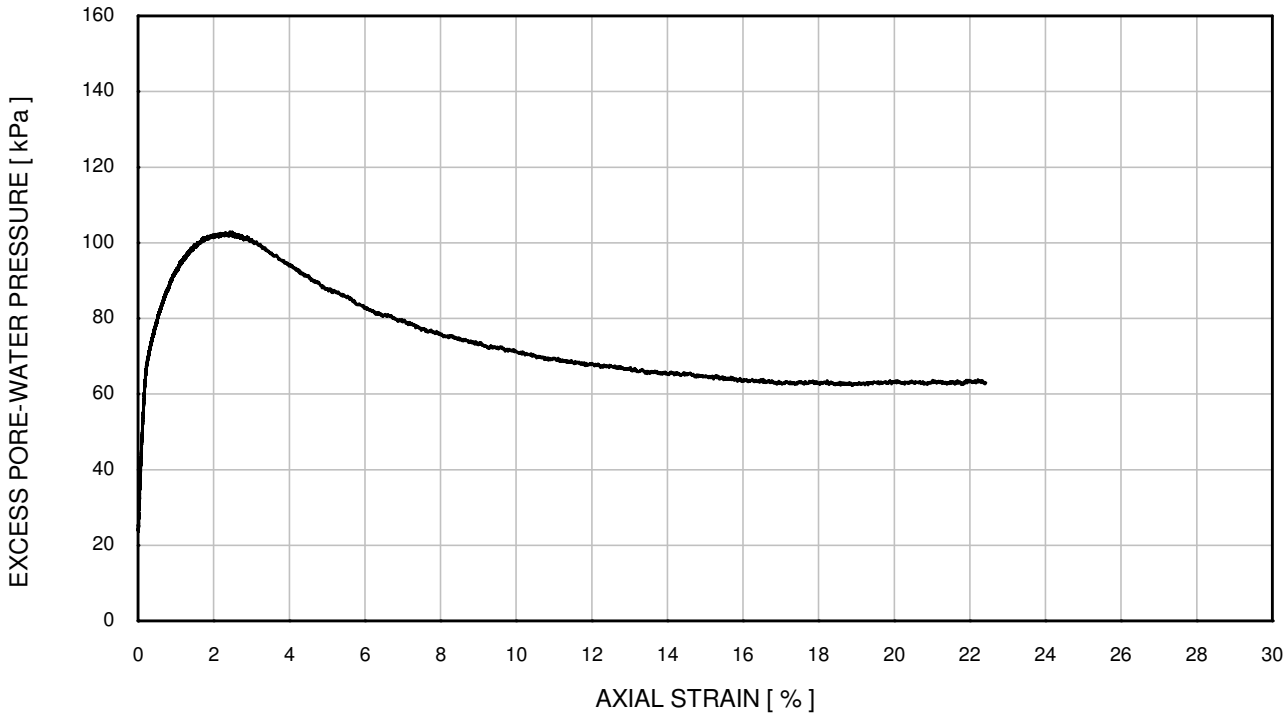




Initial σ'_r	: 180 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	: 234 kPa	Sample	: 25WAXA
q_{av}	: 54 kPa	Depth [m]	: 22.55
q_{cy}	: 43 kPa	Test No.	: CTX16
Frequency	: 0.10 Hz		

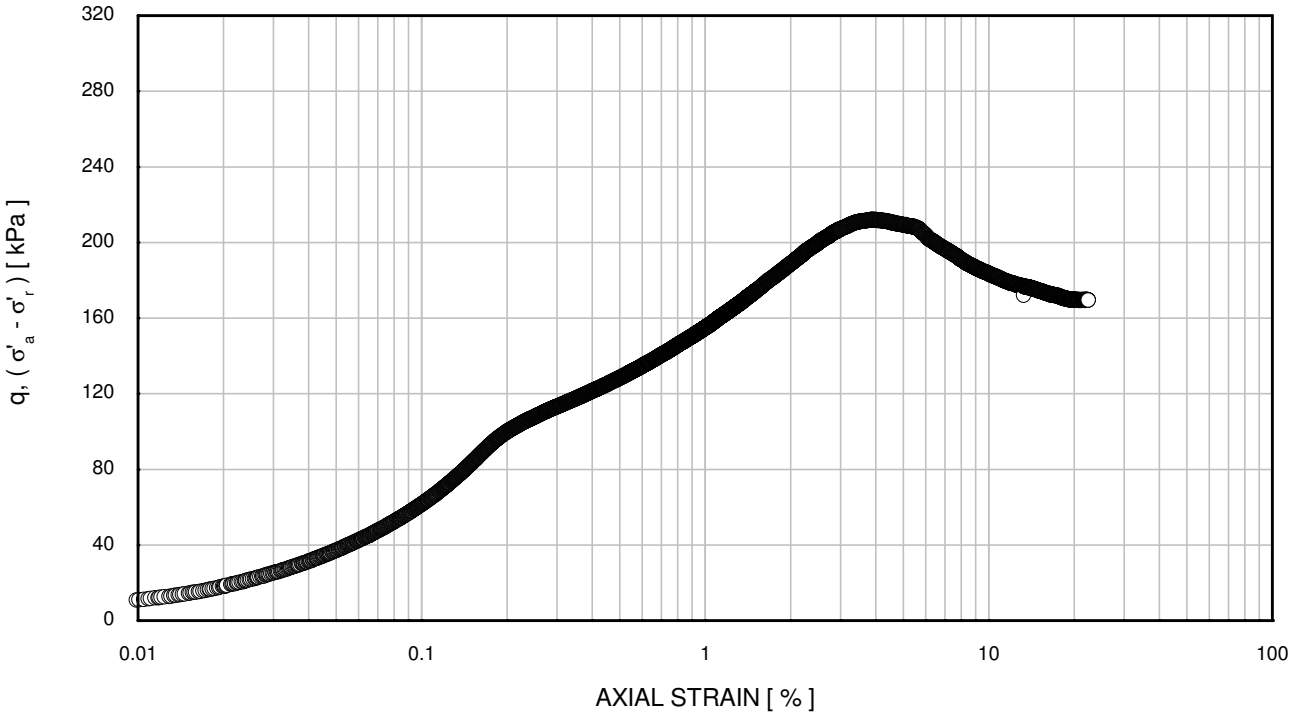
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

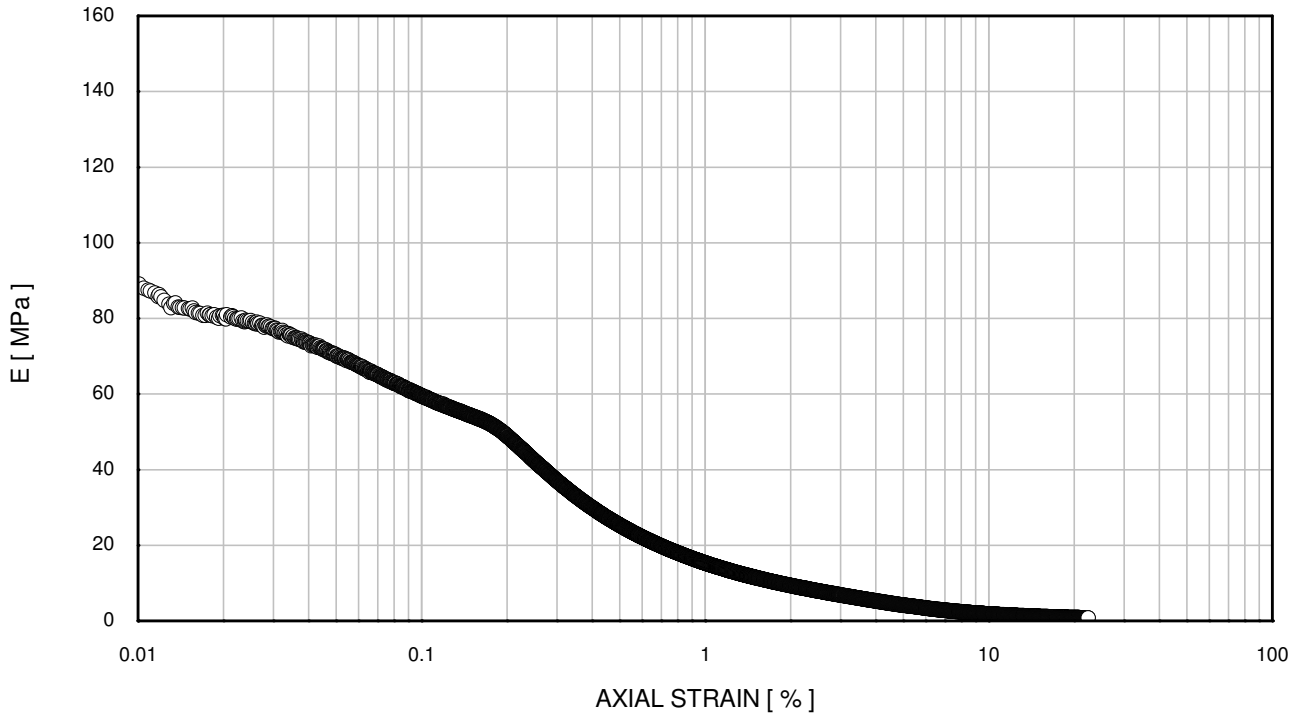




Initial σ'_r	:	183 kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	185 kPa	Sample	: 25WAXA
q_{peak}	:	212 kPa	Depth [m]	: 22.55
Ext. ε at q_{peak}	:	3.90 %	Test No.	: CTX16
Rate of strain	:	0.50 %/hour		

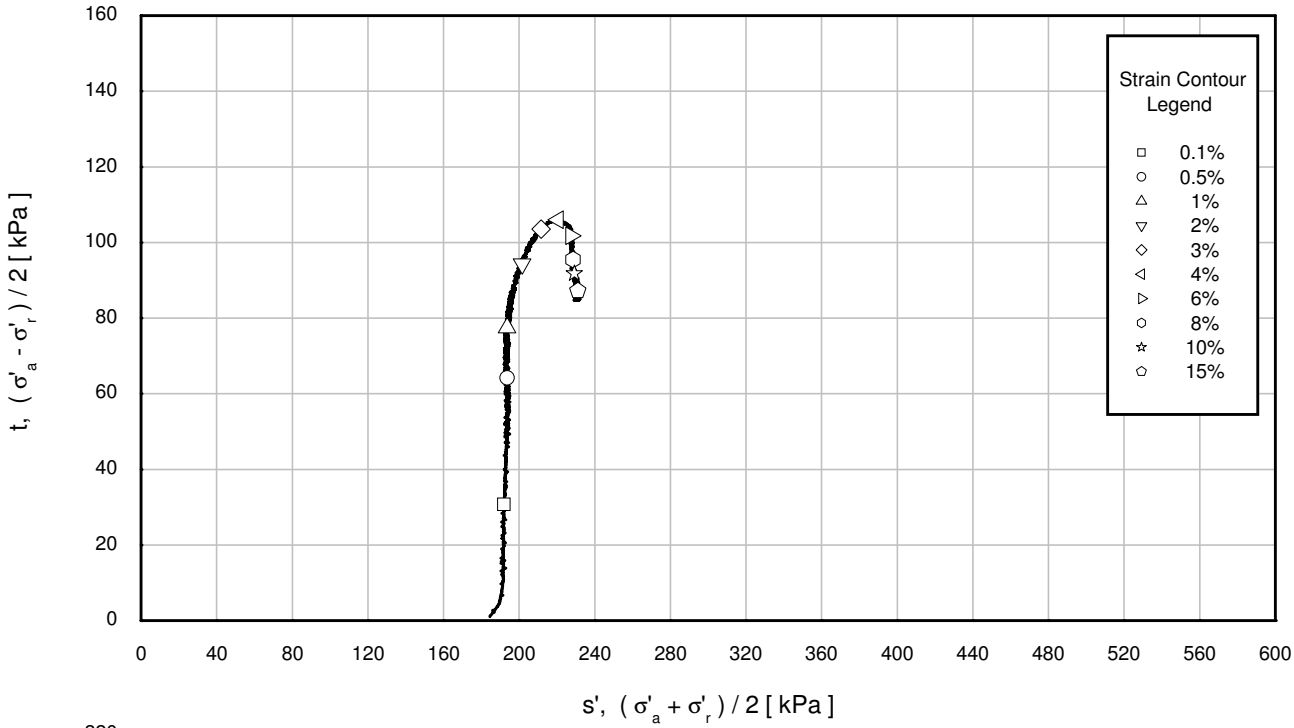
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

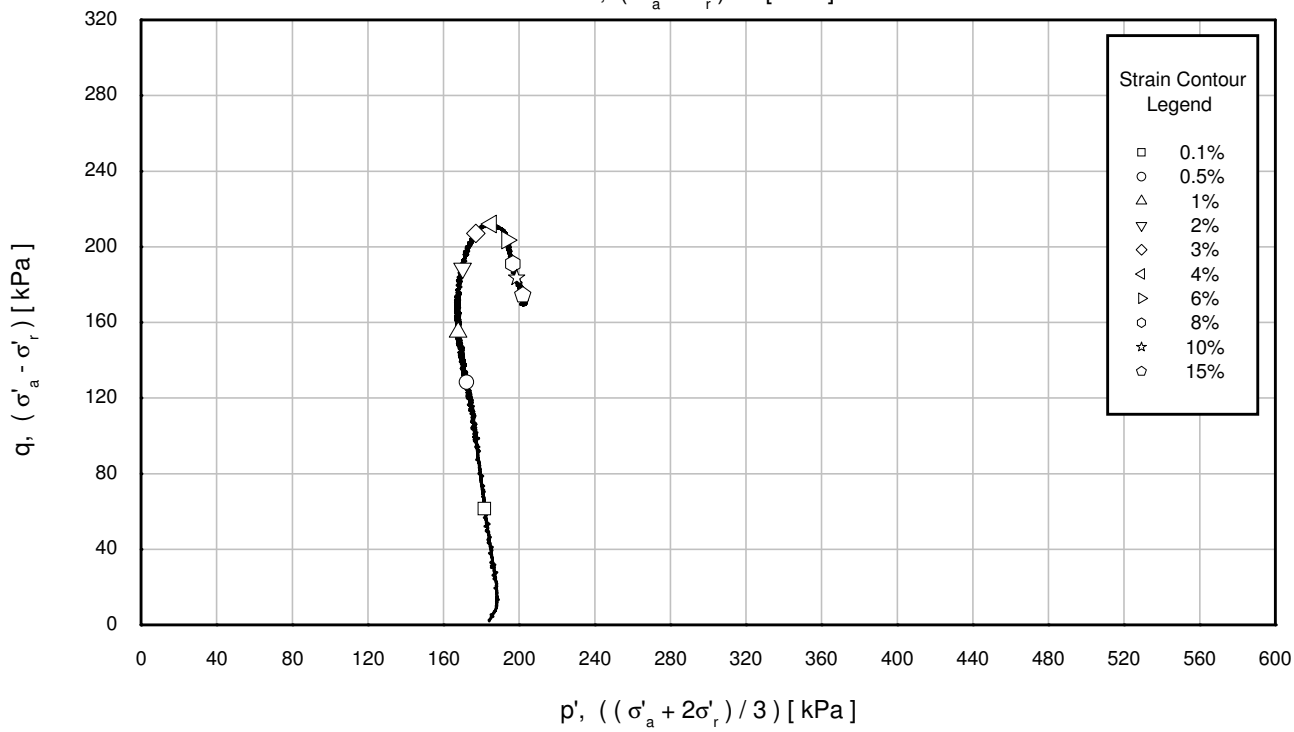




Initial σ'_r	:	183 kPa	Borehole	:	HKZ1-BH01-SA
Initial σ'_a	:	185 kPa	Sample	:	25WAXA
q_{peak}	:	212 kPa	Depth [m]	:	22.55
Ext. ε at q_{peak}	:	3.90 %	Test No.	:	CTX16
Rate of strain	:	0.50 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	183	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	185	kPa	Sample	: 25WAXA
q_{peak}	:	212	kPa	Depth [m]	: 22.55
Ext. ε at q_{peak}	:	3.90	%	Test No.	: CTX16
Rate of strain	:	0.50	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark grey slightly silty CLAY

GENERAL	
Date test started	08/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	71.3
Length	[mm]	144.3
Water content	[%]	30.2
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.52
Void ratio	[-]	0.780
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ1-BH21-SA_29D_CTX17_CTXL
Processed by Date	JLS 23/12/2016
Checked by Date	
Approved by Date	

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	877
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1077
Back pressure	[kPa]	877
Base PWP	[kPa]	876
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	201
Effective axial pressure	[kPa]	220
Deviator stress	[kPa]	19
Volumetric strain	[%]	2.76
External axial strain	[%]	1.35
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.735
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1077
Back pressure	[kPa]	877
Base PWP	[kPa]	880
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	197
Effective axial pressure	[kPa]	226
Deviator stress	[kPa]	29
Volumetric strain	[%]	0.00
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.735
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	29
Mean q_{cy}	[kPa]	29
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	-0.01
External ε_{cy} at N_f	[%]	0.04
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	8
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.735
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.01	0.04	70.35	-	24.45	-
2	-0.01	0.04	70.30	-	24.32	-
5	-0.01	0.04	69.69	-	24.01	-
10	-0.01	0.04	69.86	-	23.07	-
20	-0.01	0.04	69.37	-	22.50	-
30	-0.01	0.04	69.14	-	22.14	-
40	-0.01	0.04	69.00	-	22.30	-
50	-0.01	0.04	68.83	-	21.97	-
100	-0.01	0.04	68.09	-	21.27	-
500	-0.01	0.04	66.31	-	22.99	-
1000	-0.01	0.04	65.87	-	23.52	-
1500	-0.01	0.04	65.02	-	22.97	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1077
Back pressure	[kPa]	876
Base PWP	[kPa]	888
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	189
Effective axial pressure	[kPa]	232
Deviator stress	[kPa]	43
Volumetric strain	[%]	0.02
External axial strain	[%]	0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.735
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	43
Mean q_{cy}	[kPa]	43
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.04
External ε_{cy} at N_f	[%]	0.06
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	11
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.735
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.02	0.05	80.05	-	18.42	-
2	0.02	0.05	79.11	-	18.47	-
5	0.02	0.05	78.20	-	16.24	-
10	0.02	0.05	78.00	-	15.03	-
20	0.02	0.06	77.28	-	14.04	-
30	0.02	0.06	76.60	-	13.82	-
40	0.03	0.06	75.99	-	13.89	-
50	0.03	0.06	75.42	-	13.78	-
100	0.03	0.06	74.78	-	13.66	-
200	0.03	0.06	74.00	-	13.22	-
300	0.04	0.06	71.78	-	13.55	-
400	0.04	0.06	71.74	-	13.87	-

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	177
Initial effective axial pressure	[kPa]	220
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	313
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.17
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	73
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	124
Effective axial pressure	[kPa]	437
Principal effective stress ratio	[-]	3.53
ε_{50}	[%]	0.58
Secant modulus (E_{50}) at ε_{50}	[kPa]	26152
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	299
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.97
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	85
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	112
Effective axial pressure	[kPa]	411
Principal effective stress ratio	[-]	3.67
At 10% external axial strain		
Corrected deviator stress	[kPa]	263
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	10.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	84
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	114
Effective axial pressure	[kPa]	377
Principal effective stress ratio	[-]	3.32

TEST IDENTIFICATION	
Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





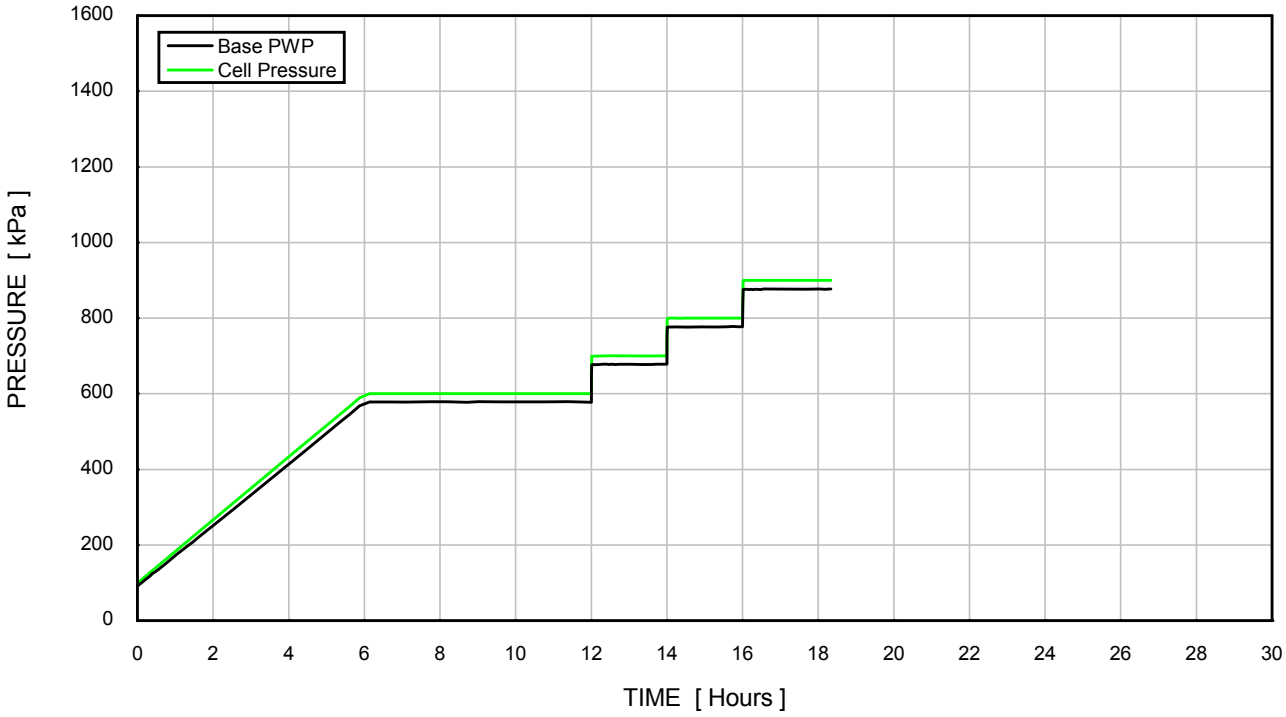
FINAL CONDITIONS

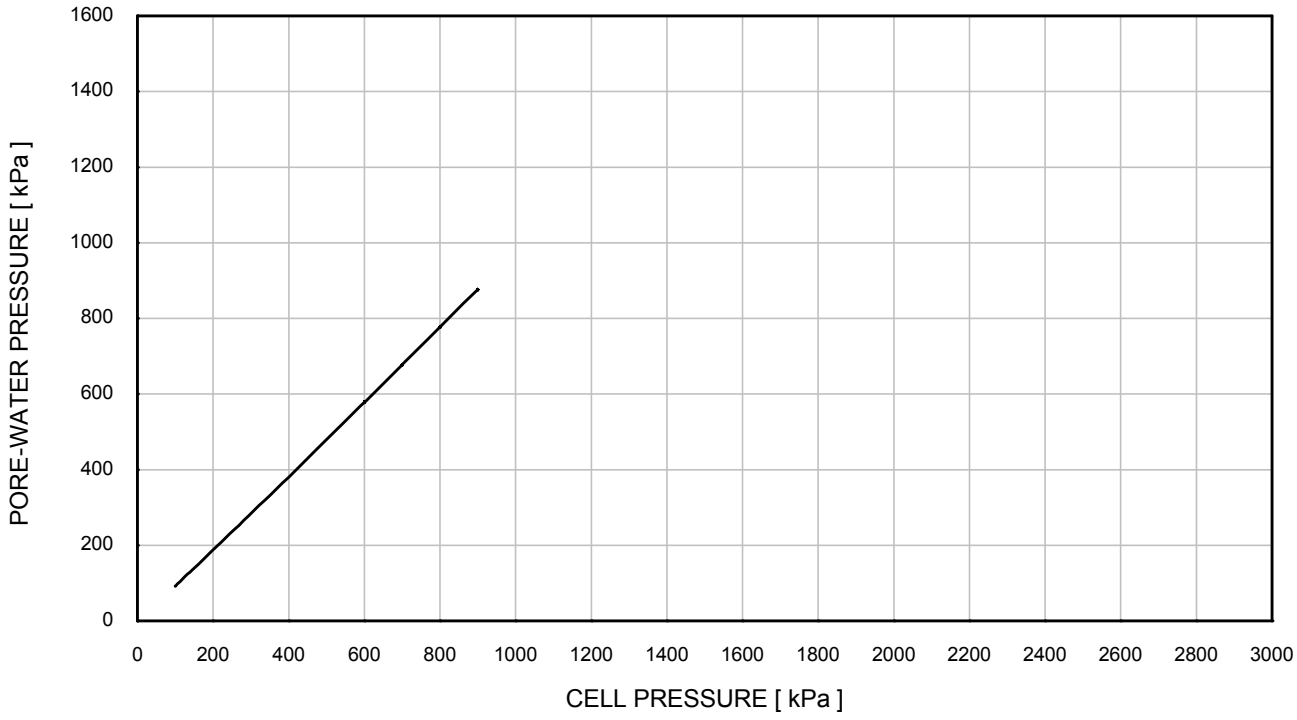
Water content	[%]	28.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.56

TEST IDENTIFICATION

Borehole	HKZ1-BH21-SA
Sample	29WAXD
Depth [m]	22.56
Test number	CTX17

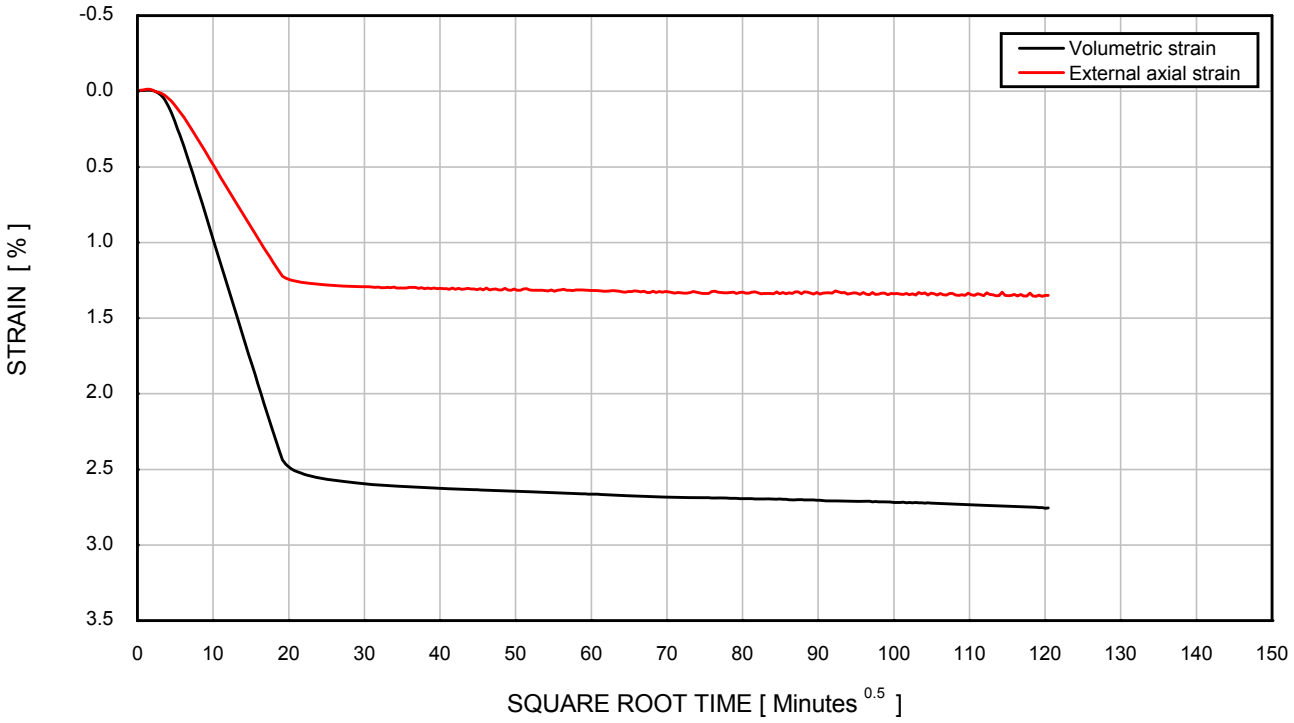
SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

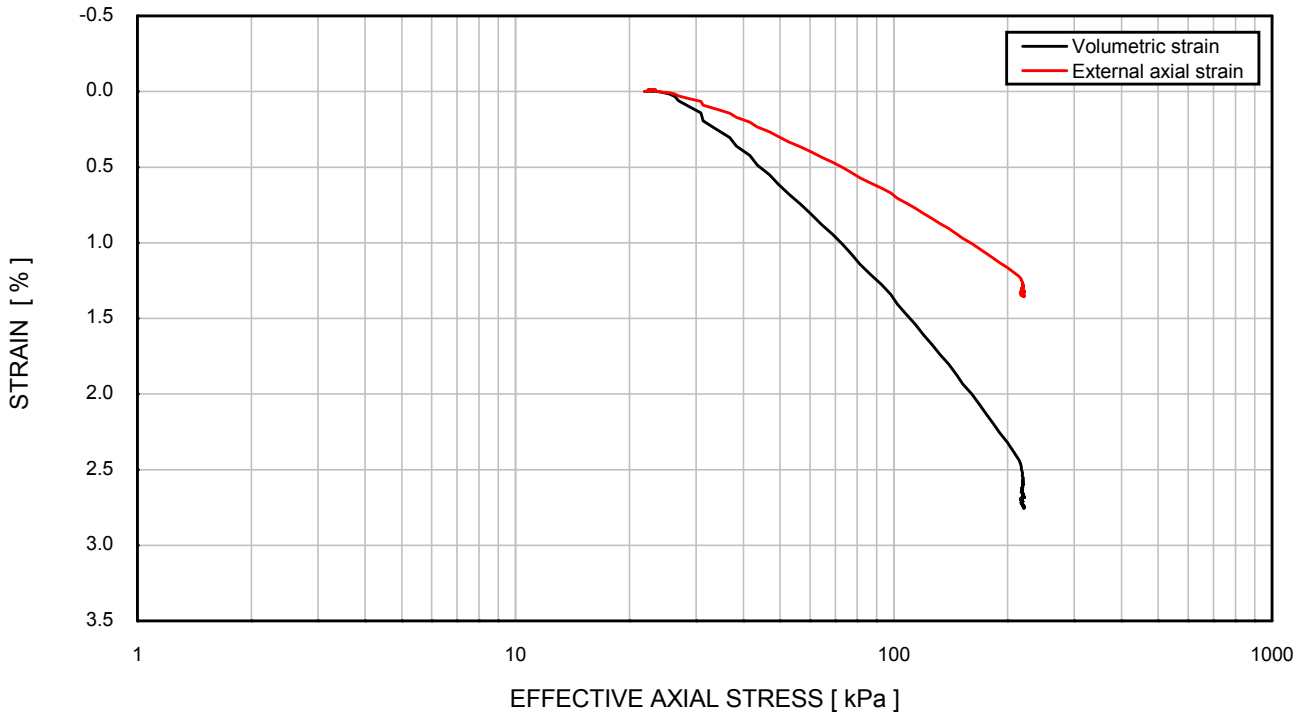




B value	:	1.00			
Initial σ'_r	:	9	kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	:	8	kPa	Sample	: 29WAXD
Final σ'_r	:	23	kPa	Depth [m]	: 22.56
Final σ'_a	:	24	kPa	Test No.	: CTX17

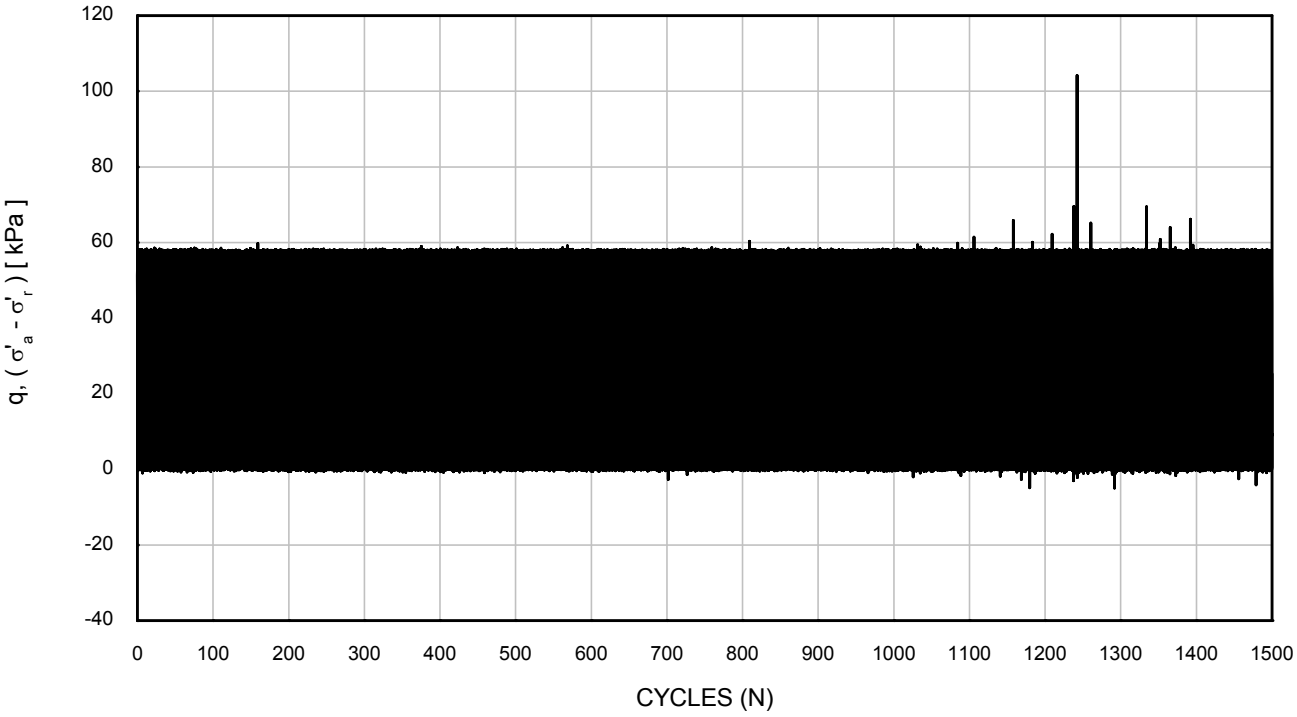
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

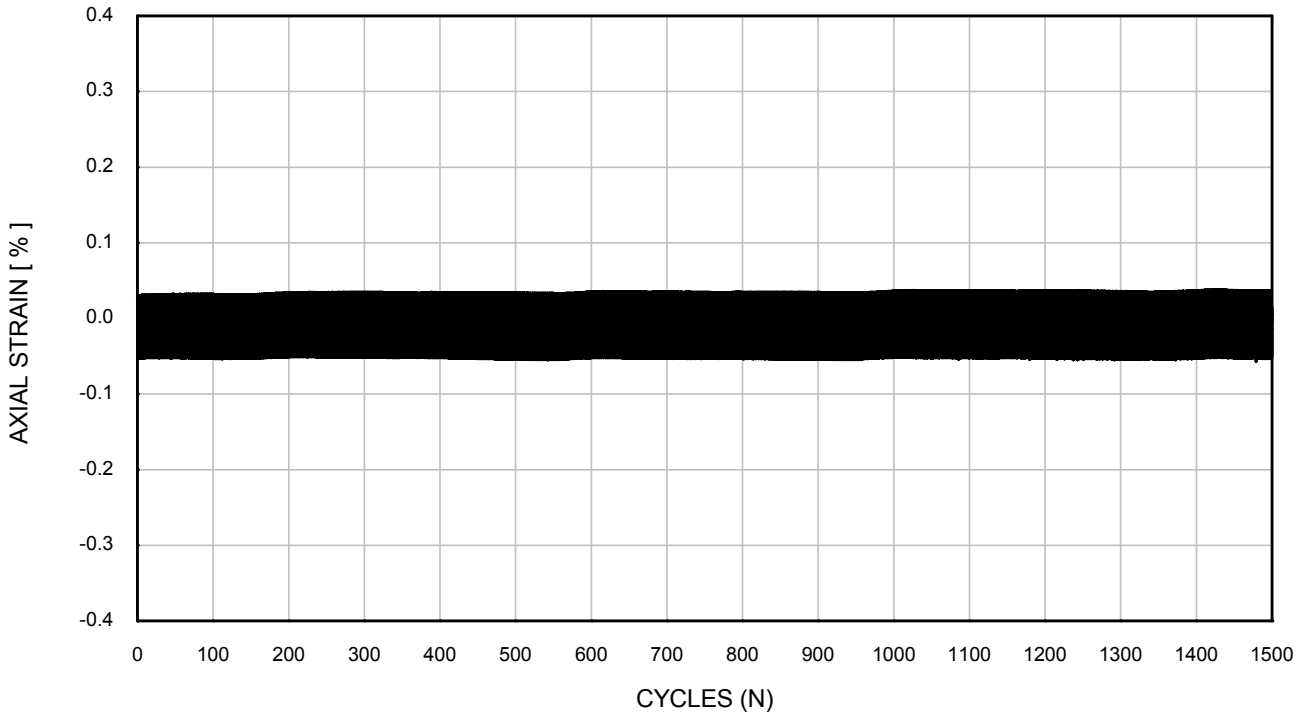




Stage 1 σ'_{rc}	: 201 kPa	Borehole	: HKZ1-BH21-SA
Stage 1 σ'_{ac}	: 220 kPa	Sample	: 29WAXD
		Depth [m]	: 22.56
		Test No.	: CTX17

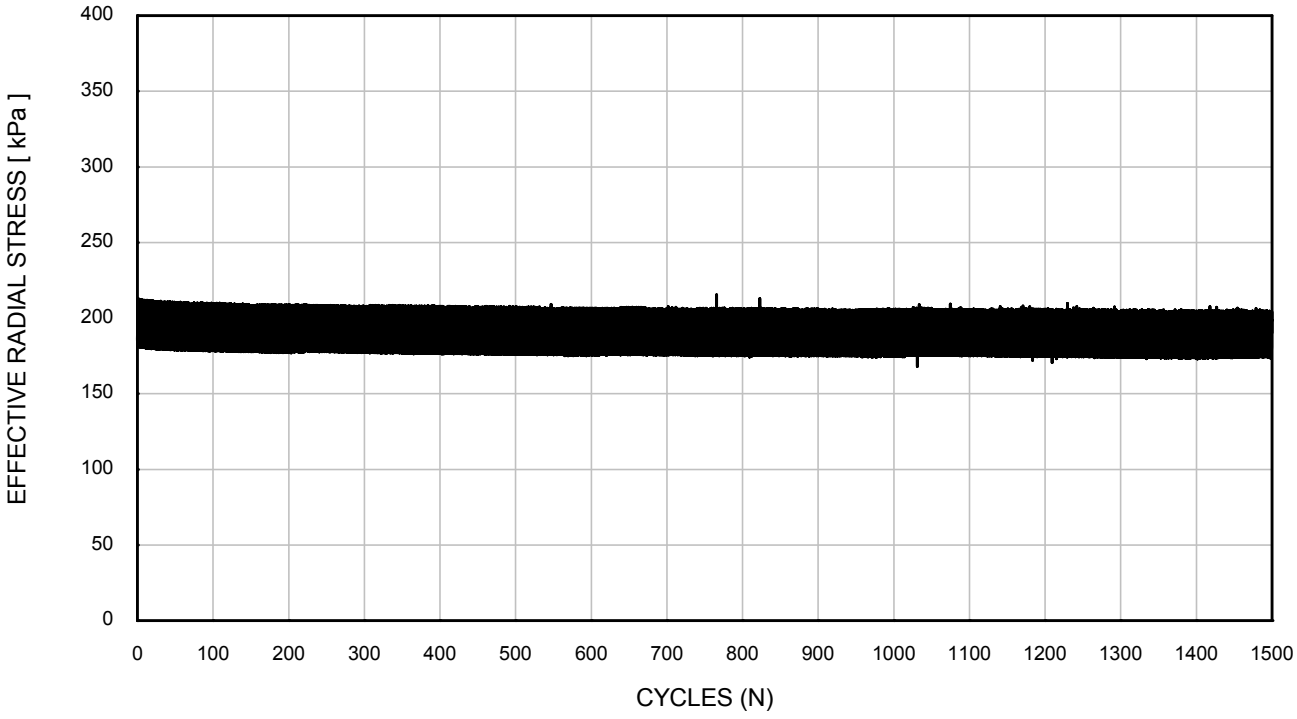
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

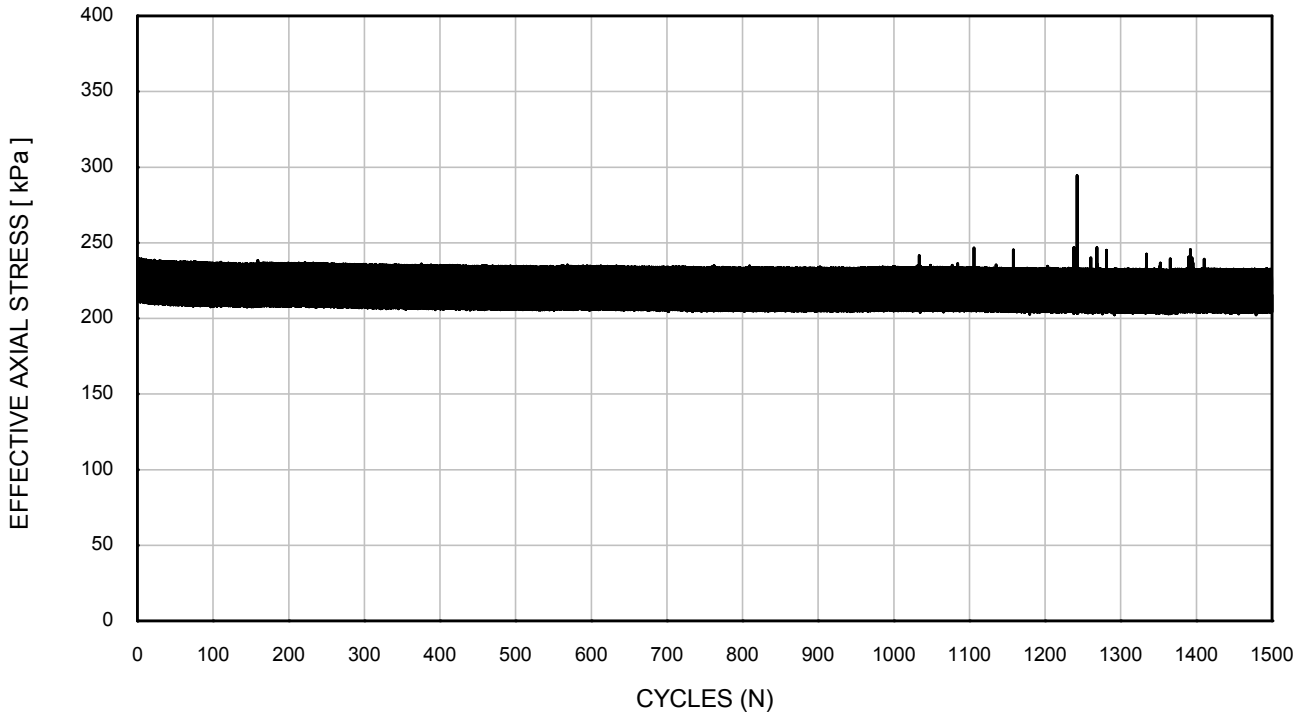




Initial σ'_r	:	197 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	226 kPa	Sample	:	29WAXD
q_{av}	:	29 kPa	Depth [m]	:	22.56
q_{cy}	:	29 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

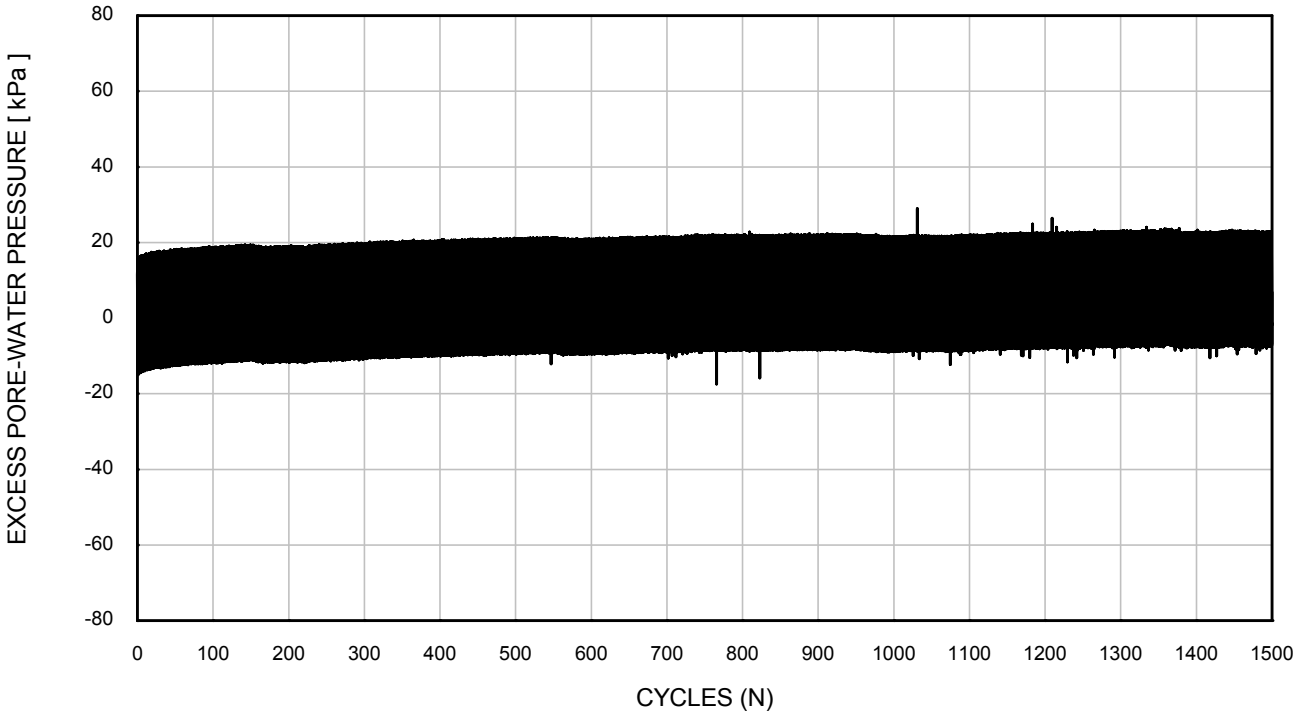
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

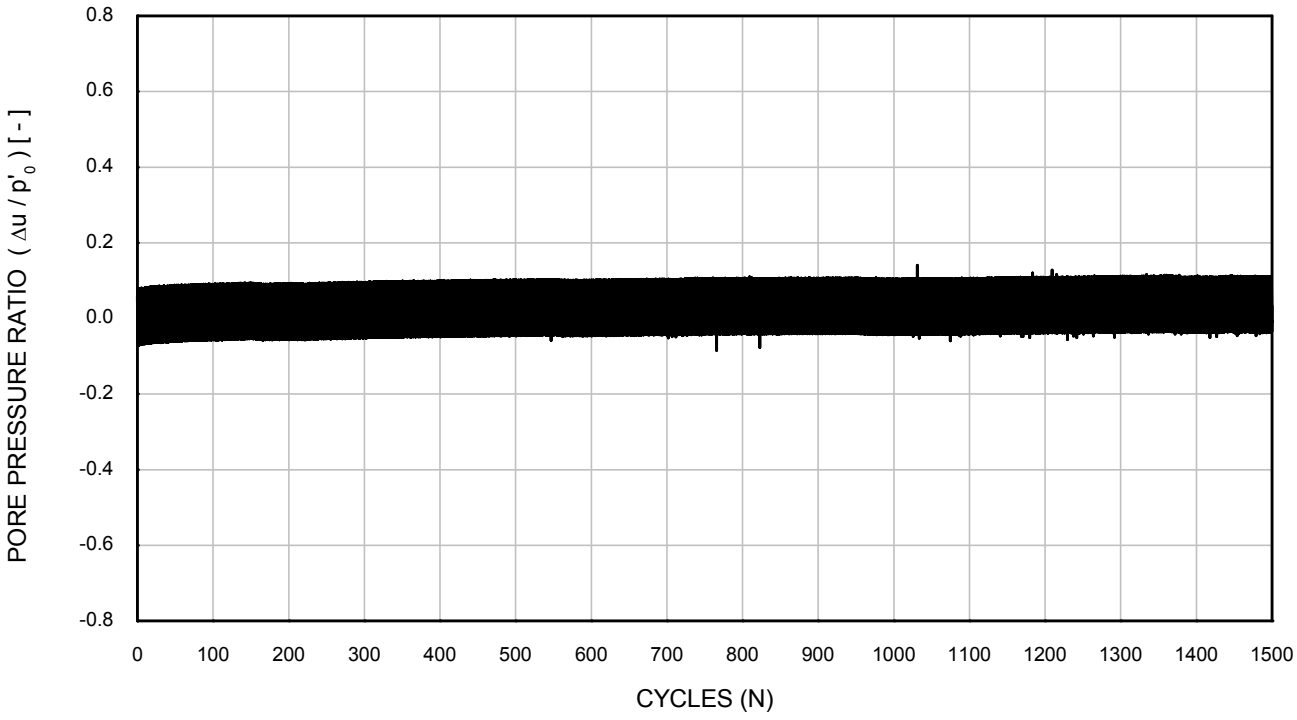




Initial σ'_r	: 197 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	: 226 kPa	Sample	: 29WAXD
q_{av}	: 29 kPa	Depth [m]	: 22.56
q_{cy}	: 29 kPa	Test No.	: CTX17
Frequency	: 0.10 Hz		

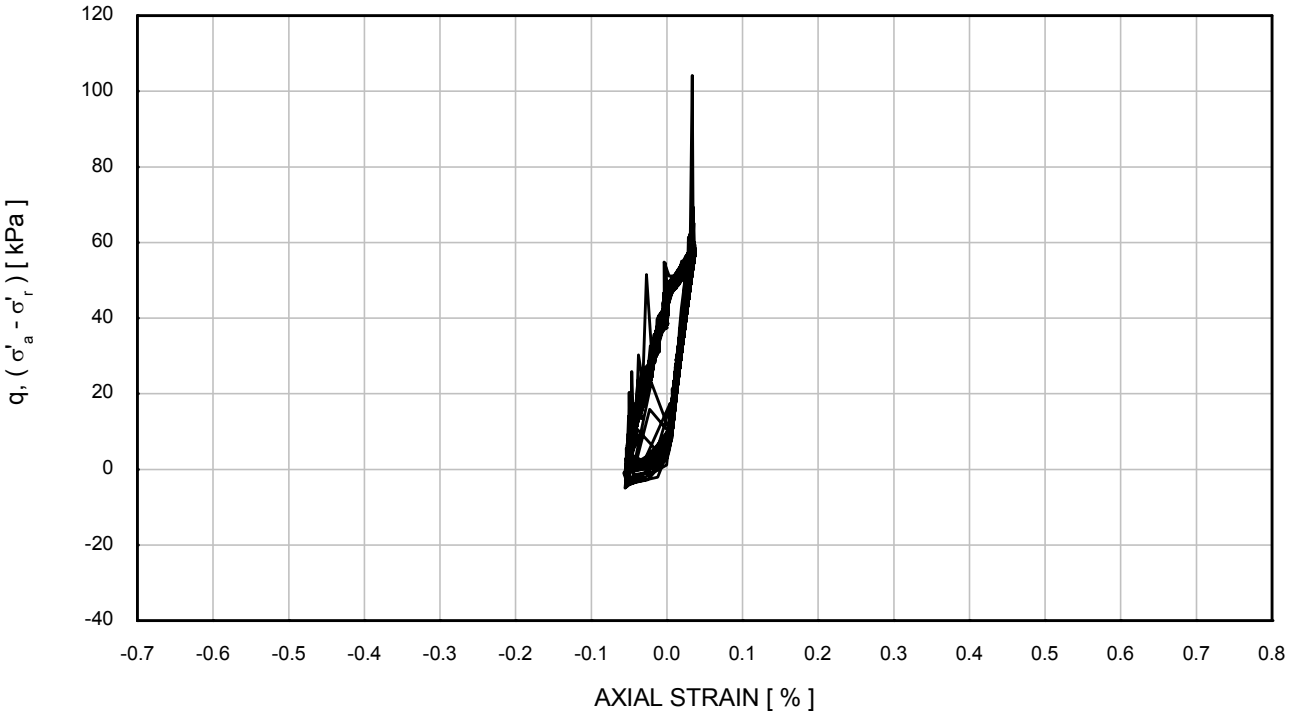
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

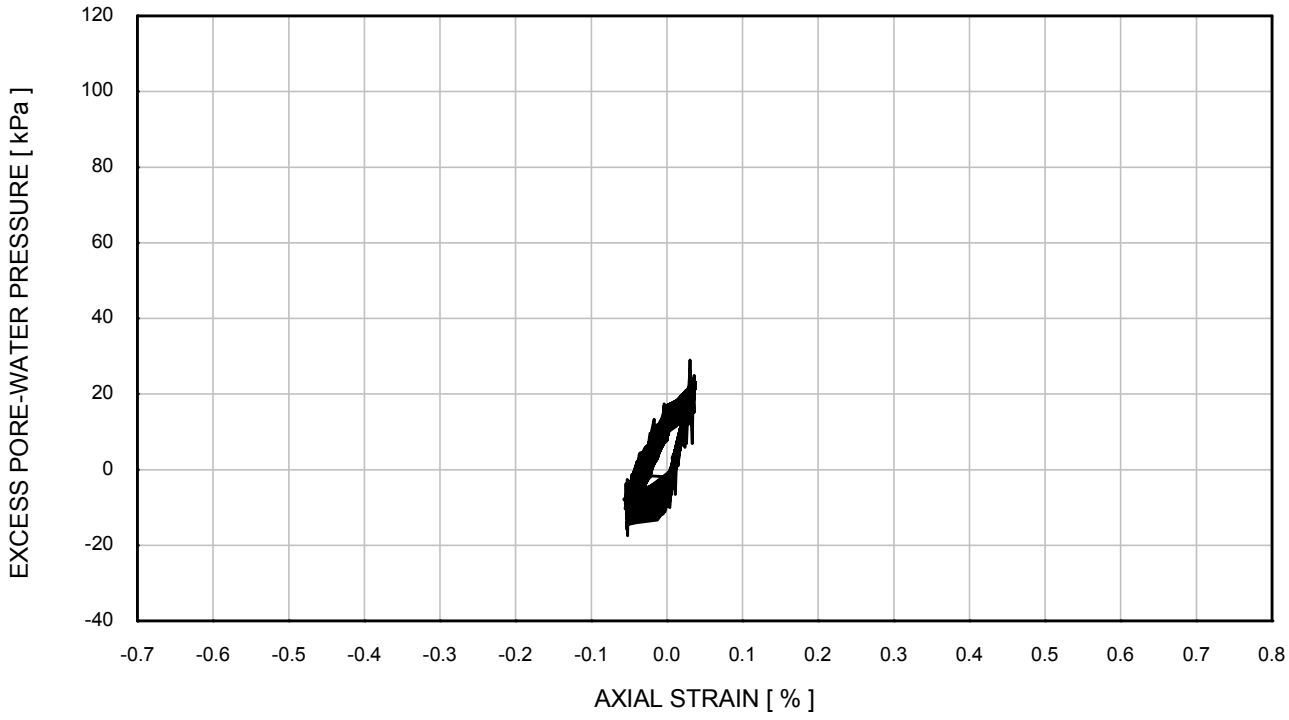




Initial σ'_r	: 197 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	: 226 kPa	Sample	: 29WAXD
q_{av}	: 29 kPa	Depth [m]	: 22.56
q_{cy}	: 29 kPa	Test No.	: CTX17
Frequency	: 0.10 Hz		

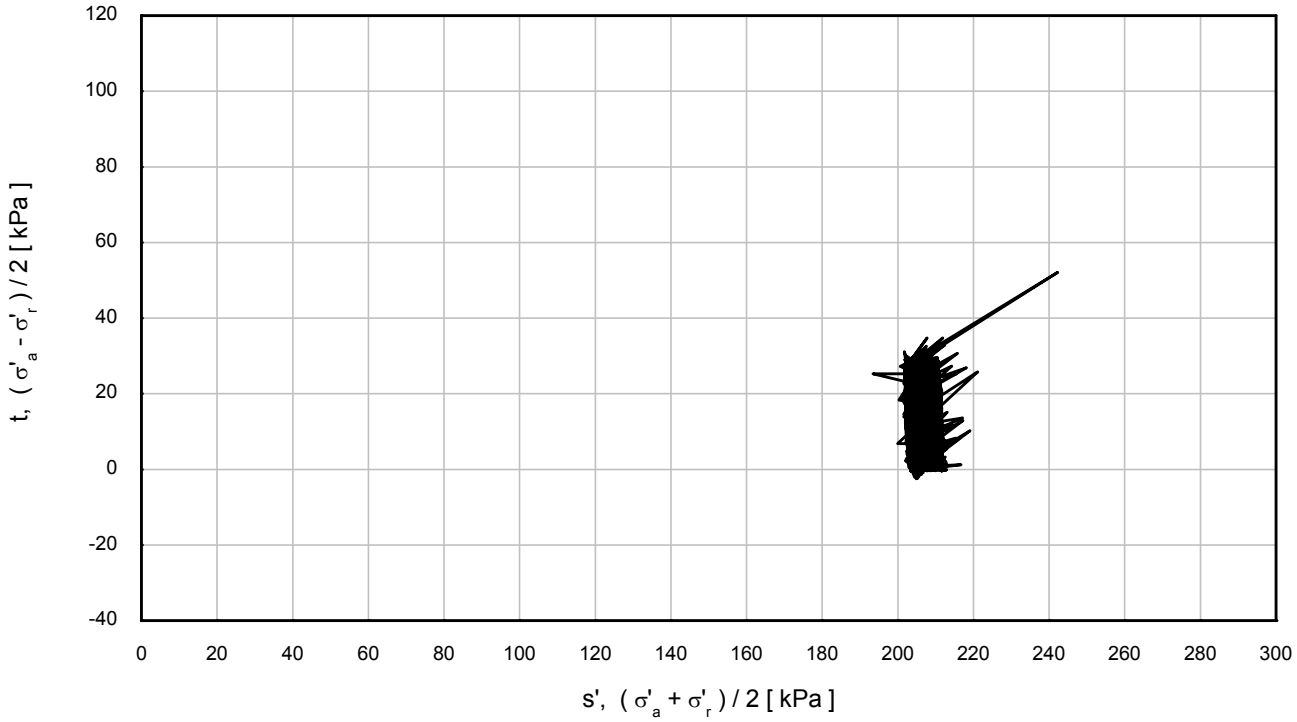
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

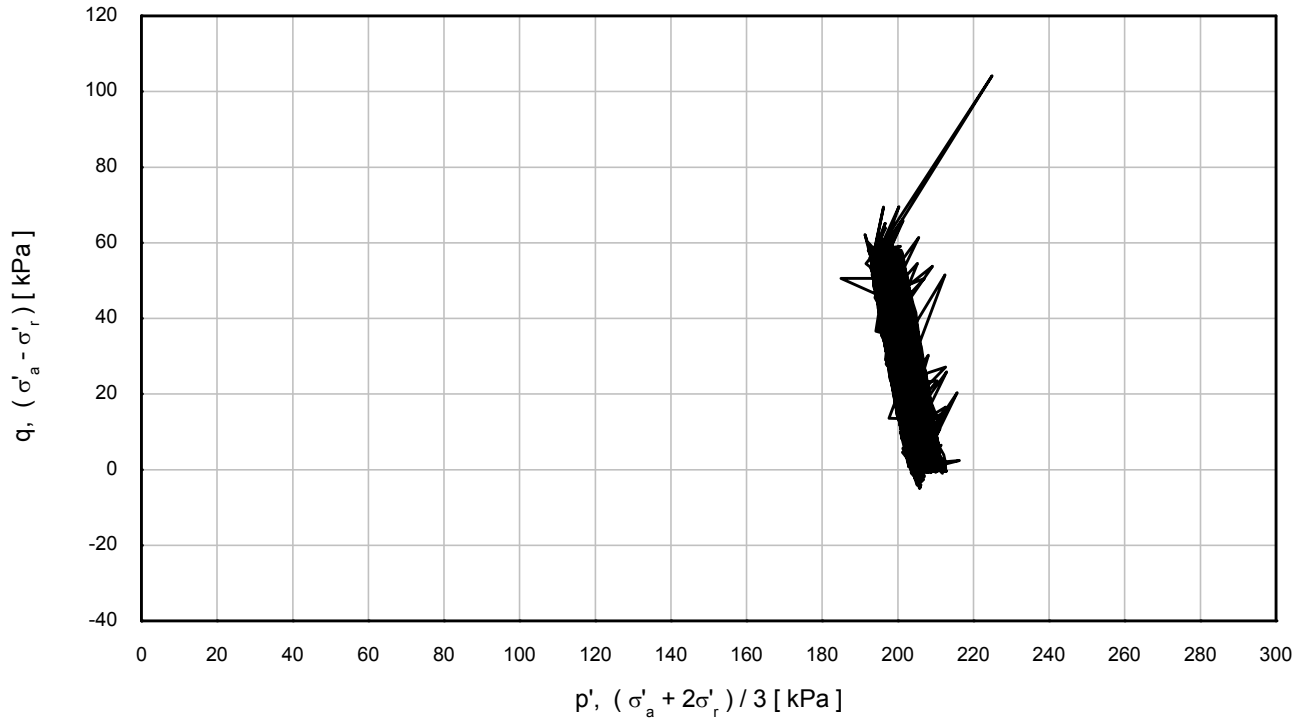




Initial σ'_r	:	197 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	:	226 kPa	Sample	: 29WAXD
q_{av}	:	29 kPa	Depth [m]	: 22.56
q_{cy}	:	29 kPa	Test No.	: CTX17
Frequency	:	0.10 Hz		

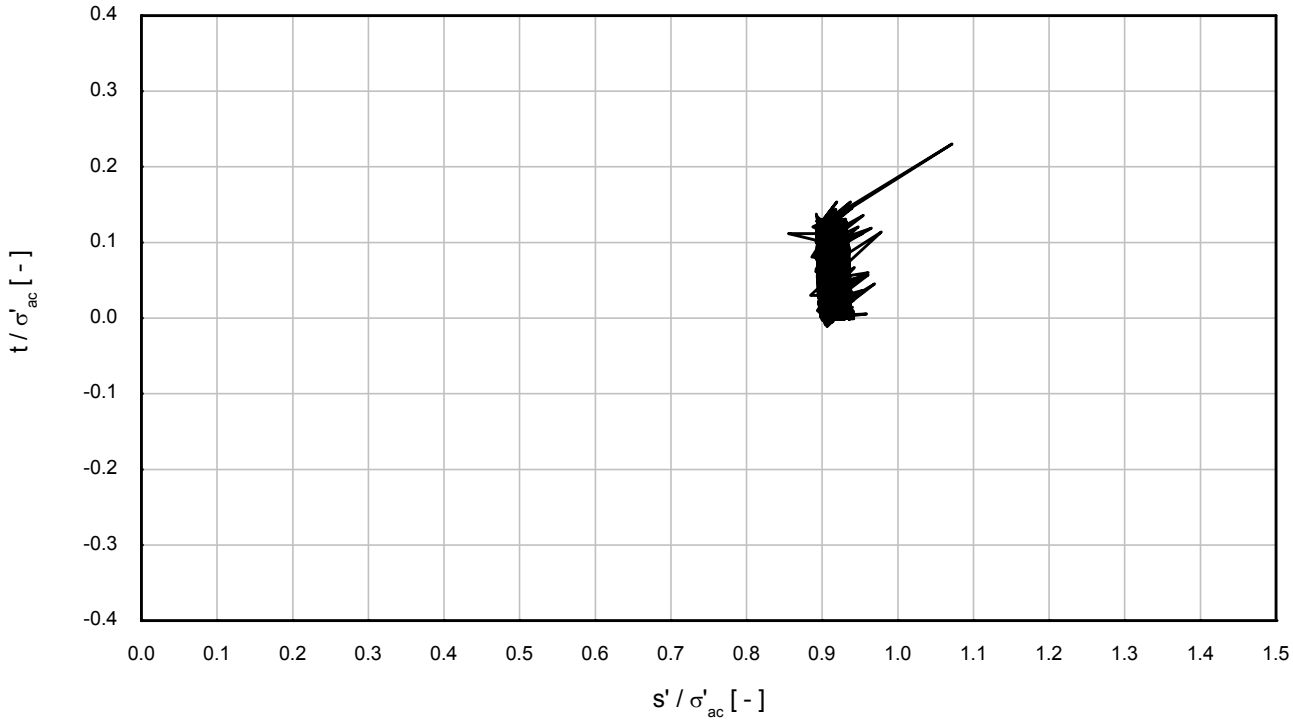
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

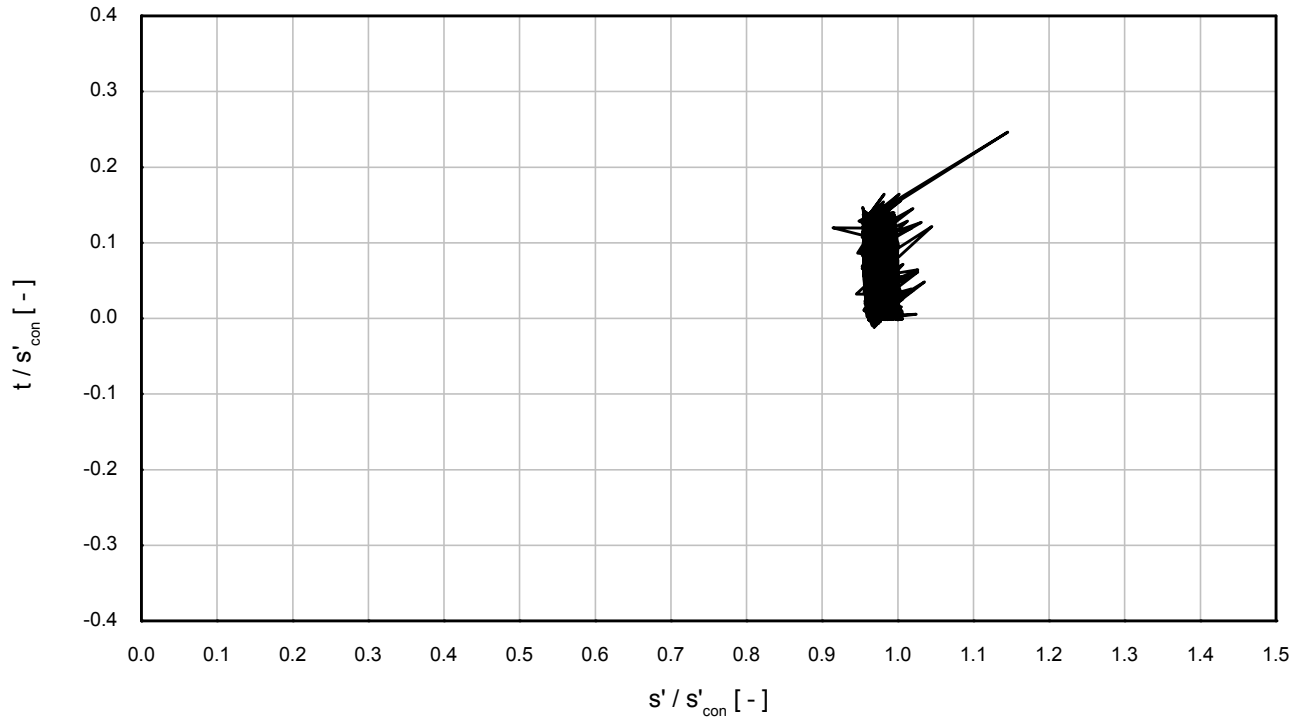




Initial σ'_r	:	197 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	226 kPa	Sample	:	29WAXD
q_{av}	:	29 kPa	Depth [m]	:	22.56
q_{cy}	:	29 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

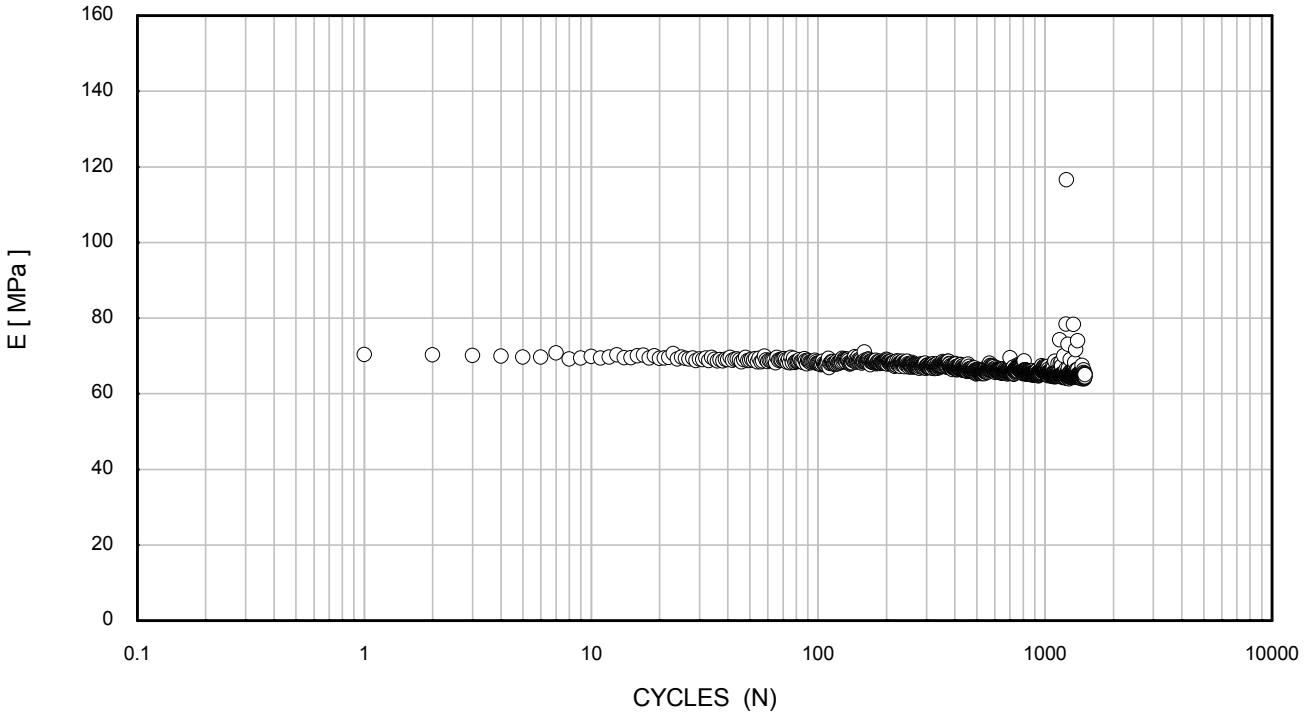
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

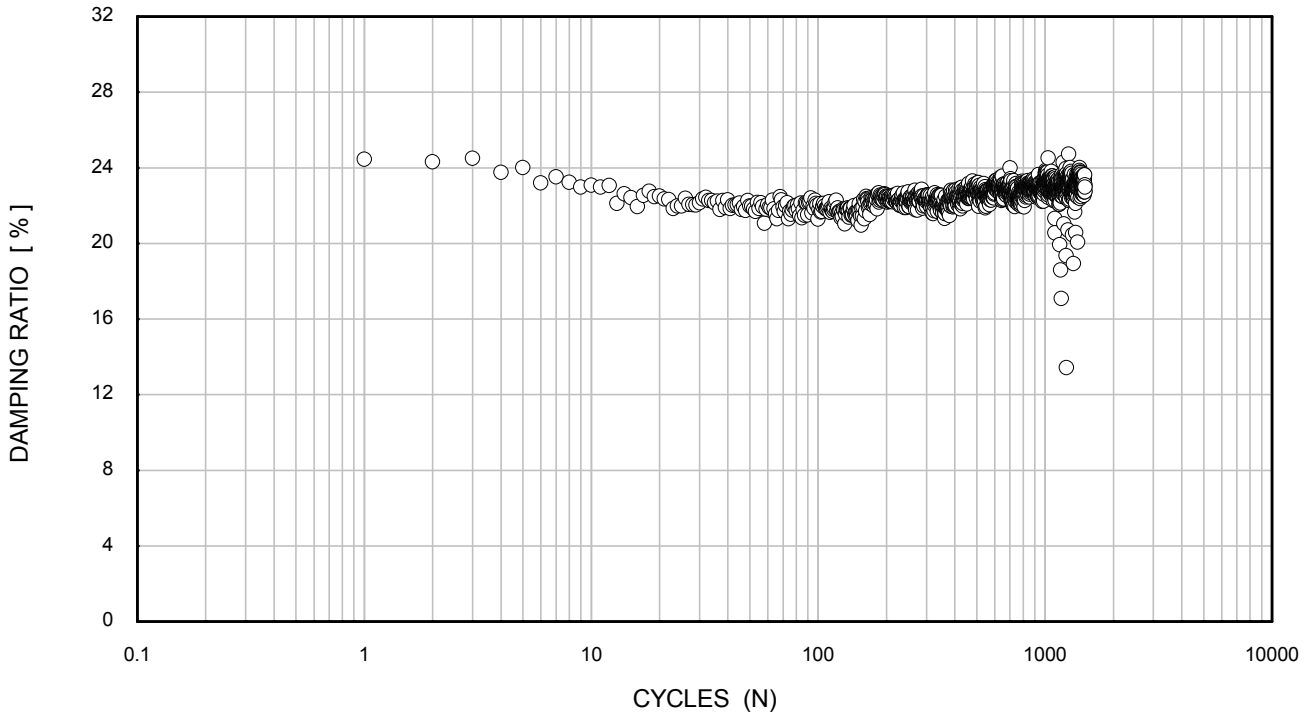




Initial σ'_r	:	197 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	226 kPa	Sample	:	29WAXD
q_{av}	:	29 kPa	Depth [m]	:	22.56
q_{cy}	:	29 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

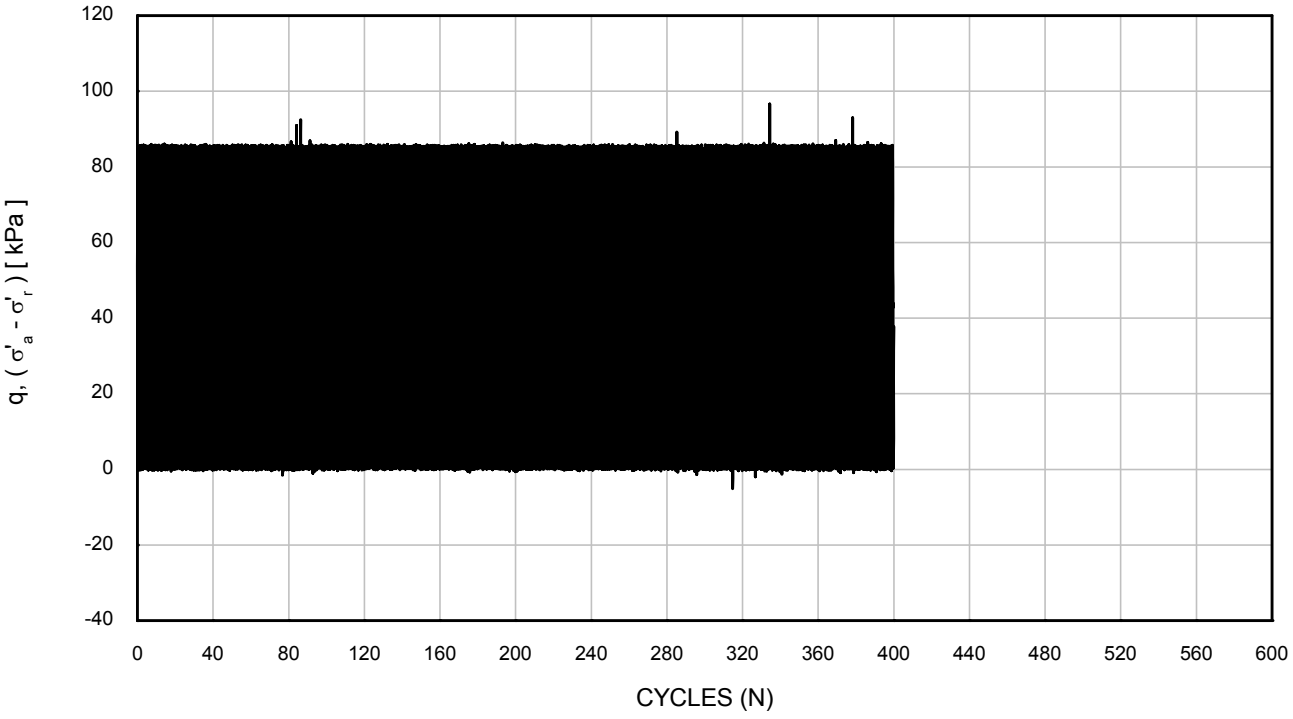
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

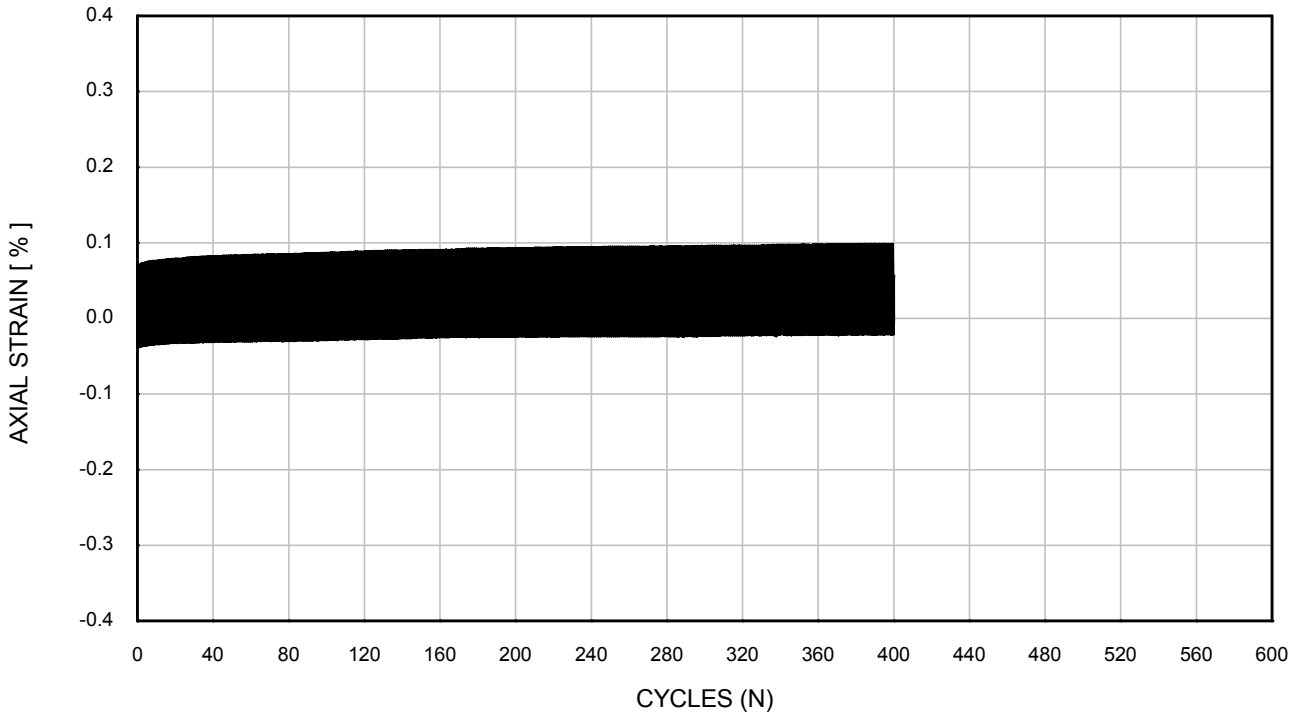




Initial σ'_r	: 197 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	: 226 kPa	Sample	: 29WAXD
q_{av}	: 29 kPa	Depth [m]	: 22.56
q_{cy}	: 29 kPa	Test No.	: CTX17
Frequency	: 0.10 Hz		

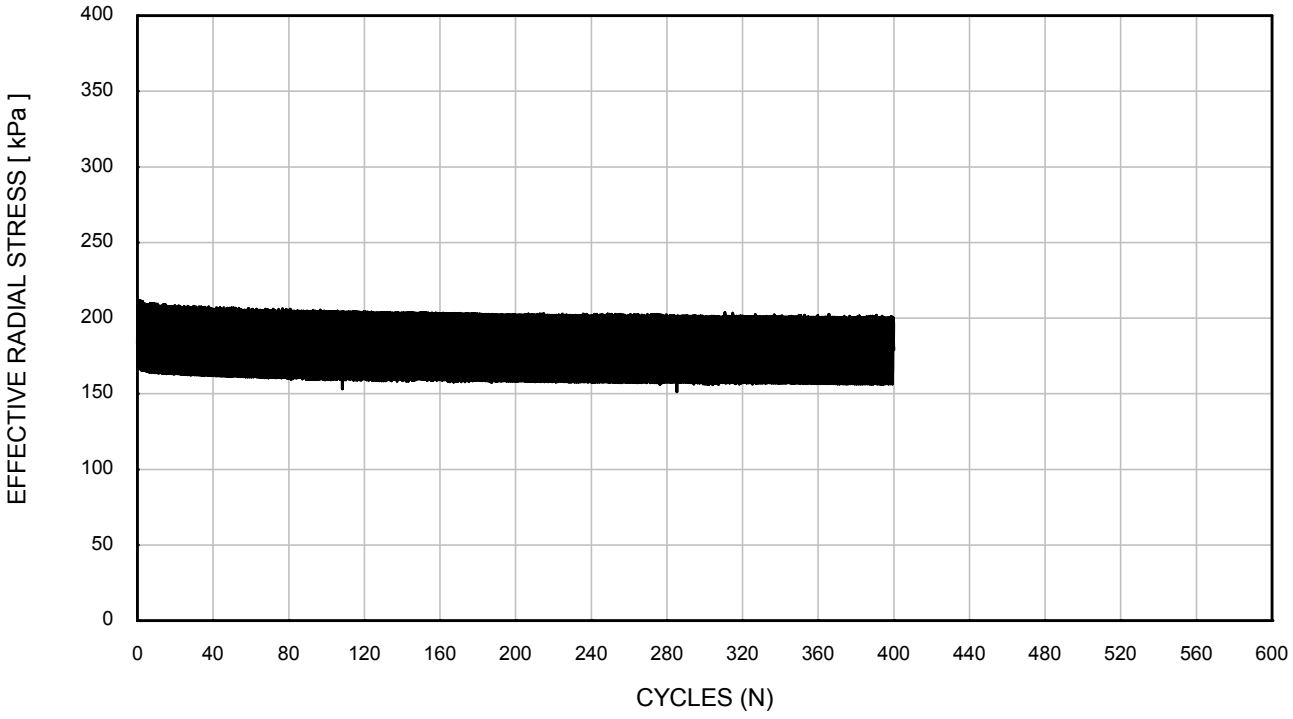
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - UNDRAINED

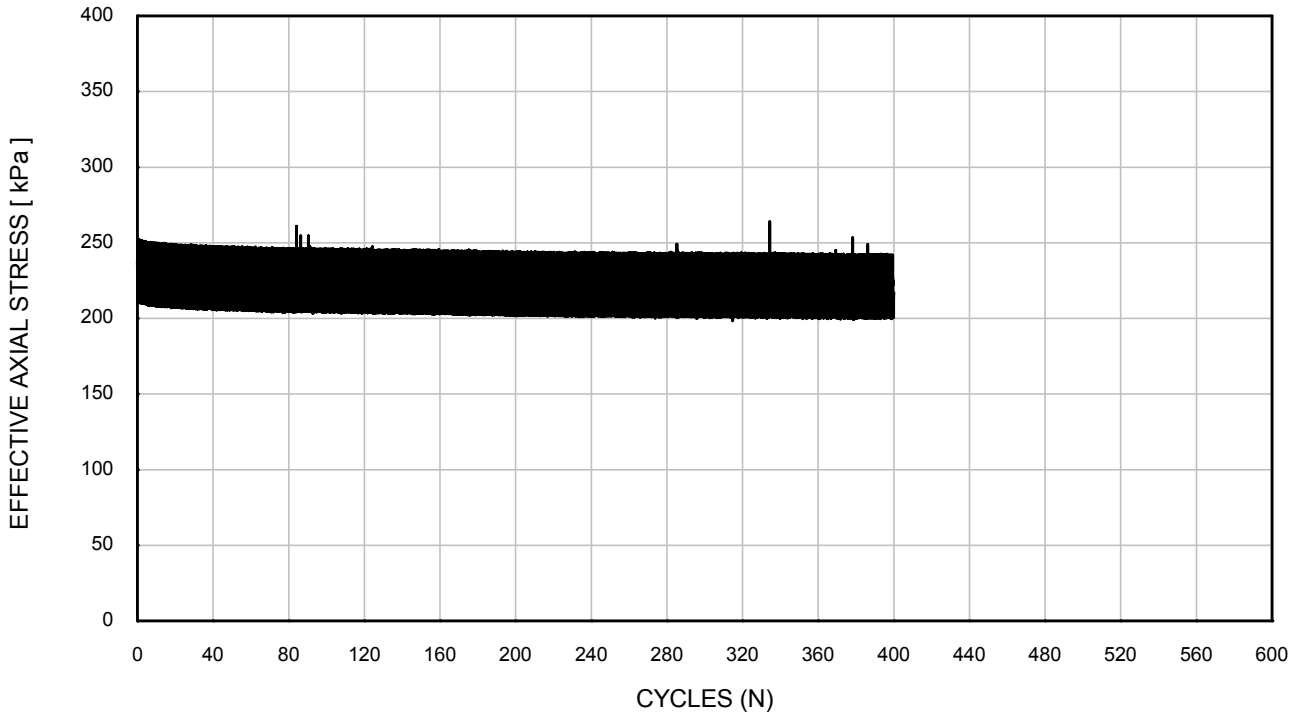




Initial σ'_r	:	189 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	: 29WAXD
q_{av}	:	43 kPa	Depth [m]	: 22.56
q_{cy}	:	43 kPa	Test No.	: CTX17
Frequency	:	0.10 Hz		

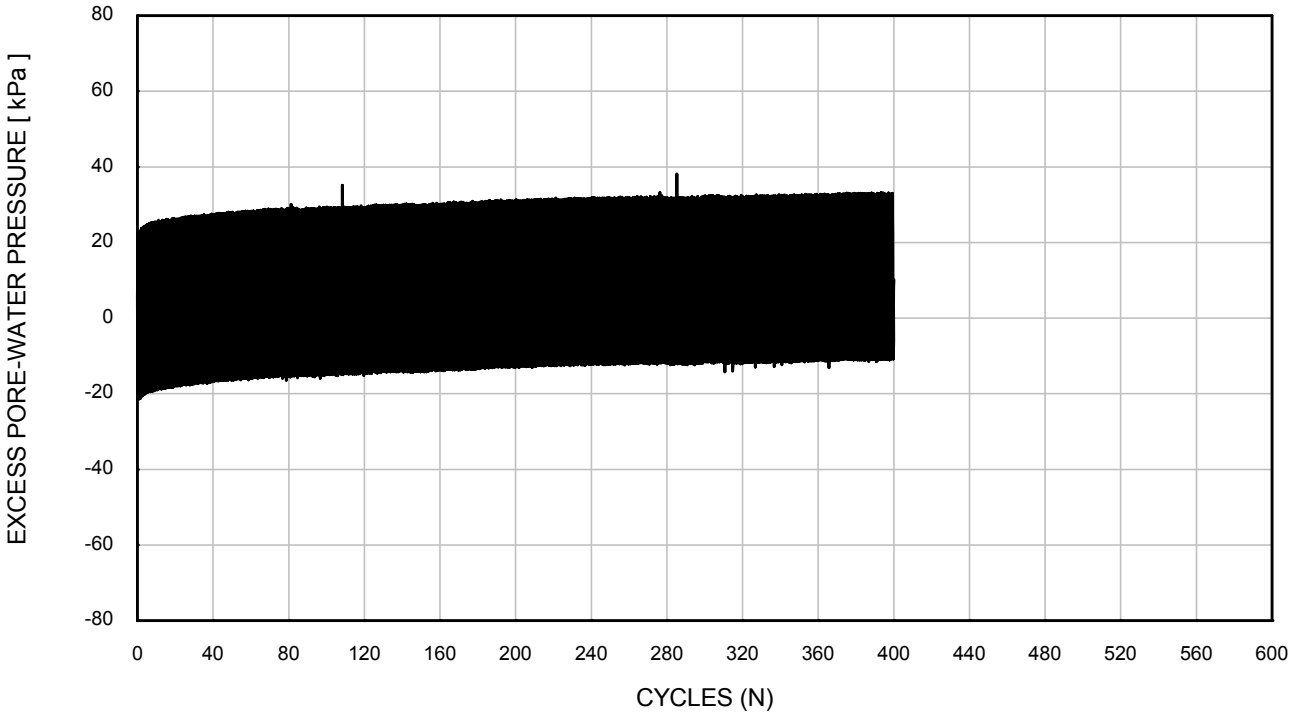
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

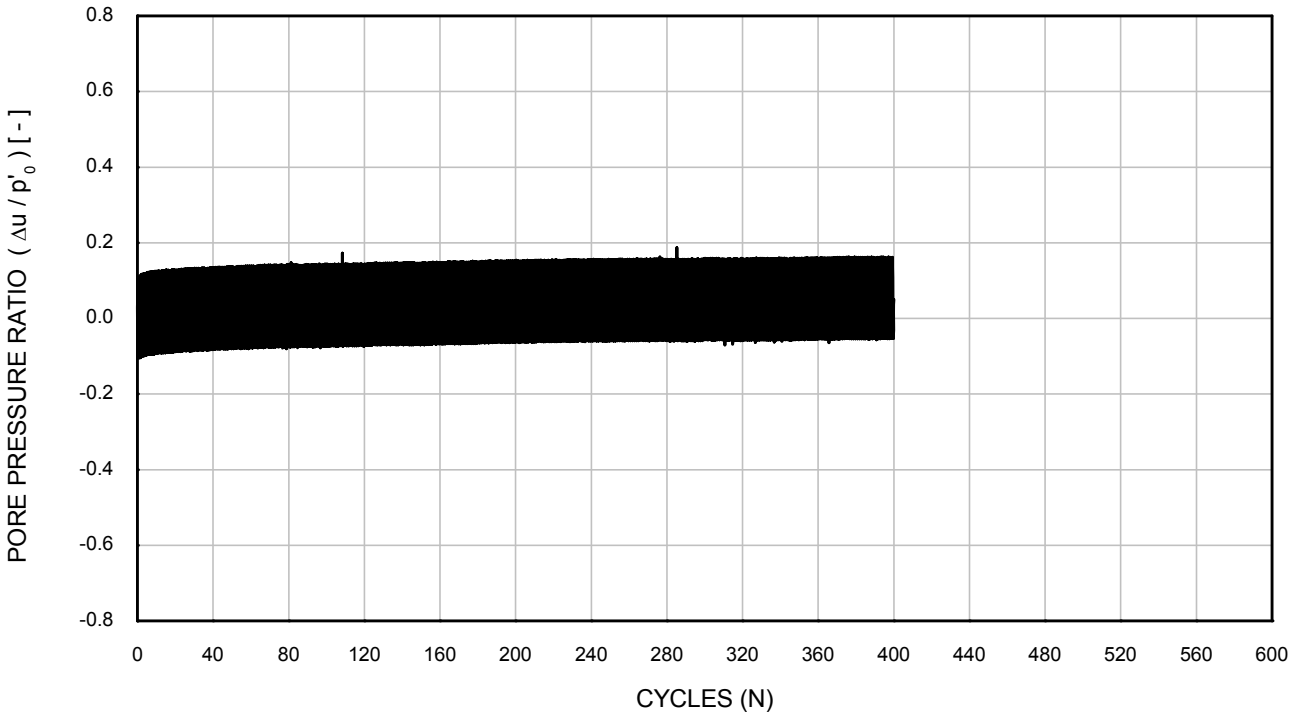




Initial σ'_r	:	189 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	:	29WAXD
q_{av}	:	43 kPa	Depth [m]	:	22.56
q_{cy}	:	43 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

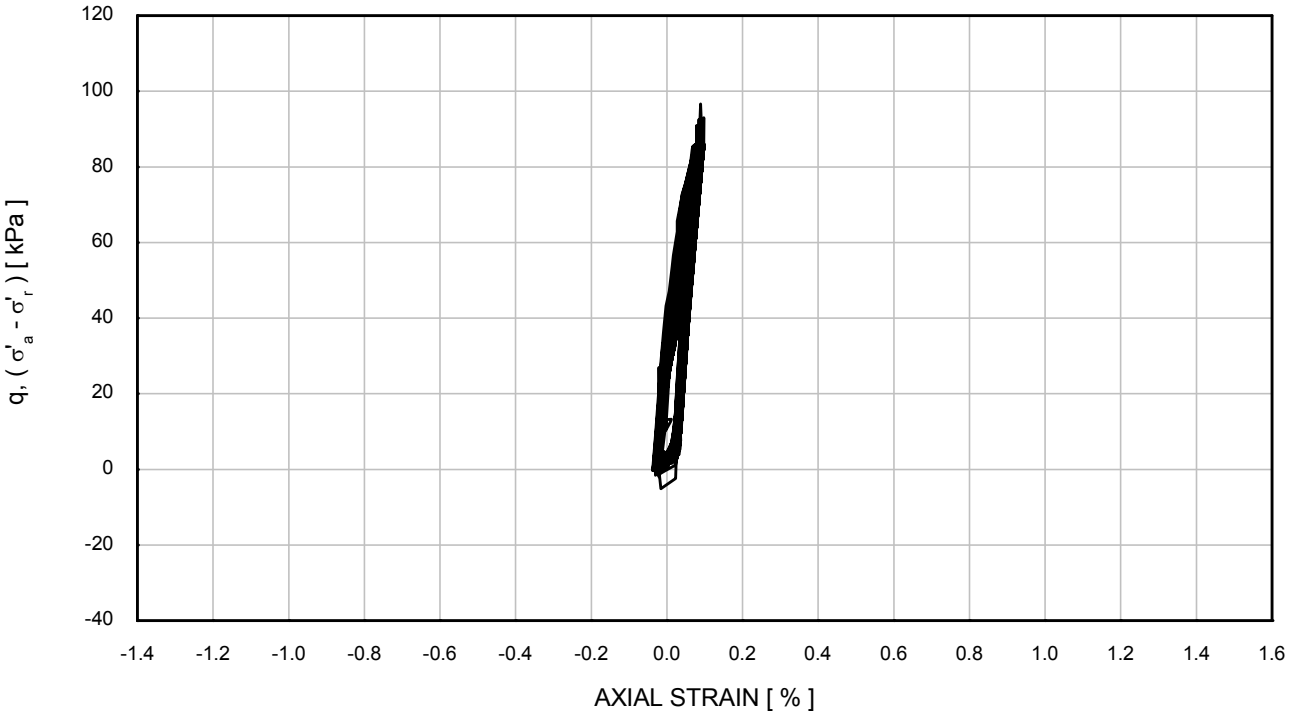
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

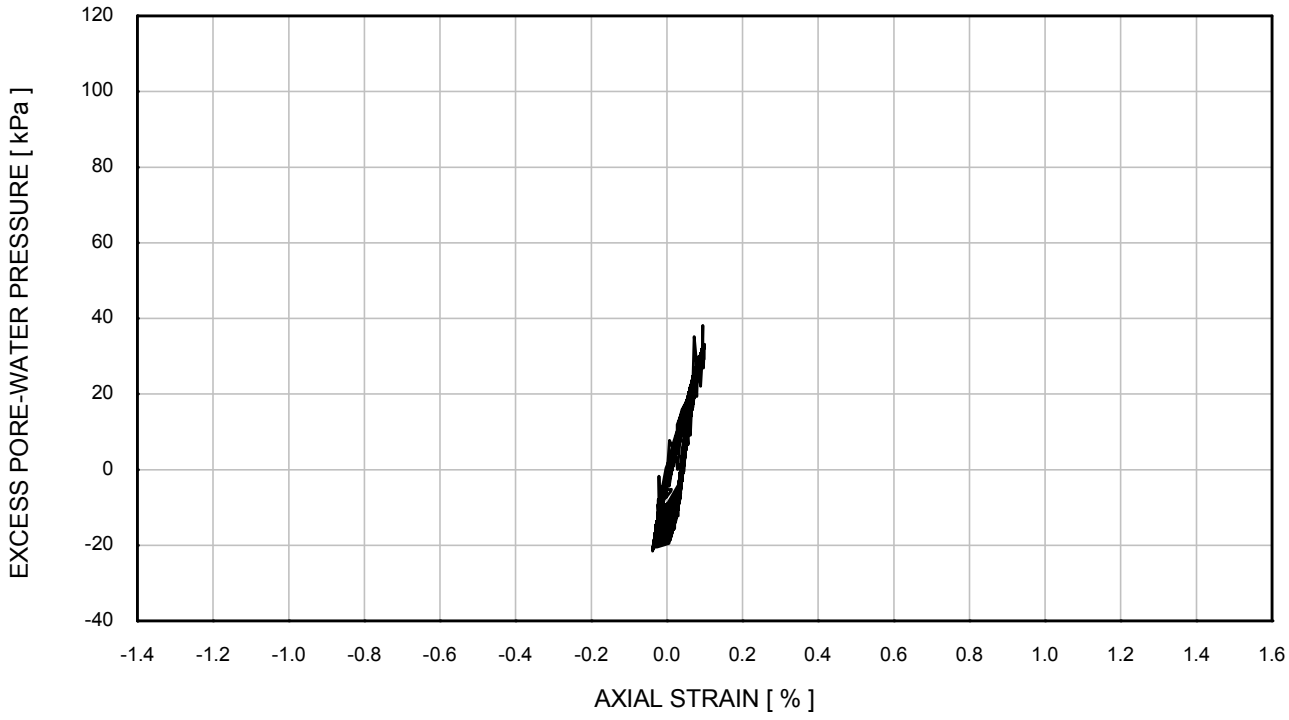




Initial σ'_r	:	189 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	:	29WAXD
q_{av}	:	43 kPa	Depth [m]	:	22.56
q_{cy}	:	43 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

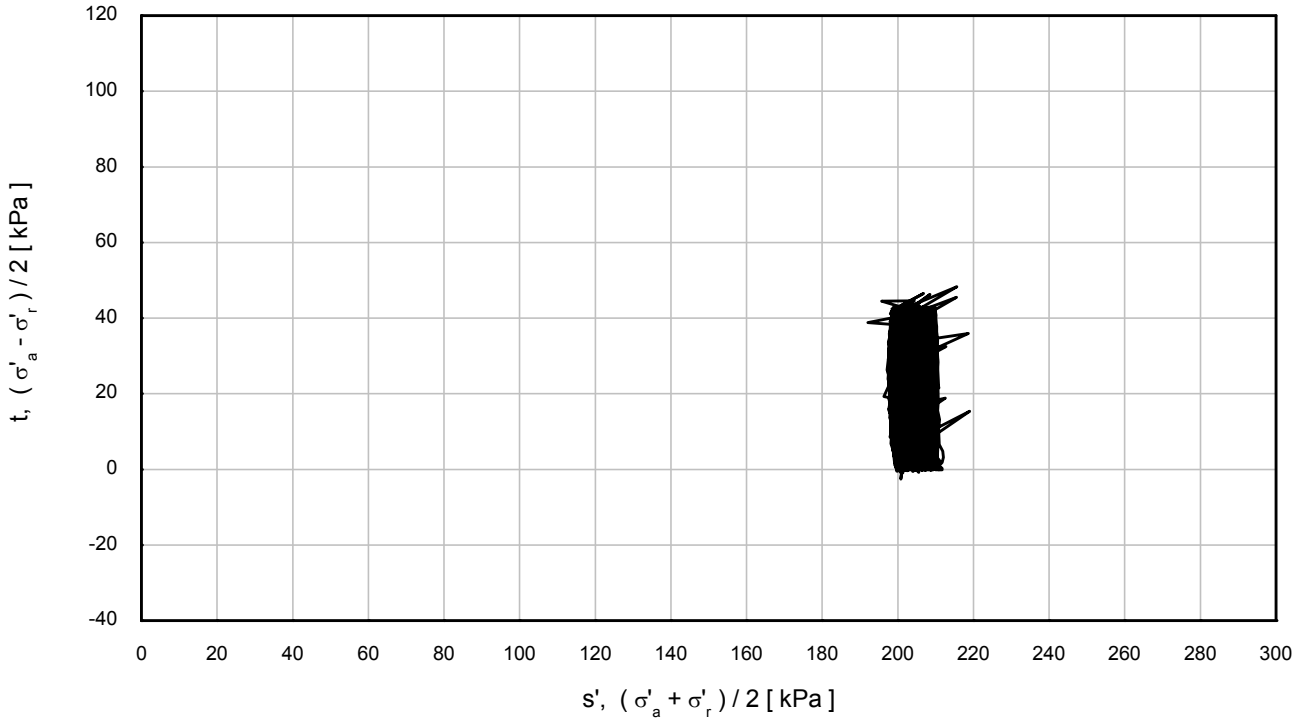
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

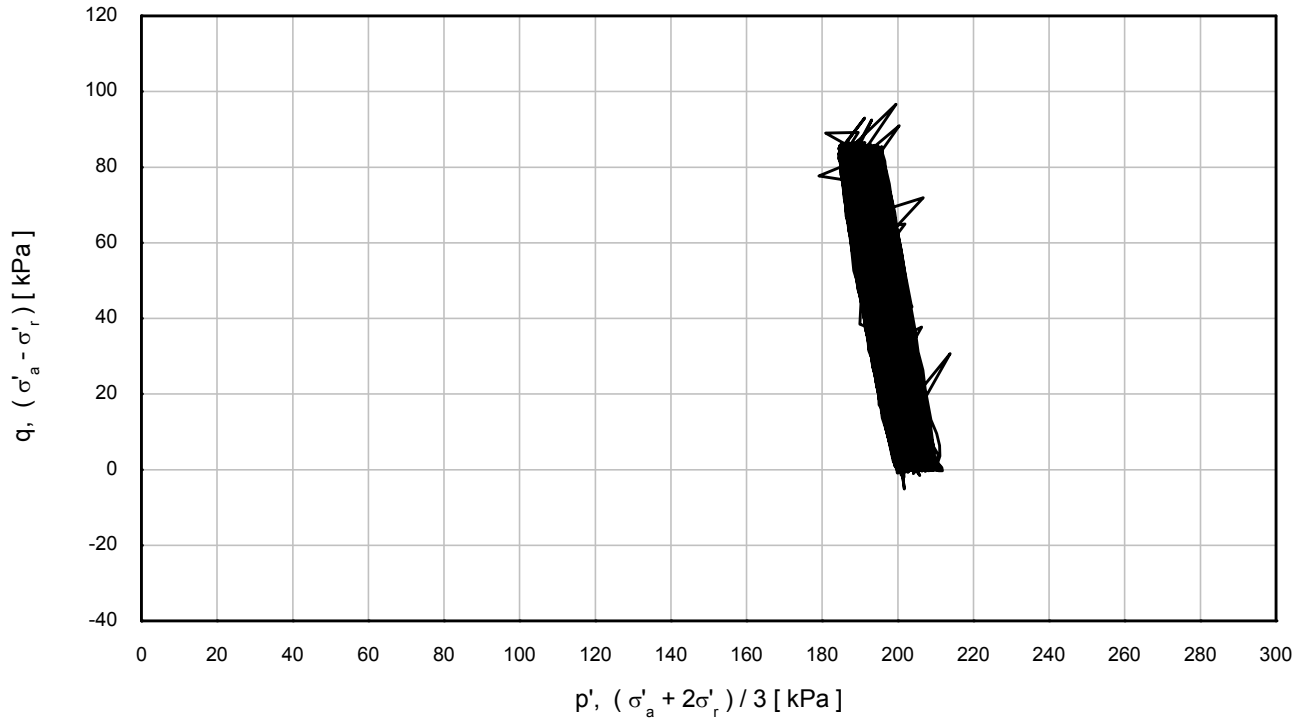




Initial σ'_r	:	189 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	: 29WAXD
q_{av}	:	43 kPa	Depth [m]	: 22.56
q_{cy}	:	43 kPa	Test No.	: CTX17
Frequency	:	0.10 Hz		

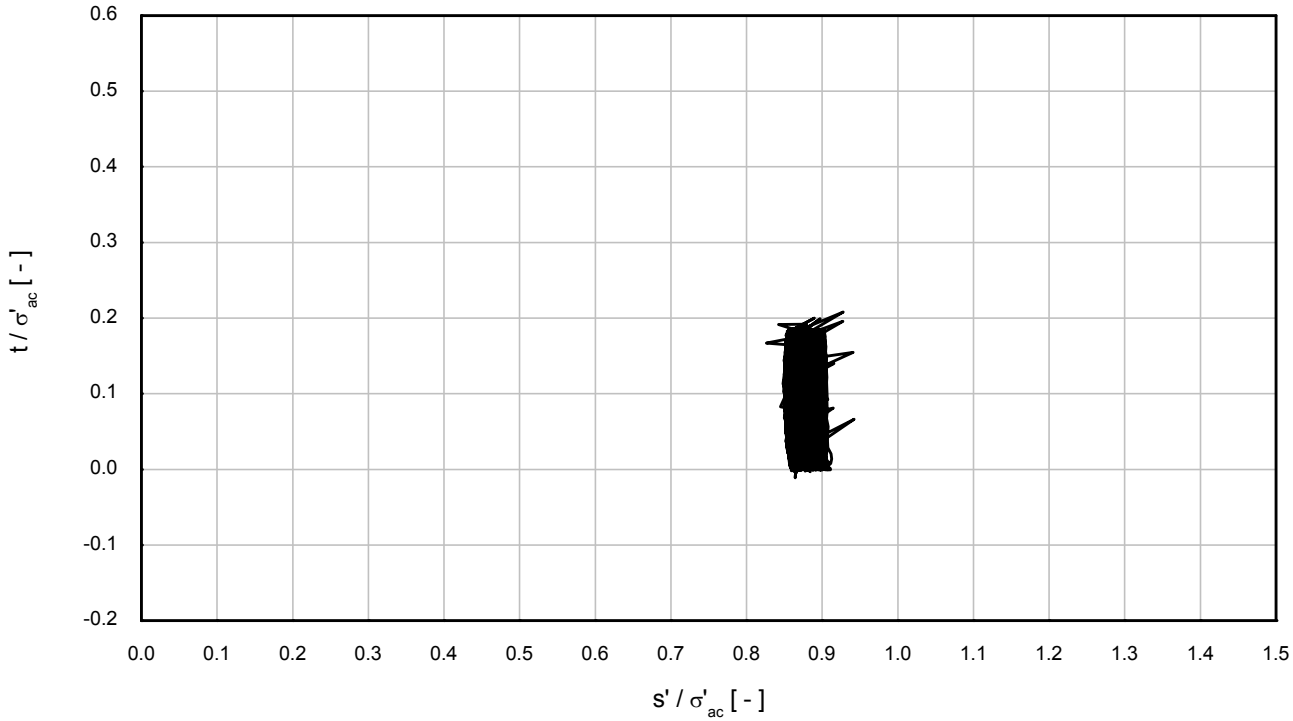
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

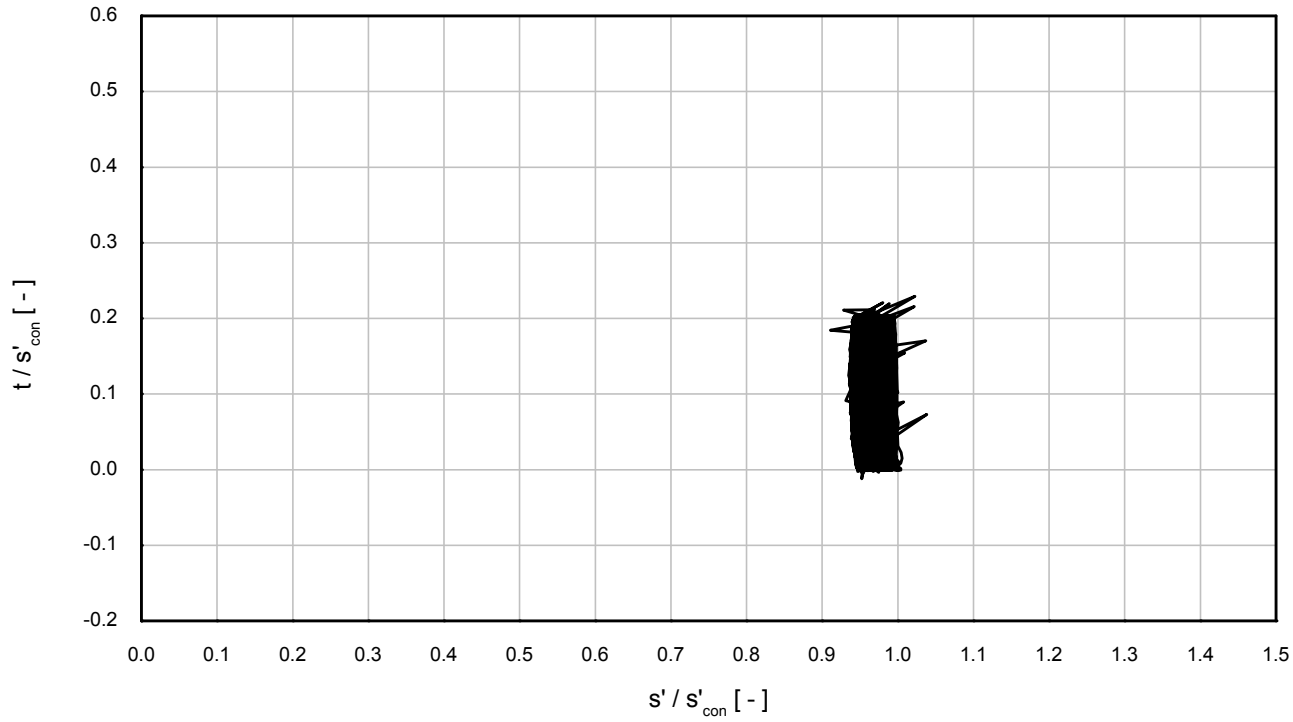




Initial σ'_r	:	189 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	:	29WAXD
q_{av}	:	43 kPa	Depth [m]	:	22.56
q_{cy}	:	43 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

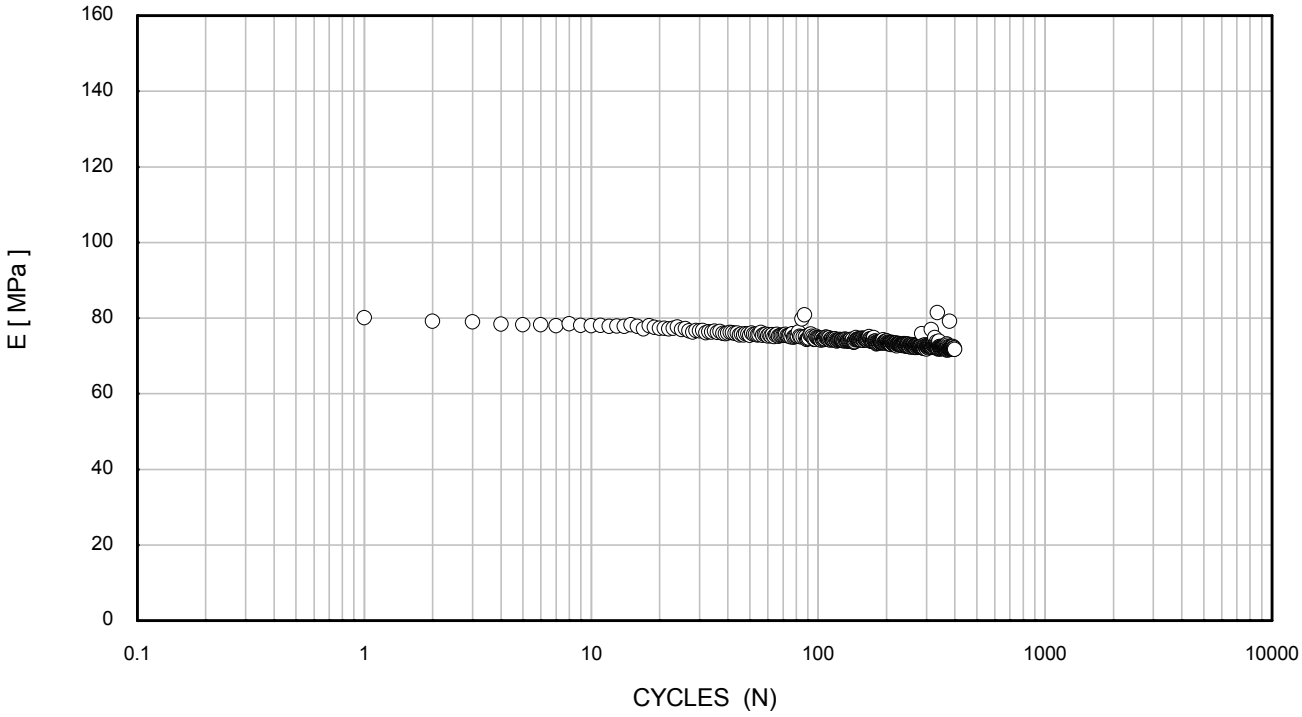
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

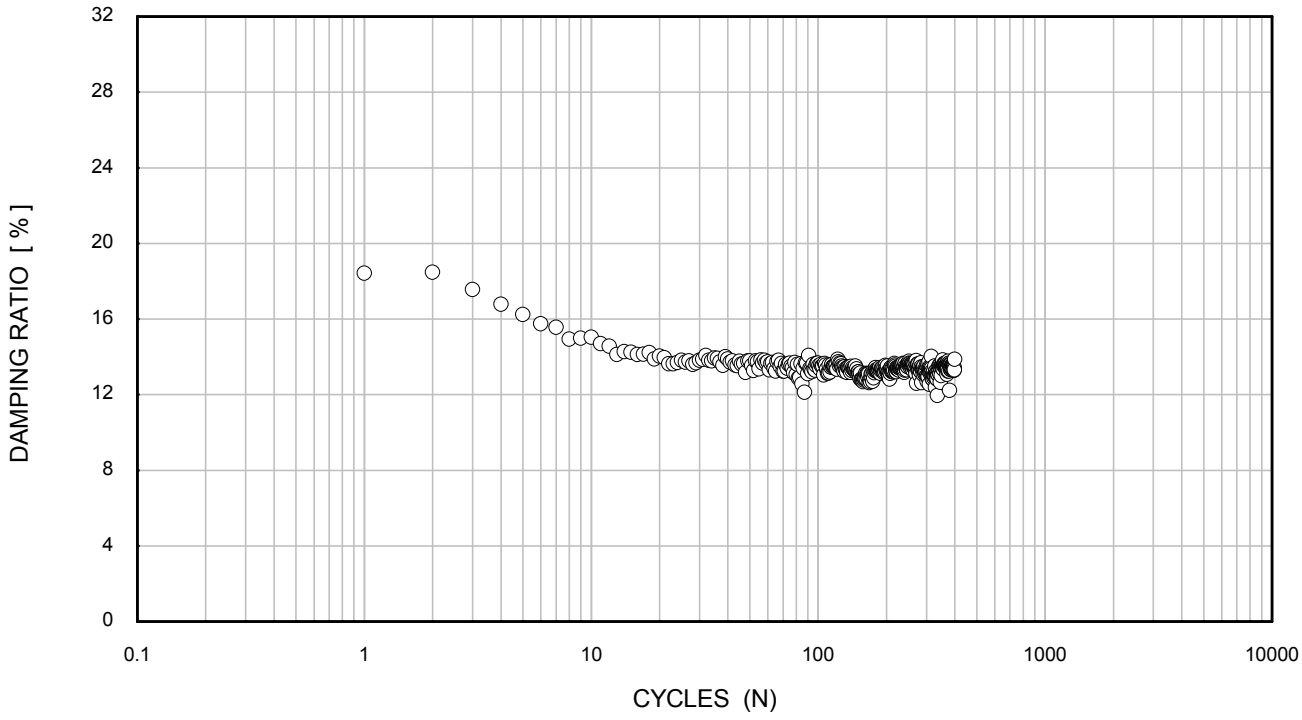




Initial σ'_r	:	189 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	232 kPa	Sample	:	29WAXD
q_{av}	:	43 kPa	Depth [m]	:	22.56
q_{cy}	:	43 kPa	Test No.	:	CTX17
Frequency	:	0.10 Hz			

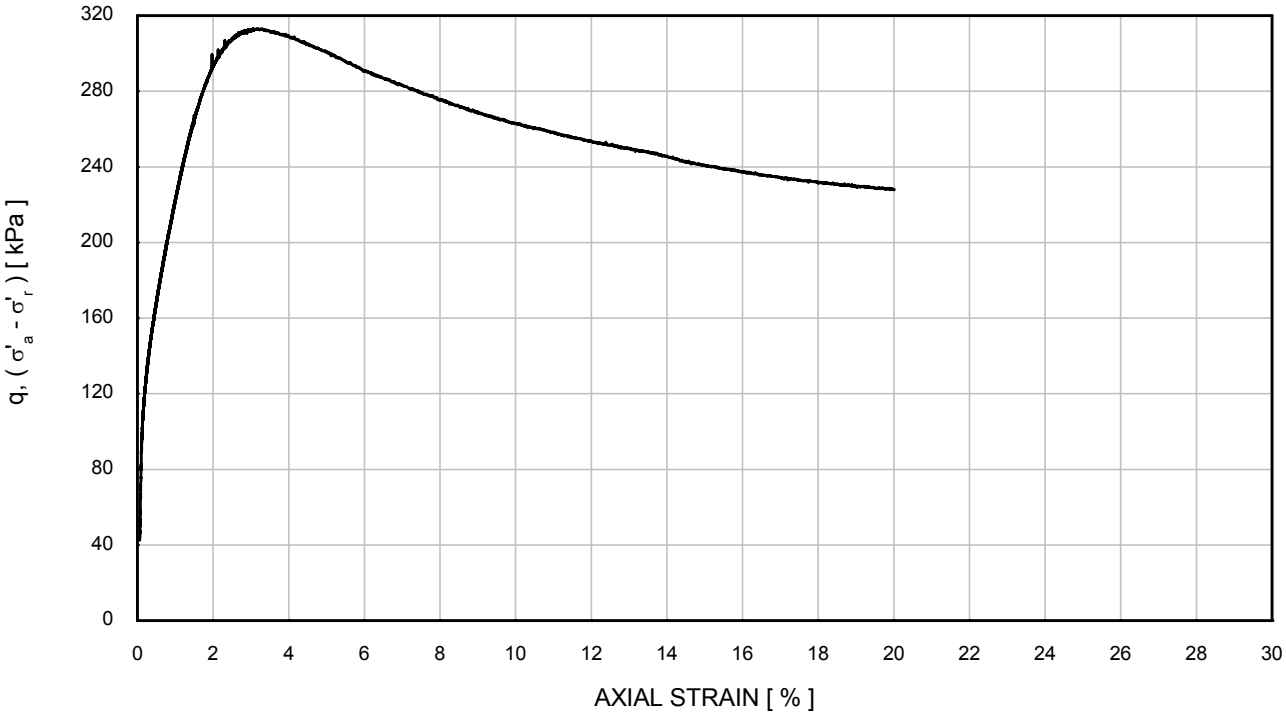
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

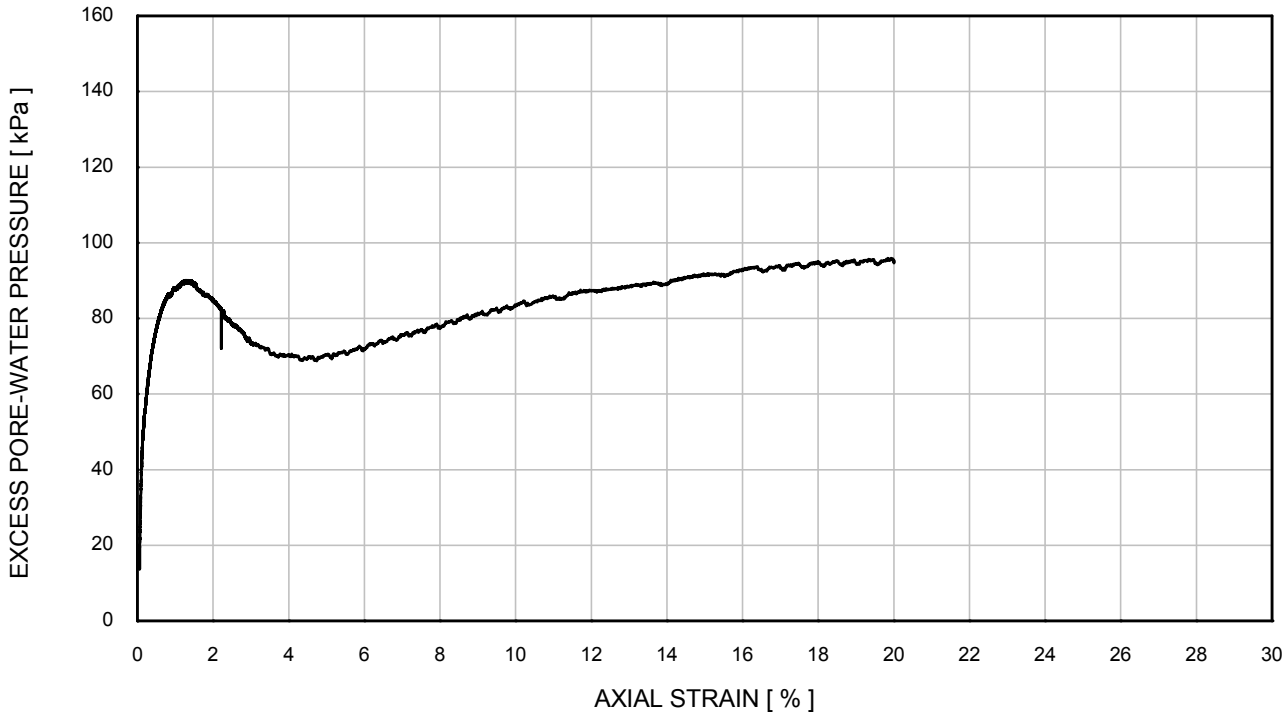




Initial σ'_r	: 189 kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 29WAXD
q_{av}	: 43 kPa	Depth [m]	: 22.56
q_{cy}	: 43 kPa	Test No.	: CTX17
Frequency	: 0.10 Hz		

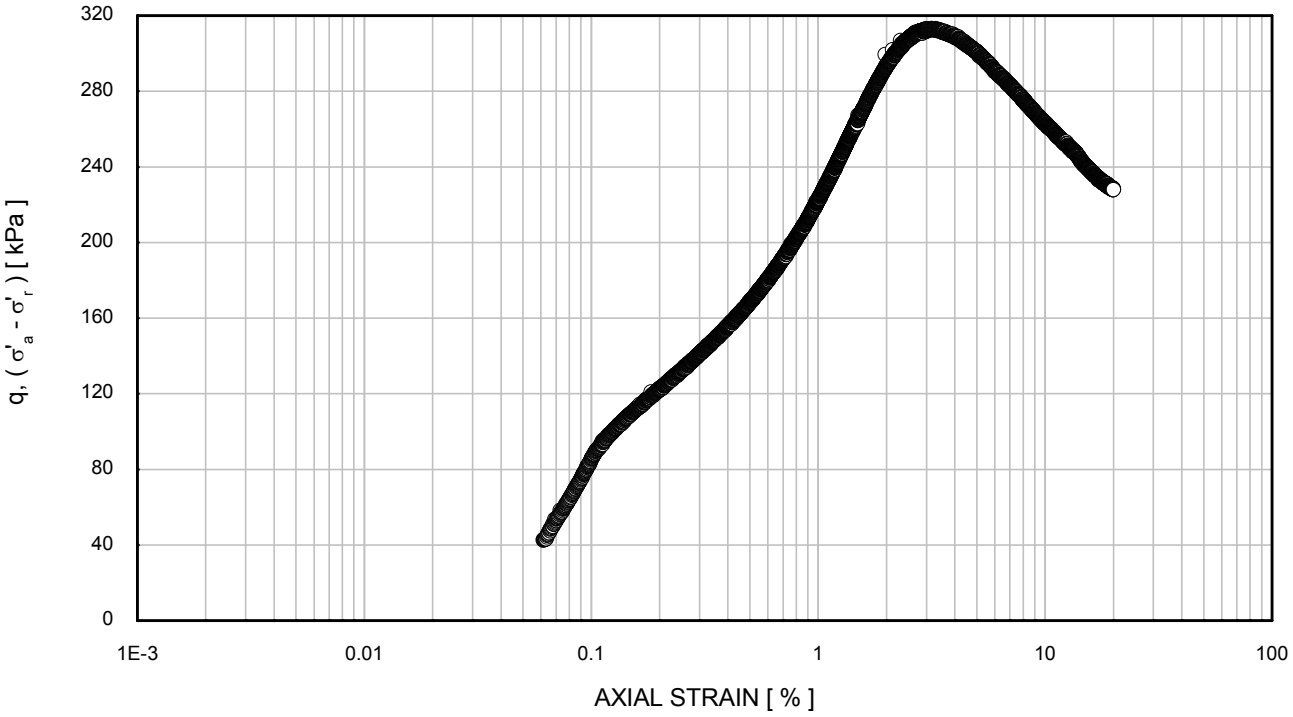
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

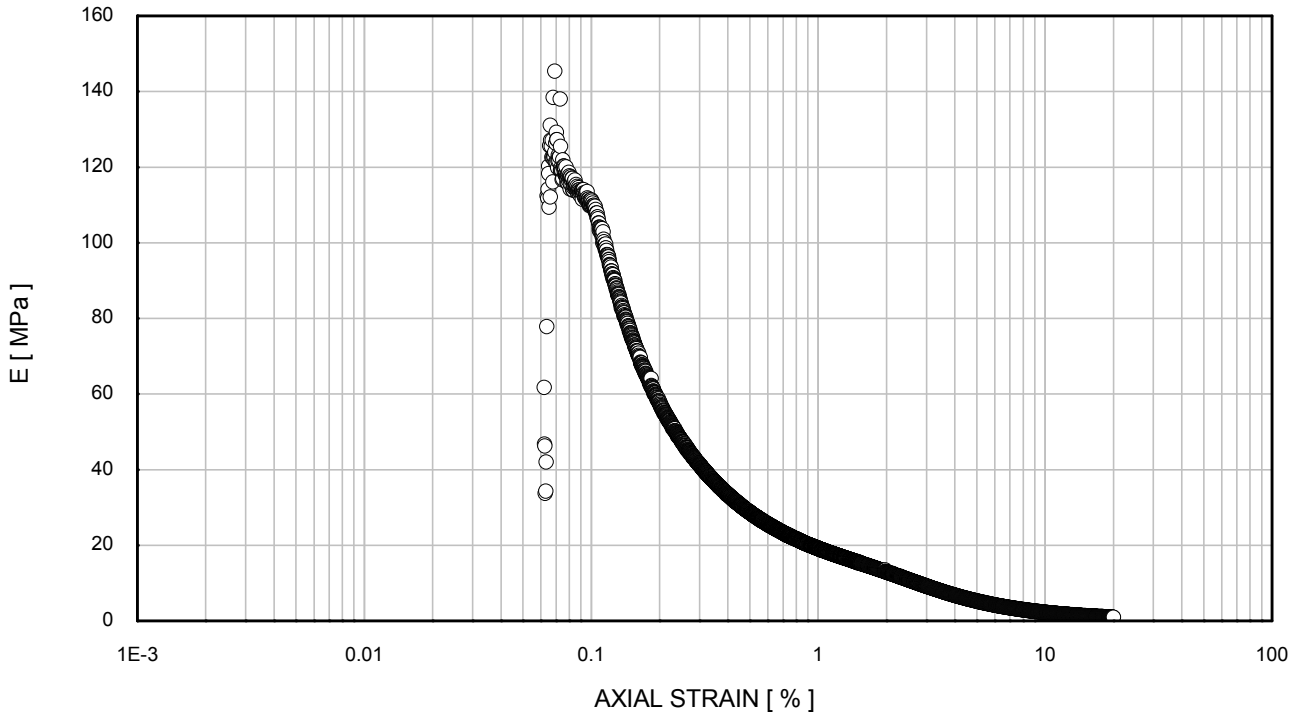




Initial σ'_r	:	177 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	220 kPa	Sample	:	29WAXD
q_{peak}	:	313 kPa	Depth [m]	:	22.56
Ext. ε at q_{peak}	:	3.17 %	Test No.	:	CTX17
Rate of strain	:	0.50 %/hour			

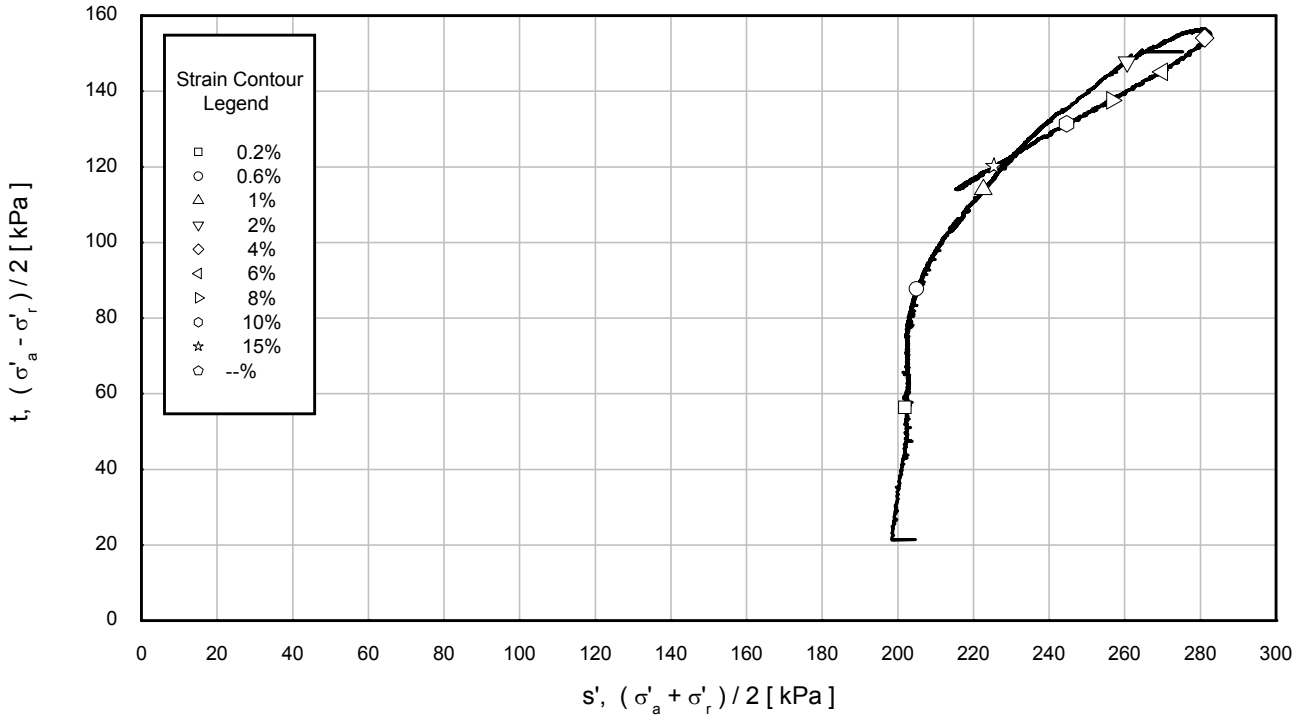
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

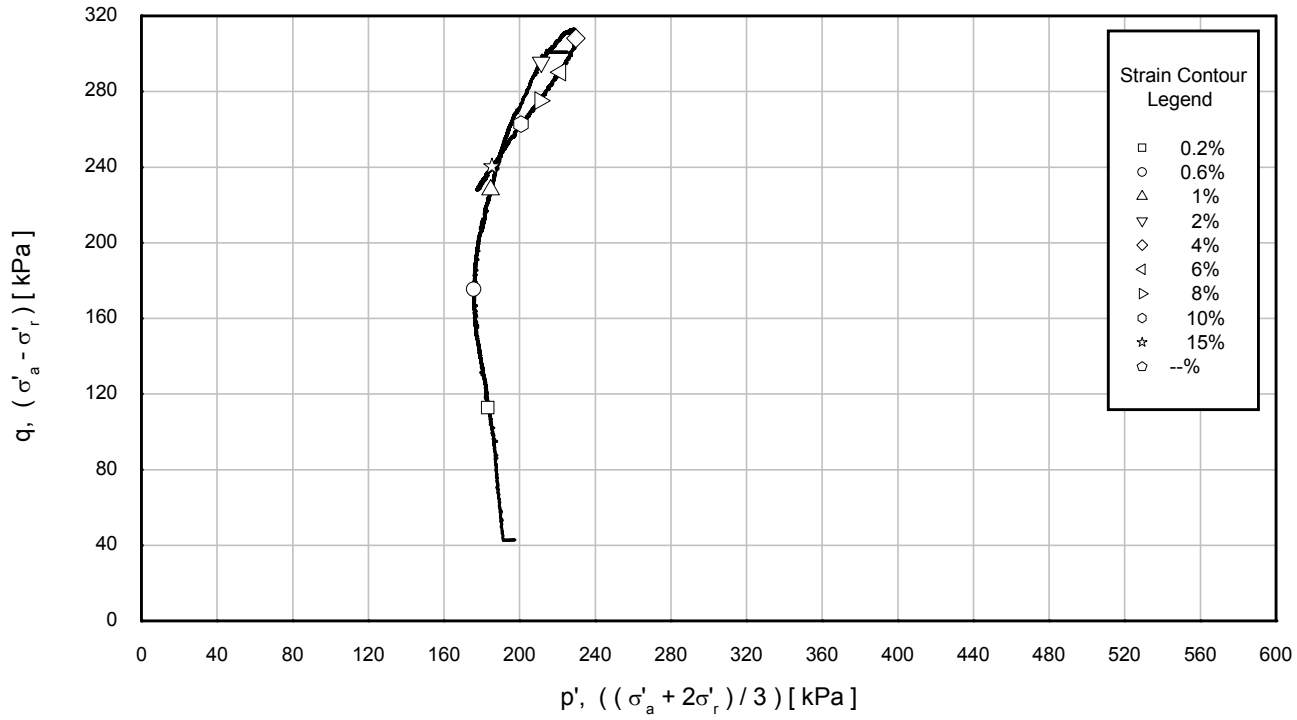




Initial σ'_r	:	177 kPa	Borehole	:	HKZ1-BH21-SA
Initial σ'_a	:	220 kPa	Sample	:	29WAXD
q_{peak}	:	313 kPa	Depth [m]	:	22.56
Ext. ε at q_{peak}	:	3.17 %	Test No.	:	CTX17
Rate of strain	:	0.50 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	177	kPa	Borehole	: HKZ1-BH21-SA
Initial σ'_a	:	220	kPa	Sample	: 29WAXD
q_{peak}	:	313	kPa	Depth [m]	: 22.56
Ext. ε at q_{peak}	:	3.17	%	Test No.	: CTX17
Rate of strain	:	0.50	%/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
High strength dark grey CLAY

GENERAL	
Date test started	21/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	71.9
Length	[mm]	144.3
Water content	[%]	31.3
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.798
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	113
Pocket penetrometer	[kPa]	154

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ2-BH21-SA_30B_CTX18
Processed by Date	MSR 09/01/2017
Checked by Date	JLS 11/01/2017
Approved by Date	PH 11/01/2017

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1100
Base PWP	[kPa]	850
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1050
Back pressure	[kPa]	850
Base PWP	[kPa]	850
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	200
Effective axial pressure	[kPa]	220
Deviator stress	[kPa]	20
Volumetric strain	[%]	-0.14
External axial strain	[%]	-0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.801
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 1		
Cell pressure	[kPa]	1050
Back pressure	[kPa]	850
Base PWP	[kPa]	861
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	189
Effective axial pressure	[kPa]	232
Deviator stress	[kPa]	43
Volumetric strain	[%]	0.00
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.801
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	43
Mean q_{cy}	[kPa]	29
Frequency	[Hz]	0.10
Number of cycles applied (Nf)	[-]	1500
External ε_{av} at N_f	[%]	0.02
External ε_{cy} at N_f	[%]	0.01
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	16
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.801
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.01	213	-	2.18	-
2	0.02	0.01	213	-	1.57	-
5	0.02	0.01	212	-	1.34	-
10	0.02	0.01	210	-	1.34	-
20	0.02	0.01	209	-	1.31	-
30	0.02	0.01	209	-	1.33	-
40	0.02	0.01	209	-	1.34	-
50	0.02	0.01	208	-	1.34	-
100	0.02	0.01	208	-	1.31	-
500	0.02	0.01	207	-	1.24	-
1000	0.02	0.01	206	-	1.29	-
1500	0.02	0.01	206	-	1.29	-

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 2		
Cell pressure	[kPa]	1050
Back pressure	[kPa]	850
Base PWP	[kPa]	862
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	188
Effective axial pressure	[kPa]	231
Deviator stress	[kPa]	43
Volumetric strain	[%]	0.00
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.801
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	43
Mean q_{cy}	[kPa]	57
Frequency	[Hz]	0.10
Number of cycles applied (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.03
External ε_{cy} at N_f	[%]	0.03
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	16
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50
Void ratio	[-]	0.801
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.03	206	-	3.46	-
2	0.02	0.03	203	-	3.37	-
5	0.02	0.03	199	-	3.48	-
10	0.02	0.03	195	-	3.62	-
20	0.02	0.03	192	-	3.79	-
30	0.02	0.03	190	-	3.91	-
40	0.02	0.03	189	-	4.00	-
50	0.02	0.03	188	-	4.04	-
100	0.02	0.03	185	-	4.21	-
200	0.02	0.03	181	-	4.35	-
300	0.03	0.03	180	-	4.43	-
400	0.03	0.03	178	-	4.50	-

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	185
Initial effective axial pressure	[kPa]	228
Rate of strain	[%/hour]	0.30
At peak deviator stress		
Corrected deviator stress	[kPa]	244
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	4.98
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	67
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	134
Effective axial pressure	[kPa]	378
Principal effective stress ratio	[-]	2.82
ε_{50}	[%]	0.20
Secant modulus (E_{50}) at ε_{50}	[kPa]	61893
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	234
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.35
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	105
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	95
Effective axial pressure	[kPa]	329
Principal effective stress ratio	[-]	3.47
At 15% external axial strain		
Corrected deviator stress	[kPa]	242
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	22
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	179
Effective axial pressure	[kPa]	421
Principal effective stress ratio	[-]	2.35

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





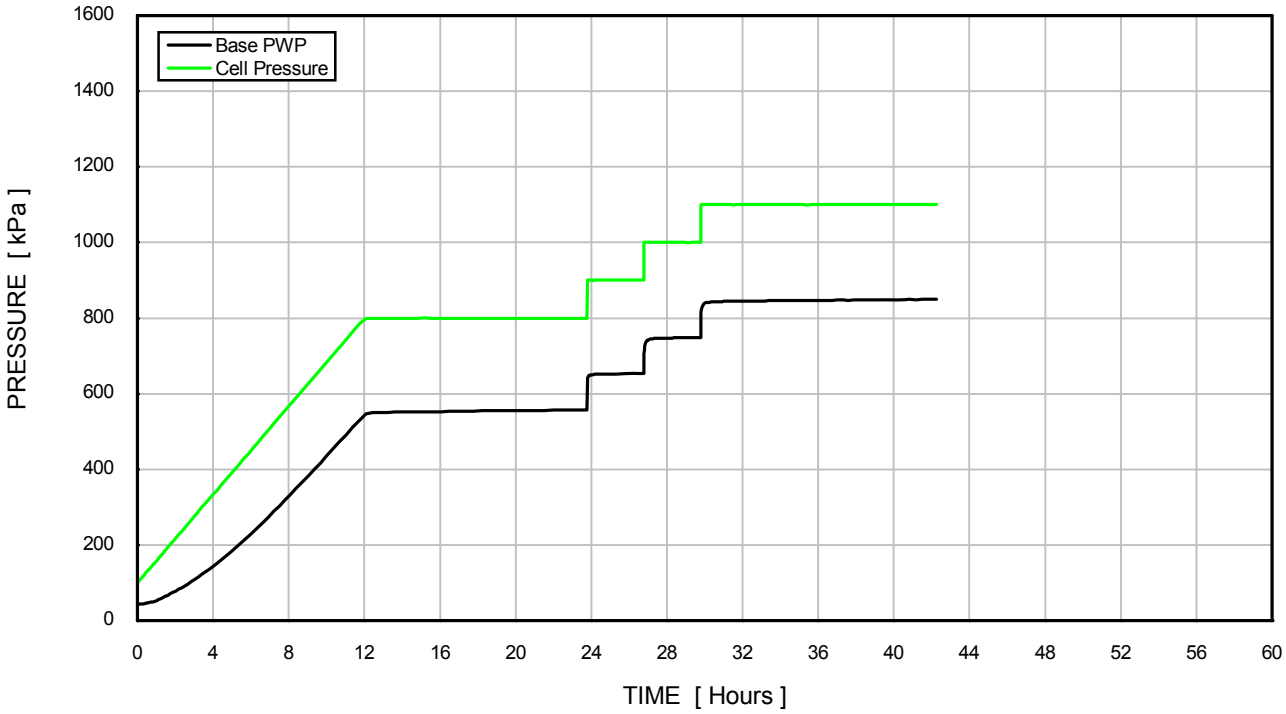
FINAL CONDITIONS

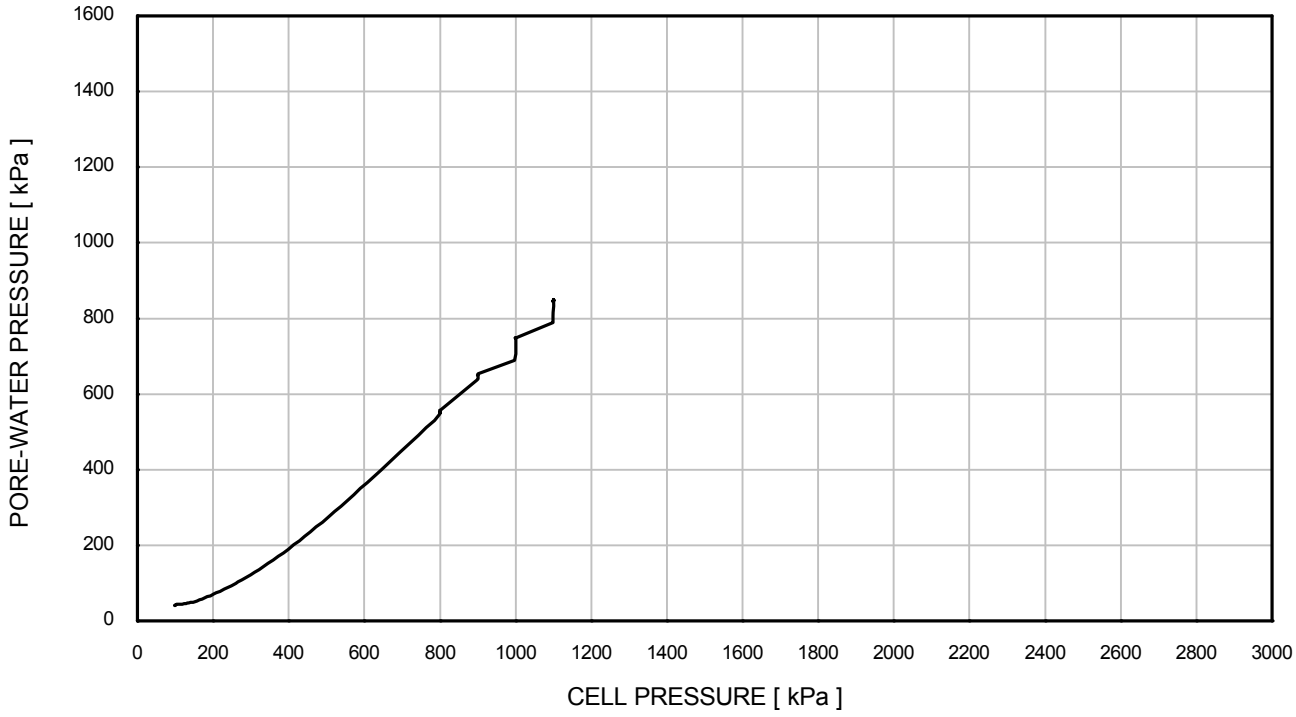
Water content	[%]	31.4
Bulk density	[Mg/m³]	1.97
Dry density	[Mg/m³]	1.50

TEST IDENTIFICATION

Borehole	HKZ2-BH21-SA
Sample	30WaxB
Depth [m]	23.28
Test number	CTXL18

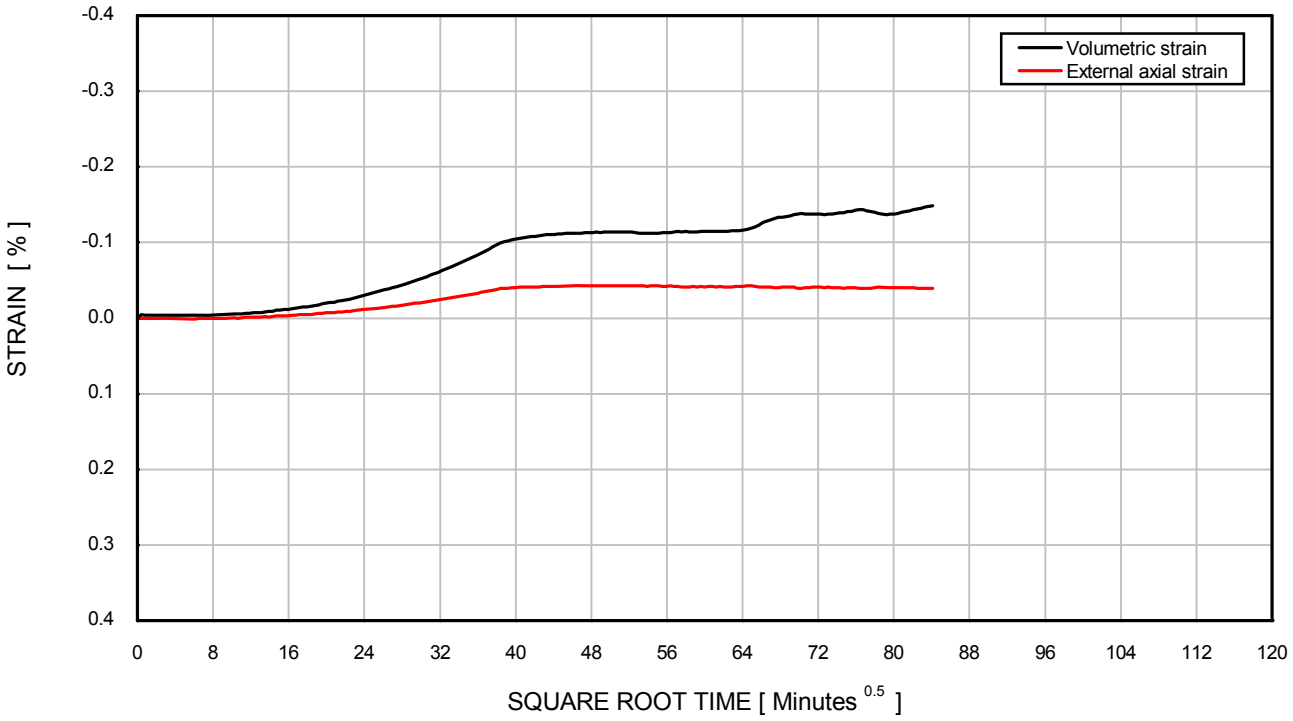
SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

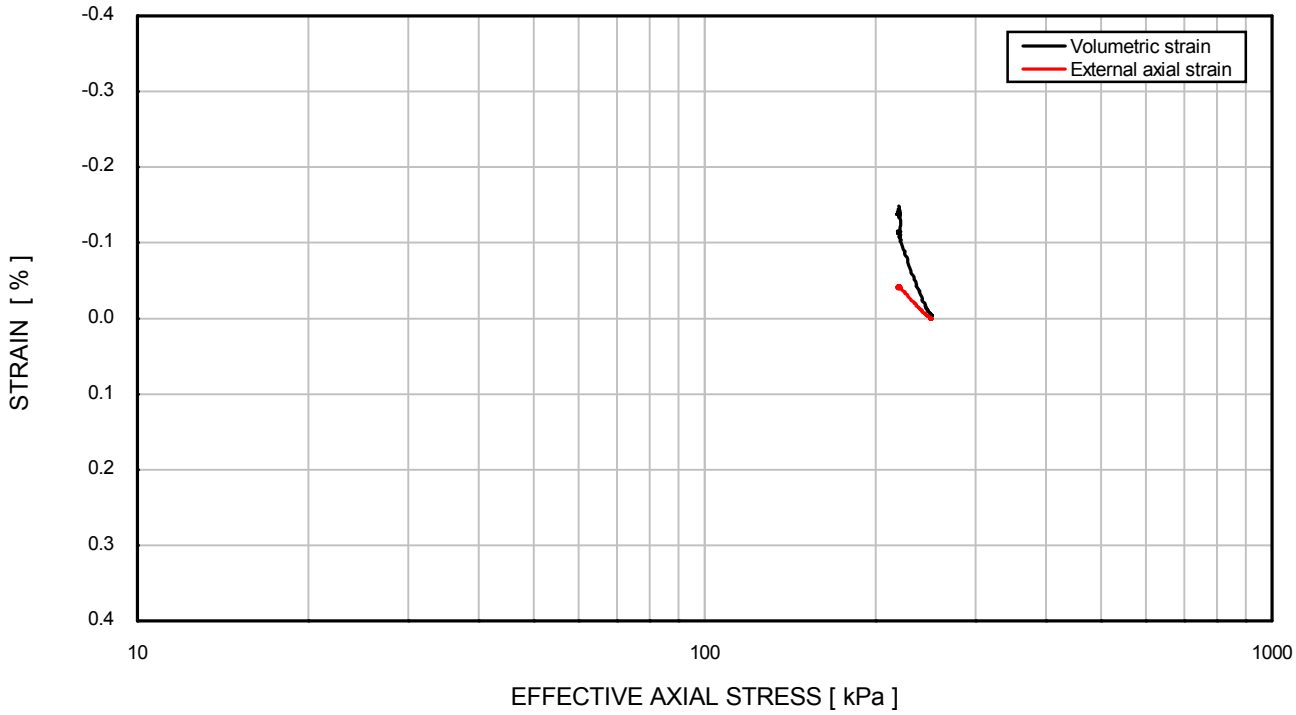




B value	: 1.00	Borehole	: HKZ2-BH21-SA
Initial σ'_r	: 59 kPa	Sample	: 30WaxB
Initial σ'_a	: 59 kPa	Depth [m]	: 23.28
Final σ'_r	: 250 kPa	Test No.	: CTXL18
Final σ'_a	: 250 kPa		

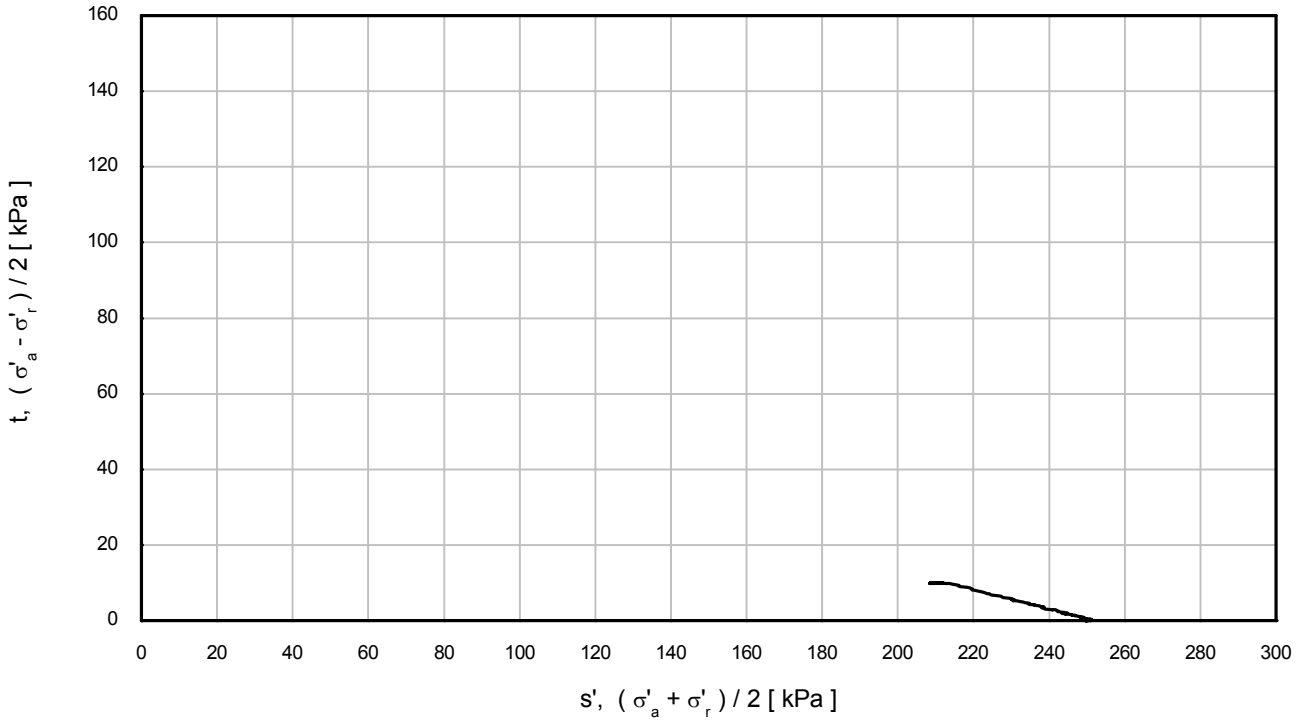
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

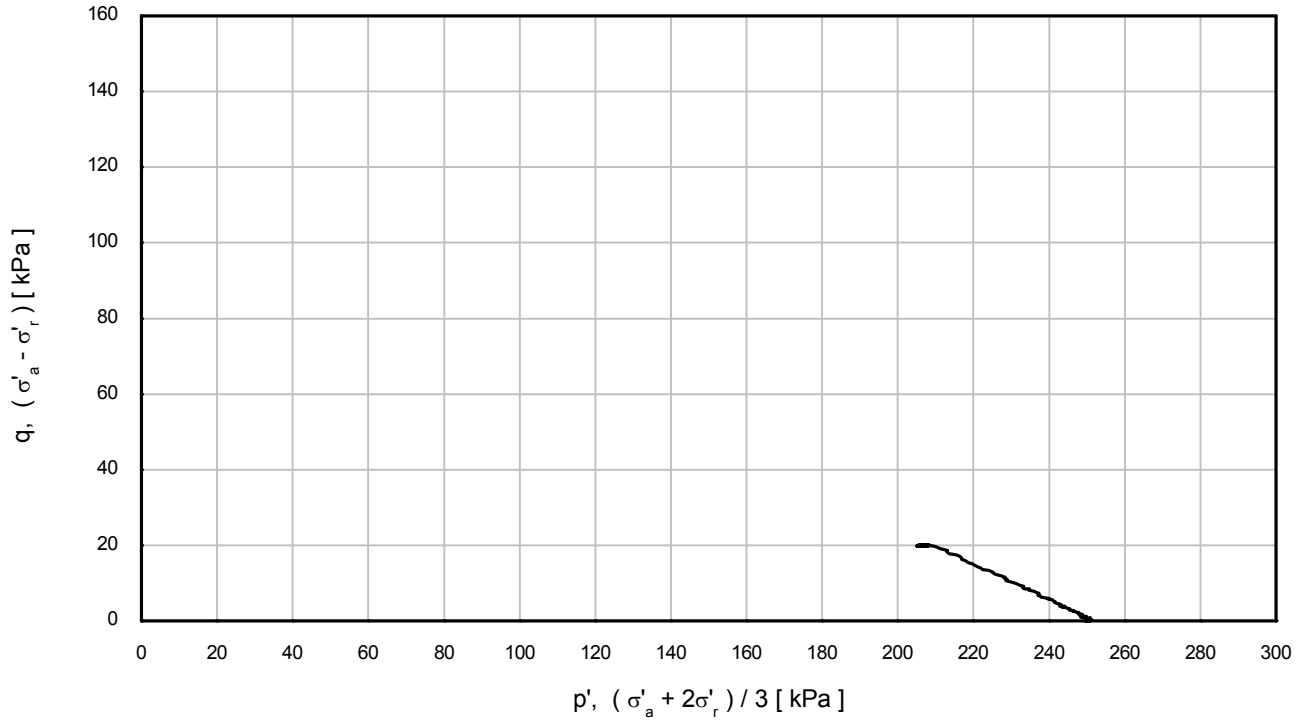




Stage 1 σ'_{rc}	:	200 kPa	Batch	:	HKZ2-BH21-SA
Stage 1 σ'_{ac}	:	220 kPa	Sample	:	30WaxB
			Unit	:	23.28
			Test No.	:	CTXL18

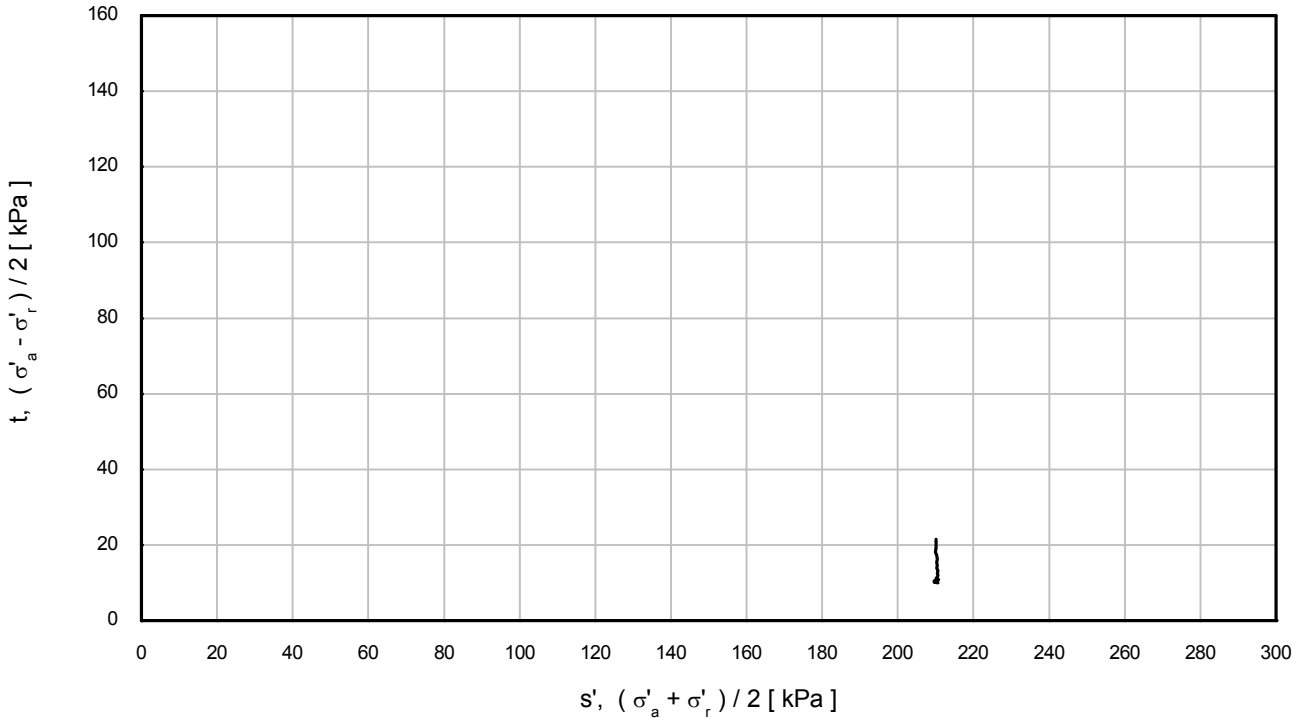
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

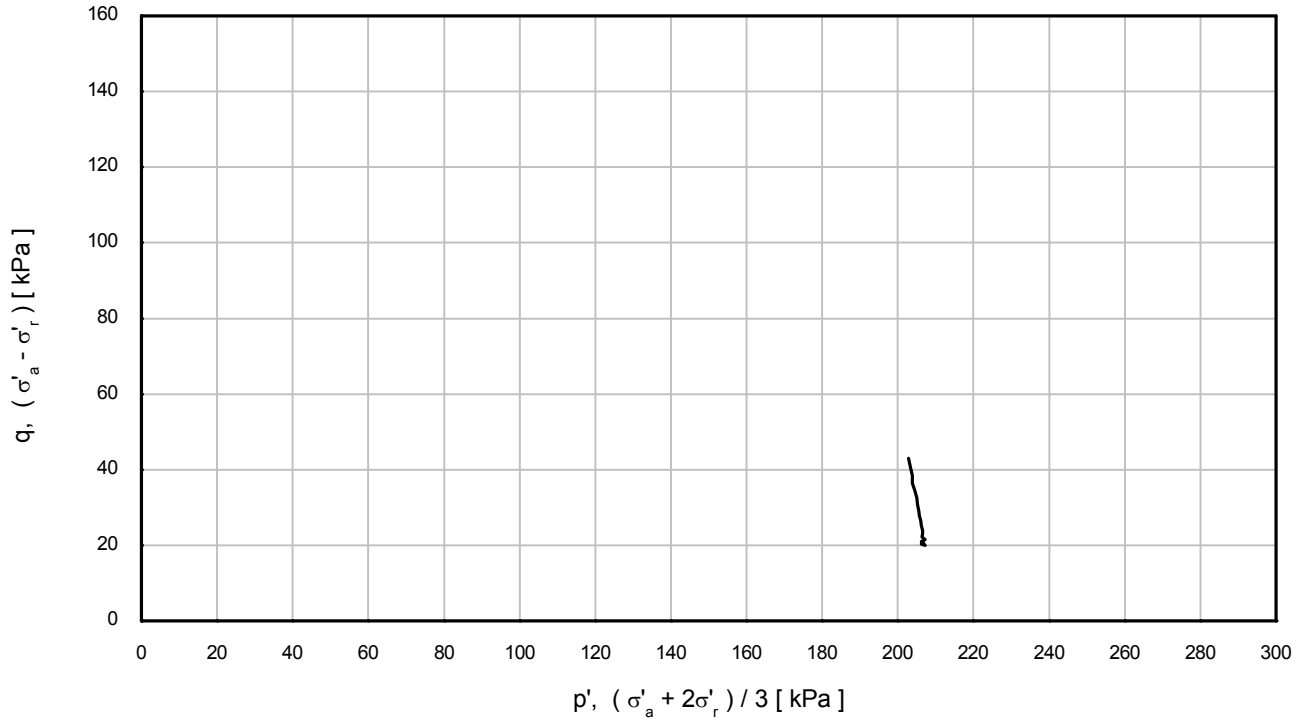




Stage 1 σ'_{rc}	: 200 kPa	Batch	: HKZ2-BH21-SA
Stage 1 σ'_{ac}	: 220 kPa	Sample	: 30WaxB
		Unit	: 23.28
		Test No.	: CTXL18

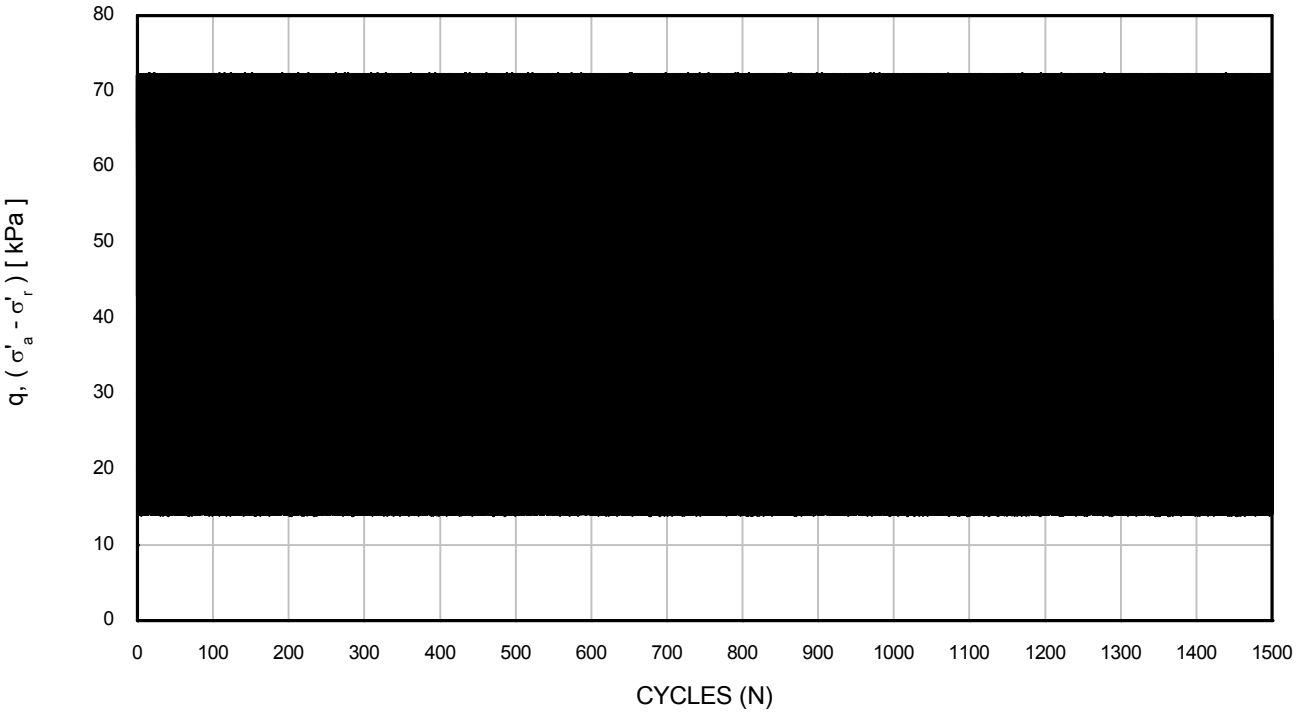
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

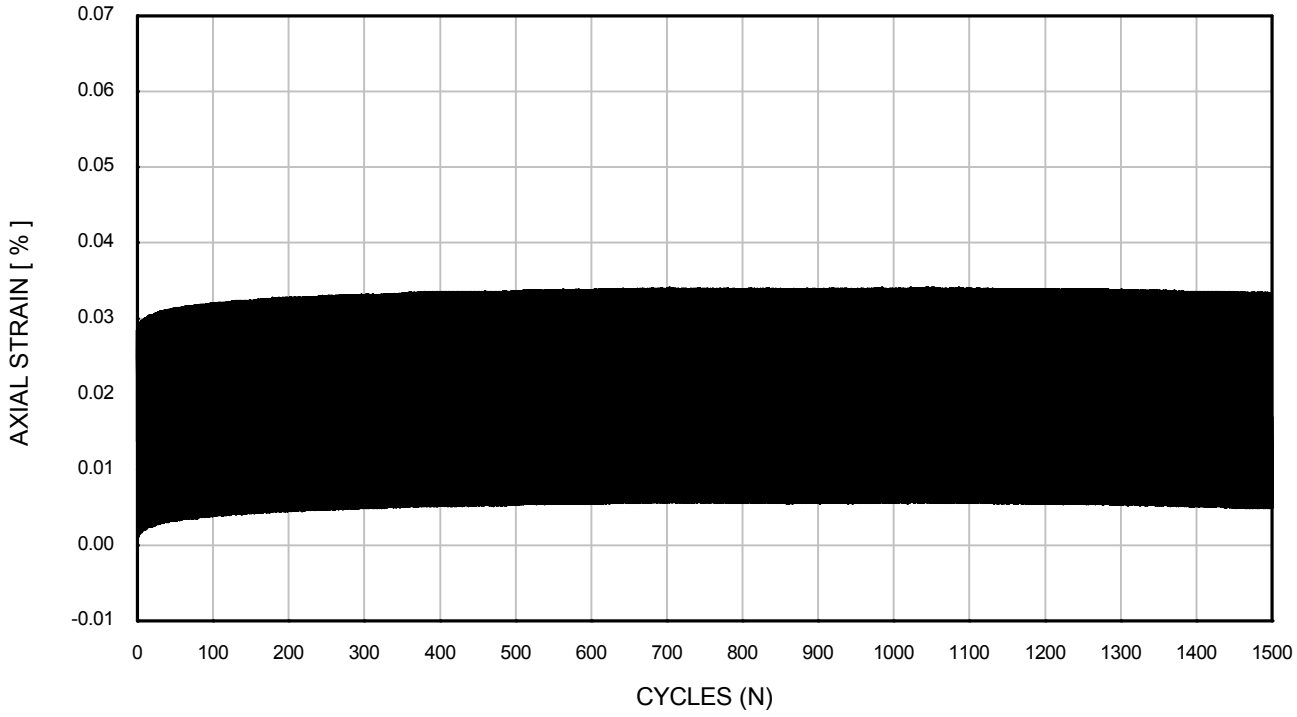




σ'_{rc}	: 189 kPa	Borehole	: HKZ2-BH21-SA
σ'_{ac}	: 232 kPa	Sample	: 30WaxB
		Depth [m]	: 23.28
		Test No.	: CTXL18

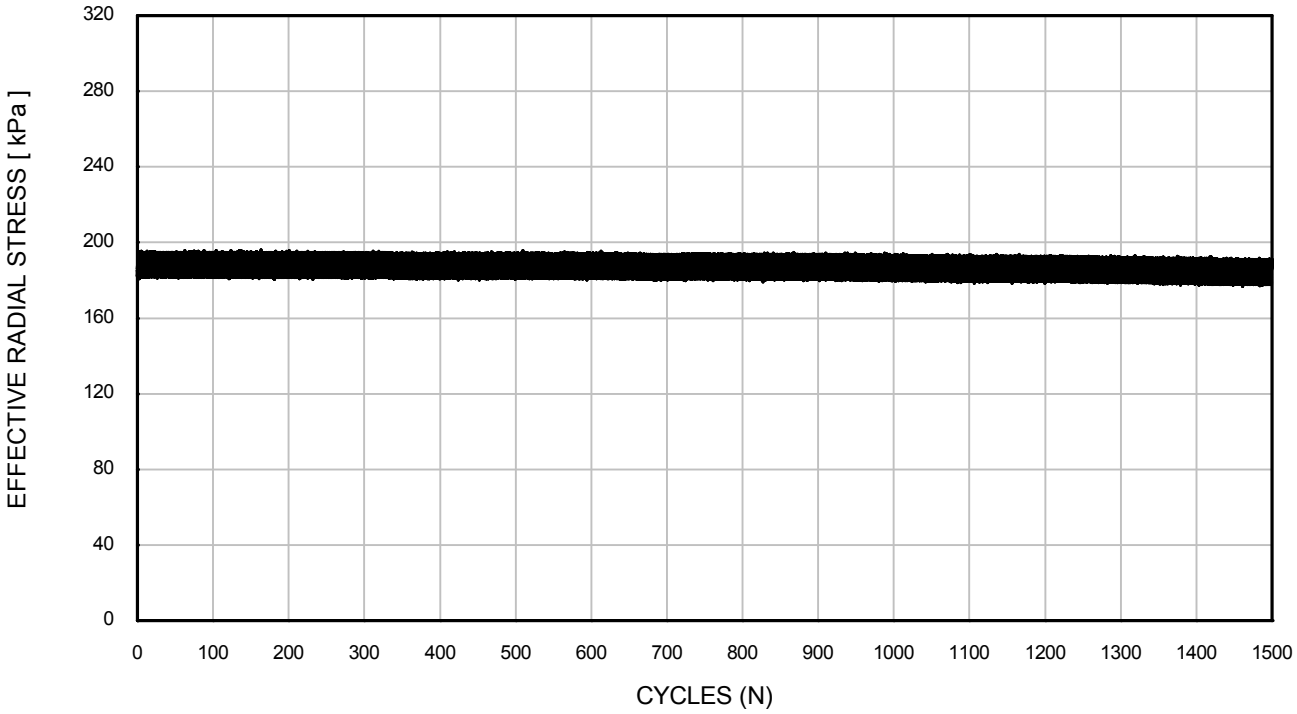
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

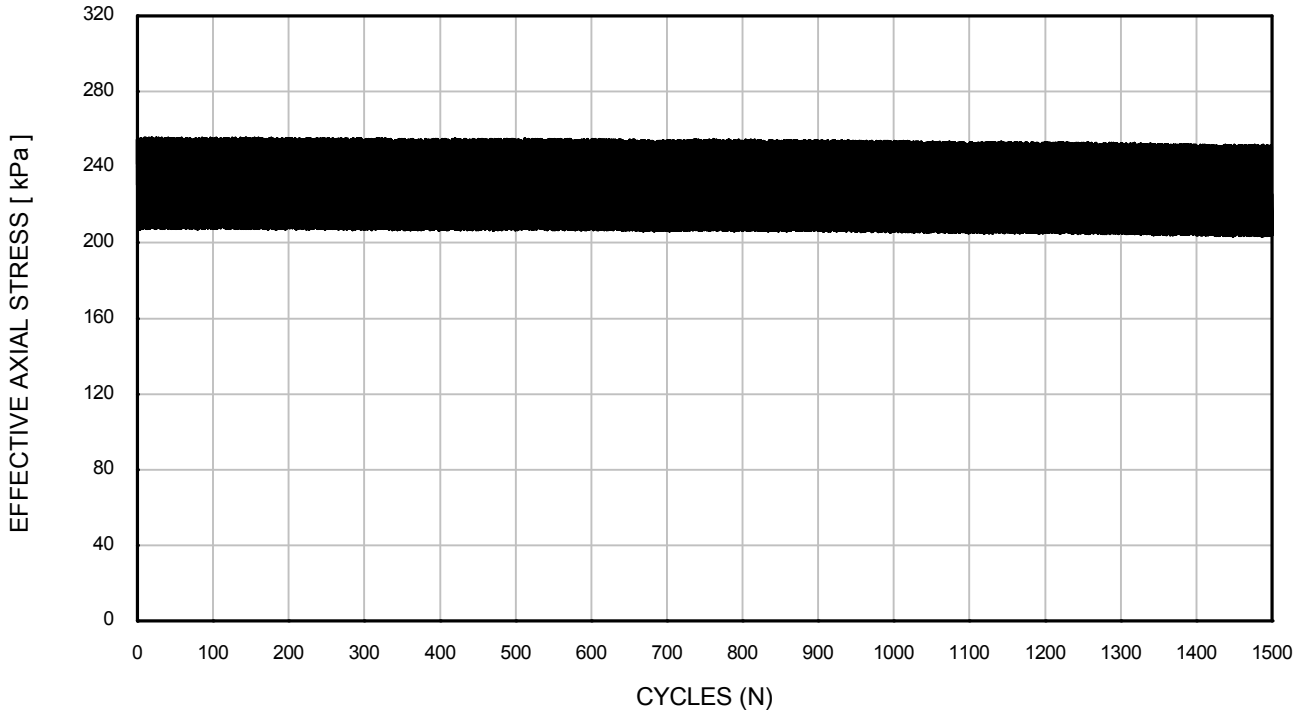




Initial σ'_r	:	188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	: 30WaxB
q_{av}	:	43 kPa	Depth [m]	: 23.28
q_{cy}	:	29 kPa	Test No.	: CTXL18
Frequency	:	0.10 Hz		

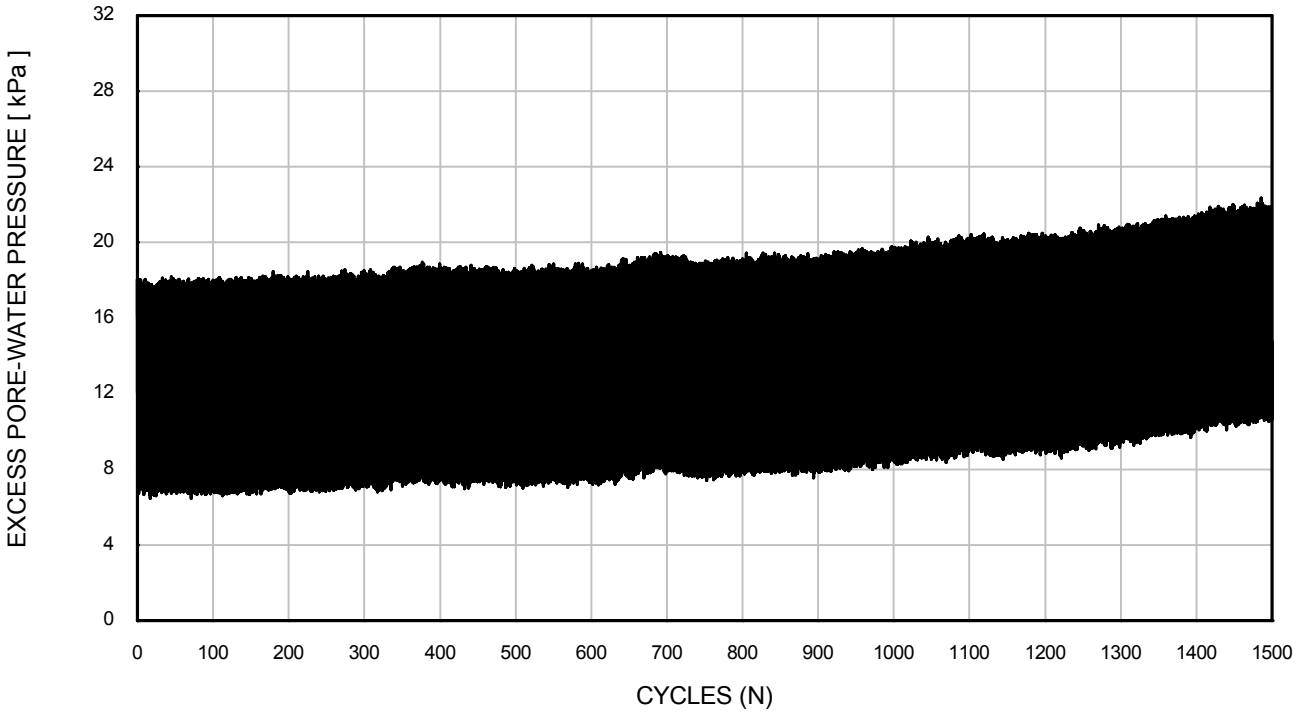
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

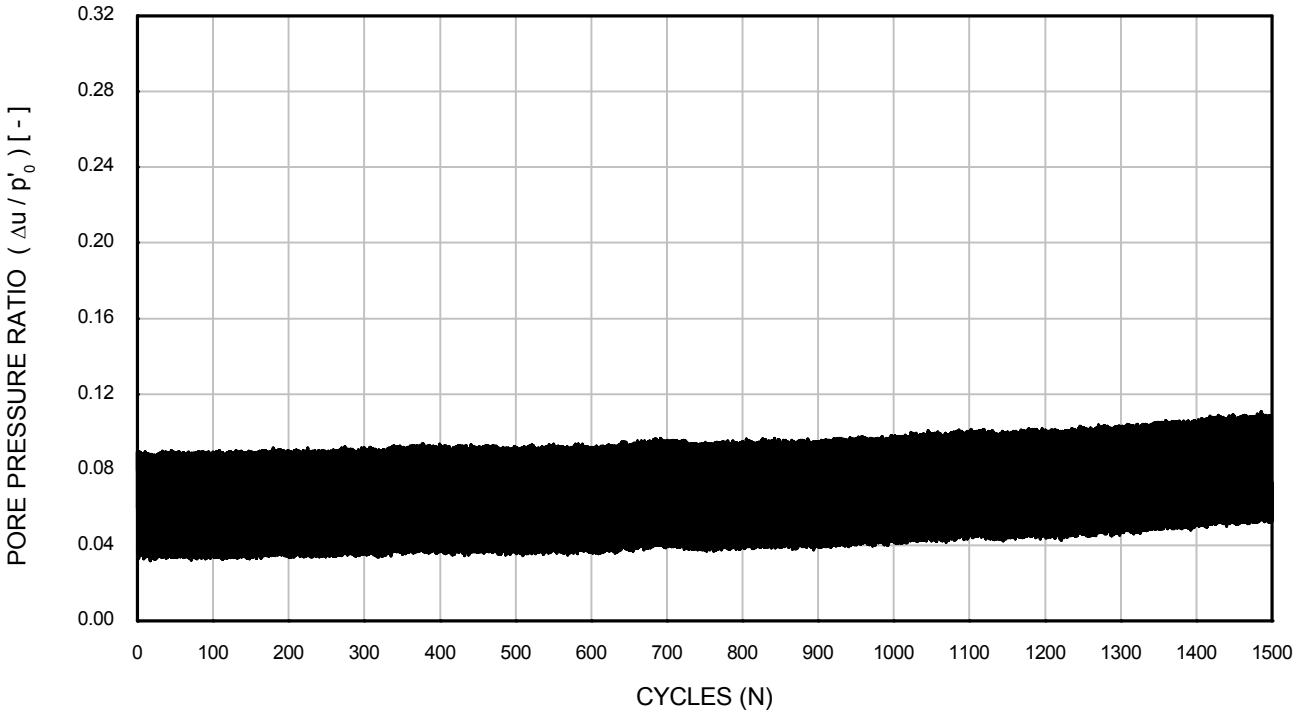




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	29 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

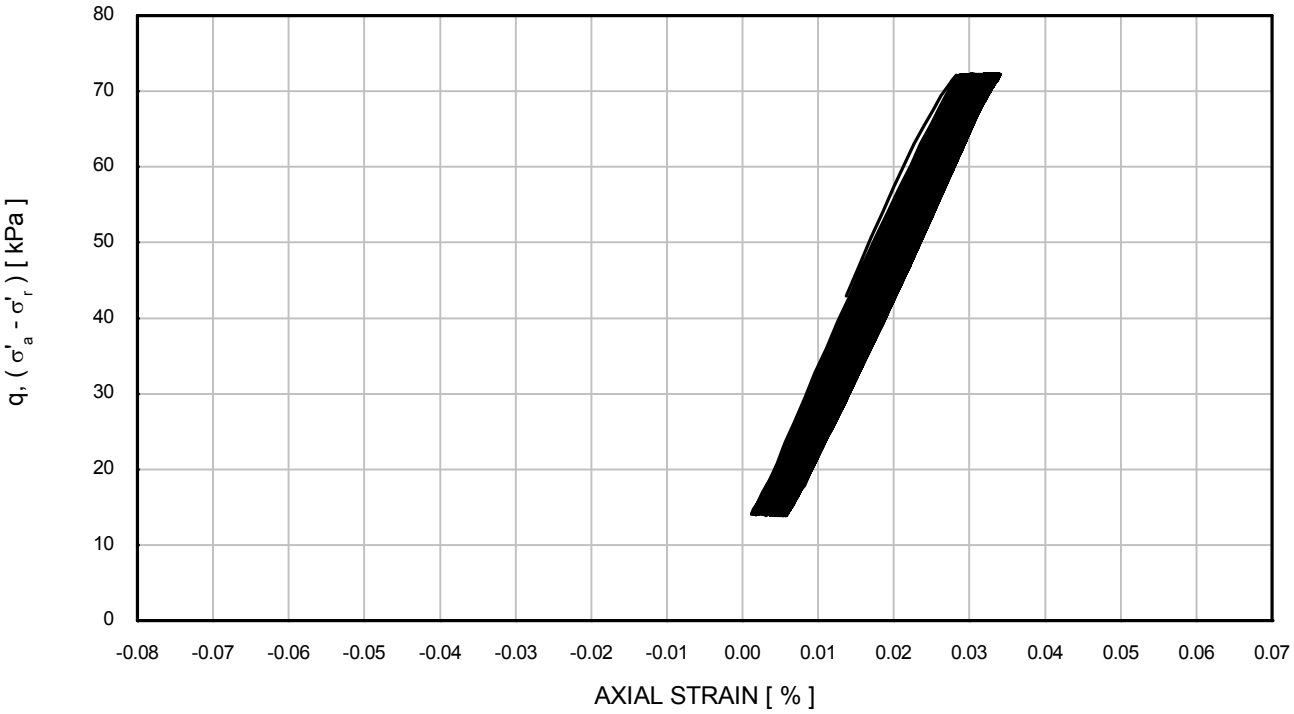
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

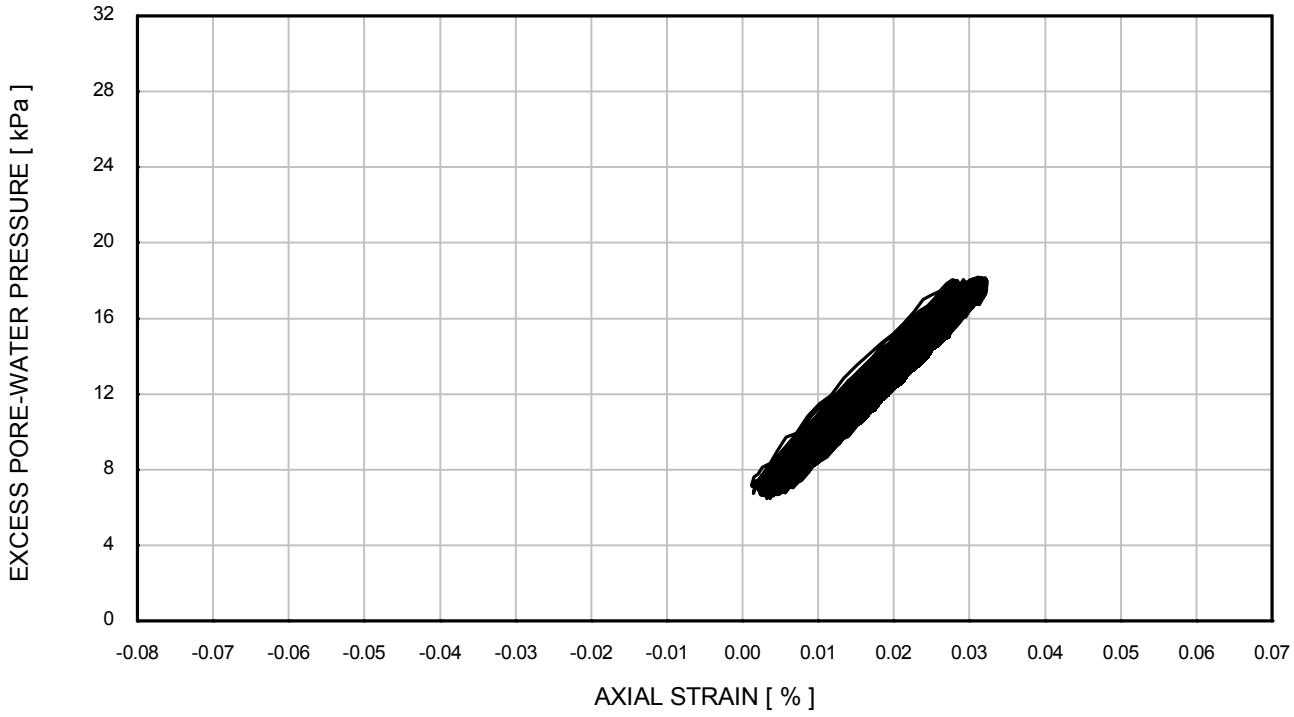




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	29 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

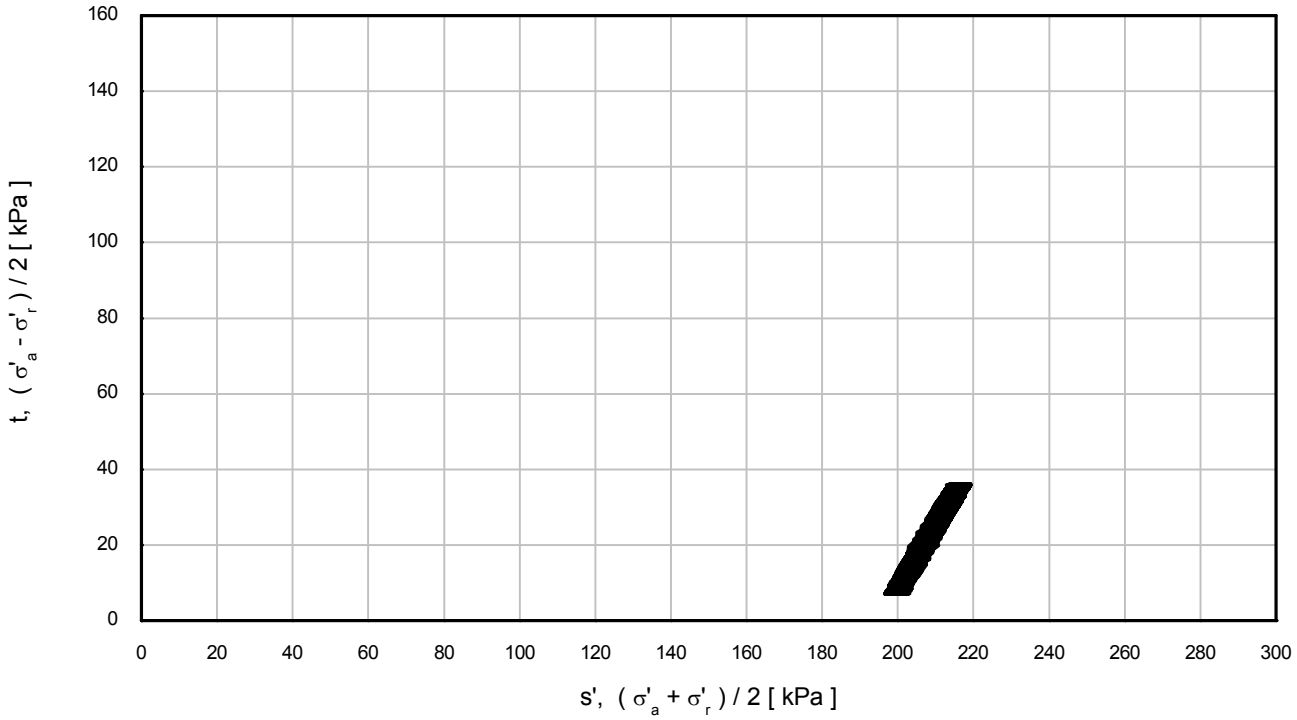
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

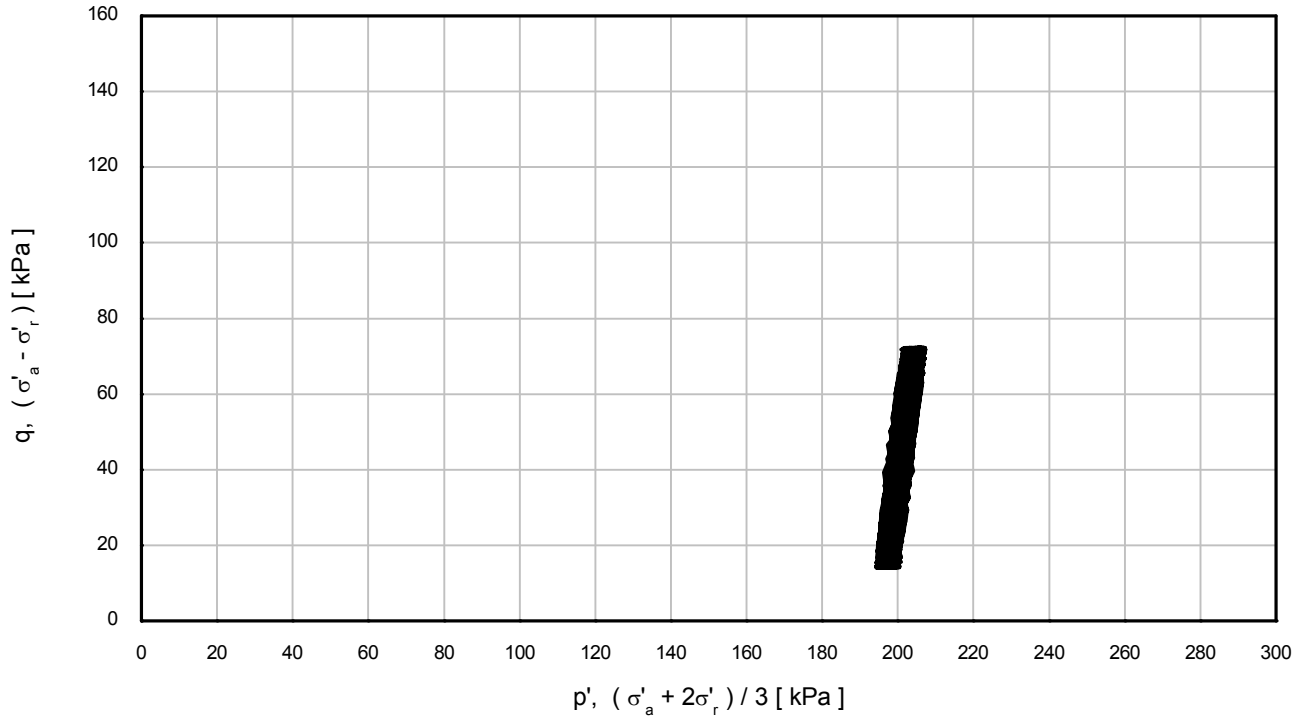




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	29 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

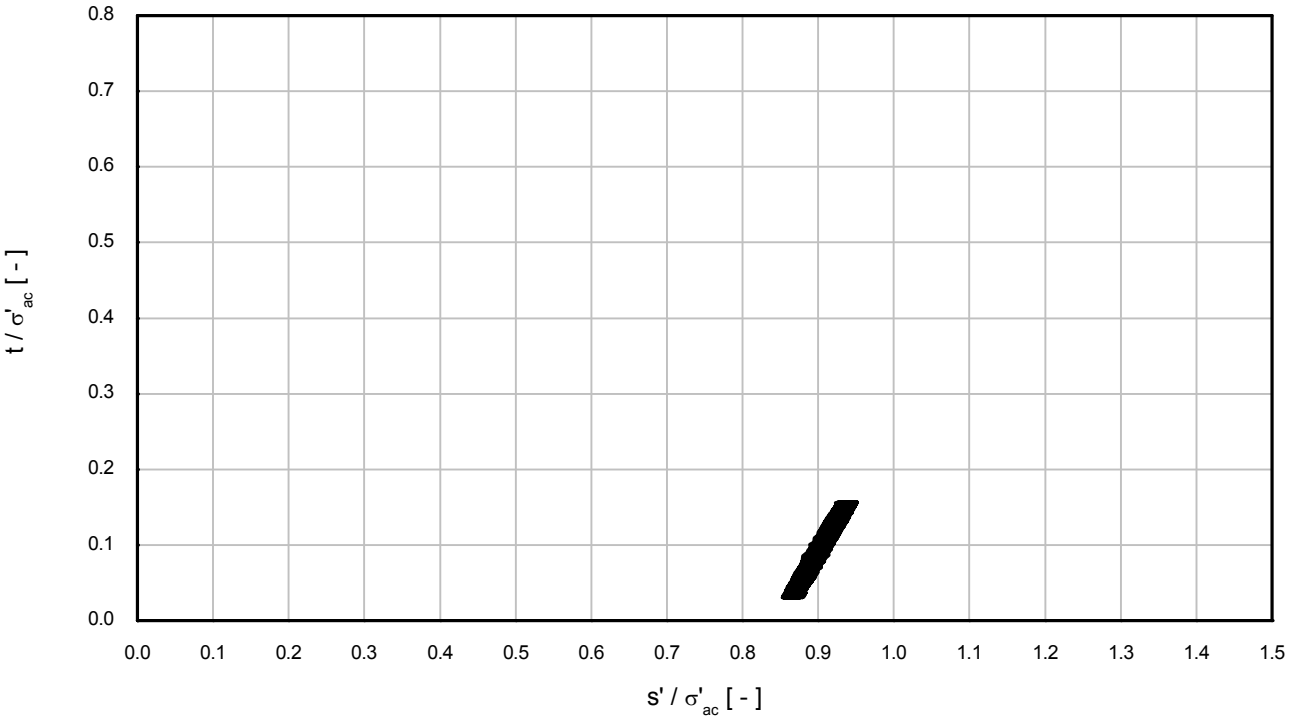
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CYCLIC LOADING STAGE - UNDRAINED

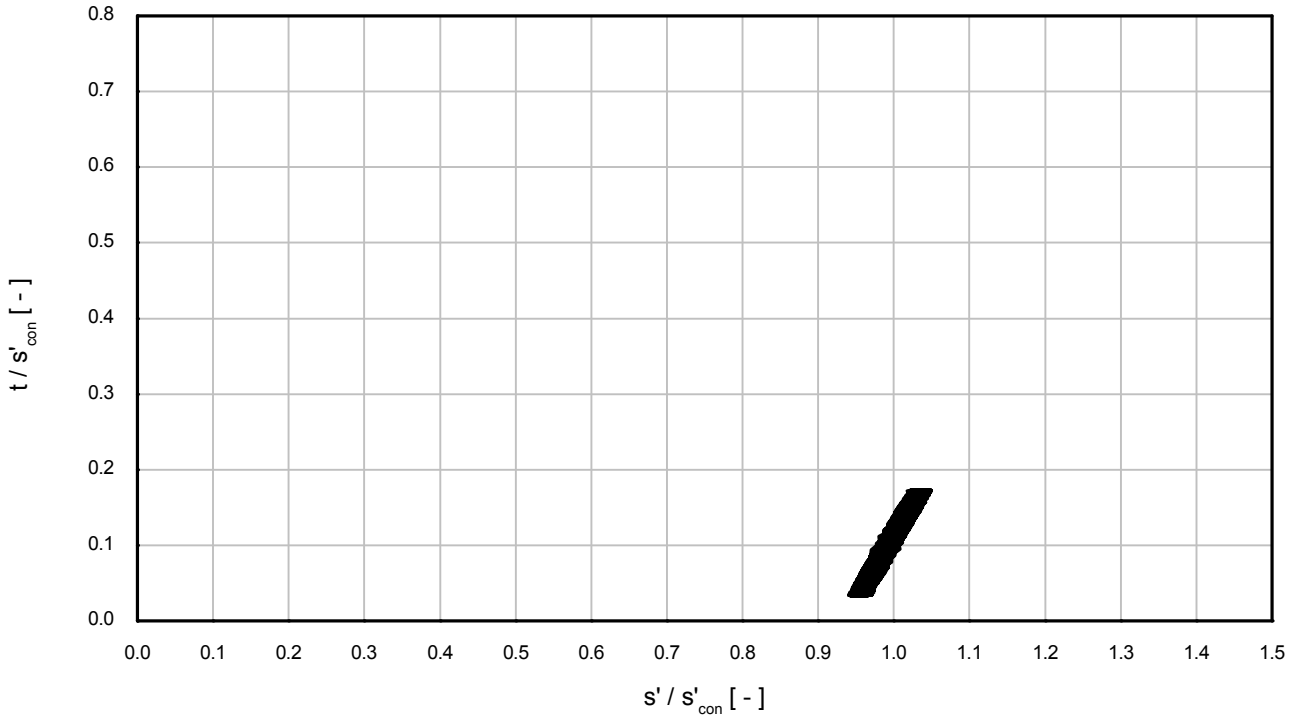




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	29 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

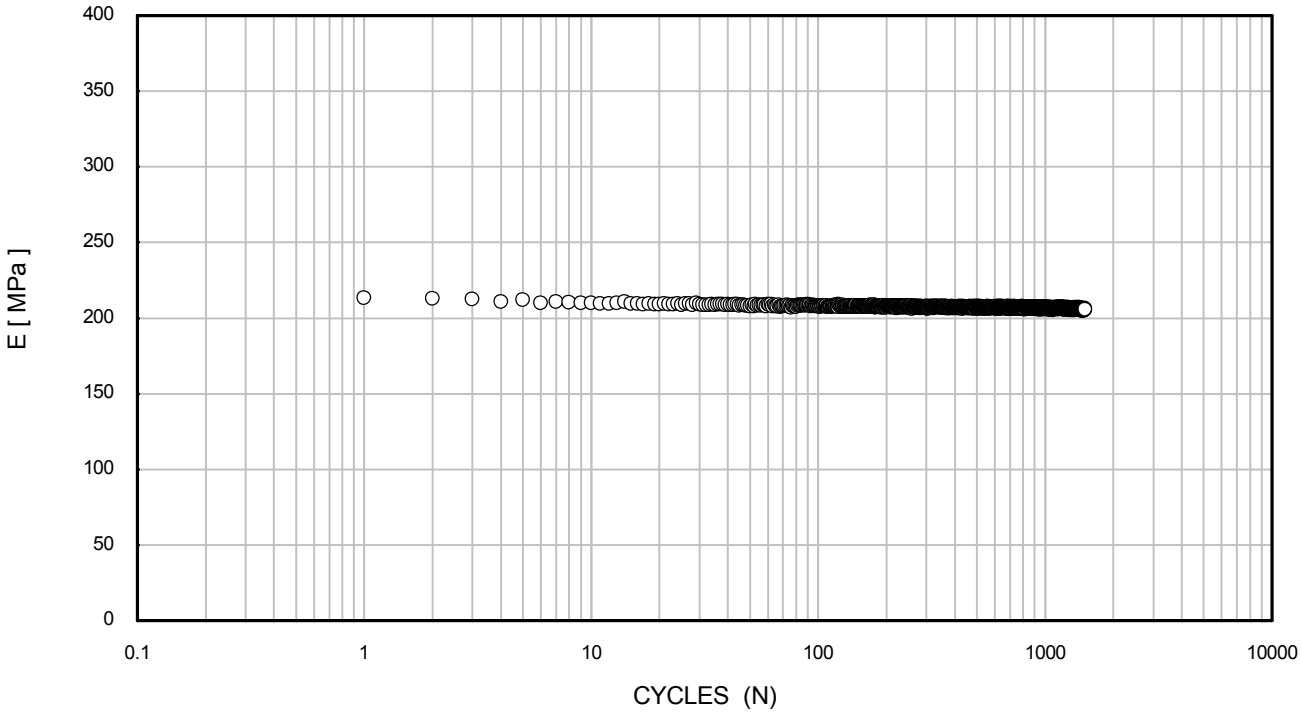
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

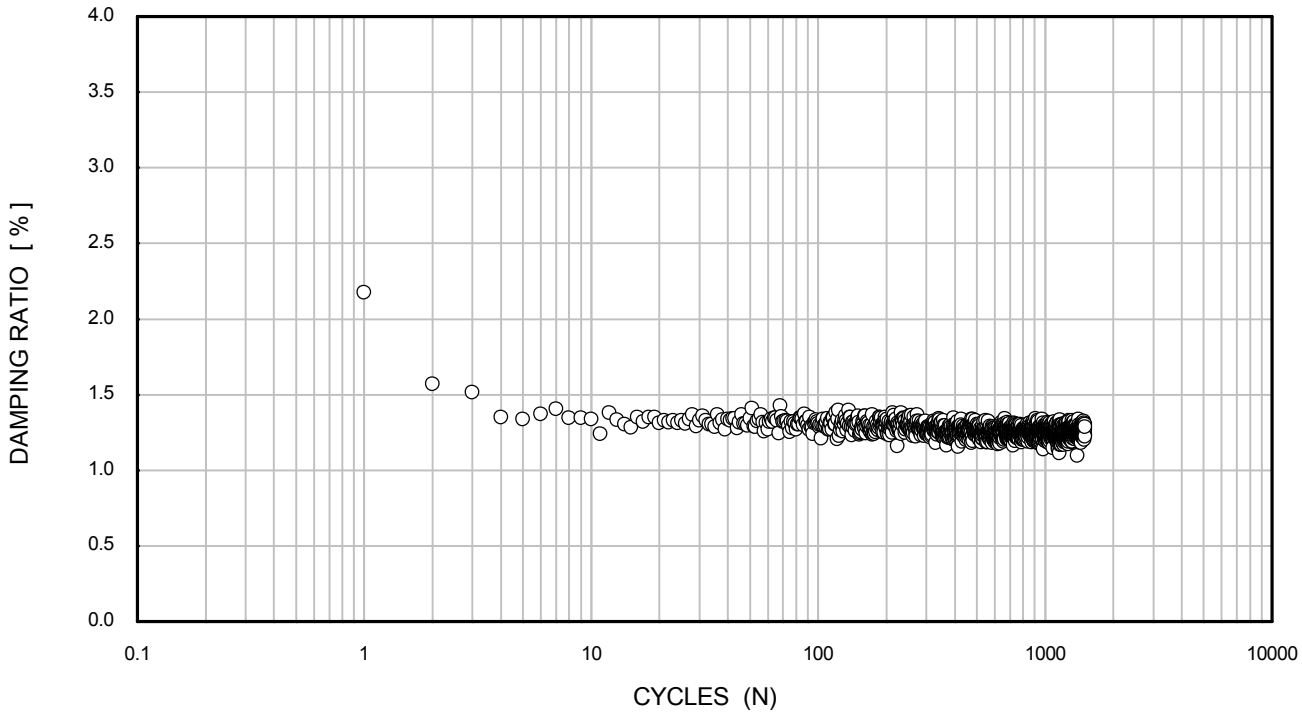




Initial σ'_r	:	188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	: 30WaxB
q_{av}	:	43 kPa	Depth [m]	: 23.28
q_{cy}	:	29 kPa	Test No.	: CTXL18
Frequency	:	0.10 Hz		

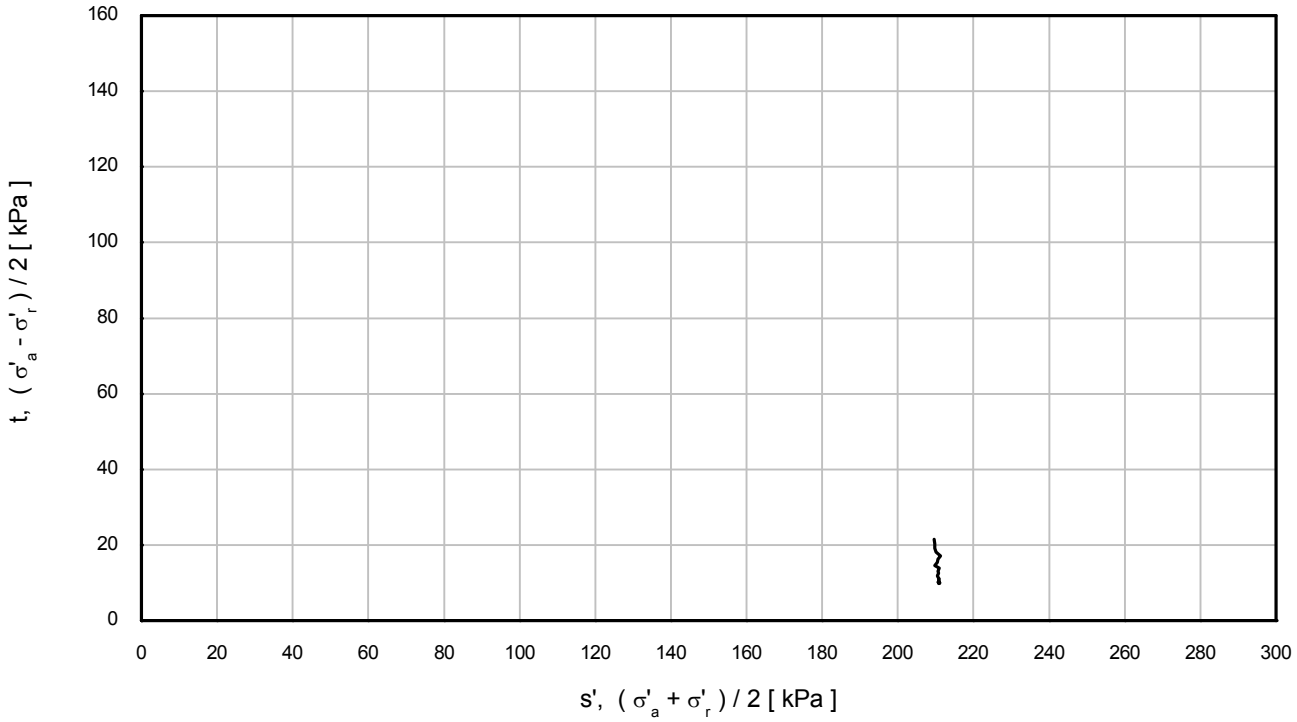
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

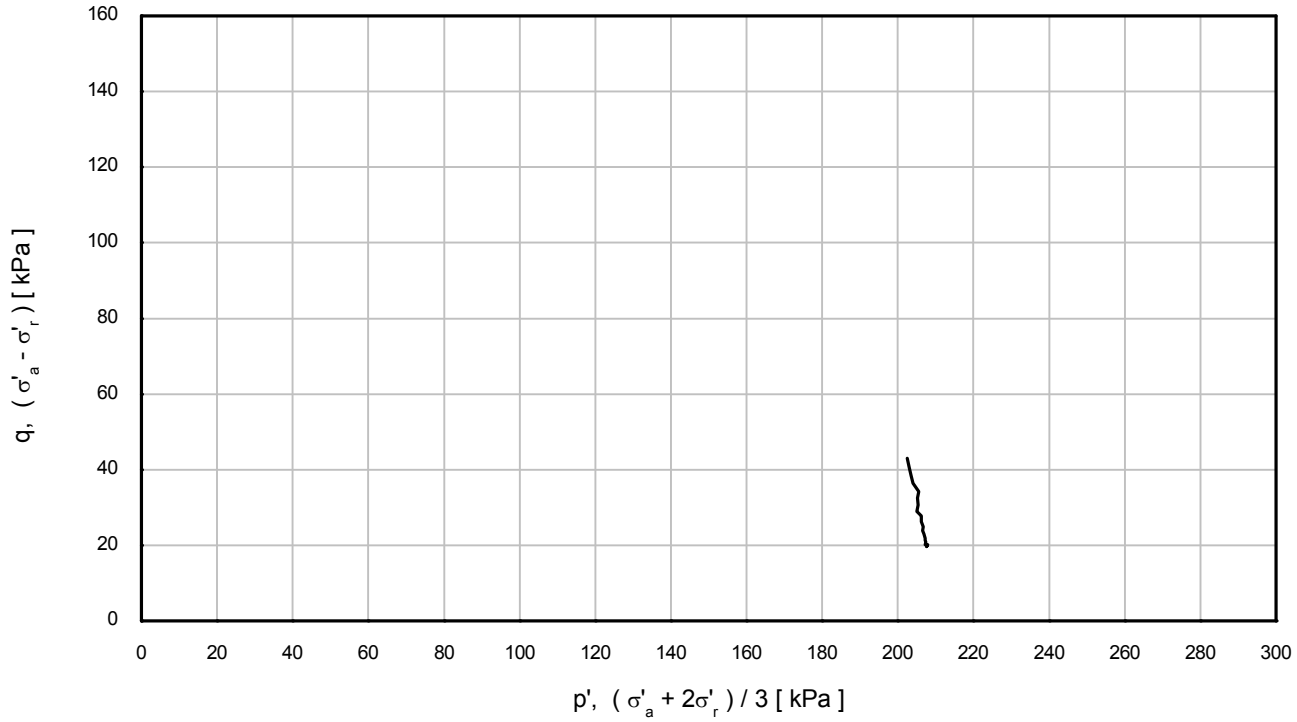




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 231 kPa	Sample	: 30WaxB
q_{av}	: 43 kPa	Depth [m]	: 23.28
q_{cy}	: 29 kPa	Test No.	: CTXL18
Frequency	: 0.10 Hz		

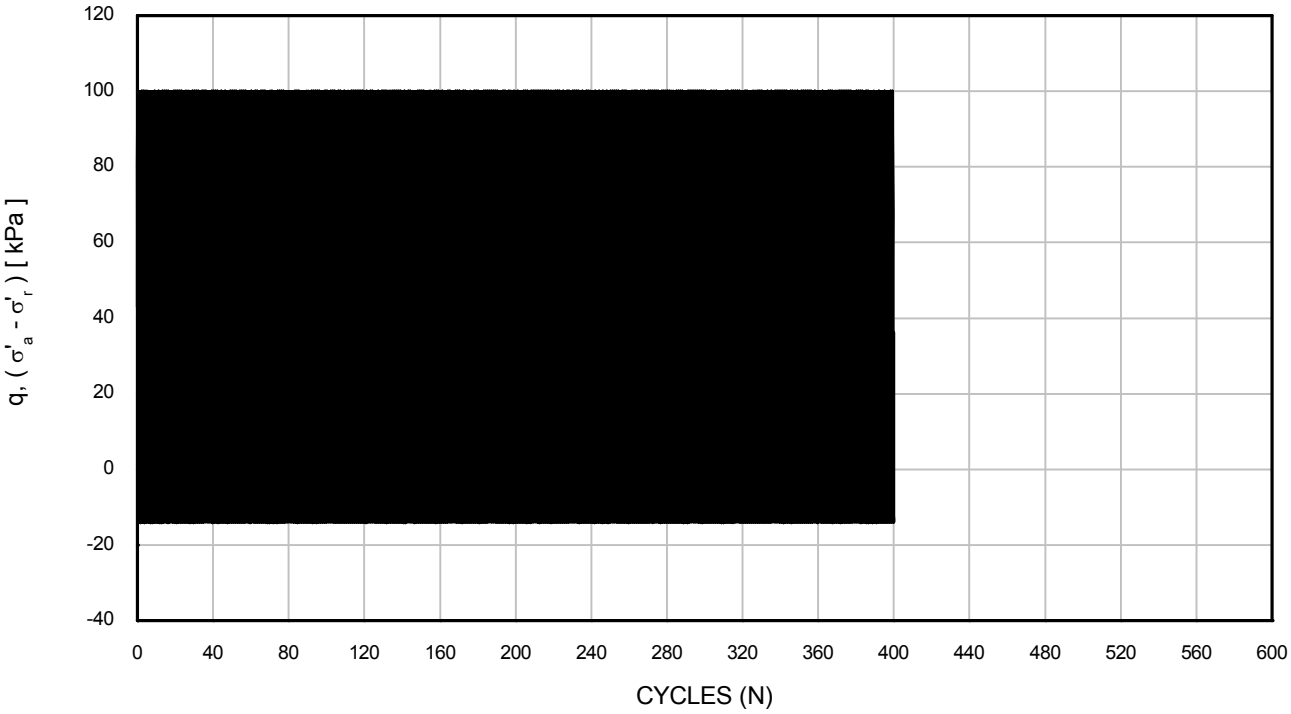
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

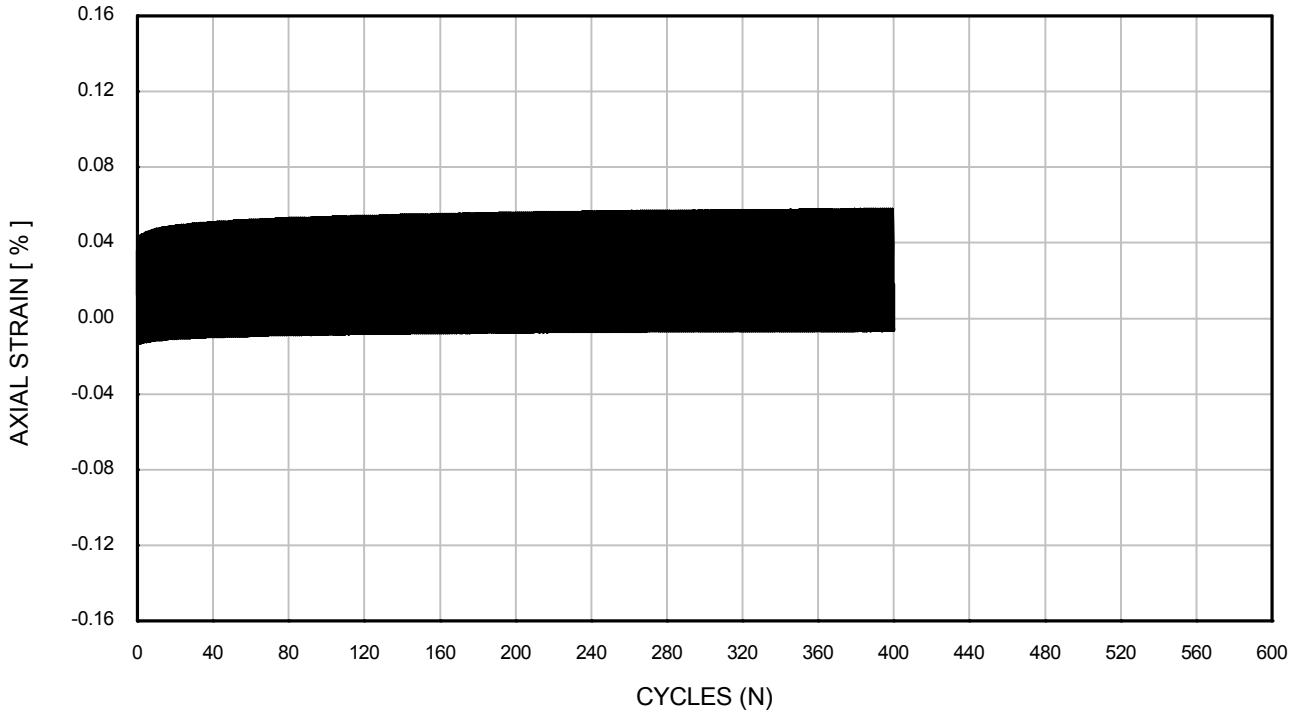




σ'_{rc}	: 188 kPa	Borehole	: HKZ2-BH21-SA
σ'_{ac}	: 231 kPa	Sample	: 30WaxB
		Depth [m]	: 23.28
		Test No.	: CTXL18

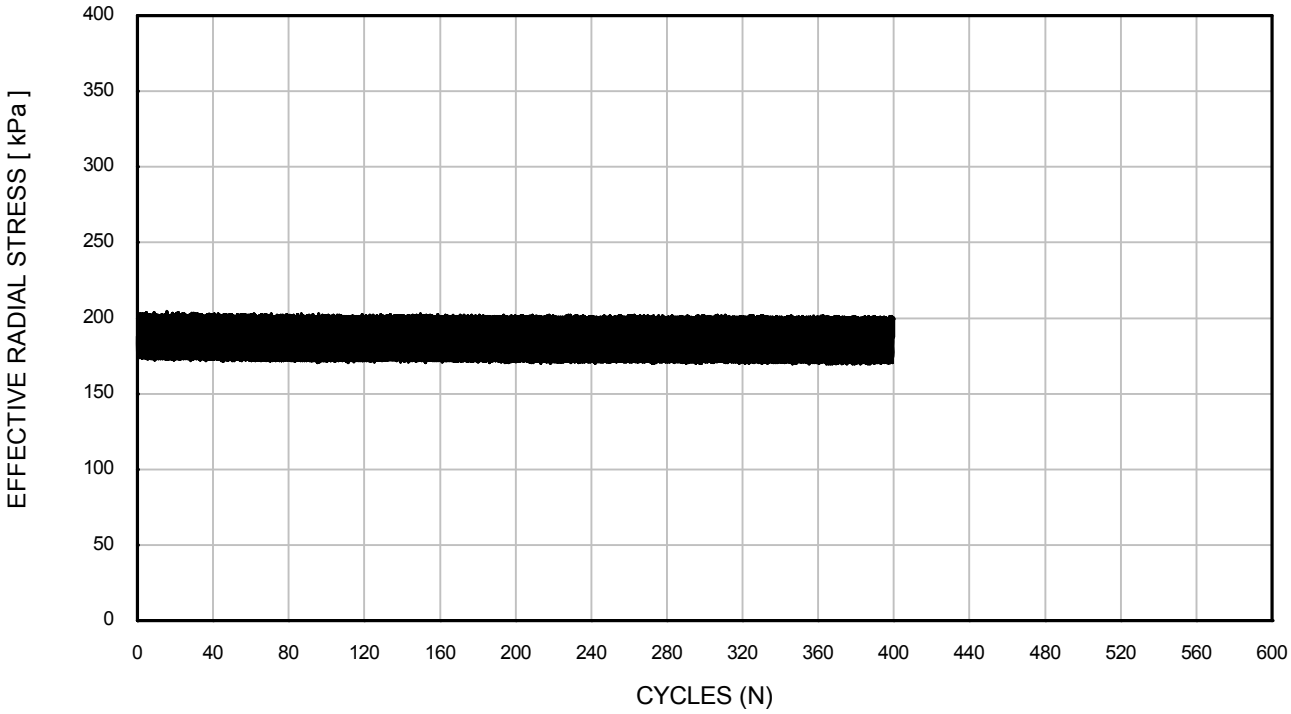
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 2 - UNDRAINED

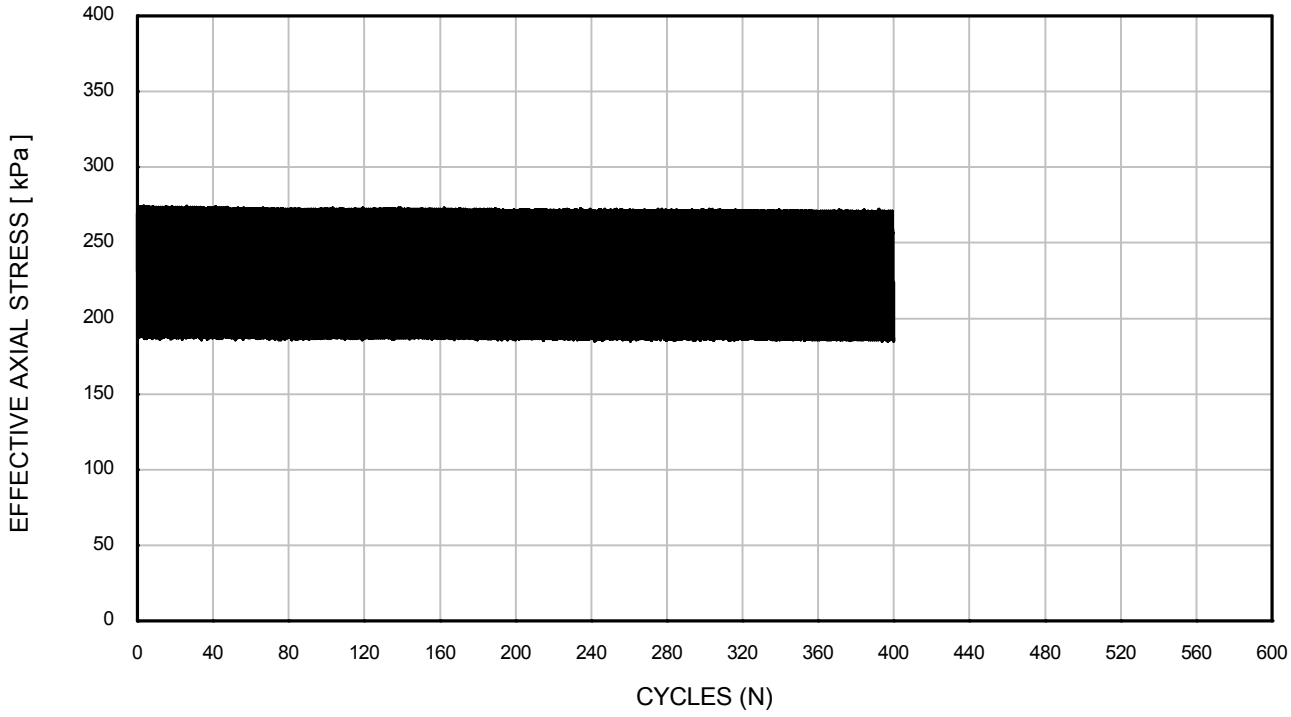




Initial σ'_r	:	188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	: 30WaxB
q_{av}	:	43 kPa	Depth [m]	: 23.28
q_{cy}	:	57 kPa	Test No.	: CTXL18
Frequency	:	0.10 Hz		

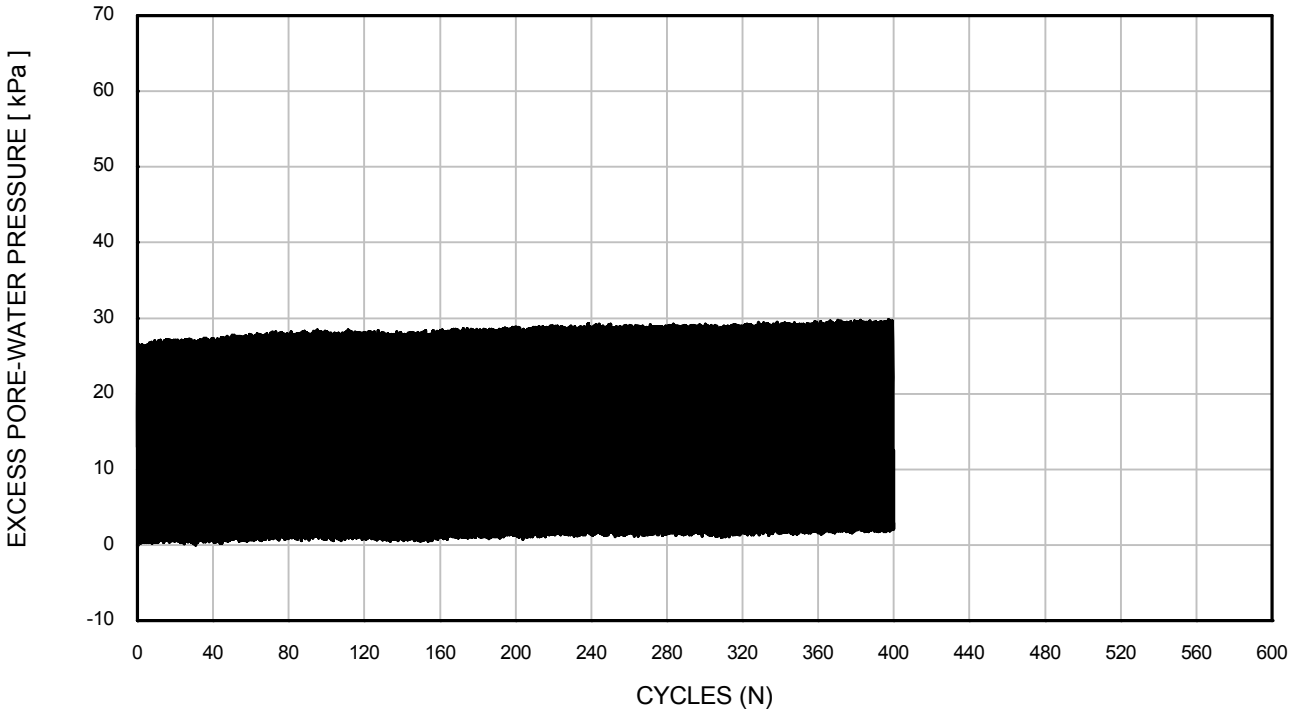
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

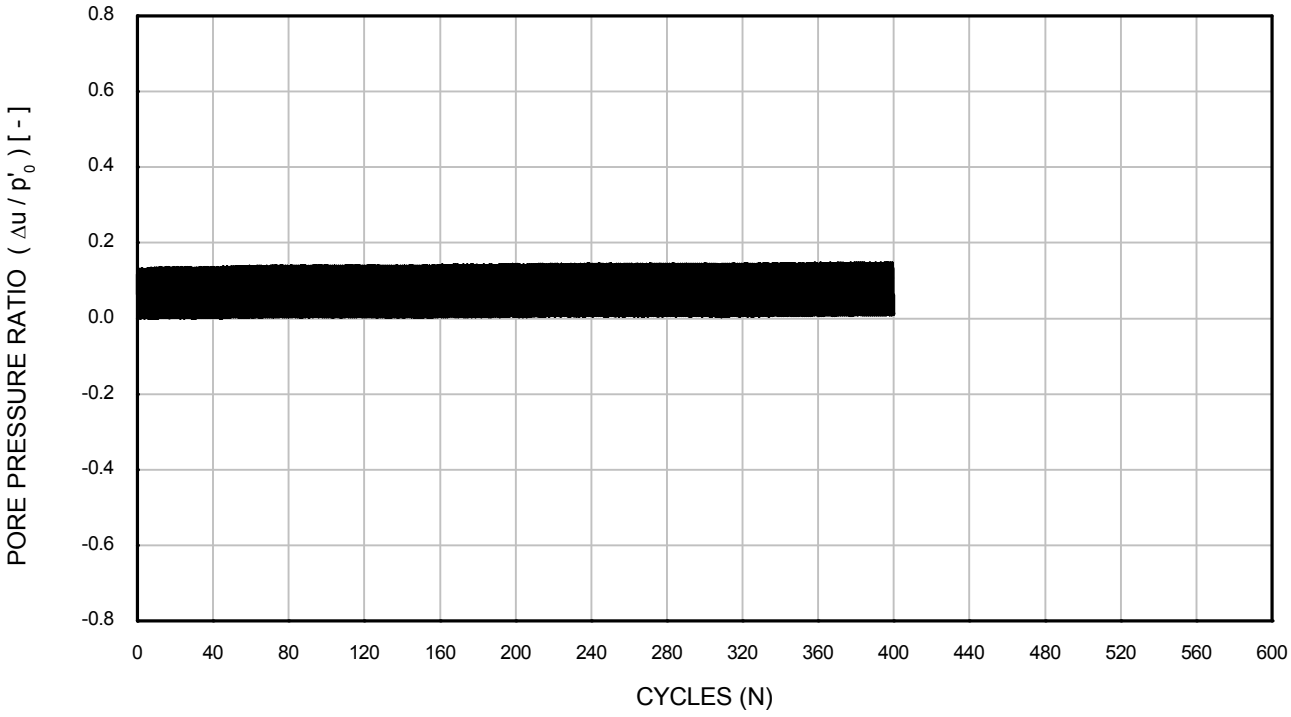




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	57 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

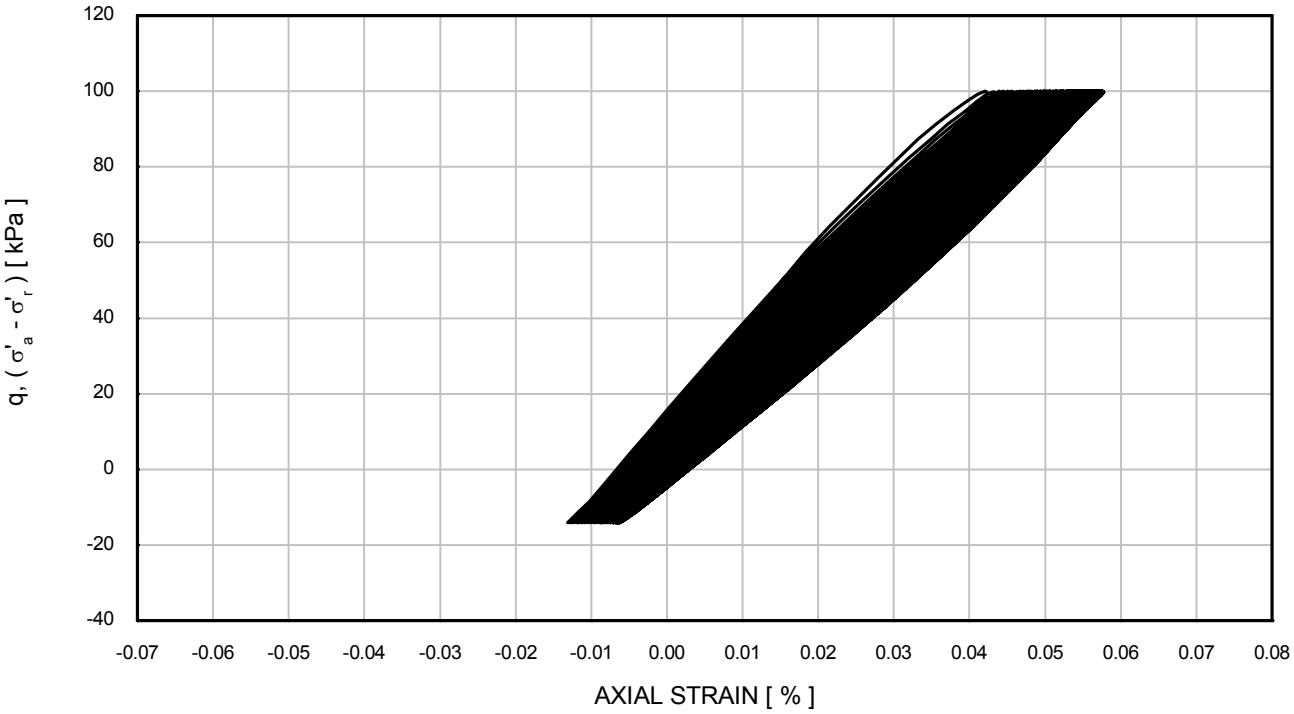
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

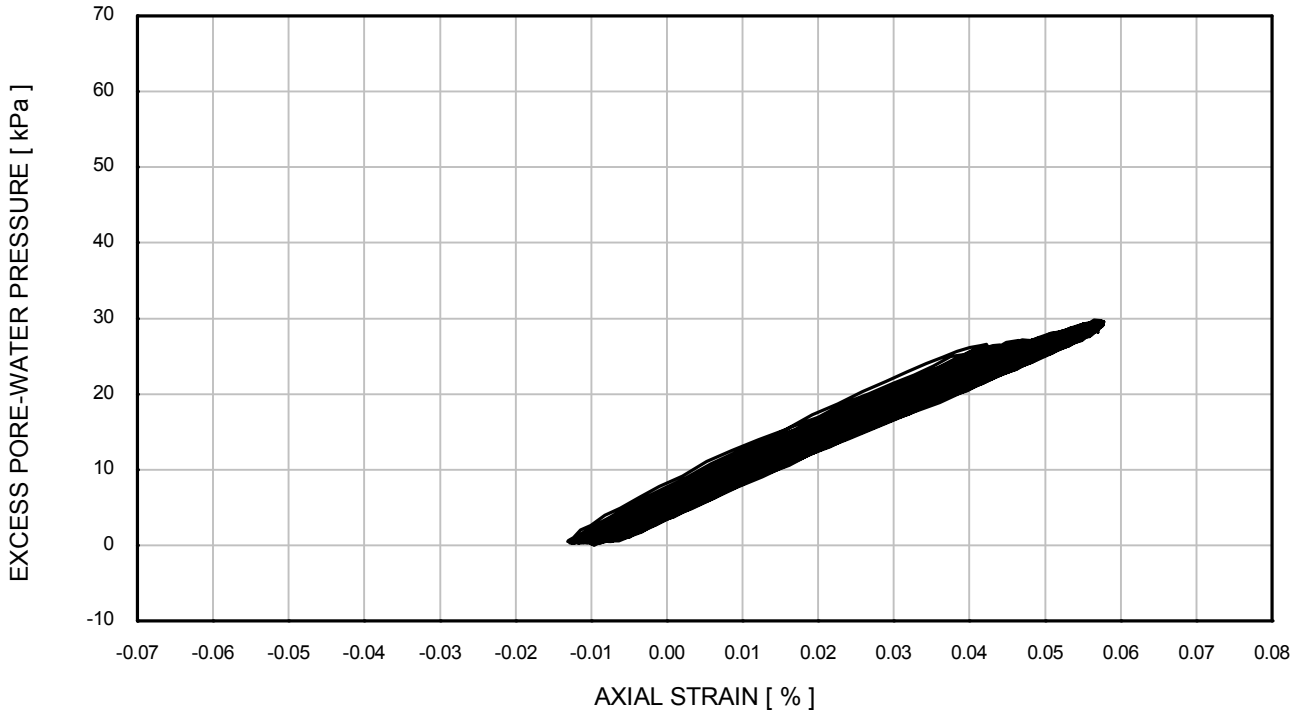




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	57 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

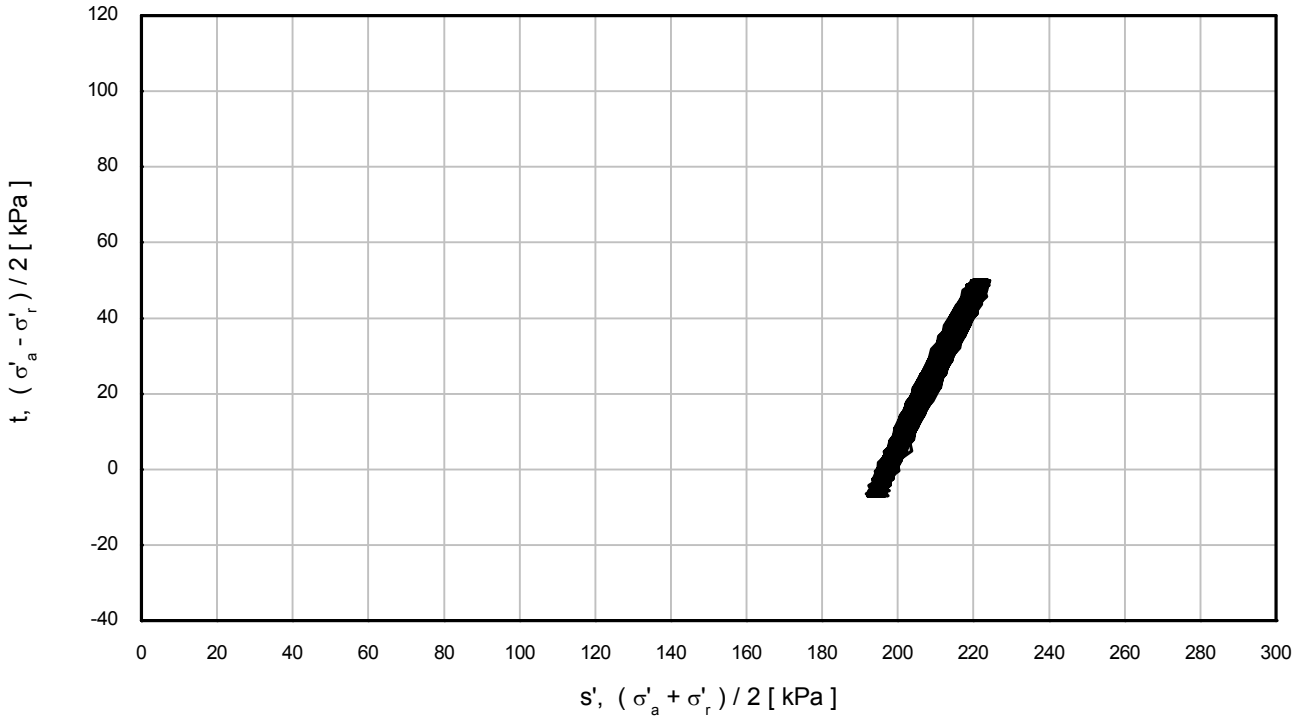
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

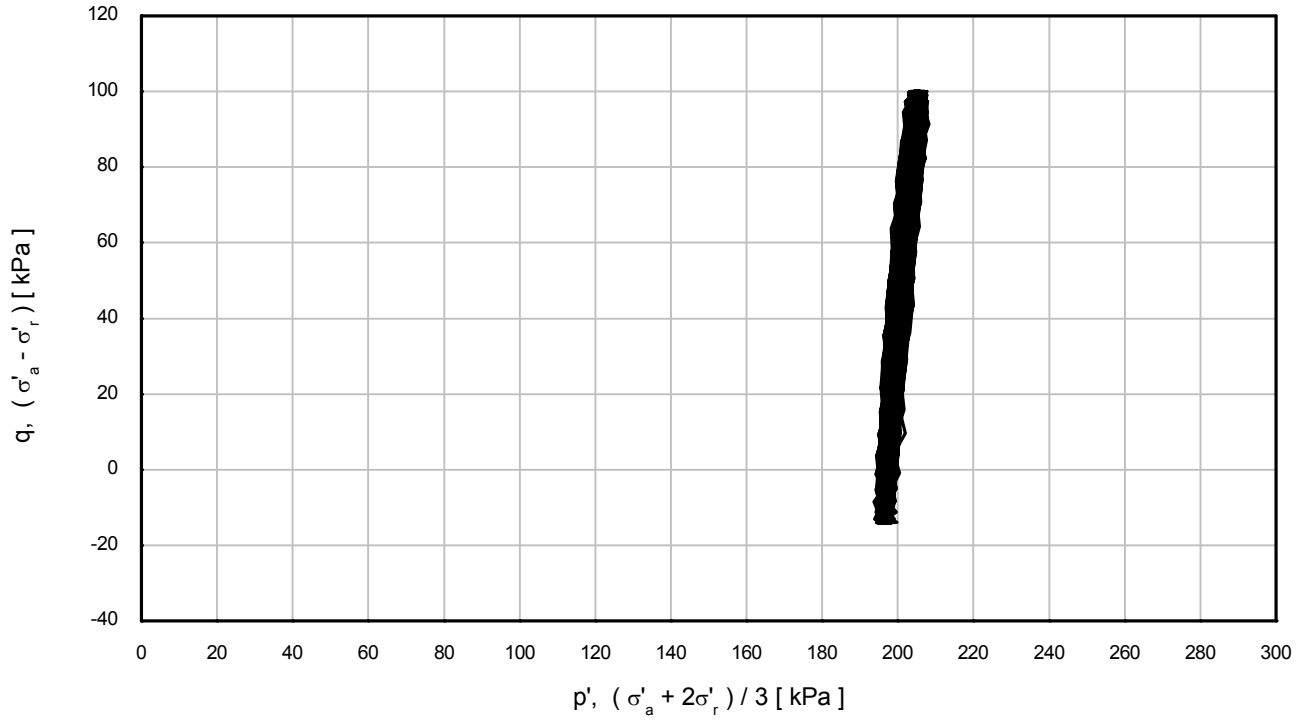




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 231 kPa	Sample	: 30WaxB
q_{av}	: 43 kPa	Depth [m]	: 23.28
q_{cy}	: 57 kPa	Test No.	: CTXL18
Frequency	: 0.10 Hz		

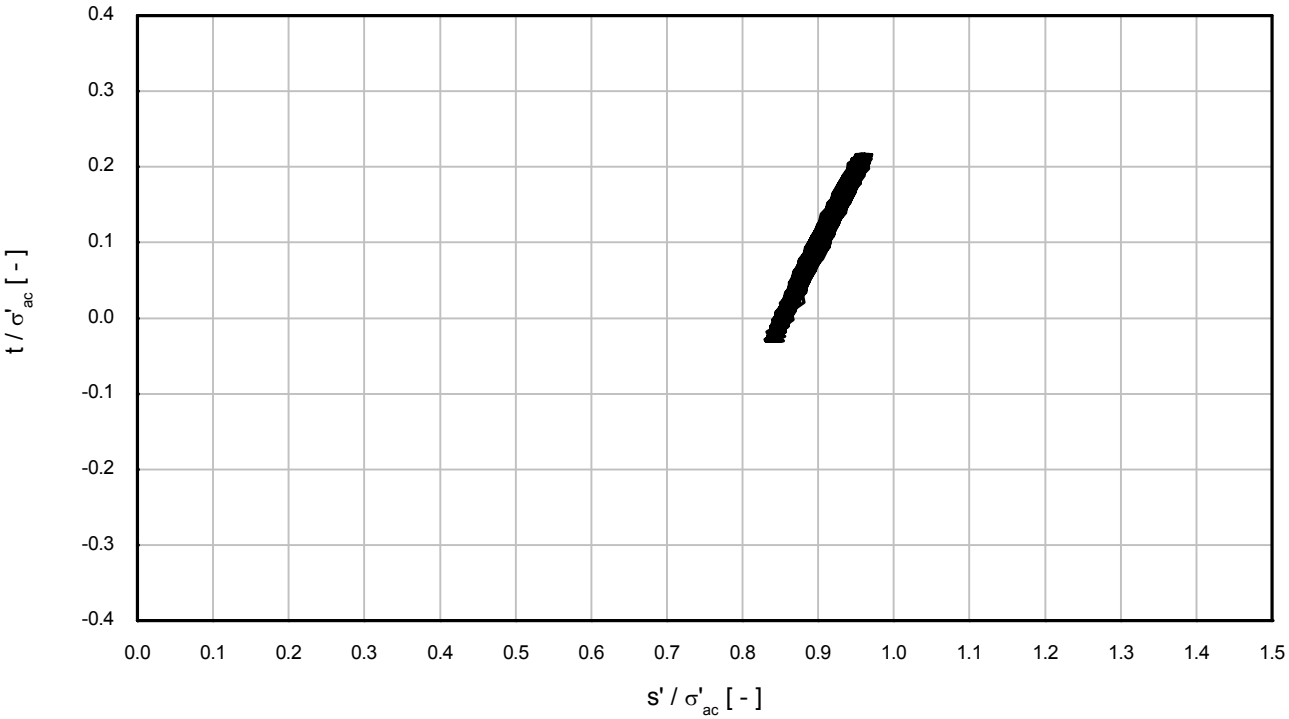
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

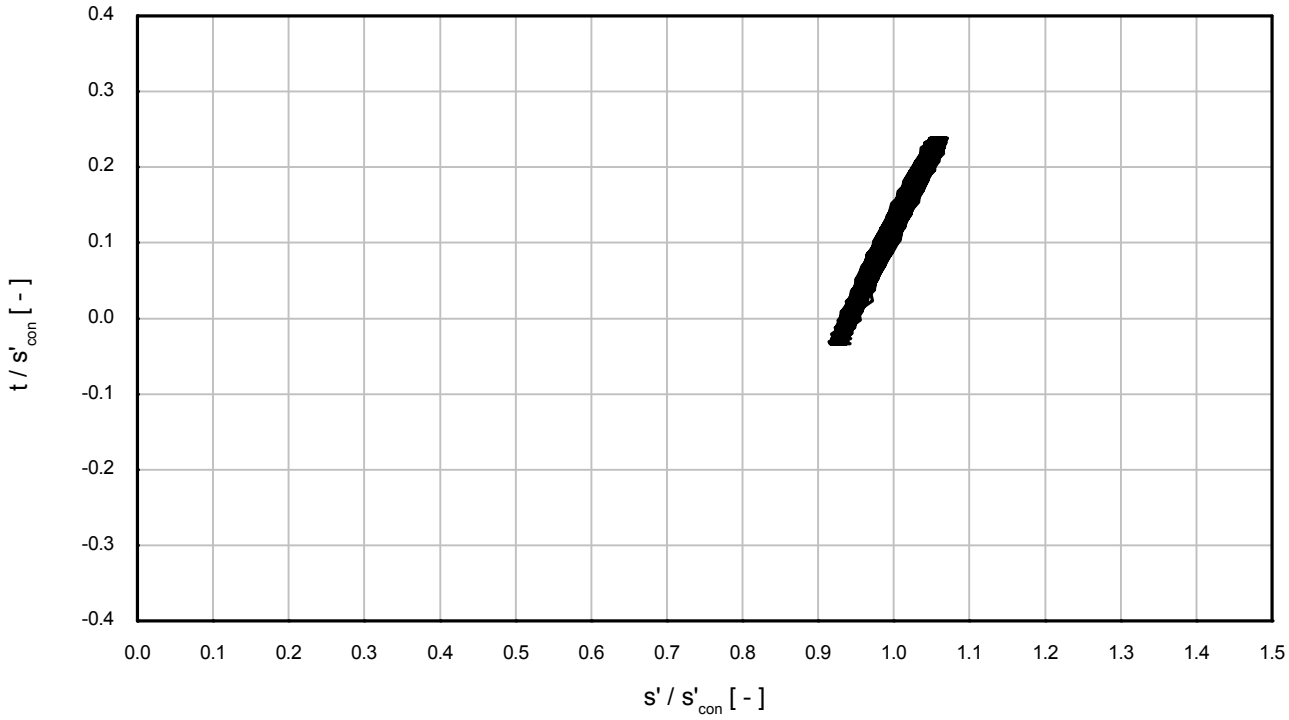




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	57 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

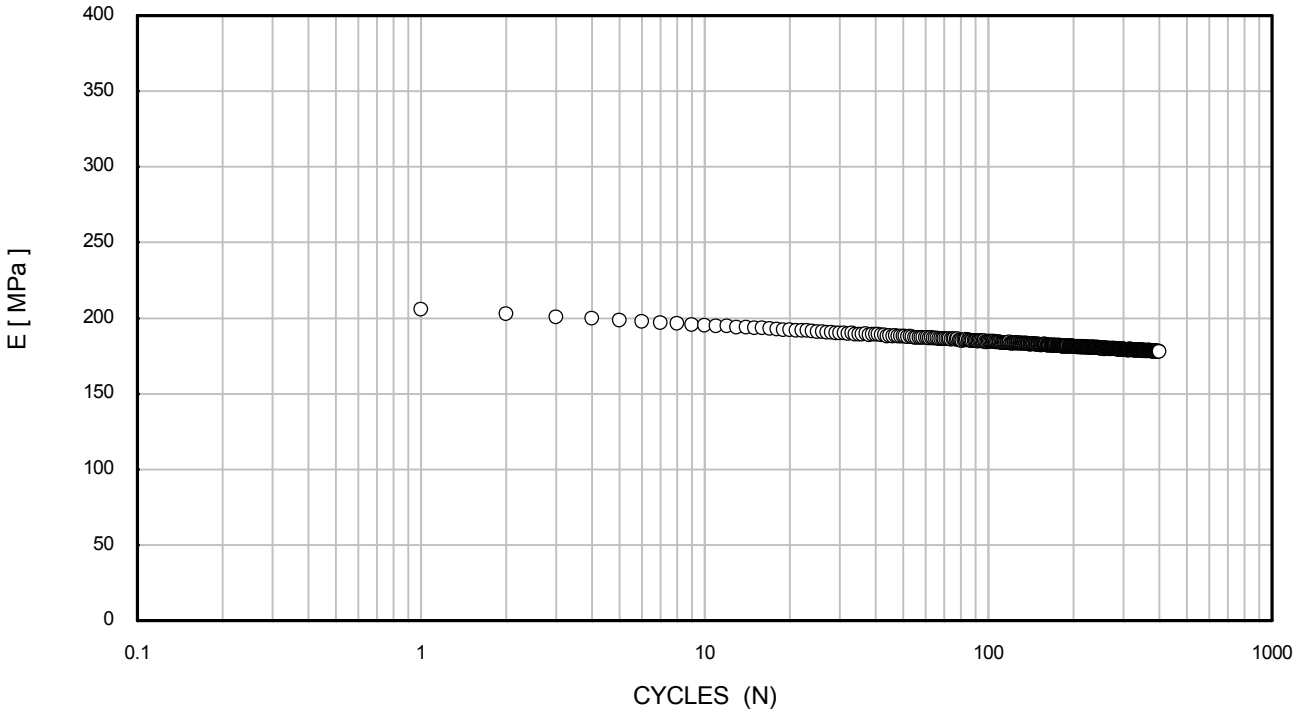
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

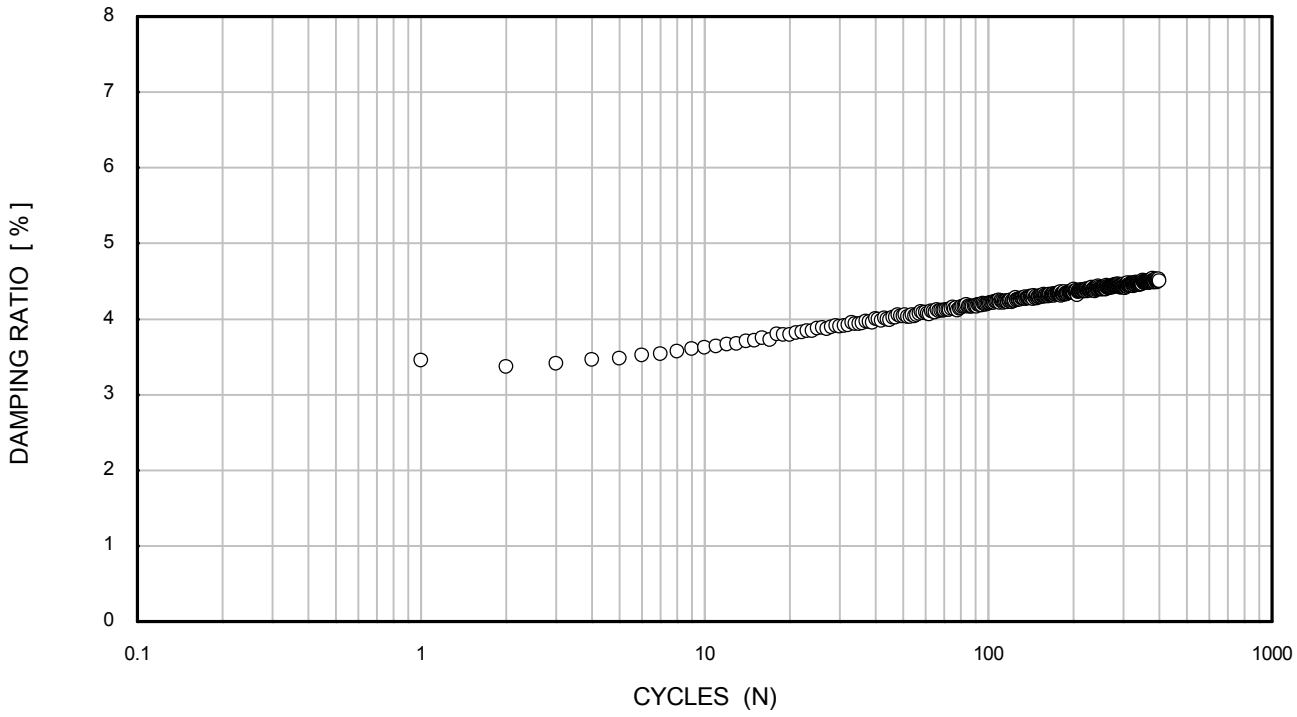




Initial σ'_r	:	188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	: 30WaxB
q_{av}	:	43 kPa	Depth [m]	: 23.28
q_{cy}	:	57 kPa	Test No.	: CTXL18
Frequency	:	0.10 Hz		

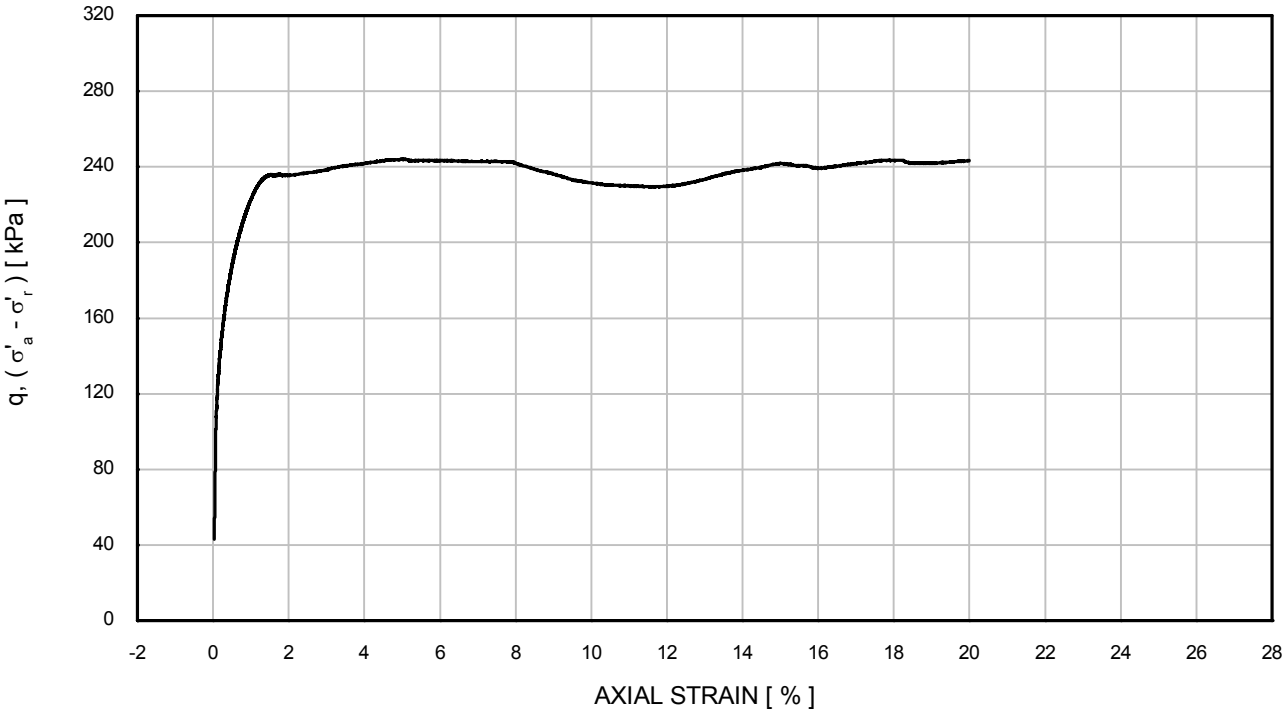
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

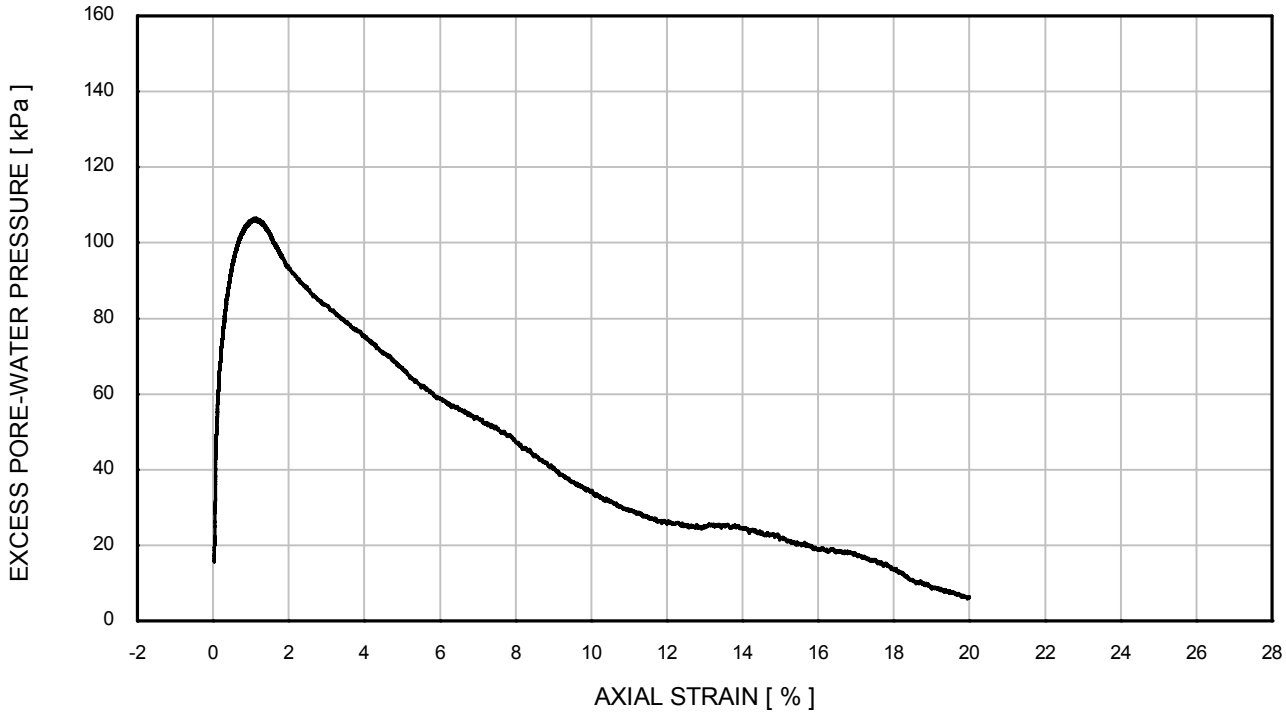




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	231 kPa	Sample	:	30WaxB
q_{av}	:	43 kPa	Depth [m]	:	23.28
q_{cy}	:	57 kPa	Test No.	:	CTXL18
Frequency	:	0.10 Hz			

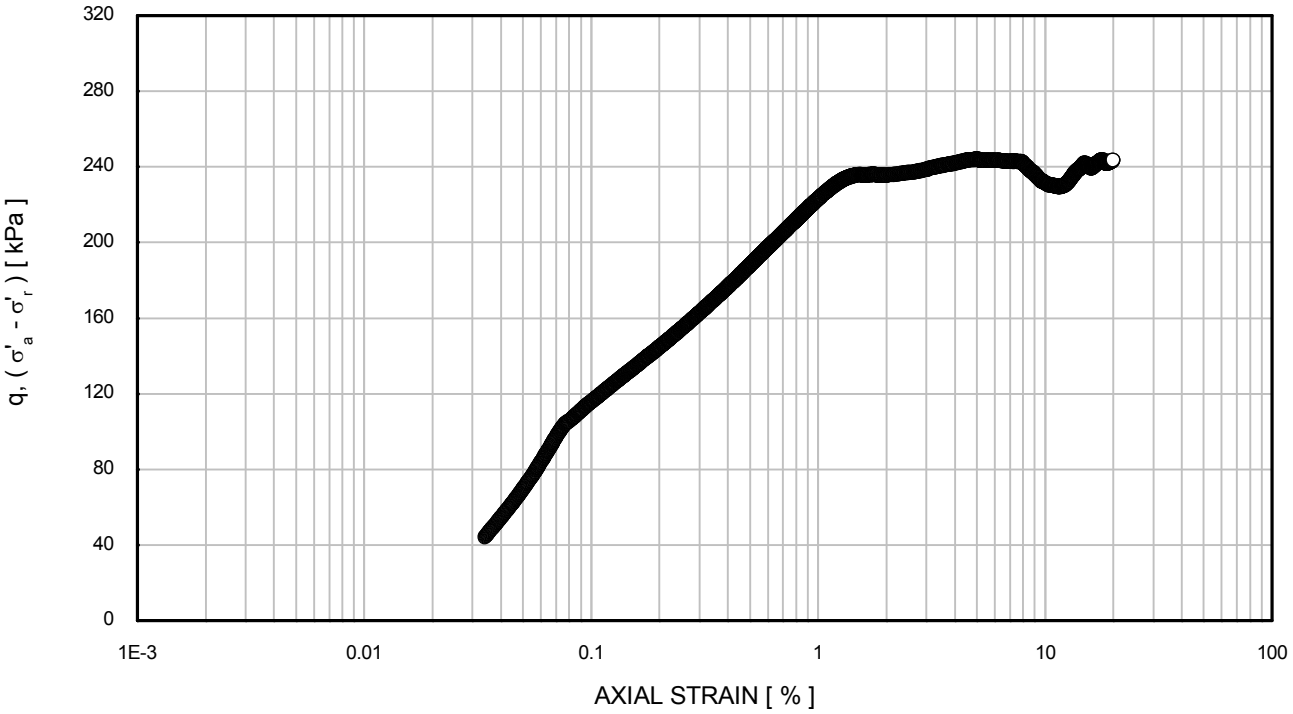
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

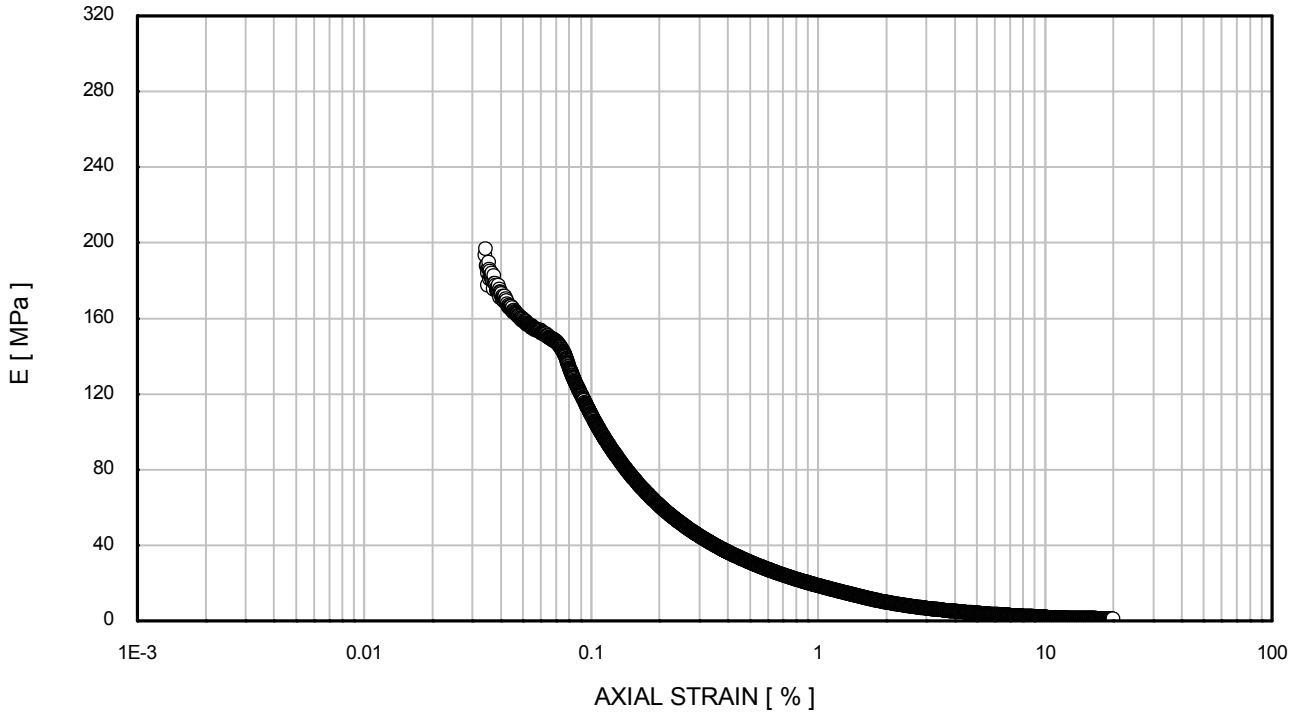




Initial σ'_r	:	185 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	228 kPa	Sample	:	30WaxB
q_{peak}	:	244 kPa	Depth [m]	:	23.28
Ext. ε at q_{peak}	:	4.98 %	Test No.	:	CTXL18
Rate of strain	:	0.30 %/hour			

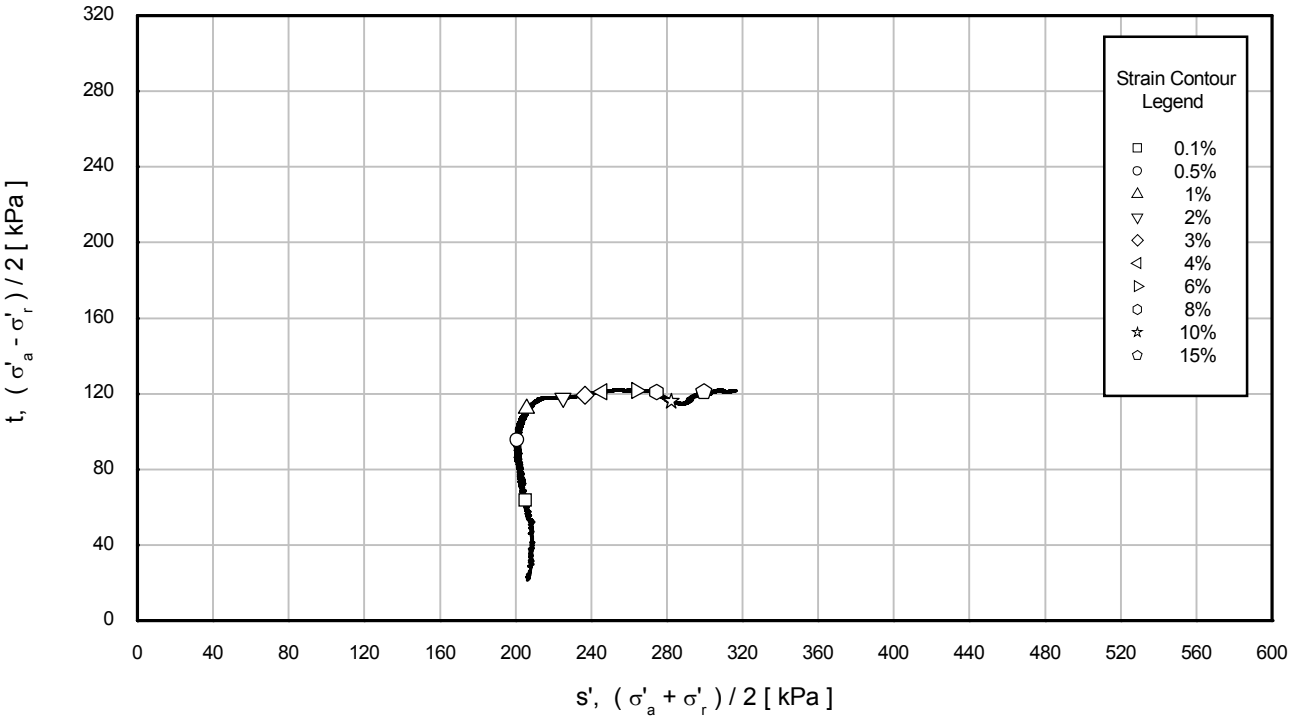
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

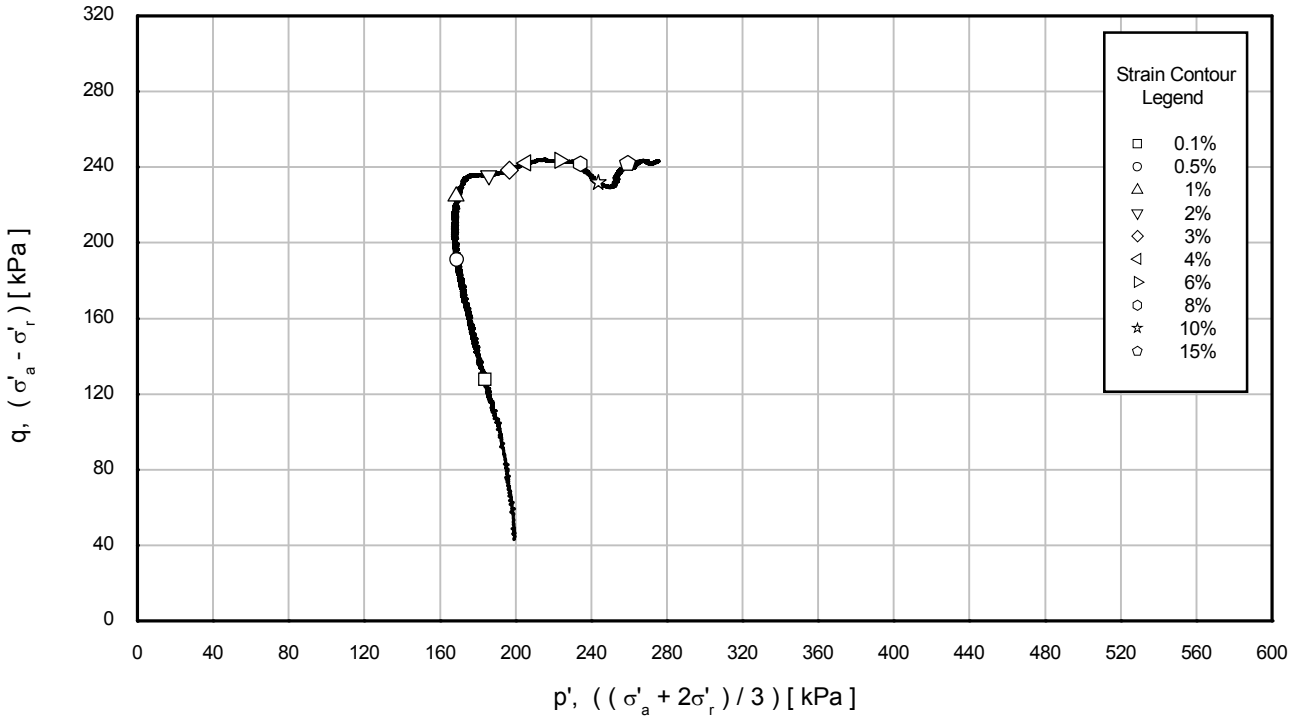




Initial σ'_r	:	185 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	228 kPa	Sample	:	30WaxB
q_{peak}	:	244 kPa	Depth [m]	:	23.28
Ext. ε at q_{peak}	:	4.98 %	Test No.	:	CTXL18
Rate of strain	:	0.30 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	185	kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	228	kPa	Sample	: 30WaxB
q_{peak}	:	244	kPa	Depth [m]	: 23.28
Ext. ε at q_{peak}	:	4.98	%	Test No.	: CTXL18
Rate of strain	:	0.30	%/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
High strength dark grey blocky CLAY

GENERAL	
Date test started	19/12/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	72.0
Length	[mm]	144.2
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.836
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	175
Pocket penetrometer	[kPa]	292

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ2-BH21-SA_30WaxC_CTX19
Processed by Date	JLS 04/01/2016
Checked by Date	PH 11/01/2017
Approved by Date	PH 11/01/2017

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1000
Base PWP	[kPa]	780
Mid height PWP	[kPa]	-
B value achieved	[-]	0.96

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	980
Back pressure	[kPa]	780
Base PWP	[kPa]	780
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	200
Effective axial pressure	[kPa]	220
Deviator stress	[kPa]	20
Volumetric strain	[%]	-0.02
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.837
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 1		
Cell pressure	[kPa]	980
Back pressure	[kPa]	780
Base PWP	[kPa]	792
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	188
Effective axial pressure	[kPa]	232
Deviator stress	[kPa]	43
Volumetric strain	[%]	0.00
External axial strain	[%]	0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.837
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	43
Mean q_{cy}	[kPa]	43
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.04
External ε_{cy} at N_f	[%]	0.03
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	17
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.837
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.02	0.03	158.01	-	6.04	-
2	0.03	0.03	155.52	-	4.98	-
5	0.03	0.03	152.91	-	4.86	-
10	0.03	0.03	150.62	-	4.83	-
20	0.03	0.03	149.54	-	4.76	-
30	0.03	0.03	148.66	-	4.74	-
40	0.03	0.03	148.13	-	4.73	-
50	0.03	0.03	147.39	-	4.74	-
100	0.03	0.03	146.47	-	4.64	-
500	0.04	0.03	144.38	-	4.38	-
1000	0.04	0.03	144.46	-	4.32	-
1500	0.04	0.03	145.05	-	4.29	-

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 2		
Cell pressure	[kPa]	980
Back pressure	[kPa]	781
Base PWP	[kPa]	798
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	182
Effective axial pressure	[kPa]	239
Deviator stress	[kPa]	57
Volumetric strain	[%]	0.00
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.837
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	287
Mean q_{av}	[kPa]	57
Mean q_{cy}	[kPa]	86
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.10
External ε_{cy} at N_f	[%]	0.10
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	31
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.837
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.05	0.07	123.57	-	10.64	-
2	0.05	0.07	118.56	-	9.73	-
5	0.06	0.08	112.70	-	9.80	-
10	0.06	0.08	108.79	-	9.95	-
20	0.07	0.08	104.88	-	10.05	-
30	0.08	0.08	102.54	-	10.10	-
40	0.08	0.08	101.08	-	10.14	-
50	0.08	0.09	99.66	-	10.17	-
100	0.09	0.09	95.90	-	10.21	-
200	0.10	0.09	92.06	-	10.31	-
300	0.10	0.10	89.86	-	10.35	-
400	0.10	0.10	88.33	-	10.39	-

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	168
Initial effective axial pressure	[kPa]	225
Rate of strain	[%/hour]	0.50
At peak deviator stress		
Corrected deviator stress	[kPa]	235
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.43
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	88
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	113
Effective axial pressure	[kPa]	348
Principal effective stress ratio	[-]	3.09
ε_{50}	[%]	0.24
Secant modulus (E_{50}) at ε_{50}	[kPa]	61394
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	230
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	1.75
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	95
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	105
Effective axial pressure	[kPa]	334
Principal effective stress ratio	[-]	3.20
At 15% external axial strain		
Corrected deviator stress	[kPa]	223
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	35
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	165
Effective axial pressure	[kPa]	388
Principal effective stress ratio	[-]	2.35

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





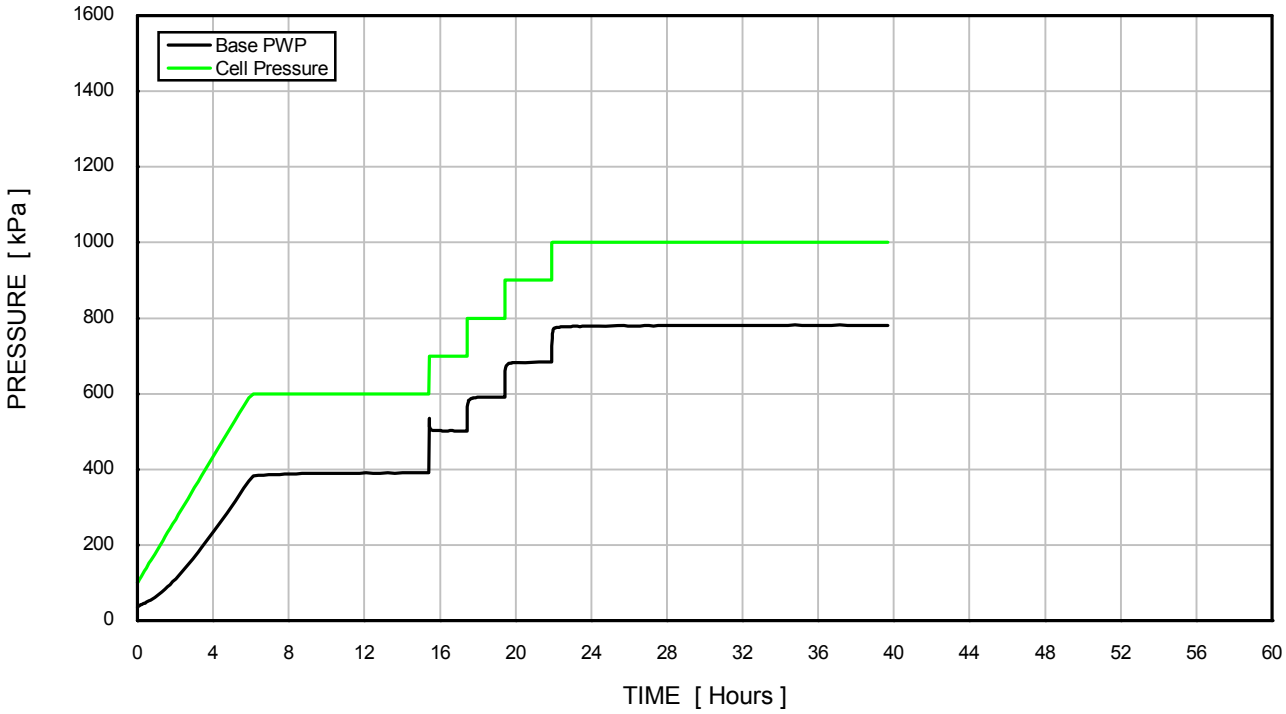
FINAL CONDITIONS

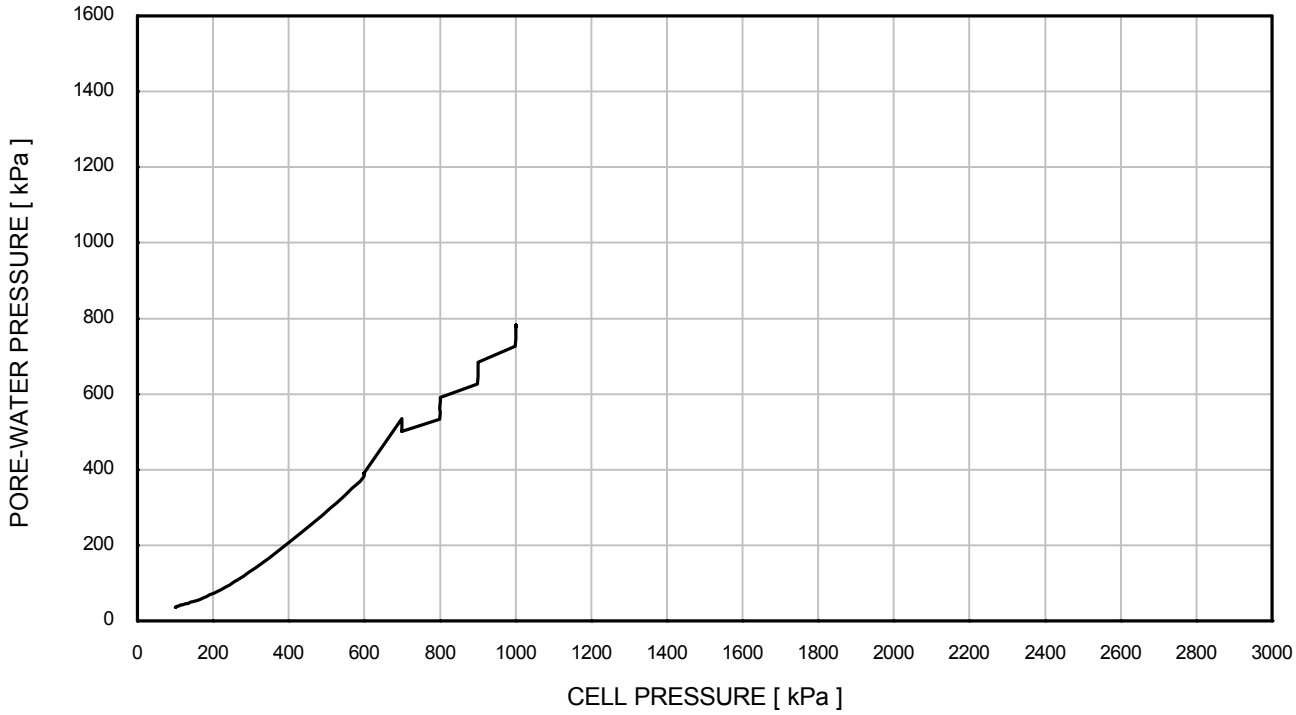
Water content	[%]	30.9
Bulk density	[Mg/m³]	1.92
Dry density	[Mg/m³]	1.47

TEST IDENTIFICATION

Borehole	HKZ2-BH21-SA
Sample	30WaxC
Depth [m]	23.46
Test number	CTX19

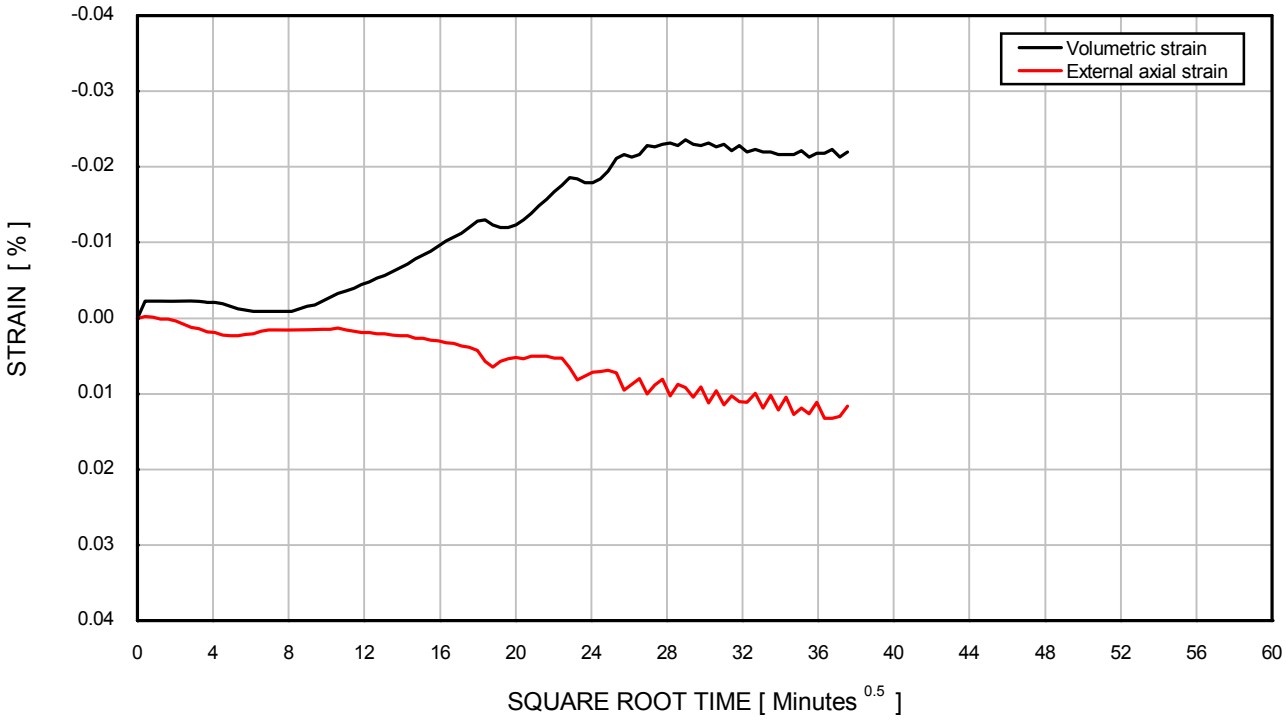
SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

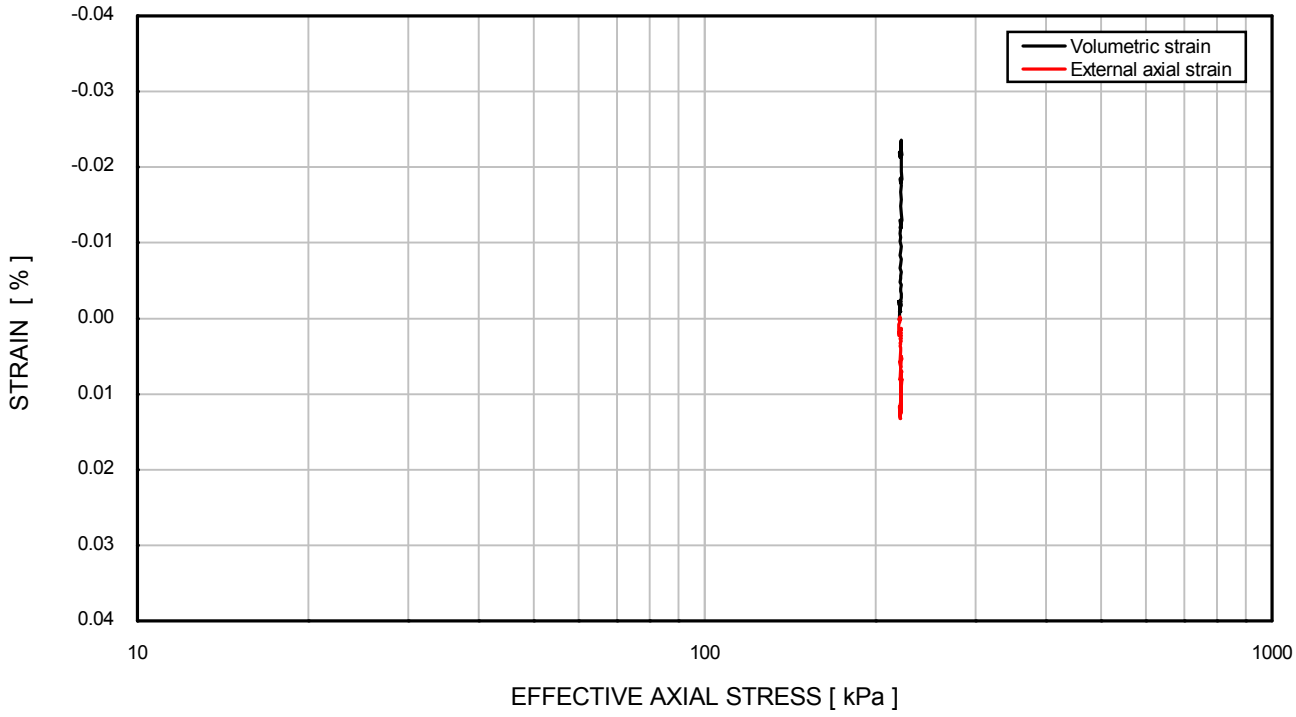




B value	: 0.96	Borehole	: HKZ2-BH21-SA
Initial σ'_r	: 65 kPa	Sample	: 30WaxC
Initial σ'_a	: 65 kPa	Depth [m]	: 23.46
Final σ'_r	: 220 kPa	Test No.	: CTX19
Final σ'_a	: 220 kPa		

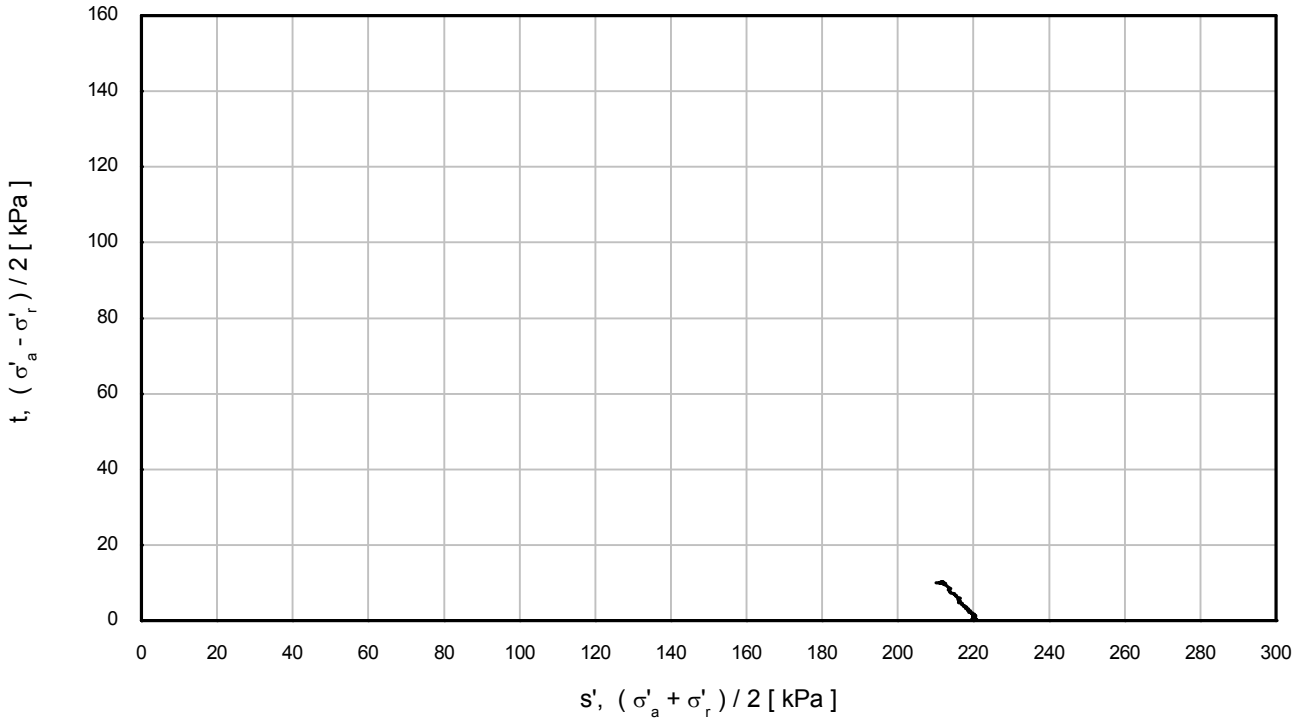
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - UNDRAINED

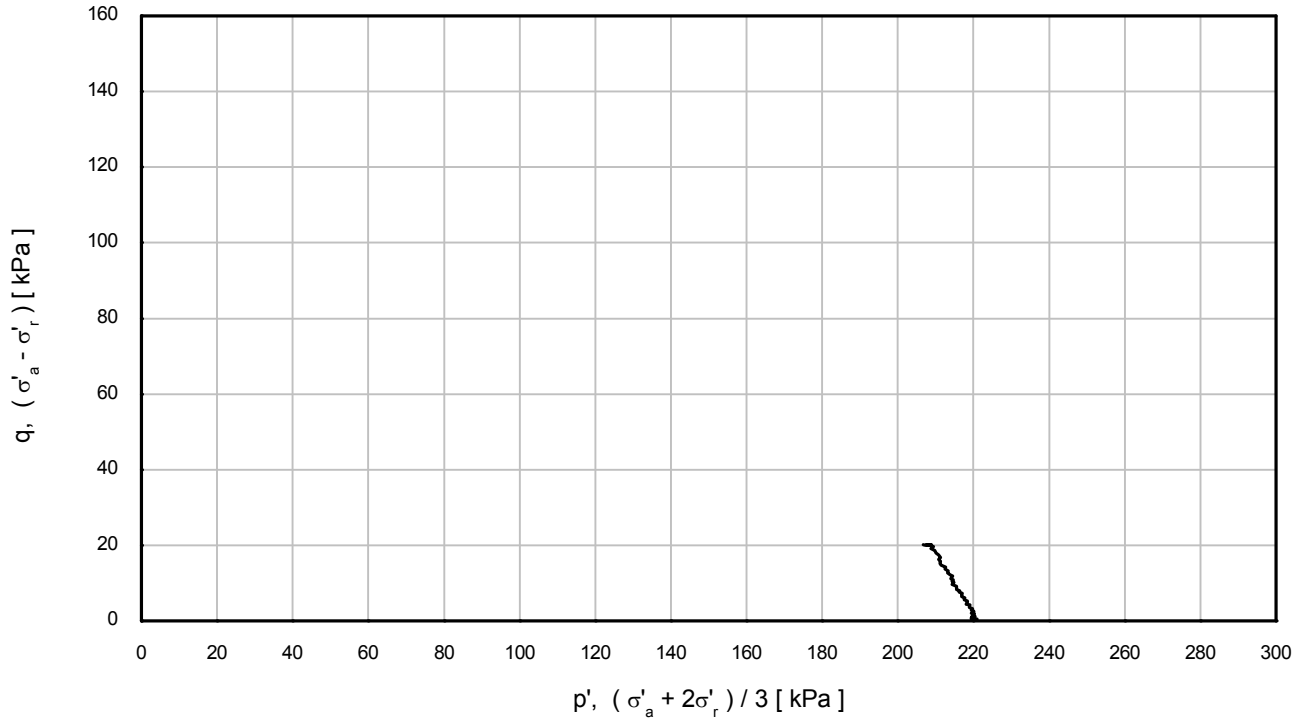




Stage 1 σ'_{rc}	:	200 kPa	Batch	:	HKZ2-BH21-SA
Stage 1 σ'_{ac}	:	220 kPa	Sample	:	30WaxC
			Unit	:	23.46
			Test No.	:	CTX19

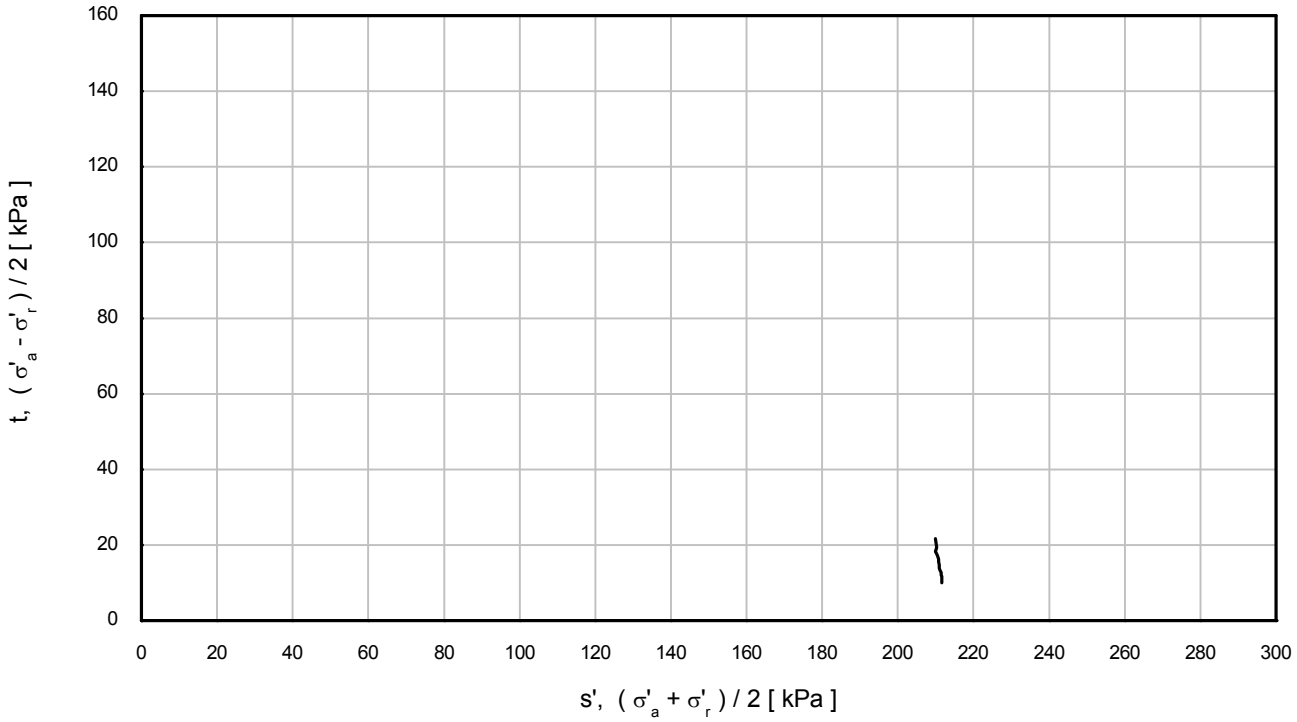
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

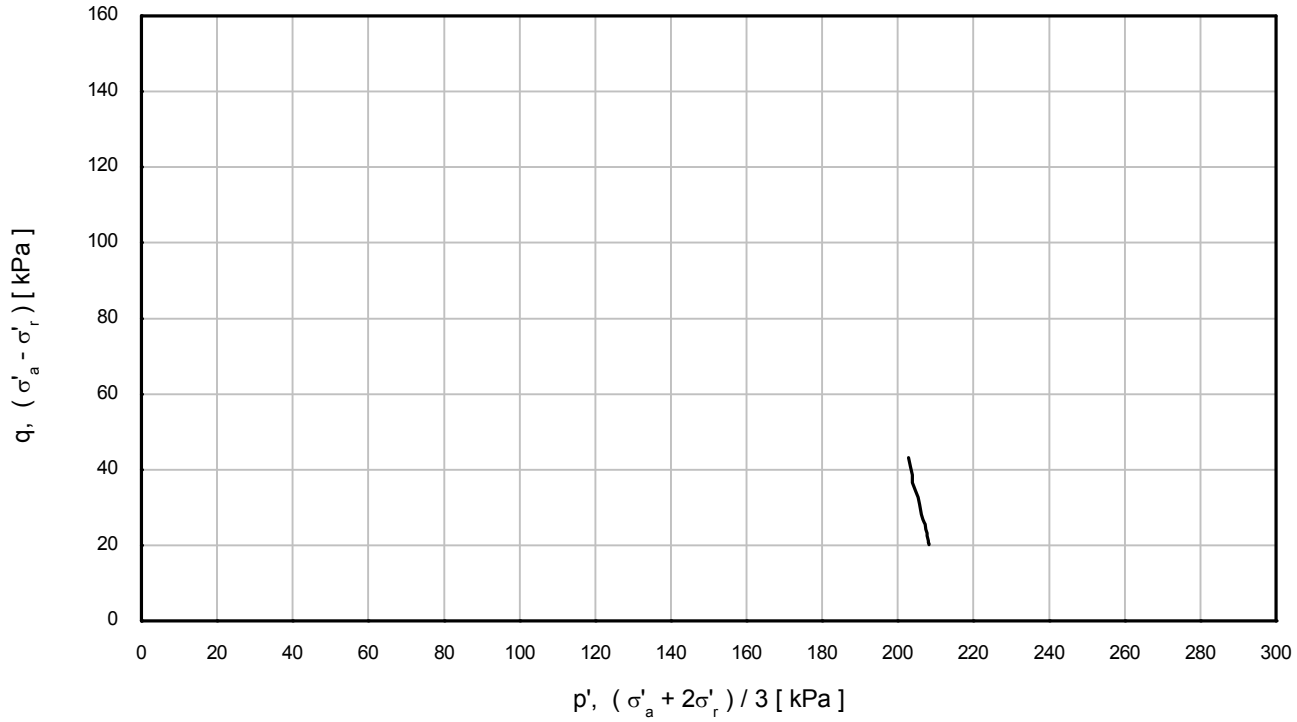




Stage 1 σ'_{rc}	: 200 kPa	Batch	: HKZ2-BH21-SA
Stage 1 σ'_{ac}	: 220 kPa	Sample	: 30WaxC
		Unit	: 23.46
		Test No.	: CTX19

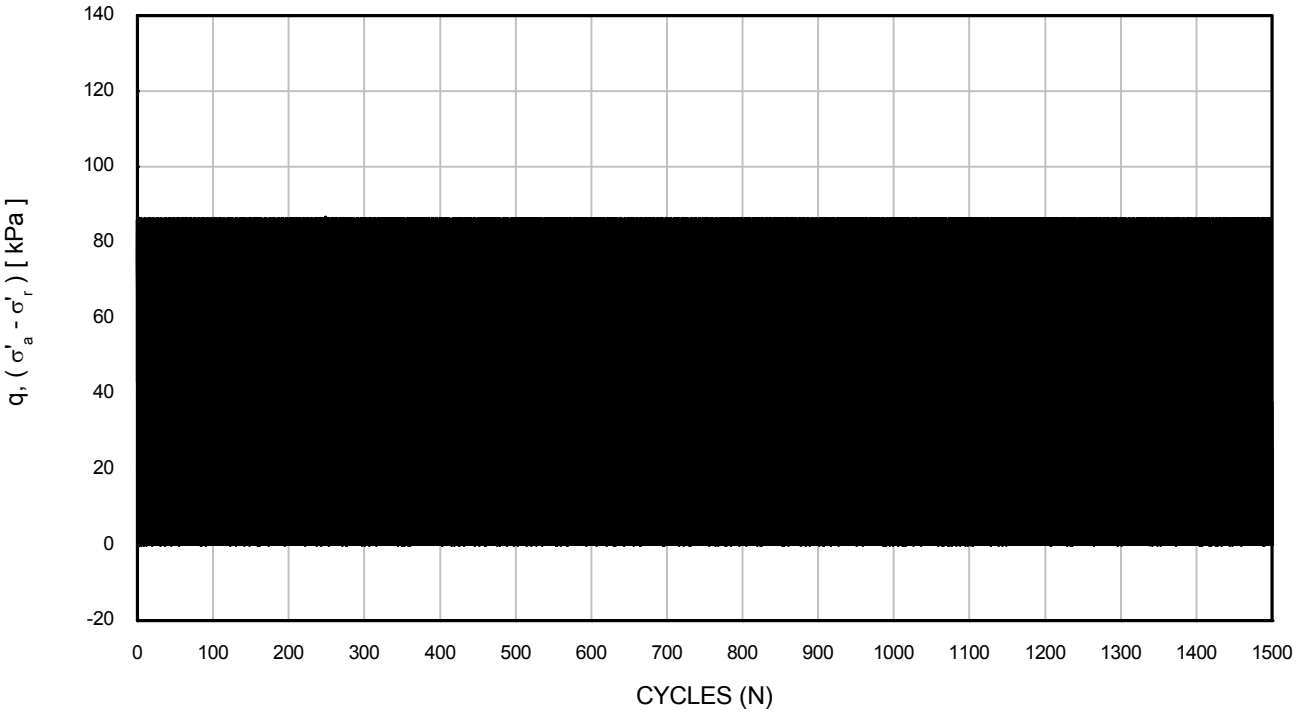
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

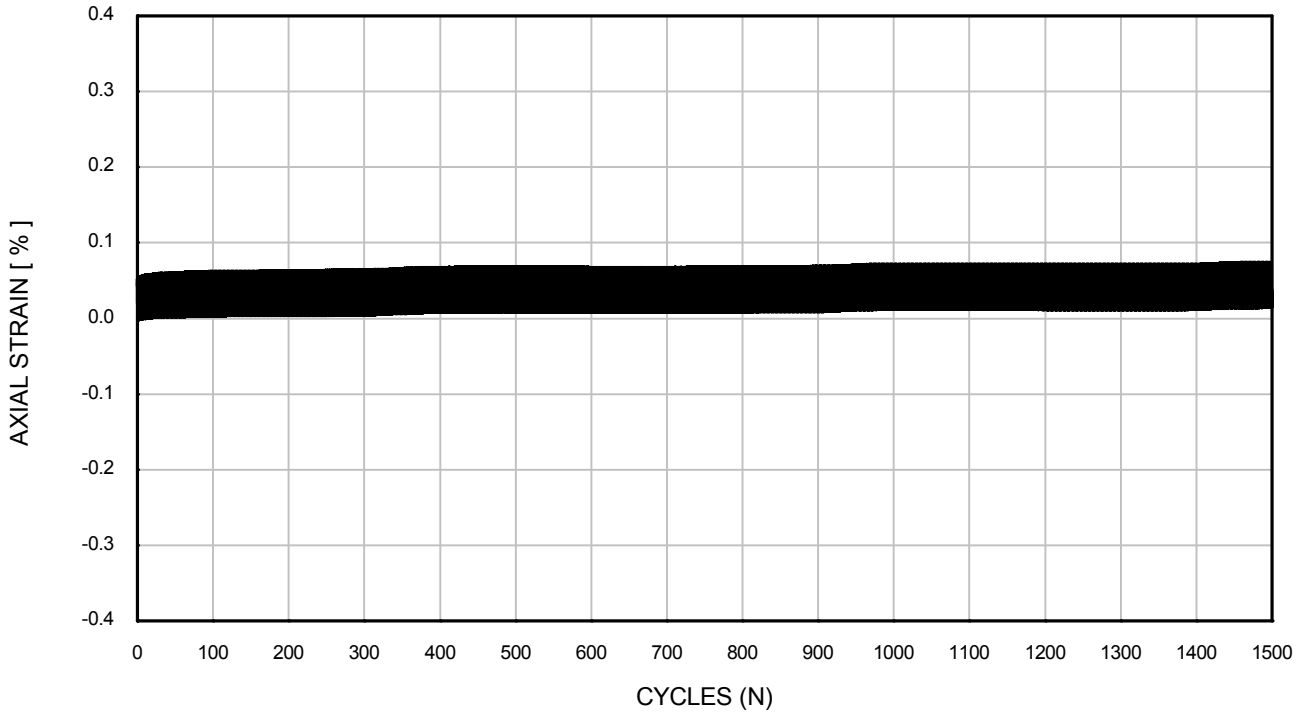




σ'_{rc}	: 188 kPa	Borehole	: HKZ2-BH21-SA
σ'_{ac}	: 232 kPa	Sample	: 30WaxC
		Depth [m]	: 23.46
		Test No.	: CTX19

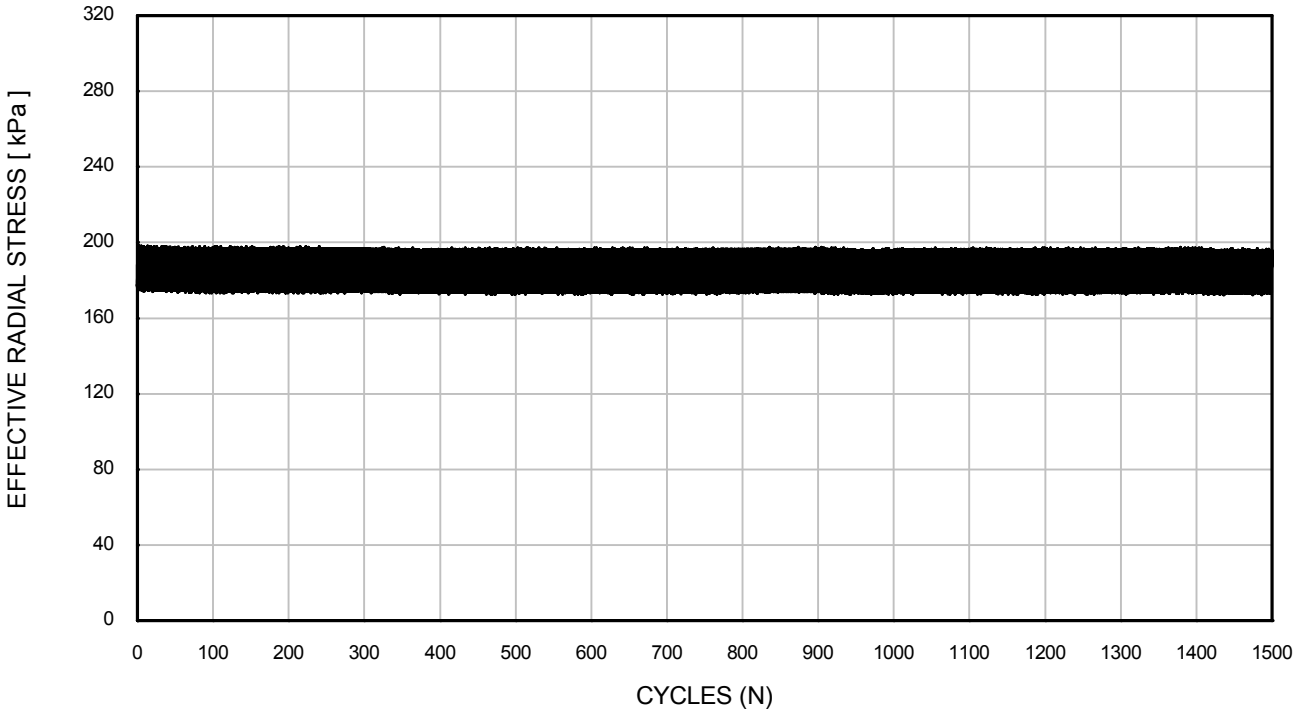
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

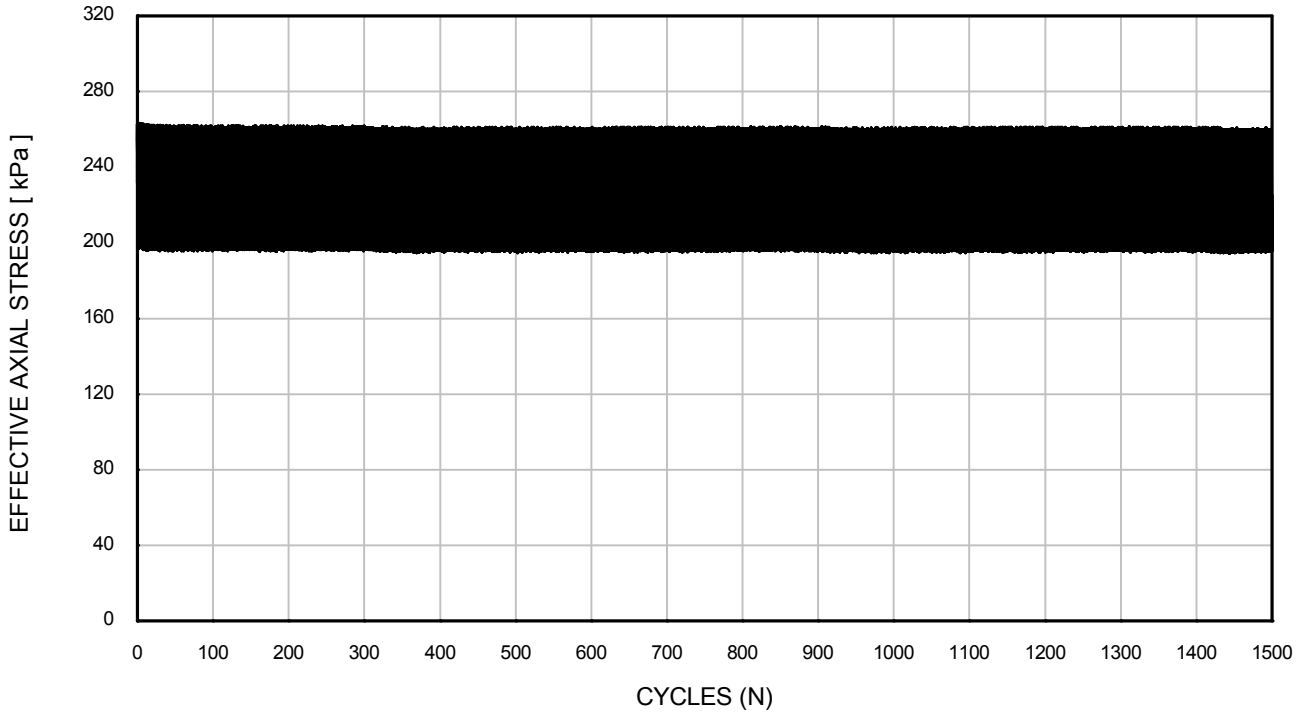




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 30WaxC
q_{av}	: 43 kPa	Depth [m]	: 23.46
q_{cy}	: 43 kPa	Test No.	: CTX19
Frequency	: 0.10 Hz		

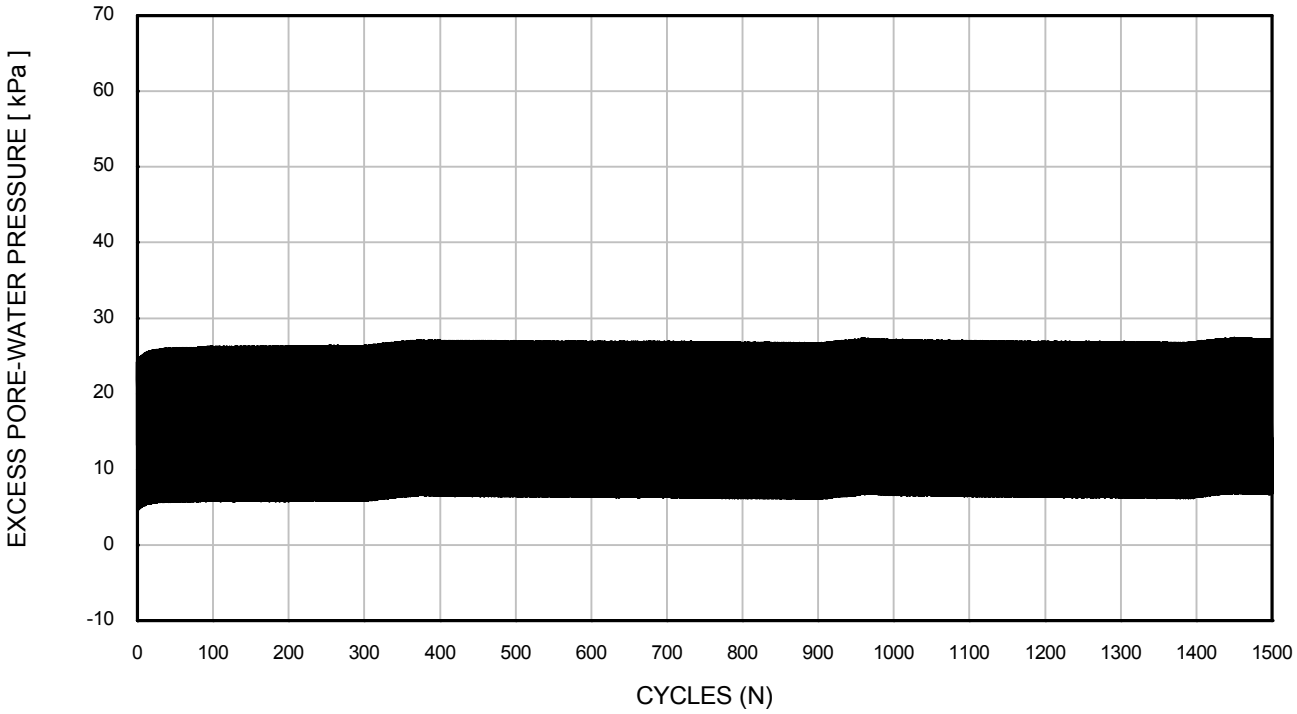
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

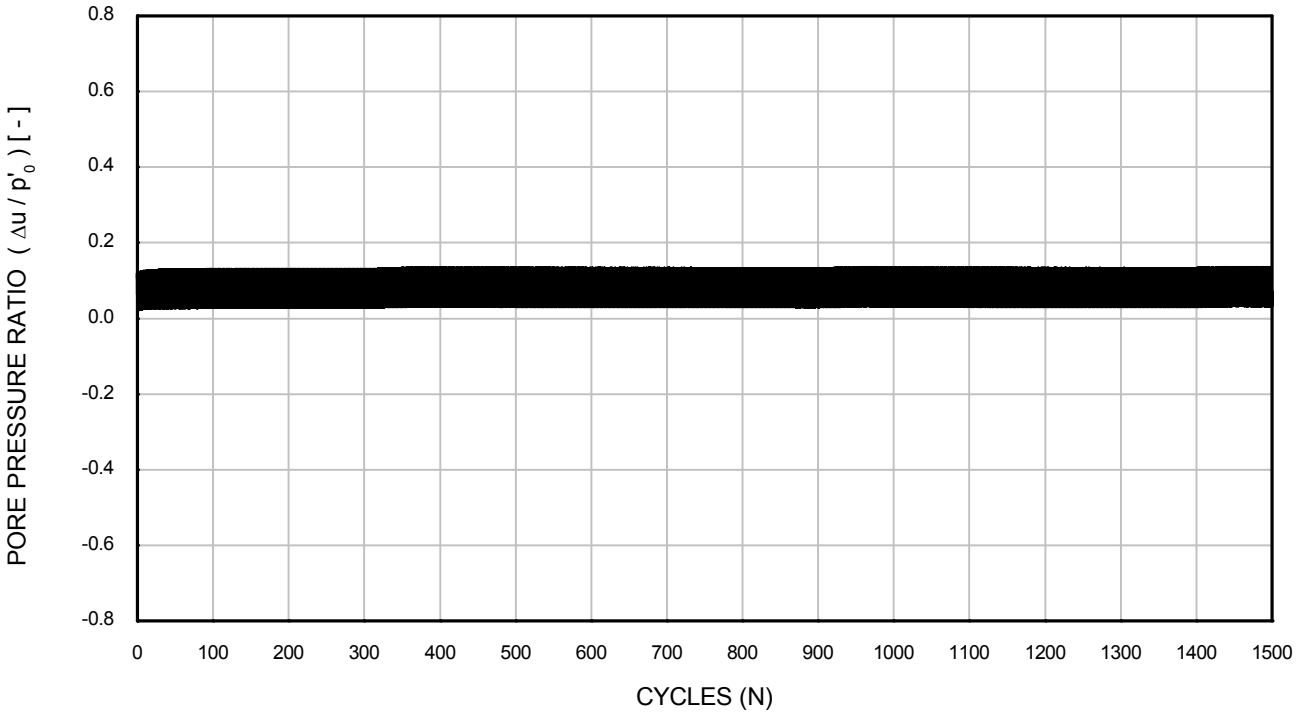




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 30WaxC
q_{av}	: 43 kPa	Depth [m]	: 23.46
q_{cy}	: 43 kPa	Test No.	: CTX19
Frequency	: 0.10 Hz		

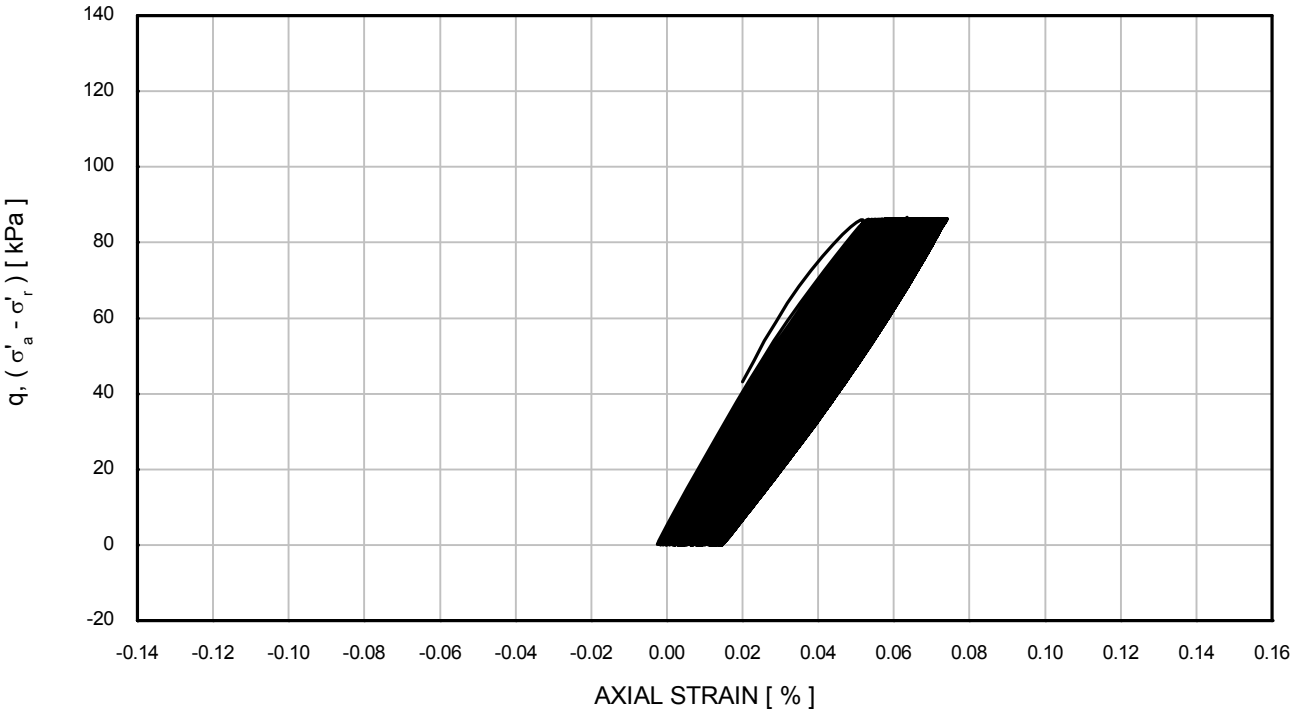
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

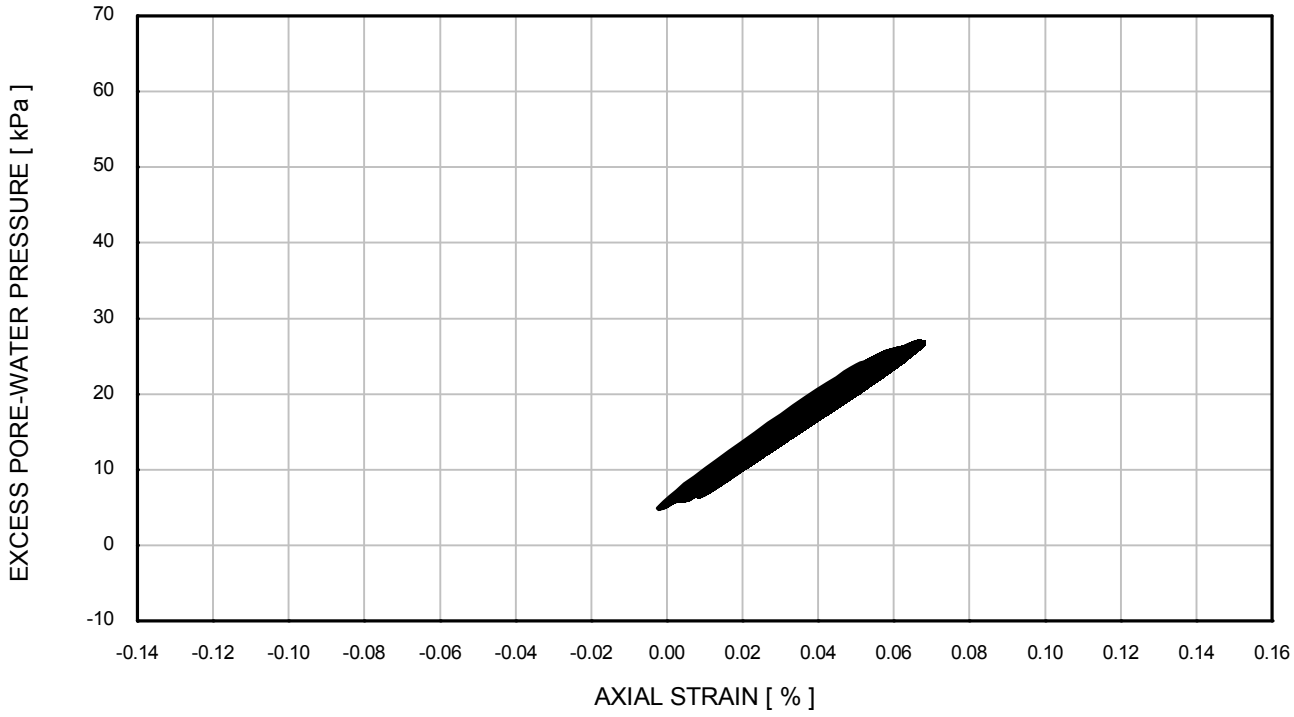




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 30WaxC
q_{av}	: 43 kPa	Depth [m]	: 23.46
q_{cy}	: 43 kPa	Test No.	: CTX19
Frequency	: 0.10 Hz		

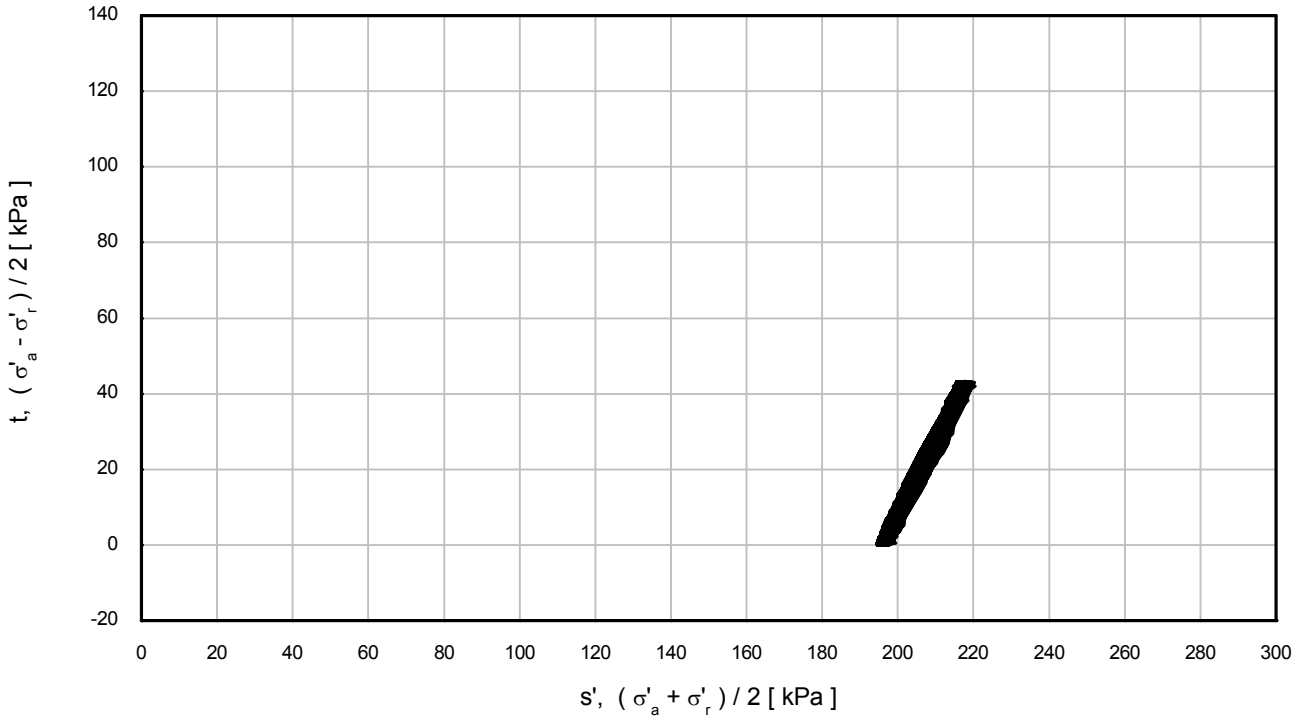
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

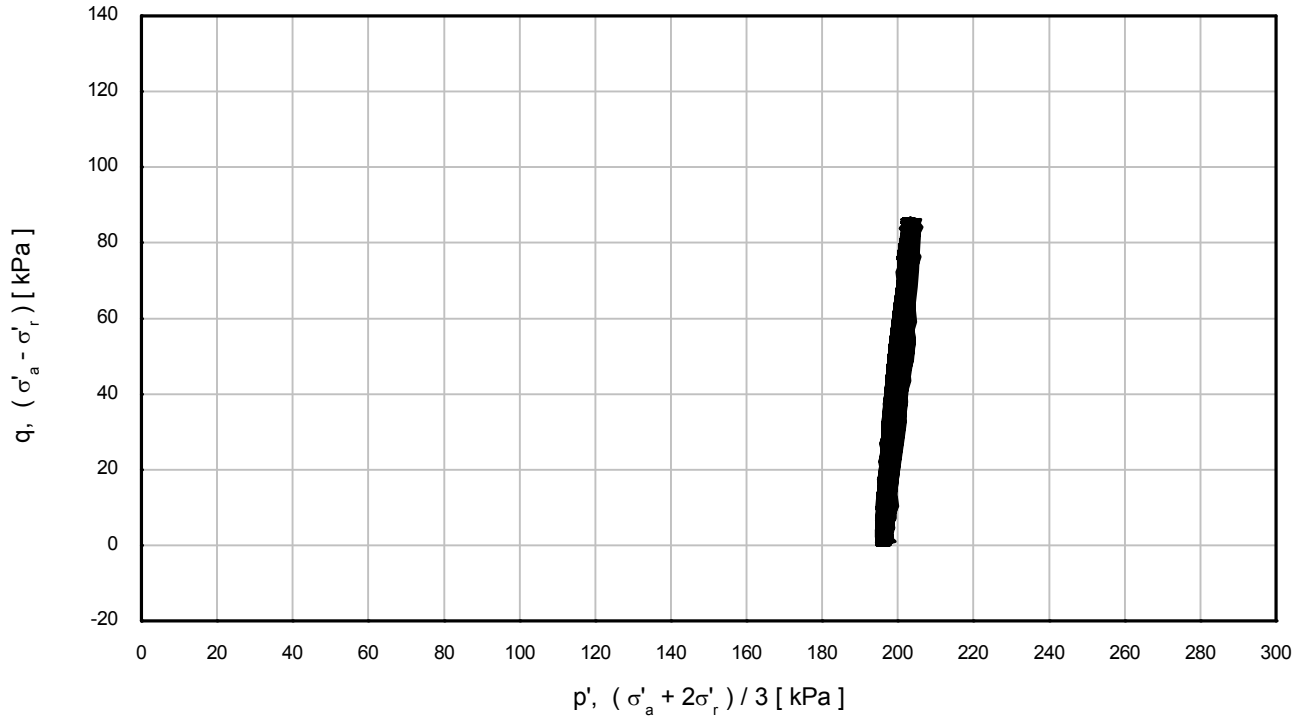




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 30WaxC
q_{av}	: 43 kPa	Depth [m]	: 23.46
q_{cy}	: 43 kPa	Test No.	: CTX19
Frequency	: 0.10 Hz		

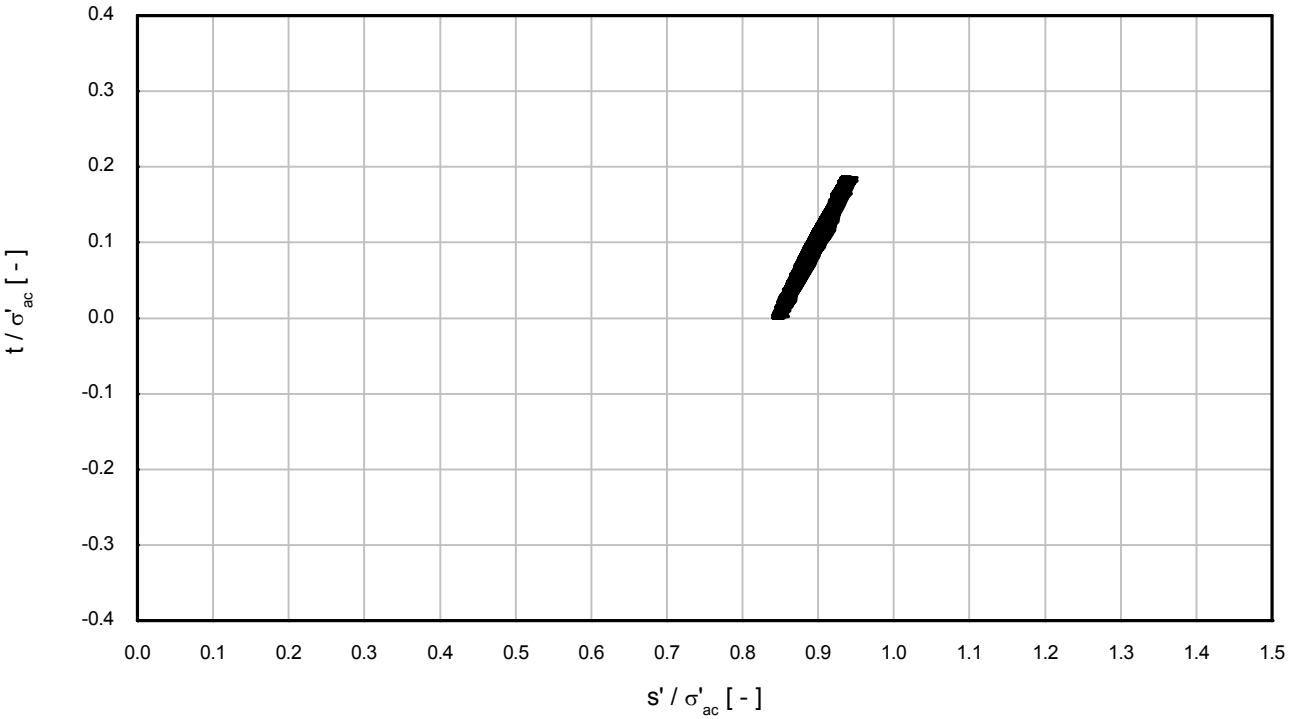
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

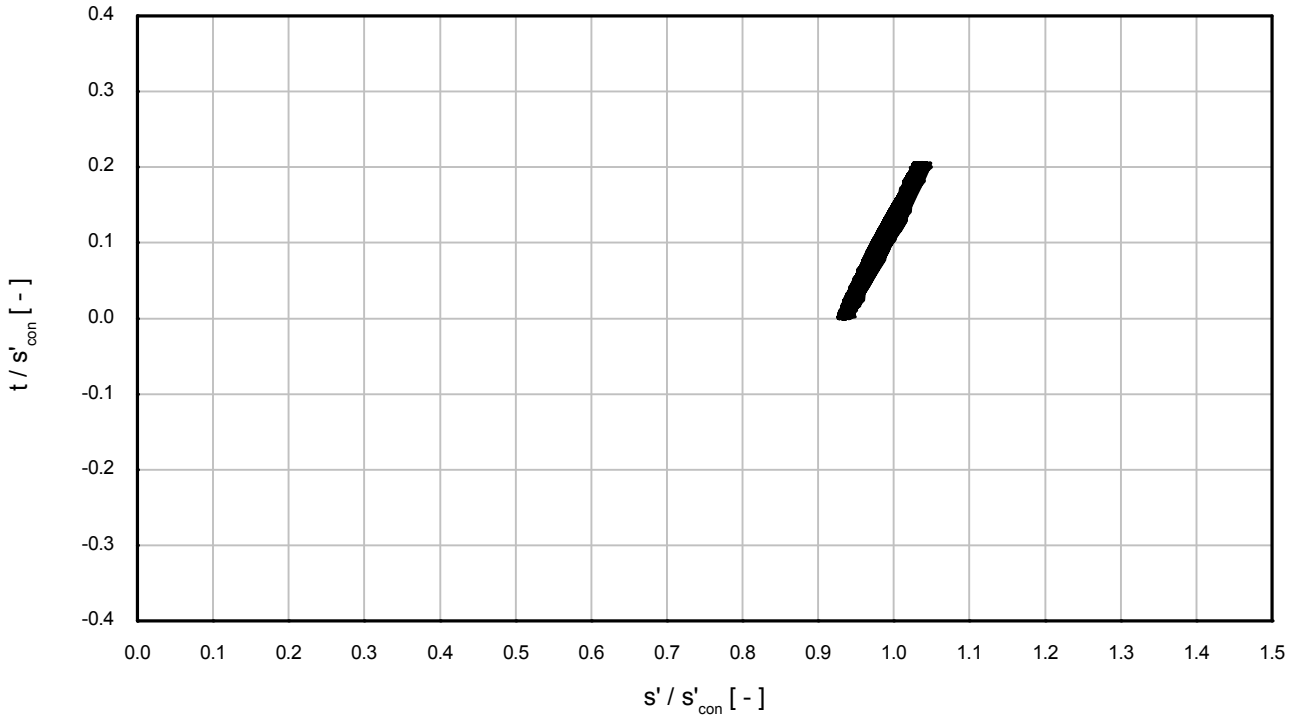




Initial σ'_r	:	188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	232 kPa	Sample	: 30WaxC
q_{av}	:	43 kPa	Depth [m]	: 23.46
q_{cy}	:	43 kPa	Test No.	: CTX19
Frequency	:	0.10 Hz		

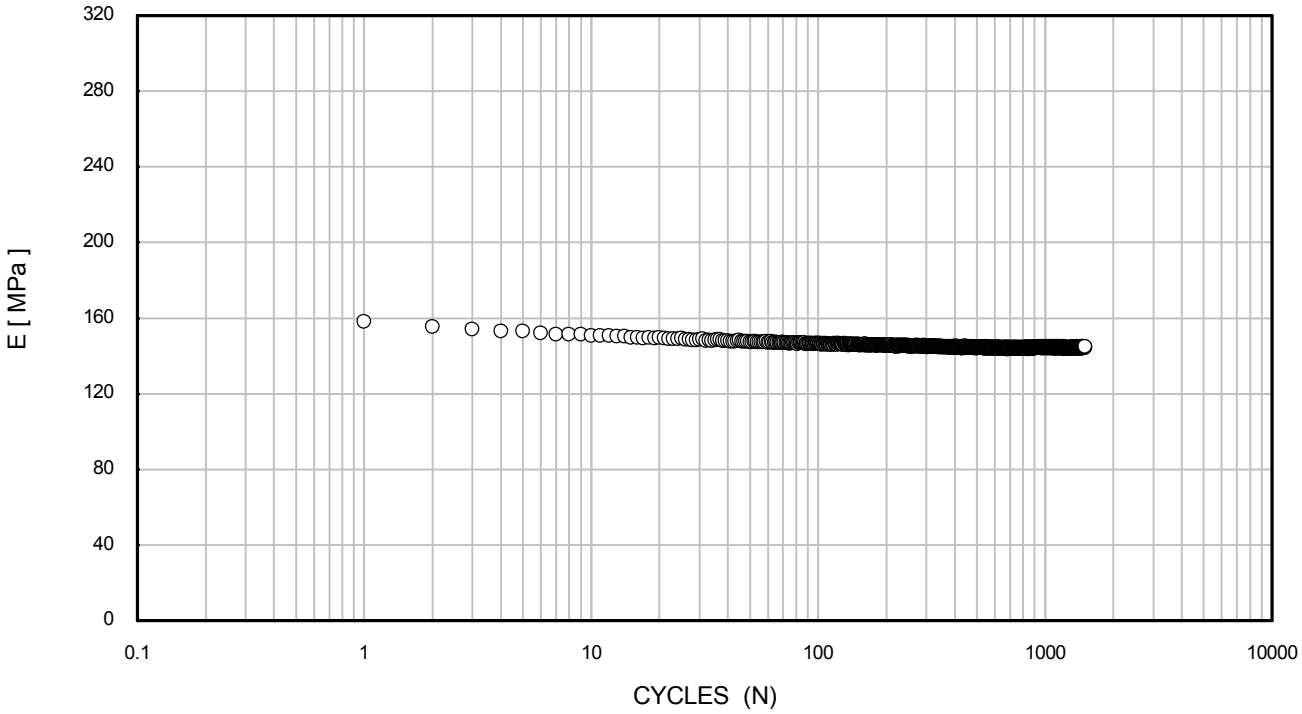
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

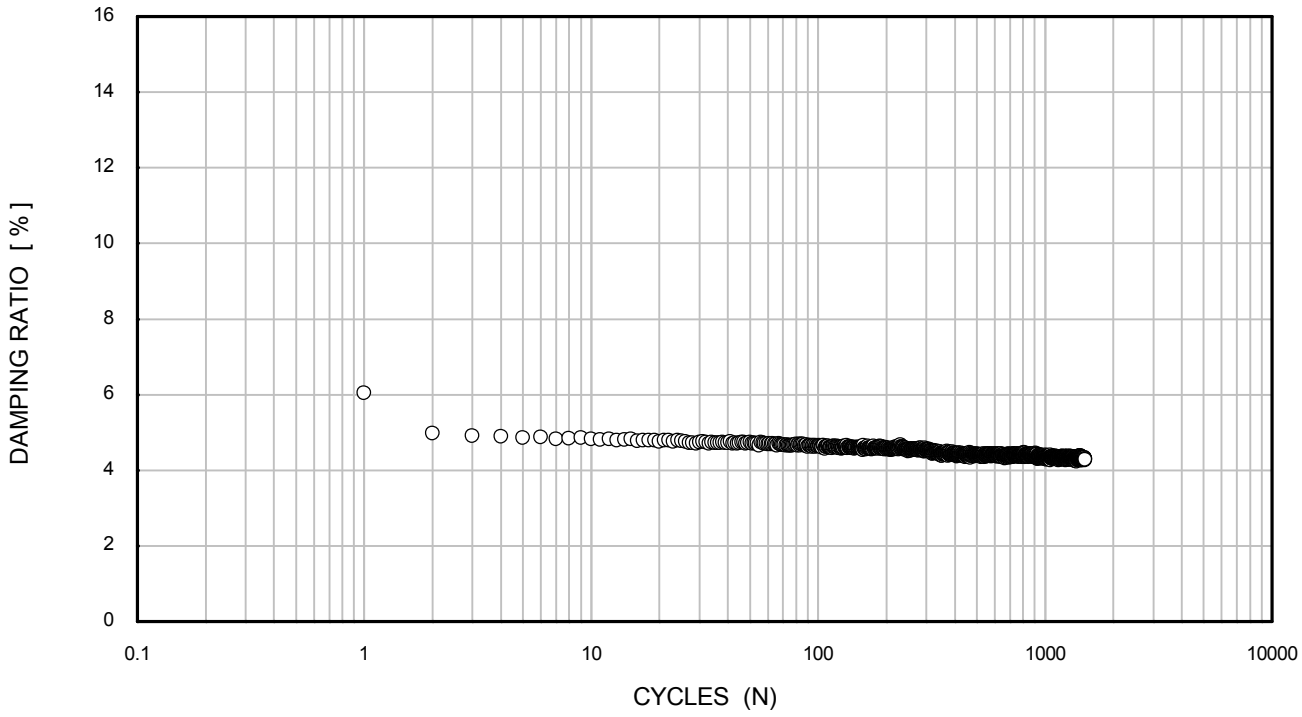




Initial σ'_r	:	188 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	232 kPa	Sample	:	30WaxC
q_{av}	:	43 kPa	Depth [m]	:	23.46
q_{cy}	:	43 kPa	Test No.	:	CTX19
Frequency	:	0.10 Hz			

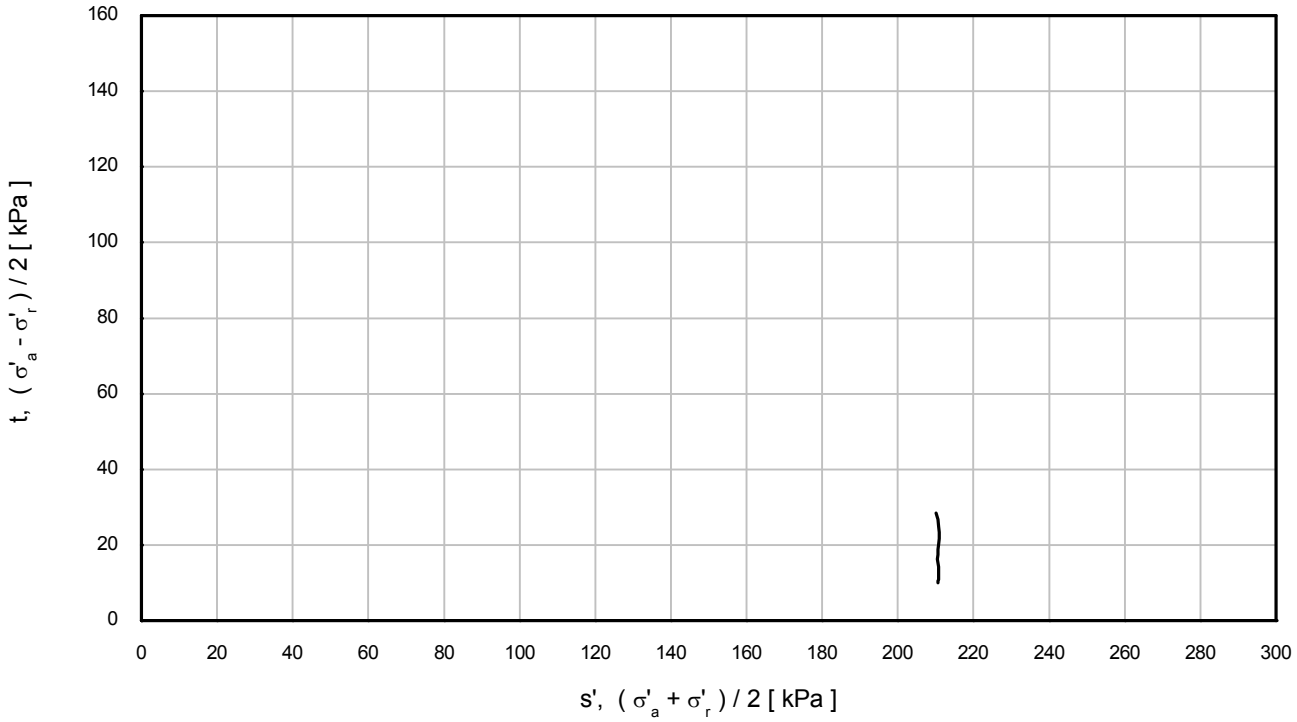
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

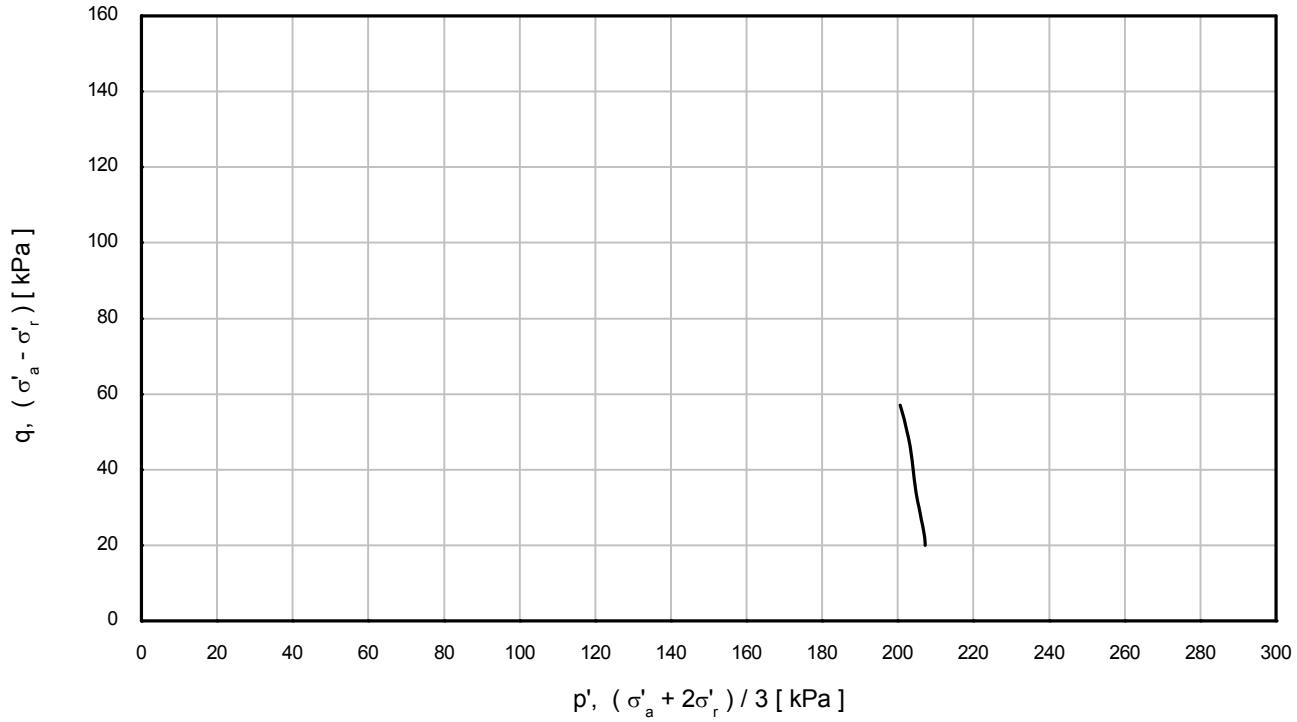




Initial σ'_r	: 188 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	: 232 kPa	Sample	: 30WaxC
q_{av}	: 43 kPa	Depth [m]	: 23.46
q_{cy}	: 43 kPa	Test No.	: CTX19
Frequency	: 0.10 Hz		

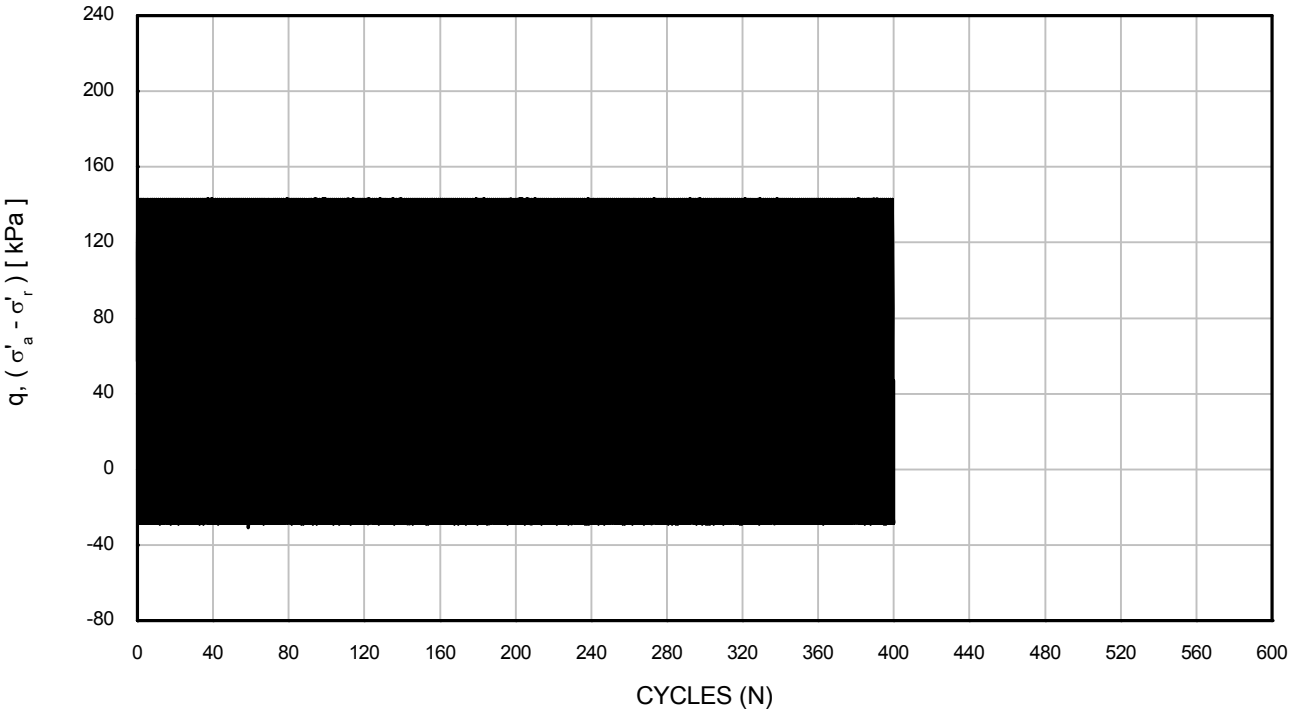
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

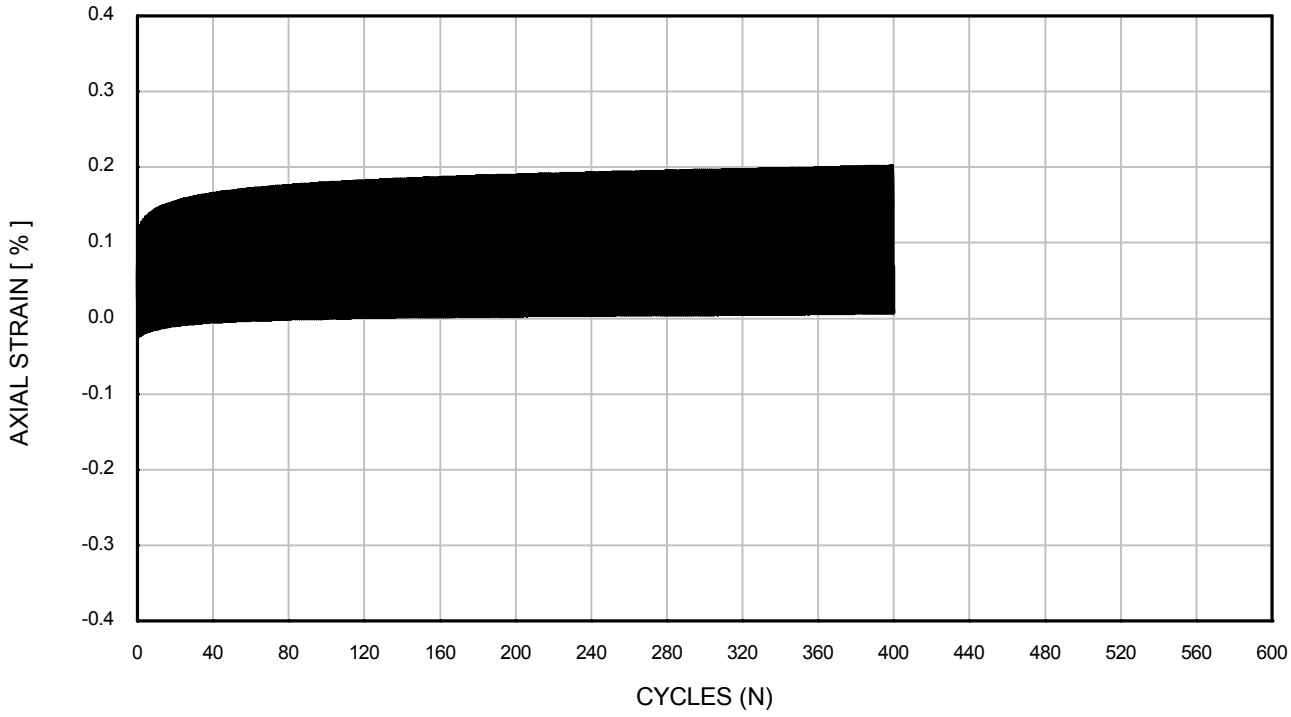




σ'_{rc}	: 182 kPa	Borehole	: HKZ2-BH21-SA
σ'_{ac}	: 239 kPa	Sample	: 30WaxC
		Depth [m]	: 23.46
		Test No.	: CTX19

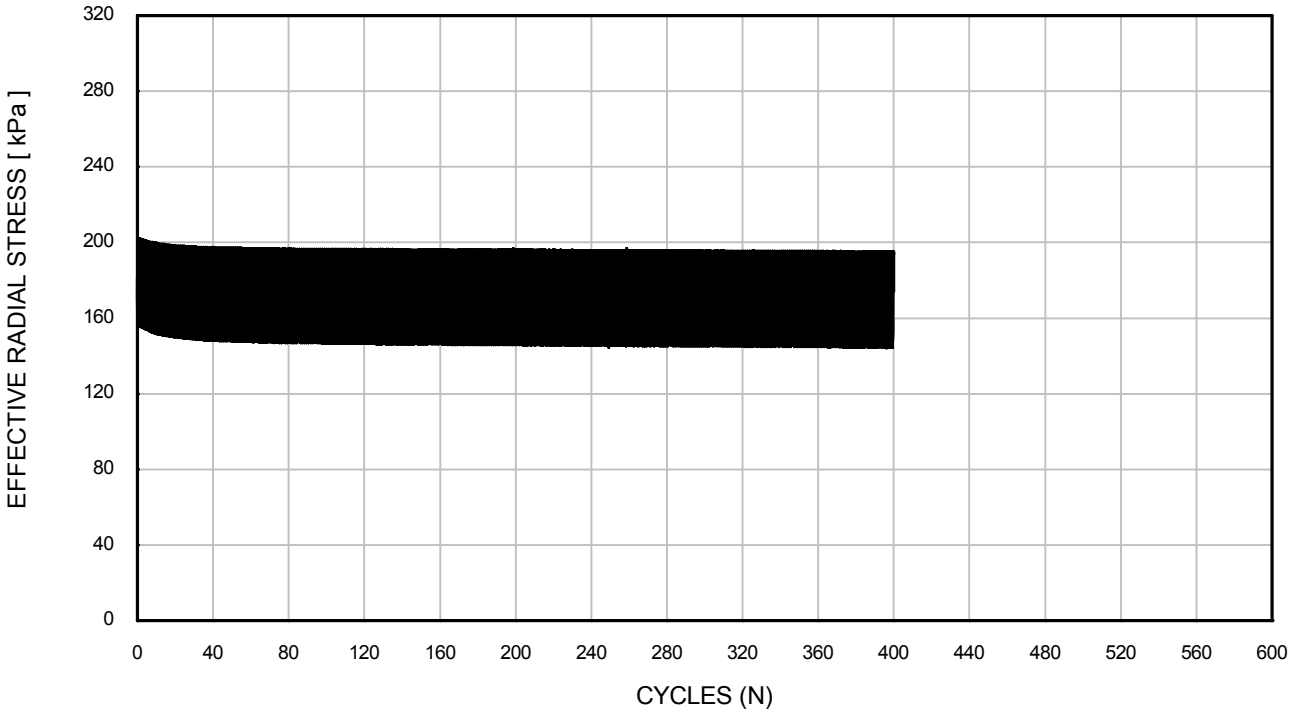
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE 2 - UNDRAINED

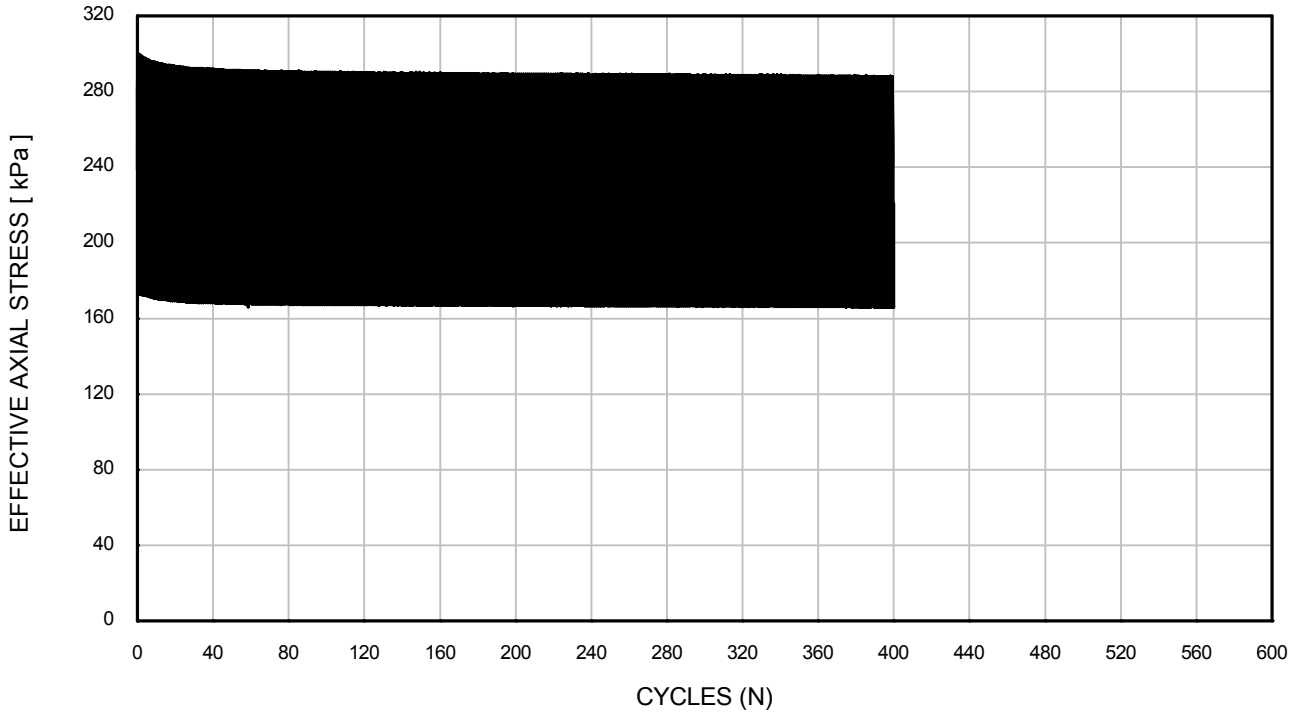




Initial σ'_r	:	182 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	: 30WaxC
q_{av}	:	57 kPa	Depth [m]	: 23.46
q_{cy}	:	86 kPa	Test No.	: CTX19
Frequency	:	0.10 Hz		

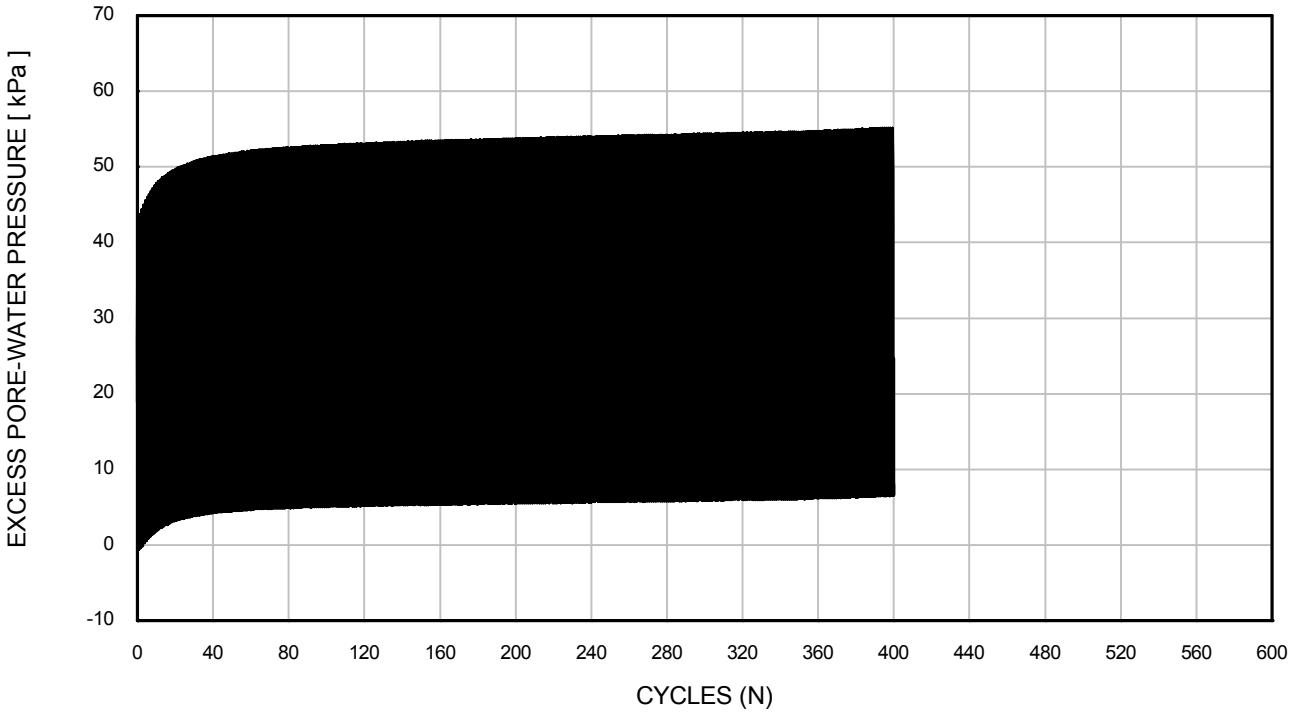
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

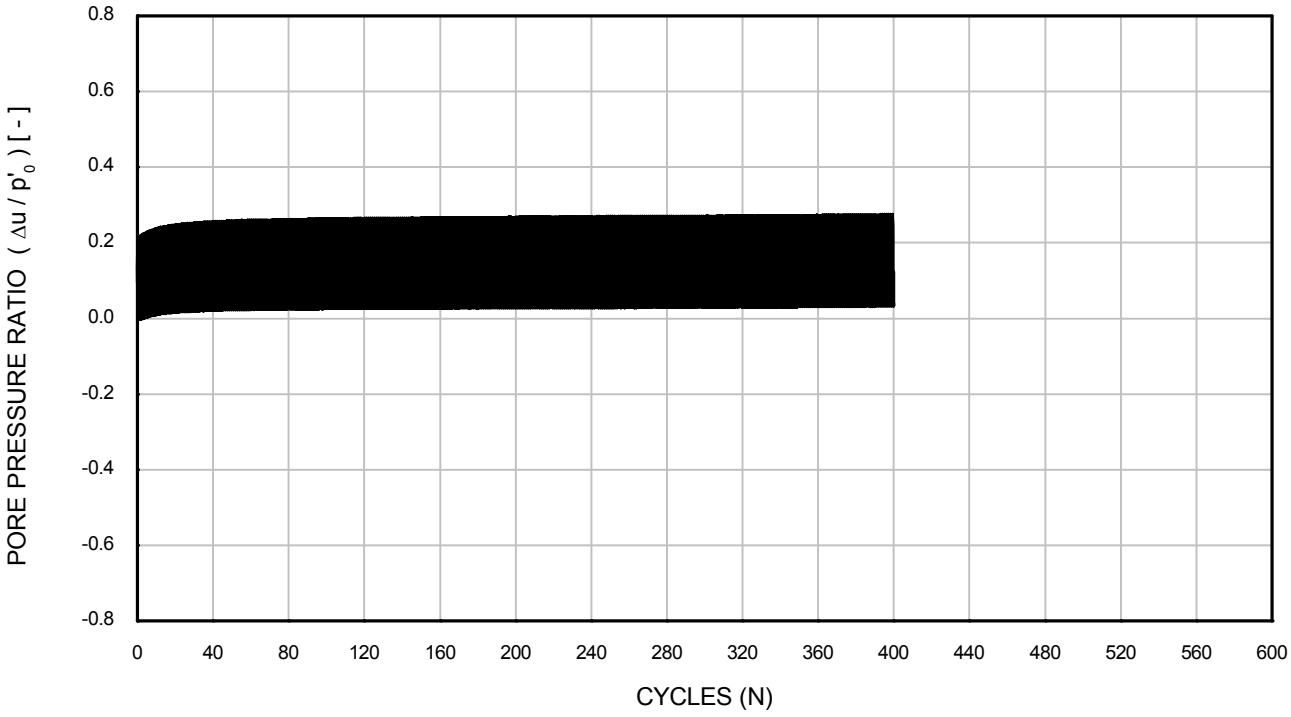




Initial σ'_r	:	182 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	: 30WaxC
q_{av}	:	57 kPa	Depth [m]	: 23.46
q_{cy}	:	86 kPa	Test No.	: CTX19
Frequency	:	0.10 Hz		

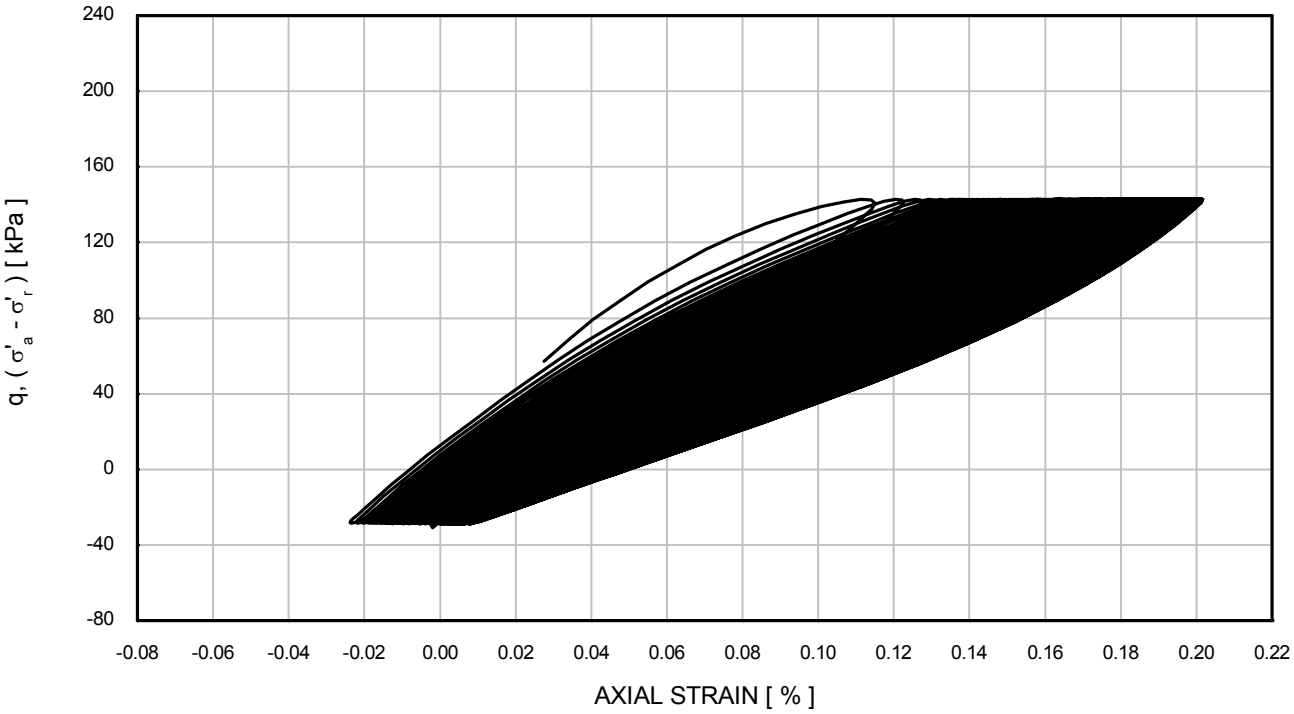
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

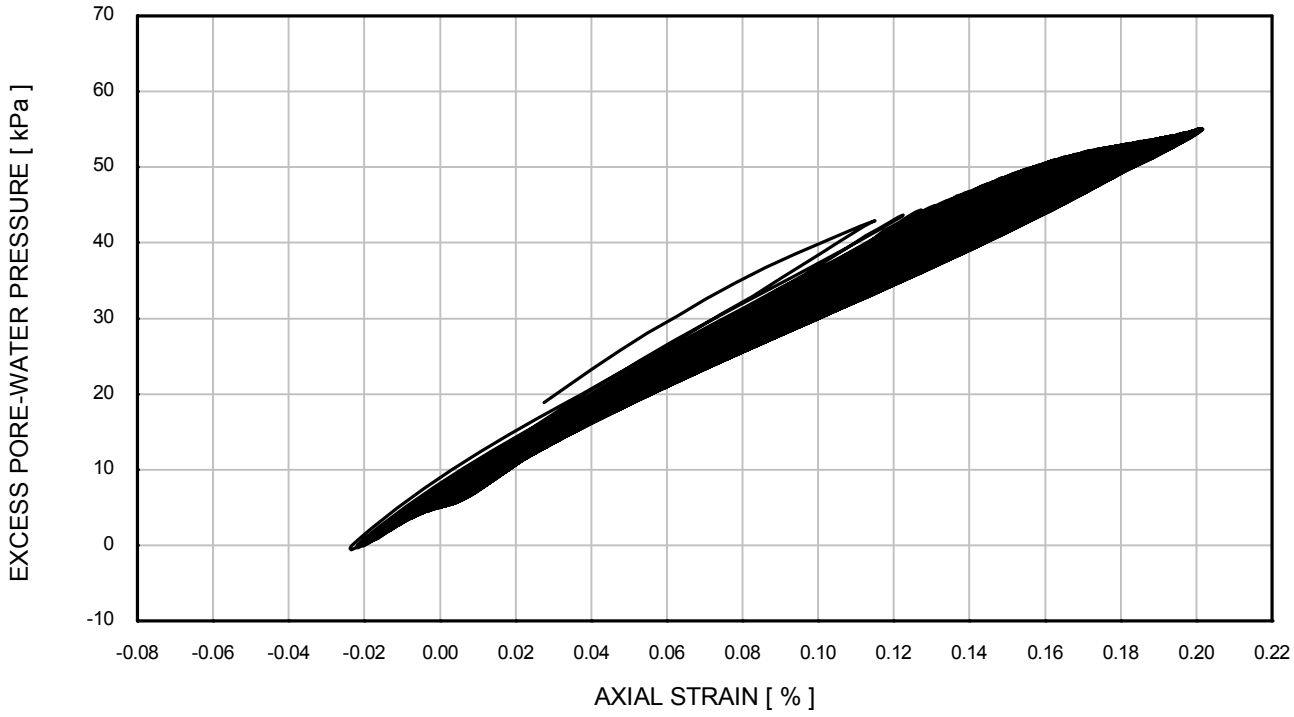




Initial σ'_r	:	182 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	:	30WaxC
q_{av}	:	57 kPa	Depth [m]	:	23.46
q_{cy}	:	86 kPa	Test No.	:	CTX19
Frequency	:	0.10 Hz			

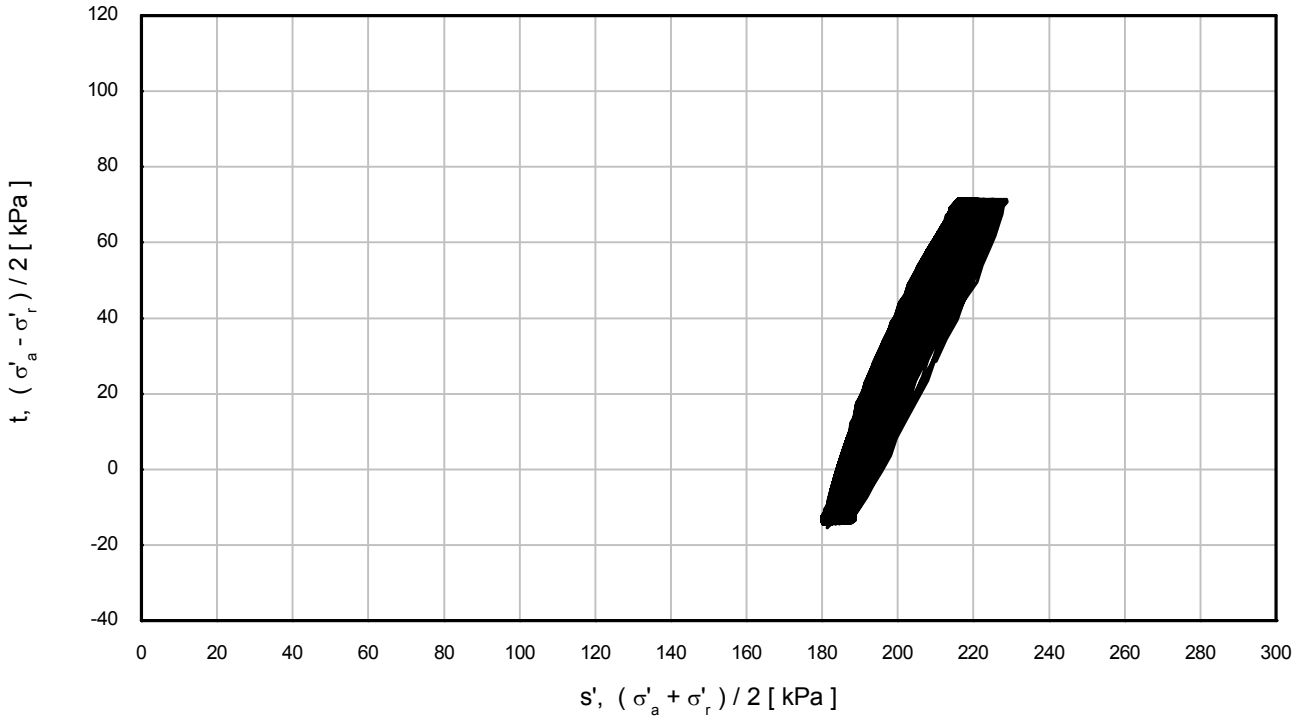
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

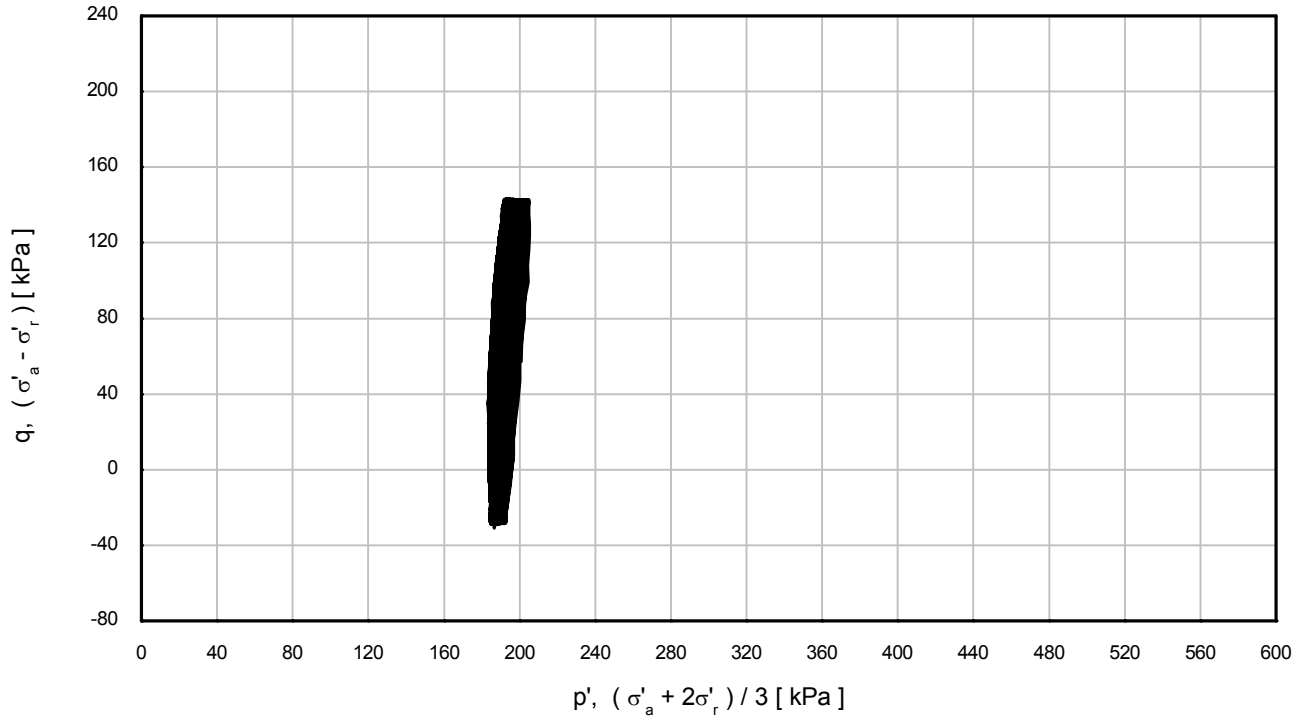




Initial σ'_r	:	182 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	:	30WaxC
q_{av}	:	57 kPa	Depth [m]	:	23.46
q_{cy}	:	86 kPa	Test No.	:	CTX19
Frequency	:	0.10 Hz			

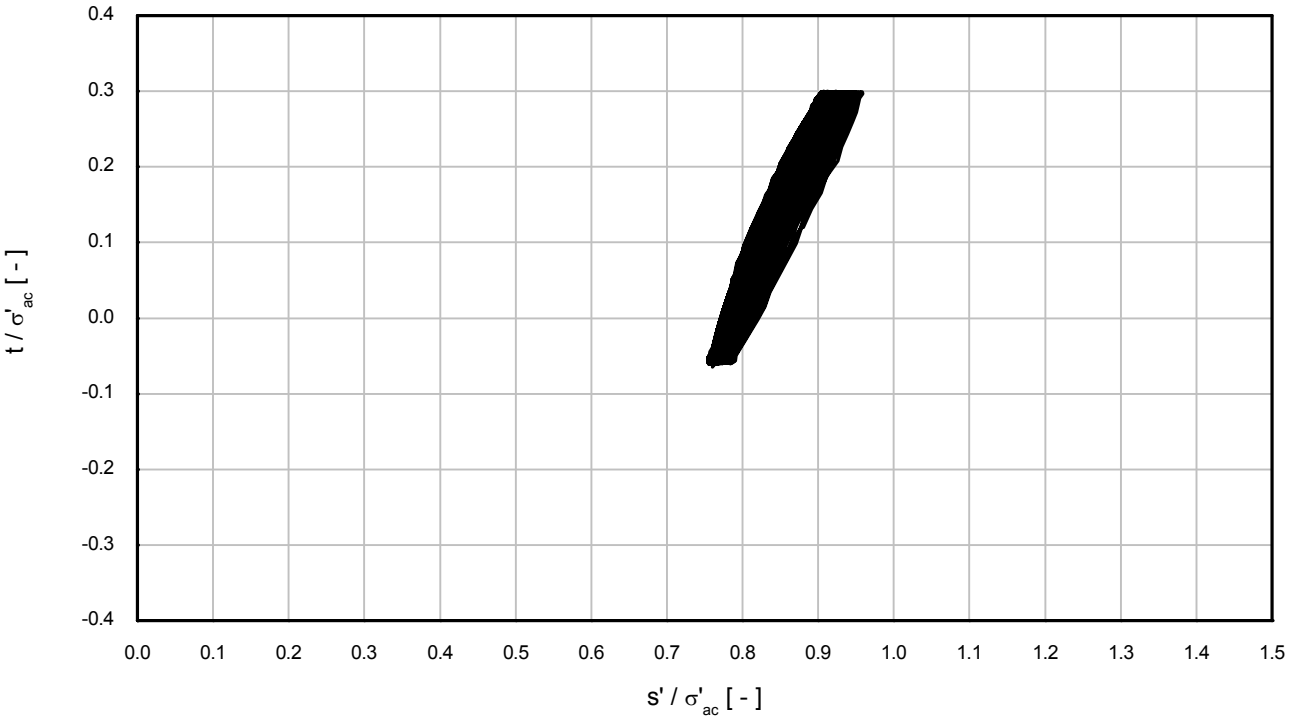
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

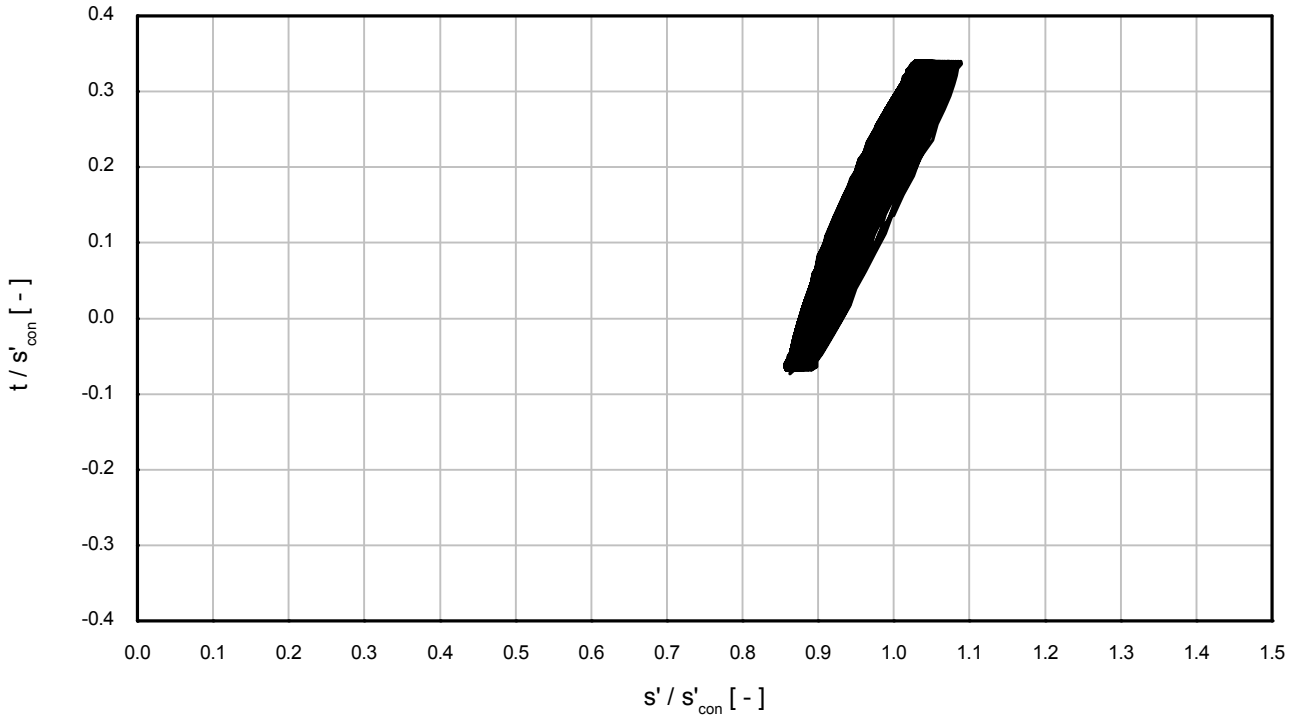




Initial σ'_r	:	182	kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	239	kPa	Sample	: 30WaxC
q_{av}	:	57	kPa	Depth [m]	: 23.46
q_{cy}	:	86	kPa	Test No.	: CTX19
Frequency	:	0.10	Hz		

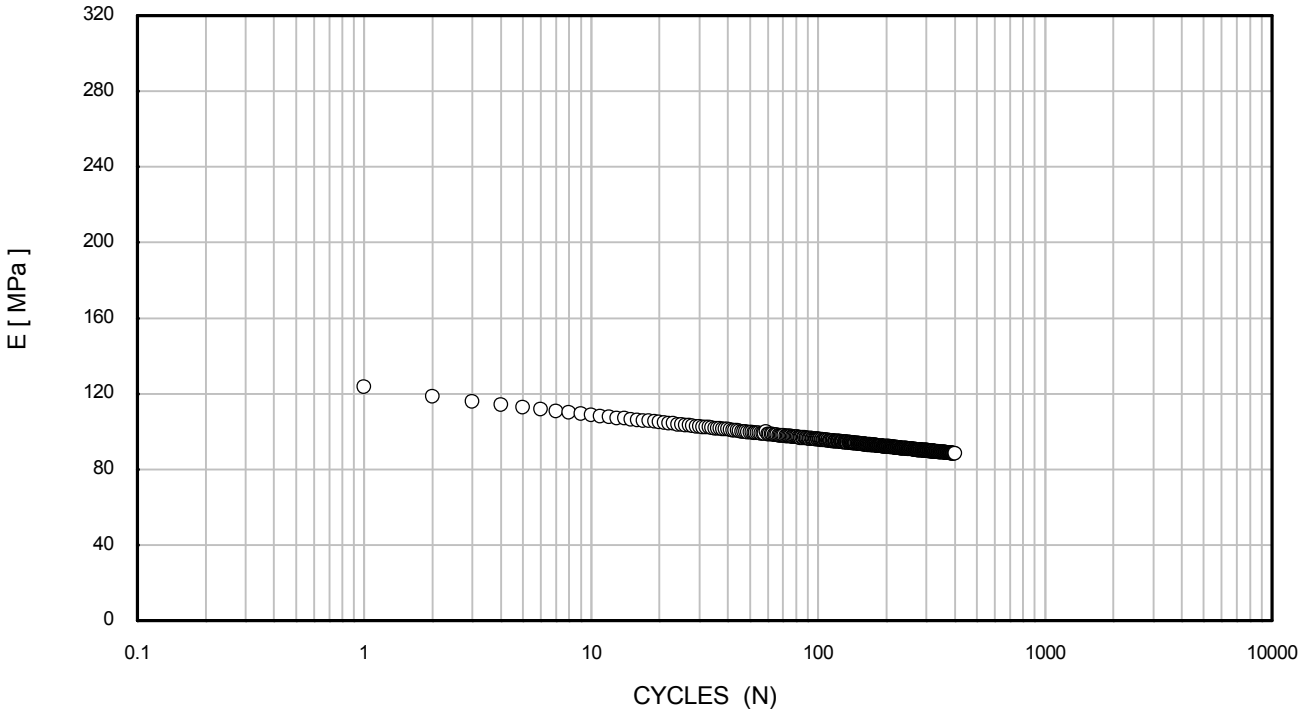
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

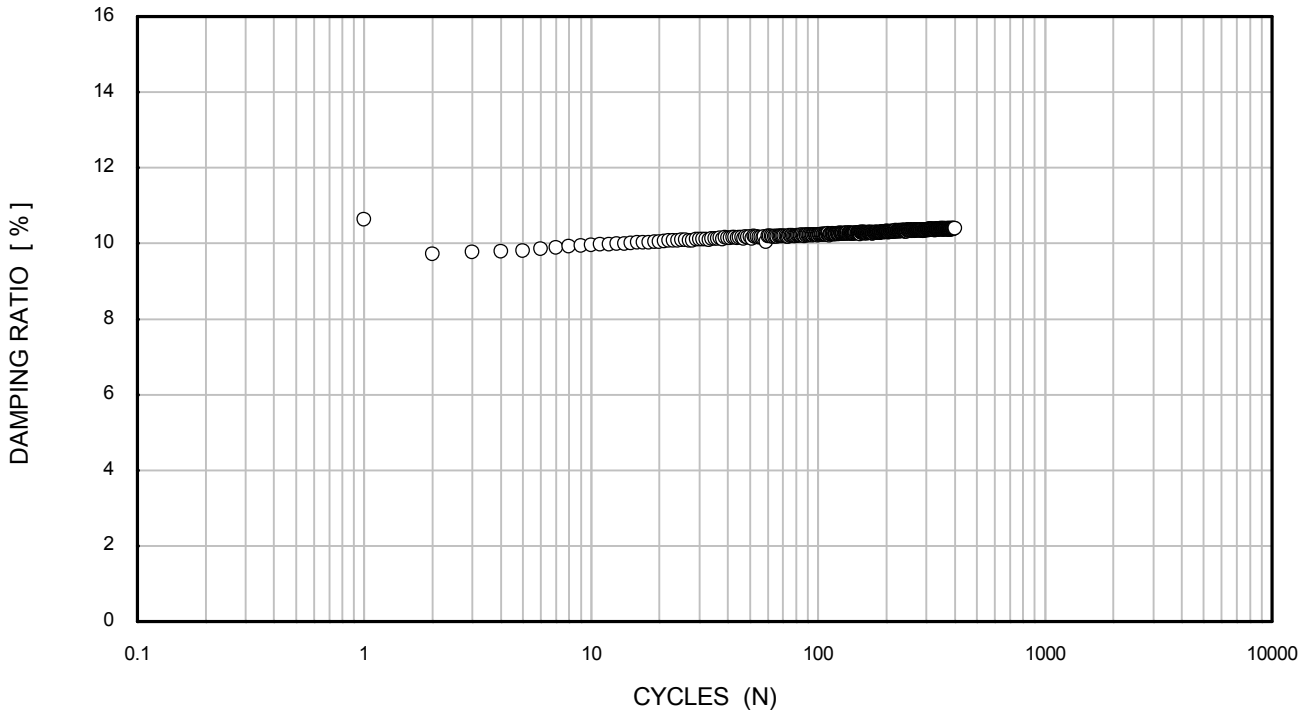




Initial σ'_r	:	182 kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	: 30WaxC
q_{av}	:	57 kPa	Depth [m]	: 23.46
q_{cy}	:	86 kPa	Test No.	: CTX19
Frequency	:	0.10 Hz		

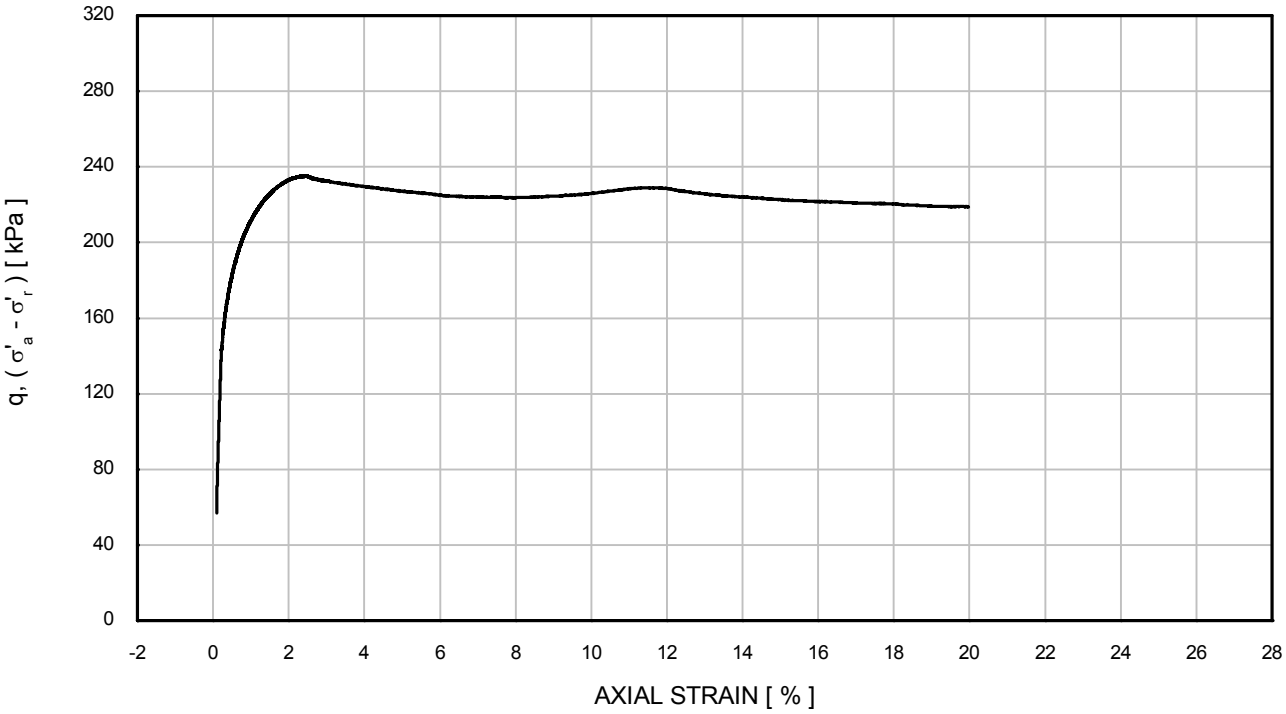
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

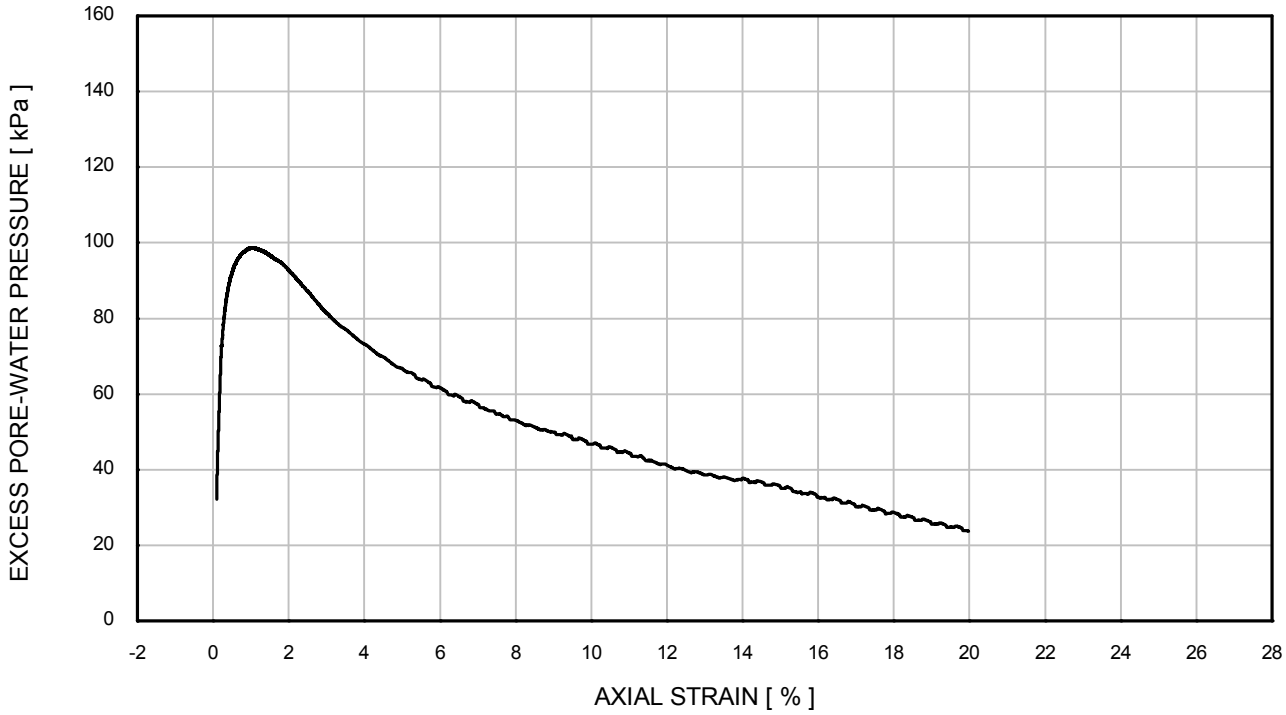




Initial σ'_r	:	182 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	239 kPa	Sample	:	30WaxC
q_{av}	:	57 kPa	Depth [m]	:	23.46
q_{cy}	:	86 kPa	Test No.	:	CTX19
Frequency	:	0.10 Hz			

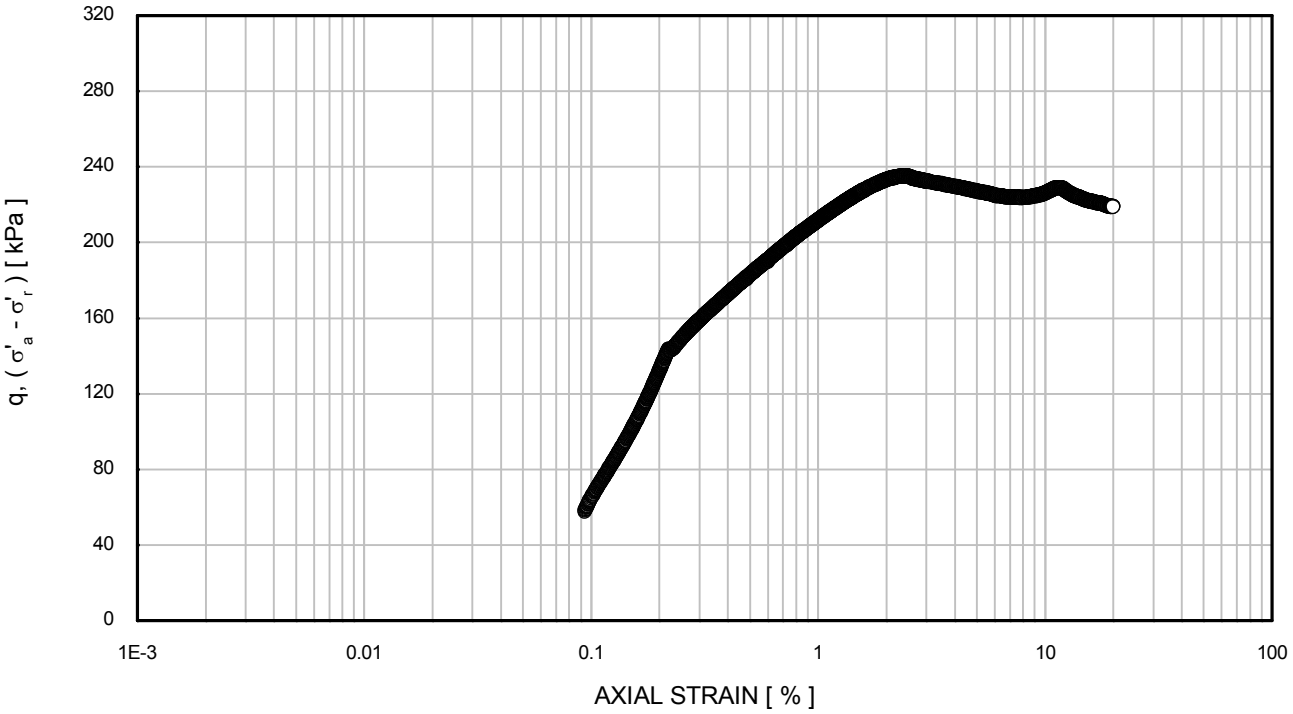
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

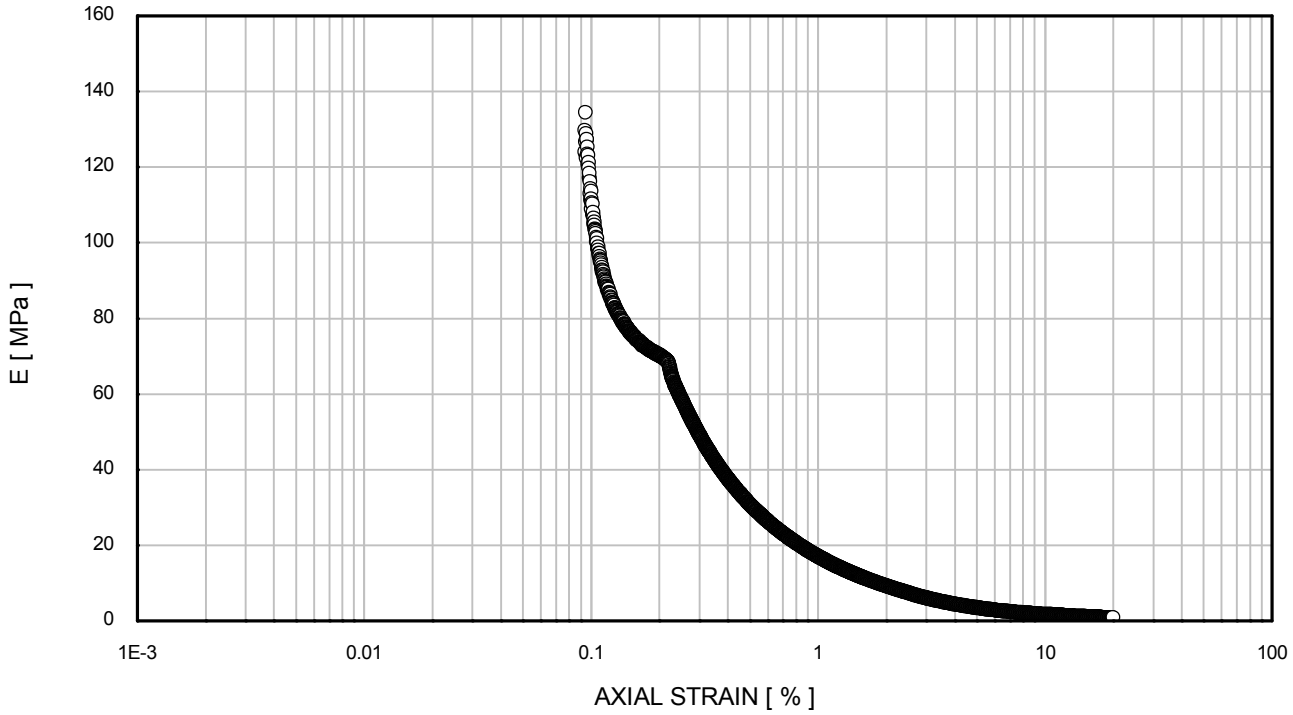




Initial σ'_r	:	168 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	225 kPa	Sample	:	30WaxC
q_{peak}	:	235 kPa	Depth [m]	:	23.46
Ext. ε at q_{peak}	:	2.43 %	Test No.	:	CTX19
Rate of strain	:	0.50 %/hour			

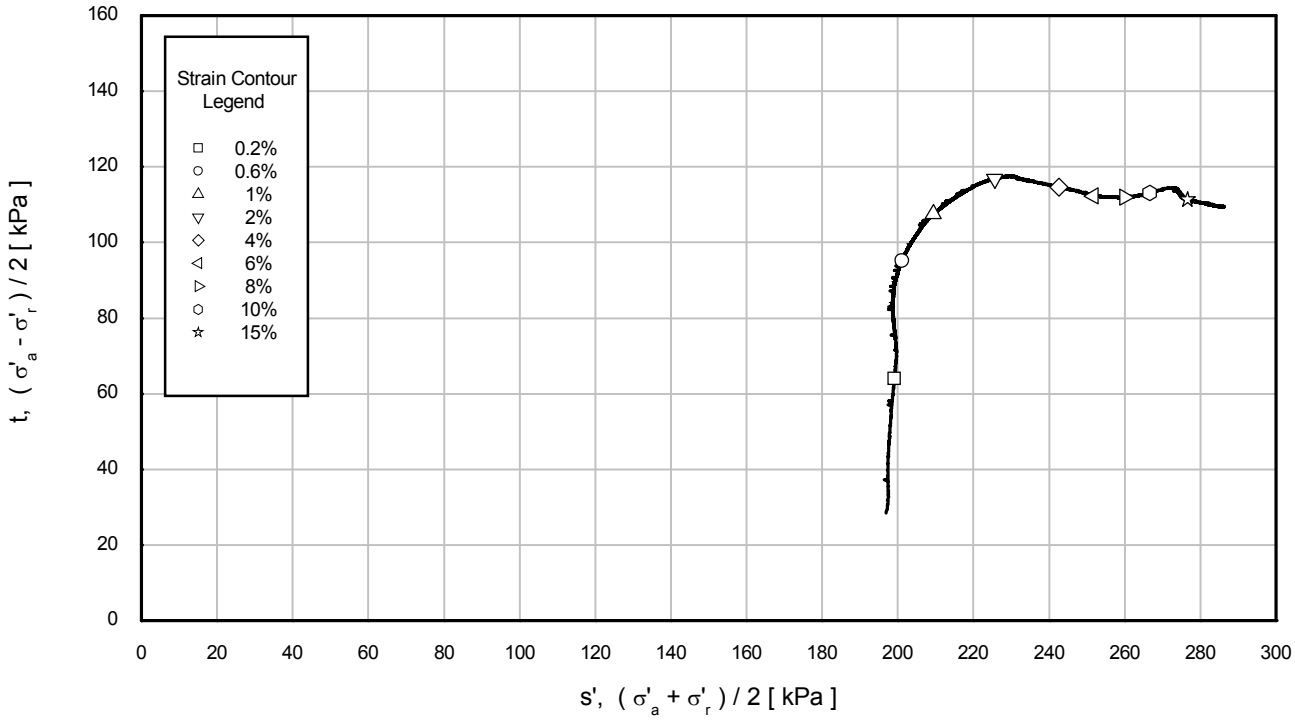
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

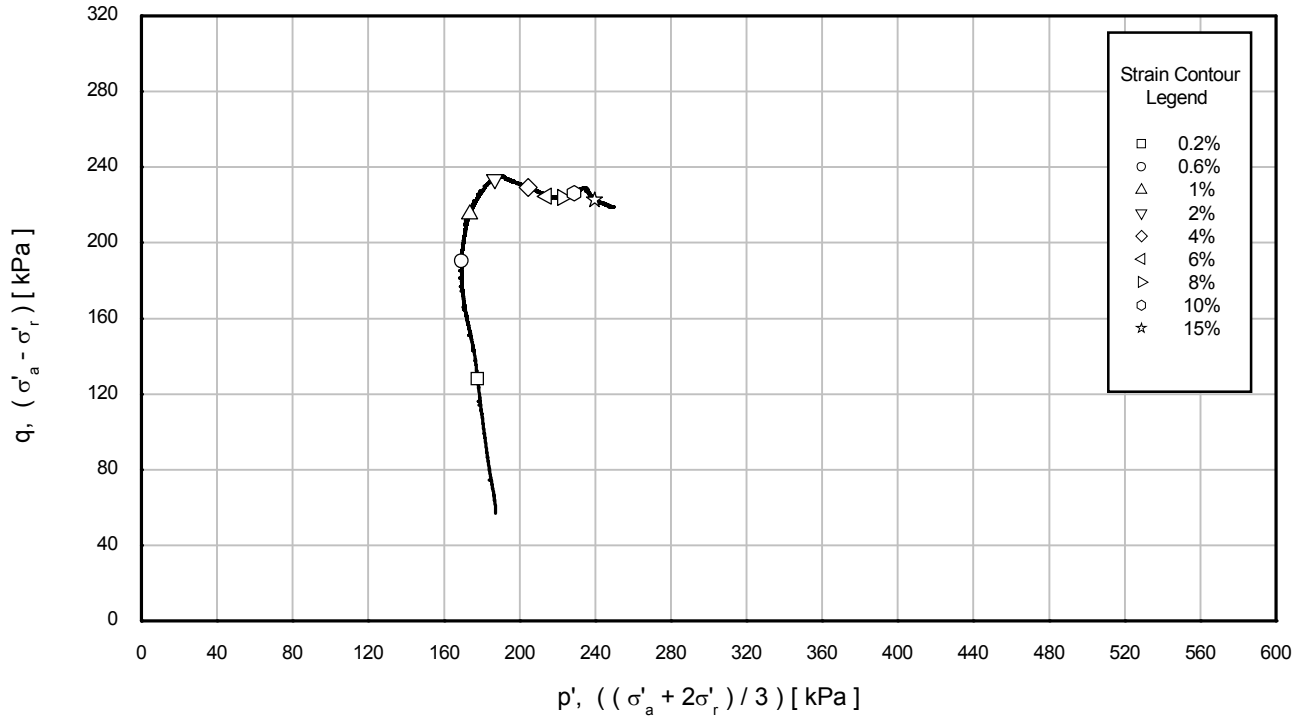




Initial σ'_r	:	168 kPa	Borehole	:	HKZ2-BH21-SA
Initial σ'_a	:	225 kPa	Sample	:	30WaxC
q_{peak}	:	235 kPa	Depth [m]	:	23.46
Ext. ε at q_{peak}	:	2.43 %	Test No.	:	CTX19
Rate of strain	:	0.50 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	168	kPa	Borehole	: HKZ2-BH21-SA
Initial σ'_a	:	225	kPa	Sample	: 30WaxC
q_{peak}	:	235	kPa	Depth [m]	: 23.46
Ext. ε at q_{peak}	:	2.43	%	Test No.	: CTX19
Rate of strain	:	0.50	%/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	08/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	71.7
Length	[mm]	144.0
Water content	[%]	9.2
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.592
Degree of saturation	[%]	41
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH01_CTX05
Processed by Date	MSR 14/12/2016
Checked by Date	JLS 15/12/2016
Approved by Date	AR 15/12/2016

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-1
Unit	Unit A (Southern Bight)
Test number	CTX05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1000
Base PWP	[kPa]	985
Mid height PWP	[kPa]	-
B value achieved	[-]	0.95

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1003
Back pressure	[kPa]	984
Base PWP	[kPa]	983
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.10
External axial strain	[%]	0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.594
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-1
Unit	Unit A (Southern Bight)
Test number	CTX05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	40
Mean q_{av}	[kPa]	0
Mean q_{cy}	[kPa]	2
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.01
External ε_{cy} at N_f	[%]	0.01
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	2
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.594
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.00	0.01	35	-	5.01	-
2	0.00	0.01	31	-	7.75	-
5	0.00	0.01	31	-	7.14	-
10	0.00	0.01	31	-	7.16	-
20	0.00	0.01	31	-	6.73	-
30	0.00	0.01	31	-	6.67	-
40	0.00	0.01	30	-	6.64	-
50	0.00	0.01	31	-	6.49	-
100	0.00	0.01	30	-	6.43	-
500	0.01	0.01	29	-	6.69	-
1000	0.01	0.01	28	-	6.87	-
1500	0.01	0.01	27	-	7.05	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-1
Unit	Unit A (Southern Bight)
Test number	CTX05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	40
Mean q_{av}	[kPa]	0
Mean q_{cy}	[kPa]	10
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	19
External ε_{av} at N_f	[%]	-1.02
External ε_{cy} at N_f	[%]	3.36
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	12
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.594
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.01	0.03	30	-	10.54	-
2	0.02	0.03	29	-	9.29	-
5	0.03	0.04	23	-	11.52	-
10	0.04	0.11	9	-	19.72	-
11	0.05	0.16	6	-	20.60	-
12	0.05	0.23	4	-	19.42	-
13	0.05	0.34	3	-	16.72	-
14	0.03	0.49	2	-	13.41	-
15	-0.03	0.73	1	-	10.49	-
16	-0.15	1.10	1	-	7.40	-
17	-0.38	1.65	1	-	6.85	-
19	-1.02	3.36	0	-	7.54	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-1
Unit	Unit A (Southern Bight)
Test number	CTX05

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





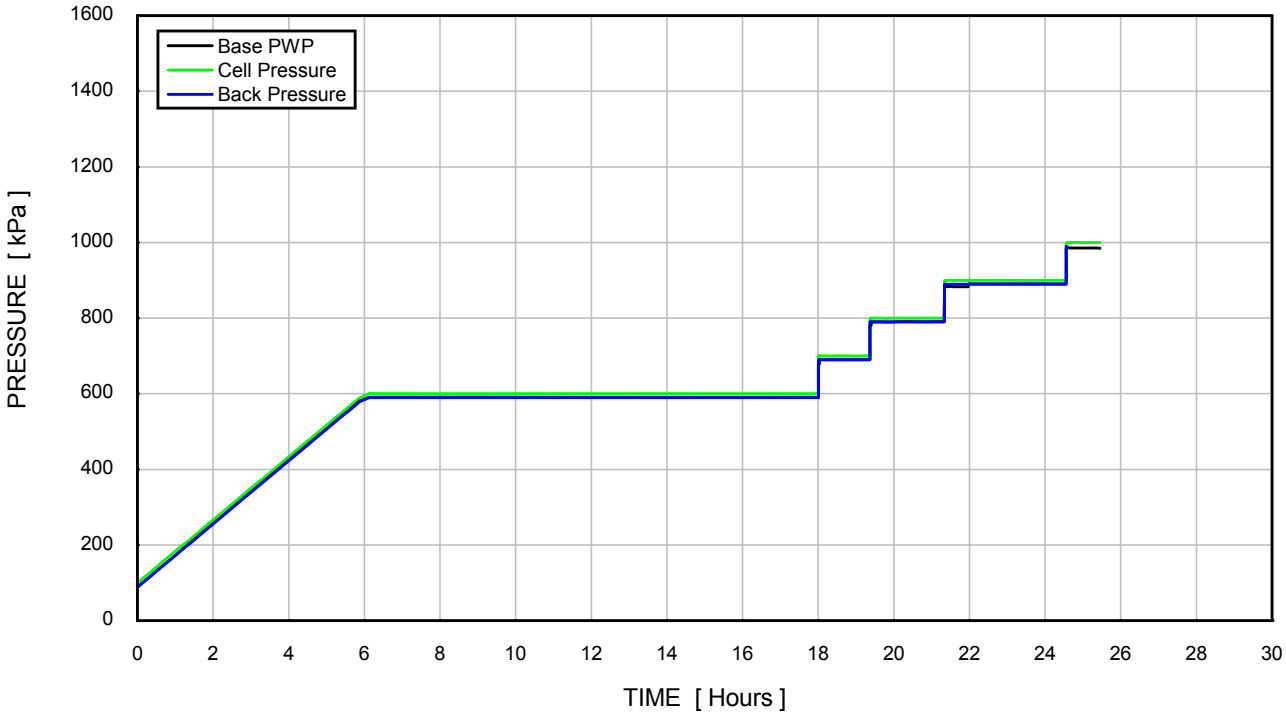
FINAL CONDITIONS

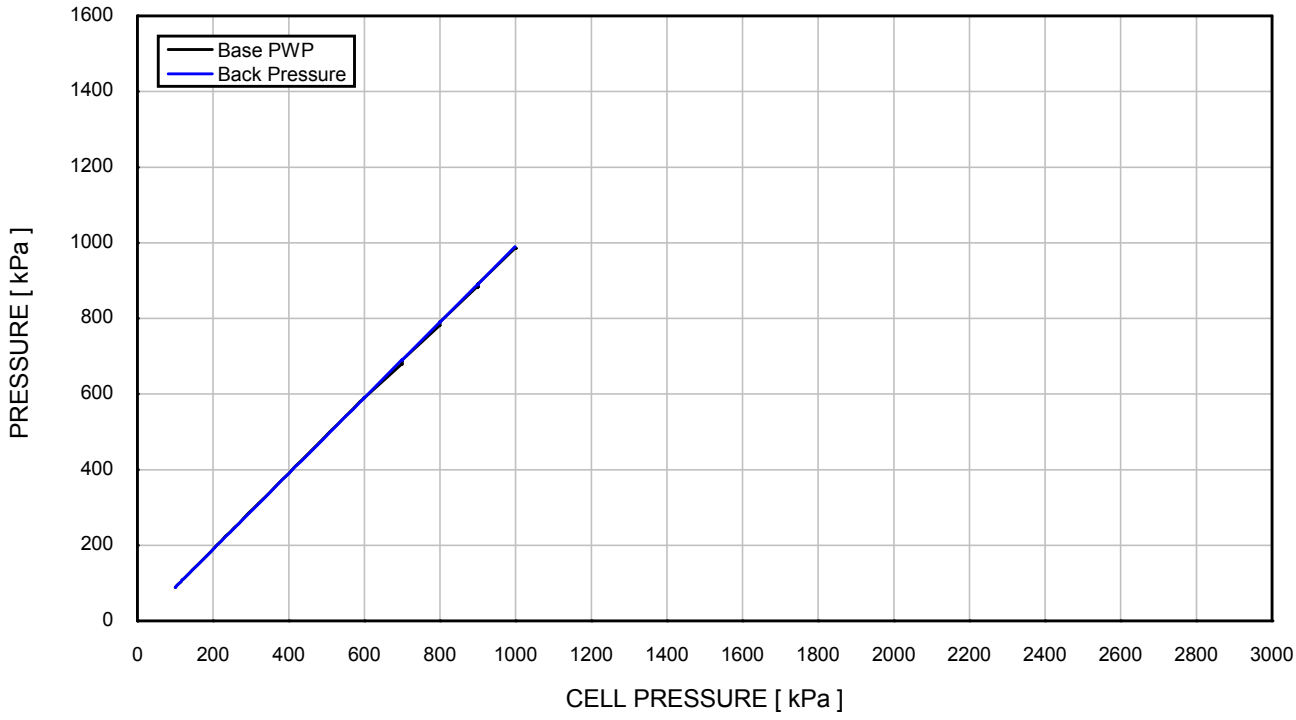
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66

TEST IDENTIFICATION

Batch	1
Sample	CTX_1-1
Unit	Unit A (Southern Bight)
Test number	CTX05

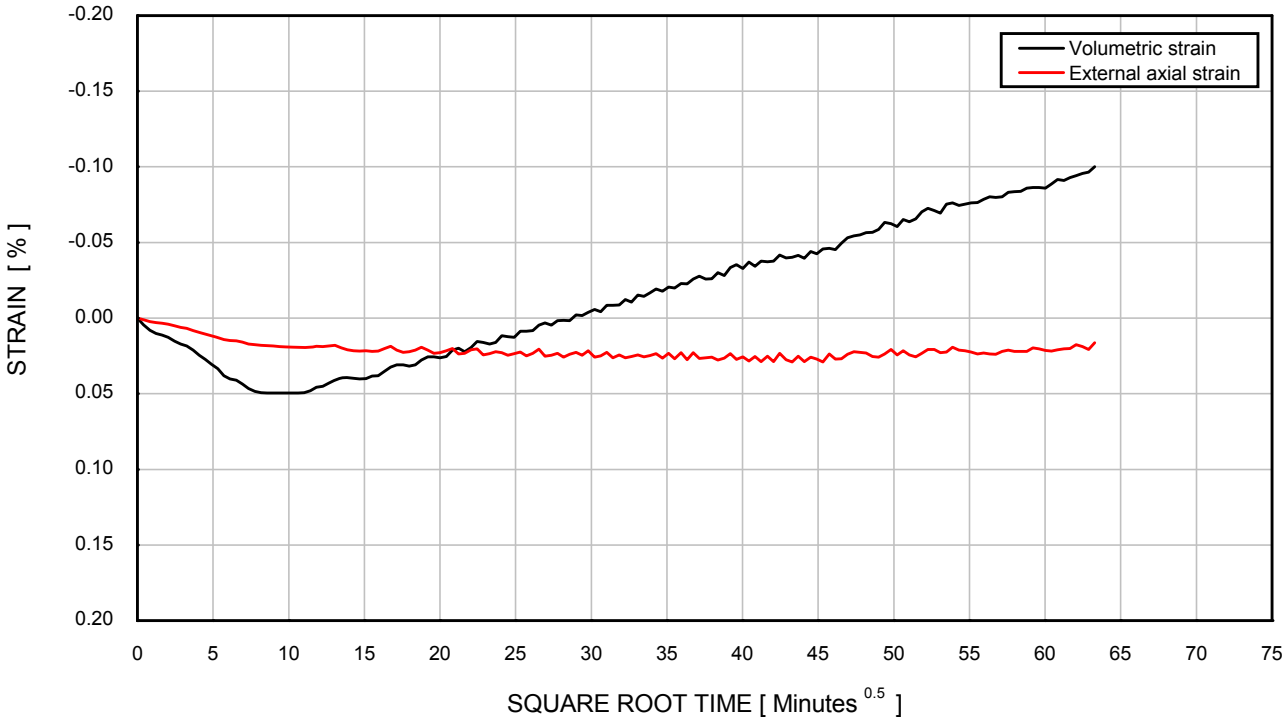
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

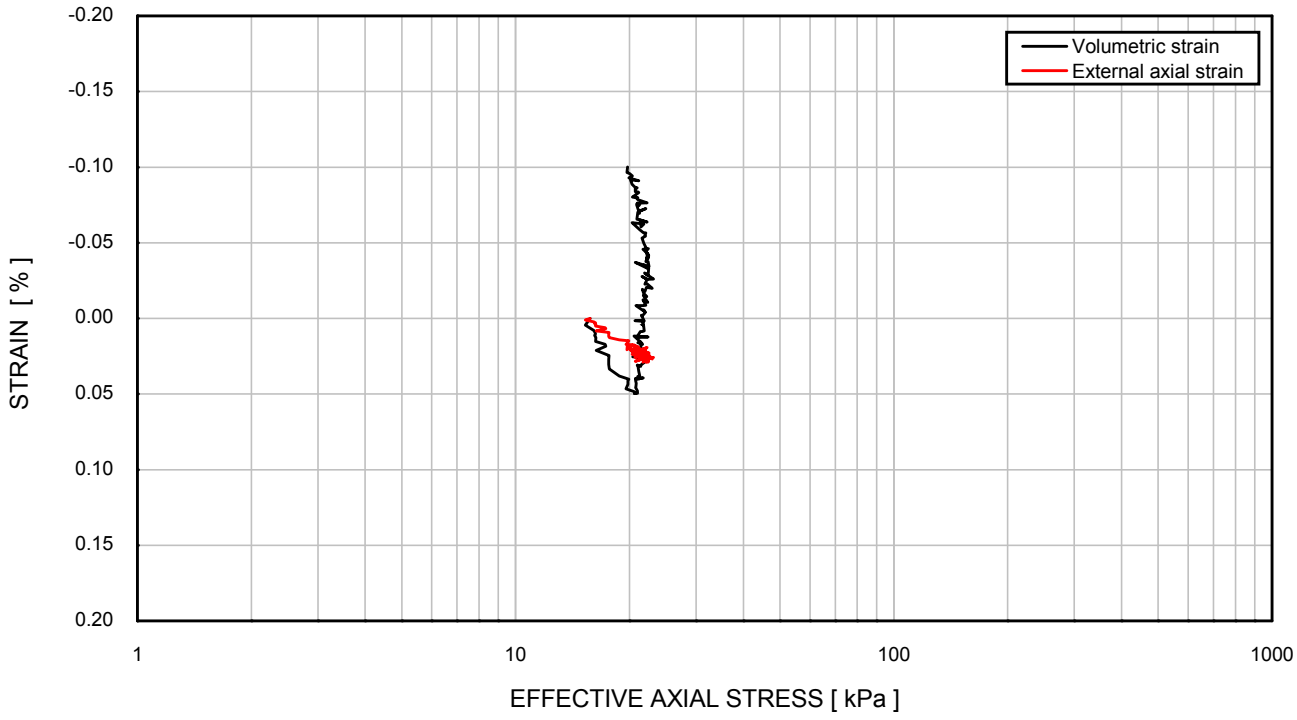




B value	:	0.95			
Initial σ'_r	:	11	kPa	Batch	: 1
Initial σ'_a	:	11	kPa	Sample	: CTX_1-1
Final σ'_r	:	15	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	15	kPa	Test No.	: CTX05

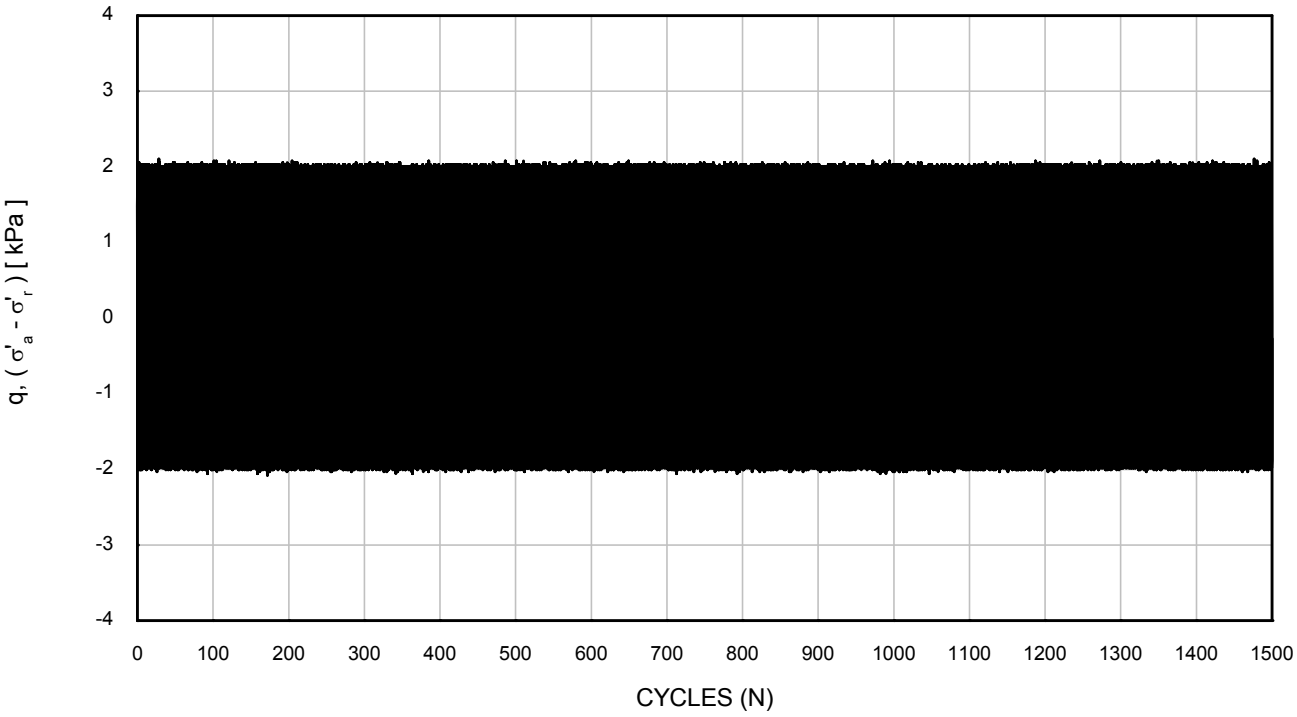
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

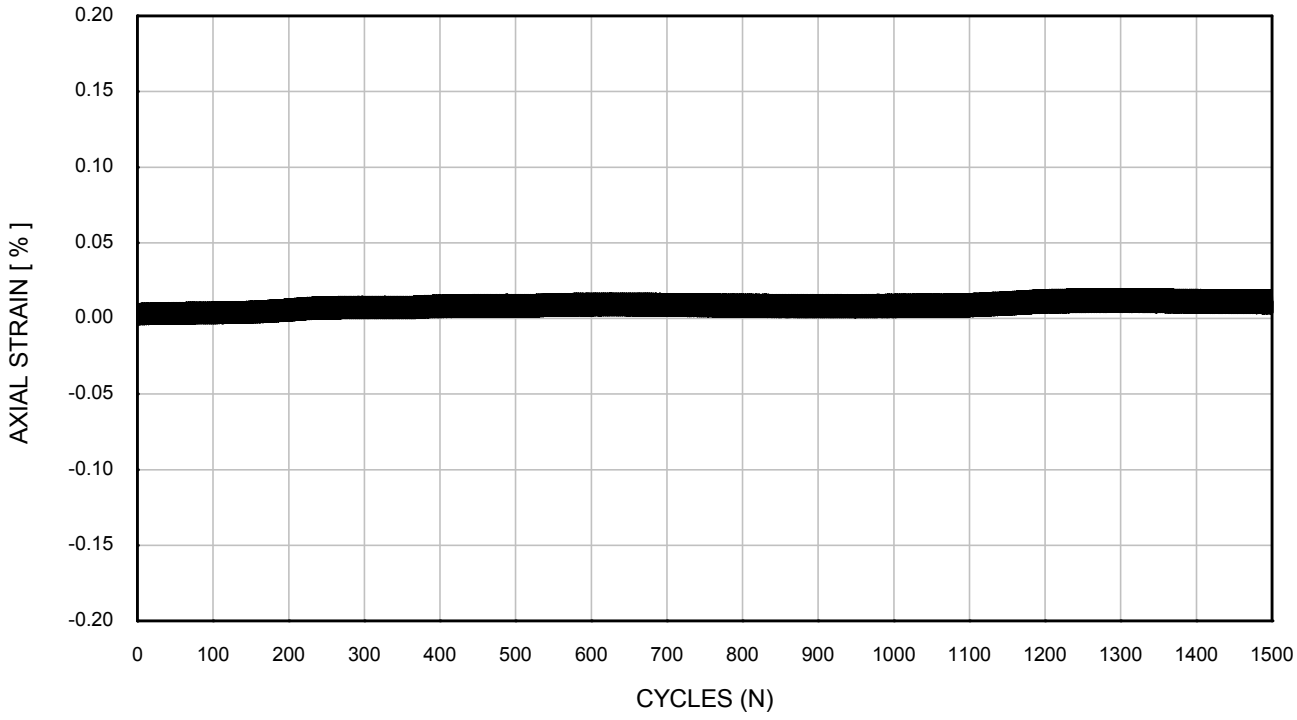




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	20 kPa	Sample	:	CTX_1-1
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX05

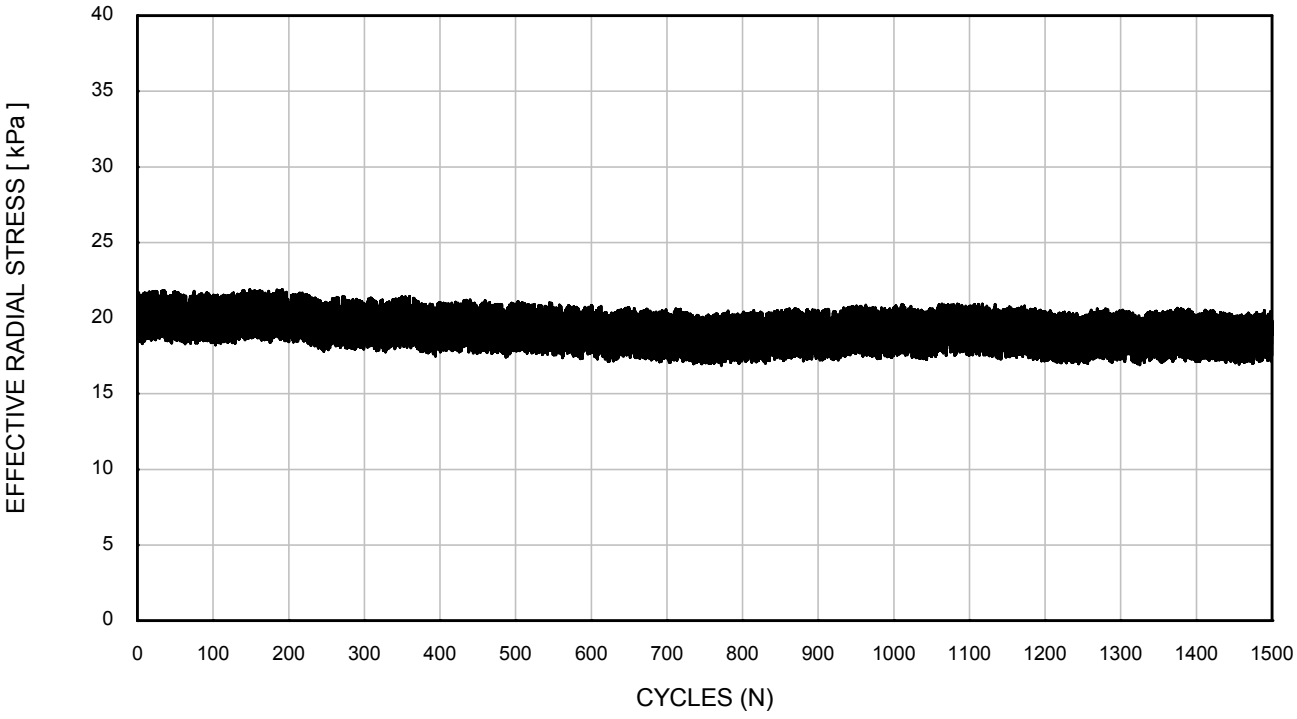
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

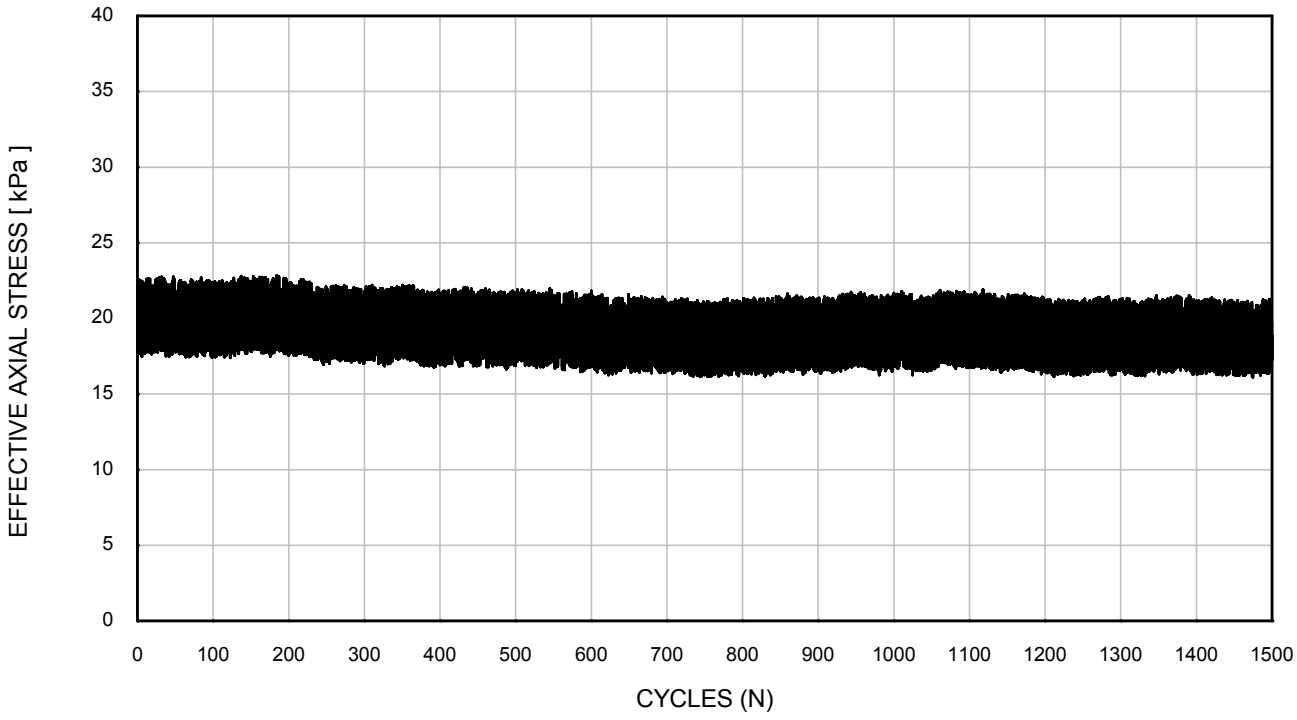




Initial σ'_r	:	21 kPa	Batch	:	1
Initial σ'_a	:	21 kPa	Sample	:	CTX_1-1
q_{av}	:	0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	2 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

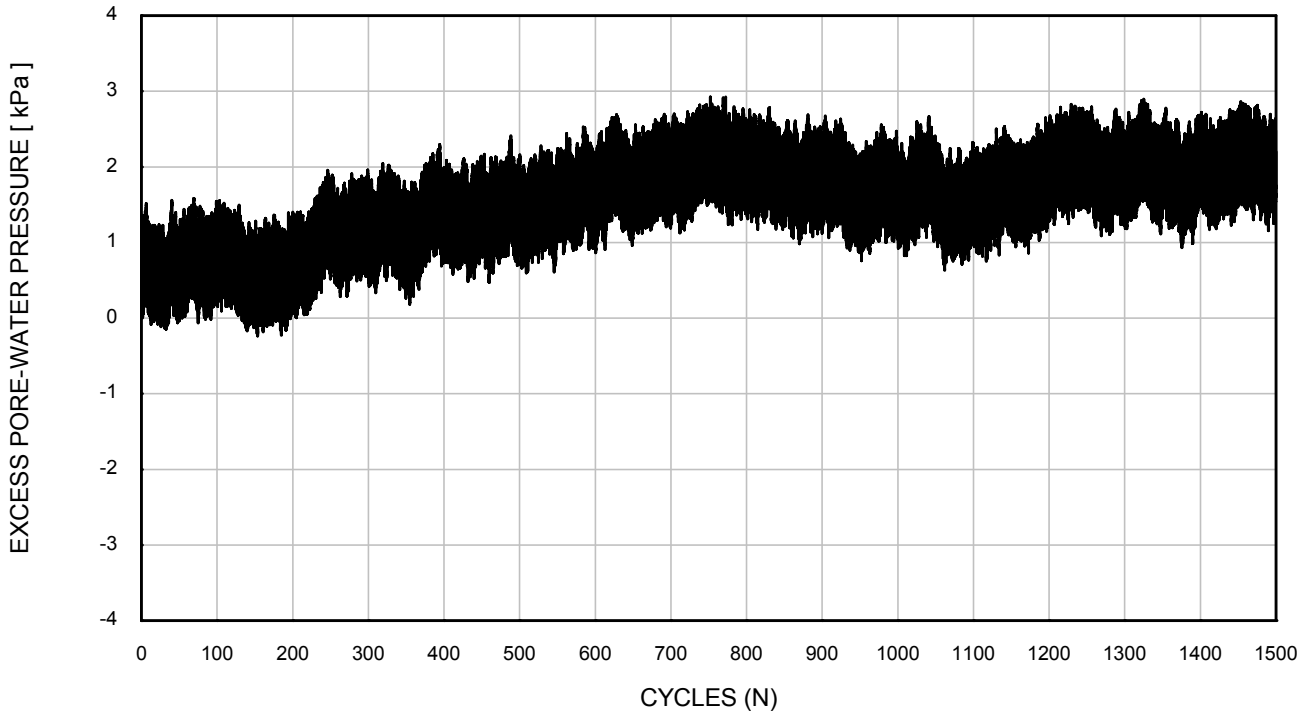
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

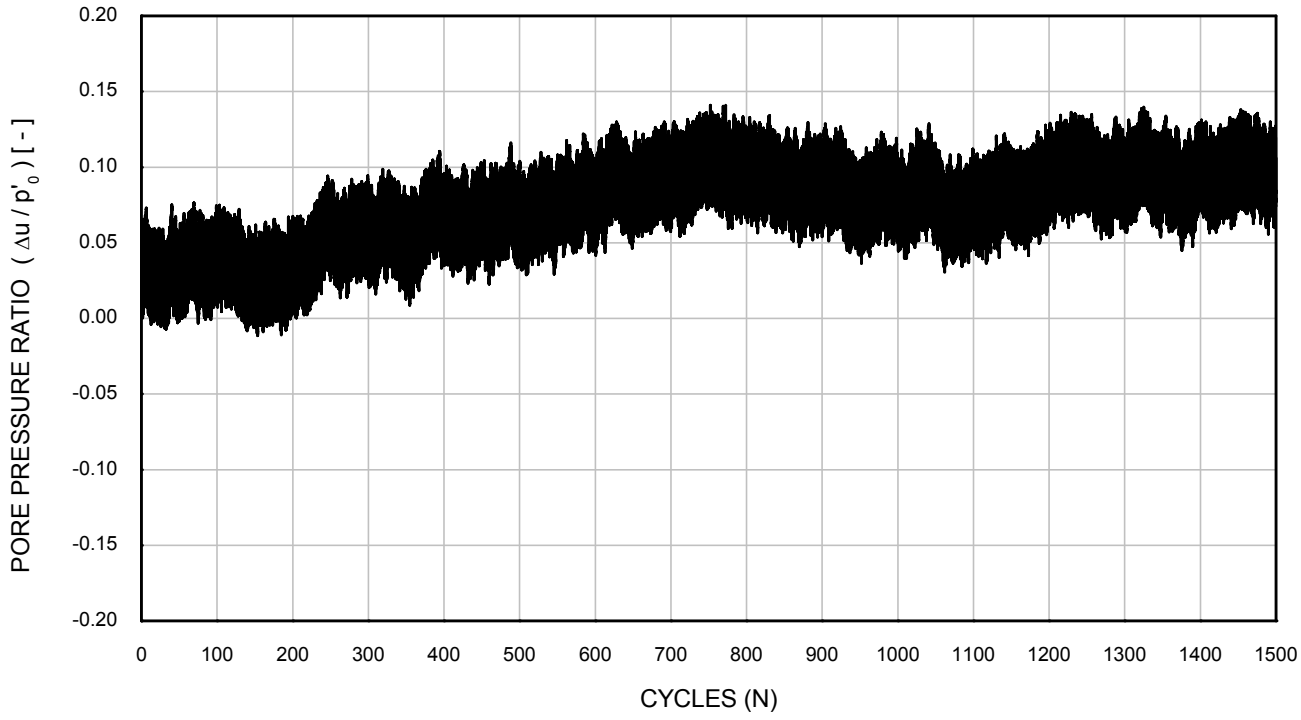




Initial σ'_r	:	21 kPa	Batch	:	1
Initial σ'_a	:	21 kPa	Sample	:	CTX_1-1
q_{av}	:	0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	2 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

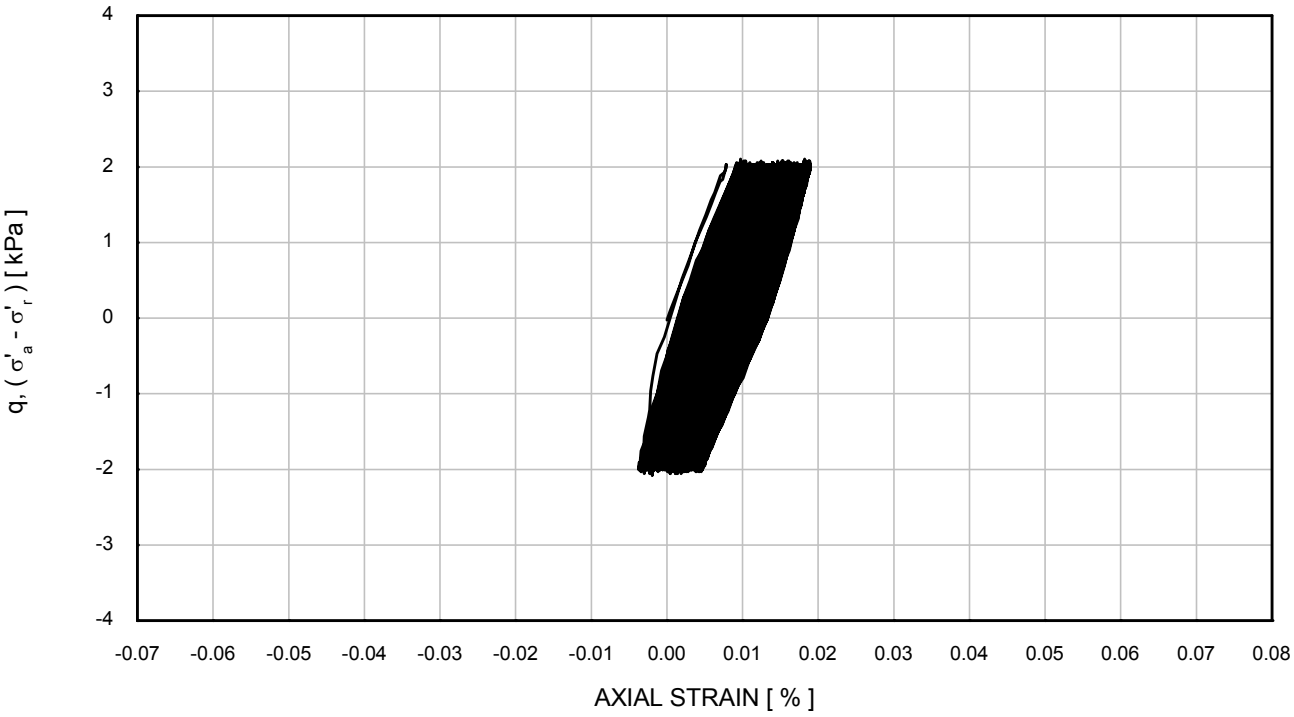
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

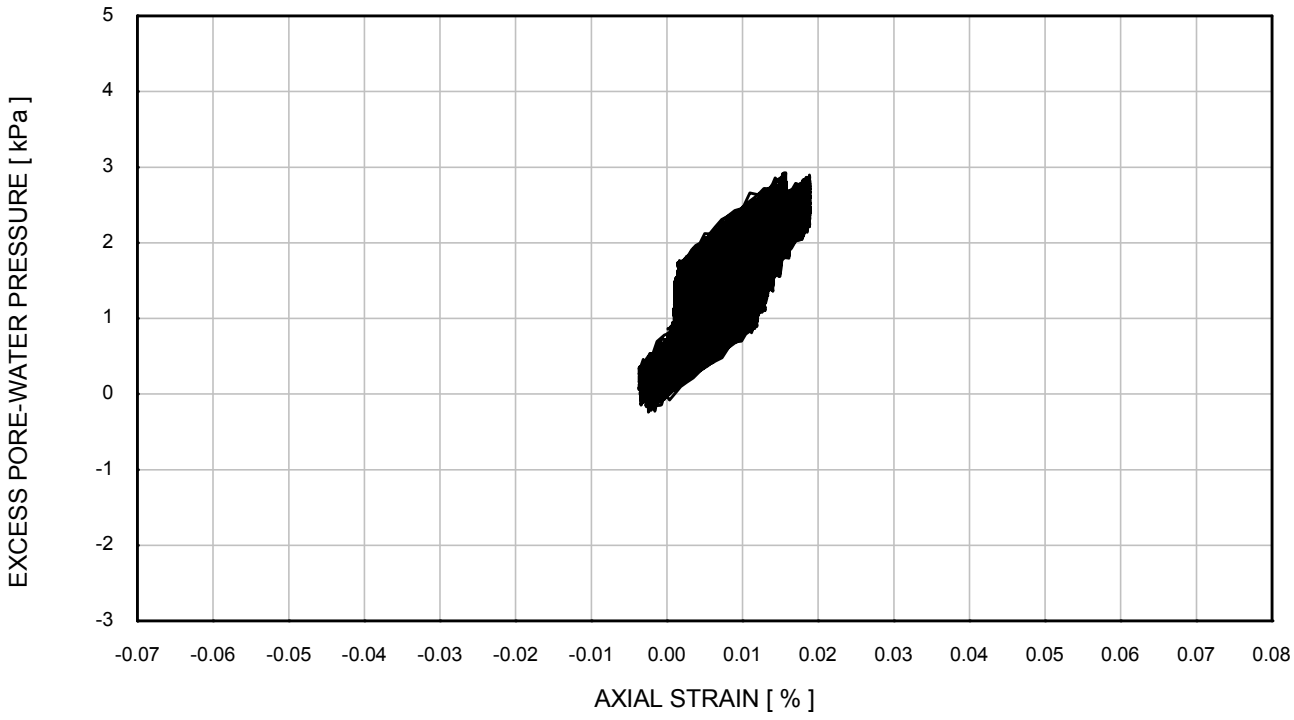




Initial σ'_r	:	21 kPa	Batch	:	1
Initial σ'_a	:	21 kPa	Sample	:	CTX_1-1
q_{av}	:	0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	2 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

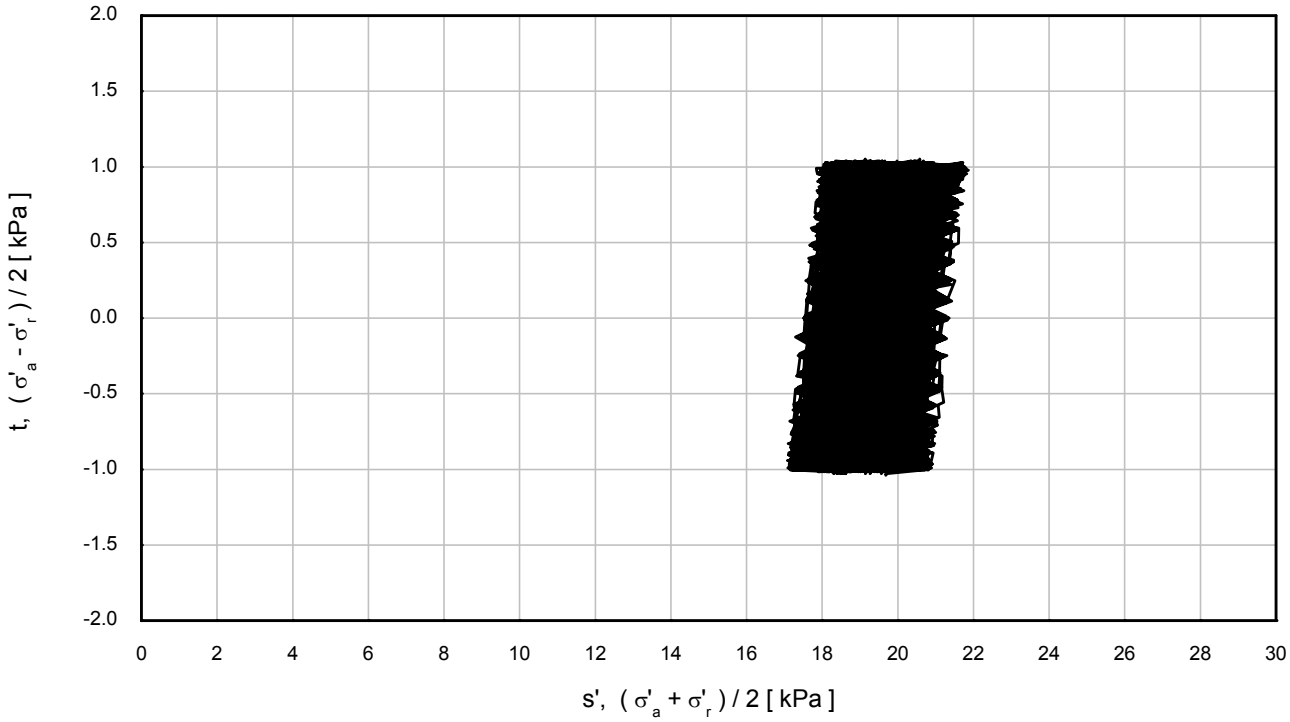
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

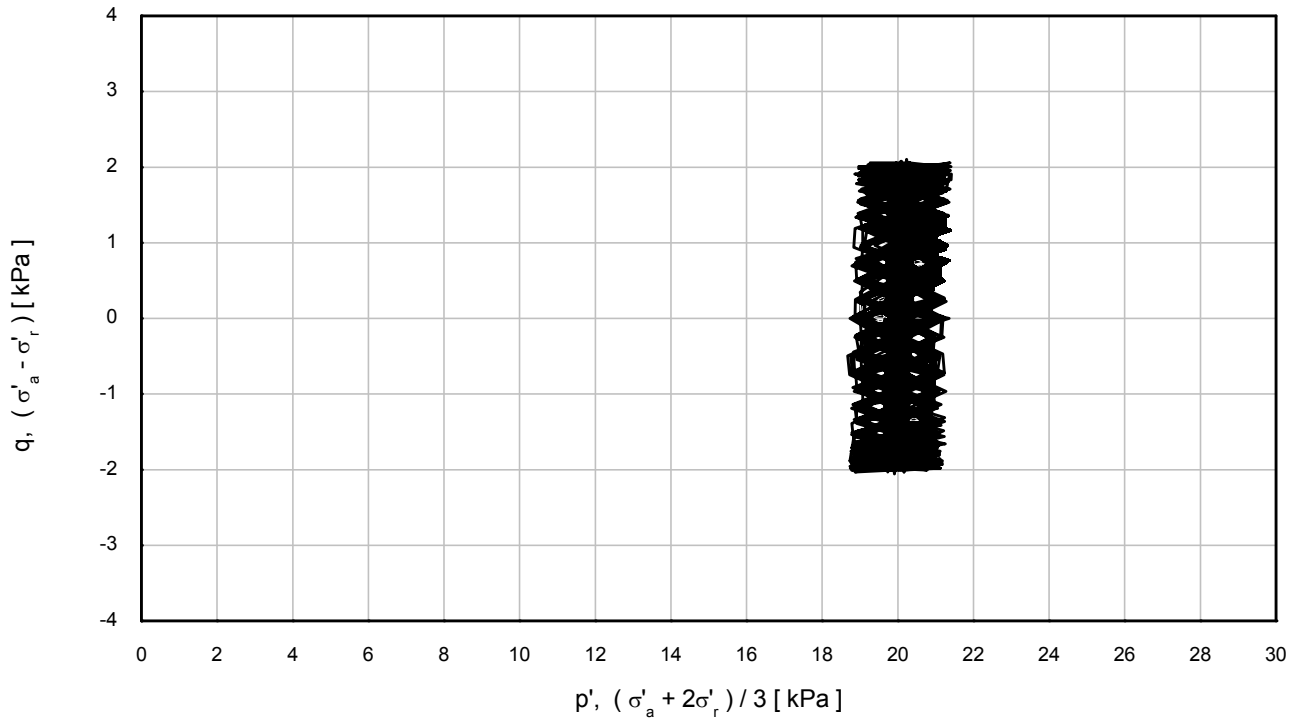




Initial σ'_r	:	21 kPa	Batch	:	1
Initial σ'_a	:	21 kPa	Sample	:	CTX_1-1
q_{av}	:	0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	2 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

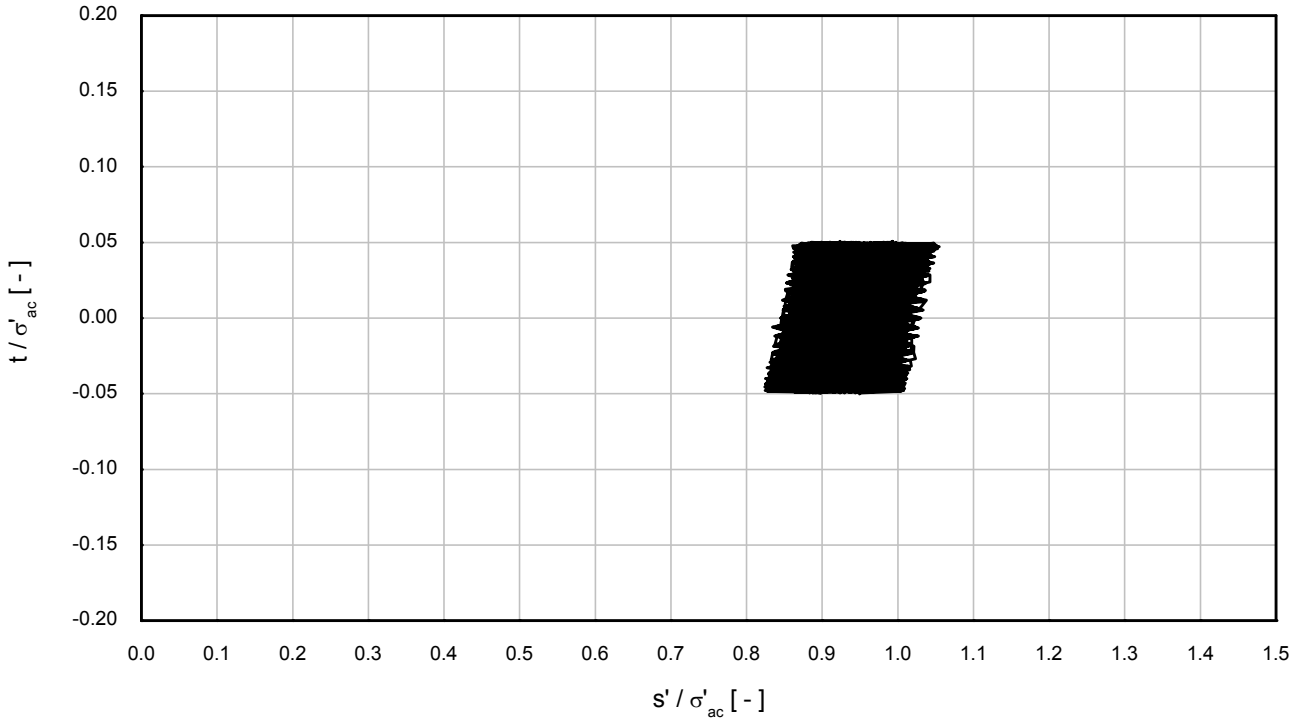
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

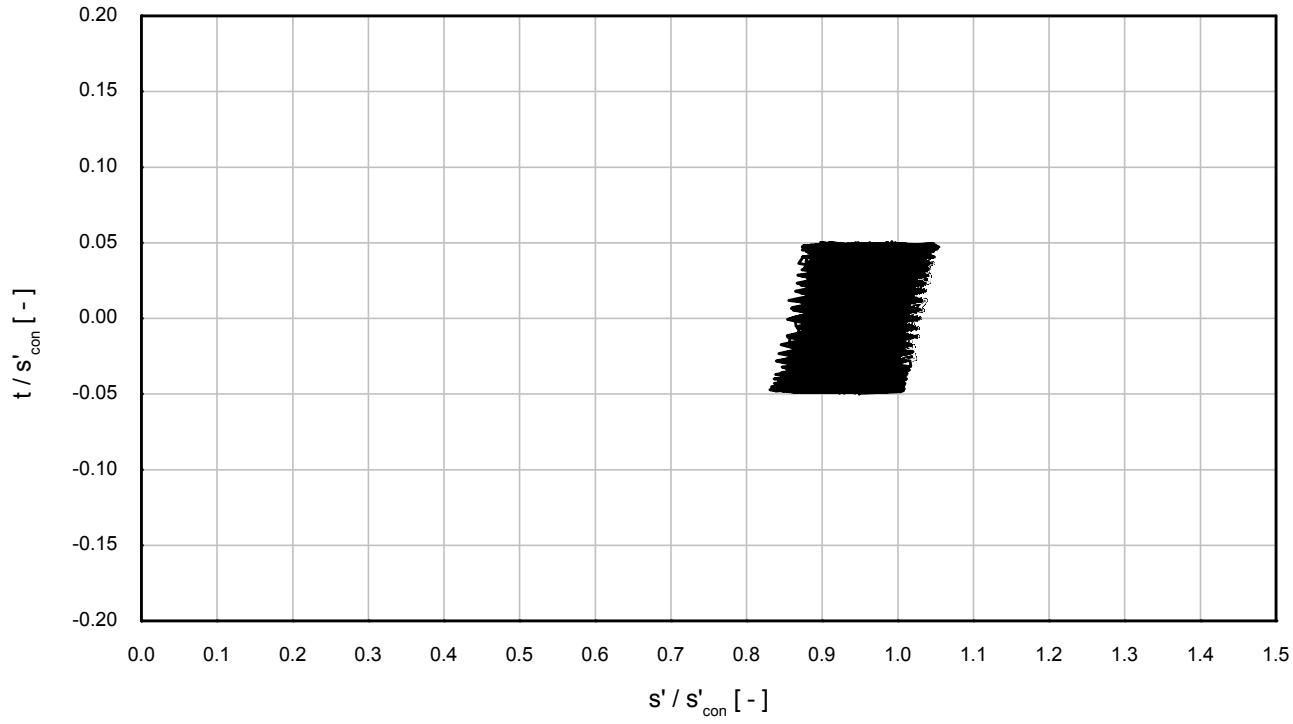




Initial σ'_r	:	21	kPa	Batch	: 1
Initial σ'_a	:	21	kPa	Sample	: CTX_1-1
q_{av}	:	0	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	2	kPa	Test No.	: CTX05
Frequency	:	0.10	Hz		

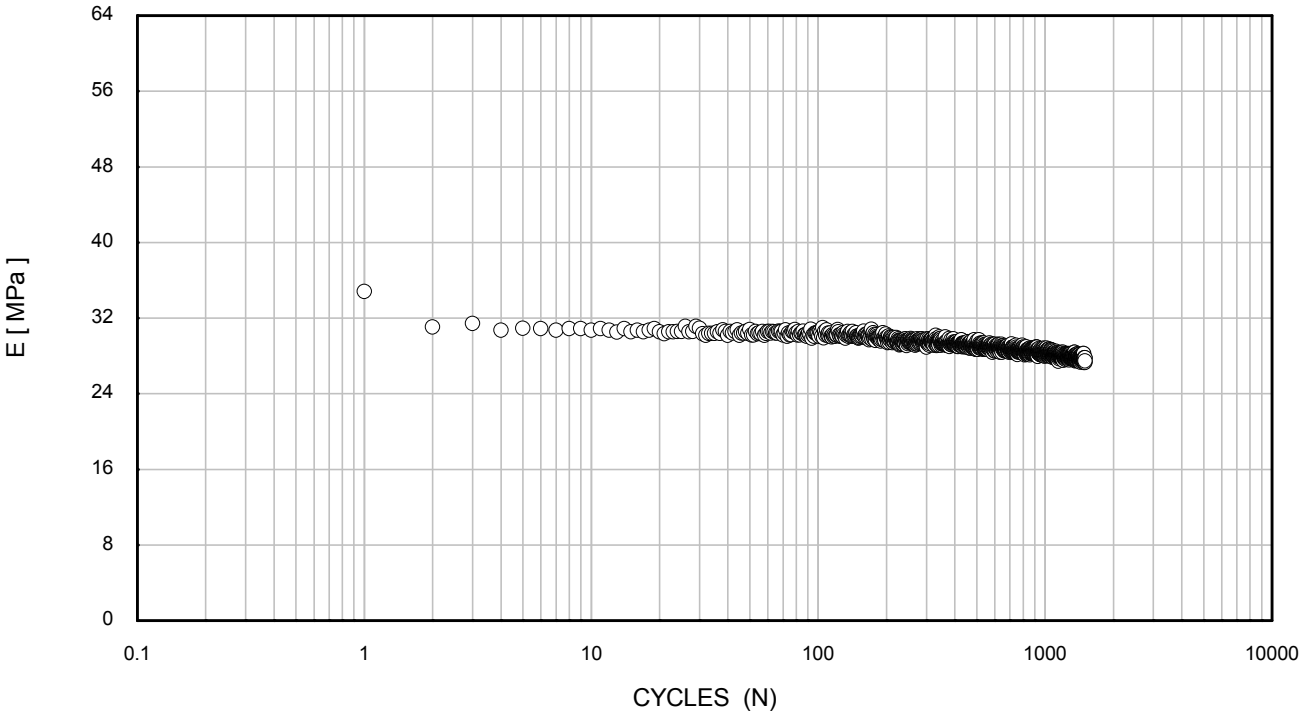
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

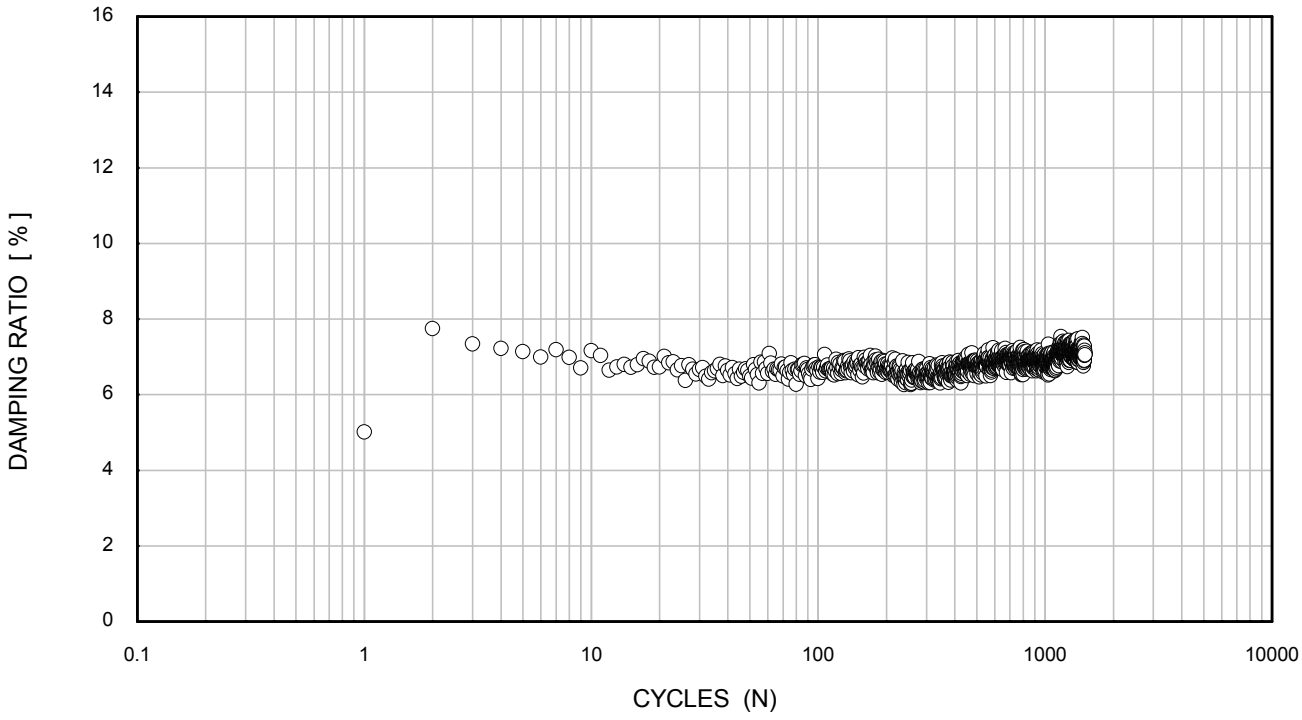




Initial σ'_r	:	21	kPa	Batch	: 1
Initial σ'_a	:	21	kPa	Sample	: CTX_1-1
q_{av}	:	0	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	2	kPa	Test No.	: CTX05
Frequency	:	0.10	Hz		

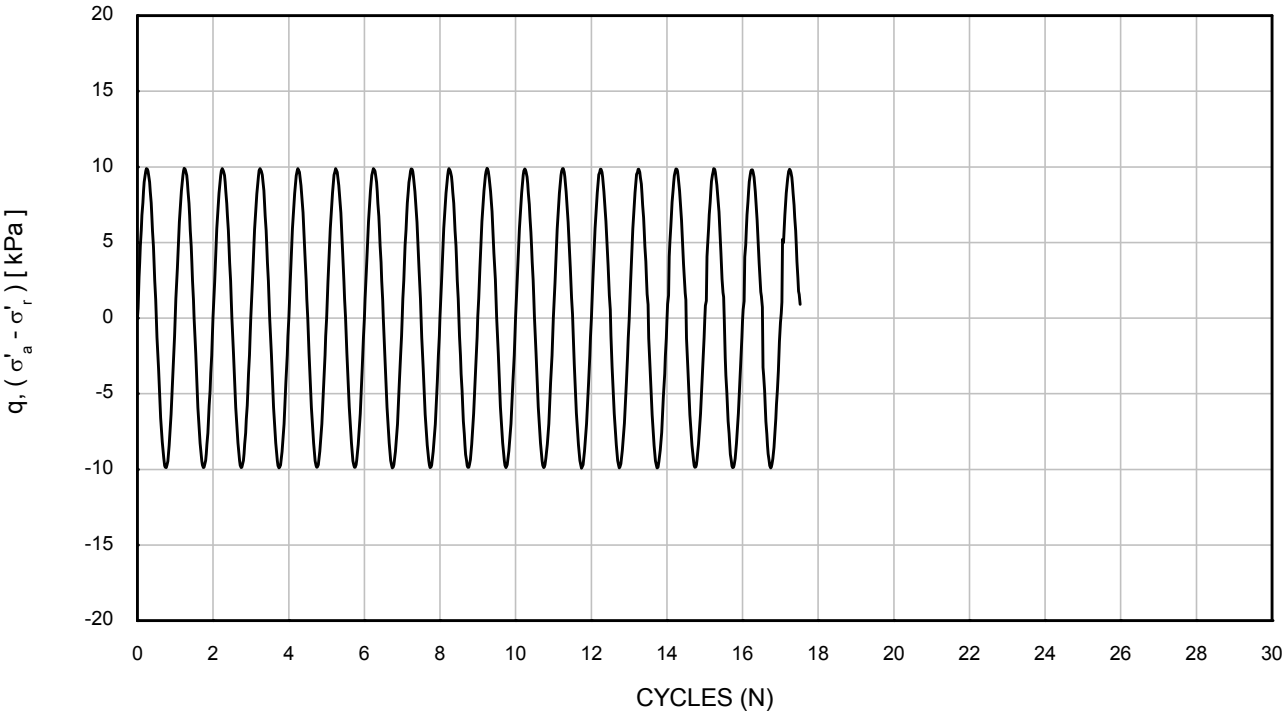
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

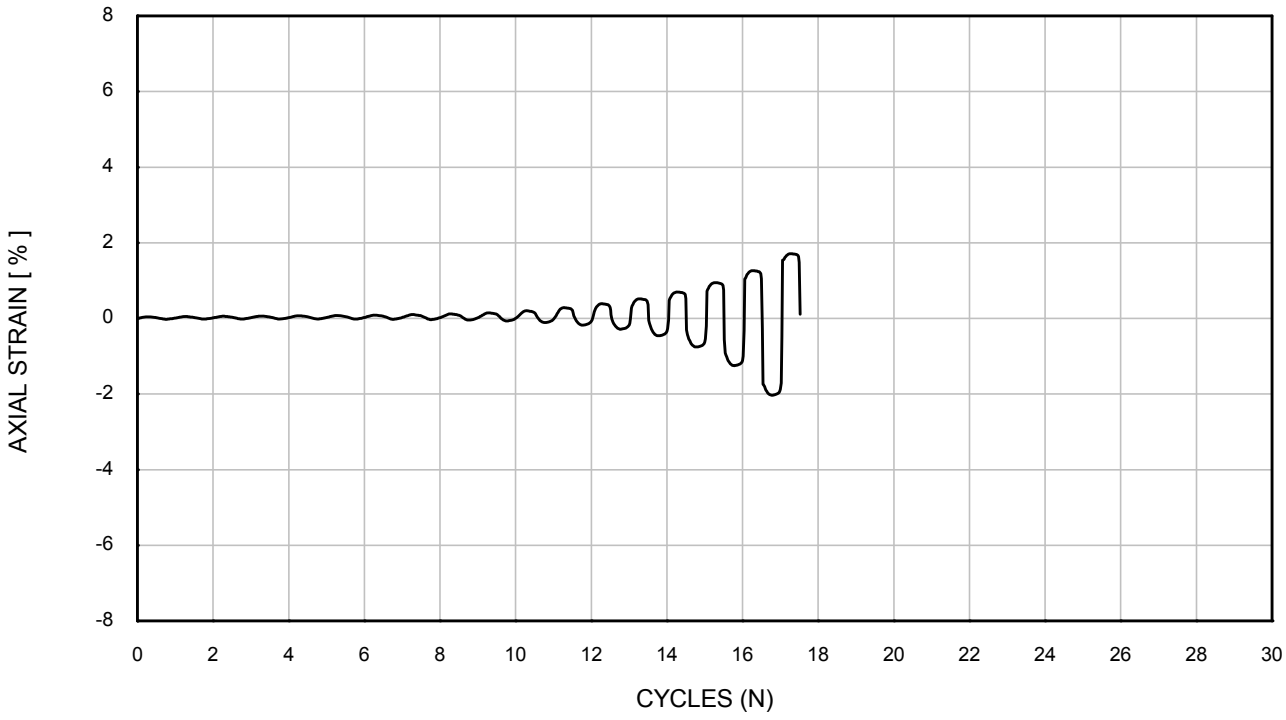




Initial σ'_r	:	21 kPa	Batch	:	1
Initial σ'_a	:	21 kPa	Sample	:	CTX_1-1
q_{av}	:	0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	2 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

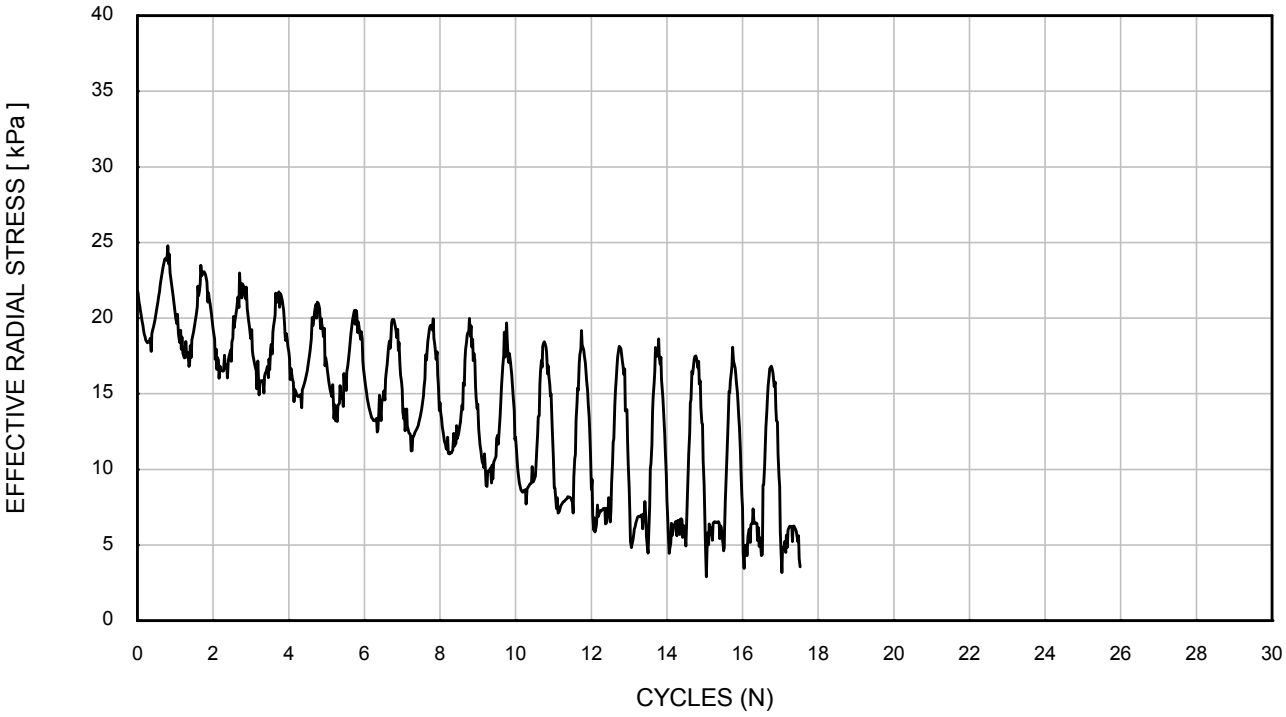
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

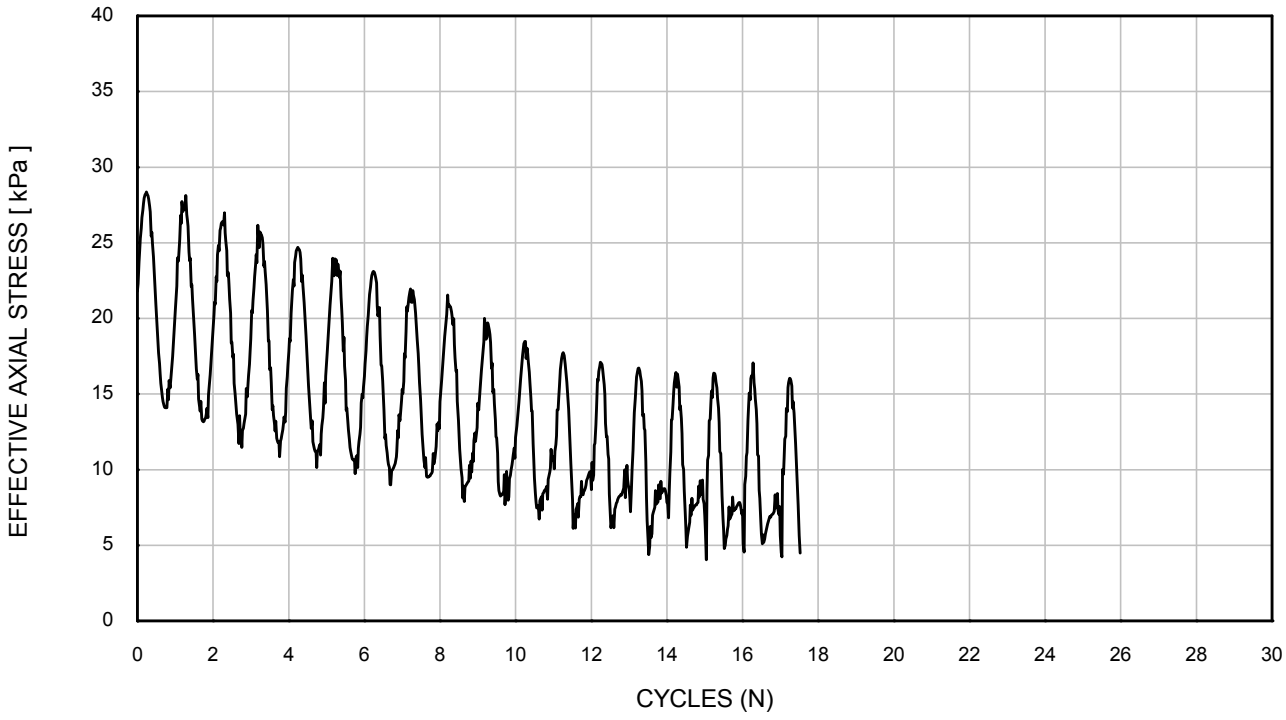




Initial σ'_r	:	22 kPa	Batch	:	1
Initial σ'_a	:	22 kPa	Sample	:	CTX_1-1
q_{av}	:	-0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	10 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

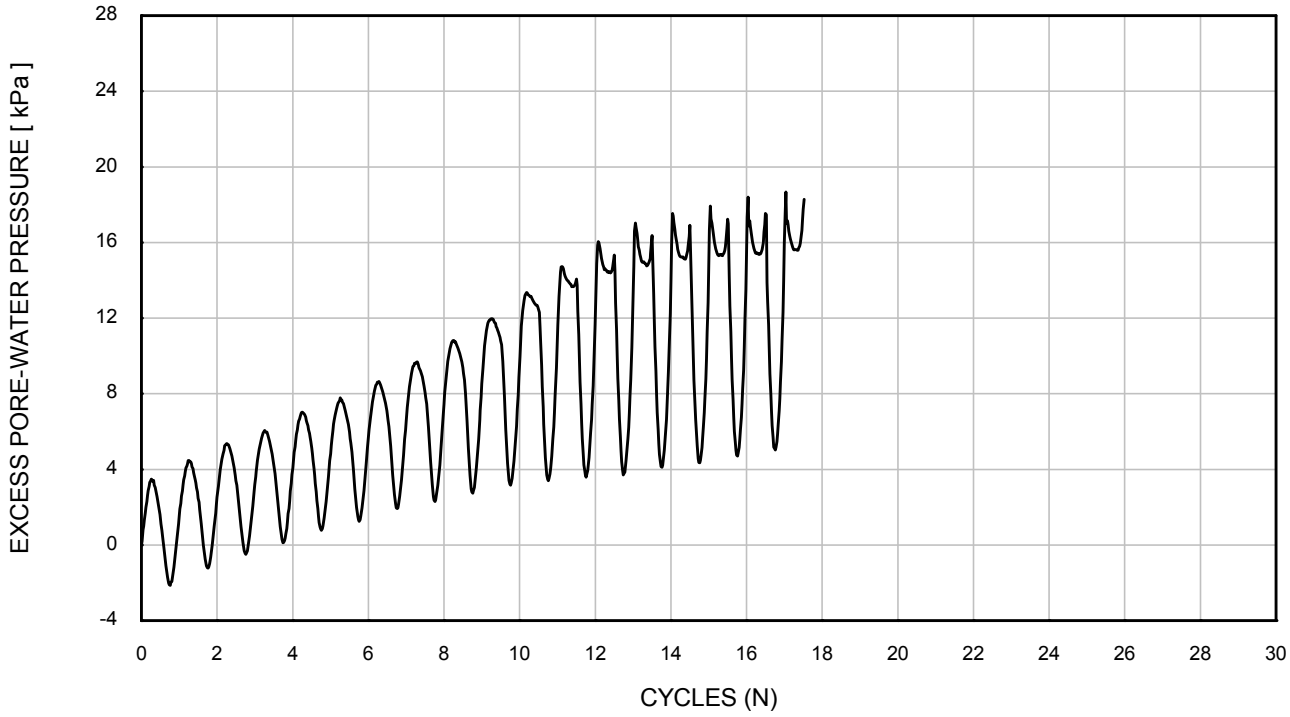
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

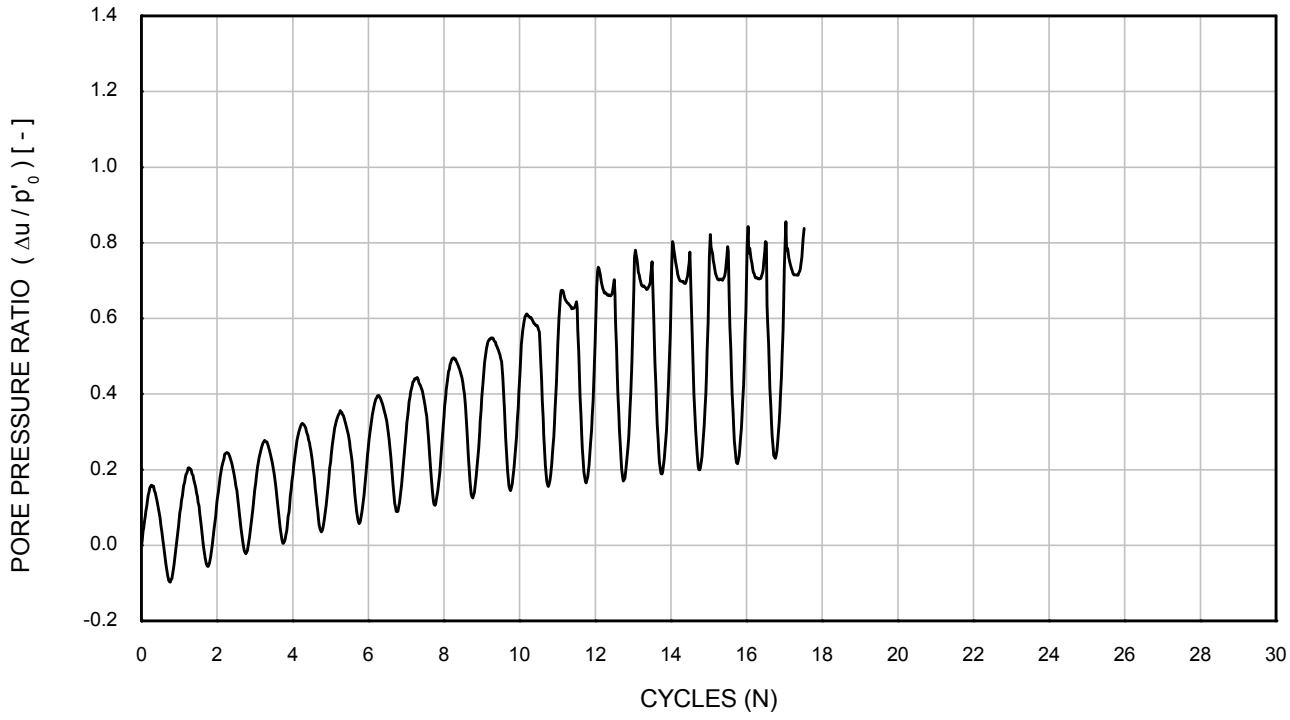




Initial σ'_r	:	22 kPa	Batch	:	1
Initial σ'_a	:	22 kPa	Sample	:	CTX_1-1
q_{av}	:	-0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	10 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

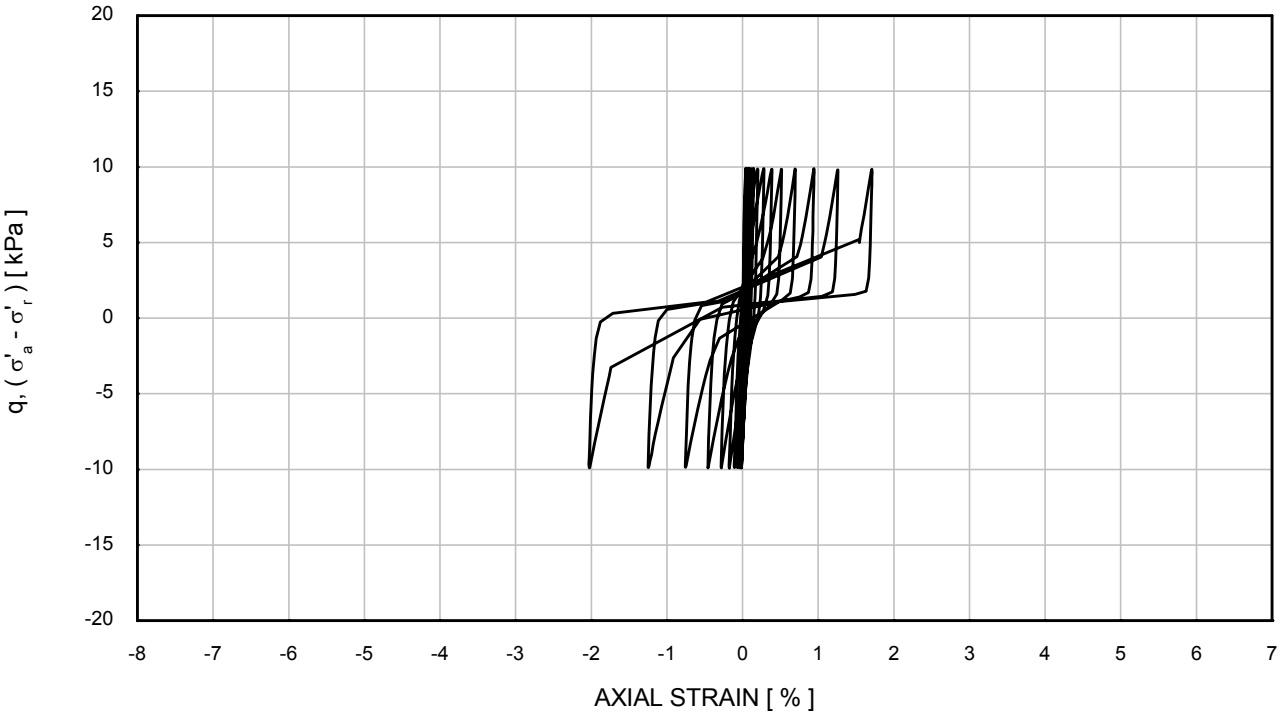
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

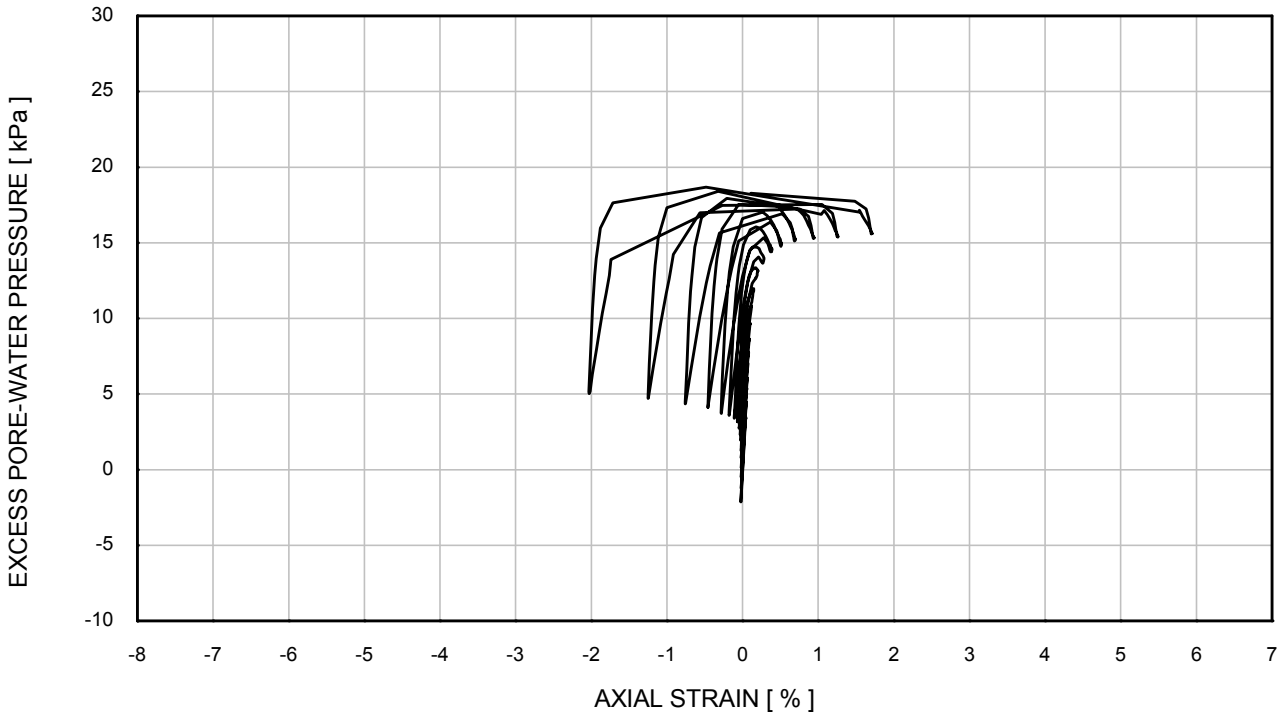




Initial σ'_r	:	22 kPa	Batch	:	1
Initial σ'_a	:	22 kPa	Sample	:	CTX_1-1
q_{av}	:	-0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	10 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

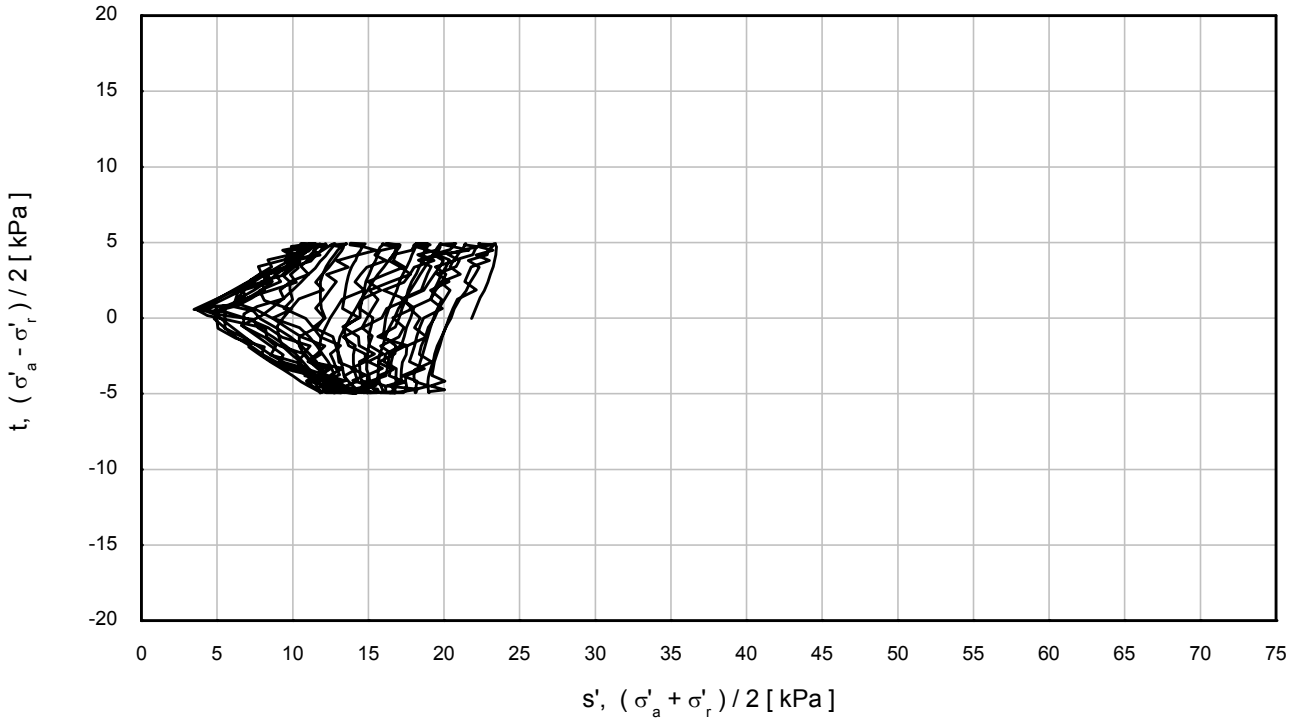
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

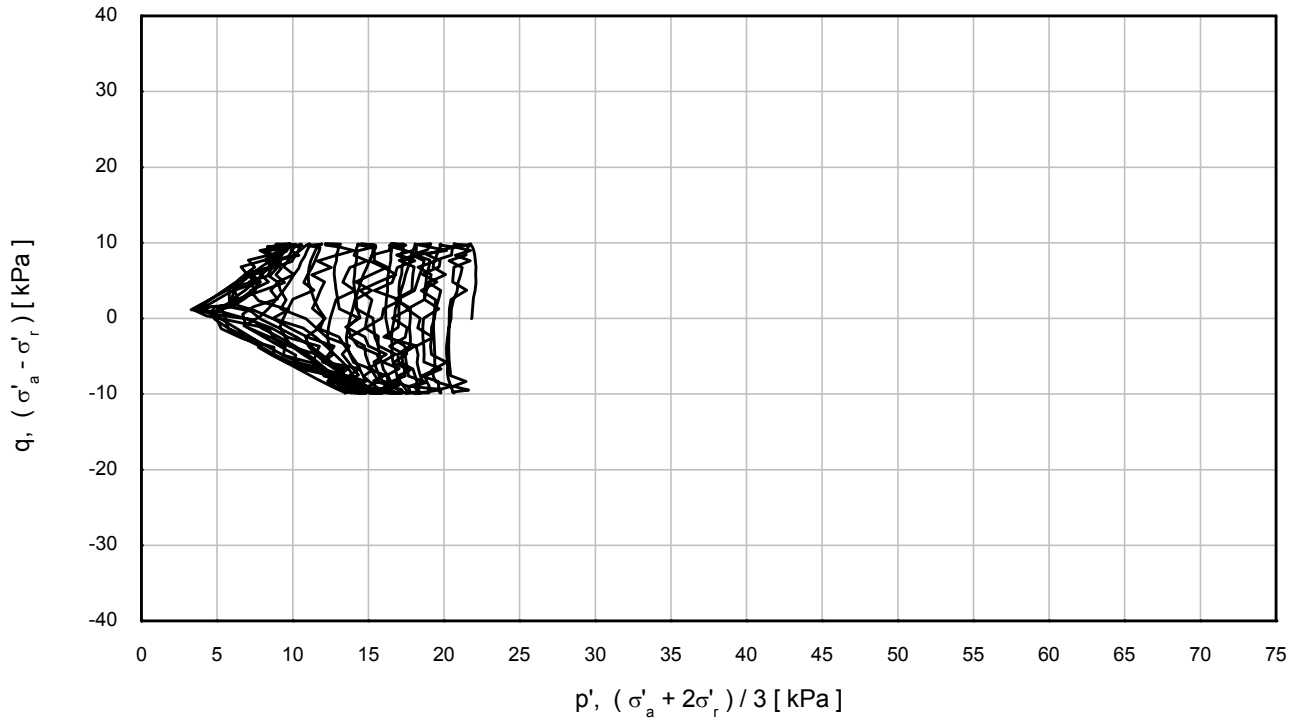




Initial σ'_r	:	22 kPa	Batch	:	1
Initial σ'_a	:	22 kPa	Sample	:	CTX_1-1
q_{av}	:	-0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	10 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

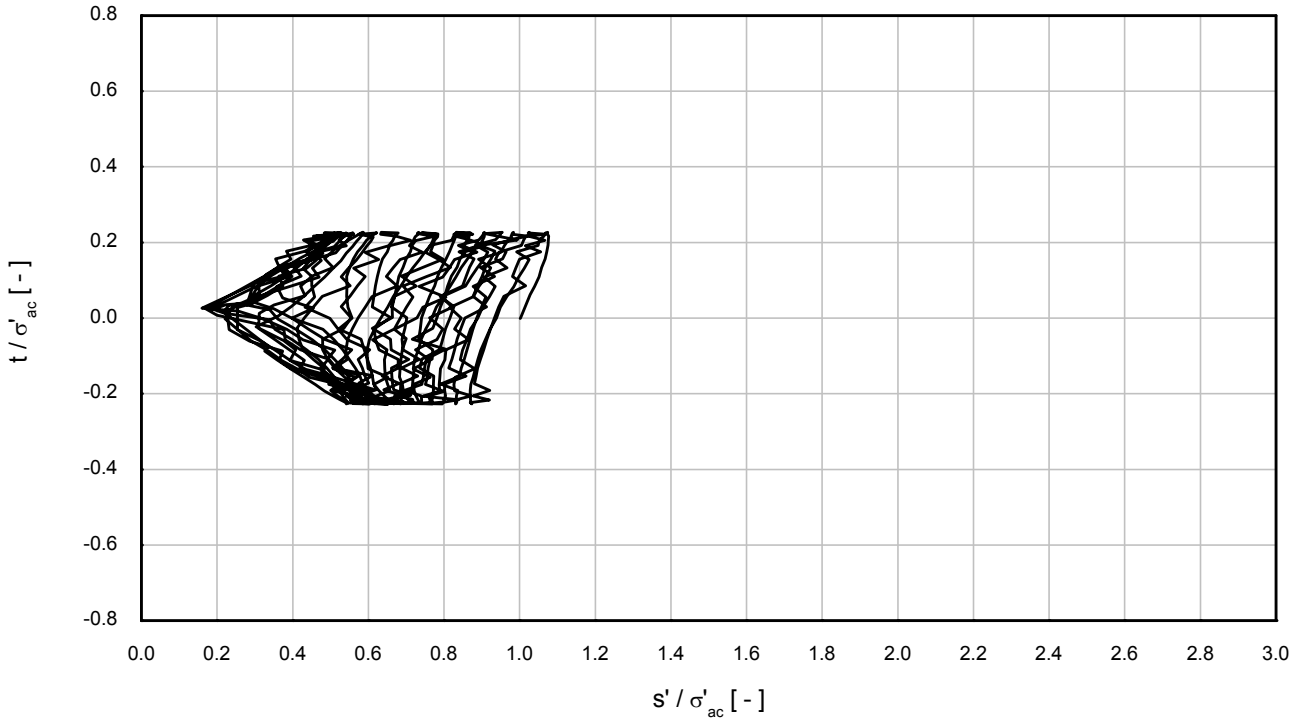
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

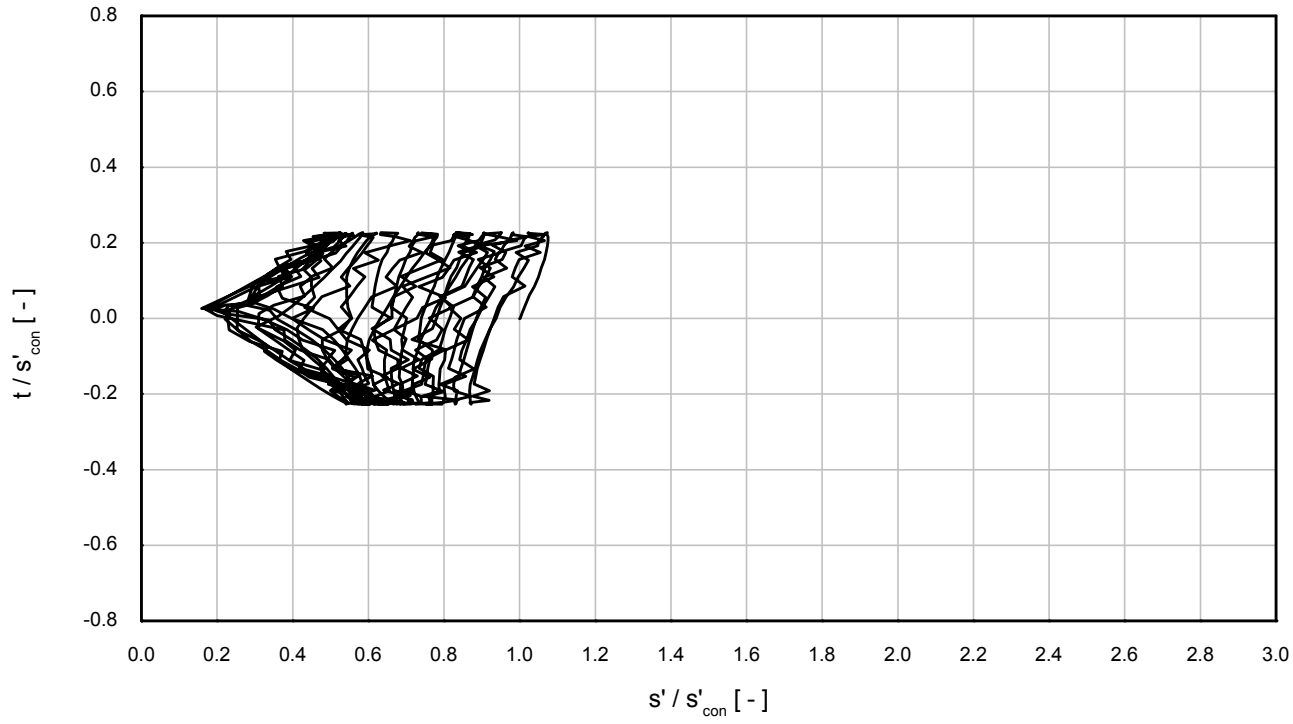




Initial σ'_r	:	22	kPa	Batch	: 1
Initial σ'_a	:	22	kPa	Sample	: CTX_1-1
q_{av}	:	-0	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	10	kPa	Test No.	: CTX05
Frequency	:	0.10	Hz		

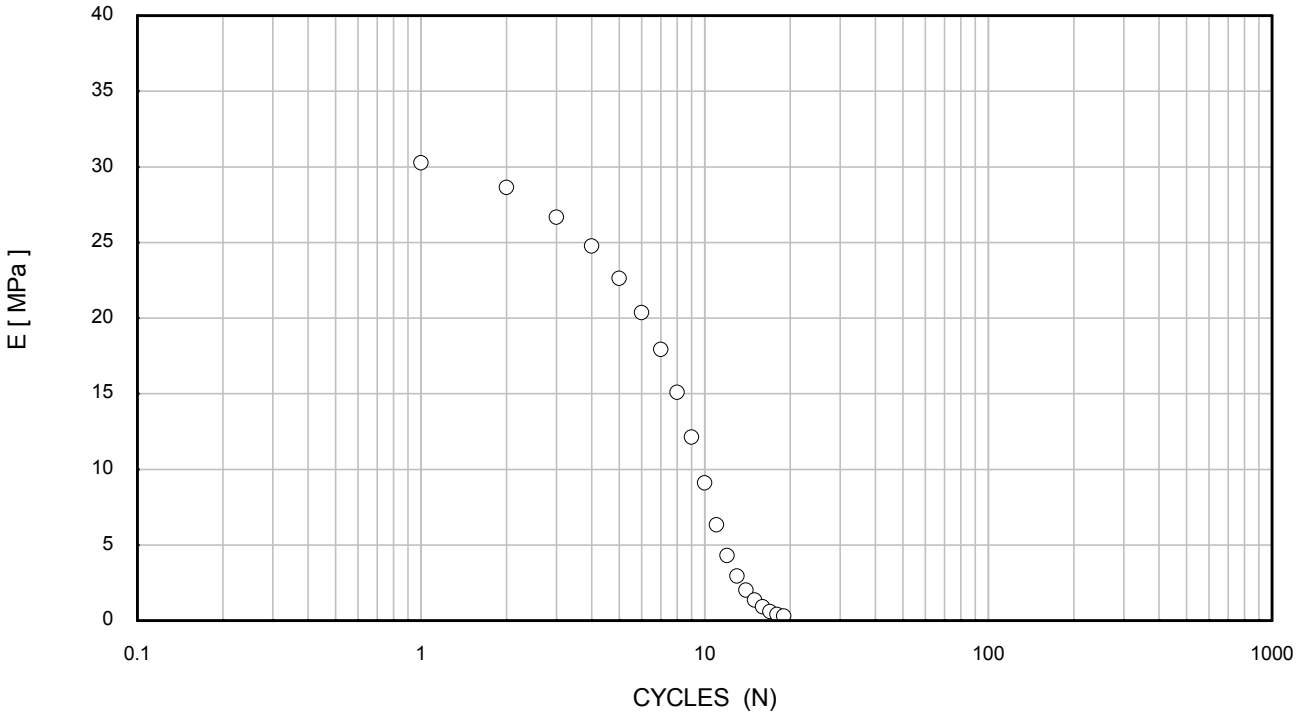
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

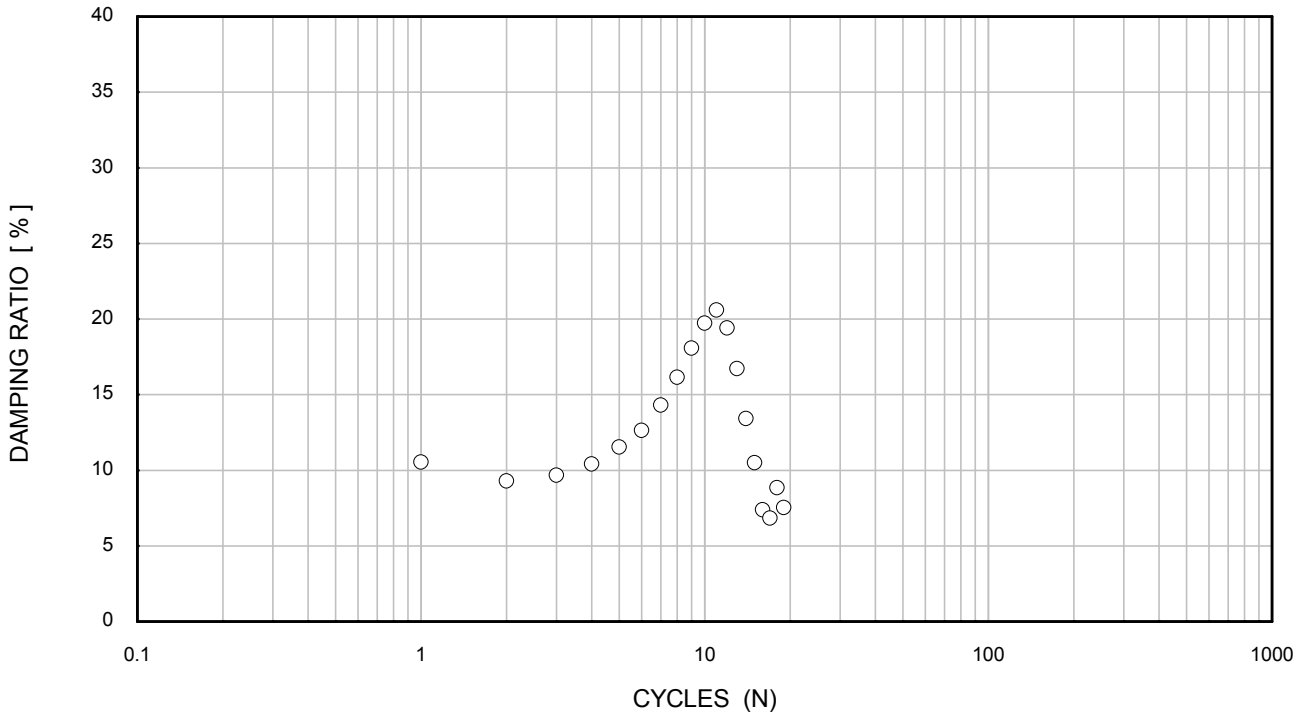




Initial σ'_r	:	22	kPa	Batch	: 1
Initial σ'_a	:	22	kPa	Sample	: CTX_1-1
q_{av}	:	-0	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	10	kPa	Test No.	: CTX05
Frequency	:	0.10	Hz		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED





Initial σ'_r	:	22 kPa	Batch	:	1
Initial σ'_a	:	22 kPa	Sample	:	CTX_1-1
q_{av}	:	-0 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	10 kPa	Test No.	:	CTX05
Frequency	:	0.10 Hz			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	03/01/2017
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	140.0
Water content	[%]	11.2
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.624
Degree of saturation	[%]	47
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH01_CTX06
Processed by Date	MSR 12/01/2017
Checked by Date	JLS 13/01/2017
Approved by Date	AR 13/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit:	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1000
Base PWP	[kPa]	988
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1008
Back pressure	[kPa]	998
Base PWP	[kPa]	988
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.08
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1008
Back pressure	[kPa]	988
Base PWP	[kPa]	988
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	26
Deviator stress	[kPa]	6
Volumetric strain	[%]	0.01
External axial strain	[%]	0.97
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	40
Mean q_{av}	[kPa]	6
Mean q_{cy}	[kPa]	4
Frequency	[Hz]	0.10
Number of cycles applied (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.99
External ε_{cy} at N_f	[%]	0.01
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	0
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.98	0.01	40	-	0.00	-
2	0.98	0.01	39	-	0.00	-
5	0.98	0.01	40	-	0.00	-
10	0.98	0.01	41	-	0.00	-
20	0.98	0.01	40	-	0.00	-
30	0.98	0.01	39	-	0.00	-
40	0.98	0.01	40	-	0.00	-
50	0.98	0.01	39	-	0.00	-
100	0.98	0.01	42	-	0.00	-
500	0.99	0.01	43	-	0.00	-
1000	0.99	0.01	44	-	0.00	-
1500	0.99	0.01	43	-	0.00	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1008
Back pressure	[kPa]	988
Base PWP	[kPa]	989
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	19
Effective axial pressure	[kPa]	27
Deviator stress	[kPa]	8
Volumetric strain	[%]	-0.02
External axial strain	[%]	1.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	40
Mean q_{av}	[kPa]	8
Mean q_{cy}	[kPa]	5
Frequency	[Hz]	0.10
Number of cycles applied (N_f)	[-]	400
External ε_{av} at N_f	[%]	1.03
External ε_{cy} at N_f	[%]	0.01
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	1
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	1.01	0.01	47	-	0.00	-
2	1.01	0.01	47	-	0.00	-
5	1.01	0.01	47	-	0.00	-
10	1.01	0.01	46	-	0.00	-
20	1.02	0.01	48	-	0.00	-
30	1.02	0.01	48	-	0.00	-
40	1.02	0.01	48	-	0.00	-
50	1.02	0.01	48	-	0.00	-
100	1.02	0.01	47	-	0.00	-
400	1.03	0.01	47	-	0.00	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	19
Initial effective axial pressure	[kPa]	26
Rate of strain	[%/hour]	1.01
At peak deviator stress		
Corrected deviator stress	[kPa]	2380
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	14.10
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-973
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	993
Effective axial pressure	[kPa]	3373
Principal effective stress ratio	[-]	3.40
ε_{50}	[%]	5.95
Secant modulus (E_{50}) at ε_{50}	[kPa]	24088
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	272
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.07
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-62
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	82
Effective axial pressure	[kPa]	354
Principal effective stress ratio	[-]	4.32
At 15% external axial strain		
Corrected deviator stress	[kPa]	2373
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	14.96
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-980
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	999
Effective axial pressure	[kPa]	3372
Principal effective stress ratio	[-]	3.37

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





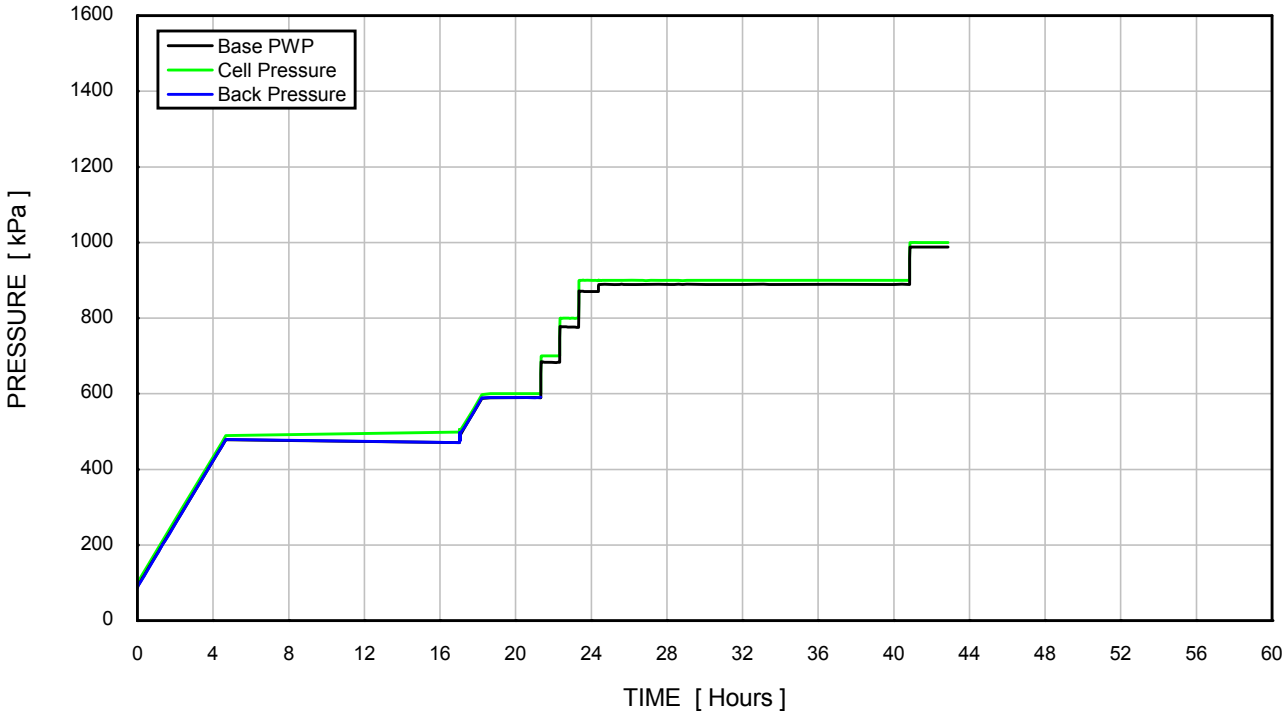
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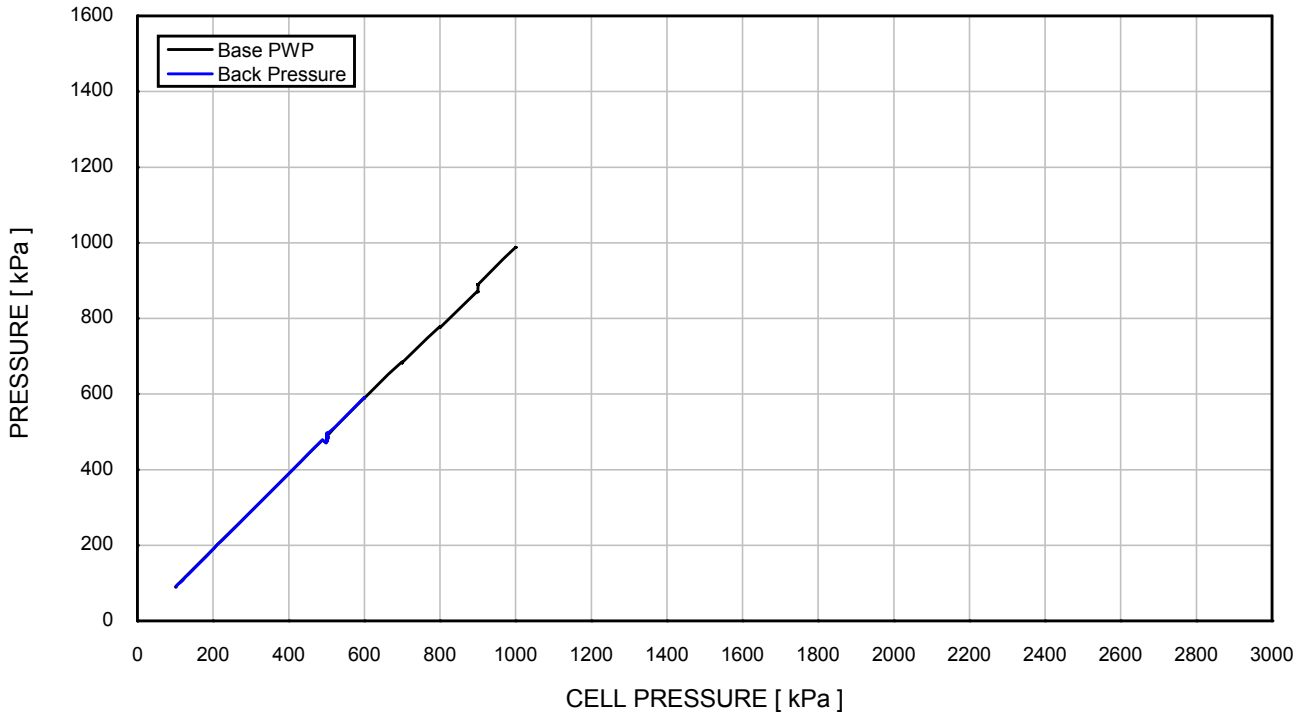
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63

TEST IDENTIFICATION

Batch	1
Sample	CTX_1-6
Unit	Unit A (Southern Bight)
Test number	CTX06

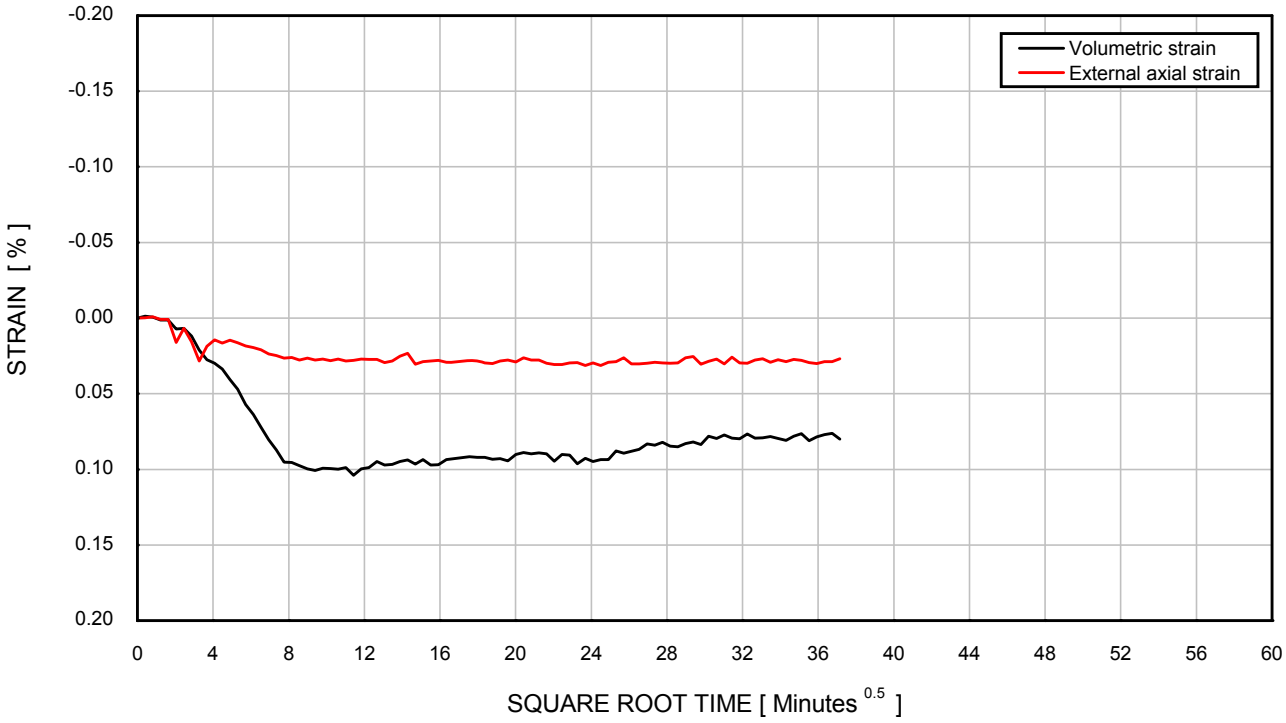
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

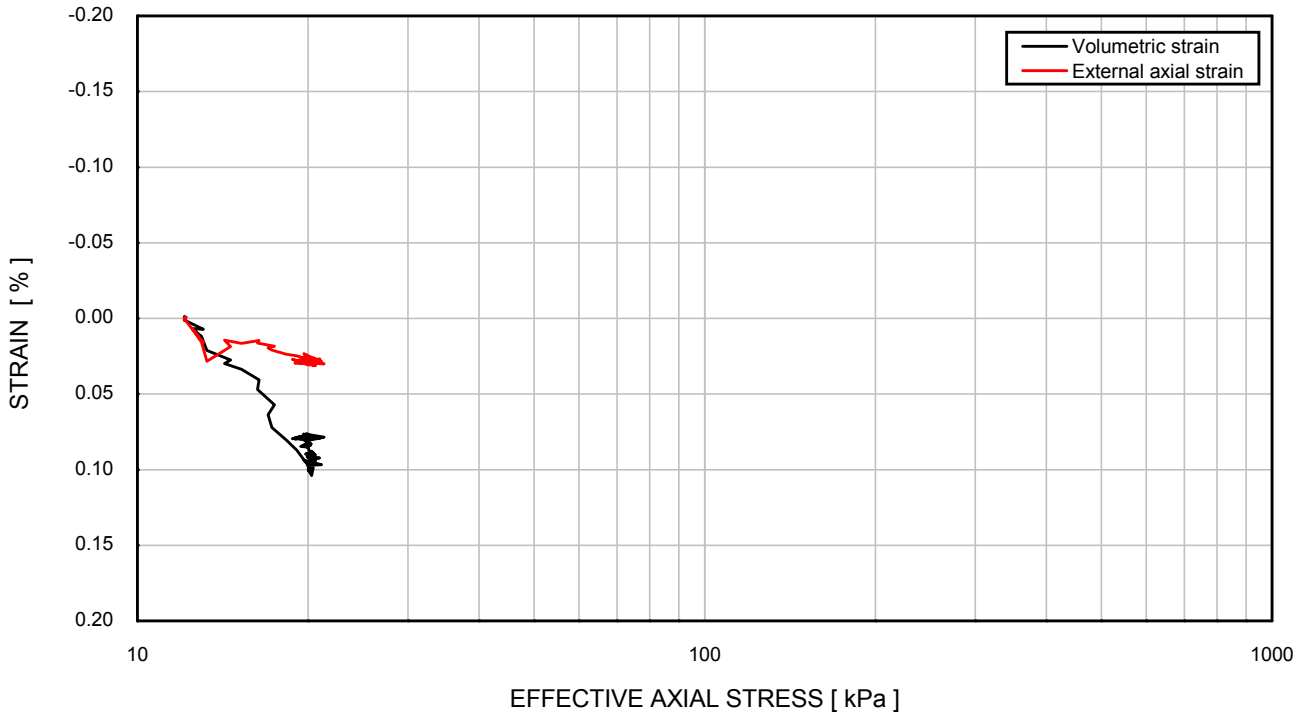




B value	:	0.99			
Initial σ'_r	:	13	kPa	Batch	: 1
Initial σ'_a	:	13	kPa	Sample	: CTX_1-6
Final σ'_r	:	12	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	12	kPa	Test No.	: CTX06

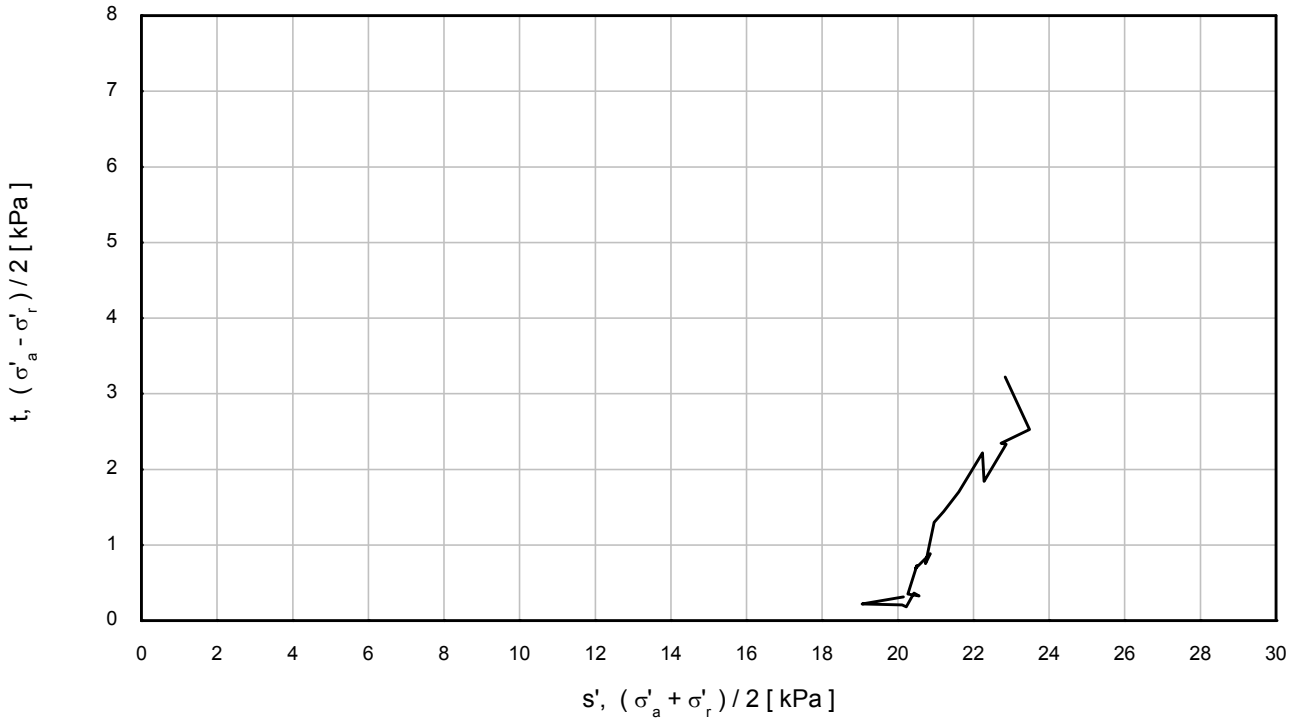
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

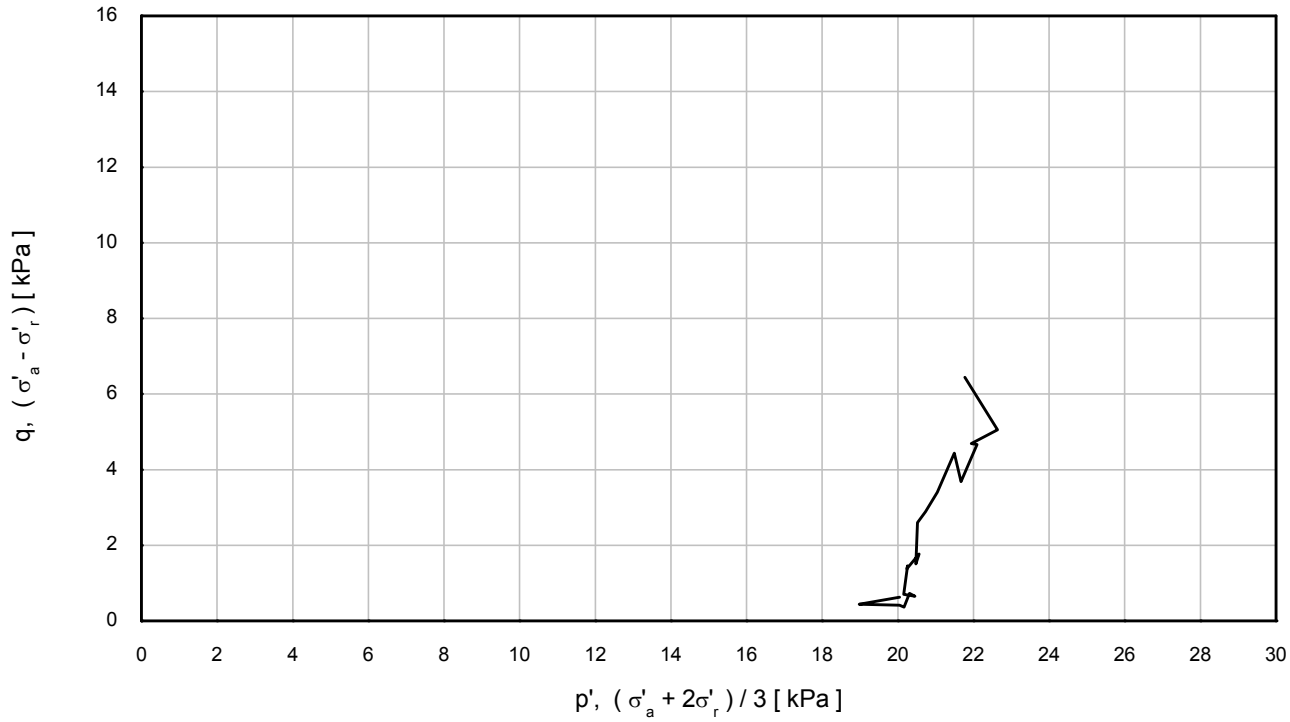




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	20 kPa	Sample	:	CTX_1-6
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX06

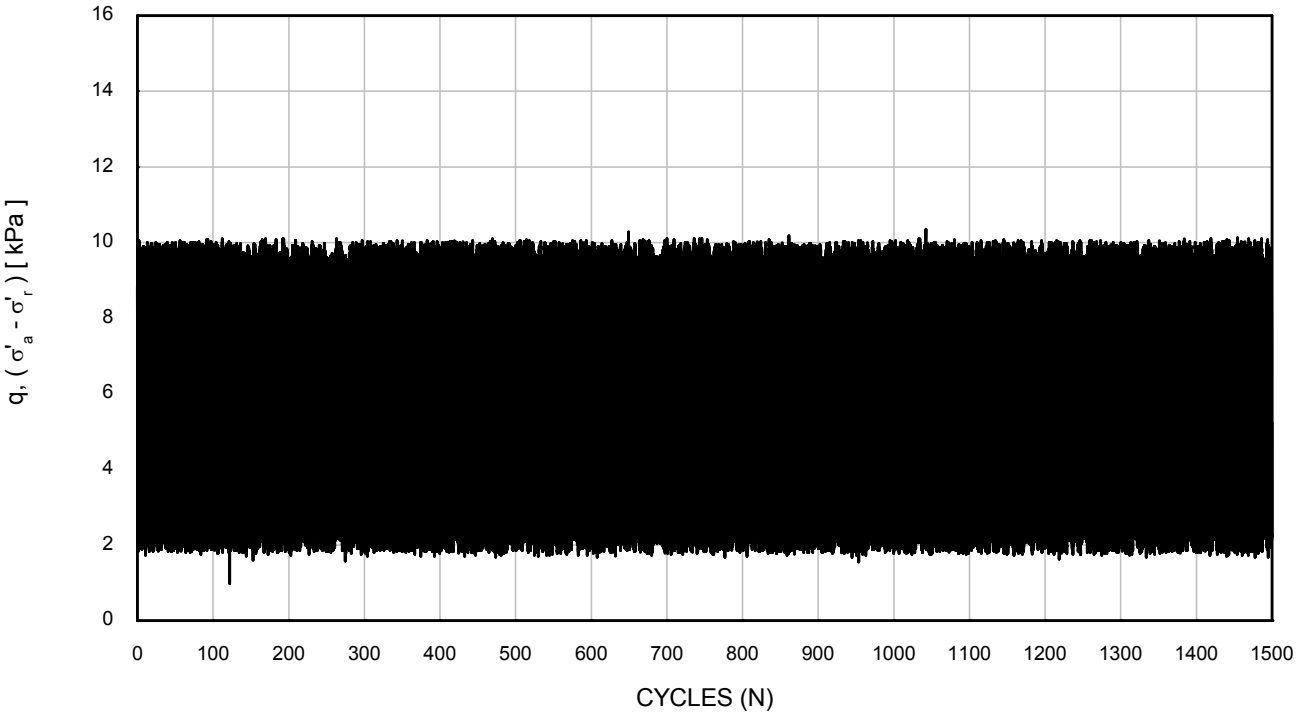
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

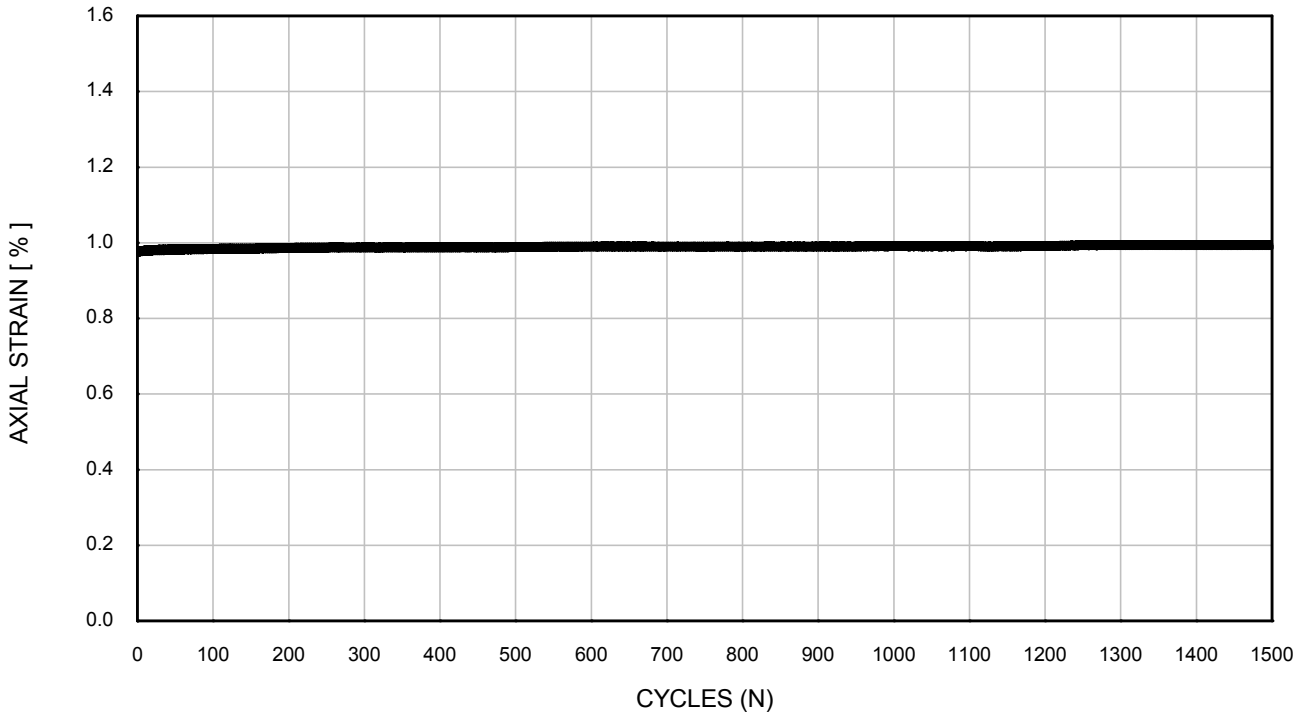




σ'_{rc}	:	20 kPa	Batch	:	1
σ'_{ac}	:	26 kPa	Sample	:	CTX_1-6
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX06

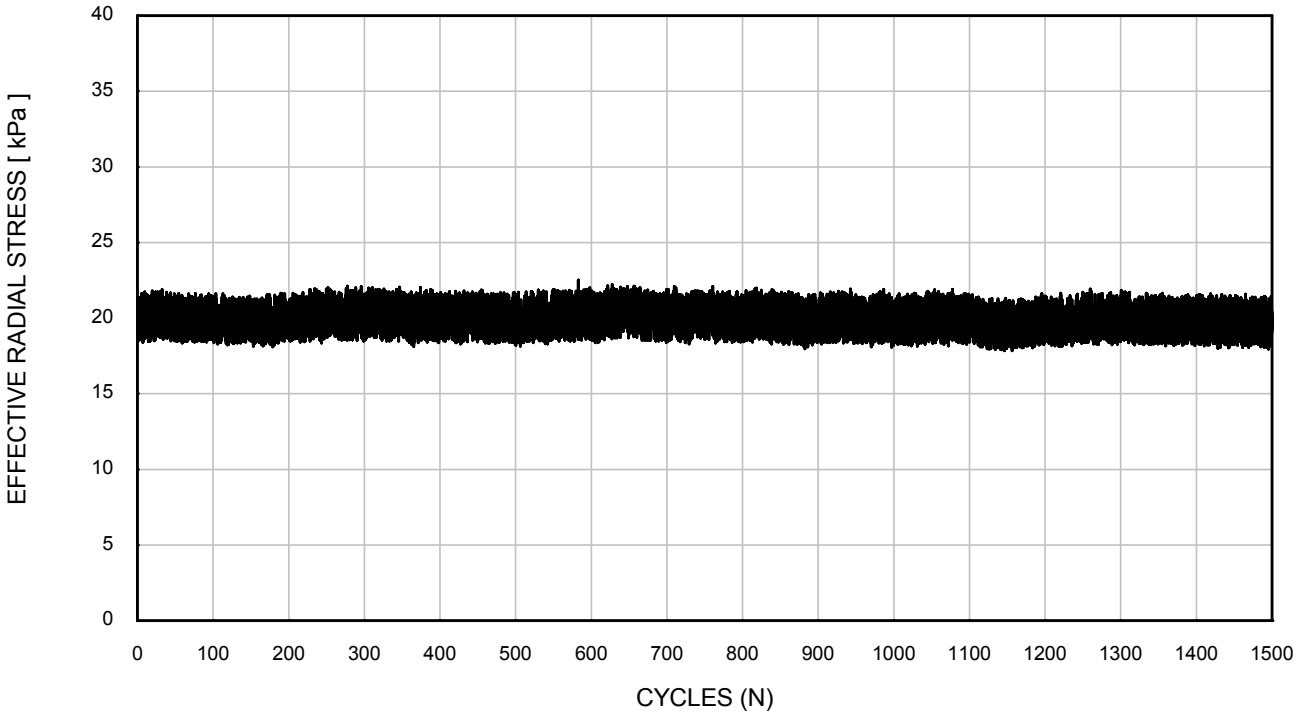
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

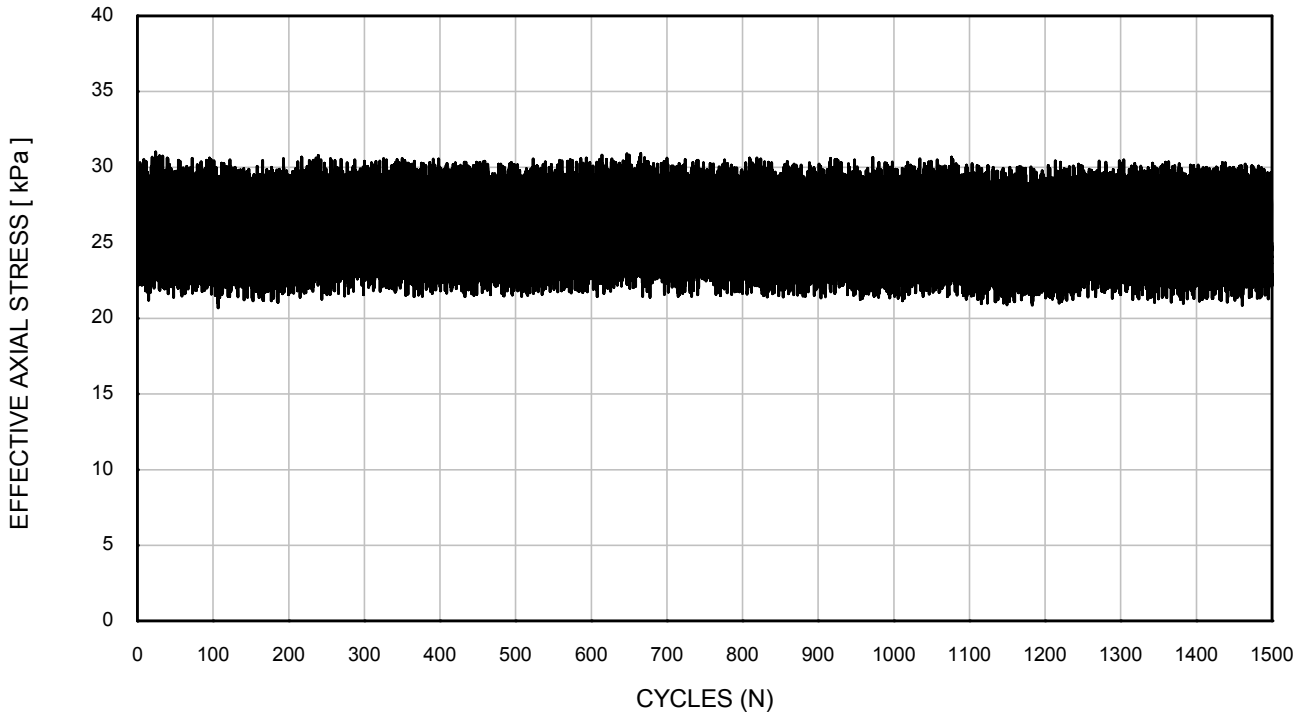




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{av}	:	6 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	4 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

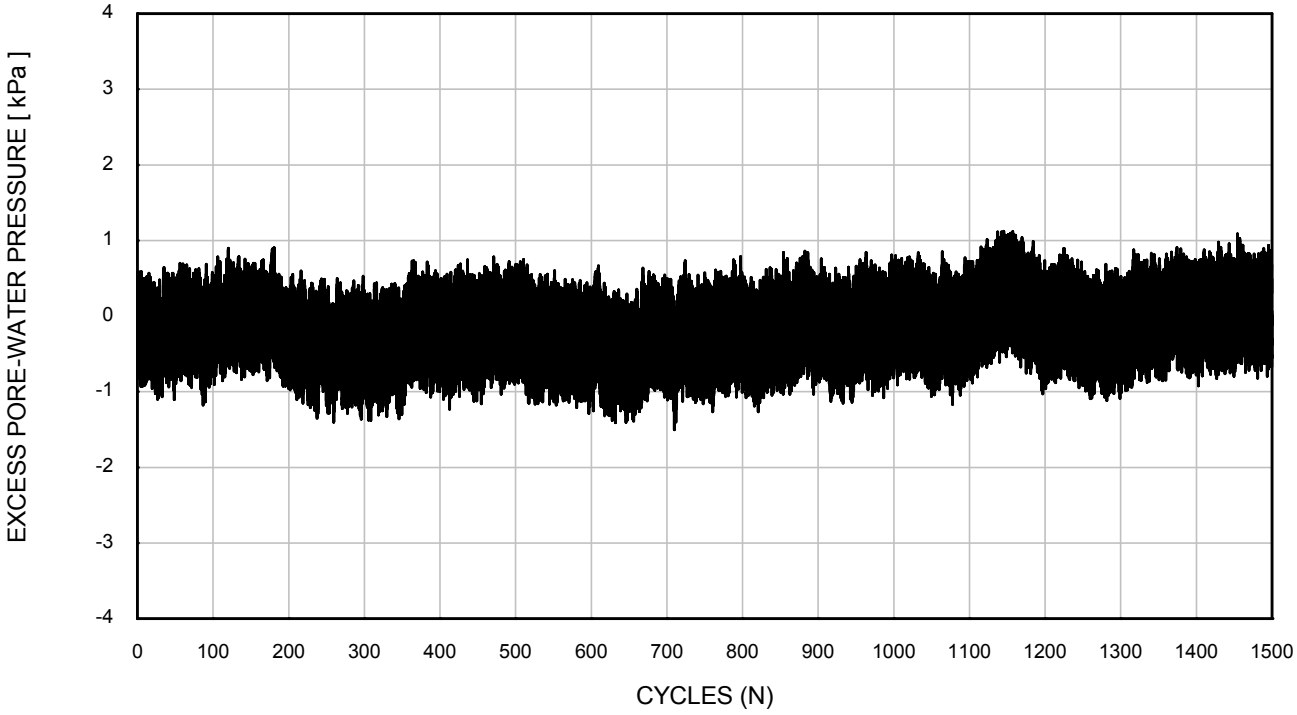
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

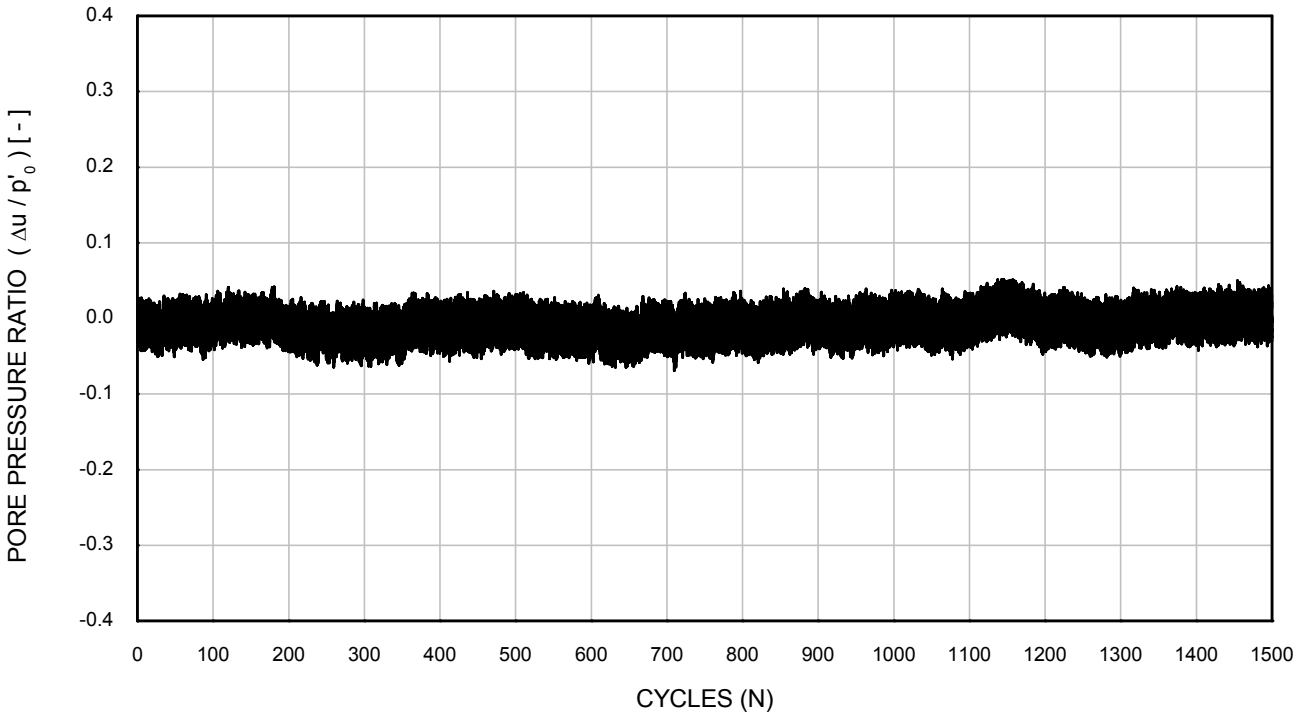




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{av}	:	6 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	4 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

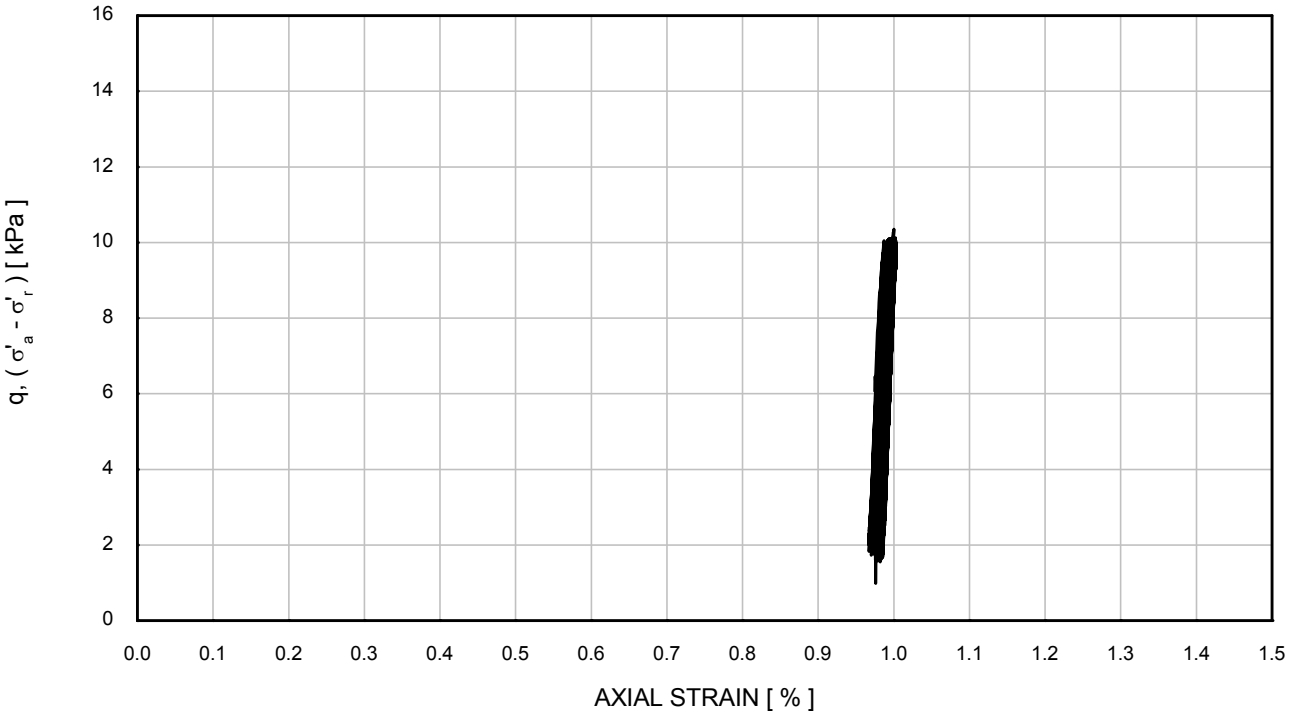
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

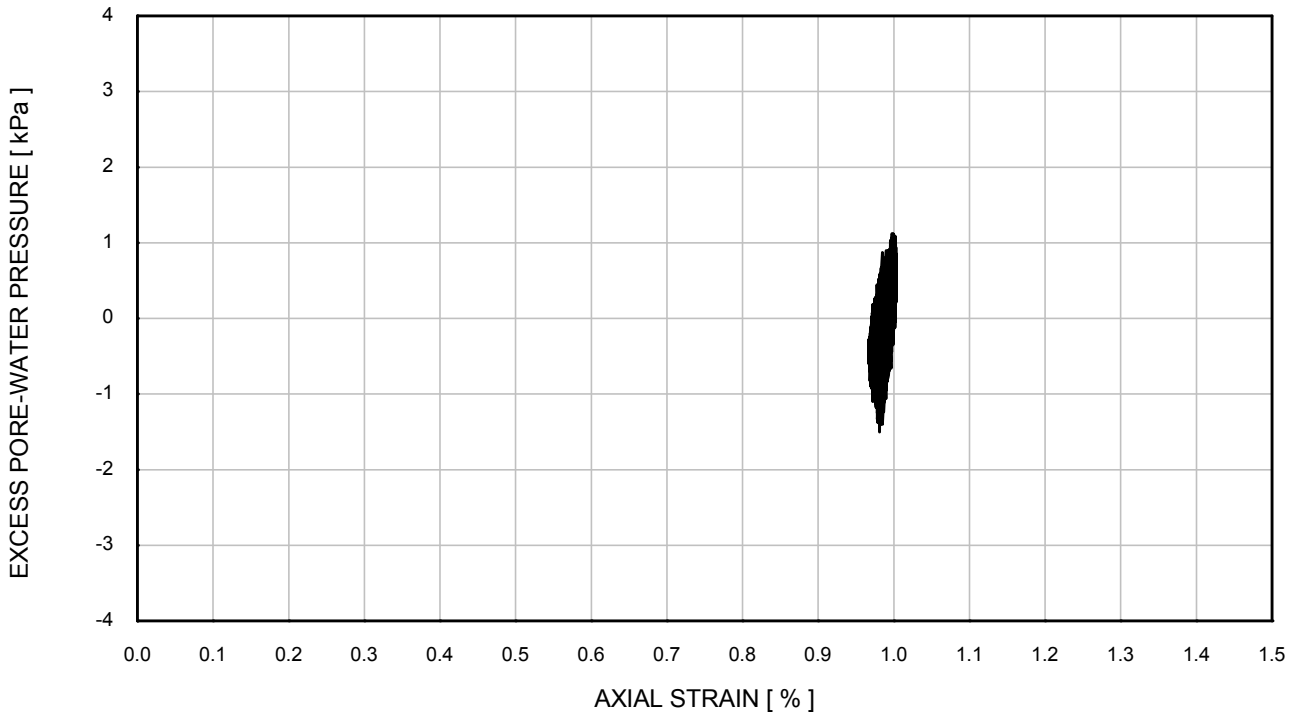




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{av}	:	6 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	4 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

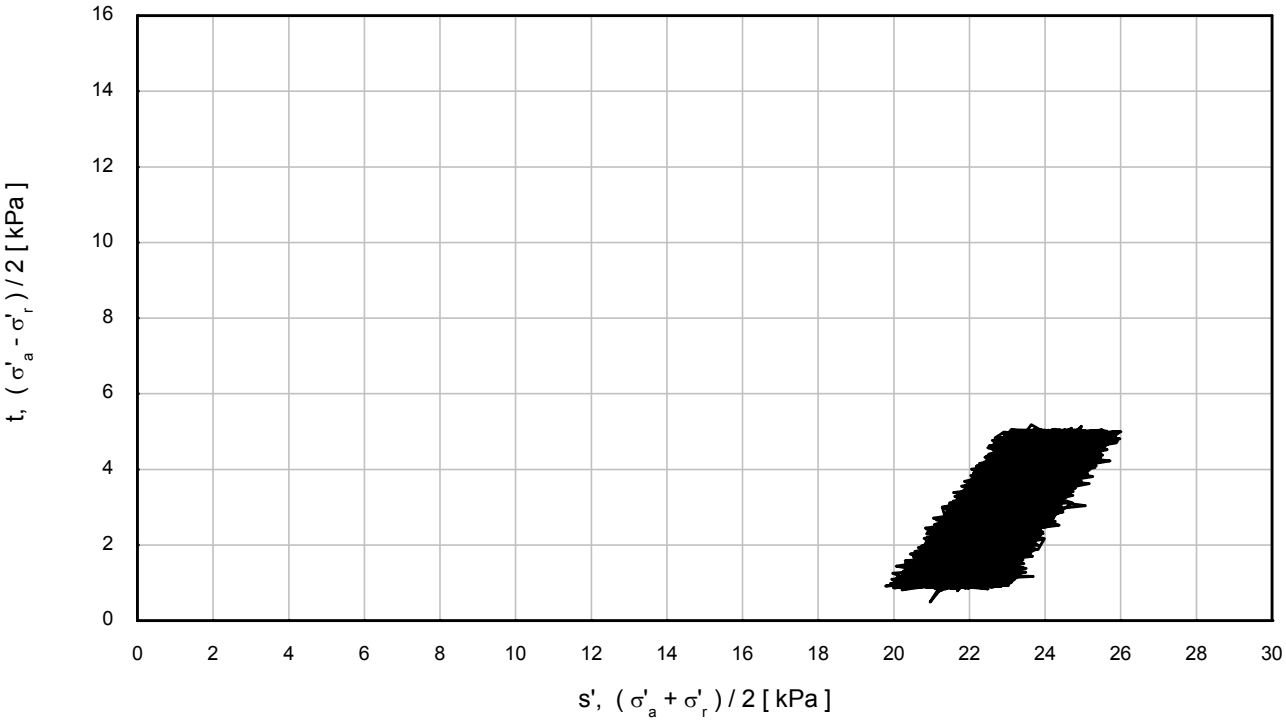
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

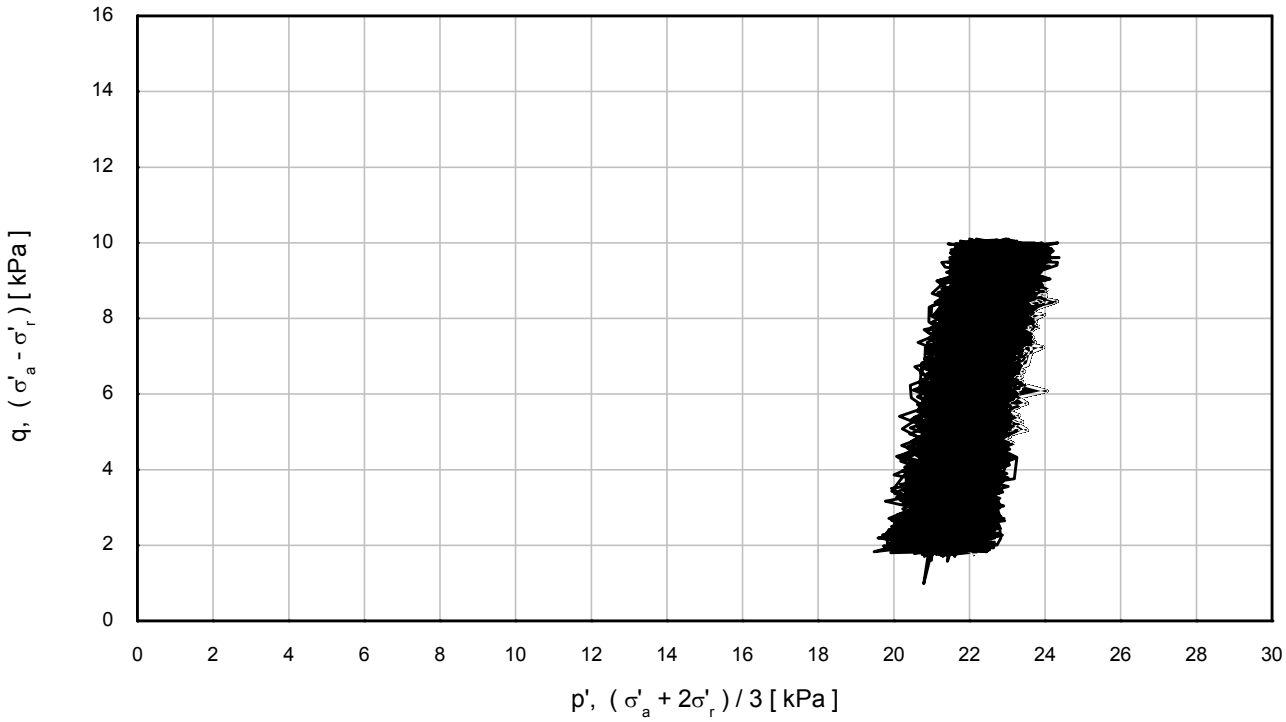




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{av}	:	6 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	4 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

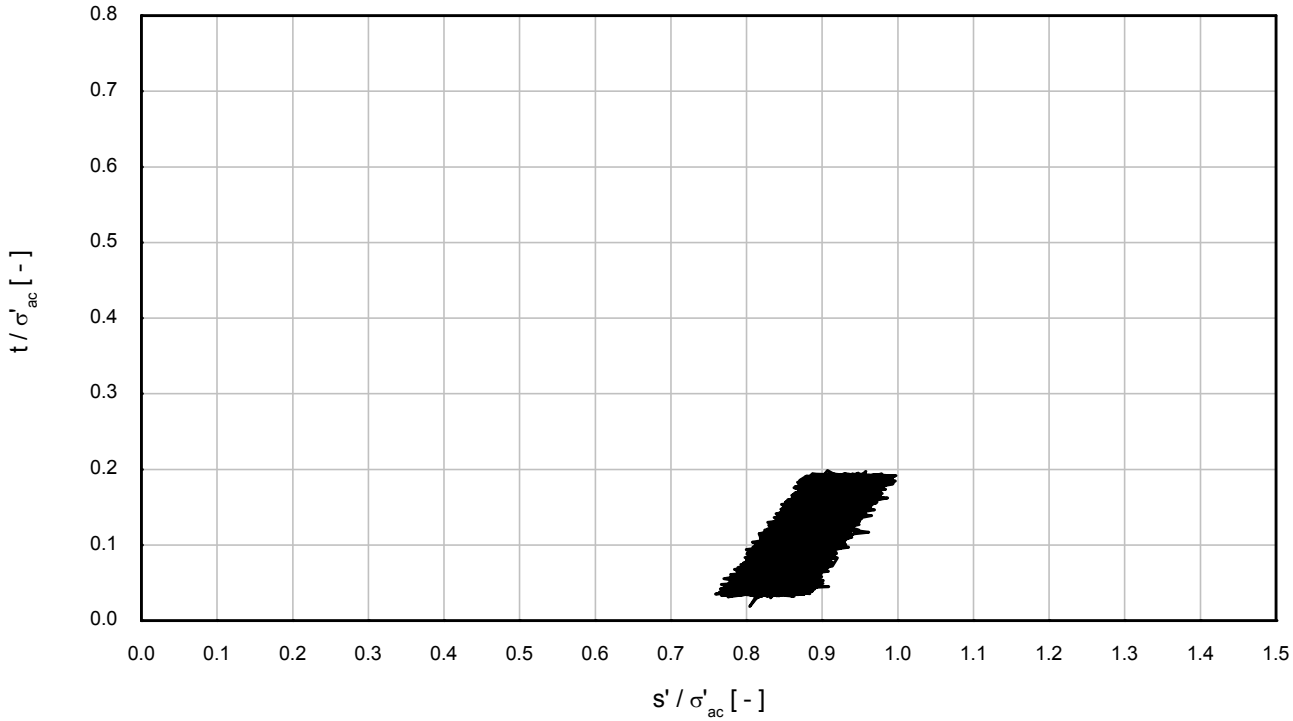
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

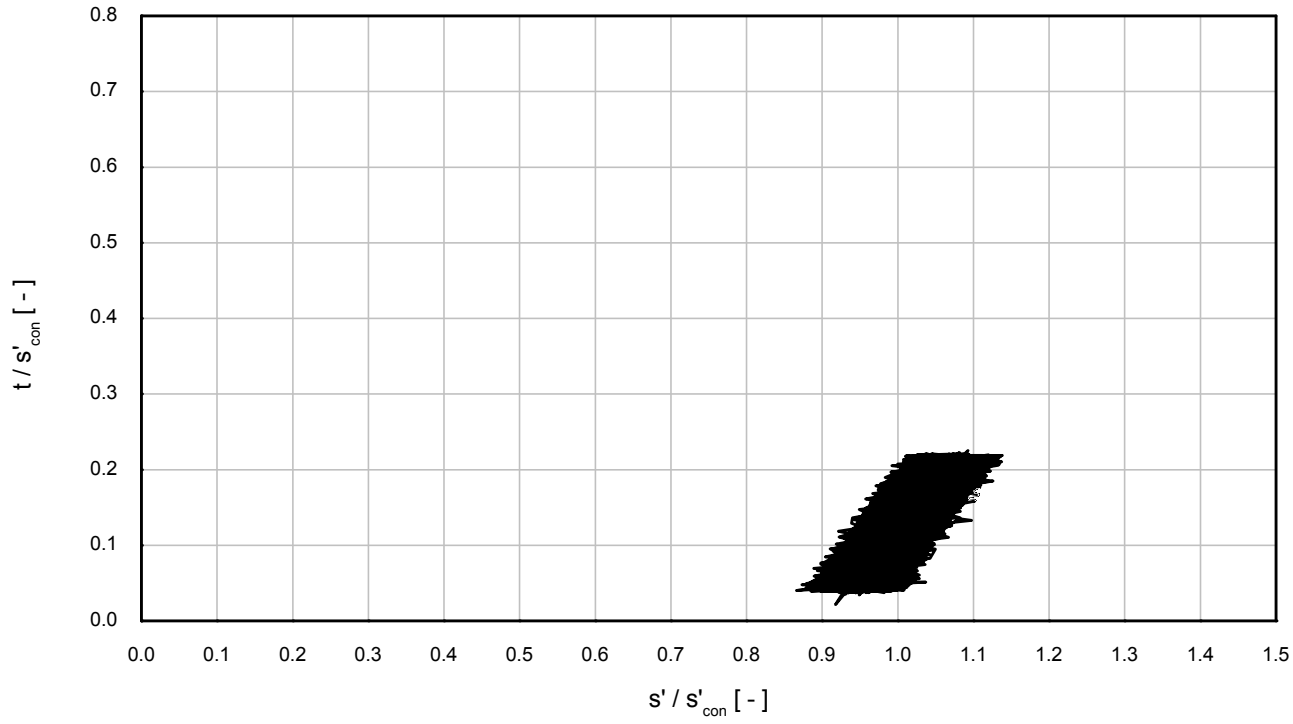




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	26	kPa	Sample	: CTX_1-6
q_{av}	:	6	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	4	kPa	Test No.	: CTX06
Frequency	:	0.10	Hz		

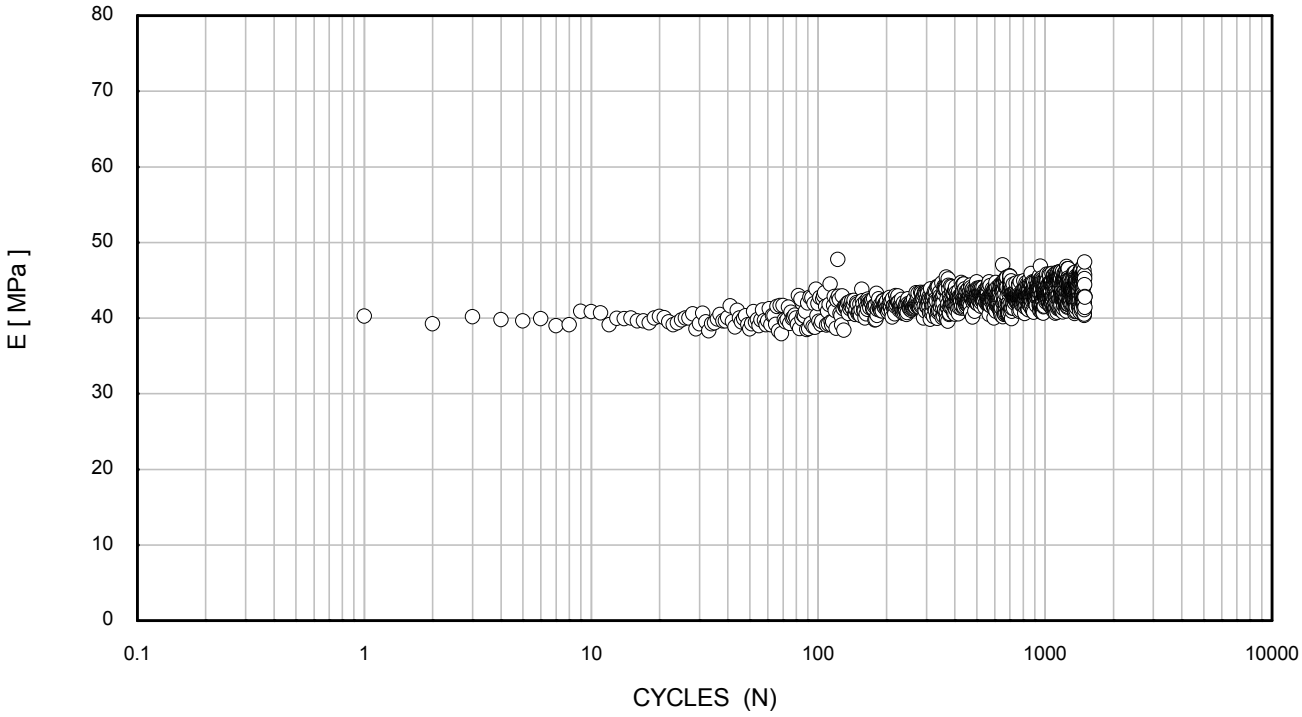
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

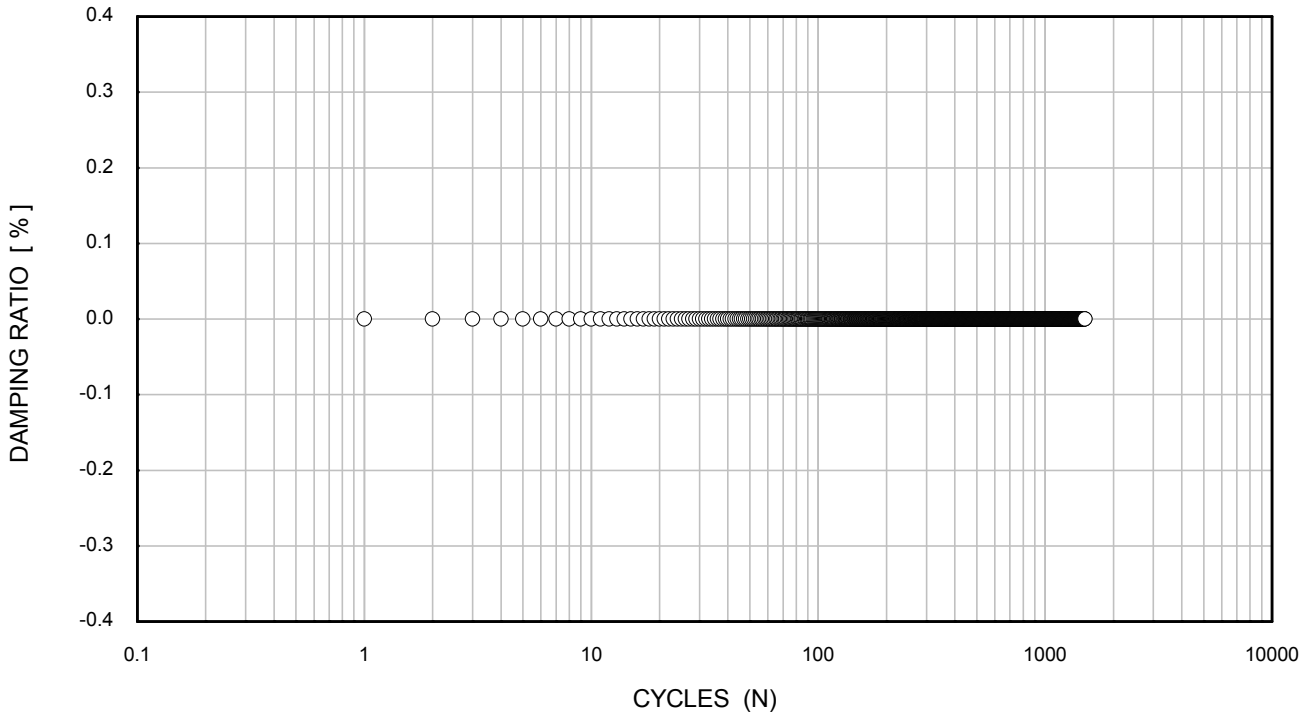




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	26	kPa	Sample	: CTX_1-6
q_{av}	:	6	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	4	kPa	Test No.	: CTX06
Frequency	:	0.10	Hz		

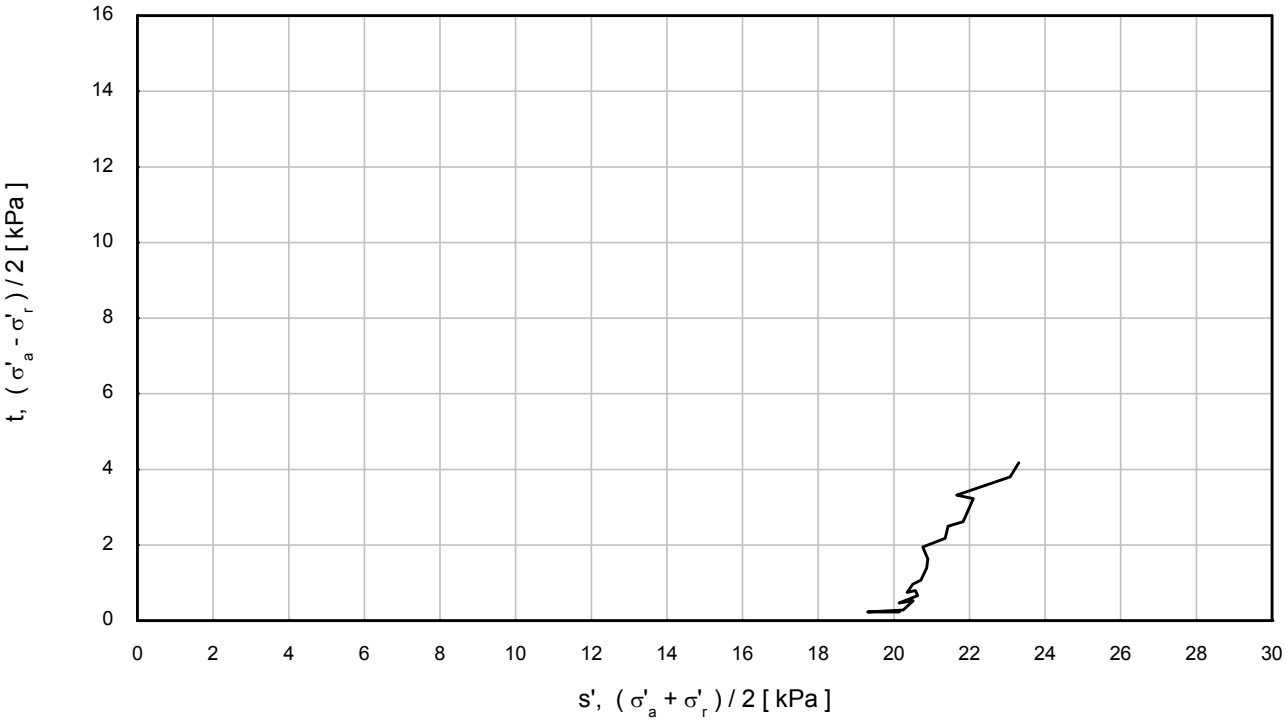
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

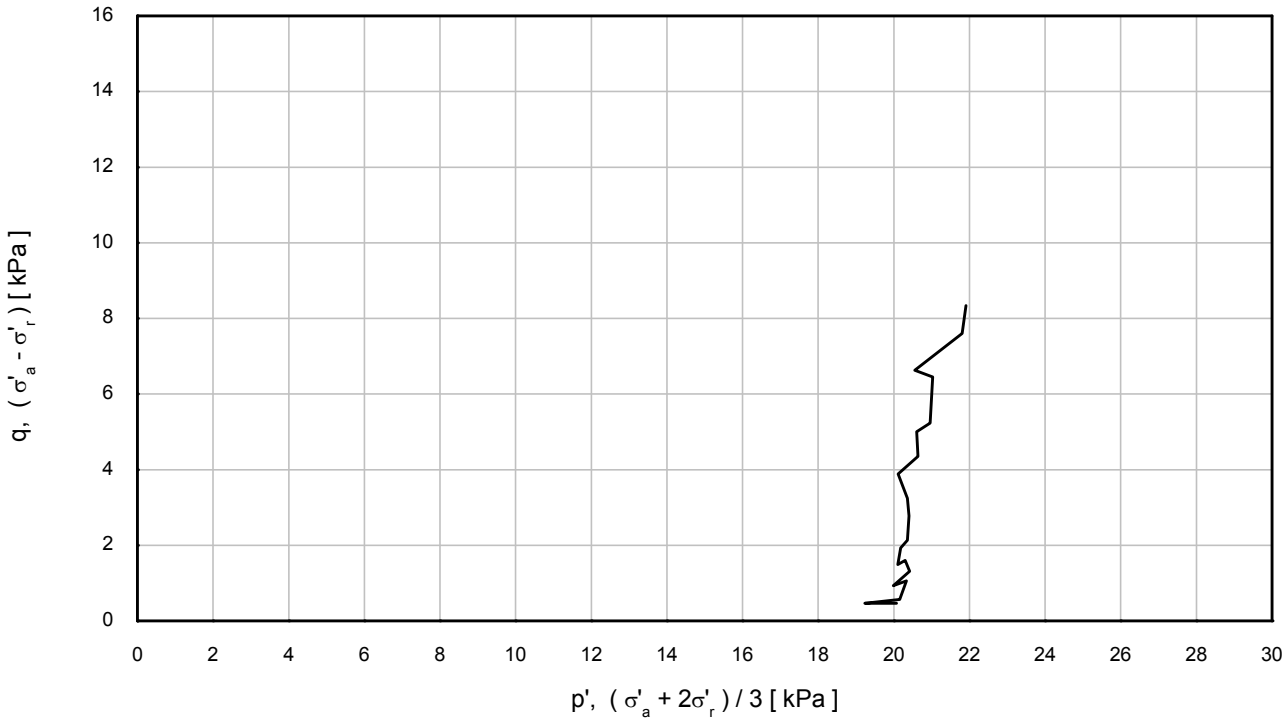




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{av}	:	6 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	4 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

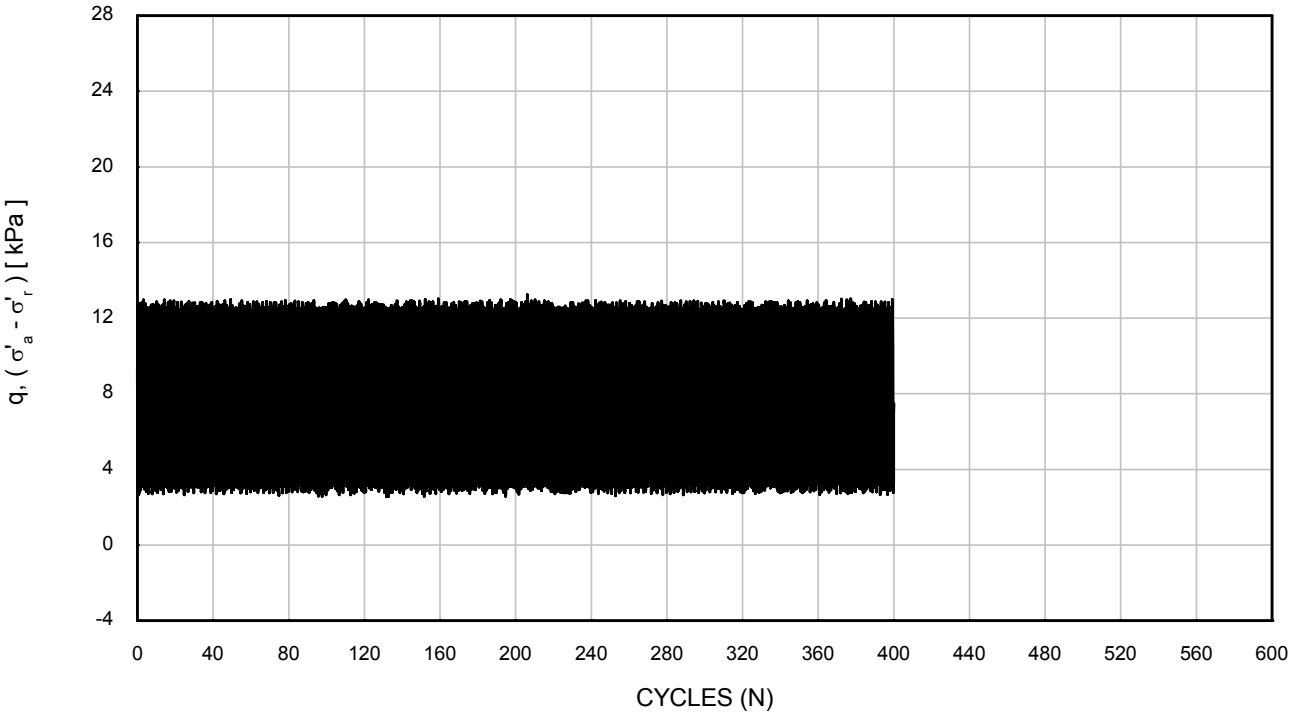
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

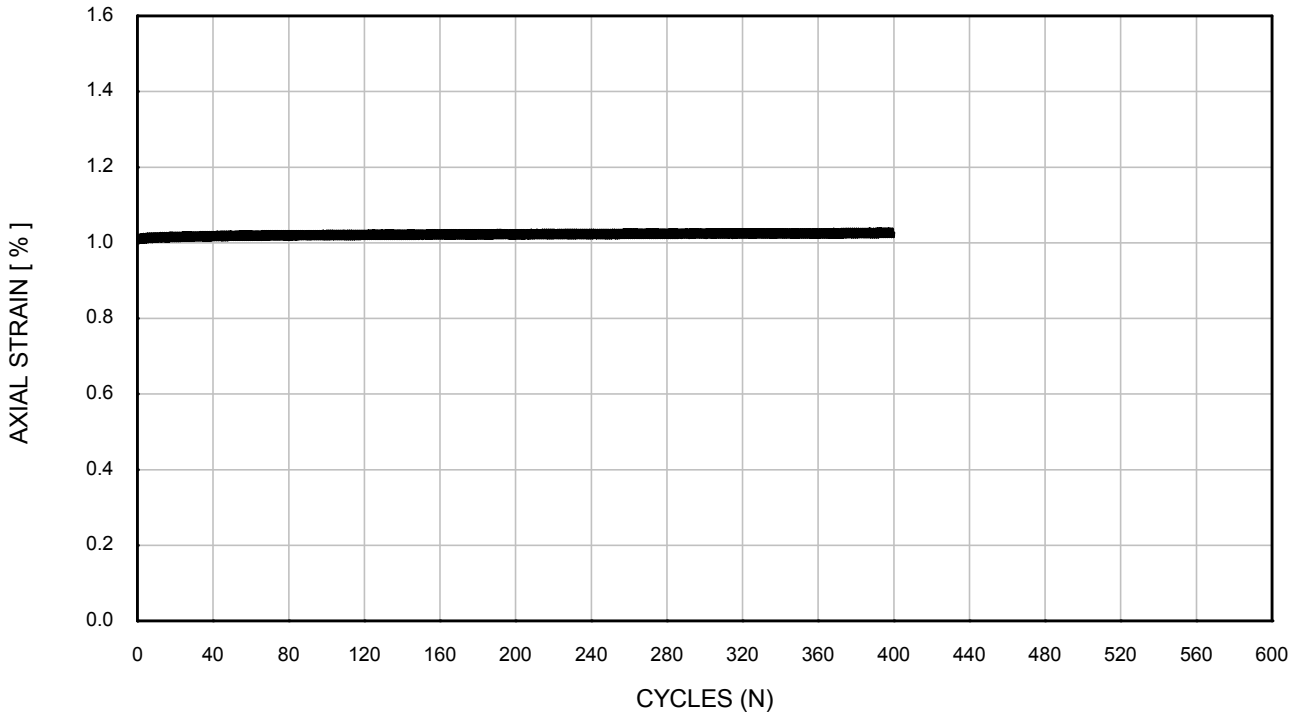




σ'_{rc}	:	19 kPa	Batch	:	1
σ'_{ac}	:	27 kPa	Sample	:	CTX_1-6
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX06

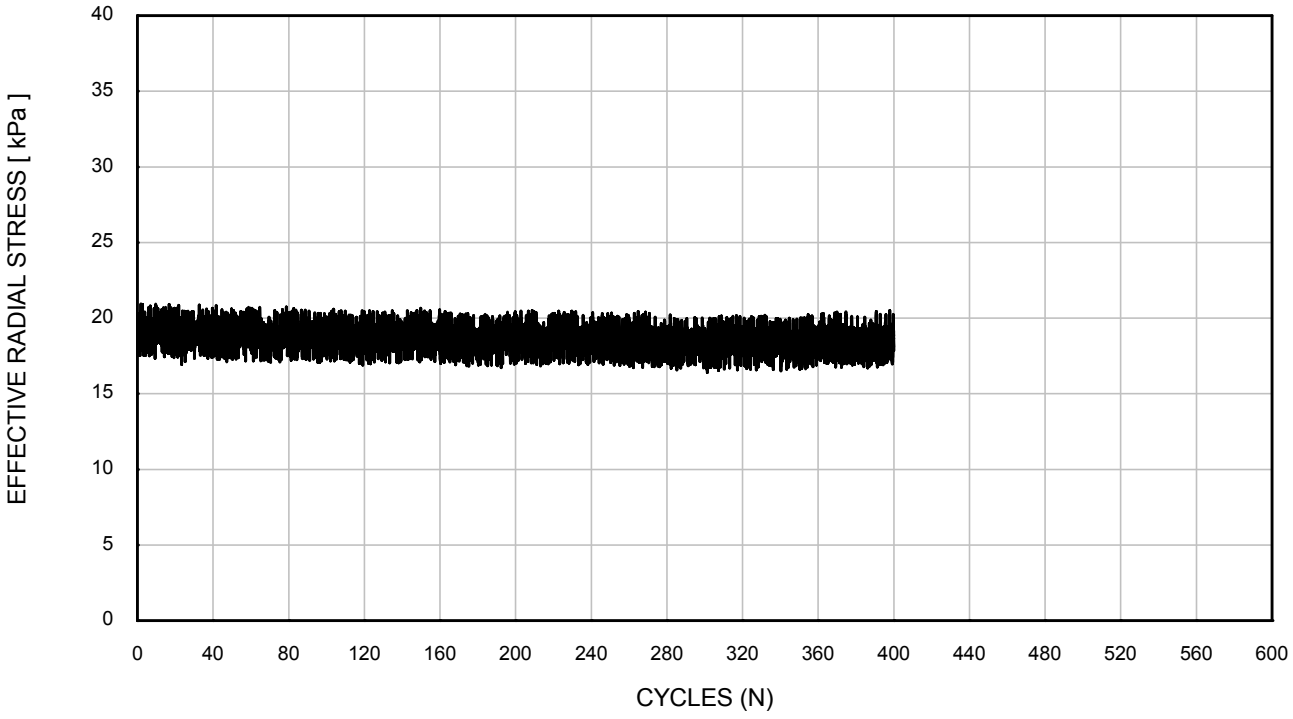
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

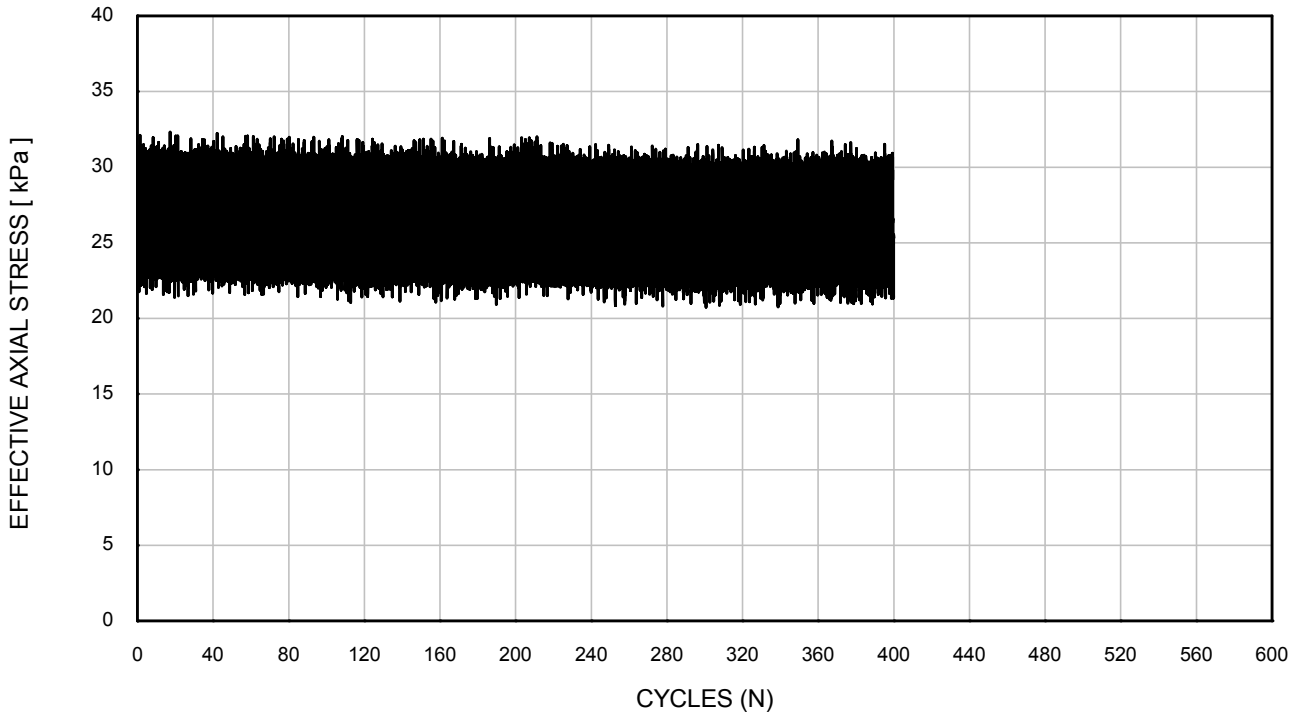




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	28 kPa	Sample	:	CTX_1-6
q_{av}	:	8 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	5 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

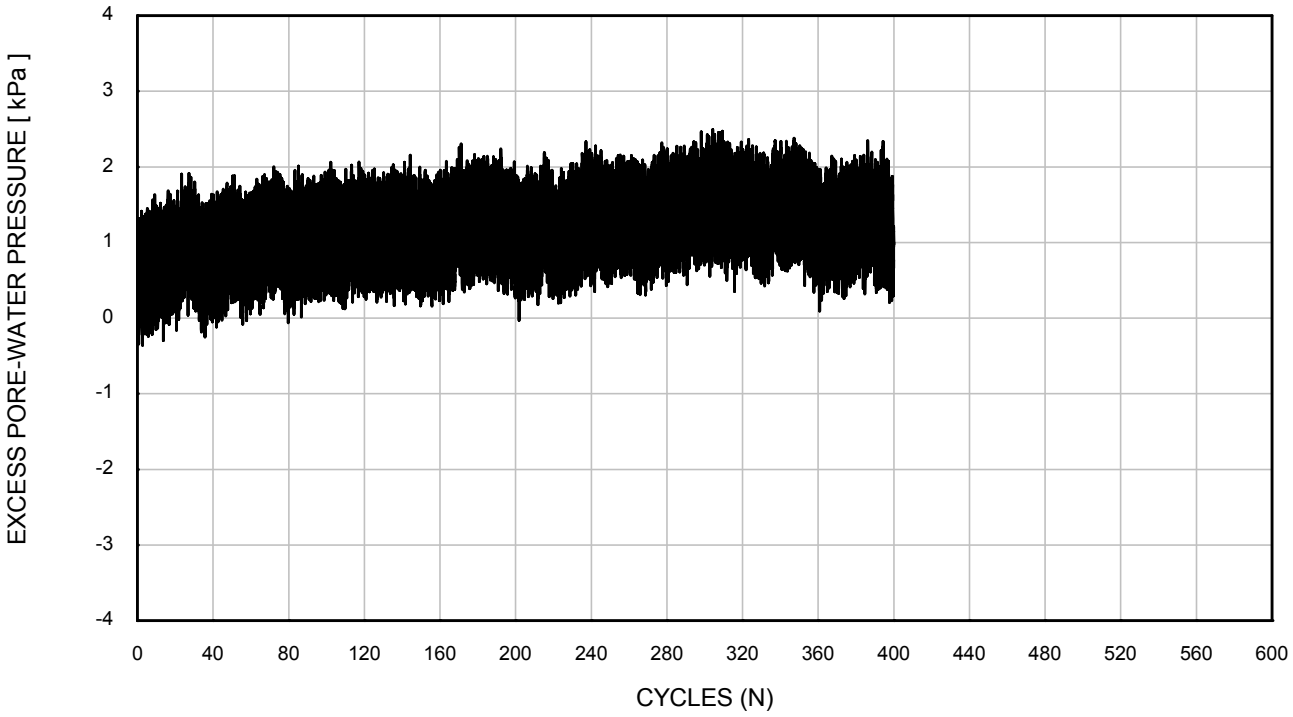
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

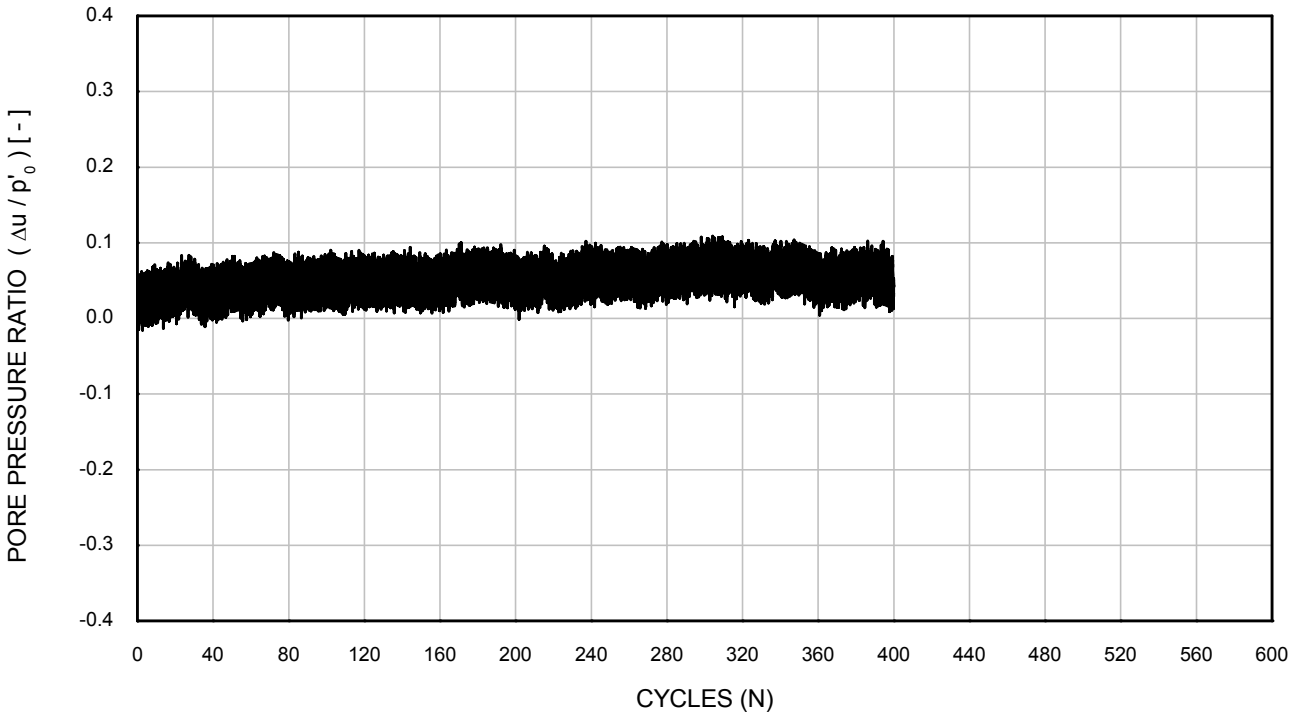




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	28 kPa	Sample	:	CTX_1-6
q_{av}	:	8 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	5 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

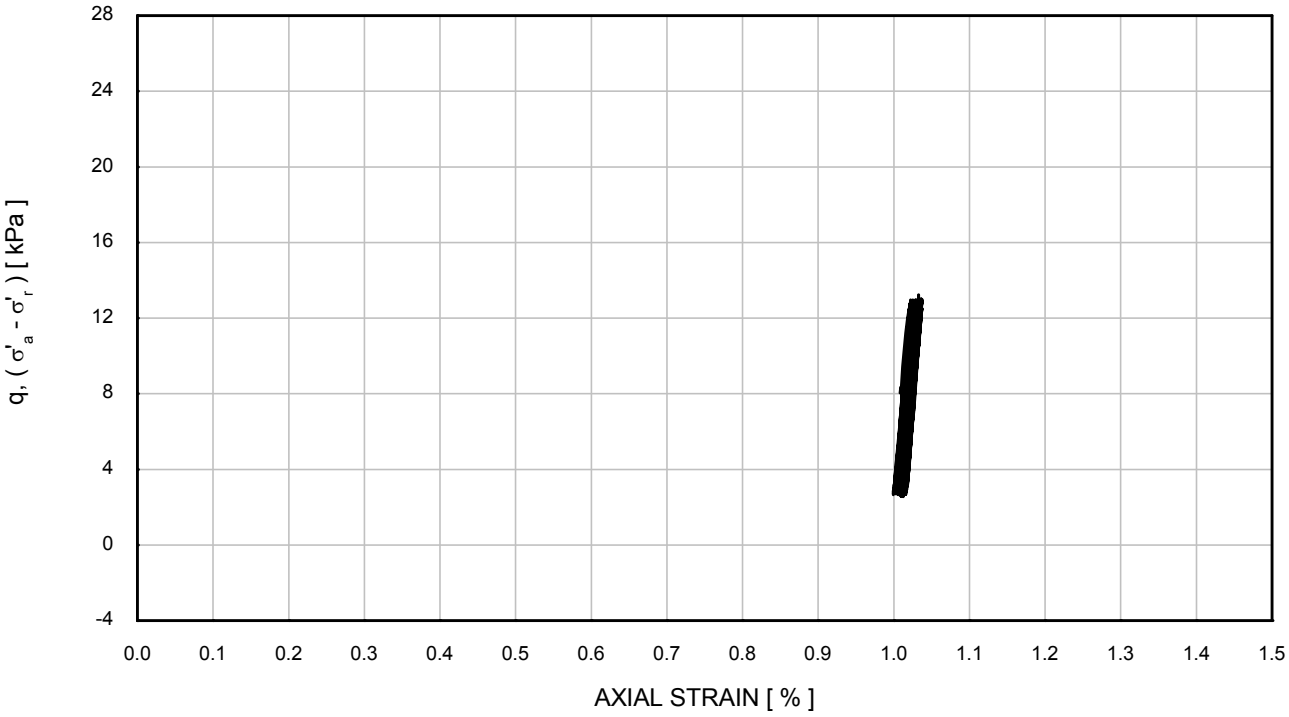
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

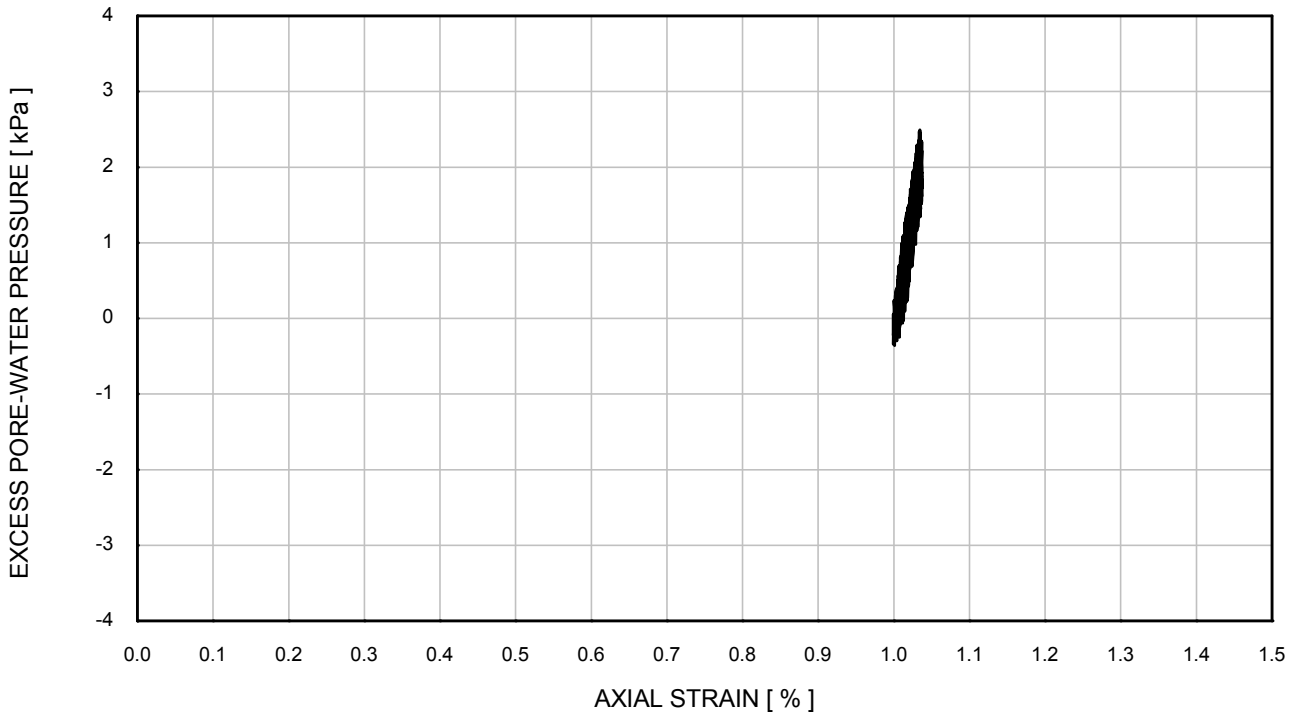




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	28	kPa	Sample	: CTX_1-6
q_{av}	:	8	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	5	kPa	Test No.	: CTX06
Frequency	:	0.10	Hz		

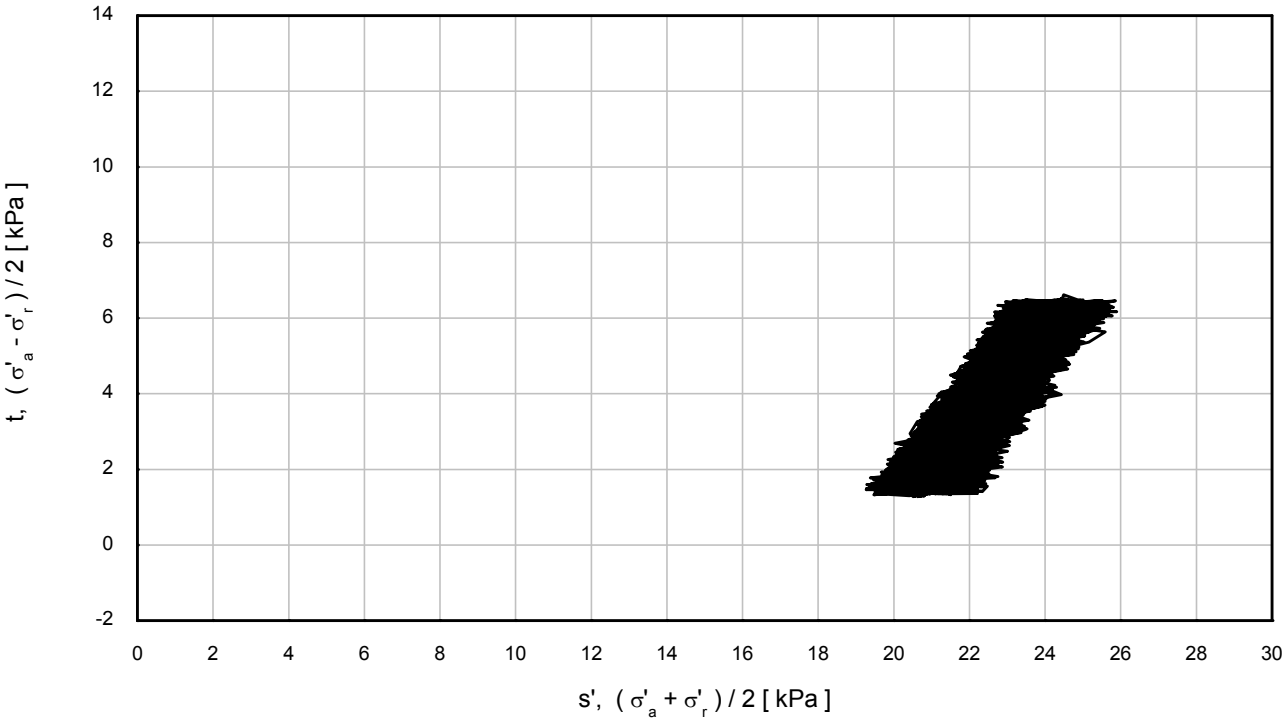
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

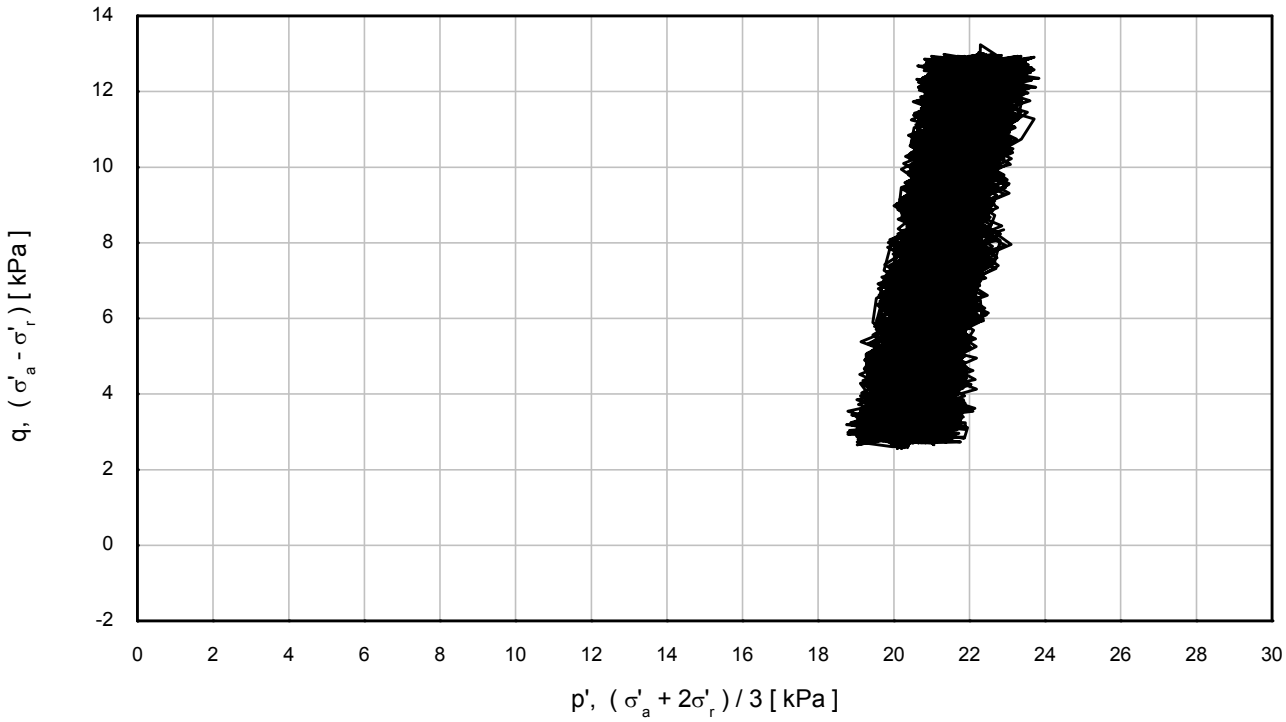




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	28 kPa	Sample	:	CTX_1-6
q_{av}	:	8 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	5 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

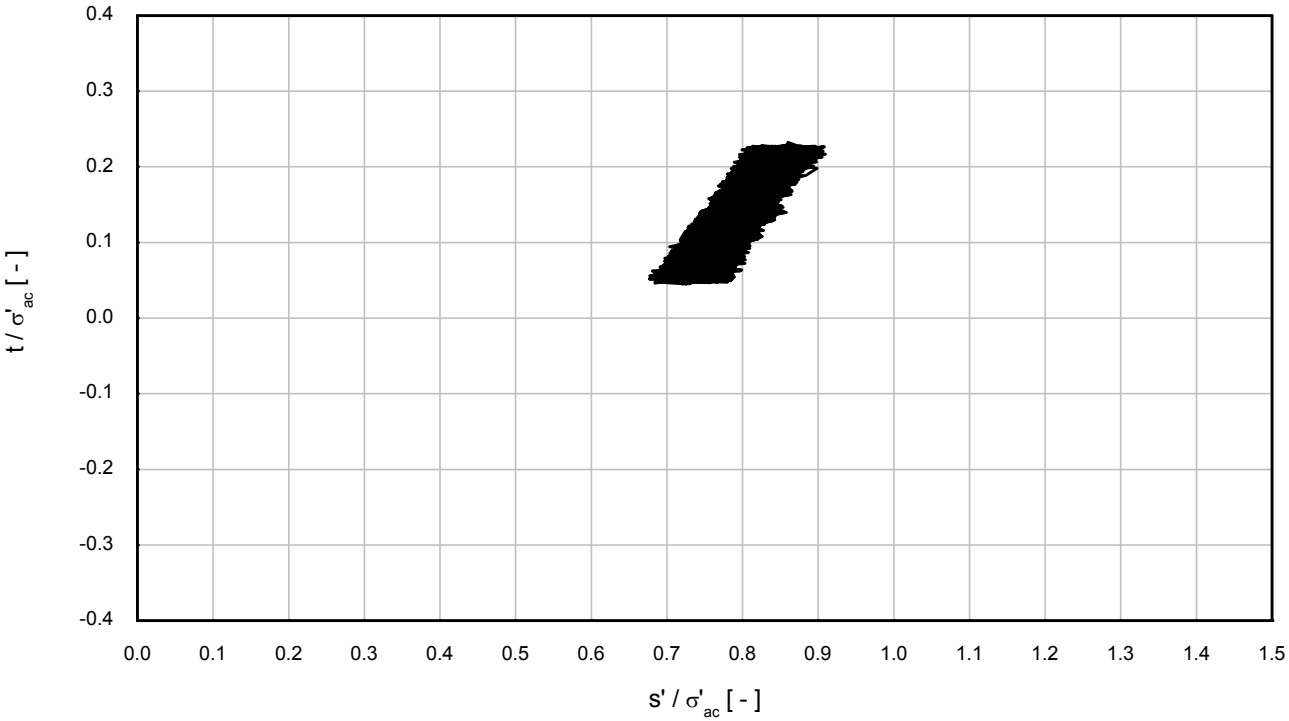
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

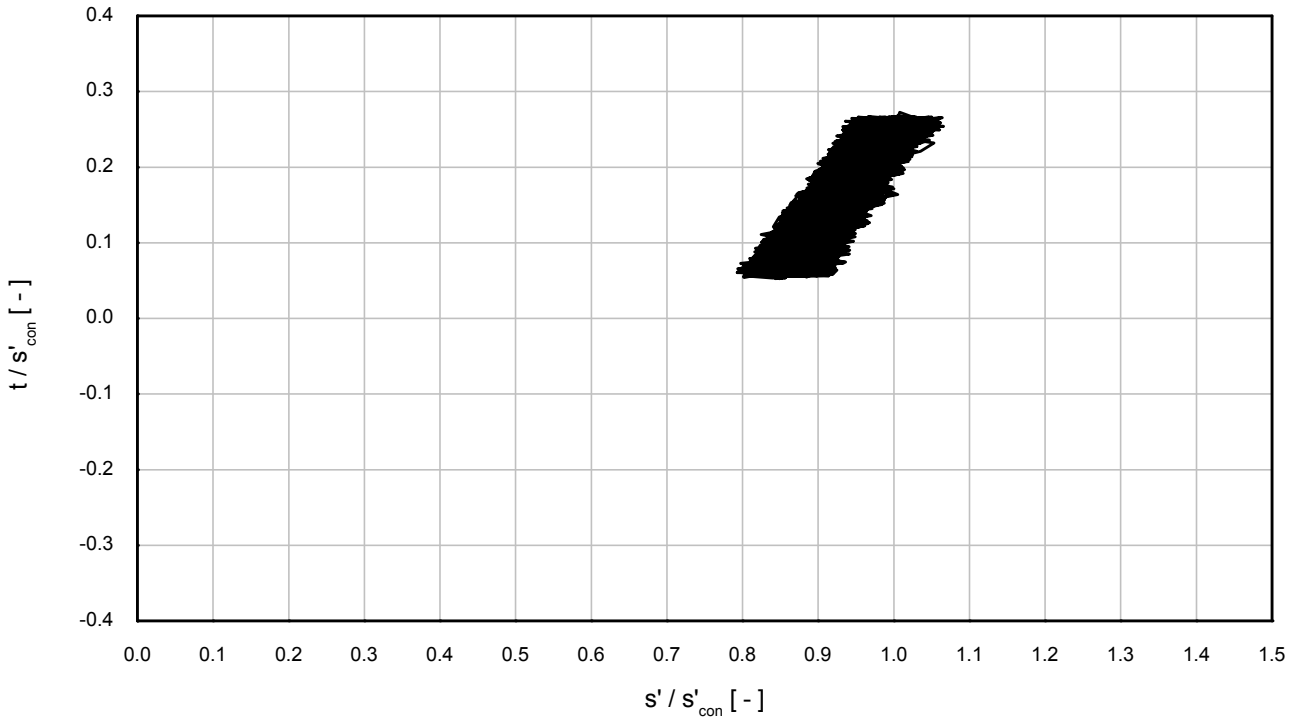




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	28 kPa	Sample	:	CTX_1-6
q_{av}	:	8 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	5 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

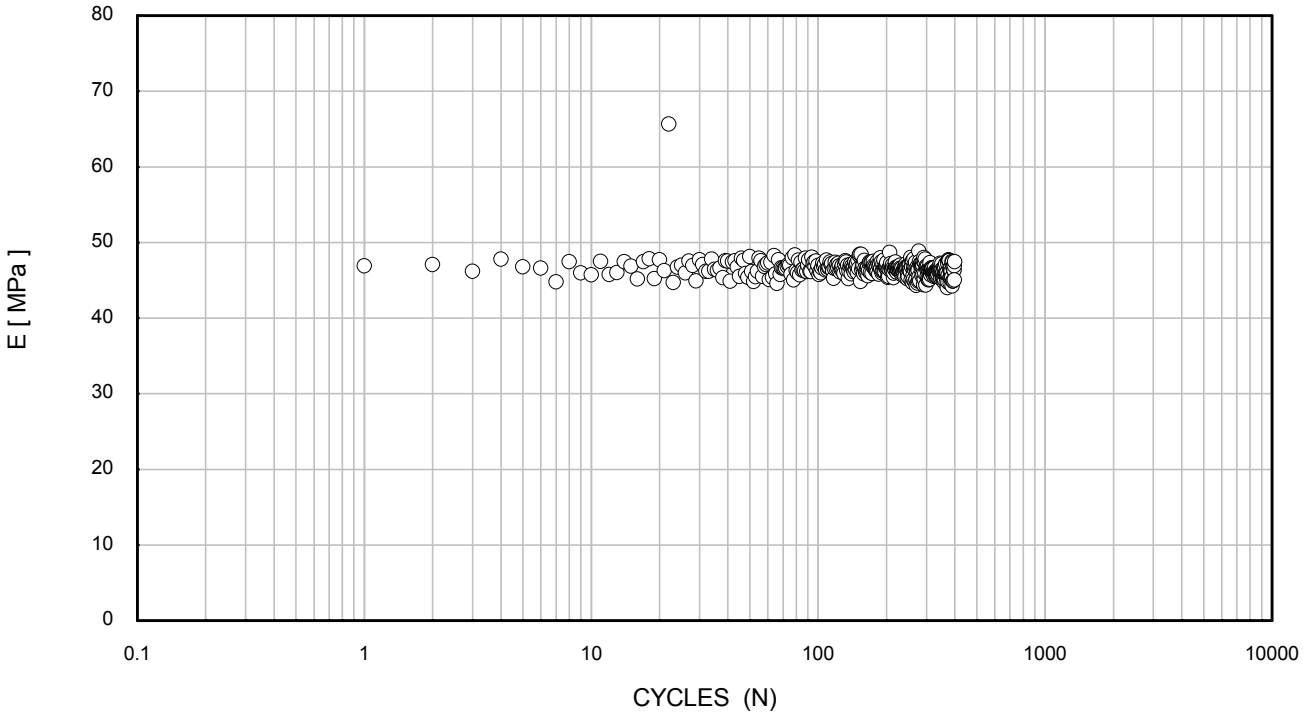
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

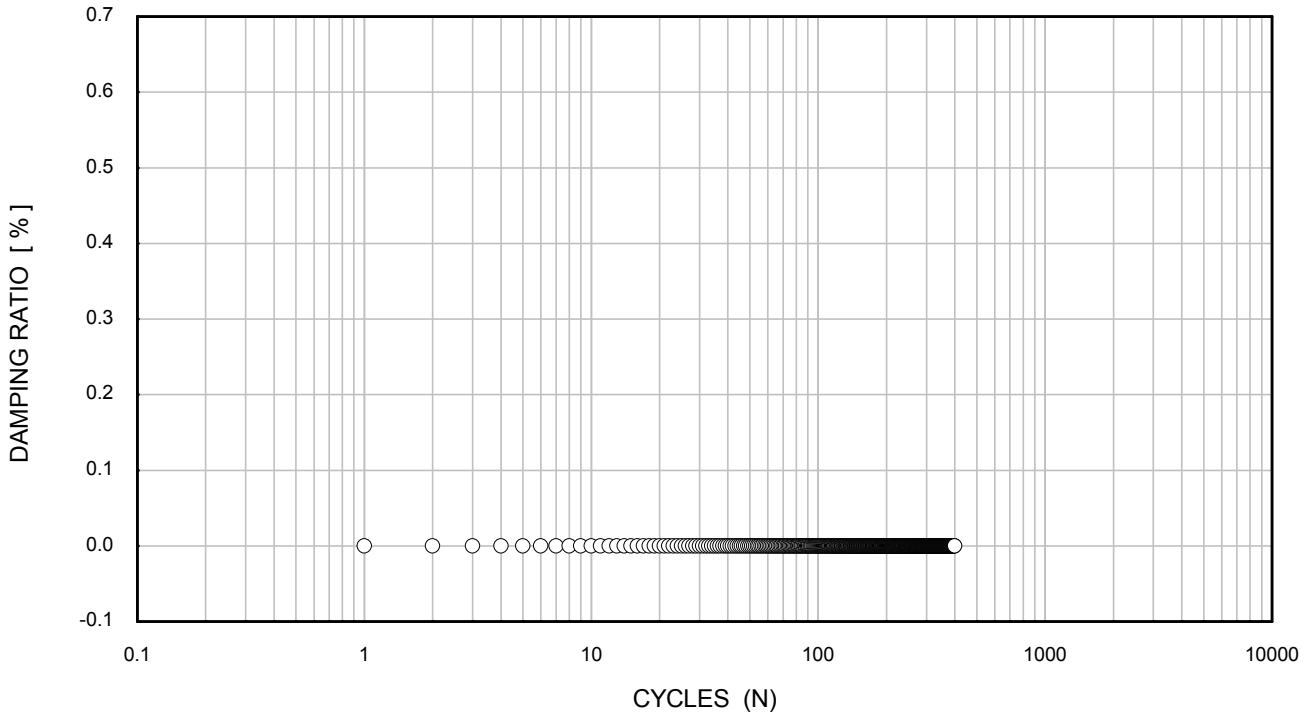




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	28	kPa	Sample	: CTX_1-6
q_{av}	:	8	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	5	kPa	Test No.	: CTX06
Frequency	:	0.10	Hz		

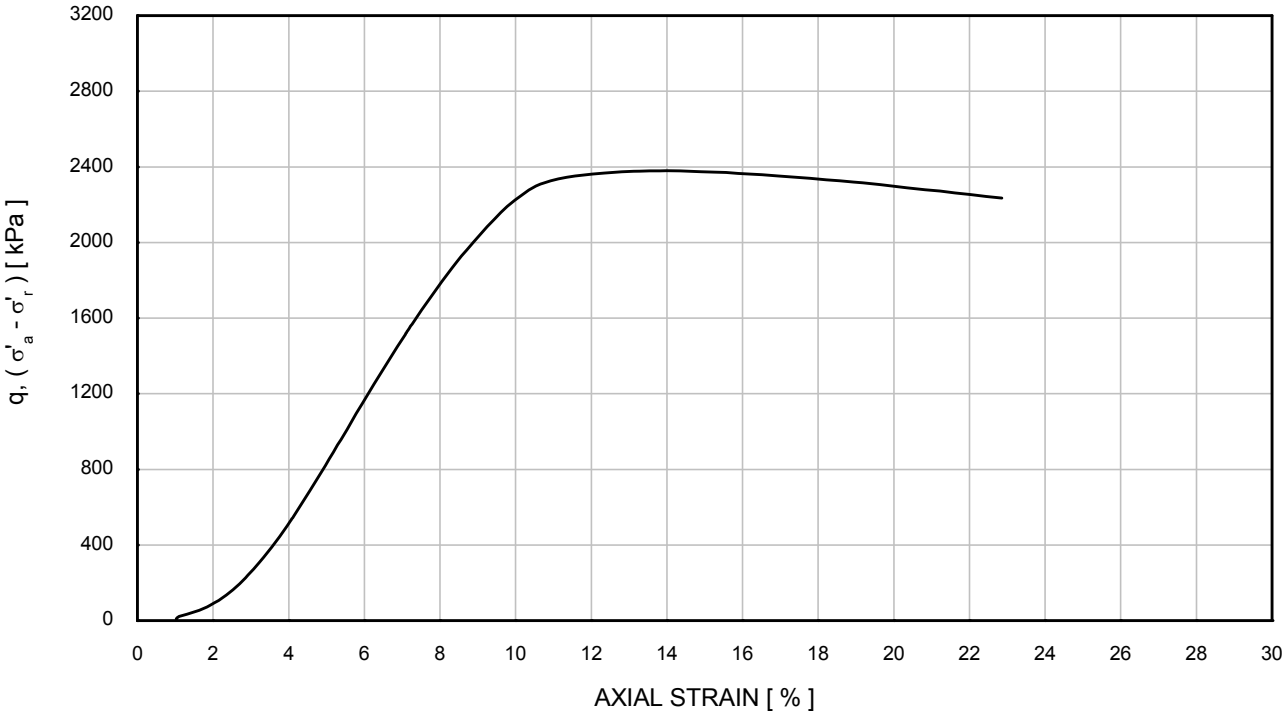
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

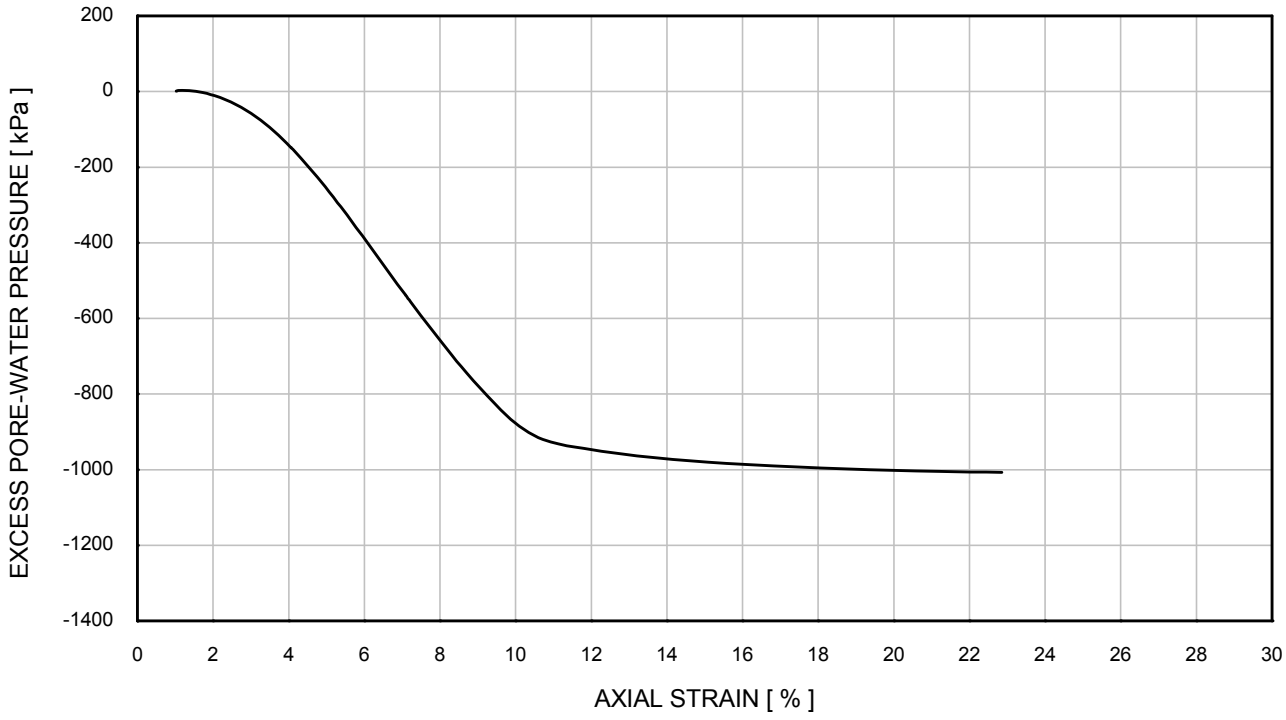




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	28 kPa	Sample	:	CTX_1-6
q_{av}	:	8 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	5 kPa	Test No.	:	CTX06
Frequency	:	0.10 Hz			

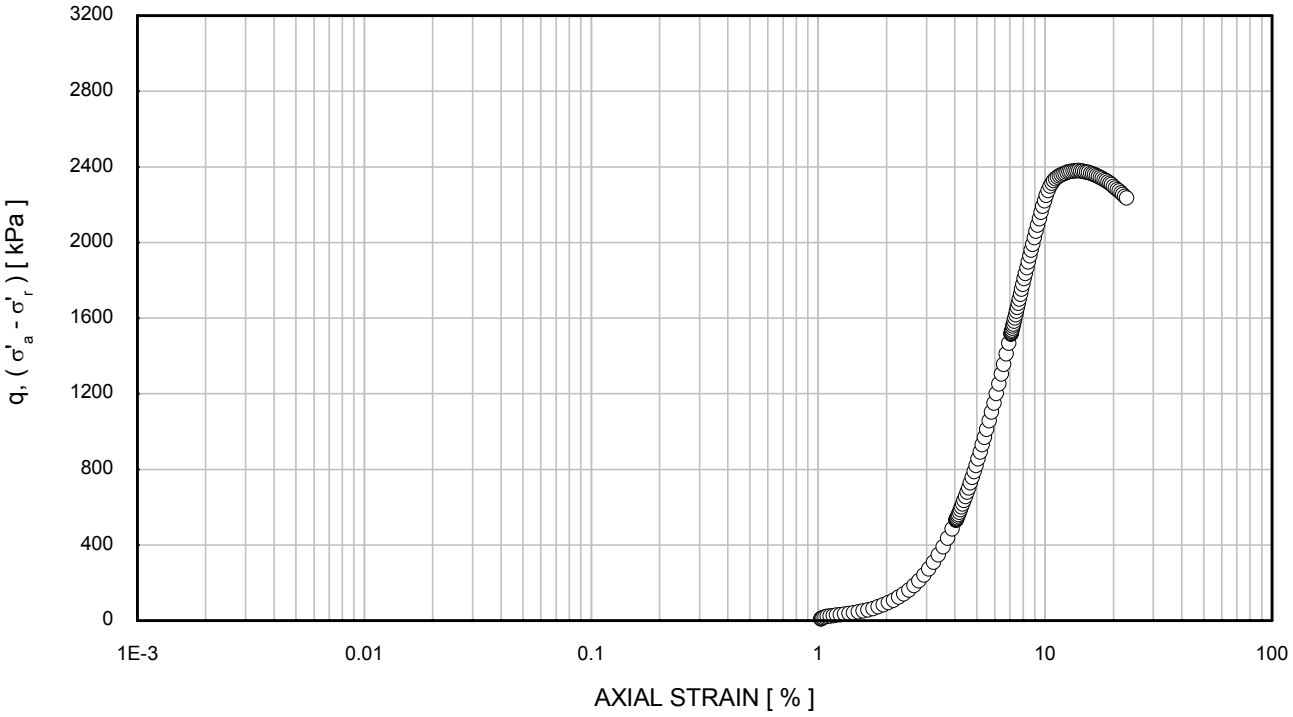
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

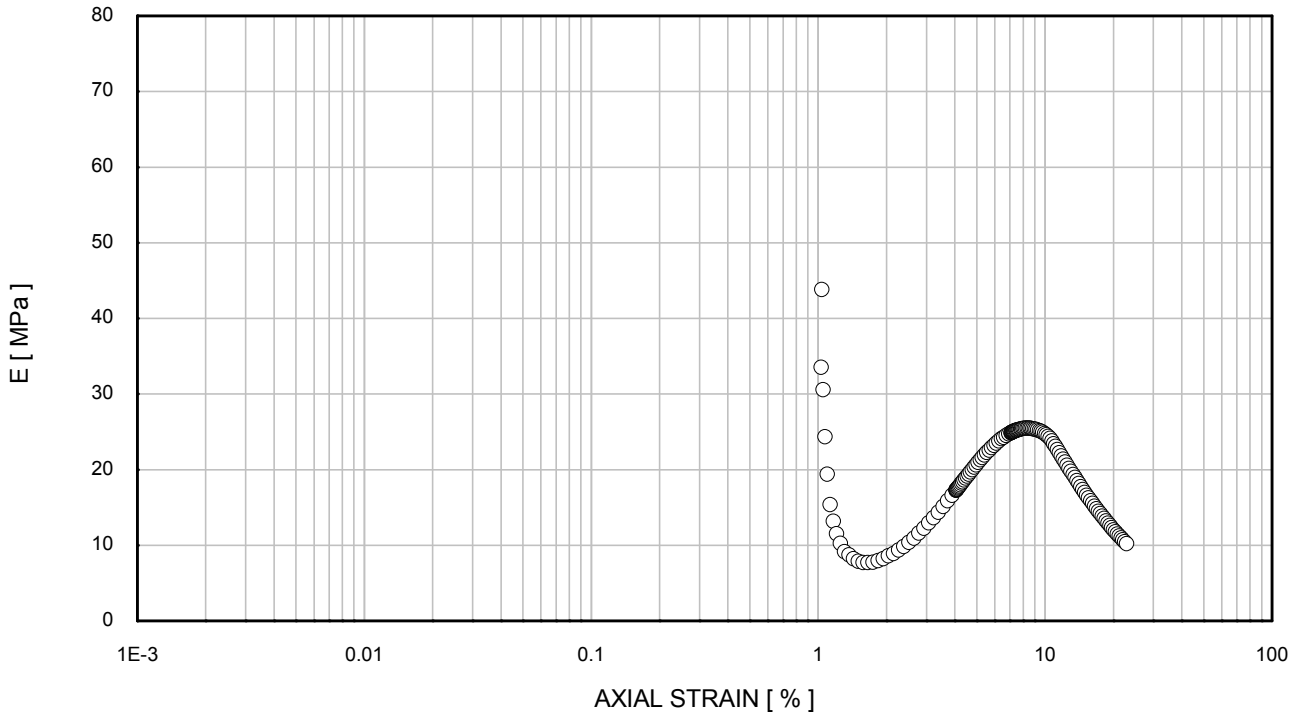




Initial σ'_r	:	19 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{peak}	:	2380 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	14.10 %	Test No.	:	CTX06
Rate of strain	:	1.01 %/hour			

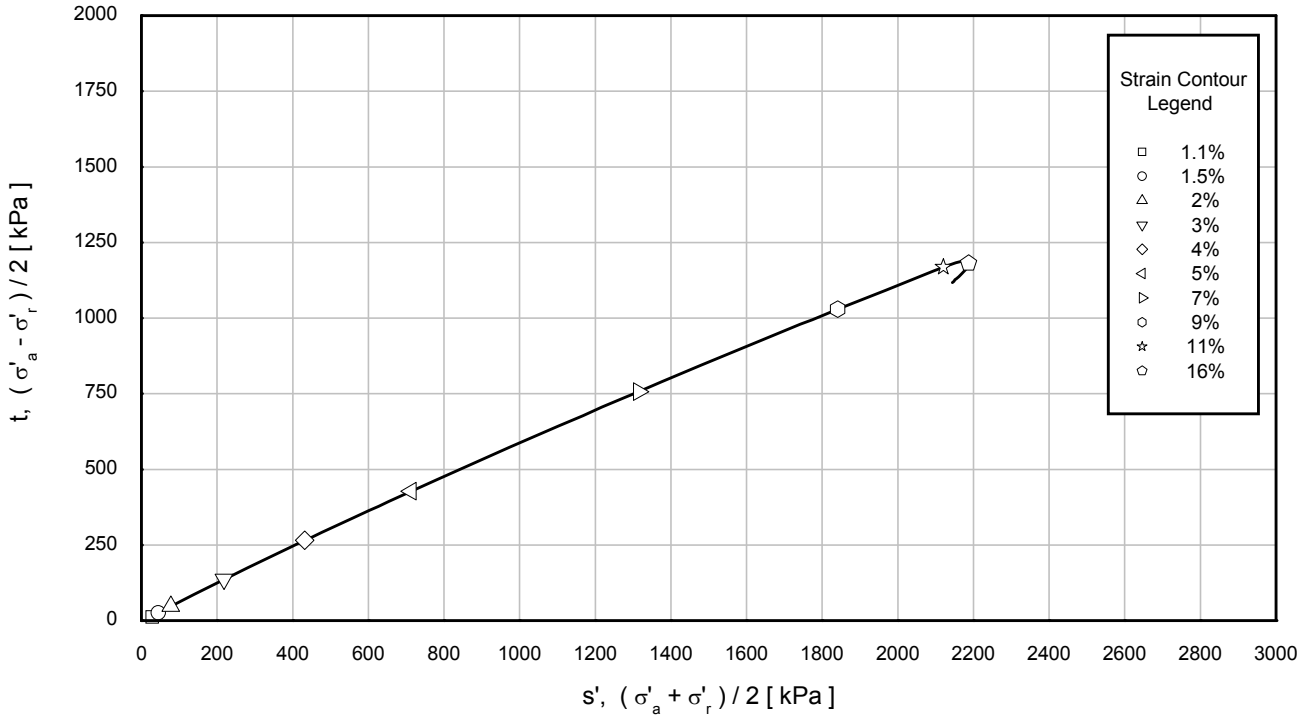
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

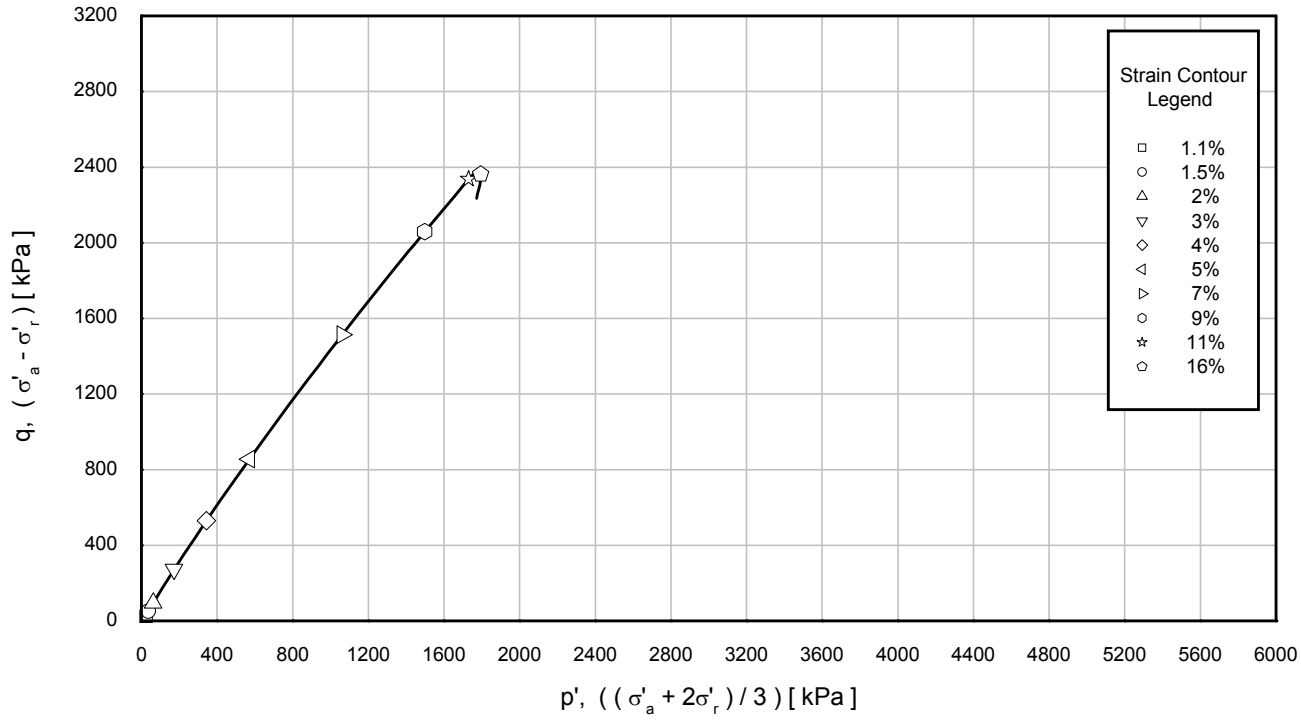




Initial σ'_r	:	19 kPa	Batch	:	1
Initial σ'_a	:	26 kPa	Sample	:	CTX_1-6
q_{peak}	:	2380 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	14.10 %	Test No.	:	CTX06
Rate of strain	:	1.01 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	19	kPa	Batch	: 1
Initial σ'_a	:	26	kPa	Sample	: CTX_1-6
q_{peak}	:	2380	kPa	Unit	: Unit A (Southern Bight)
Ext. ε at q_{peak}	:	14.10	%	Test No.	: CTX06
Rate of strain	:	1.01	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND with traces of shell fragments

GENERAL	
Date test started	30/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.0
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.616
Degree of saturation	[%]	43
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 03_CTX11
Processed by	MSR
Date	06/12/2016
Checked by	AR
Date	07/12/2016
Approved by	PH
Date	14/12/2016

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	876
Mid height PWP	[kPa]	-
B value achieved	[-]	0.96

CONSOLIDATION: ISOTROPIC 1		
Cell pressure	[kPa]	1011
Back pressure	[kPa]	876
Base PWP	[kPa]	876
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.54
External axial strain	[%]	0.15
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	270
Mean q_{av}	[kPa]	0
Mean q_{cy}	[kPa]	27
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.02
External ε_{cy} at N_f	[%]	0.02
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	13
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.00	0.02	157.09	-	0.72	-
2	0.00	0.02	160.09	-	1.44	-
5	0.00	0.02	156.73	-	1.51	-
10	0.00	0.02	156.36	-	1.55	-
20	0.00	0.02	154.79	-	1.64	-
30	0.00	0.02	153.49	-	2.29	-
40	0.00	0.02	155.69	-	1.59	-
50	0.00	0.02	152.97	-	1.43	-
100	0.01	0.02	150.90	-	1.52	-
500	0.01	0.02	144.83	-	1.16	-
1000	0.01	0.02	140.98	-	0.81	-
1500	0.02	0.02	137.73	-	1.00	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CONSOLIDATION: ISOTROPIC 2		
Cell pressure	[kPa]	1011
Back pressure	[kPa]	876
Base PWP	[kPa]	876
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.03
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.606
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	270
Mean q_{av}	[kPa]	0
Mean q_{cy}	[kPa]	47
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.03
External ε_{cy} at N_f	[%]	0.05
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	36
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.00	0.03	135.18	-	5.88	-
2	0.00	0.03	138.74	-	4.86	-
5	0.00	0.03	138.10	-	4.23	-
10	0.00	0.03	137.95	-	4.10	-
20	0.00	0.03	135.50	-	3.80	-
30	0.00	0.03	134.88	-	4.07	-
40	0.00	0.04	133.94	-	4.22	-
50	0.01	0.04	133.20	-	3.99	-
100	0.01	0.04	127.21	-	3.79	-
200	0.02	0.04	118.94	-	4.21	-
300	0.02	0.04	112.18	-	4.74	-
400	0.03	0.05	104.13	-	5.15	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	97
Initial effective axial pressure	[kPa]	96
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	1950
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	18.60
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-736
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	871
Effective axial pressure	[kPa]	2821
Principal effective stress ratio	[-]	3.24
ε_{50}	[%]	4.59
Secant modulus (E_{50}) at ε_{50}	[kPa]	21368
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	634
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.96
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-104
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	239
Effective axial pressure	[kPa]	873
Principal effective stress ratio	[-]	3.66
At 15% external axial strain		
Corrected deviator stress	[kPa]	1924
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-695
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	830
Effective axial pressure	[kPa]	2754
Principal effective stress ratio	[-]	3.32

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

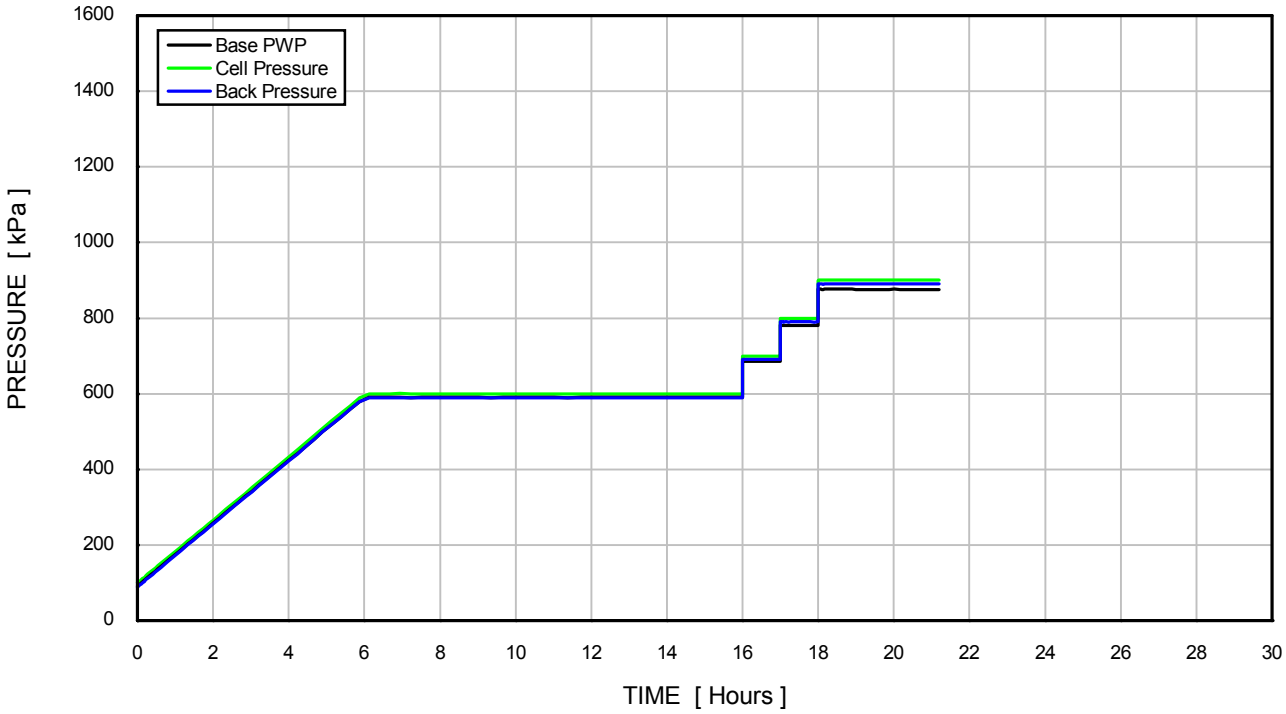


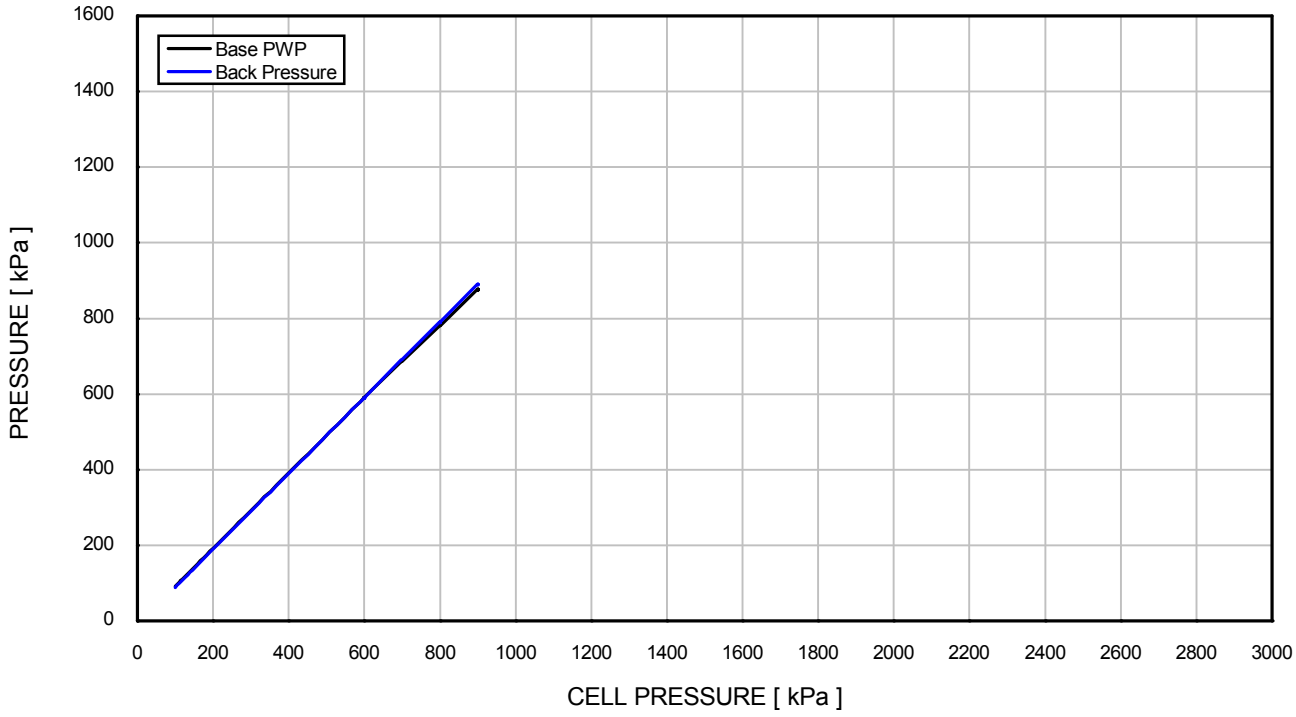


FINAL CONDITIONS		
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX11

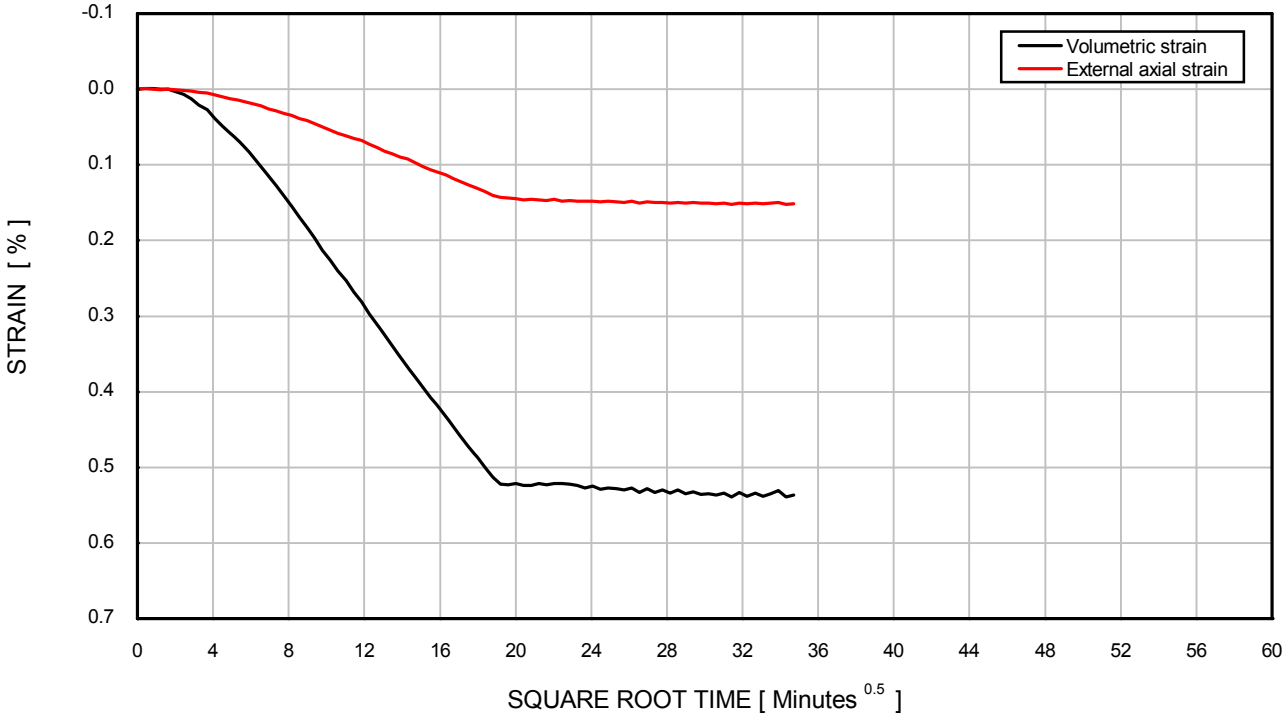
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

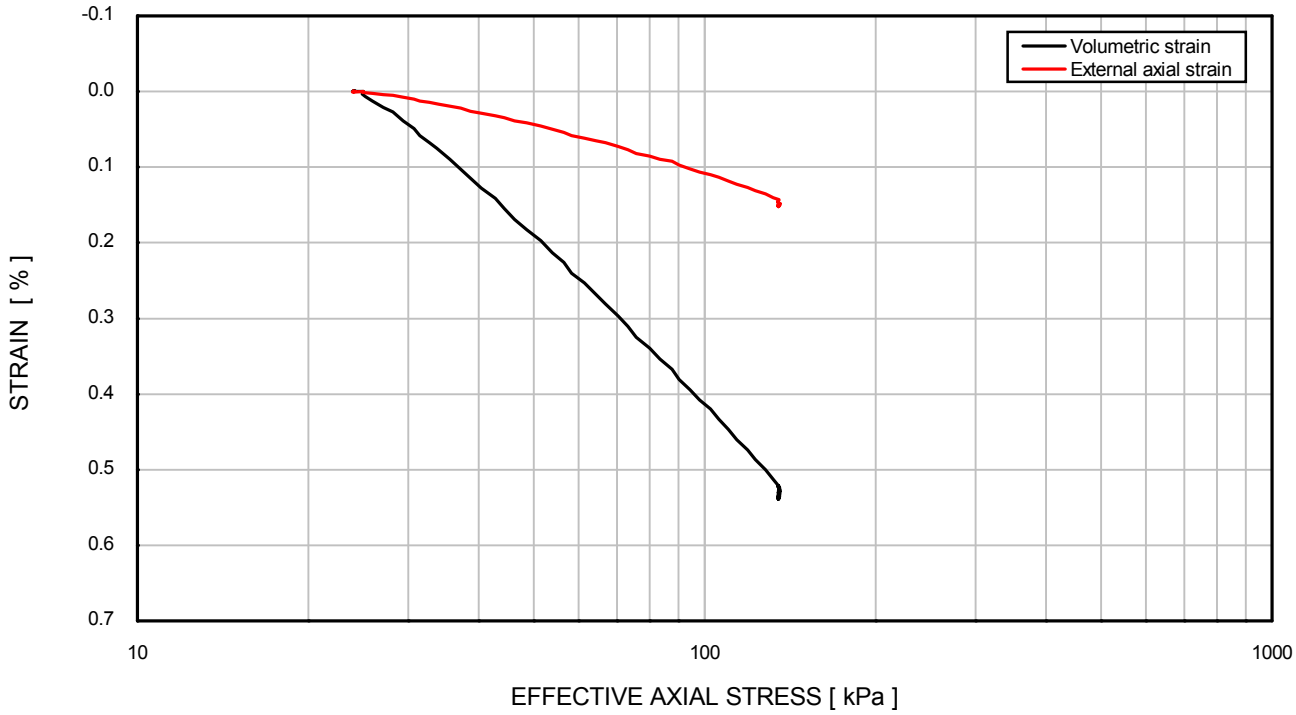




B value	:	0.96			
Initial σ'_r	:	9	kPa	Batch	: 3
Initial σ'_a	:	9	kPa	Sample	: CTX_3-1
Final σ'_r	:	24	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	24	kPa	Test No.	: CTX11

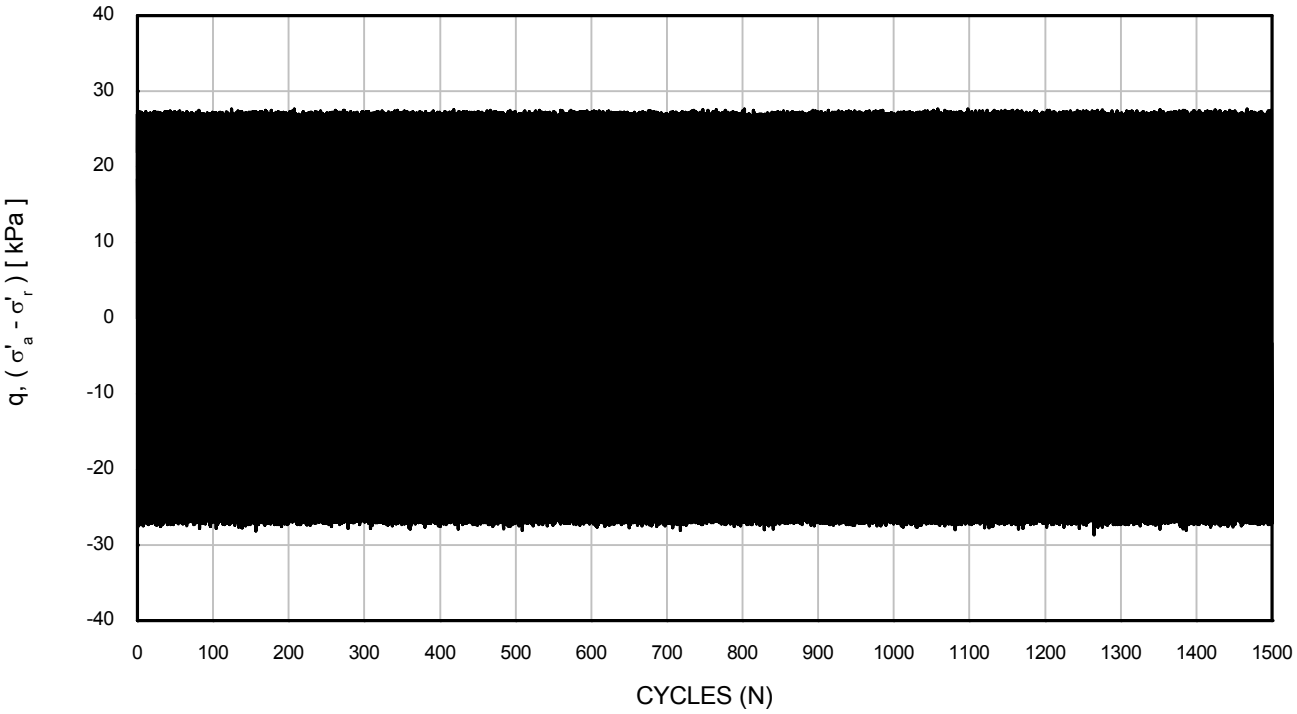
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

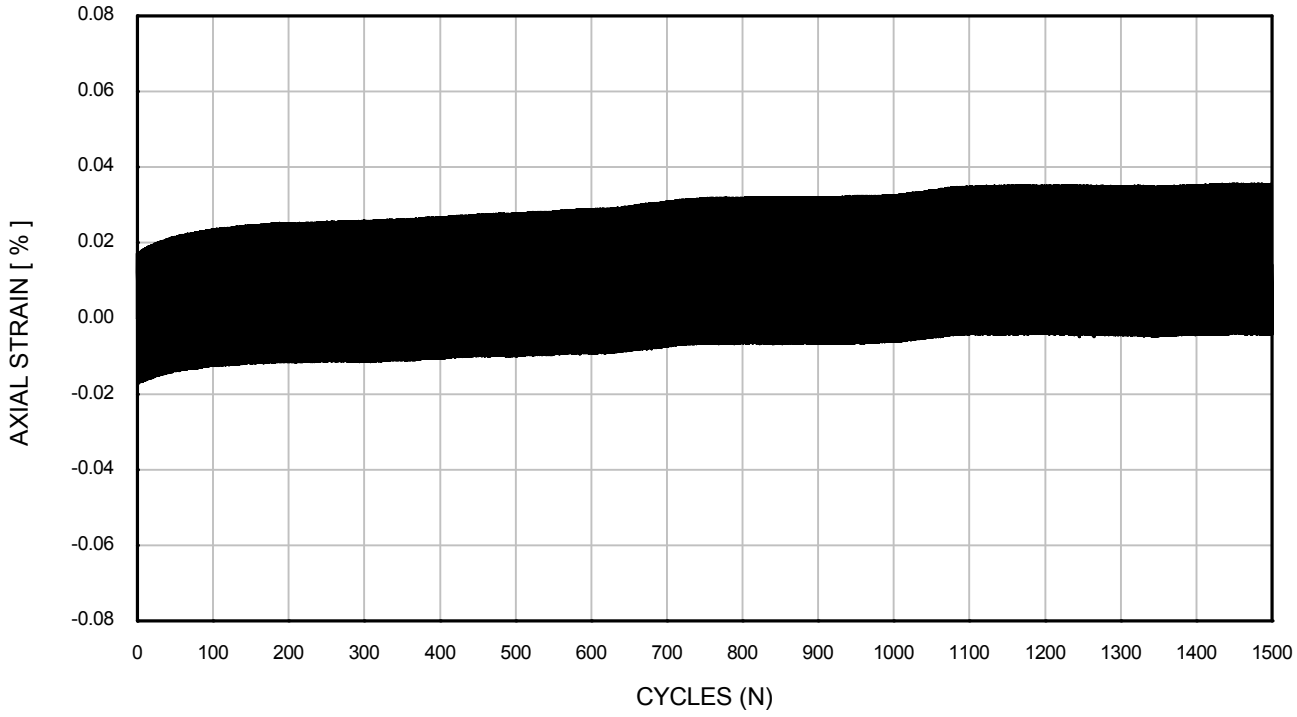




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTX_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX11

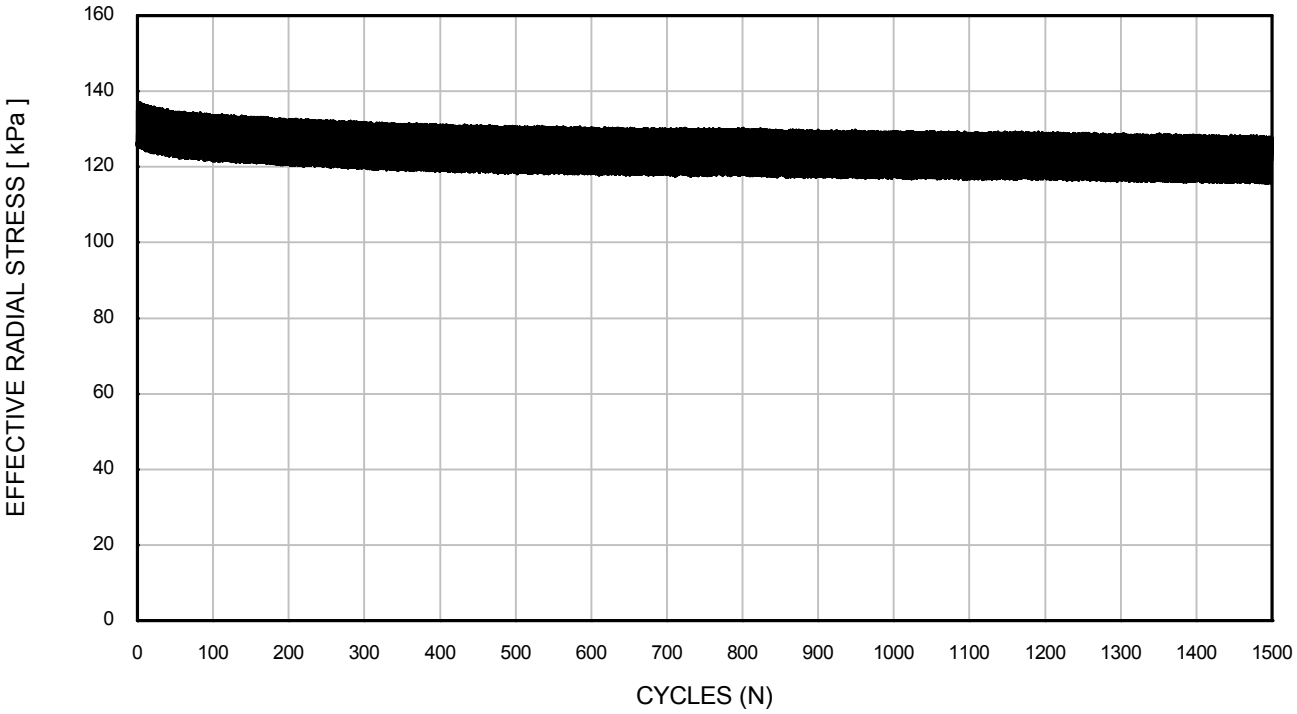
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE 1

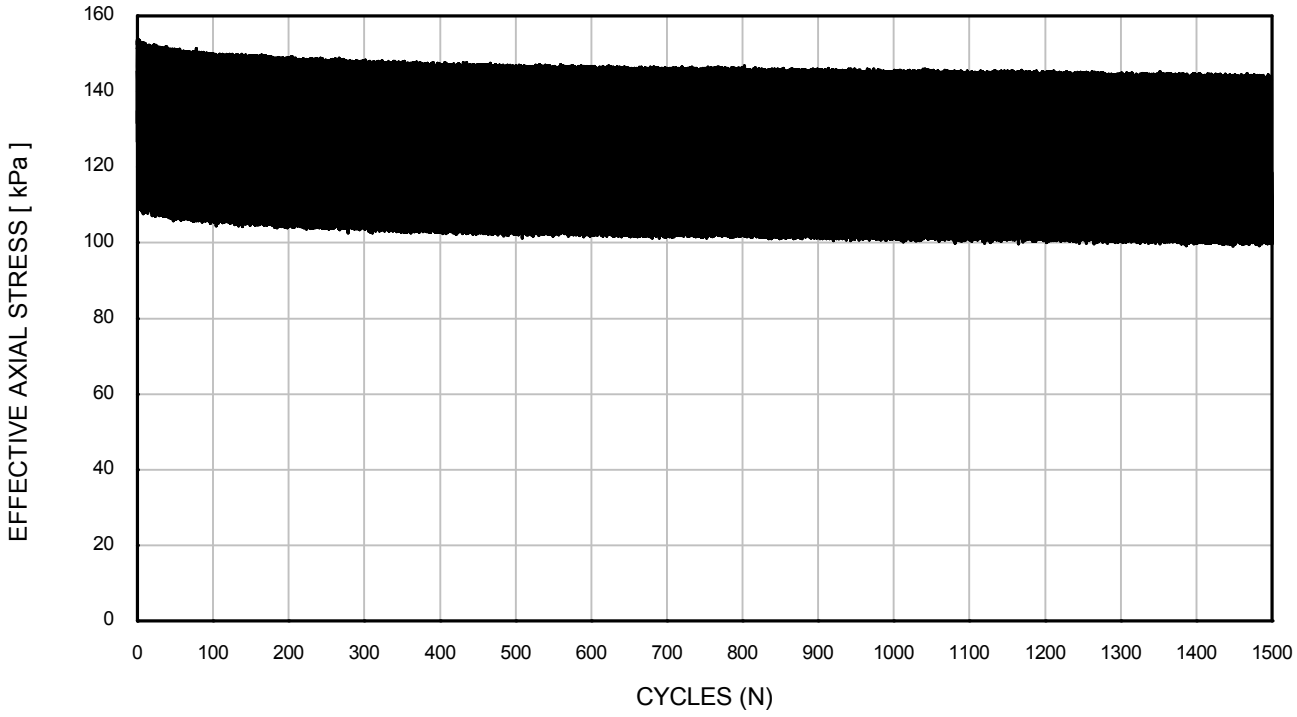




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

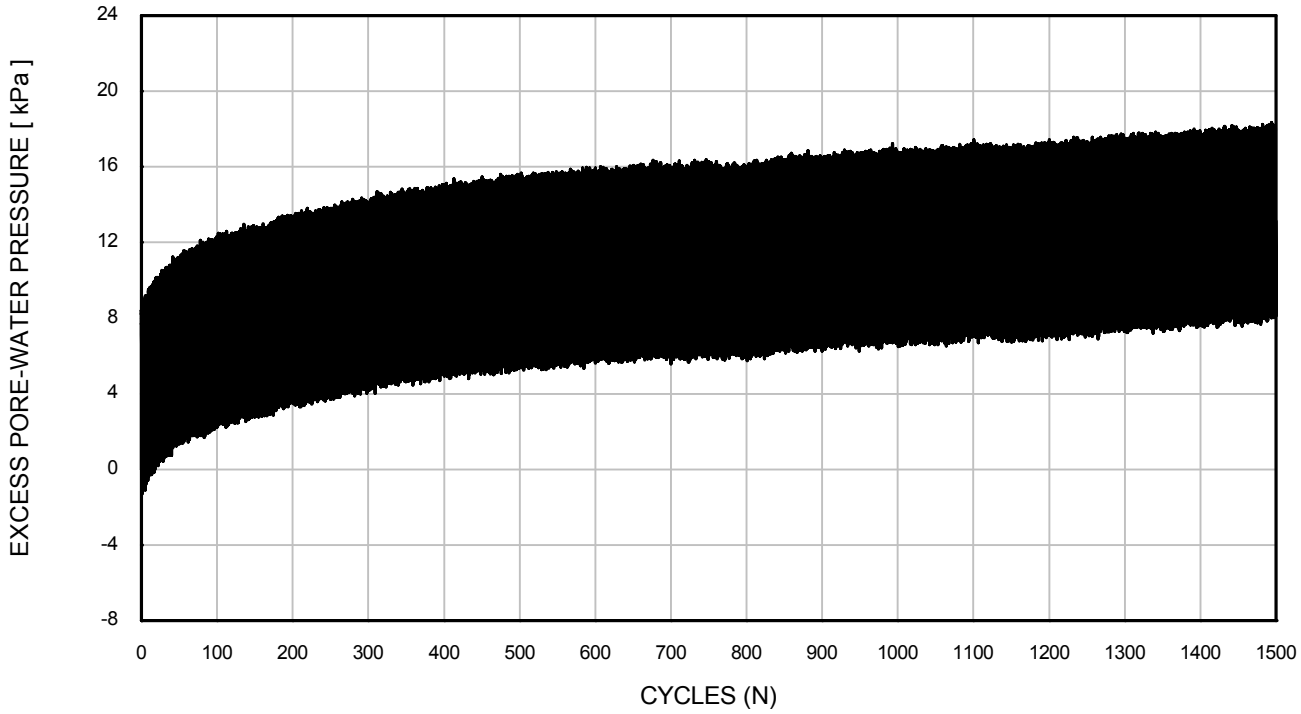
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

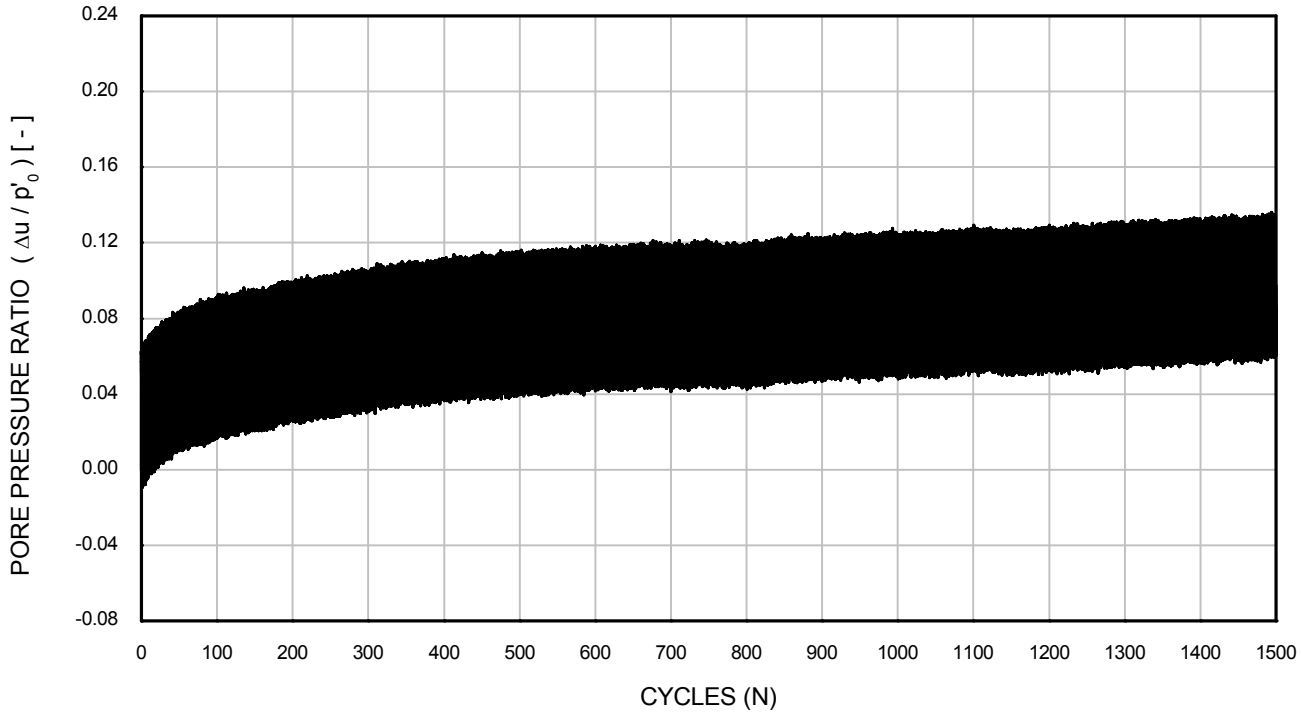




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

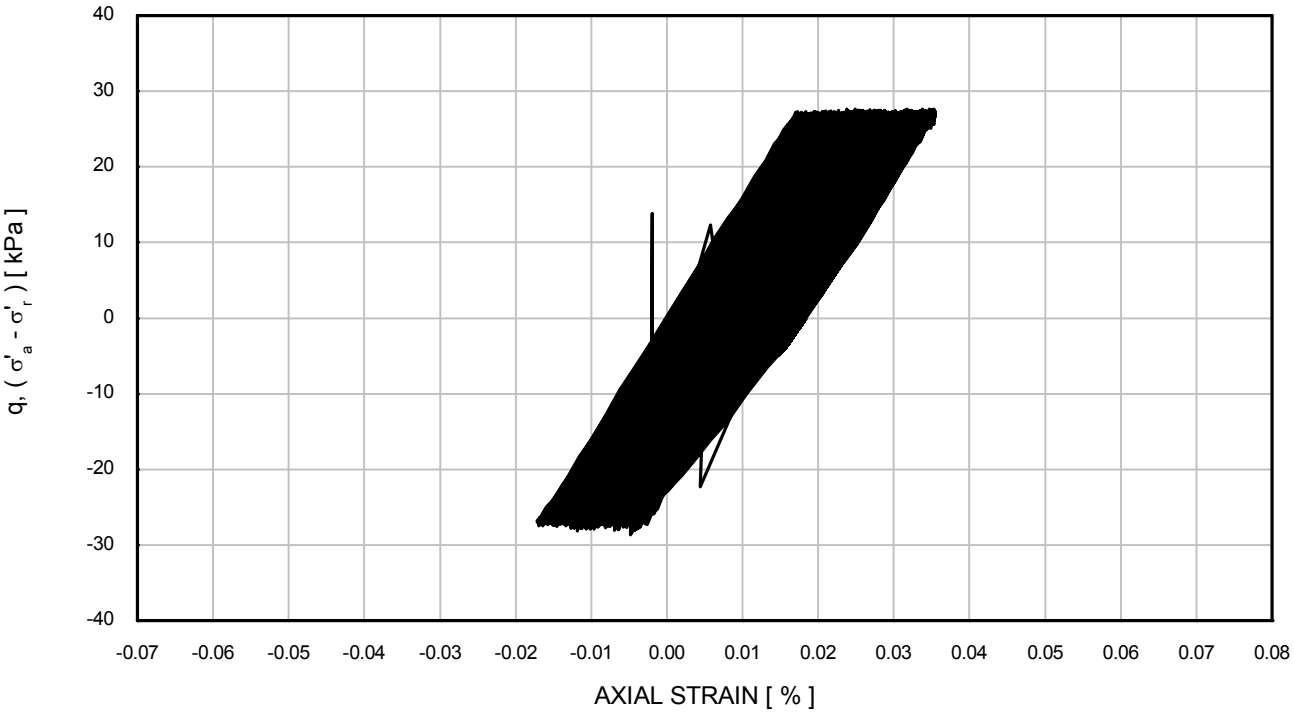
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

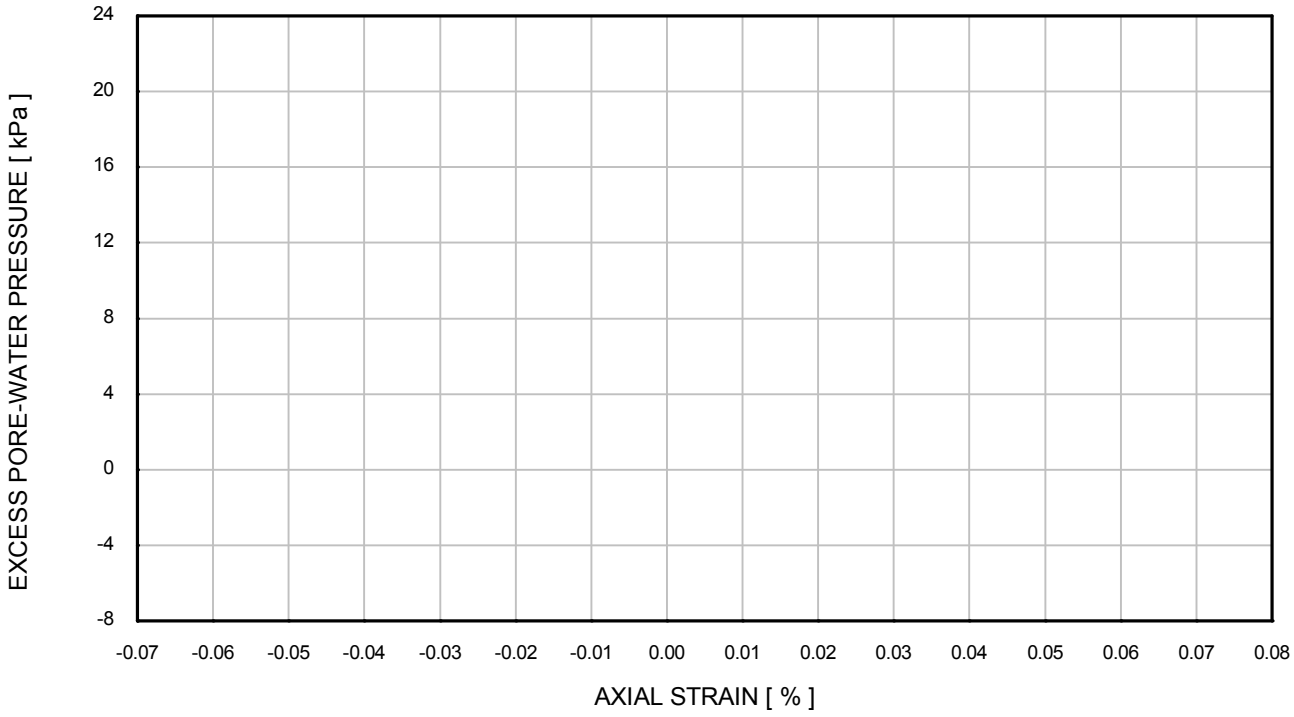




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

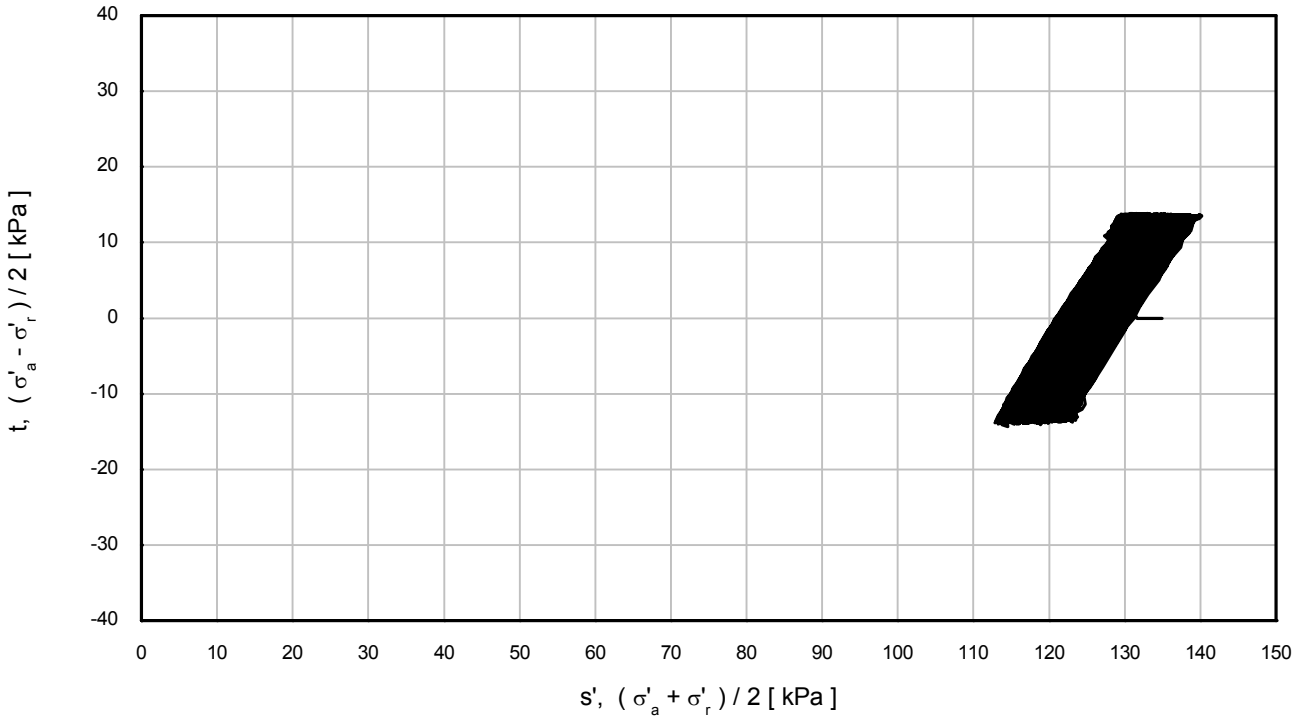
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

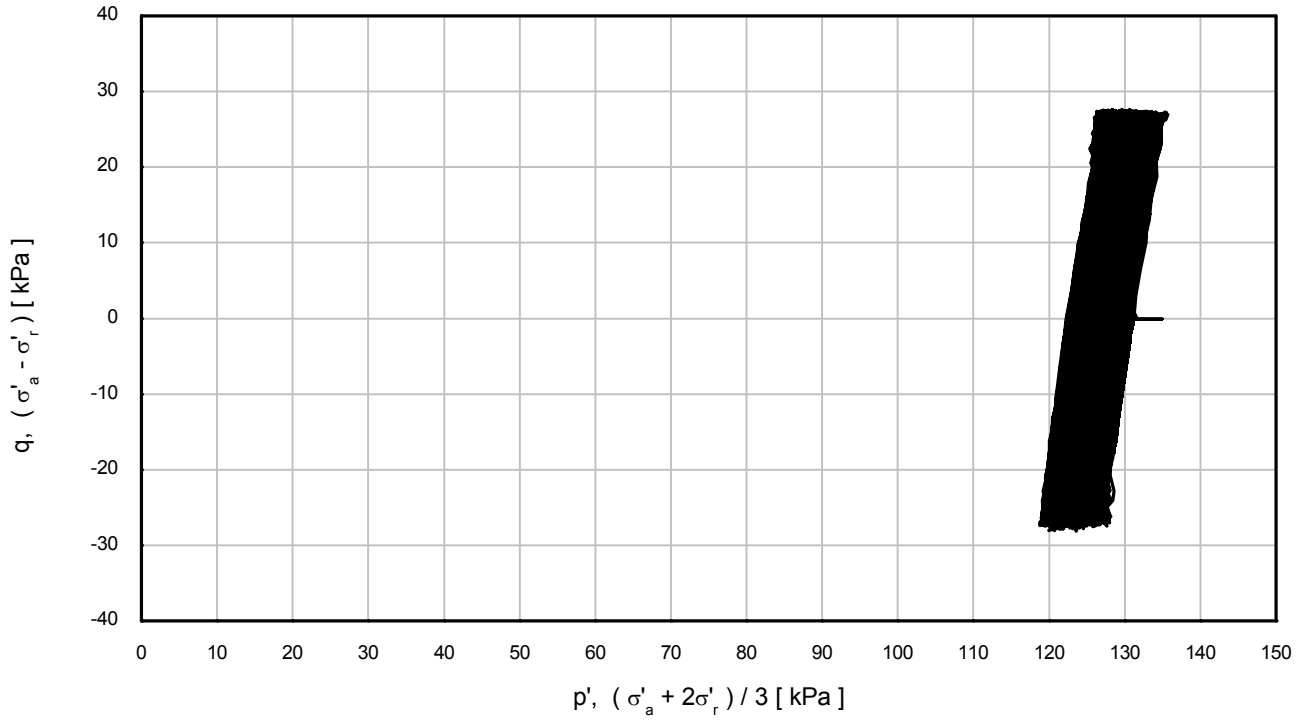




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

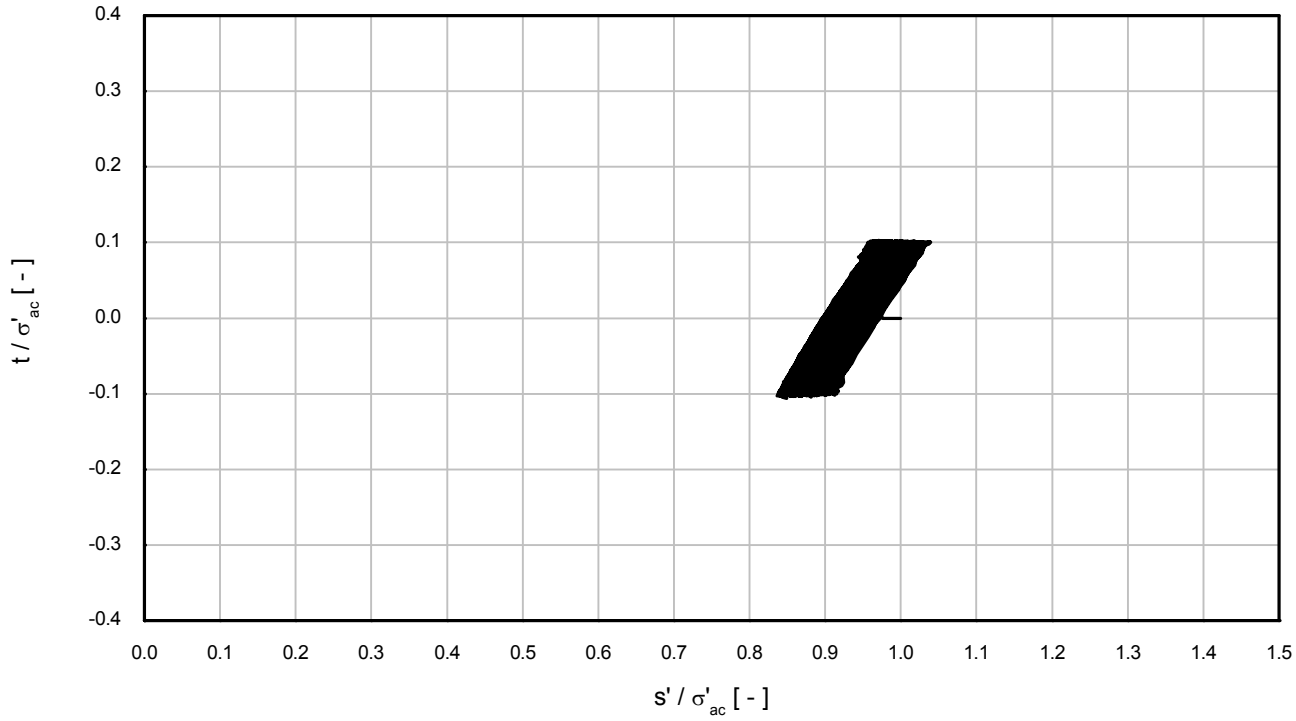
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

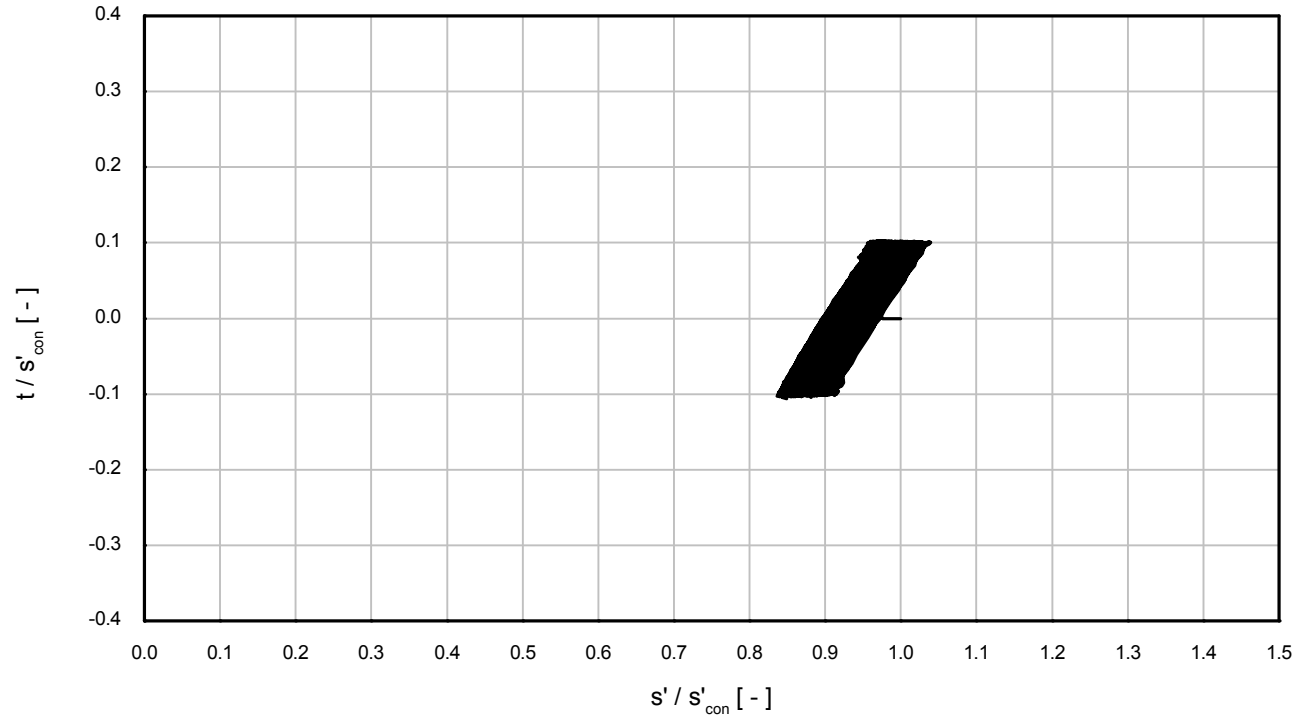




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

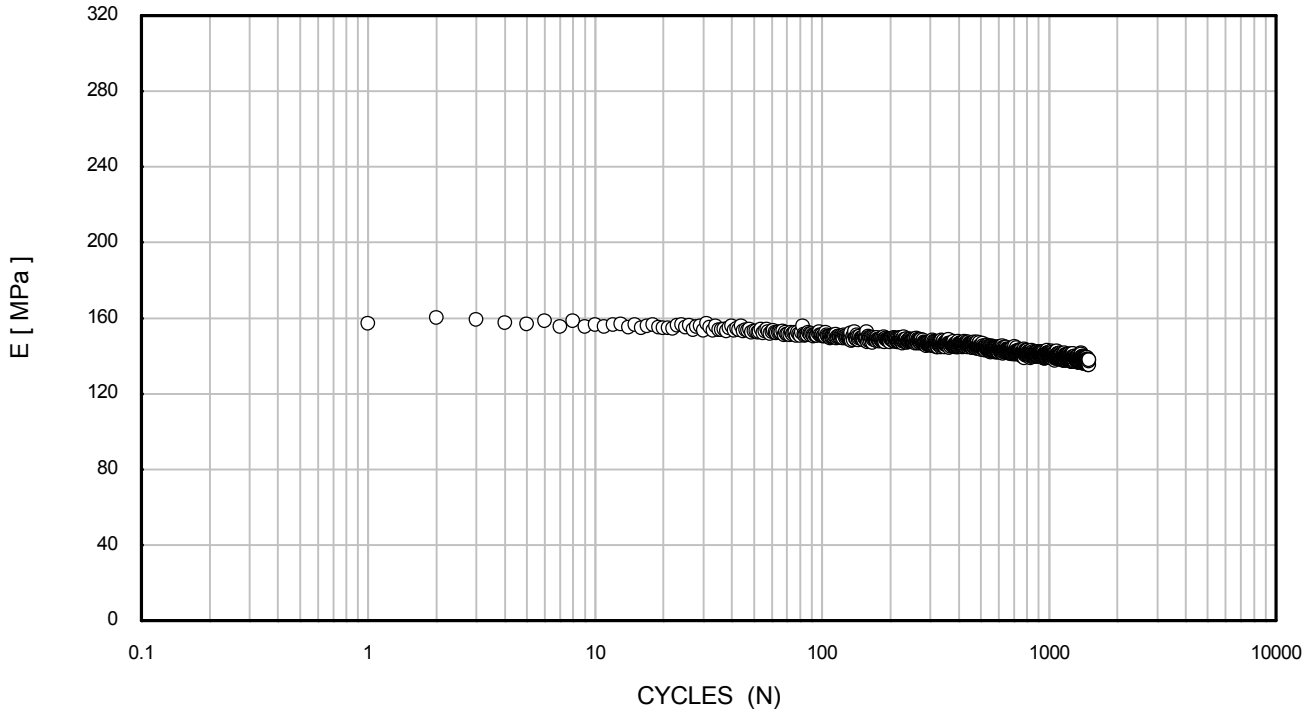
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

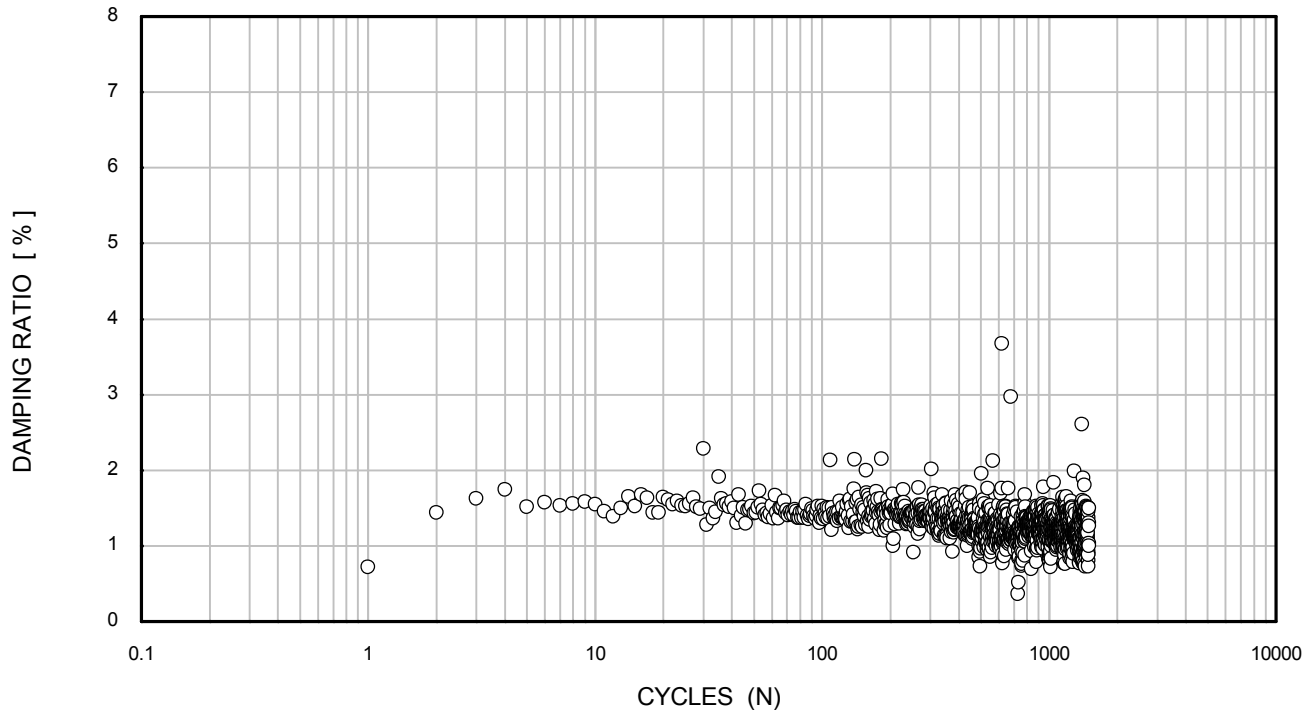




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

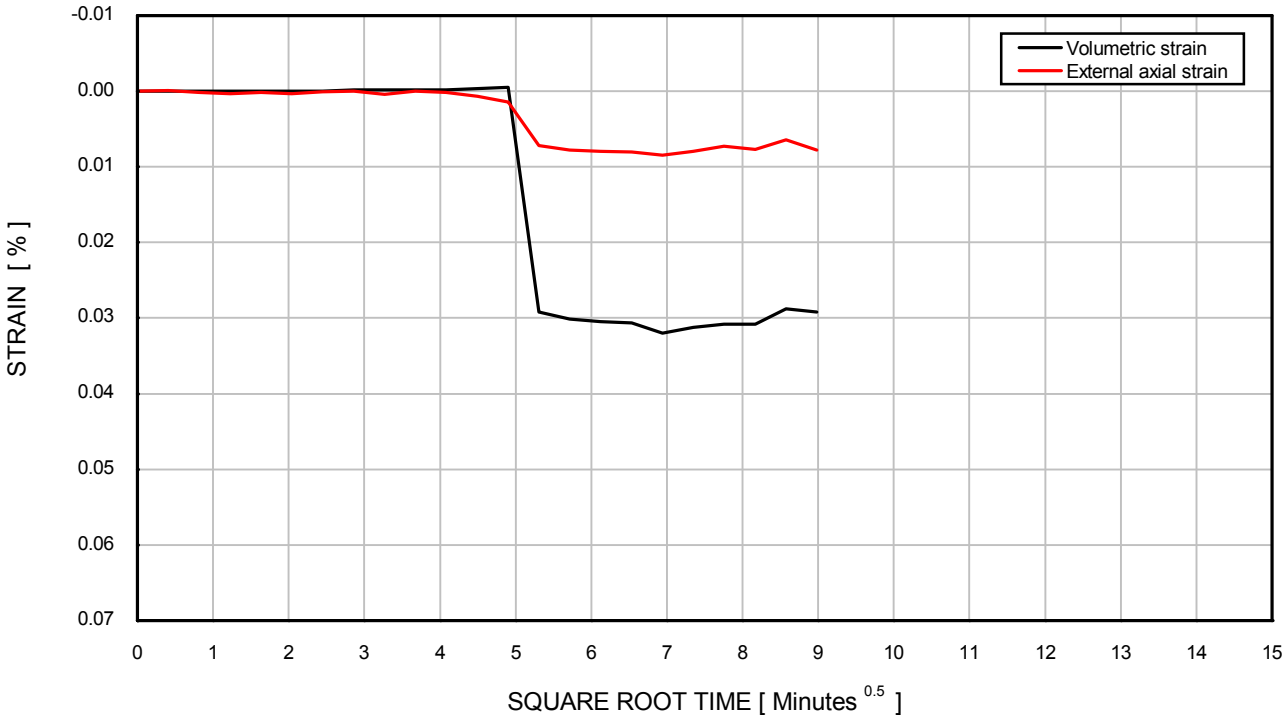
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED





Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	27 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

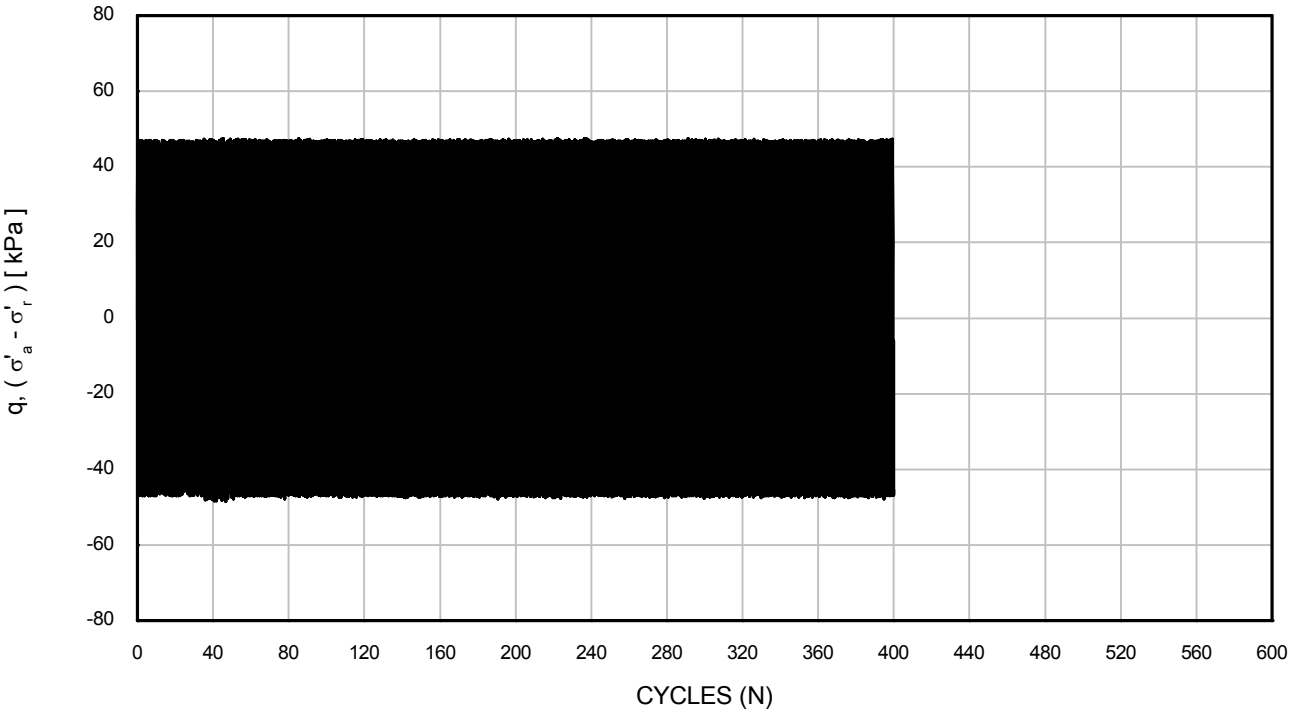
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

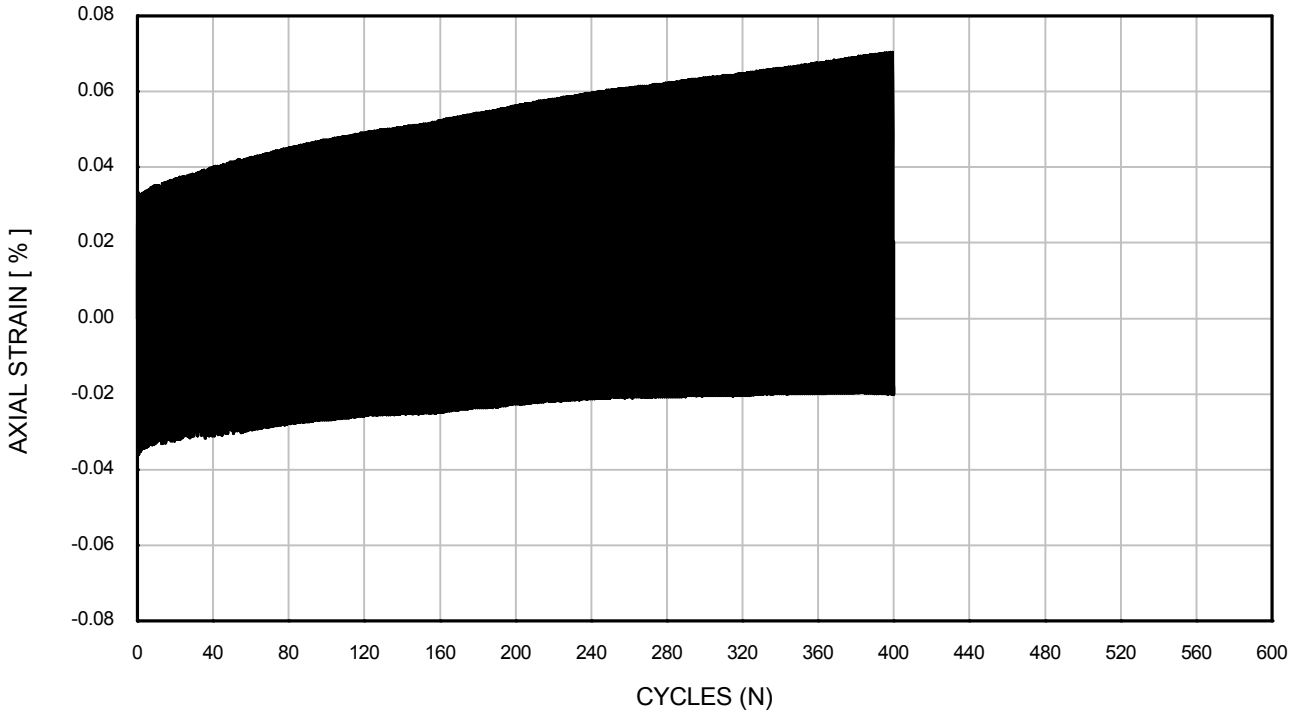




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTX_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX11

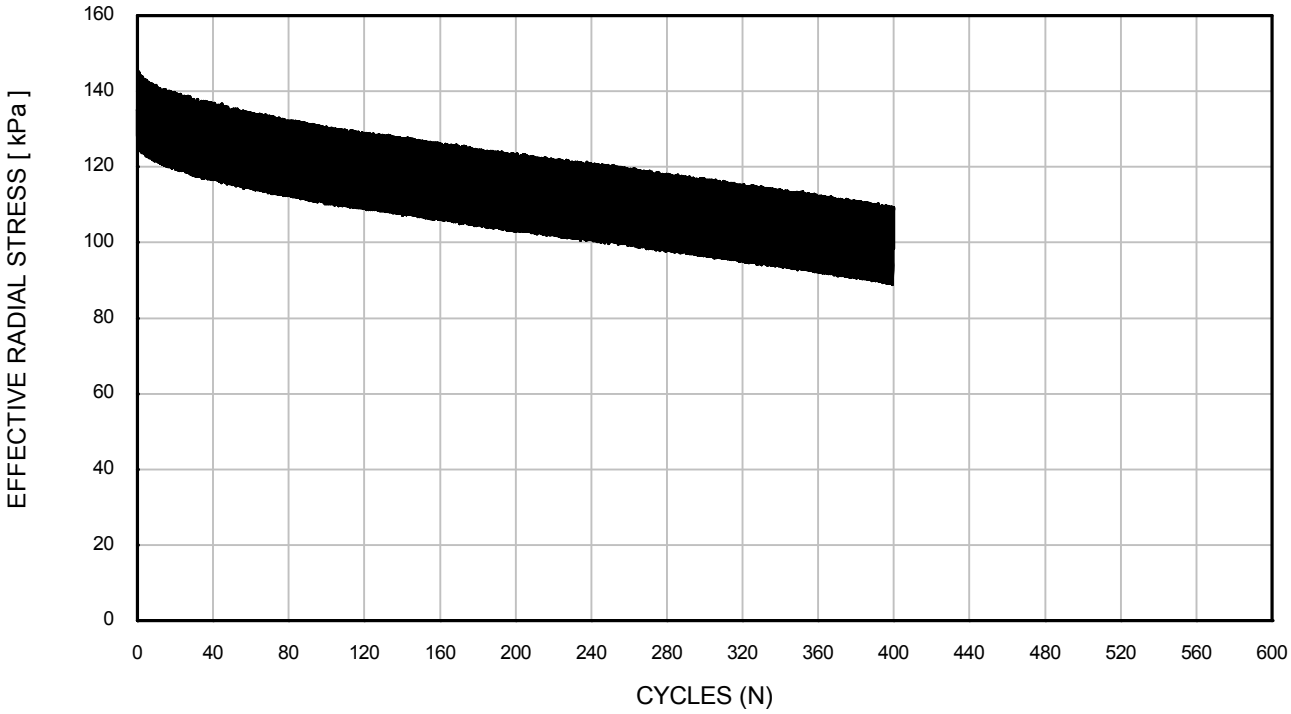
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE 2

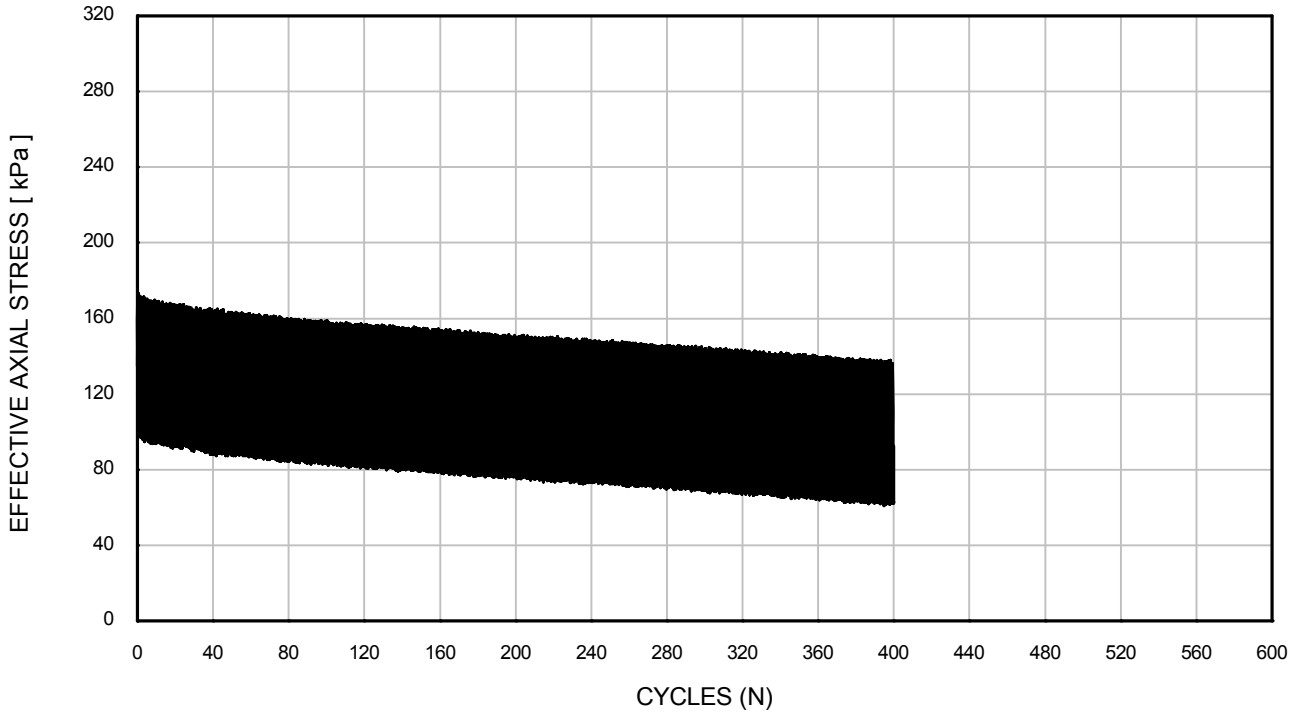




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

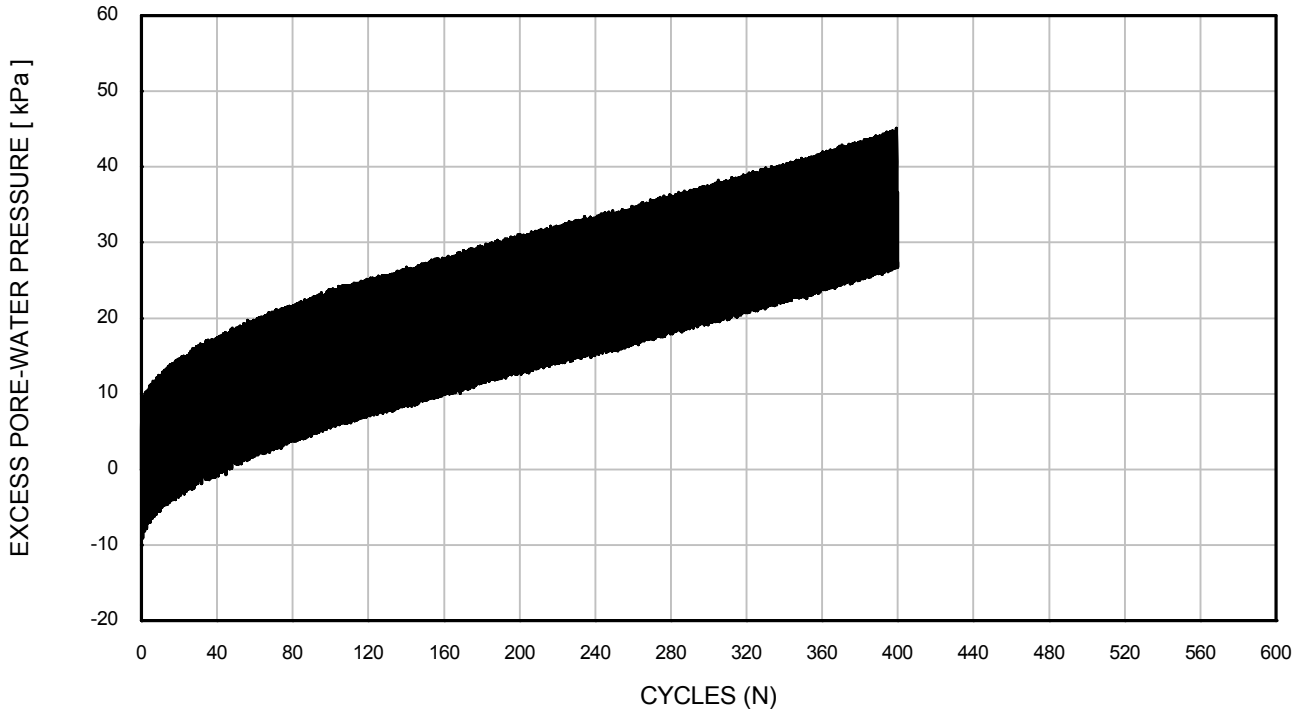
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

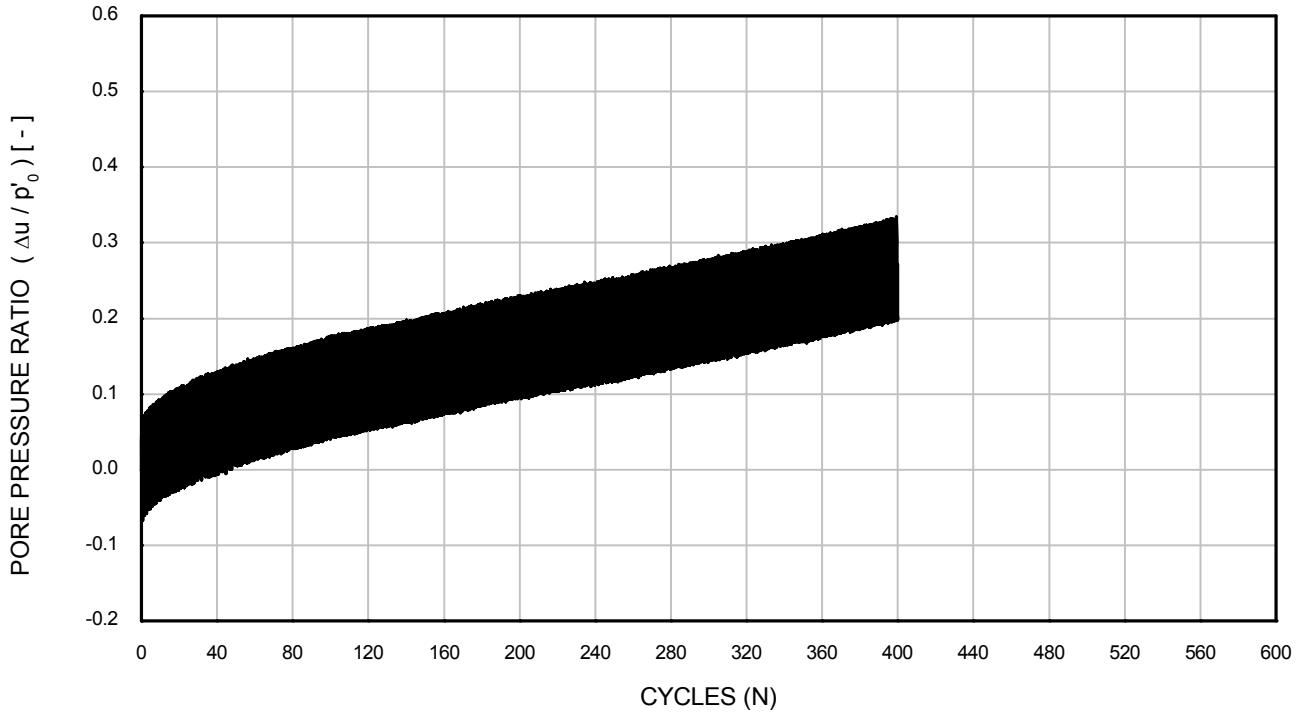




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

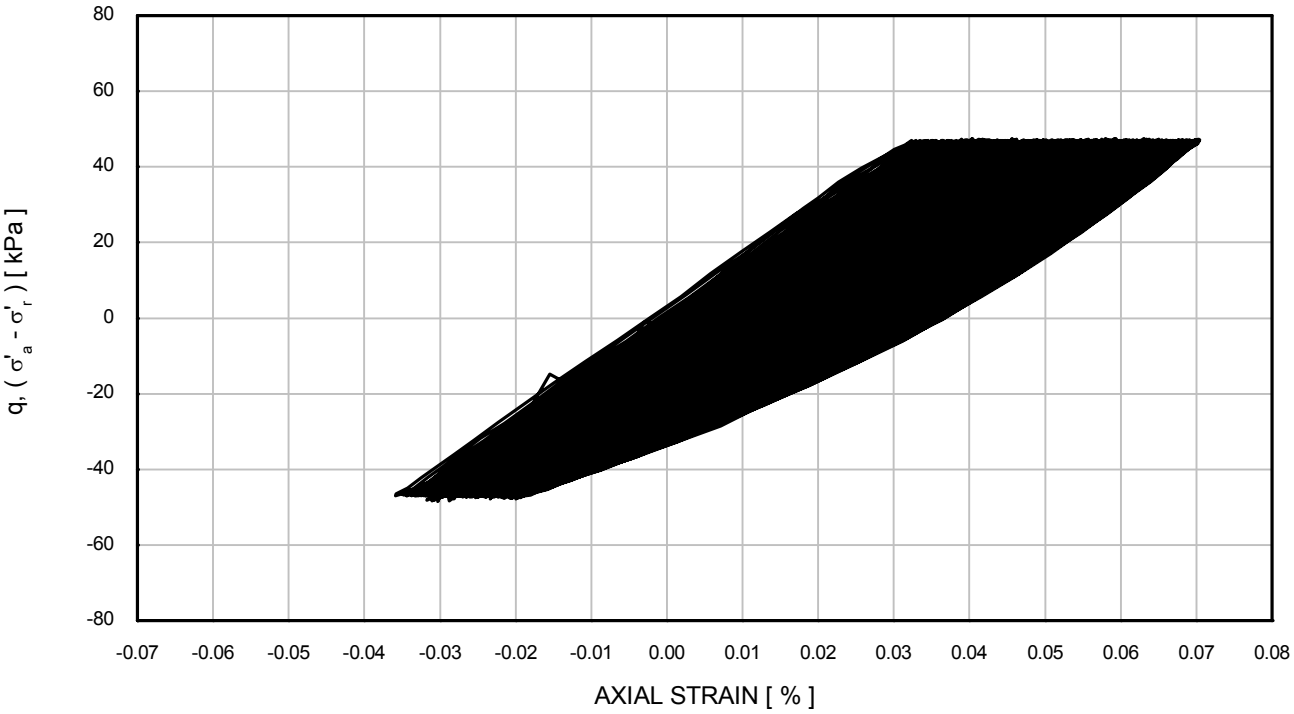
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

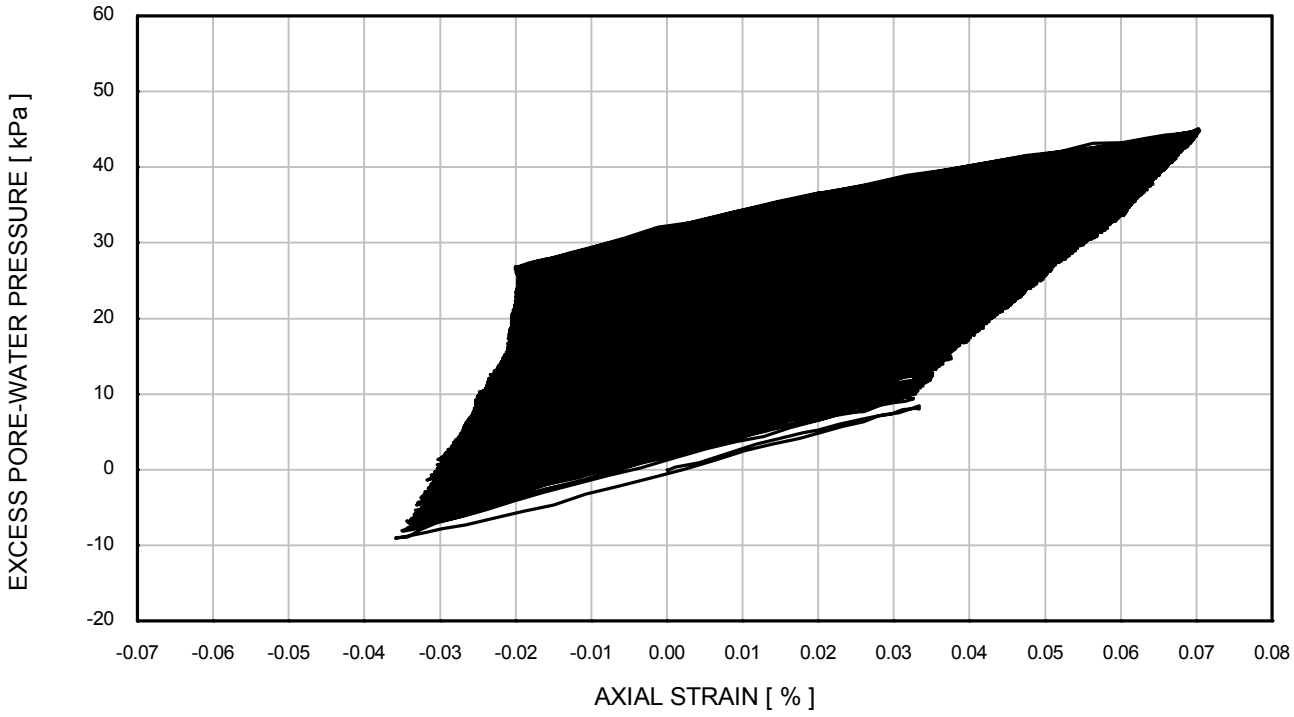




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

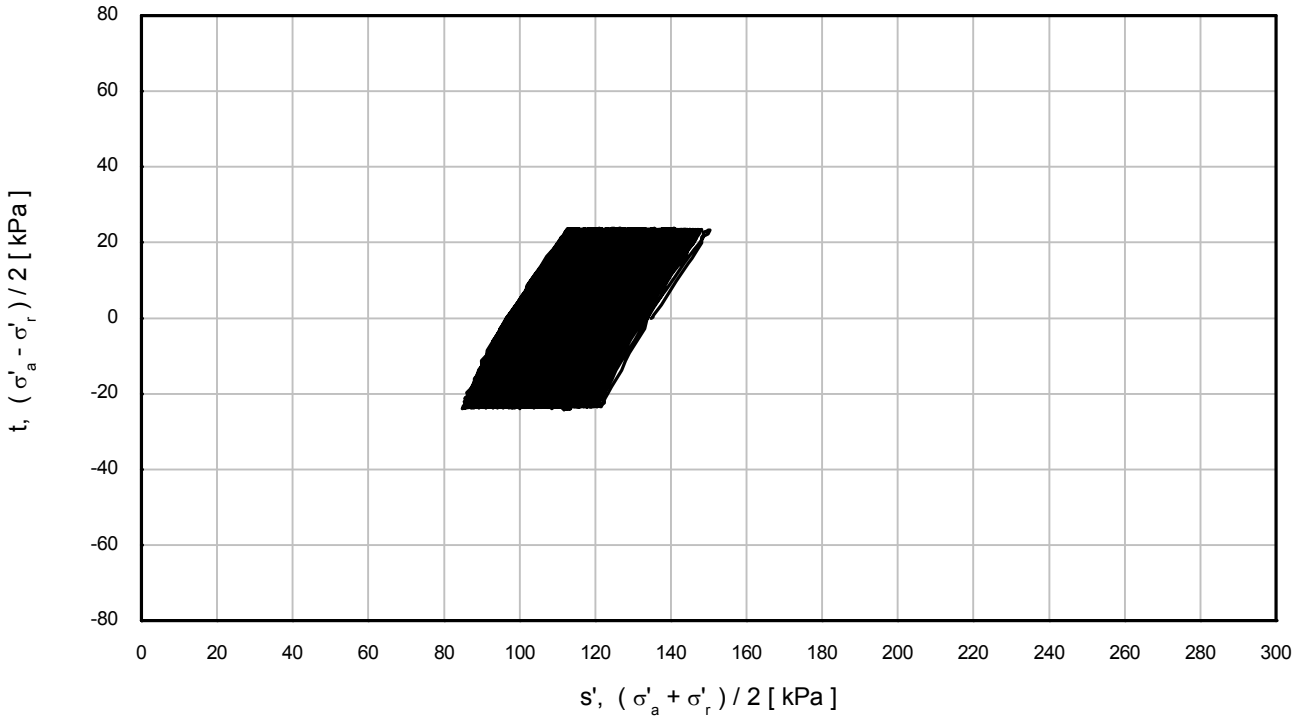
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

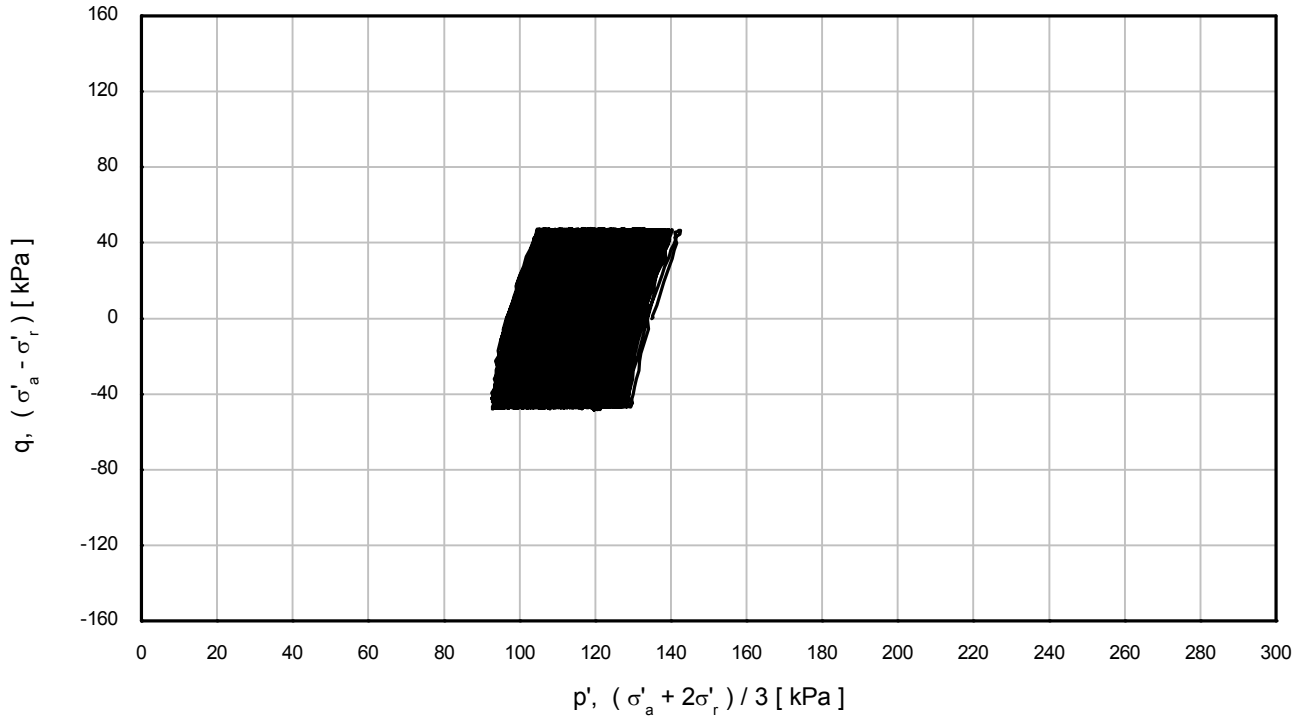




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

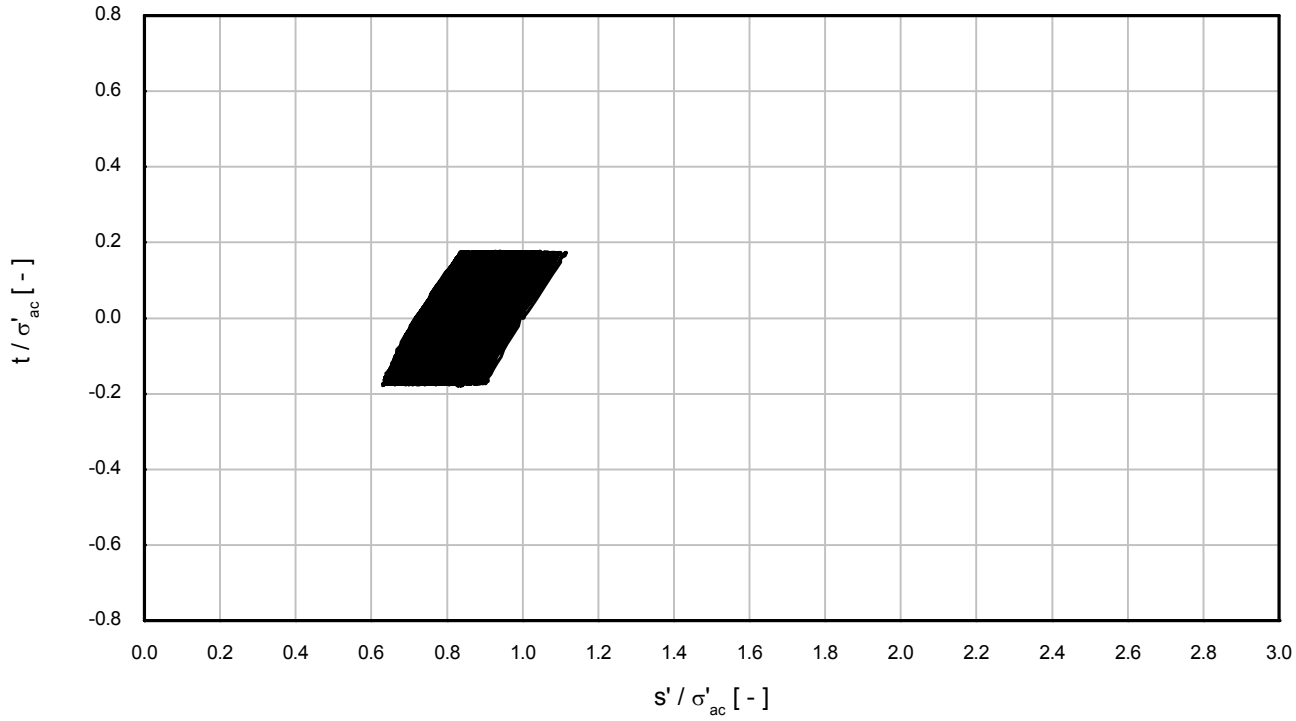
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

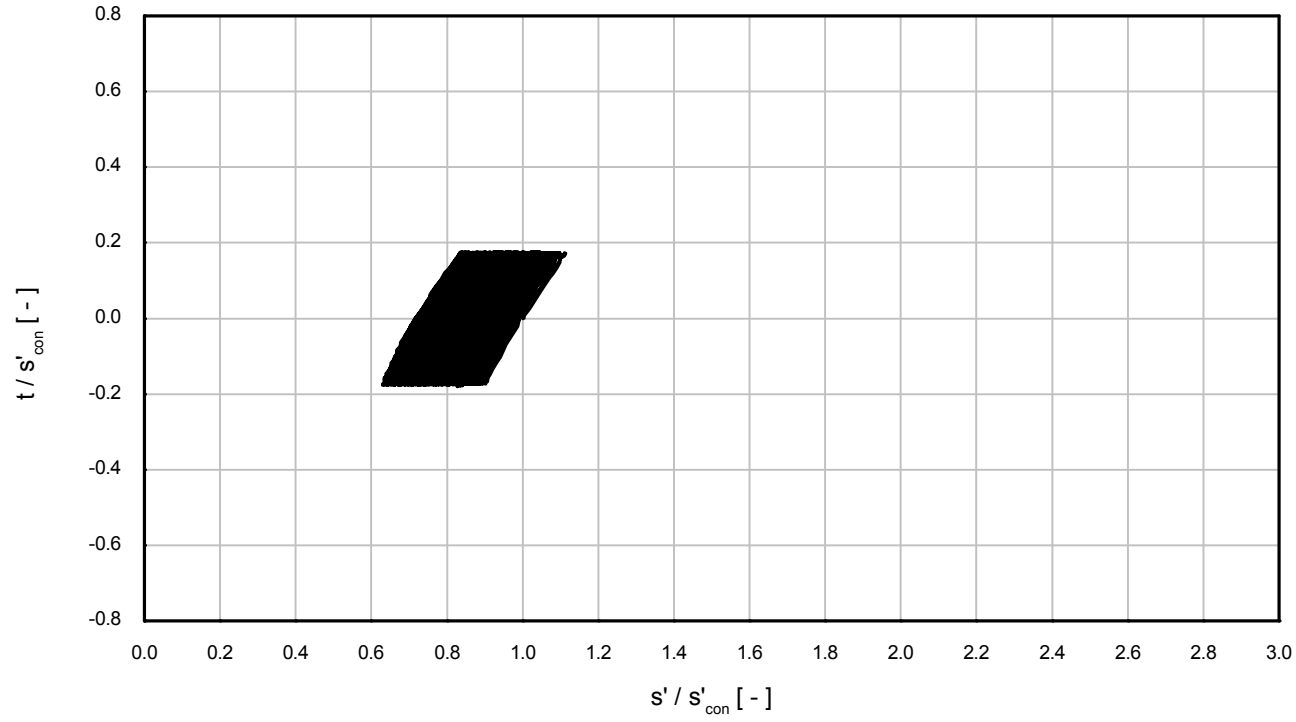




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

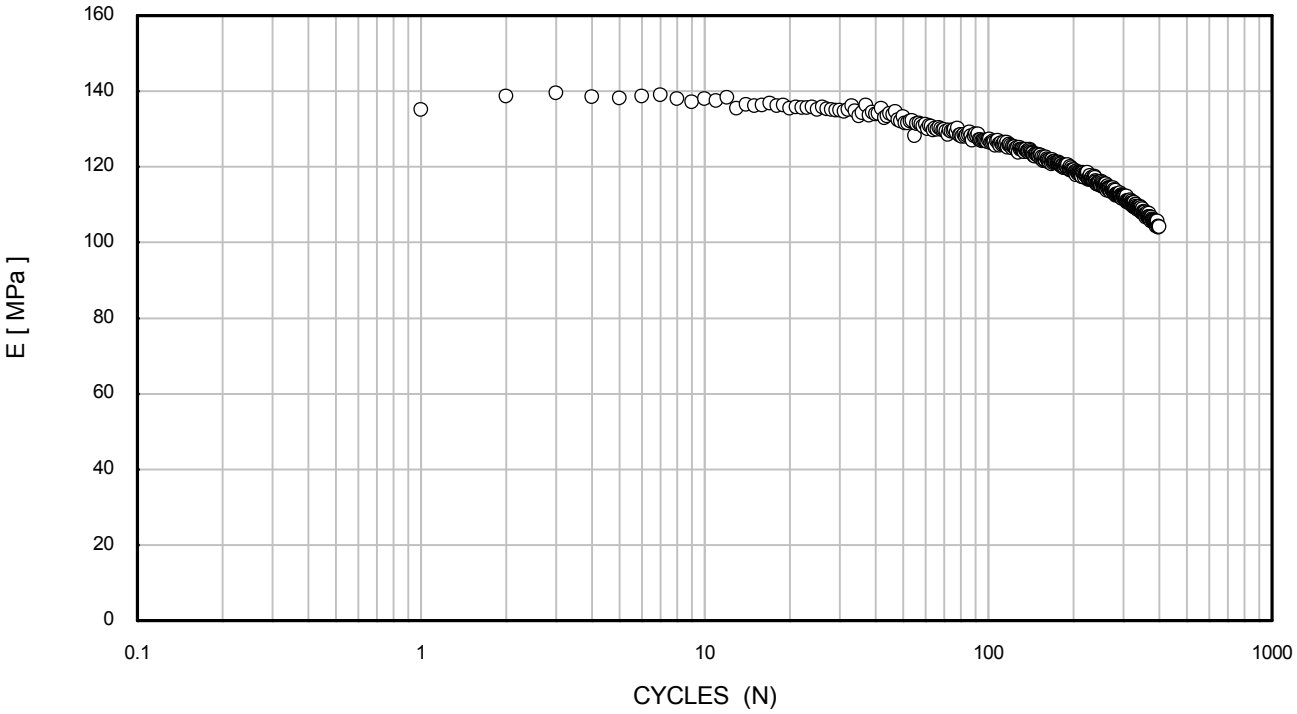
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

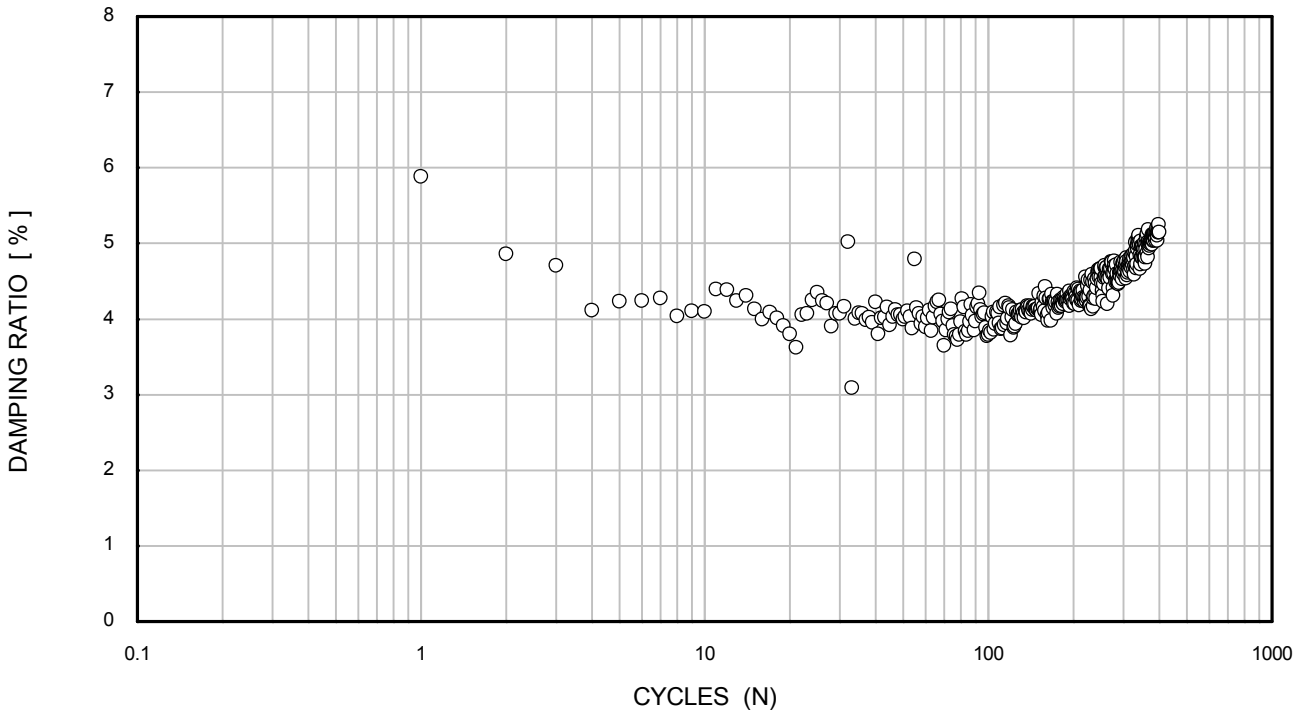




Initial σ'_r	:	135	kPa	Batch	: 3
Initial σ'_a	:	135	kPa	Sample	: CTX_3-1
q_{av}	:	0	kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	:	47	kPa	Test No.	: CTX11
Frequency	:	0.10	Hz		

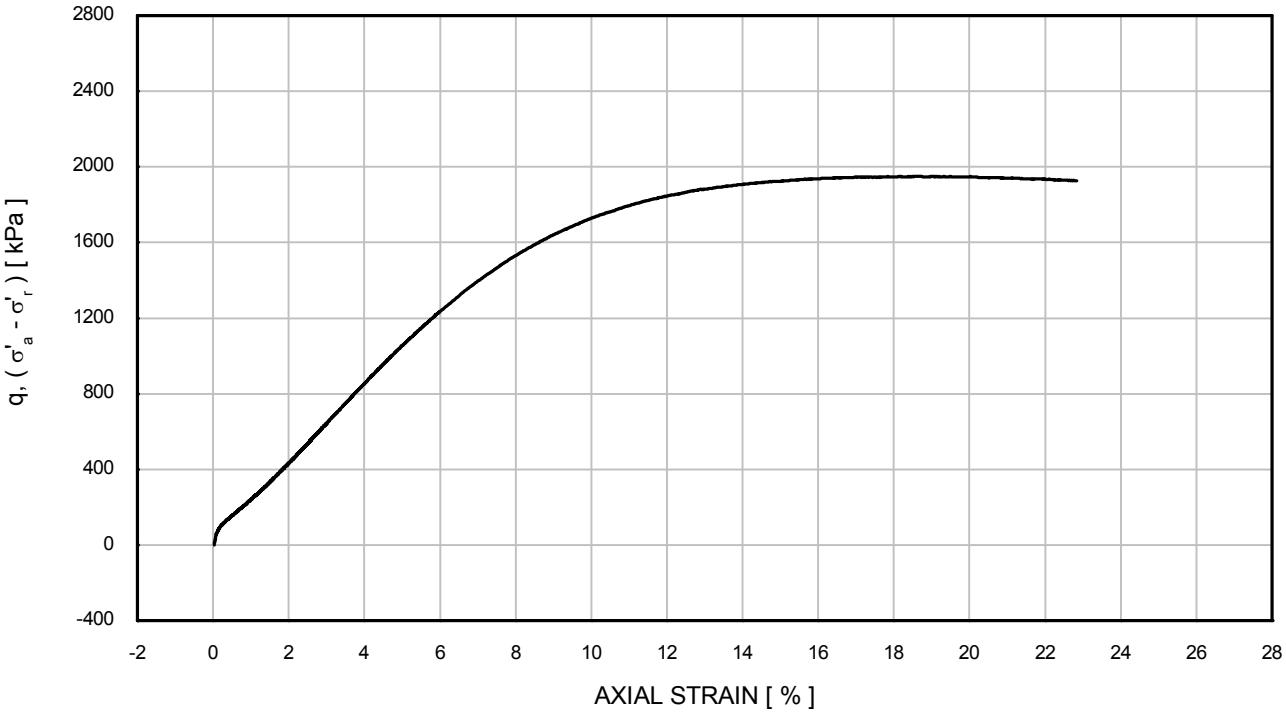
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

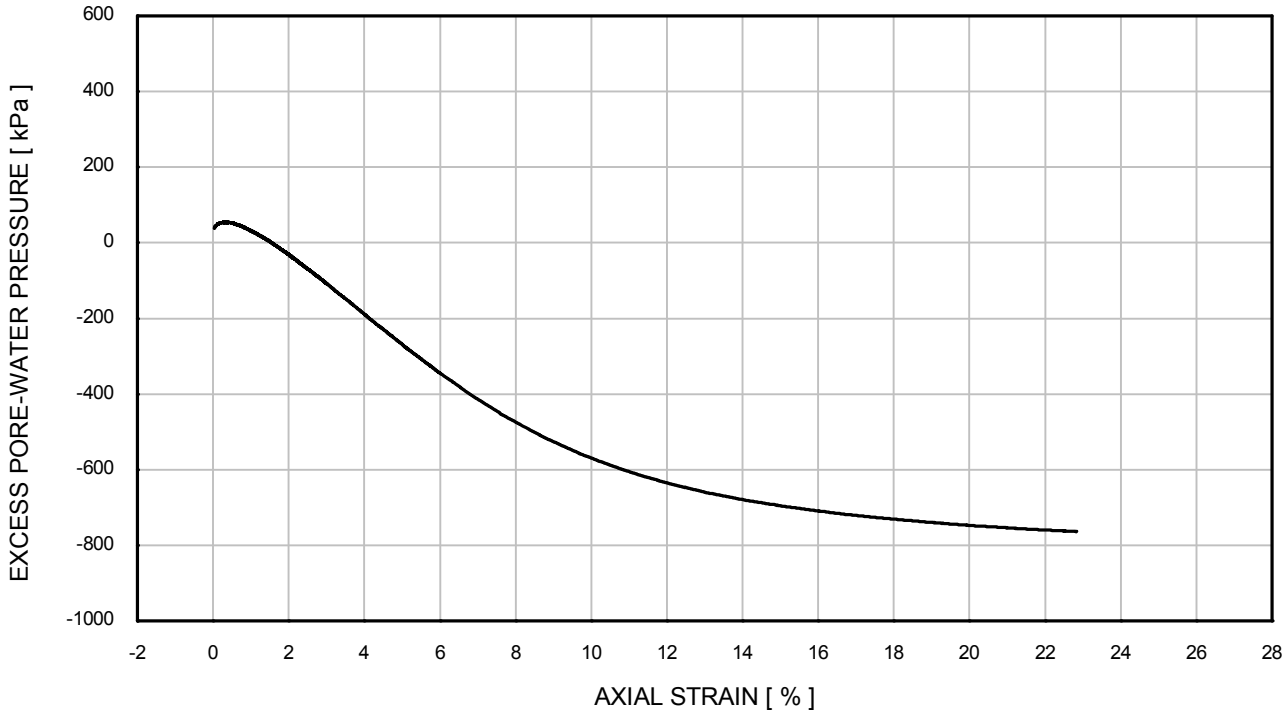




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	135 kPa	Sample	:	CTX_3-1
q_{av}	:	0 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	47 kPa	Test No.	:	CTX11
Frequency	:	0.10 Hz			

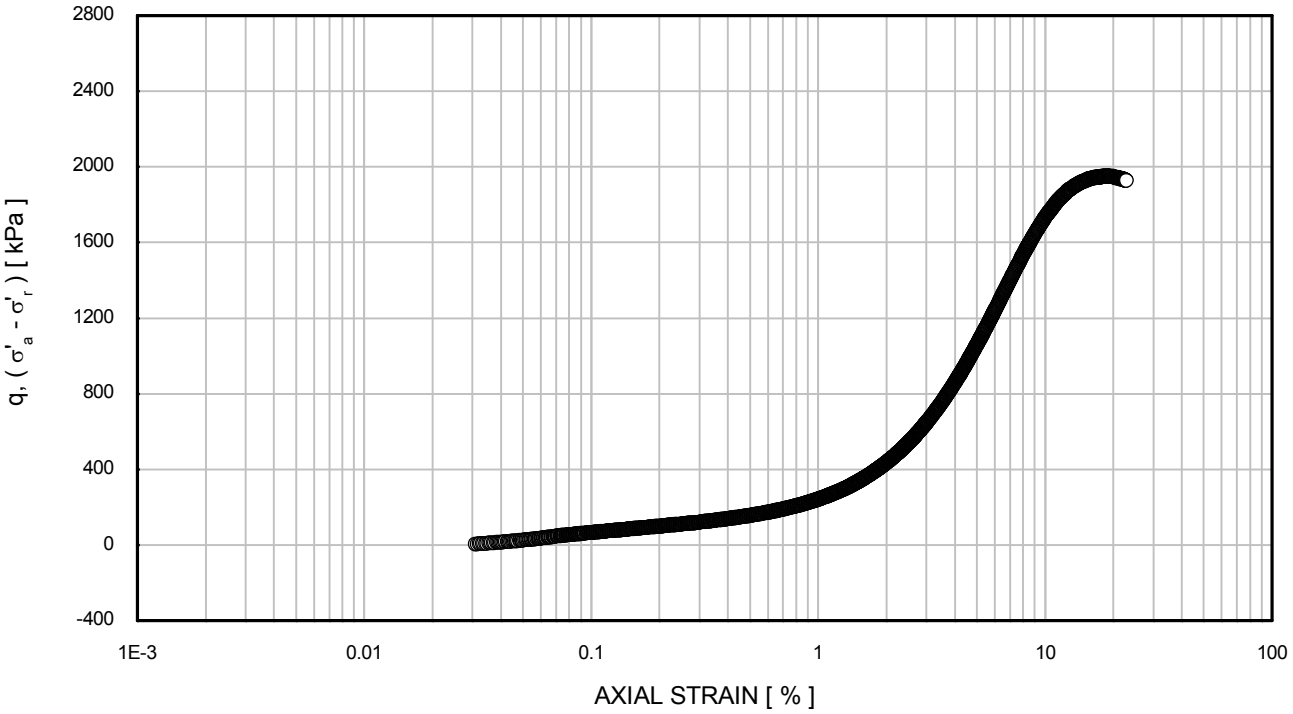
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

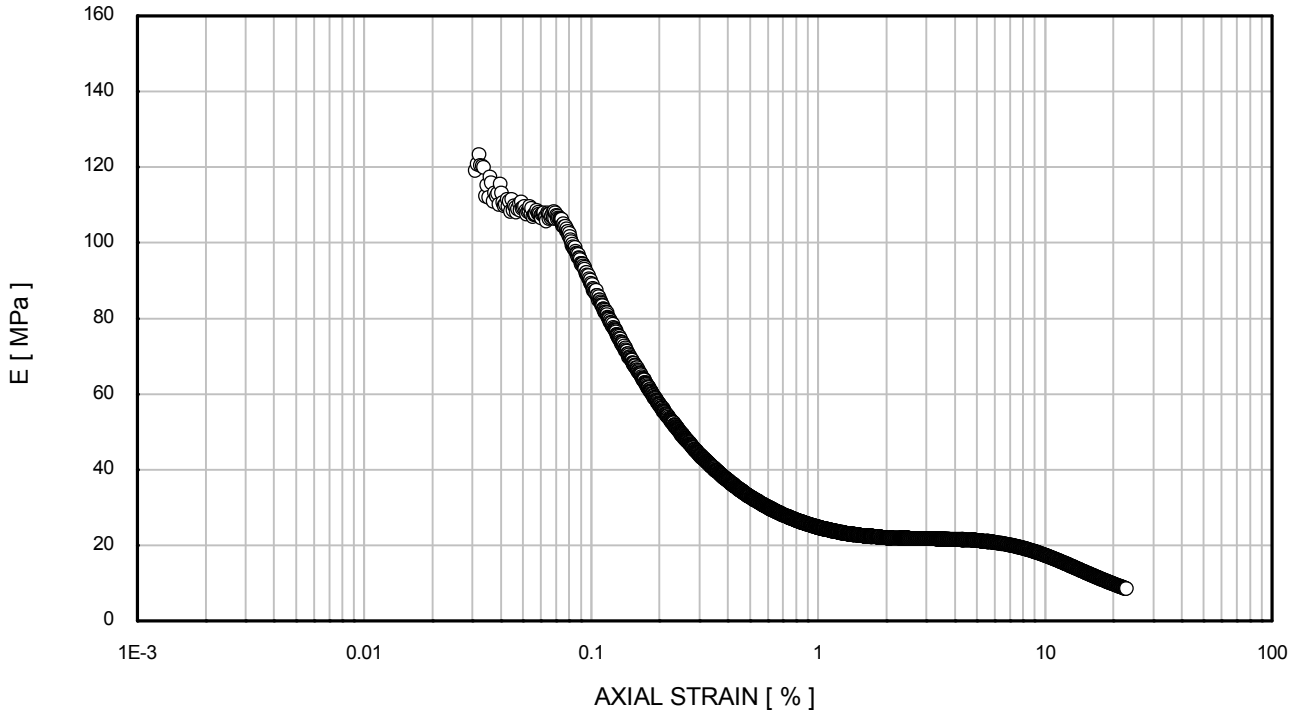




Initial σ'_r	:	97 kPa	Batch	:	3
Initial σ'_a	:	96 kPa	Sample	:	CTX_3-1
q_{peak}	:	1950 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	18.60 %	Test No.	:	CTX11
Rate of strain	:	1.00 %/hour			

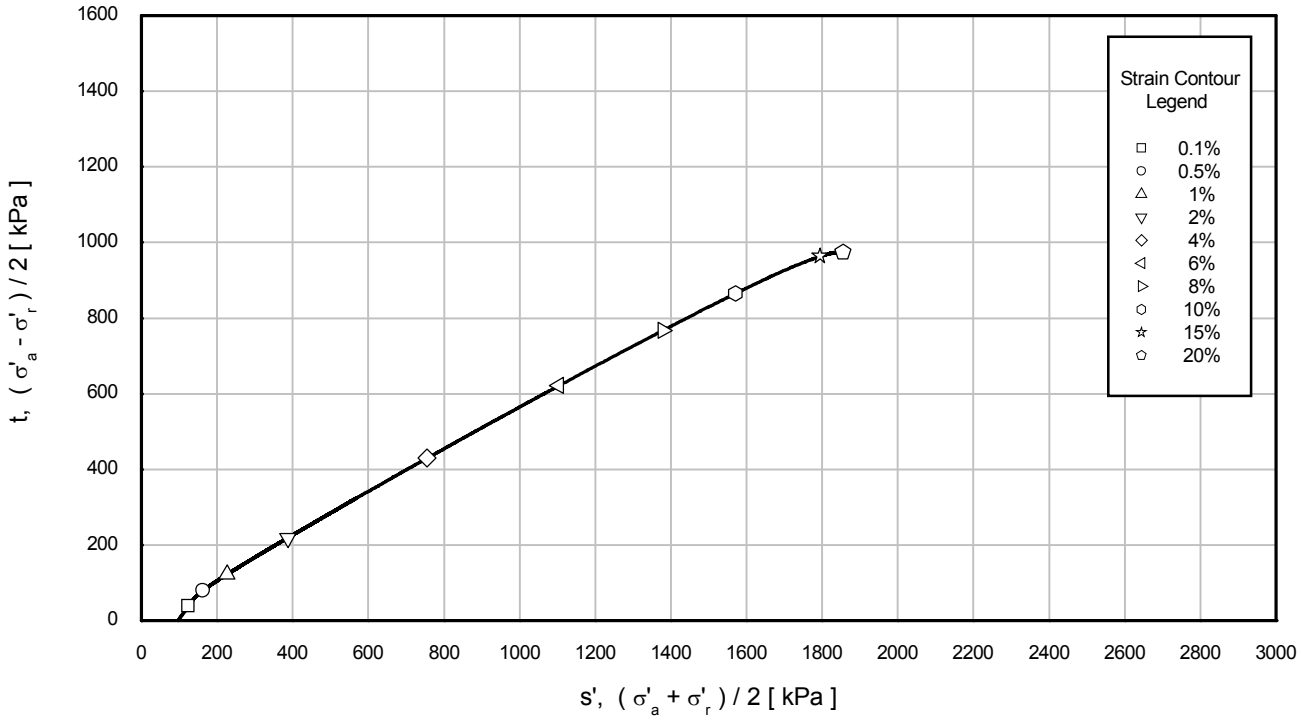
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

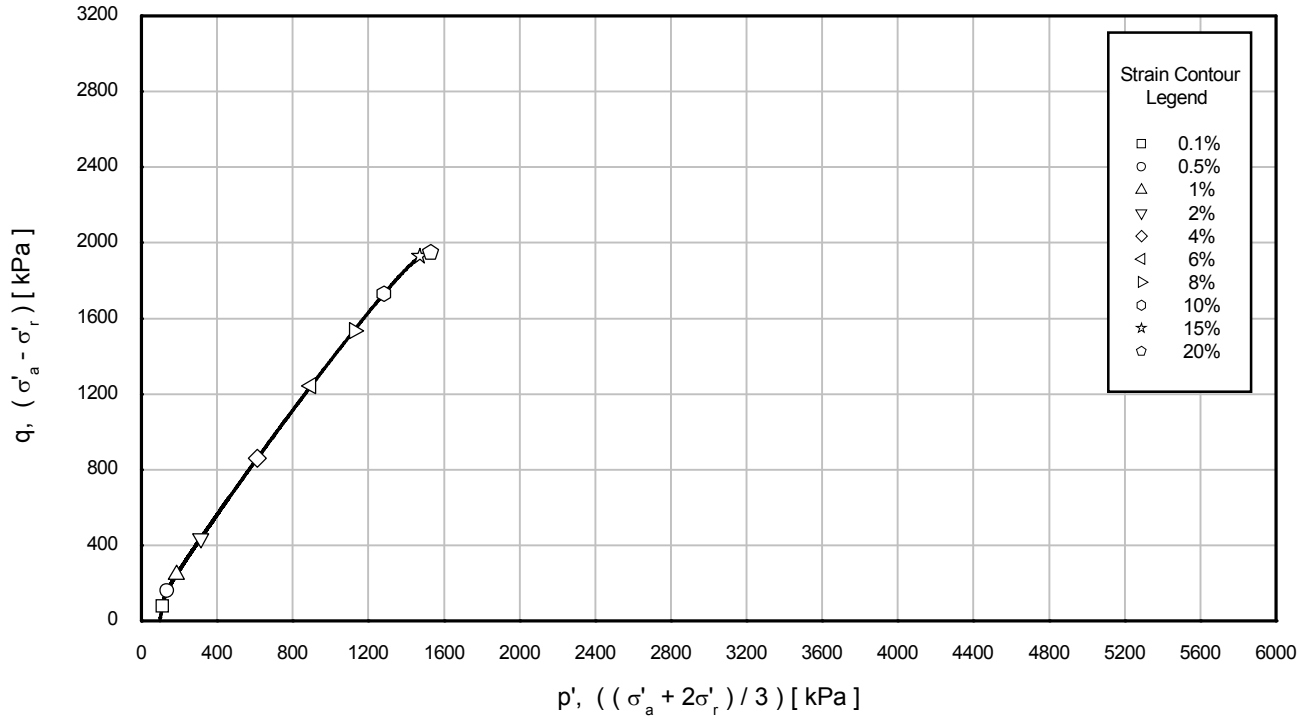




Initial σ'_r	:	97 kPa	Batch	:	3
Initial σ'_a	:	96 kPa	Sample	:	CTX_3-1
q_{peak}	:	1950 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	18.60 %	Test No.	:	CTX11
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	97	kPa	Batch	: 3
Initial σ'_a	:	96	kPa	Sample	: CTX_3-1
q_{peak}	:	1950	kPa	Unit	: Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	18.60	%	Test No.	: CTX11
Rate of strain	:	1.00	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark yellowish brown fine SAND

GENERAL	
Date test started	23/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.2
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.680
Degree of saturation	[%]	40
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 05_CTX20
Processed by Date	MSR 06/01/2017
Checked by Date	PH 10/01/2017
Approved by Date	PH 10/01/2017

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1112
Back pressure	[kPa]	887
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	225
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	1.18
External axial strain	[%]	0.46
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.661
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 1		
Cell pressure	[kPa]	1112
Back pressure	[kPa]	887
Base PWP	[kPa]	880
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	232
Effective axial pressure	[kPa]	264
Deviator stress	[kPa]	32
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.661
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	640
Mean q_{av}	[kPa]	32
Mean q_{cy}	[kPa]	64
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	-0.01
External ε_{cy} at N_f	[%]	0.06
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	96
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.661
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.05	0.05	134	-	2.28	-
2	-0.05	0.04	143	-	4.46	-
5	-0.06	0.04	145	-	4.71	-
10	-0.06	0.04	142	-	4.65	-
20	-0.06	0.05	142	-	4.82	-
30	-0.05	0.05	141	-	5.14	-
40	-0.05	0.05	139	-	5.15	-
50	-0.05	0.05	139	-	5.03	-
100	-0.05	0.05	135	-	5.25	-
500	-0.04	0.05	125	-	5.27	-
1000	-0.03	0.05	117	-	4.99	-
1500	-0.01	0.06	106	-	3.61	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 2		
Cell pressure	[kPa]	1112
Back pressure	[kPa]	887
Base PWP	[kPa]	883
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	229
Effective axial pressure	[kPa]	293
Deviator stress	[kPa]	64
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.661
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	640
Mean q_{av}	[kPa]	64
Mean q_{cy}	[kPa]	96
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.02
External ε_{cy} at N_f	[%]	0.07
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	55
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.661
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.03	0.06	161	-	1.01	-
2	-0.03	0.06	163	-	1.94	-
5	-0.03	0.06	161	-	2.17	-
10	-0.03	0.06	159	-	2.19	-
20	-0.03	0.06	157	-	2.36	-
30	-0.02	0.06	156	-	2.19	-
40	-0.02	0.06	156	-	2.29	-
50	-0.02	0.06	154	-	2.27	-
100	-0.01	0.06	151	-	2.12	-
200	0.00	0.07	146	-	1.94	-
300	0.01	0.07	142	-	1.65	-
400	0.02	0.07	136	-	1.28	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	167
Initial effective axial pressure	[kPa]	231
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	1870
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	20.34
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-640
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	866
Effective axial pressure	[kPa]	2736
Principal effective stress ratio	[-]	3.16
ε_{50}	[%]	4.19
Secant modulus (E_{50}) at ε_{50}	[kPa]	21791
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	663
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	2.35
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-36
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	260
Effective axial pressure	[kPa]	924
Principal effective stress ratio	[-]	3.55
At 15% external axial strain		
Corrected deviator stress	[kPa]	1807
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-577
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	801
Effective axial pressure	[kPa]	2609
Principal effective stress ratio	[-]	3.26

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





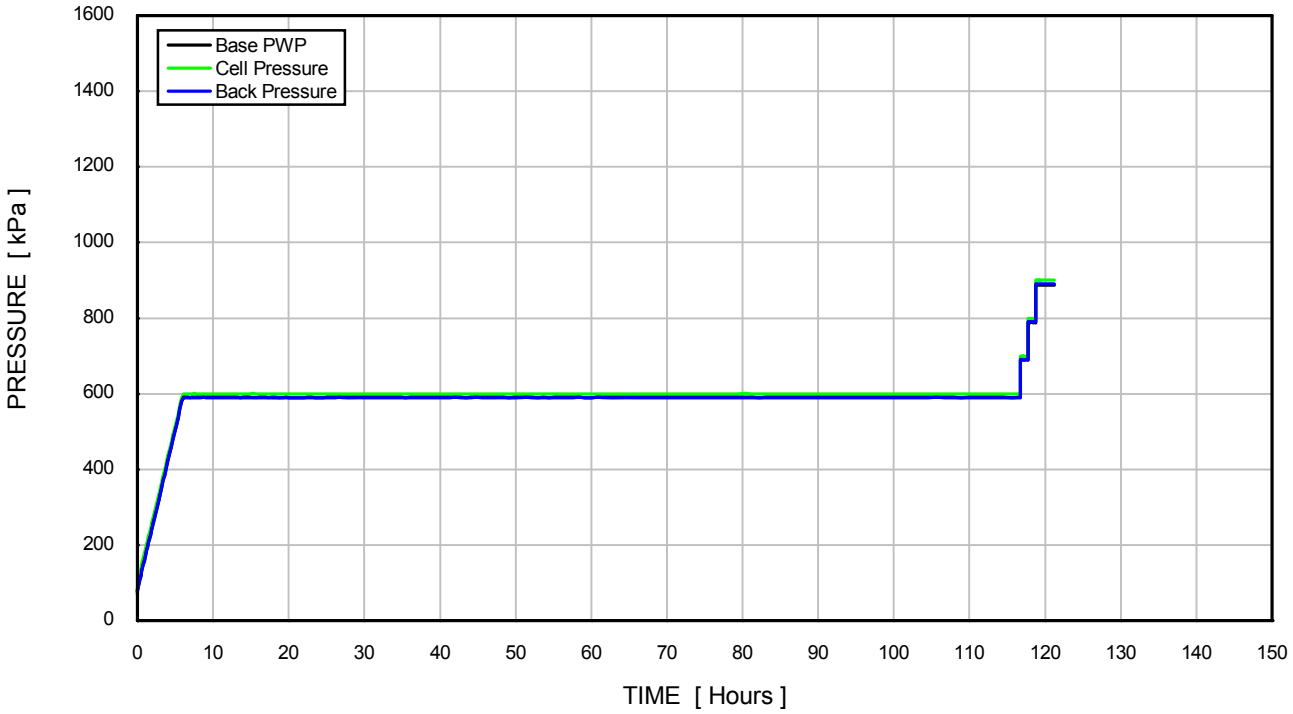
FINAL CONDITIONS

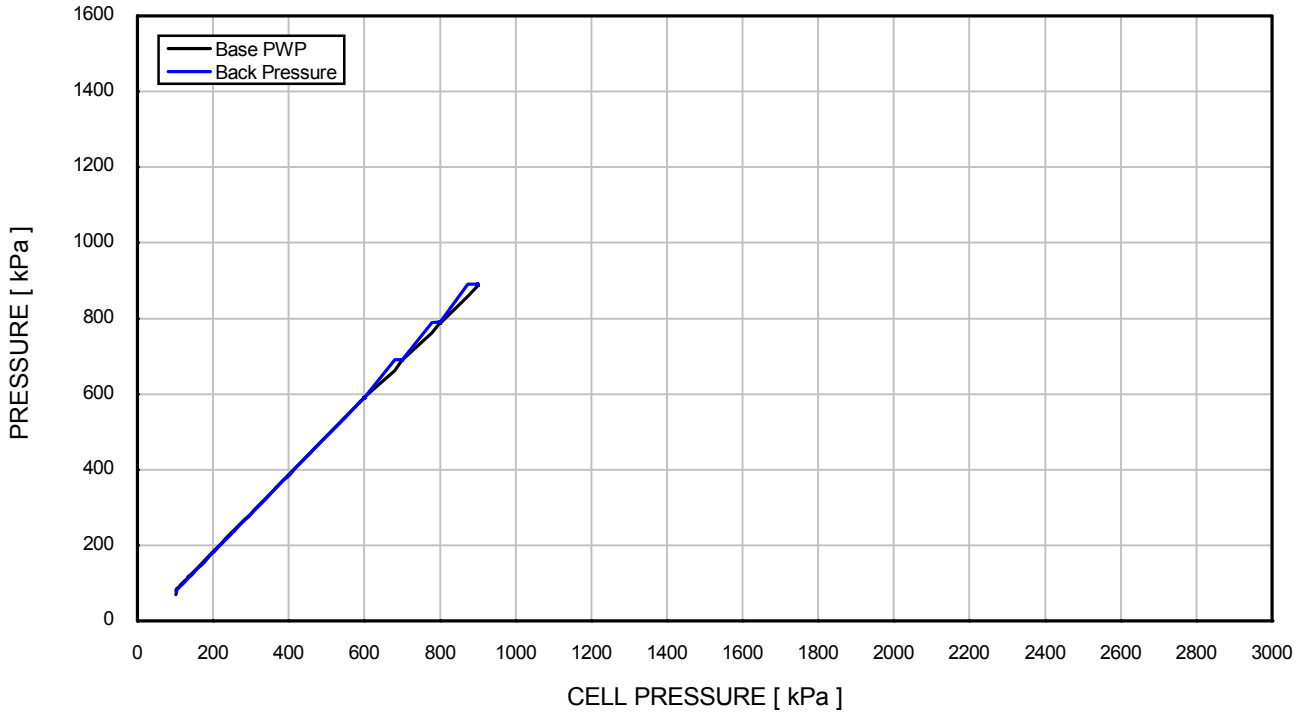
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Batch	5
Sample	CTX_5-1
Unit	Unit C2 (Eem)
Test number	CTX20

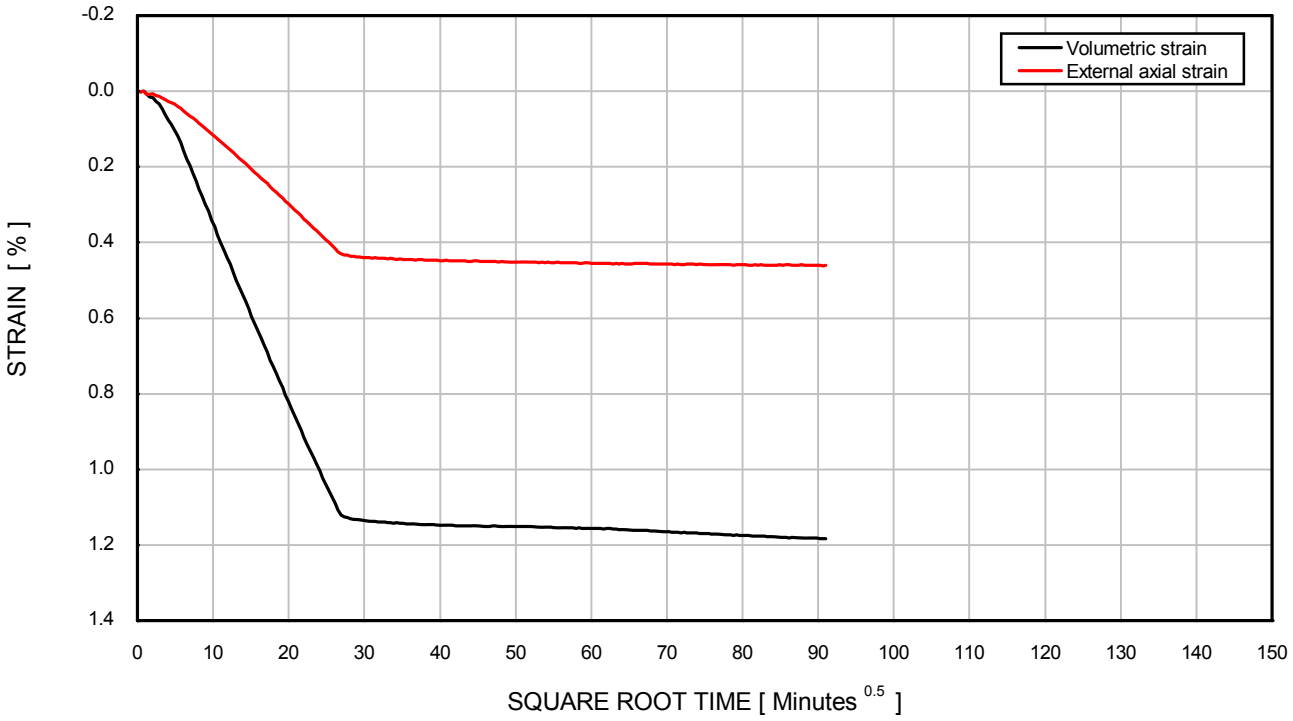
SUMMARY OF ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

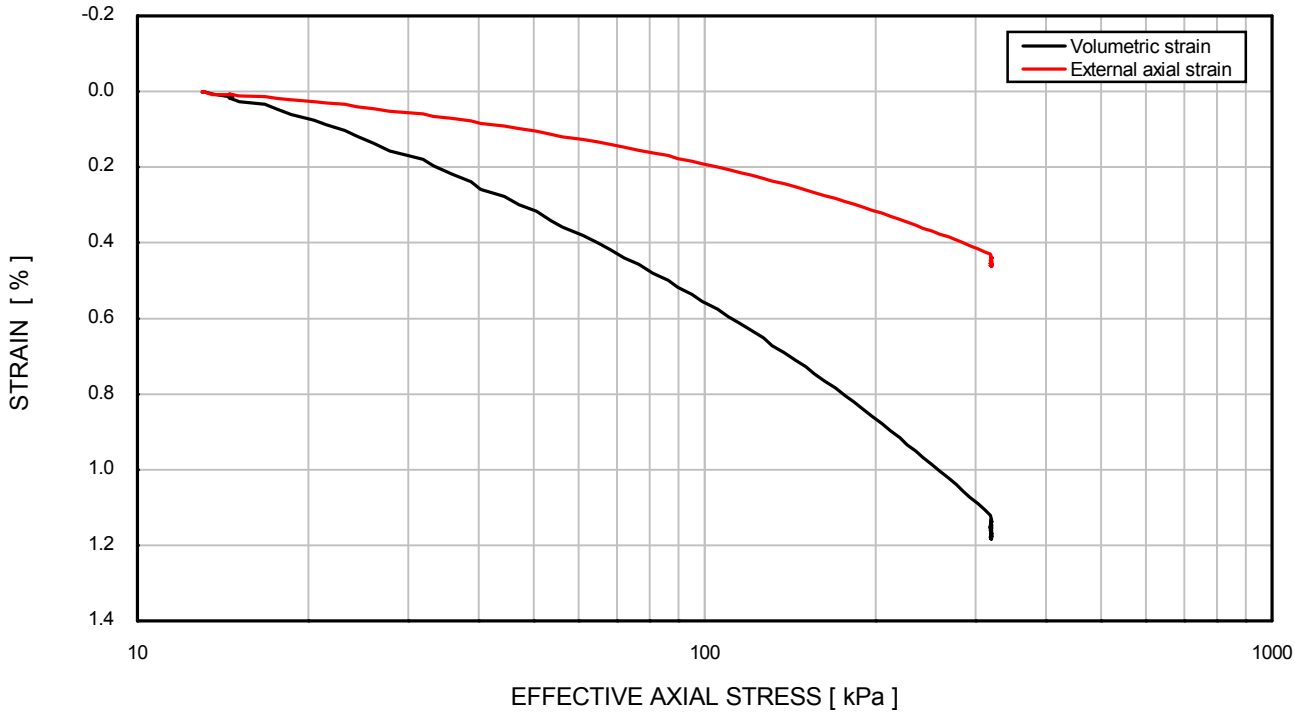




B value	:	1.00	Batch	:	5
Initial σ'_r	:	33 kPa	Sample	:	CTX_5-1
Initial σ'_a	:	33 kPa	Unit	:	Unit C2 (Eem)
Final σ'_r	:	13 kPa	Test No.	:	CTX20
Final σ'_a	:	13 kPa			

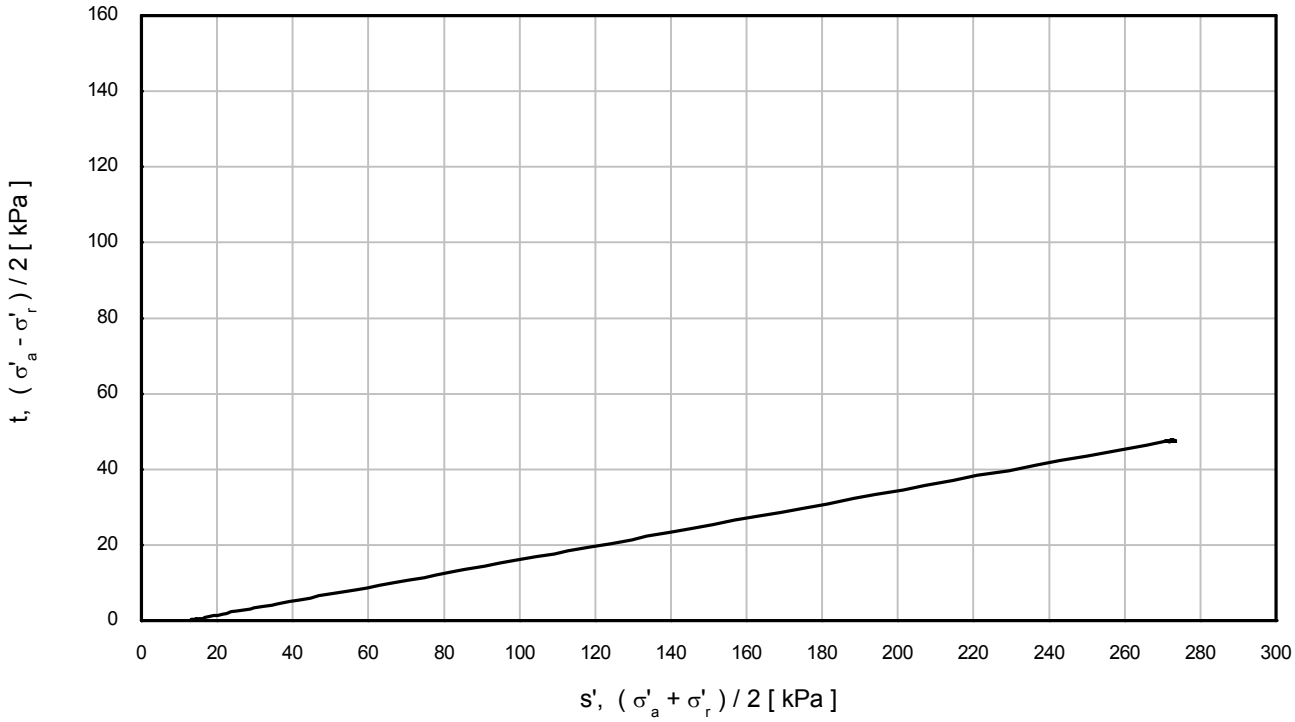
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

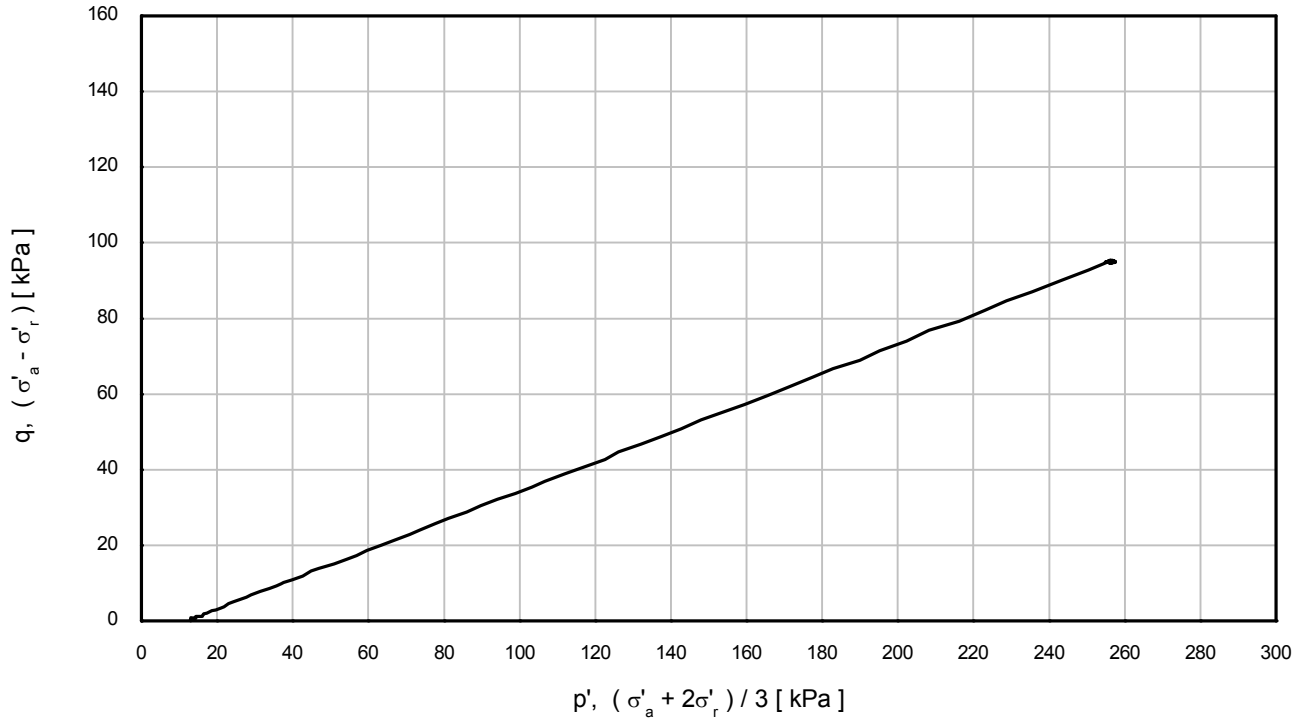




Stage 1 σ'_{rc}	:	225 kPa	Batch	:	5
Stage 1 σ'_{ac}	:	320 kPa	Sample	:	CTX_5-1
			Unit	:	Unit C2 (Eem)
			Test No.	:	CTX20

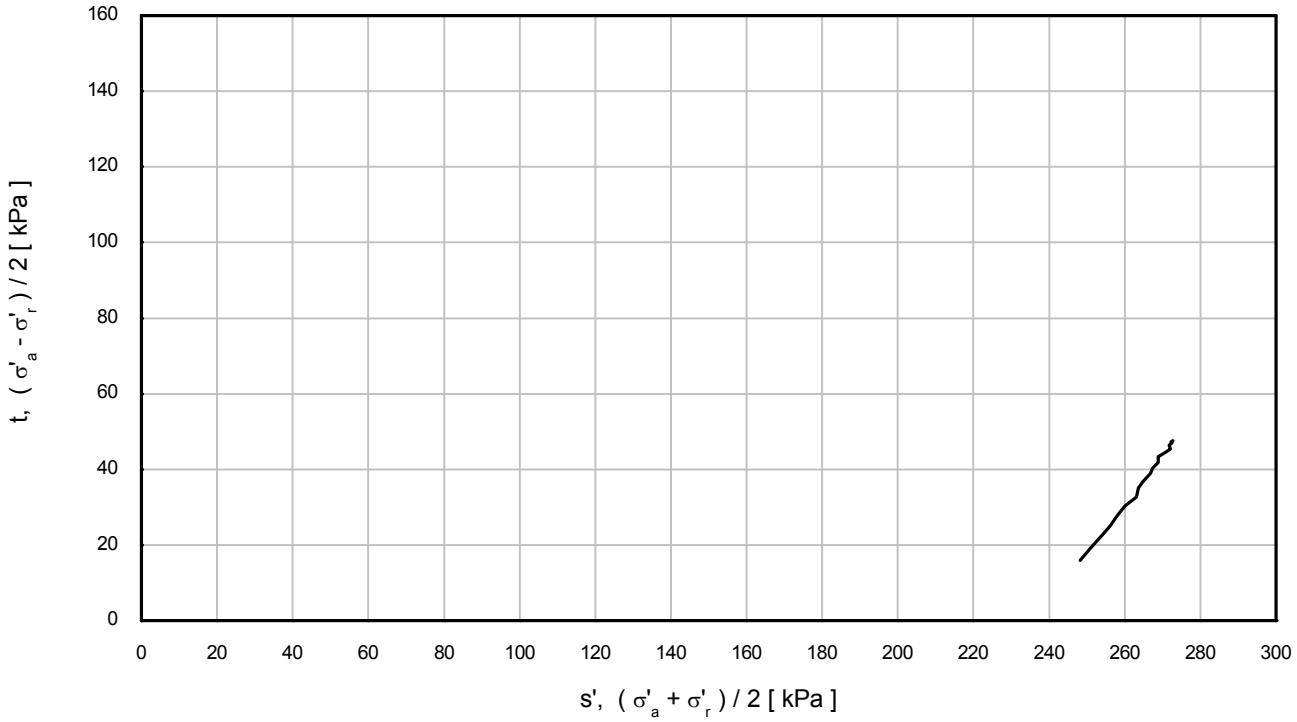
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

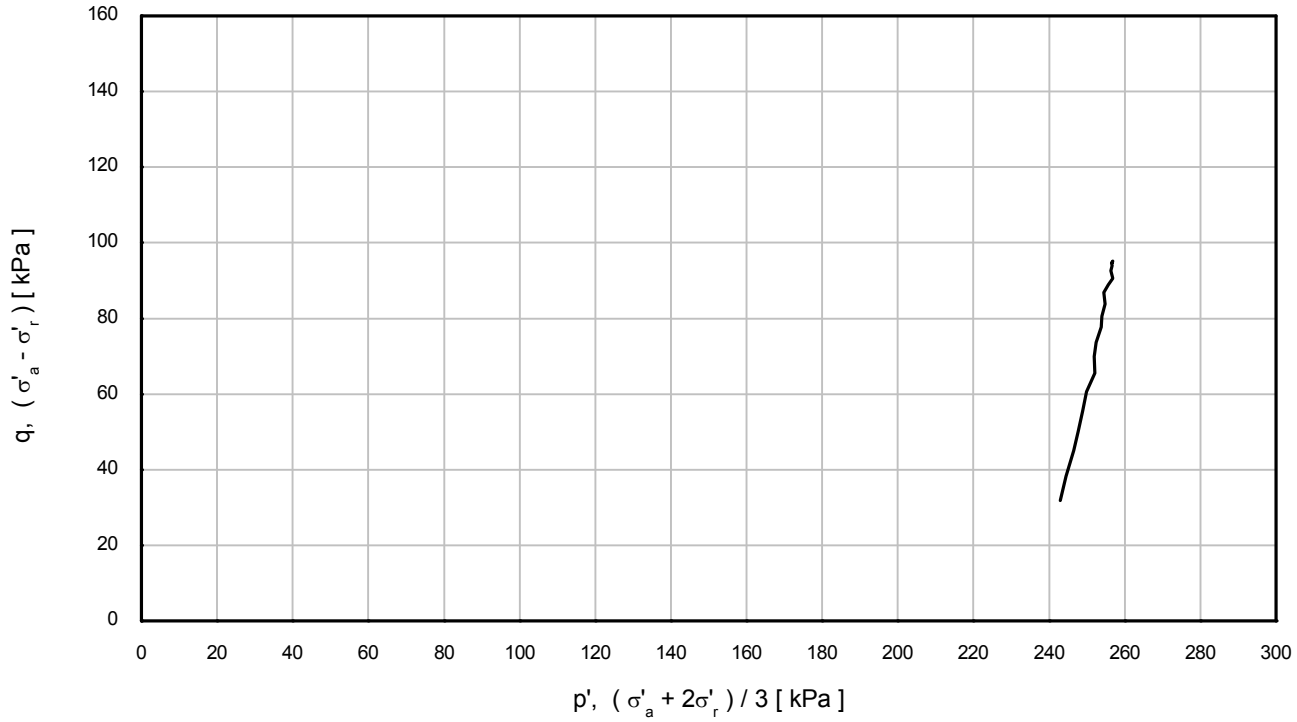




Stage 1 σ'_{rc}	: 225 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-1
		Unit	: Unit C2 (Eem)
		Test No.	: CTX20

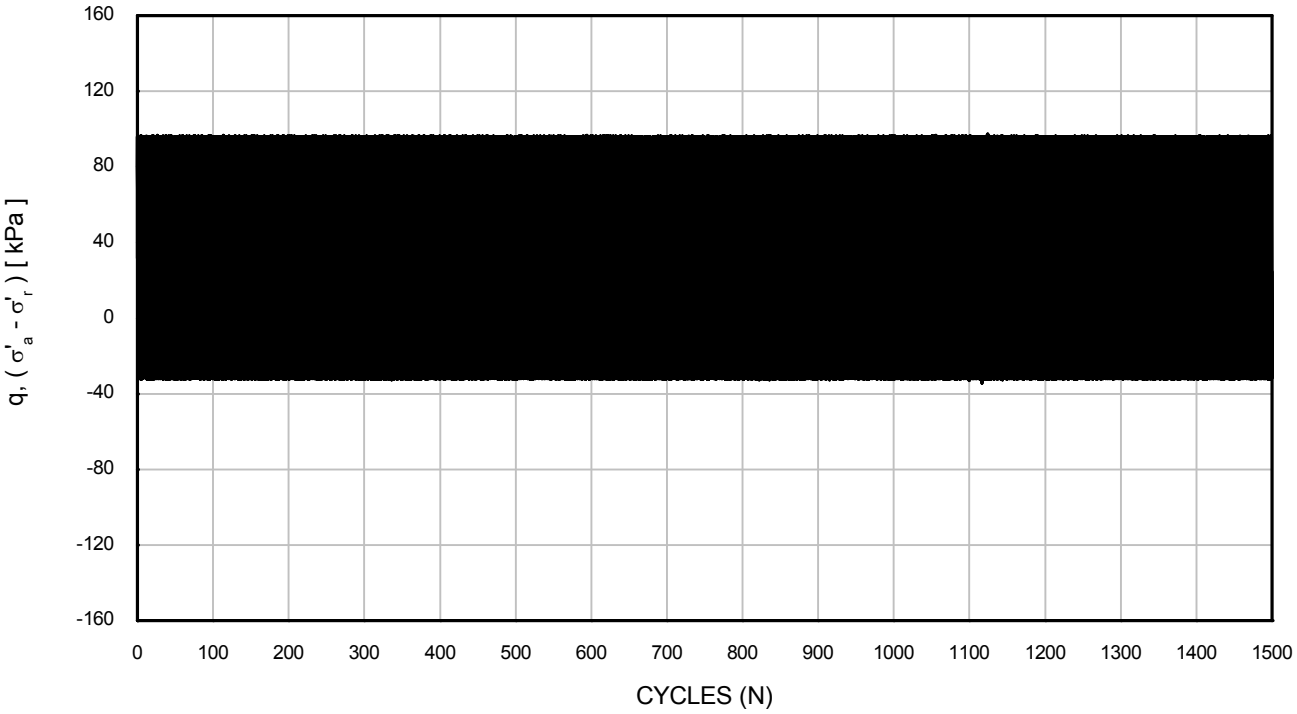
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

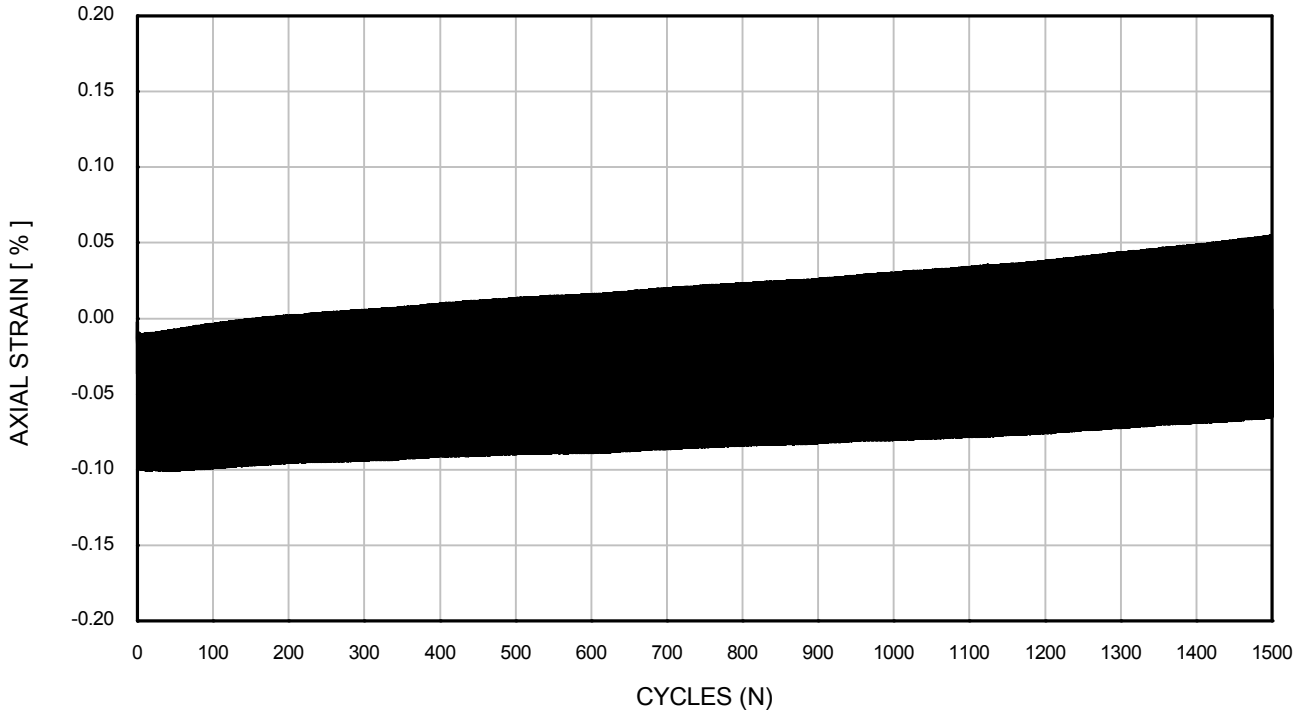




σ'_{rc}	: 232 kPa	Batch	: 5
σ'_{ac}	: 264 kPa	Sample	: CTX_5-1
		Unit	: Unit C2 (Eem)
		Test No.	: CTX20

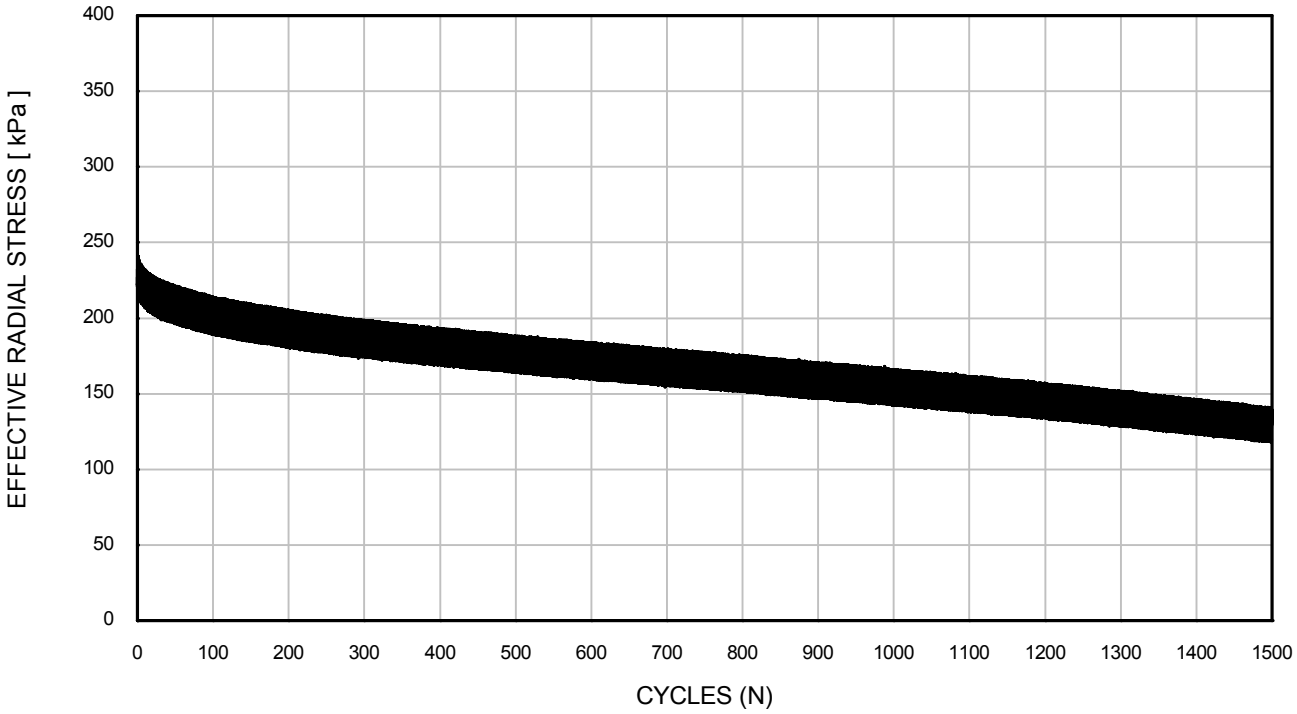
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

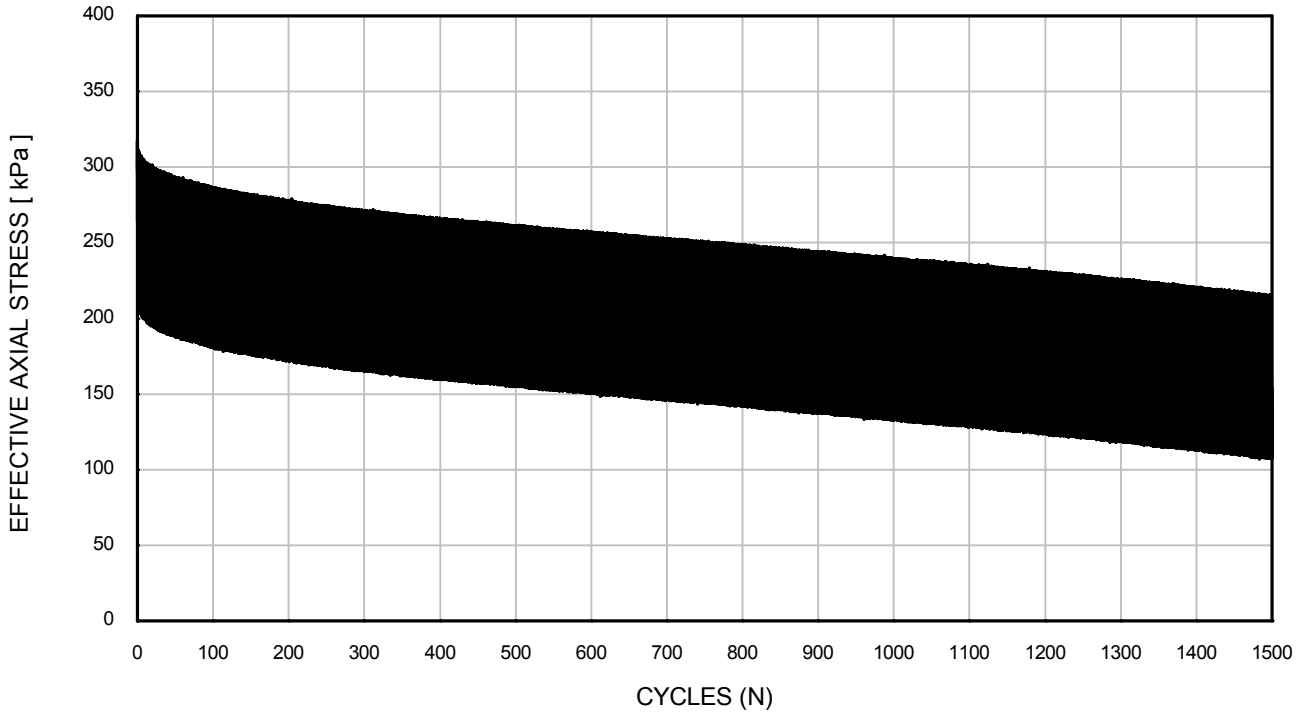




Initial σ'_r	:	232 kPa	Batch	:	5
Initial σ'_a	:	264 kPa	Sample	:	CTX_5-1
q_{av}	:	32 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

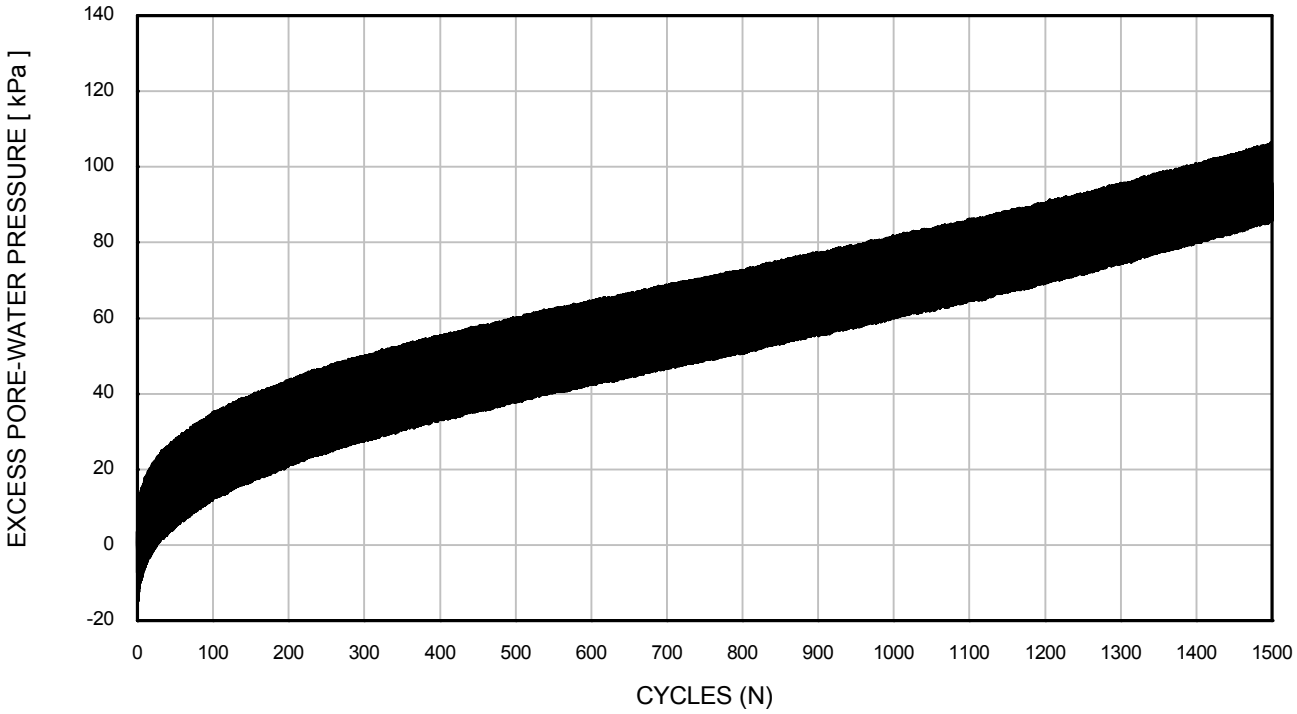
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

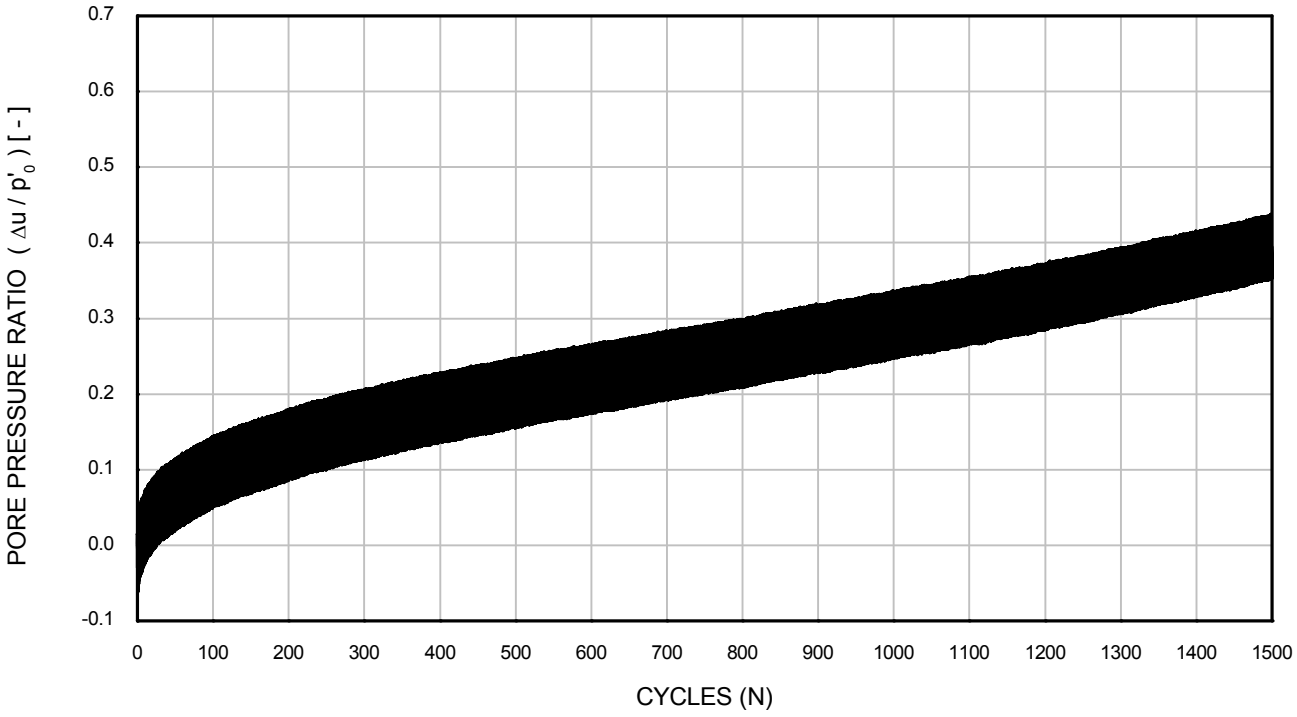




Initial σ'_r	:	232 kPa	Batch	:	5
Initial σ'_a	:	264 kPa	Sample	:	CTX_5-1
q_{av}	:	32 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

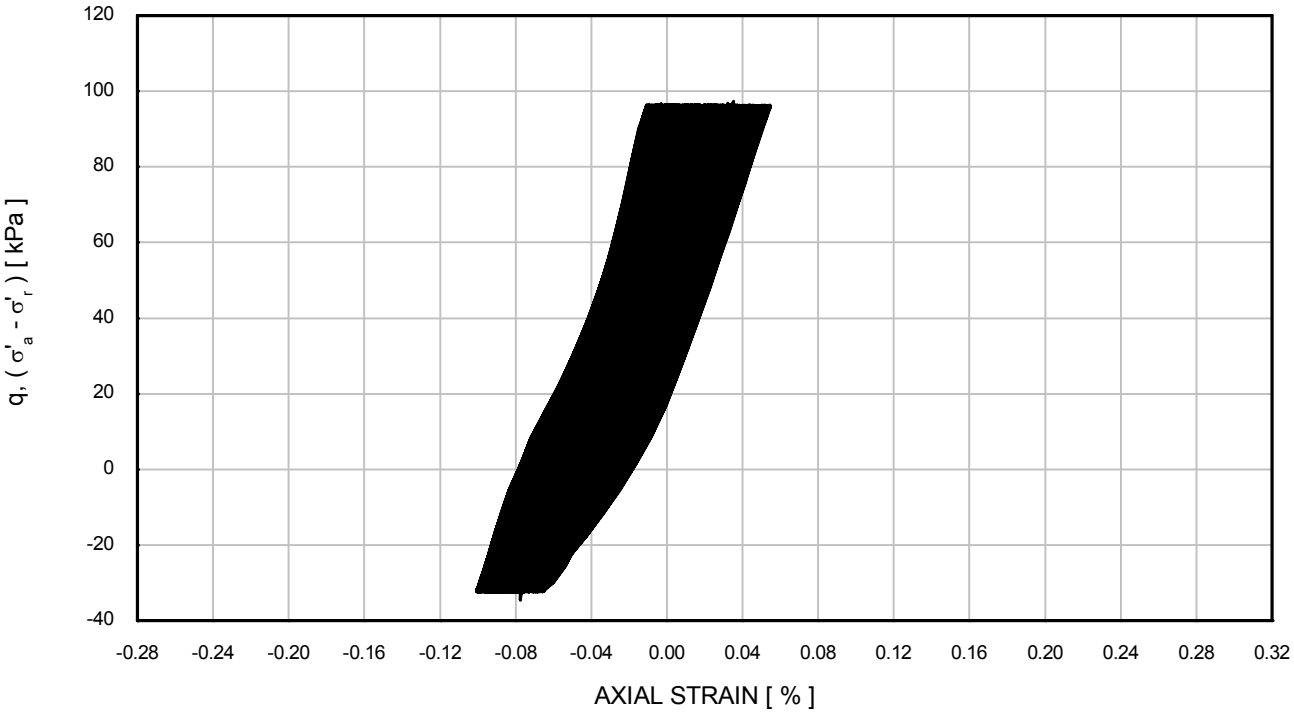
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

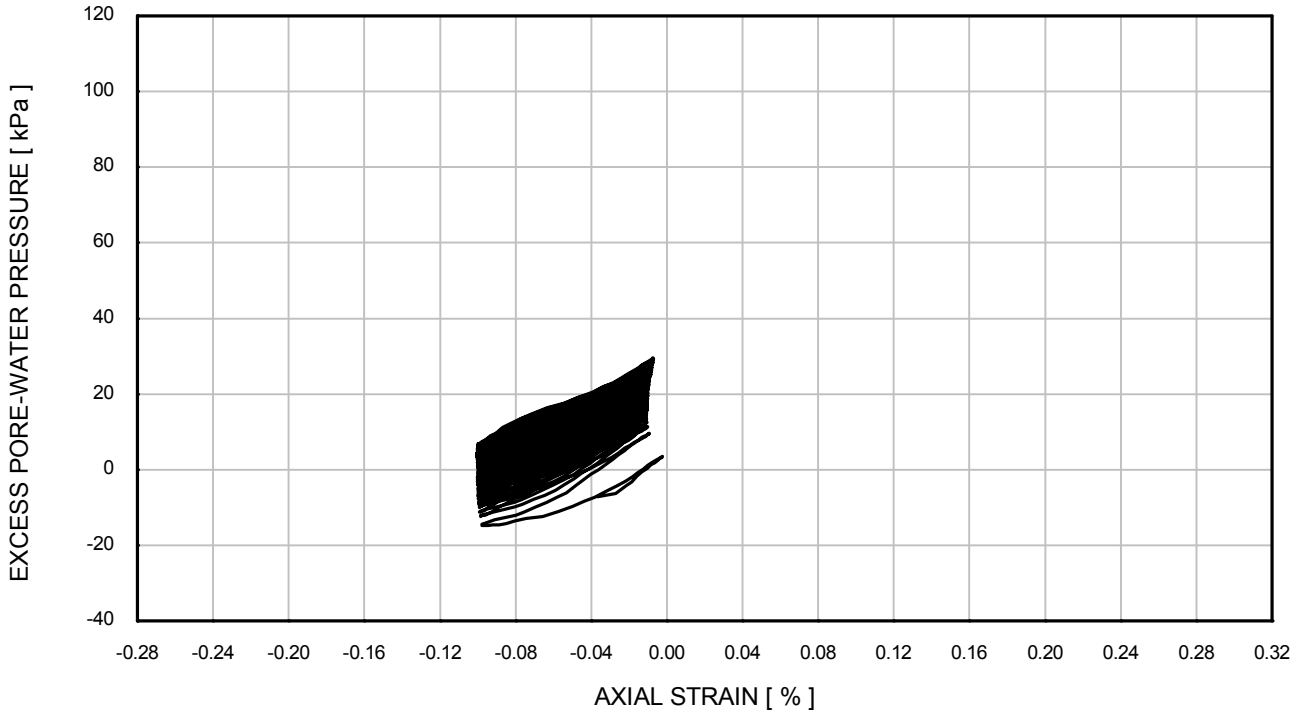




Initial σ'_r	:	232 kPa	Batch	:	5
Initial σ'_a	:	264 kPa	Sample	:	CTX_5-1
q_{av}	:	32 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

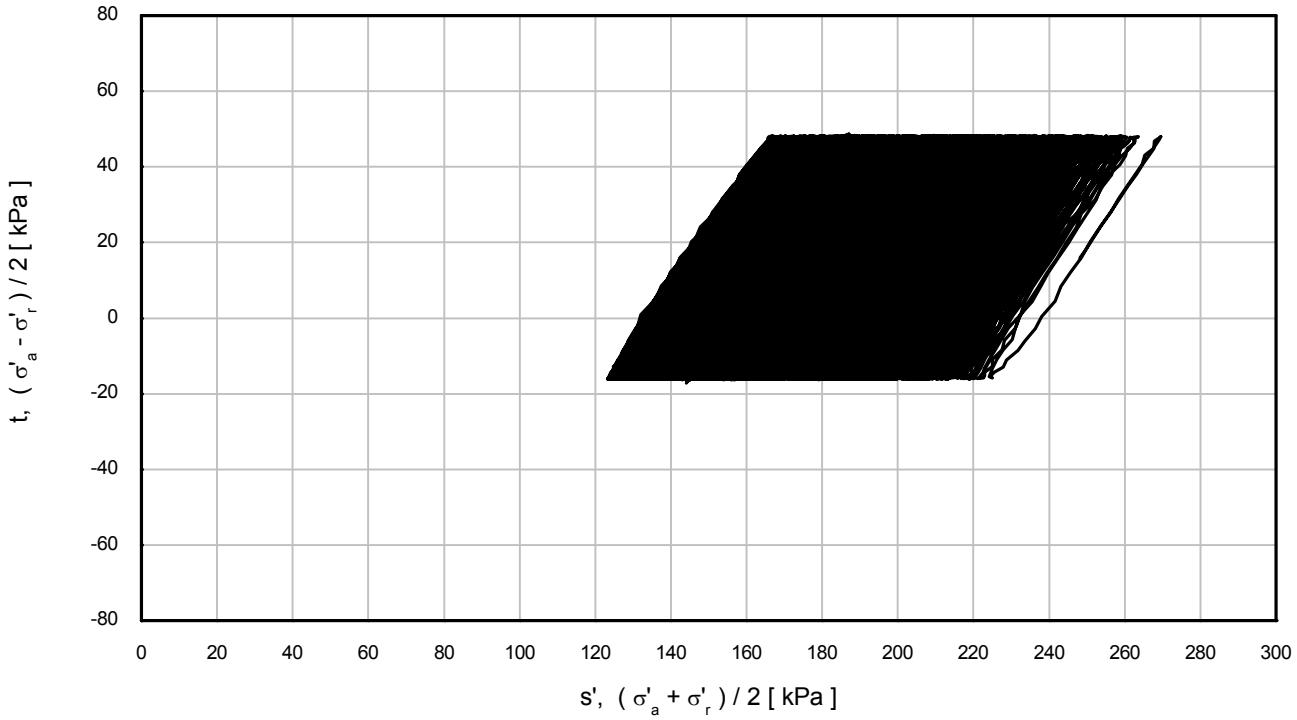
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

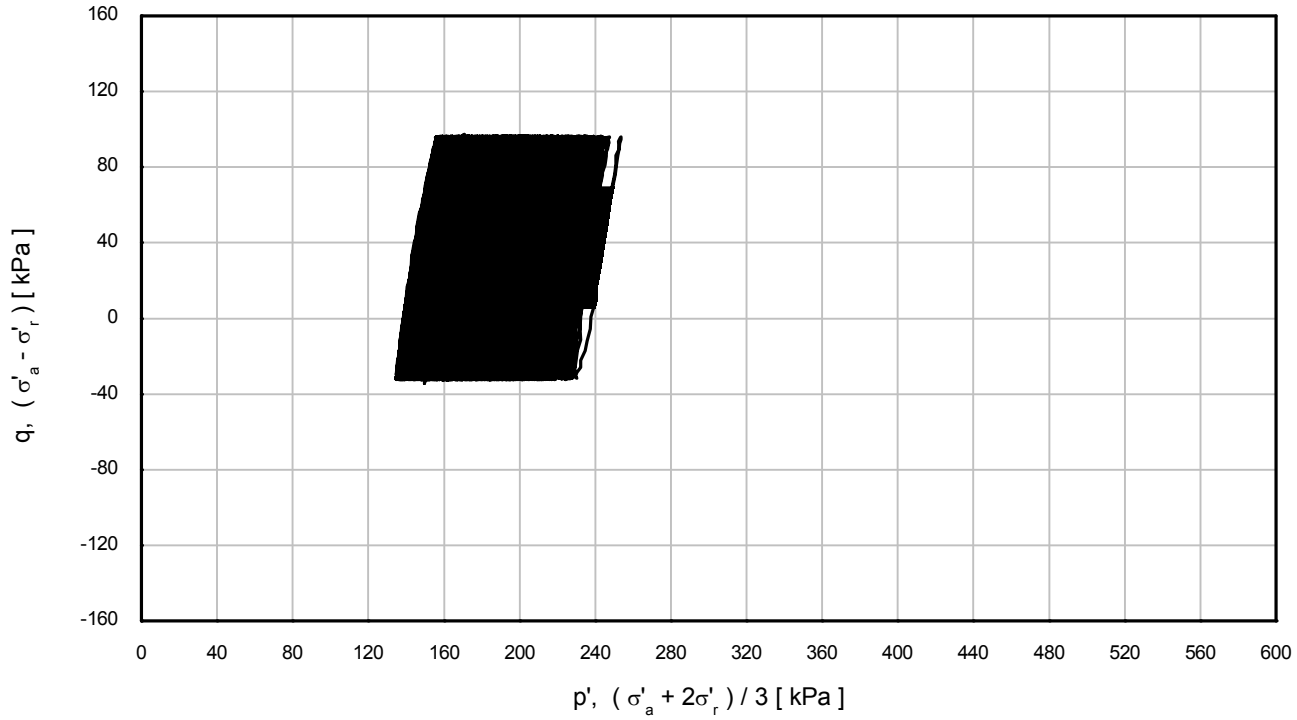




Initial σ'_r	: 232 kPa	Batch	: 5
Initial σ'_a	: 264 kPa	Sample	: CTX_5-1
q_{av}	: 32 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 64 kPa	Test No.	: CTX20
Frequency	: 0.10 Hz		

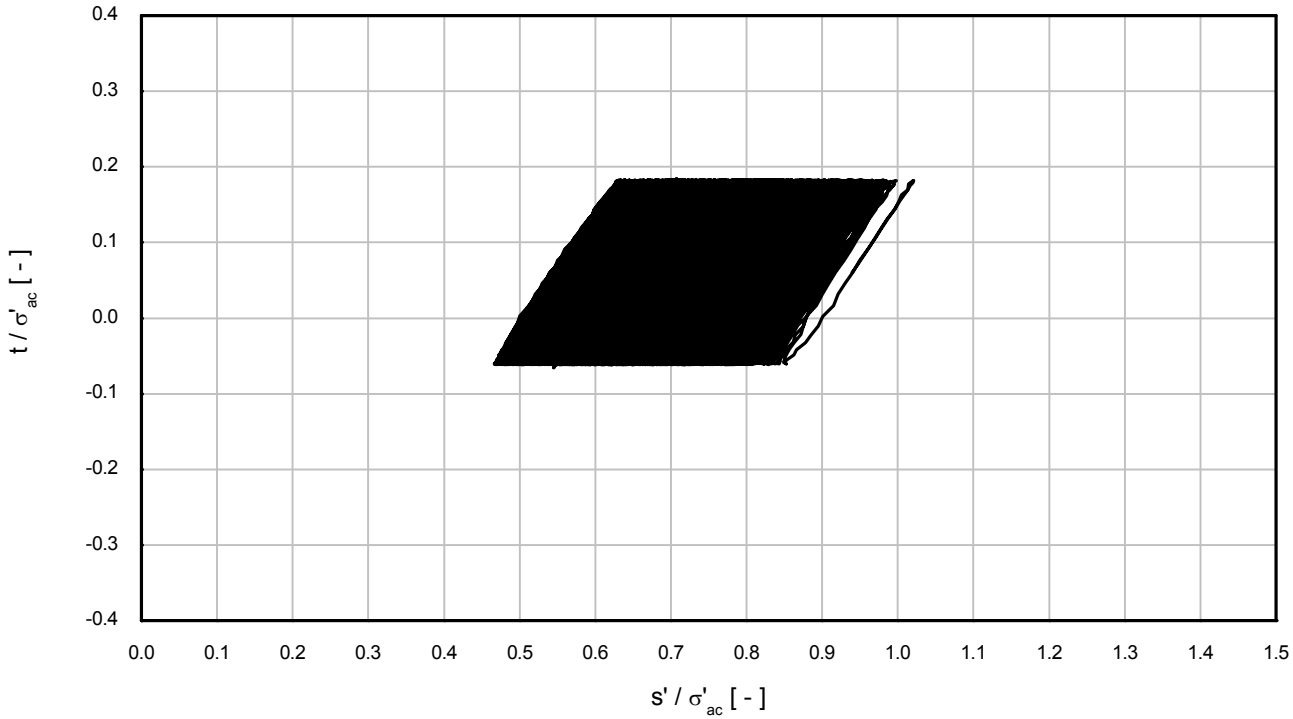
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

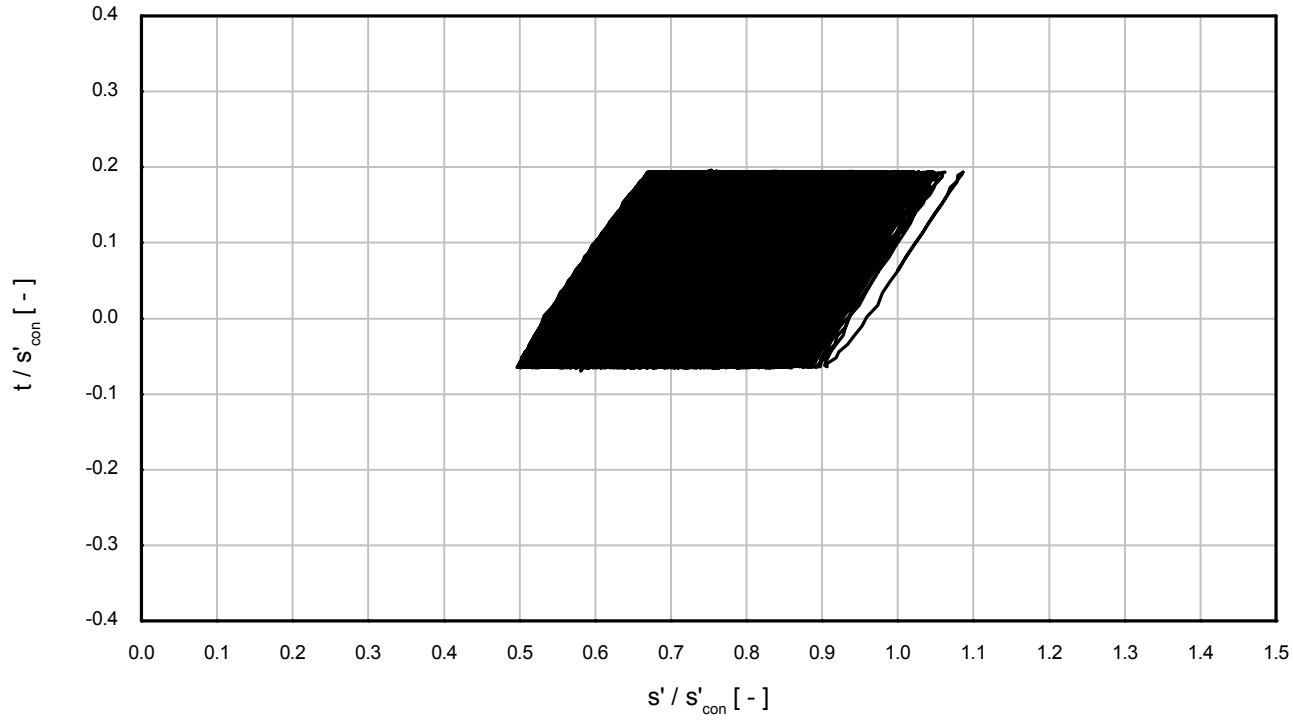




Initial σ'_r	:	232	kPa	Batch	: 5
Initial σ'_a	:	264	kPa	Sample	: CTX_5-1
q_{av}	:	32	kPa	Unit	: Unit C2 (Eem)
q_{cy}	:	64	kPa	Test No.	: CTX20
Frequency	:	0.10	Hz		

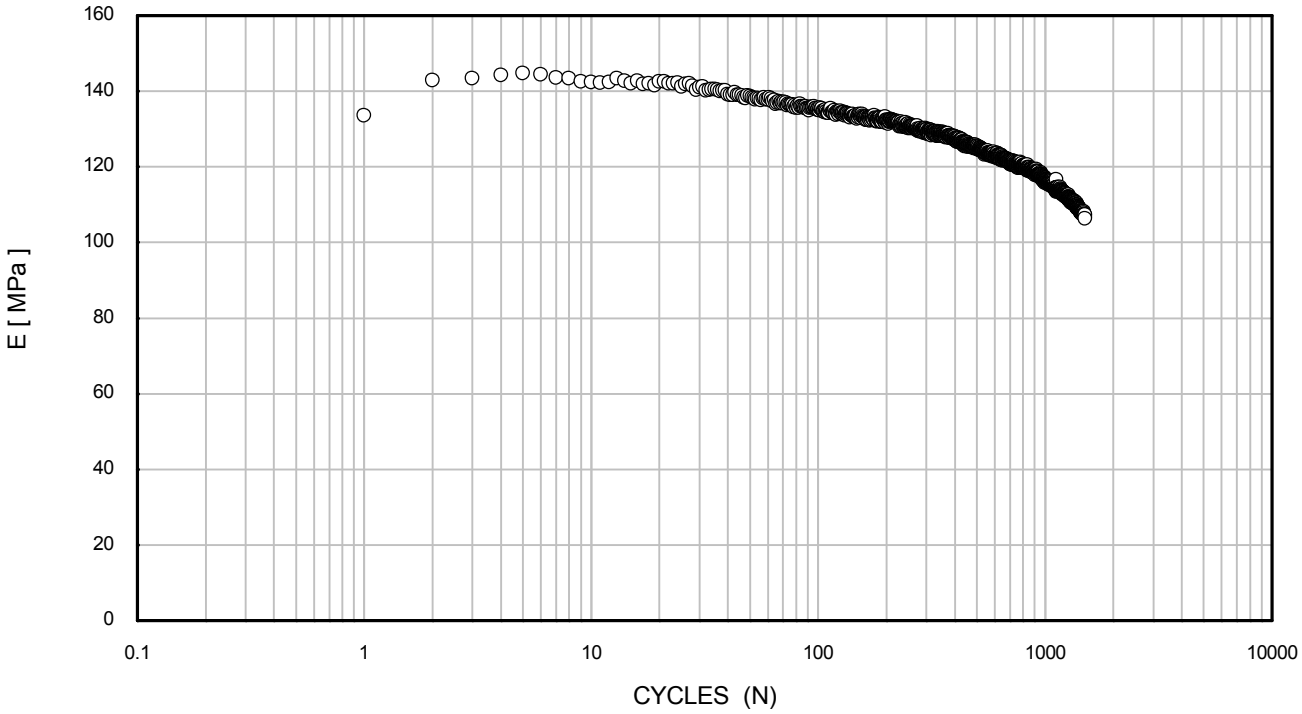
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CYCLIC LOADING STAGE - UNDRAINED

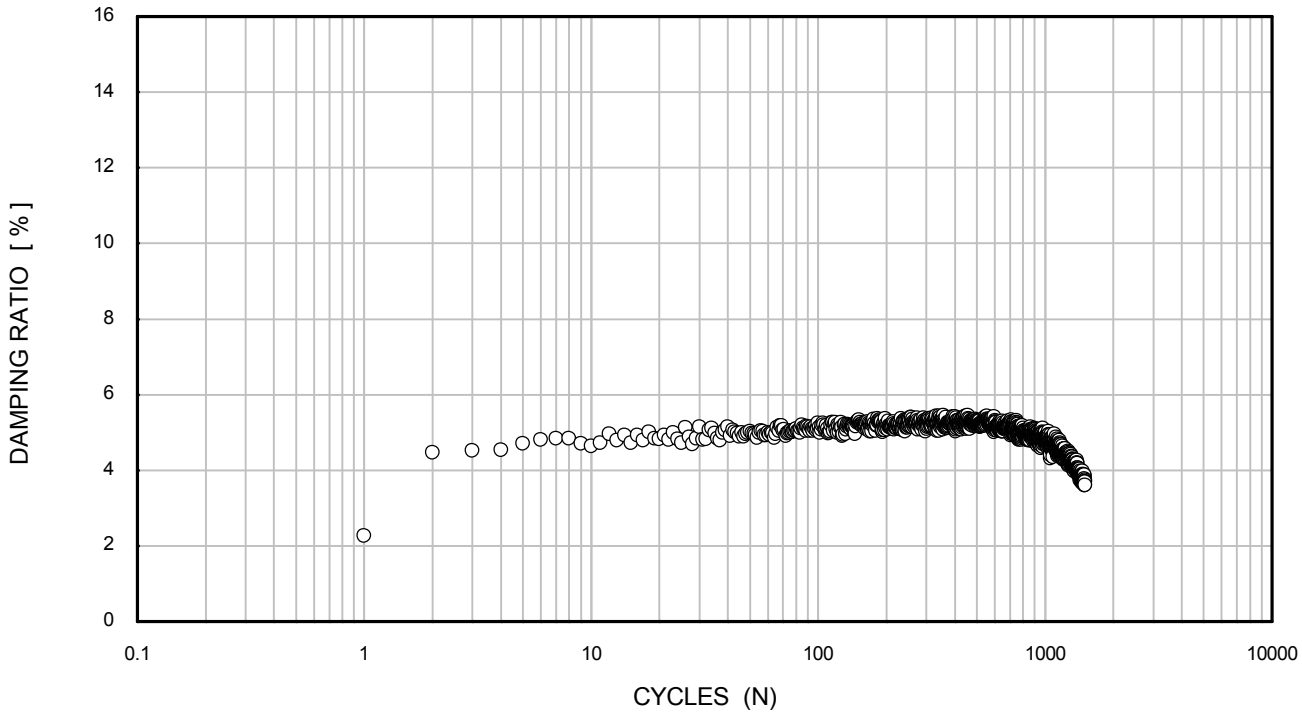




Initial σ'_r	:	232 kPa	Batch	:	5
Initial σ'_a	:	264 kPa	Sample	:	CTX_5-1
q_{av}	:	32 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

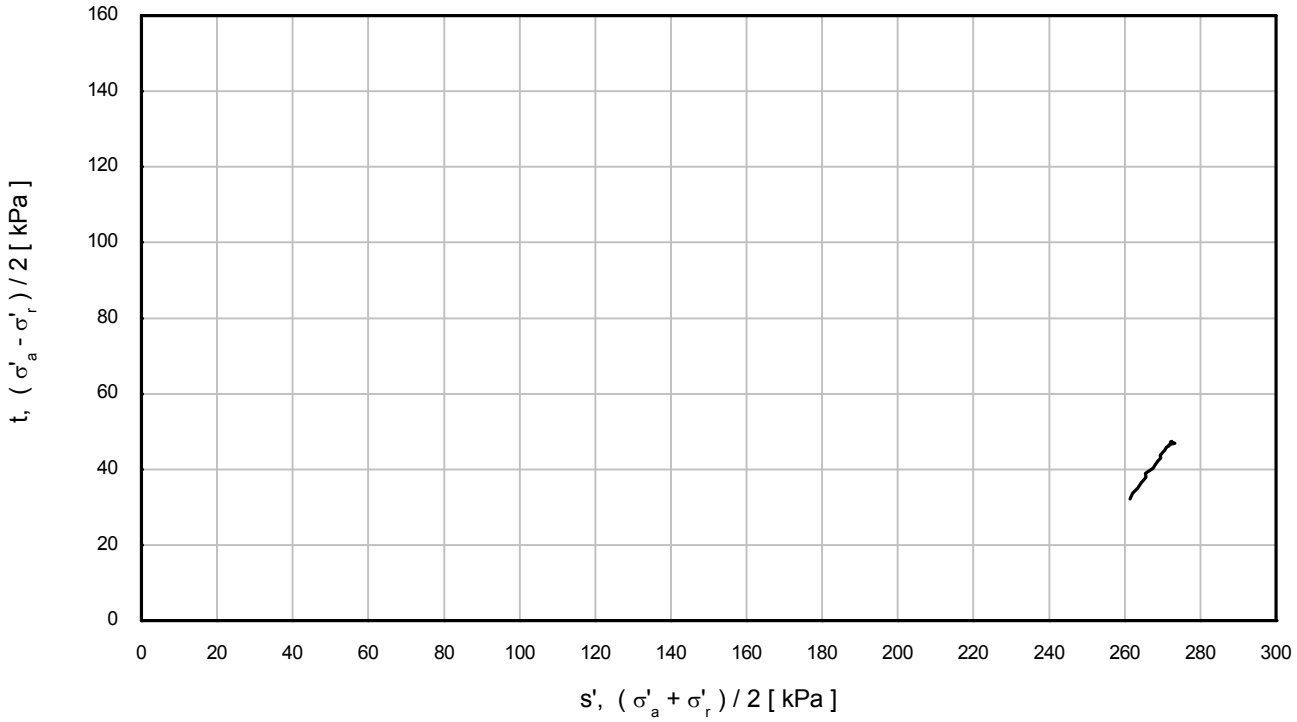
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

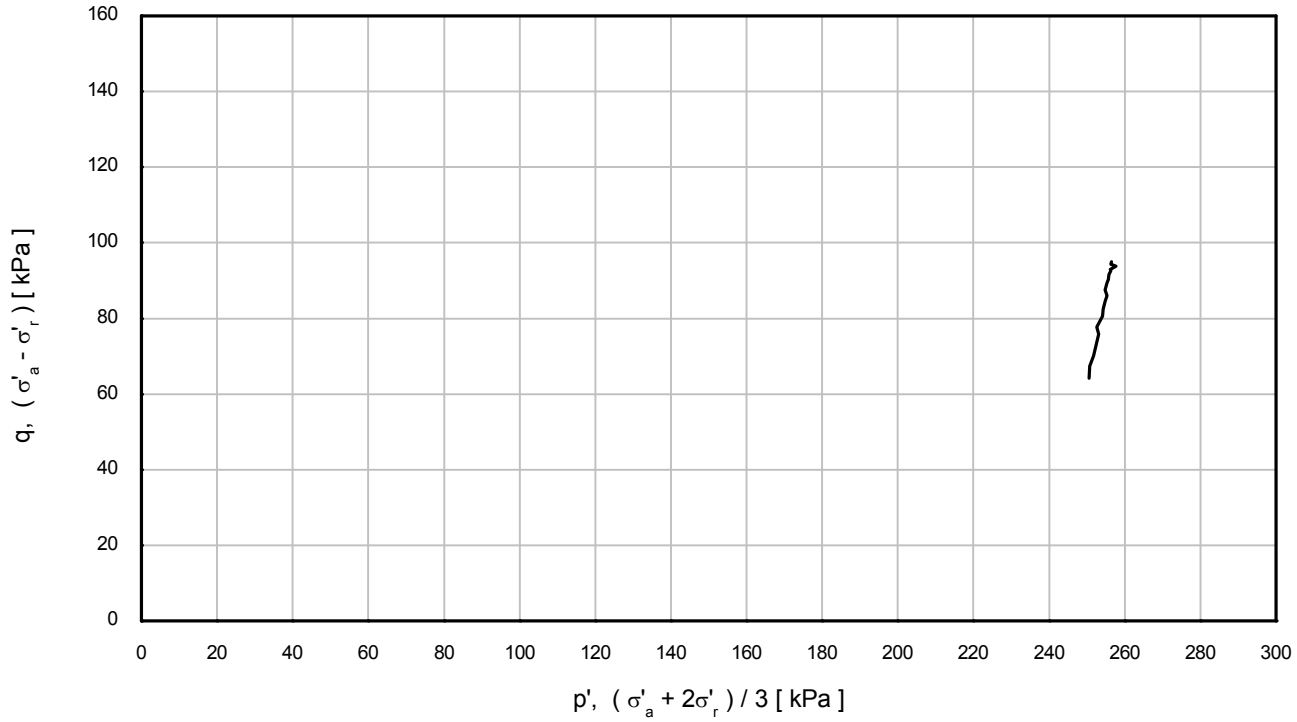




Initial σ'_r	: 232 kPa	Batch	: 5
Initial σ'_a	: 264 kPa	Sample	: CTX_5-1
q_{av}	: 32 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 64 kPa	Test No.	: CTX20
Frequency	: 0.10 Hz		

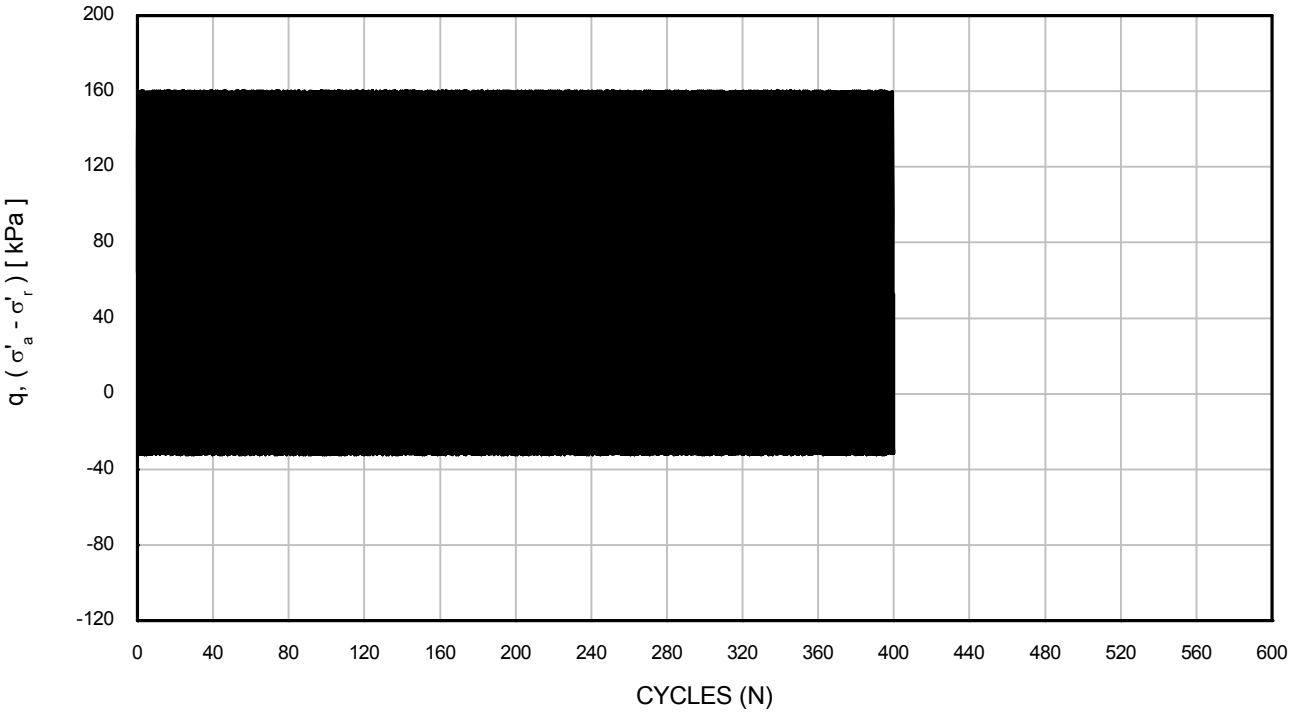
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

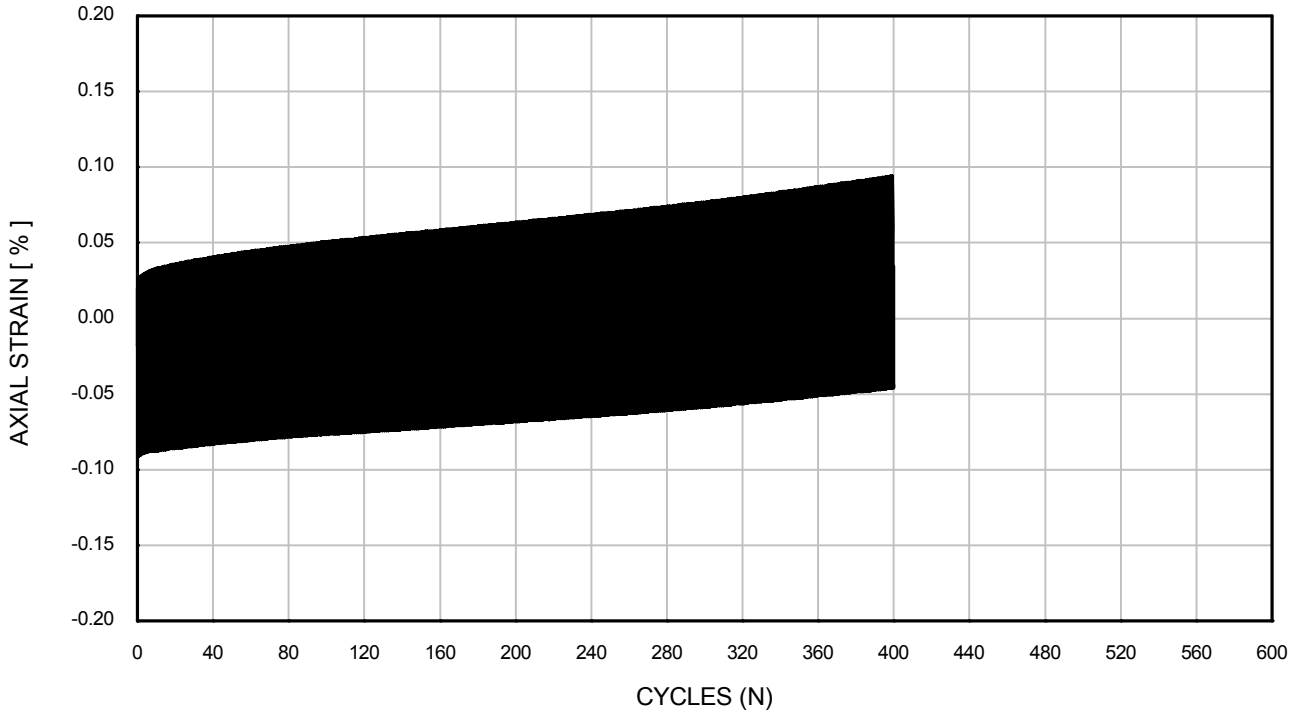




σ'_{rc}	: 229 kPa	Batch	: 5
σ'_{ac}	: 293 kPa	Sample	: CTX_5-1
		Unit	: Unit C2 (Eem)
		Test No.	: CTX20

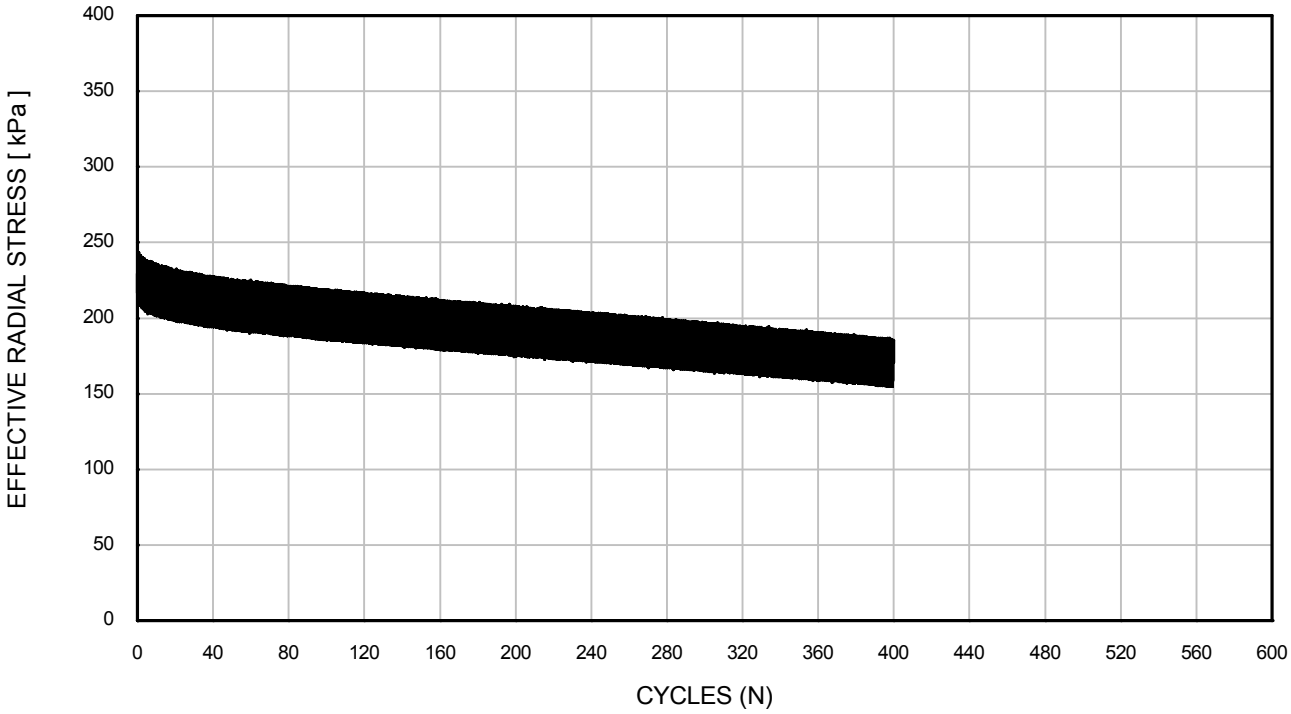
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 2 - UNDRAINED

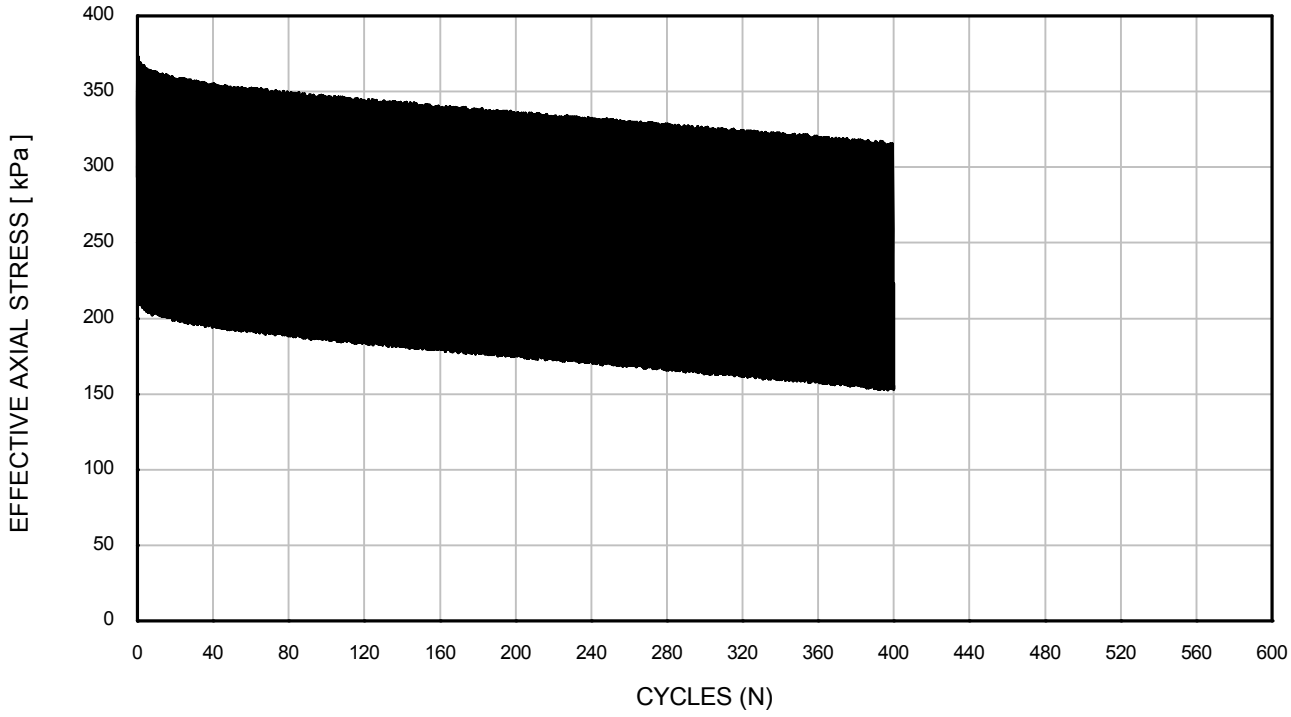




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

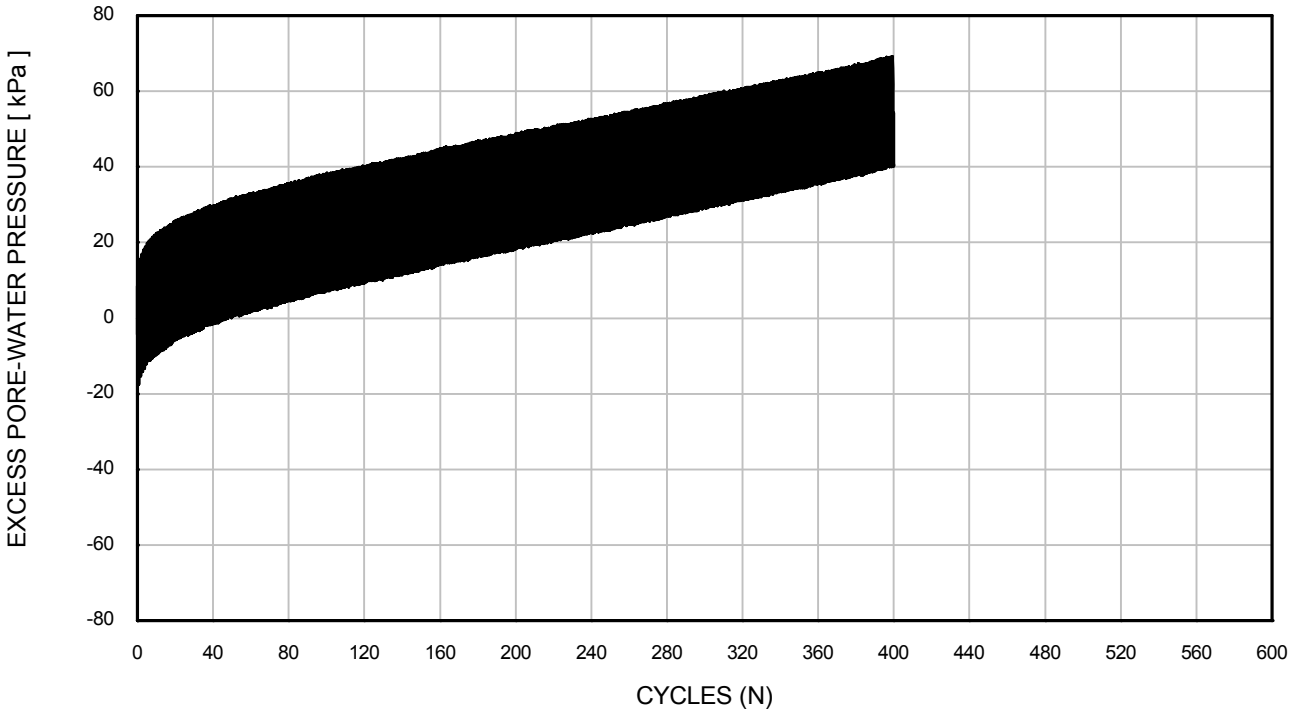
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

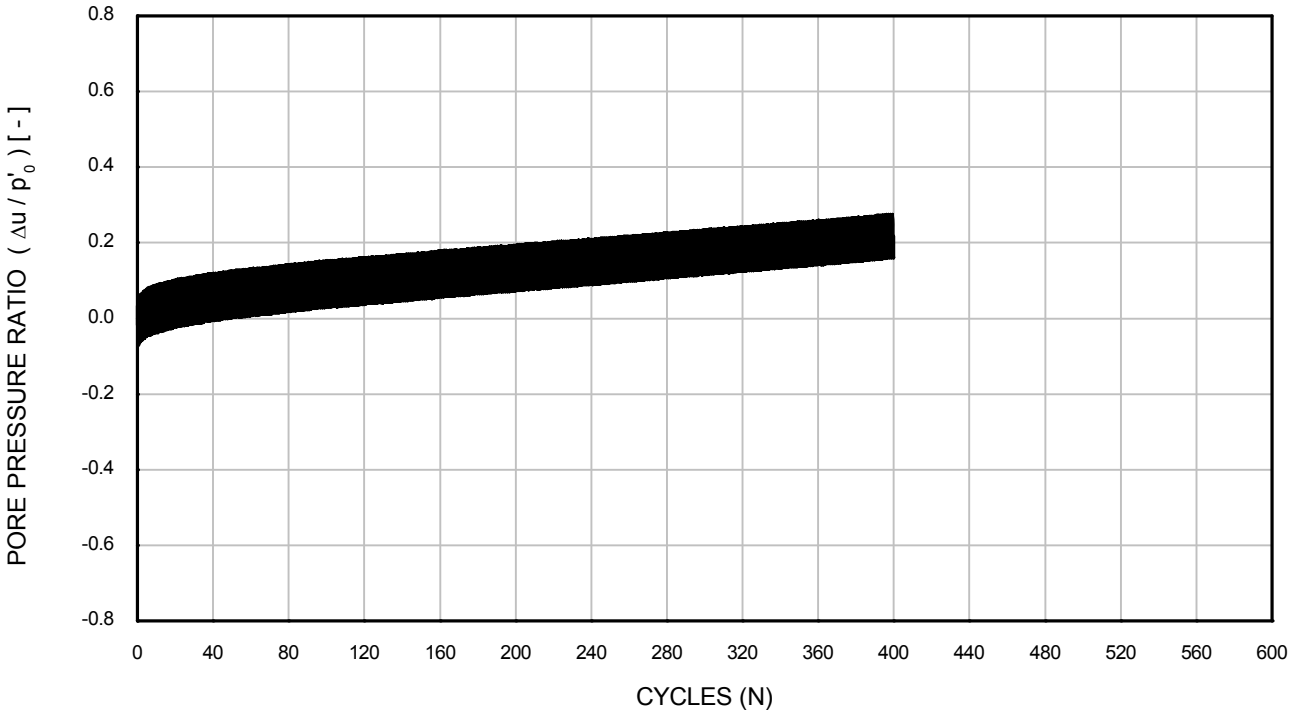




Initial σ'_r	: 229 kPa	Batch	: 5
Initial σ'_a	: 293 kPa	Sample	: CTX_5-1
q_{av}	: 64 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 96 kPa	Test No.	: CTX20
Frequency	: 0.10 Hz		

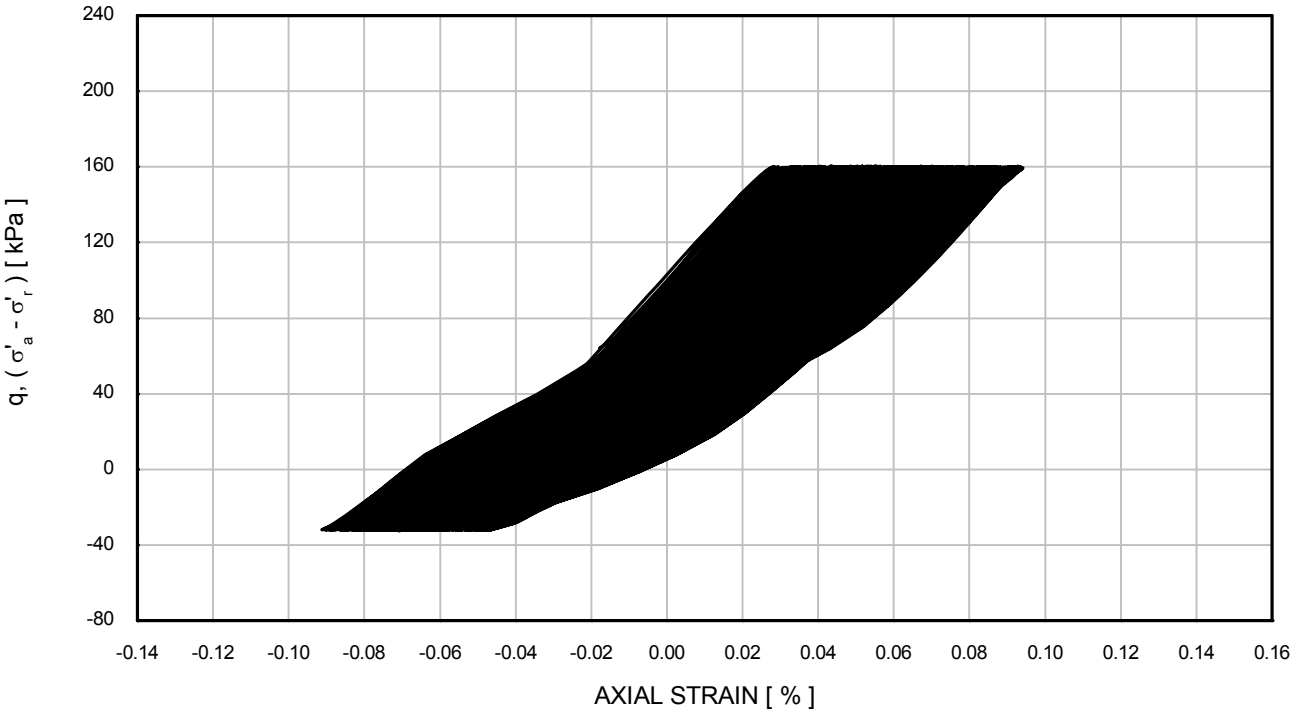
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

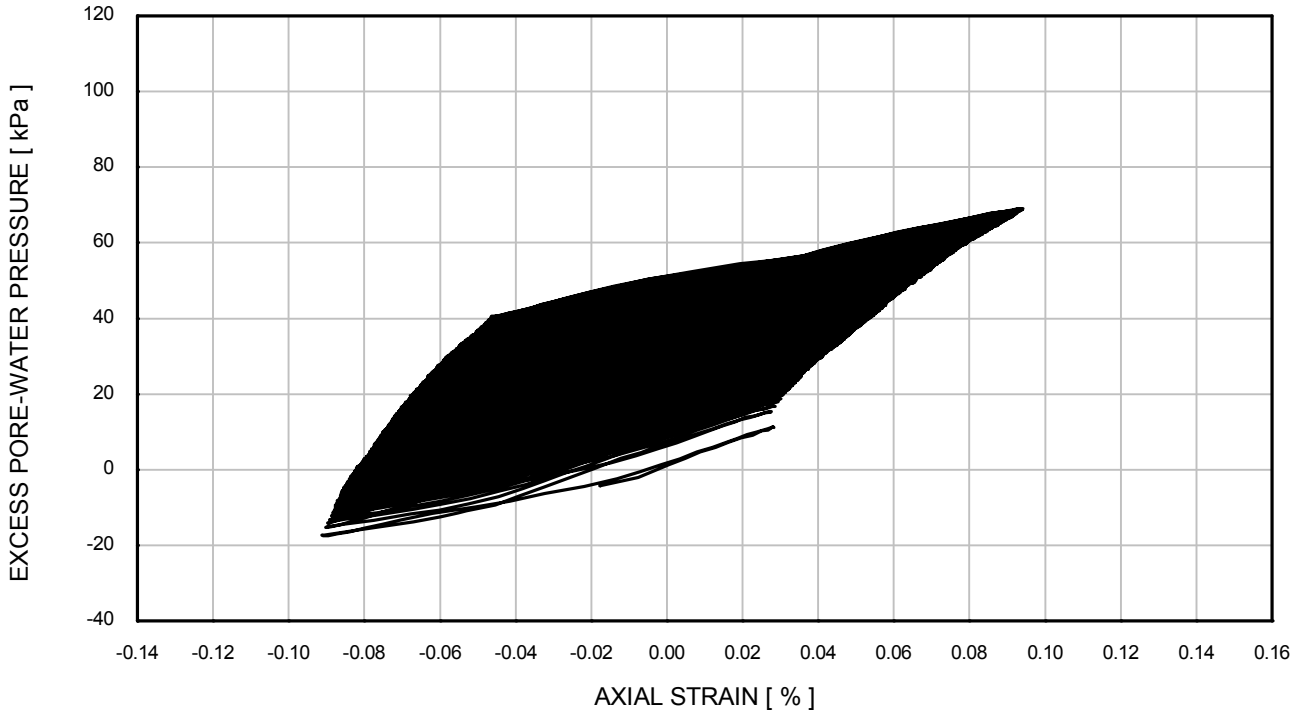




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

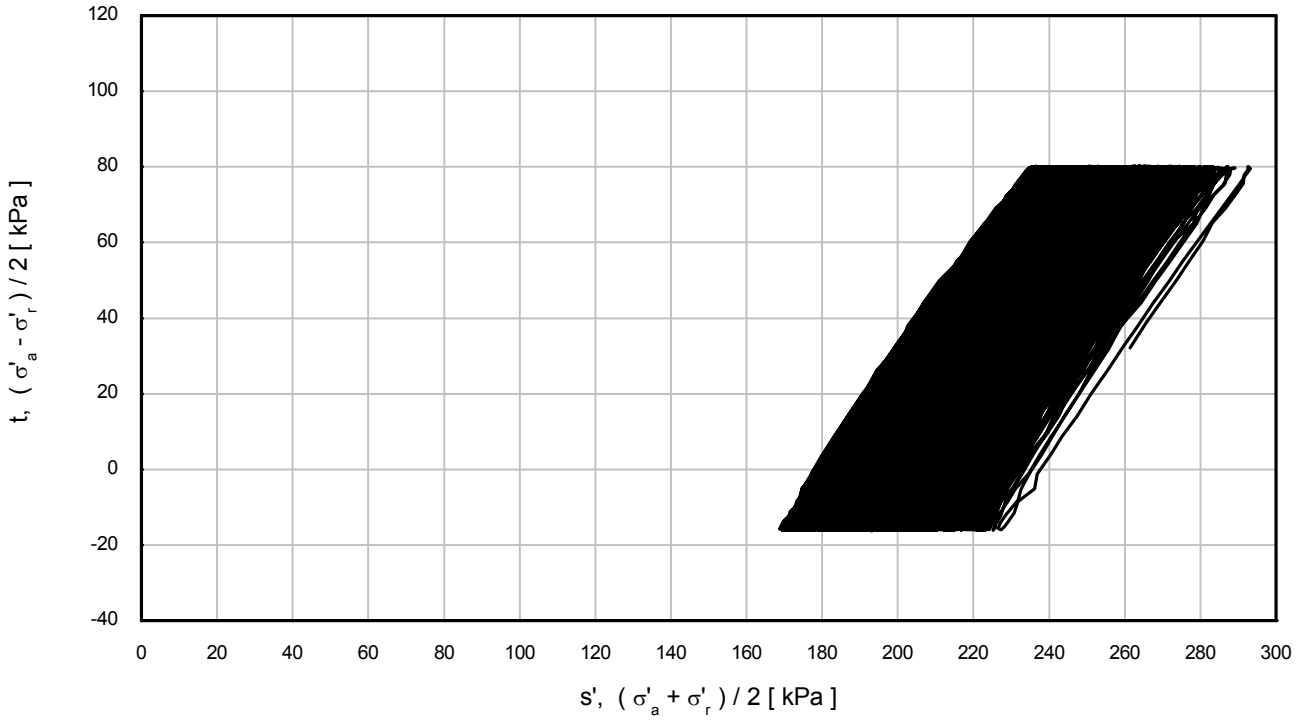
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

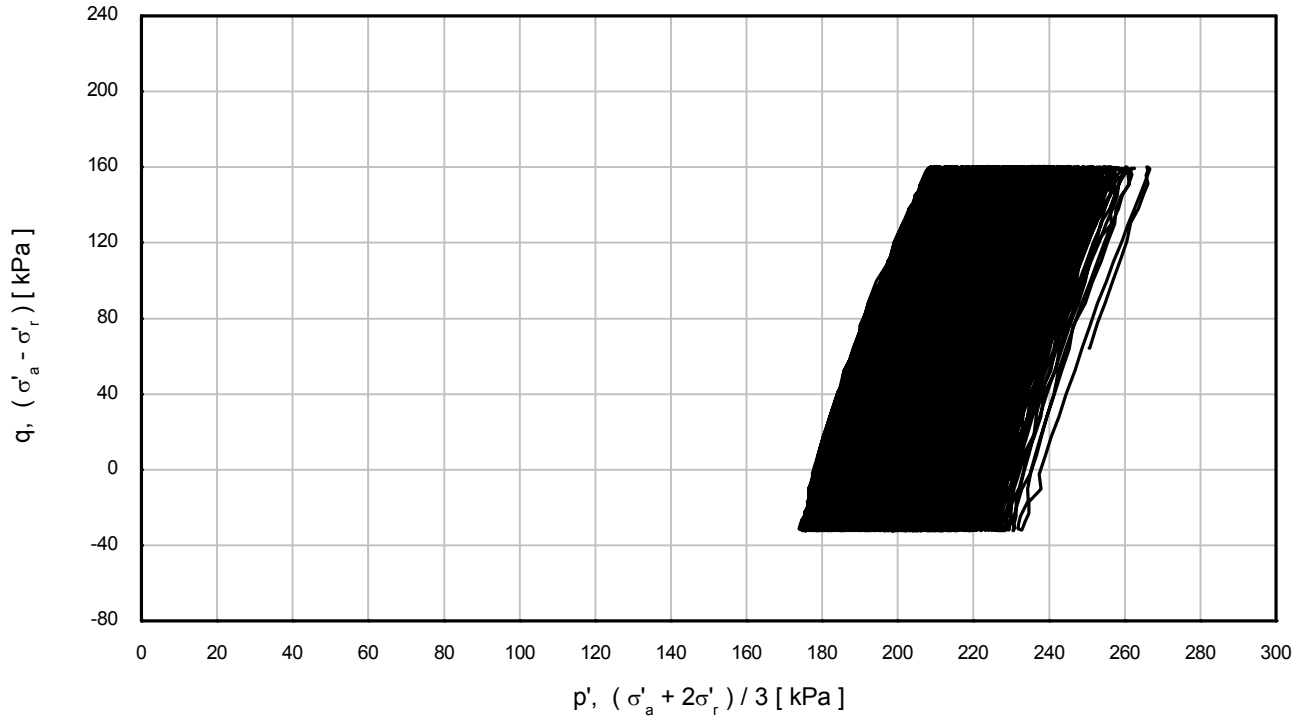




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

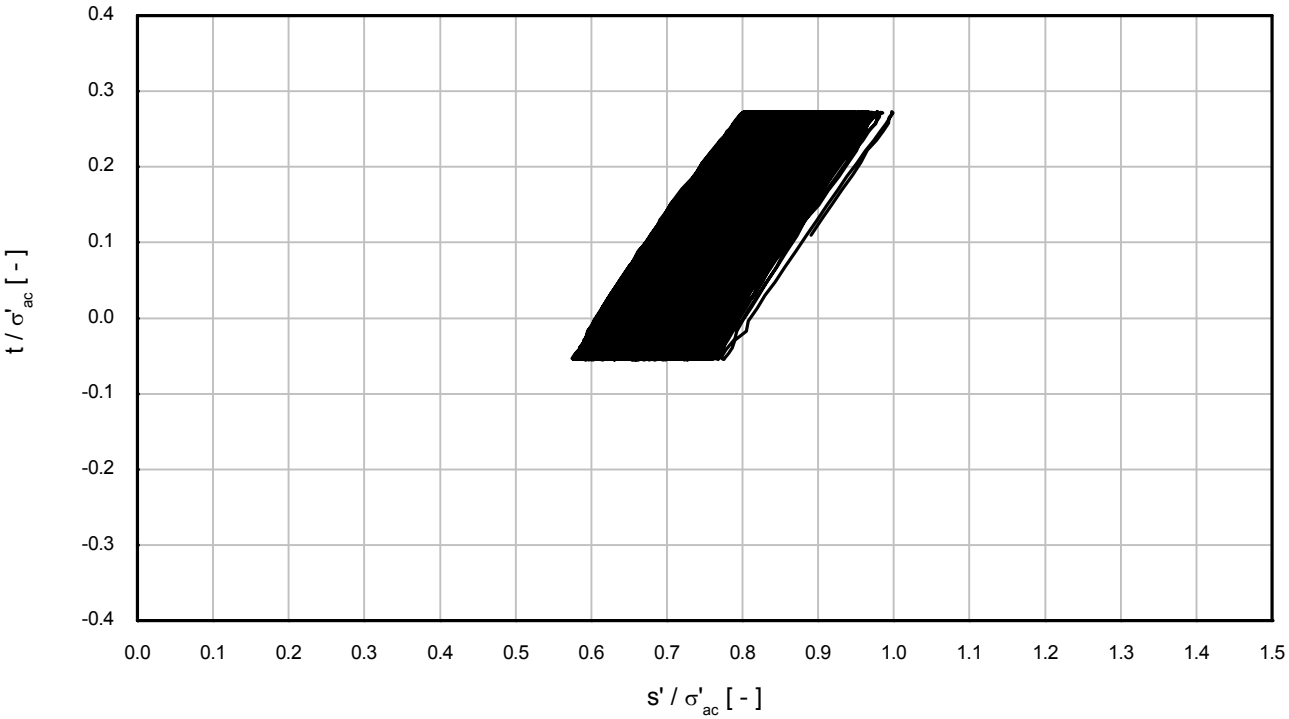
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

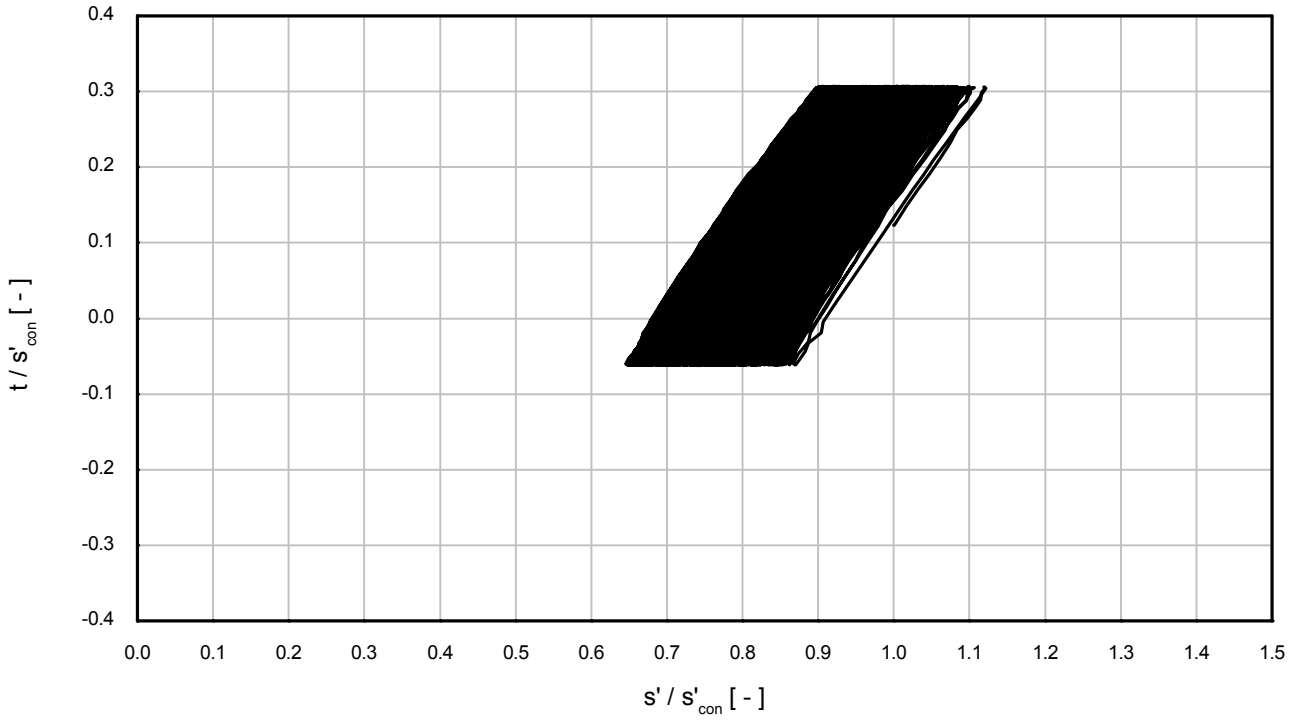




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

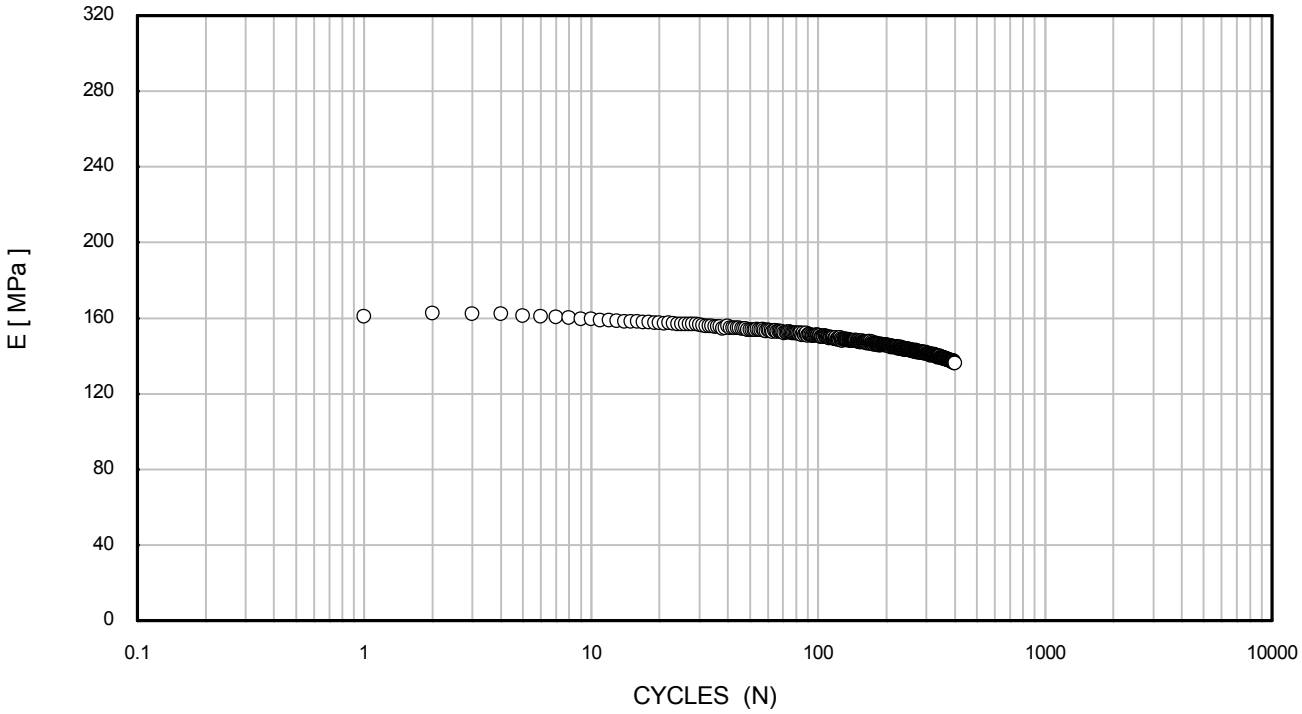
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

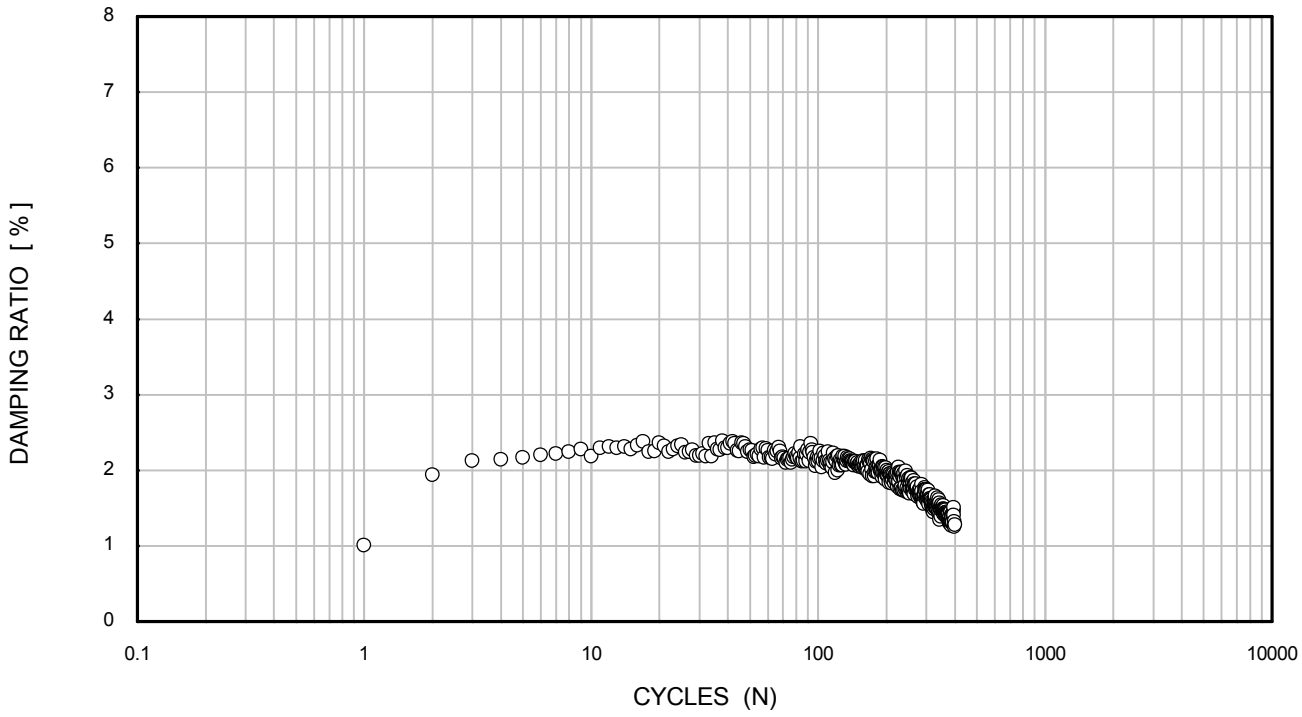




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

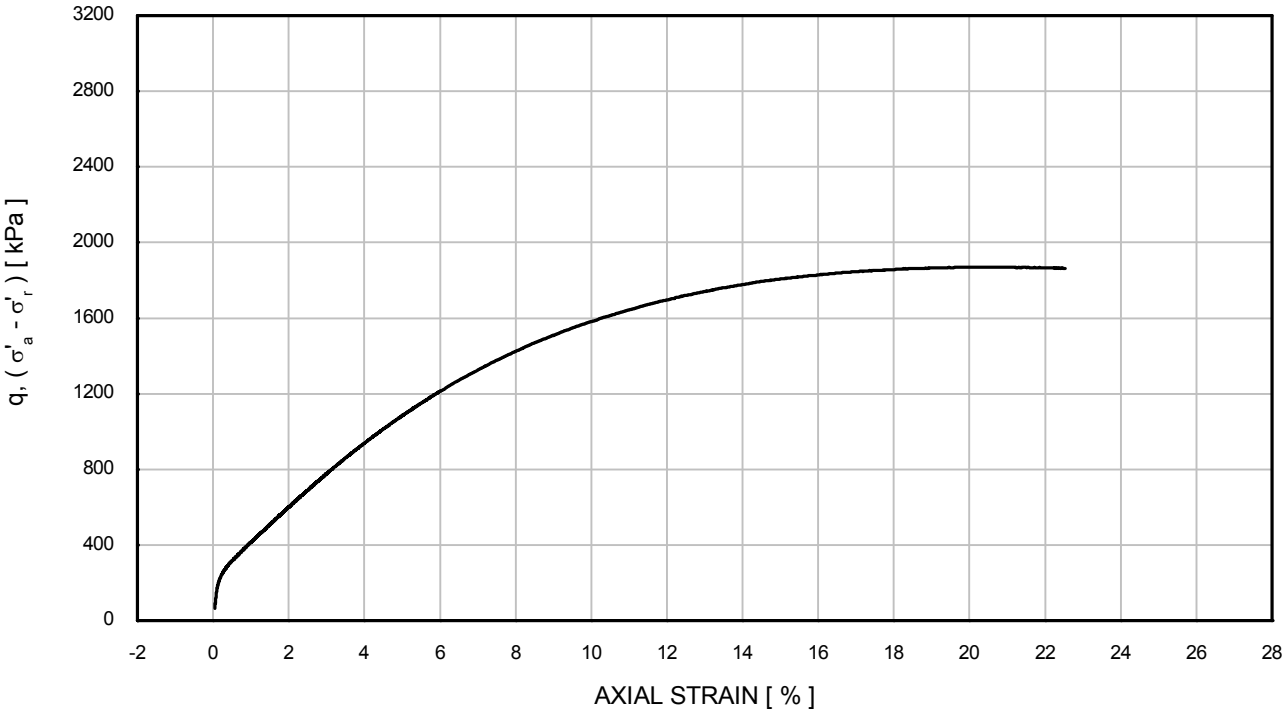
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

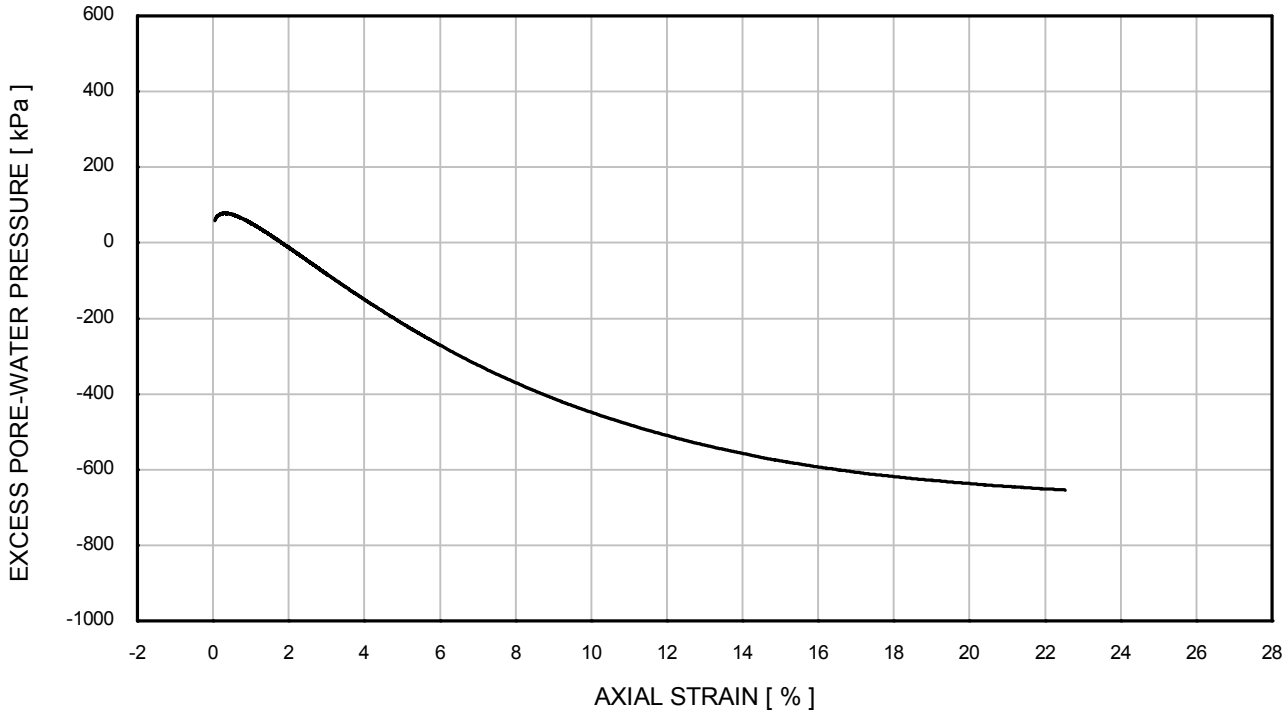




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-1
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX20
Frequency	:	0.10 Hz			

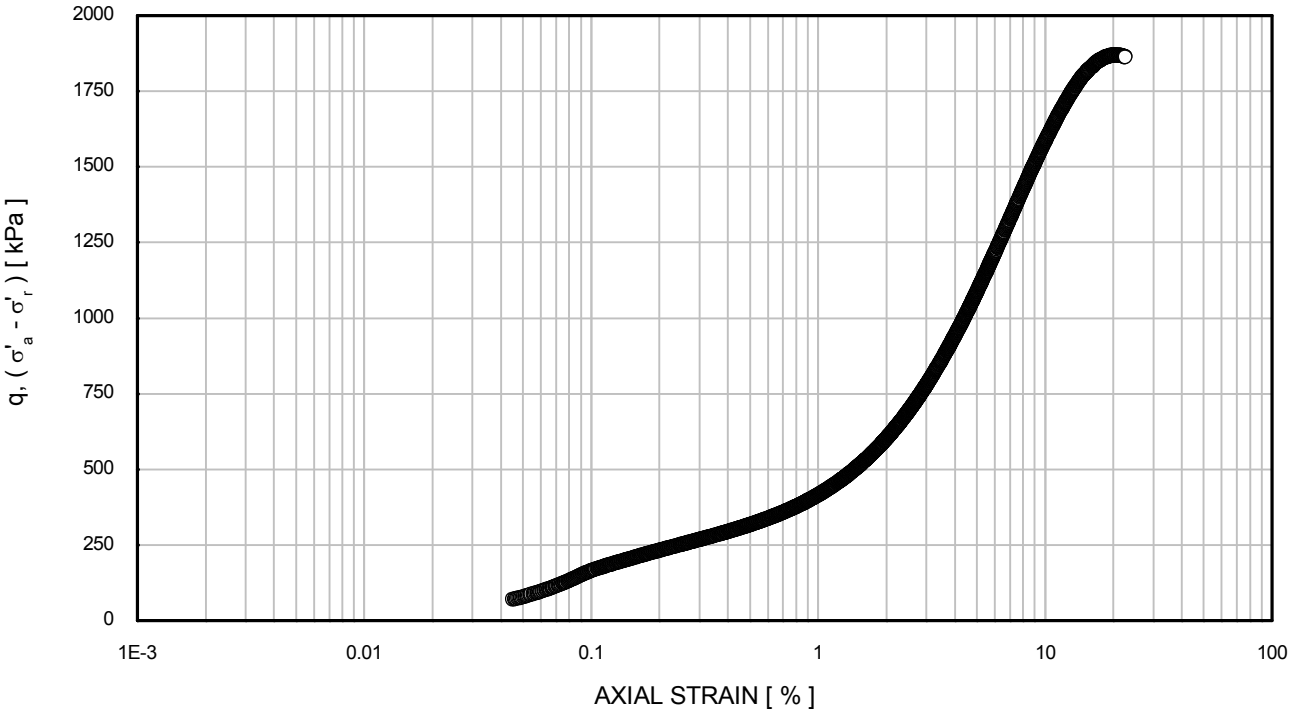
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - UNDRAINED

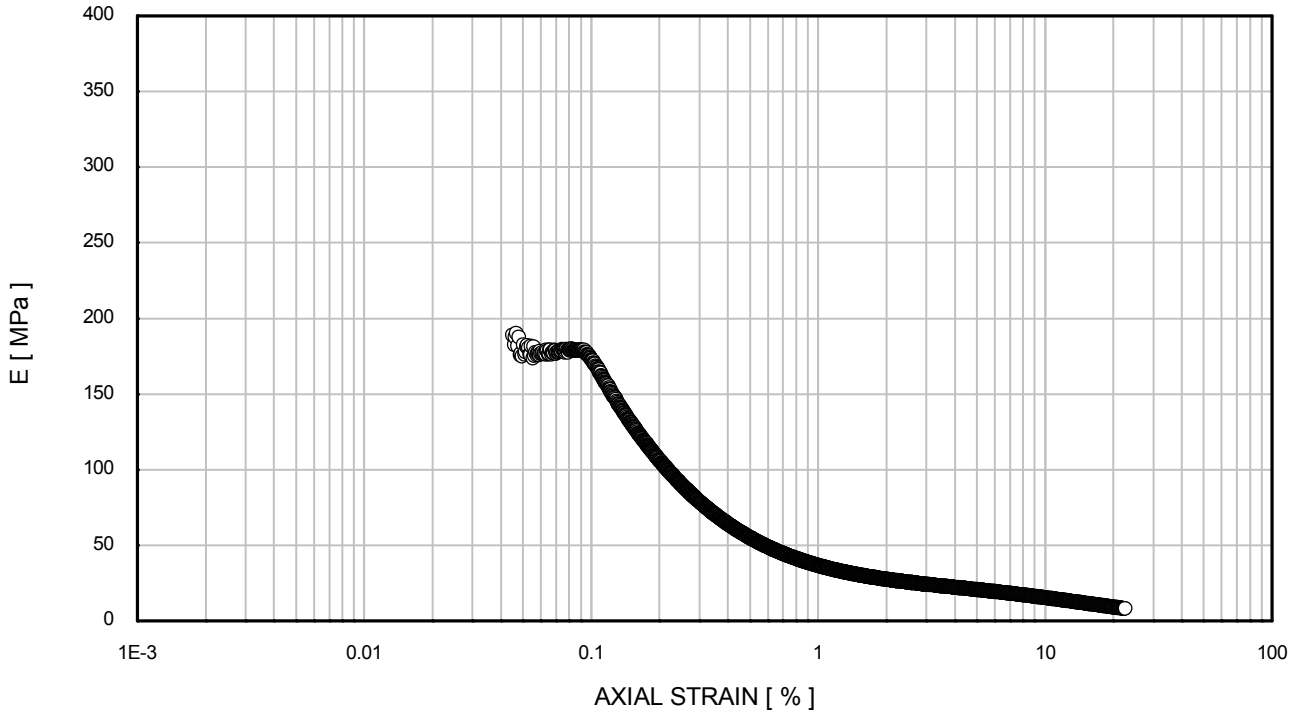




Initial σ'_r	: 167 kPa	Batch	: 5
Initial σ'_a	: 231 kPa	Sample	: CTX_5-1
q_{peak}	: 1870 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 20.34 %	Test No.	: CTX20
Rate of strain	: 1.00 %/hour		

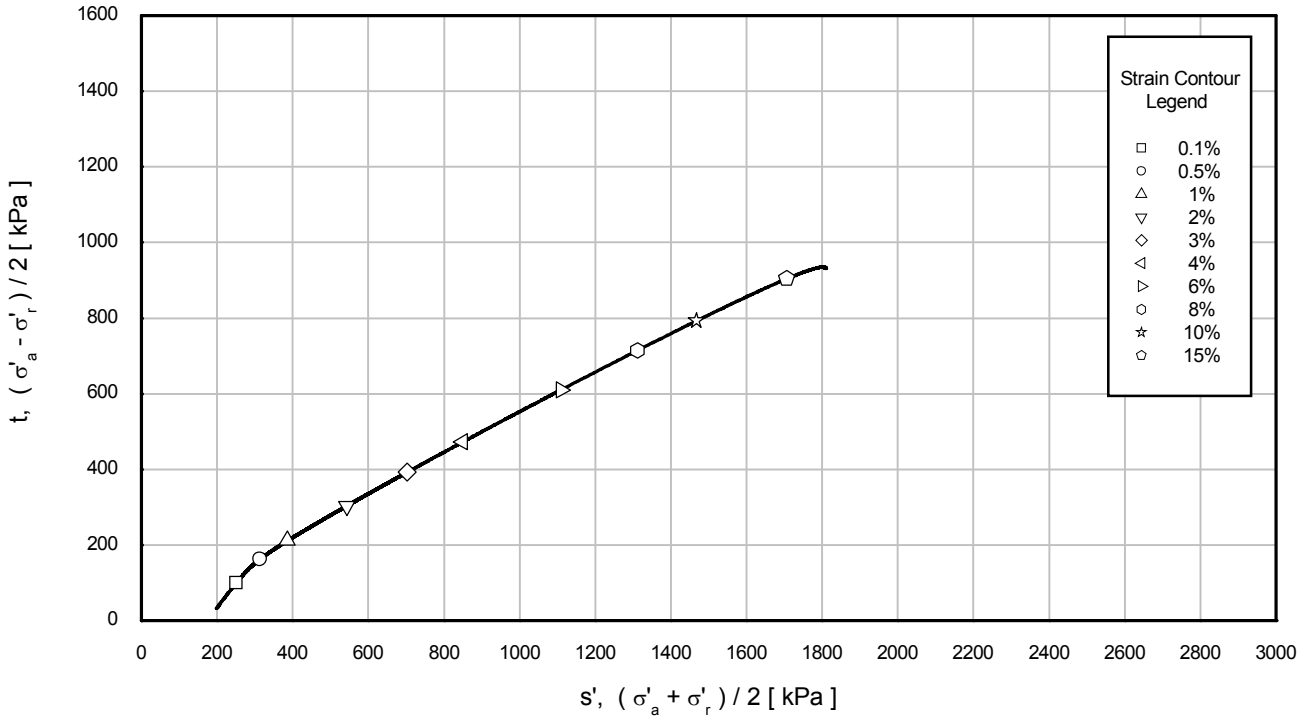
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

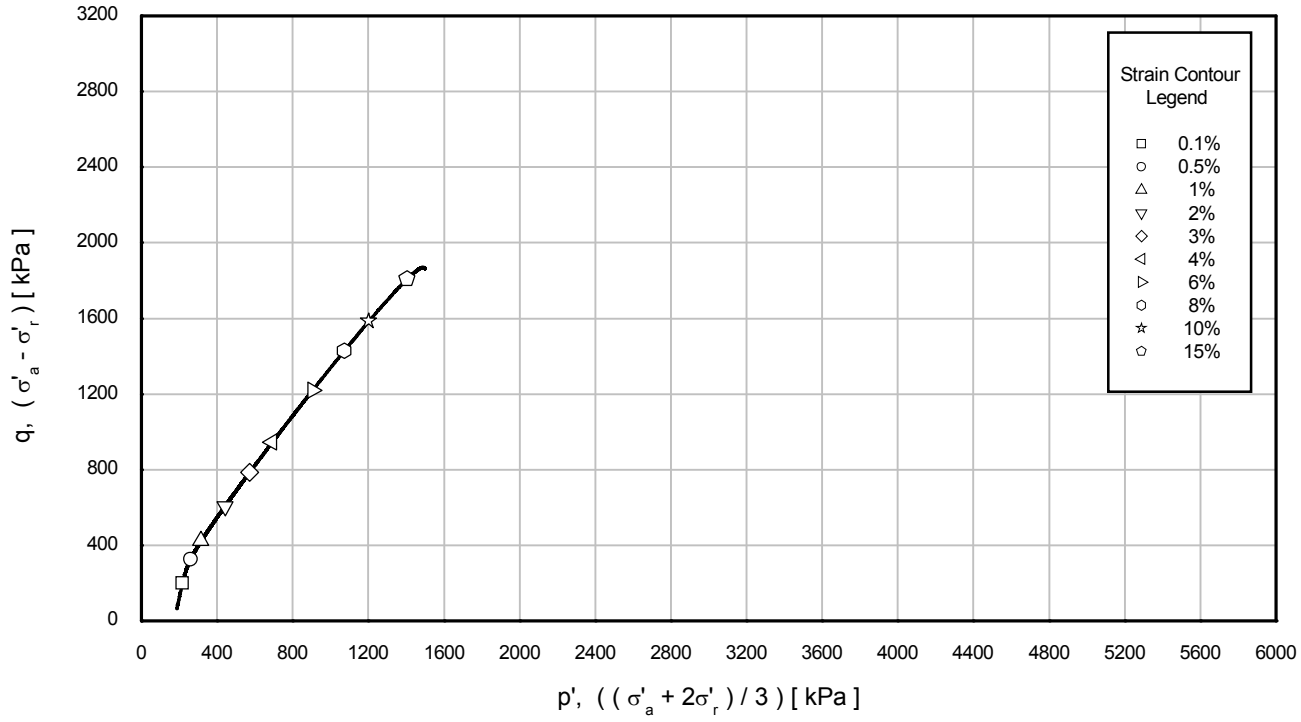




Initial σ'_r	: 167 kPa	Batch	: 5
Initial σ'_a	: 231 kPa	Sample	: CTX_5-1
q_{peak}	: 1870 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 20.34 %	Test No.	: CTX20
Rate of strain	: 1.00 %/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	: 167 kPa	Batch	: 5
Initial σ'_a	: 231 kPa	Sample	: CTX_5-1
q_{peak}	: 1870 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 20.34 %	Test No.	: CTX20
Rate of strain	: 1.00 %/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark grey fine to coarse SAND with traces of organic matter

GENERAL	
Date test started	23/12/2016
Type of sample	Re-compacted
Type of drains fitted	Both ends

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	9.5
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.669
Degree of saturation	[%]	37
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH05_CTX21
Processed by Date	MSR 13/01/2017
Checked by Date	JLS 13/01/2017
Approved by Date	AR 13/01/2017

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	872
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1097
Back pressure	[kPa]	872
Base PWP	[kPa]	872
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	225
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	1.03
External axial strain	[%]	0.44
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.652
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1097
Back pressure	[kPa]	872
Base PWP	[kPa]	869
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	228
Effective axial pressure	[kPa]	292
Deviator stress	[kPa]	64
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.652
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	640
Mean q_{av}	[kPa]	64
Mean q_{cy}	[kPa]	64
Frequency	[Hz]	0.10
Number of cycles applied (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.00
External ε_{cy} at N_f	[%]	0.06
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	52
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.652
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.04	0.06	113	-	11.08	-
2	-0.04	0.06	116	-	11.77	-
5	-0.04	0.06	116	-	12.38	-
10	-0.04	0.06	114	-	12.28	-
20	-0.04	0.06	113	-	12.90	-
30	-0.04	0.06	113	-	13.10	-
40	-0.04	0.06	112	-	12.99	-
50	-0.04	0.06	112	-	13.27	-
100	-0.03	0.06	110	-	13.04	-
500	-0.02	0.06	106	-	13.82	-
1000	-0.01	0.06	104	-	14.19	-
1500	0.00	0.06	100	-	15.13	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1097
Back pressure	[kPa]	872
Base PWP	[kPa]	874
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	223
Effective axial pressure	[kPa]	319
Deviator stress	[kPa]	96
Volumetric strain	[%]	0.10
External axial strain	[%]	0.06
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.652
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	640
Mean q_{av}	[kPa]	96
Mean q_{cy}	[kPa]	128
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	96
External ε_{av} at N_f	[%]	8.98
External ε_{cy} at N_f	[%]	11.34
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	185
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.652
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.05	0.09	140	-	4.78	-
2	0.06	0.09	140	-	5.41	-
5	0.07	0.09	137	-	5.38	-
10	0.09	0.09	135	-	4.42	-
20	0.13	0.10	130	-	3.52	-
30	0.17	0.10	125	-	3.05	-
40	0.21	0.11	120	-	0.99	-
50	0.28	0.11	112	-	0.31	-
60	0.39	0.12	102	-	3.38	-
70	0.60	0.15	85	-	8.33	-
80	1.06	0.25	52	-	16.36	-
96	8.98	11.34	1	-	26.76	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	35
Initial effective axial pressure	[kPa]	16
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	3
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	14.29
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	218
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	6
Effective axial pressure	[kPa]	10
Principal effective stress ratio	[-]	1.49
ε_{50}	[%]	-2.18
Secant modulus (E_{50}) at ε_{50}	[kPa]	6377
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	-18
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	-2.35
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	190
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	34
Effective axial pressure	[kPa]	16
Principal effective stress ratio	[-]	2.15
At 20% external axial strain		
Corrected deviator stress	[kPa]	-
Membrane correction applied	[kPa]	-
Drain correction applied	[kPa]	-
External axial strain	[%]	-
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	-
Effective axial pressure	[kPa]	-
Principal effective stress ratio	[-]	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





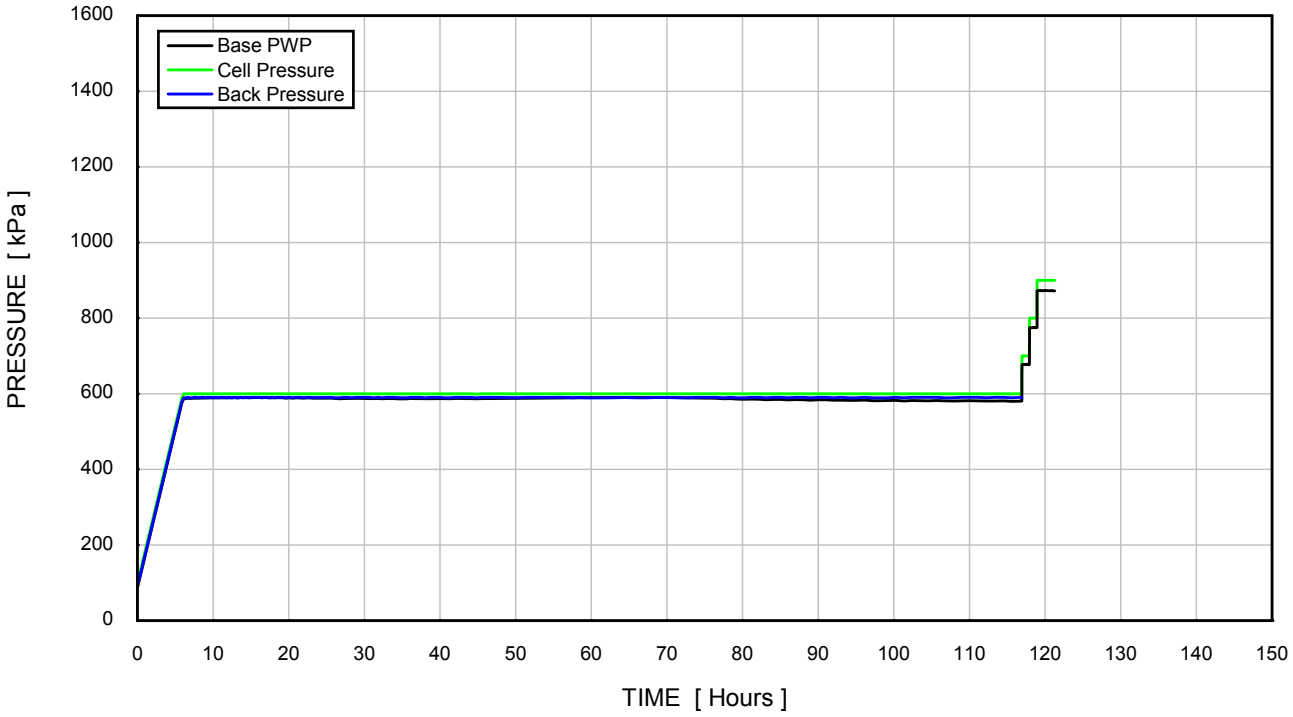
FINAL CONDITIONS

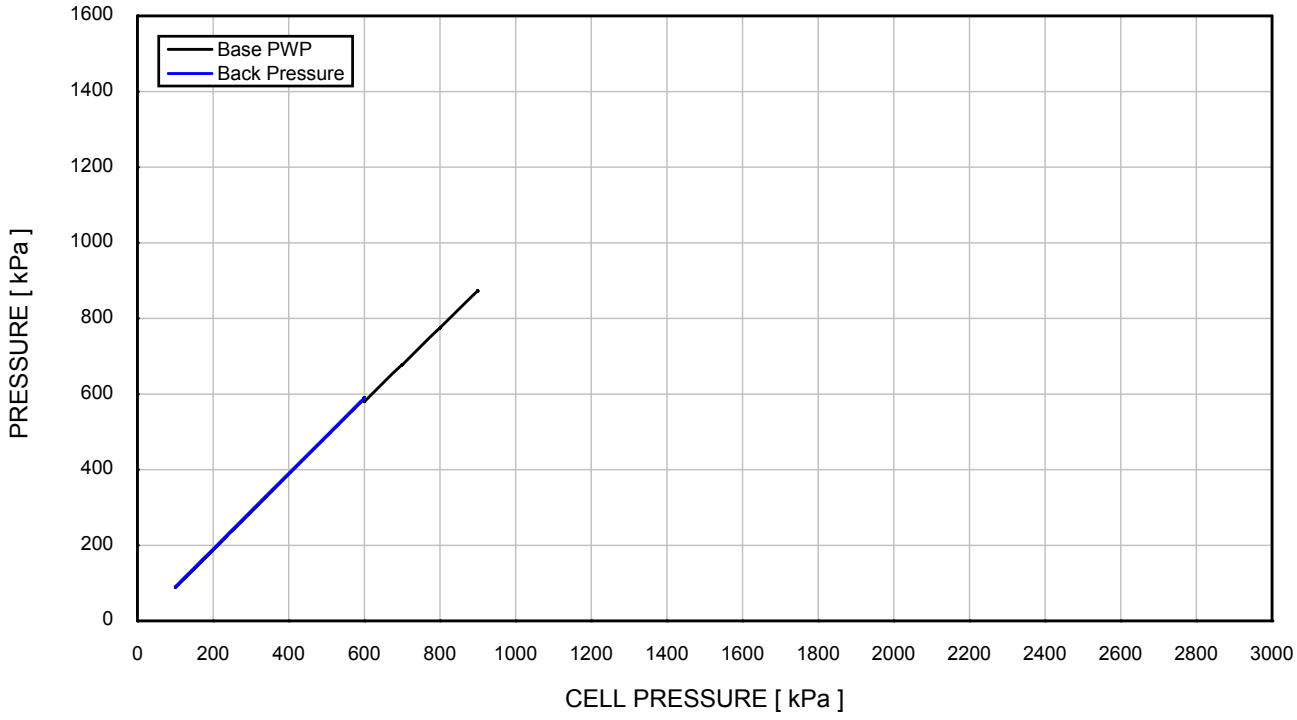
Water content	[%]	24.6
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Batch	5
Sample	CTX_5-4
Depth [m]	Unit C2 (Eem)
Test number	CTX21

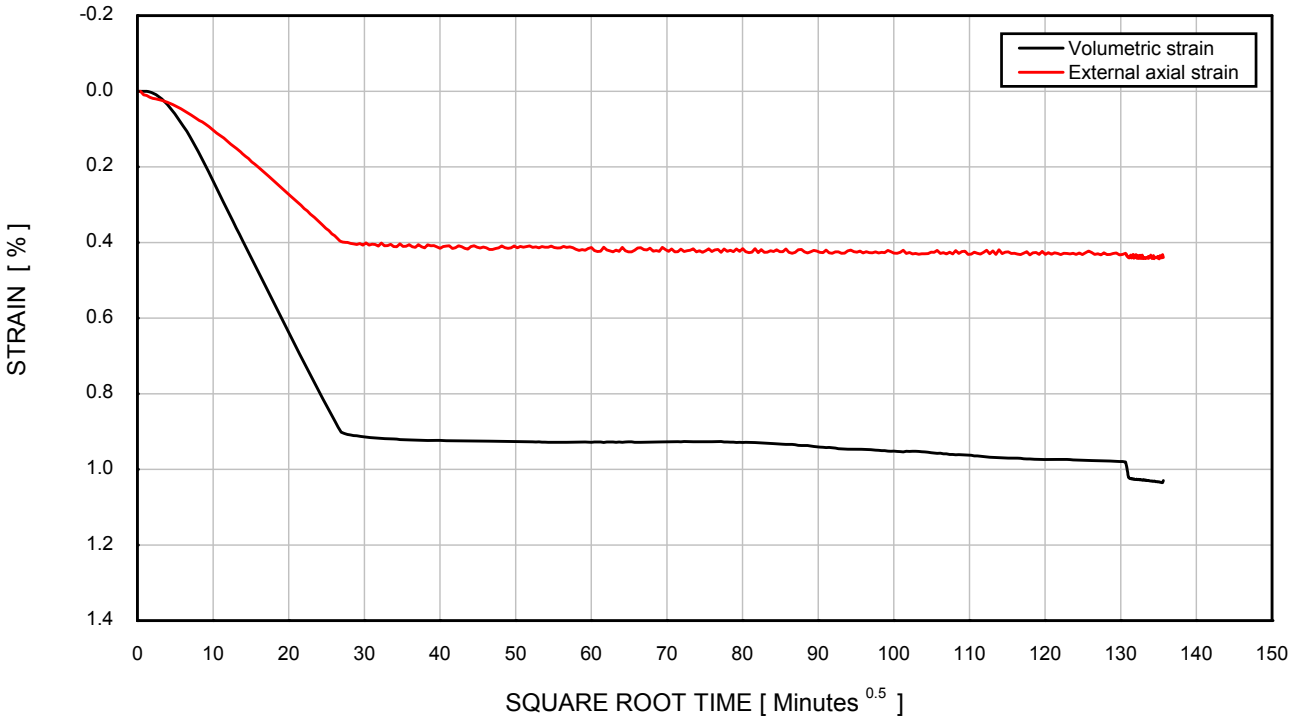
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

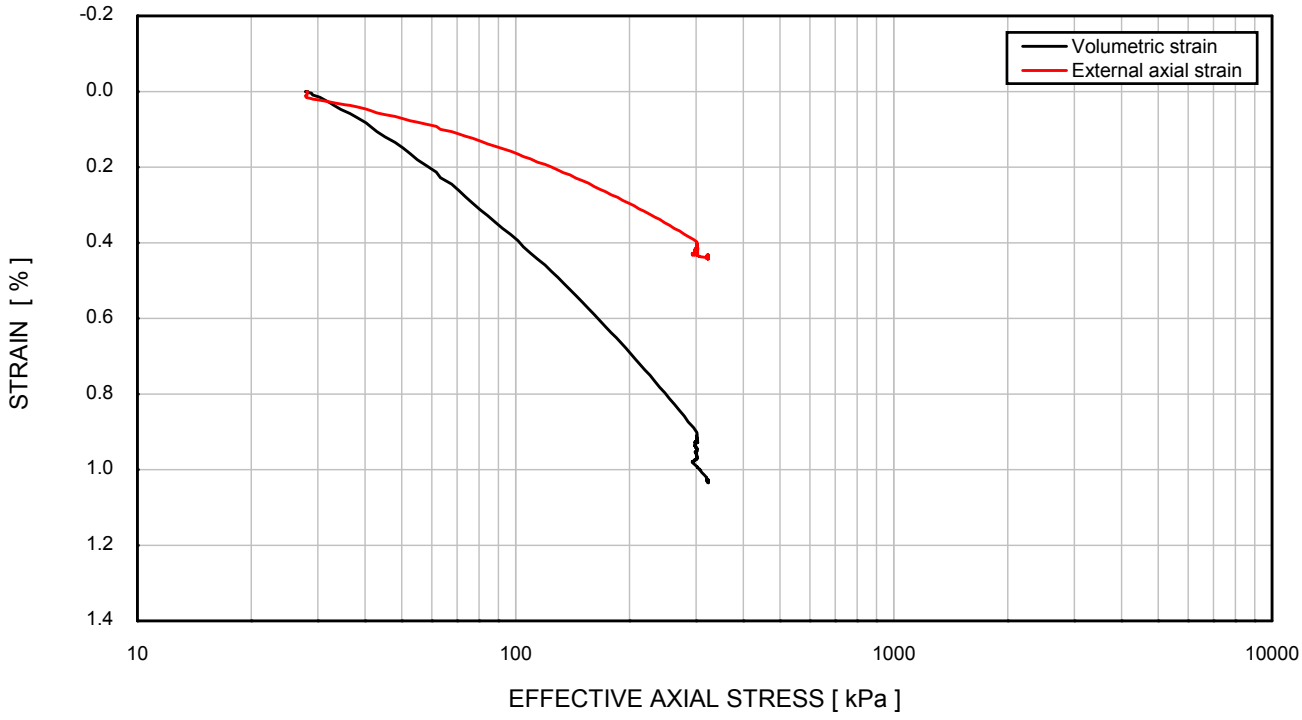




B value	:	0.97	Batch	:	5
Initial σ'_r	:	12 kPa	Sample	:	CTX_5-4
Initial σ'_a	:	12 kPa	Unit	:	Unit C2 (Eem)
Final σ'_r	:	28 kPa	Test No.	:	CTX21
Final σ'_a	:	28 kPa			

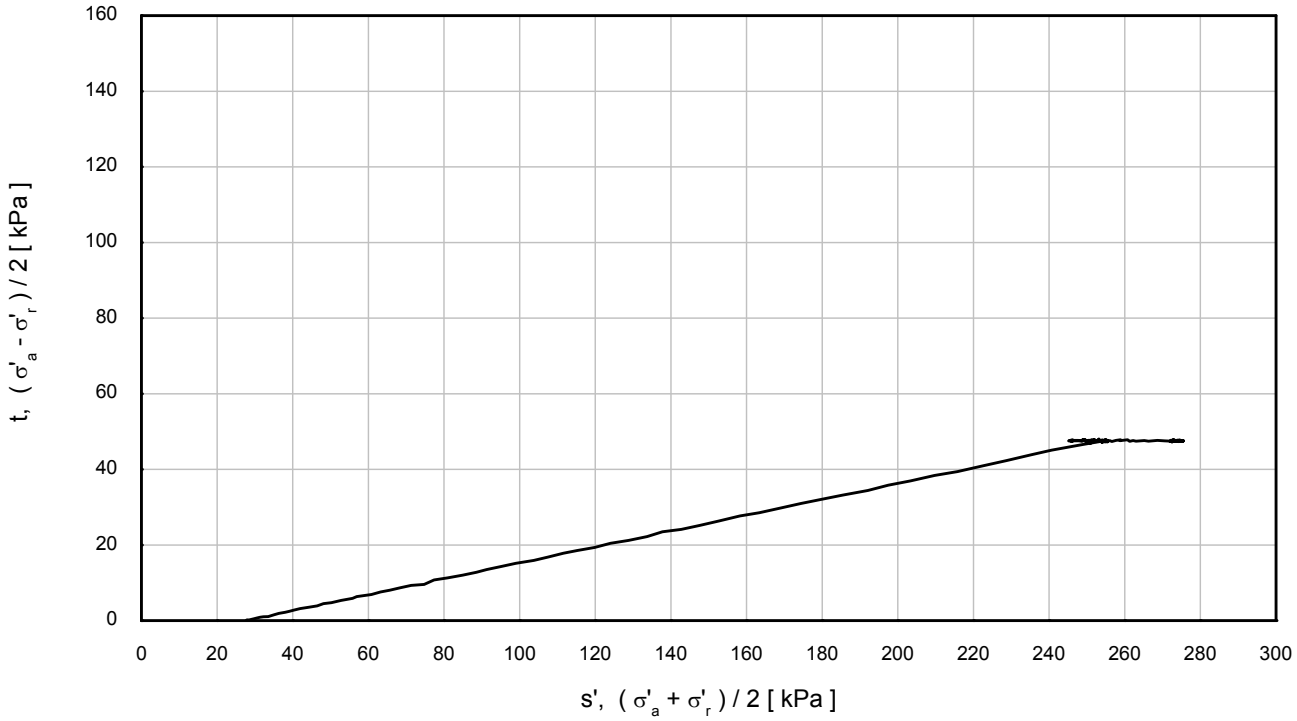
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

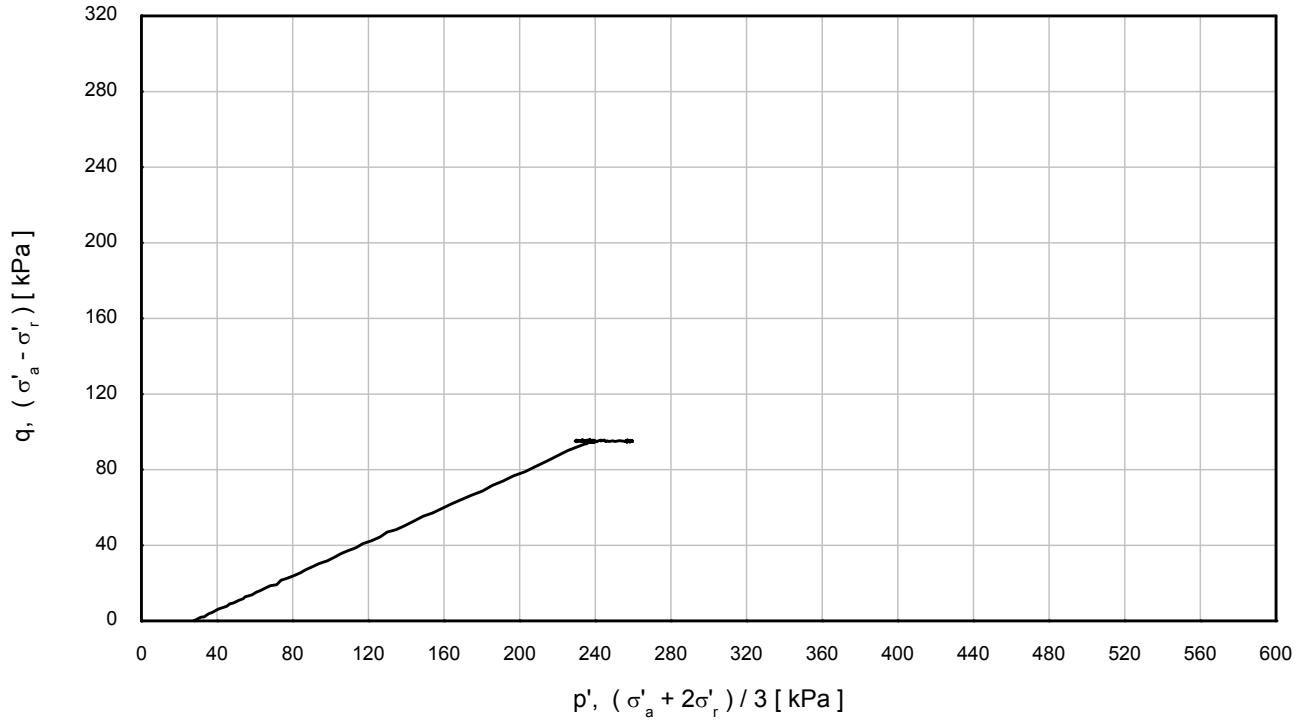




Stage 1 σ'_{rc}	: 225 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-4
		Unit	: Unit C2 (Eem)
		Test No.	: CTX21

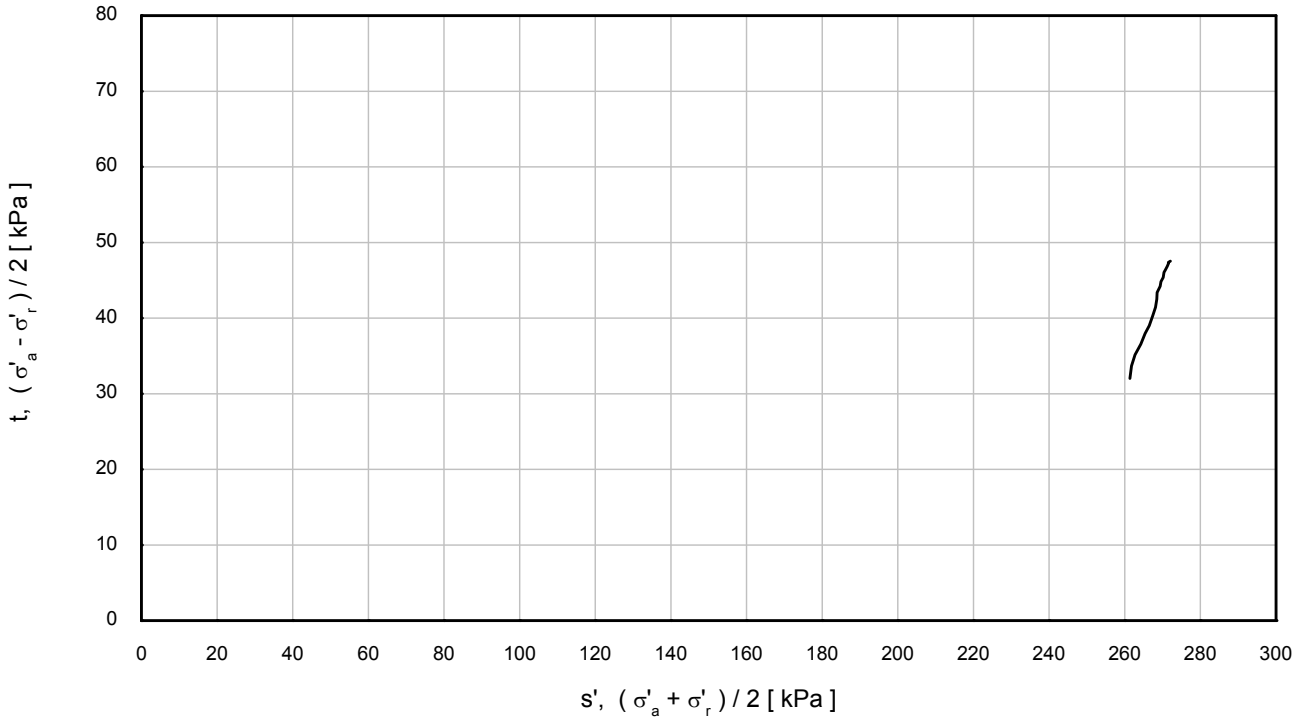
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

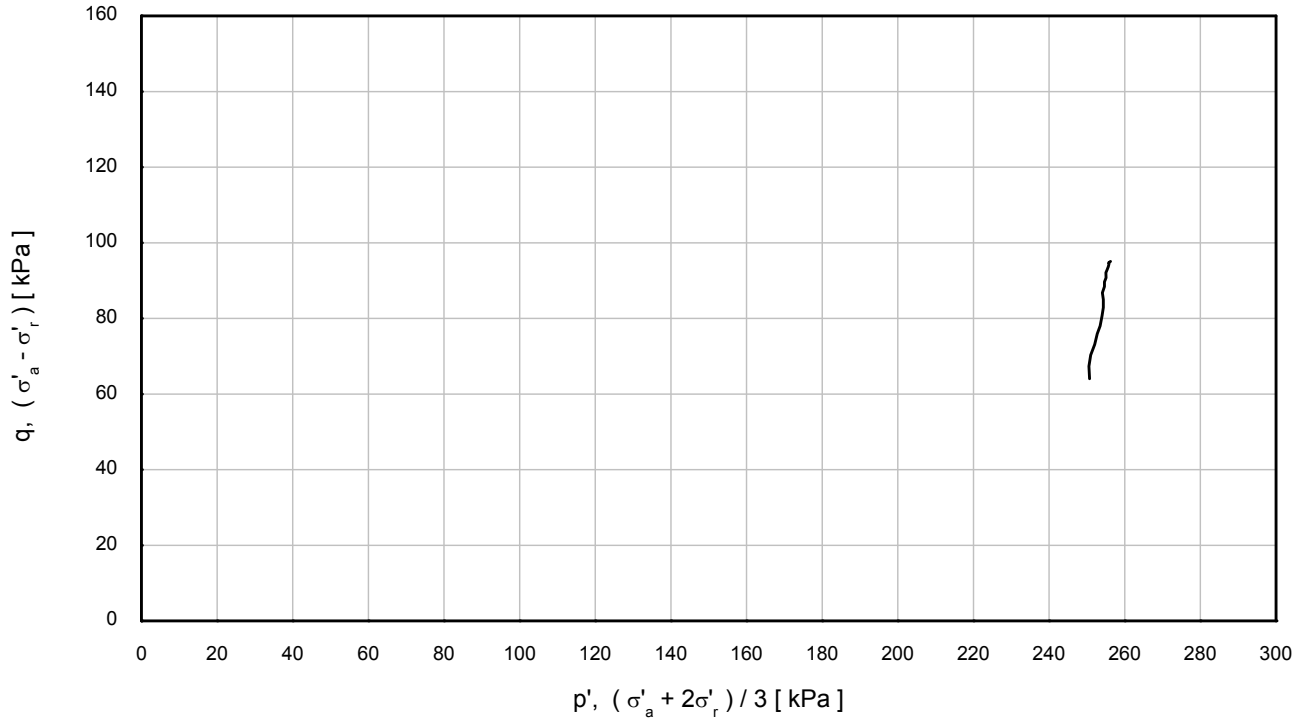




Stage 1 σ'_{rc}	: 225 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-4
		Unit	: Unit C2 (Eem)
		Test No.	: CTX21

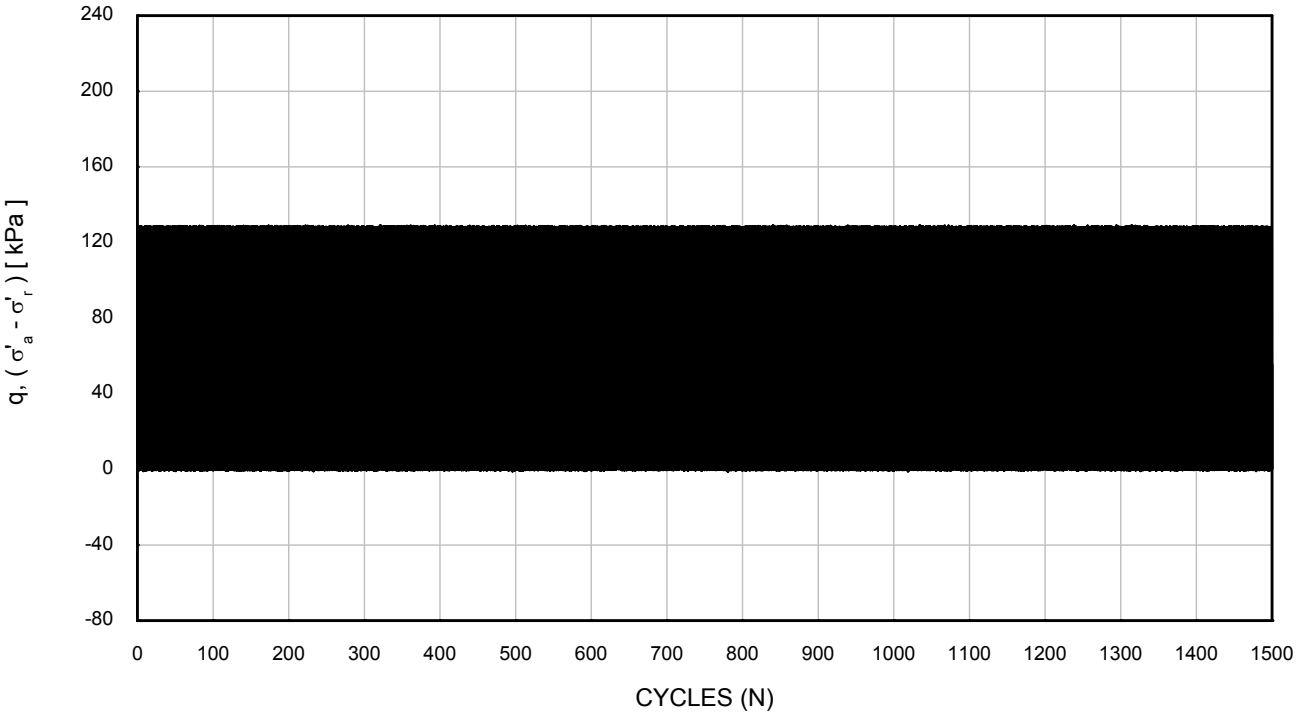
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

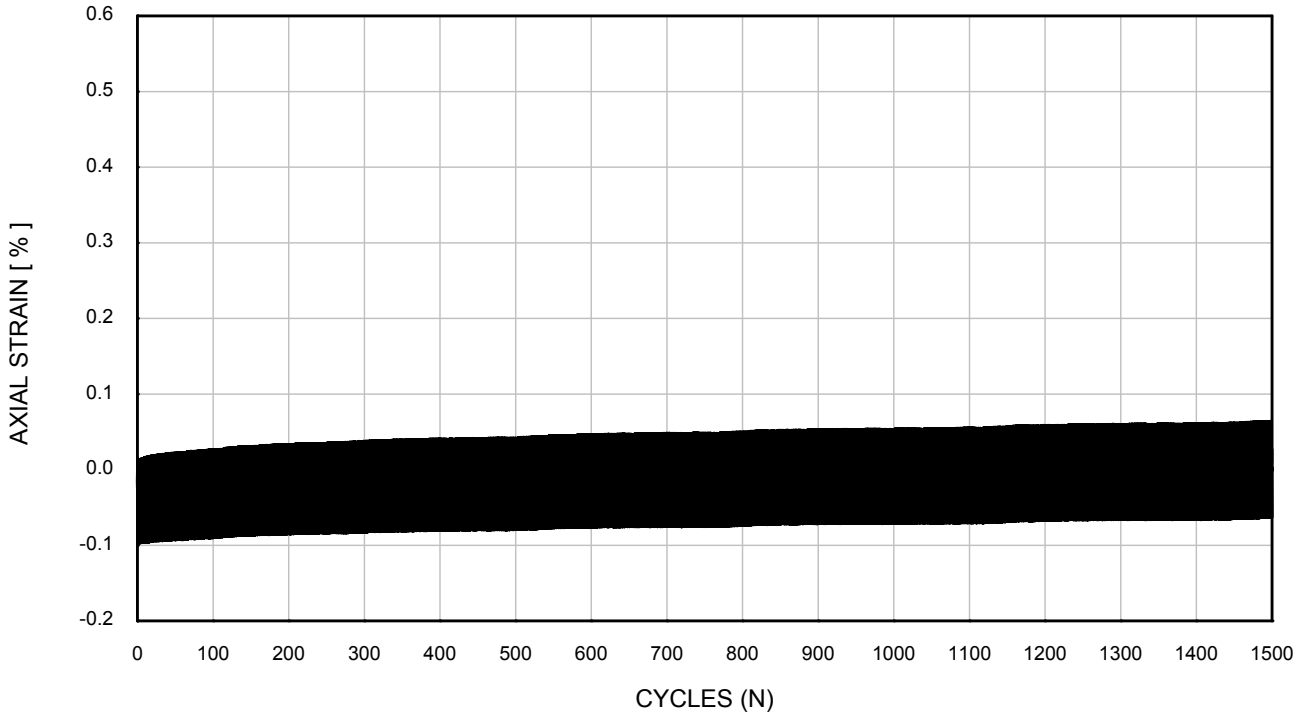




σ'_{rc}	: 229 kPa	Batch	: 5
σ'_{ac}	: 293 kPa	Sample	: CTX_5-4
		Unit	: Unit C2 (Eem)
		Test No.	: CTX21

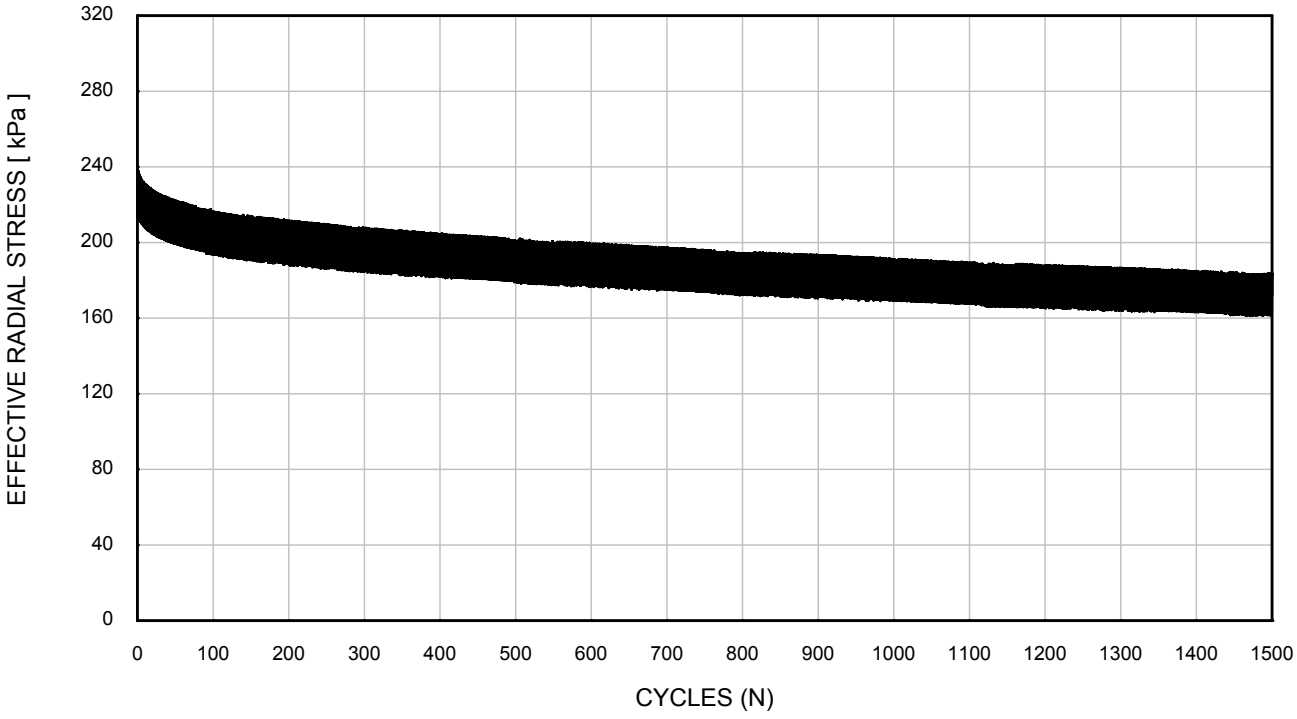
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

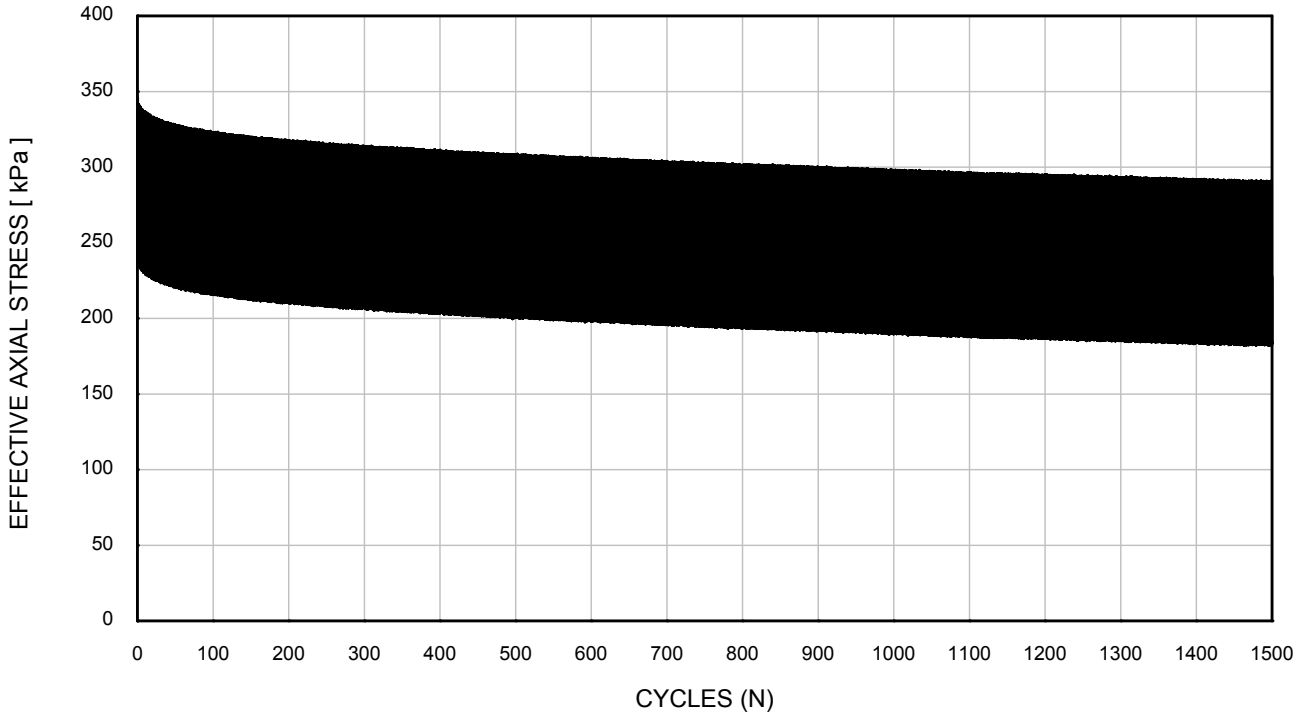




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

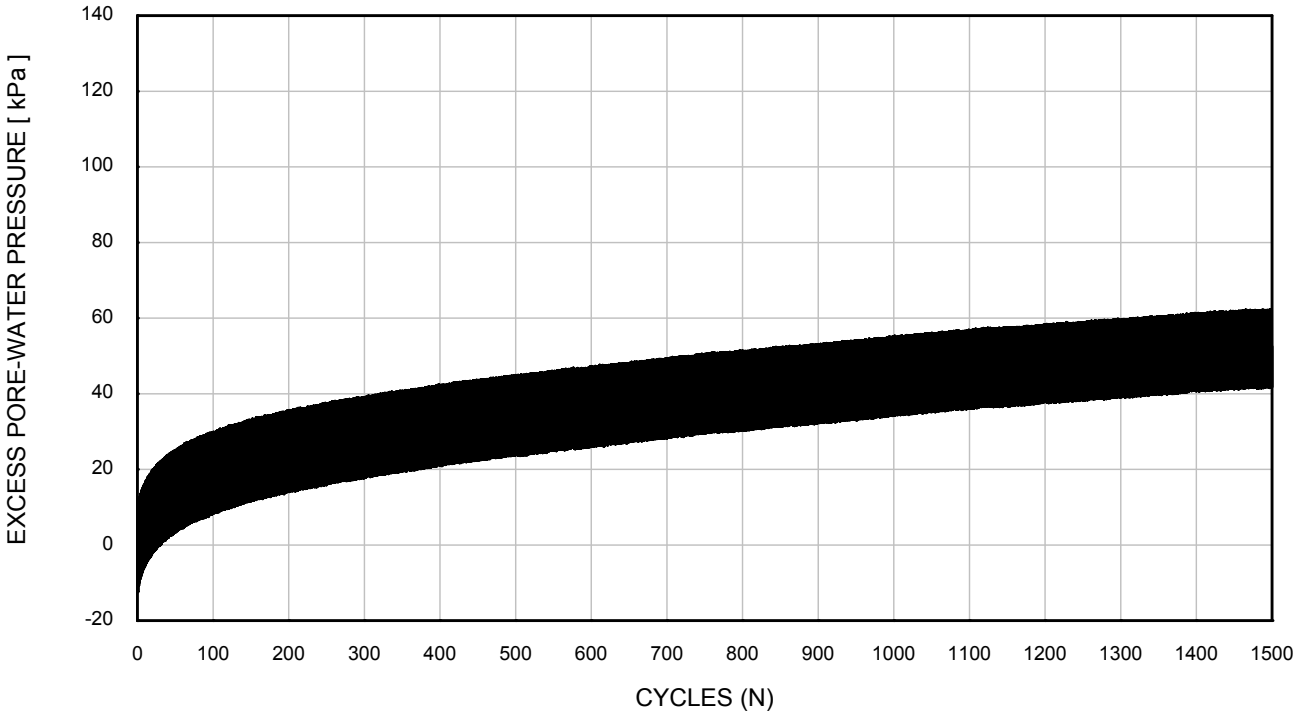
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

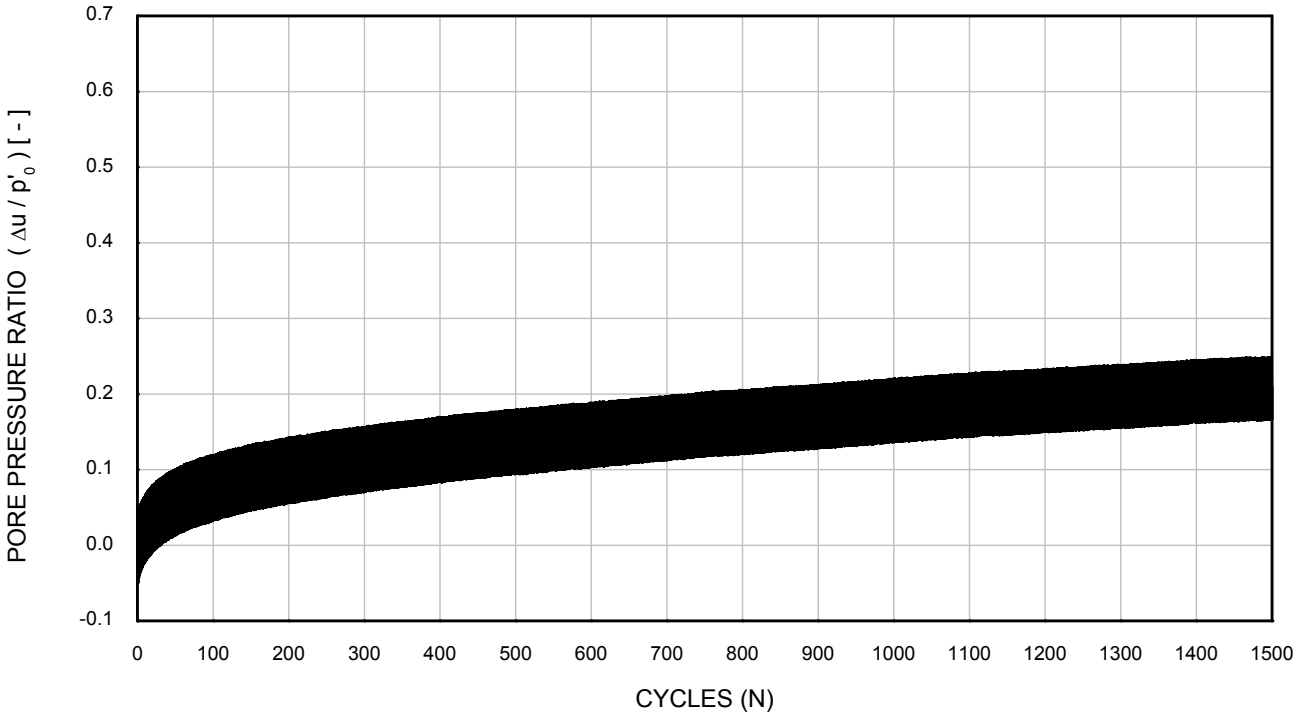




Initial σ'_r	: 229 kPa	Batch	: 5
Initial σ'_a	: 293 kPa	Sample	: CTX_5-4
q_{av}	: 64 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 64 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

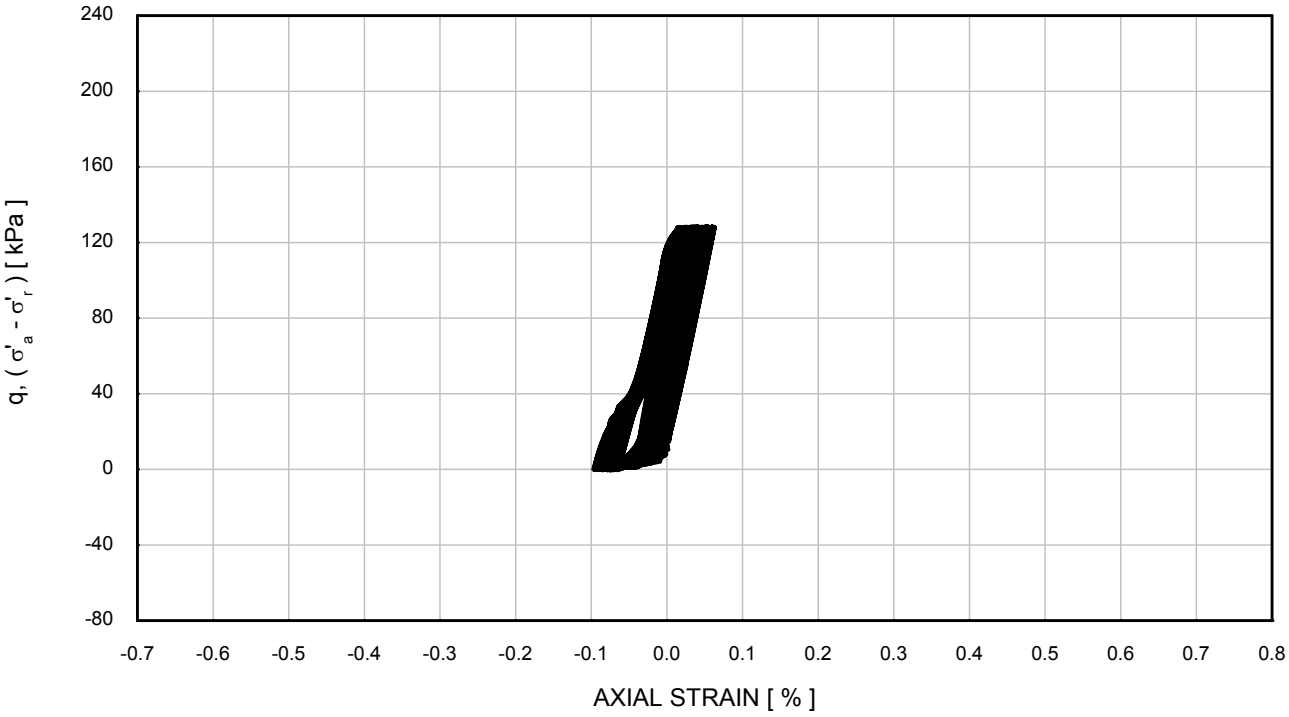
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

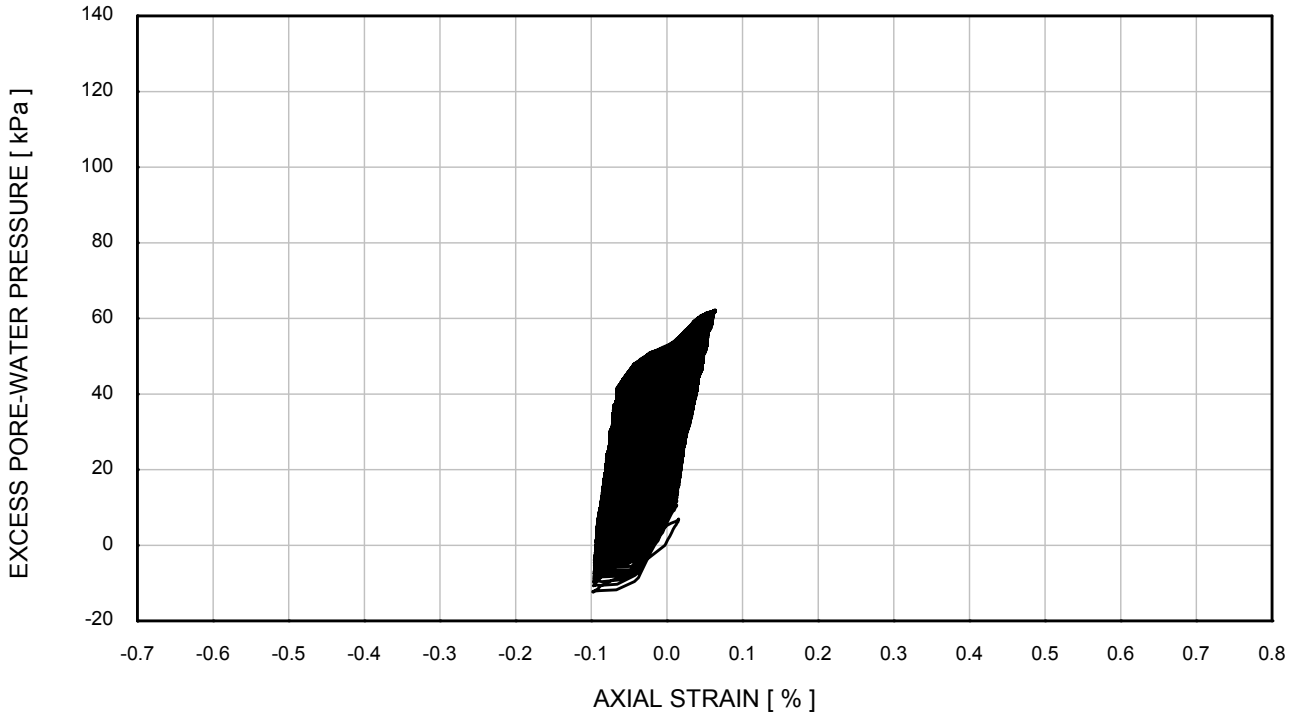




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

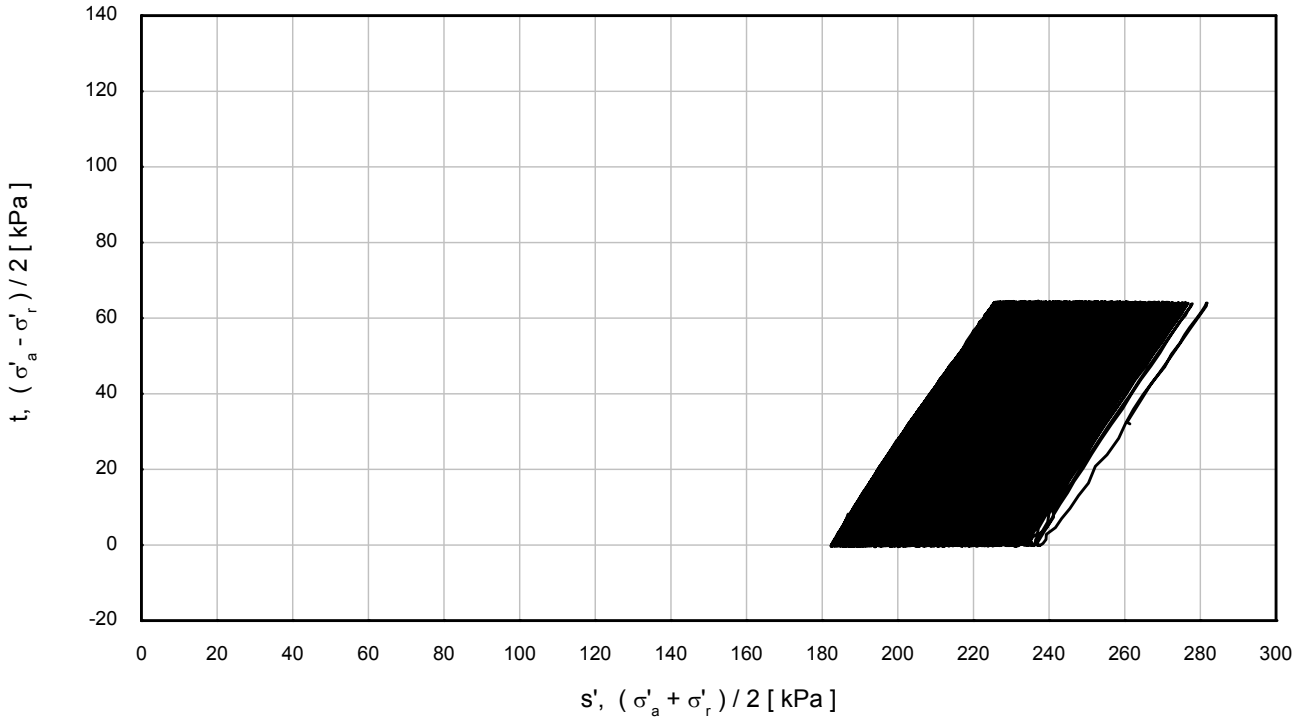
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

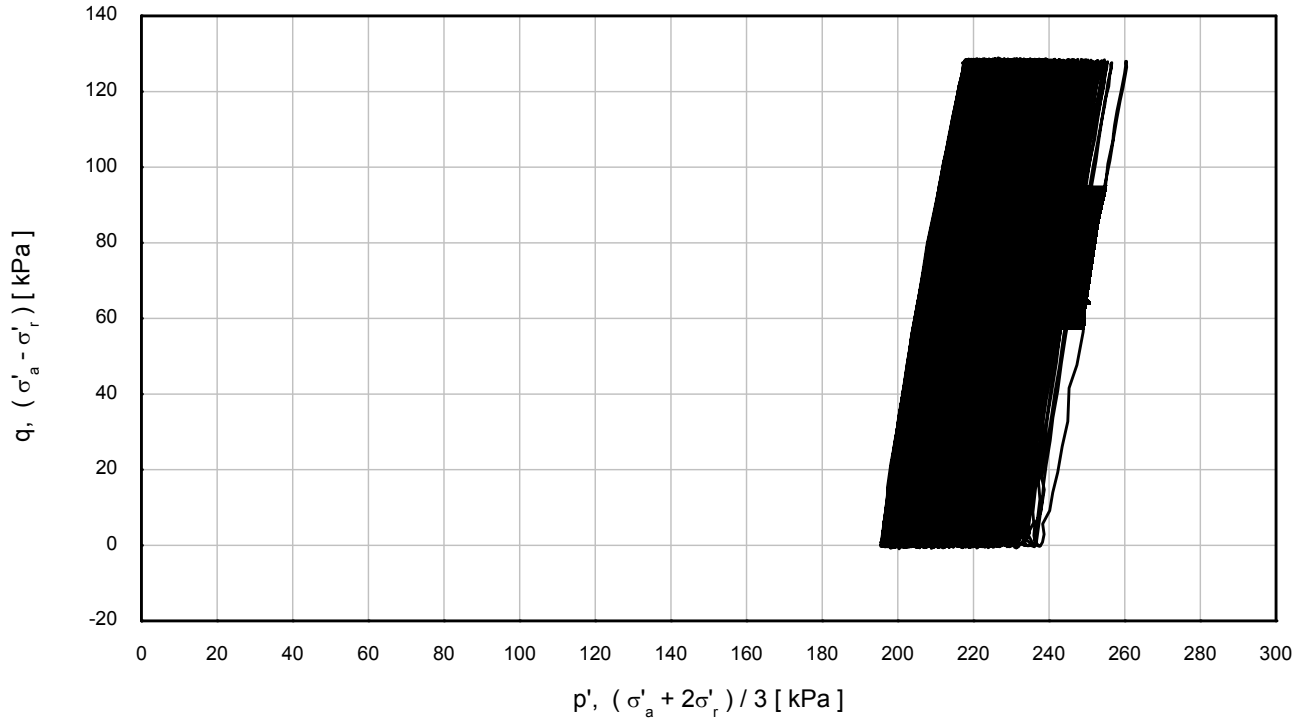




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

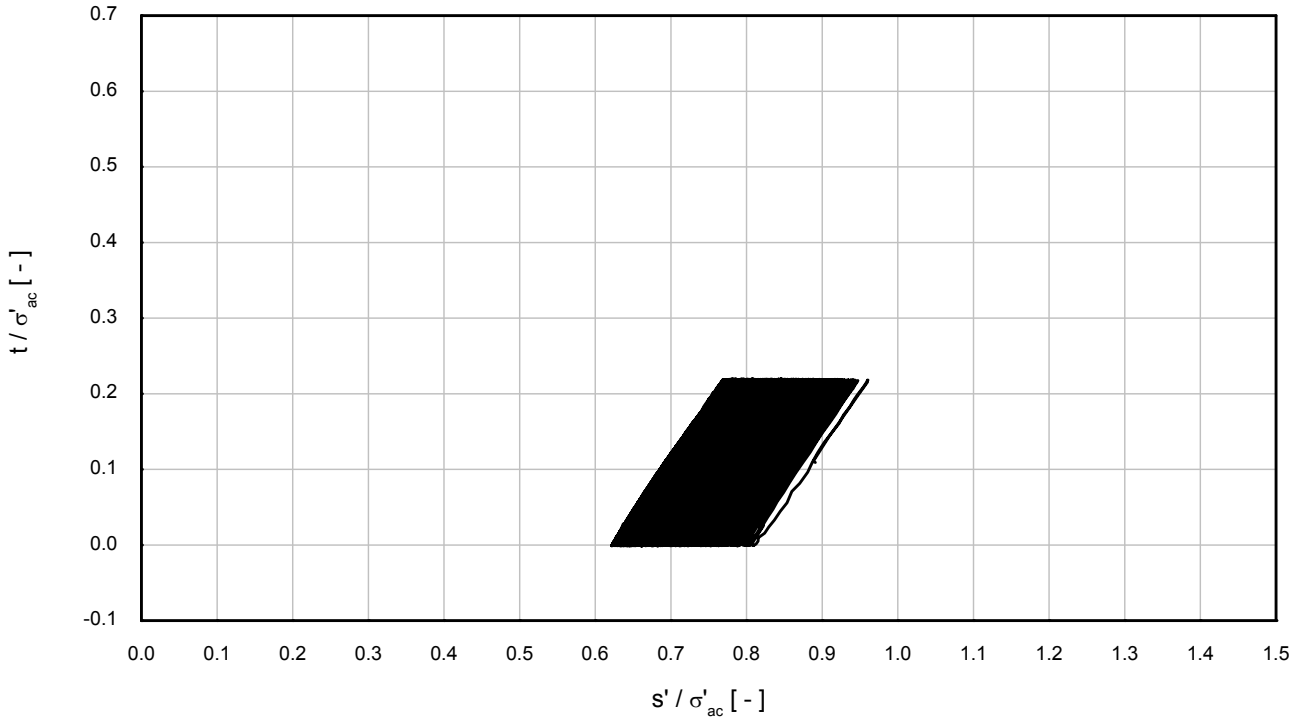
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

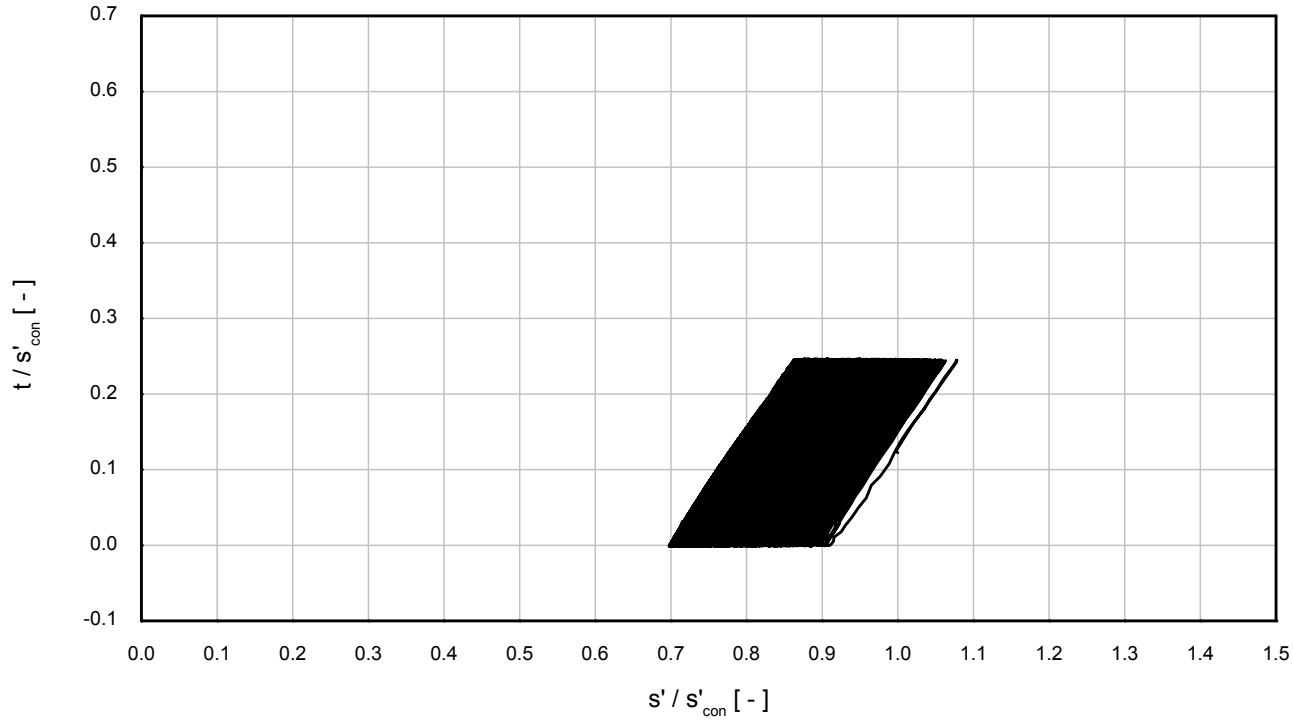




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

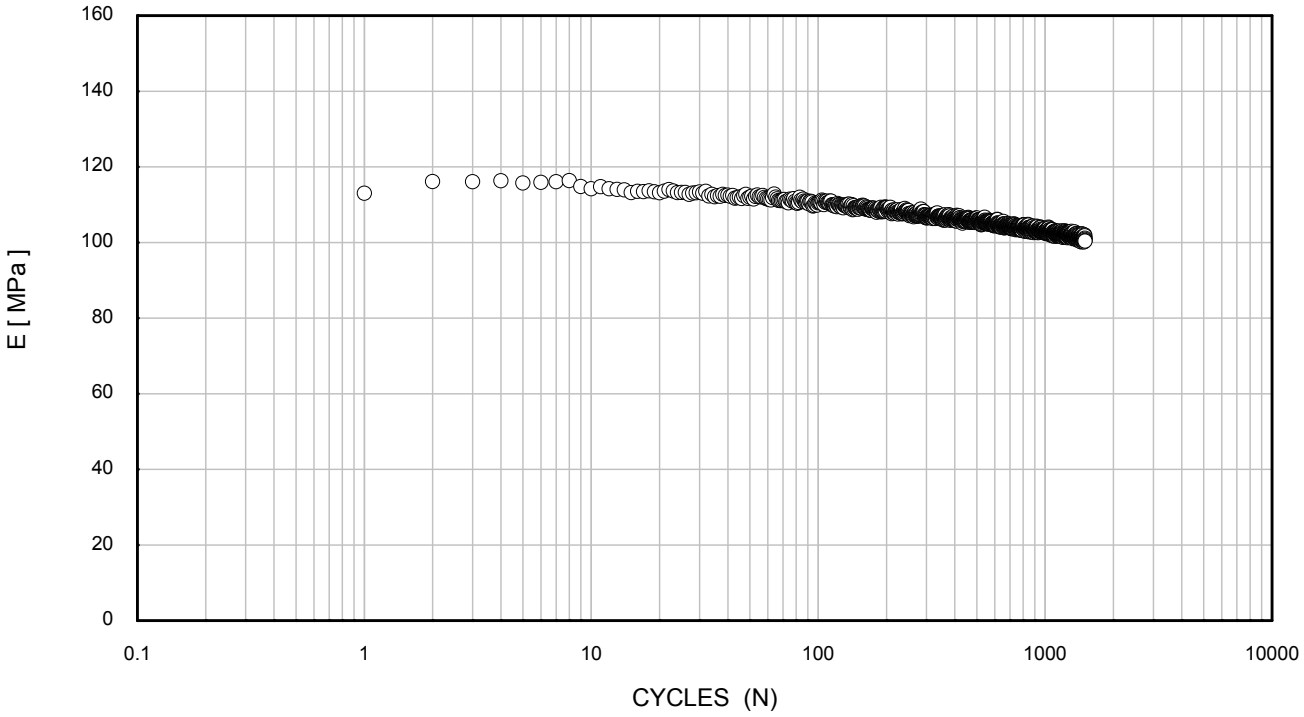
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

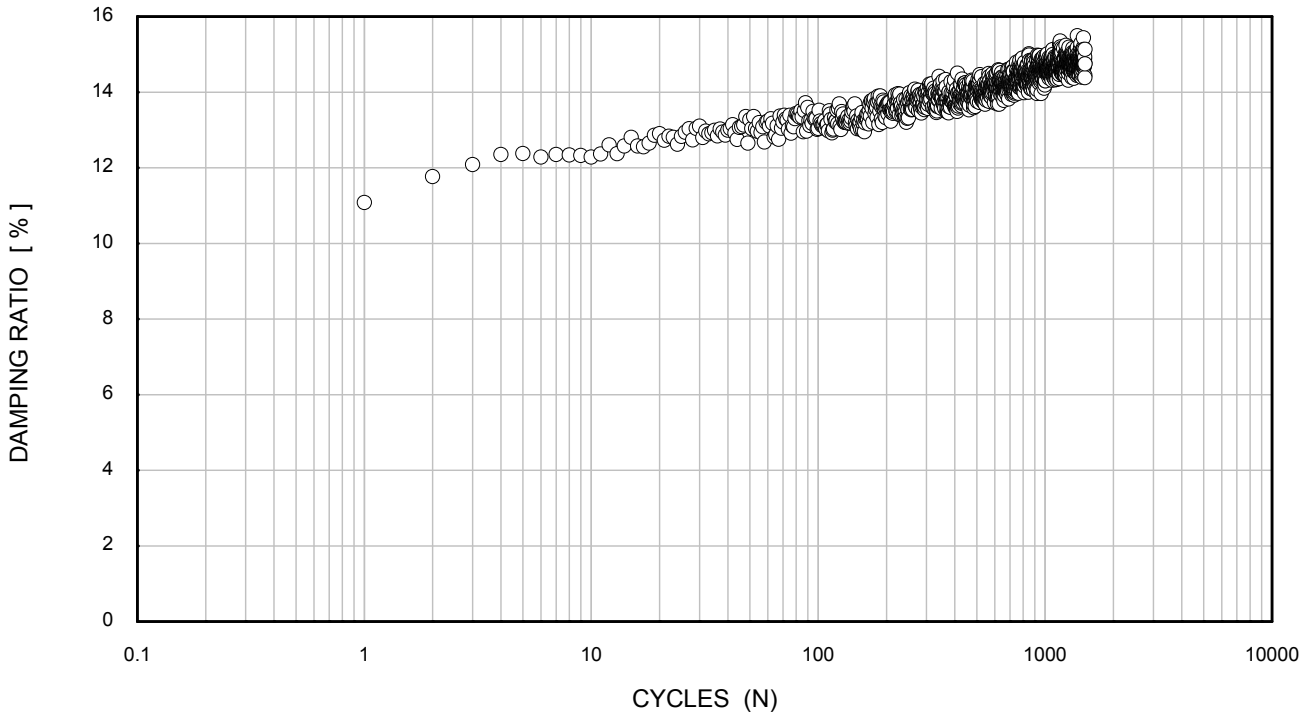




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

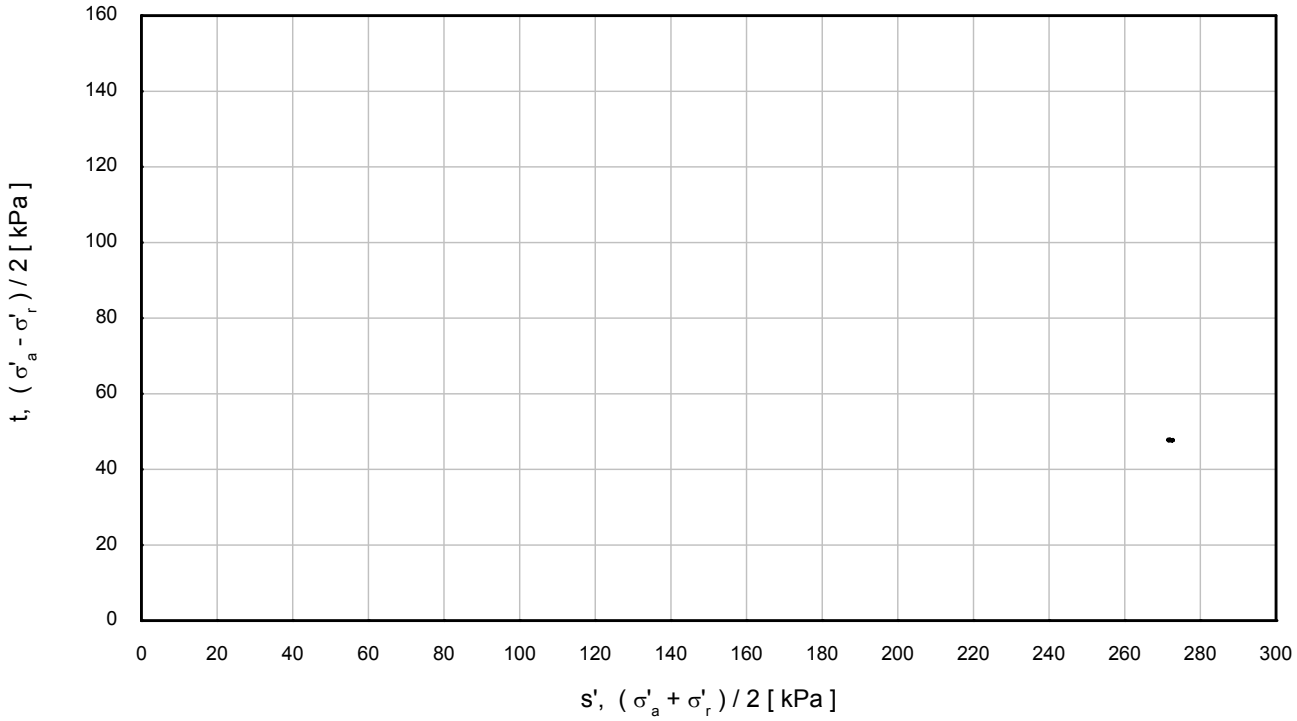
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

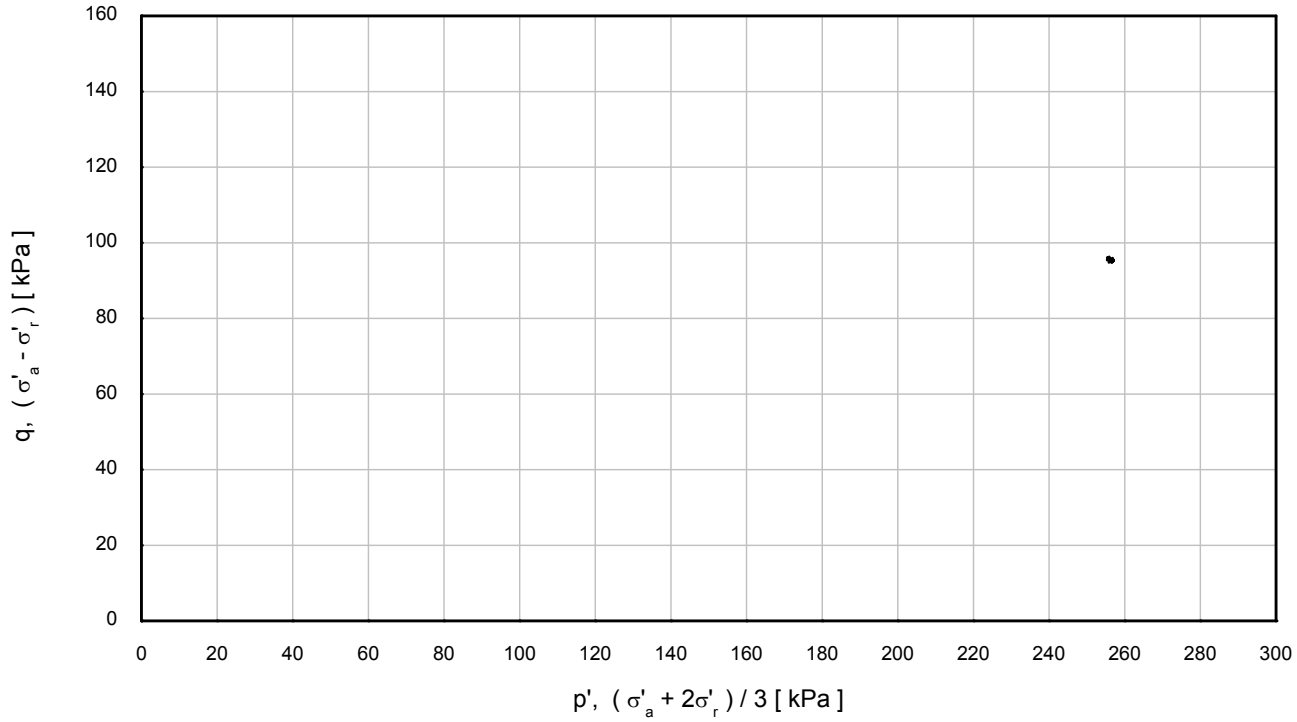




Initial σ'_r	:	229 kPa	Batch	:	5
Initial σ'_a	:	293 kPa	Sample	:	CTX_5-4
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	64 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

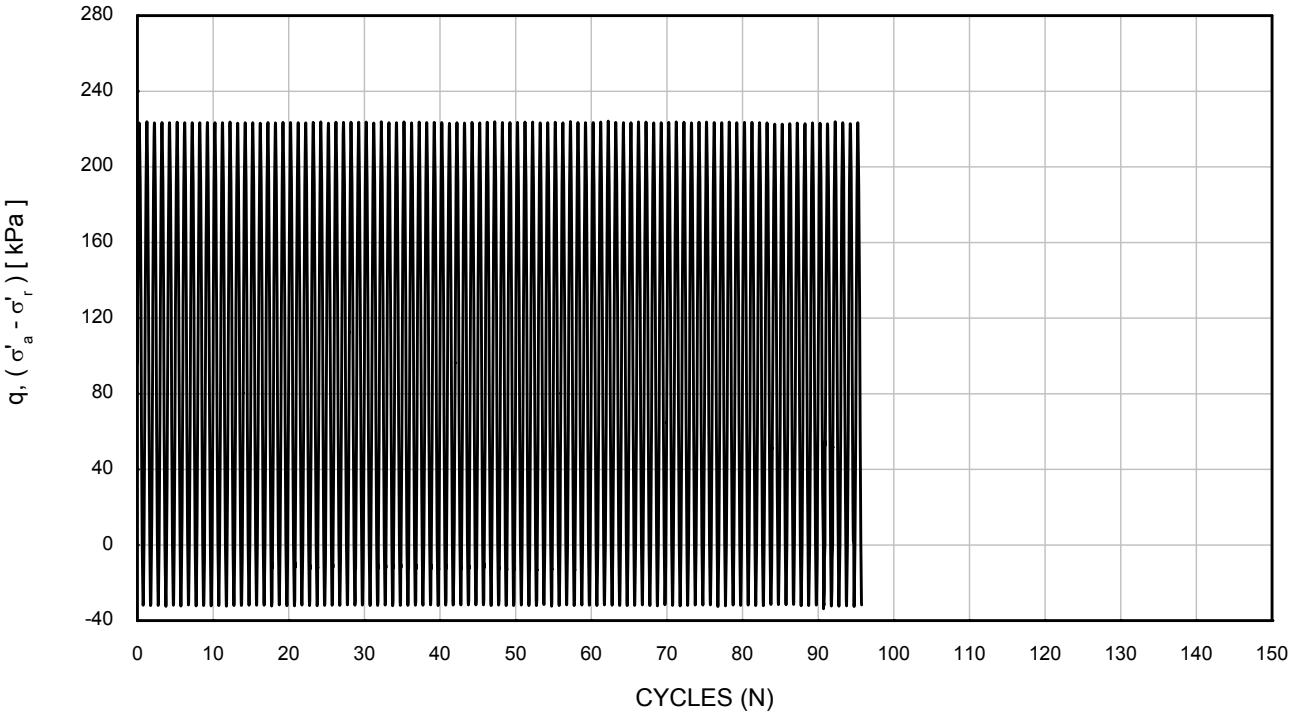
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

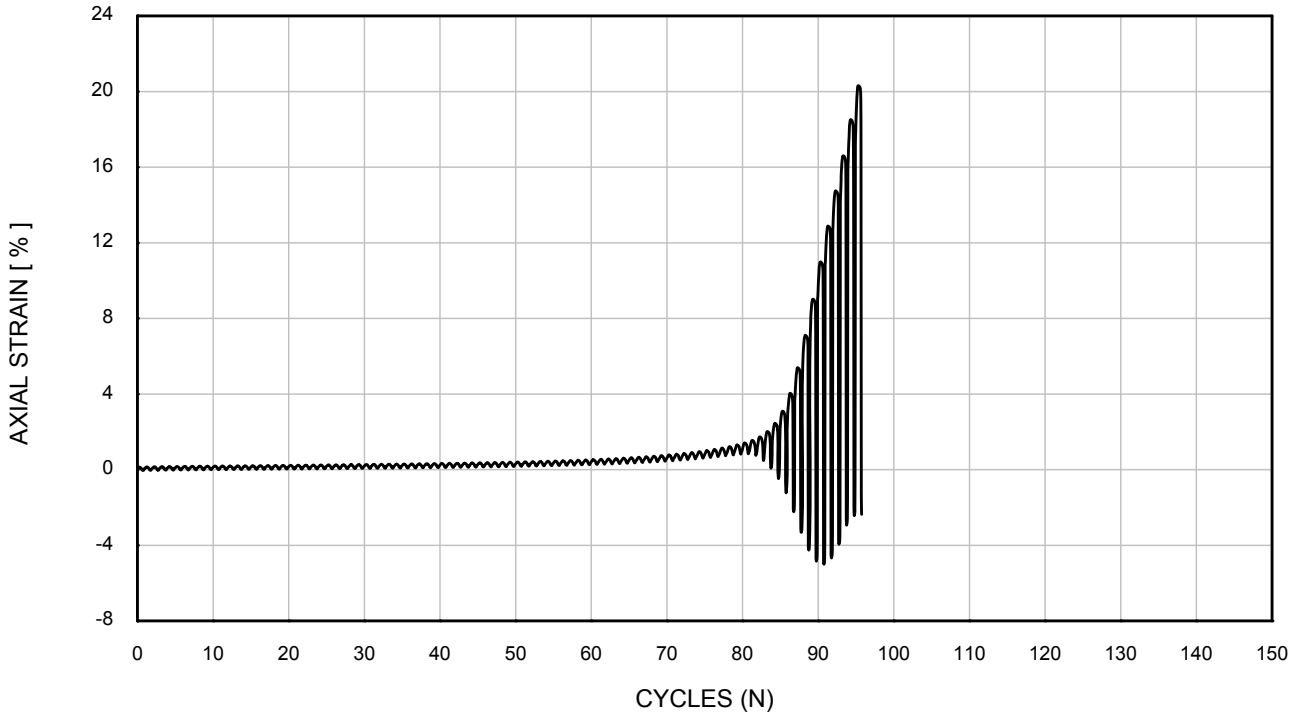




σ'_{rc}	: 223 kPa	Batch	: 5
σ'_{ac}	: 319 kPa	Sample	: CTX_5-4
		Unit	: Unit C2 (Eem)
		Test No.	: CTX21

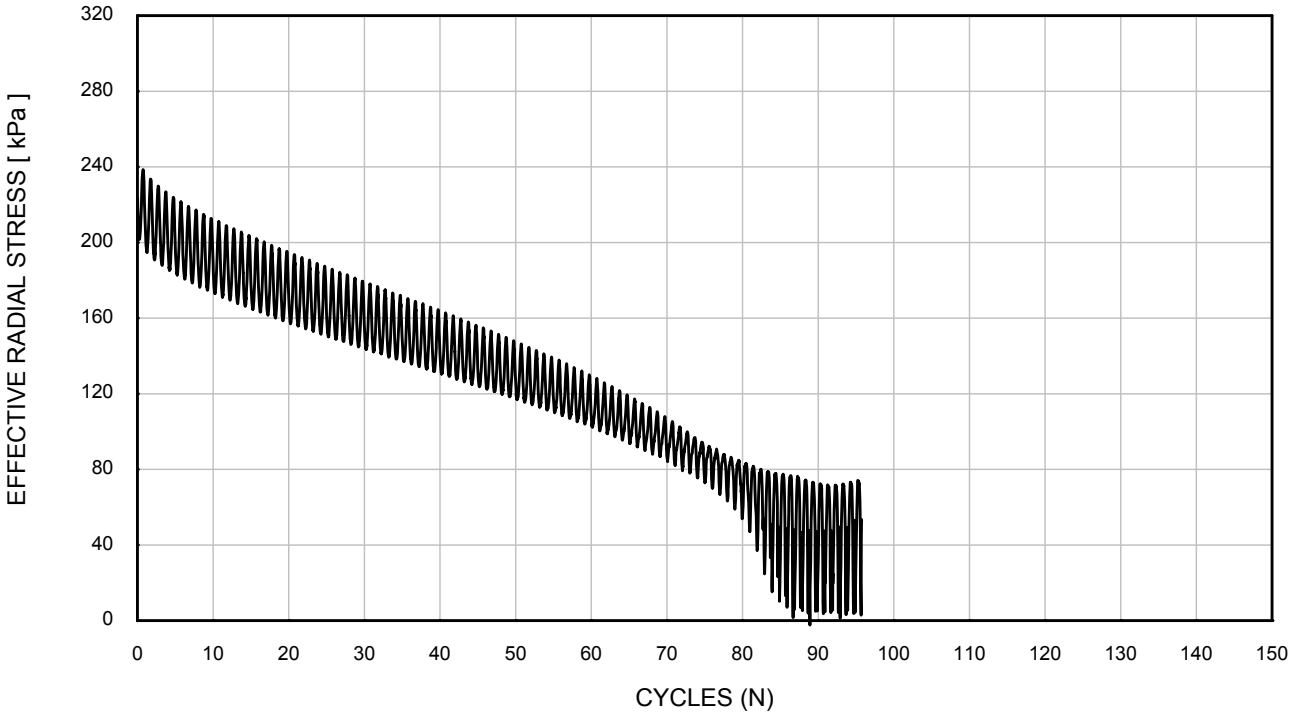
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

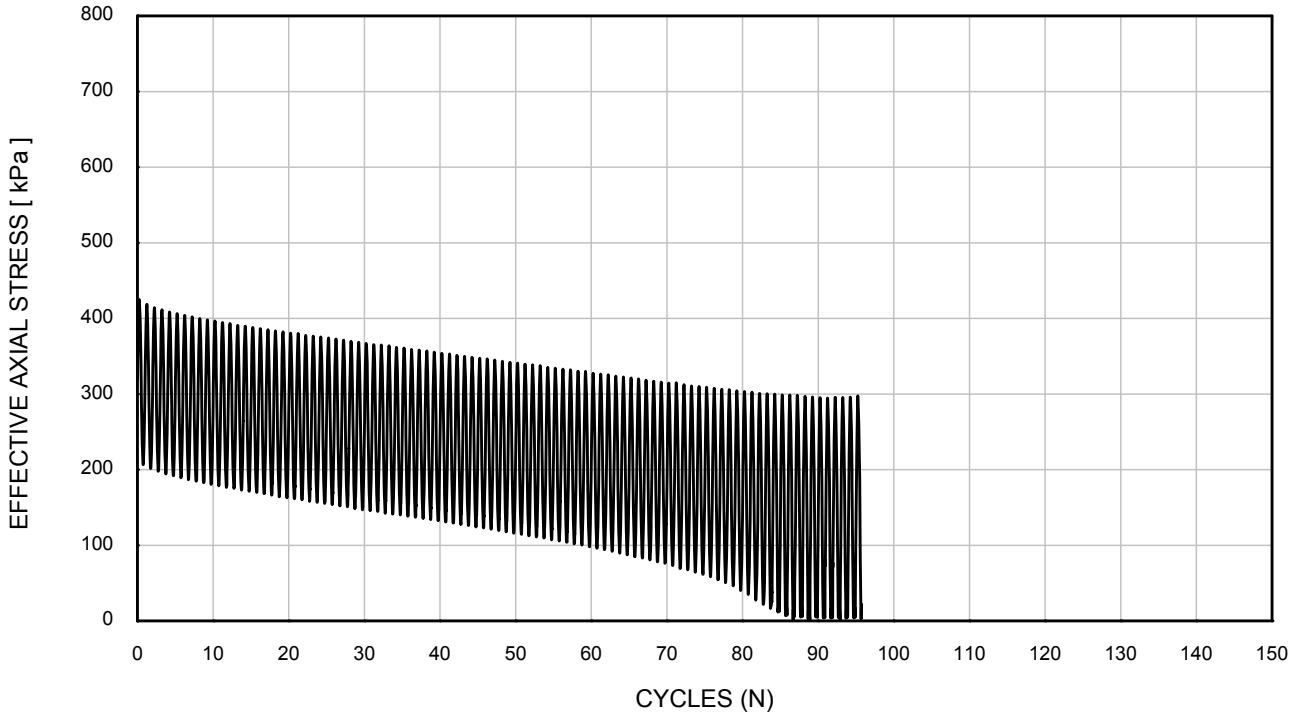




Initial σ'_r	:	223 kPa	Batch	:	5
Initial σ'_a	:	319 kPa	Sample	:	CTX_5-4
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	128 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

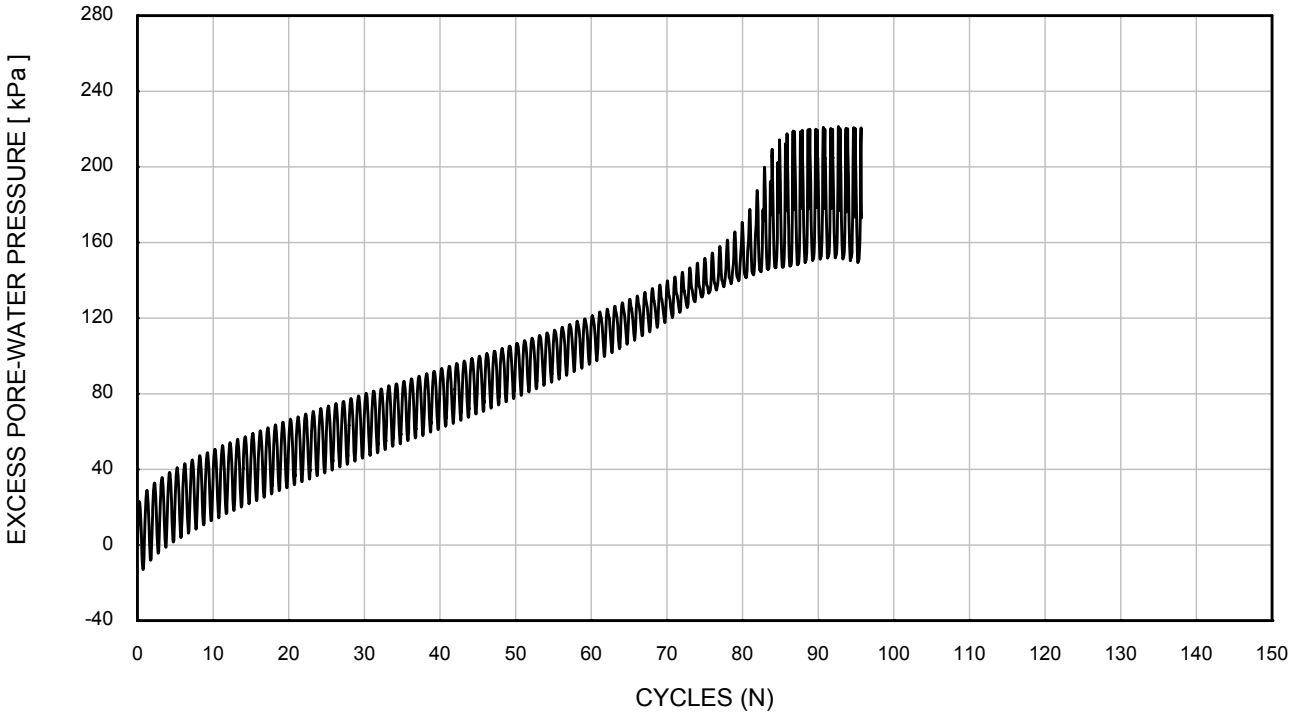
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

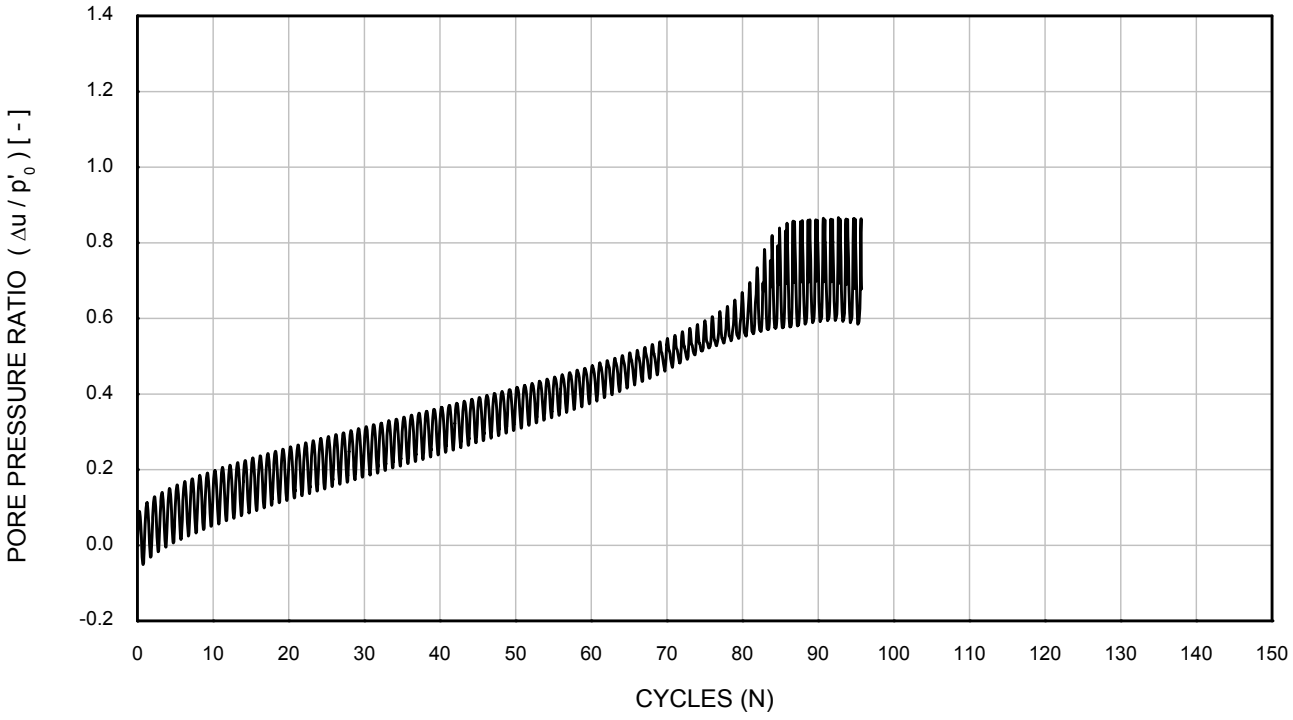




Initial σ'_r	: 223 kPa	Batch	: 5
Initial σ'_a	: 319 kPa	Sample	: CTX_5-4
q_{av}	: 96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 128 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

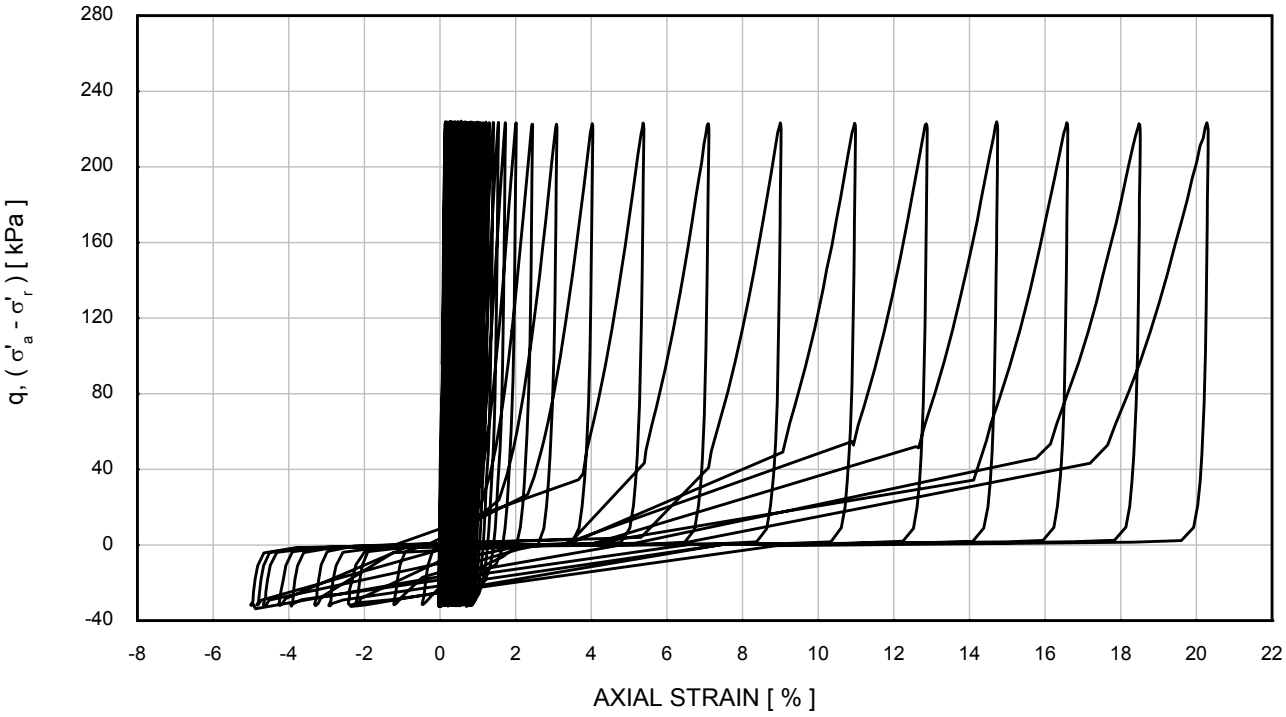
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

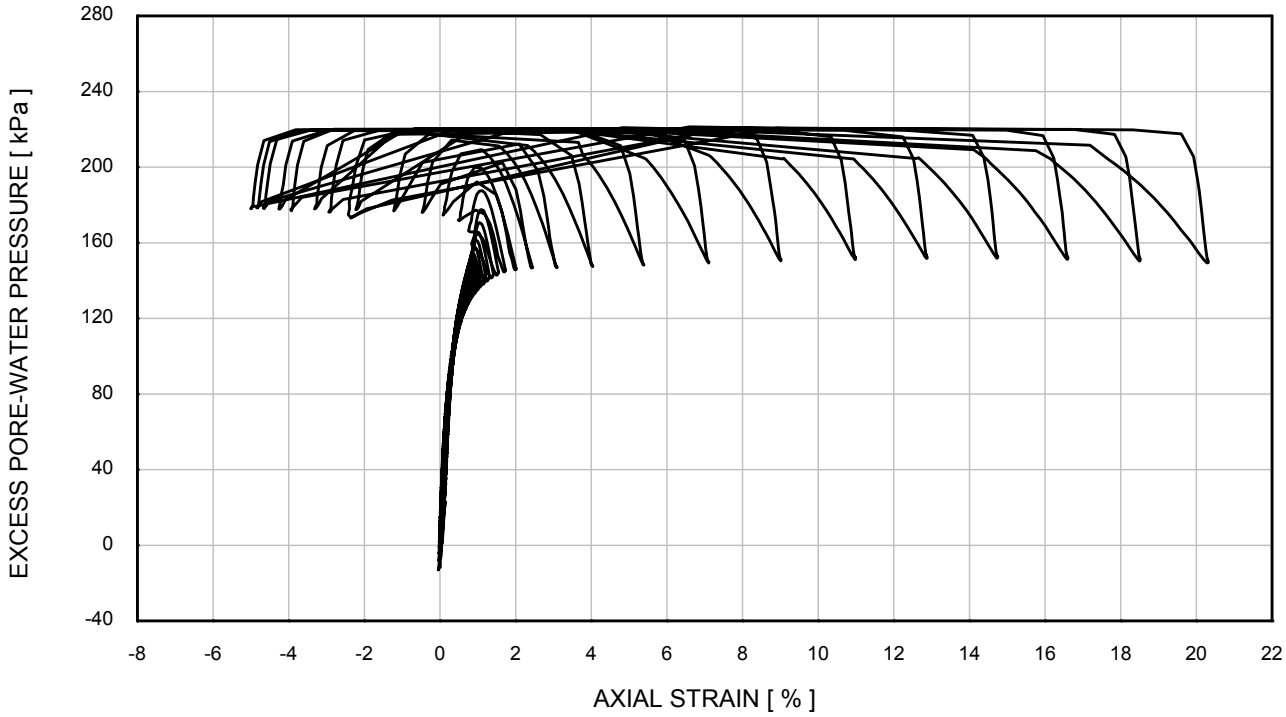




Initial σ'_r	: 223 kPa	Batch	: 5
Initial σ'_a	: 319 kPa	Sample	: CTX_5-4
q_{av}	: 96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 128 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

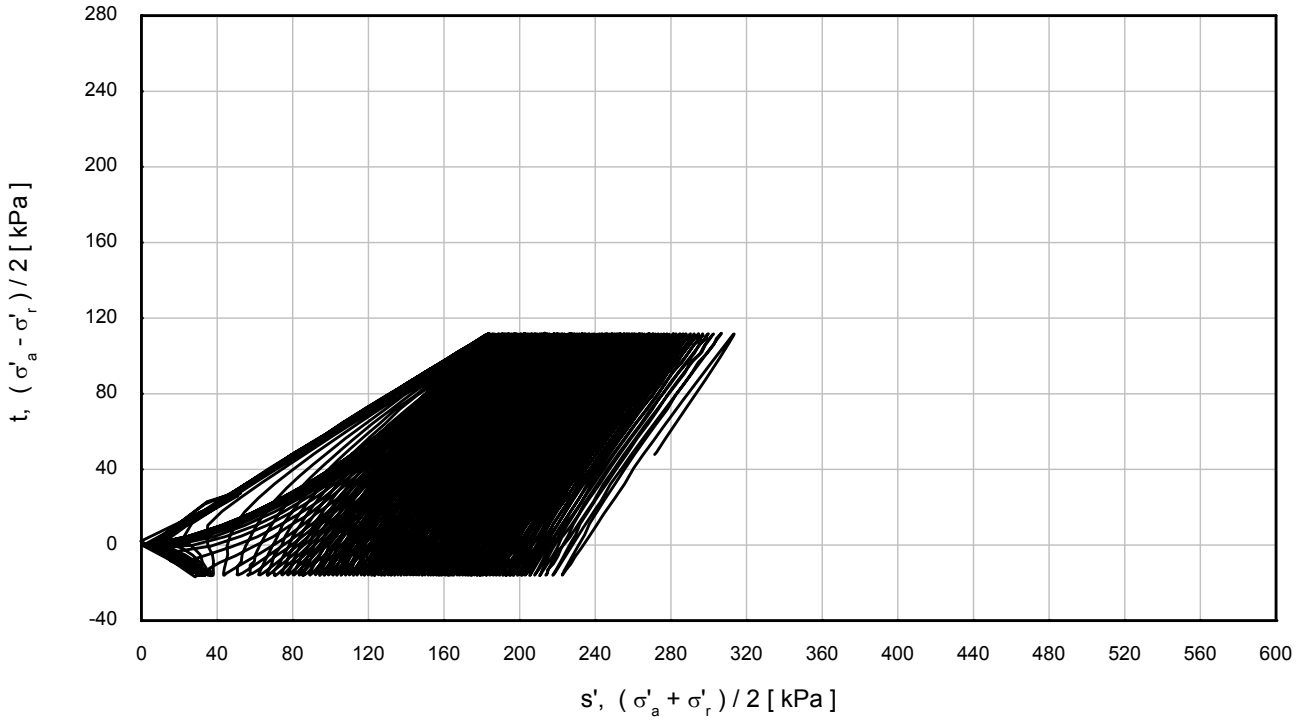
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

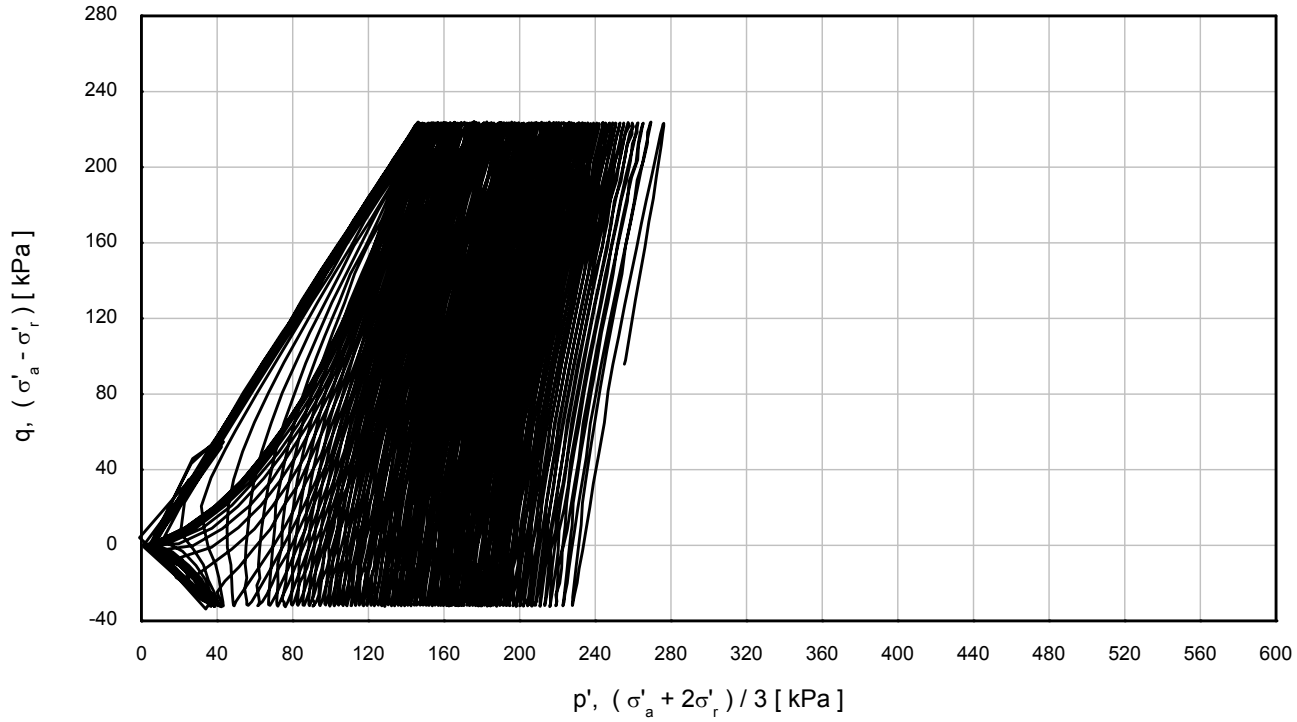




Initial σ'_r	: 223 kPa	Batch	: 5
Initial σ'_a	: 319 kPa	Sample	: CTX_5-4
q_{av}	: 96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 128 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

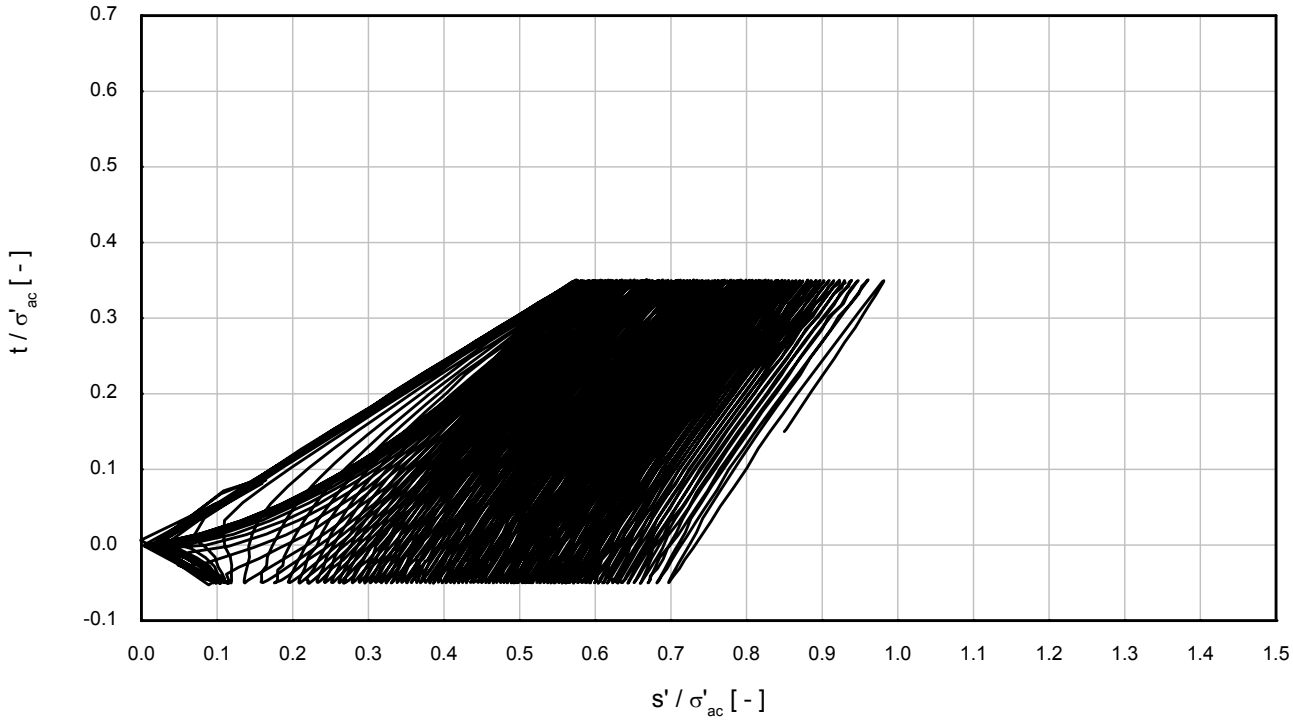
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

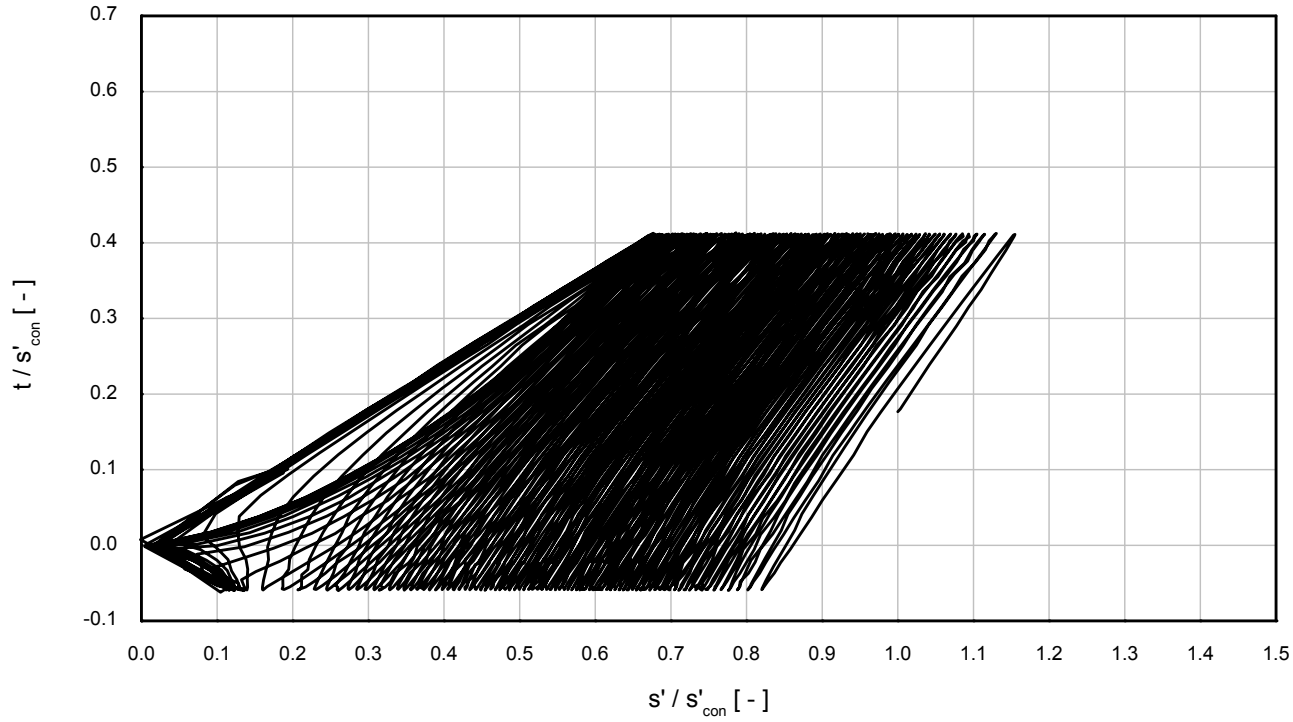




Initial σ'_r	:	223 kPa	Batch	:	5
Initial σ'_a	:	319 kPa	Sample	:	CTX_5-4
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	128 kPa	Test No.	:	CTX21
Frequency	:	0.10 Hz			

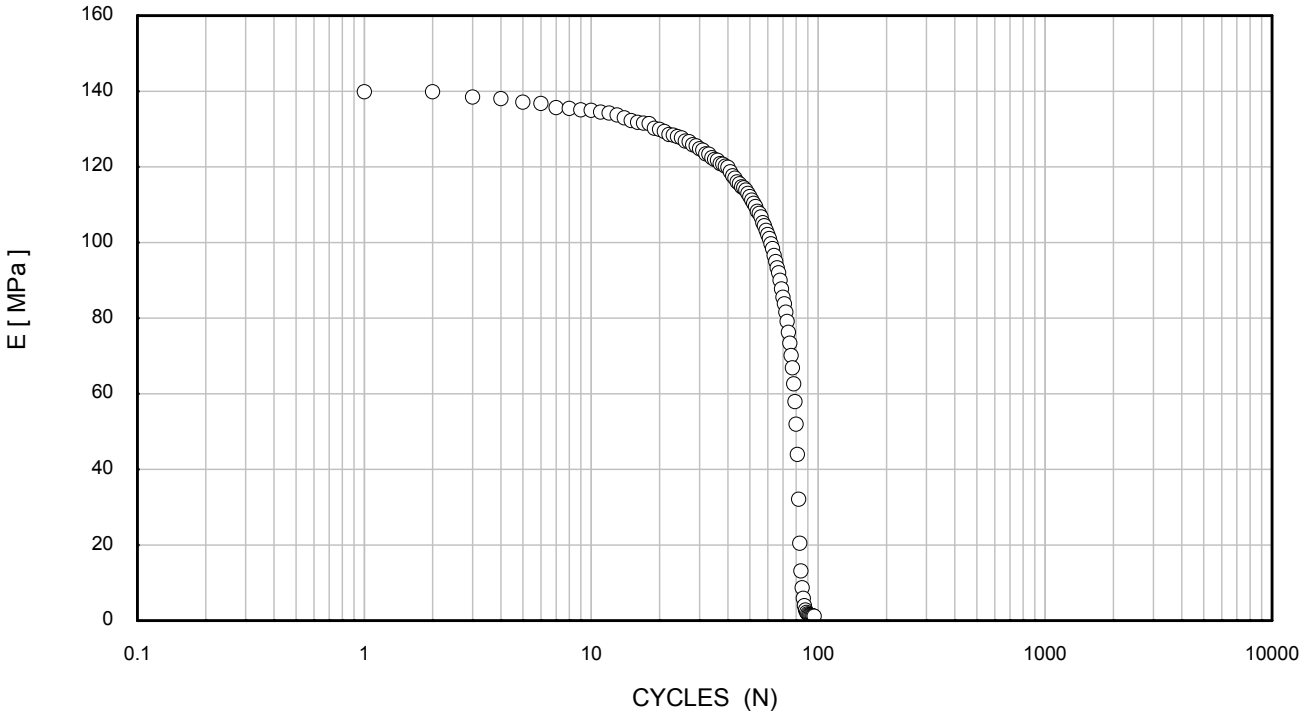
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

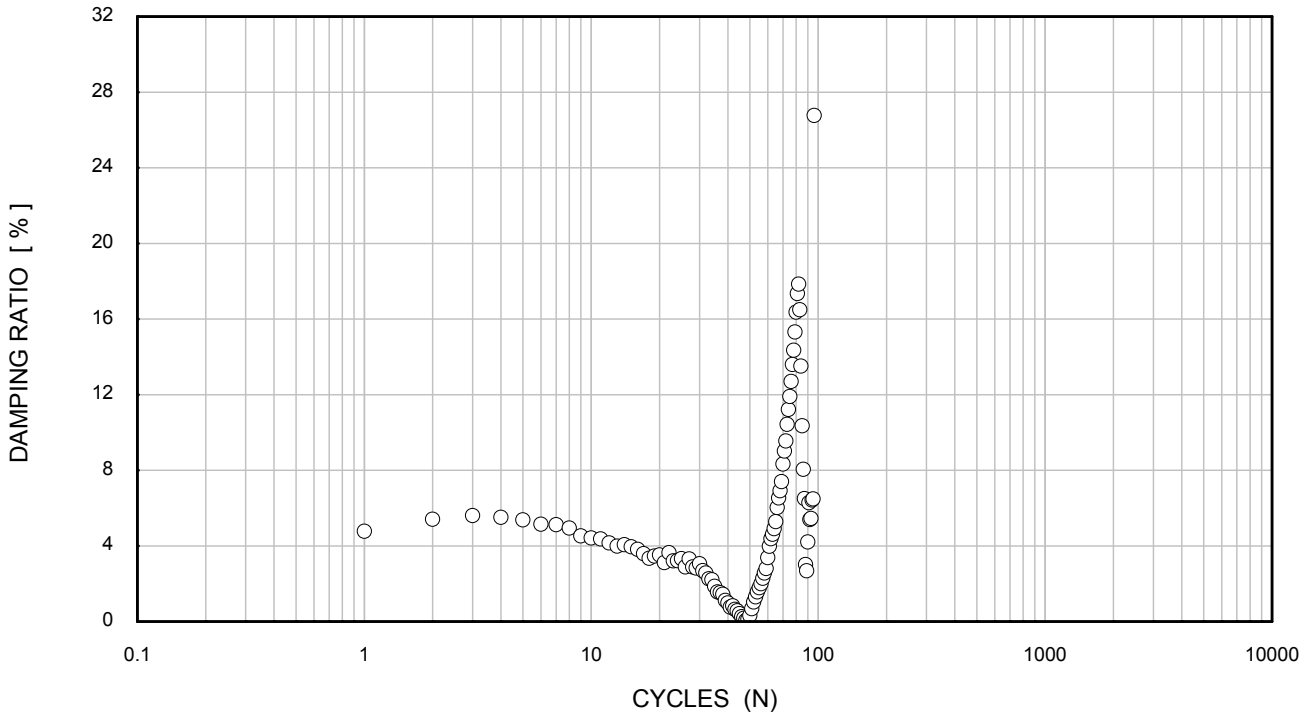




Initial σ'_r	: 223 kPa	Batch	: 5
Initial σ'_a	: 319 kPa	Sample	: CTX_5-4
q_{av}	: 96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 128 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

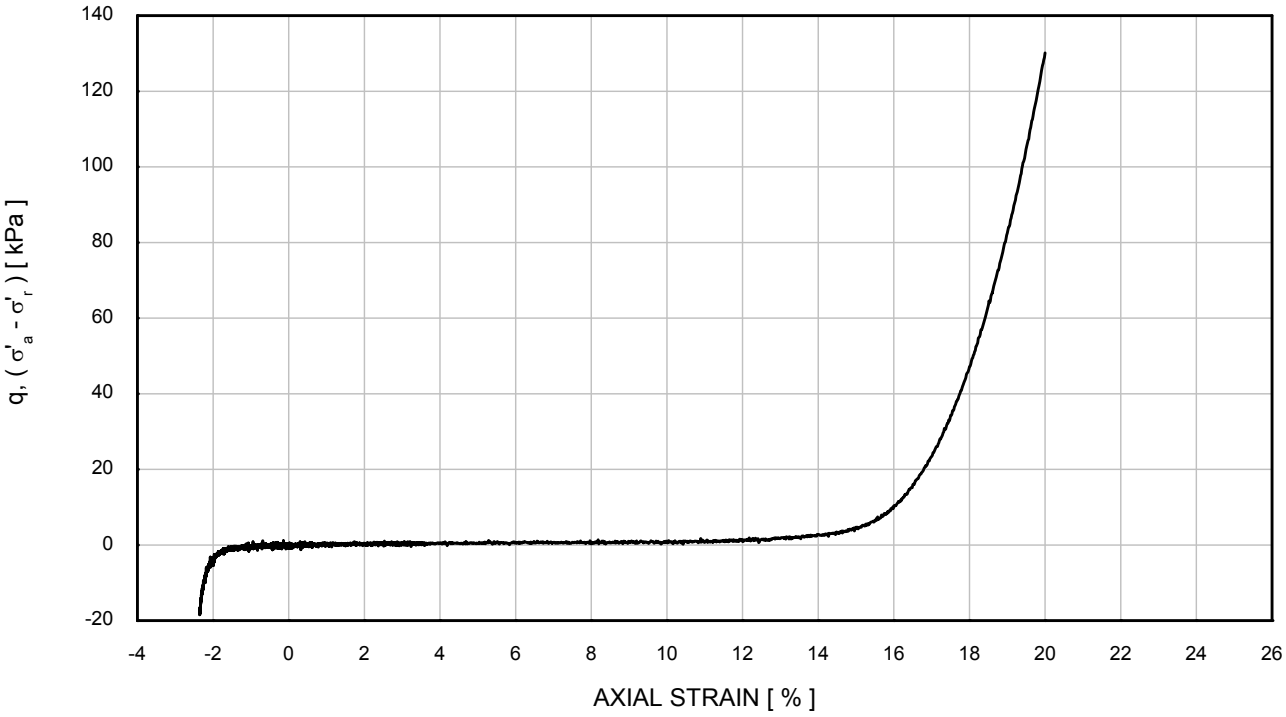
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

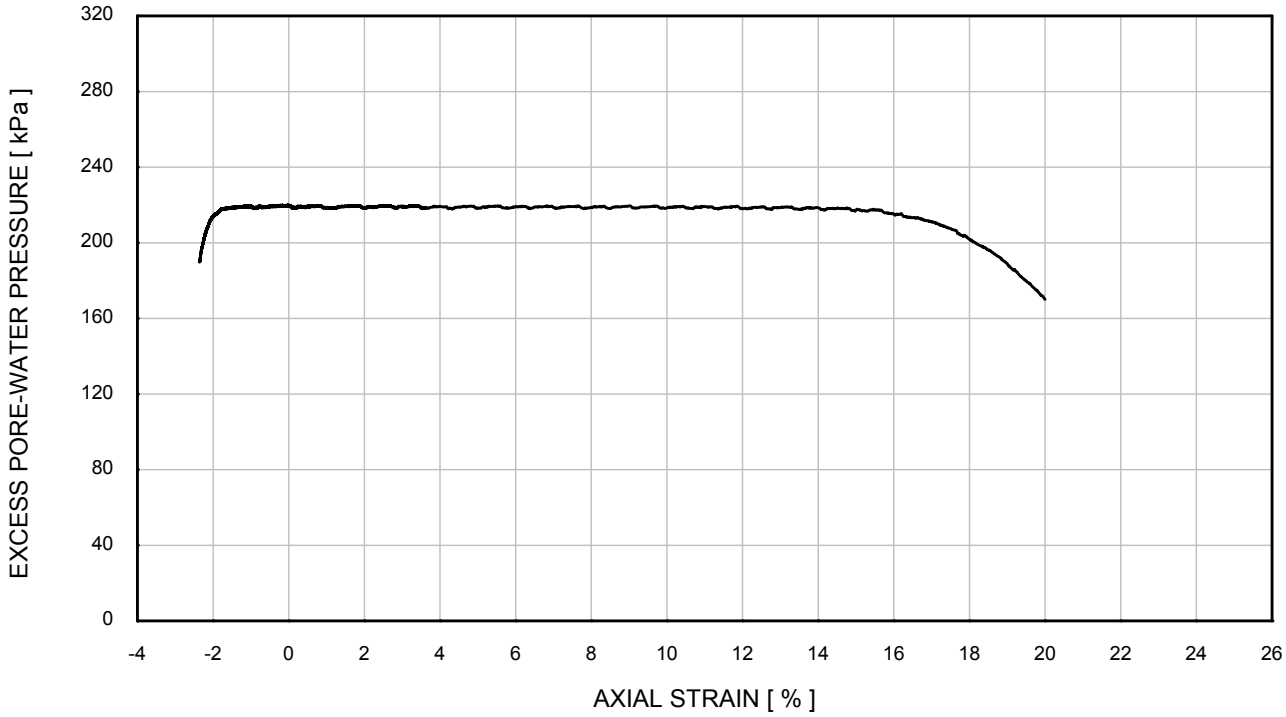




Initial σ'_r	: 223 kPa	Batch	: 5
Initial σ'_a	: 319 kPa	Sample	: CTX_5-4
q_{av}	: 96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 128 kPa	Test No.	: CTX21
Frequency	: 0.10 Hz		

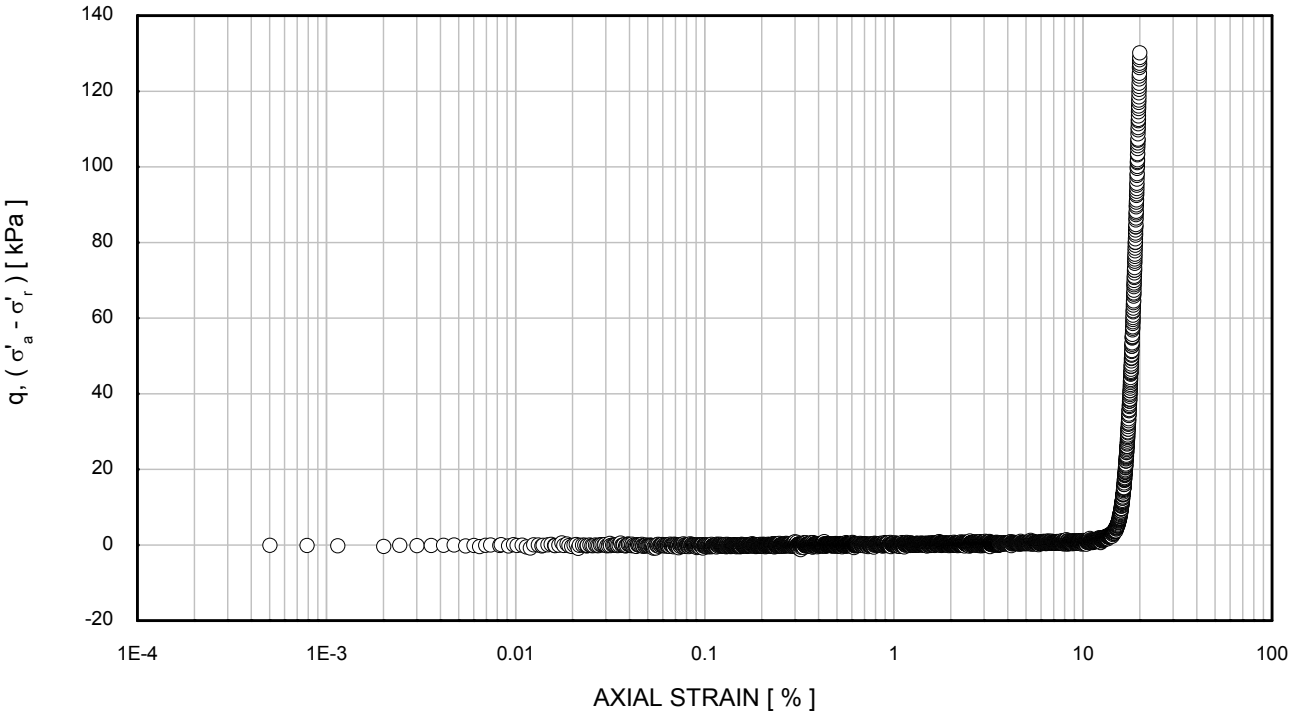
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

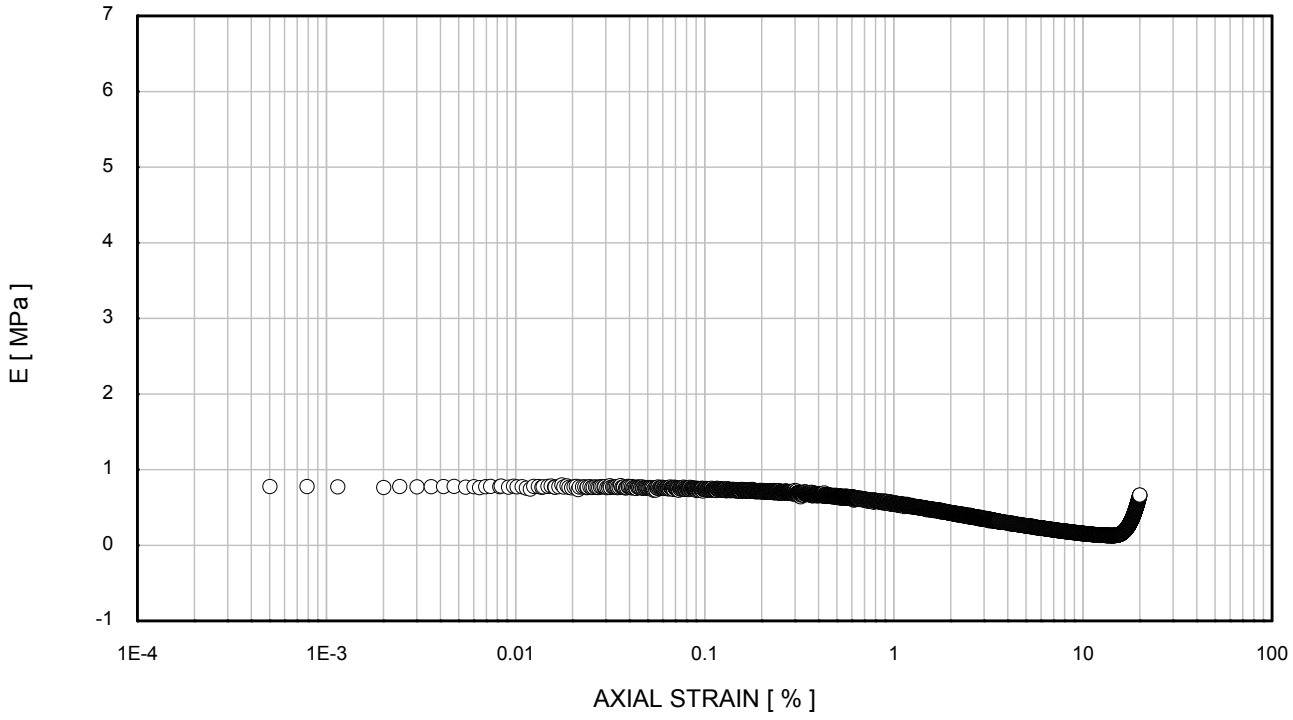




Initial σ'_r	:	35 kPa	Batch	:	5
Initial σ'_a	:	16 kPa	Sample	:	CTX_5-4
q_{peak}	:	130 kPa	Unit	:	Unit C2 (Eem)
Ext. ε at q_{peak}	:	20.00 %	Test No.	:	CTX21
Rate of strain	:	1.00 %/hour			

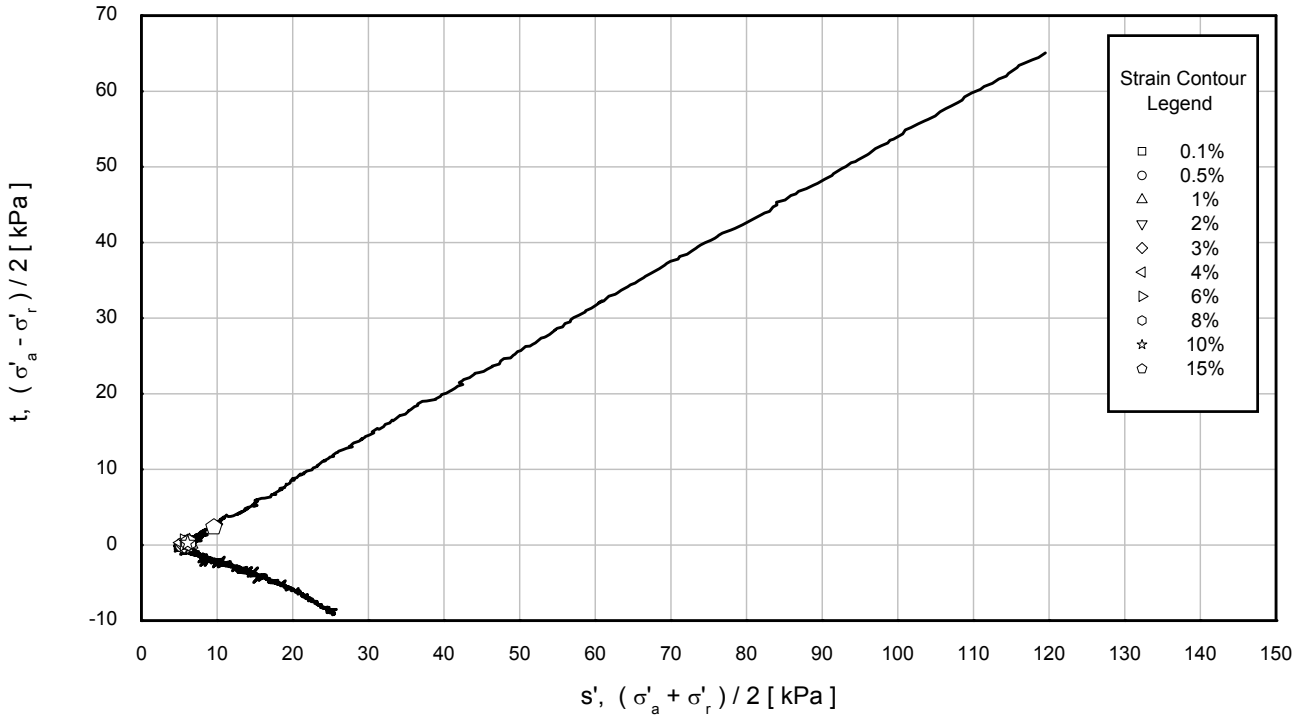
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

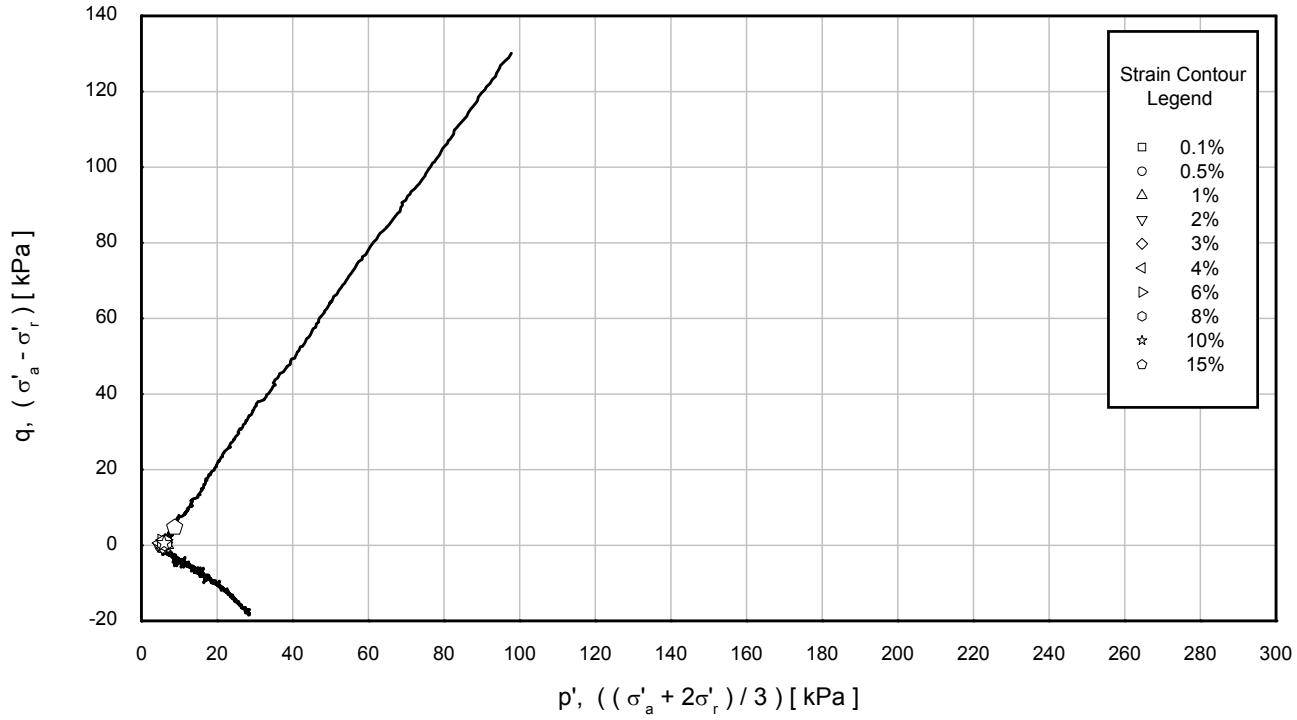




Initial σ'_r	:	35 kPa	Batch	:	5
Initial σ'_a	:	16 kPa	Sample	:	CTX_5-4
q_{peak}	:	130 kPa	Unit	:	Unit C2 (Eem)
Ext. ε at q_{peak}	:	20.00 %	Test No.	:	CTX21
Rate of strain	:	1.00 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	35	kPa	Batch	: 5
Initial σ'_a	:	16	kPa	Sample	: CTX_5-4
q_{peak}	:	130	kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	:	20.00	%	Test No.	: CTX21
Rate of strain	:	1.00	%/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark yellowish brown fine SAND

GENERAL	
Date test started	10/01/2017
Type of sample	Undisturbed
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	9.9
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.677
Degree of saturation	[%]	39
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 05_CTX22a
Processed by Date	MSR 13/01/2017
Checked by Date	JLS 13/01/2017
Approved by Date	AR 13/01/2017

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX22

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1000
Base PWP	[kPa]	983
Mid height PWP	[kPa]	-
B value achieved	[-]	0.93

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1208
Back pressure	[kPa]	983
Base PWP	[kPa]	984
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	224
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	0.88
External axial strain	[%]	0.52
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	25.0
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.662
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX22

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO CYCLIC LOADING		
Cell pressure	[kPa]	1208
Back pressure	[kPa]	984
Base PWP	[kPa]	978
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	230
Effective axial pressure	[kPa]	294
Deviator stress	[kPa]	64
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	25.0
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.662
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX22

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	640
Mean q_{av}	[kPa]	64
Mean q_{cy}	[kPa]	96
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	74
External ε_{av} at N_f	[%]	9.68
External ε_{cy} at N_f	[%]	15.30
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	197
Δ mid height PWP at N_f Water	[kPa]	-
content	[%]	25.0
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.662
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.01	0.07	145	-	7.12	-
2	0.00	0.07	146	-	5.29	-
5	0.02	0.07	142	-	3.92	-
10	0.05	0.07	135	-	3.77	-
20	0.10	0.08	124	-	4.29	-
30	0.17	0.08	113	-	5.52	-
40	0.26	0.10	101	-	7.81	-
50	0.43	0.12	79	-	13.11	-
60	0.60	1.02	9	-	13.54	-
70	7.54	12.67	1	-	6.29	-
74	9.68	15.30	1	-	5.72	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX22

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

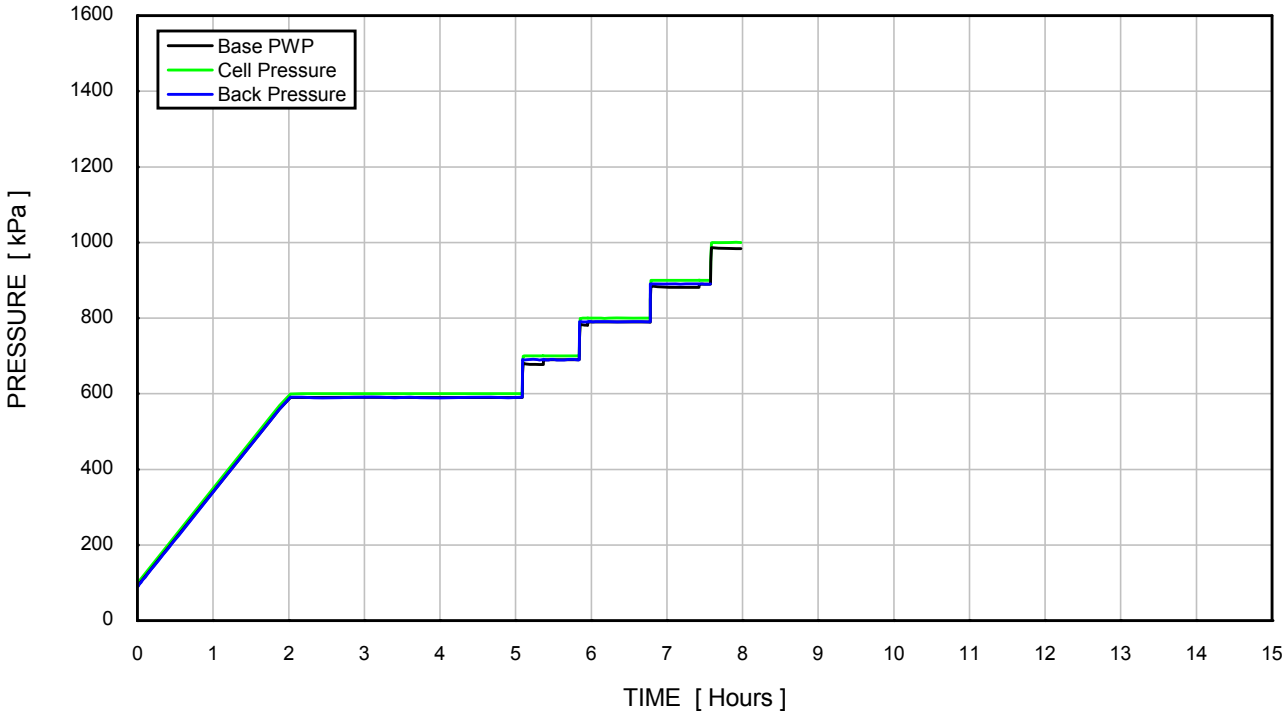


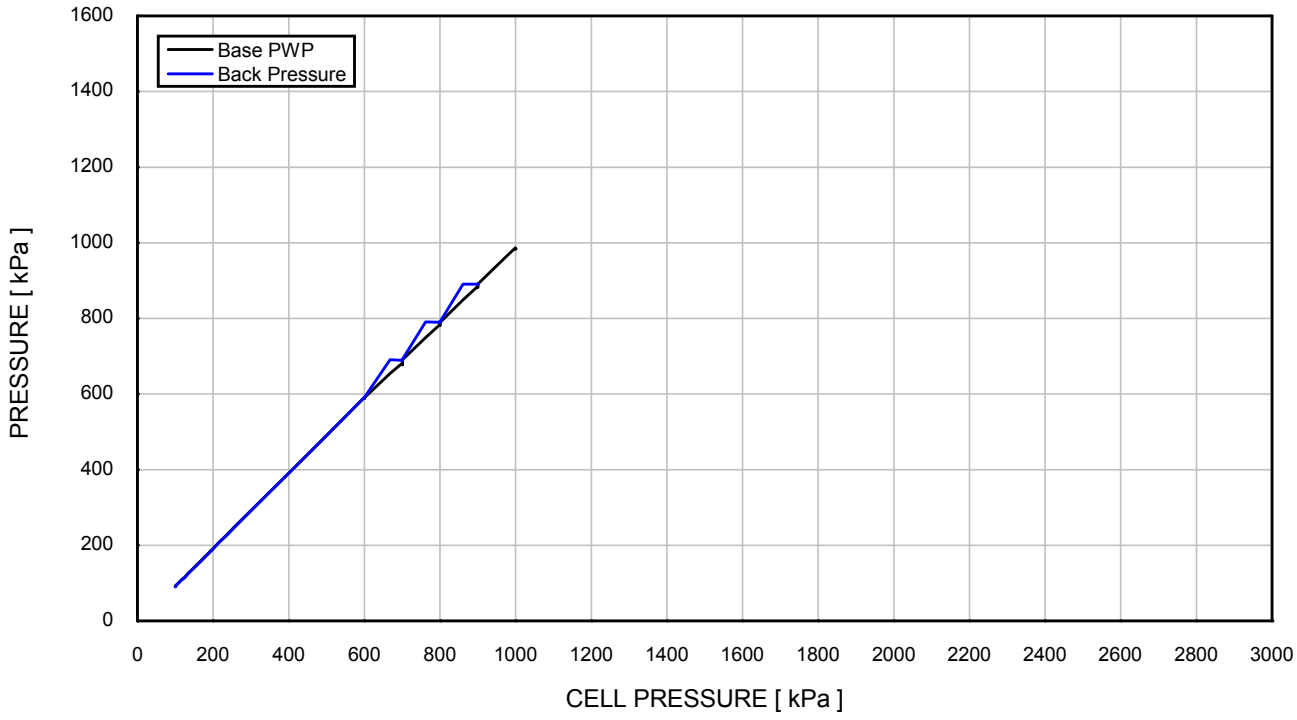


FINAL CONDITIONS		
Water content	[%]	25.0
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.59

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX22

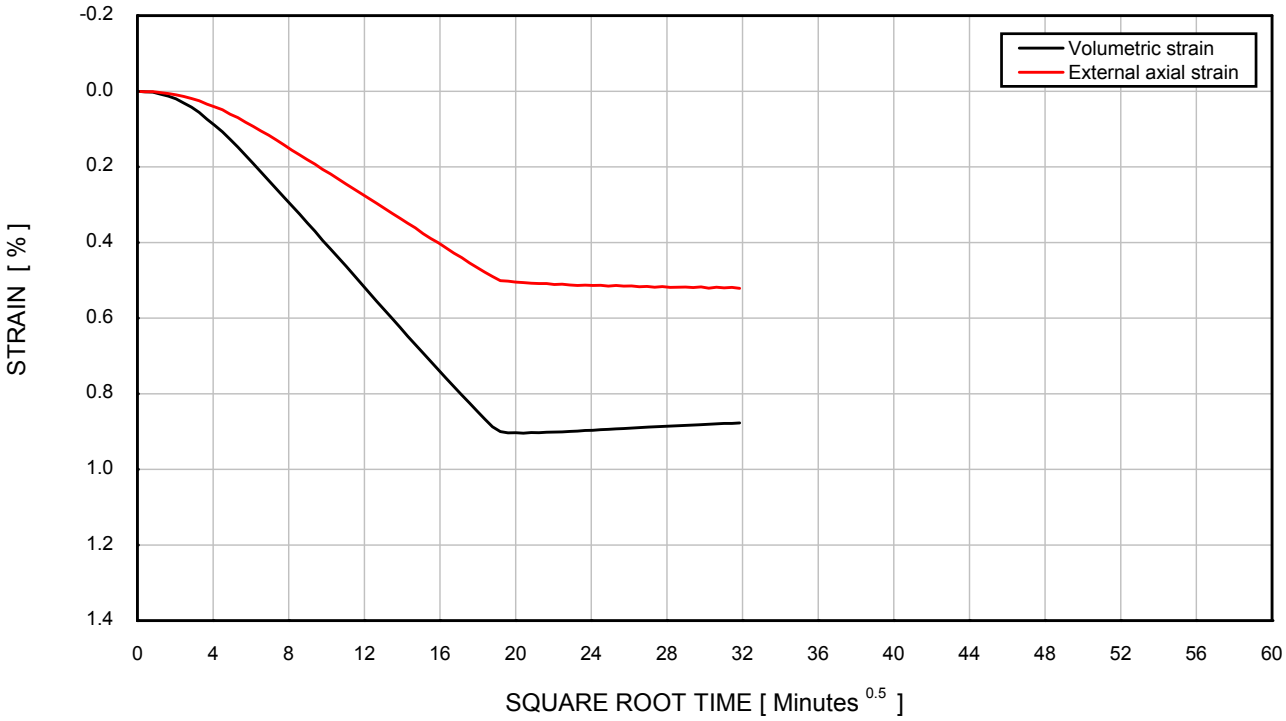
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

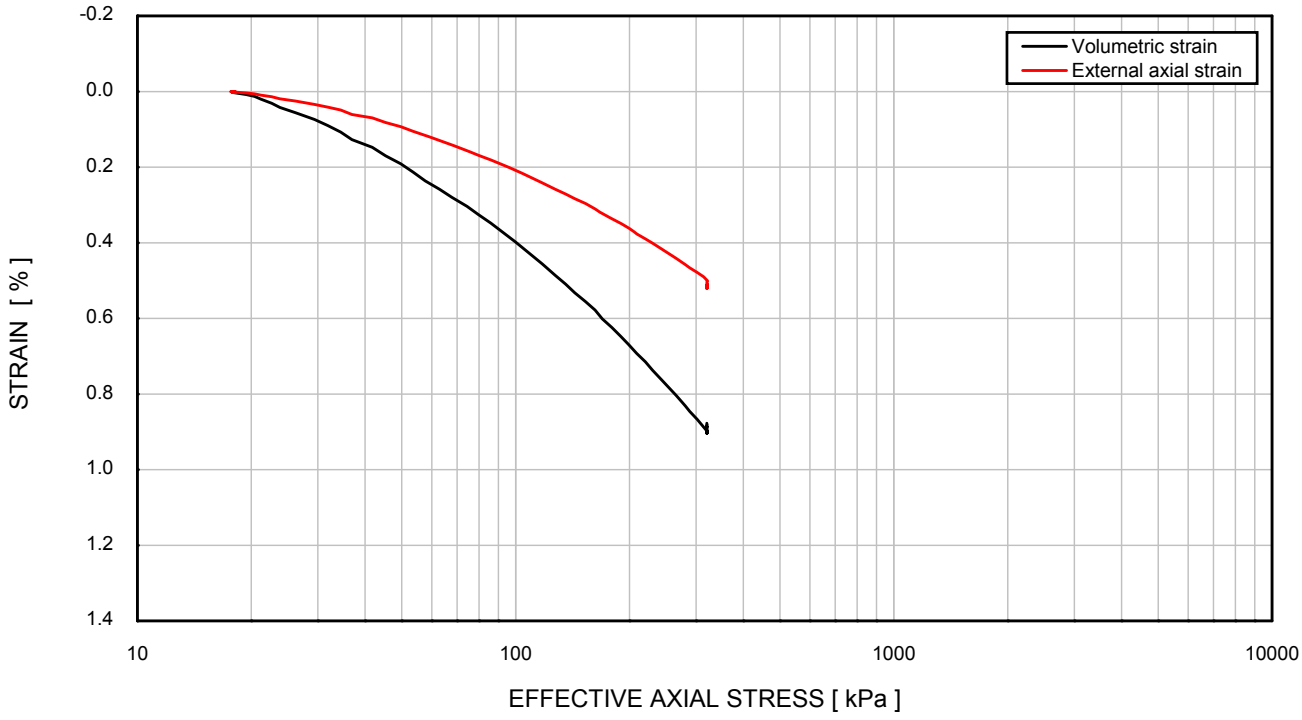




B value	:	0.93			
Initial σ'_r	:	8	kPa	Batch	: 5
Initial σ'_a	:	8	kPa	Sample	: CTX_5-3
Final σ'_r	:	17	kPa	Unit	: Unit C2 (Eem)
Final σ'_a	:	17	kPa	Test No.	: CTX22

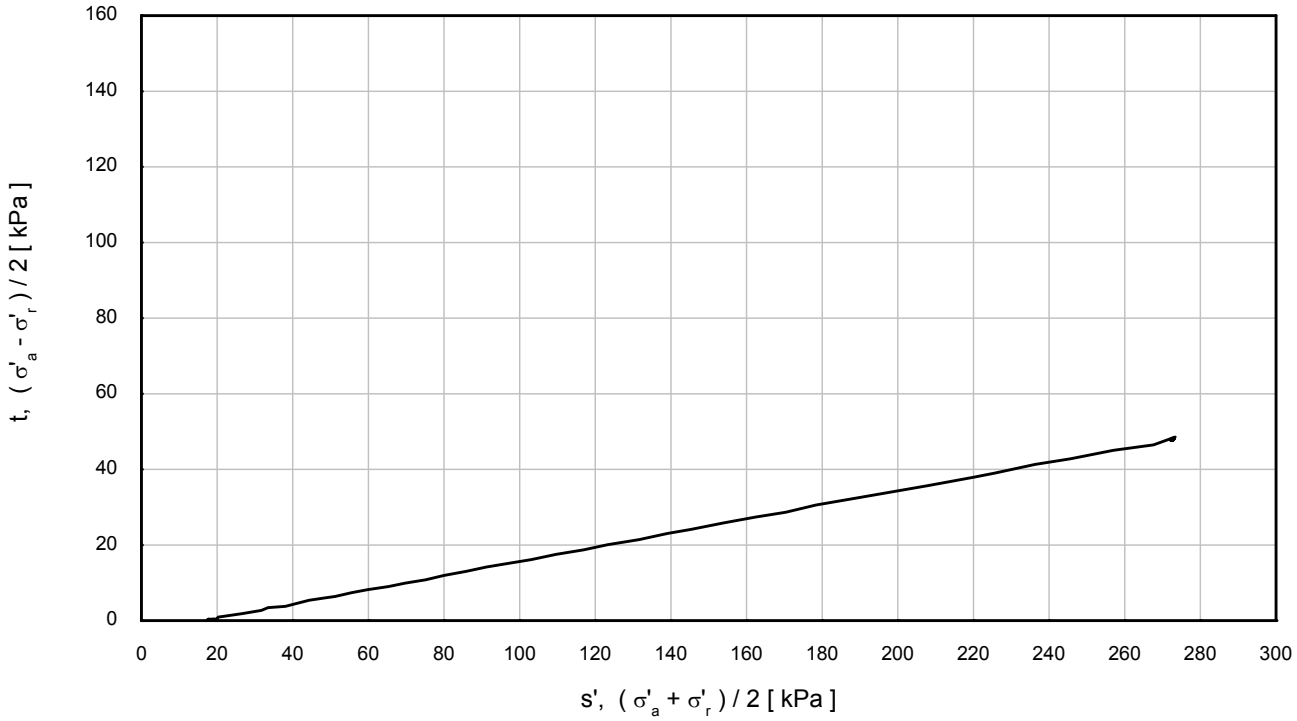
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

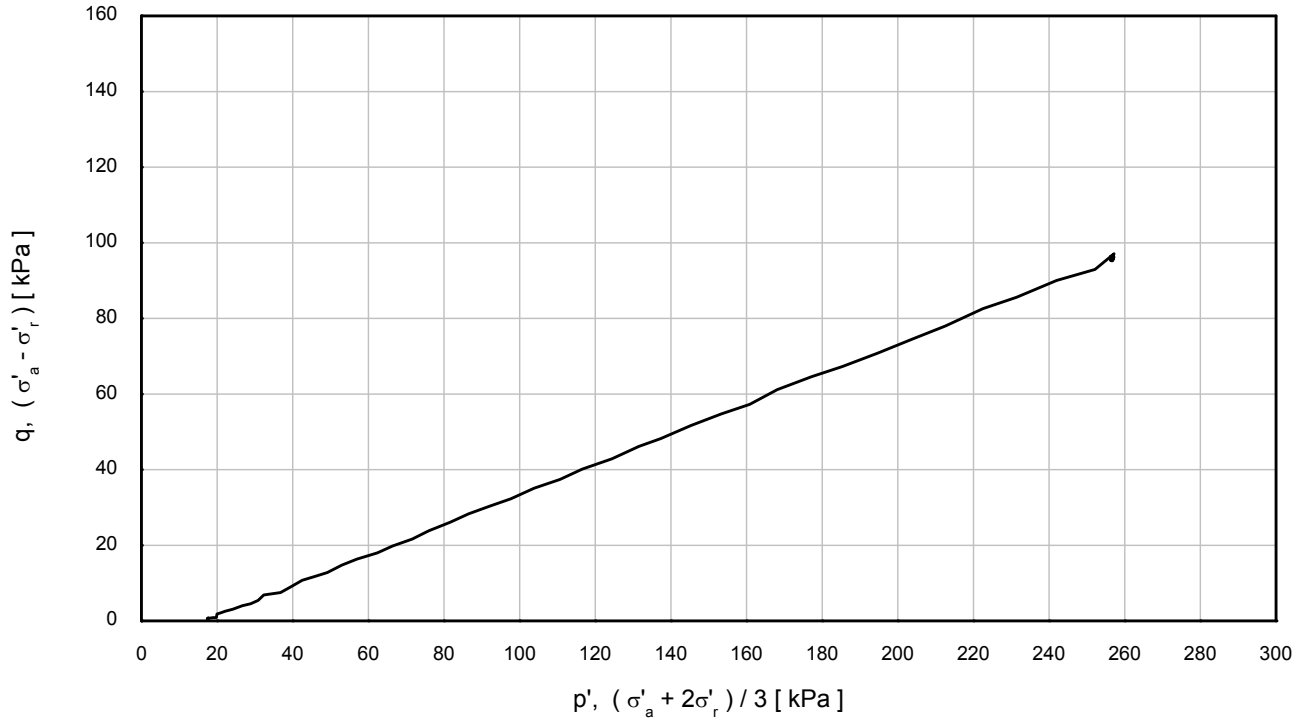




Stage 1 σ'_{rc}	: 224 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-3
		Unit	: Unit C2 (Eem)
		Test No.	: CTX22

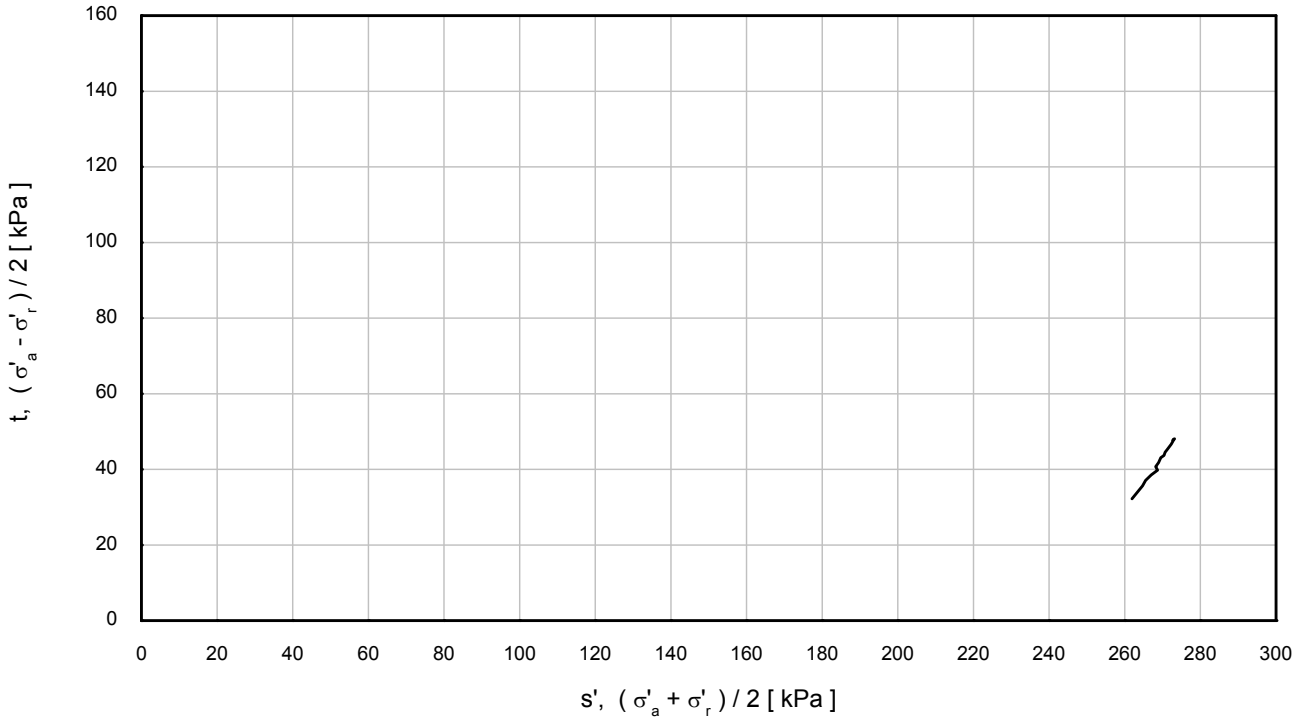
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

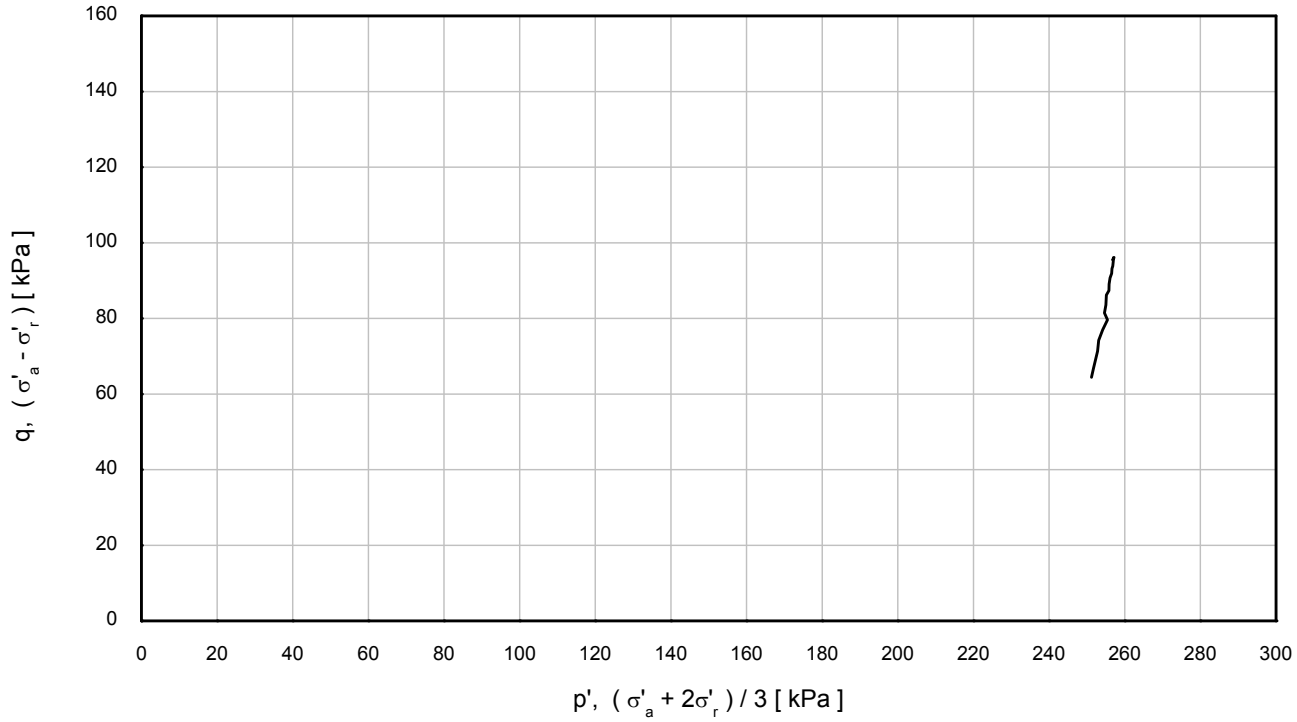




Stage 1 σ'_{rc}	: 224 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-3
		Unit	: Unit C2 (Eem)
		Test No.	: CTX22

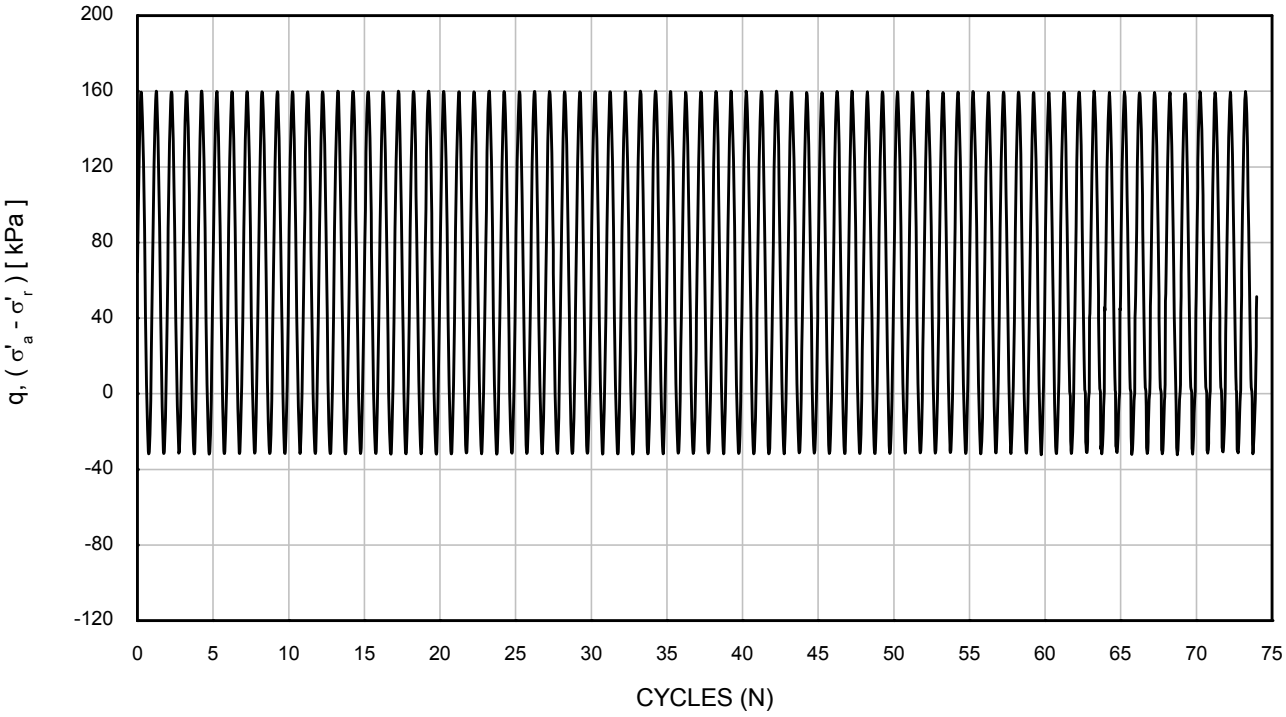
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

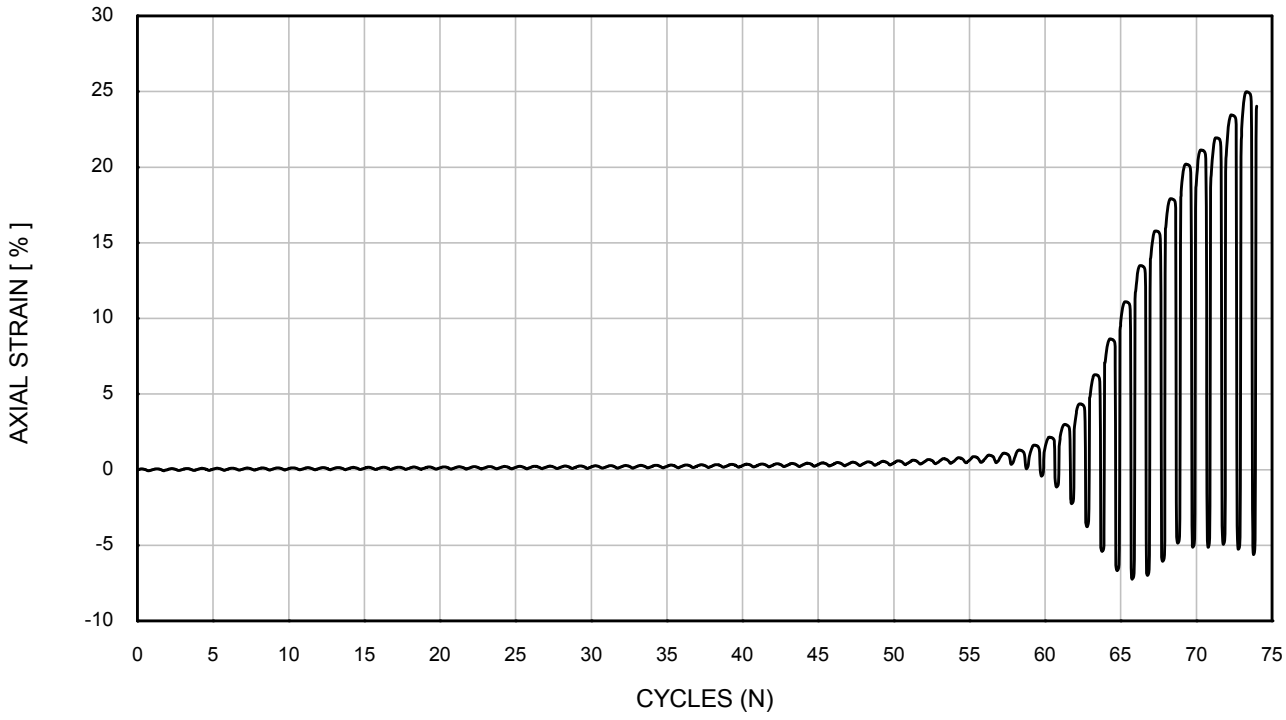




σ'_{rc}	: 230 kPa	Batch	: 5
σ'_{ac}	: 294 kPa	Sample	: CTX5-3
		Unit	: Unit C2 (Eem)
		Test No.	: CTX22

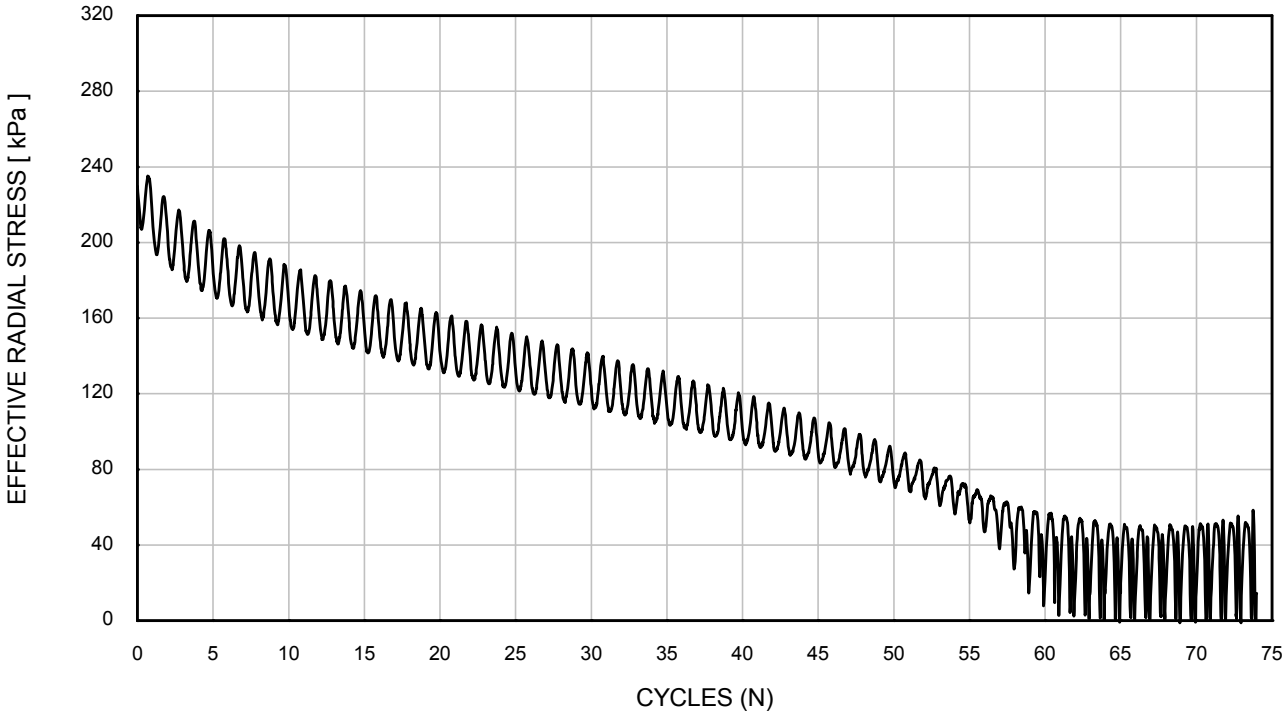
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO CYCLIC LOADING

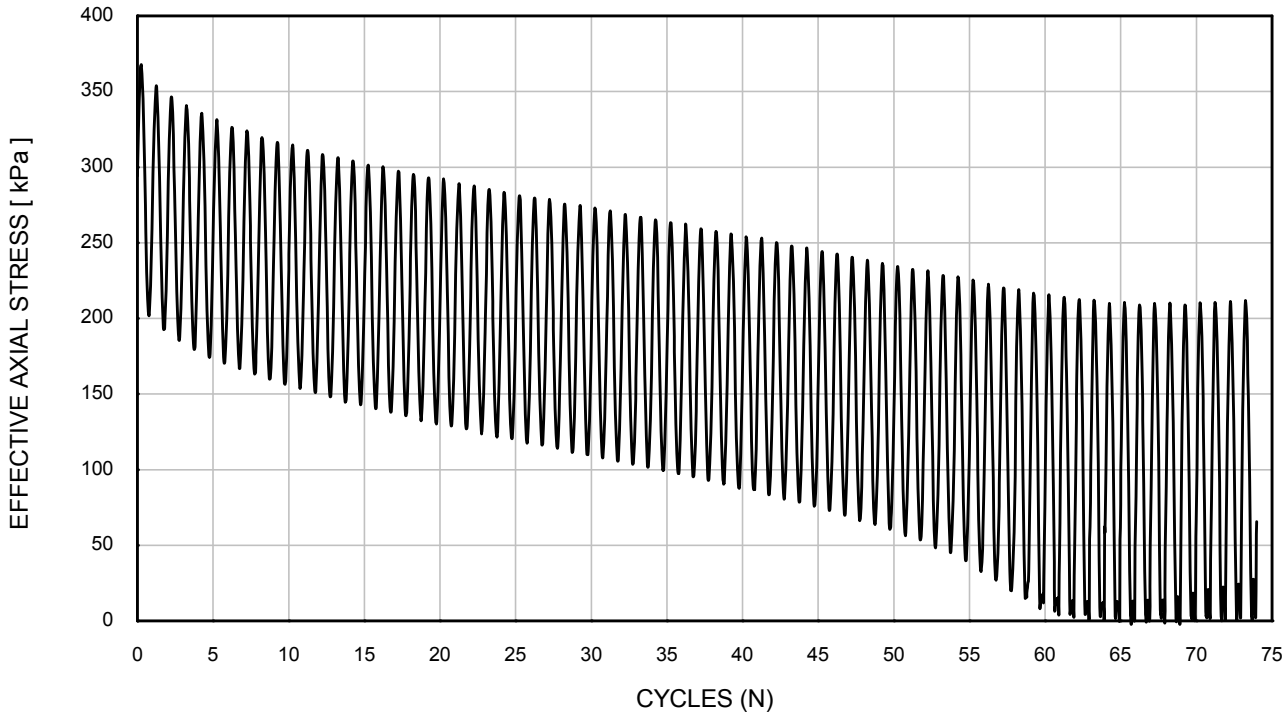




Initial σ'_r	:	230 kPa	Borehole	:	5
Initial σ'_a	:	294 kPa	Sample	:	CTX_5-3
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX22
Frequency	:	0.10 Hz			

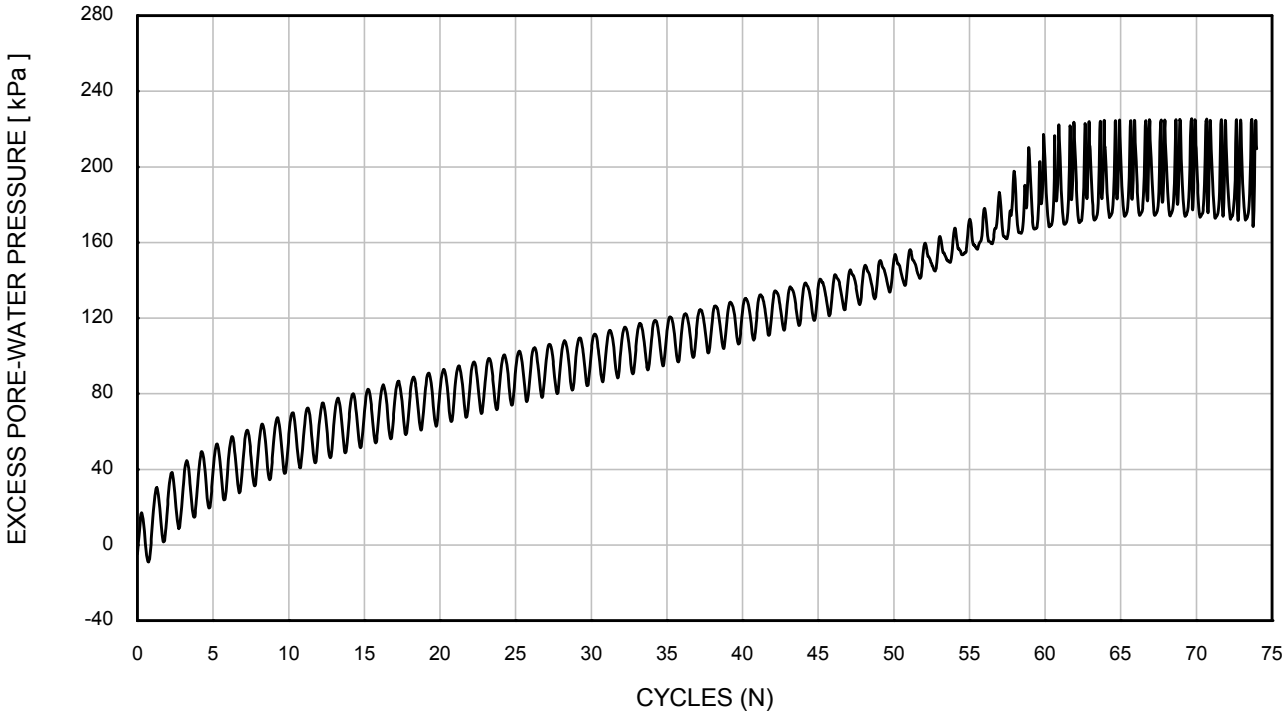
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

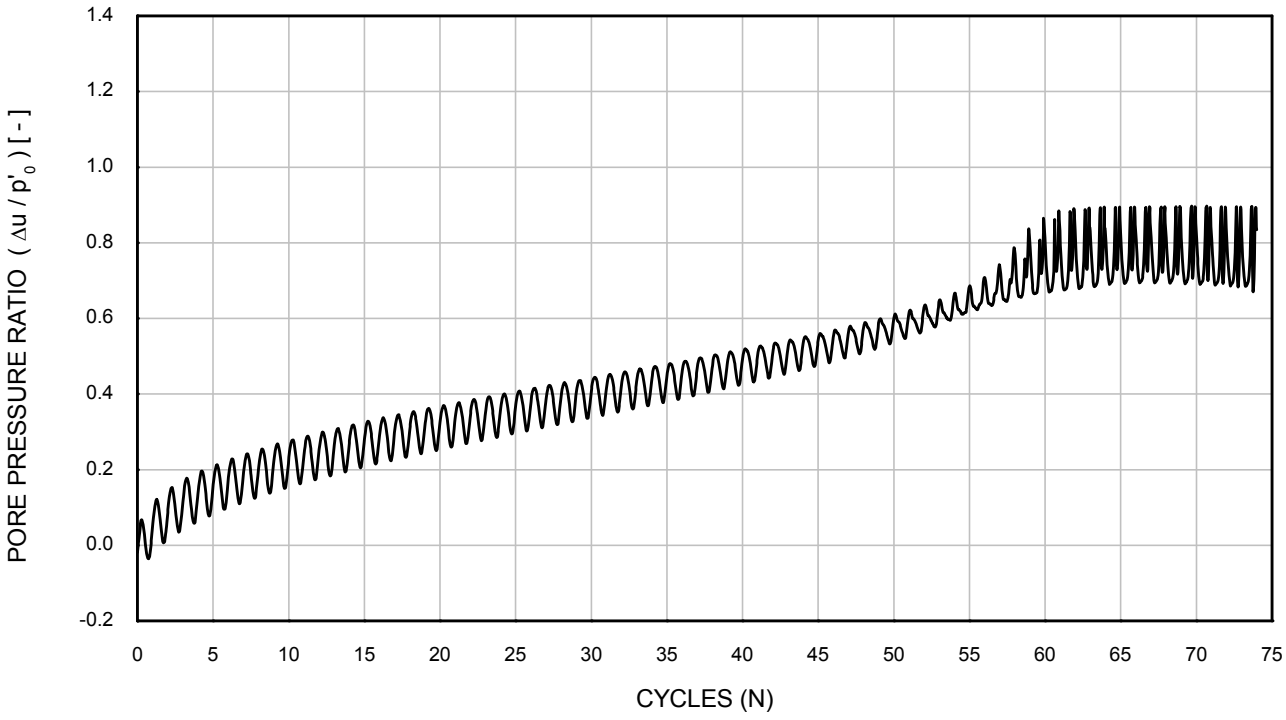




Initial σ'_r	:	230 kPa	Borehole	:	5
Initial σ'_a	:	294 kPa	Sample	:	CTX_5-3
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX22
Frequency	:	0.10 Hz			

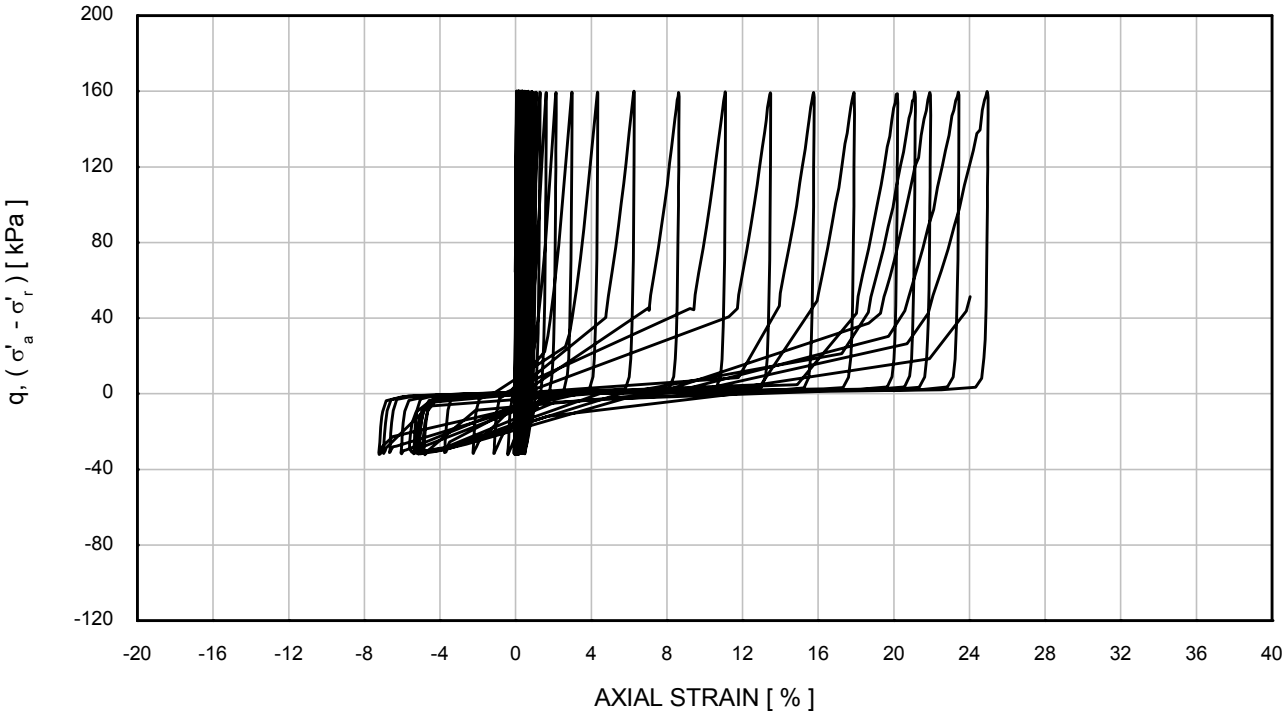
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

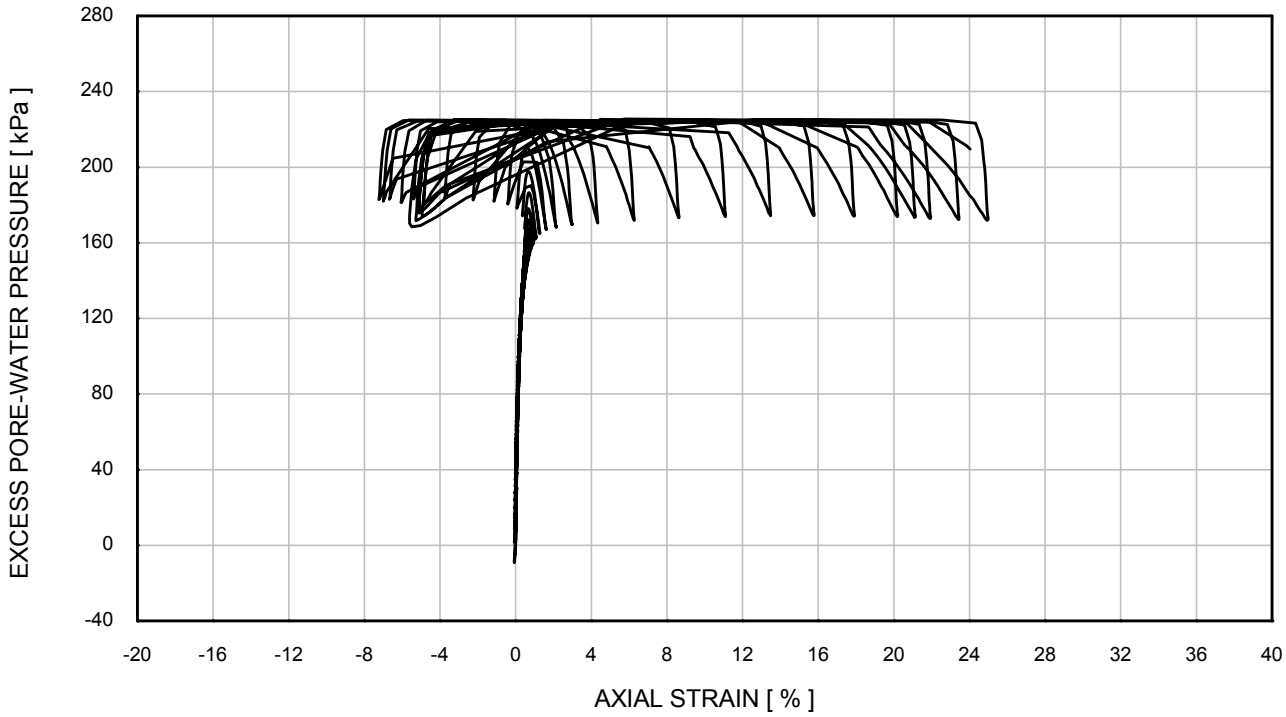




Initial σ'_r	: 230 kPa	Borehole	: 5
Initial σ'_a	: 294 kPa	Sample	: CTX_5-3
q_{av}	: 64 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 96 kPa	Test No.	: CTX22
Frequency	: 0.10 Hz		

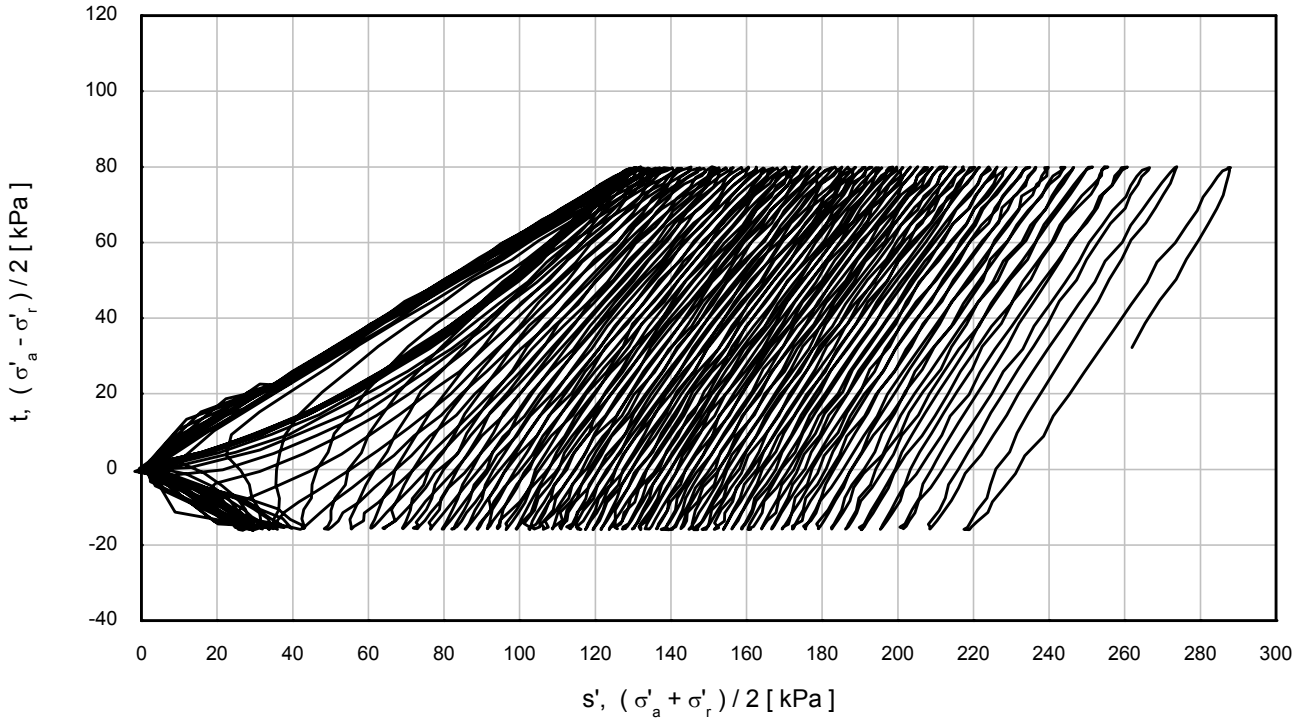
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

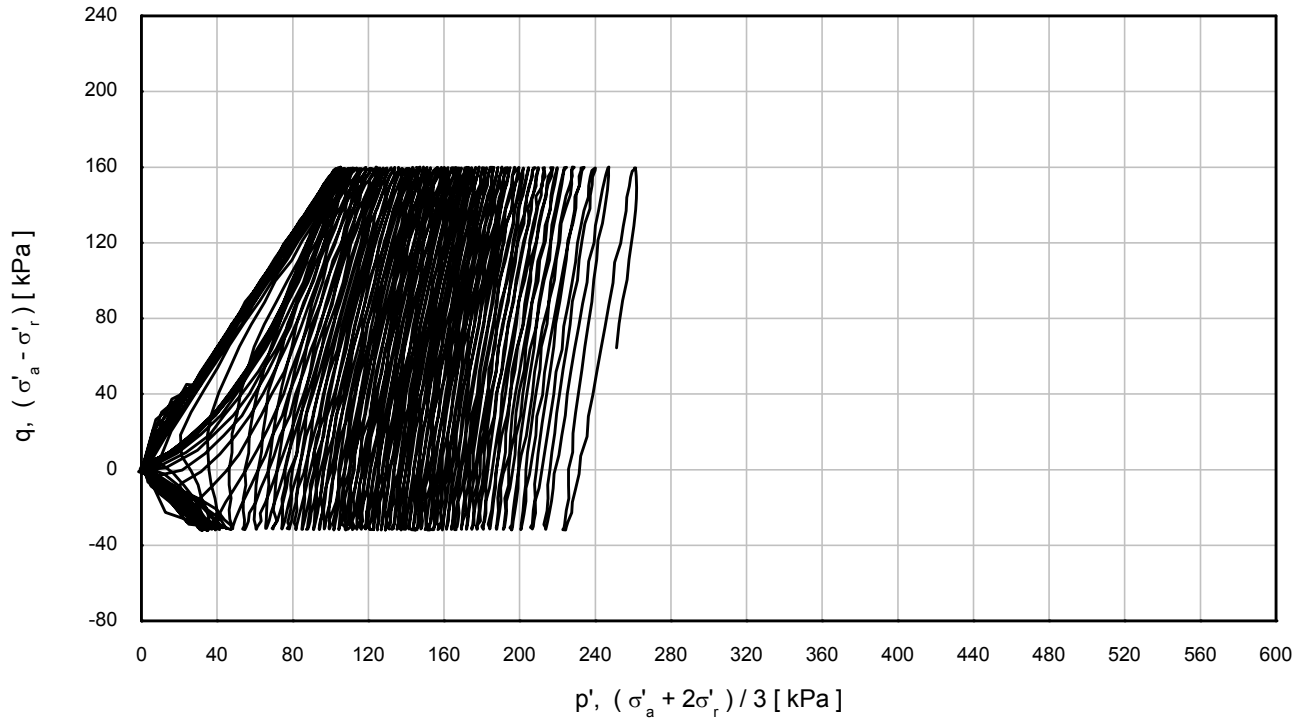




Initial σ'_r	: 230 kPa	Borehole	: 5
Initial σ'_a	: 294 kPa	Sample	: CTX_5-3
q_{av}	: 64 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 96 kPa	Test No.	: CTX22
Frequency	: 0.10 Hz		

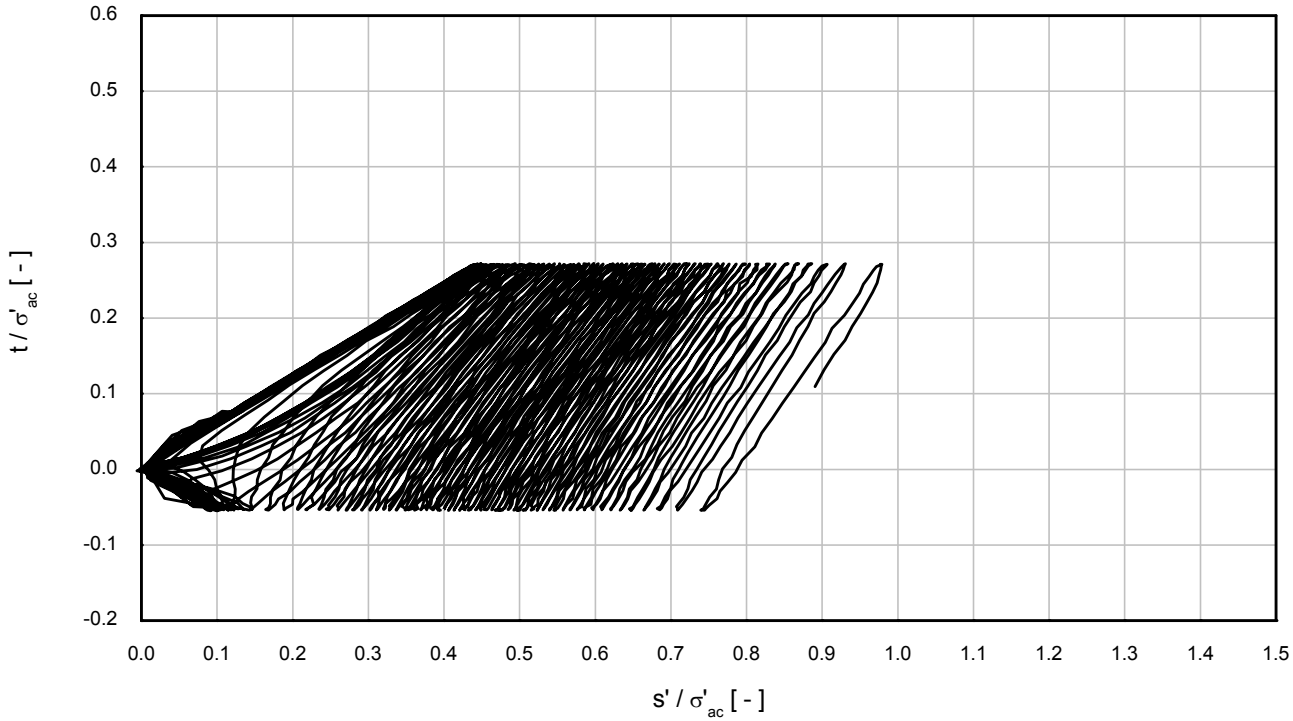
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

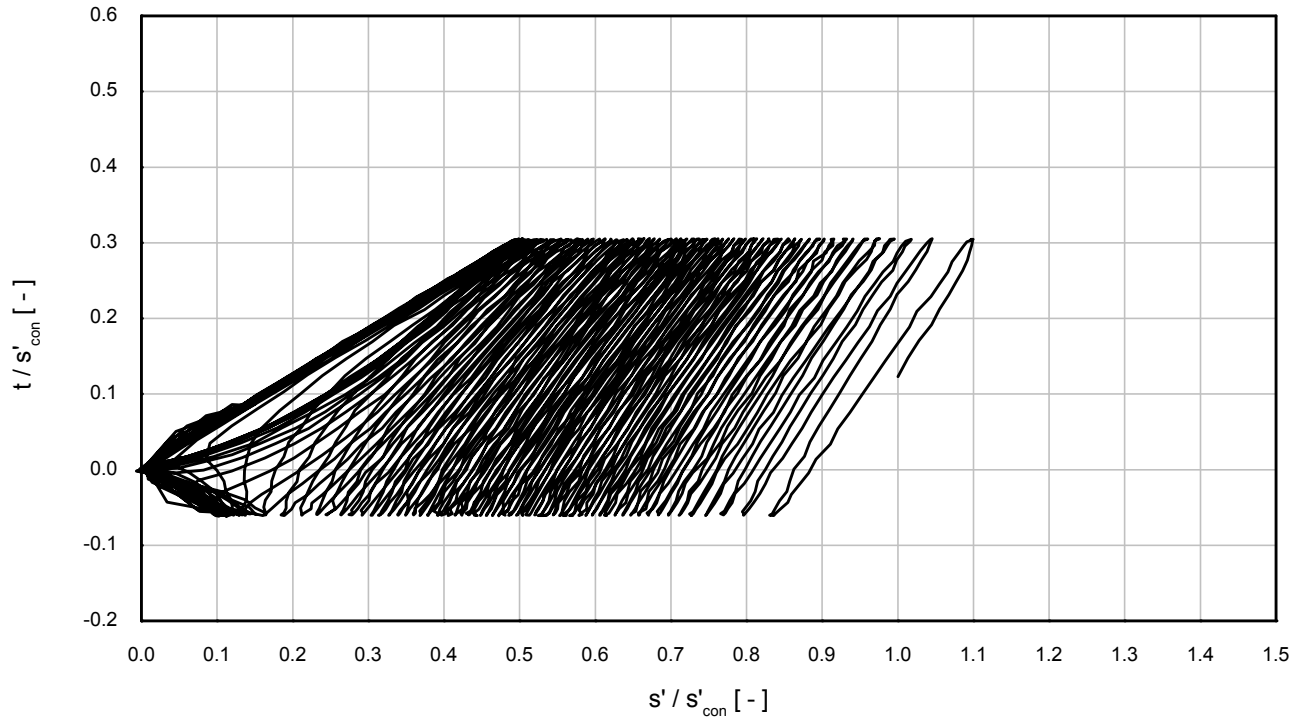




Initial σ'_r	:	230	kPa	Borehole	: 5
Initial σ'_a	:	294	kPa	Sample	: CTX_5-3
q_{av}	:	64	kPa	Unit	: Unit C2 (Eem)
q_{cy}	:	96	kPa	Test No.	: CTX22
Frequency	:	0.10	Hz		

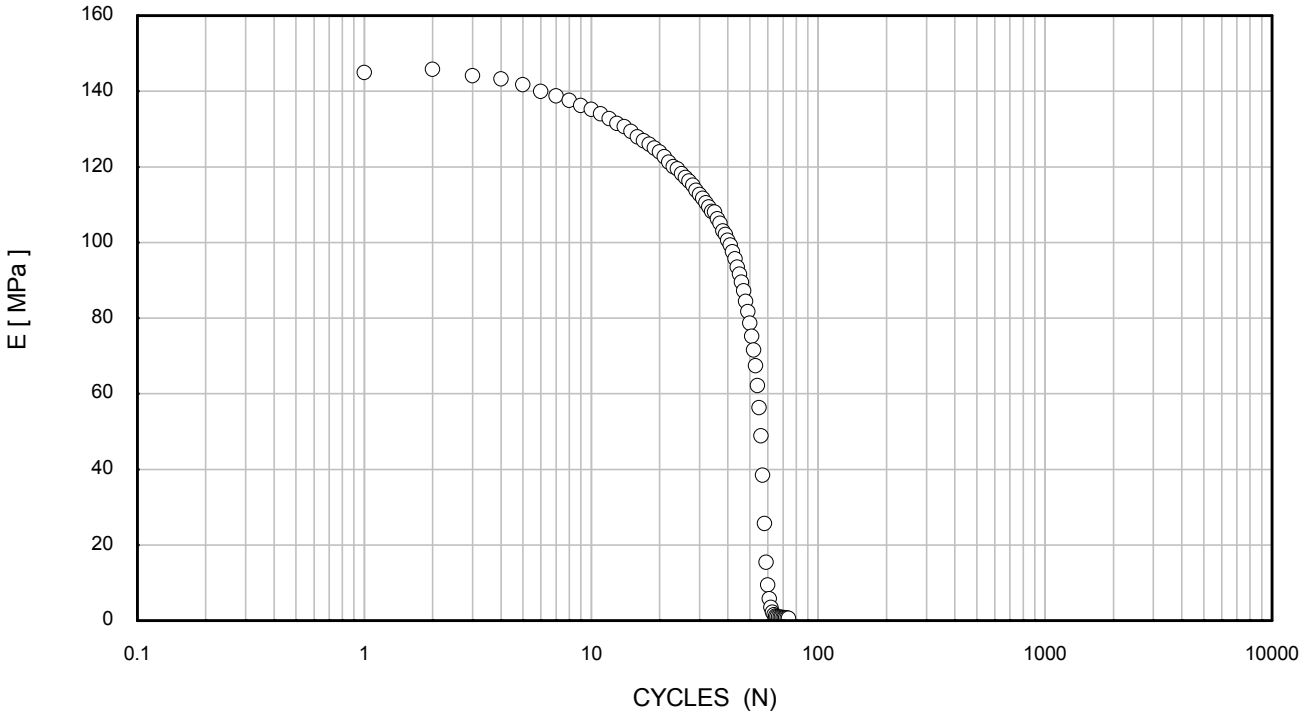
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

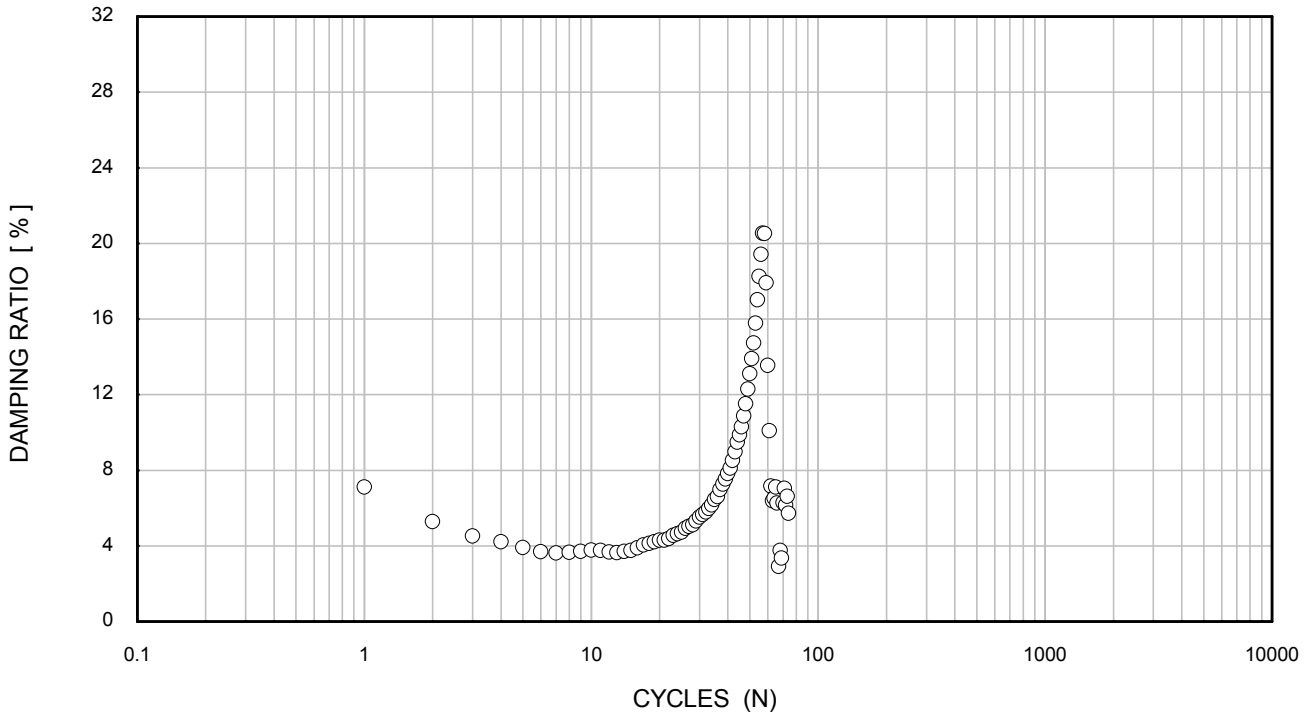




Initial σ'_r	:	230 kPa	Borehole	:	5
Initial σ'_a	:	294 kPa	Sample	:	CTX_5-3
q_{av}	:	64 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX22
Frequency	:	0.10 Hz			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED





Initial σ'_r	: 230 kPa	Borehole	: 5
Initial σ'_a	: 294 kPa	Sample	: CTX_5-3
q_{av}	: 64 kPa	Unit	: Unit C2 (Eem)
q_{cy}	: 96 kPa	Test No.	: CTX22
Frequency	: 0.10 Hz		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

VISUAL DESCRIPTION
Dark yellowish brown fine SAND

GENERAL	
Date test started	28/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.4
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.57
Void ratio	[-]	0.685
Degree of saturation	[%]	40
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH05_CTX23
Processed by Date	MSR 12/01/2017
Checked by Date	JLS 13/01/2017
Approved by Date	AR 13/01/2017

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1112
Back pressure	[kPa]	887
Base PWP	[kPa]	888
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	224
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	1.55
External axial strain	[%]	1.12
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.659
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO CYCLIC LOADING		
Cell pressure	[kPa]	1112
Back pressure	[kPa]	887
Base PWP	[kPa]	888
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	224
Effective axial pressure	[kPa]	321
Deviator stress	[kPa]	96
Volumetric strain	[%]	0.00
External axial strain	[%]	0.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.659
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	640
Mean q_{av}	[kPa]	96
Mean q_{cy}	[kPa]	96
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	371
External ε_{av} at N_f	[%]	15.01
External ε_{cy} at N_f	[%]	0.22
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	190
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.659
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.02	0.06	162	-	9.46	-
2	0.02	0.06	159	-	5.21	-
5	0.05	0.06	155	-	3.68	-
10	0.07	0.06	151	-	3.28	-
20	0.11	0.07	145	-	3.27	-
30	0.15	0.07	139	-	3.72	-
40	0.19	0.07	134	-	4.06	-
50	0.24	0.07	128	-	4.66	-
100	0.76	0.10	101	-	10.41	-
200	4.15	0.15	65	-	14.46	-
300	9.49	0.17	55	-	15.27	-
371	15.01	0.22	44	-	15.06	-

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	31
Initial effective axial pressure	[kPa]	125
Rate of strain	[%/hour]	1.01
At peak deviator stress		
Corrected deviator stress	[kPa]	1435
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	22.10
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-376
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	601
Effective axial pressure	[kPa]	2036
Principal effective stress ratio	[-]	3.39
ε_{50}	[%]	18.42
Secant modulus (E_{50}) at ε_{50}	[kPa]	30410
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	171
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	16.43
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	173
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	50
Effective axial pressure	[kPa]	221
Principal effective stress ratio	[-]	4.42
At 20% external axial strain		
Corrected deviator stress	[kPa]	1120
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	20.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-212
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	436
Effective axial pressure	[kPa]	1556
Principal effective stress ratio	[-]	3.57

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

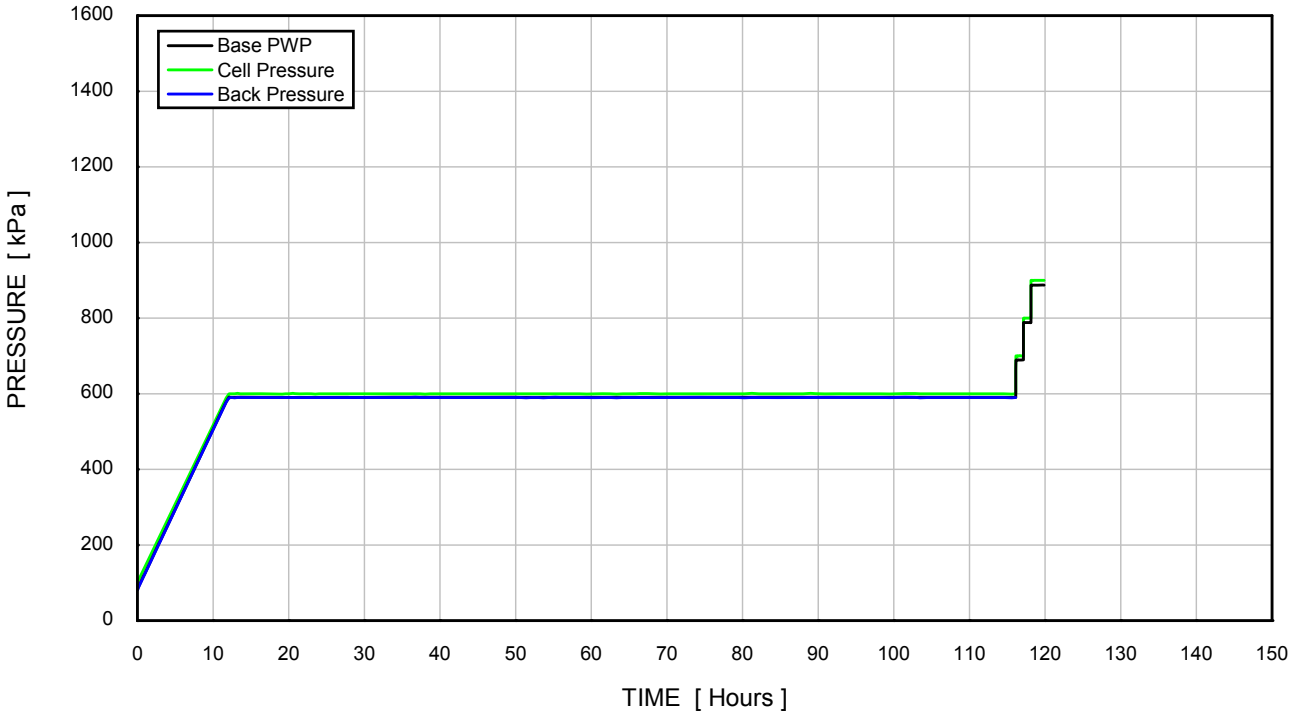


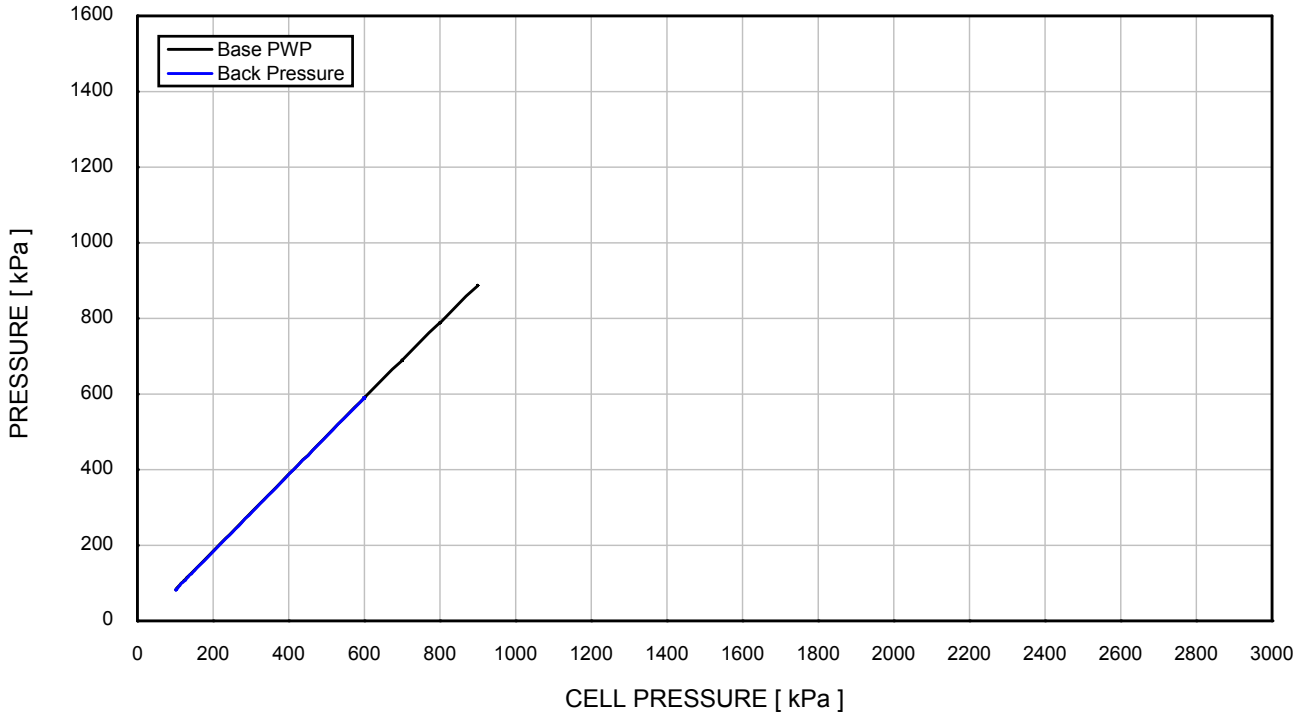


FINAL CONDITIONS		
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION	
Batch	5
Sample	CTX_5-3
Unit	Unit C2 (Eem)
Test number	CTX23

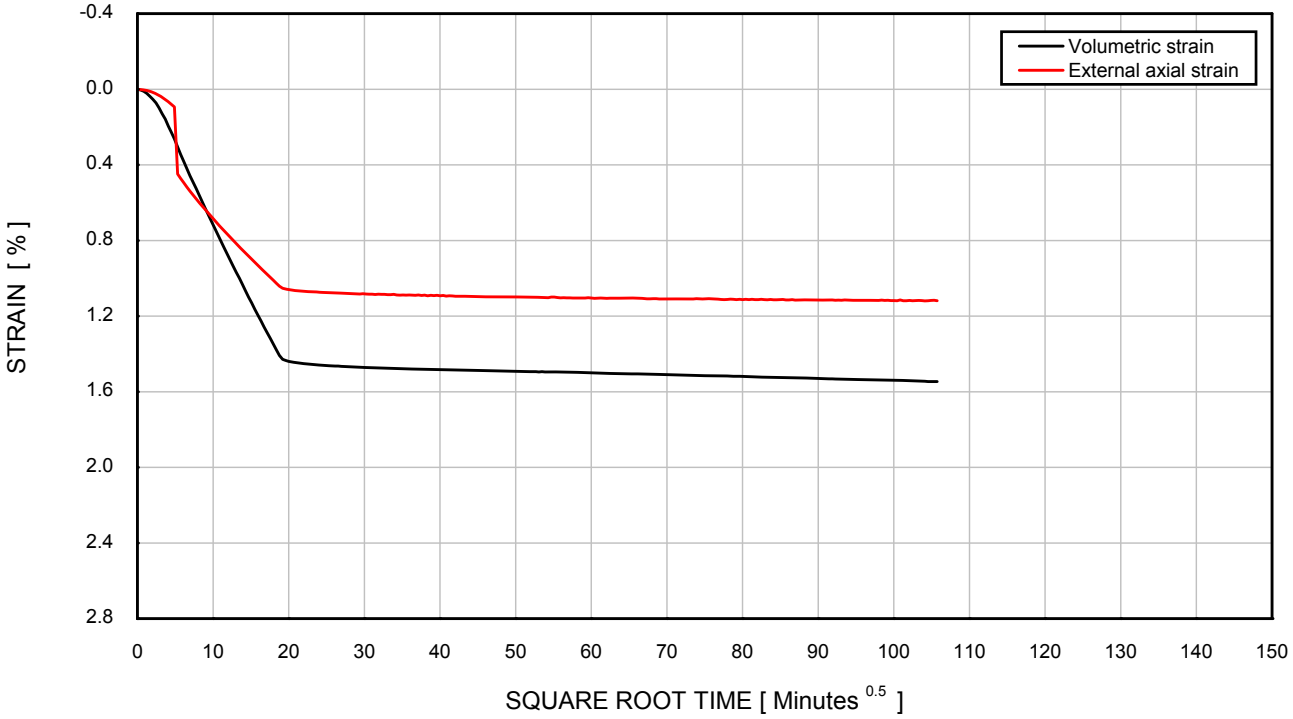
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

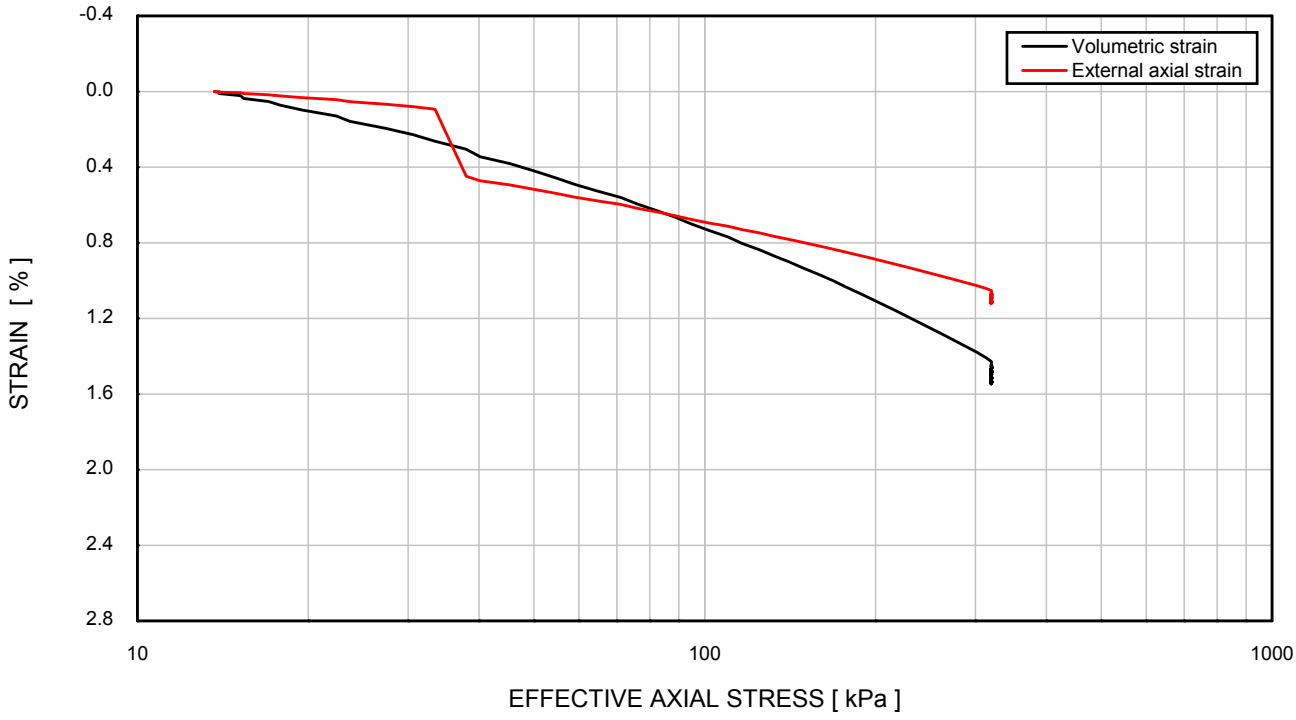




B value	:	1.00	Batch	:	5
Initial σ'_r	:	19 kPa	Sample	:	CTX_5-3
Initial σ'_a	:	19 kPa	Unit	:	Unit C2 (Eem)
Final σ'_r	:	13 kPa	Test No.	:	CTX23
Final σ'_a	:	13 kPa			

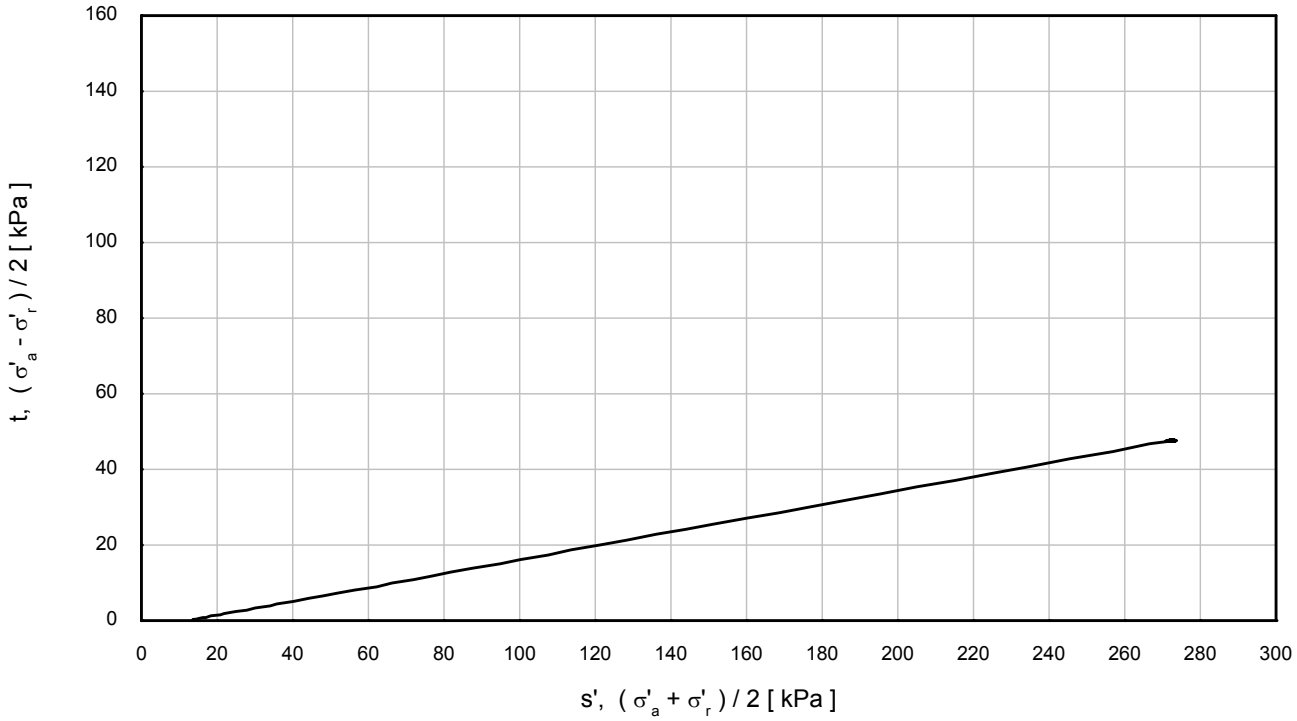
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

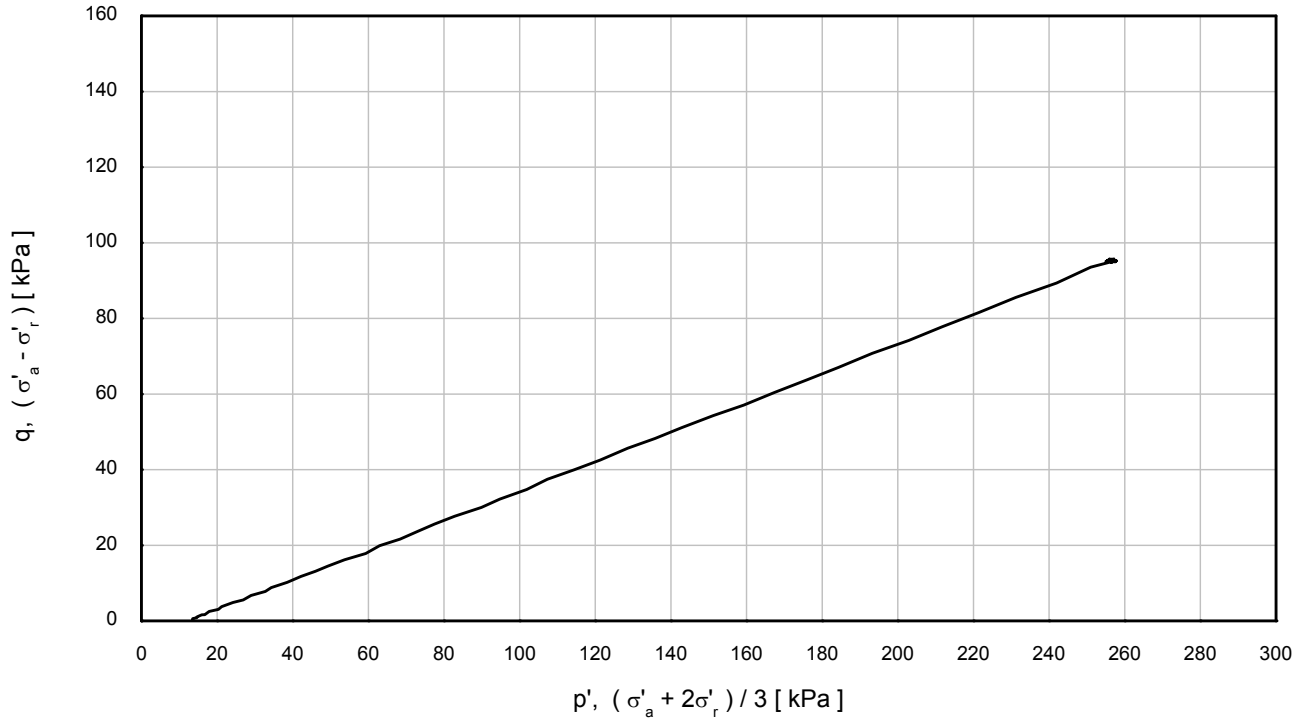




Stage 1 σ'_{rc}	:	224 kPa	Batch	:	5
Stage 1 σ'_{ac}	:	320 kPa	Sample	:	CTX_5-3
			Unit	:	Unit C2 (Eem)
			Test No.	:	CTX23

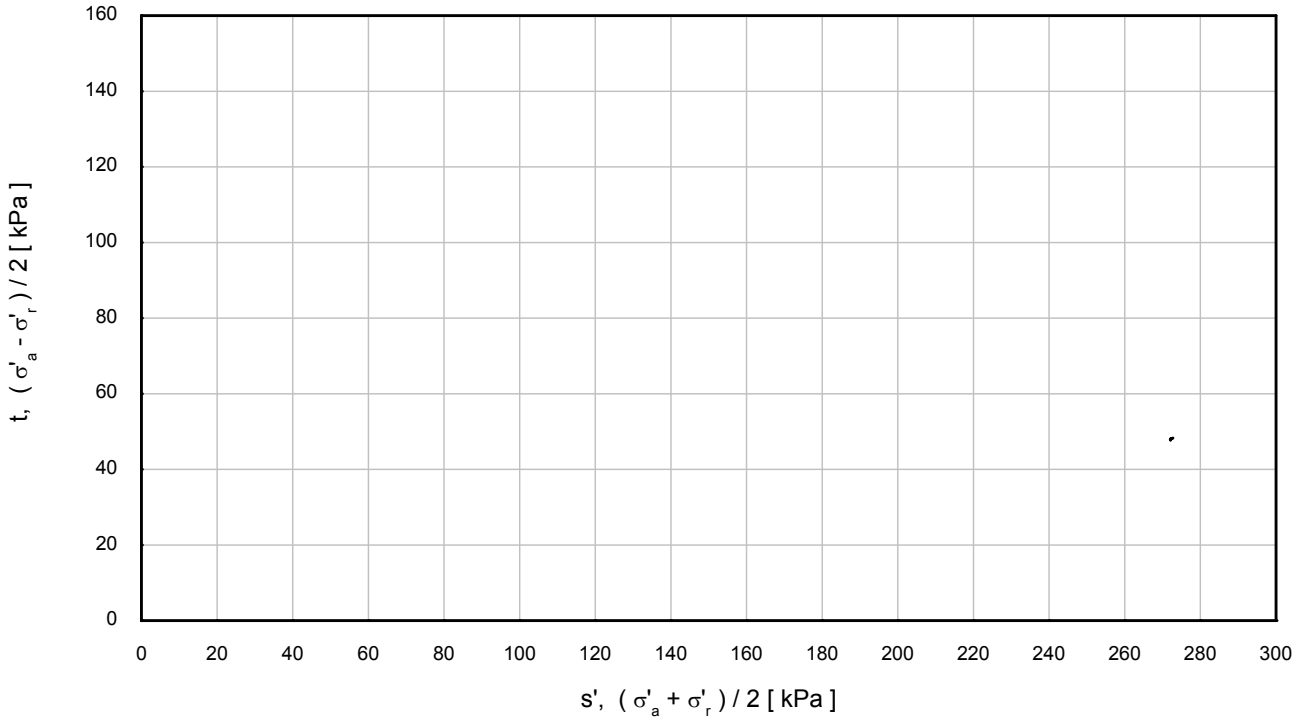
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

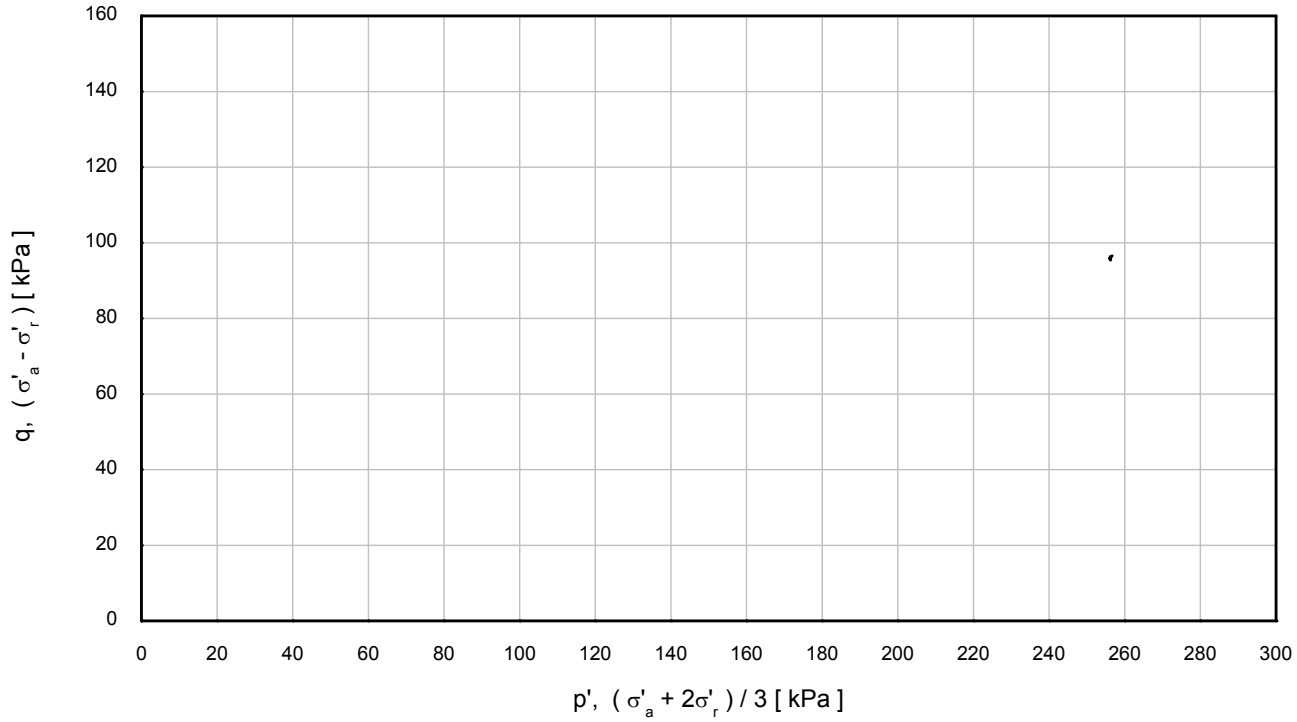




Stage 1 σ'_{rc}	: 224 kPa	Batch	: 5
Stage 1 σ'_{ac}	: 320 kPa	Sample	: CTX_5-3
		Unit	: Unit C2 (Eem)
		Test No.	: CTX23

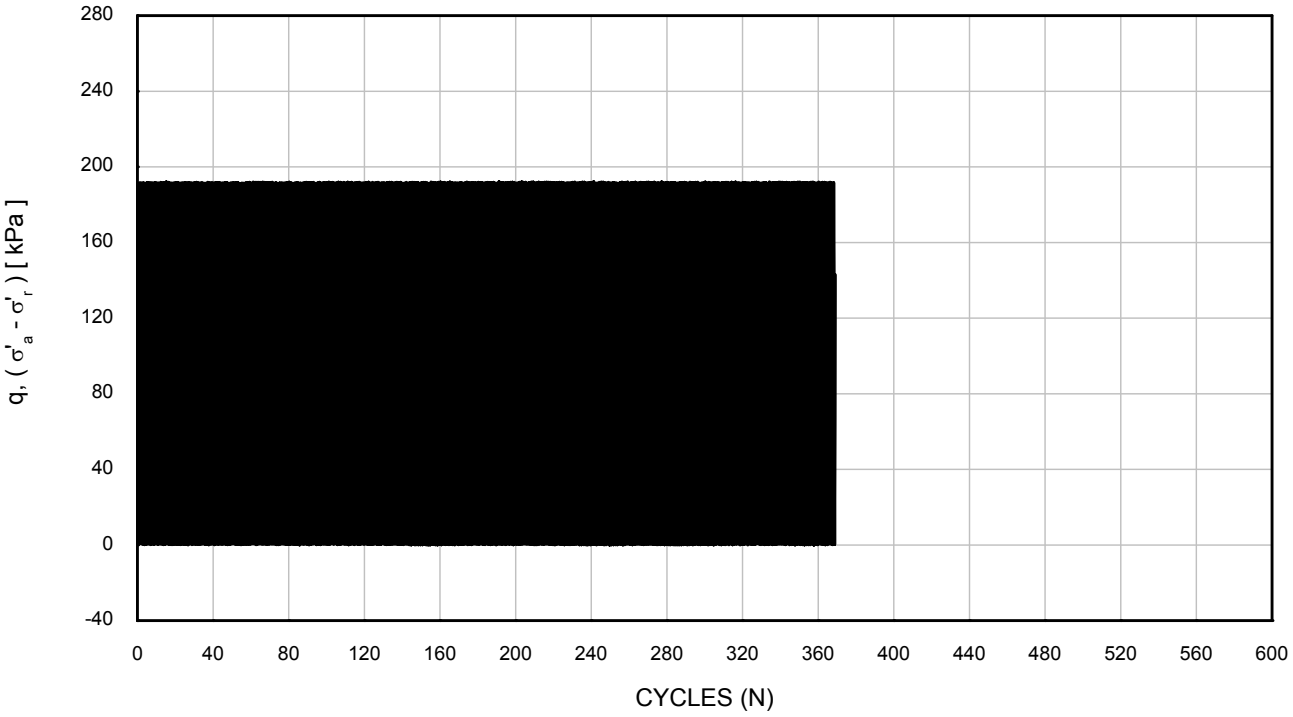
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

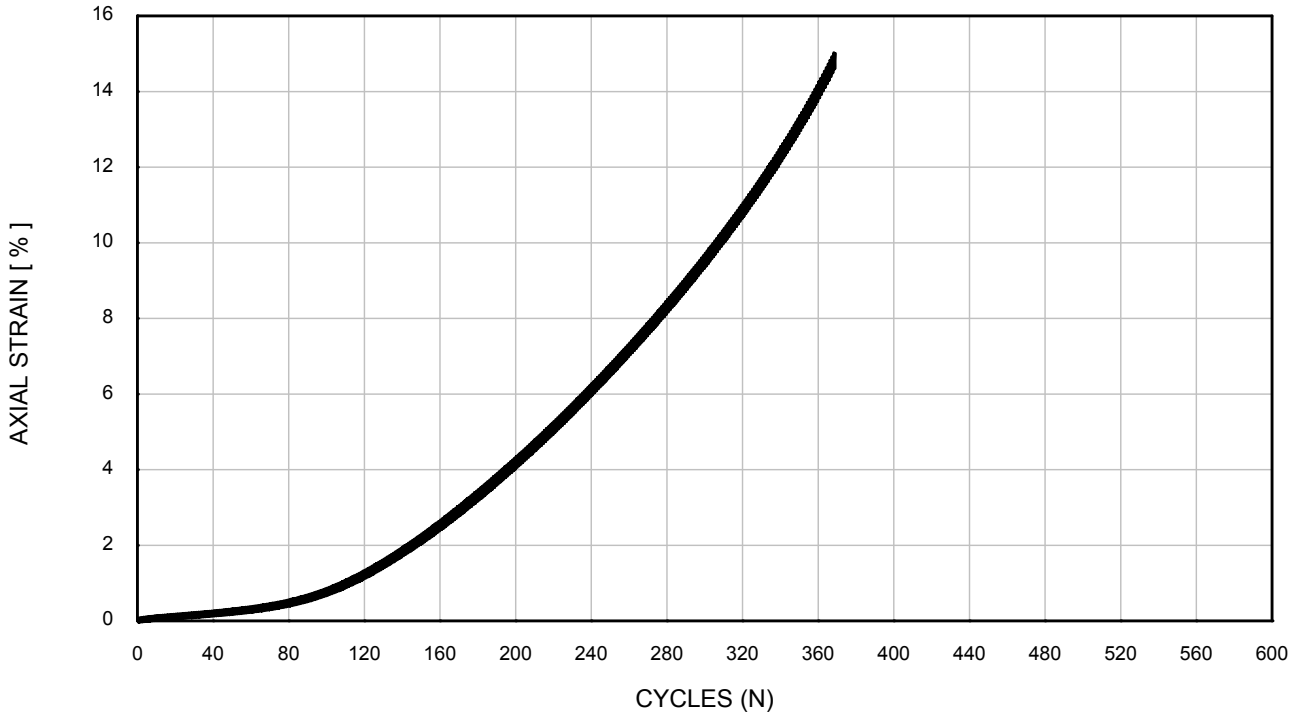




σ'_{rc}	: 224 kPa	Batch	: 5
σ'_{ac}	: 321 kPa	Sample	: CTX_5-3
		Unit	: Unit C2 (Eem)
		Test No.	: CTX23

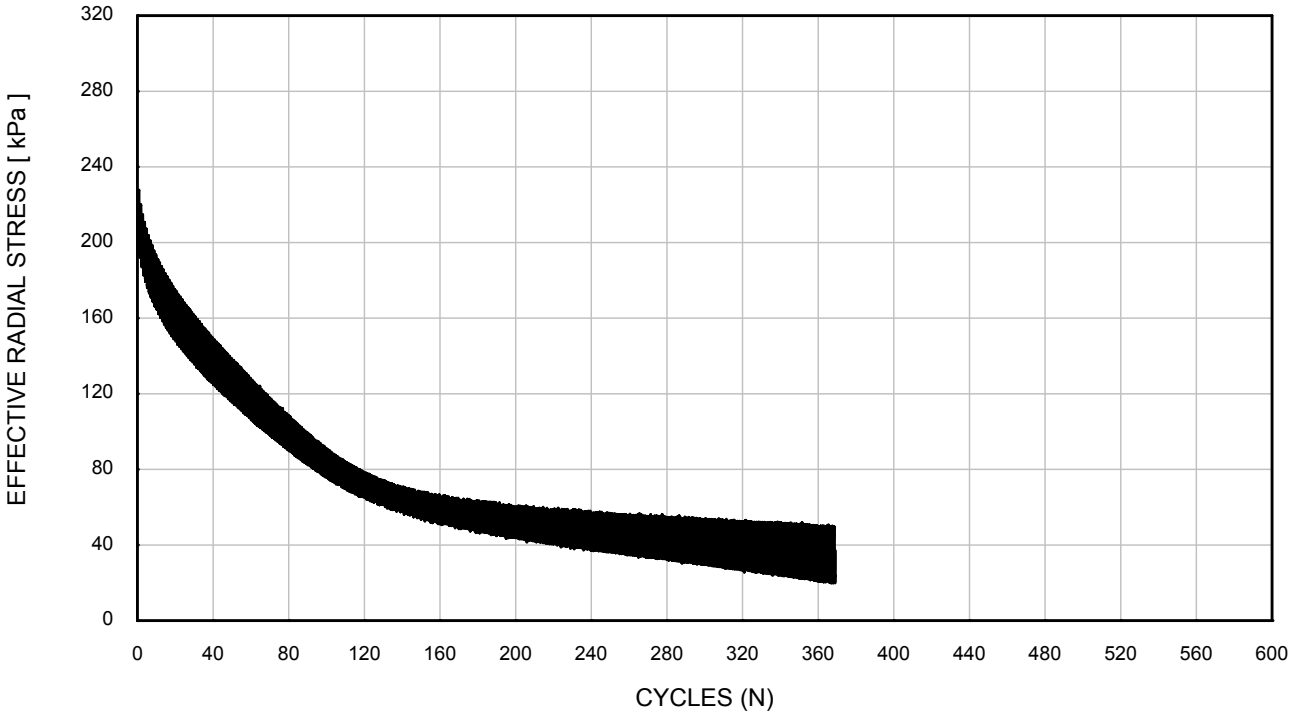
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO CYCLIC LOADING

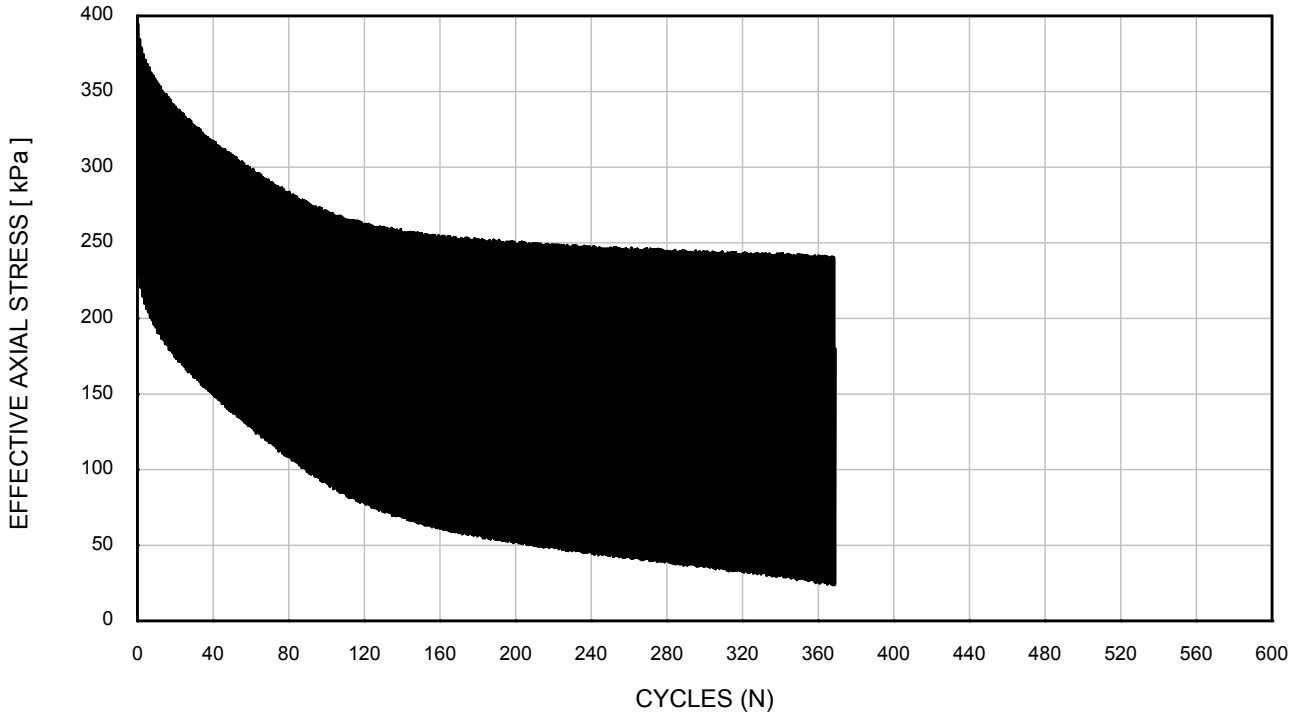




Initial σ'_r	:	224 kPa	Batch	:	5
Initial σ'_a	:	321 kPa	Sample	:	CTX_5-3
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX23
Frequency	:	0.10 Hz			

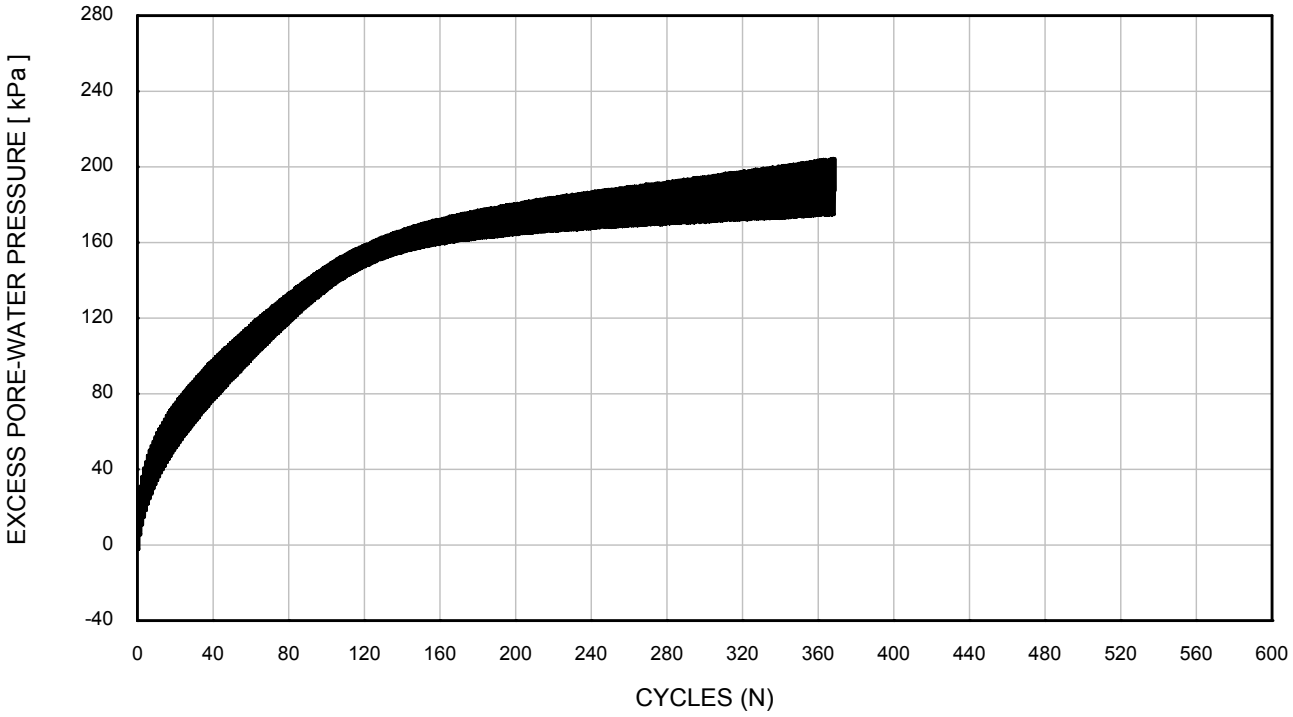
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

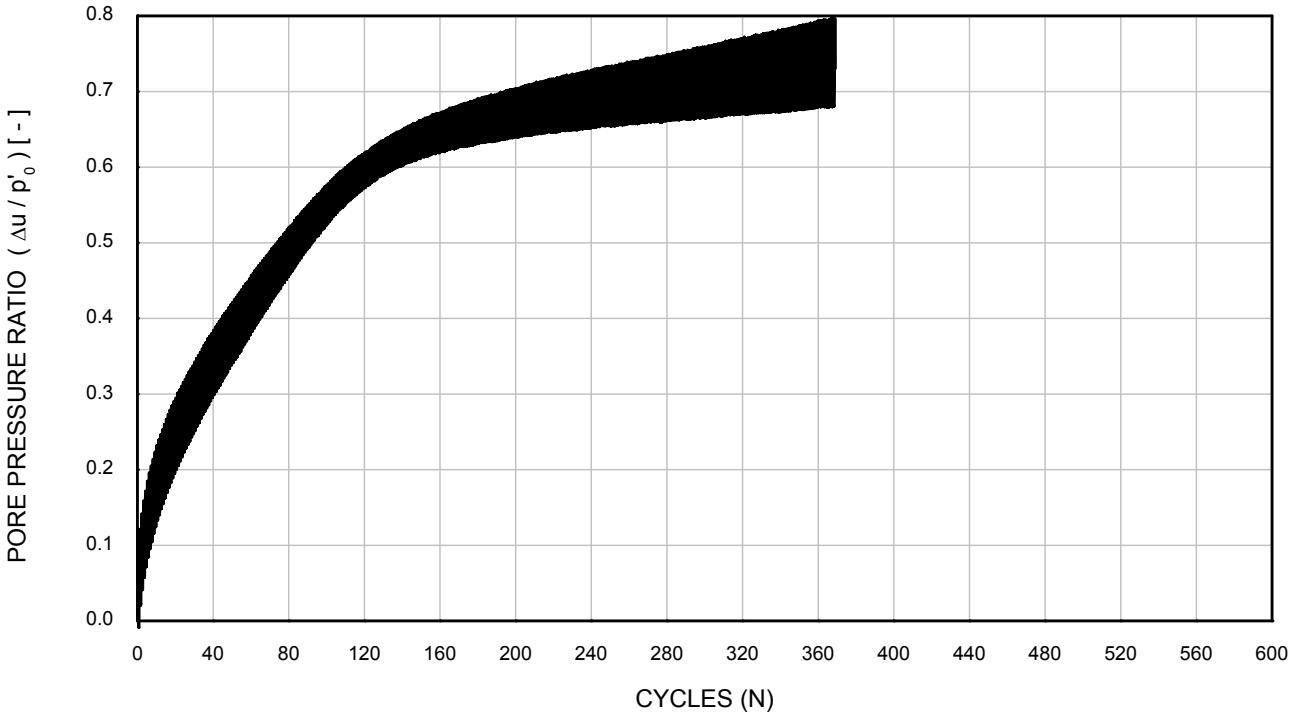




Initial σ'_r	:	224 kPa	Batch	: 5
Initial σ'_a	:	321 kPa	Sample	: CTX_5-3
q_{av}	:	96 kPa	Unit	: Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	: CTX23
Frequency	:	0.10 Hz		

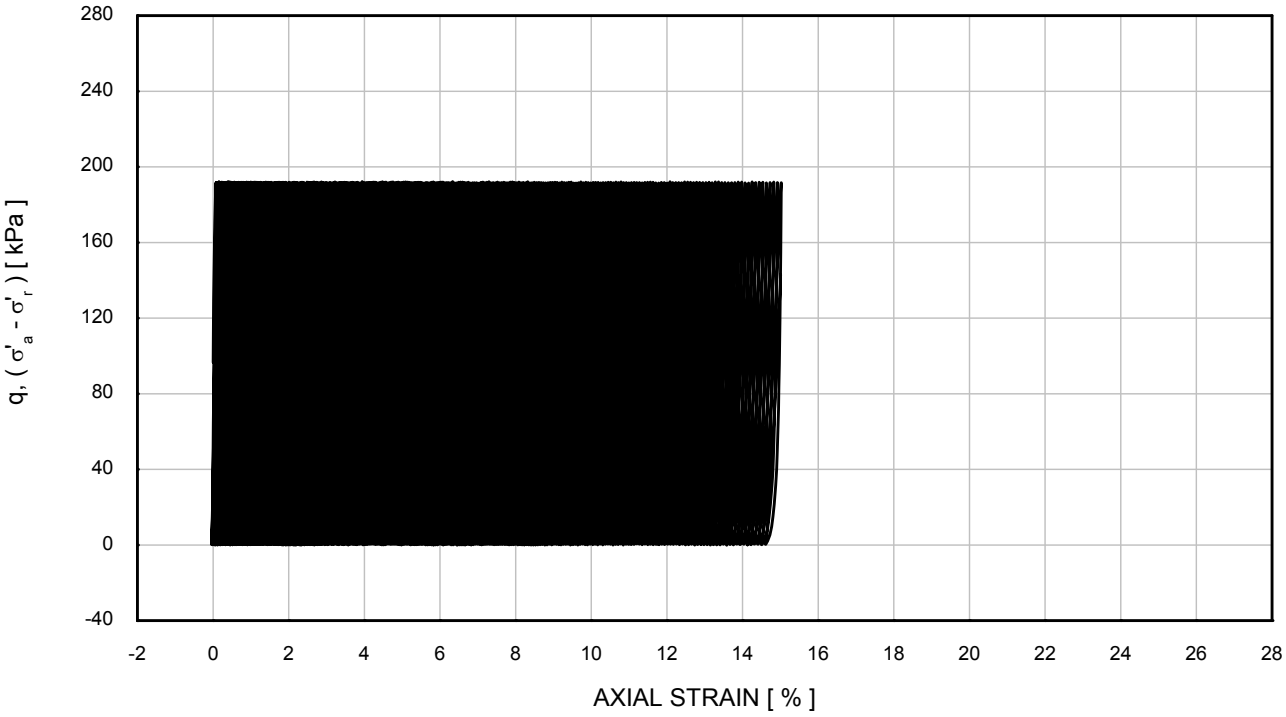
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

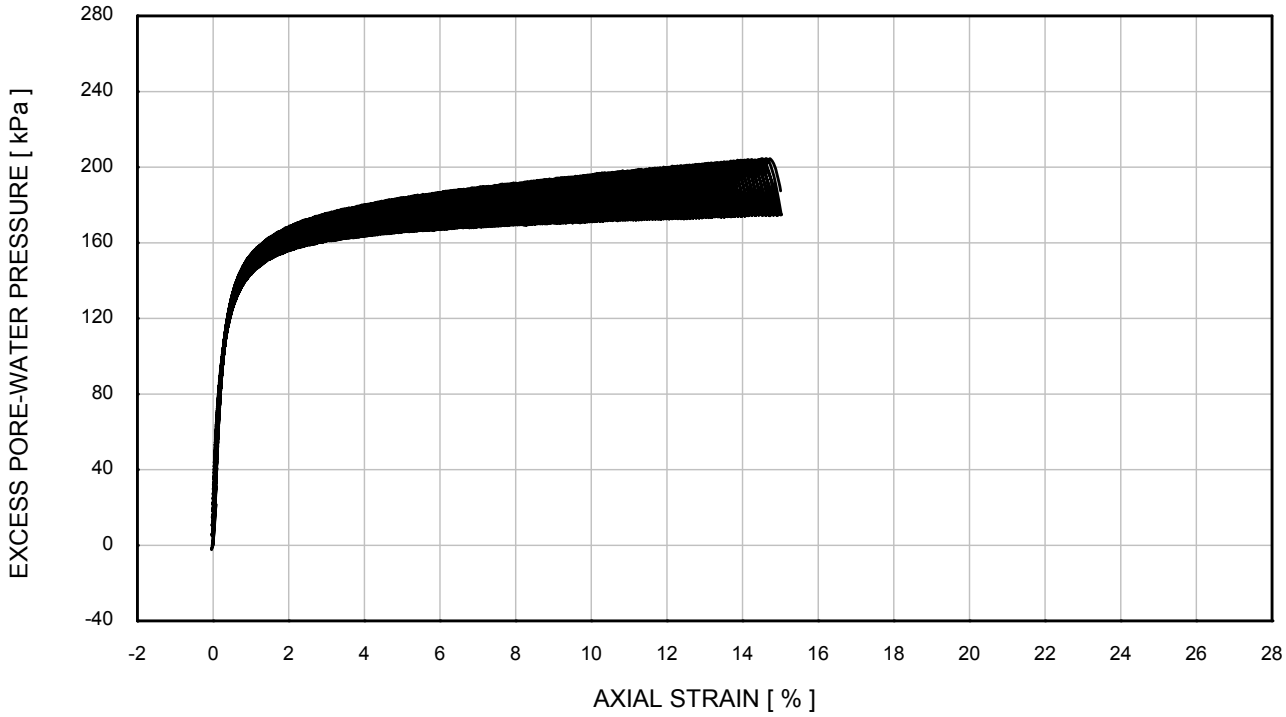




Initial σ'_r	:	224 kPa	Batch	:	5
Initial σ'_a	:	321 kPa	Sample	:	CTX_5-3
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX23
Frequency	:	0.10 Hz			

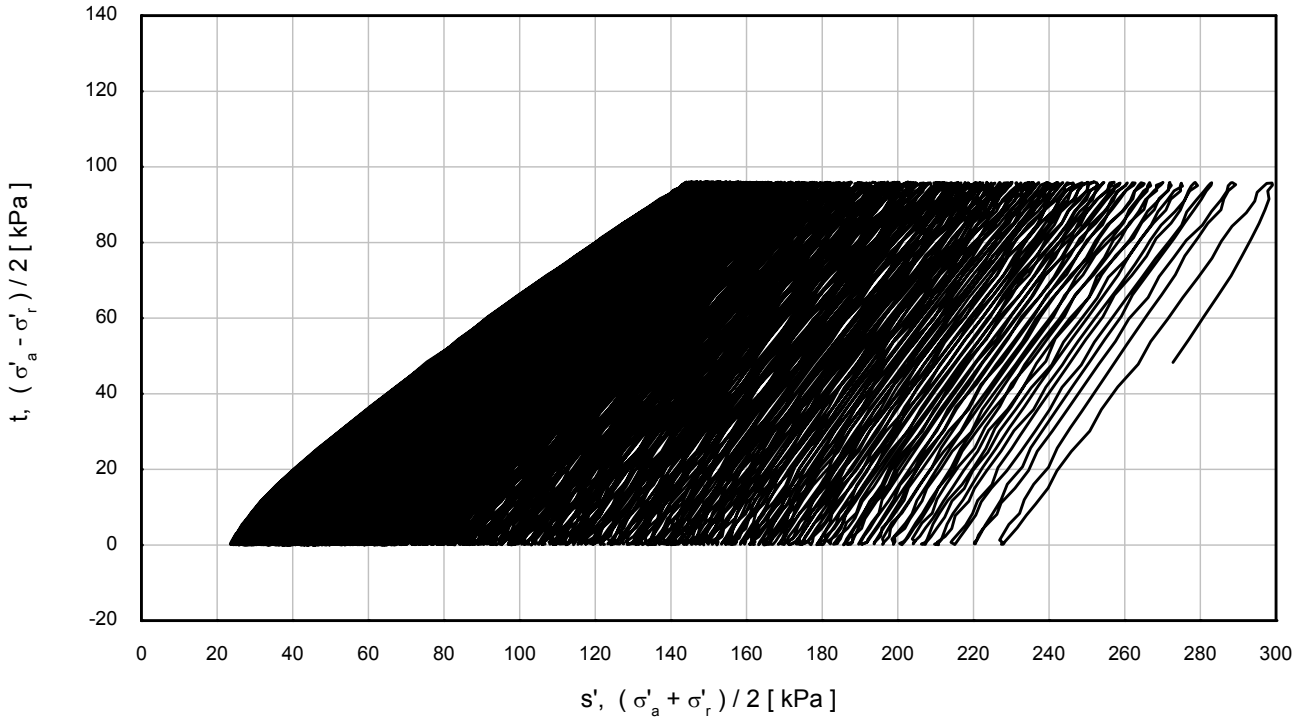
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

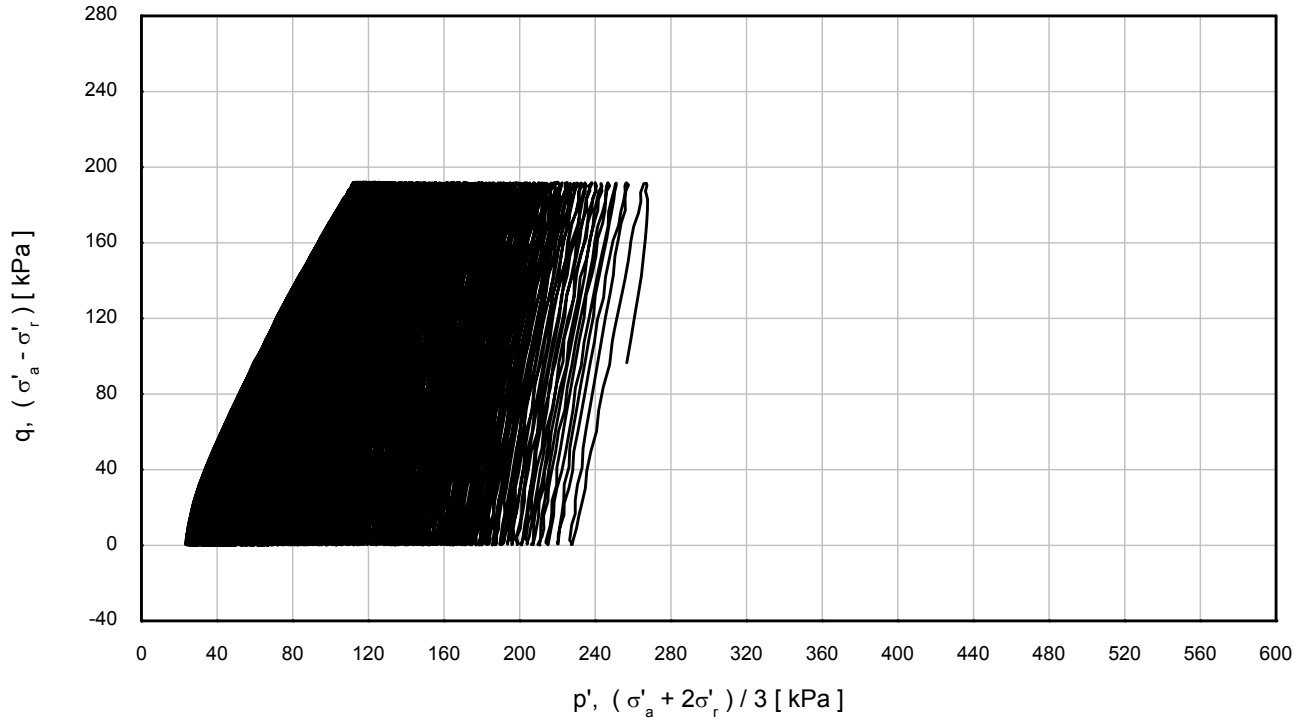




Initial σ'_r	:	224 kPa	Batch	:	5
Initial σ'_a	:	321 kPa	Sample	:	CTX_5-3
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX23
Frequency	:	0.10 Hz			

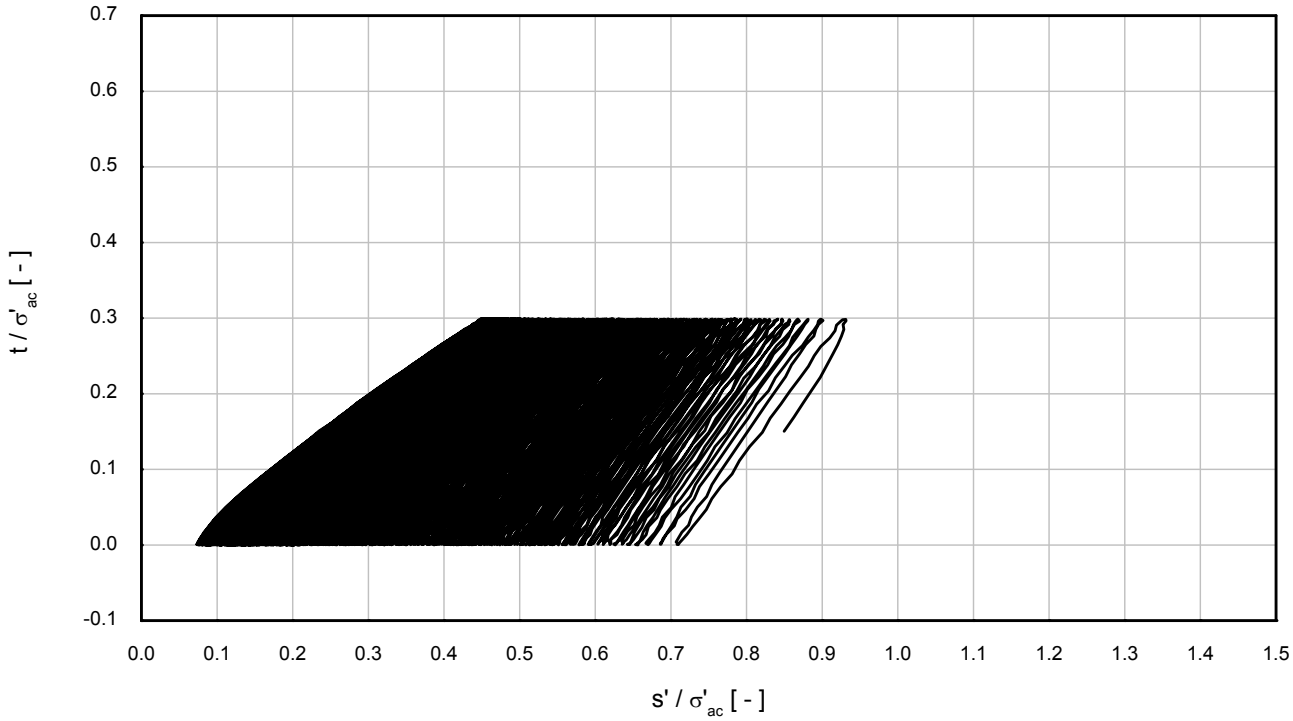
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

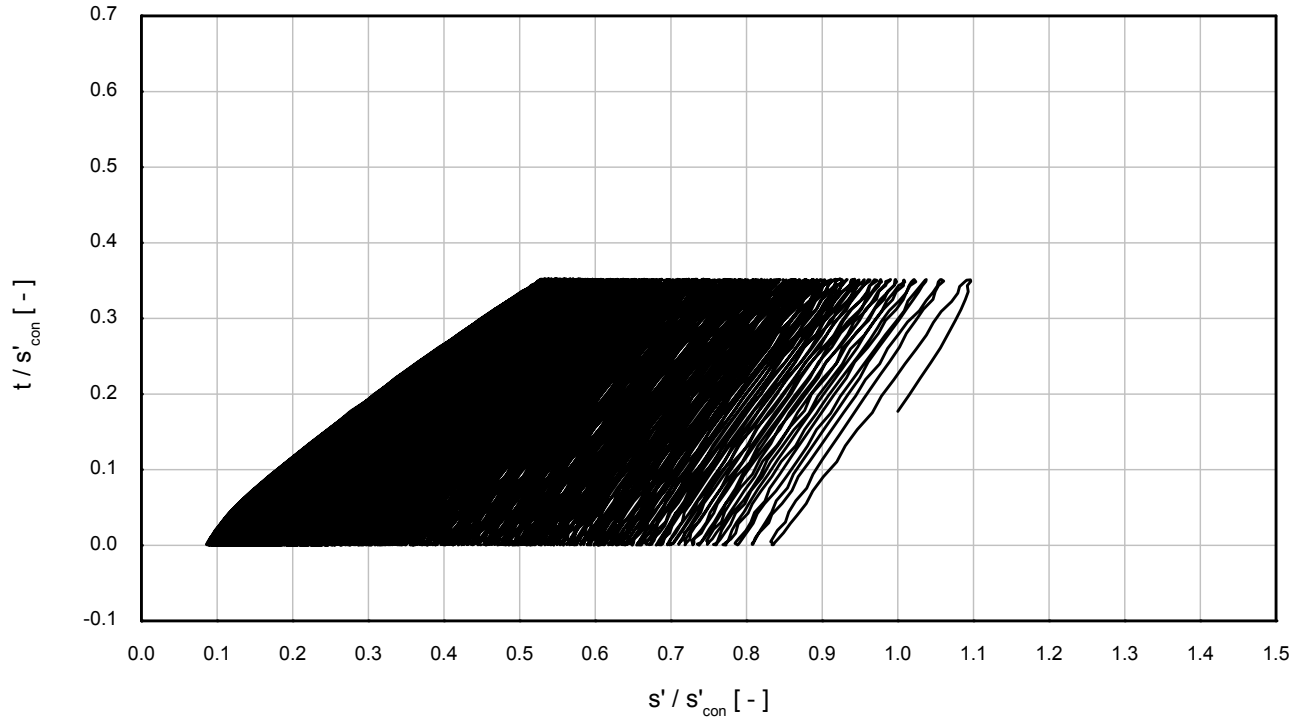




Initial σ'_r	:	224	kPa	Batch	: 5
Initial σ'_a	:	321	kPa	Sample	: CTX_5-3
q_{av}	:	96	kPa	Unit	: Unit C2 (Eem)
q_{cy}	:	96	kPa	Test No.	: CTX23
Frequency	:	0.10	Hz		

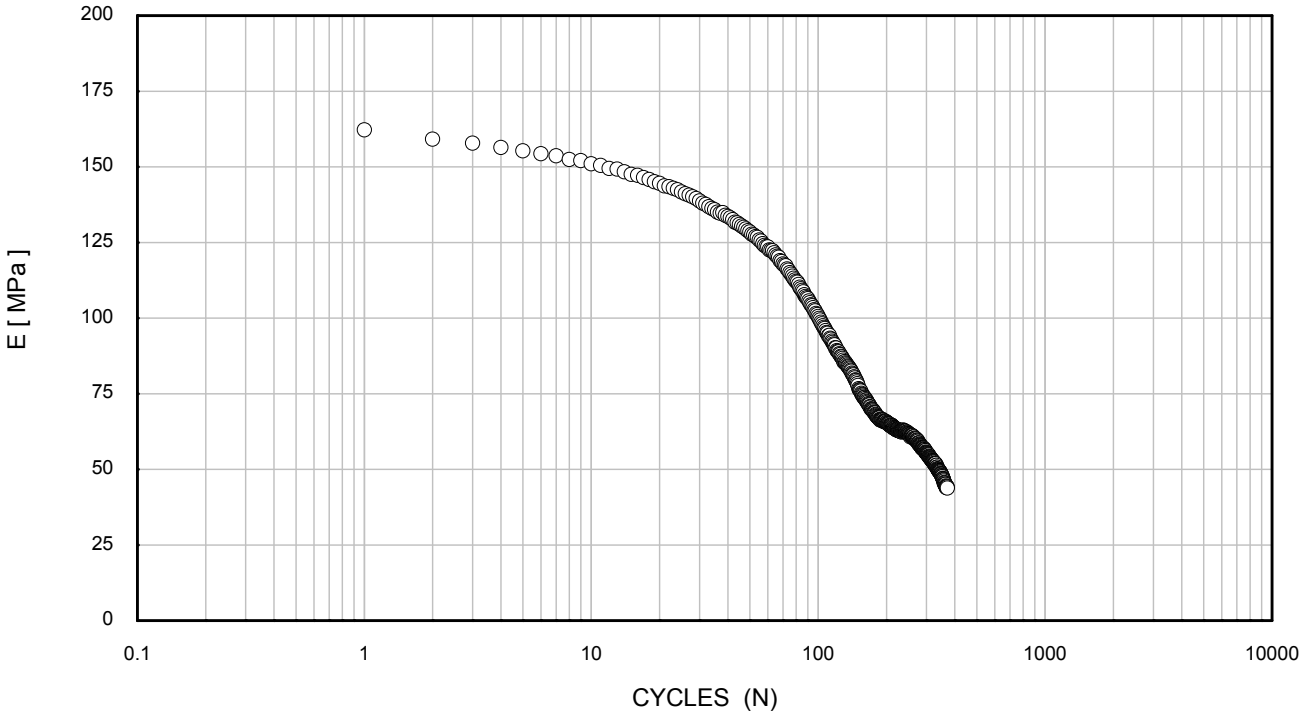
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

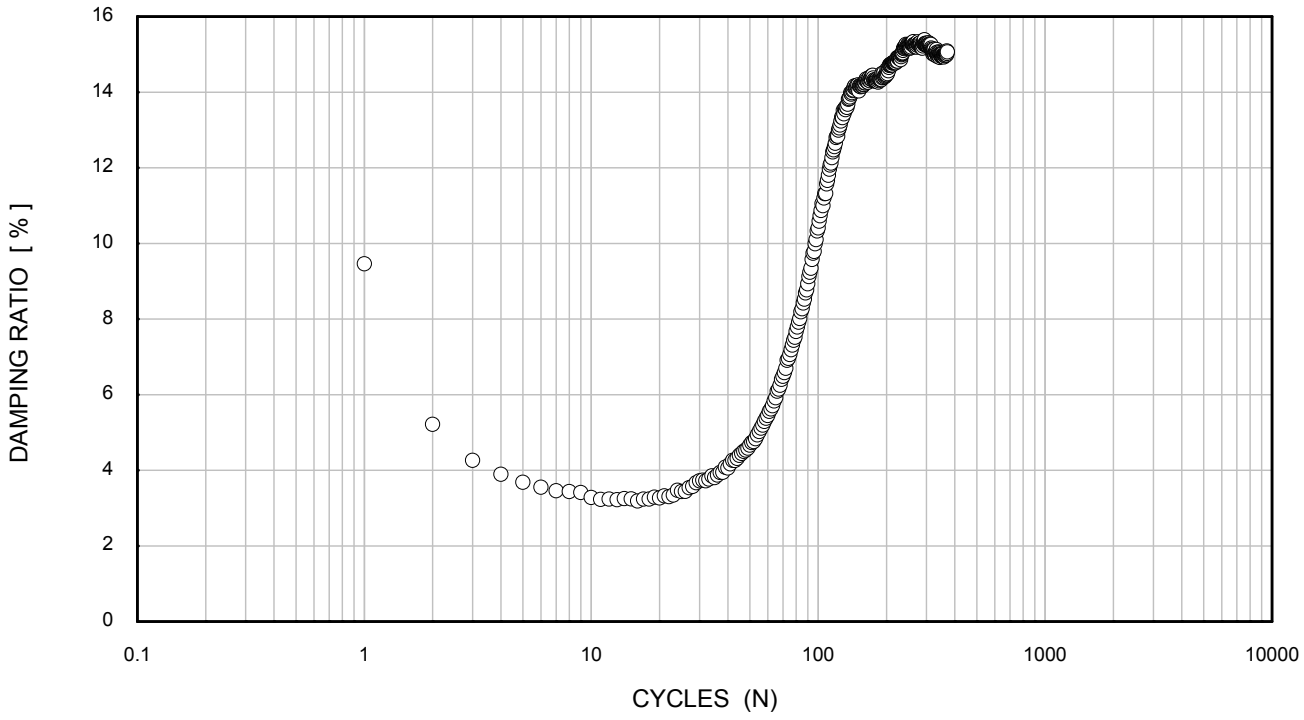




Initial σ'_r	:	224	kPa	Batch	: 5
Initial σ'_a	:	321	kPa	Sample	: CTX_5-3
q_{av}	:	96	kPa	Unit	: Unit C2 (Eem)
q_{cy}	:	96	kPa	Test No.	: CTX23
Frequency	:	0.10	Hz		

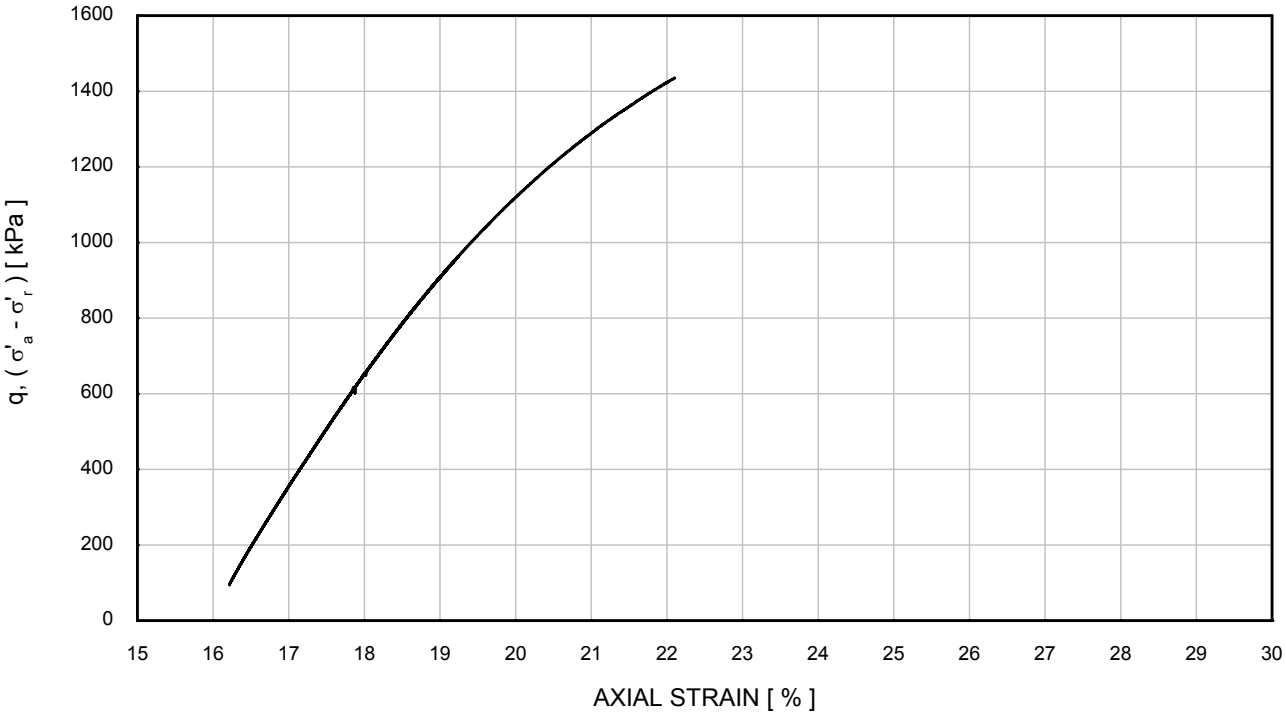
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

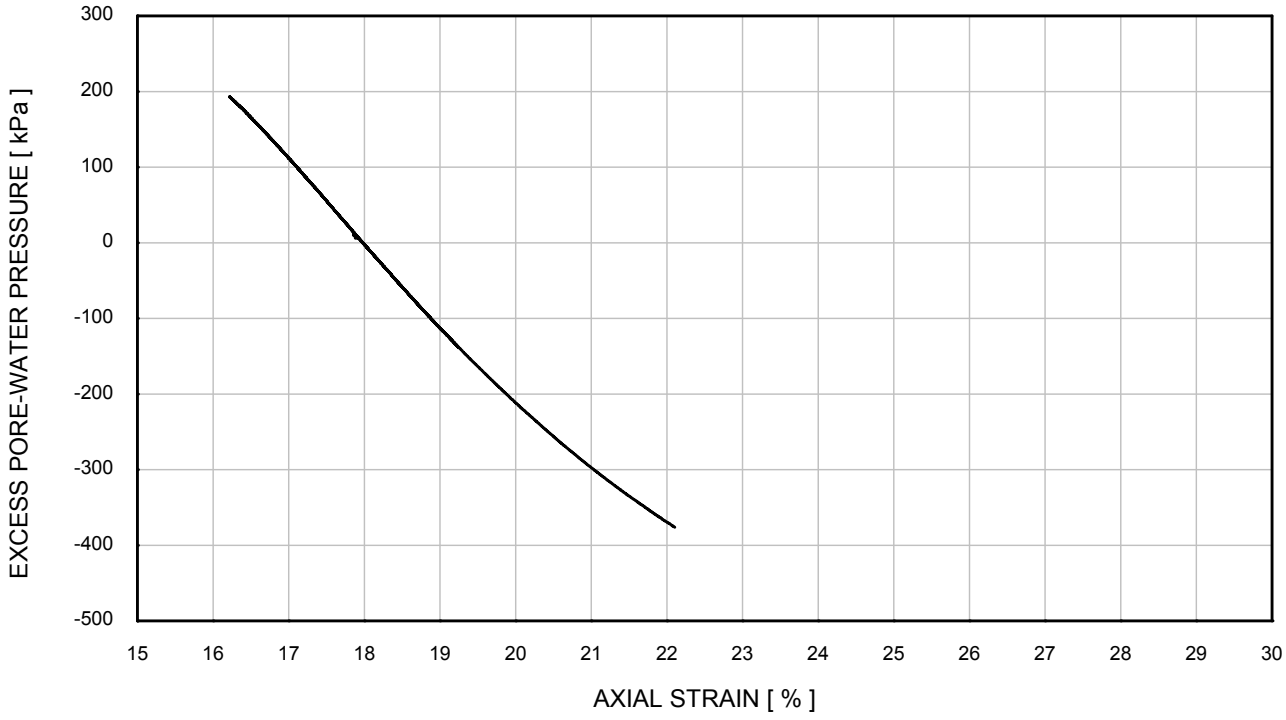




Initial σ'_r	:	224 kPa	Batch	:	5
Initial σ'_a	:	321 kPa	Sample	:	CTX_5-3
q_{av}	:	96 kPa	Unit	:	Unit C2 (Eem)
q_{cy}	:	96 kPa	Test No.	:	CTX23
Frequency	:	0.10 Hz			

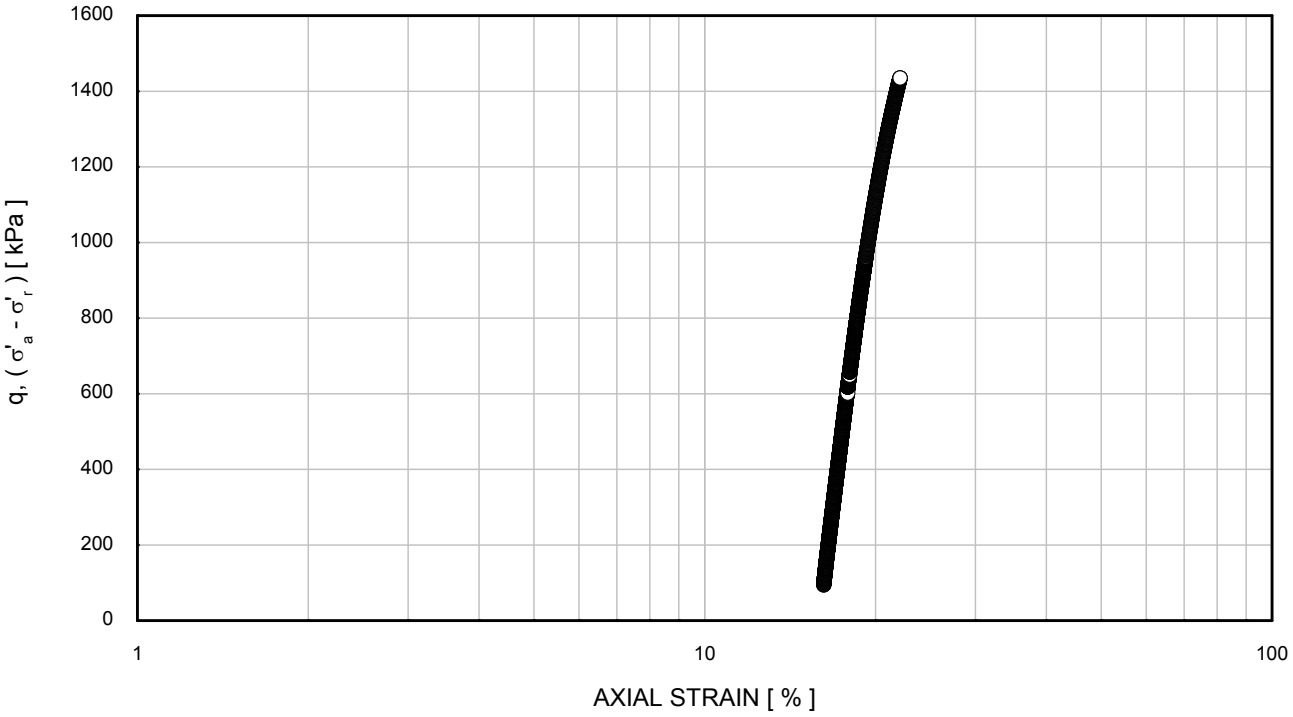
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

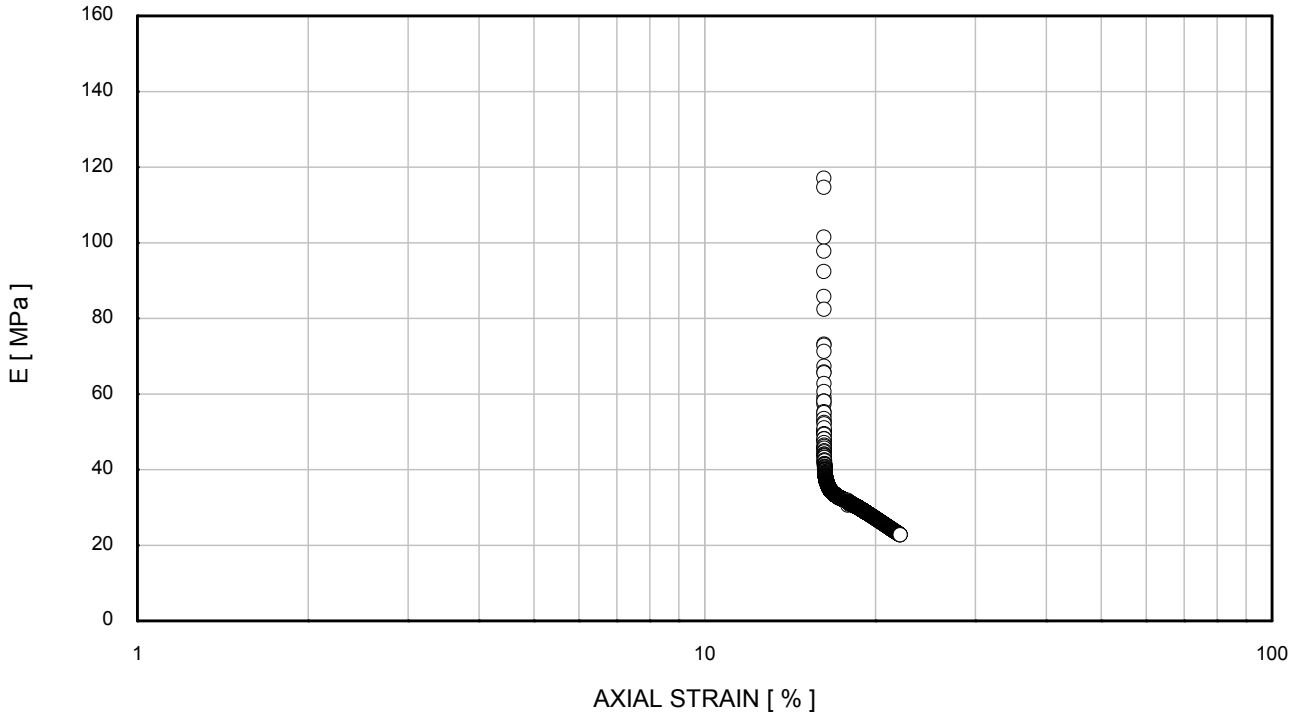




Initial σ'_r	: 31 kPa	Batch	: 5
Initial σ'_a	: 125 kPa	Sample	: CTX_5-3
q_{peak}	: 1435 kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	: 22.10 %	Test No.	: CTX23
Rate of strain	: 1.01 %/hour		

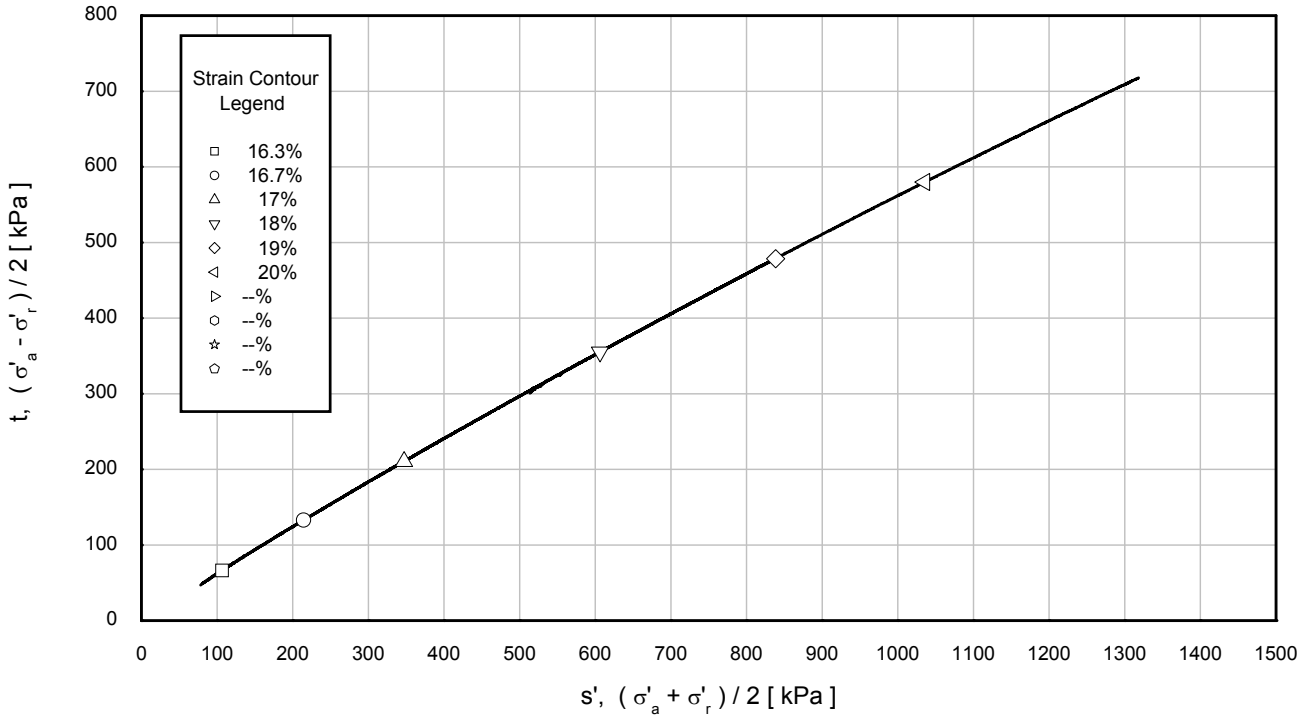
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

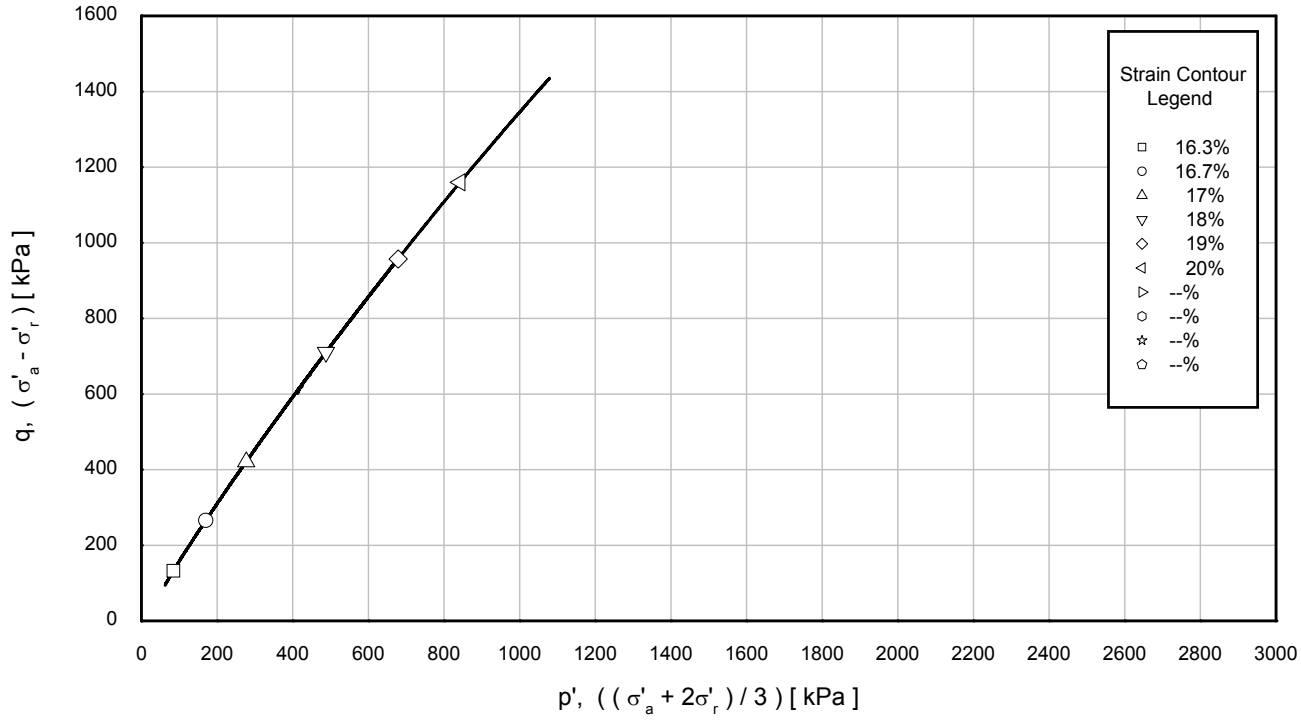




Initial σ'_r	:	31 kPa	Batch	:	5
Initial σ'_a	:	125 kPa	Sample	:	CTX_5-3
q_{peak}	:	1435 kPa	Unit	:	Unit C2 (Eem)
Ext. ε at q_{peak}	:	22.10 %	Test No.	:	CTX23
Rate of strain	:	1.01 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	31	kPa	Batch	: 5
Initial σ'_a	:	125	kPa	Sample	: CTX_5-3
q_{peak}	:	1435	kPa	Unit	: Unit C2 (Eem)
Ext. ε at q_{peak}	:	22.10	%	Test No.	: CTX23
Rate of strain	:	1.01	%/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Light yellowish brown fine to medium SAND

GENERAL	
Date test started	08/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	71.7
Length	[mm]	143.8
Water content	[%]	10.2
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.674
Degree of saturation	[%]	40
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ HKZ_WFSI_WFSII_Advanced Laboratory Tes
Processed by Date	MSR 15/12/2016
Checked by Date	AR 22/12/2016
Approved by Date	AR 04/01/2017

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	1000
Base PWP	[kPa]	970
Mid height PWP	[kPa]	-
B value achieved	[-]	0.95

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1220
Back pressure	[kPa]	970
Base PWP	[kPa]	970
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	250
Effective axial pressure	[kPa]	380
Deviator stress	[kPa]	130
Volumetric strain	[%]	1.00
External axial strain	[%]	0.67
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.657
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1220
Back pressure	[kPa]	970
Base PWP	[kPa]	959
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	261
Effective axial pressure	[kPa]	299
Deviator stress	[kPa]	38
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.06
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.658
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	760
Mean q_{av}	[kPa]	38
Mean q_{cy}	[kPa]	38
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	1500
External ε_{av} at N_f	[%]	-0.07
External ε_{cy} at N_f	[%]	0.02
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	73
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.657
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.06	0.02	166	-	0.00	-
2	-0.06	0.02	194	-	0.00	-
5	-0.07	0.02	196	-	0.00	-
10	-0.07	0.02	196	-	0.00	-
20	-0.07	0.02	193	-	0.00	-
30	-0.07	0.02	193	-	0.00	-
40	-0.07	0.02	191	-	0.00	-
50	-0.07	0.02	190	-	0.00	-
100	-0.07	0.02	187	-	0.00	-
500	-0.08	0.02	173	-	0.00	-
1000	-0.08	0.02	164	-	0.00	-
1500	-0.07	0.02	156	-	0.00	-

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1220
Back pressure	[kPa]	971
Base PWP	[kPa]	961
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	259
Effective axial pressure	[kPa]	335
Deviator stress	[kPa]	76
Volumetric strain	[%]	0.00
External axial strain	[%]	0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.658
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	760
Mean q_{av}	[kPa]	76
Mean q_{cy}	[kPa]	38
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	0.04
External ε_{cy} at N_f	[%]	0.02
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	17
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.657
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.04	0.02	201	-	1.51	-
2	0.04	0.02	213	-	0.53	-
5	0.04	0.02	215	-	0.28	-
10	0.04	0.02	213	-	0.13	-
20	0.04	0.02	212	-	0.12	-
30	0.04	0.02	211	-	0.05	-
40	0.04	0.02	212	-	0.03	-
50	0.04	0.02	210	-	0.00	-
100	0.04	0.02	209	-	0.08	-
200	0.04	0.02	206	-	0.08	-
300	0.04	0.02	204	-	0.19	-
400	0.04	0.02	202	-	0.21	-

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	242
Initial effective axial pressure	[kPa]	318
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	392
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	18.54
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	83
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	167
Effective axial pressure	[kPa]	559
Principal effective stress ratio	[-]	3.34
ε_{50}	[%]	0.26
Secant modulus (E_{50}) at ε_{50}	[kPa]	72016
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	373
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	8.90
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	98
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	151
Effective axial pressure	[kPa]	524
Principal effective stress ratio	[-]	3.46
At 10% external axial strain		
Corrected deviator stress	[kPa]	377
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	10.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	96
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	154
Effective axial pressure	[kPa]	531
Principal effective stress ratio	[-]	3.44

TEST IDENTIFICATION	
Batch	BATCH06
Sample	CTX_6-1
Unit	Unit D (Yarmouth Roads)
Test number	CTX24

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





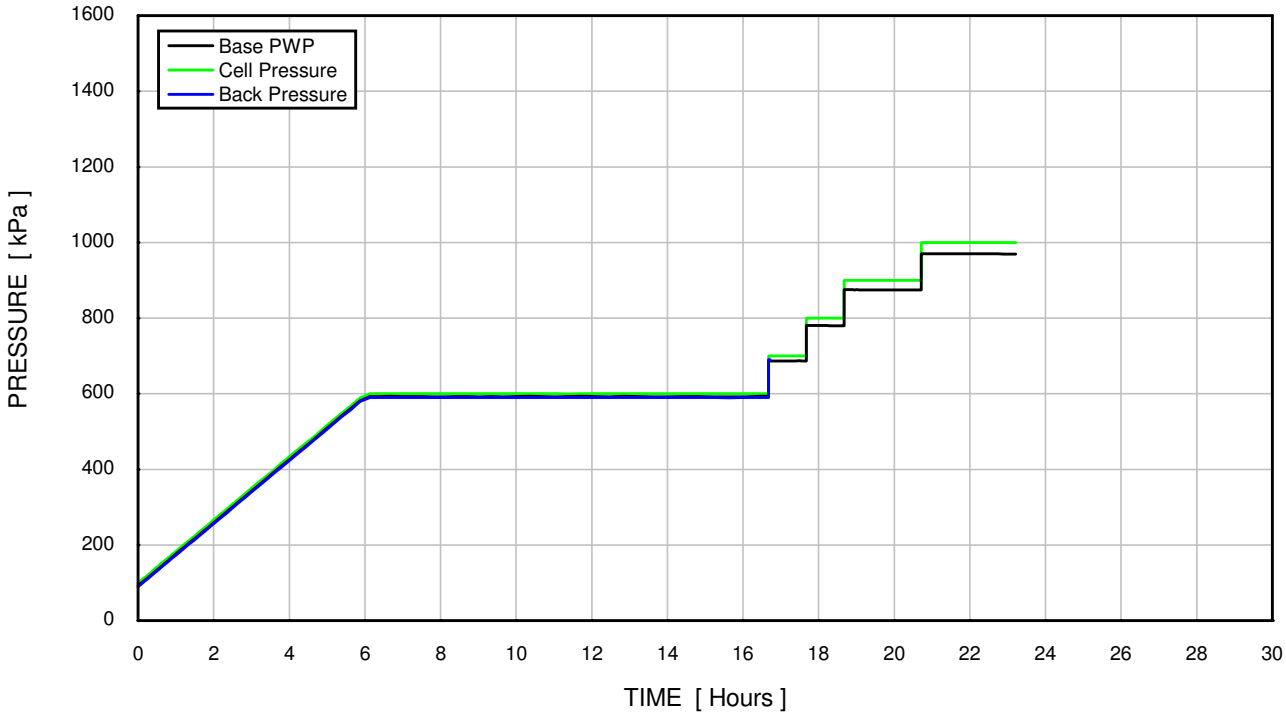
FINAL CONDITIONS

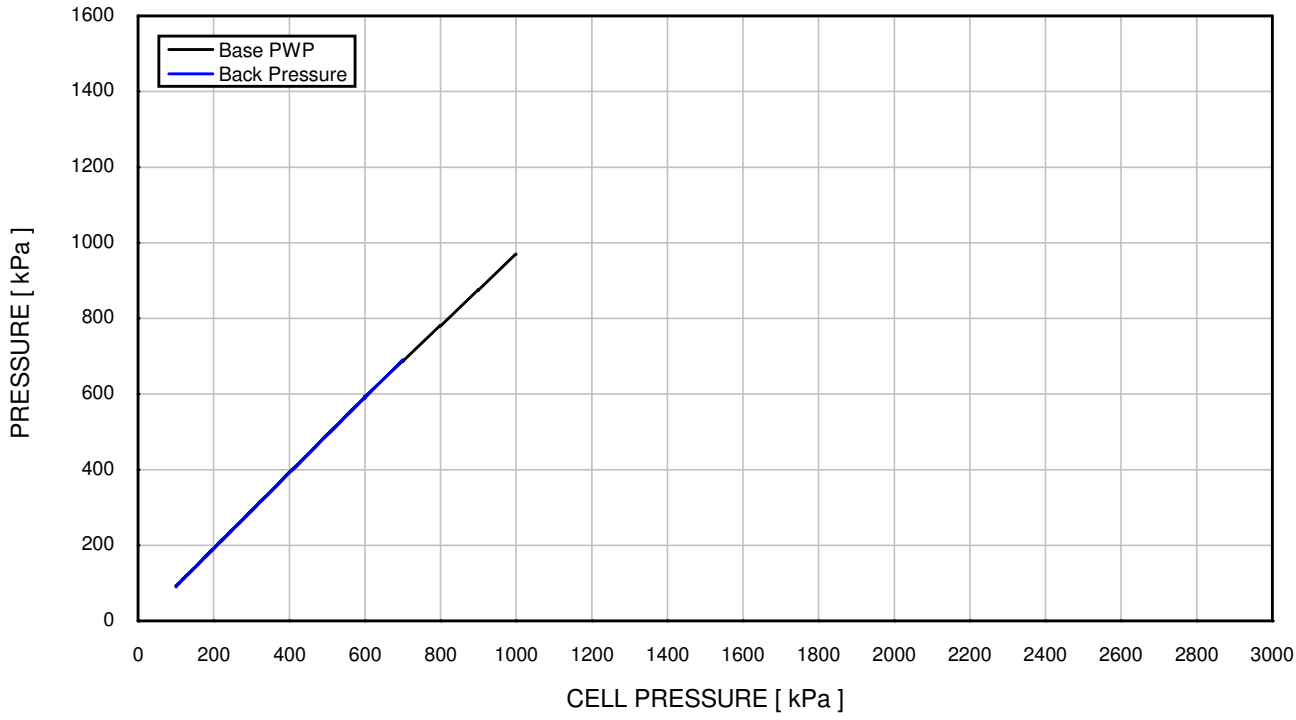
Water content	[%]	24.8
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Borehole	BATCH06
Sample	CTX_6-1
Depth [m]	Unit D (Yarmouth Roads)
Test number	CTX24

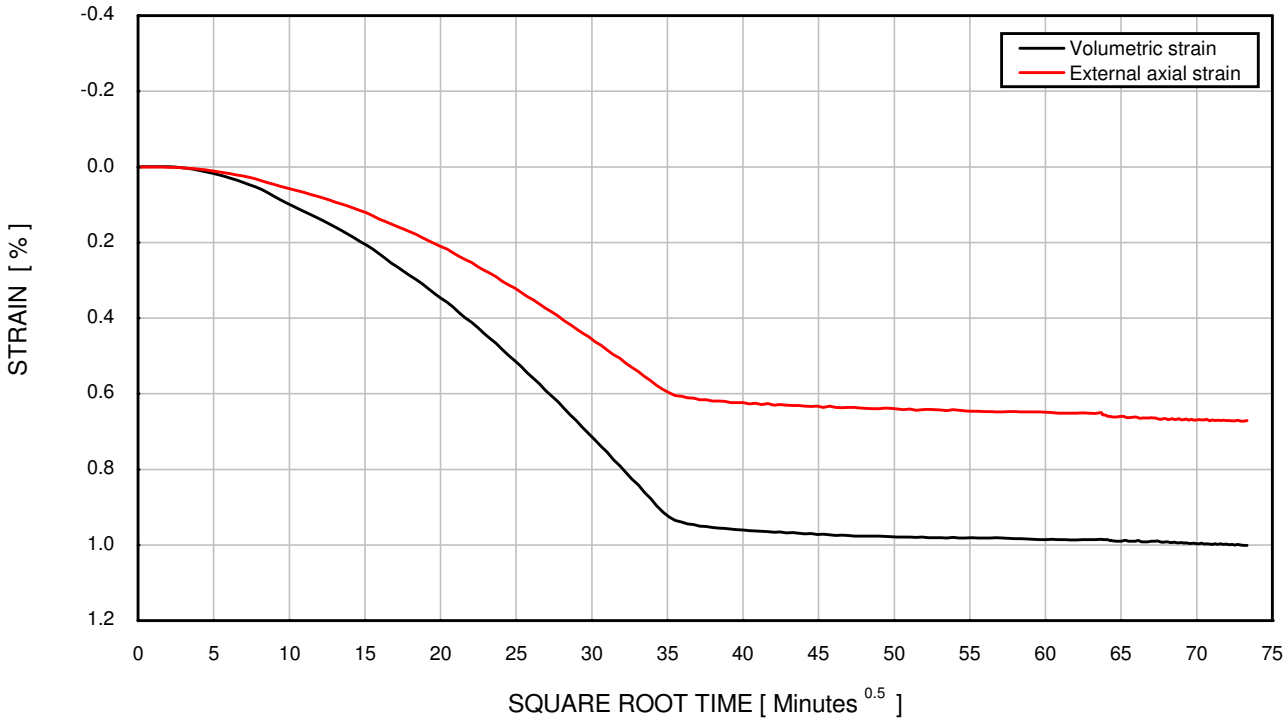
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

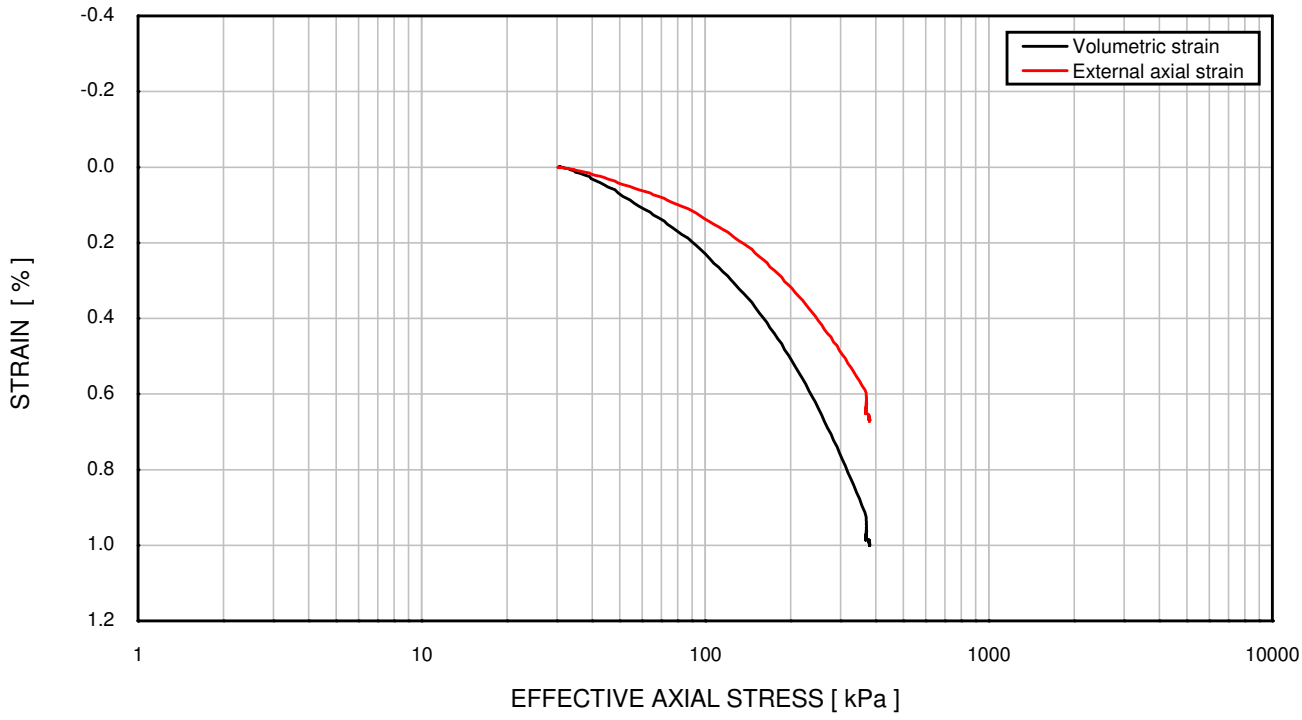




B value	: 0.95		Batch	: BATCH06	
Initial σ'_r	: 8	kPa	Sample	: CTX_6-1	
Initial σ'_a	: 8	kPa	Unit	: Unit D (Yarmouth Roads)	
Final σ'_r	: 30	kPa	Test No.	: CTX24	
Final σ'_a	: 30	kPa			

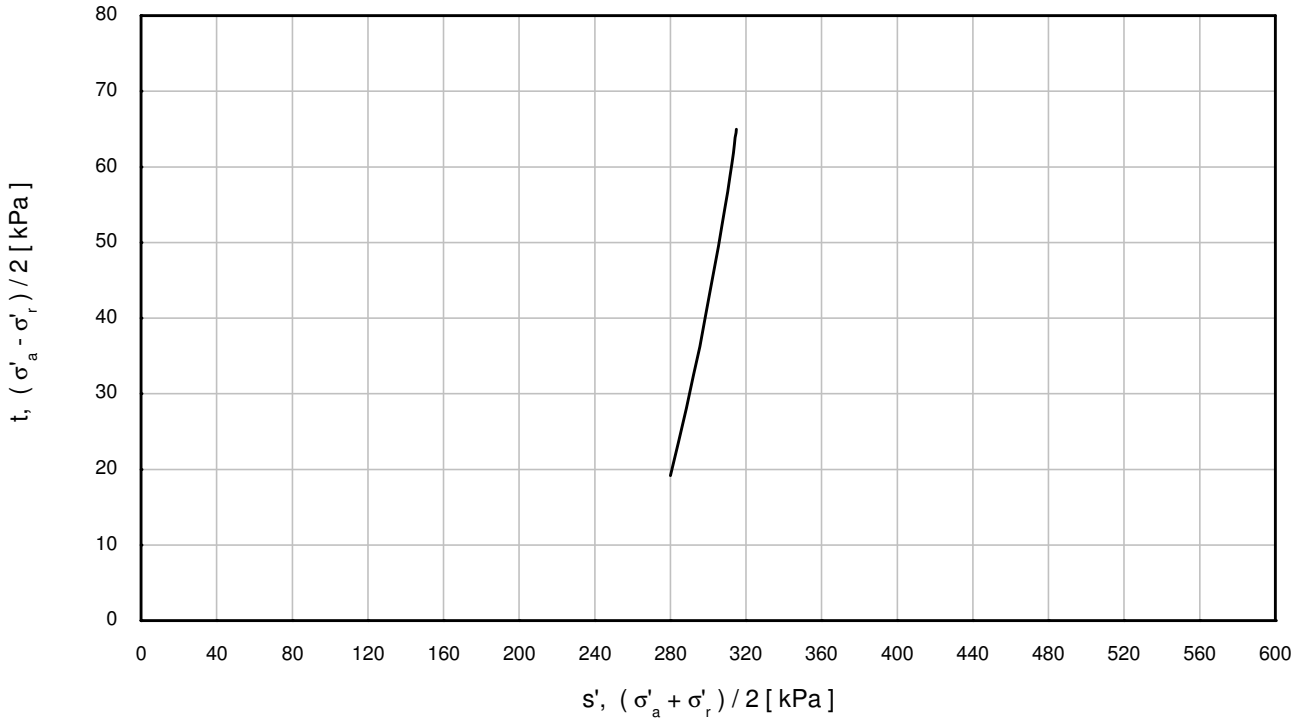
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

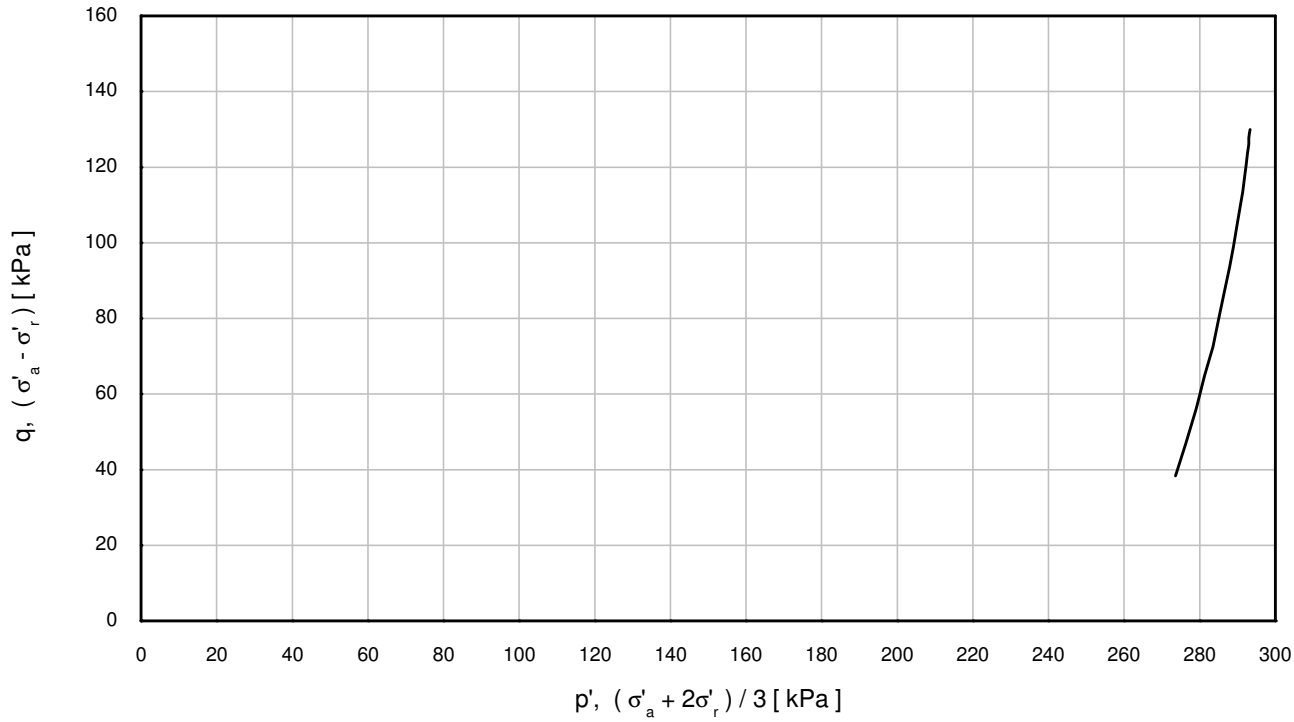




Stage 1 σ'_{rc}	: 250 kPa	Batch	: BATCH06
Stage 1 σ'_{ac}	: 380 kPa	Sample	: CTX_6-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX24

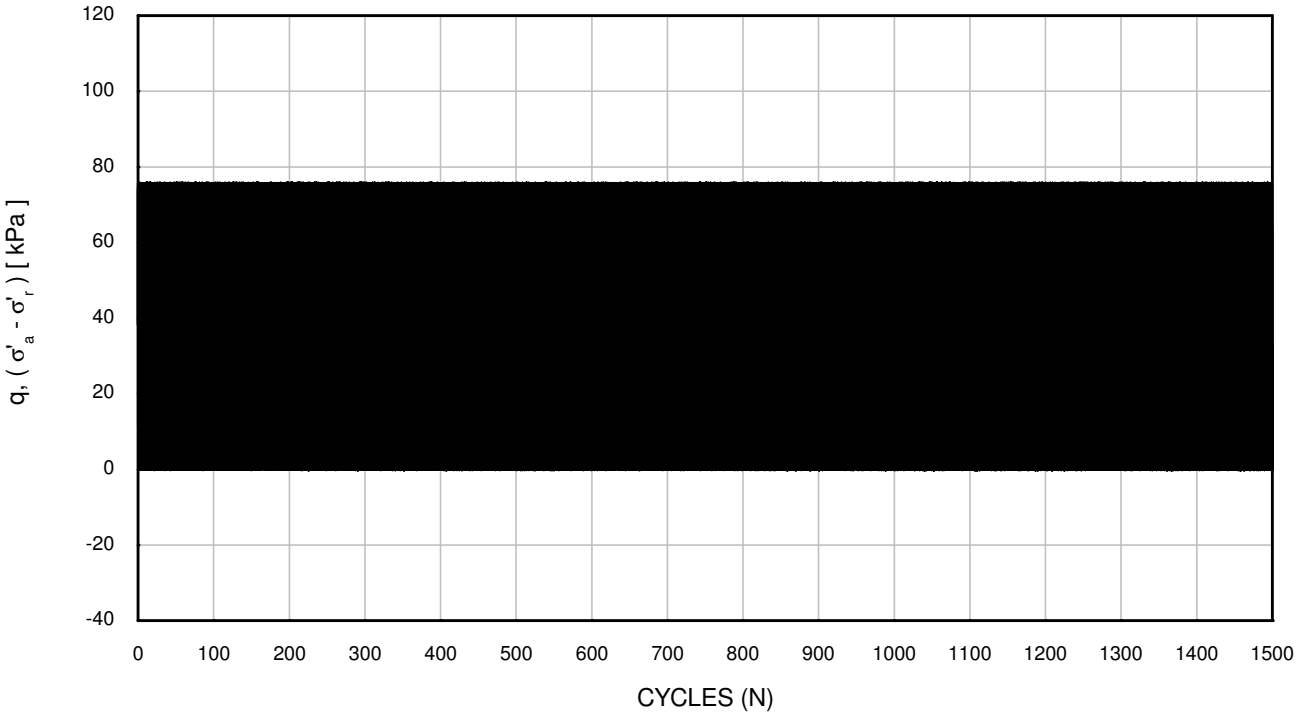
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

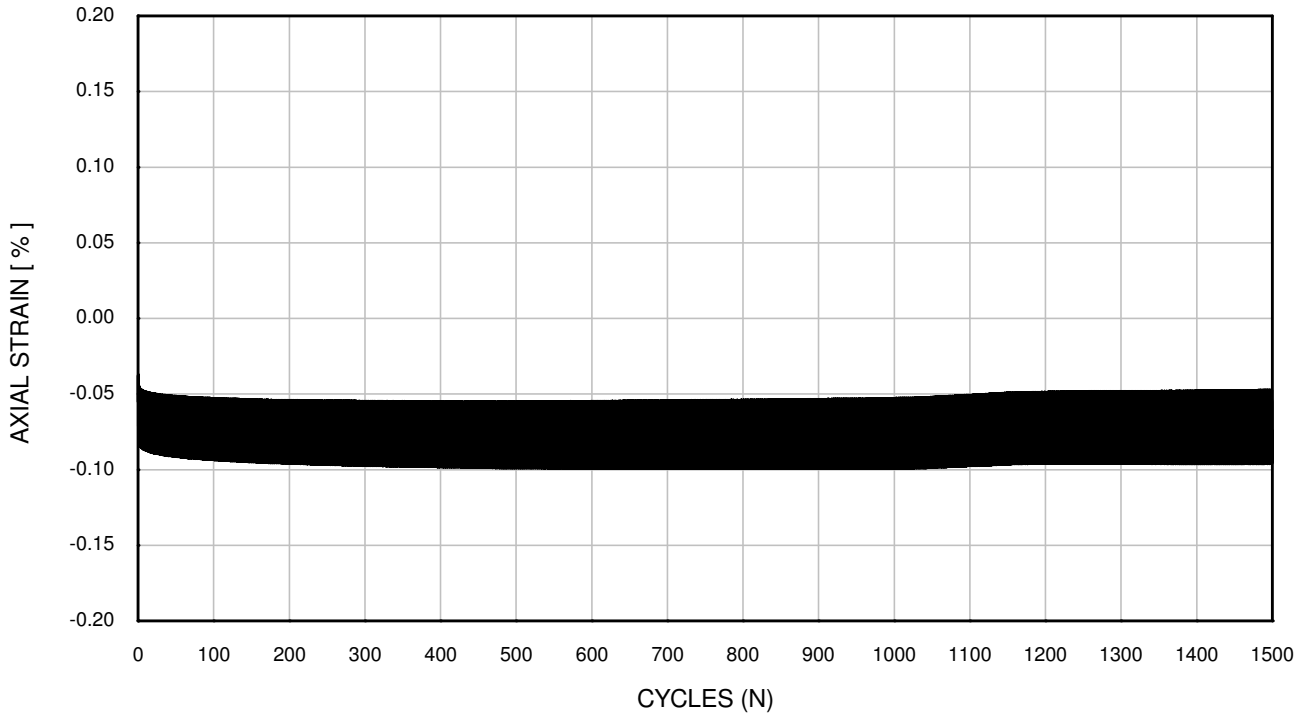




Stage 1 σ'_{rc}	: 261 kPa	Batch	: BATCH06
Stage 1 σ'_{ac}	: 299 kPa	Sample	: CTX_6-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX24

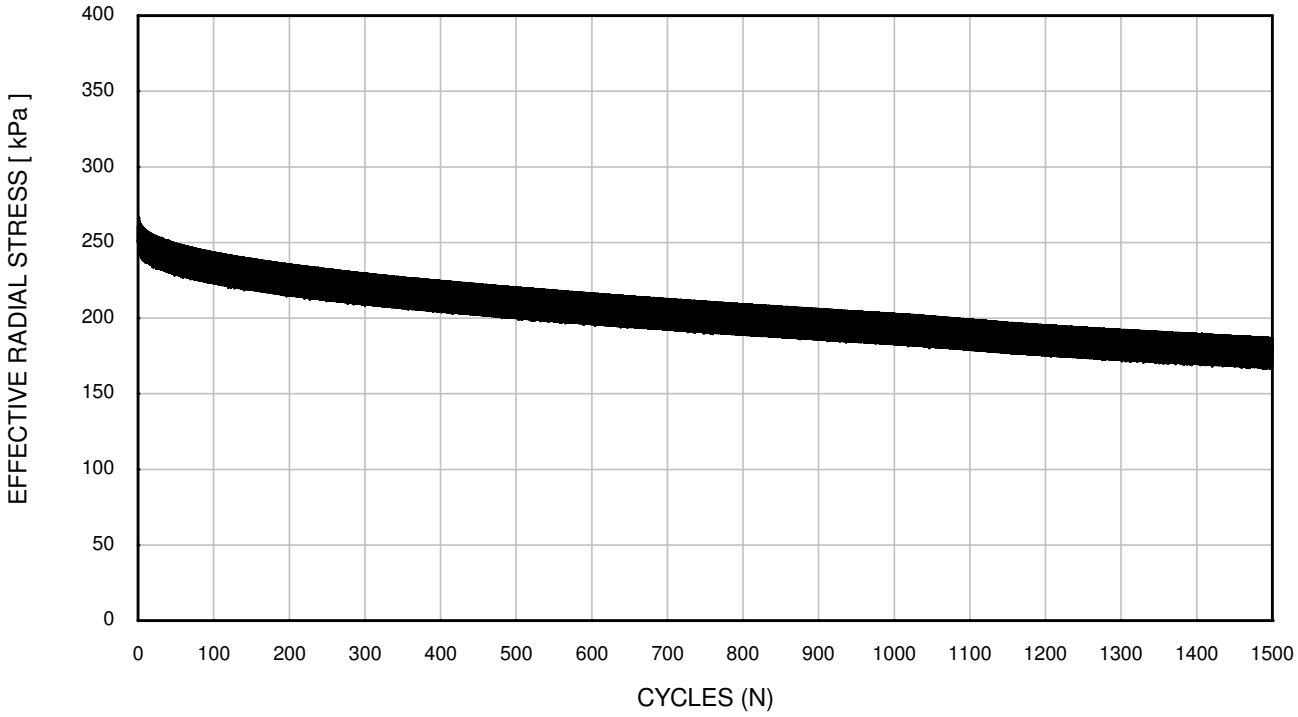
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

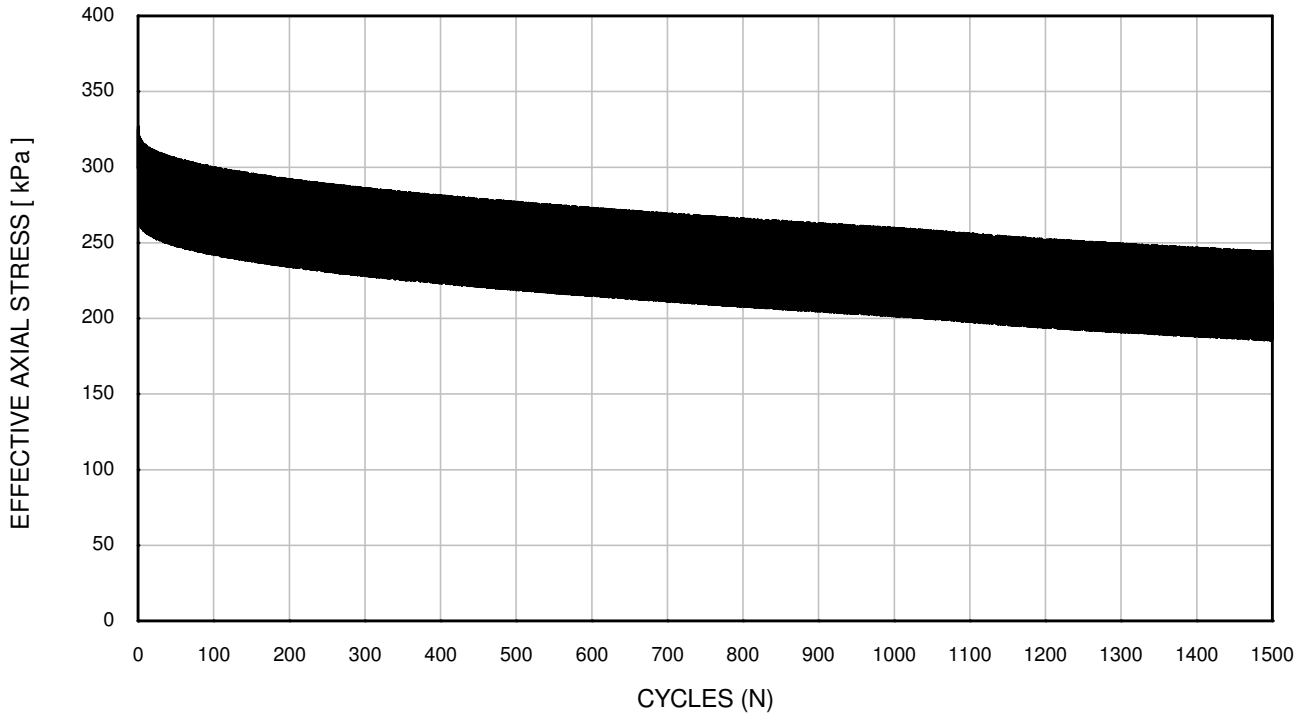




Initial σ'_r	:	261 kPa	Batch	: BATCH06
Initial σ'_a	:	299 kPa	Sample	: CTX_6-1
q_{av}	:	38 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	: CTX24
Frequency	:	0.10 Hz		

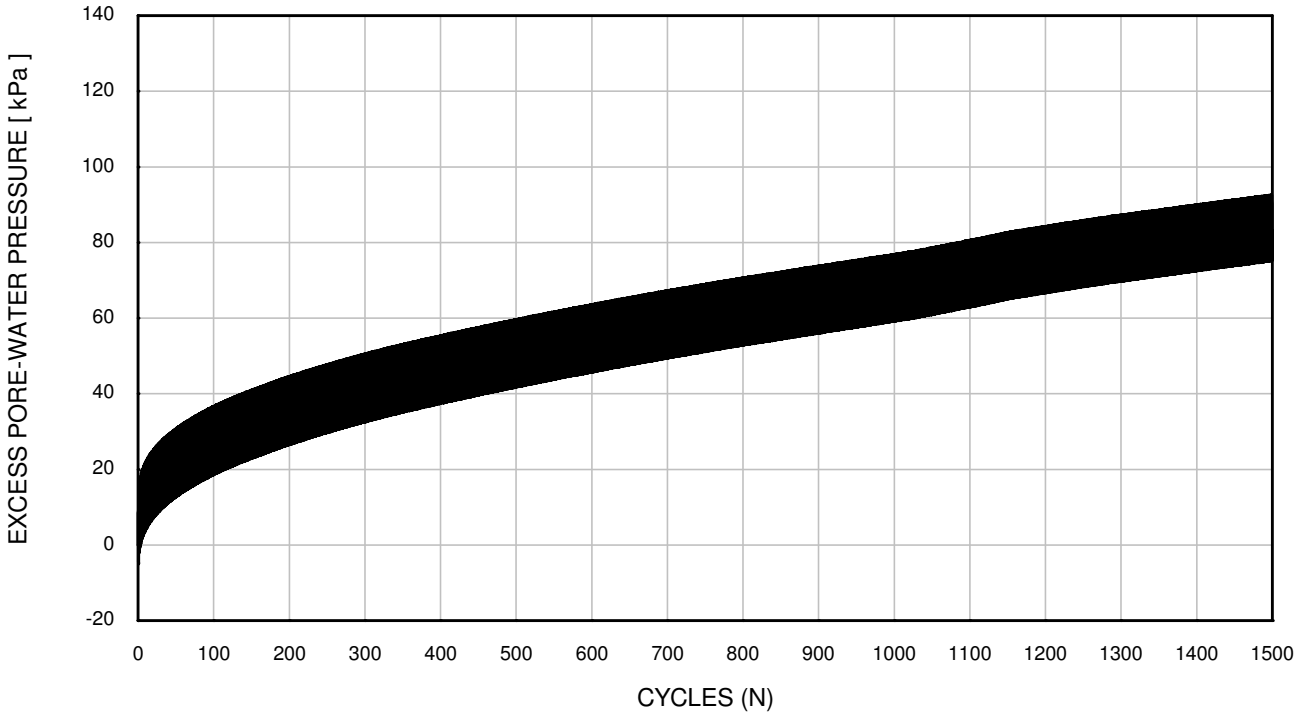
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

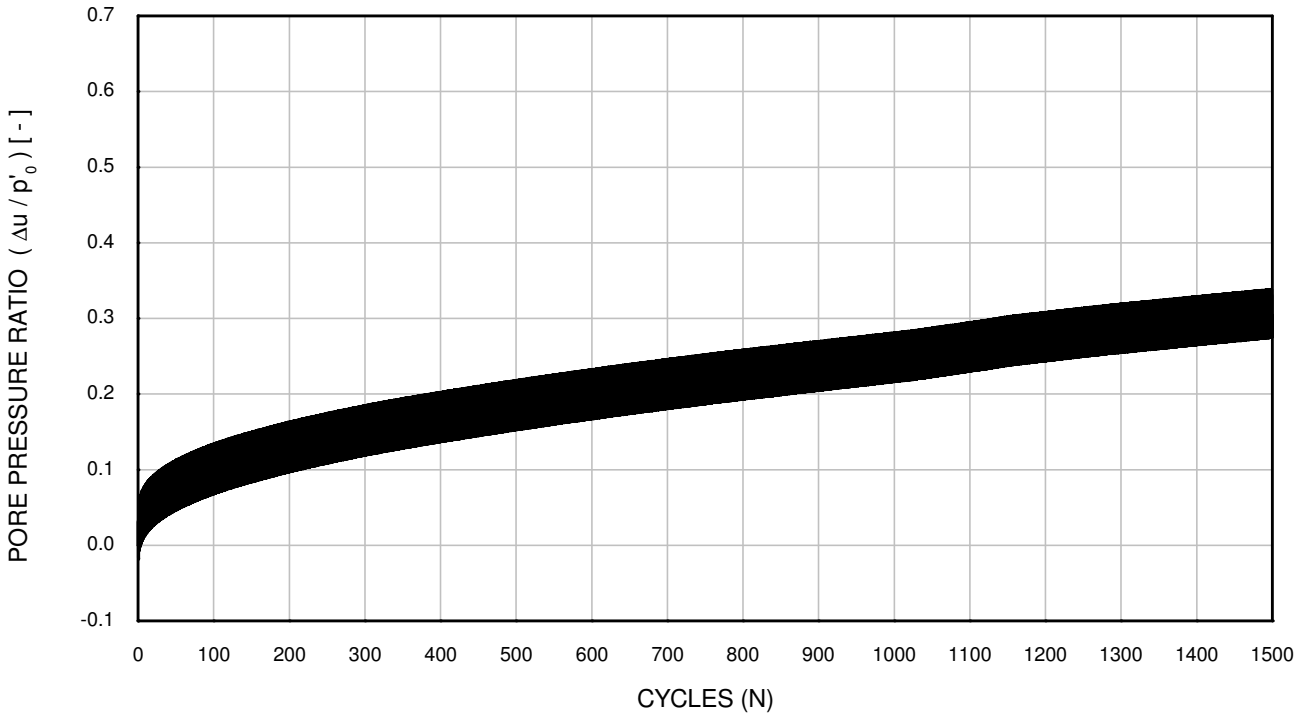




Initial σ'_r	:	261 kPa	Batch	:	BATCH06
Initial σ'_a	:	299 kPa	Sample	:	CTX_6-1
q_{av}	:	38 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

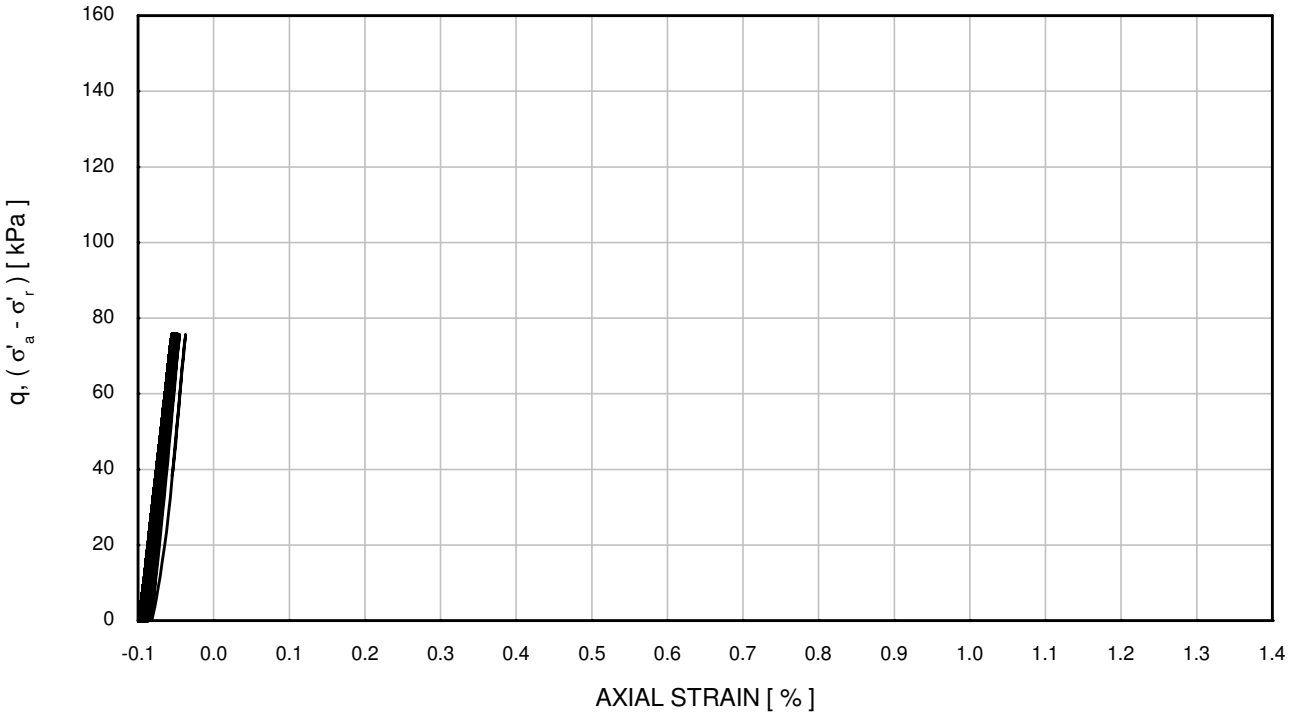
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

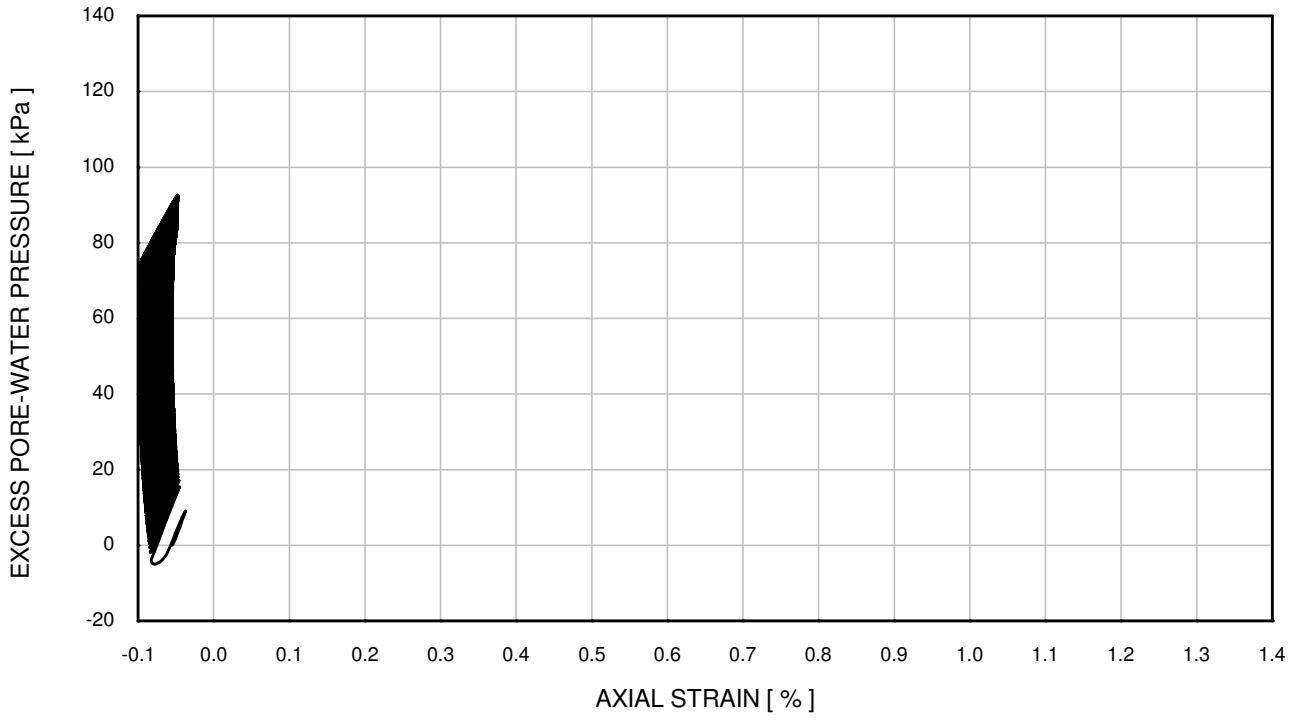




Initial σ'_r	:	261 kPa	Batch	:	BATCH06
Initial σ'_a	:	299 kPa	Sample	:	CTX_6-1
q_{av}	:	38 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

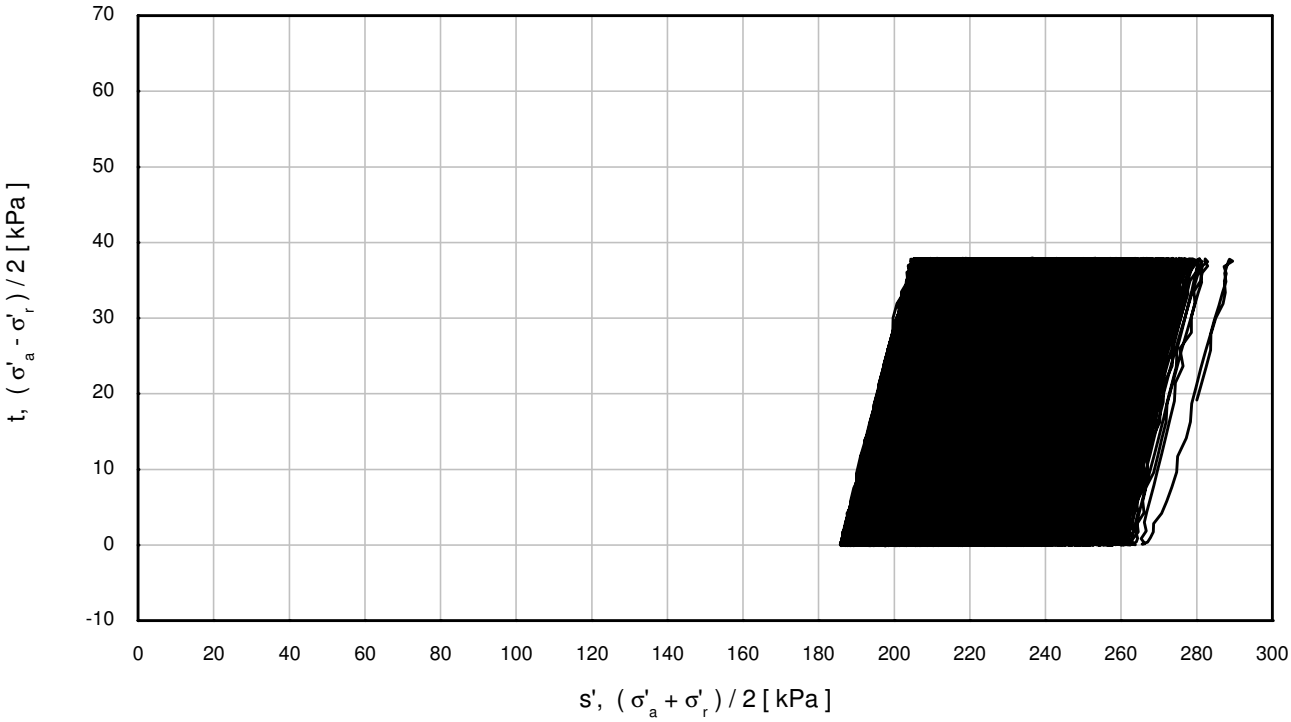
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

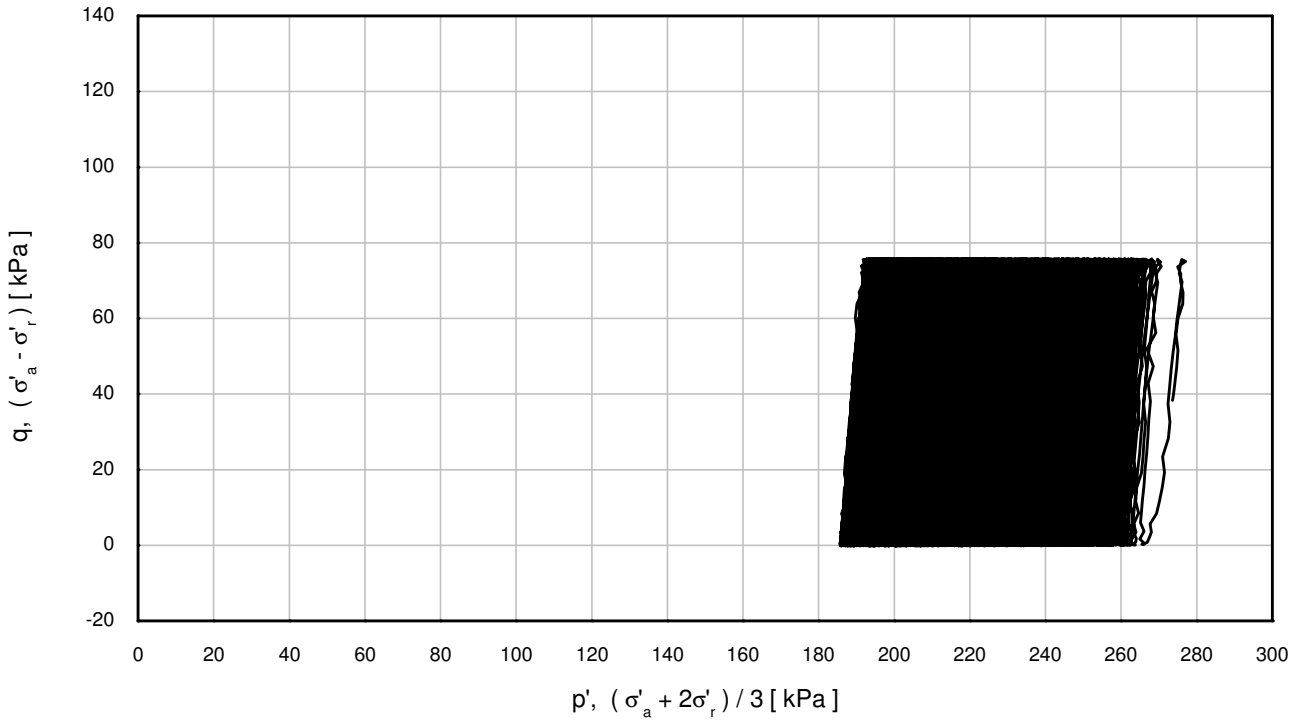




Initial σ'_r	:	261 kPa	Batch	: BATCH06
Initial σ'_a	:	299 kPa	Sample	: CTX_6-1
q_{av}	:	38 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	: CTX24
Frequency	:	0.10 Hz		

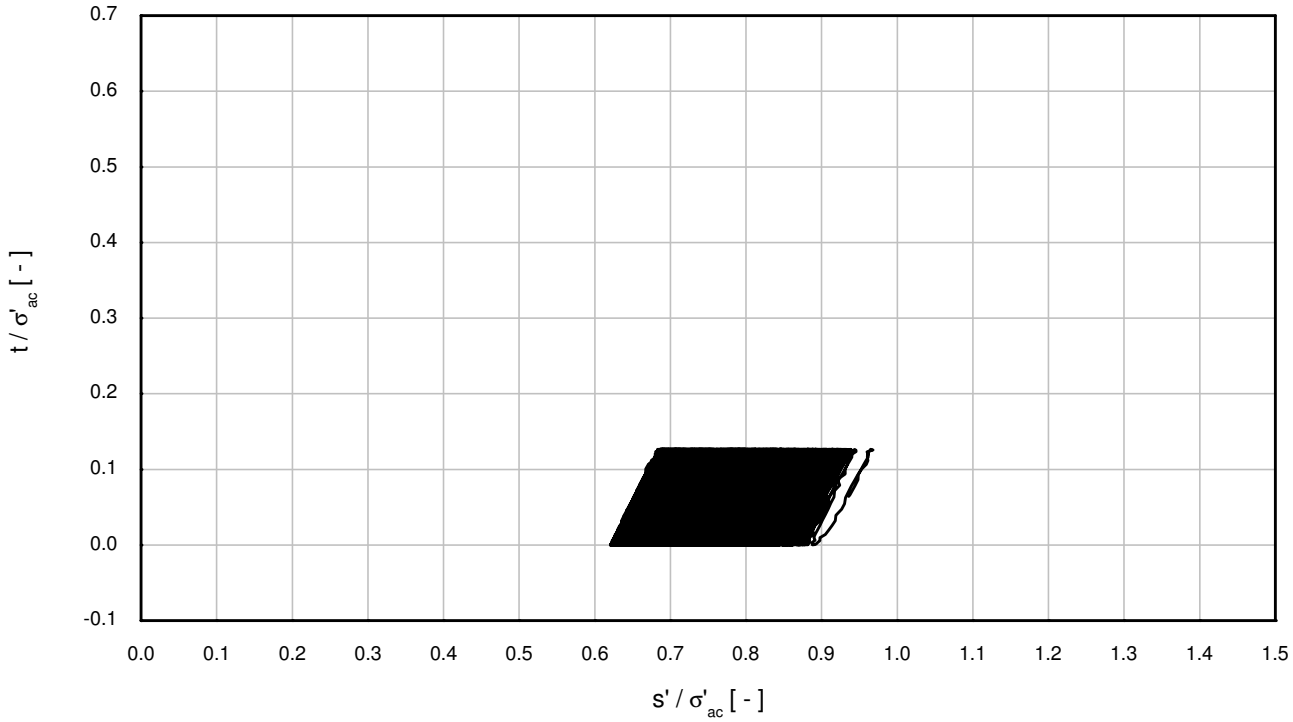
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

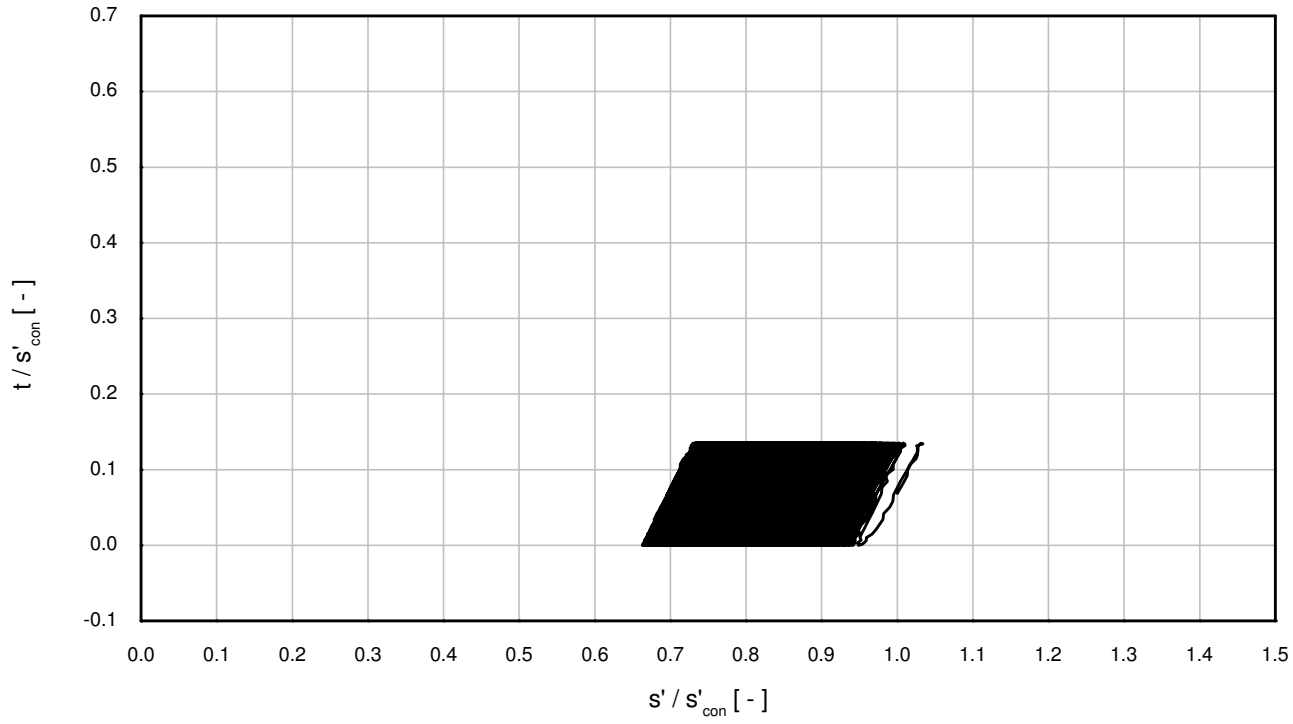




Initial σ'_r	:	261 kPa	Batch	:	BATCH06
Initial σ'_a	:	299 kPa	Sample	:	CTX_6-1
q_{av}	:	38 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

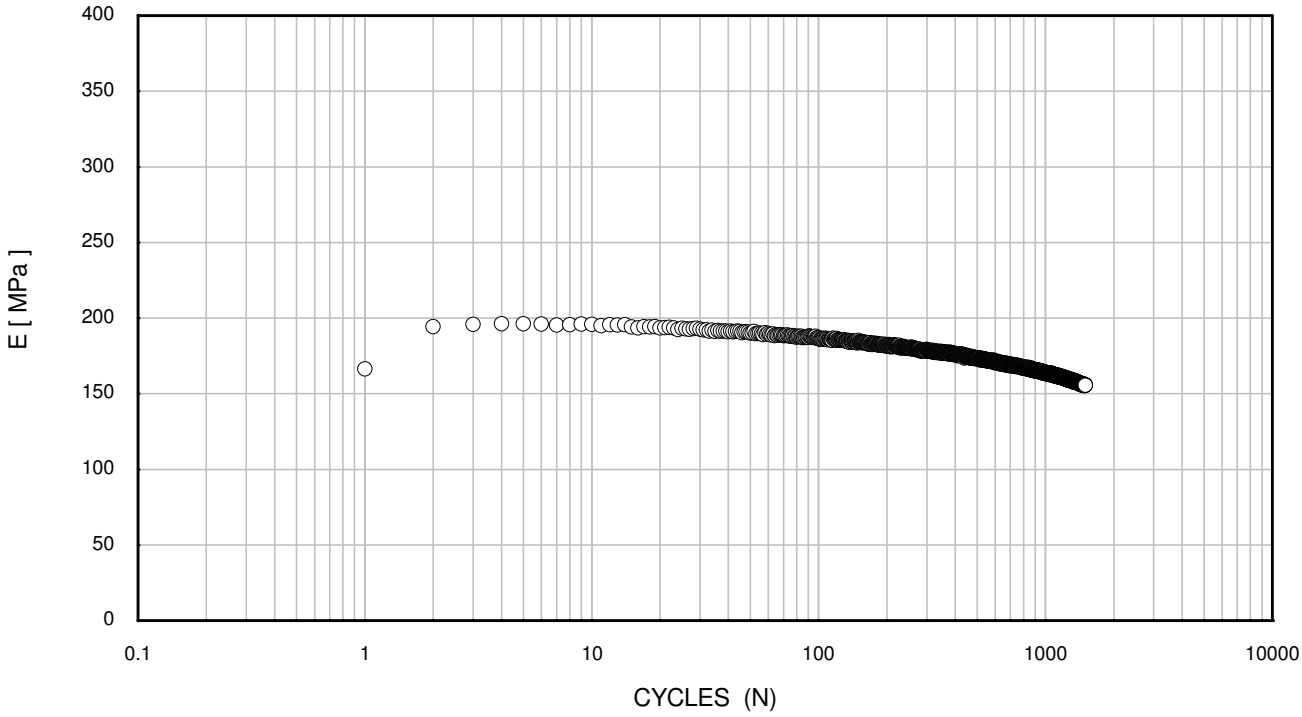
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

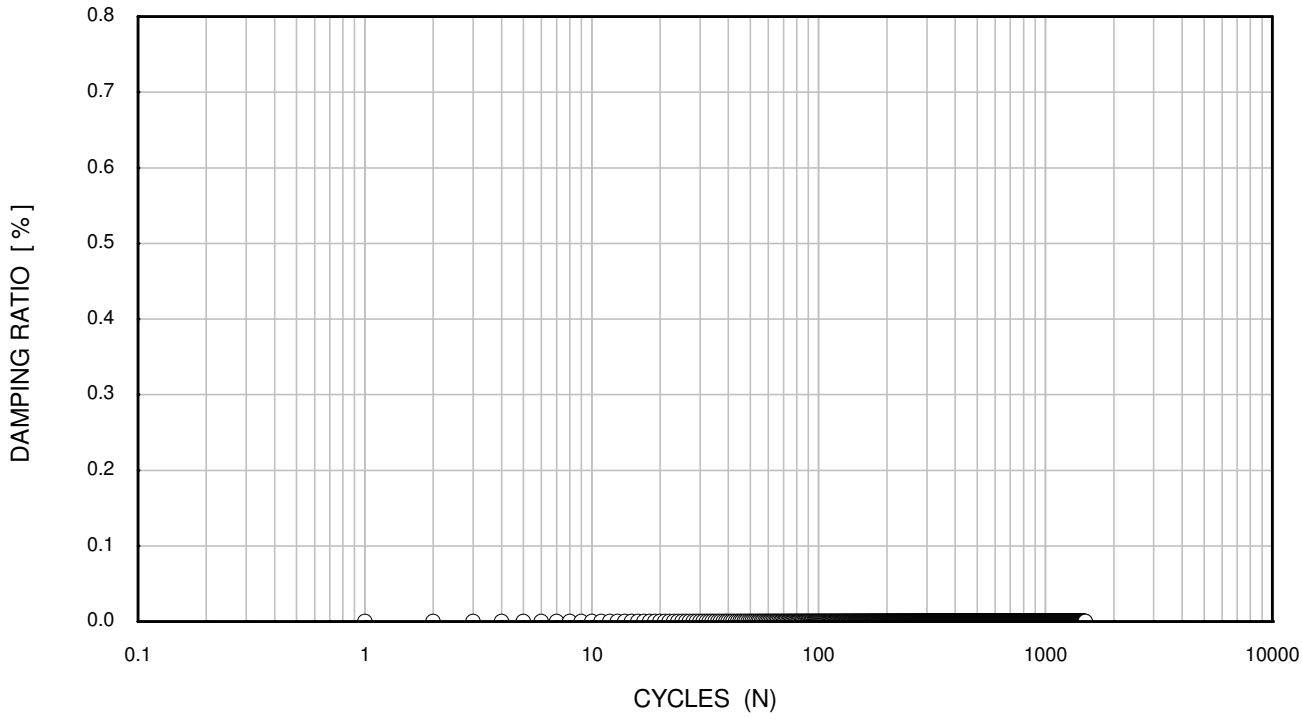




Initial σ'_r	:	261 kPa	Batch	: BATCH06
Initial σ'_a	:	299 kPa	Sample	: CTX_6-1
q_{av}	:	38 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	:	38 kPa	Test No.	: CTX24
Frequency	:	0.10 Hz		

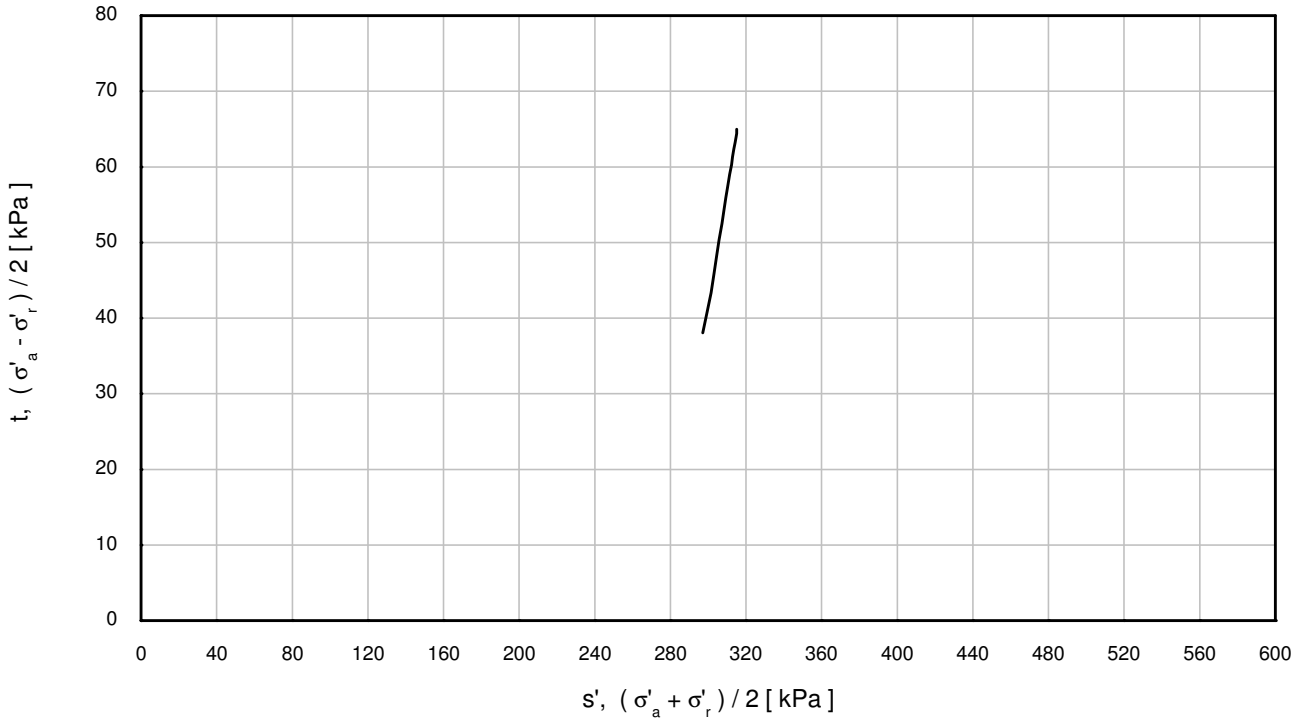
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

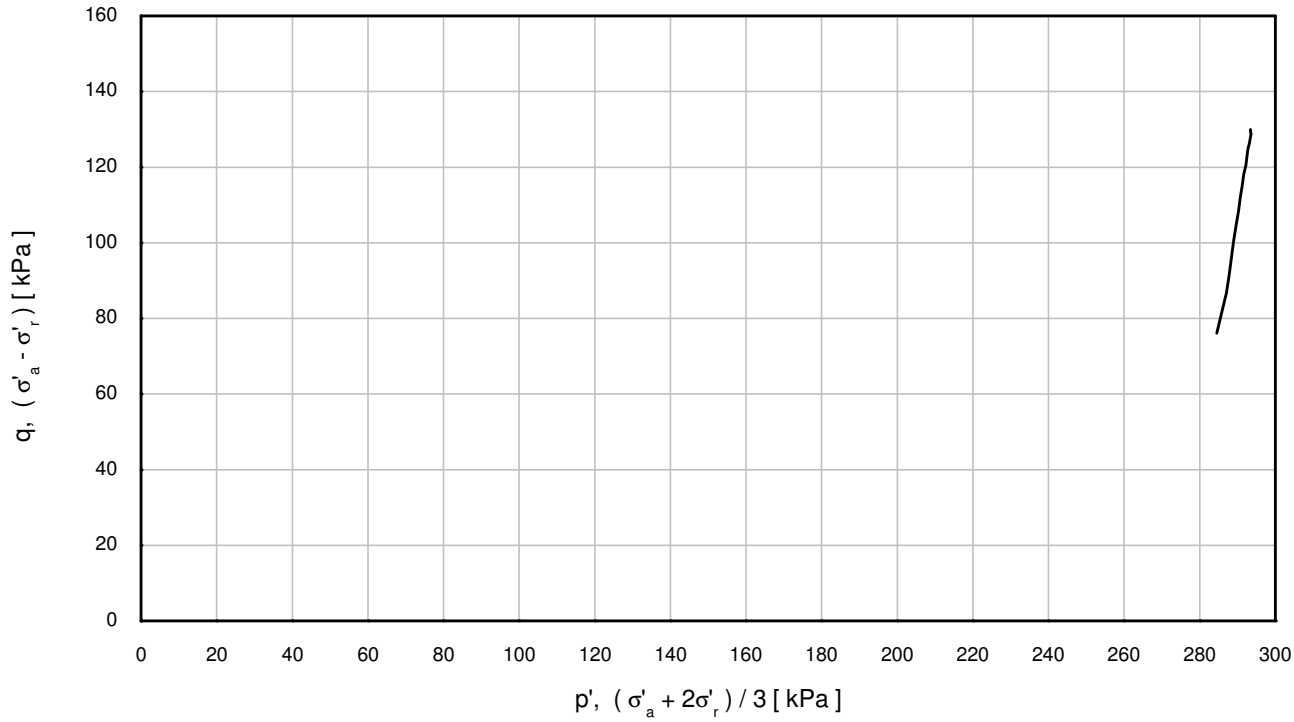




Initial σ'_r	: 261 kPa	Batch	: BATCH06
Initial σ'_a	: 299 kPa	Sample	: CTX_6-1
q_{av}	: 38 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 38 kPa	Test No.	: CTX24
Frequency	: 0.10 Hz		

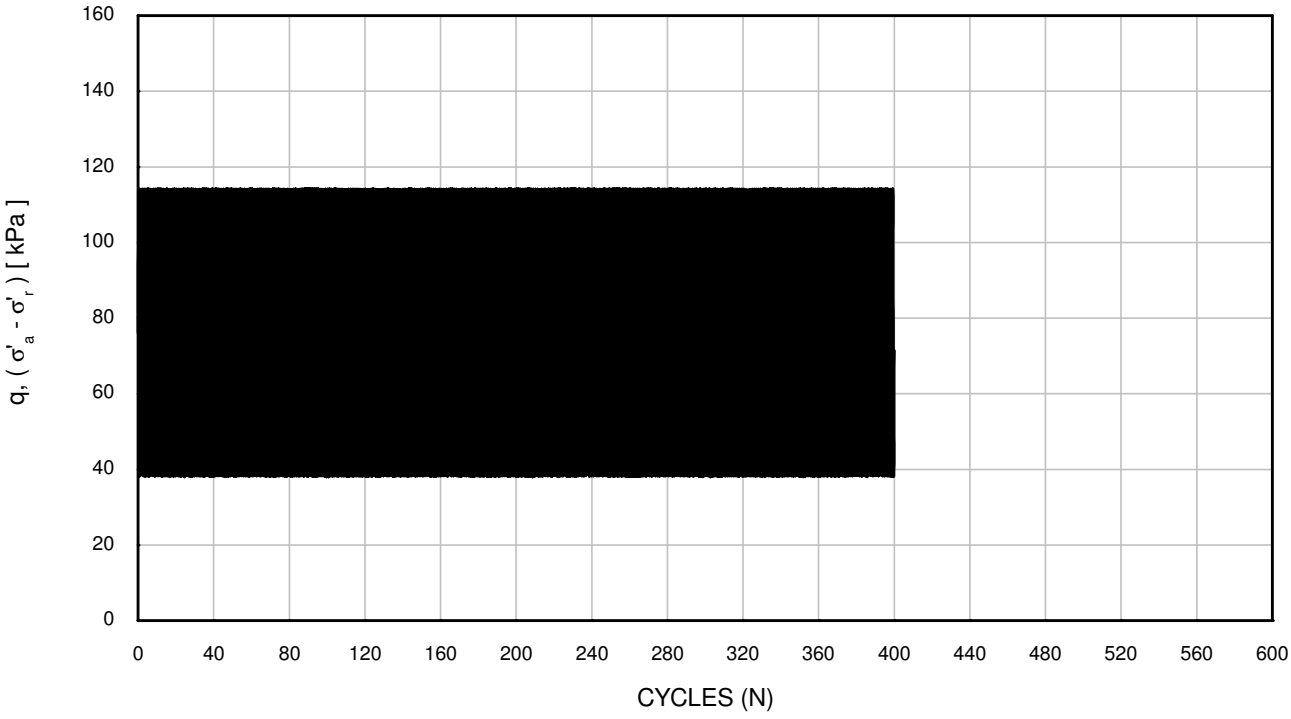
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - UNDRAINED

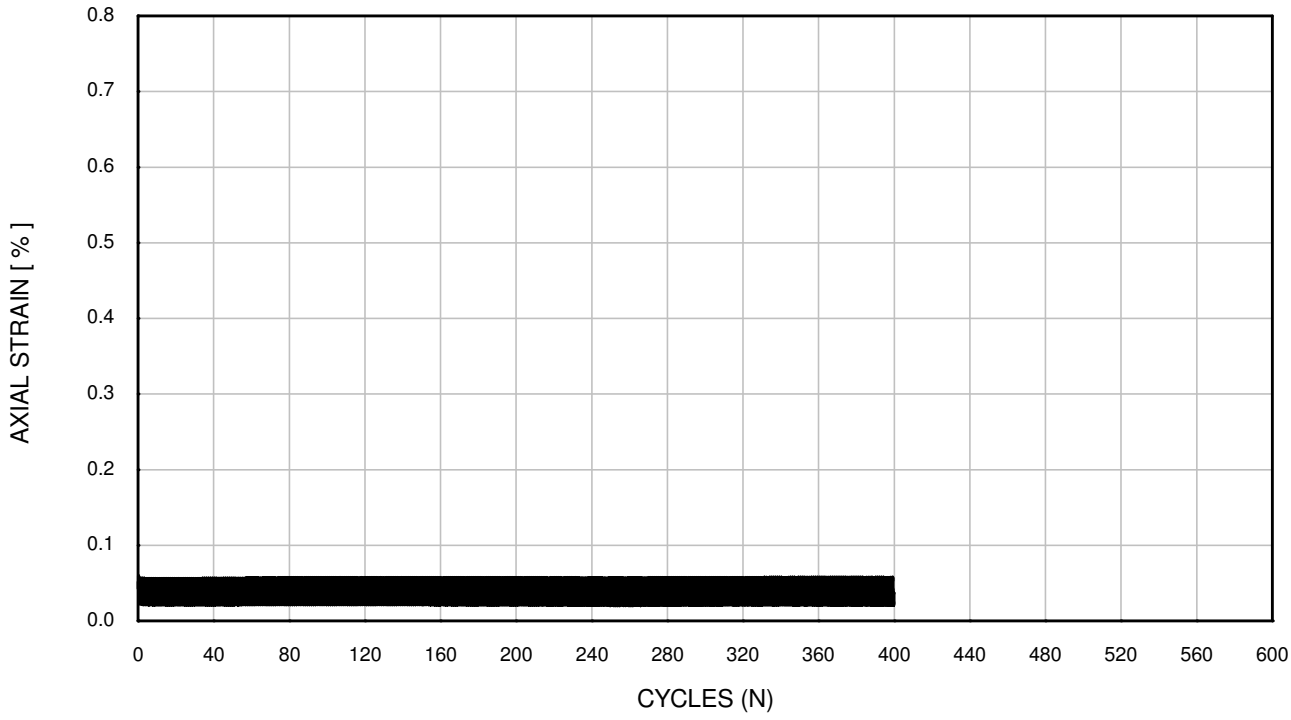




Stage 1 σ'_{rc}	: 259 kPa	Batch	: BATCH06
Stage 1 σ'_{ac}	: 335 kPa	Sample	: CTX_6-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX24

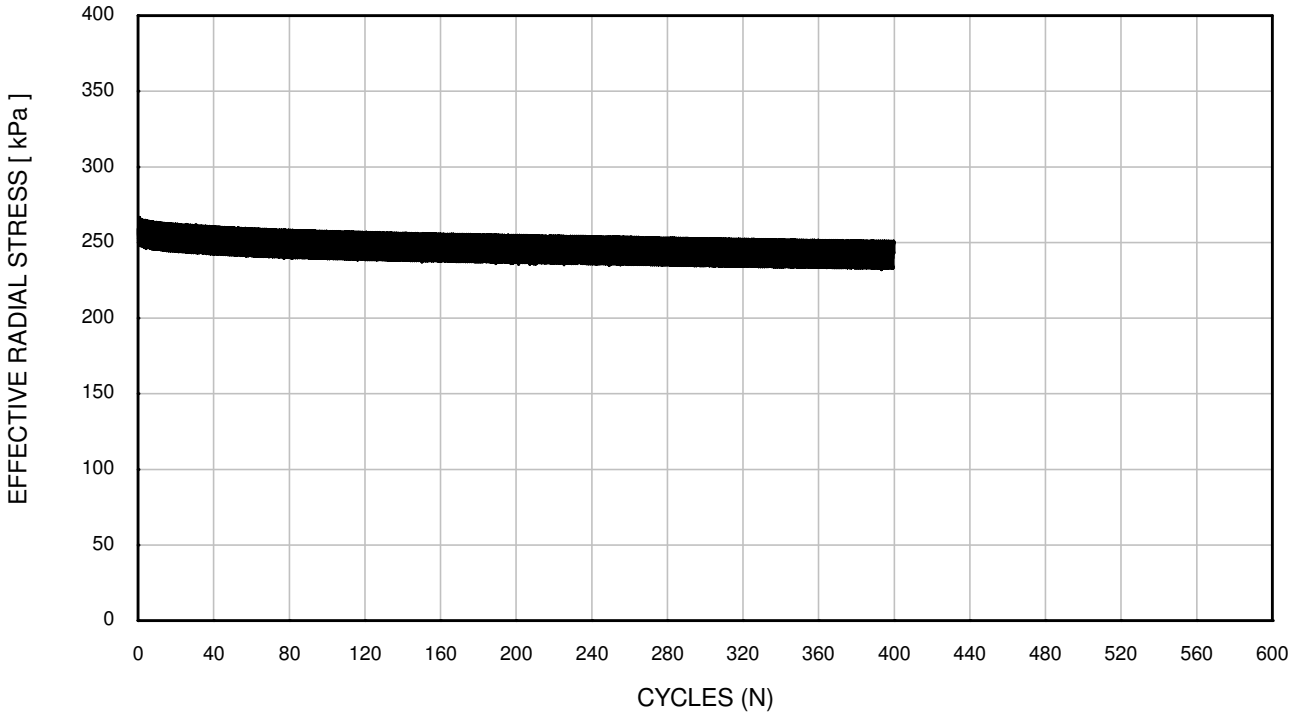
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

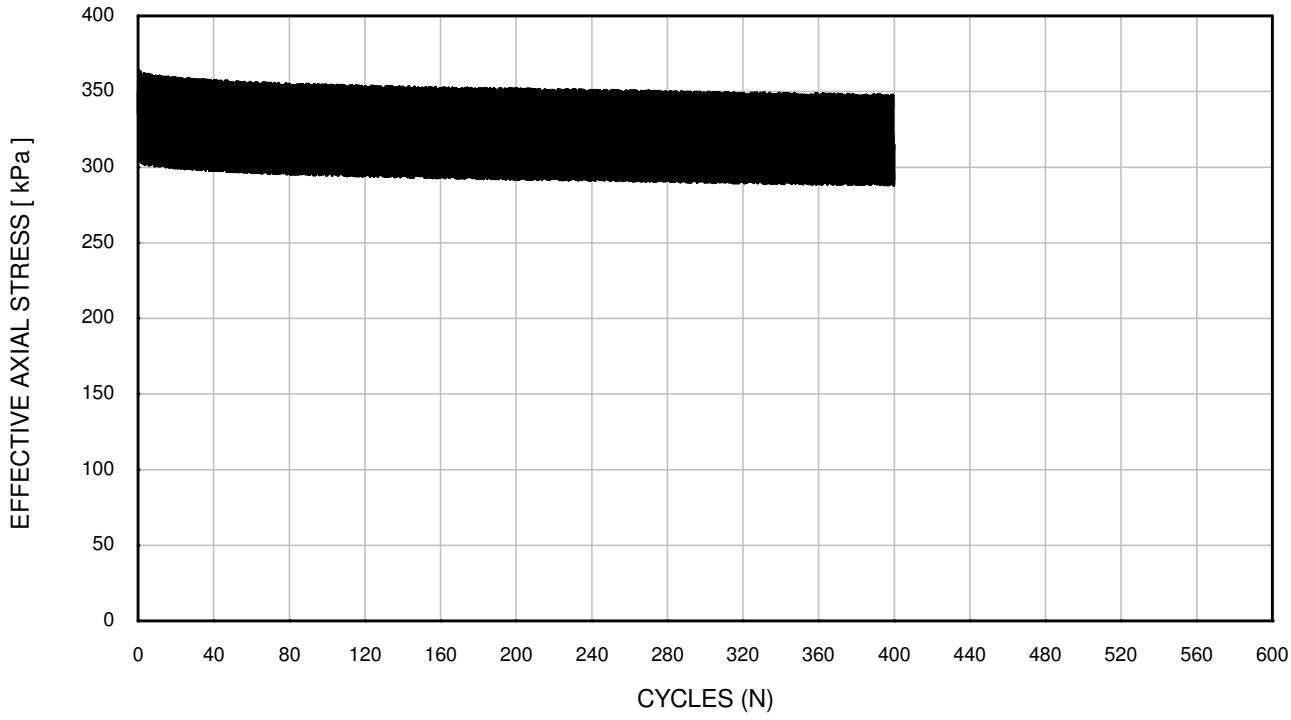




Initial σ'_r	:	259 kPa	Batch	:	BATCH06
Initial σ'_a	:	335 kPa	Sample	:	CTX_6-1
q_{av}	:	20 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	10 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

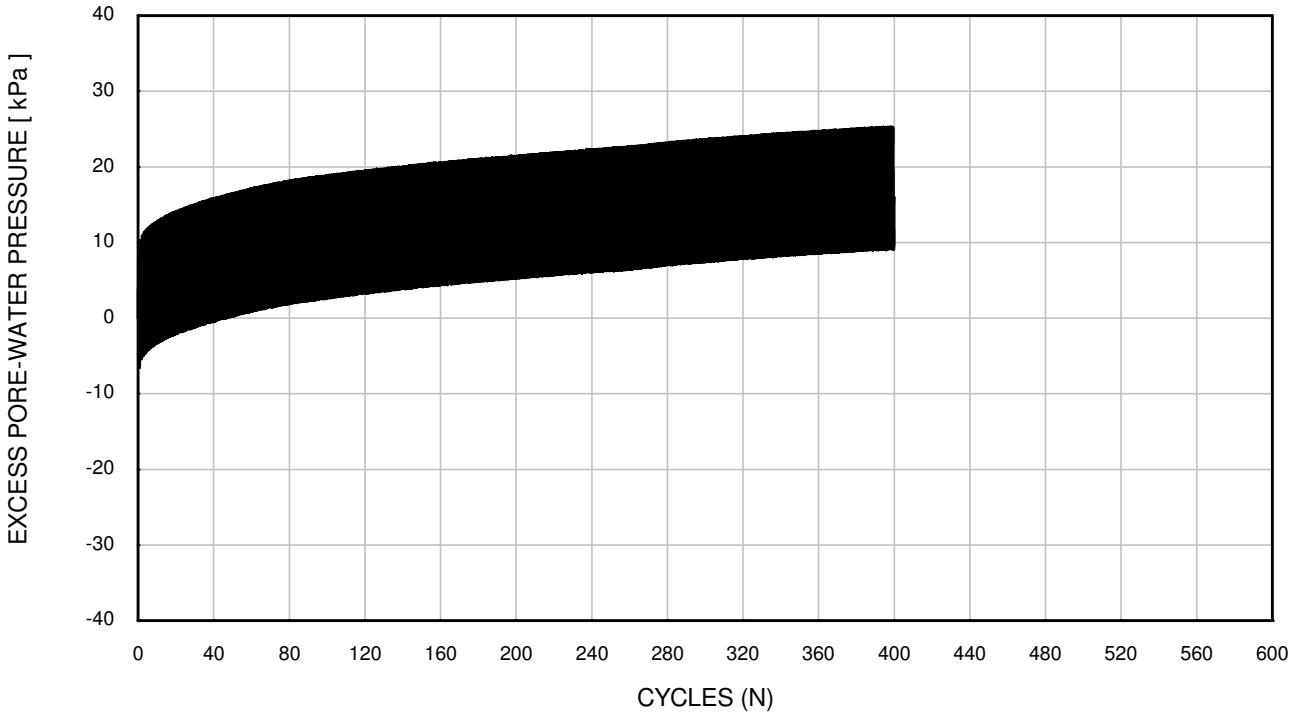
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

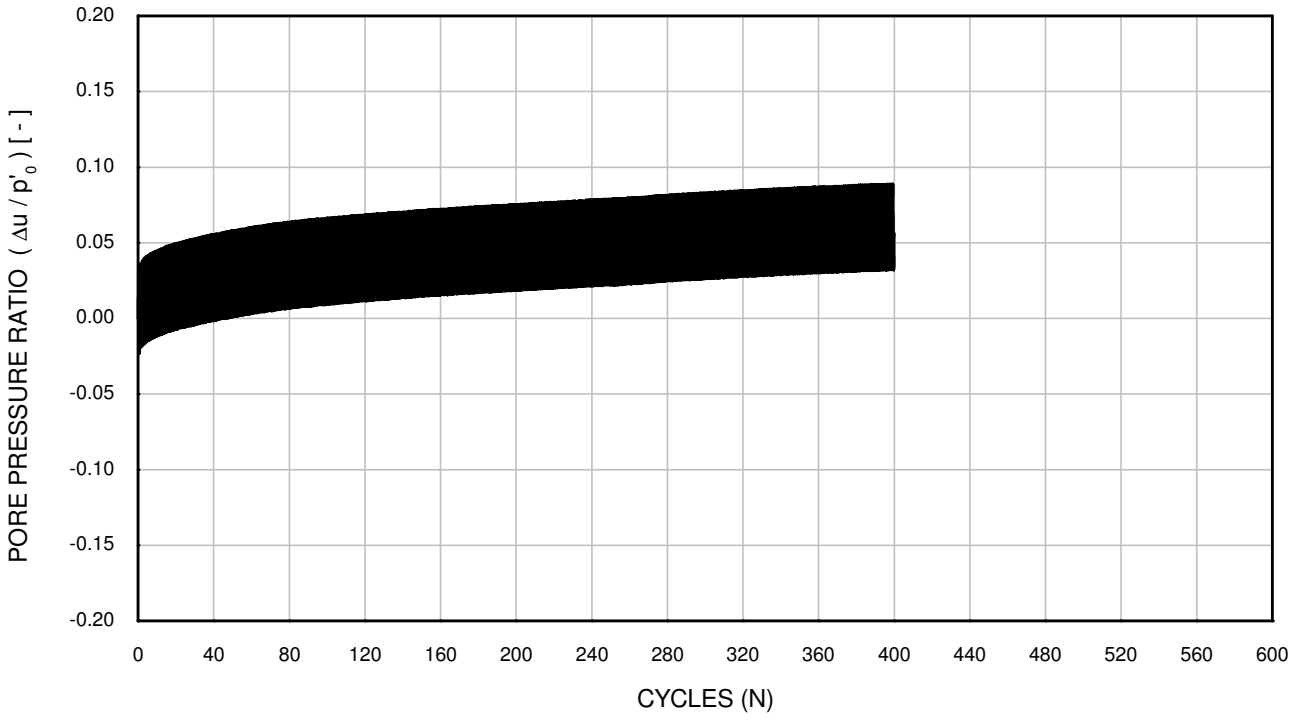




Initial σ'_r	:	259 kPa	Batch	:	BATCH06
Initial σ'_a	:	335 kPa	Sample	:	CTX_6-1
q_{av}	:	20 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	10 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

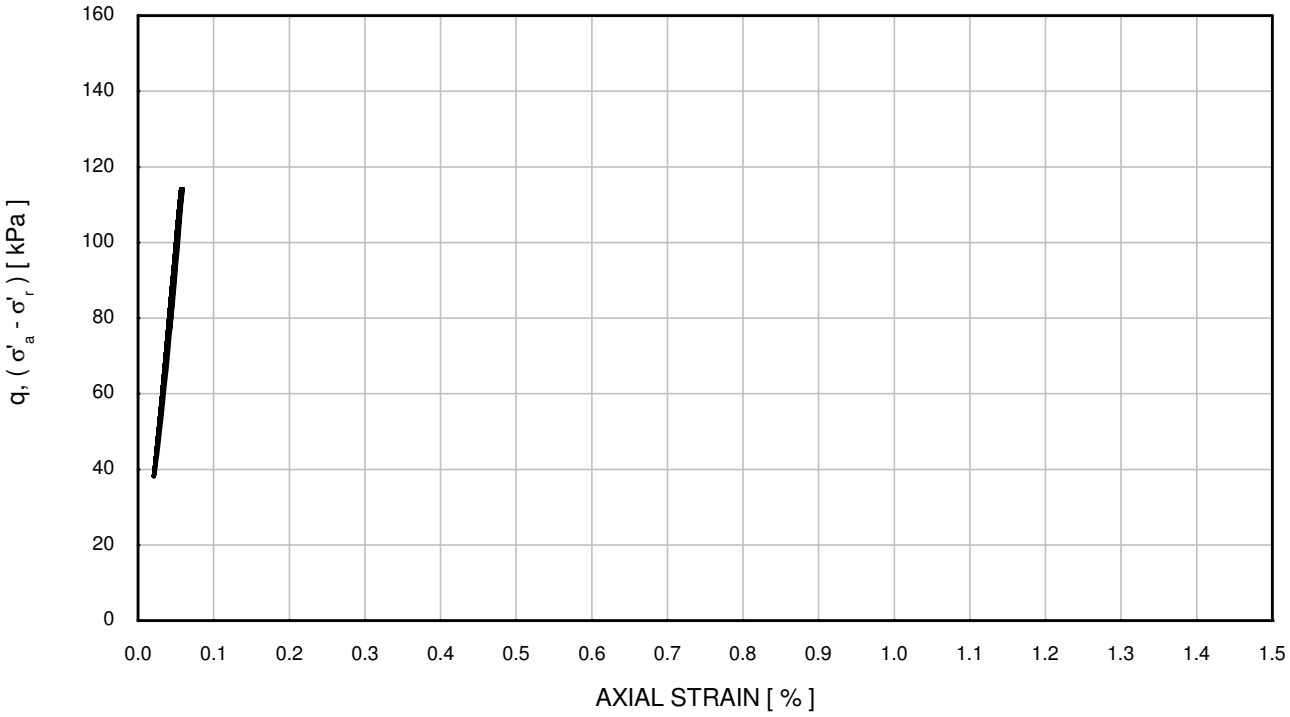
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

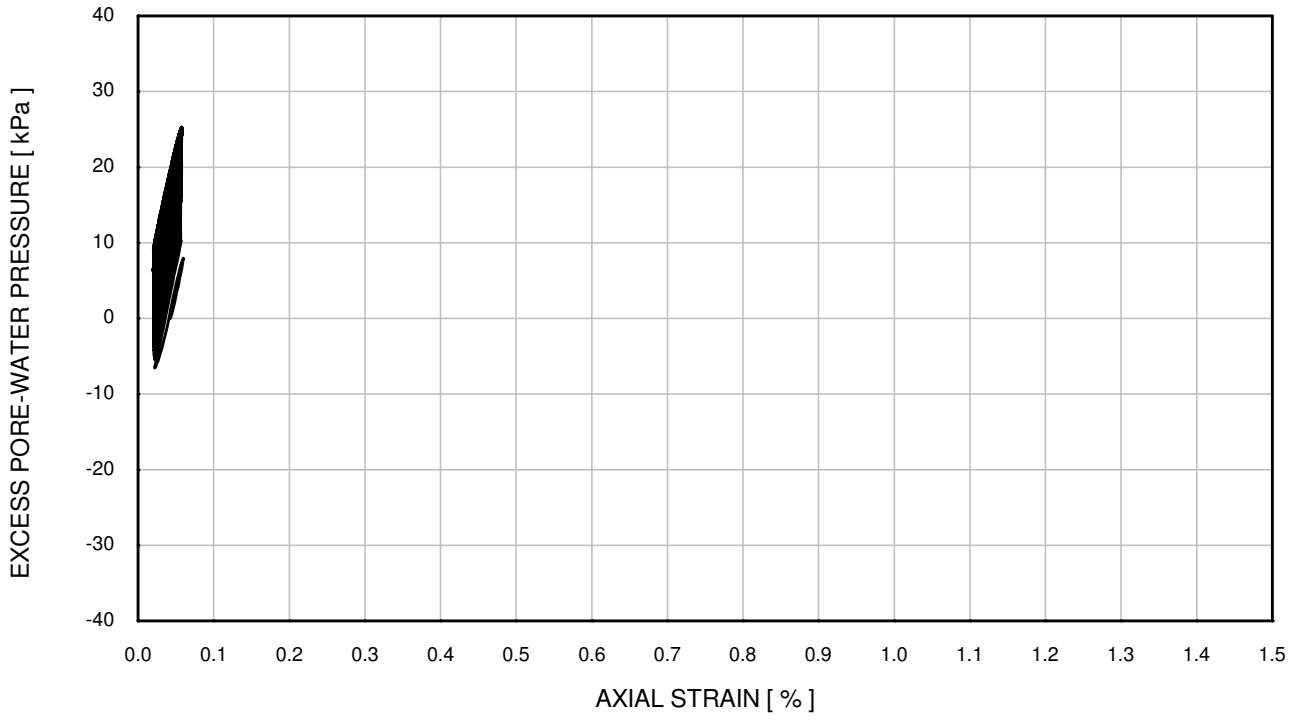




Initial σ'_r	:	259 kPa	Batch	:	BATCH06
Initial σ'_a	:	335 kPa	Sample	:	CTX_6-1
q_{av}	:	20 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	10 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

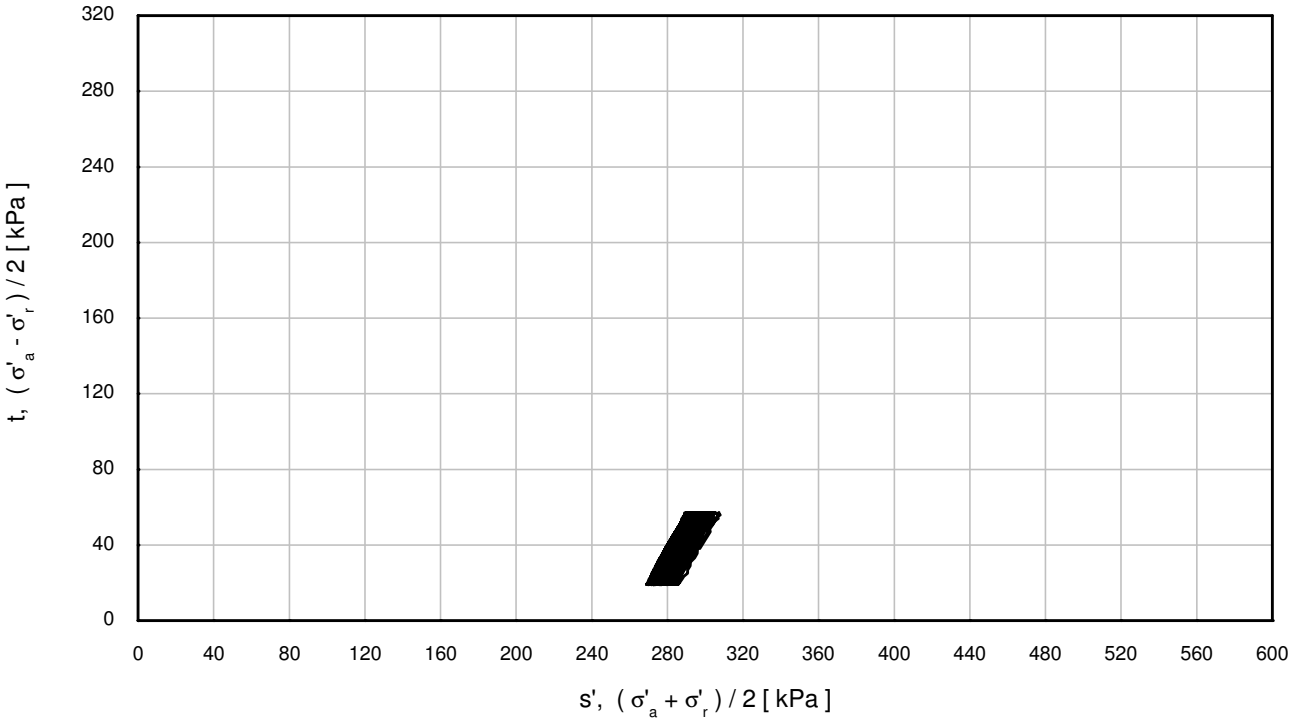
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

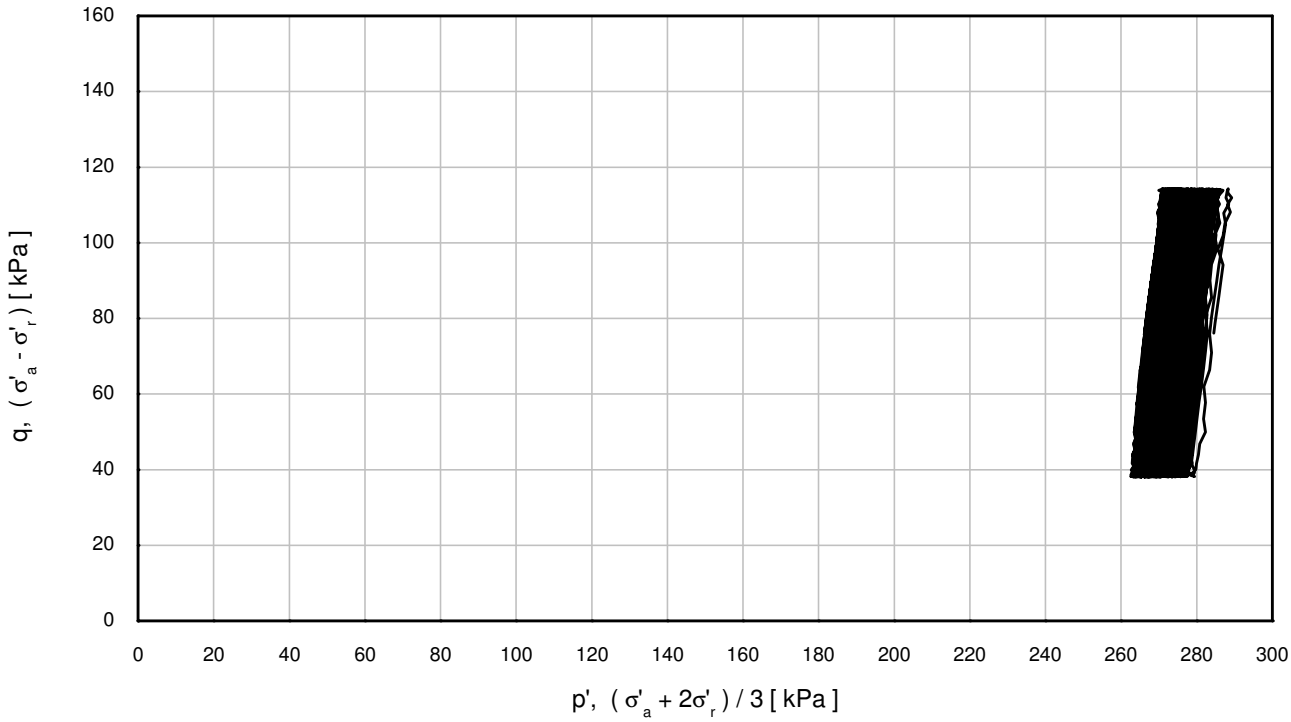




Initial σ'_r	: 259 kPa	Batch	: BATCH06
Initial σ'_a	: 335 kPa	Sample	: CTX_6-1
q_{av}	: 20 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 10 kPa	Test No.	: CTX24
Frequency	: 0.10 Hz		

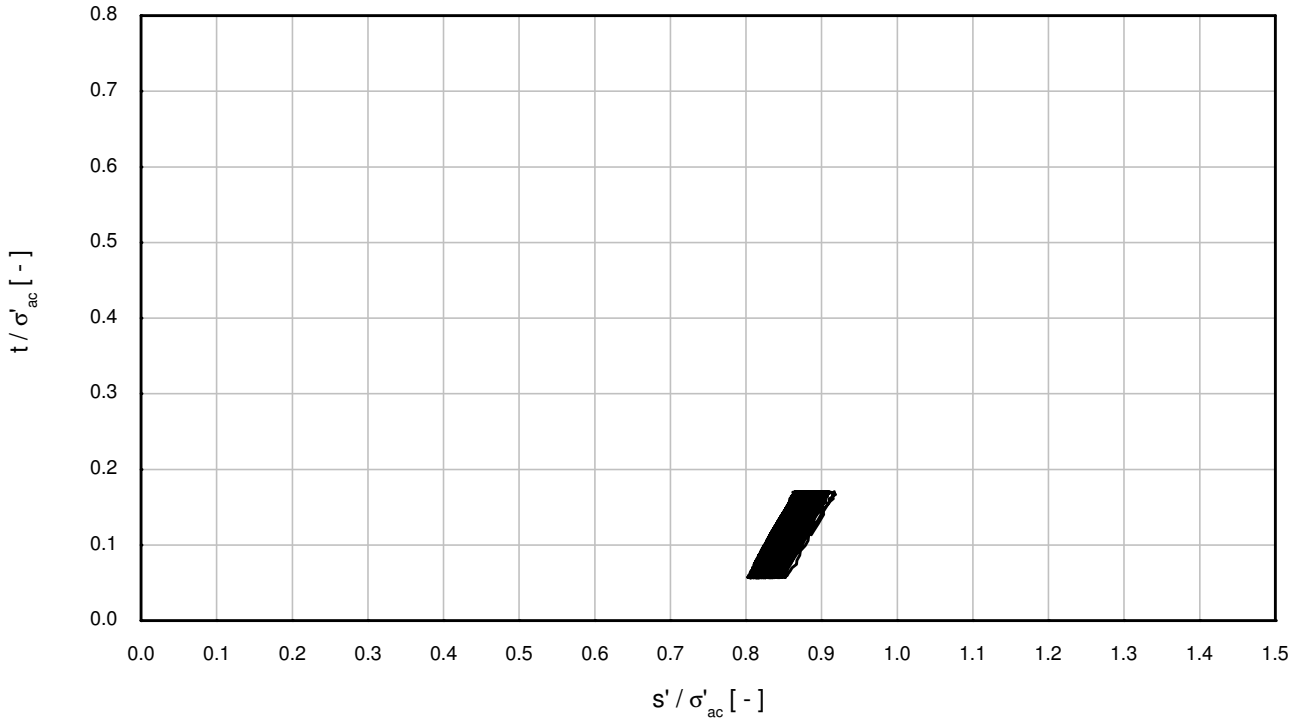
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

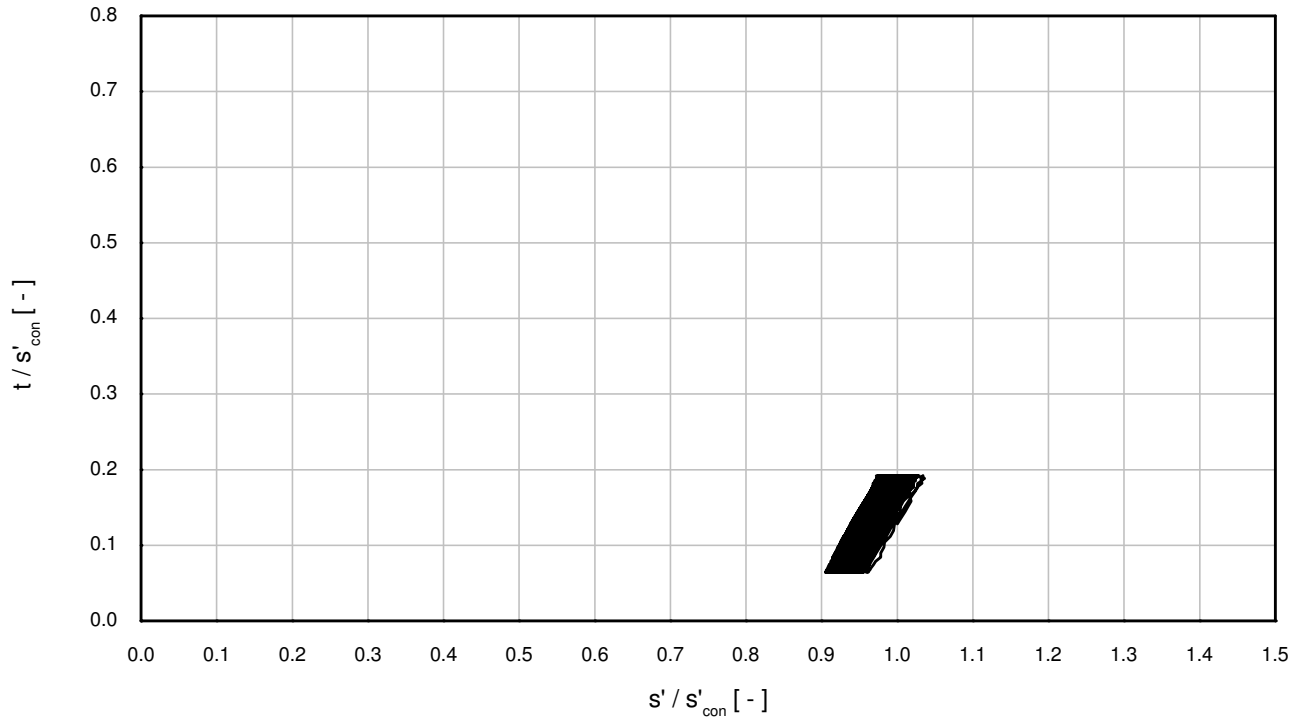




Initial σ'_r	:	259 kPa	Batch	:	BATCH06
Initial σ'_a	:	335 kPa	Sample	:	CTX_6-1
q_{av}	:	20 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	10 kPa	Test No.	:	CTX24
Frequency	:	0.10 Hz			

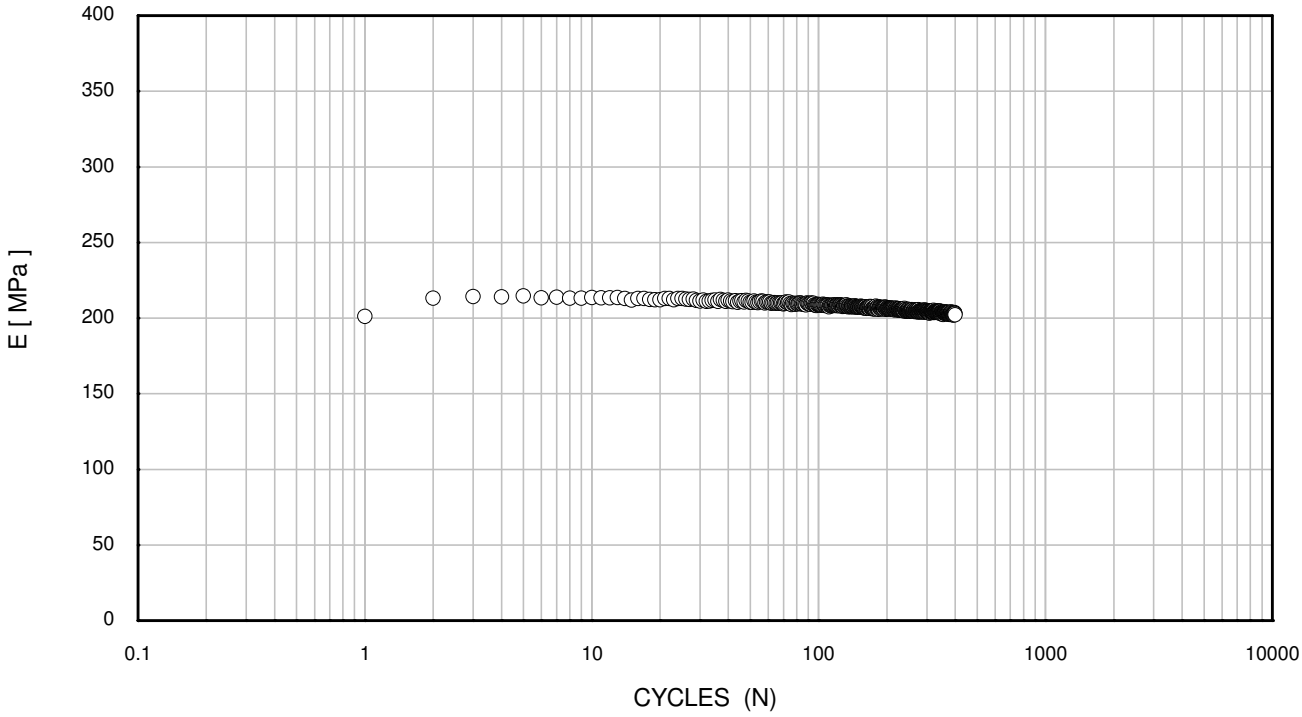
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

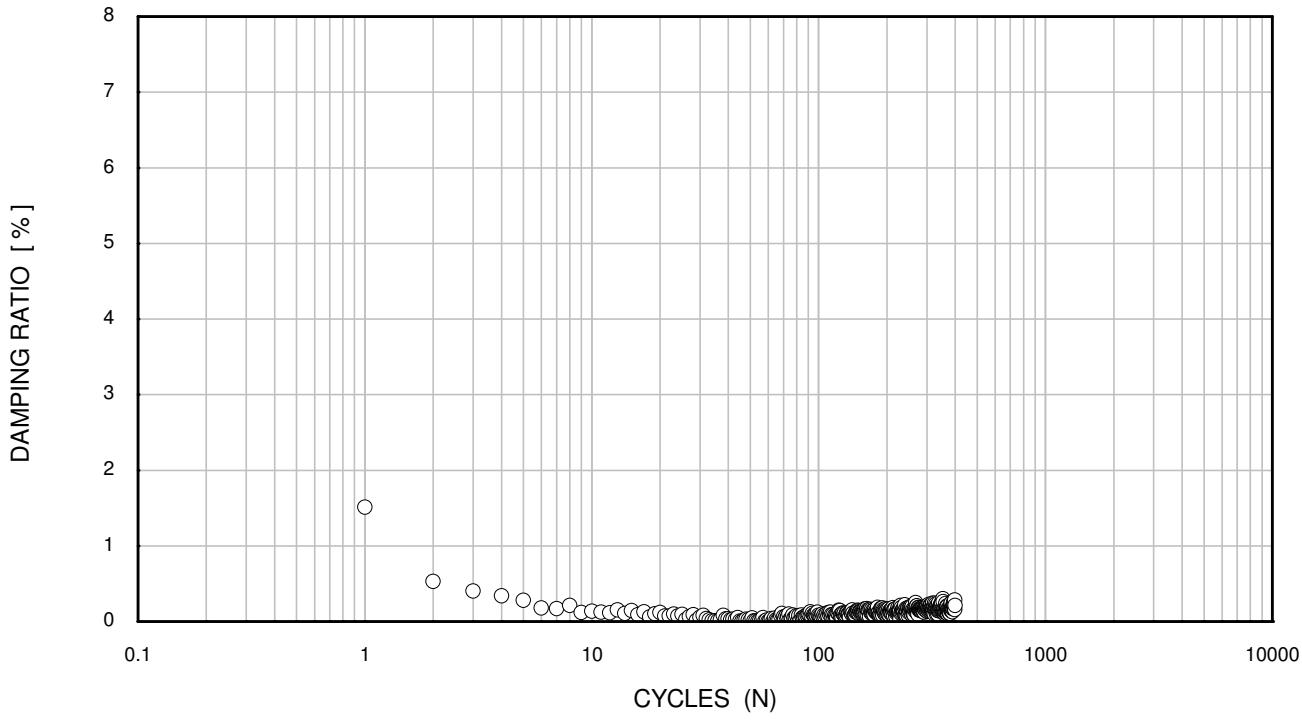




Initial σ'_r	: 259 kPa	Batch	: BATCH06
Initial σ'_a	: 335 kPa	Sample	: CTX_6-1
q_{av}	: 20 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 10 kPa	Test No.	: CTX24
Frequency	: 0.10 Hz		

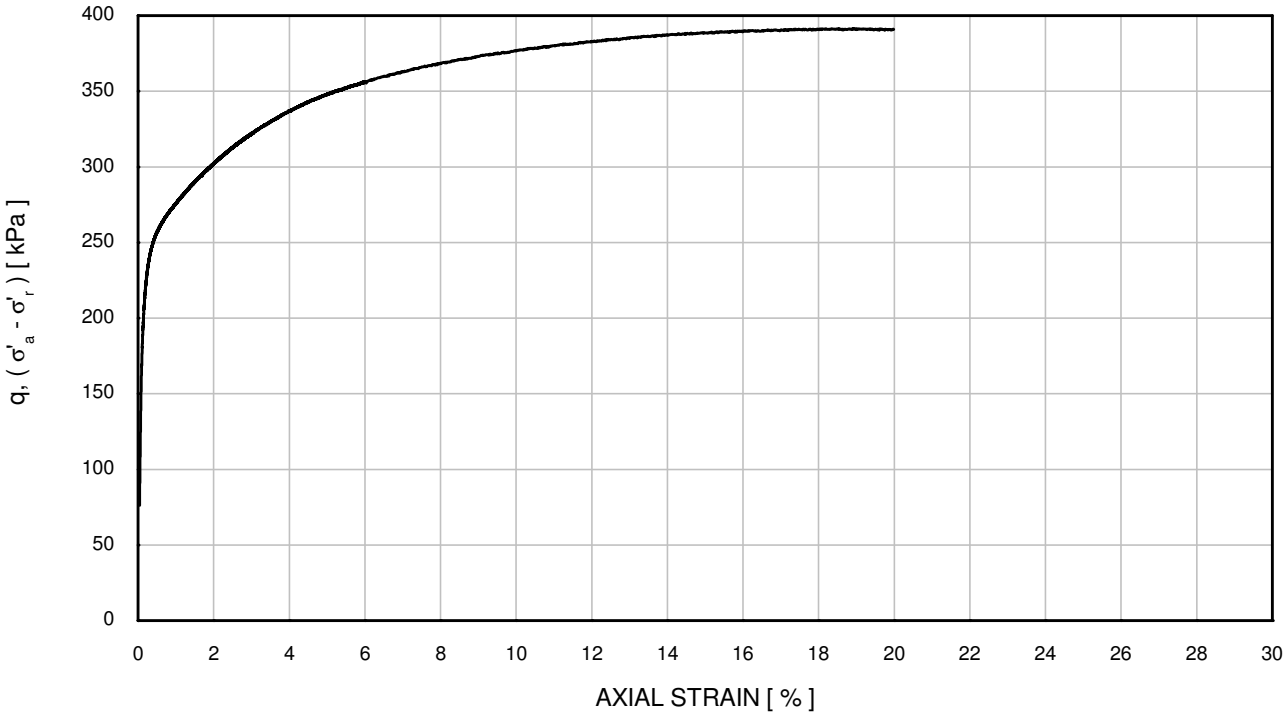
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

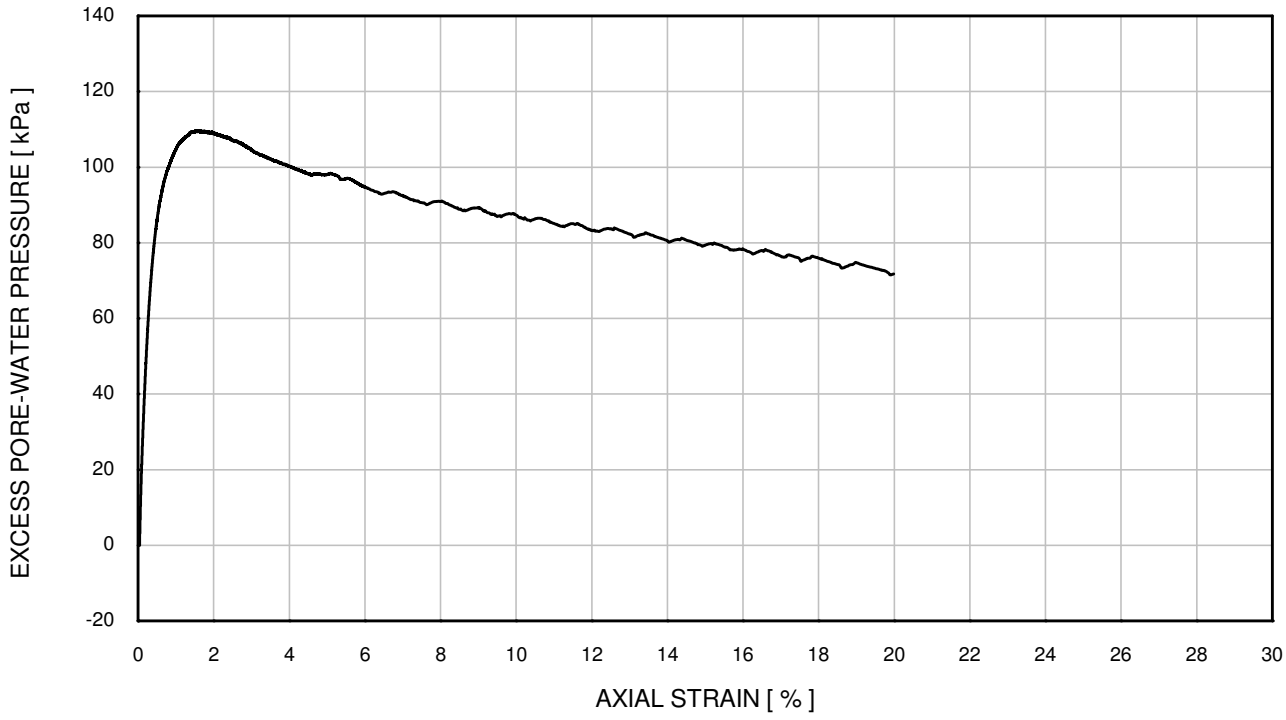




Initial σ'_r	: 259 kPa	Batch	: BATCH06
Initial σ'_a	: 335 kPa	Sample	: CTX_6-1
q_{av}	: 20 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 10 kPa	Test No.	: CTX24
Frequency	: 0.10 Hz		

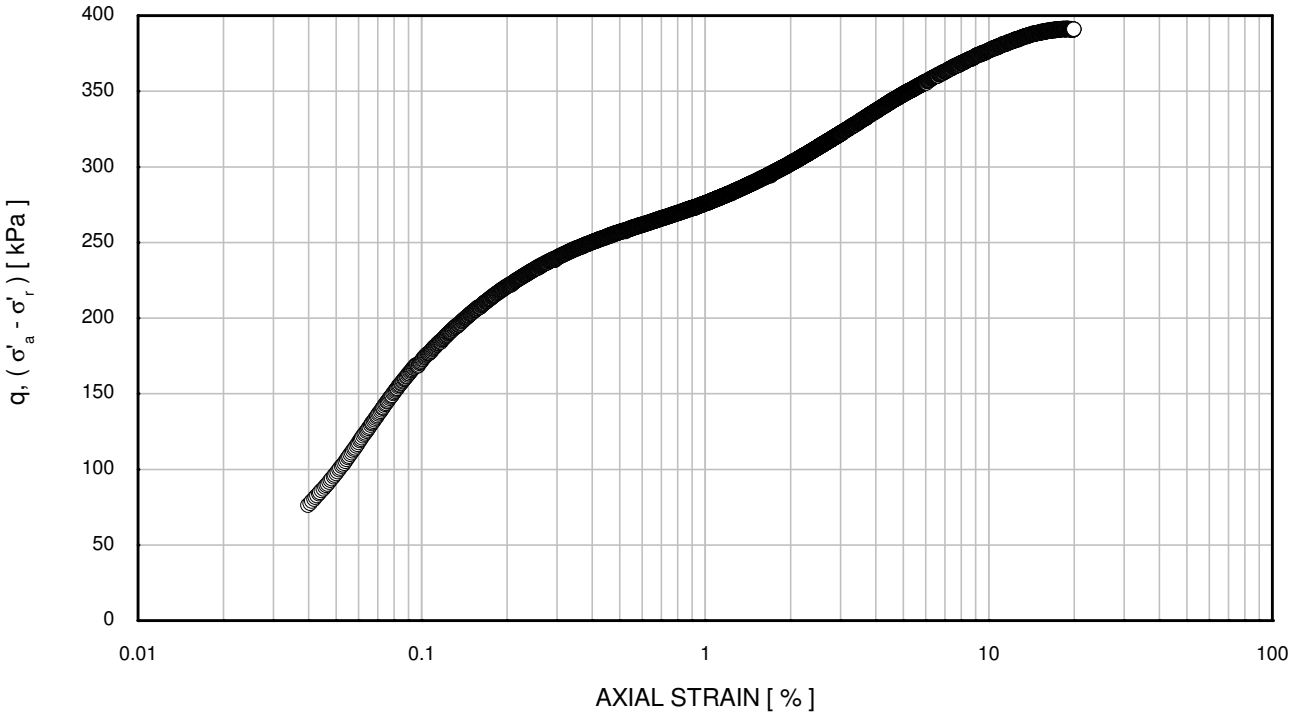
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - UNDRAINED

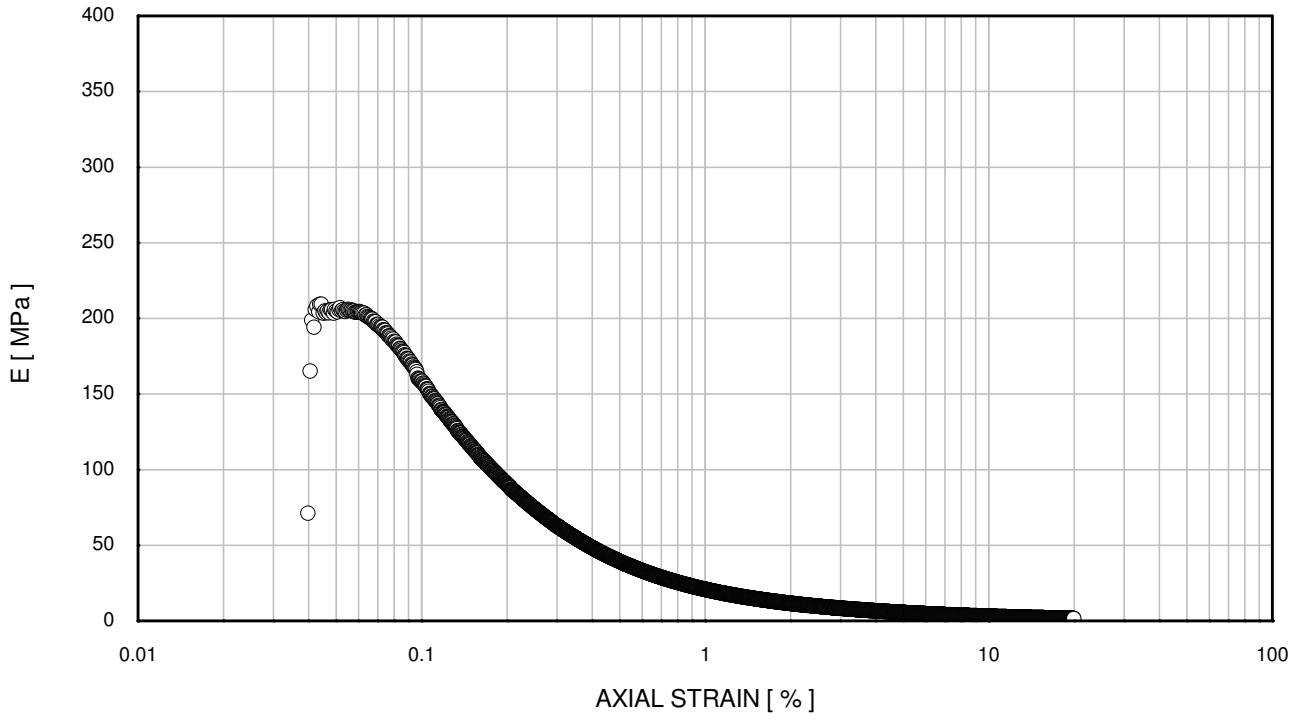




Initial σ'_r	:	242 kPa	Batch	:	BATCH06
Initial σ'_a	:	318 kPa	Sample	:	CTX_6-1
q_{peak}	:	392 kPa	Unit	:	Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	:	18.54 %	Test No.	:	CTX24
Rate of strain	:	1.00 %/hour			

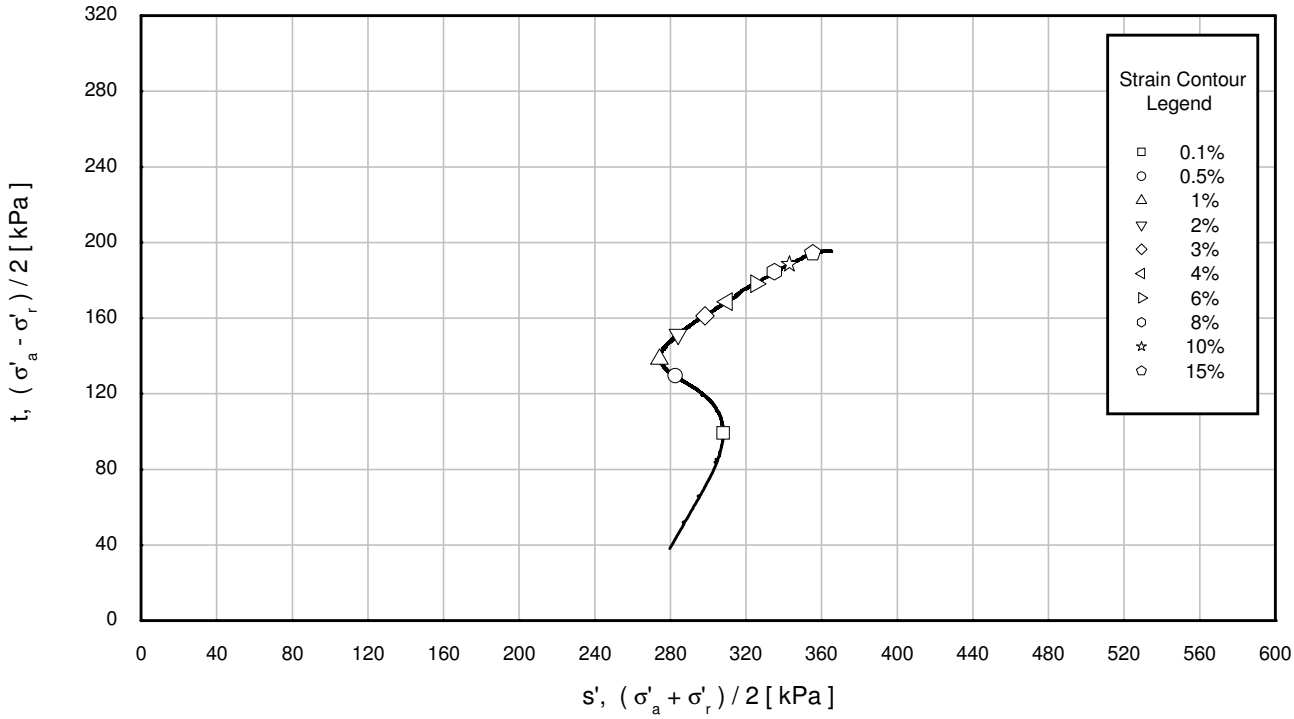
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

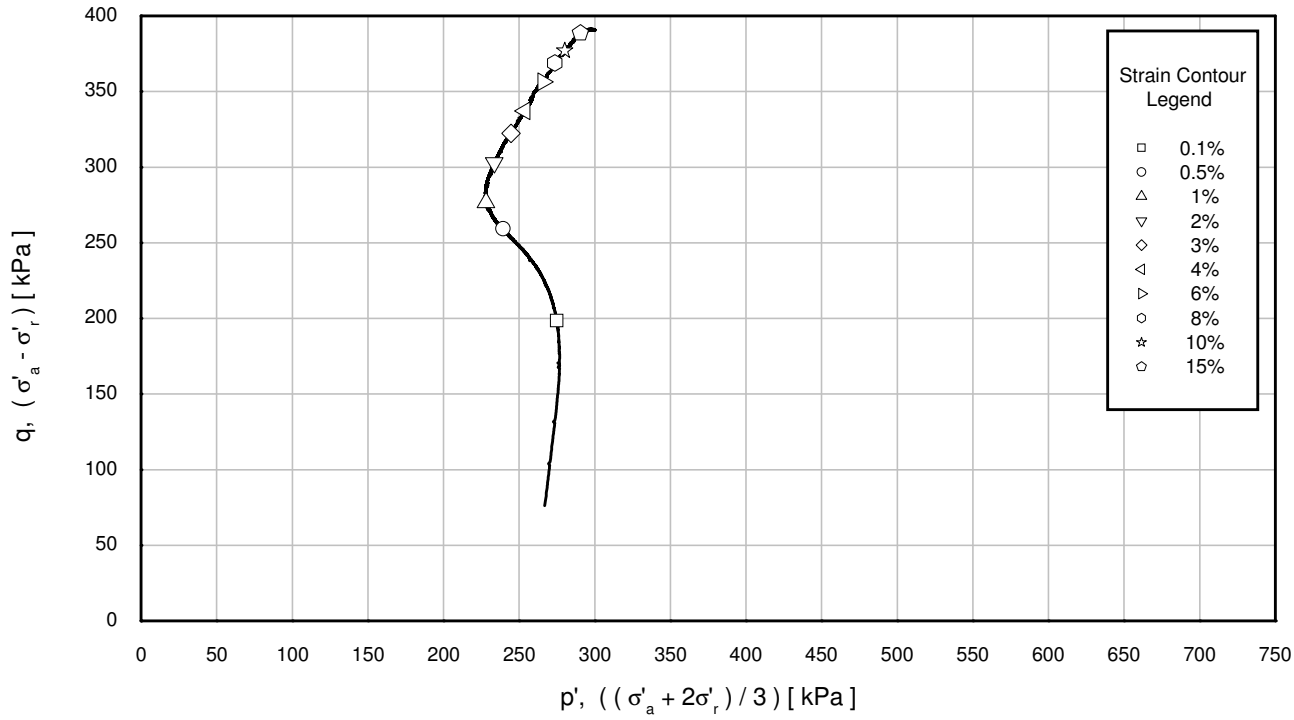




Initial σ'_r	: 242 kPa	Batch	: BATCH06
Initial σ'_a	: 318 kPa	Sample	: CTX_6-1
q_{peak}	: 392 kPa	Unit	: Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	: 18.54 %	Test No.	: CTX24
Rate of strain	: 1.00 %/hour		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED





Initial σ'_r	:	242 kPa	Batch	:	BATCH06
Initial σ'_a	:	318 kPa	Sample	:	CTX_6-1
q_{peak}	:	392 kPa	Unit	:	Unit D (Yarmouth Roads)
Ext. ε at q_{peak}	:	18.54 %	Test No.	:	CTX24
Rate of strain	:	1.00 %/hour			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - UNDRAINED

VISUAL DESCRIPTION
Light yellowish brown fine to medium SAND

GENERAL	
Date test started	02/01/2017
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	72.0
Length	[mm]	144.0
Water content	[%]	9.5
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.669
Degree of saturation	[%]	38
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH06_CTX25
Processed by Date	MSR 09/01/2017
Checked by Date	JLS 11/01/2017
Approved by Date	AR 12/01/2017

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX25

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
B value achieved	[-]	0.98

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1137
Back pressure	[kPa]	887
Base PWP	[kPa]	887
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	250
Effective axial pressure	[kPa]	380
Deviator stress	[kPa]	130
Volumetric strain	[%]	0.95
External axial strain	[%]	0.62
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.653
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX25

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

UNDRAINED SHEAR PRIOR TO CYCLIC LOADING		
Cell pressure	[kPa]	1137
Back pressure	[kPa]	887
Base PWP	[kPa]	879
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	258
Effective axial pressure	[kPa]	334
Deviator stress	[kPa]	77
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.653
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX25

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	760
Mean q_{av}	[kPa]	76
Mean q_{cy}	[kPa]	114
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	54
External ε_{av} at N_f	[%]	18.05
External ε_{cy} at N_f	[%]	12.89
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	232
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.653
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.02	0.07	168	-	12.33	-
2	-0.02	0.06	175	-	8.61	-
5	-0.01	0.07	168	-	7.56	-
10	0.02	0.07	156	-	8.55	-
20	0.07	0.08	134	-	8.84	-
30	0.14	0.10	109	-	11.62	-
40	0.35	0.18	62	-	18.02	-
50	2.57	10.67	1	-	4.72	-
54	18.05	12.89	1	-	6.34	-

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX25

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





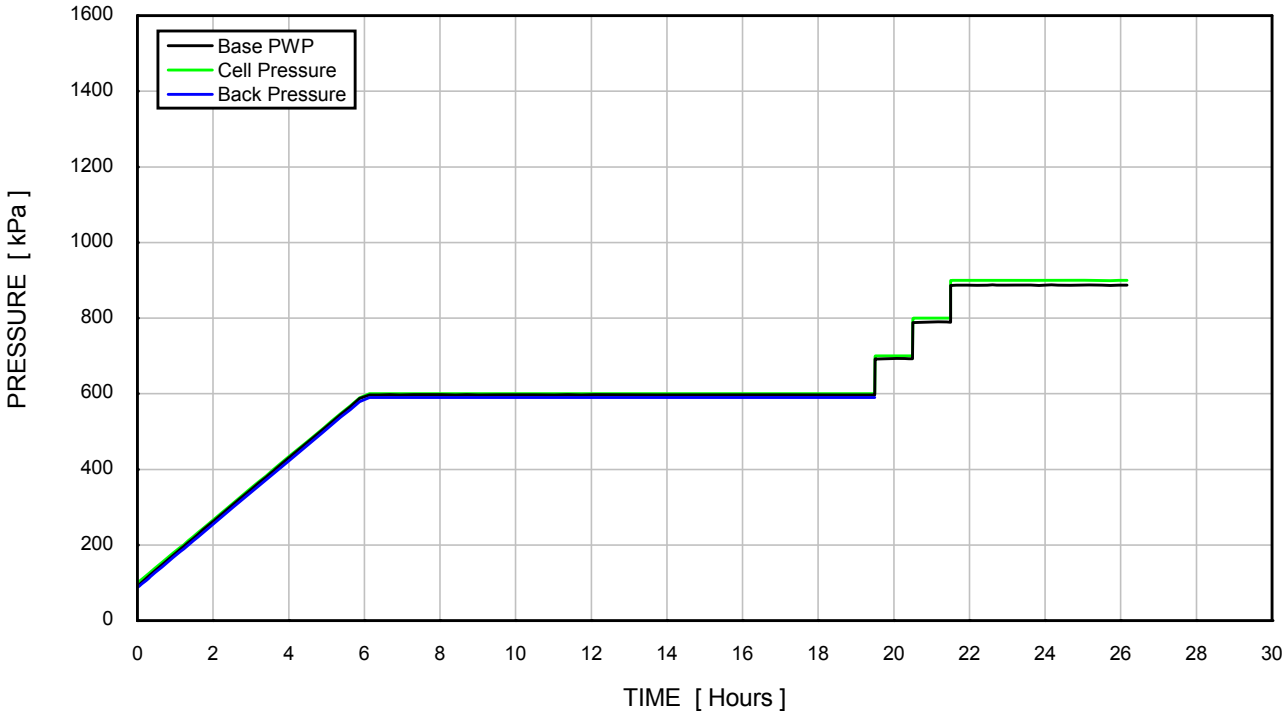
FINAL CONDITIONS

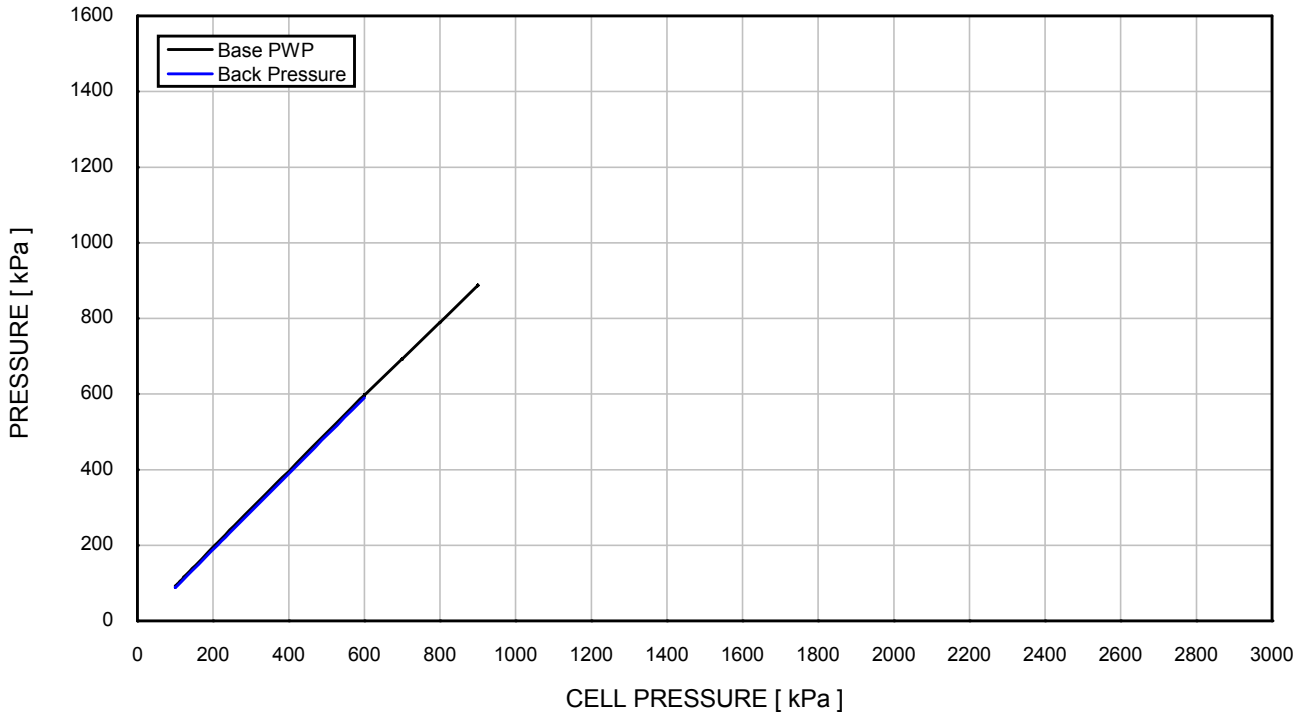
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX25

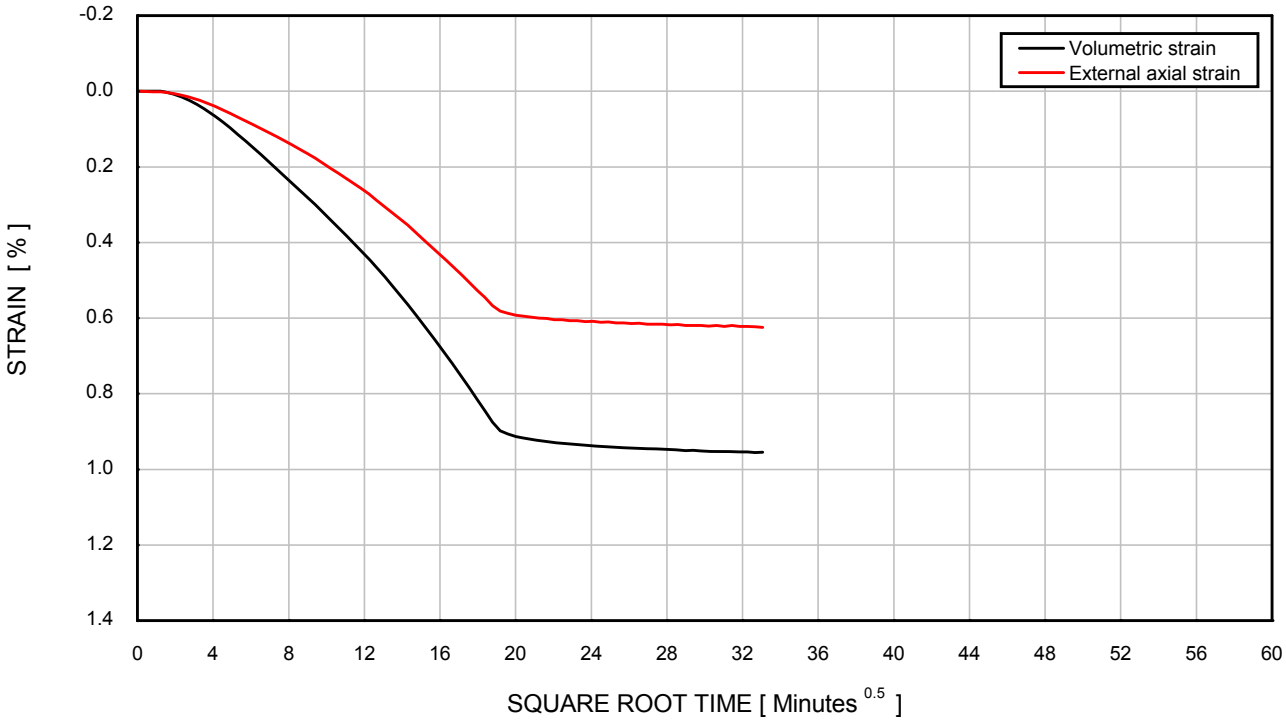
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

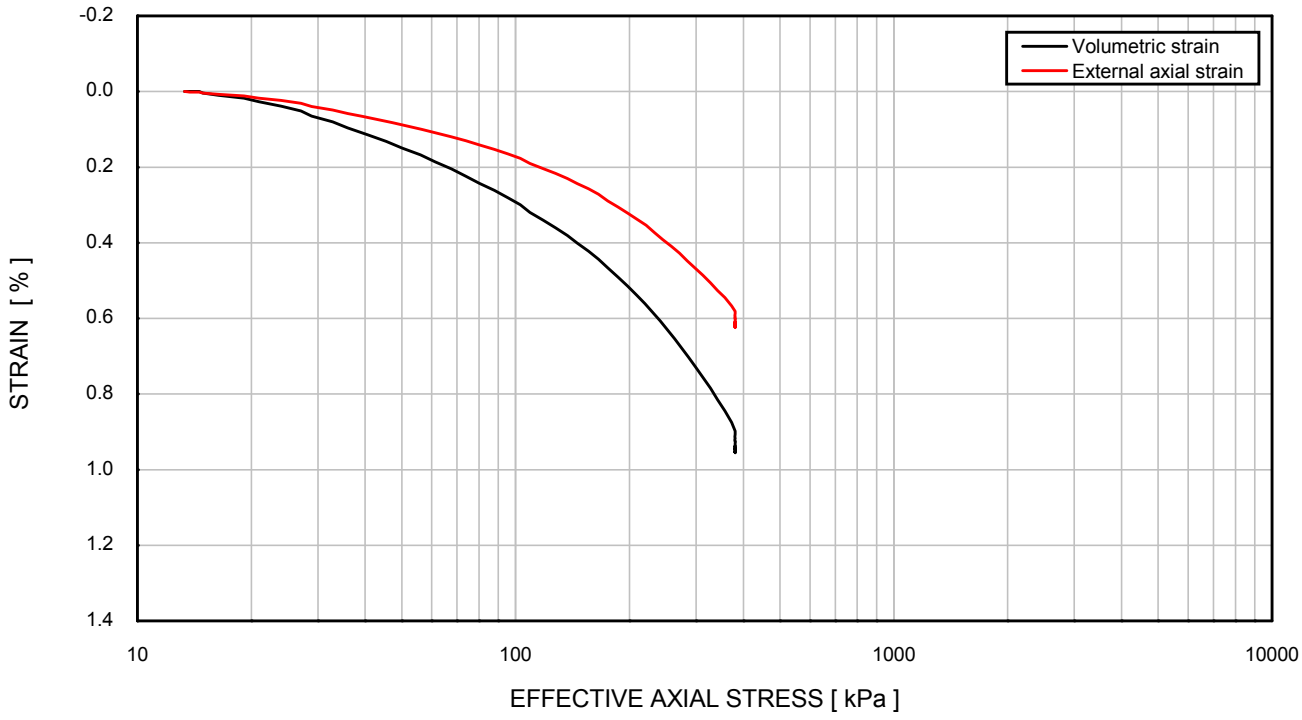




B value	:	0.98			
Initial σ'_r	:	8	kPa	Batch	: 6
Initial σ'_a	:	8	kPa	Sample	: CTX_6-3
Final σ'_r	:	13	kPa	Unit	: Unit D (Yarmouth Roads)
Final σ'_a	:	13	kPa	Test No.	: CTX25

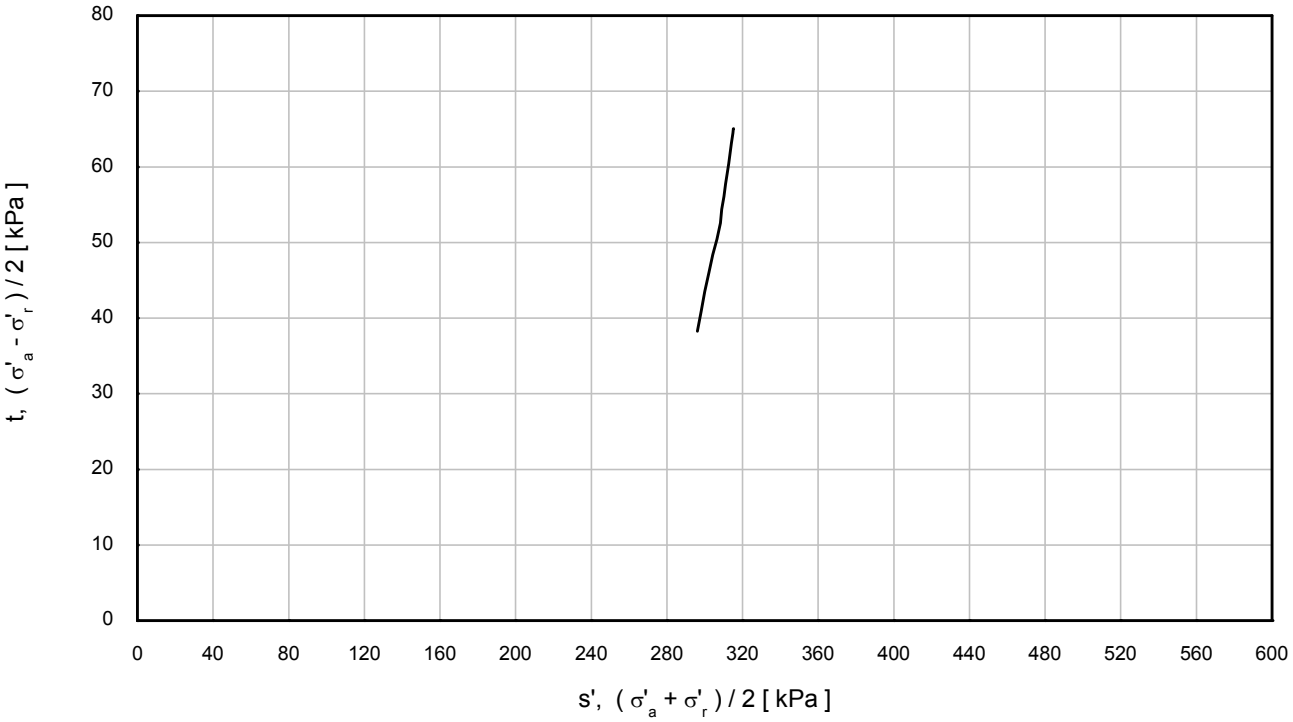
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

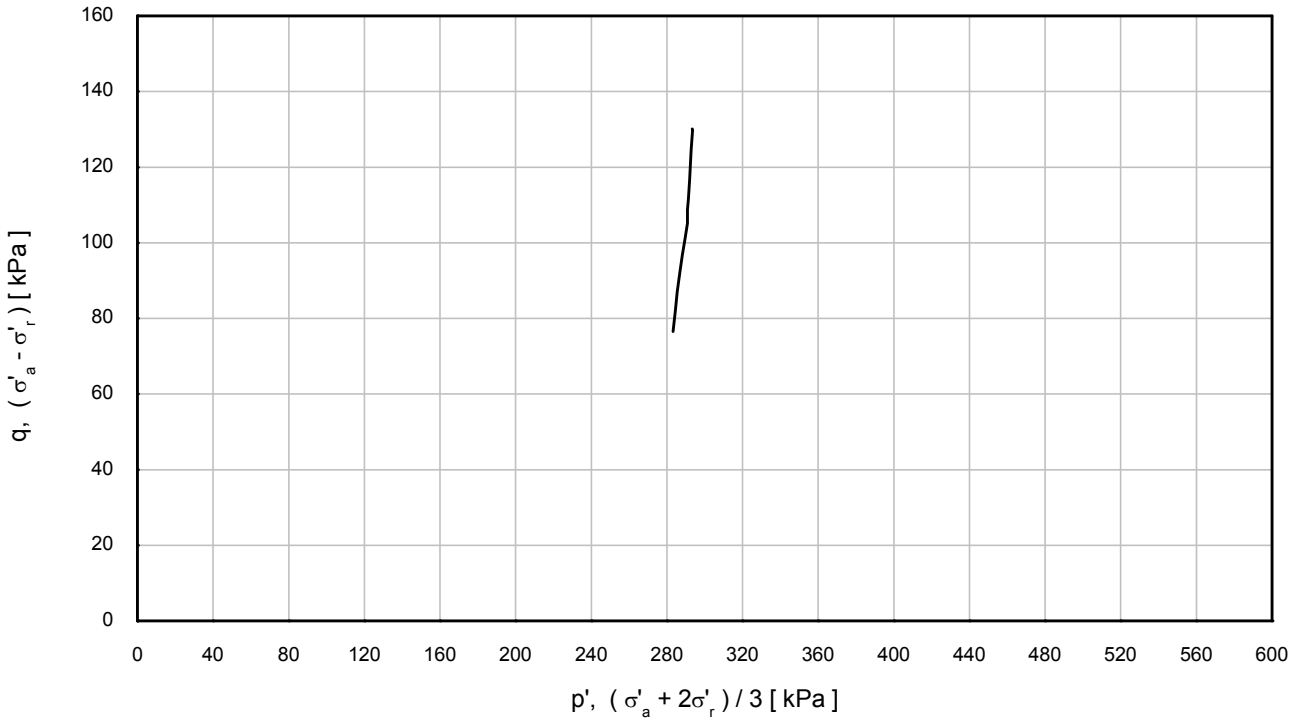




Stage 1 σ'_{rc}	: 250 kPa	Batch	: 6
Stage 1 σ'_{ac}	: 380 kPa	Sample	: CTX_6-3
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX25

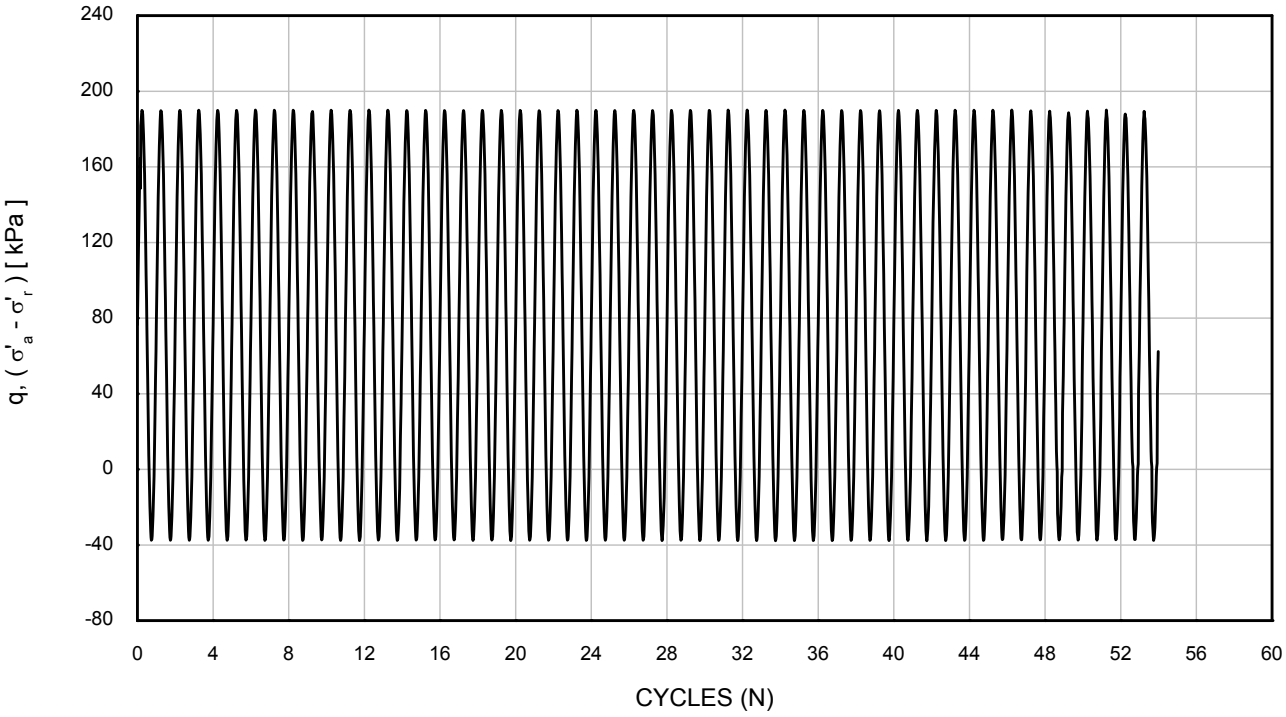
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ANISOTROPIC CONSOLIDATION STAGE

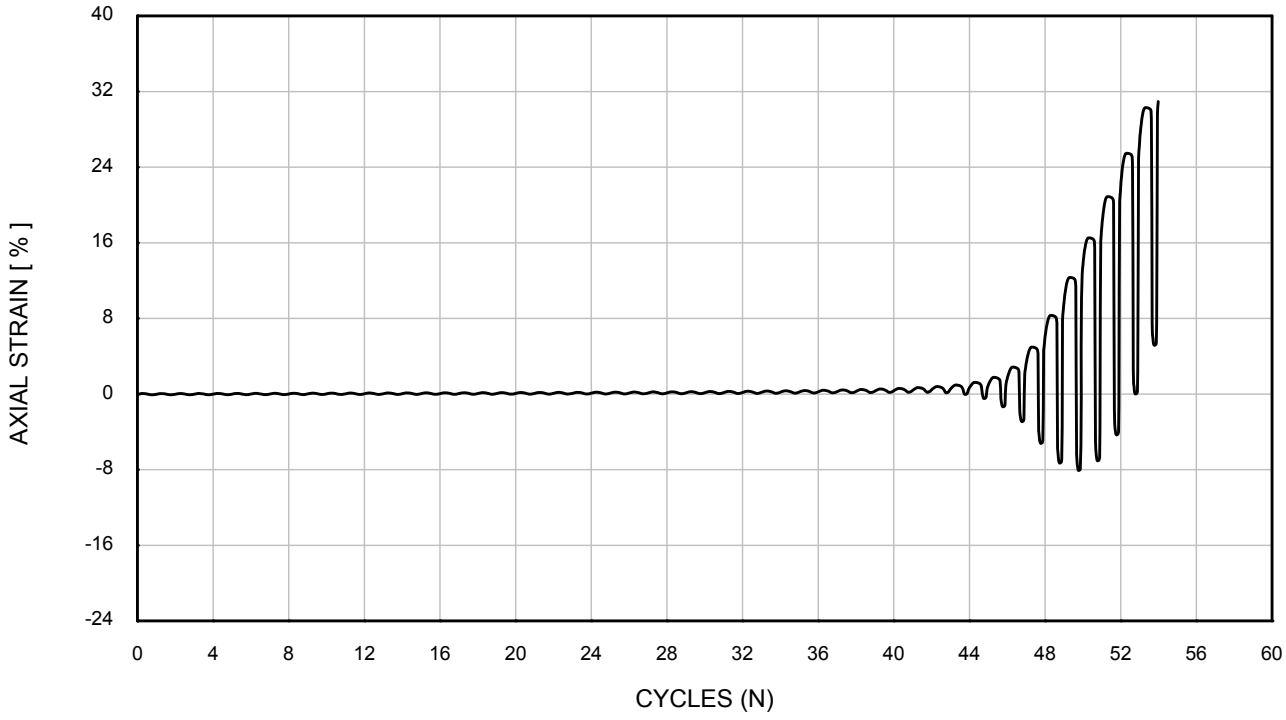




σ'_{rc}	: 258 kPa	Batch	: 6
σ'_{ac}	: 334 kPa	Sample	: CTX_6-3
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX25

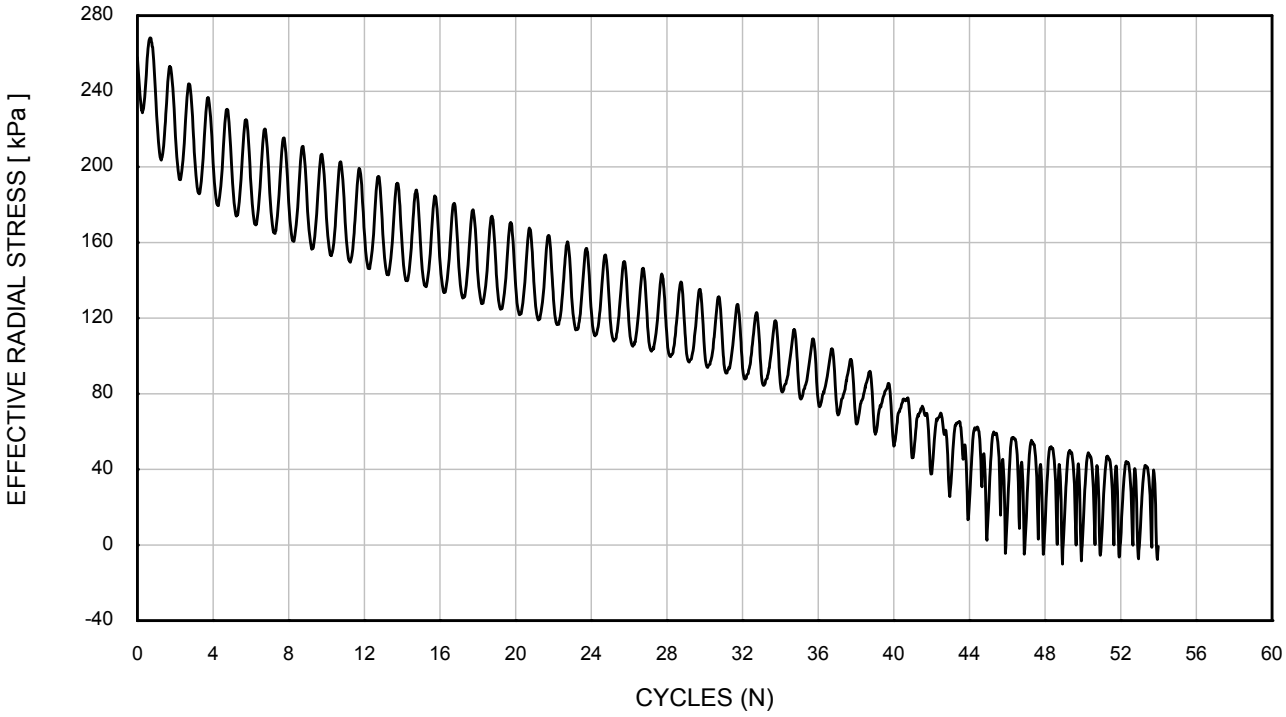
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
UNDRAINED SHEAR PRIOR TO CYCLIC LOADING

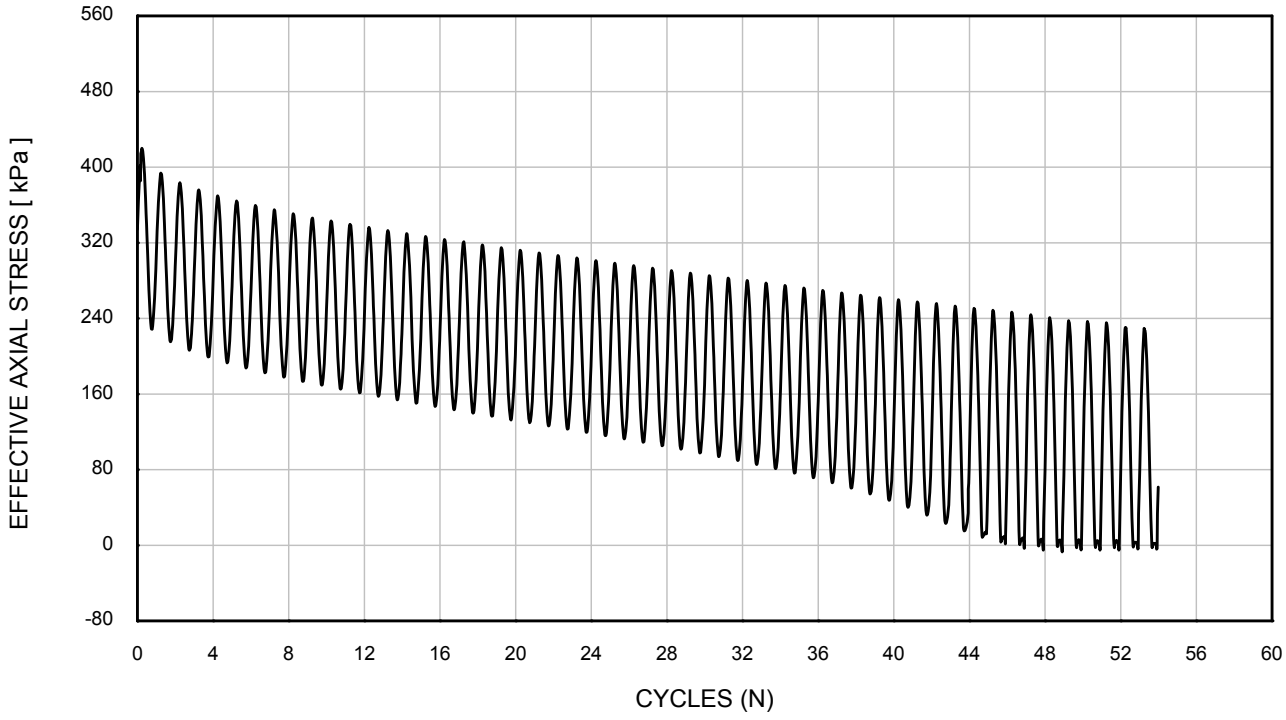




Initial σ'_r	:	258 kPa	Batch	:	6
Initial σ'_a	:	334 kPa	Sample	:	CTX_6-3
q_{av}	:	76 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	:	CTX25
Frequency	:	0.10 Hz			

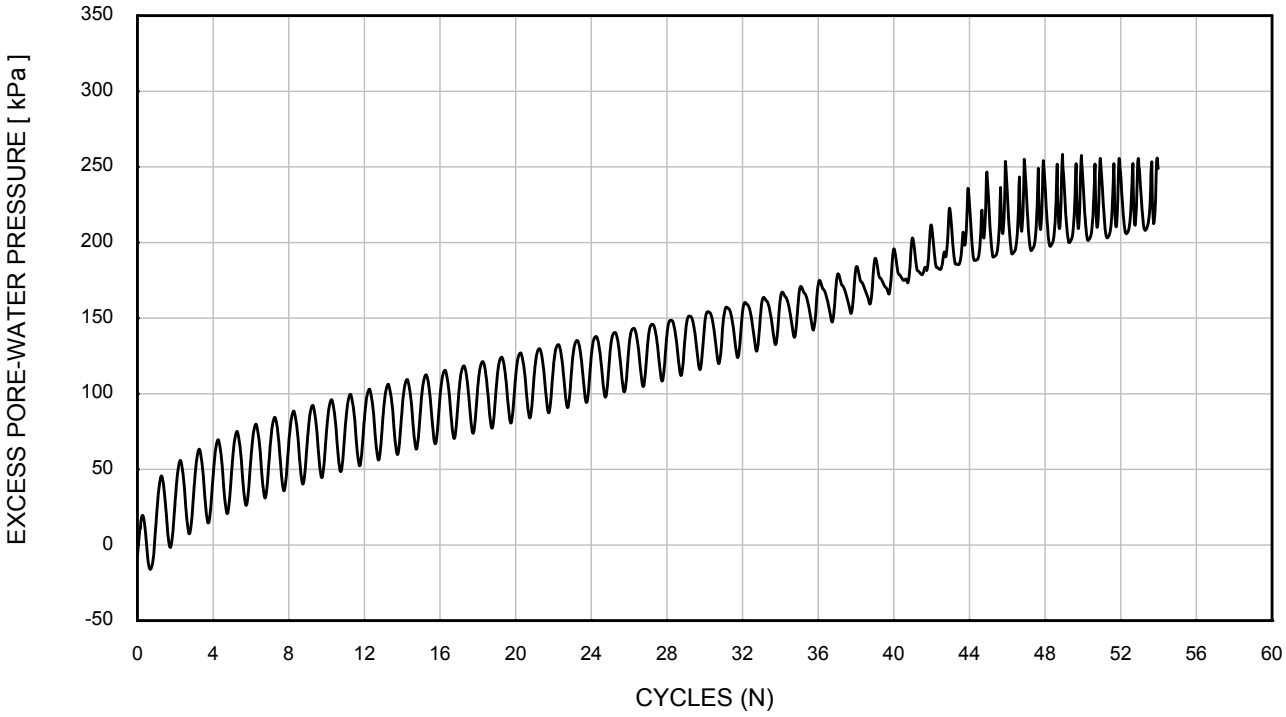
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

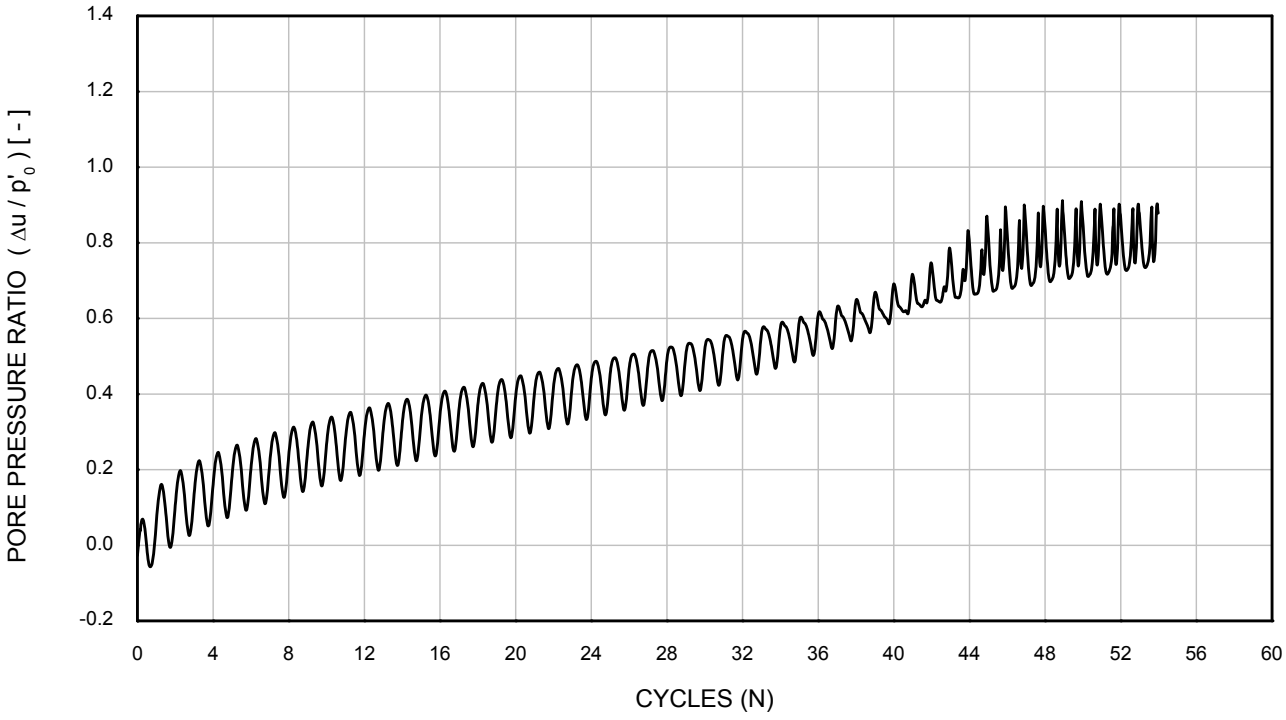




Initial σ'_r	:	258 kPa	Batch	: 6
Initial σ'_a	:	334 kPa	Sample	: CTX_6-3
q_{av}	:	76 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	: CTX25
Frequency	:	0.10 Hz		

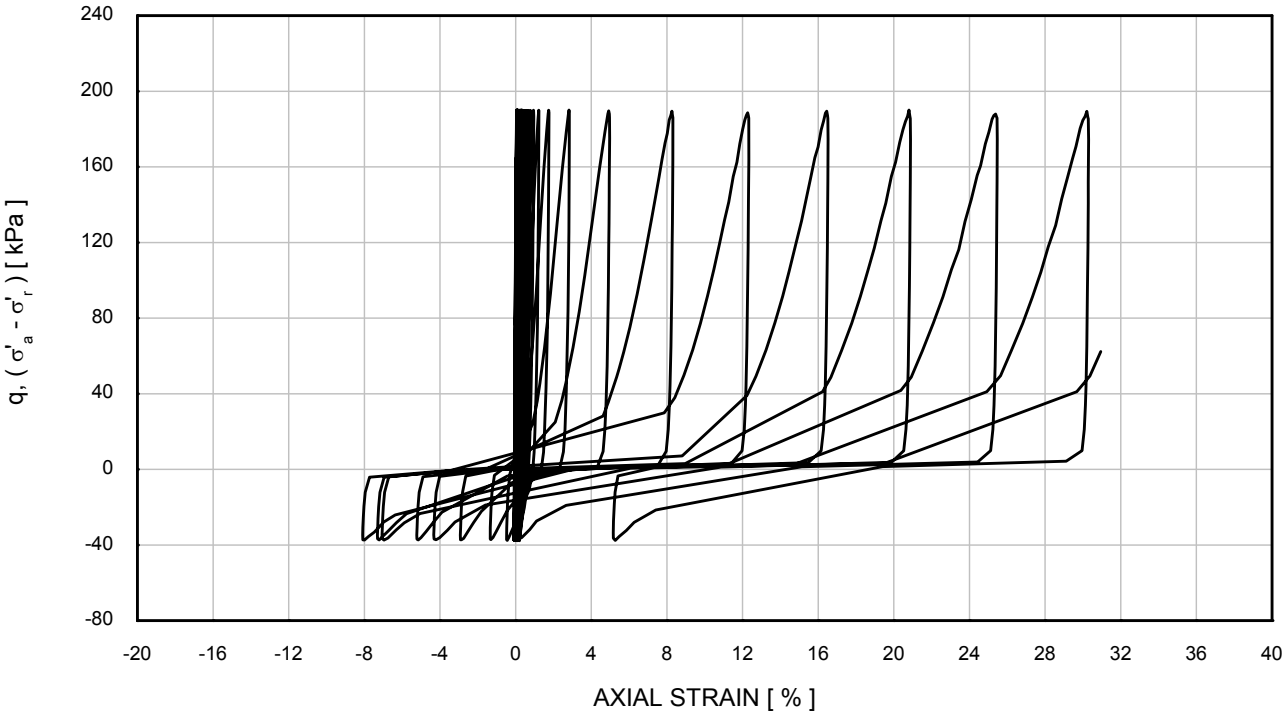
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

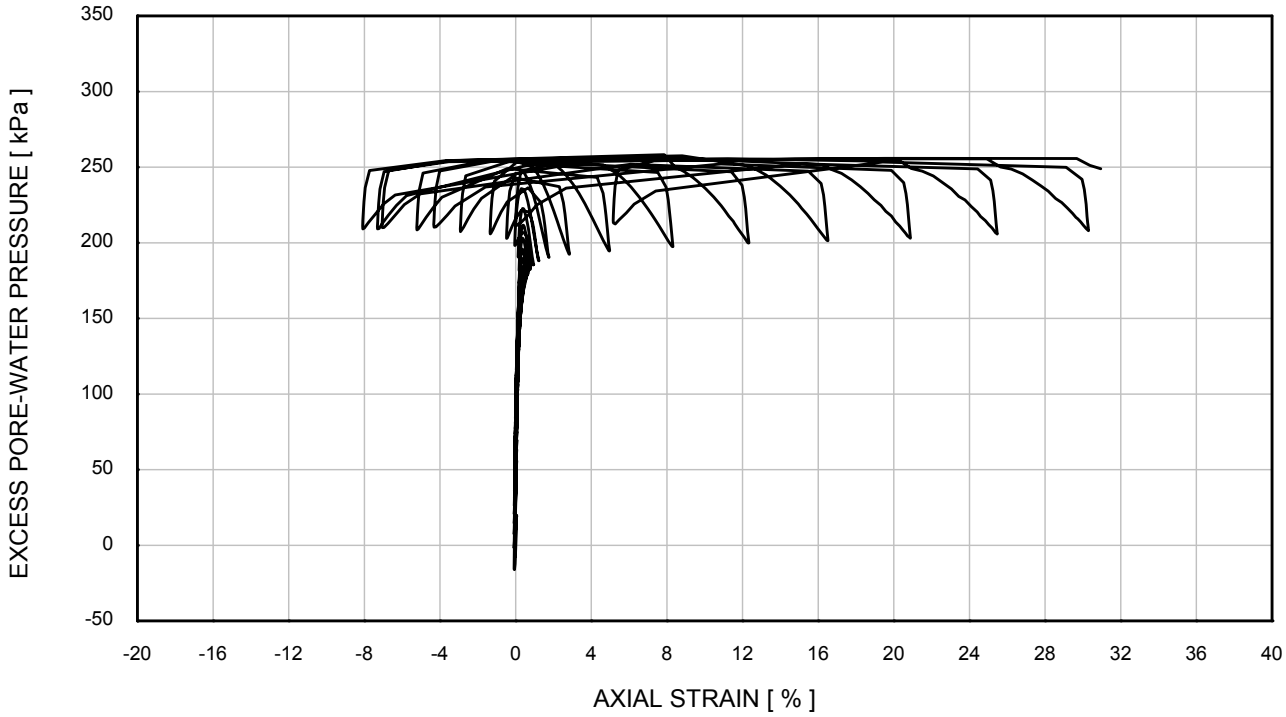




Initial σ'_r	:	258 kPa	Batch	:	6
Initial σ'_a	:	334 kPa	Sample	:	CTX_6-3
q_{av}	:	76 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	:	CTX25
Frequency	:	0.10 Hz			

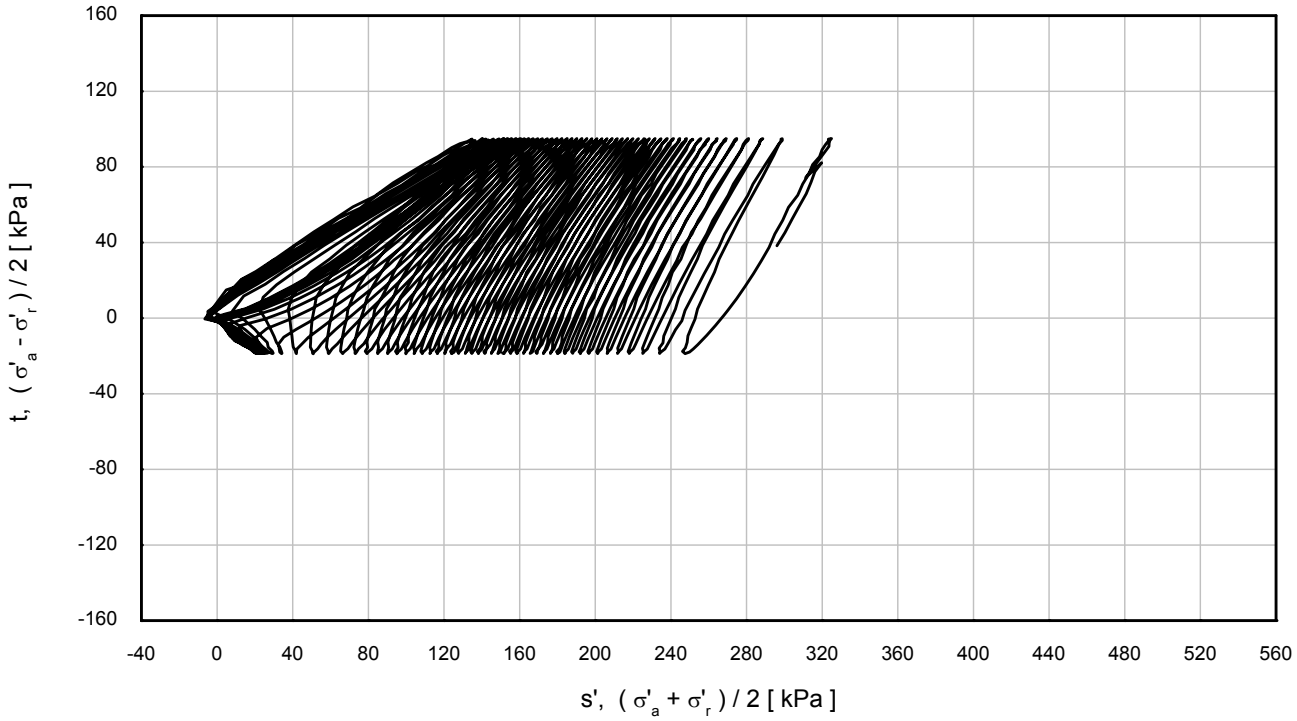
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

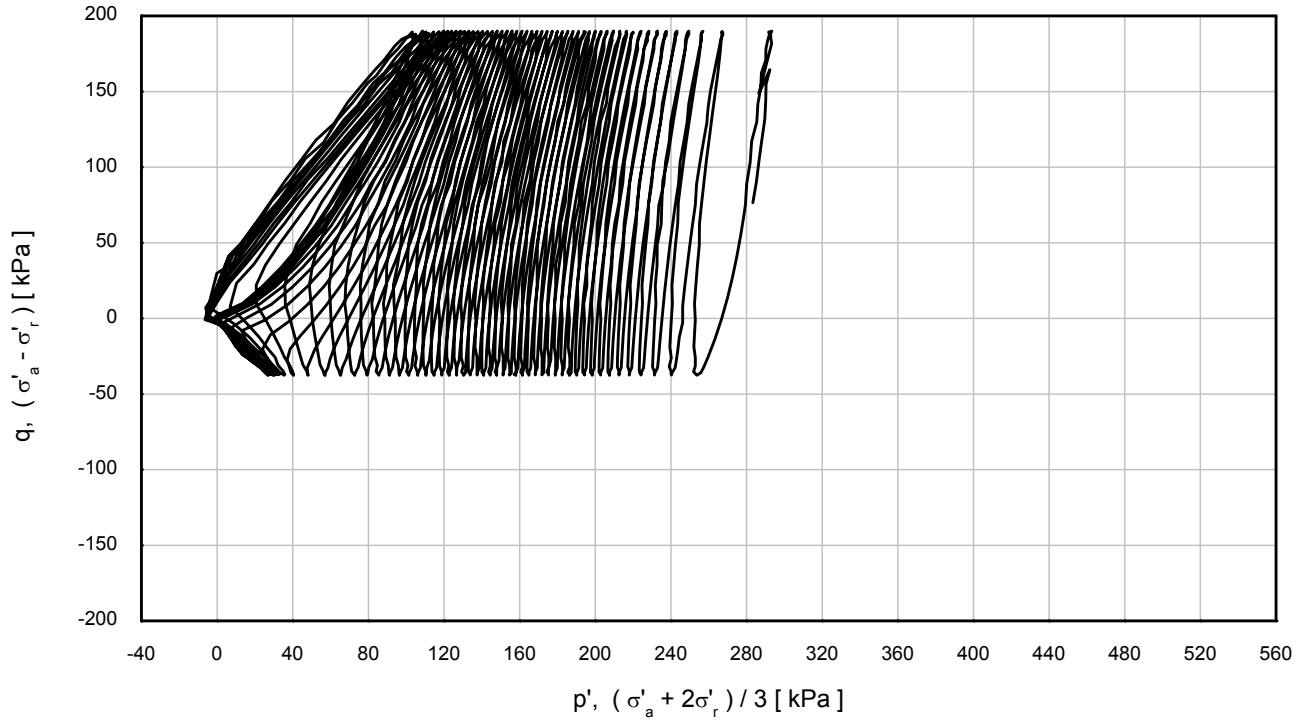




Initial σ'_r	: 258 kPa	Batch	: 6
Initial σ'_a	: 334 kPa	Sample	: CTX_6-3
q_{av}	: 76 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX25
Frequency	: 0.10 Hz		

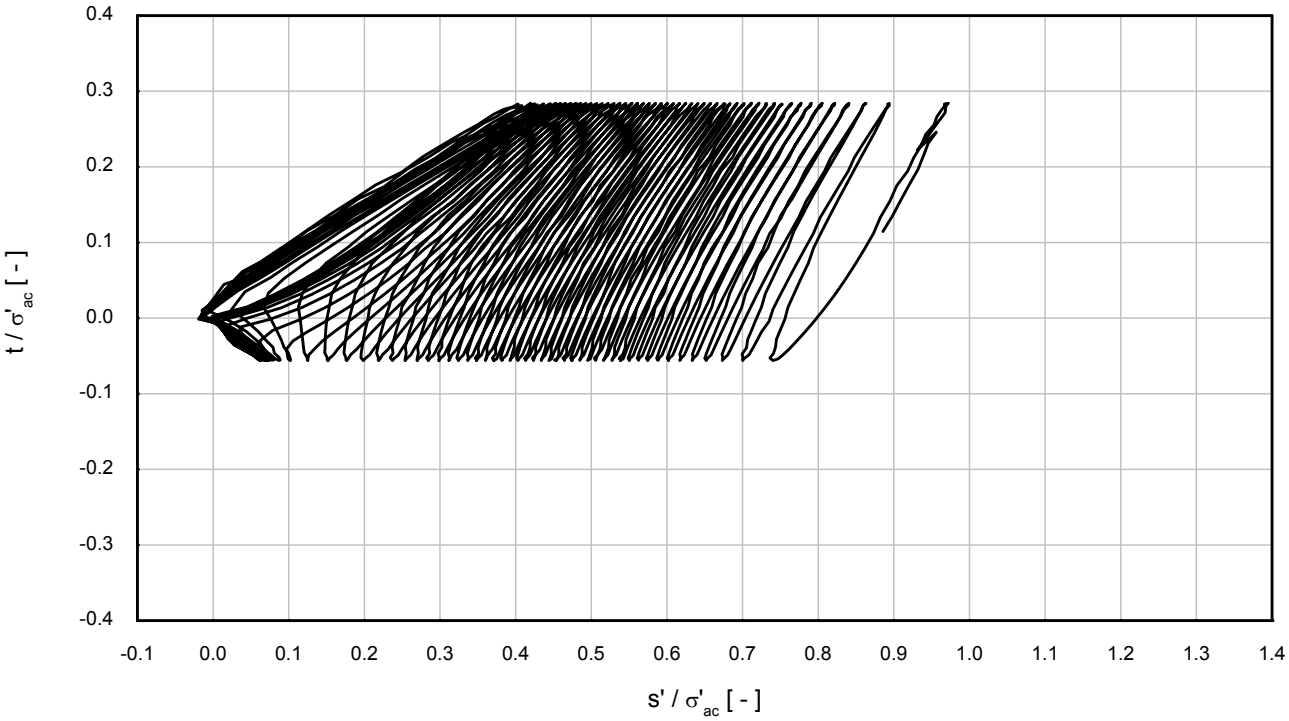
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

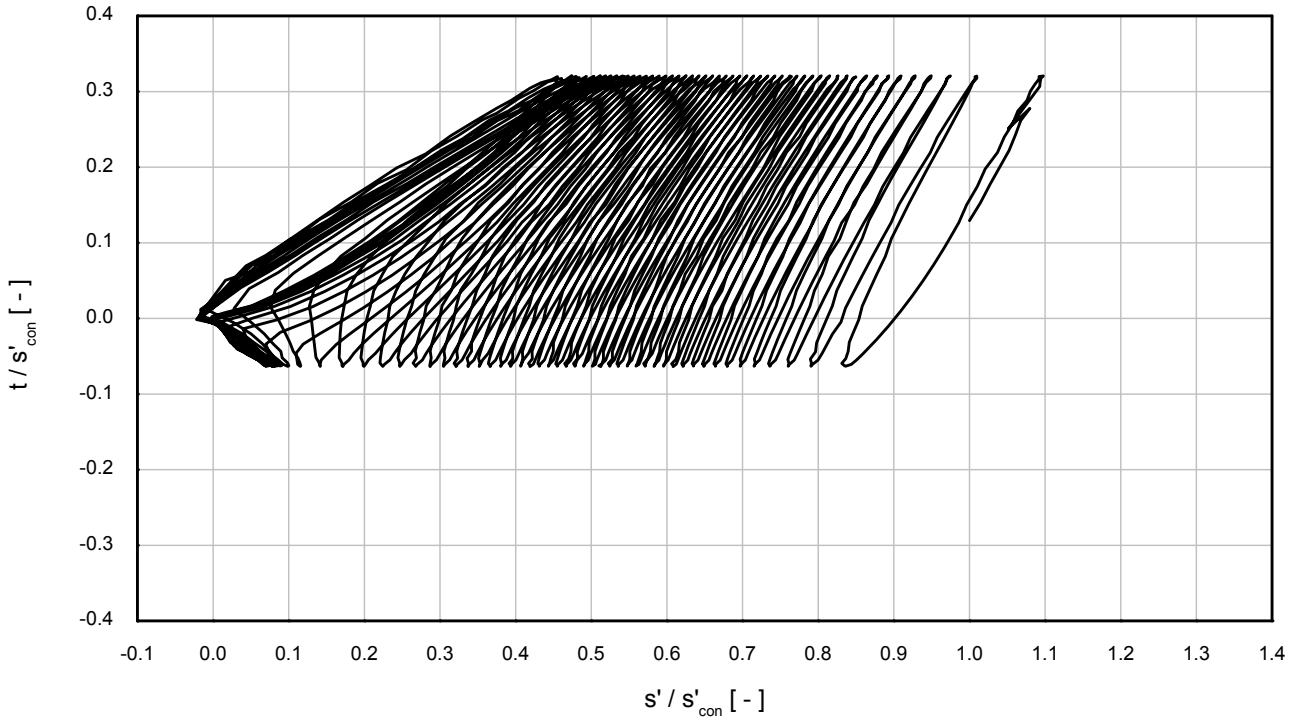




Initial σ'_r	:	258 kPa	Batch	:	6
Initial σ'_a	:	334 kPa	Sample	:	CTX_6-3
q_{av}	:	76 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	:	CTX25
Frequency	:	0.10 Hz			

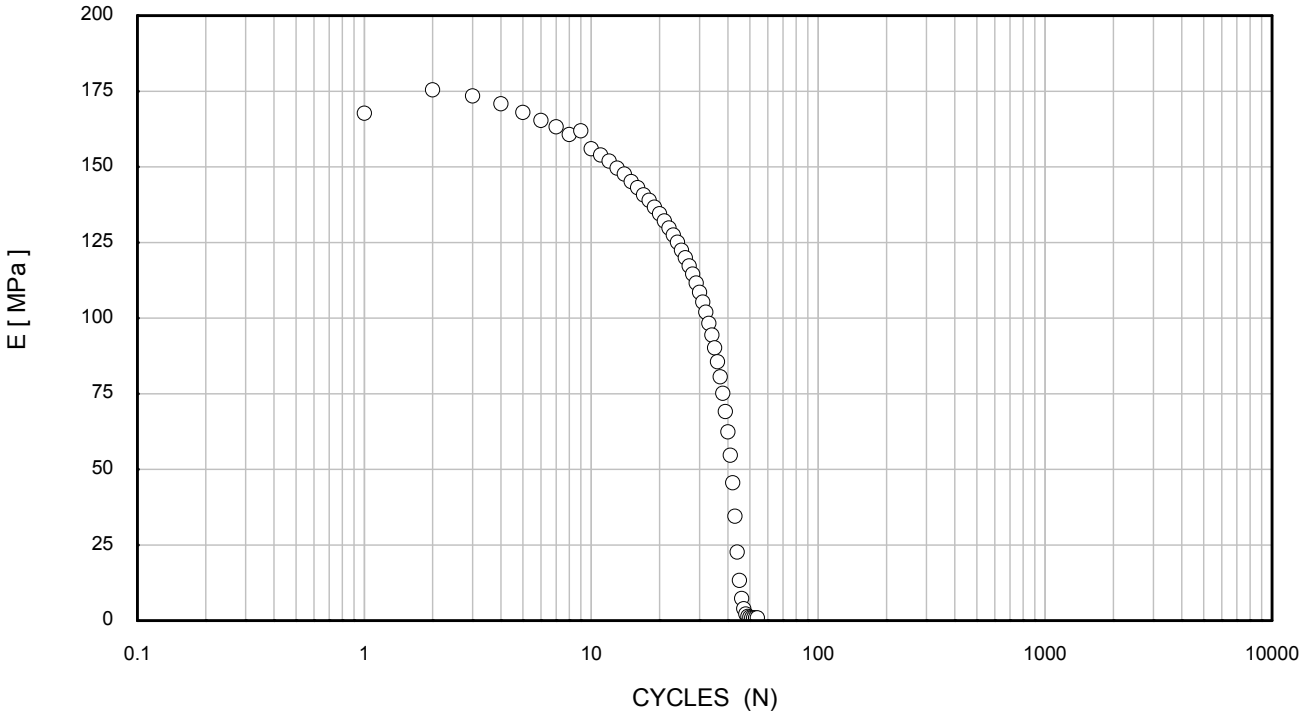
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

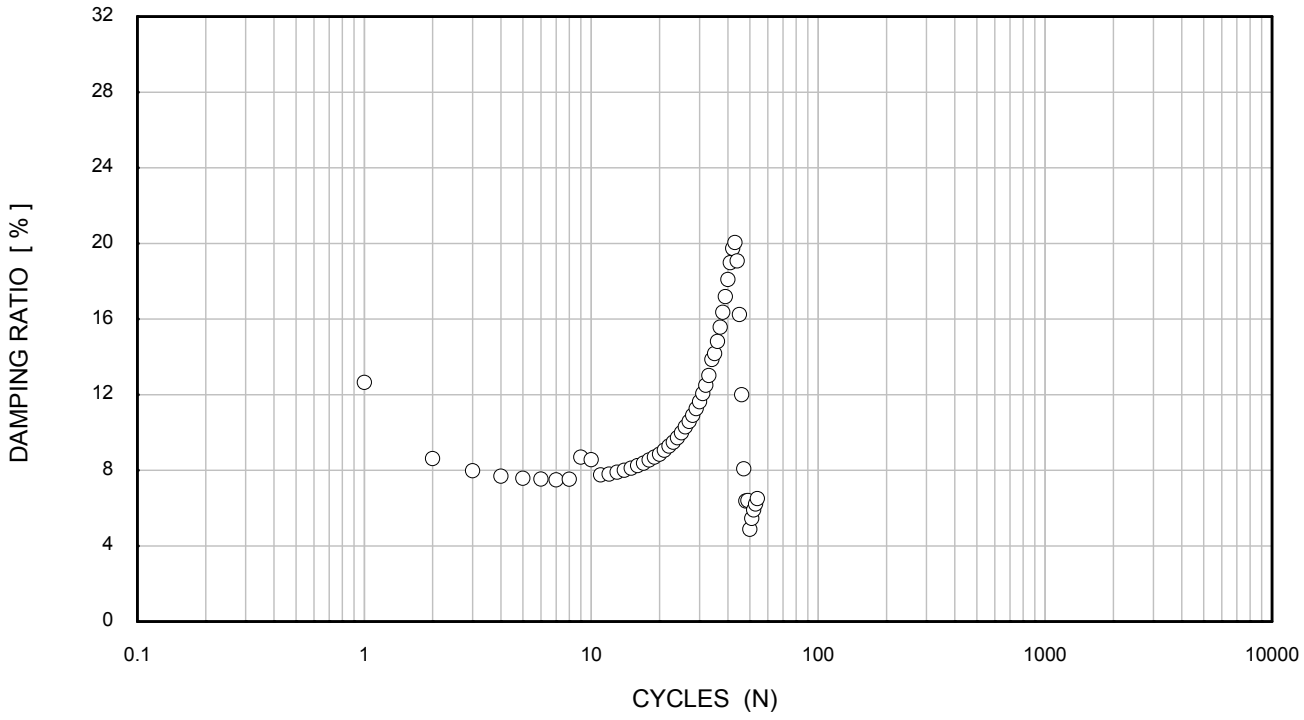




Initial σ'_r	:	258 kPa	Batch	:	6
Initial σ'_a	:	334 kPa	Sample	:	CTX_6-3
q_{av}	:	76 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	:	CTX25
Frequency	:	0.10 Hz			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED





Initial σ'_r	:	258 kPa	Batch	:	6
Initial σ'_a	:	334 kPa	Sample	:	CTX_6-3
q_{av}	:	76 kPa	Unit	:	Unit D (Yarmouth Roads)
q_{cy}	:	114 kPa	Test No.	:	CTX25
Frequency	:	0.10 Hz			

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

VISUAL DESCRIPTION
Light yellowish brown fine to medium SAND

GENERAL	
Date test started	02/01/2017
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	72.0
Length	[mm]	144.0
Water content	[%]	9.7
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.674
Degree of saturation	[%]	38
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH06_CTX26
Processed by Date	MSR 06/01/2017
Checked by Date	PH 11/01/2017
Approved by Date	PH 11/01/2017

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX26

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	As per test instruction
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	885
Mid height PWP	[kPa]	-
B value achieved	[-]	0.98

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	1135
Back pressure	[kPa]	886
Base PWP	[kPa]	886
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	249
Effective axial pressure	[kPa]	379
Deviator stress	[kPa]	130
Volumetric strain	[%]	1.14
External axial strain	[%]	0.67
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.655
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX26

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

PRE-CYCLING LOADING		
Cell pressure	[kPa]	1135
Back pressure	[kPa]	885
Base PWP	[kPa]	883
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	252
Effective axial pressure	[kPa]	367
Deviator stress	[kPa]	116
Volumetric strain	[%]	0.00
External axial strain	[%]	-0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.655
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX26

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress	[kPa]	760
Mean q_{av}	[kPa]	114
Mean q_{cy}	[kPa]	114
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	28
External ε_{av} at N_f	[%]	17.19
External ε_{cy} at N_f	[%]	7.12
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	208
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.655
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.04	0.07	164	-	16.95	-
2	0.08	0.07	157	-	14.19	-
5	0.25	0.09	128	-	18.61	-
10	0.92	0.18	62	-	24.15	-
20	4.94	0.37	31	-	22.13	-
28	17.19	7.12	2	-	2.73	-

TEST IDENTIFICATION	
Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX26

SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





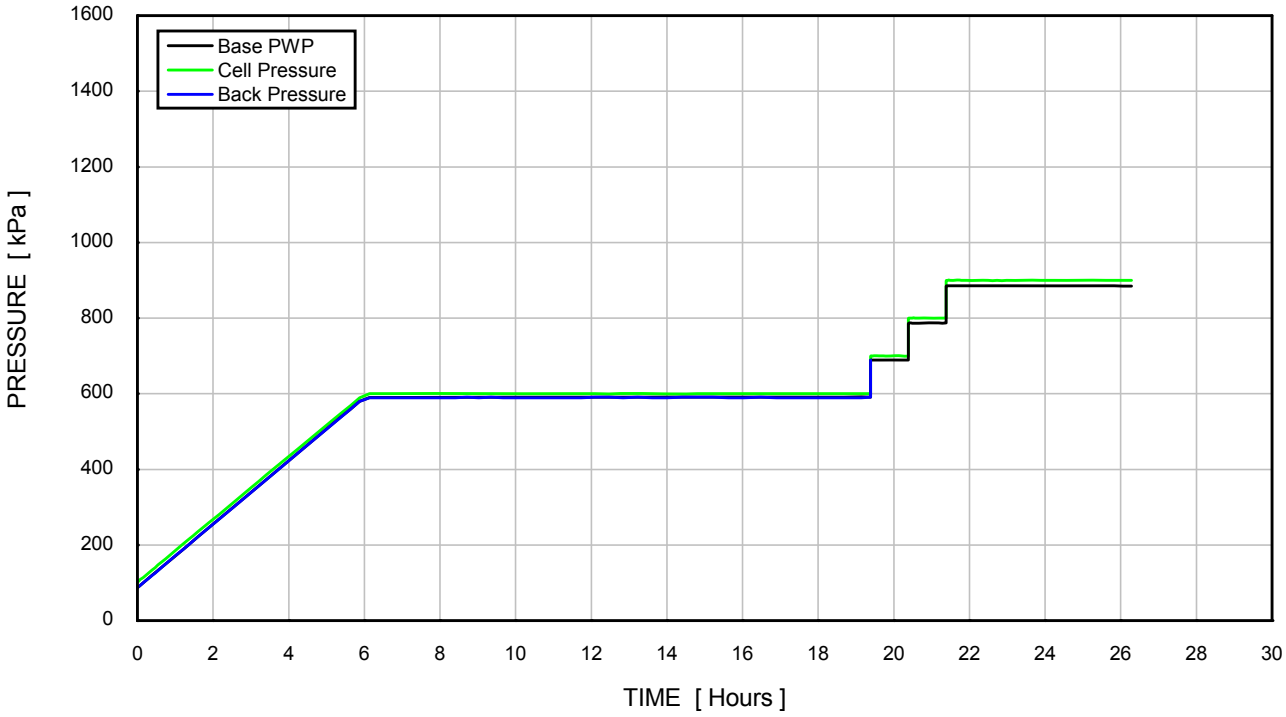
FINAL CONDITIONS

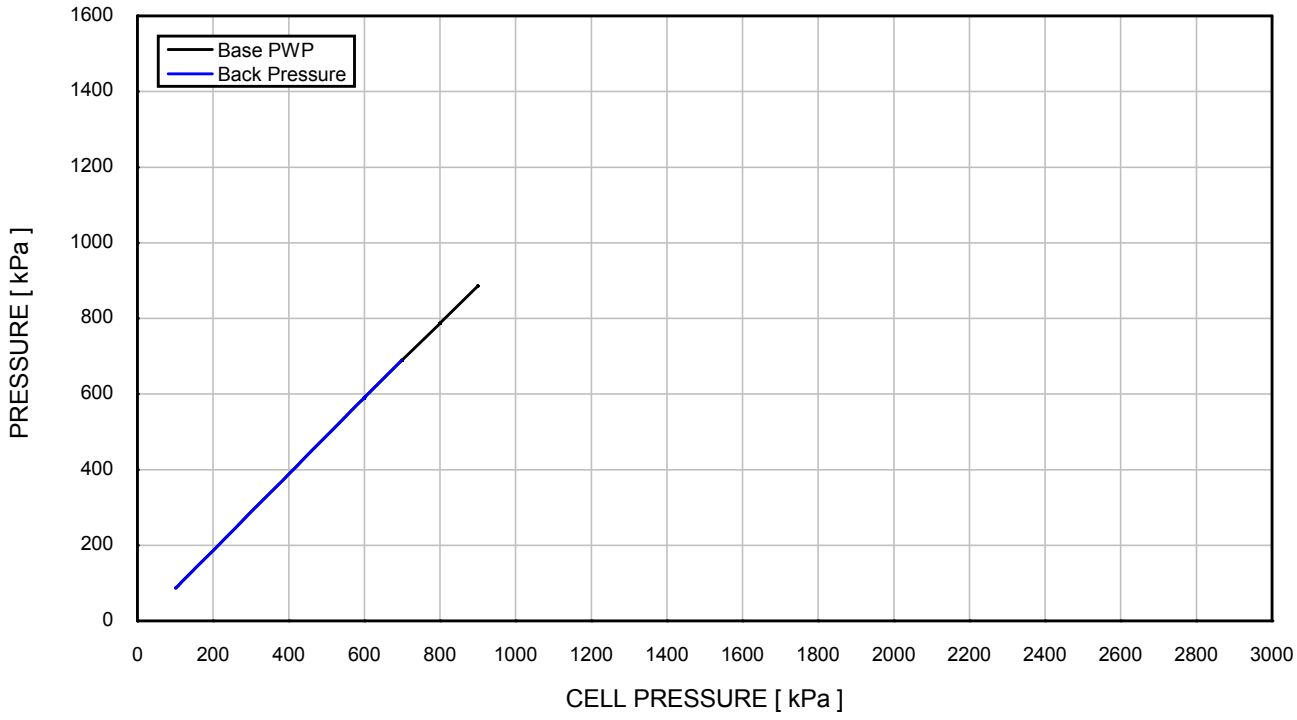
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Batch	6
Sample	CTX_6-3
Unit	Unit D (Yarmouth Roads)
Test number	CTX26

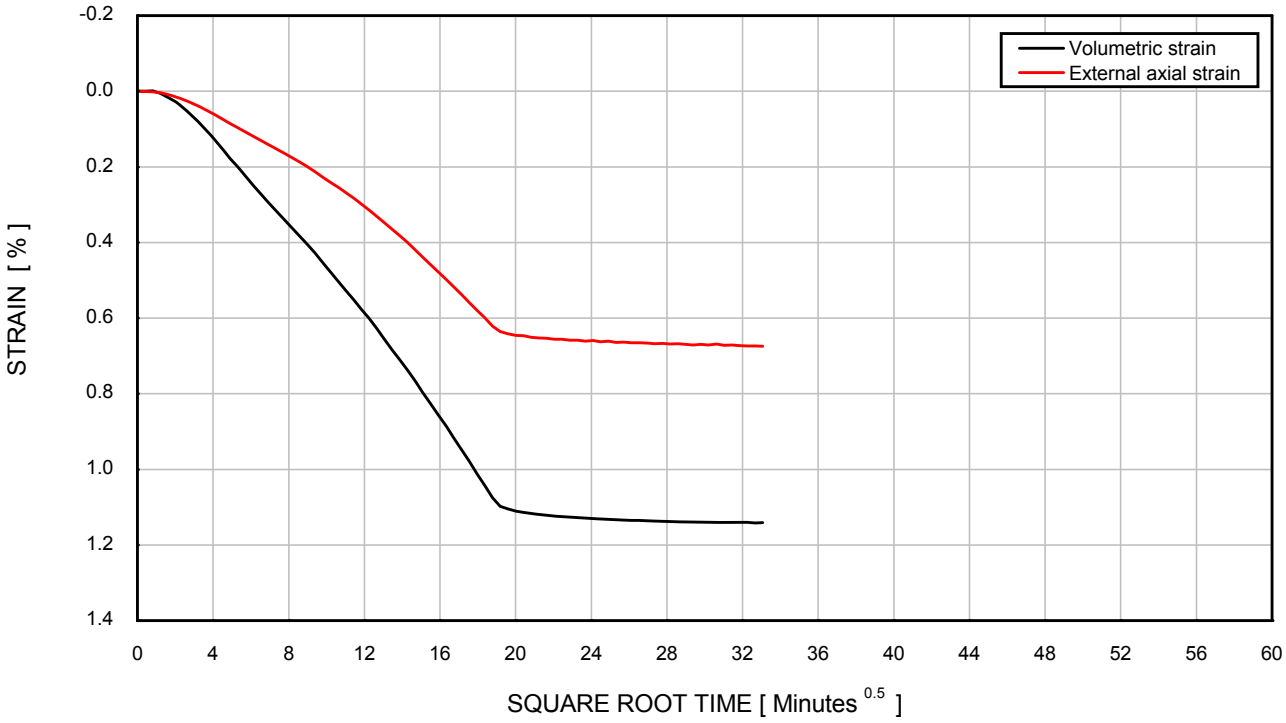
SUMMARY OF ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

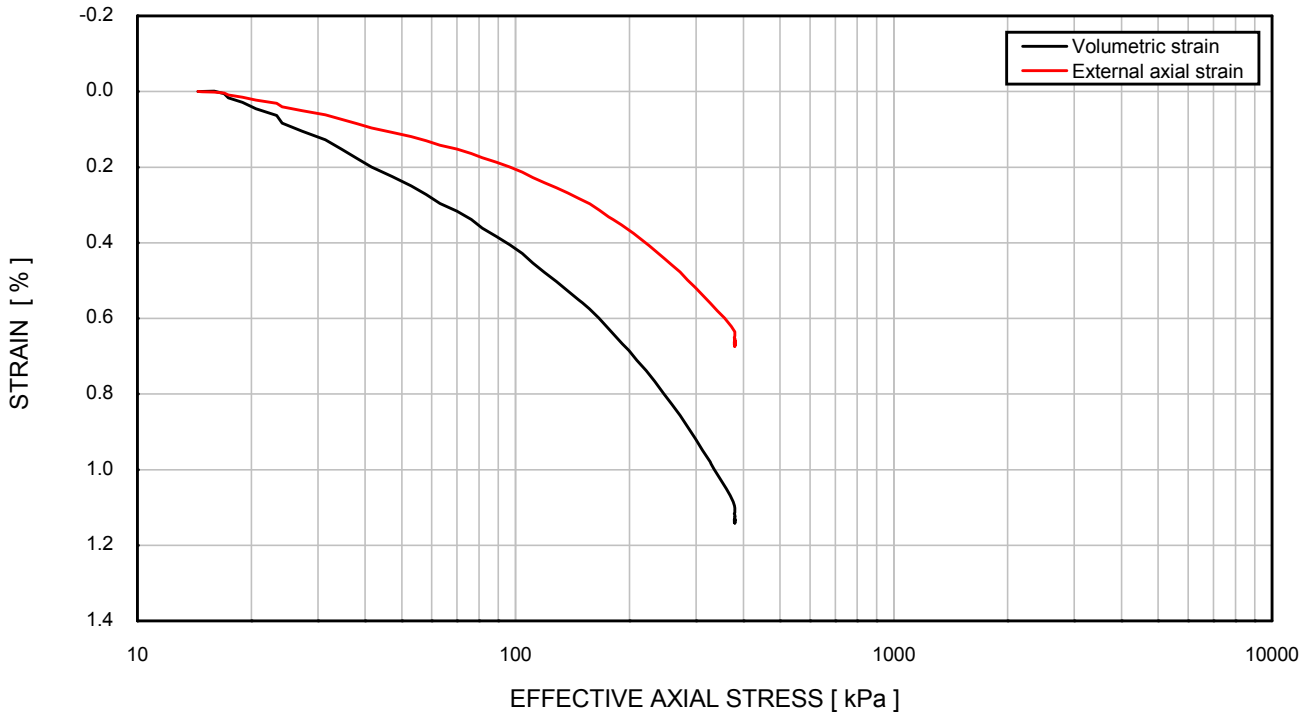




B value	:	0.98	Batch	:	06
Initial σ'_r	:	15 kPa	Sample	:	CTX_6-3
Initial σ'_a	:	15 kPa	Unit	:	Unit D (Yarmouth Roads)
Final σ'_r	:	15 kPa	Test No.	:	CTX26
Final σ'_a	:	15 kPa			

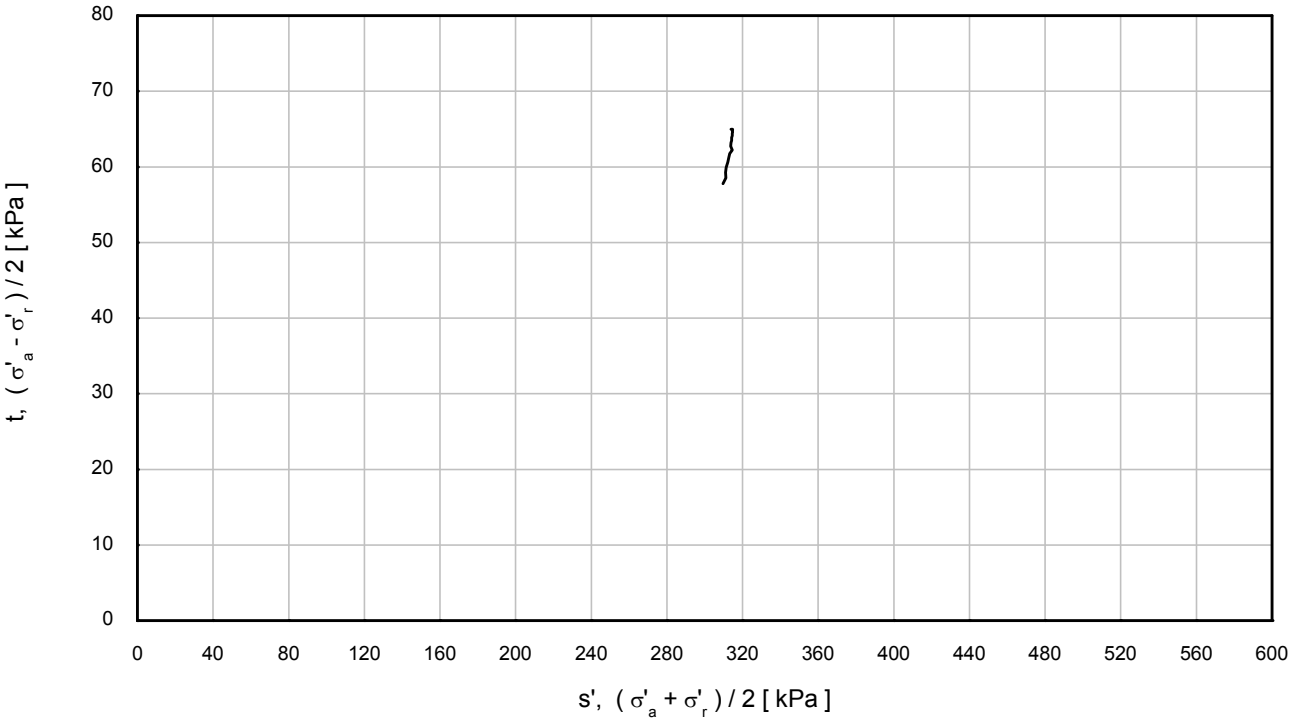
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

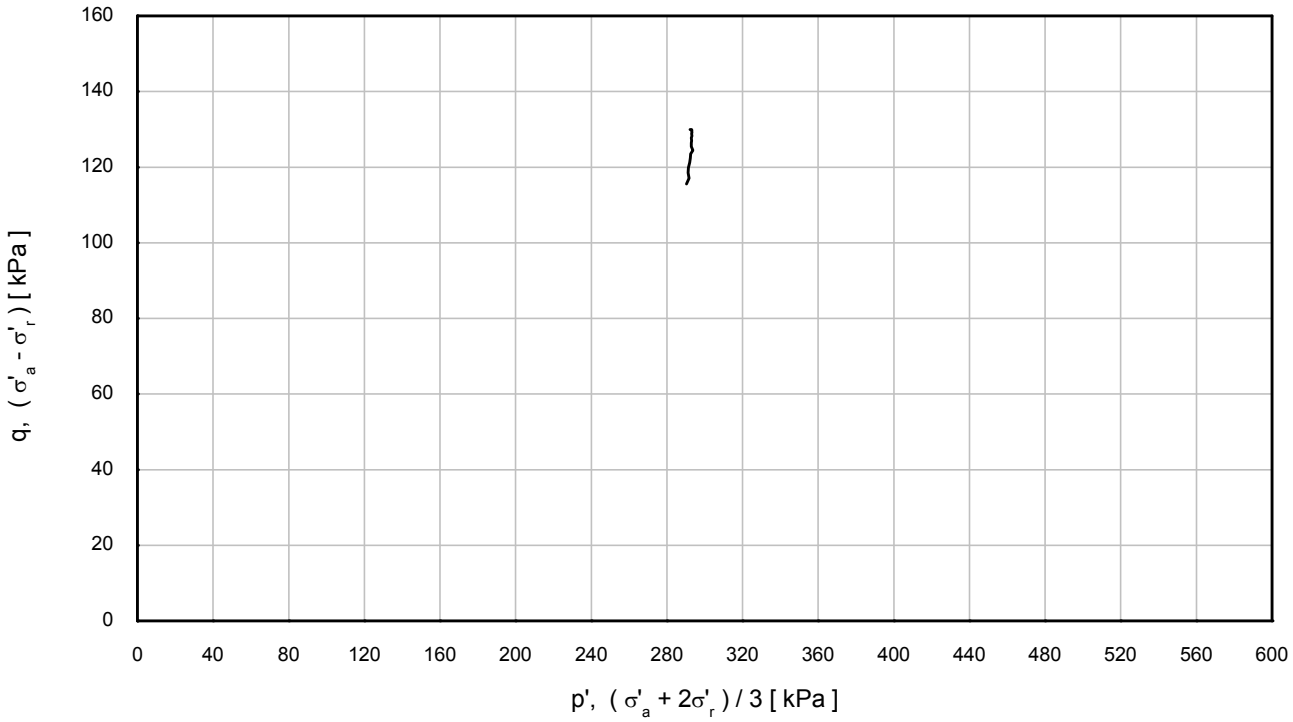




Stage 1 σ'_{rc}	: 249 kPa	Batch	: 06
Stage 1 σ'_{ac}	: 379 kPa	Sample	: CTX_6-3
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX26

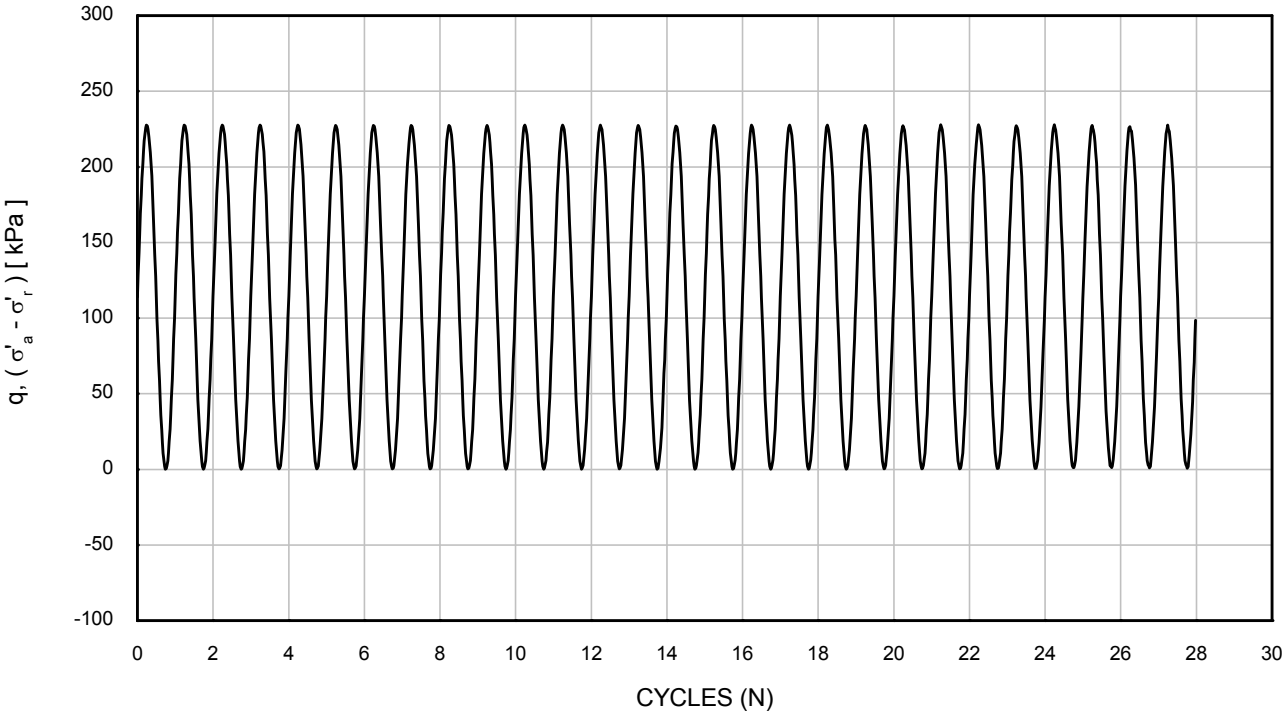
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

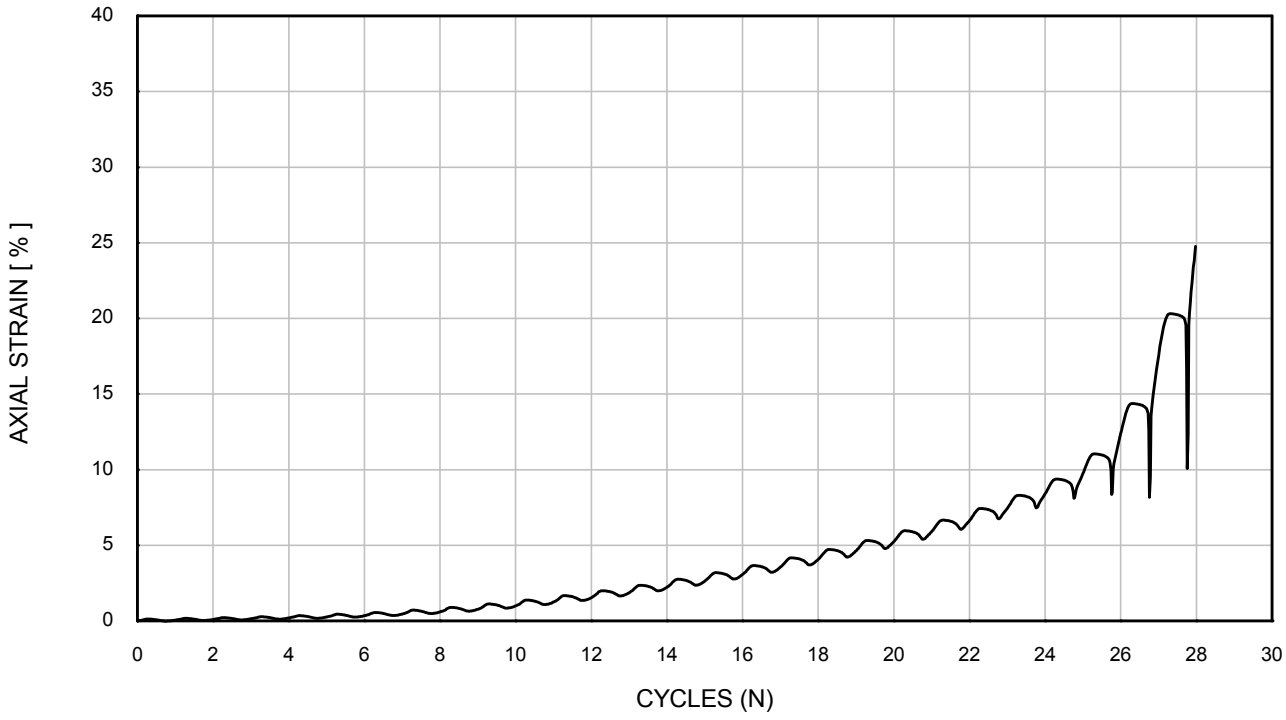




σ'_{rc}	: 252 kPa	Batch	: 06
σ'_{ac}	: 367 kPa	Sample	: CTX_6-3
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: CTX26

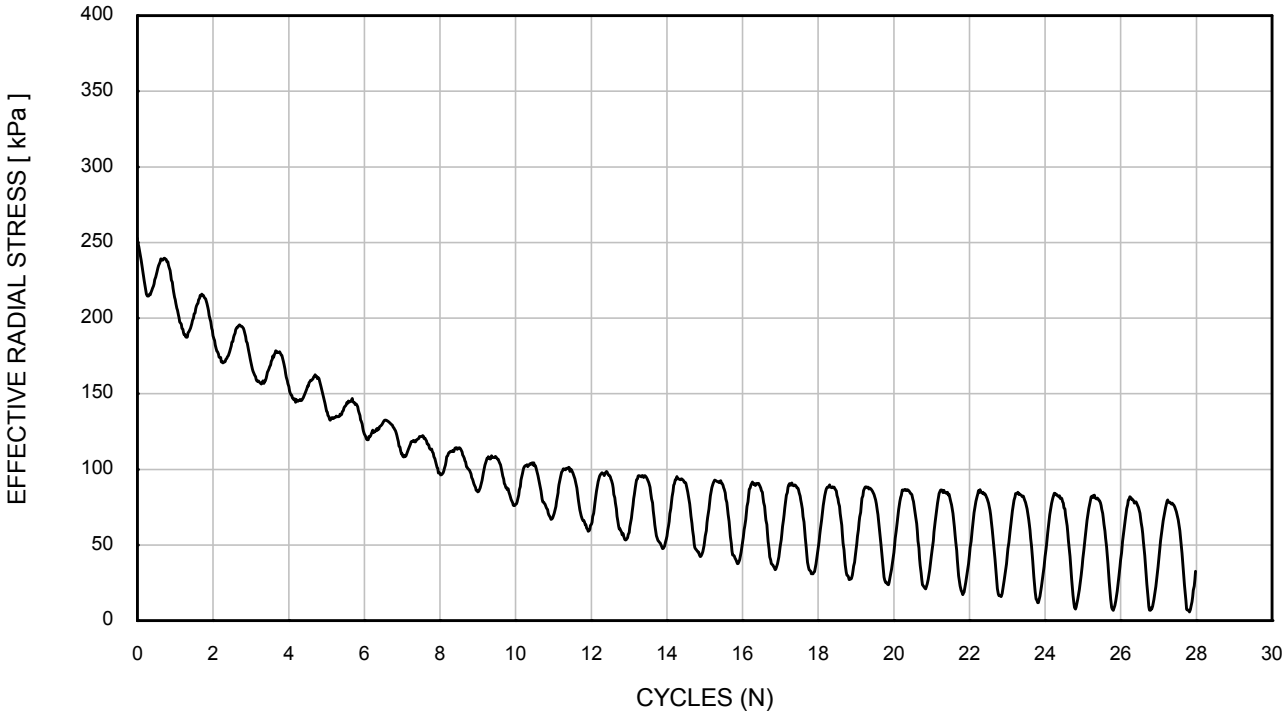
ANISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - UNDRAINED

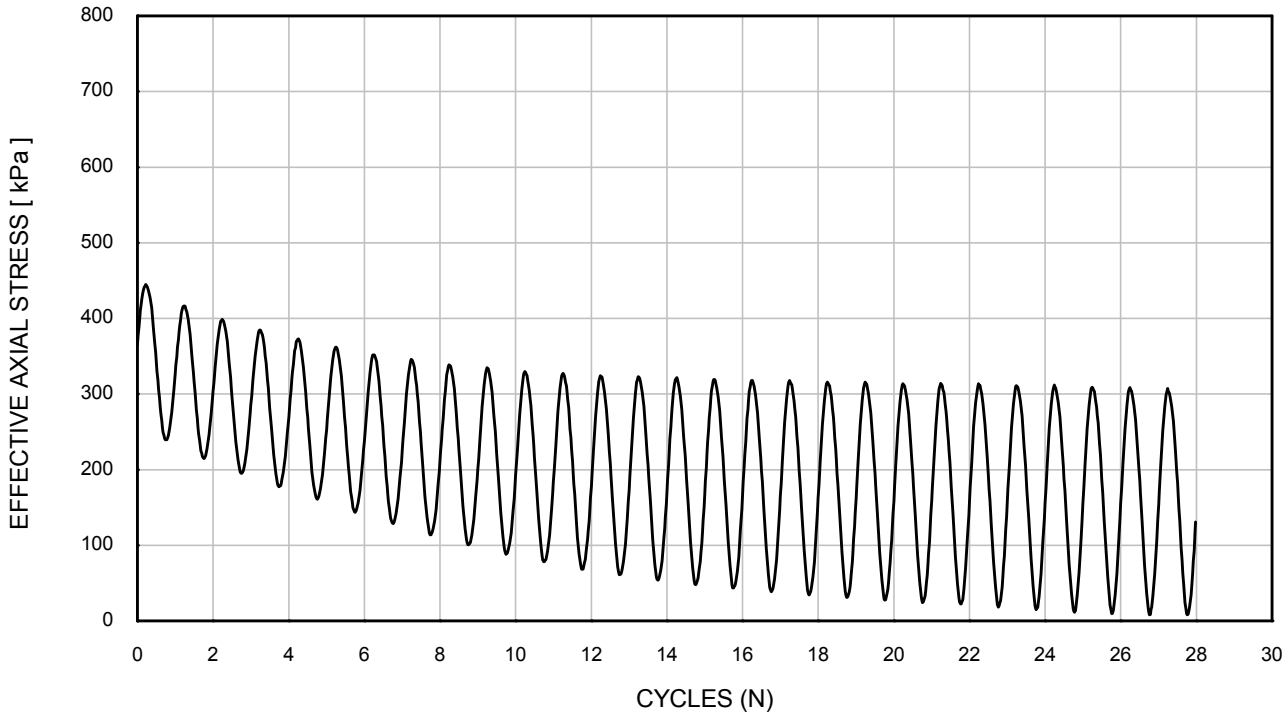




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

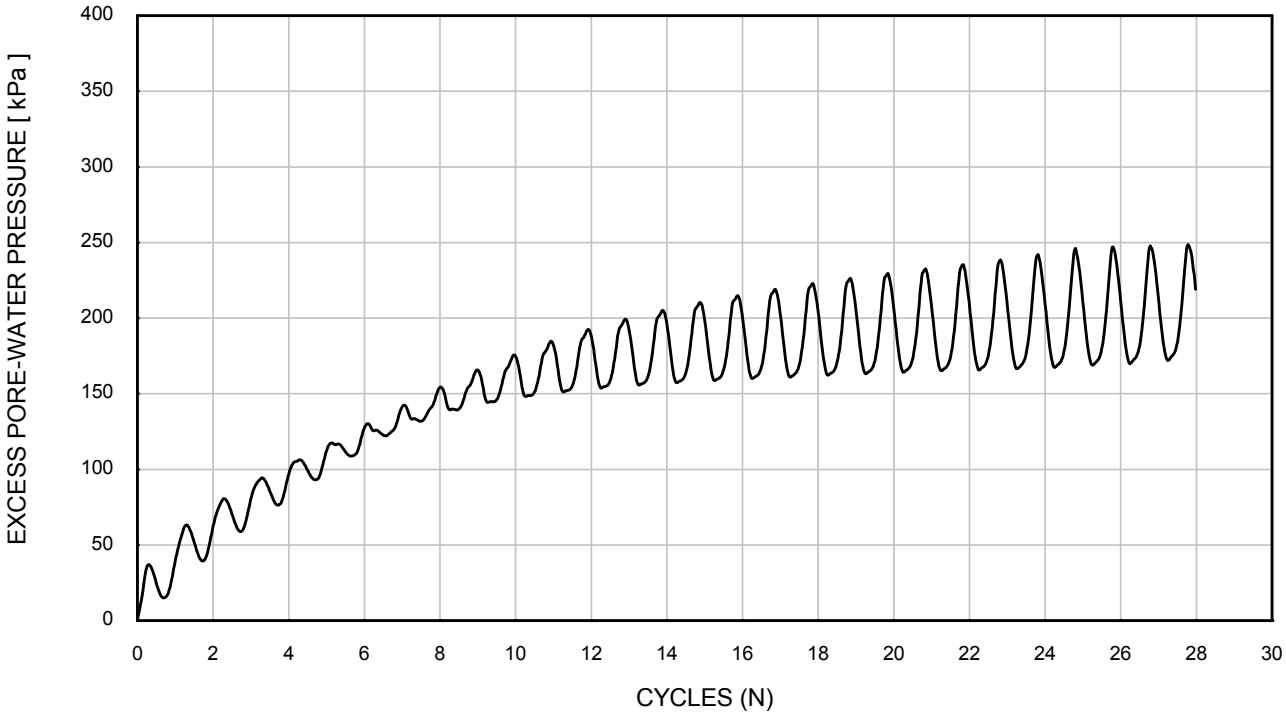
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

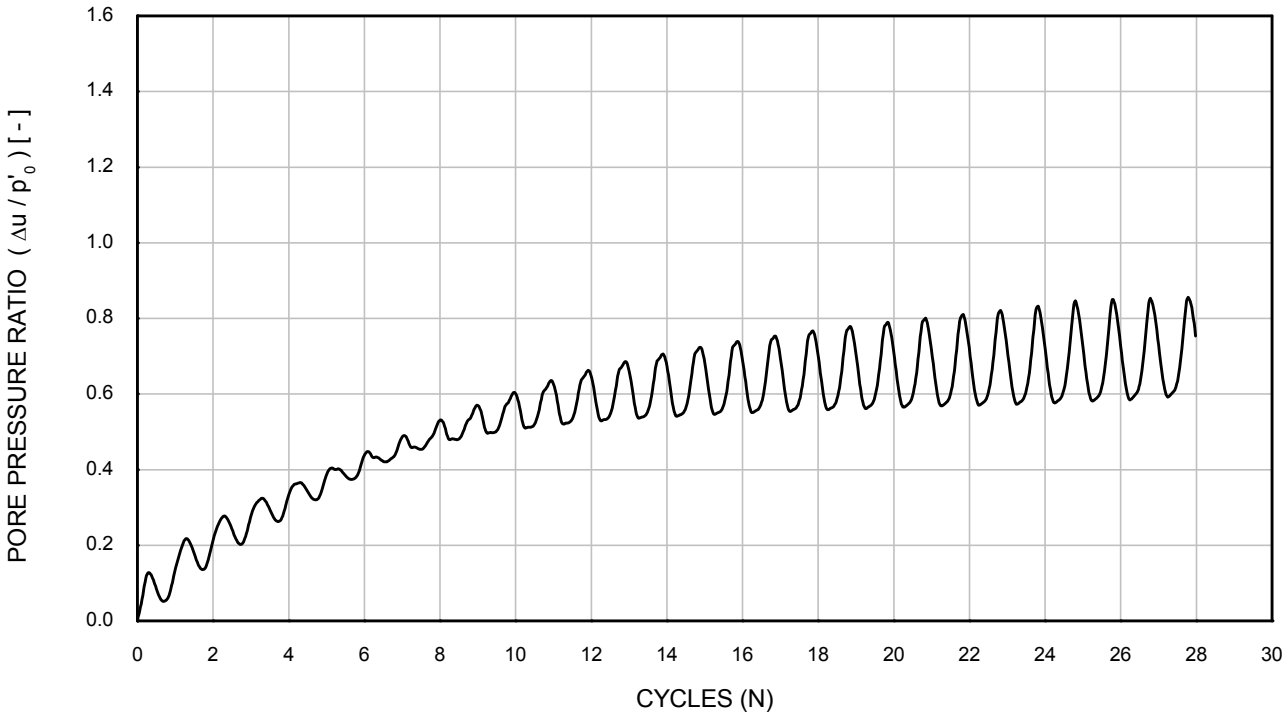




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

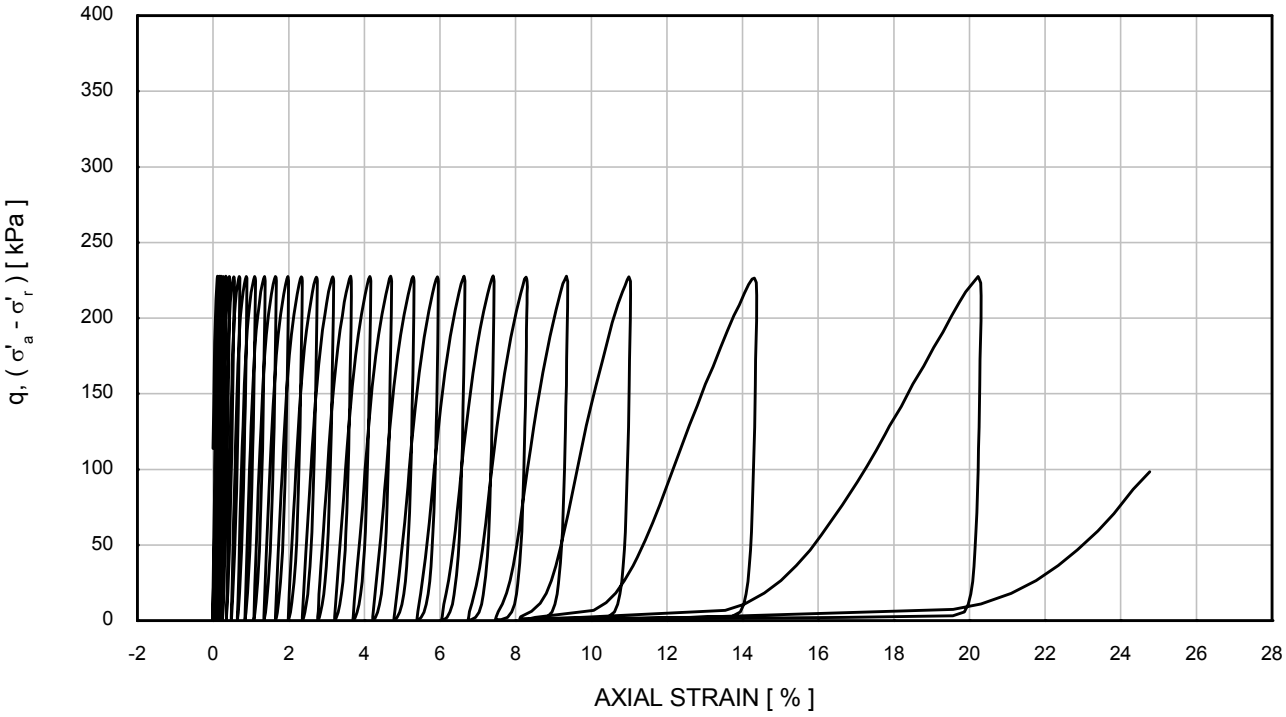
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

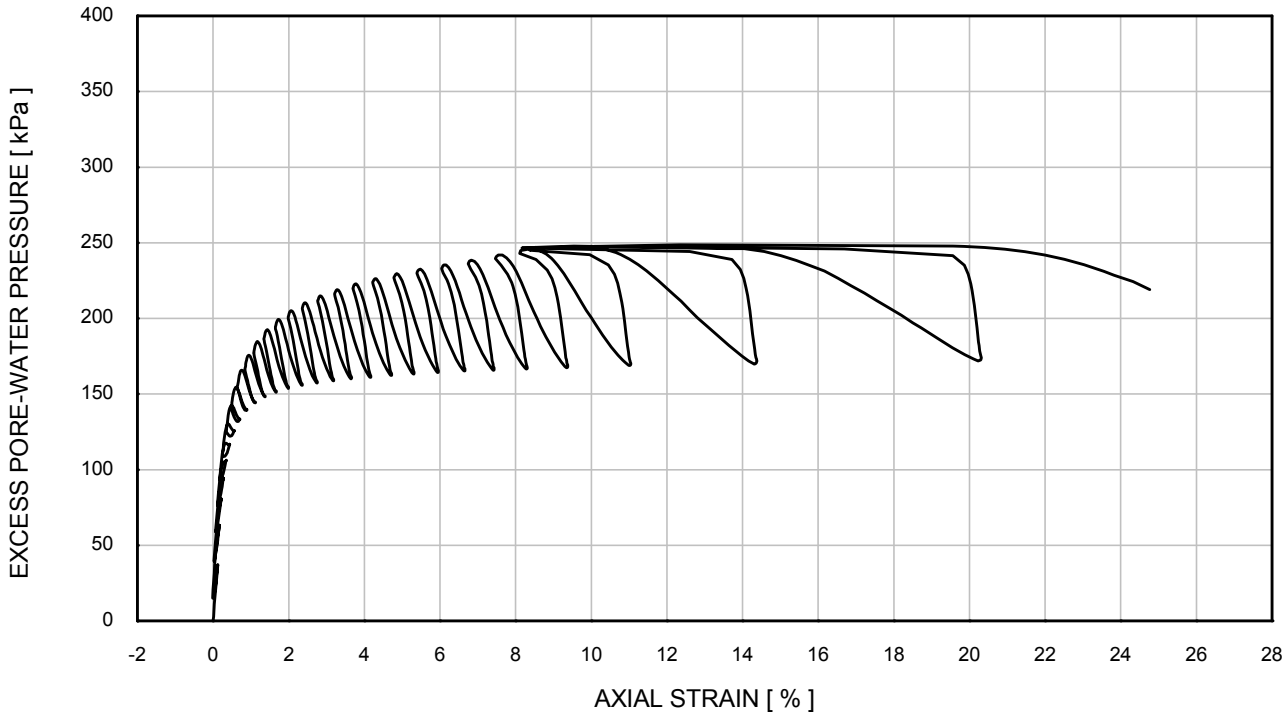




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

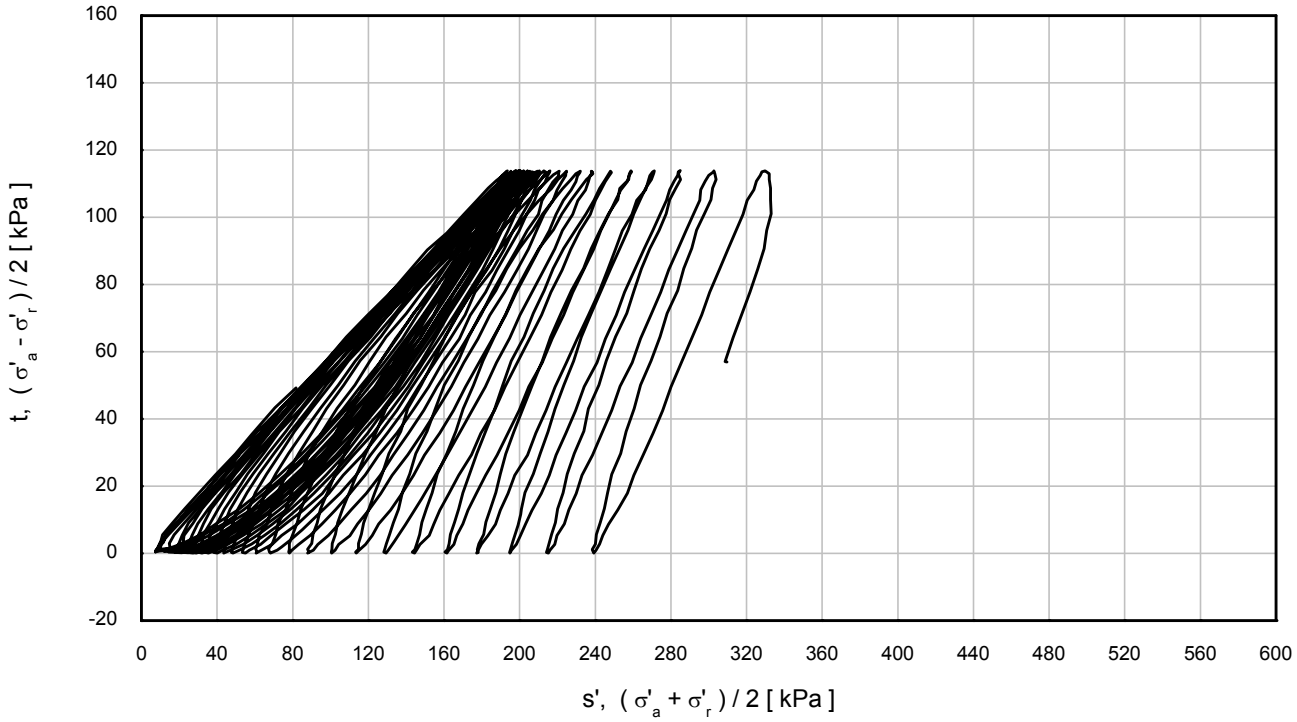
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

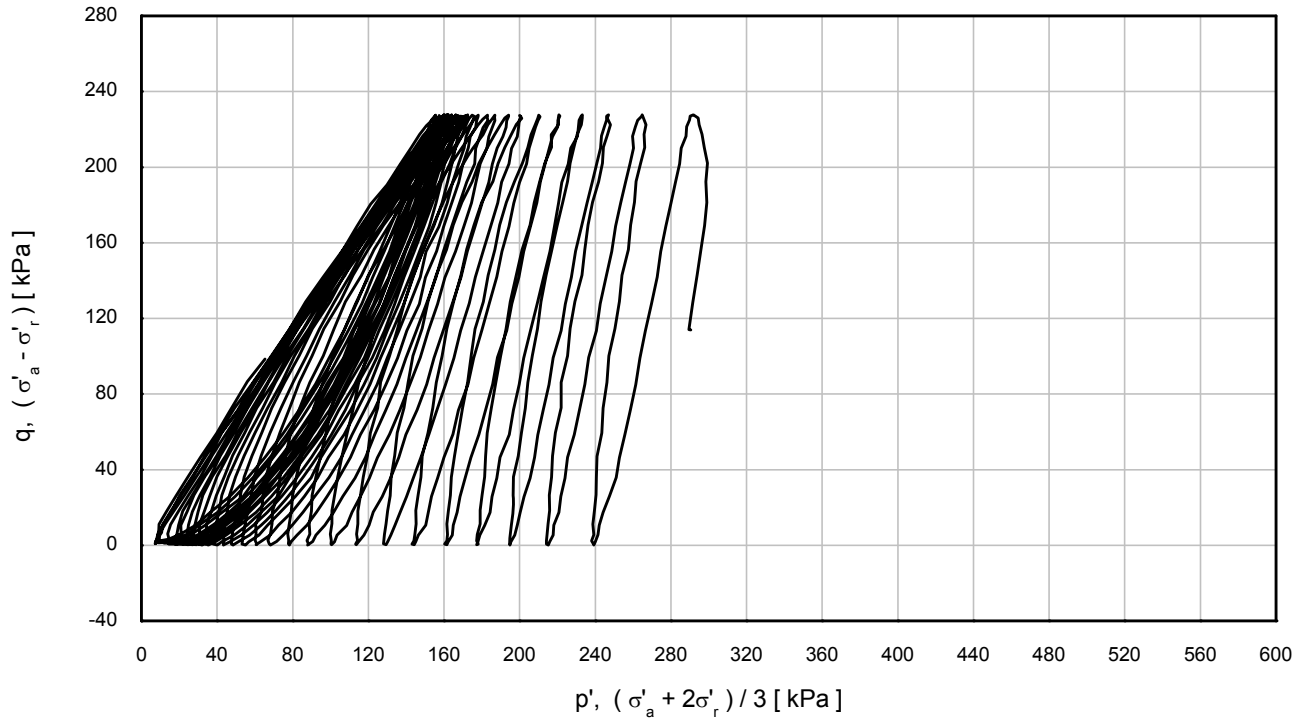




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

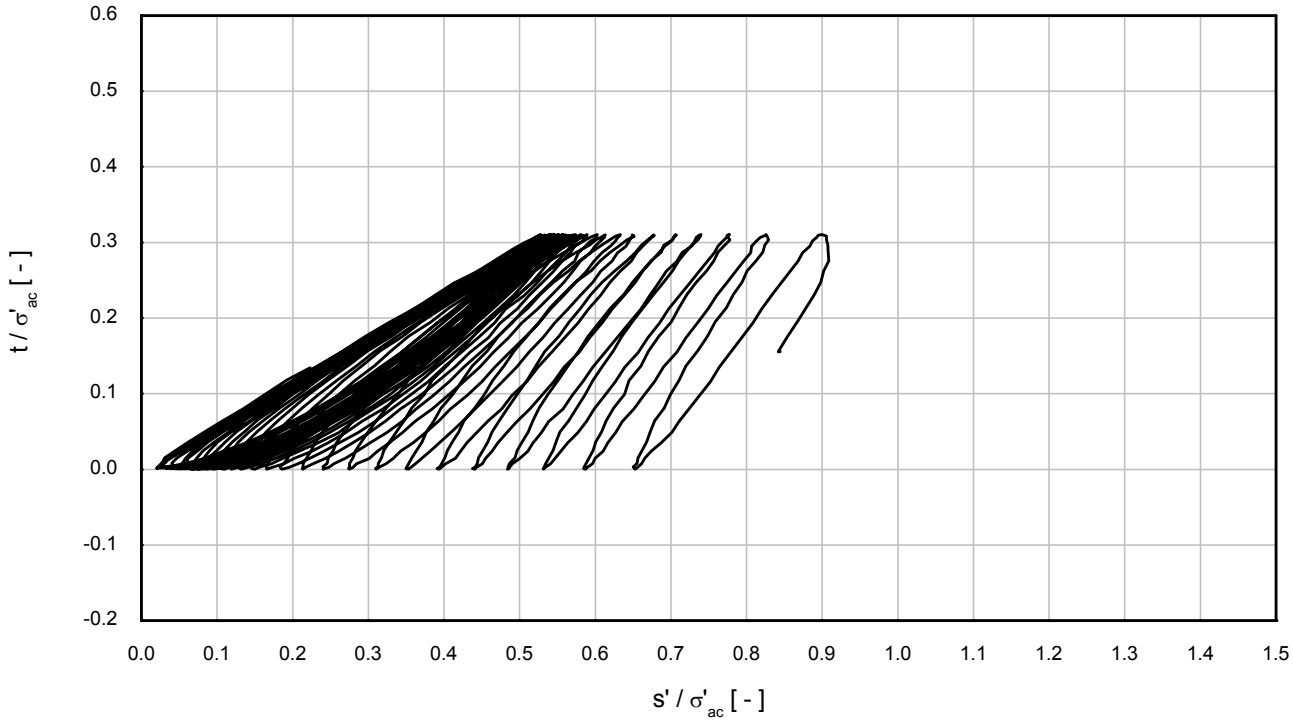
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

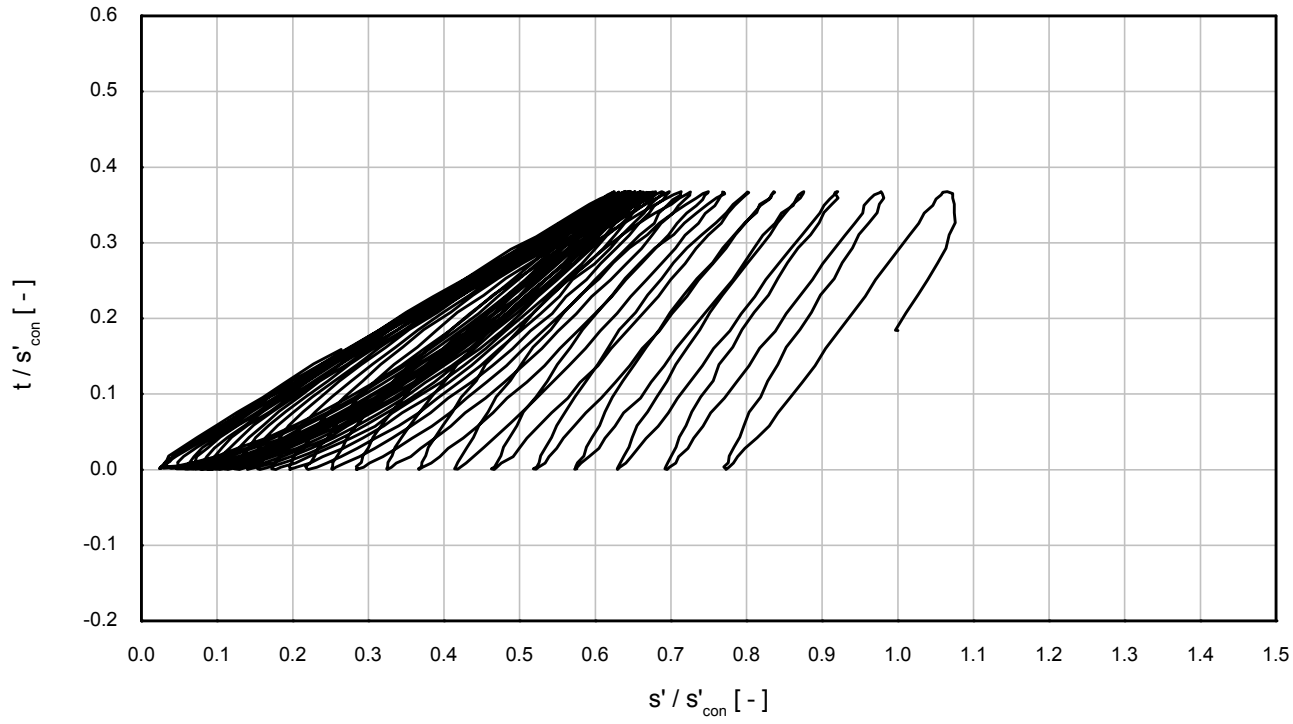




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

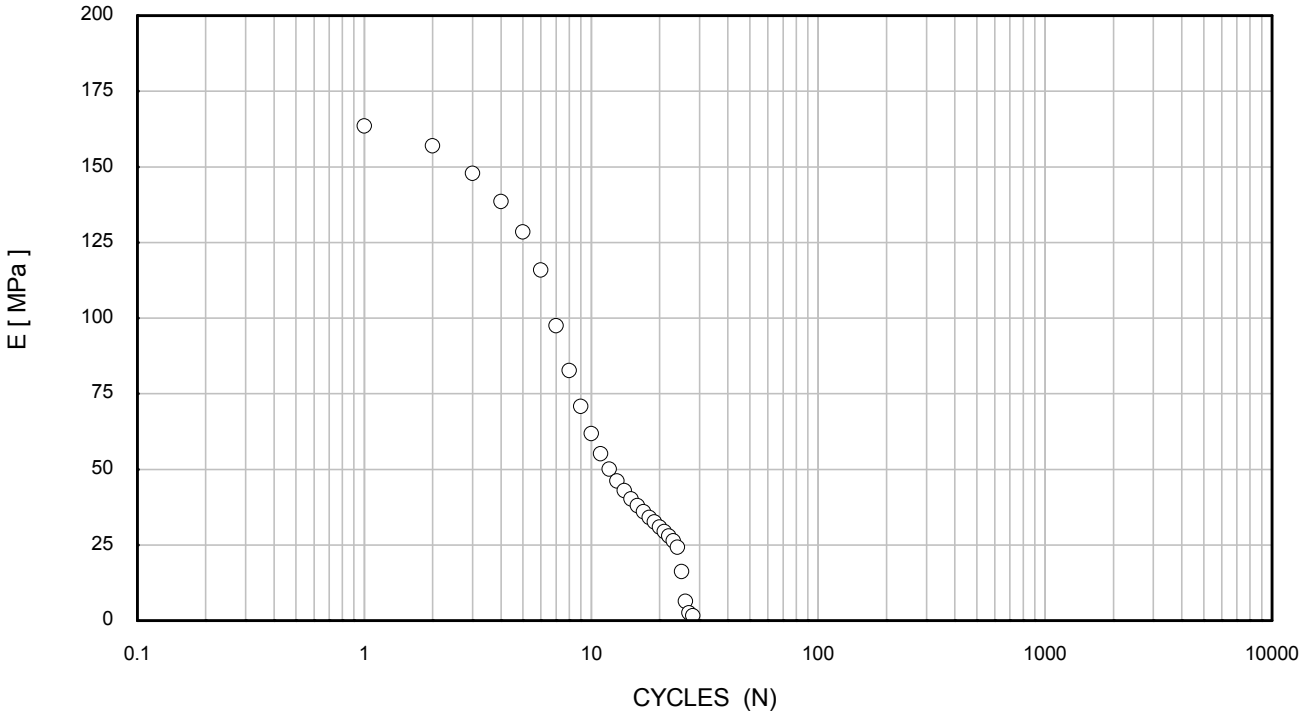
ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

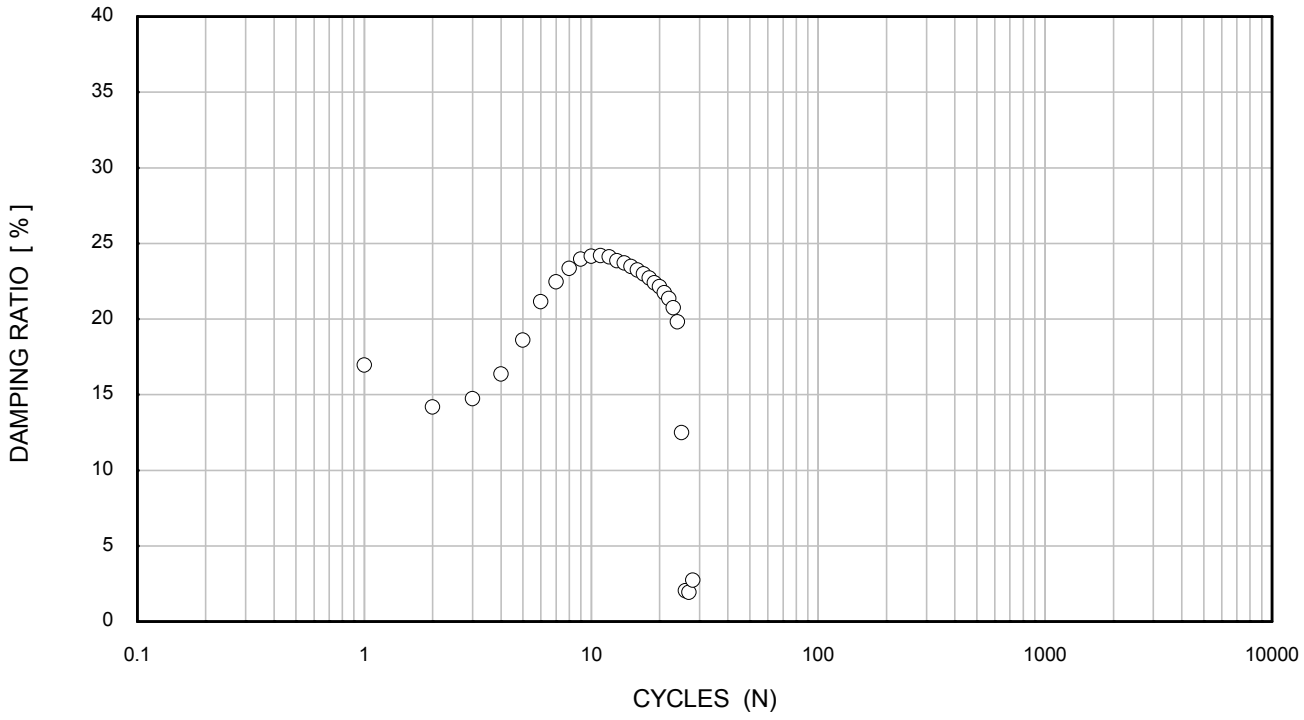




Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED





Initial σ'_r	: 253 kPa	Batch	: 06
Initial σ'_a	: 367 kPa	Sample	: CTX_6-3
q_{av}	: 114 kPa	Unit	: Unit D (Yarmouth Roads)
q_{cy}	: 114 kPa	Test No.	: CTX26
Frequency	: 0.10 Hz		

ANISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - UNDRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium Sand

GENERAL	
Date test started	08/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	140.0
Water content	[%]	9.7
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.600
Degree of saturation	[%]	43
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch01_CTXL01_CTXL
Processed by Date	MG 06/01/2017
Checked by Date	JLS 12/01/2017
Approved by Date	AR 12/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	800
Base PWP	[kPa]	786
Mid height PWP	[kPa]	-
B value achieved	[-]	0.96

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	806
Back pressure	[kPa]	786
Base PWP	[kPa]	786
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.43
External axial strain	[%]	-0.02
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

DRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	806
Back pressure	[kPa]	786
Base PWP	[kPa]	786
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	32
Deviator stress	[kPa]	12
Volumetric strain	[%]	0.01
External axial strain	[%]	0.07
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	122
Mean q_{av}	[kPa]	12
Mean q_{cy}	[kPa]	12
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
External ε_{av} at N	[%]	0.89
External ε_{cy} at N	[%]	0.02
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	0
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.8
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.605
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.51	0.02	48.39	-	7.72	-
2	0.51	0.02	47.80	-	7.35	-
5	0.51	0.02	48.51	-	7.65	-
10	0.52	0.02	47.92	-	7.10	-
20	0.52	0.02	48.90	-	5.23	-
30	0.53	0.02	49.34	-	6.48	-
40	0.54	0.02	49.83	-	7.08	-
50	0.55	0.02	49.40	-	6.85	-
100	0.58	0.02	48.34	-	7.55	-
500	0.73	0.02	50.91	-	5.76	-
1000	0.82	0.02	50.74	-	5.76	-
1500	0.89	0.02	49.67	-	5.97	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

DRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	806
Back pressure	[kPa]	786
Base PWP	[kPa]	787
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	19
Effective axial pressure	[kPa]	51
Deviator stress	[kPa]	31
Volumetric strain	[%]	0.18
External axial strain	[%]	0.93
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.8
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.605
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	122
Mean q_{av}	[kPa]	31
Mean q_{cy}	[kPa]	37
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
External ε_{av} at N	[%]	3.49
External ε_{cy} at N	[%]	0.06
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	-5
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.9
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.607
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.98	0.09	43.56	-	21.22	-
2	1.03	0.09	41.94	-	19.46	-
5	1.14	0.08	44.46	-	18.16	-
10	1.27	0.08	48.08	-	16.68	-
20	1.44	0.07	52.60	-	15.28	-
30	1.56	0.07	55.12	-	14.53	-
40	1.65	0.07	56.50	-	13.87	-
50	1.73	0.06	58.25	-	13.32	-
100	2.06	0.06	59.67	-	12.74	-
200	2.56	0.06	61.62	-	12.60	-
300	3.02	0.06	60.34	-	12.55	-
400	3.49	0.06	59.60	-	12.72	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





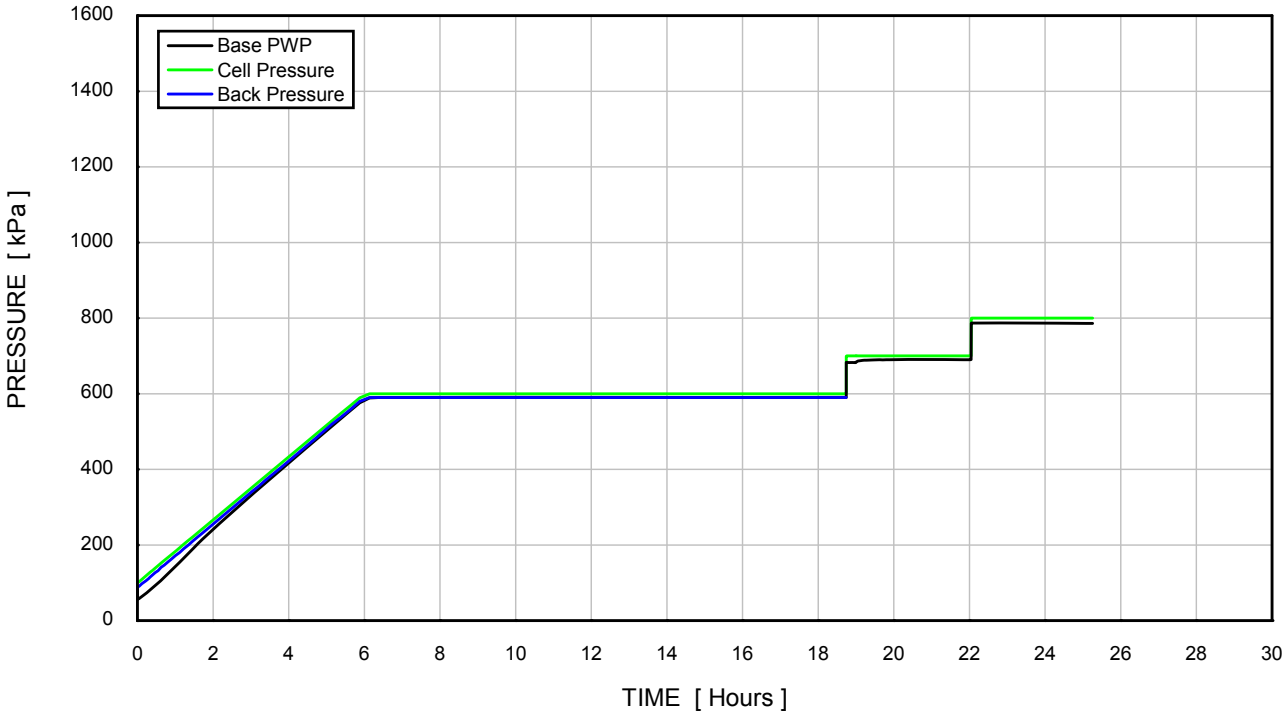
FINAL CONDITIONS

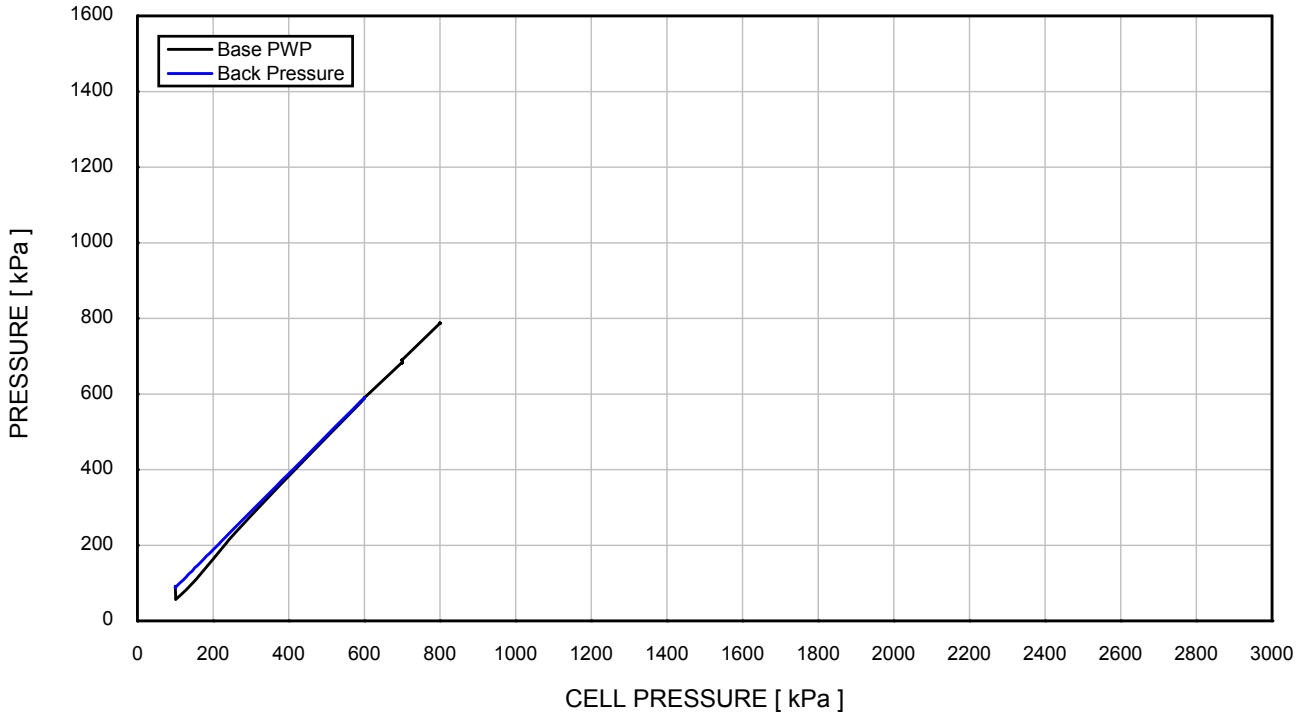
Water content	[%]	24.2
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.61

TEST IDENTIFICATION

Batch	1
Sample	CTX_1-4
Unit	Unit A (Southern Bight)
Test number	CTX01

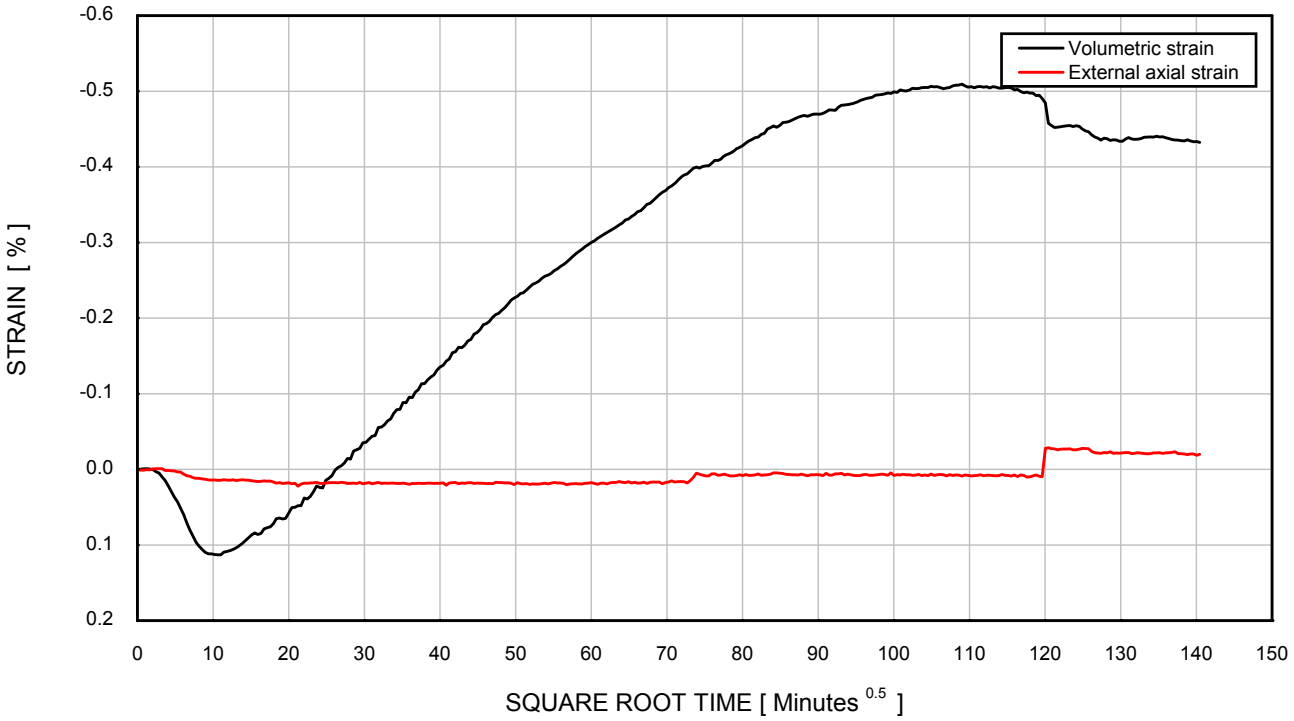
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

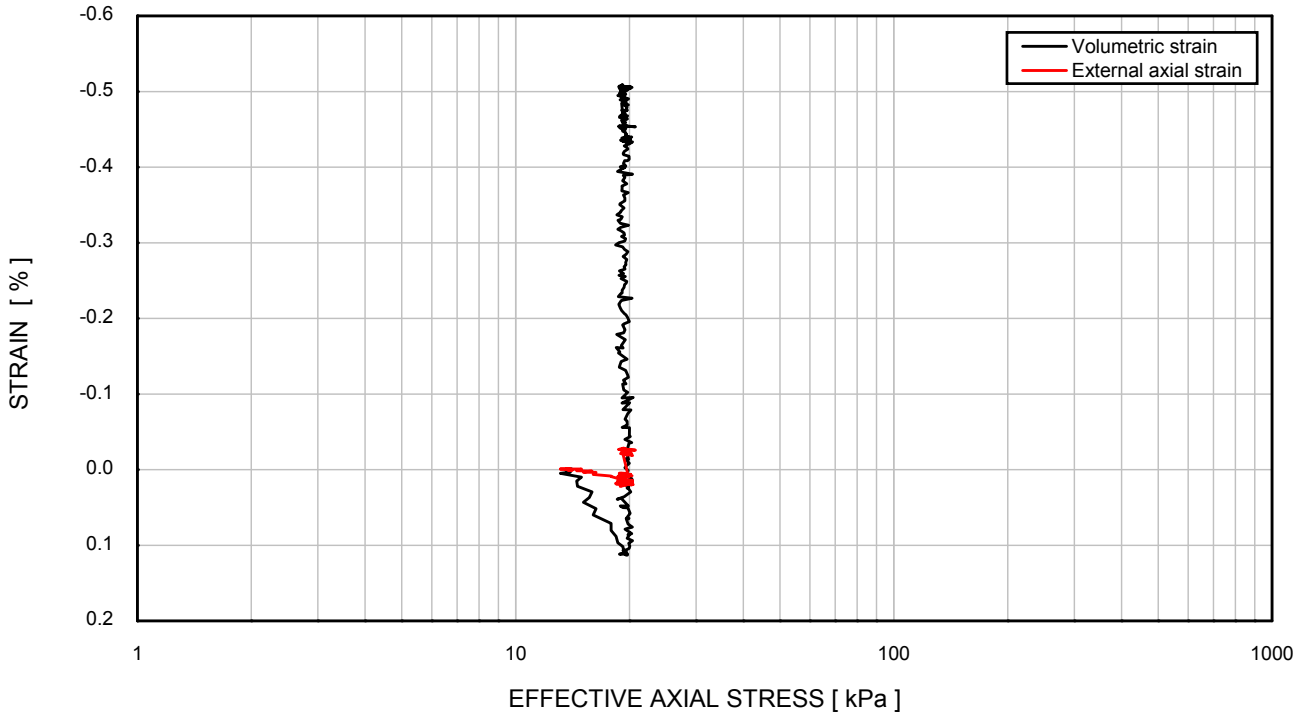




B value	:	0.96			
Initial σ'_r	:	8	kPa	Batch	: 1
Initial σ'_a	:	8	kPa	Sample	: CTX_1-4
Final σ'_r	:	14	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	14	kPa	Test No.	: CTX01

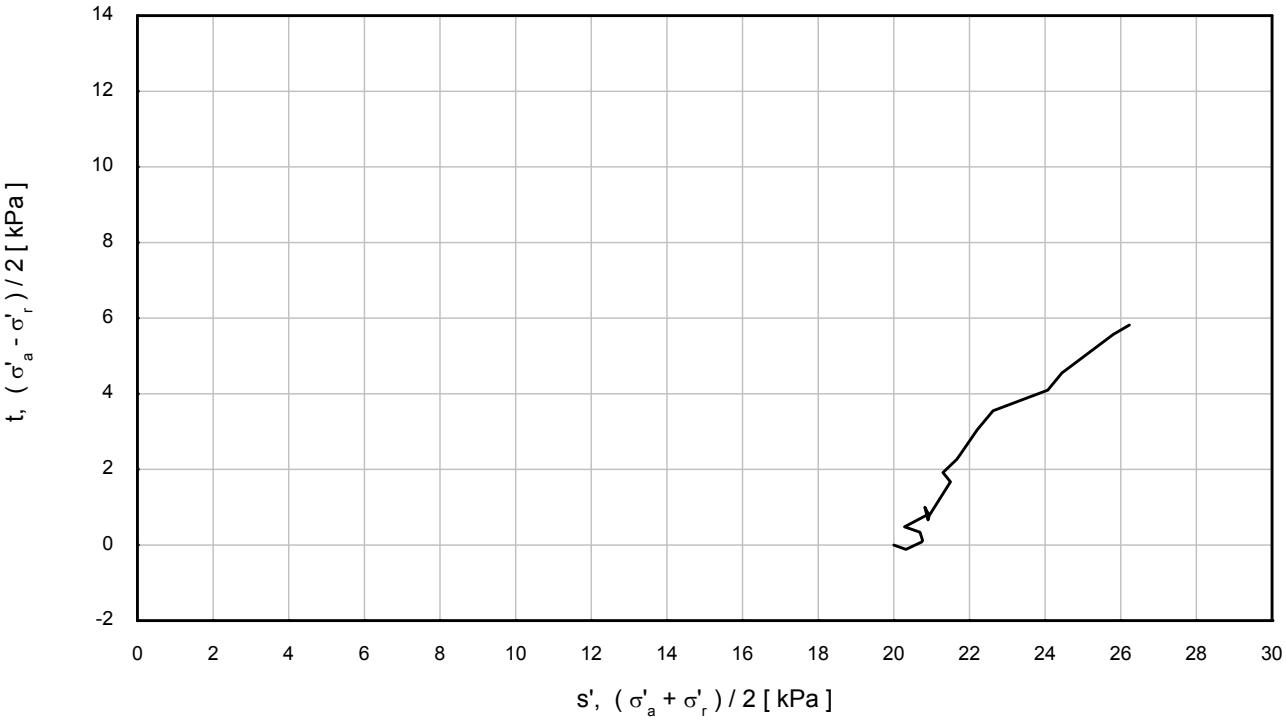
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

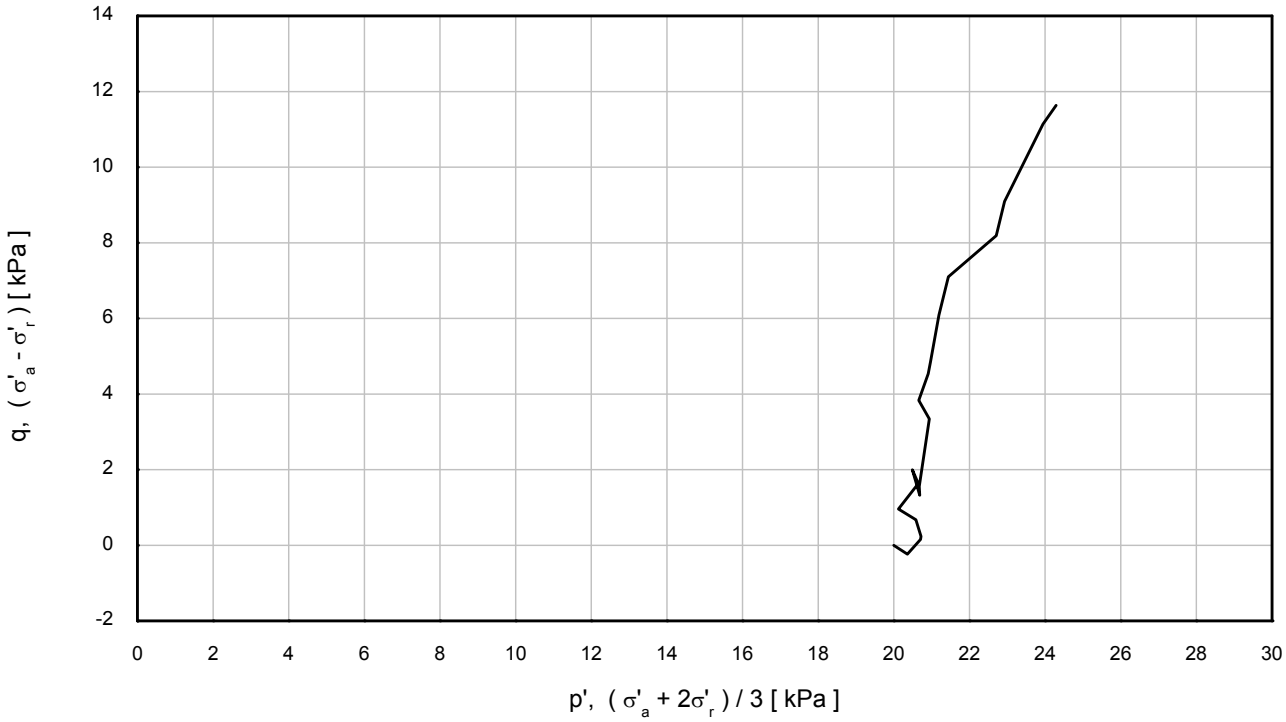




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	20 kPa	Sample	:	CTX_1-4
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX01

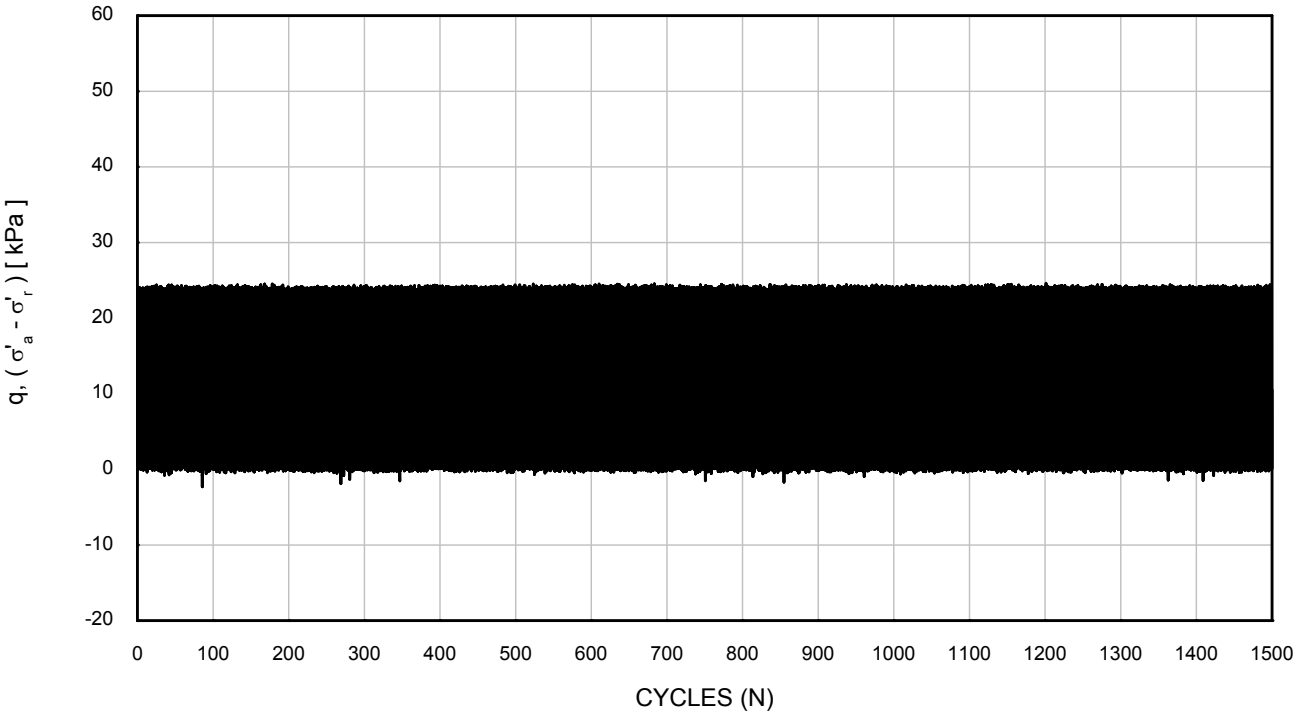
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

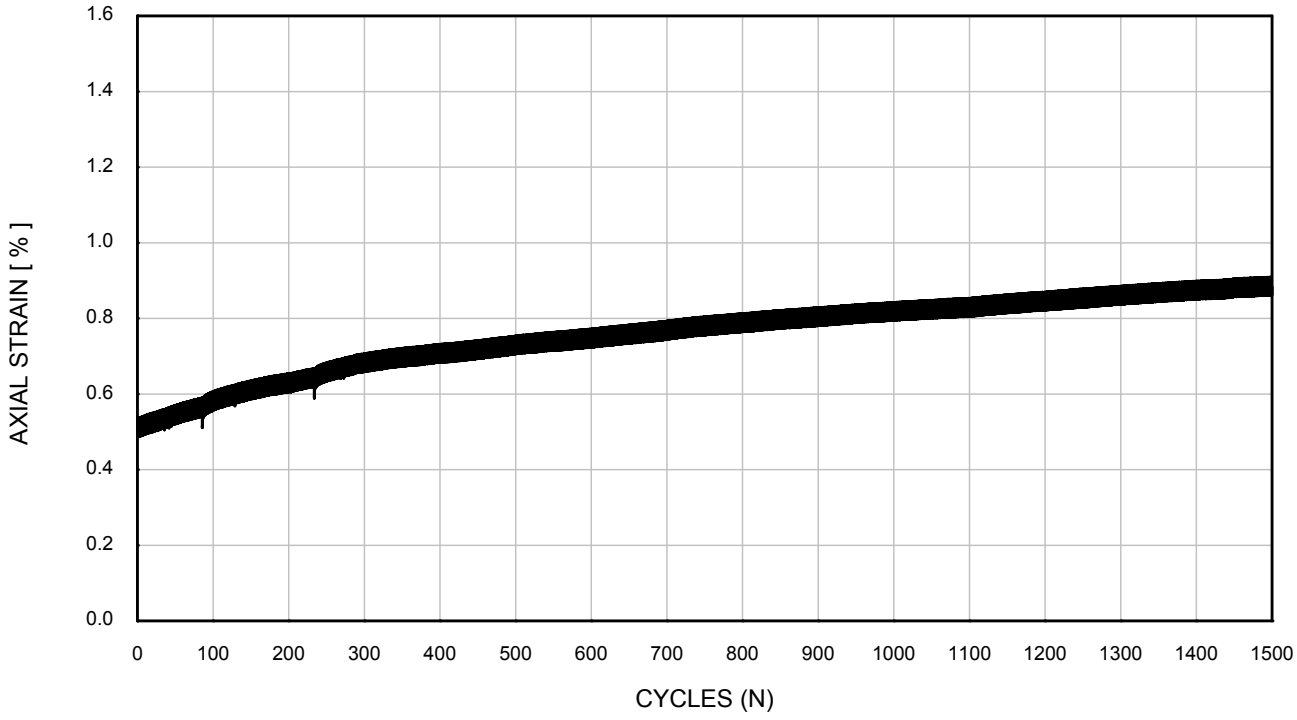




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	32 kPa	Sample	:	CTX_1-4
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX01

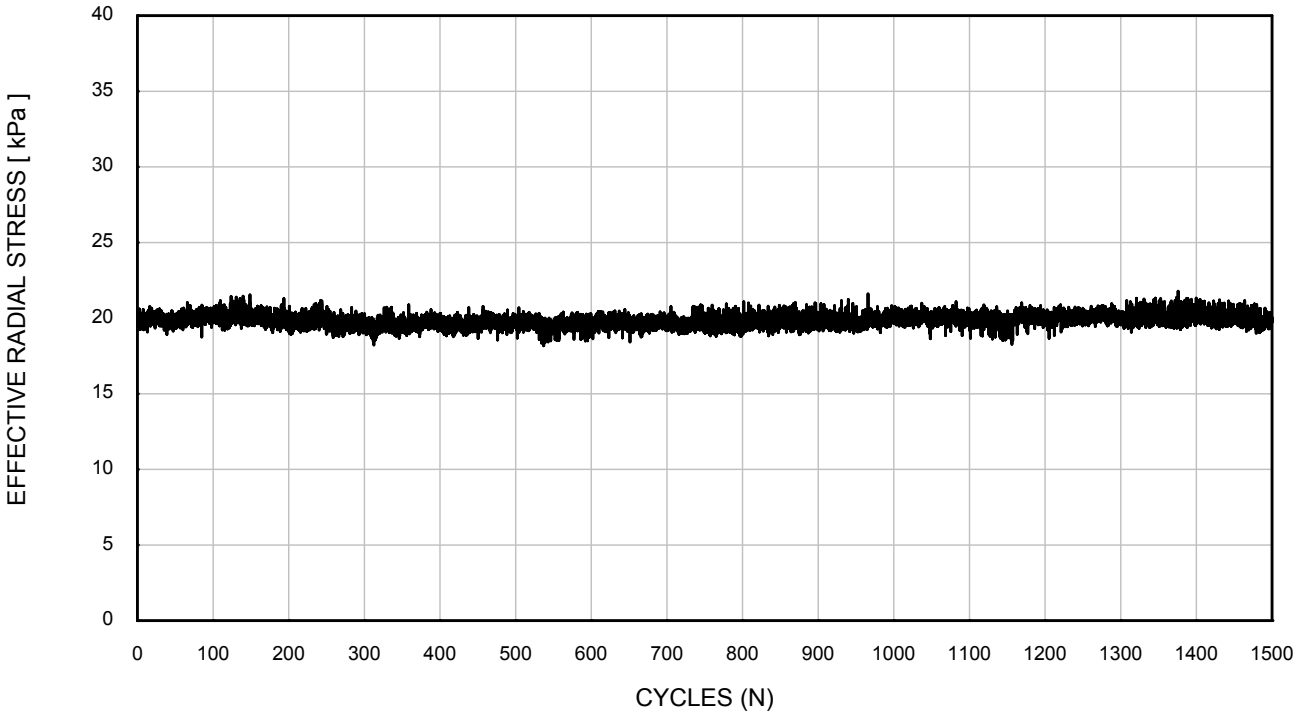
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
DRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

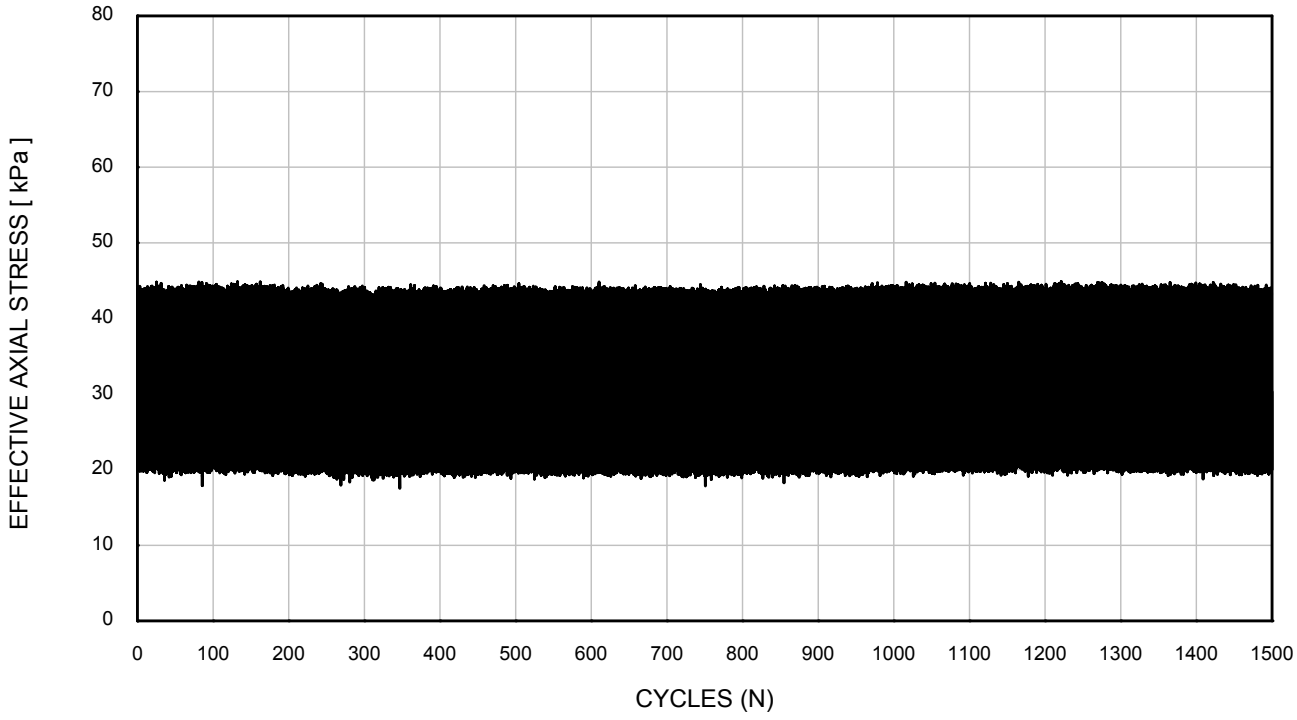




Initial σ'_r	:	20 kPa	Batch	: 1
Initial σ'_a	:	31 kPa	Sample	: CTX_1-4
q_{av}	:	12 kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	12 kPa	Test No.	: CTX01
Frequency	:	0.10 Hz		

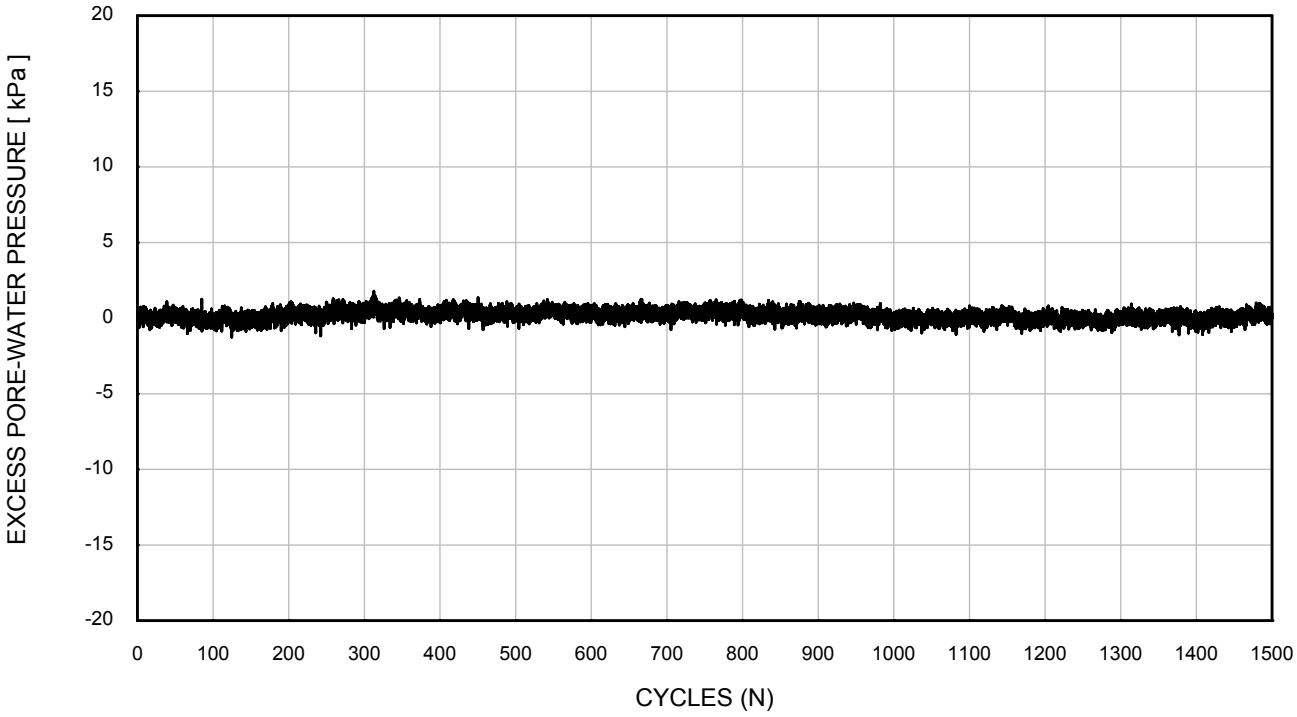
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

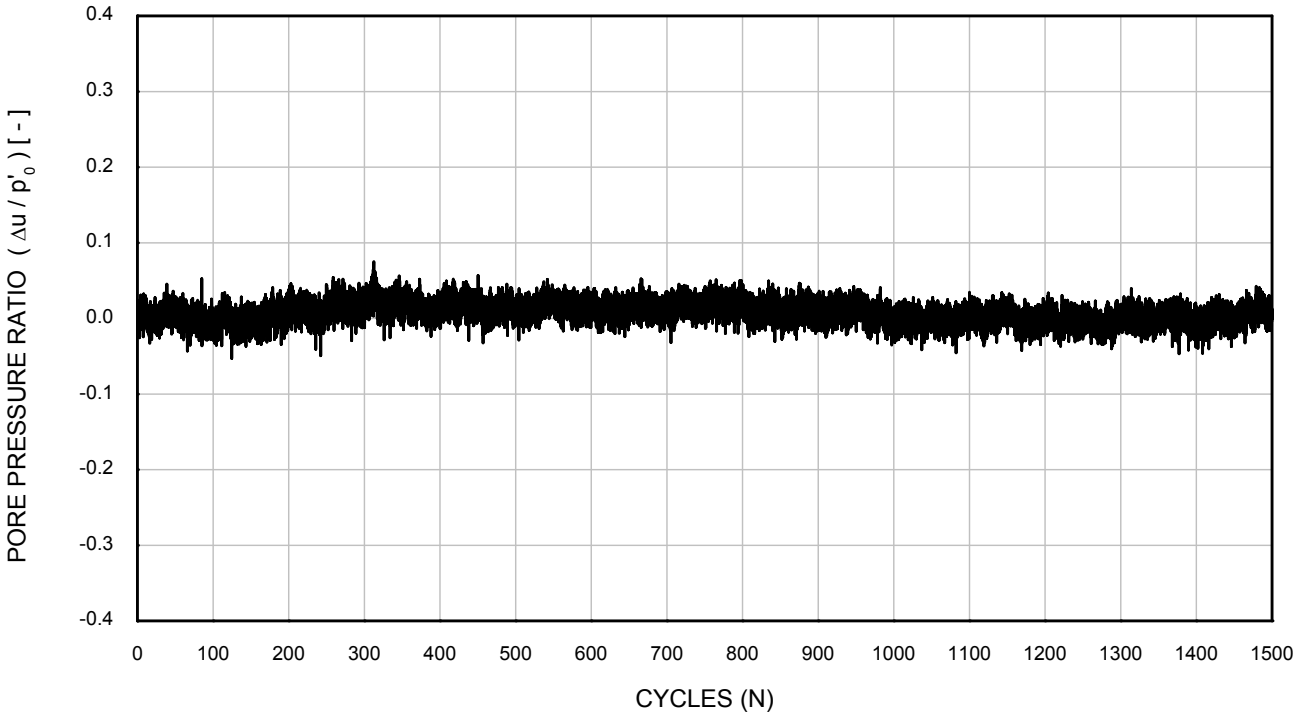




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	31 kPa	Sample	:	CTX_1-4
q_{av}	:	12 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	12 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

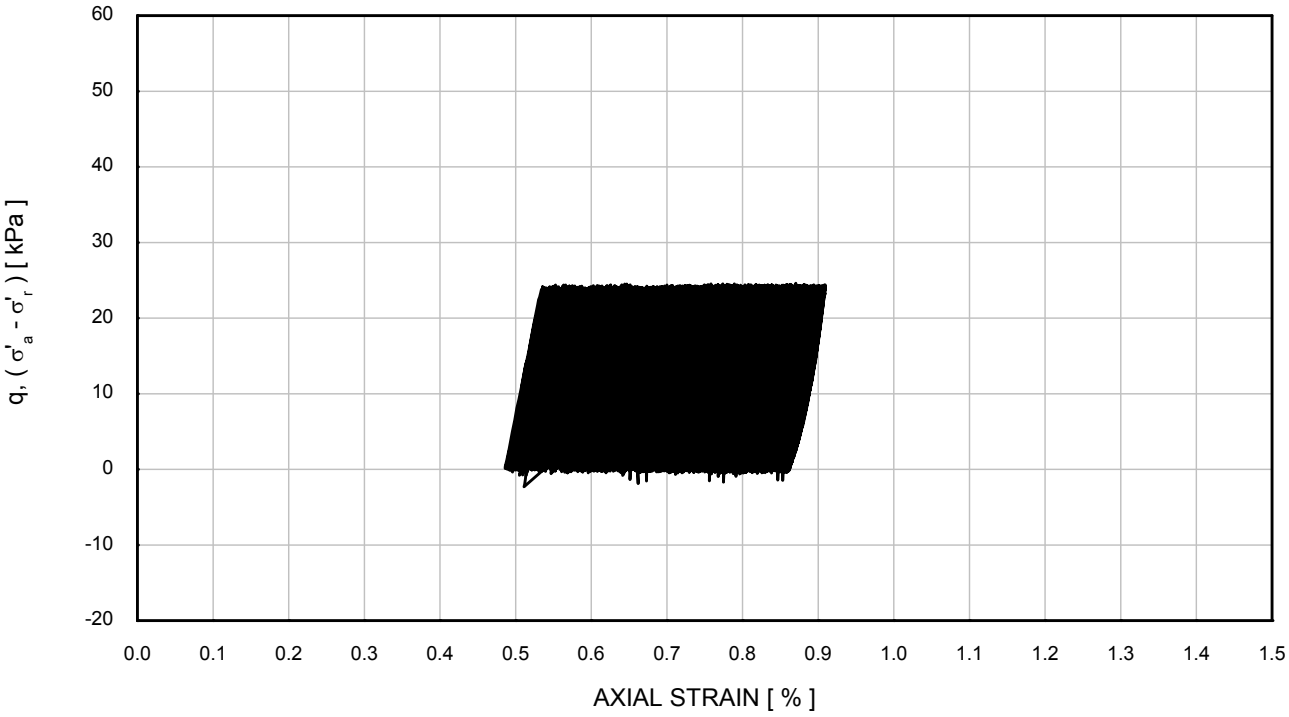
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

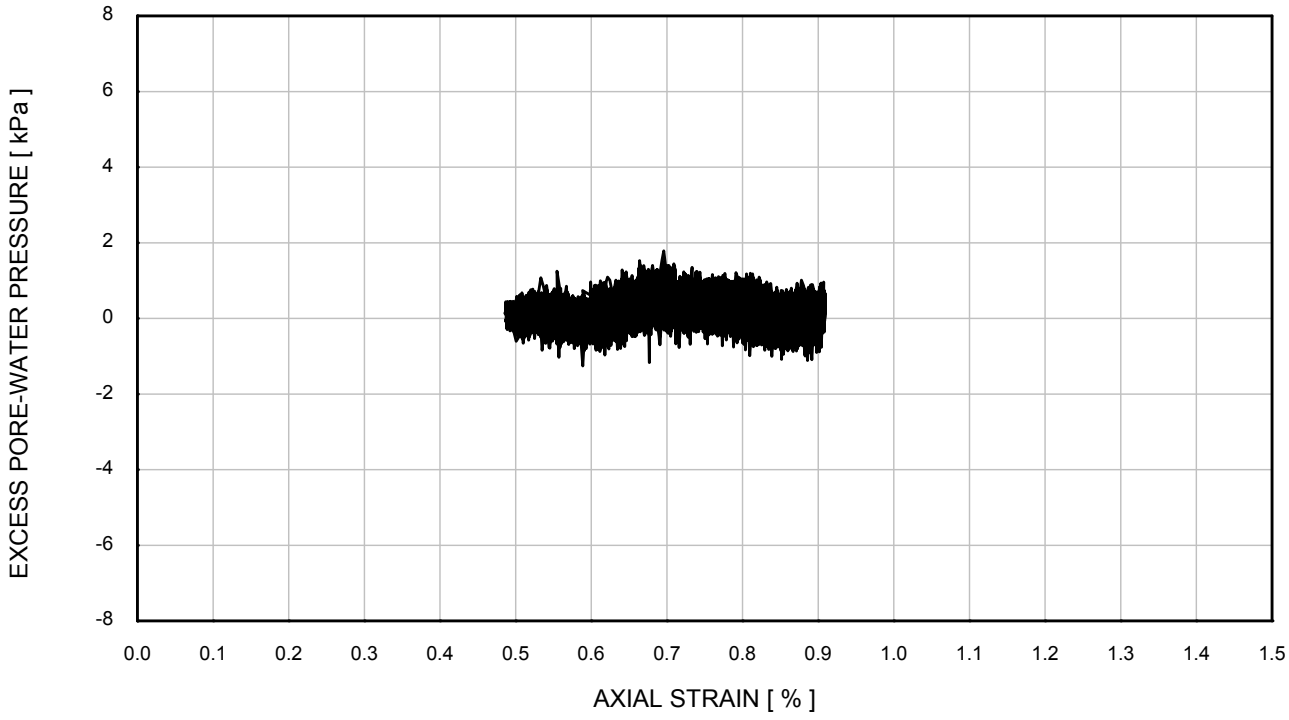




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	31 kPa	Sample	:	CTX_1-4
q_{av}	:	12 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	12 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

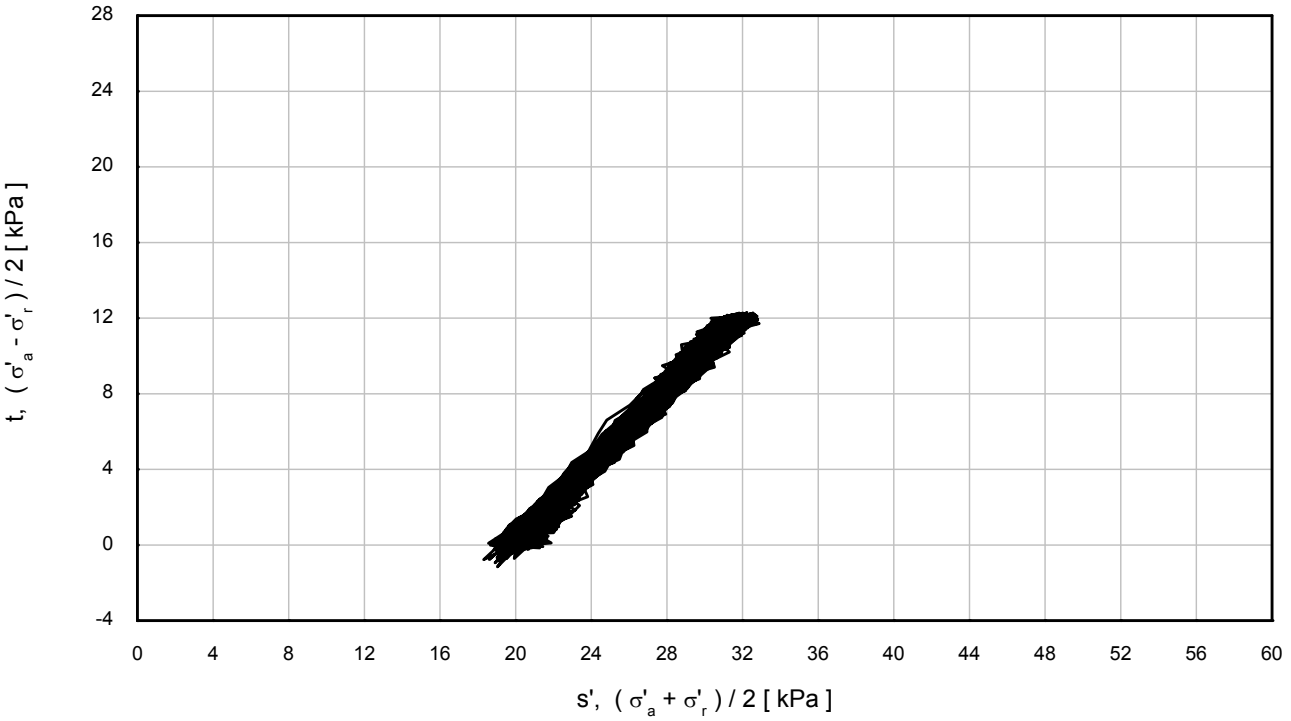
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

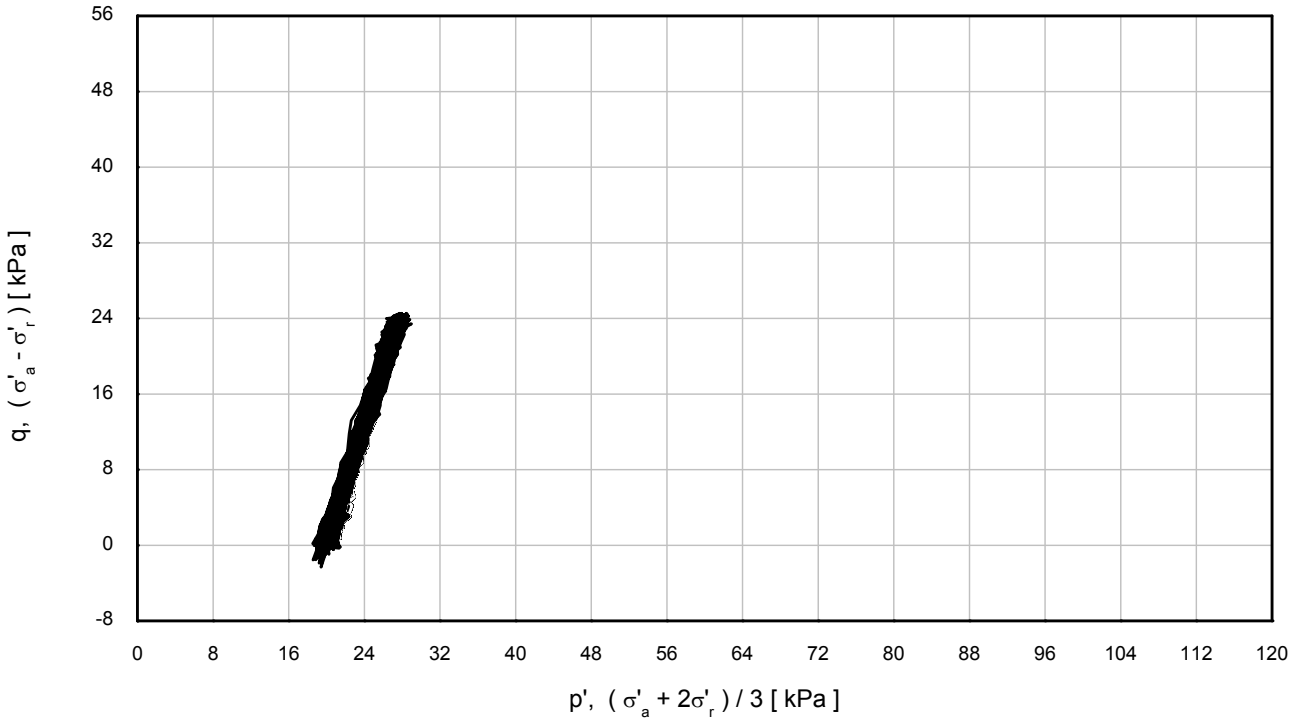




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	31 kPa	Sample	:	CTX_1-4
q_{av}	:	12 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	12 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

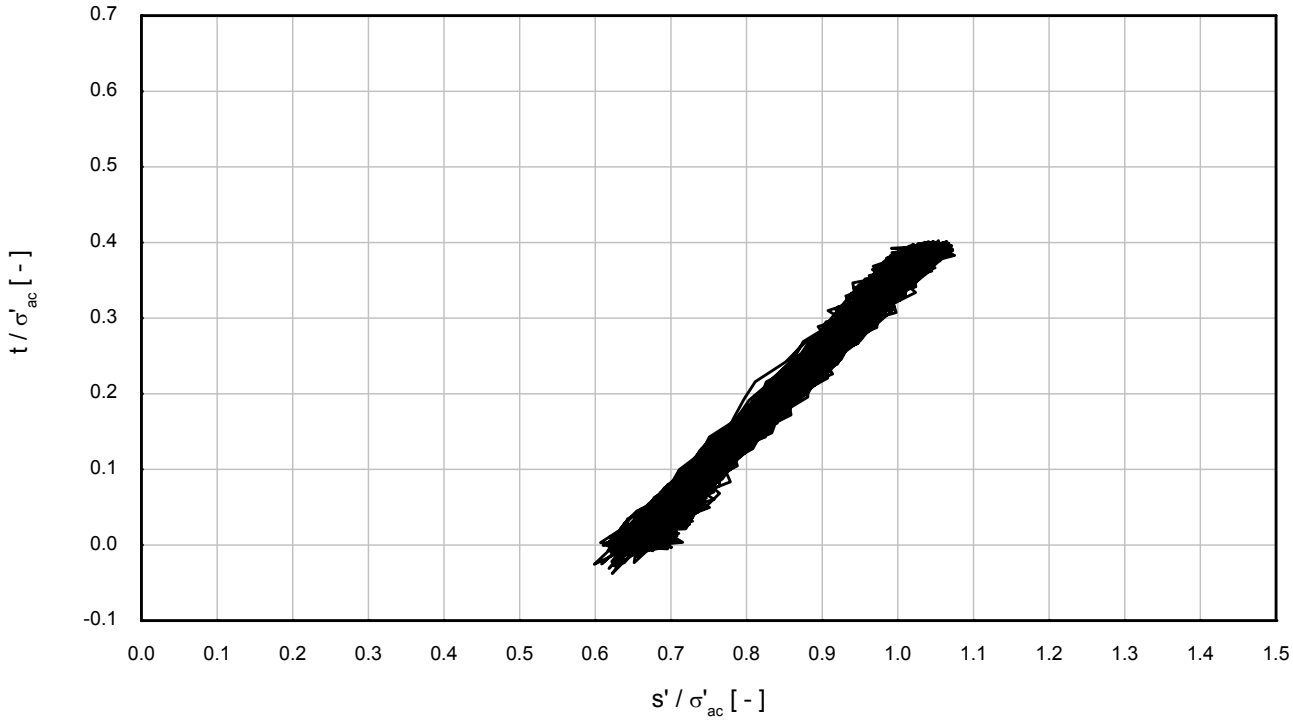
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

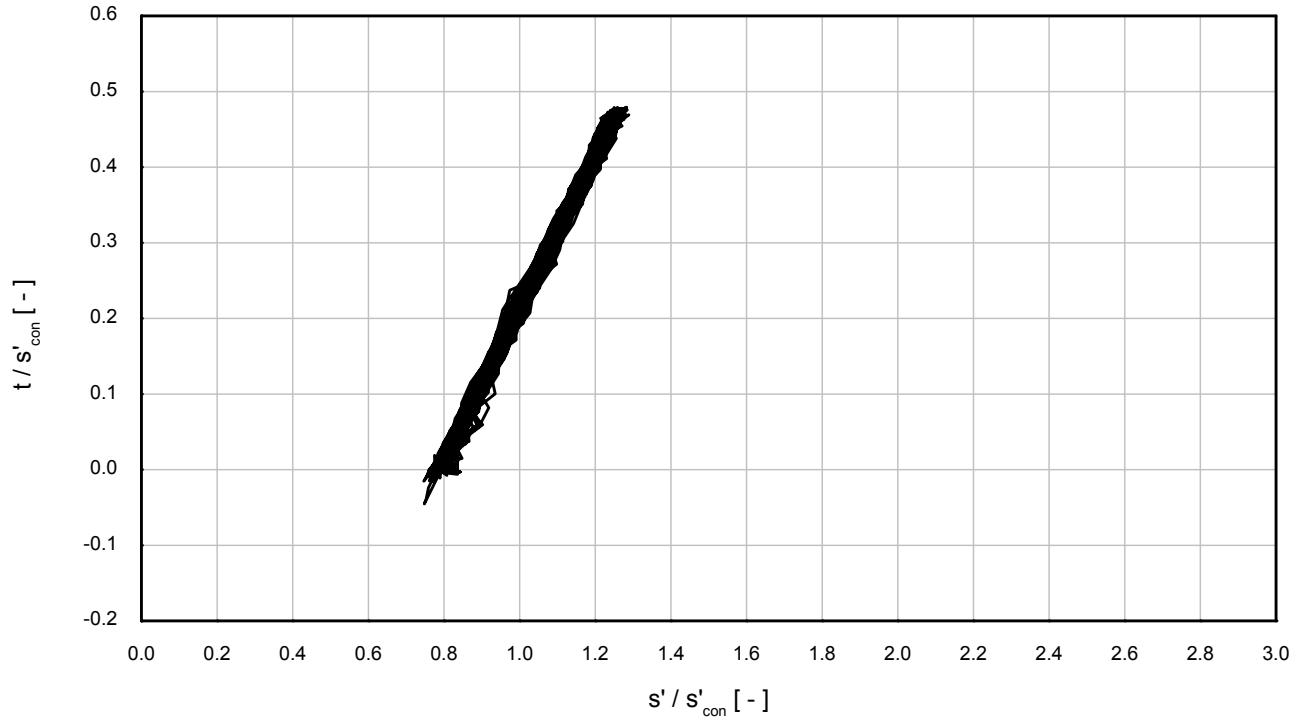




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	31	kPa	Sample	: CTX_1-4
q_{av}	:	12	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	12	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

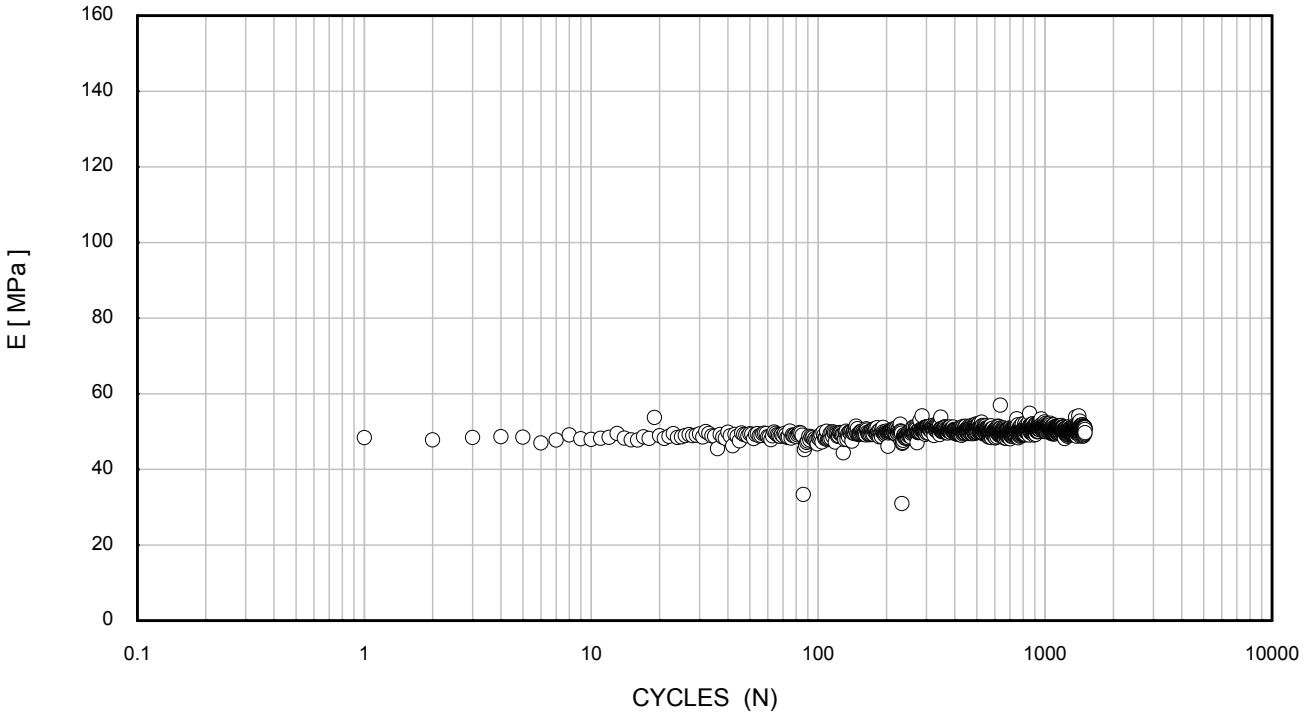
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

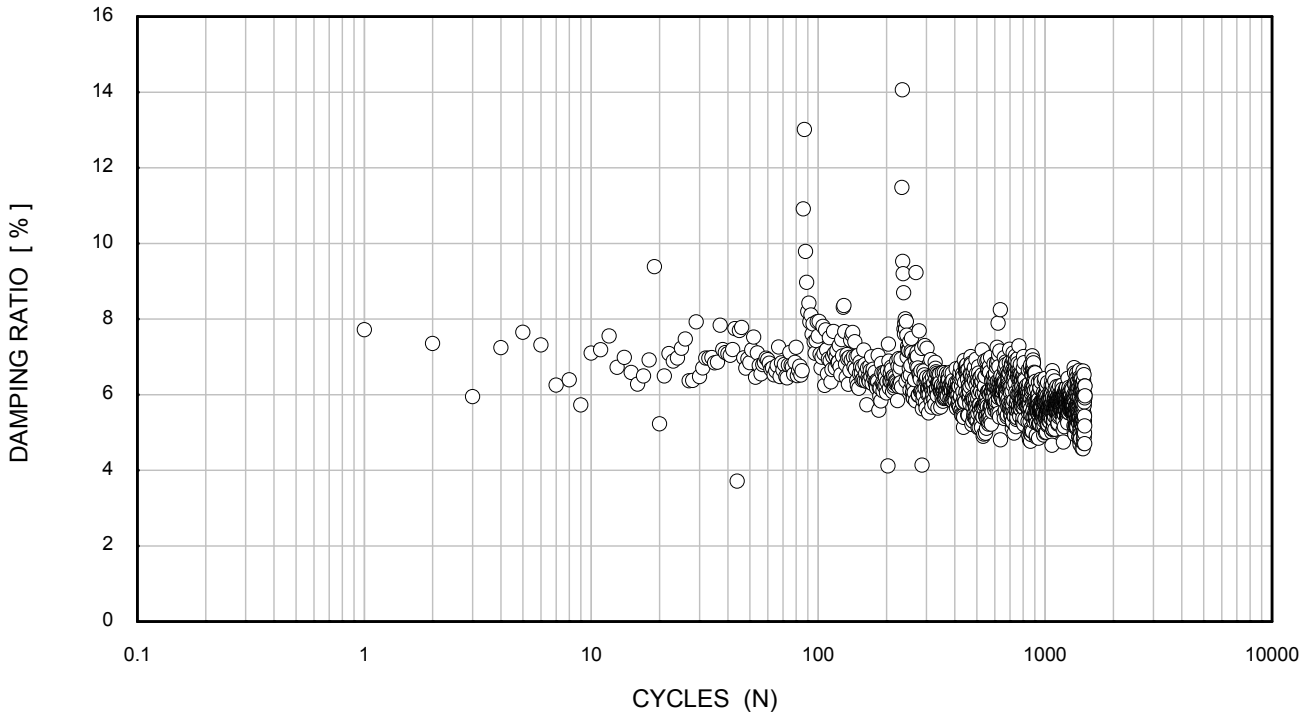




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	31	kPa	Sample	: CTX_1-4
q_{av}	:	12	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	12	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

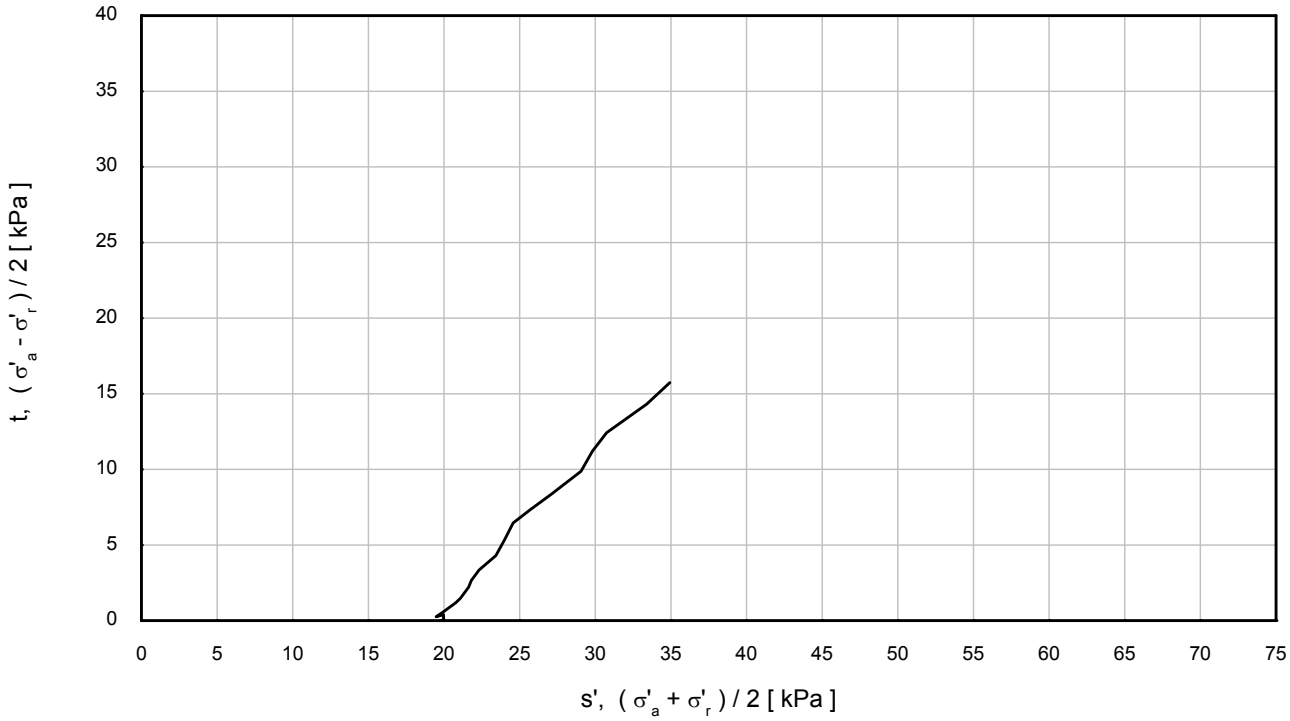
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

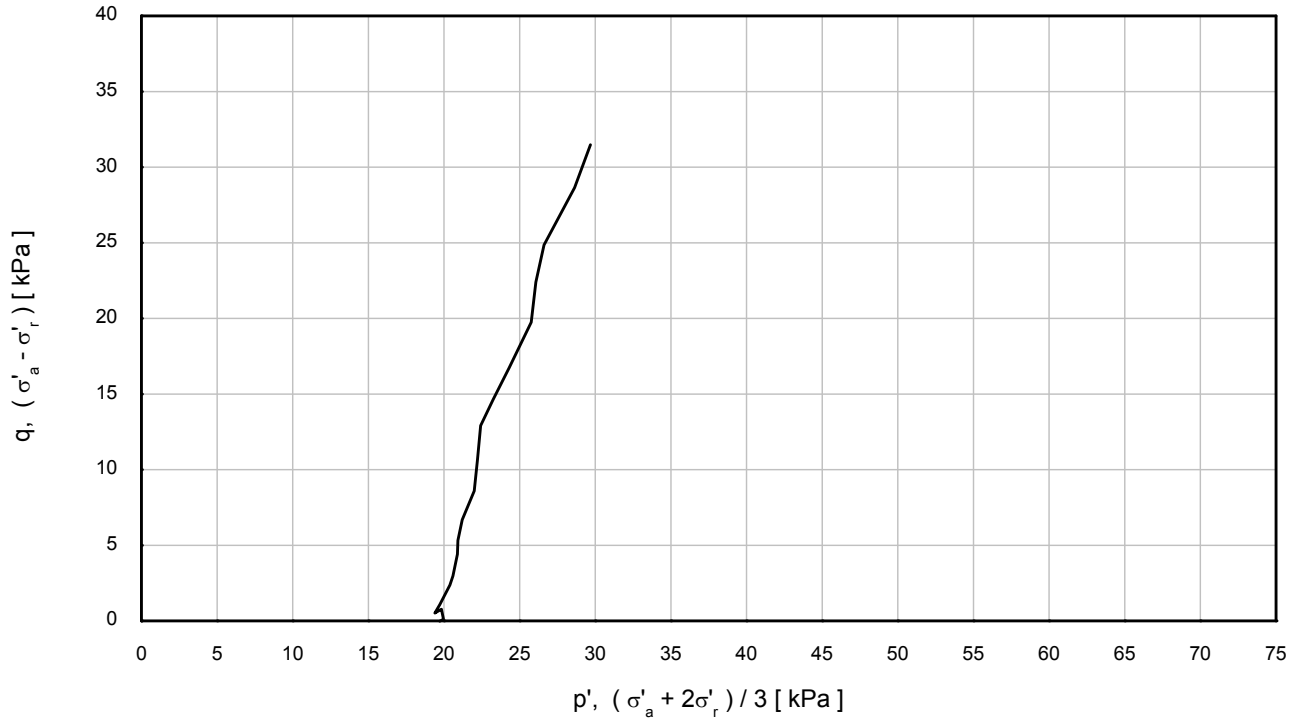




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	31 kPa	Sample	:	CTX_1-4
q_{av}	:	12 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	12 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

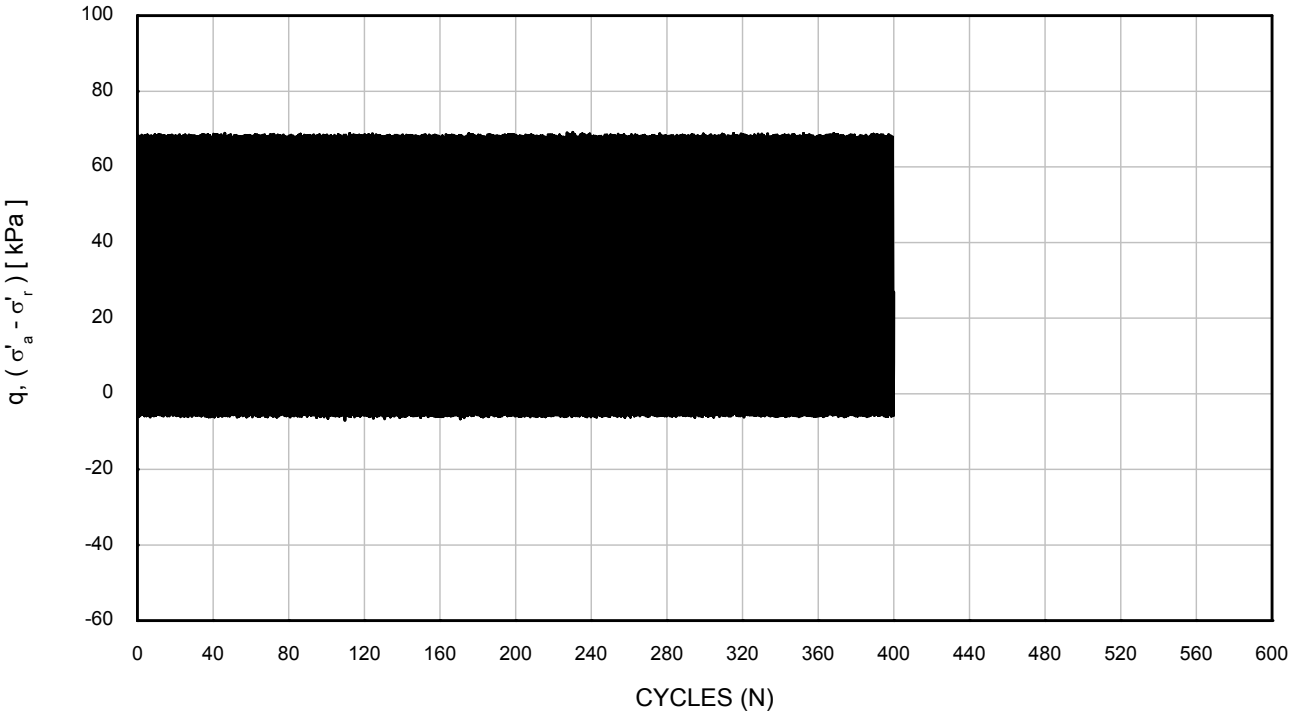
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

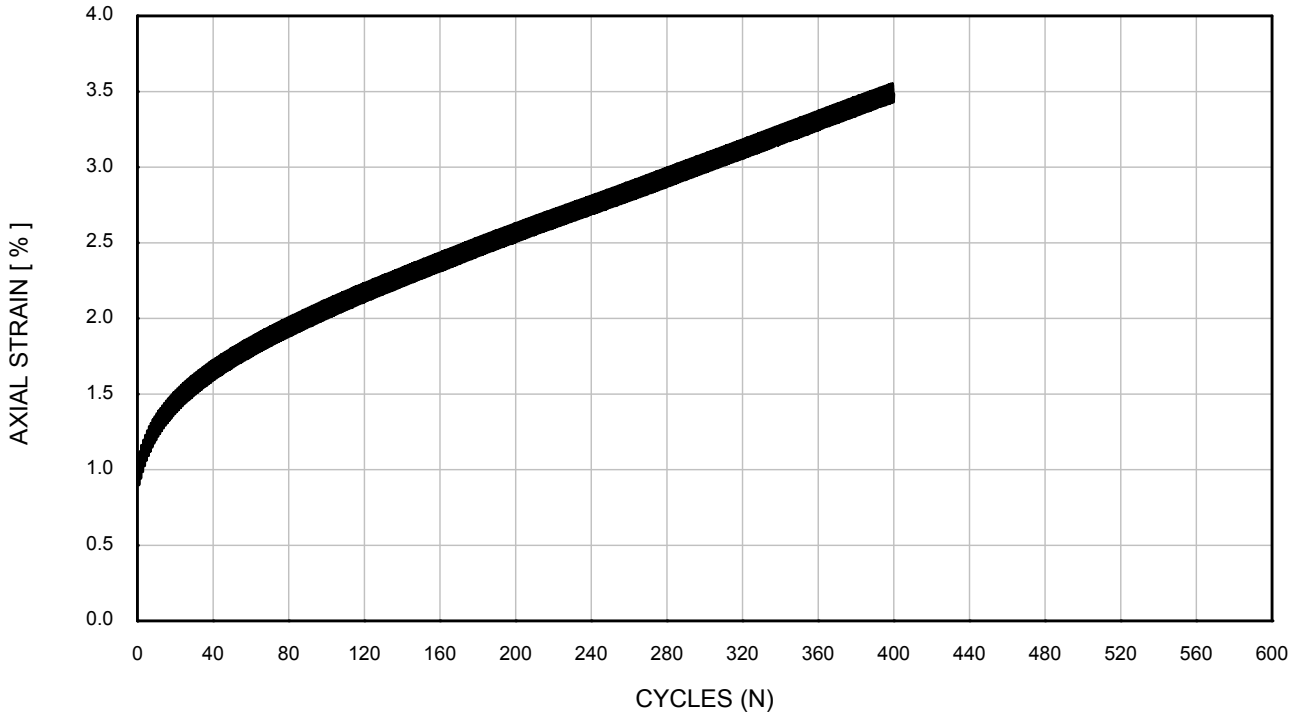




Stage 1 σ'_{rc}	:	19 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	51 kPa	Sample	:	CTX_1-4
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX01

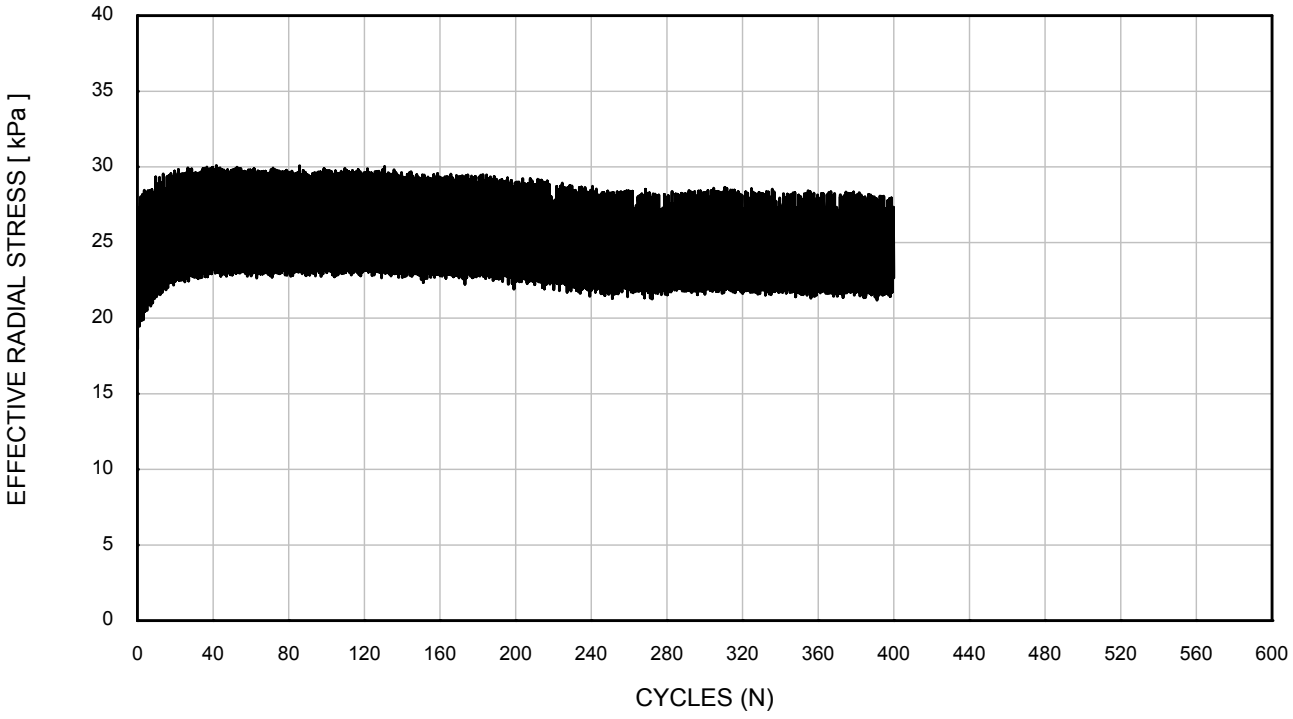
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
DRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

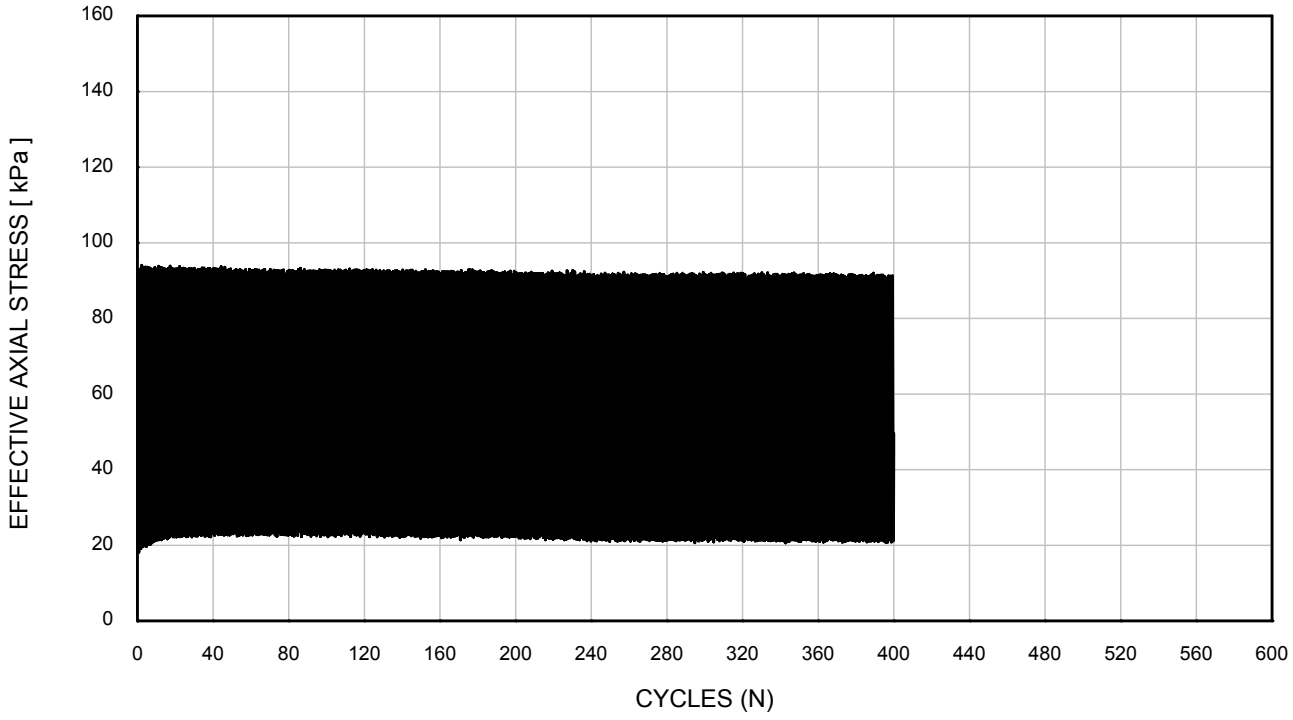




Initial σ'_r	:	19 kPa	Batch	:	1
Initial σ'_a	:	51 kPa	Sample	:	CTX_1-4
q_{av}	:	31 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	37 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

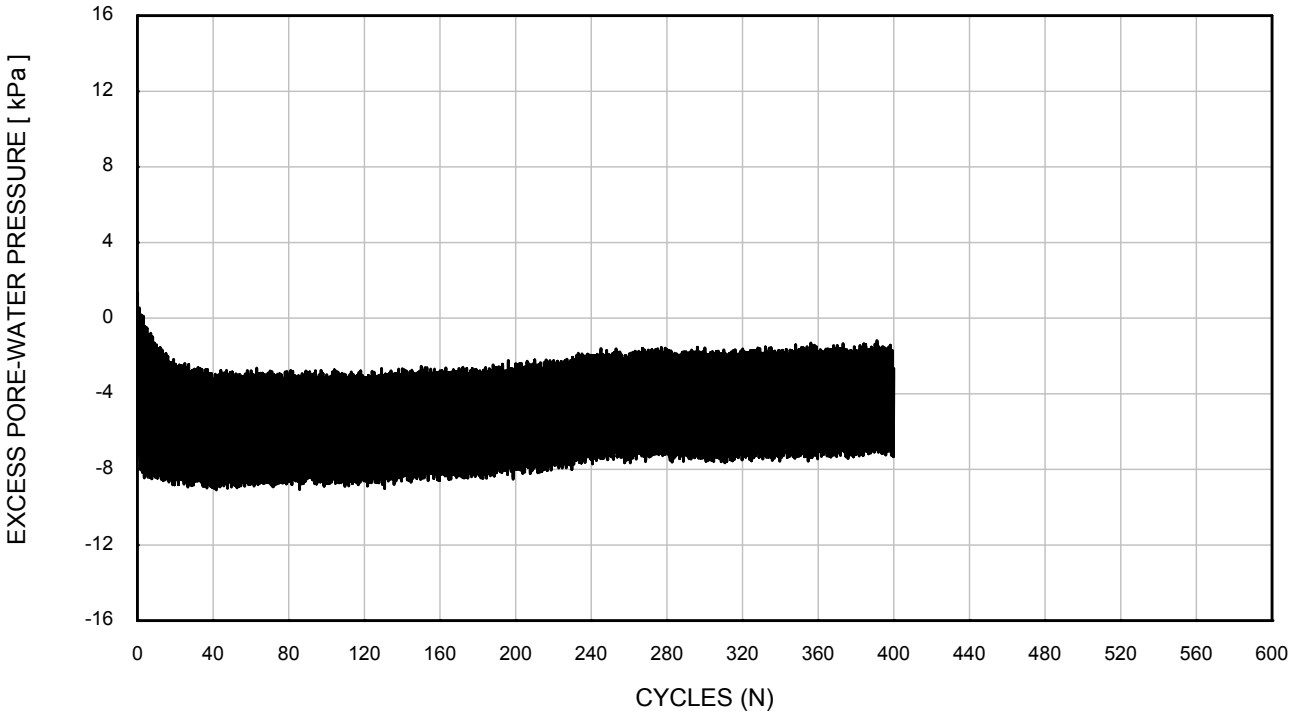
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

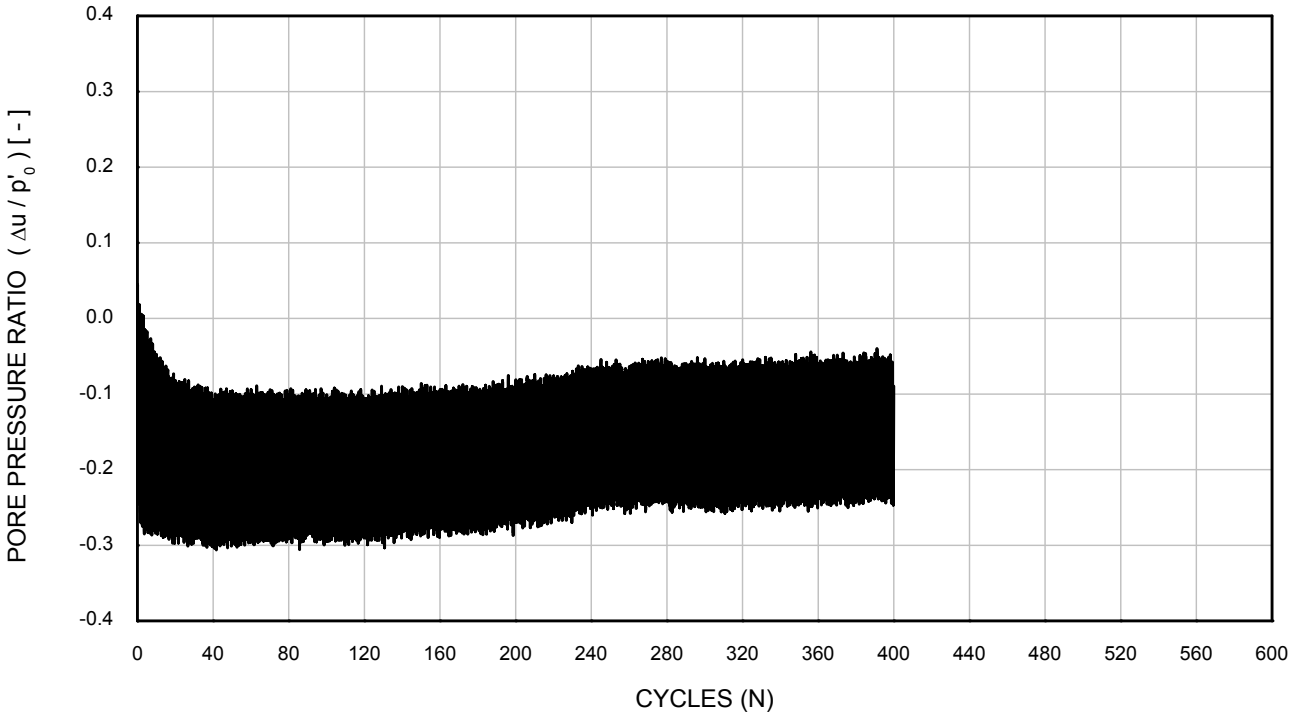




Initial σ'_r	:	19	kPa	Batch	: 1
Initial σ'_a	:	51	kPa	Sample	: CTX_1-4
q_{av}	:	31	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	37	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

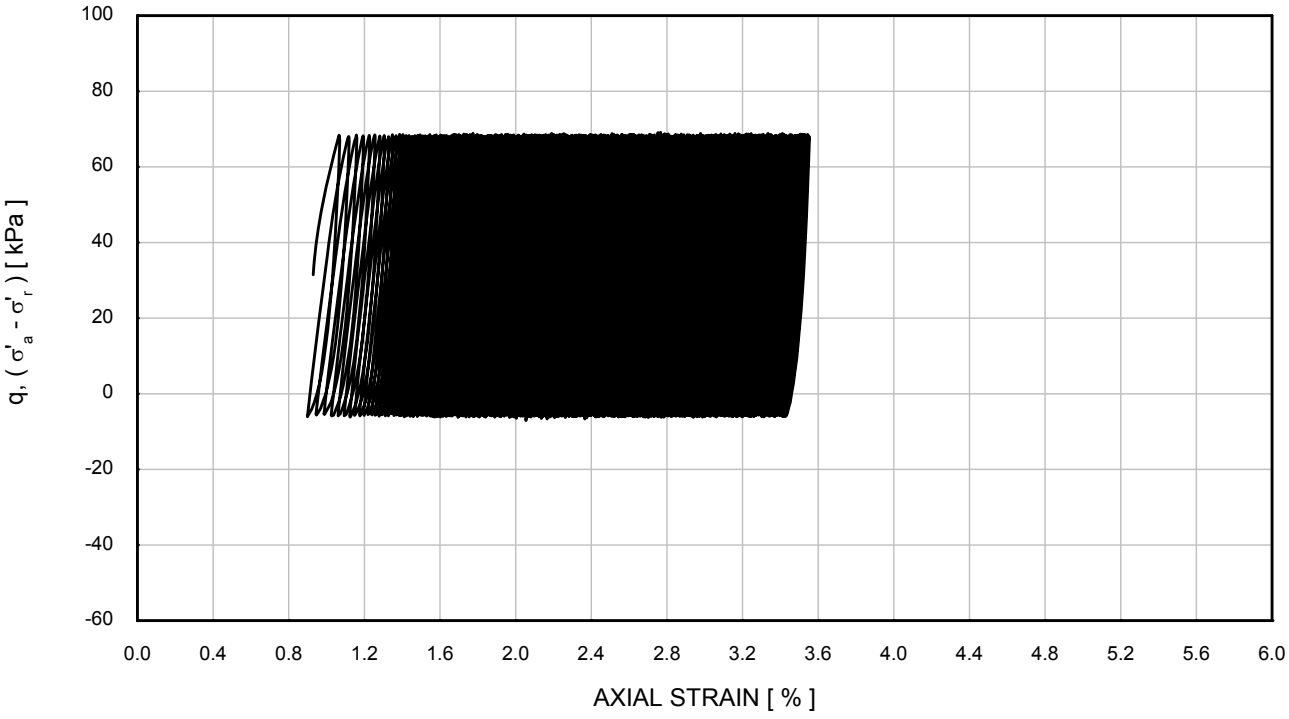
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

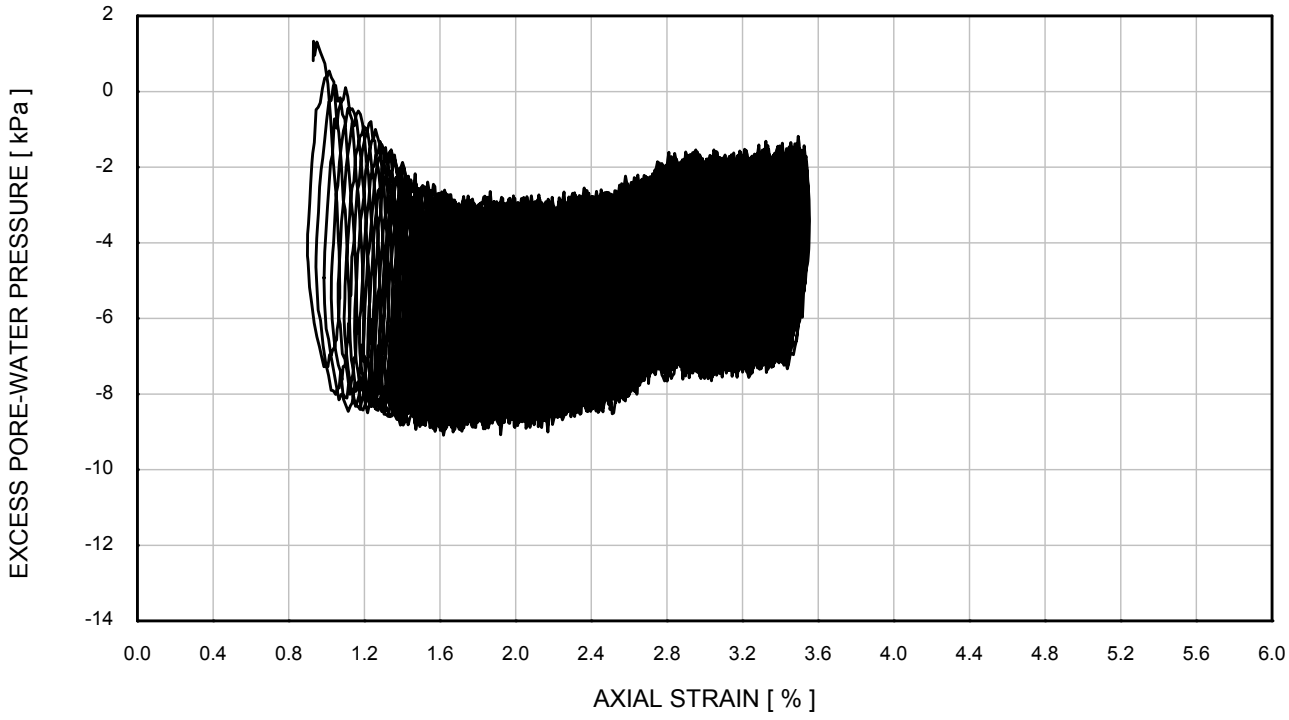




Initial σ'_r	:	19 kPa	Batch	:	1
Initial σ'_a	:	51 kPa	Sample	:	CTX_1-4
q_{av}	:	31 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	37 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

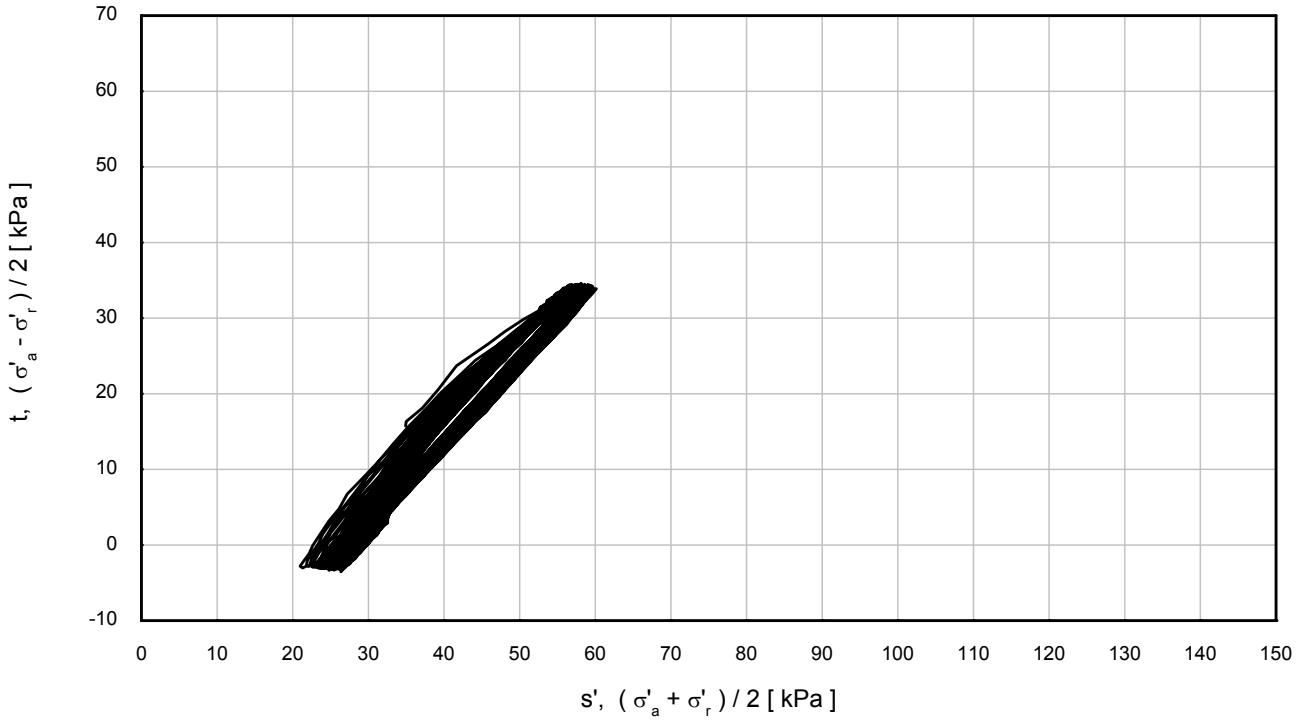
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

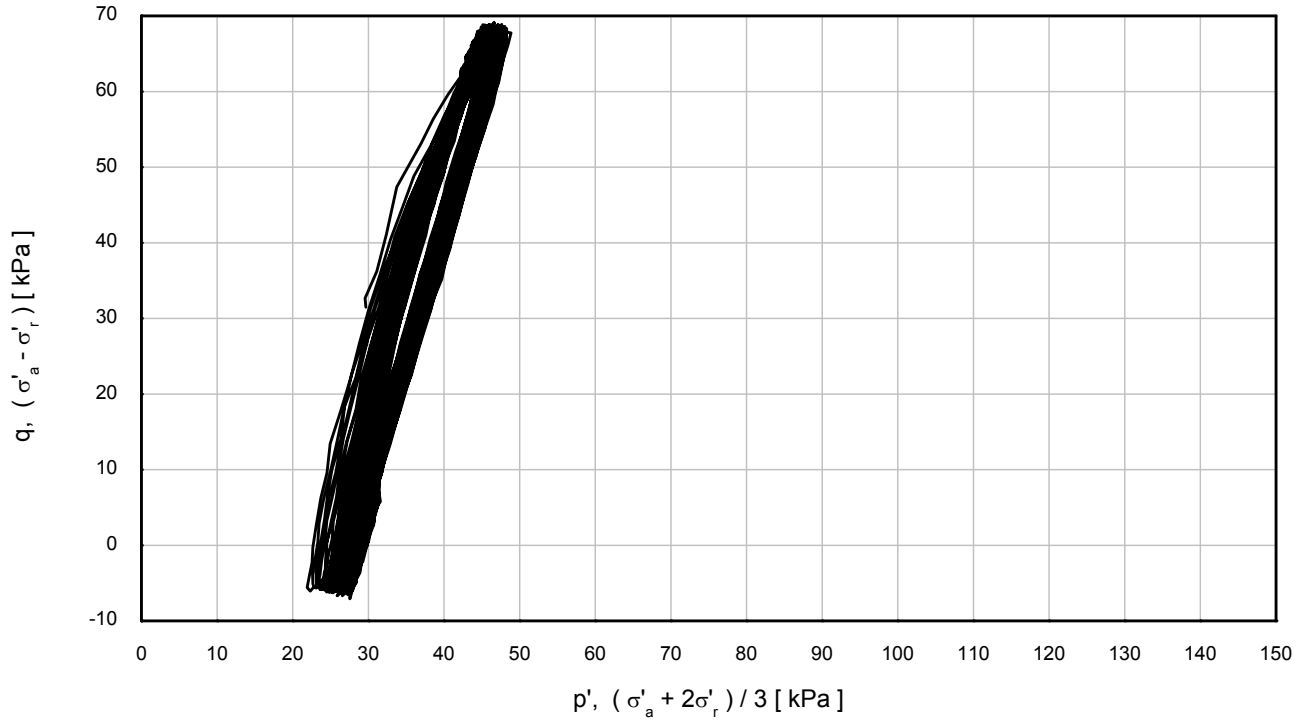




Initial σ'_r	:	19 kPa	Batch	:	1
Initial σ'_a	:	51 kPa	Sample	:	CTX_1-4
q_{av}	:	31 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	37 kPa	Test No.	:	CTX01
Frequency	:	0.10 Hz			

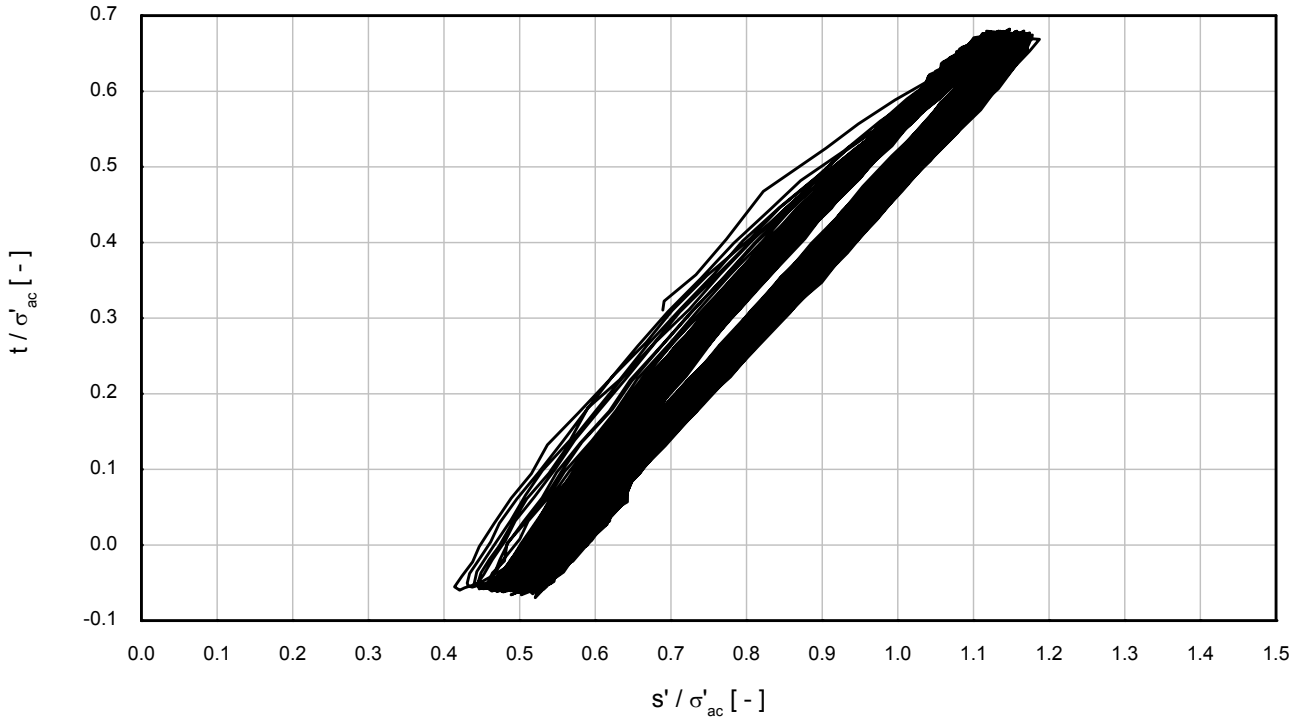
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

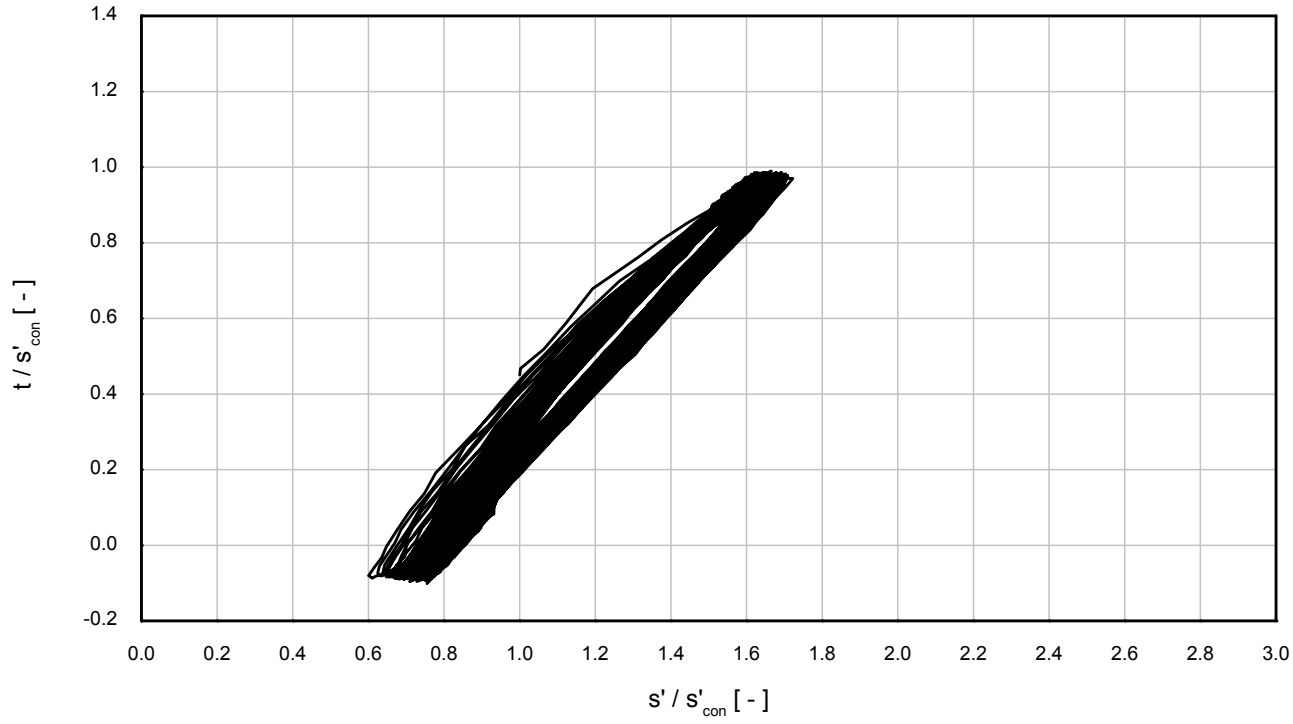




Initial σ'_r	:	19	kPa	Batch	: 1
Initial σ'_a	:	51	kPa	Sample	: CTX_1-4
q_{av}	:	31	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	37	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

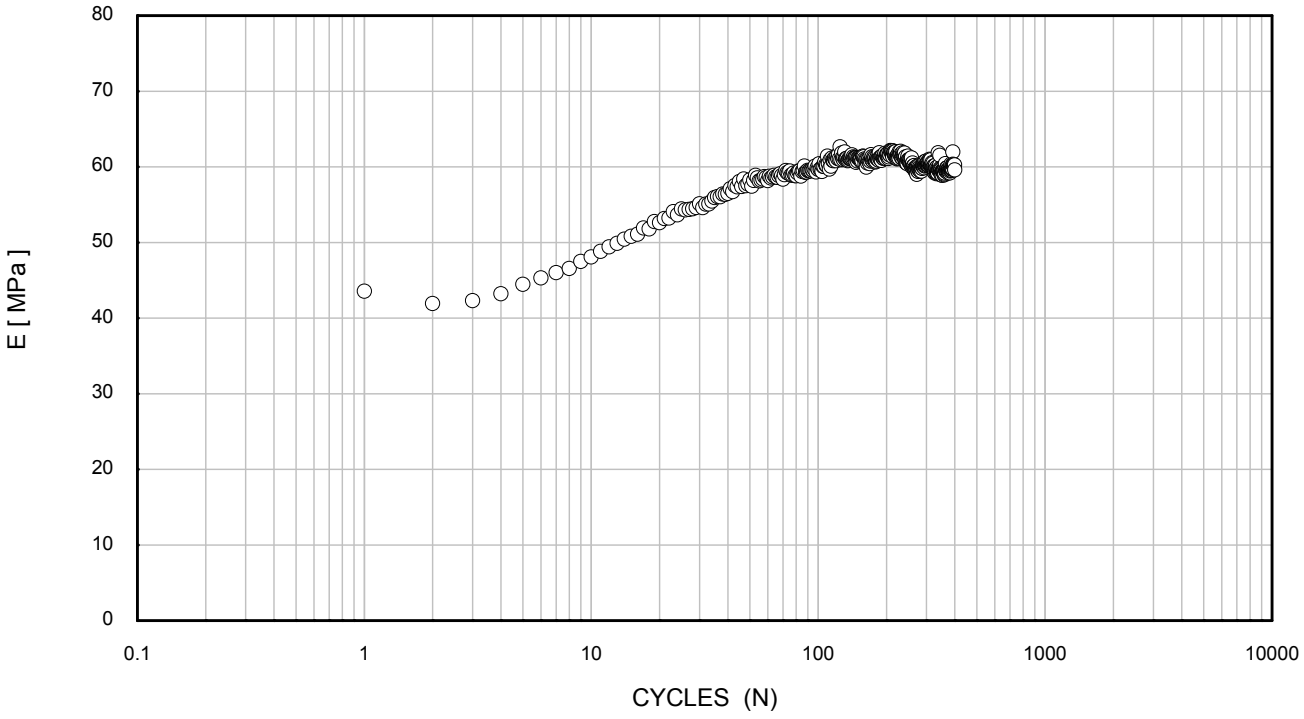
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

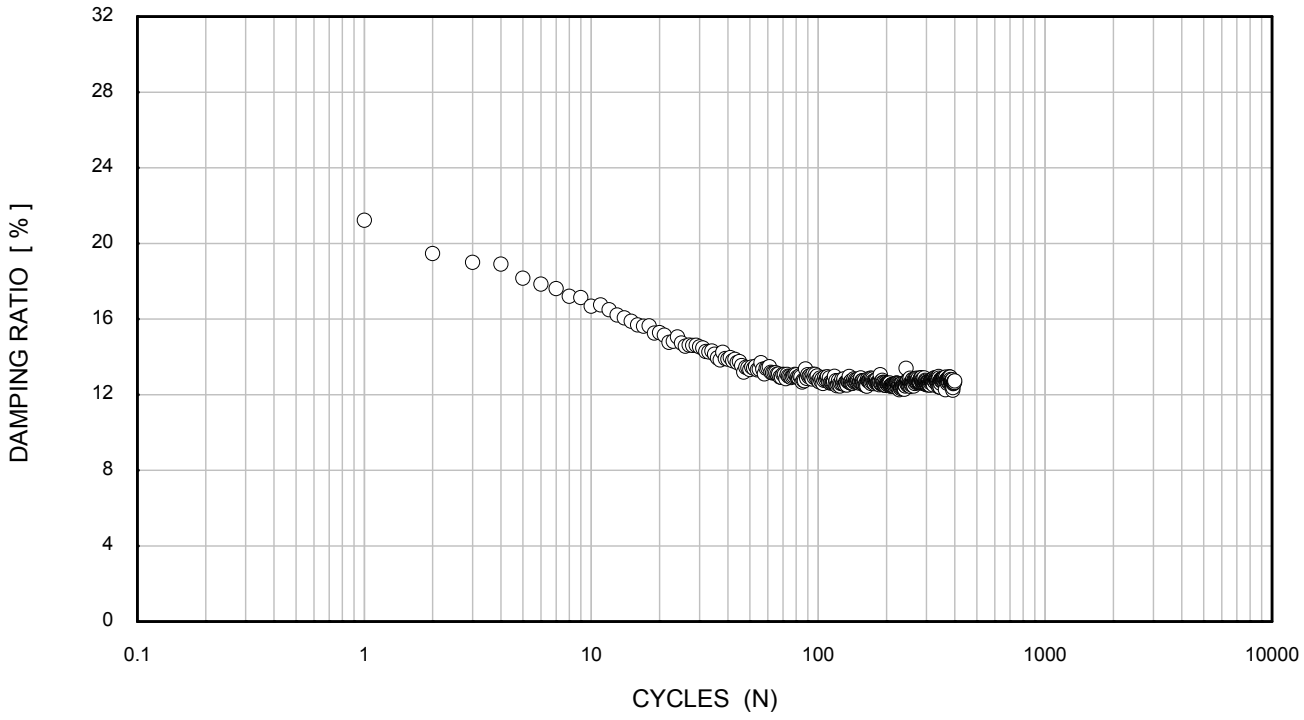




Initial σ'_r	:	19	kPa	Batch	: 1
Initial σ'_a	:	51	kPa	Sample	: CTX_1-4
q_{av}	:	31	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	37	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED





Initial σ'_r	:	19	kPa	Batch	: 1
Initial σ'_a	:	51	kPa	Sample	: CTX_1-4
q_{av}	:	31	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	37	kPa	Test No.	: CTX01
Frequency	:	0.10	Hz		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	19/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.1
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.609
Degree of saturation	[%]	44
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 01_CTX02
Processed by Date	JLS 03/01/2017
Checked by Date	PH 04/01/2017
Approved by Date	PH 04/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-2
Unit	Unit A (Southern Bight)
Test number	CTX02

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1100
Base PWP	[kPa]	1087
Mid height PWP	[kPa]	-
B value achieved	[-]	0.96

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1106
Back pressure	[kPa]	1086
Base PWP	[kPa]	1086
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.08
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-2
Unit	Unit A (Southern Bight)
Test number	CTX02

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING		
Cell pressure	[kPa]	1106
Back pressure	[kPa]	1085
Base PWP	[kPa]	1086
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	134
Deviator stress	[kPa]	113
Volumetric strain	[%]	-0.44
External axial strain	[%]	1.81
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.2
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.616
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-2
Unit	Unit A (Southern Bight)
Test number	CTX02

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	563
Mean q_{av}	[kPa]	113
Mean q_{cy}	[kPa]	55
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	220
External ε_{av} at N_f	[%]	15.02
External ε_{cy} at N_f	[%]	0.07
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	-19
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	25.4
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.673
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	1.96	0.15	35.51	-	19.89	-
2	2.14	0.08	72.12	-	21.15	-
5	2.39	0.06	95.78	-	20.61	-
10	2.69	0.05	107.37	-	20.02	-
20	3.21	0.05	117.27	-	19.38	-
30	3.68	0.05	121.25	-	19.09	-
40	4.13	0.04	121.50	-	18.75	-
50	4.58	0.05	120.96	-	18.69	-
100	6.91	0.05	116.51	-	19.07	-
200	13.26	0.06	88.50	-	20.63	-
220	15.02	0.07	80.86	-	21.05	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-2
Unit	Unit A (Southern Bight)
Test number	CTX02

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





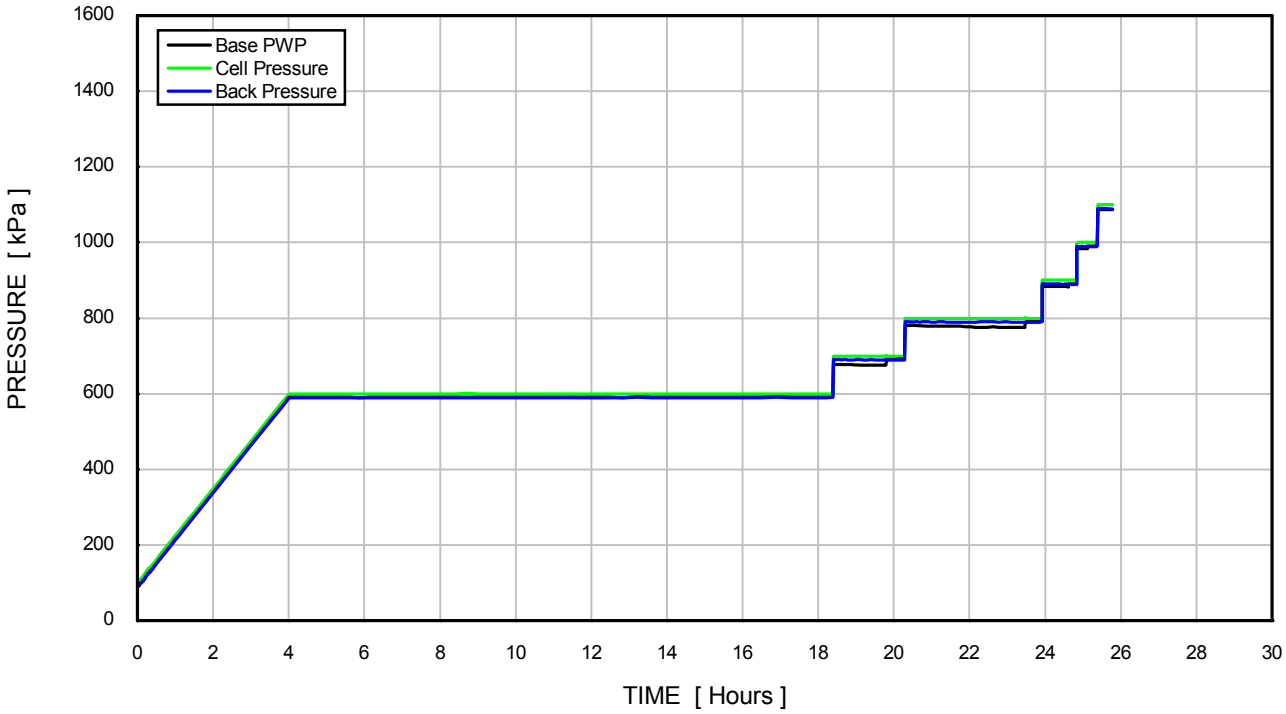
FINAL CONDITIONS

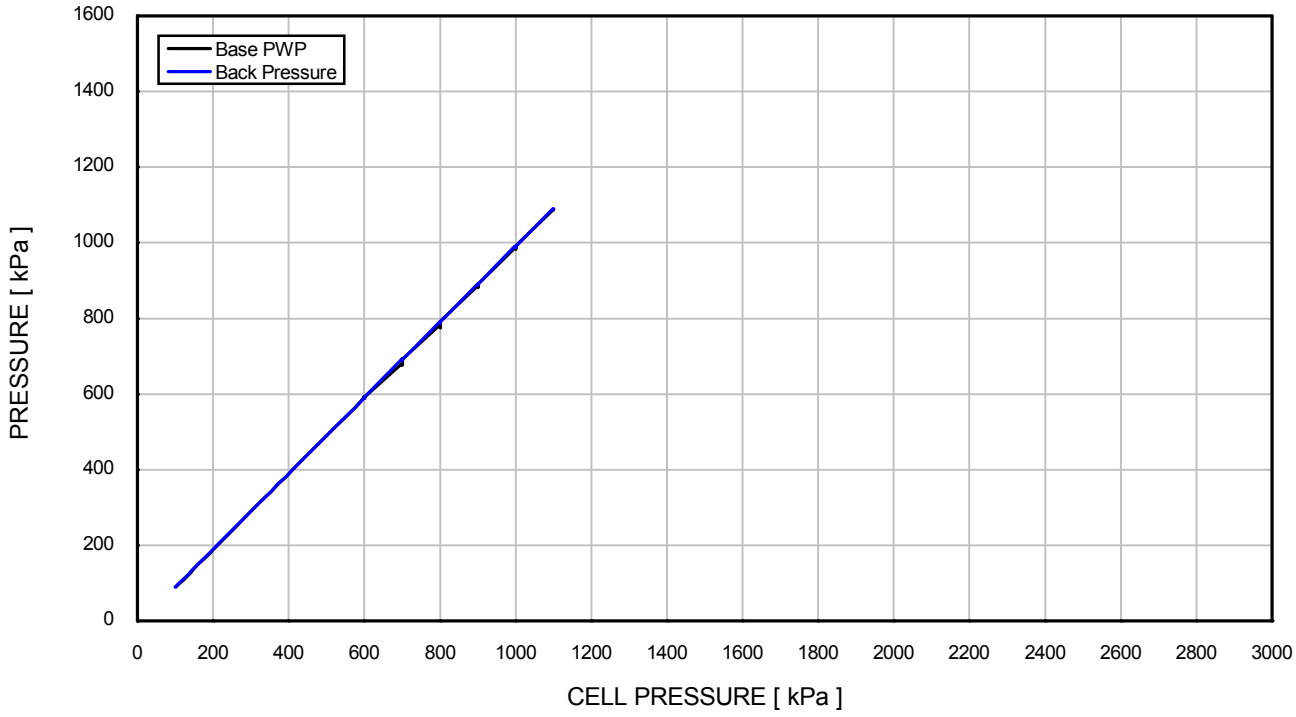
Water content	[%]	25.4
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.58

TEST IDENTIFICATION

Batch	1
Sample	CTX_1-2
Unit	Unit A (Southern Bight)
Test number	CTX02

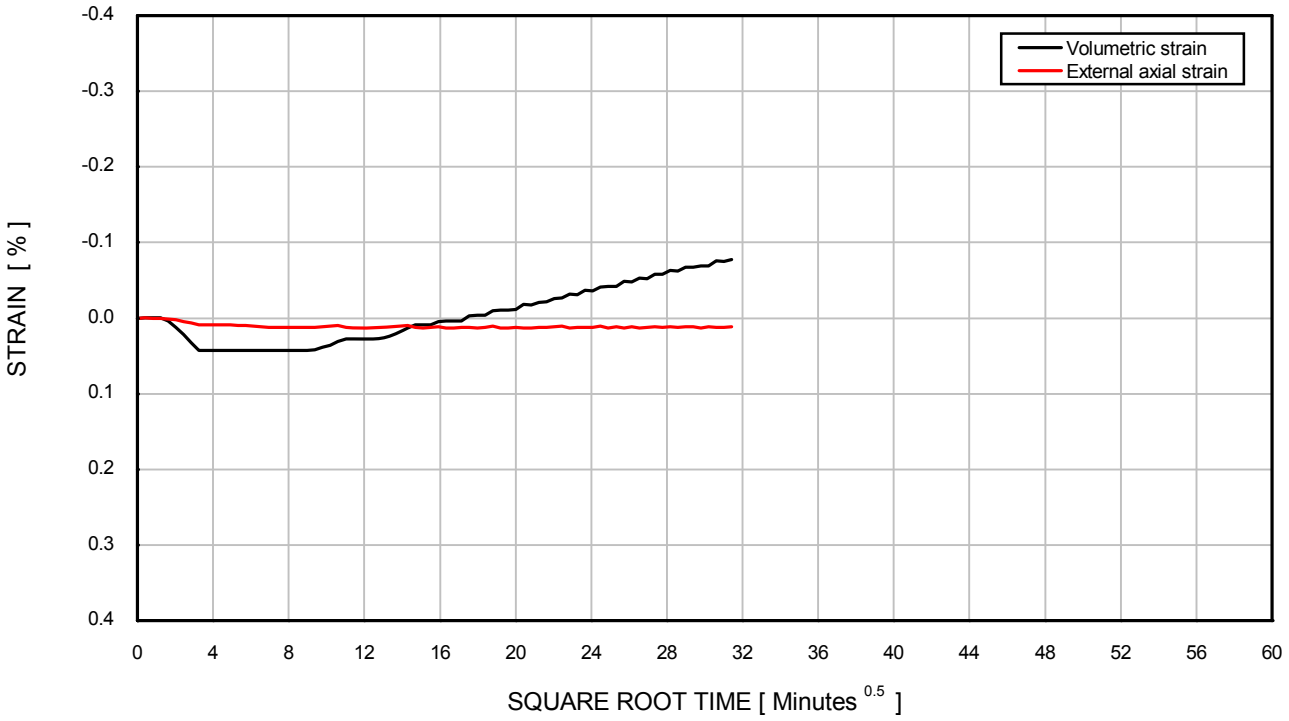
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST





B value	:	0.96			
Initial σ'_r	:	10	kPa	Batch	: 1
Initial σ'_a	:	10	kPa	Sample	: CTX_1-2
Final σ'_r	:	13	kPa	Unit	: Unit A (Southern Bight)
Final σ'_a	:	13	kPa	Test No.	: CTX02

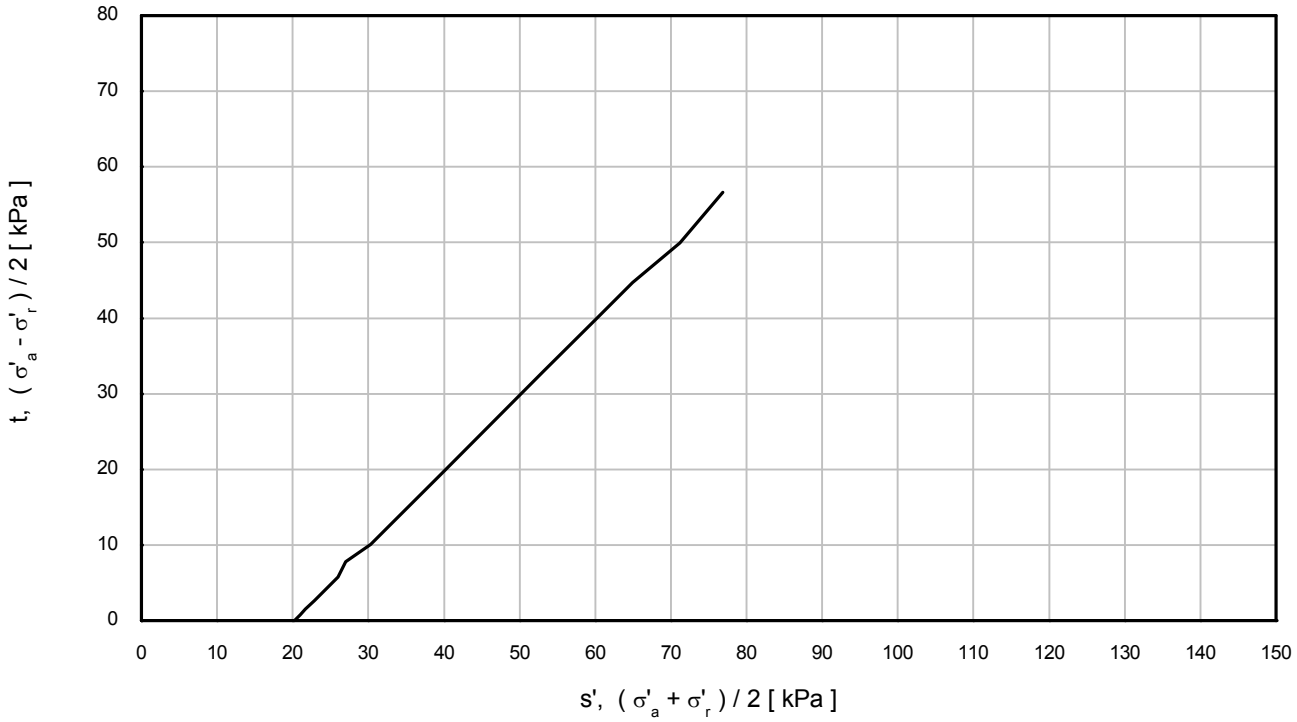
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

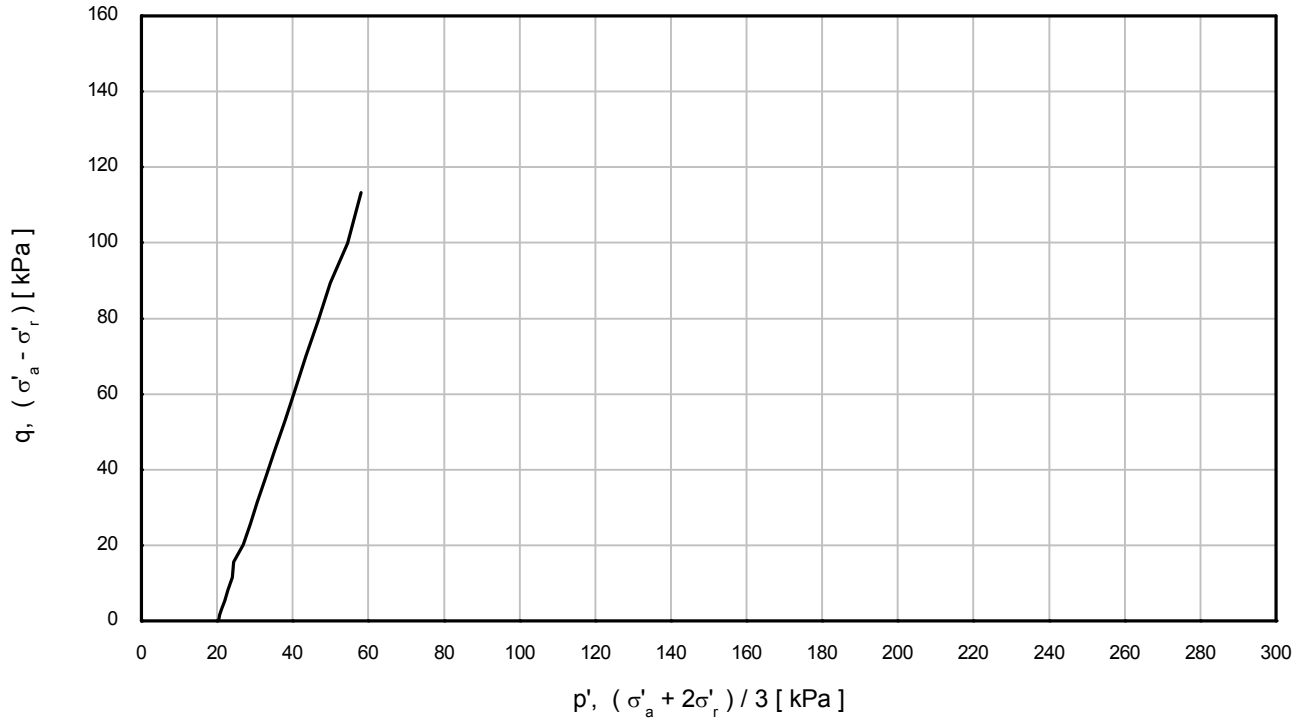




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	20 kPa	Sample	:	CTX_1-2
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX02

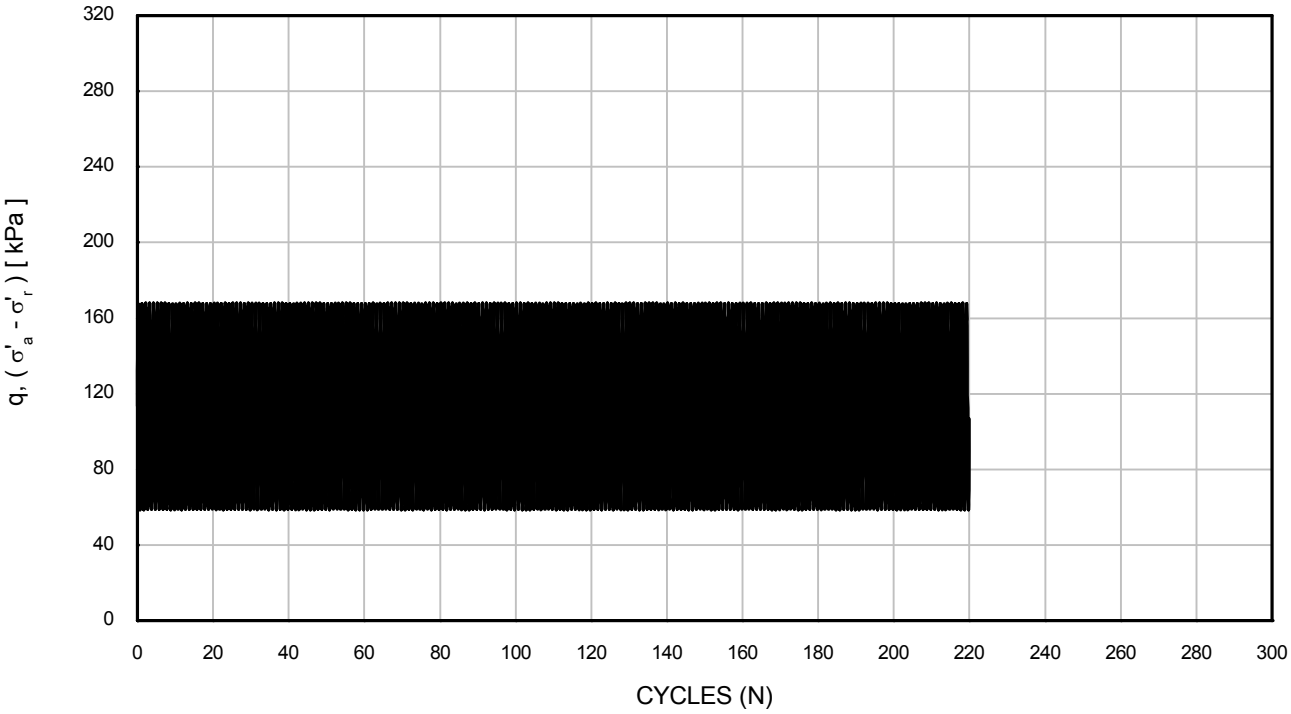
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

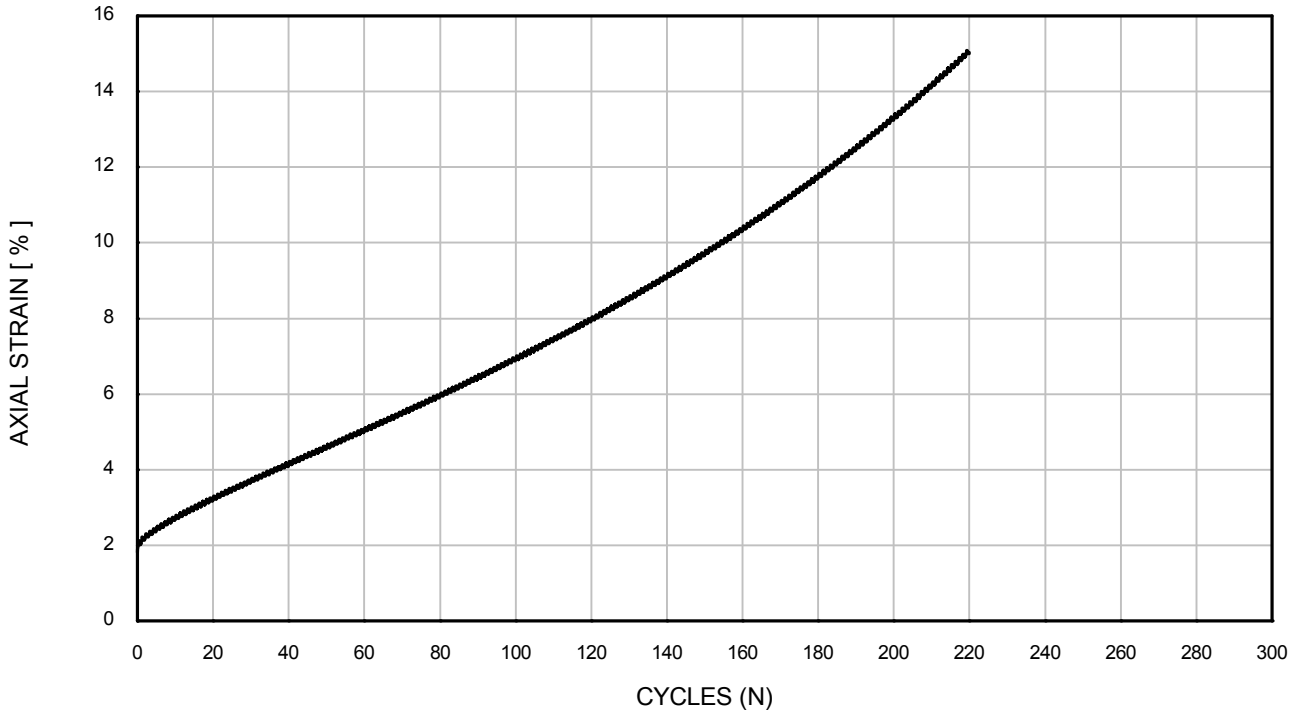




σ'_{rc}	: 20 kPa	Batch	: 1
σ'_{ac}	: 134 kPa	Sample	: CTX_1-2
		Unit	: Unit A (Southern Bight)
		Test No.	: CTX02

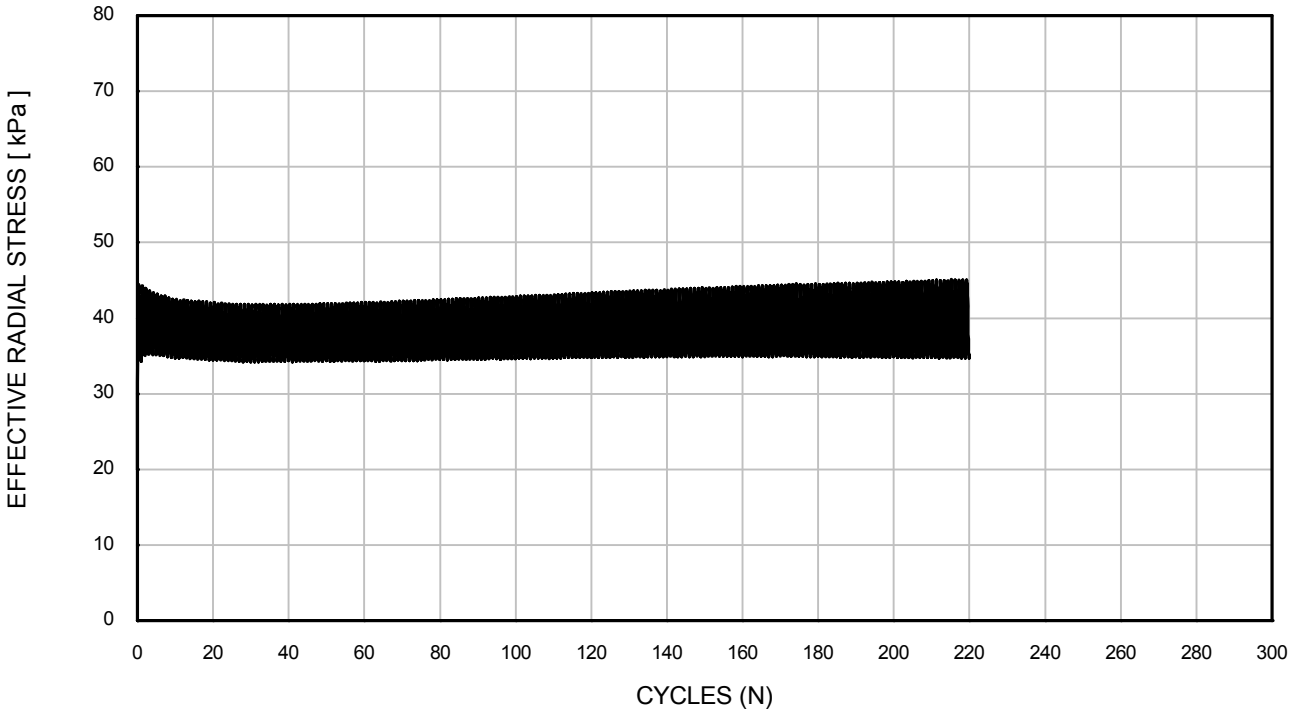
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - DRAINED

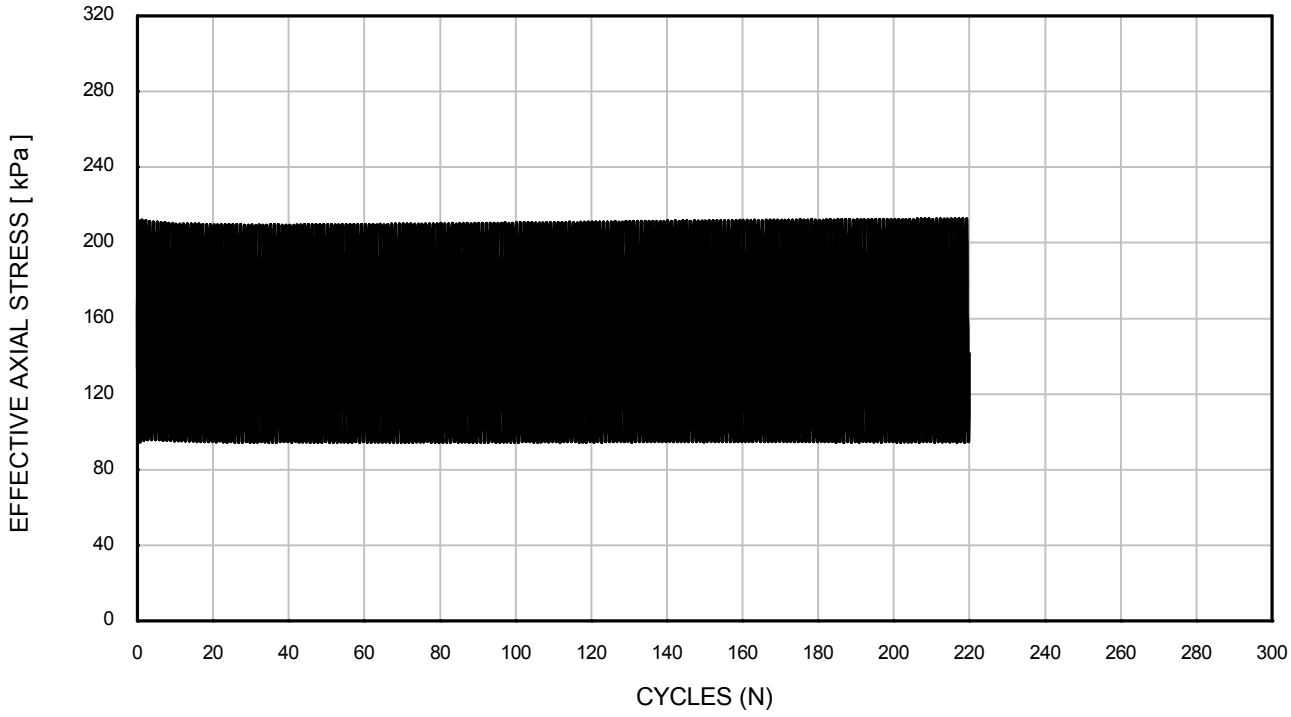




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	133 kPa	Sample	:	CTX_1-2
q_{av}	:	113 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	55 kPa	Test No.	:	CTX02
Frequency	:	0.10 Hz			

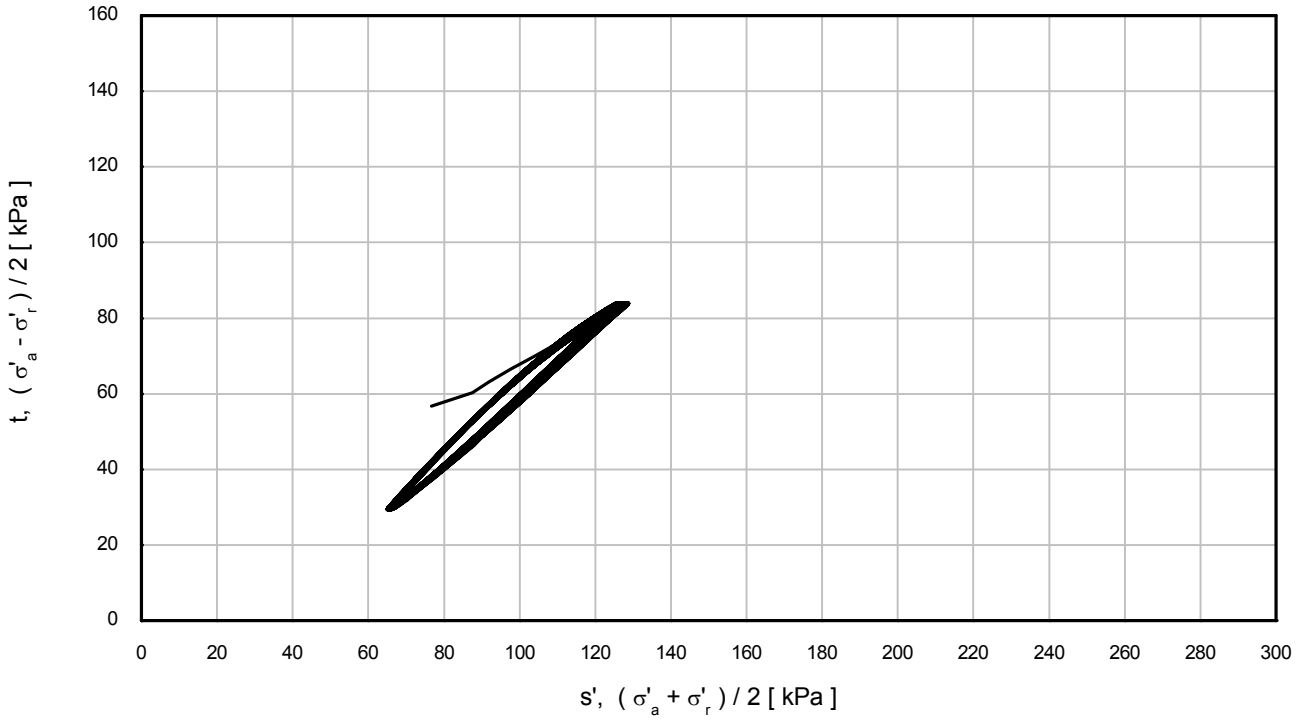
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

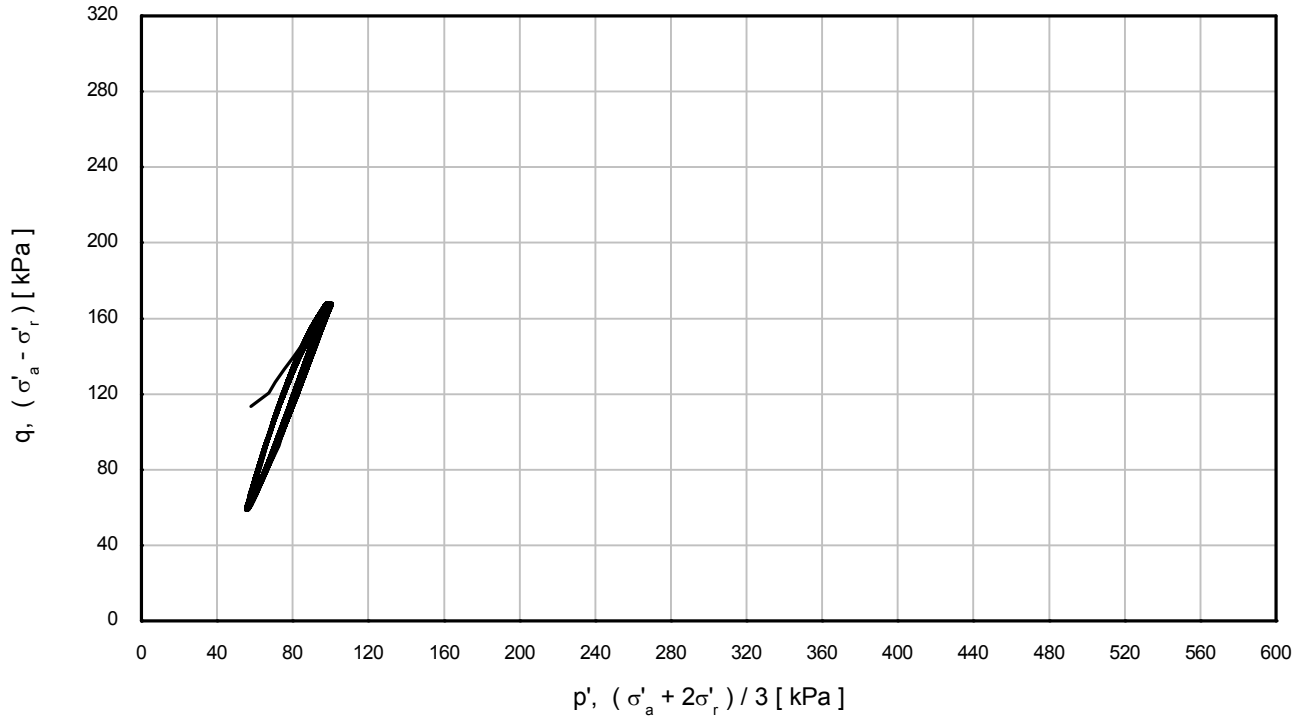




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	133 kPa	Sample	:	CTX_1-2
q_{av}	:	113 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	55 kPa	Test No.	:	CTX02
Frequency	:	0.10 Hz			

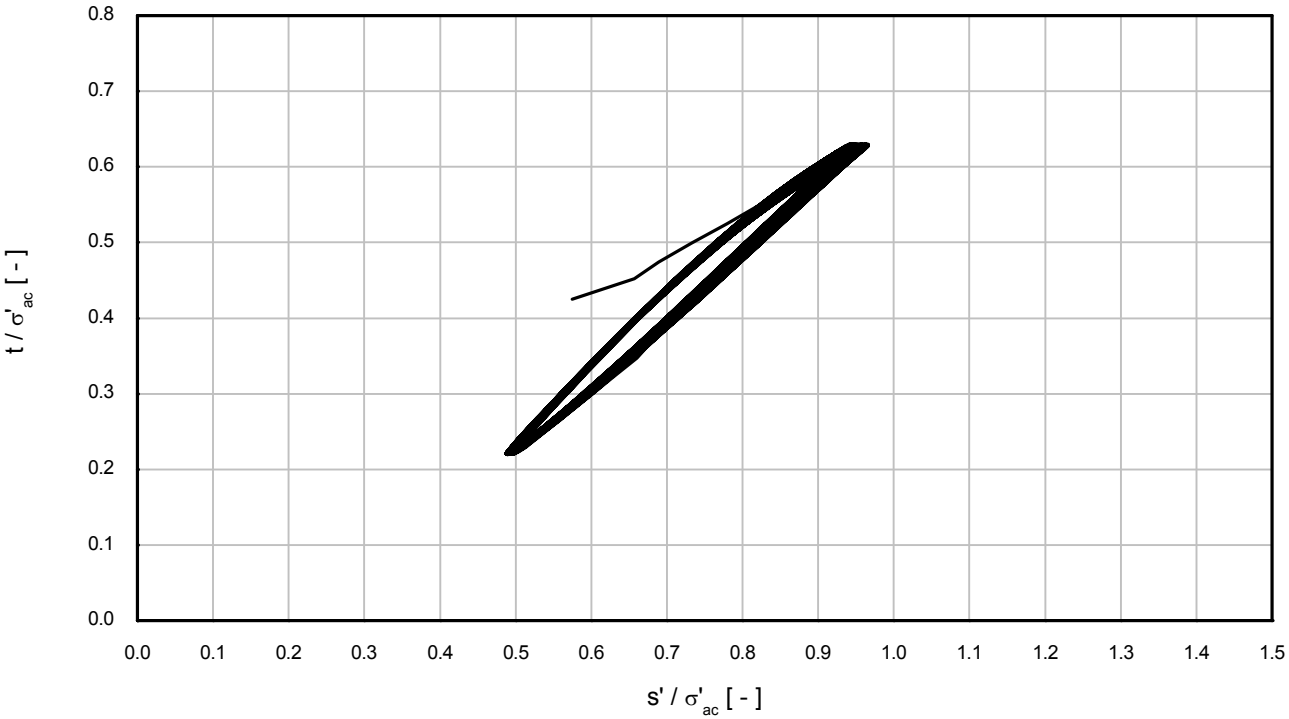
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

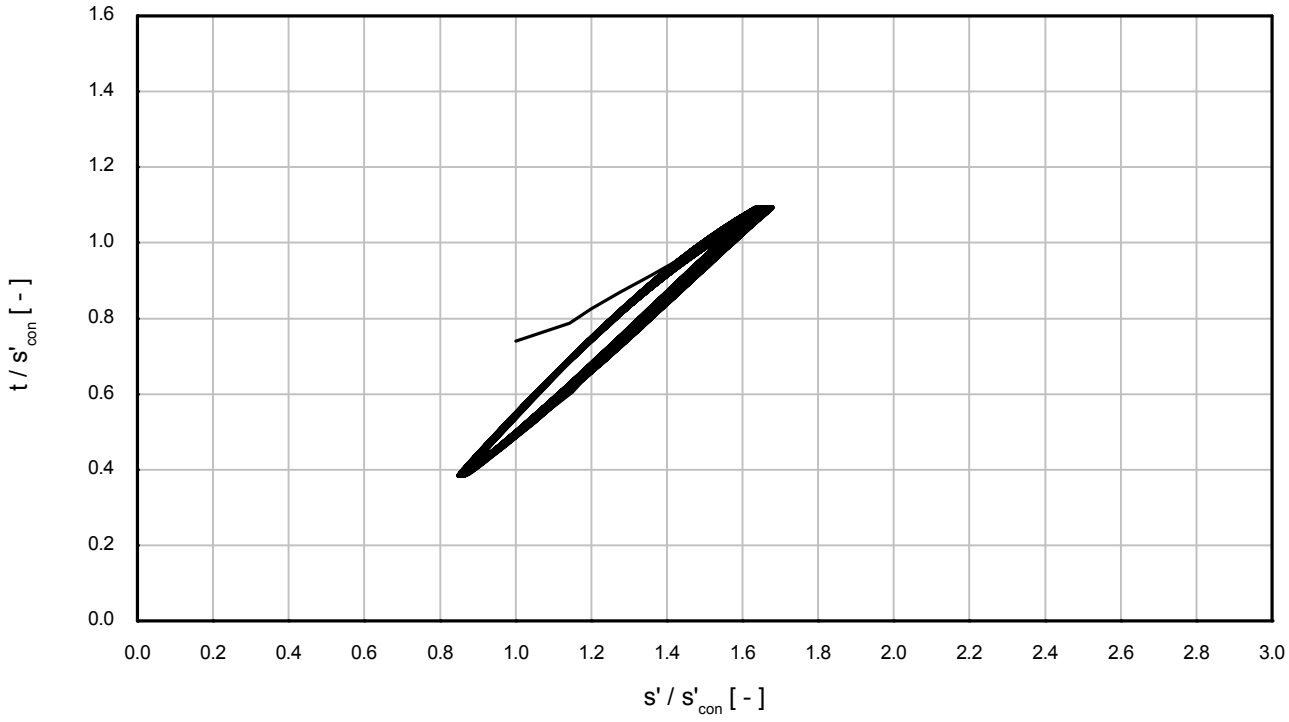




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	133 kPa	Sample	:	CTX_1-2
q_{av}	:	113 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	55 kPa	Test No.	:	CTX02
Frequency	:	0.10 Hz			

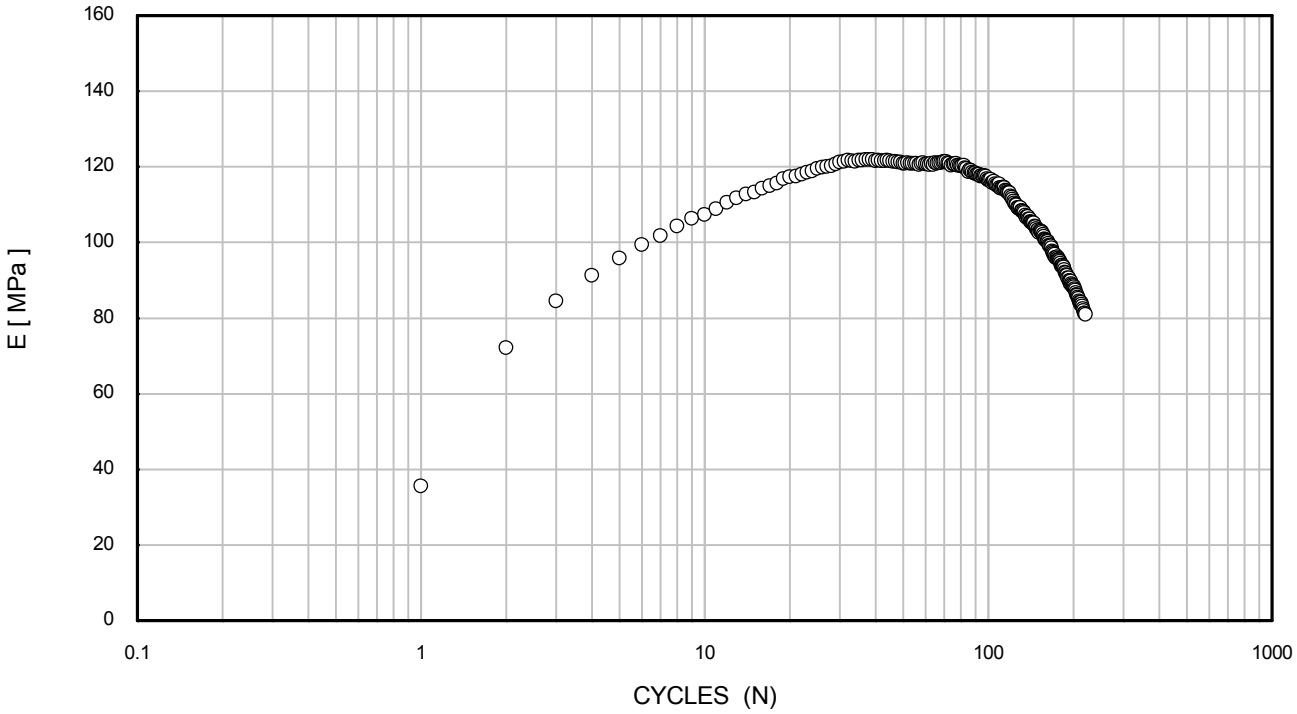
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

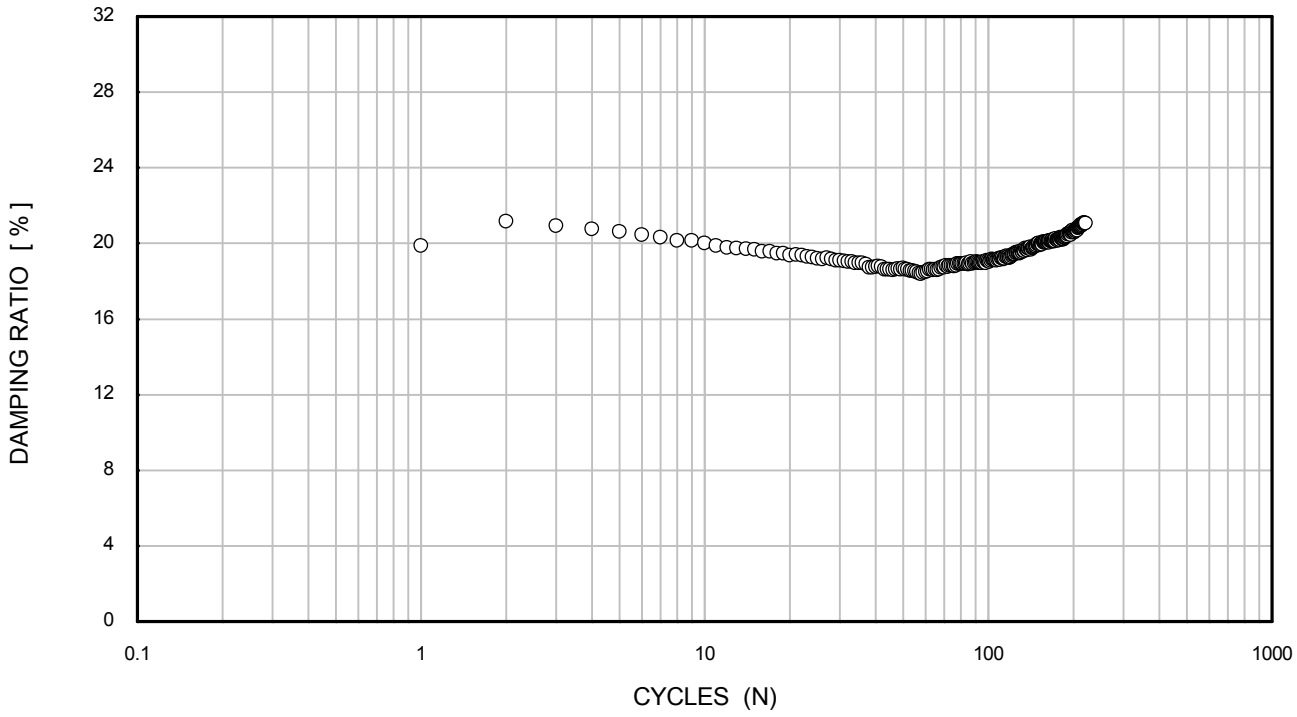




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	133 kPa	Sample	:	CTX_1-2
q_{av}	:	113 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	55 kPa	Test No.	:	CTX02
Frequency	:	0.10 Hz			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED





Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	133 kPa	Sample	:	CTX_1-2
q_{av}	:	113 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	55 kPa	Test No.	:	CTX02
Frequency	:	0.10 Hz			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	16/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.3
Bulk density	[Mg/m³]	1.82
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.609
Degree of saturation	[%]	45
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 01_CTX03
Processed by	JLS
Date	23/12/2016
Checked by	PH
Date	04/01/2017
Approved by	PH
Date	04/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-3
Unit	Unit A (Southern Bight)
Test number	CTX03

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1100
Base PWP	[kPa]	1084
Mid height PWP	[kPa]	-
B value achieved	[-]	0.95

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1103
Back pressure	[kPa]	1083
Base PWP	[kPa]	1083
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	-0.07
External axial strain	[%]	0.01
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-3
Unit	Unit A (Southern Bight)
Test number	CTX03

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING		
Cell pressure	[kPa]	1103
Back pressure	[kPa]	1083
Base PWP	[kPa]	1083
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	75
Deviator stress	[kPa]	56
Volumetric strain	[%]	-0.04
External axial strain	[%]	0.41
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-3
Unit	Unit A (Southern Bight)
Test number	CTX03

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	563
Mean q_{av}	[kPa]	56
Mean q_{cy}	[kPa]	112
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	9
External ε_{av} at N_f	[%]	-7.09
External ε_{cy} at N_f	[%]	17.41
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	-14
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	-0.29	1.43	7.82	-	13.20	-
2	-0.36	3.17	3.54	-	13.75	-
3	-0.69	5.33	2.11	-	5.90	-
4	-0.92	7.09	1.58	-	6.45	-
5	-0.82	8.30	1.35	-	7.70	-
6	-0.57	9.16	1.22	-	4.78	-
7	-0.44	9.89	1.13	-	4.91	-
8	-0.73	10.81	1.04	-	5.94	-
9	-7.09	17.41	0.62	-	22.30	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-3
Unit	Unit A (Southern Bight)
Test number	CTX03

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS

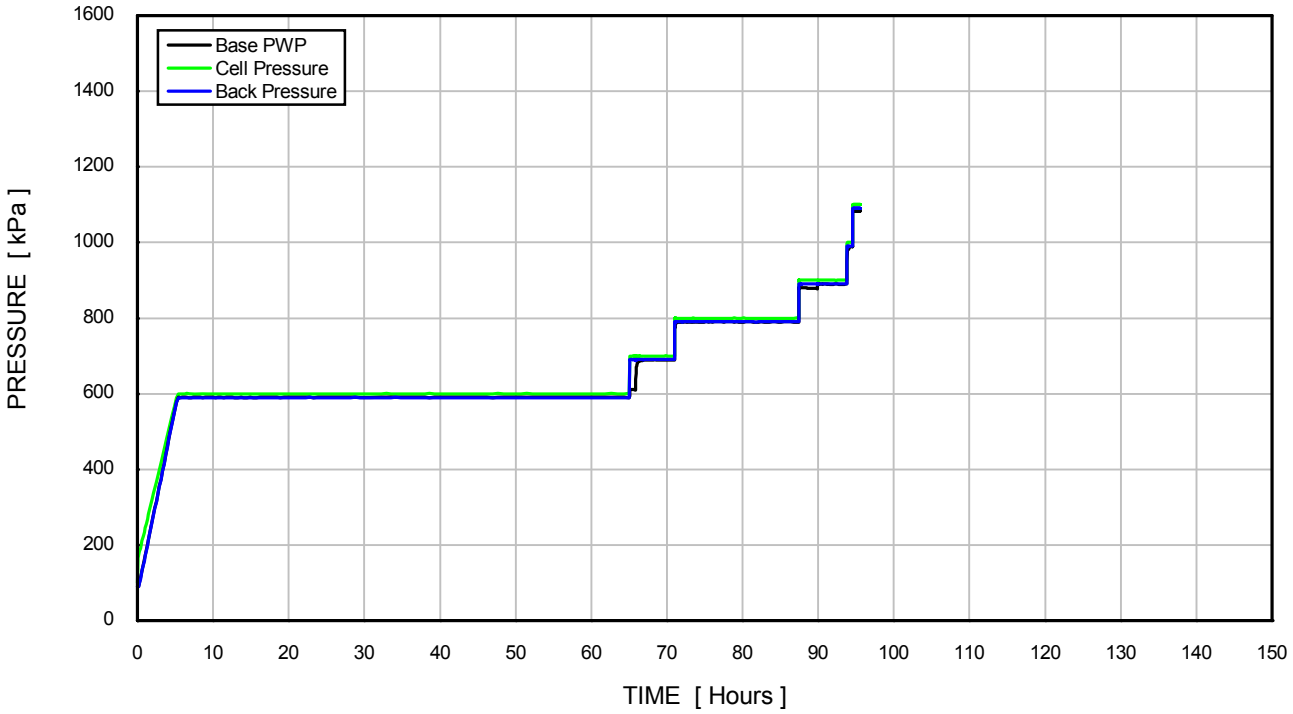
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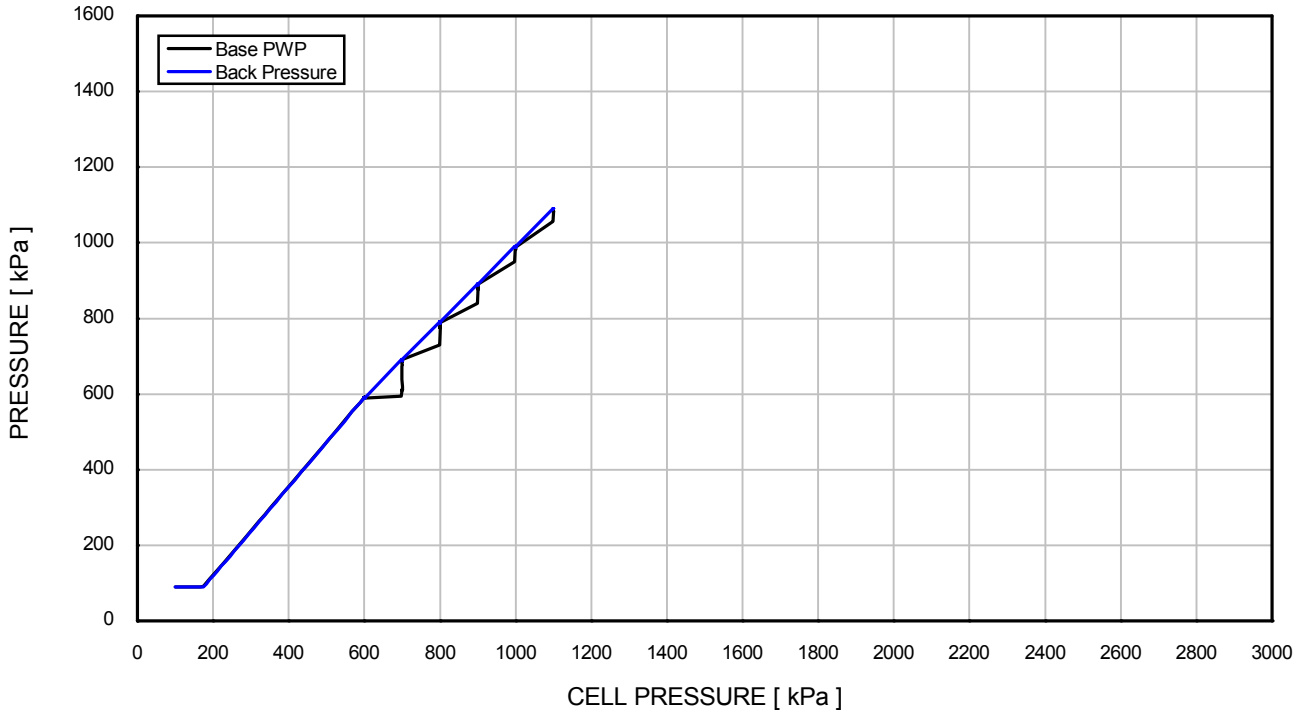
Photograph unavailable - sample collapsed

FINAL CONDITIONS		
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.65

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-3
Unit	Unit A (Southern Bight)
Test number	CTX03

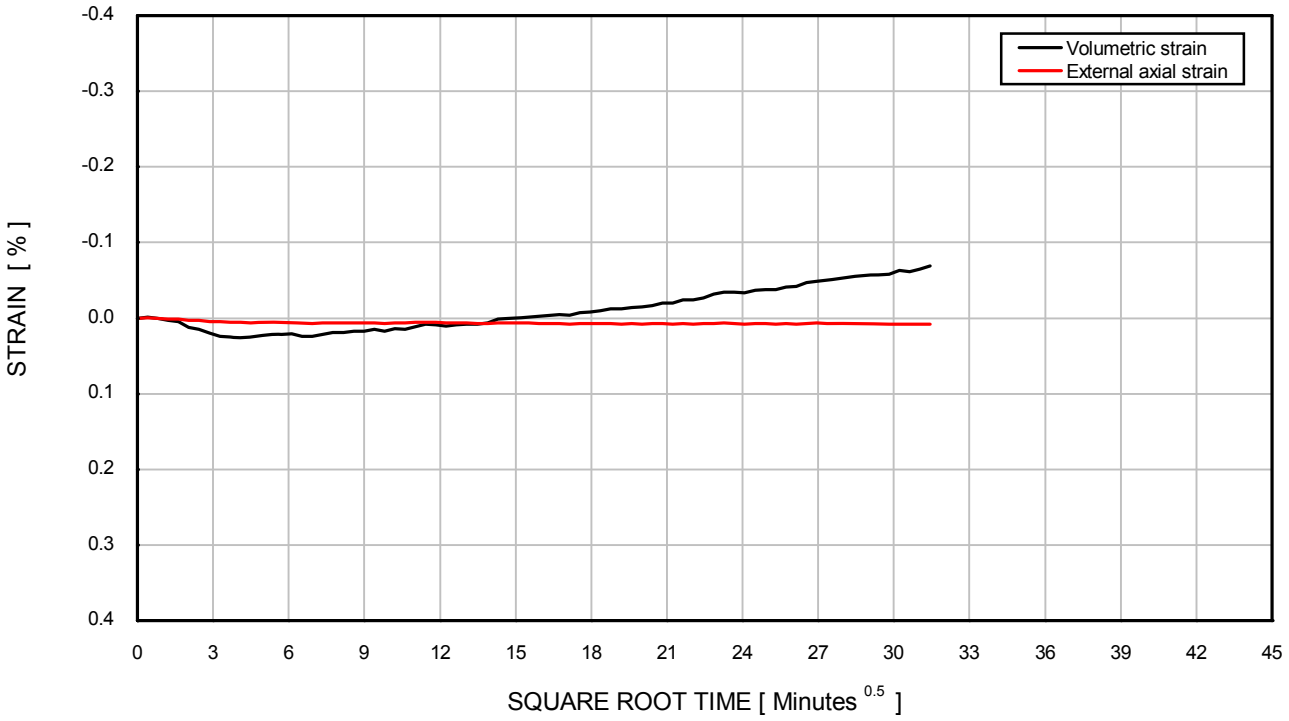
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST





B value	:	0.95	Batch	:	1
Initial σ'_r	:	10 kPa	Sample	:	CTX_1-3
Initial σ'_a	:	10 kPa	Unit	:	Unit A (Southern Bight)
Final σ'_r	:	16 kPa	Test No.	:	CTX03
Final σ'_a	:	16 kPa			

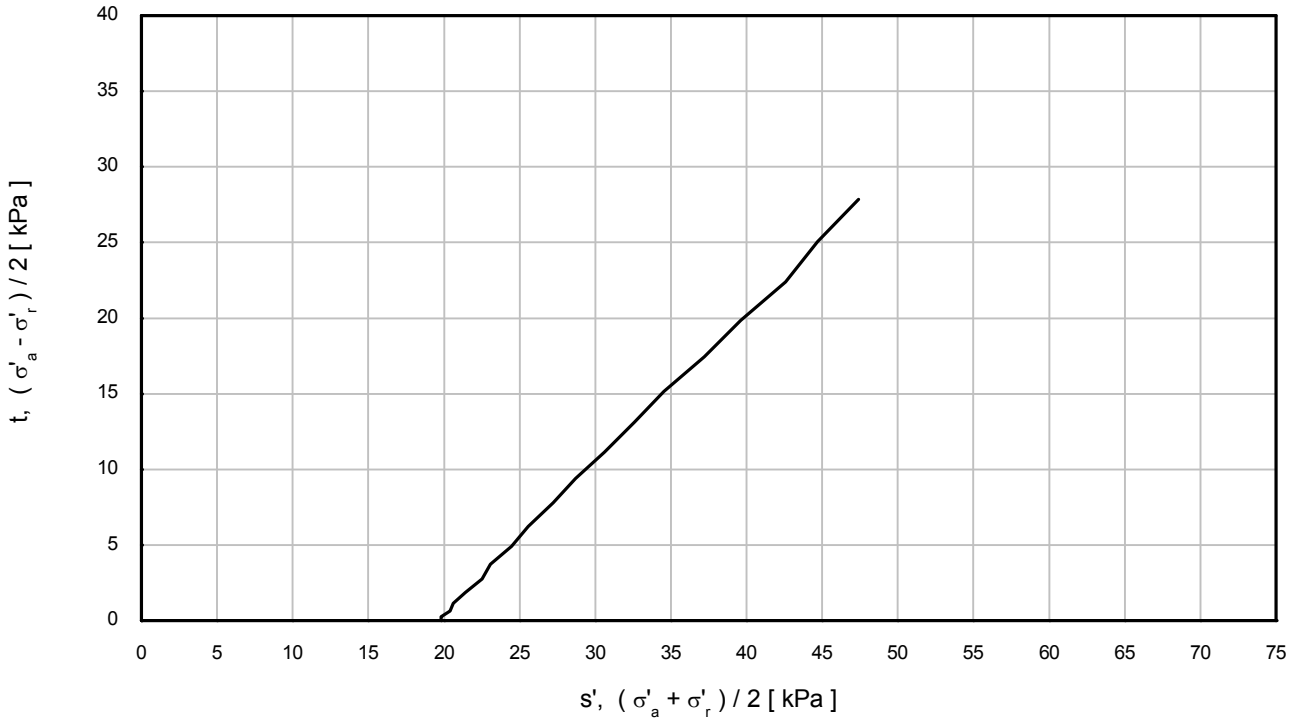
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

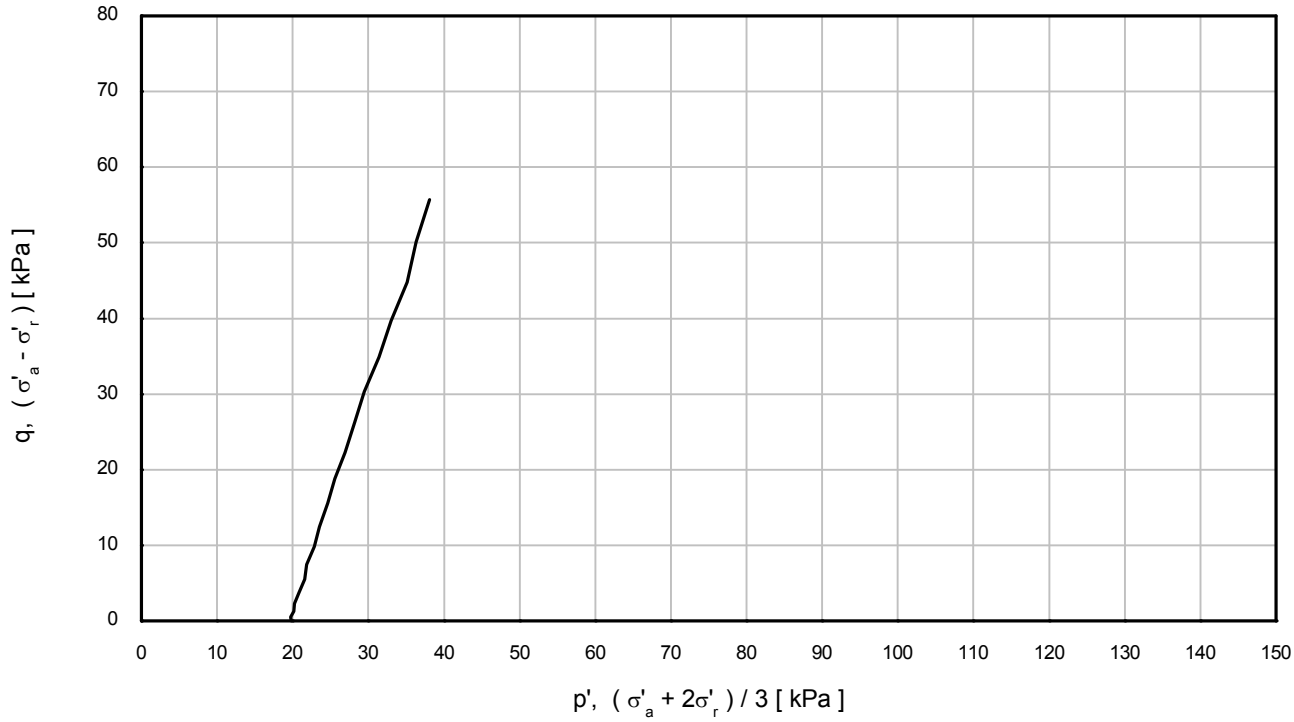




Stage 1 σ'_{rc}	:	20 kPa	Batch	:	1
Stage 1 σ'_{ac}	:	20 kPa	Sample	:	CTX_1-3
			Unit	:	Unit A (Southern Bight)
			Test No.	:	CTX03

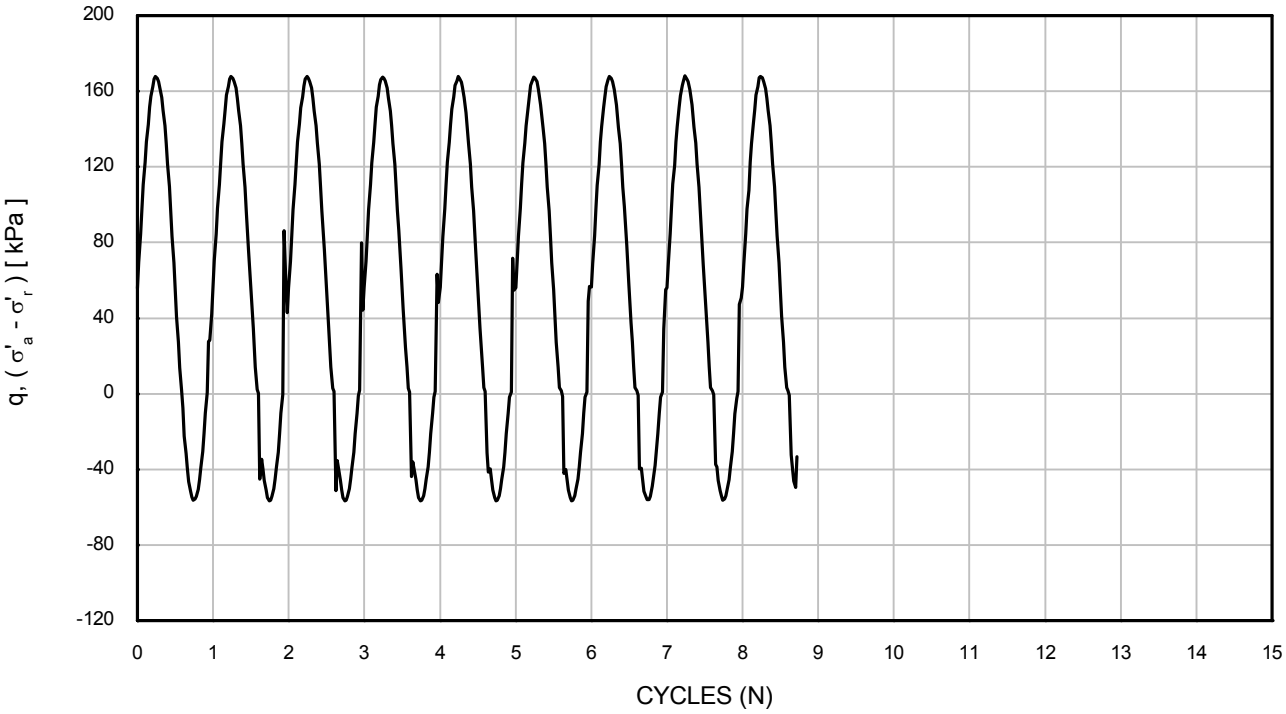
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

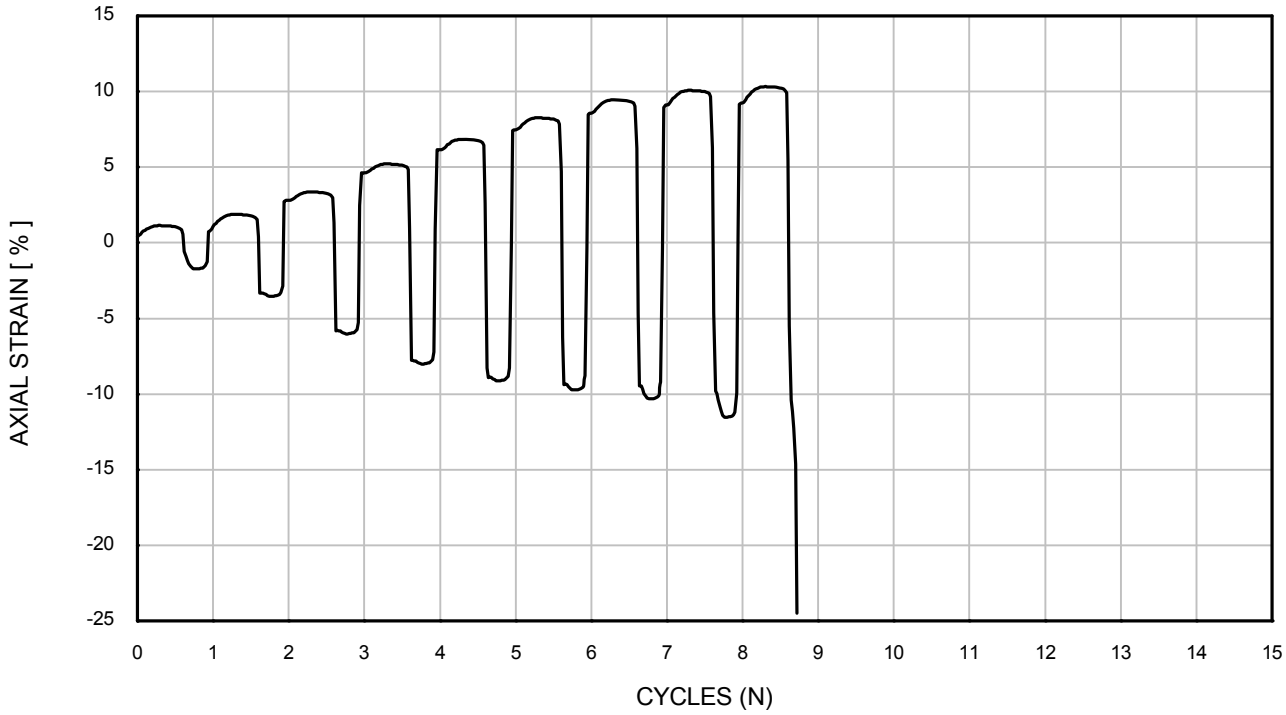




σ'_{rc}	:	20 kPa	Batch	: 1
σ'_{ac}	:	75 kPa	Sample	: CTX_1-3
			Unit	: Unit A (Southern Bight)
			Test No.	: CTX03

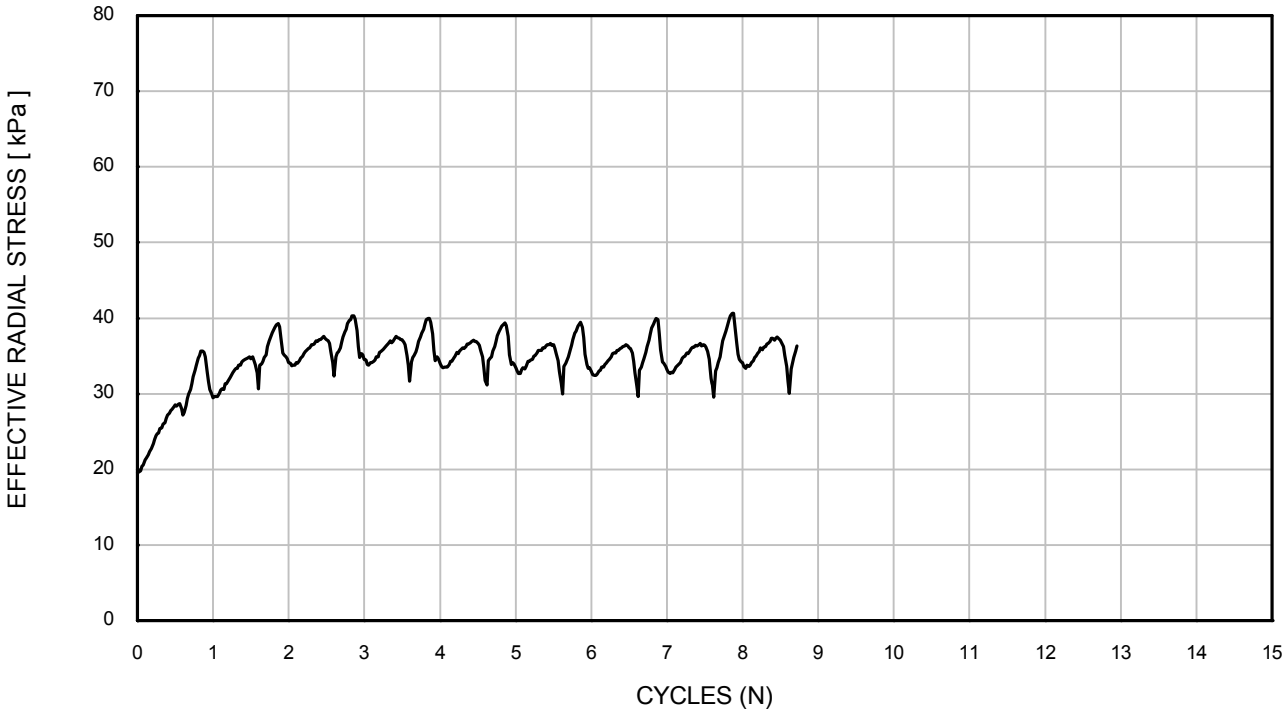
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
PRELOADING STAGE - DRAINED

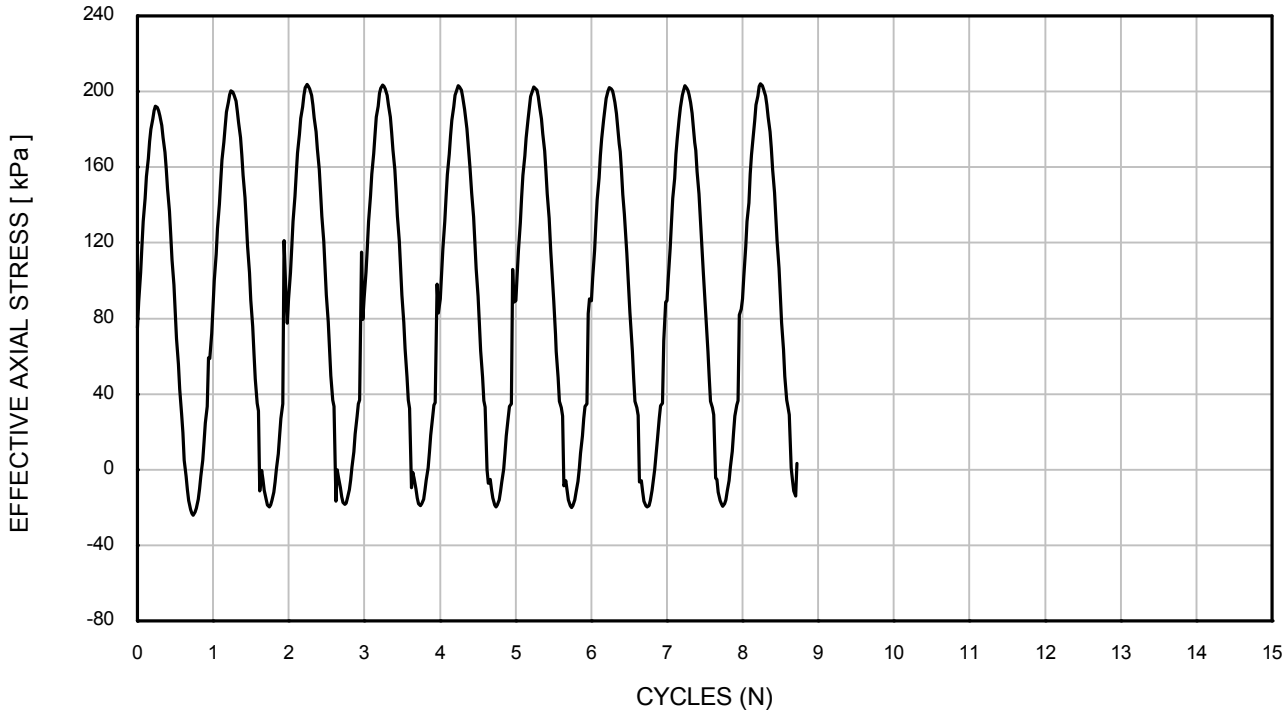




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	75	kPa	Sample	: CTX_1-3
q_{av}	:	56	kPa	Depth [m]	: Unit A (Southern Bight)
q_{cy}	:	112	kPa	Test No.	: CTX03
Frequency	:	0.10	Hz		

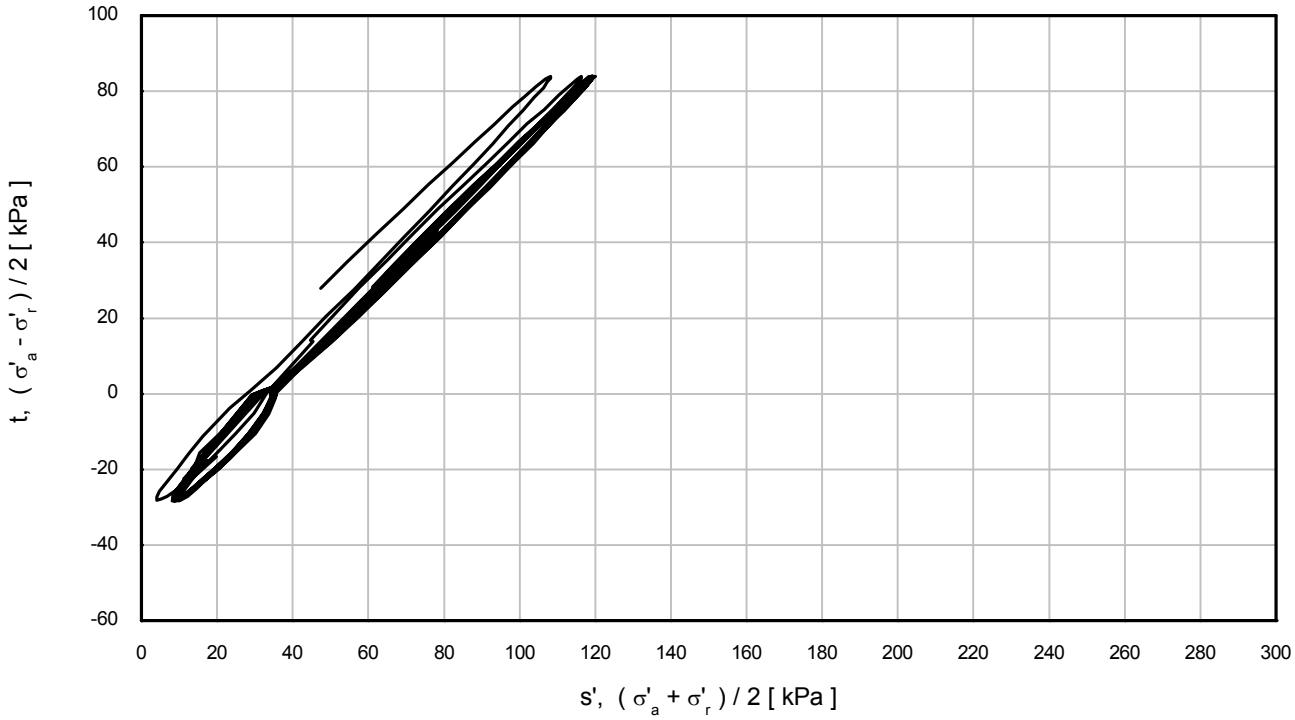
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

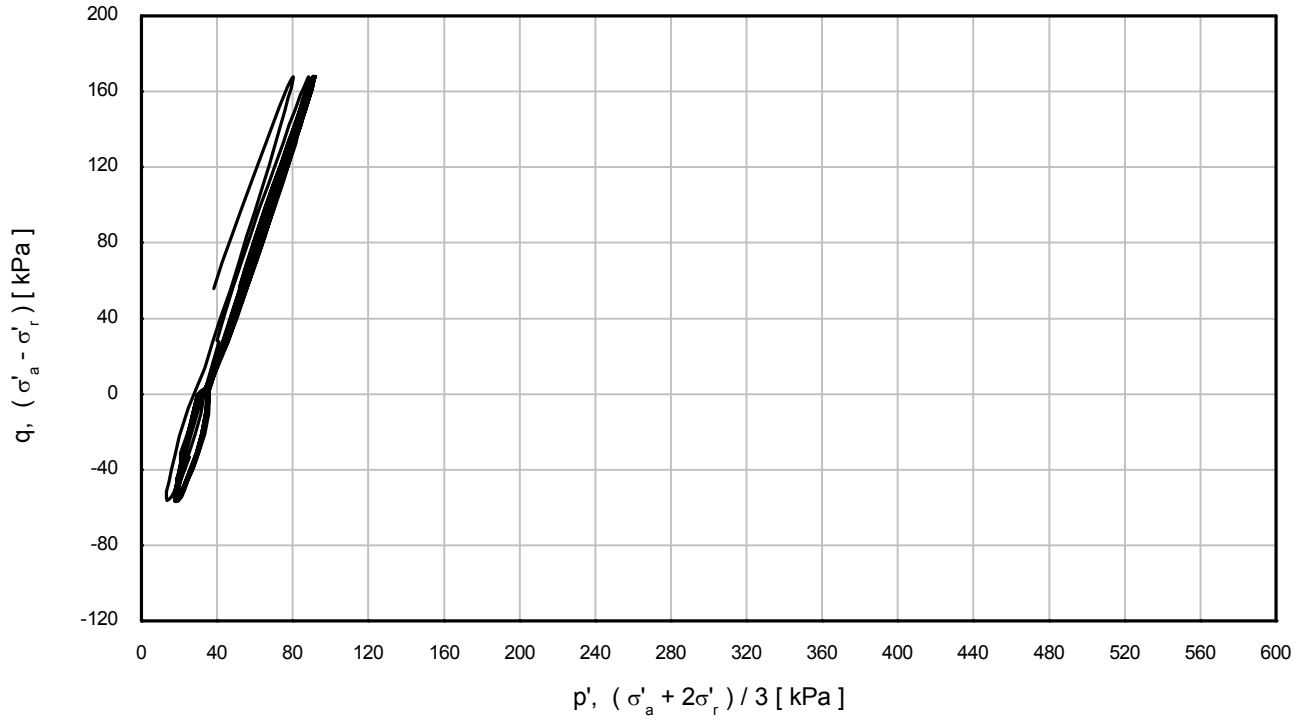




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	75	kPa	Sample	: CTX_1-3
q_{av}	:	56	kPa	Depth [m]	: Unit A (Southern Bight)
q_{cy}	:	112	kPa	Test No.	: CTX03
Frequency	:	0.10	Hz		

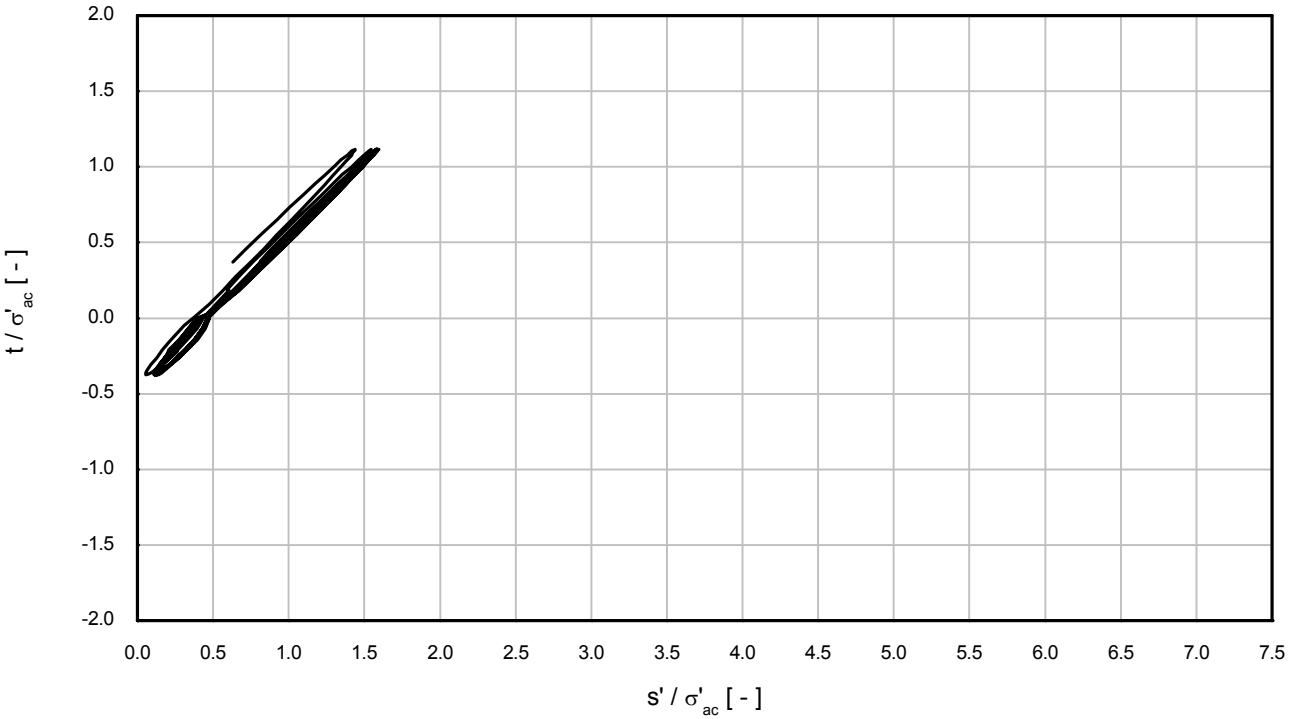
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

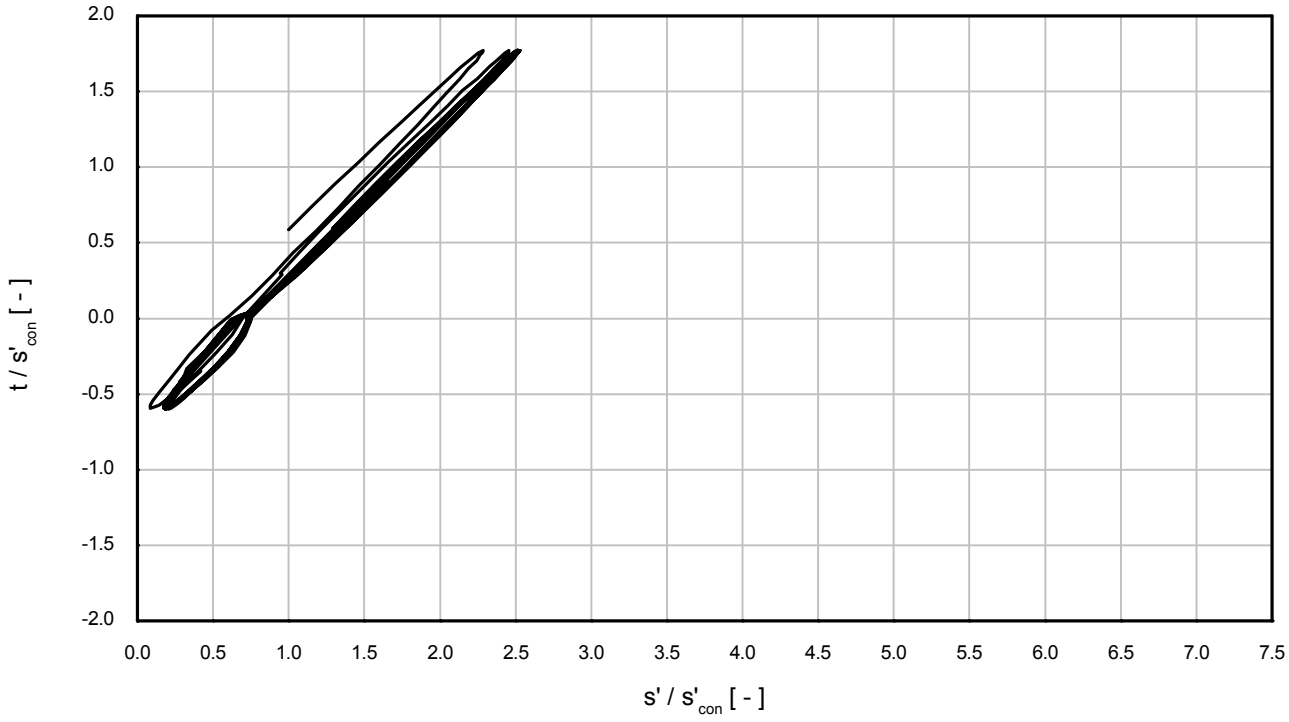




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	75	kPa	Sample	: CTX_1-3
q_{av}	:	56	kPa	Depth [m]	: Unit A (Southern Bight)
q_{cy}	:	112	kPa	Test No.	: CTX03
Frequency	:	0.10	Hz		

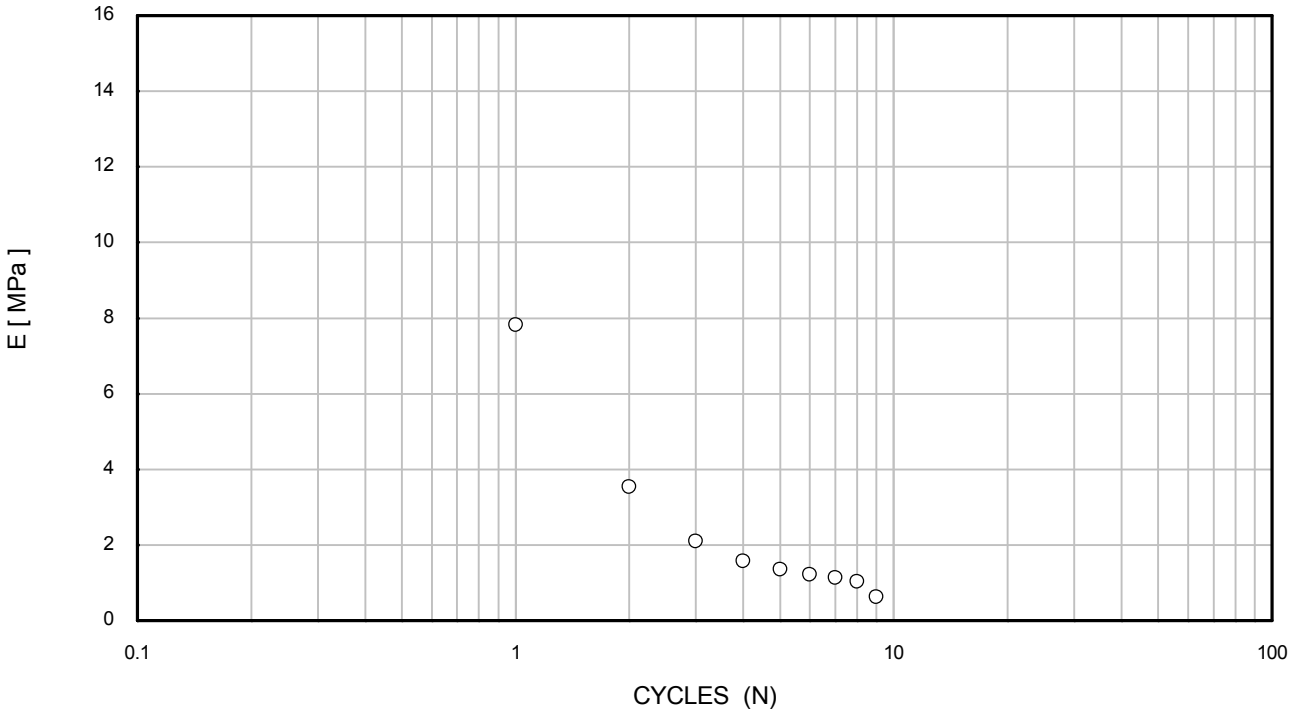
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

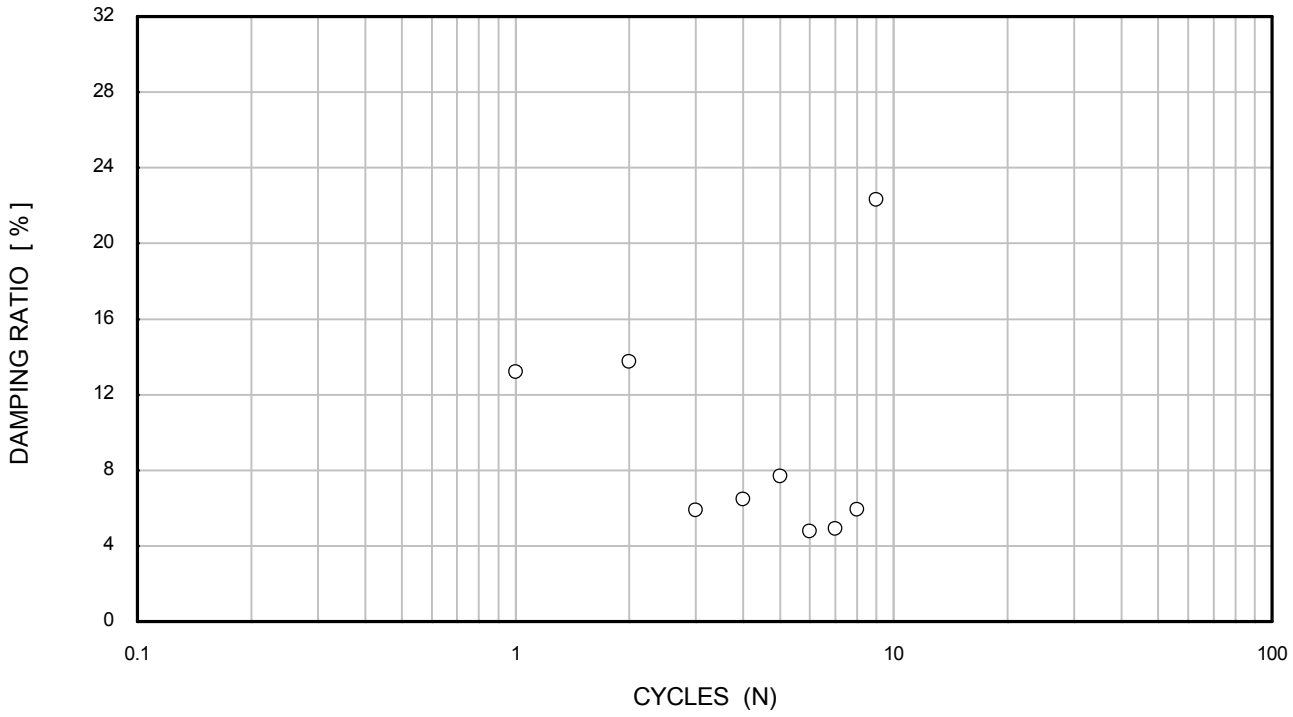




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	75 kPa	Sample	:	CTX_1-3
q_{av}	:	56 kPa	Depth [m]	:	Unit A (Southern Bight)
q_{cy}	:	112 kPa	Test No.	:	CTX03
Frequency	:	0.10 Hz			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED





Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	75 kPa	Sample	:	CTX_1-3
q_{av}	:	56 kPa	Depth [m]	:	Unit A (Southern Bight)
q_{cy}	:	112 kPa	Test No.	:	CTX03
Frequency	:	0.10 Hz			

ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	03/01/2017
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	140.0
Water content	[%]	10.5
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.614
Degree of saturation	[%]	45
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch01_CTX04-Check (Autosaved)
Processed by Date	MG 09/01/2017
Checked by Date	JLS 12/01/2017
Approved by Date	AR 13/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	900
Base PWP	[kPa]	889
Mid height PWP	[kPa]	-
B value achieved	[-]	0.99

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	909
Back pressure	[kPa]	889
Base PWP	[kPa]	889
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.17
External axial strain	[%]	0.03
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.611
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	909
Back pressure	[kPa]	889
Base PWP	[kPa]	889
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	44
Deviator stress	[kPa]	24
Volumetric strain	[%]	0.06
External axial strain	[%]	0.18
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.610
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	122
Mean q_{av}	[kPa]	24
Mean q_{cy}	[kPa]	24
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1491
External ε_{av} at N	[%]	5.45
External ε_{cy} at N	[%]	0.03
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	0
Δ mid height PWP at N	[kPa]	-
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.613
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.29	0.12	20.83	-	20.72	-
2	0.42	0.06	37.10	-	23.35	-
5	0.60	0.05	50.17	-	22.80	-
10	0.75	0.05	52.06	-	18.63	-
20	0.94	0.04	54.20	-	16.11	-
30	1.09	0.05	52.95	-	20.11	-
40	1.21	0.04	55.26	-	12.52	-
50	1.32	0.04	55.49	-	14.28	-
100	1.74	0.04	59.74	-	12.02	-
500	3.54	0.04	62.16	-	10.44	-
1000	4.68	0.04	62.19	-	9.45	-
1491	5.45	0.03	63.28	-	1.96	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	909
Back pressure	[kPa]	889
Base PWP	[kPa]	889
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	63
Deviator stress	[kPa]	43
Volumetric strain	[%]	0.02
External axial strain	[%]	5.48
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.613
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (Deviator)	[kPa]	122
Mean q_{av}	[kPa]	43
Mean q_{cy}	[kPa]	43
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	163
External ε_{av} at N_f	[%]	20.51
External ε_{cy} at N_f	[%]	0.10
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	1
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	24.7
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.654
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	5.53	0.07	60.51	-	21.18	-
2	5.59	0.08	54.52	-	20.01	-
5	5.79	0.09	49.75	-	20.14	-
10	6.16	0.09	47.87	-	20.17	-
20	6.97	0.09	45.49	-	20.15	-
30	7.81	0.10	44.36	-	19.99	-
40	8.69	0.10	43.21	-	19.86	-
50	9.61	0.10	41.59	-	19.74	-
70	11.58	0.09	45.84	-	21.46	-
100	14.62	0.10	40.78	-	19.51	-
150	19.37	0.10	42.36	-	19.36	-
163	20.51	0.10	42.01	-	19.46	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	20
Initial effective axial pressure	[kPa]	53
Rate of strain	[%/hour]	0.95
At peak deviator stress		
Corrected deviator stress	[kPa]	57
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	21.06
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	0
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	78
Principal effective stress ratio	[-]	3.81
ε_{50}	[%]	22.98
Secant modulus (E_{50}) at ε_{50}	[kPa]	539
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	56
Membrane correction applied	[kPa]	2
Drain correction applied	[kPa]	0
External axial strain	[%]	21.20
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	1
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	19
Effective axial pressure	[kPa]	75
Principal effective stress ratio	[-]	3.88
At 25% external axial strain		
Corrected deviator stress	[kPa]	-
Membrane correction applied	[kPa]	-
Drain correction applied	[kPa]	-
External axial strain	[%]	-
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	-
Effective axial pressure	[kPa]	-
Principal effective stress ratio	[-]	-

TEST IDENTIFICATION	
Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





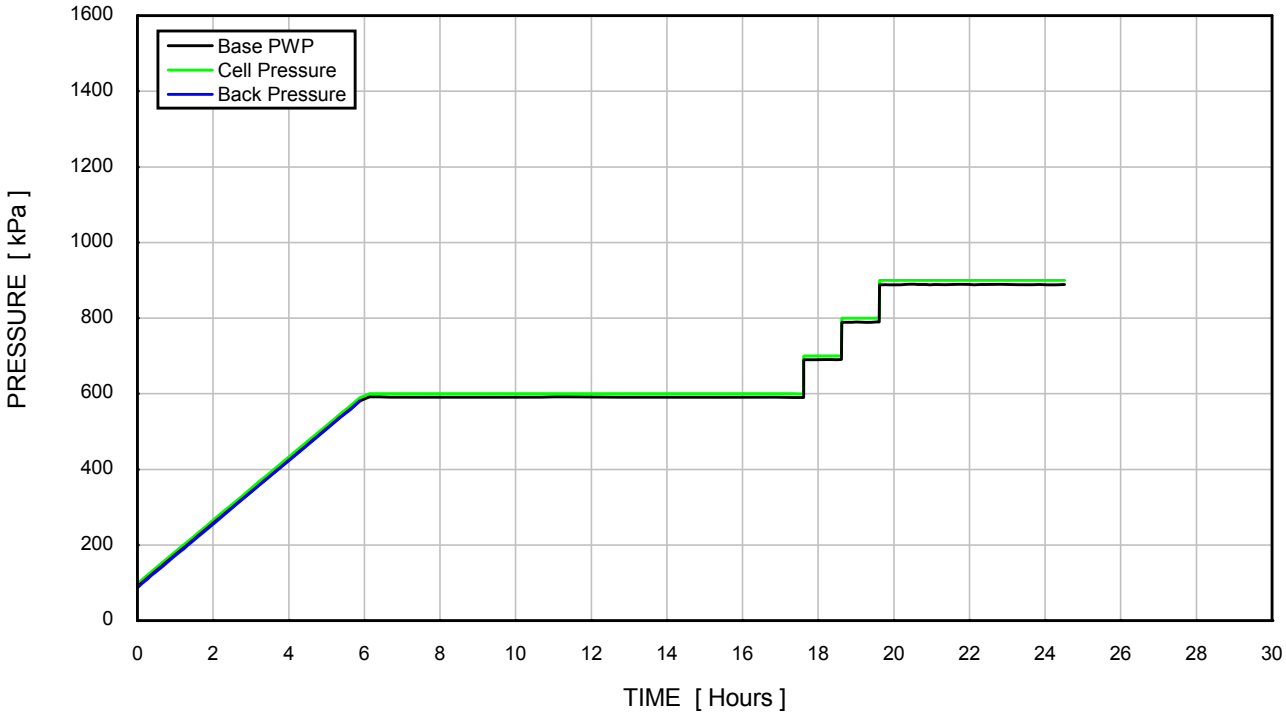
FINAL CONDITIONS

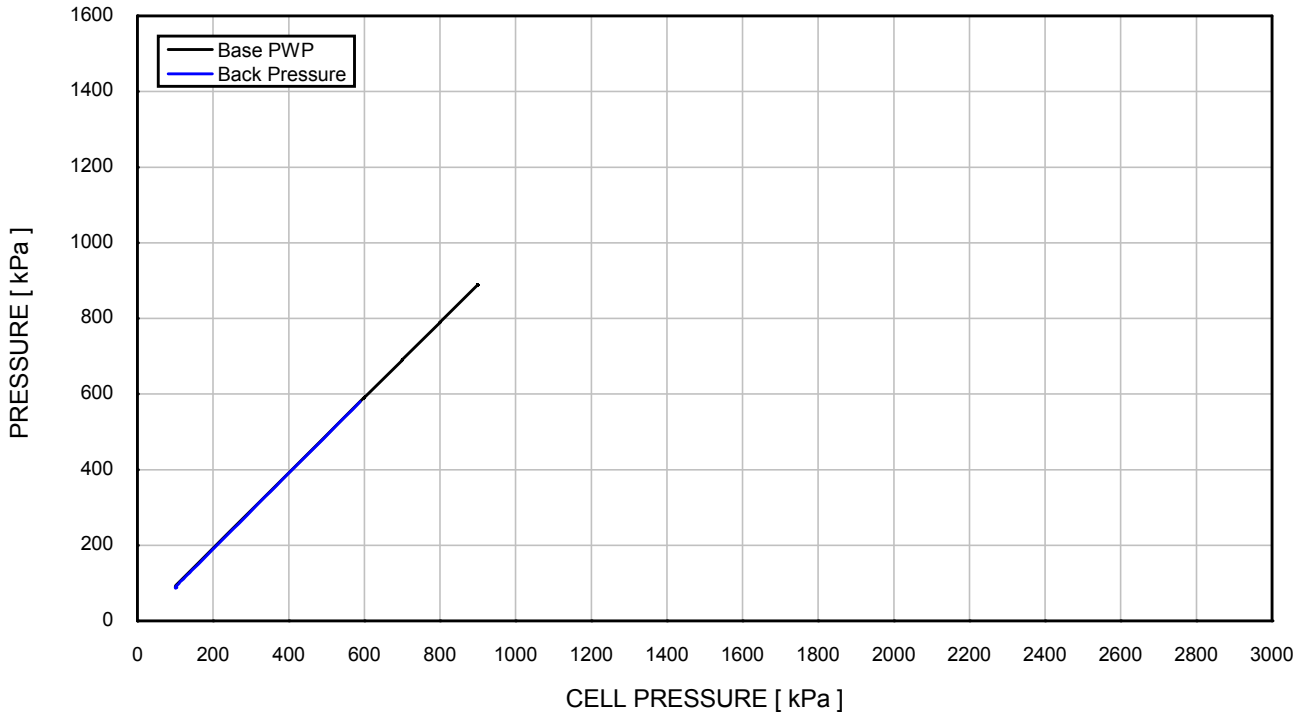
Water content	[%]	25.7
Bulk density	[Mg/m³]	1.98
Dry density	[Mg/m³]	1.58

TEST IDENTIFICATION

Batch	1
Sample	CTX_1-5
Unit	Unit A (Southern Bight)
Test number	CTX04

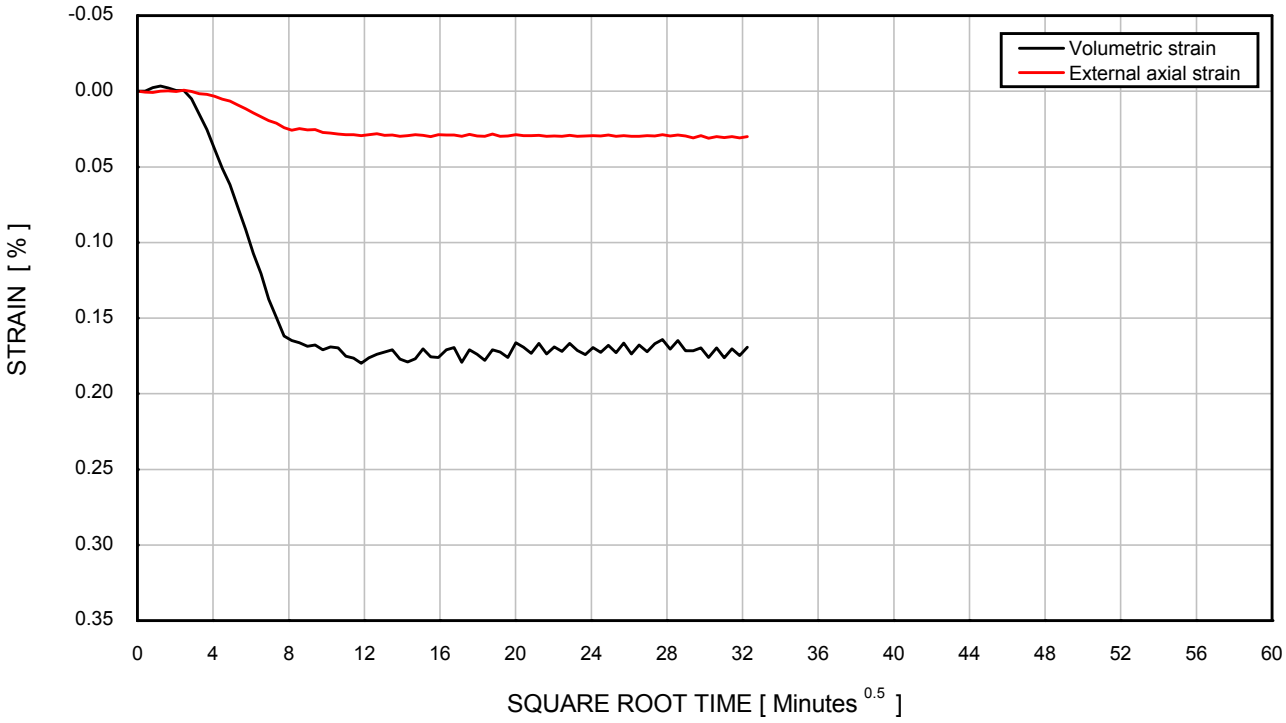
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST





B value	:	0.99	Batch	:	1
Initial σ'_r	:	15 kPa	Sample	:	CTX_1-5
Initial σ'_a	:	15 kPa	Unit	:	Unit A (Southern Bight)
Final σ'_r	:	11 kPa	Test No.	:	CTX04
Final σ'_a	:	11 kPa			

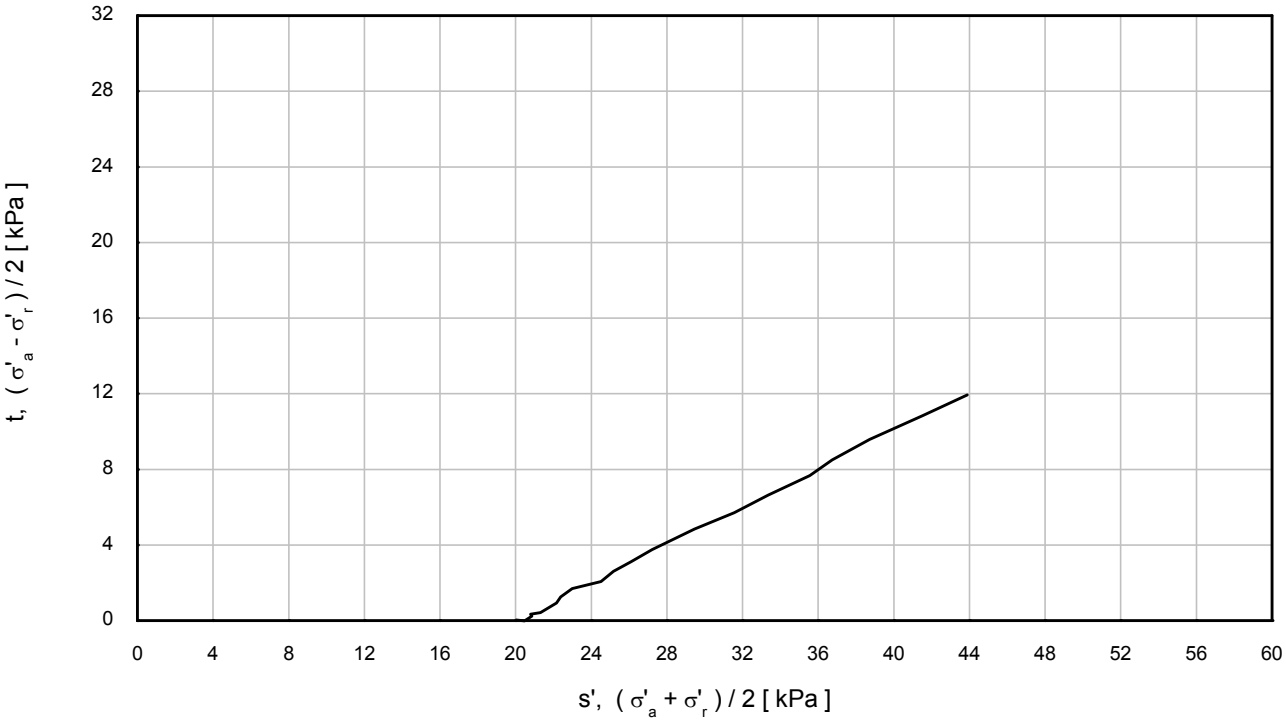
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

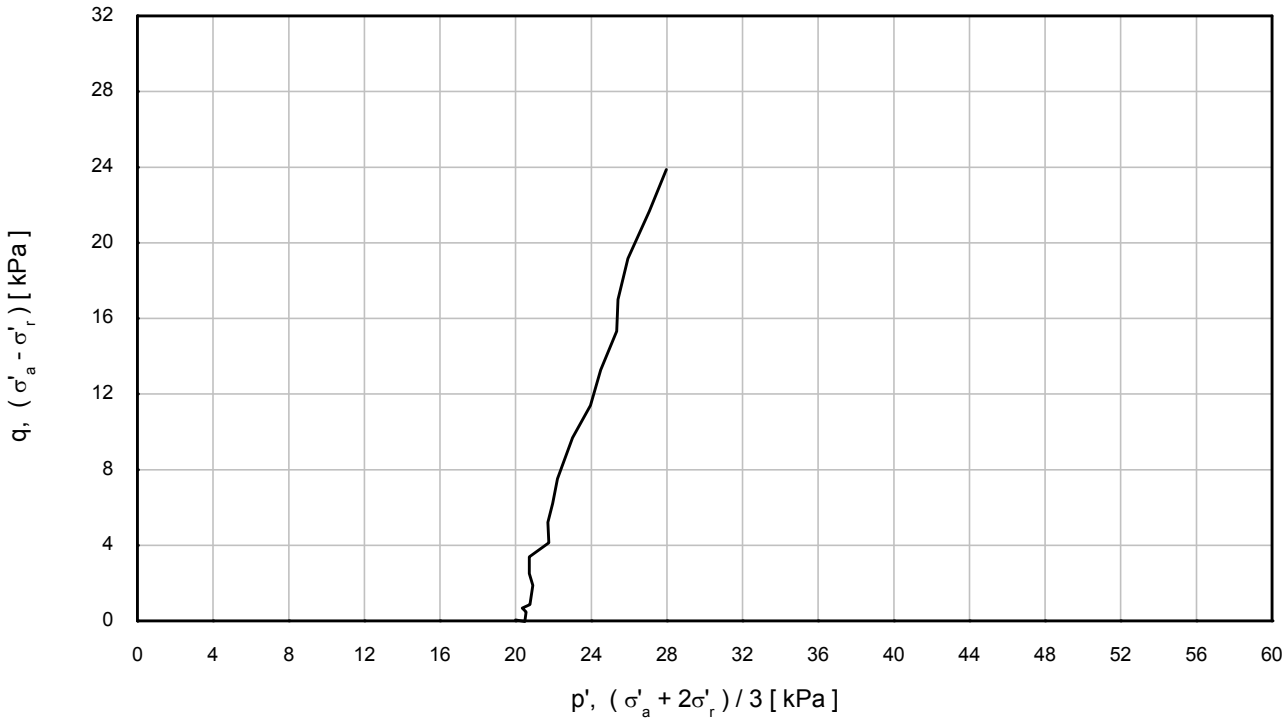




Stage 1 σ'_{rc}	:	20	kPa	Batch	: 1
Stage 1 σ'_{ac}	:	20	kPa	Sample	: CTX_1-5
				Unit	: Unit A (Southern Bight)
				Test No.	: CTX04

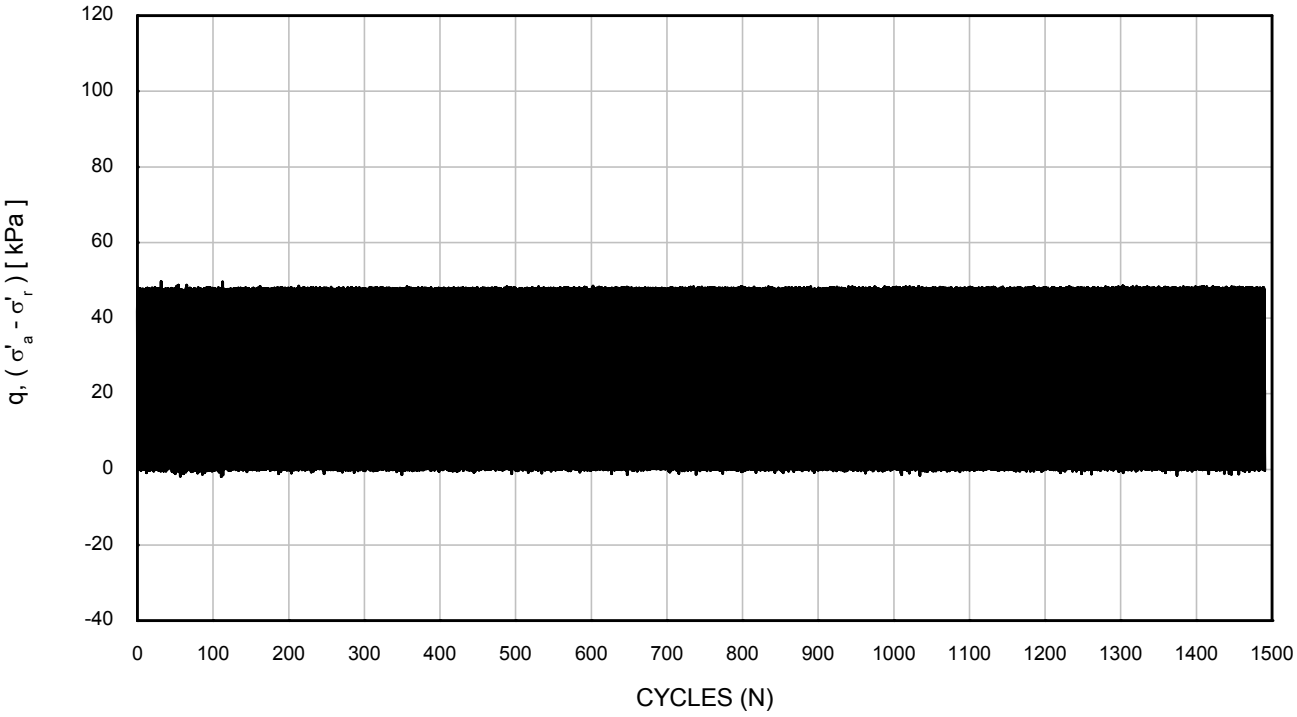
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

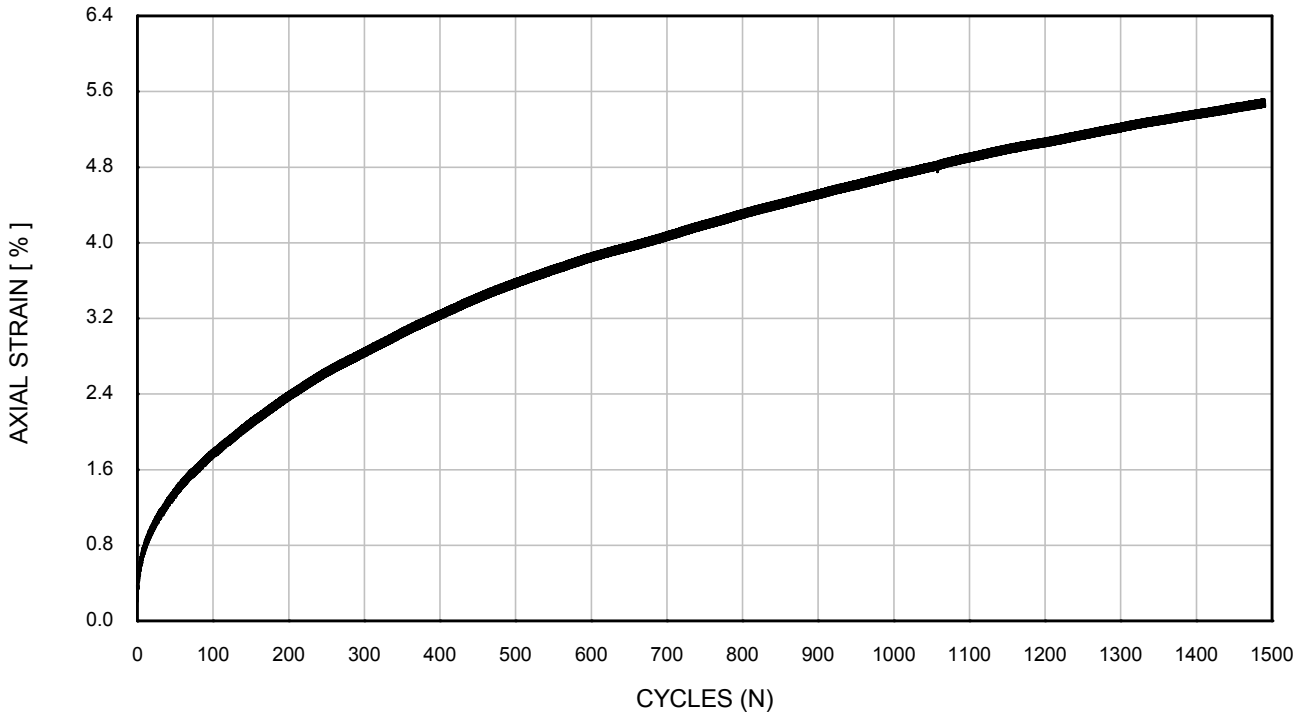




σ'_{rc}	:	20 kPa	Batch	: 1
σ'_{ac}	:	44 kPa	Sample	: CTX_1-5
			Unit	: Unit A (Southern Bight)
			Test No.	: CTX04

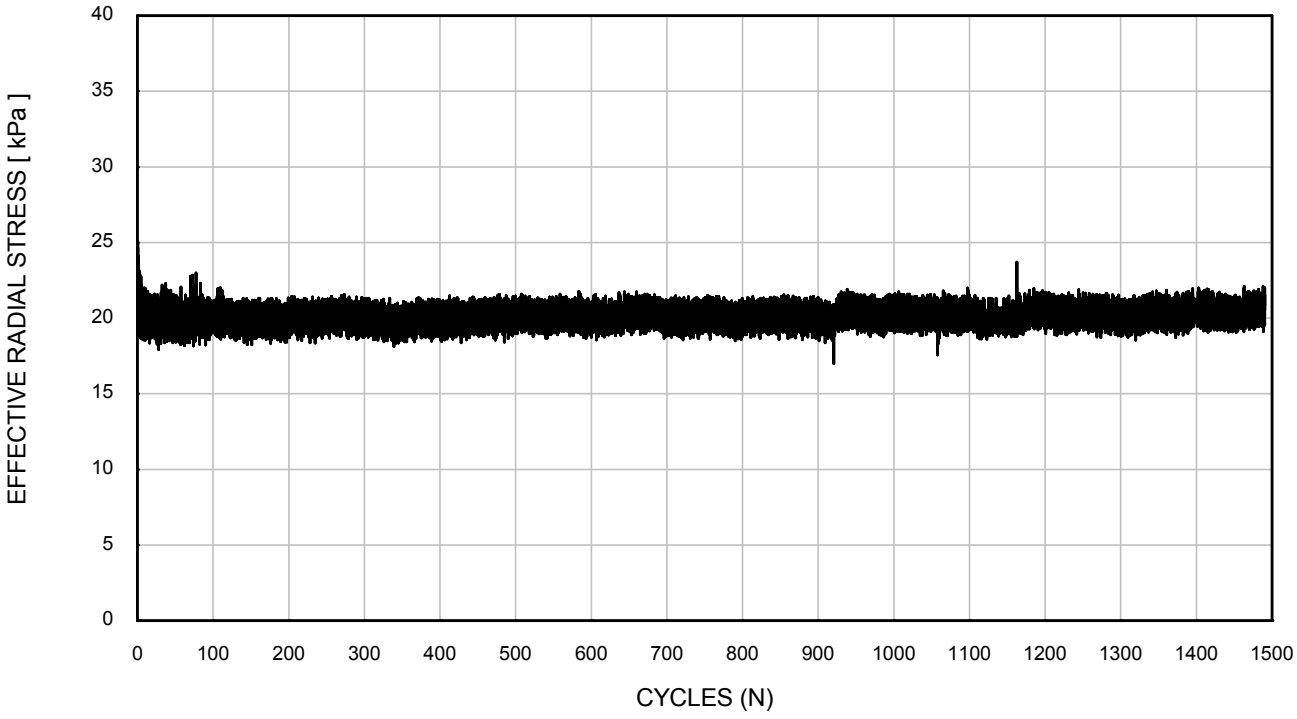
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
DRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

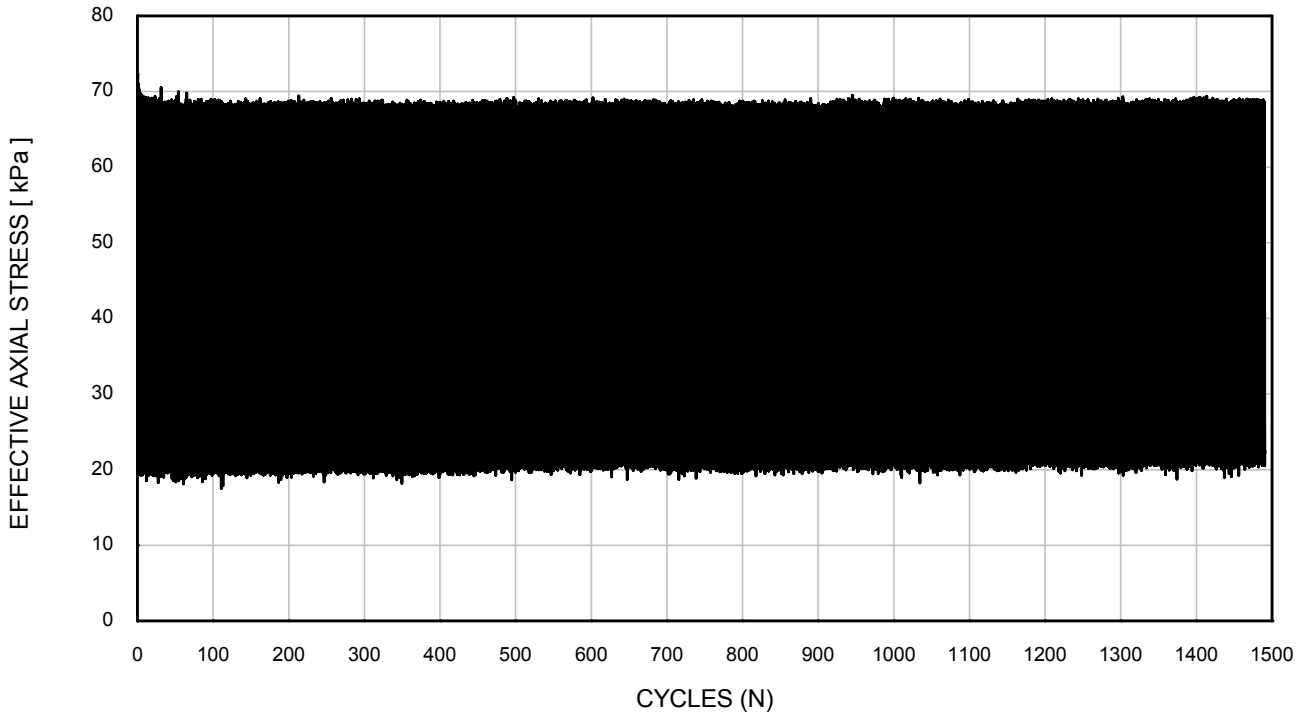




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

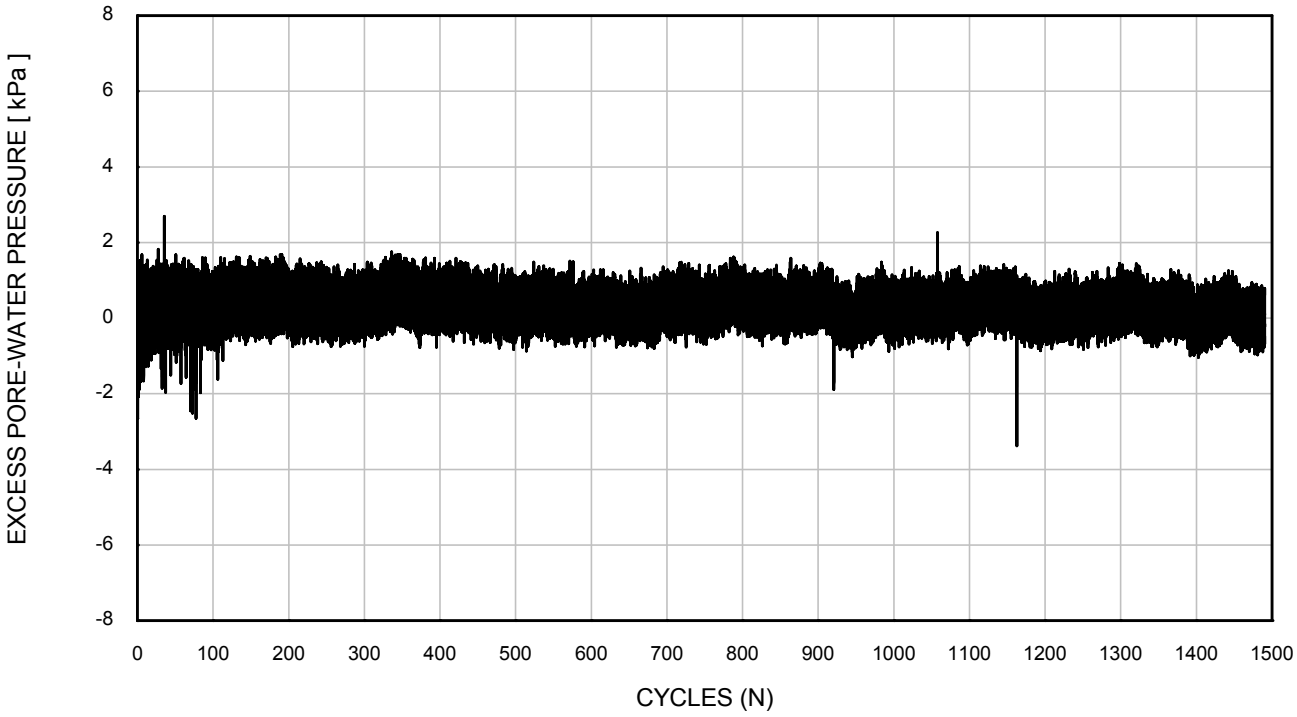
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

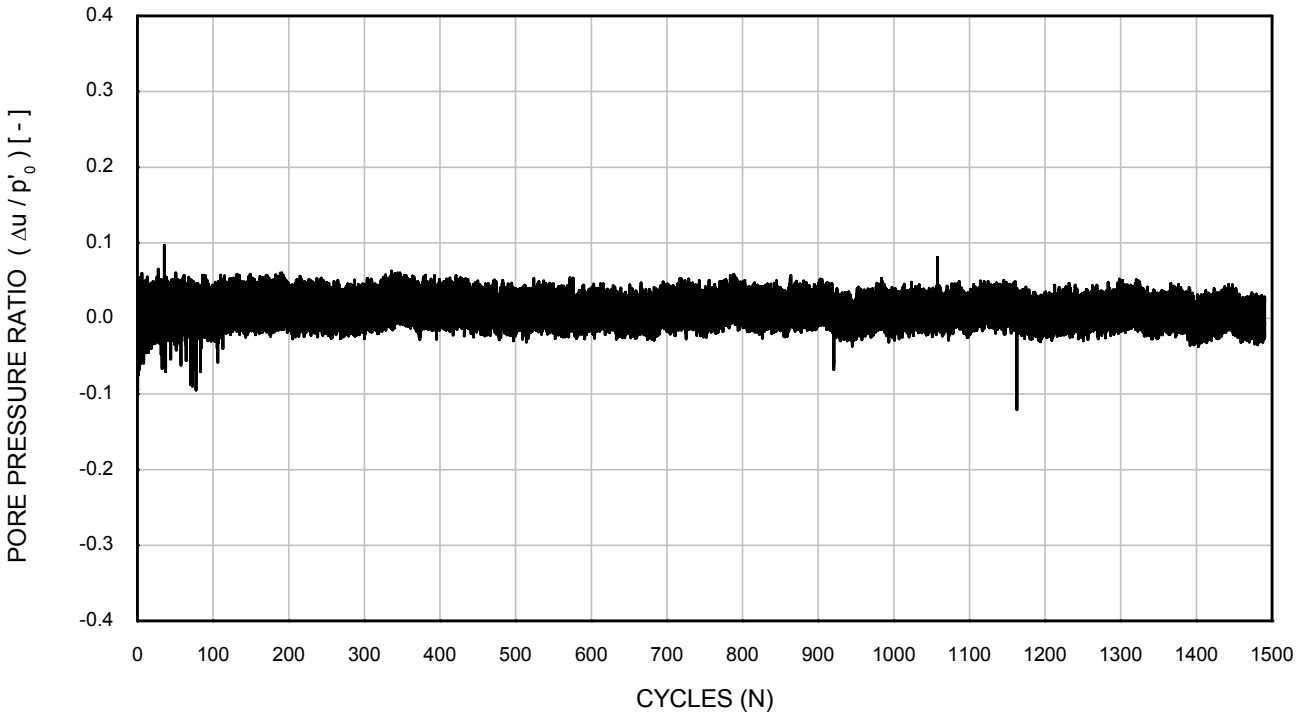




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

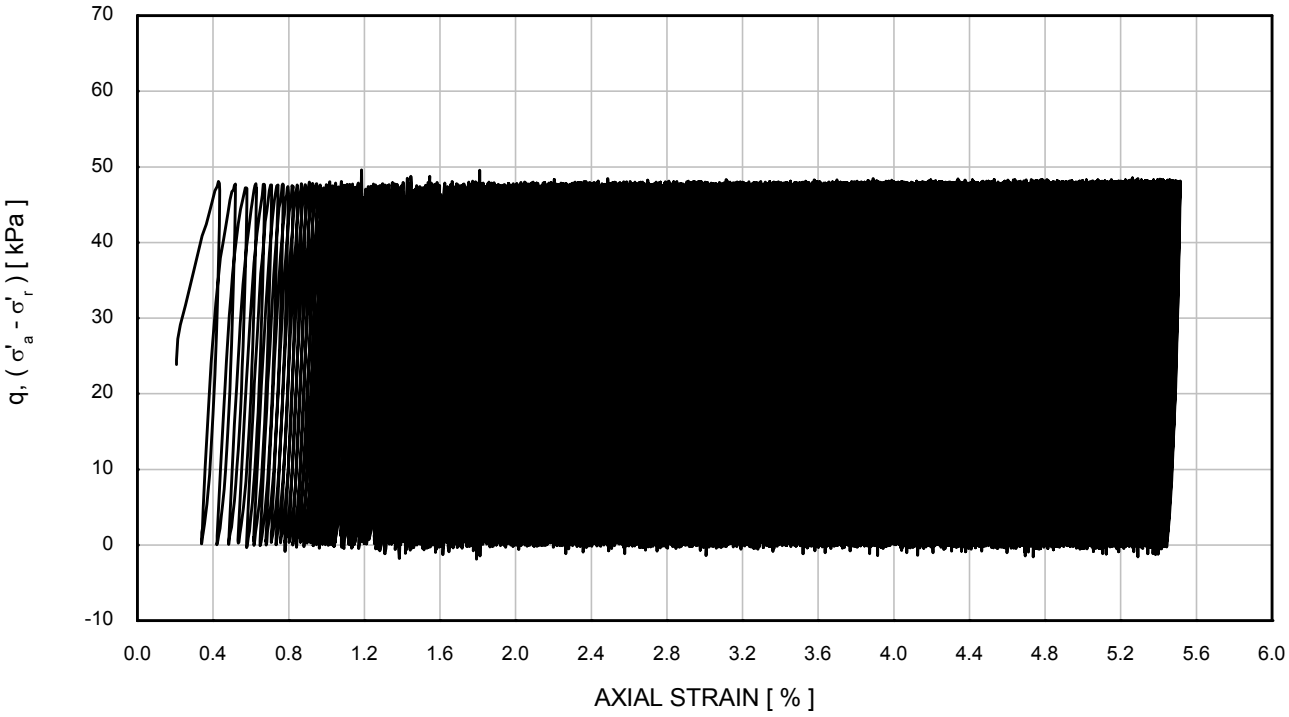
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

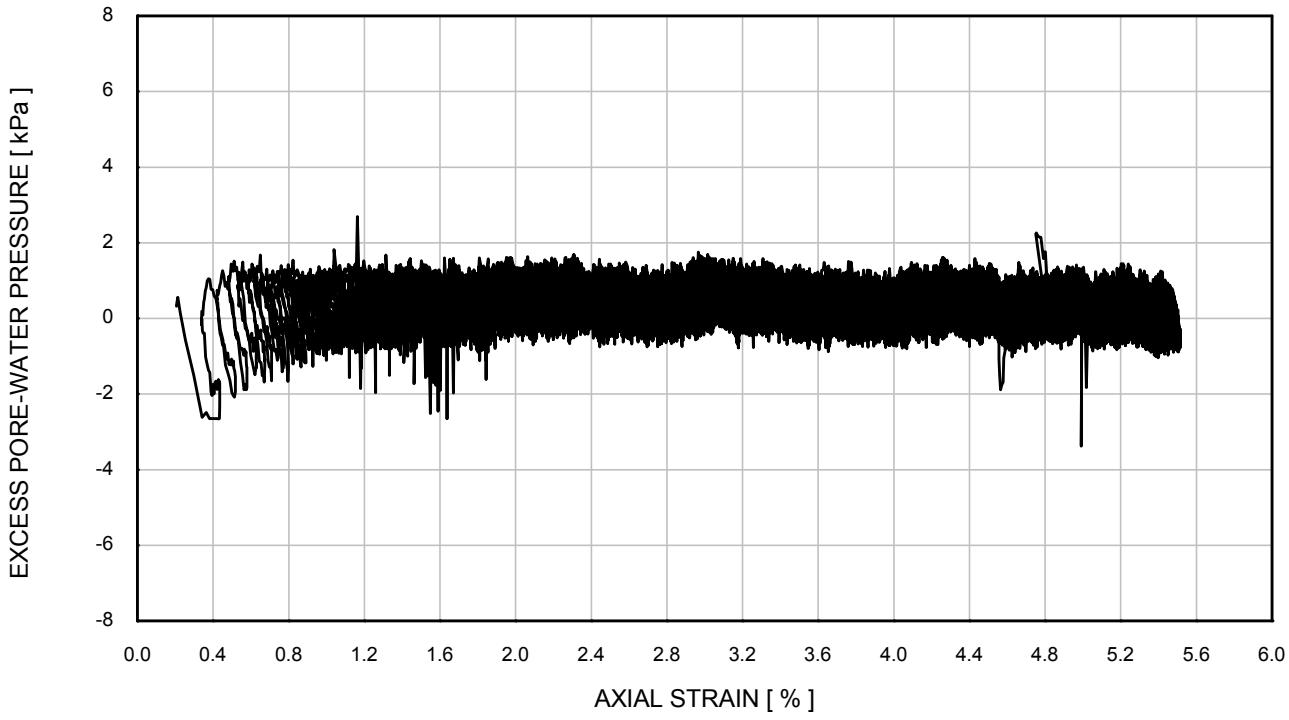




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

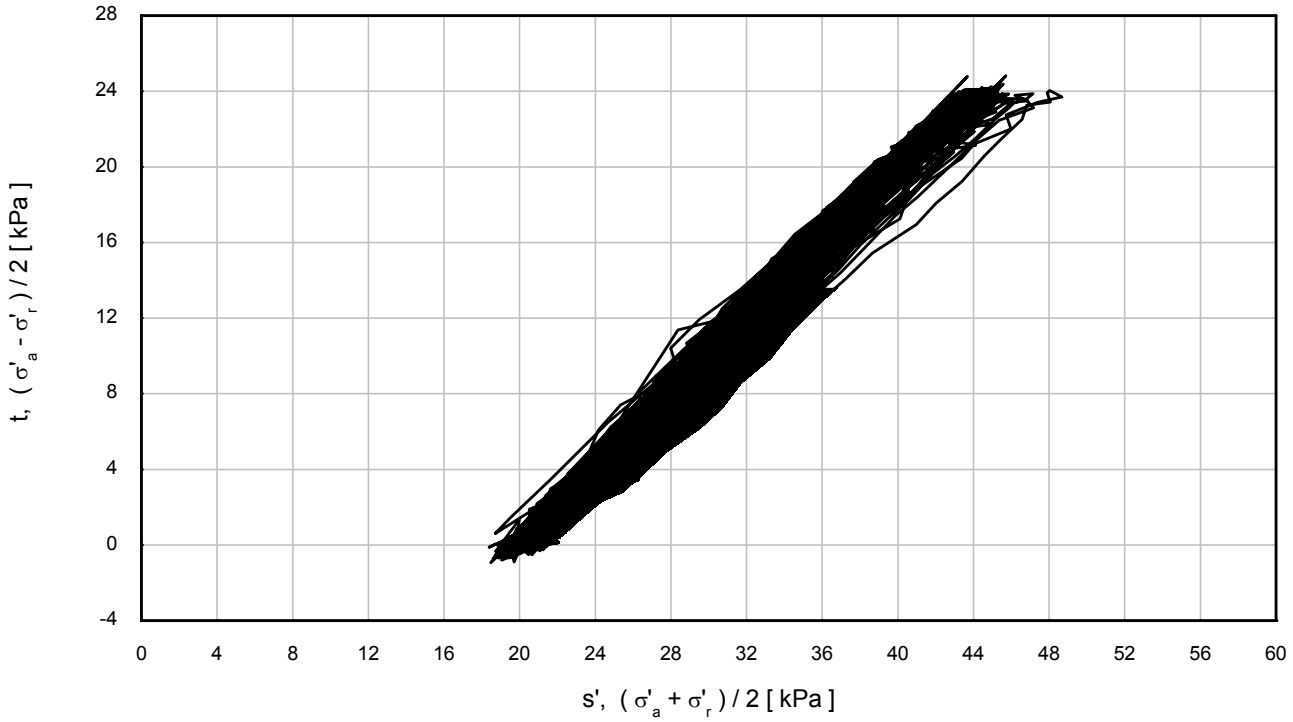
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

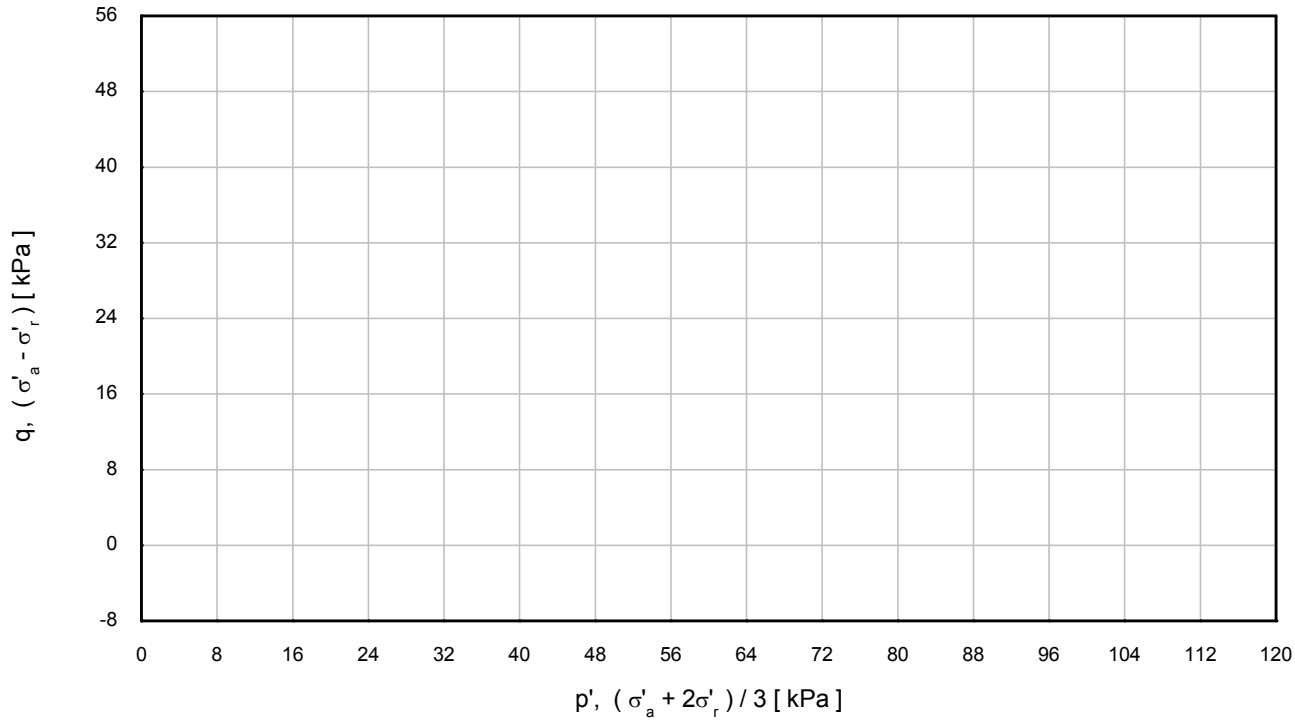




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

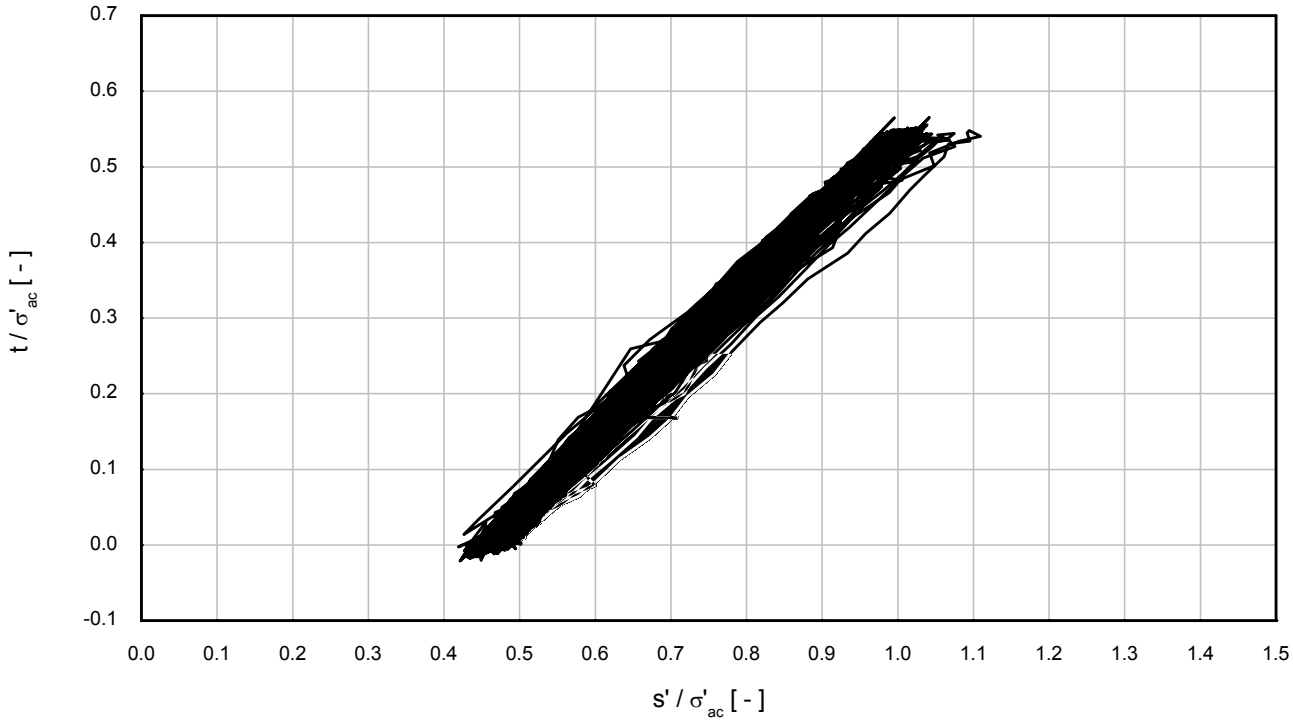
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

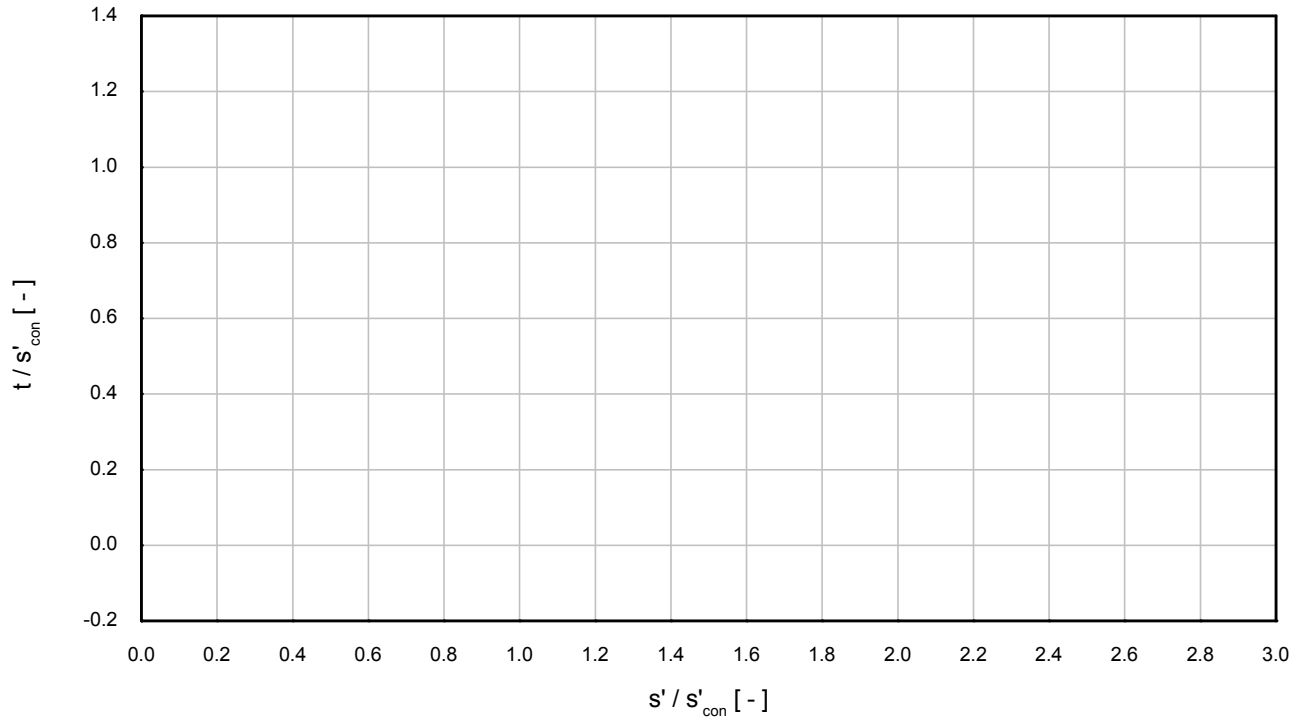




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

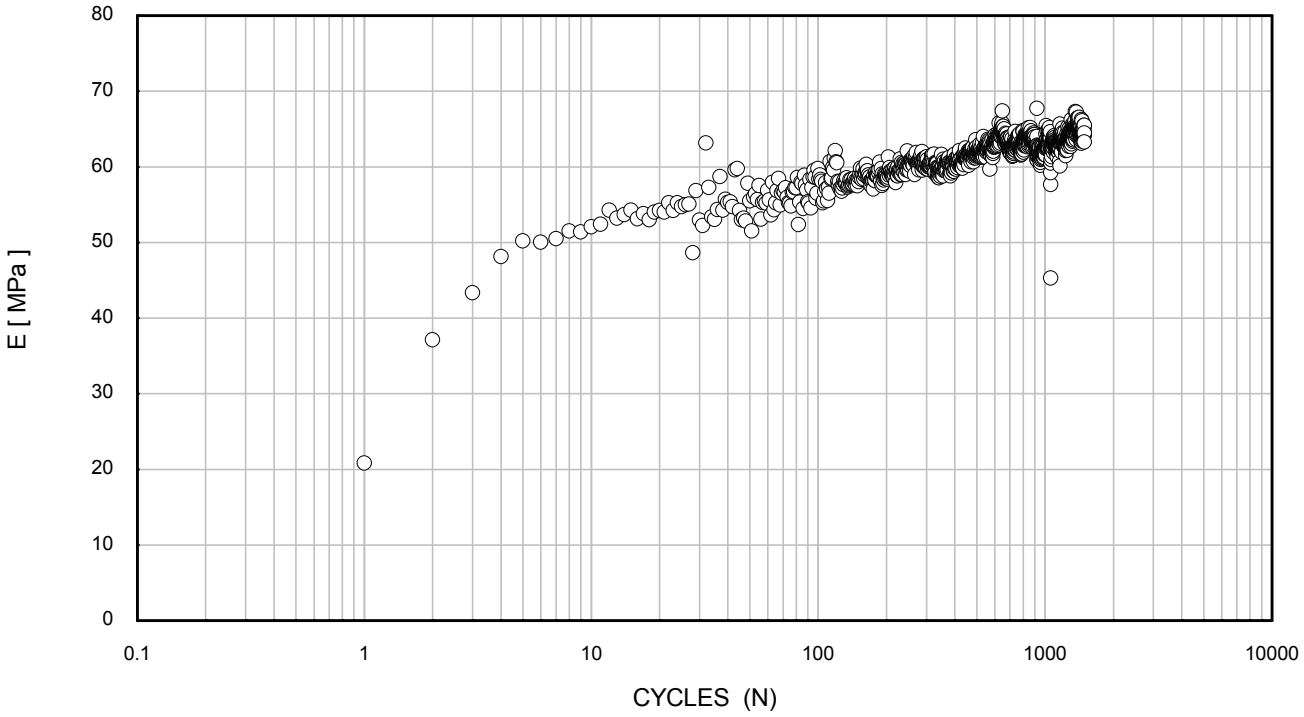
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

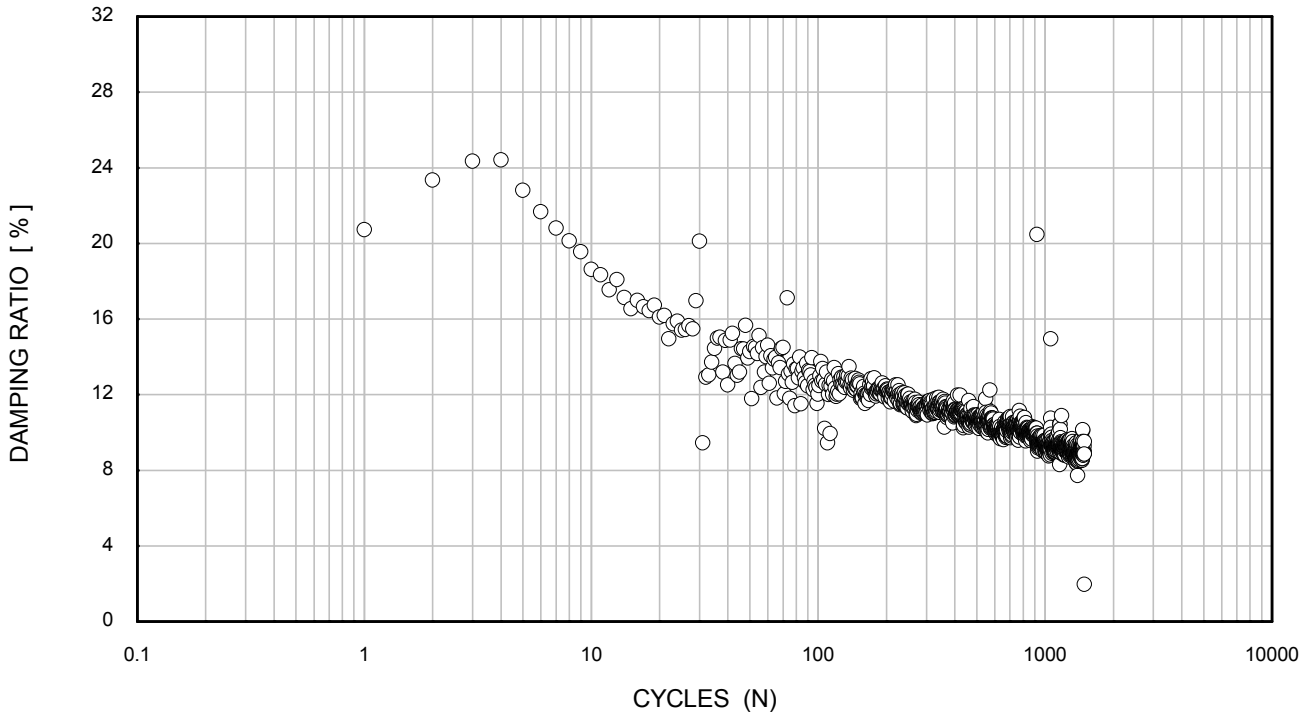




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

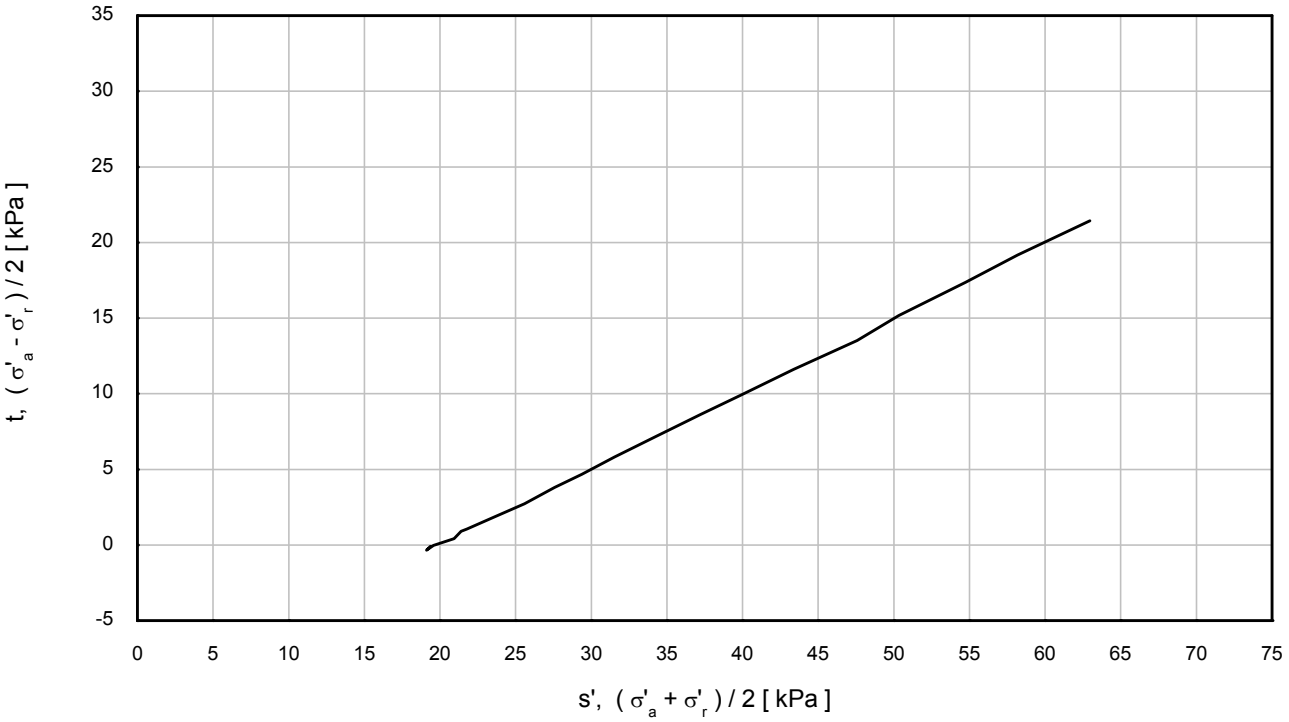
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

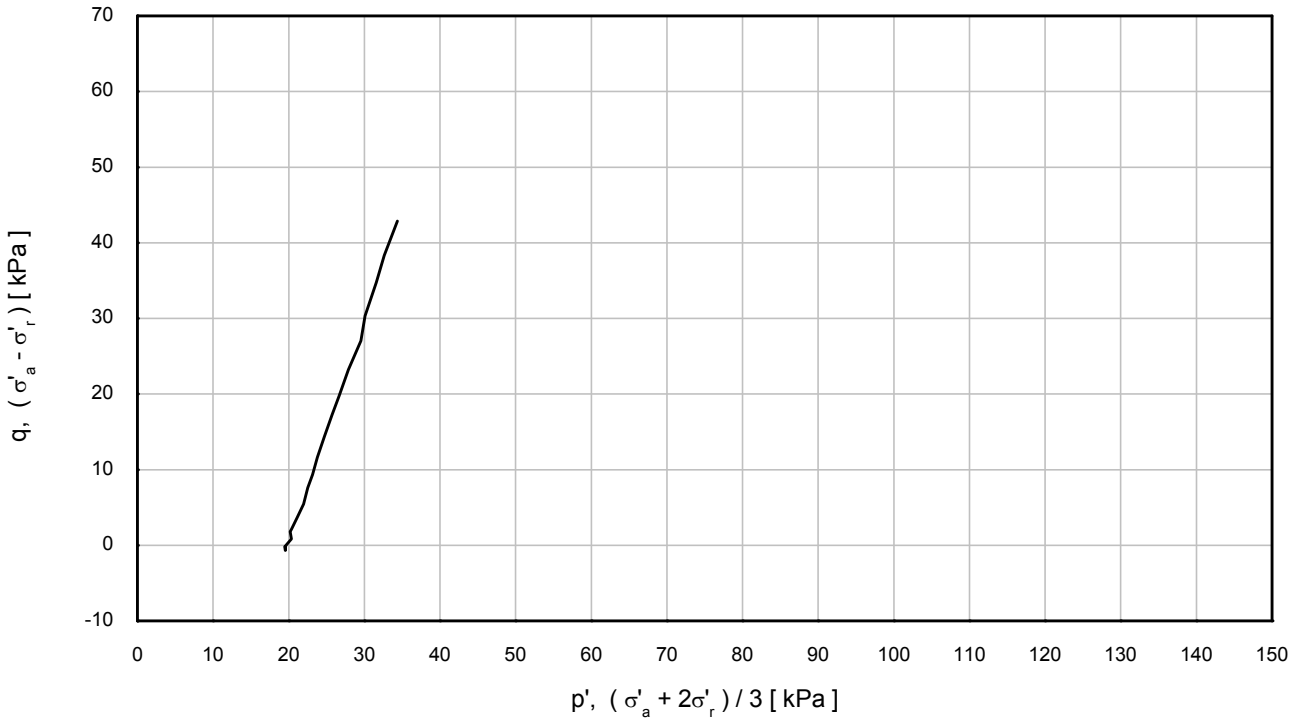




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	44 kPa	Sample	:	CTX_1-5
q_{av}	:	24 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	24 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

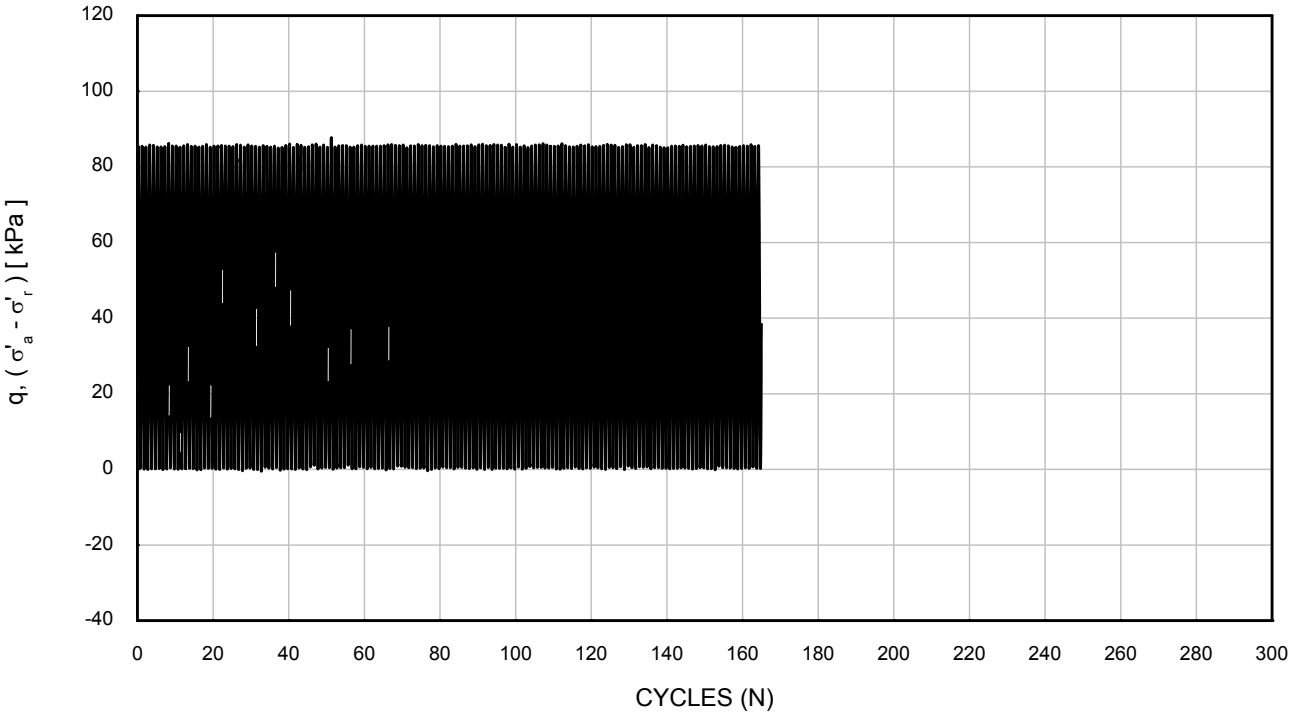
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

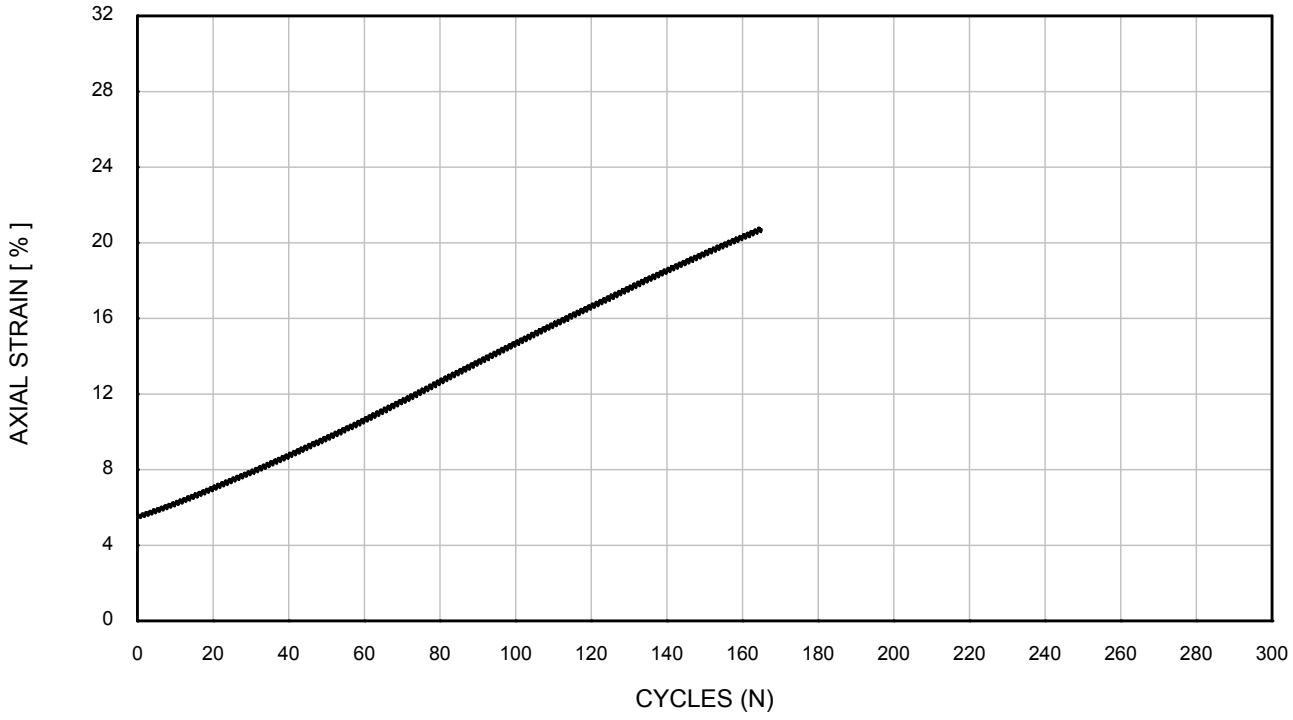




σ'_{rc}	:	20 kPa	Batch	: 1
σ'_{ac}	:	63 kPa	Sample	: CTX_1-5
			Unit	: Unit A (Southern Bight)
			Test No.	: CTX04

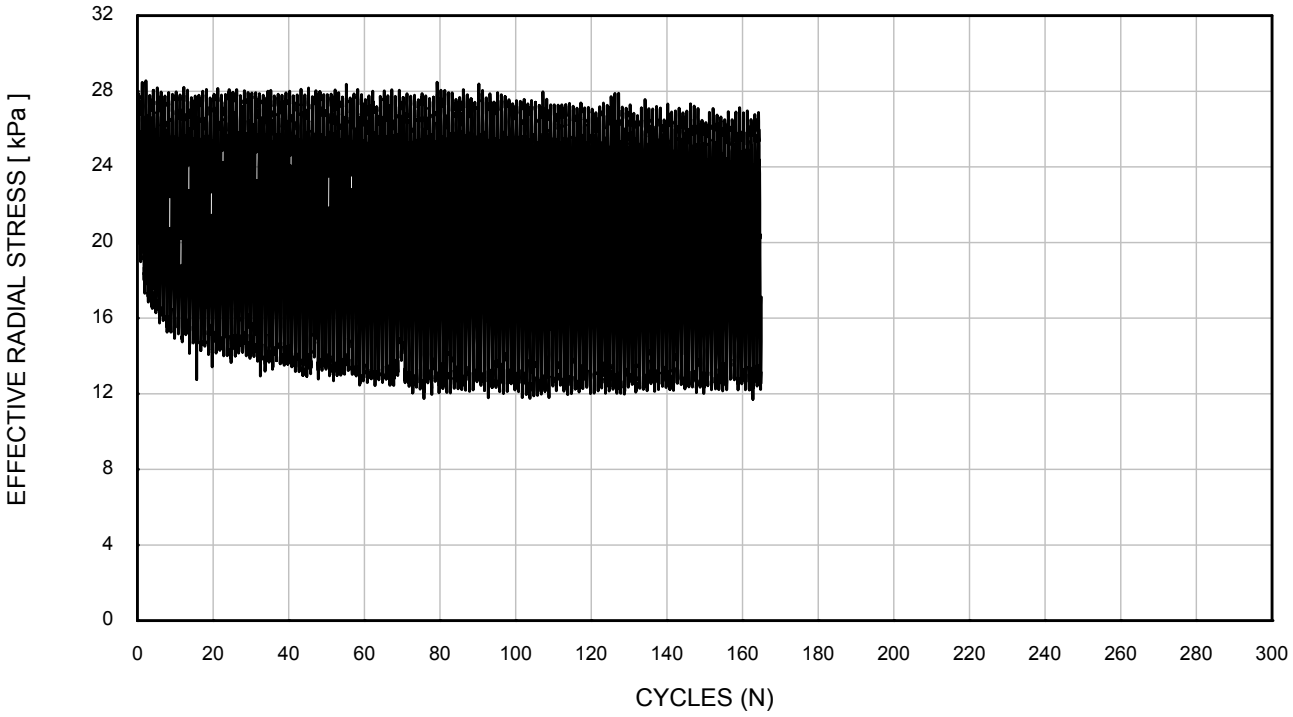
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
DRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

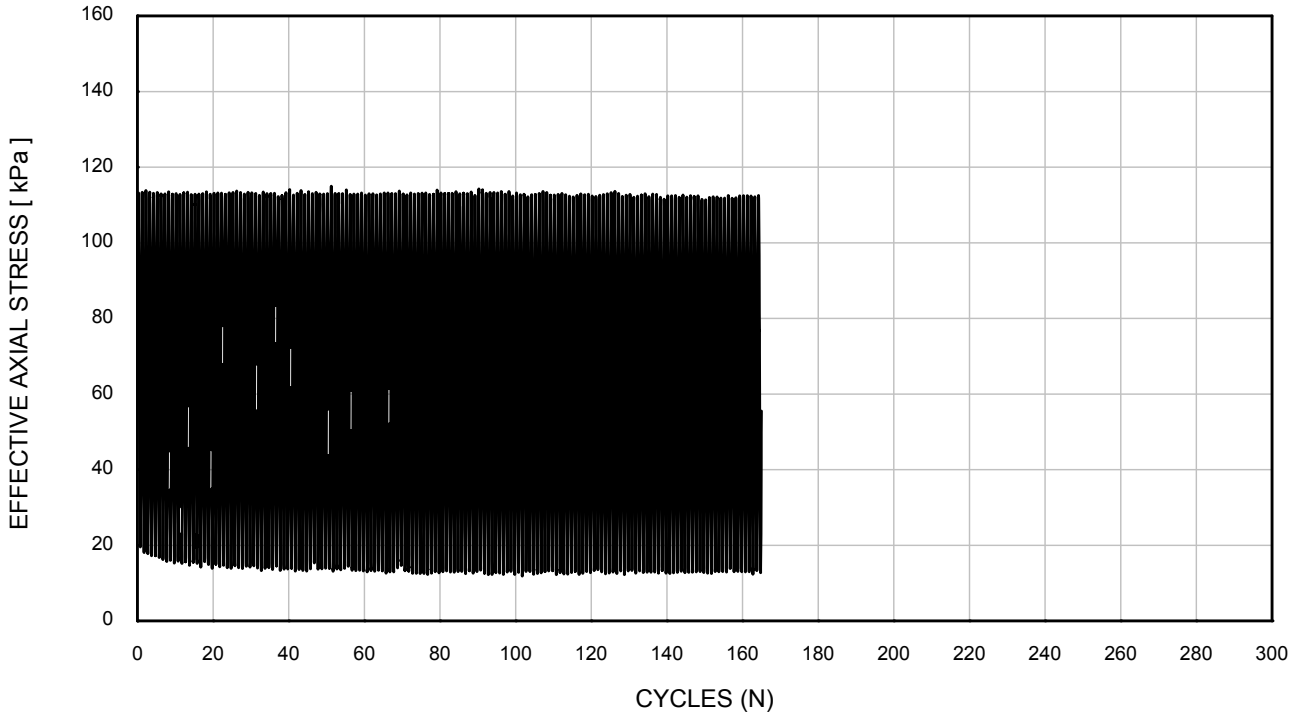




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	63 kPa	Sample	:	CTX_1-5
q_{av}	:	43 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	43 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

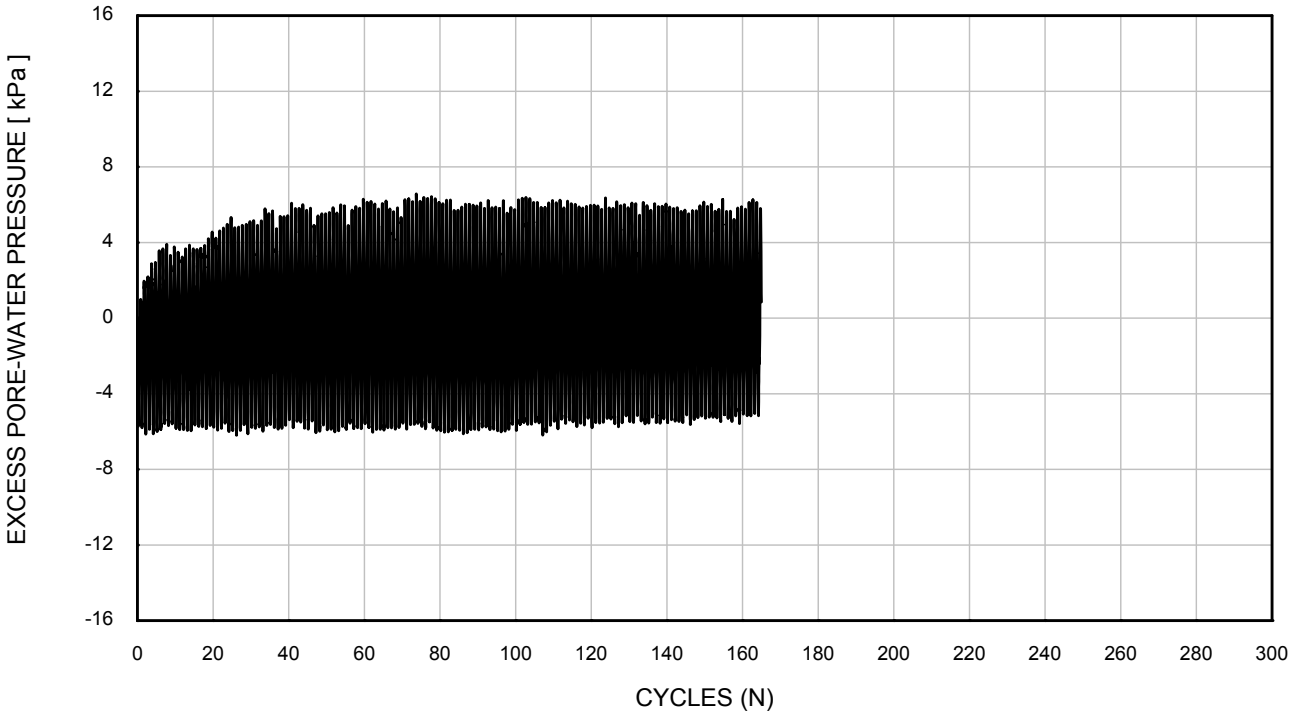
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

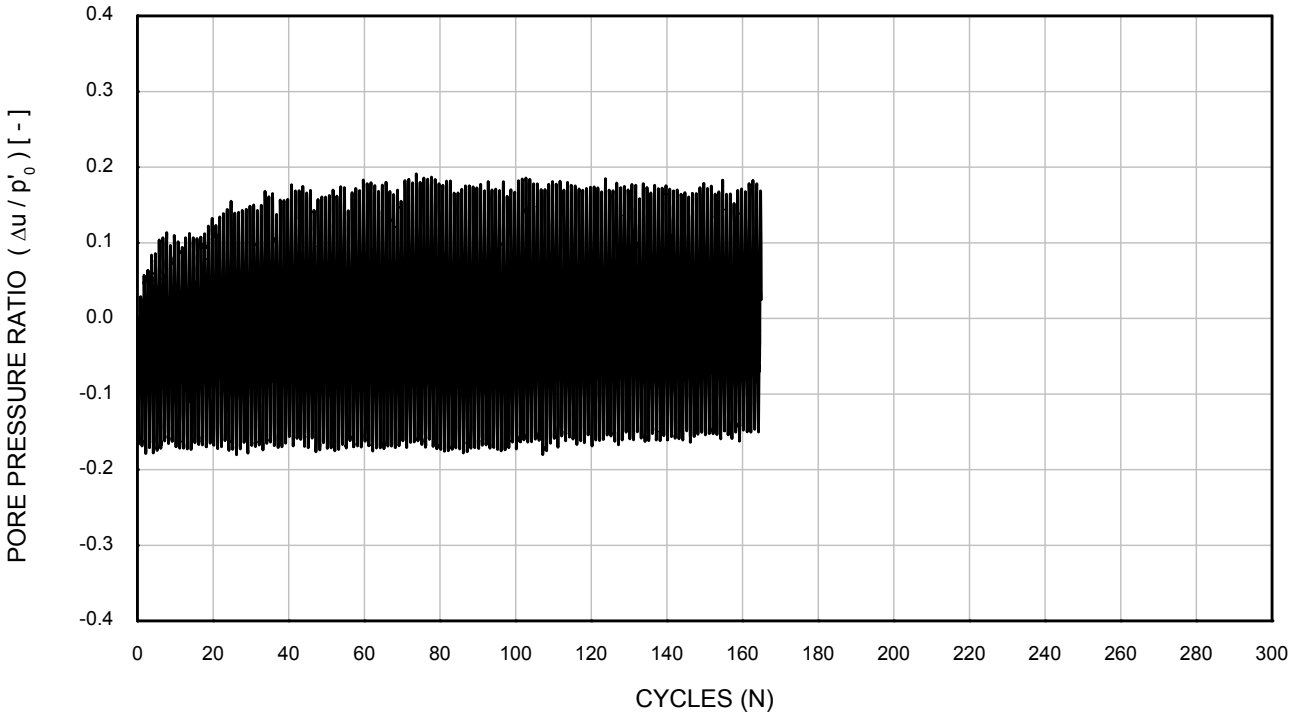




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	63 kPa	Sample	:	CTX_1-5
q_{av}	:	43 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	43 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

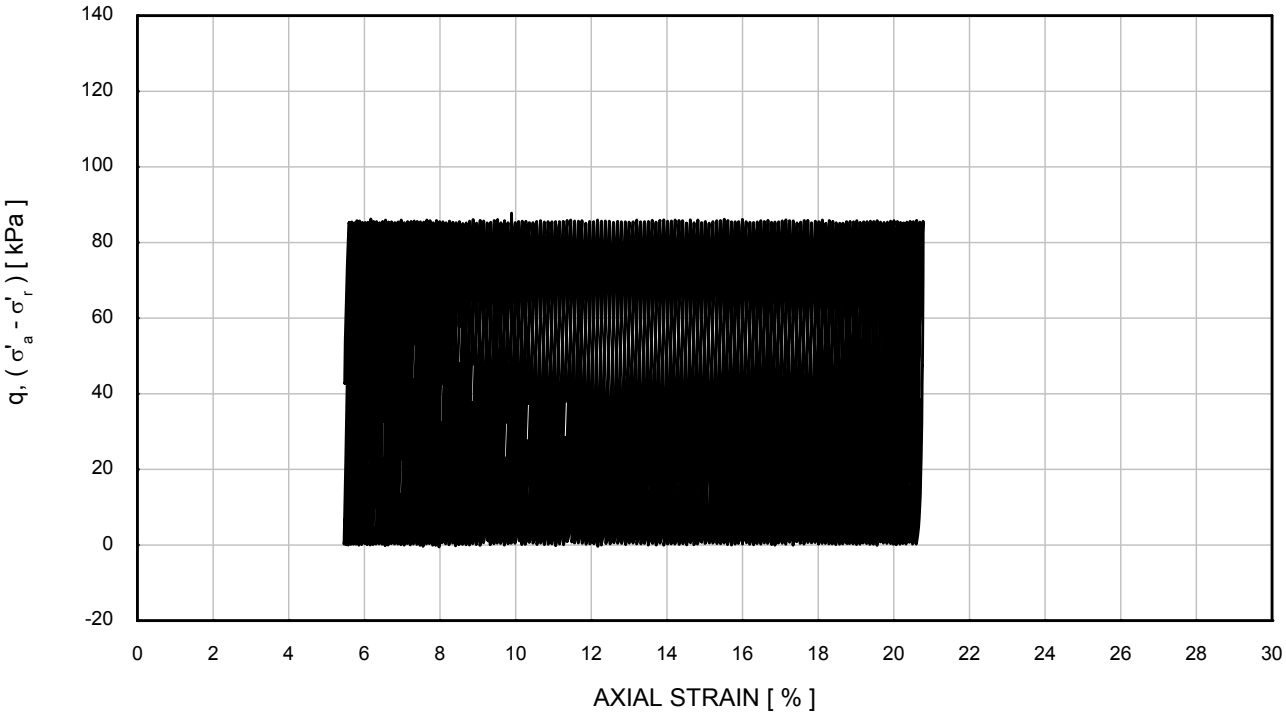
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

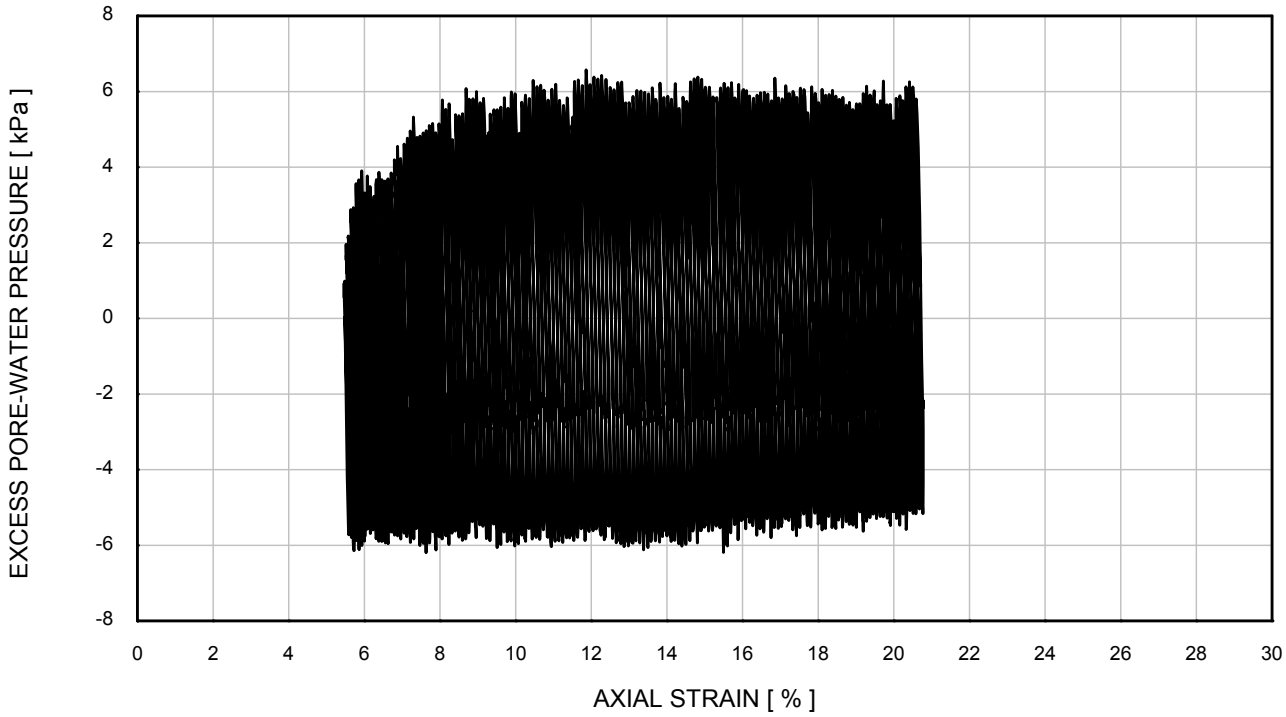




Initial σ'_r	:	20 kPa	Batch	: 1
Initial σ'_a	:	63 kPa	Sample	: CTX_1-5
q_{av}	:	43 kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	43 kPa	Test No.	: CTX04
Frequency	:	0.10 Hz		

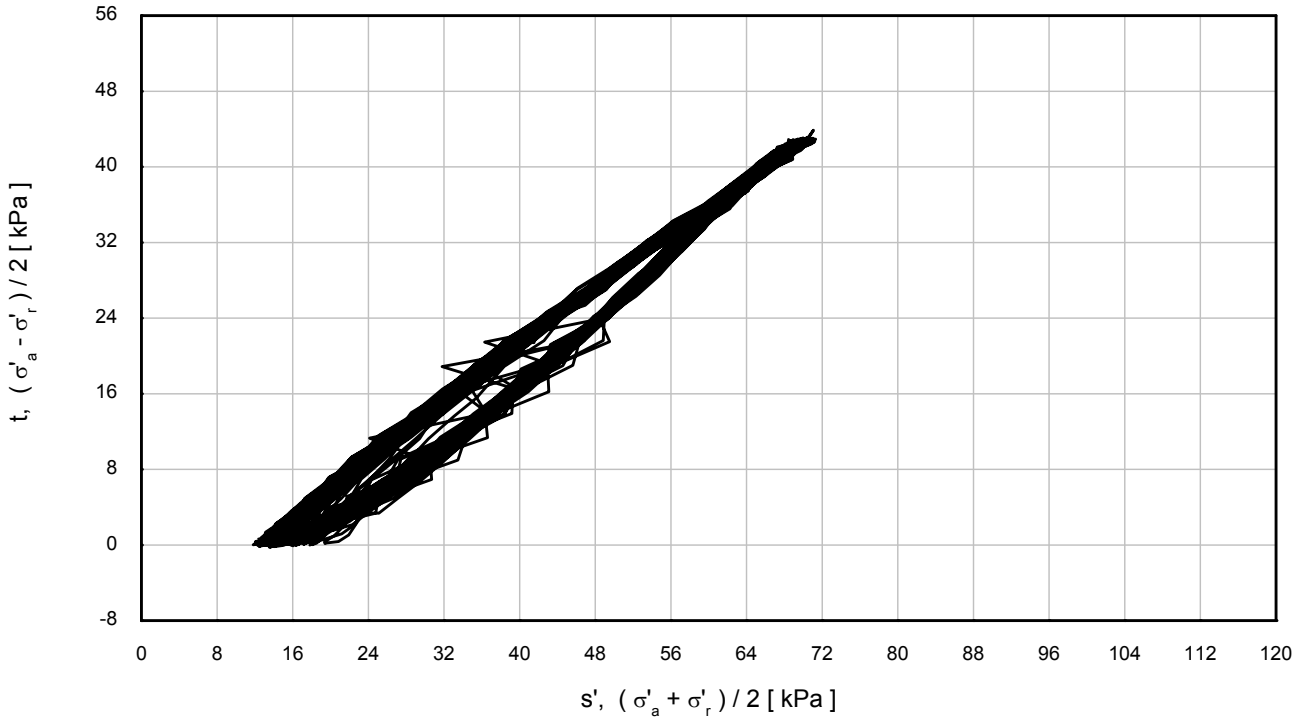
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

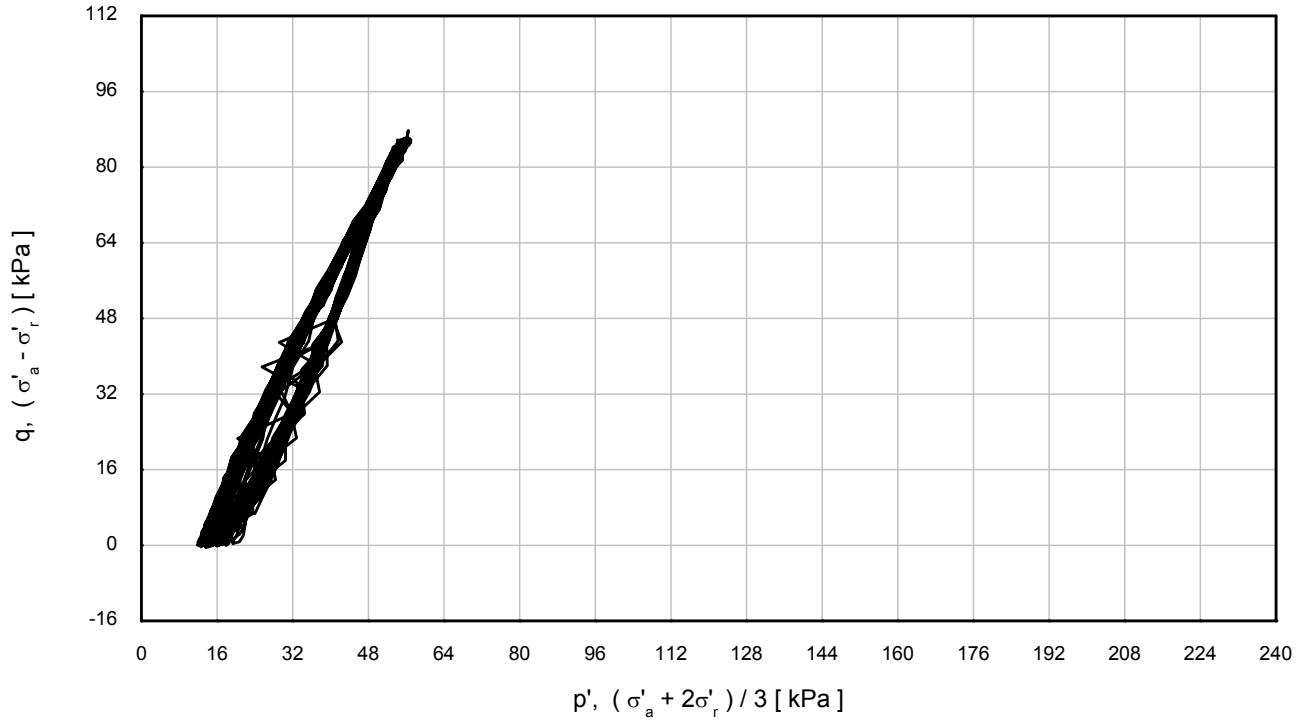




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	63 kPa	Sample	:	CTX_1-5
q_{av}	:	43 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	43 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

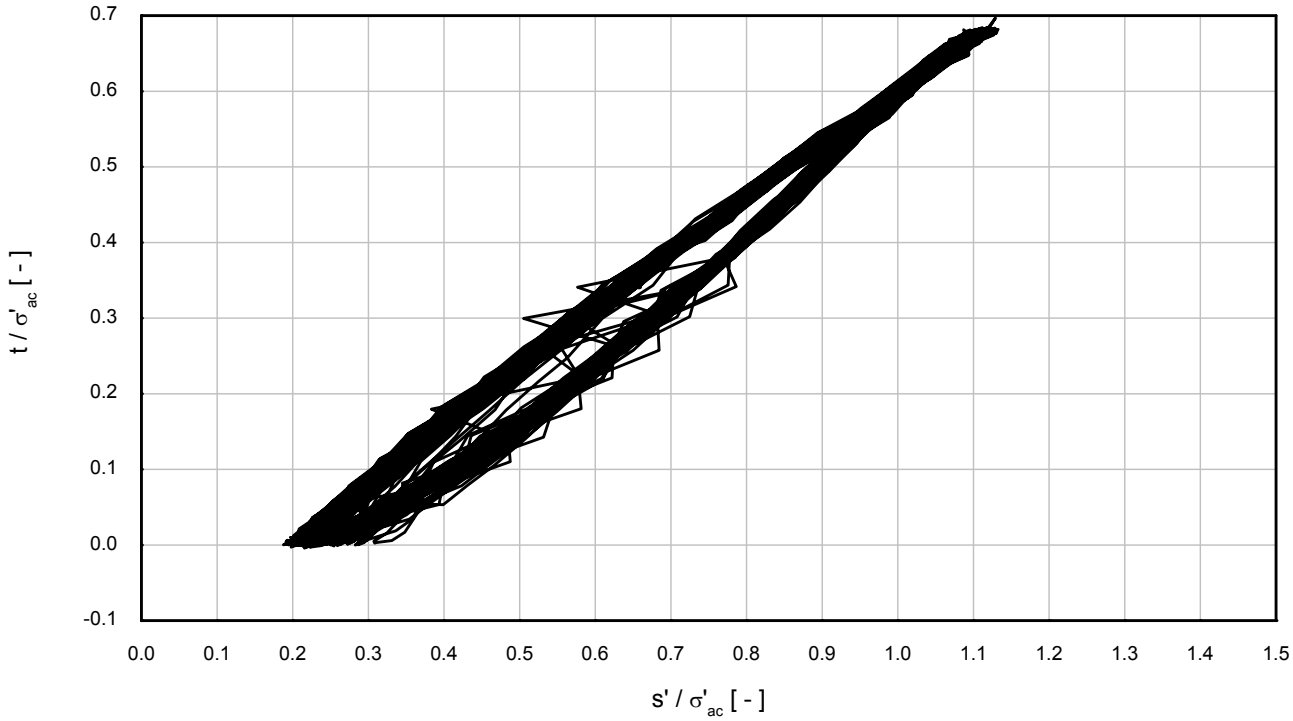
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

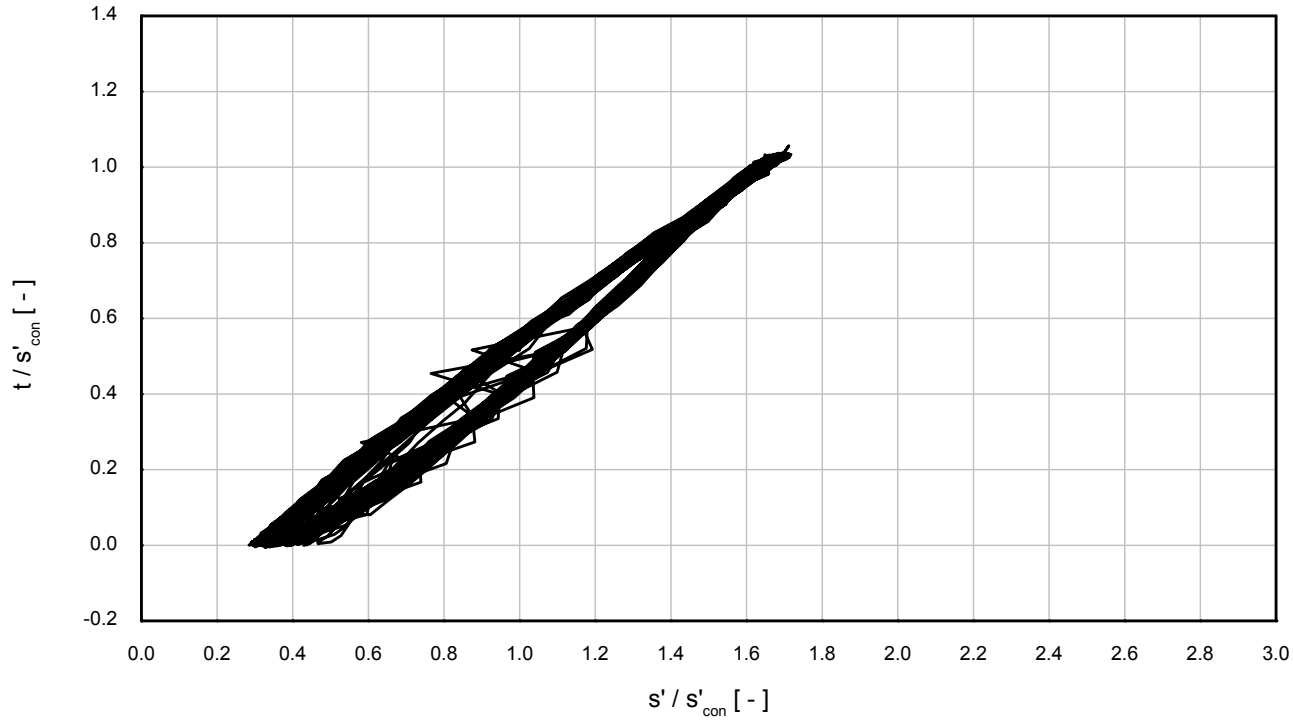




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	63	kPa	Sample	: CTX_1-5
q_{av}	:	43	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	43	kPa	Test No.	: CTX04
Frequency	:	0.10	Hz		

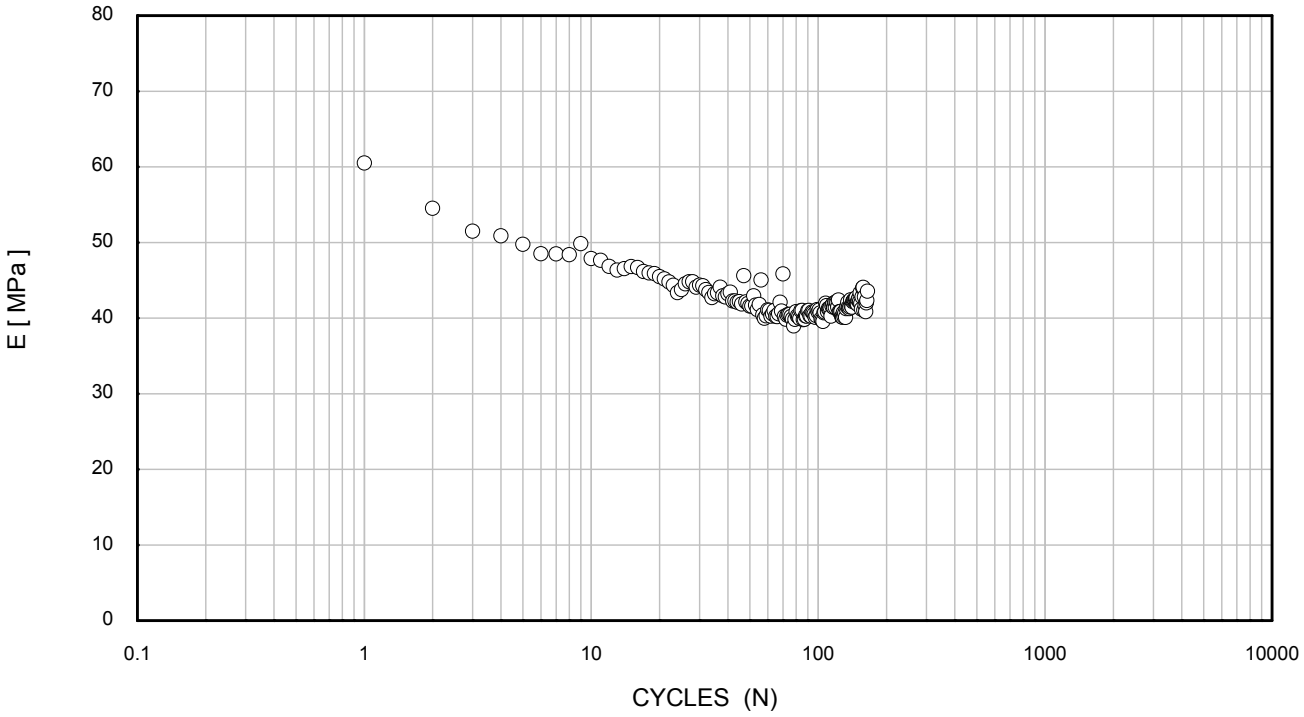
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

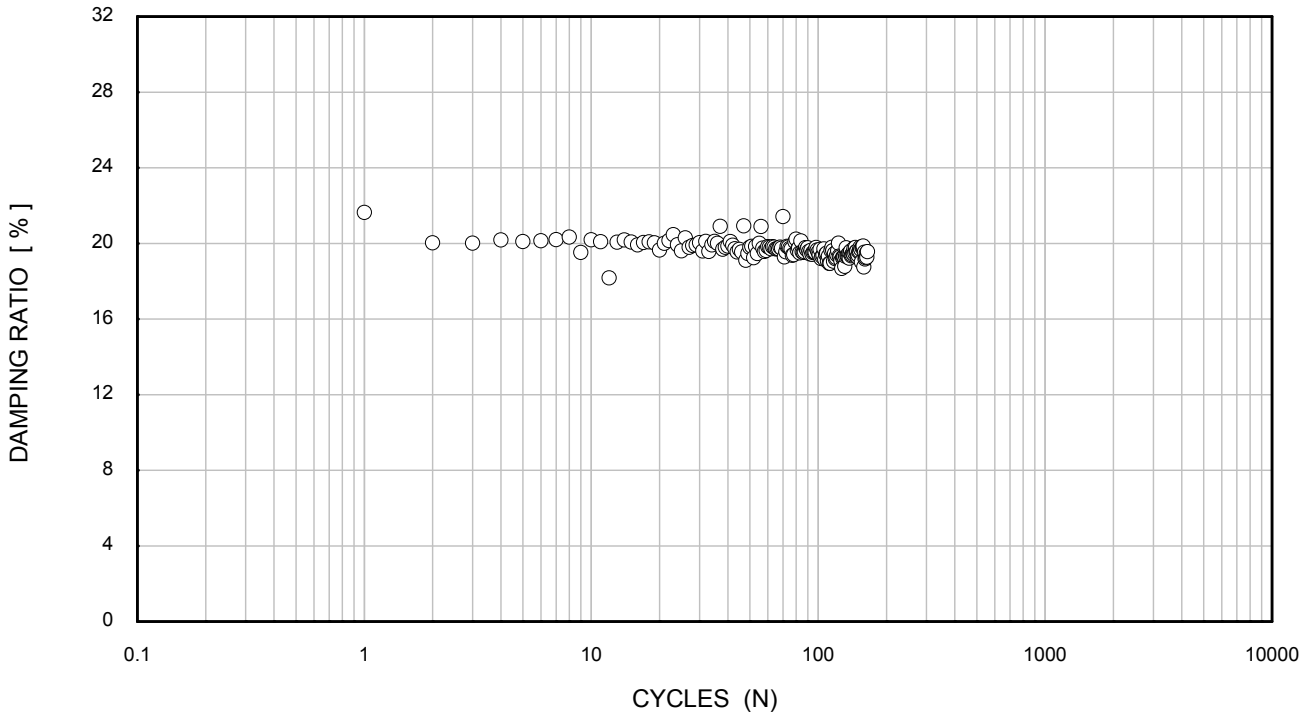




Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	63	kPa	Sample	: CTX_1-5
q_{av}	:	43	kPa	Unit	: Unit A (Southern Bight)
q_{cy}	:	43	kPa	Test No.	: CTX04
Frequency	:	0.10	Hz		

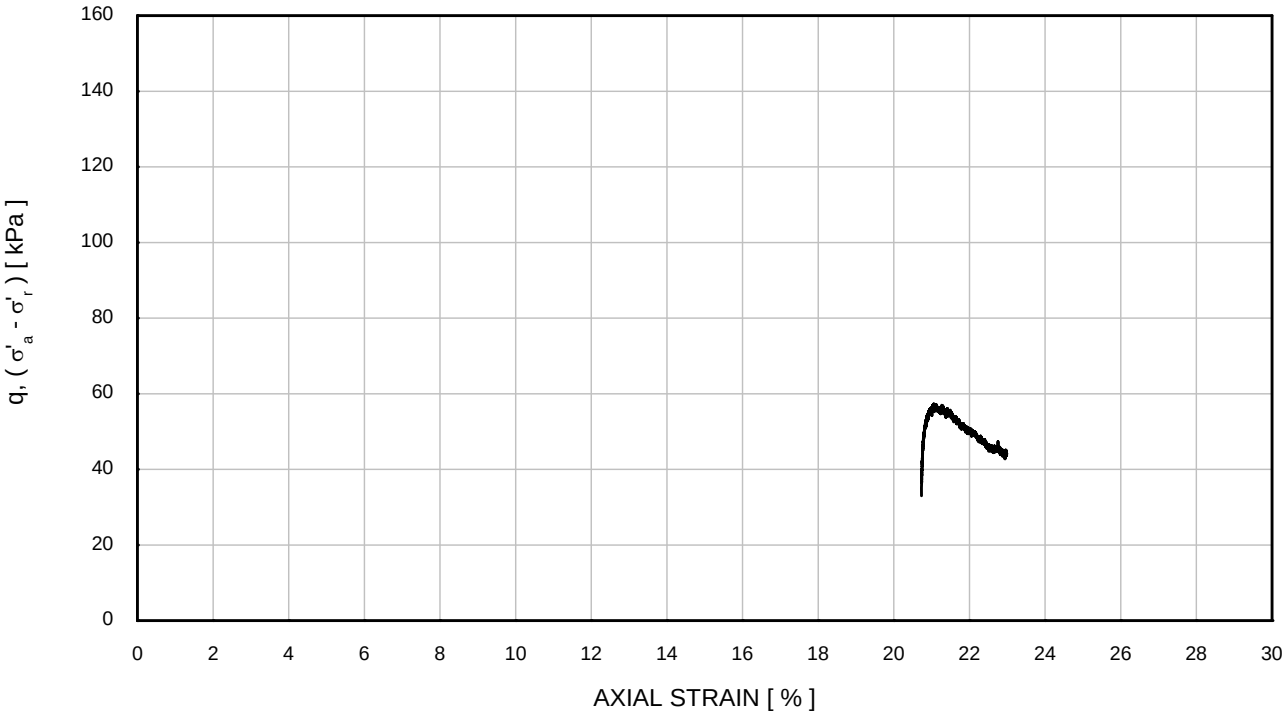
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

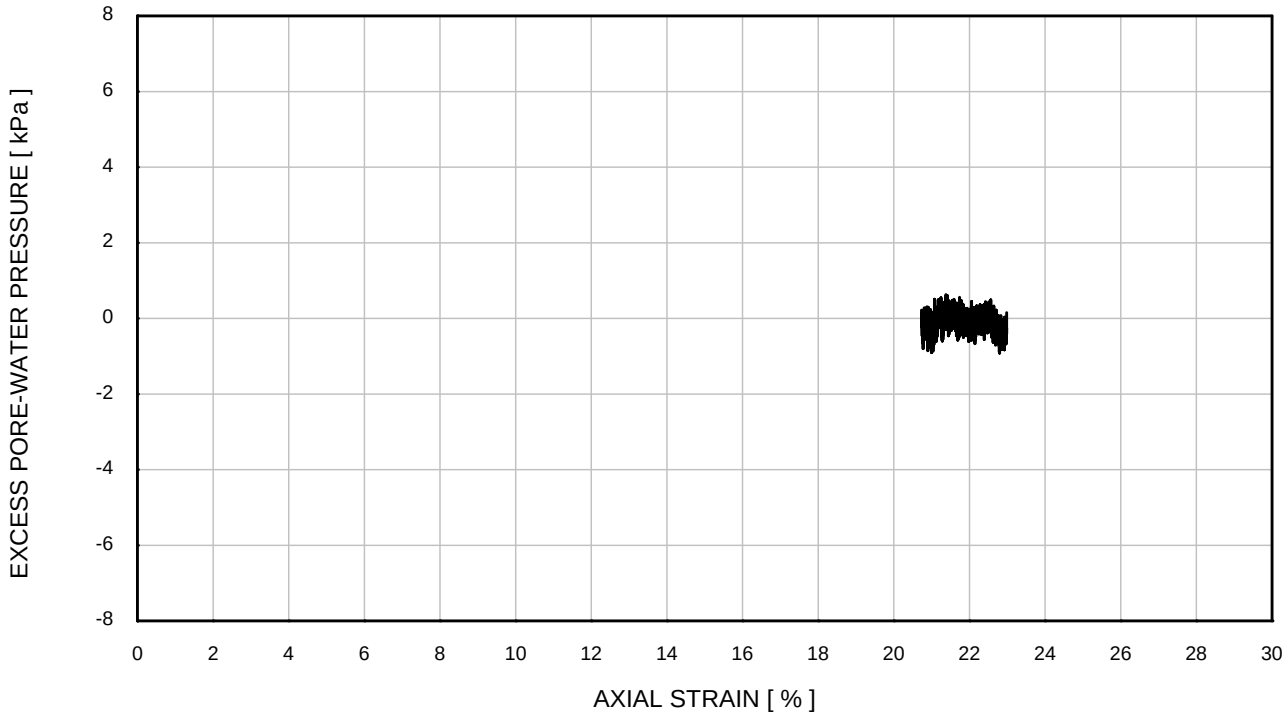




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	63 kPa	Sample	:	CTX_1-5
q_{av}	:	43 kPa	Unit	:	Unit A (Southern Bight)
q_{cy}	:	43 kPa	Test No.	:	CTX04
Frequency	:	0.10 Hz			

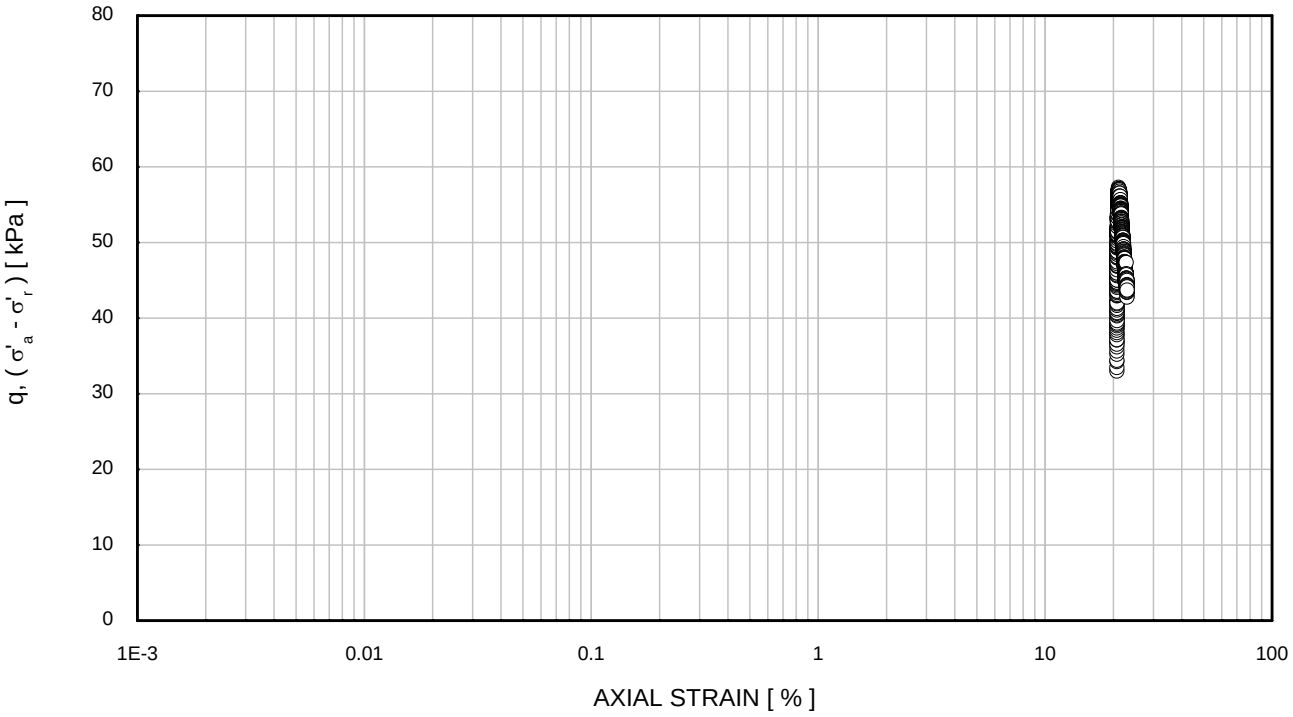
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

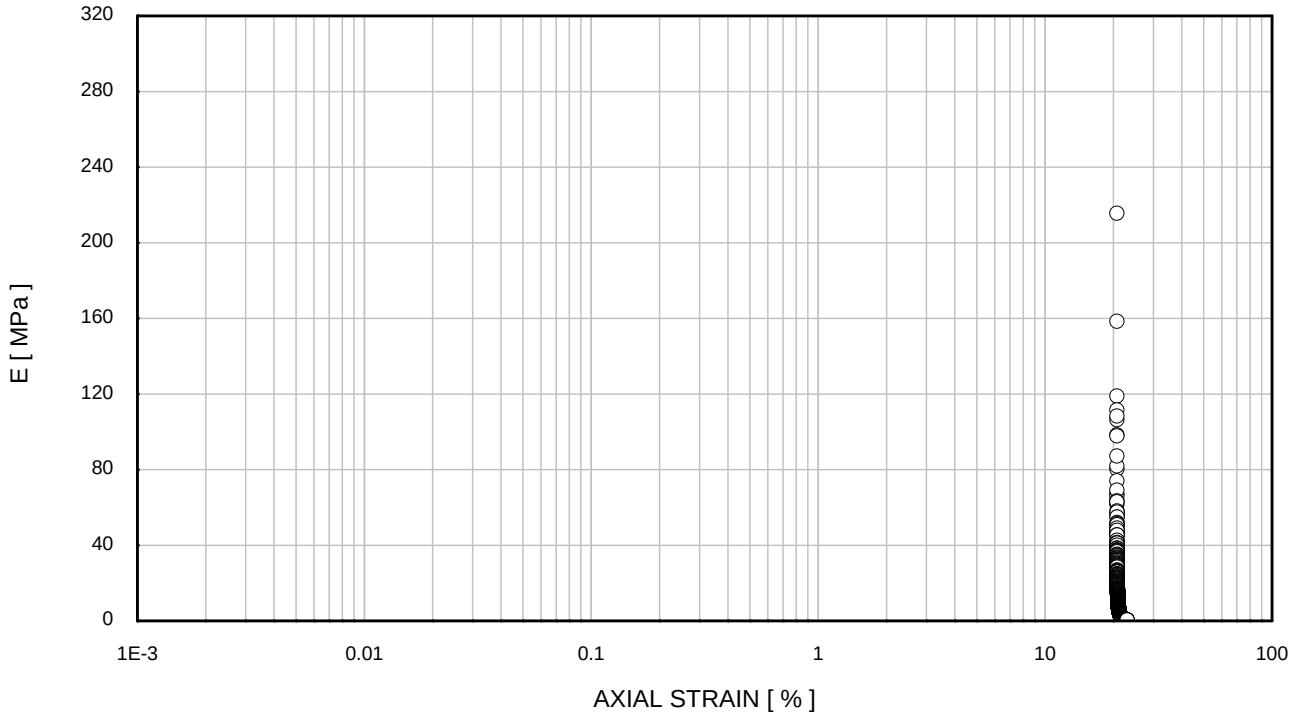




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	53 kPa	Sample	:	CTX_1-5
q_{peak}	:	57 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	21.06 %	Test No.	:	CTX04
Rate of strain	:	0.95 %/hour			

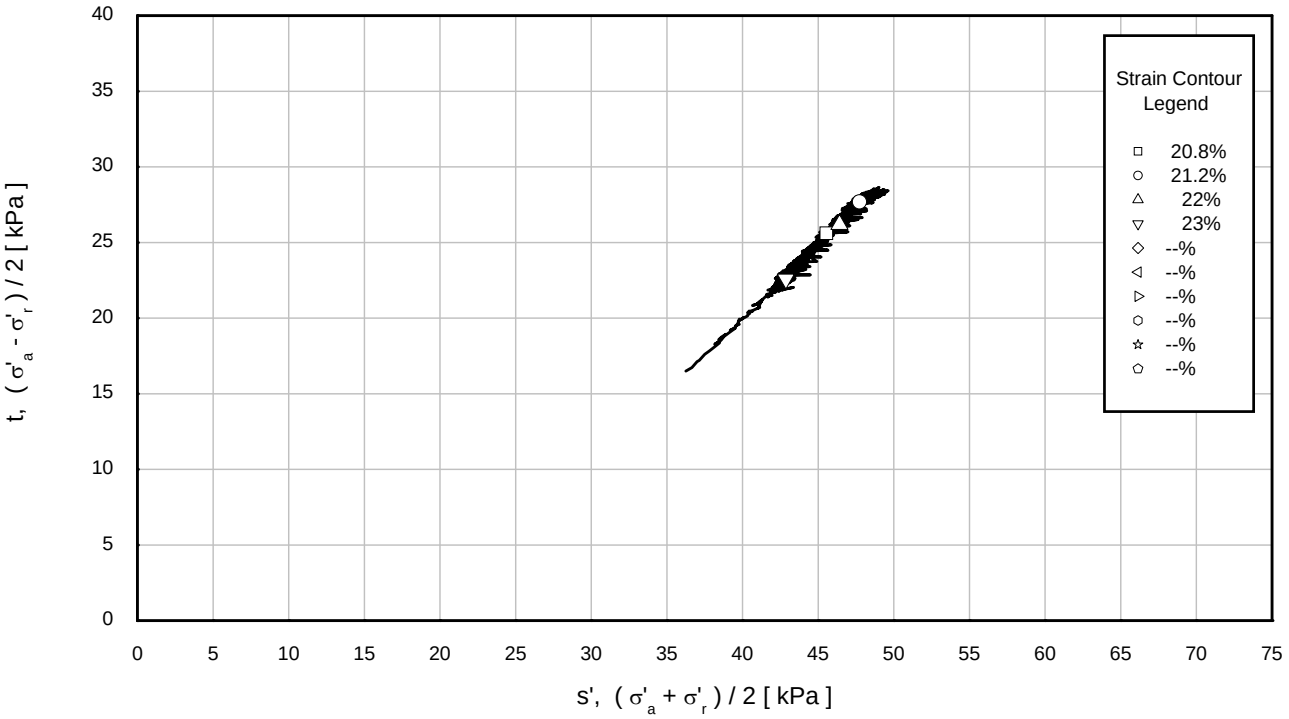
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

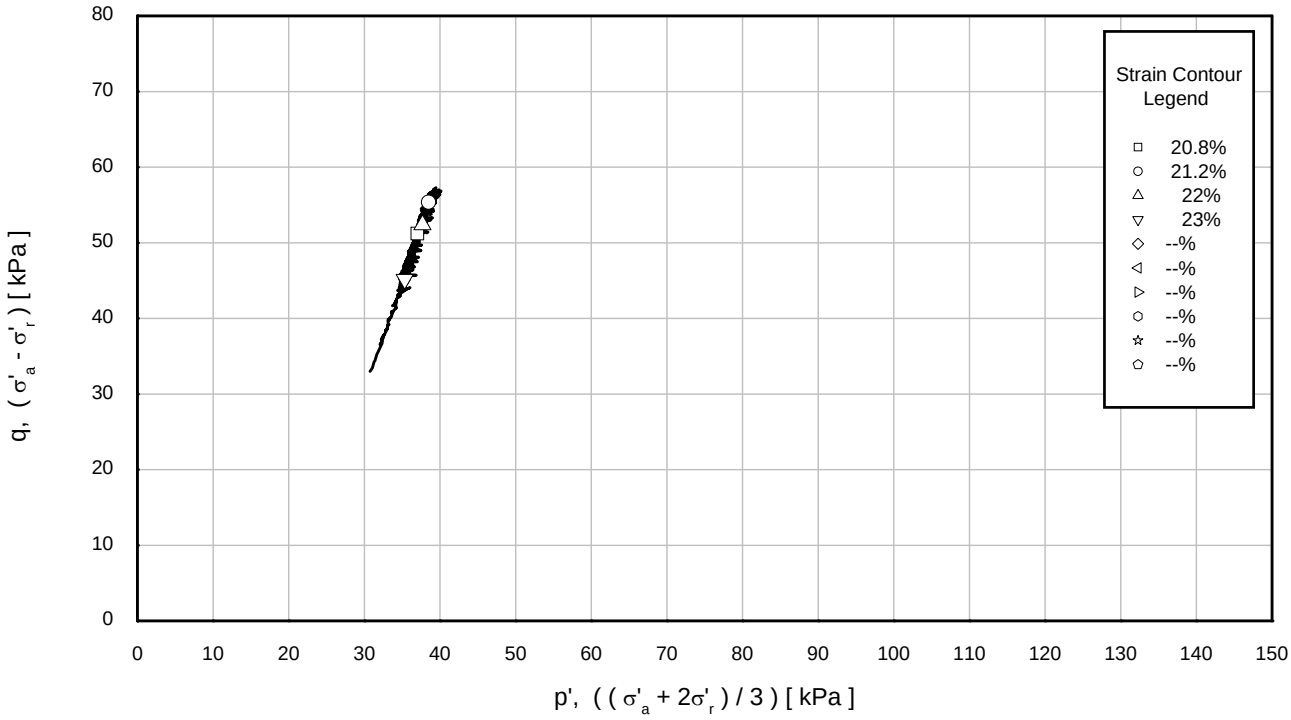




Initial σ'_r	:	20 kPa	Batch	:	1
Initial σ'_a	:	53 kPa	Sample	:	CTX_1-5
q_{peak}	:	57 kPa	Unit	:	Unit A (Southern Bight)
Ext. ε at q_{peak}	:	21.06 %	Test No.	:	CTX04
Rate of strain	:	0.95 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	20	kPa	Batch	: 1
Initial σ'_a	:	53	kPa	Sample	: CTX_1-5
q_{peak}	:	57	kPa	Unit	: Unit A (Southern Bight)
Ext. ε at q_{peak}	:	21.06	%	Test No.	: CTX04
Rate of strain	:	0.95	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND with traces of shell fragments

GENERAL	
Date test started	08/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	140.0
Water content	[%]	9.1
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.604
Degree of saturation	[%]	40
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 03_CTXL07
Processed by	MG
Date	05/01/2017
Checked by	PH
Date	05/01/2017
Approved by	PH
Date	06/01/2017

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1099
Base PWP	[kPa]	1085
Mid height PWP	[kPa]	-
B value achieved	[-]	0.96

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1221
Back pressure	[kPa]	1086
Base PWP	[kPa]	1086
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.59
External axial strain	[%]	0.18
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.594
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 1		
Cell pressure	[kPa]	1220
Back pressure	[kPa]	1086
Base PWP	[kPa]	1085
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	180
Deviator stress	[kPa]	45
Volumetric strain	[%]	0.45
External axial strain	[%]	0.24
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.594
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	46
Mean q_{cy}	[kPa]	46
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
External ε_{av} at N	[%]	0.36
External ε_{cy} at N	[%]	0.03
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	0
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.3
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.592
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.27	0.03	151.00	-	14.20	-
2	0.27	0.03	149.85	-	3.10	-
5	0.28	0.03	149.98	-	1.19	-
10	0.29	0.03	150.04	-	0.75	-
20	0.30	0.03	147.84	-	0.49	-
30	0.30	0.03	148.01	-	0.13	-
40	0.31	0.03	147.67	-	0.05	-
50	0.31	0.03	148.34	-	0.01	-
100	0.32	0.03	151.66	-	0.33	-
500	0.35	0.03	148.69	-	0.37	-
1000	0.35	0.03	145.85	-	0.31	-
1500	0.36	0.03	145.27	-	0.18	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 2		
Cell pressure	[kPa]	1221
Back pressure	[kPa]	1086
Base PWP	[kPa]	1086
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	248
Deviator stress	[kPa]	113
Volumetric strain	[%]	0.61
External axial strain	[%]	0.41
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.3
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.67
Void ratio	[-]	0.591
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	112
Mean q_{cy}	[kPa]	112
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
External ε_{av} at N	[%]	0.80
External ε_{cy} at N	[%]	0.07
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	0
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.2
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.67
Void ratio	[-]	0.588
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.50	0.09	124.65	-	18.64	-
2	0.54	0.07	152.08	-	8.98	-
5	0.58	0.07	155.86	-	6.29	-
10	0.60	0.07	158.79	-	5.08	-
20	0.64	0.07	161.39	-	4.36	-
30	0.66	0.07	162.11	-	4.08	-
40	0.67	0.07	162.45	-	3.80	-
50	0.68	0.07	162.92	-	3.62	-
100	0.72	0.07	164.08	-	3.33	-
200	0.76	0.07	163.93	-	3.12	-
300	0.78	0.07	163.68	-	2.94	-
400	0.80	0.07	162.43	-	2.87	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	248
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	460
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.12
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.38
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	137
Effective axial pressure	[kPa]	597
Principal effective stress ratio	[-]	4.37
ε_{50}	[%]	0.94
Secant modulus (E_{50}) at ε_{50}	[kPa]	139813
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	460
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.18
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.21
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	595
Principal effective stress ratio	[-]	4.42
At 15% external axial strain		
Corrected deviator stress	[kPa]	-
Membrane correction applied	[kPa]	-
Drain correction applied	[kPa]	-
External axial strain	[%]	-
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	-
Effective axial pressure	[kPa]	-
Principal effective stress ratio	[-]	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





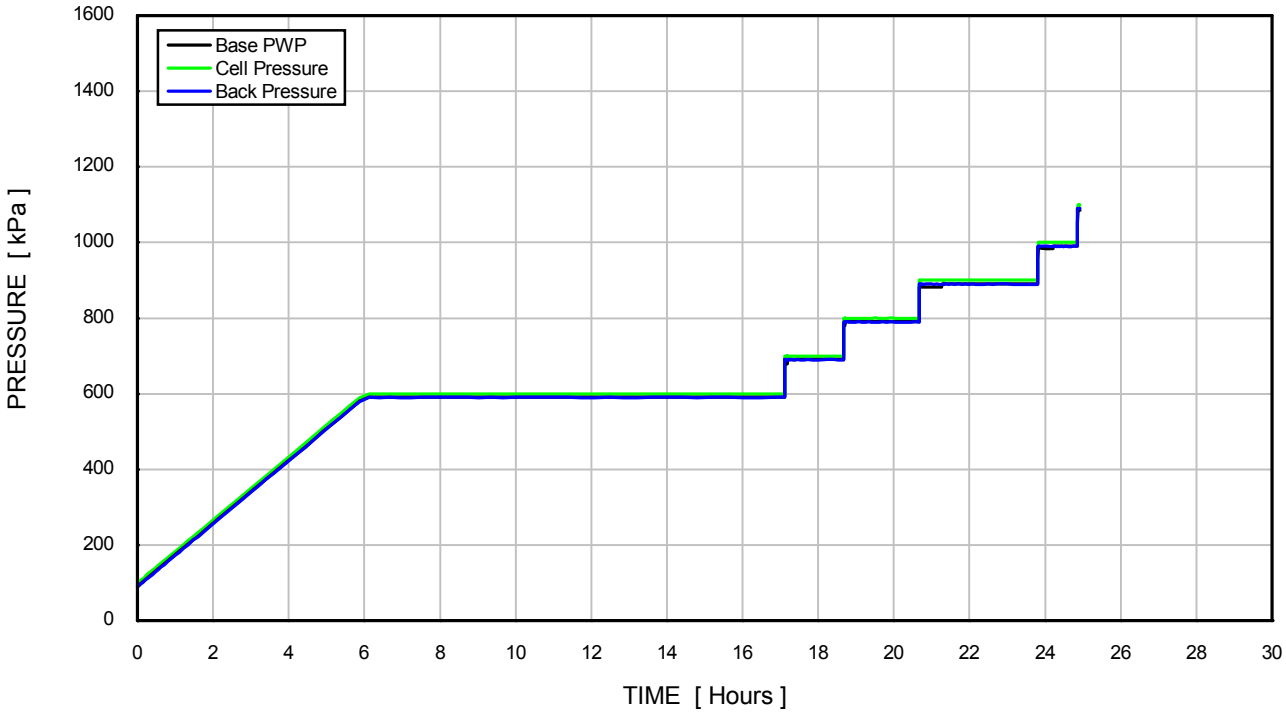
FINAL CONDITIONS

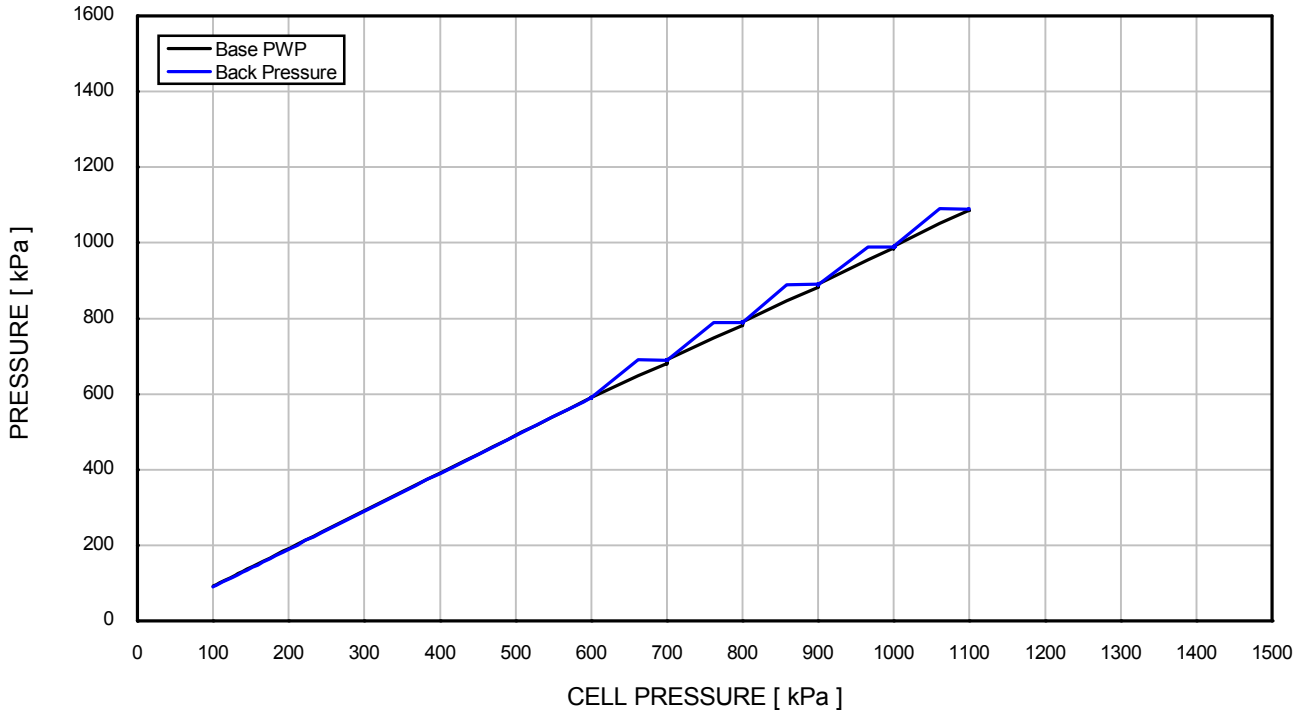
Water content	[%]	23.8
Bulk density	[Mg/m³]	2.01
Dry density	[Mg/m³]	1.62

TEST IDENTIFICATION

Batch	3
Sample	CTX_3-1
Unit	Unit B1 (Kreftenheye)
Test number	CTX07

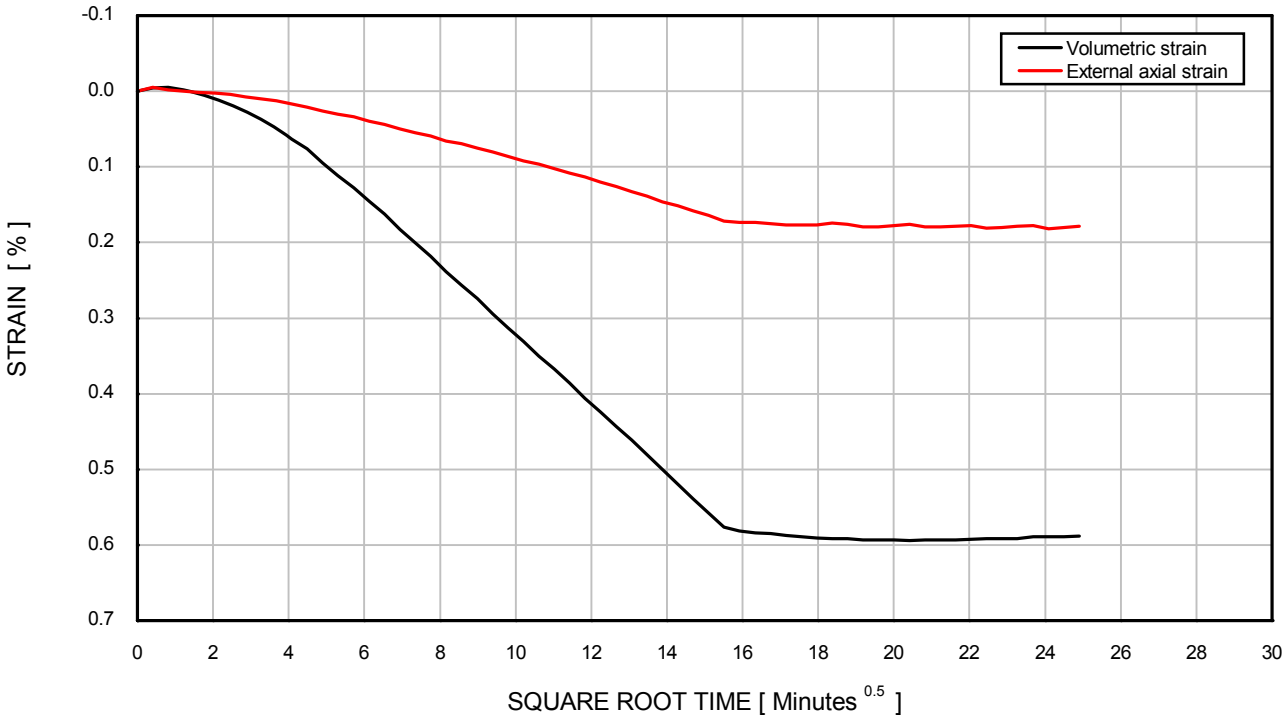
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

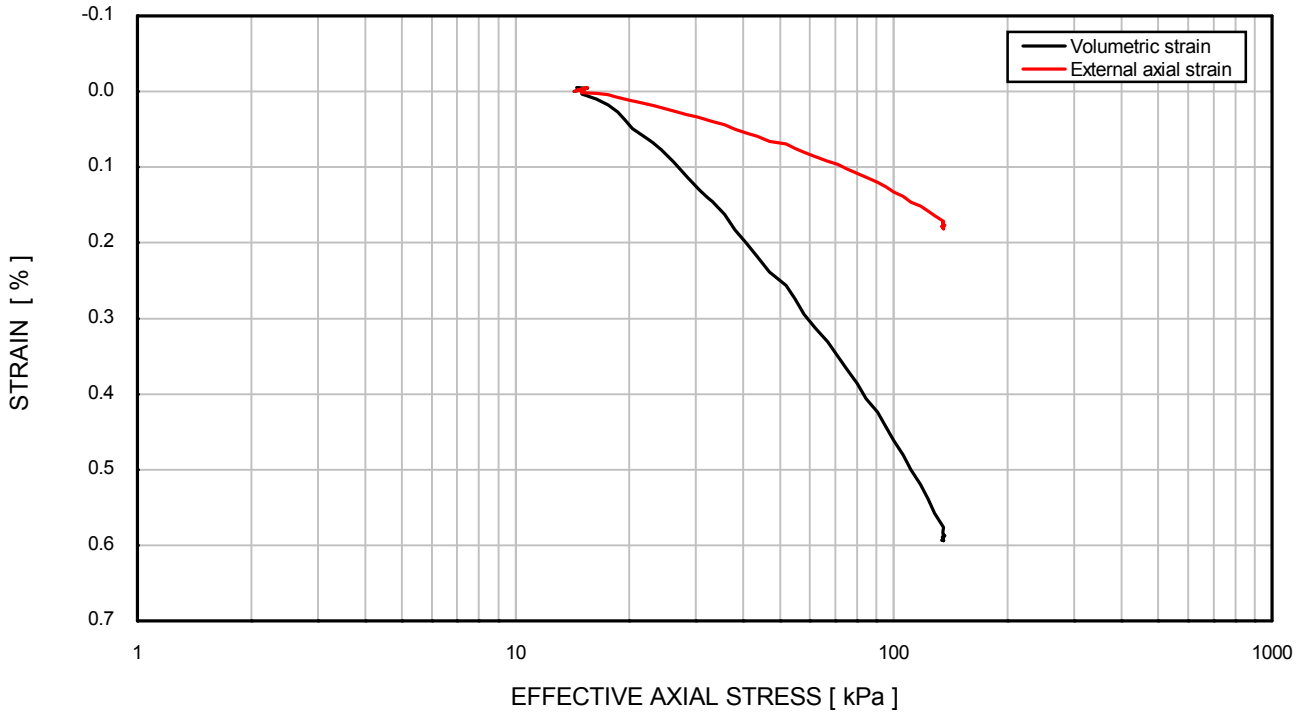




B value	:	0.96			
Initial σ'_r	:	8	kPa	Batch	: 3
Initial σ'_a	:	8	kPa	Sample	: CTX_3-1
Final σ'_r	:	14	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	14	kPa	Test No.	: CTX07

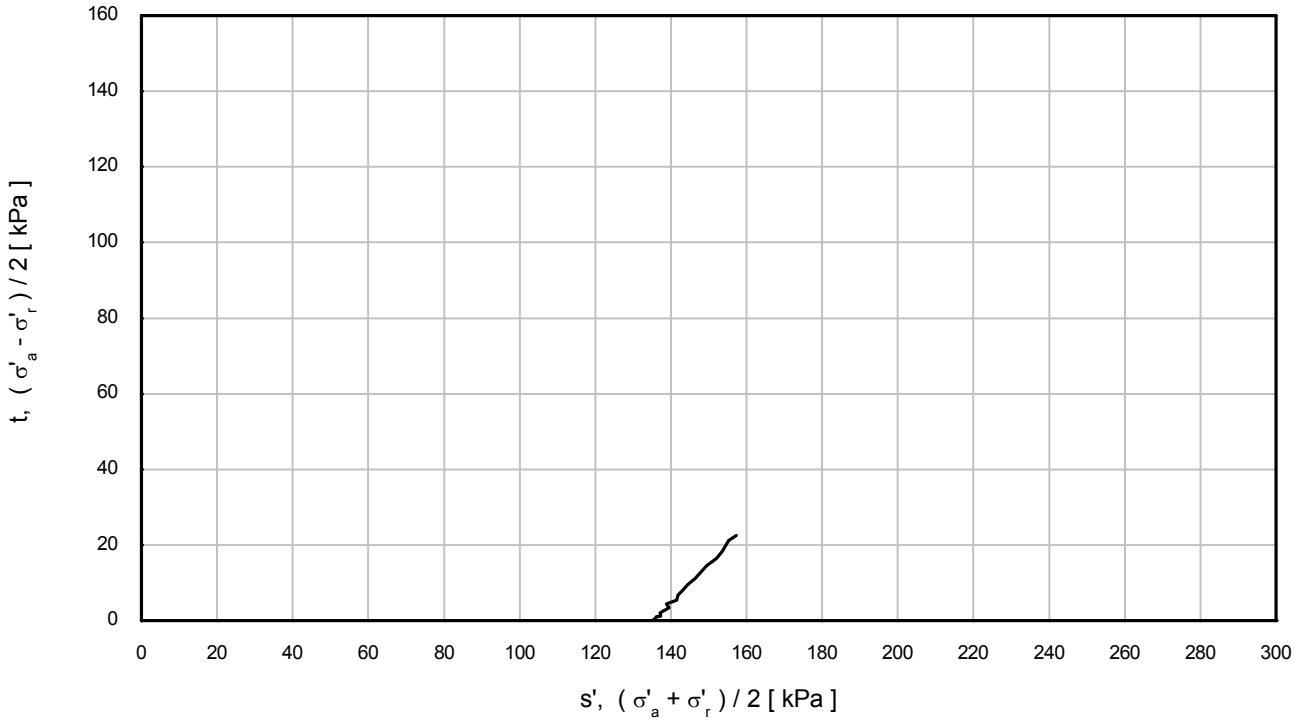
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

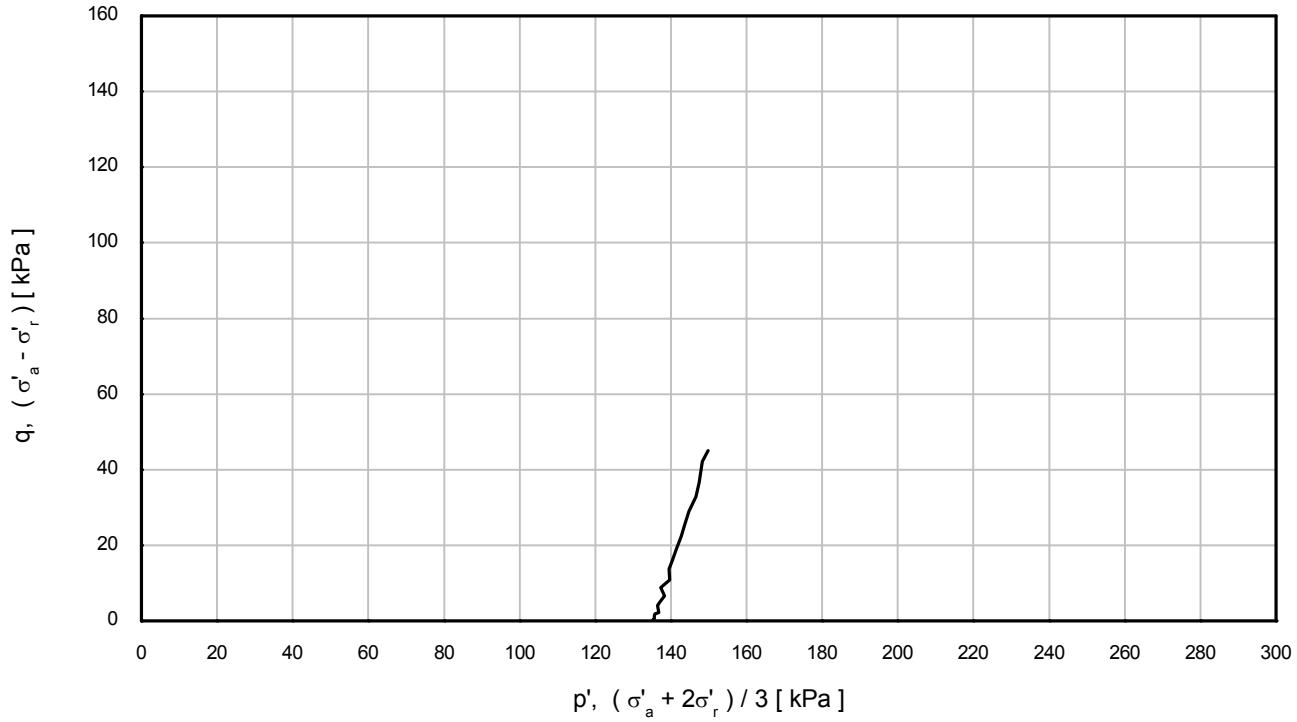




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTX_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX07

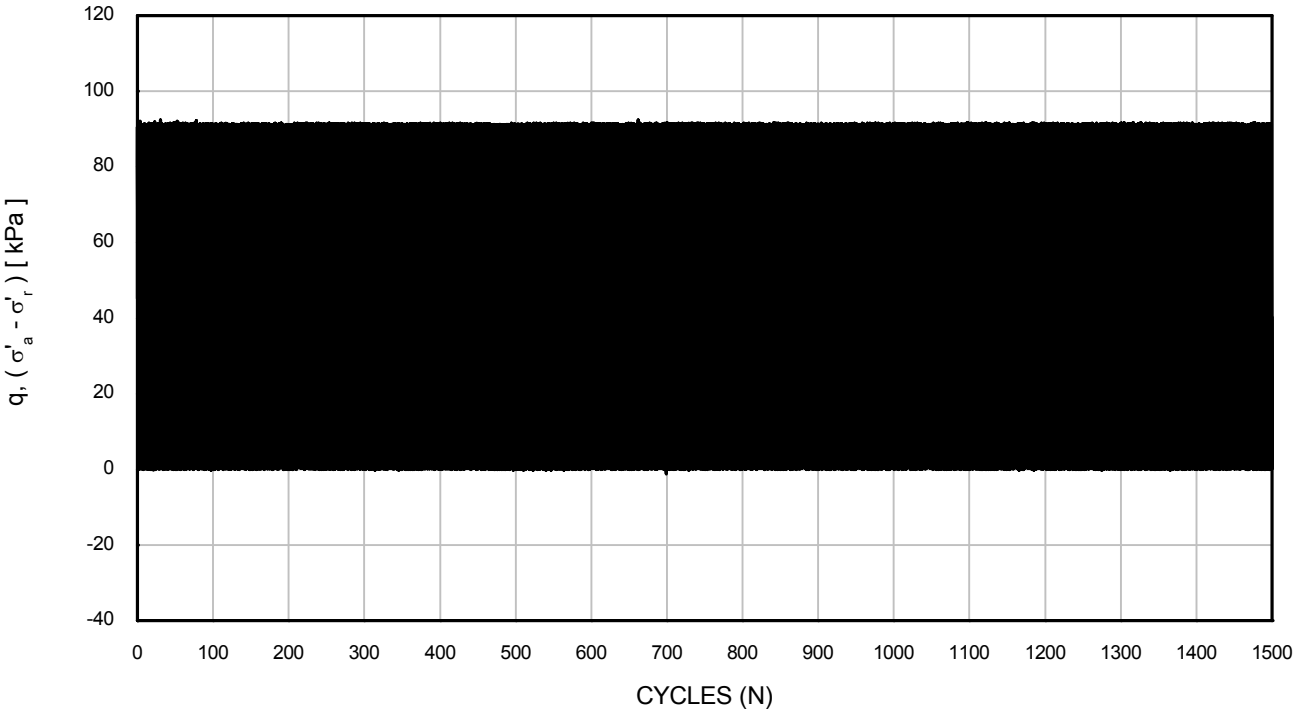
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

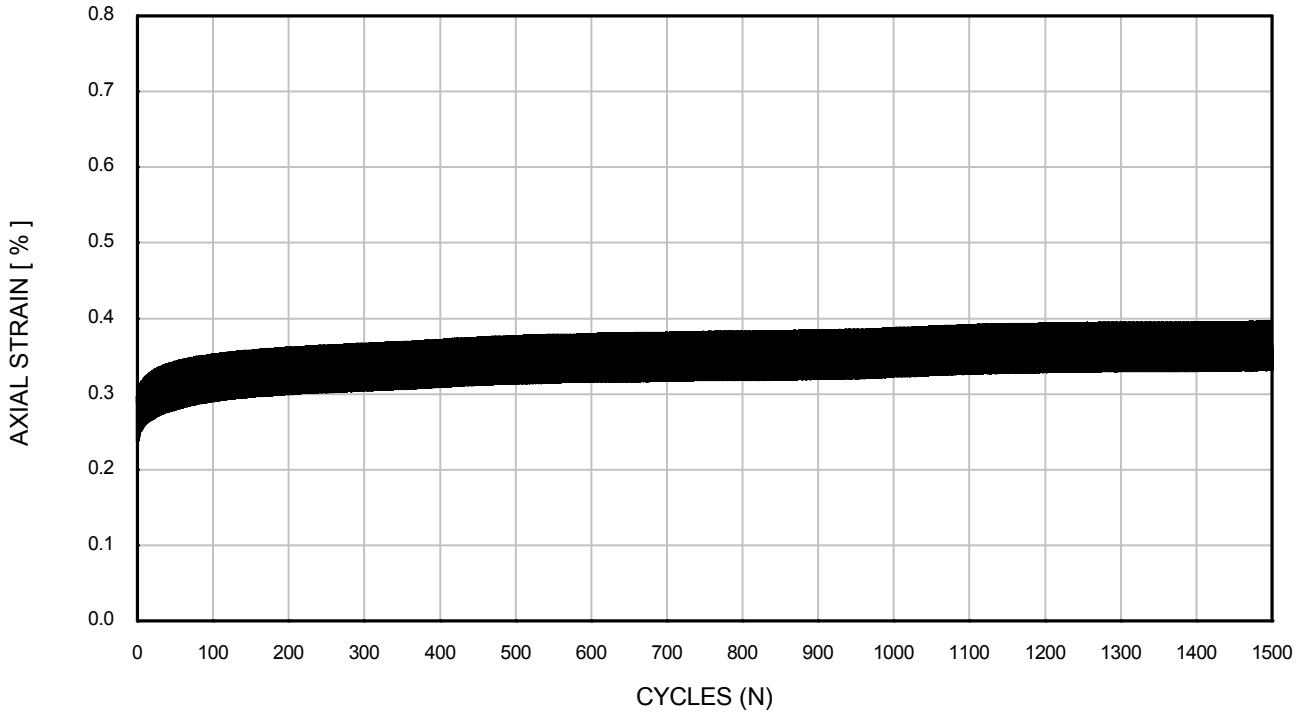




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 180 kPa	Sample	: CTX_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX07

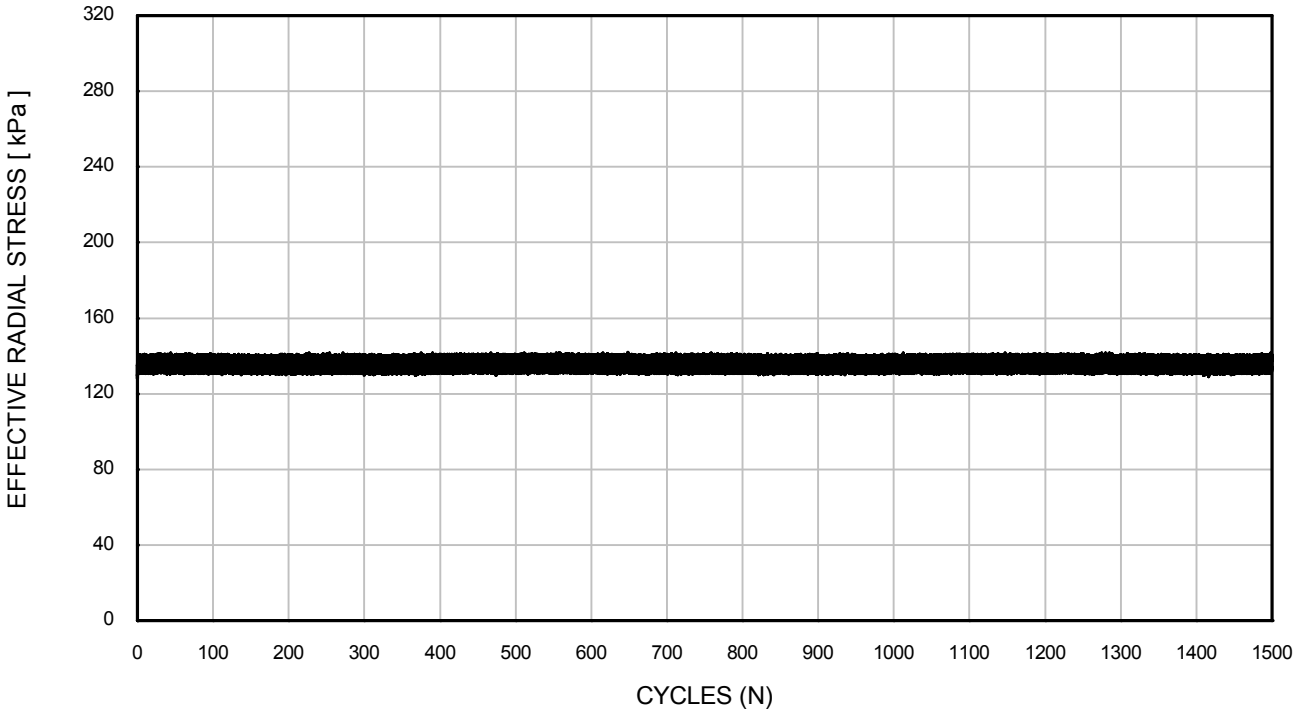
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 1 - UNDRAINED

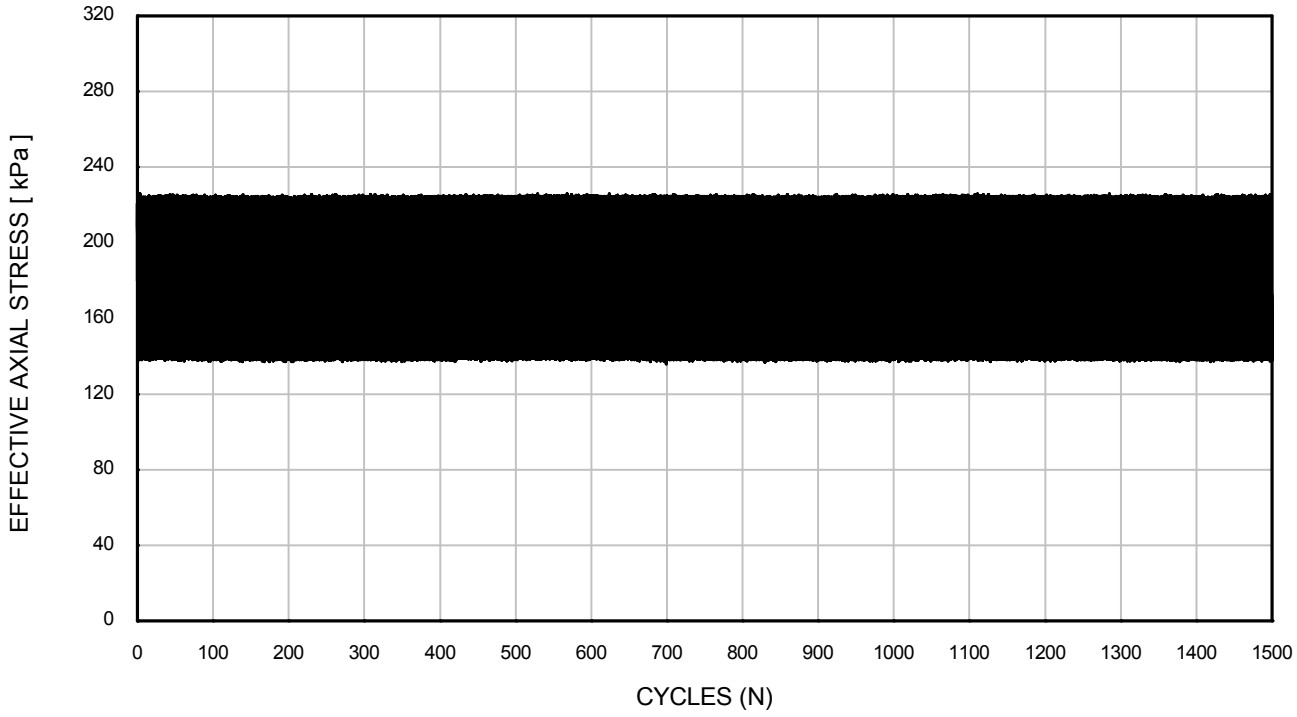




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

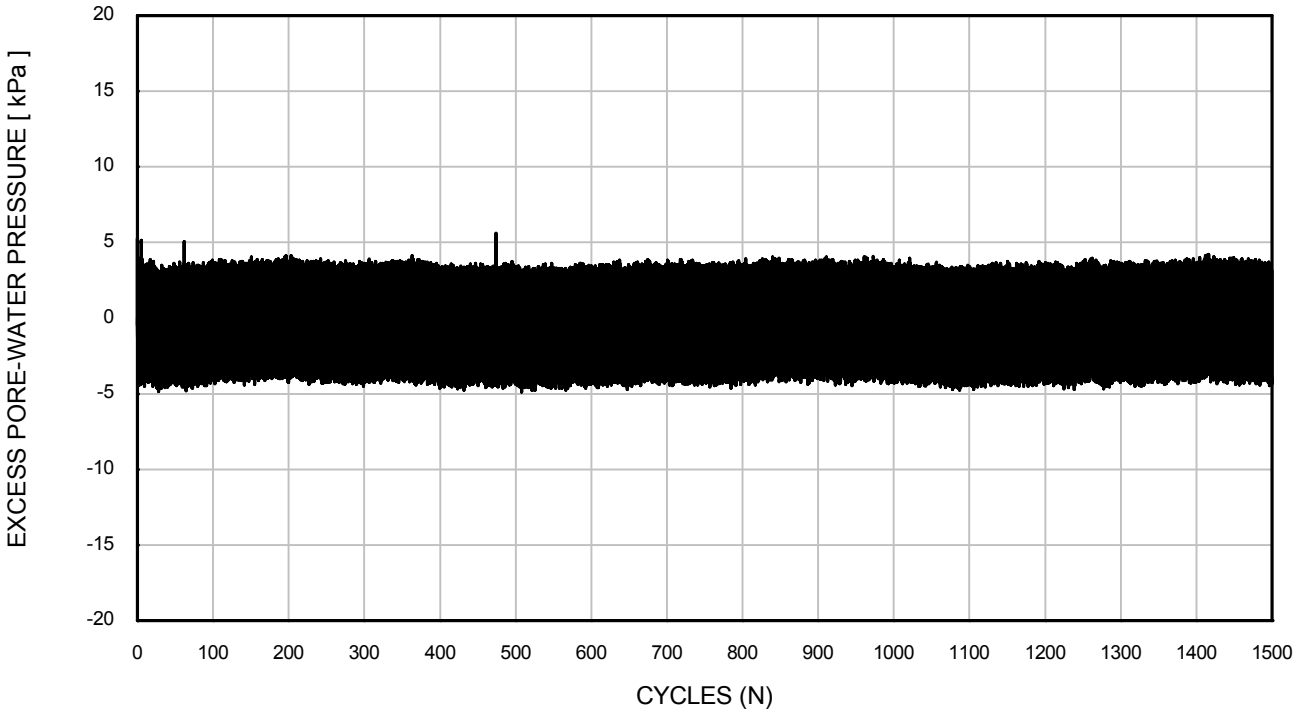
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

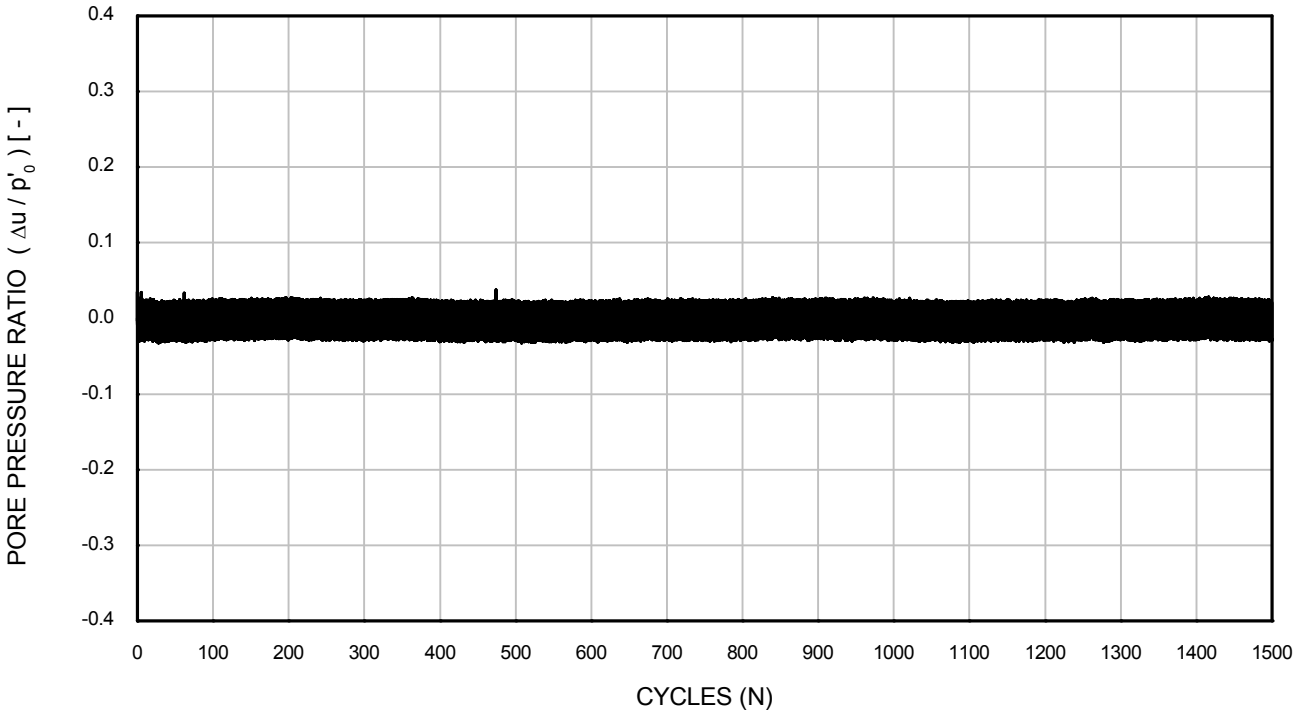




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

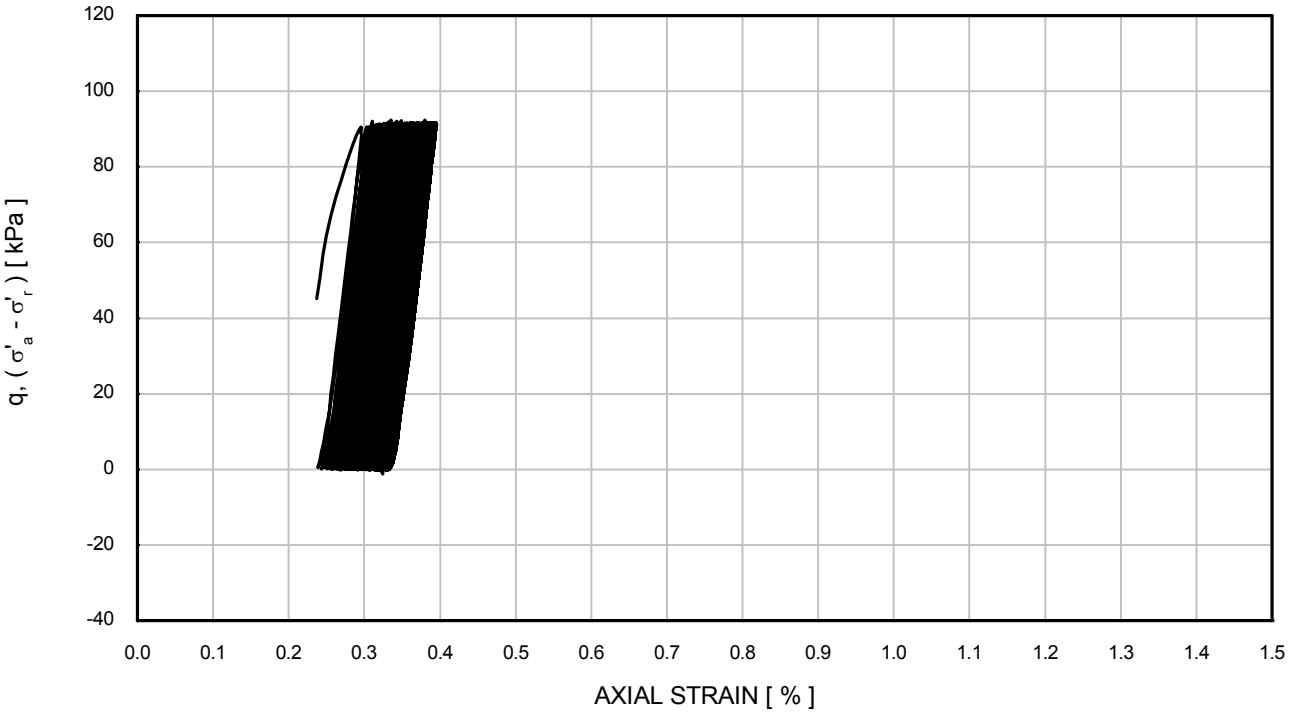
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

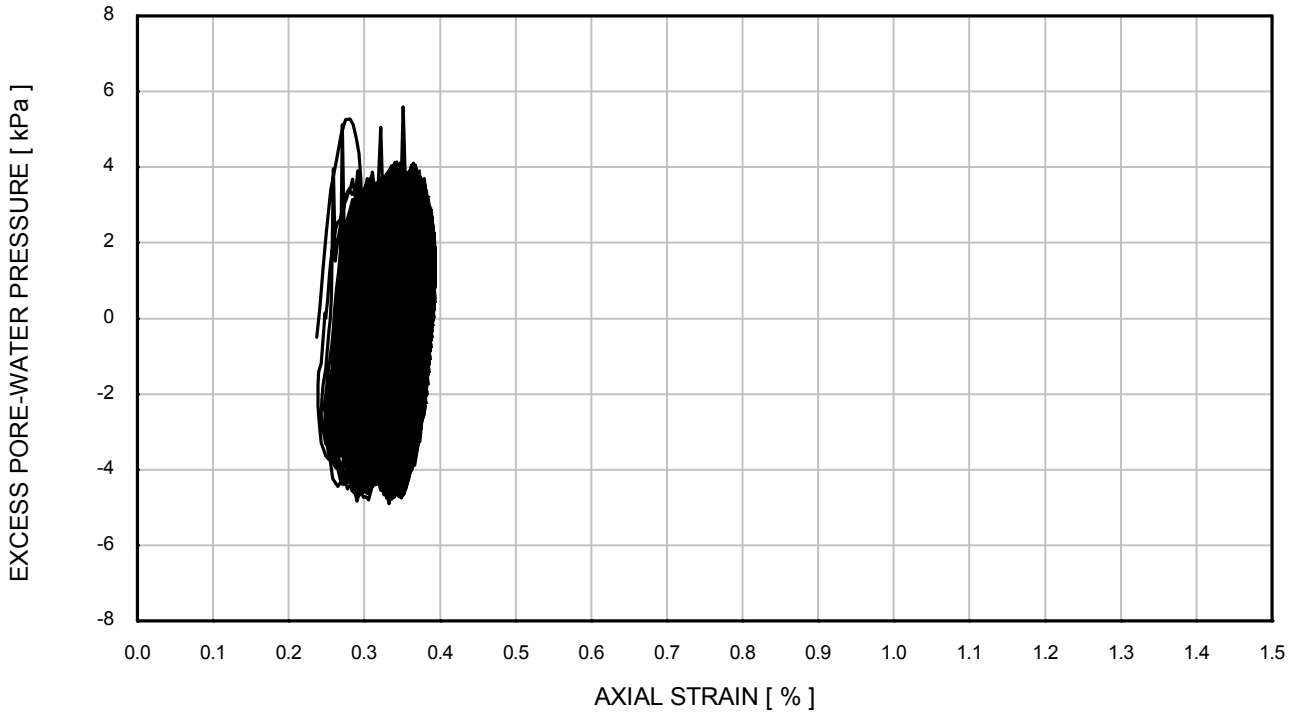




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

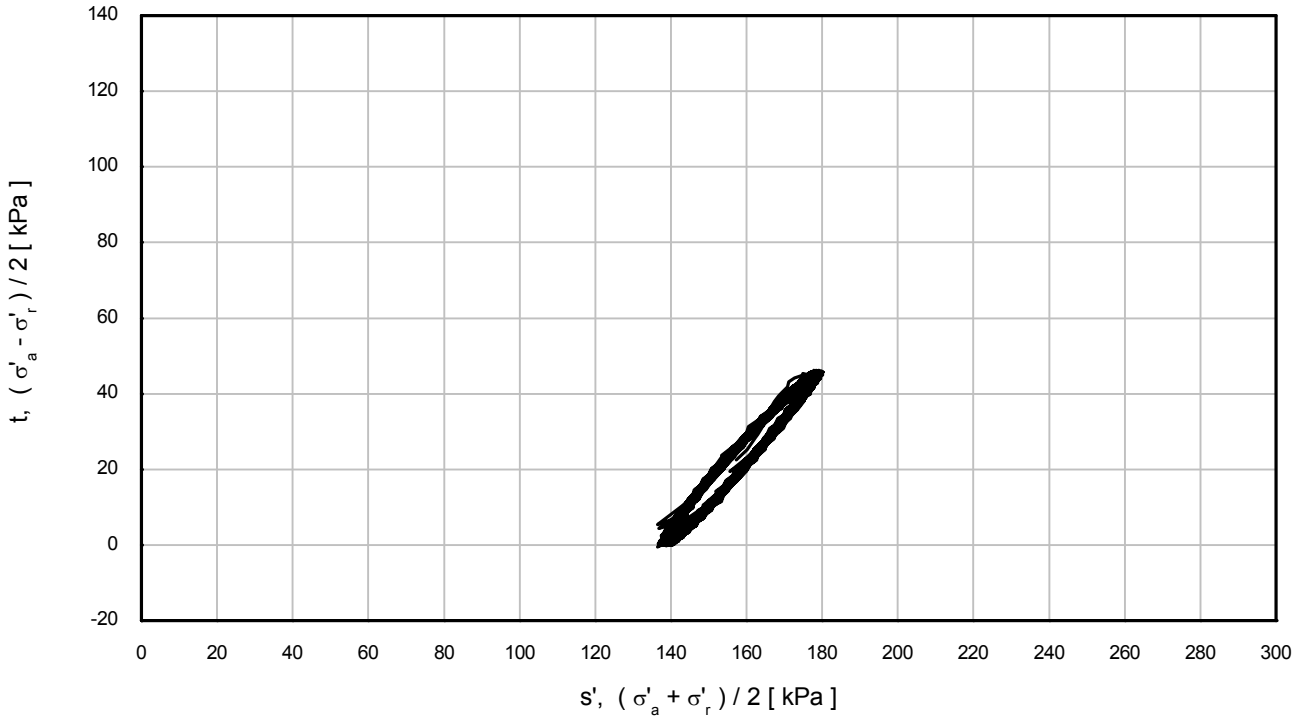
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

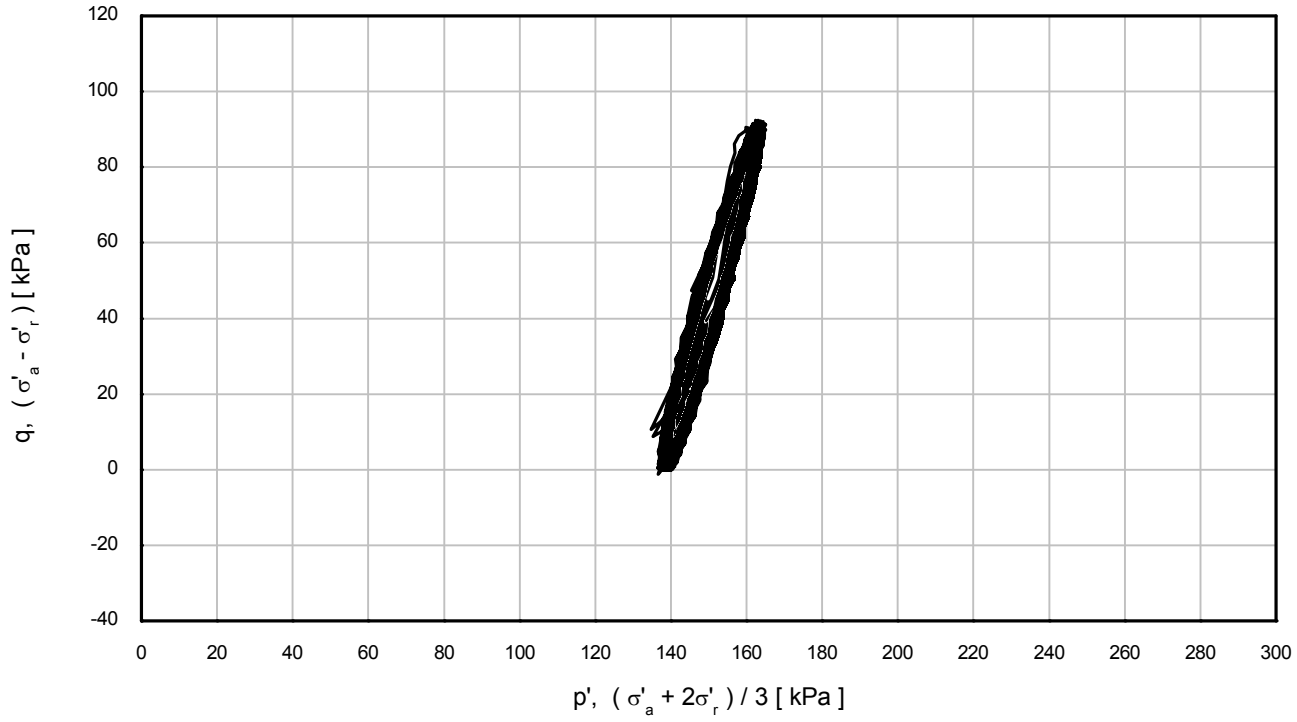




Initial σ'_r	:	135 kPa	Batch	: 3
Initial σ'_a	:	180 kPa	Sample	: CTX_3-1
q_{av}	:	46 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	: CTX07
Frequency	:	0.10 Hz		

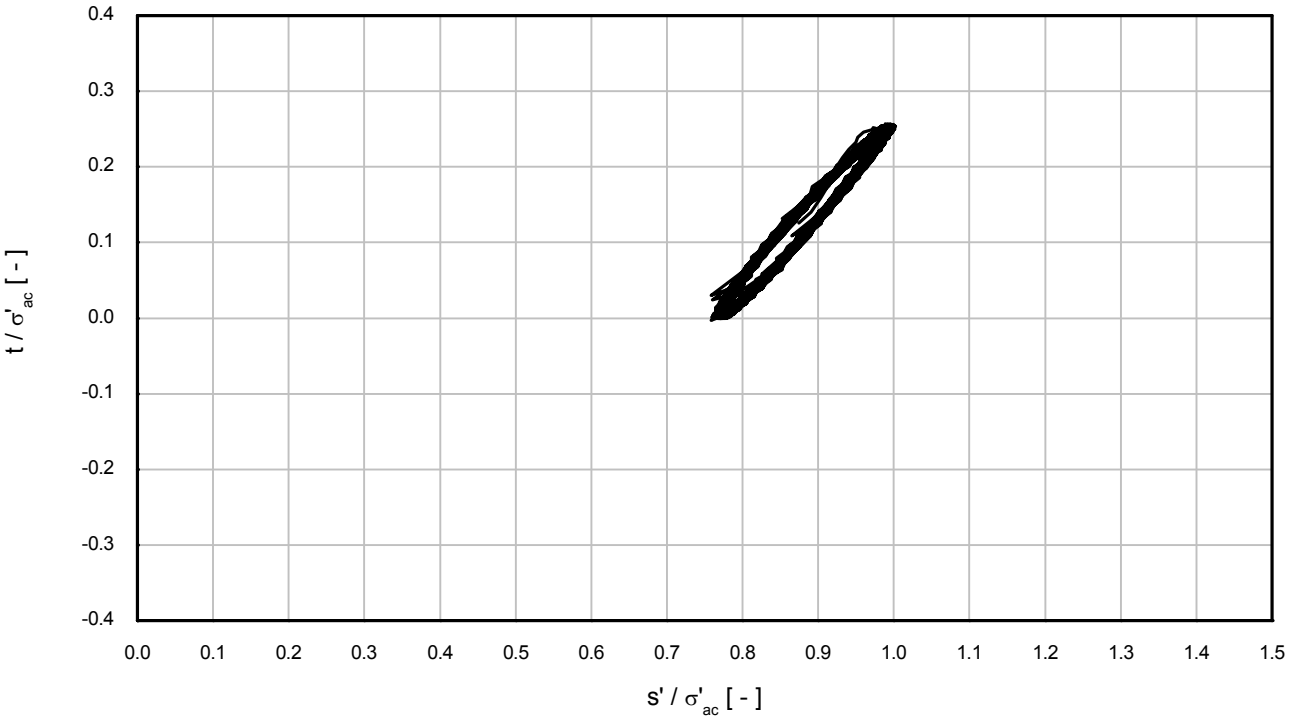
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

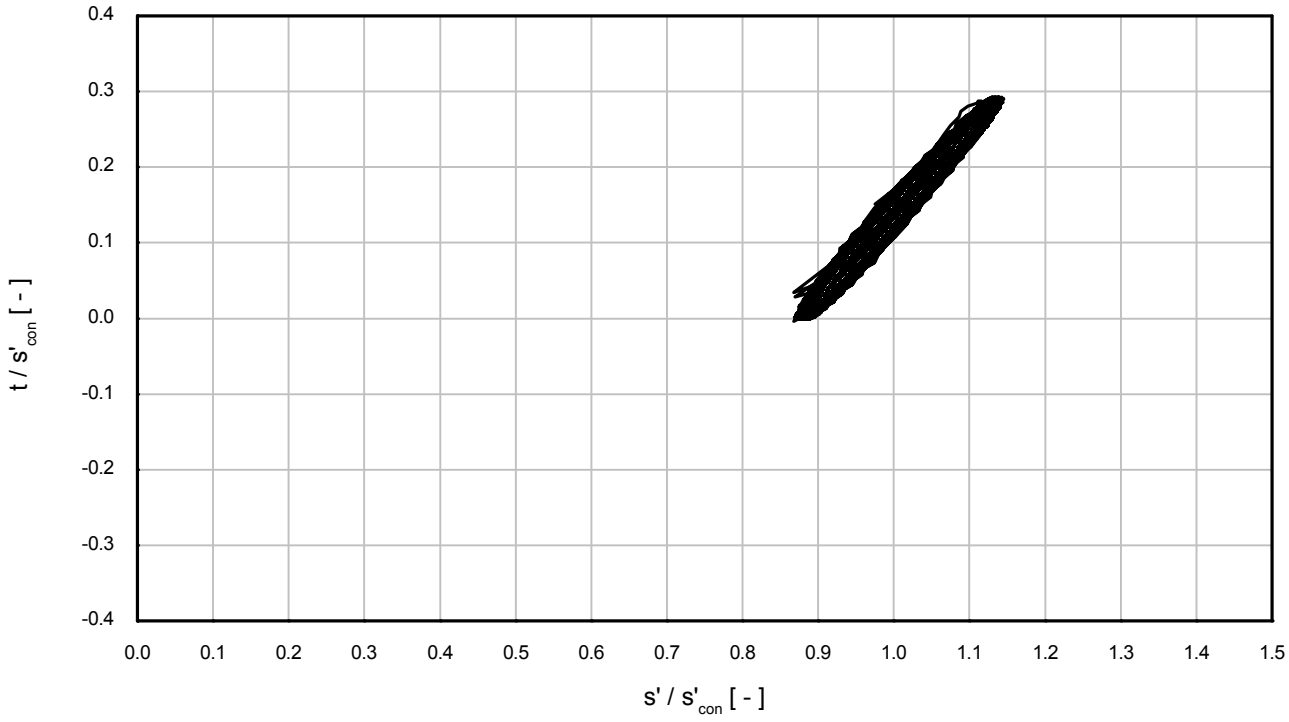




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

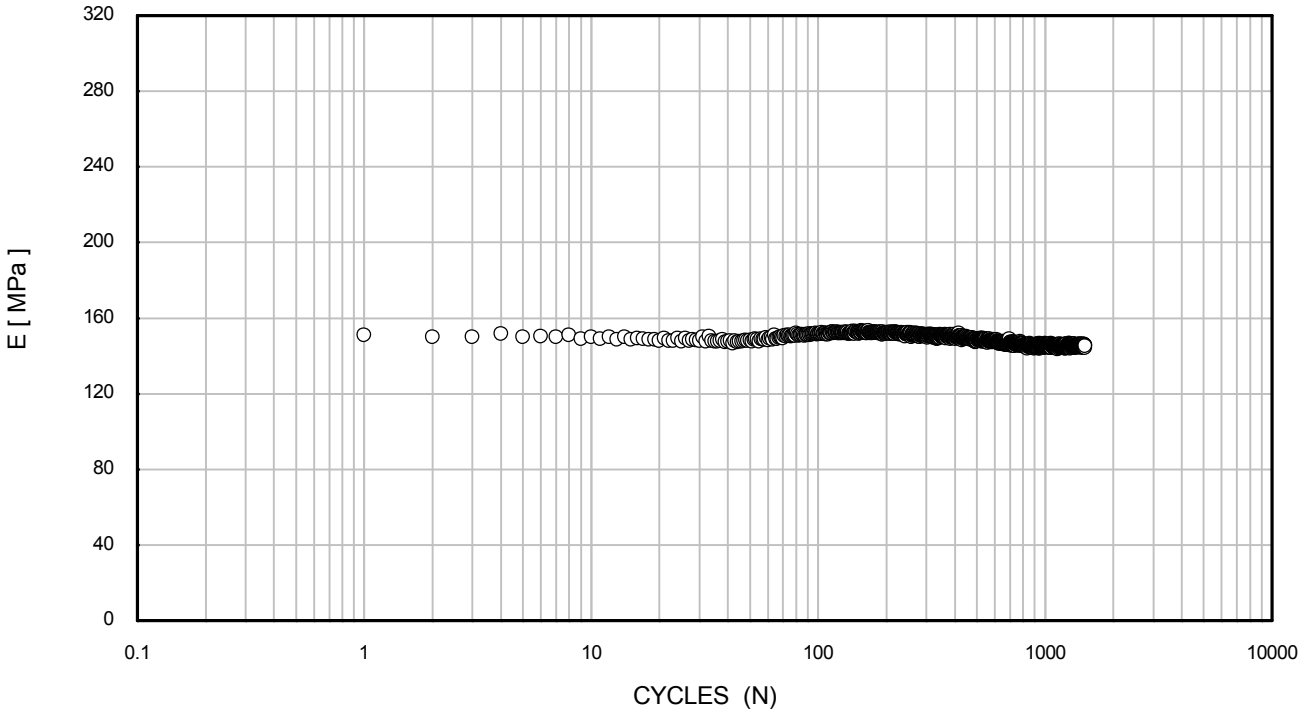
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

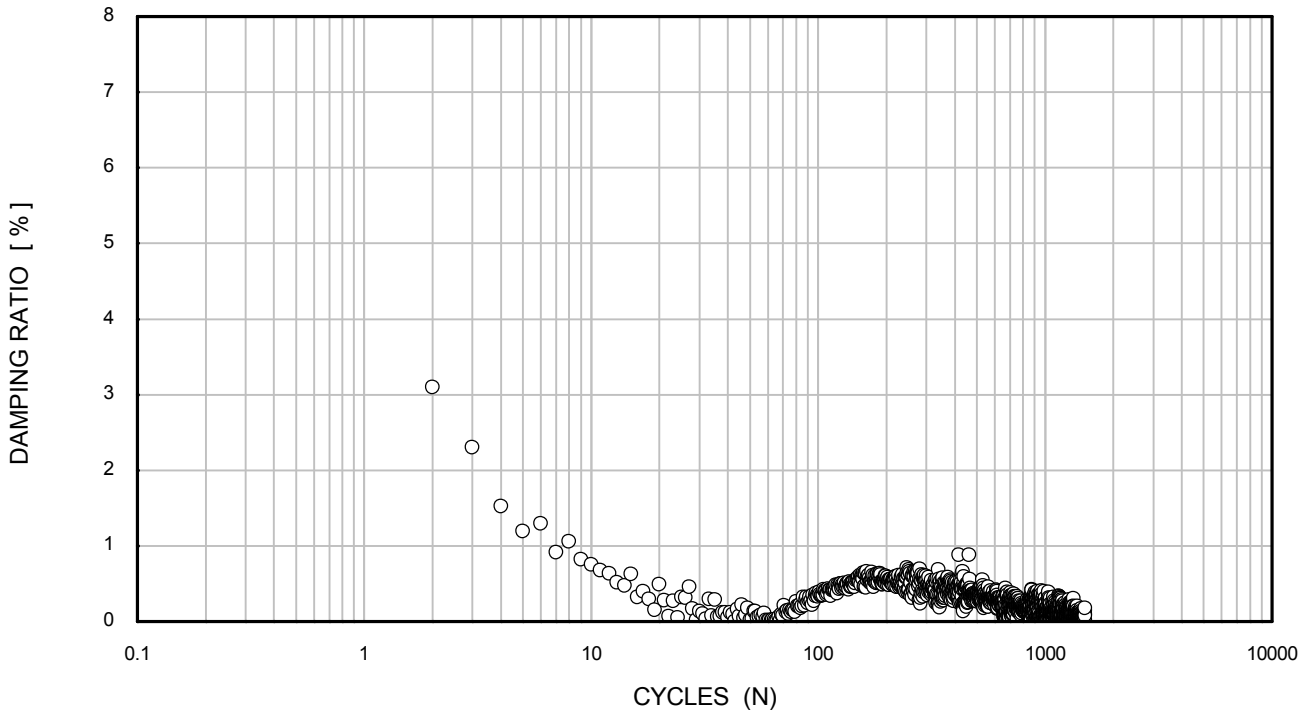




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

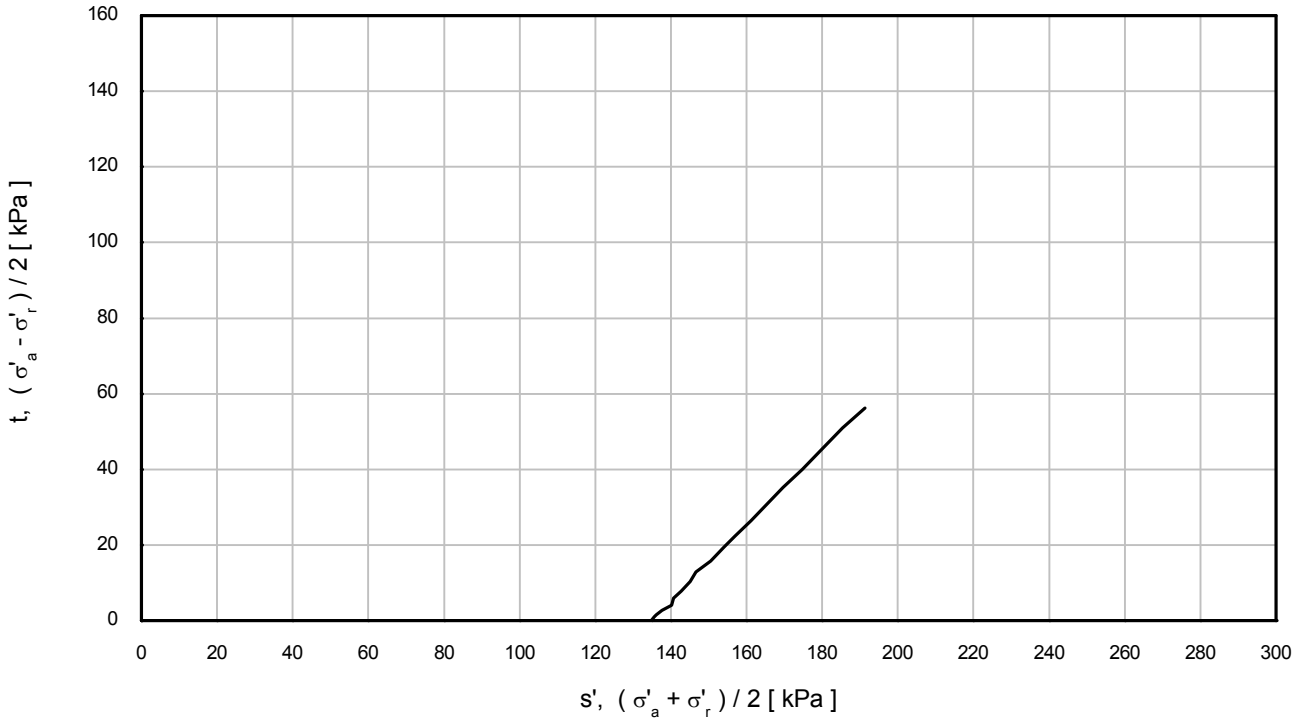
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

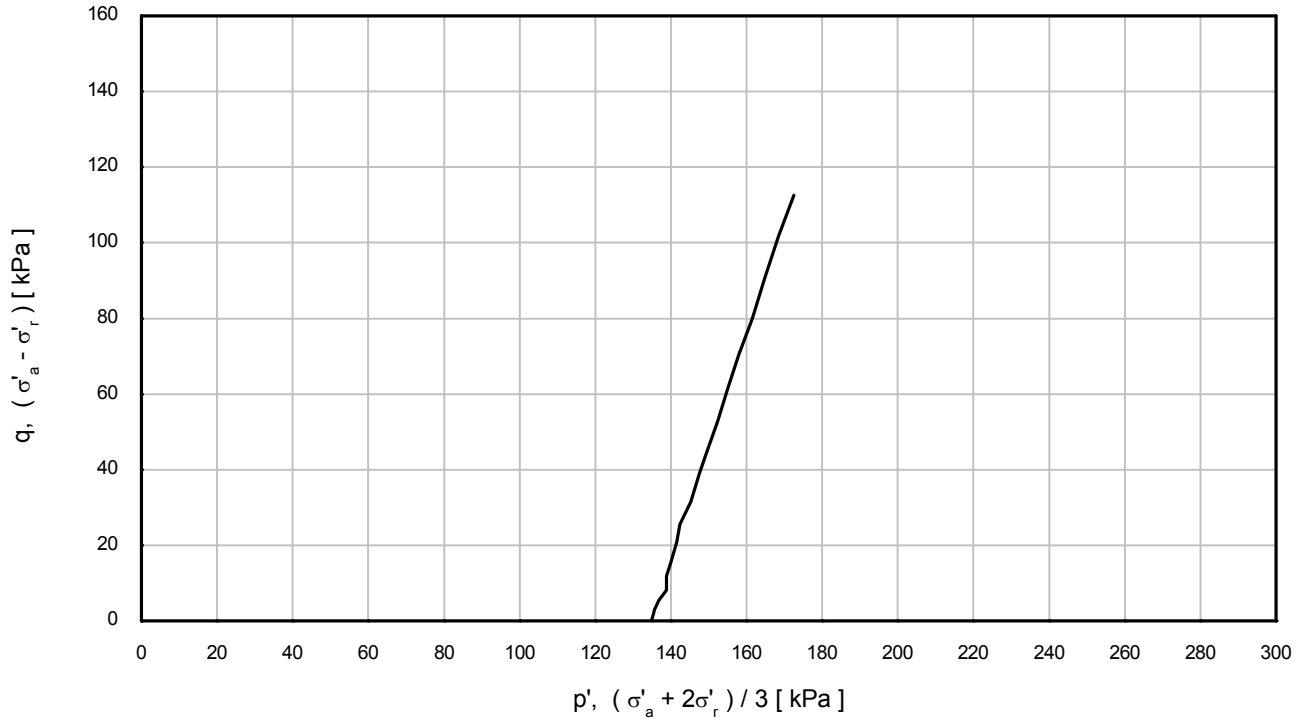




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	180 kPa	Sample	:	CTX_3-1
q_{av}	:	46 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	46 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

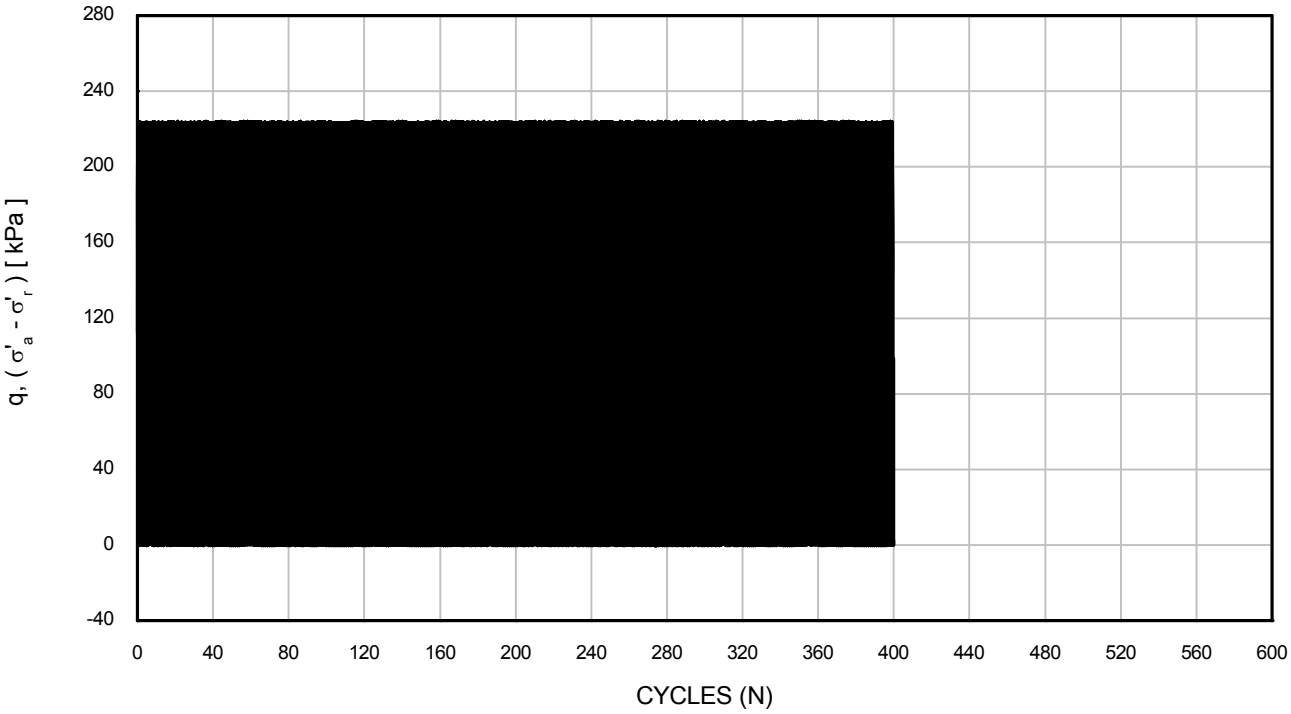
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE - DRAINED

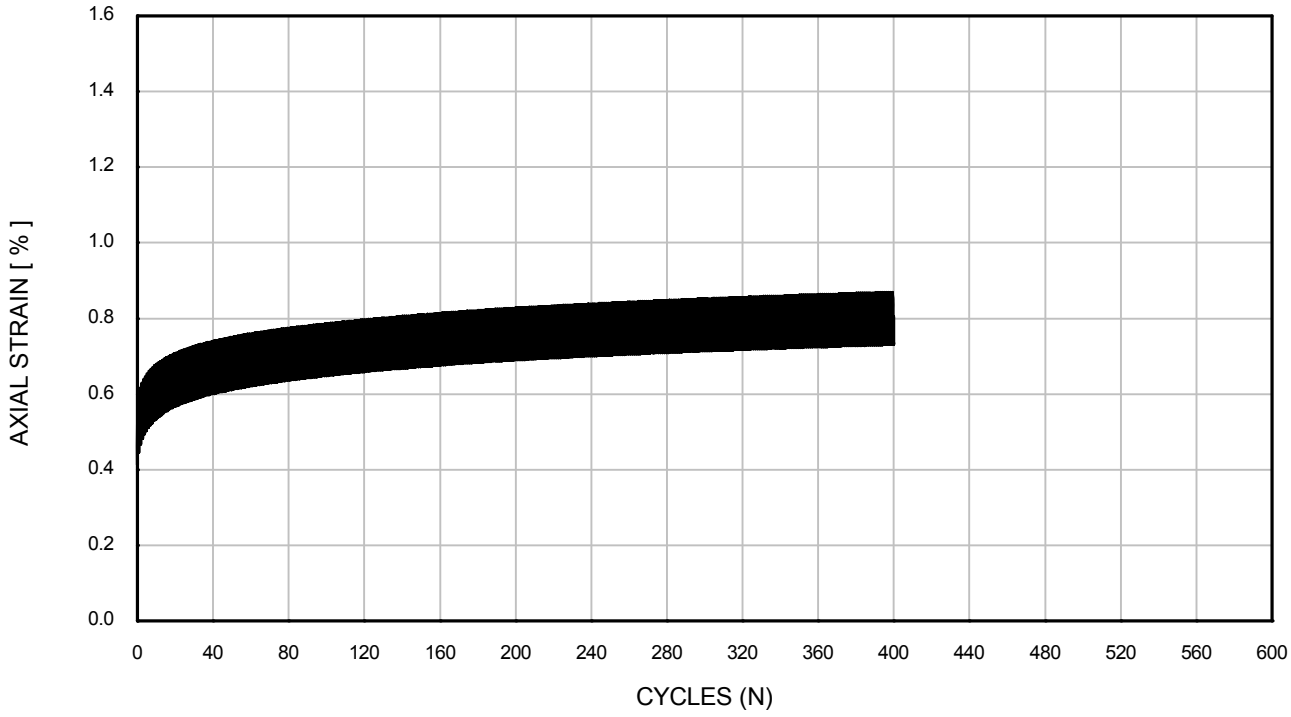




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 248 kPa	Sample	: CTX_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX07

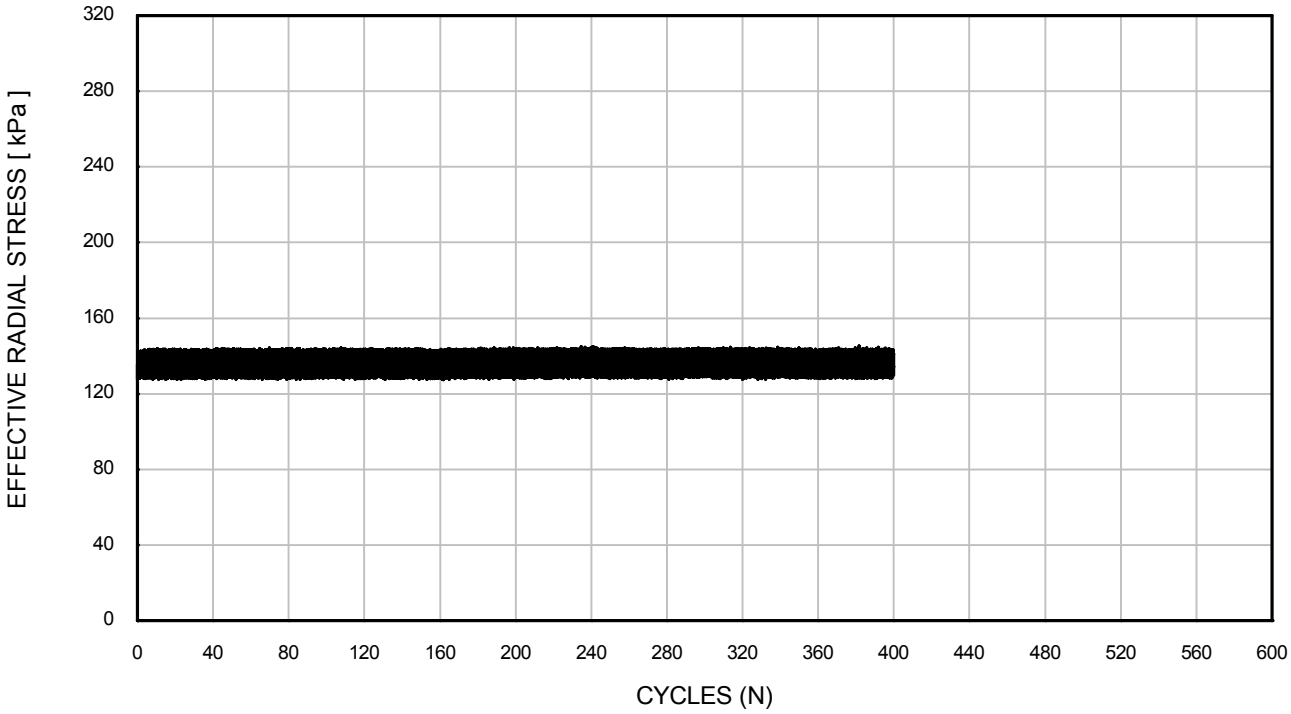
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 2 - UNDRAINED

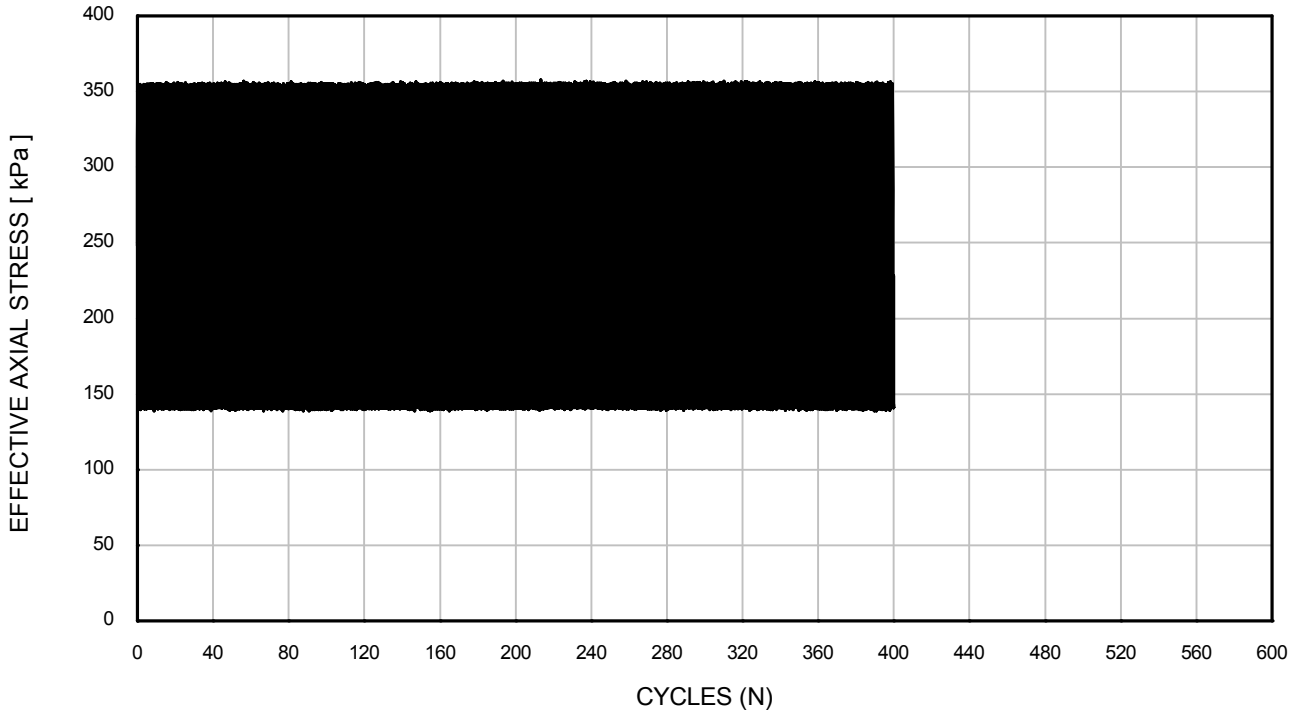




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{av}	:	112 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	112 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

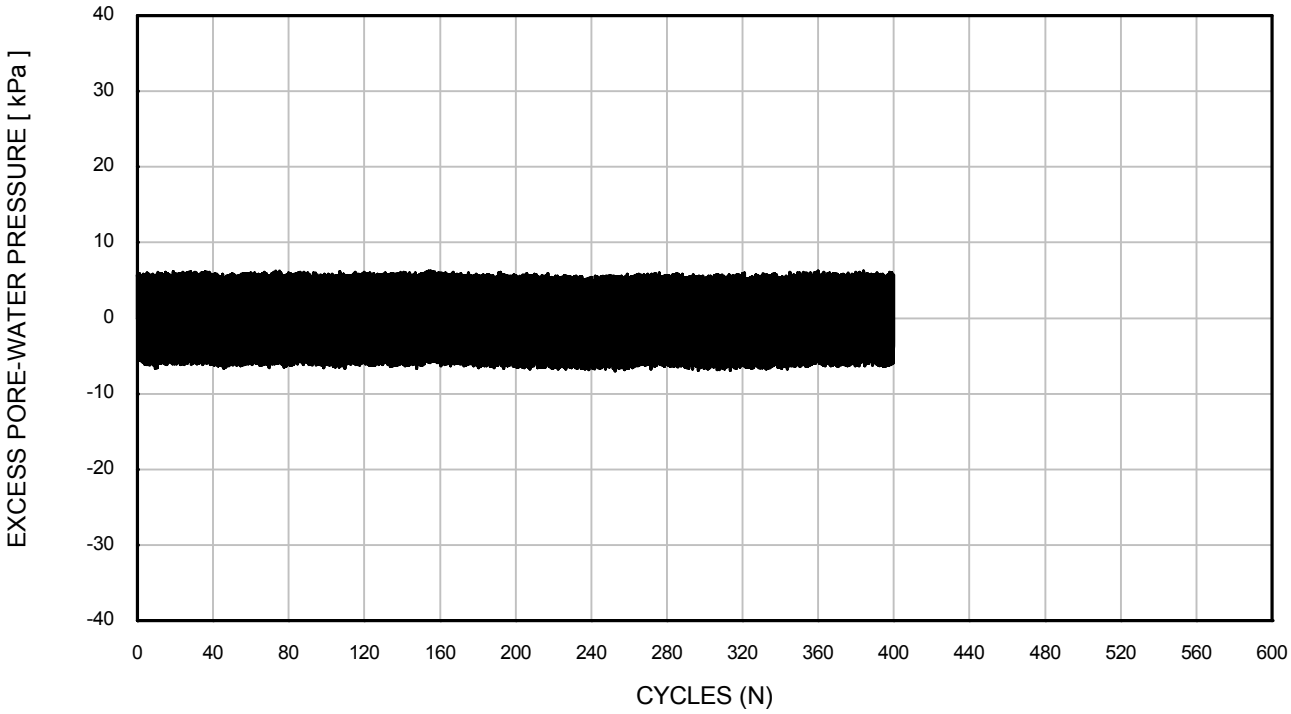
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

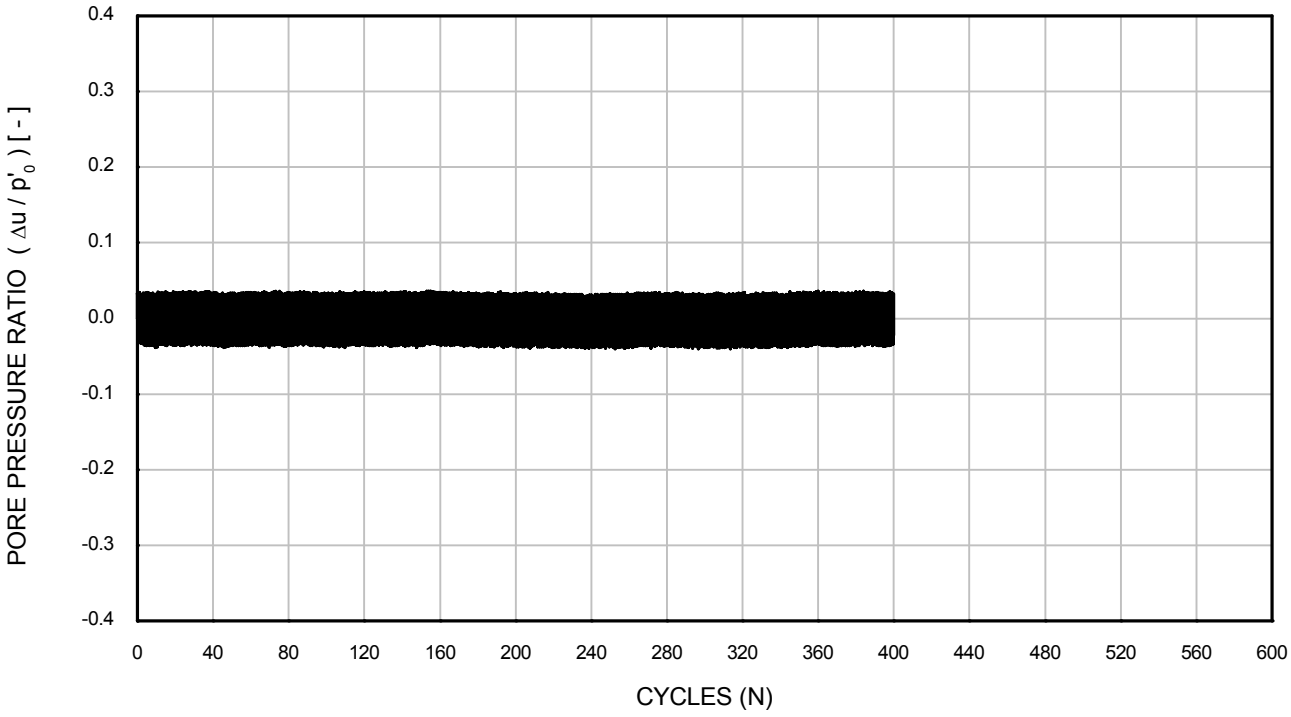




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{av}	:	112 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	112 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

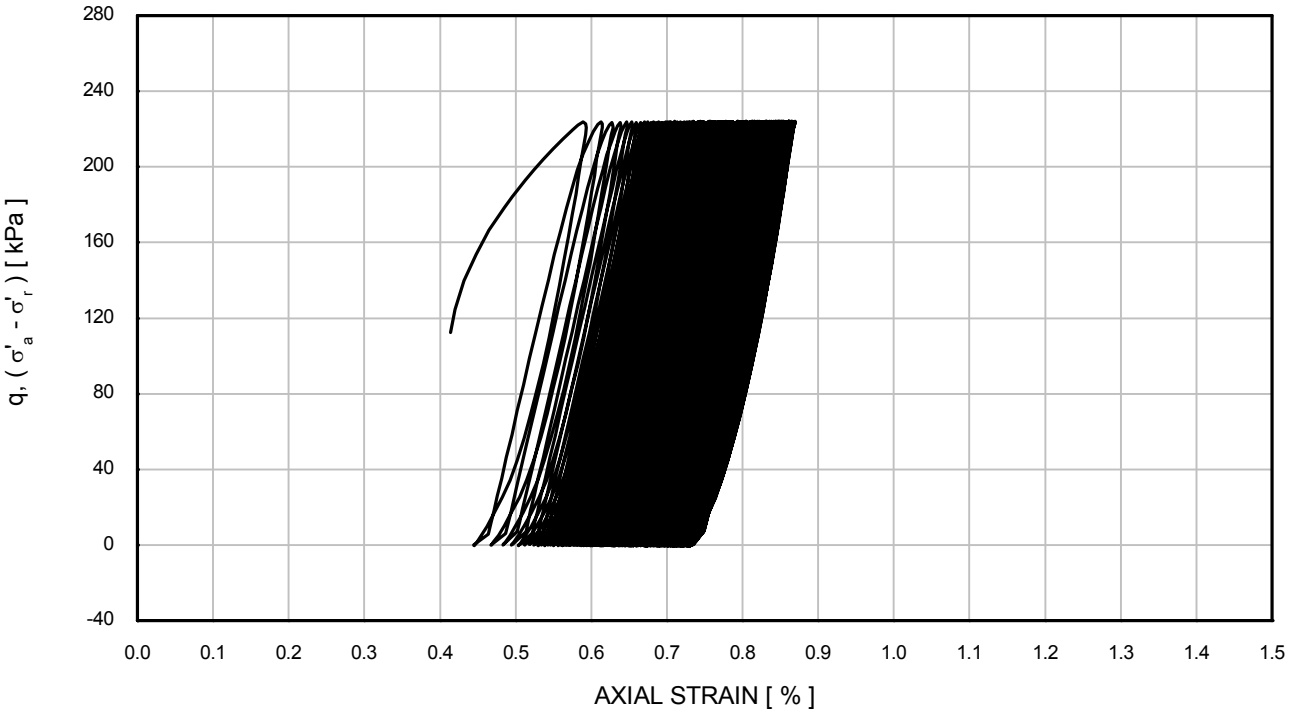
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

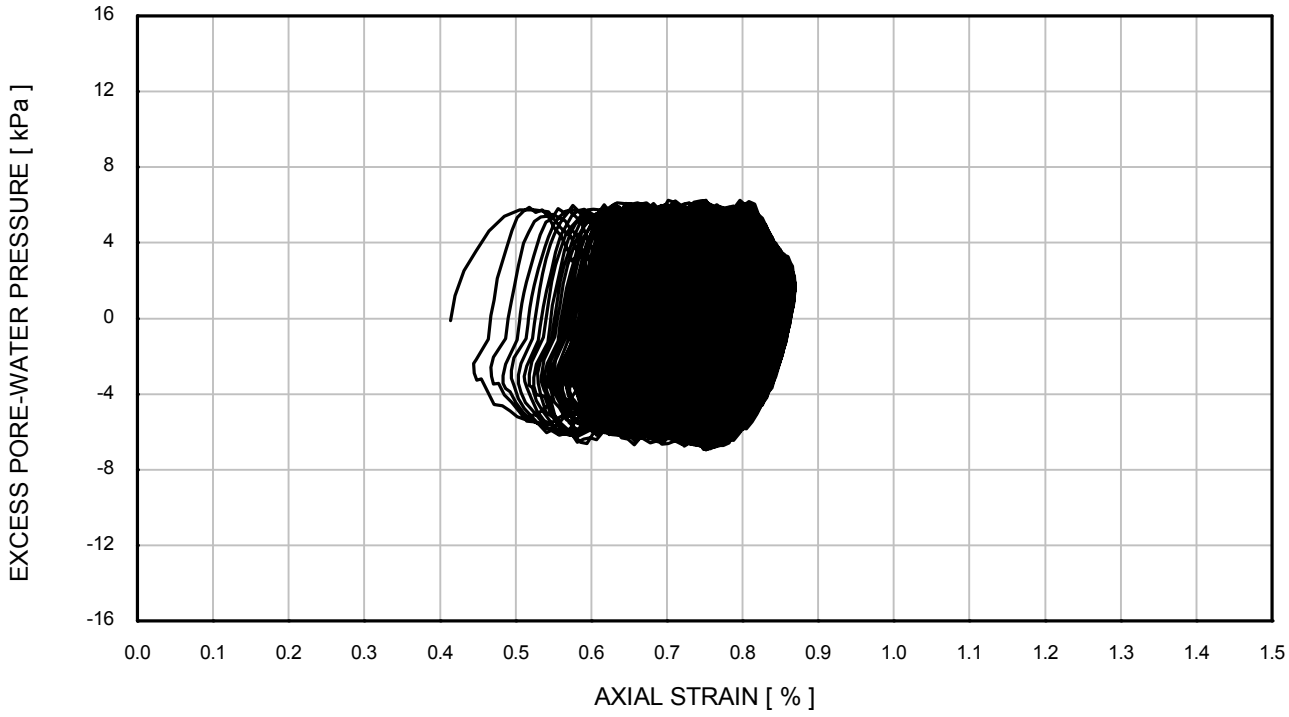




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{av}	:	112 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	112 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

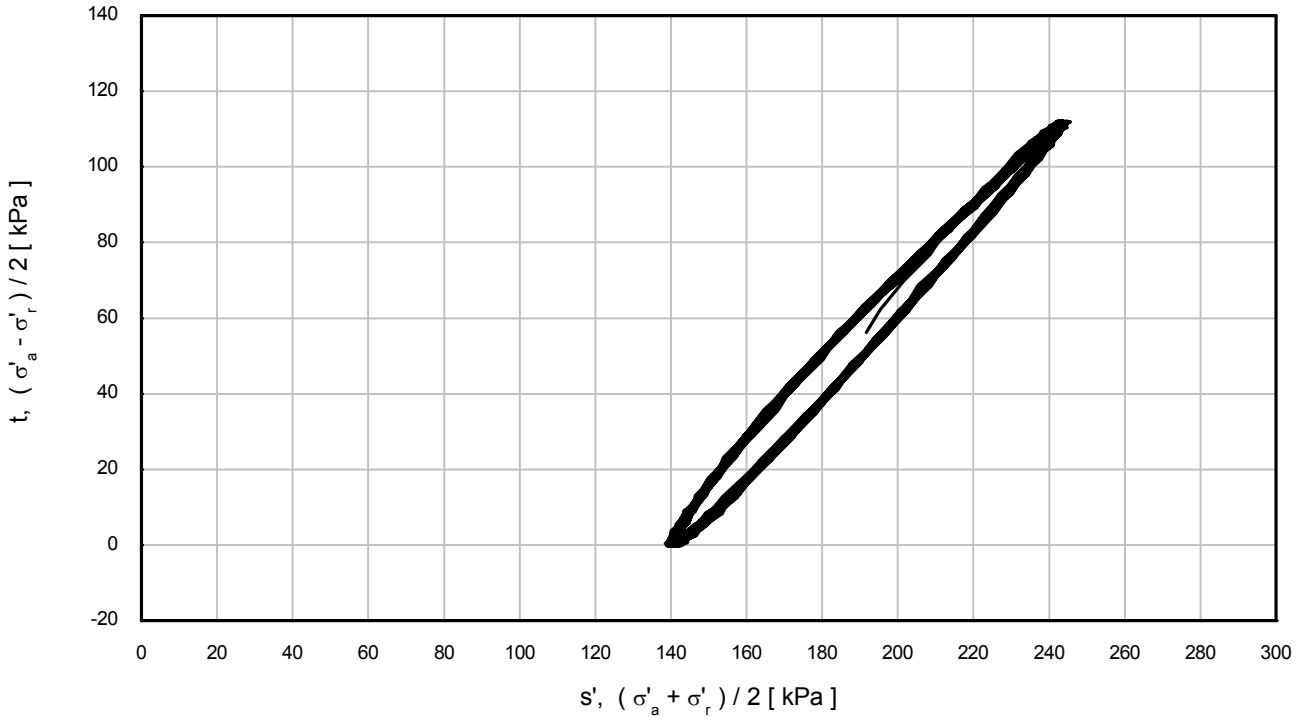
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

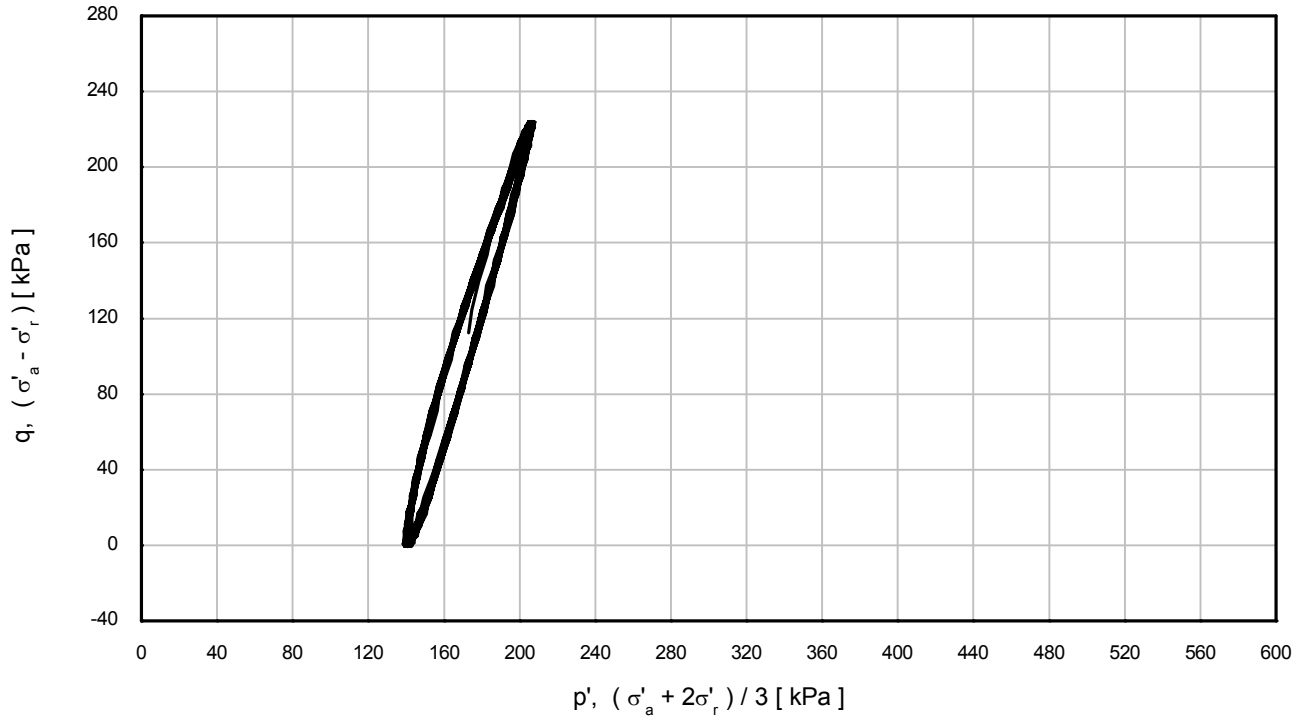




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 248 kPa	Sample	: CTX_3-1
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX07
Frequency	: 0.10 Hz		

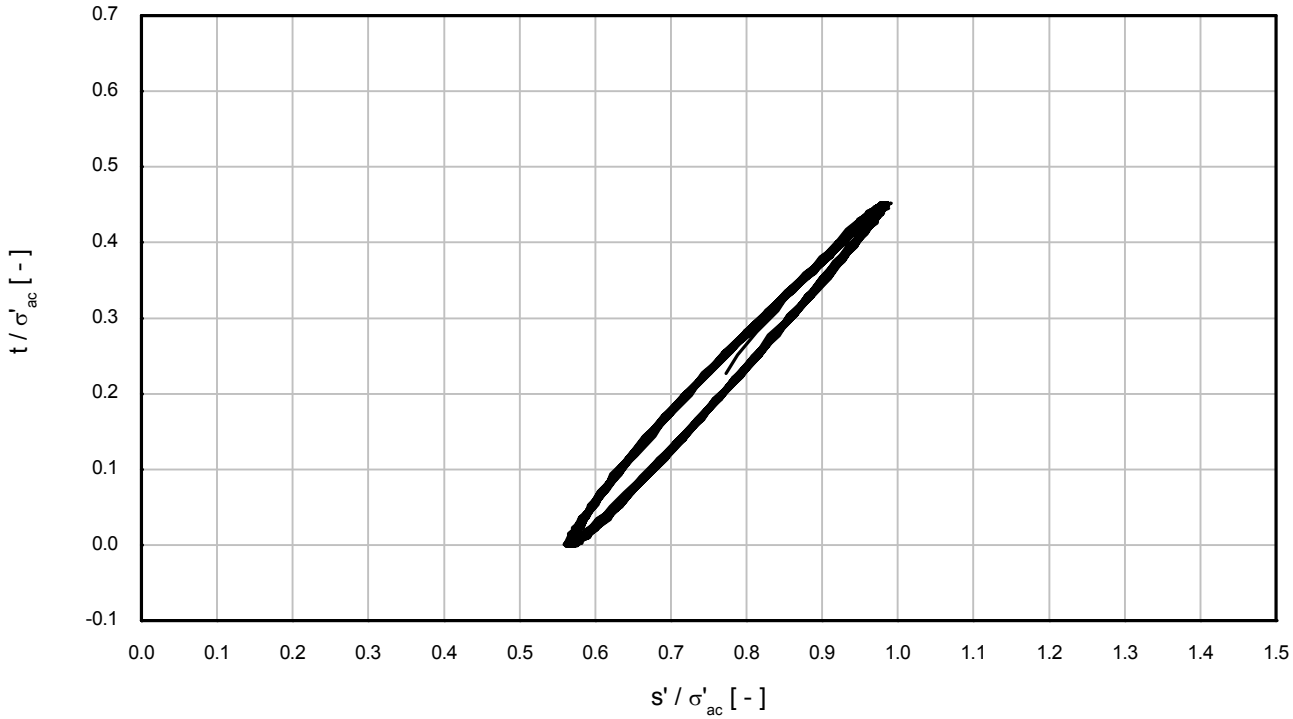
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

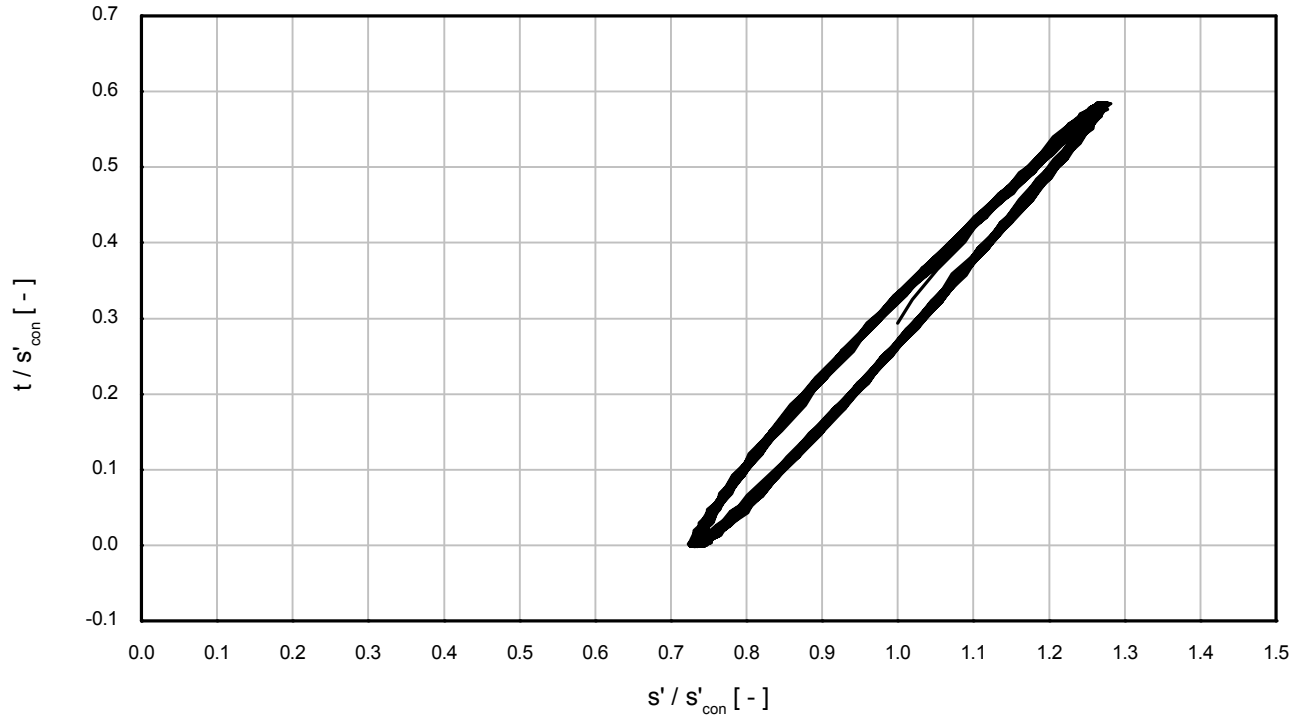




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{av}	:	112 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	112 kPa	Test No.	:	CTX07
Frequency	:	0.10 Hz			

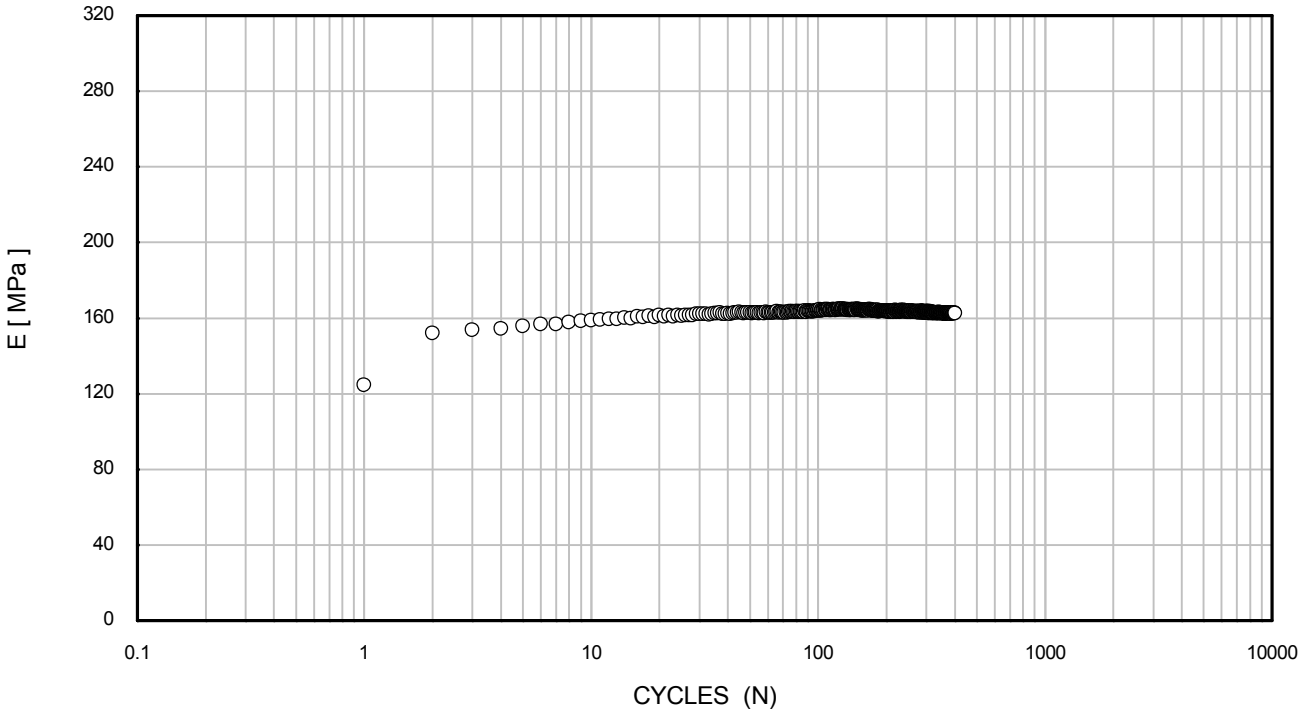
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

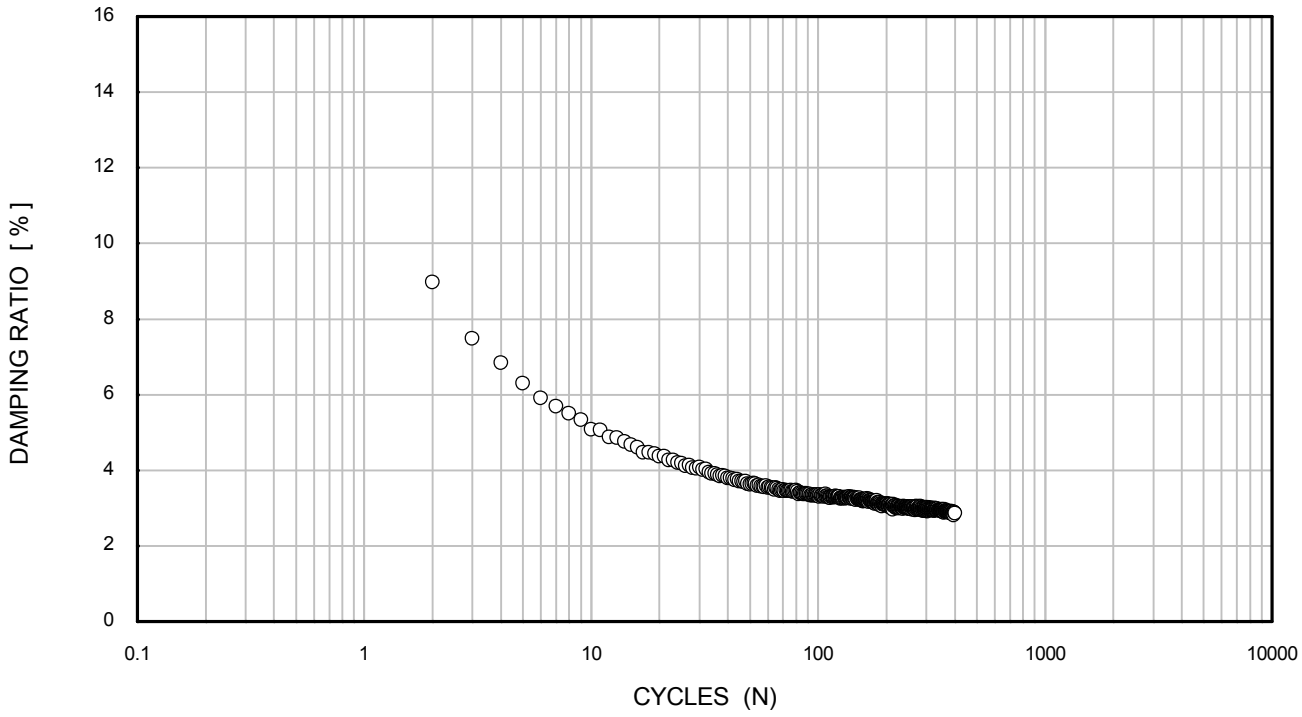




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 248 kPa	Sample	: CTX_3-1
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX07
Frequency	: 0.10 Hz		

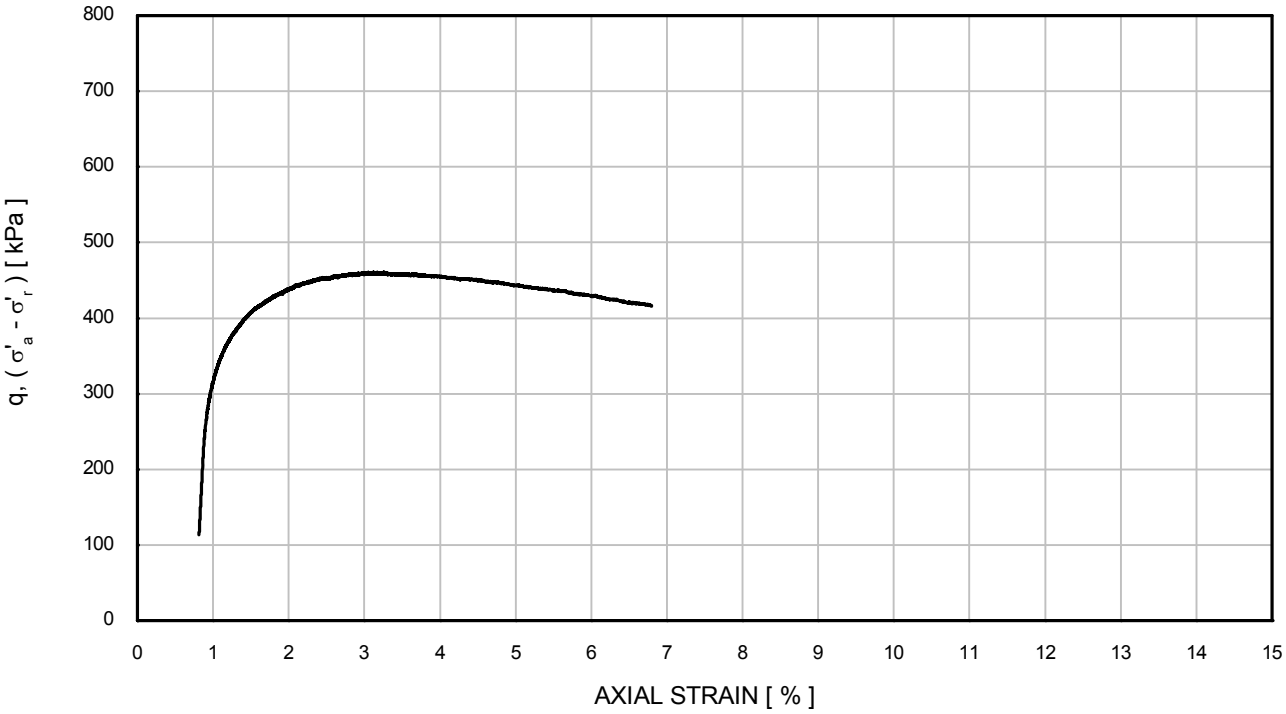
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

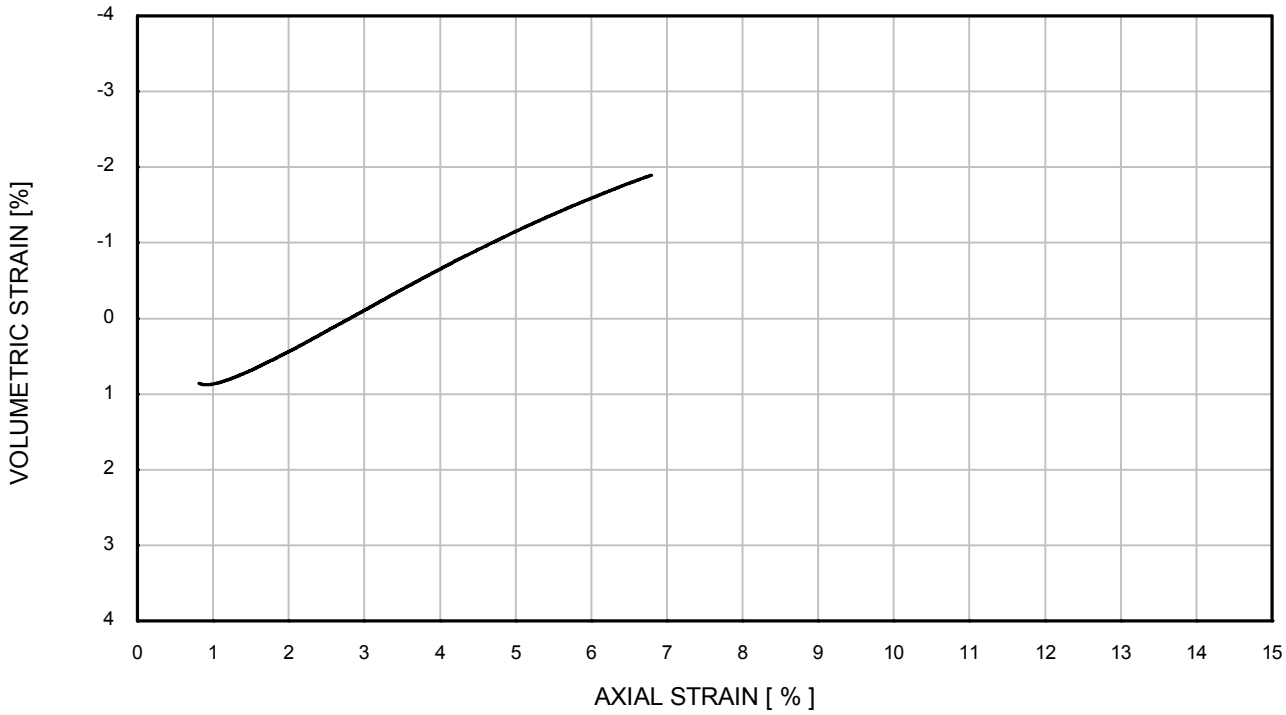




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 248 kPa	Sample	: CTX_3-1
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX07
Frequency	: 0.10 Hz		

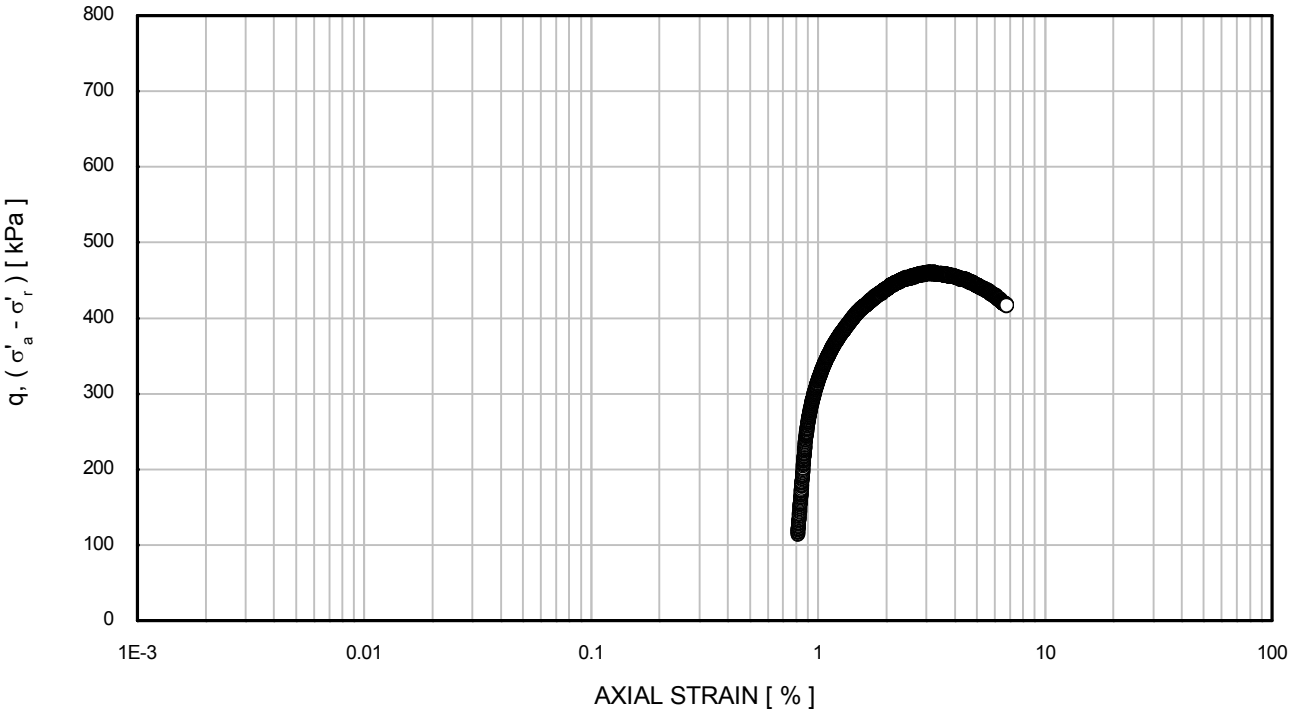
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

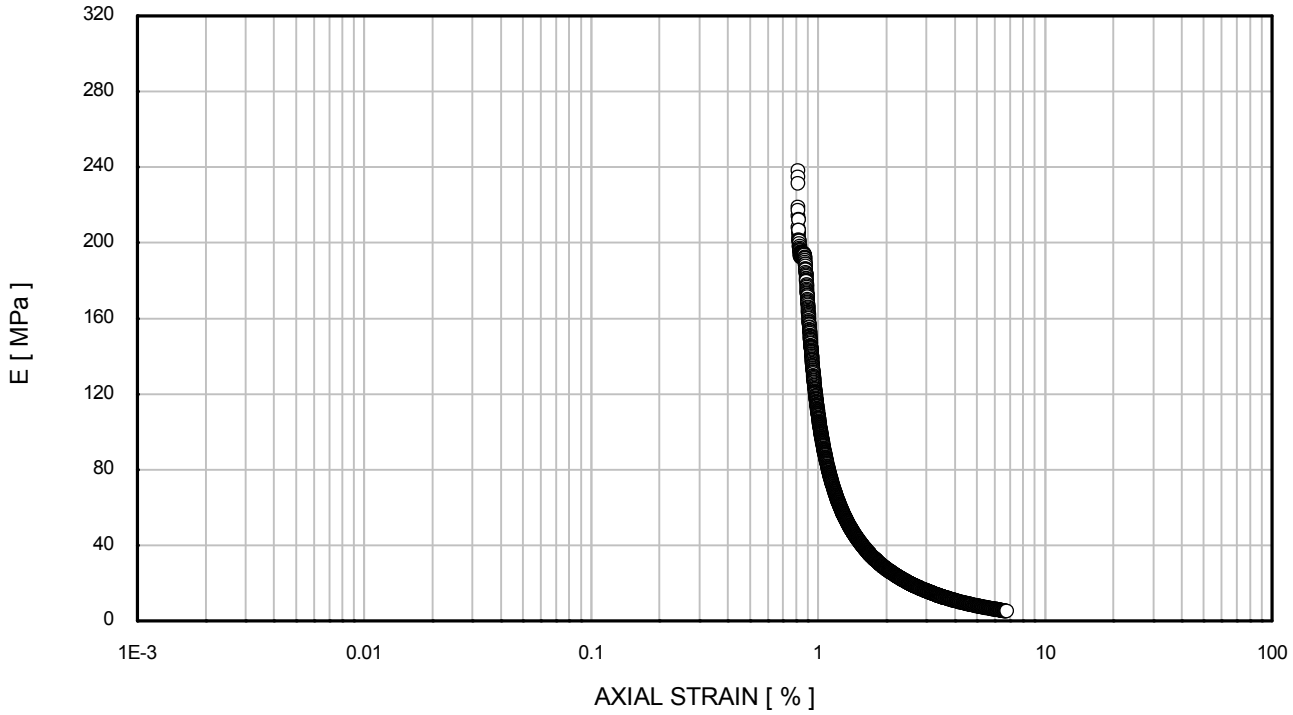




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{peak}	:	460 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.12 %	Test No.	:	CTX07
Rate of strain	:	1.00 %/hour			

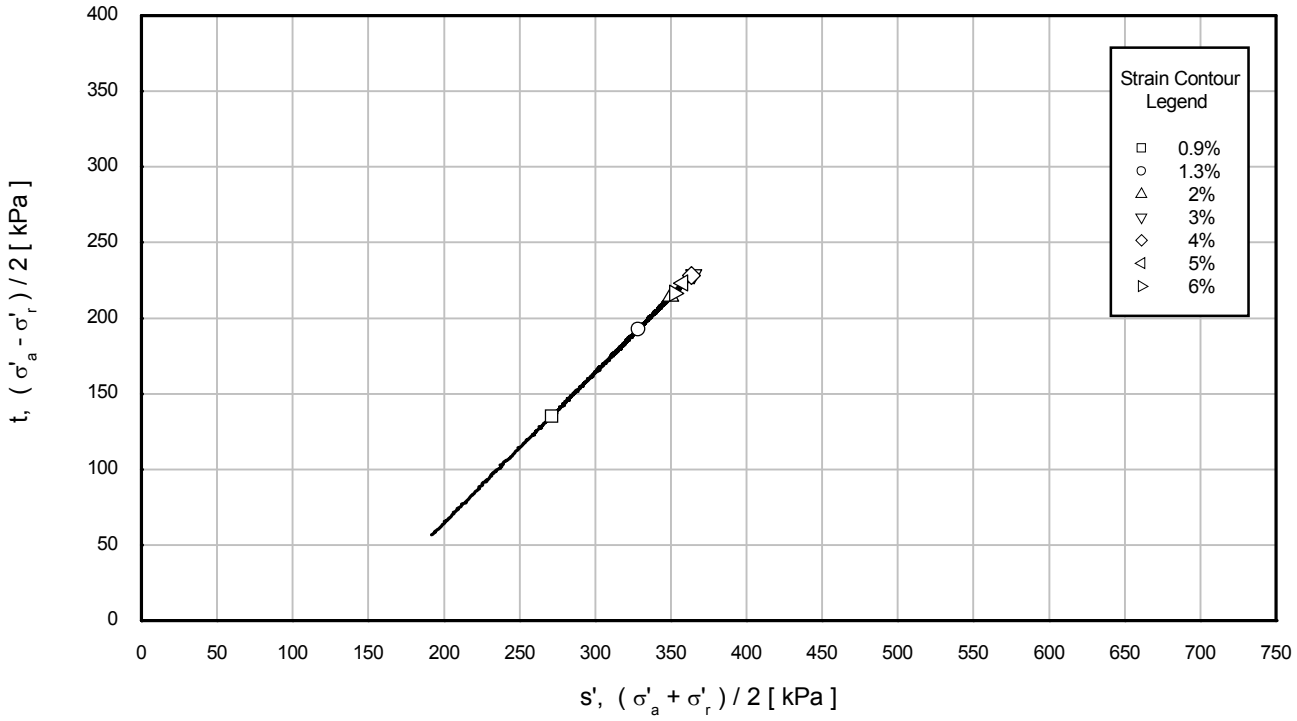
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

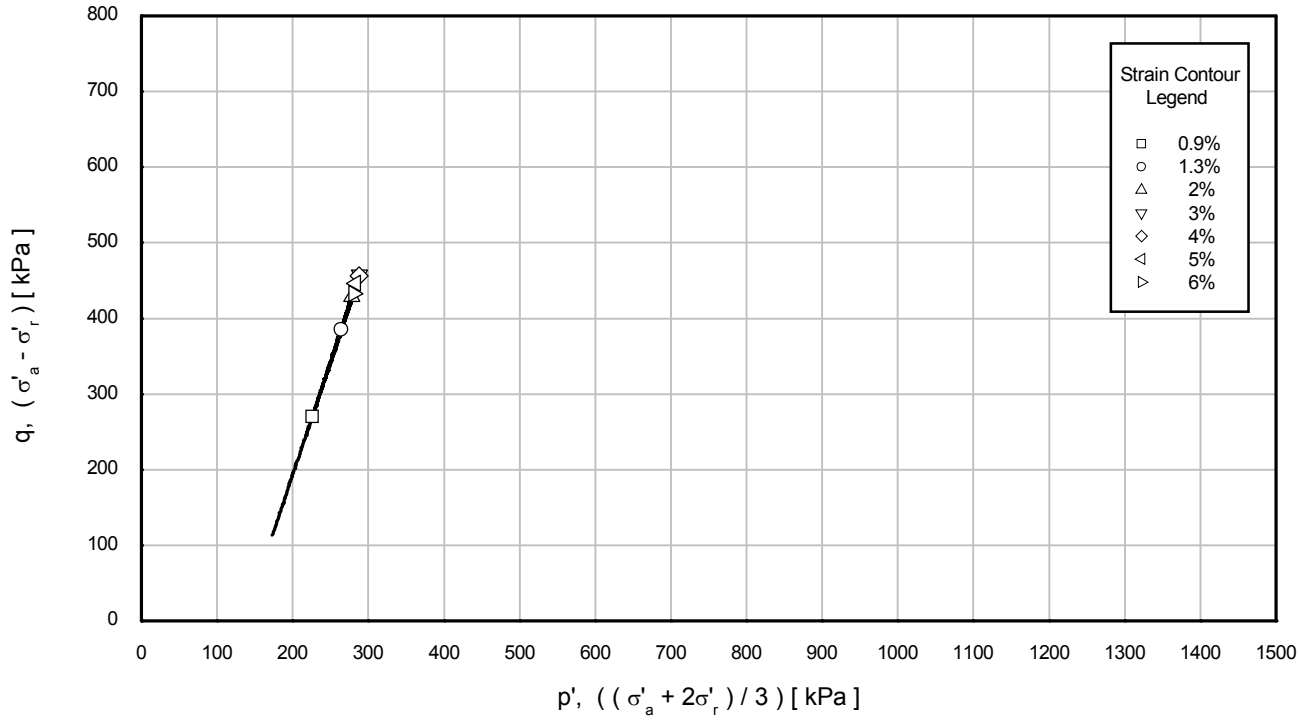




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{peak}	:	460 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.12 %	Test No.	:	CTX07
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	248 kPa	Sample	:	CTX_3-1
q_{peak}	:	460 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	3.12 %	Test No.	:	CTX07
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND with traces of shell fragments

GENERAL	
Date test started	20/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.2
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.614
Degree of saturation	[%]	44
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 03_CTX08
Processed by	JLS
Date	05/01/2017
Checked by	PH
Date	06/01/2017
Approved by	PH
Date	06/01/2017

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	882
Mid height PWP	[kPa]	-
B value achieved	[-]	0.95

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1016
Back pressure	[kPa]	881
Base PWP	[kPa]	881
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.63
External axial strain	[%]	0.24
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.8
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.604
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 1		
Cell pressure	[kPa]	1016
Back pressure	[kPa]	881
Base PWP	[kPa]	881
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	225
Deviator stress	[kPa]	90
Volumetric strain	[%]	0.71
External axial strain	[%]	0.46
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.7
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.602
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	90
Mean q_{cy}	[kPa]	45
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
External ε_{av} at N	[%]	0.79
External ε_{cy} at N	[%]	0.03
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	-1
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.6
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.599
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.54	0.08	55.21	-	18.56	-
2	0.60	0.03	156.37	-	3.62	-
5	0.62	0.03	157.32	-	0.28	-
10	0.63	0.03	158.02	-	1.48	-
20	0.64	0.03	157.78	-	2.22	-
30	0.65	0.03	157.93	-	2.51	-
40	0.66	0.03	157.44	-	2.69	-
50	0.67	0.03	157.64	-	2.79	-
100	0.68	0.03	156.53	-	3.18	-
500	0.73	0.03	154.70	-	3.63	-
1000	0.76	0.03	153.14	-	3.72	-
1500	0.79	0.03	152.48	-	3.74	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

PRE CYCLIC LOADING 2		
Cell pressure	[kPa]	1016
Back pressure	[kPa]	881
Base PWP	[kPa]	881
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	292
Deviator stress	[kPa]	157
Volumetric strain	[%]	0.86
External axial strain	[%]	0.84
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.6
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.598
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	157
Mean q_{cy}	[kPa]	112
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
External ε_{av} at N	[%]	2.01
External ε_{cy} at N	[%]	0.06
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	-2
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.4
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.593
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	1.05	0.21	53.22	-	20.65	-
2	1.26	0.07	157.74	-	18.47	-
5	1.35	0.07	163.02	-	9.56	-
10	1.43	0.07	167.35	-	6.63	-
20	1.52	0.07	171.27	-	4.84	-
30	1.57	0.06	173.07	-	4.14	-
40	1.61	0.06	174.05	-	3.70	-
50	1.64	0.06	175.05	-	3.43	-
100	1.75	0.06	176.55	-	2.75	-
200	1.87	0.06	177.74	-	2.22	-
300	1.95	0.06	177.84	-	2.05	-
400	2.01	0.06	178.20	-	1.91	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	290
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	398
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	4.20
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.82
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	137
Effective axial pressure	[kPa]	534
Principal effective stress ratio	[-]	3.91
ε_{50}	[%]	2.09
Secant modulus (E_{50}) at ε_{50}	[kPa]	177366
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	397
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	3.95
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-0.72
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	533
Principal effective stress ratio	[-]	3.94
At 15% external axial strain		
Corrected deviator stress	[kPa]	328
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	14.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-2.99
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	137
Effective axial pressure	[kPa]	465
Principal effective stress ratio	[-]	3.39

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





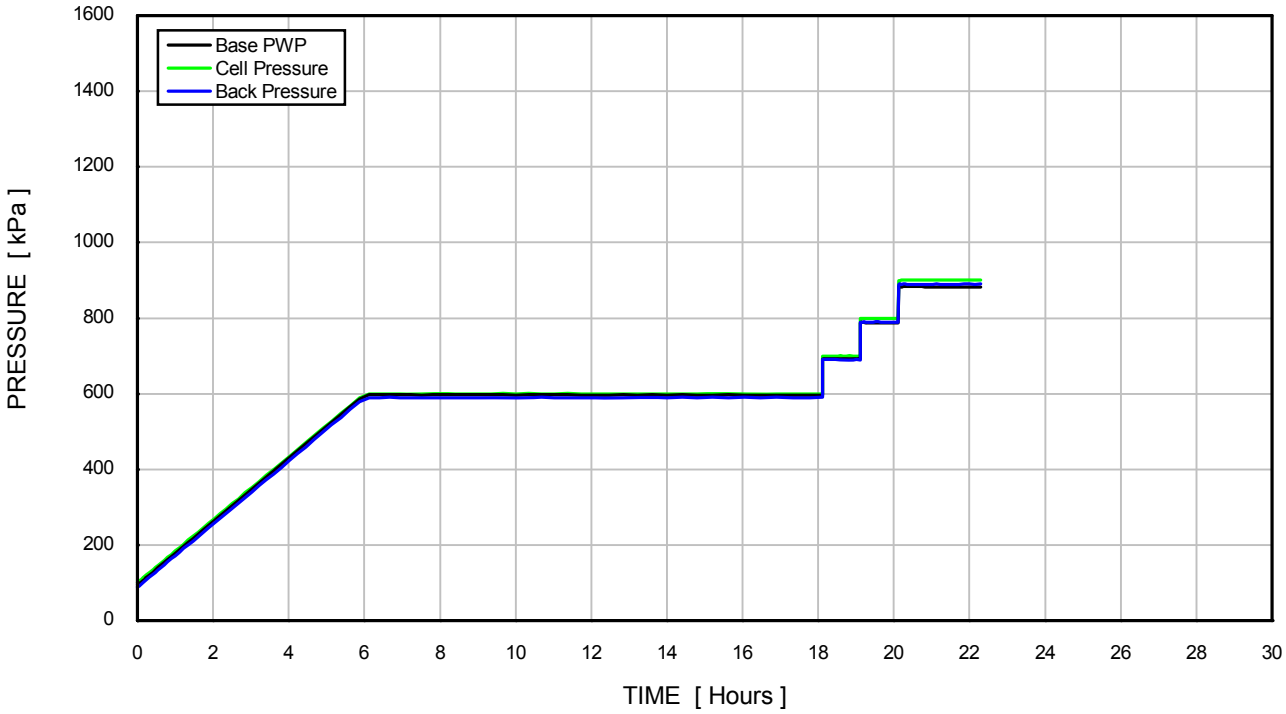
FINAL CONDITIONS

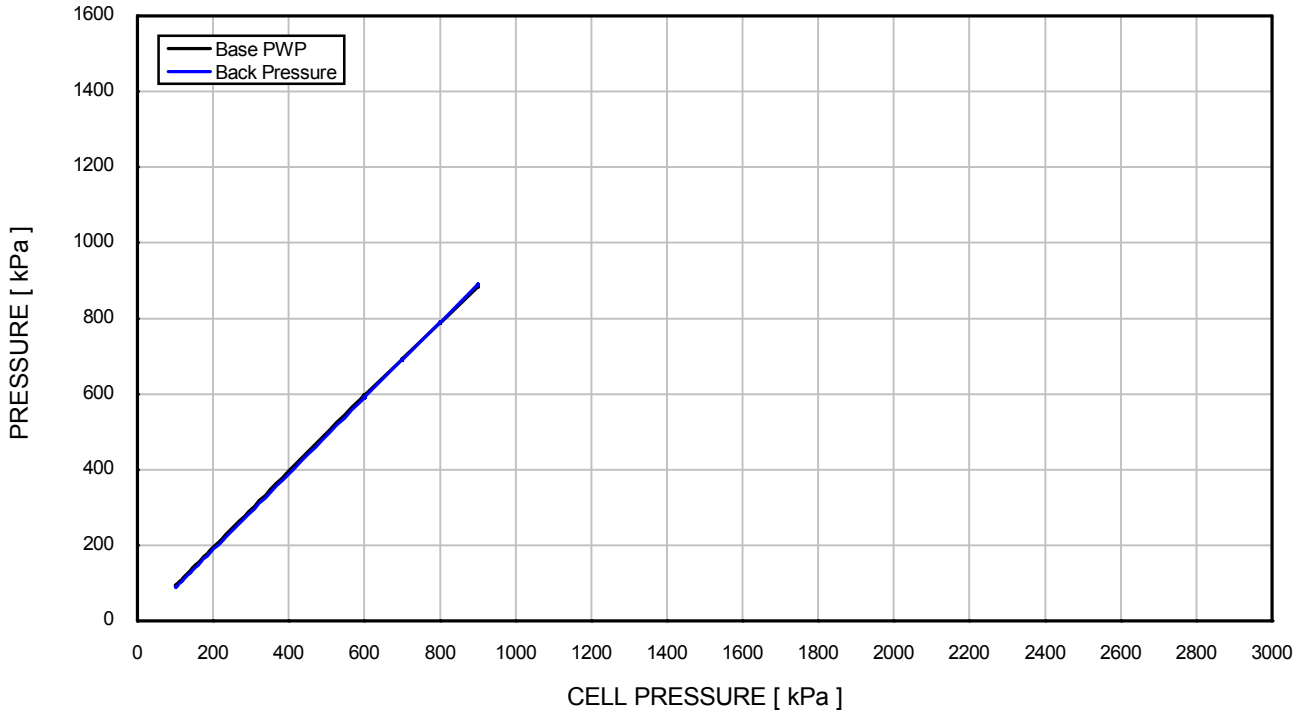
Water content	[%]	24.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.61

TEST IDENTIFICATION

Batch	3
Sample	CTX_3-2
Unit	Unit B1 (Kreftenheye)
Test number	CTX08

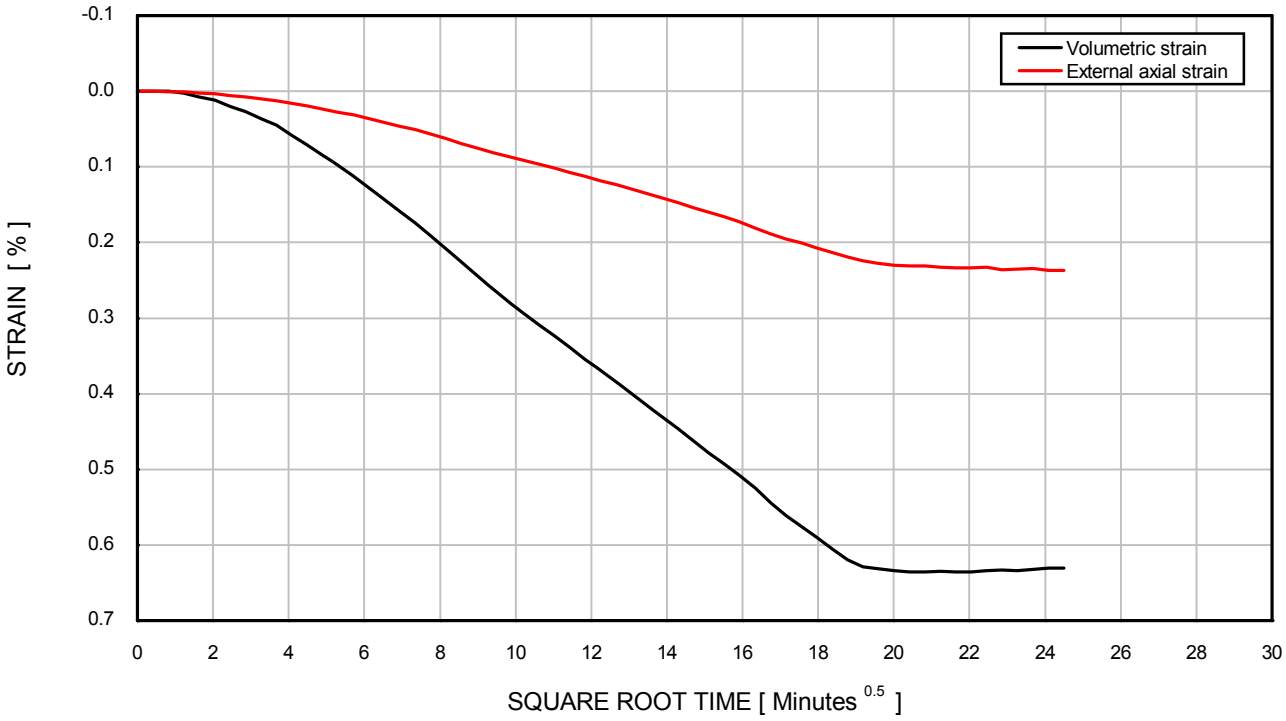
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

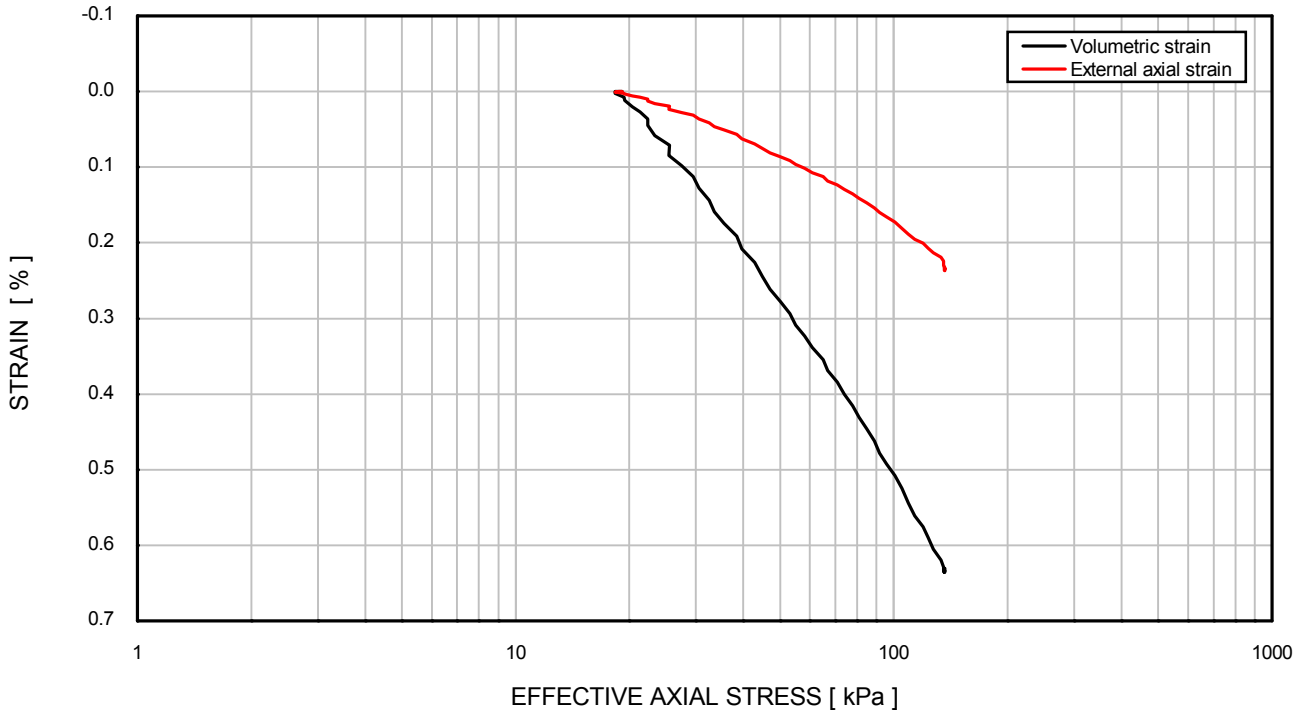




B value	:	0.95			
Initial σ'_r	:	5	kPa	Batch	: 3
Initial σ'_a	:	5	kPa	Sample	: CTX_3-2
Final σ'_r	:	18	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	18	kPa	Test No.	: CTX08

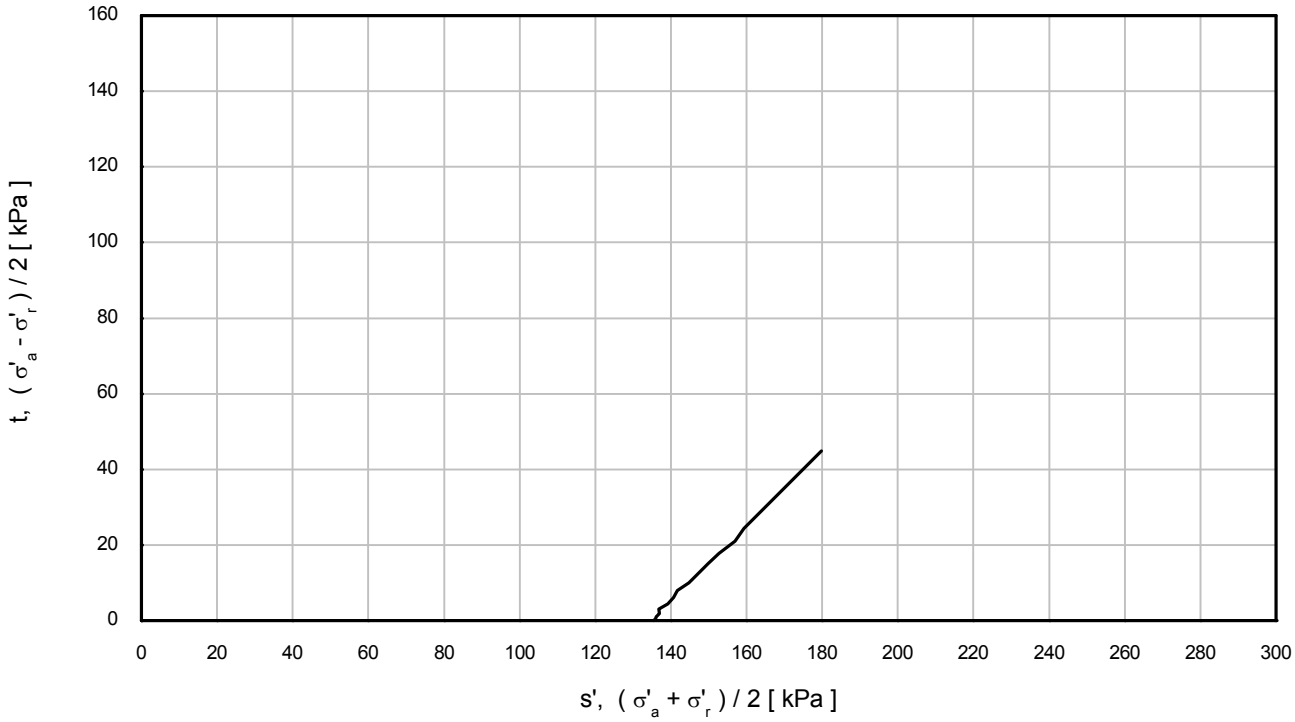
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

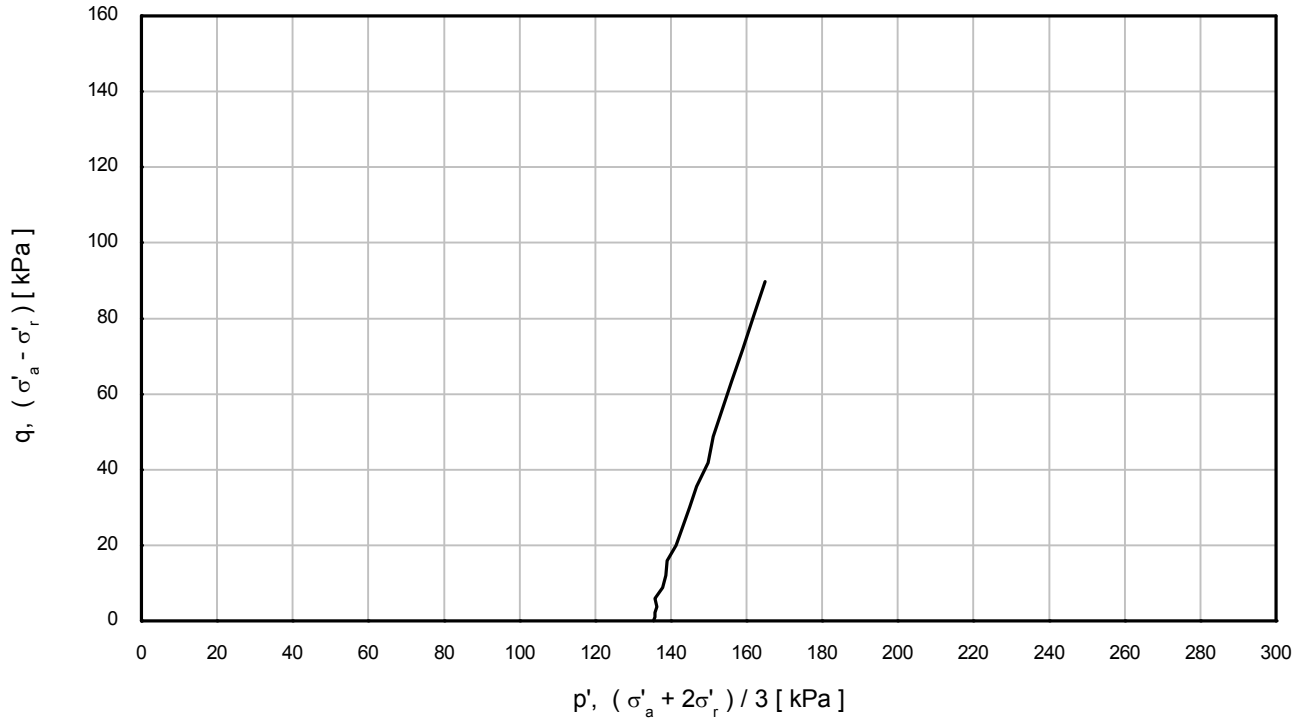




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTX_3-2
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX08

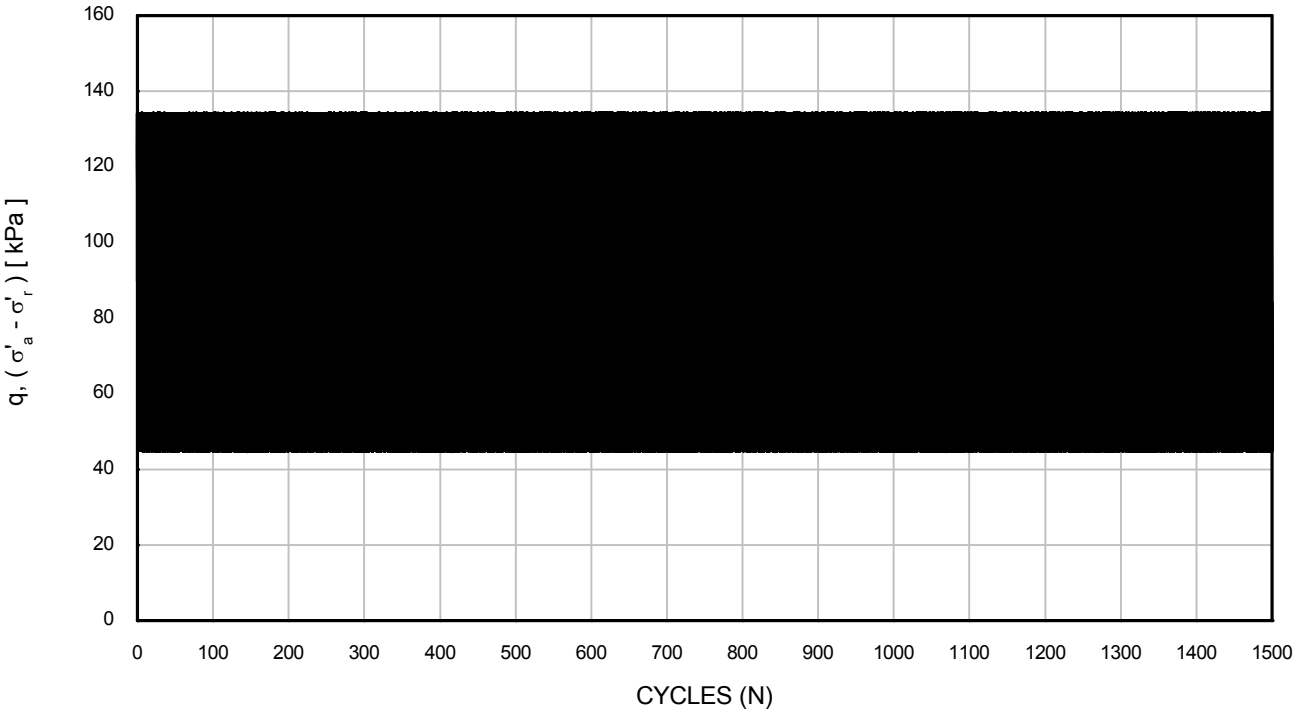
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

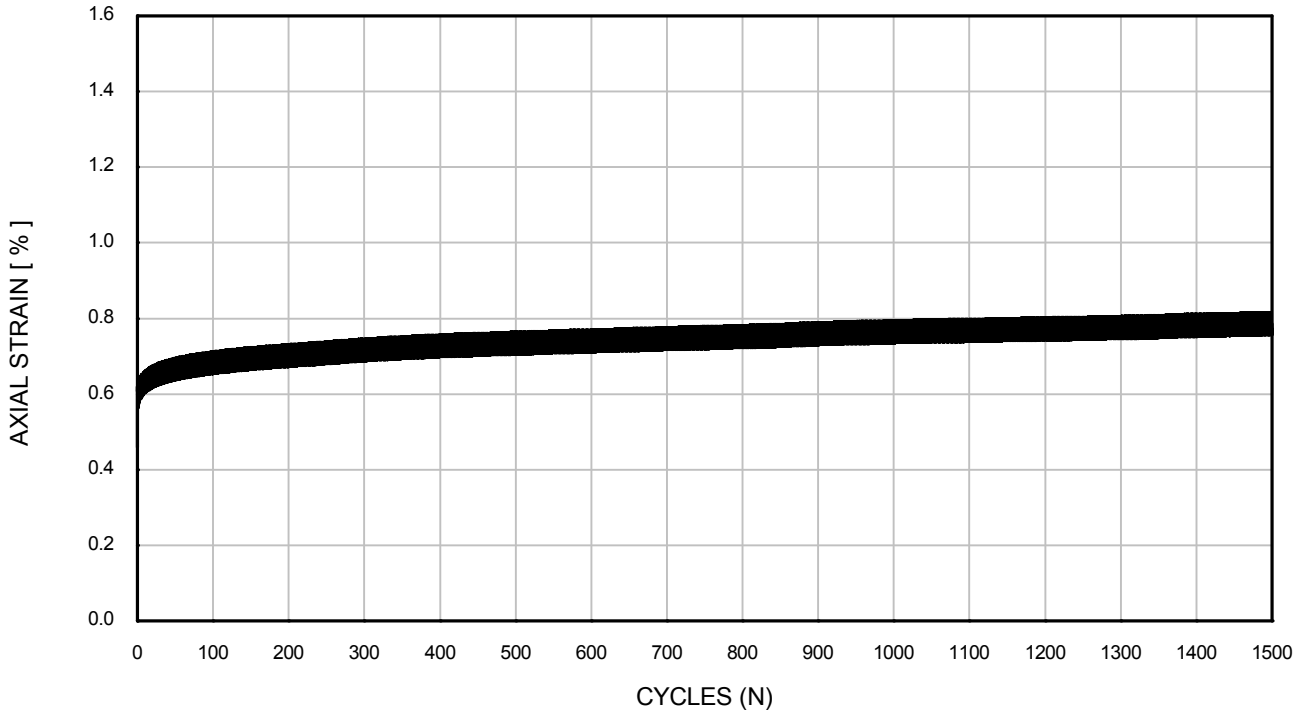




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 225 kPa	Sample	: CTX_3-2
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX08

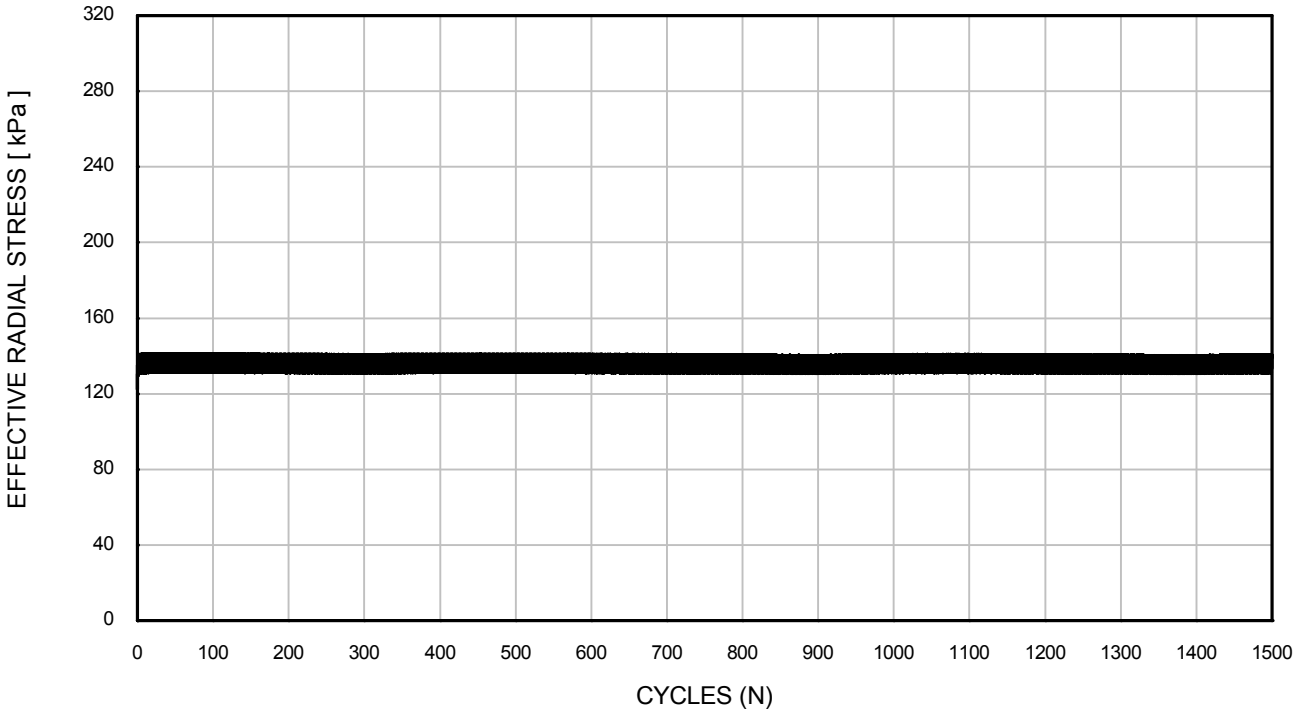
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 1 - DRAINED

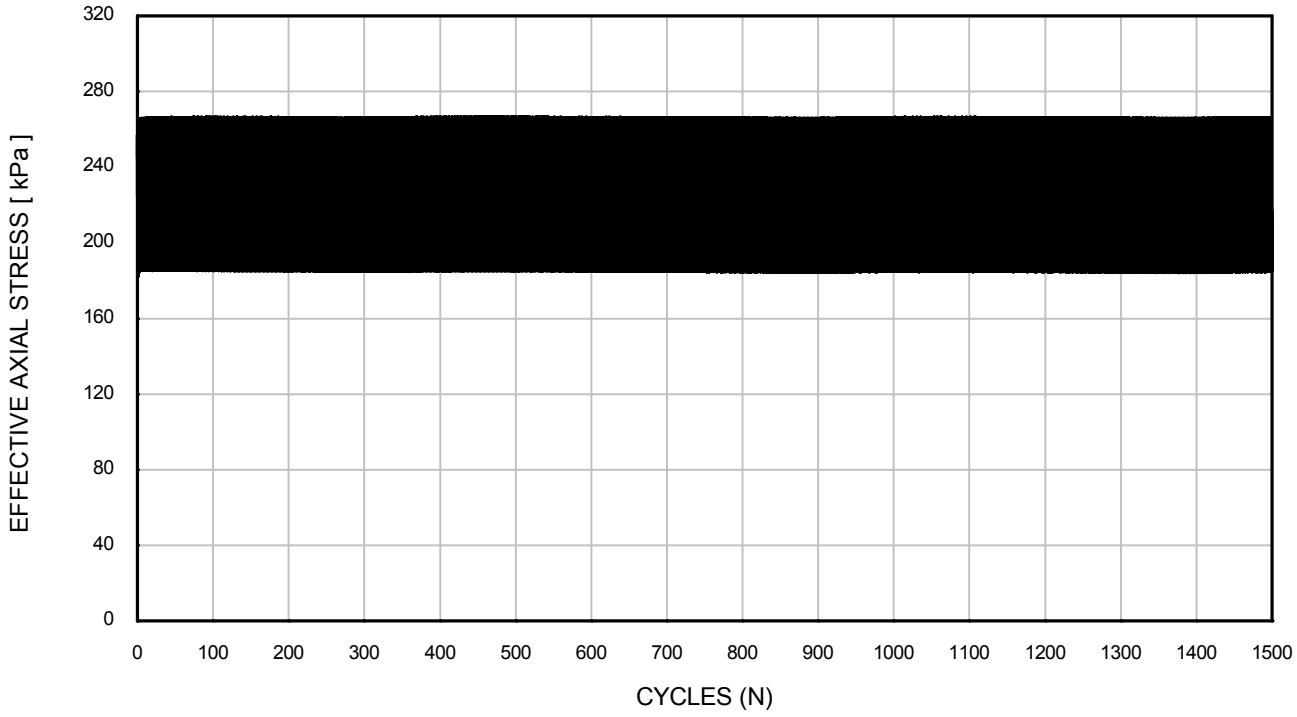




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

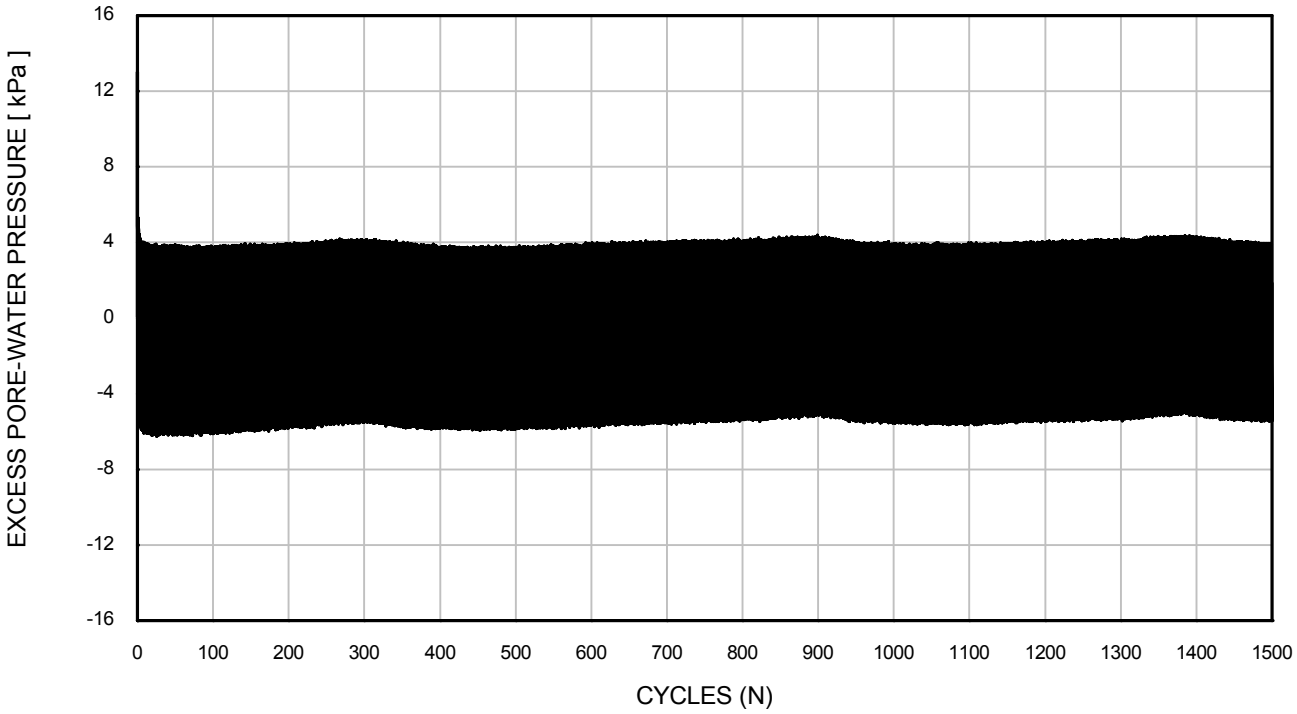
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CYCLIC LOADING STAGE 1 - DRAINED

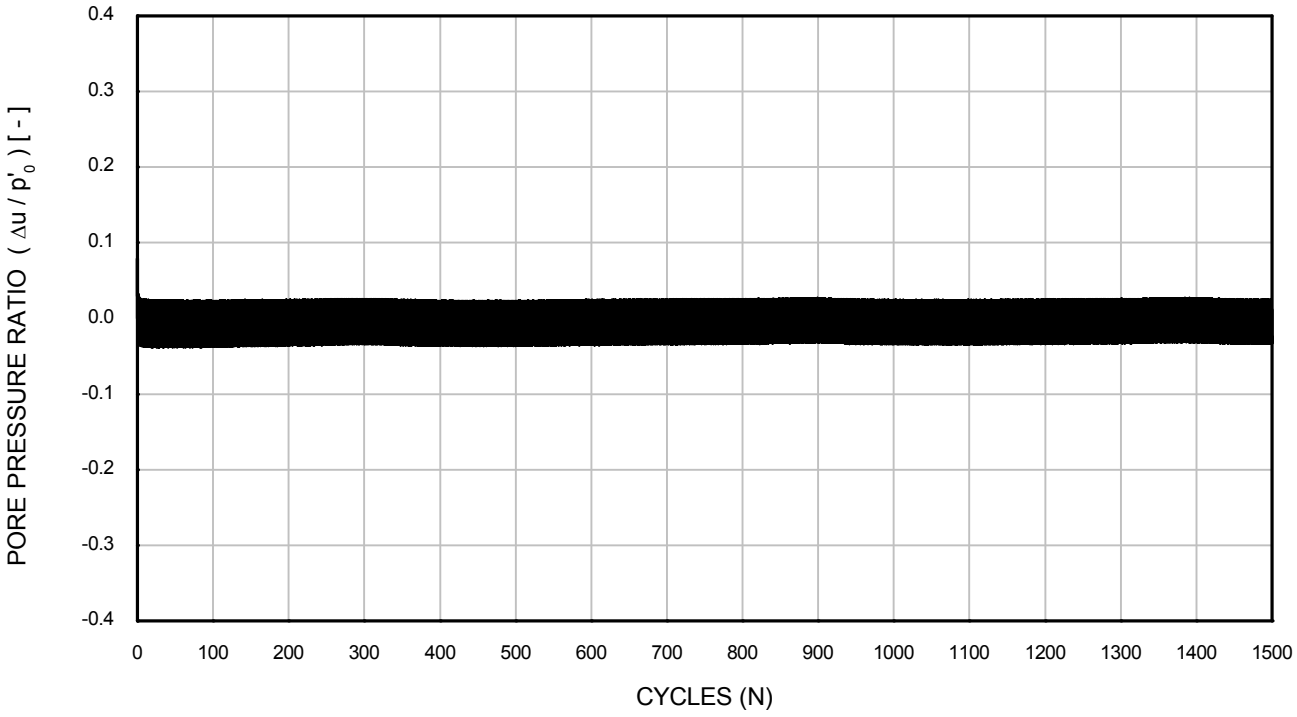




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

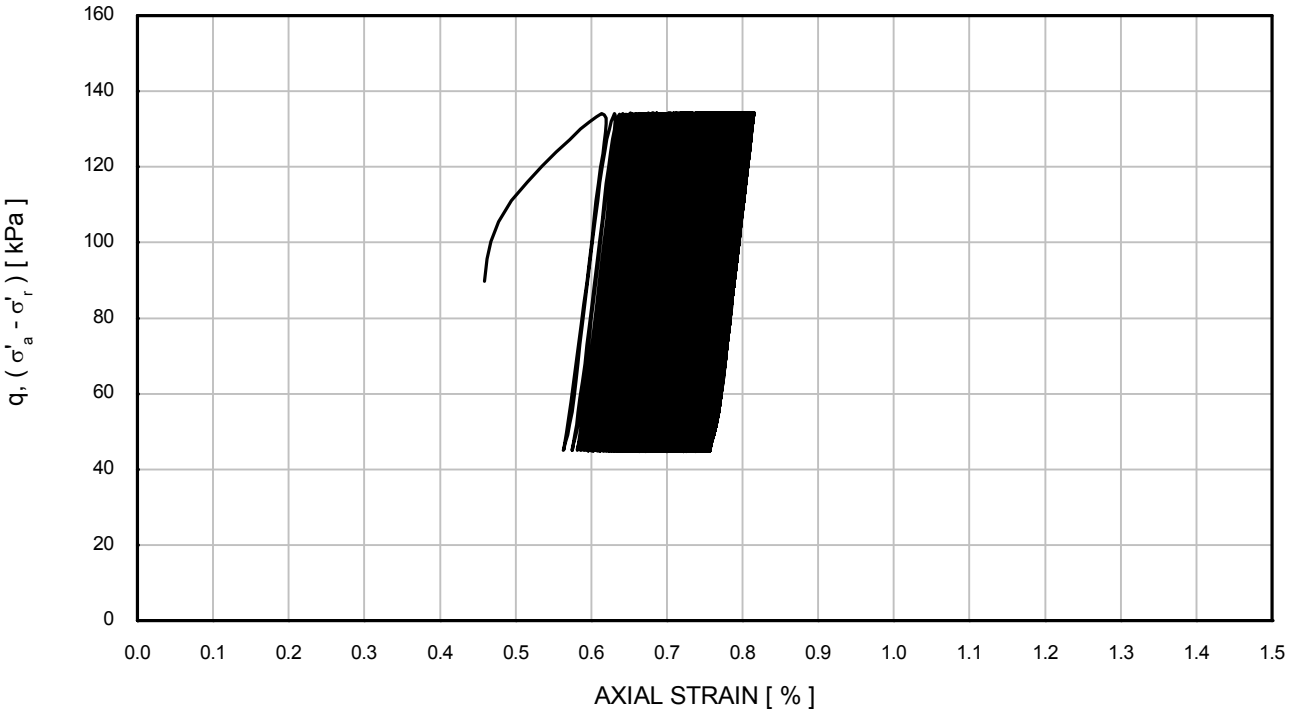
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

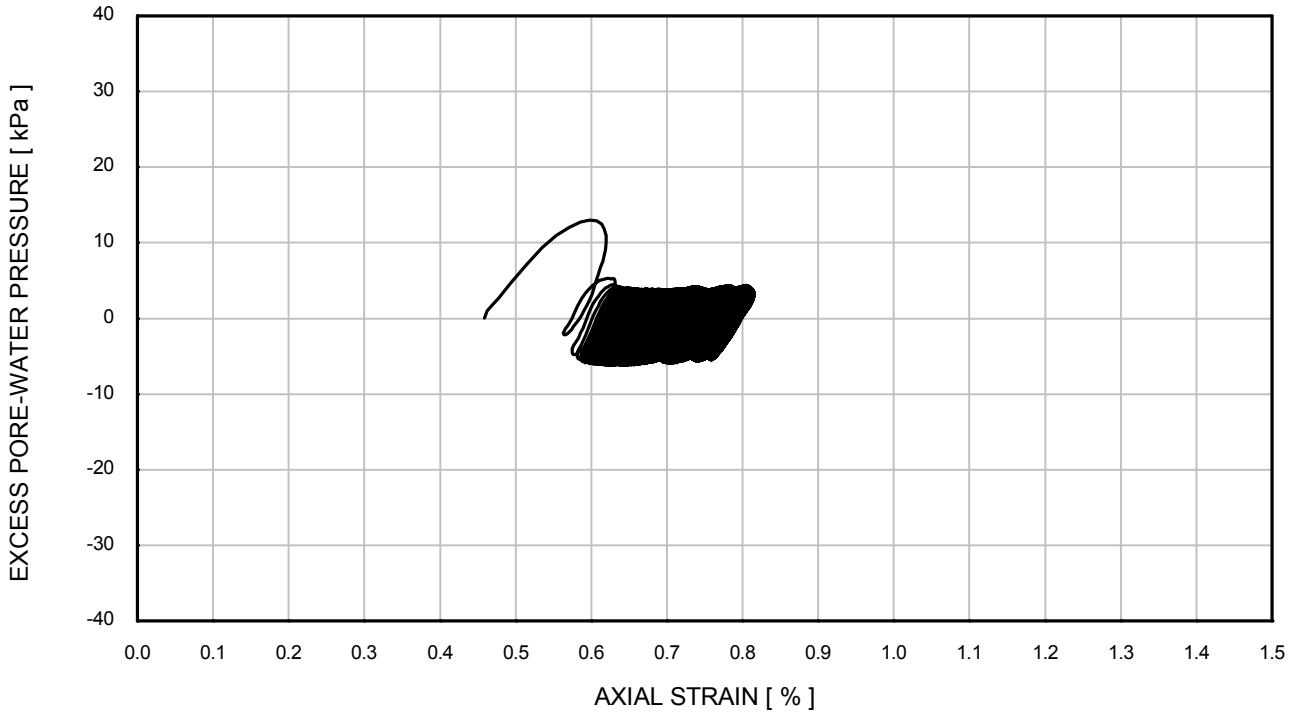




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

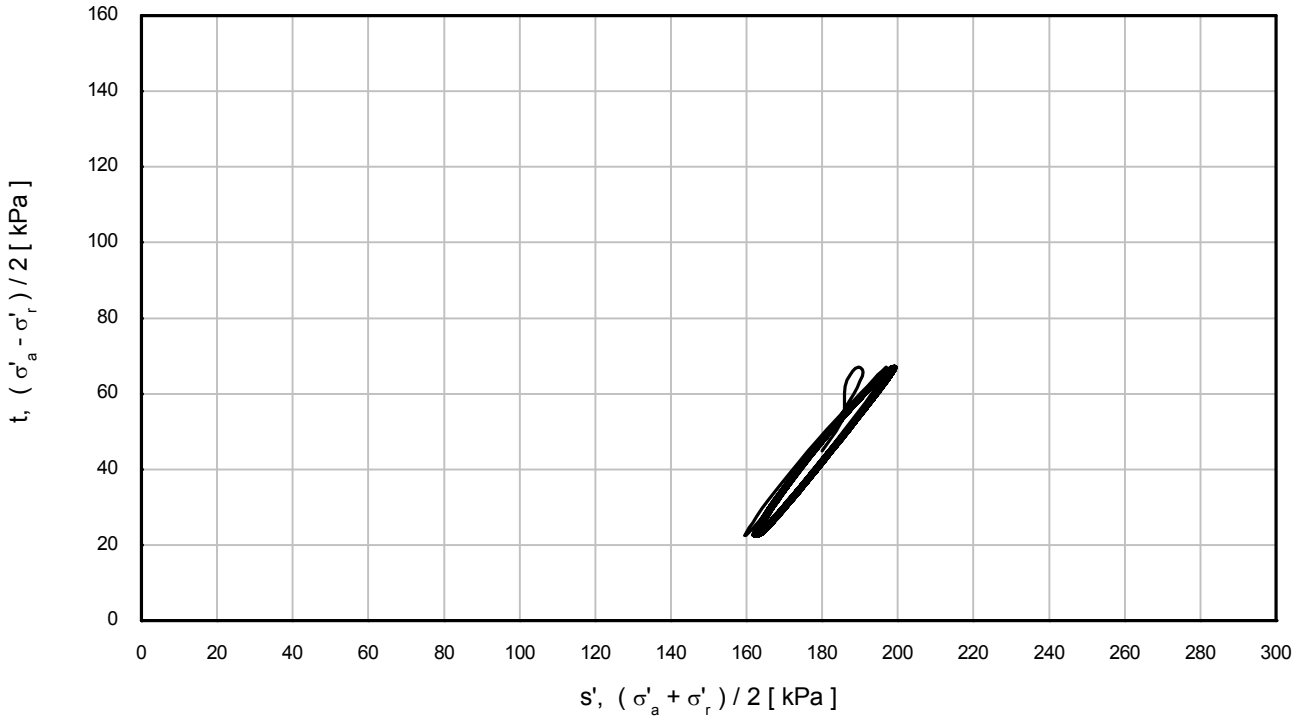
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

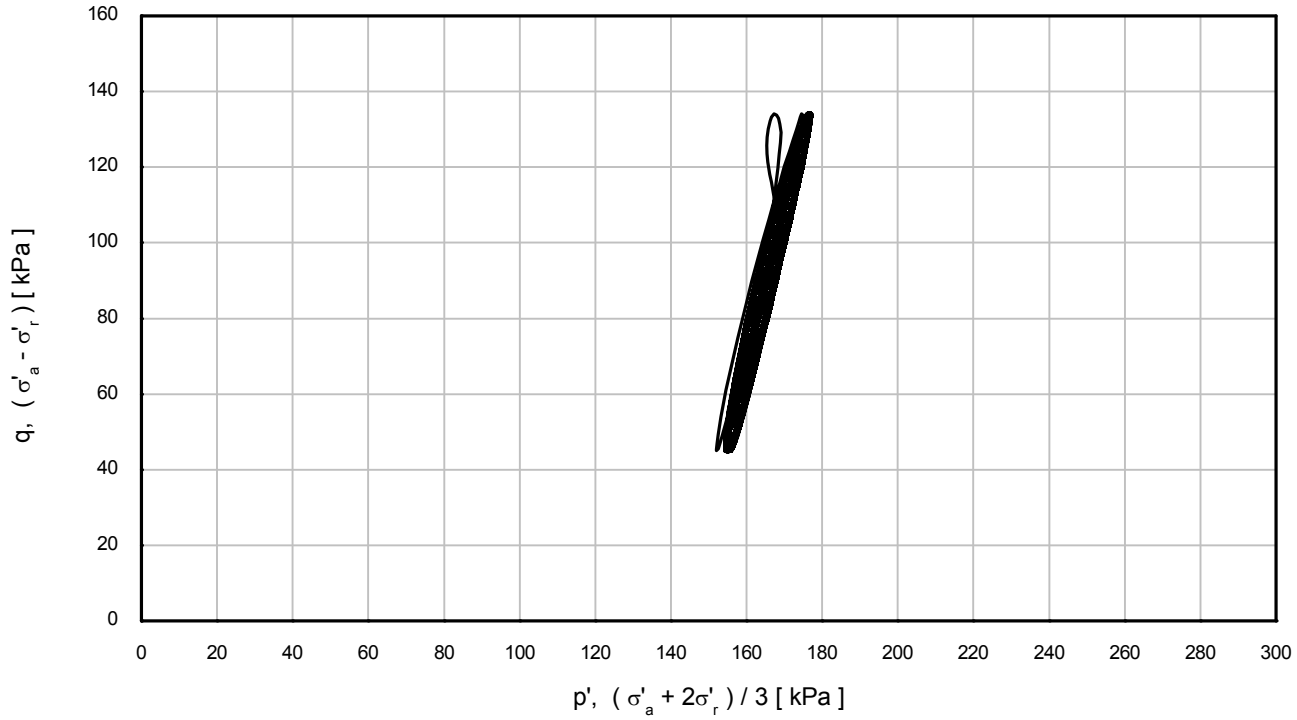




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

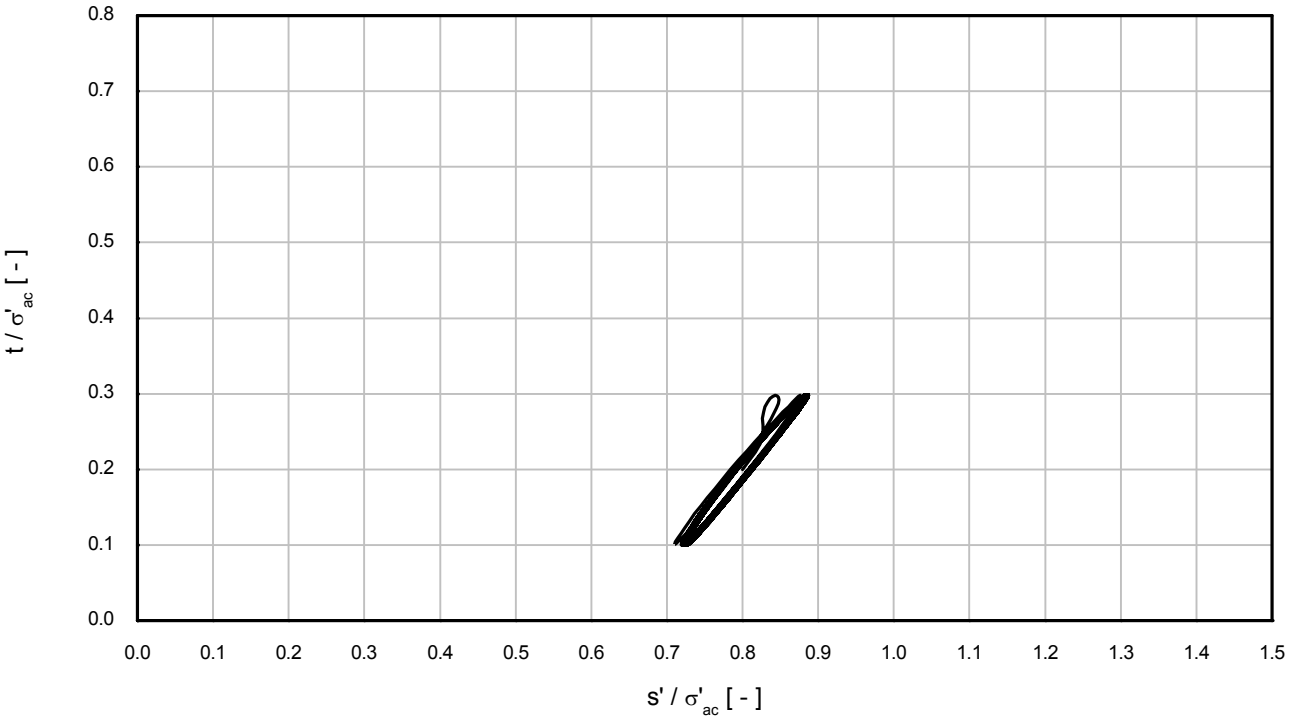
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

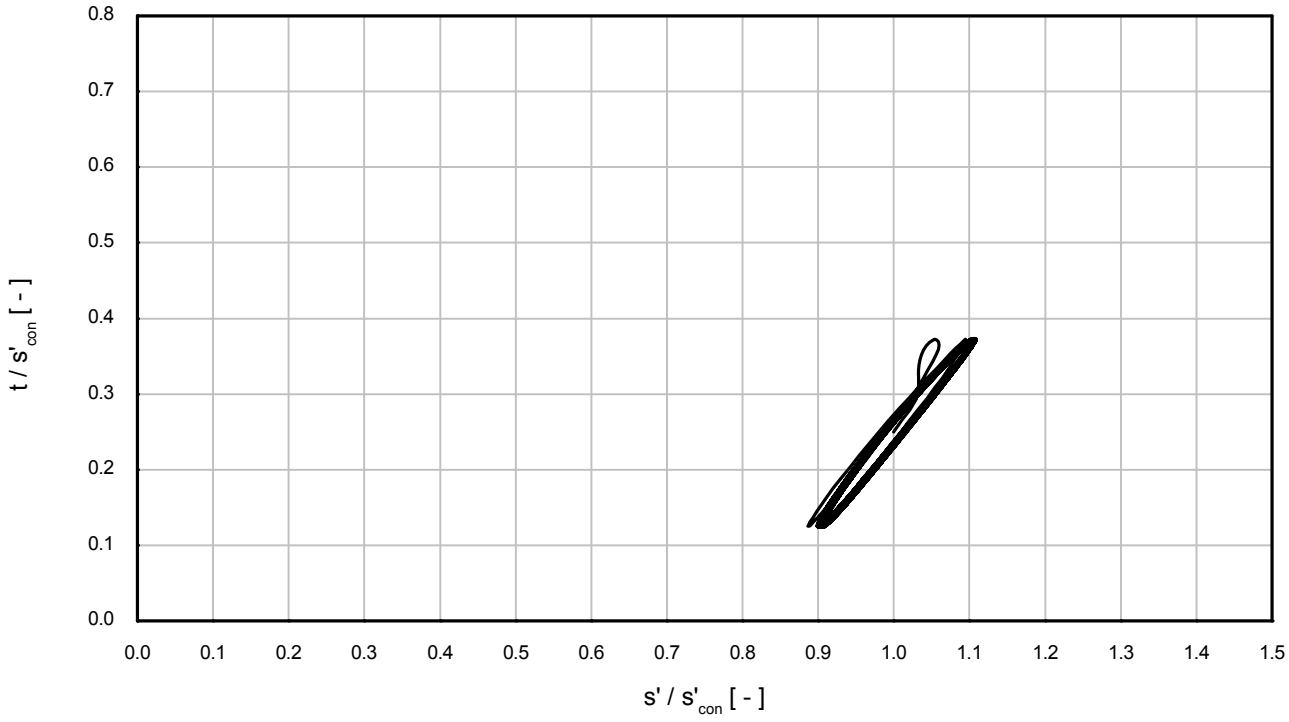




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

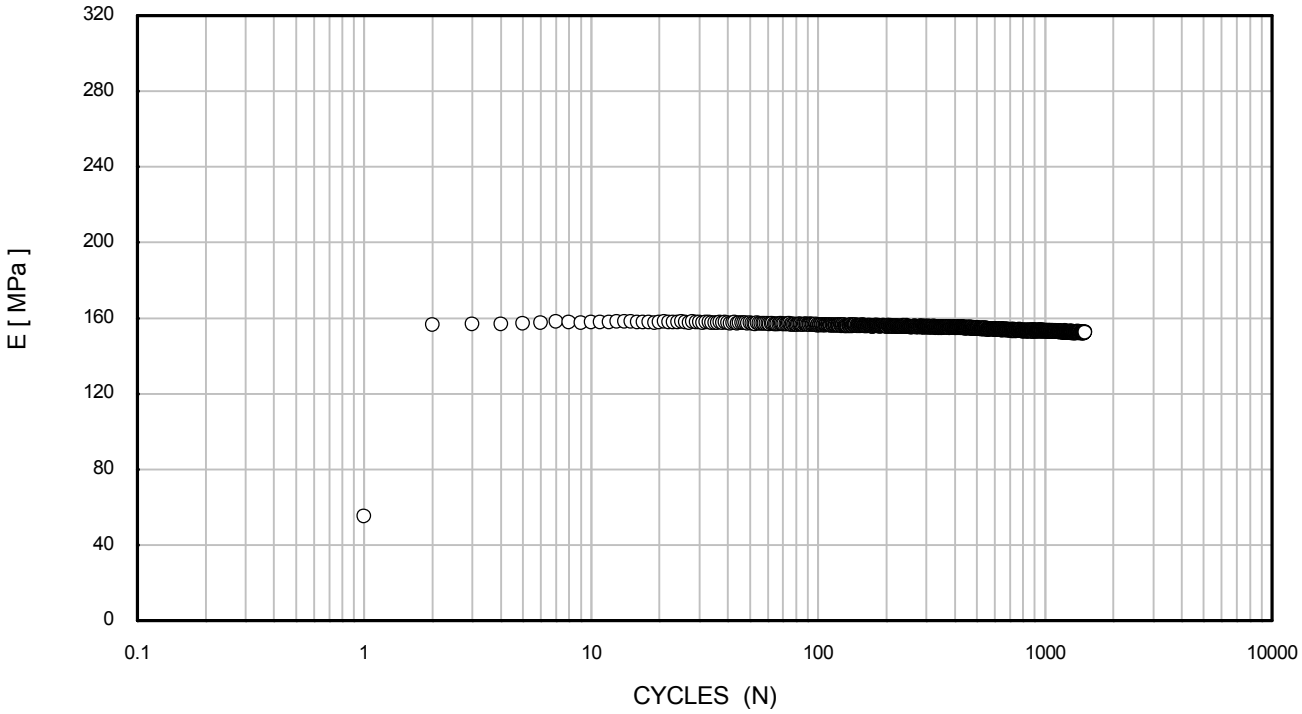
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CYCLIC LOADING STAGE 1 - DRAINED

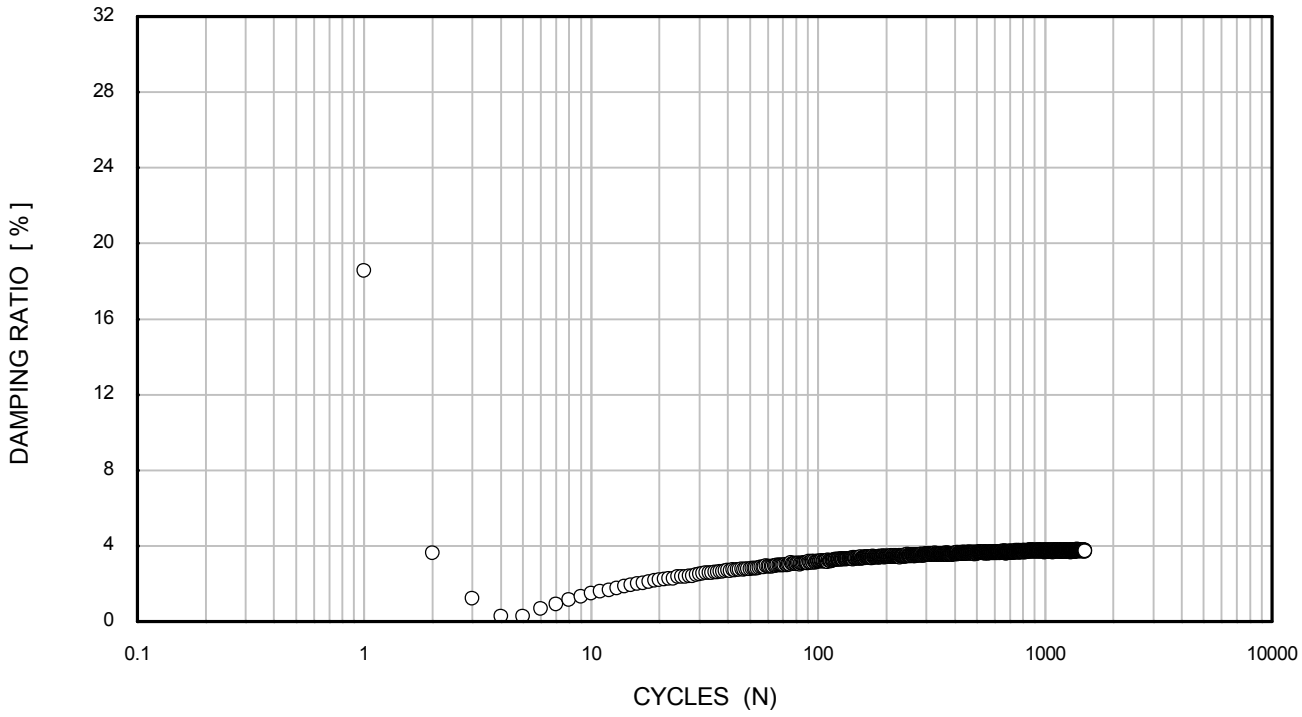




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

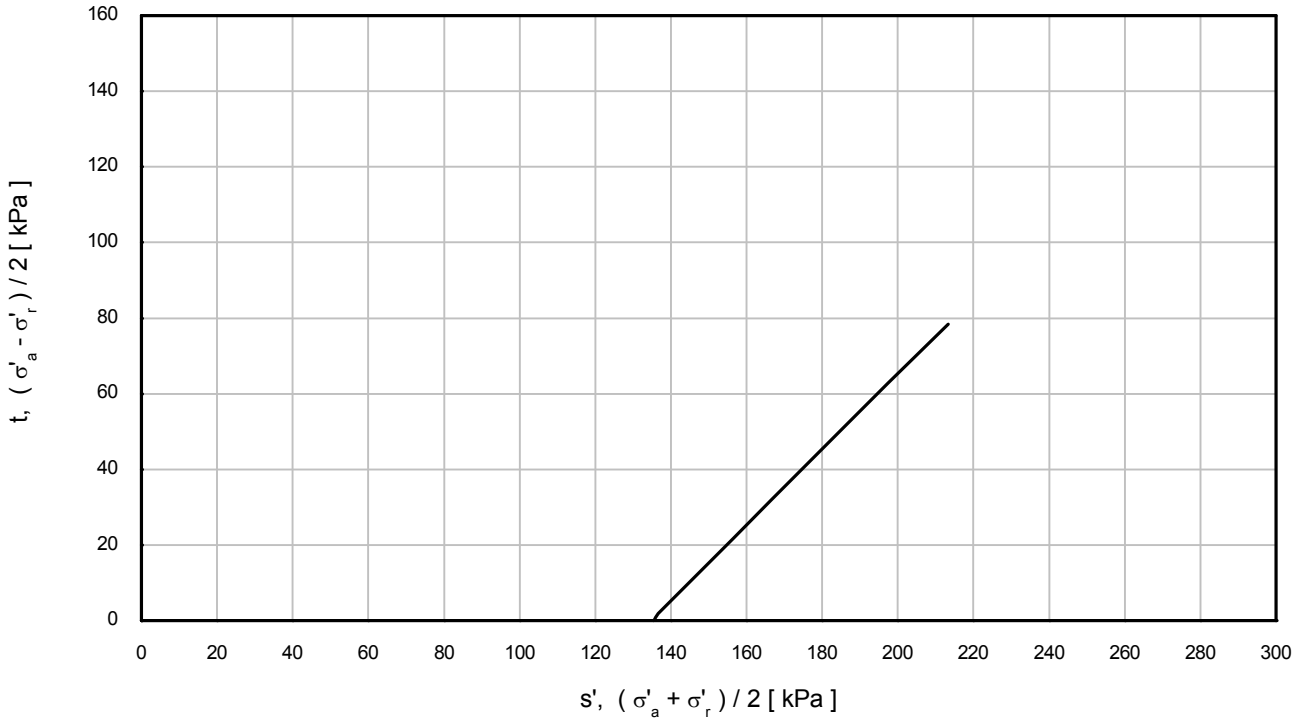
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

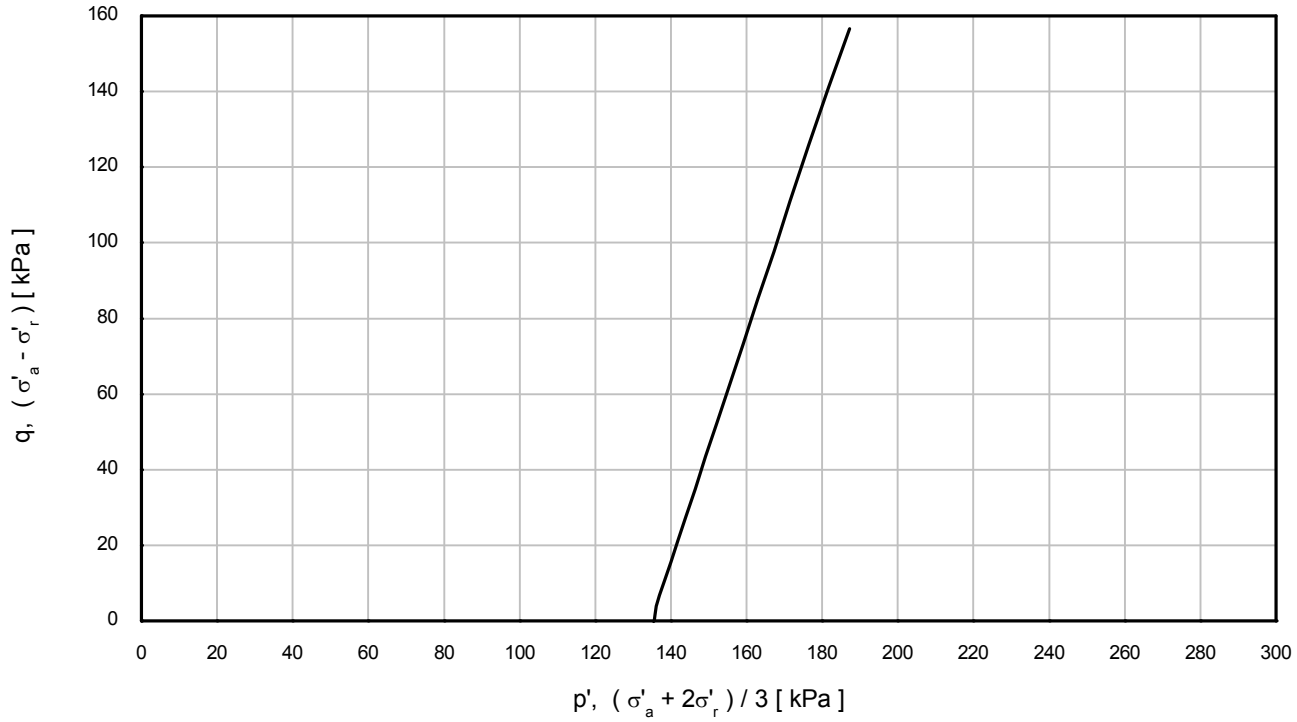




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	225 kPa	Sample	:	CTX_3-2
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	45 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

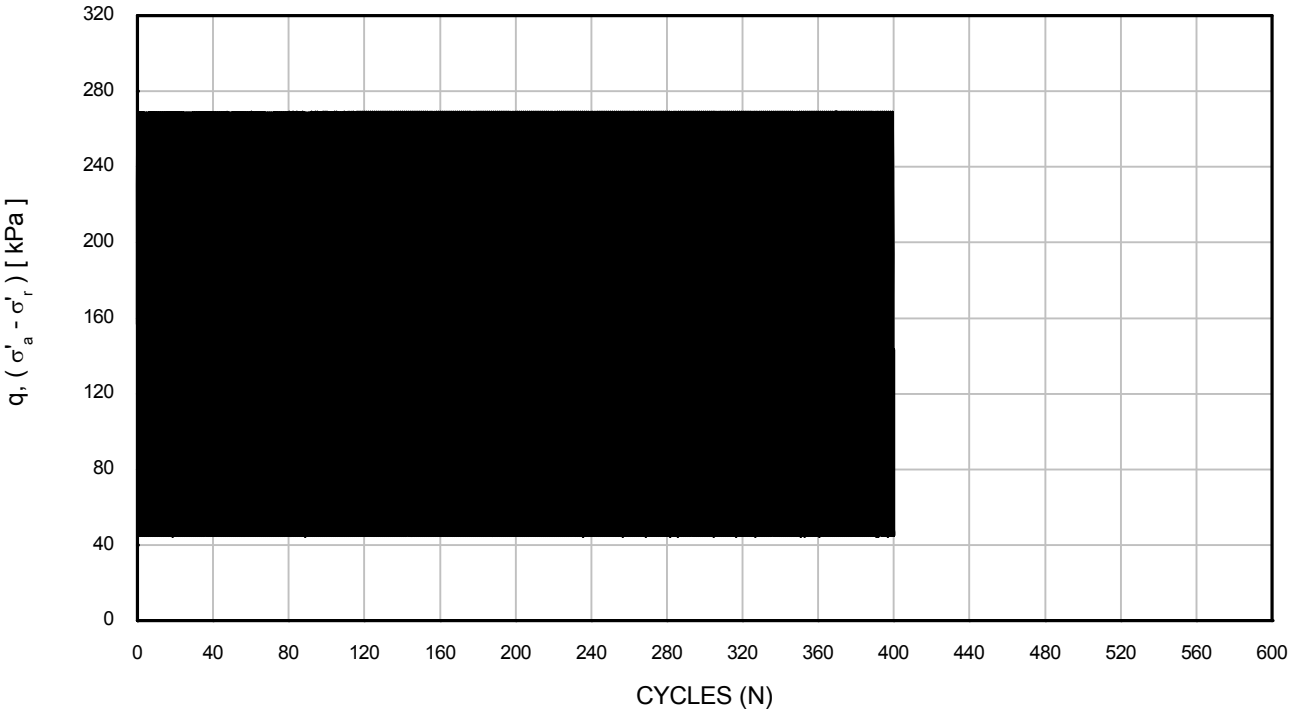
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

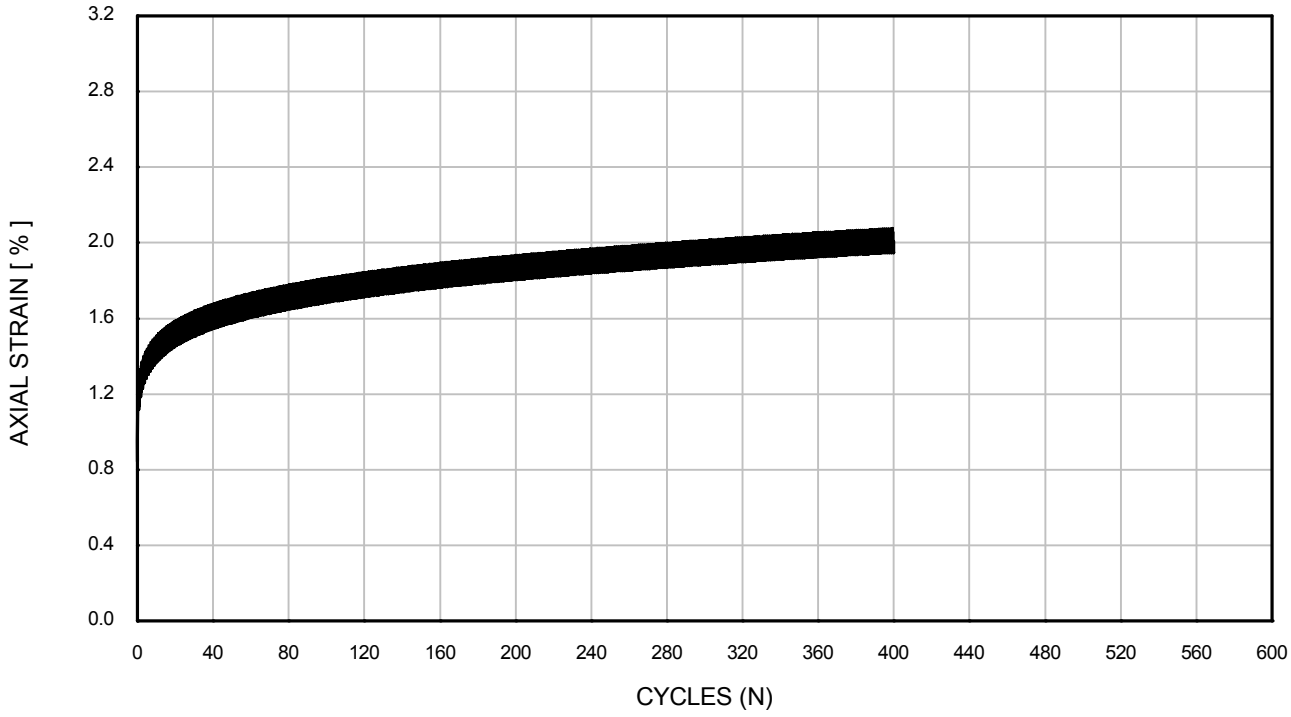




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 292 kPa	Sample	: CTX_3-2
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX08

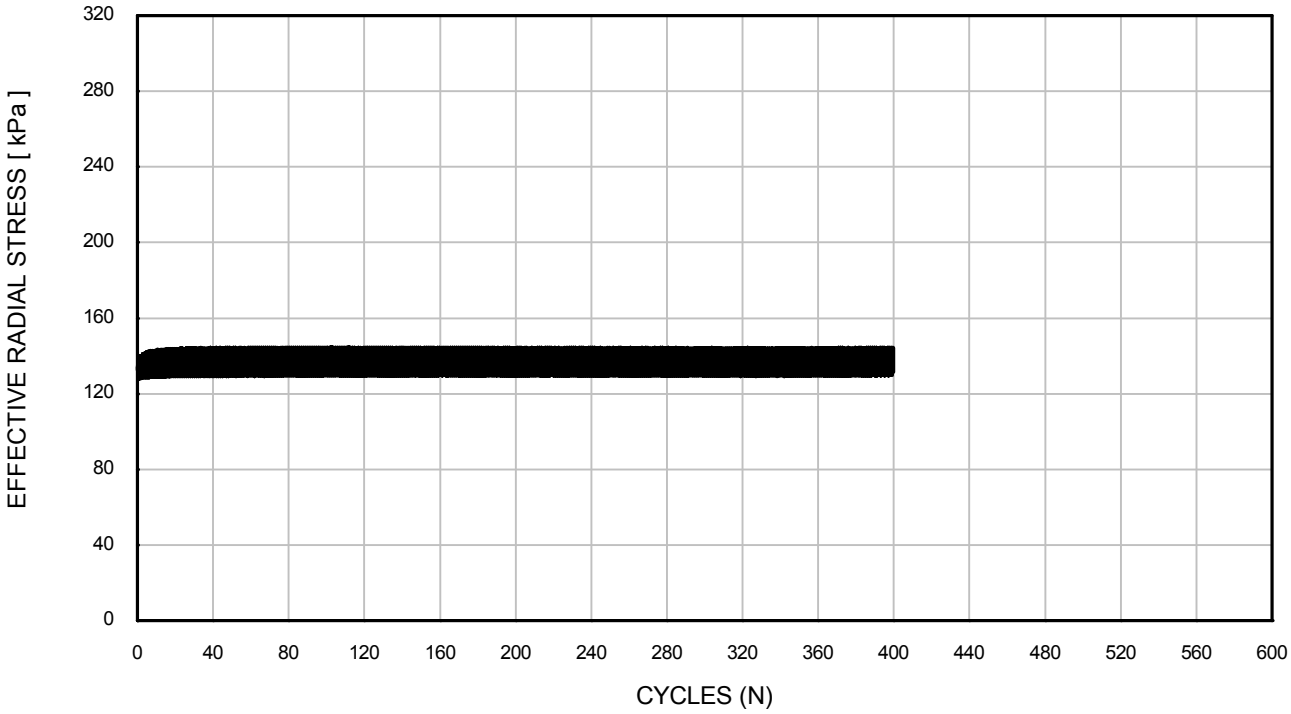
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE - DRAINED

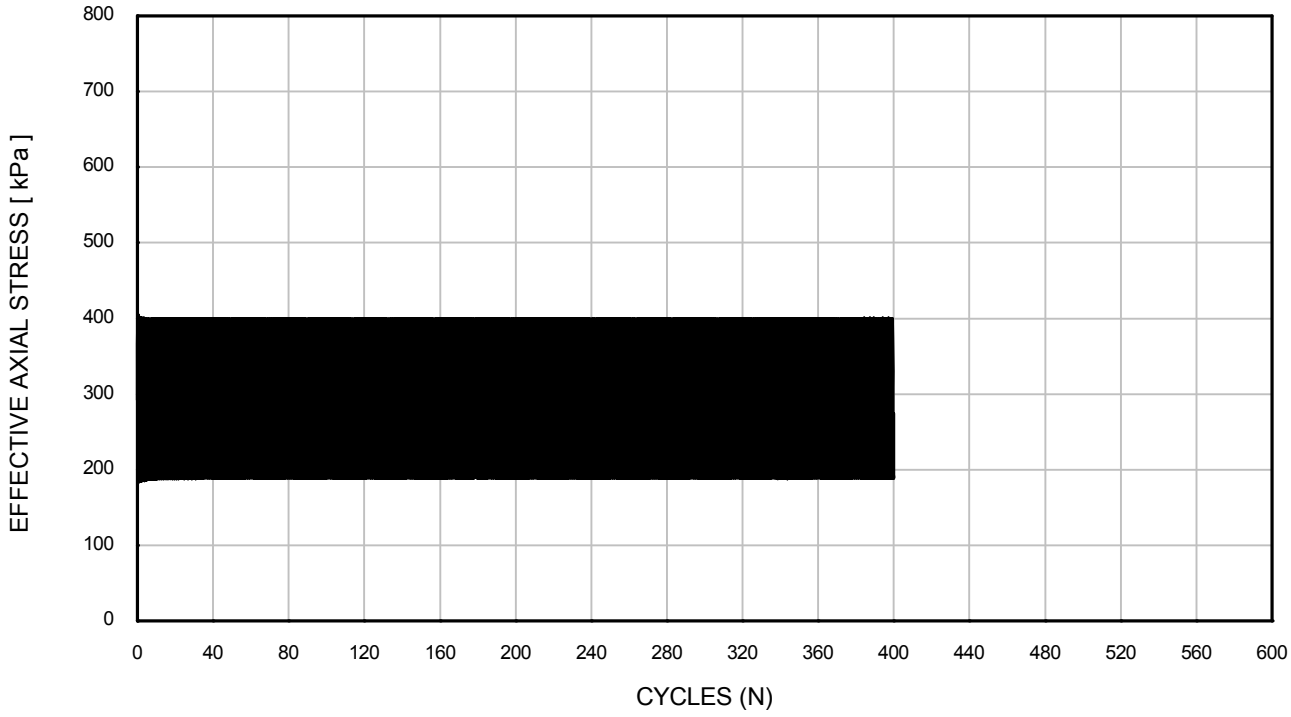




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

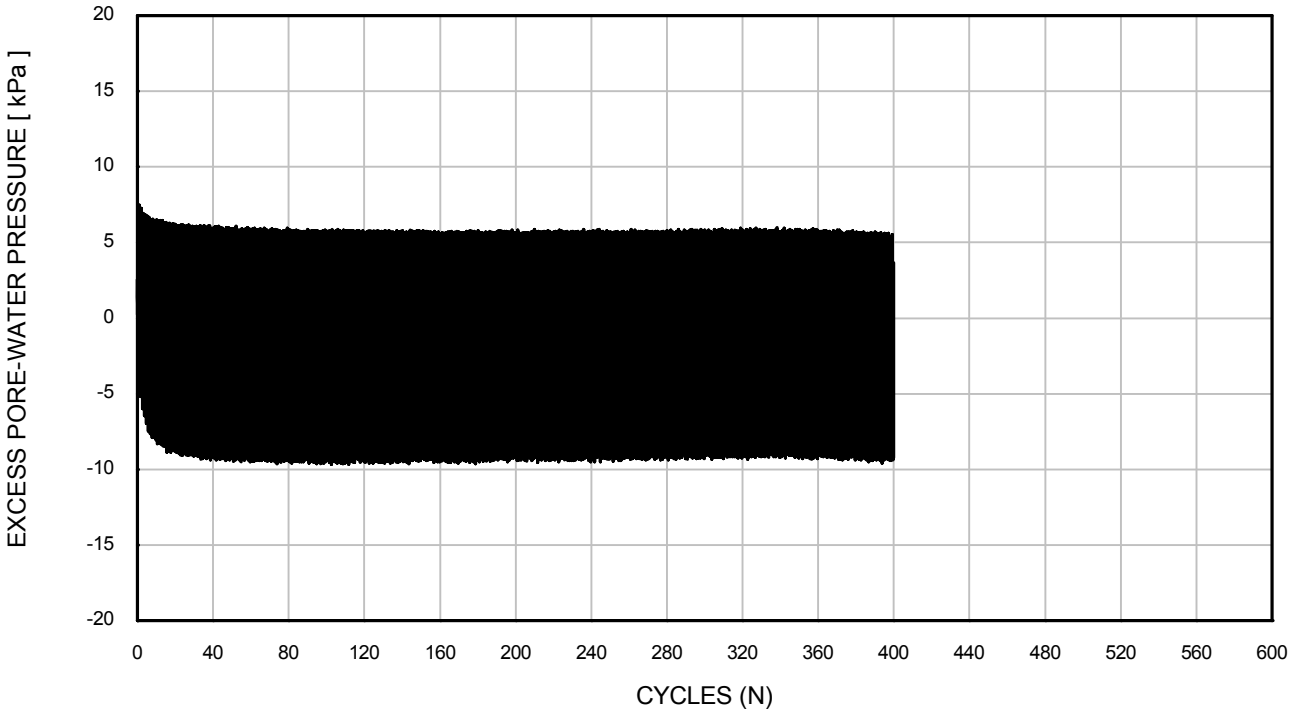
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

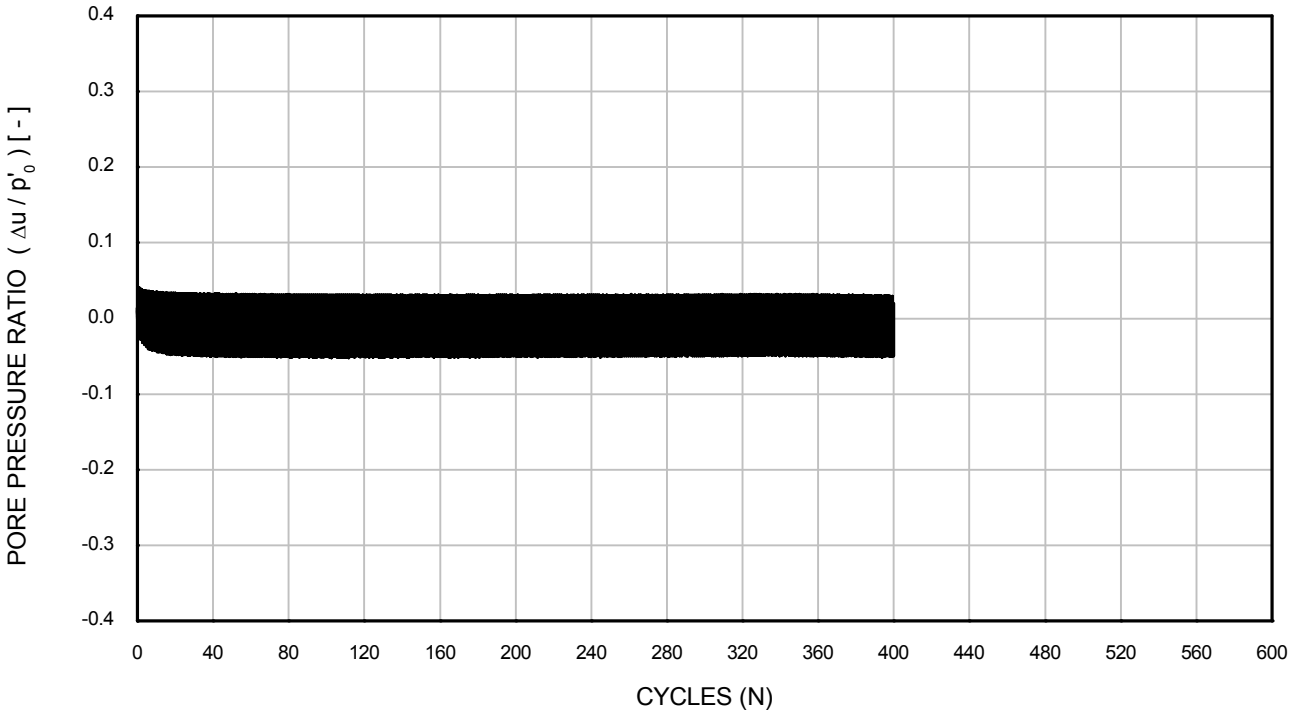




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

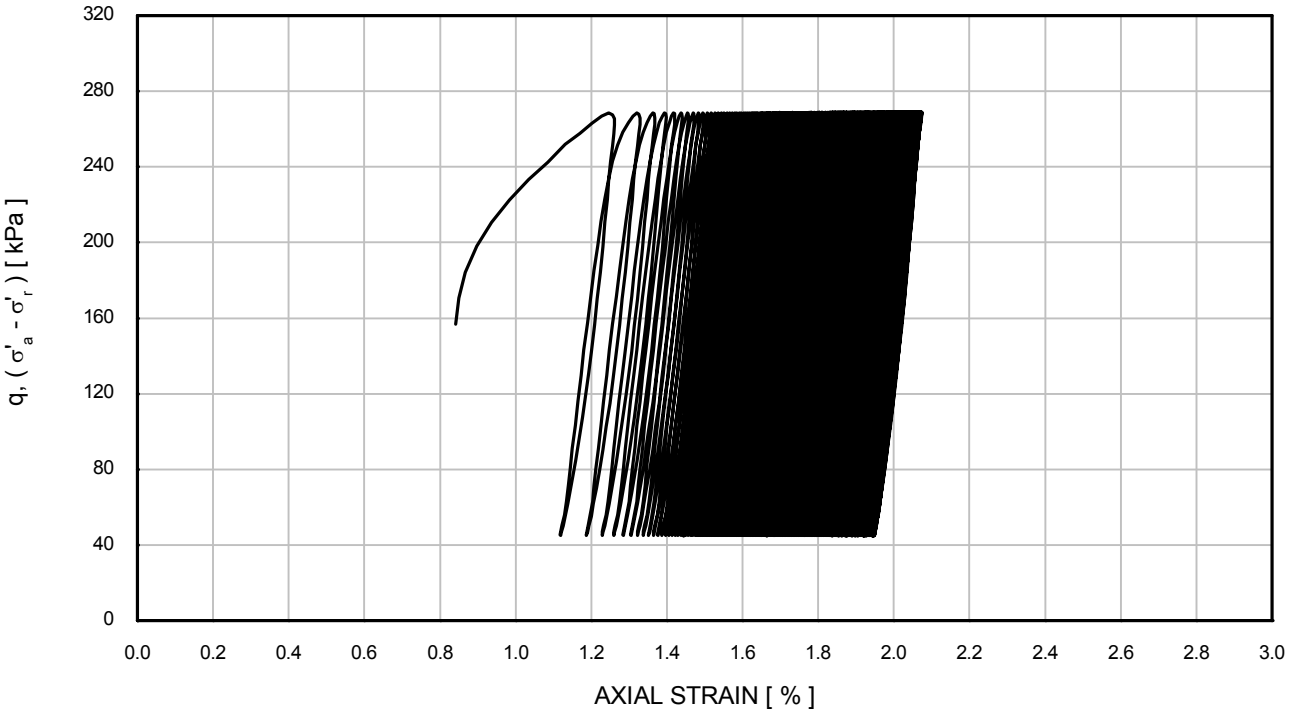
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

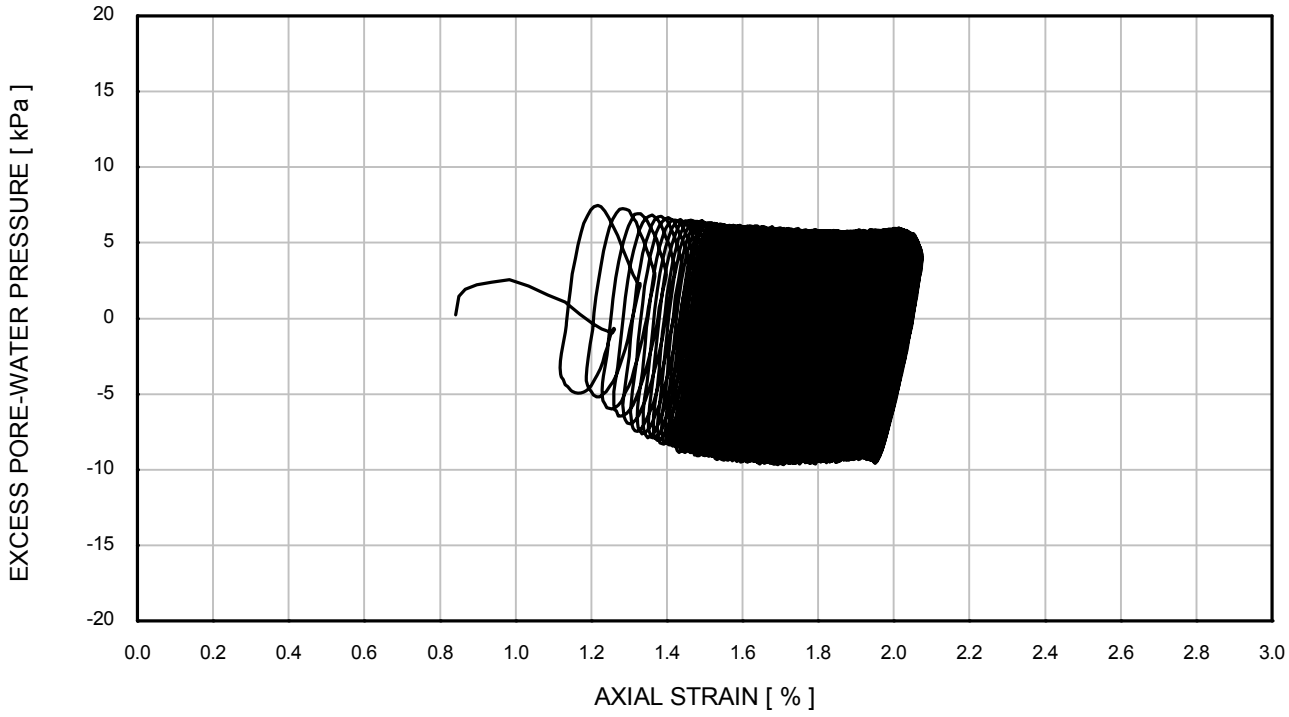




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

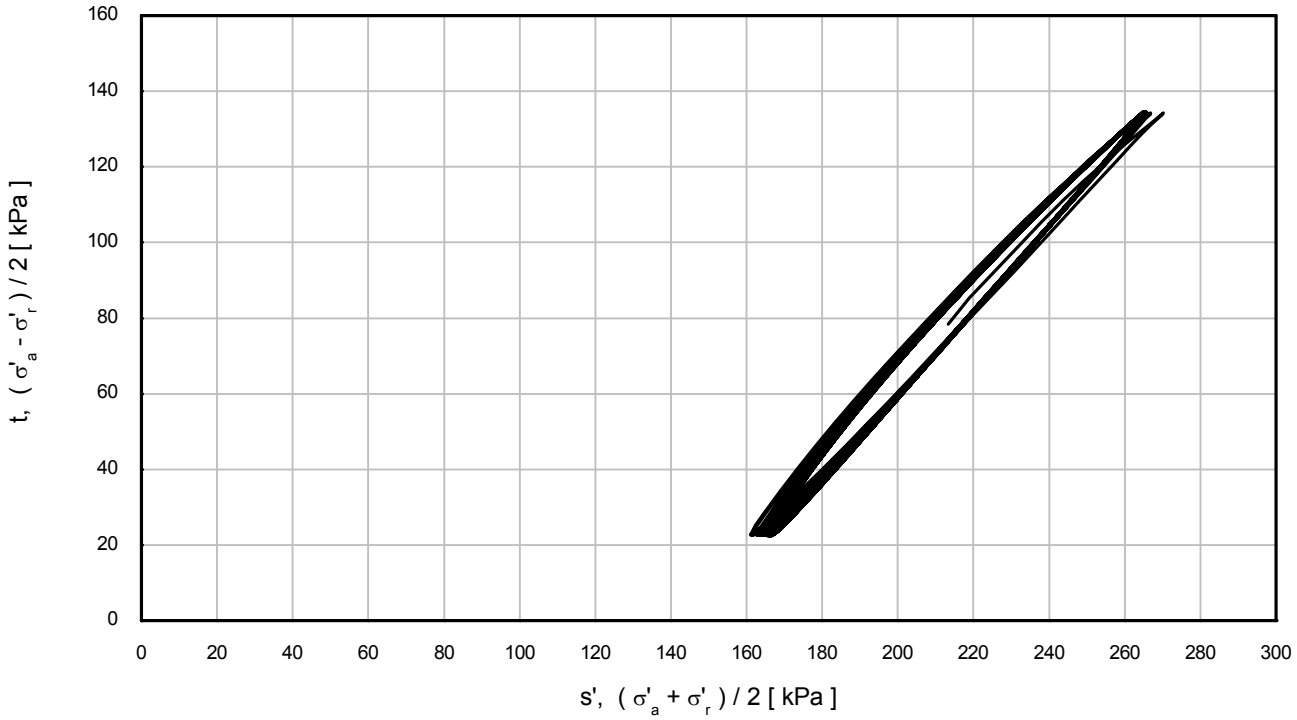
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

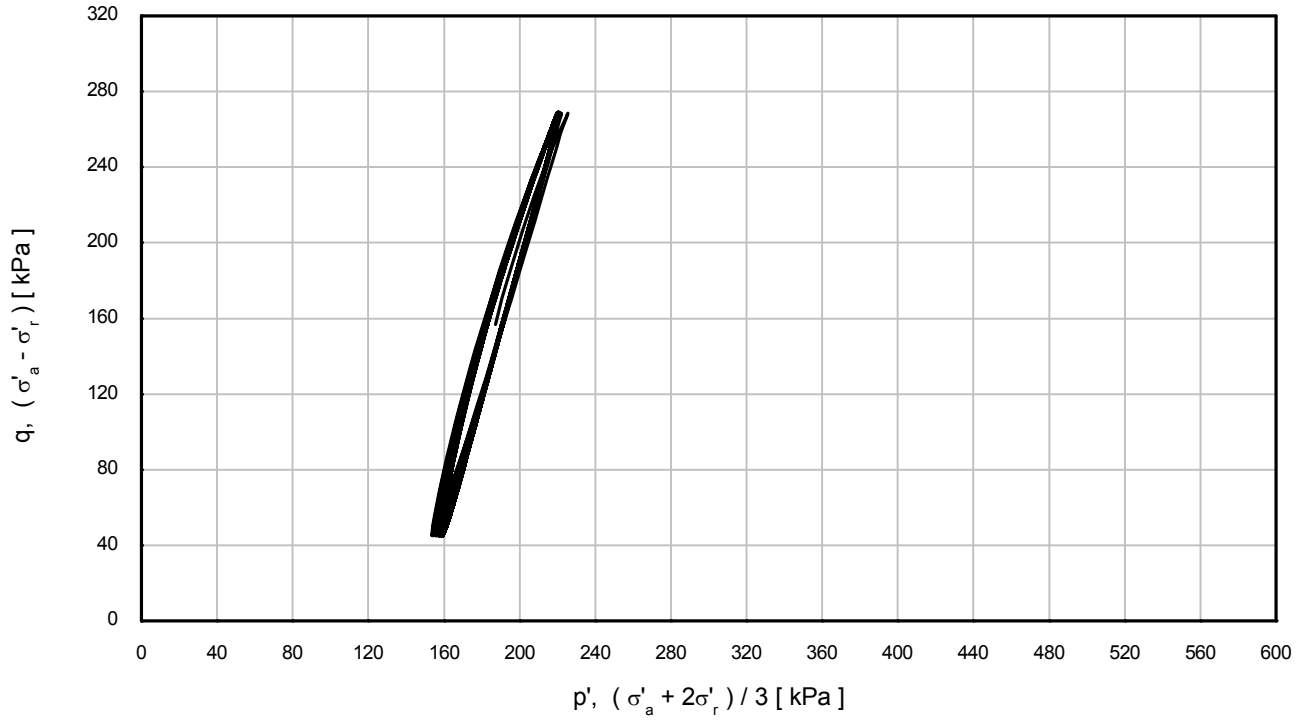




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

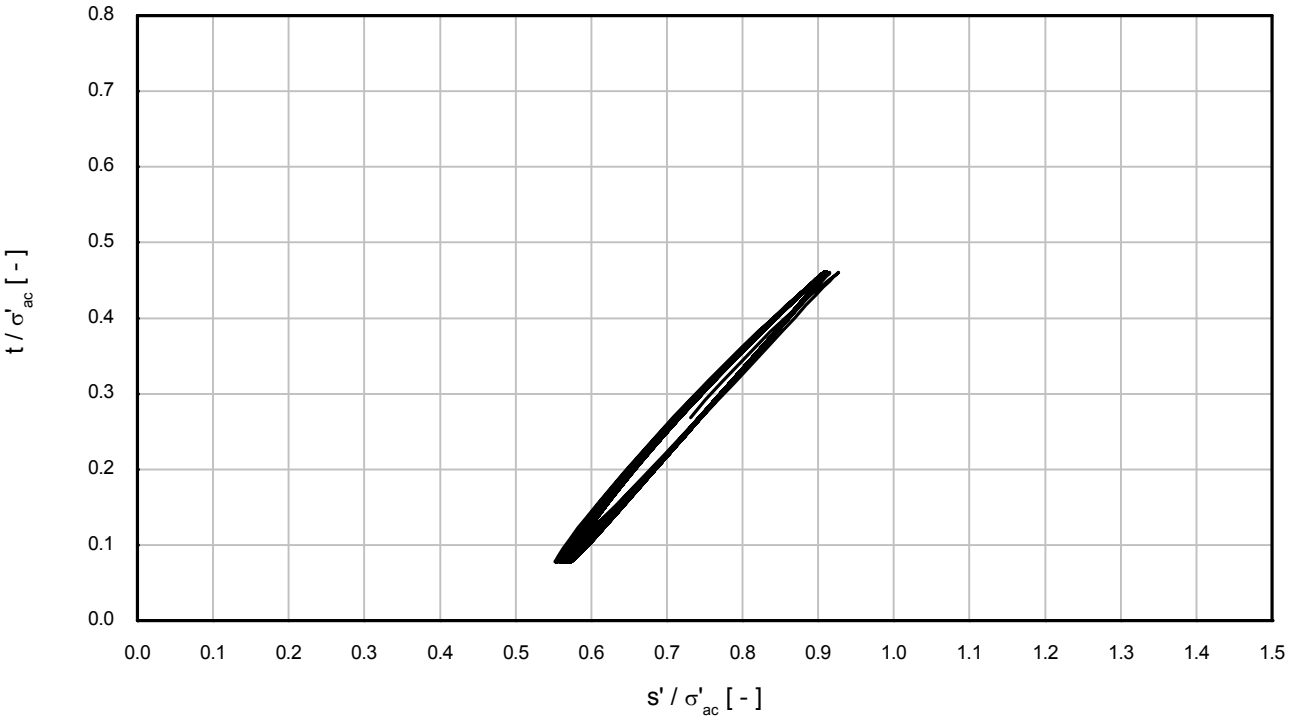
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

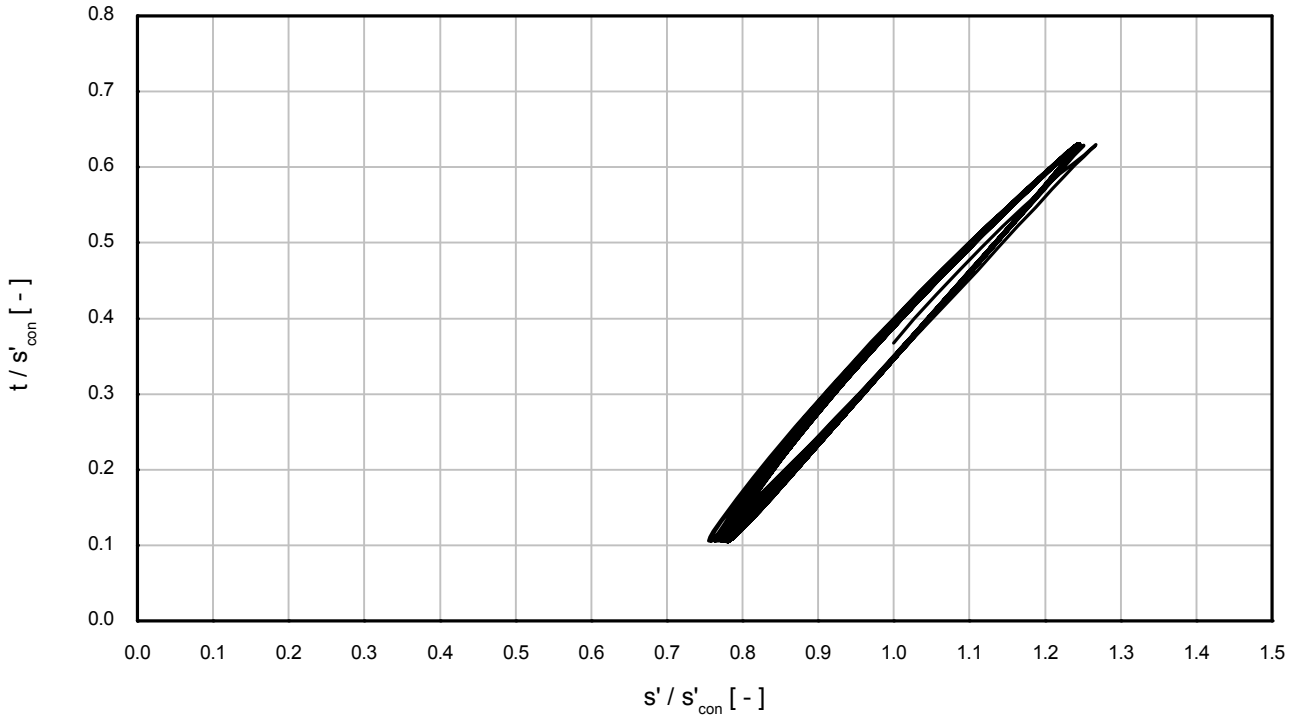




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	292 kPa	Sample	:	CTX_3-2
q_{av}	:	157 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	112 kPa	Test No.	:	CTX08
Frequency	:	0.10 Hz			

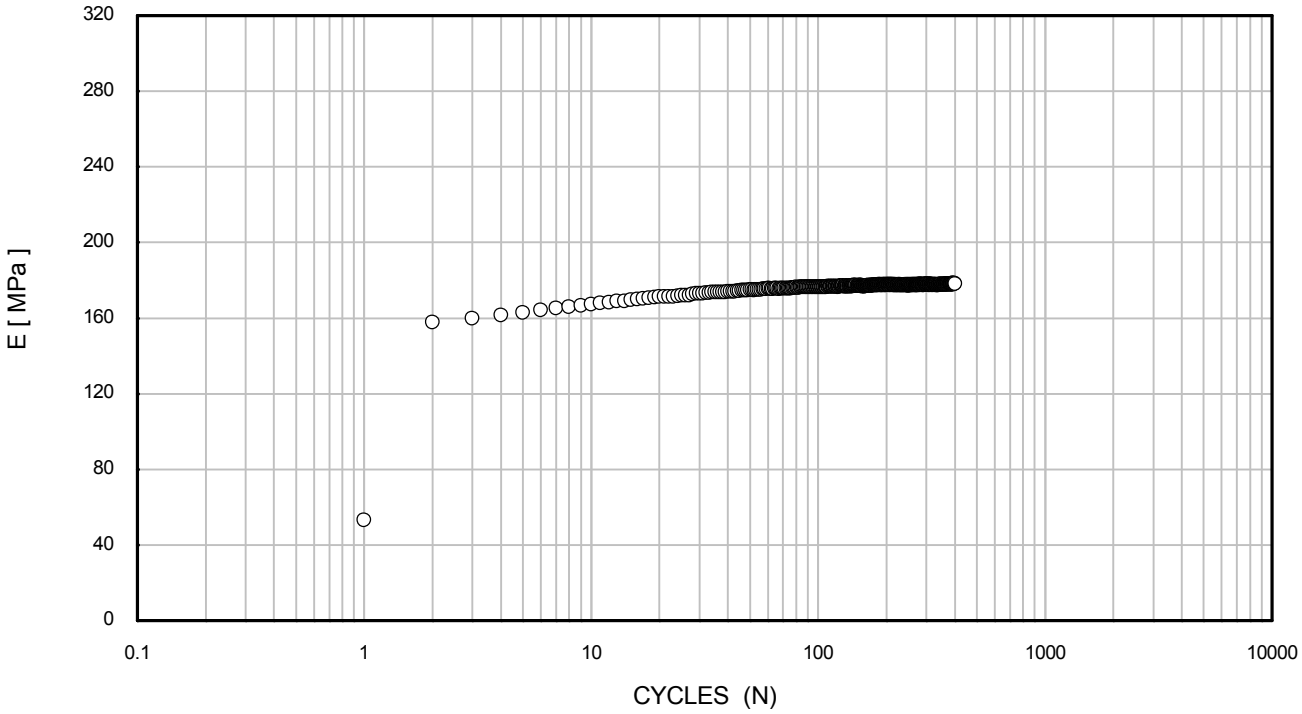
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

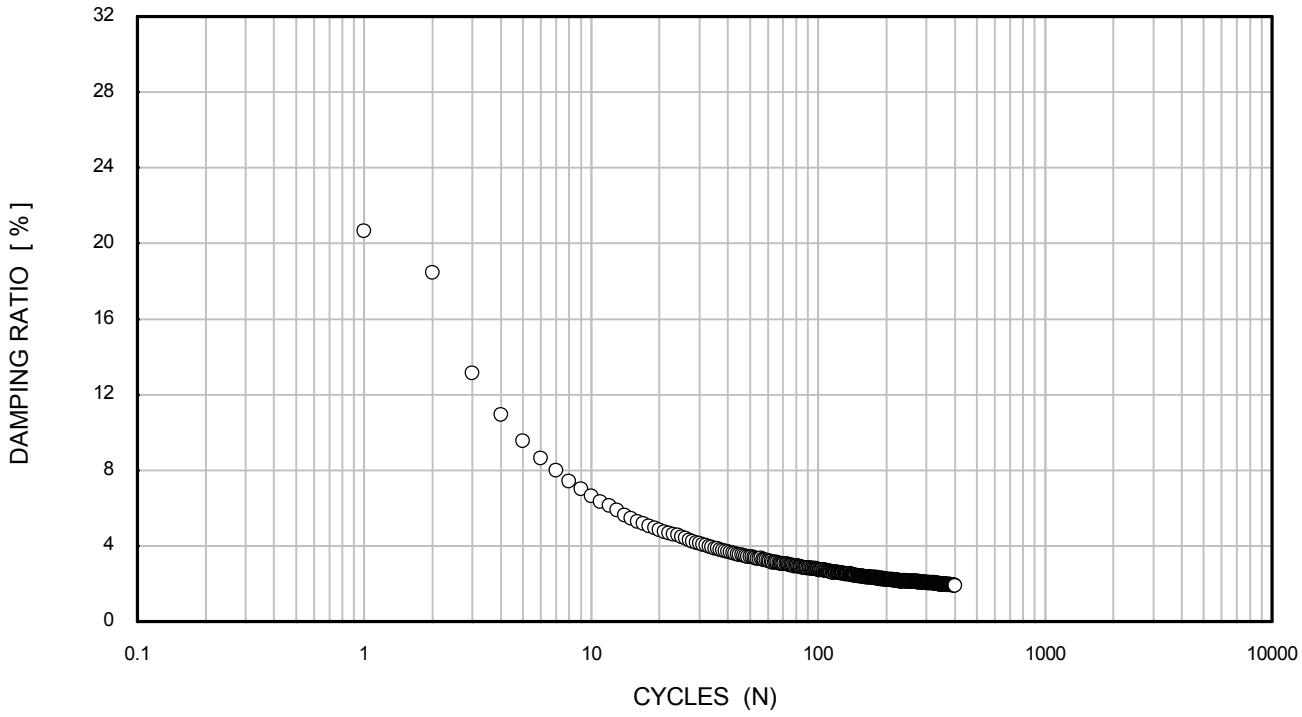




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

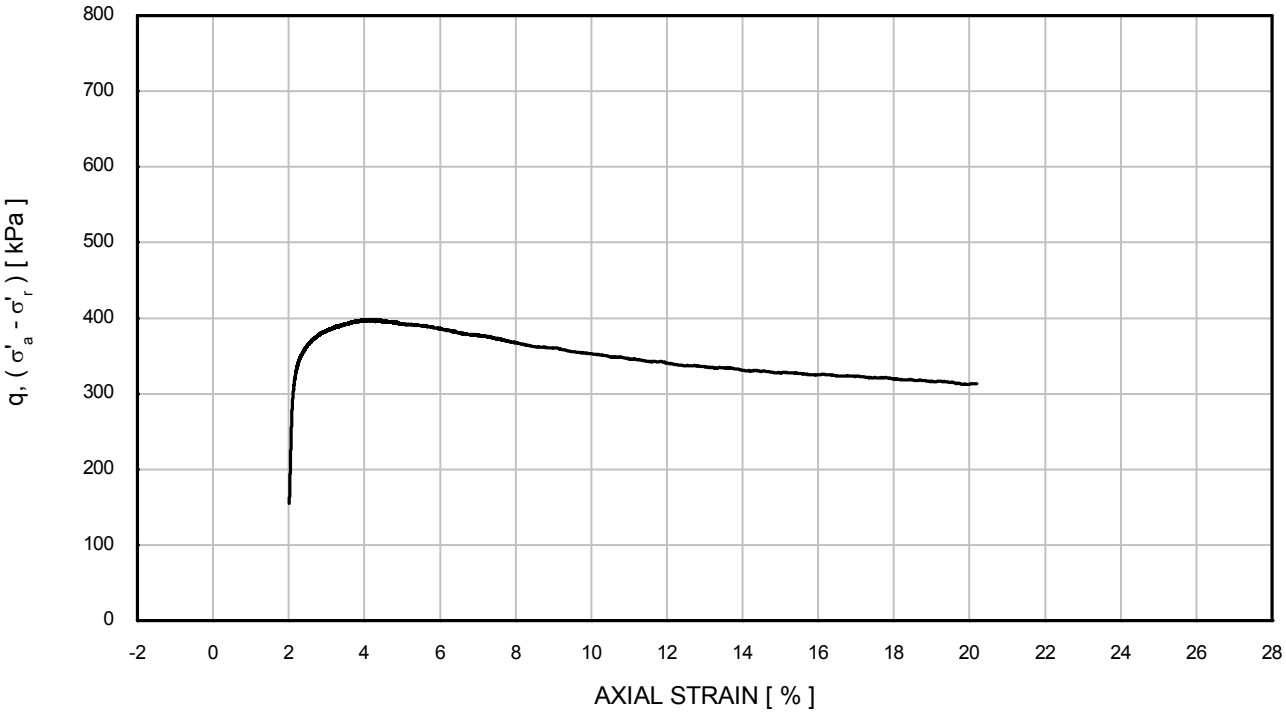
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

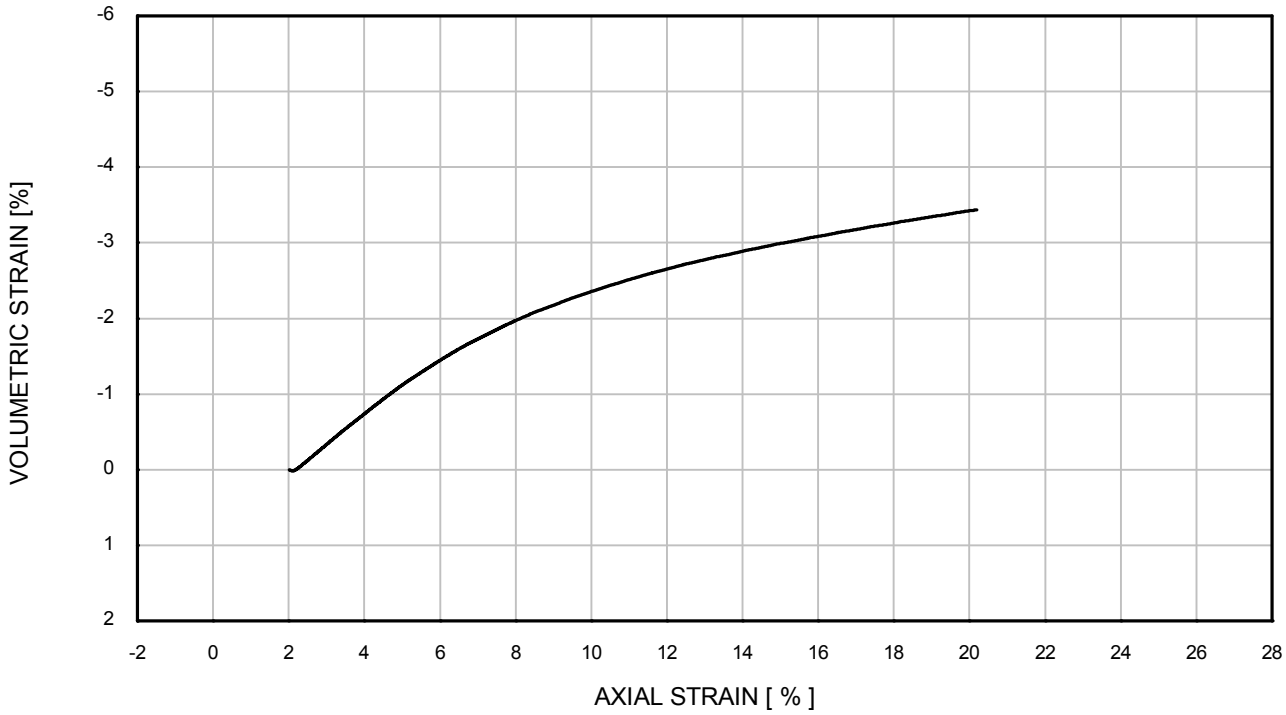




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-2
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 112 kPa	Test No.	: CTX08
Frequency	: 0.10 Hz		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

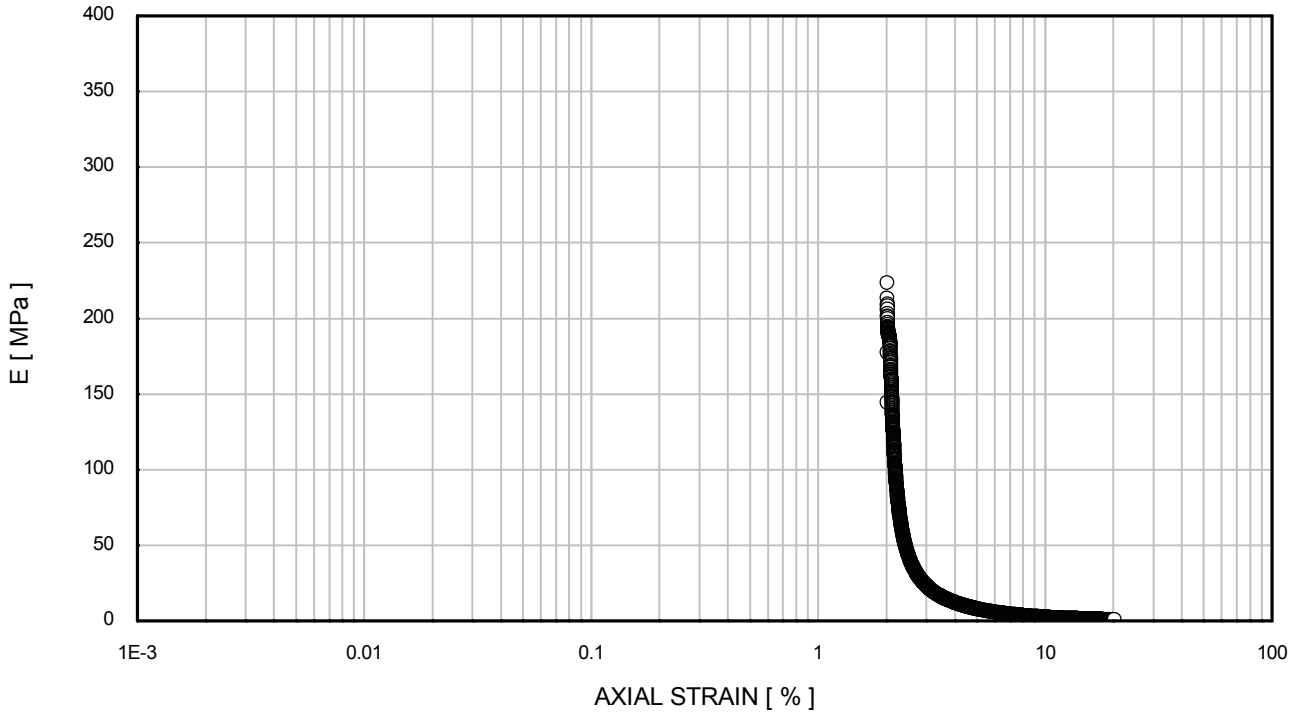




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	290 kPa	Sample	:	CTX_3-2
q_{peak}	:	398 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.20 %	Test No.	:	CTX08
Rate of strain	:	1.00 %/hour			

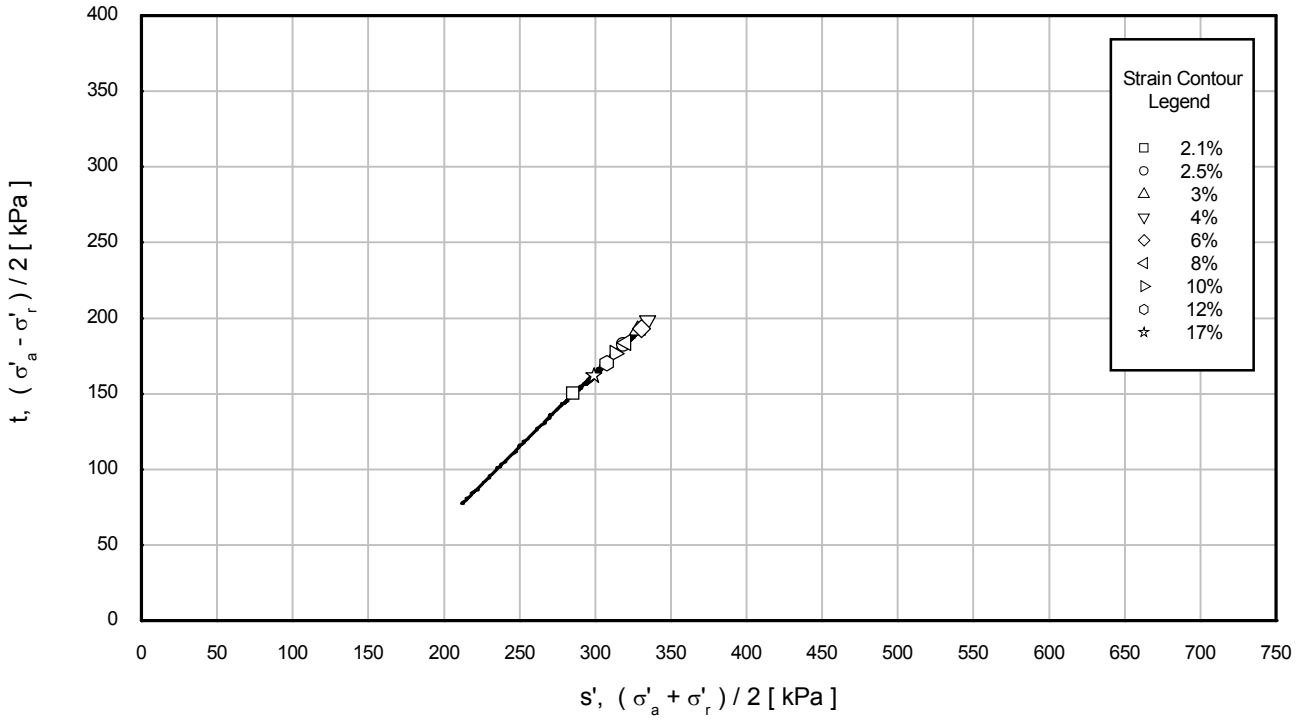
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

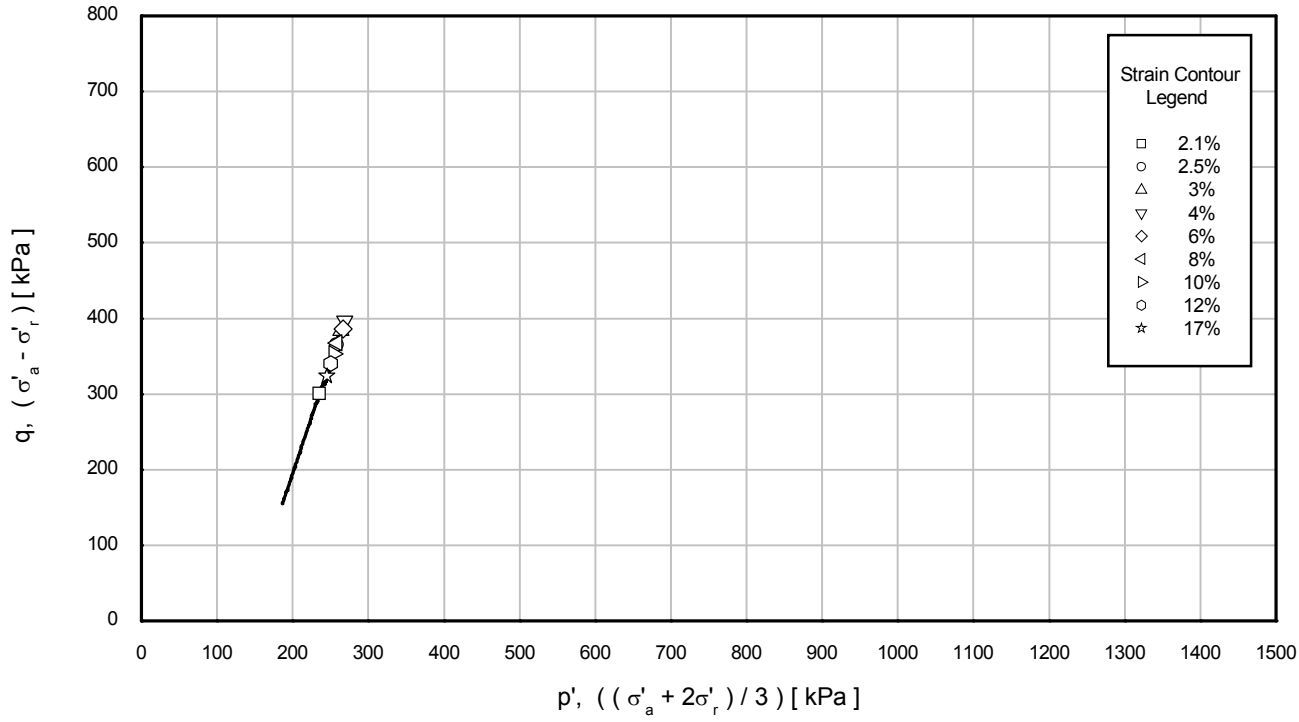




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	290 kPa	Sample	:	CTX_3-2
q_{peak}	:	398 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.20 %	Test No.	:	CTX08
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	290 kPa	Sample	:	CTX_3-2
q_{peak}	:	398 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.20 %	Test No.	:	CTX08
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND with traces of shell fragments

GENERAL	
Date test started	28/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.9
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.630
Degree of saturation	[%]	46
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.4
Consolidation - Isotropic Consolidation - Anisotropic	BS1377: Part 8: 1990 Clause 6 Fugro testing procedure L-T-023 Clause 5.3.6
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ BATCH03_CTX09
Processed by Date	MSR 09/01/2017
Checked by Date	JLS 11/01/2017
Approved by Date	AR 12/01/2017

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	900
Base PWP	[kPa]	881
Mid height PWP	[kPa]	-
B value achieved	[-]	0.98

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1017
Back pressure	[kPa]	882
Base PWP	[kPa]	882
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.48
External axial strain	[%]	0.12
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.623
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

DRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING		
Cell pressure	[kPa]	1017
Back pressure	[kPa]	883
Base PWP	[kPa]	883
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	134
Effective axial pressure	[kPa]	179
Deviator stress	[kPa]	45
Volumetric strain	[%]	0.02
External axial strain	[%]	0.04
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.5
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

FIRST STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	448
Mean q_{av}	[kPa]	45
Mean q_{cy}	[kPa]	67
Frequency	[Hz]	0.10
Number of cycles applied (N_f)	[-]	1500
External ε_{av} at N_f	[%]	0.30
External ε_{cy} at N_f	[%]	0.05
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	-1
Δ mid height PWP at N_f Water	[kPa]	-
content	[%]	23.3
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.619
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.09	0.05	143	-	16.61	-
2	0.09	0.05	144	-	8.57	-
5	0.11	0.05	145	-	6.55	-
10	0.12	0.05	146	-	5.78	-
20	0.13	0.05	146	-	5.18	-
30	0.14	0.05	145	-	4.92	-
40	0.15	0.05	146	-	4.76	-
50	0.16	0.05	145	-	4.68	-
100	0.18	0.05	145	-	4.44	-
500	0.24	0.05	143	-	4.03	-
1000	0.28	0.05	141	-	3.91	-
1500	0.30	0.05	140	-	3.80	-

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

DRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING		
Cell pressure	[kPa]	1017
Back pressure	[kPa]	883
Base PWP	[kPa]	882
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	247
Deviator stress	[kPa]	112
Volumetric strain	[%]	0.28
External axial strain	[%]	0.35
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.3
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.618
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SECOND STRESS-CONTROLLED CYCLIC LOADING STAGE		
Reference stress (deviator)	[kPa]	448
Mean q_{av}	[kPa]	112
Mean q_{cy}	[kPa]	178
Frequency	[Hz]	0.10
Number of cycles at failure (N_f)	[-]	400
External ε_{av} at N_f	[%]	1.91
External ε_{cy} at N_f	[%]	0.12
Local ε_{av} at N_f	[%]	-
Local ε_{cy} at N_f	[%]	-
Δ base PWP at N_f	[kPa]	-2
Δ mid height PWP at N_f	[kPa]	-
Water content	[%]	22.7
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.601
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.59	0.23	76	-	28.33	-
2	0.73	0.20	90	-	22.65	-
5	0.90	0.18	101	-	17.82	-
10	1.04	0.16	113	-	14.75	-
20	1.17	0.15	123	-	12.62	-
30	1.26	0.14	127	-	11.73	-
40	1.32	0.14	130	-	11.17	-
50	1.37	0.14	132	-	10.80	-
100	1.53	0.13	137	-	9.77	-
200	1.71	0.13	142	-	8.95	-
300	1.83	0.12	144	-	8.58	-
400	1.91	0.12	146	-	8.35	-

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	246
Rate of strain	[%/hour]	1.00
At peak deviator stress		
Corrected deviator stress	[kPa]	445
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	4.14
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-2
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	136
Effective axial pressure	[kPa]	580
Principal effective stress ratio	[-]	4.28
ε_{50}	[%]	2.03
Secant modulus (E_{50}) at ε_{50}	[kPa]	163303
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	445
Membrane correction applied	[kPa]	0
Drain correction applied	[kPa]	0
External axial strain	[%]	4.06
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-2
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	580
Principal effective stress ratio	[-]	4.28
At 10% external axial strain		
Corrected deviator stress	[kPa]	383
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	9.99
Local axial strain	[%]	-
Local radial strain	[%]	-
Excess base PWP	[kPa]	-3
Excess mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	136
Effective axial pressure	[kPa]	519
Principal effective stress ratio	[-]	3.82

TEST IDENTIFICATION	
Batch	3
Sample	CTXL_3-5
Unit	Unit B1 (Kreftenheye)
Test number	CTX09

SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





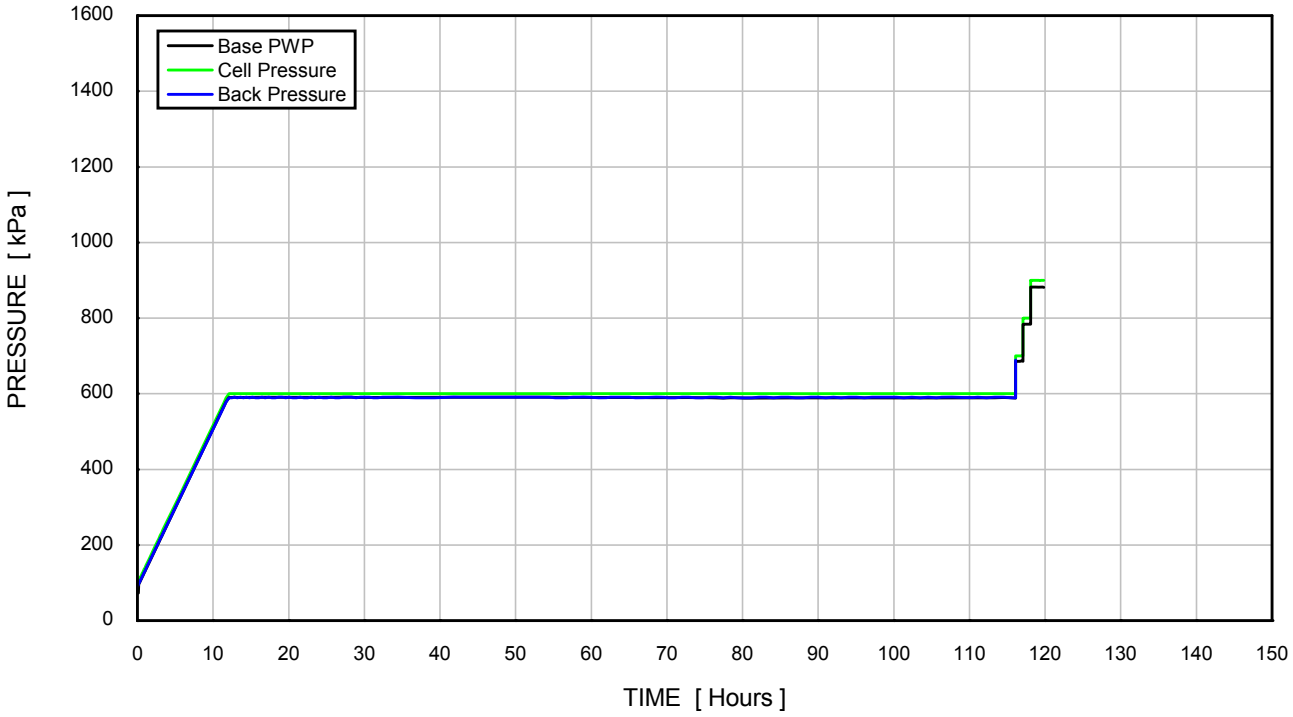
FINAL CONDITIONS

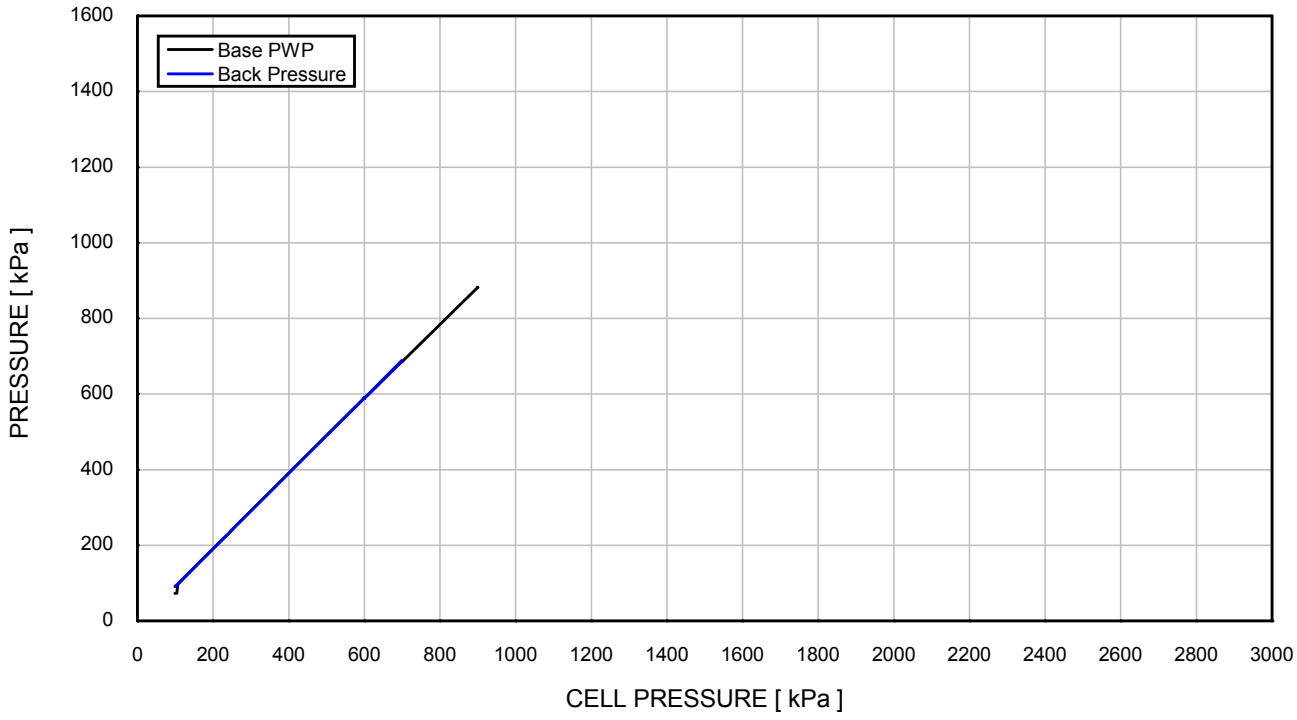
Water content	[%]	25.4
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.58

TEST IDENTIFICATION

Borehole	3
Sample	CTXL_3-5
Depth [m]	Unit B1 (Kreftenheye)
Test number	CTX09

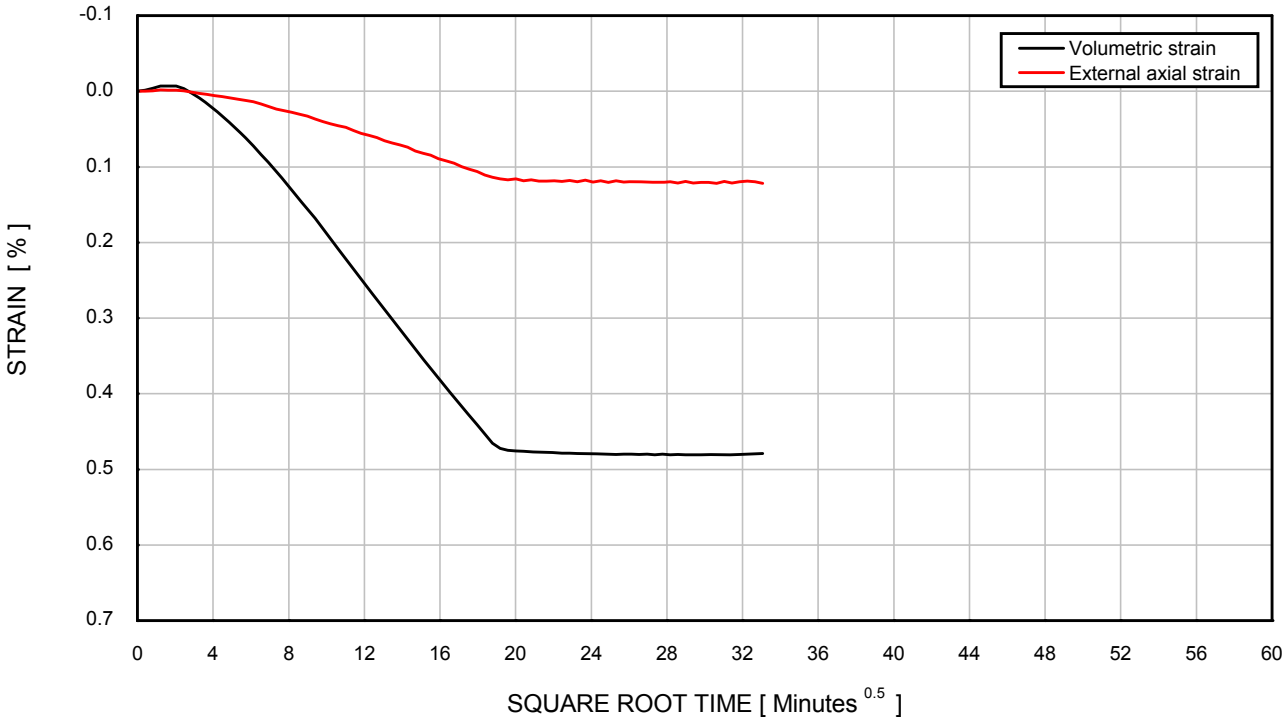
SUMMARY OF ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST

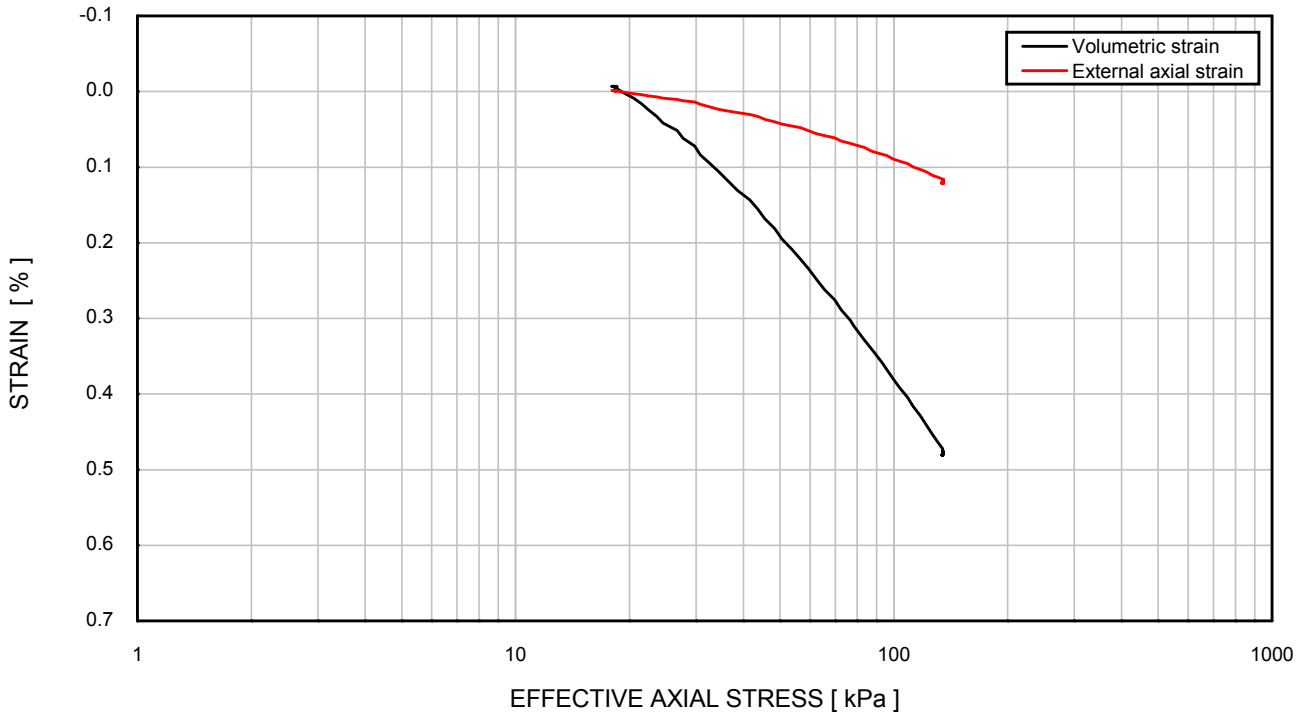




B value	:	0.98			
Initial σ'_r	:	26	kPa	Batch	: 3
Initial σ'_a	:	26	kPa	Sample	: CTXL_3-5
Final σ'_r	:	19	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	19	kPa	Test No.	: CTX09

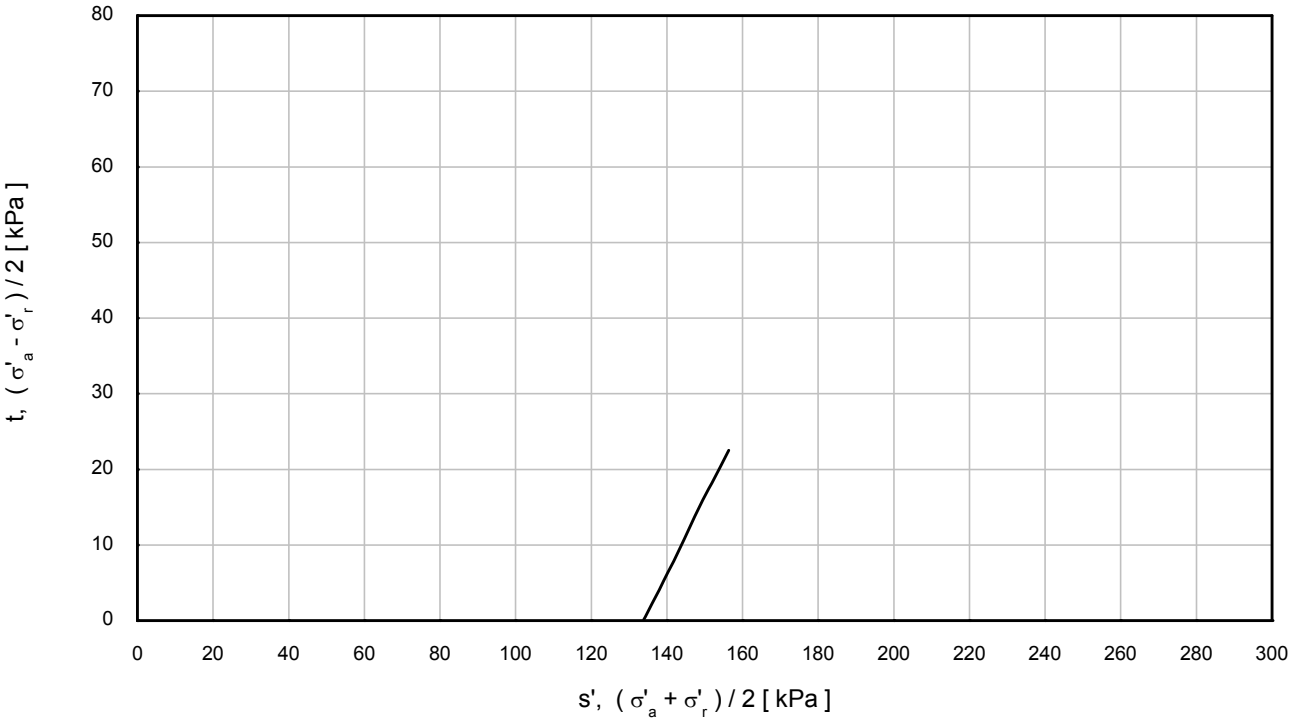
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

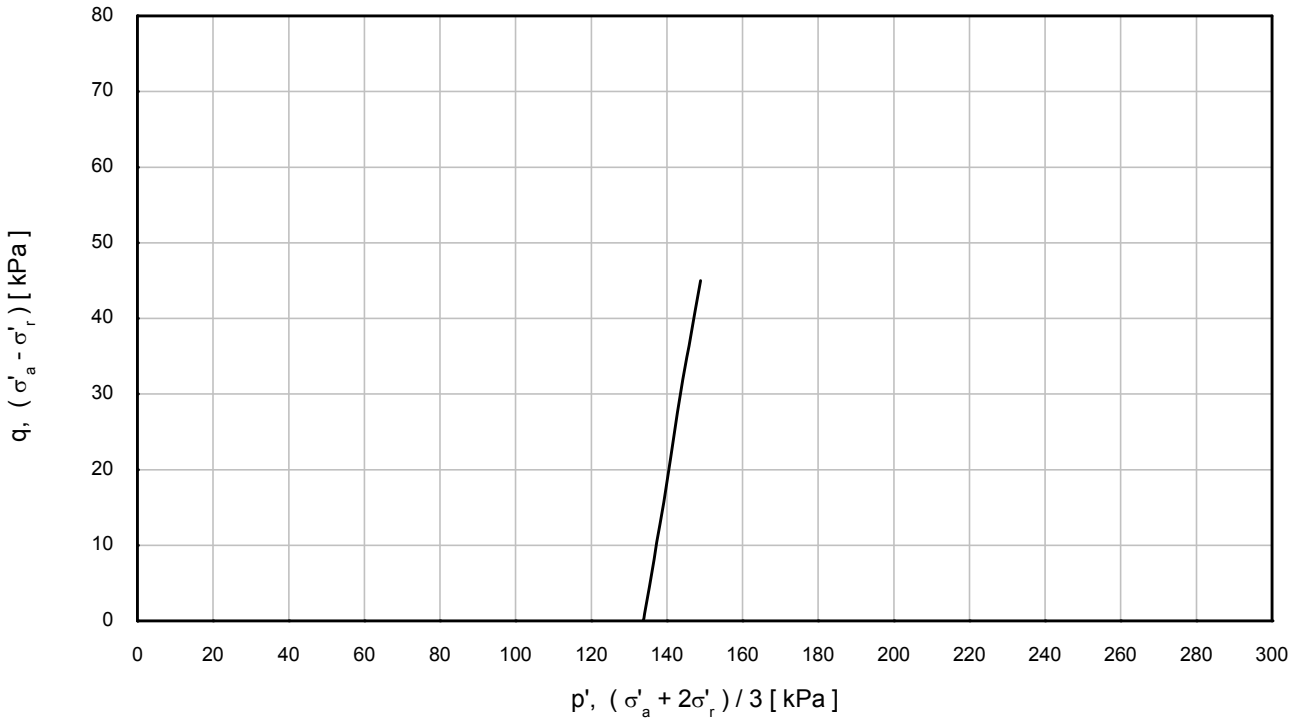




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTXL_3-5
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX09

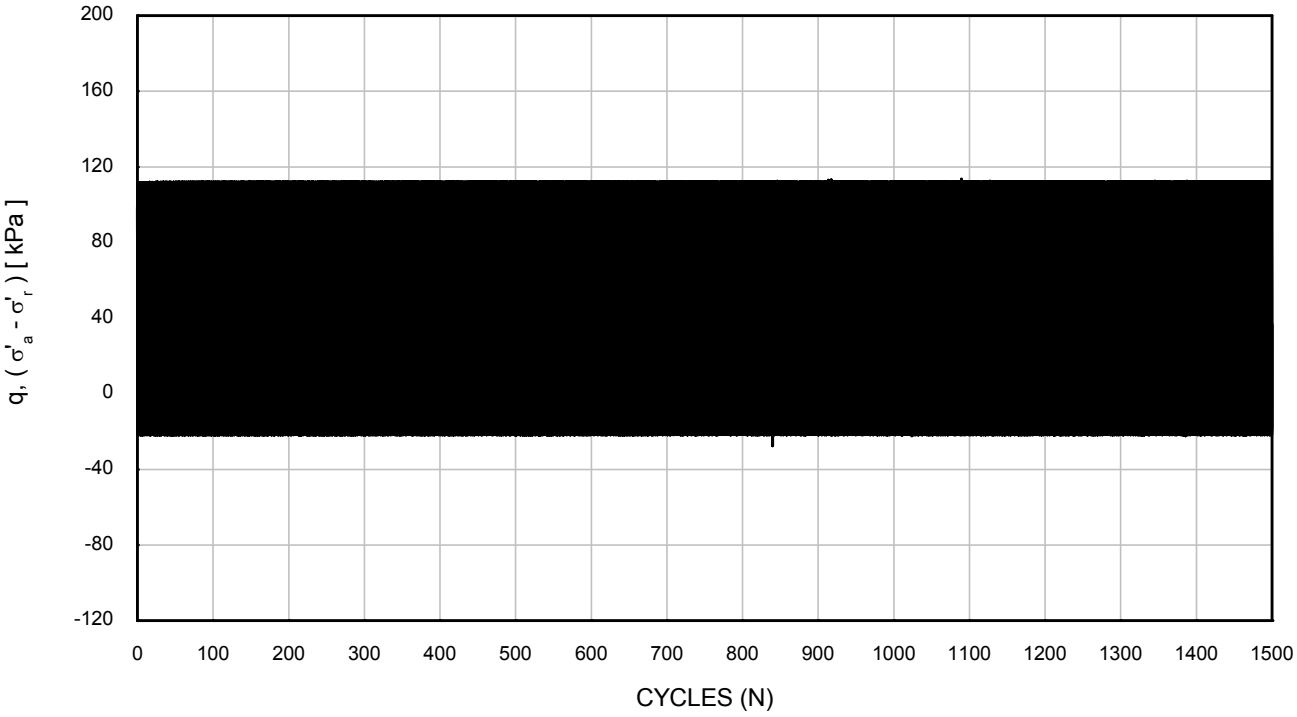
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

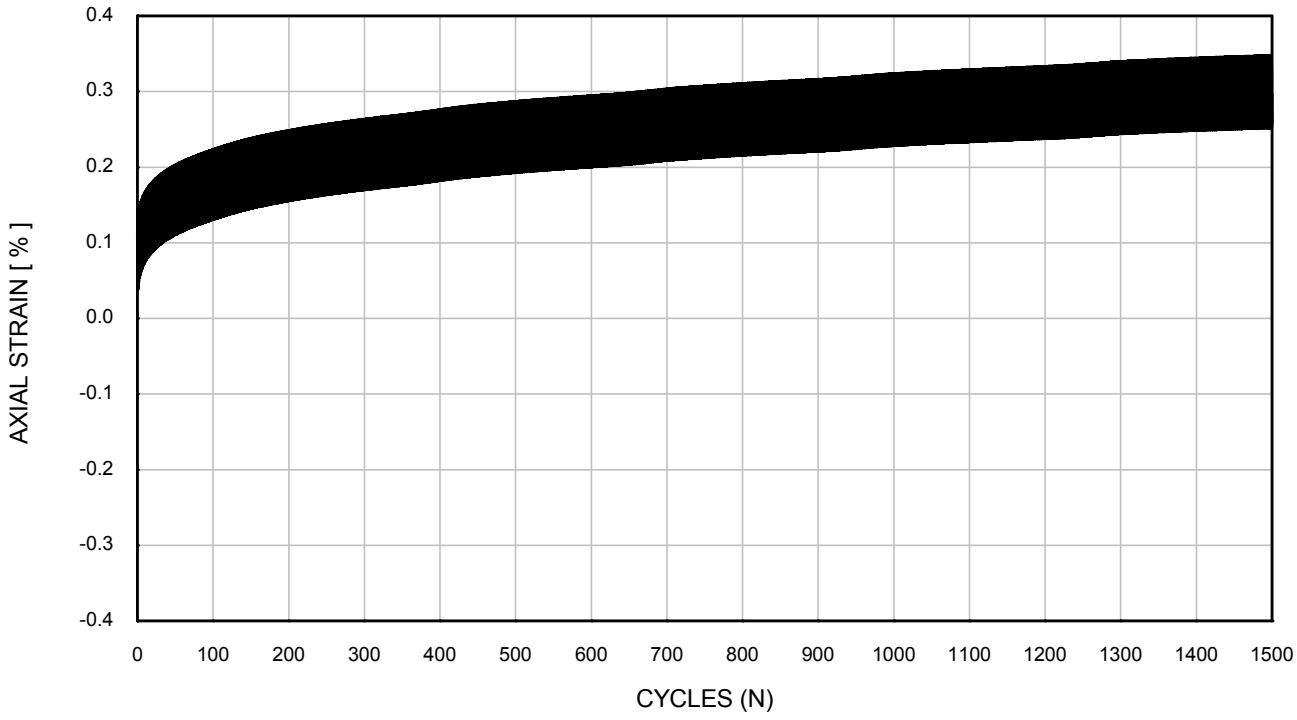




σ'_{rc}	: 134 kPa	Batch	: 3
σ'_{ac}	: 179 kPa	Sample	: CTXL_3-5
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX09

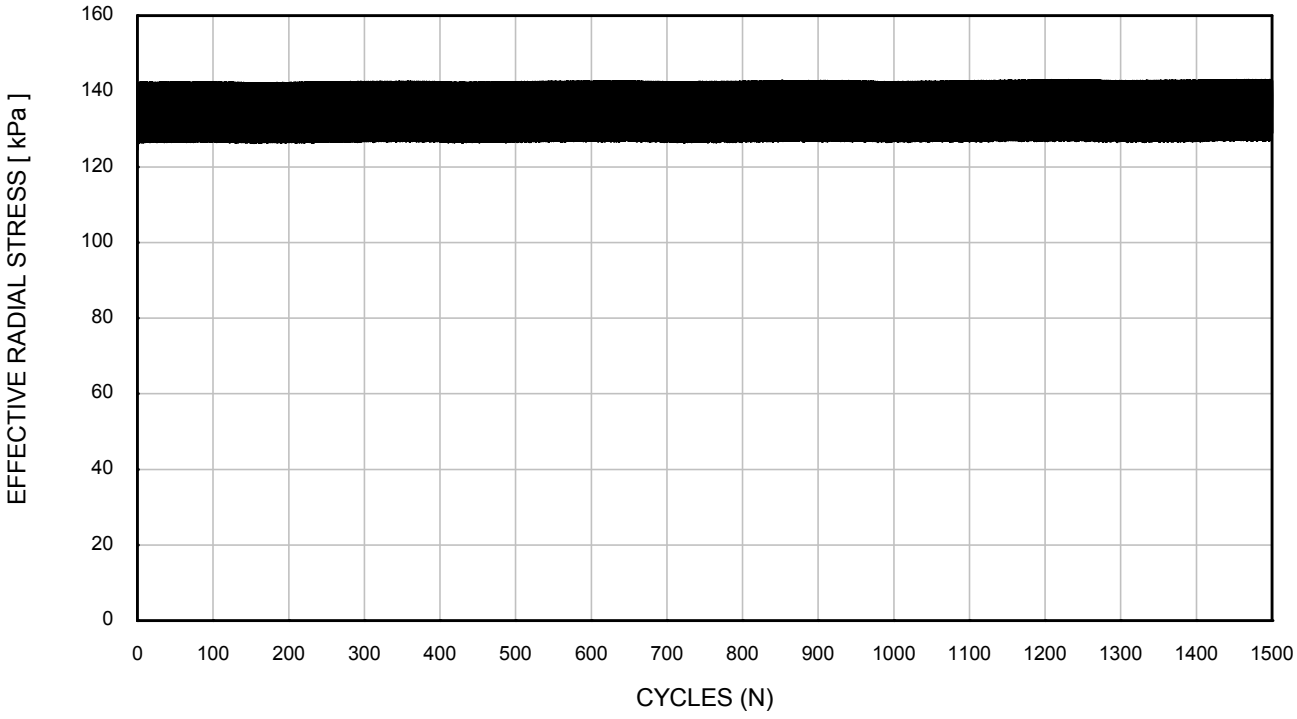
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
DRAINED SHEAR PRIOR TO FIRST CYCLIC LOADING

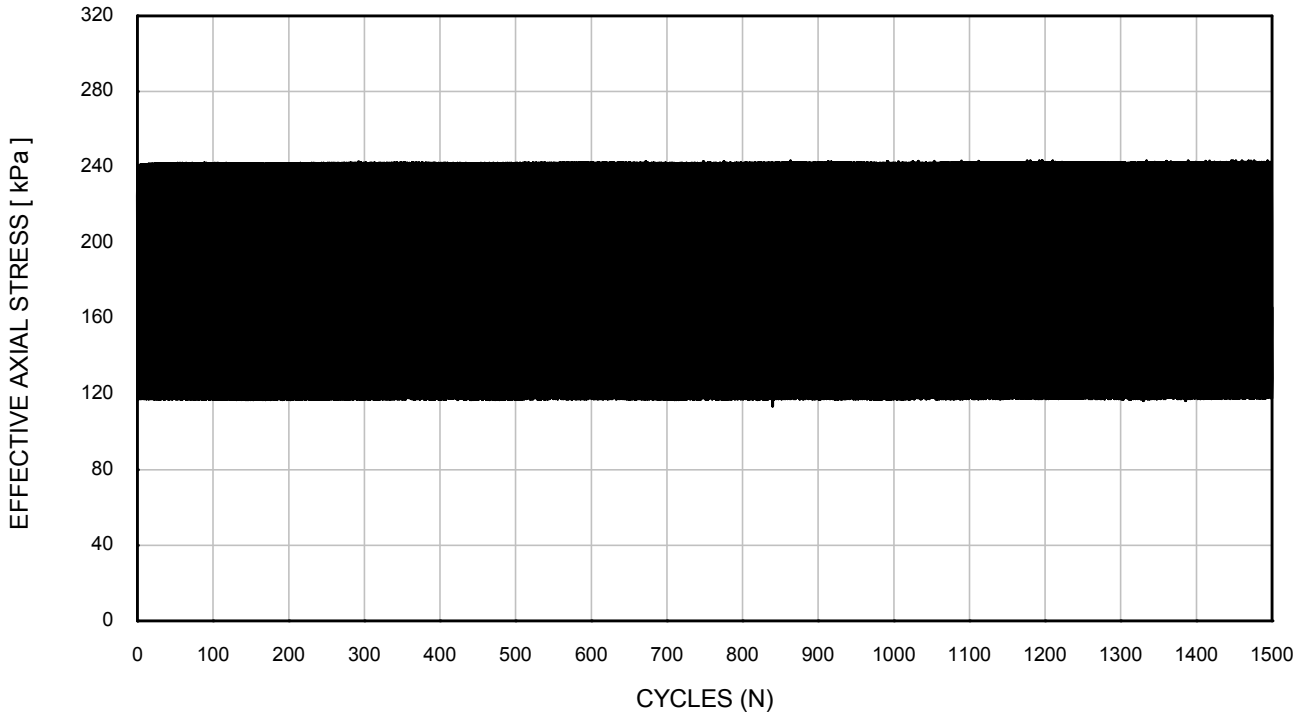




Initial σ'_r	:	134 kPa	Batch	: 3
Initial σ'_a	:	179 kPa	Sample	: CTXL_3-5
q_{av}	:	45 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	: CTX09
Frequency	:	0.10 Hz		

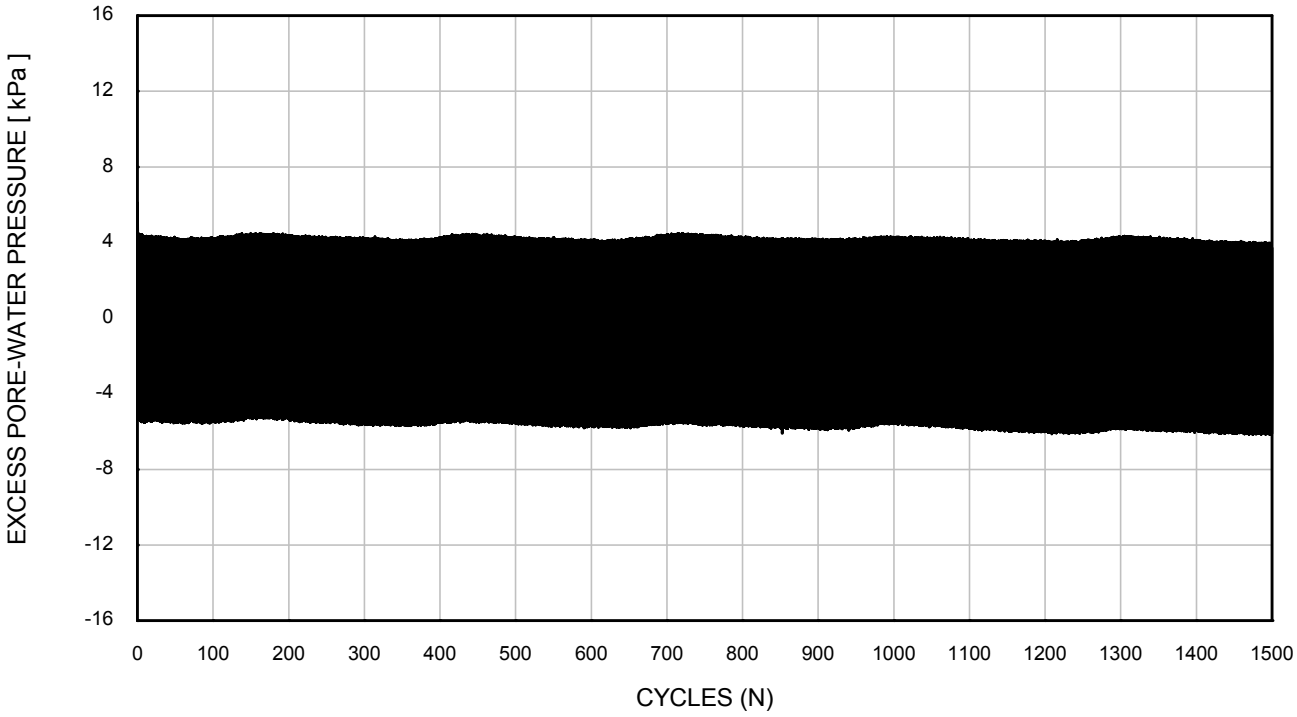
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

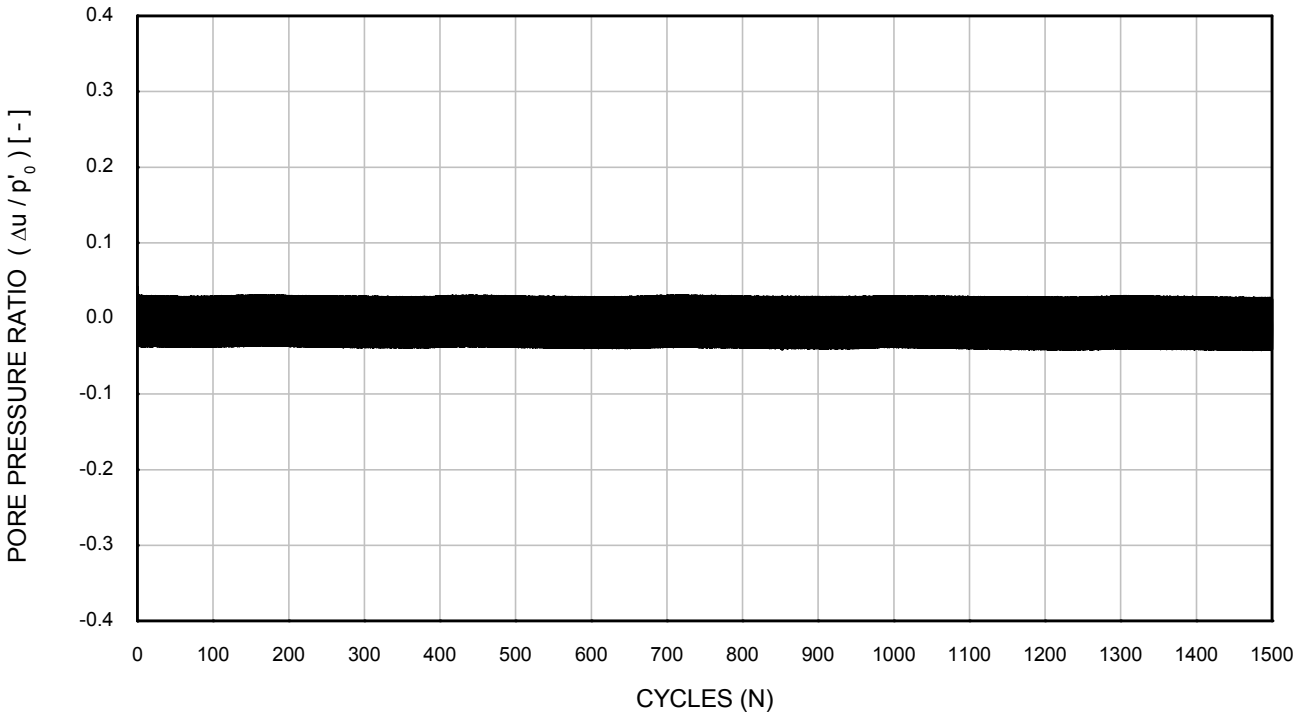




Initial σ'_r	:	134 kPa	Batch	:	3
Initial σ'_a	:	179 kPa	Sample	:	CTXL_3-5
q_{av}	:	45 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX09
Frequency	:	0.10 Hz			

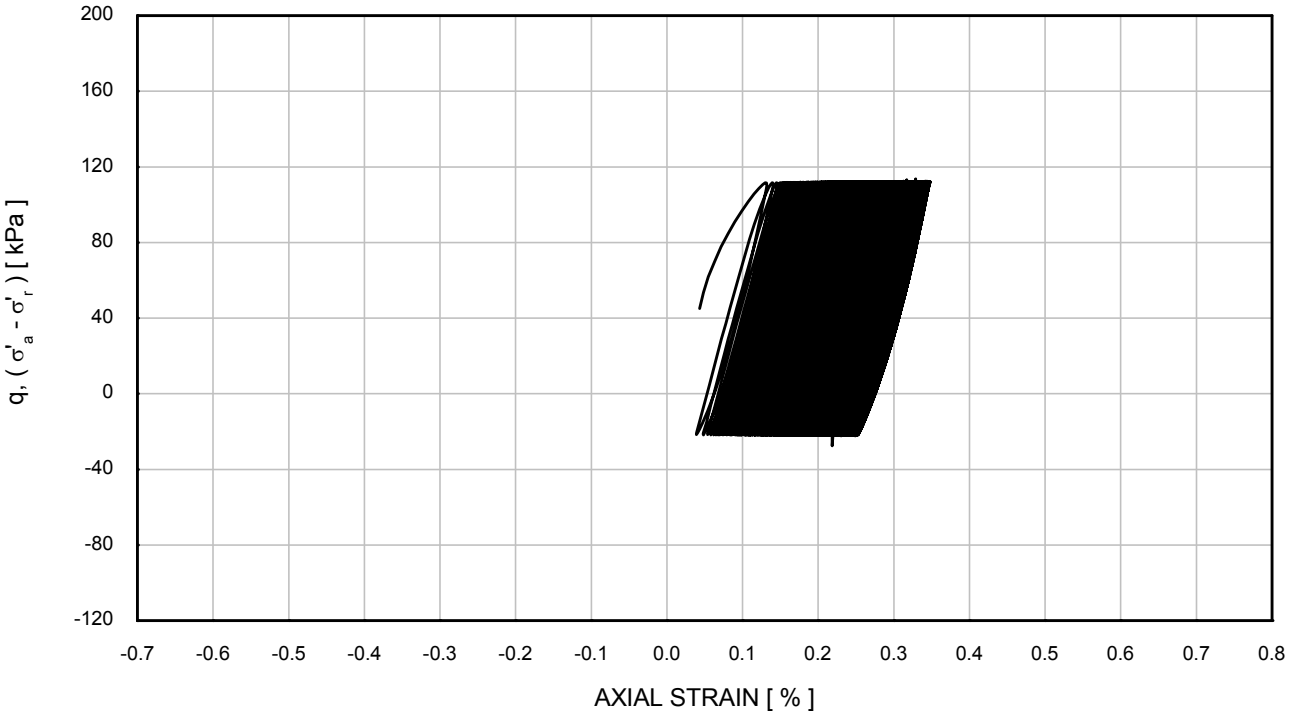
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

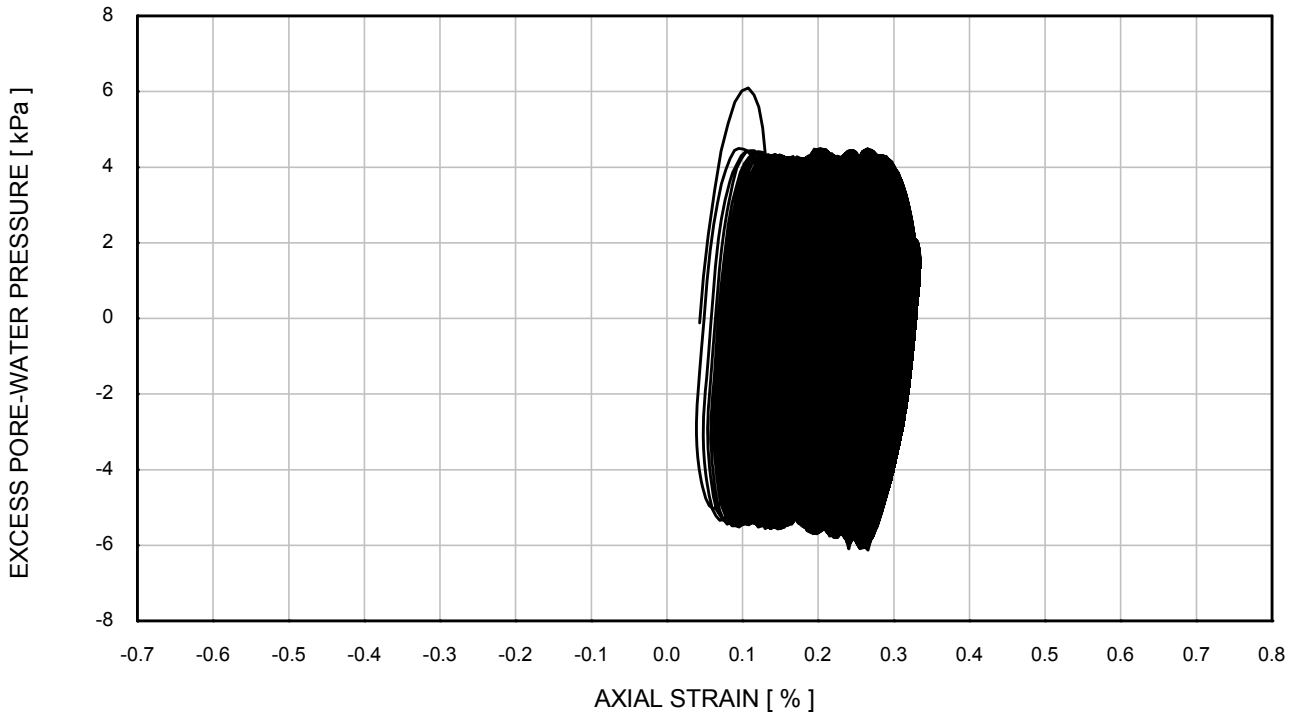




Initial σ'_r	:	134 kPa	Batch	:	3
Initial σ'_a	:	179 kPa	Sample	:	CTXL_3-5
q_{av}	:	45 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX09
Frequency	:	0.10 Hz			

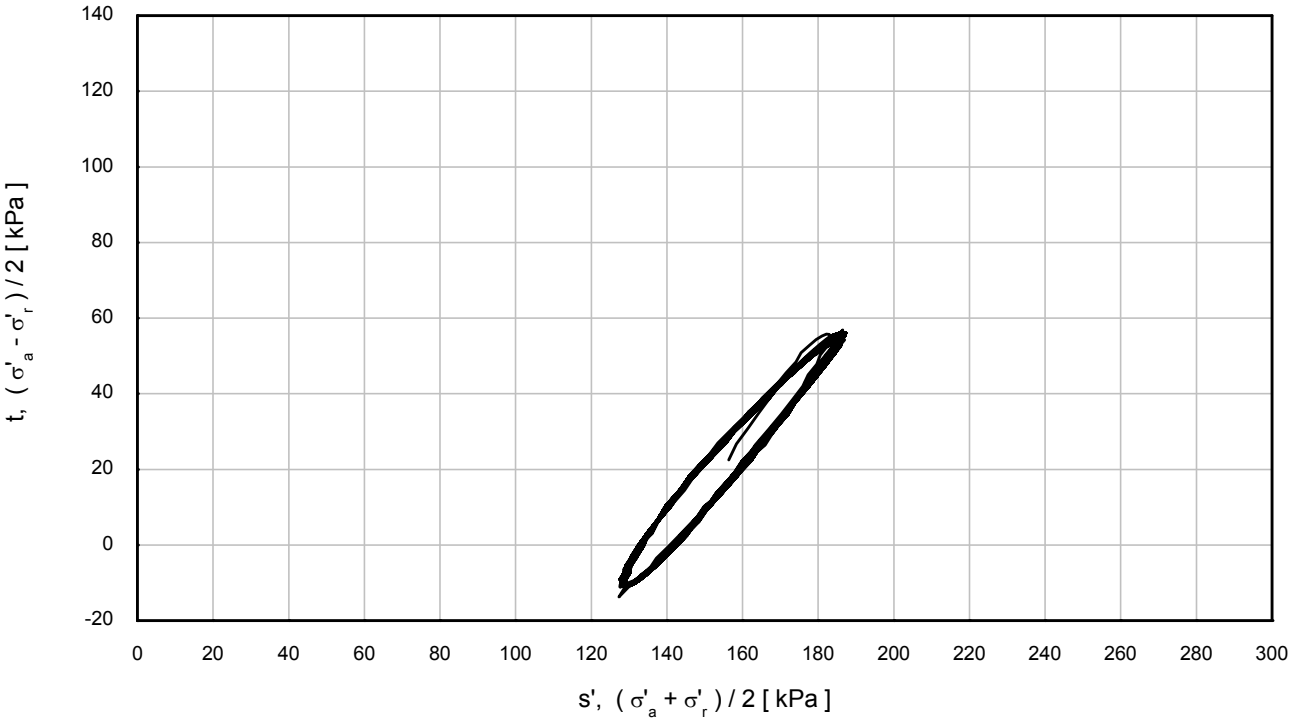
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

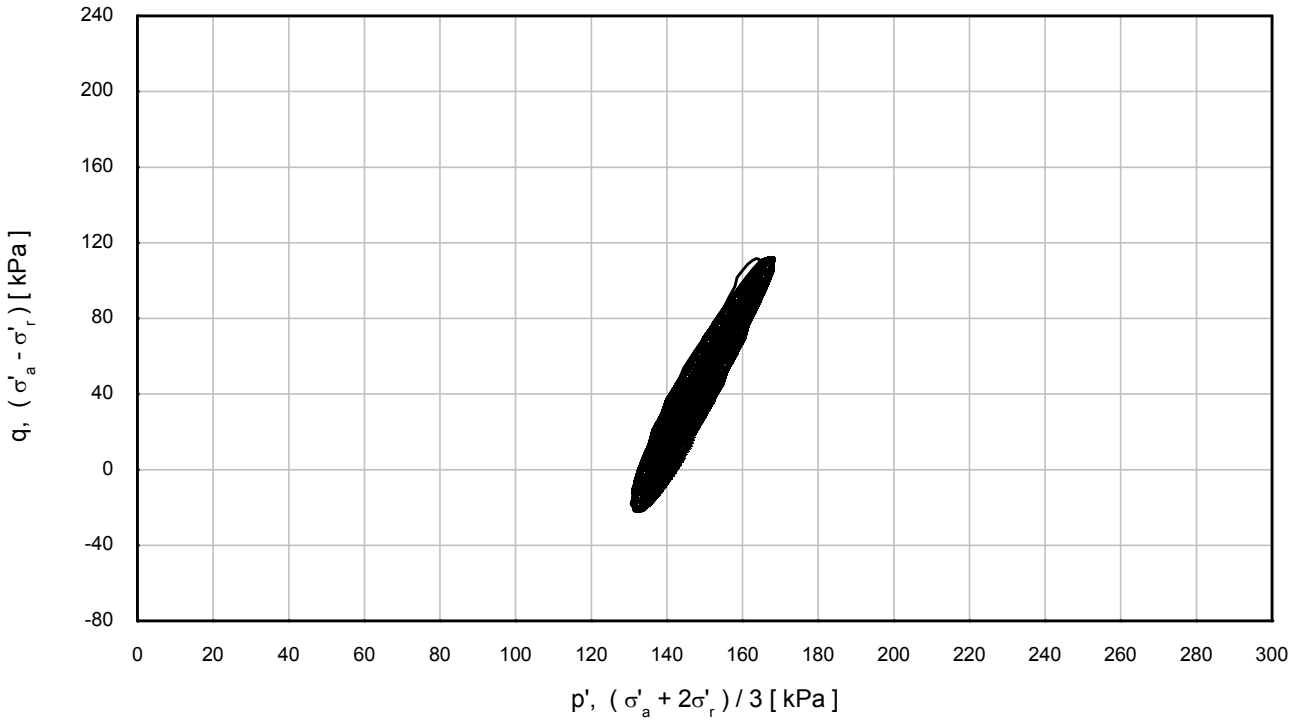




Initial σ'_r	:	134 kPa	Batch	:	3
Initial σ'_a	:	179 kPa	Sample	:	CTXL_3-5
q_{av}	:	45 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX09
Frequency	:	0.10 Hz			

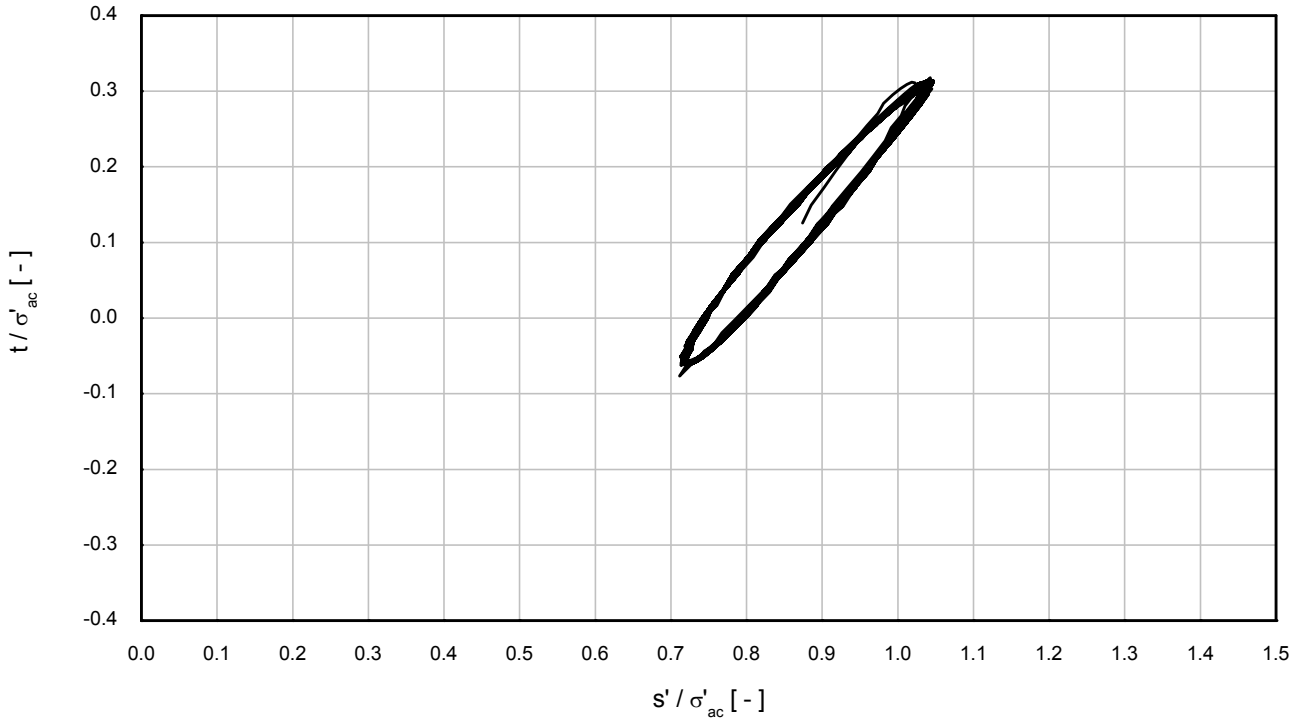
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

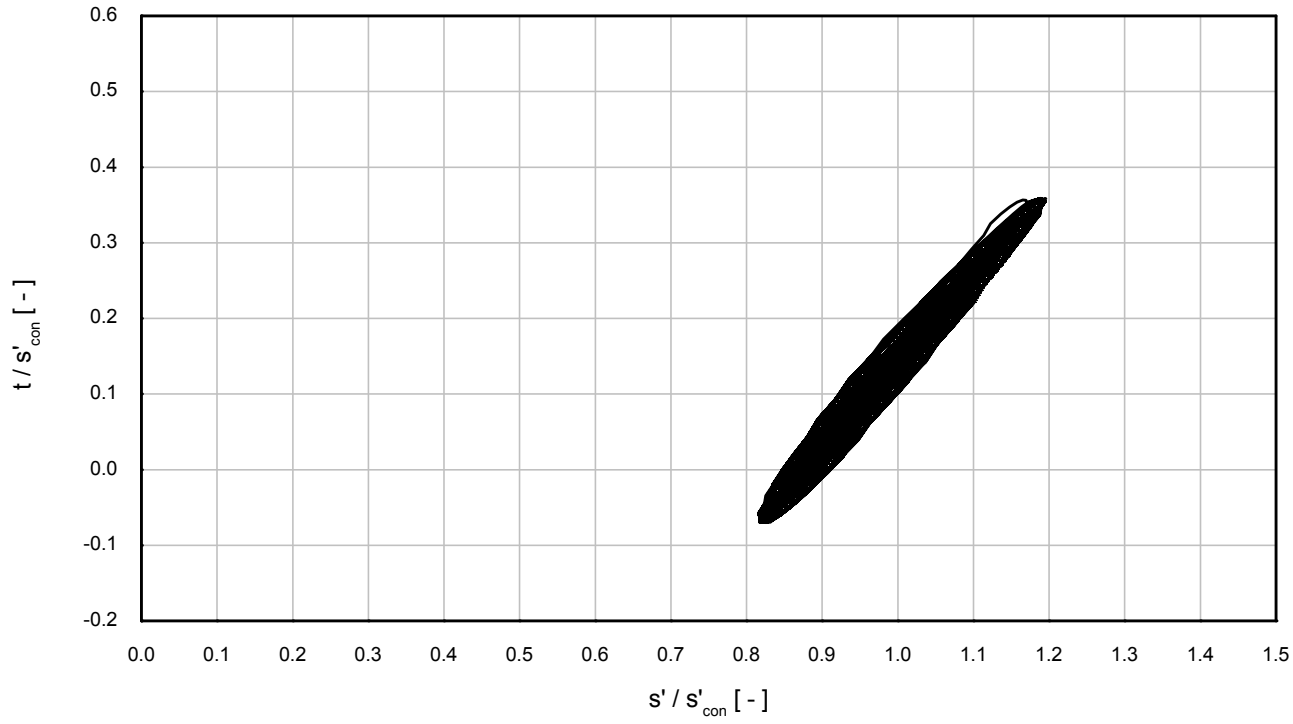




Initial σ'_r	:	134 kPa	Batch	:	3
Initial σ'_a	:	179 kPa	Sample	:	CTXL_3-5
q_{av}	:	45 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX09
Frequency	:	0.10 Hz			

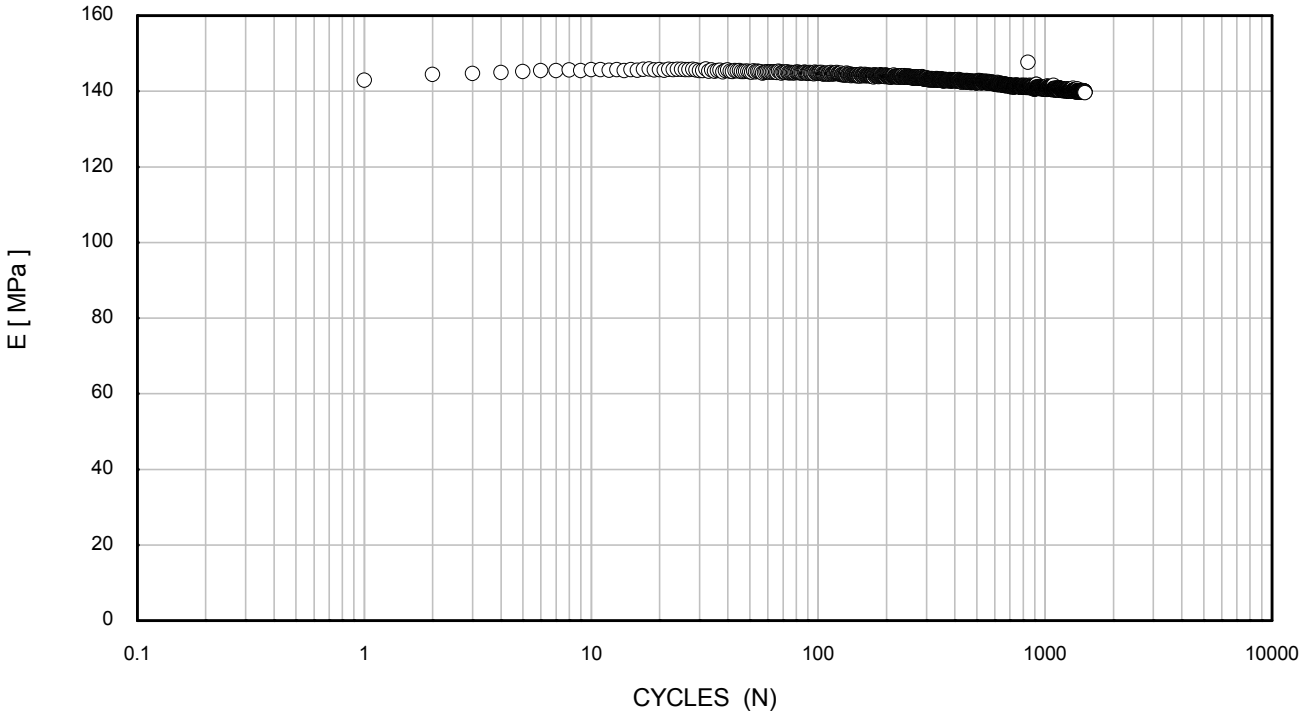
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

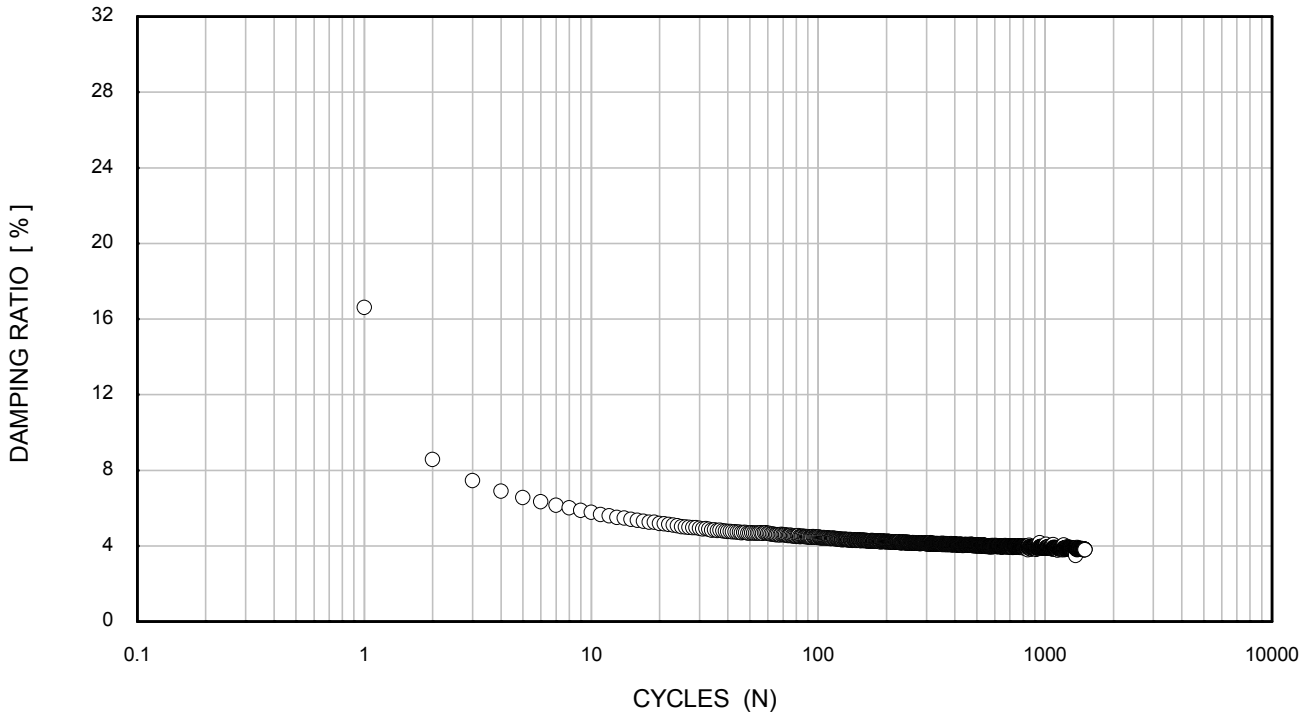




Initial σ'_r	:	134 kPa	Batch	:	3
Initial σ'_a	:	179 kPa	Sample	:	CTXL_3-5
q_{av}	:	45 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX09
Frequency	:	0.10 Hz			

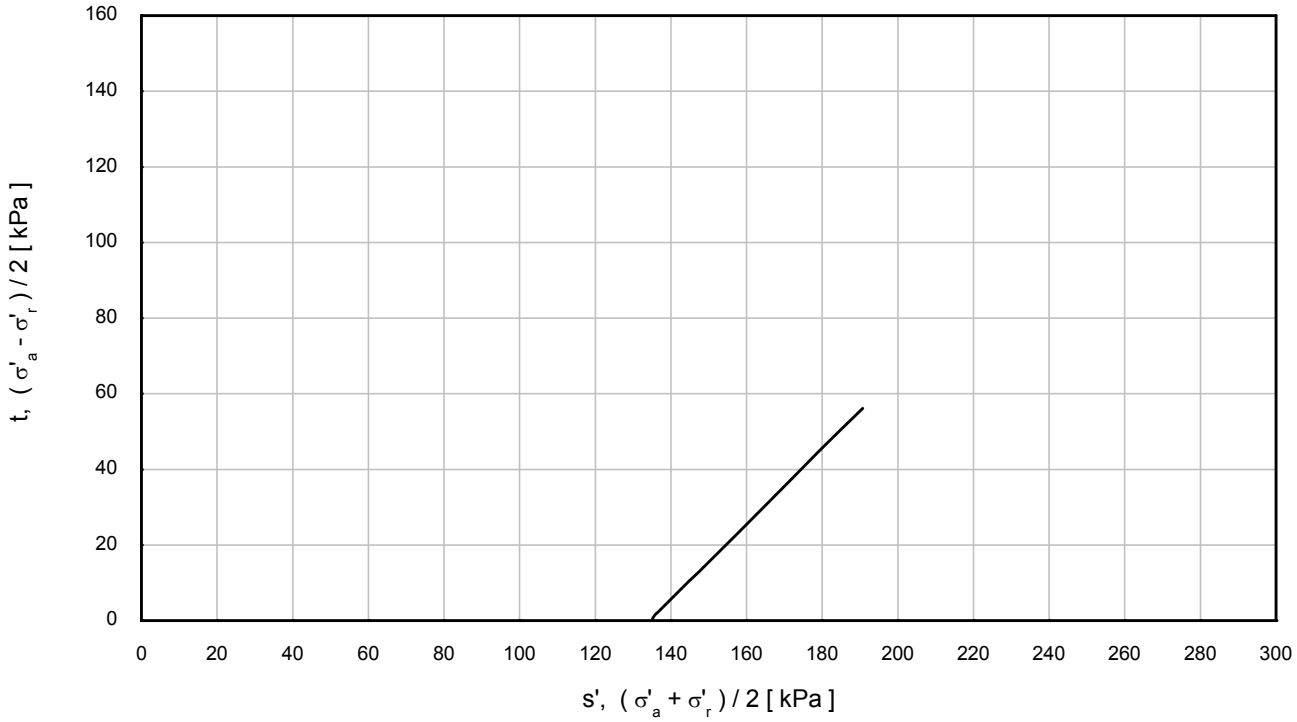
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

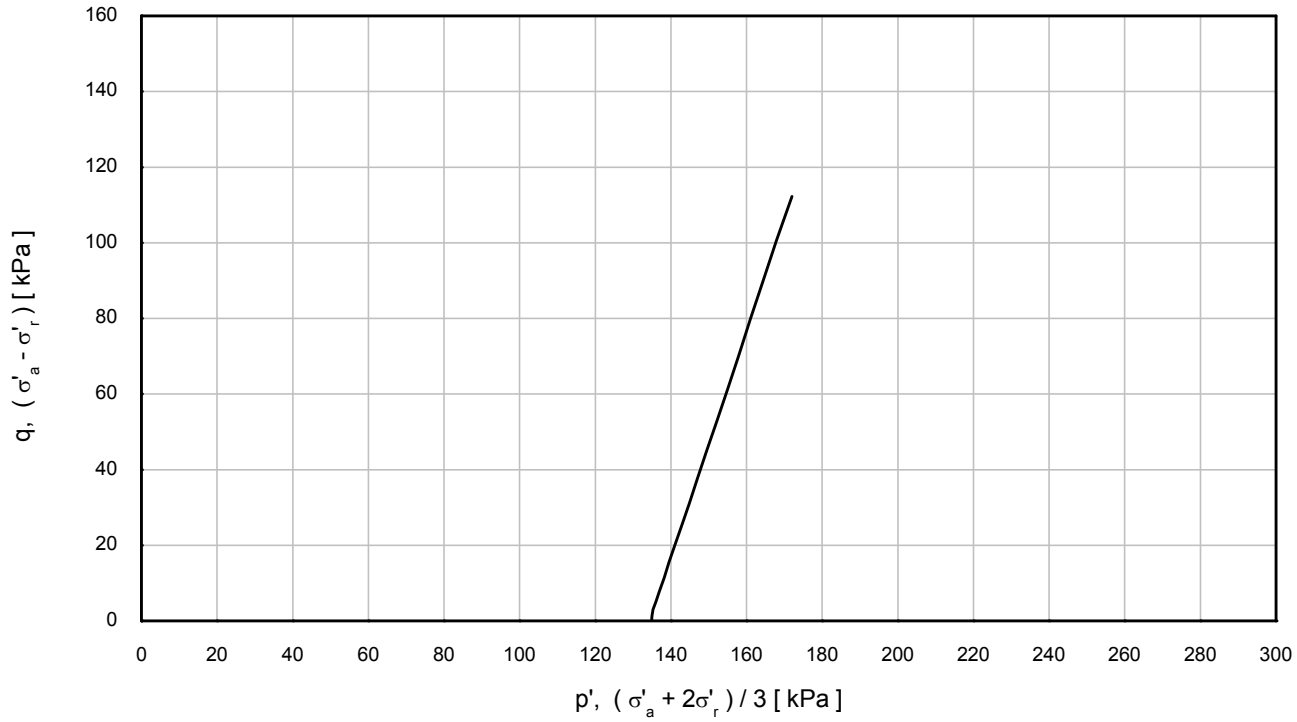




Initial σ'_r	: 134 kPa	Batch	: 3
Initial σ'_a	: 179 kPa	Sample	: CTXL_3-5
q_{av}	: 45 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 67 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

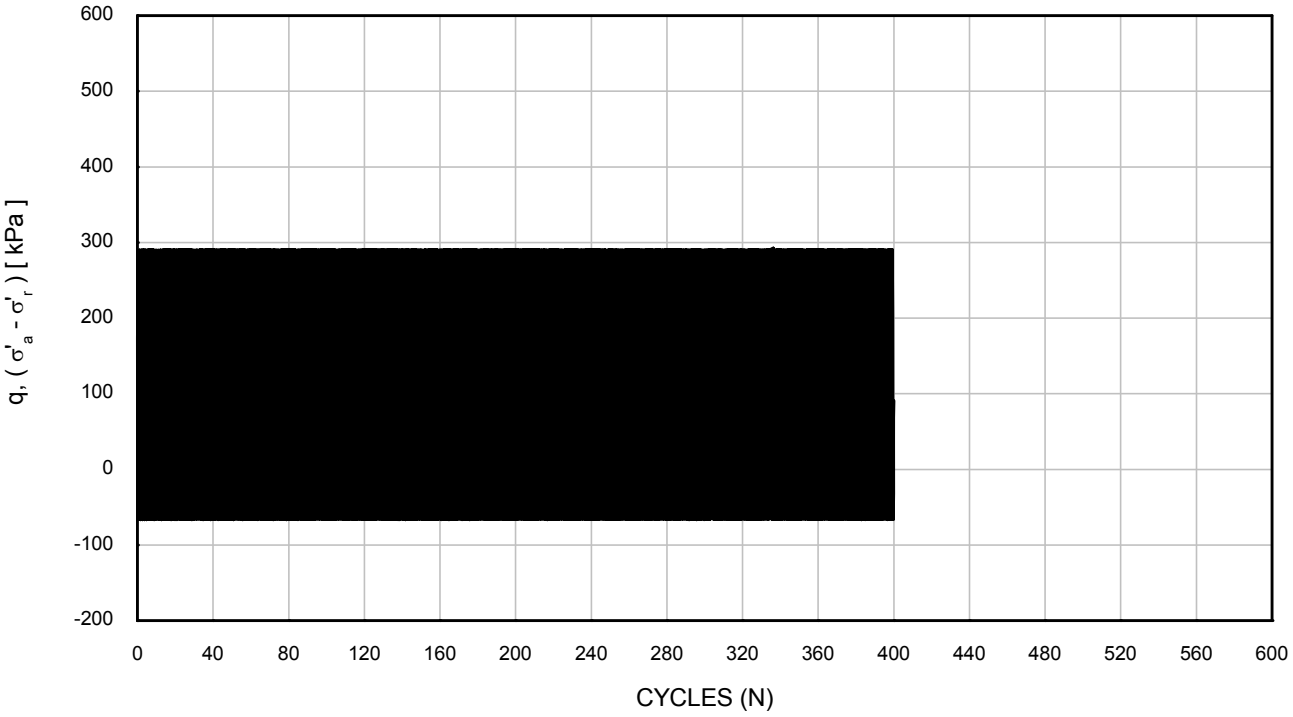
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
FIRST CYCLIC LOADING STAGE - DRAINED

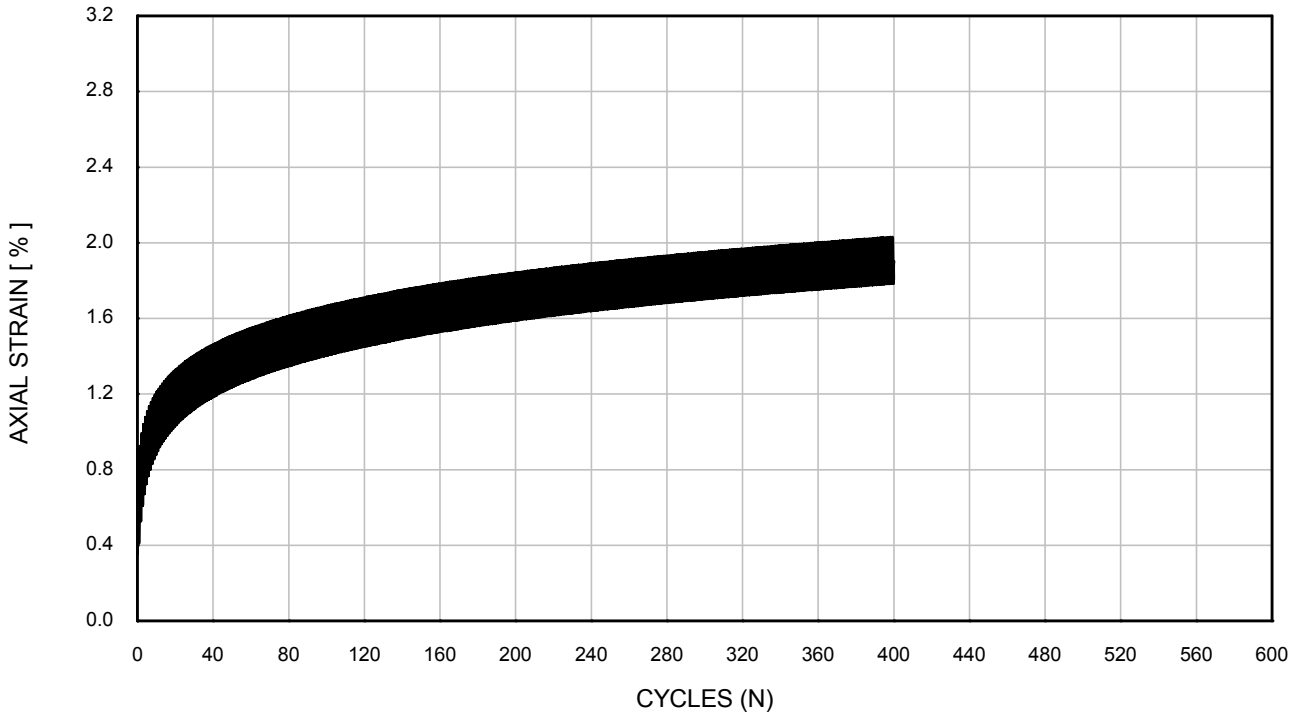




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 247 kPa	Sample	: CTXL_3-5
		Unit	: Unit B1 (kreftenheye)
		Test No.	: CTX09

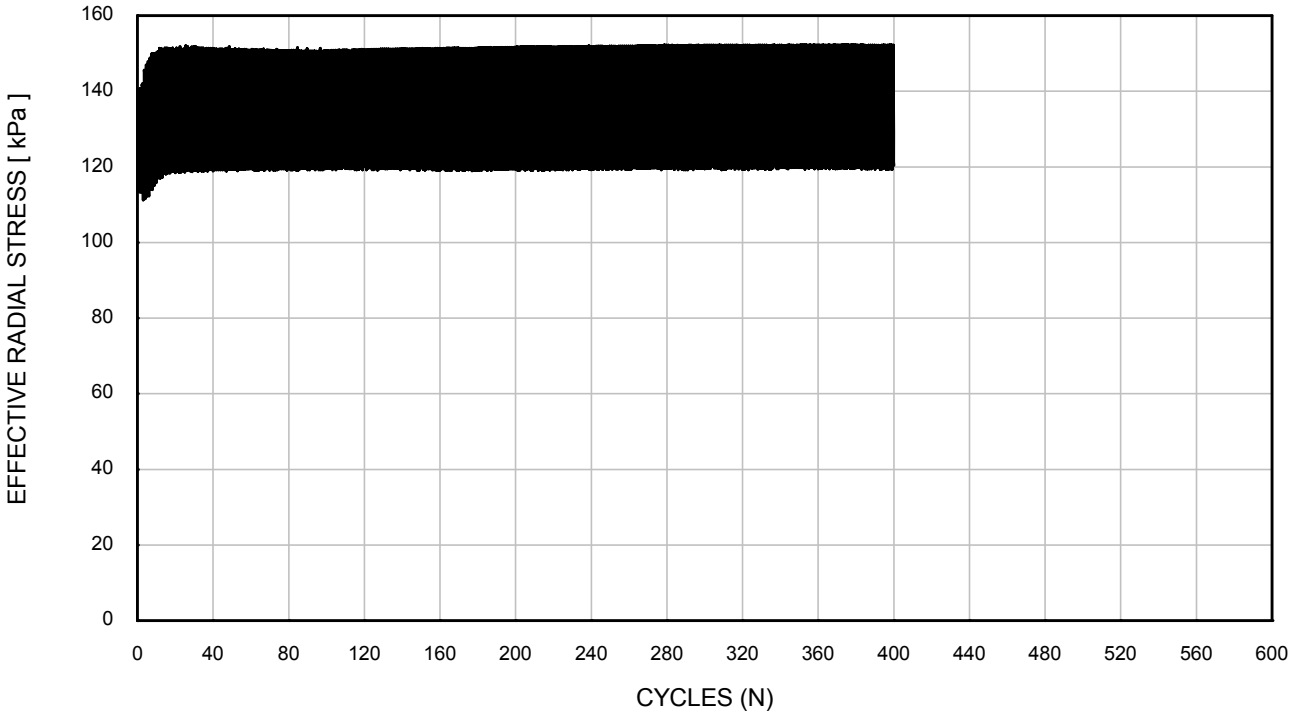
ISOTROPICALLY CONSOLIDATED TRIAXIAL TEST
DRAINED SHEAR PRIOR TO SECOND CYCLIC LOADING

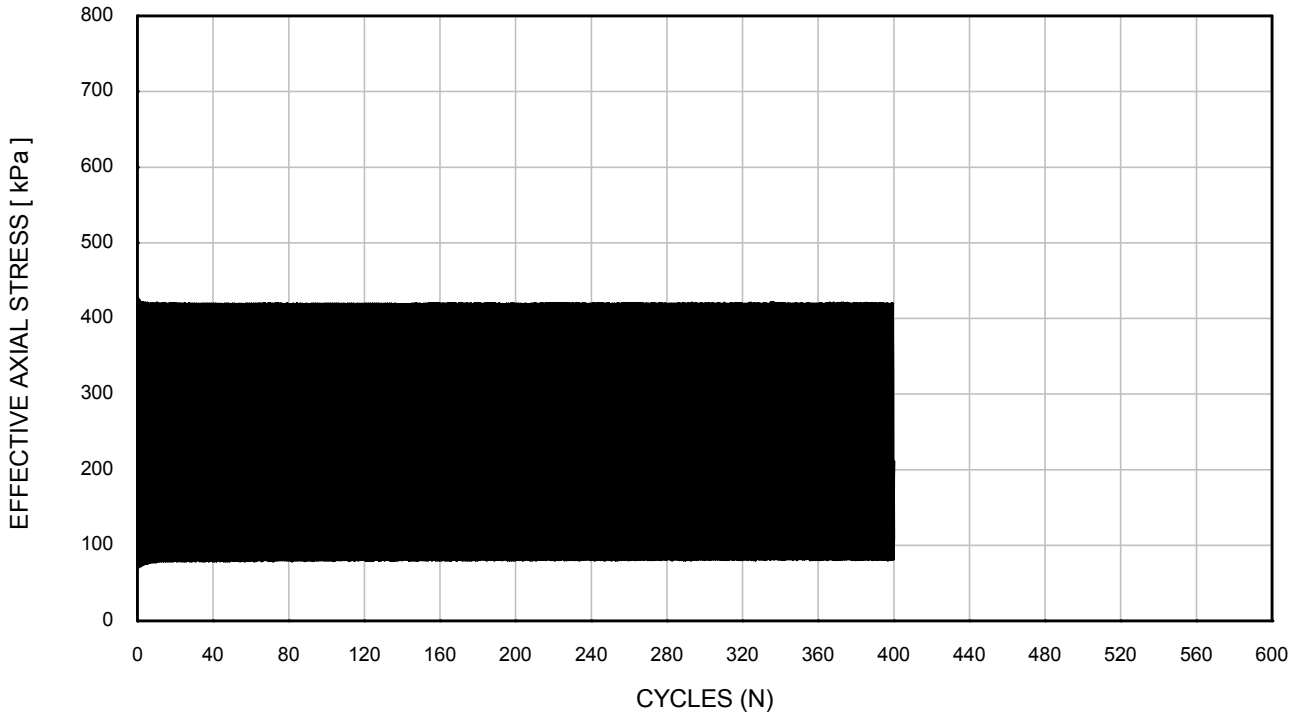




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

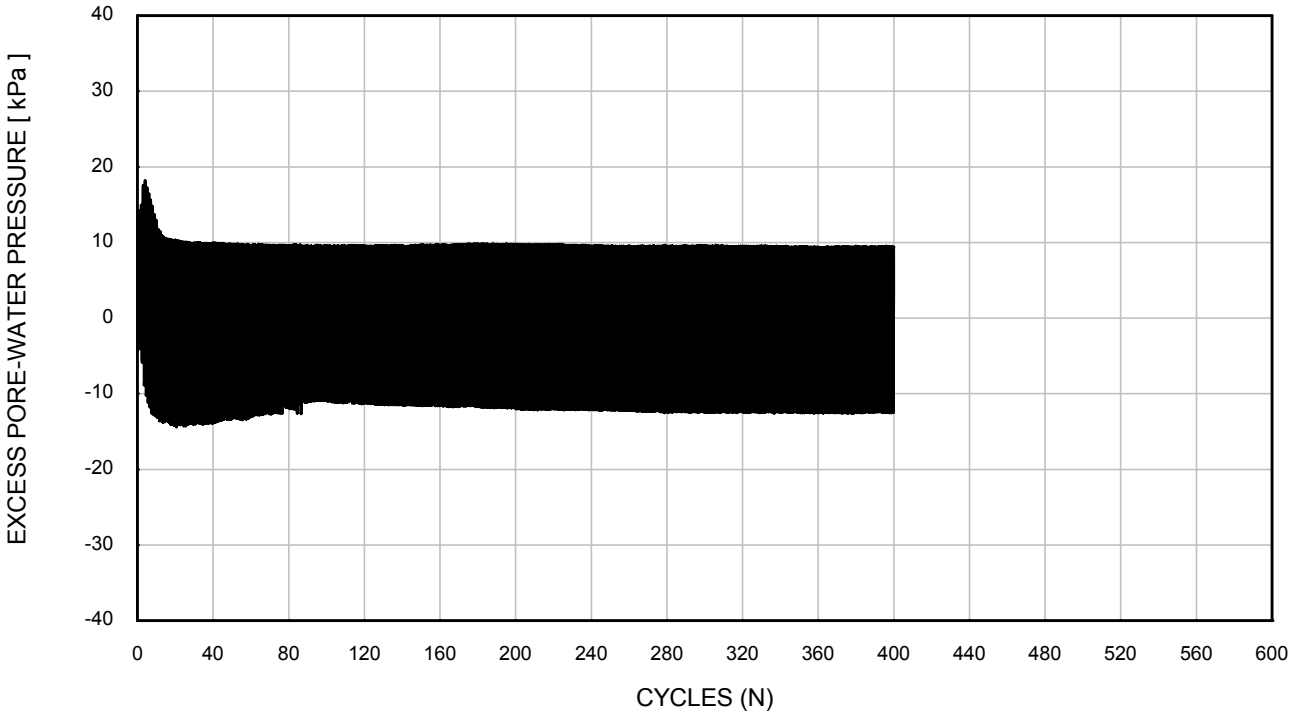
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

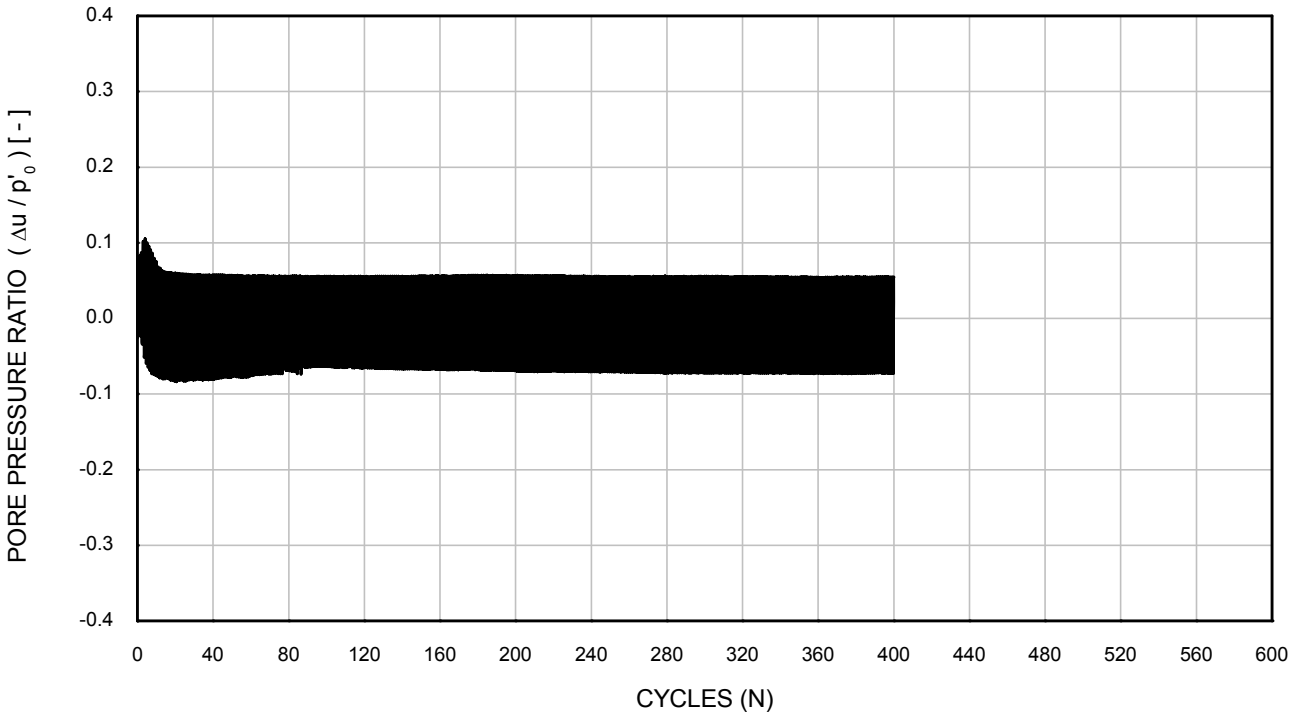




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

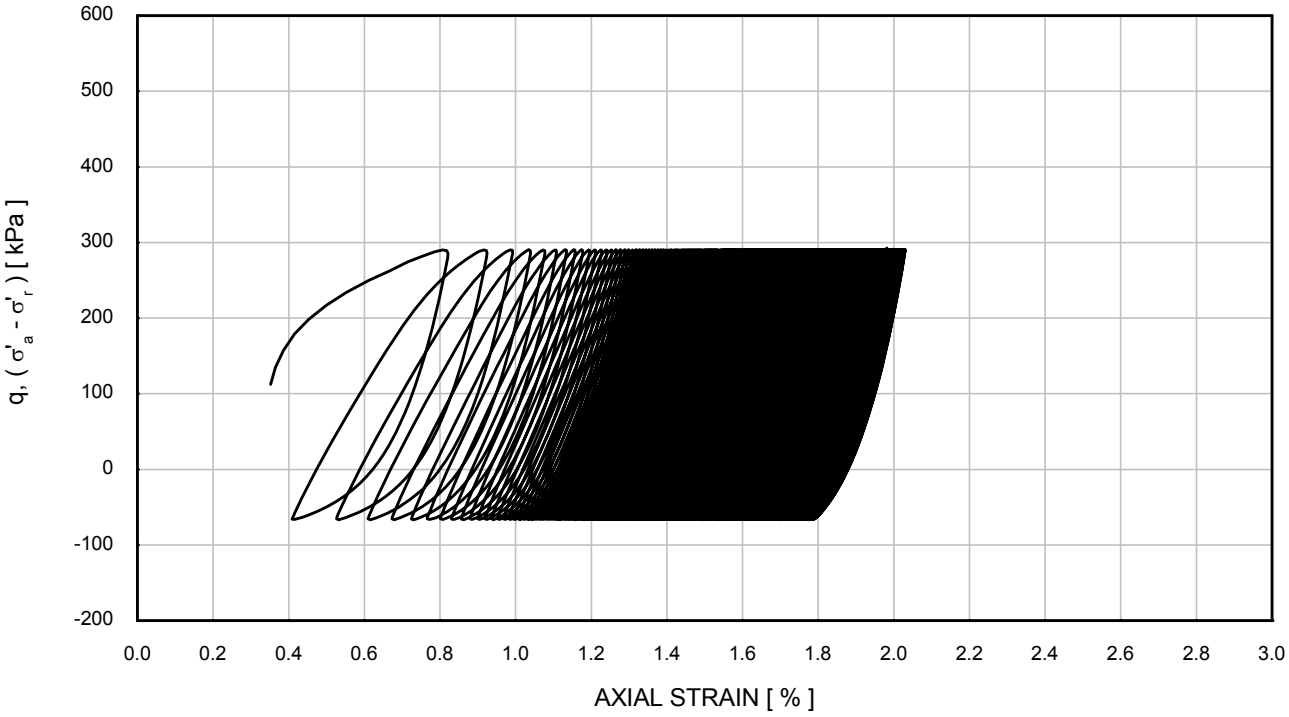
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

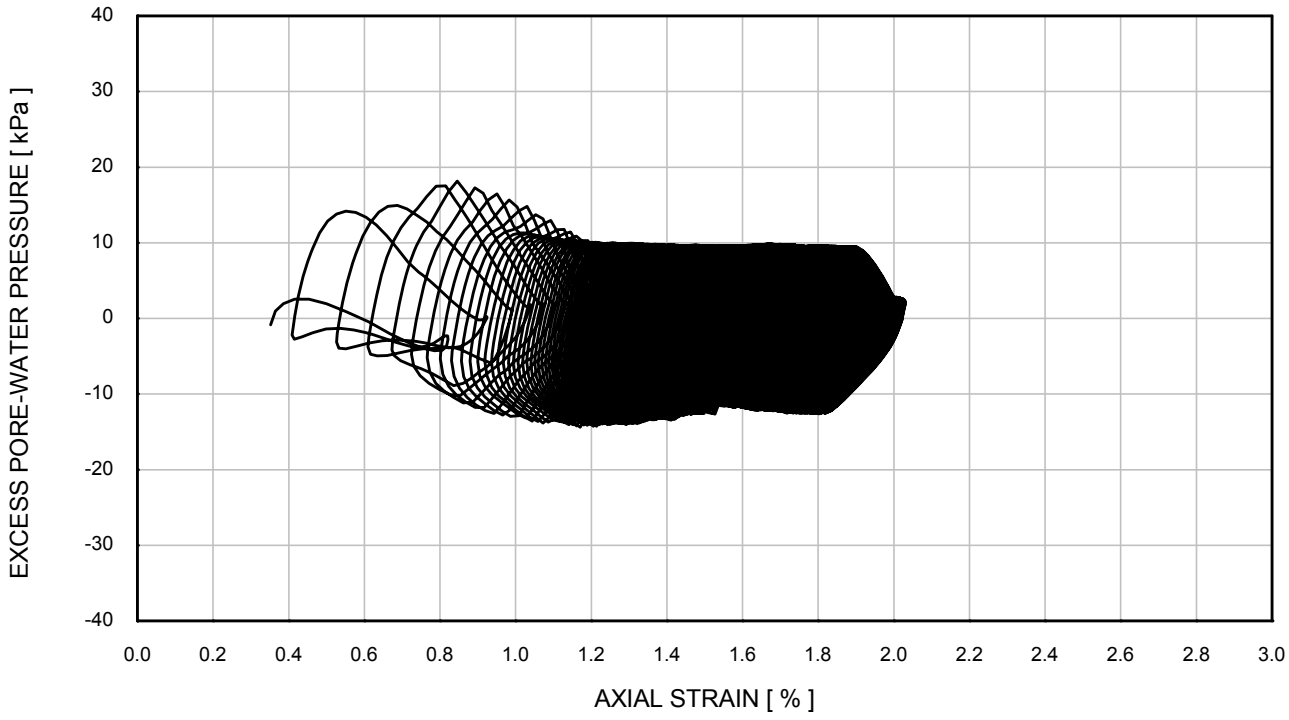




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

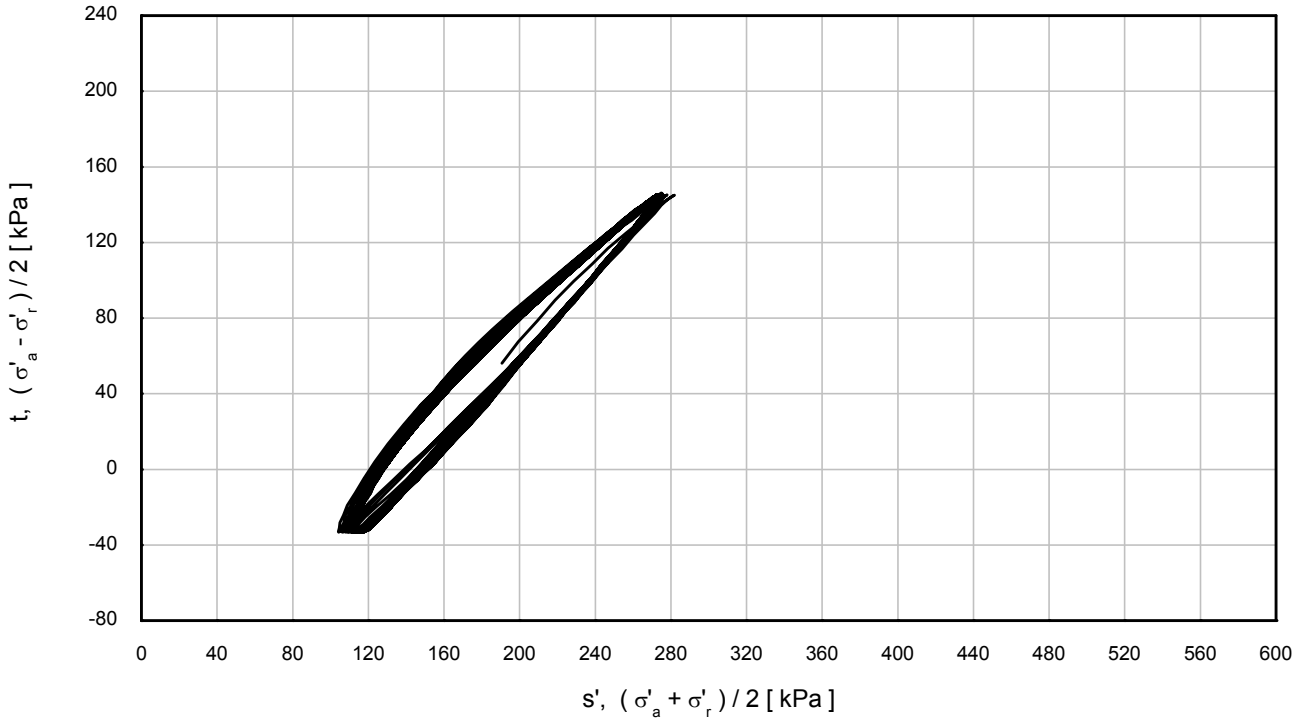
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

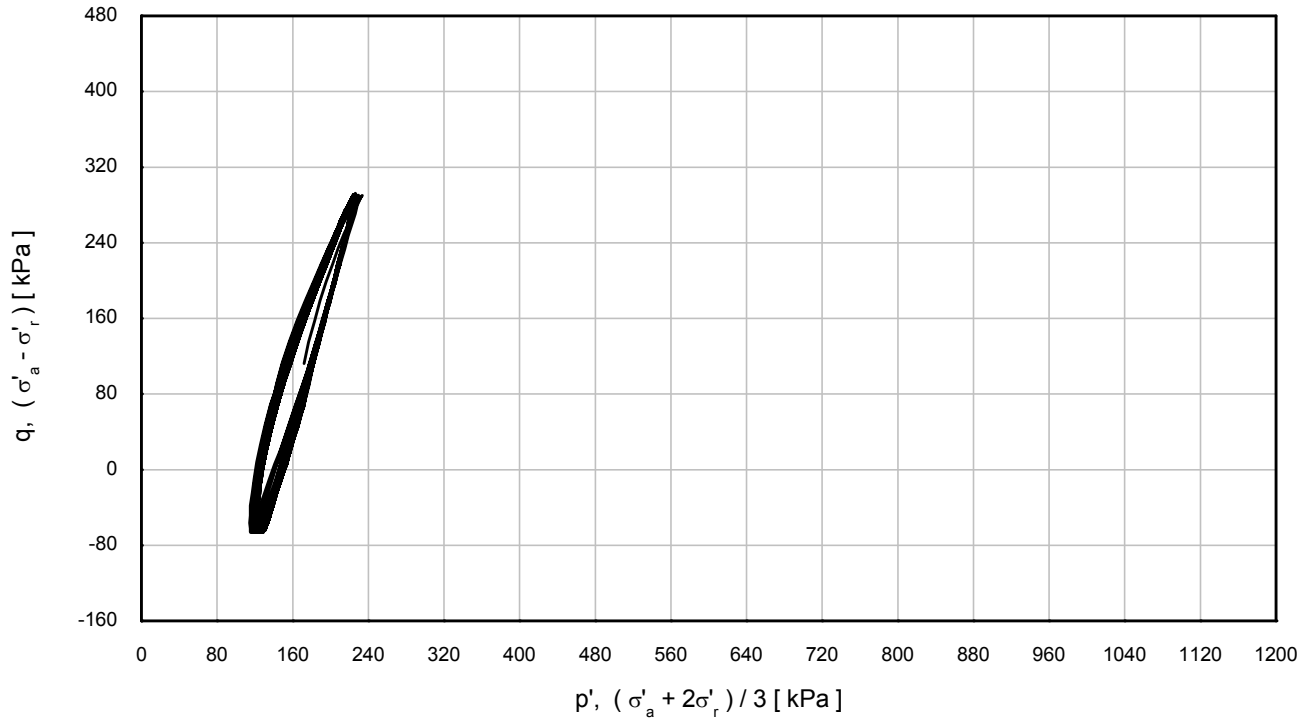




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

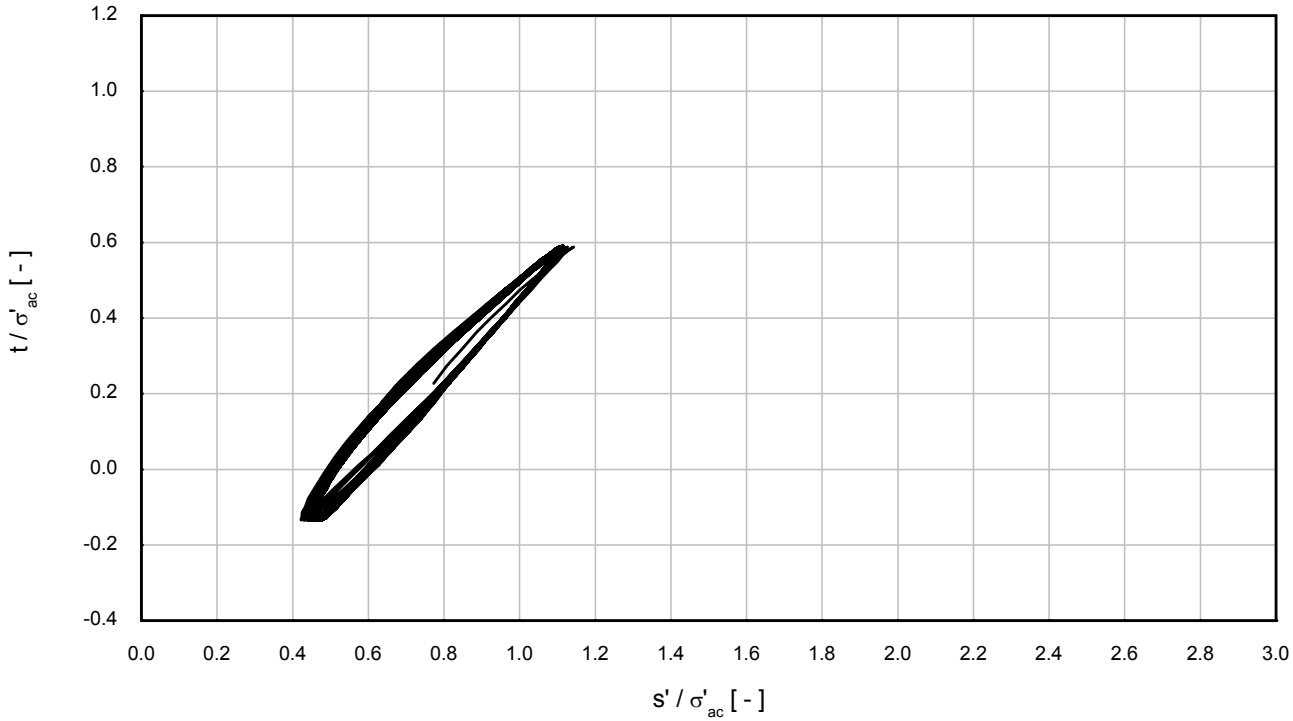
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

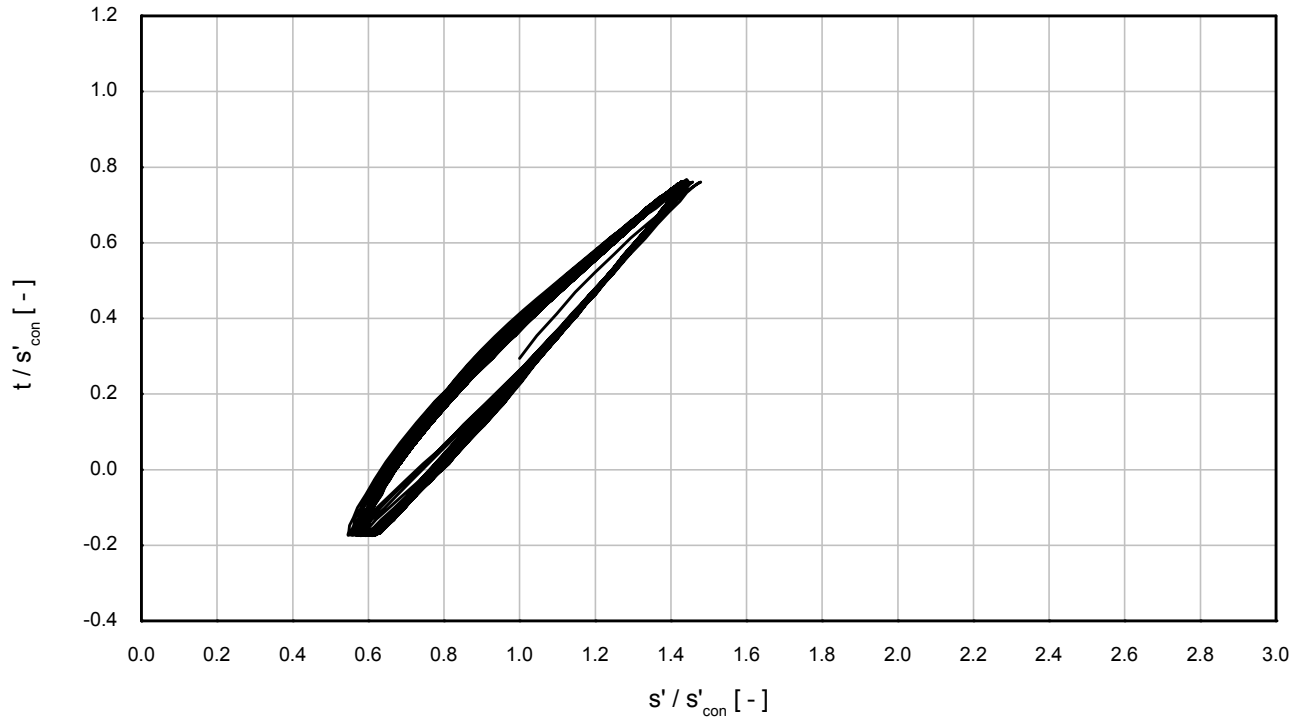




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

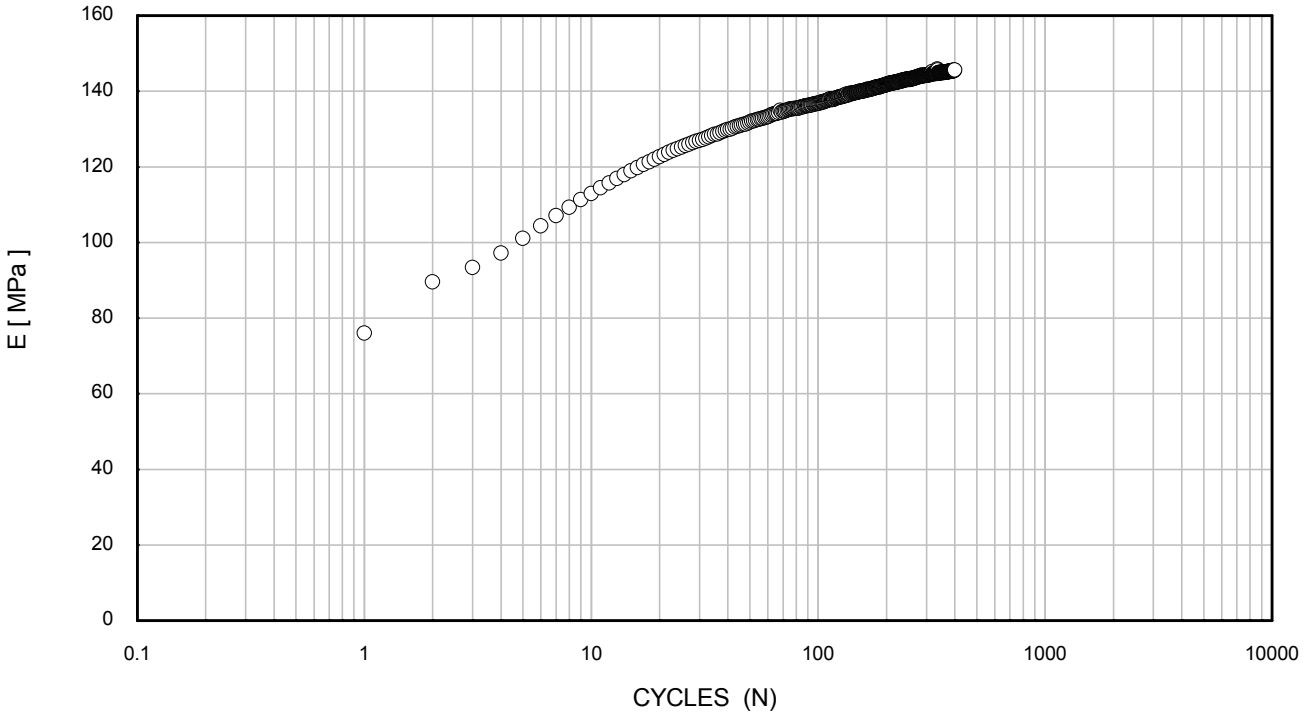
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

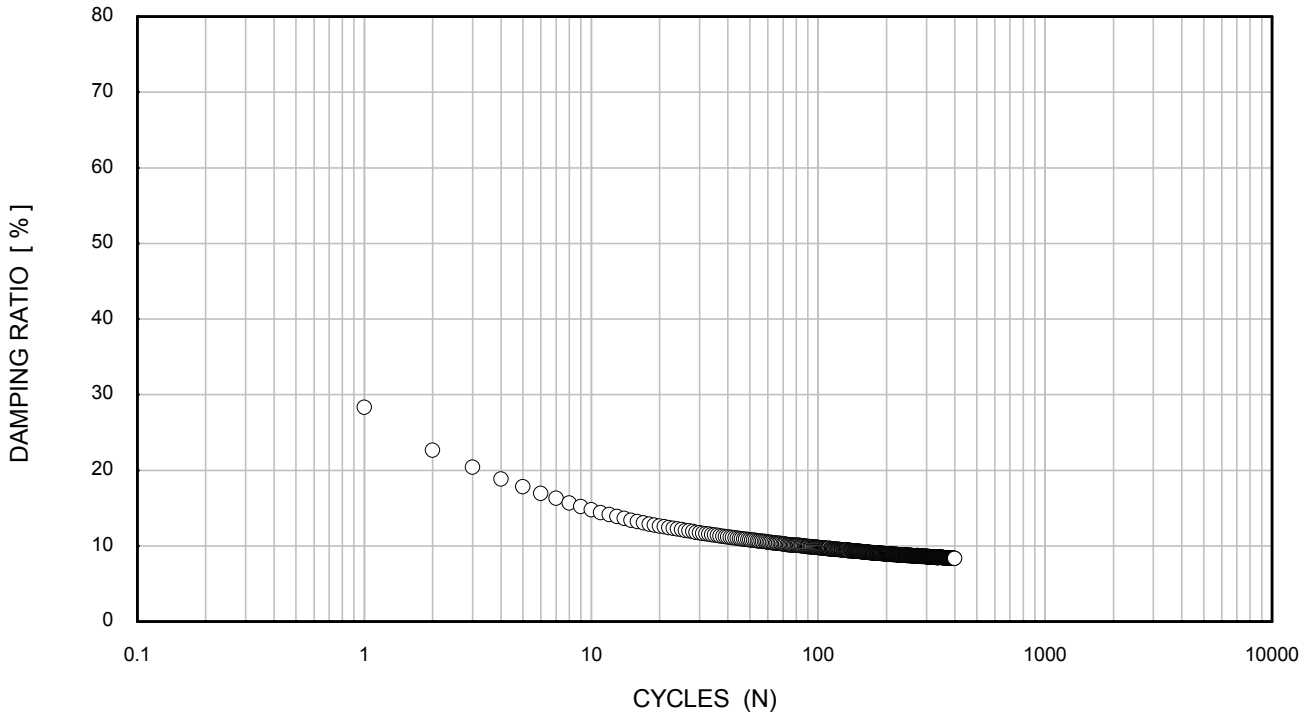




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

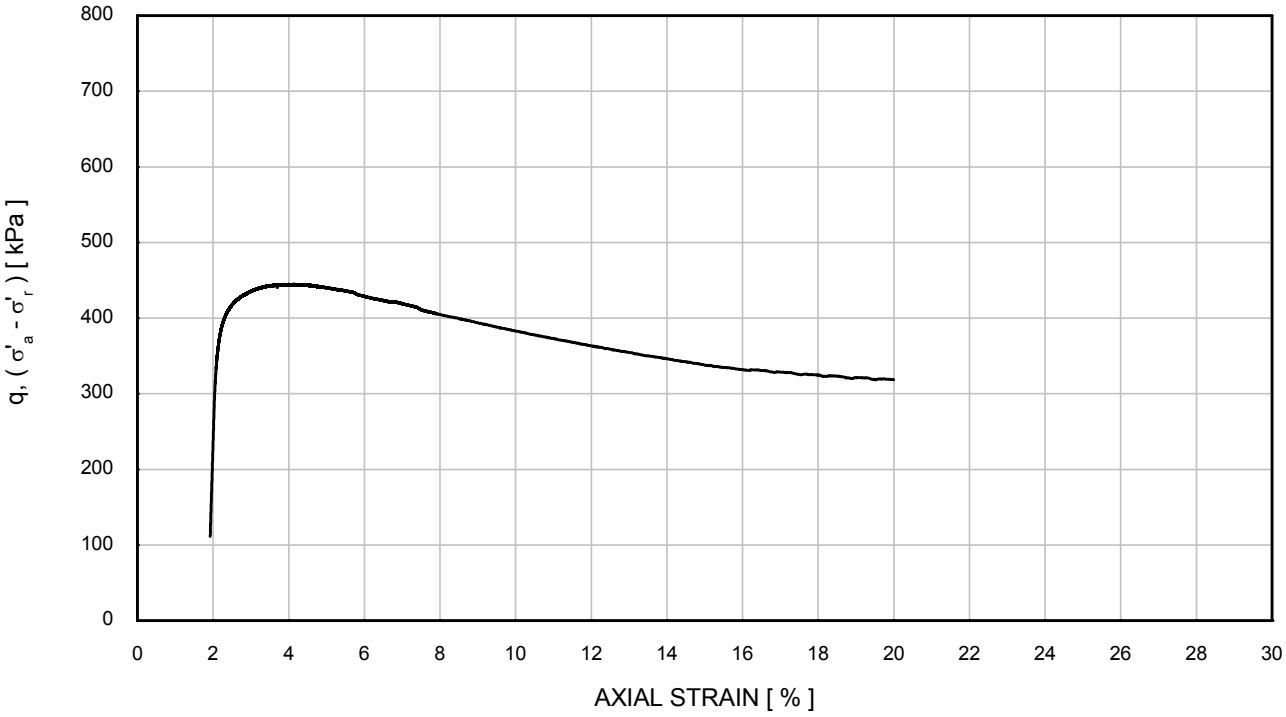
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

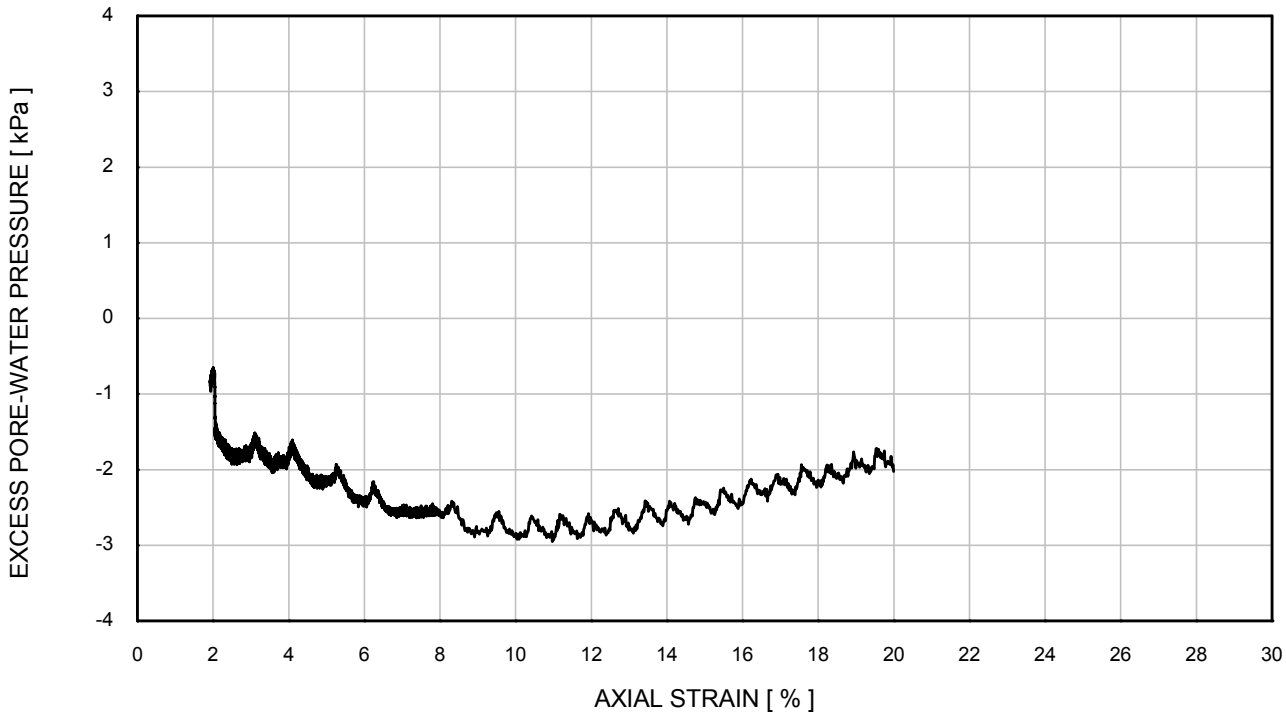




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 247 kPa	Sample	: CTXL_3-5
q_{av}	: 112 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 178 kPa	Test No.	: CTX09
Frequency	: 0.10 Hz		

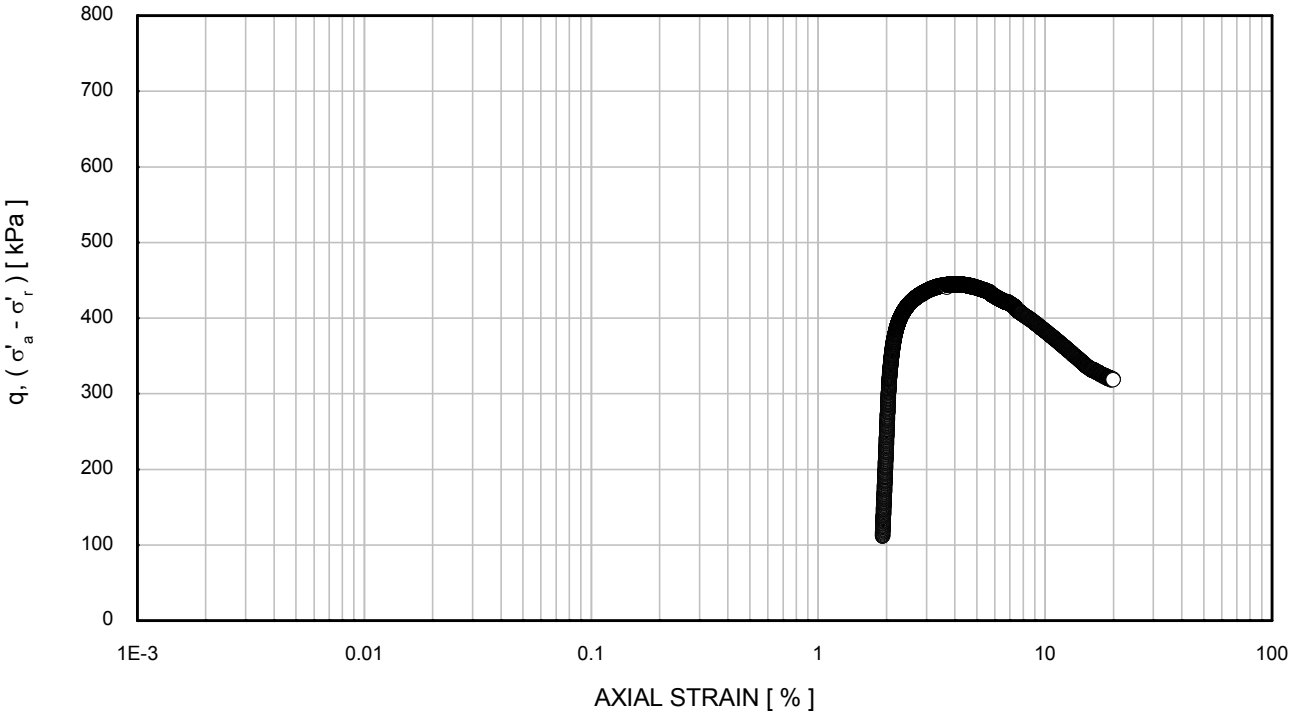
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SECOND CYCLIC LOADING STAGE - DRAINED

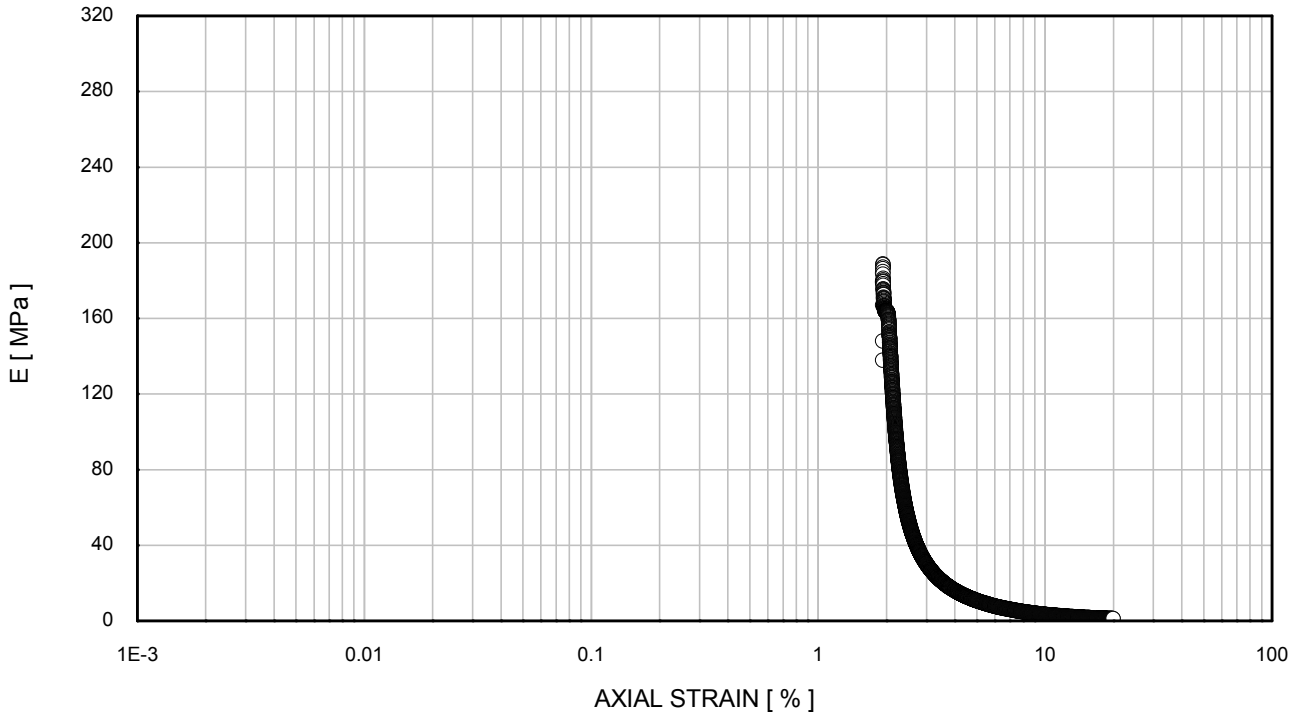




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	246 kPa	Sample	:	CTXL_3-5
q_{peak}	:	445 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.14 %	Test No.	:	CTX09
Rate of strain	:	1.00 %/hour			

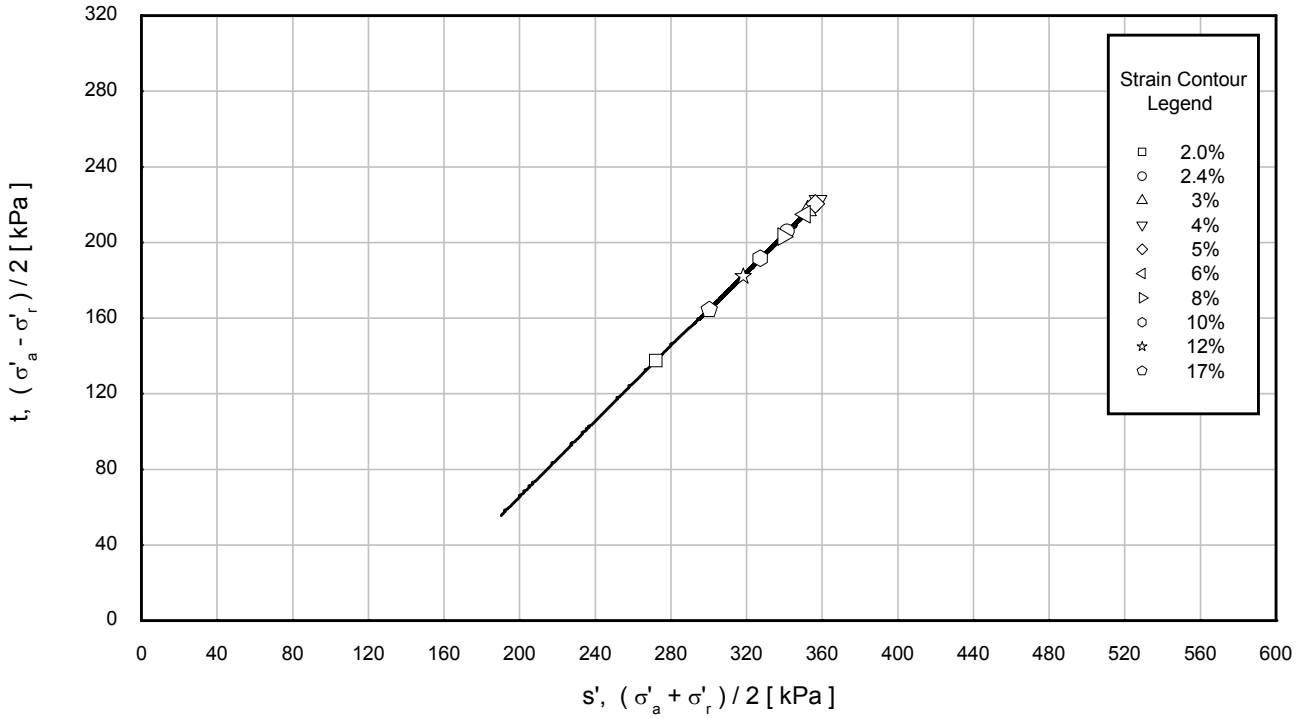
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

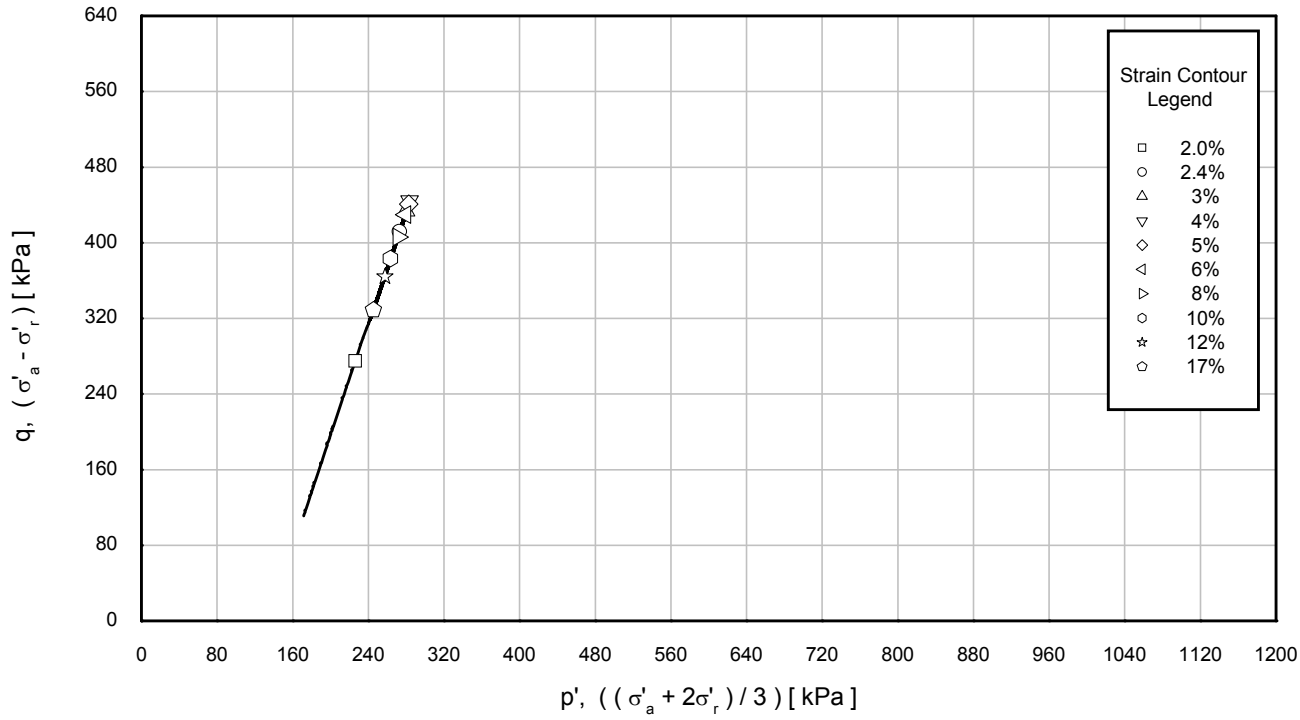




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	246 kPa	Sample	:	CTXL_3-5
q_{peak}	:	445 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.14 %	Test No.	:	CTX09
Rate of strain	:	1.00 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	135	kPa	Batch	: 3
Initial σ'_a	:	246	kPa	Sample	: CTXL_3-5
q_{peak}	:	445	kPa	Unit	: Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.14	%	Test No.	: CTX09
Rate of strain	:	1.00	%/hour		

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND with traces of shell fragments

GENERAL	
Date test started	20/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.4
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.63
Void ratio	[-]	0.622
Degree of saturation	[%]	44
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	BS1377: Part 8: 1990 Clause 4 Fugro testing procedure L-T-023 Clause 5.2.2
Saturation	Fugro testing procedure L-T-023 Clause 5.2.3 BS1377: Part 8: 1990 Clause 5.3
Consolidation - Isotropic	BS1377: Part 8: 1990 Clause 6
Consolidation - Anisotropic	Not applicable
Shearing	BS1377: Part 8: 1990 Clause 7
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.0
Filename	J11335 \ Batch 03_CTX10
Processed by	JLS
Date	04/01/2016
Checked by	PH
Date	06/01/2017
Approved by	PH
Date	06/01/2017

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	1100
Base PWP	[kPa]	1087
Mid height PWP	[kPa]	-
B value achieved	[-]	0.97

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	1222
Back pressure	[kPa]	1087
Base PWP	[kPa]	1087
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.68
External axial strain	[%]	0.23
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.1
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.611
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 1		
Cell pressure	[kPa]	1222
Back pressure	[kPa]	1087
Base PWP	[kPa]	1087
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	224
Deviator stress	[kPa]	90
Volumetric strain	[%]	0.80
External axial strain	[%]	0.50
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	23.0
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.609
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 1		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	90
Mean q_{cy}	[kPa]	67
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	1500
External ε_{av} at N	[%]	1.27
External ε_{cy} at N	[%]	0.05
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	-1
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.7
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.602
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	0.73	0.23	28.96	-	19.48	-
2	0.93	0.05	136.40	-	9.65	-
5	0.95	0.05	139.00	-	5.89	-
10	0.97	0.05	140.13	-	4.51	-
20	1.00	0.05	139.94	-	3.58	-
30	1.02	0.05	139.53	-	3.23	-
40	1.03	0.05	139.31	-	2.89	-
50	1.04	0.05	139.37	-	2.70	-
100	1.07	0.05	139.30	-	2.54	-
500	1.17	0.05	137.49	-	1.97	-
1000	1.23	0.05	136.13	-	1.88	-
1500	1.27	0.05	135.57	-	1.79	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

CYCLIC PRE LOADING 2		
Cell pressure	[kPa]	1222
Back pressure	[kPa]	1087
Base PWP	[kPa]	1087
Mid height PWP	[kPa]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	292
Deviator stress	[kPa]	157
Volumetric strain	[%]	1.20
External axial strain	[%]	1.32
Local axial strain	[%]	-
Local radial strain	[%]	-
Water content	[%]	22.7
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.602
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

STRESS-CONTROLLED CYCLIC LOADING STAGE 2		
Reference stress (Deviator)	[kPa]	448
Mean q_{av}	[kPa]	157
Mean q_{cy}	[kPa]	157
Frequency	[Hz]	0.10
Number of cycles applied (N)	[-]	400
External ε_{av} at N	[%]	3.51
External ε_{cy} at N	[%]	0.11
Local ε_{av} at N	[%]	-
Local ε_{cy} at N	[%]	-
Δ base PWP at N	[kPa]	-1
Δ mid height PWP at N	[kPa]	-
Water content	[%]	22.3
Bulk density	[Mg/m³]	2.04
Dry density	[Mg/m³]	1.67
Void ratio	[-]	0.590
Degree of saturation	[%]	100

Cycle (N)	ε_{av} [%]	ε_{cy} [%]	E_{ext} [MPa]	E_{loc} [MPa]	λ_{ext} [%]	λ_{loc} [%]
1	1.56	0.24	65.01	-	23.87	-
2	1.81	0.14	114.60	-	23.74	-
5	2.05	0.13	120.37	-	16.01	-
10	2.22	0.12	129.38	-	11.49	-
20	2.41	0.12	135.42	-	9.13	-
30	2.53	0.11	138.48	-	8.33	-
40	2.62	0.11	139.82	-	7.77	-
50	2.69	0.11	140.96	-	7.40	-
100	2.92	0.11	142.32	-	6.30	-
200	3.20	0.11	143.18	-	5.62	-
300	3.37	0.11	144.84	-	5.28	-
400	3.51	0.11	144.90	-	5.09	-

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SHEARING STAGE		
Initial effective radial pressure	[kPa]	135
Initial effective axial pressure	[kPa]	289
Rate of strain	[%/hour]	1.43
At peak deviator stress		
Corrected deviator stress	[kPa]	420
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	4.89
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	1.29
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	136
Effective axial pressure	[kPa]	556
Principal effective stress ratio	[-]	4.09
ε_{50}	[%]	3.61
Secant modulus (E_{50}) at ε_{50}	[kPa]	175564
At peak principal effective stress ratio		
Corrected deviator stress	[kPa]	419
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	4.94
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	1.26
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	134
Effective axial pressure	[kPa]	553
Principal effective stress ratio	[-]	4.12
At 15% external axial strain		
Corrected deviator stress	[kPa]	325
Membrane correction applied	[kPa]	1
Drain correction applied	[kPa]	0
External axial strain	[%]	15.00
Local axial strain	[%]	-
Local radial strain	[%]	-
Volumetric strain	[%]	-1.28
Local volumetric strain	[%]	-
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	460
Principal effective stress ratio	[-]	3.42

TEST IDENTIFICATION	
Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

SPECIMEN PHOTOGRAPHS





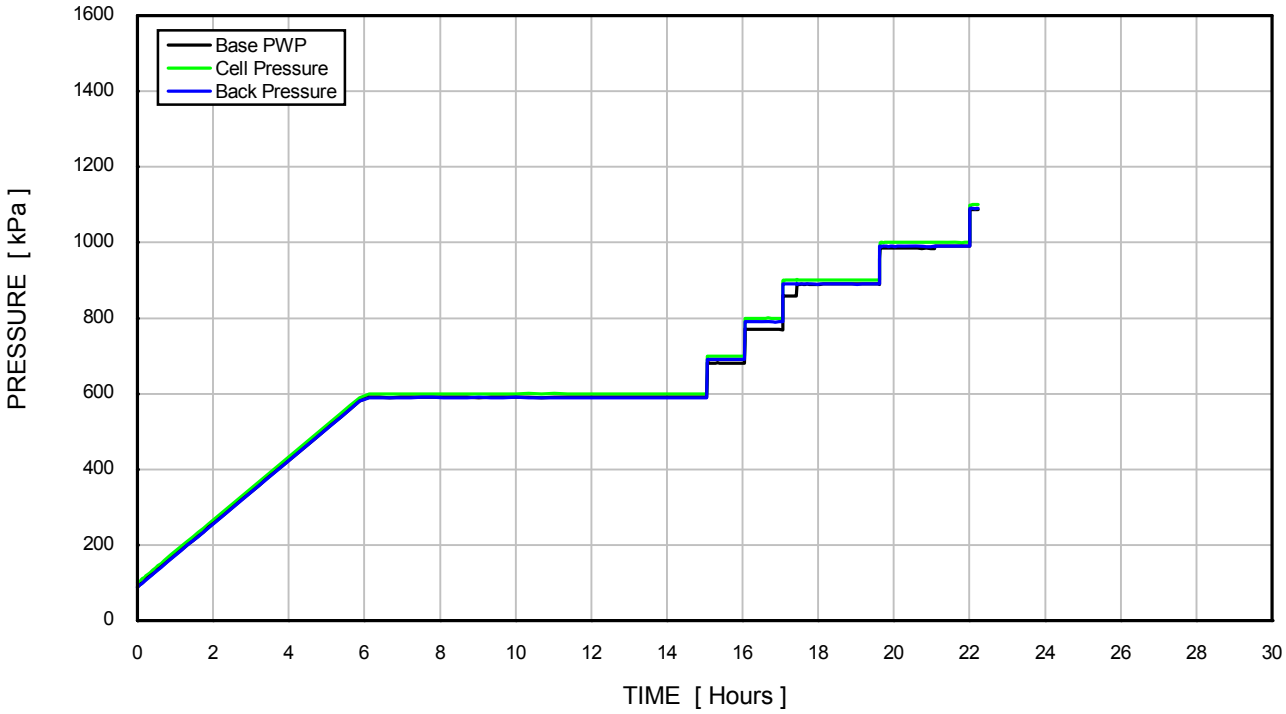
FINAL CONDITIONS

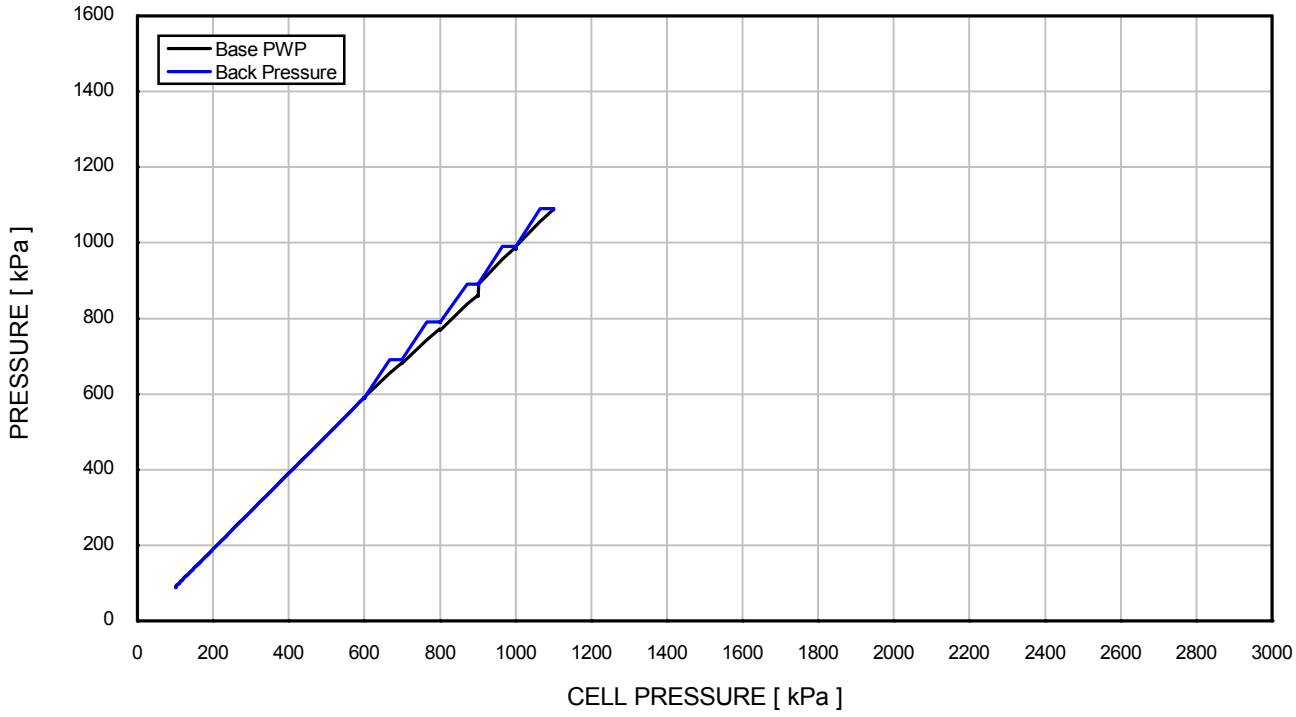
Water content	[%]	24.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.61

TEST IDENTIFICATION

Batch	3
Sample	CTX_3-4
Unit	Unit B1 (Kreftenheye)
Test number	CTX10

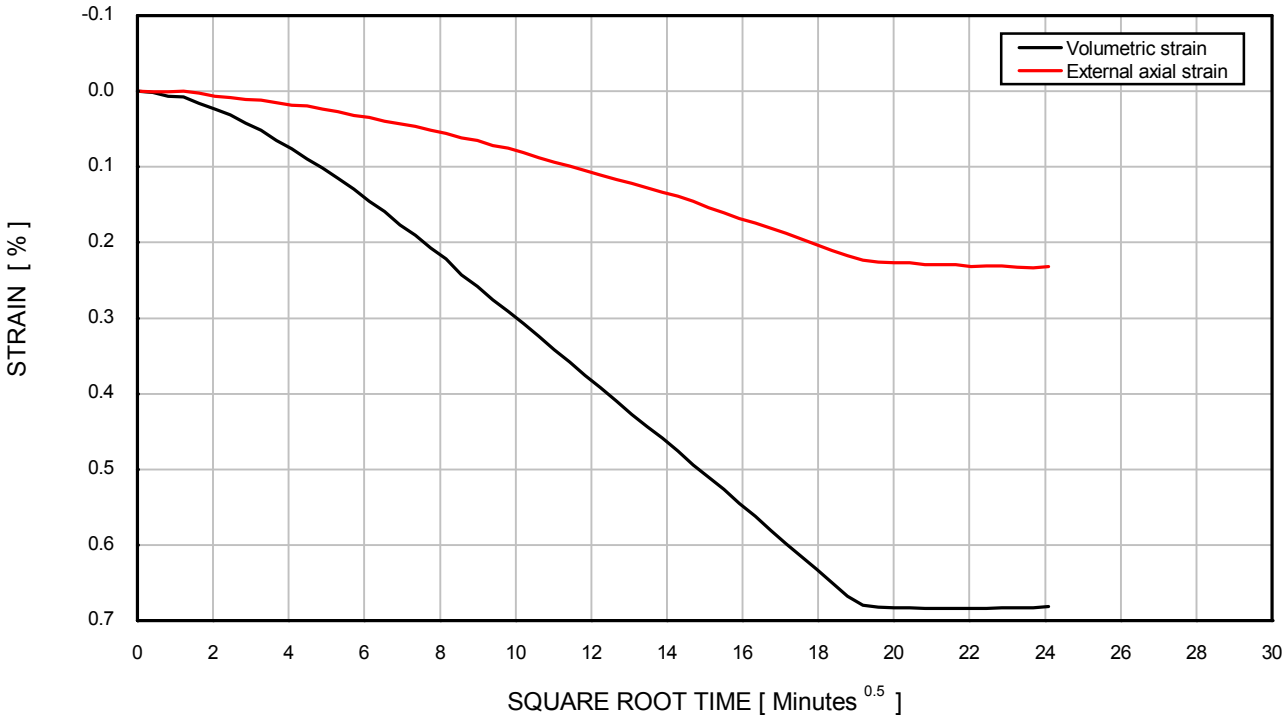
SUMMARY OF ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST

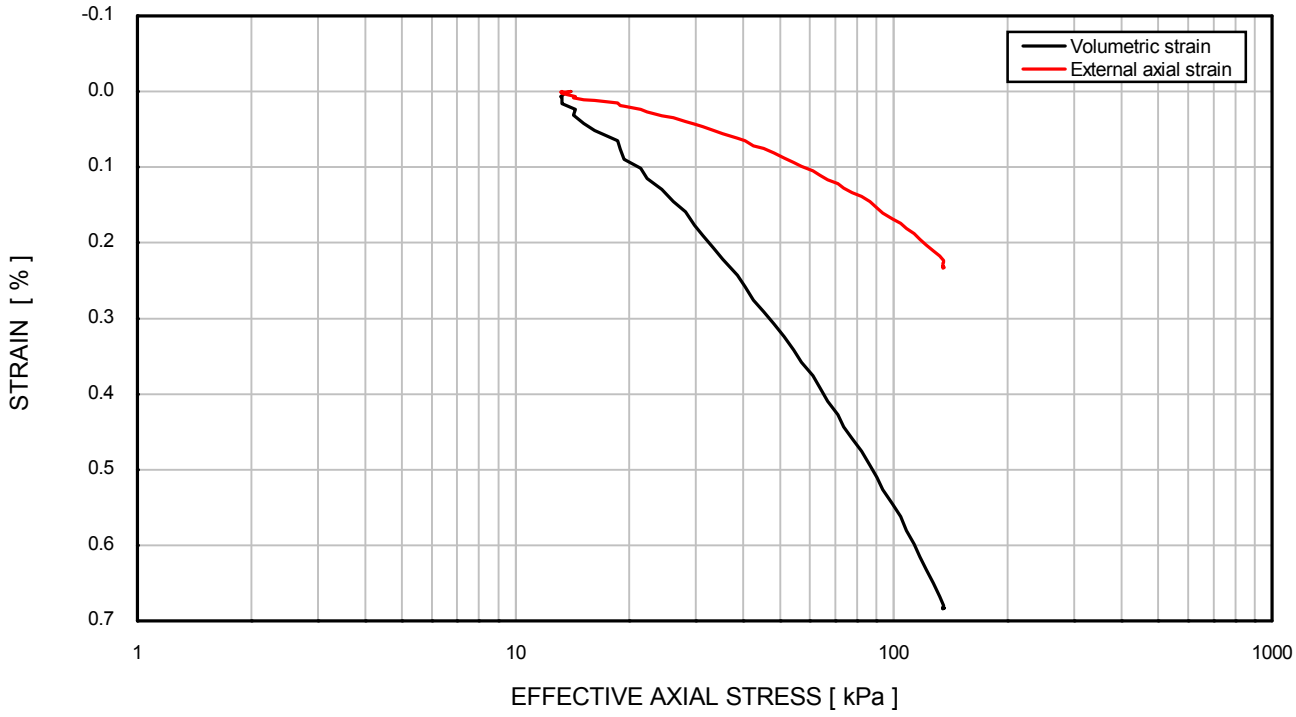




B value	:	0.97	Batch	:	3
Initial σ'_r	:	13 kPa	Sample	:	CTX_3-4
Initial σ'_a	:	13 kPa	Unit	:	Unit B1 (Kreftenheye)
Final σ'_r	:	13 kPa	Test No.	:	CTX10
Final σ'_a	:	13 kPa			

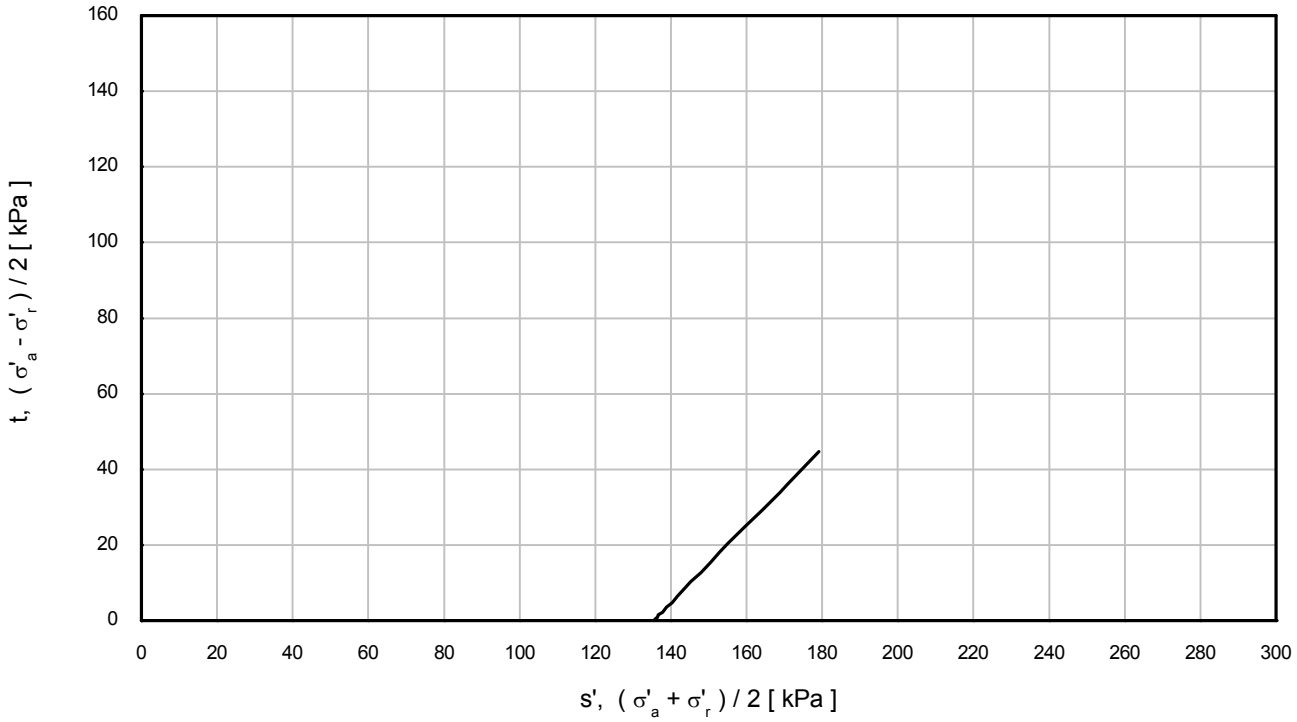
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SATURATION STAGE - DRAINED

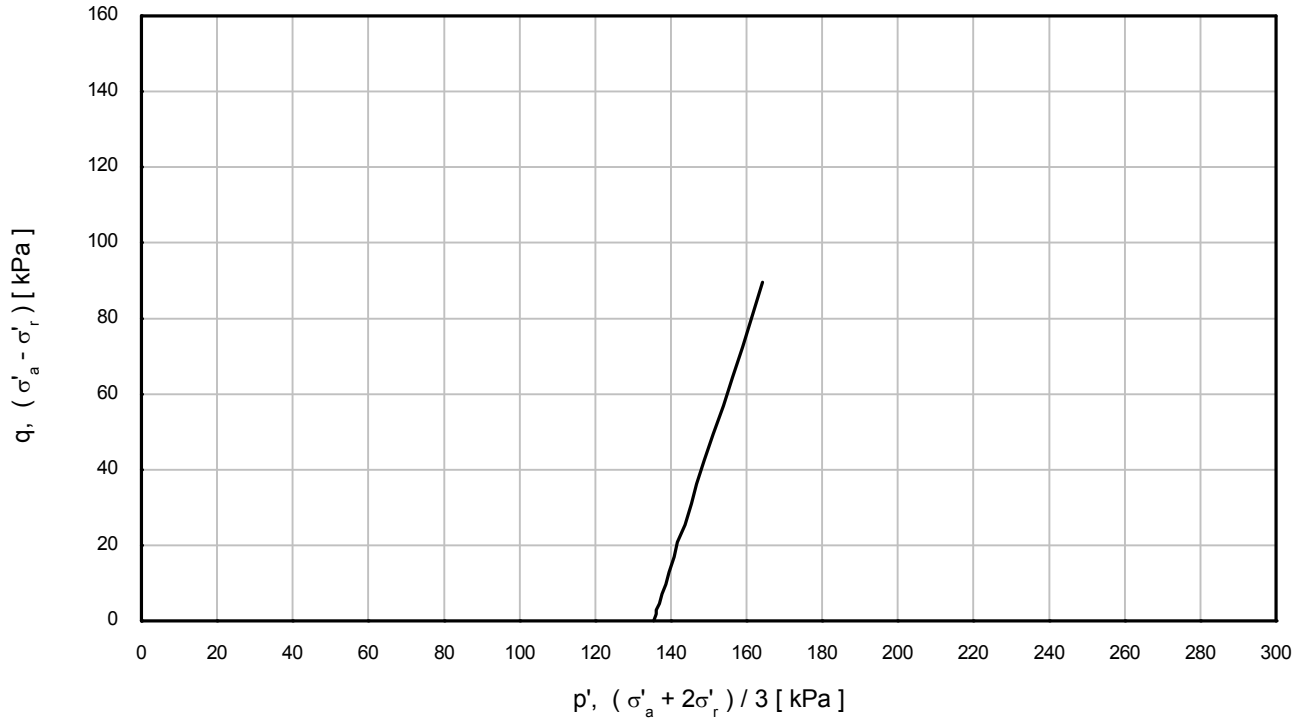




Stage 1 σ'_{rc}	: 135 kPa	Batch	: 3
Stage 1 σ'_{ac}	: 135 kPa	Sample	: CTX_3-4
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX10

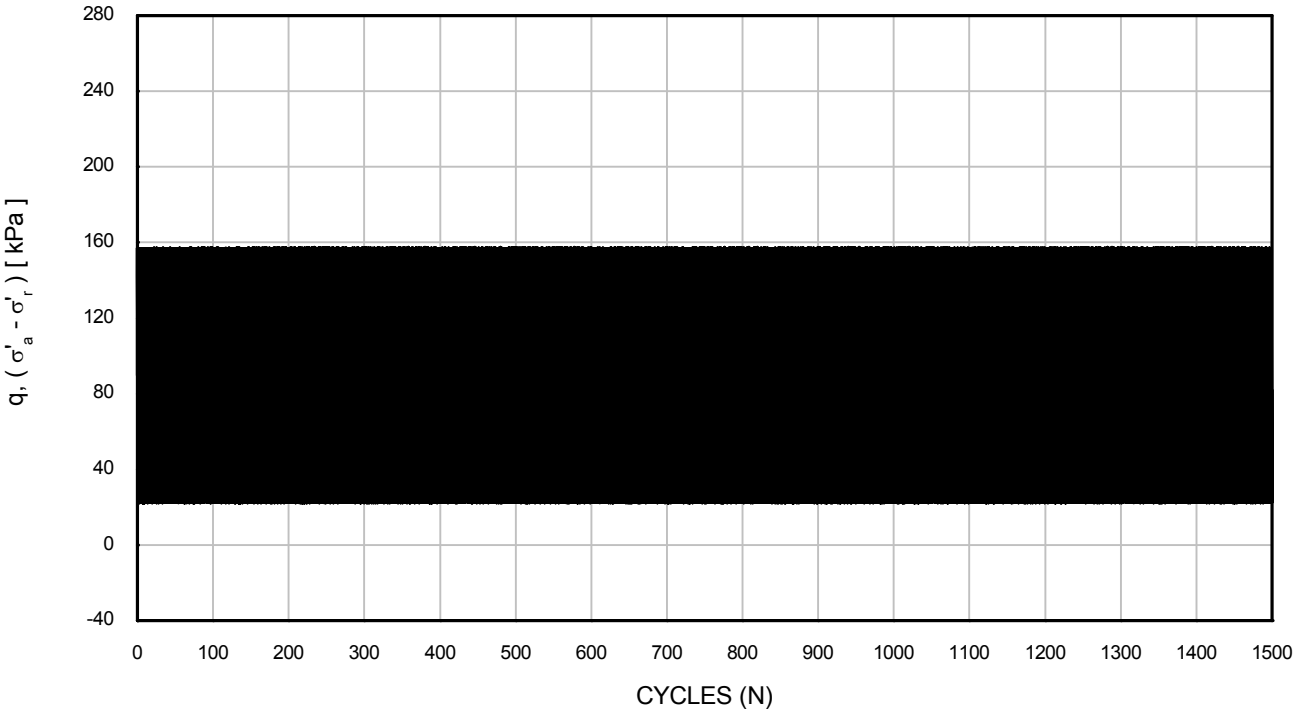
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
ISOTROPIC CONSOLIDATION STAGE

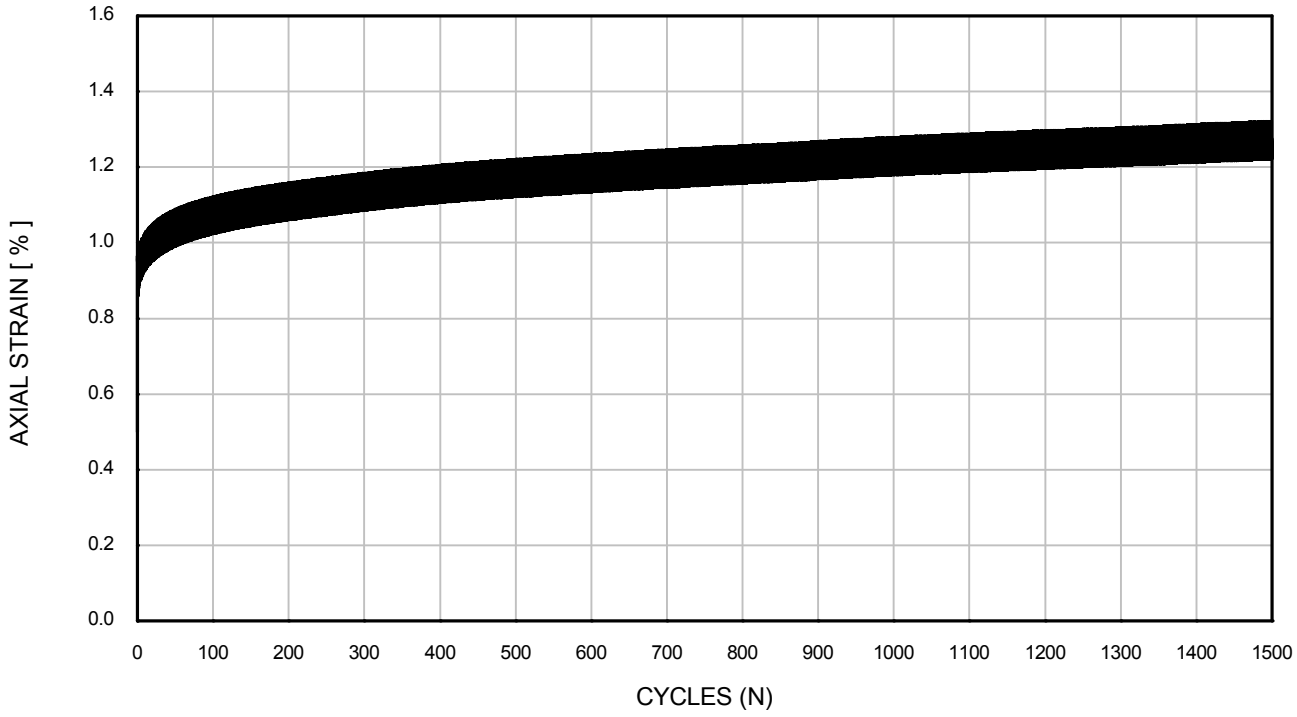




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 224 kPa	Sample	: CTX_3-4
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX10

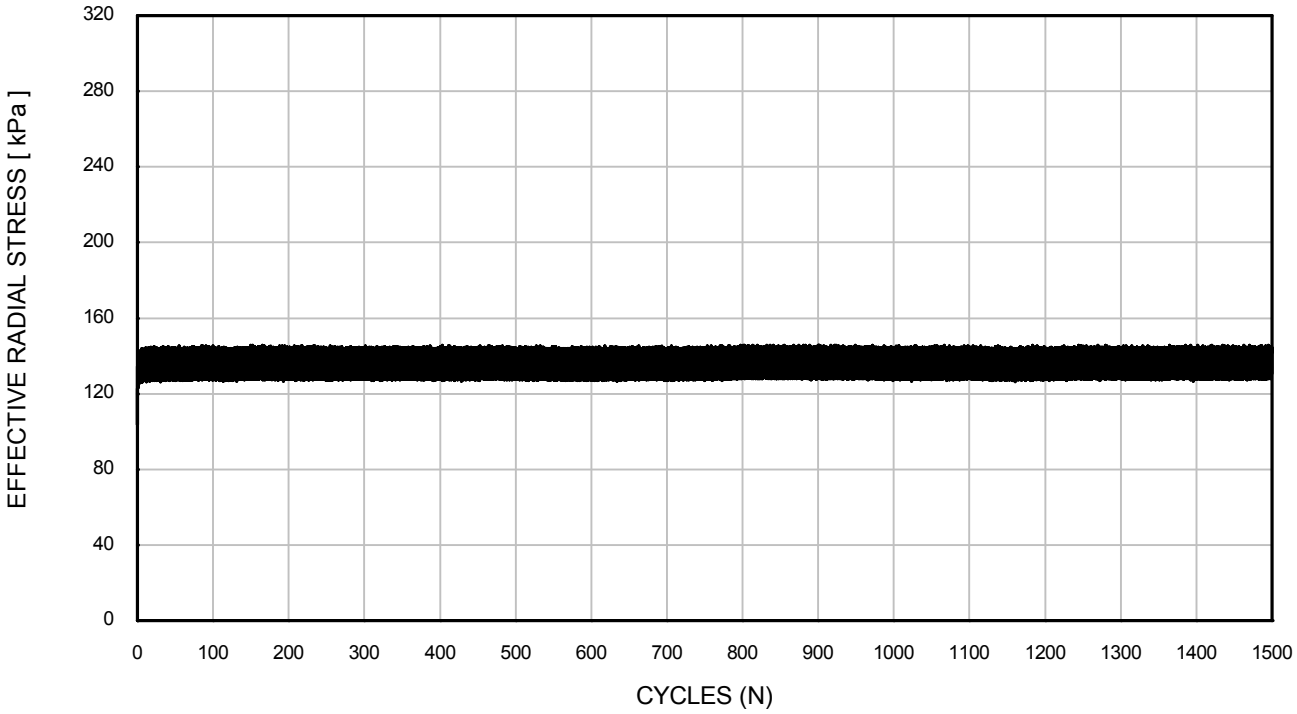
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 1 - DRAINED

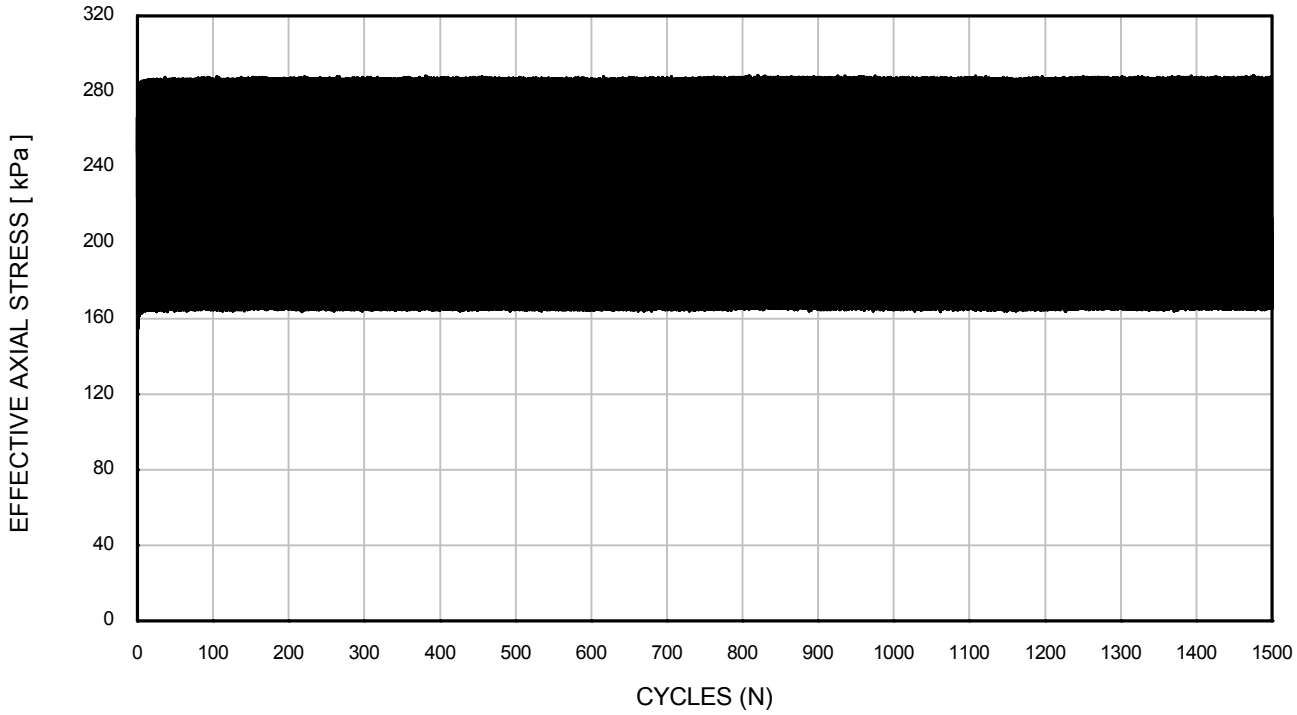




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

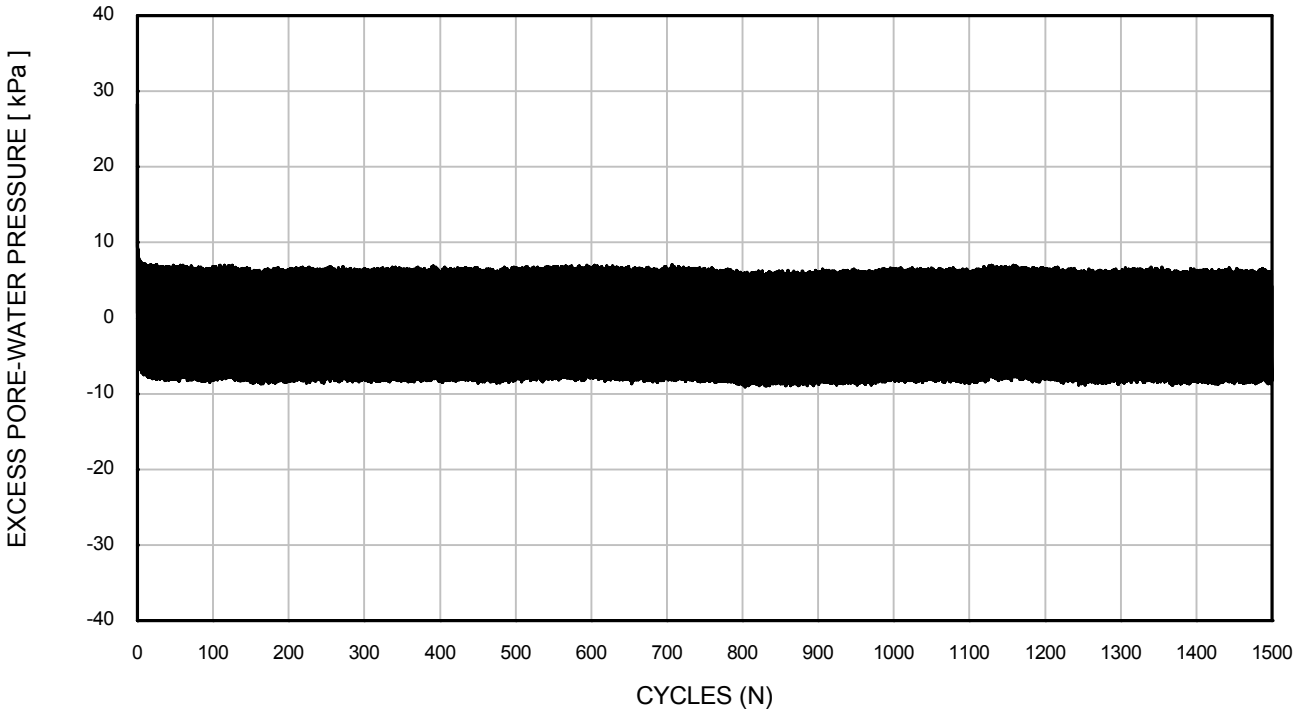
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CYCLIC LOADING STAGE 1 - DRAINED

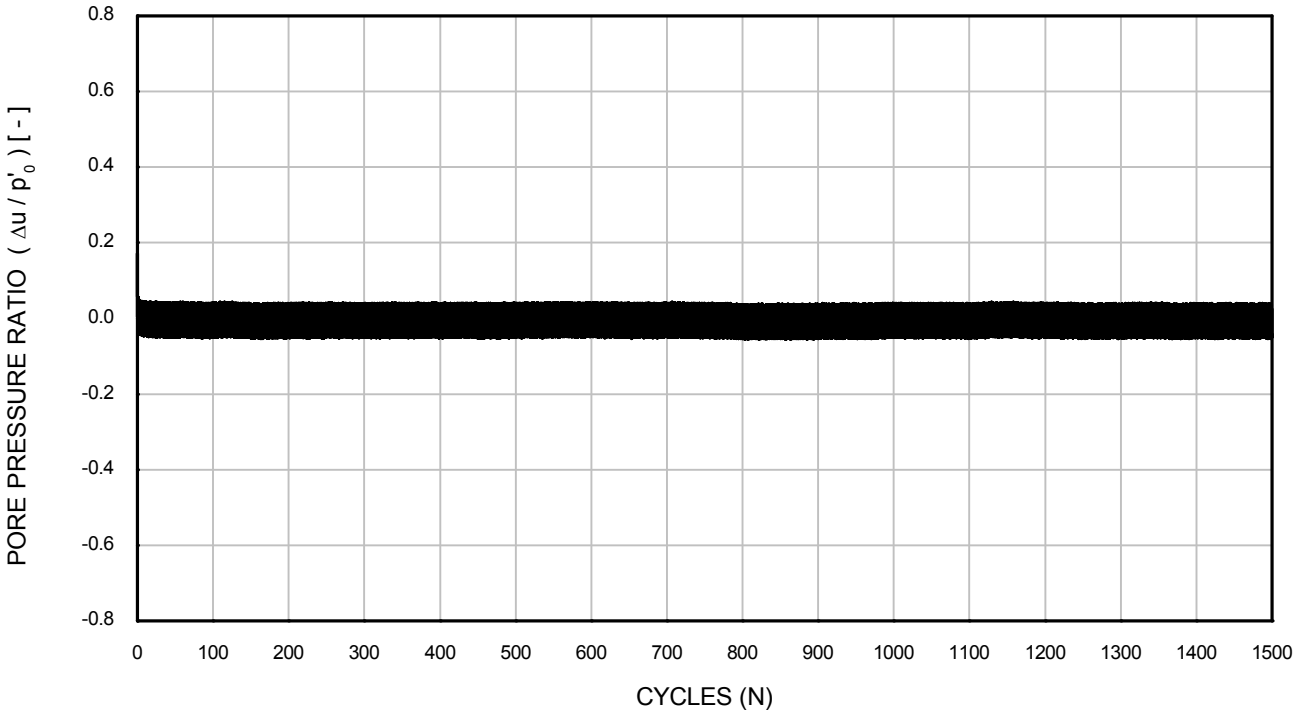




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

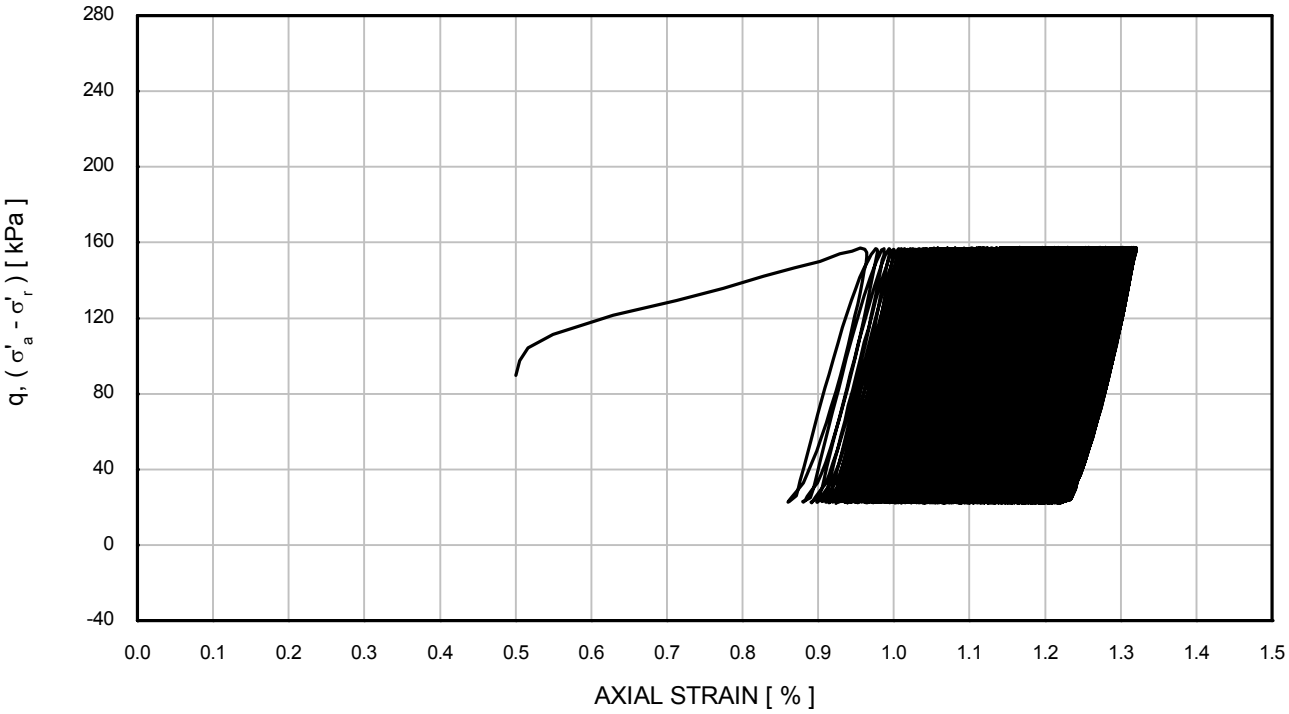
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

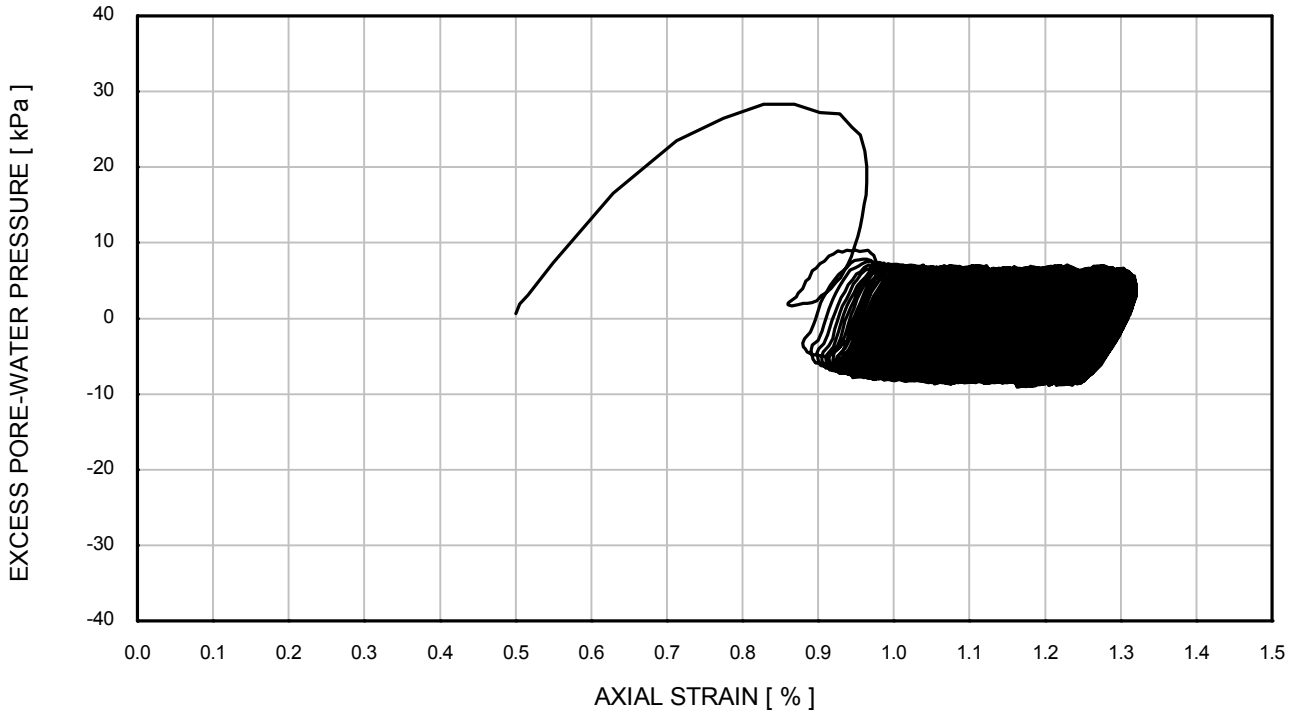




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

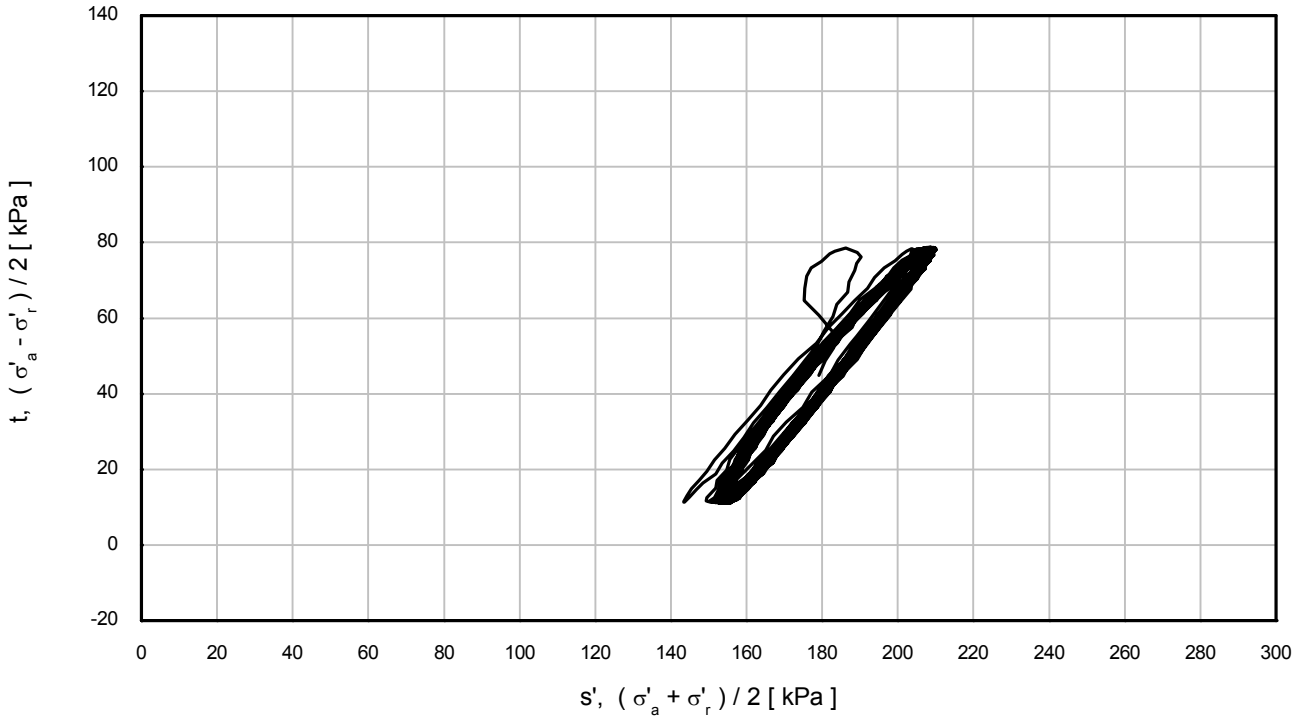
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CYCLIC LOADING STAGE 1 - DRAINED

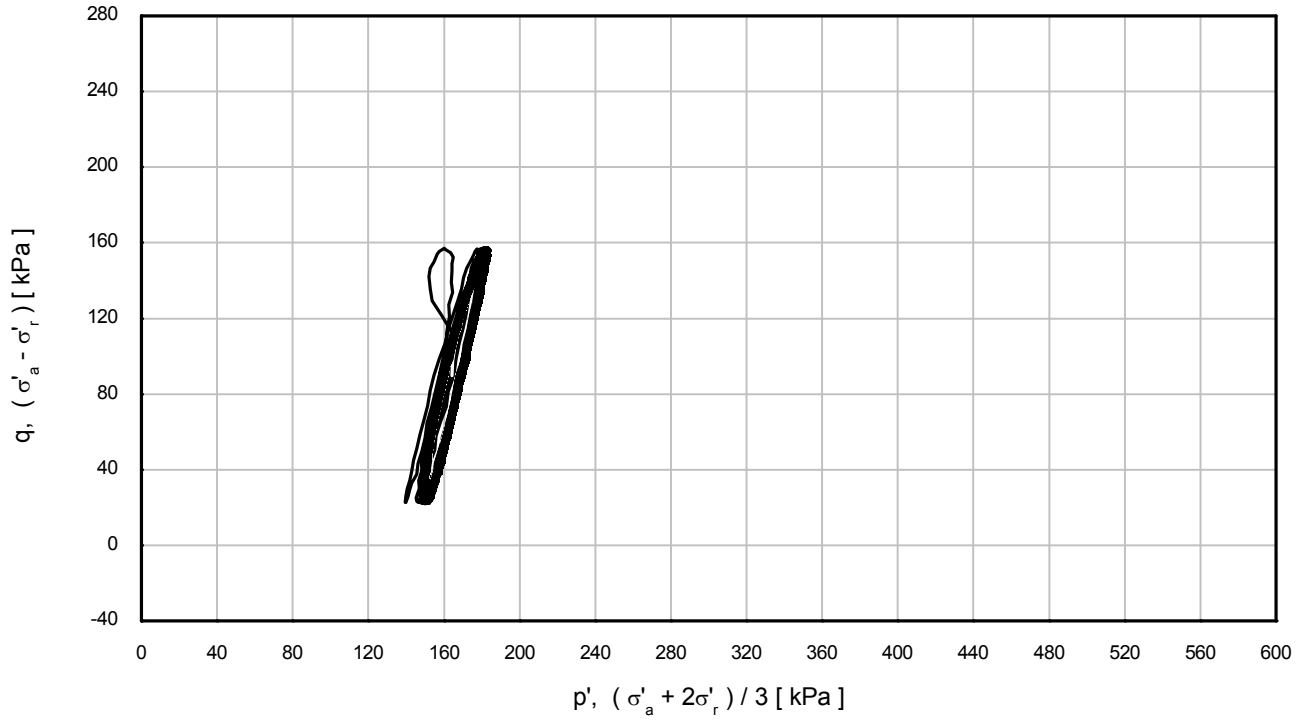




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

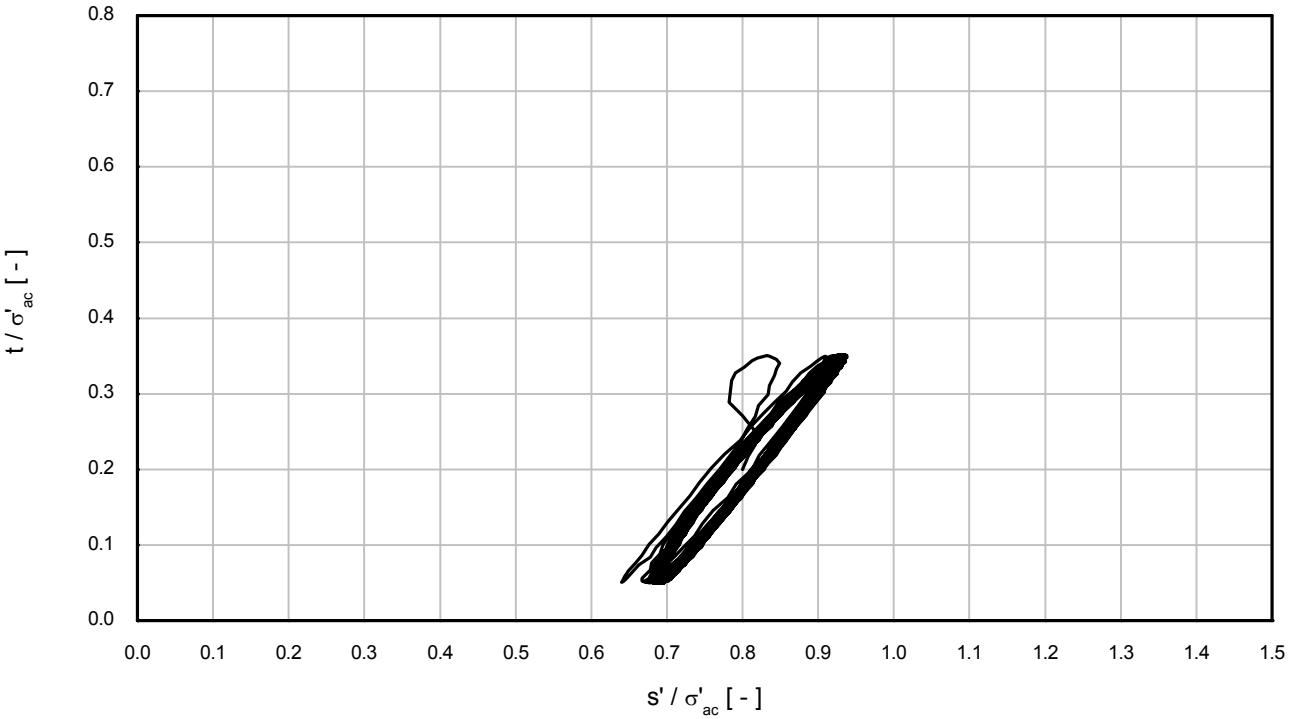
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 1 - DRAINED

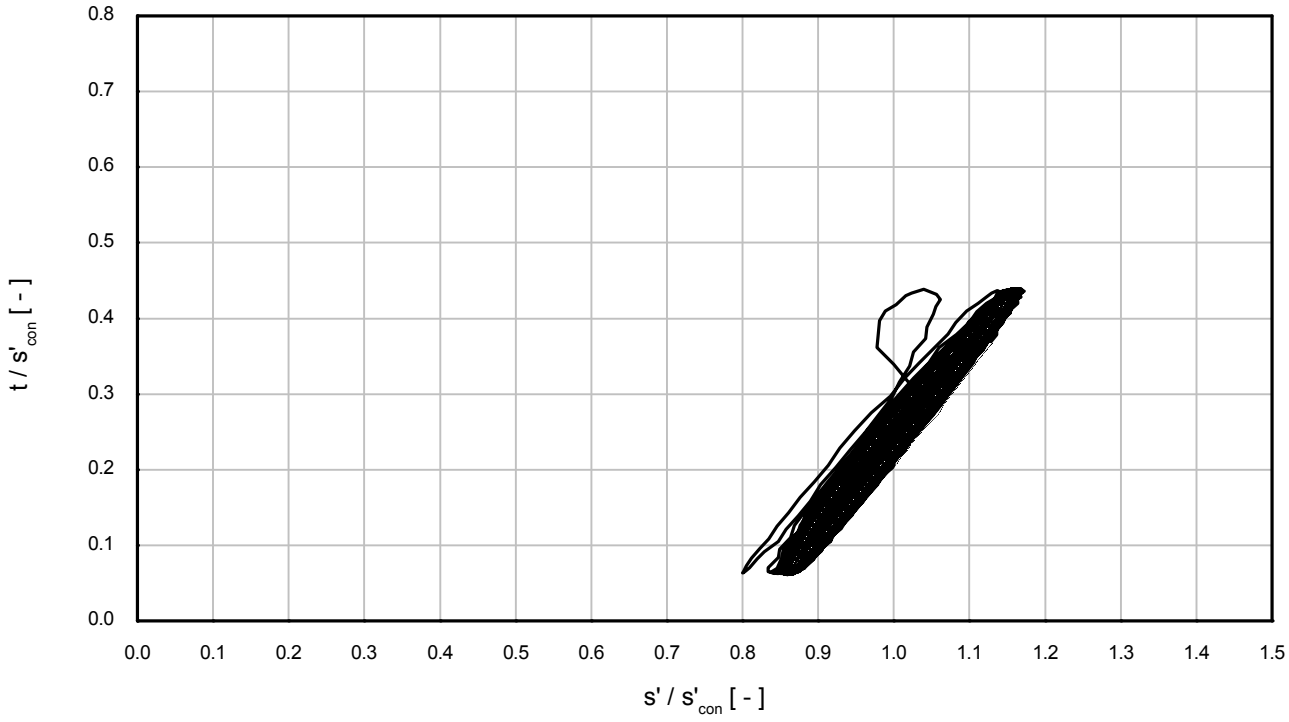




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

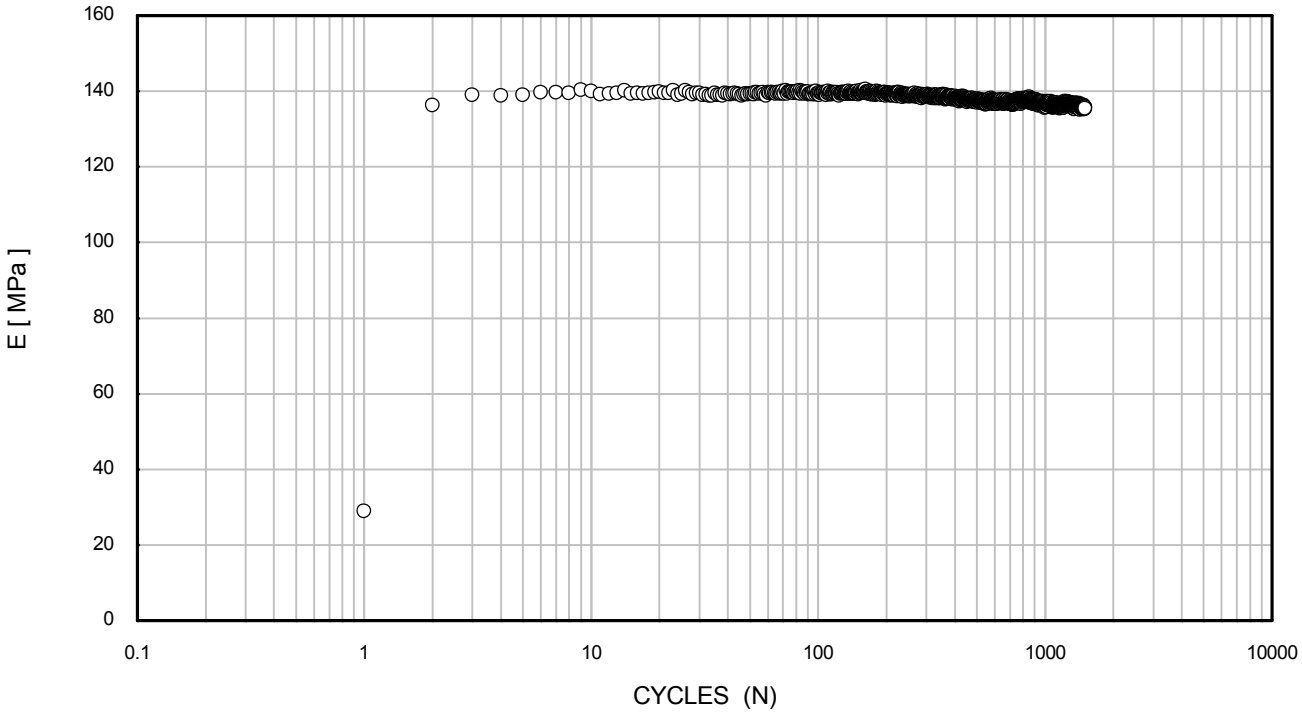
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CYCLIC LOADING STAGE 1 - DRAINED

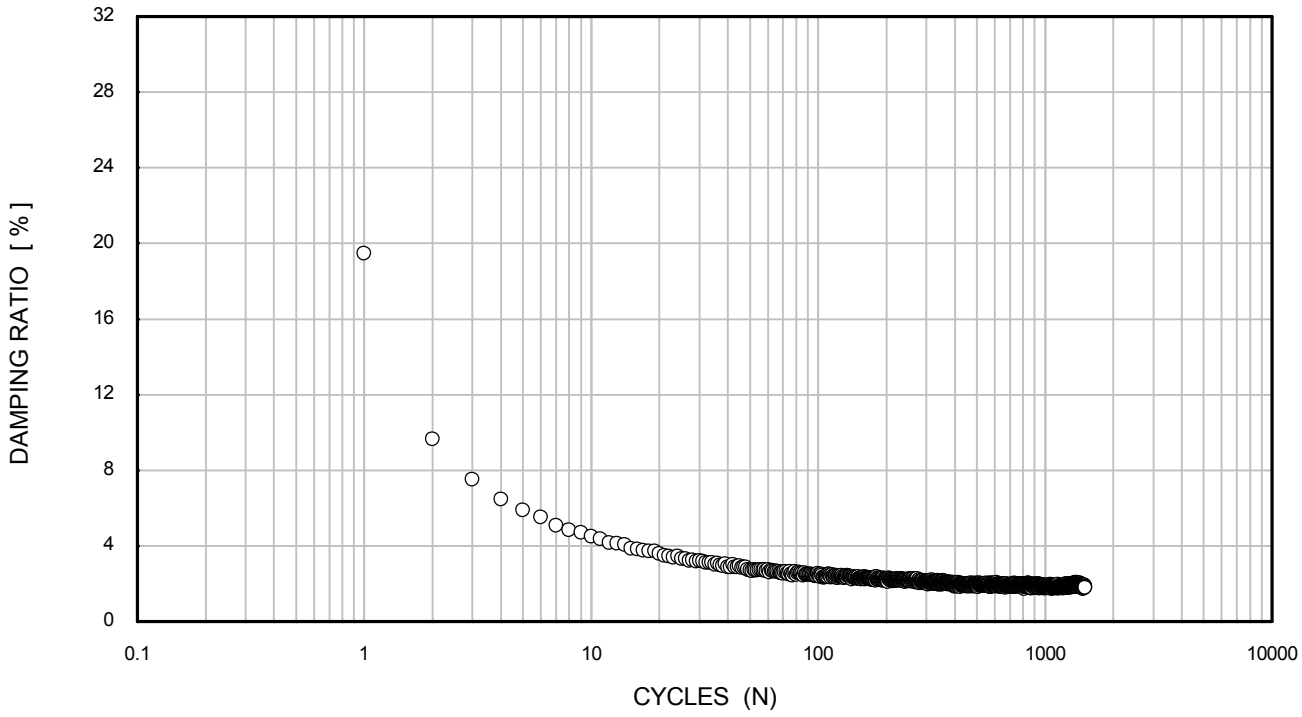




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

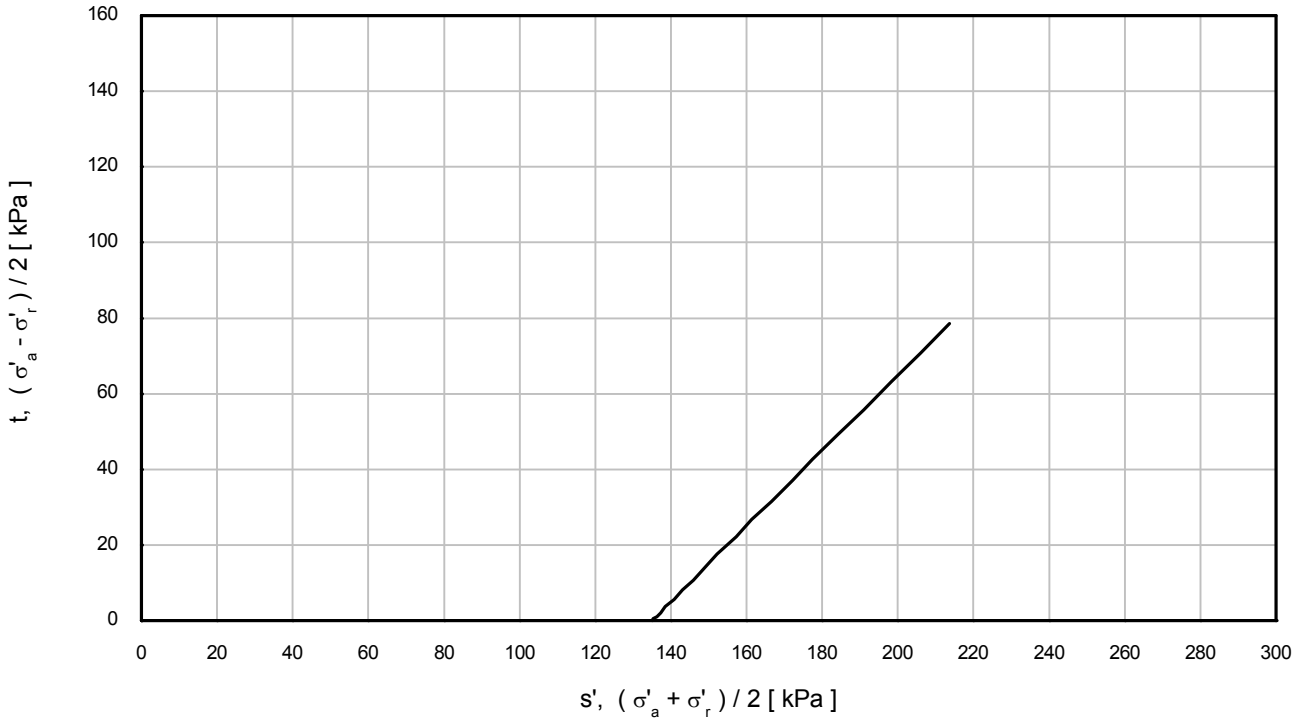
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CYCLIC LOADING STAGE 1 - DRAINED

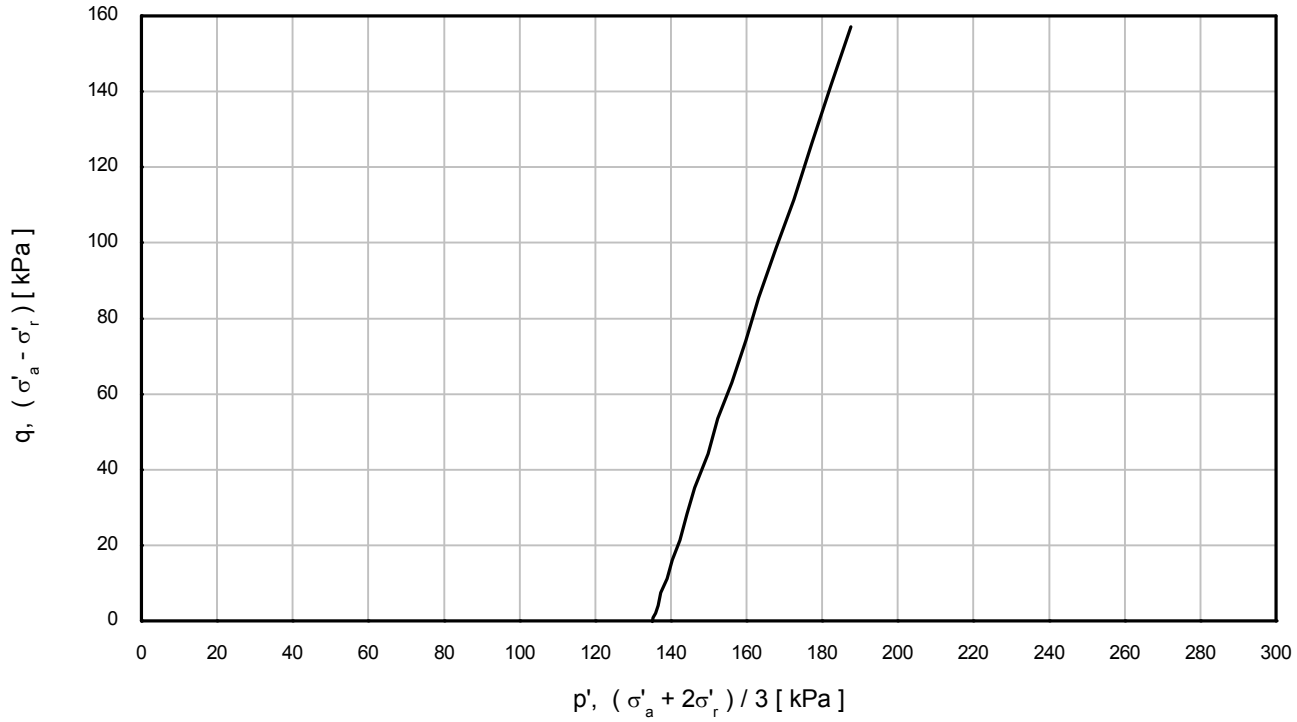




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	224 kPa	Sample	:	CTX_3-4
q_{av}	:	90 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	67 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

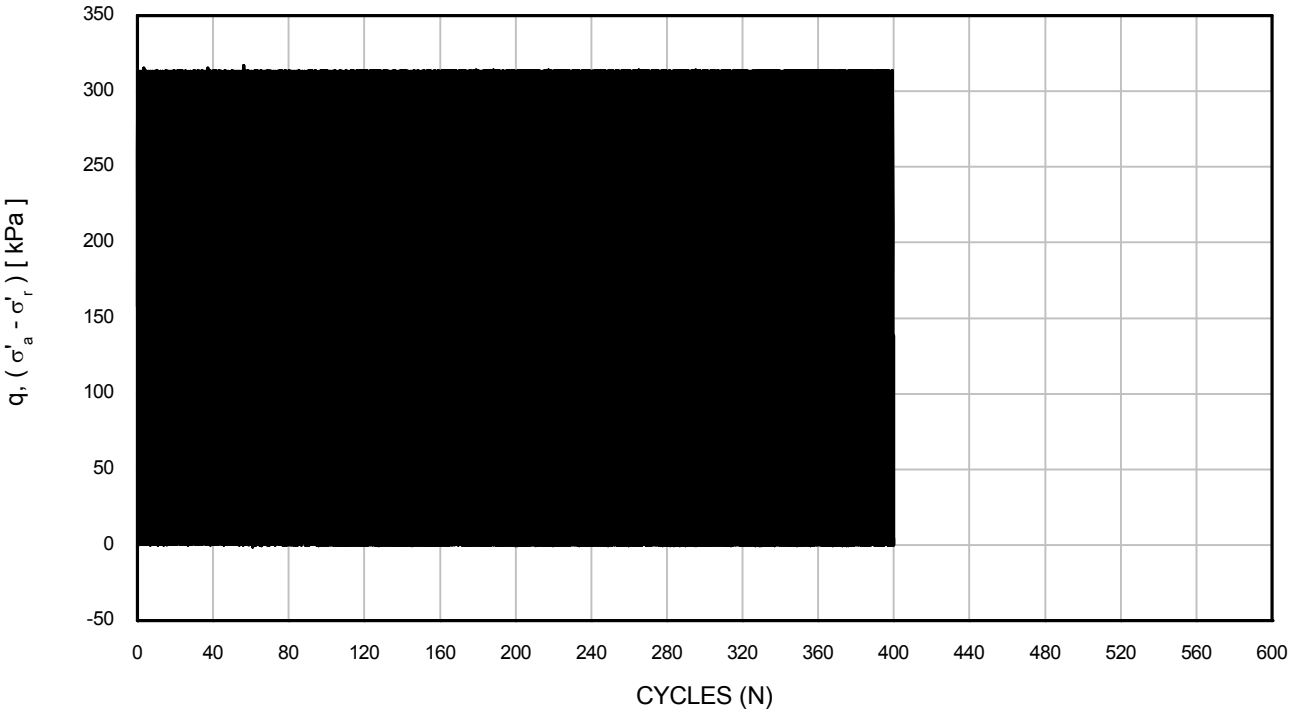
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CYCLIC LOADING STAGE 1 - DRAINED

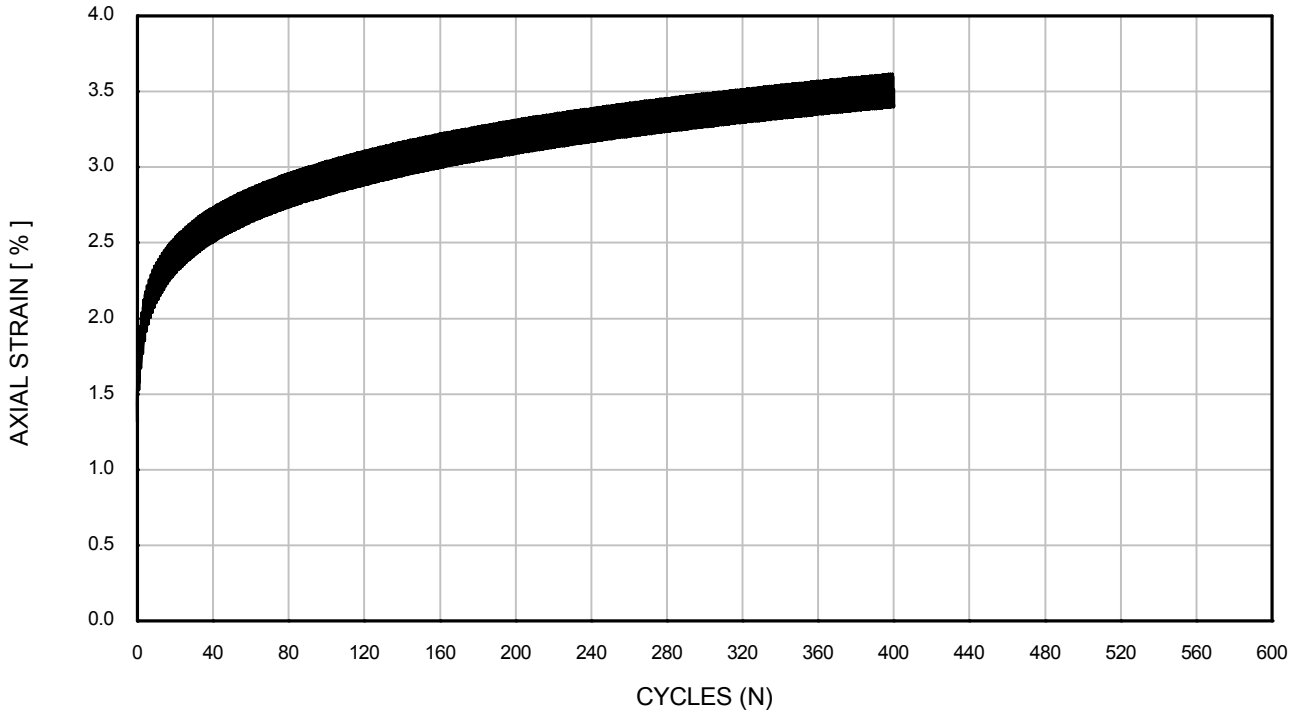




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 292 kPa	Sample	: CTX_3-4
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: CTX10

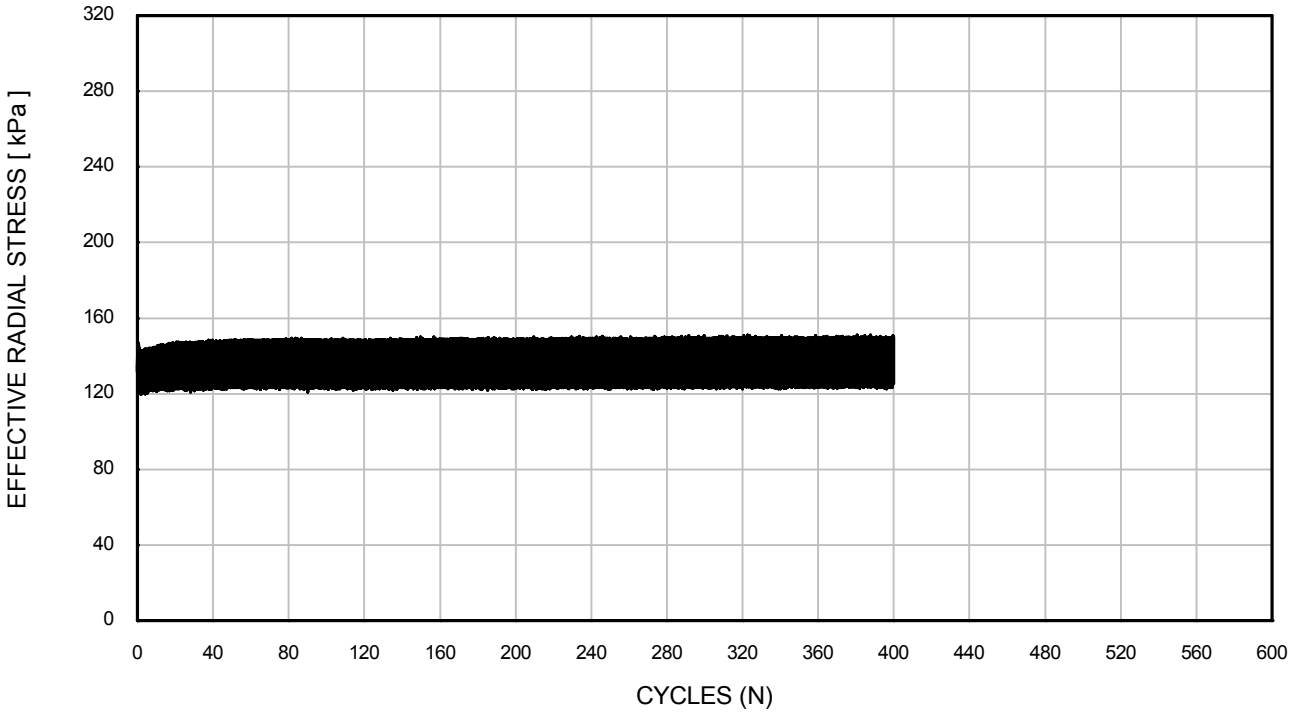
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
PRELOADING STAGE 2 - DRAINED

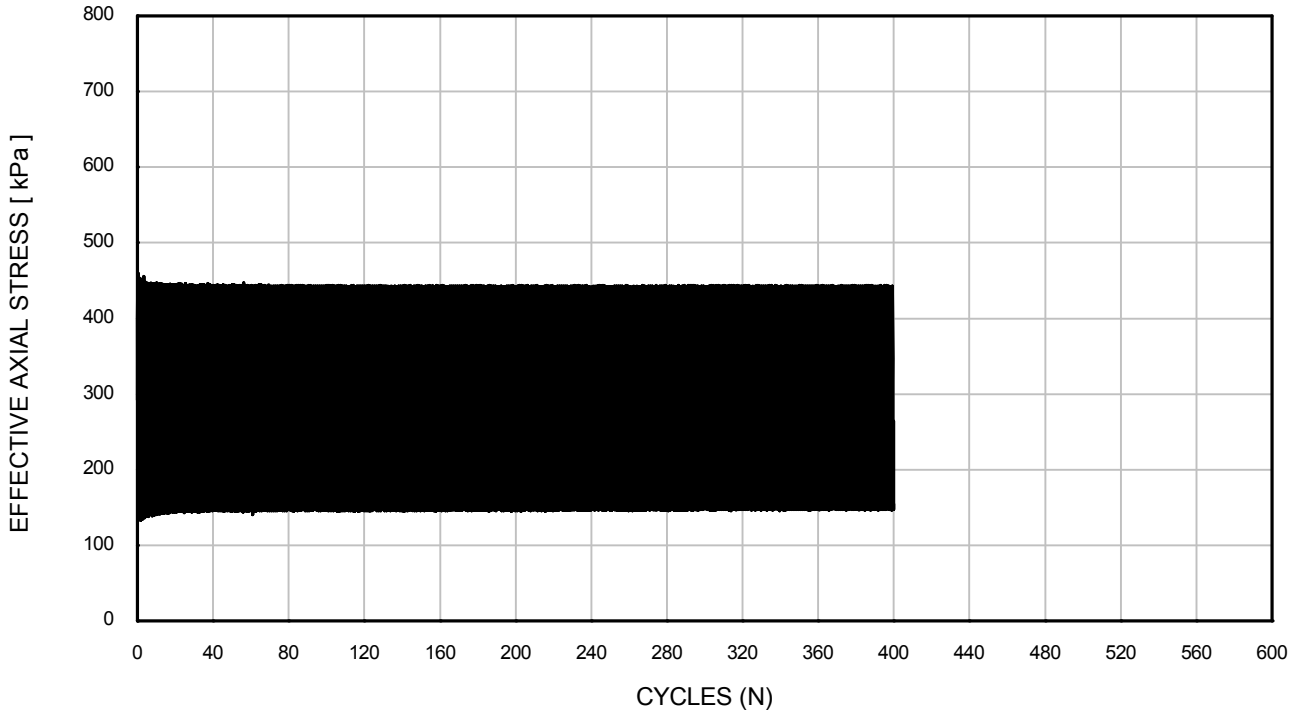




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	292 kPa	Sample	:	CTX_3-4
q_{av}	:	157 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	157 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

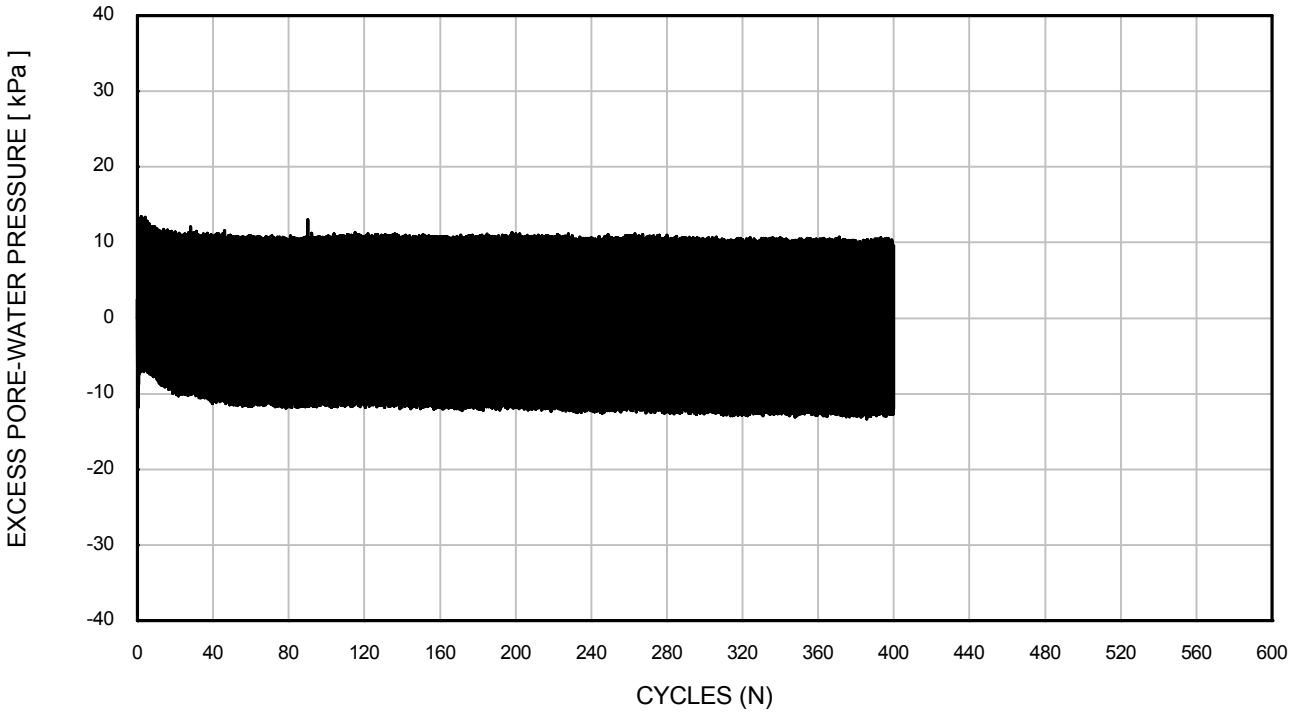
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

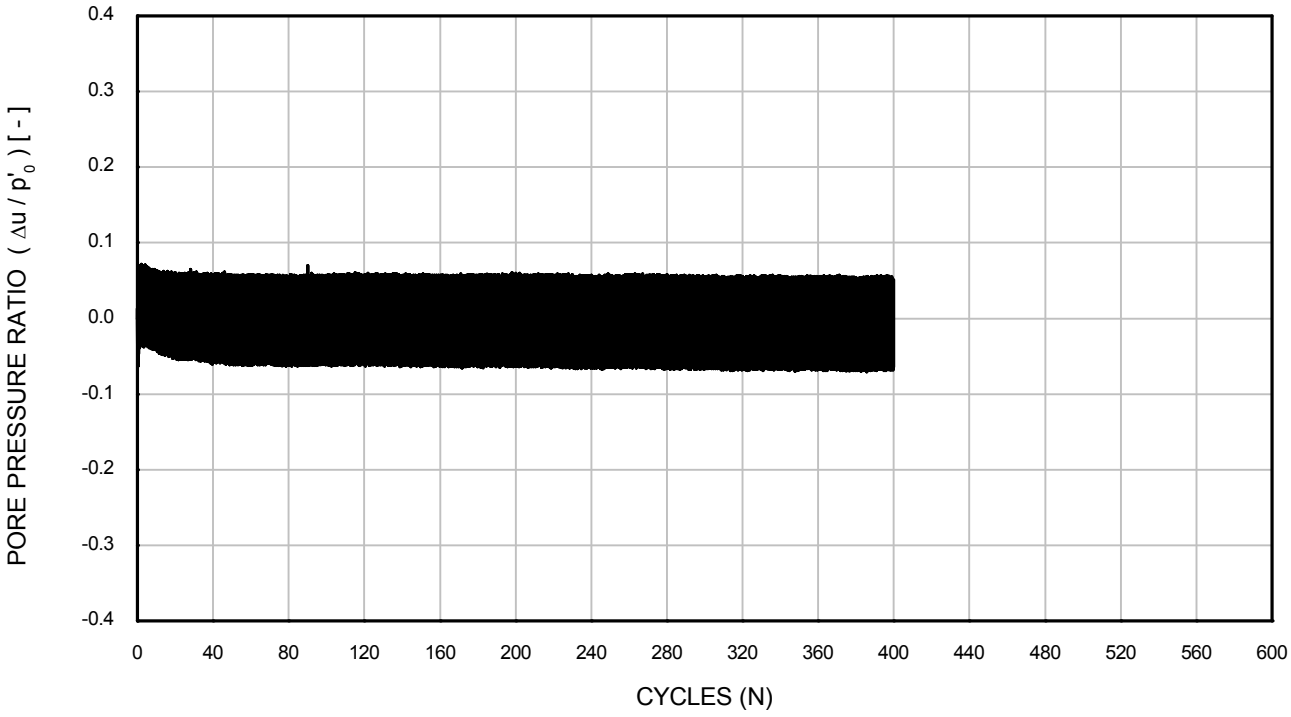




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-4
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 157 kPa	Test No.	: CTX10
Frequency	: 0.10 Hz		

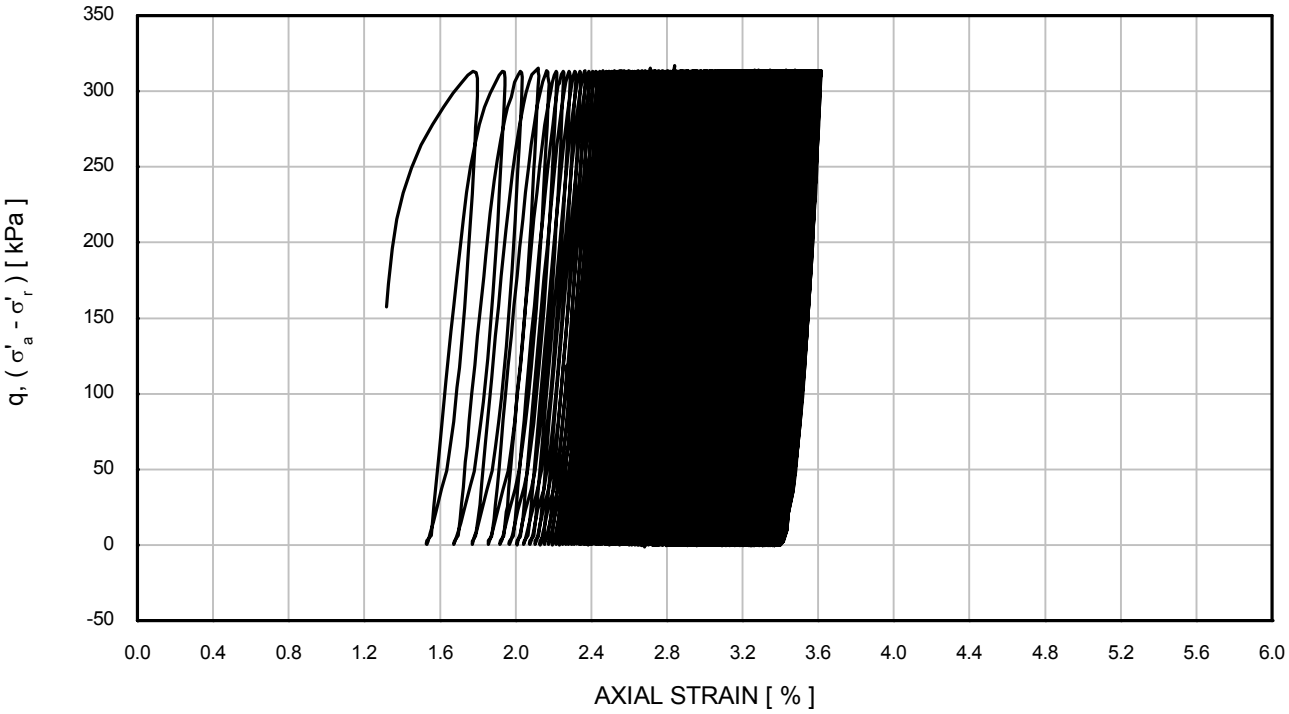
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

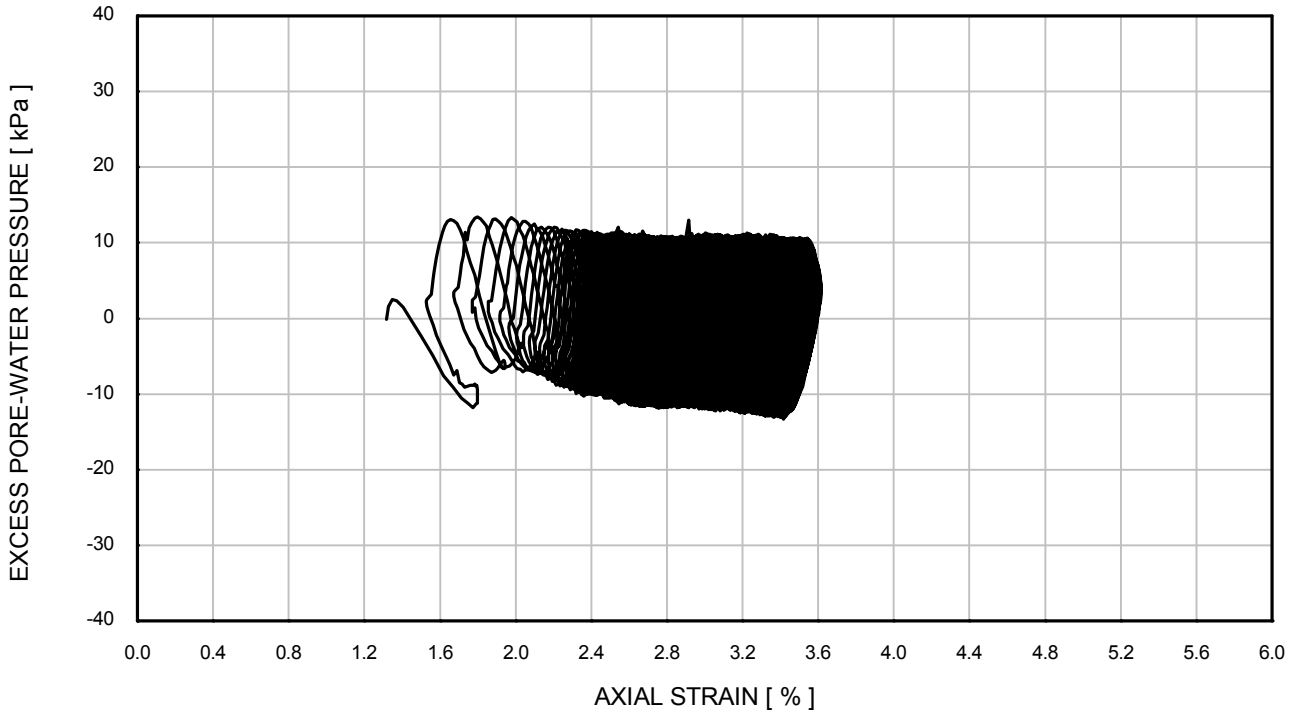




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-4
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 157 kPa	Test No.	: CTX10
Frequency	: 0.10 Hz		

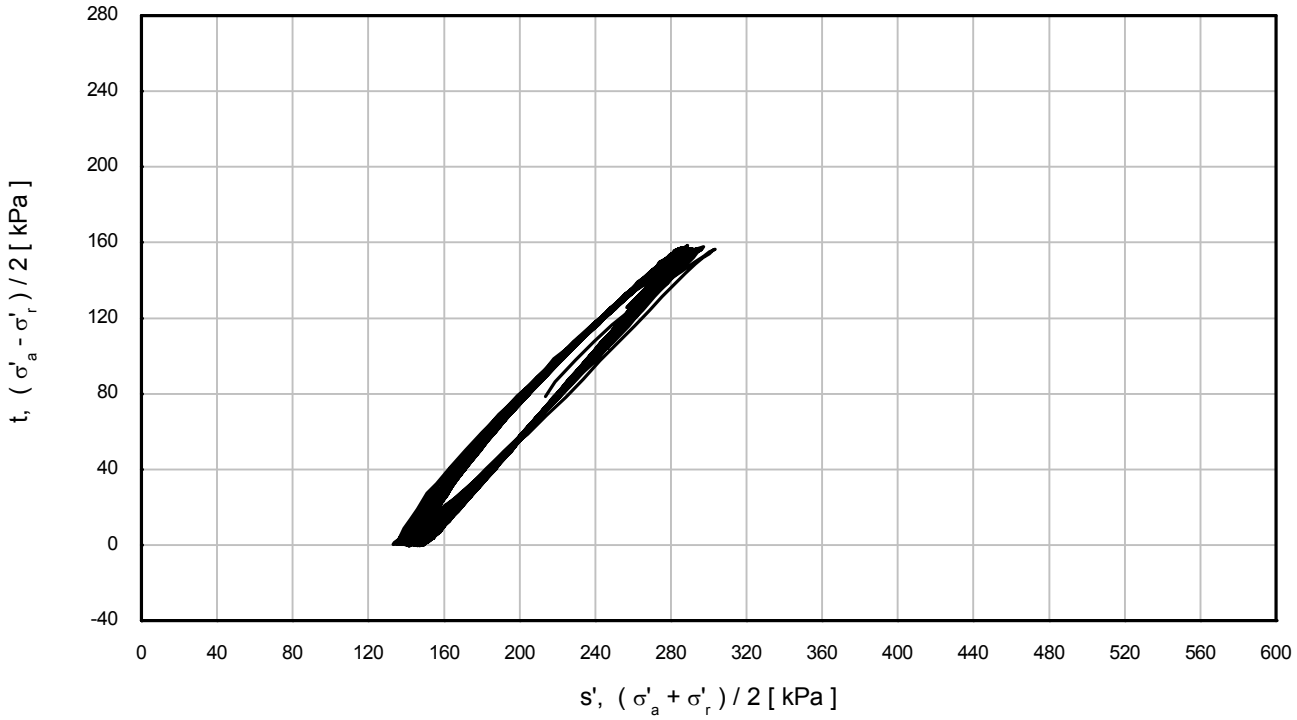
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

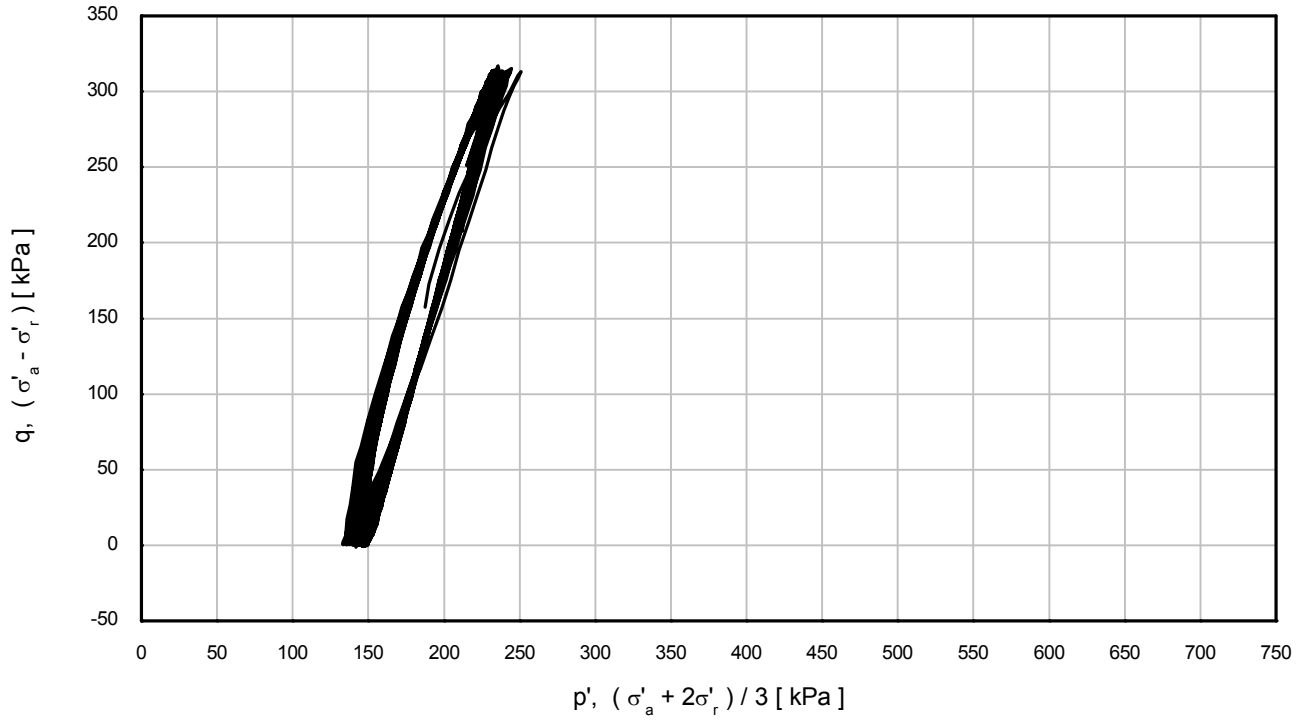




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-4
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 157 kPa	Test No.	: CTX10
Frequency	: 0.10 Hz		

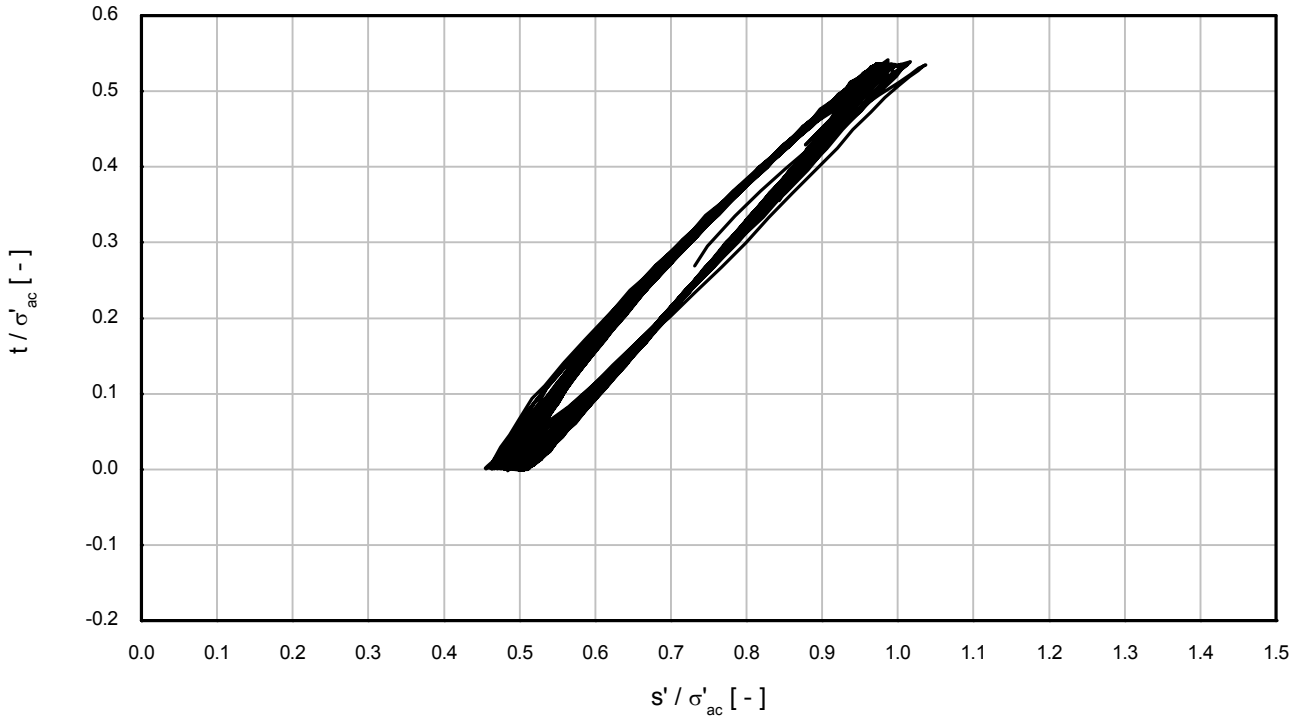
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

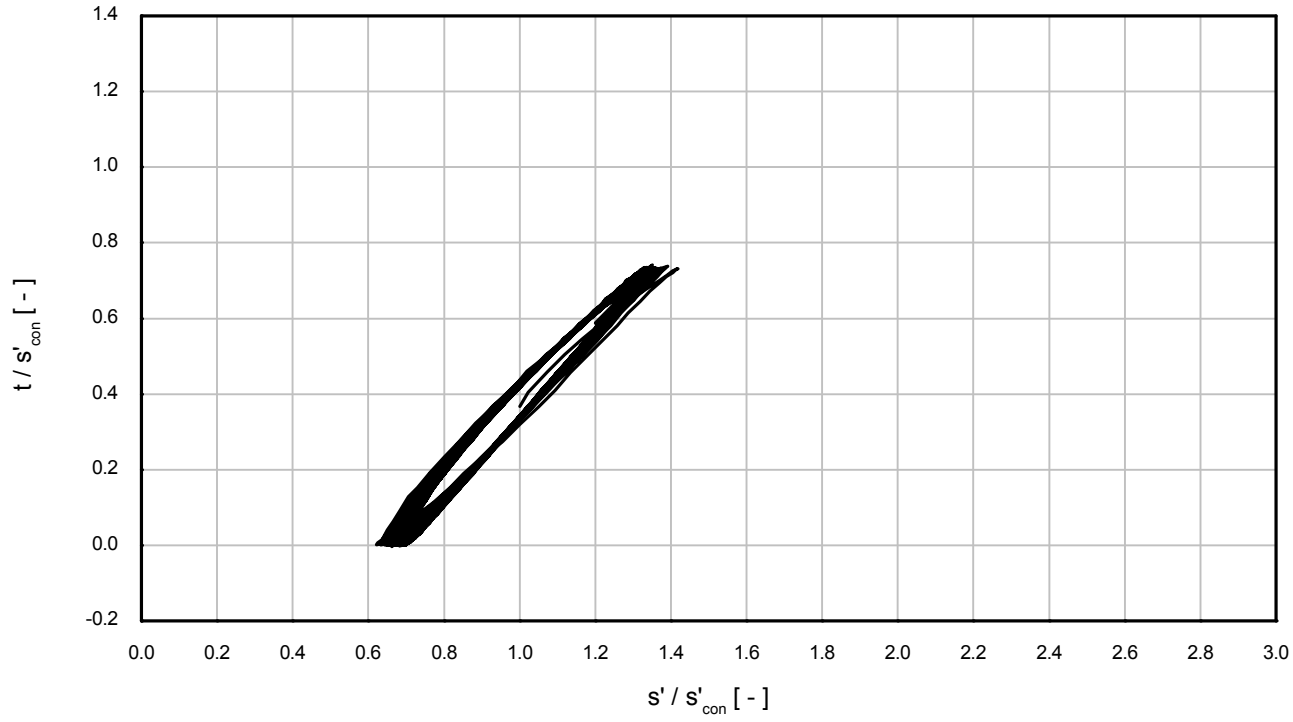




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-4
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 157 kPa	Test No.	: CTX10
Frequency	: 0.10 Hz		

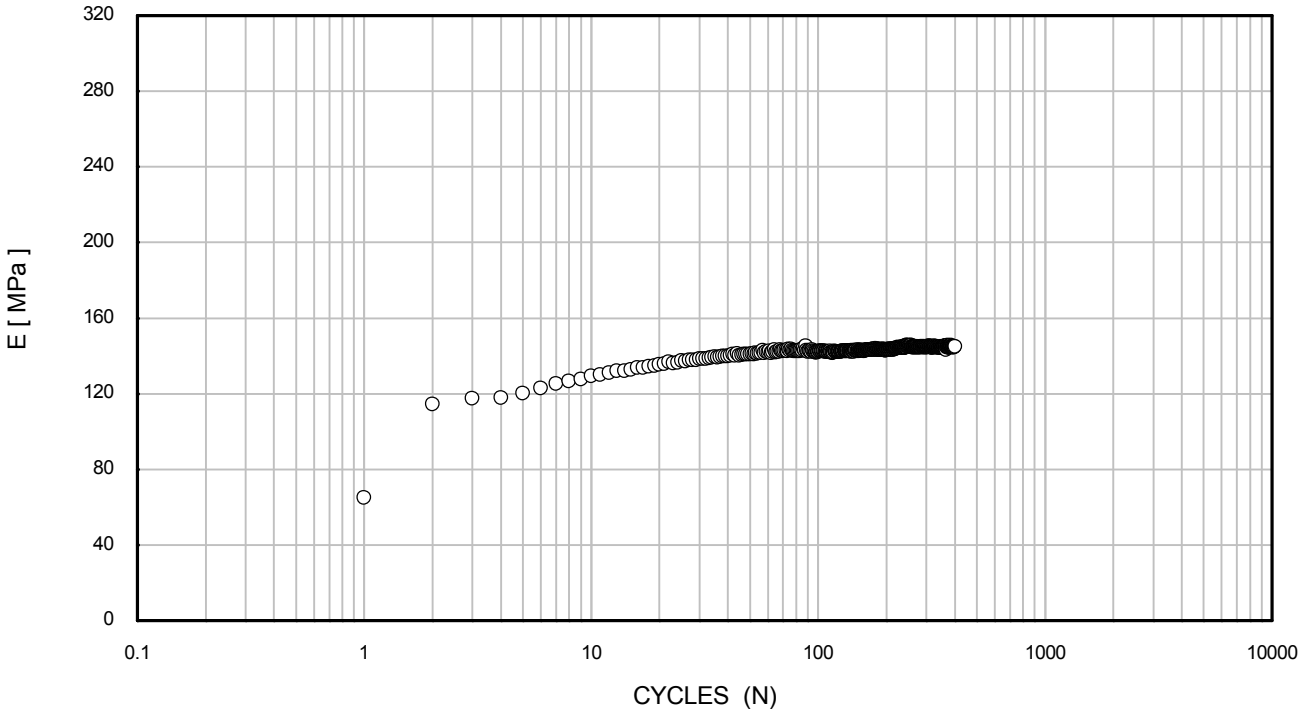
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

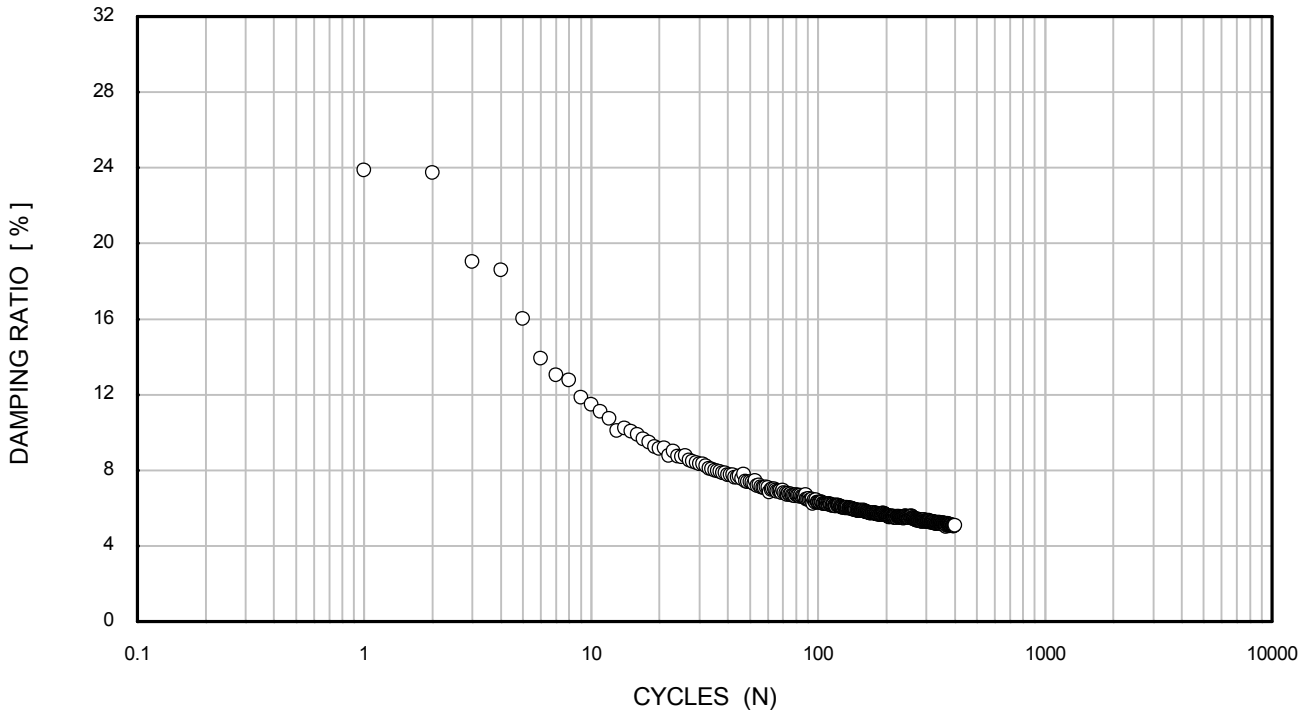




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	292 kPa	Sample	:	CTX_3-4
q_{av}	:	157 kPa	Unit	:	Unit B1 (Kreftenheye)
q_{cy}	:	157 kPa	Test No.	:	CTX10
Frequency	:	0.10 Hz			

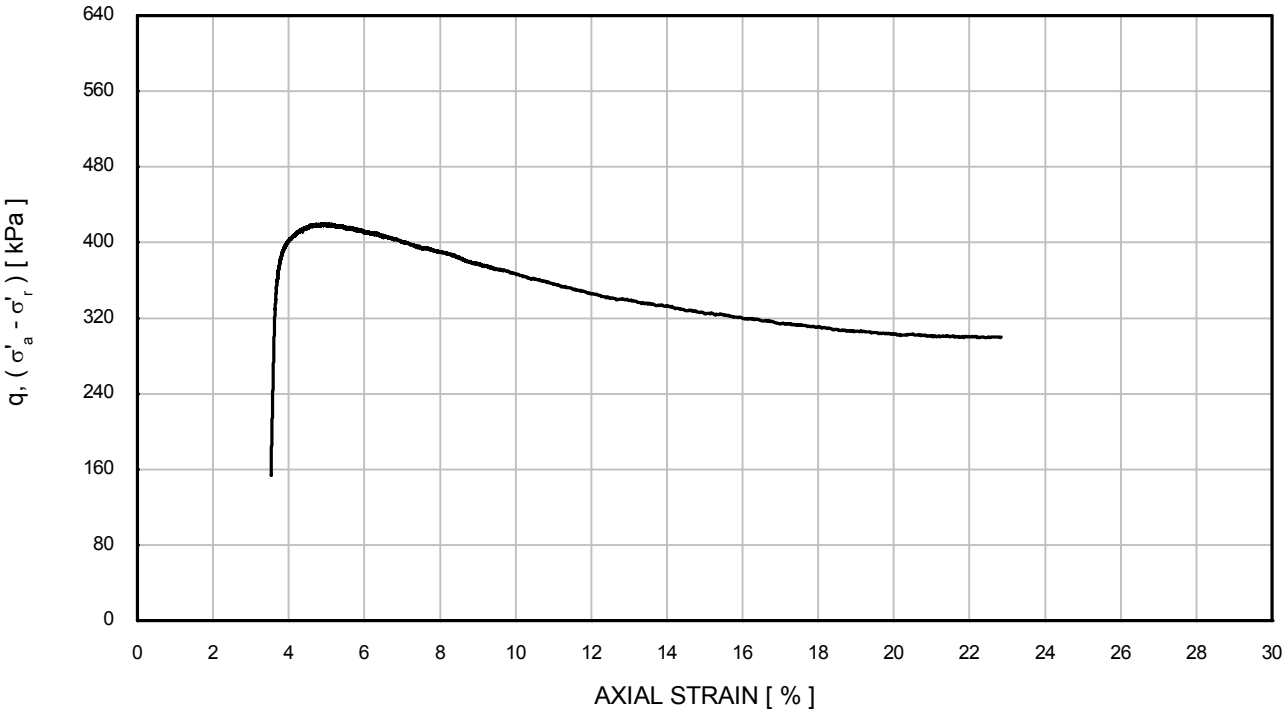
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

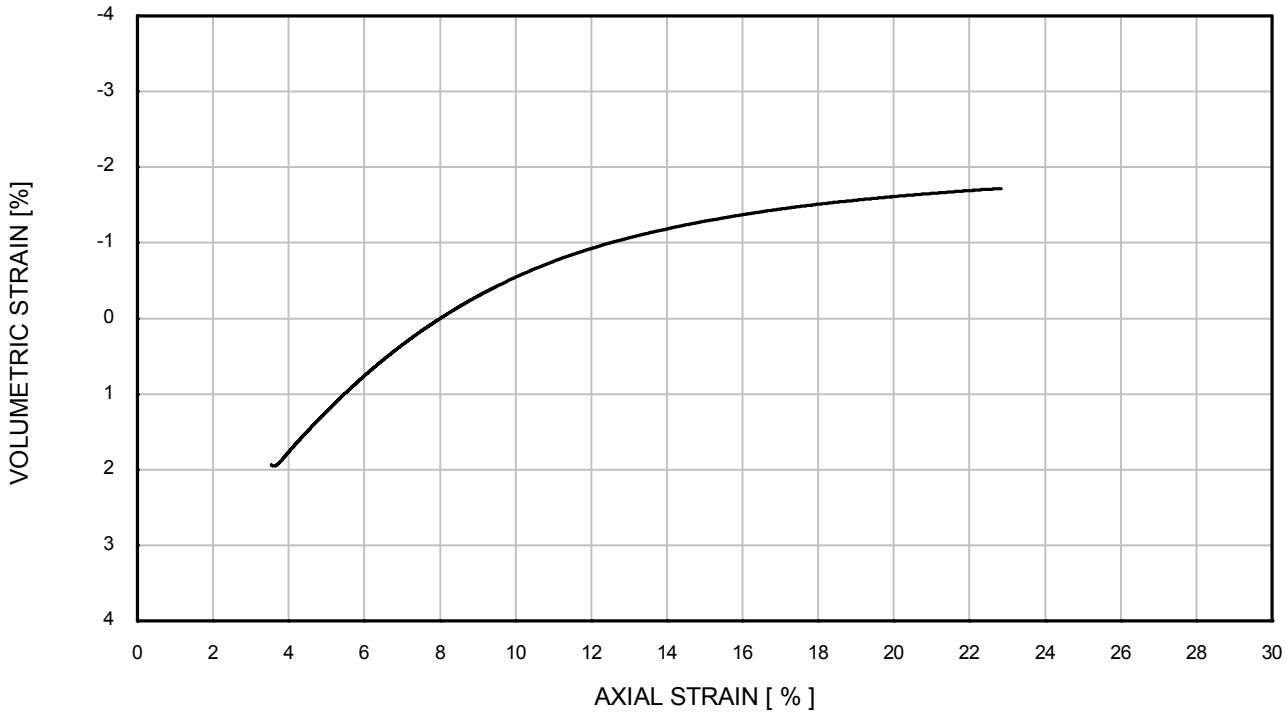




Initial σ'_r	: 135 kPa	Batch	: 3
Initial σ'_a	: 292 kPa	Sample	: CTX_3-4
q_{av}	: 157 kPa	Unit	: Unit B1 (Kreftenheye)
q_{cy}	: 157 kPa	Test No.	: CTX10
Frequency	: 0.10 Hz		

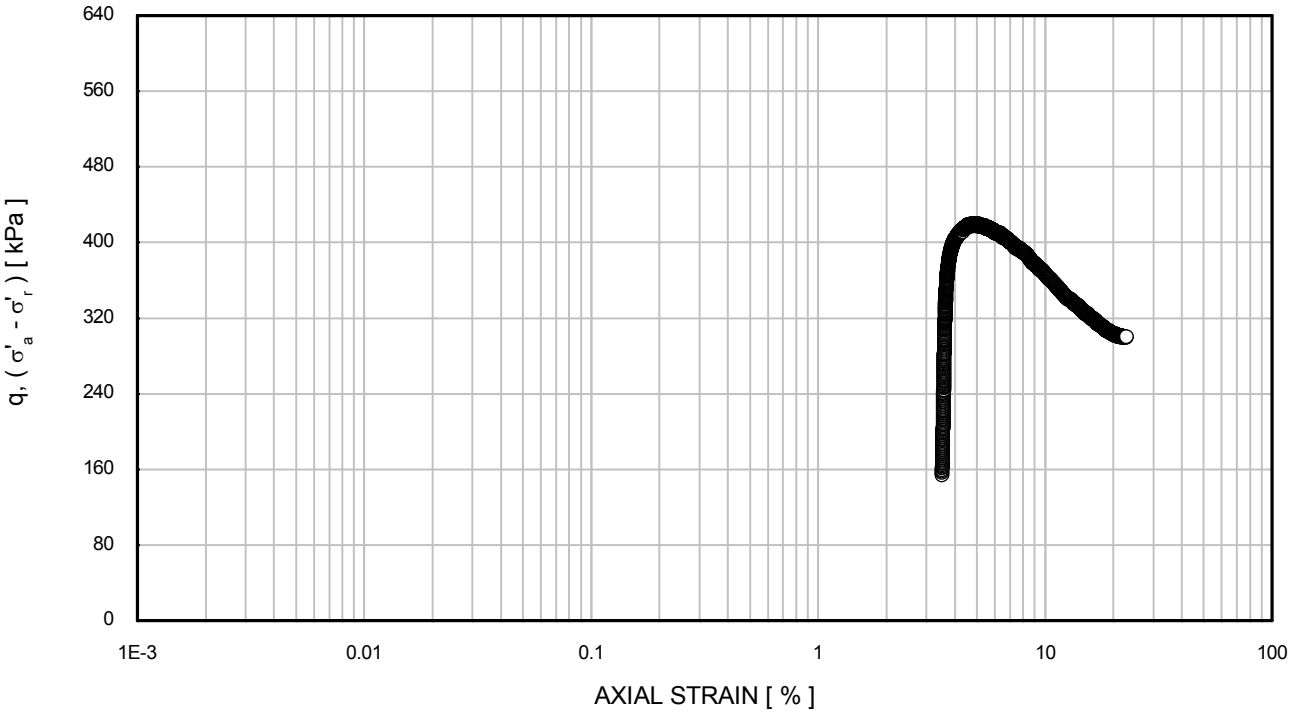
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
CYCLIC LOADING STAGE 2 - DRAINED

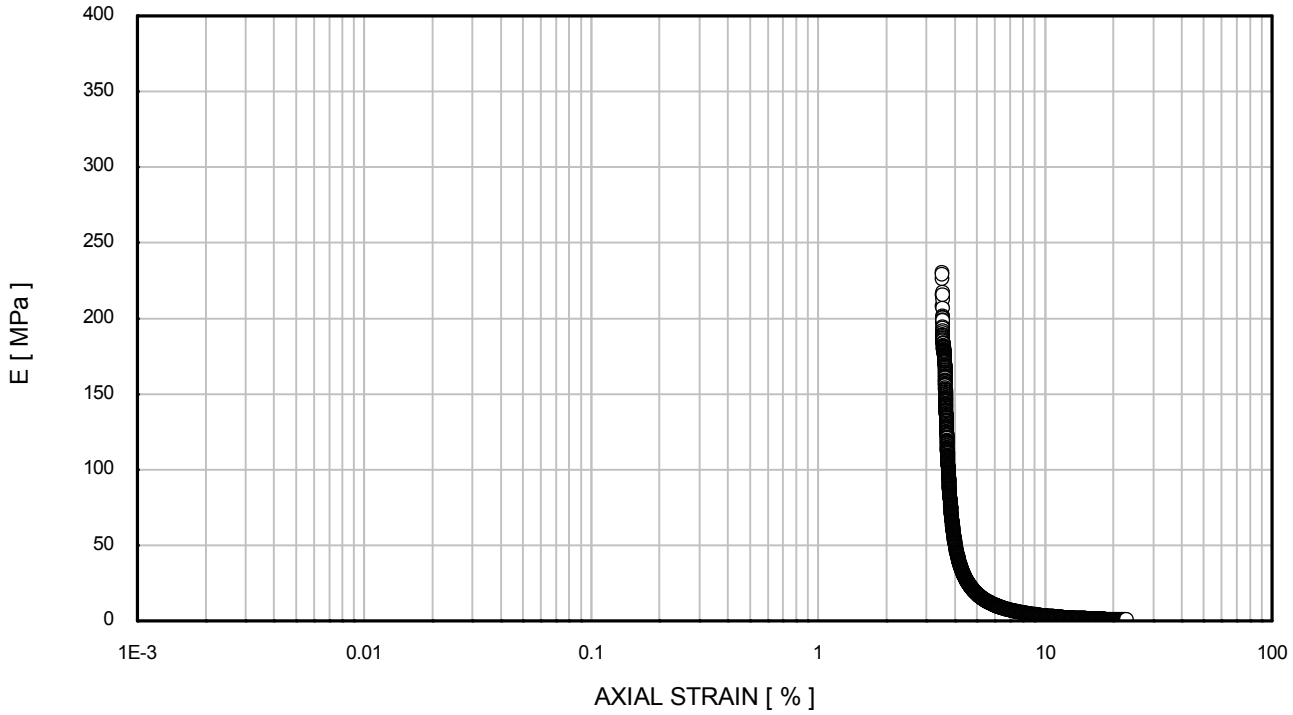




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	289 kPa	Sample	:	CTX_3-4
q_{peak}	:	420 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.89 %	Test No.	:	CTX10
Rate of strain	:	1.43 %/hour			

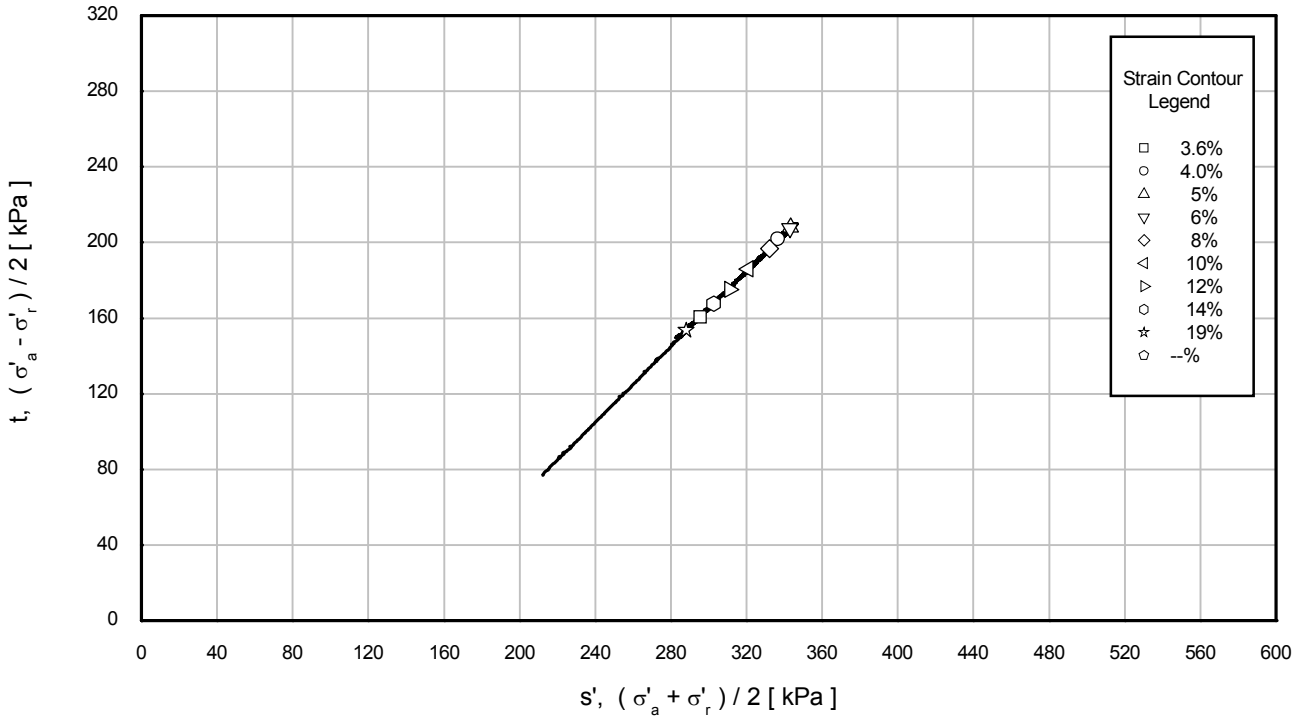
ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

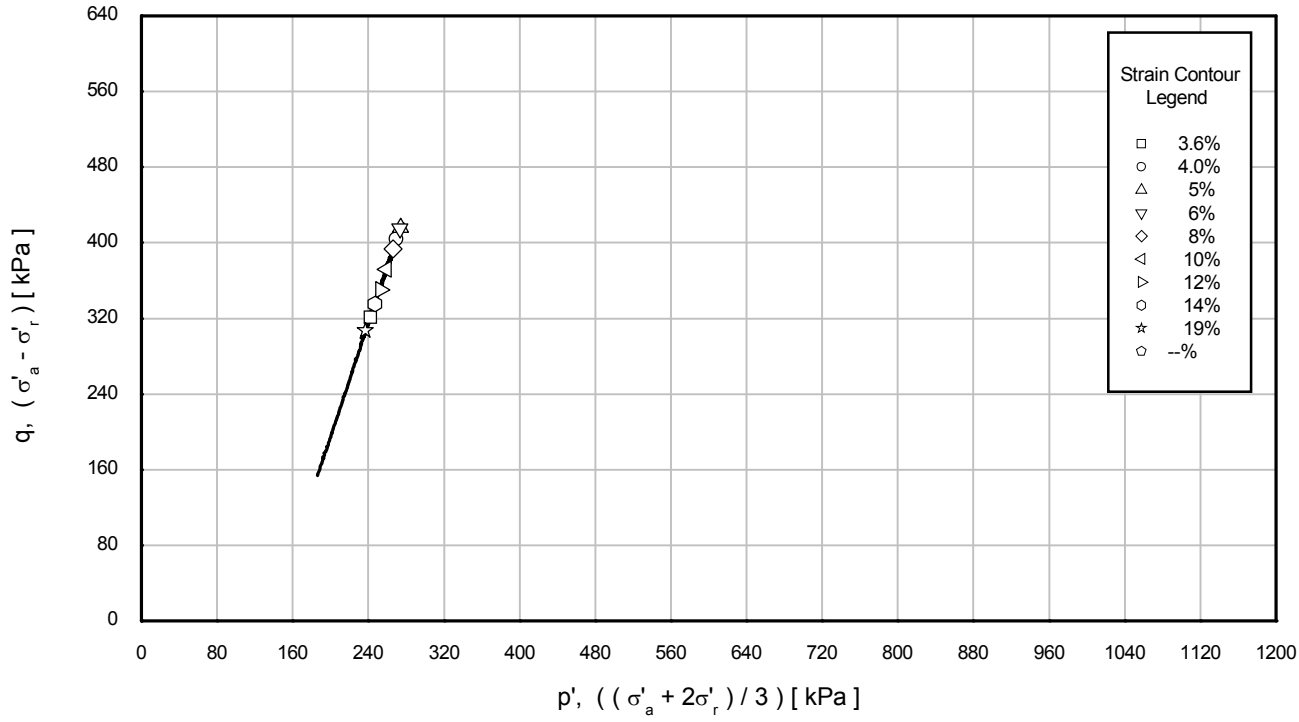




Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	289 kPa	Sample	:	CTX_3-4
q_{peak}	:	420 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.89 %	Test No.	:	CTX10
Rate of strain	:	1.43 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED





Initial σ'_r	:	135 kPa	Batch	:	3
Initial σ'_a	:	289 kPa	Sample	:	CTX_3-4
q_{peak}	:	420 kPa	Unit	:	Unit B1 (Kreftenheye)
Ext. ε at q_{peak}	:	4.89 %	Test No.	:	CTX10
Rate of strain	:	1.43 %/hour			

ISOTROPICALLY CONSOLIDATED CYCLIC TRIAXIAL TEST
SHEARING STAGE - DRAINED

SECTION A7: RESONANT COLUMN TESTS

LIST OF PLATES IN SECTION A7: Plate

Resonant Column Test – Cohesive Specimens	A7.1-1 to A7.1-38
Resonant Column Test – Cohesionless Specimens	A7.2-1 to A7.2-27

VISUAL DESCRIPTION
Dark grey silty CLAY with laminations of fine sand

GENERAL	
Date test started	01/11/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	139.9
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.95
Dry density	[Mg/m³]	1.49
Void ratio	[-]	0.814
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	35
Pocket penetrometer	[kPa]	75

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Not applicable
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ HKZ1-BH01-SA_17B_RC07
Processed by	NC
Date	04/11/2016
Checked by	PH
Date	28/11/2016
Approved by	PH
Date	28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	RC07

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	410
Base PWP	[kPa]	406
Axial strain	[%]	0.06
Water Content	[%]	30.8
Bulk Density	[Mg/m³]	1.95
Dry Density	[Mg/m³]	1.49
Void Ratio	[-]	0.814
Degree of saturation	[%]	100
B value achieved	[-]	1.00

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	550
Back pressure	[kPa]	405
Base PWP	[kPa]	405
Effective radial pressure	[kPa]	145
Effective axial pressure	[kPa]	145
Deviator stress	[kPa]	0
Volumetric strain	[%]	4.87
Axial strain	[%]	1.43
Water content	[%]	27.5
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.56
Void ratio	[-]	0.726
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	RC07

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000481	69.13	1.000	1.42
0.000697	68.44	0.990	0.25
0.000968	68.27	0.988	0.58
0.001511	67.93	0.983	1.52
0.002203	67.59	0.978	1.11
0.002904	67.25	0.973	1.30
0.004194	66.57	0.963	1.41
0.005417	65.73	0.951	1.53
0.007536	64.39	0.931	1.86
0.011047	62.41	0.903	2.34
0.015531	58.86	0.851	2.70
0.019160	56.96	0.824	3.06
0.032683	49.41	0.715	4.39
0.041579	44.58	0.645	8.45

TORSIONAL RESONANCE STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000457	68.27	0.988	1.25
0.000653	68.10	0.985	0.94
0.000899	68.27	0.988	0.92
0.001403	67.76	0.980	1.48
0.002059	67.42	0.975	1.21
0.002698	67.08	0.970	1.49
0.003861	66.23	0.958	1.67
0.004842	65.39	0.946	1.83
0.006396	63.73	0.922	2.35
0.008560	59.81	0.865	3.43
0.010351	56.96	0.824	4.92
0.012210	52.97	0.766	5.59
0.017600	40.92	0.592	13.63

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	RC07

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

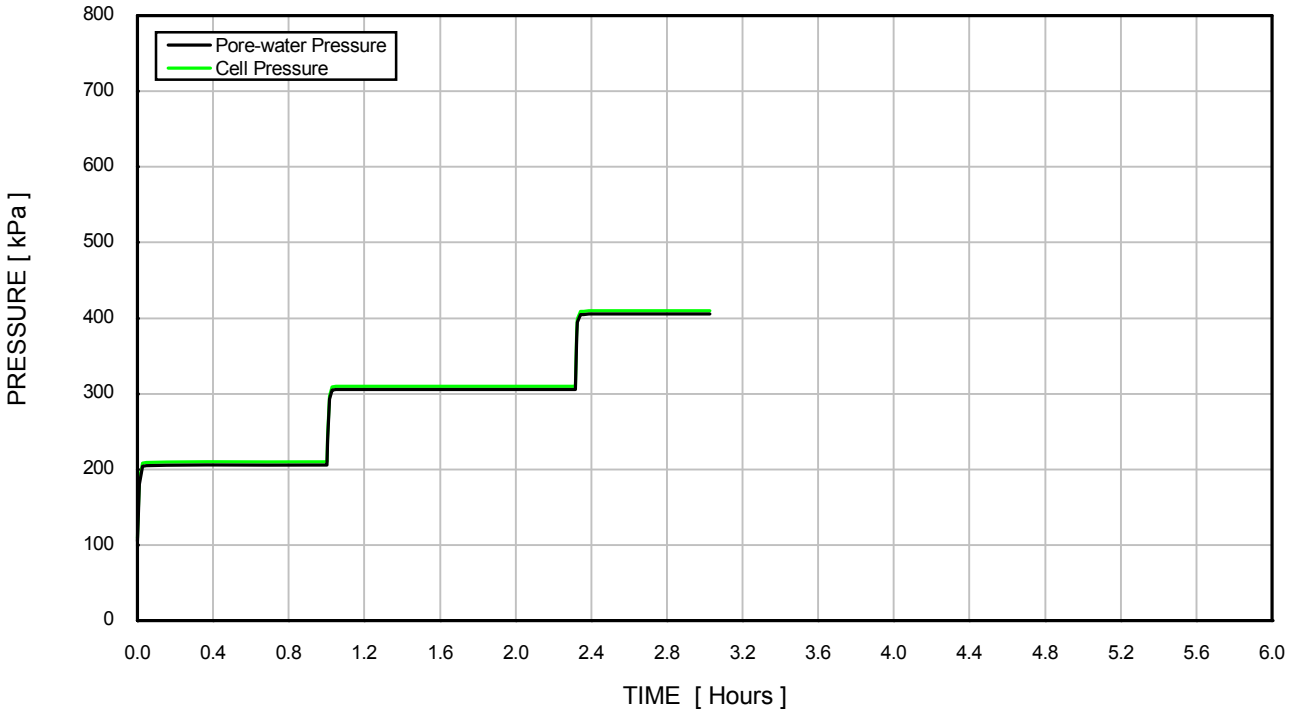
SPECIMEN PHOTOGRAPHS

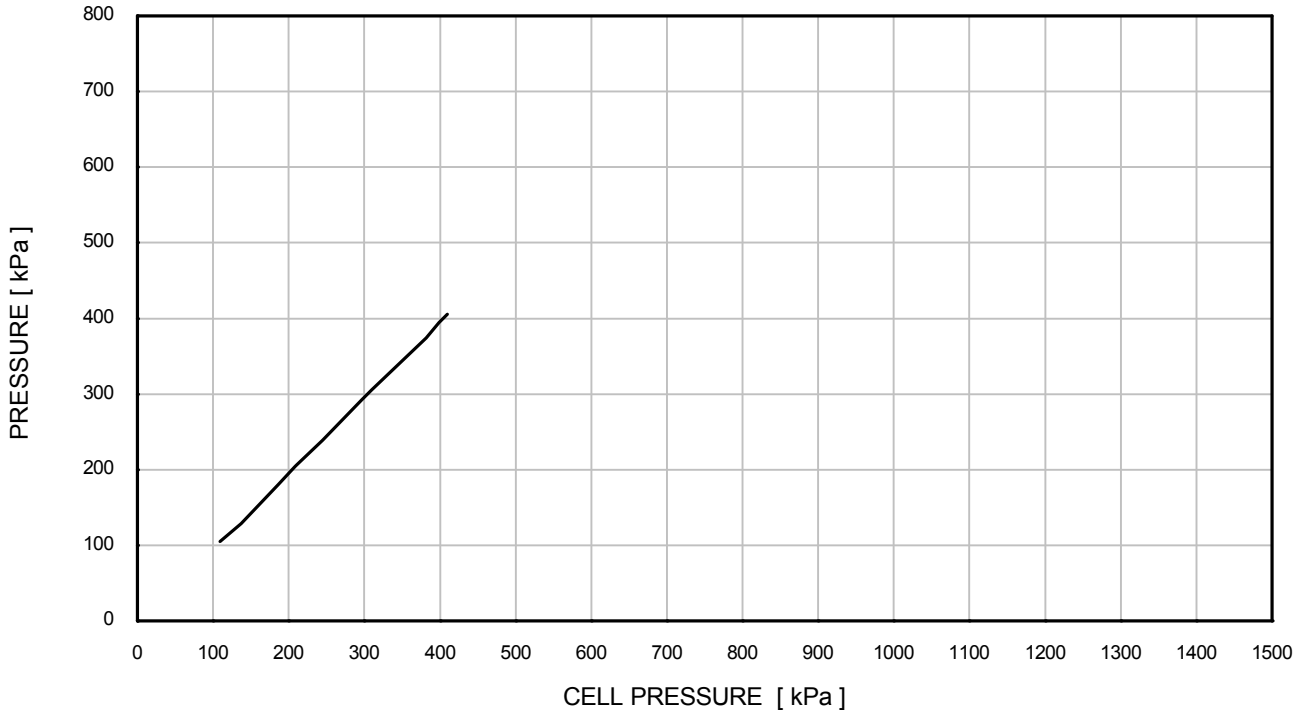


FINAL CONDITIONS		
Water content	[%]	27.5
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.56

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	17WaxB
Depth [m]	14.67
Test number	RC07

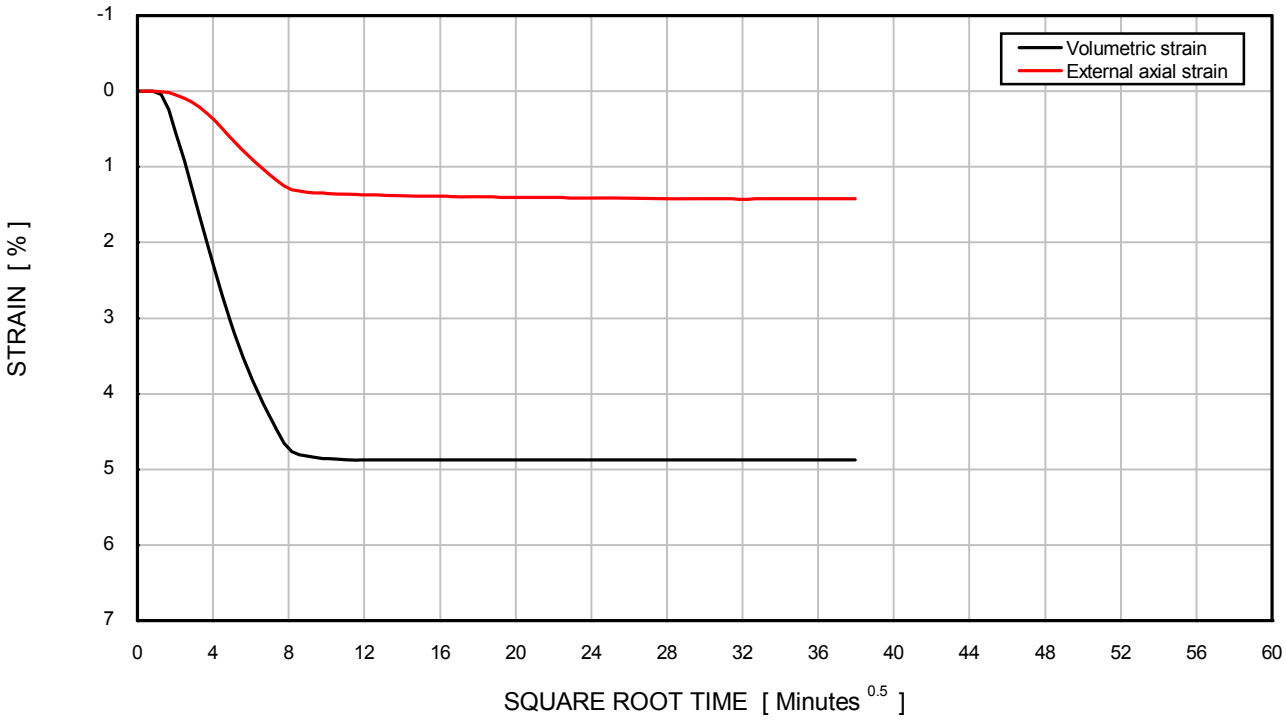
SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

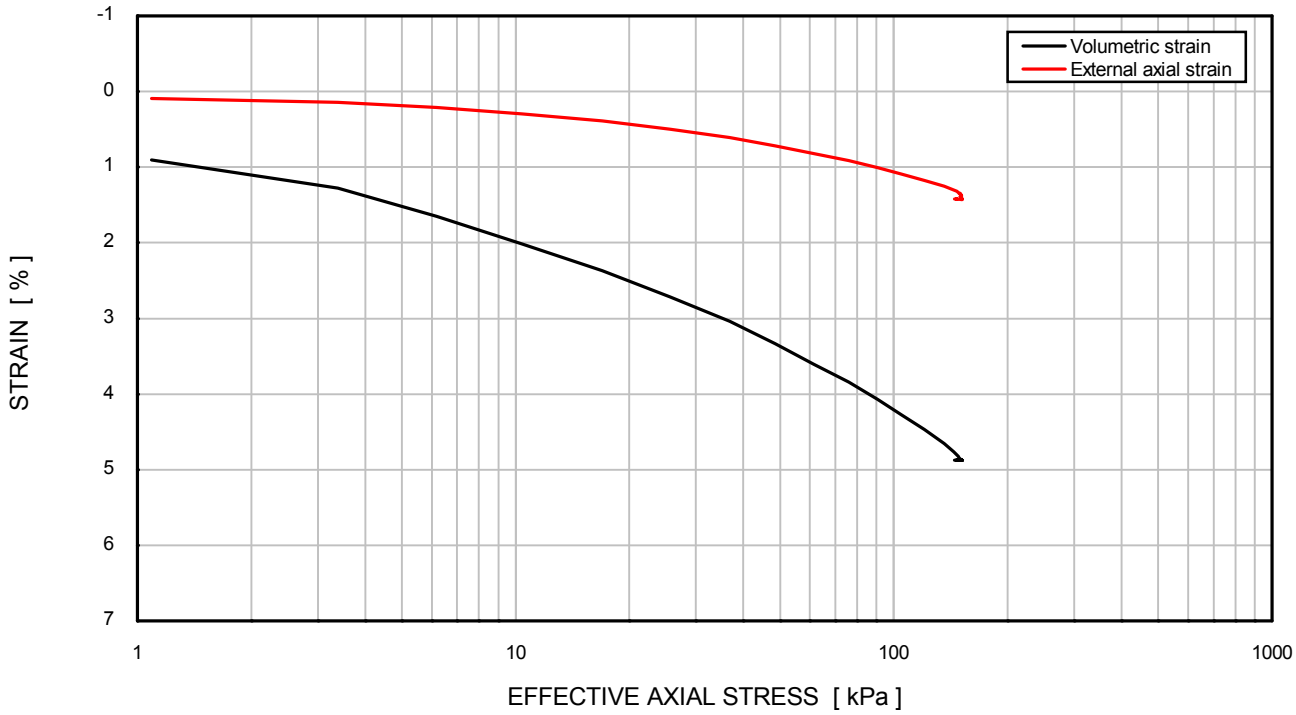




B value	:	1.00			
Initial σ'_r	:	4	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	4	kPa	Sample	: 17WaxB
Final σ'_r	:	5	kPa	Depth [m]	: 14.67
Final σ'_a	:	4	kPa	Test No.	: RC07

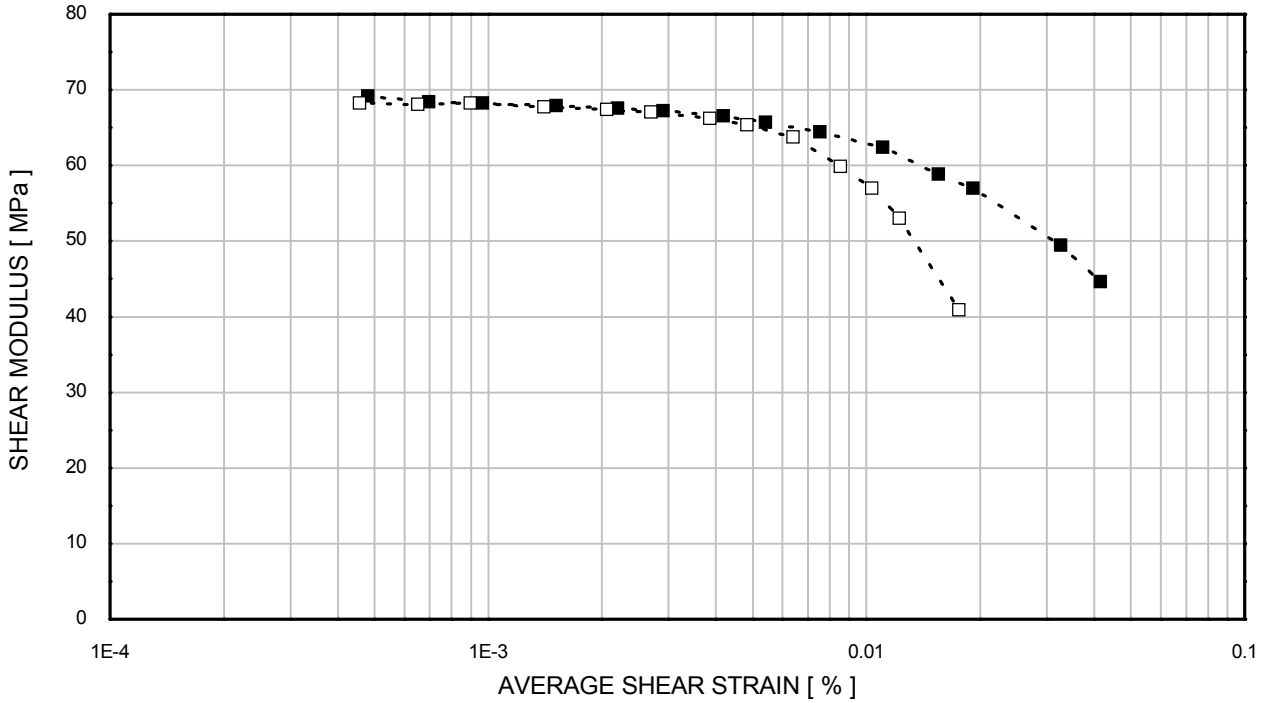
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - UNDRAINED

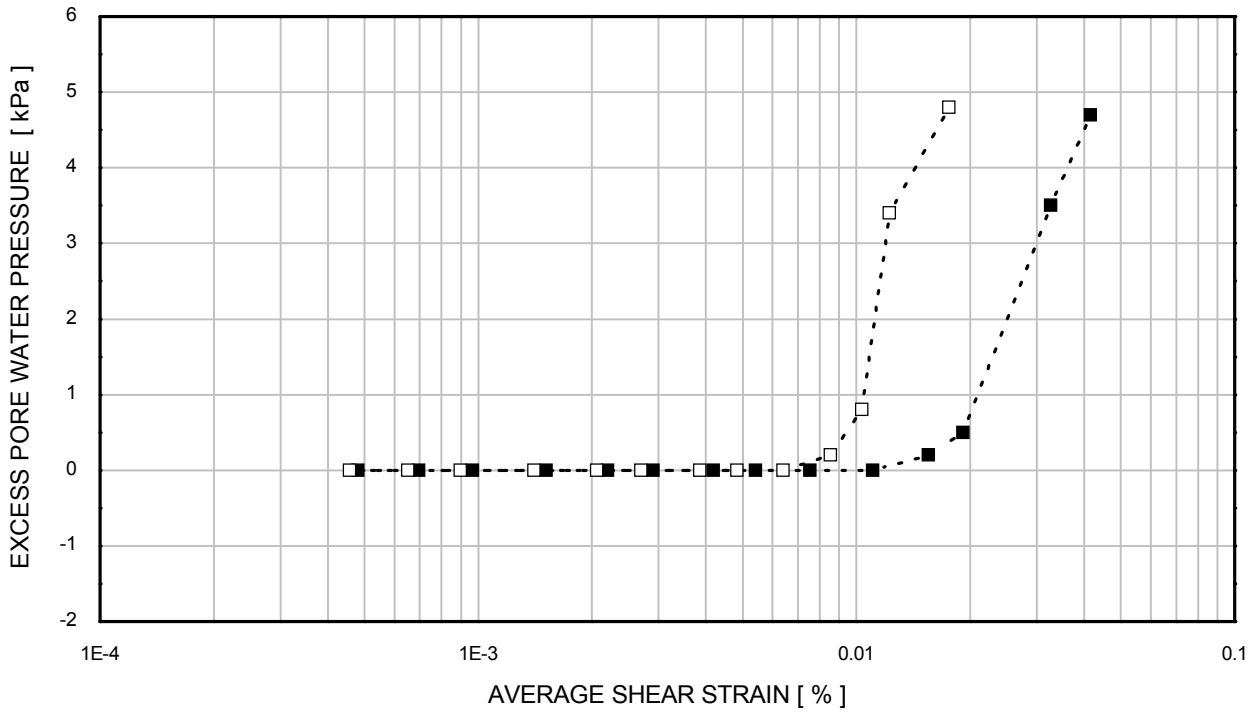




σ'_{rc}	: 145 kPa	Borehole	: HKZ1-BH01-SA
σ'_{ac}	: 145 kPa	Sample	: 17WaxB
		Depth [m]	: 14.67
		Test No.	: RC07

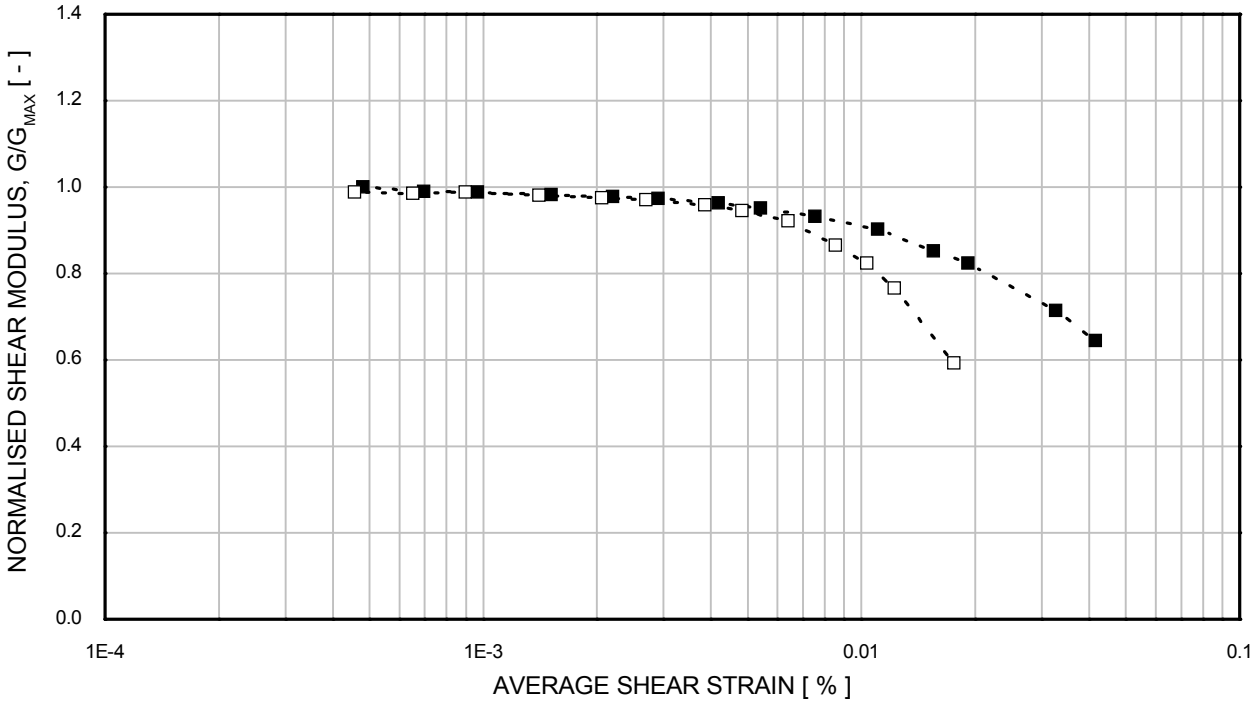
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ISOTROPIC CONSOLIDATION STAGE

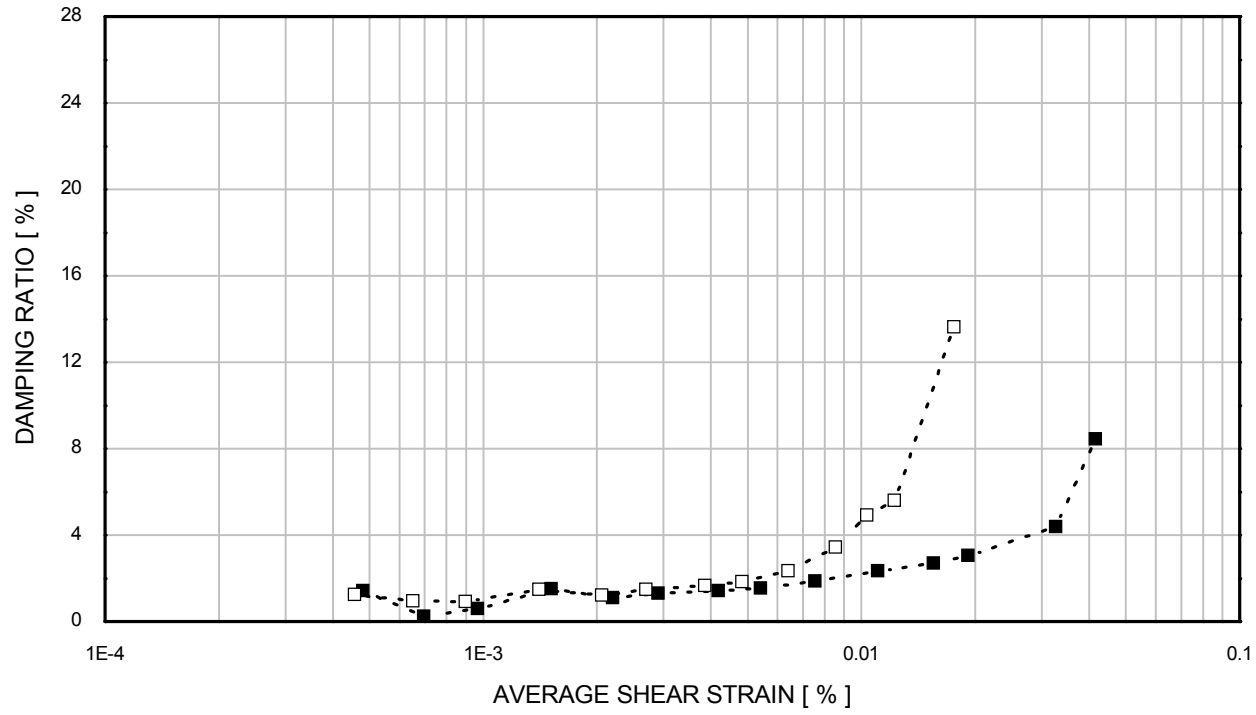




σ'_0	: 145 kPa	Borehole	: HKZ1-BH01-SA
- ·■- · Load		Sample	: 17WaxB
- ·□- · Reload		Depth [m]	: 14.67
		Test No.	: RC07

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1





σ'_0	: 145 kPa	Borehole	: HKZ1-BH01-SA
- ·■- · Load		Sample	: 17WaxB
- ·□- · Reload		Depth [m]	: 14.67
		Test No.	: RC07

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1

VISUAL DESCRIPTION
Dark grey CLAY with laminations of fine sand

GENERAL	
Date test started	08/11/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.1
Water content	[%]	30.8
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.45
Void ratio	[-]	0.863
Degree of saturation	[%]	97
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	63
Pocket penetrometer	[kPa]	88

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Not applicable
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ HKZ1-BH01-SA_20D_RC08
Processed by	NC
Date	12/11/2016
Checked by	PH
Date	28/11/2016
Approved by	PH
Date	28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	RC08

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	100
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	451
Base PWP	[kPa]	363
Axial strain	[%]	1.79
Water Content	[%]	30.8
Bulk Density	[Mg/m³]	1.90
Dry Density	[Mg/m³]	1.45
Void Ratio	[-]	0.863
Degree of saturation	[%]	97
B value achieved	[-]	0.96

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	528
Back pressure	[kPa]	363
Base PWP	[kPa]	363
Effective radial pressure	[kPa]	165
Effective axial pressure	[kPa]	165
Deviator stress	[kPa]	0
Volumetric strain	[%]	1.31
Axial strain	[%]	0.73
Water content	[%]	29.9
Bulk density	[Mg/m³]	1.91
Dry density	[Mg/m³]	1.47
Void ratio	[-]	0.839
Degree of saturation	[%]	96

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	RC08

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000488	61.37	0.980	0.16
0.000671	61.52	0.983	0.34
0.000894	61.52	0.983	0.52
0.001339	60.91	0.973	1.12
0.001934	60.91	0.973	1.36
0.002540	60.91	0.973	1.55
0.003710	60.44	0.965	1.74
0.004834	59.98	0.958	1.85
0.006972	59.37	0.948	2.06
0.010725	58.01	0.926	2.34
0.015158	55.47	0.886	2.62
0.019035	53.58	0.856	3.05
0.031991	47.26	0.755	4.16
0.042500	44.05	0.704	5.04

TORSIONAL RESONANCE STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000488	62.62	1.000	0.07
0.000679	61.99	0.990	0.21
0.000976	62.46	0.998	1.09
0.001343	61.99	0.990	0.82
0.001938	61.84	0.988	1.38
0.002555	61.52	0.983	1.58
0.003726	61.22	0.978	1.74
0.004852	60.75	0.970	1.87
0.006986	59.98	0.958	2.02
0.010998	57.86	0.924	2.20
0.015277	55.92	0.893	2.74
0.019198	54.16	0.865	2.95
0.032240	48.63	0.777	4.08
0.043616	44.58	0.712	5.07

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	RC08

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

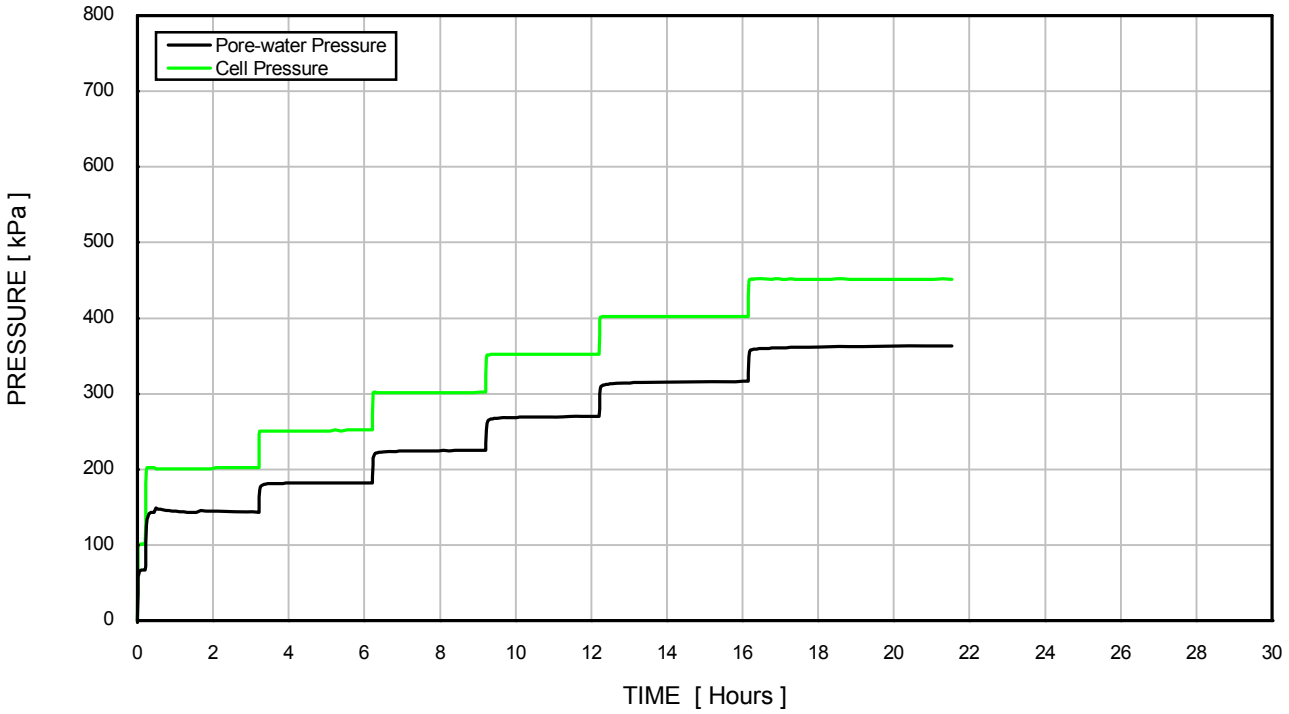
SPECIMEN PHOTOGRAPHS

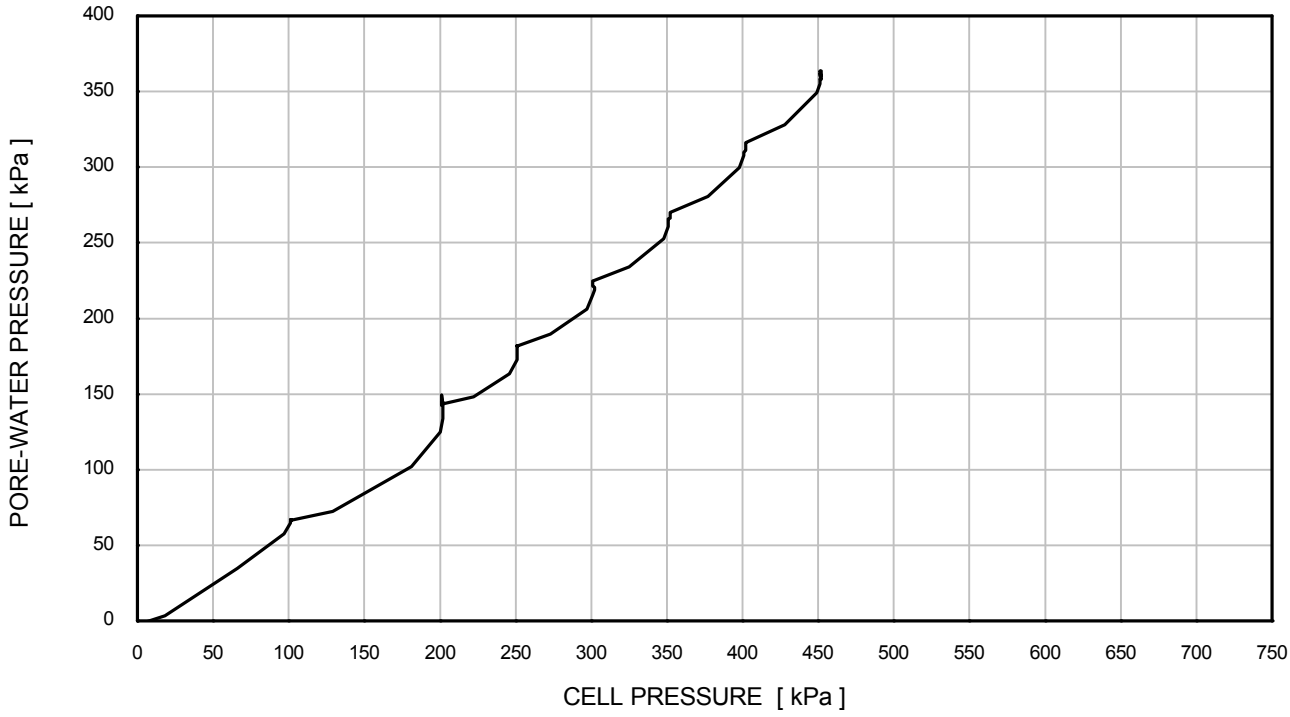


FINAL CONDITIONS		
Water content	[%]	29.9
Bulk density	[Mg/m³]	1.91
Dry density	[Mg/m³]	1.47

TEST IDENTIFICATION	
Borehole	HKZ1-BH01-SA
Sample	20WaxD
Depth [m]	18.11
Test number	RC08

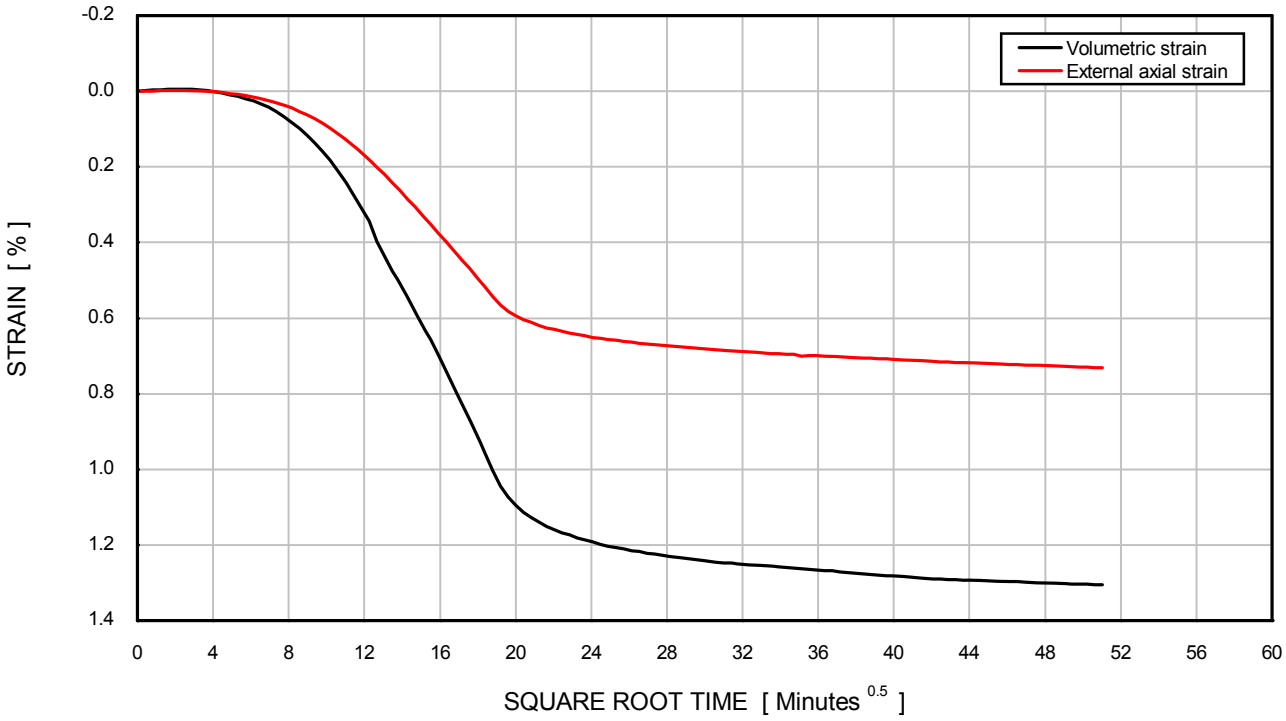
SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

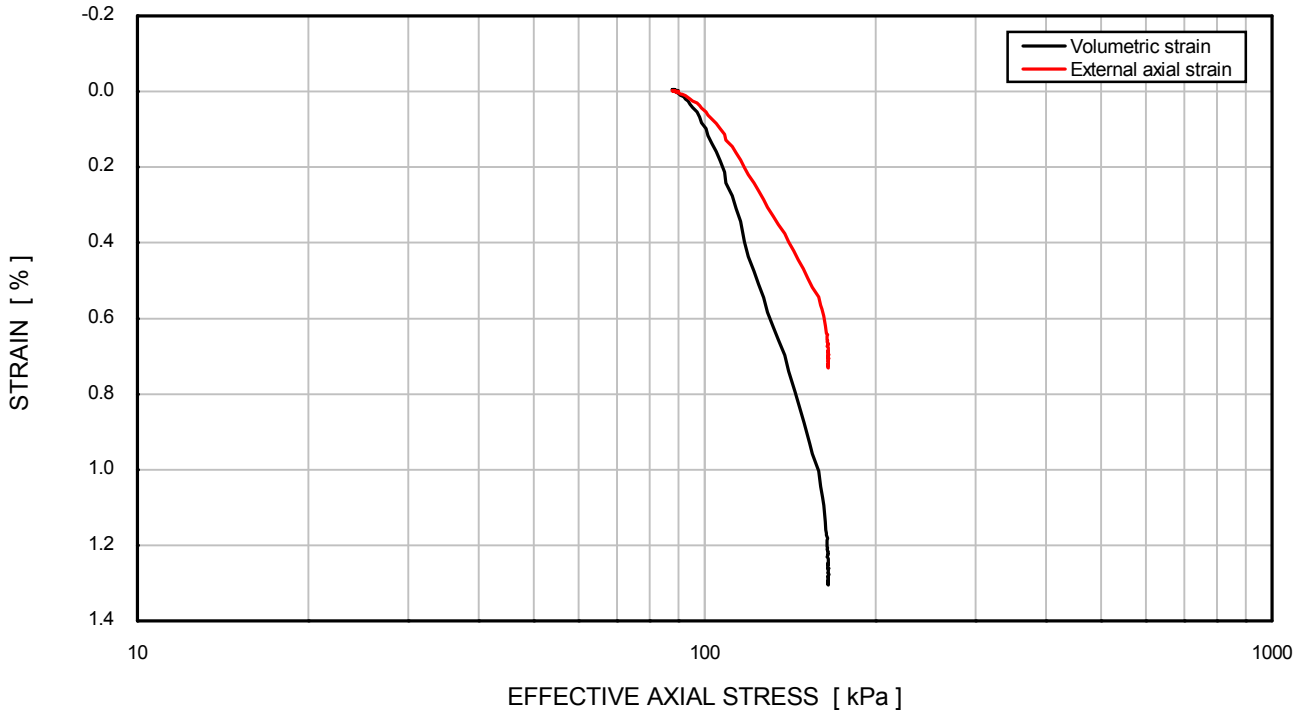




B value	:	0.96			
Initial σ'_r	:	3	kPa	Borehole	: HKZ1-BH01-SA
Initial σ'_a	:	3	kPa	Sample	: 20WaxD
Final σ'_r	:	88	kPa	Depth [m]	: 18.11
Final σ'_a	:	87	kPa	Test No.	: RC08

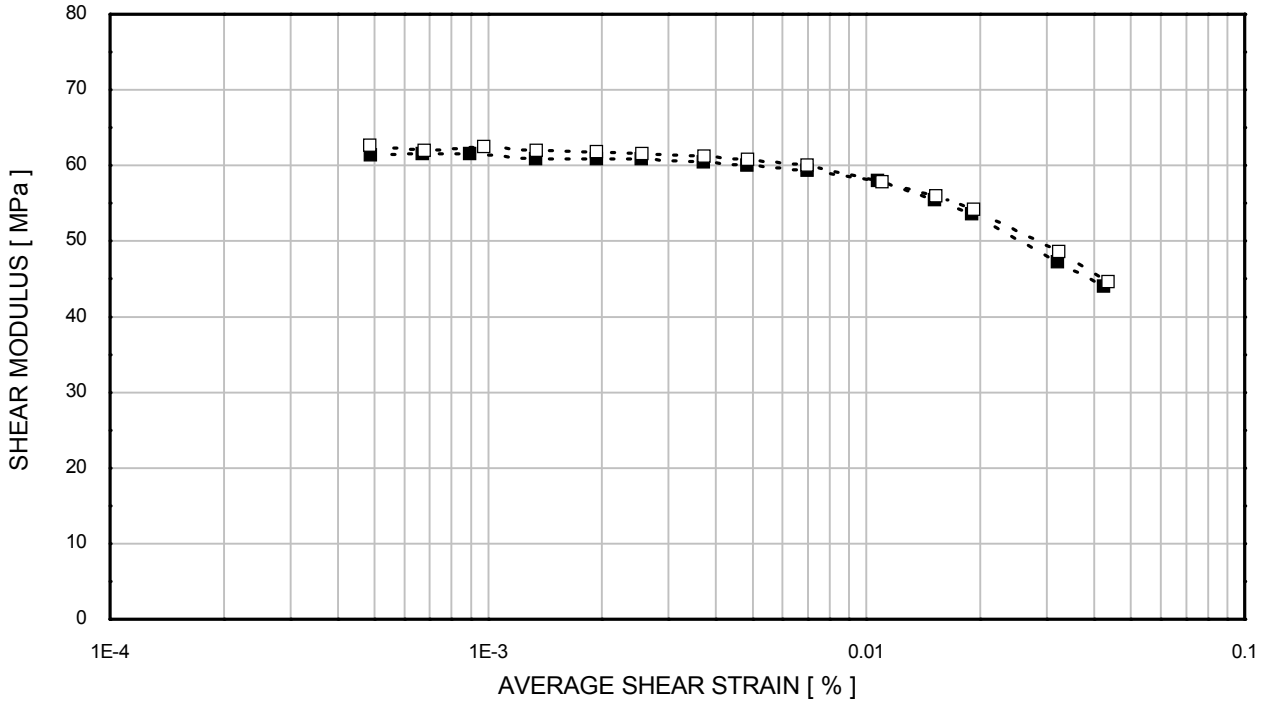
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - UNDRAINED

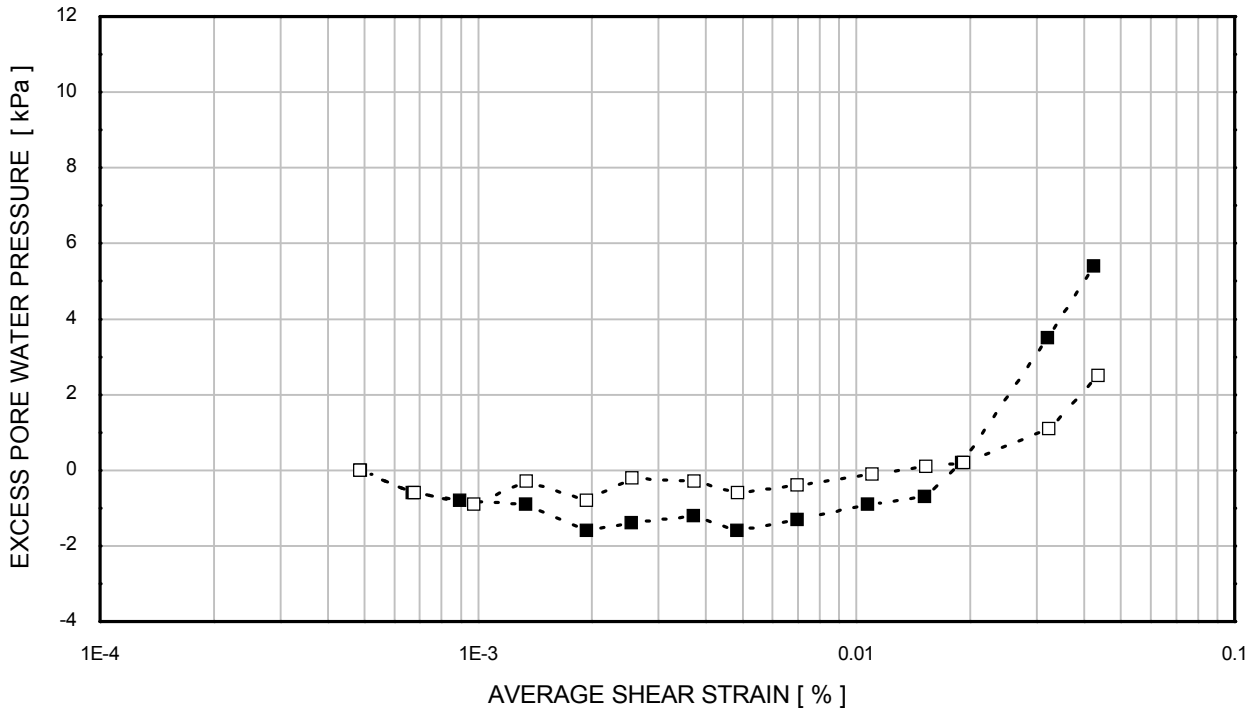




σ'_{rc}	: 165 kPa	Borehole	: HKZ1-BH01-SA
σ'_{ac}	: 165 kPa	Sample	: 20WaxD
		Depth [m]	: 18.11
		Test No.	: RC08

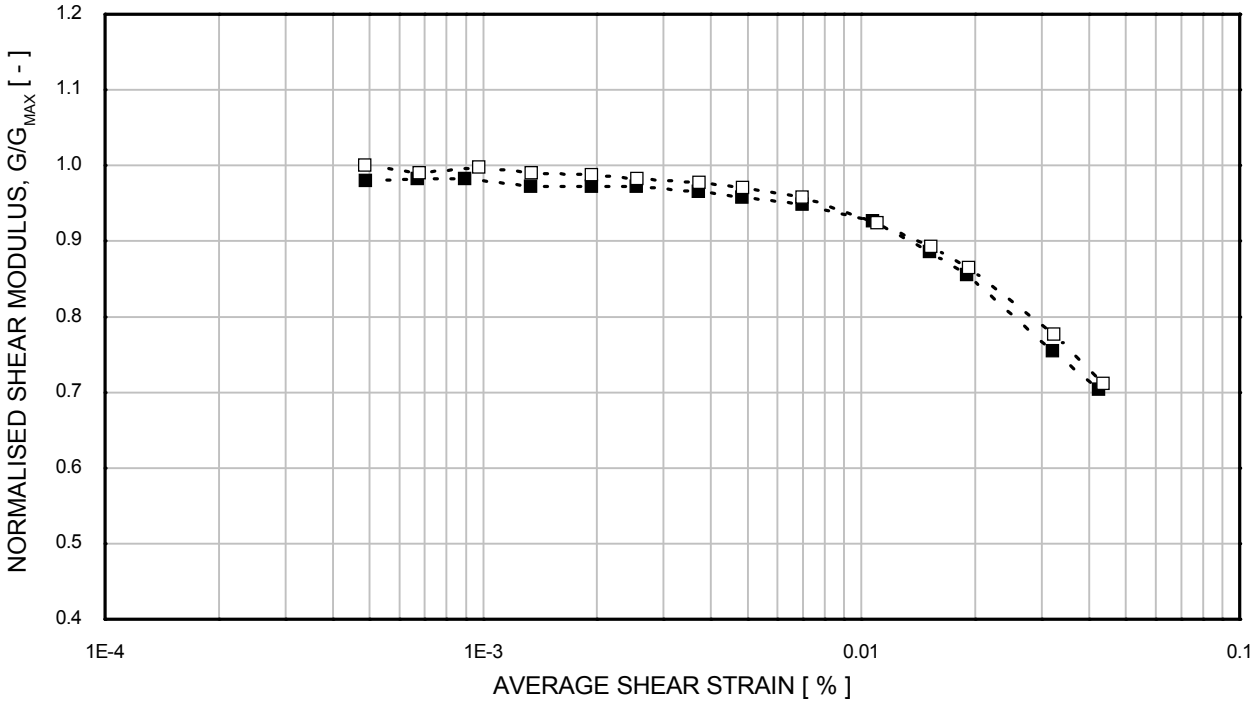
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ISOTROPIC CONSOLIDATION STAGE

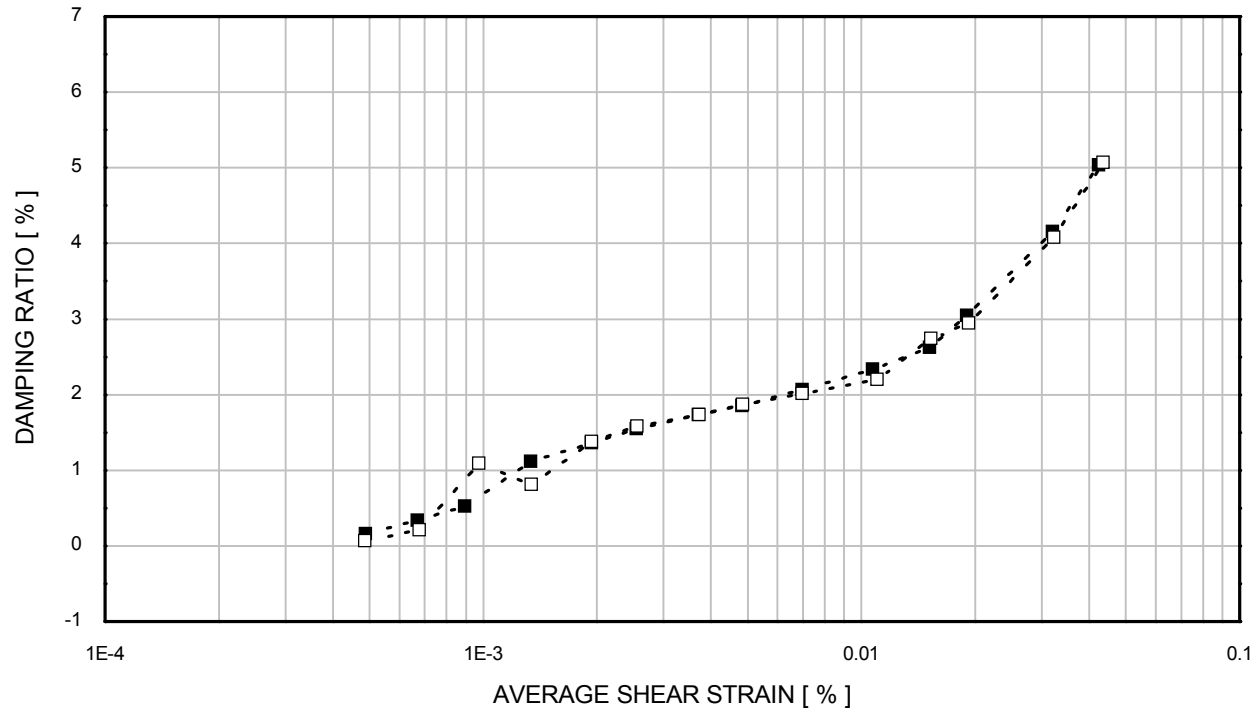




σ'_0	: 165 kPa	Borehole	: HKZ1-BH01-SA
- ·■- · Load		Sample	: 20WaxD
- ·□- · Reload		Depth [m]	: 18.11
		Test No.	: RC08

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE





σ'_0	: 165 kPa	Borehole	: HKZ1-BH01-SA
- ·■- · Load		Sample	: 20WaxD
- ·□- · Reload		Depth [m]	: 18.11
		Test No.	: RC08

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE

VISUAL DESCRIPTION
Mottled bluish grey and dark bluish grey CLAY

GENERAL	
Date test started	15/11/2016
Type of sample	Undisturbed
Type of drains fitted	Radial (spiral) & one end only

INITIAL		
Diameter	[mm]	70.0
Length	[mm]	139.8
Water content	[%]	32.5
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.44
Void ratio	[-]	0.881
Degree of saturation	[%]	100
Assumed particle density	[Mg/m³]	2.70
Torvane	[kPa]	150
Pocket penetrometer	[kPa]	125

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Not applicable
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ HKZ2-BH21-SA_31D_RC09
Processed by	NC
Date	21/11/2016
Checked by	PH
Date	28/11/2016
Approved by	PH
Date	28/11/2016

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	31WaxD
Depth [m]	24.52
Test number	RC09

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	50
Differential pressure used	[kPa]	N/A
Cell pressure	[kPa]	500
Base PWP	[kPa]	305
Axial strain	[%]	0.75
Water Content	[%]	32.5
Bulk Density	[Mg/m³]	1.90
Dry Density	[Mg/m³]	1.44
Void Ratio	[-]	0.881
Degree of saturation	[%]	100
B value achieved	[-]	0.95

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	505
Back pressure	[kPa]	305
Base PWP	[kPa]	305
Effective radial pressure	[kPa]	200
Effective axial pressure	[kPa]	200
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.04
Axial strain	[%]	0.01
Water content	[%]	32.5
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.44
Void ratio	[-]	0.881
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	31WaxD
Depth [m]	24.52
Test number	RC09

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000338	93.05	1.000	0.79
0.000473	92.66	0.996	0.74
0.000622	92.66	0.996	1.07
0.000952	92.28	0.992	0.75
0.001372	92.47	0.994	1.48
0.001805	92.47	0.994	1.42
0.002663	92.47	0.994	1.55
0.003512	92.09	0.990	1.60
0.005170	91.89	0.988	1.63
0.008276	90.75	0.975	1.78
0.011748	88.66	0.953	2.00
0.014810	86.79	0.933	2.16
0.024472	79.86	0.858	2.98
0.032203	75.11	0.807	3.72
0.046997	69.17	0.743	4.77
0.058001	60.79	0.653	6.44

TORSIONAL RESONANCE STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000342	90.37	0.971	0.03
0.000476	91.13	0.979	0.59
0.000631	90.94	0.977	0.67
0.000944	91.13	0.979	1.27
0.001365	91.51	0.983	1.29
0.001802	91.89	0.988	1.54
0.002658	91.32	0.981	1.52
0.003508	91.13	0.979	1.66
0.005178	90.94	0.977	1.67
0.008333	89.80	0.965	1.78
0.011827	88.29	0.949	1.96
0.014968	86.23	0.927	2.15
0.024576	80.04	0.860	3.05
0.032275	74.93	0.805	3.81
0.045790	67.84	0.729	5.14
0.057079	60.48	0.650	6.48

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	31WaxD
Depth [m]	24.52
Test number	RC09

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

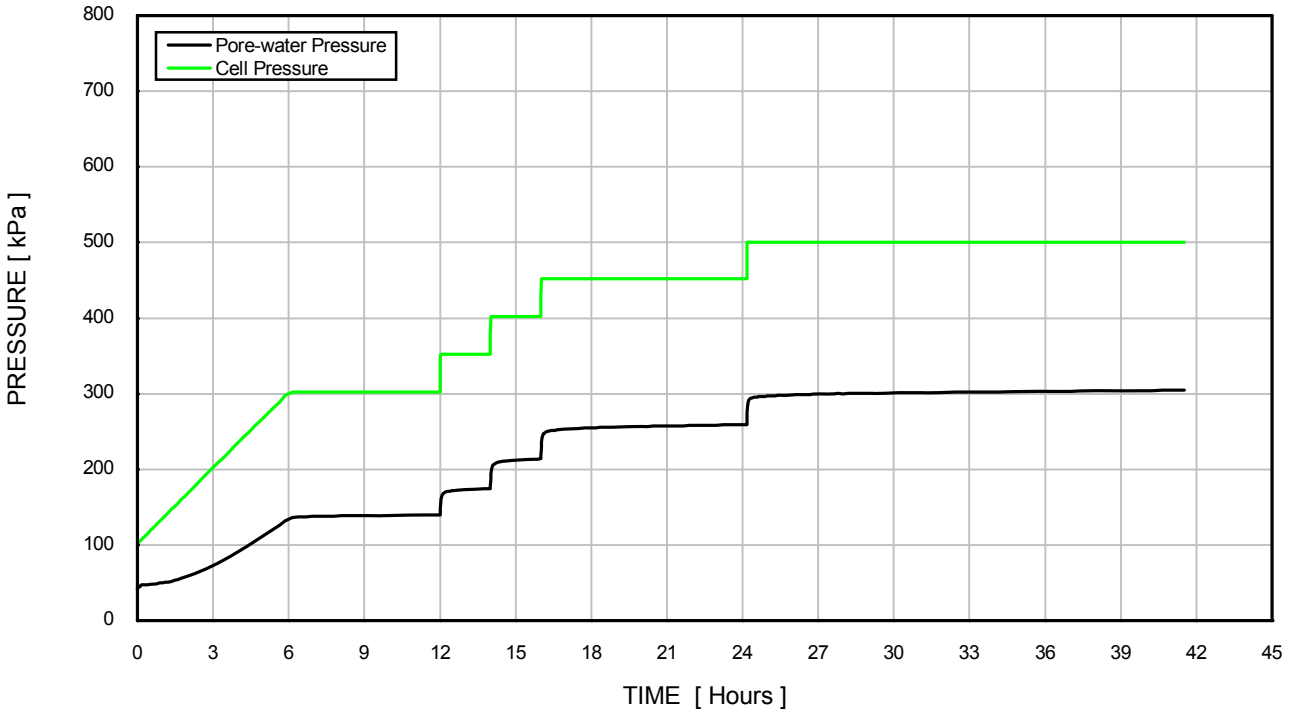
SPECIMEN PHOTOGRAPHS

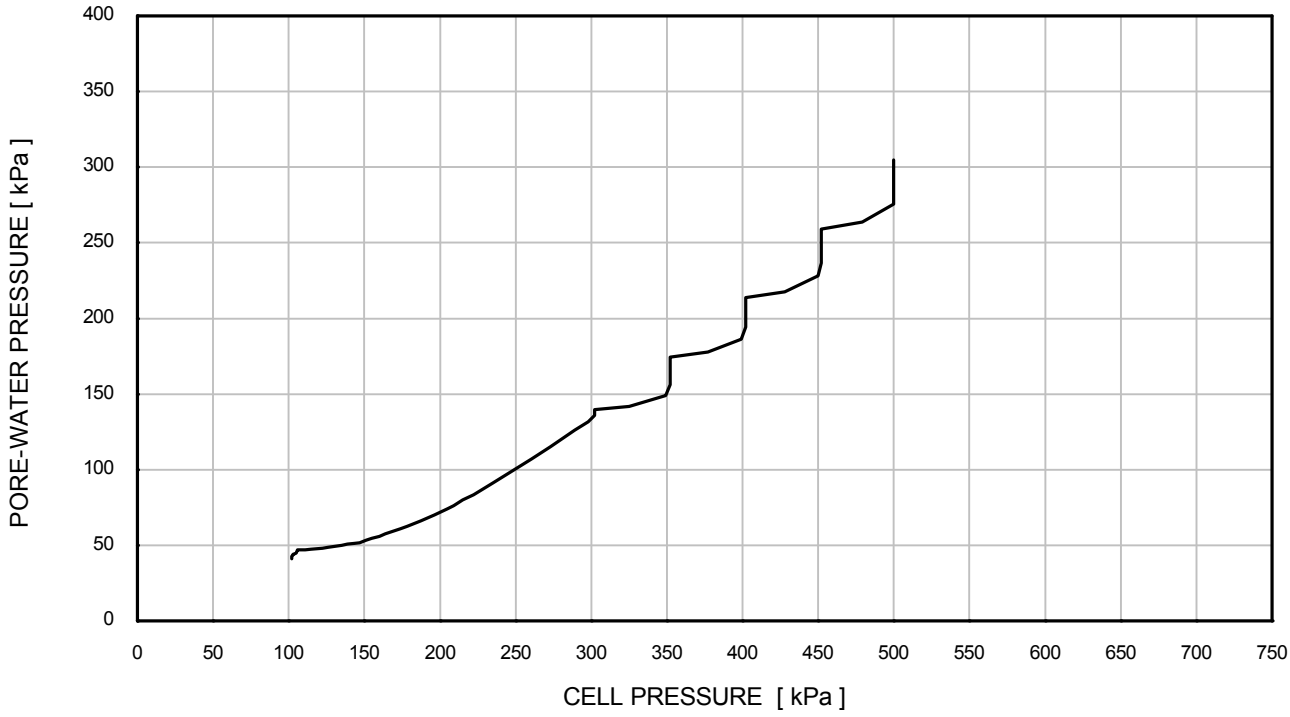


FINAL CONDITIONS		
Water content	[%]	32.5
Bulk density	[Mg/m³]	1.90
Dry density	[Mg/m³]	1.44

TEST IDENTIFICATION	
Borehole	HKZ2-BH21-SA
Sample	31WaxD
Depth [m]	24.52
Test number	RC09

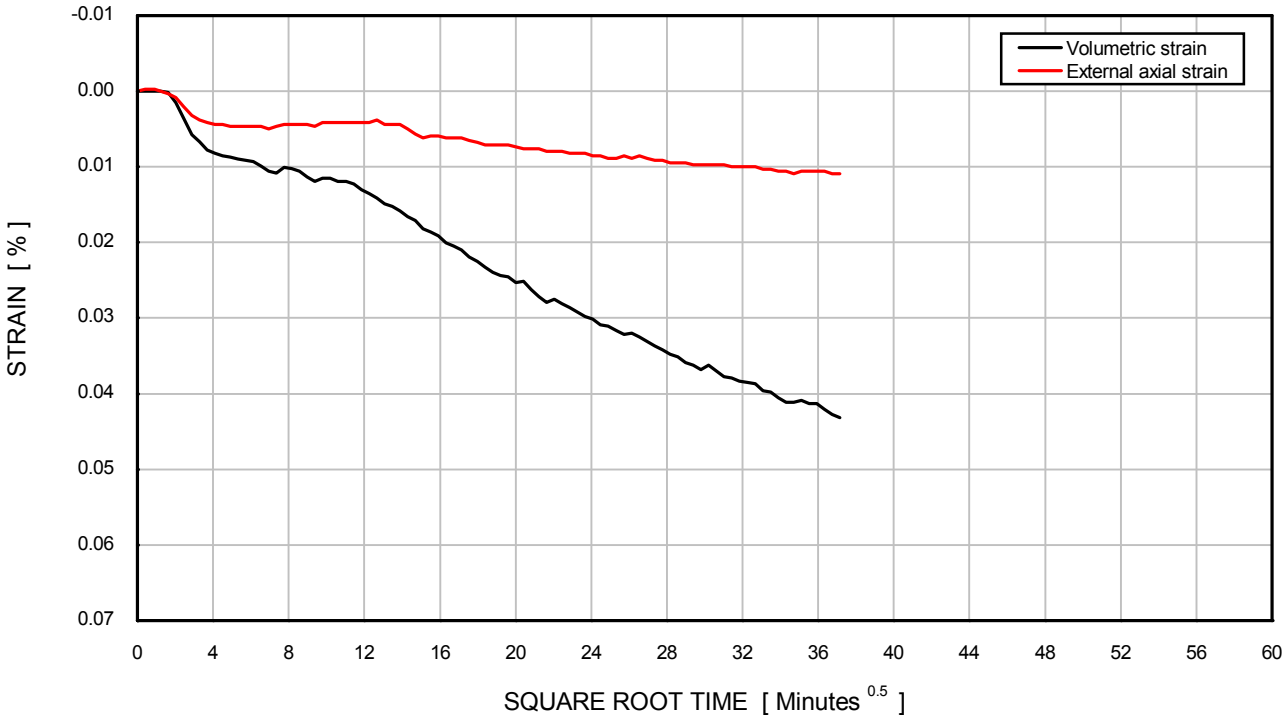
SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

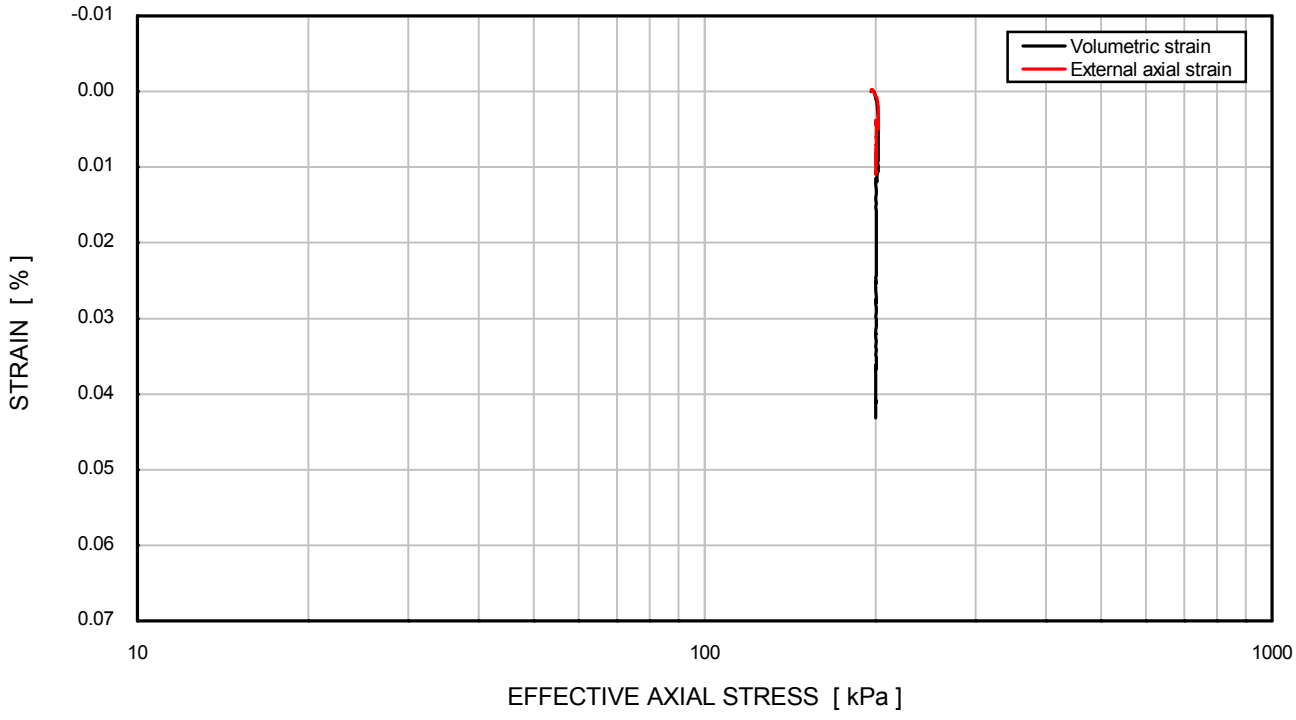




B value	: 0.95	Borehole	: HKZ2-BH21-SA
Initial σ'_r	: 61 kPa	Sample	: 31WaxD
Initial σ'_a	: 61 kPa	Depth [m]	: 24.52
Final σ'_r	: 195 kPa	Test No.	: RC09
Final σ'_a	: 195 kPa		

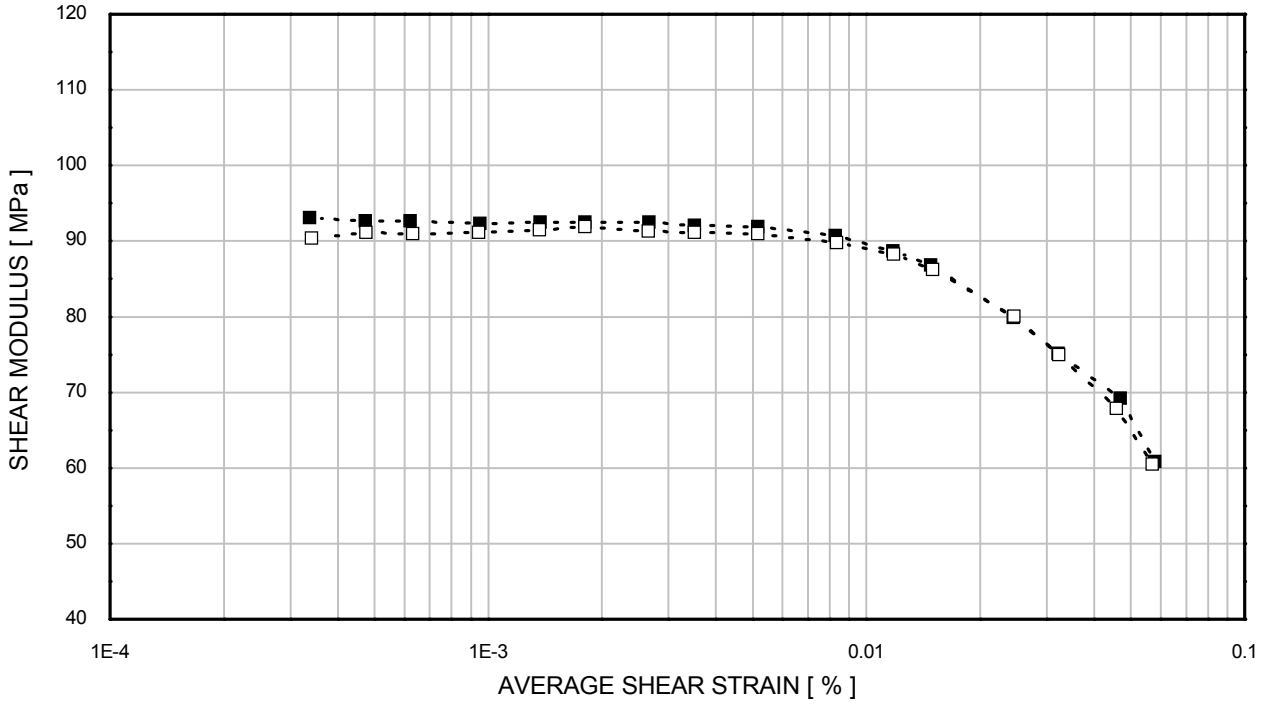
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - UNDRAINED

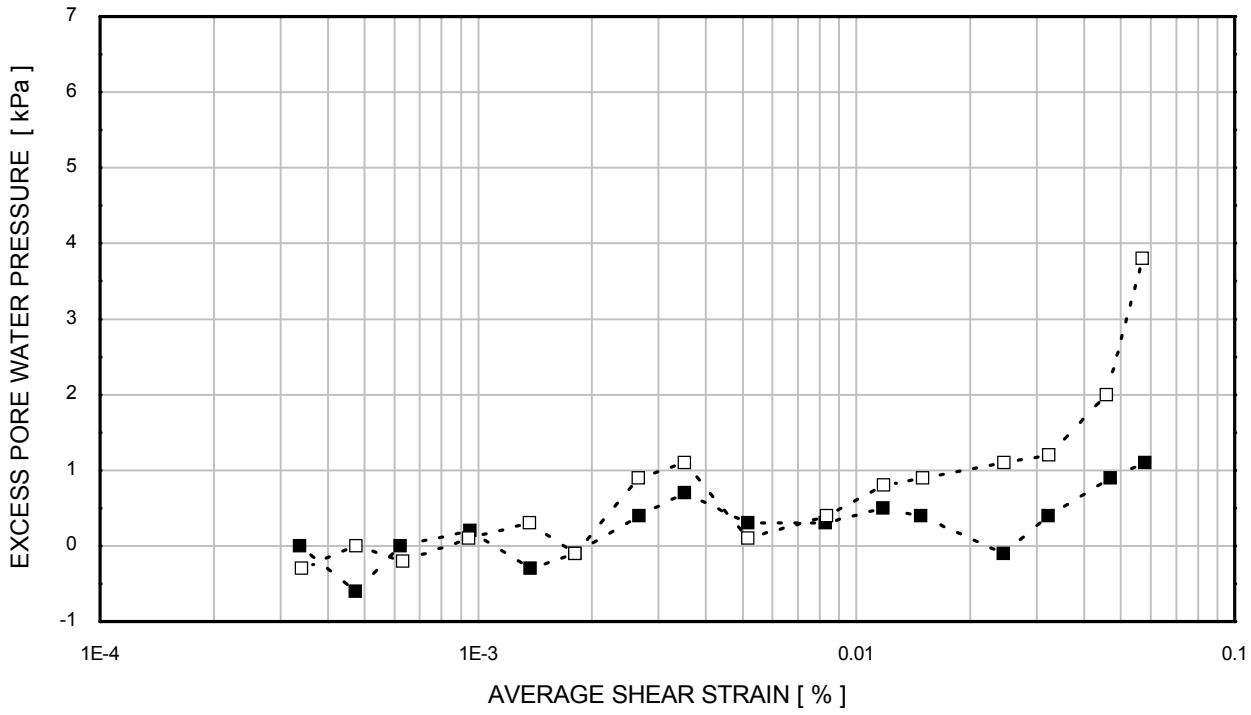




σ'_{rc}	: 200 kPa	Borehole	: HKZ2-BH21-SA
σ'_{ac}	: 200 kPa	Sample	: 31WaxD
		Depth [m]	: 24.52
		Test No.	: RC09

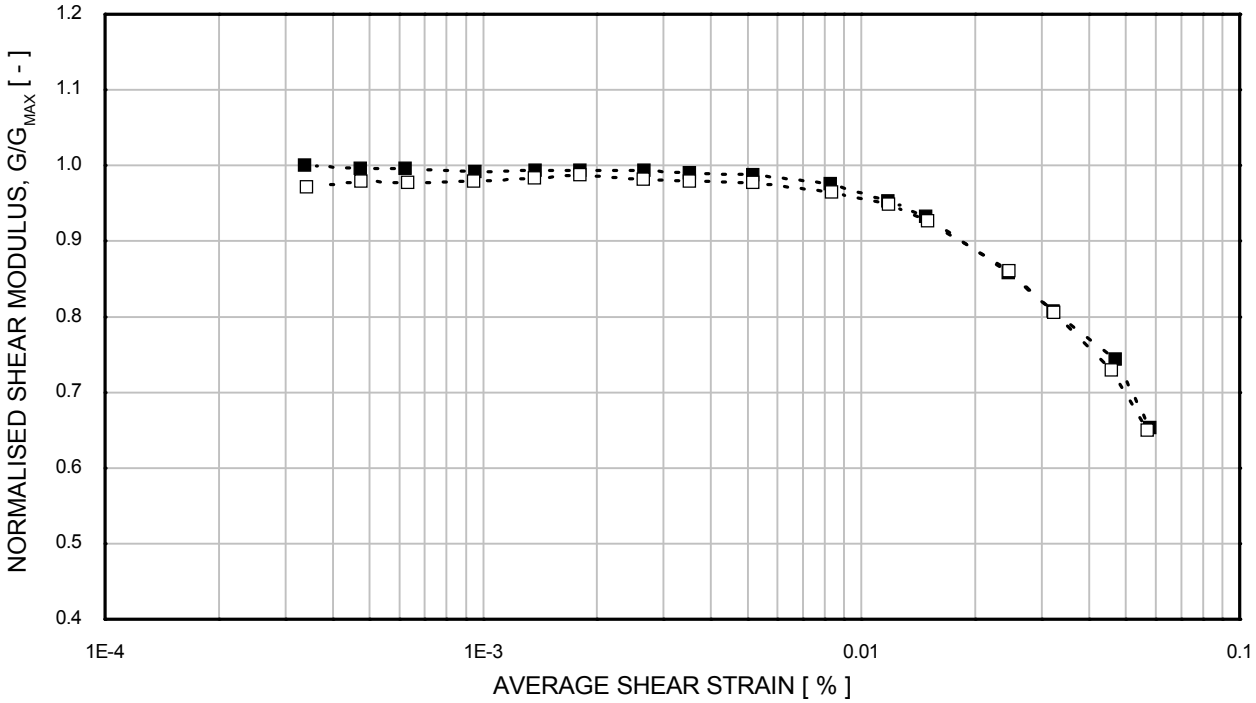
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ISOTROPIC CONSOLIDATION STAGE

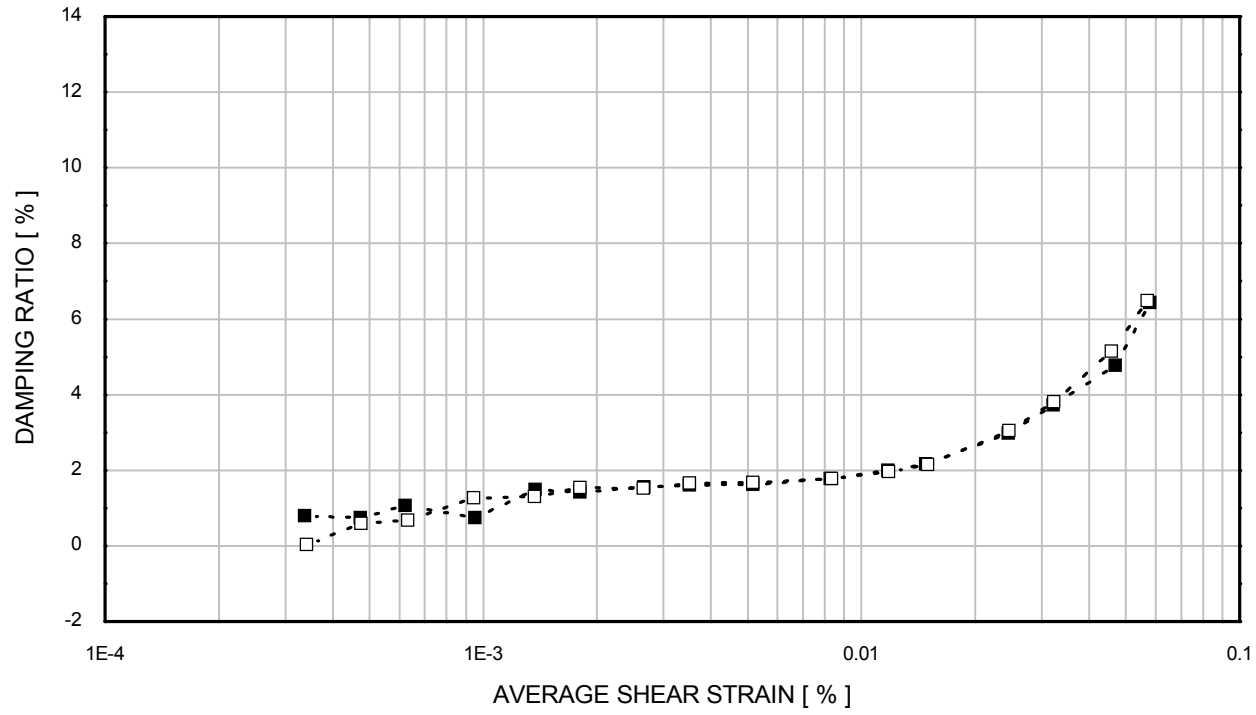




σ'_0	: 200 kPa	Borehole	: HKZ2-BH21-SA
Load		Sample	: 31WaxD
Reload		Depth [m]	: 24.52
		Test No.	: RC09

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1





σ'_0	: 200 kPa	Borehole	: HKZ2-BH21-SA
- ·■- · Load		Sample	: 31WaxD
- ·□- · Reload		Depth [m]	: 24.52
		Test No.	: RC09

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1

VISUAL DESCRIPTION
Yellowish brown fine to medium SAND

GENERAL	
Date test started	06/01/2017
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	10.9
Bulk density	[Mg/m³]	1.81
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.619
Degree of saturation	[%]	47
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Not applicable
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ BATCH01_RC01
Processed by	NC
Date	11/01/2017
Checked by	DT
Date	13/01/2017
Approved by	DT
Date	13/01/2017

TEST IDENTIFICATION	
Batch	1
Sample	RC_1-1
Unit	Unit A (Southern Bight)
Test number	RC01

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	50
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	500
Base PWP	[kPa]	486
Axial strain	[%]	0.05
Water Content	[%]	23.4
Bulk Density	[Mg/m³]	2.02
Dry Density	[Mg/m³]	1.64
Void Ratio	[-]	0.619
Degree of saturation	[%]	100
B value achieved	[-]	0.93

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	507
Back pressure	[kPa]	487
Base PWP	[kPa]	487
Effective radial pressure	[kPa]	20
Effective axial pressure	[kPa]	20
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.01
Axial strain	[%]	0.01
Water content	[%]	23.3
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64
Void ratio	[-]	0.619
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	1
Sample	RC_1-1
Unit	Unit A (Southern Bight)
Test number	RC01

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE DRAINED STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000307	37.65	1.000	1.38
0.000817	36.32	0.965	1.95
0.001366	34.68	0.921	2.02
0.002106	33.29	0.884	1.86
0.002914	32.05	0.851	2.11
0.003670	30.94	0.822	2.14
0.004844	29.64	0.787	2.73
0.006015	28.36	0.753	2.98
0.007803	27.01	0.717	3.42
0.011440	23.82	0.633	4.70
0.015029	21.66	0.575	5.97
0.022534	16.89	0.449	7.22

TORSIONAL RESONANCE DRAINED STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000597	32.28	0.857	1.13
0.001139	31.27	0.831	1.18
0.001599	30.29	0.805	1.40
0.002351	28.89	0.767	1.58
0.003204	27.42	0.728	2.19
0.003900	26.09	0.693	2.45
0.005174	25.19	0.669	2.98
0.006372	24.02	0.638	3.71
0.008557	22.68	0.602	4.24
0.012128	21.47	0.570	5.43
0.019557	16.65	0.442	6.46
0.023766	15.08	0.400	7.72

TEST IDENTIFICATION	
Batch	1
Sample	RC_1-1
Unit	Unit A (Southern Bight)
Test number	RC01

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE UNDRAINED STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000479	32.28	0.997	0.94
0.001076	30.61	0.945	1.62
0.001539	29.53	0.912	1.96
0.002271	28.26	0.872	2.13
0.003049	27.01	0.834	2.34
0.003875	25.79	0.796	2.62
0.005805	24.50	0.757	3.78
0.008233	22.12	0.683	4.70
0.012070	20.39	0.629	6.04
0.021039	14.32	0.442	6.81

TORSIONAL RESONANCE UNDRAINED STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000267	32.39	1.000	1.22
0.000937	28.68	0.885	1.69
0.001378	27.84	0.859	1.76
0.002068	26.50	0.818	2.35
0.002901	25.09	0.775	2.65
0.003594	24.40	0.754	3.26
0.005884	22.12	0.683	4.71
0.007992	20.66	0.638	5.38
0.014734	17.38	0.537	5.67
0.020400	15.31	0.473	6.14

TEST IDENTIFICATION	
Batch	1
Sample	RC_1-1
Unit	Unit A (Southern Bight)
Test number	RC01

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SPECIMEN PHOTOGRAPHS





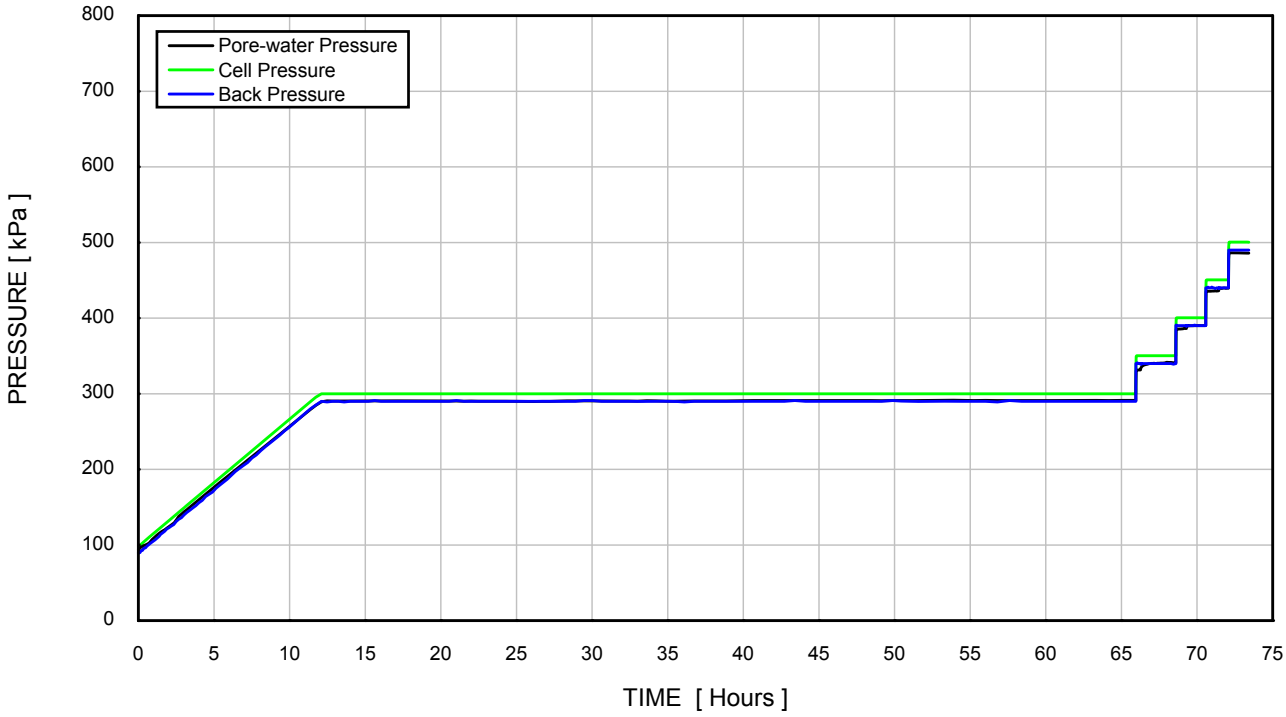
FINAL CONDITIONS

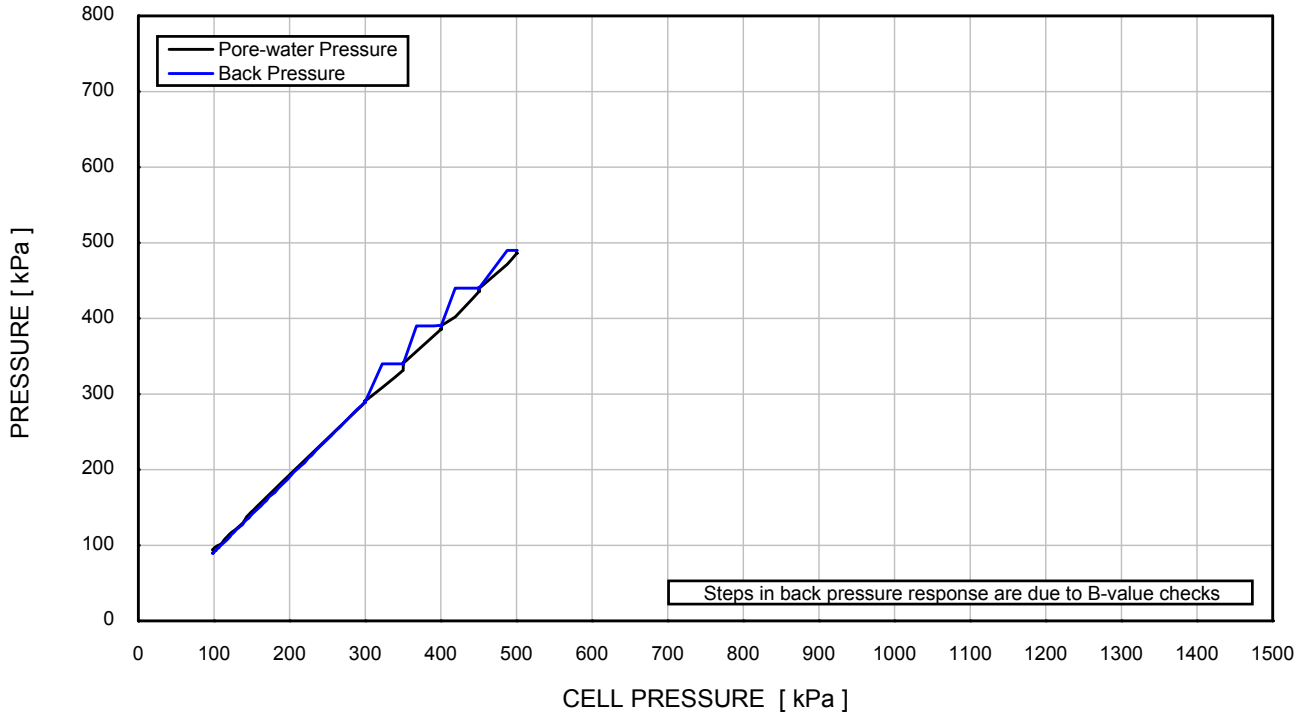
Water content	[%]	23.3
Bulk density	[Mg/m³]	2.02
Dry density	[Mg/m³]	1.64

TEST IDENTIFICATION

Batch	1
Sample	RC_1-1
Unit	Unit A (Southern Bight)
Test number	RC01

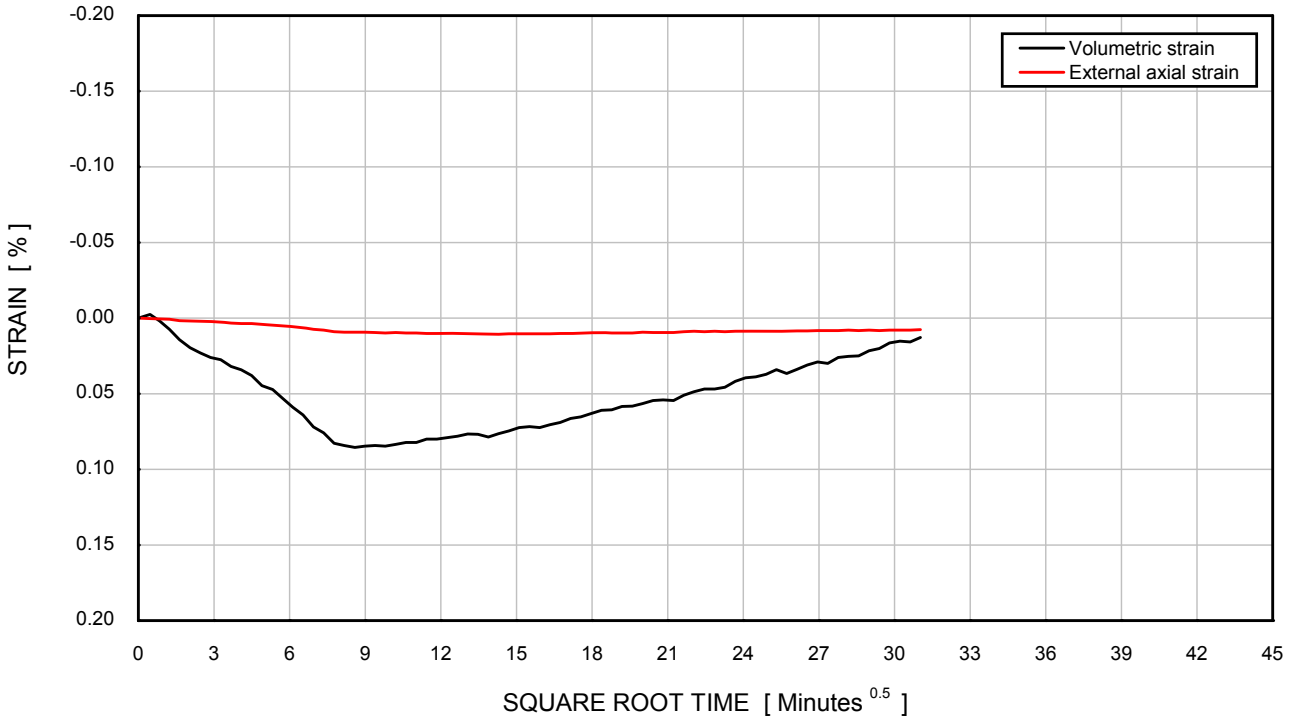
SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST





B value	:	0.93			
Initial σ'_r	:	4	kPa	Borehole	: BATCH01
Initial σ'_a	:	4	kPa	Sample	: -
Final σ'_r	:	15	kPa	Depth [m]	: --
Final σ'_a	:	14	kPa	Test No.	: RC01

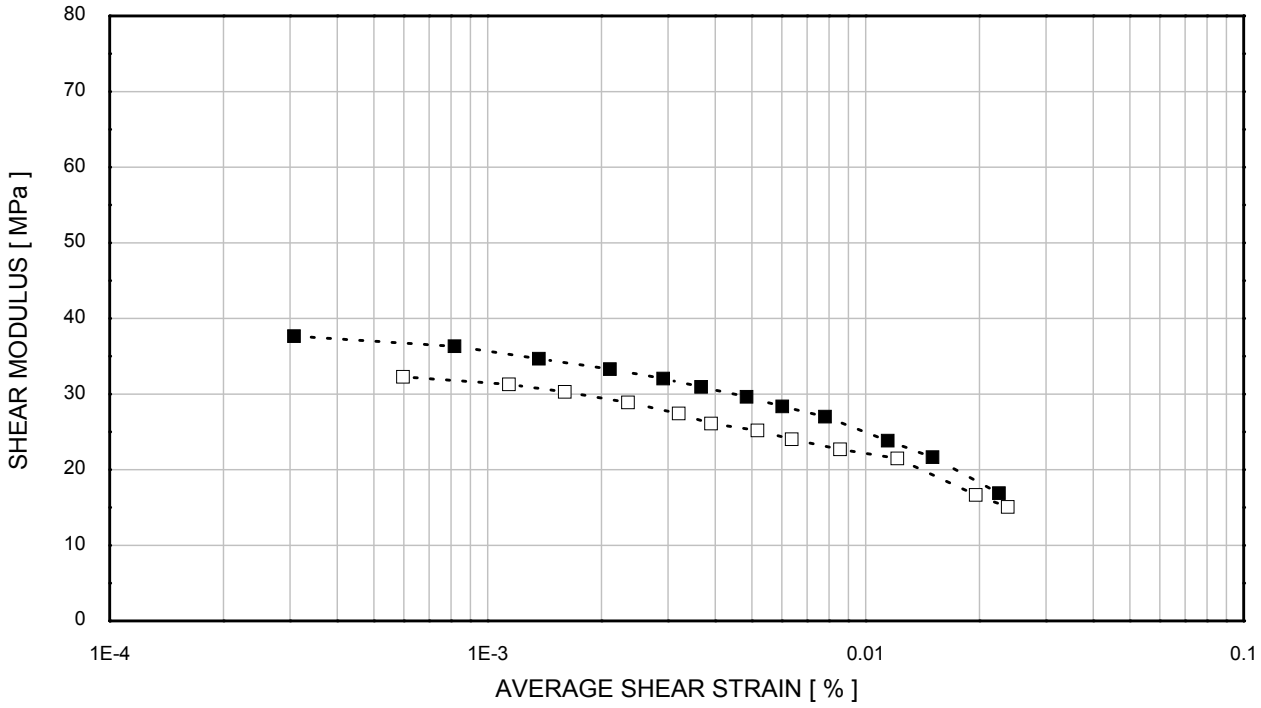
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - DRAINED

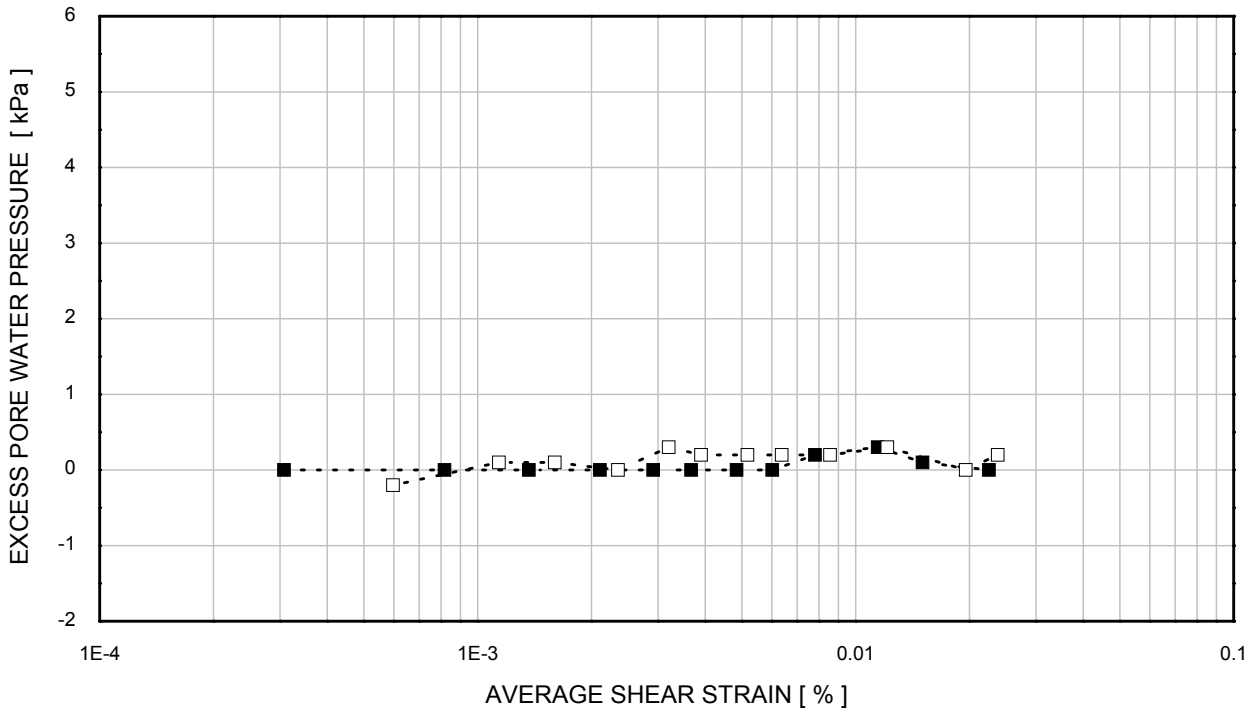




σ'_{rc}	:	20 kPa	Borehole	: BATCH01
σ'_{ac}	:	20 kPa	Sample	: -
			Depth [m]	: --
			Test No.	: RC01

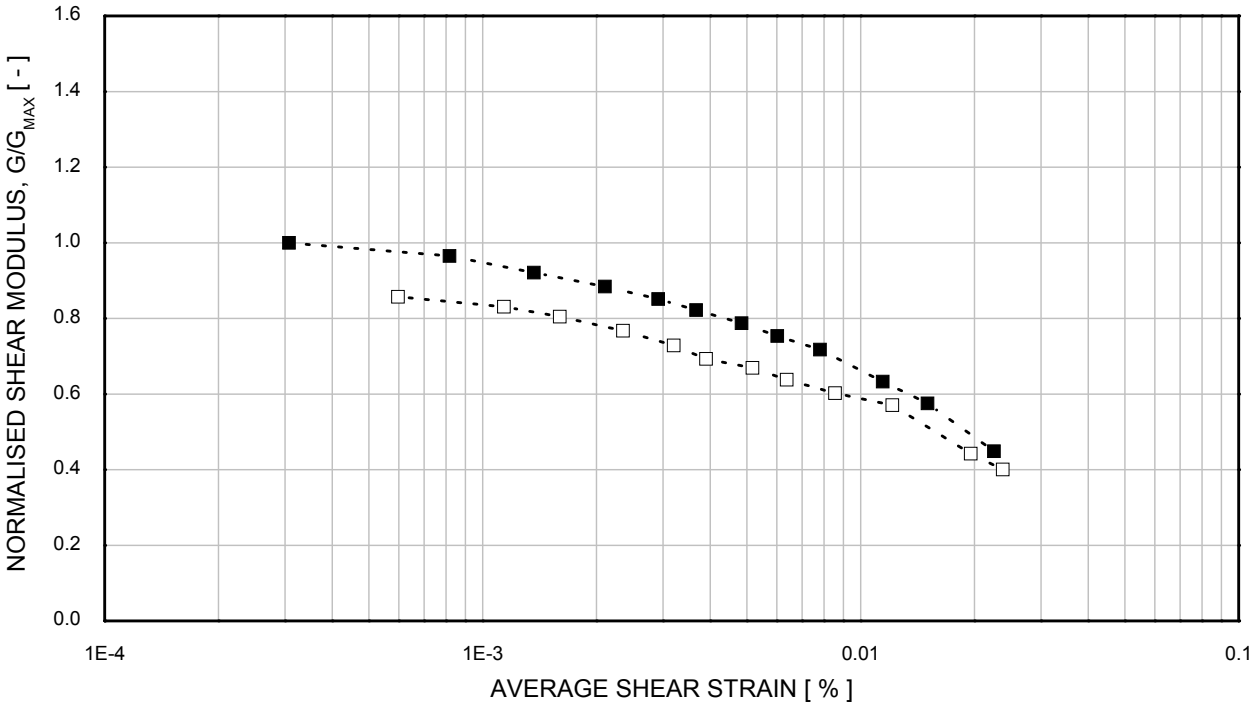
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ISOTROPIC CONSOLIDATION STAGE

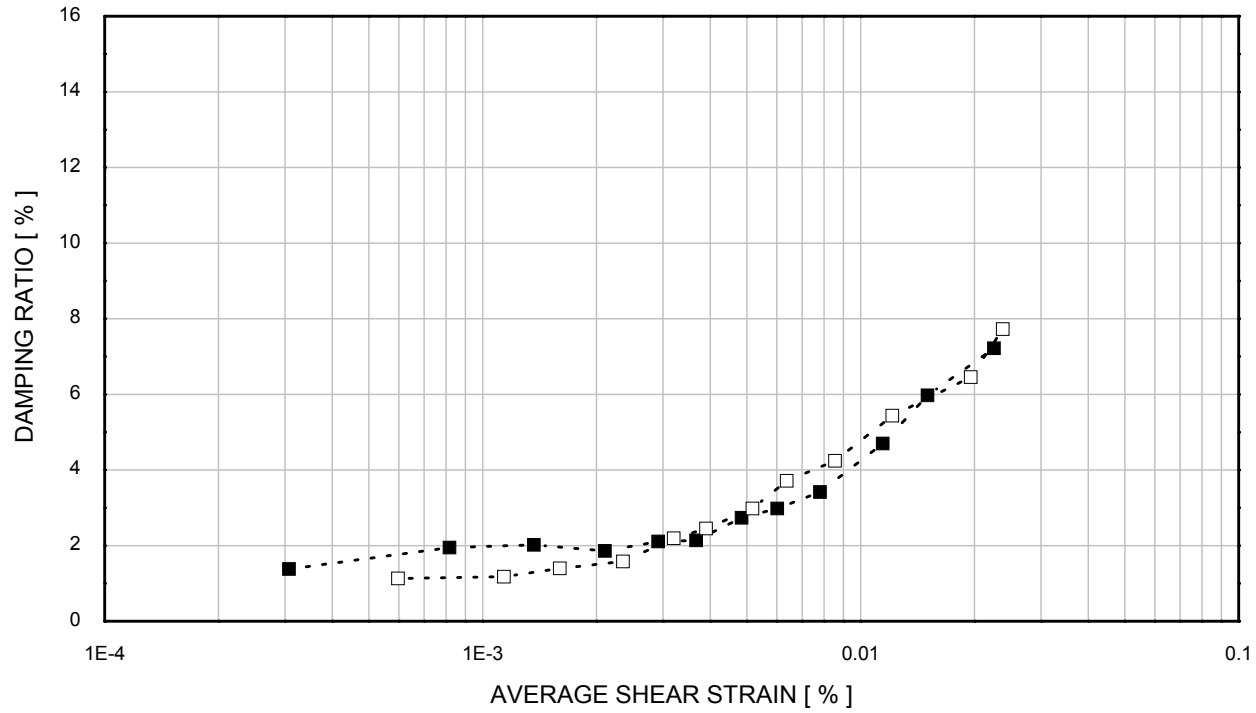




σ'_0	: 20 kPa	Borehole	: BATCH01
- ·■- · Load		Sample	: -
- ·□- · Reload		Depth [m]	: --
		Test No.	: RC01

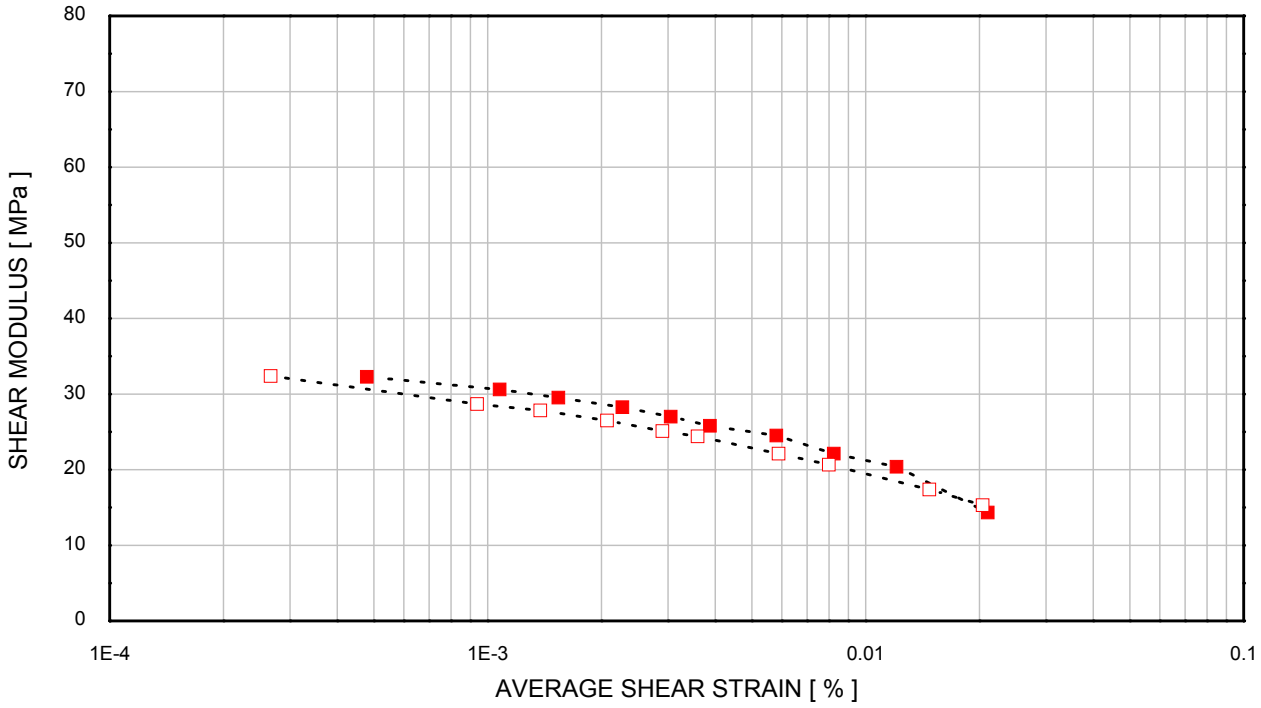
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION DRAINED STAGE

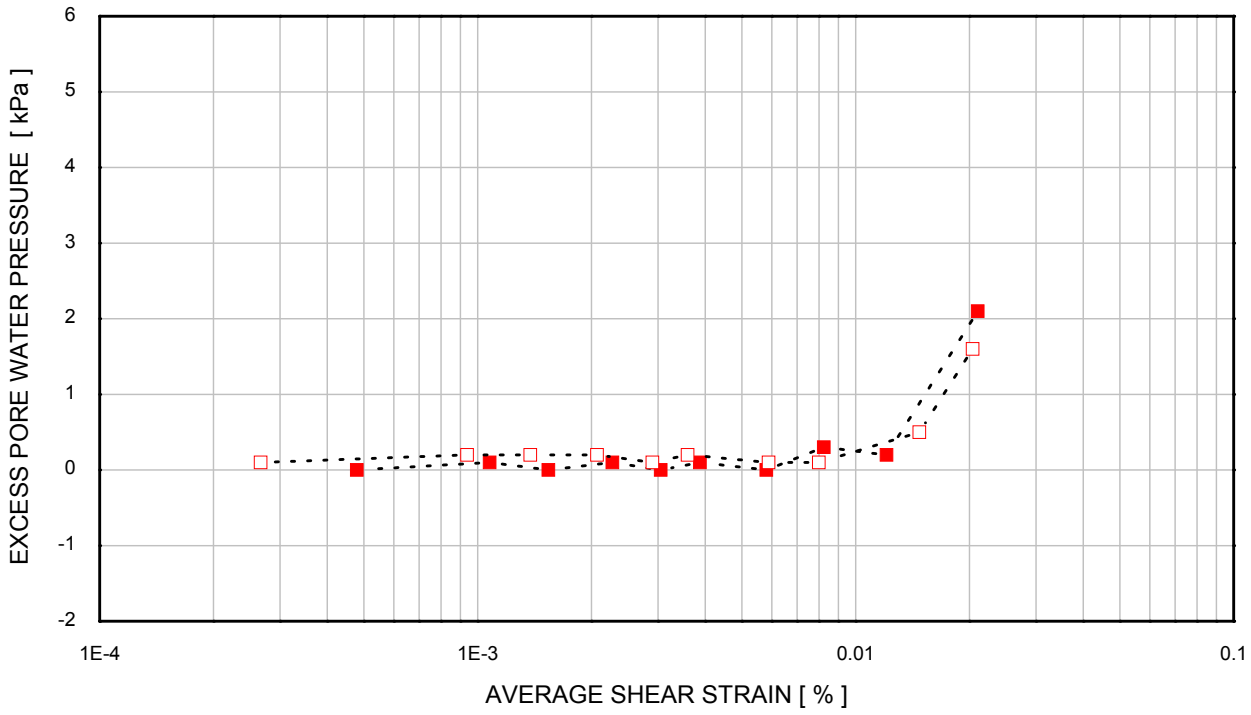




σ'_0	: 20 kPa	Borehole	: BATCH01
Load		Sample	: -
Reload		Depth [m]	: --
		Test No.	: RC01

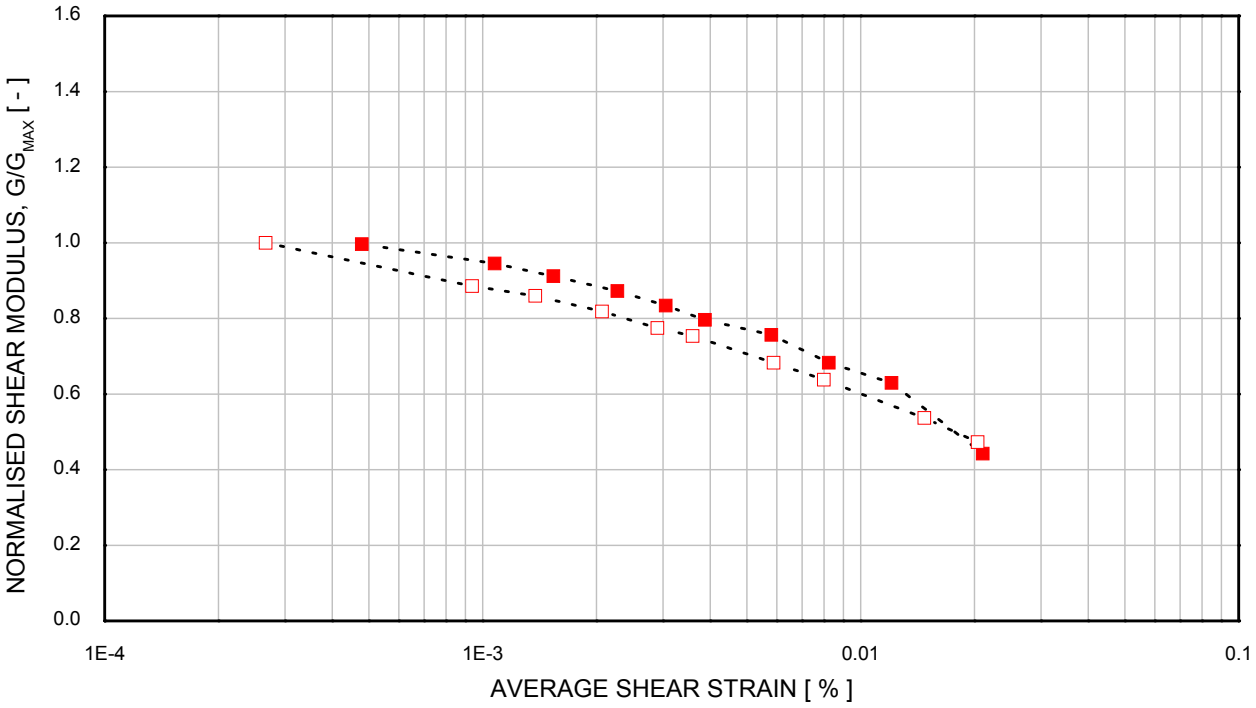
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION DRAINED STAGE

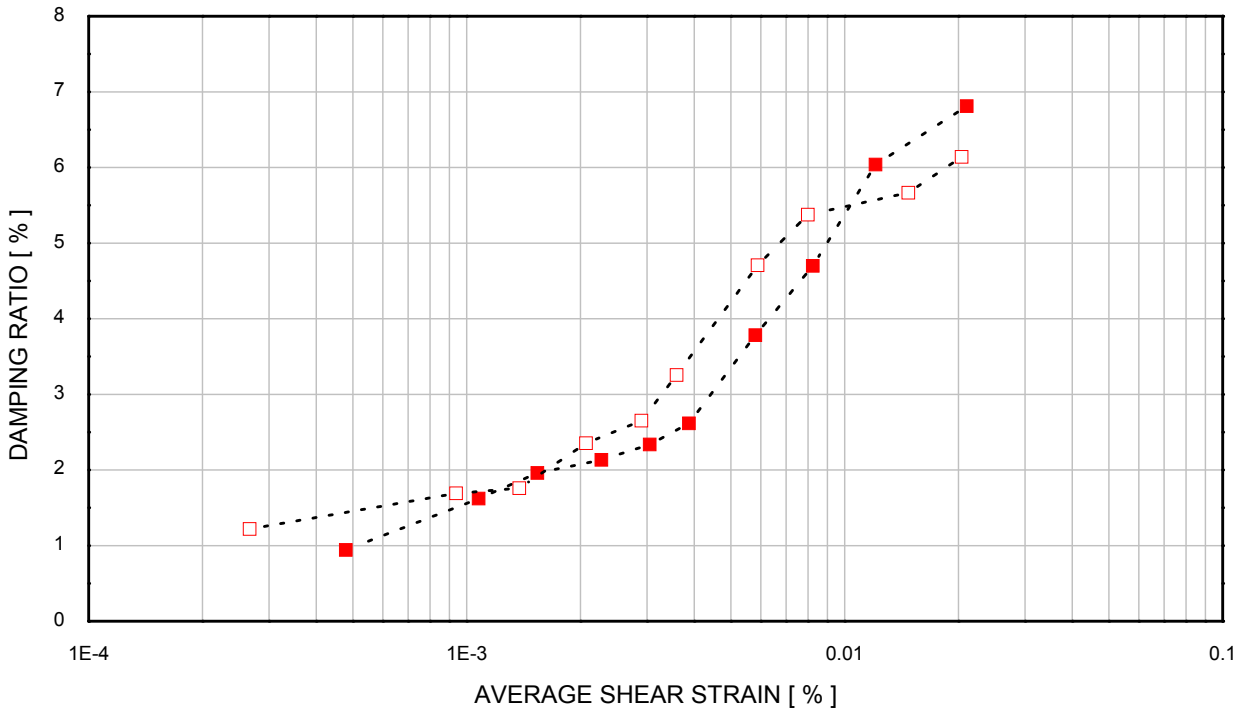




σ'_0	: 20 kPa	Borehole	: BATCH01
Load		Sample	: -
Reload		Depth [m]	: --
		Test No.	: RC01

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION UNDRAINED STAGE





σ'_0	: 20 kPa	Borehole	: BATCH01
Load		Sample	: -
Reload		Depth [m]	: --
		Test No.	: RC01

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION UNDRAINED STAGE

VISUAL DESCRIPTION
Grey fine to medium SAND

GENERAL	
Date test started	01/12/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	69.9
Length	[mm]	140.0
Water content	[%]	9.5
Bulk density	[Mg/m³]	1.80
Dry density	[Mg/m³]	1.65
Void ratio	[-]	0.609
Degree of saturation	[%]	41
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ Batch 3_RC03
Processed by	NC
Date	07/12/2016
Checked by	PH
Date	14/12/2016
Approved by	PH
Date	14/12/2016

TEST IDENTIFICATION	
Batch	3
Sample	RC_3-1
Unit	Unit B1 (Kreftenheye)
Test number	RC03

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	50
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	500
Base PWP	[kPa]	486
Axial strain	[%]	0.01
Water Content	[%]	23.0
Bulk Density	[Mg/m³]	2.03
Dry Density	[Mg/m³]	1.65
Void Ratio	[-]	0.609
Degree of saturation	[%]	100
B value achieved	[-]	0.95

CONSOLIDATION: ISOTROPIC		
Cell pressure	[kPa]	621
Back pressure	[kPa]	486
Base PWP	[kPa]	486
Effective radial pressure	[kPa]	135
Effective axial pressure	[kPa]	135
Deviator stress	[kPa]	0
Volumetric strain	[%]	0.61
Axial strain	[%]	0.13
Water content	[%]	22.6
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.66
Void ratio	[-]	0.599
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	3
Sample	RC_3-1
Unit	Unit B1 (Kreftenheye)
Test number	RC03

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING (DRAINED)			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000455	106.83	1.000	0.07
0.000765	106.41	0.996	0.32
0.001093	105.78	0.990	0.42
0.001673	105.15	0.984	0.50
0.002373	104.11	0.975	0.59
0.003048	103.07	0.965	0.67
0.004199	101.63	0.951	0.73
0.005249	100.19	0.938	0.86
0.007104	96.55	0.904	1.04
0.010033	93.18	0.872	1.23
0.014091	87.37	0.818	1.57
0.017891	83.41	0.781	1.56

TORSIONAL RESONANCE STAGE - REPEAT LOADING (DRAINED)			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000499	98.77	0.925	0.18
0.000865	98.16	0.919	0.40
0.001268	97.76	0.915	0.50
0.001795	96.95	0.908	0.49
0.002533	95.75	0.896	0.66
0.003230	94.56	0.885	0.69
0.004436	93.18	0.872	0.79
0.005699	91.61	0.858	0.90
0.007839	90.06	0.843	1.01
0.012151	86.61	0.811	1.22
0.016153	83.78	0.784	1.51
0.019107	80.46	0.753	1.78

TEST IDENTIFICATION	
Batch	3
Sample	RC_3-1
Unit	Unit B1 (Kreftenheye)
Test number	RC03

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING (UNDRAINED)			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000504	96.35	1.000	0.19
0.000862	95.75	0.994	0.47
0.001184	95.16	0.988	0.42
0.001794	94.36	0.979	0.45
0.002509	93.18	0.967	0.75
0.003221	92.00	0.955	0.77
0.004383	90.64	0.941	0.86
0.005575	89.67	0.931	0.91
0.007770	87.94	0.913	1.07
0.012152	84.91	0.881	1.23
0.016684	81.74	0.848	1.49
0.019886	78.28	0.812	1.69

TORSIONAL RESONANCE STAGE - REPEAT LOADING (UNDRAINED)			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000501	93.18	0.967	0.16
0.000834	92.59	0.961	0.08
0.001146	91.61	0.951	0.50
0.001733	90.25	0.937	0.49
0.002447	89.09	0.925	0.66
0.003165	88.13	0.915	0.69
0.004396	86.99	0.903	0.79
0.005647	85.85	0.891	0.90
0.007977	84.53	0.877	1.01
0.011966	82.85	0.860	1.22
0.016182	81.19	0.843	1.51
0.020156	77.92	0.809	1.78

TEST IDENTIFICATION	
Batch	3
Sample	RC_3-1
Unit	Unit B1 (Kreftenheye)
Test number	RC03

SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SPECIMEN PHOTOGRAPHS

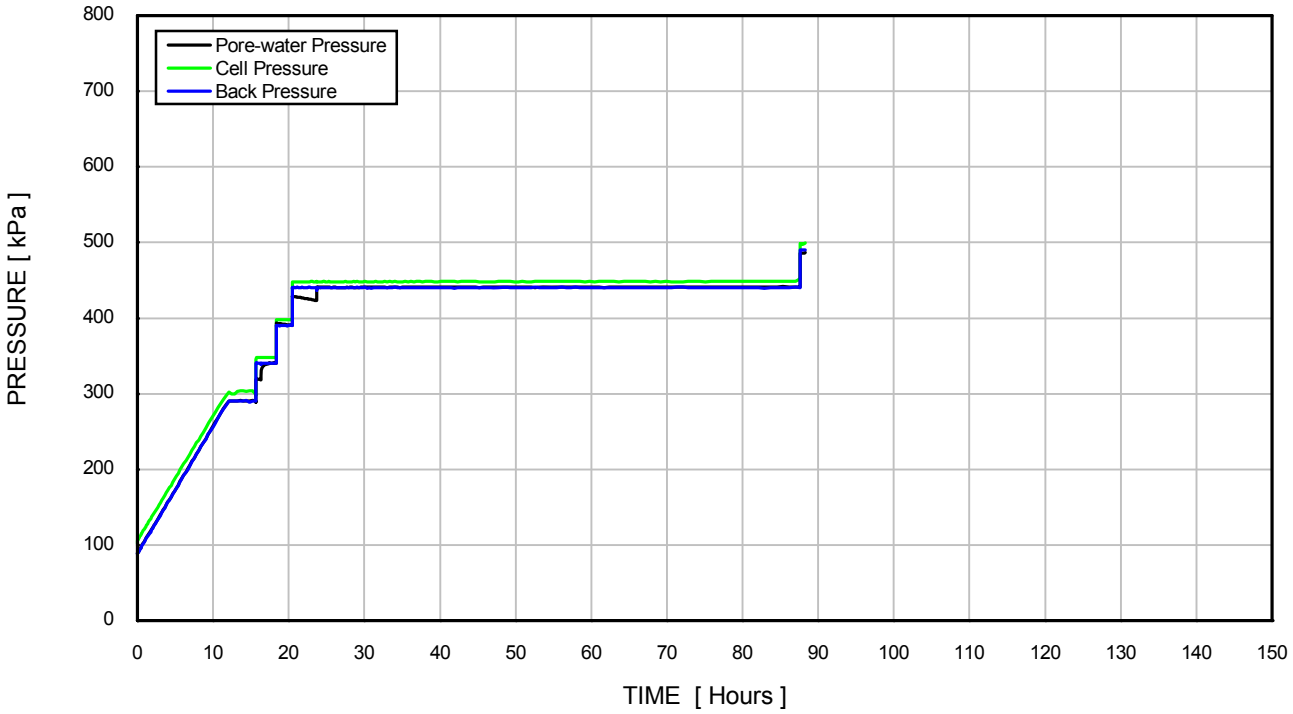
Photograph unavailable

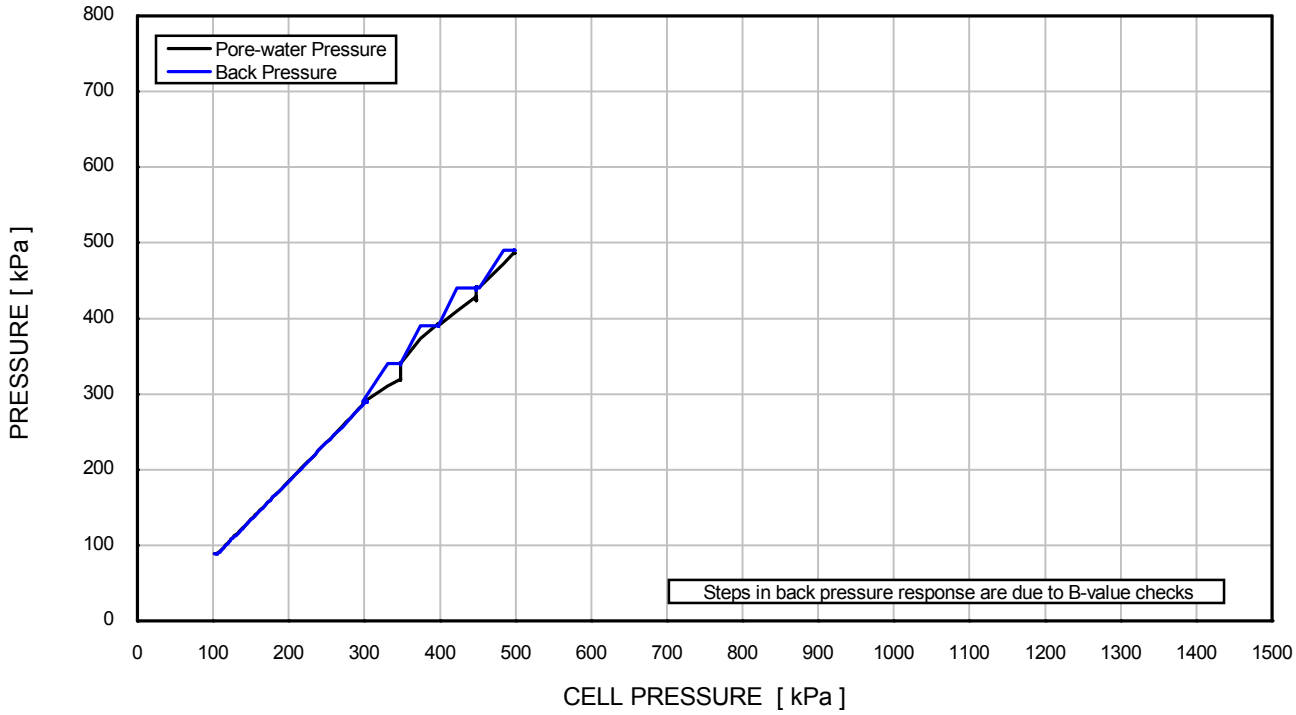
Photograph unavailable

FINAL CONDITIONS		
Water content	[%]	22.6
Bulk density	[Mg/m³]	2.03
Dry density	[Mg/m³]	1.66

TEST IDENTIFICATION	
Batch	3
Sample	RC_3-1
Unit	Unit B1 (Kreftenheye)
Test number	RC03

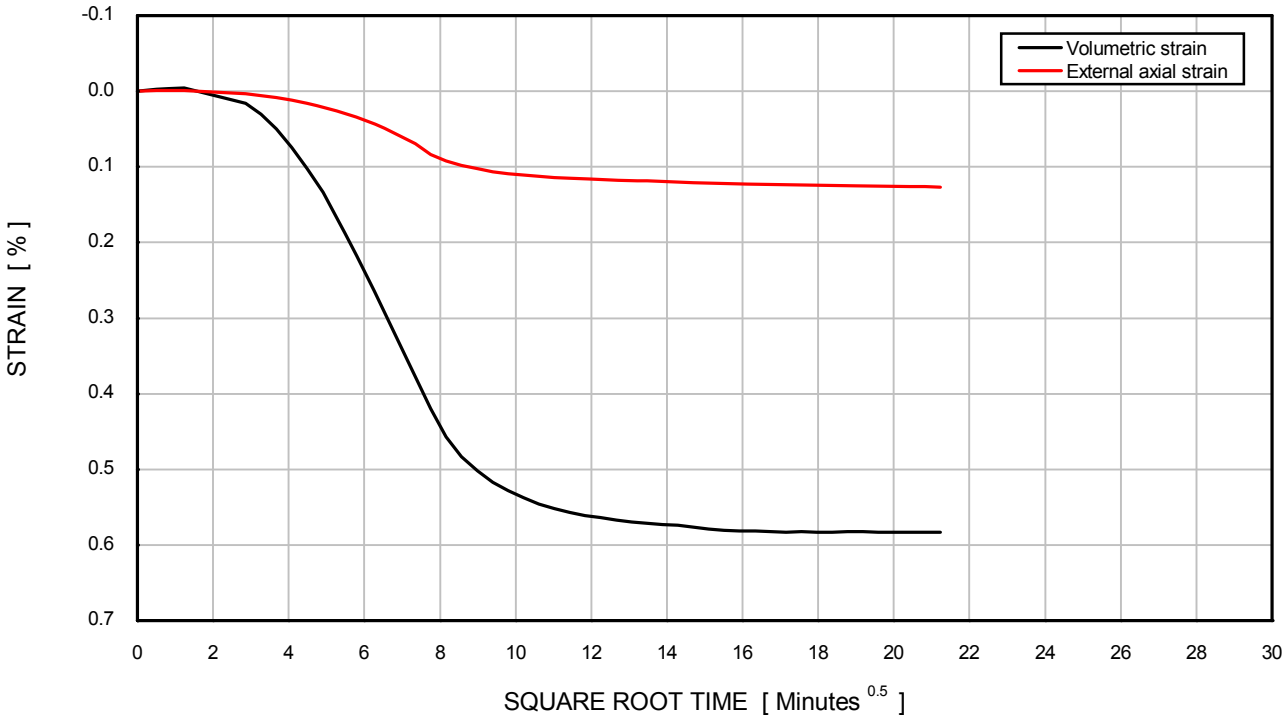
SUMMARY OF ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

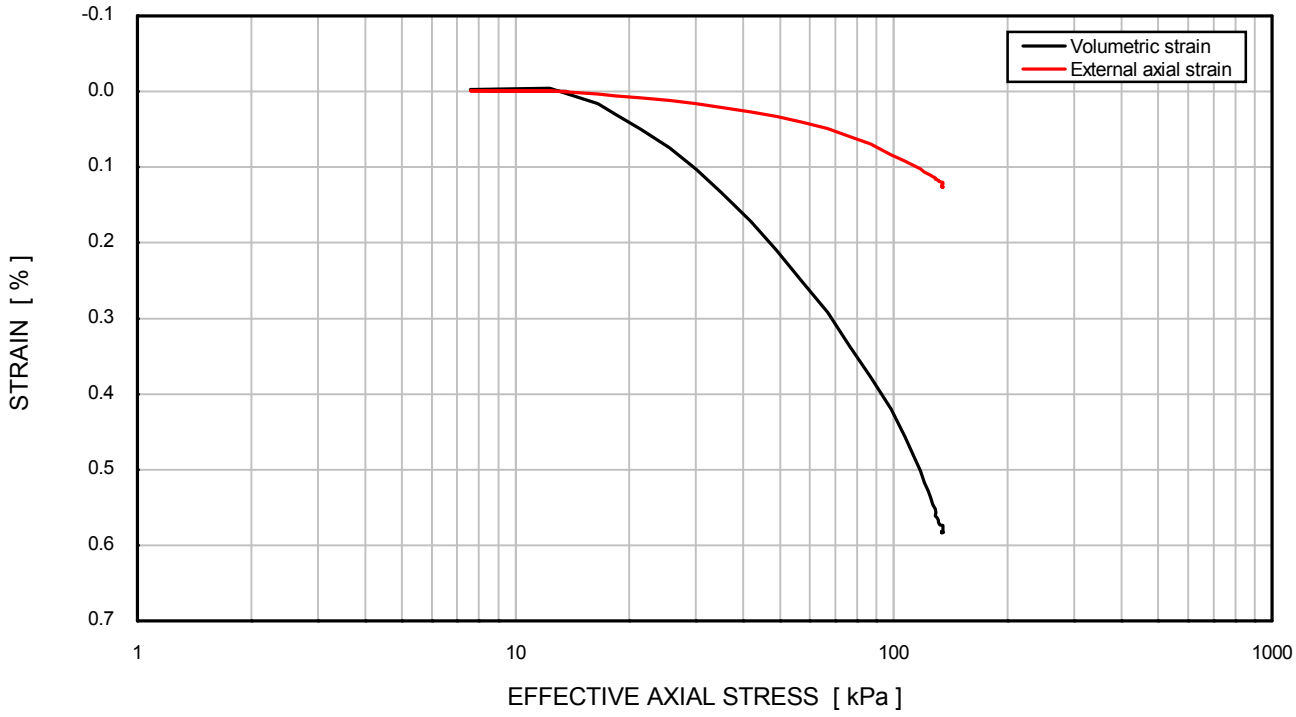




B value	:	0.95			
Initial σ'_r	:	13	kPa	Batch	: 3
Initial σ'_a	:	13	kPa	Sample	: RC_3-1
Final σ'_r	:	13	kPa	Unit	: Unit B1 (Kreftenheye)
Final σ'_a	:	13	kPa	Test No.	: RC03

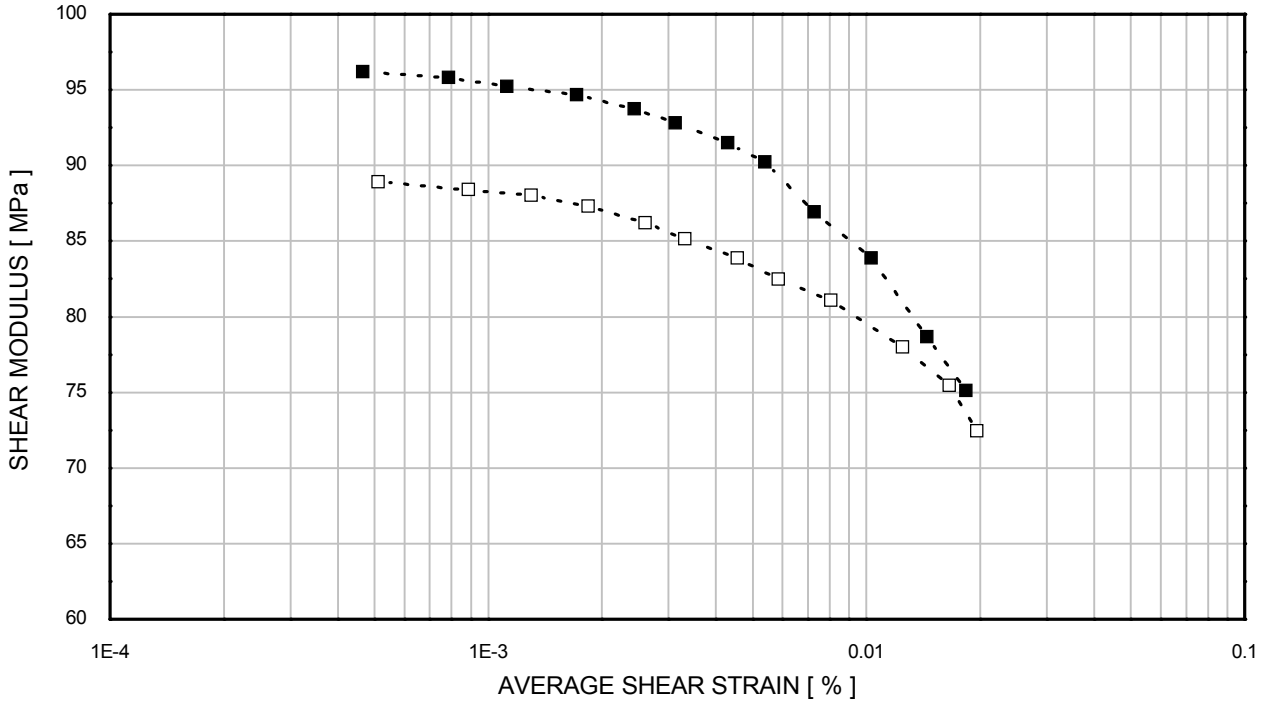
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - DRAINED

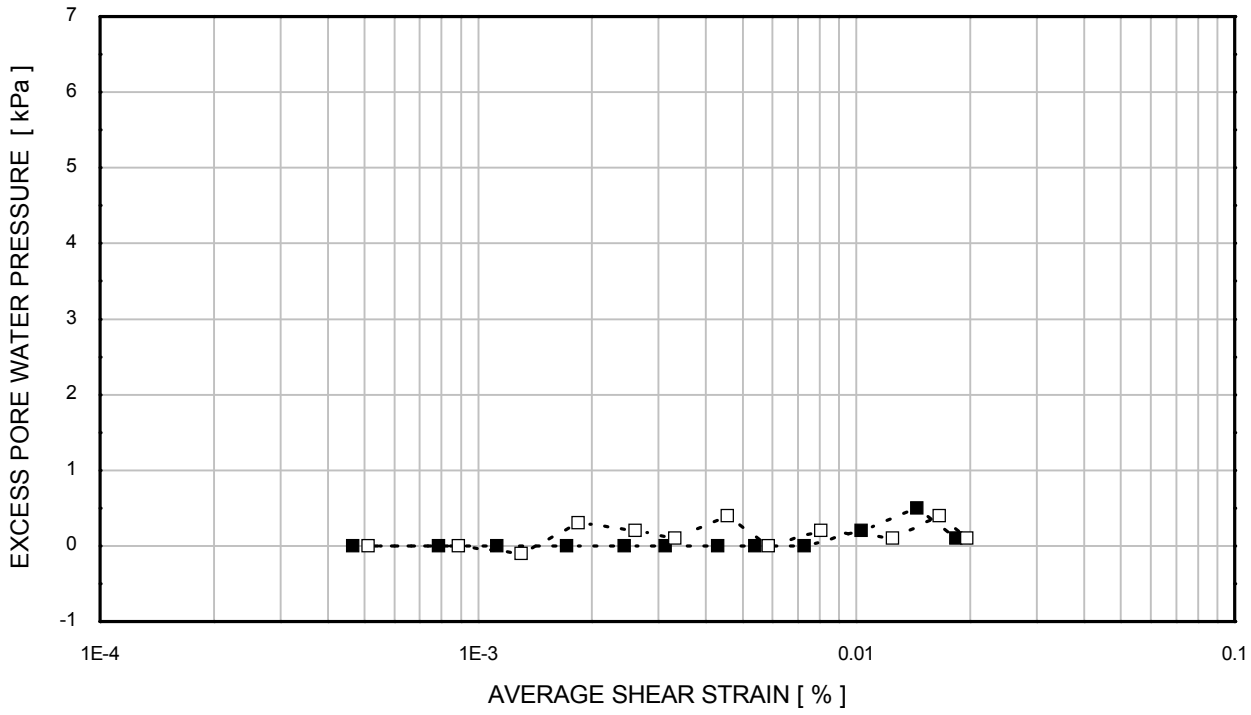




σ'_{rc}	: 135 kPa	Batch	: 3
σ'_{ac}	: 135 kPa	Sample	: RC_3-1
		Unit	: Unit B1 (Kreftenheye)
		Test No.	: RC03

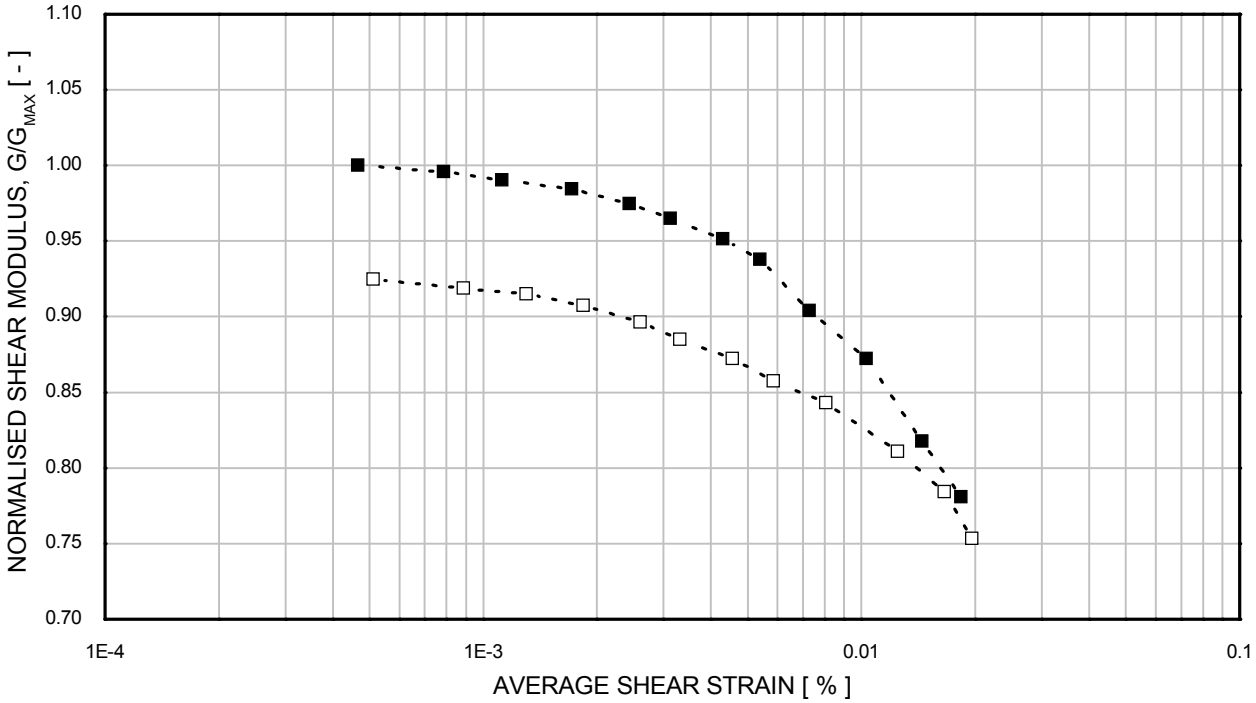
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ISOTROPIC CONSOLIDATION STAGE

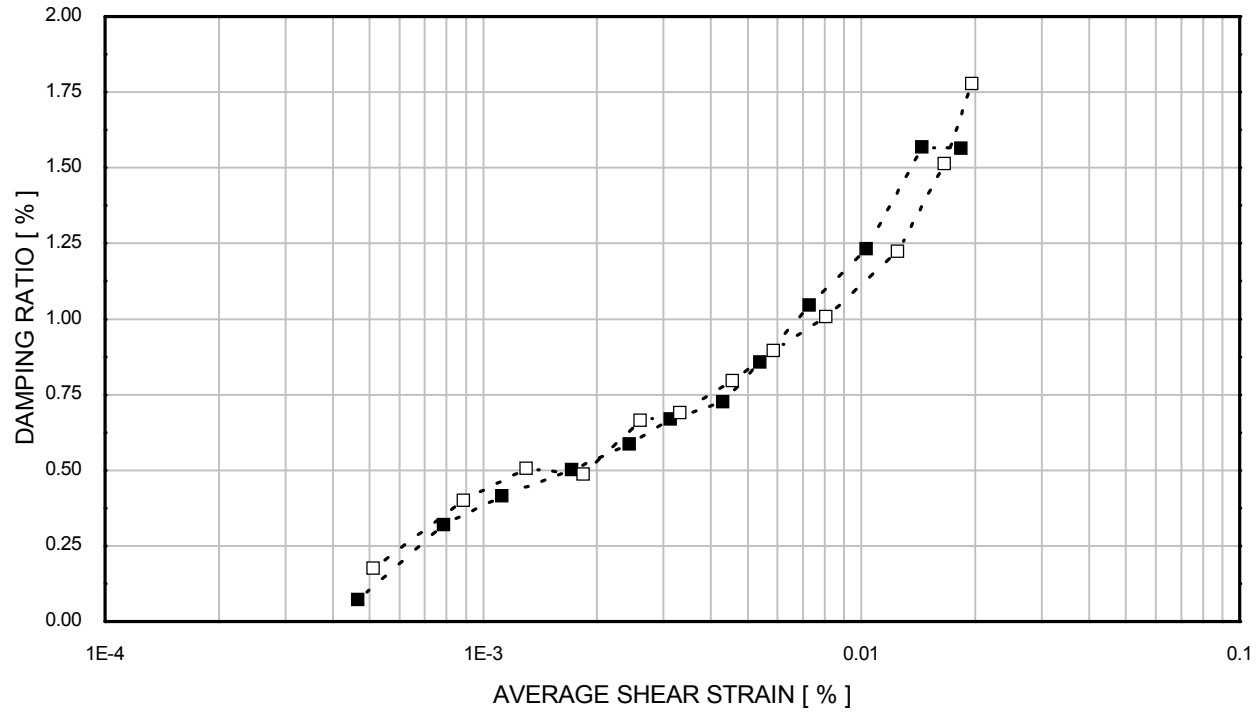




σ'_0	: 135 kPa	Batch	: 3
Load		Sample	: RC_3-1
Reload		Unit	: Unit B1 (Kreftenheye)
		Test No.	: RC03

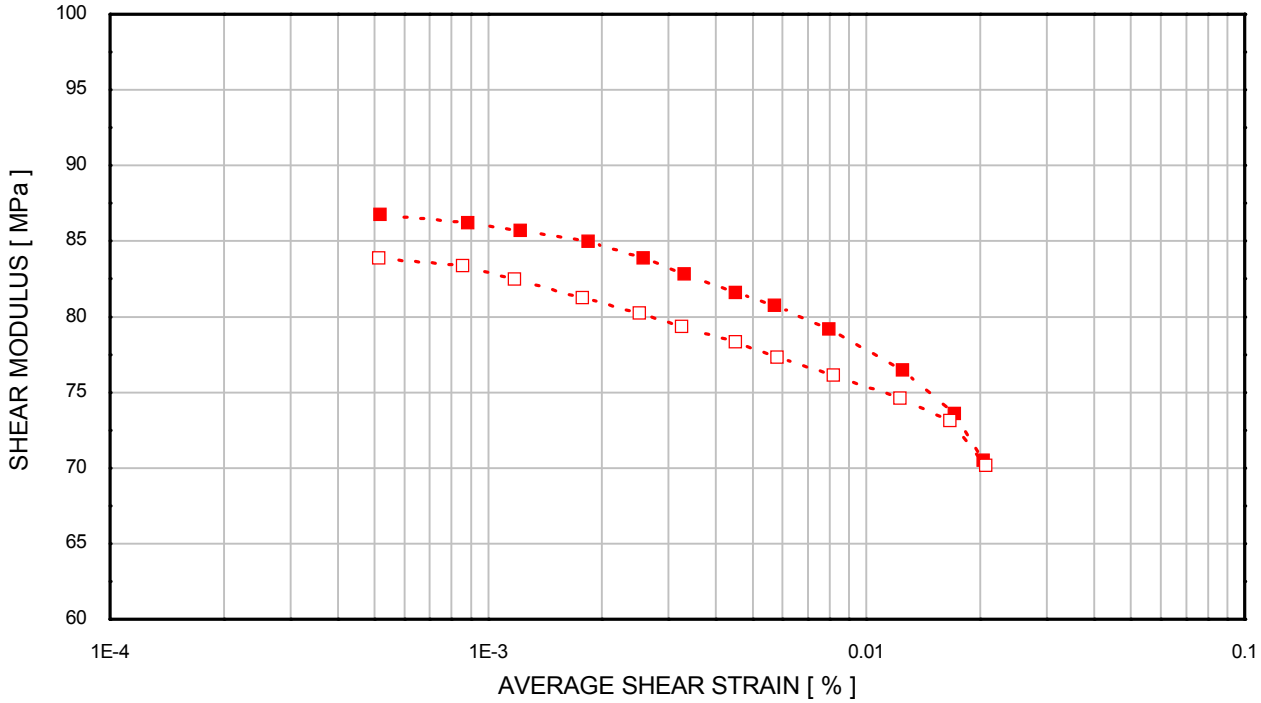
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE - DRAINED

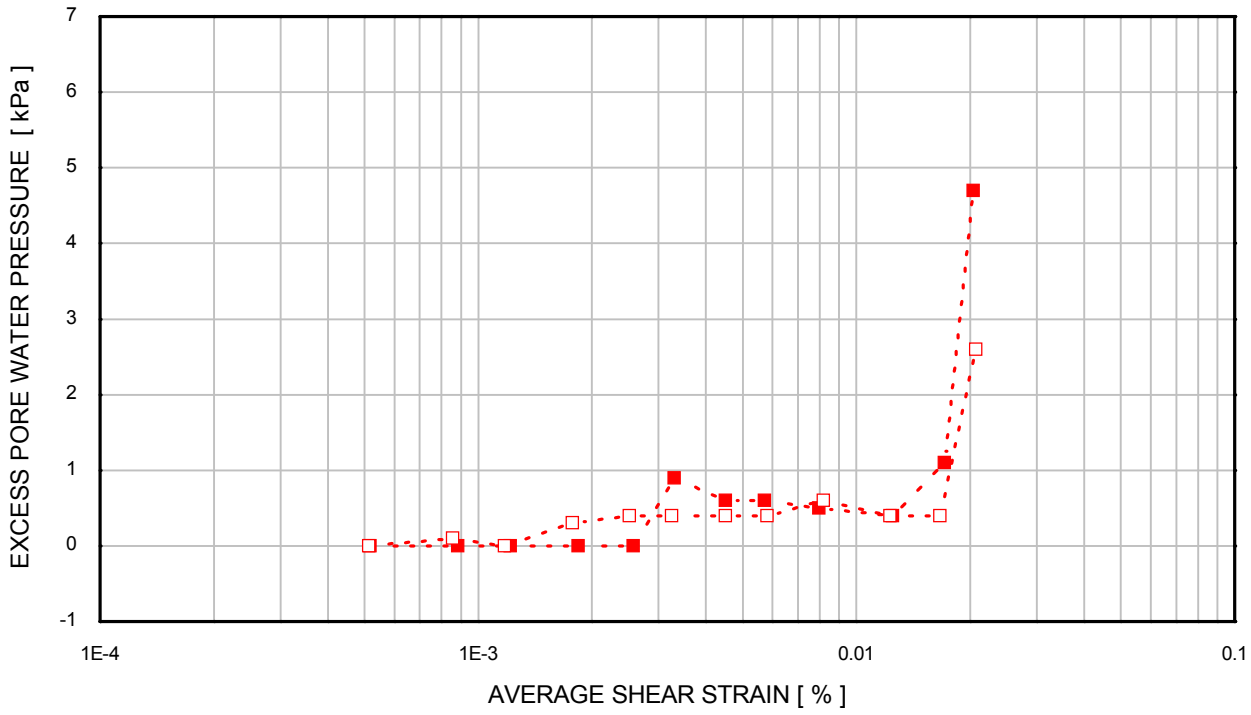




σ'_0	: 135 kPa	Batch	: 3
- ·■- · Load		Sample	: RC_3-1
- ·□- · Reload		Unit	: Unit B1 (Kreftenheye)
		Test No.	: RC03

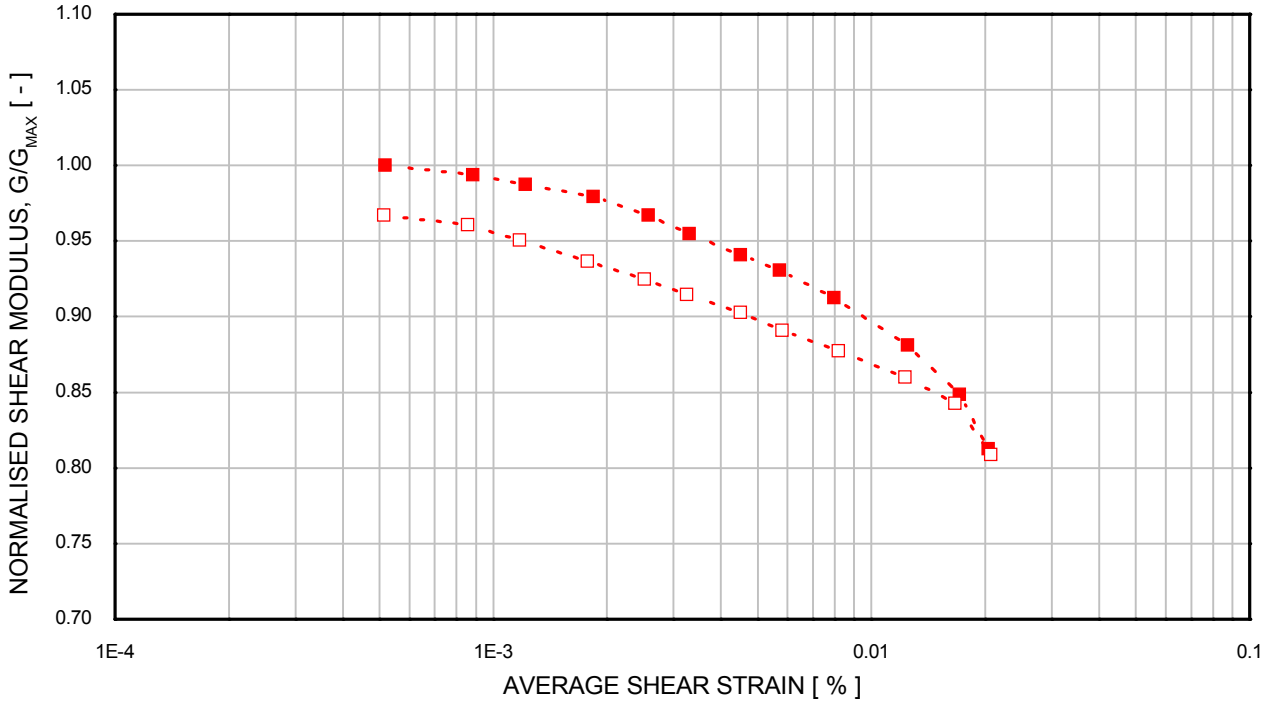
ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE - DRAINED

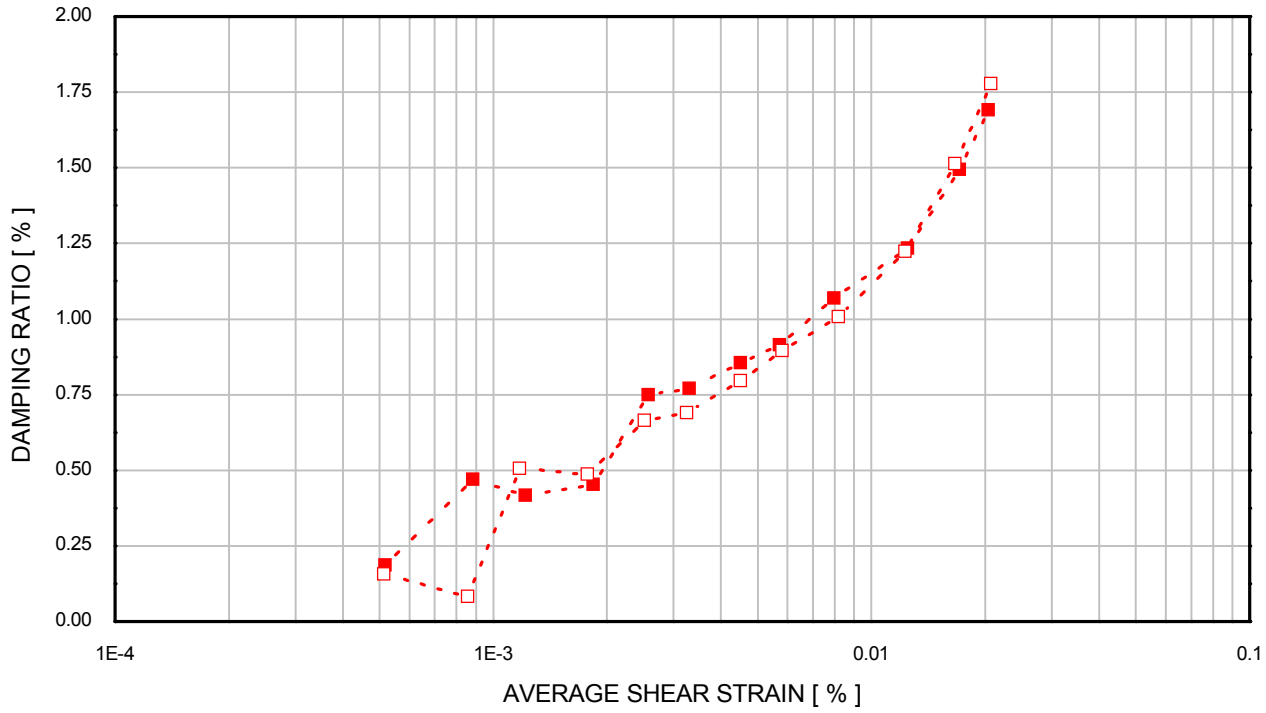




σ'_0	: 135 kPa	Batch	: 3
Load		Sample	: RC_3-1
Reload		Unit	: Unit B1 (Kreftenheye)
		Test No.	: RC03

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE - UNDRAINED





σ'_0	: 135 kPa	Batch	: 3
Load		Sample	: RC_3-1
Reload		Unit	: Unit B1 (Kreftenheye)
		Test No.	: RC03

ISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE - UNDRAINED

VISUAL DESCRIPTION
Grey fine to medium SAND

GENERAL	
Date test started	23/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	51.0
Length	[mm]	100.0
Water content	[%]	10.0
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.58
Void ratio	[-]	0.676
Degree of saturation	[%]	39
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Fugro testing procedure L-M-309
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ Batch 5_RC05
Processed by	NC
Date	28/11/2016
Checked by	PH
Date	14/12/2016
Approved by	PH
Date	14/12/2016

TEST IDENTIFICATION	
Batch	5
Sample	RC_5-1
Unit	Unit C2 (Eem)
Test number	RC05

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	50
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	500
Base PWP	[kPa]	491
Axial strain	[%]	0.08
Water Content	[%]	25.5
Bulk Density	[Mg/m³]	1.98
Dry Density	[Mg/m³]	1.58
Void Ratio	[-]	0.676
Degree of saturation	[%]	100
B value achieved	[-]	1.00

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	716
Back pressure	[kPa]	491
Base PWP	[kPa]	491
Effective radial pressure	[kPa]	225
Effective axial pressure	[kPa]	320
Deviator stress	[kPa]	95
Volumetric strain	[%]	1.01
Axial strain	[%]	0.48
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60
Void ratio	[-]	0.660
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	5
Sample	RC_5-1
Unit	Unit C2 (Eem)
Test number	RC05

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000133	130.74	0.999	1.41
0.000199	130.71	0.999	1.44
0.000329	130.87	1.000	1.39
0.000501	130.57	0.998	1.39
0.000676	130.26	0.995	1.29
0.001386	129.62	0.990	1.18
0.002111	128.94	0.985	1.19
0.002881	128.24	0.980	1.13
0.003770	126.73	0.968	1.08
0.004655	125.26	0.957	1.07
0.005873	123.38	0.943	1.09
0.007721	120.64	0.922	1.07

TORSIONAL RESONANCE STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000143	128.03	0.978	1.34
0.000212	128.03	0.978	1.31
0.000285	127.87	0.977	1.29
0.000355	127.95	0.978	1.30
0.000540	127.69	0.976	1.25
0.000730	127.61	0.975	1.19
0.001517	126.86	0.969	1.13
0.002431	125.25	0.957	1.04
0.003971	124.47	0.951	1.00
0.006049	122.65	0.937	1.07
0.008097	120.22	0.919	1.08

TEST IDENTIFICATION	
Batch	5
Sample	RC_5-1
Unit	Unit C2 (Eem)
Test number	RC05

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SPECIMEN PHOTOGRAPHS





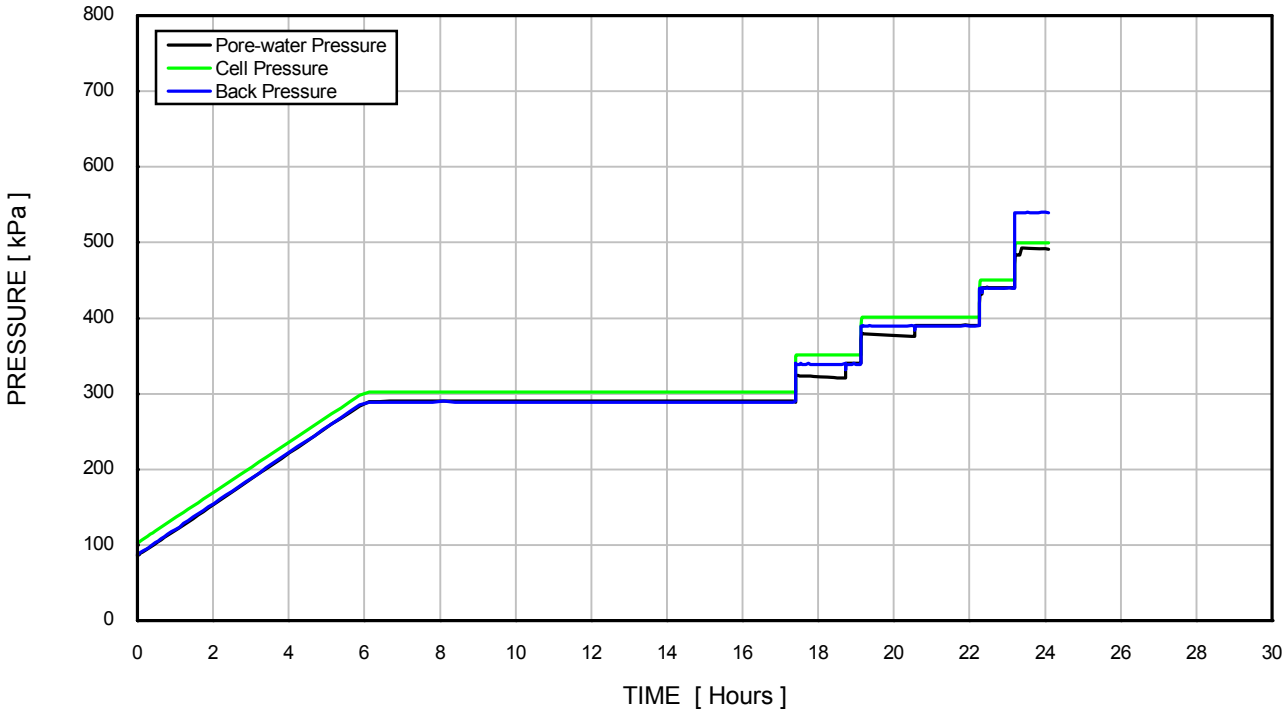
FINAL CONDITIONS

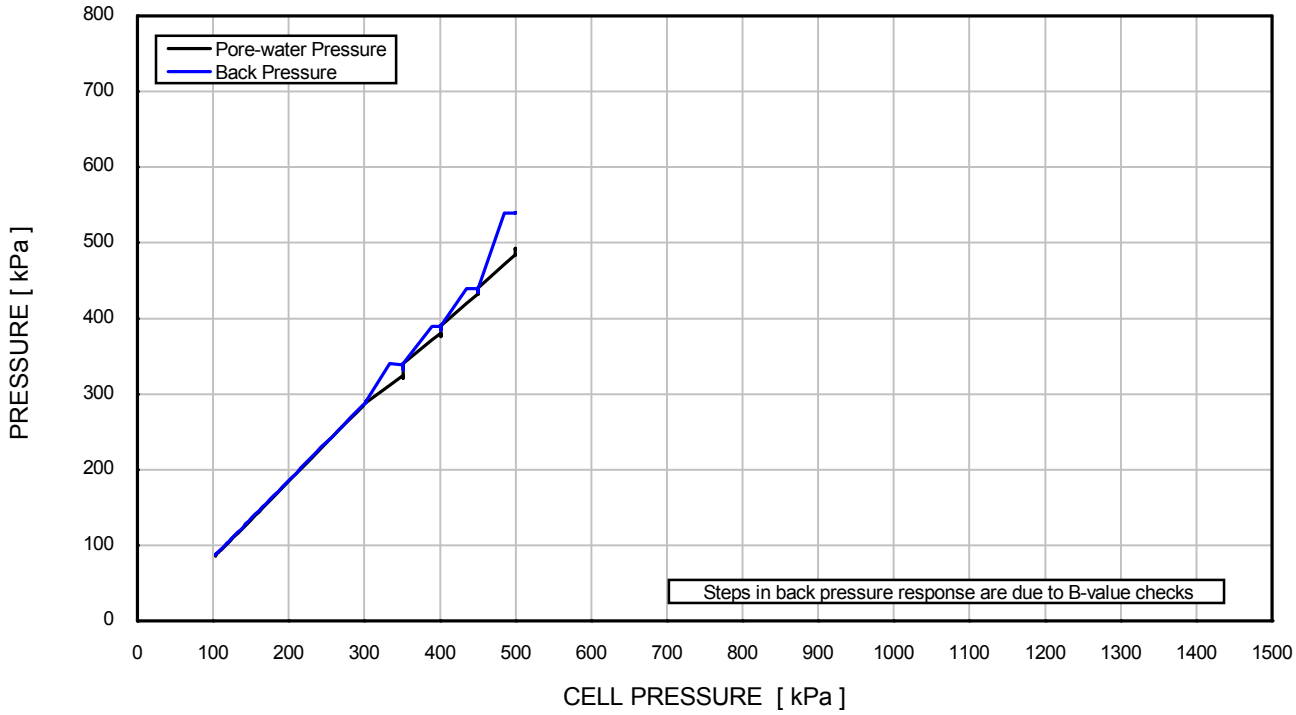
Water content	[%]	24.9
Bulk density	[Mg/m³]	1.99
Dry density	[Mg/m³]	1.60

TEST IDENTIFICATION

Batch	5
Sample	RC_5-1
Unit	Unit C2 (Eem)
Test number	RC05

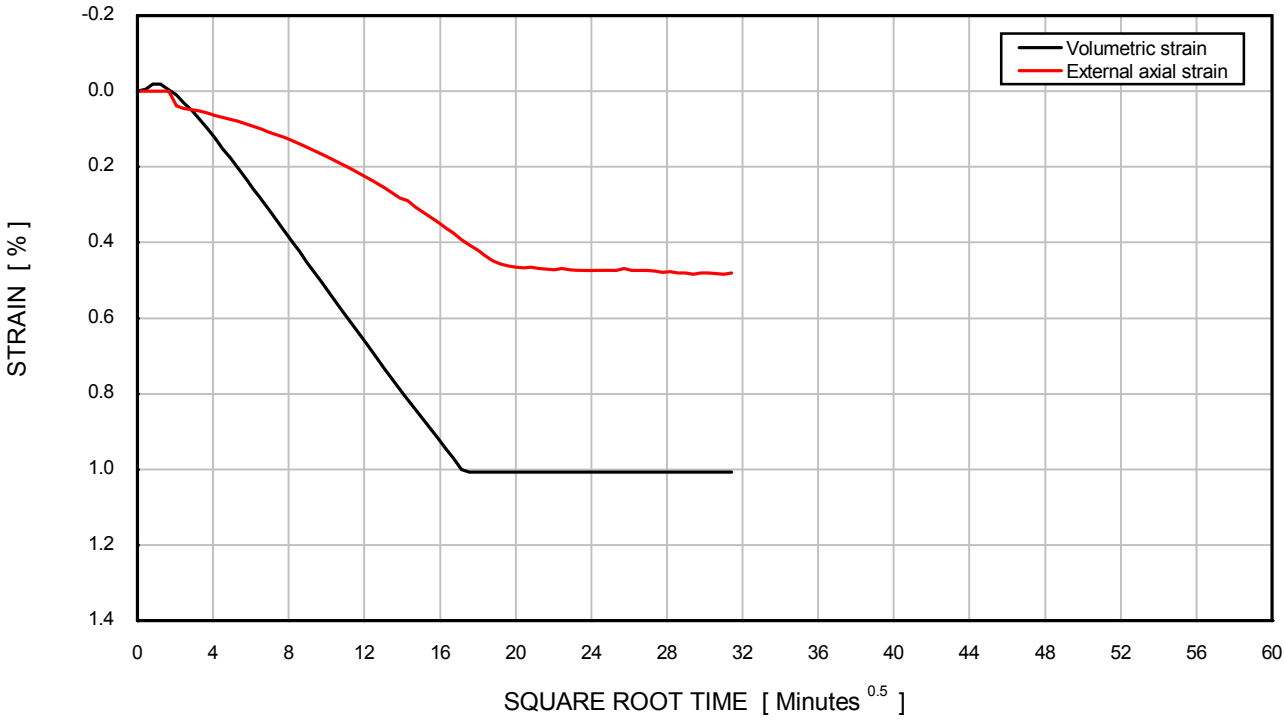
SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

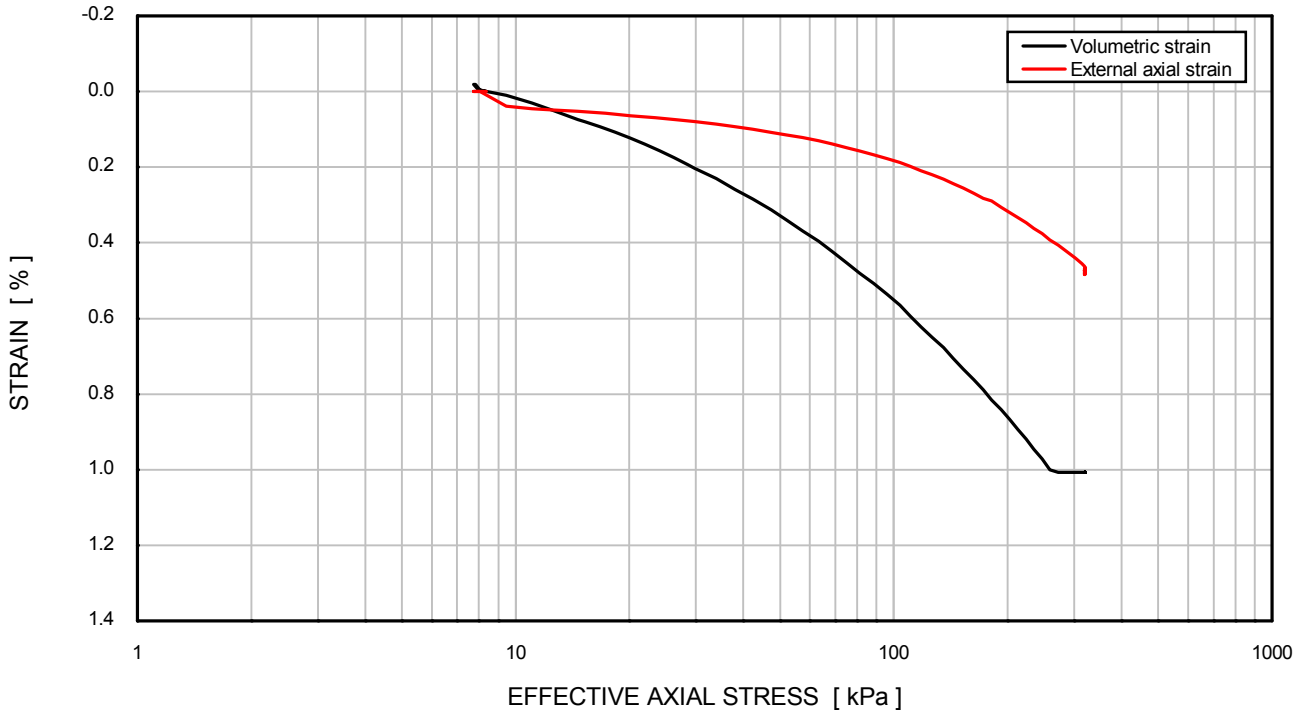




B value	:	1.00			
Initial σ'_r	:	18	kPa	Batch	: 5
Initial σ'_a	:	17	kPa	Sample	: RC_5-1
Final σ'_r	:	8	kPa	Unit	: Unit C2 (Eem)
Final σ'_a	:	8	kPa	Test No.	: RC05

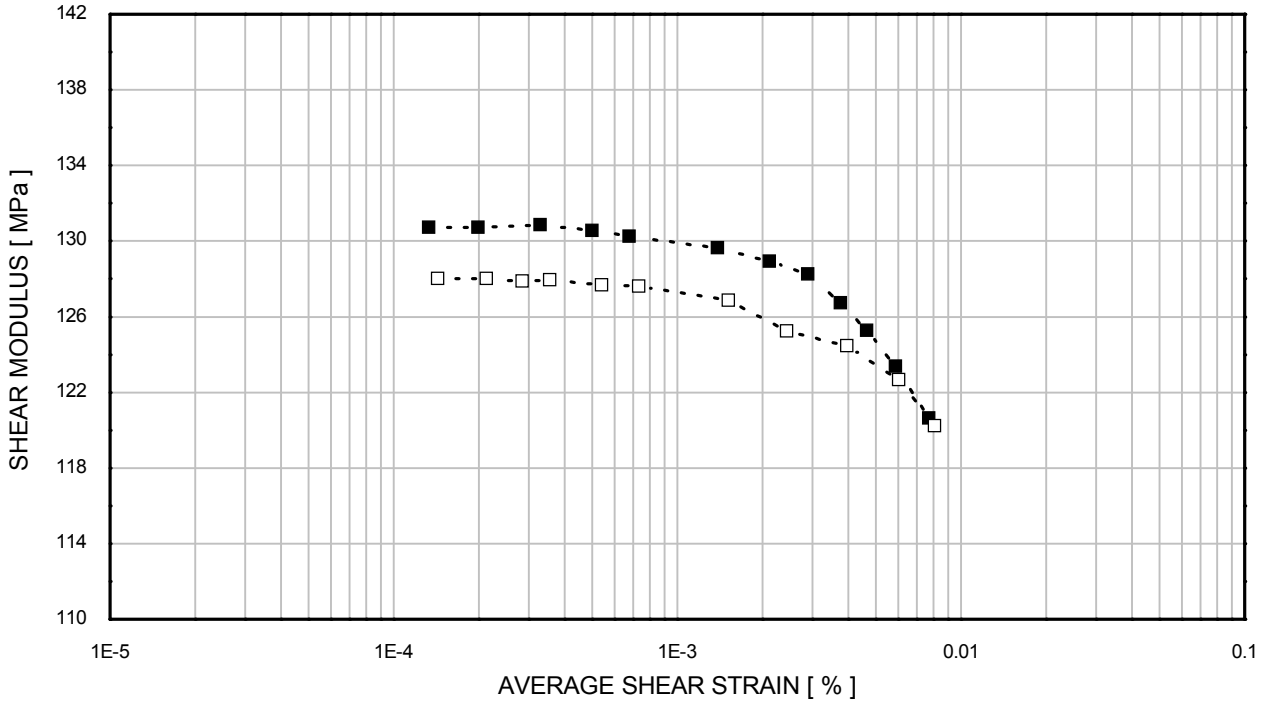
ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - DRAINED

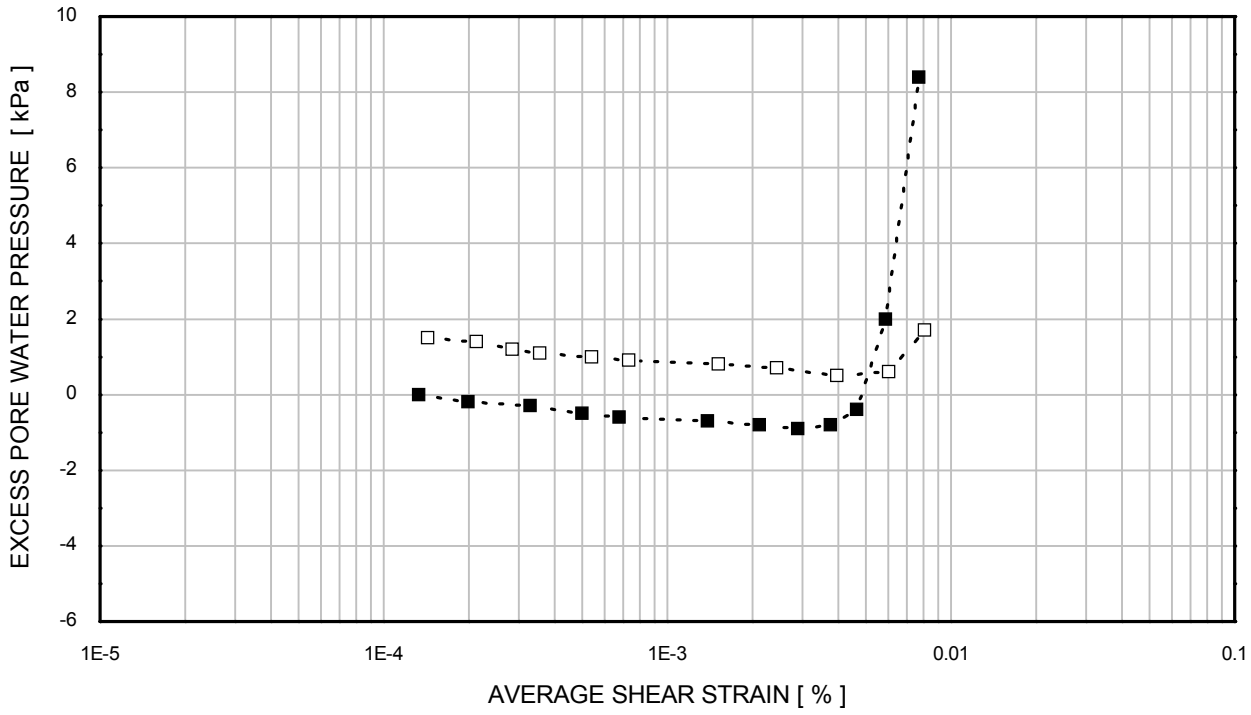




σ'_{rc}	: 225 kPa	Batch	: 5
σ'_{ac}	: 320 kPa	Sample	: RC_5-1
		Unit	: Unit C2 (Eem)
		Test No.	: RC05

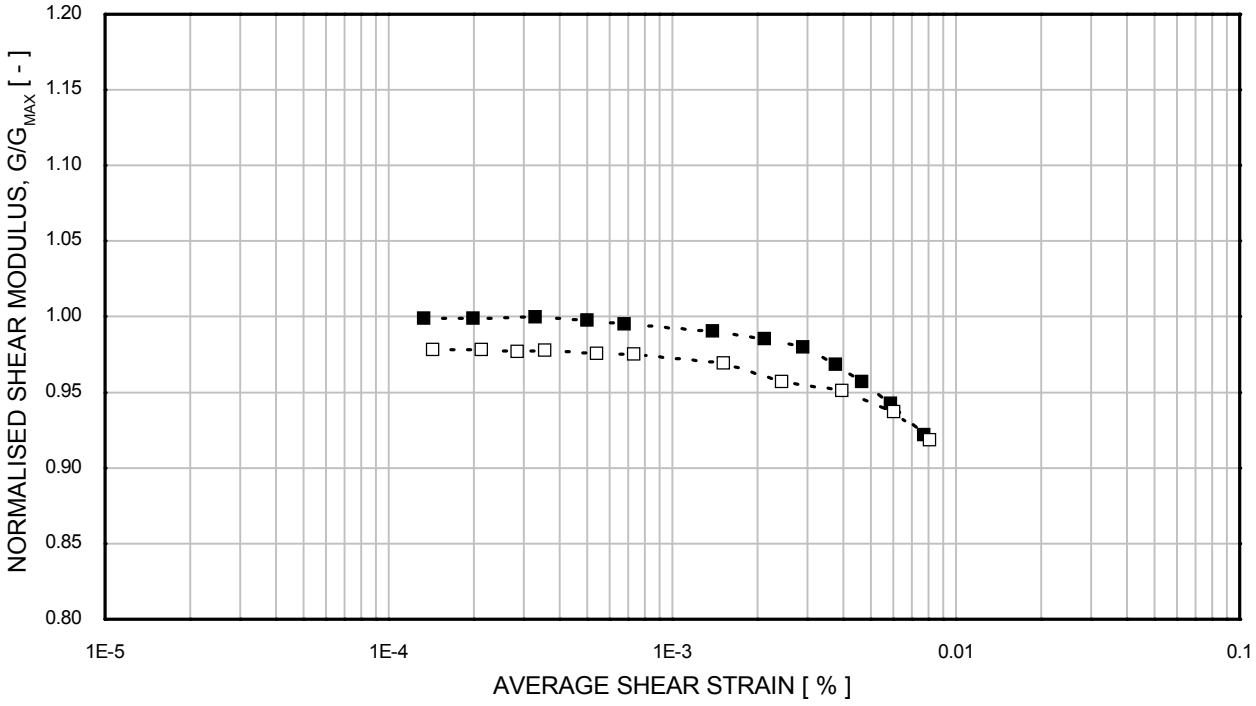
ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ANISOTROPIC CONSOLIDATION STAGE

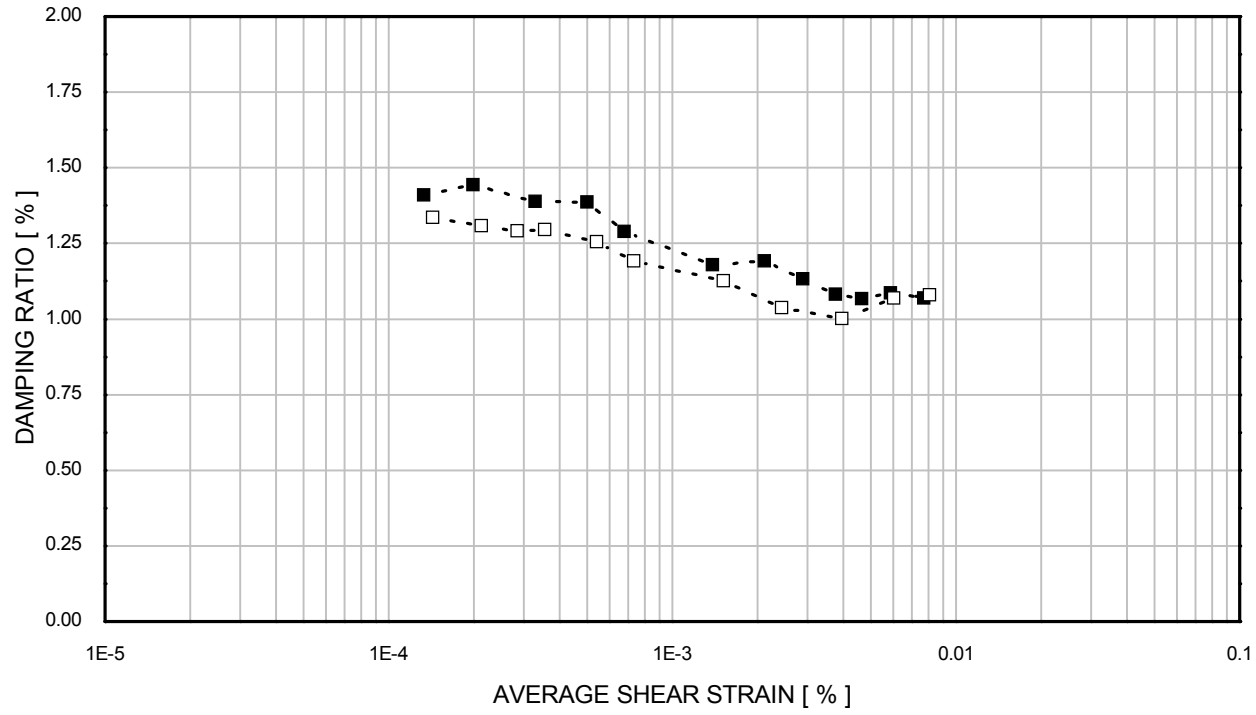




σ'_0	: 257 kPa	Batch	: 5
Load		Sample	: RC_5-1
Reload		Unit	: Unit C2 (Eem)
		Test No.	: RC05

ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1





σ'_0	: 257 kPa	Batch	: 5
Load		Sample	: RC_5-1
Reload		Unit	: Unit C2 (Eem)
		Test No.	: RC05

ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1

VISUAL DESCRIPTION
Grey fine SAND

GENERAL	
Date test started	18/11/2016
Type of sample	Re-compacted
Type of drains fitted	One end only

INITIAL		
Diameter	[mm]	50.6
Length	[mm]	100.0
Water content	[%]	9.5
Bulk density	[Mg/m³]	1.74
Dry density	[Mg/m³]	1.59
Void ratio	[-]	0.672
Degree of saturation	[%]	37
Assumed particle density	[Mg/m³]	2.65
Torvane	[kPa]	-
Pocket penetrometer	[kPa]	-

TESTING PROCEDURES USED	
Specimen Set-up	Fugro testing procedure L-M-309
Saturation	Fugro testing procedure L-M-309
Consolidation - Isotropic	Fugro testing procedure L-M-309
Consolidation - Anisotropic	Fugro testing procedure L-M-309
Shearing	Fugro testing procedure L-M-309
Note: Fugro testing procedures are available upon request	

QUALITY ASSURANCE	
Template Issue	1.1
Filename	J11335 \ Batch 6_RC06
Processed by	NC
Date	22/11/2016
Checked by	PH
Date	28/11/2016
Approved by	PH
Date	28/11/2016

TEST IDENTIFICATION	
Batch	6
Sample	RC_6-1
Unit	Unit D (Yarmouth Roads)
Test number	RC06

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SATURATION		
Pressure increments applied	[kPa]	50
Differential pressure used	[kPa]	10
Cell pressure	[kPa]	545
Base PWP	[kPa]	540
Axial strain	[%]	0.07
Water Content	[%]	25.4
Bulk Density	[Mg/m³]	1.99
Dry Density	[Mg/m³]	1.59
Void Ratio	[-]	0.672
Degree of saturation	[%]	100
B value achieved	[-]	0.97

CONSOLIDATION: ANISOTROPIC		
Cell pressure	[kPa]	790
Back pressure	[kPa]	540
Base PWP	[kPa]	540
Effective radial pressure	[kPa]	250
Effective axial pressure	[kPa]	380
Deviator stress	[kPa]	130
Volumetric strain	[%]	1.29
Axial strain	[%]	0.81
Water content	[%]	24.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.61
Void ratio	[-]	0.650
Degree of saturation	[%]	100

TEST IDENTIFICATION	
Batch	6
Sample	RC_6-1
Unit	Unit D (Yarmouth Roads)
Test number	RC06

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

TORSIONAL RESONANCE STAGE - INITIAL LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000102	117.23	1.000	0.65
0.000130	117.42	1.000	0.68
0.000192	117.32	0.999	0.70
0.000253	117.14	0.998	0.71
0.000378	117.14	0.998	0.71
0.000617	116.86	0.995	0.73
0.000958	116.40	0.991	0.75
0.001180	115.94	0.987	0.78
0.002128	115.11	0.980	0.91
0.003010	113.64	0.968	1.04
0.003898	112.73	0.960	1.07
0.004819	111.64	0.951	1.09
0.006883	109.48	0.932	1.14
0.008843	107.15	0.913	1.24

TORSIONAL RESONANCE STAGE - REPEAT LOADING			
Average shear strain, γ [%]	Shear modulus, G [MPa]	G/G_{max} [-]	Damping Ratio, D [%]
0.000105	115.66	0.985	0.66
0.000136	115.57	0.984	0.68
0.000199	115.57	0.984	0.69
0.000263	115.38	0.983	0.68
0.000391	115.29	0.982	0.70
0.000635	115.02	0.980	0.74
0.000925	114.38	0.974	0.77
0.001199	114.01	0.971	0.80
0.002154	112.64	0.959	0.97
0.003113	111.73	0.952	1.00
0.004087	110.65	0.942	1.03
0.005059	109.66	0.934	1.06
0.007124	108.40	0.923	1.16
0.009042	106.80	0.910	1.25

TEST IDENTIFICATION	
Batch	6
Sample	RC_6-1
Unit	Unit D (Yarmouth Roads)
Test number	RC06

SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

SPECIMEN PHOTOGRAPHS

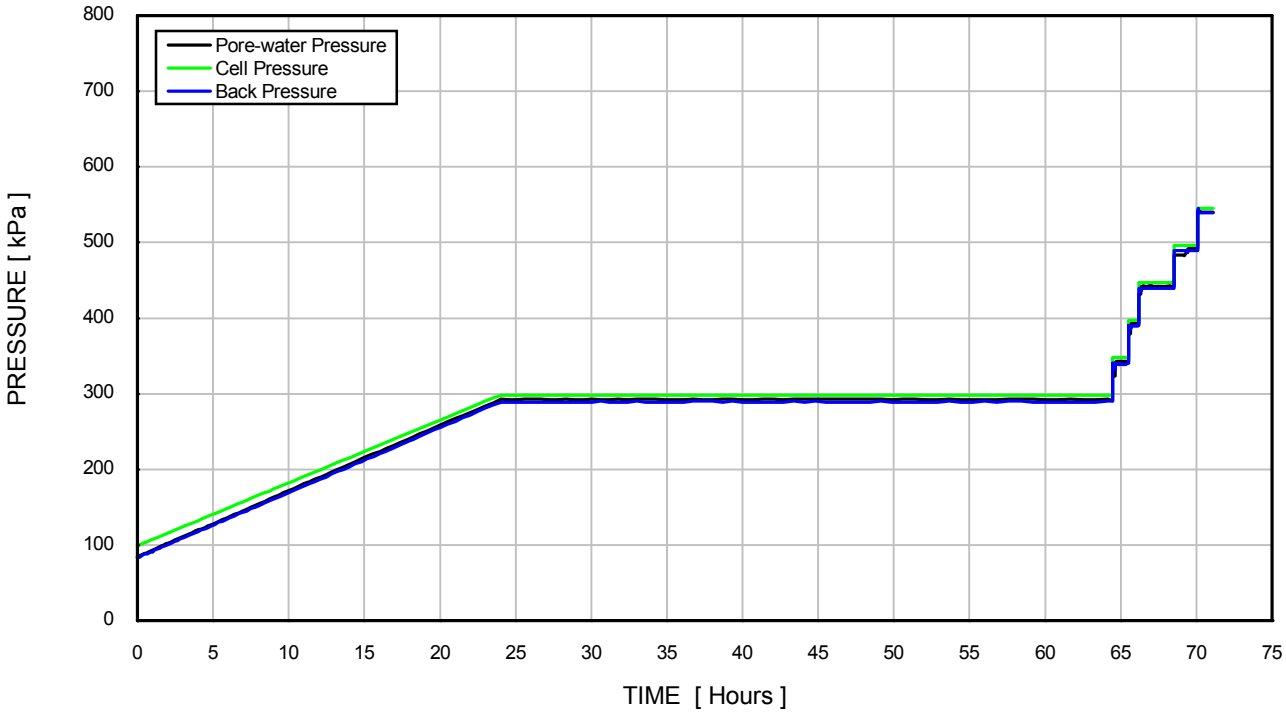


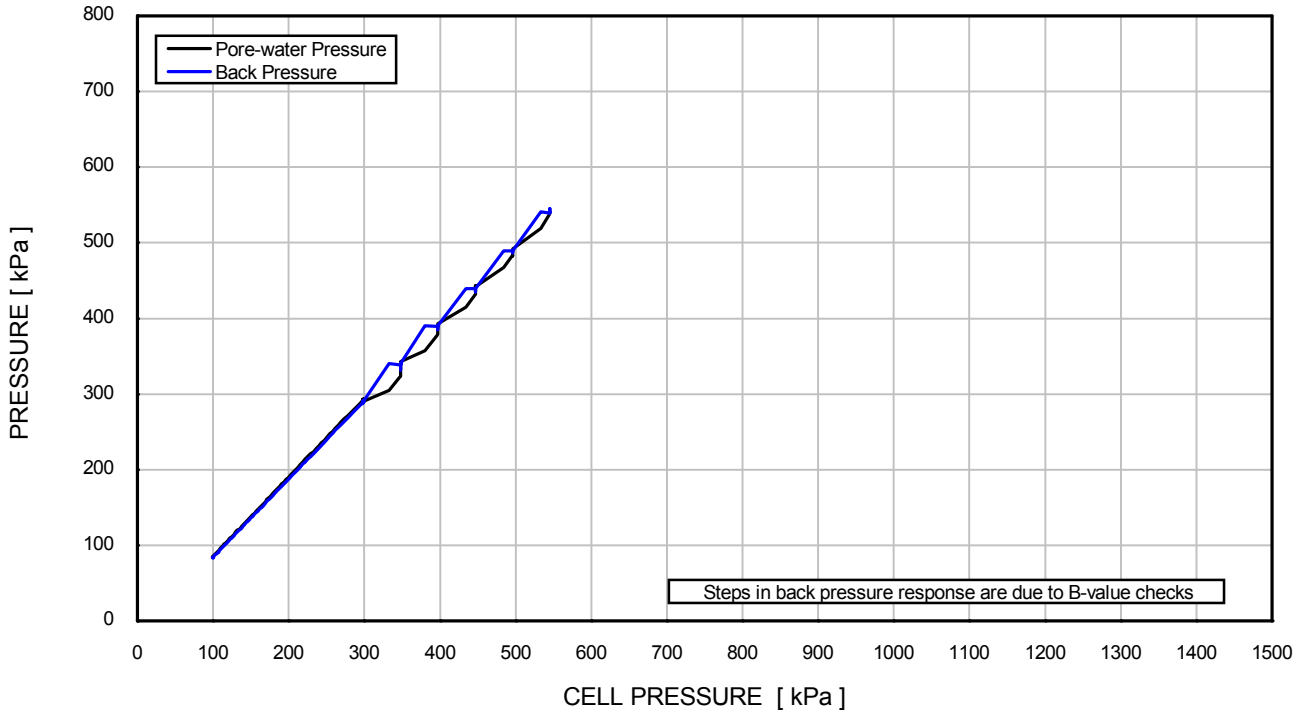


FINAL CONDITIONS		
Water content	[%]	24.5
Bulk density	[Mg/m³]	2.00
Dry density	[Mg/m³]	1.61

TEST IDENTIFICATION	
Batch	6
Sample	RC_6-1
Unit	Unit D (Yarmouth Roads)
Test number	RC06

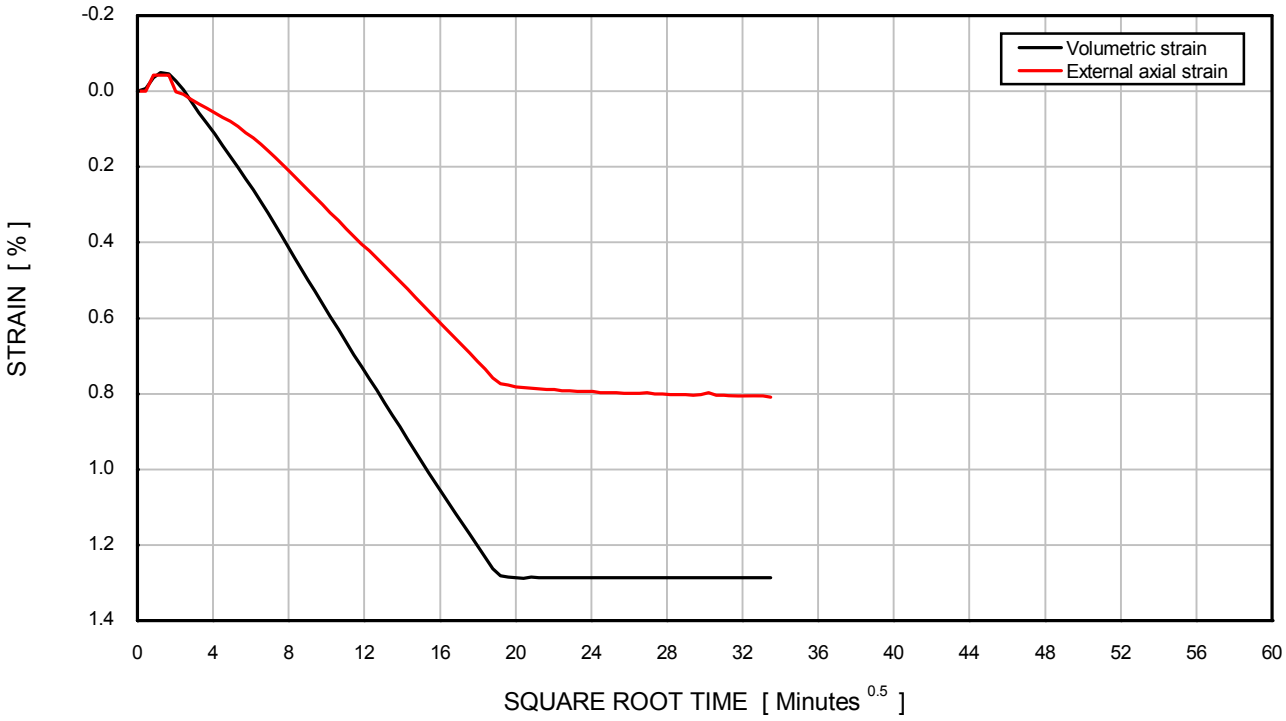
SUMMARY OF ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST

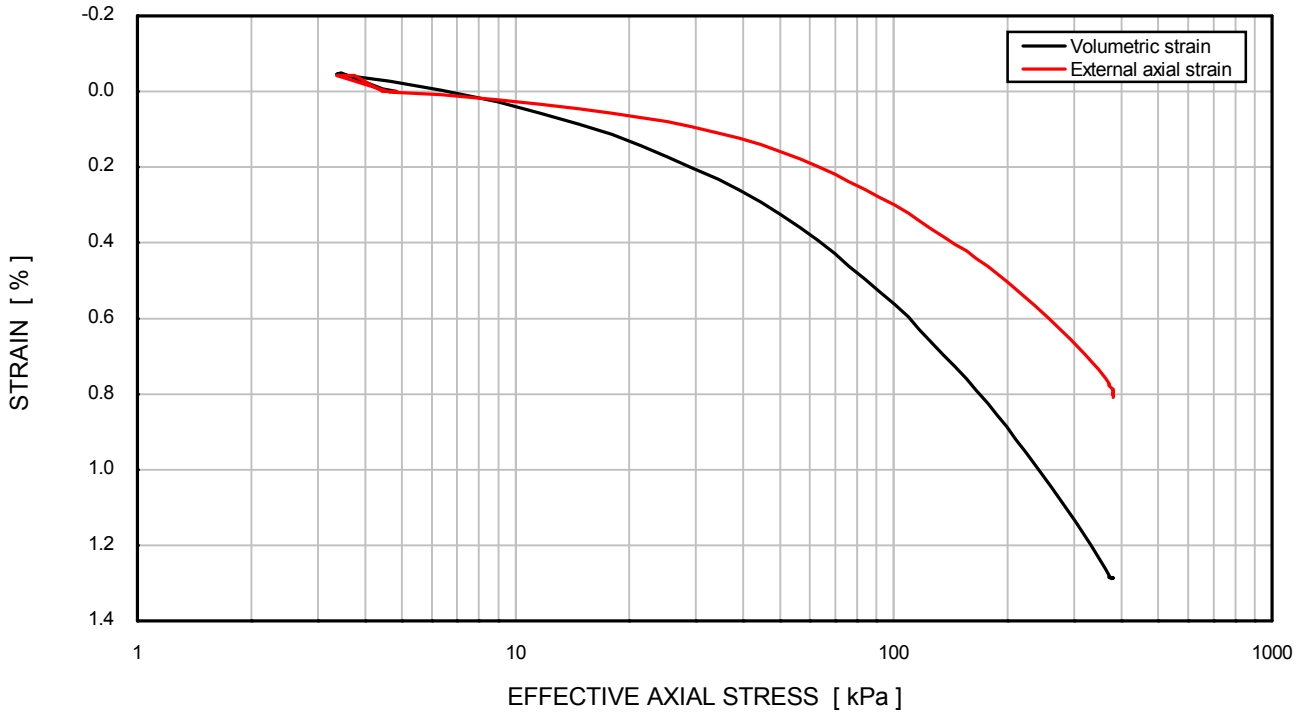




B value	:	0.97			
Initial σ'_r	:	15	kPa	Batch	: 6
Initial σ'_a	:	16	kPa	Sample	: RC_6-1
Final σ'_r	:	6	kPa	Unit	: Unit D (Yarmouth Roads)
Final σ'_a	:	5	kPa	Test No.	: RC06

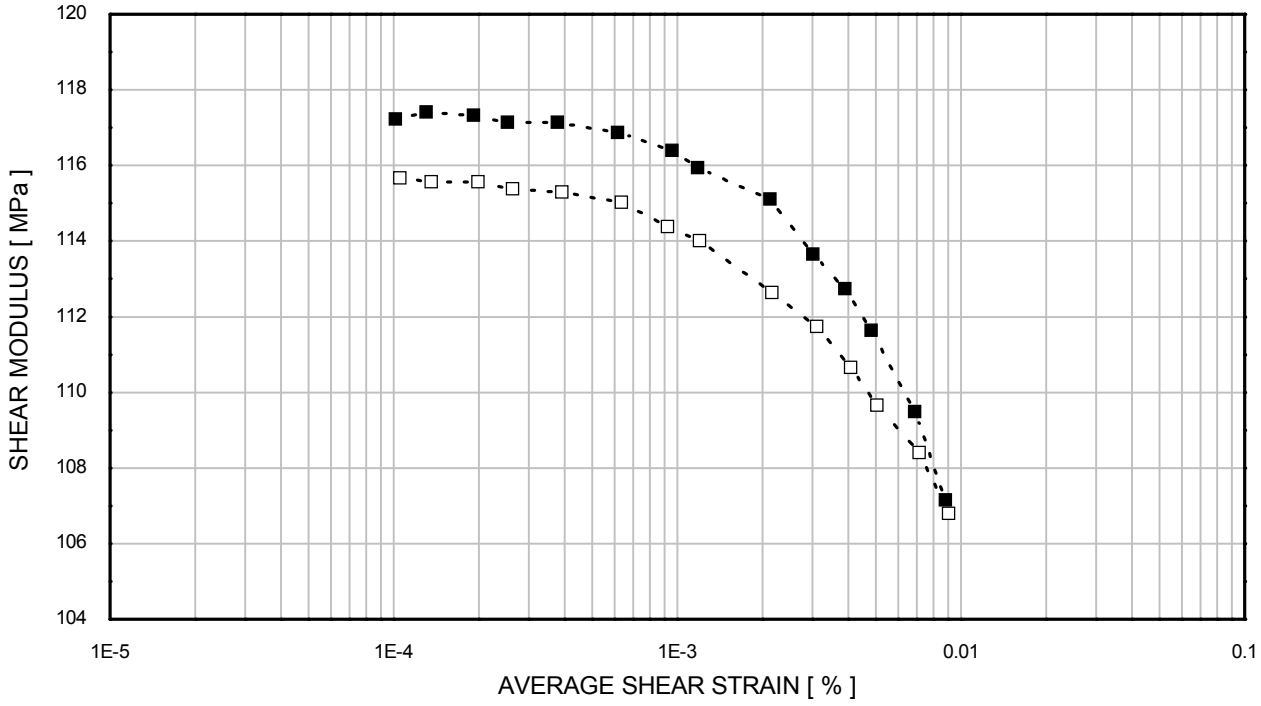
ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
SATURATION STAGE - DRAINED

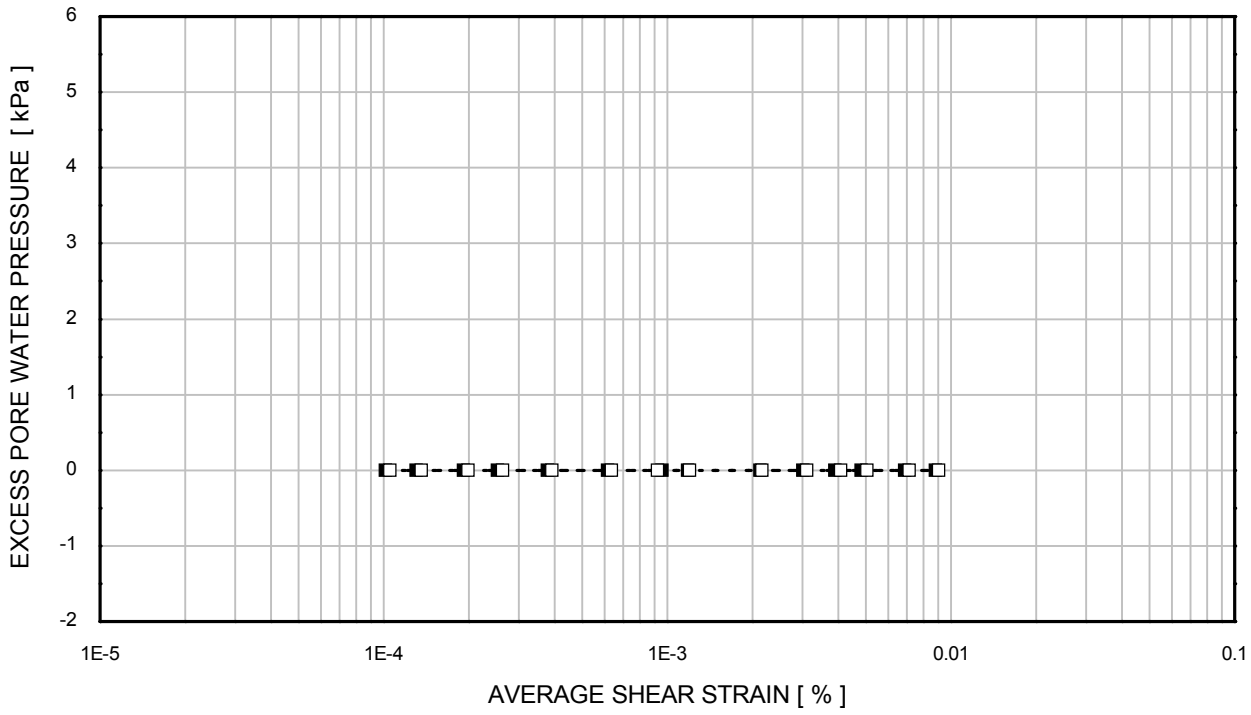




σ'_{rc}	: 250 kPa	Batch	: 6
σ'_{ac}	: 380 kPa	Sample	: RC_6-1
		Unit	: Unit D (Yarmouth Roads)
		Test No.	: RC06

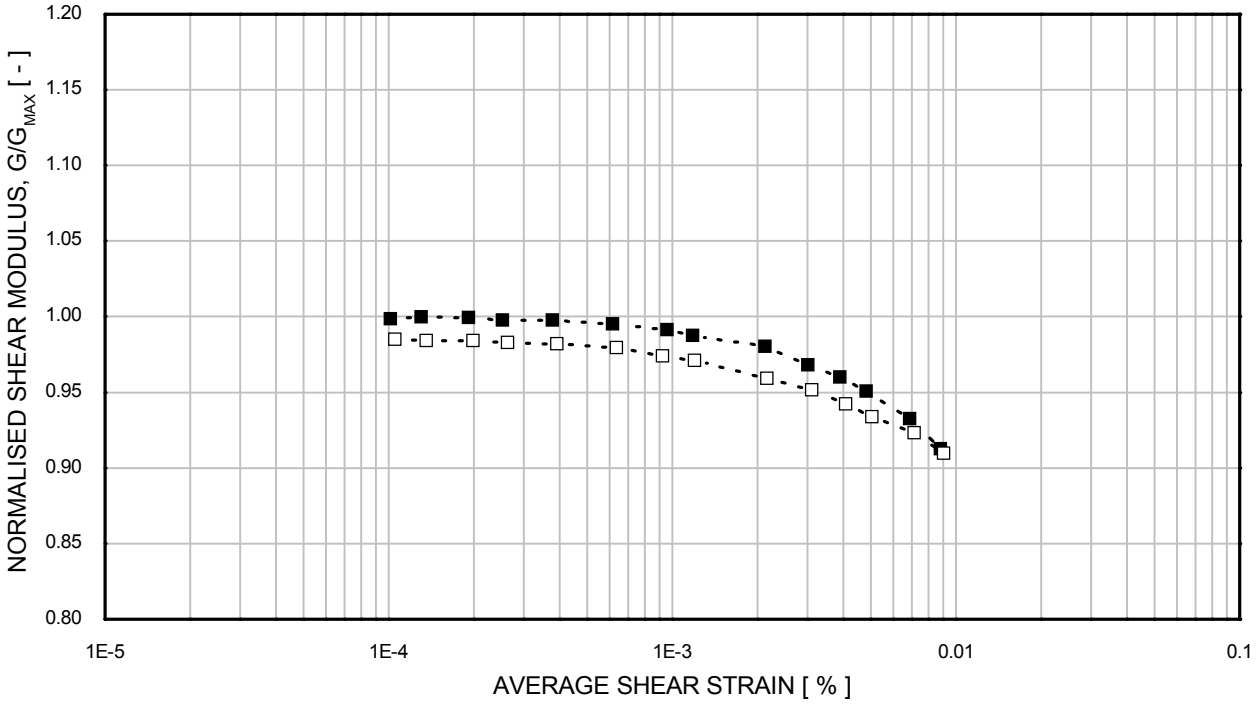
ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
ANISOTROPIC CONSOLIDATION STAGE

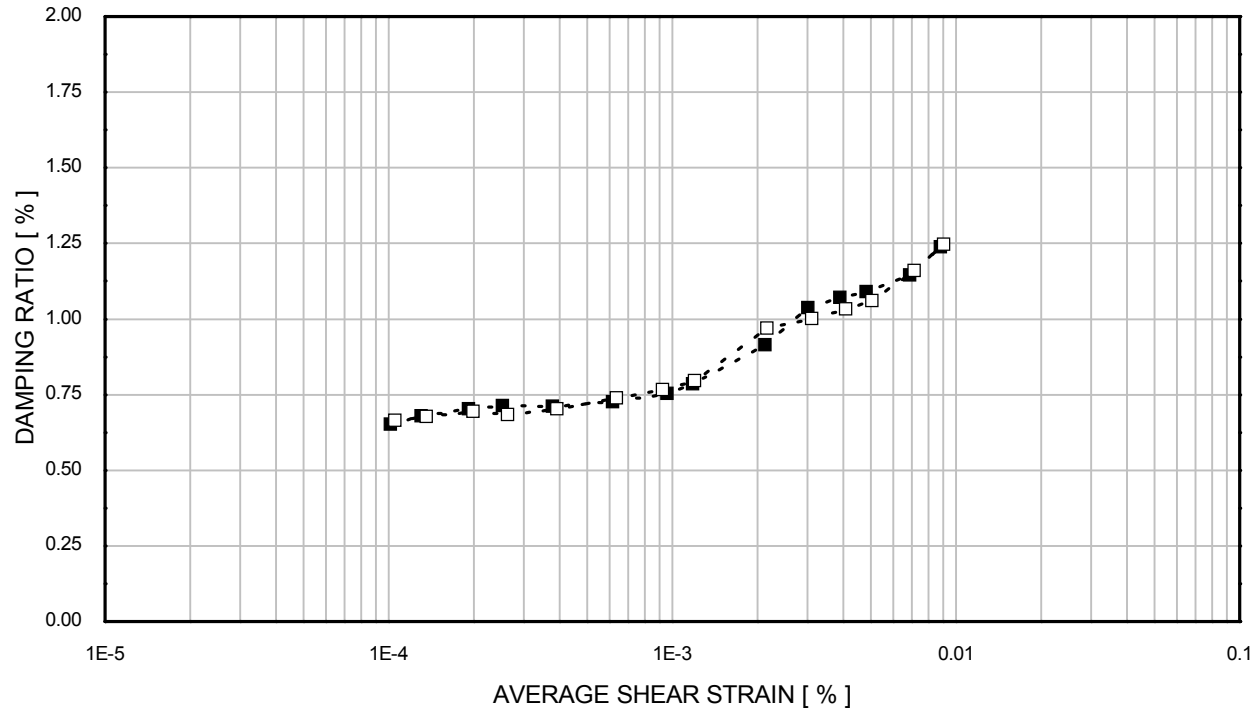




σ'_0	: 294 kPa	Batch	: 6
Load		Sample	: RC_6-1
Reload		Unit	: Unit D (Yarmouth Roads)
		Test No.	: RC06

ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1





σ'_0	: 294 kPa	Batch	: 6
- ·■- · Load		Sample	: RC_6-1
- ·□- · Reload		Unit	: Unit D (Yarmouth Roads)
		Test No.	: RC06

ANISOTROPICALLY CONSOLIDATED RESONANT COLUMN TEST
TORSIONAL VIBRATION STAGE 1

SECTION B: USE OF REPORT

CONTENTS Reference

Document Issue Control
Quality Management Record
Guide for Use of Report FEBV/GEO/APP/077

DOCUMENT ISSUE CONTROL

Section	Page No.	Plate No.	Issue	Revision
Summary	i-ii	-	4	Revisions to Summary text
Main Text	5-6	-	4	Editorial corrections and additions
Section A1	A1-10, A1-11	-	4	Editorial corrections and additions
Main Text	All	-	3	Updates, editorials and addition of laboratory tests
Main Text	All	-	3	Updates, editorials and addition of laboratory tests
Section A	All	All	3	Updates, editorials and addition of laboratory tests

1) The definitive copy of this document is held in Fugro's information system
2) Document distribution is restricted to project participants approved by the Client
3) The document issue number is the same as the highest issue number of any individual page
4) Pages of this document are at Issue 2, except those pages listed above
5) The reference at the bottom left-hand corner of each page shows the Fugro document ID and the page issue number (between brackets)

QUALITY MANAGEMENT RECORD

Fugro Project Lead:	E. Schoute Senior Project Engineer	Signed:
Report Review and Approval:	M. Klein Principal Geotechnical Engineer	Signed:

Document Section	Prepared By	Checked By
Main Text	JLK	ESE
Plates following Main Text	LHT	ESE
A Geotechnical Laboratory Test Results		
– Laboratory Testing Overview	JLK	ESE
– Index Laboratory Tests	PH/JLK	ESE
– Direct Simple Shear Tests	PH/JLK	ESE
– Triaxial Tests	PH/AR/JLK	ESE
– Cyclic Simple Shear Tests	PH/AR/JLK	ESE
– Cyclic Triaxial Tests	PH/AR/JLK	ESE
– Resonant Column Tests	PH/JLK	ESE

Person(s):

AR	A. Rismanchian
ESE	E. Schoute
JLK	J. Lakeman
LHT	L. van der Horst
PH	P. Holley

INTRODUCTION

This document provides guidelines, recommendations and limitations regarding the use of information in this report.

The cost of geotechnical data acquisition, interpretation and monitoring is a small portion of the total cost of a construction project. By contrast, the costs of correcting a wrongly designed programme or mobilising alternative construction methods are often far greater than the cost of the original investigation. Attention and adherence to the guidelines and recommendations presented in this guide and in the geotechnical report can reduce delays and cost overruns related to geotechnical factors.

This guide applies equally to the use of geotechnical and multi-disciplinary project information and advice.

REQUIREMENTS FOR QUALITY GEOTECHNICAL INFORMATION

Fugro follows ISO 9001 quality principles for project management and ISO 2394 for general principles on reliability for structures. Project activities usually comprise part of specific phases of a construction project. The quality plan for the entire construction project should incorporate geotechnical input in every phase - from the feasibility planning stages to project completion. The parties involved should do the following:

- Provide complete and accurate information necessary to plan an appropriate geotechnical site investigation.
- Describe the purpose(s), type(s) and construction methods of planned structures in detail.
- Provide the time, financial, personnel and other resources necessary for the planning, execution and follow-up of a site investigation programme.
- Understand the limitations and degree of accuracy inherent in the geotechnical data and engineering advice based upon these data.
- During all design and construction activities, be aware of the limitations of geotechnical data and geotechnical engineering analyses/advice, and use appropriate preventative measures.
- Incorporate all geotechnical input in the design, planning, construction and other activities involving the site and structures. Provide the entire geotechnical report to parties involved in design and construction.
- Use the geotechnical data and engineering advice for only the structures, site and activities which were described to Fugro prior to and for the purpose of planning the geotechnical site investigation or geotechnical engineering analysis programme.

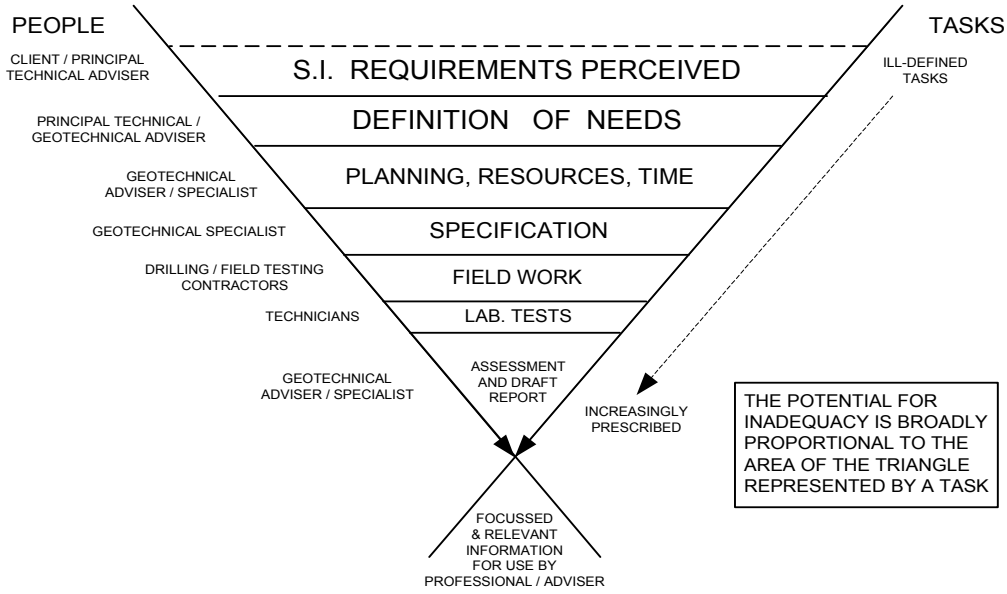
AUTHORITY, TIME AND RESOURCES NECESSARY FOR GEOTECHNICAL INVESTIGATIONS

Adequate designation of authority and accountability for geotechnical aspects of construction projects is necessary. This way, an appropriate investigation can be performed, and the use of the results by project design and construction professionals can be optimised.

Figure 1 illustrates the importance of the initial project phases for gathering adequate geotechnical information for a project. The initial phases, when site investigation requirements are defined and resources are allocated, are represented by more than 50% of the Quality Triangle (Figure 1). Decisions and actions made during these phases have a large impact of the outcome and thus the potential of the investigation to meet project requirements.

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Figure 1: Quality of Geotechnical Site Investigation (adapted from SISG[1]).



DATA ACQUISITION AND MONITORING PROGRAMMES

Geotechnical investigations are operations of discovery. Investigation should proceed in logical stages. Planning should allow operational adjustments deemed necessary by newly available information. This observational approach permits the development of a sound engineering strategy and reduces the risk of discovering unexpected hazards during or after construction.

GEOTECHNICAL INFORMATION – DATA TYPES AND LIMITATIONS

1. RELIABILITY OF SUPPLIED INFORMATION

Geotechnical engineering can involve the use of information and physical material that is publicly available or supplied by the Client. Examples are geodetic data, geological maps, geophysical records, earthquake data, earlier geotechnical logs and soil samples. Fugro endeavours to identify potential anomalies, but does not independently verify the accuracy or completeness of public or Client-supplied information unless indicated otherwise. This information, therefore, can limit the accuracy of the report.

2. COMPLEXITY OF GROUND CONDITIONS

There are hazards associated with the ground. An adequate understanding of these hazards can help to minimize risks to a project and the site. The ground is a vital element of all structures which rest on or in the ground. Information about ground behaviour is necessary to achieve a safe and economical structure. Often less is known about the ground than for any other element of a structure.

3. GEOTECHNICAL INVESTIGATION - SPATIAL COVERAGE LIMITATIONS

Geotechnical investigations collect data at specific test locations. Interpretation of ground conditions away from test locations is a matter of extrapolation and judgement based on geotechnical knowledge and experience, but actual conditions in untested areas may differ from predictions. For example, the interface between ground materials may be far more gradual or abrupt than a report indicates. It is not realistic to expect a geotechnical investigation to reveal or anticipate every detail of ground conditions. Nevertheless, an investigation can reduce the residual risk associated with unforeseen conditions to a tolerable level. If ground problems do arise, it is important to have geotechnical expertise available to help reduce and mitigate safety and financial risks.

1 Site Investigation Steering Group SISG 1993. *Site Investigation in Construction 2: Planning, Procurement and Quality Management*. London: Thomas Telford.

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4. ROLE OF JUDGEMENT AND OPINION IN GEOTECHNICAL ENGINEERING

Geotechnical engineering is less exact than most other design disciplines, and requires extensive judgement and opinion. Therefore, a geotechnical report may contain definitive statements that identify where the responsibility of Fugro begins and ends. These are not exculpatory clauses designed to transfer liabilities to another party, but they are statements that can help all parties involved to recognise their individual responsibilities and take appropriate actions.

COMPLETE GEOTECHNICAL REPORT SHOULD BE AVAILABILE TO ALL PARTIES INVOLVED

To prevent costly construction problems, construction contractors should have access to the best available information. They should have access to the complete original report to prevent or minimize any misinterpretation of site conditions and engineering advice. To prevent errors or omissions that could lead to misinterpretation, geotechnical logs and illustrations should not be redrawn, and users of geotechnical engineering information and advice should confer with the authors when applying the report information and/or recommendations.

GEOTECHNICAL INFORMATION IS PROJECT-SPECIFIC

Fugro's investigative programmes and engineering assessments are designed and conducted specifically for the Client described project and conditions. Thus this report presents data and/or recommendations for a unique construction project. Project-specific factors for a structure include but are not limited to:

- location
- size and configuration of structure
- type and purpose or use of structure
- other facilities or structures in the area.

Any factor that changes subsequent to the preparation of this report may affect its applicability. A specialised review of the impact of changes would be necessary. Fugro is not responsible for conditions which develop after any factor in site investigation programming or report development changes.

For purposes or parties other than the original project or Client, the report may not be adequate and should not be used.

CHANGES IN SUBSURFACE CONDITIONS AFFECT THE ACCURACY / SUITABILITY OF THE DATA

Ground is complex and can be changed by natural phenomena such as earthquakes, floods, seabed scour and groundwater fluctuations. Construction operations at or near the site can also change ground conditions. This report considers conditions at the time of investigation. Construction decisions should consider any changes in site conditions, regulatory provisions, technology or economic conditions subsequent to the investigation. In general, two years after the report date, the information may be considered inaccurate or unreliable. A specialist should be consulted regarding the adequacy of this geotechnical report for use after any passage of time.

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The information in this document is valid at the time of publishing (see month/year). Updates will be published on the website https://offshorewind.rvo.nl/ at the relevant sitemap (Hollandse Kust (zuid)/Hollandse Kust (noord)/Hollandse Kust (west)), General Information, submap Revision Log and Q & A. In the Revision Log is indicated which versions are the latest and what the changes are in relation to previous versions. The documents can be found at the relevant sites, indicated in the Revision Log.

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Netherlands Enterprise Agency (RVO.nl) | February 2017