Appendix A Work proposal

PROJECT PROPOSAL PP/2002/00
2 August 2002

FURTHER CALIBRATION OF DESIGN MODELS FOR FOAMED BITUMEN TREATED MATERIALS

Contact persons

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1 BACKGROUND

The projects that the Gautrans Department of Public Transport, Roads and Works and SABITA have undertaken thus far have led to the development of "Interim Guidelines for the Design and Use of Foamed Bitumen Treated Materials". Several areas where further research is necessary were highlighted during the development of these guidelines and from discussions with SANRAL representatives. These focus areas are captured and discussed in the accompanying discussion document (DD/2002/01). One such area is to test a wider range of material types than used in the previous projects to validate and, where necessary, expand the design guidelines. This proposal describes the minimum testing and model calibration required to address the first two items identified in the discussion document for future research namely:

- *The effect of aggregate type and aggregate quality on the characteristics and performance of foamed bitumen treated material;*
- *The effect of active filler to bitumen content ratio on the characteristics and performance of foamed bitumen treated material.*

2 PROBLEM STATEMENT AND MOTIVATION

A general mechanistic-empirical design model for foamed bitumen treated material was developed during the development of the guideline document. It was, however, not possible to generate pavement designs for high bearing capacity levels using this model. The reason for this is probably related to the moderate quality of the material that was used in the development of the model prior to foamed bitumen treatment. The material that was used is also not the most appropriate for use in designs for low traffic classes. The material classification system in the new guideline document allows for one material class above and one material class below the material that was used in the development and initial calibration of the design model. It is particularly important to test materials and calibrate the empirical components of the

general design model for materials from these two material classes that would then be used in designs for the high and low traffic classes.

To adequately characterise and test a material so that it can be used to validate and extend the guidelines and the structural design method for foamed bitumen treated materials requires extensive testing, as discussed in the accompanying discussion document. The two main types of tests used in the development and calibration of the structural design model are:

- Comprehensive laboratory testing including standard and advanced tests; and
- Heavy Vehicle Simulator (HVS) tests.

The different laboratory tests each contribute to understanding different aspects of the material behaviour, and together will allow full material characterisation. The results from the advanced laboratory tests also serve as the data set for calibration of the empirical components of the design model, which is then adjusted for full-scale conditions with the results from HVS tests.

3 METHODOLOGY

The work that is required to address the two research requirements listed in the background statement includes the following:

- Heavy Vehicle Simulator testing of foamed bitumen treated, recycled crushed stone base layer. A potential site for this HVS testing has already been identified on a recent project on TR11/1 near Cape Town in the Western Cape province. A project schedule and cost estimate for the HVS testing is therefore provided in this proposal.
- Comprehensive laboratory testing of foamed bitumen treated, recycled crushed stone material to calibrate the empirical components of the general design model for this material type. Although an appropriate source of material has not yet been identified for this component of the work, a project schedule and cost estimate is provided in this proposal for the full laboratory assessment of a generic material type.
- Heavy Vehicle Simulator testing of foamed bitumen treated natural gravel base layer. A potential site for this HVS testing has not been identified yet and a cost estimate for this work is therefore not included in this proposal. The cost estimate for the HVS testing on TR11/1 should, however, serve as a conservative indication of the cost for this component.
- Comprehensive laboratory testing of foamed bitumen treated natural gravel material to calibrate the empirical components of the general design model for this material type. Although an appropriate source of material has not yet been identified for this component of the work, the cost estimate provided for laboratory testing of the generic material type should serve as an indication of the cost of this component.

The methodology for the first two of these components is presented and should also apply to last two components.

3.1 HVS testing of foamed bitumen treated, recycled crushed stone base layer

As mentioned previously, a potential site has already been identified on TR11/1 for this HVS testing. The methodology that is suggested for the HVS tests on this site is the same as the process used for testing a foamed-bitumen treated, recycled cemented base on Road P243/1. The programme consists of two phases of HVS testing. Phase I consists of a relatively short test (about 1 month duration) done at a high wheel load of 80 to 100 kN for approximately 400 000 to 500 000 load repetitions. This serves to rapidly establish the basic behaviour of the pavement. The second phase of HVS testing then characterizes the pavement behaviour under a standard wheel load of 40 kN and usually confirms the behaviour observed under the high wheel load, only at a much slower rate of deterioration. The duration of the second phase test is expected to be 3 months with about 1,3 to 1,5 million load repetitions being applied. Water will be sprayed onto the test sections towards the end of the HVS tests for both phases of testing.

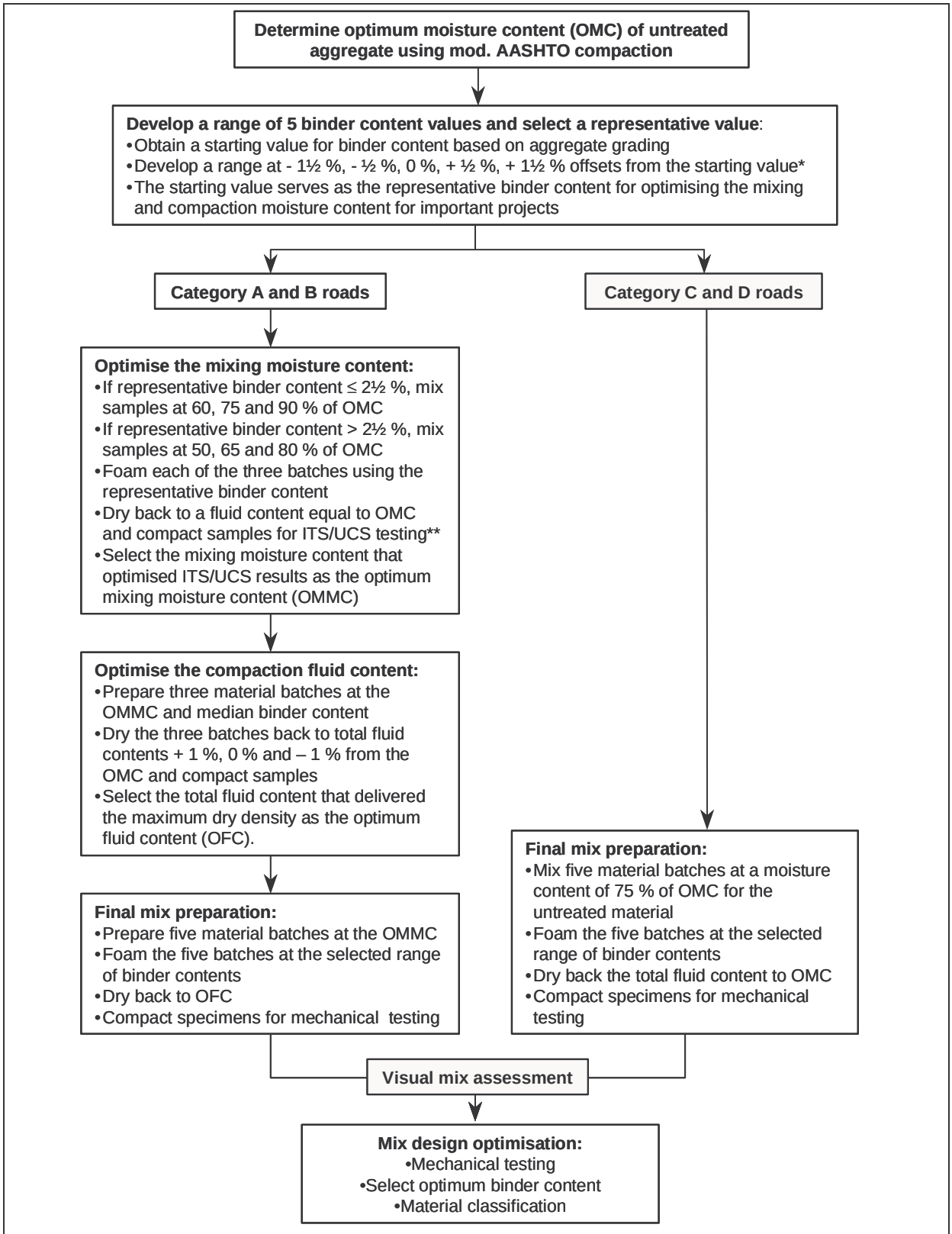
In addition to the two phases of HVS testing, the process is also divided into different stages. The first stage precedes HVS testing and consists mostly of a pre-test site visit, deflection and DCP survey, test section location, instrumentation and site establishment. The second stage consists of the actual HVS testing according to the two phases described above. This is followed by a demobilisation stage. The cost estimates are provided for each stage separately.

3.2 Laboratory testing of foamed bitumen treated, recycled crushed stone material

This proposal is written for a generic material, and once approval is obtained and a specific material is identified, the specific details can be finalised. To maximise the contribution to the validation and further development of the structural design models for foamed bitumen treated materials, it is suggested that a high quality crushed stone material from an existing recycling project is used. The material from TR11/1 is currently being investigated for this purpose. No samples were, however, dry-milled from this section for laboratory testing and therefore the available test results may not be representative of the actual material after recycling. The laboratory test programme presented in this document will, however, be applicable to any other material as well.

The project will take place in several stages. The first stage of the project is to identify, obtain and prepare the parent material for the laboratory testing. This untreated material needs to be fully characterised and the behaviour of the untreated material investigated to be able to compare with the behaviour after treating the material.

The second stage of the project is to perform a mix design to determine the optimum foamed bitumen content. This involves first selecting the cement content and then determining the optimum mixing moisture content. Once the mixing moisture content has been selected, the optimum foamed bitumen content will be selected. The mix design process will follow that set out in the “Interim Guidelines for the Design and Use of Foamed Bitumen Treated Materials” and is shown in Figure 1.



* The range of binder content values only serve as a guideline, users should apply their own judgement.

** If the mix contains cement, leave the mix for four hours prior to compaction. Monitor the fluid content during the four hours and seal when the fluid content equals the OMC

Figure 1 Mix design procedure to be used during the project

The specified mix design procedure requires optimisation in terms of mixing moisture content, compaction fluid content and binder content. This requires 9 UCS or ITS specimens to be prepared and tested for optimising the mixing moisture content, 9 UCS or ITS specimens to be prepared for optimising the compaction fluid content and 15 UCS or ITS specimens to be prepared and tested for optimising the binder content. In total, 33 specimens need to be prepared of which 24 are tested for a single mix design. The test matrix requires 3 mix designs to be done resulting in the preparation of 99 specimens and the testing of 72 UCS or ITS specimens depending on which test is selected for the mix design process.

The third stage of the project is to treat the parent material at selected cement and foamed bitumen contents and prepare specimens for the laboratory testing according to the test matrix in Table 1. It should be realized that each of the blocks that are ticked in the test matrix represents a comprehensive test programme. Each block requires the foaming, specimen preparation and testing set out in Table 2.

Table 1 Proposed test matrix

Aggregate type	Active filler content	Binder content			
		None	Below optimum	Optimum	Above optimum
	None	✓1		✓5 b	
	1 % (HVS site)		✓3	✓2 a	✓4
	Above ICC*			✓6 c	

Note: ✓1= sequence for triaxial testing a = sequence for mix design

Mix design option “a” needs to be completed before any specimen preparation can commence for the main laboratory testing of the foamed bitumen treated specimens. Mix design option “a” will therefore be done while the triaxial testing of the untreated material (triaxial option “1”) is being done. The mix design options “b” and “c” will be done while triaxial test options “3” and “4” are being completed.

Table 2 Foaming, specimen preparation and testing requirements for each combination of active filler and binder content

Item	Units	Notes
Foaming 680 kg material	72 hours, D Ventura	34 batches @ 4/day
Foaming machine rental	9 days	
UCS specimens and tests	3	
ITS specimens and tests	3	
ITS specimens and tests (soaked)	3	
CBR specimens and tests	3	
Flexural beam tests	6	
Fatigue tests	6	
Static triaxial tests	16	
Dynamic triaxial tests	24	
Permeability	3	
Erosion tests	3	
Shrinkage tests	1	
Microscopic pictures	6	

4 PROJECT DELIVERABLES

4.1 Deliverables from HVS testing

The deliverables from the HVS test programme for which the cost was included in this proposal, is the 1st level report normally produced from HVS projects. This data will feed into the 2nd and 3rd level analyses and reports, which will then combine the data from TR11/1 and Road P243/1 into a single HVS based structural design model for foamed-bitumen treated, recycled material. The 2nd and 3rd level analyses and reports will be motivated and priced in a separate proposal.

4.2 Deliverables from laboratory testing

The project deliverables will be included in a project report containing all the specimen preparation and laboratory testing results for both the treated and untreated material. The report will provide analyses and discussion of the test results and the results will be compared to existing data from foamed bitumen treated materials. The results will include:

1. Elastic stiffness models for the treated and untreated materials. Suggested stiffness input values for pavement design will be derived from these models.
2. Permanent deformation and shear failure models for the estimation of the bearing capacity of the untreated and treated materials.
3. Flexural characteristics of the treated materials.

These data will be used to calibrate the empirical components of the existing mechanistic-empirical design model for foamed bitumen treated material for the selected aggregate type. This laboratory-derived model will be calibrated for full-scale conditions using the HVS-derived model. This calibration will form part of the 3rd level analysis of the HVS data referred to above and will be included in the proposal for the 3rd level analysis. Recommendations will be made for the modification, if necessary, of the guidelines for the structural design of foamed bitumen treated pavement layers.

4.3 Deliverables from the full process

A structural design model for foamed bitumen treated material that is calibrated for the crushed stone material and full-scale boundary conditions. This will have a huge impact on the applicability of the design model to any general design case.

5 BENEFIT TO THE ROAD AUTHORITY

In general, the benefit of the work proposed will be to increase the reliability of sound performance and to reduce the risk of early failure or over-design, and thereby improve the confidence in using foamed bitumen treated materials. The work will advance the technology development, as discussed in the discussion document. This should allow the road authority to better evaluate foamed bitumen projects.

More specifically the work motivated in this proposal for HVS and laboratory testing of a good quality material that is treated with foamed bitumen will extend the proven validity of the current structural design model for foamed bitumen treated material to material types appropriate for very high design traffic classes. This will hopefully be

supplemented in future to also test a weaker material for application to low design traffic volumes. In doing this, the identified research needs listed in the background statement will be addressed satisfactorily.

6 PROJECT TEAMS

6.1 Team for HVS testing

The manpower component of HVS testing is split into two components, HVS operations and technical supervision and value addition. The exact responsibility of these two sections and the individuals involved in HVS and laboratory testing are currently being documented and should be available by September 2002. Briefly, the individual responsibilities are as follows:

Project Manager, HVS operations:	Mr J L du Plessis
HVS Operator:	Mr W Diedericks
Assistant operators:	A team of 6 assistant operators who are rotated to have 3 assistant operators on site permanently with an additional operator during the day.
	Mr B Mashishi
	Mr P Chabane
	Mr J Legodi
	Mr C Motha
	Mr W Dantji
	Mr A Masemola
Project Manager, Technical:	Mr H L Theyse
Project Engineer:	Mr B Morton
Project Technician:	Mr C Fisher
Assistant Technician:	Mr L Gamoo

6.2 Team for laboratory testing

The proposed manning for the laboratory test programme is as follows:

Project Manager (Admin):	Mr HL Theyse
Technical Manager:	Dr FM Long
Project Manager (Process and quality):	Mr D Ventura
Dynamic testing technician:	Mr C Fisher
Dynamic testing assistant:	Mr J Marima
Standard testing technician:	Mr P Botha
Specimen preparation:	Mr N Masango
Foaming technician:	Mr D Ventura

The cost of the laboratory test programme is largely determined by the time spent by the above individuals on their respective functions. The cost estimates provided in Section 7 therefore provides further detail on the function of these individuals and the time allocated per activity.

7 ESTIMATED COST

Cost estimates are provided for the anticipated HVS testing on TR11/1 in the Western Cape and for a full laboratory assessment of a generic material type. These cost estimates also serve as indicators of the cost for similar HVS and laboratory testing of a relatively weaker material to fully address the identified research need. It is not the intention that all the work on both the good and relatively weaker quality material should be funded at once. Potential clients should, however, be aware of the total funding requirement, which may then be addressed in separate smaller components.

7.1 Cost estimate for HVS testing on TR11/1 in the Western Cape

The cost estimate for HVS testing provides for the operation of the HVS, technical management of the test programme, data capture, data processing, data validation and the production of a 1st level report. The cost for combining the data with results from other HVS and laboratory test programmes on the same type of material and the calibration on the structural design model will be addressed in a separate proposal for the 2nd and 3rd level analysis of the data. The cost estimate for the HVS testing in the Western Cape is subject to the following conditions:

- The HVS testing will be preceded with a site visit to assess the suitability of the site;
- A deflection truck with a standard load will have to be provided by PAWC for pre-HVS deflection testing. The cost of this is excluded from the estimate;
- The establishment and demobilisation cost only covers Transportek's involvement and excludes the cost of the horse and escort vehicles. The cost estimate for the horse and escort vehicles is R85 000,00 one-way (R170 000,00 return);
- Site visits are planned twice a month for the HVS engineer and once a month for the project manager, operations manager and technical specialist;
- Material will be sampled from all pavement layers during the excavation of the test-pits but no allowance is made for the cost of standard laboratory testing (hopefully, this can again be done by the Gautrans laboratories to reduce cost);
- Travel costs are planned according to current airfares that may fluctuate.
- A contingency of R130 000,00 is included because of the uncertainty associated with HVS testing. Tests are often delayed because of unforeseen circumstances. The contingency should allow for an additional two weeks of HVS testing if required.

Comparing the estimated cost for testing in the Western Cape with the cost of a similar programme recently done on Road P243/1, the estimate seems somewhat low considering that 200 000 more load repetitions are planned for the test in the Western Cape. The reduction in cost is probably because of the higher production rate of the HVS Mk IV+.

Table 3 Cost estimate for HVS-testing in the Western Cape

	Resource	Rate	Units	Cost	S&T	Travel cost	
Pre-HVS testing							
Site visit	HT		8				
	BM		8				
	WD		8				
Deflection survey and section location	CF		16				
	LS		16				
	BM		16				
Instrumentation	CF		40				
	LS		40				
Establishment			1				
HVS testing							
Calibration and N10 Phase I	CF		16				
	LS		16				
Calibration and N10 Phase II	CF		8				
Site visits	BM		64				
	FL		32				
	HT		32				
HVS operation			16				
1st level analysis							
Ongoing	LG		128				
	CF		128				
	BM		160				
Report	BM		120				
	HT		40				
Post-HVS testing							
Test-pits	CF		40				
	LG		40				
Demobilization			1				

Contingency
Sub-total
VAT (14 %)
Total

7.2 Cost estimate for the comprehensive laboratory assessment of one material type

The tables below provide cost estimates for the various stages of the laboratory assessment, and the total cost for the incorporation of the new material into the empirical component of the structural design model. The calibration of the design model for full-scale conditions using the results from the HVS tests will be included in the proposals for the 2nd and 3rd level analysis of the HVS data. The mass of material required to complete the full laboratory assessment is about 3 200 kg hence the relatively high cost for initial sampling and material preparation.

Table 4 Obtain and prepare parent material

Item	Quantity
Obtain parent material	1
Process parent material (dry, riffle, store)	1

Table 5 Tests on Parent Material

		Number of tests
5.01	Grading	3
5.02	CBR	3
5.03	Atterburg limits	3
5.04	MDD/OMC	3
5.05	ARD/BRD	3
5.06	ICC	1
5.07	ICL	1
5.08	Static triaxial test	16
5.09	Dynamic triaxial test	24
5.10	Erosion	1
5.11	Permeability	3

Table 6 Mix Design (one cement content, 5 binder contents)

		Number of units	Units
6.01	Foaming supervision	24	hours, D Ventura
6.02	Foaming machine rental	3	days
6.03	UCS	33	tests
6.04	ITS	33	tests

Table 7 Specimen preparation and testing at one cement and foamed bitumen content combination

		Number of units	Units
7.01	Foaming supervision	72	hours, D Ventura
7.02	Foaming machine rental	9	days
7.03	UCS	3	tests
7.04	ITS	3	tests
7.05	ITS (soaked)	3	tests
7.06	CBR	3	tests
7.07	Flexural Beam Test	6	tests
7.08	Fatigue Test	6	tests
7.09	Static Triaxial Test	16	tests
7.10	Dynamic Triaxial Test	24	tests
7.11	Permeability	3	tests
7.12	Erosion	1	tests
7.13	Shrinkage	1	tests
7.14	Microsope Pictures	6	tests

Table 8 Human Resource Cost and Value Addition

Task		Person	Rate	Hours	Cost	Total Cost			Comment
Detailed briefs		D Ventura		80	-				
		C Fisher		16	-				
		F Long		24	-				
		H Theyse		8	-	-			
						-			
Mix design stage (x3)									
	Test supervision	D Ventura		8	-	-			
	Data Analysis	D Ventura		16	-				
		F Long		2	-				
		H Theyse		1	-	-			
						-	x 3	-	
Full assessment stage (x6)									
	Supervision	D Ventura		28	-	-			2 hours per day
	Data processing	D Ventura		8	-				for items 7.03 to 7.06
		D Ventura		8	-				for items 7.11 to 7.13
		D Ventura		8	-				for item 7.14
		C Fisher		48	-	-			for items 7.07 to 7.08
	Data analysis	F Long		30	-				
		H Theyse		8	-	-			
	Component of report	F Long		30	-				
		H Theyse		8	-	-			
						-	x 6	-	
Project management		F Long		128	-				32 weeks, 4 hours per week
		H Theyse		32	-	-			32 weeks, 1 hour per week
						-			
Finalisation stage		F Long		120	-				Final analysis, one laboratory model, final
		H Theyse		32	-	-			draft report, incorporate review comments,
						-			technical presentations

Summary

Detailed briefs			-
Mix design stage	-	x 3	-
Full assessment stage	-	x 6	-
Project management			-
Finalisation stage			-
			-

Table 9 Total costs of the full laboratory test programme

	Number
Obtain and prepare parent material (Table 4)	1
Tests on parent material (Table 5)	1
Mix Design (Table 6)	3
Specimen preparation and testing (Table 7)	5
Human Resouce Cost (Table 8)	
Report production	1
TOTAL COST, Rand (excluding VAT)	
VAT	
TOTAL COST, Rand (including VAT)	

Tables 4 and 5 are for Stage 1, Table 6 for Stage 2 and Table 7 for Stage 3. (Refer to Section 3.2)

In the mix design phase, for 1 cement content, 3 ITS and UCS tests are performed at 3 moisture contents to determine the optimum mixing moisture content. Then, three UCS and ITS tests are performed at three fluid contents to determine the optimum fluid content. At the optimum fluid content, 3 UCS and ITS tests are performed at 3 foamed bitumen contents to select the optimum foamed bitumen content.

Four static triaxial tests will be done at each combination of two levels of density and two levels of saturation, resulting in 16 tests. Each of the four tests is done at a different confining stress. Two dynamic triaxial tests will be done at three stress levels for each of the four density and saturation combinations, giving 24 dynamic triaxial tests. Both dynamic tests are done at a different confining stress. It is likely that the fatigue test can only be performed on mixes with high foamed bitumen contents. Two specimens will be tested at three strain levels, giving six specimens.

The cost estimates shown in Tables 3 to 7 are for one parent material, a mix design on the parent material for a single cement content, and the specimen preparation and tests at only one cement and foamed bitumen content combination. Tables 8 and 9 assume that three cement contents are used, i.e., three mix designs are performed. The full range of tests will be performed at the specific optimum binder content for each cement content as well as at two other selected combinations of cement and foamed bitumen. This results in 5 cement and foamed bitumen combinations as shown in the proposed test matrix in Section 3. This rationale for this test plan is explained in the discussion document. The total human resource cost for the testing, data processing and analysis associated with these 5 combinations is given in Table 8 and the total cost of the laboratory test programme is given in Table 9.

The total cost estimate for the laboratory test programme given in Table 9 exceeds the initial estimate provided to the client. Transportek undertakes to do the work for the initial cost estimate.

The volume of work for the laboratory test programme should not be underestimated. Table 10 provides a summary of the number of tests to be done excluding the tests for the mix design stage. Each of the flexural beam, static triaxial and dynamic triaxial tests requires the non-linear regression analysis of at least 3 output measurements by hand. This data then needs to be transferred to summary sheets

where further regression analysis of the combined data is done. This excludes any model development and calibration. The number of tests that are required and the planning of curing schedules require detail control of the whole process to ensure success. The main responsibilities of D Ventura will be to plan and manage the process and to ensure the highest level of quality for the test results.

Table 10: Type and total number of tests to be performed as part of the laboratory test programme

Test	Number of tests
ICC/ICL	1
ARD/BRD	3
OMC/MDD	3
Atterberg limits	3
Grading analyses	3
CBR	18
UCS	15
ITS	30
Flexural beam	30
Fatigue tests	30
Static triaxial tests	96
Dynamic triaxial	144
Erosion	18
Permeability	18
Shrinkage	5
Microscope pictures	30

8 PAYMENTS

A monthly cash flow schedule will be developed based on the information presented in Section 9 of this proposal and certain budget restraints that may apply to individual clients.

9 BUDGET

Gautrans, SANRAL and PAWC will share the cost of the combined HVS and laboratory programmes. Table 11 provides an estimate of the cost for the process to the point where the structural design model for foamed bitumen treated material is calibrated for the crushed stone material and full-scale boundary conditions.

Table 11: Budgets and expenditure for combined Gautrans, SANRAL and PAWC projects

Budget		Actual/expected expenditure	
Client	Amount	Item	Cost
Gautrans		Estimated expenditure to mid September 2002	
Western Cape		HVS website	
SANRAL		Move to western Cape (return)	
		HVS testing western Cape	
		Laboratory testing western Cape	
		2nd level analysis (preliminary estimate)	
		3rd level analysis (preliminary estimate)	
		HVS rental (Texas SIM)	
Total	R 0.00		R 0.00
Shortfall	R 0.00		

10 APPROVAL OF PROJECT:

I …….. hereby accept the content of the proposal "FURTHER CALIBRATION OF DESIGN MODELS FOR FOAMED BITUMEN TREATED MATERIALS (PP/2002/00)" and the conditions of contract on behalf of …… (GAUTRANS)

Signed at …… on this ….. day of …….. 2002.

……

As witness:

1.

2.

I …….. hereby accept the content of the proposal "FURTHER CALIBRATION OF DESIGN MODELS FOR FOAMED BITUMEN TREATED MATERIALS (PP/2002/00)" and the conditions of contract on behalf of …… (PAWC)

Signed at …… on this ….. day of …….. 2002.

……

As witness:

1.

2.

I …….. hereby undertake on behalf of CSIR Transportek (CONTRACTOR) to complete the work set out in the proposal "FURTHER CALIBRATION OF DESIGN MODELS FOR FOAMED BITUMEN TREATED MATERIALS (PP/2002/00)"
under the conditions of contract.

Signed at …… on this ….. day of …….. 2002.

……

As witness:

1.

2.

11 PROJECT SCHEDULE

Gantt chart showing the schedule for the main tasks of the HVS test programme in the western Cape

Item	15/09/2002	22/09/2002	29/09/2002	06/10/2002	13/10/2002	20/10/2002	27/10/2002	03/11/2002	10/11/2002	17/11/2002	24/11/2002	01/12/2002	08/12/2002	15/12/2002	22/12/2002	29/12/2002	05/01/2003	12/01/2003	19/01/2003	26/01/2003	02/02/2003	09/02/2003	16/02/2003	23/02/2003	02/03/2003	09/03/2003	16/03/2003	23/03/2003	30/03/2003	06/04/2003	13/04/2003	20/04/2003	27/04/2003	04/05/2003	11/05/2003	18/05/2003	25/05/2003	01/06/2003	08/06/2003
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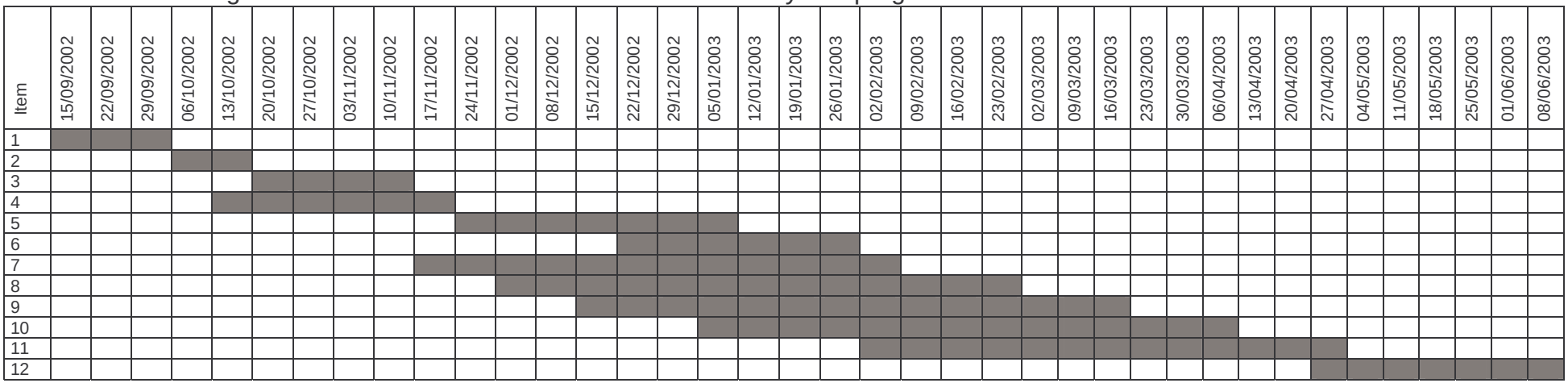
Items:
1 Pre-test site visit
2 Deflection survey and section location
3 Instrumentation
4 Establishment
5 Phase I testing
6 Phase II testing
7 Test pits
8 Demobilization
9 1st level analysis and report
10 2nd level analysis and report

Gantt chart showing the schedule for the main tasks of the laboratory test programme



Items:
1 Obtain and prepare bulk sample
2 Standard tests on untreated material (Test batch 1, Table 1)
3 Performance tests on untreated material (Test batch 1, Table 1)
11 Mix design test batch “a” from Table 1
12 Mix design test batch “b” from Table 1
13 Mix design test batch “c” from Table 1
14 Test batch 2, Table 1
15 Test batch 3, Table 1
16 Test batch 4, Table 1
17 Test batch 5, Table 1
18 Test batch 6, Table 1
19 Draft final report

The 3rd level analysis of the laboratory and HVS data and the final calibration of the structural design model will only be able to commence in mid-June 2003. The target date for the completion of the full process is August 2003.

Appendix B Flexural beam tests (Strain-at-break)

Table A.1. Summary of strain-at-break test results

Mix	Cement content	Binder content	Days of curing	Specimen name	LVDT	Strain-at-break	Stress-at-break
HNS	0	2.25	28	BHNS1	1	Data unreasonable	
					2		
				BHNS2	1	Specimen broke under initial load	
					2		
				BHNS3	1	Specimen broke under initial load	
					2		
				BHNS4	1	~~460~~ [1,2]	~~39~~ [1,2]
					2	~~510~~ [1,2]	~~39~~ [1,2]
				BHNS5	1	Data unreasonable	
					2		
				BHNS6	1	297	23
					2	289	23
HSN	1	0	28	RHSN1	1	Data unreasonable	
					2		
				RHSN2	1	Data unreasonable	
					2		
				RHSN3	1	92	253
					2	41	263
				RHSN4	1	Data unreasonable	
					2	69	238
				RHSN5	1	49	256
					2	68	263
				RHSN6	1	103	245
					2	78	245
			105	BHSN1	1	202	89
					2	~~384~~ [2]	~~84~~ [2]
				BHSN2	1	92	448
					2	50	452
				BHSN3	1	158	446
					2	110	449
				BHSN4	1	88	380
					2	68	383
				BHSN5	1	66	325
					2	131	325
				BHSN6	1	205	84
					2	185	84
HSB	1	1.5	28	BHSB1	1	138	103
					2	100	105
				BHSB2	1	~~251~~ [2]	~~316~~ [2]
					2	~~290~~ [2]	~~333~~ [2]
				BHSB3	1	113	269
					2	113	269
				BHSB4	1	~~34~~ [2]	~~382~~ [2]
					2	133	268
				BHSB5	1	92	372
					2	106	376
				BHSB6	1	87	132
					2	127	131

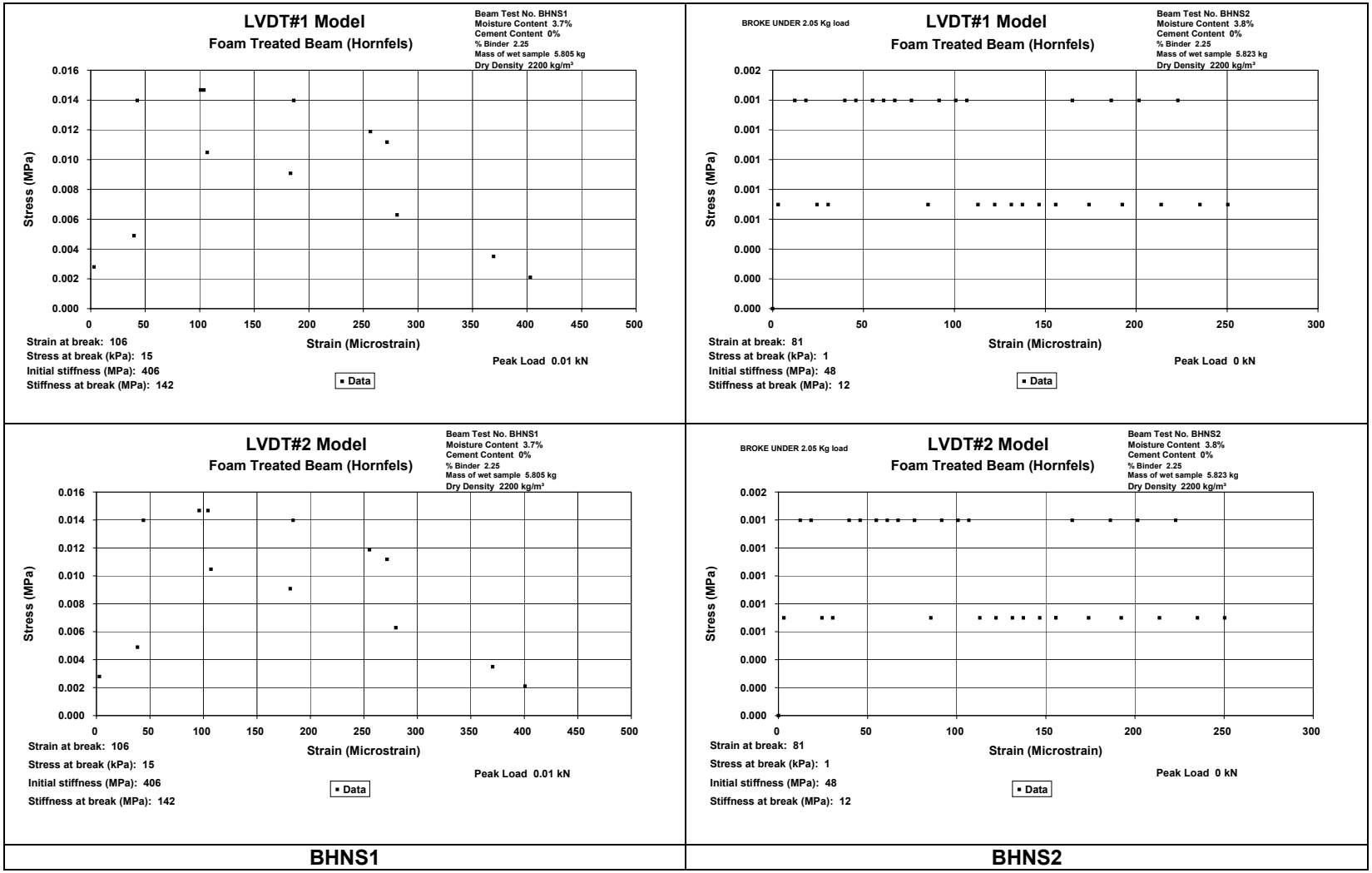
1. Data fitted by hand
2. Crossed out data excluded from analyses

Table A.1. Summary of strain-at-break test results (continued)

Mix	Cement content	Binder content	Days of curing	Specimen name	LVDT	Strain-at-break	Stress-at-break
HSS	1	2.25	28	BHSS1	1	132	421
					2	Data unreasonable	
				BHSS2	1	131	365
					2	~~199~~[2]	~~356~~[2]
				BHSS3	1	128	79
					2	120	83
				BHSS4	1	138	254
					2	Data unreasonable	
				BHSS5	1	116	362
					2	118	362
				BHSS6	1	~~78~~[2]	~~256~~[2]
					2	Data unreasonable	
HSA	1	3.0	28	BHSA1	1	146	286
					2	146	286
				BHSA2	1	101	209
					2	173	212
				BHSA3	1	147	223
					2	Data unreasonable	
				BHSA4	1	~~316~~[2]	~~191~~[2]
					2	Data unreasonable	
				BHSA5	1	~~87~~[2]	~~201~~[2]
					2	125	203
				BHSA6	1	115	238
					2	188	232
HAS	2	2.25	28	BHAS1	1	122	486
					2	122	486
				BHAS2	1	145	356
					2	147	361
				BHAS3	1	102	261
					2	135	267
				BHAS4	1	107	~~454~~
					2	107	~~454~~
				BHAS5	1	97	310
					2	Data unreasonable	
				BHAS6	1	~~73~~[2]	~~430~~[2]
					2	~~73~~[2]	~~430~~[2]

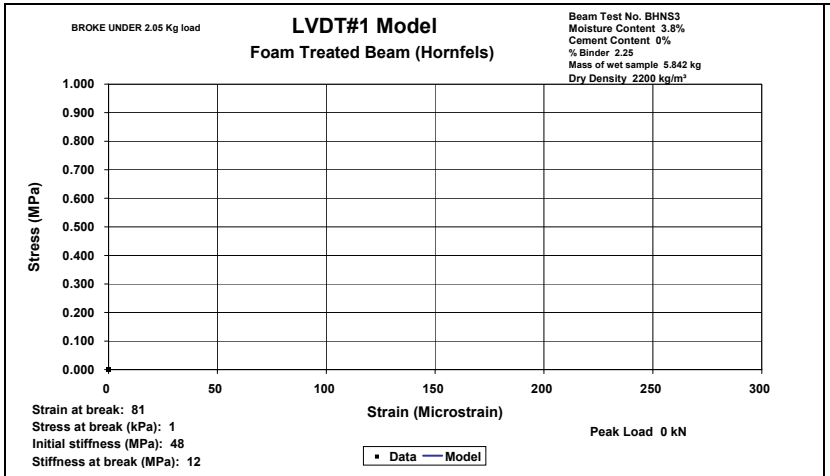
1. Data fitted by hand
2. Crossed out data excluded from analyses

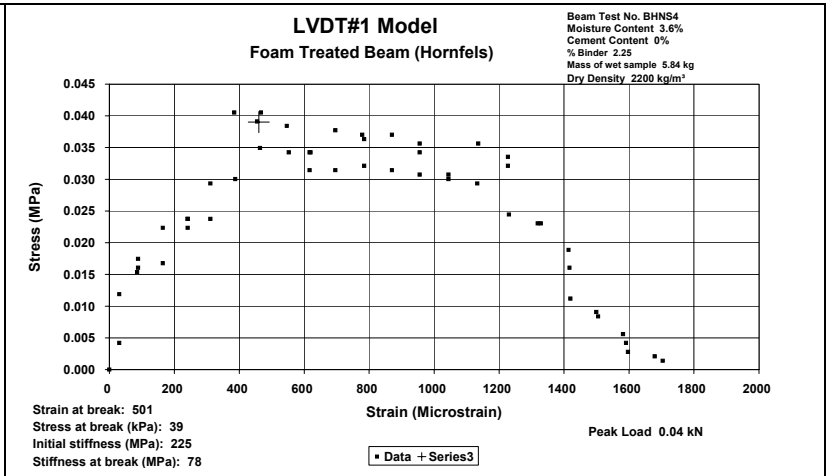
HNS: Treated with 2.25% Foamed Bitumen

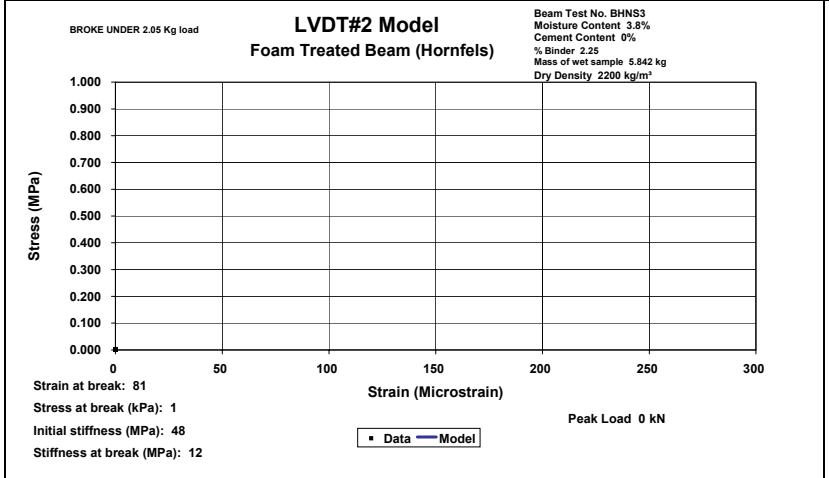


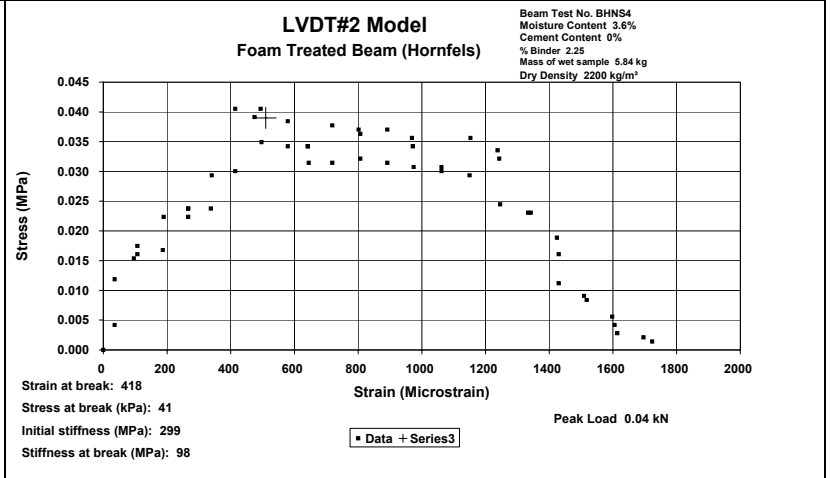
BHNS1	BHNS2

HNS: Treated with 2.25% Foamed Bitumen (continued)



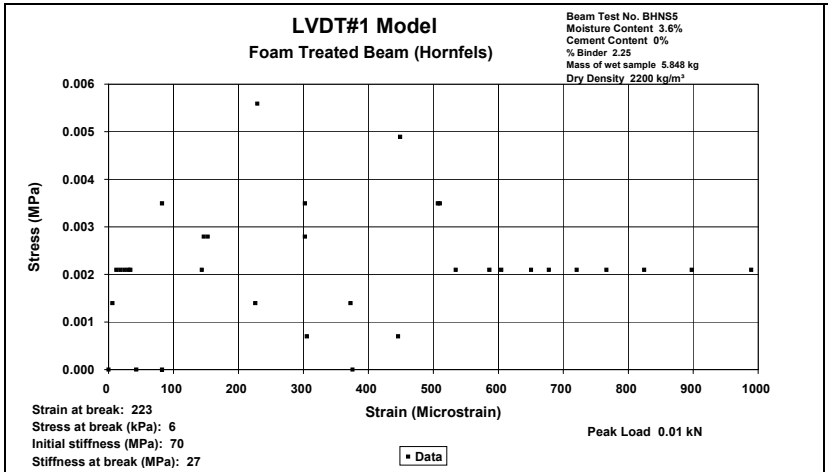


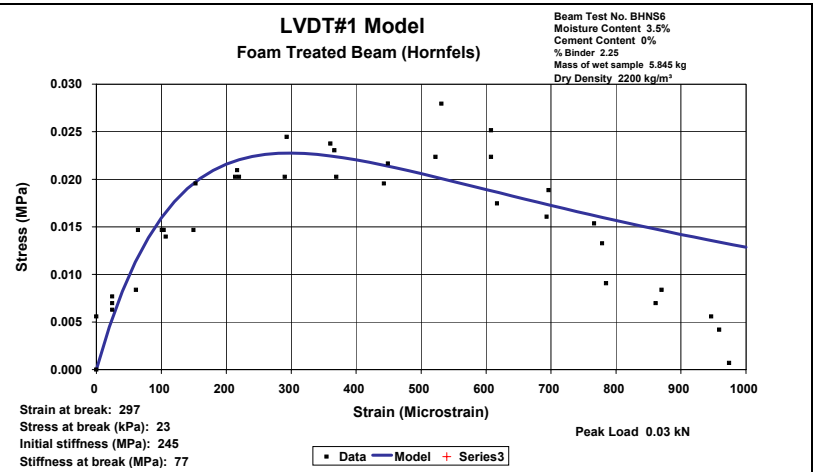


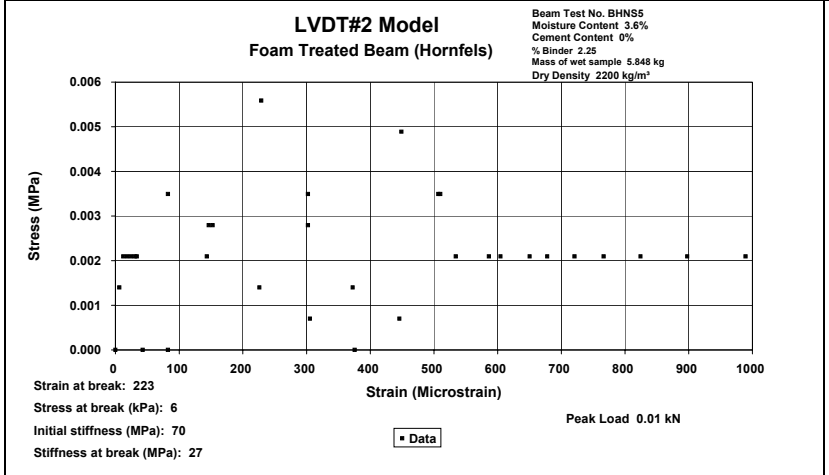


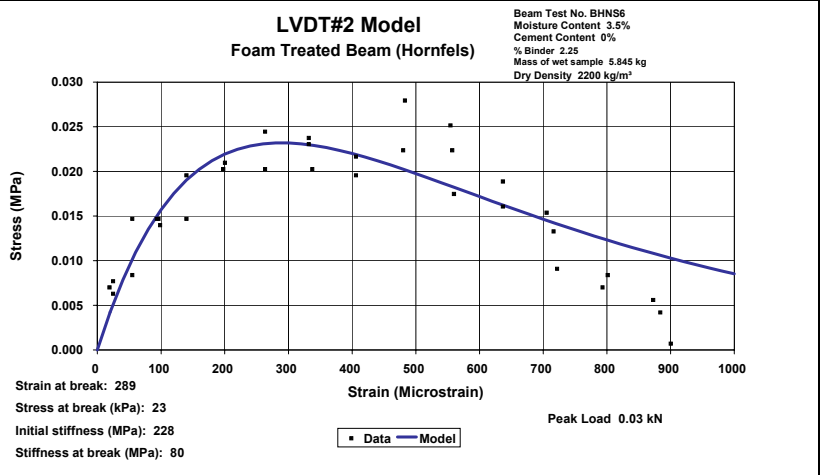
BHNS3	BHNS4

HNS: Treated with 2.25% Foamed Bitumen (continued)



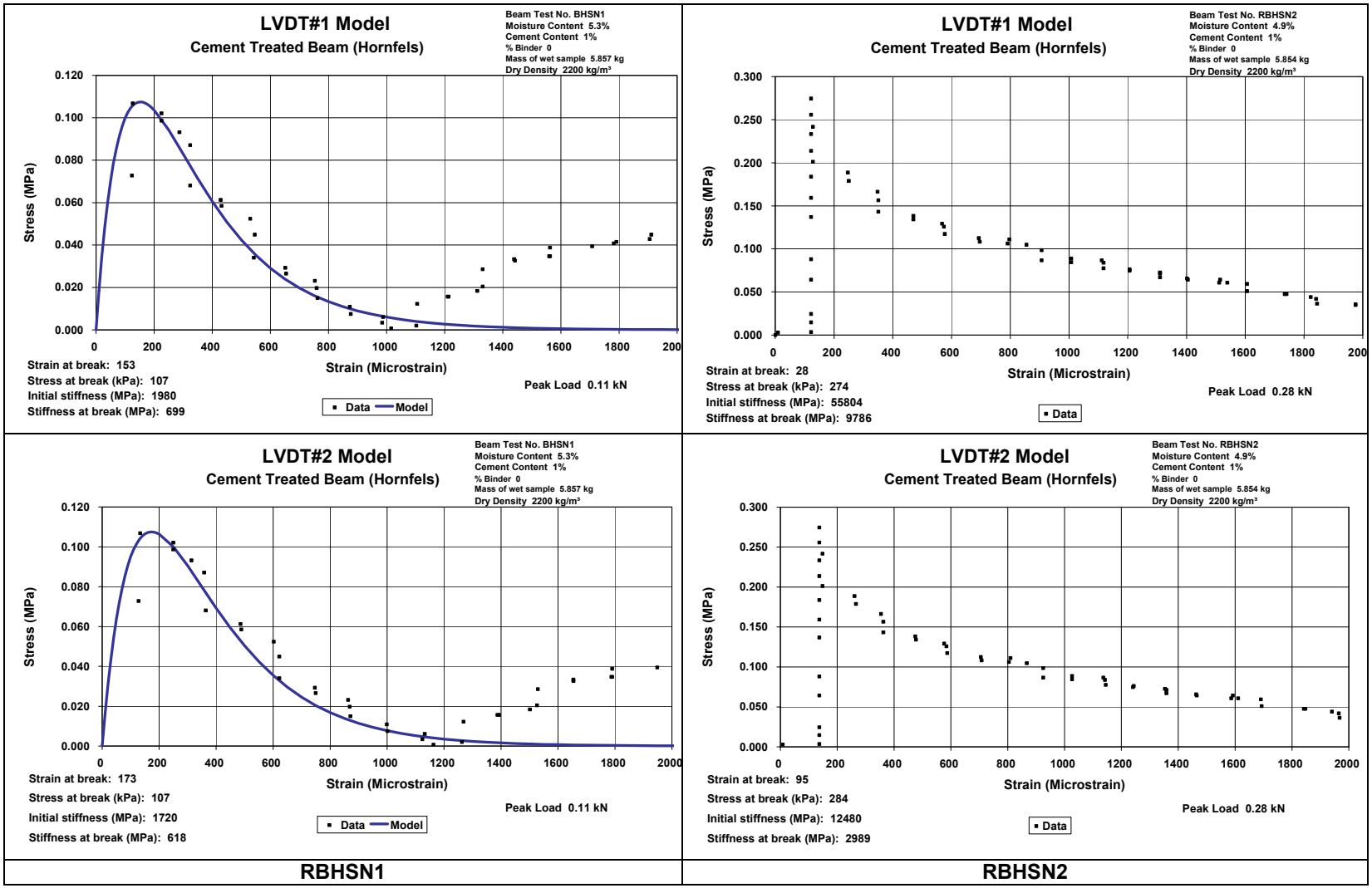






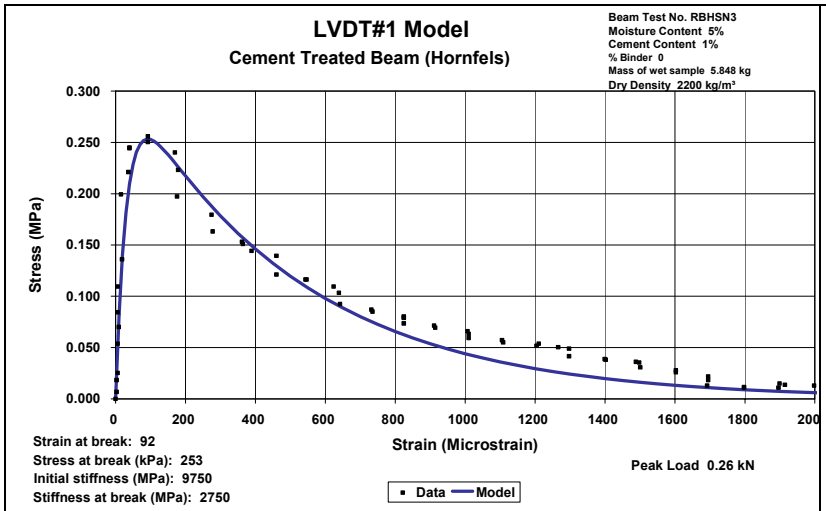
BHNS5	BHNS6

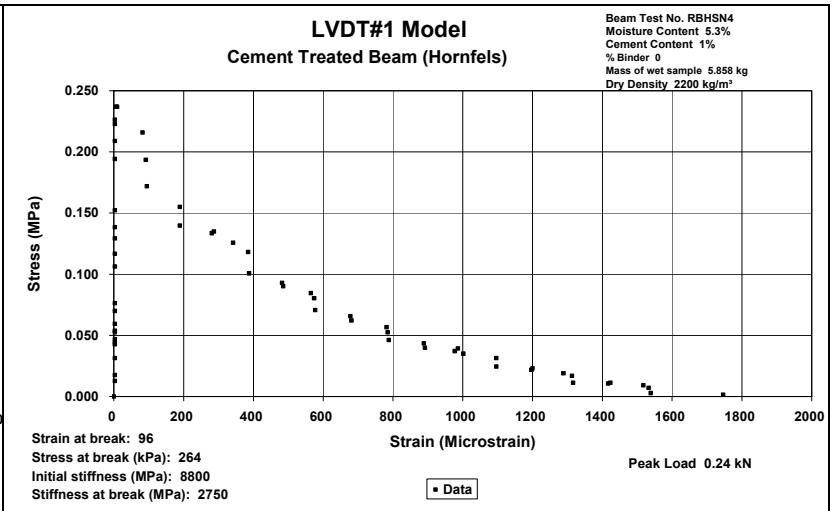
HSN: Treated with 1% Cement (28 days of curing)

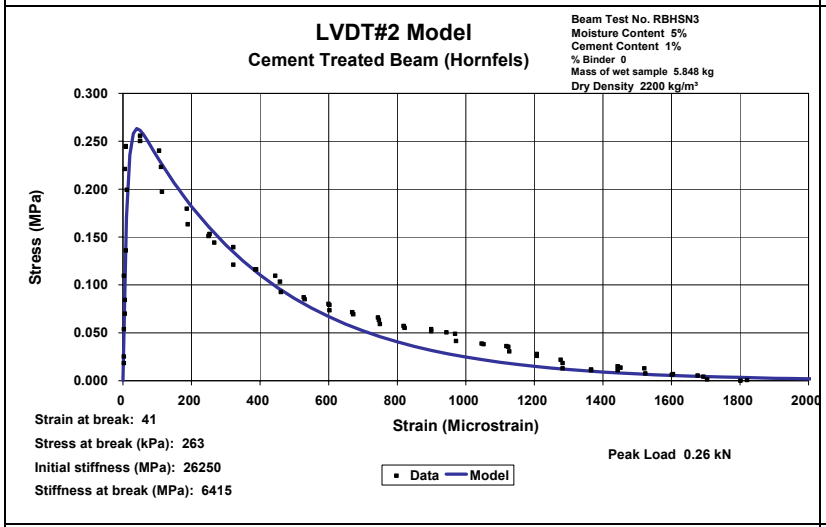


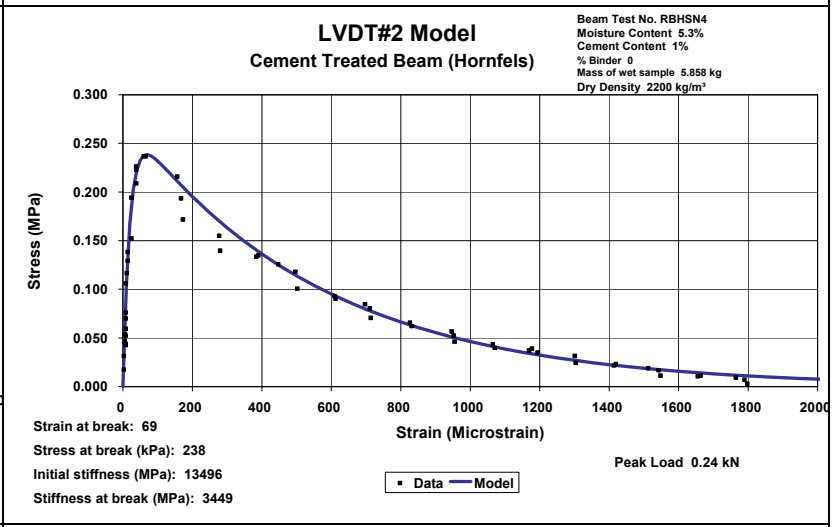
RBHSN1	RBHSN2

HSN: Treated with 1% Cement (28 days of curing) (continued)



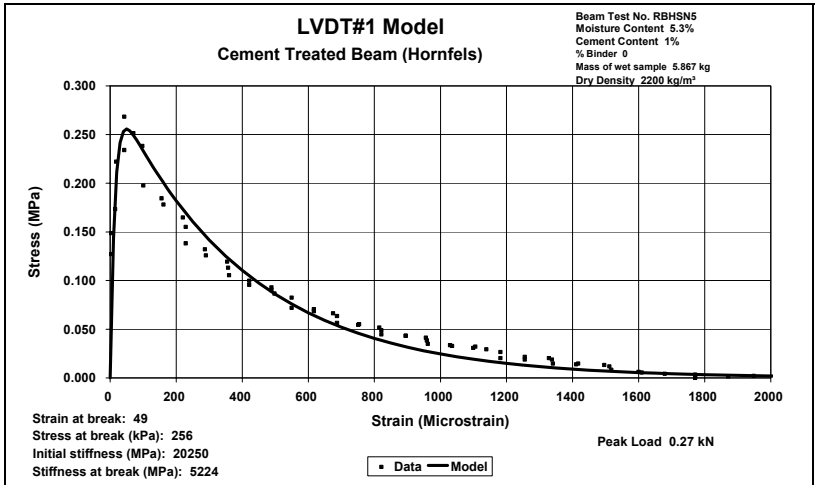


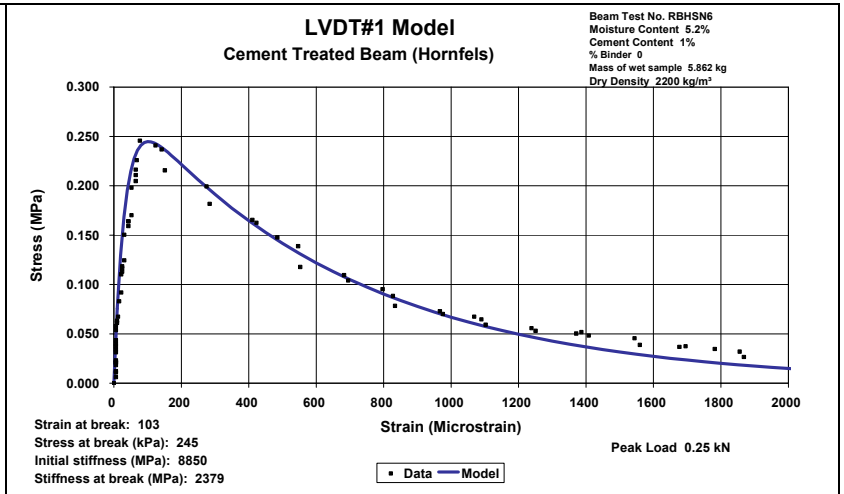


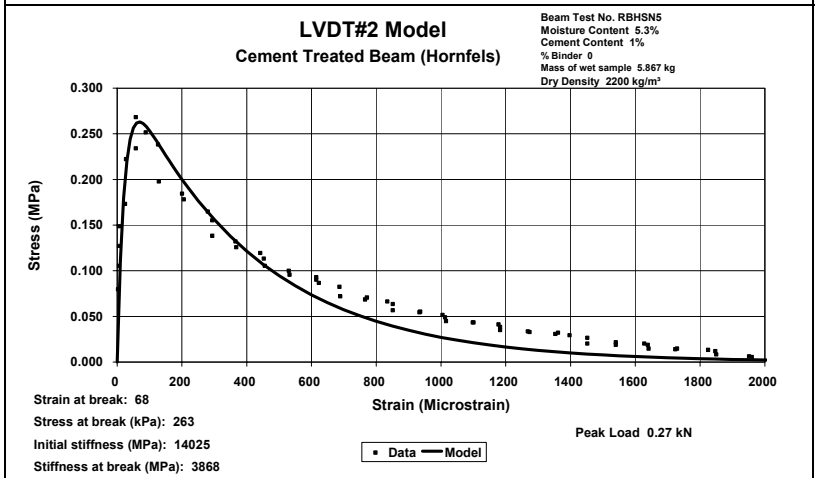


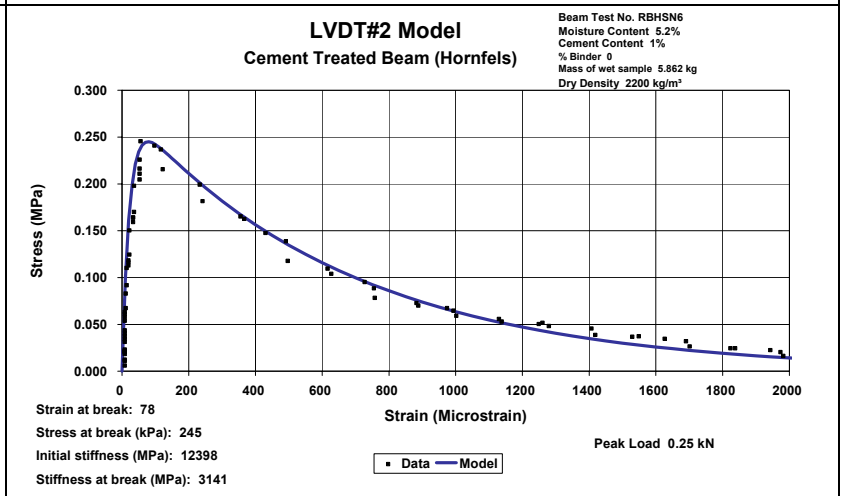
RBHSN3	RBHSN4

HSN: Treated with 1% Cement (28 days of curing) (continued)



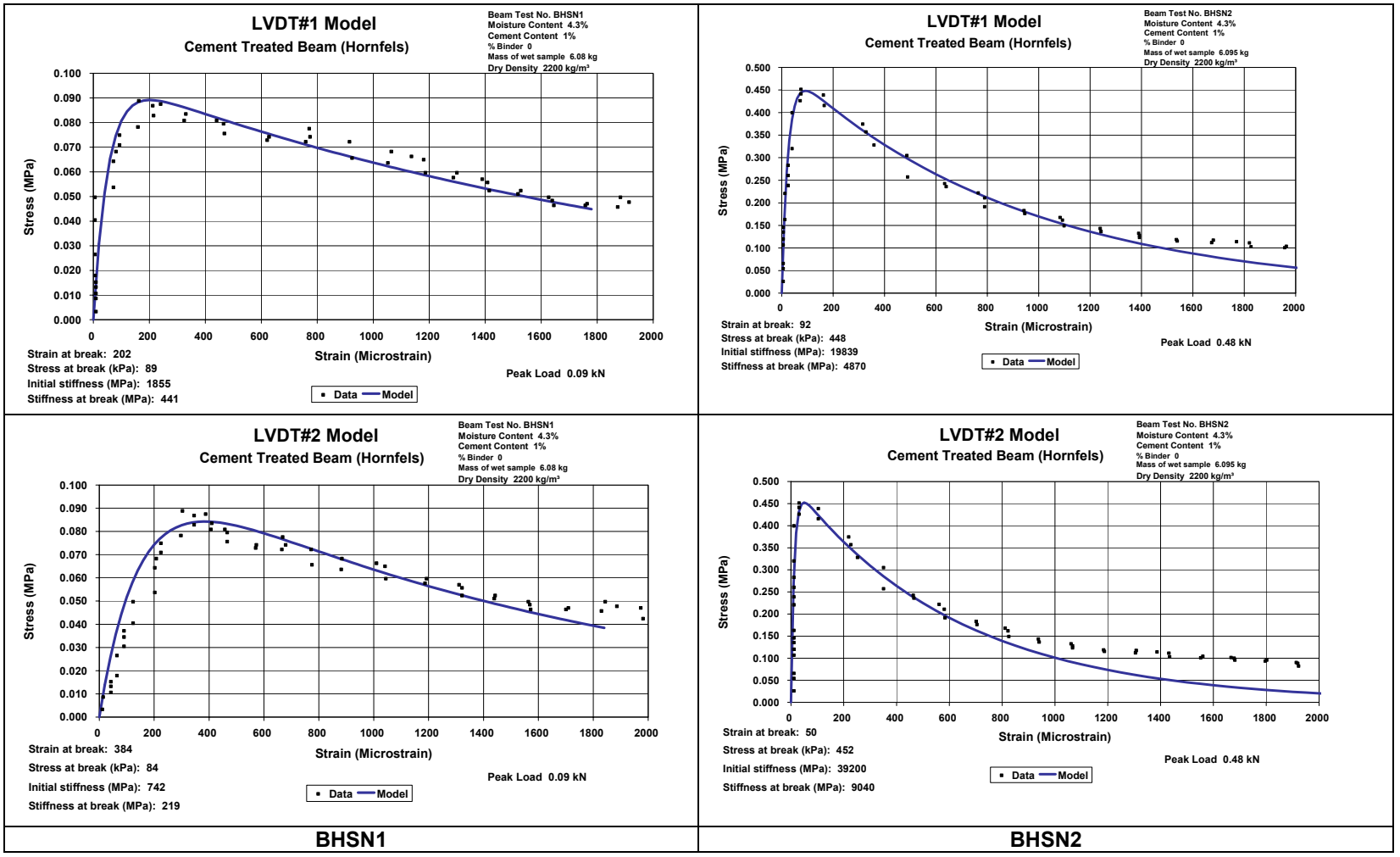




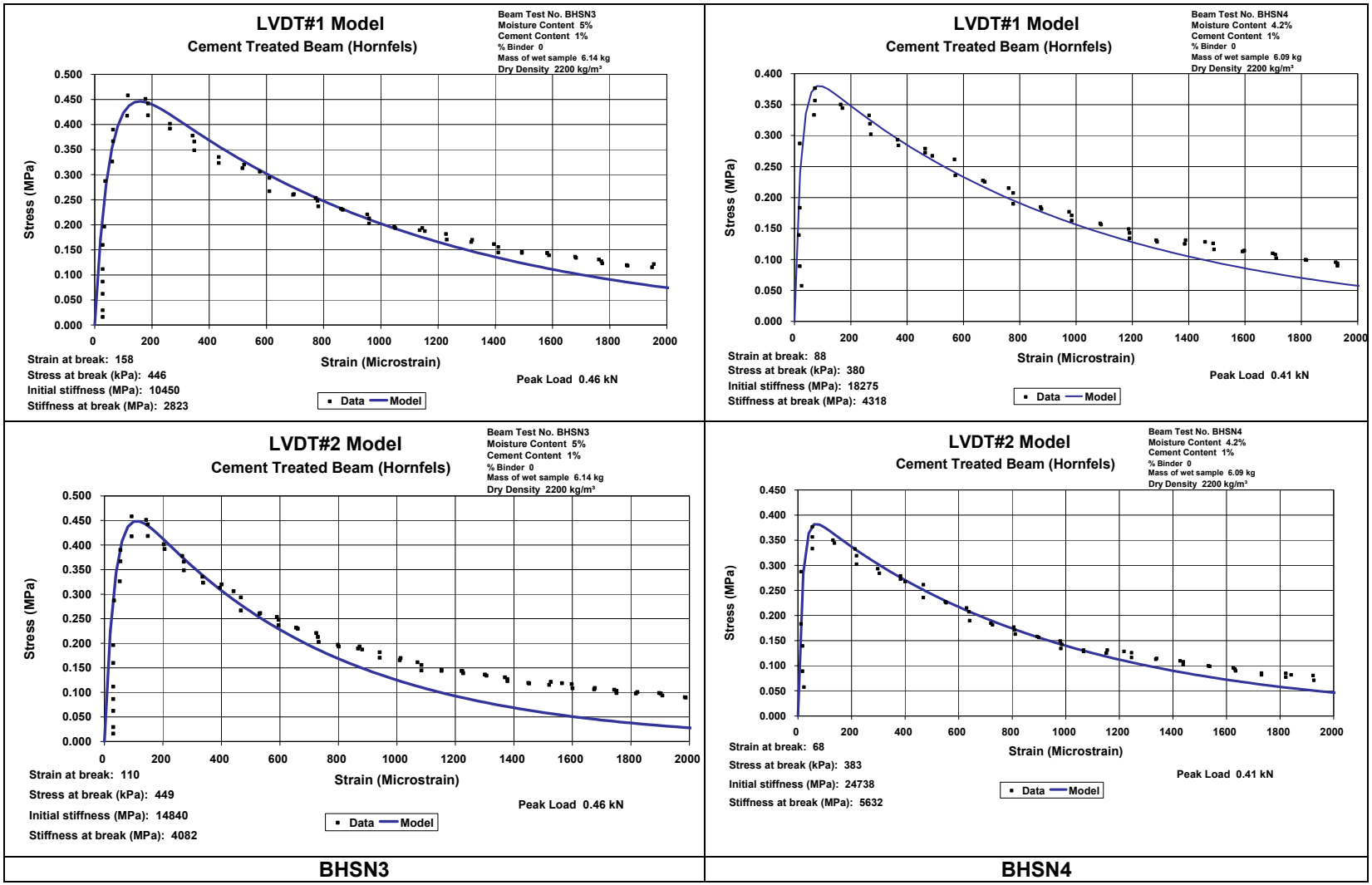


RBHSN5	RBHSN6

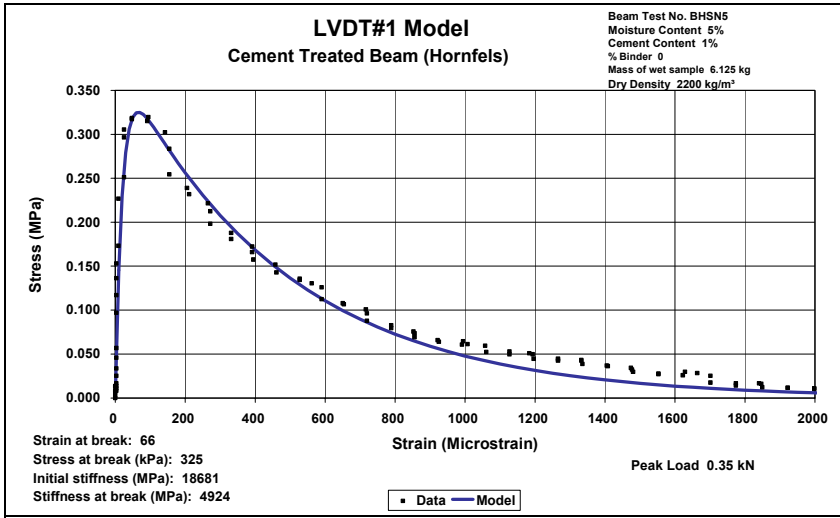
HSN: Treated with 1% Cement (105 days of curing)

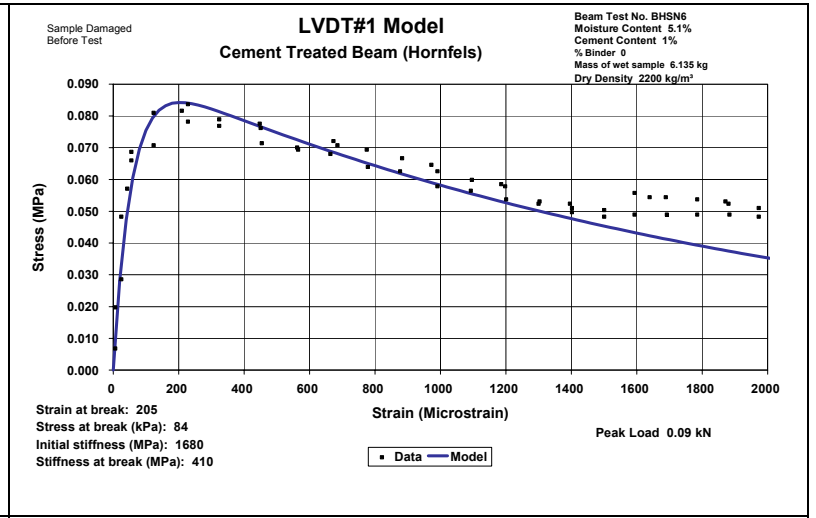


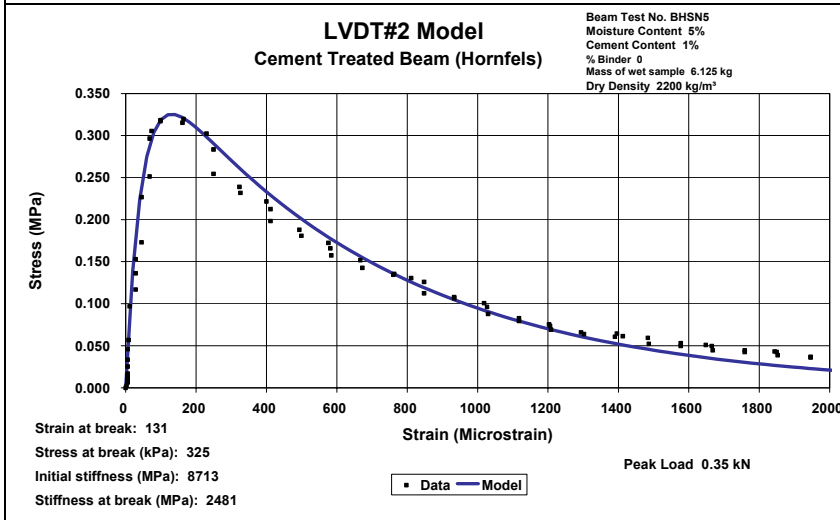
HSN: Treated with 1% Cement (105 days of curing) (continued)

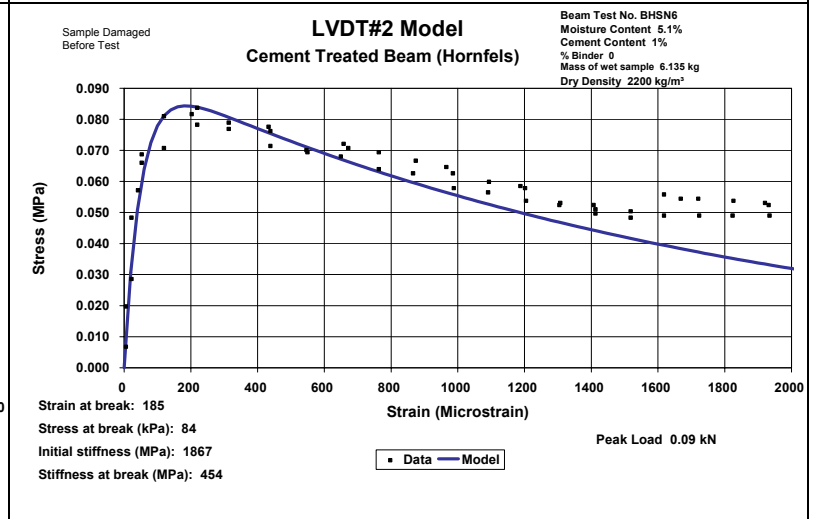


HSN: Treated with 1% Cement (105 days of curing) (continued)



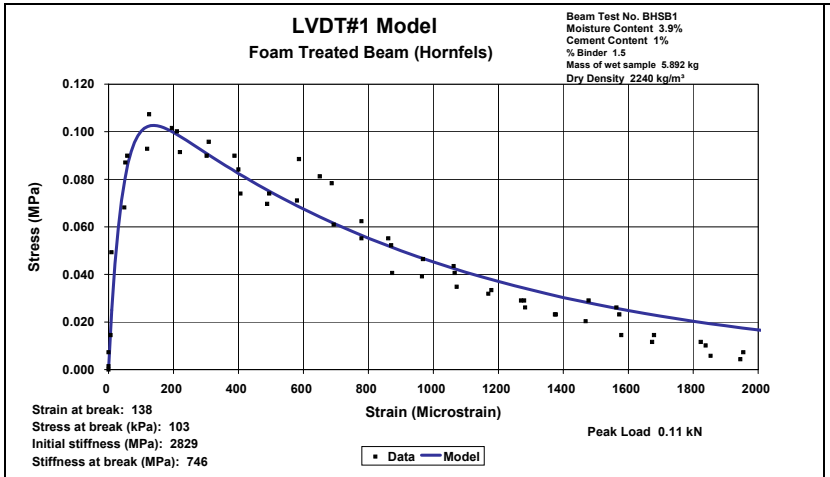


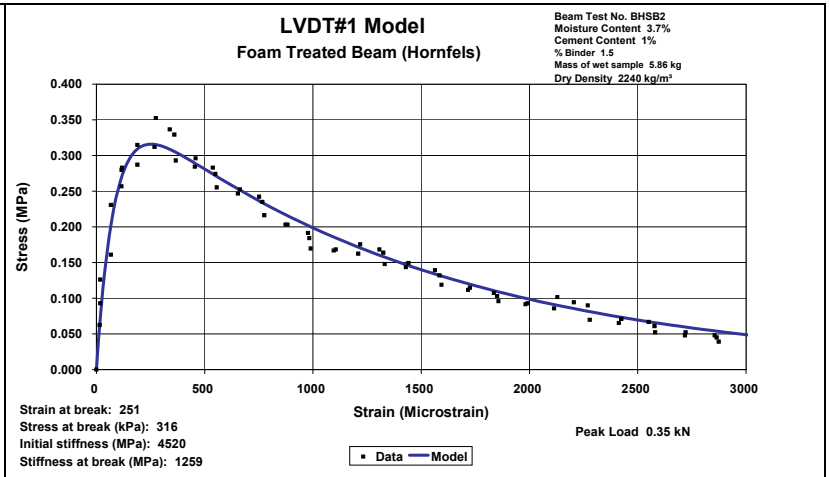


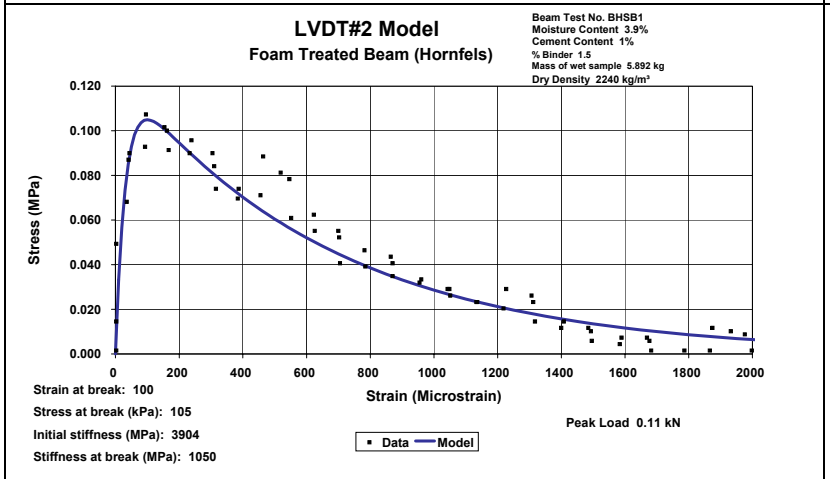


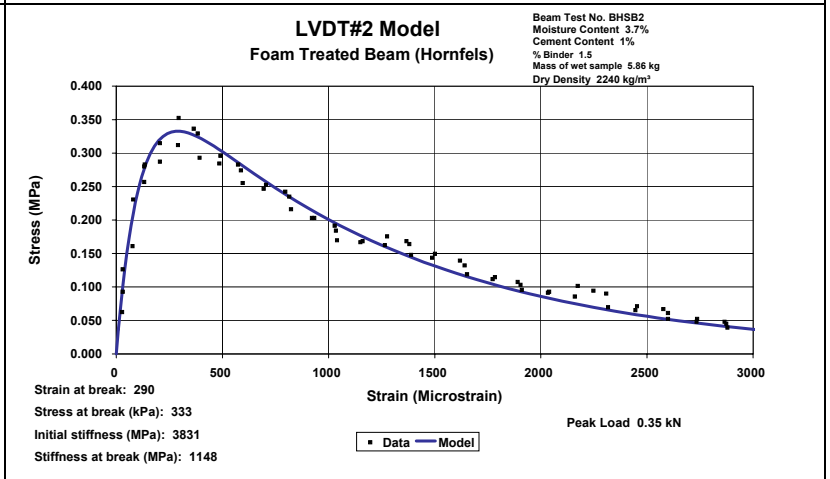
BHSN5	BHSN6

HSB: Treated with 1% Cement and 1.50% Foamed Bitumen



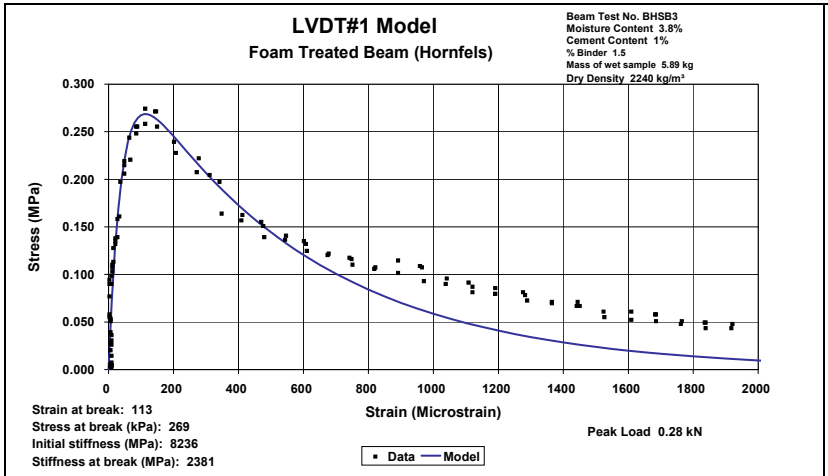


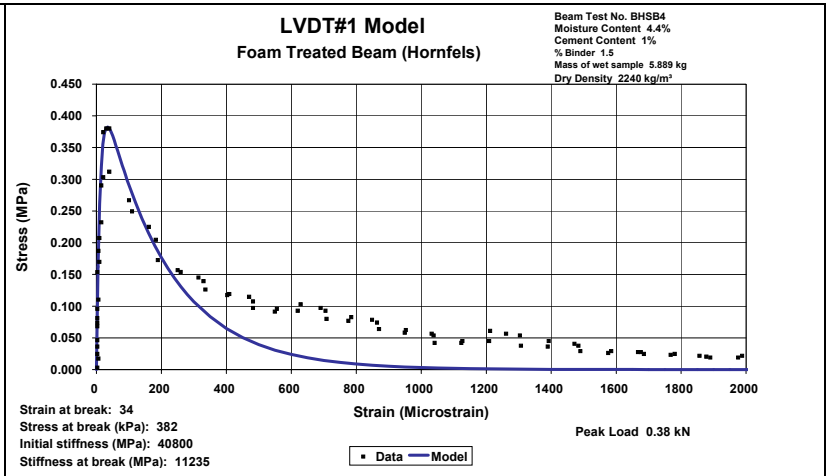


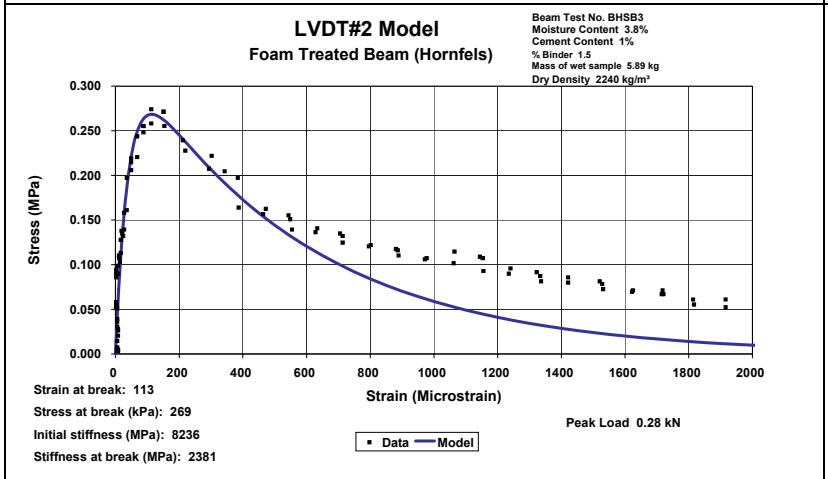


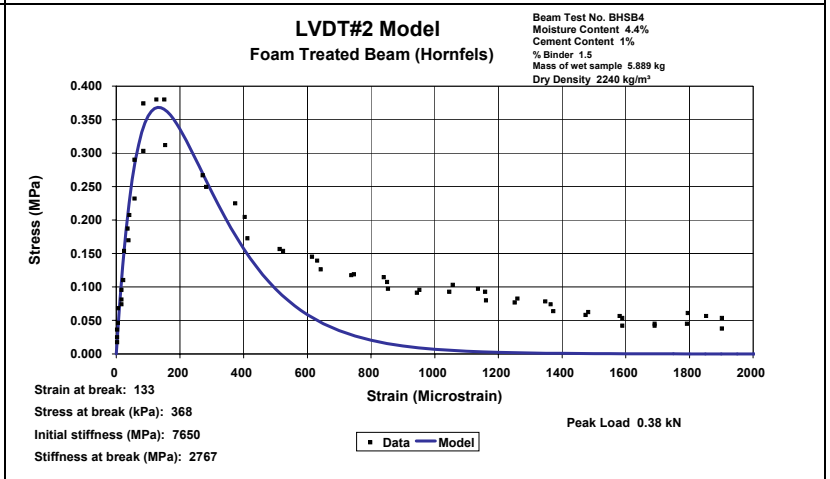
BHSB1	BHSB2

HSB: Treated with 1% Cement and 1.50% Foamed Bitumen (continued)



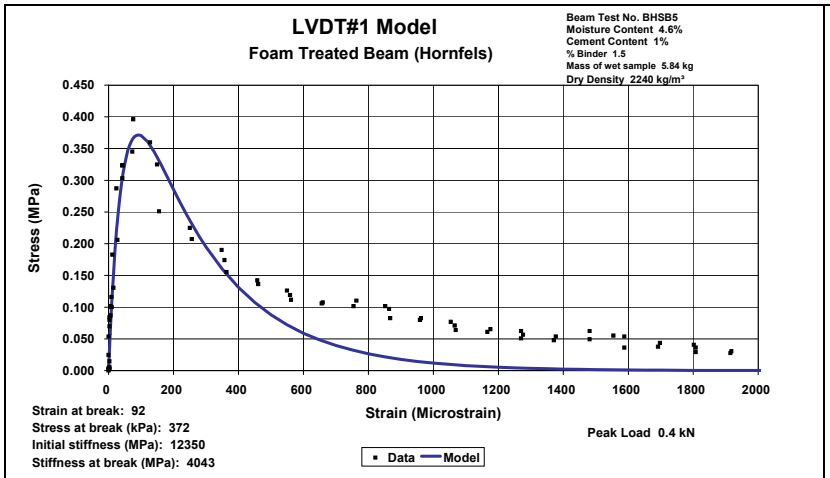


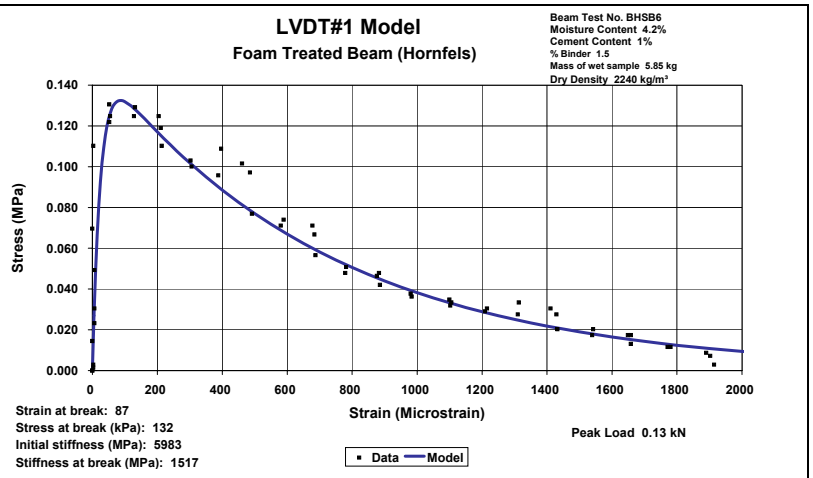


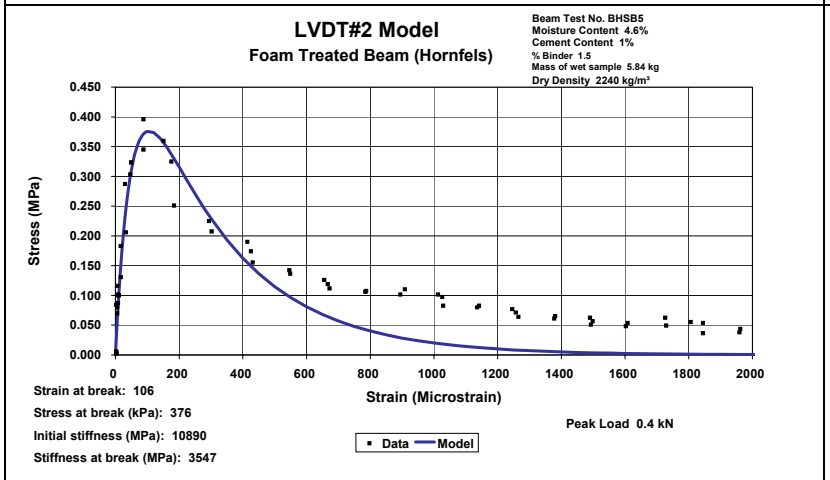


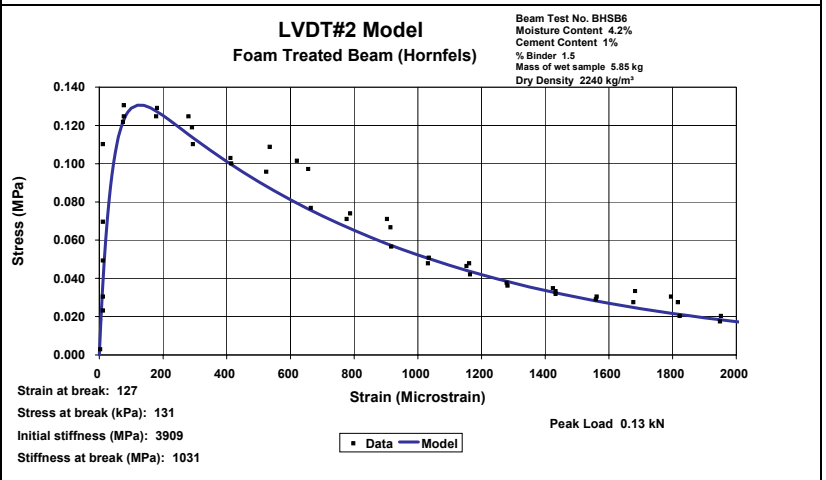
BHSB3	BHSB4

HSB: Treated with 1% Cement and 1.50% Foamed Bitumen (continued)



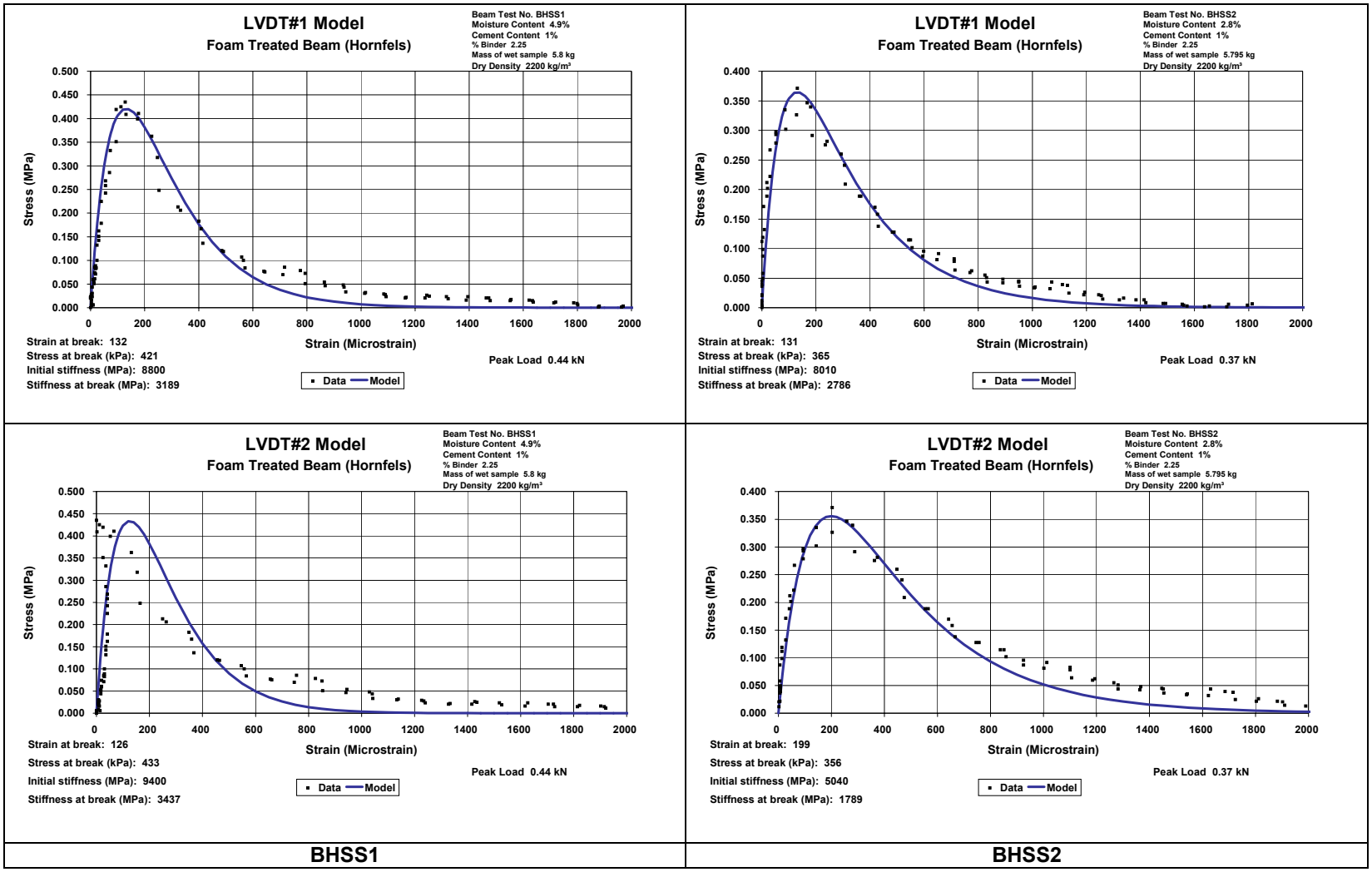






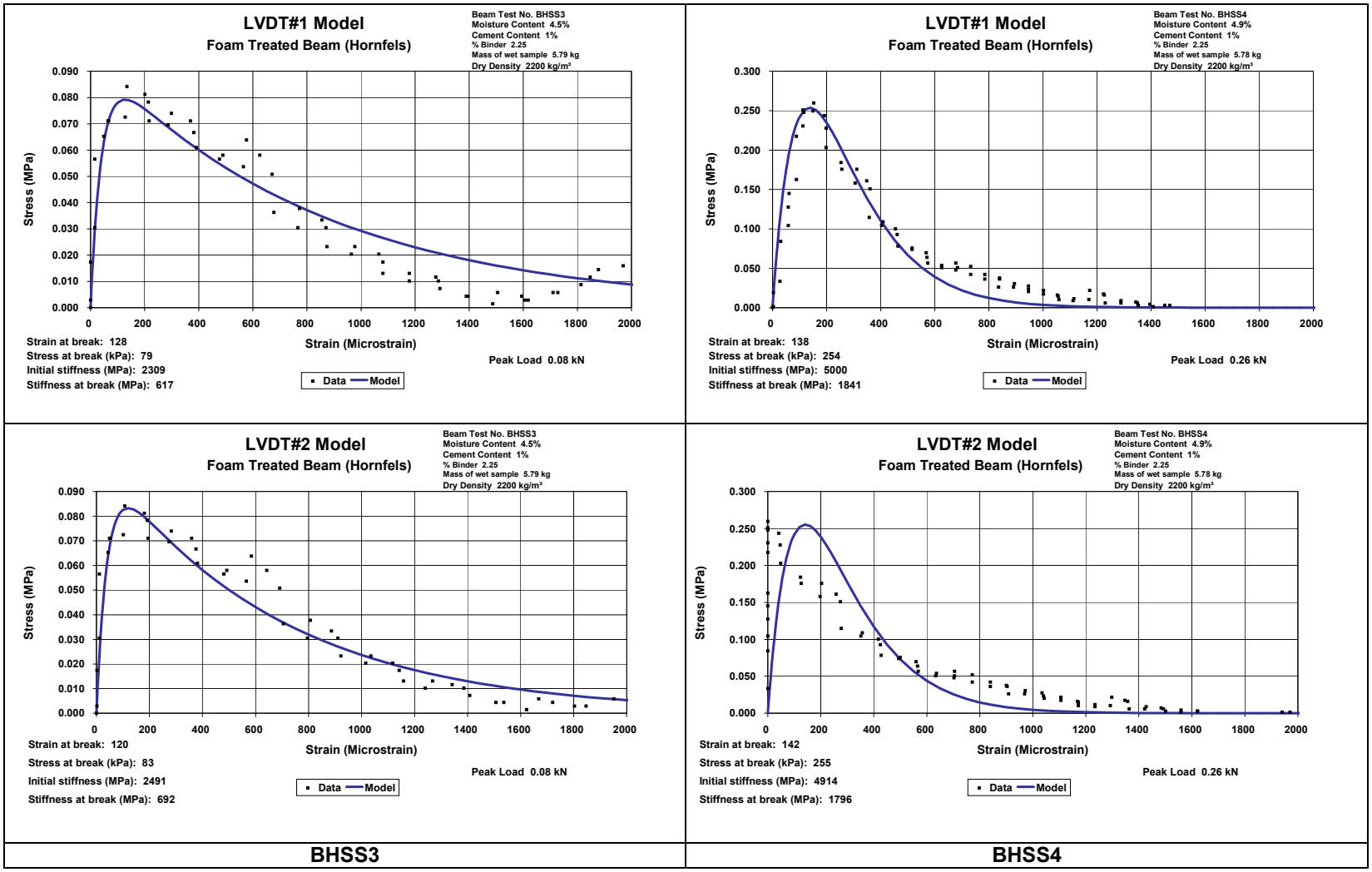
BHSB5	BHSB6

HSS: Treated with 1% Cement and 2.25% Foamed Bitumen

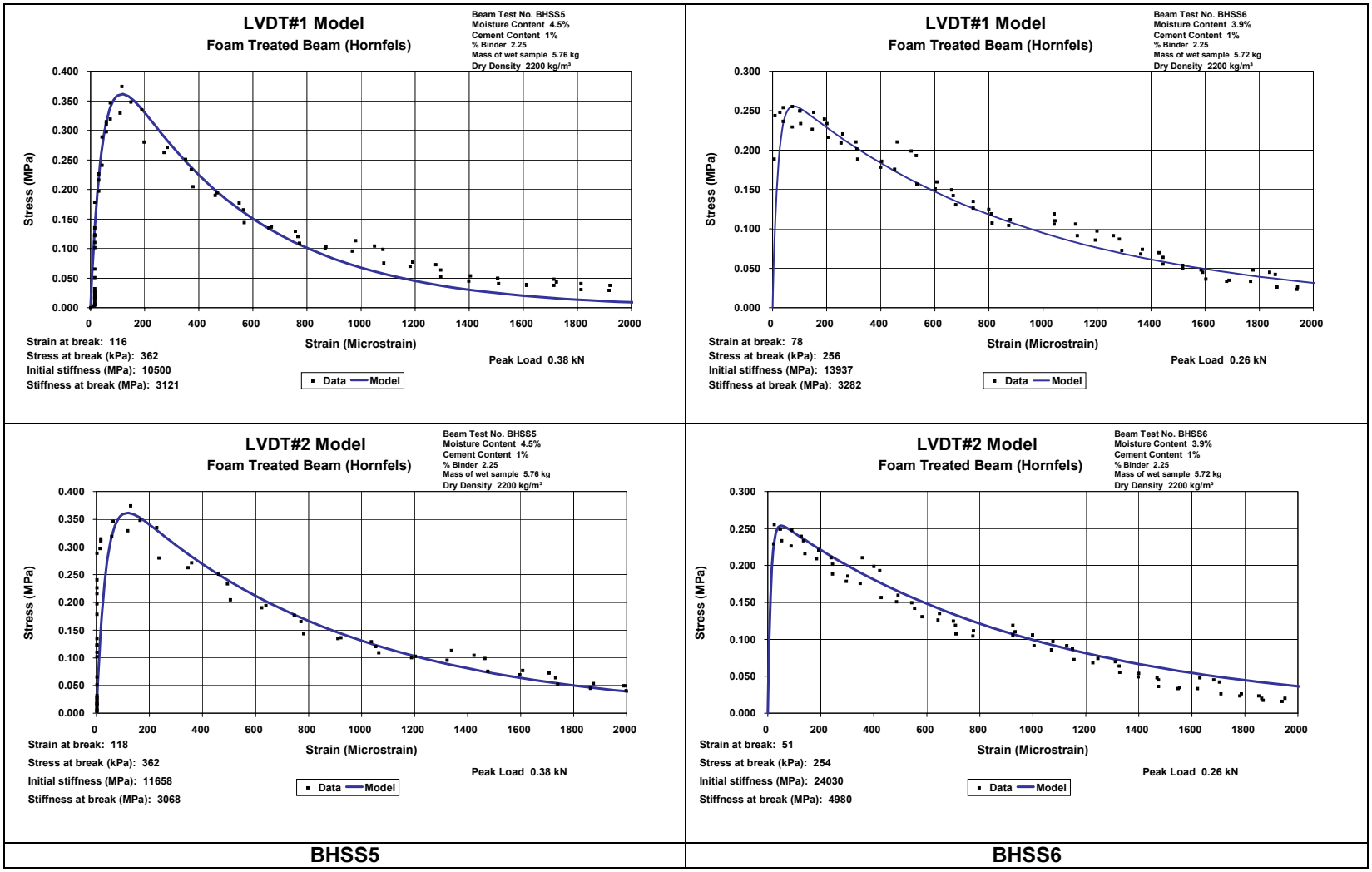


BHSS1	BHSS2

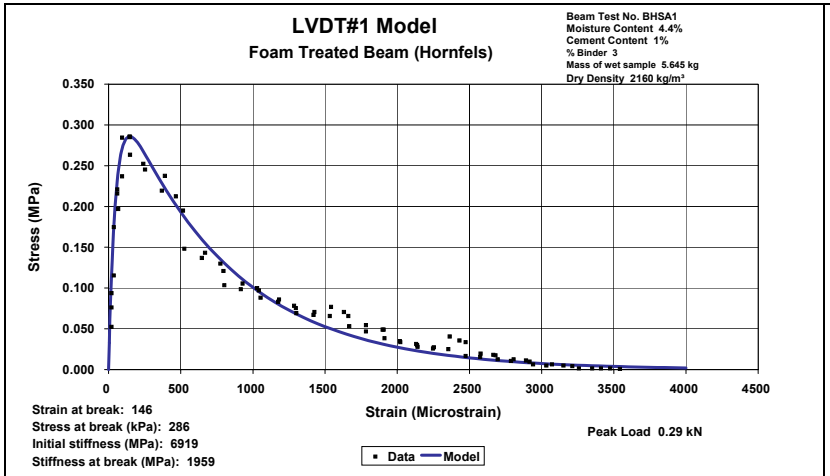
HSS: Treated with 1% Cement and 2.25% Foamed Bitumen (continued)

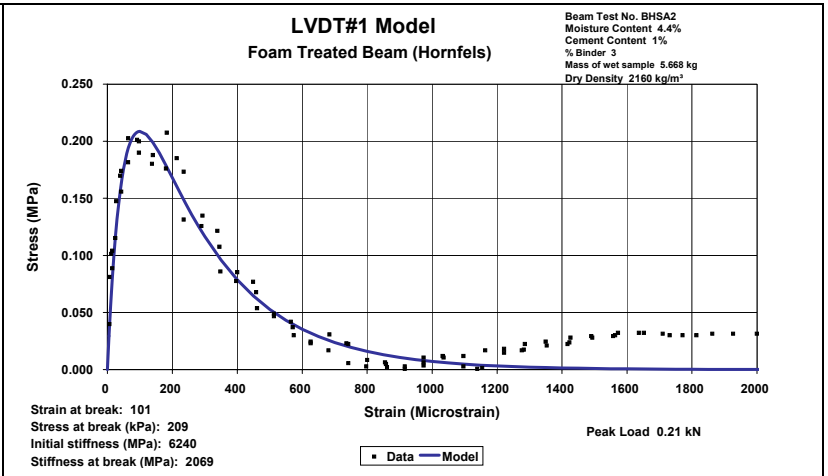


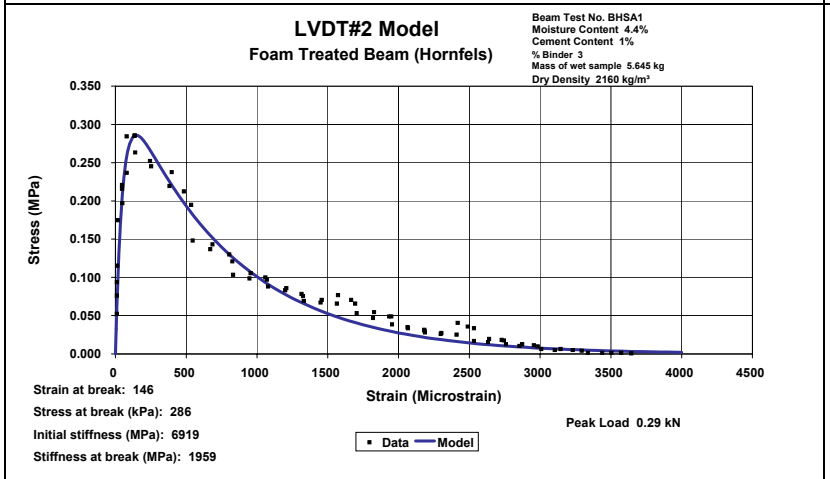
HSS: Treated with 1% Cement and 2.25% Foamed Bitumen (continued)

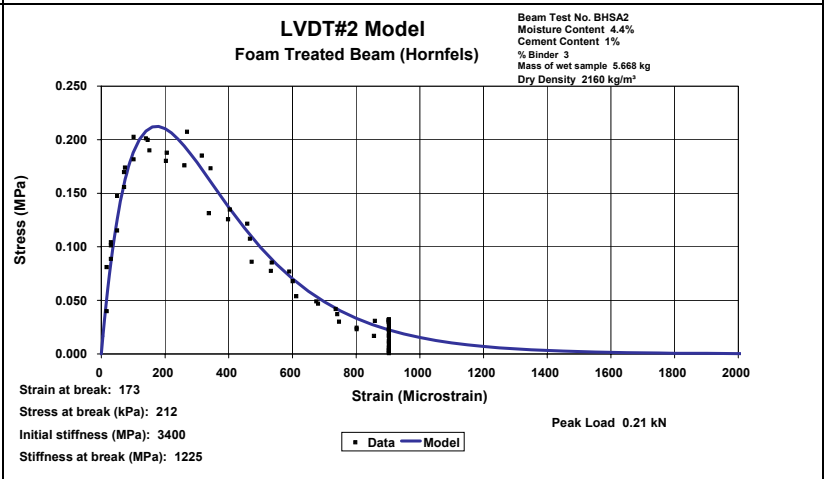


HSA: Treated with 1% Cement and 3.0% Foamed Bitumen



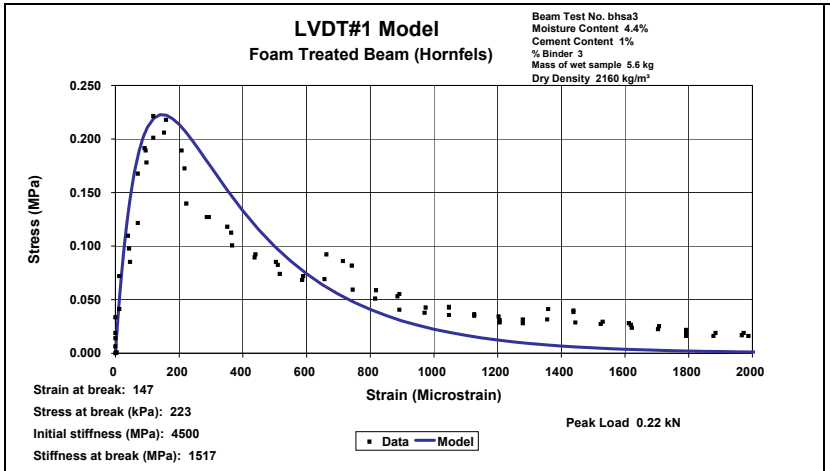


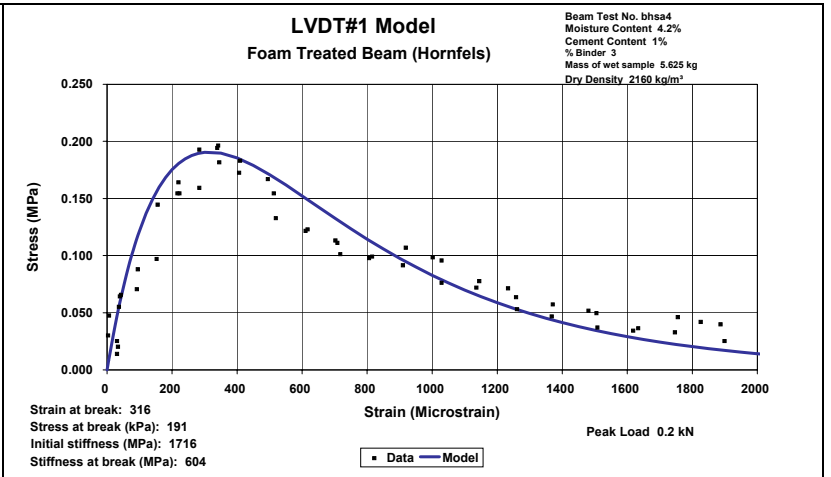


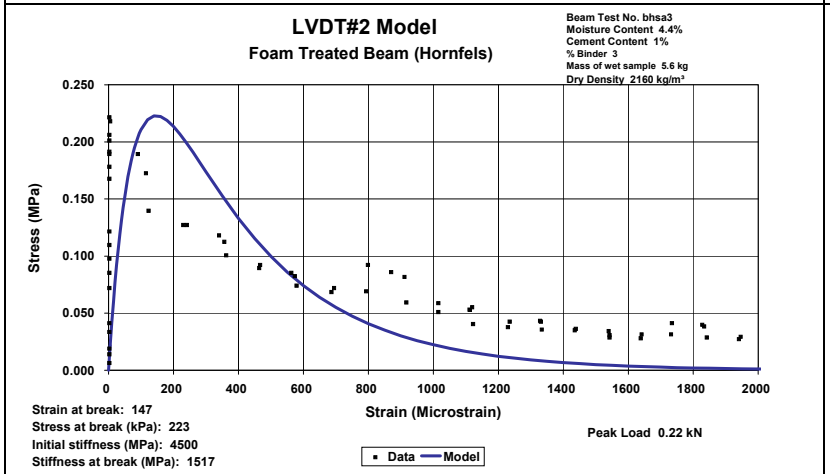


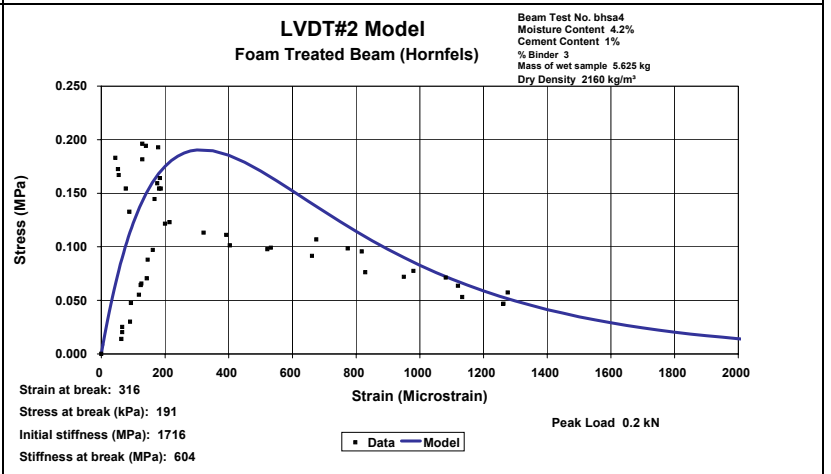
BHSA1	BHSA2

HSA: Treated with 1% Cement and 3.0% Foamed Bitumen (continued)



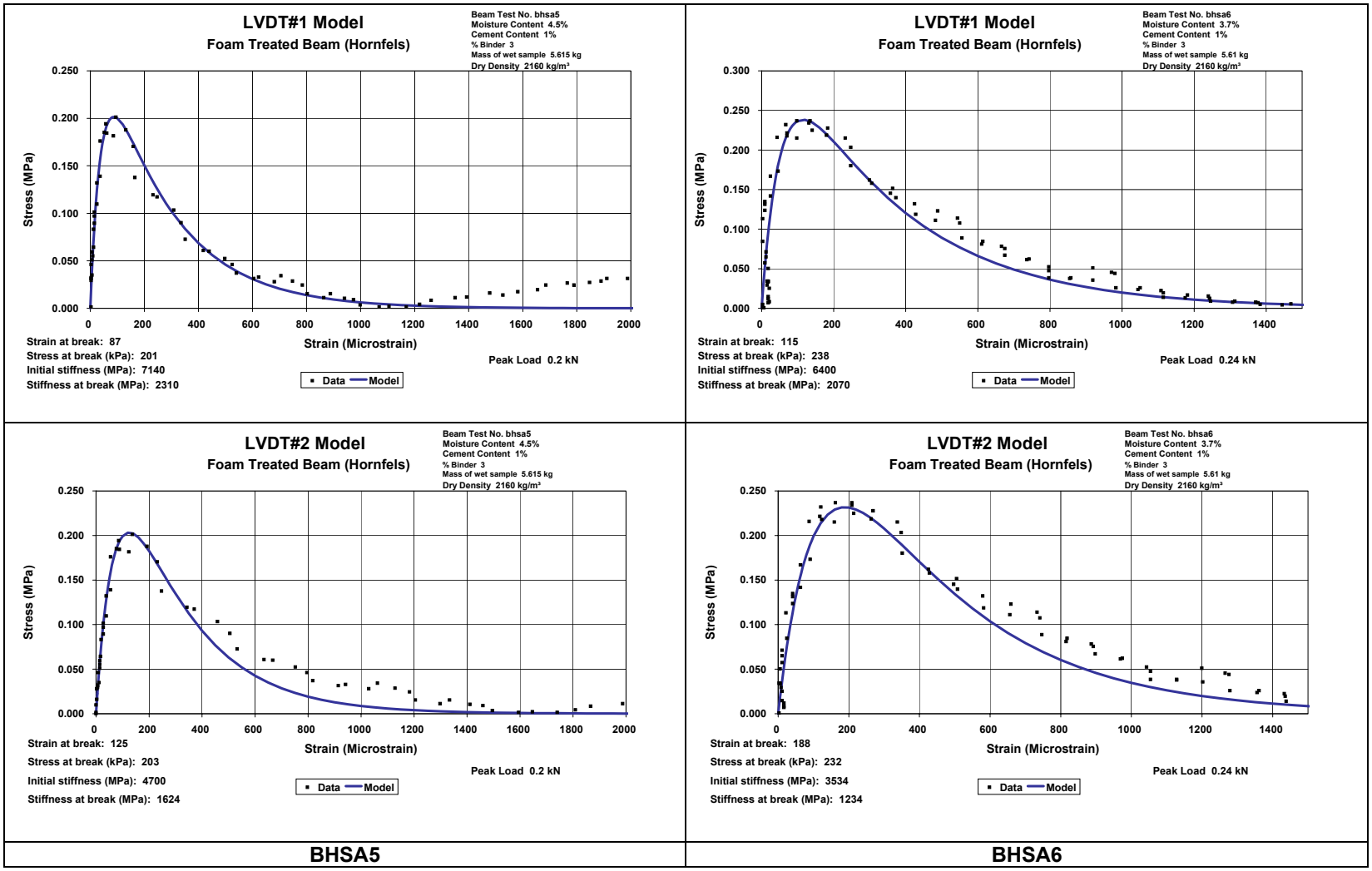




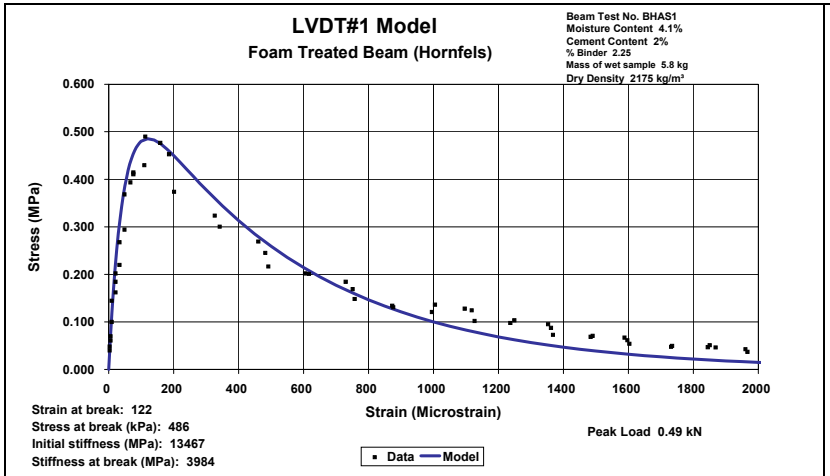


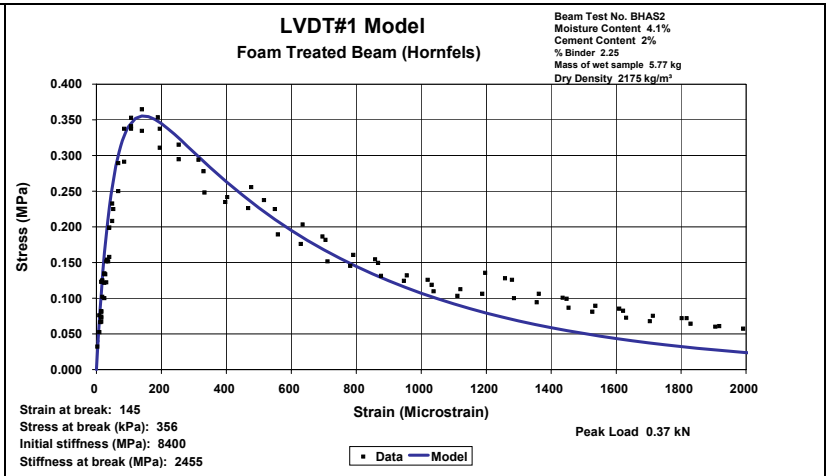
BHSA3	BHSA4

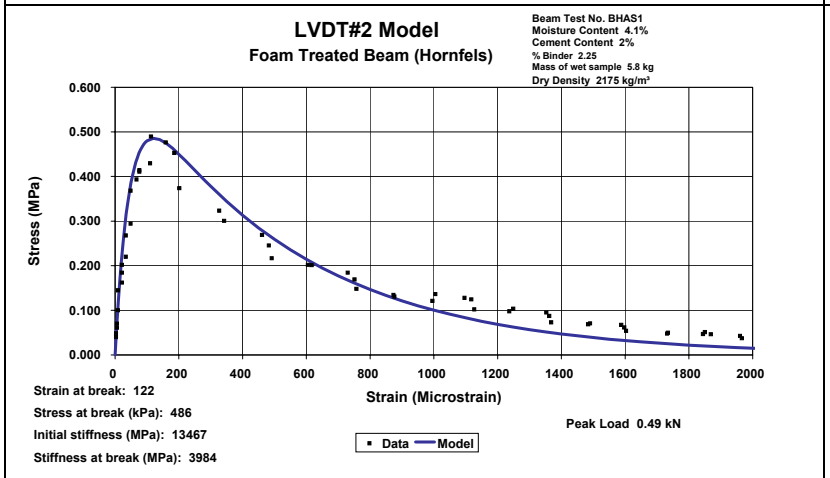
HSA: Treated with 1% Cement and 3.0% Foamed Bitumen (continued)

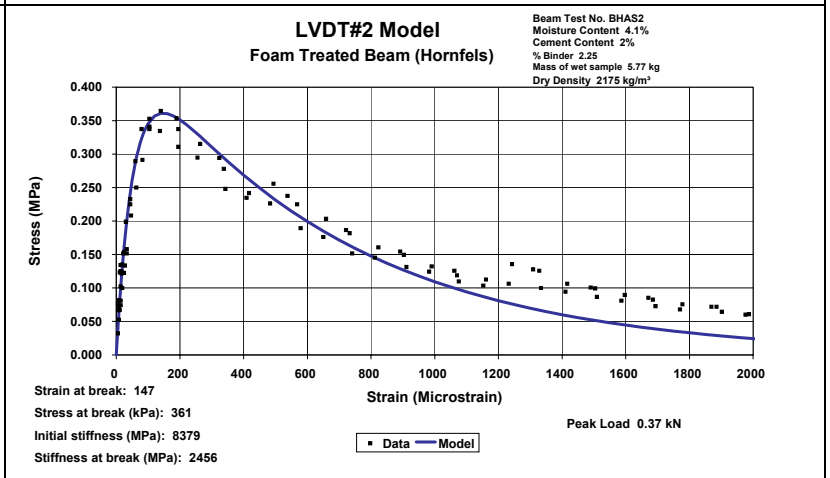


HAS: Treated with 2% Cement and 2.25% Foamed Bitumen



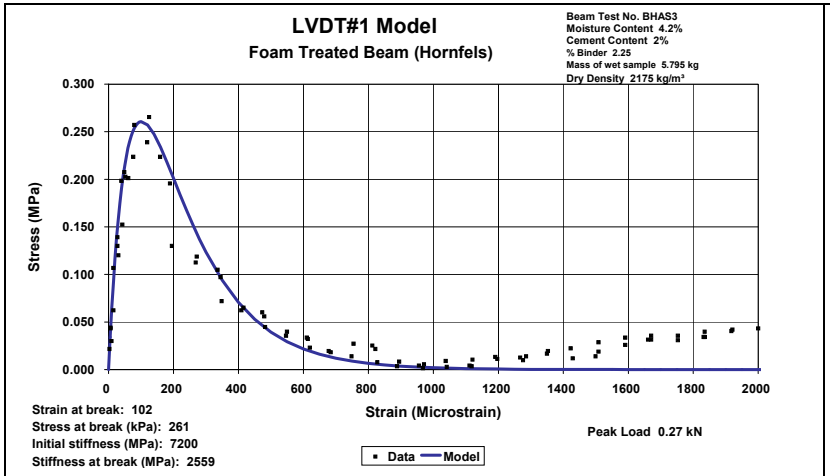


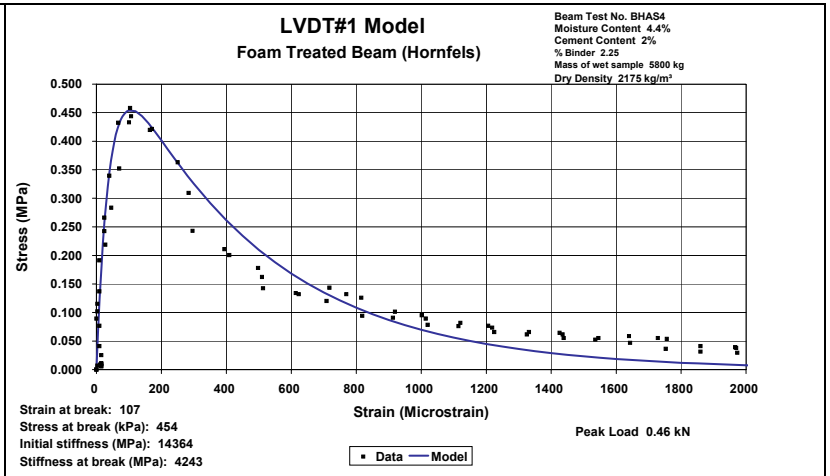


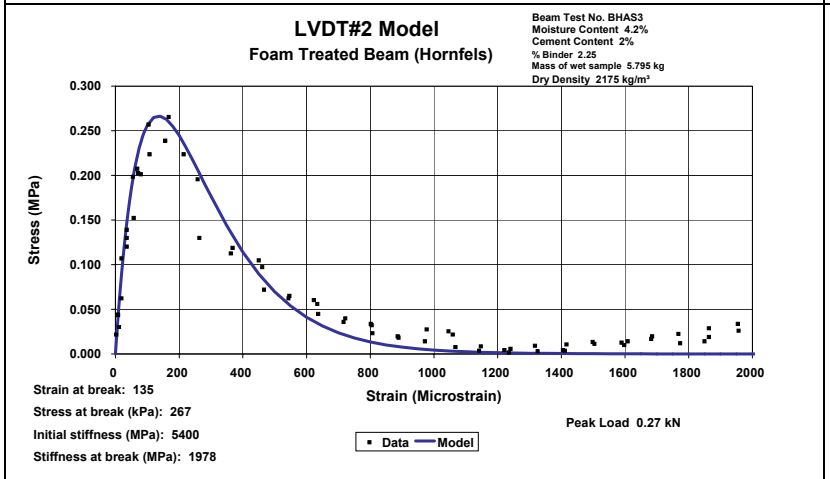


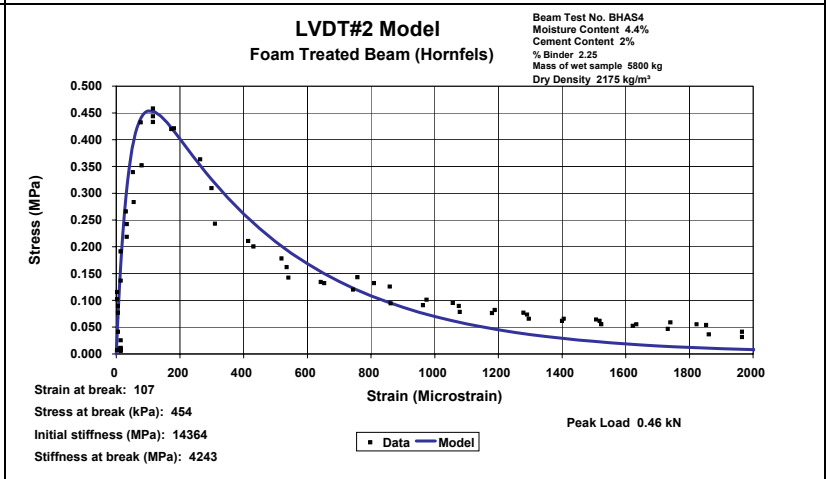
BHAS1	BHAS2

HAS: Treated with 2% Cement and 2.25% Foamed Bitumen (continued)



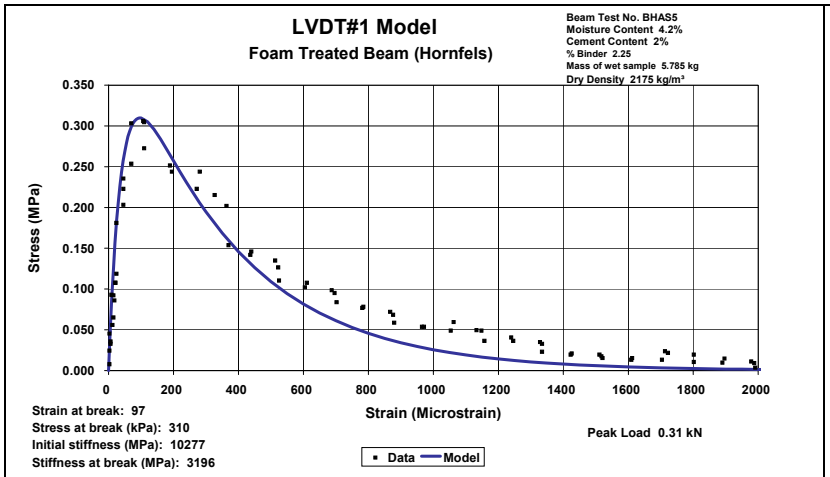


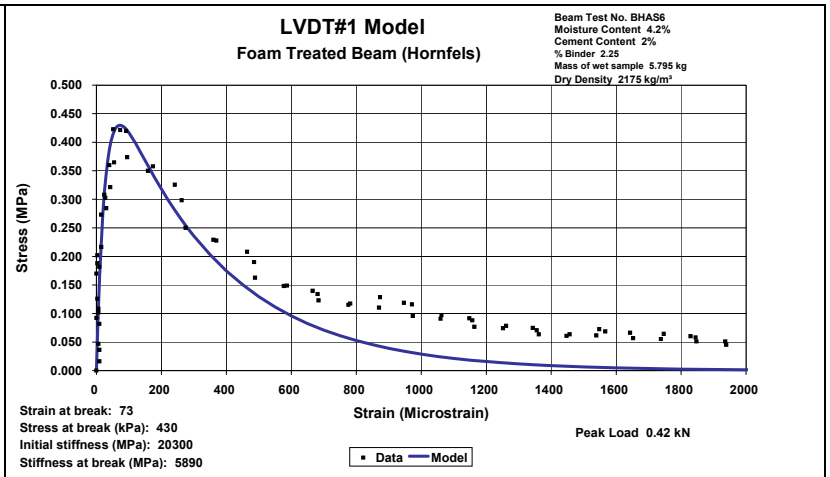


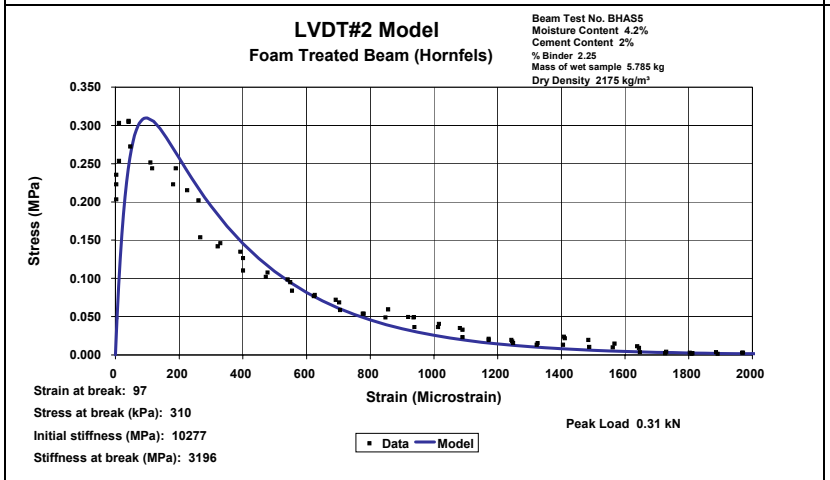


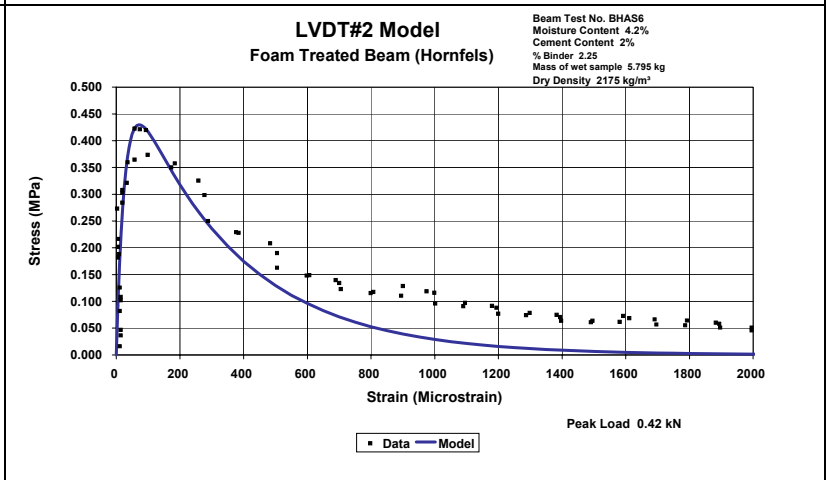
BHAS3	BHAS4

HAS: Treated with 2% Cement and 2.25% Foamed Bitumen (continued)









BHAS5	BHAS6

Appendix C Summary of triaxial tests and specimen preparation data sheets

Summary Triaxial test data for the Hornfels (untreated)

MDD:	2318	0.855035042	0.8721357
OMC:	5.8		
ARD:	2.7110		

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Target confining stress (kPa)	Actual confining stress (kPa)	Static test results							Actual MC (%)	Actual Dry density (kg/cub m)	Compaction		Saturation	
							Failure load kN	Failure stress (kPa)	Stiffness (MPa)	Sigma 1 (kPa)	p (kPa)	q (kPa)	Cohesion, friction angle & R^2			(%)	Average	(%)	Average
	(kg/cub m)	(%)	(%)	(%)															
HNN01	2360	87.1%	4.1	75.0%	20	20	14.4	791	55	811	415.5	395.5		3.6	2362	87.1%		65.9%	
HNN02	101.8				80	80	21.8	1203	77	1283	681.5	601.5	112.5	3.5	2370	87.4%	87.2%	65.8%	65.6%
HNN03					140	141	29.2	1611	114	1752	946.5	805.5	51.2	3.6	2359	87.0%	0.2%	65.3%	0.5%
HNN04					200	200	37.6	2071	154	2271	1235.5	1035.5	1.000	3.5	2366	87.3%		65.2%	
HNN05	2360	87.1%	2.2	40.2%	20	22	21.6	1192	273	1214	618	596		1.4	2371	87.4%		26.1%	
HNN06	101.8				80	80	29.4	1619	130	1699	889.5	809.5	172.5	1.6	2358	87.0%	87.1%	29.3%	28.4%
HNN07					140	141	39.7	2187	187	2328	1234.5	1093.5	52.7	1.6	2361	87.1%	0.2%	28.8%	5.3%
HNN08					200	202	46.3	2554	187	2756	1479	1277	1.000	1.6	2357	86.9%		29.2%	
HNN09	2200	81.2%	6.4	74.9%	20	21	5.5	304	35	325	173	152		5.6	2209	81.5%		66.7%	
HNN10	94.9				80	82	12.9	710	67	792	437	355	37.5	5.8	2206	81.4%	81.4%	69.1%	67.9%
HNN11					140	142	18.0	994	67	1136	639	497	48.1	5.8	2206	81.4%	0.1%	69.2%	2.1%
HNN12					200	201	24.8	1369	90	1570	885	684	1.000	5.7	2203	81.3%		66.7%	
HNN13	2200	81.2%	3.4	39.8%	20	21	10.1	557	67	578	299.5	278.5		3.2	2206	81.4%		37.9%	
HNN14	94.9				80	81	16.2	891	89	972	526.5	445.5	83.6	3.3	2206	81.4%	81.7%	38.8%	37.3%
HNN15					140	141	24.6	1354	105	1495	818	677	48.3	2.9	2218	81.8%	0.4%	35.5%	3.8%
HNN16					200	201	28.4	1563	151	1764	982.5	781.5	0.999	3.0	2227	82.1%		36.8%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Target dynamic test conditions					Actual dynamic test conditions					Actual MC (%)	Actual Dry density (kg/cub m)	Compaction		Saturation	
					Confining stress (kPa)		Test load kN	Test stress (kPa)	Stress Ratio	Confining stress (kPa)	Test load kN	Test stress (kPa)	Stress ratio Coh, phi	Stress ratio Model			(%)	Average	(%)	Average
	(kg/cub m)	(%)	(%)	(%)																
HNN17	2360	87.1%	4.1	75.0%	80		4.4	241.0	0.20	79.43	4.4	239.98	0.20	0.19	3.6	2371.4	87.5%		68.1%	
HNN18					80		12.0	662.8	0.55	80.70	12.23	673.72	0.56	0.55	3.7	2367.7	87.3%		69.2%	
HNN19					80		19.7	1084.5	0.90	81.20	19.89	1095.93	0.90	0.90	3.7	2361.7	87.1%	87.3%	67.5%	67.6%
HNN20					140		5.9	325.9	0.20	139.52	5.98	329.59	0.20	0.20	3.6	2362.2	87.1%	0.2%	66.1%	1.6%
HNN21					140		16.3	896.2	0.55	143.55	16.41	904.57	0.55	0.54	3.6	2368.6	87.4%		66.8%	
HNN22					140		26.6	1466.5	0.90	139.04	26.18	1442.87	0.89	0.88	3.6	2370.9	87.5%		67.7%	
HNN23	2360	87.1%	2.2	40.2%	80		6.0	329.0	0.20	81.25	6.19	341.09	0.21	0.23	2.0	2335.6	86.2%		33.1%	
HNN24					80		16.4	904.7	0.55	82.56	17.06	940.23	0.56	0.61	1.8	2359.3	87.0%		33.0%	
HNN25					80		26.9	1480.3	0.90	82.00	27.87	1536.12	0.93	0.95	1.6	2358.3	87.0%	86.9%	29.8%	32.2%
HNN26					140		7.7	422.3	0.20	142.18	7.97	439.32	0.21	0.22	1.8	2366.8	87.3%	0.4%	32.9%	3.9%
HNN27					140		21.1	1161.4	0.55	146.96	21.76	1199.10	0.55	0.60	1.8	2357.0	86.9%		31.9%	
HNN28					140		34.5	1900.6	0.90	139.17	35.06	1932.04	0.92	0.99	1.8	2362.2	87.1%		32.4%	
HNN29	2200	81.2%	6.4	74.9%	80		2.4	132.2	0.20	82.83	2.35	129.73	0.19	0.18	5.1	2217.0	81.8%		61.6%	
HNN30					80		6.6	363.6	0.55	82.95	7.00	385.60	0.57	0.59	5.4	2205.7	81.4%		64.3%	
HNN31					80		10.8	594.9	0.90	81.20	11.26	620.64	0.93	0.95	5.4	2210.5	81.5%	81.6%	65.0%	62.1%
HNN32					140		3.7	202.0	0.20	141.10	3.75	206.66	0.20	0.19	5.0	2214.0	81.7%	0.2%	60.4%	4.1%
HNN33					140		10.1	555.5	0.55	142.11	10.68	588.38	0.58	0.53	4.8	2215.1	81.7%		58.3%	
HNN34					140		16.5	909.0	0.90	140.64	17.20	948.09	0.94	0.88	5.2	2215.2	81.7%		63.2%	
HNN35	2200	81.2%	3.4	39.8%	80		3.3	181.8	0.20	85.67	3.33	183.25	0.19	0.19	2.8	2208.4	81.5%		33.8%	
HNN36					80		9.1	499.9	0.55	79.55	9.49	522.84	0.58	0.60	3.1	2202.2	81.2%		36.1%	
HNN37					80		14.8	818.0	0.90	81.94	15.35	845.91	0.92	0.86	2.7	2207.9	81.4%	81.6%	32.1%	32.1%
HNN38					140		4.6	252.4	0.20	148.56	4.72	260.22	0.20	0.18	2.8	2211.4	81.6%	0.3%	33.5%	8.2%
HNN39					140		12.6	694.0	0.55	147.15	13.17	725.90	0.56	0.47	2.4	2217.6	81.8%		28.9%	
HNN40					140		20.6	1135.6	0.90	144.01	20.79	1145.69	0.89	0.74	2.3	2219.5	81.9%		27.9%	

Sheet 1 **Sample preparation data for the** **Hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC:
5.8 %

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Dry mass (kg)	Volume of compaction water (ml)	Wet sample mass (kg)	Target mass before test (kg)	Sample dimensions					Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
							Height measurement			Avg height	Avg diameter										
							1	2	3												
HNN01	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.545	13.074	12.800	0.730	12.380	3.6	2362	29/10/2002	31/10/2002	2
HNN02	2360	4.1	13.061	758	13.819	13.597	305	305	304	0.305	0.152	13.560	13.103	14.390	0.880	13.935	3.5	2370	29/10/2002	31/10/2002	2
HNN03	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.525	13.054	14.390	0.903	13.920	3.6	2359	29/10/2002	31/10/2002	2
HNN04	2360	4.1	13.061	758	13.819	13.597	305	305	306	0.305	0.152	13.565	13.109	14.435	0.895	13.980	3.5	2366	29/10/2002	31/10/2002	2
HNN05	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.302	13.120	14.162	0.880	13.980	1.4	2371	29/10/2002	04/11/2002	6
HNN06	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.262	13.051	14.107	0.900	13.897	1.6	2358	29/10/2002	04/11/2002	6
HNN07	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.270	13.065	14.135	0.893	13.930	1.6	2361	29/10/2002	04/11/2002	6
HNN08	2360	2.2	13.061	758	13.819	13.348	305	306	305	0.305	0.152	13.271	13.059	13.992	0.730	13.780	1.6	2357	29/10/2002	04/11/2002	6
HNN09	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.910	12.227	13.778	0.900	13.097	5.6	2209	30/10/2002	05/11/2002	6
HNN10	2200	6.4	12.176	706	12.882	12.955	305	305	304	0.305	0.152	12.905	12.195	13.759	0.880	13.050	5.8	2206	30/10/2002	05/11/2002	6
HNN11	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.920	12.208	13.785	0.900	13.075	5.8	2206	30/10/2002	05/11/2002	6
HNN12	2200	6.4	12.176	706	12.882	12.955	305	306	306	0.306	0.152	12.910	12.219	13.615	0.730	12.925	5.7	2203	30/10/2002	05/11/2002	6
HNN13	2200	3.4	12.176	706	12.882	12.59	305	305	305	0.305	0.152	12.600	12.210	13.490	0.894	13.100	3.2	2206	30/10/2002	05/11/2002	6
HNN14	2200	3.4	12.176	706	12.882	12.59	305	305	305	0.305	0.152	12.611	12.212	13.509	0.910	13.110	3.3	2206	30/10/2002	05/11/2002	6
HNN15	2200	3.4	12.176	706	12.882	12.59	303	303	303	0.303	0.152	12.551	12.196	13.455	0.910	13.100	2.9	2218	30/10/2002	05/11/2002	6
HNN16	2200	3.4	12.176	706	12.882	12.59	303	303	303	0.303	0.152	12.605	12.243	13.487	0.890	13.125	3.0	2227	30/10/2002	05/11/2002	6
HNN17	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.595	13.124	14.420	0.848	13.950	3.6	2371	05/11/2002	11/11/2002	6
HNN18	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.590	13.104	14.390	0.830	13.905	3.7	2368	05/11/2002	11/11/2002	6
HNN19	2360	4.1	13.061	758	13.819	13.597	306	306	306	0.306	0.152	13.597	13.114	14.347	0.788	13.865	3.7	2362	05/11/2002	12/11/2002	7
HNN20	2360	4.1	13.061	758	13.819	13.597	306	306	306	0.306	0.152	13.590	13.117	14.421	0.845	13.948	3.6	2362	05/11/2002	12/11/2002	7
HNN21	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.575	13.109	14.340	0.790	13.875	3.6	2369	05/11/2002	13-Nov-02	8
HNN22	2360	4.1	13.061	758	13.819	13.597	305	305	305	0.305	0.152	13.590	13.122	14.410	0.830	13.942	3.6	2371	05/11/2002	13-Nov-02	8
HNN23	2360	2.2	13.061	758	13.819	13.348	306	306	306	0.306	0.152	13.222	12.969	14.160	0.848	13.905	2.0	2336	06/11/2002	14-Nov-02	8
HNN24	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.295	13.058	14.109	0.832	13.872	1.8	2359	06/11/2002	14-Nov-02	8
HNN25	2360	2.2	13.061	758	13.819	13.348	306	306	306	0.306	0.152	13.310	13.095	14.090	0.788	13.875	1.6	2358	06/11/2002	15-Nov-02	9
HNN26	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.330	13.099	14.150	0.830	13.919	1.8	2367	06/11/2002	15-Nov-02	9
HNN27	2360	2.2	13.061	758	13.819	13.348	306	306	306	0.306	0.152	13.320	13.088	14.092	0.788	13.860	1.8	2357	06/11/2002	18-Nov-02	12
HNN28	2360	2.2	13.061	758	13.819	13.348	305	305	305	0.305	0.152	13.305	13.074	14.140	0.848	13.909	1.8	2362	06/11/2002	18-Nov-02	12
HNN29	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.890	12.270	13.709	0.845	13.090	5.1	2217	14/11/2002	19-Nov-02	5
HNN30	2200	6.4	12.176	706	12.882	12.955	304	305	305	0.305	0.152	12.855	12.194	13.670	0.830	13.010	5.4	2206	14/11/2002	19-Nov-02	5
HNN31	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.900	12.234	13.670	0.790	13.005	5.4	2210	14/11/2002	20-Nov-02	6
HNN32	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.865	12.253	13.660	0.830	13.050	5.0	2214	14/11/2002	20-Nov-02	6
HNN33	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.850	12.259	13.080	0.788	12.515	4.8	2215	14/11/2002	21-Nov-02	7
HNN34	2200	6.4	12.176	706	12.882	12.955	305	305	305	0.305	0.152	12.900	12.260	13.710	0.848	13.072	5.2	2215	14/11/2002	21-Nov-02	7
HNN35	2200	3.4	12.176	706	12.882	12.59	305	305	304	0.305	0.152	12.555	12.209	13.360	0.848	13.015	2.8	2208	15/11/2002	22-Nov-02	7
HNN36	2200	3.4	12.176	706	12.882	12.59	305	305	304	0.305	0.152	12.550	12.175	13.375	0.830	13.000	3.1	2202	15/11/2002	22-Nov-02	7
HNN37	2200	3.4	12.176	706	12.882	12.59	305	305	305	0.305	0.152	12.550	12.219	13.360	0.830	13.030	2.7	2208	15/11/2002	25-Nov-02	10
HNN38	2200	3.4	12.176	706	12.882	12.59	305	305	305	0.305	0.152	12.580	12.239	13.335	0.788	12.995	2.8	2211	15/11/2002	25-Nov-02	10
HNN39	2200	3.4	12.176	706	12.882	12.59	305	305	305	0.305	0.152	12.565	12.273	13.345	0.845	13.055	2.4	2218	15/11/2002	26-Nov-02	11
HNN40	2200	3.4	12.176	706	12.882	12.59	305	304	305	0.305	0.152	12.550	12.270	13.260	0.830	12.983	2.3	2219	15/11/2002	26-Nov-02	11

Summary Triaxial test data for the Foam treated hornfels No cement, 2.25% foamed bitumen

MDD:	2318	Cement %	0		
OMC:	5.8	Foamed bitumen %	2.25		
ARD:	2.711	ARD incl bit	2.614		

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target confining	Actual confining	Static test results							Actual MC	Actual Dry density	Compaction	Average	Saturation	Average
								Failure load	Failure stress	Stiffness	Sigma 1	p	q	Cohesion, friction						
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	stress (kPa)	kN	(kPa)	(MPa)	(kPa)	(kPa)	(kPa)	angle & R^2	(%)	(kg/cub m)	(%)		(%)	
HNS01	2200	81.2%	5.7	66.7%	2.25%	20	22	5.7	315	37	337	180	158		4.67	2209.5	84.5%		66.6%	
HNS02	94.9					80	82	13.6	752	97	834	458	376	43.6	4.41	2254.9	86.3%	85.7%	72.6%	68.4%
HNS03	2200	81.2%		66.5%		140	142	18.6	1027	167	1169	656	514	47.7	4.15	2239.4	85.7%	1.0%	64.9%	4.9%
HNS04	2250	86.1%		91.9%		200	199	24.2	1333	259	1532	866	667	0.999	4.22	2254.7	86.3%		69.4%	
HNS05	2200	81.2%	3.4	39.8%	2.25%	20	22	11.5	631	52	653	338	316		2.85	2252.7	86.2%		46.5%	
HNS06	94.9					80	81	17.7	975	145	1056	569	488	118.2	2.65	2244.3	85.9%	86.1%	42.2%	45.9%
HNS07	2200	81.2%		39.7%		140	144	21.9	1206	138	1350	747	603	44.1	2.93	2250.9	86.1%	0.2%	47.4%	5.5%
HNS08	2250	86.1%		54.8%		200	212	27.5	1514	135	1726	969	757	0.999	2.97	2247.9	86.0%		47.6%	
HNS09	2050	75.6%	8.1	68.1%	2.25%	20	23	4.4	241	16	264	144	121		4.81	2112.7	80.8%		52.9%	
HNS10	88.4					80	84	9.3	513	48	597	341	257	20.7	4.90	2113.6	80.9%	81.1%	54.2%	54.9%
HNS11	2050	75.6%		68.1%		140	141	14.7	812	92	953	547	406	46.0	5.08	2136.3	81.7%	0.5%	59.3%	5.5%
HNS12	2096	80.2%		85.7%		200	203	21.1	1162	94	1365	784	581	1.000	4.79	2114.8	80.9%		53.0%	
HNS13	2050	75.6%	4.9	41.2%	2.25%	20	22	5.2	285	45	307	165	143		3.54	2099.4	80.3%		37.7%	
HNS14	88.4					80	83	10.8	595	123	678	381	298	40.0	3.27	2119.6	81.1%	80.4%	36.7%	39.5%
HNS15	2050	75.6%		41.2%		140	142	15.8	872	105	1014	578	436	44.6	3.64	2092.2	80.0%	0.6%	38.1%	10.0%
HNS16	2096	80.2%		51.8%		200	204	20.8	1145	56	1349	777	573	1.000	4.26	2098.7	80.3%		45.3%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target dynamic test conditions				Actual dynamic test conditions				Stress ratio model	Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation	Saturation Average
						Confining	Test load	Test stress	Stress	Confining	Test load	Test stress	Stress							
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	kN	(kPa)	Ratio	stress (kPa)	kN	(kPa)	Ratio		(%)	(kg/cub m)	(%)		(%)	
HNS17	2200	81.2%	4.3	50.3%	2.25%	80	2.5	135.9	0.20	79.00	2.5	136.97	0.24	0.28	4.5	2096.9	80.2%		47.2%	
HNS18						80	6.8	373.6	0.55	83.06	7.05	388.53	0.67	0.69	4.1	2109.6	80.7%	80.6%	44.4%	42.0%
HNS19	2200	81.2%		50.2%		80	11.1	611.4	0.90	80.54	11.11	612.18	1.07	0.95	3.2	2098.4	80.3%	0.6%	34.4%	13.1%
HNS20	2250	86.1%		69.4%		140	3.7	204.0	0.20	135.39	3.65	201.32	0.24	0.23	3.7	2124.4	81.3%		41.8%	
HNS17a						80	2.5	135.9	0.20	83.65	2.5	137.32	0.20	0.18	4.2	2255.6	86.3%		69.5%	
HNS18a						80	6.8	373.6	0.55	81.72	7.06	389.16	0.56	0.45	3.2	2268.4	86.8%		55.3%	
HNS19a						80	11.1	611.4	0.90	81.87	11.62	640.16	0.93	0.82	4.0	2254.1	86.2%	86.3%	64.5%	63.2%
HNS20a						140	3.7	204.0	0.20	140.66	3.75	206.81	0.20	0.18	3.2	2264.3	86.6%	0.4%	53.4%	12.5%
HNS21						140	10.2	561.0	0.55	137.30	10.66	587.28	0.58	0.55	3.9	2249.3	86.0%		62.5%	
HNS22						140	16.7	918.0	0.90	141.06	17.50	964.46	0.94	0.94	4.6	2244.9	85.9%		73.7%	
HNS23	2200	81.2%	2.9	33.9%	2.25%	80	3.3	184.6	0.20	80.70	3.31	182.19	0.20	0.20	2.6	2251.6	86.1%		42.0%	
HNS24						80	9.2	507.6	0.55	79.11	9.66	532.53	0.58	0.57	2.5	2251.1	86.1%		40.8%	
HSS25	2200	81.2%		33.8%		80	15.1	830.5	0.90	79.70	15.74	867.38	0.94	1.01	2.9	2242.3	85.8%	86.4%	46.2%	42.4%
HNS26	2250	86.1%		46.8%		140	4.3	239.4	0.20	138.00	4.42	243.46	0.20	0.20	2.5	2264.1	86.6%	0.6%	42.0%	5.2%
HNS27						140	11.9	658.2	0.55	140.54	12.43	685.19	0.57	0.54	2.5	2273.2	87.0%		43.3%	
HNS28						140	19.5	1077.1	0.90	140.41	20.09	1106.96	0.92	0.85	2.3	2273.4	87.0%		39.9%	
HNS29	2050	75.6%	5.2	43.7%	2.25%	80	1.9	102.7	0.20	80.16	1.9	104.9	0.20	0.17	3.6	2115.6	80.9%		39.8%	
HNS30						80	5.1	282.5	0.55	82.31	5.3	289.8	0.55	0.57	4.7	2114.1	80.9%		52.5%	
HNS31	2050	75.6%		43.7%		80	8.4	462.3	0.90	81.51	8.8	482.6	0.93	0.98	4.6	2101.7	80.4%	80.7%	49.1%	48.3%
HNS32	2096	80.2%		55.0%		140	3.0	164.4	0.20	142.07	3.0	166.4	0.20	0.21	4.6	2099.3	80.3%	0.3%	49.2%	11.1%
HNS33						140	8.2	452.1	0.55	147.59	8.5	468.1	0.54	0.53	4.0	2111.8	80.8%		44.5%	
HNS34						140	13.4	739.9	0.90	144.86	13.7	754.8	0.89	0.95	5.0	2110.0	80.7%		54.4%	
HNS35	2050	75.6%	3.8	31.9%	2.25%	80	2.1	113.9	0.20	82.02	2.09	115.34	0.20	0.17	3.3	2123.0	81.2%		36.9%	
HNS36						80	5.7	313.2	0.55	83.55	5.90	325.04	0.55	0.54	3.8	2119.1	81.1%		42.7%	
HNS37	2050	75.6%		32.0%		80	9.3	512.5	0.90	80.44	9.73	536.48	0.94	1.04	4.4	2109.7	80.7%	80.8%	48.1%	42.2%
HNS38	2096	80.2%		40.2%		140	3.1	170.6	0.20	140.76	3.10	170.61	0.20	0.20	4.0	2112.2	80.8%	0.4%	43.7%	9.4%
HNS39						140	8.5	469.2	0.55	138.50	8.82	485.81	0.57	0.54	3.6	2106.3	80.6%		38.6%	
HNS40						140	13.9	767.7	0.90	140.91	14.36	791.10	0.92	0.94	4.0	2099.1	80.3%		42.9%	

Sheet 1 **Sample preparation data for the** **Foam treated hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC: 5.8 %
OMMC: 4 %
OFC (excl BC): 5.8 % for low density

Cement Content: 0.00 %
Foam bitumen content 2.25 %
RD of bitumen 1.01

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Residual Binder Content (%)	Dry mass (kg)	Cement (g)	Mass of bitumen to foam (g)	Volume of mixing water (ml)	Mass of wet sample after mixing (kg)	Volume of compaction fluid (ml)	Volume of compaction water (ml)	Volume of additional water (ml)	Volume of residual binder (ml)	Wet sample mass after compact (kg)	Measured wet sample mass after compact	Target mass before test (kg)	Avg height	Avg diameter	Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
HNS01	2200	5.7	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	12.918	13.144	0.305	0.152	12.800	12.229	13.675	0.905	13.105	4.7	2210	11/12/2002	15/01/2003	35
HNS02	2200	5.7	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.136	13.144	0.305	0.152	13.030	12.480	13.955	0.935	13.405	4.4	2255	11/12/2002	15/01/2003	35
HNS03	2200	5.7	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.112	13.144	0.306	0.152	12.950	12.434	13.750	0.818	13.235	4.1	2239	11/12/2002	15/01/2003	35
HNS04	2200	5.7	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.117	13.144	0.305	0.152	13.005	12.479	13.810	0.833	13.285	4.2	2255	11/12/2002	15/01/2003	35
HNS05	2200	3.4	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.125	12.864	0.304	0.152	12.780	12.426	13.585	0.755	13.230	2.8	2253	11/12/2002	15/01/2003	35
HNS06	2200	3.4	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.864	0.305	0.152	12.750	12.421	13.555	0.770	13.225	2.6	2244	11/12/2002	15/01/2003	35
HNS07	2200	3.4	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.127	12.864	0.304	0.152	12.780	12.417	13.610	0.770	13.245	2.9	2251	11/12/2002	15/01/2003	35
HNS08	2200	3.4	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.135	12.864	0.305	0.152	12.810	12.441	13.670	0.822	13.300	3.0	2248	11/12/2002	15/01/2003	35
HNS09	2050	8.1	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.258	12.520	0.304	0.152	12.215	11.654	13.105	0.905	12.545	4.8	2113	12/12/2002	15/01/2003	34
HNS10	2050	8.1	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.262	12.520	0.304	0.152	12.230	11.659	13.025	0.815	12.455	4.9	2114	12/12/2002	15/01/2003	34
HNS11	2050	8.1	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.251	12.520	0.300	0.152	12.220	11.630	13.140	0.930	12.550	5.1	2136	12/12/2002	15/01/2003	34
HNS12	2050	8.1	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.250	12.520	0.304	0.152	12.225	11.666	13.020	0.815	12.462	4.8	2115	12/12/2002	15/01/2003	34
HNS13	2050	4.9	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.236	12.157	0.305	0.152	12.030	11.619	12.845	0.845	12.435	3.5	2099	12/12/2002	15/01/2003	34
HNS14	2050	4.9	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.224	12.157	0.303	0.152	12.035	11.654	12.780	0.775	12.400	3.3	2120	12/12/2002	15/01/2003	34
HNS15	2050	4.9	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.233	12.157	0.306	0.152	12.040	11.617	12.852	0.830	12.430	3.6	2092	12/12/2002	15/01/2003	34
HNS16	2050	4.9	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.213	12.157	0.303	0.152	12.030	11.539	12.915	0.910	12.425	4.3	2099	12/12/2002	15/01/2003	34
HNS17a	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.304	0.152	12.968	12.4425	13.850	0.895	13.325	4.2	2256	30/01/2003	27/02/2003	28
HNS18a	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.305	0.152	12.958	12.5543	13.745	0.810	13.342	3.2	2268	30/01/2003	3-Mar-03	32
HNS19a	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.305	0.152	12.968	12.4752	13.842	0.895	13.350	4.0	2254	30/01/2003	04/03/2003	33
HNS20a	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.305	0.152	12.928	12.532	13.725	0.830	13.330	3.2	2264	30/01/2003	04/03/2003	33
HNS21	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.305	0.152	12.933	12.4488	13.735	0.808	13.251	3.9	2249	24/01/2003	2/23/2003	30
HNS22	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.146	12.974	0.305	0.152	13.000	12.4245	13.895	0.906	13.32	4.6	2245	24/01/2003	2/24/2003	31
HNS17	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.118	12.974	0.305	0.152	12.122	11.6053	12.822	0.81	12.31	4.5	2097	14/01/2003	2/13/2003	30
HNS18	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.114	12.974	0.304	0.152	12.110	11.6372	12.84	0.75	12.368	4.1	2110	14/01/2003	2/13/2003	30
HNS19	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	12.990	12.974	0.306	0.152	12.028	11.6514	12.784	0.775	12.408	3.2	2098	14/01/2003	2/14/2003	31
HNS20	2200	4.3	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.112	12.974	0.302	0.152	12.070	11.6416	12.834	0.774	12.406	3.7	2124	14/01/2003	2/15/2003	32
HNS23	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.120	12.803	0.305	0.152	12.785	12.4617	13.618	0.845	13.295	2.6	2252	08/01/2003	1/31/2003	23
HNS24	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.155	12.803	0.306	0.152	12.815	12.4998	13.65	0.845	13.335	2.5	2251	08/01/2003	1/30/2003	22
HSS25	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.122	12.803	0.306	0.152	12.815	12.4507	13.712	0.908	13.348	2.9	2242	08/01/2003	1/30/2003	22
HNS26	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.145	12.803	0.304	0.152	12.800	12.4894	13.552	0.775	13.242	2.5	2264	08/01/2003	1/31/2003	23
HNS27	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.148	12.803	0.303	0.152	12.808	12.4988	13.61	0.812	13.301	2.5	2273	08/01/2003	2/1/2003	24
HNS28	2200	2.9	2.25	12.176	0	273.96	487	12.937	980	709	222	271.2	13.159	13.142	12.803	0.303	0.152	12.785	12.4998	13.705	0.93	13.42	2.3	2273	08/01/2003	2/1/2003	24
HNS29	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.261	12.191	0.303	0.152	12.050	11.6322	12.842	0.815	12.425	3.6	2116	09/01/2003	2/6/2003	28
HNS30	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.254	12.191	0.303	0.152	12.175	11.6239	12.995	0.845	12.445	4.7	2114	09/01/2003	2/6/2003	28
HNS31	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.240	12.191	0.305	0.152	12.165	11.632	12.934	0.792	12.402	4.6	2102	09/01/2003	2/7/2003	29
HNS32	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.230	12.191	0.305	0.152	12.155	11.6188	12.975	0.848	12.44	4.6	2099	09/01/2003	2/7/2003	29
HNS33	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.229	12.191	0.305	0.152	12.160	11.6875	4.64	0.908	4.495	4.0	2112	09/01/2003	2/9/2003	31
HNS34	2050	5.2	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.241	12.191	0.303	0.152	12.178	11.6012	12.915	0.775	12.34	5.0	2110	09/01/2003	2/8/2003	30
HNS35	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.238	12.032	0.302	0.152	12.015	11.634	12.930	0.935	12.550	3.3	2123	14/01/2003	2/10/2003	27
HNS36	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.257	12.032	0.303	0.152	12.095	11.651	13.005	0.908	12.561	3.8	2119	14/01/2003	2/10/2003	27
HNS37	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.243	12.032	0.304	0.152	12.150	11.638	13.063	0.935	12.552	4.4	2110	14/01/2003	2/11/2003	28
HNS38	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.245	12.032	0.303	0.152	12.074	11.613	12.840	0.792	12.380	4.0	2112	14/01/2003	2/11/2003	28
HNS39	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.239	12.032	0.304	0.152	12.032	11.619	12.930	0.930	12.518	3.6	2106	14/01/2003	2/12/2003	29
HNS40	2050	3.8	2.25	11.346	0	255.29	454	12.055	913	661	207	252.8	12.262	12.204	12.032	0.305	0.152	12.085	11.617	12.815	0.748	12.348	4.0	2099	14/01/2003	2/12/2003	29

Summary Triaxial test data for the Foam treated hornfels 1% cement, 1.5% foamed bitumen

MDD:	2318	Cement %	1
OMC:	5.8	Foamed bitumen %	1.5
ARD:	2.711	ARD incl bit	2.649

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target confining	Actual confining	Static test results								Actual	Compaction	Compaction	Saturation	Saturation
								Failure load	Failure stress	Stiffness	Sigma 1	p	q	Cohesion, friction	MC	Dry density	Average	Average	Average	
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	stress (kPa)	kN	(kPa)	(MPa)	(kPa)	(kPa)	(kPa)	angle & R^2	(%)	(kg/cub m)		(%)		
HSB01	2090	77.1%	6.2	56.6%	1.50%	20	22.0	24.1	1327	296	1349	686	664		5.3	2151.7	79.4%		55.8%	
HSB02	90.2					80	76.0	26.9	1485	319	1561	819	743	227.5	5.2	2142.8	79.0%	79.1%	53.3%	54.6%
HSB03	2111	77.9%		59.1%		140	138.0	33.7	1856	232	1994	1066	928	46.7	5.3	2129.8	78.6%	0.5%	53.1%	2.9%
HSB04	2143	80.9%		69.5%		200	201.0	40.8	2249	302	2450	1326	1125	0.999	5.4	2148.5	79.3%		56.0%	
HSB05	2090	77.1%	2.7	24.6%	1.50%	20	24.0	24.0	1324	194	1348	686	662		2.4	2160.7	79.7%		25.1%	
HSB06	90.2					80	80.0	29.5	1623	276	1703	892	812	240.9	2.4	2149.4	79.3%	79.3%	24.6%	25.3%
HSB07	2111	77.9%		25.7%		140	140.0	35.5	1954	251	2094	1117	977	46.4	2.5	2147.5	79.2%	0.4%	25.4%	2.2%
HSB08	2143	80.9%		30.3%		200	202.0	40.8	2251	282	2453	1328	1126	1.000	2.5	2141.3	79.0%		25.9%	
HSB09	2260	83.4%	3.8	51.7%	1.50%	20	27.0	39.5	2178	325	2205	1116	1089		3.8	2319.3	85.6%		60.6%	
HSB10	97.5					80	78.0	46.4	2559	228	2637	1358	1280	410.7	3.9	2320.1	85.6%	84.8%	62.0%	54.2%
HSB11	2283	84.2%		54.9%		140		0.0						46.8	3.2	2281.6	84.2%	1.1%	46.7%	15.2%
HSB12	2317	87.5%		70.3%		200	202.0	56.9	3136	305	3338	1770	1568	0.999	3.4	2271.0	83.8%		47.5%	
HSB13	2260	83.4%	1.6	21.8%	1.50%	20	24.0	48.3	2662	274	2686	1355	1331		1.9	2308.5	85.2%		29.6%	
HSB14	97.5					80	76.0	52.6	2899	295	2975	1526	1450	378.4	1.8	2296.7	84.7%	84.7%	26.4%	27.6%
HSB15	2283	84.2%		23.1%		140	139.0	69.0	3800	334	3939	2039	1900	54.6	2.0	2303.1	85.0%	0.8%	30.3%	10.5%
HSB16	2317	87.5%		29.6%		200	202.0	73.1	4030	431	4232	2217	2015	0.998	1.7	2268.7	83.7%		24.1%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target dynamic test conditions				Actual dynamic test conditions				Stress Ratio	Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation Average	Saturation Average
						Confining stress (kPa)	Test load kN	Test stress (kPa)	Stress Ratio	Confining stress (kPa)	Test load kN	Test stress (kPa)	Stress Ratio	Model	(%)	(kg/cub m)	(%)		(%)	
HSB17	2090	77.1%	6.2	56.6%	1.50%	80	5.7	314.6	0.20	77.6	5.90	325	0.21	0.26	4.7	2141.0	79.0%		48.3%	
HSB18						80	15.7	865.2	0.55	78.5	16.30	900	0.58	0.80	5.1	2128.8	78.5%		50.3%	
HSS19	2111	77.9%		59.1%		80	25.7	1415.7	0.90	78.1	26.50	1458	0.93	0.99	5.1	2171.1	80.1%	79.0%	55.3%	52.5%
HSB20	2143	80.9%		69.5%		140	6.9	378.7	0.20	137.8	7.10	390	0.21	0.25	5.2	2126.2	78.4%	0.9%	51.1%	5.8%
HSB21						140	18.9	1041.4	0.55	142.0	19.60	1079	0.57	0.58	5.3	2158.9	79.6%		55.6%	
HSB22						140	30.9	1704.1	0.90	139.2	30.40	1674	0.89	1.07	5.5	2128.3	78.5%		54.5%	
HSB23	2090	77.1%	2.7	24.6%	1.50%	80	5.9	324.6	0.20	82.6	6.10	337	0.21	0.21	2.7	2147.4	79.2%		27.4%	
HSB24						80	16.2	892.6	0.55	80.7	16.70	918	0.56	0.61	2.8	2137.7	78.9%		28.8%	
HSB25	2111	77.9%		25.7%		80	26.5	1460.6	0.90	81.1	27.30	1504	0.92	0.86	2.4	2156.2	79.5%	79.4%	25.2%	25.5%
HSB26	2143	80.9%		30.3%		140	7.0	387.5	0.20	142.1	7.20	397	0.20	0.18	2.5	2154.4	79.5%	0.3%	26.6%	10.1%
HSB27						140	19.3	1065.5	0.55	141.7	20.00	1103	0.57	0.48	2.2	2153.7	79.4%		22.8%	
HSB28						140	31.6	1743.6	0.90	142.2	31.80	1754	0.90	0.74	2.1	2158.0	79.6%		22.3%	
HSB29	2260	83.4%	3.8	51.7%	1.50%	80	9.1	500.9	0.20	77.1	9.50	521	0.21	0.20	3.5	2290.6	84.5%		51.0%	
HSB30						80	25.0	1377.3	0.55	78.3	25.80	1424	0.57	0.52	3.0	2303.4	85.0%		46.2%	
HSB31	2283	84.2%		54.9%		80	40.9	2253.8	0.90	79.0	41.10	2263	0.91	0.85	3.3	2299.4	84.8%	85.0%	49.4%	48.9%
HSB32	2317	87.5%		70.3%		140	10.3	565.4	0.20	136.5	10.40	572	0.20	0.18	3.3	2299.6	84.8%	0.5%	49.5%	5.3%
HSB33						140	28.2	1554.8	0.55	138.0	29.00	1599	0.57	0.48	3.2	2323.3	85.7%		51.9%	
HSB34						140	46.2	2544.2	0.90	137.5	46.50	2562	0.91	0.79	2.9	2309.5	85.2%		45.4%	
HSB35	2260	83.4%	1.6	21.8%	1.50%	80	11.2	616.1	0.20	78.3	11.60	640	0.21	0.20	1.5	2304.3	85.0%		22.6%	
HSS36						80	30.7	1694.3	0.55	78.7	31.50	1737	0.57	0.64	2.3	2283.6	84.2%		33.1%	
HSB37	2283	84.2%		23.1%		80	50.3	2772.4	0.90	79.4	50.30	2774	0.90	0.96	2.4	2309.0	85.2%	85.2%	37.2%	28.2%
HSB38	2317	87.5%		29.6%		140	13.1	722.1	0.20	135.6	13.60	748	0.21	0.21	1.7	2310.0	85.2%	0.7%	26.3%	20.2%
HSB39						140	36.0	1985.8	0.55	136.7	37.30	2058	0.57	0.55	1.4	2327.9	85.9%		23.9%	
HSB40						140	59.0	3249.5	0.90	135.4	58.50	3224	0.90	0.90	1.6	2314.2	85.4%		26.1%	

Sheet 1 **Sample preparation data for the** **Foam treated hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC: 5.8 %
OMMC: 4.5 %
OFC (excl BC): 5.8 %

Cement Content: 1.00 %
Foam bitumen content 1.5 %
RD of bitumen 1.01

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Residual Binder Content (%)	Dry mass (kg)	Cement (g)	Mass of bitumen to foam (g)	Volume of mixing water (ml)	Mass of wet sample after mixing (kg)	Volume of compaction fluid (ml)	Volume of compaction water (ml)	Volume of additional water (ml)	Volume of residual binder (ml)	Wet sample mass after compact (kg)	Measured wet sample mass after compact	Target mass before test (kg)	Avg height	Avg diameter	Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
HSB01	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.304	0.152	12.504	11.869	13.394	0.902	12.760	5.3	2152	20-Feb-03	20-Mar-03	28
HSB02	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.306	0.152	12.520	11.898	13.251	0.788	12.632	5.2	2143	20-Feb-03	20-Mar-03	28
HSB03	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.307	0.152	12.498	11.865	13.330	0.896	12.700	5.3	2130	20-Feb-03	20-Mar-03	28
HSB04	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.305	0.152	12.532	11.891	13.402	0.891	12.762	5.4	2149	20-Feb-03	20-Mar-03	28
HSB05	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.303	0.152	12.160	11.880	12.995	0.876	12.716	2.4	2161	20-Feb-03	20-Mar-03	28
HSB06	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.178	11.896	12.982	0.820	12.700	2.4	2149	20-Feb-03	20-Mar-03	28
HSB07	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.178	11.886	13.062	0.904	12.770	2.5	2148	20-Feb-03	20-Mar-03	28
HSB08	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.306	0.152	12.192	11.890	13.032	0.846	12.730	2.5	2141	20-Feb-03	20-Mar-03	28
HSB09	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.305	0.152	13.319	12.836	14.182	0.886	13.700	3.8	2319	21-Feb-03	20-Mar-03	27
HSB10	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.304	0.152	13.291	12.798	14.100	0.830	13.608	3.9	2320	21-Feb-03	20-Mar-03	27
HSB11	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.311	0.152	13.292	12.876	14.070	0.790	13.654	3.2	2282	21-Feb-03	20-Mar-03	27
HSB12	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.312	0.152	13.293	12.857	13.903	0.792	13.473	3.4	2271	21-Feb-03	20-Mar-03	27
HSB13	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.306	0.152	13.061	12.818	13.741	0.780	13.500	1.9	2308	21-Feb-03	20-Mar-03	27
HSB14	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.308	0.152	13.062	12.836	13.963	0.945	13.738	1.8	2297	21-Feb-03	20-Mar-03	27
HSB15	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.307	0.152	13.083	12.830	13.826	0.790	13.574	2.0	2303	21-Feb-03	20-Mar-03	27
HSB16	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.313	0.152	13.108	12.885	13.918	0.850	13.696	1.7	2269	21-Feb-03	20-Mar-03	27
HSB17	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.307	0.152	12.492	11.927	13.353	0.902	12.790	4.7	2141	13-Mar-03	10-Apr-03	28
HSB18	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.308	0.152	12.502	11.898	13.284	0.828	12.682	5.1	2129	13-Mar-03	10-Apr-03	28
HSS19	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.303	0.152	12.542	11.937	13.393	0.895	12.790	5.1	2171	13-Mar-03	11-Apr-03	29
HSB20	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.308	0.152	12.500	11.883	13.370	0.908	12.755	5.2	2126	13-Mar-03	11-Apr-03	29
HSB21	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.304	0.152	12.535	11.909	13.306	0.825	12.683	5.3	2159	13-Mar-03	12-Apr-03	30
HSB22	2090	6.2	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.582	0.308	0.152	12.550	11.895	13.278	0.708	12.622	5.5	2128	13-Mar-03	11-Apr-03	29
HSB23	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.200	11.885	12.992	0.832	12.678	2.7	2147	17-Mar-03	14-Apr-03	28
HSB24	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.306	0.152	12.208	11.870	13.108	0.900	12.770	2.8	2138	17-Mar-03	14-Apr-03	28
HSB25	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.220	11.934	13.065	0.900	12.780	2.4	2156	17-Mar-03	15-Apr-03	29
HSB26	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.225	11.924	12.992	0.786	12.691	2.5	2154	17-Mar-03	15-Apr-03	29
HSB27	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.180	11.920	13.058	0.900	12.798	2.2	2154	17-Mar-03	16-Apr-03	30
HSB28	2090	2.7	1.5	11.567	115.67	175.24	526	12.384	853	679	154	173.5	12.537		12.173	0.305	0.152	12.195	11.944	13.071	0.892	12.820	2.1	2158	17-Mar-03	16-Apr-03	30
HSB29	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.31	0.152	13.330	12.885	14.121	0.843	13.678	3.5	2291	4-Mar-03	1-Apr-03	28
HSB30	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.309	0.152	13.304	12.915	14.041	0.790	13.654	3.0	2303	4-Mar-03	1-Apr-03	28
HSB31	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.309	0.152	13.314	12.893	14.176	0.890	13.756	3.3	2299	4-Mar-03	2-Apr-03	29
HSB32	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.309	0.152	13.316	12.894	14.092	0.842	13.672	3.3	2300	4-Mar-03	3-Apr-03	30
HSB33	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.306	0.152	13.312	12.900	14.044	0.790	13.634	3.2	2323	4-Mar-03	2-Apr-03	29
HSB34	2260	3.8	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.303	0.309	0.152	13.326	12.949	14.124	0.892	13.750	2.9	2309	4-Mar-03	3-Apr-03	30
HSB35	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.308	0.152	13.068	12.879	13.950	0.902	13.761	1.5	2304	6-Mar-03	4-Apr-03	29
HSS36	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.311	0.152	13.182	12.887	13.934	0.792	13.640	2.3	2284	6-Mar-03	4-Apr-03	29
HSB37	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.308	0.152	13.212	12.905	13.938	0.788	13.632	2.4	2309	6-Mar-03	4-Apr-03	29
HSB38	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.308	0.152	13.128	12.911	13.828	0.786	13.612	1.7	2310	6-Mar-03	6-Apr-03	31
HSB39	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.305	0.152	13.070	12.884	13.826	0.786	13.640	1.4	2328	6-Mar-03	7-Apr-03	32
HSB40	2260	1.6	1.5	12.508	125.08	189.50	568	13.391	922	735	166	187.6	13.557		13.025	0.307	0.152	13.104	12.892	13.935	0.892	13.724	1.6	2314	6-Mar-03	7-Apr-03	32

Summary Triaxial test data for the Foam treated hornfels 1% cement, 2.25% foamed bitumen

MDD:	2318	Cement %	1		
OMC:	5.8	Foamed bitumen %	2.25		
ARD:	2.711	ARD incl bit	2.618		

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target confining	Actual confining	Static test results							Actual MC	Actual Dry density	Compaction		Saturation	
								Failure load	Failure stress	Stiffness	Sigma 1	p	q	Cohesion, friction angle & R^2				Average		Average
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	stress (kPa)	kN	(kPa)	(MPa)	(kPa)	(kPa)	(kPa)		(%)	(kg/cub m)	(%)		(%)	
HSS01	2040	75.2%	8.1	66.6%	2.25%	20	20	18.4	1012	169	1032	526	506		3.95	2113.7	80.8%		43.4%	
HSS02	88.0					80	80	25.8	1423	241	1503	792	712	212.2	3.75	2121.1	81.0%	81.0%	41.9%	41.6%
HSS03	2060	76.0%		69.5%		140	142	29.1	1604	252	1746	944	802	43.2	3.69	2120.7	81.0%	0.1%	41.2%	3.7%
HSS04	2107	80.5%		87.4%		200	201	32.6	1799	200	2000	1101	900	0.996	3.56	2119.9	81.0%		39.7%	
HSS05	2040	75.2%	4.9	40.3%	2.25%	20	22	29.3	1617	289	1639	831	809		2.82	2115.8	80.8%		31.0%	
HSS06	88.0					80	81	34.9	1924	334	2005	1043	962	378.2	2.56	2118.5	80.9%	80.9%	28.4%	29.5%
HSS07	2060	76.0%		42.1%		140	~~144~~	~~33.4~~	~~1842~~	~~250~~	1986	1065	921	38.9	2.56	2121.2	81.0%	0.1%	28.5%	4.3%
HSS08	2107	80.5%		52.9%		200	202	40.5	2233	328	2435	1319	1117	0.995	2.74	2115.7	80.8%		30.2%	
HSS09	2200	81.2%	5.7	66.7%	2.25%	20	19	35.5	1954	286	1973	996	977		2.84	2287.5	87.4%		51.6%	
HSS10	94.9					80	81	41.4	2279	256	2360	1221	1140	357.6	3.02	2284.4	87.3%	87.4%	54.4%	52.5%
HSS11	2222	82.0%		70.2%		140	139	42.1	2321	269	2460	1300	1161	46.4	2.87	2287.7	87.4%	0.1%	52.2%	2.5%
HSS12	2272	86.8%		98.1%		200	203	53.1	2924	328	3127	1665	1462	0.992	2.85	2287.4	87.4%		51.7%	
HSS13	2200	81.2%	3.4	39.8%	2.25%	20	21	30.3	1672	236	1693	857	836		1.98	2294.7	87.7%		37.0%	
HSS14	94.9					80	83	40.1	2211	194	2294	1189	1106	264.5	2.27	2288.0	87.4%	87.5%	41.2%	42.4%
HSS15	2222	82.0%		41.9%		140	140	50.5	2781	336	2921	1531	1391	52.4	2.58	2286.3	87.3%	0.2%	46.5%	10.0%
HSS16	2272	86.8%		58.5%		200	200	53.3	2936	293	3136	1668	1468	0.998	2.43	2293.2	87.6%		44.9%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target dynamic test conditions				Actual dynamic test conditions				Stress ratio model	Actual MC	Actual Dry density	Compaction		Saturation	
						Confining	Test load	Test stress	Stress	Confining	Test load	Test stress	Stress					Average		Average
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	kN	(kPa)	Ratio	stress (kPa)	kN	(kPa)	Ratio		(%)	(kg/cub m)	(%)		(%)	
HSS17	2040	75.2%	*3.8*	31.3%	2.25%	80	4.8	265.3	0.20	80.0	4.86	267.69	0.20	0.20	3.6	2107.0	80.5%		39.3%	
HSS18						80	13.2	729.5	0.55	78.5	13.73	756.73	0.57	0.52	3.5	2126.9	81.3%		40.0%	
HSS19	2060	76.0%		32.6%		80	21.7	1193.7	0.90	80.6	22.63	1247.05	0.94	0.85	3.3	2115.0	80.8%	80.8%	36.7%	33.7%
HSS20	2107	*81.1%*		42.2%		140	5.8	317.2	0.20	137.5	5.95	327.85	0.21	0.19	3.2	2101.3	80.3%	0.7%	34.3%	26.8%
HSS21						140	15.8	872.4	0.55		membrane broke				1.4	2132.1	81.5%		15.8%	
HSS22						140	25.9	1427.6	0.90	138.5	26.05	1435.48	0.91	0.86	3.4	2095.6	80.1%		36.2%	
HSS23	2040	75.2%	*2.7*	22.2%	2.25%	80	6.7	370.3	0.20	78.8	6.83	376.63	0.20	0.17	2.0	2119.3	81.0%		22.4%	
HSS24						80	18.5	1018.4	0.55	78.4	19.27	1061.98	0.58	0.56	2.3	2107.8	80.5%		25.3%	
HSS25	2060	76.0%		23.2%		80	30.2	1666.4	0.90	81.9	30.35	1672.69	0.90	0.83	2.2	2097.0	80.1%	80.7%	22.8%	24.0%
HSS26	2107	*81.0%*		29.9%		140	7.5	410.8	0.20	140.7	7.80	429.64	0.21	0.15	1.7	2107.5	80.5%	0.5%	18.4%	14.9%
HSS27						140	20.5	1129.7	0.55	140.0	21.20	1168.19	0.57	0.55	2.5	2118.1	80.9%		28.1%	
HSS28						140	33.5	1848.6	0.90	140.3	34.13	1881.00	0.92	0.86	2.4	2122.9	81.1%		27.2%	
HSS29	2200	81.2%	3.4	39.8%	2.25%	80	7.9	432.7	*0.20*	81.8	7.91	435.8	0.20	0.20	3.2	2282.2	87.2%		56.4%	
HSS30						80	21.6	1190.0	*0.54*	81.5	22.02	1213.6	0.55	0.56	3.1	2280.0	87.1%		54.7%	
HSS31	2222	82.0%		41.9%		80	35.3	1947.2	*0.88*	82.6	36.01	1984.7	0.89	0.91	3.2	2284.7	87.3%	87.2%	57.0%	56.4%
HSS32	2272	86.8%		58.5%		140	9.5	524.2	*0.21*	141.1	9.59	528.3	0.21	0.21	2.9	2289.2	87.5%	0.3%	53.5%	4.5%
HSS33						140	26.2	1441.6	*0.57*	147.0	27.23	1500.7	0.59	0.60	3.2	2279.1	87.1%		55.8%	
HSS34						140	42.8	2359.1	*0.93*	142.5	43.55	2400.2	0.95	1.02	3.5	2272.1	86.8%		60.9%	
HSS35	2200	81.2%	*2.3*	26.9%	2.25%	80	8.0	441.8	0.20	81.4	8.32	458.65	0.21	0.20	2.9	2289.0	87.5%		53.8%	
HSS36						80	22.0	1215.1	0.55	79.3	22.66	1248.59	0.58	0.54	2.9	2297.9	87.8%		53.8%	
HSS37	2222	82.0%		28.3%		80	28.5	1569.1	0.90	82.1	29.40	1620.12	0.74	0.76	3.2	2274.7	86.9%	86.8%	56.0%	49.5%
HSS38	2272	*87.6%*		42.2%		140	9.2	504.9	0.20	143.7	9.60	528.81	0.20	0.23	2.9	2216.6	84.7%	1.3%	41.9%	13.5%
HSS39						140	25.2	1388.5	0.55	138.7	26.04	1435.28	0.55	0.57	2.9	2281.9	87.2%		50.9%	
HSS40						140	41.2	2272.1	0.90	140.4	41.01	2260.04	0.86	0.84	2.3	2271.9	86.8%		40.3%	

Sheet 1 **Sample preparation data for the** **Foam treated hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC: 5.8 %
OMMC: 4.5 %
OFC (excl BC): 5.8 %

Cement Content: 1.00 %
Foam bitumen content 2.25 %
RD of bitumen 1.01

5.0

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Residual Binder Content (%)	Dry mass (kg)	Cement (g)	Mass of bitumen to foam (g)	Volume of mixing water (ml)	Mass of wet sample after mixing (kg)	Volume of compaction fluid (ml)	Volume of compaction water (ml)	Volume of additional water (ml)	Volume of residual binder (ml)	Wet sample mass after compact (kg)	Measured wet sample mass after compact	Target mass before test (kg)	Avg height	Avg diameter	Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
HSS01	2040	8.1	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.583	0.305	0.152	12.160	11.698	13.050	0.930	12.590	3.9	2114	09/12/2002	6-Jan-03	28
HSS02	2040	8.1	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.583	0.305	0.152	12.180	11.739	12.944	0.810	12.505	3.8	2121	09/12/2002	6-Jan-03	28
HSS03	2040	8.1	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.583	0.305	0.152	12.170	11.737	12.909	0.775	12.477	3.7	2121	09/12/2002	6-Jan-03	28
HSS04	2040	8.1	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.583	0.305	0.152	12.150	11.733	12.875	0.790	12.460	3.6	2120	09/12/2002	6-Jan-03	28
HSS05	2040	4.9	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.218	0.305	0.152	12.040	11.710	12.943	0.790	12.610	2.8	2116	09/12/2002	6-Jan-03	28
HSS06	2040	4.9	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.218	0.305	0.152	12.025	11.725	12.850	0.830	12.550	2.6	2119	09/12/2002	6-Jan-03	28
HSS07	2040	4.9	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.218	0.305	0.152	12.040	11.740	12.850	0.814	12.550	2.6	2121	09/12/2002	6-Jan-03	28
HSS08	2040	4.9	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.218	0.305	0.152	12.030	11.709	12.905	0.900	12.585	2.7	2116	09/12/2002	6-Jan-03	28
HSS09	2200	5.7	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		13.275	0.305	0.152	13.020	12.660	13.835	0.775	13.474	2.8	2287	21-Nov-02	20-Dec-02	29
HSS10	2200	5.7	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		13.275	0.305	0.152	13.025	12.643	13.850	0.900	13.470	3.0	2284	21-Nov-02	20-Dec-02	29
HSS11	2200	5.7	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		13.275	0.305	0.152	13.025	12.661	13.755	0.790	13.393	2.9	2288	22-Nov-02	20-Dec-02	28
HSS12	2200	5.7	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		13.275	0.305	0.152	13.020	12.660	13.820	0.812	13.460	2.8	2287	22-Nov-02	20-Dec-02	28
HSS13	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	12.952	12.700	13.760	0.905	13.510	2.0	2295	22-Nov-02	20-Dec-02	28
HSS14	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	12.950	12.663	13.680	0.790	13.394	2.3	2288	22-Nov-02	20-Dec-02	28
HSS15	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	12.980	12.653	13.745	0.830	13.420	2.6	2286	22-Nov-02	20-Dec-02	28
HSS16	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.000	12.692	13.700	0.845	13.395	2.4	2293	22-Nov-02	20-Dec-02	28
HSS17	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.305	0.152	12.085	11.6612	12.902	0.812	12.478	3.6	2107	05/02/2003	05/03/2003	28
HSS18	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.303	0.152	12.105	11.694	12.97	0.895	12.56	3.5	2127	05/02/2003	06/03/2003	29
HSS19	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.305	0.152	12.095	11.7053	12.863	0.82	12.475	3.3	2115	05/02/2003	06/03/2003	29
HSS20	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.305	0.152	12.004	11.6297	12.87	0.845	12.495	3.2	2101	05/02/2003	07/03/2003	30
HSS21	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.308	0.152	12.080	11.9164	12.605	0.79	12.445	1.4	2132	05/02/2003	08/03/2003	31
HSS22	2040	*3.8*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		12.093	0.308	0.152	12.115	11.7121	12.982	0.895	12.58	3.4	2096	05/02/2003	08/03/2003	31
HSS23	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.305	0.152	11.965	11.7294	12.83	0.895	12.595	2.0	2119	10/02/2003	09/03/2003	27
HSS24	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.306	0.152	11.978	11.7037	12.758	0.793	12.484	2.3	2108	10/02/2003	10/03/2003	28
HSS25	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.307	0.152	11.935	11.682	12.782	0.896	12.53	2.2	2097	10/02/2003	10/03/2003	28
HSS26	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.309	0.152	12.018	11.8171	12.855	0.89	12.655	1.7	2108	10/02/2003	11/03/2003	29
HSS27	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.304	0.152	11.98	11.684	12.84	0.9	12.545	2.5	2118	10/02/2003	11/03/2003	29
HSS28	2040	*2.7*	2.25	11.29	112.9	256.57	513	12.173	918	664	151	254.0	12.323		11.967	0.303	0.152	11.955	11.672	12.755	0.802	12.472	2.4	2123	10/02/2003	12/03/2003	30
HSS29	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.030	12.6306	13.925	0.907	13.526	3.2	2282	10/12/2002	07/01/2003	28
HSS30	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.009	12.6188	13.845	0.844	13.455	3.1	2280	10/12/2002	07/01/2003	28
HSS31	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.045	12.6445	13.958	0.930	13.558	3.2	2285	12/12/2002	08/01/2003	27
HSS32	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.040	12.6698	13.897	0.900	13.528	2.9	2289	12/12/2002	08/01/2003	27
HSS33	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.012	12.6136	13.813	0.815	13.415	3.2	2279	12/12/2002	10/01/2003	29
HSS34	2200	3.4	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.993	0.305	0.152	13.020	12.575	13.949	0.930	13.504	3.5	2272	12/12/2002	10/01/2003	29
HSS35	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.304	0.152	12.998	12.627	13.755	0.790	13.385	2.9	2289	07/01/2003	03/02/2003	27
HSS36	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.303	0.152	12.995	12.634	13.810	0.835	13.450	2.9	2298	07/01/2003	03/02/2003	27
HSS37	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.305	0.152	12.995	12.589	13.848	0.845	13.442	3.2	2275	07/01/2003	04/02/2003	28
HSS38	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.314	0.152	12.995	12.630	13.805	0.818	13.440	2.9	2217	07/01/2003	04/02/2003	28
HSS39	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.305	0.152	12.990	12.629	13.750	0.790	13.390	2.9	2282	07/01/2003	05/02/2003	29
HSS40	2200	*2.3*	2.25	12.176	121.76	276.70	553	13.128	990	716	163	274.0	13.290		12.857	0.308	0.152	12.995	12.698	13.820	0.845	13.523	2.3	2272	07/01/2003	05/02/2003	29

Summary Triaxial test data for the Foam treated hornfels 1% cement, 3.0% foamed bitumen

MDD:	2318	Cement %	1		
OMC:	5.8	Foamed bitumen %	3		
ARD:	2.711	ARD incl bit	2.588		

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target confining	Actual confining	Static test results							Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation	Saturation Average
								Failure load	Failure stress	Stiffness	Sigma 1	p	q	Cohesion, friction						
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	stress (kPa)	kN	(kPa)	(MPa)	(kPa)	(kPa)	(kPa)	angle & R^2	(%)	(kg/cub m)	(%)		(%)	
HSA01	2020	74.5%	6.2	49.1%	3.00%	20	19.0	23.1	1272	218	1291	655	636		4.95	2126.7	82.2%		59.2%	
HSA02	87.1					80	79.0	25.4	1402	213	1481	780	701	296.1	5.39	2098.7	81.1%	81.8%	59.8%	61.5%
HSA03	2040	75.3%		51.1%		140	140.0	27.4	1509	203	1649	895	755	36.5	5.46	2114.9	81.7%	0.6%	63.1%	3.8%
HSA04	2101	81.2%		69.4%		200	200.0	32.8	1807	266	2007	1104	904	0.990	5.41	2121.4	82.0%		63.8%	
HSA05	2020	74.5%	2.7	21.4%	3.00%	20	20.0	22.3	1229	203	1249	635	615		2.42	2116.8	81.8%		28.2%	
HSA06	87.1					80	80.0	26.4	1453	358	1533	807	727	276.7	2.42	2103.0	81.3%	82.0%	27.3%	28.6%
HSA07	2040	75.3%		22.3%		140	140.0	31.1	1716	221	1856	998	858	39.5	2.60	2138.6	82.7%	0.7%	32.2%	8.6%
HSA08	2101	81.2%		30.2%		200	197.0	33.0	1817	205	2014	1106	909	0.997	2.27	2120.7	82.0%		26.8%	
HSA09	2173	80.2%	3.9	42.8%	3.00%	19	21.0	33.4	1842	615	1863	942	921		3.41	2244.4	86.7%		57.6%	
HSA10	93.7					81	81.0	37.9	2091	299	2172	1127	1046	470.8	3.38	2272.2	87.8%	87.5%	62.9%	61.8%
HSA11	2195	81.0%		44.9%		139	140.0	40.2	2216	349	2356	1248	1108	35.2	3.52	2273.0	87.8%	0.6%	65.6%	5.5%
HSA12	2260	87.4%		69.7%		203	197.0	42.1	2320	293	2517	1357	1160	0.993	3.36	2264.2	87.5%		60.9%	
HSA13	2173	80.2%	1.7	18.7%	3.00%	21	23.0	38.5	2120	286	2143	1083	1060		2.59	2260.2	87.3%		46.1%	
HSA14	93.7					83	81.0	46.0	2536	294	2617	1349	1268	444.4	2.29	2257.7	87.3%	87.0%	40.8%	41.1%
HSA15	2195	81.0%		19.6%		140	139.0	47.6	2622	326	2761	1450	1311	43.4	2.40	2243.4	86.7%	0.4%	40.5%	9.2%
HSA16	2260	87.4%		30.4%		200	200.0	53.0	2920	383	3120	1660	1460	0.994	2.21	2239.9	86.6%		36.9%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target dynamic test conditions				Actual dynamic test conditions				Stress ratio model	Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation	Saturation Average
						Confining	Test load	Test stress	Stress	Confining	Test load	Test stress	Stress							
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	kN	(kPa)	Ratio	stress (kPa)	kN	(kPa)	Ratio		(%)	(kg/cub m)	(%)		(%)	
HSA17	2020	74.5%	6.2	49.1%	3.00%	80	5.1	282.2	0.20	80.61	5.30	289.70	0.21	0.22	4.8	2113.7	81.7%		55.5%	
HSA18						80	14.1	775.9	0.55	79.92	14.60	804.37	0.57	0.57	4.8	2126.5	82.2%		57.2%	
HSA19	2040	75.3%		51.1%		80	23.0	1269.7	0.90	79.72	23.70	1305.06	0.93	1.02	5.4	2107.1	81.4%	81.4%	61.0%	56.6%
HSA20	2101	81.2%		69.4%		140	5.8	317.4	0.20	139.12	6.00	328.72	0.21	0.21	4.9	2119.1	81.9%	0.8%	57.3%	5.1%
HSA21						140	15.8	873.0	0.55	138.44	16.50	912.04	0.58	0.69	4.9	2078.3	80.3%		52.1%	
HSA22						140	25.9	1428.5	0.90	139.26	26.30	1446.86			5.1	2097.9	81.1%		56.3%	
HSS22a										141.99	26.00	1432.00	0.90	0.99	5.1	2097.9	81.1%		56.3%	
HSA23	2020	74.5%	2.7	21.4%	3.00%	80	5.3	290.3	0.20	80.13	5.40	298.68	0.21	0.21	2.8	2109.9	81.5%		32.3%	
HSA24						80	14.5	798.4	0.55	79.05	15.00	828.60	0.57	0.52	1.9	2105.1	81.4%		22.0%	
HSA25	2040	75.3%		22.3%		80	23.7	1306.5	0.90	78.59	24.50	1350.26	0.93	0.89	2.4	2107.6	81.5%	80.5%	27.1%	25.7%
HSA26	2101	81.2%		30.2%		140	6.0	332.2	0.20	136.67	6.20	343.62	0.21	0.33	2.4	1975.6	76.3%	2.6%	19.9%	17.2%
HSA27						140	16.6	913.6	0.55	137.69	17.40	960.07	0.58	0.60	2.3	2085.8	80.6%		25.2%	
HSA28						140	27.1	1494.9	0.90	140.59	27.70	1528.21	0.92	0.90	2.4	2108.0	81.5%		27.8%	
HSA29	2173	80.2%	3.9	42.8%	3.00%	80	7.4	407.2	0.20	83.657539	7.4	408.41	0.20	0.19	3.1	2240.1	86.6%		52.6%	
HSA30						80	20.3	1119.9	0.55	81.021958	21.1	1164.83	0.57	0.51	3.7	2281.6	88.2%		72.0%	
HSA31	2195	81.0%		44.9%		80	33.3	1832.5	0.90	79.097069	32.9	1810.95	0.89	0.80	3.4	2273.6	87.9%	87.5%	64.1%	63.8%
HSA32	2260	87.4%		69.7%		140	8.0	439.9	0.20	139.41153	8.4	461.02	0.21	0.20	3.7	2249.8	86.9%	0.7%	63.3%	9.9%
HSA33						140	22.0	1209.9	0.55	140.21937	22.8	1257.40	0.57	0.52	3.6	2272.7	87.8%		66.3%	
HSA34						140	35.9	1979.8	0.90	140.5667	35.9	1977.37	0.90	0.81	3.5	2271.4	87.8%		64.3%	
HSA35	2173	80.2%	1.7	18.7%	3.00%	80	8.8	482.9	0.20	80.36	9.10	502.05	0.21	0.21	1.7	2262.8	87.5%		31.0%	
HSA36						80	24.1	1328.0	0.55	81.79	25.00	1376.50	0.57	0.56	1.5	2261.2	87.4%		26.4%	
HSA37	2195	81.0%		19.6%		80	39.4	2173.1	0.90	79.78	50.1	2758.36	1.14	1.14	1.7	2269.8	87.7%	87.3%	31.1%	26.4%
HSA38	2260	87.4%		30.4%		140	9.7	535.6	0.20	139.84	9.80	540.51	0.20	0.22	1.5	2232.0	86.3%	0.6%	25.2%	15.4%
HSA39						140	26.7	1472.8	0.55	139.12	27.70	1526.75	0.57	0.54	1.1	2272.1	87.8%		21.0%	
HSA40						140	43.7	2410.1	0.90	139.62	43.20	2379.22	0.89	0.89	1.3	2259.3	87.3%		23.4%	

Sheet 1 **Sample preparation data for the** **Foam treated hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC: 5.8 %
OMMC: 4.5 %
OFC (excl BC) 5.8 %

Cement Content: 1.00 %
Foam bitumen content 3 %
RD of bitume 3.15 1.01

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Residual Binder Content (%)	Dry mass (kg)	Cement (g)	Mass of bitumen to foam (g)	Volume of mixing water (ml)	Mass of wet sample after mixing (kg)	Volume of compaction fluid (ml)	Volume of compaction water (ml)	Volume of additional water (ml)	Volume of residual binder (ml)	Wet sample mass after compact (kg)	Measured wet sample mass after compact	Target mass before test (kg)	Avg height	Avg diameter	Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
HSA01	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.303	0.152	12.272	11.693	13.123	0.870	12.545	5.0	2127	3-Feb-03	5-Mar-03	30
HSA02	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.306	0.152	12.281	11.653	13.068	0.818	12.442	5.4	2099	3-Feb-03	5-Mar-03	30
HSA03	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.304	0.152	12.304	11.667	13.100	0.844	12.465	5.5	2115	3-Feb-03	5-Mar-03	30
HSA04	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.303	0.152	12.295	11.664	13.150	0.893	12.521	5.4	2121	3-Feb-03	5-Mar-03	30
HSA05	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.304	0.152	11.960	11.677	12.748	0.790	12.465	2.4	2117	3-Feb-03	5-Mar-03	30
HSA06	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.306	0.152	11.960	11.677	12.855	0.895	12.572	2.4	2103	3-Feb-03	5-Mar-03	30
HSA07	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.300	0.152	11.945	11.642	12.838	0.892	12.535	2.6	2139	3-Feb-03	5-Mar-03	30
HSA08	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.303	0.152	11.925	11.660	12.725	0.808	12.460	2.3	2121	3-Feb-03	5-Mar-03	30
HSA09	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.308	0.152	12.972	12.544	13.730	0.790	13.303	3.4	2244	4-Feb-03	6-Mar-03	30
HSA10	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.305	0.152	13.000	12.575	13.825	0.848	13.401	3.4	2272	4-Feb-03	6-Mar-03	30
HSA11	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.304	0.152	12.980	12.539	13.815	0.870	13.375	3.5	2273	4-Feb-03	6-Mar-03	30
HSA12	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.306	0.152	12.995	12.572	13.810	0.892	13.390	3.4	2264	4-Feb-03	6-Mar-03	30
HSA13	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.305	0.152	12.833	12.509	13.820	1.028	13.497	2.6	2260	4-Feb-03	7-Mar-03	31
HSA14	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.306	0.152	12.824	12.536	13.605	0.808	13.318	2.3	2258	4-Feb-03	7-Mar-03	31
HSA15	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.307	0.152	12.798	12.498	13.575	0.790	13.275	2.4	2243	4-Feb-03	7-Mar-03	31
HSA16	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.308	0.152	12.795	12.519	13.325	0.828	13.055	2.2	2240	4-Feb-03	7-Mar-03	31
HSA17	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.306	0.152	12.301	11.7365	12.992	0.788	12.432	4.8	2114	25-Feb-03	26-Mar-03	29
HSA18	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.304	0.152	12.292	11.7303	13.116	0.906	12.558	4.8	2126	25-Feb-03	25-Mar-03	28
HSA19	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.305	0.152	12.29	11.6616	13.153	0.89	12.526	5.4	2107	25-Feb-03	26-Mar-03	29
HSA20	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.304	0.152	12.262	11.6896	12.95	0.782	12.382	4.9	2119	25-Feb-03	25-Mar-03	28
HSA21	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.31	0.152	12.268	11.6908	13.088	0.845	12.512	4.9	2078	25-Feb-03	27-Mar-03	30
HSA22	2020	6.2	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		12.331	0.307	0.152	12.28	11.687	13.008	0.79	12.418	5.1	2098	25-Feb-03	26-Mar-03	29
HSA23	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.305	0.152	12.008	11.6773	12.8	0.852	12.471	2.8	2110	27-Feb-03	28-Mar-03	29
HSA24	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.306	0.152	11.916	11.6888	12.64	0.788	12.414	1.9	2105	27-Feb-03	27-Mar-03	28
HSA25	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.305	0.152	11.942	11.6644	12.766	0.892	12.49	2.4	2108	27-Feb-03	28-Mar-03	29
HSA26	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.306	0.152	11.232	10.9697	12.791	0.888	12.513	2.4	1976	27-Feb-03	31-Mar-03	32
HSA27	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.307	0.152	11.892	11.6195	12.58	0.795	12.31	2.3	2086	27-Feb-03	30-Mar-03	31
HSA28	2020	2.7	3	11.180	111.8	338.75	508	12.139	994	658	150	335.4	12.289		11.935	0.305	0.152	11.952	11.667	12.75	0.842	12.466	2.4	2108	27-Feb-03	31-Mar-03	32
HSA29	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.31	0.152	12.998	12.6012	13.75	0.81	13.355	3.1	2240	12-Feb-03	12-Mar-03	28
HSA30	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.304	0.152	13.055	12.5863	13.85	0.815	13.382	3.7	2282	12-Feb-03	13-Mar-03	29
HSA31	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.304	0.152	12.97	12.542	13.732	0.792	13.305	3.4	2274	12-Feb-03	13-Mar-03	29
HSA32	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.307	0.152	12.995	12.5332	13.735	0.79	13.275	3.7	2250	12-Feb-03	14-Mar-03	30
HSA33	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.303	0.152	12.94	12.4956	13.72	0.85	13.278	3.6	2273	12-Feb-03	15-Mar-03	31
HSA34	2173	3.9	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.984	0.305	0.152	13.005	12.5708	13.83	0.89	13.398	3.5	2271	12-Feb-03	14-Mar-03	30
HSA35	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.306	0.152	12.780	12.565	13.645	0.885	13.430	1.7	2263	18-Feb-03	17-Mar-03	27
HSA36	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.307	0.152	12.782	12.597	13.540	0.790	13.355	1.5	2261	18-Feb-03	17-Mar-03	27
HSA37	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.304	0.152	12.732	12.521	13.550	0.876	13.340	1.7	2270	18-Feb-03	18-Mar-03	28
HSA38	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.31	0.152	12.750	12.556	13.498	0.775	13.304	1.5	2232	18-Feb-03	18-Mar-03	28
HSA39	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.307	0.152	12.800	12.657	13.450	0.903	13.310	1.1	2272	18-Feb-03	18-Mar-03	28
HSA40	2173	1.7	3	12.026	120.3	364.39	547	13.057	1069	708	162	360.8	13.219		12.717	0.306	0.152	12.710	12.545	13.438	0.812	13.274	1.3	2259	18-Feb-03	19-Mar-03	29

Summary Triaxial test data for the Foam treated hornfels 2% cement, 2.25% foamed bitumen

MDD:	2318	Cement %	2		
OMC:	5.8	Foamed bitumen %	2.25		
ARD:	2.711	ARD incl bit	2.621		

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target confining	Actual confining	Static test results							Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation	Saturation Average
								Failure load	Failure stress	Stiffness	Sigma 1	p	q	Cohesion, friction angle & R^2						
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	stress (kPa)	kN	(kPa)	(MPa)	(kPa)	(kPa)	(kPa)		(%)	(kg/cub m)	(%)		(%)	
HAS01	2030	74.9%	6.3	51.0%	2.25%	20	21.0	23.6	1298	212	1319	670	649		5.19	2123.4	81.0%		58.0%	
HAS02	87.6					80	81.0	29.6	1629	288	1710	896	815	235.6	4.61	2122.9	81.0%	80.8%	51.6%	54.9%
HAS03	2071	76.4%		55.2%		140	135.0	33.5	1846	241	1981	1058	923	46.5	4.77	2121.2	80.9%	0.36%	53.0%	5.66%
HAS04	2117	80.8%		69.4%		200	202.0	41.2	2268	259	2470	1336	1134	1.000	5.31	2106.5	80.4%		57.1%	
HAS05	2030	74.9%	2.7	21.8%	2.25%	20	22.0	36.1	1992	289	2014	1018	996		2.19	2135.8	81.5%		25.3%	
HAS06	87.6					80	79.0	42.5	2341	322	2420	1250	1171	389.0	2.34	2138.3	81.6%	81.4%	27.2%	25.2%
HAS07	2071	76.4%		23.7%		140	145.0	47.2	2601	289	2746	1446	1301	45.5	2.22	2129.6	81.3%	0.22%	25.3%	6.64%
HAS08	2117	80.8%		29.7%		200	Data unreasonable							0.999	2.04	2128.7	81.2%		23.1%	
HAS09	2190	80.8%	3.9	44.5%	2.25%	19	21.0	48.3	2664	355	2685	1353	1332		3.07	2293.9	87.5%		56.3%	
HAS10	94.5					81	Data unreasonable							477.4	2.94	2284.2	87.2%	87.1%	52.5%	52.9%
HAS11	2234	82.4%		49.5%		139	135.0	62.8	3462	394	3597	1866	1731	49.0	2.87	2268.7	86.6%	0.43%	48.6%	6.12%
HAS12	2284	87.2%		69.3%		203	208.0	68.8	3792	457	4000	2104	1896	0.999	3.08	2279.9	87.0%		54.0%	
HAS13	2190	80.8%	1.7	19.4%	2.25%	21	21.0	74.0	4076	508	4097	2059	2038		2.20	2295.0	87.6%		40.8%	
HAS14	94.5					83	78.0	75.0	4131	428	4209	2144	2066	640.6	1.89	2267.4	86.5%	87.2%	31.8%	31.7%
HAS15	2234	82.4%		21.6%		140	Data unreasonable							52.2	1.84	2328.0	88.8%	1.15%	38.2%	25.71%
HAS40						140	141.0	87.9	4846	404	4987	2564	2423		1.19	2279.2	87.0%		20.9%	
HAS16	2284	87.2%		30.2%		200	Data unreasonable							0.991	1.62	2262.3	86.3%		26.8%	

Sample #	Dry density	Compaction	Moisture Content (MC)	Saturation	Residual Binder	Target dynamic test conditions				Actual dynamic test conditions					Actual MC	Actual Dry density	Compaction	Compaction Average	Saturation	Saturation Average
						Confining	Test load	Test stress	Stress	Confining	Test load	Test stress	Stress	Stress ratio						
	(kg/cub m)	(%)	(%)	(%)	Content (%)	stress (kPa)	kN	(kPa)	Ratio	stress (kPa)	kN	(kPa)	Ratio	model	(%)	(kg/cub m)	(%)		(%)	
HAS17	2030	74.9%	6.3	51.0%	2.25%	80	5.8	320.6	0.20	81.0	6.0	328.3	0.20	0.18	4.9	2135.7	81.50%		56.70%	
HAS18						80	16.0	881.8	0.55	80.9	16.6	912.9	0.57	0.49	5.0	2144.0	81.80%		59.10%	
HAS19	2071	76.4%		55.2%		80	26.2	1442.9	0.90	81.6	26.7	1469.3	0.91	0.93	5.2	2119.2	80.90%	81.47%	57.80%	56.80%
HAS20	2117	80.8%		69.4%		140	7.0	384.0	0.20	137.9	7.2	398.8	0.21	0.19	4.8	2143.8	81.80%	0.47%	56.80%	3.27%
HAS21						140	19.2	1056.0	0.55	137.5	20.0	1099.7	0.58	0.58	4.8	2124.8	81.10%		53.50%	
HAS22						140	31.4	1727.9	0.90	138.2	31.4	1732.3	0.91	0.84	4.9	2140.4	81.70%		56.90%	
HAS23	2030	74.9%	2.7	21.8%	2.25%	80	8.4	460.3	0.20	77.5	8.5	468.4	0.20	0.21	2.5	2131.5	81.30%		28.10%	
HAS24						80	23.0	1265.8	0.55	81.7	23.9	1314.9	0.57	0.60	2.5	2124.1	81.00%		27.90%	
HAS25	2071	76.4%		23.7%		80	37.6	2071.2	0.90	80.4	37.0	2039.3	0.89	0.90	2.5	2130.2	81.30%	81.33%	28.10%	26.65%
HAS26	2117	80.8%		29.7%		140	9.4	520.1	0.20	139.2	9.5	523.5	0.20	0.21	2.4	2129.8	81.30%	0.25%	27.90%	8.24%
HAS27						140	26.0	1430.1	0.55	136.1	26.9	1483.7	0.57	0.55	2.1	2138.8	81.60%		25.00%	
HAS28						140	42.5	2340.2	0.90	135.6	42.6	2350.0	0.91	0.84	2.0	2136.5	81.50%		22.90%	
HAS29	2190	80.8%	3.9	44.5%	2.25%	80	11.1	610.2	0.20	78.9	11.6	637.56	0.21	0.17	3.5	2306.8	88.00%		66.70%	
HAS30						80	30.4	1678.0	0.55	77.6	31.3	1726.2	0.57	0.49	3.3	2274.3	86.80%		57.40%	
HAS31	2234	82.4%		49.5%		80	49.8	2745.8	0.90	80.3	50.5	2781.3	0.91	0.72	3.3	2304.9	87.90%	87.37%	62.30%	59.50%
HAS32	2284	87.2%		69.3%		140	12.4	684.2	0.20	139.0	12.5	688.7	0.20	0.18	3.3	2289.0	87.30%	0.55%	59.40%	7.46%
HAS33						140	34.1	1881.7	0.55	139.1	34.5	1899.6	0.56	0.49	3.2	2283.5	87.10%		57.00%	
HAS34						140	55.9	3079.1	0.90	136.6	56.2	3095.4	0.91	0.80	3.1	2281.9	87.10%		54.20%	
HAS35	2190	80.8%	1.7	19.4%	2.25%	80	15.8	870.2	0.20	79.2	16.0	883.6	0.20	0.21	1.3	2266.6	86.50%		22.50%	
HAS36						80	43.4	2393.1	0.55	82.3	43.5	2395.0	0.55	0.57	1.4	2263.8	86.40%		22.90%	
HAS37	2234	82.4%		21.6%		80	71.1	3915.9	0.90	75.6	71.0	3914.1	0.91	0.96	1.6	2271.6	86.70%	86.85%	27.10%	22.98%
HAS38	2284	87.2%		30.2%		140	17.4	960.8	0.20	135.7	17.6	970.3	0.20	0.21	1.2	2259.9	86.20%	0.88%	19.00%	12.87%
HAS39						140	47.9	2642.3	0.55	139.0	47.3	2604.7	0.54	0.53	1.3	2313.4	88.30%		25.50%	
HAS40						140	78.5	4323.7	0.90	Used for static triaxial test					1.2	2279.2	87.00%		20.90%	

Sheet 1 **Sample preparation data for the** **Foam treated hornfels**

Sample dimensions:
Height: 0.305 m
Diameter: 0.152 m

OMC: 5.8 %
OMMC: 5 %
OFC (excl BC): 6 %

Cement Content: 2.00 %
Foam bitumen content 2.25 %
RD of bitumen 1.01

Not whole specimen

Sample #	Dry density at testing (kg/cub m)	Moisture content (MC) at testing (%)	Residual Binder Content (%)	Dry mass (kg)	Cement (g)	Mass of bitumen to foam (g)	Volume of mixing water (ml)	Mass of wet sample after mixing (kg)	Volume of compaction fluid (ml)	Volume of compaction water (ml)	Volume of additional water (ml)	Volume of residual binder (ml)	Wet sample mass after compact (kg)	Measured wet sample mass after compact	Target mass before test (kg)	Avg height	Avg diameter	Wet mass before test (kg)	Dry mass before test (kg)	Wet mass after test (kg)	Mass of pan (kg)	Dry mass after test (kg)	Actual MC (%)	Actual Dry density (kg/cub m)	Date Prepared	Date Tested	Days of curing
HAS01	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.306	0.152	12.402	11.790	13.142	0.792	12.533	5.2	2123	10-Mar-03	8-Apr-03	29
HAS02	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.307	0.152	12.372	11.826	13.176	0.842	12.632	4.6	2123	10-Mar-03	8-Apr-03	29
HAS03	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.307	0.152	12.380	11.816	13.196	0.850	12.634	4.8	2121	10-Mar-03	8-Apr-03	29
HAS04	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.308	0.152	12.398	11.773	13.166	0.792	12.542	5.3	2106	10-Mar-03	8-Apr-03	29
HAS05	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.305	0.152	12.080	11.821	12.953	0.888	12.694	2.2	2136	10-Mar-03	8-Apr-03	29
HAS06	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.304	0.152	12.072	11.795	12.830	0.783	12.554	2.3	2138	10-Mar-03	8-Apr-03	29
HAS07	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.305	0.152	12.048	11.786	12.921	0.903	12.660	2.2	2130	10-Mar-03	8-Apr-03	29
HAS08	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.307	0.152	12.100	11.858	12.964	0.902	12.723	2.0	2129	10-Mar-03	8-Apr-03	29
HAS09	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.306	0.152	13.128	12.737	13.932	0.830	13.542	3.1	2294	11-Mar-03	9-Apr-03	29
HAS10	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.308	0.152	13.142	12.766	13.936	0.822	13.561	2.9	2284	11-Mar-03	9-Apr-03	29
HAS11	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.31	0.152	13.128	12.762	13.992	0.900	13.627	2.9	2269	11-Mar-03	9-Apr-03	29
HAS12	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.308	0.152	13.134	12.742	13.840	0.776	13.450	3.1	2280	11-Mar-03	9-Apr-03	29
HAS13	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.306	0.152	13.024	12.743	13.850	0.902	13.571	2.2	2295	11-Mar-03	9-Apr-03	29
HAS14	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.312	0.152	13.080	12.837	13.769	0.790	13.528	1.9	2267	11-Mar-03	9-Apr-03	29
HAS15	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.301	0.152	12.949	12.715	13.701	0.782	13.468	1.8	2328	11-Mar-03	9-Apr-03	29
HAS16	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.311	0.152	12.974	12.767	13.708	0.812	13.502	1.6	2262	11-Mar-03	9-Apr-03	29
HAS17	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.305	0.152	12.400	11.8198	13.12	0.788	12.543	4.9	2136	20-Mar-03	18-Apr-03	29
HAS18	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.304	0.152	12.420	11.8268	13.168	0.815	12.578	5.0	2144	20-Mar-03	17-Apr-03	28
HAS19	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.306	0.152	12.380	11.7673	13.145	0.78	12.533	5.2	2119	20-Mar-03	18-Apr-03	29
HAS20	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.304	0.152	12.396	11.826	13.2	0.848	12.632	4.8	2144	20-Mar-03	19-Apr-03	30
HAS21	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.306	0.152	12.360	11.7981	13.206	0.888	12.646	4.8	2125	20-Mar-03	19-Apr-03	30
HAS22	2030	6.3	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.440	0.304	0.152	12.382	11.8074	13.139	0.792	12.566	4.9	2140	20-Mar-03	21-Apr-03	32
HAS23	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.305	0.152	12.087	11.7966	12.912	0.842	12.622	2.5	2131	24-Mar-03	21-Apr-03	28
HAS24	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.306	0.152	12.089	11.7944	12.851	0.787	12.557	2.5	2124	24-Mar-03	22-Apr-03	29
HAS25	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.305	0.152	12.080	11.7893	12.84	0.788	12.55	2.5	2130	24-Mar-03	22-Apr-03	29
HAS26	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.305	0.152	12.076	11.7872	12.894	0.85	12.606	2.4	2130	24-Mar-03	22-Apr-03	29
HAS27	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.304	0.152	12.052	11.7985	12.847	0.82	12.594	2.1	2139	24-Mar-03	23-Apr-03	30
HAS28	2030	2.7	2.25	11.235	224.7	257.84	573	12.291	945	690	117	255.3	12.408		12.027	0.306	0.152	12.099	11.8634	12.957	0.888	12.722	2.0	2137	24-Mar-03	23-Apr-03	30
HAS29	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.304	0.152	13.167	12.7252	13.998	0.886	13.558	3.5	2307	25-Mar-03	24-Apr-03	30
HAS30	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.309	0.152	13.177	12.7522	13.931	0.842	13.509	3.3	2274	25-Mar-03	24-Apr-03	30
HAS31	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.304	0.152	13.130	12.7144	13.924	0.843	13.51	3.3	2305	25-Mar-03	25-Apr-03	31
HAS32	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.306	0.152	13.129	12.7102	13.865	0.792	13.448	3.3	2289	25-Mar-03	27-Apr-03	33
HAS33	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.307	0.152	13.131	12.7211	14.004	0.902	13.595	3.2	2284	25-Mar-03	26-Apr-03	32
HAS34	2190	3.9	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		13.124	0.308	0.152	13.144	12.7533	13.908	0.786	13.518	3.1	2282	25-Mar-03	25-Apr-03	31
HAS35	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.309	0.152	12.879	12.709	13.622	0.826	13.453	1.3	2267	28-Mar-03	28-Apr-03	31
HAS36	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.309	0.152	12.868	12.693	13.644	0.892	13.471	1.4	2264	28-Mar-03	28-Apr-03	31
HAS37	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.308	0.152	12.897	12.696	13.710	0.892	13.510	1.6	2272	28-Mar-03	29-Apr-03	32
HAS38	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.31	0.152	12.860	12.712	13.609	0.812	13.462	1.2	2260	28-Mar-03	29-Apr-03	32
HAS39	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.302	0.152	12.841	12.677	13.562	0.773	13.399	1.3	2313	28-Mar-03	30-Apr-03	33
HAS40	2190	1.7	2.25	12.121	242.42	278.18	618	13.260	1020	745	126	275.4	13.386		12.852	0.307	0.152	12.848	12.697	13.538	0.784	13.388	1.2	2279	28-Mar-03	25-Apr-03	28

Appendix D Static triaxial test results

HNN: Untreated material

STATIC TRIAXIAL TEST

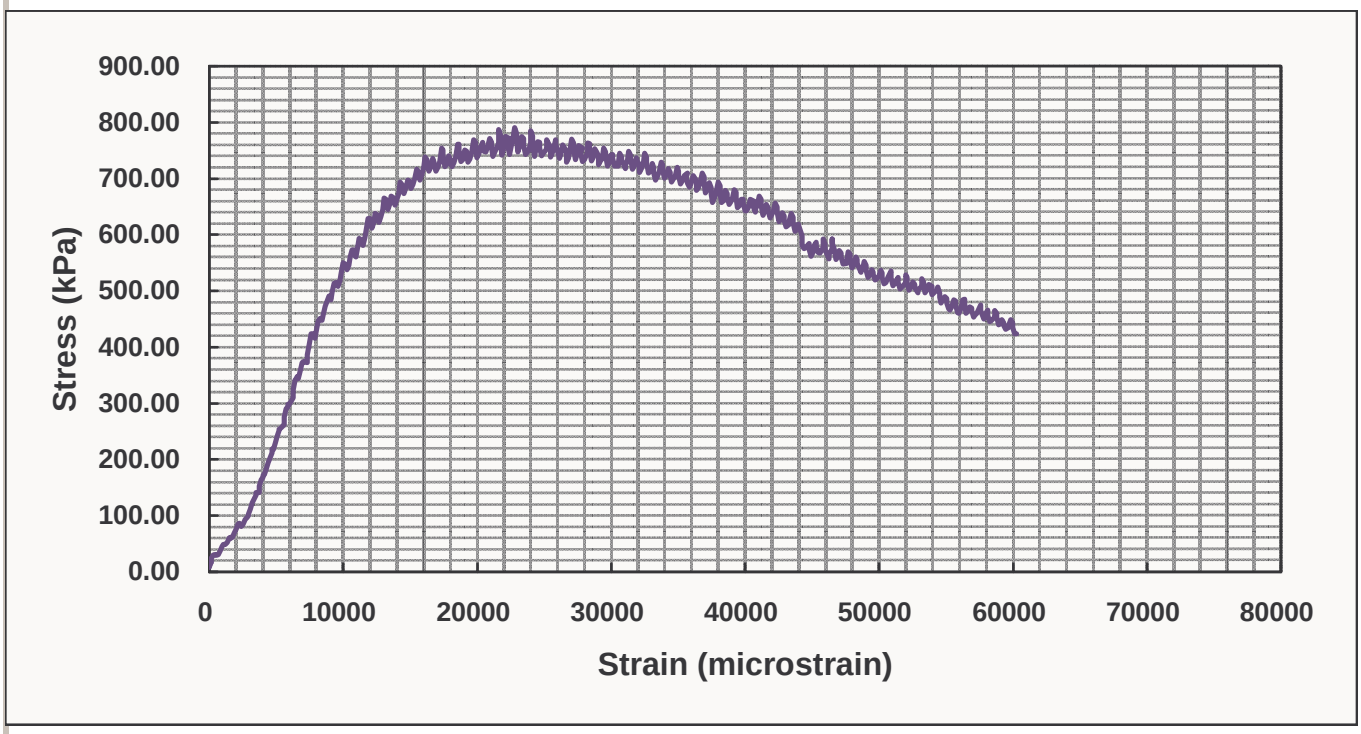
Material: Hornfels | **Treatment None**

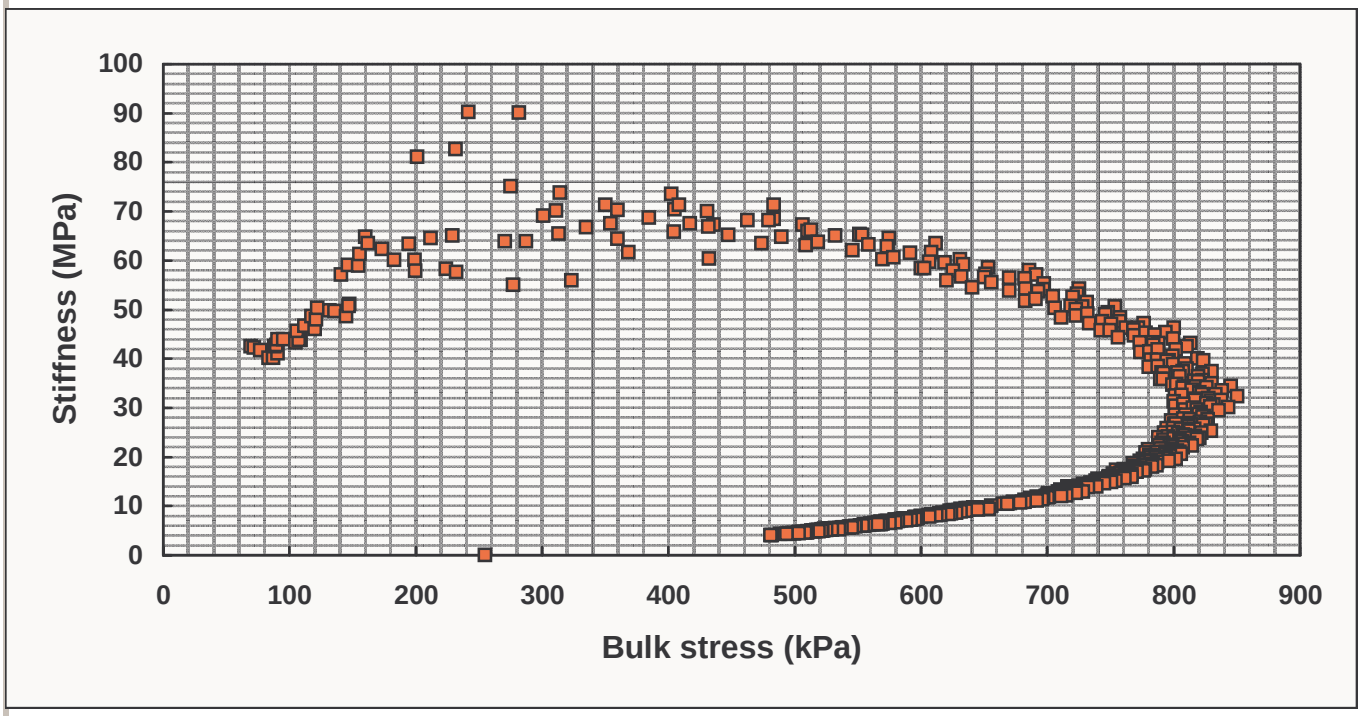
Sample #: HNN01

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 20**

Moisture (%): 3.6 | **Linear stiffness (MPa): 55**

Maximum deviator stress (kPa): 791





STATIC TRIAXIAL TEST

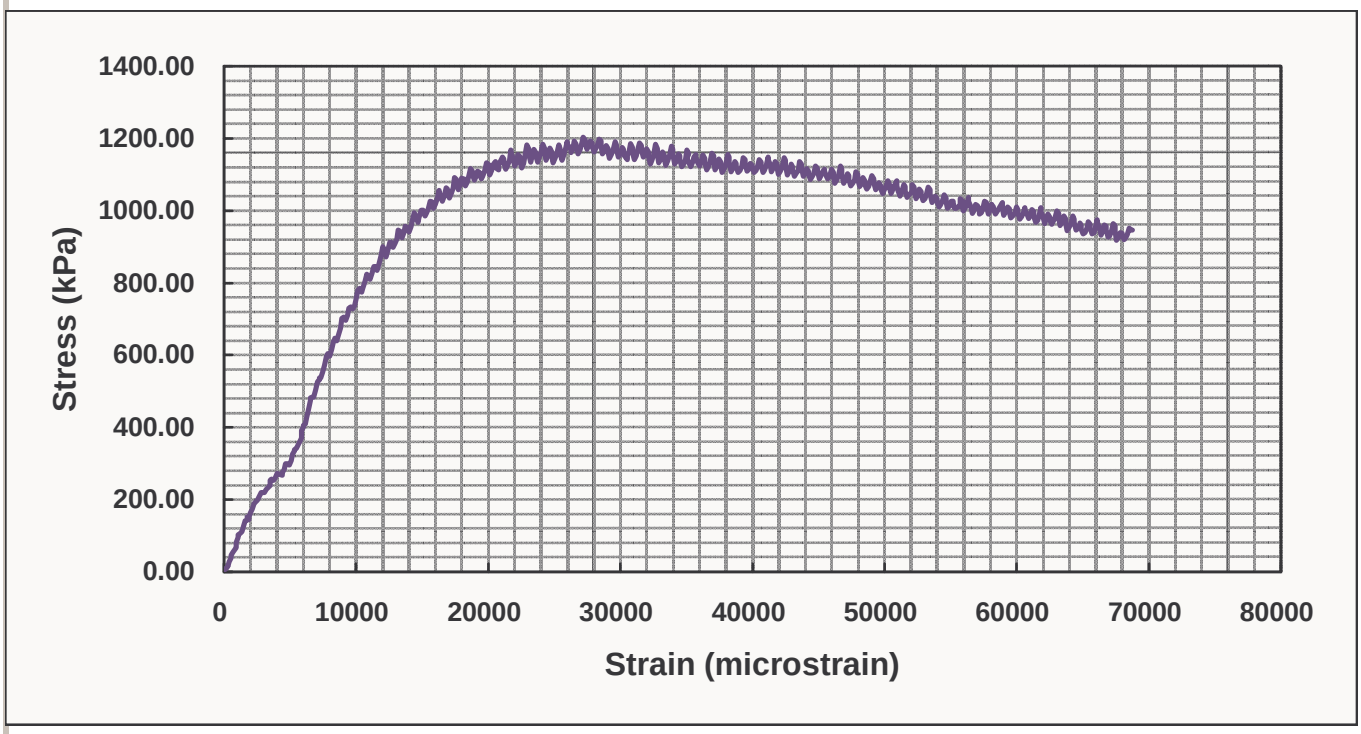
Material: Hornfels | **Treatment None**

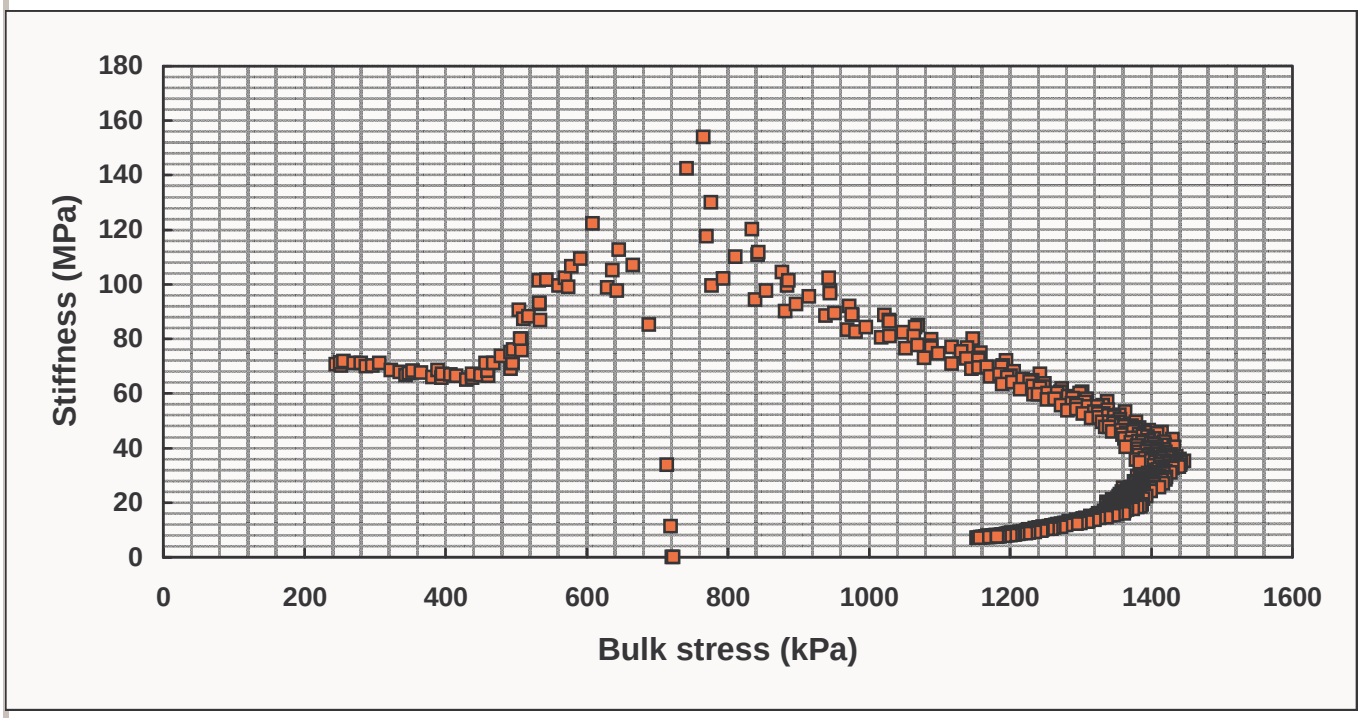
Sample #: HNN02

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 80**

Moisture (%): 3.5 | **Linear stiffness (MPa): 77**

Maximum deviator stress (kPa): 1203





STATIC TRIAXIAL TEST

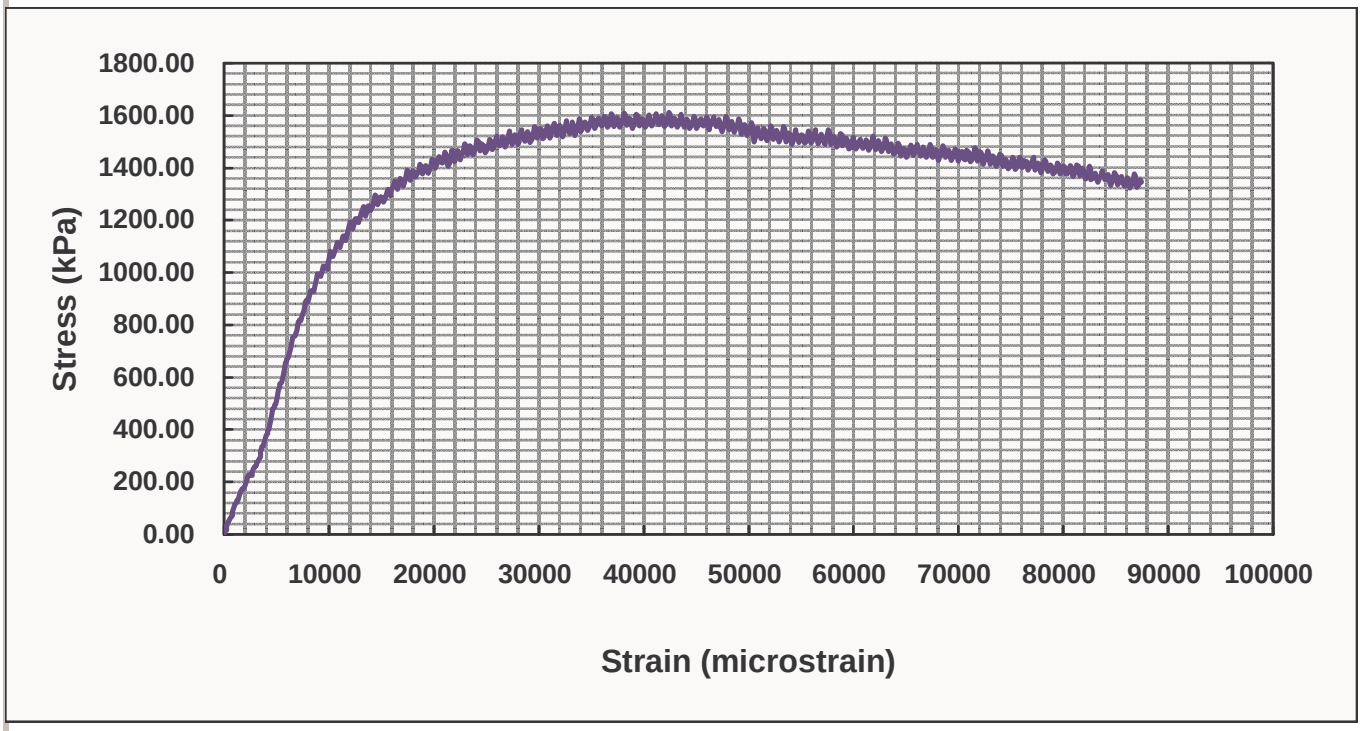
Material: Hornfels | **Treatment None**

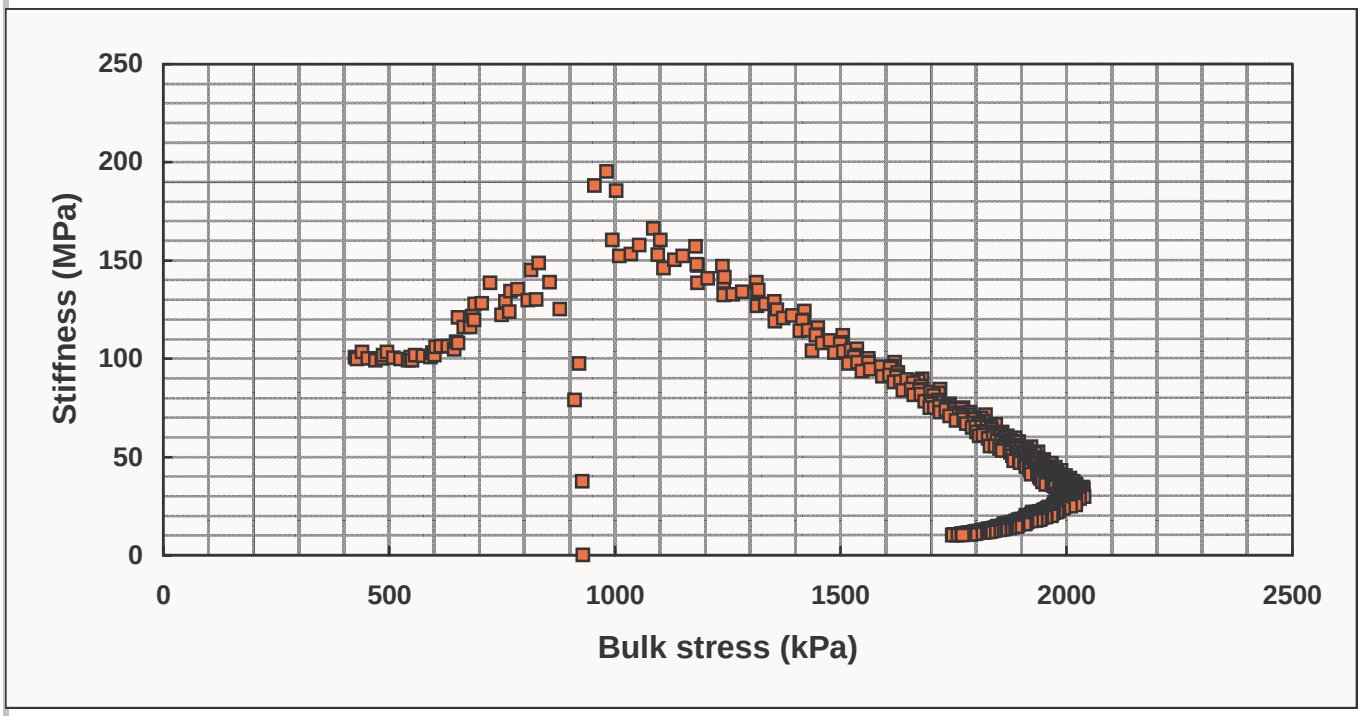
Sample #: HNN03

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 141**

Moisture (%): 3.6 | **Linear stiffness (MPa): 114**

Maximum deviator stress (kPa): 1611





STATIC TRIAXIAL TEST

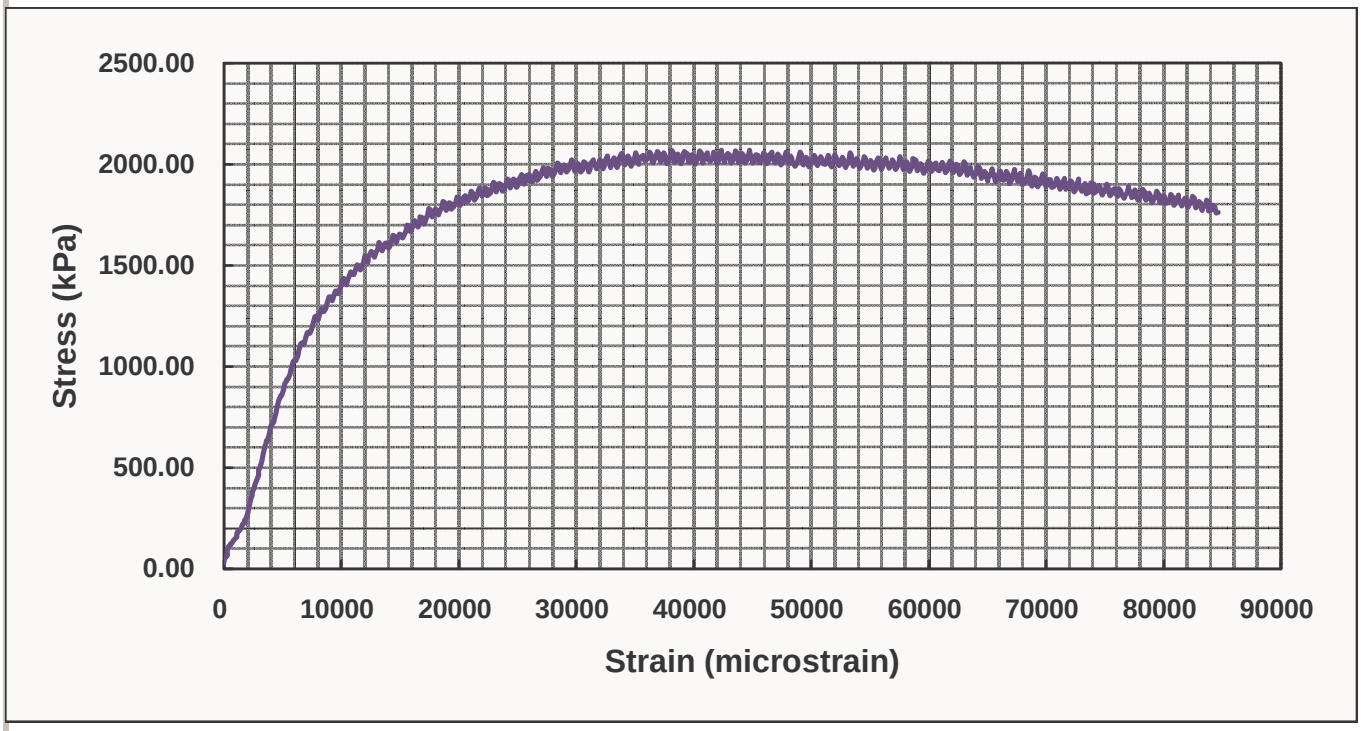
Material: Hornfels | **Treatment None**

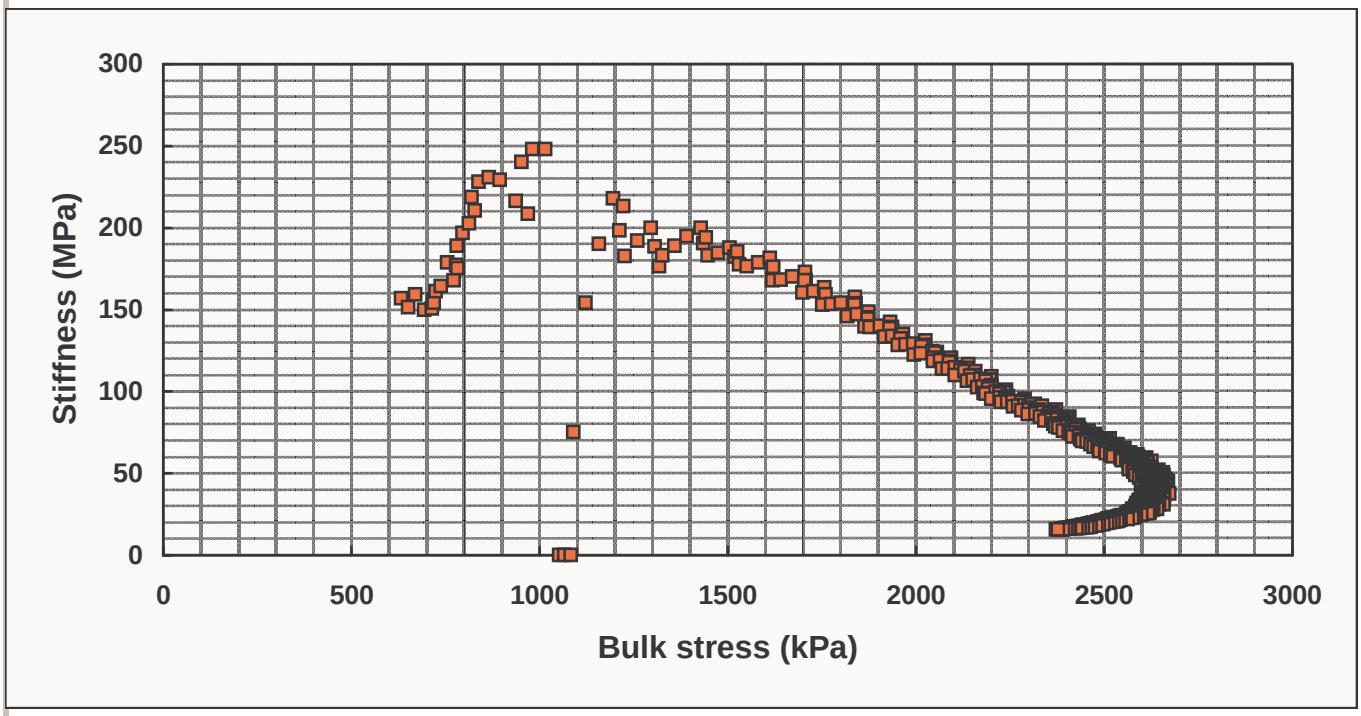
Sample #: HNN04

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 200**

Moisture (%): 3.5 | **Linear stiffness (MPa): 154**

Maximum deviator stress (kPa): 2071





STATIC TRIAXIAL TEST

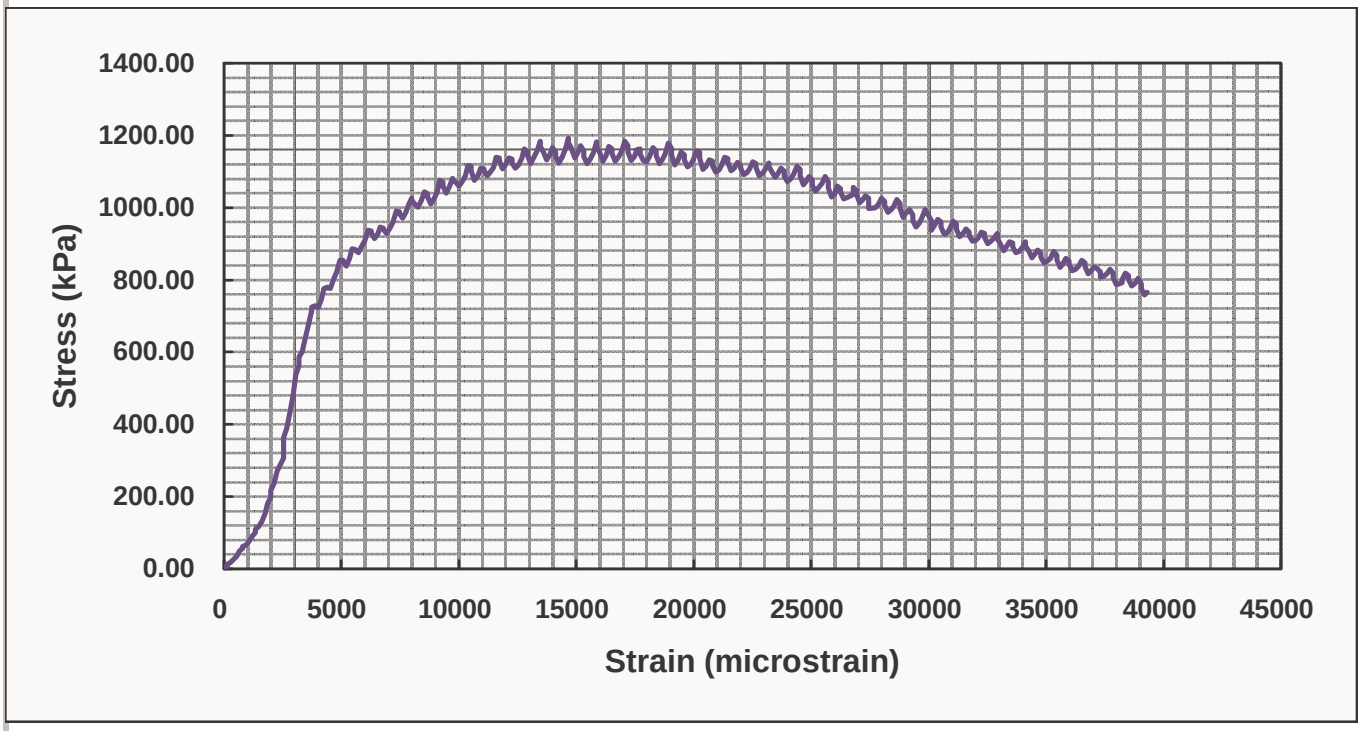
Material: Hornfels | **Treatment None**

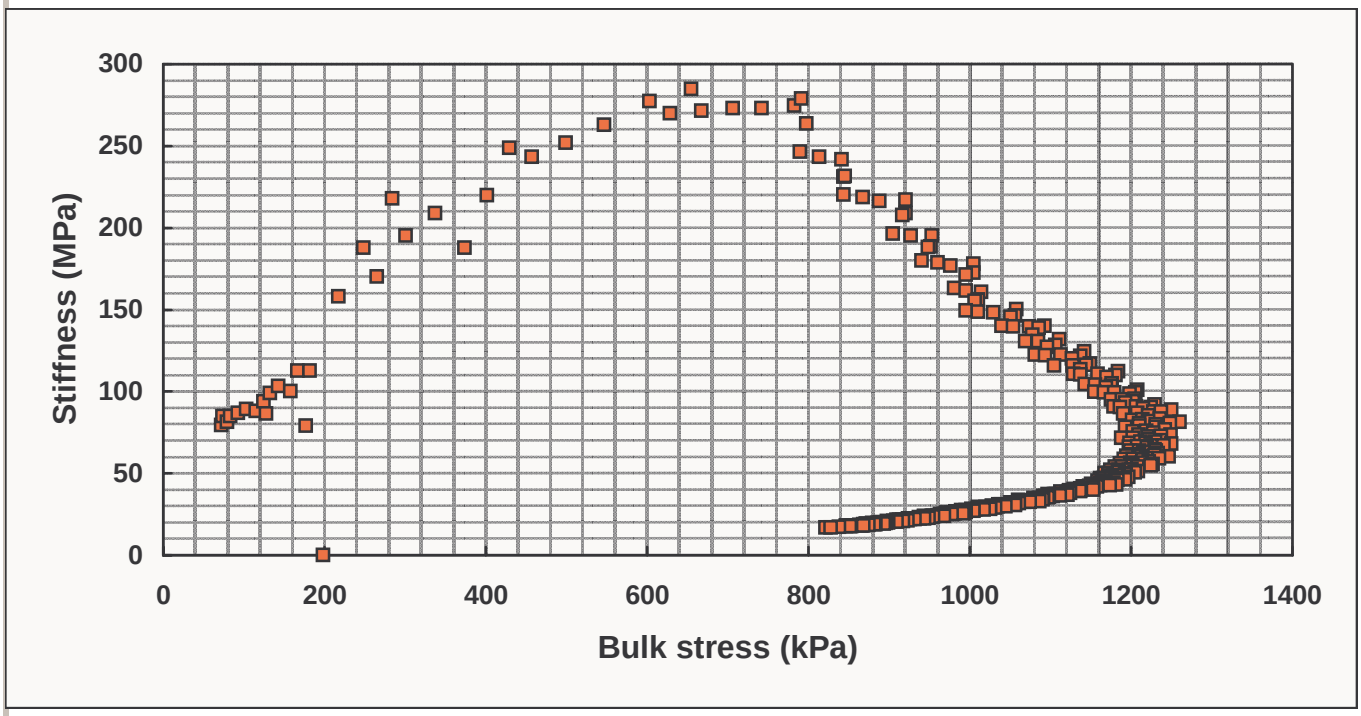
Sample #: HNN05

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 22**

Moisture (%): 1.4 | **Linear stiffness (MPa): 273**

Maximum deviator stress (kPa): 1192





STATIC TRIAXIAL TEST

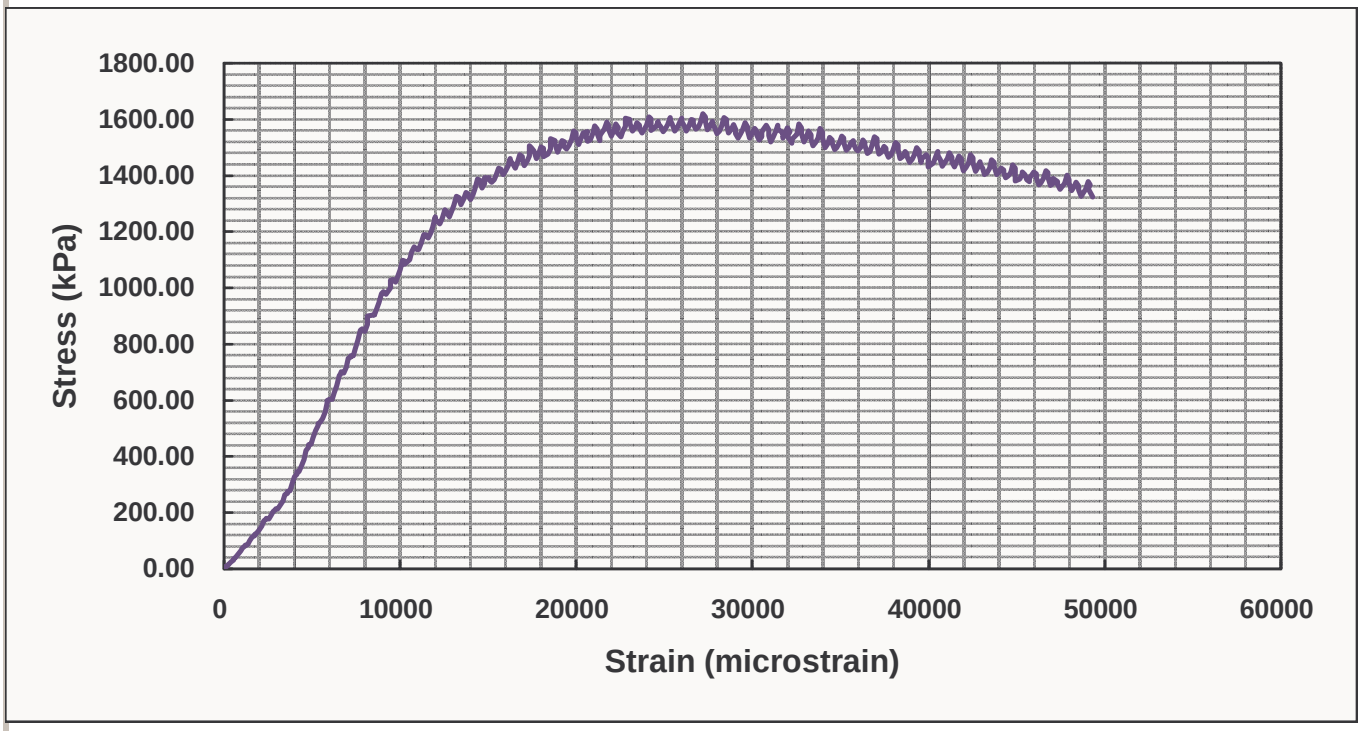
Material: Hornfels **Treatment None**

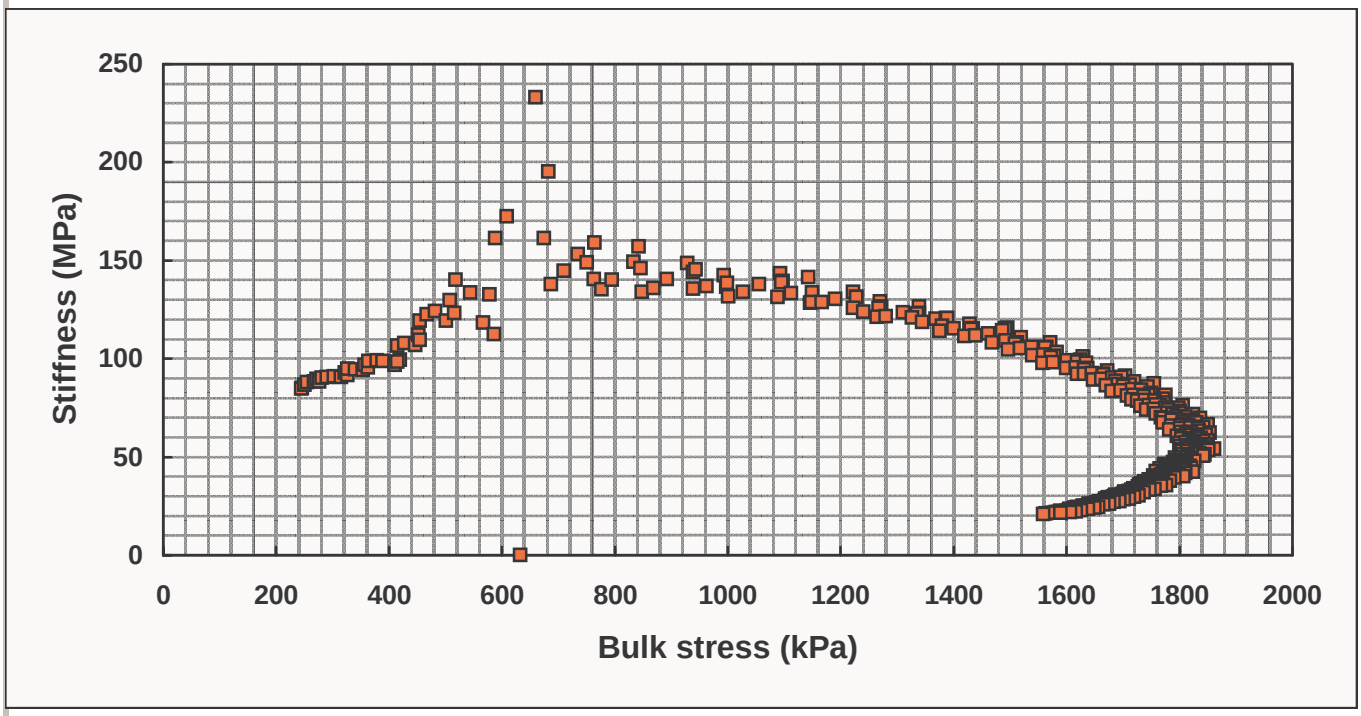
Sample #: HNN06

Dry Density (kg/cub m): 2360 **Confining pressure (kPa): 80**

Moisture (%): 1.6 **Linear stiffness (MPa): 130**

Maximum deviator stress (kPa): 1619





STATIC TRIAXIAL TEST

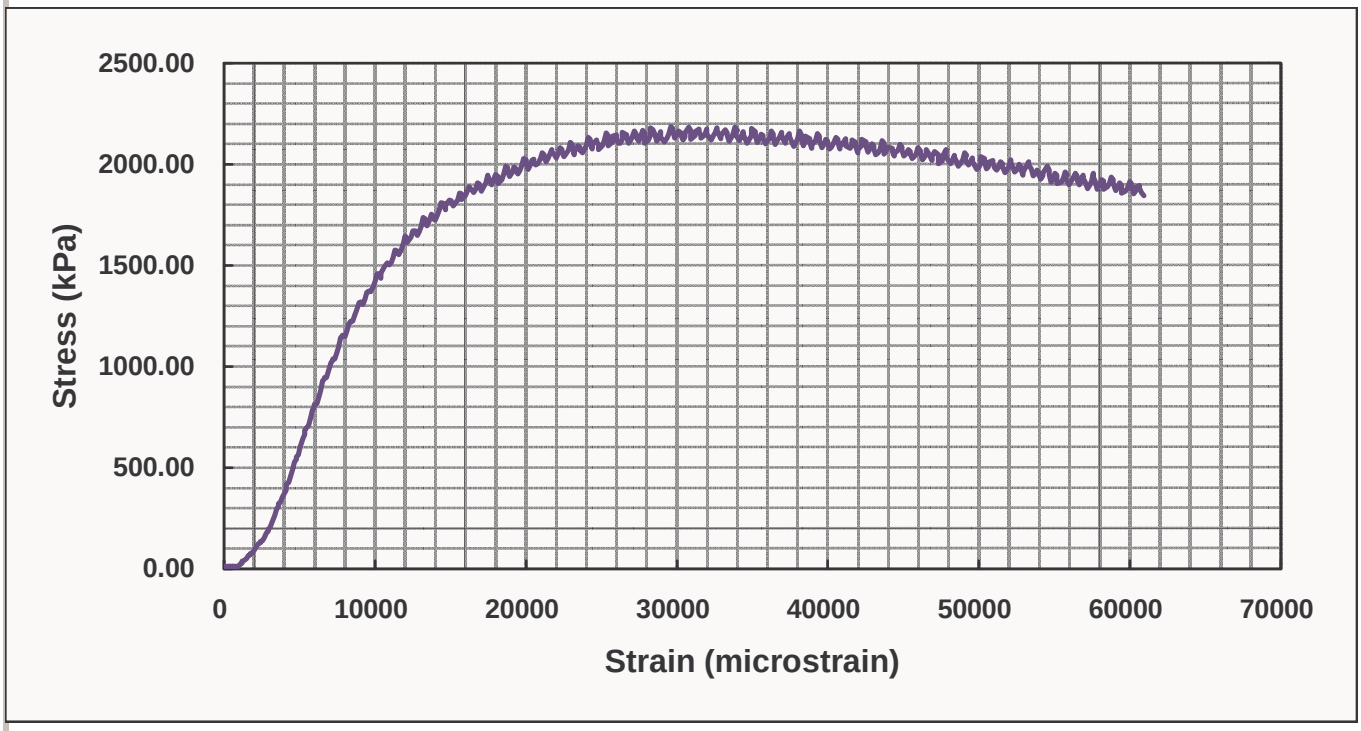
Material: Hornfels **Treatment None**

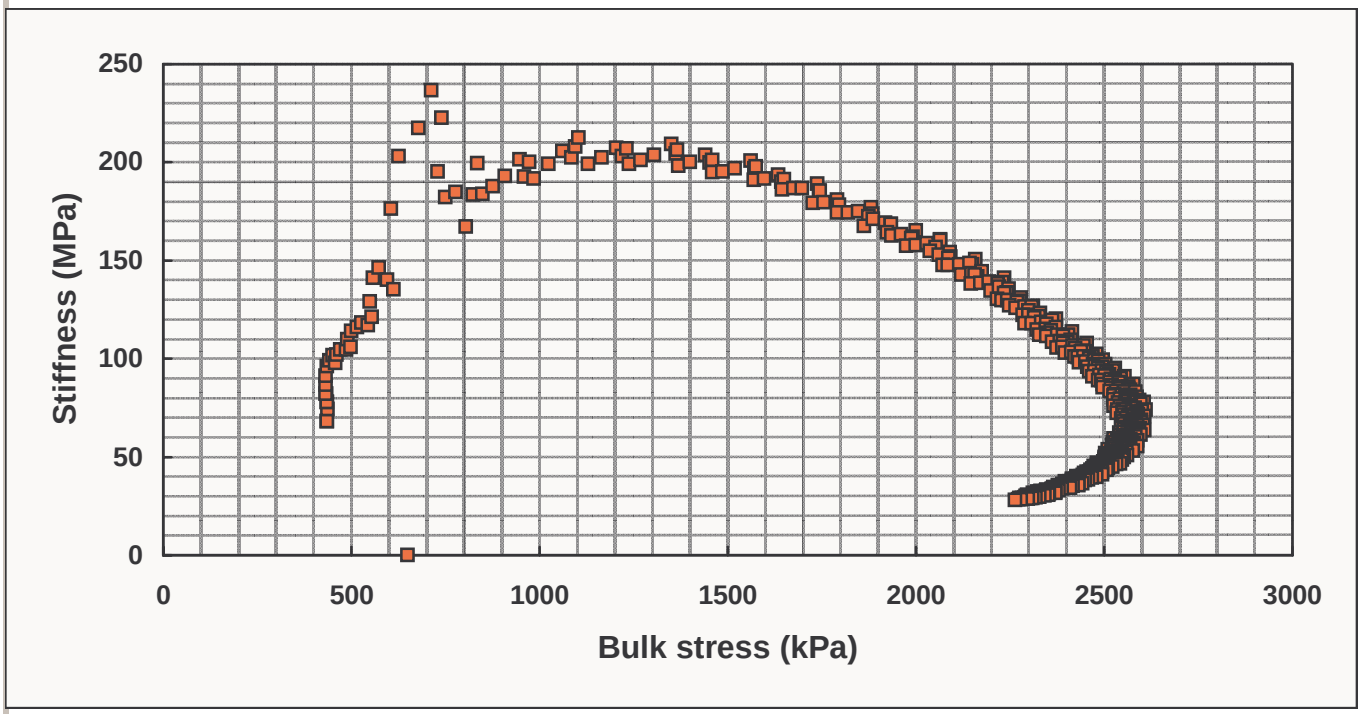
Sample #: HNN07

Dry Density (kg/cub m): 2360 **Confining pressure (kPa): 141**

Moisture (%): 1.6 **Linear stiffness (MPa): 187**

Maximum deviator stress (kPa): 2187





STATIC TRIAXIAL TEST

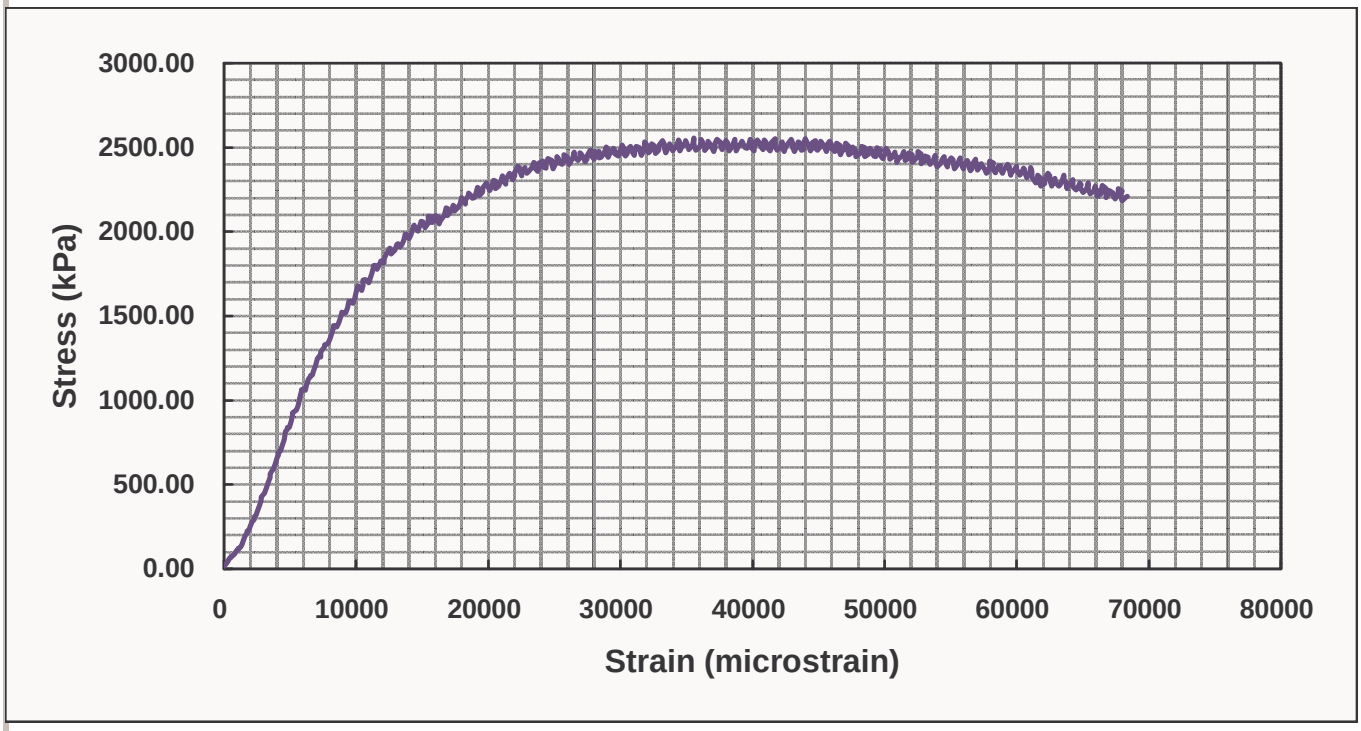
Material: Hornfels | **Treatment None**

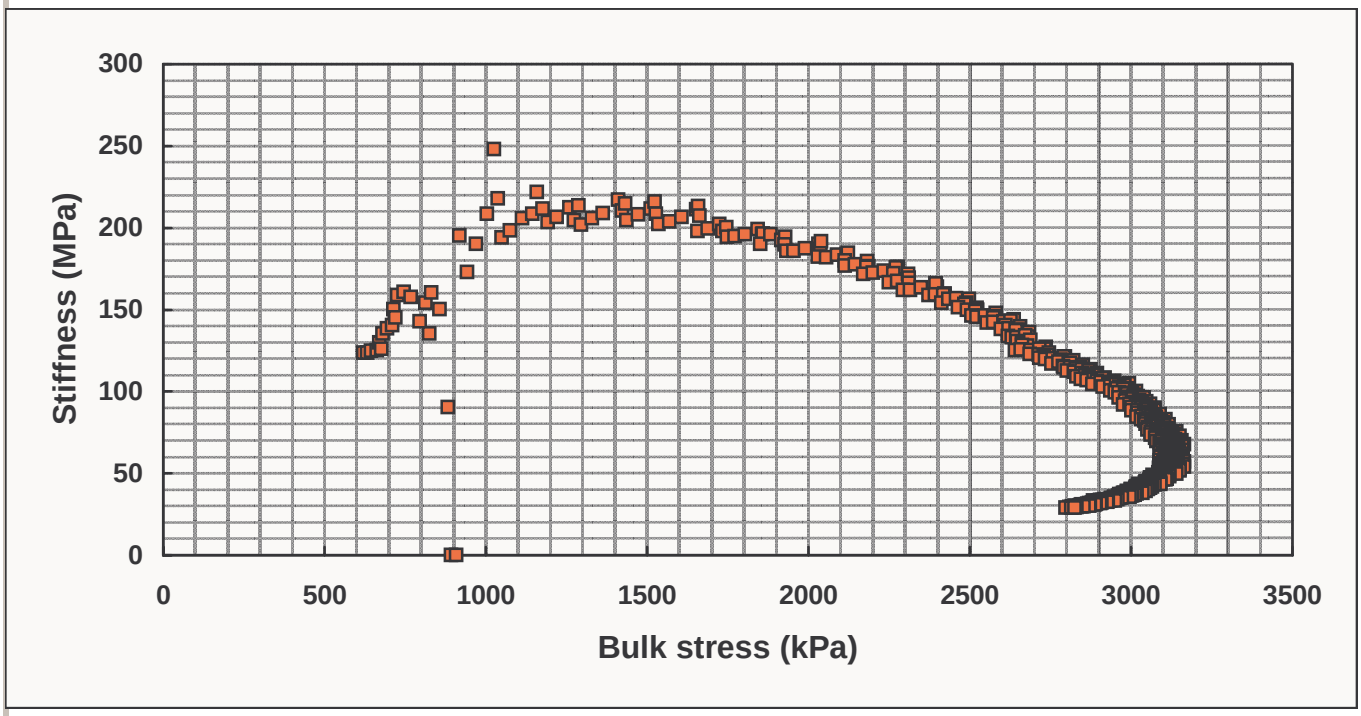
Sample #: HNN08

Dry Density (kg/cub m): 2360 | **Confining pressure (kPa): 202**

Moisture (%): 1.6 | **Linear stiffness (MPa): 187**

Maximum deviator stress (kPa): 2554





STATIC TRIAXIAL TEST

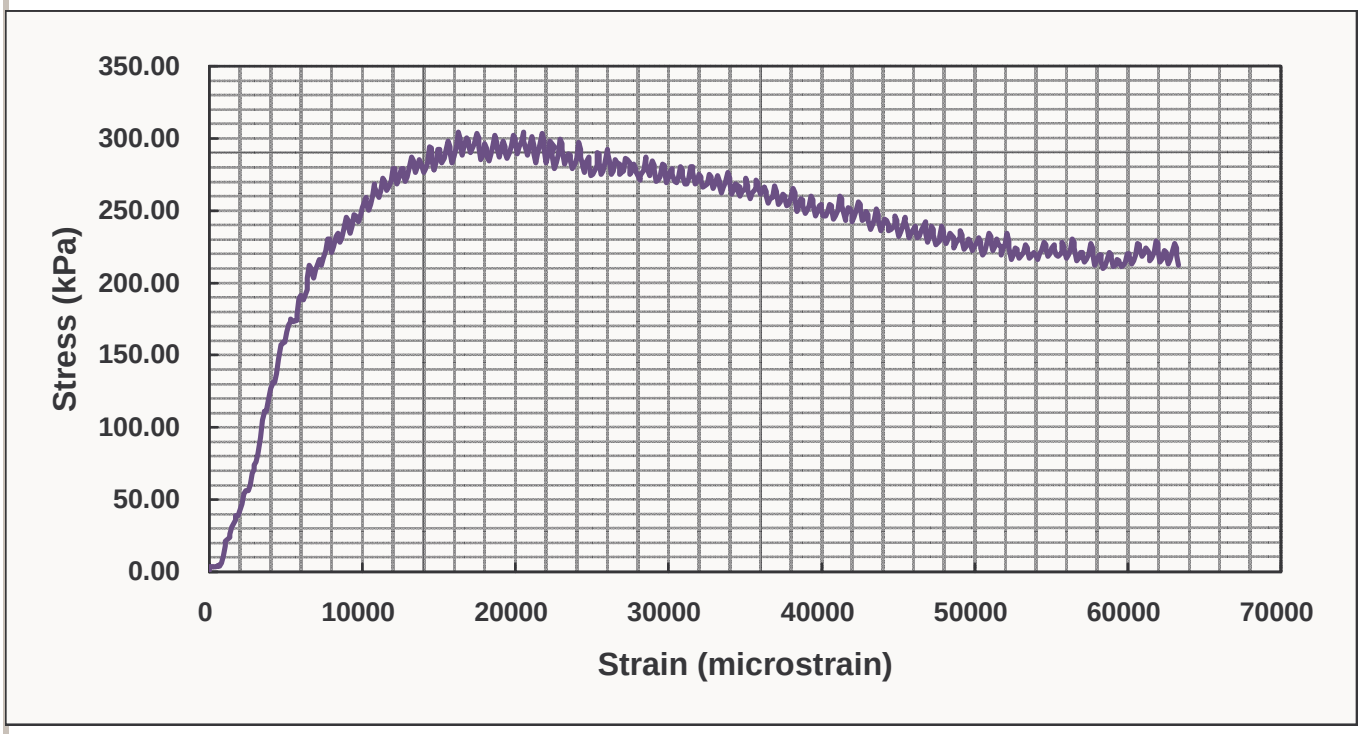
Material: Hornfels — **Treatment None**

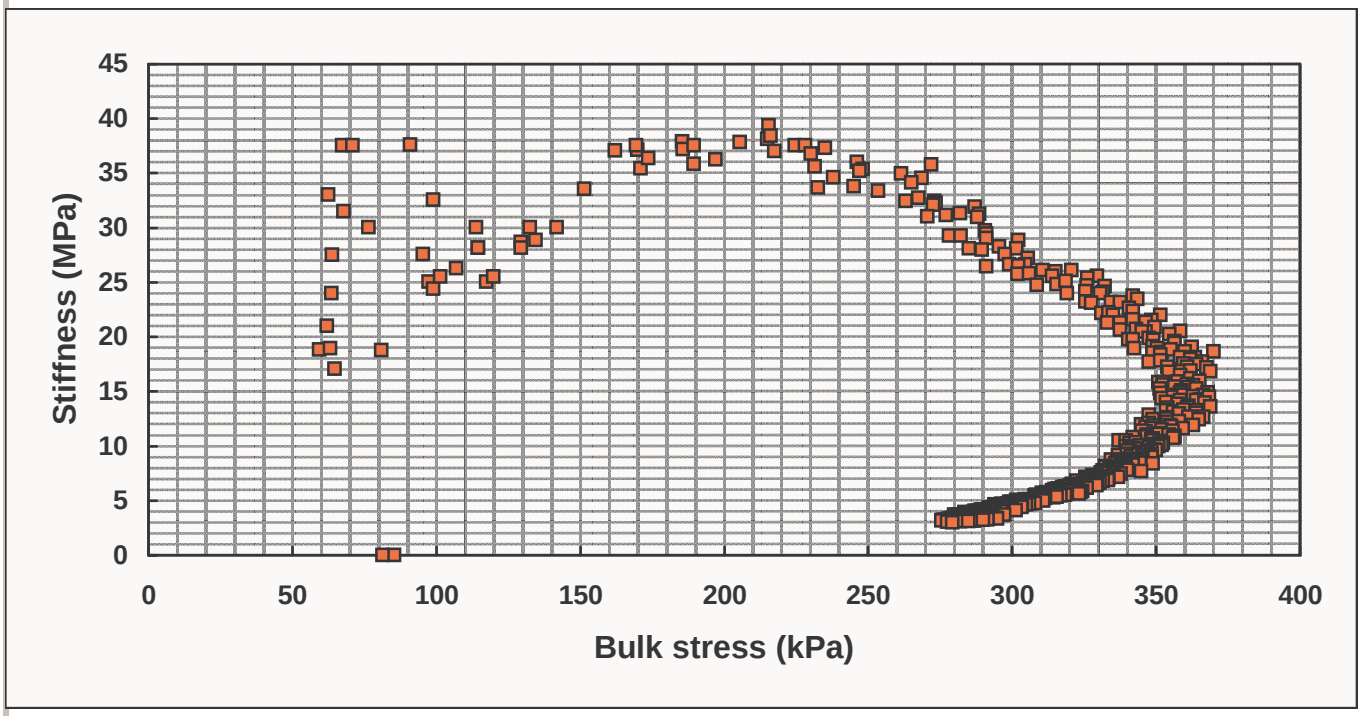
Sample #: HNN09

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 21**

Moisture (%): 5.6 — **Linear stiffness (MPa): 35**

Maximum deviator stress (kPa): 304





STATIC TRIAXIAL TEST

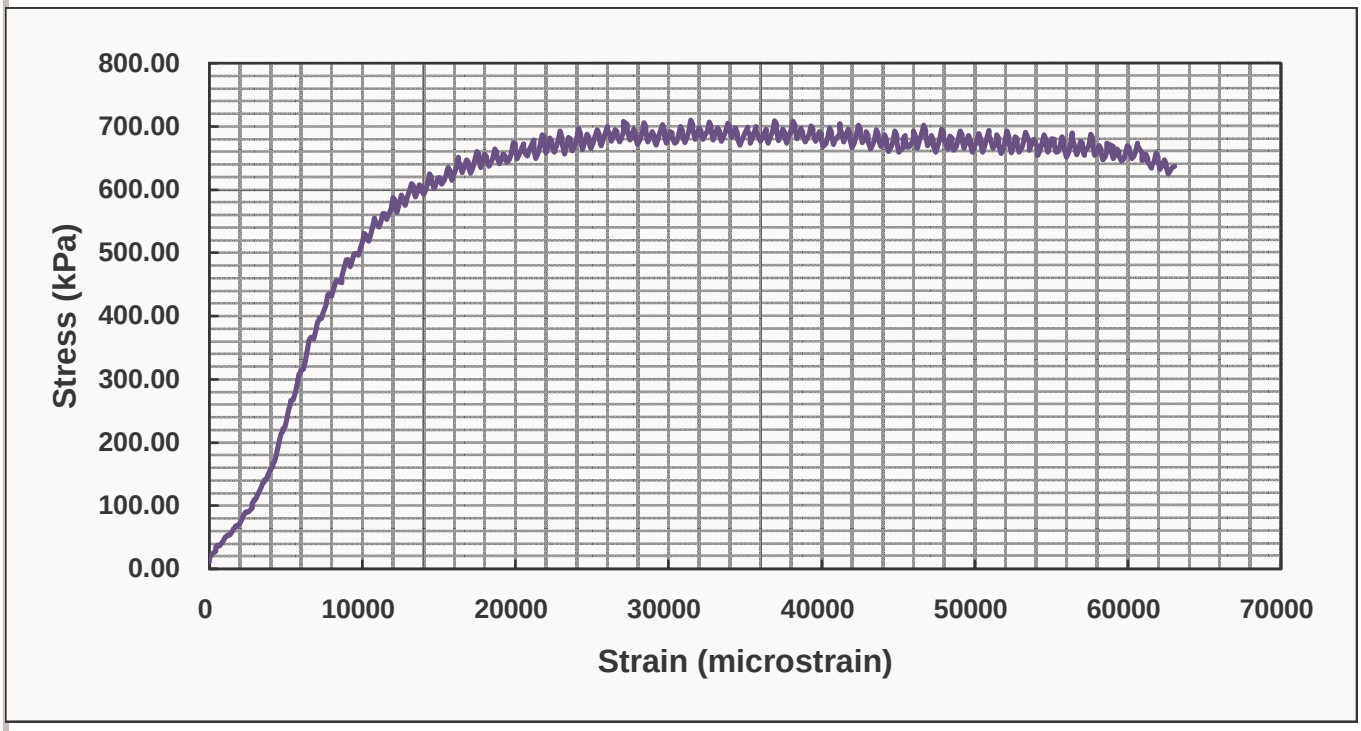
Material: Hornfels — **Treatment None**

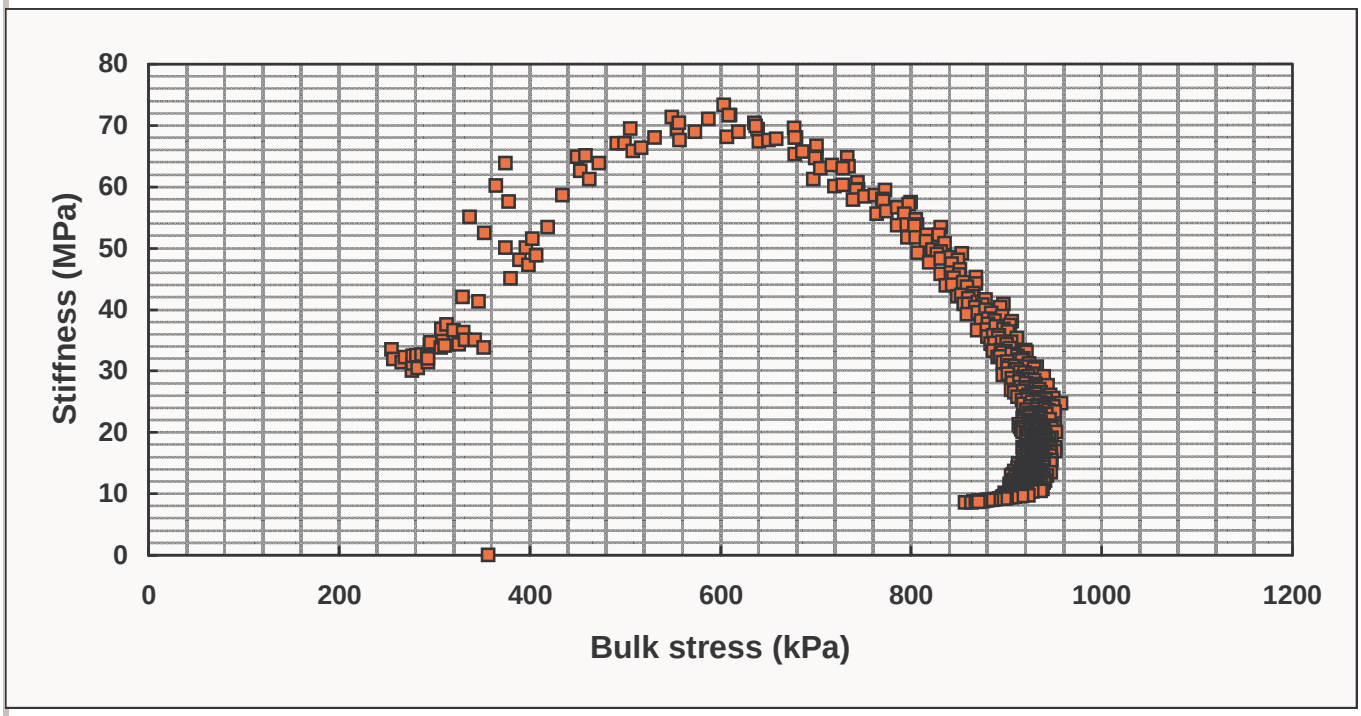
Sample #: HNN10

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 82**

Moisture (%): 5.8 — **Linear stiffness (MPa): 67**

Maximum deviator stress (kPa): 710





STATIC TRIAXIAL TEST

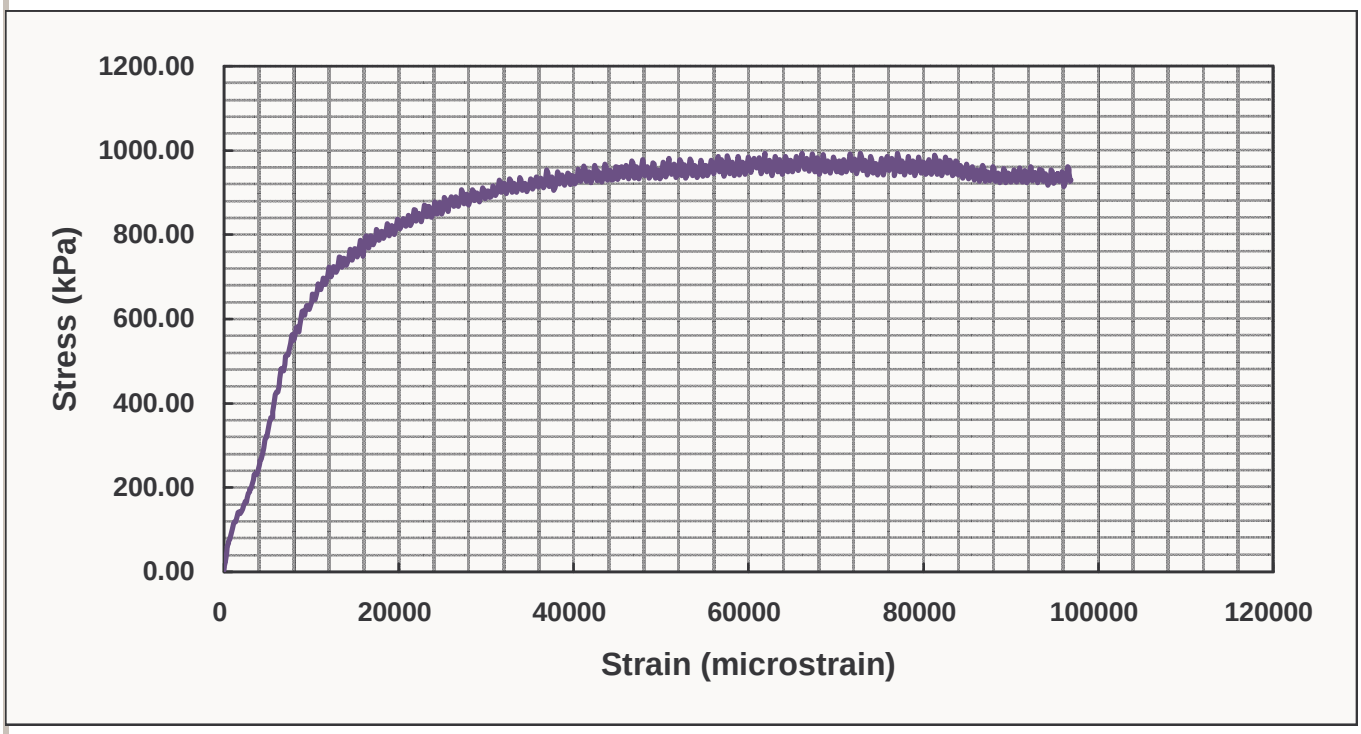
Material: Hornfels | **Treatment None**

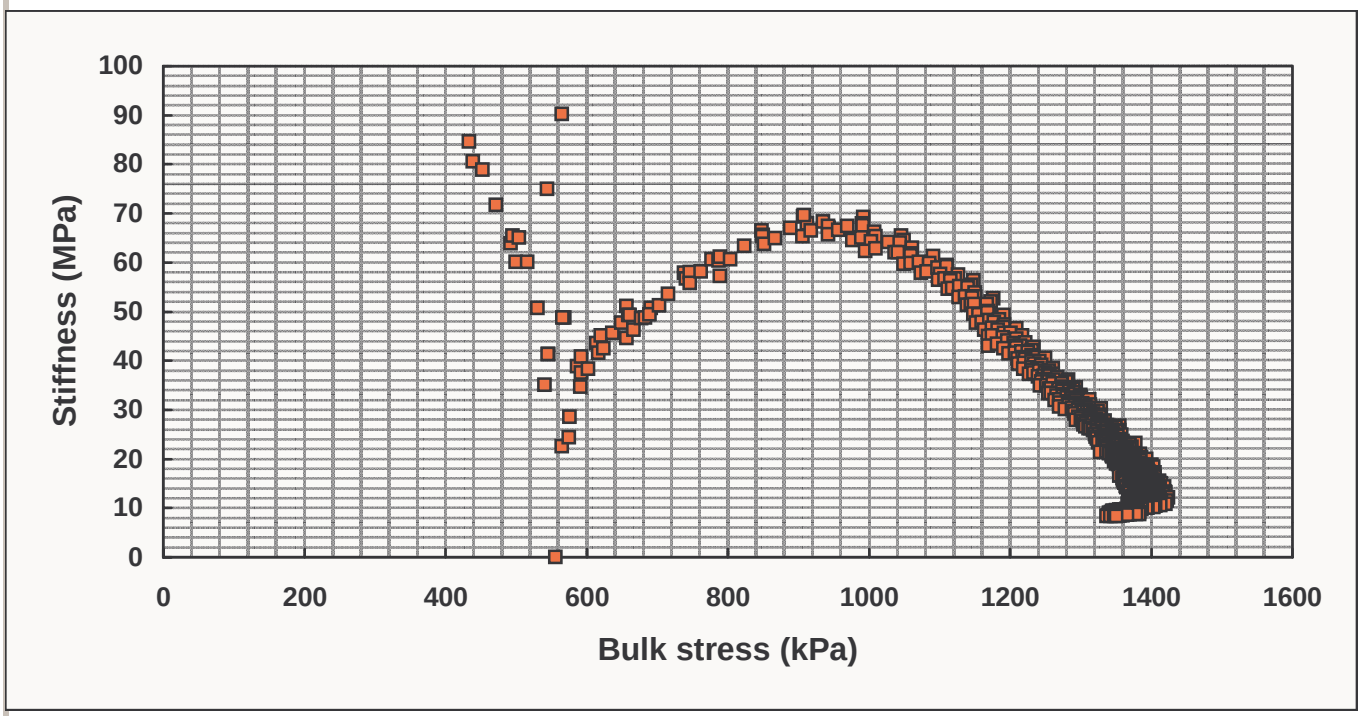
Sample #: HNN11

Dry Density (kg/cub m): 2200 | **Confining pressure (kPa): 142**

Moisture (%): 5.8 | **Linear stiffness (MPa): 67**

Maximum deviator stress (kPa): 994





STATIC TRIAXIAL TEST

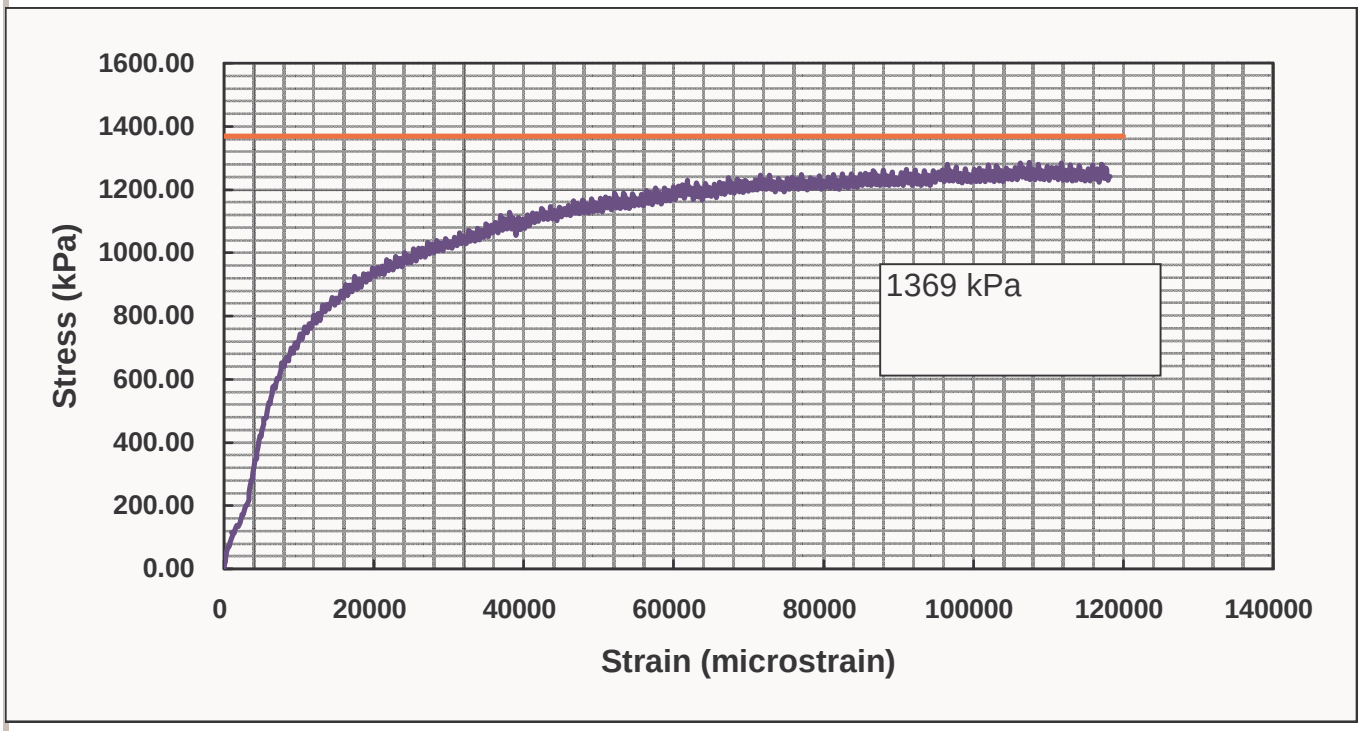
Material: Hornfels | **Treatment None**

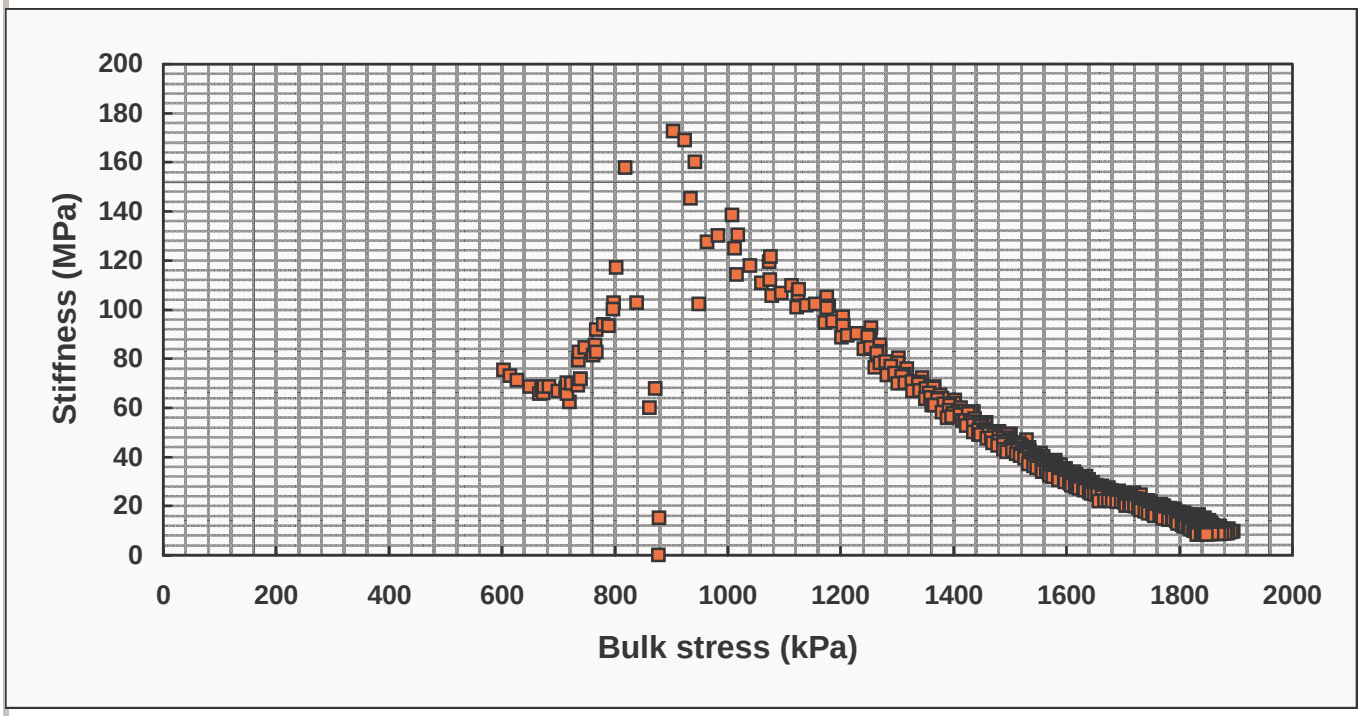
Sample #: HNN12

Dry Density (kg/cub m): 2200 | **Confining pressure (kPa): 201**

Moisture (%): 5.7 | **Linear stiffness (MPa): 90**

Maximum deviator stress (kPa): 1285





STATIC TRIAXIAL TEST

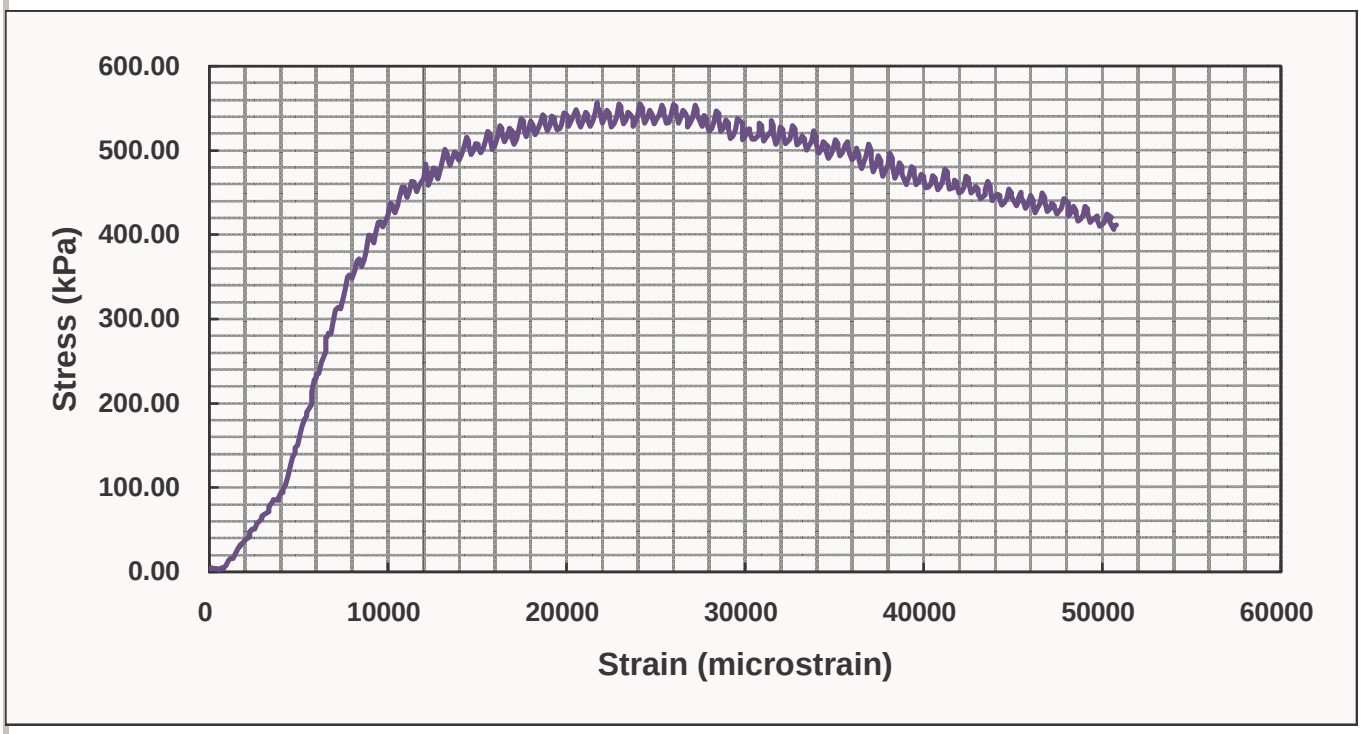
Material: Hornfels — **Treatment None**

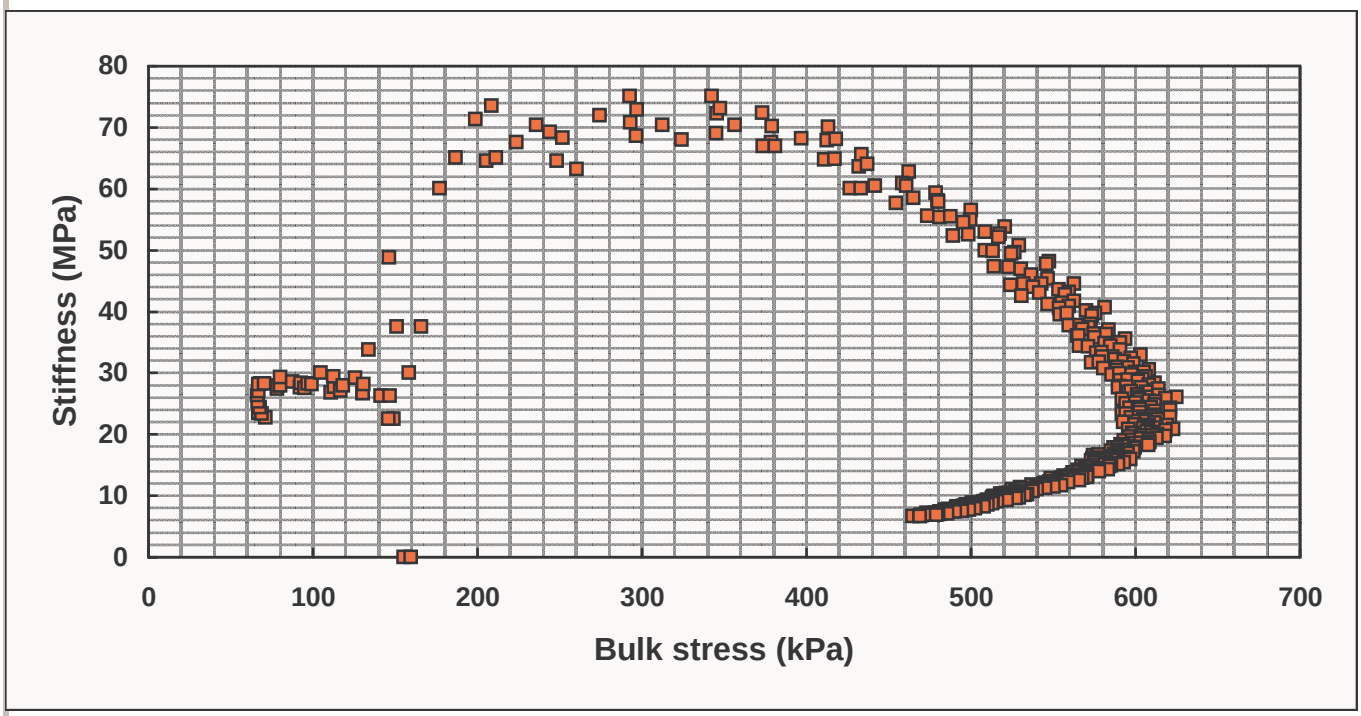
Sample #: HNN13

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 21**

Moisture (%): 3.2 — **Linear stiffness (MPa): 67**

Maximum deviator stress (kPa): 557





STATIC TRIAXIAL TEST

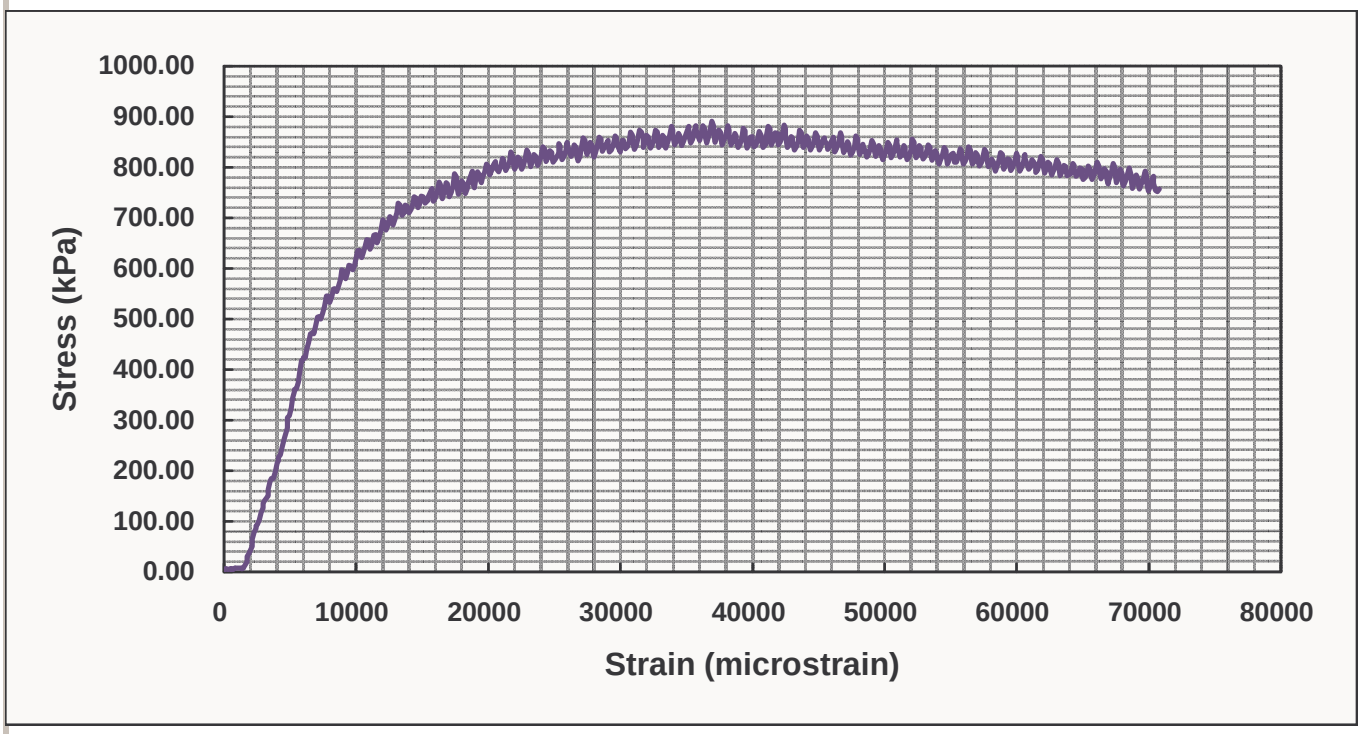
Material: Hornfels | **Treatment None**

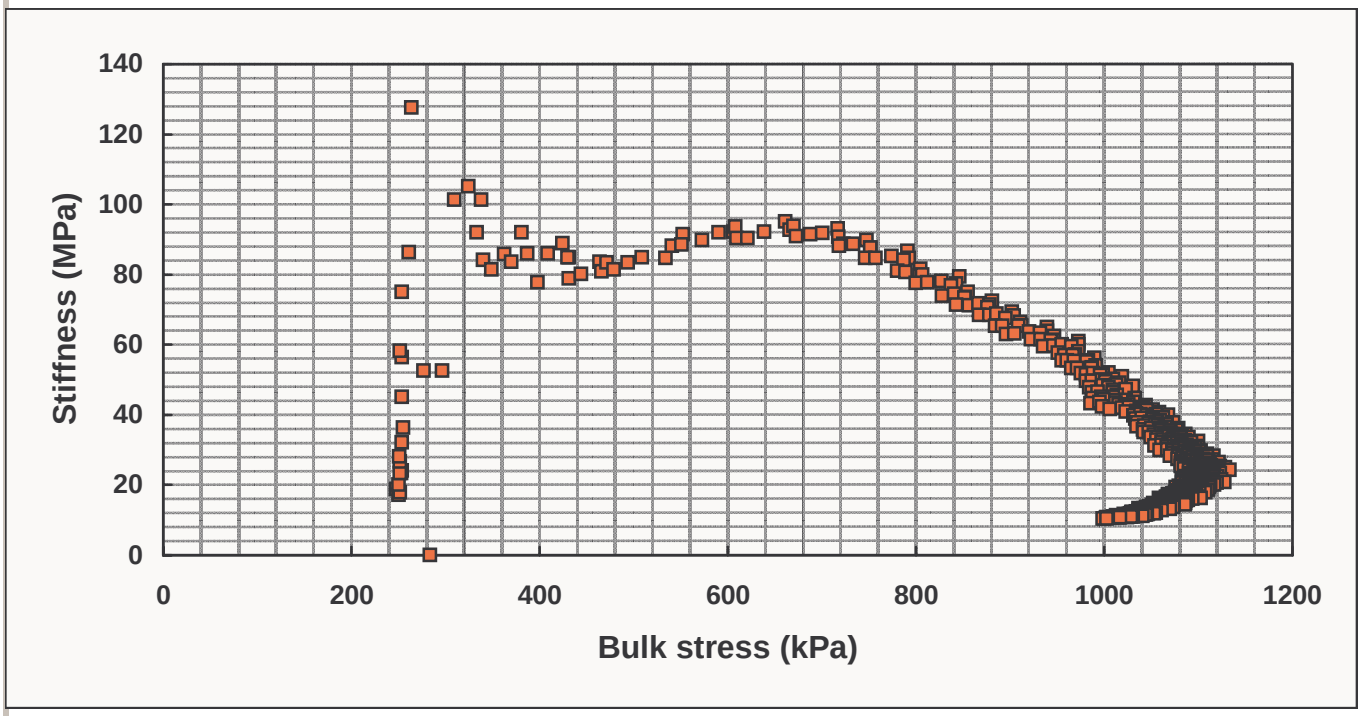
Sample #: HNN14

Dry Density (kg/cub m): 2200 | **Confining pressure (kPa): 81**

Moisture (%): 3.3 | **Linear stiffness (MPa): 89**

Maximum deviator stress (kPa): 891





STATIC TRIAXIAL TEST

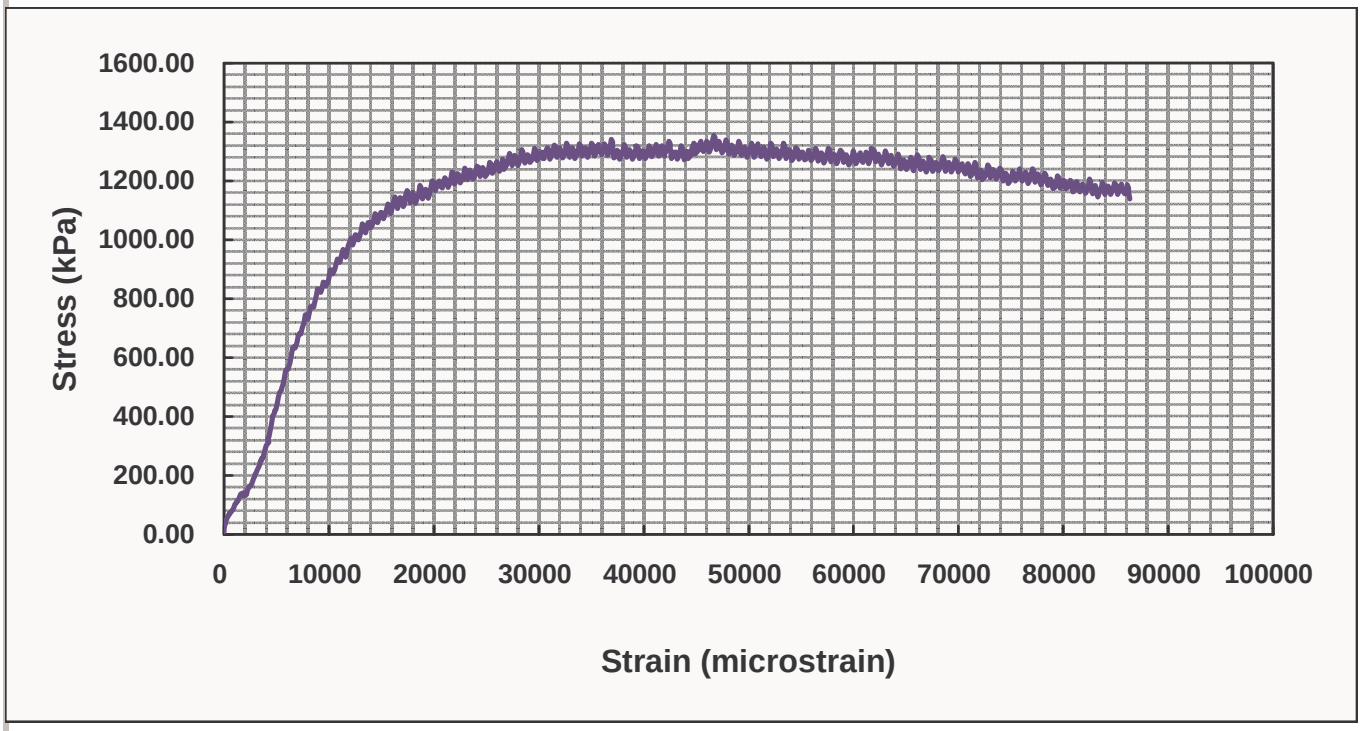
Material: Hornfels | **Treatment None**

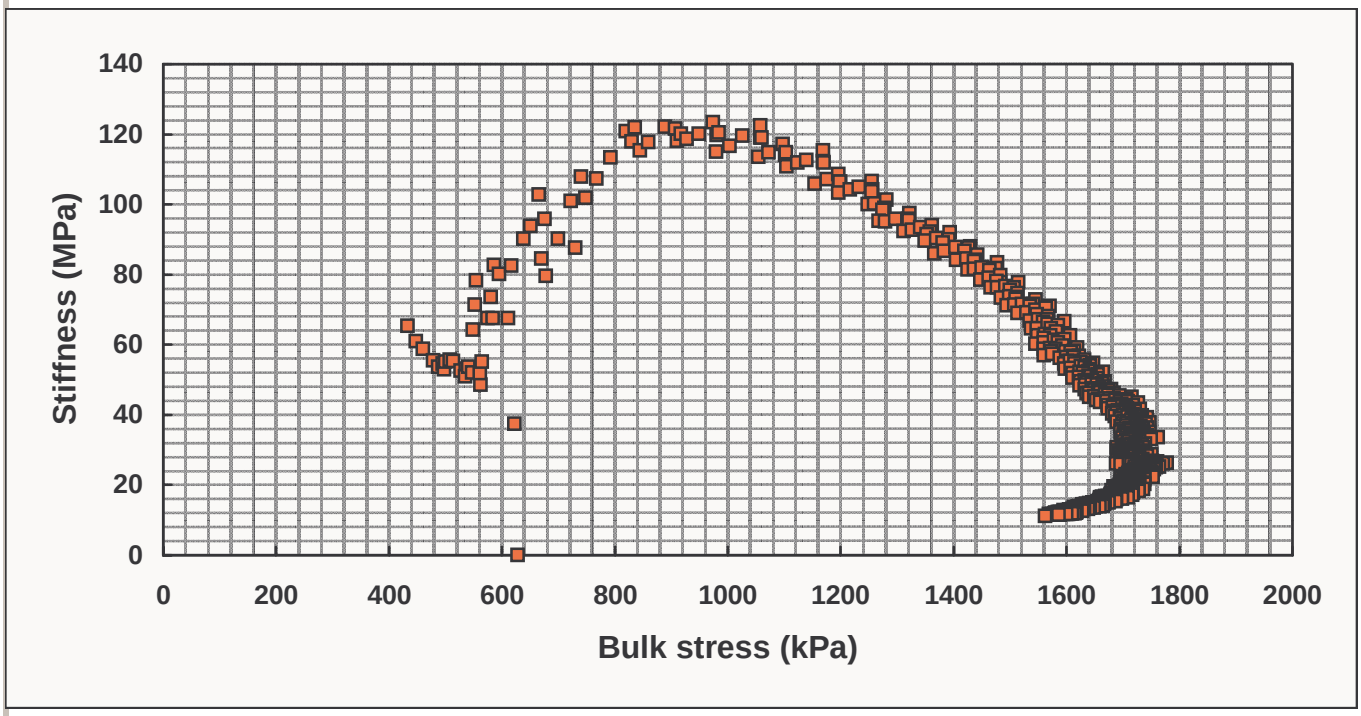
Sample #: HNN15

Dry Density (kg/cub m): 2200 | **Confining pressure (kPa): 141**

Moisture (%): 2.9 | **Linear stiffness (MPa): 105**

Maximum deviator stress (kPa): 1354





STATIC TRIAXIAL TEST

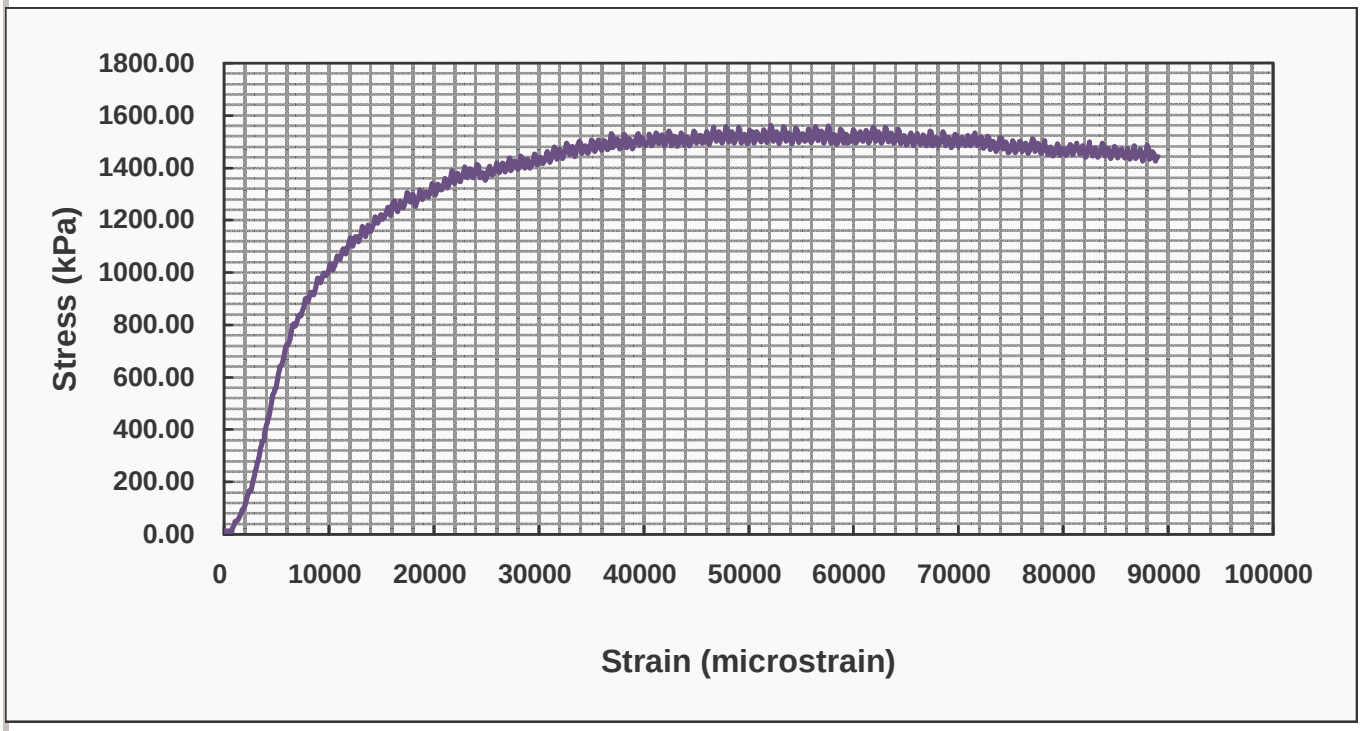
Material: Hornfels | **Treatment None**

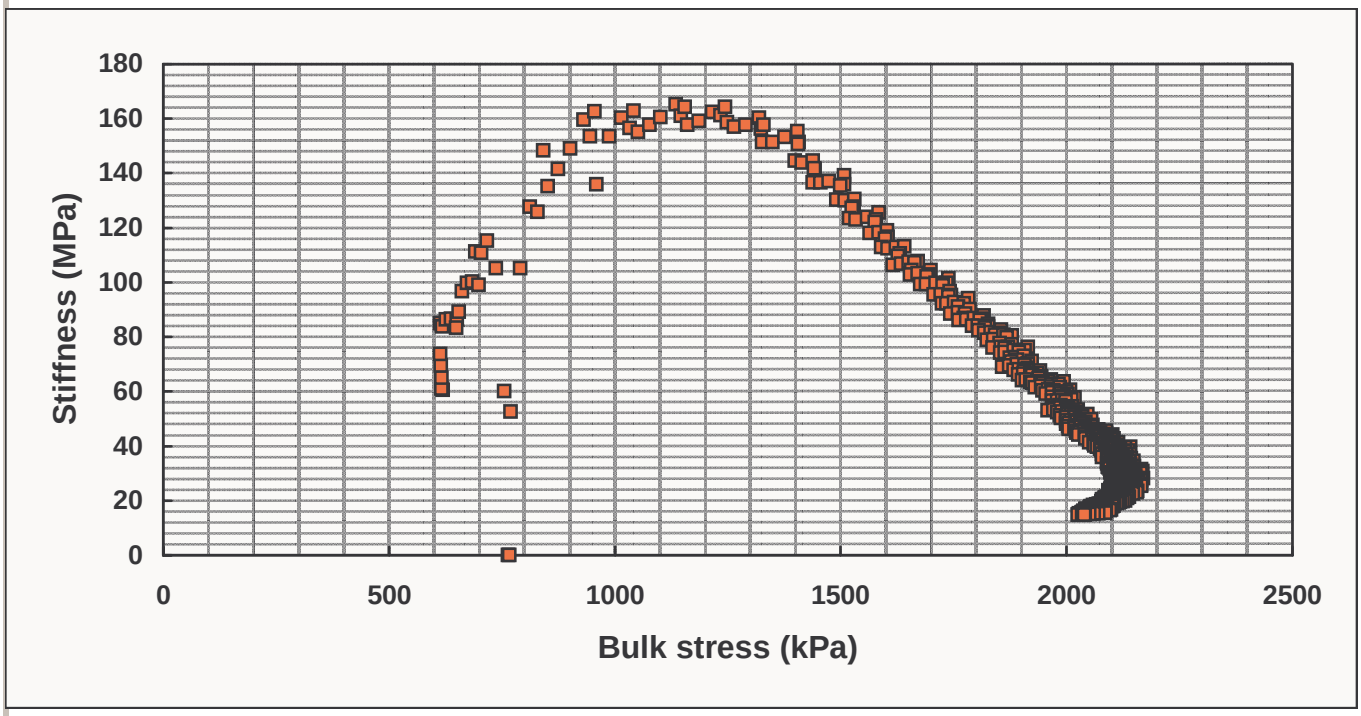
Sample #: HNN16

Dry Density (kg/cub m): 2200 | **Confining pressure (kPa): 201**

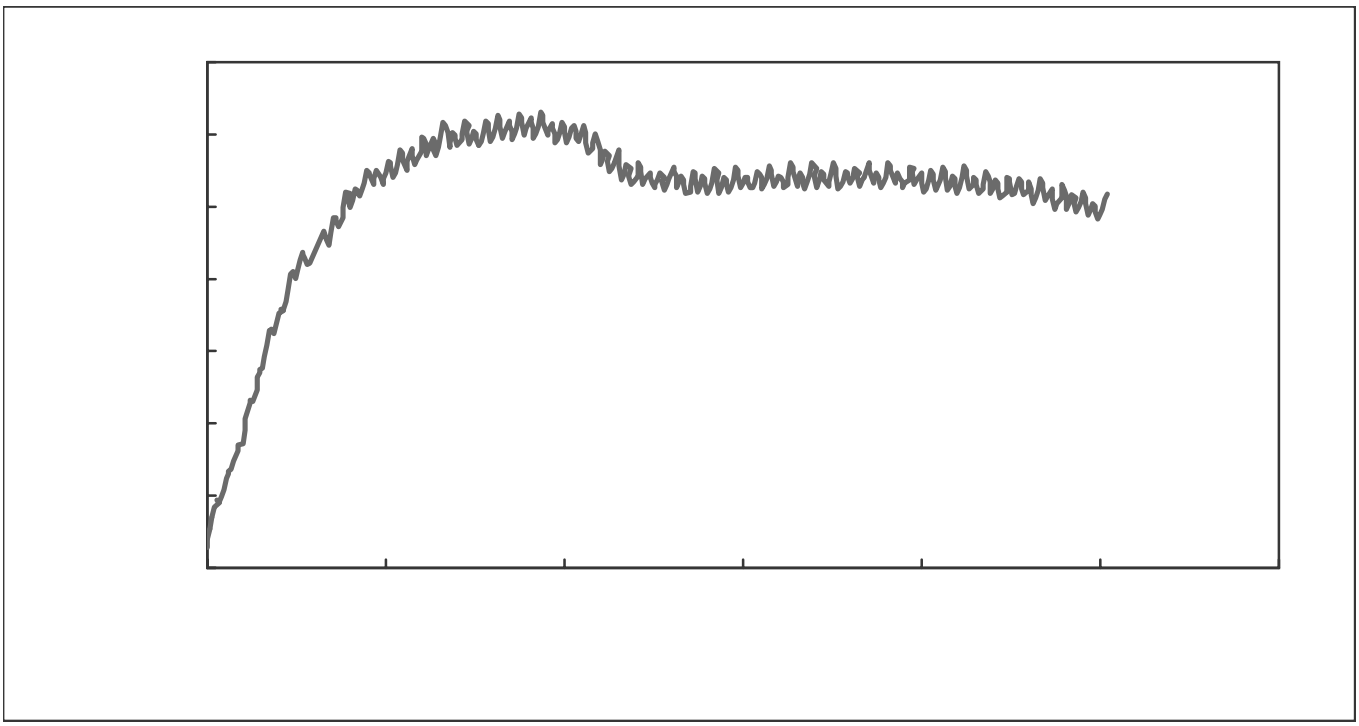
Moisture (%): 3.0 | **Linear stiffness (MPa): 151**

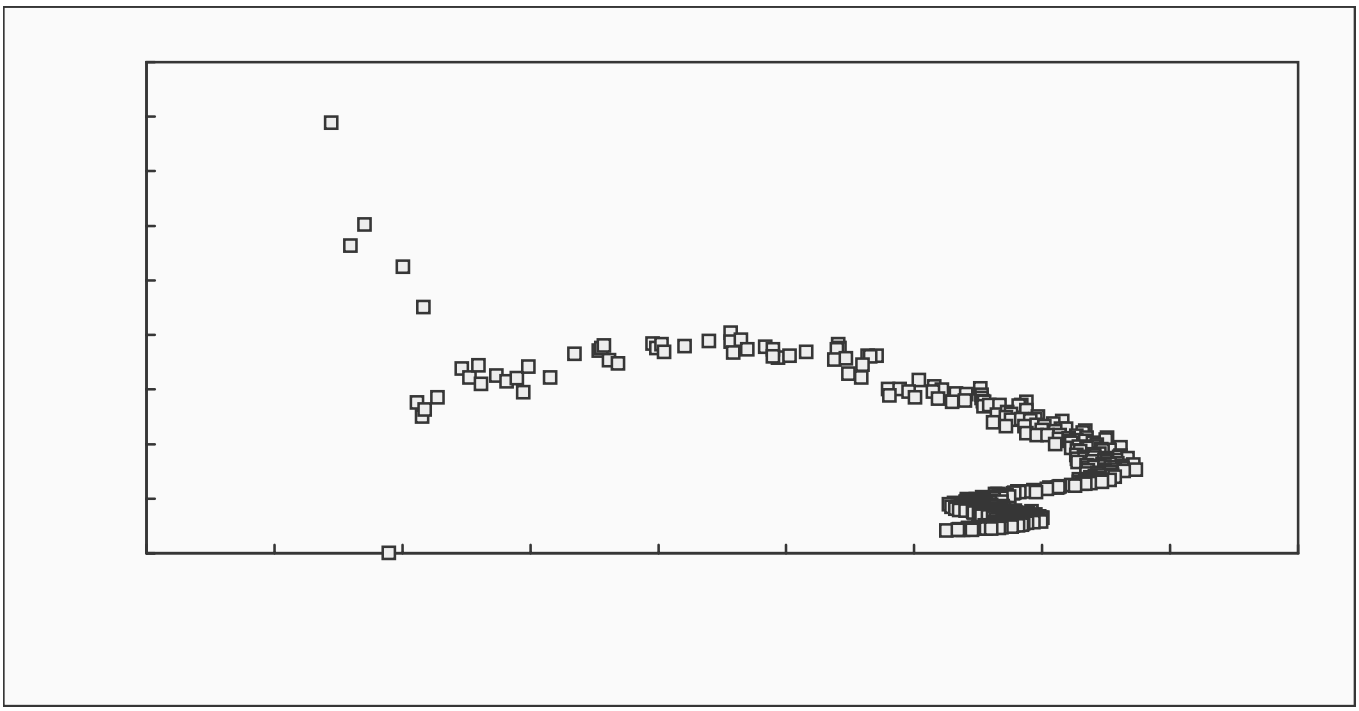
Maximum deviator stress (kPa): 1563





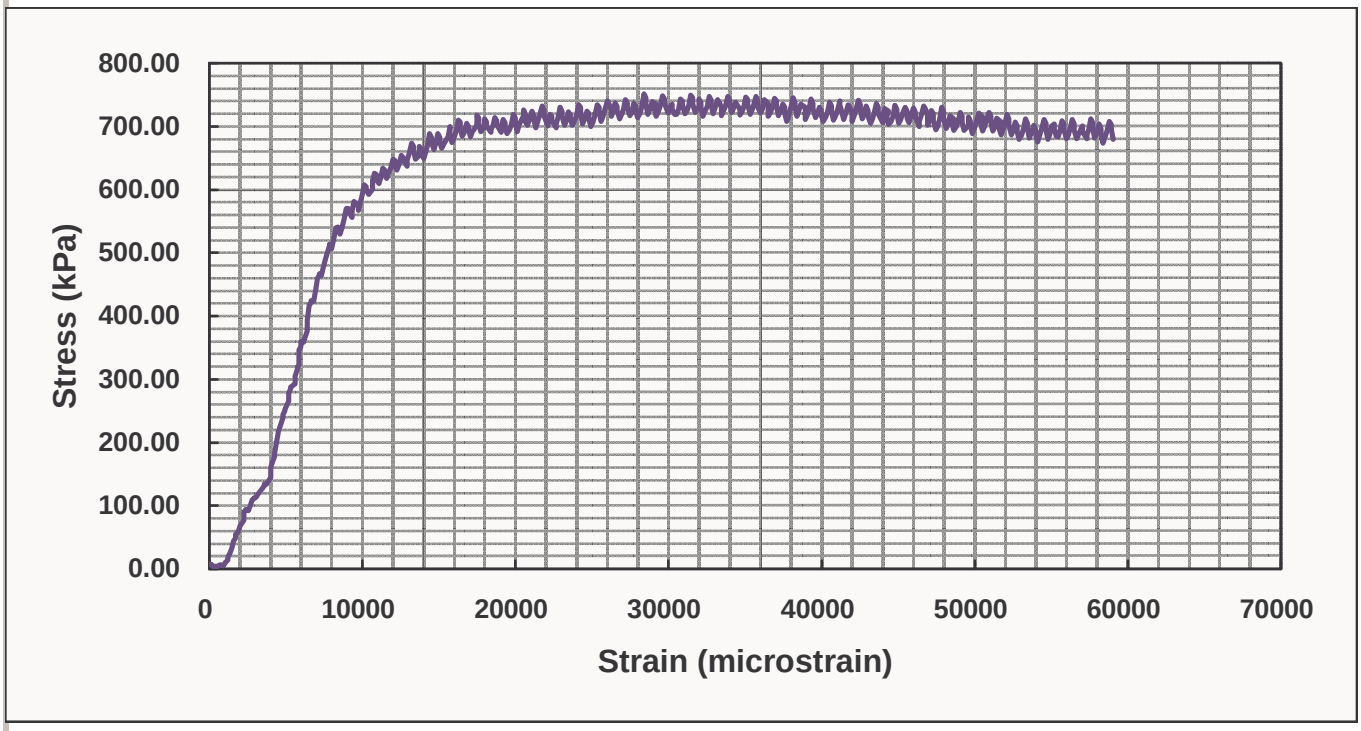
HNS: Treated with 1% Cement

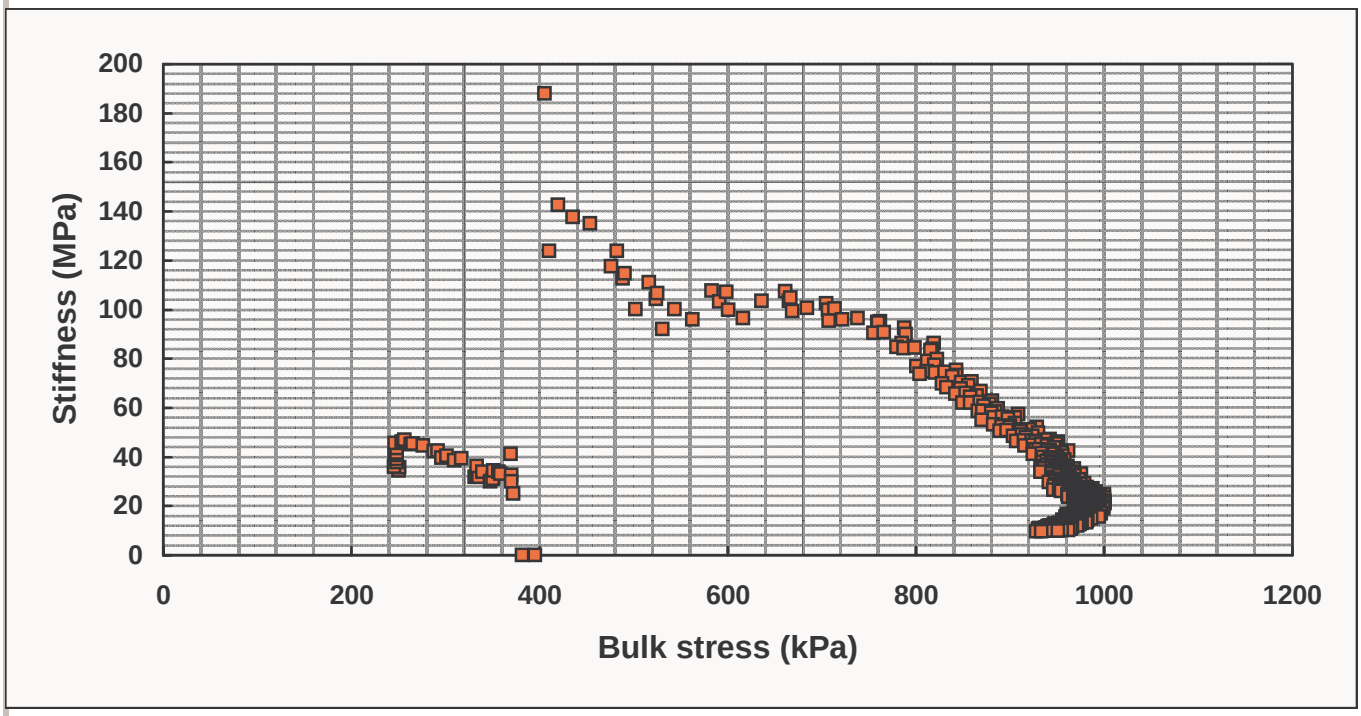




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS02
Dry Density (kg/cub m): 2200
Confining pressure (kPa): 82
Moisture (%): 4.4
Linear stiffness (MPa): 97
Maximum deviator stress (kPa): 752





STATIC TRIAXIAL TEST

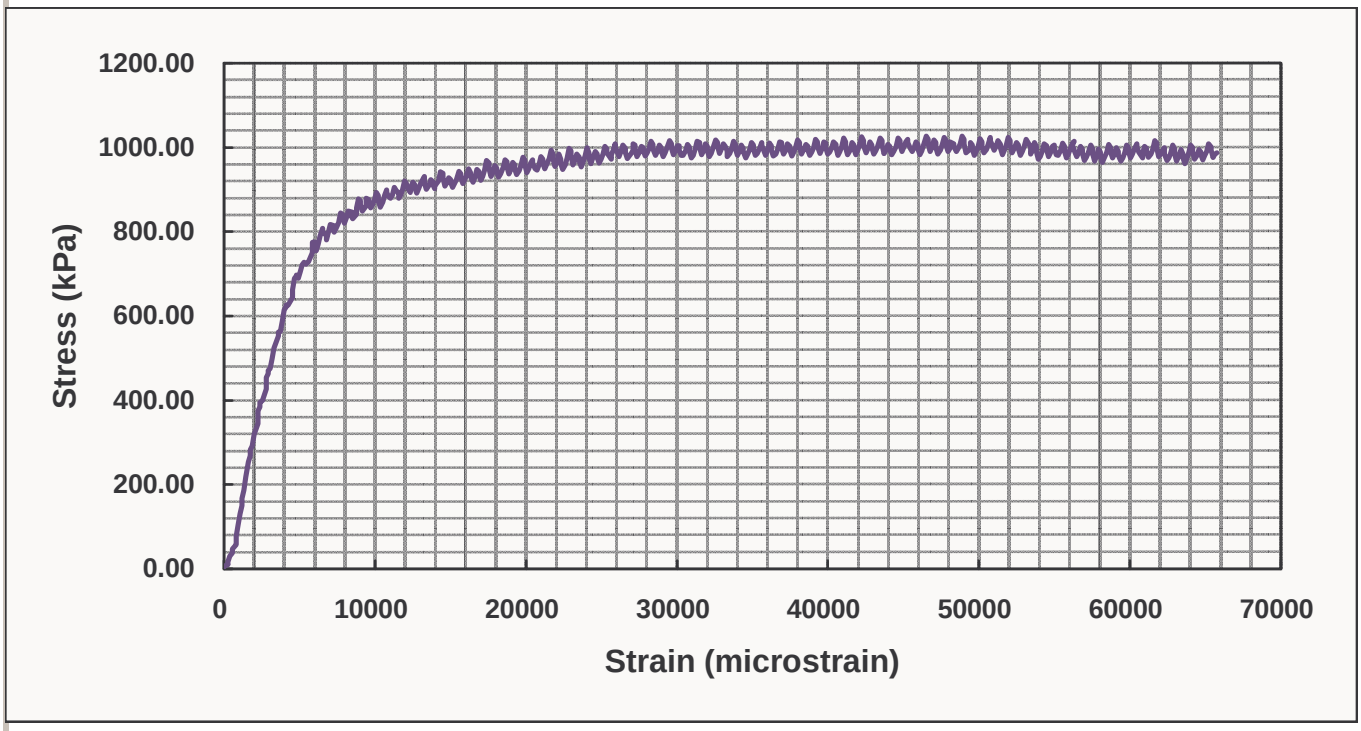
Material: Hornfels — **Treatment** **0 % cement & 2.25% bitumen**

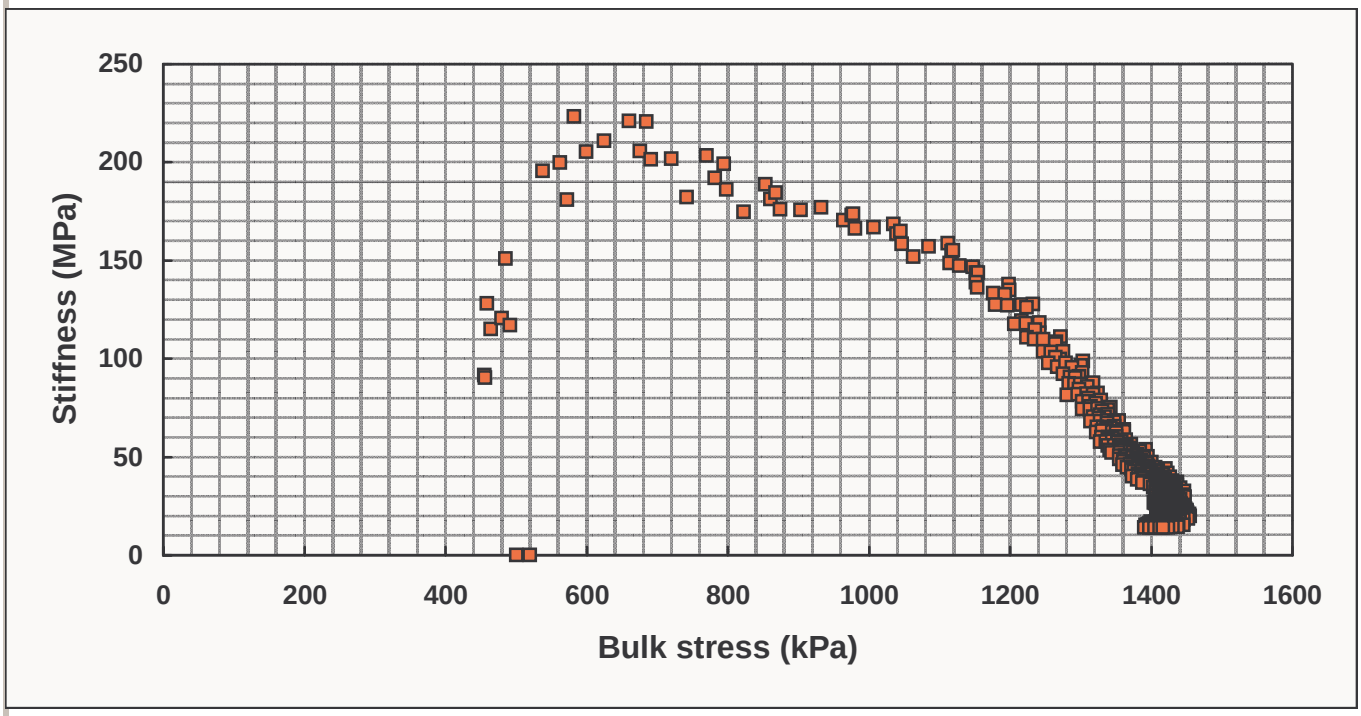
Sample #: HNS03

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 142**

Moisture (%): 4.1 — **Linear stiffness (MPa): 167**

Maximum deviator stress (kPa): 1027

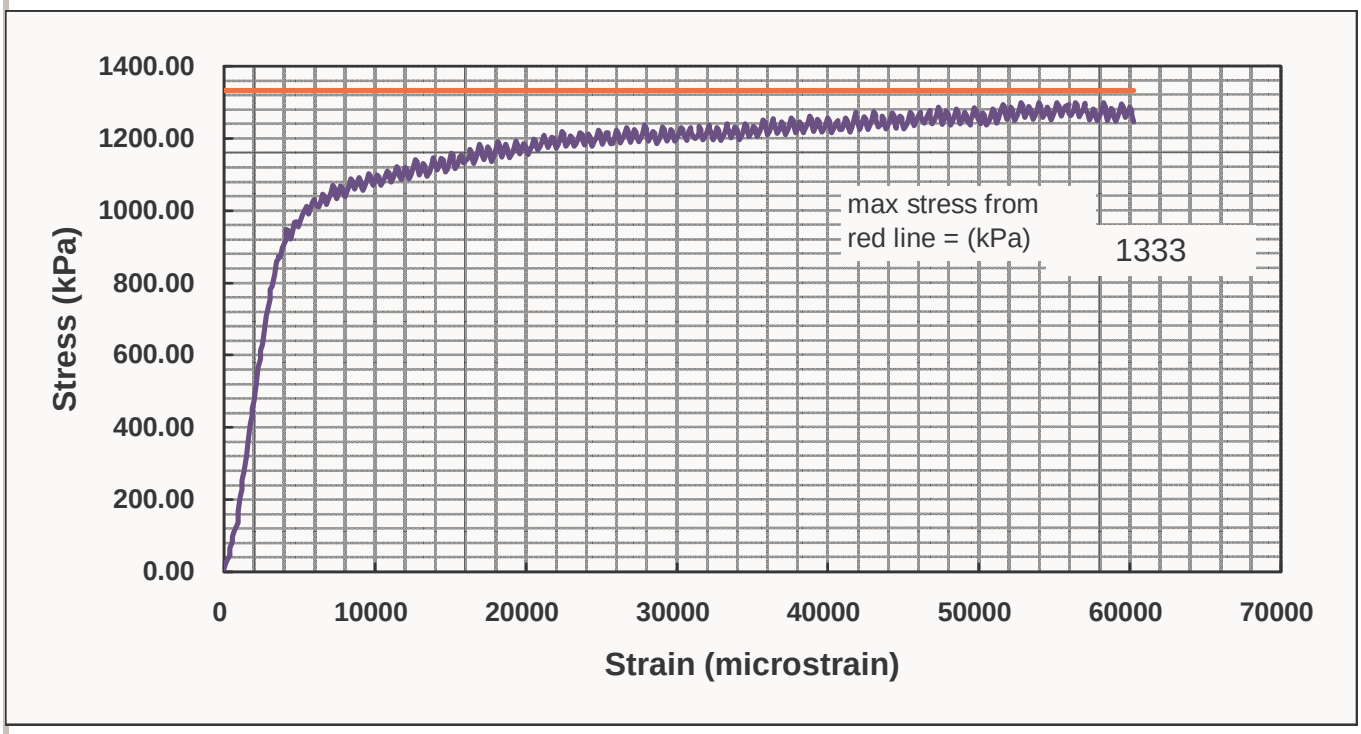


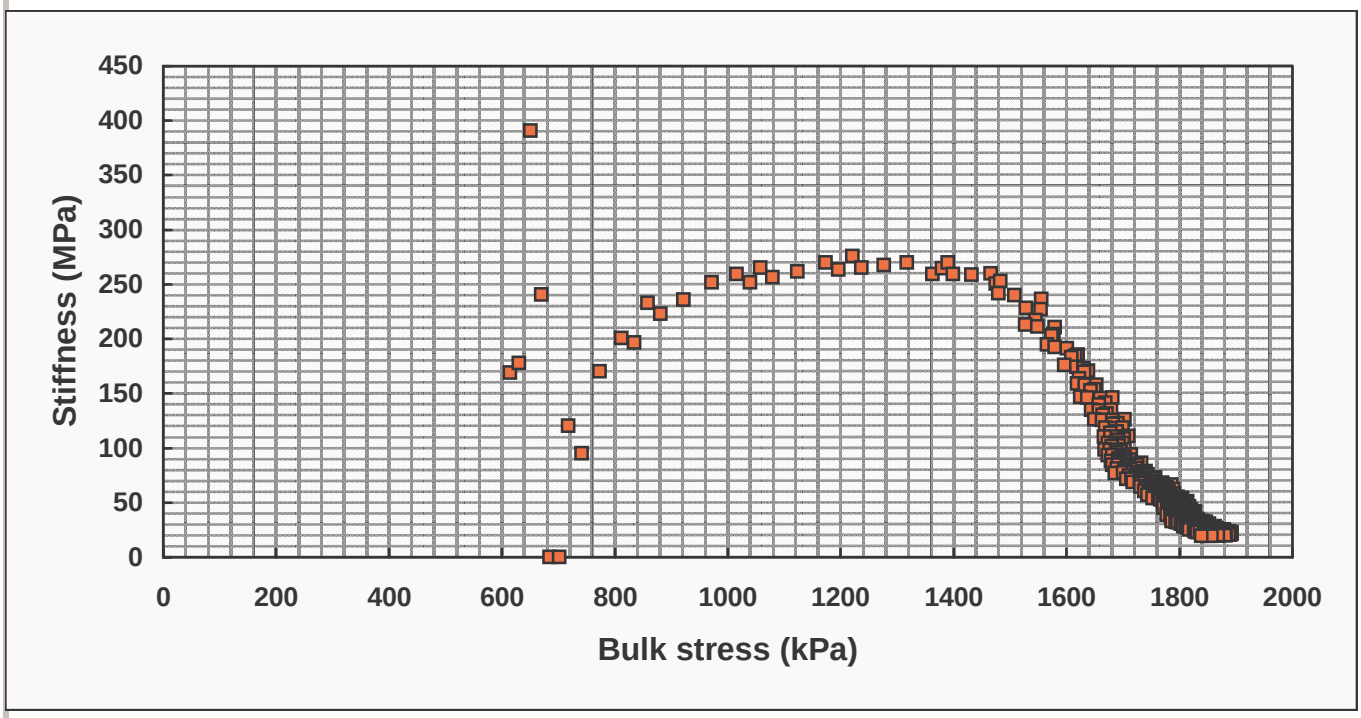


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HNS 04
Dry Density (kg/cub m): 2200
Moisture (%): 4.2

Treatment 0 % cement & 2.25% bitumen
Confining pressure (kPa): 199
Linear stiffness (MPa): 259
Maximum deviator stress (kPa): 1299

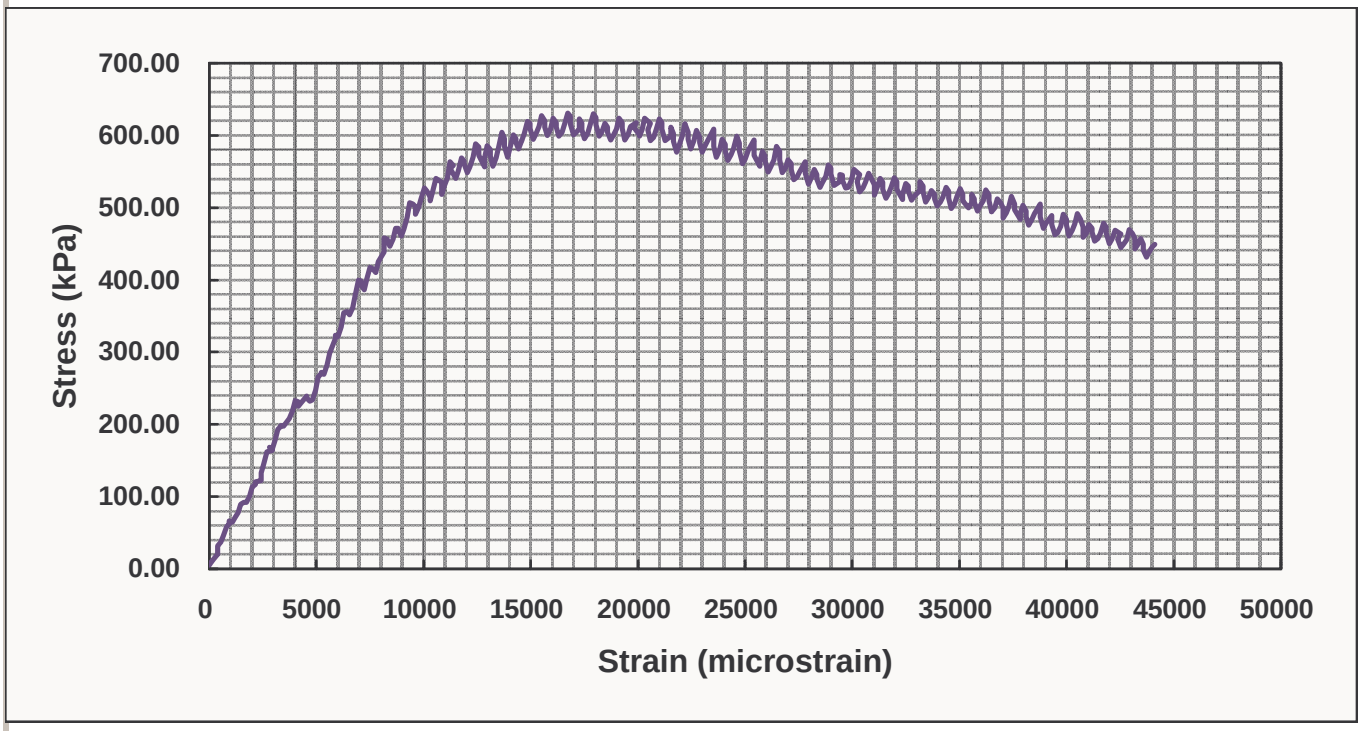


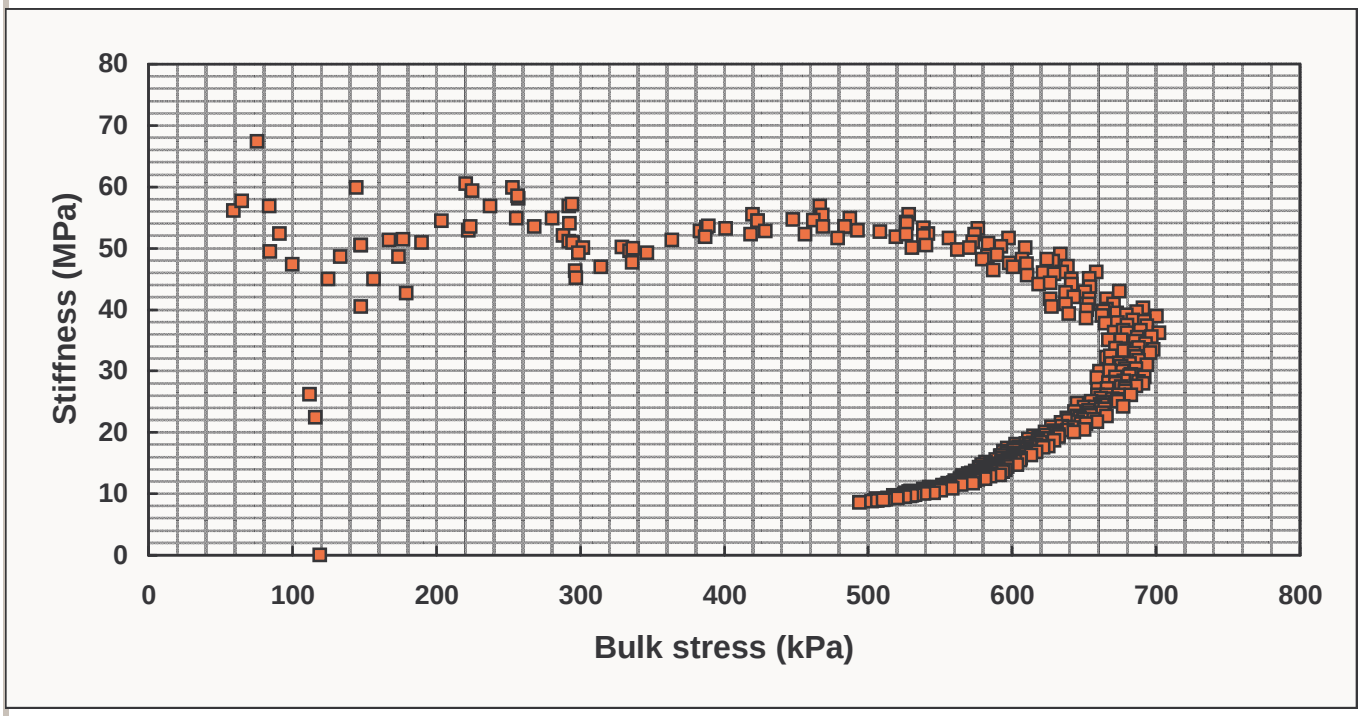


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HNS05
Dry Density (kg/cub m): 2200
Moisture (%): 2.8

Treatment 0 % cement & 2.25% bitumen
Confining pressure (kPa): 22
Linear stiffness (MPa): 52
Maximum deviator stress (kPa): 631

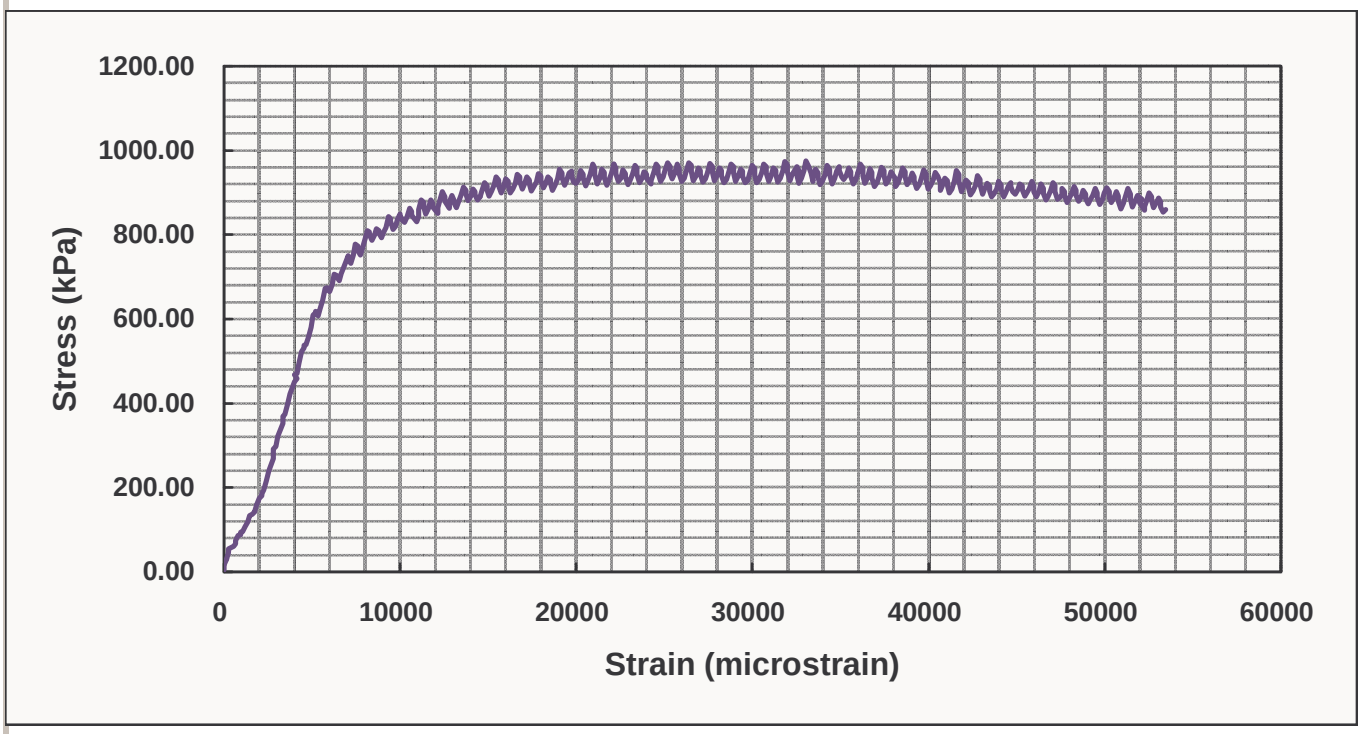


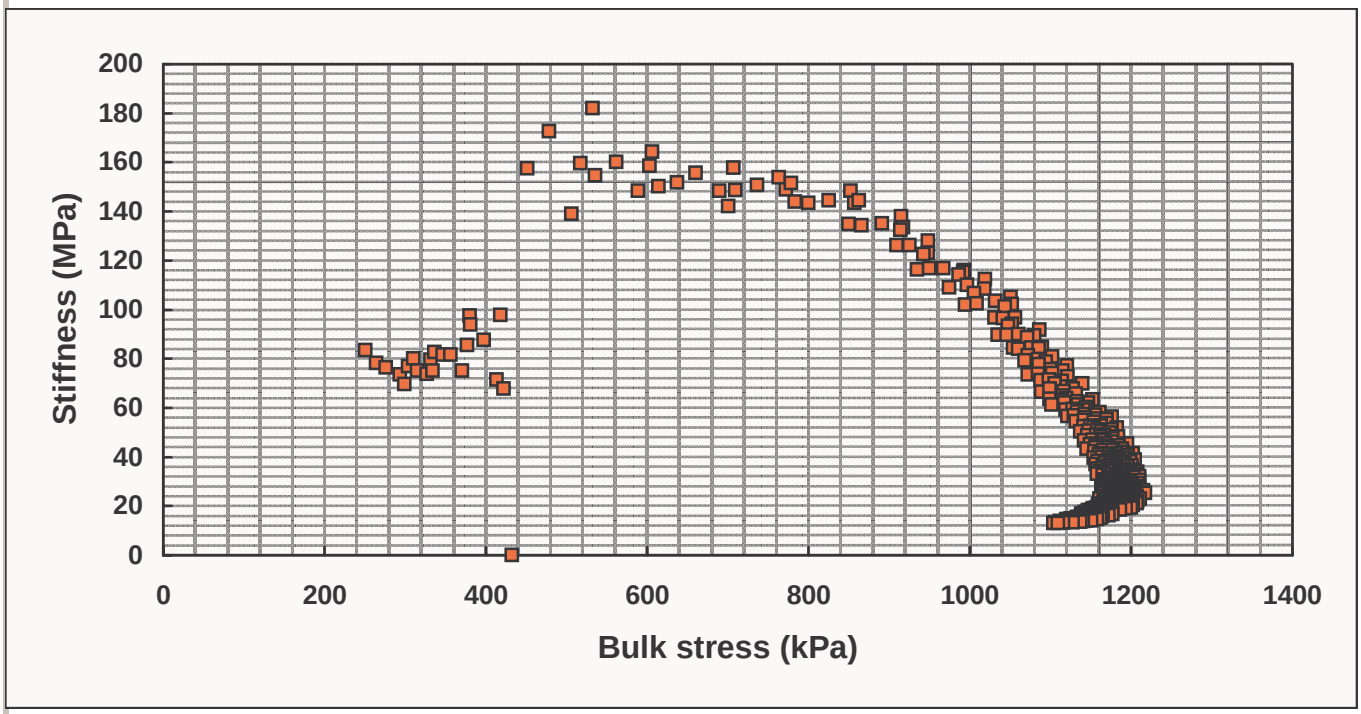


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HNS06
Dry Density (kg/cub m): 2200
Moisture (%): 2.6

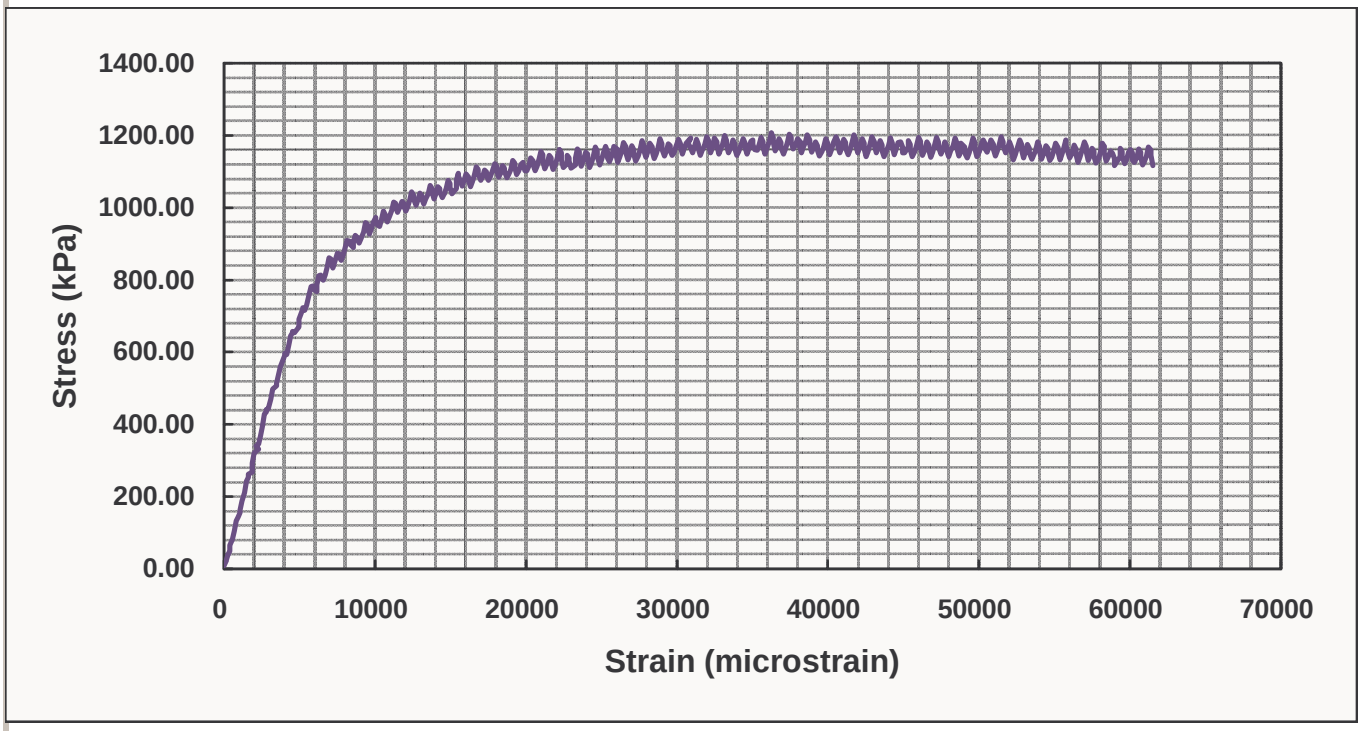
Treatment 0 % cement & 2.25% bitumen
Confining pressure (kPa): 81
Linear stiffness (MPa): 145
Maximum deviator stress (kPa): 975

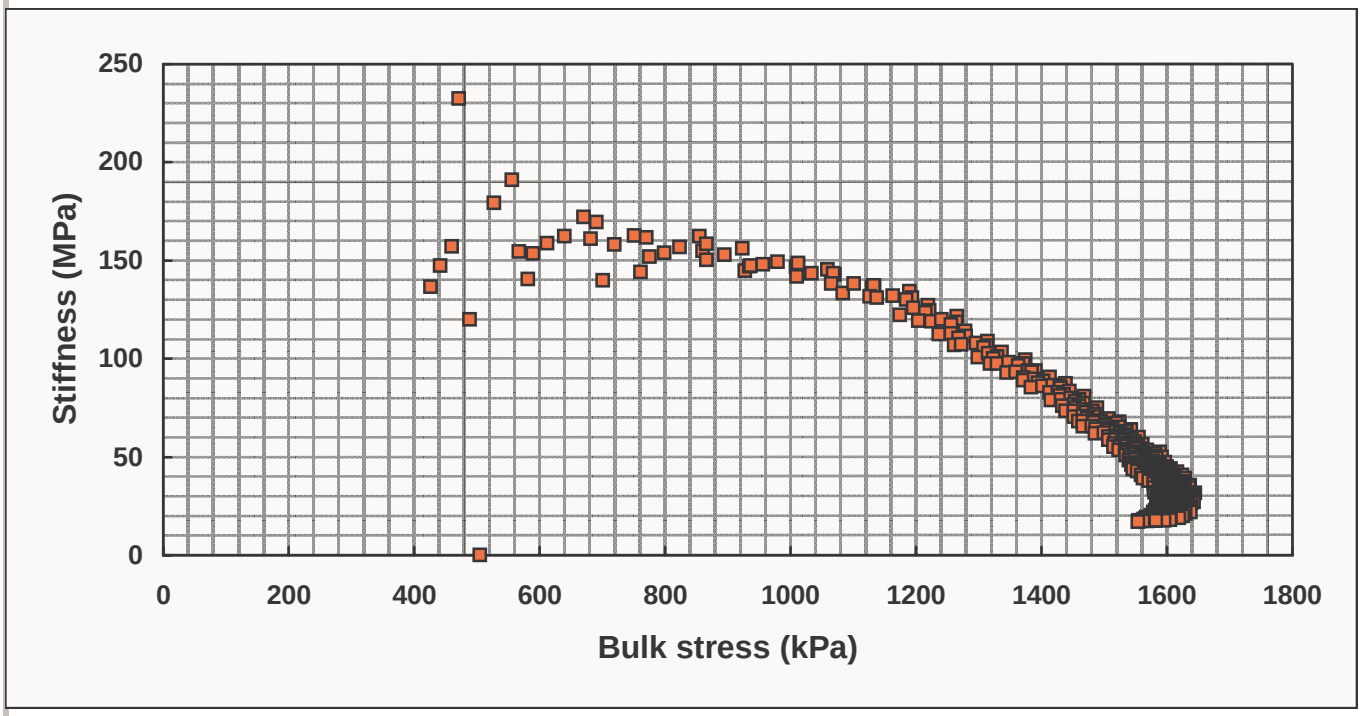




STATIC TRIAXIAL TEST

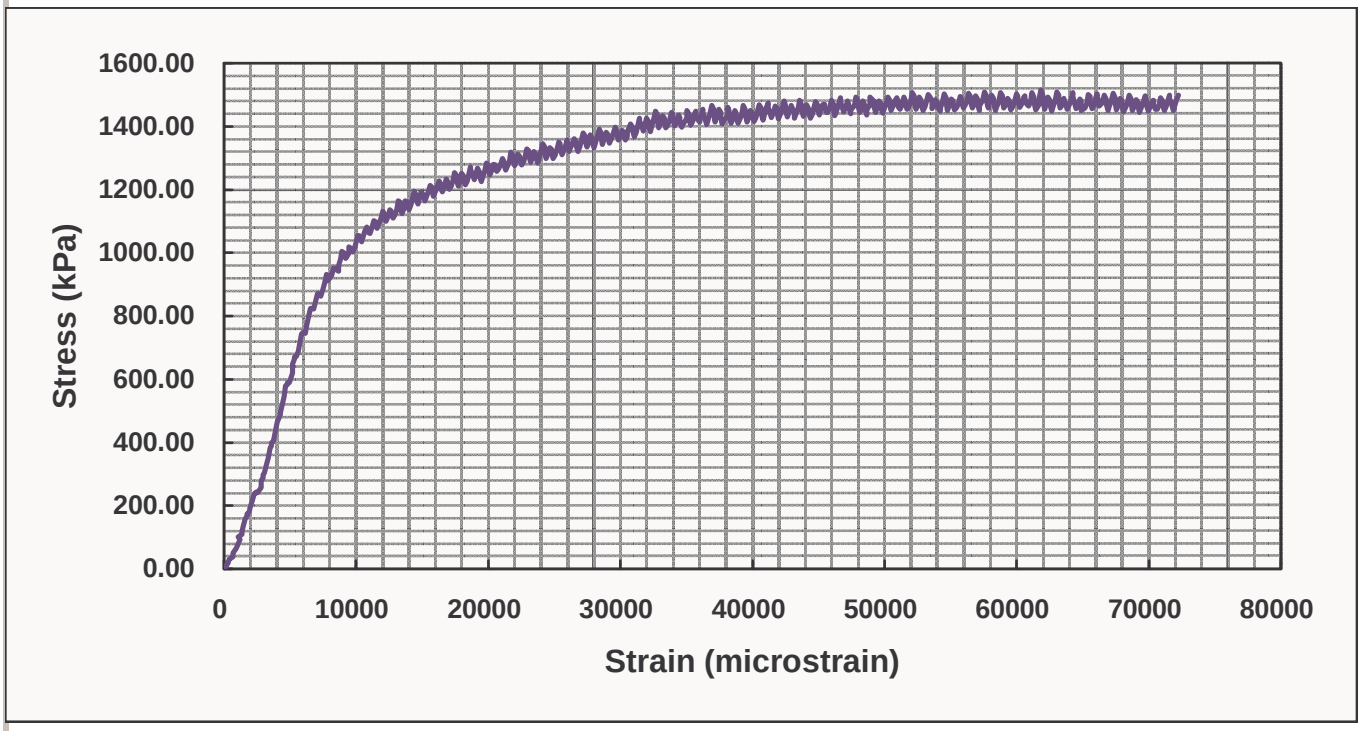
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS07
Dry Density (kg/cub m): 2200
Confining pressure (kPa): 144
Moisture (%): 2.9
Linear stiffness (MPa): 138
Maximum deviator stress (kPa): 1206

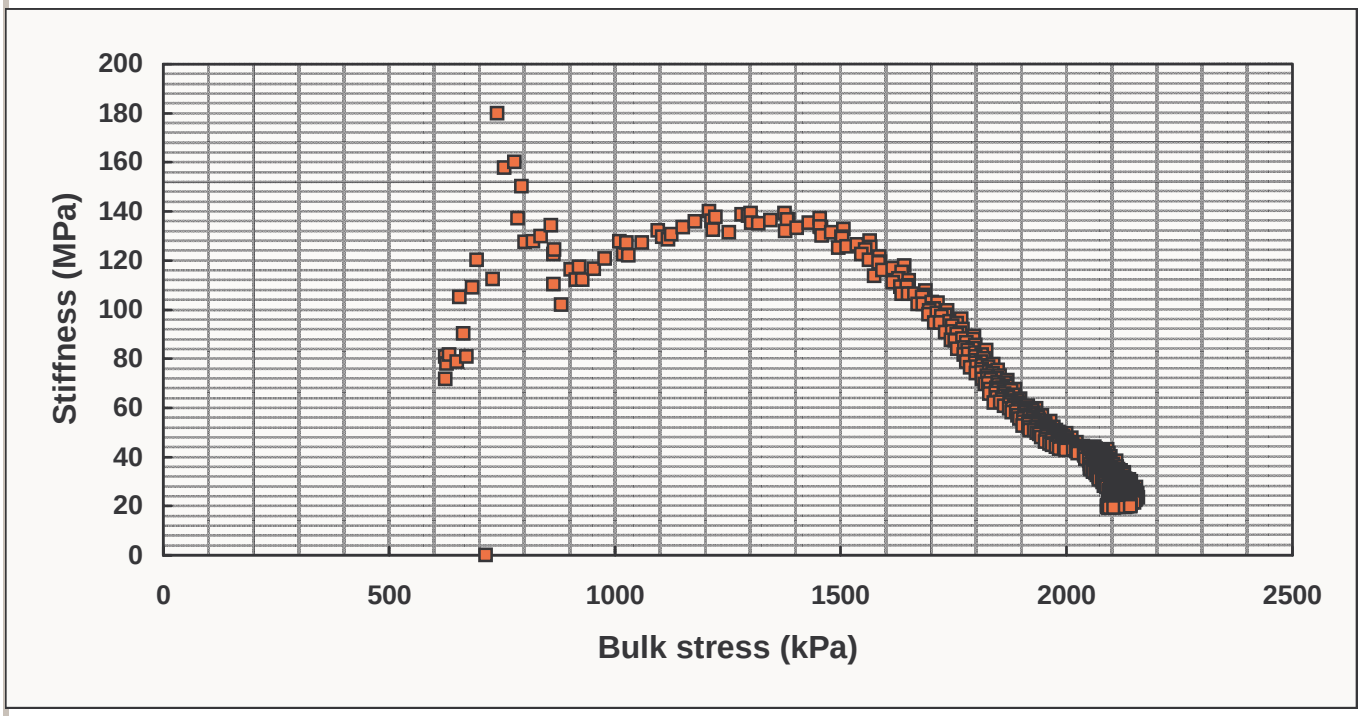




STATIC TRIAXIAL TEST

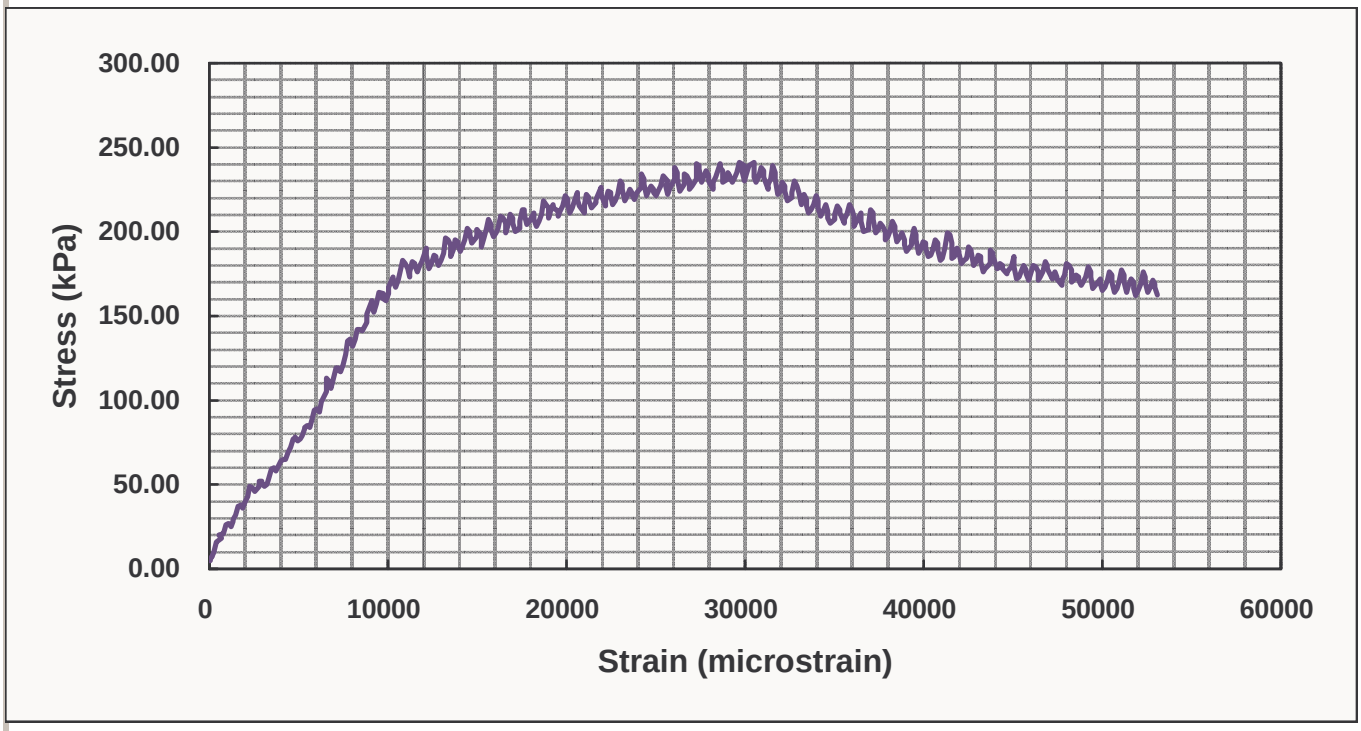
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS08
Dry Density (kg/cub m): 2200
Confining pressure (kPa): 212
Moisture (%): 3.0
Linear stiffness (MPa): 135
Maximum deviator stress (kPa): 1514

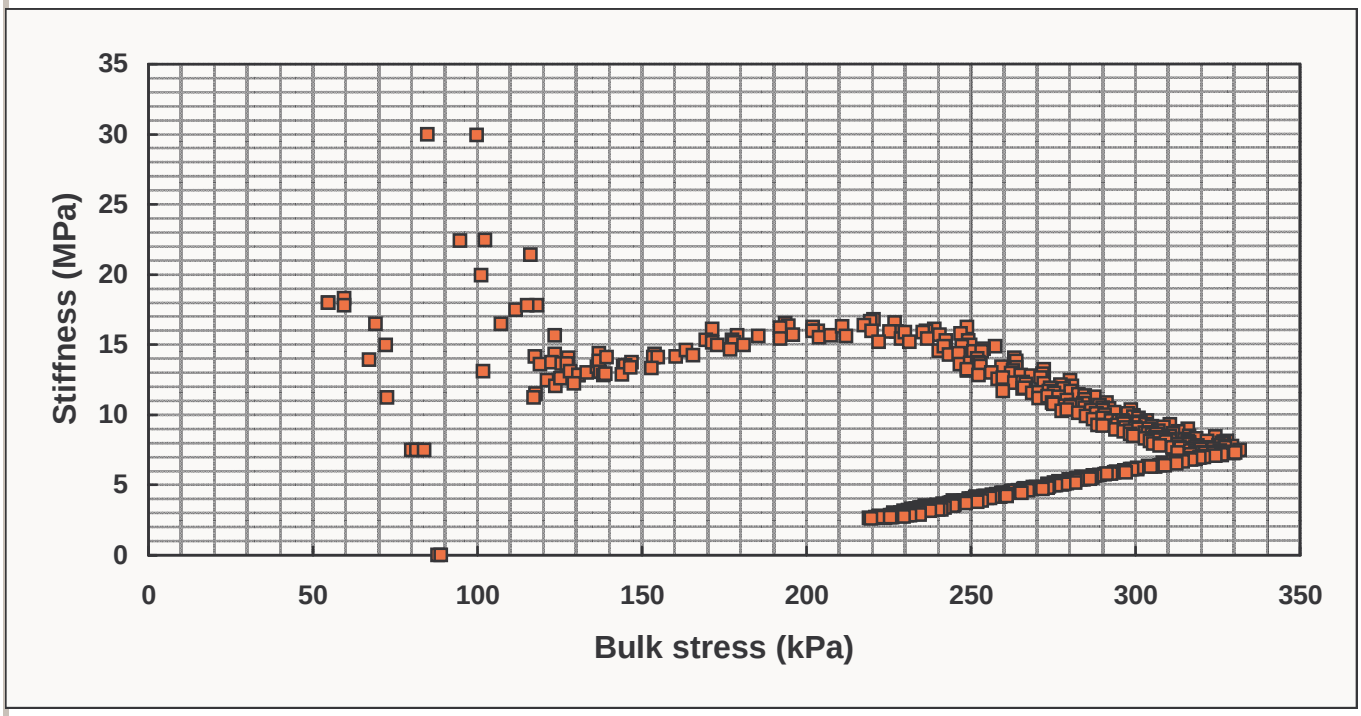




STATIC TRIAXIAL TEST

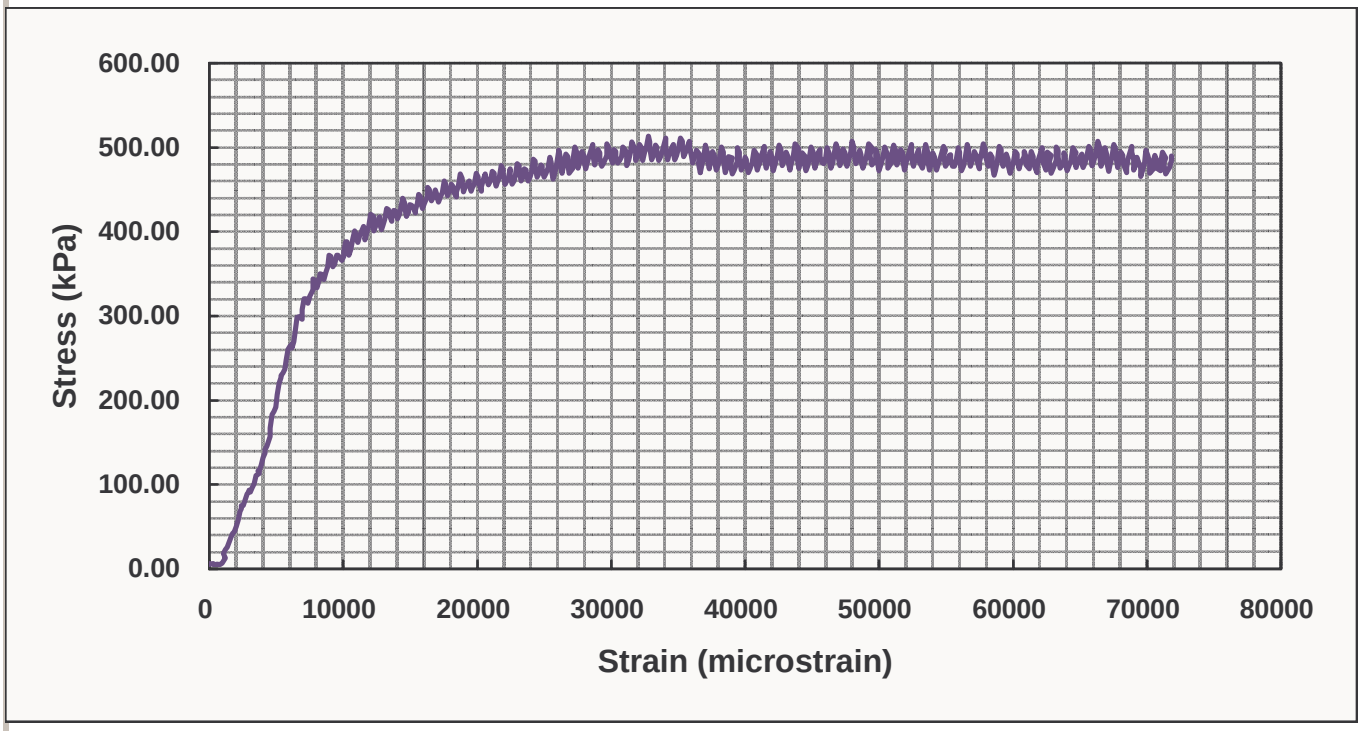
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS09
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 23
Moisture (%): 4.8
Linear stiffness (MPa): 16
Maximum deviator stress (kPa): 241

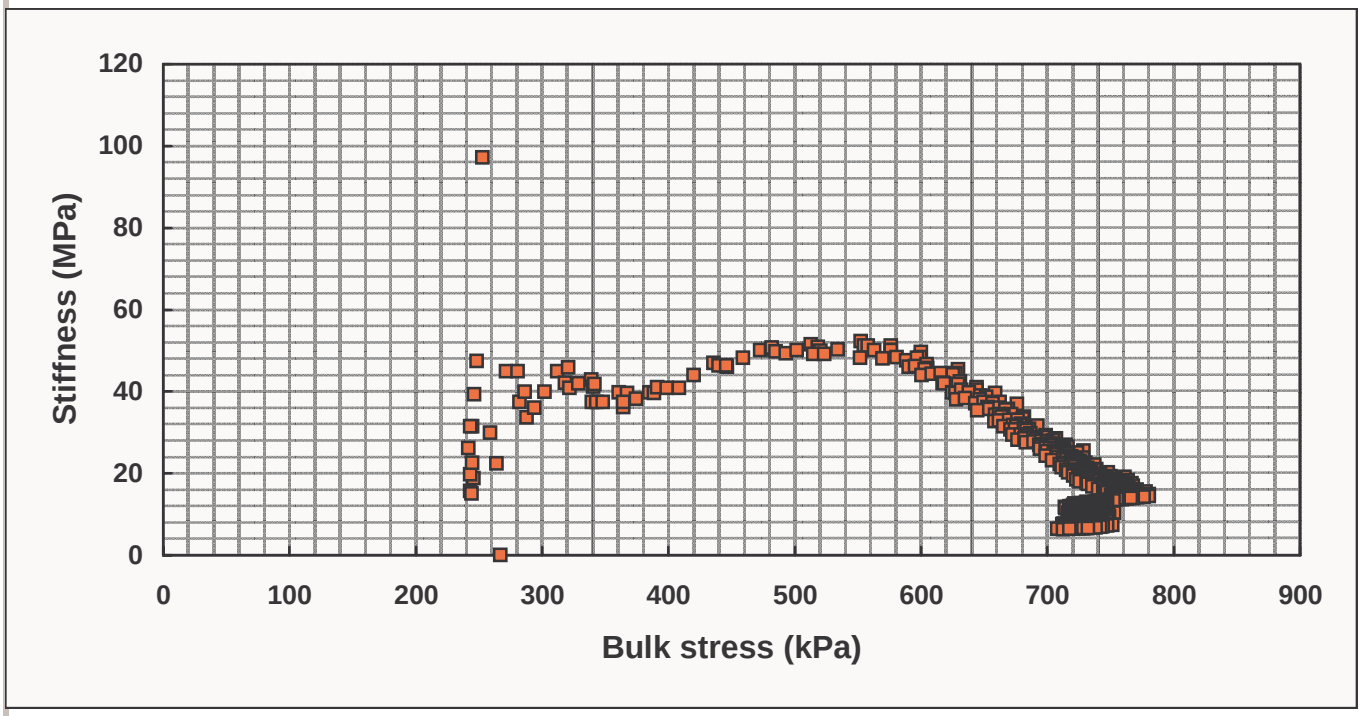




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS10
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 84
Moisture (%): 4.9
Linear stiffness (MPa): 48
Maximum deviator stress (kPa): 513





STATIC TRIAXIAL TEST

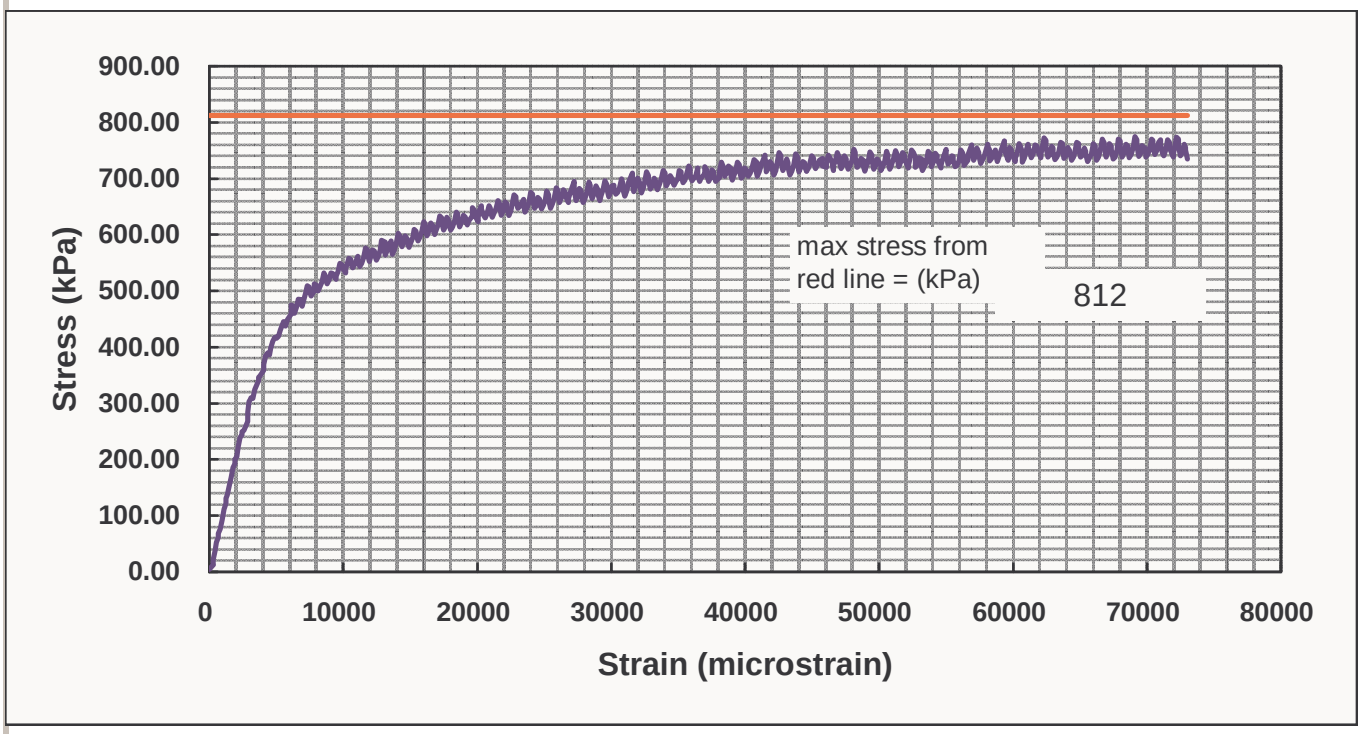
Material: Hornfels **Treatment 0 % cement & 2.25% bitumen**

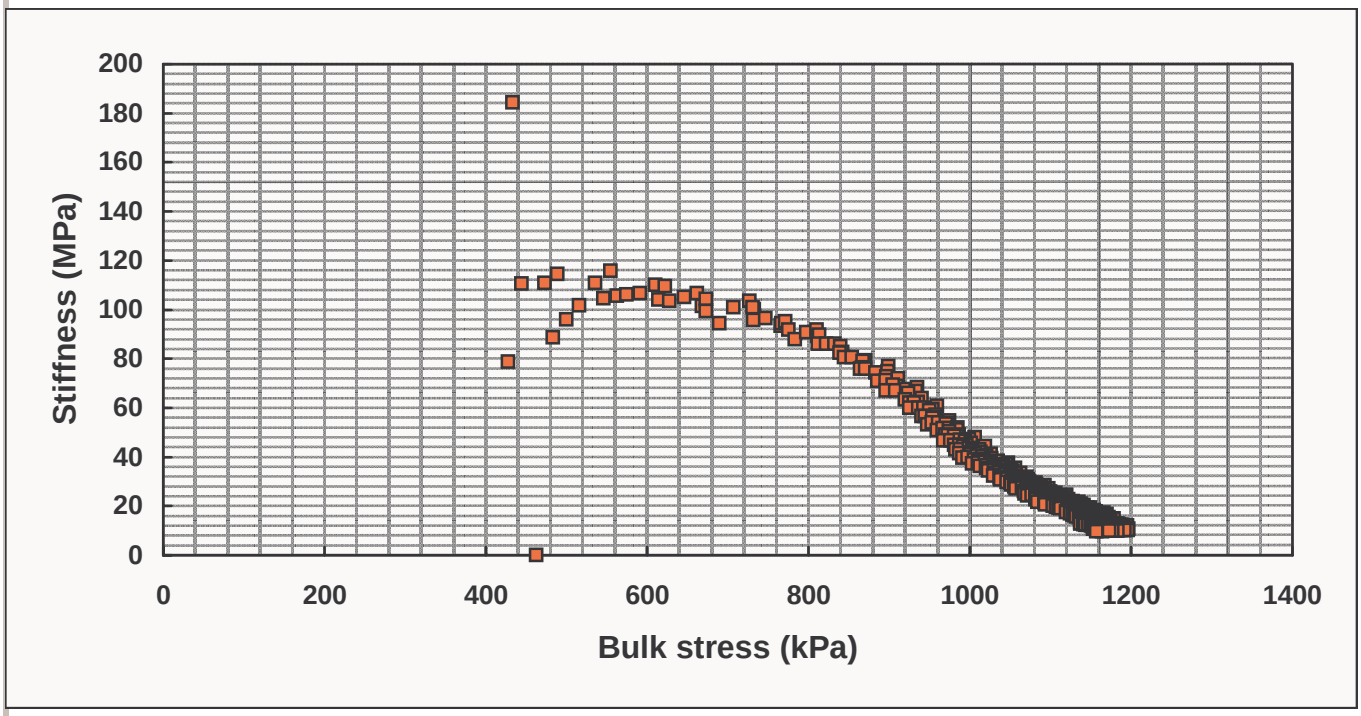
Sample #: HNS11

Dry Density (kg/cub m): 2050 **Confining pressure (kPa): 141**

Moisture (%): 5.1 **Linear stiffness (MPa): 92**

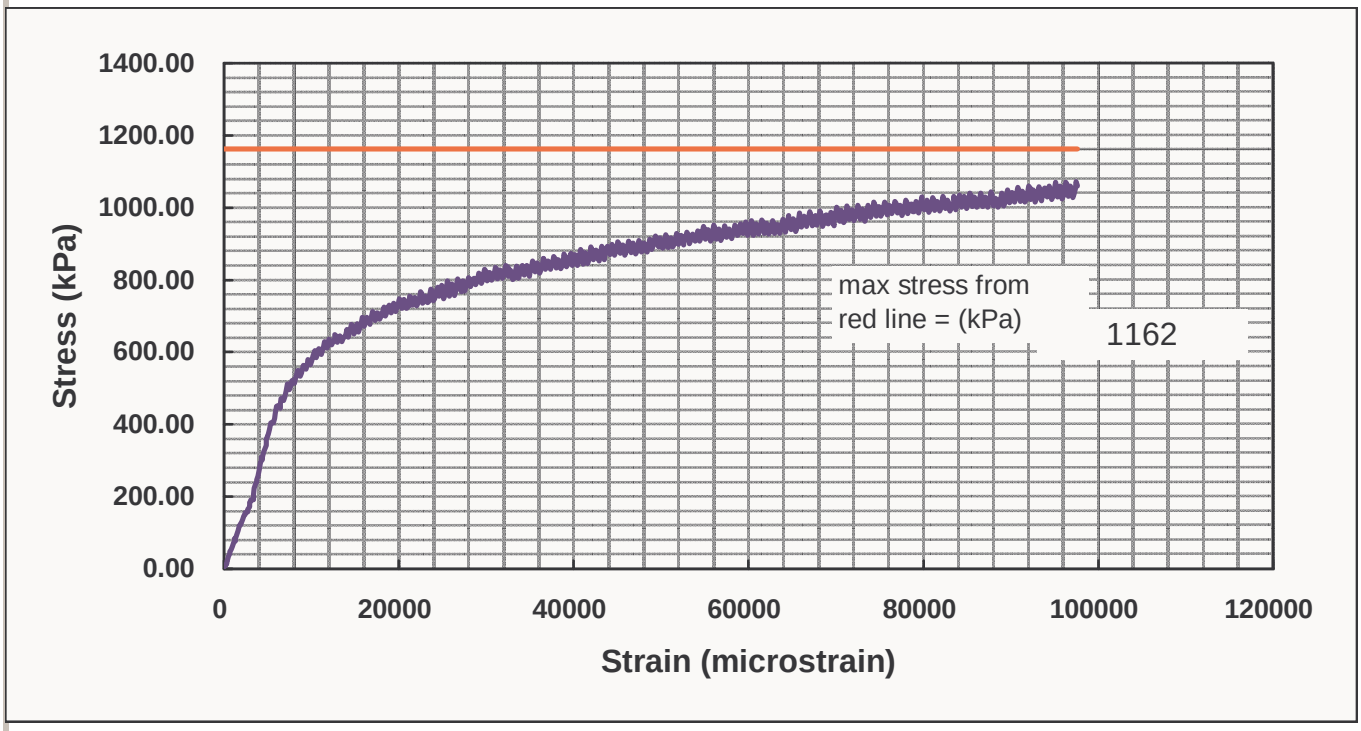
Maximum deviator stress (kPa): 775

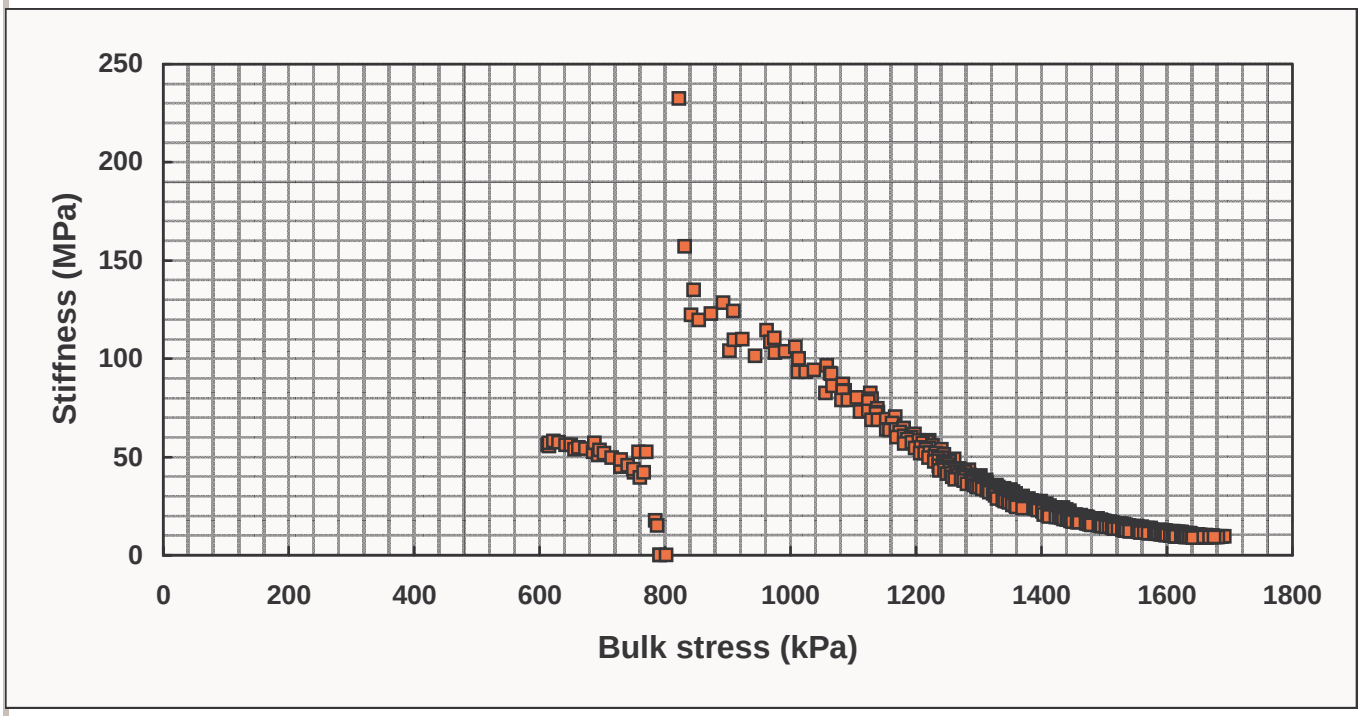




STATIC TRIAXIAL TEST

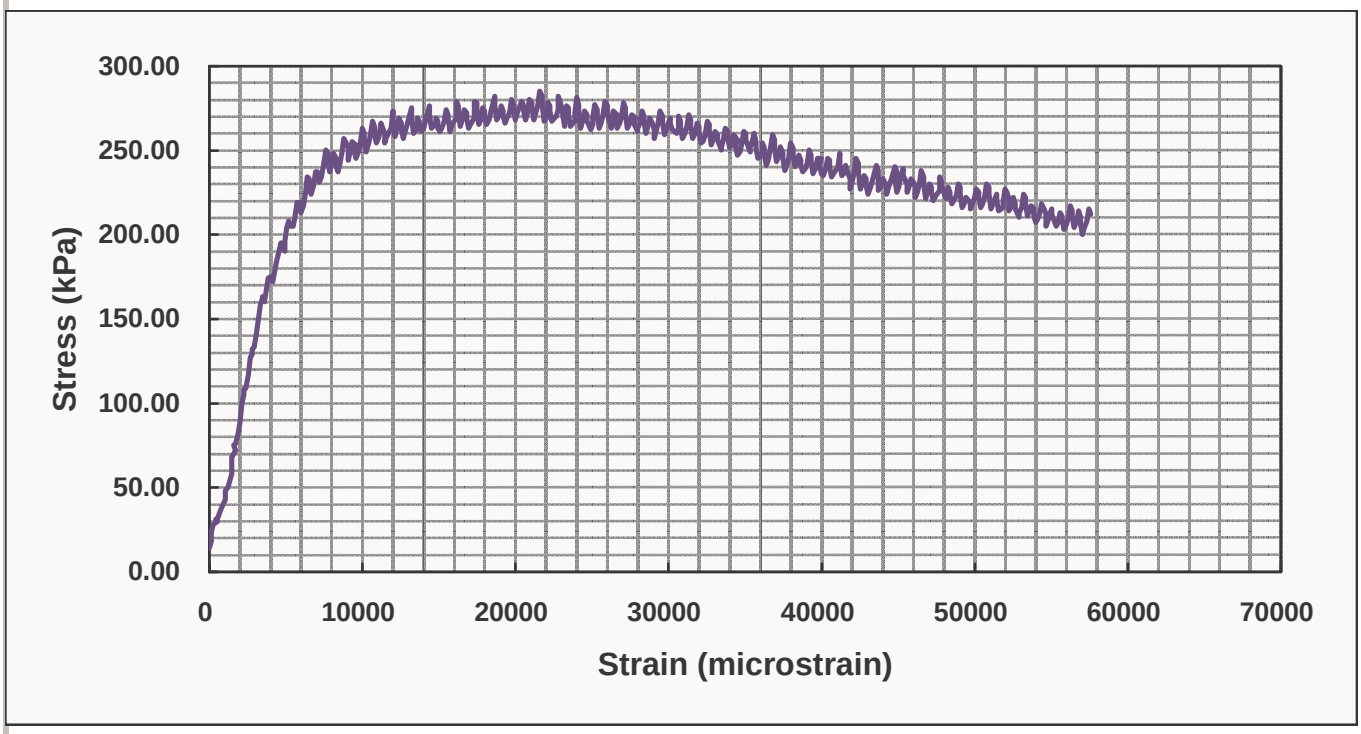
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS12
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 203
Moisture (%): 4.8
Linear stiffness (MPa): 94
Maximum deviator stress (kPa): 1072

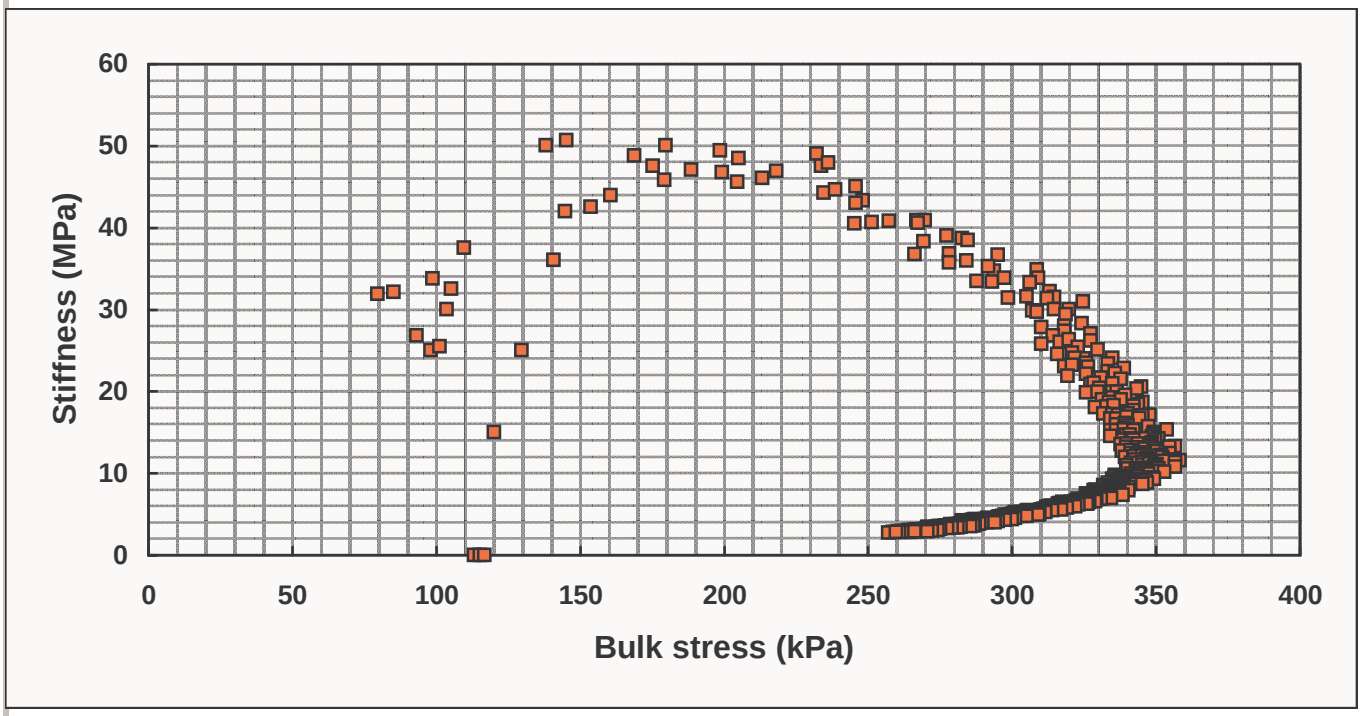




STATIC TRIAXIAL TEST

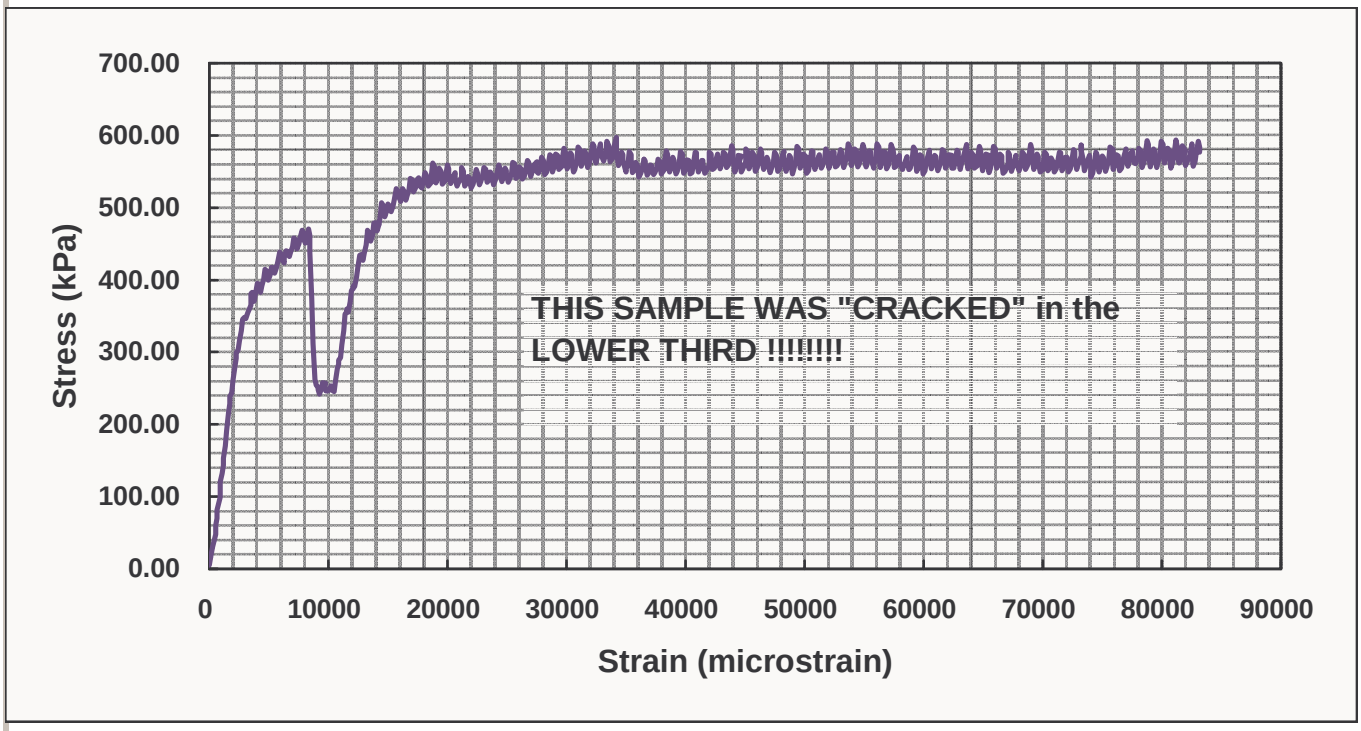
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS13
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 22
Moisture (%): 3.5
Linear stiffness (MPa): 45
Maximum deviator stress (kPa): 285

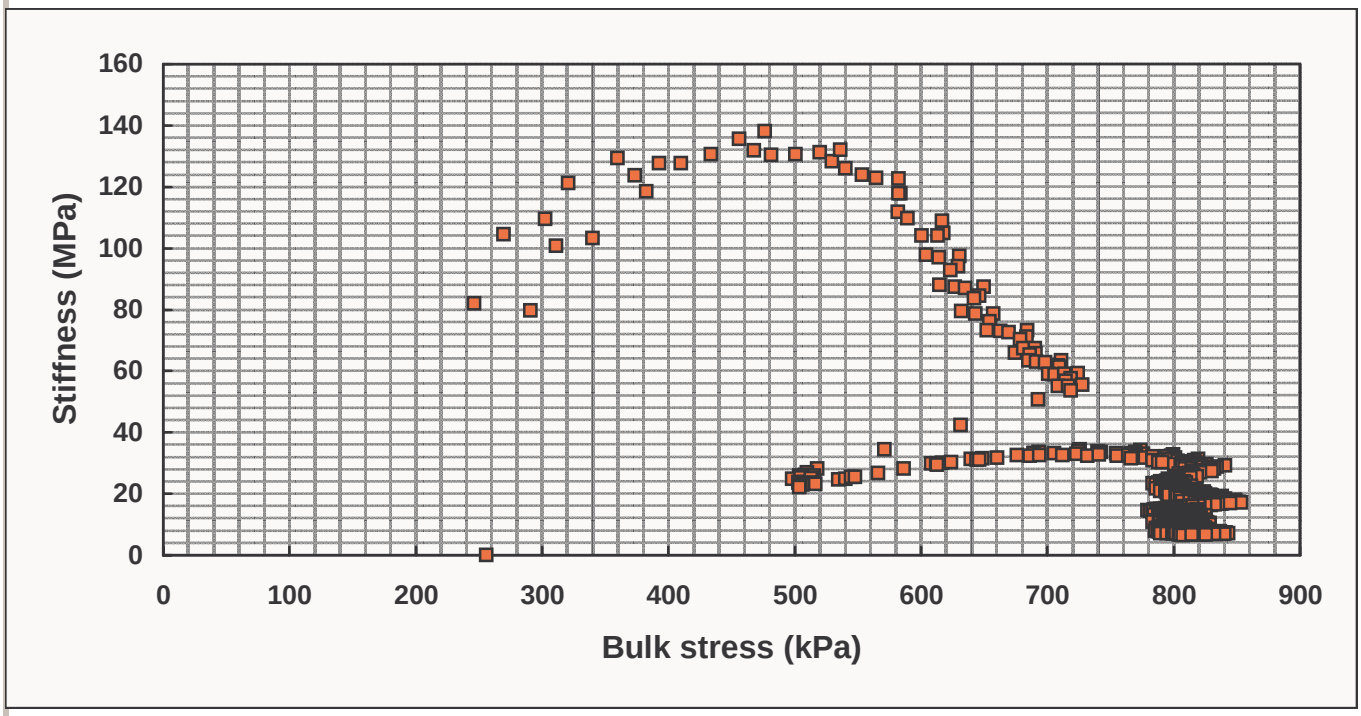




STATIC TRIAXIAL TEST

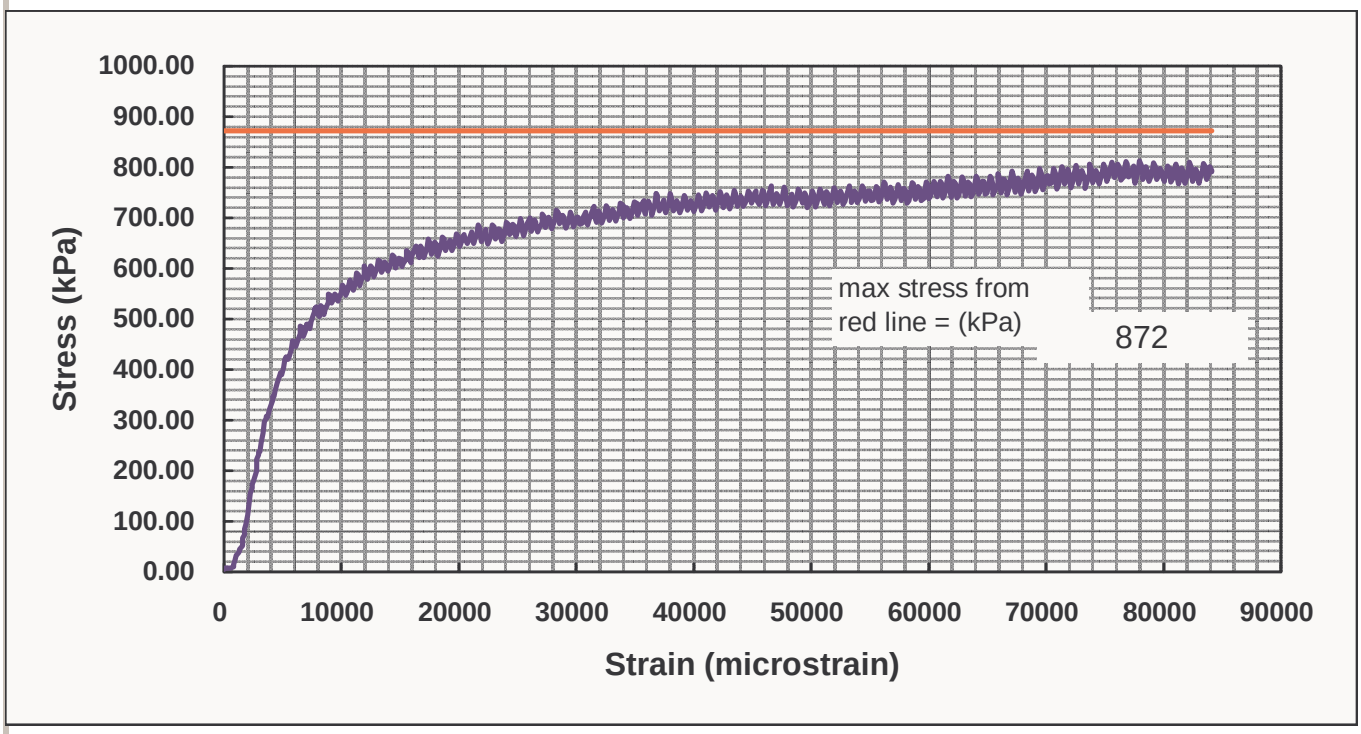
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS14
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 83
Moisture (%): 3.6
Linear stiffness (MPa): 123
Maximum deviator stress (kPa): 598

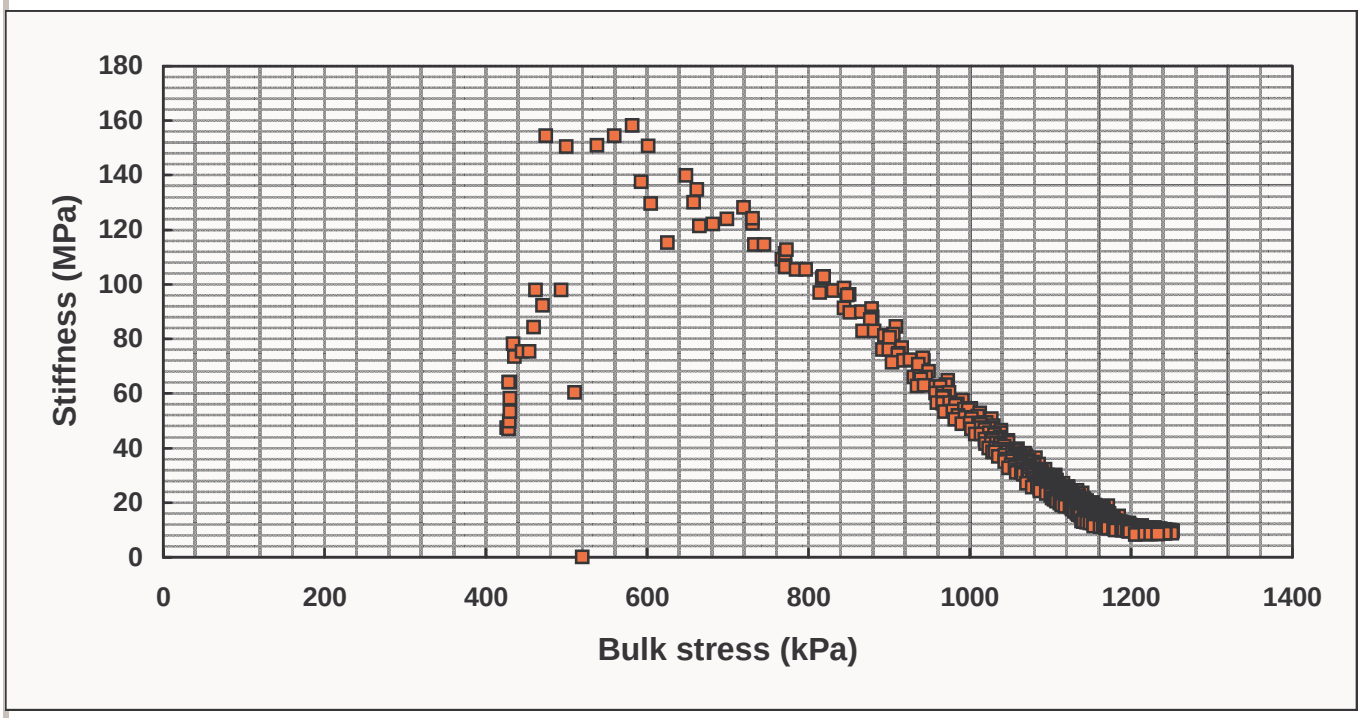




STATIC TRIAXIAL TEST

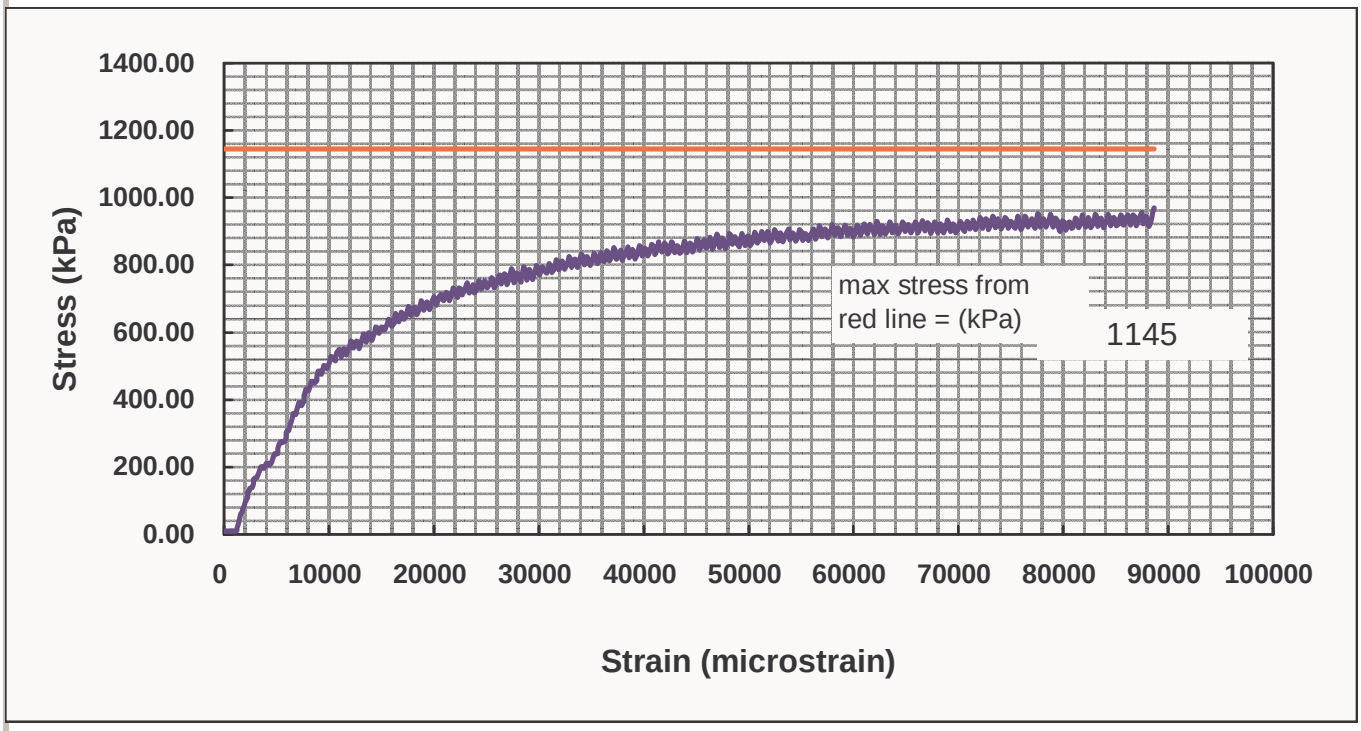
Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS15
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 142
Moisture (%): 3.6
Linear stiffness (MPa): 105
Maximum deviator stress (kPa): 813

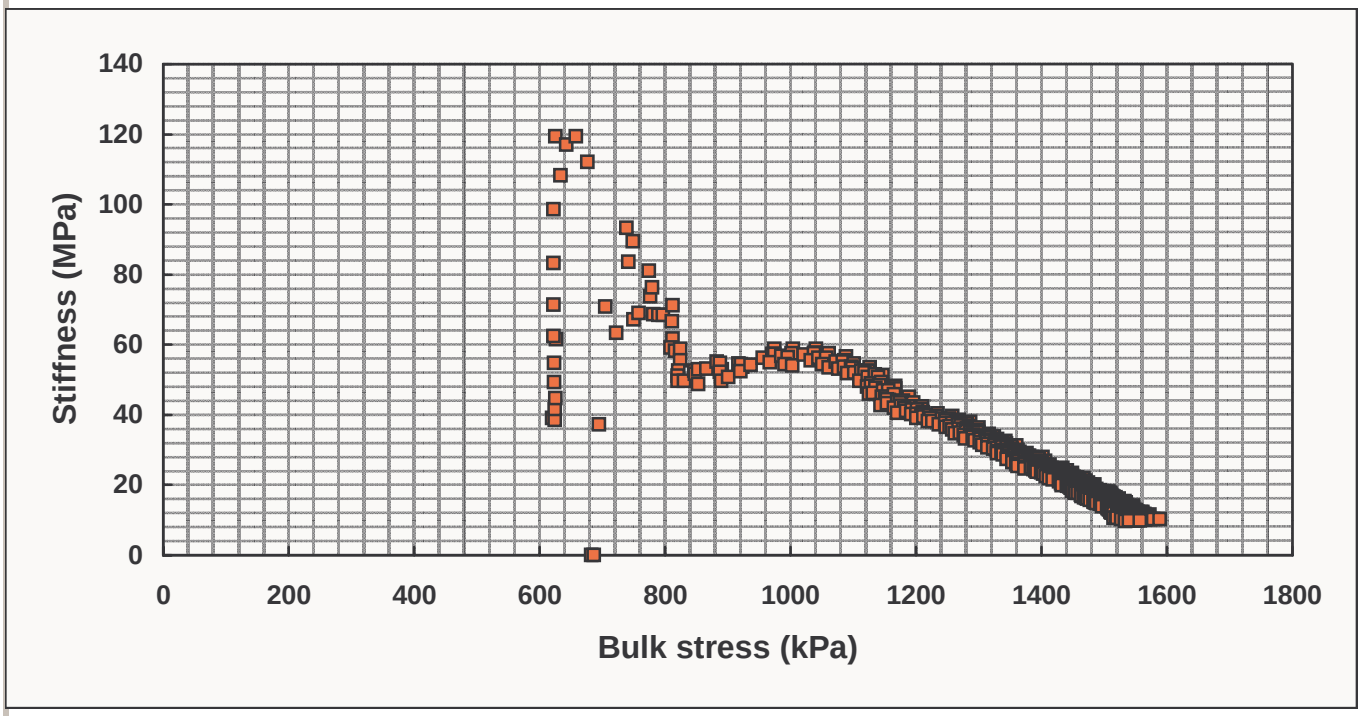




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 0 % cement & 2.25% bitumen
Sample #: HNS16
Dry Density (kg/cub m): 2050
Confining pressure (kPa): 204
Moisture (%): 4.3
Linear stiffness (MPa): 56
Maximum deviator stress (kPa): 970



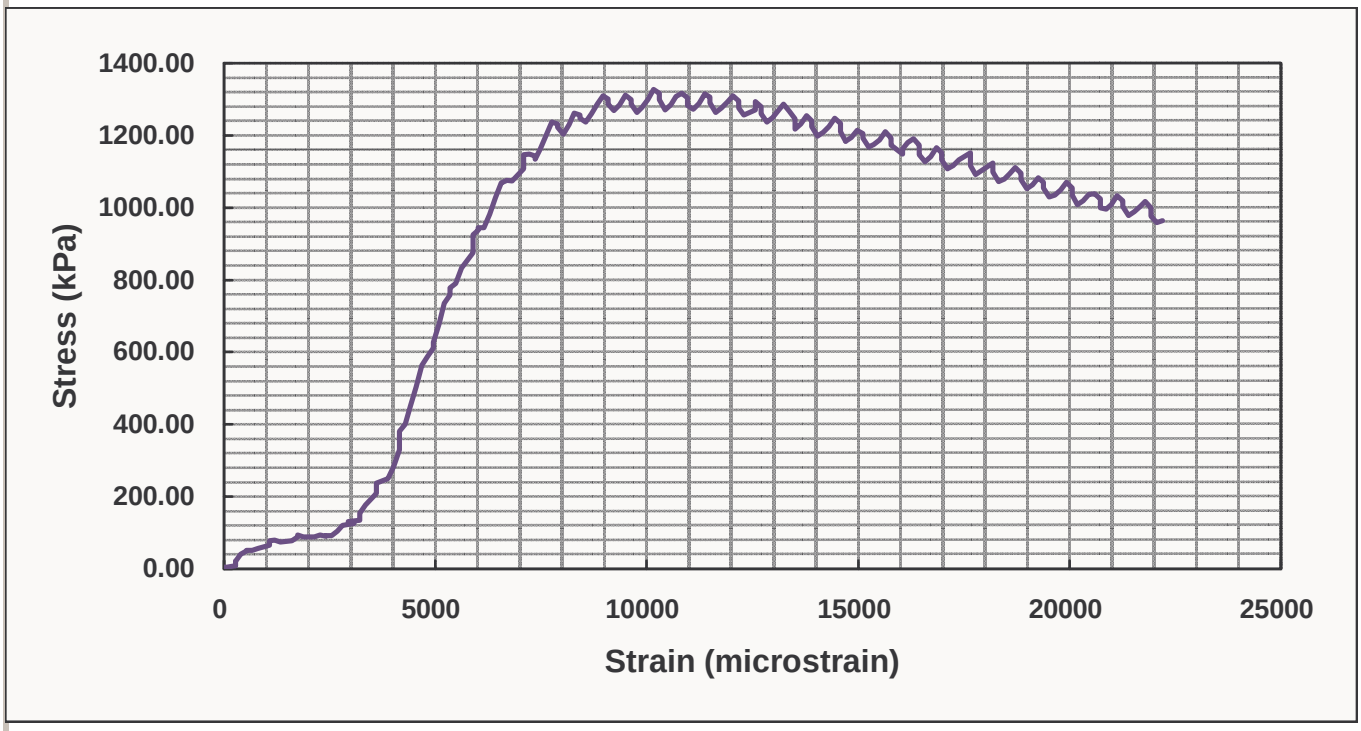


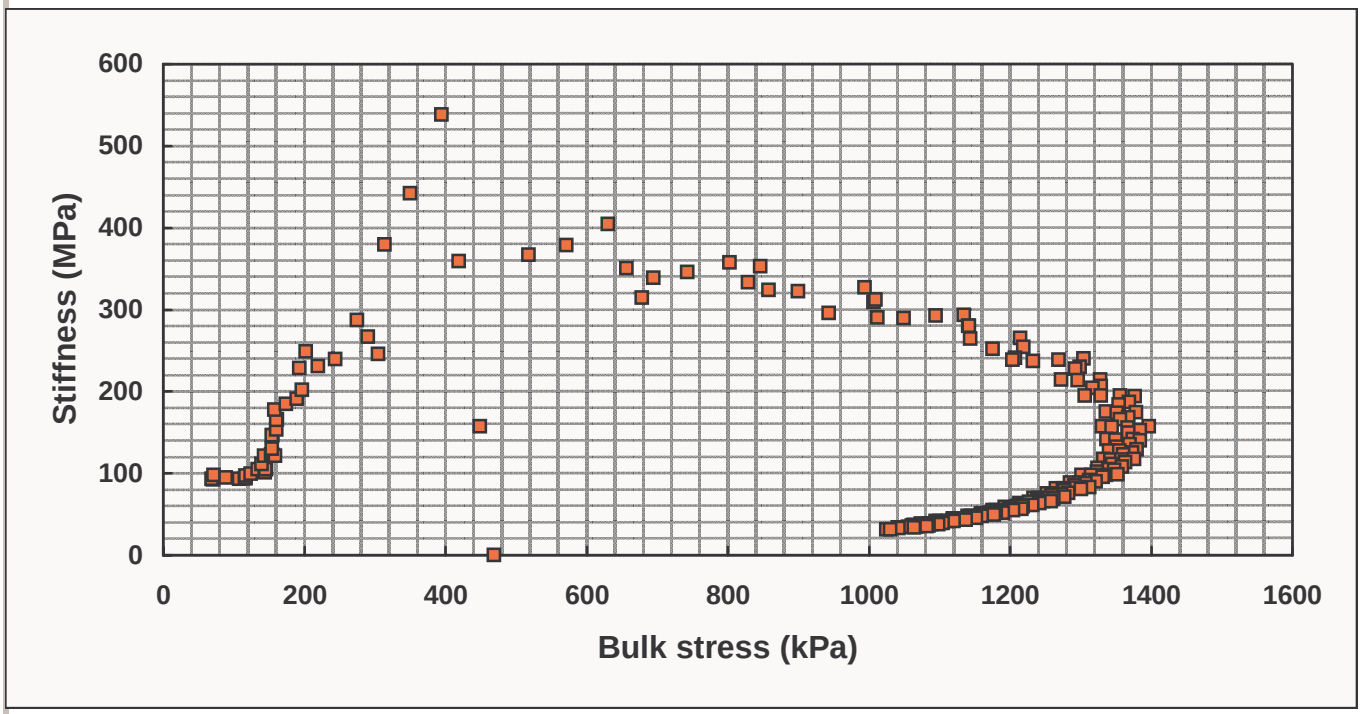
HSB: Treated with 1% Cement and 1.50% Foamed Bitumen

STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB01
Dry Density (kg/cub m): 2090
Moisture (%): 5.3

Treatment 1% cement & 1.5% bitumen
Confining pressure (kPa): 22
Linear stiffness (MPa): 296
Maximum deviator stress (kPa): 1327

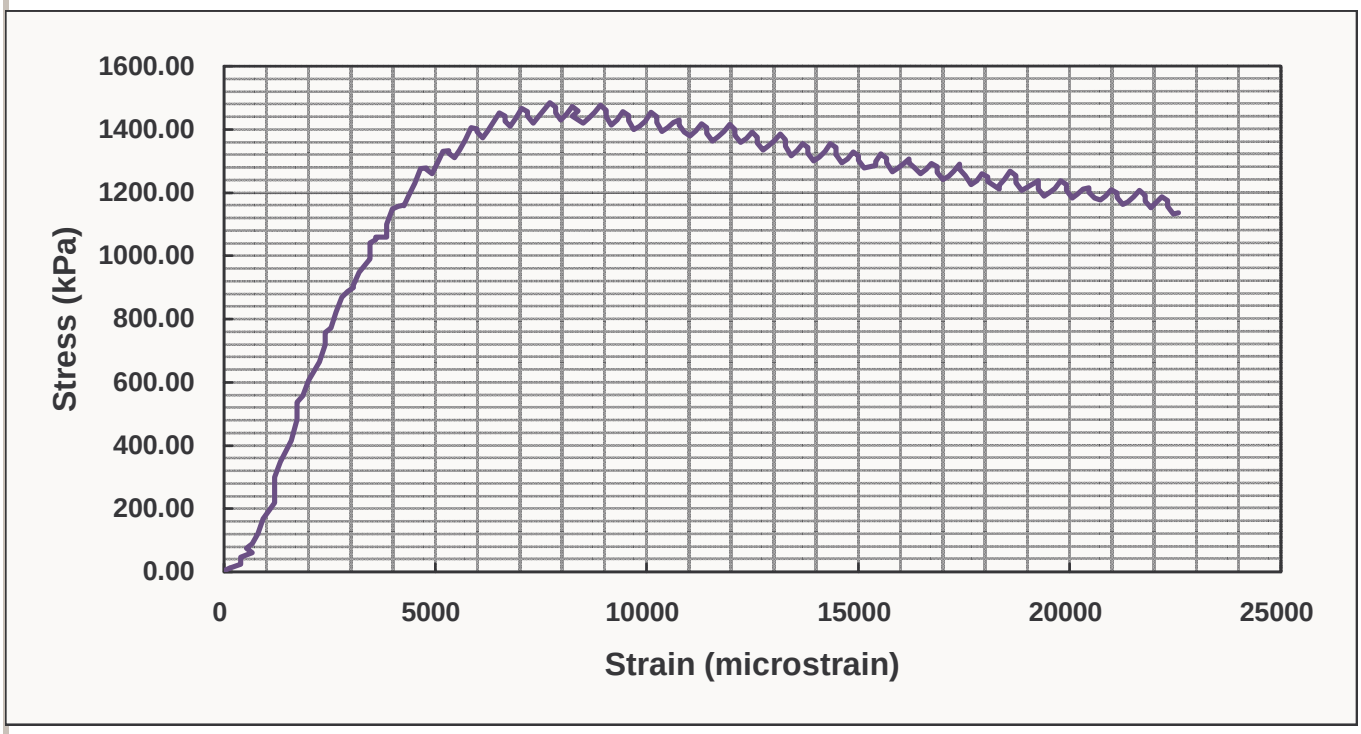


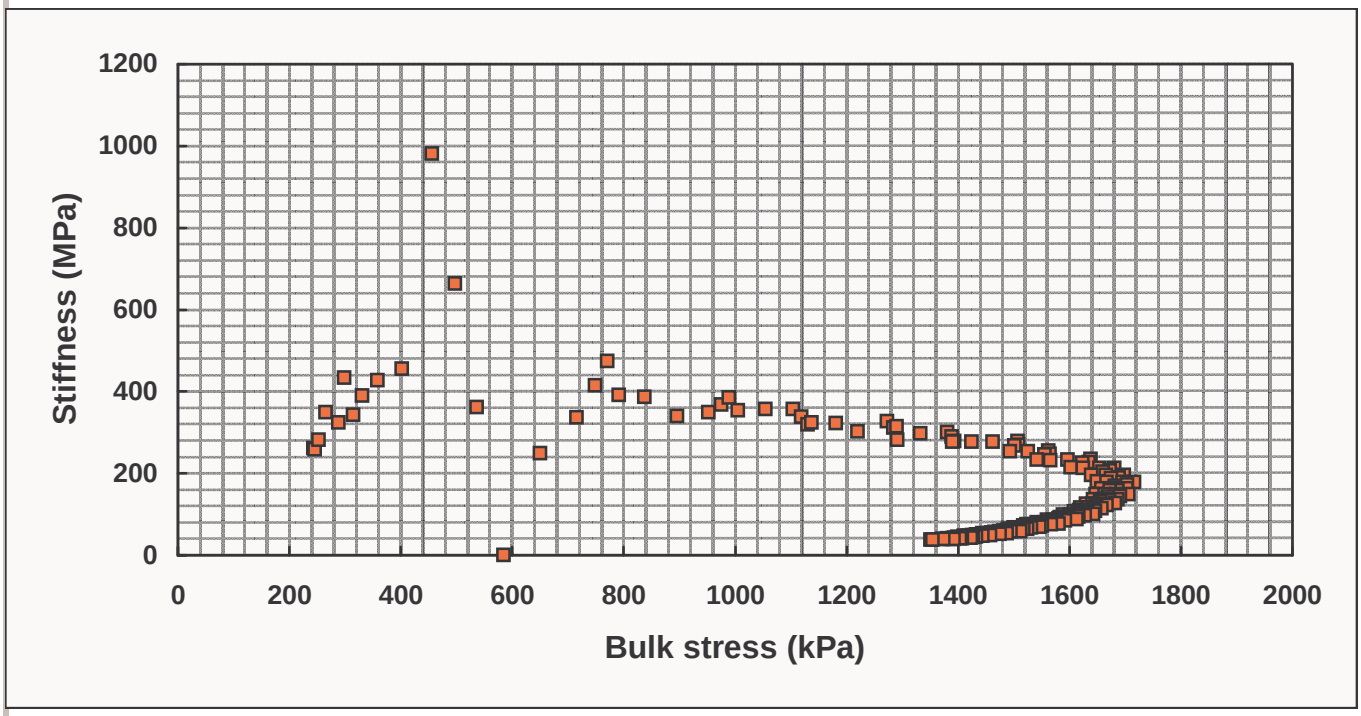


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB02
Dry Density (kg/cub m): 2090
Moisture (%): 5.2

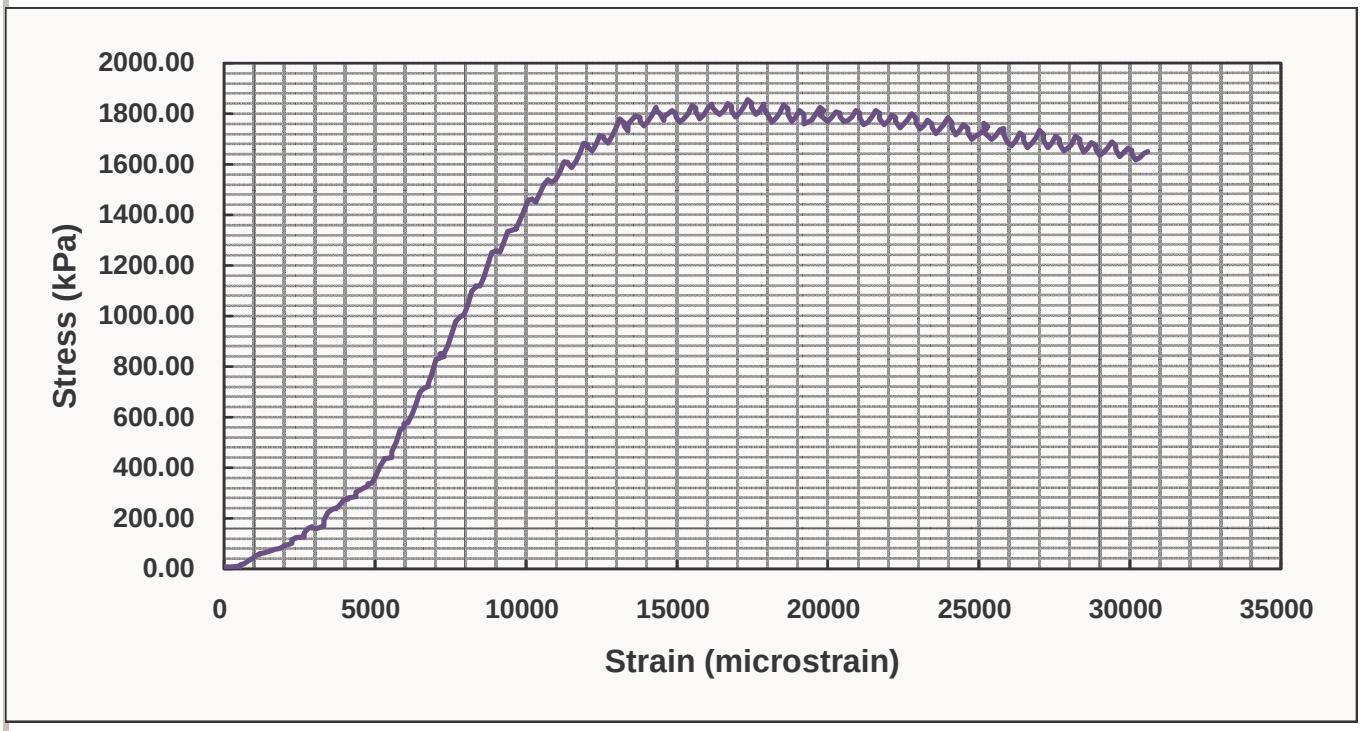
Treatment 1% cement & 1.5% bitumen
Confining pressure (kPa): 76
Linear stiffness (MPa): 319
Maximum deviator stress (kPa): 1485

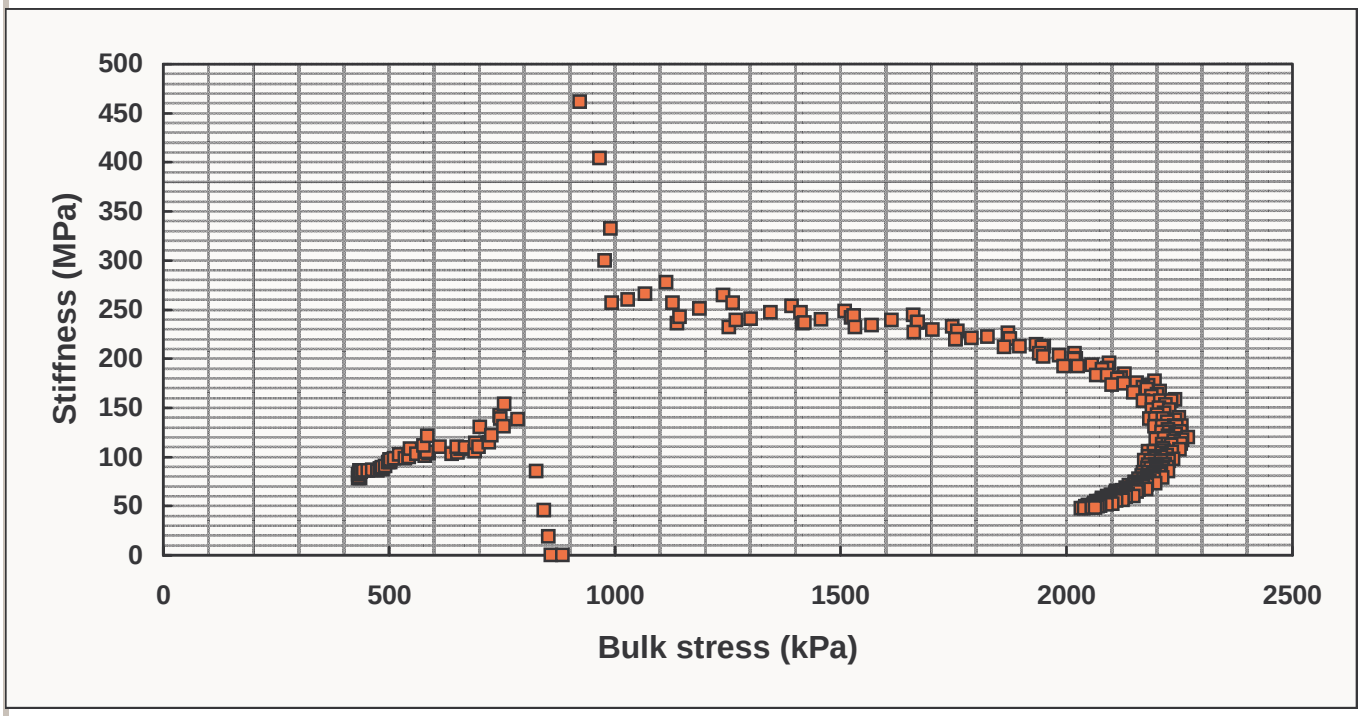




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1% cement & 1.5% bitumen
Sample #: HSB03
Dry Density (kg/cub m): 2090
Confining pressure (kPa): 138
Moisture (%): 5.3
Linear stiffness (MPa): 232
Maximum deviator stress (kPa): 1856

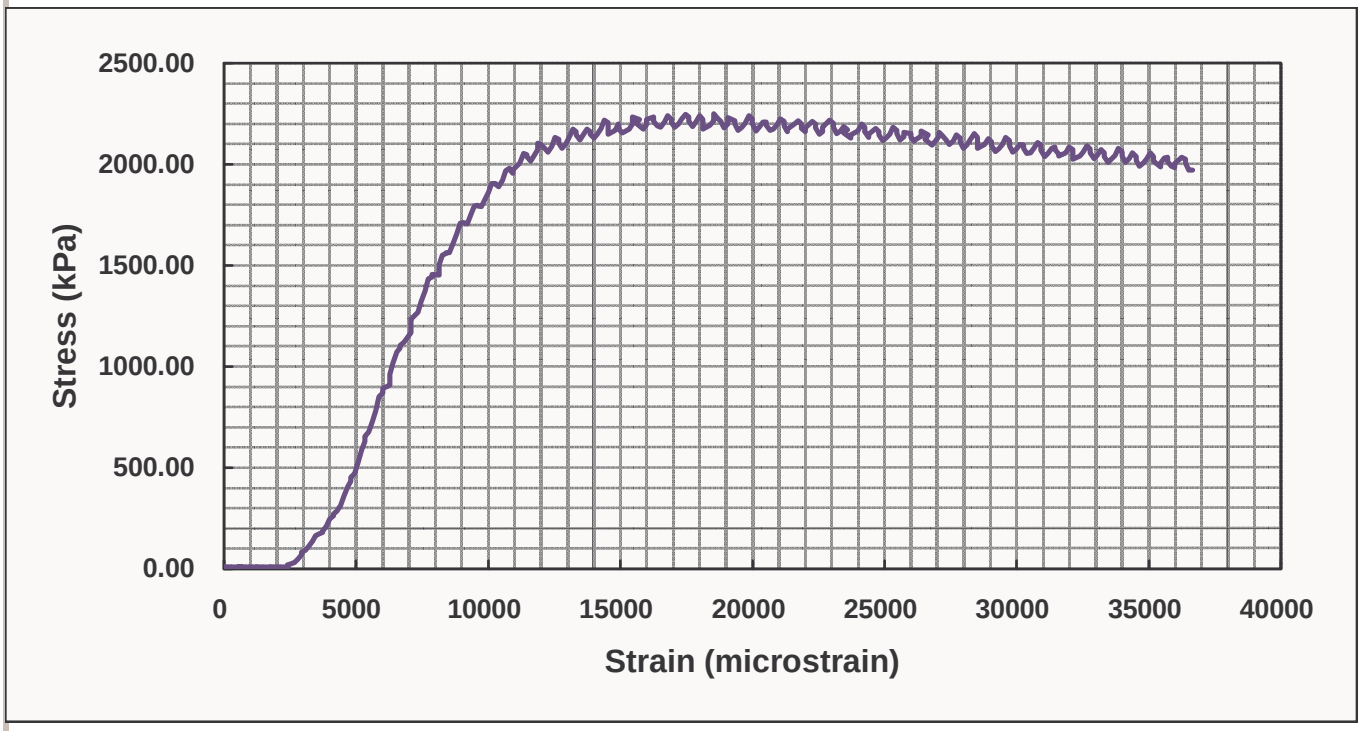


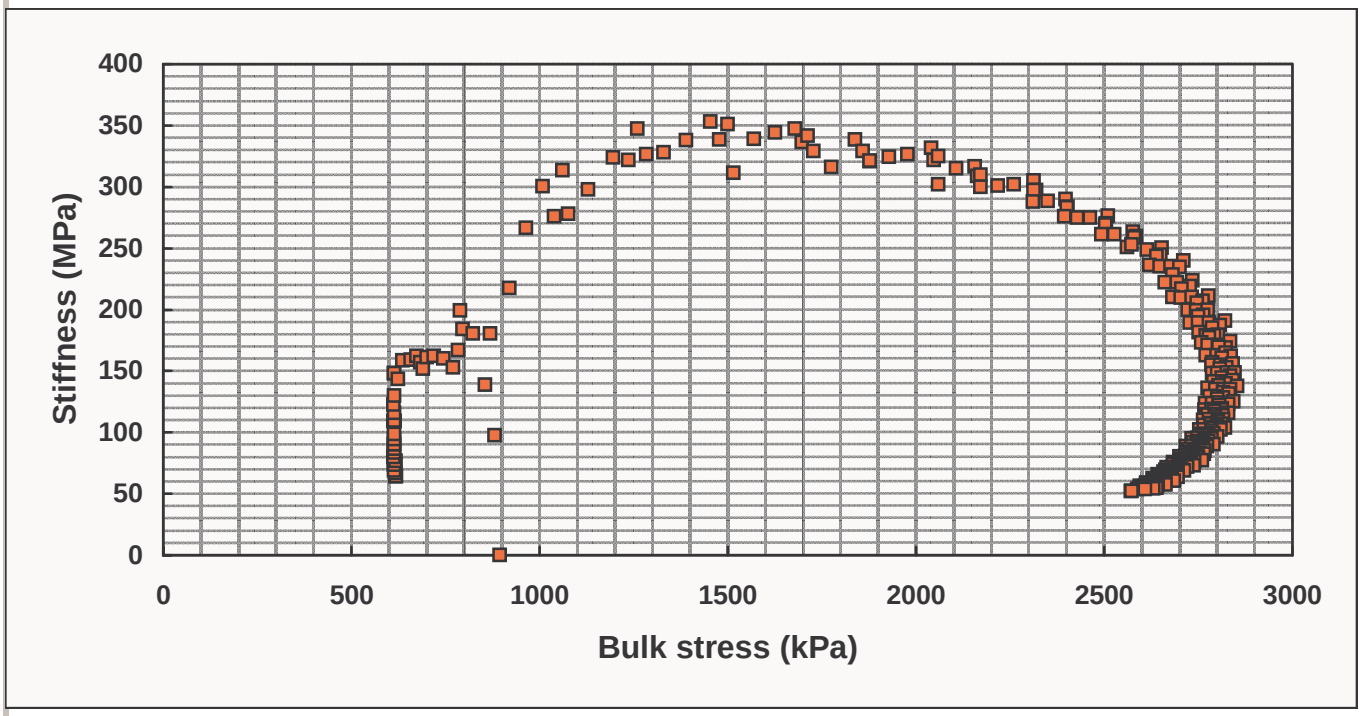


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB04
Dry Density (kg/cub m): 2090
Moisture (%): 5.4

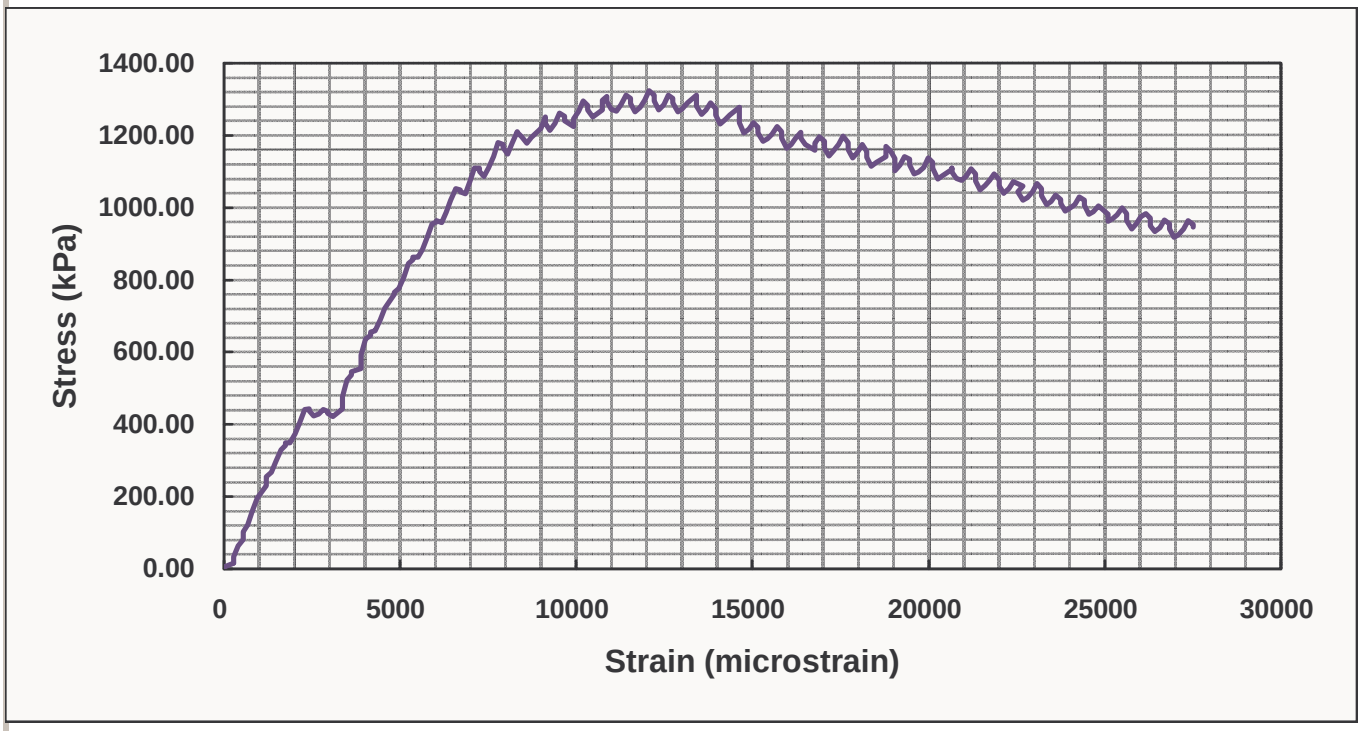
Treatment 1% cement & 1.5% bitumen
Confining pressure (kPa): 201
Linear stiffness (MPa): 302
Maximum deviator stress (kPa): 2249

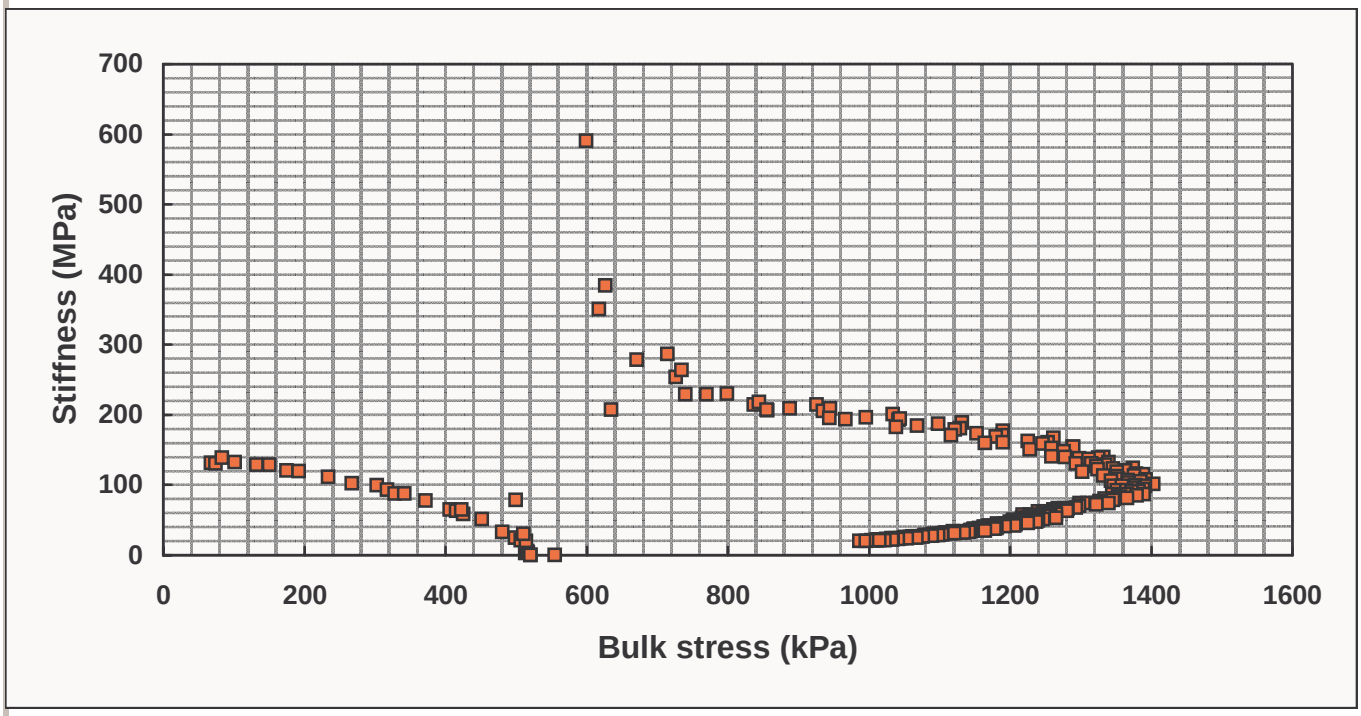




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1% cement & 1.5% bitumen
Sample #: HSB05
Dry Density (kg/cub m): 2090
Confining pressure (kPa): 24
Moisture (%): 2.4
Linear stiffness (MPa): 194
Maximum deviator stress (kPa): 1324

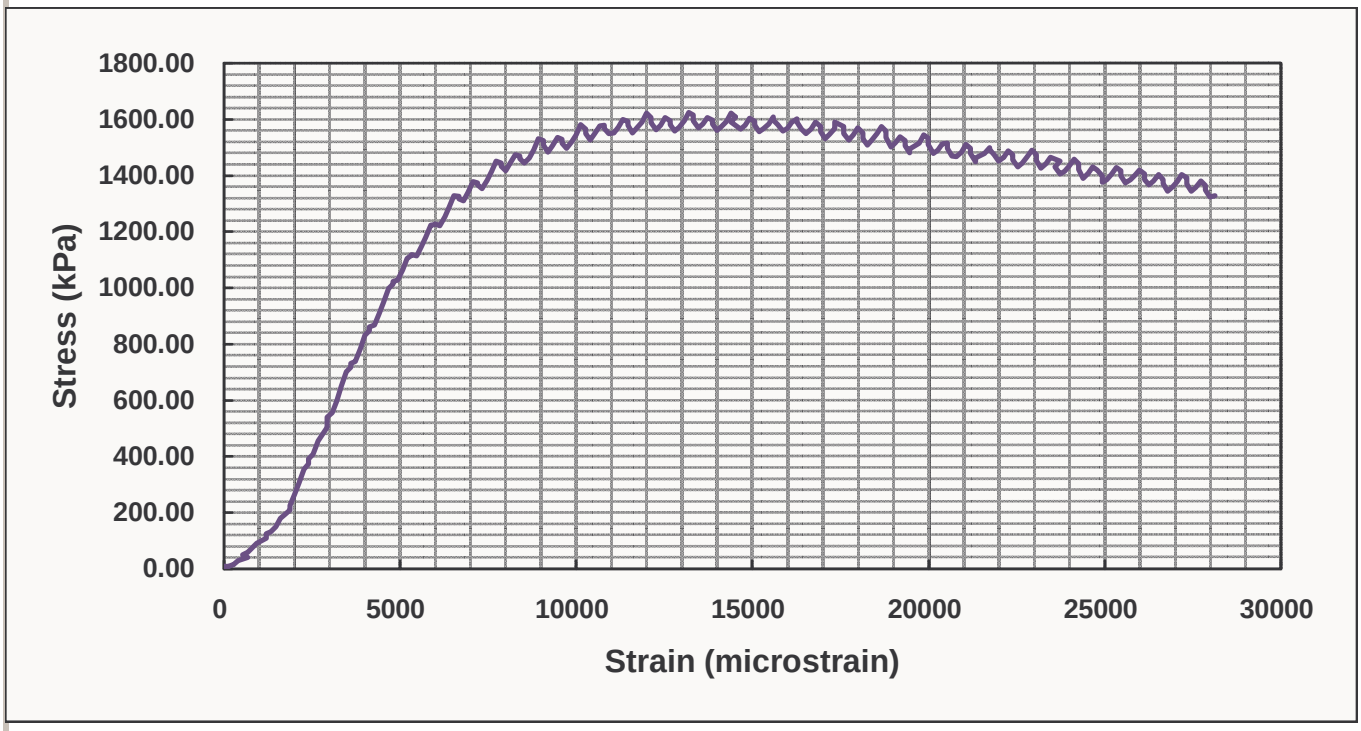


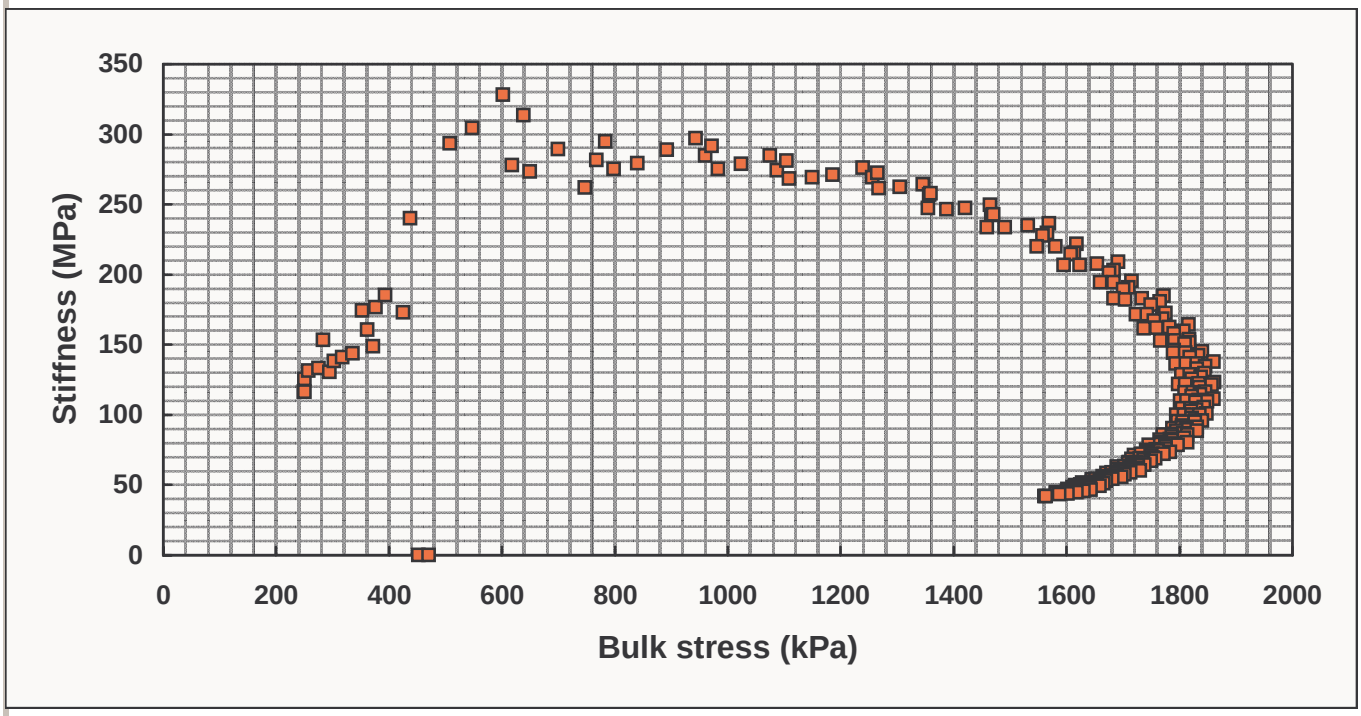


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB06
Dry Density (kg/cub m): 2090
Moisture (%): 2.4

Treatment 1% cement & 1.5% bitumen
Confining pressure (kPa): 80
Linear stiffness (MPa): 276
Maximum deviator stress (kPa): 1623





STATIC TRIAXIAL TEST

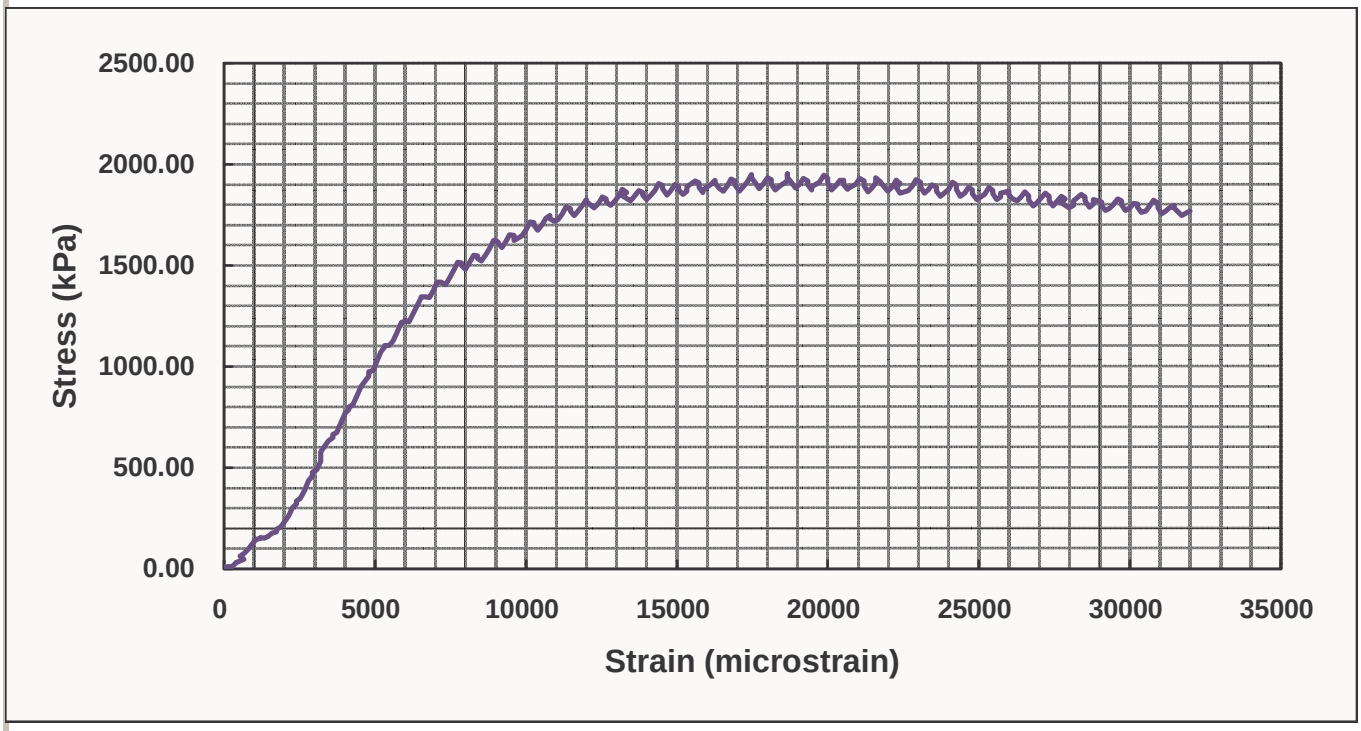
Material: Hornfels — **Treatment** **1% cement & 1.5% bitumen**

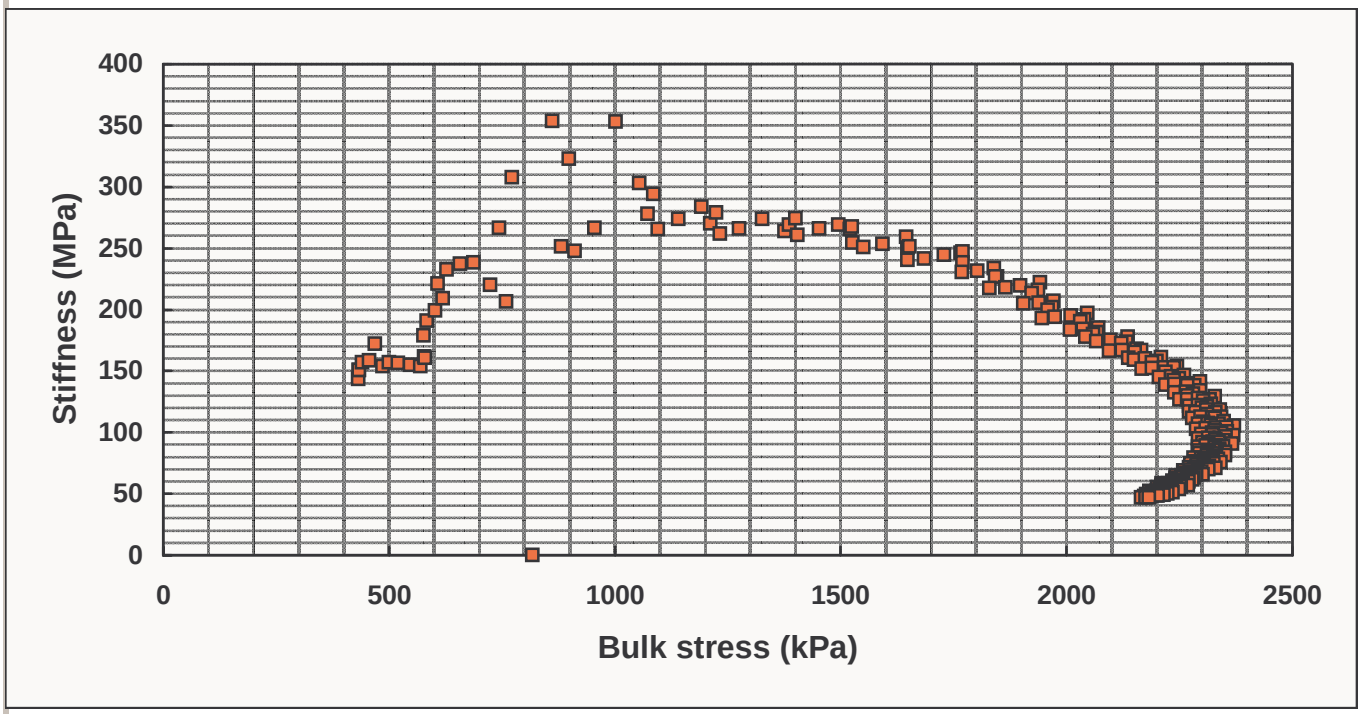
Sample #: HSB07

Dry Density (kg/cub m): 2090 — **Confining pressure (kPa): 140**

Moisture (%): 2.5 — **Linear stiffness (MPa): 251**

Maximum deviator stress (kPa): 1954





STATIC TRIAXIAL TEST

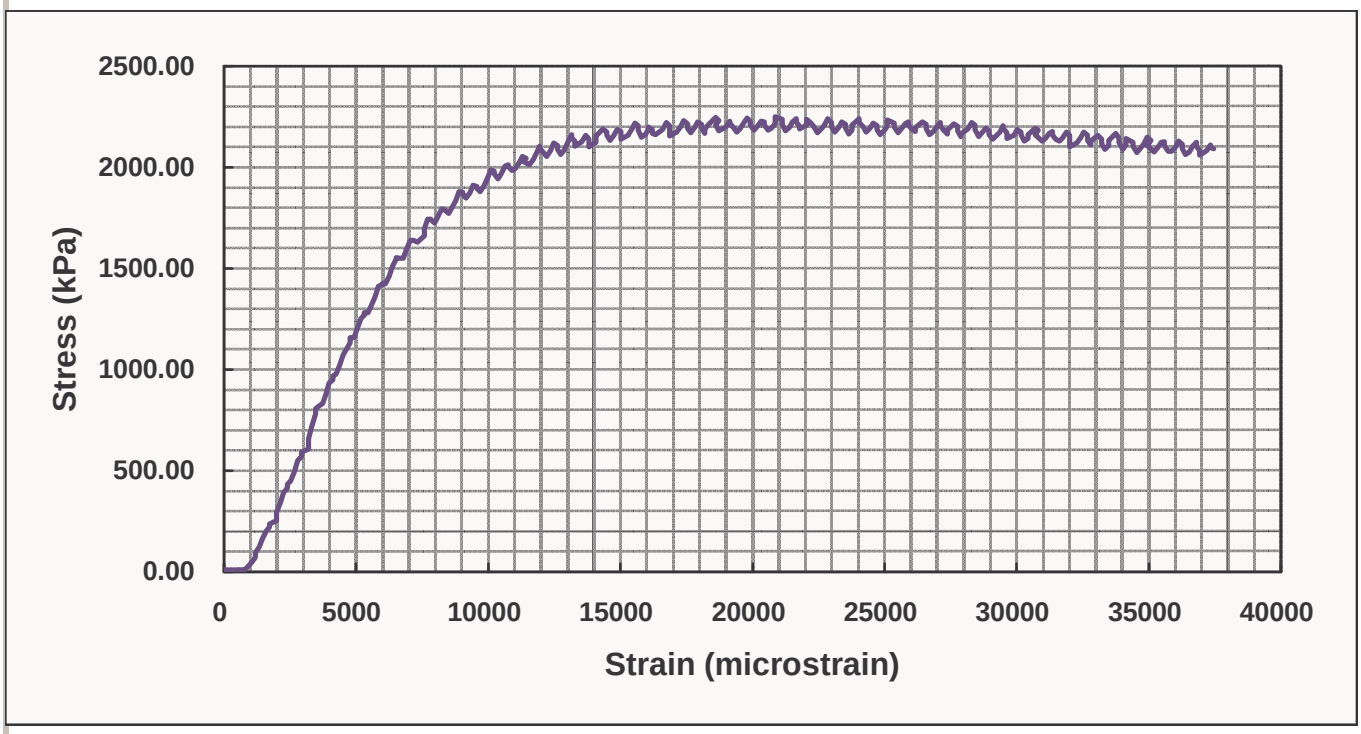
Material: Hornfels — **Treatment** **1% cement & 1.5% bitumen**

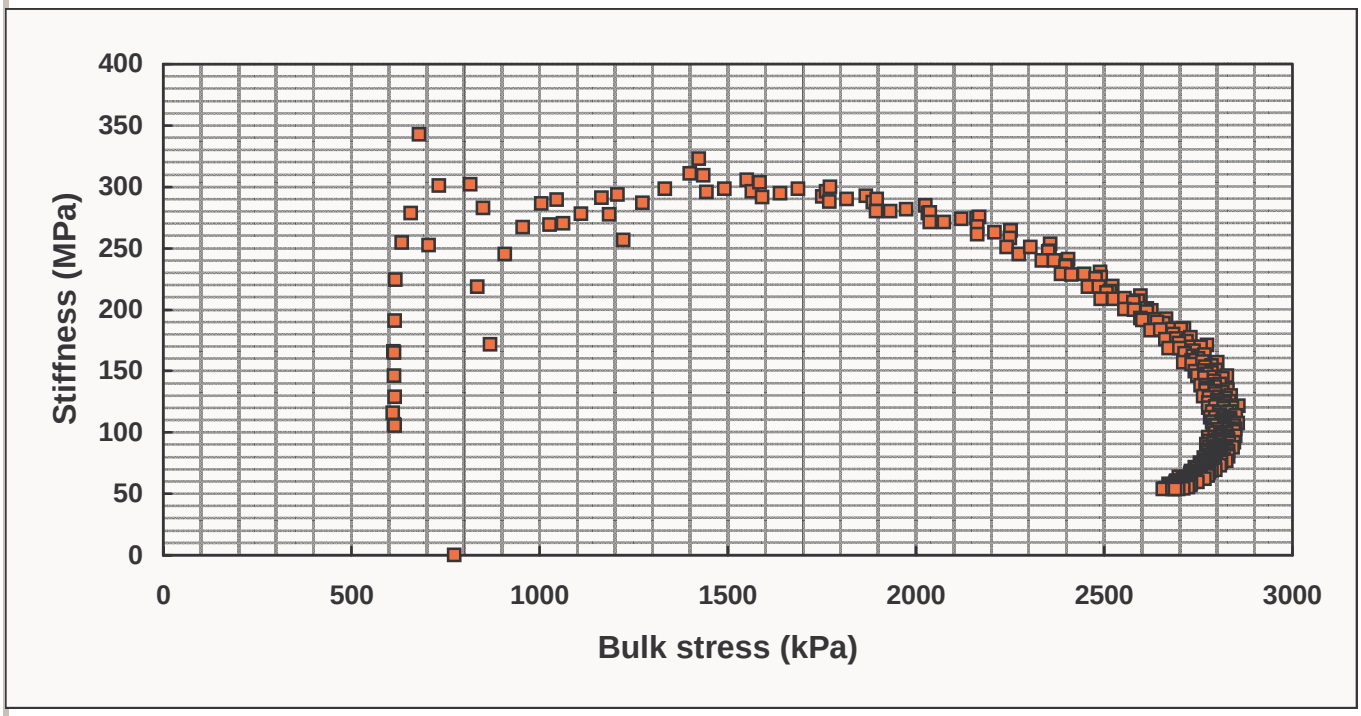
Sample #: HSB08

Dry Density (kg/cub m): 2090 — **Confining pressure (kPa): 202**

Moisture (%): 2.5 — **Linear stiffness (MPa): 282**

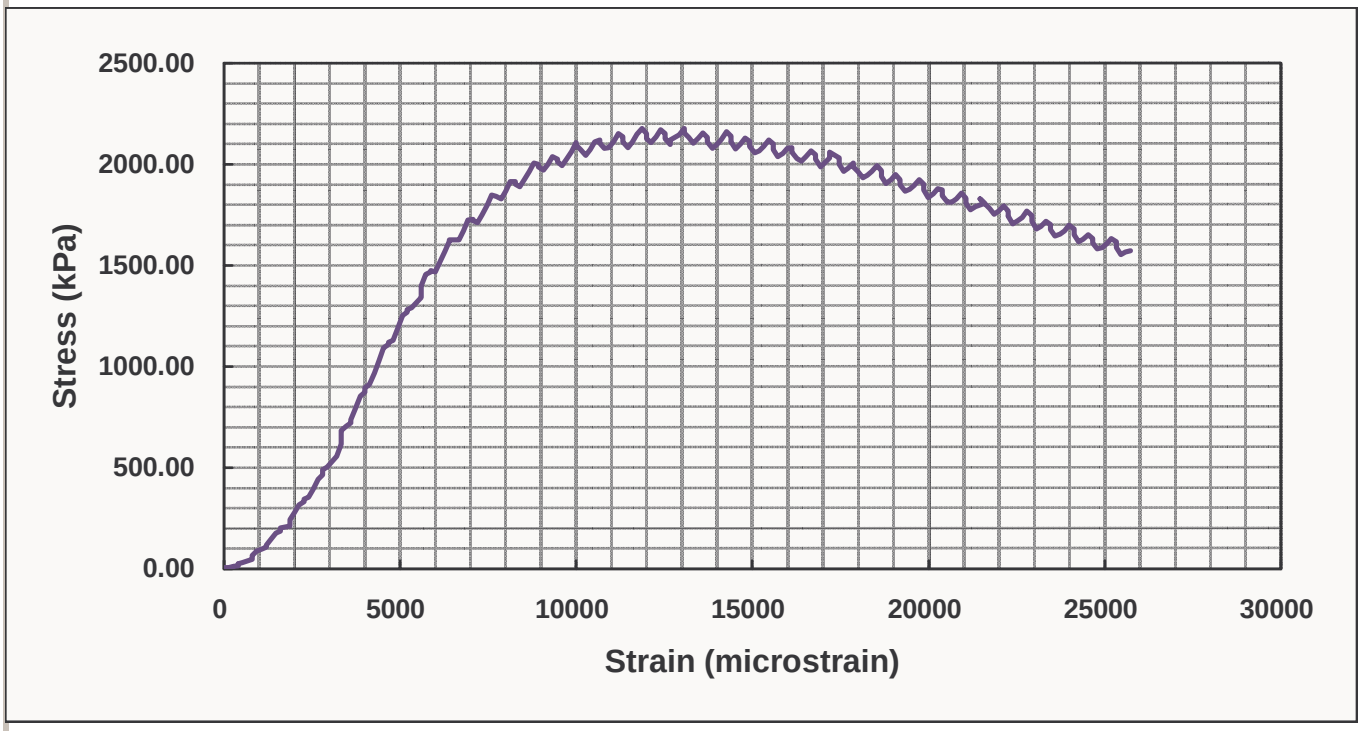
Maximum deviator stress (kPa): 2251

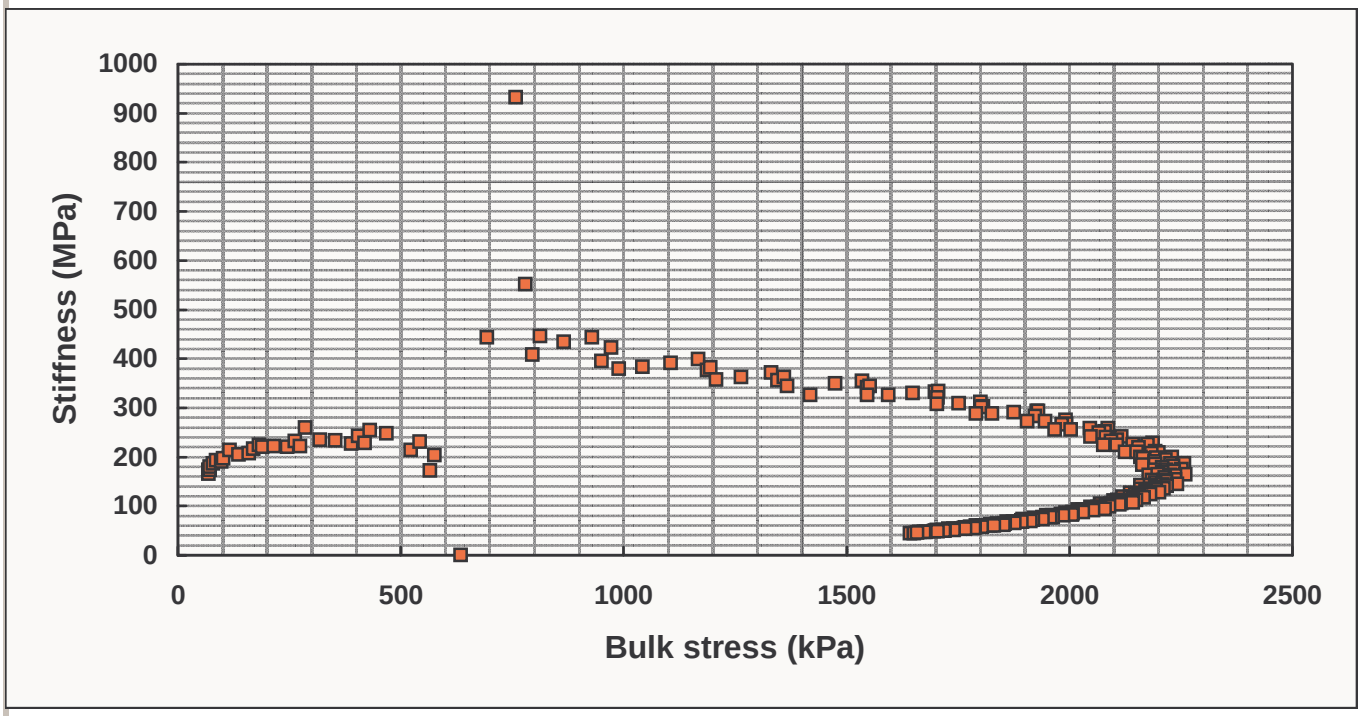




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 1.5% bitumen
Sample #: hsb09
Dry Density (kg/cub m): 2260
Confining pressure (kPa): 27
Moisture (%): 3.8
Linear stiffness (MPa): 325
Maximum deviator stress (kPa): 2178

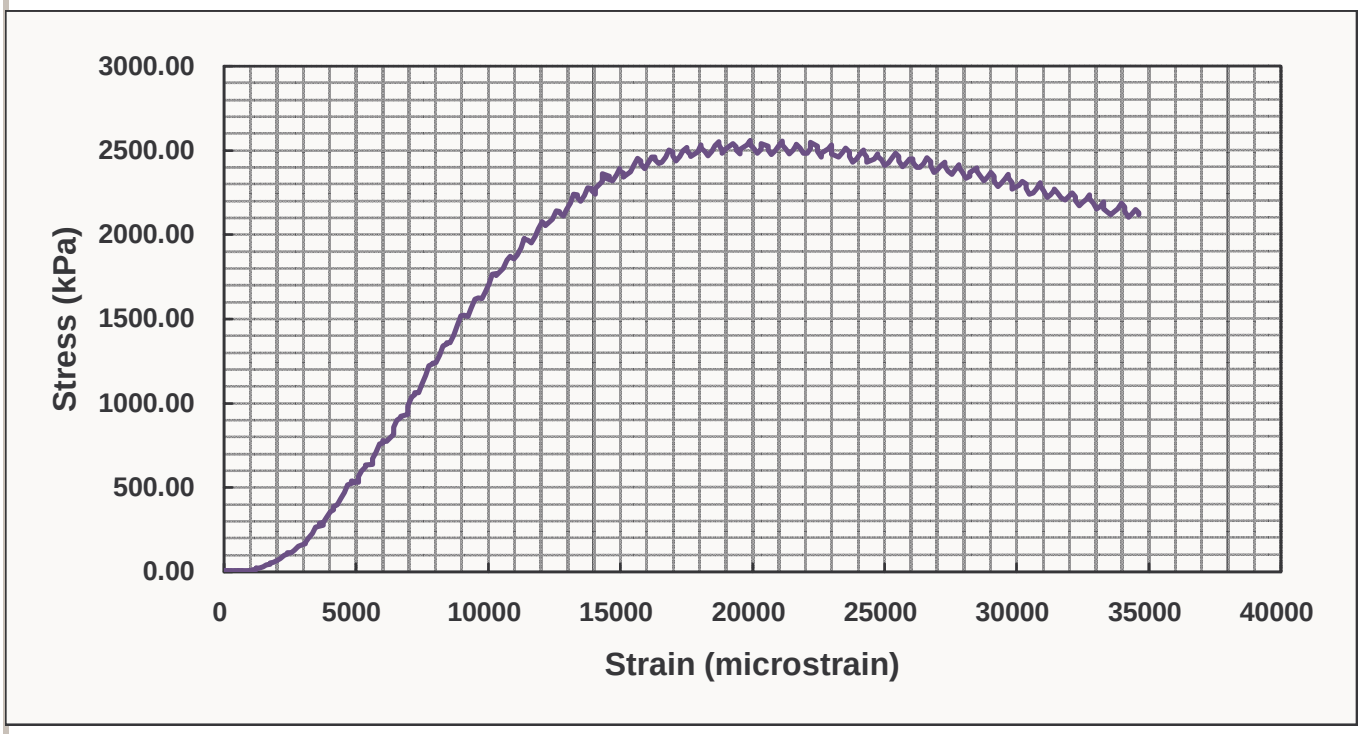


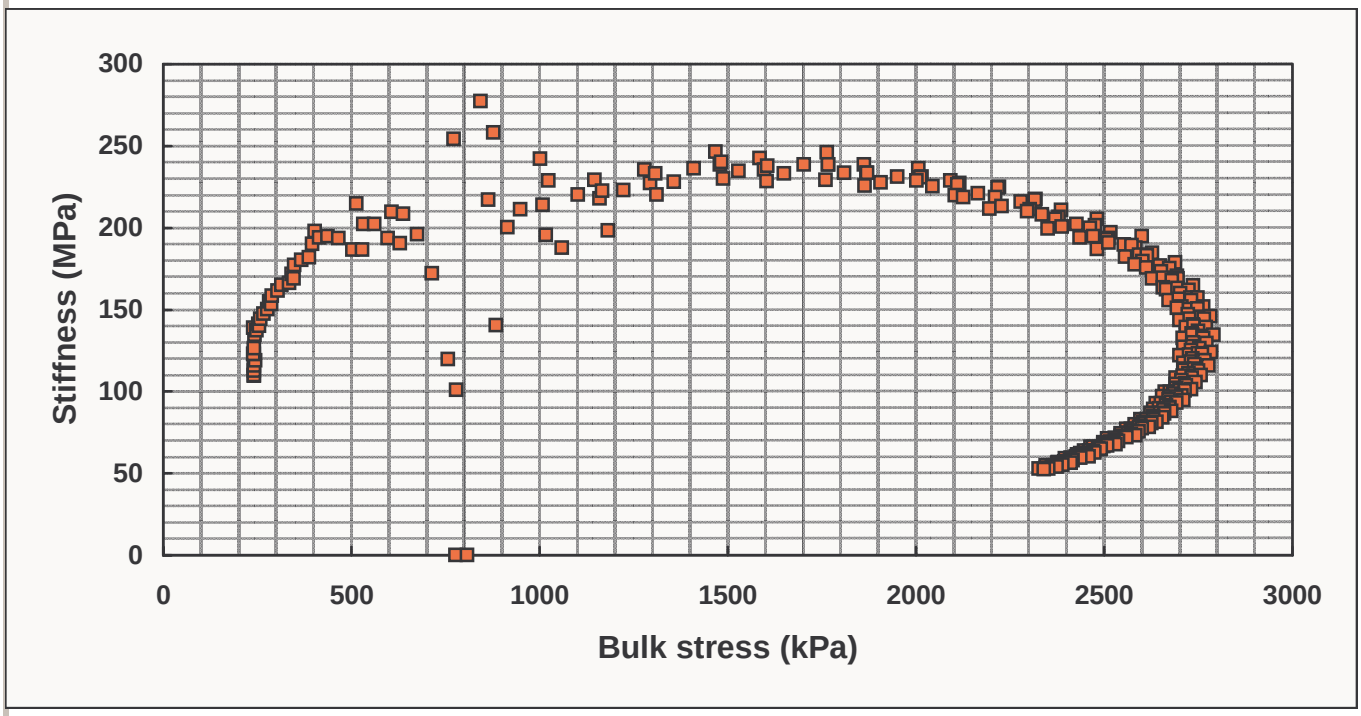


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB10
Dry Density (kg/cub m): 2260
Moisture (%): 3.9

Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 78
Linear stiffness (MPa): 228
Maximum deviator stress (kPa): 2559

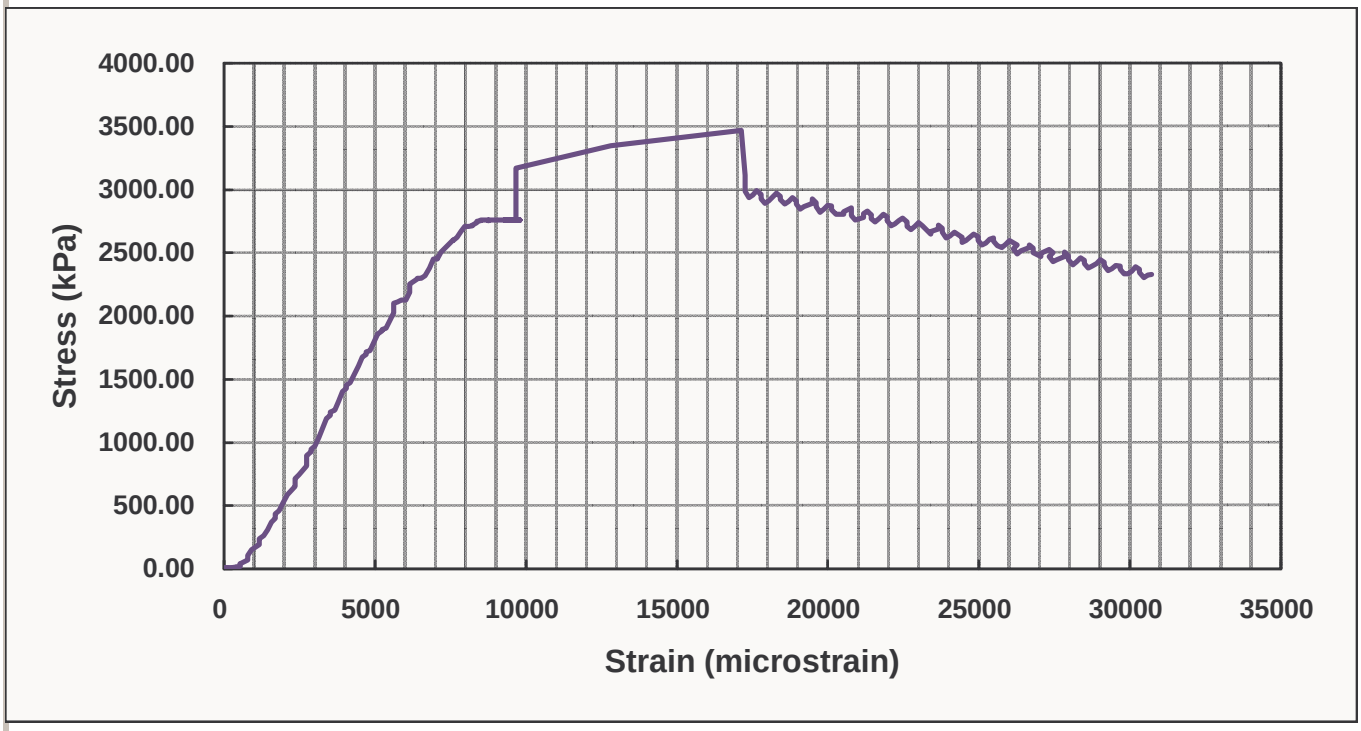


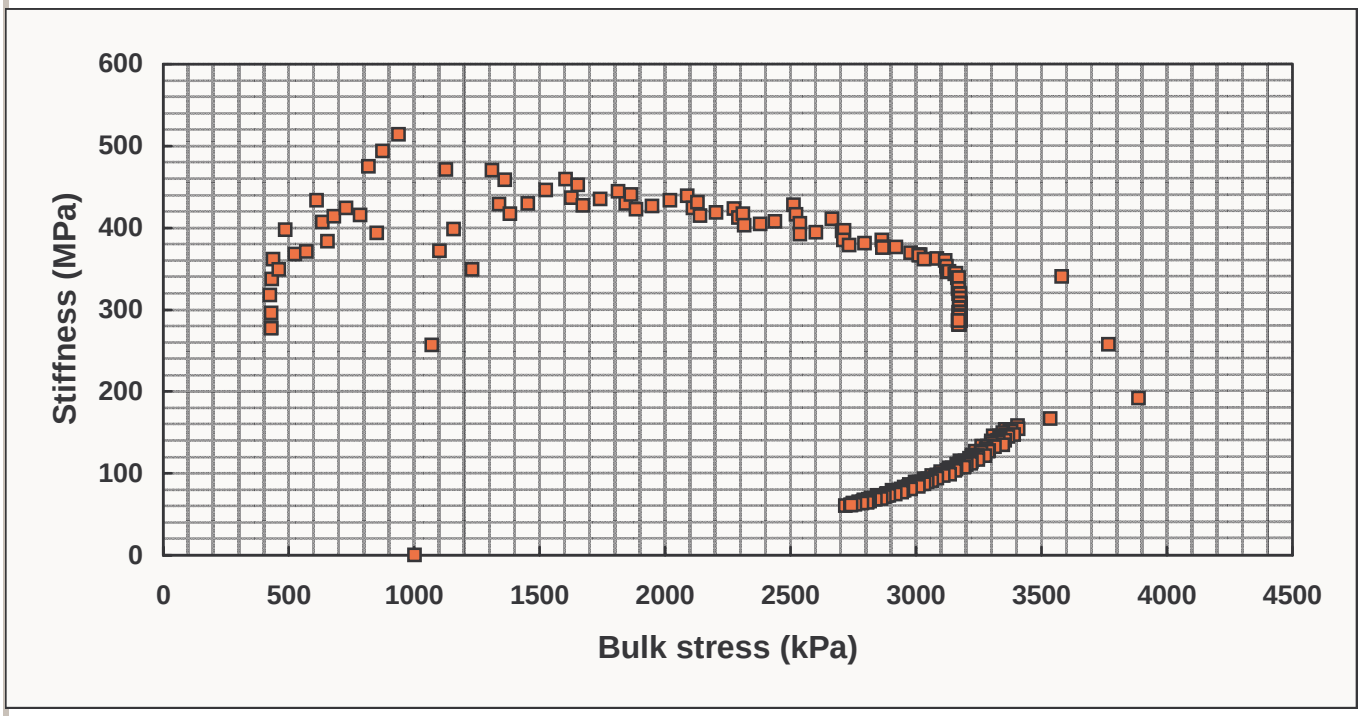


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB11
Dry Density (kg/cub m): 2260
Moisture (%): 3.2

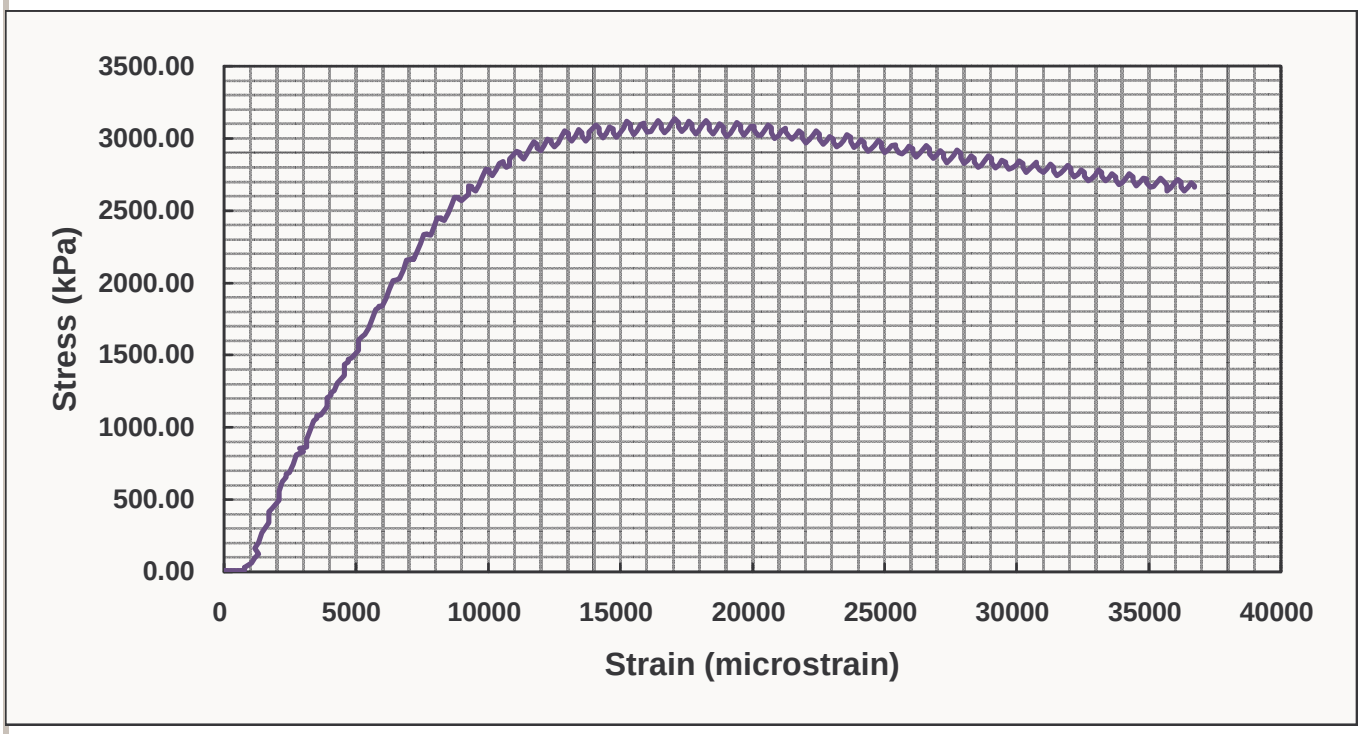
Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 139
Linear stiffness (MPa): 404
Maximum deviator stress (kPa): 3467

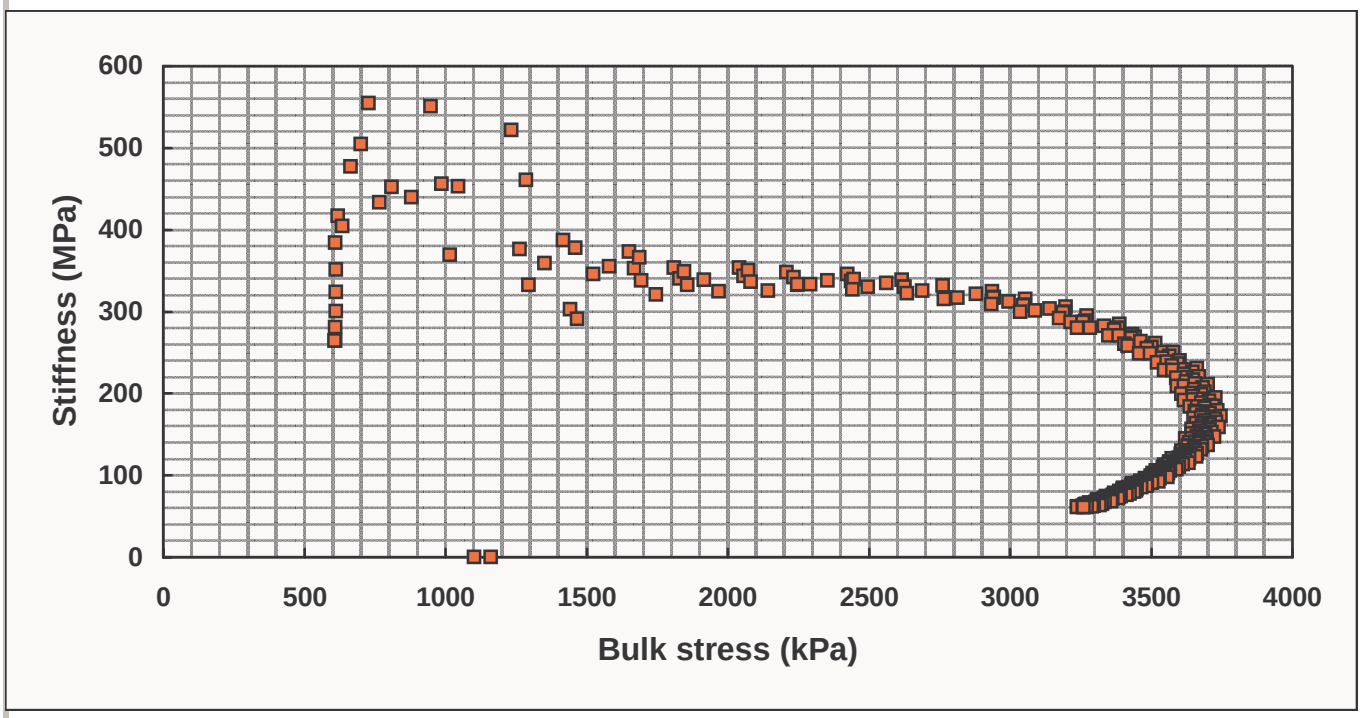




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 1.5% bitumen
Sample #: HSB12
Dry Density (kg/cub m): 2260
Confining pressure (kPa): 202
Moisture (%): 3.4
Linear stiffness (MPa): 335
Maximum deviator stress (kPa): 3136

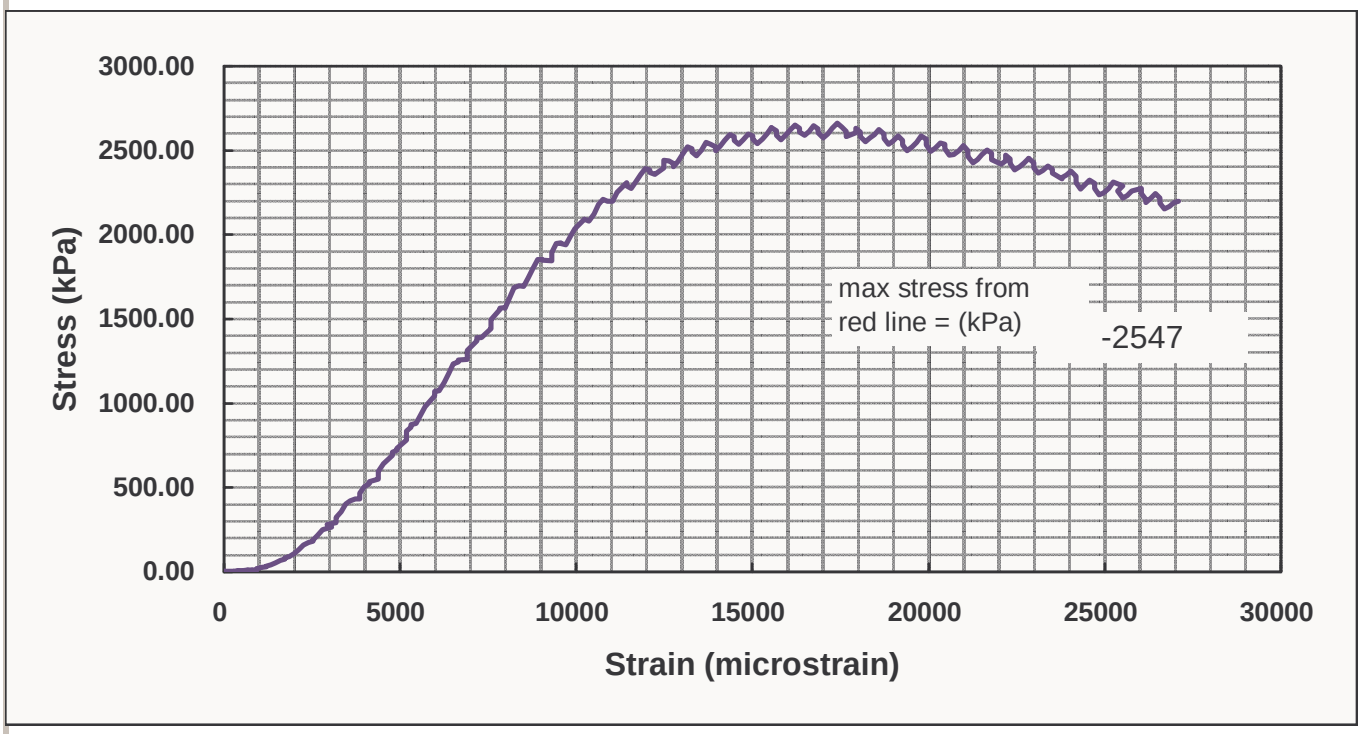


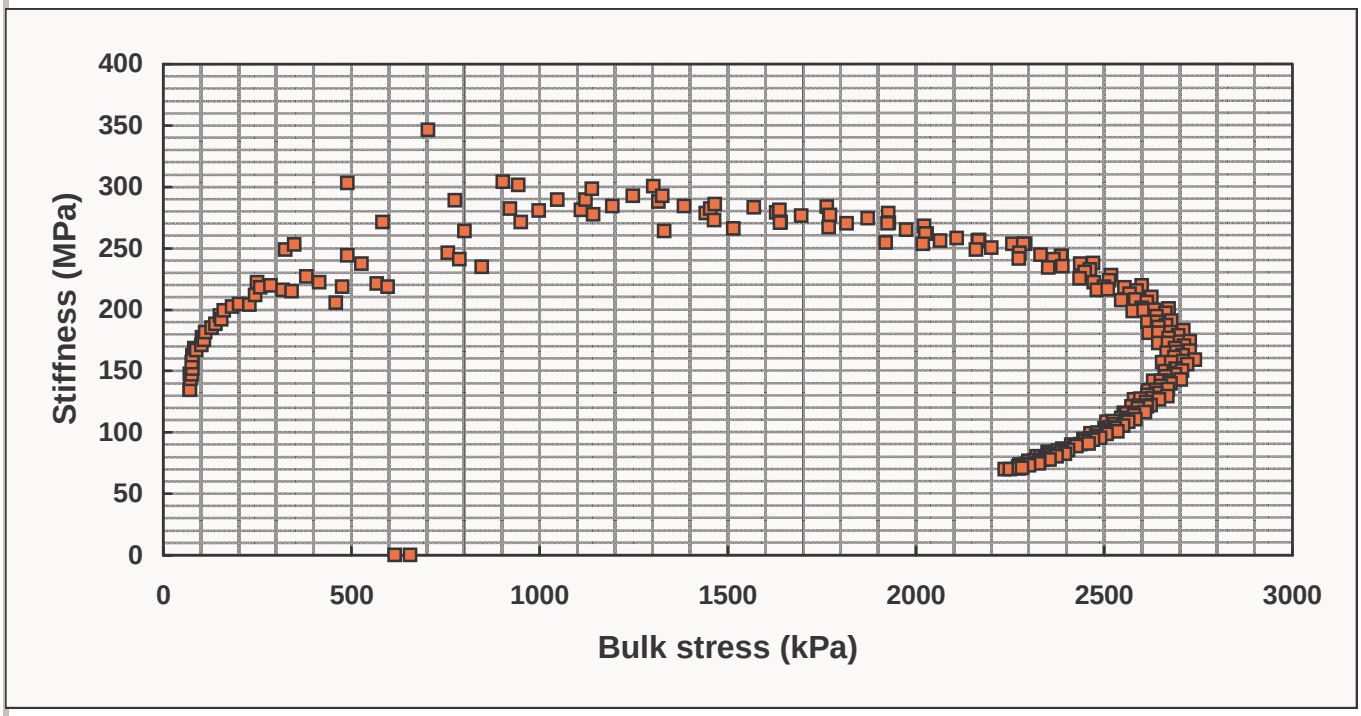


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB13
Dry Density (kg/cub m): 2260
Moisture (%): 1.9

Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 25
Linear stiffness (MPa): 274
Maximum deviator stress (kPa): 2662

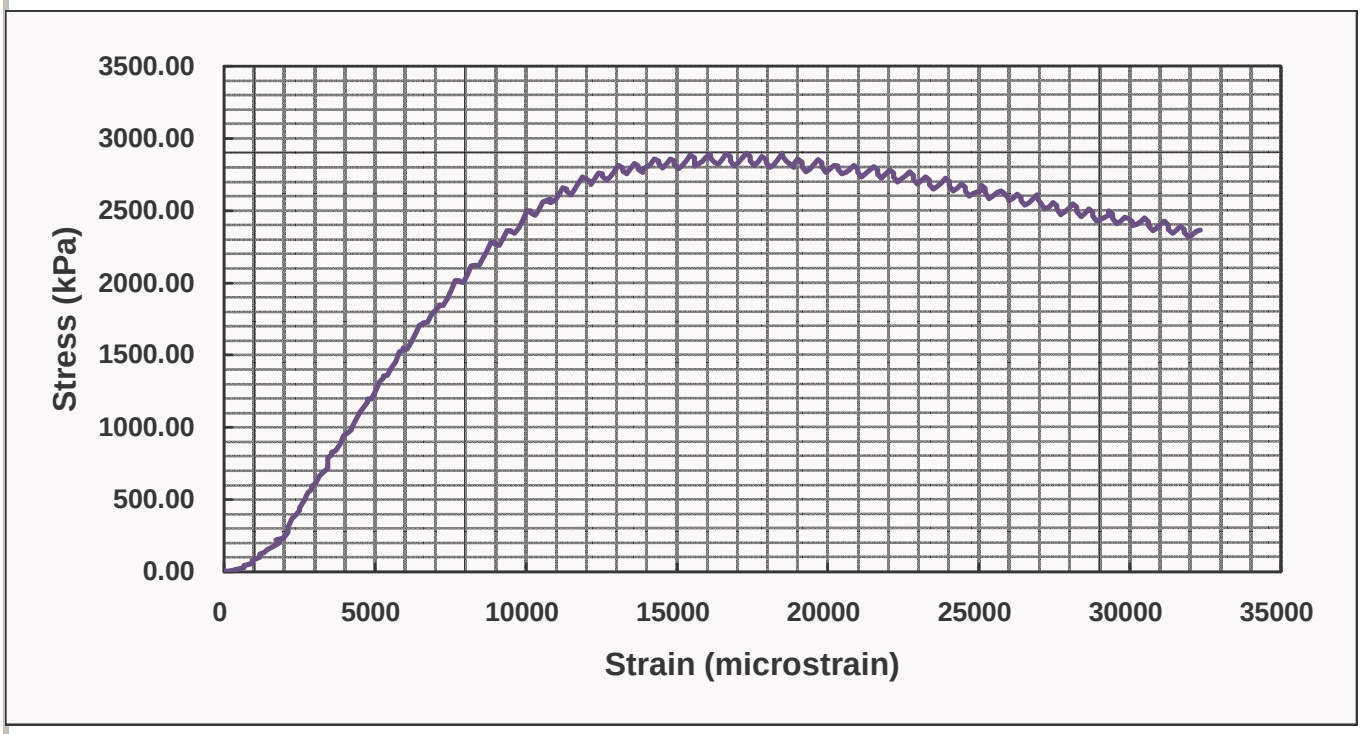


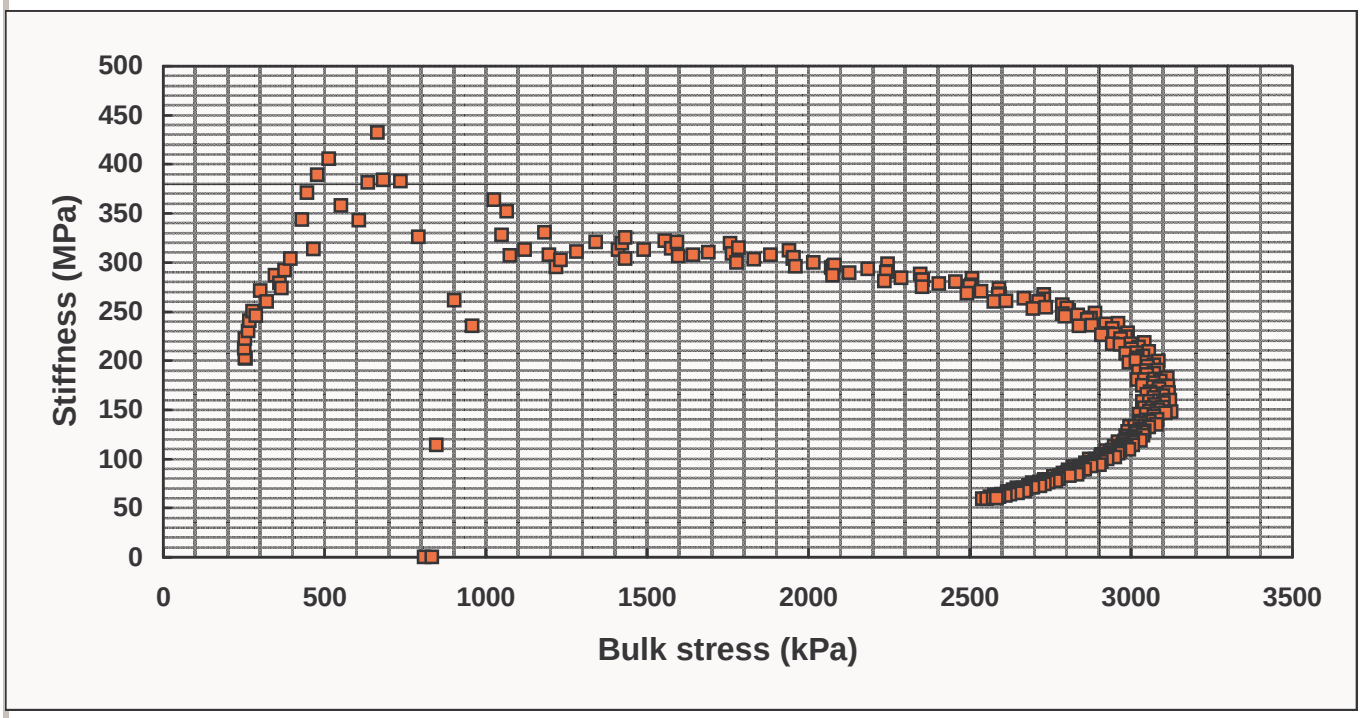


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB14
Dry Density (kg/cub m): 2260
Moisture (%): 1.8

Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 76
Linear stiffness (MPa): 295
Maximum deviator stress (kPa): 2899

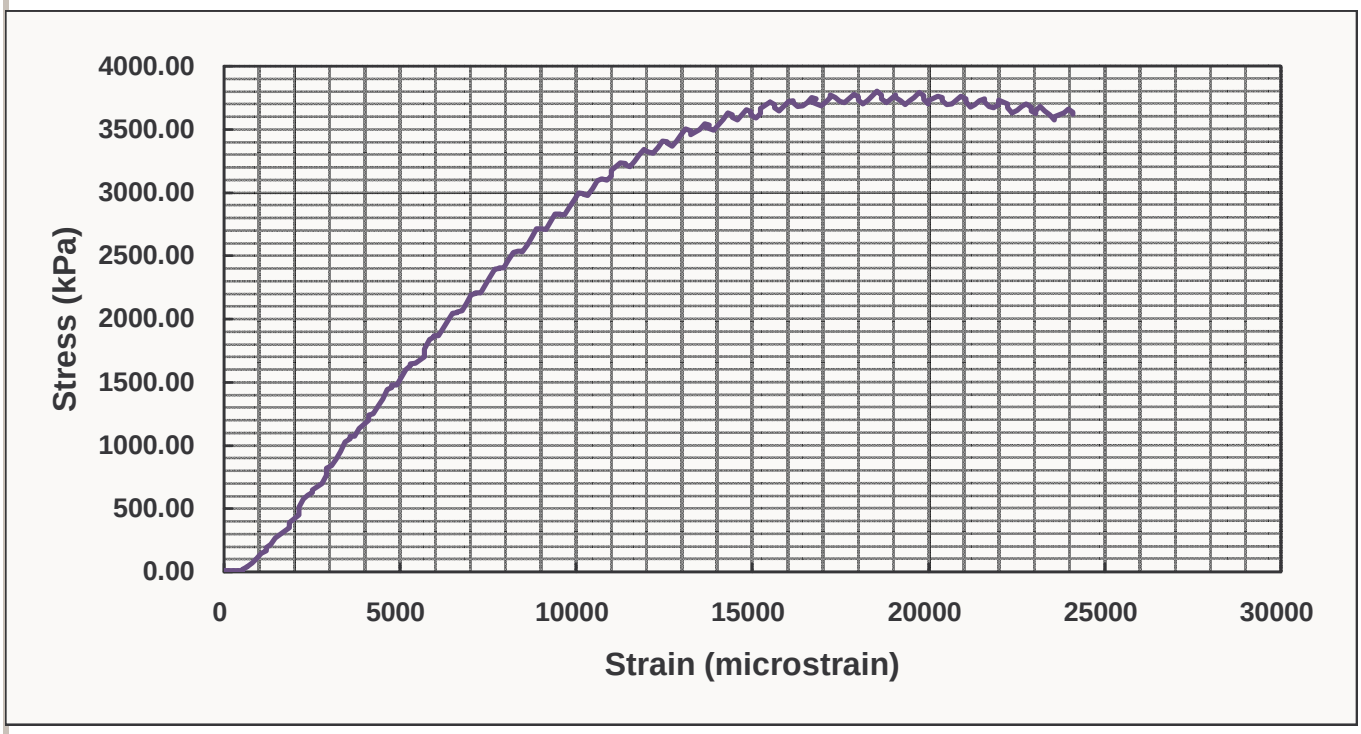


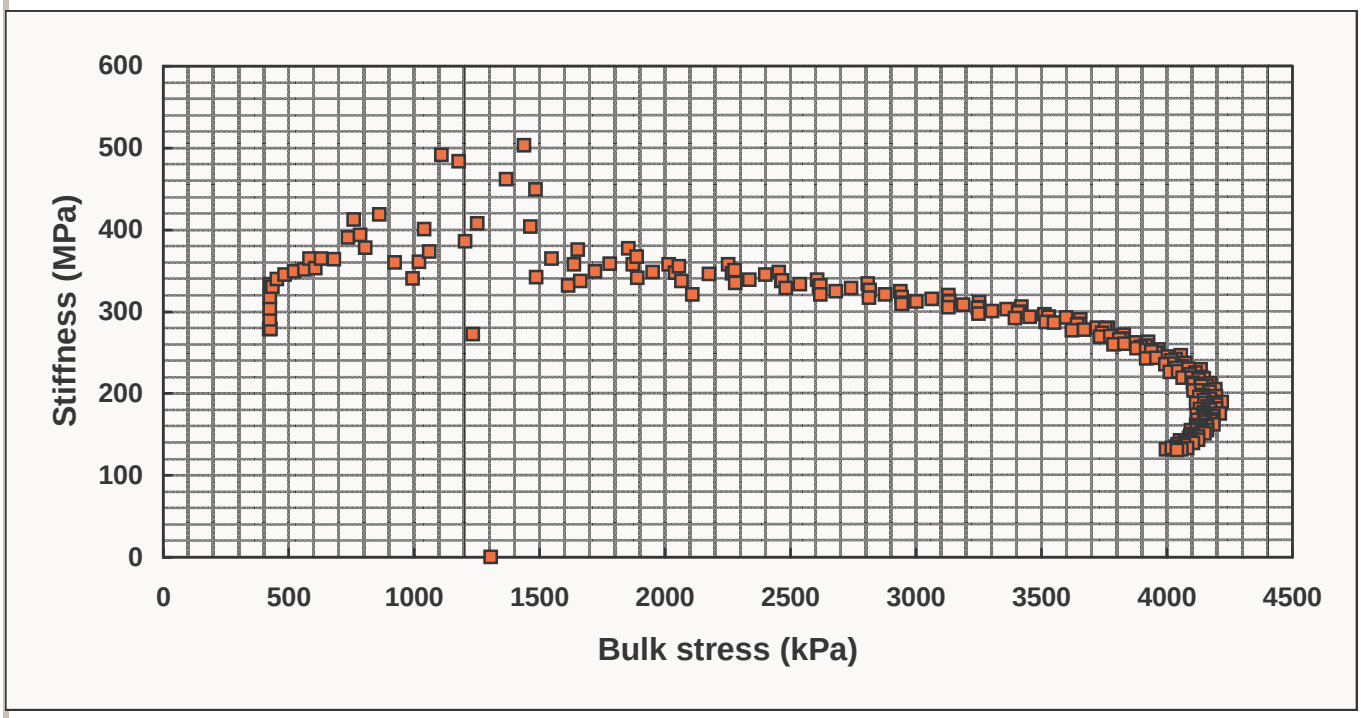


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB15
Dry Density (kg/cub m): 2260
Moisture (%): 2.0

Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 139
Linear stiffness (MPa): 334
Maximum deviator stress (kPa): 3800

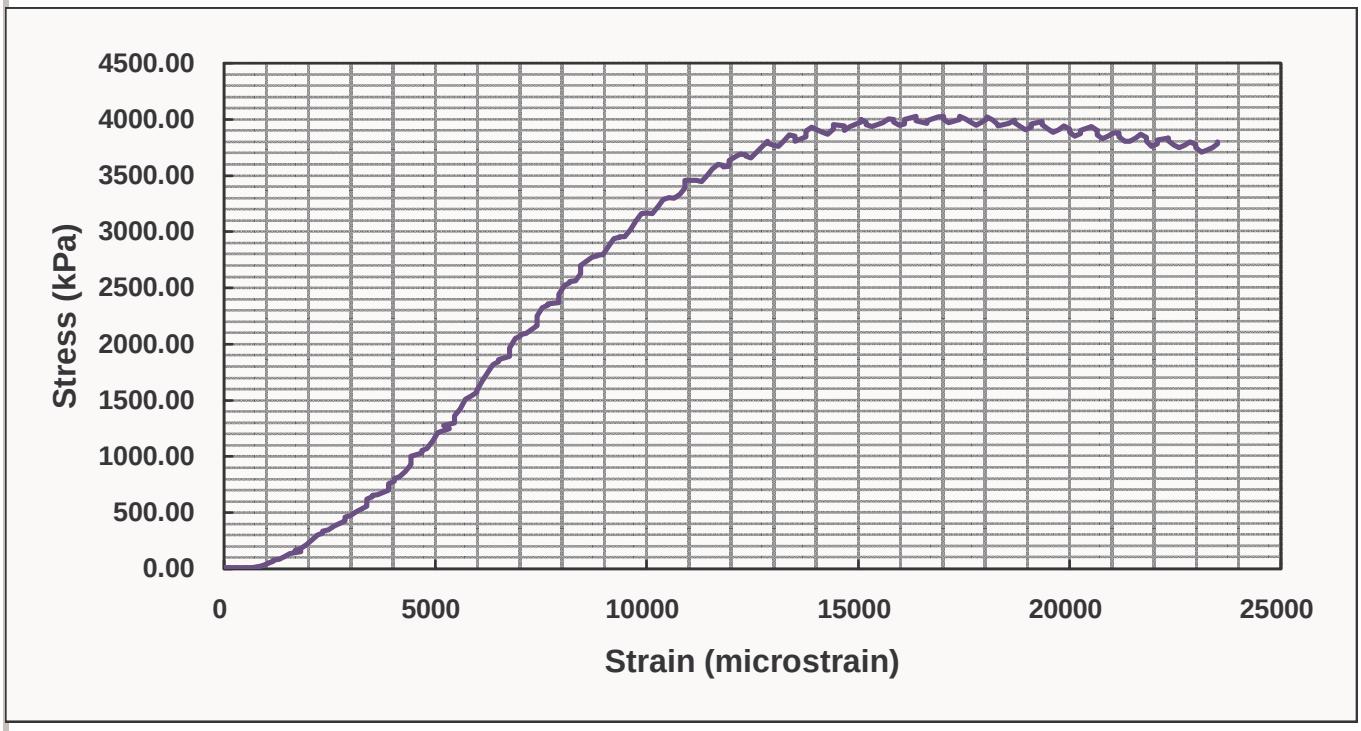


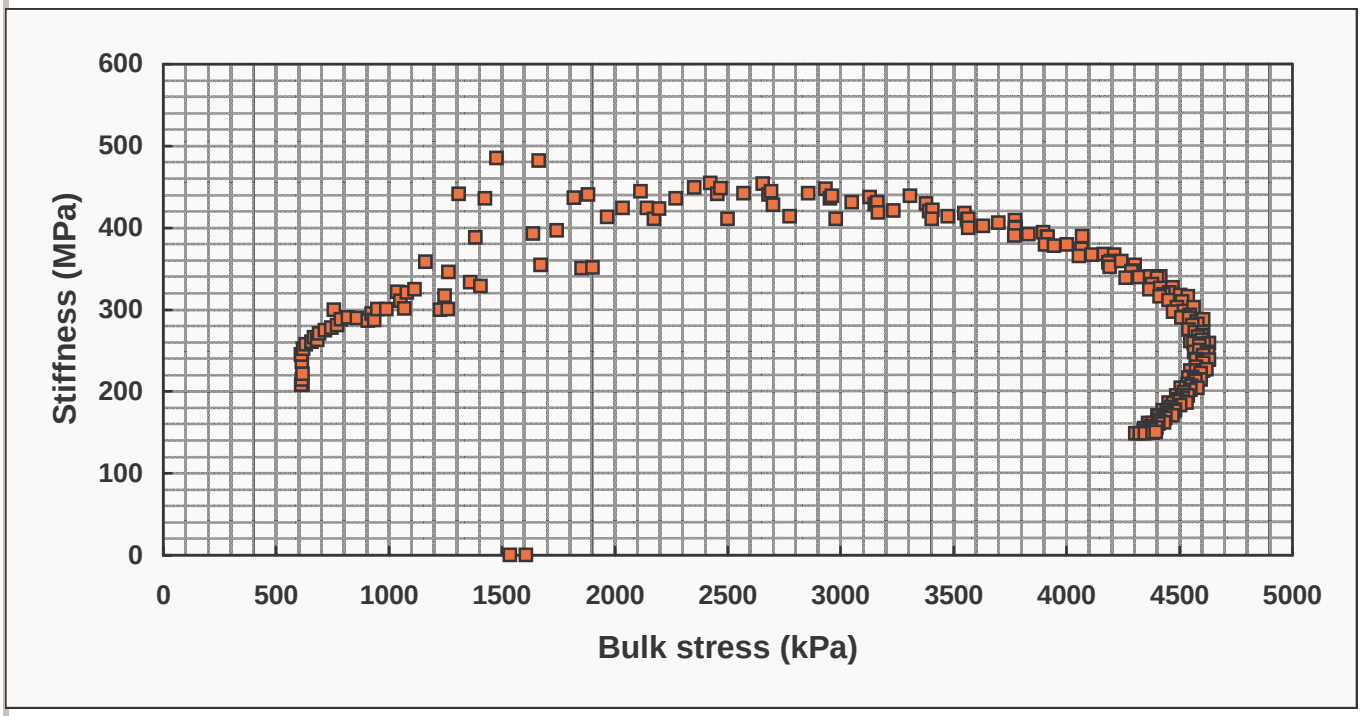


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSB16
Dry Density (kg/cub m): 2260
Moisture (%): 1.7

Treatment 1 % cement & 1.5% bitumen
Confining pressure (kPa): 202
Linear stiffness (MPa): 431
Maximum deviator stress (kPa): 4030

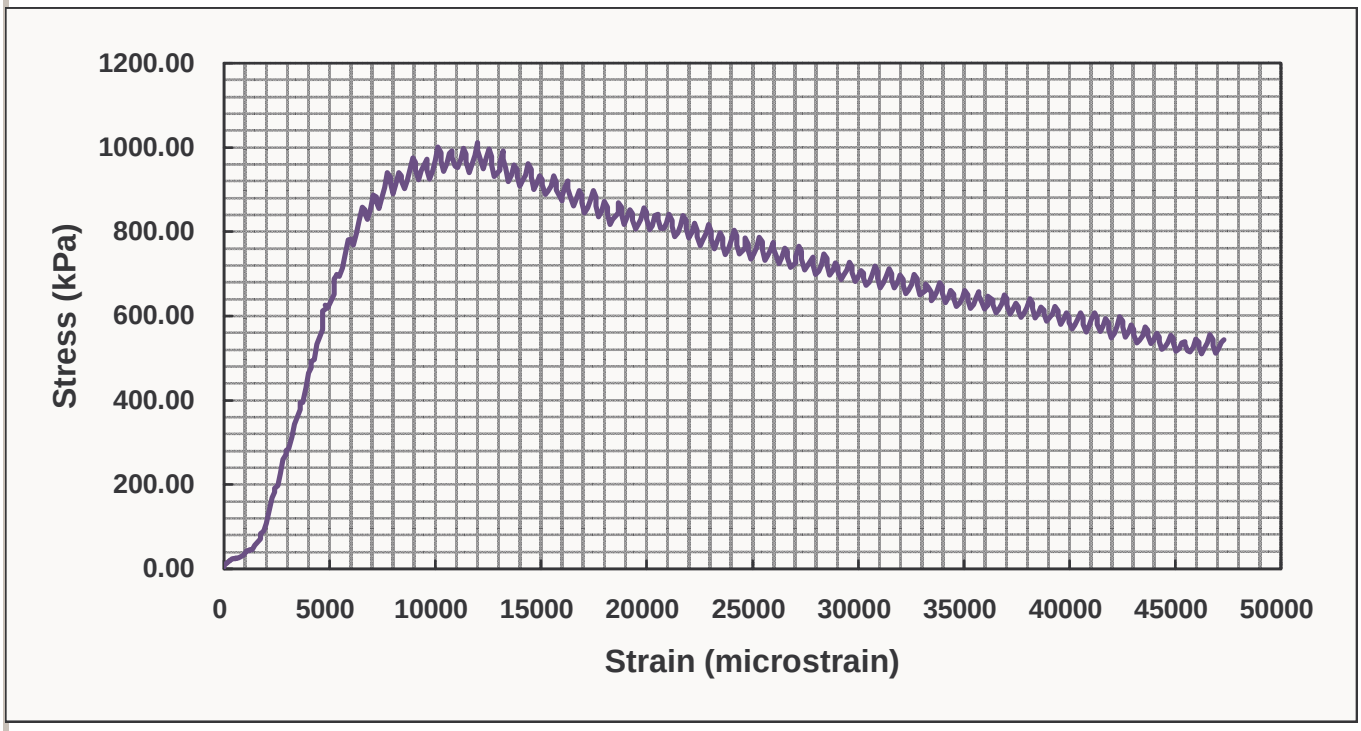


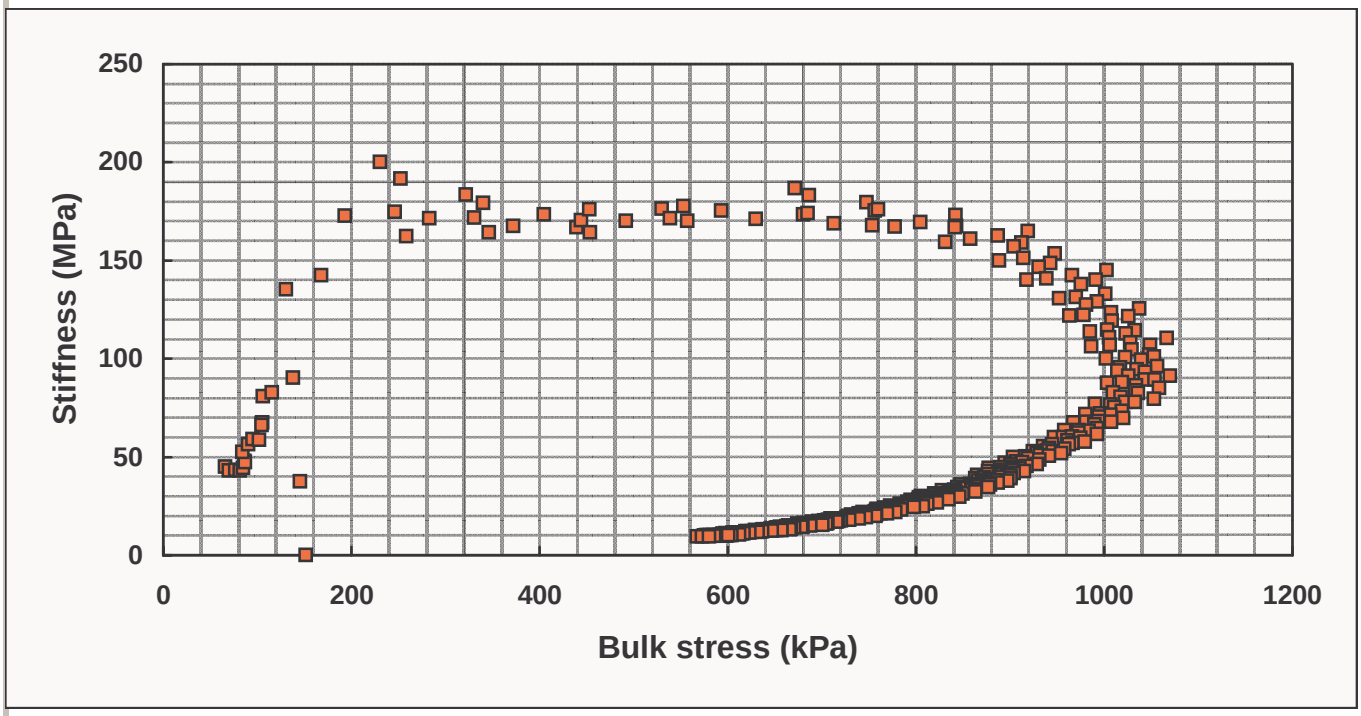


HSS: Treated with 1% Cement and 2.25% Foamed Bitumen

STATIC TRIAXIAL TEST

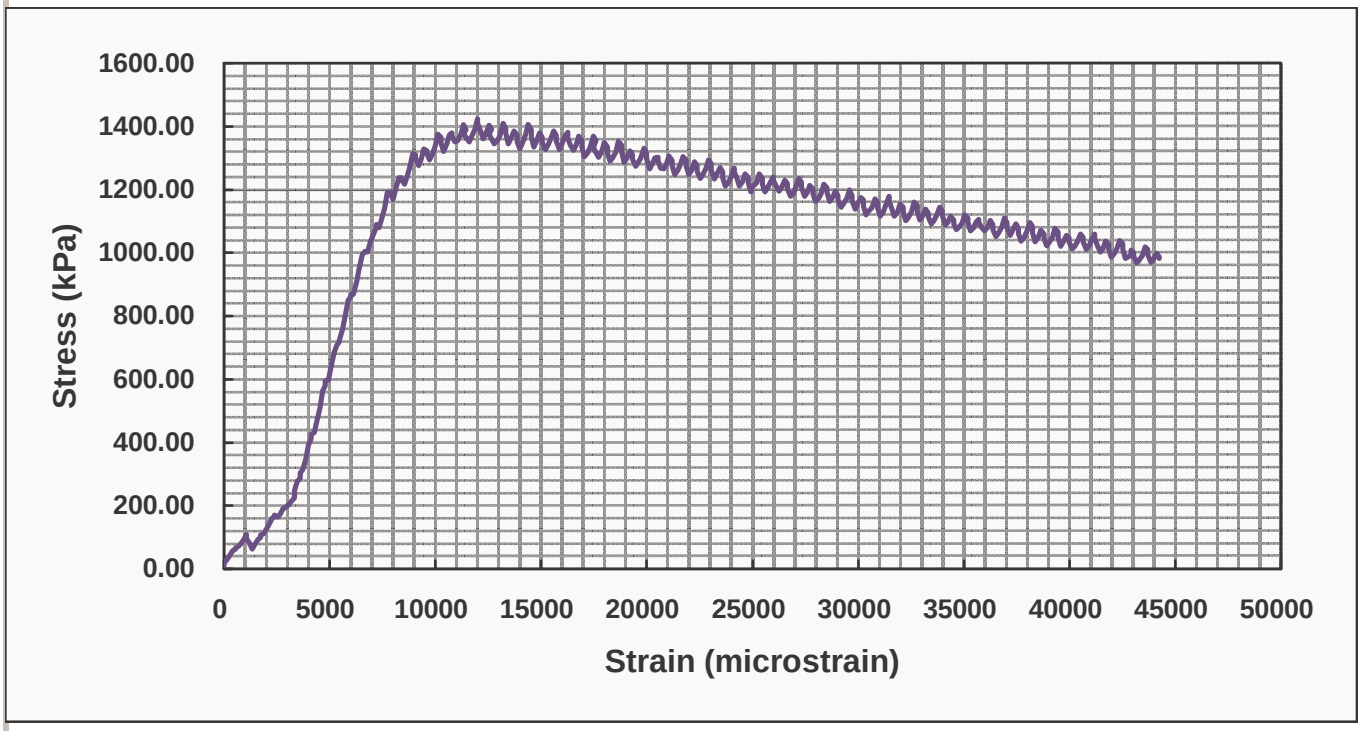
Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS01
Dry Density (kg/cub m): 2040
Confining pressure (kPa): 20
Moisture (%): 3.9
Linear stiffness (MPa): 169
Maximum deviator stress (kPa): 1012

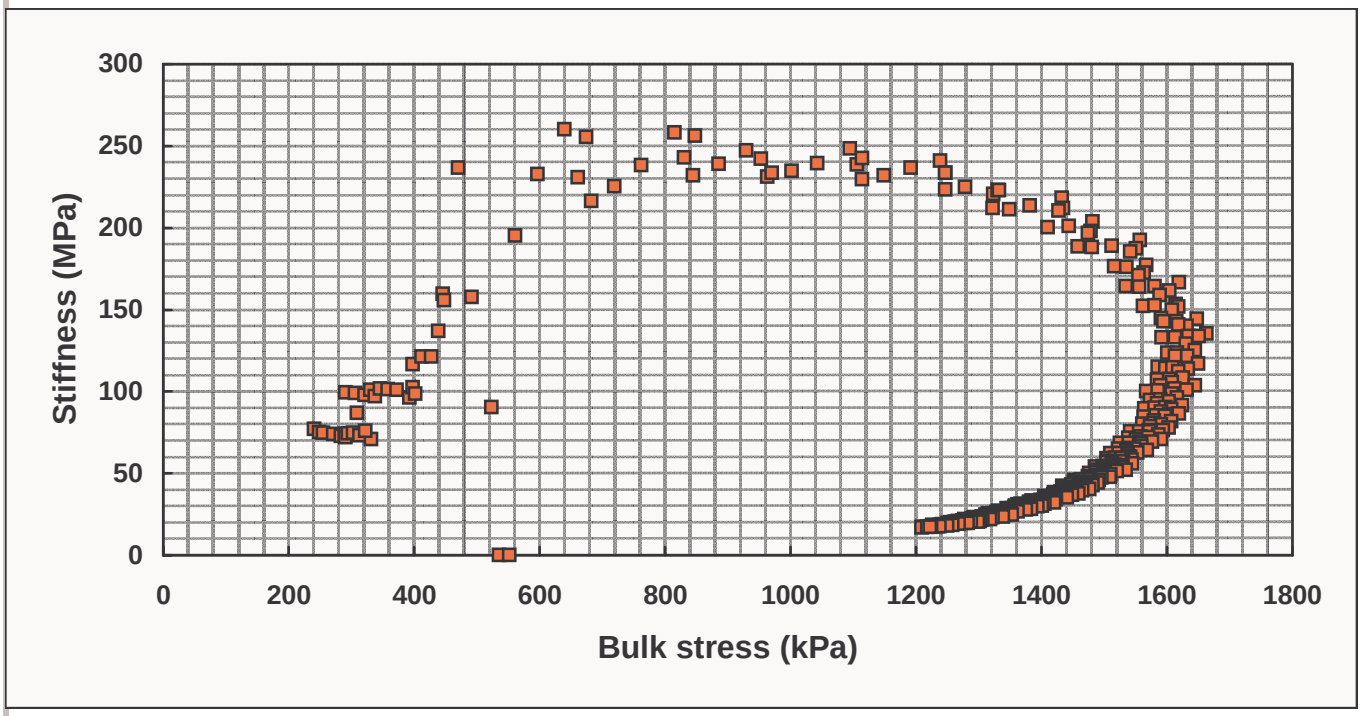




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS02
Dry Density (kg/cub m): 2040
Confining pressure (kPa): 80
Moisture (%): 3.8
Linear stiffness (MPa): 241
Maximum deviator stress (kPa): 1423





STATIC TRIAXIAL TEST

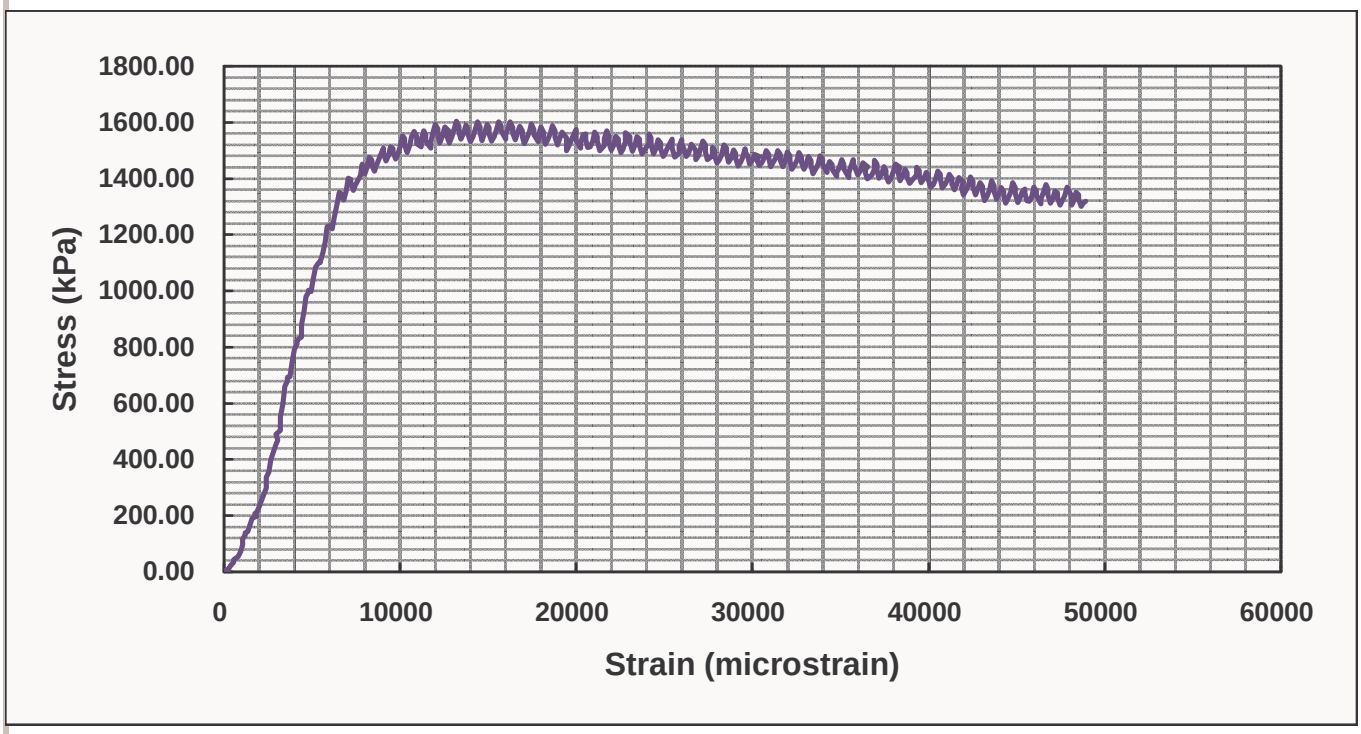
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

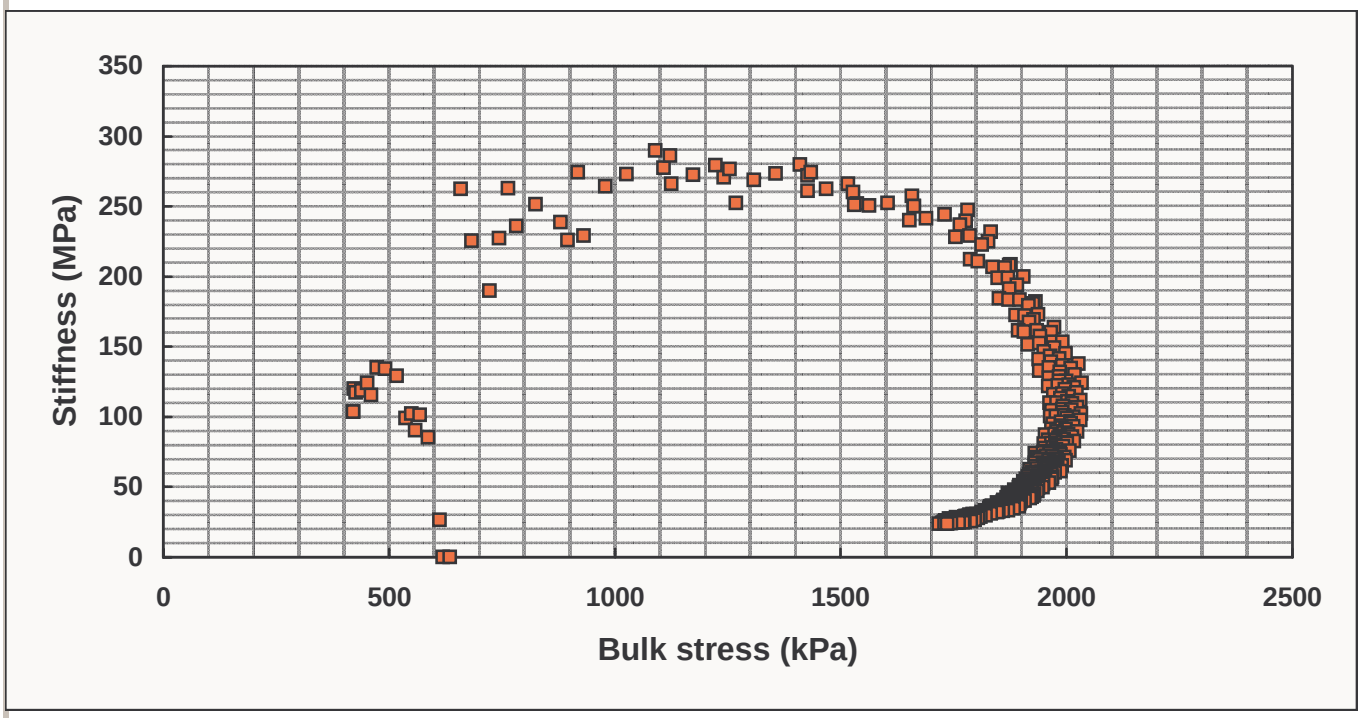
Sample #: HSS03

Dry Density (kg/cub m): 2040 — **Confining pressure (kPa): 142**

Moisture (%): 3.7 — **Linear stiffness (MPa): 252**

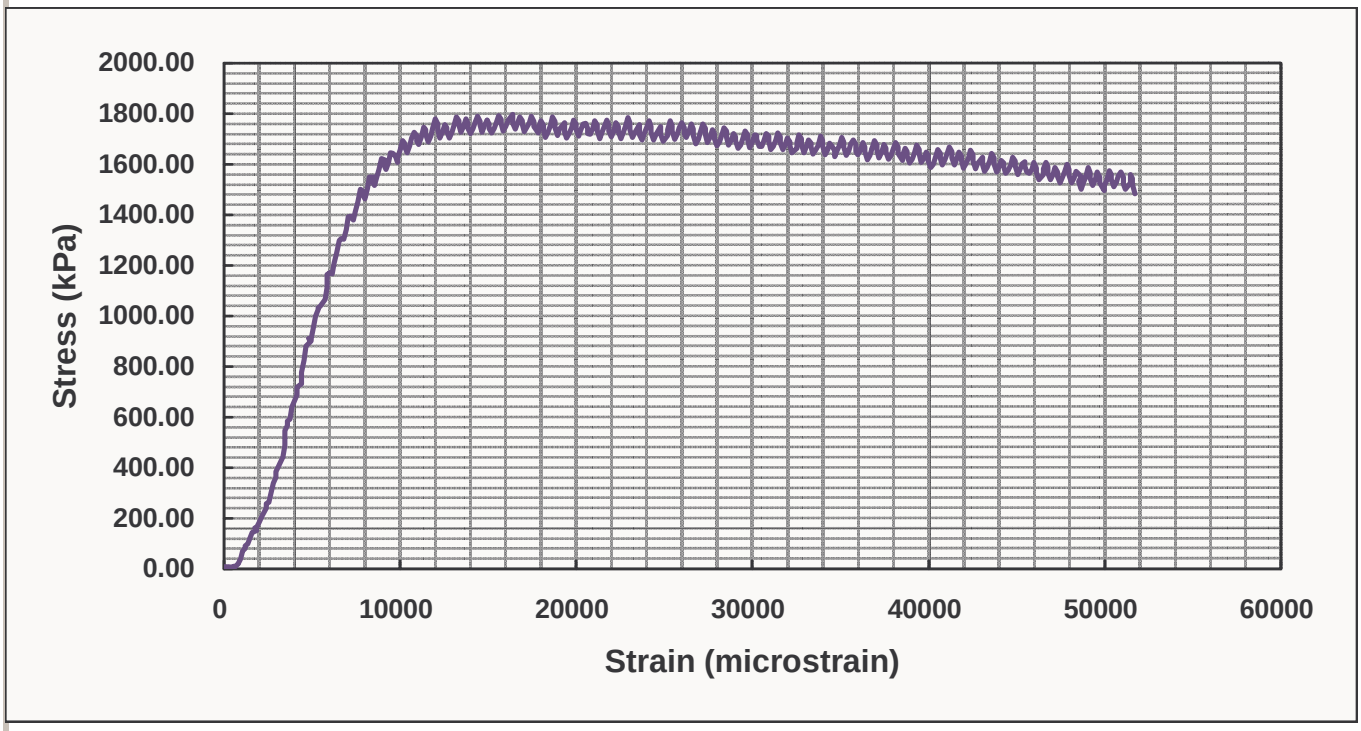
Maximum deviator stress (kPa): 1604

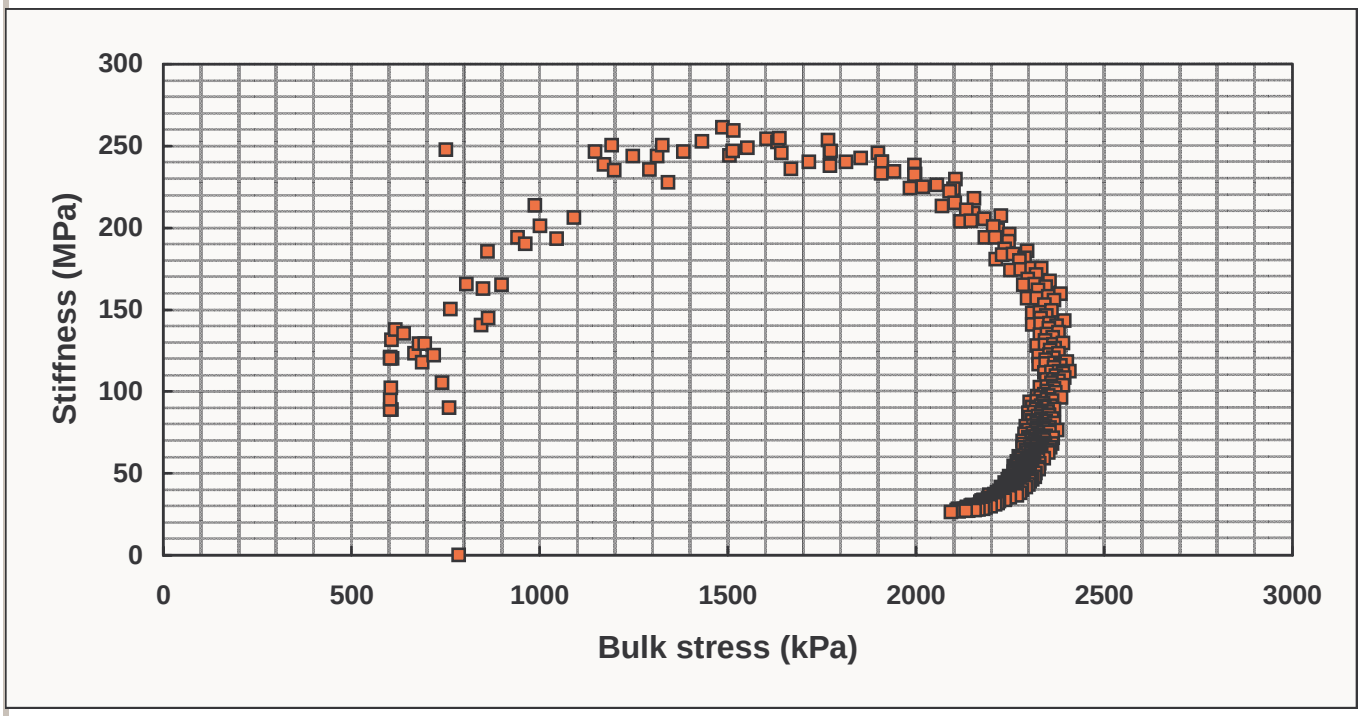




STATIC TRIAXIAL TEST

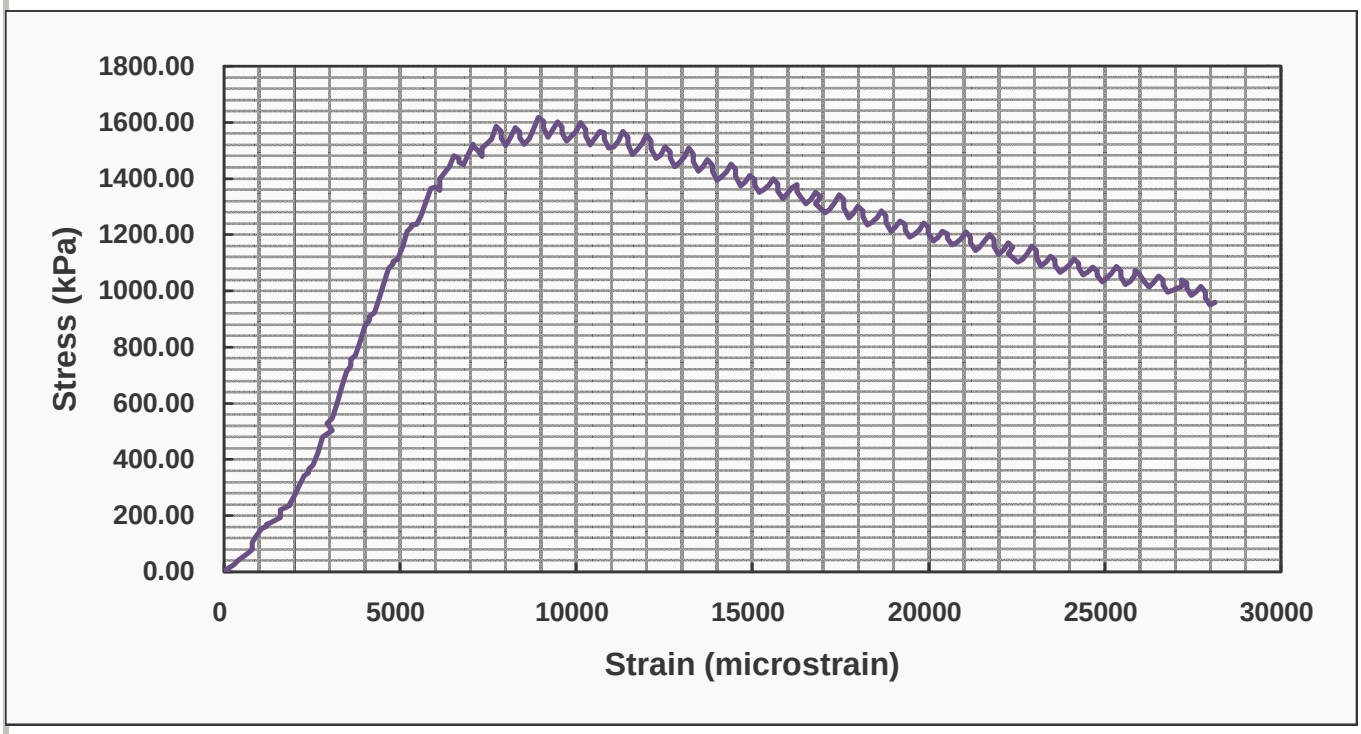
Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS04
Dry Density (kg/cub m): 2040
Confining pressure (kPa): 201
Moisture (%): 3.6
Linear stiffness (MPa): 224
Maximum deviator stress (kPa): 1799

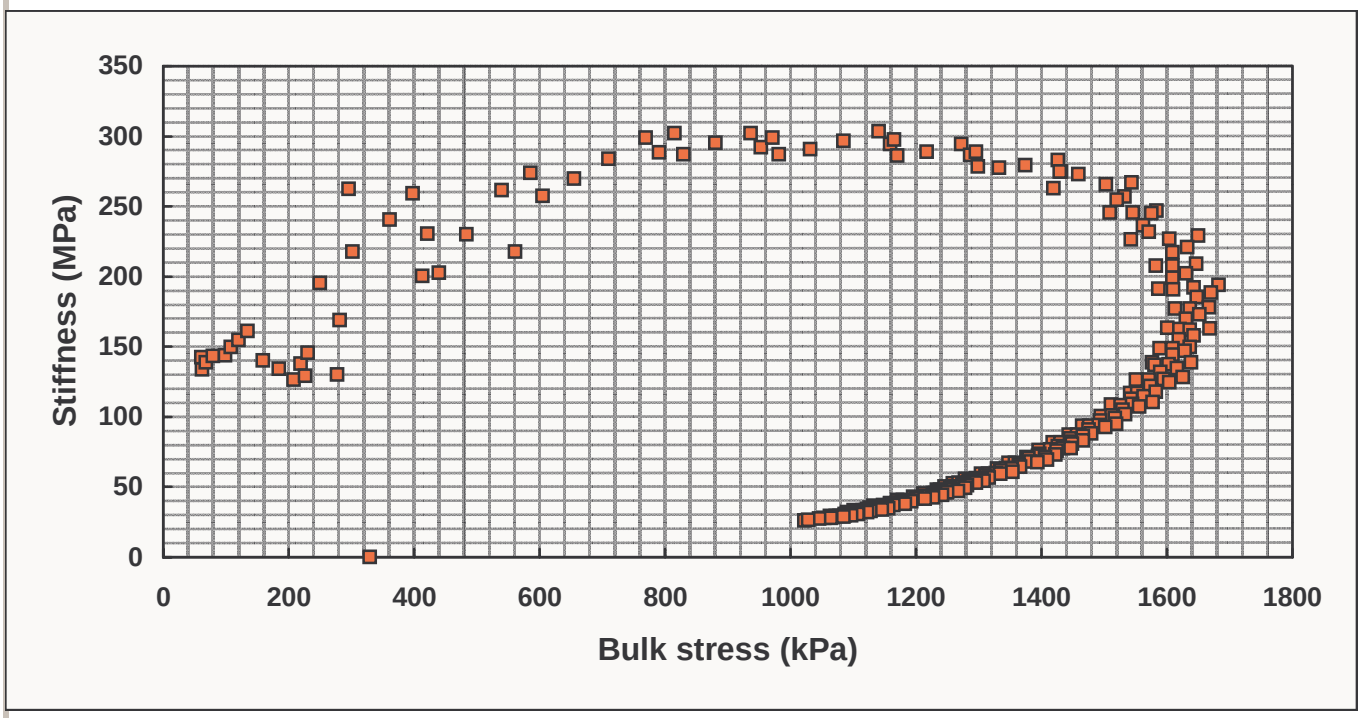




STATIC TRIAXIAL TEST

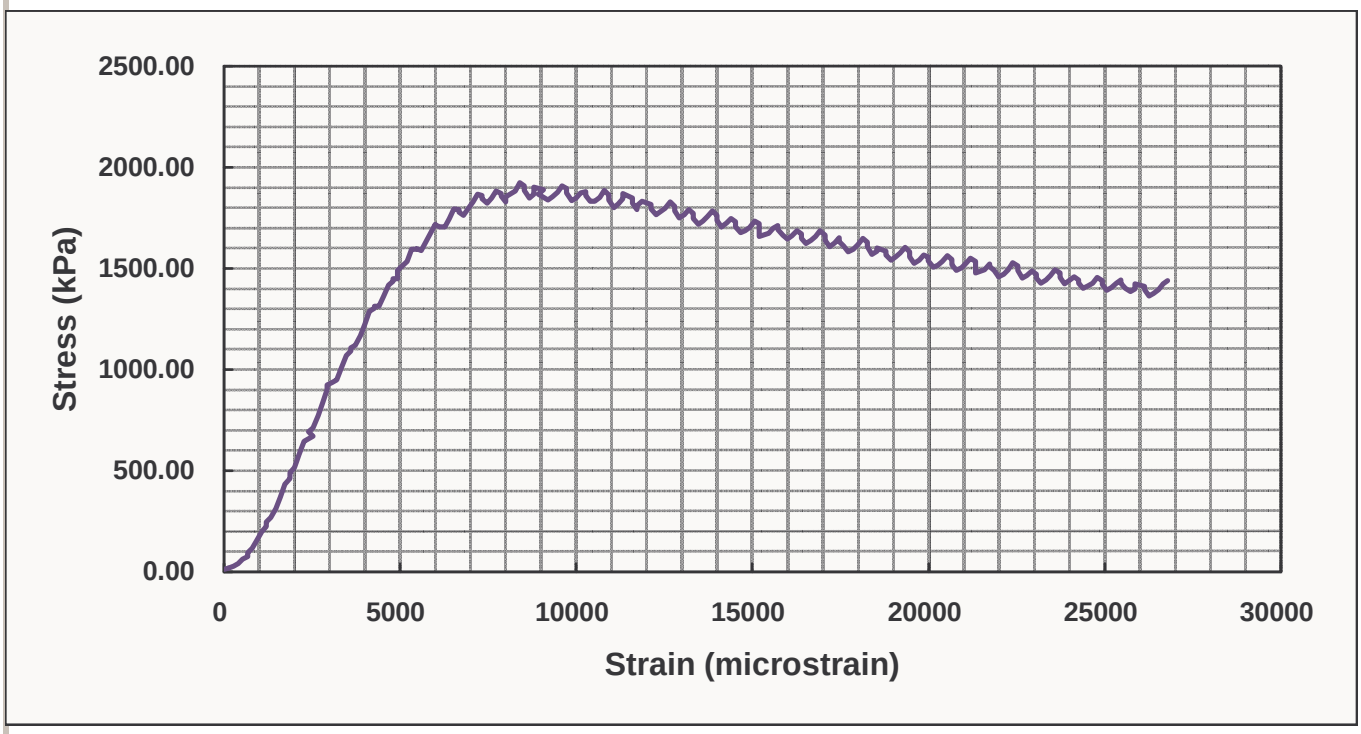
Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS05
Dry Density (kg/cub m): 2040
Confining pressure (kPa): 22
Moisture (%): 2.8
Linear stiffness (MPa): 289
Maximum deviator stress (kPa): 1617

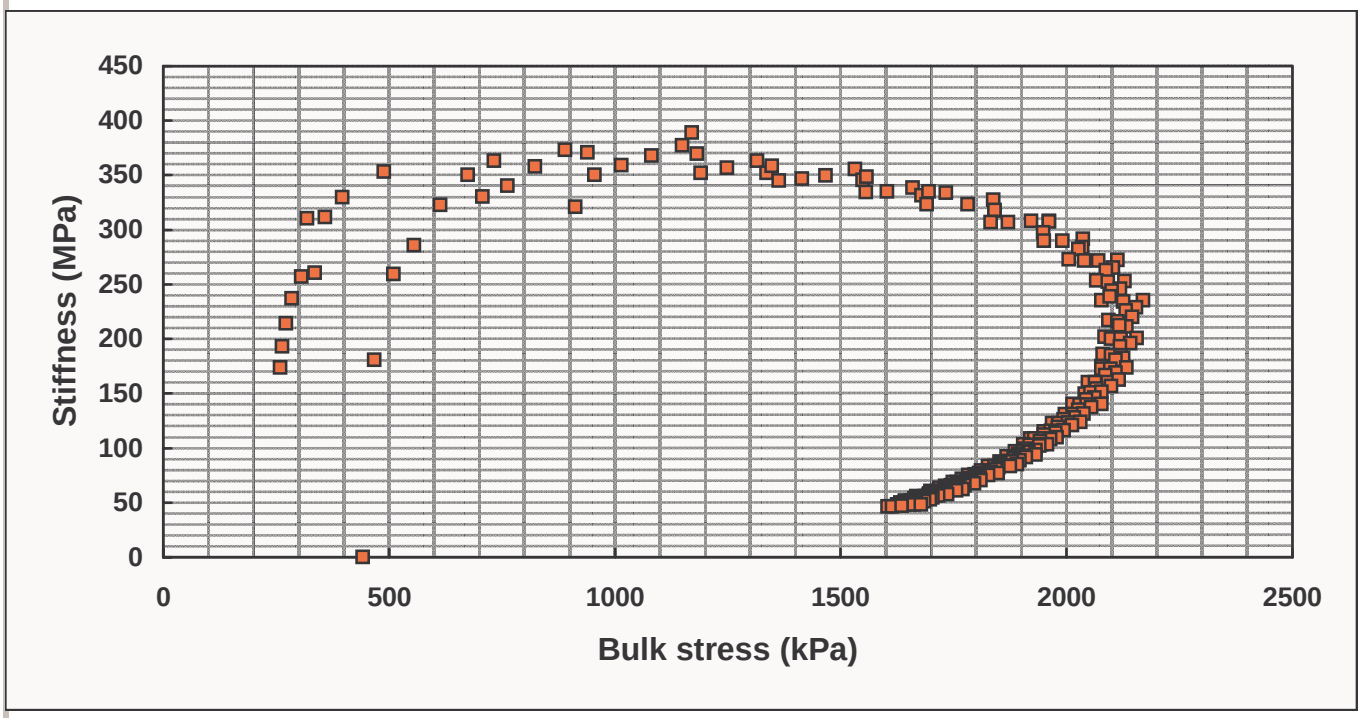




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS06
Dry Density (kg/cub m): 2040
Confining pressure (kPa): 81
Moisture (%): 2.6
Linear stiffness (MPa): 334
Maximum deviator stress (kPa): 1924





STATIC TRIAXIAL TEST

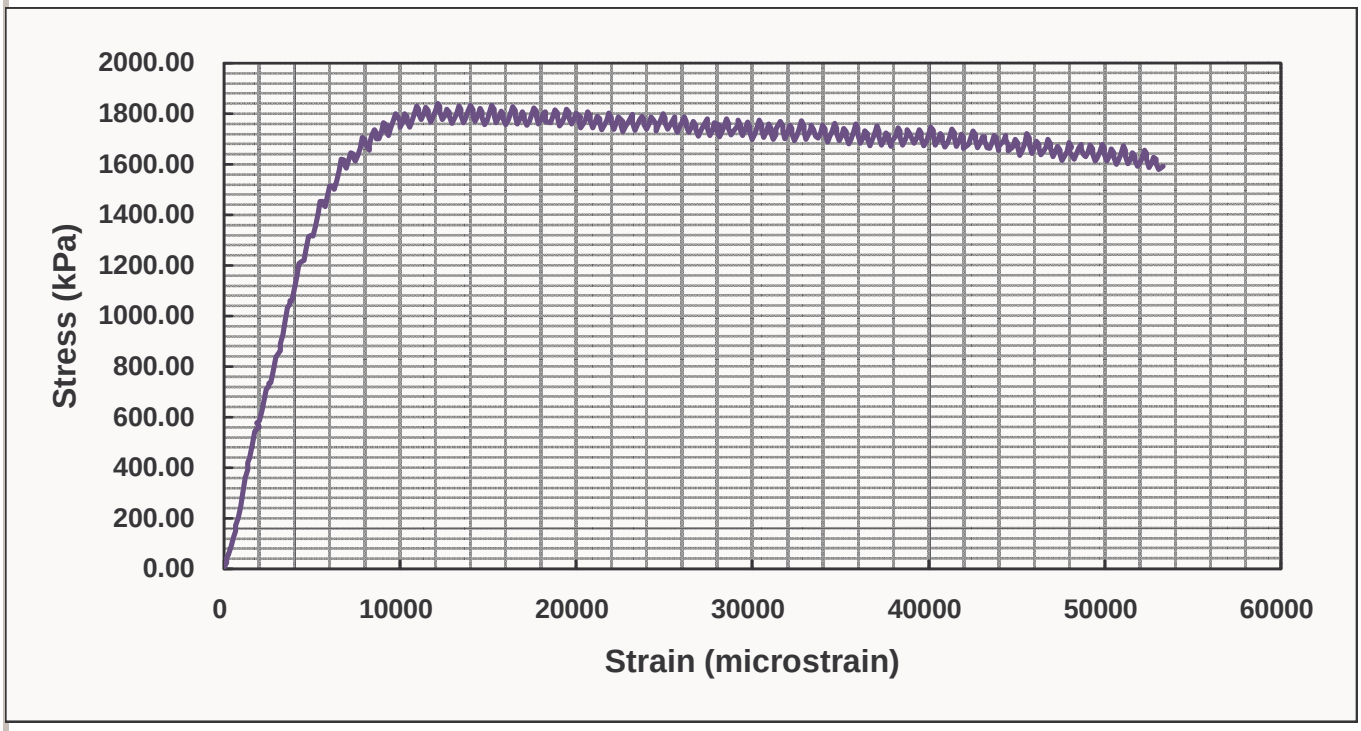
Material: Hornfels — **Treatment 1 % cement & 2.25% bitumen**

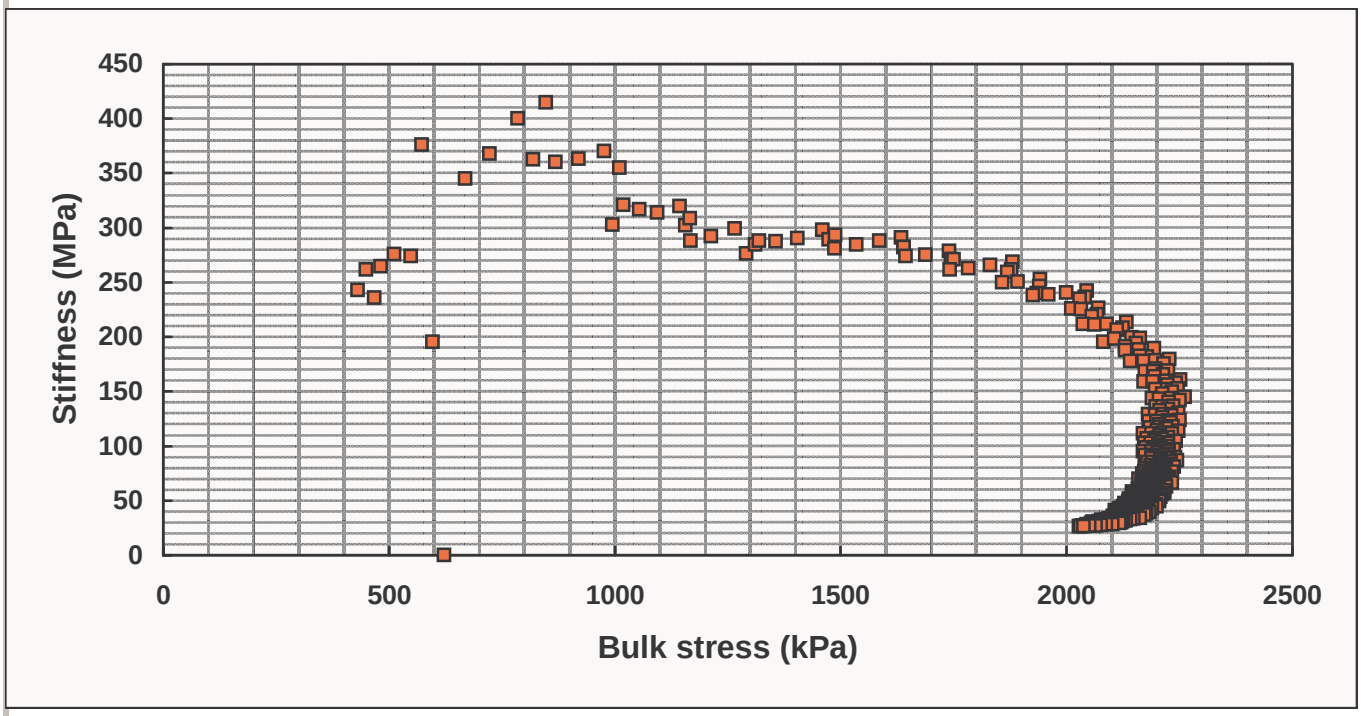
Sample #: HSS07

Dry Density (kg/cub m): 2040 — **Confining pressure (kPa): 144**

Moisture (%): 2.6 — **Linear stiffness (MPa): 250**

Maximum deviator stress (kPa): 1842





STATIC TRIAXIAL TEST

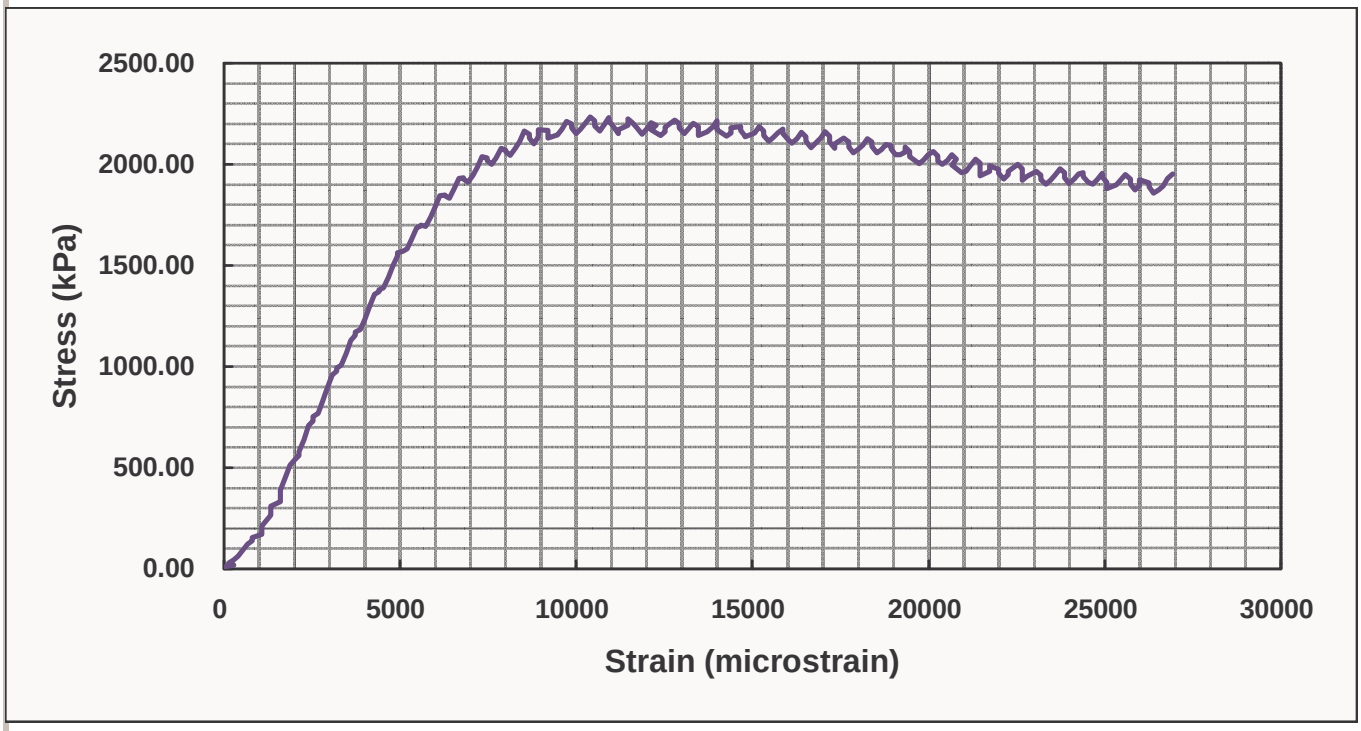
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

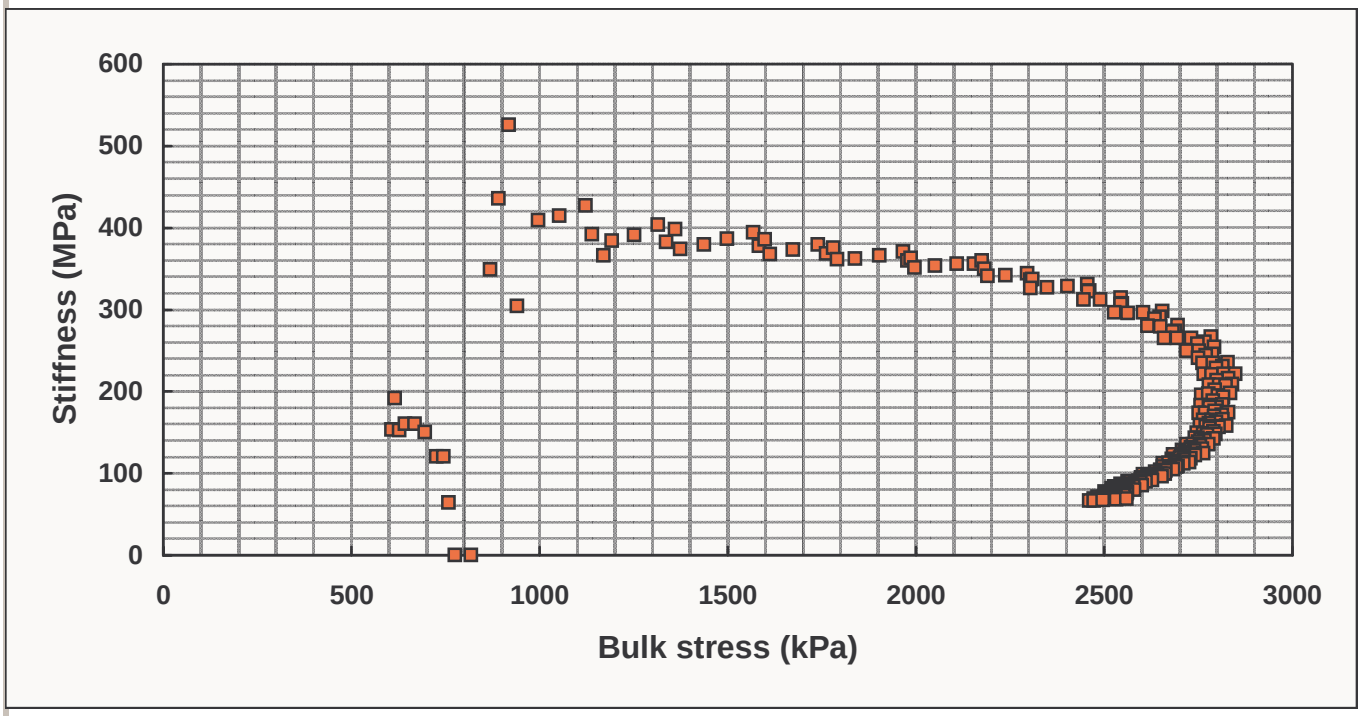
Sample #: HSS08

Dry Density (kg/cub m): 2040 — **Confining pressure (kPa): 202**

Moisture (%): 2.7 — **Linear stiffness (MPa): 328**

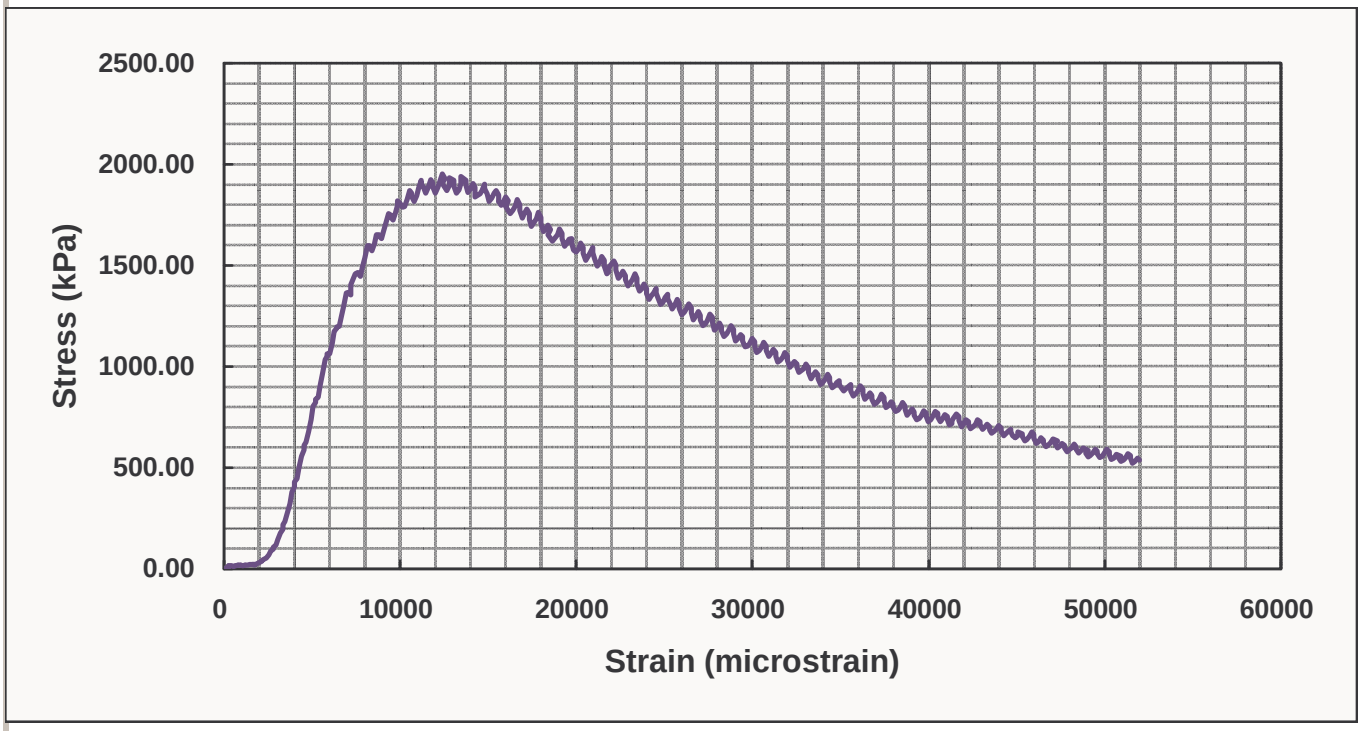
Maximum deviator stress (kPa): 2233

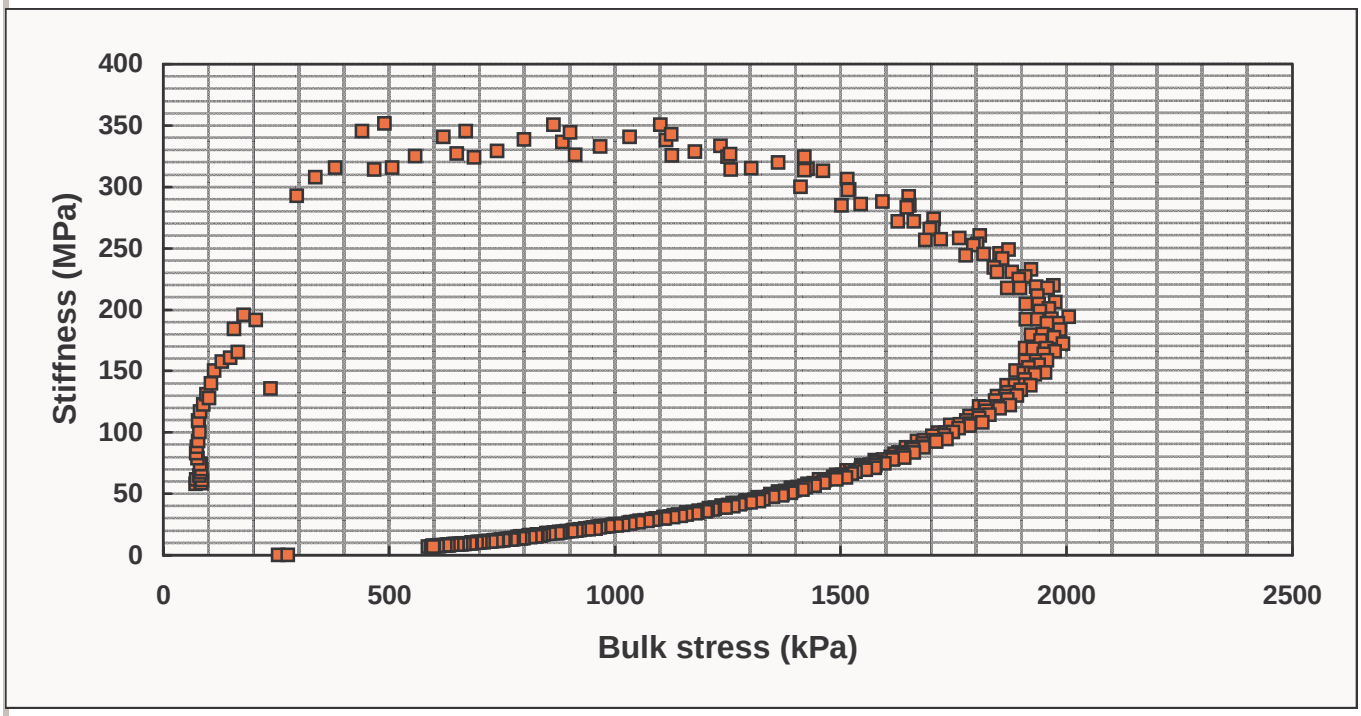




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS09
Dry Density (kg/cub m): 2200
Confining pressure (kPa): 19
Moisture (%): 2.8
Linear stiffness (MPa): 286
Maximum deviator stress (kPa): 1954

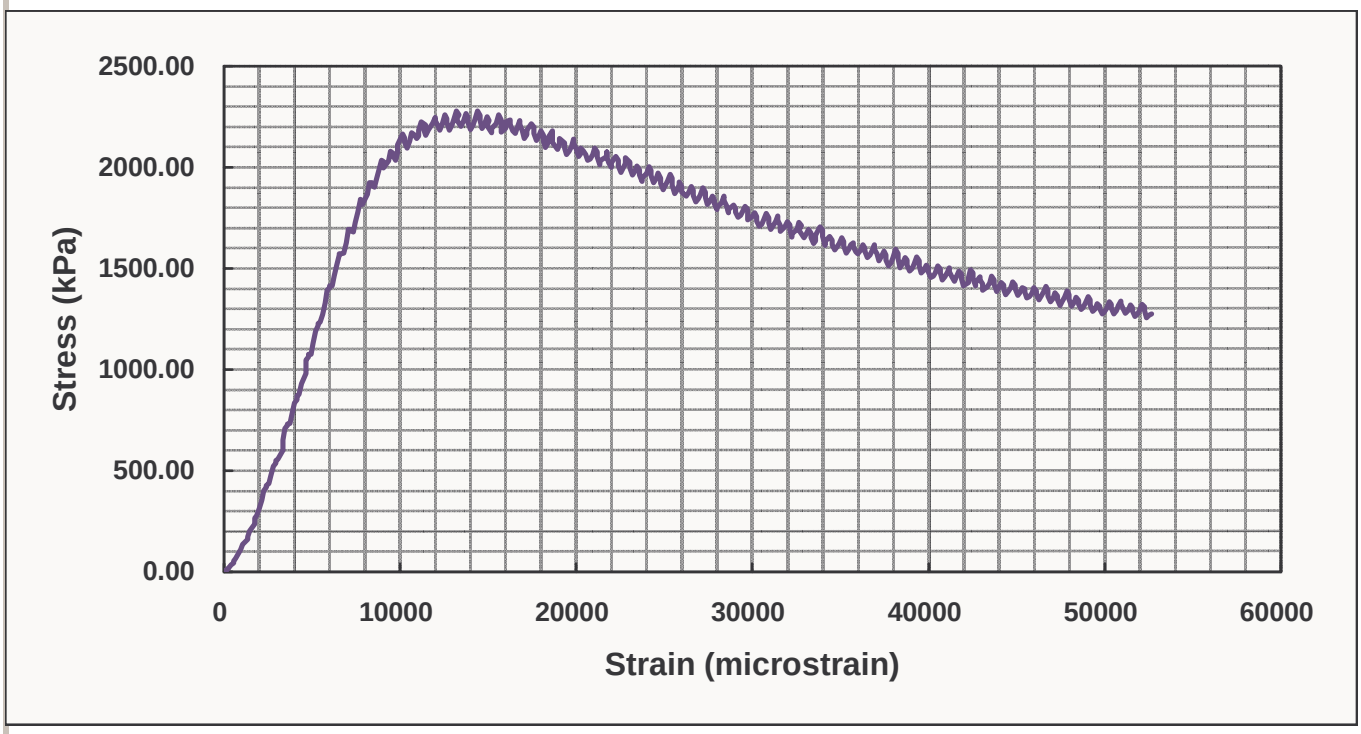


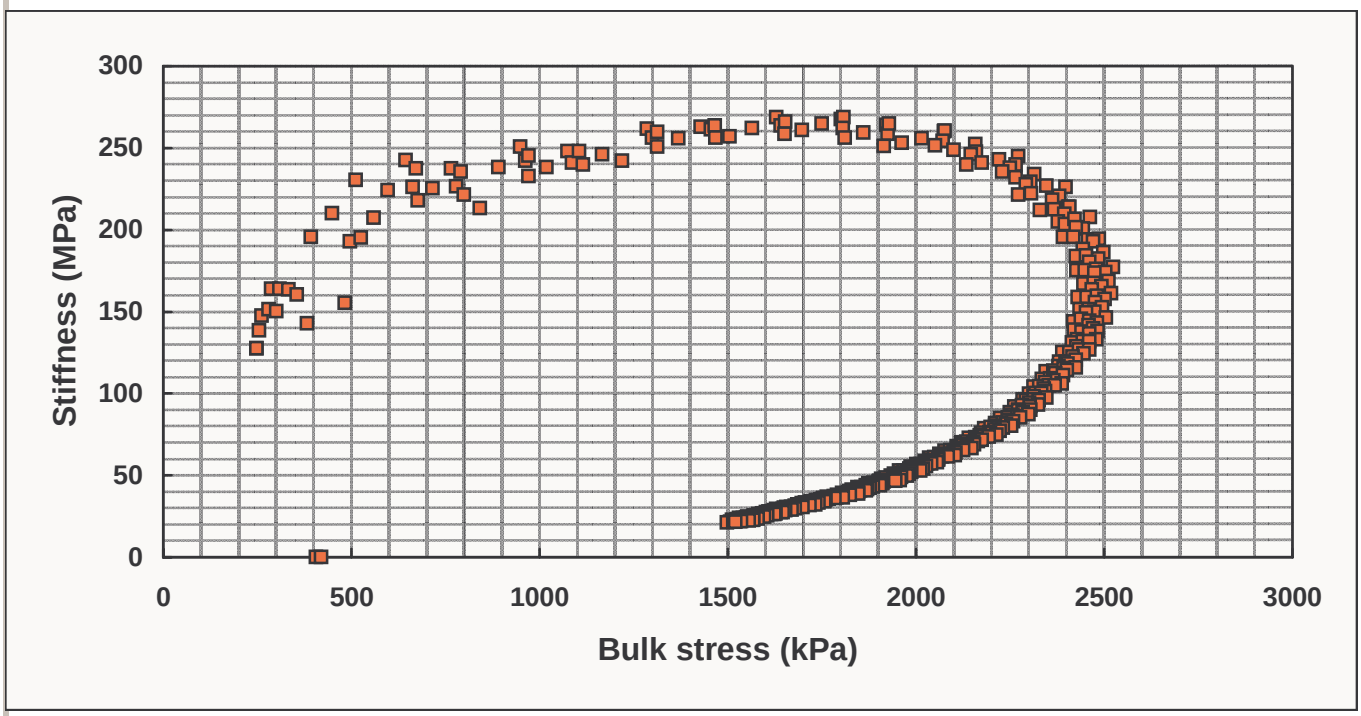


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSS10
Dry Density (kg/cub m): 2200
Moisture (%): 3.0

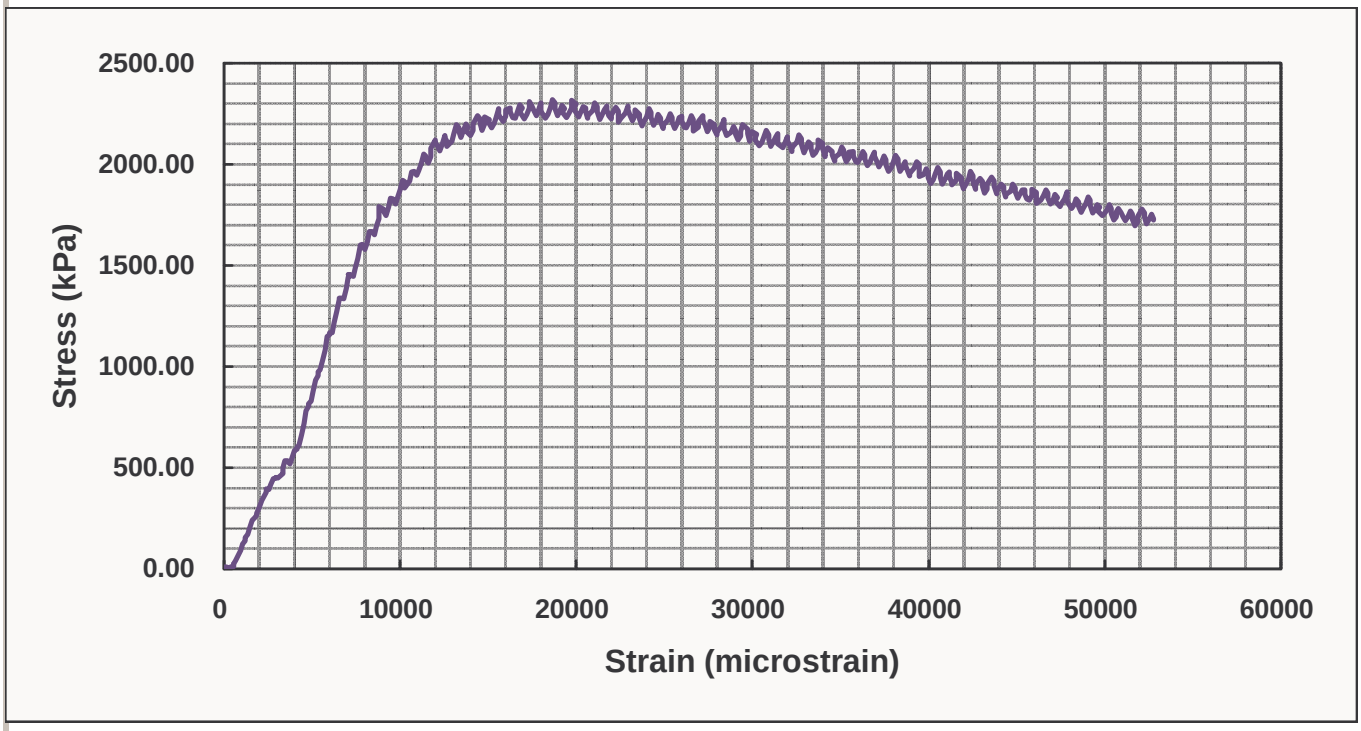
Treatment 1 % cement & 2.25% bitumen
Confining pressure (kPa): 81
Linear stiffness (MPa): 256
Maximum deviator stress (kPa): 2279

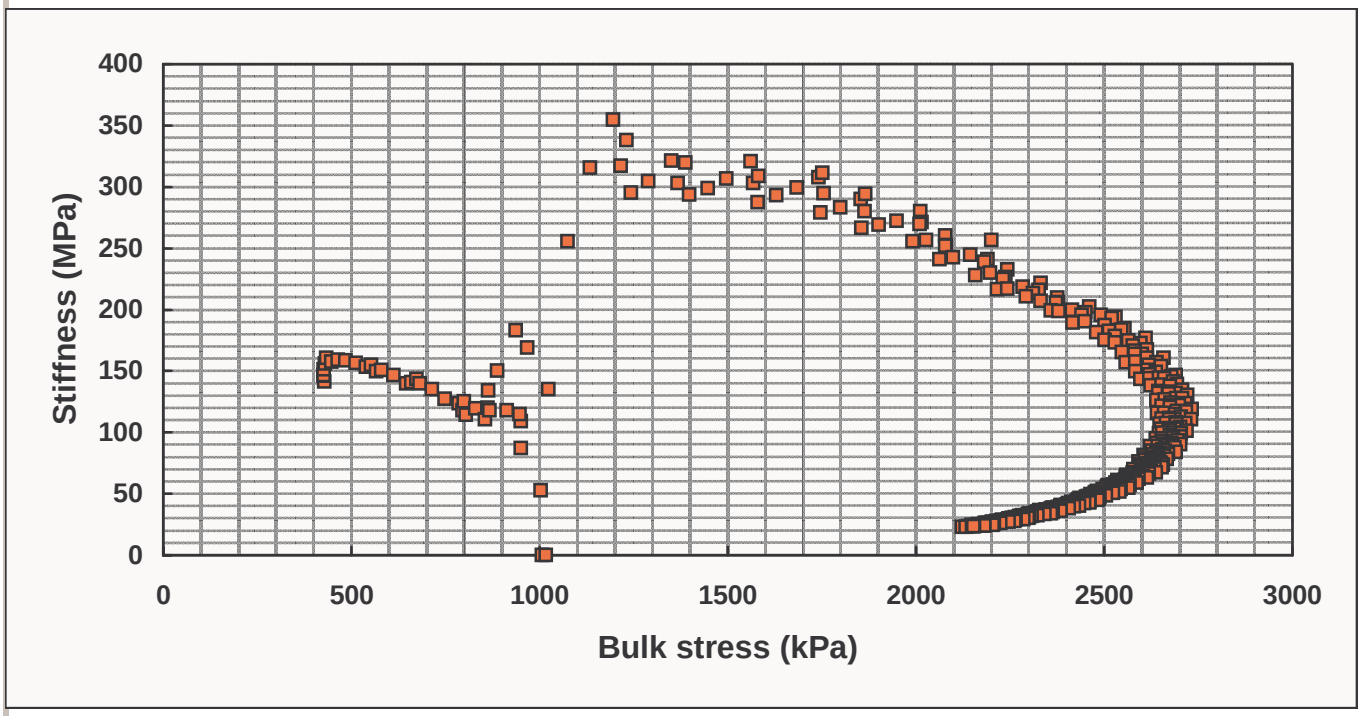




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS11
Dry Density (kg/cub m): 2200
Moisture (%): 2.9
Confining pressure (kPa): 139
Linear stiffness (MPa): 269
Maximum deviator stress (kPa): 2321





STATIC TRIAXIAL TEST

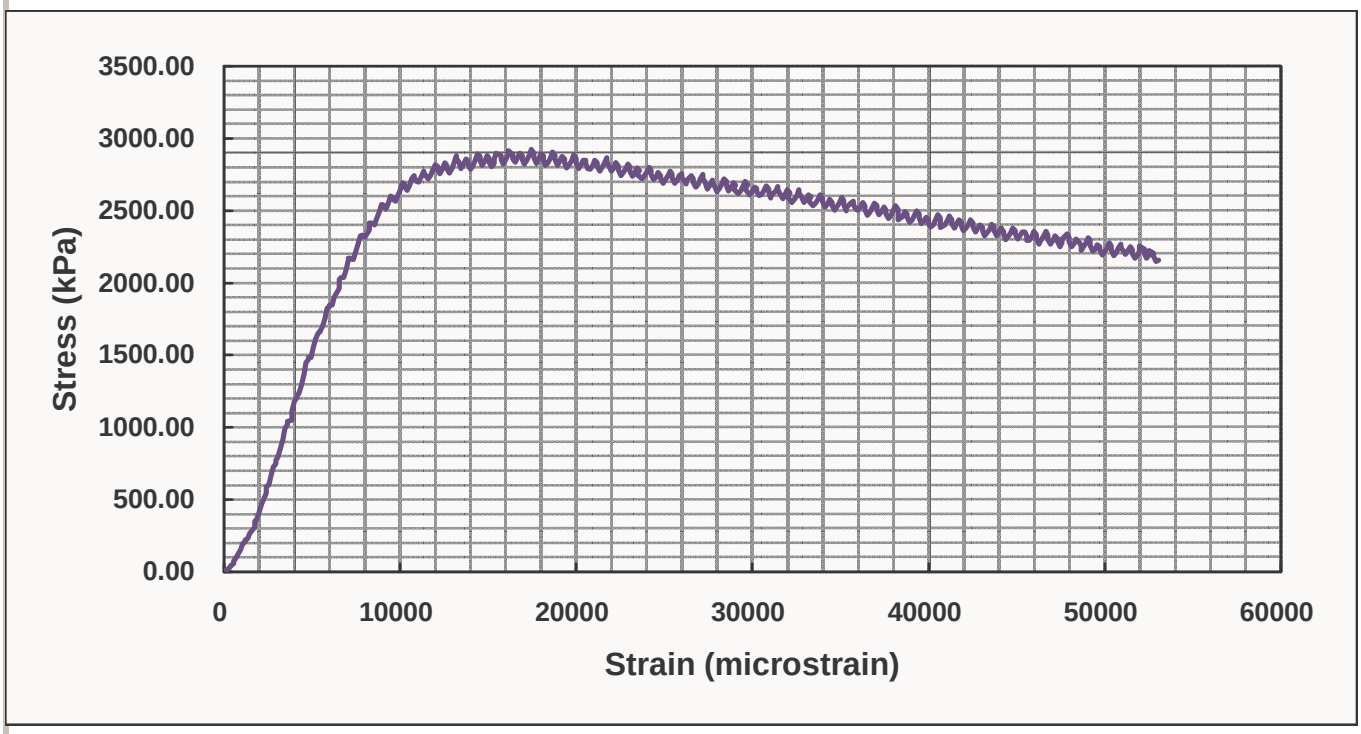
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

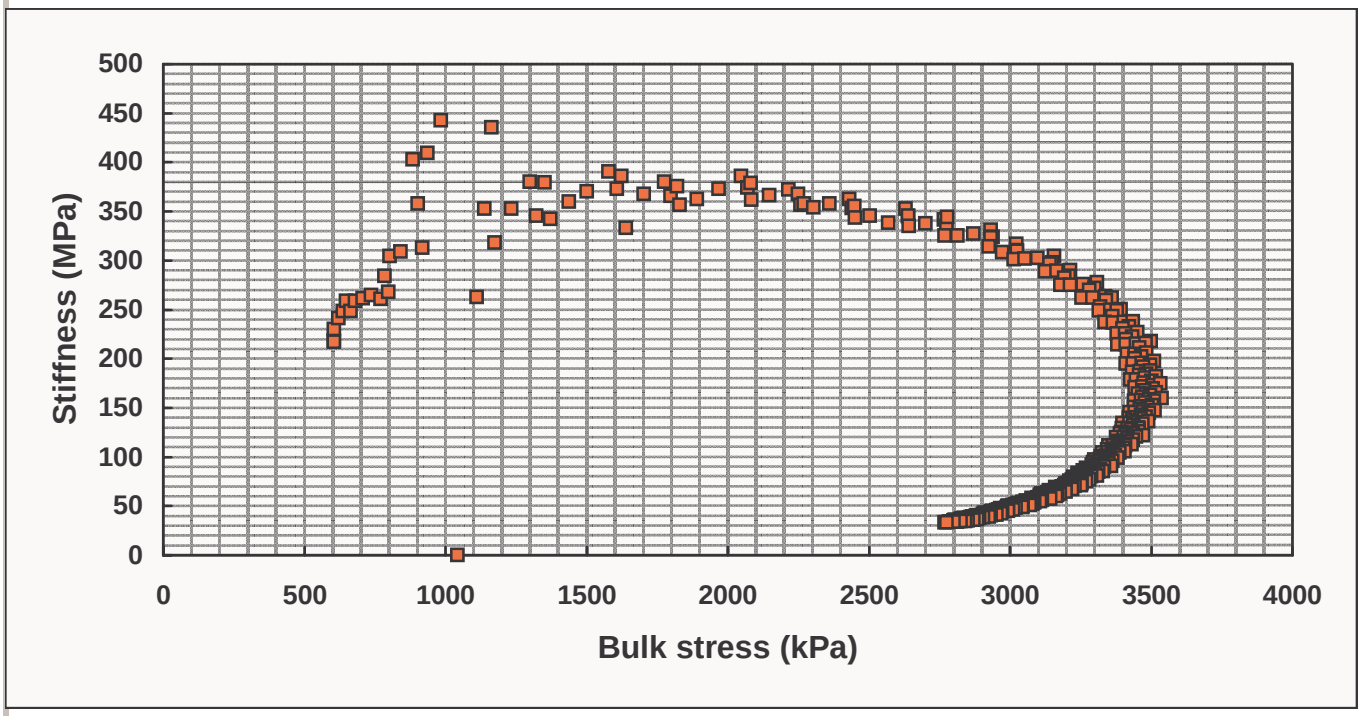
Sample #: HSS12

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 203**

Moisture (%): 2.8 — **Linear stiffness (MPa): 328**

Maximum deviator stress (kPa): 2924





STATIC TRIAXIAL TEST

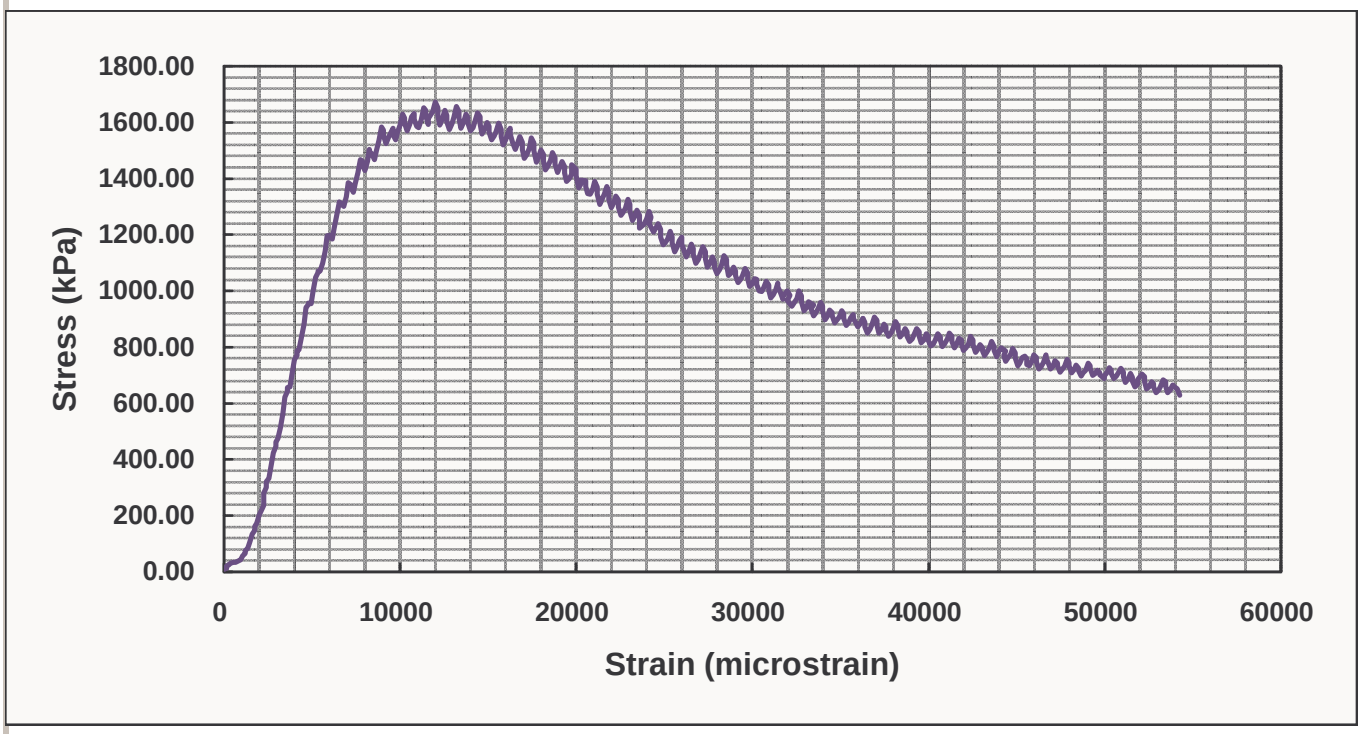
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

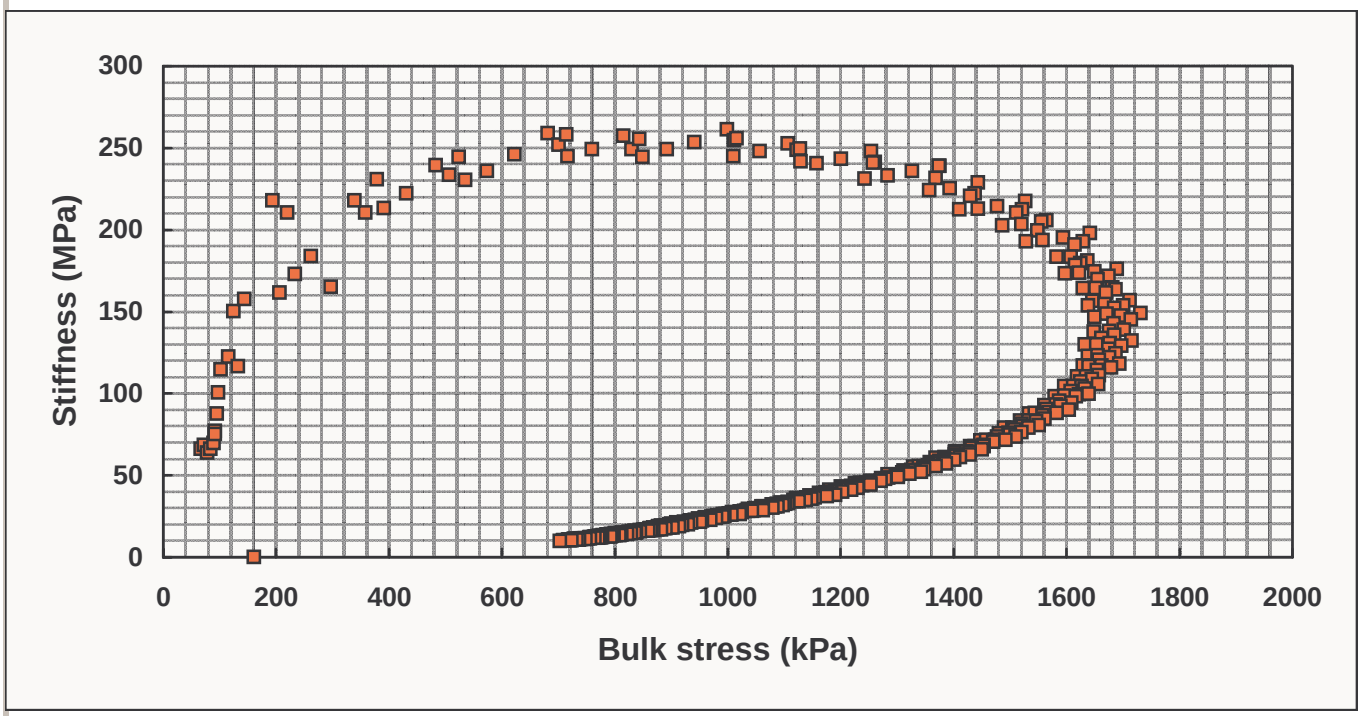
Sample #: HSS13

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 21**

Moisture (%): 2.0 — **Linear stiffness (MPa): 236**

Maximum deviator stress (kPa): 1672





STATIC TRIAXIAL TEST

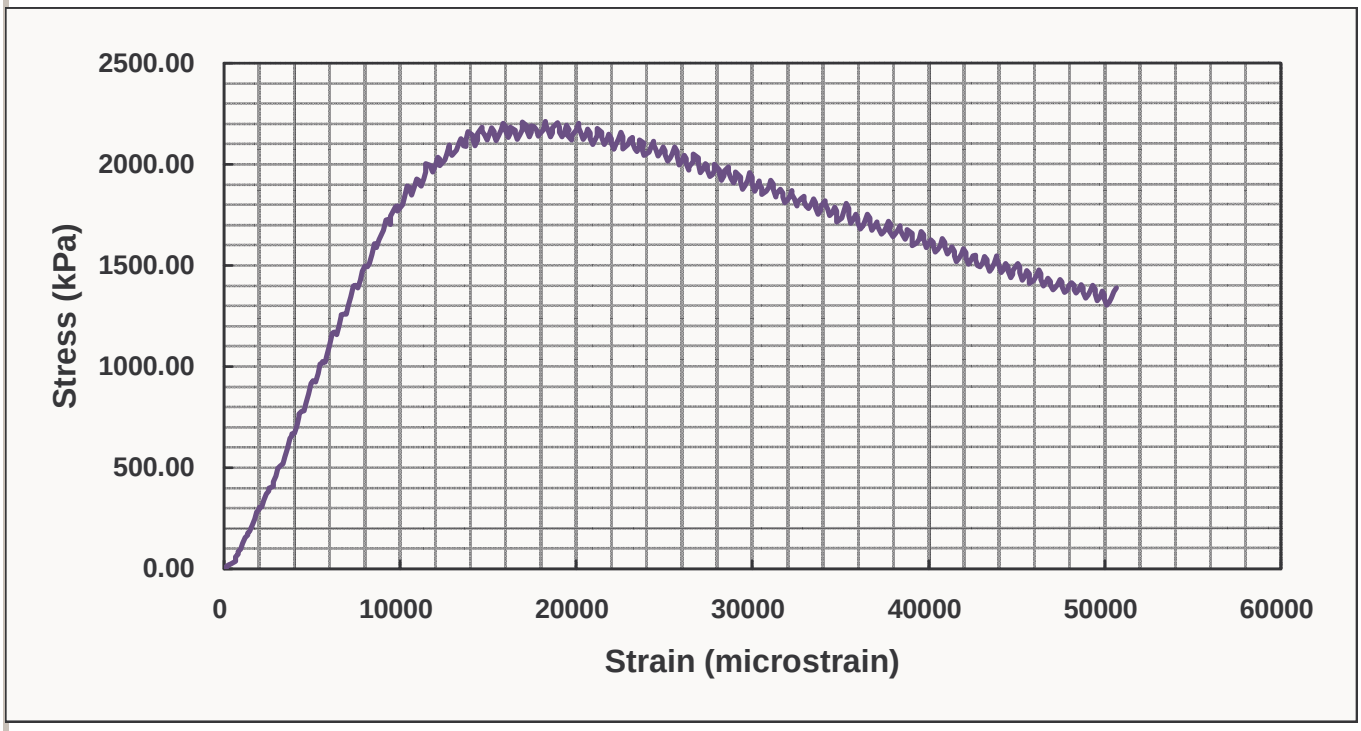
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

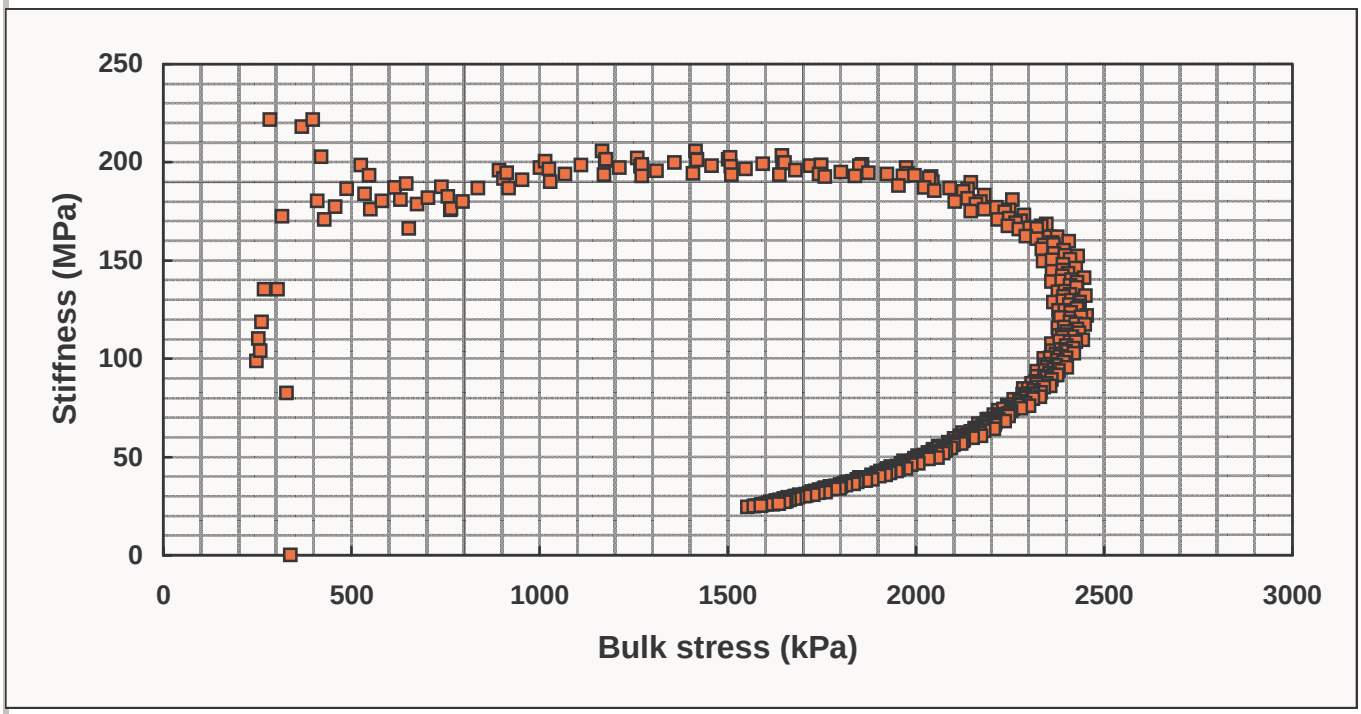
Sample #: HSS14

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 83**

Moisture (%): 2.3 — **Linear stiffness (MPa): 194**

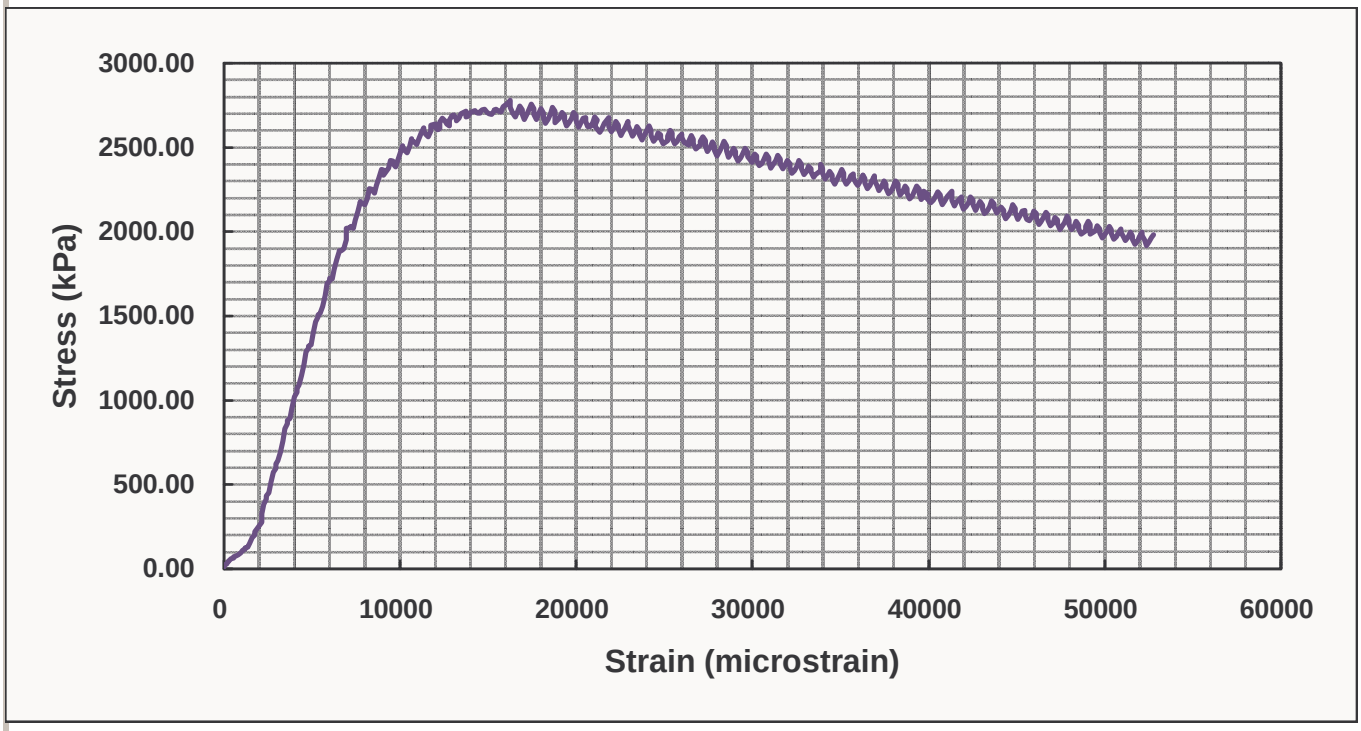
Maximum deviator stress (kPa): 2211

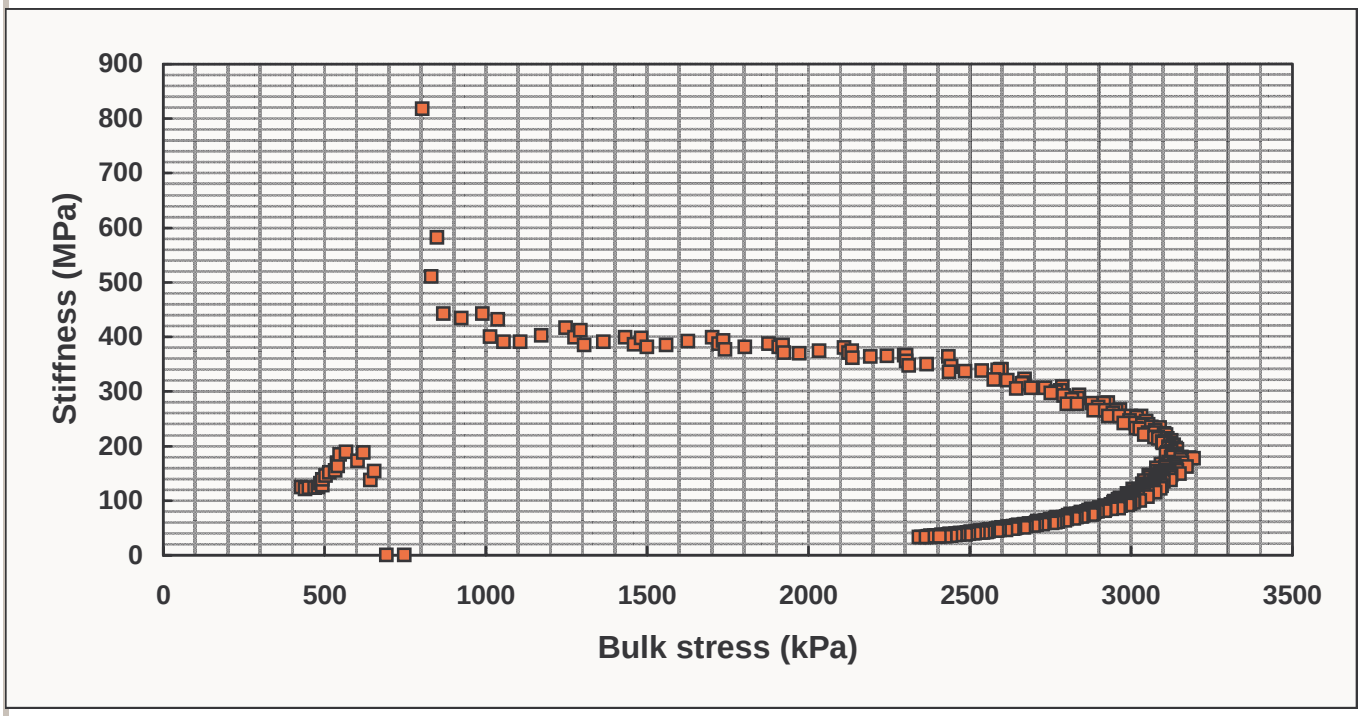




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1 % cement & 2.25% bitumen
Sample #: HSS15
Dry Density (kg/cub m): 2200
Moisture (%): 2.6
Confining pressure (kPa): 140
Linear stiffness (MPa): 336
Maximum deviator stress (kPa): 2781





STATIC TRIAXIAL TEST

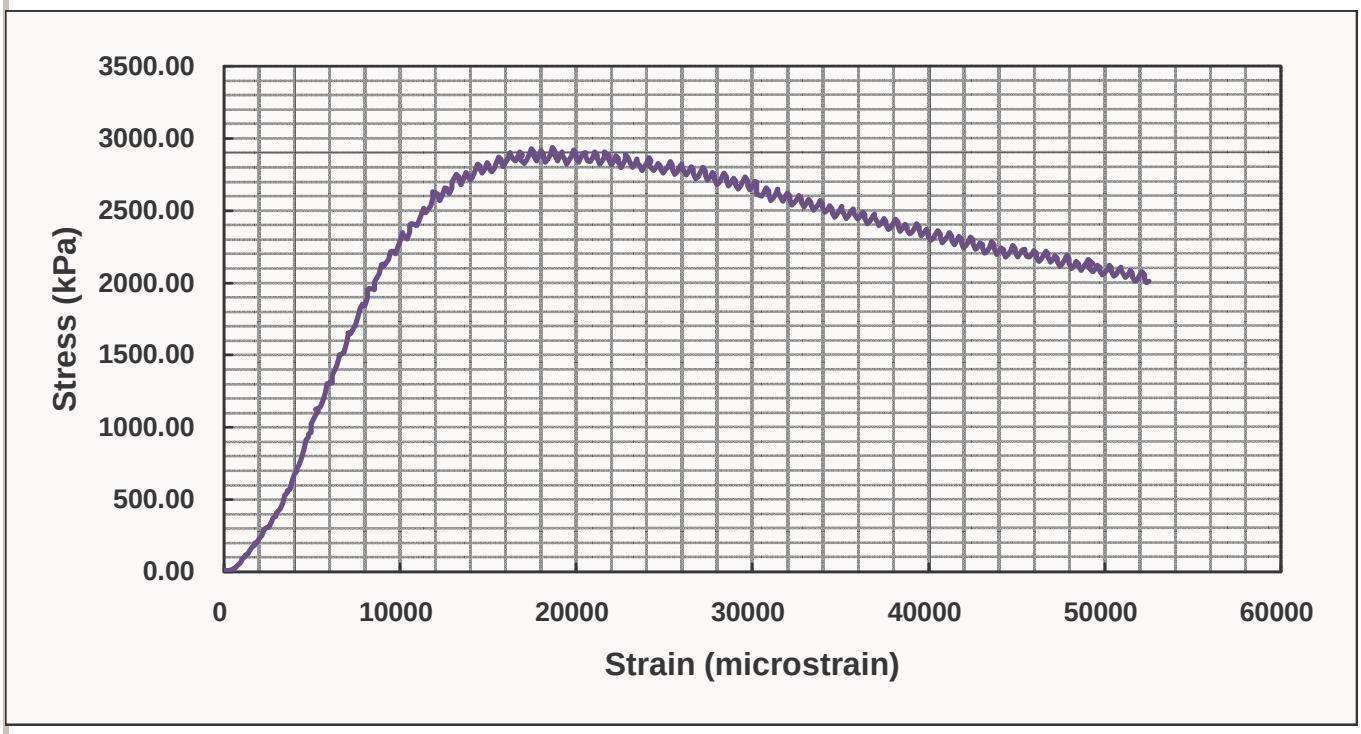
Material: Hornfels — **Treatment** **1 % cement & 2.25% bitumen**

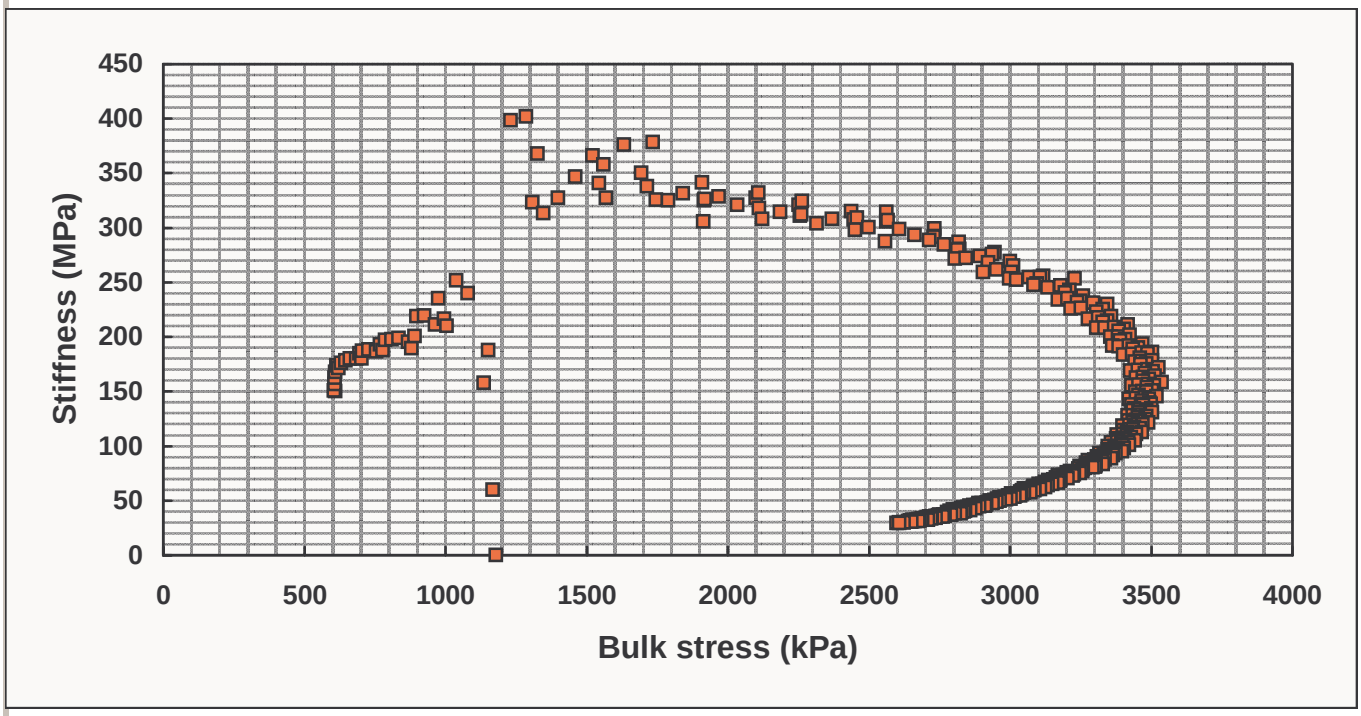
Sample #: HSS16

Dry Density (kg/cub m): 2200 — **Confining pressure (kPa): 200**

Moisture (%): 2.4 — **Linear stiffness (MPa): 293**

Maximum deviator stress (kPa): 2936





HSA: Treated with 1% Cement and 3.00% Foamed Bitumen

STATIC TRIAXIAL TEST

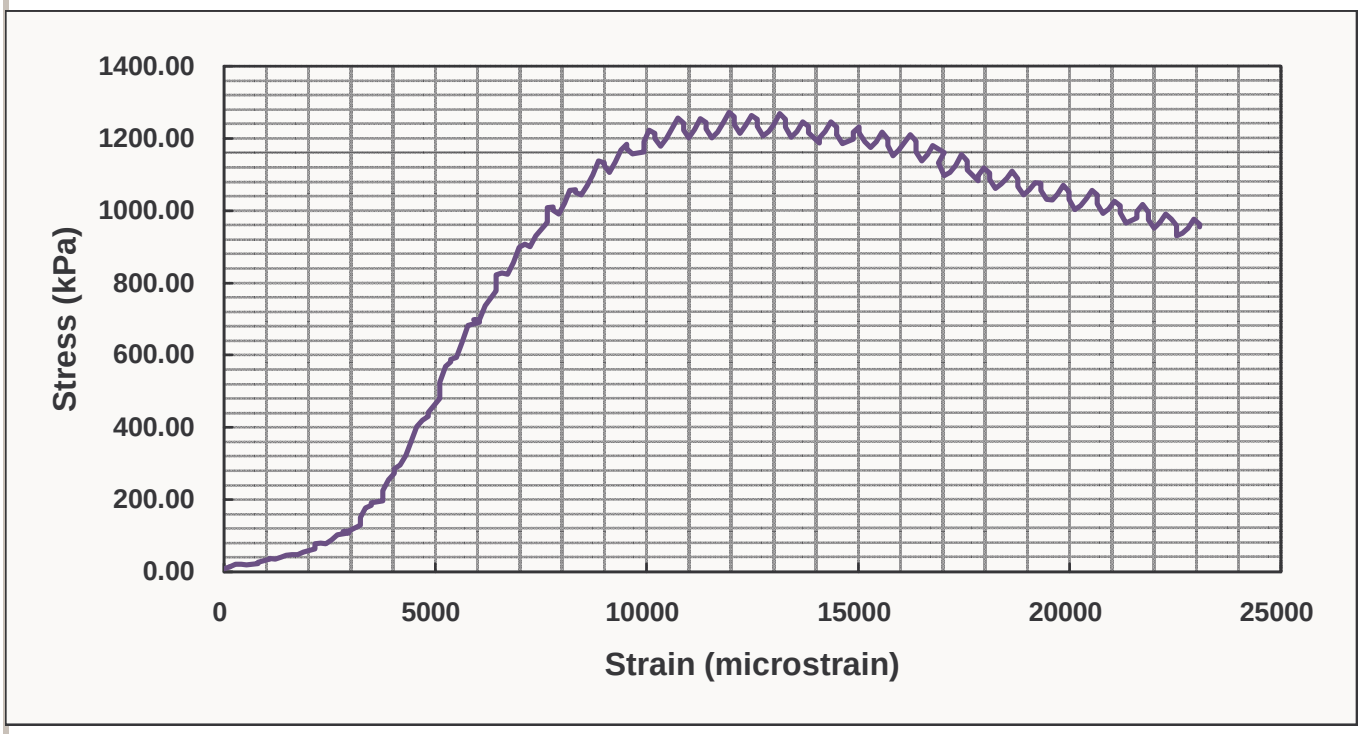
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

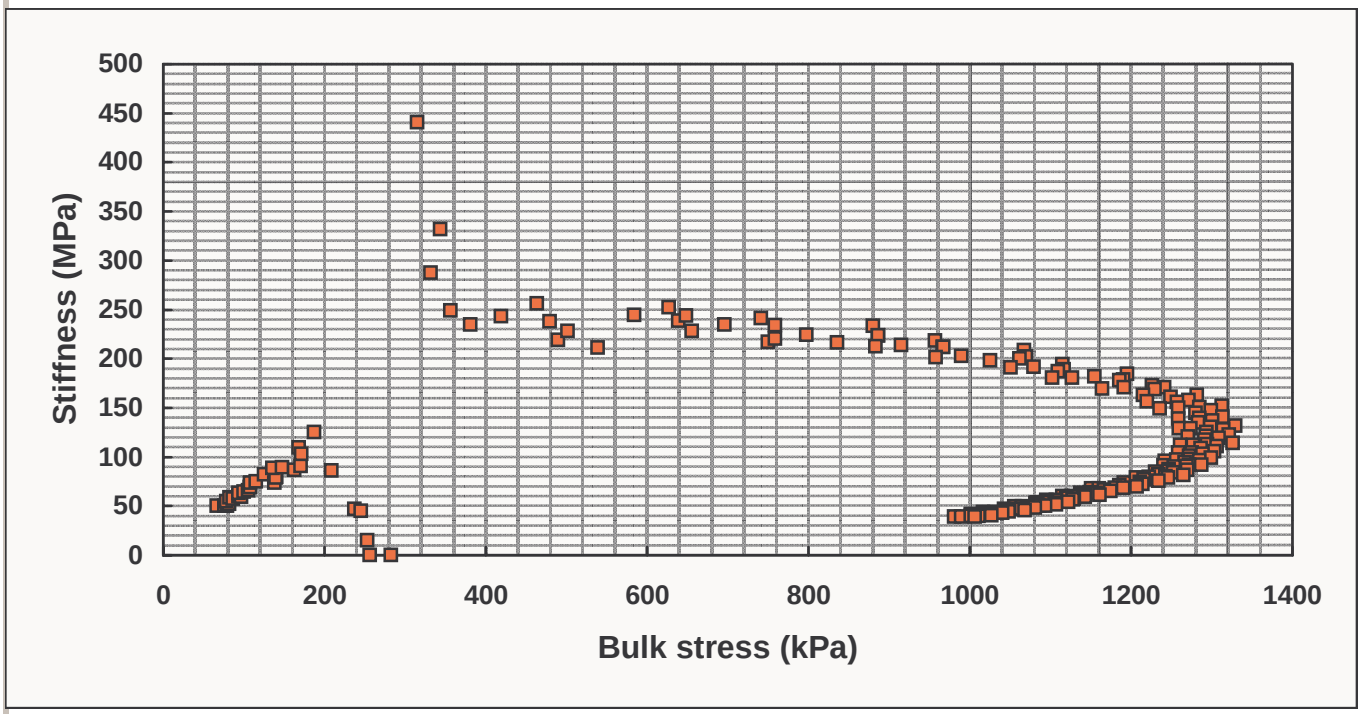
Sample #: HSA01

Dry Density (kg/cub m): 2020 — **Confining pressure (kPa): 19**

Moisture (%): 5.0 — **Linear stiffness (MPa): 218**

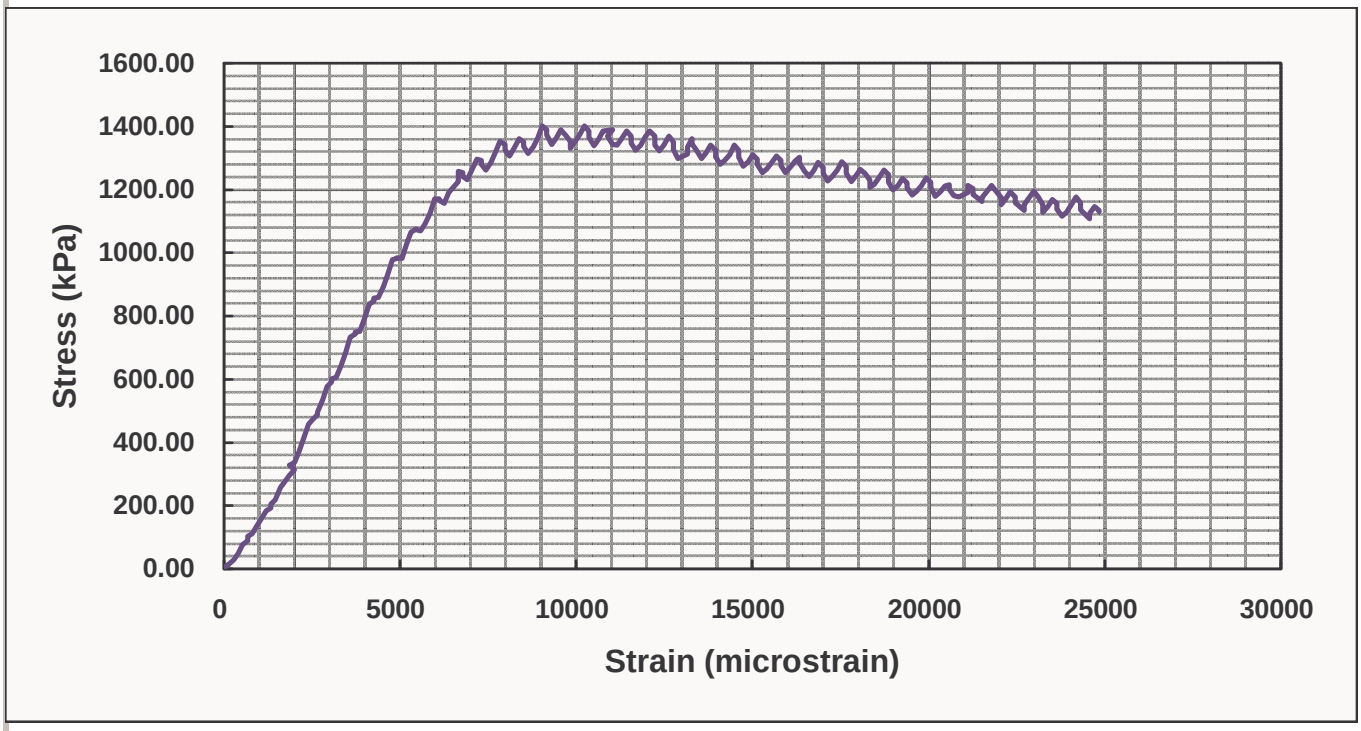
Maximum deviator stress (kPa): 1272

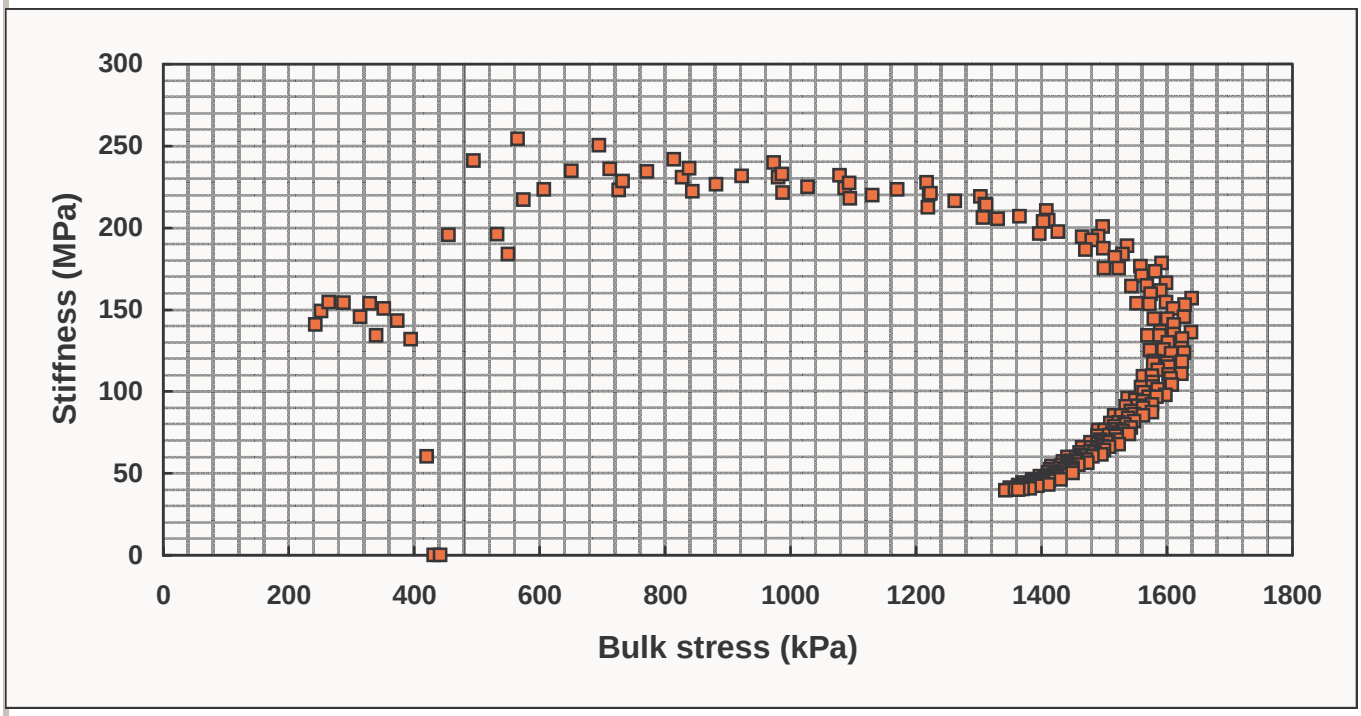




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1% cement & 3% bitumen
Sample #: HSA02
Dry Density (kg/cub m): 2020
Confining pressure (kPa): 79
Moisture (%): 5.4
Linear stiffness (MPa): 213
Maximum deviator stress (kPa): 1402





STATIC TRIAXIAL TEST

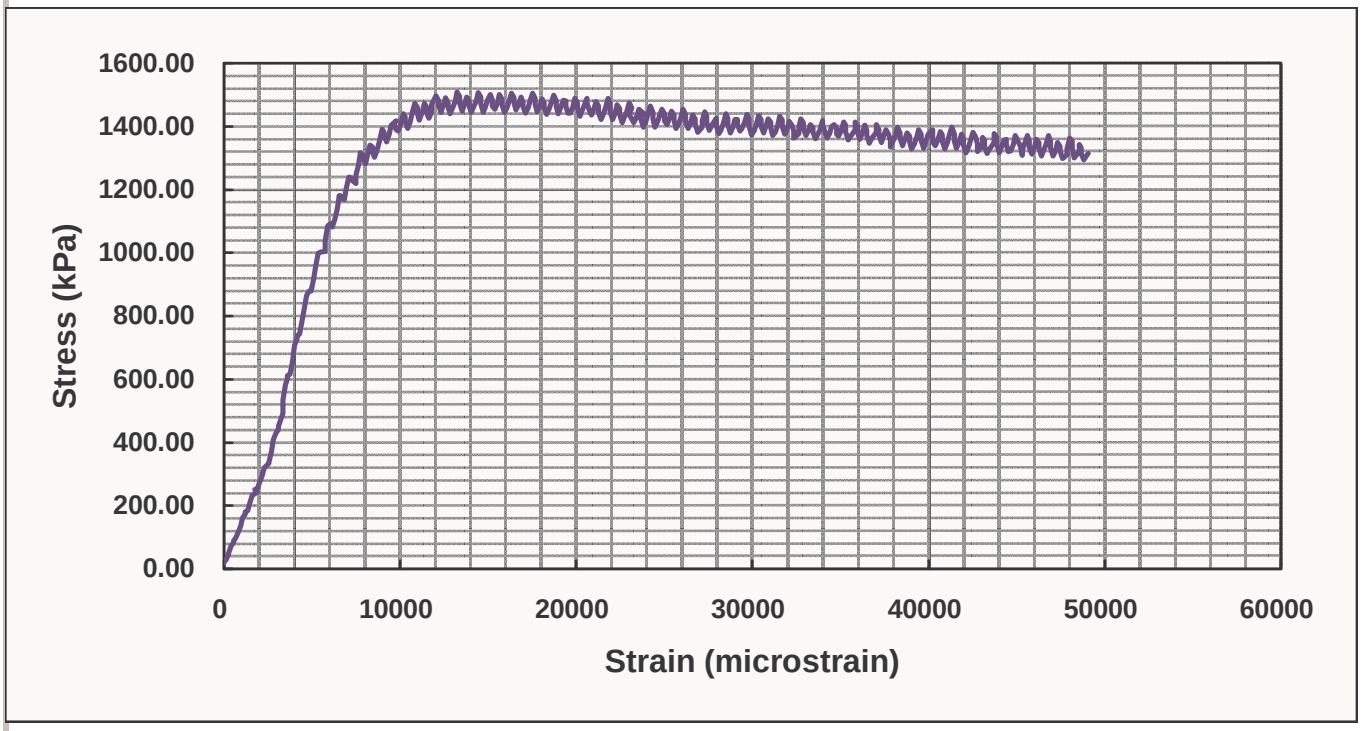
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

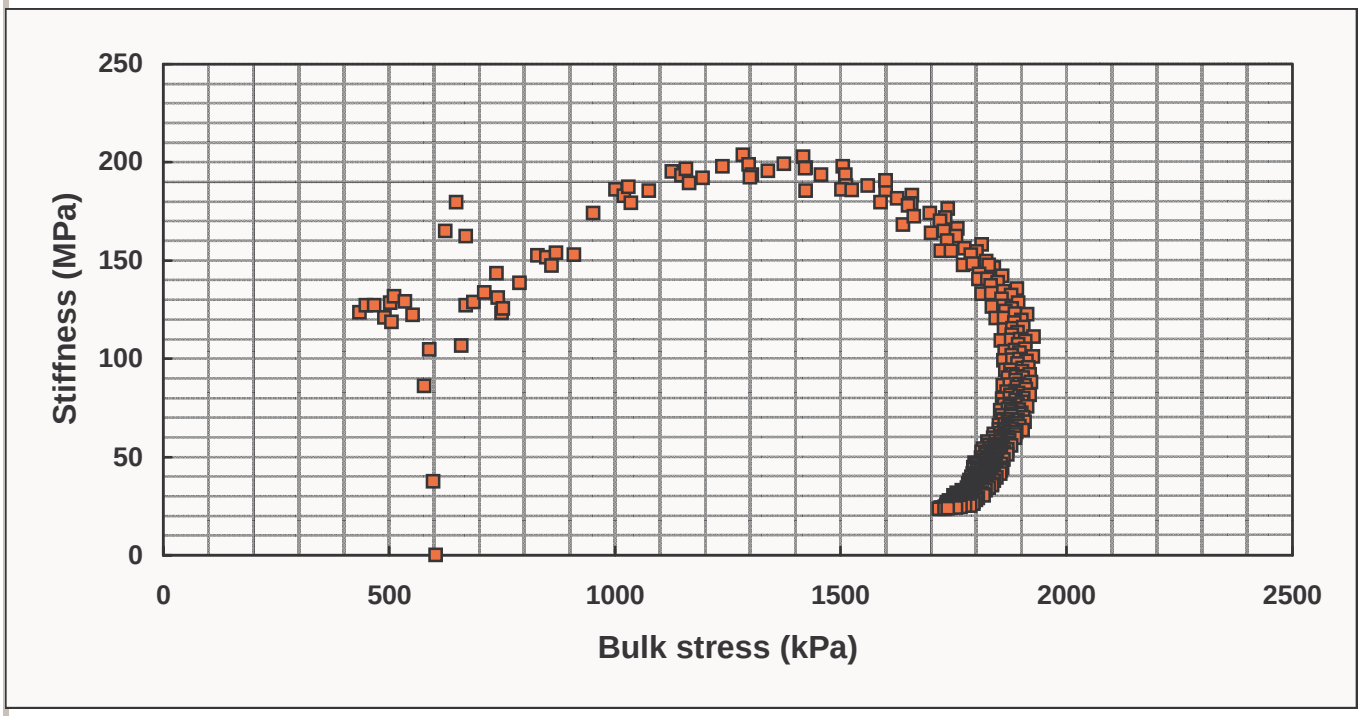
Sample #: HSA03

Dry Density (kg/cub m): 2020 — **Confining pressure (kPa): 140**

Moisture (%): 5.5 — **Linear stiffness (MPa): 203**

Maximum deviator stress (kPa): 1509

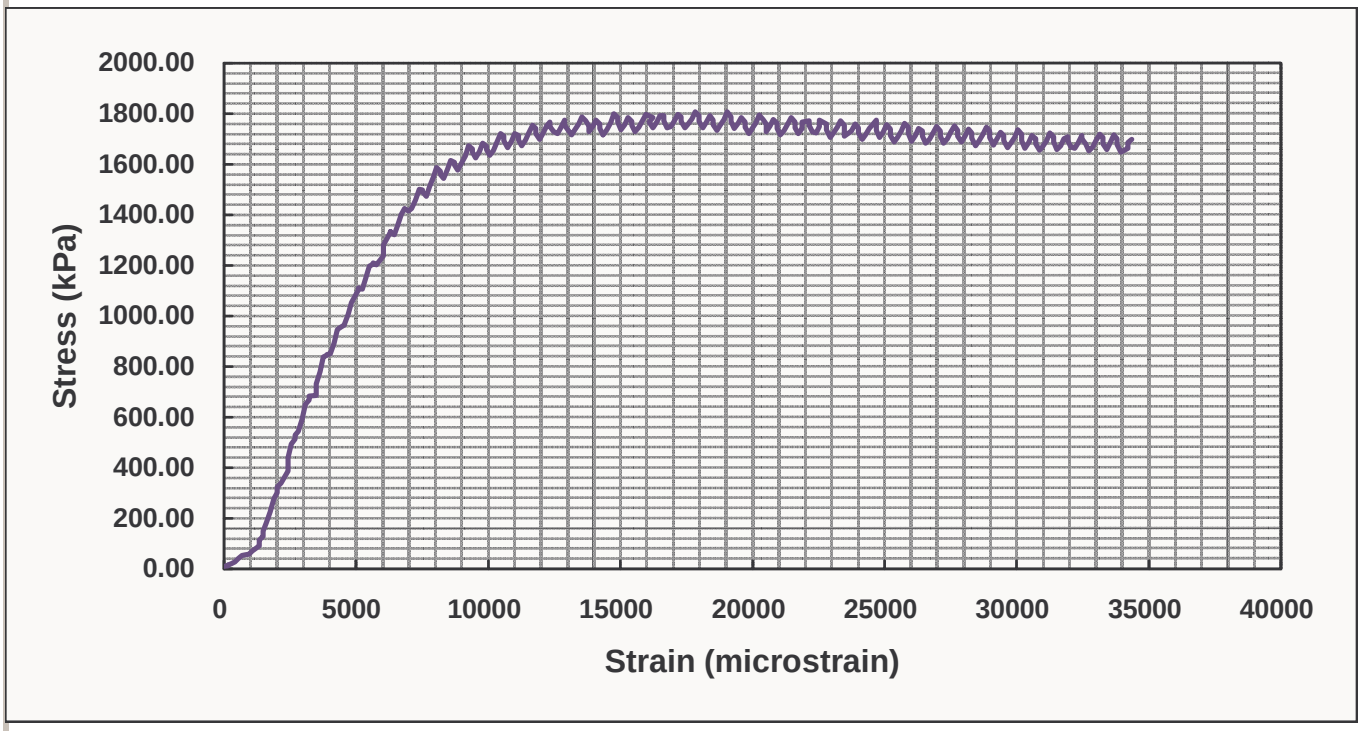


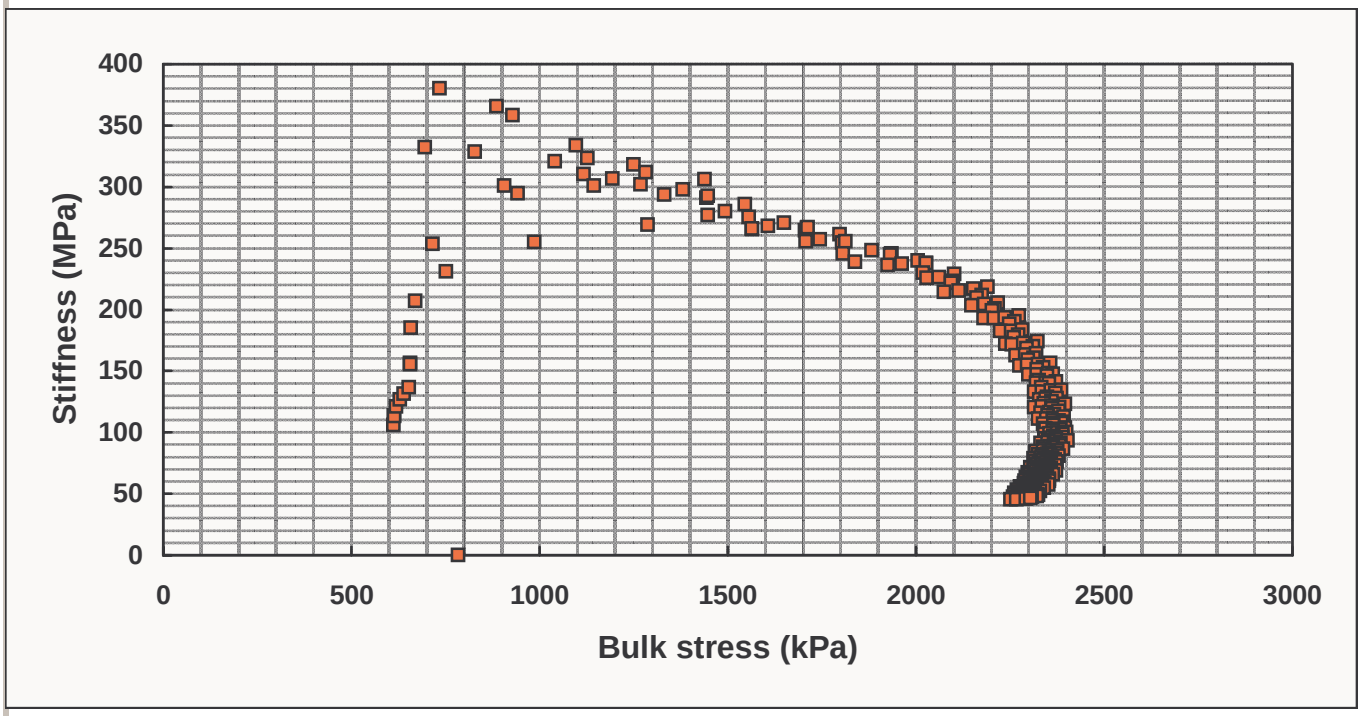


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HSA04
Dry Density (kg/cub m): 2020
Moisture (%): 5.4

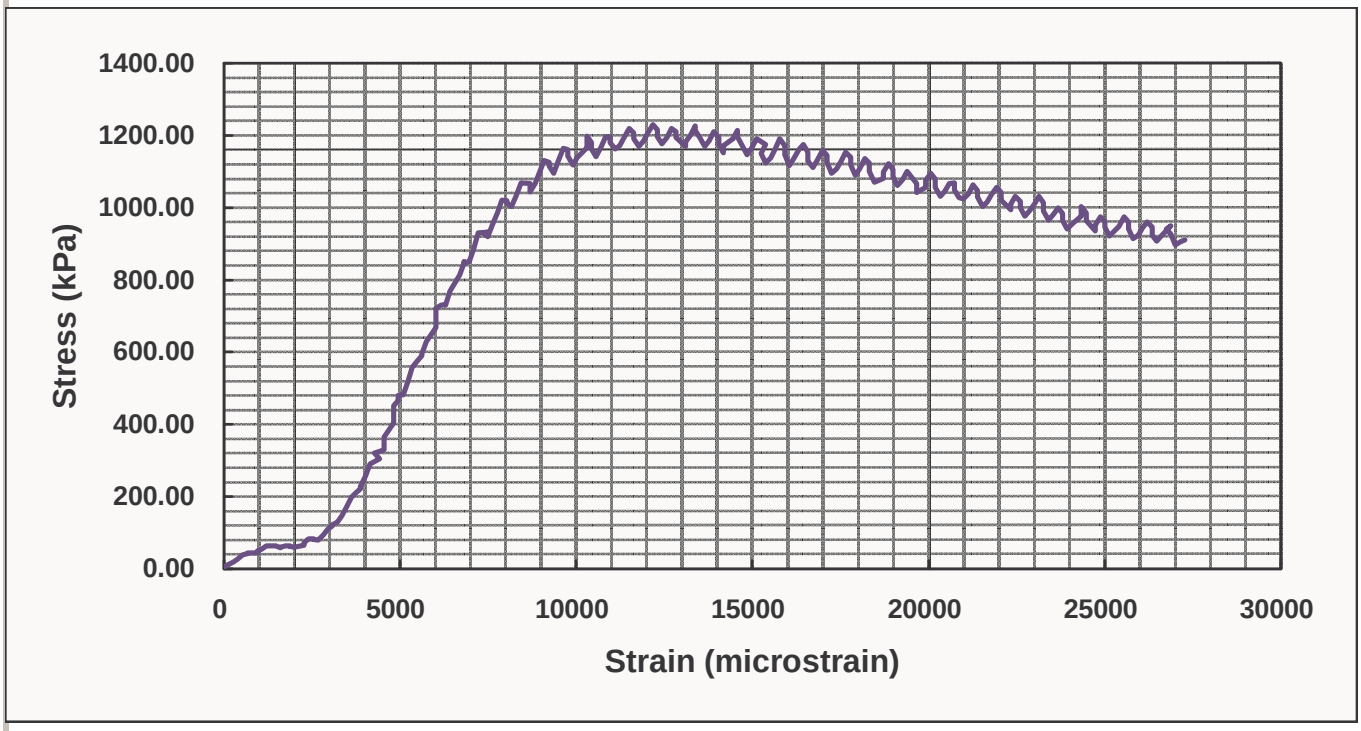
Treatment 1% cement & 3% bitumen
Confining pressure (kPa): 200
Linear stiffness (MPa): 266
Maximum deviator stress (kPa): 1807

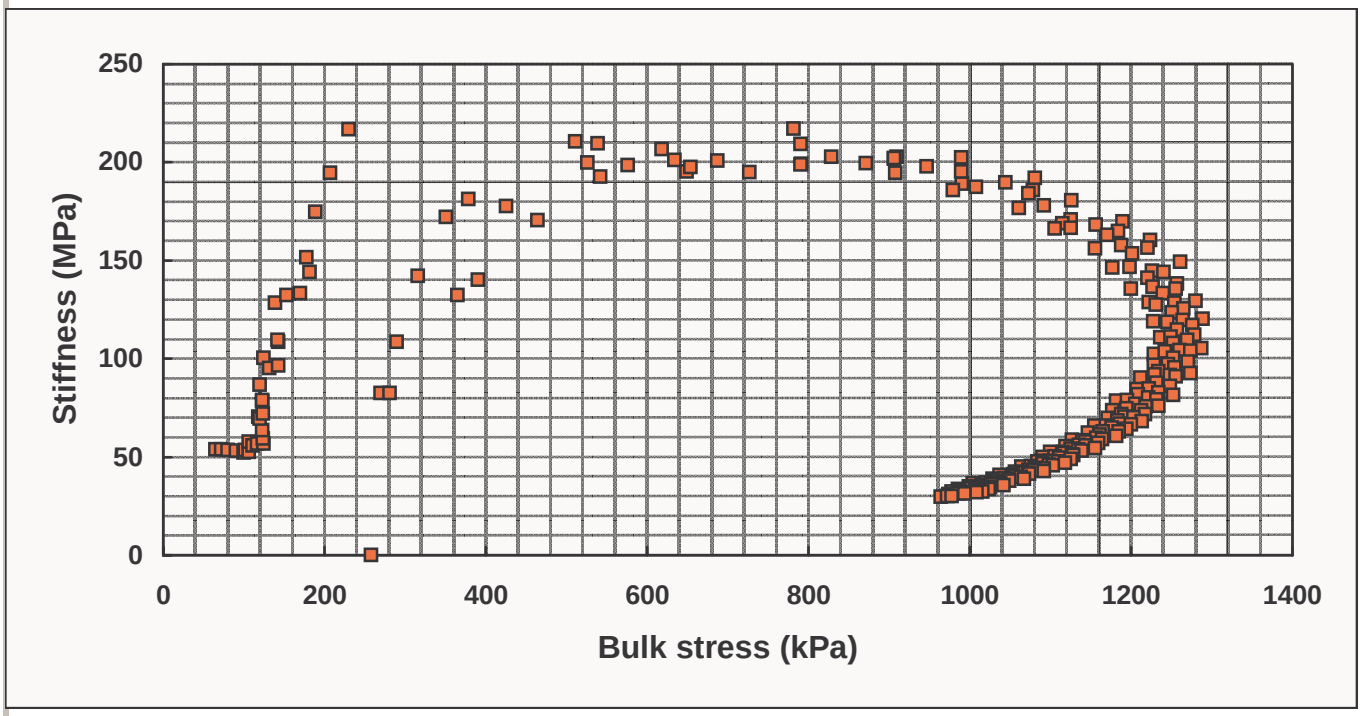




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1% cement & 3% bitumen
Sample #: HSA05
Dry Density (kg/cub m): 2020
Moisture (%): 2.4
Confining pressure (kPa): 20
Linear stiffness (MPa): 203
Maximum deviator stress (kPa): 1229





STATIC TRIAXIAL TEST

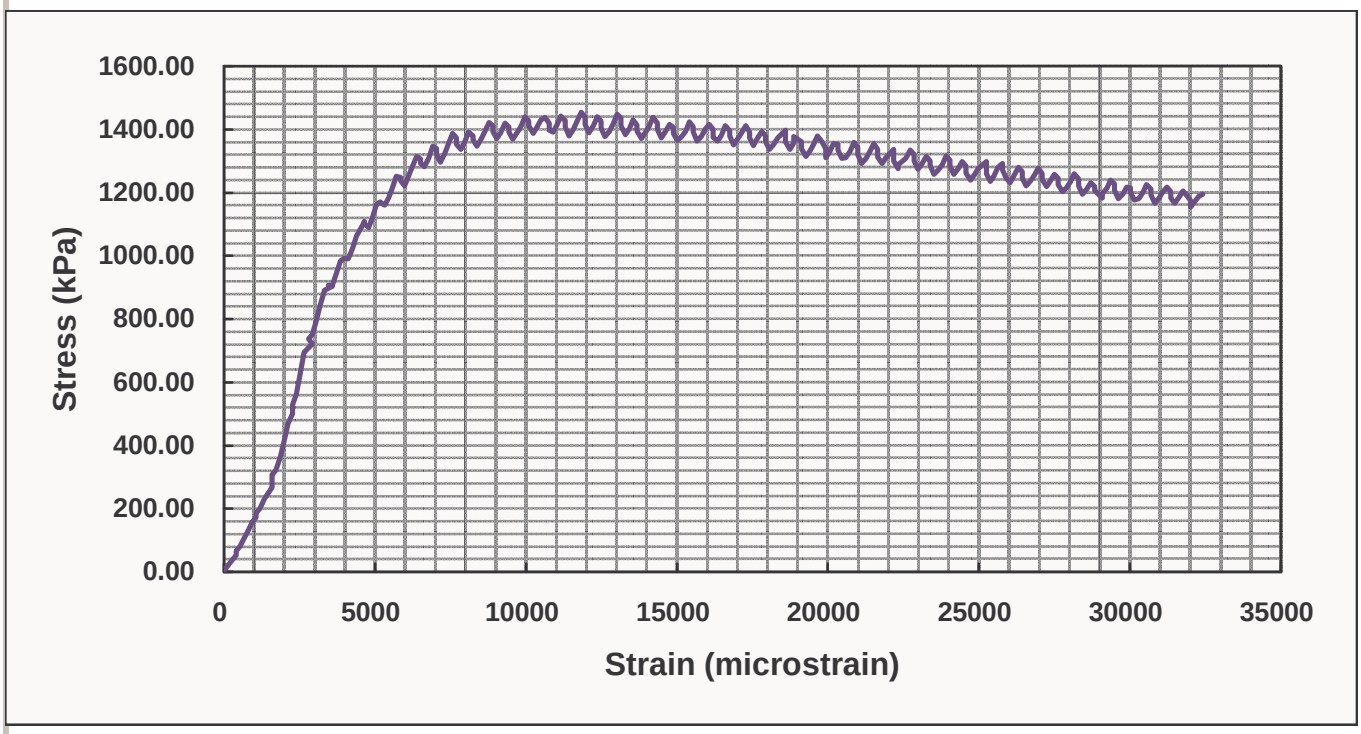
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

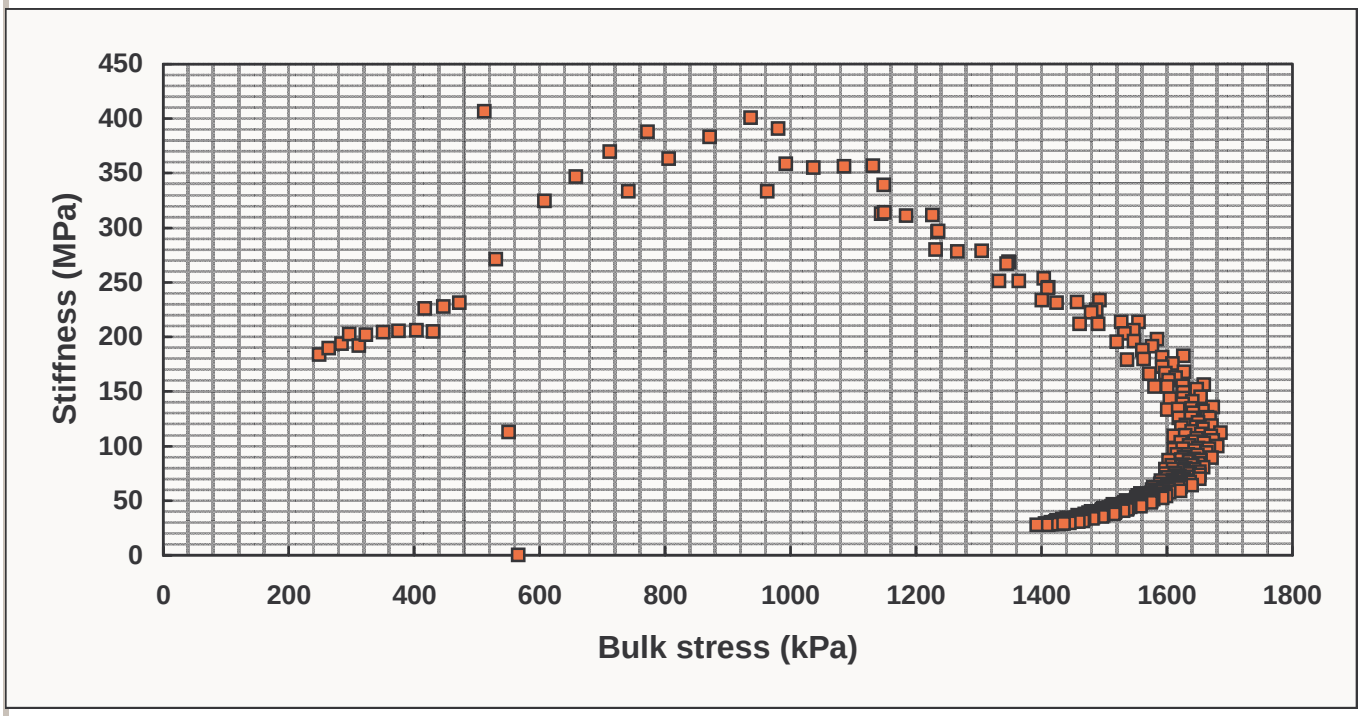
Sample #: HSA06

Dry Density (kg/cub m): 2020 — **Confining pressure (kPa): 80**

Moisture (%): 2.4 — **Linear stiffness (MPa): 358**

Maximum deviator stress (kPa): 1453





STATIC TRIAXIAL TEST

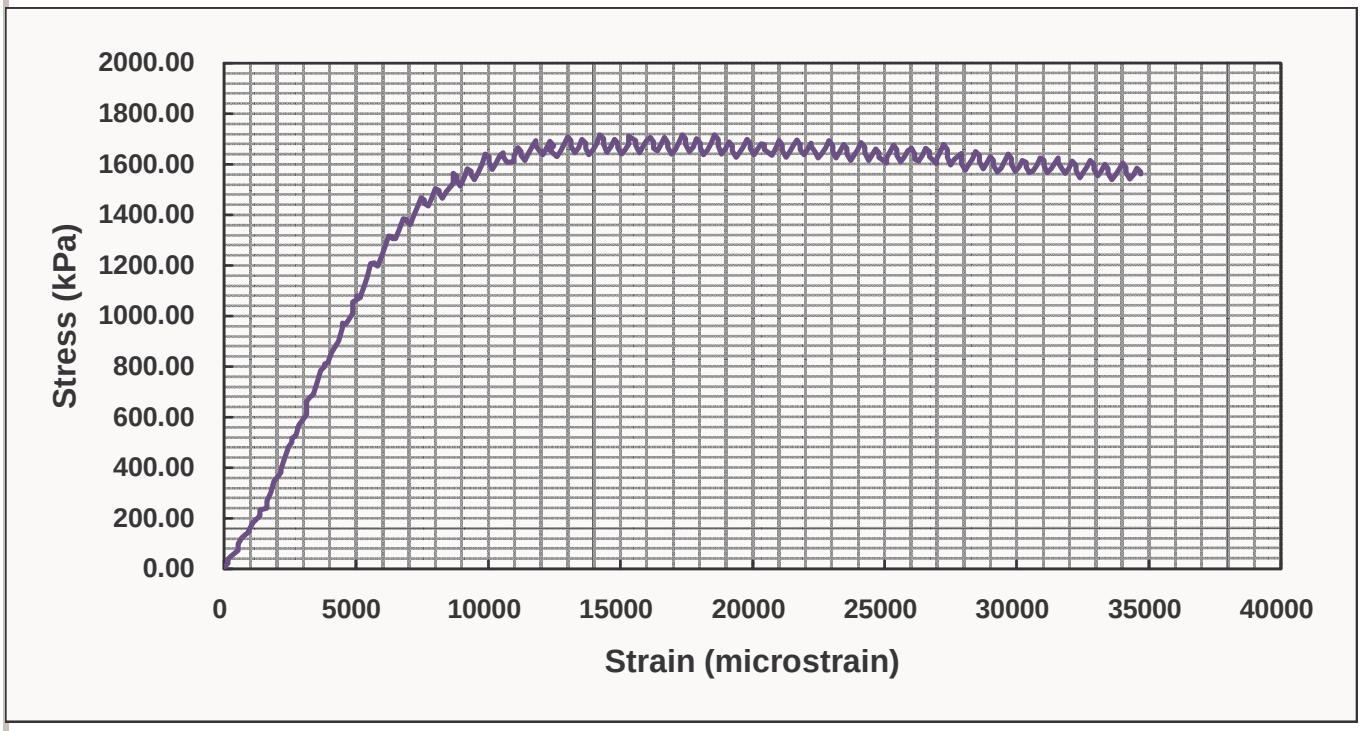
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

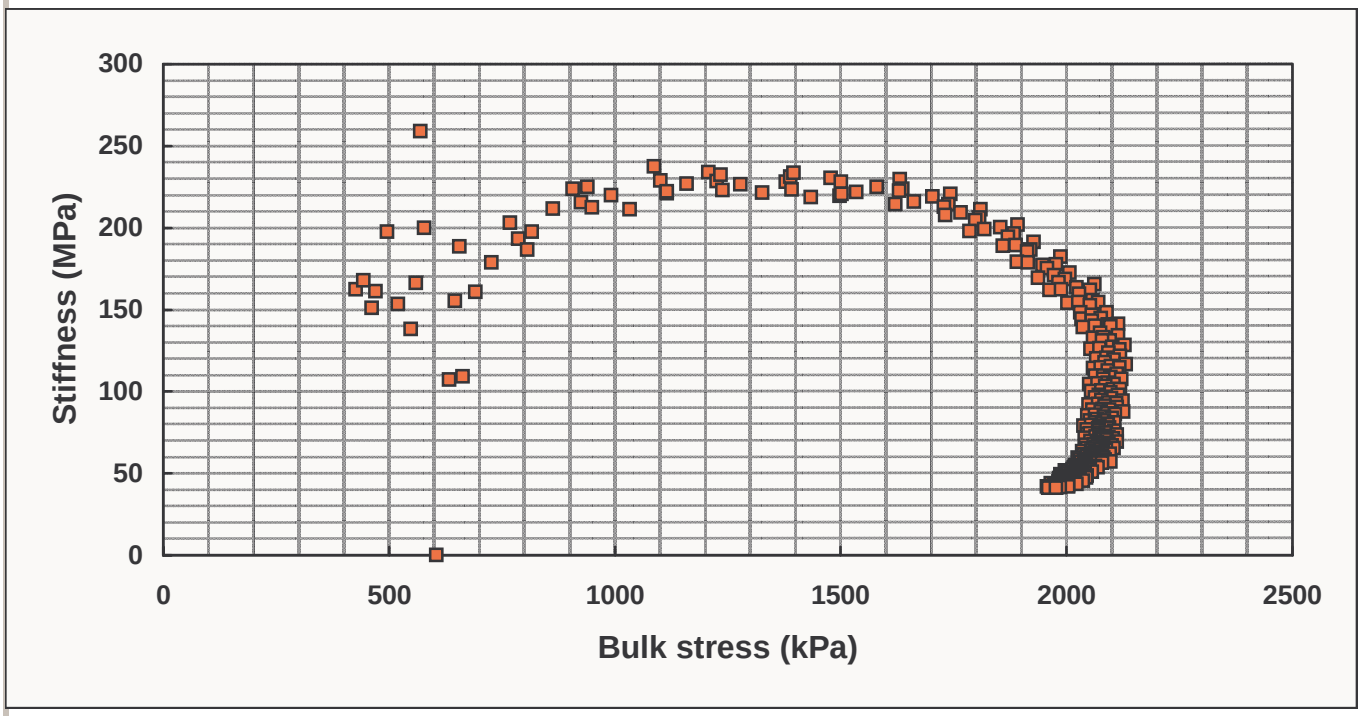
Sample #: HSA07

Dry Density (kg/cub m): 2020 — **Confining pressure (kPa): 140**

Moisture (%): 2.6 — **Linear stiffness (MPa): 221**

Maximum deviator stress (kPa): 1716





STATIC TRIAXIAL TEST

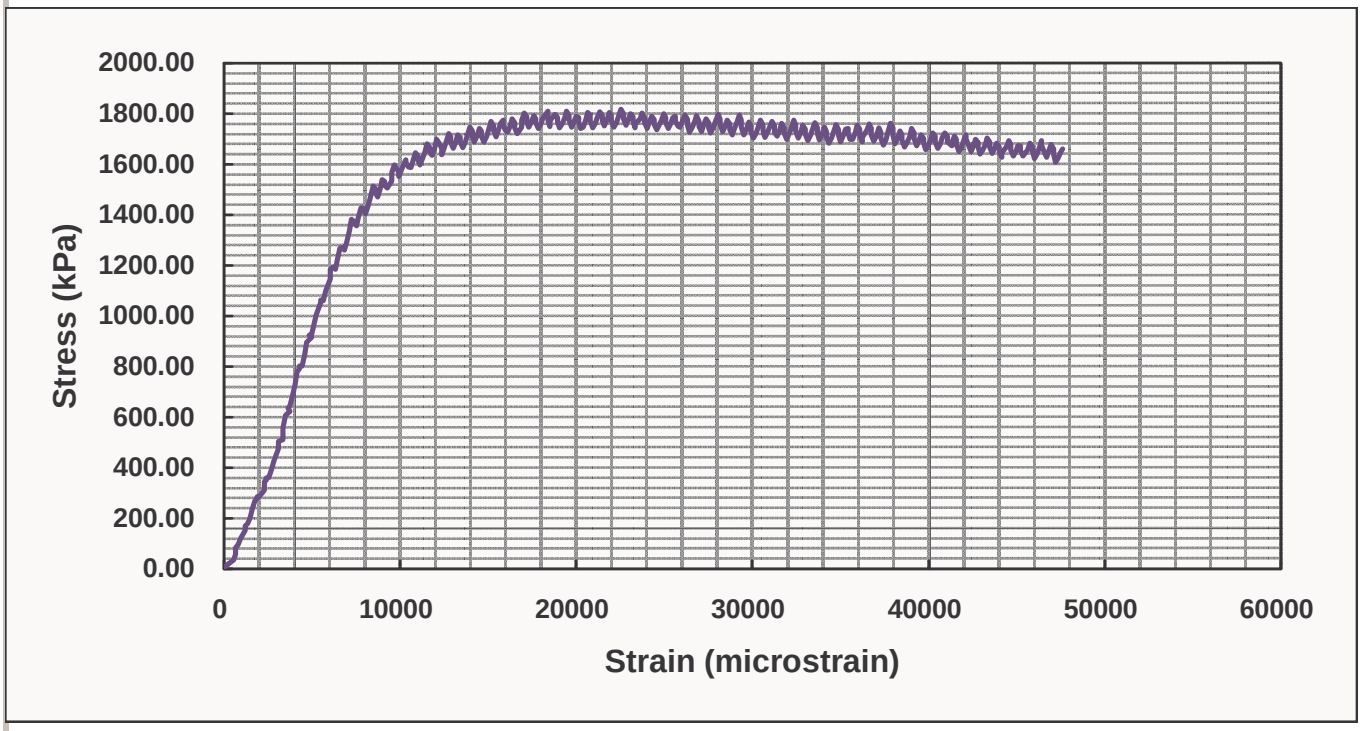
Material: Hornfels | **Treatment** **1% cement & 3% bitumen**

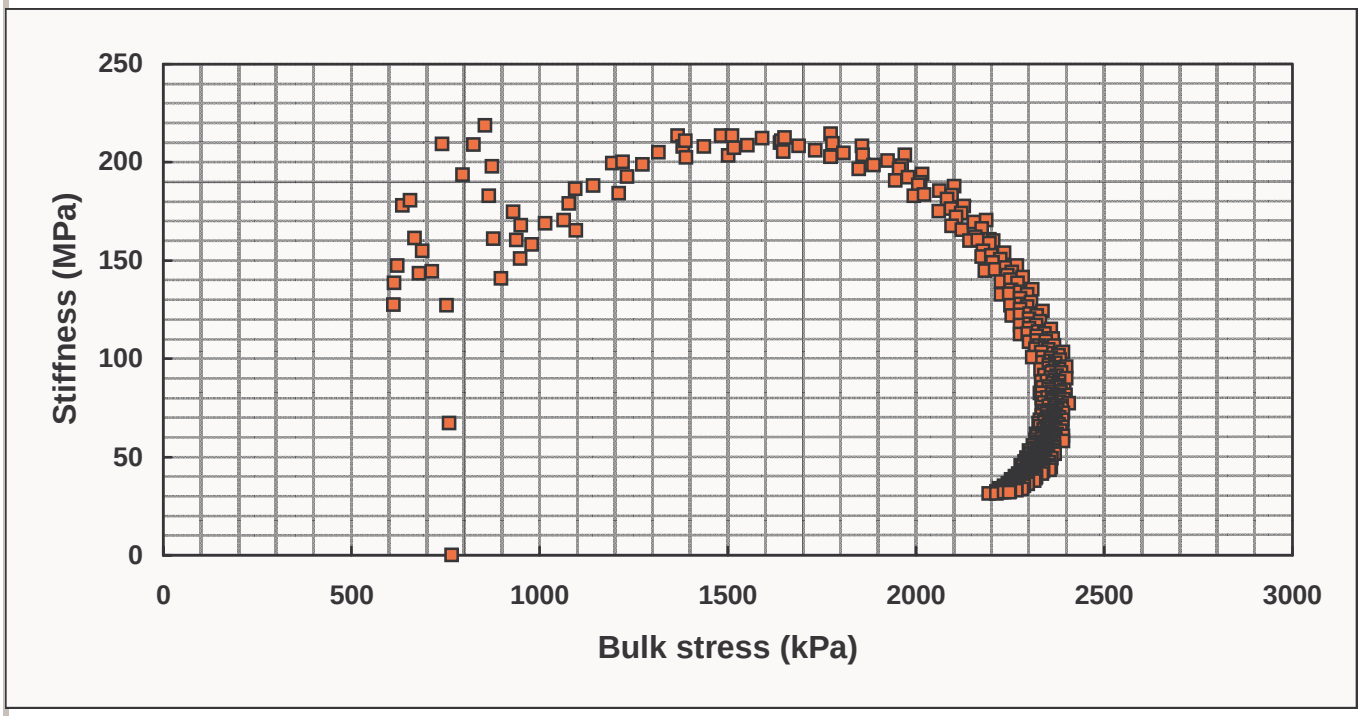
Sample #: HSA08

Dry Density (kg/cub m): 2020 | **Confining pressure (kPa): 197**

Moisture (%): 2.3 | **Linear stiffness (MPa): 205**

Maximum deviator stress (kPa): 1817





STATIC TRIAXIAL TEST

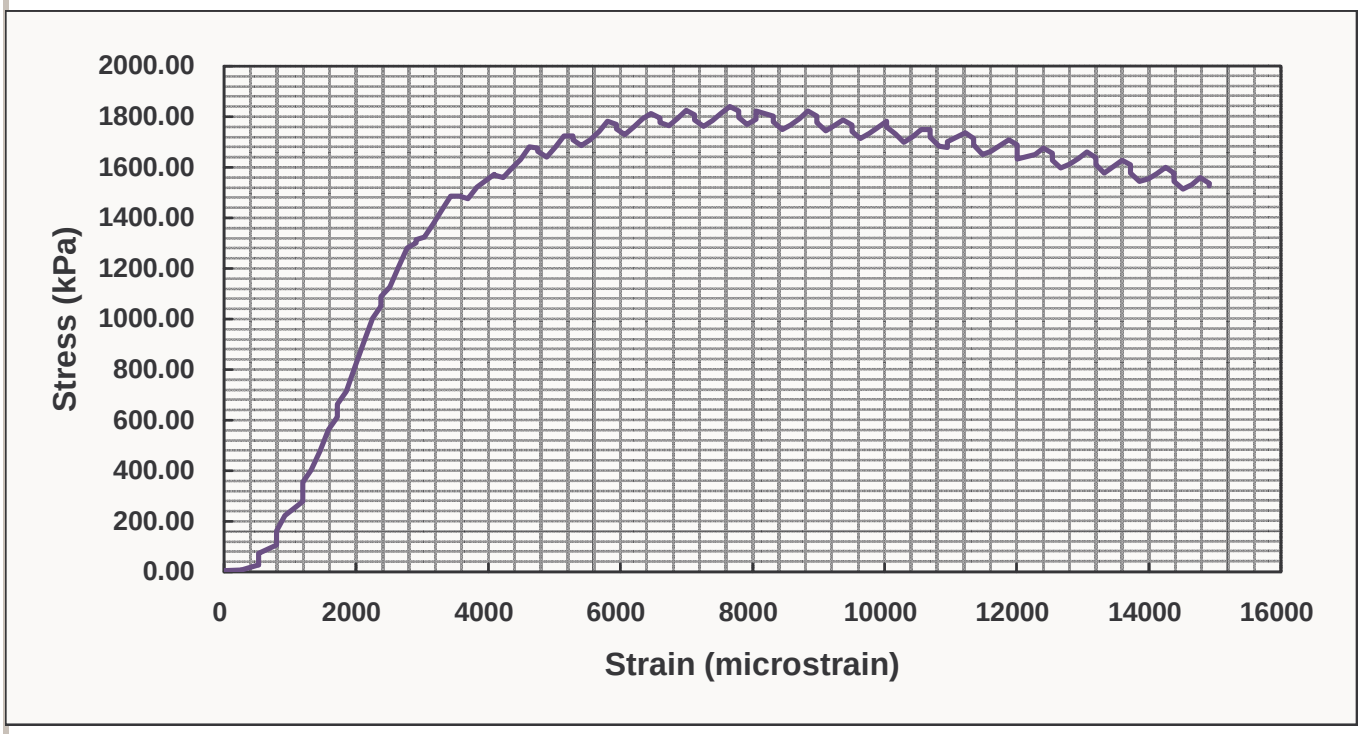
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

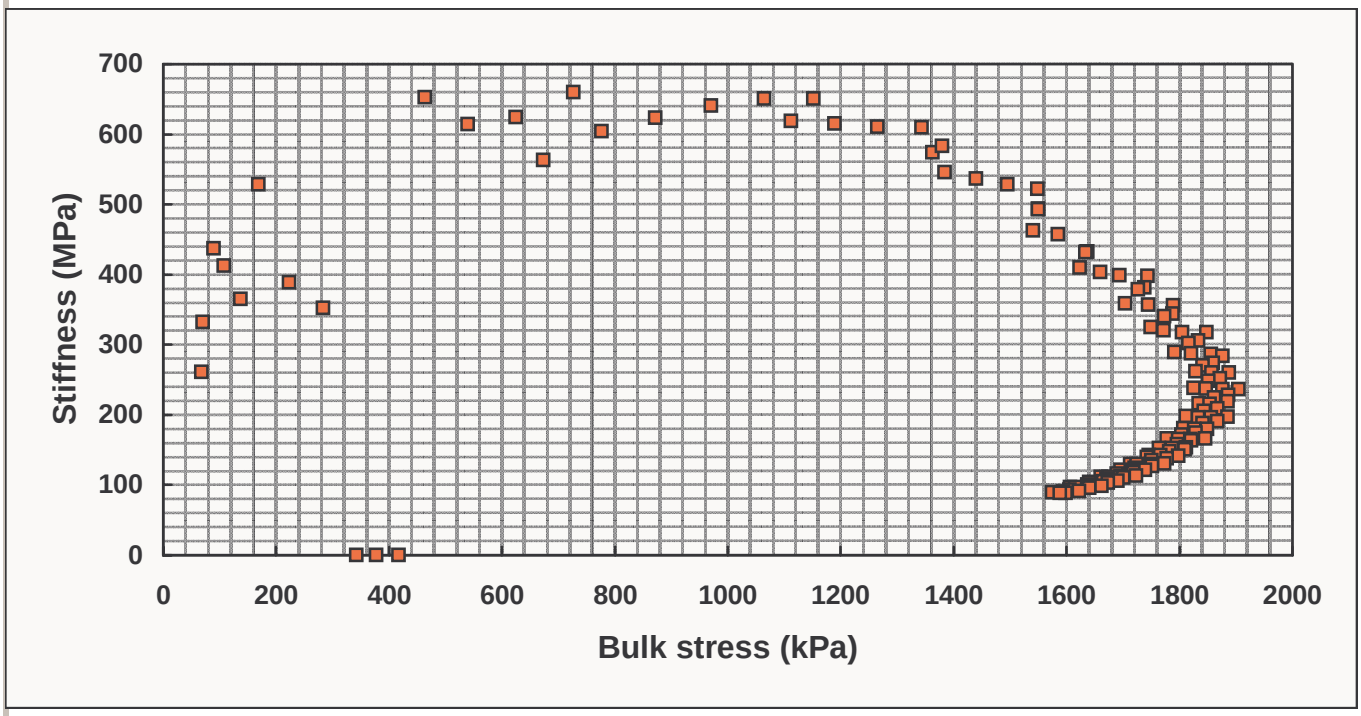
Sample #: HSA09

Dry Density (kg/cub m): 2173 — **Confining pressure (kPa): 21**

Moisture (%): 3.4 — **Linear stiffness (MPa): 615**

Maximum deviator stress (kPa): 1842





STATIC TRIAXIAL TEST

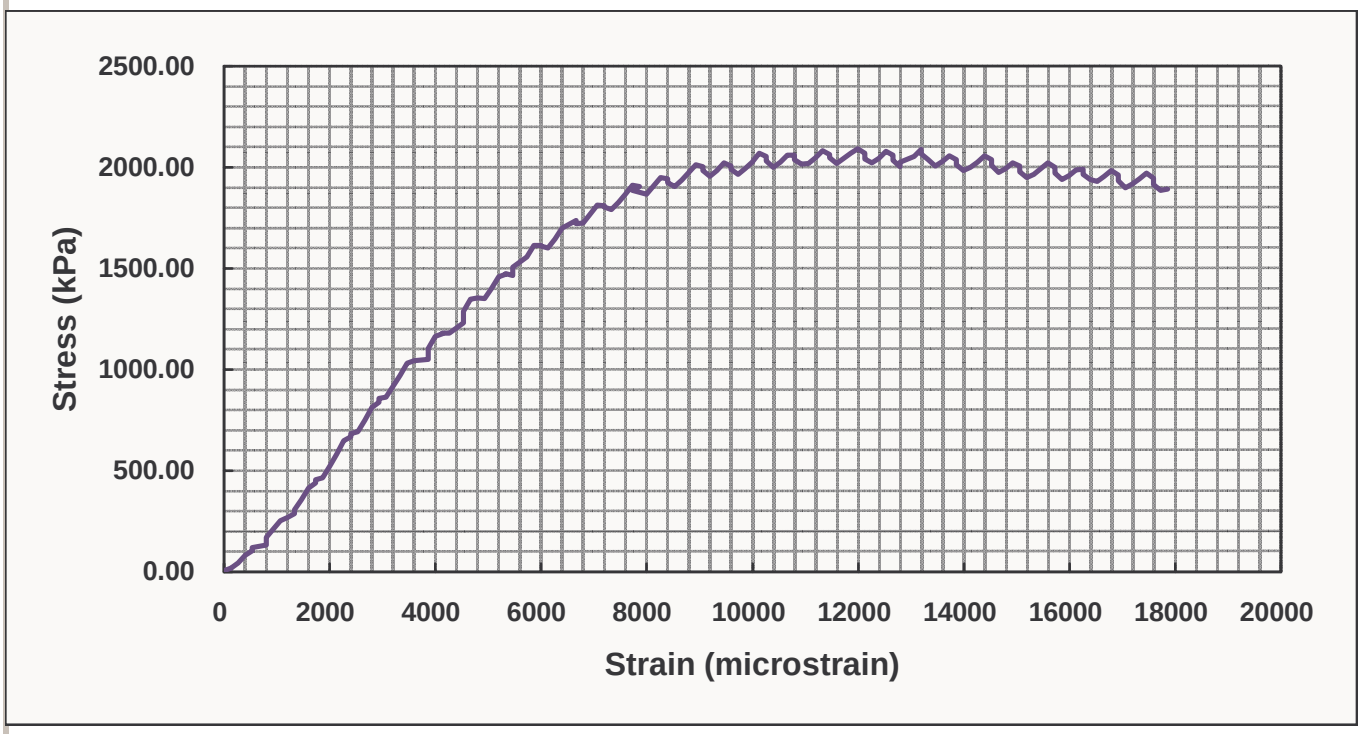
Material: Hornfels **Treatment 1% cement & 3% bitumen**

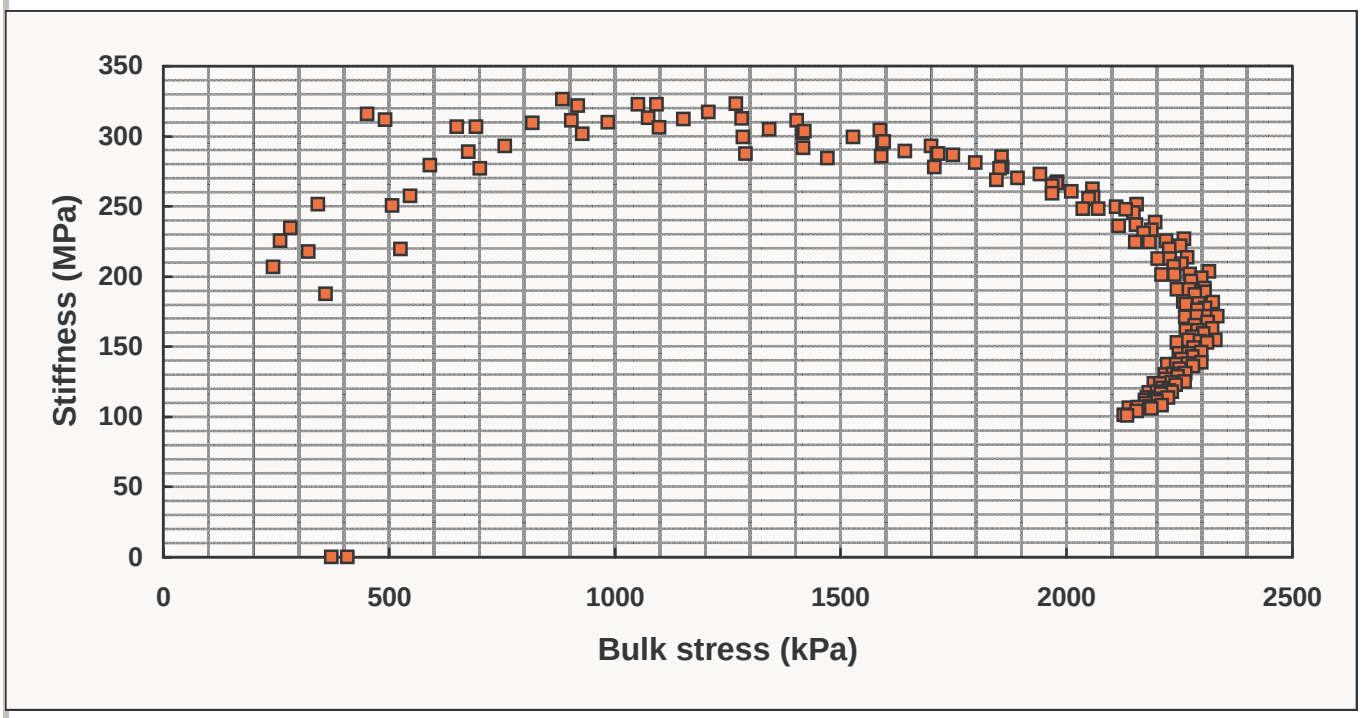
Sample #: HSA10

Dry Density (kg/cub m): 2173 **Confining pressure (kPa): 81**

Moisture (%): 3.4 **Linear stiffness (MPa): 299**

Maximum deviator stress (kPa): 2091





STATIC TRIAXIAL TEST

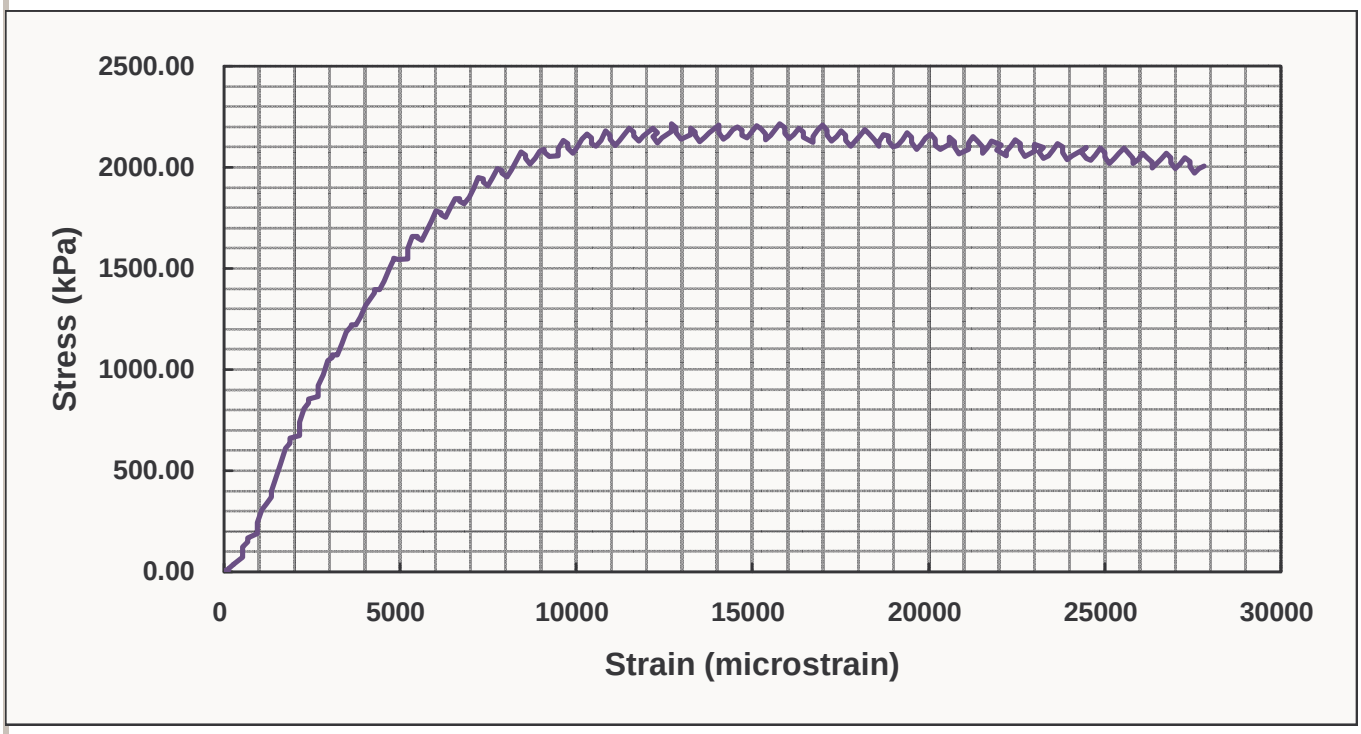
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

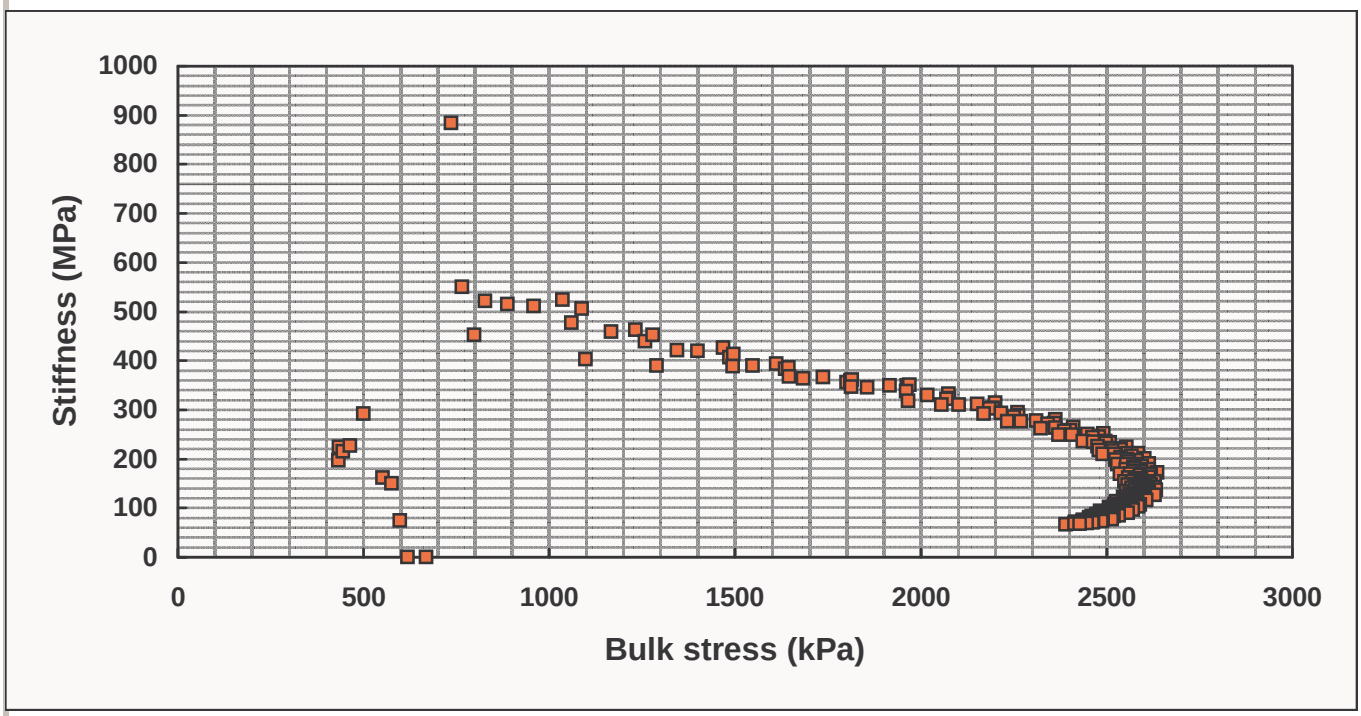
Sample #: HSA11

Dry Density (kg/cub m): 2173 — **Confining pressure (kPa): 140**

Moisture (%): 3.5 — **Linear stiffness (MPa): 349**

Maximum deviator stress (kPa): 2216





STATIC TRIAXIAL TEST

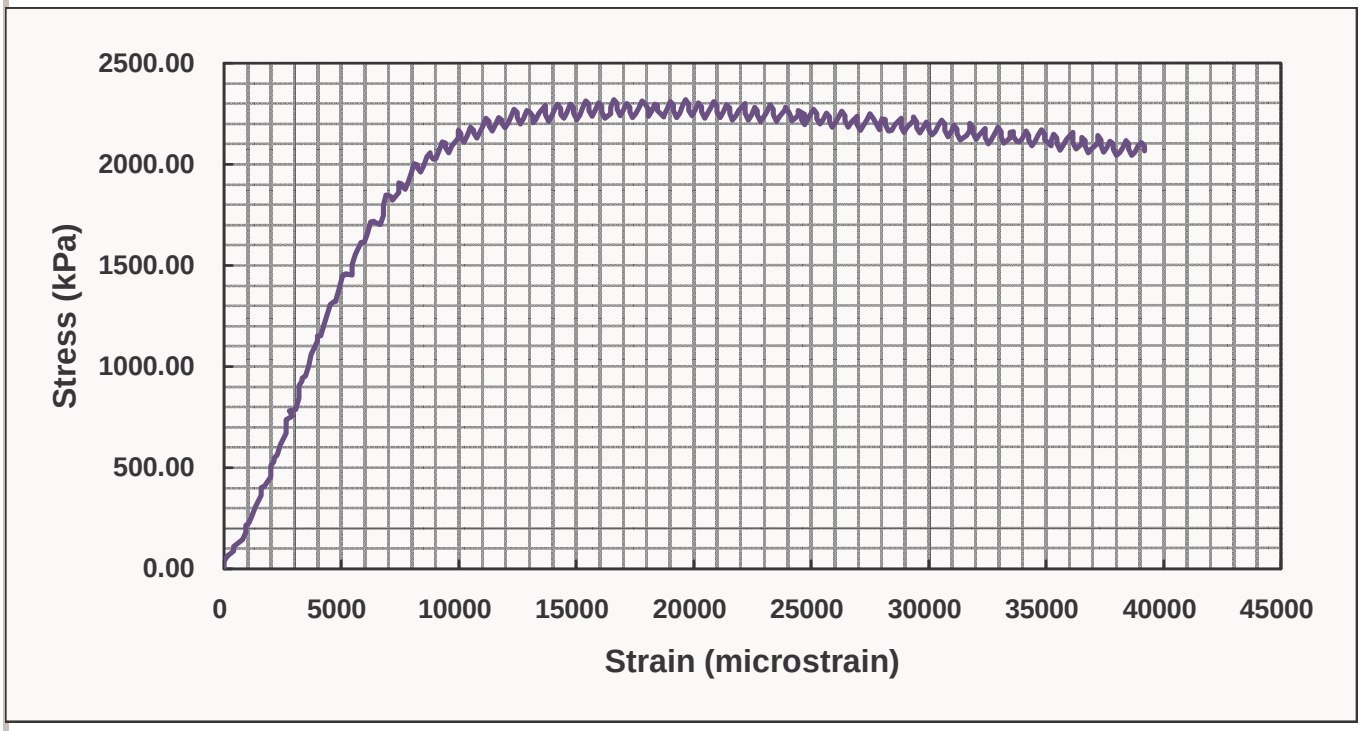
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

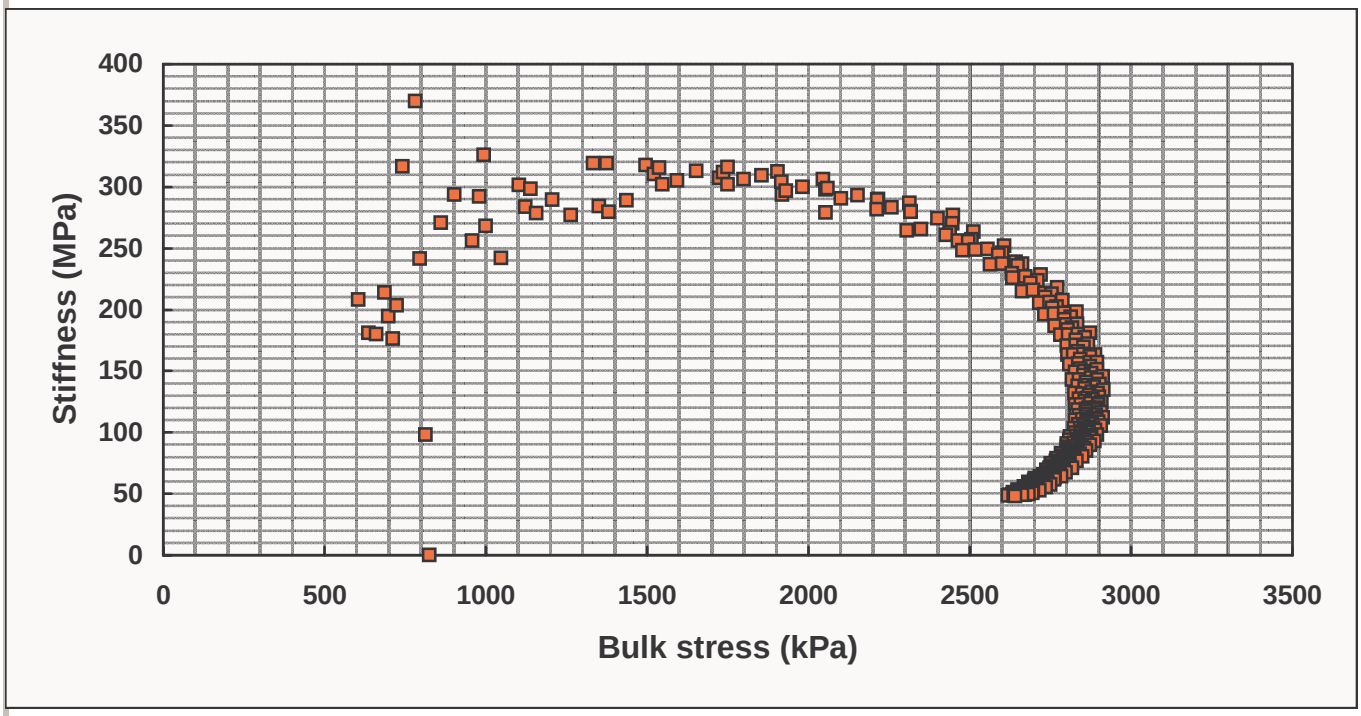
Sample #: HSA12

Dry Density (kg/cub m): 2173 — **Confining pressure (kPa): 197**

Moisture (%): 3.4 — **Linear stiffness (MPa): 293**

Maximum deviator stress (kPa): 2320





STATIC TRIAXIAL TEST

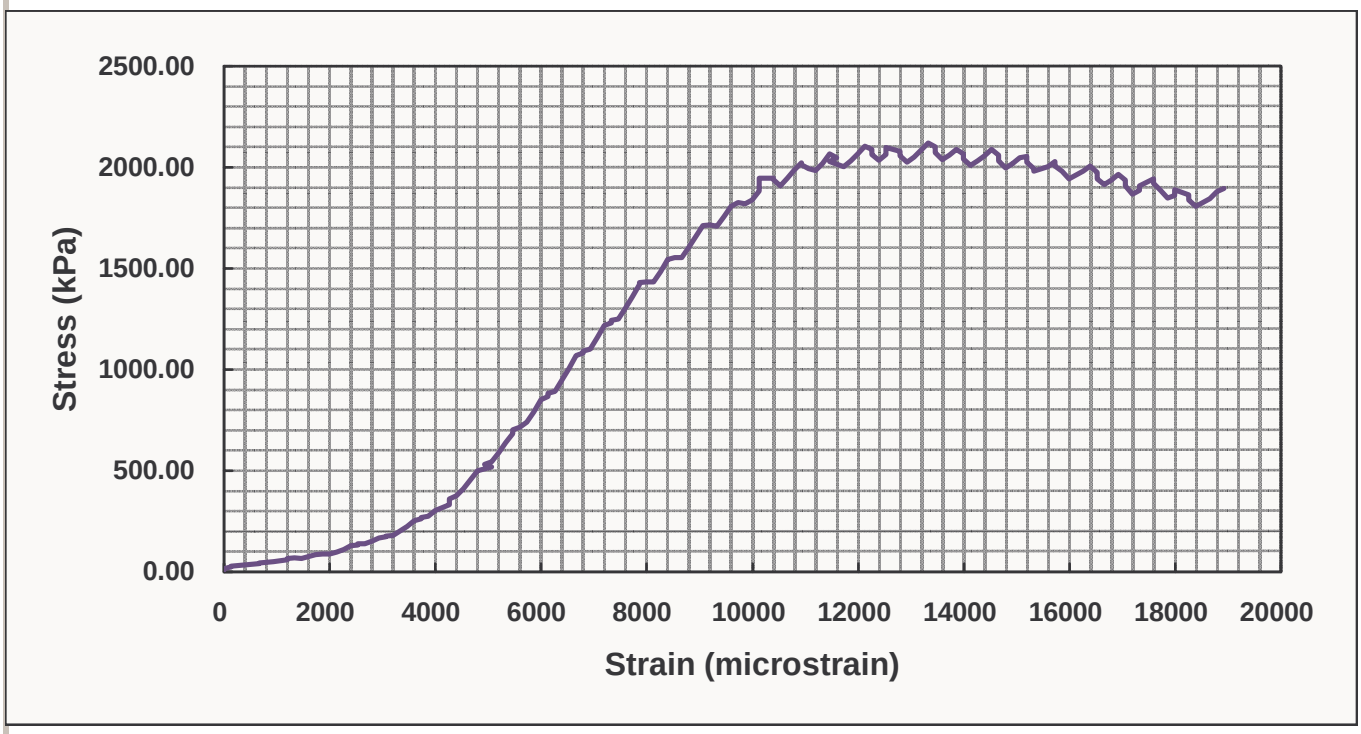
Material: Hornfels **Treatment 1% cement & 3% bitumen**

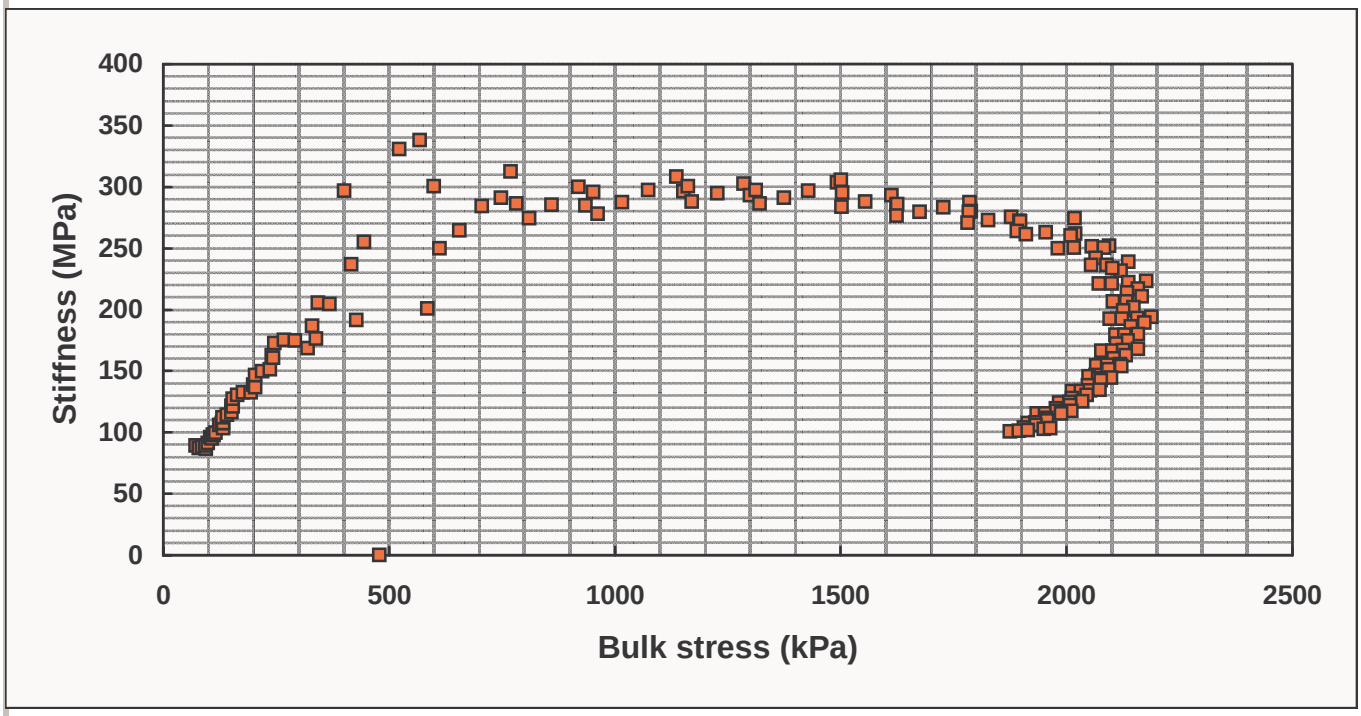
Sample #: HSA13

Dry Density (kg/cub m): 2173 **Confining pressure (kPa): 23**

Moisture (%): 2.6 **Linear stiffness (MPa): 286**

Maximum deviator stress (kPa): 2120





STATIC TRIAXIAL TEST

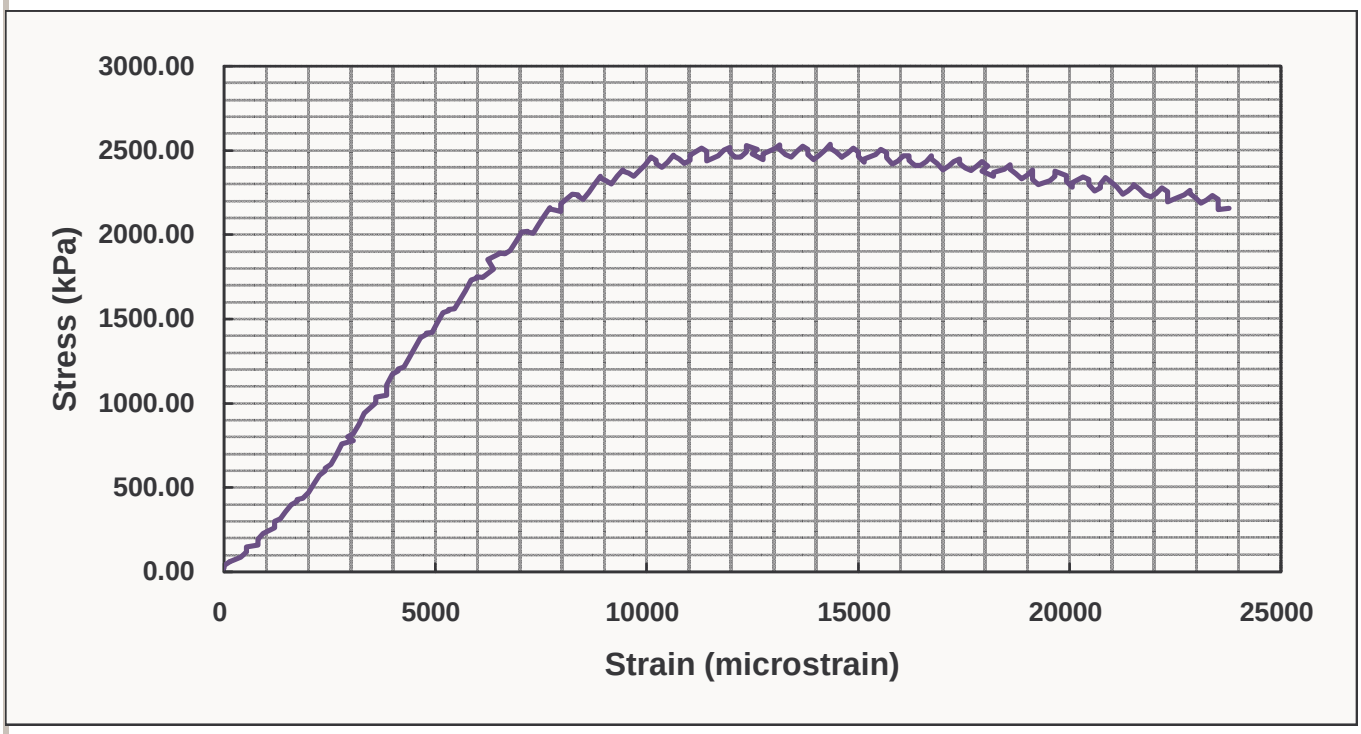
Material: Hornfels — **Treatment** **1% cement & 3% bitumen**

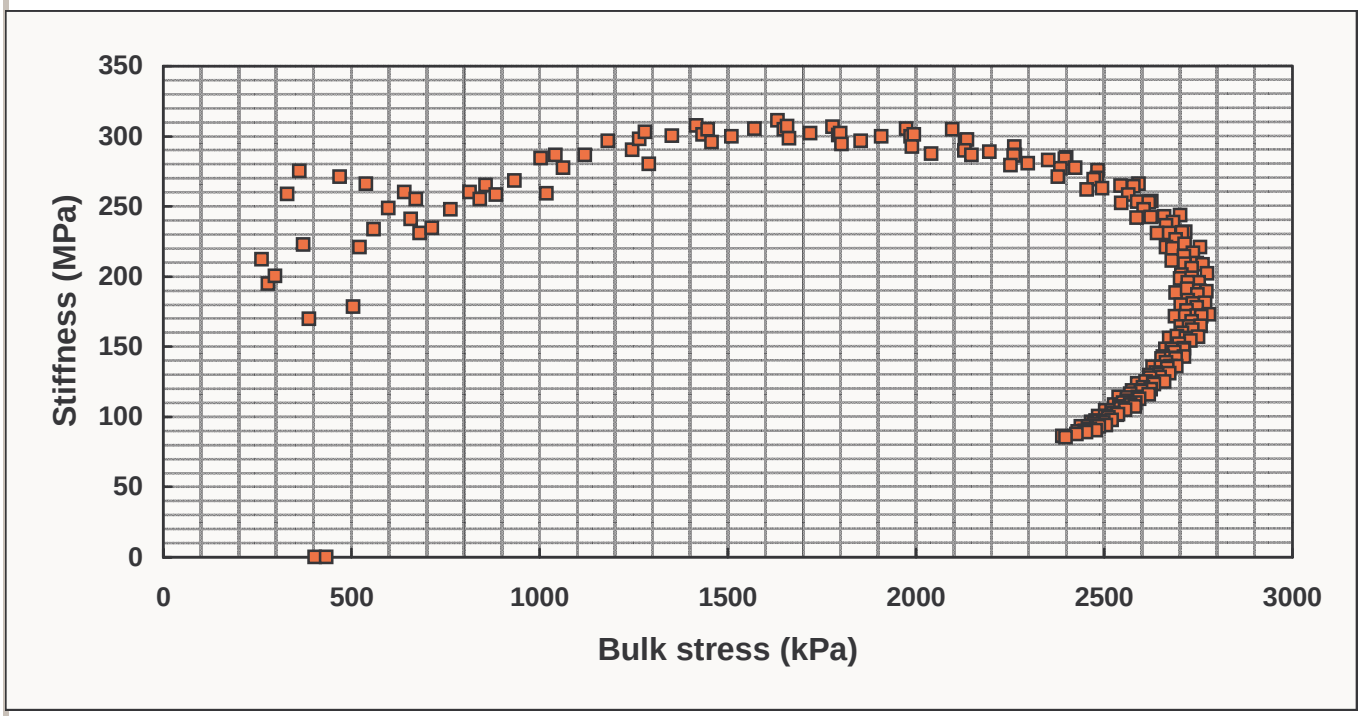
Sample #: HSA14

Dry Density (kg/cub m): 2173 — **Confining pressure (kPa): 81**

Moisture (%): 2.3 — **Linear stiffness (MPa): 294**

Maximum deviator stress (kPa): 2536





STATIC TRIAXIAL TEST

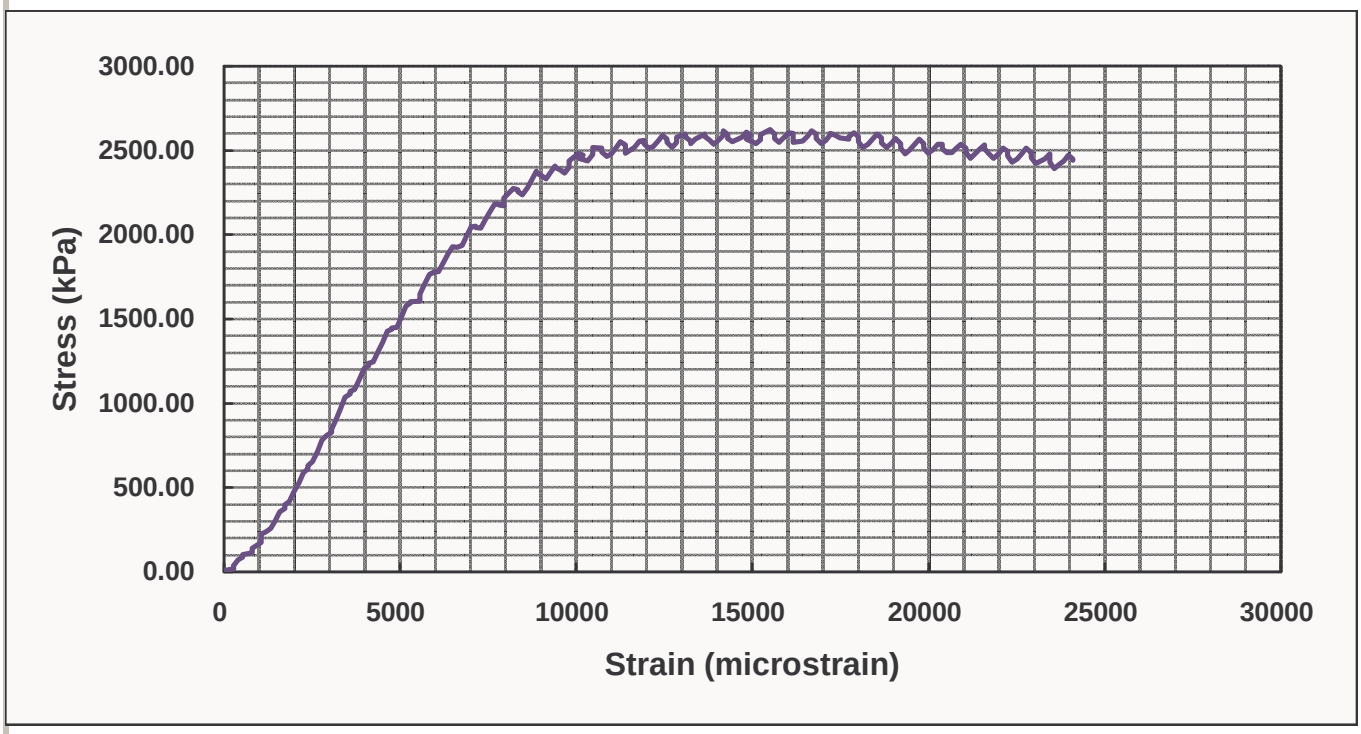
Material: Hornfels | **Treatment** 1% cement & 3% bitumen

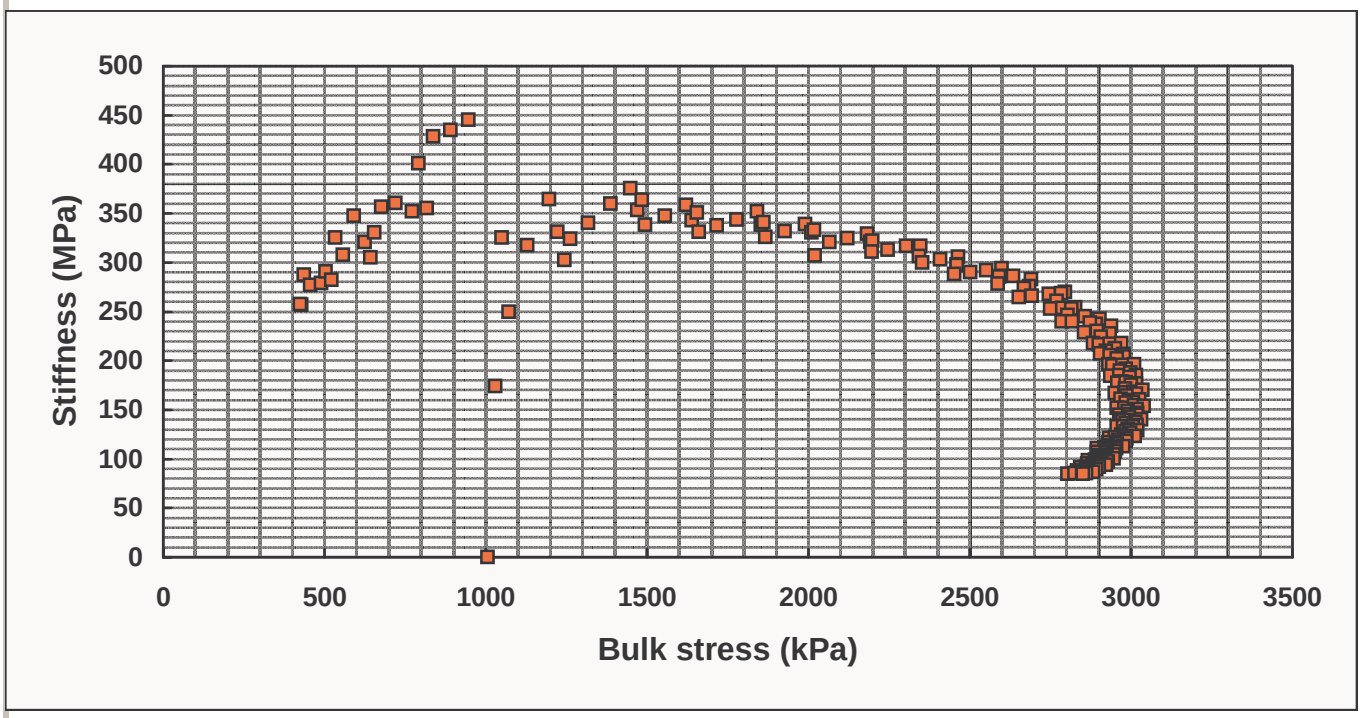
Sample #: HSA15

Dry Density (kg/cub m): 2173 | **Confining pressure (kPa): 139**

Moisture (%): 2.4 | **Linear stiffness (MPa): 326**

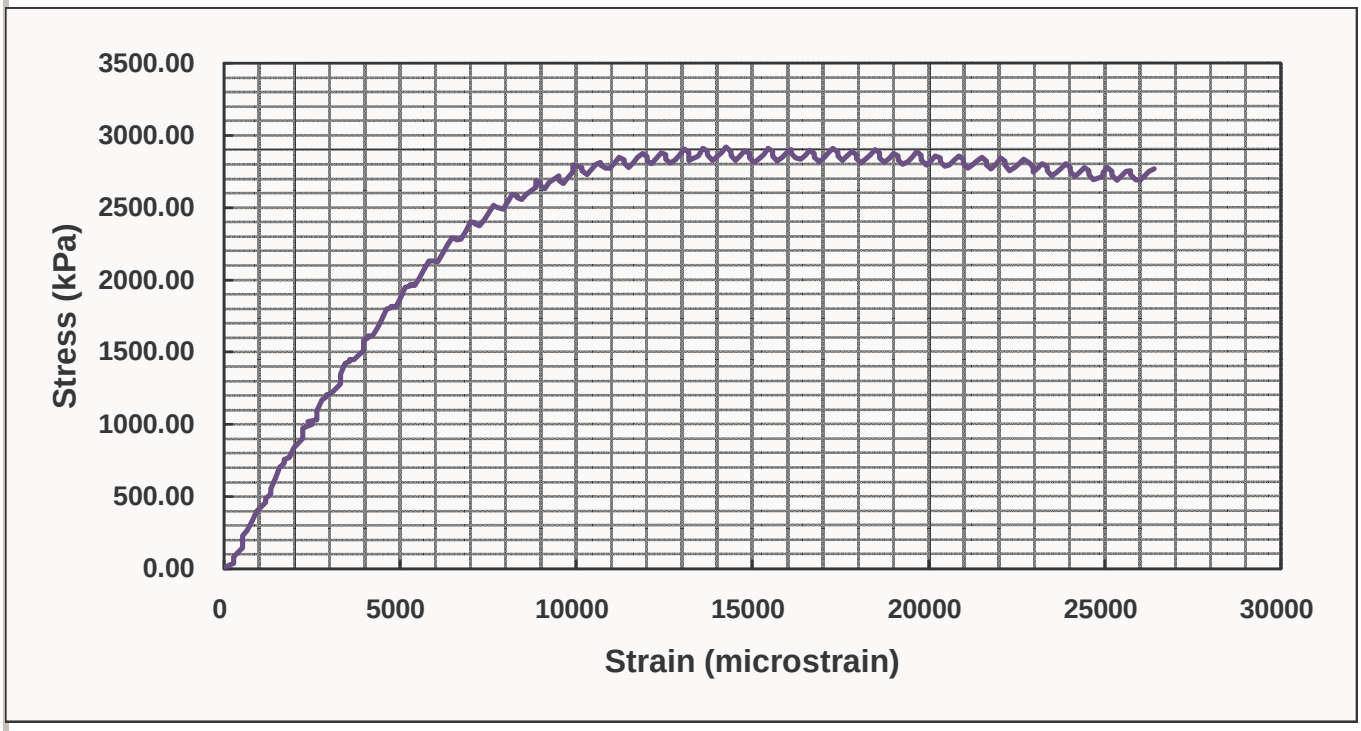
Maximum deviator stress (kPa): 2622

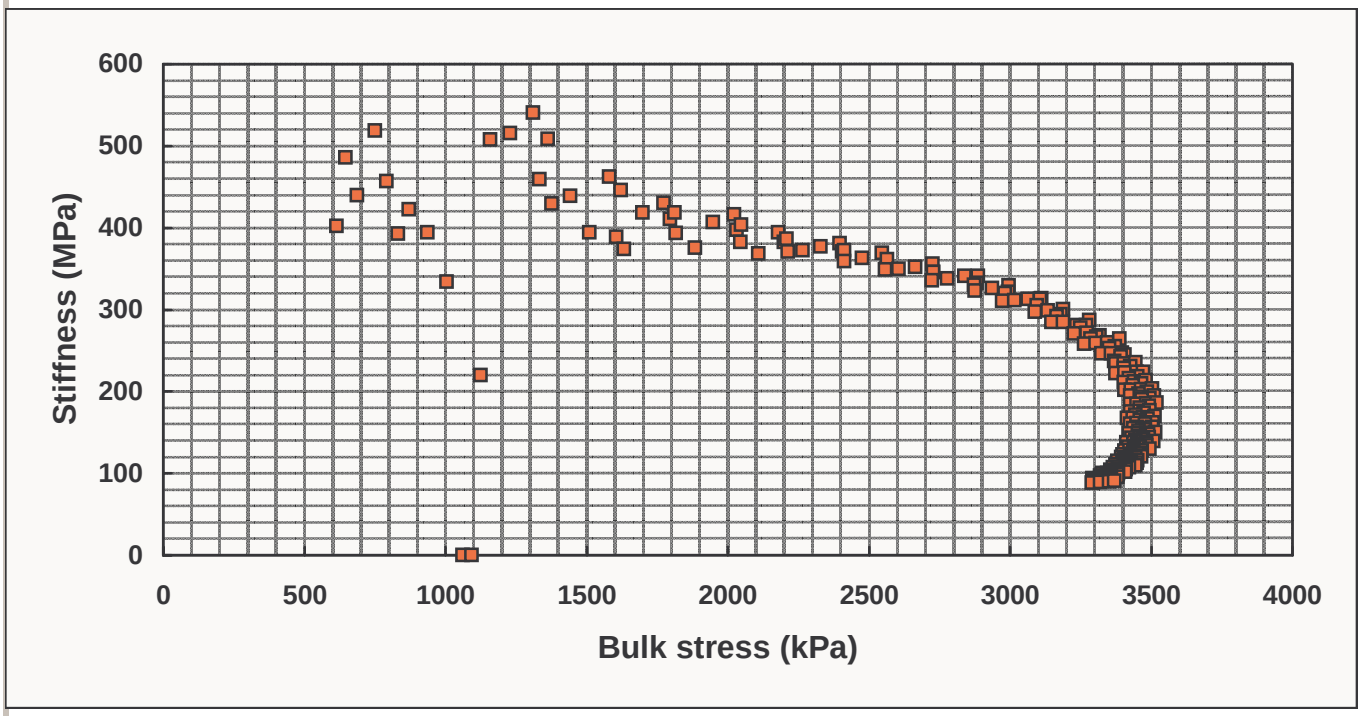




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 1% cement & 3% bitumen
Sample #: HSA16
Dry Density (kg/cub m): 2173
Moisture (%): 2.2
Confining pressure (kPa): 200
Linear stiffness (MPa): 383
Maximum deviator stress (kPa): 2920

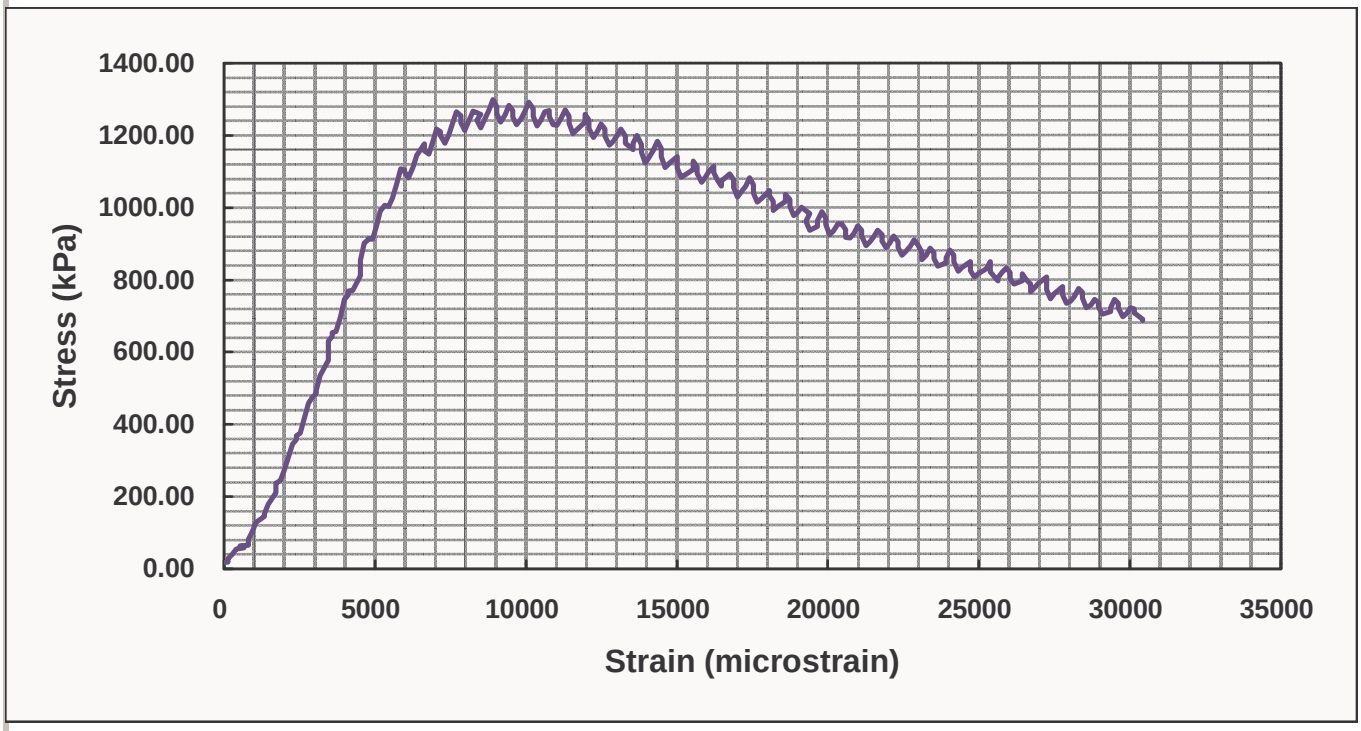


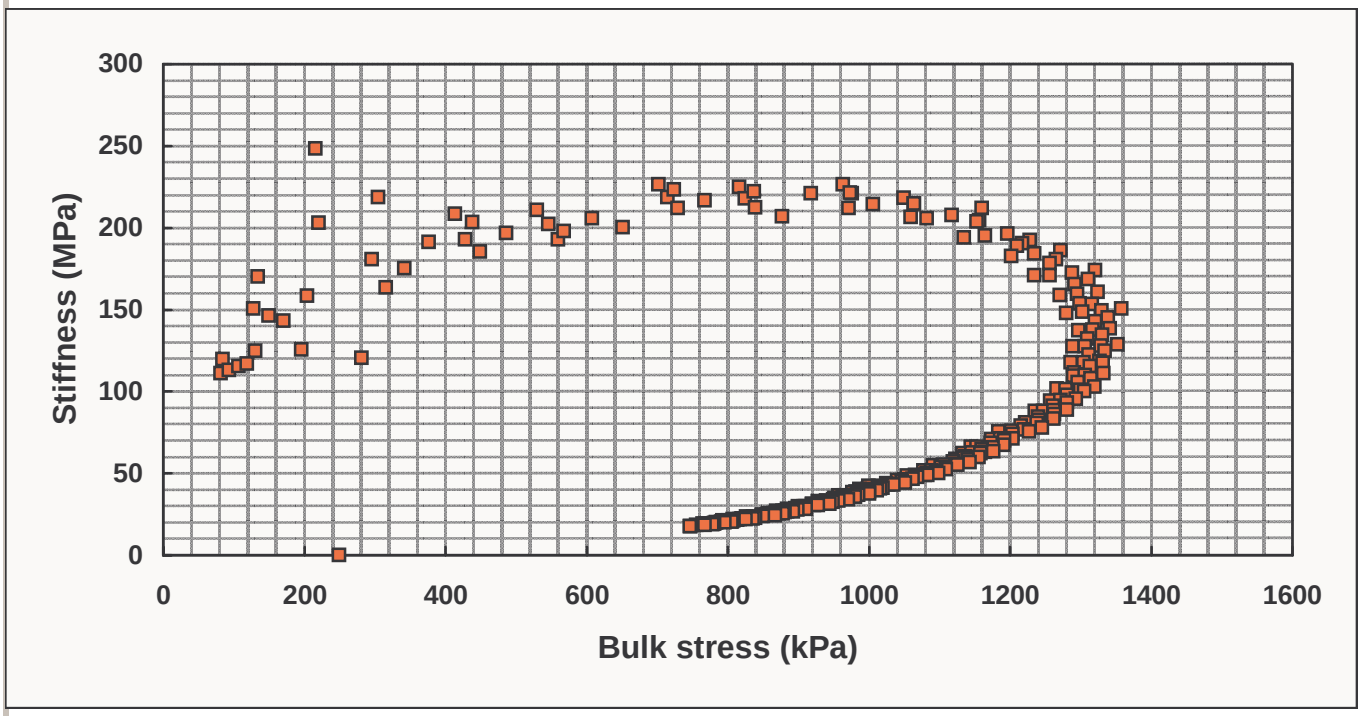


HAS: Treated with 2% Cement and 2.25% Foamed Bitumen

STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS01
Dry Density (kg/cub m): 2030
Confining pressure (kPa): 21
Moisture (%): 5.2
Linear stiffness (MPa): 212
Maximum deviator stress (kPa): 1298

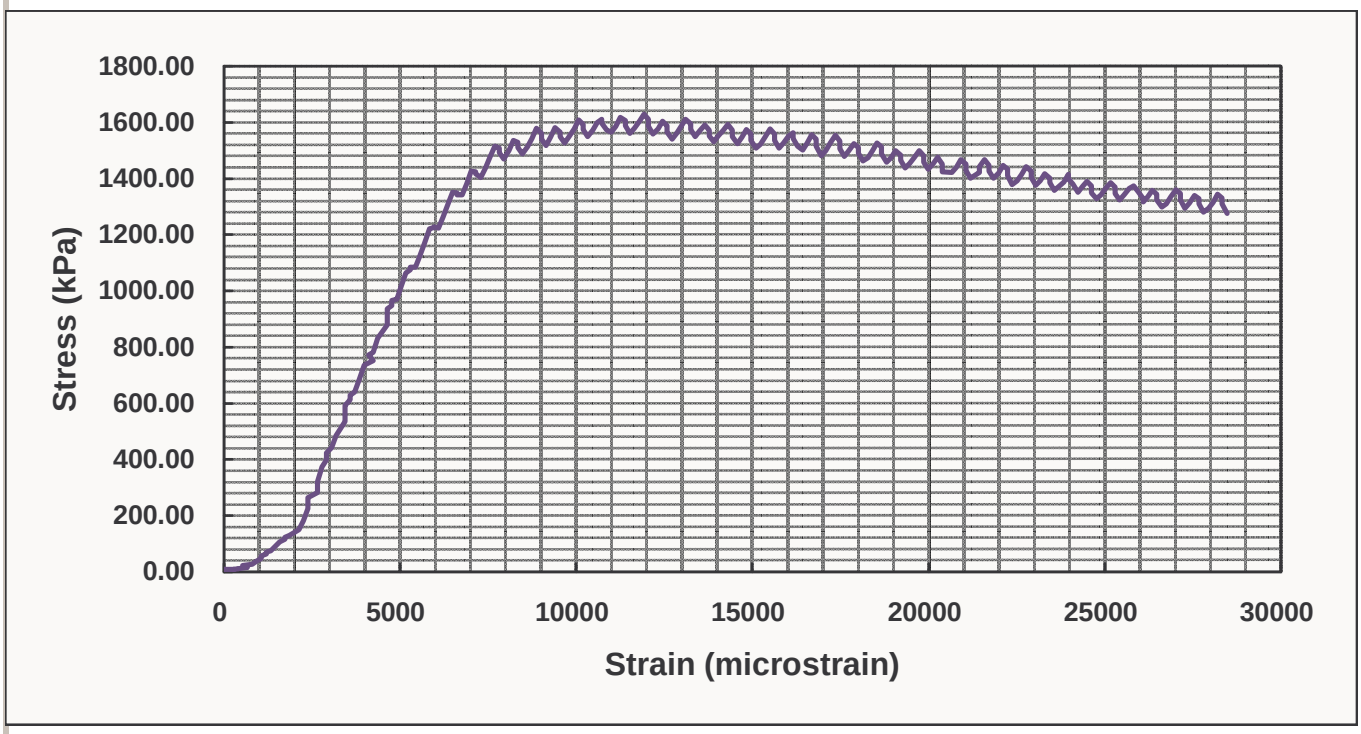


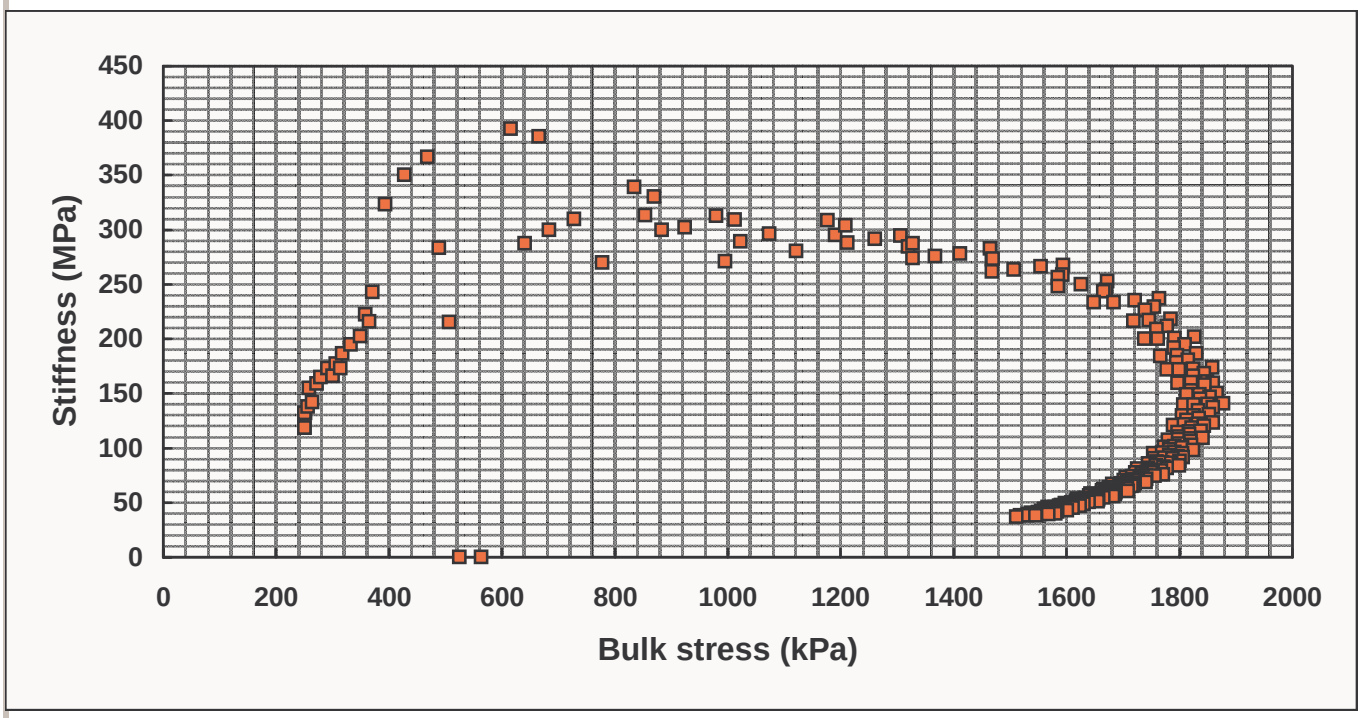


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HAS02
Dry Density (kg/cub m): 2030
Moisture (%): 4.6

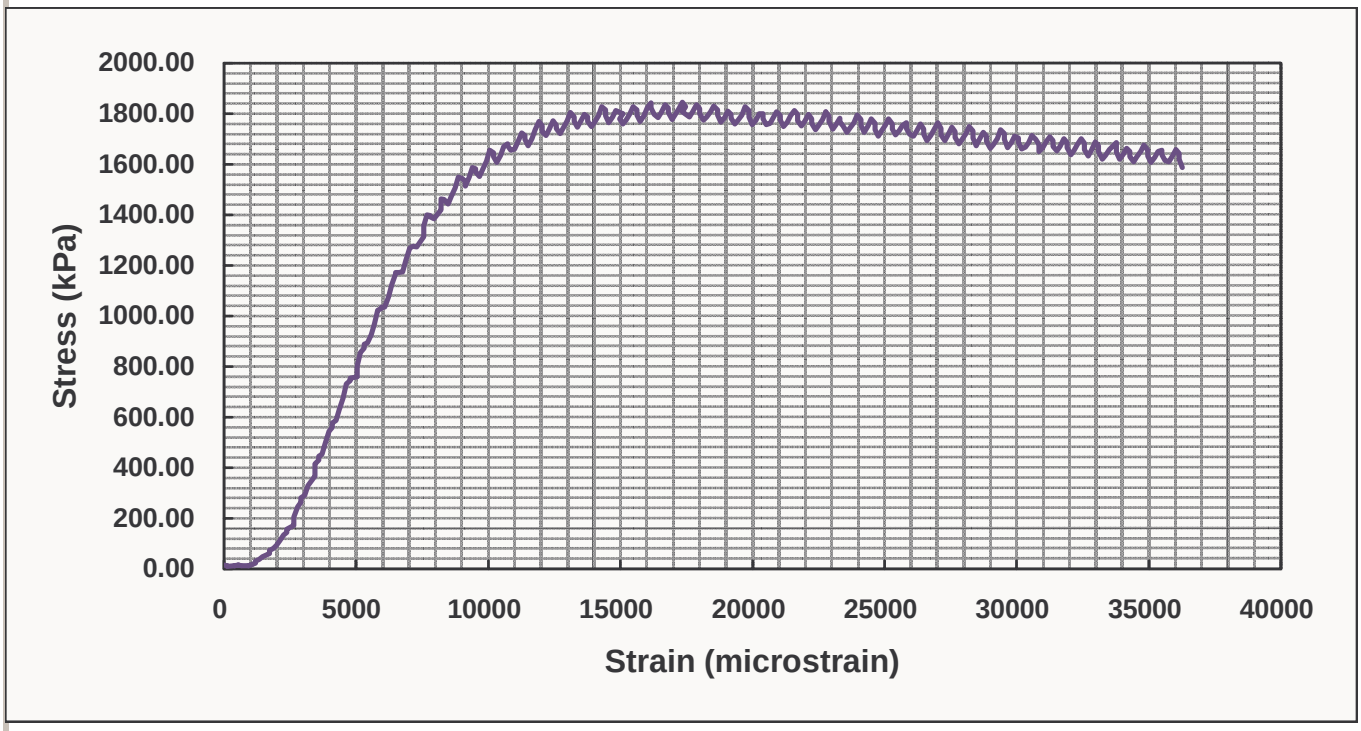
Treatment 2% cement & 2,25% bitumen
Confining pressure (kPa): 81
Linear stiffness (MPa): 288
Maximum deviator stress (kPa): 1629

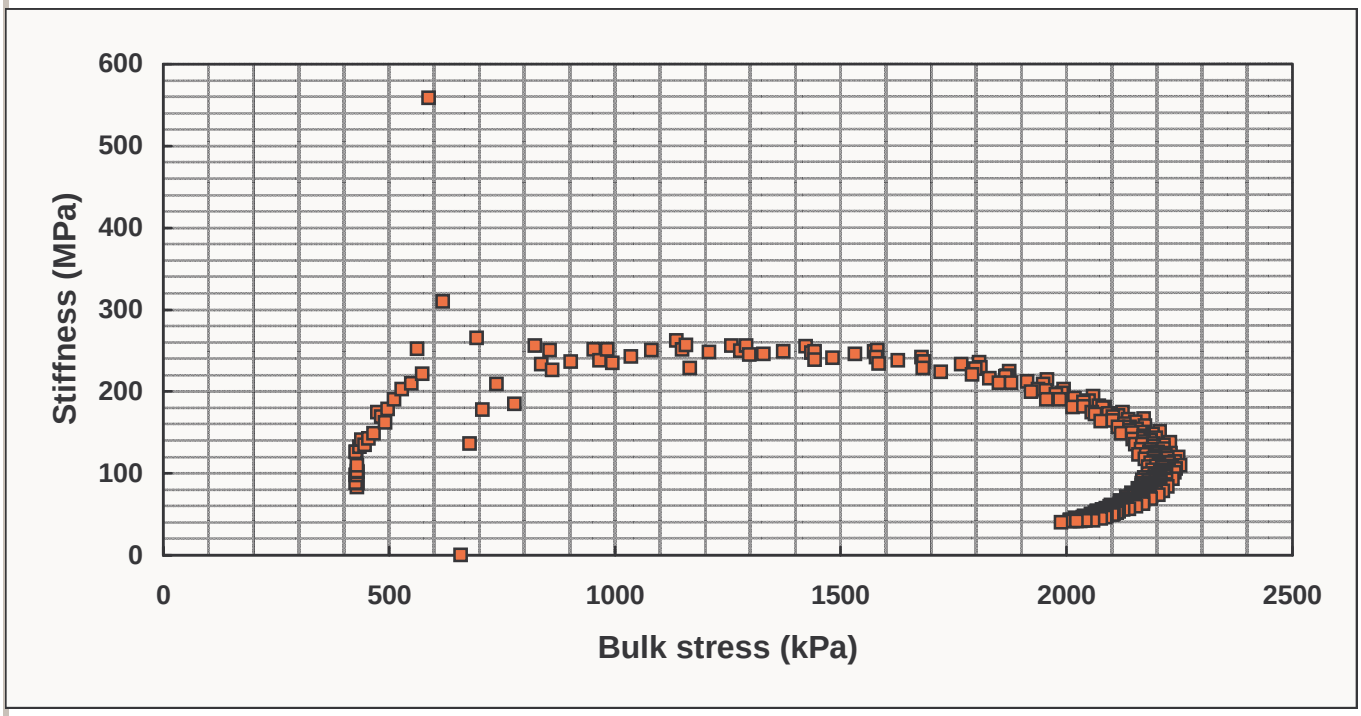




STATIC TRIAXIAL TEST

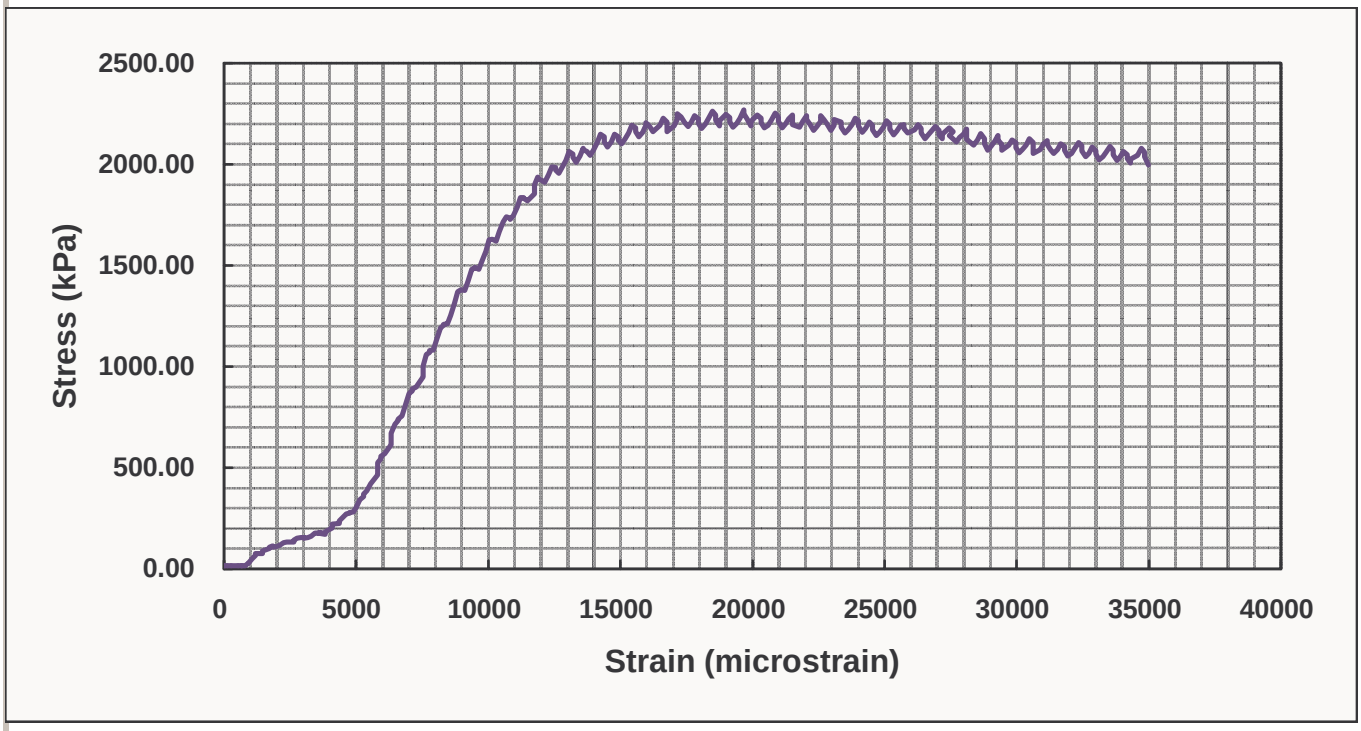
Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS03
Dry Density (kg/cub m): 2030
Confining pressure (kPa): 135
Moisture (%): 4.8
Linear stiffness (MPa): 241
Maximum deviator stress (kPa): 1846

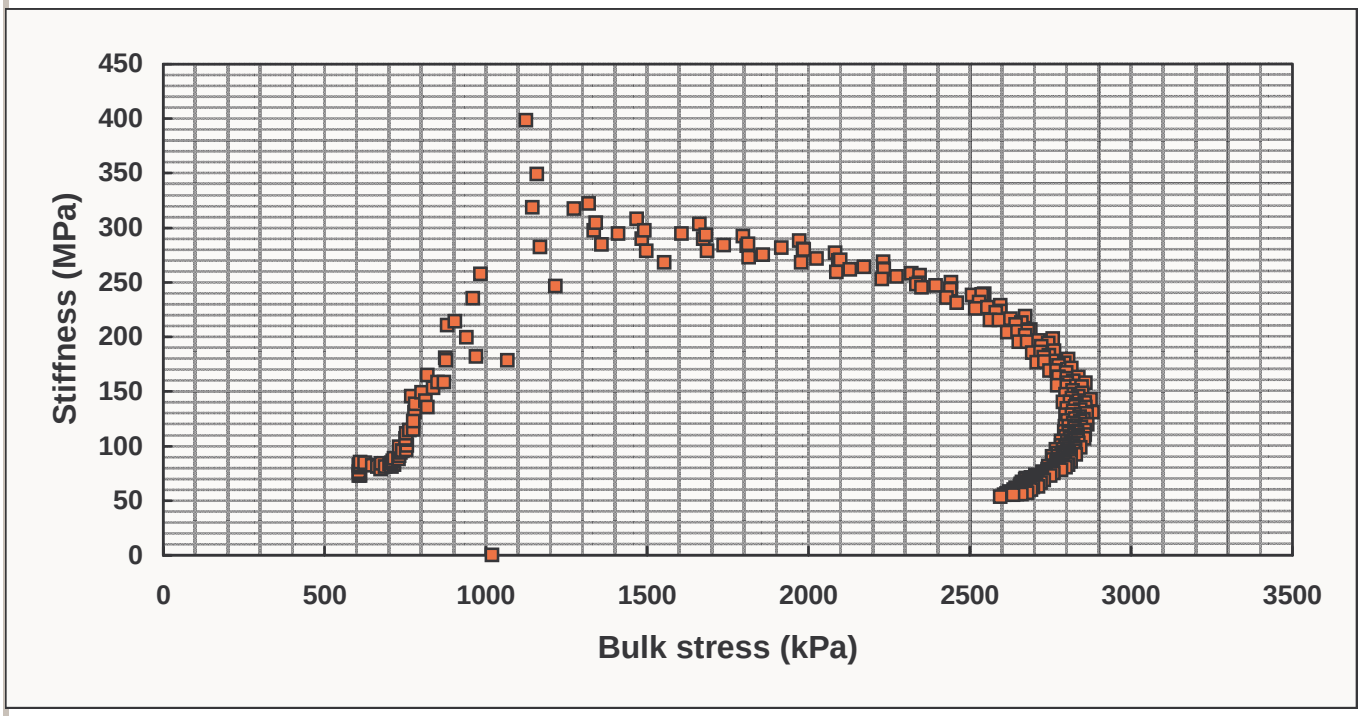




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS04
Dry Density (kg/cub m): 2030
Moisture (%): 5.3
Confining pressure (kPa): 202
Linear stiffness (MPa): 259
Maximum deviator stress (kPa): 2268





STATIC TRIAXIAL TEST

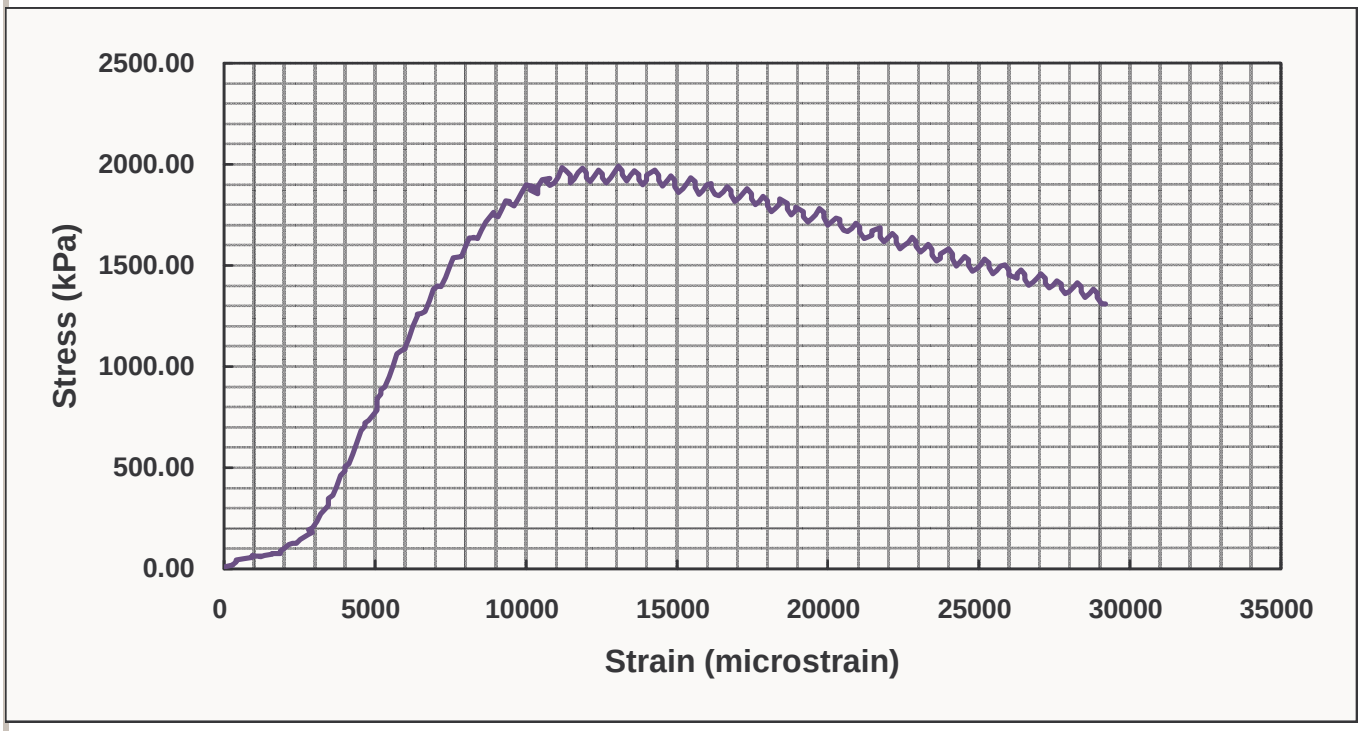
Material: Hornfels — **Treatment** **2% cement & 2,25% bitumen**

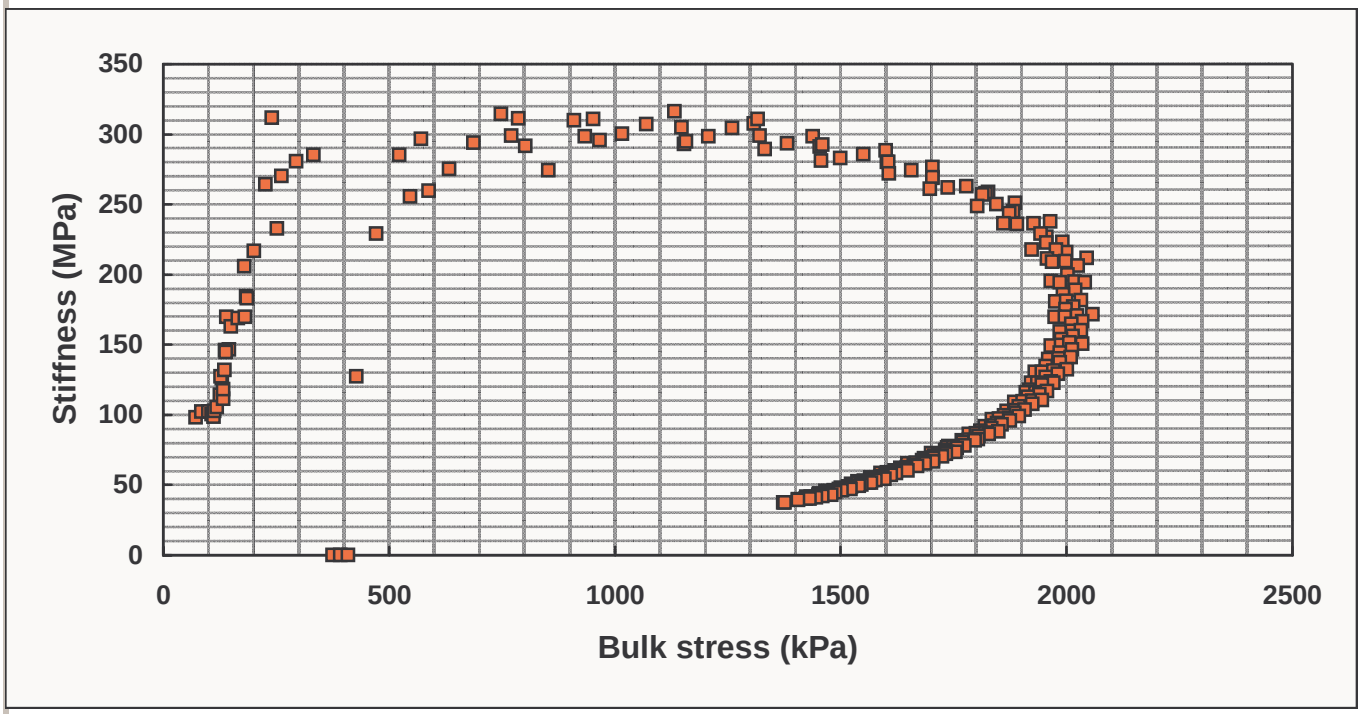
Sample #: HAS05

Dry Density (kg/cub m): 2030 — **Confining pressure (kPa): 22**

Moisture (%): 2.2 — **Linear stiffness (MPa): 289**

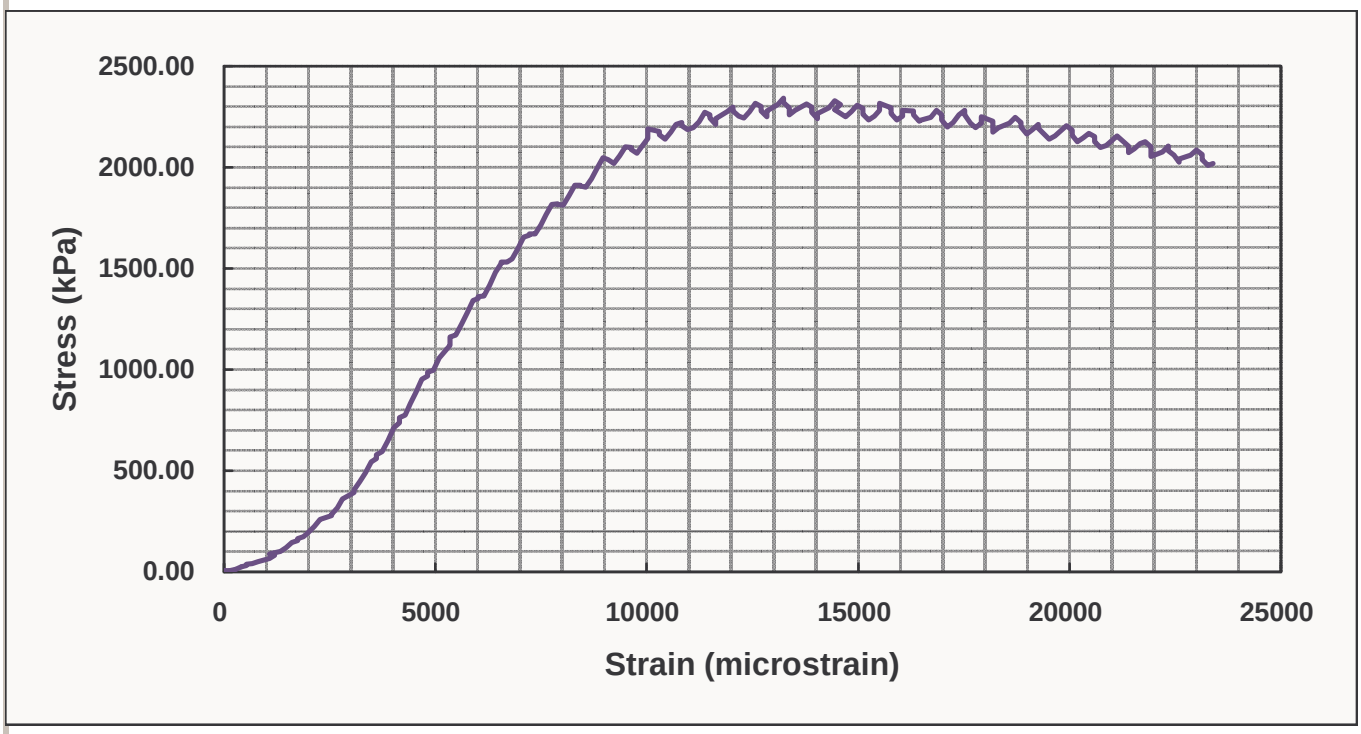
Maximum deviator stress (kPa): 1992

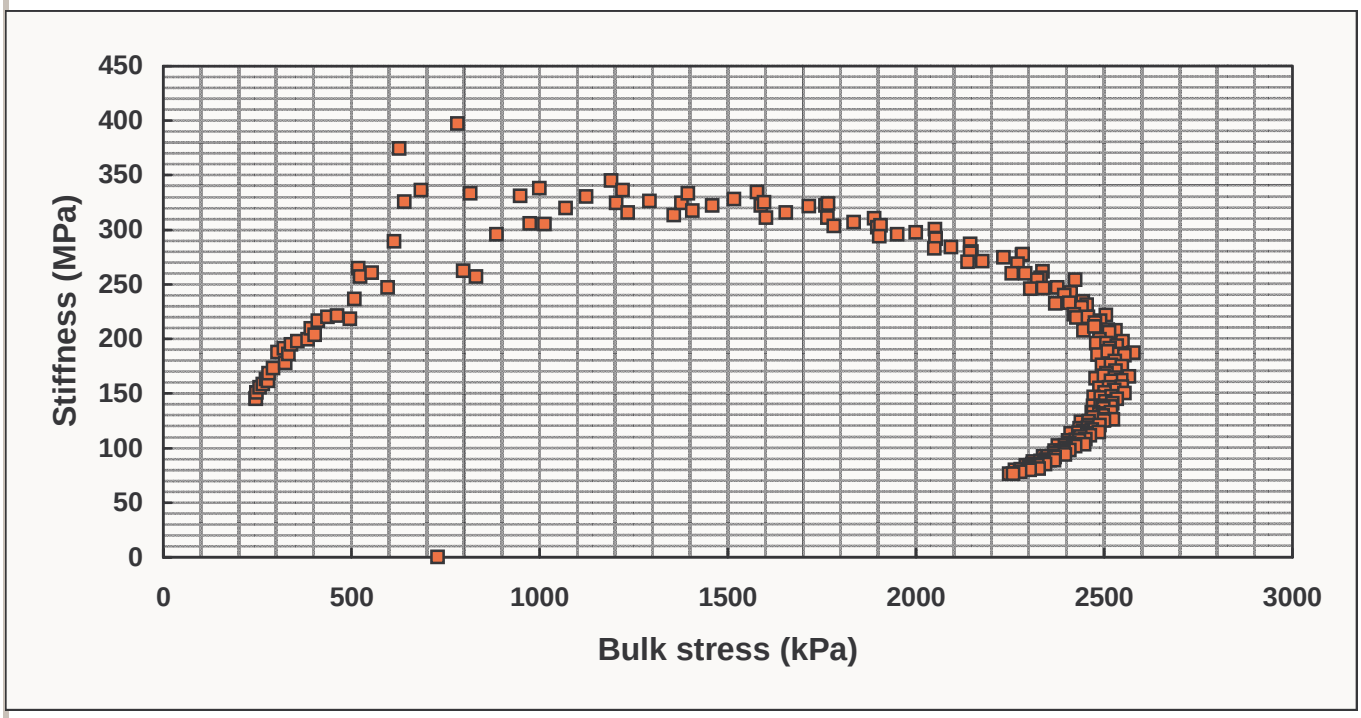




STATIC TRIAXIAL TEST

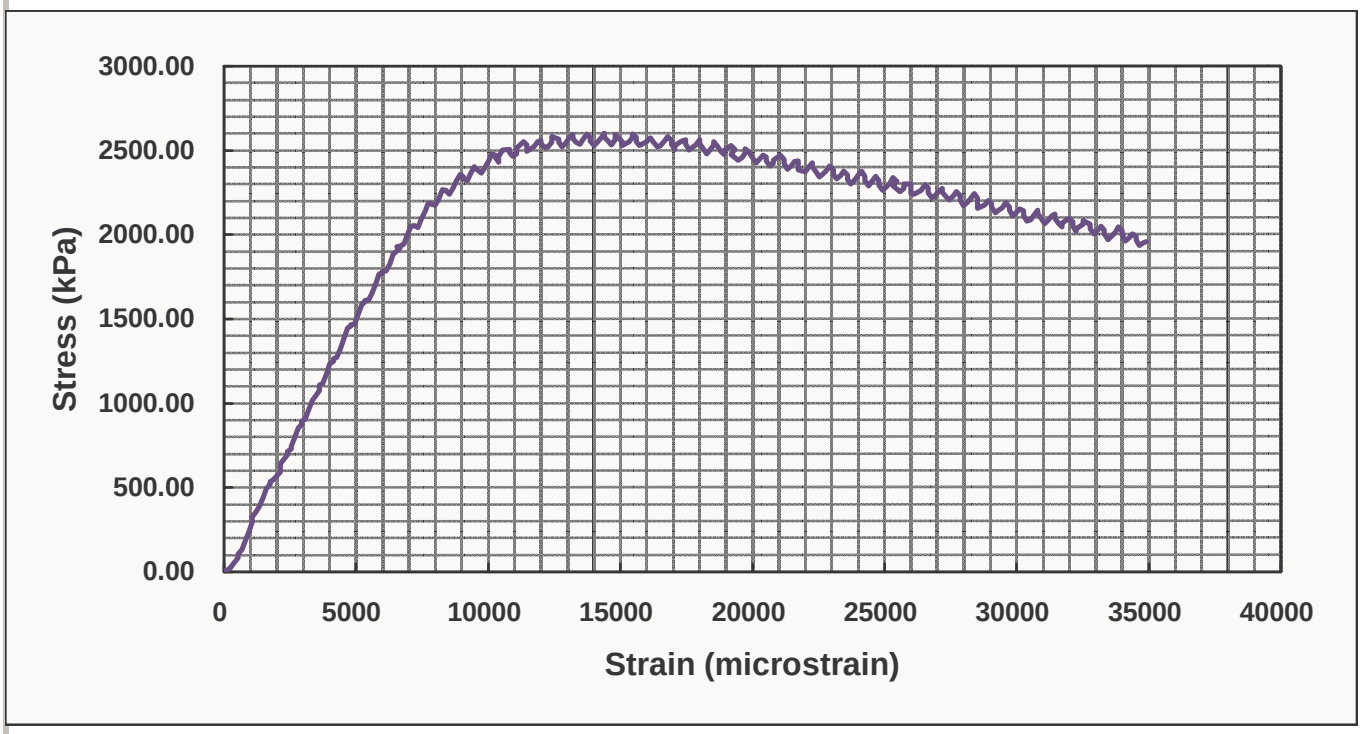
Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS06
Dry Density (kg/cub m): 2030
Confining pressure (kPa): 79
Moisture (%): 2.3
Linear stiffness (MPa): 322
Maximum deviator stress (kPa): 2341

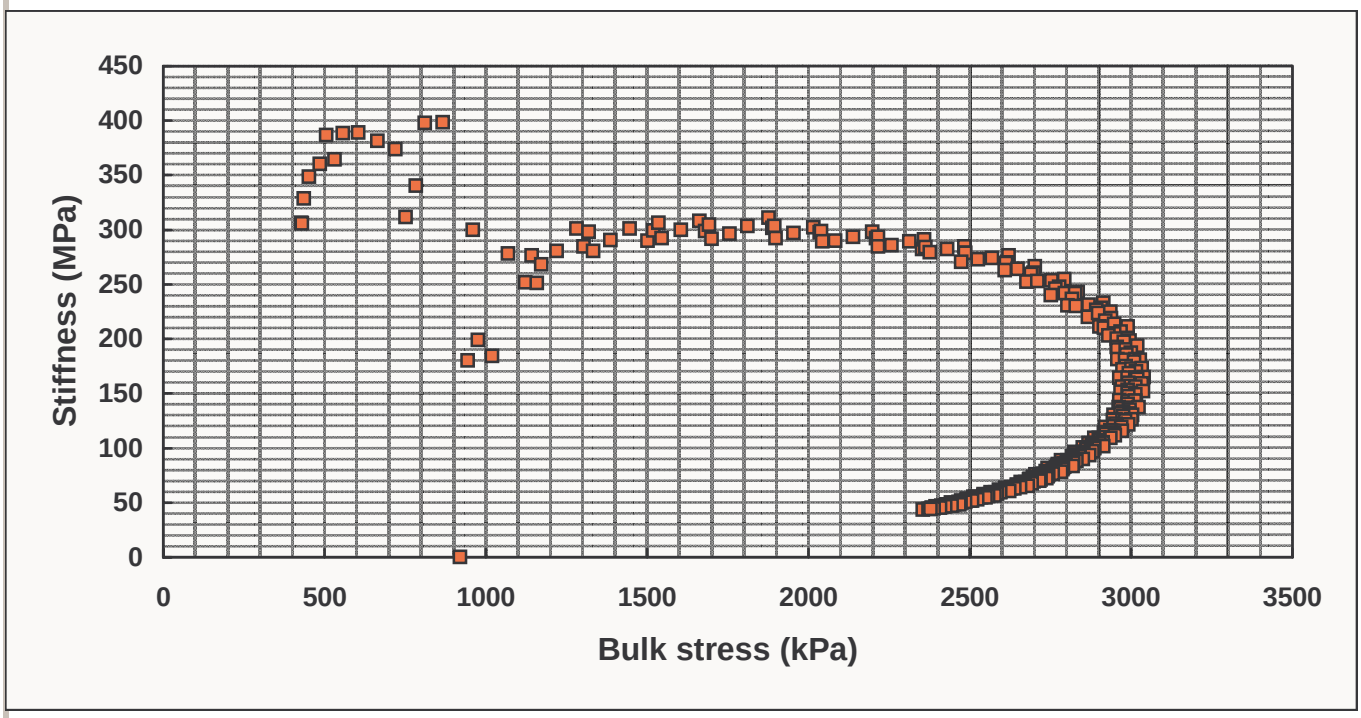




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS07
Dry Density (kg/cub m): 2030
Confining pressure (kPa): 145
Moisture (%): 2.2
Linear stiffness (MPa): 289
Maximum deviator stress (kPa): 2601





STATIC TRIAXIAL TEST

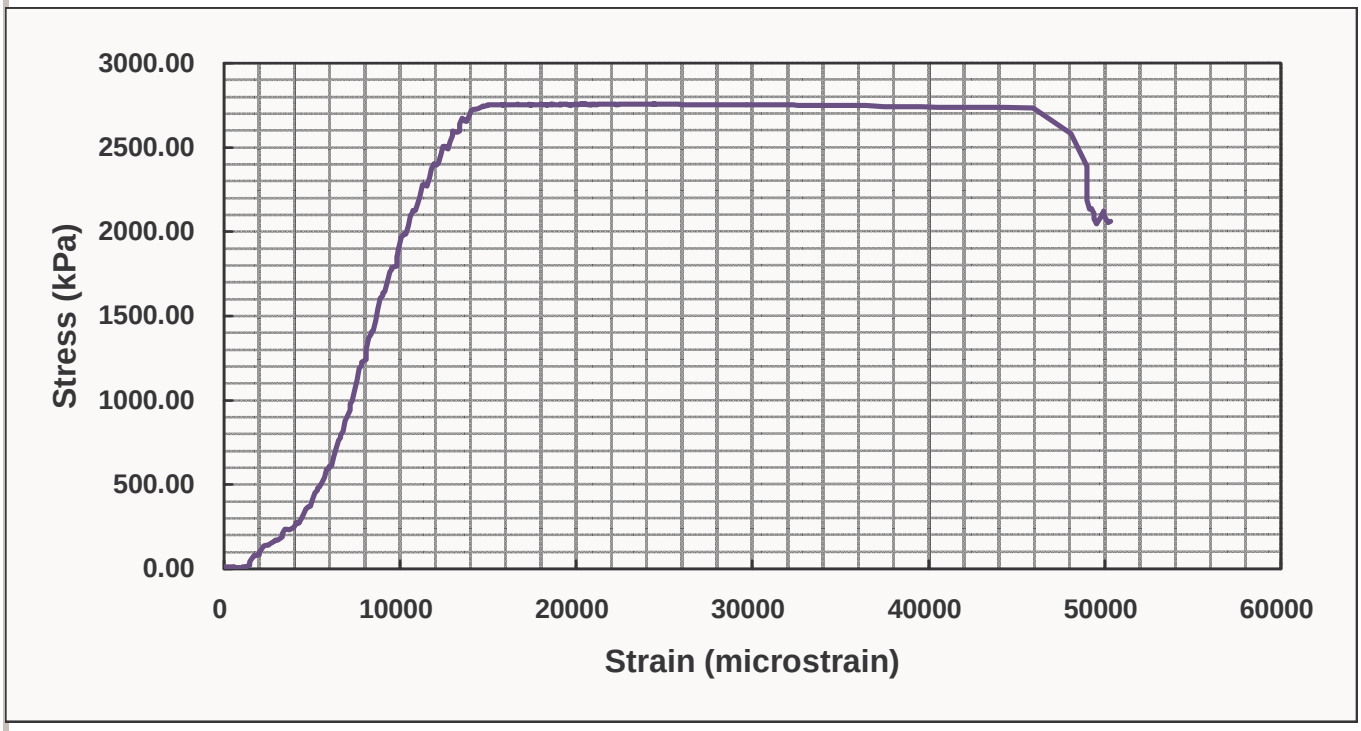
Material: Hornfels — **Treatment** **2% cement & 2,25% bitumen**

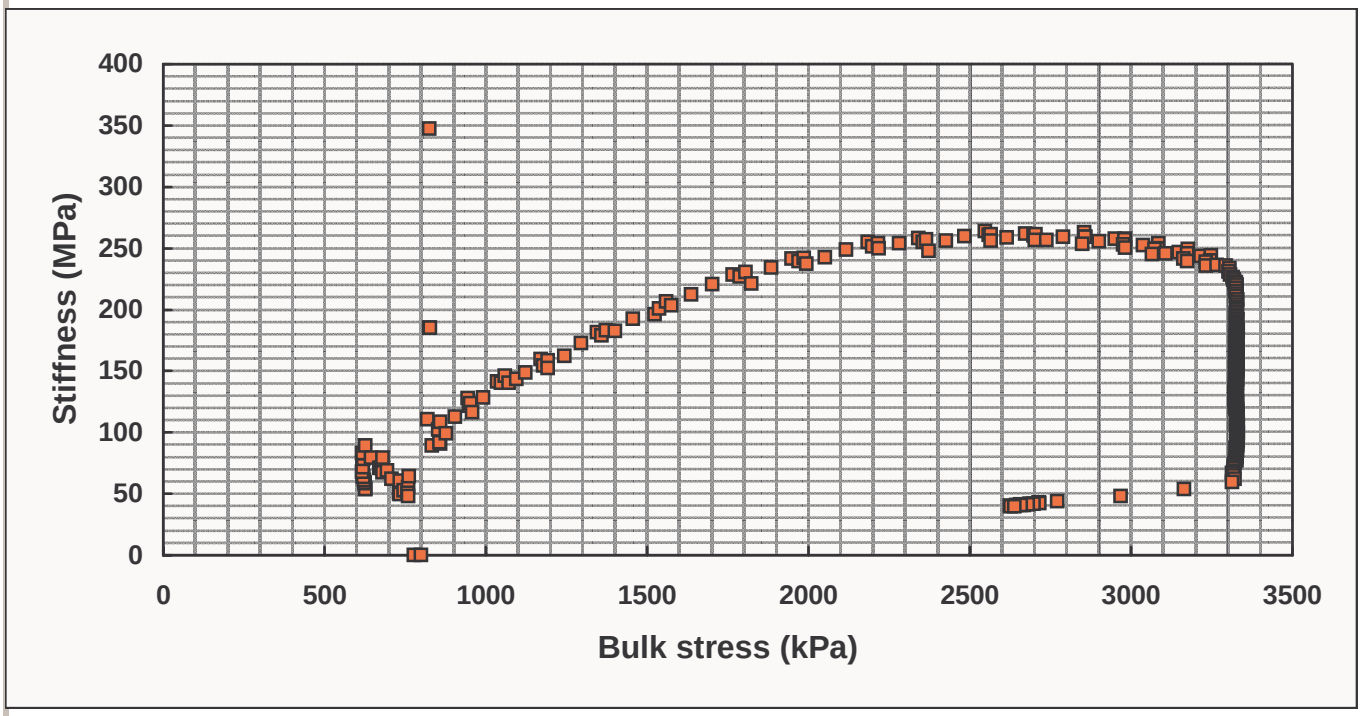
Sample #: HAS08

Dry Density (kg/cub m): 2030 — **Confining pressure (kPa): 192**

Moisture (%): 2.0 — **Linear stiffness (MPa): 242**

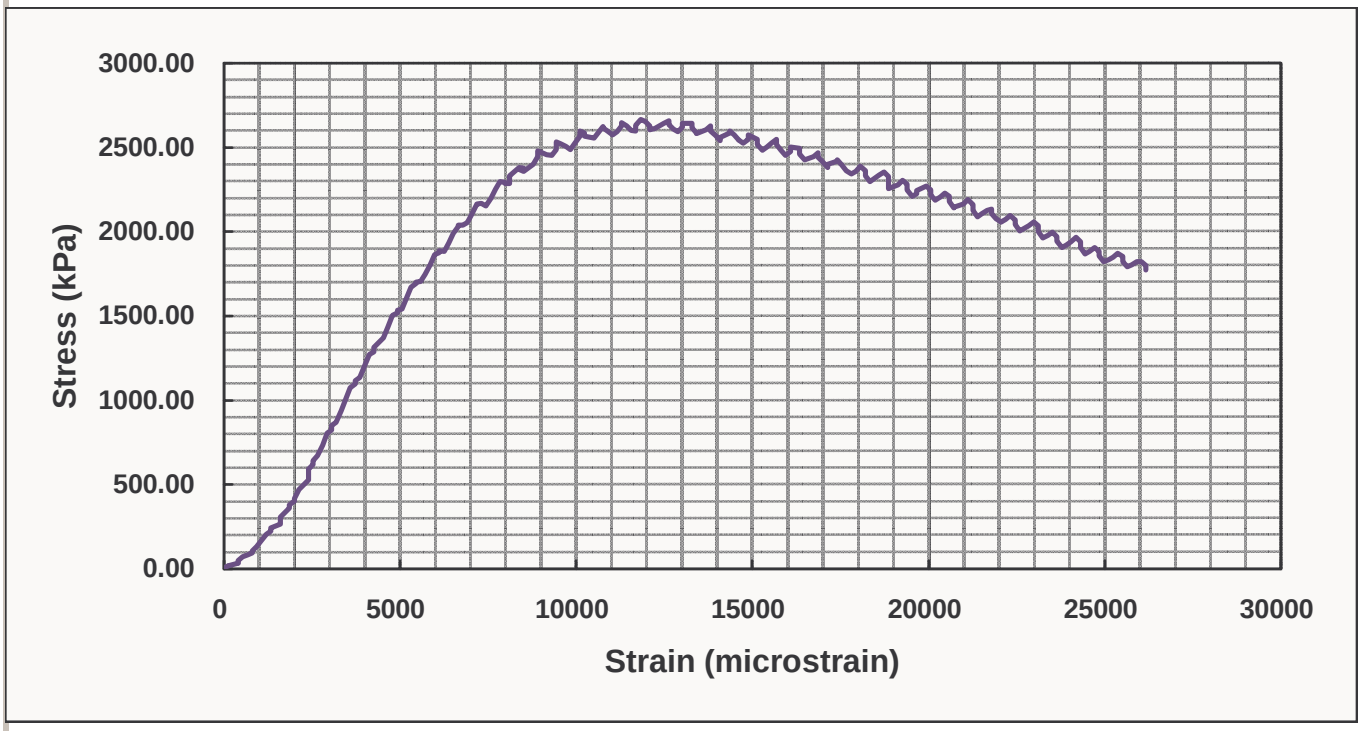
Maximum deviator stress (kPa): 2757

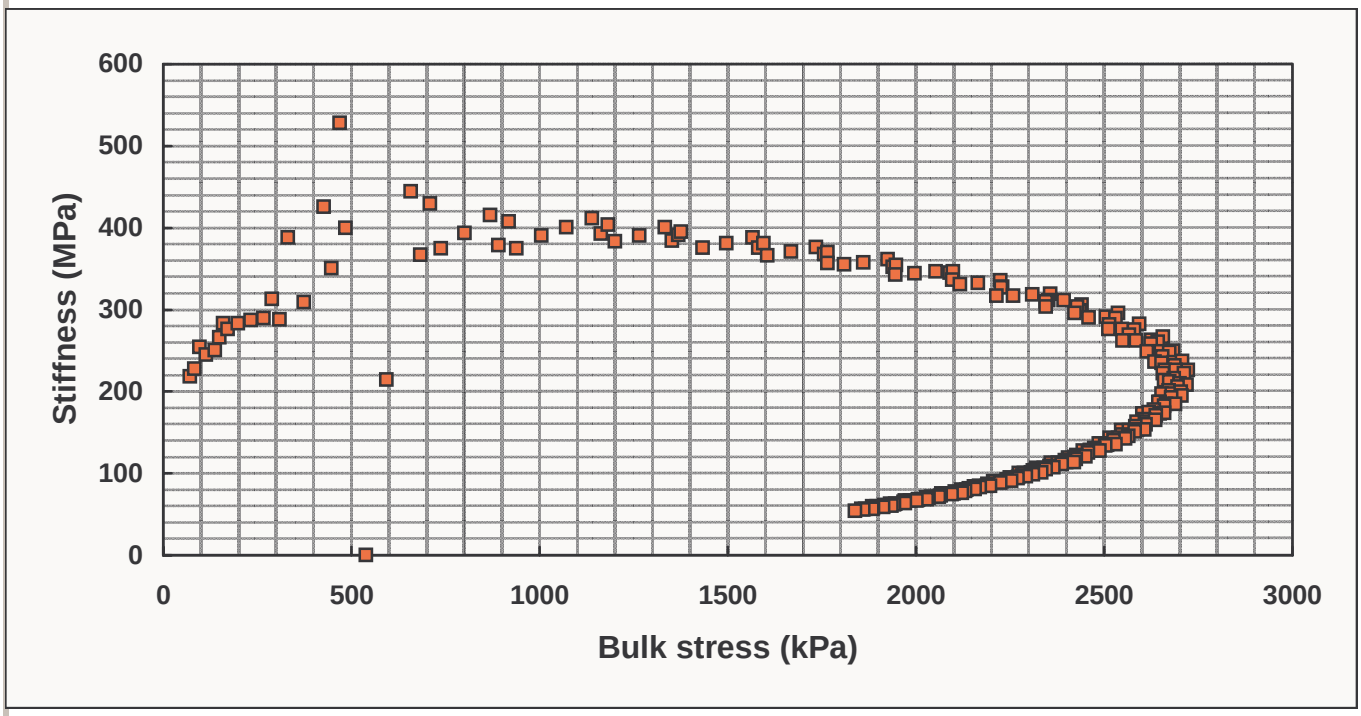




STATIC TRIAXIAL TEST

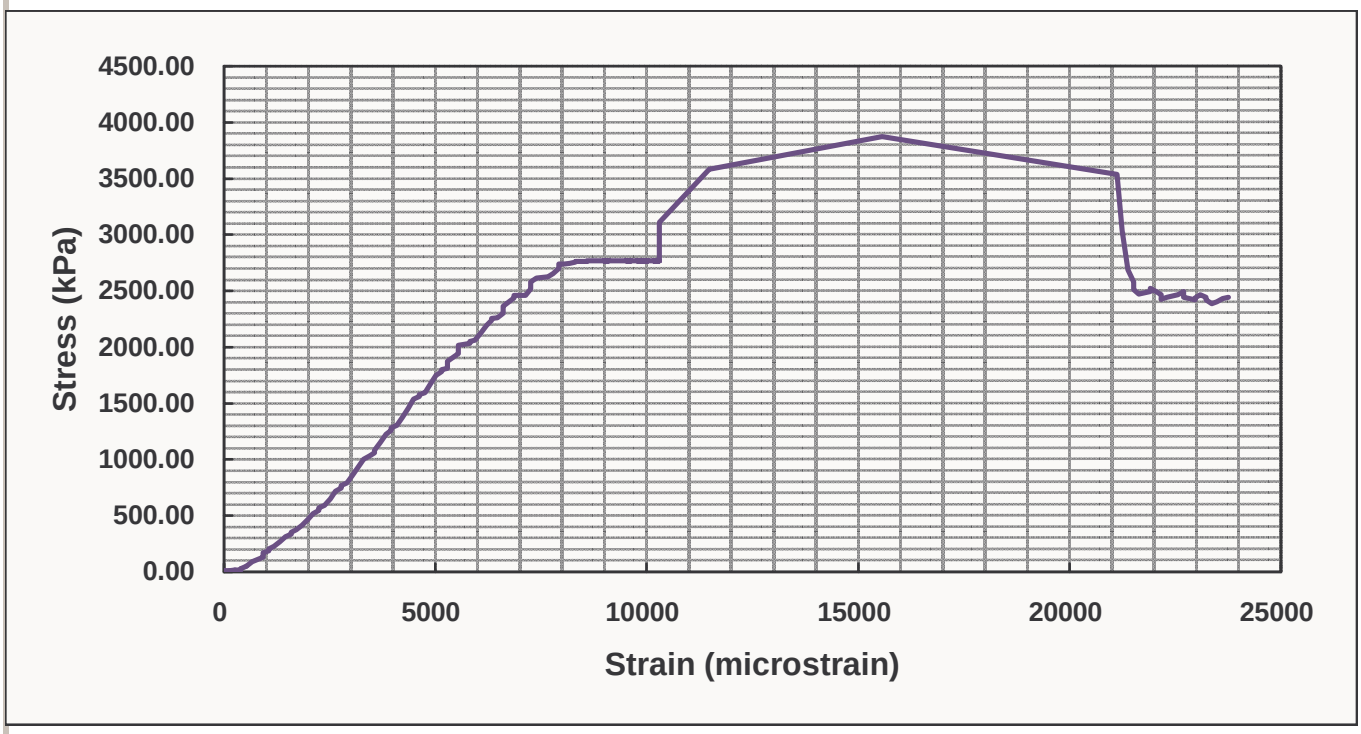
Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS09
Dry Density (kg/cub m): 2190
Confining pressure (kPa): 21
Moisture (%): 3.1
Linear stiffness (MPa): 355
Maximum deviator stress (kPa): 2664

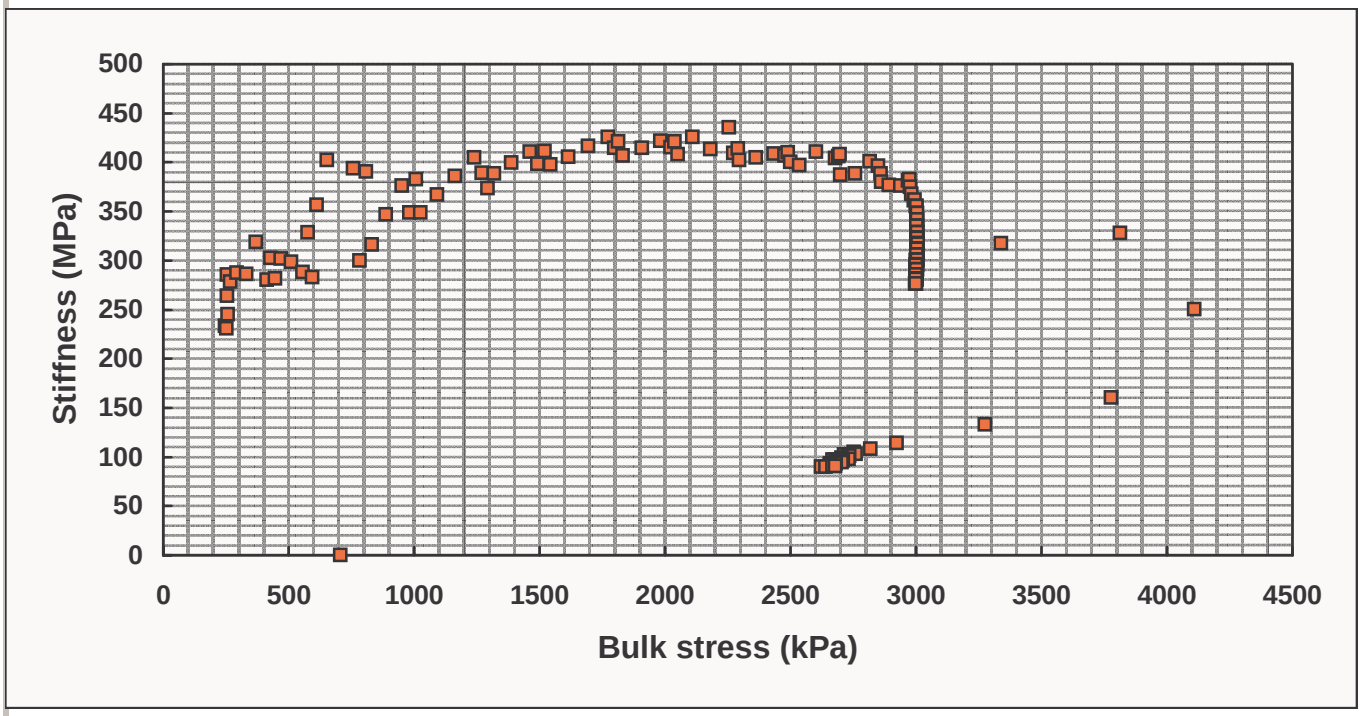




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS10
Dry Density (kg/cub m): 2190
Confining pressure (kPa): 79
Moisture (%): 2.9
Linear stiffness (MPa): 400
Maximum deviator stress (kPa): 3873

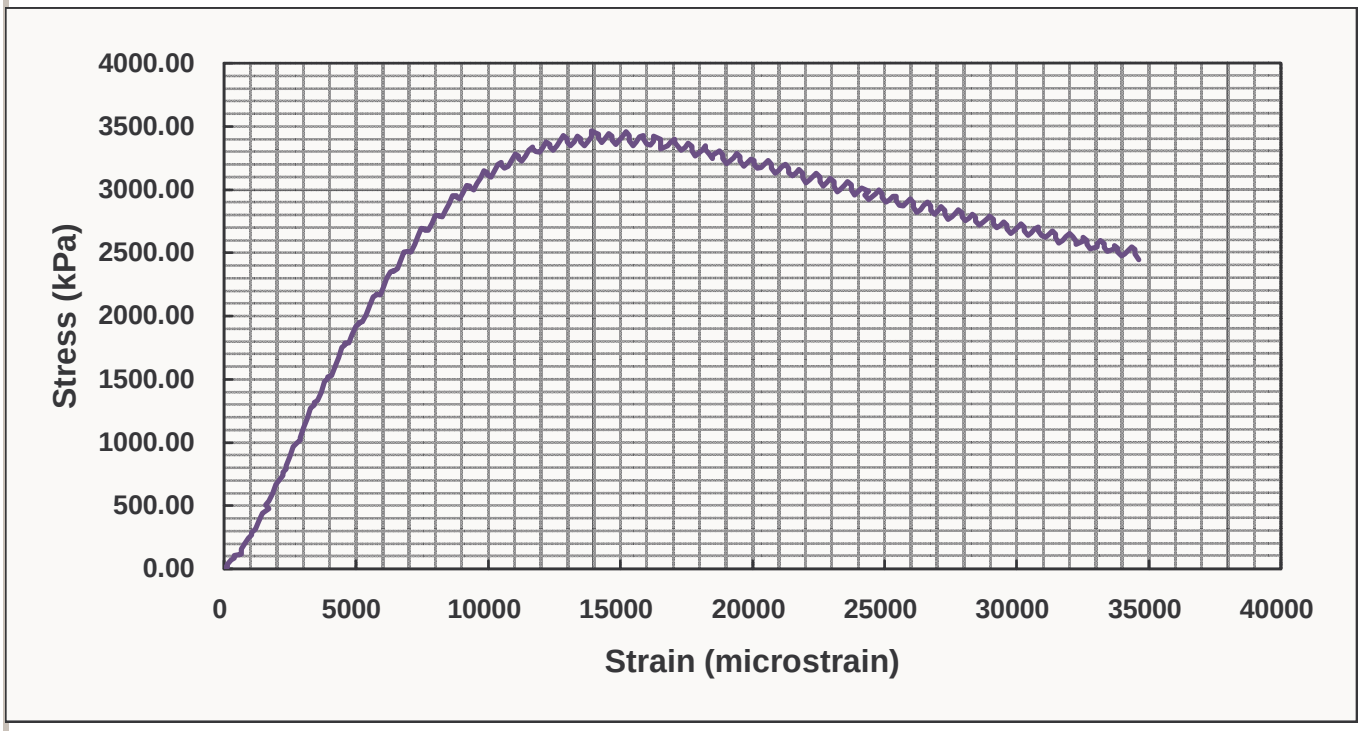


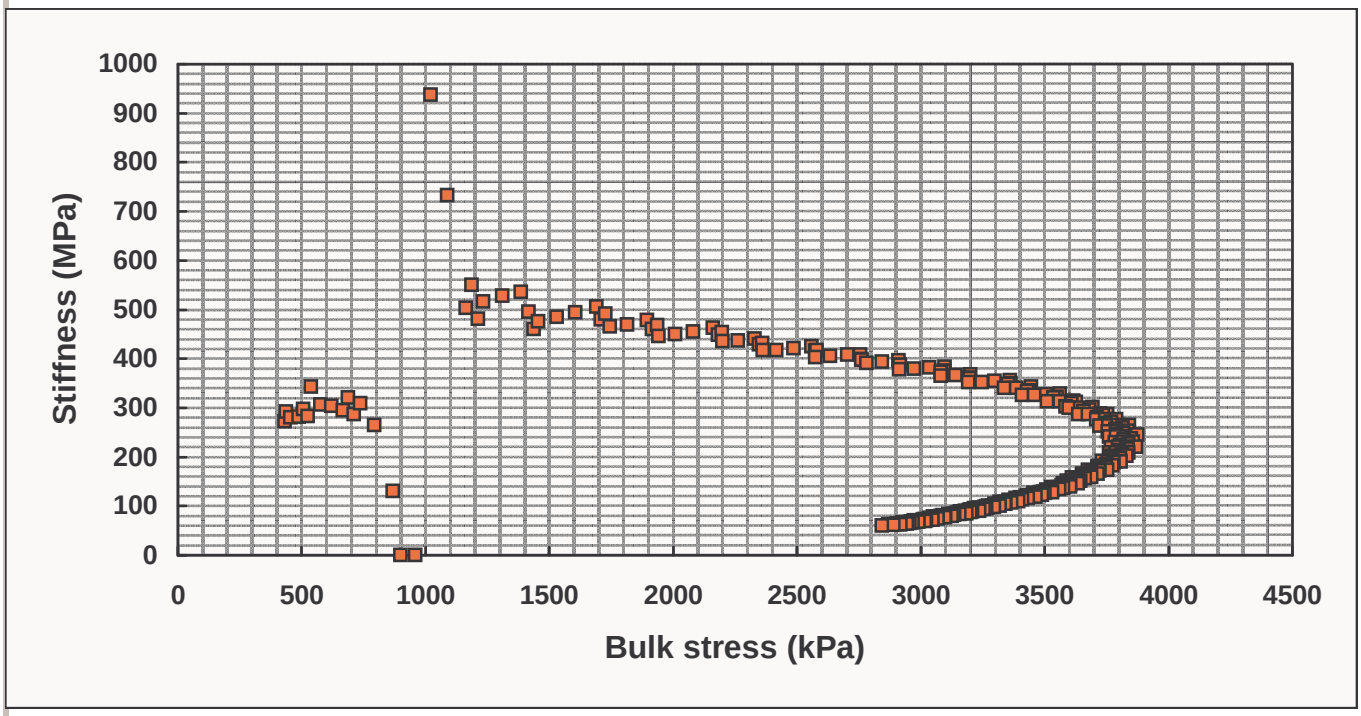


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HAS11
Dry Density (kg/cub m): 2190
Moisture (%): 2.9

Treatment 2% cement & 2,25% bitumen
Confining pressure (kPa): 135
Linear stiffness (MPa): 394
Maximum deviator stress (kPa): 3462

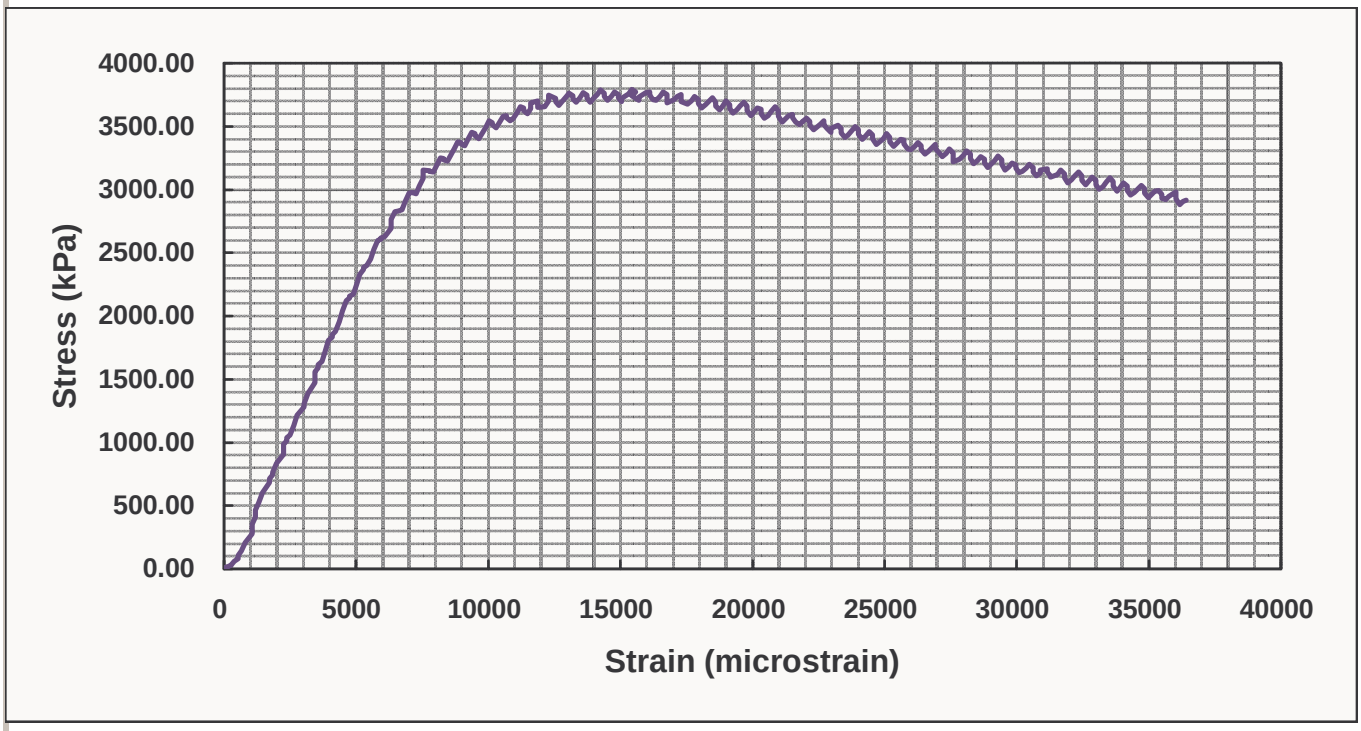


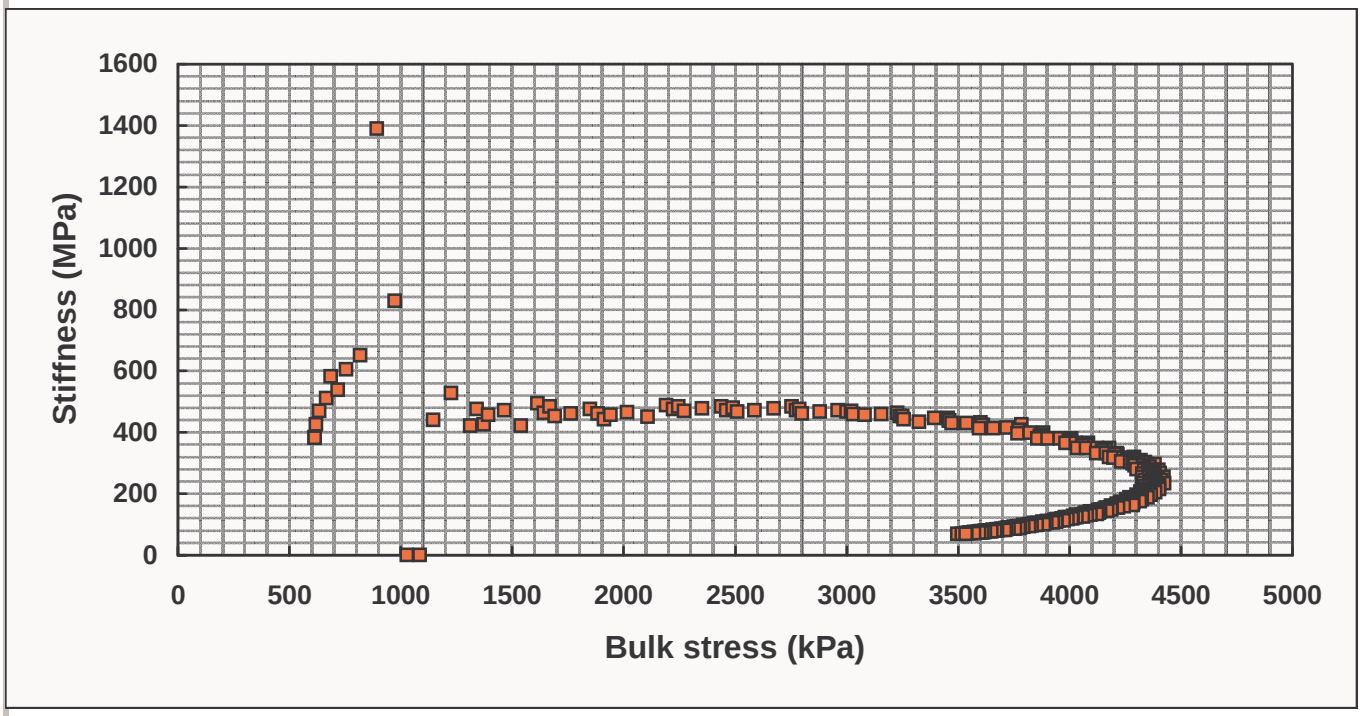


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HAS12
Dry Density (kg/cub m): 2190
Moisture (%): 3.1

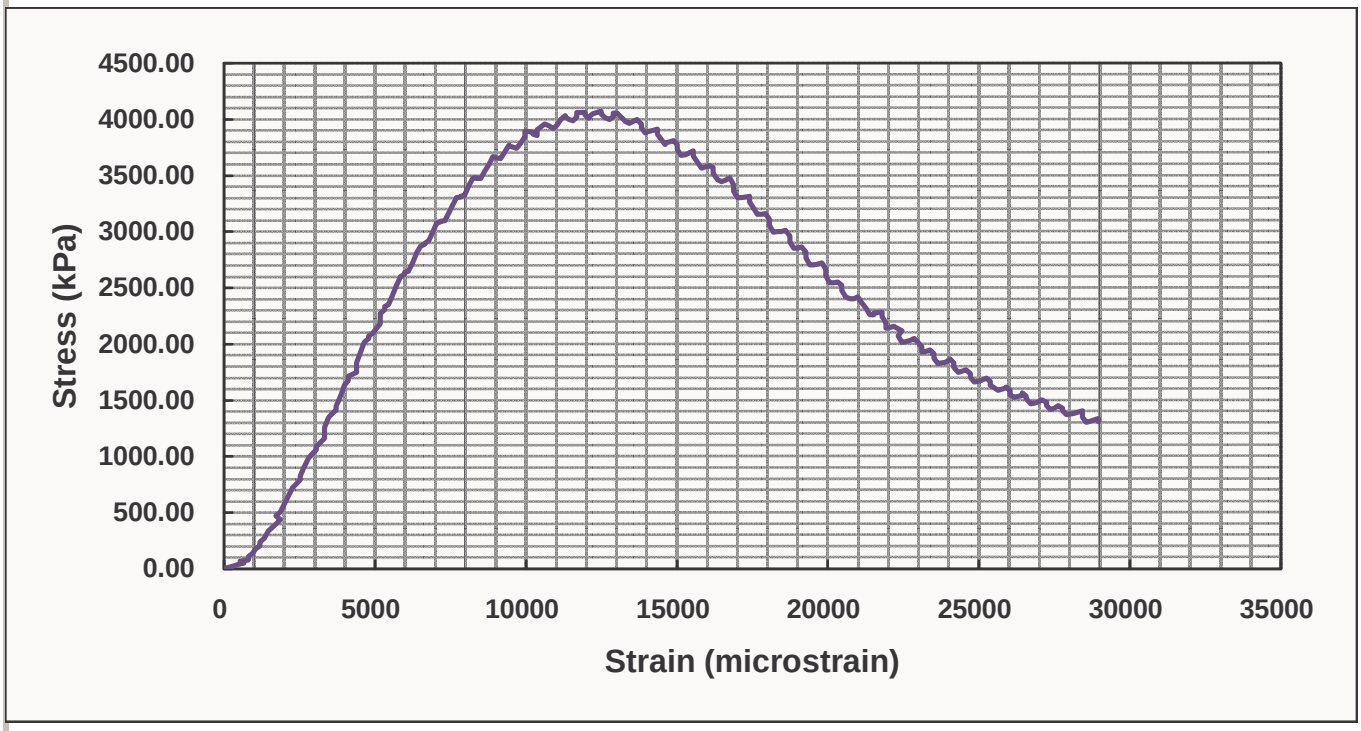
Treatment 2% cement & 2,25% bitumen
Confining pressure (kPa): 208
Linear stiffness (MPa): 457
Maximum deviator stress (kPa): 3792

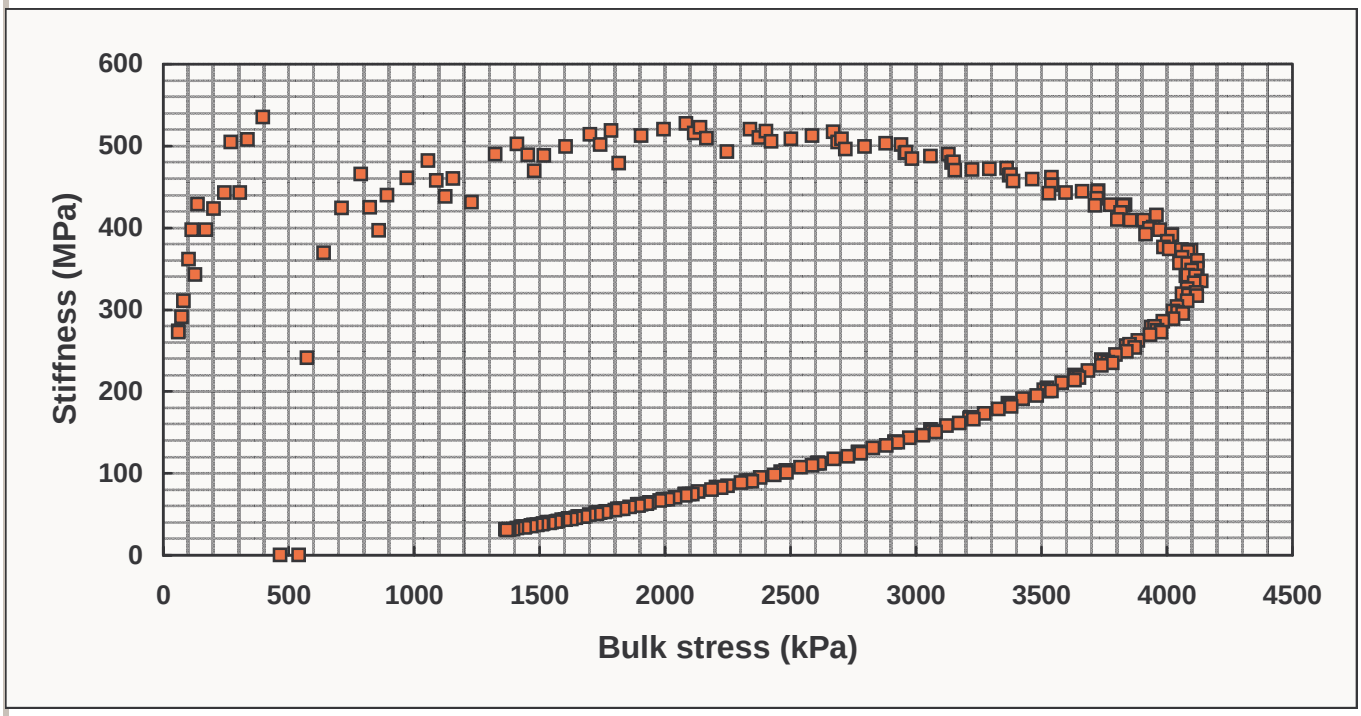




STATIC TRIAXIAL TEST

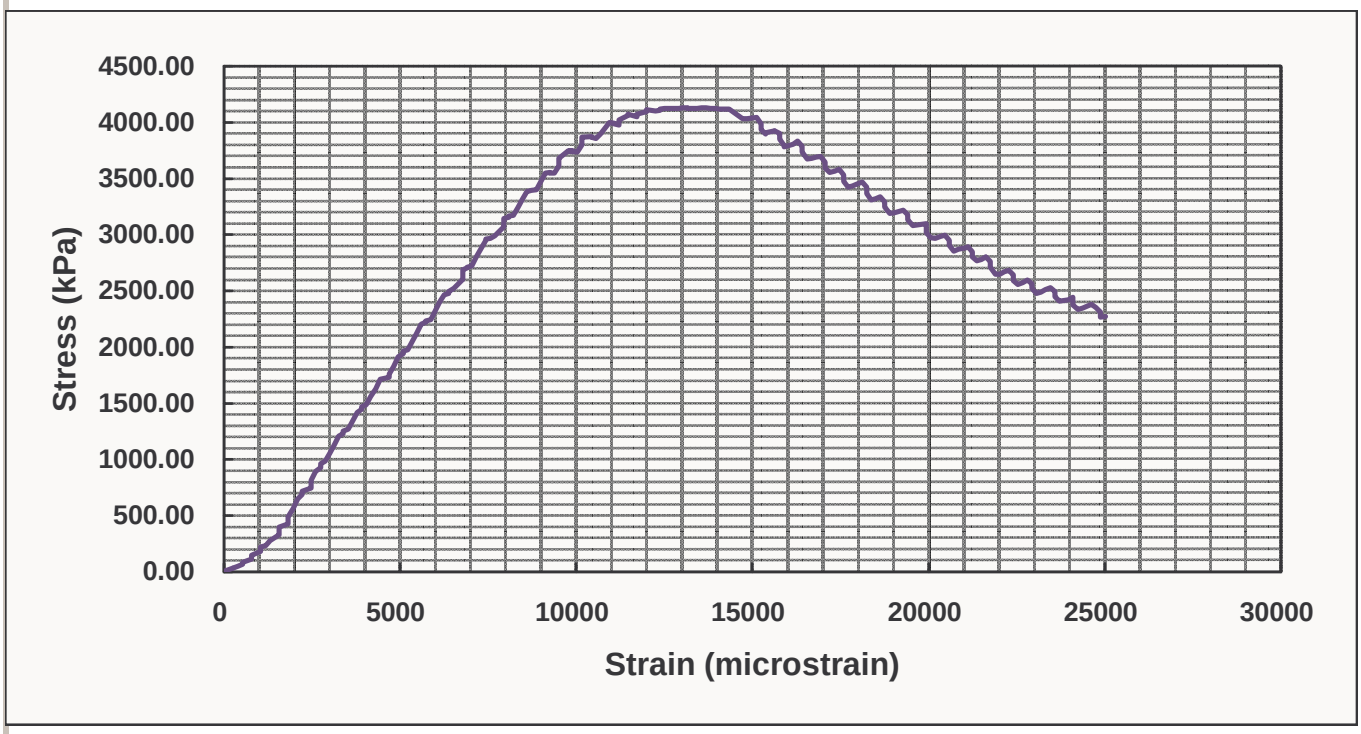
Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS13
Dry Density (kg/cub m): 2190
Confining pressure (kPa): 21
Moisture (%): 2.2
Linear stiffness (MPa): 508
Maximum deviator stress (kPa): 4076

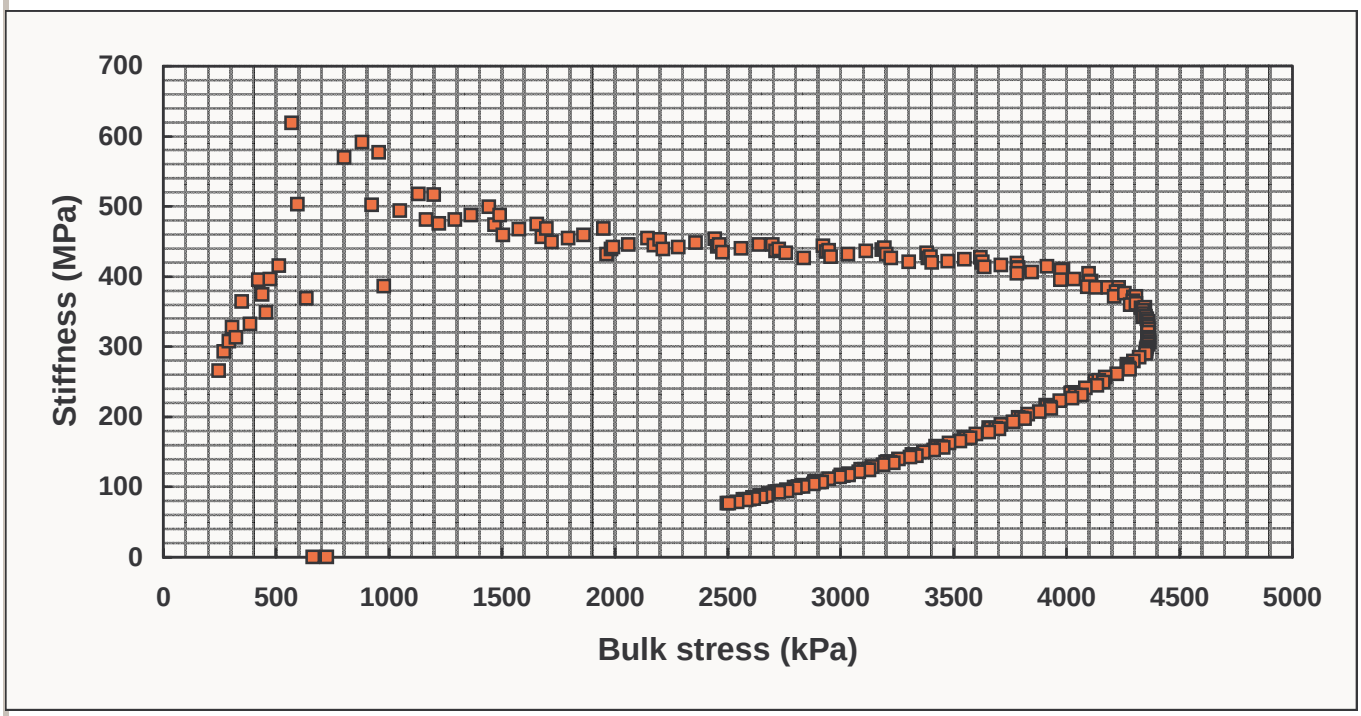




STATIC TRIAXIAL TEST

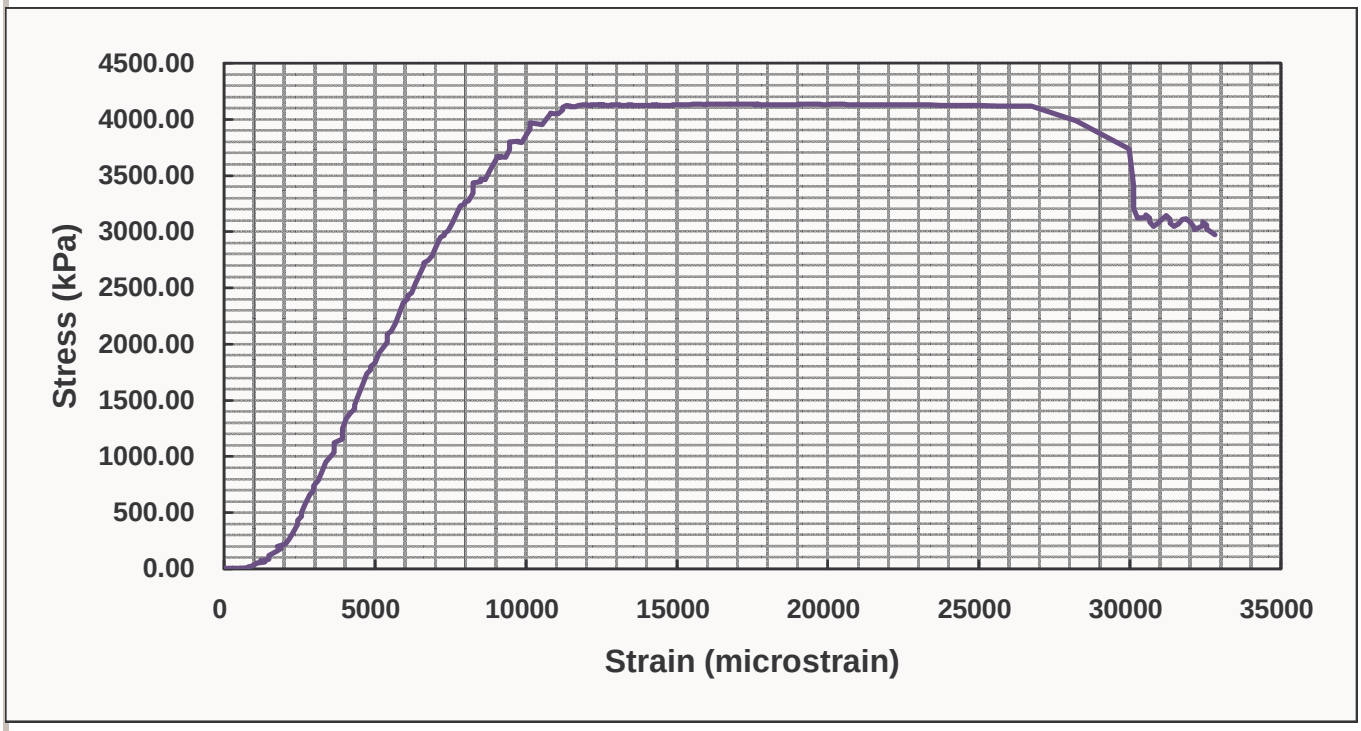
Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS14
Dry Density (kg/cub m): 2190
Confining pressure (kPa): 78
Moisture (%): 1.9
Linear stiffness (MPa): 428
Maximum deviator stress (kPa): 4131

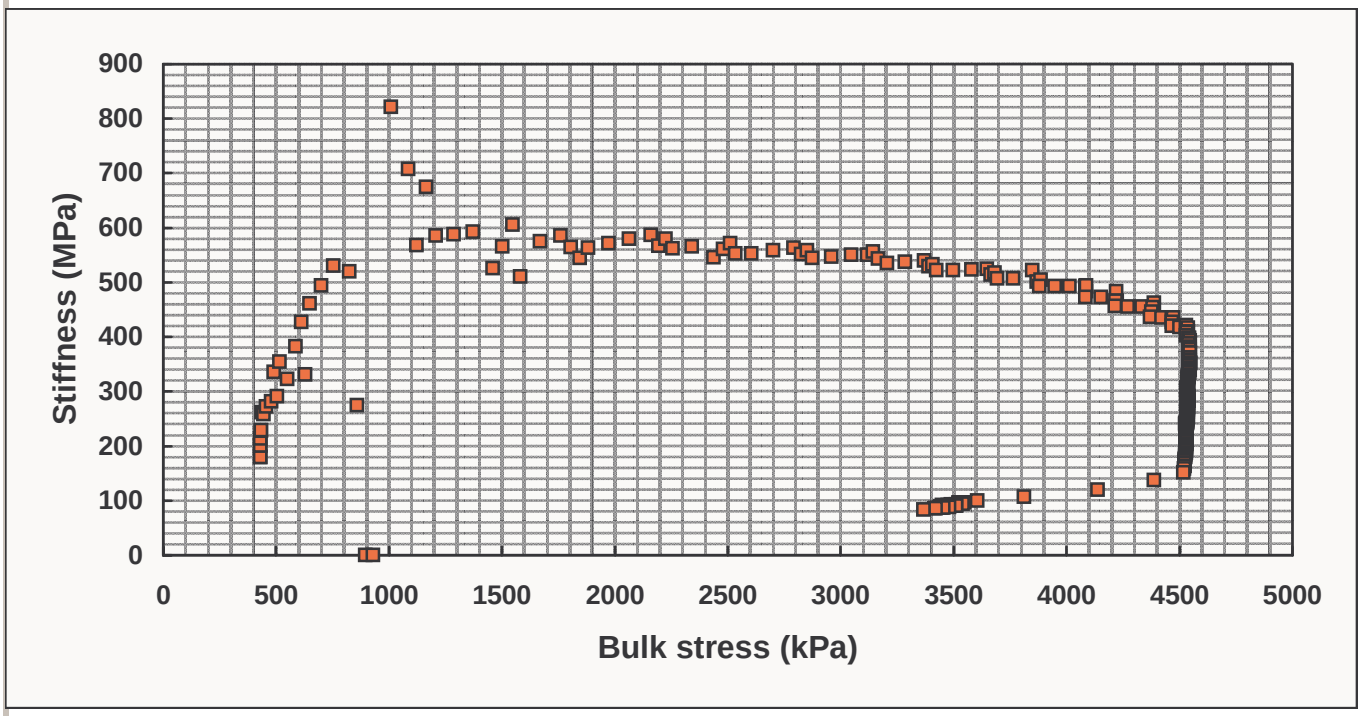




STATIC TRIAXIAL TEST

Material: Hornfels
Treatment 2% cement & 2,25% bitumen
Sample #: HAS15
Dry Density (kg/cub m): 2190
Confining pressure (kPa): 137
Moisture (%): 1.8
Linear stiffness (MPa): 524
Maximum deviator stress (kPa): 4135

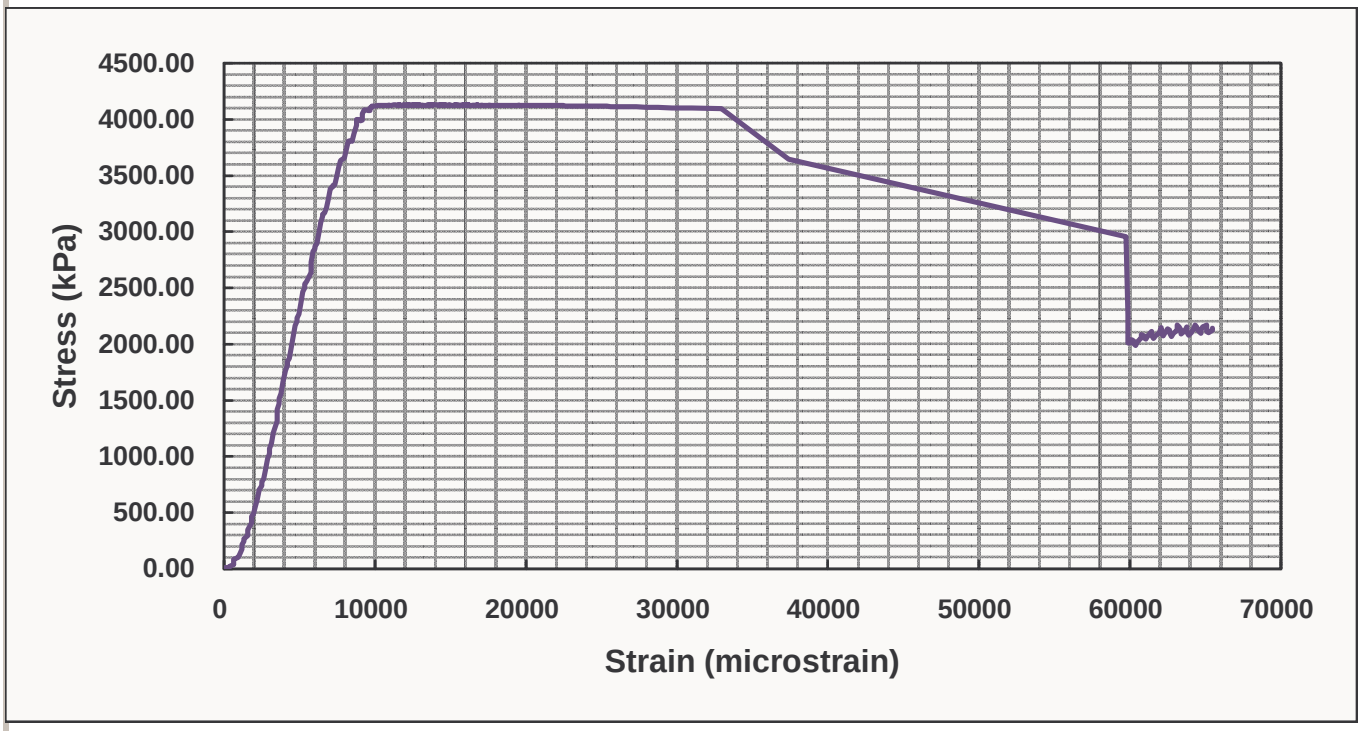


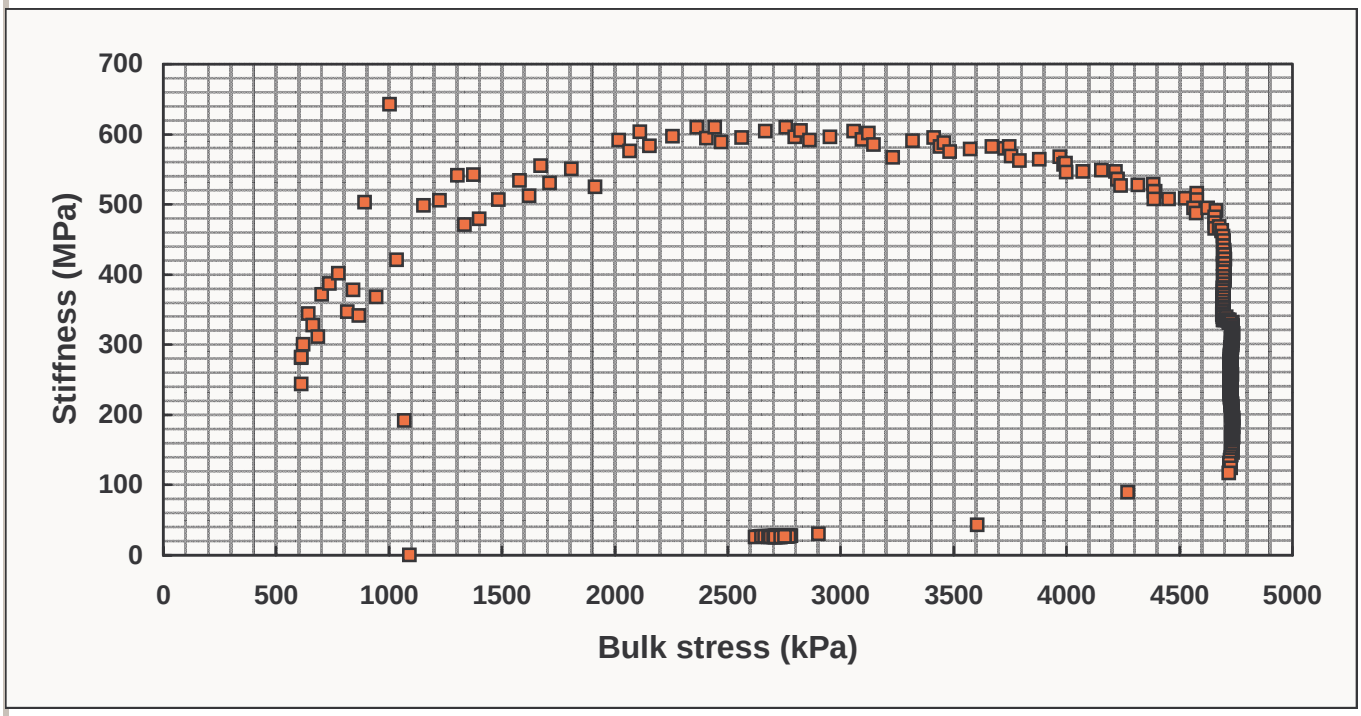


STATIC TRIAXIAL TEST

Material: Hornfels
Sample #: HAS16
Dry Density (kg/cub m): 2190
Moisture (%): 1.8

Treatment 2% cement & 2,25% bitumen
Confining pressure (kPa): 200
Linear stiffness (MPa): 546
Maximum deviator stress (kPa): 4129





STATIC TRIAXIAL TEST

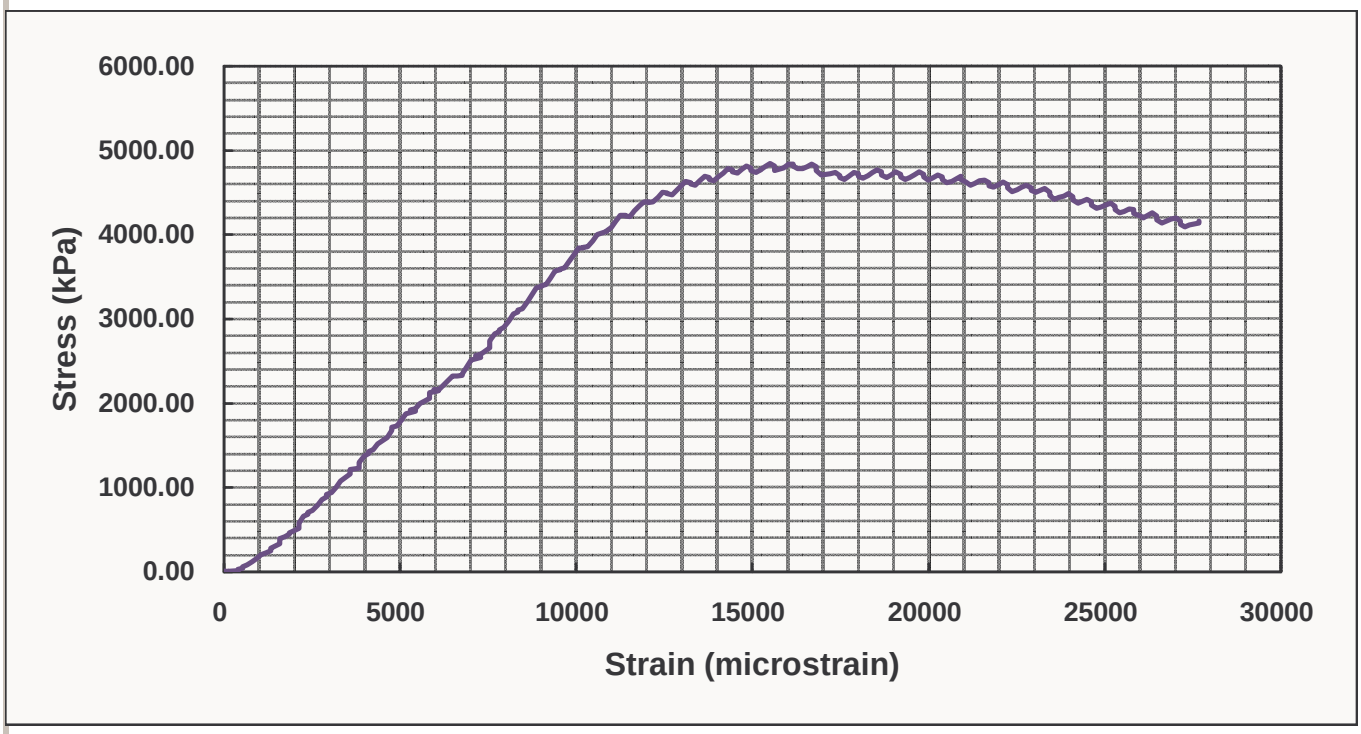
Material: Hornfels — **Treatment** **2% cement & 2,25% bitumen**

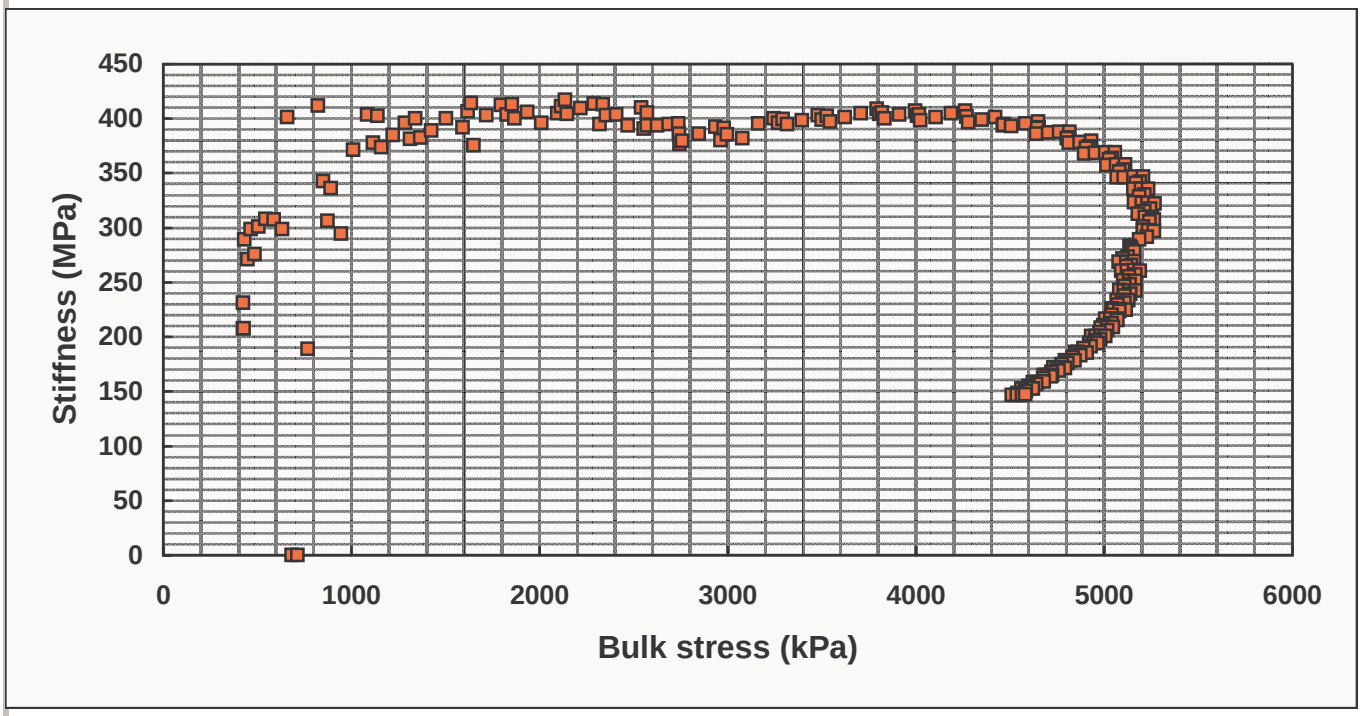
Sample #: HAS40

Dry Density (kg/cub m): 2190 — **Confining pressure (kPa): 141**

Moisture (%): 1.7 — **Linear stiffness (MPa): 404**

Maximum deviator stress (kPa): 4846





HSB: Treated with 1% Cement and 1.50% Foamed Bitumen

HSS: Treated with 1% Cement and 2.25% Foamed Bitumen

HSA: Treated with 1% Cement and 3.00% Foamed Bitumen

HAS: Treated with 2% Cement and 2.25% Foamed Bitumen

Appendix E Dynamic triaxial test results: Test Data

HNN: Untreated material

HNS: Treated with 1% Cement

HSB: Treated with 1% Cement and 1.50% Foamed Bitumen

HSS: Treated with 1% Cement and 2.25% Foamed Bitumen

HSA: Treated with 1% Cement and 3.00% Foamed Bitumen

HAS: Treated with 2% Cement and 2.25% Foamed Bitumen

Appendix F Dynamic triaxial test results: Resilient moduli

HNN: Untreated material

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HNN17	79	240	0.19	88	68	10 000 – 50 000	369	943	649
HNN18	81	674	0.55	87	69	20 000 – 50 000	490	866	730
HNN19	81	1096	0.90	87	68	2 000 – 50 000	427	676	655
HNN20	140	330	0.20	87	66	2 000 – 50 000	368	559	851
HNN21	144	905	0.54	87	67	2 000 – 50 000	385	701	646
HNN22	139	1443	0.88	88	68	2 000 – 50 000	580	910	820
HNN23	81	341	0.23	86	33	2 000 – 50 000	385	567	750
HNN24	83	940	0.61	87	33	2 000 – 50 000	452	937	804
HNN25	82	1536	0.95	87	30	2 000 – 50 000	475		975
HNN26	142	439	0.22	87	33	2 000 – 50 000	450	~~1528~~	855
HNN27	147	1199	0.60	87	32	2 000 – 50 000	487	1169	973
HNN28	139	1932	0.99	87	32	3 000 – 40 000	692		1100
HNN29	83	130	0.18	82	62	10 000 – 50 000	268	345	376
HNN30	83	386	0.59	81	64	2 000 – 50 000	306	424	418
HNN32	141	207	0.19	82	60	2 000 – 50 000	278	501	402
HNN33	142	588	0.53	82	58	9 000 – 50 000	322	542	719
HNN34	141	948	0.88	82	63	2 000 – 50 000	294		
HNN35	86	183	0.19	82	34	7 000 – 50 000	335	768	697
HNN36	80	523	0.60	81	36	2 000 – 50 000	333	616	571
HNN37	82	846	0.86	81	32	2 000 – 50 000	376	558	
HNN38	149	260	0.18	82	34	2 000 – 50 000	370	906	709
HNN39	147	726	0.47	82	29	2 000 – 50 000	384	613	706
HNN40	144	1146	0.74	82	28	2 000 – 50 000	484	897	850

HNS: Mix with 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HNS17a	84	137	0.18	86	70	15 000 – 50 000	319	464	548
HNS18a	82	389	0.45	87	55	2 000 – 50 000	384	656	586
HNS19a	82	640	0.82	86	65	2 000 – 40 000	305	426	563
HNS20a	141	207	0.18	87	53	2 000 – 50 000	382		664
HNS21	137	587	0.55	86	63	2 000 – 50 000	401	625	696
HNS22	141	964	0.94	86	74	10 000 – 50 000	413	579	737
HNS23	81	182	0.20	86	42	15 000 – 50 000	400	~~1295~~	780
HNS24	79	533	0.57	86	41	2 000 – 50 000	428	672	856
HNS25	80	867	1.01	86	46	8 000 – 50 000	439	677	776
HNS26	138	243	0.20	87	42	2 000 – 10 000	452	~~1315~~	831
HNS27	141	685	0.54	87	43	2 000 – 50 000	490	787	806
HNS28	140	1107	0.85	87	40	2 000 – 50 000	382	734	897
HNS29	80	105	0.17	81	40	20 000 – 50 000	337	488	595
HNS30	82	290	0.57	81	53	15 000 – 50 000	279	373	430
HNS31	82	483	0.98	80	49	2 000 – 10 000	290	485	421
HNS32	142	166	0.21	80	49	6 000 – 40 000	325	500	546
HNS33	148	468	0.53	81	45	2 000 – 50 000	255	496	475
HNS34	145	755	0.95	81	54	4 000 – 50 000	370	724	525
HNS35	82	115	0.17	81	37	2 000 – 50 000	359	604	1019
HNS36	84	325	0.54	81	43	3 000 – 50 000	322	405	518
HNS37	80	536	1.04	81	48	5 000 – 10 000	316	453	485
HNS38	141	171	0.20	81	44	2 000 – 50 000	312	574	448
HNS39	139	486	0.54	81	39	15 000 – 50 000	342	433	578
HNS40	141	791	0.94	80	43	500 – 1 000	334	526	820
HNS17	79	137	0.28	80	47	2 000 – 50 000	221	325	302
HNS18	83	389	0.69	81	44	2 000 – 50 000	285	396	454
HNS19	81	612	0.95	80	34	15 000 – 50 000	348	416	592
HNS20	135	201	0.23	81	42	2 000 – 50 000	319	798	492

HSB: Mix with 1 per cent cement and 1.5 per cent foamed bitumen

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HSB17	78	325	0.26	79	48	1 000 – 20 000	595	1467	1931
HSB18	78	900	0.80	79	50	1 000 – 10 000	494	781	1291
HSB19	78	1458	0.99	80	55	1 000 – 4 000	434	914	707
HSB20	138	390	0.25	78	51	2 000 – 50 000	593		1480
HSB21	142	1079	0.58	80	56	20 000 – 50 000	557	1324	1375
HSB22	139	1674	1.07	79	55	2 000 – 50 000	407	846	1100
HSB23	83	337	0.21	79	27	2 000 – 50 000	580	1621	4973
HSB24	81	918	0.61	79	29	4 000 – 50 000	520	1186	1318
HSB25	81	1504	0.86	80	25	8 000 – 50 000	548	1059	1593
HSB26	142	397	0.18	80	27	7 000 – 50 000	655	2687	1684
HSB27	142	1103	0.48	79	23	7 000 – 50 000	559	1557	1296
HSB28	142	1754	0.74	80	22	2 000 – 50 000	494	1445	1199
HSB29	77	521	0.20	85	51	10 000 – 50 000	749	2723	2643
HSB30	78	1424	0.52	85	46	3 000 – 50 000	738	1999	2066
HSB31	79	2263	0.85	85	49	10 000 – 50 000	712	1386	1956
HSB32	137	572	0.18	85	50	200 – 10 000	798	4018	4258
HSB33	138	1599	0.48	86	52	9 000 – 50 000	667	1417	2506
HSB34	137	2562	0.79	85	45	2 000 – 10 000	913	1664	2279
HSB35	78	640	0.20	85	23	10 000 – 50 000	606	1395	2166
HSB36	79	1737	0.64	84	33	4 000 – 50 000	585	1211	1742
HSB37	79	2774	0.96	85	37	100 – 500	792	1342	1361
HSB38	136	748	0.21	85	26	10 000 – 50 000	697	2366	1821
HSB39	137	2058	0.55	86	24	20 000 – 50 000	689	1352	2134
HSB40	135	3224	0.90	85	26	10 000 – 50 000	913	1851	1823

HSS: Mix with 1 per cent cement and 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HSS17	80	268	0.20	81	39	2 000 – 20 000	601	2800	2987
HSS18	79	757	0.52	81	40	2 000 – 50 000	596		3166
HSS19	81	1247	0.85	81	37	20 000 – 50 000	591	1091	1895
HSS20	138	328	0.19	80	34	2 000 – 50 000	653	3004	1983
HSS22	138	1435	0.86	80	36	2 000 – 50 000		1602	1691
HSS23	79	377	0.17	81	22	10 000 – 50 000	522		1769
HSS24	78	1062	0.56	81	25	3 000 – 50 000	581	1096	1812
HSS25	82	1673	0.83	80	23	4 000 – 40 000	597	1254	916
HSS26	141	430	0.15	81	18	10 000 – 50 000	704	2053	1690
HSS27	140	1168	0.55	81	28	15 000 – 50 000	515	1260	1349
HSS28	140	1881	0.86	81	27	2 000 – 50 000	549	1562	1051
HSS40	140	2260	0.84	87	40	15 000 – 50 000	773	1607	1725
HSS38	144	529	0.23	85	42	2 000 – 50 000	657	1923	4949
HSS39	139	1435	0.57	87	51	2 000 – 50 000	766	2092	2733
HSS32	141	528	0.21	88	54	2 000 – 50 000	717		2075
HSS35	81	459	0.20	88	54	1 000 – 50 000	773	3889	
HSS36	79	1249	0.54	88	54	20 000 – 50 000	793	1636	2377
HSS30	82	1214	0.56	87	55	2 000 – 50 000	786	1871	1928
HSS33	147	1501	0.60	87	56	2 000 – 50 000	655	2544	1649
HSS37	82	1620	0.76	87	56	2 000 – 50 000	843		1659
HSS29	82	436	0.20	87	56	200 – 10 000	635		1780
HSS31	83	1985	0.91	87	57	15 000 – 50 000	637	1991	1316
HSS34	143	2400	1.02	87	61	2 000 – 50 000	903	2011	1426

HSA: Mix with 1 per cent cement and 3.0 per cent foamed bitumen

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HSA17	81	290	0.22	82	56	500 – 50 000	558	1662	2336
HSA18	80	804	0.57	82	57	4 000 – 50 000	504	852	1115
HSA19	80	1305	1.02	81	61	200 – 1 000	406	800	714
HSA20	139	329	0.21	82	57	20 000 – 50 000	645	1575	~~3730~~
HSA21	138	912	0.69	80	52	10 000 – 50 000	419	1120	924
HSA22a	142	1432	0.99	81	56	3 000 – 50 000	616	1149	
HSA23	80	299	0.21	82	32	3 000 – 50 000	637	1467	2009
HSA24	79	829	0.52	81	22	2 000 – 50 000	592	1567	1247
HSA25	79	1350	0.89	82	27	20 000 – 50 000	480	1154	895
HSA26	137	344	0.33	76	20	20 000 – 50 000	562	1414	2670
HSA27	138	960	0.60	81	25	3 000 – 50 000	518	1494	1148
HSA28	141	1528	0.90	82	28	8 000 – 20 000	376	1060	1476
HSA29	84	408	0.19	87	53	15 000 – 50 000	738	2629	~~4218~~
HSA30	81	1165	0.51	88	72	1 000 – 50 000	682	1967	1746
HSA31	79	1811	0.80	88	64	20 000 – 50 000	593	1666	1375
HSA32	139	461	0.20	87	63	4 000 – 50 000	712	3172	2205
HSA33	140	1257	0.52	88	66	10 000 – 50 000	641	2072	1960
HSA34	141	1977	0.81	88	64	10 000 – 50 000	569	1648	1333
HSA35	80	502	0.21	88	31	8 000 – 50 000	690	2201	3506
HSA36	82	1377	0.56	87	26	20 000 – 50 000	646	3968	2133
HSA37	80	2758	1.14	88	31	50 – 500	772	1345	1350
HSA38	140	541	0.22	86	25	600 – 50 000	733	2508	1721
HSA39	139	1527	0.54	88	21	15 000 – 50 000	789	2570	1825
HSA40	140	2379	0.89	87	23	15 000 – 50 000	624	1480	1694

HAS: Mix with 2 per cent cement and 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Test stress (kPa)	Stress ratio	Relative density (%)	Saturation (%)	Data range (repetitions)	Resilient Modulus (MPa)		
							LVDT1	LVDT 2	LVDT M
HAS17	81	328	0.18	82	57	2 000 – 50 000	559	~~5011~~	2341
HAS18	81	913	0.49	82	59	20 000 – 50 000	538	2263	1183
HAS19	82	1469	0.93	81	58	20 000 – 50 000	405	773	818
HAS20	138	399	0.19	82	57	2 000 – 50 000	604	1680	
HAS21	138	1100	0.58	81	54	15 000 – 50 000	516	1479	1132
HAS22	138	1732	0.84	82	57	10 000 – 40 000	603	1346	948
HAS23	77	468	0.21	81	28	10 000 – 50 000	647	4391	2058
HAS24	82	1315	0.60	81	28	20 000 – 50 000	684	2105	1863
HAS25	80	2039	0.90	81	28	20 000 – 50 000	555	2298	1179
HAS26	139	523	0.21	81	28	10 000 – 50 000	638	1821	4052
HAS27	136	1484	0.55	82	25	20 000 – 50 000	659	2137	2277
HAS28	136	2350	0.84	82	23	20 000 – 50 000	649	1351	1853
HAS29	Data unreasonable		88	67		3 000 – 50 000	646	1922	
HAS30	78	1726	0.49	87	57	15 000 – 50 000	792	2441	2686
HAS31	80	2781	0.72	88	62	20 000 – 50 000	699	1677	1780
HAS32	139	689	0.18	87	59	10 000 – 50 000	918	3032	
HAS33	139	1900	0.49	87	57	20 000 – 50 000	752	2325	2757
HAS34	137	3095	0.80	87	54	20 000 – 50 000	968	2299	1929
HAS35	79	884	0.21	87	23	15 000 – 50 000	801	2297	3482
HAS36	82	2395	0.57	86	23	20 000 – 50 000	1006	2632	3553
HAS37	76	3914	0.96	87	27	500 – 1 000	1097	2436	2336
HAS38	136	970	0.21	86	19	15 000 – 50 000	882	3023	4254
HAS39	139	2605	0.53	88	26	15 000 – 50 000	1059	2794	4022

Appendix G Dynamic triaxial test results: Permanent deformation model fits

Notes referred to in tables:

Note 1: Data unreasonable

Note 2: Data unreasonable, permanent deformation decreasing with increasing load repetitions

Note 3: LVDT out of range

Note 4: Membrane burst

Note 5: Specimen collapsed on one side

Note 6: Specimen failed early

Note 7: Membrane broke

Note 8: Data unreasonable, no PD accumulation with increasing load repetitions

HNN: Untreated material

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	c b	R^2	SEE	
HNN17	79.4	0.19	87.5	68.1	HL	1 2 M	Note 2 Note 2 0.310	 2.000×10^{-6}	 1.80	 5.60×10^{-3}	0.85	0.029	0.416
HNN18	80.7	0.55	87.3	69.2	HL	1 2 M	1.850 1.800 1.830	1.620×10^{-6} 1.670×10^{-6} 2.800×10^{-6}	0.85 0.90 0.94	2.60×10^{-2} 1.20×10^{-2} 2.30×10^{-2}	0.97 0.96 0.97	0.068 0.080 0.069	1.933 1.882 1.949
HNN19	81.2	0.90	87.1	67.5	HL	1 2 M	3.755 3.600 3.730	3.159×10^{-5} 2.570×10^{-5} 2.360×10^{-5}	1.40 1.34 1.32	3.50×10^{-3} 3.55×10^{-3} 4.00×10^{-3}	0.97 0.97 0.97	0.237 0.245 0.230	5.326 4.885 4.910
HNN20	139.5	0.20	87.1	66.1	HL	1 2 M	Note 1 0.448 0.548	 1.310×10^{-6} 1.773×10^{-6}	 1.20 0.80	 2.00×10^{-3} 7.00×10^{-3}	 -0.87 0.24	 0.141 0.108	 0.512 0.683
HNN21	143.5	0.54	87.4	66.8	HL	1 2 M	1.868 2.370 2.057	8.007×10^{-6} 7.800×10^{-6} 4.641×10^{-6}	0.90 0.95 1.00	1.20×10^{-2} 1.35×10^{-2} 1.40×10^{-2}	0.87 0.94 0.85	0.163 0.151 0.172	2.267 2.762 2.297
HNN22	139.0	0.88	87.5	67.7	HL	1 2 M	3.473 3.485 3.309	3.480×10^{-5} 3.360×10^{-5} 2.630×10^{-5}	1.05 1.05 1.00	4.90×10^{-3} 4.90×10^{-3} 5.00×10^{-3}	0.97 0.97 0.97	0.232 0.244 0.212	5.179 5.137 4.591
HNN23	81.2	0.23	86.2	33.1	HL	1 2 M	0.193 0.275 Note 1	1.845×10^{-6} 1.300×10^{-6}	1.10 1.50	1.50×10^{-3} 4.00×10^{-3}	0.78 0.55	0.027 0.032	0.286 0.347
HNN24	82.6	0.61	87.0	33.0	HL	1 2 M	0.540 1.071 0.639	1.003×10^{-6} 2.122×10^{-6} 6.811×10^{-7}	0.70 0.95 0.65	2.50×10^{-2} 5.00×10^{-3} 4.00×10^{-2}	0.92 0.98 0.81	0.029 0.040 0.047	0.590 1.177 0.672
HNN25	82.0	0.95	87.0	29.8	HL	1 2 M	Note 2 1.770 1.222	 3.680×10^{-6} 2.580×10^{-6}	 0.98 1.00	 1.00×10^{-2} 2.50×10^{-2}	 0.97 0.95	 0.071 0.051	 1.933 1.330
HNN26	142.2	0.22	87.3	32.9	HL	1 2 M	0.072 0.182 Note 1	6.517×10^{-7} 6.015×10^{-7}	1.00 0.80	4.50×10^{-4} 7.00×10^{-3}	-0.10 0.97	0.025 0.008	0.104 0.212
HNN27	147.0	0.60	86.9	31.9	HL	1 2 M	0.619 0.866 0.864	1.350×10^{-6} 2.129×10^{-6} 1.964×10^{-6}	1.10 0.90 0.90	1.90×10^{-2} 7.50×10^{-3} 2.00×10^{-2}	0.98 0.97 0.98	0.015 0.037 0.025	0.687 0.972 0.968
HNN28	139.2	0.99	87.1	32.4	HL	1 2 M	Note 1 0.856 Note 2	 2.960×10^{-6}	 1.05	 3.50×10^{-3}	 1.00	 0.017	 0.991

HNN: Untreated material (continued)

HNN29	82.8	0.18	81.8	61.6	HL	1 2 M	Note 2 Note 2 0.251	 2.829 x10^{-6}	 1.20	 7.00 x10^{-4}	 0.81	 0.036	 0.398
HNN30	82.9	0.59	81.4	64.3	HL	1 2 M	1.801 2.804 2.330	4.780 x10^{-6} 5.134 x10^{-6} 4.250 x10^{-6}	1.00 0.90 0.80	5.00 x10^{-3} 1.90 x10^{-2} 2.00 x10^{-2}	0.95 0.97 0.98	0.110 0.124 0.078	2.034 3.055 2.521
HNN31	81.2	0.95	81.5	65.0	HL	1 2 M	Note 1 Note 1 9.794	2.889 x10^{-5}	1.00	5.00 x10^{-2}	1.00	0.192	11.189
HNN32	141.1	0.19	81.7	60.4	HL	1 2 M	0.515 0.321 0.444	2.240 x10^{-6} 2.440 x10^{-6} 3.000 x10^{-7}	0.91 0.93 1.00	2.00 x10^{-3} 8.00 x10^{-4} 1.50 x10^{-3}	0.93 0.99 0.90	0.036 0.013 0.034	0.624 0.440 0.459
HNN33	142.1	0.53	81.7	58.3	HL	1 2 M	Note 1 Note 1 Note 1						
HNN34	140.6	0.88	81.7	63.2	HL	1 2 M	Note 3 Note 3 12.462	 4.649 x10^{-5}	 1.02	 4.30 x10^{-2}	 0.97	 0.617	 14.795
HNN35	85.7	0.19	81.5	33.8	HL	1 2 M	0.119 0.104 0.187	1.683 x10^{-6} 1.813 x10^{-6} 5.010 x10^{-7}	0.80 0.83 0.90	8.00 x10^{-4} 1.10 x10^{-3} 9.00 x10^{-4}	0.98 0.99 0.92	0.006 0.005 0.014	0.202 0.194 0.203
HNN36	79.6	0.60	81.2	36.1	HL	1 2 M	Note 1 0.700 0.961	1.230 x10^{-6} 1.353 x10^{-6}	0.93 0.95	4.50 x10^{-3} 8.50 x10^{-3}	0.95 0.88	0.036 0.069	0.760 1.035
HNN37	81.9	0.86	81.4	32.1	HL	1 2 M	2.302 Note 1 0.623	4.090 x10^{-6} 4.589 x10^{-6}	1.20 1.00	2.50 x10^{-3} 2.50 x10^{-3}	1.00 0.80	0.038 0.085	2.498 0.833
HNN38	148.6	0.18	81.6	33.5	HL	1 2 M	0.123 0.225 0.214	6.725 x10^{-7} 7.622 x10^{-7} 7.250 x10^{-7}	0.87 1.00 0.90	6.50 x10^{-4} 1.00 x10^{-3} 2.00 x10^{-3}	0.92 0.98 0.84	0.009 0.009 0.018	0.156 0.262 0.251
HNN39	147.1	0.47	81.8	28.9	HL	1 2 M	1.489 0.598 0.803	2.285 x10^{-6} 1.624 x10^{-6} 1.793 x10^{-6}	0.95 0.78 0.75	6.50 x10^{-3} 1.10 x10^{-2} 1.50 x10^{-2}	0.96 0.97 0.98	0.072 0.024 0.026	1.602 0.679 0.901
HNN40	144.0	0.74	81.9	27.9	HL	1 2 M	2.641 2.121 2.415	2.480 x10^{-5} 1.686 x10^{-5} 1.760 x10^{-5}	1.40 1.40 1.40	5.80 x10^{-3} 5.00 x10^{-3} 5.50 x10^{-3}	0.97 0.95 0.96	0.135 0.141 0.153	2.891 2.292 2.594

HNS: Mix with 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	c b	R^2	SEE	
HNS17a	83.7	0.18	86.3	69.5	HL	1	0.2931	9.989×10^{-7}	1.000	1.60×10^{-3}	0.94	0.02	0.344
					HL	2	0.2560	8.218×10^{-7}	1.000	2.50×10^{-3}	0.98	0.01	0.296
					HL	M	0.3530	8.000×10^{-7}	1.000	2.70×10^{-3}	0.95	0.02	0.396
HNS18a	81.7	0.45	86.8	55.3	HL	1	0.3320	6.257×10^{-7}	1.200	5.00×10^{-4}	-0.83	0.09	0.365
					HL	2	0.7000	6.204×10^{-7}	1.056	3.50×10^{-3}	0.97	0.03	0.732
					HL	M	0.4253	4.440×10^{-7}	1.000	1.50×10^{-3}	0.07	0.08	0.447
HNS19a	81.9	0.82	86.2	64.5	HL	1	5.9142	4.430×10^{-5}	1.300	6.00×10^{-3}	0.99	0.28	8.076
					HL	2	2.1500	6.420×10^{-6}	1.500	3.00×10^{-3}	0.16	0.45	2.506
					HL	M	3.1500	2.200×10^{-5}	1.030	7.60×10^{-3}	0.96	0.21	4.266
HNS20a	140.7	0.18	86.6	53.4	HL	1	0.4500	6.480×10^{-7}	2.500	1.00×10^{-2}	0.92	0.02	0.485
					HL	2	0.1430	1.270×10^{-6}	2.500	6.00×10^{-5}	0.55	0.04	0.209
					HL	M	0.4259	4.149×10^{-7}	0.880	1.00×10^{-2}	0.95	0.02	0.447
HNS21	137.3	0.55	86.0	62.5	HL	1	1.5540	2.870×10^{-6}	0.880	7.00×10^{-3}	0.91	0.11	1.694
					HL	2	0.7020	3.200×10^{-6}	1.015	1.30×10^{-3}	0.95	0.05	0.859
					HL	M	1.3560	3.750×10^{-6}	0.820	1.00×10^{-2}	0.80	0.13	1.545
HNS22	141.1	0.94	85.9	73.7	HL	1	8.2100	2.970×10^{-5}	1.040	1.60×10^{-2}	0.99	0.31	9.687
					HL	2	3.1120	2.690×10^{-5}	0.890	1.07×10^{-2}	0.93	0.26	4.436
					HL	M	4.8500	2.790×10^{-5}	0.980	1.17×10^{-2}	0.96	0.32	6.224
HNS23	80.7	0.20	86.1	42.0		1	Note 1						
						2	Note 1						
						M	Note 1						
HNS24	79.1	0.57	86.1	40.8	HL	1	0.5020	6.302×10^{-7}	1.000	3.50×10^{-3}	0.96	0.02	0.531
					HL	2	0.4510	5.827×10^{-7}	0.860	4.00×10^{-3}	0.96	0.02	0.478
					HL	M	0.5020	1.109×10^{-6}	0.920	4.00×10^{-3}	0.86	0.04	0.554
HNS25	79.7	1.01	85.8	46.2	HL	1	2.6700	6.900×10^{-6}	1.200	1.20×10^{-2}	0.99	0.07	2.975
					HL	2	1.9200	4.200×10^{-6}	0.850	2.00×10^{-2}	0.95	0.10	2.120
					HL	M	2.0560	2.960×10^{-6}	0.880	2.00×10^{-2}	0.95	0.10	2.200
HNS26	138.0	0.20	86.6	42.0	HL	1	0.4390	8.741×10^{-7}	0.930	7.00×10^{-3}	0.97	0.02	0.484
					HL	2	Note 1						
					HL	M	0.4638	1.140×10^{-6}	1.000	4.00×10^{-3}	0.95	0.02	0.520
HNS27	140.5	0.54	87.0	43.3		1	Note 2						
						2	Note 2						
					HL	M	0.6910	4.358×10^{-6}	1.100	4.00×10^{-3}	0.92	0.05	0.909
HNS28	140.4	0.85	87.0	39.9	HL	1	2.2503	7.372×10^{-6}	1.100	6.00×10^{-3}	0.98	0.09	2.616
					HL	2	Note 1						
					HL	M	1.5390	5.970×10^{-6}	1.000	8.00×10^{-3}	0.74	0.18	1.851

HNS: Mix with 2.25 per cent foamed bitumen (continued)

HNS29	80.2	0.17	80.9	39.8	HL	1	0.4580	7.050×10^{-7}	1.100	9.00×10^{-4}	0.78	0.06	0.495
					HL	2	0.2488	8.755×10^{-7}	1.500	1.40×10^{-4}	0.83	0.04	0.292
					HL	M	0.4340	2.199×10^{-7}	1.100	1.20×10^{-3}	0.75	0.05	0.447
HNS30	82.3	0.57	80.9	52.5	HL	1	2.1740	6.700×10^{-6}	1.180	2.50×10^{-3}	0.94	0.16	2.503
					HL	2	1.7030	5.942×10^{-6}	1.115	2.60×10^{-3}	0.93	0.14	1.998
					HL	M	1.9879	6.404×10^{-6}	1.150	3.20×10^{-3}	0.93	0.16	2.312
HNS31	81.5	0.98	80.4	49.1	HL	1	8.7000	7.690×10^{-6}	1.100	9.00×10^{-3}	0.94	0.62	8.837
					HL	2	6.7400	8.130×10^{-6}	1.100	7.50×10^{-3}	0.94	0.49	6.930
					HL	M	7.4000	6.783×10^{-6}	1.000	8.00×10^{-3}	0.93	0.57	7.486
HNS32	142.1	0.21	80.3	49.2	HL	1	0.4188	1.720×10^{-6}	1.000	8.00×10^{-4}	0.93	0.03	0.509
					HL	2	0.2212	1.510×10^{-6}	1.400	1.00×10^{-4}	0.95	0.02	0.418
					HL	M	0.3868	1.513×10^{-6}	0.950	1.20×10^{-3}	0.78	0.05	0.548
HNS33	147.6	0.53	80.8	44.5		all	Note 4						
HNS34	144.9	0.95	80.7	54.4	HL	1	10.0500	1.675×10^{-5}	0.900	3.50×10^{-2}	0.92	0.71	10.830
					HL	2	13.9000	2.190×10^{-5}	1.000	2.00×10^{-2}	0.86	1.41	14.524
					HL	M	10.9400	1.656×10^{-5}	1.010	4.85×10^{-2}	0.90	0.85	11.744
HNS35	82.0	0.17	81.2	36.9	HL	all	Note 3						
HNS36	83.6	0.54	81.1	42.7	HL	1	1.6120	3.956×10^{-6}	1.155	2.90×10^{-3}	0.92	0.13	1.810
					HL	2	1.0760	2.930×10^{-6}	1.100	2.00×10^{-3}	0.81	0.12	1.222
					HL	M	1.2770	4.880×10^{-6}	0.870	6.00×10^{-3}	0.96	0.07	1.522
HNS37	80.4	1.04	80.7	48.1	HL	1	8.8000	1.514×10^{-5}	1.150	1.10×10^{-2}	0.97	0.50	9.544
					HL	2	6.7410	1.633×10^{-5}	1.150	1.15×10^{-2}	0.93	0.52	7.548
					HL	M	6.8840	1.455×10^{-5}	1.065	1.50×10^{-2}	0.95	0.44	7.603
HNS38	140.8	0.20	80.8	43.7	HL	1	0.2917	8.100×10^{-7}	1.200	3.00×10^{-3}	0.93	0.02	0.332
					HL	2	0.1461	6.636×10^{-7}	1.240	5.00×10^{-4}	0.90	0.02	0.179
					HL	M	0.3500	1.894×10^{-6}	0.860	4.00×10^{-3}	0.96	0.02	0.443
HNS39	138.5	0.54	80.6	38.6	HL	1	3.5850	1.619×10^{-5}	1.500	3.50×10^{-3}	0.96	0.25	4.389
						2	Note 1						
					HL	M	2.0500	6.050×10^{-6}	0.970	5.50×10^{-3}	0.94	0.14	2.353
HNS40	140.9	0.94	80.3	42.9		all	Note 5						
HNS17	79.0	0.28	80.2	47.2	HL	1	0.3672	1.700×10^{-6}	0.880	2.20×10^{-3}	0.95	0.02	0.451
					HL	2	0.4315	2.477×10^{-6}	1.150	1.00×10^{-3}	0.94	0.03	0.555
					HL	M	0.4844	1.585×10^{-6}	0.890	3.00×10^{-3}	0.96	0.03	0.566
HNS18	83.1	0.69	80.7	44.4	HL	1	3.0100	7.956×10^{-6}	1.300	3.00×10^{-3}	0.96	0.19	3.407
					HL	2	1.5799	7.232×10^{-6}	0.960	5.80×10^{-3}	0.95	0.10	1.942
					HL	M	2.0773	7.796×10^{-6}	1.020	6.00×10^{-3}	0.95	0.13	2.472
HNS19	80.5	0.95	80.3	34.4	HL	1	6.3207	2.359×10^{-5}	1.700	6.00×10^{-3}	0.93	0.67	7.511
					HL	2	4.3522	1.330×10^{-5}	1.040	1.10×10^{-2}	0.97	0.21	4.997
					HL	M	5.3270	1.550×10^{-5}	0.950	1.30×10^{-2}	0.98	0.22	6.073
HNS20	135.4	0.23	81.3	41.8	HL	1	0.0870	1.560×10^{-6}	2.000	3.00×10^{-3}	0.76	0.02	0.164
					HL	2	0.4370	1.840×10^{-6}	1.250	8.00×10^{-4}	0.99	0.01	0.527
					HL	M	0.3184	1.761×10^{-6}	1.000	1.90×10^{-3}	0.85	0.03	0.408

HSB: Mix with 1 per cent cement and 1.5 per cent foamed bitumen

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	C b	R^2	SEE	
HSB17	77.6	0.26	79.0	48.3	HL	1	0.1042	2.900×10^{-7}	1.60	1.70×10^{-4}	0.941	0.008	0.138
						2	Note 1						
					HL	M	0.2825	2.830×10^{-7}	1.20	5.00×10^{-4}	0.108	0.066	0.303
HSB18	78.5	0.80	78.5	50.3	HL	1	1.0090	1.674×10^{-5}	1.90	9.00×10^{-4}	0.996	0.035	1.852
						2	Note 1						
					HL	M	0.5302	1.389×10^{-5}	0.65	1.00×10^{-2}	0.951	0.055	1.236
HSB19	78.1	0.99	80.1	55.3	DE	1	0.1422	1.144	0.00	7.17×10^{-3}	0.993	0.214	10.640
					DE	2	0.0475	2.928	0.00	6.75×10^{-4}	0.999	0.099	12.816
					DE	M	0.2872	1.067	0.00	5.68×10^{-3}	0.998	0.130	10.679
HSB20	137.8	0.25	78.4	51.1		1	Note 1						
					HL	2	0.3192	1.794×10^{-7}	1.05	1.30×10^{-3}	0.981	0.012	0.328
					HL	M	0.0746	1.983×10^{-7}	1.00	3.00×10^{-4}	0.344	0.018	0.085
HSB21	142.0	0.58	79.6	55.6	HL	1	0.5798	1.374×10^{-6}	1.50	1.05×10^{-3}	0.980	0.025	0.650
					HL	2	0.4256	4.536×10^{-6}	1.00	1.00×10^{-3}	0.757	0.068	0.653
					HL	M	0.5580	3.058×10^{-6}	0.86	3.50×10^{-3}	0.824	0.056	0.694
HSB22	139.2	1.07	78.5	54.5	HL	1	2.1430	2.493×10^{-4}	1.50	4.00×10^{-3}	0.994	0.105	4.619
					HL	2	1.4750	6.740×10^{-5}	1.20	3.00×10^{-3}	0.969	0.106	2.132
					HL	M	1.4200	1.285×10^{-4}	1.00	1.00×10^{-2}	0.955	0.145	2.593
HSB23	82.6	0.21	79.2	27.4	HL	1	0.2918	1.205×10^{-6}	1.15	4.20×10^{-4}	0.987	0.012	0.352
					HL	2	0.0443	7.785×10^{-7}	0.70	8.00×10^{-4}	-0.614	0.021	0.083
					HL	M	0.1027	1.039×10^{-6}	1.10	4.40×10^{-3}	0.828	0.009	0.152
HSB24	80.7	0.61	78.9	28.8	HL	1	0.8726	1.314×10^{-6}	1.10	2.00×10^{-3}	0.988	0.030	0.937
						2	Note 1						
						M	Note 1						
HSB25	81.1	0.86	79.5	25.2	HL	1	1.1023	2.567×10^{-6}	1.06	2.00×10^{-3}	0.942	0.076	1.232
						2	Note 2						
					HL	M	0.6800	1.370×10^{-6}	0.85	5.00×10^{-3}	0.834	0.059	0.734
HSB26	142.1	0.18	79.5	26.6	HL	1	0.0426	6.062×10^{-7}	1.00	9.00×10^{-4}	0.400	0.010	0.073
					HL	2	0.3160	1.150×10^{-6}	0.92	1.50×10^{-3}	0.978	0.013	0.372
					HL	M	0.1102	8.547×10^{-7}	0.90	9.00×10^{-4}	0.867	0.012	0.157
HSB27	141.7	0.48	79.4	22.8		1	Note 1						
					HL	2	0.8557	2.200×10^{-6}	0.91	6.60×10^{-3}	0.928	0.054	0.963
					HL	M	0.1550	1.700×10^{-6}	1.20	2.00×10^{-4}	0.979	0.009	0.240
HSB28	142.2	0.74	79.6	22.3	HL	1	0.7437	1.191×10^{-6}	0.95	3.50×10^{-3}	0.661	0.096	0.802
					HL	2	1.8514	1.910×10^{-6}	1.03	5.00×10^{-3}	0.980	0.073	1.947
					HL	M	0.7814	1.129×10^{-6}	0.90	5.00×10^{-3}	0.639	0.092	0.830

HSB: Mix with 1 per cent cement and 1.5 per cent foamed bitumen (continued)

HSB29	77.1	0.20	84.5	51.0	HL	1	0.2321	4.902×10^{-7}	1.30	9.00×10^{-4}	0.909	0.025	0.257
						2	Note 1						
					HL	M	0.1090	2.570×10^{-7}	1.20	5.00×10^{-3}	0.341	0.016	0.122
HSB30	78.3	0.52	85.0	46.2	HL	1	0.4580	2.640×10^{-6}	0.85	5.00×10^{-3}	0.945	0.027	0.593
						2	Note 1						
					HL	M	0.5108	3.130×10^{-6}	1.15	9.00×10^{-4}	0.733	0.078	0.672
HSB31	79.0	0.85	84.8	49.4	HL	1	2.3027	5.460×10^{-6}	0.85	2.00×10^{-2}	0.934	0.159	2.573
						2	Note 1						
					HL	M	1.5370	1.820×10^{-6}	4.50	9.00×10^{-3}	0.971	0.061	1.621
HSB32	136.5	0.18	84.8	49.5	HL	1	0.0794	2.620×10^{-7}	0.90	3.50×10^{-4}	0.816	0.010	0.087
					HL	2	0.1784	7.310×10^{-7}	1.18	4.00×10^{-4}	0.970	0.010	0.214
						M	Note 1						
HSB33	138.0	0.48	85.7	51.9	HL	1	1.1307	2.166×10^{-6}	1.35	1.10×10^{-3}	0.978	0.056	1.241
						2	Note 1						
					HL	M	0.2900	4.920×10^{-7}	0.65	9.00×10^{-3}	-0.016	0.063	0.307
HSB34	137.5	0.79	85.2	45.4	HL	1	1.2594	2.657×10^{-6}	0.75	2.50×10^{-2}	0.935	0.073	1.391
					HL	2	1.4233	3.490×10^{-6}	0.83	1.30×10^{-2}	0.913	0.101	1.592
					HL	M	1.9016	3.193×10^{-6}	0.75	5.00×10^{-2}	0.931	0.106	2.057
HSB35	78.3	0.20	85.0	22.6	HL	1	0.3656	1.077×10^{-6}	1.30	3.00×10^{-4}	0.789	0.056	0.420
						2	Note 2						
						M	Note 2						
HSB36	78.7	0.64	84.2	33.1	HL	1	0.9912	3.200×10^{-6}	0.95	2.40×10^{-3}	0.971	0.050	1.147
					HL	2	0.5322	1.634×10^{-6}	0.75	1.50×10^{-2}	0.976	0.018	0.615
					HL	M	0.6760	2.440×10^{-6}	0.85	8.50×10^{-3}	0.952	0.033	0.803
HSB37	79.4	0.96	85.2	37.2		1	Note 6						14.242
						2	Note 6						10.936
						M	Note 6						12.304
HSB38	135.6	0.21	85.2	26.3	HL	1	Note 1					0.050	0.695
					HL	2	0.6637	6.242×10^{-7}	1.00	3.50×10^{-3}	0.934	0.027	0.165
					HL	M	0.1081	1.137×10^{-6}	0.70	3.00×10^{-3}	0.165		
HSB39	136.7	0.55	85.9	23.9	HL	1	0.9852	4.358×10^{-6}	1.30	1.50×10^{-3}	0.977	0.051	1.202
						2	Note 1						
					HL	M	1.0100	1.140×10^{-6}	1.00	5.00×10^{-3}	0.103	0.194	1.069
HSB40	135.4	0.90	85.4	26.1	HL	1	2.5817	1.974×10^{-5}	1.10	4.00×10^{-3}	0.883	0.282	3.563
					HL	2	2.7921	2.000×10^{-5}	1.10	6.00×10^{-3}	0.927	0.241	3.792
					HL	M	3.5394	1.896×10^{-5}	0.95	2.00×10^{-2}	0.923	0.265	4.486

HSS: Mix with 1 per cent cement and 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	c b	R^2	SEE	
HSS17	80.0	0.20	80.5	39.3	HL	1	0.0930	8.554×10^{-7}	1.00	2.00×10^{-4}	0.939	0.009	0.147
					HL	2	Note 2						
					HL	M	0.1179	6.139×10^{-7}	1.10	4.50×10^{-4}	0.933	0.009	0.152
HSS18	78.5	0.52	81.3	40.0		1	Note 1						
						2	Note 2						
						M	Note 1						
HSS19	80.6	0.85	80.8	36.7	HL	1	1.2773	6.850×10^{-6}	0.96	2.60×10^{-3}	0.972	0.070	1.618
					HL	2	0.5576	1.755×10^{-6}	0.85	9.00×10^{-3}	0.958	0.025	0.644
					HL	M	0.8710	3.340×10^{-6}	0.75	7.00×10^{-3}	0.960	0.044	1.026
HSS20	137.5	0.19	80.3	34.3		1	Note 2				0.960	0.010	0.156
					HL	2	0.1422	2.990×10^{-7}	1.56	3.70×10^{-4}	0.858	0.009	0.152
					HL	M	0.1448	1.587×10^{-7}	0.75	5.00×10^{-3}			
HSS21			81.5	15.8		1	Note 7						
						2	Note 7						
						M	Note 7						
HSS22	138.5	0.86	80.1	36.2	HL	1	0.8718	4.760×10^{-6}	1.25	6.50×10^{-4}	0.983	0.043	1.102
					HL	2	0.3789	1.760×10^{-6}	1.20	3.50×10^{-4}	0.968	0.024	0.464
					HL	M	0.6142	3.380×10^{-6}	1.09	6.00×10^{-4}	0.984	0.028	0.775
HSS23	78.8	0.17	81.0	22.4		1	Note 2						0.338
					HL	2	0.3078	6.230×10^{-7}	1.15	1.40×10^{-3}	0.986	0.010	0.195
					HL	M	0.1549	7.653×10^{-7}	0.75	2.90×10^{-3}	0.860	0.013	
HSS24	78.4	0.56	80.5	25.3	HL	1	0.9050	3.057×10^{-6}	1.05	1.90×10^{-3}	0.971	0.046	1.059
					HL	2	0.1759	5.938×10^{-7}	1.30	1.00×10^{-3}	-0.990	0.054	8.089
					HL	M	0.4900	1.024×10^{-6}	0.86	4.50×10^{-3}	0.950	0.025	5.489
HSS25	81.9	0.83	80.1	22.8	HL	1	2.3950	5.249×10^{-6}	0.95	1.60 E-02	0.930	0.156	2.659
					HL	2	7.5360	1.112×10^{-5}	1.60	6.00×10^{-3}	0.954	0.590	8.089
					HL	M	5.0800	8.284×10^{-6}	1.15	8.00×10^{-3}	0.925	0.423	5.489
HSS26	140.7	0.15	80.5	18.4	HL	1	0.2050	1.130×10^{-6}	0.88	1.00×10^{-3}	0.898	0.019	0.261
					HL	2	0.2121	8.067×10^{-7}	1.05	5.40×10^{-4}	0.985	0.008	0.253
					HL	M	0.2690	9.011×10^{-7}	0.85	1.00×10^{-3}	0.932	0.019	0.301
HSS27	140.0	0.55	80.9	28.1	HL	1	0.7085	1.860×10^{-6}	0.90	9.00×10^{-3}	0.639	0.094	0.799
					HL	2	1.1810	1.939×10^{-6}	1.15	1.60×10^{-3}	0.968	0.065	1.277
					HL	M	0.8000	1.868×10^{-6}	0.80	8.00×10^{-3}	0.885	0.059	0.891
HSS28	140.3	0.86	81.1	27.2		1	Note1						
					HL	2	4.2500	7.240×10^{-6}	1.36	3.00×10^{-3}	0.990	0.152	4.610
					HL	M	1.3300	5.390×10^{-6}	1.05	4.00×10^{-3}	0.916	0.106	1.536

HSS: Mix with 1 per cent cement and 2.25 per cent foamed bitumen (continued)

HSS29	81.8	0.20	87.2	56.4		1 2 M	Note 1 Note 1 Note 1						
HSS30	81.5	0.56	87.1	54.7	HL HL HL	1 2 M	0.4970 0.3165 0.5360	9.963×10^{-7} 5.429×10^{-7} 6.685×10^{-7}	1.10 1.10 1.00	2.03×10^{-3} 8.00×10^{-4} 1.90×10^{-3}	0.950 0.923 0.950	0.028 0.024 0.032	0.547 0.345 0.569
HSS31	82.6	0.91	87.3	57.0	HL HL HL	1 2 M	1.4850 1.8160 1.6700	2.570×10^{-6} 4.960×10^{-6} 3.325×10^{-6}	1.00 1.05 0.80	8.00×10^{-3} 5.00×10^{-3} 3.30×10^{-2}	0.985 0.962 0.992	0.047 0.099 0.031	1.602 2.036 1.792
HSS32	141.1	0.21	87.5	53.5		1 2 M	Note 1 Note 1 Note 1						0.069 0.143 0.116
HSS33	147.0	0.60	87.1	55.8	HL HL	1 2 M	0.1002 0.7730 Note 1	6.674×10^{-7} 1.023×10^{-6}	1.10 1.50	1.00×10^{-3} 2.90×10^{-3}	-2.042 0.994	0.045 0.017	0.135 0.823
HSS34	142.5	1.02	86.8	60.9		1 2 M	Note 1 Note 1 Note 1						
HSS35	81.4	0.20	87.5	53.8	HL HL HL	1 2 M	0.0696 0.0893 0.2025	2.438×10^{-6} 1.455×10^{-6} 3.425×10^{-7}	1.52 0.75 0.75	1.50×10^{-4} 3.50×10^{-3} 2.00×10^{-3}	0.991 0.957 0.862	0.004 0.006 0.016	0.191 0.161 0.219
HSS36	79.3	0.54	87.8	53.8	HL HL HL	1 2 M	0.6590 0.3945 0.3960	2.182×10^{-6} 1.500×10^{-6} 3.745×10^{-7}	0.81 1.00 1.00	5.00×10^{-3} 1.70×10^{-3} 1.08×10^{-2}	0.977 0.527 0.805	0.029 0.063 0.028	0.768 0.469 0.411
HSS37	82.1	0.76	86.9	56.0	HL HL HL	1 2 M	0.3880 0.5900 0.5335	2.110×10^{-6} 1.950×10^{-6} 1.549×10^{-6}	0.75 1.00 0.70	1.34×10^{-2} 2.70×10^{-3} 1.80×10^{-2}	0.838 0.989 0.954	0.032 0.018 0.023	0.482 0.668 0.610
HSS38	143.7	0.23	84.7	41.9	HL HL HL	1 2 M	0.2310 0.0988 0.1800	4.253×10^{-7} 2.258×10^{-7} 4.512×10^{-7}	0.83 1.00 0.80	3.50×10^{-3} 4.00×10^{-4} 2.50×10^{-3}	0.950 0.541 0.811	0.012 0.014 0.015	0.252 0.111 0.203
HSS39	138.7	0.57	87.2	50.9	HL HL HL	1 2 M	0.8090 0.2471 0.4957	2.460×10^{-6} 7.372×10^{-7} 1.216×10^{-6}	1.10 0.72 0.95	2.50×10^{-3} 6.00×10^{-3} 7.20×10^{-3}	0.985 0.840 0.972	0.029 0.020 0.018	0.932 0.284 0.562
HSS40	140.4	0.84	86.8	40.3	HL HL HL	1 2 M	2.1740 1.3210 1.1540	6.100×10^{-6} 5.280×10^{-6} 3.348×10^{-6}	0.88 0.89 0.90	9.00×10^{-3} 1.00×10^{-2} 1.00×10^{-2}	0.984 0.991 0.958	0.080 0.034 0.055	2.472 1.583 1.303

HSA: Mix with 1 per cent cement and 3.0 per cent foamed bitumen

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	c b	R^2	SEE	
HSA17	80.6	0.22	81.7	55.5	1	HL	0.1197	5.800×10^{-7}	0.99	5.10×10^{-4}	0.951	0.007	0.149
					2	HL	0.0750	4.344×10^{-7}	1.12	4.50×10^{-4}	0.957	0.004	0.098
					M	HL	0.2285	4.907×10^{-7}	0.85	3.00×10^{-3}	0.914	0.014	0.259
HSA18	79.9	0.57	82.2	57.2	1	HL	1.0700	1.110×10^{-5}	1.15	9.00×10^{-4}	0.939	0.108	1.621
					2	HL	0.6080	6.020×10^{-6}	1.20	8.30×10^{-4}	0.903	0.074	0.907
					M	HL	1.1330	8.361×10^{-6}	1.16	1.20×10^{-3}	0.935	0.105	1.547
HSA19	79.7	1.02	81.4	61.0	1	DE	1.7929	1.736	0.00	7.23×10^{-3}	1.000	0.058	8.900
					2	DE	2.1378	2.185	0.00	4.47×10^{-3}	1.000	0.063	10.277
					M	DE	5.4436	1.165	0.00	1.67×10^{-2}	1.000	0.035	9.924
HSA20	139.1	0.21	81.9	57.3			Note2 Note1						
					M	HL	0.2460	8.330×10^{-7}	1.10	9.00×10^{-4}	0.673	0.035	0.222
HSA21	138.4	0.69	80.3	52.1	1	HL	0.6290	4.062×10^{-6}	1.10	1.06×10^{-3}	0.869	0.071	0.831
					2	HL	1.0350	1.110×10^{-5}	0.95	3.60×10^{-3}	0.982	0.050	1.553
					M	HL	0.8400	7.250×10^{-6}	1.15	1.70×10^{-3}	0.883	0.092	1.178
HSA22	139.3		81.1	56.3	1	HL	Note 7						
					2	HL	Note 7						
					M	HL	Note 7						
HSA22a	142.0	0.99	81.1	56.3	1	HL	1.1268	2.040×10^{-5}	2.15	3.40×10^{-4}	0.950	0.142	2.159
					2		Note 1						
					M	HL	1.0000	1.350×10^{-5}	3.10	2.00×10^{-4}	0.960	0.102	1.687
HSA23	80.1	0.21	81.5	32.3	1		Note1	1.810×10^{-7}	1.05	6.00×10^{-4}	0.968	0.003	0.083
					2	HL	0.0730	3.140×10^{-7}	1.15	9.00×10^{-4}	0.904	0.014	0.219
					M	HL	0.2000						
HSA24	79.1	0.52	81.4	22.0	1	HL	0.3870	2.760×10^{-6}	1.00	1.00×10^{-3}	0.444	0.074	0.522
					2	HL	0.8820	3.170×10^{-6}	1.05	2.00×10^{-3}	0.984	0.035	1.037
					M	HL	0.4581	3.000×10^{-6}	0.82	2.50×10^{-3}	0.878	0.044	0.607
HSA25	78.6	0.89	81.5	27.1	1	HL	3.3390	5.960×10^{-6}	1.30	3.00×10^{-3}	0.851	0.408	3.635
					2	HL	3.0200	6.422×10^{-6}	1.45	2.00×10^{-3}	0.622	0.548	3.339
					M	HL	3.5740	6.930×10^{-6}	1.25	3.90×10^{-3}	0.673	0.599	3.912
HSA26	136.7	0.33	76.3	19.9	1	HL	0.2345	8.050×10^{-7}	1.25	7.00×10^{-4}	0.969	0.013	0.265
					2	HL	0.0857	5.111×10^{-7}	3.00	8.00×10^{-4}	0.606	0.011	0.111
					M	HL	0.1852	5.185×10^{-7}	1.20	5.00×10^{-4}	0.685	0.024	0.213
HSA27	137.7	0.60	80.6	25.2	1	HL	Note1						
					2	HL	Note1						
					M	HL	Note1						

HSA: Mix with 1 per cent cement and 3.0 per cent foamed bitumen (continued)

HSA28	140.6	0.90	81.5	27.8	1 2 M	HL HL HL	2.4000 2.8500 2.5890	2.850×10^{-5} 6.000×10^{-5} 1.657×10^{-5}	1.50 1.50 1.30	2.00×10^{-3} 3.00×10^{-3} 6.00×10^{-3}	0.951 0.864 0.435	0.191 0.384 0.564	2.942 4.034 2.887
HSA29	83.7	0.19	86.6	52.6	1 2 M	 HL 	Note2 0.0607 Note1	9.463×10^{-8}	 1.05 	 2.20×10^{-4} 	 0.785 	 0.007 	 0.066
HSA30	81.0	0.51	88.2	72.0	1 2 M	HL HL HL	0.2840 0.7690 0.6298	8.279×10^{-7} 1.547×10^{-6} 6.241×10^{-7}	1.30 1.10 0.80	3.00×10^{-3} 2.00×10^{-3} 5.00×10^{-3}	0.901 0.979 0.936	0.018 0.032 0.036	0.325 0.847 0.654
HSA31	79.1	0.80	87.9	64.1	1 2 M	HL HL HL	1.0300 2.5629 1.9550	6.080×10^{-6} 3.525×10^{-6} 3.115×10^{-6}	0.75 1.05 0.90	1.10×10^{-2} 6.40×10^{-3} 1.20×10^{-2}	0.895 0.983 0.903	0.086 0.097 0.136	1.344 2.744 2.130
HSA32	139.4	0.20	86.9	63.3	1 2 M	HL HL HL	0.1424 0.3471 0.4440	2.847×10^{-7} 4.167×10^{-7} 8.015×10^{-5}	1.50 1.00 0.85	2.50×10^{-4} 3.00×10^{-3} 3.80×10^{-3}	0.924 0.900 0.900	0.011 0.022 0.030	0.156 0.368 0.447
HSA33	140.2	0.52	87.8	66.3	1 2 M	HL HL HL	0.5563 0.6540 0.9100	1.400×10^{-6} 1.170×10^{-6} 1.488×10^{-6}	1.10 1.00 0.80	1.90×10^{-3} 1.80×10^{-3} 3.80×10^{-3}	0.968 0.903 0.836	0.027 0.052 0.084	0.613 0.713 0.963
HSA34	140.6	0.81	87.8	64.3	1 2 M	HL HL HL	0.4570 4.8000 1.9880	7.765×10^{-6} 5.300×10^{-6} 8.067×10^{-6}	1.50 1.45 0.99	2.00×10^{-3} 5.00×10^{-3} 4.50×10^{-3}	0.101 0.994 0.940	0.171 0.125 0.150	0.847 5.024 2.389
HSA35	80.4	0.21	87.5	31.0	1 2 M	HL HL HL	0.1341 0.0760 0.1530	5.760×10^{-7} 2.340×10^{-7} 4.236×10^{-7}	1.34 1.30 1.03	3.20×10^{-4} 8.00×10^{-4} 3.30×10^{-4}	0.947 0.847 0.903	0.011 0.008 0.014	0.161 0.086 0.175
HSA36	81.8	0.56	87.4	26.4	1 2 M	HL HL HL	1.0150 0.3927 0.4649	4.029×10^{-6} 3.022×10^{-6} 2.562×10^{-6}	1.30 1.30 1.20	7.00×10^{-4} 2.00×10^{-3} 3.00×10^{-3}	0.987 0.854 0.875	0.043 0.041 0.042	1.216 0.544 0.598
HSA37	79.8	1.14	87.7	31.1	1 2 M	DE DE DE	0.0015 0.0009 0.0007	4.991 4.966 4.960	0.01 0.01 0.01	1.14×10^{-3} 7.04×10^{-4} 1.03×10^{-3}	1.000 1.000 0.999	0.051 0.036 0.073	8.664 5.884 6.979
HSA38	139.8	0.22	86.3	25.2	1 2 M	HL HL HL	0.1267 0.2394 0.2139	9.691×10^{-7} 8.967×10^{-7} 9.553×10^{-7}	1.10 1.05 1.00	2.00×10^{-4} 5.00×10^{-4} 6.50×10^{-4}	0.813 0.972 0.936	0.018 0.012 0.016	0.175 0.284 0.264
HSA39	139.1	0.54	87.8	21.0	1 2 M	 HL HL	Note1 0.9600 0.7200	5.440×10^{-6} 1.900×10^{-6}	 1.30 1.10	 9.00×10^{-4} 1.50×10^{-3}	 0.883 0.804	 0.112 0.088	 1.231 0.829
HSA40	139.6	0.89	87.3	23.4	1 2 M	HL HL HL	1.5500 0.7530 0.7915	1.810×10^{-5} 6.920×10^{-6} 9.160×10^{-6}					

HAS: Mix with 2 per cent cement and 2.25 per cent foamed bitumen

Sample	Confining stress (kPa)	Stress Ratio	Relative density (%)	Saturation (%)	Model	LVDT	Model Coefficients				Statistics		End PD (mm)
							a Q	m A	b d	c b	R^2	SEE	
HAS17	81.0	0.18	81.5	56.7	1 2 M	HL HL HL	0.0729 0.0576 0.1120	9.277×10^{-7} 3.415×10^{-7} 2.340×10^{-7}	1.20 1.75 1.15	4.50×10^{-5} 6.00×10^{-4} 4.00×10^{-4}	0.967 0.901 0.852	0.006 0.004 0.011	0.119 0.074 0.122
HAS18	80.9	0.49	81.8	59.1	1 2 M	 HL HL	Note 1 0.8490 0.2238	 4.800×10^{-6} 2.566×10^{-6}	 0.95 1.00	 2.20×10^{-3} 4.00×10^{-4}	 0.990 0.647	 0.029 0.045	 1.087 0.355
HAS19	81.6	0.93	80.9	57.8	1 2 M	HL DE HL	2.6240 2.5850 1.0020	2.107×10^{-4} 1.455 1.512×10^{-4}	1.30 0.00 1.25	5.00×10^{-4} 2.11×10^{-3} 8.00×10^{-3}	0.989 0.996 0.998	0.354 0.077 0.100	13.152 5.560 8.510
HAS20	137.3	0.19	81.8	56.8	1 2 M	 	Note 2 Note 2 Note 1	 	 	 	 	 	
HAS21	137.5	0.58	81.1	53.5	1 2 M	HL HL HL	0.2461 1.0310 0.5771	5.958×10^{-6} 1.057×10^{-5} 6.610×10^{-6}	1.00 1.30 1.10	3.00×10^{-4} 7.00×10^{-4} 1.00×10^{-3}	0.840 0.922 0.904	0.048 0.117 0.069	0.543 1.557 0.893
HAS22	138.2	0.84	81.7	56.9	1 2 M	HL HL HL	2.0660 4.4990 3.3000	1.036×10^{-4} 1.204×10^{-4} 1.100×10^{-4}	2.50 1.20 1.50	3.00×10^{-3} 6.00×10^{-3} 9.00×10^{-3}	0.962 0.951 0.956	0.354 0.582 0.461	7.269 10.454 8.790
HAS23	77.5	0.21	81.3	28.1	1 2 M	HL HL HL	0.0840 0.0629 0.1034	5.320×10^{-7} 7.752×10^{-7} 8.737×10^{-7}	0.95 1.50 1.10	5.50×10^{-4} 4.00×10^{-5} 6.00×10^{-4}	0.964 0.833 0.932	0.004 0.010 0.009	0.111 0.101 0.147
HAS24	81.7	0.60	81.0	27.9	1 2 M	HL HL HL	0.2899 0.3435 0.4380	1.750×10^{-6} 1.890×10^{-6} 1.995×10^{-6}	1.13 0.85 0.90	1.10×10^{-3} 2.40×10^{-3} 1.30×10^{-3}	0.952 0.955 0.881	0.018 0.020 0.040	0.376 0.436 0.516
HAS25	80.4	0.90	81.3	28.1	1 2 M	 HL 	Note 2 1.6730 Note 1	 1.970×10^{-5} 	 1.05 	 2.40×10^{-3} 	 0.979 	 0.097 	 2.604 1.020
HAS26	139.2	0.21	81.3	27.9	1 2 M	HL HL HL	0.1249 0.0266 0.1827	1.292×10^{-6} 7.035×10^{-7} 5.000×10^{-7}	0.90 1.20 1.05	6.50×10^{-4} 1.00×10^{-4} 8.50×10^{-4}	0.968 0.983 0.779	0.007 0.002 0.019	0.189 0.061 0.204
HAS27	136.1	0.55	81.6	25.0	1 2 M	HL HL HL	0.2469 0.2767 0.3825	1.510×10^{-6} 1.790×10^{-6} 1.540×10^{-6}	0.90 1.05 0.95	2.00×10^{-3} 4.50×10^{-4} 1.50×10^{-3}	0.971 0.954 0.906	0.011 0.020 0.030	0.322 0.364 0.456
HAS28	135.6	0.84	81.5	22.9	1 2 M	HL HL HL	0.9288 1.3134 1.1463	2.781×10^{-5} 3.130×10^{-5} 2.756×10^{-5}	0.96 1.00 1.10	2.00×10^{-3} 1.90×10^{-3} 1.60×10^{-3}	0.991 0.991 0.981	0.053 0.068 0.085	2.318 2.866 2.519

HAS: Mix with 2 per cent cement and 2.25 per cent foamed bitumen (continued)

HAS29	78.9	0.17	88.0	66.7	1 2 M	HL HL	0.3192 Note 2 0.1107	1.443×10^{-6} 3.863×10^{-7}	1.60 0.90	1.00×10^{-3} 2.00×10^{-3}	0.991 0.562	0.009 0.015	0.391 0.130
HAS30	77.6	0.49	86.8	57.4	1 2 M	HL HL HL	0.3010 0.4131 0.3310	6.550×10^{-7} 6.286×10^{-7} 1.260×10^{-6}	0.95 1.00 1.00	8.50×10^{-4} 1.15×10^{-3} 5.00×10^{-3}	0.921 0.956 0.901	0.022 0.023 0.022	0.325 0.444 0.392
HAS31	80.3	0.72	87.9	62.3	1 2 M	HL HL HL	1.8120 1.8180 2.1496	1.410×10^{-5} 3.140×10^{-5} 9.472×10^{-6}	1.20 1.19 1.15	2.00×10^{-3} 4.50×10^{-3} 4.00×10^{-3}	0.882 0.951 0.926	0.217 0.168 0.177	2.507 3.372 2.615
HAS32	139.1	0.49	87.1	57.0	1 2 M	HL HL HL	0.0689 0.1556 0.1185	3.404×10^{-7} 2.180×10^{-7} 1.650×10^{-7}	1.00 1.25 1.10	5.00×10^{-4} 4.00×10^{-4} 4.80×10^{-4}	0.802 0.951 0.910	0.008 0.009 0.010	0.052 0.009 0.149
HAS33	139.1	0.49	87.1	57.0	1 2 M	 HL HL	Note 8 0.5070 0.6287	 2.943×10^{-6} 4.511×10^{-6}	 1.00 0.95	 1.70×10^{-3} 3.00×10^{-3}	 0.861 0.505	 0.053 0.124	 0.861 0.505
HAS34	136.6	0.80	87.1	54.2	1 2 M	HL HL HL	1.4560 1.4680 1.7910	1.020×10^{-5} 1.050×10^{-5} 9.380×10^{-6}	0.92 1.00 0.90	4.50×10^{-3} 4.50×10^{-3} 1.60×10^{-2}	0.949 0.933 0.914	0.104 0.120 0.139	0.949 0.933 0.914
HAS35	79.2	0.21	86.5	22.5	1 2 M	HL HL HL	0.1783 0.1040 0.1711	1.266×10^{-6} 7.657×10^{-7} 1.201×10^{-6}	1.20 0.93 1.20	2.50×10^{-4} 4.50×10^{-4} 5.00×10^{-4}	0.975 0.902 0.934	0.010 0.010 0.014	0.975 0.902 0.934
HAS36	82.3	0.57	86.4	22.9	1 2 M	HL HL HL	0.3070 0.2866 0.5403	1.550×10^{-6} 1.490×10^{-6} 2.280×10^{-6}	0.86 0.84 0.85	2.00×10^{-3} 1.92×10^{-3} 5.30×10^{-3}	0.958 0.938 0.918	0.018 0.020 0.039	0.958 0.938 0.918
HAS37	75.6	0.96	86.7	27.1	1 2 M	DE DE DE	0.4812 0.5352 0.4469	1.347 1.482 1.933	0.00 0.00 0.00	7.23×10^{-3} 6.48×10^{-3} 7.61×10^{-3}	0.997 0.997 0.994	0.043 0.055 0.080	3.447 4.280 4.313
HAS38	135.7	0.21	86.2	19.0	1 2 M	HL HL HL	0.1510 0.1040 0.1900	8.670×10^{-7} 3.000×10^{-7} 6.199×10^{-7}	1.00 0.90 0.95	4.10×10^{-4} 4.00×10^{-4} 8.50×10^{-4}	0.963 0.921 0.833	0.010 0.008 0.020	0.195 0.118 0.223
HAS39	139.0	0.53	88.3	25.5	1 2 M	HL HL HL	0.4640 0.4760 1.1450	3.550×10^{-6} 2.090×10^{-6} 3.299×10^{-6}	0.95 1.00 0.80	1.00×10^{-3} 1.10×10^{-3} 2.50×10^{-2}	0.931 0.926 0.952	0.040 0.038 0.053	0.634 0.581 1.301
HAS40	Specimen used for static triaxial test												

Appendix H Shrinkage test results

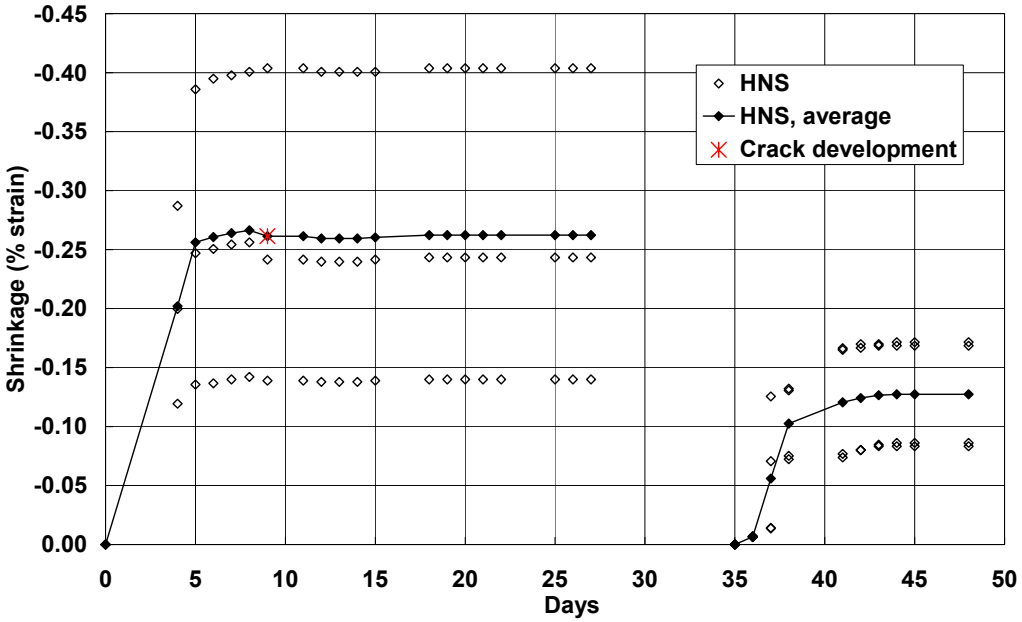


Figure H.1. Mix treated with 2.25% foamed bitumen (HNS)

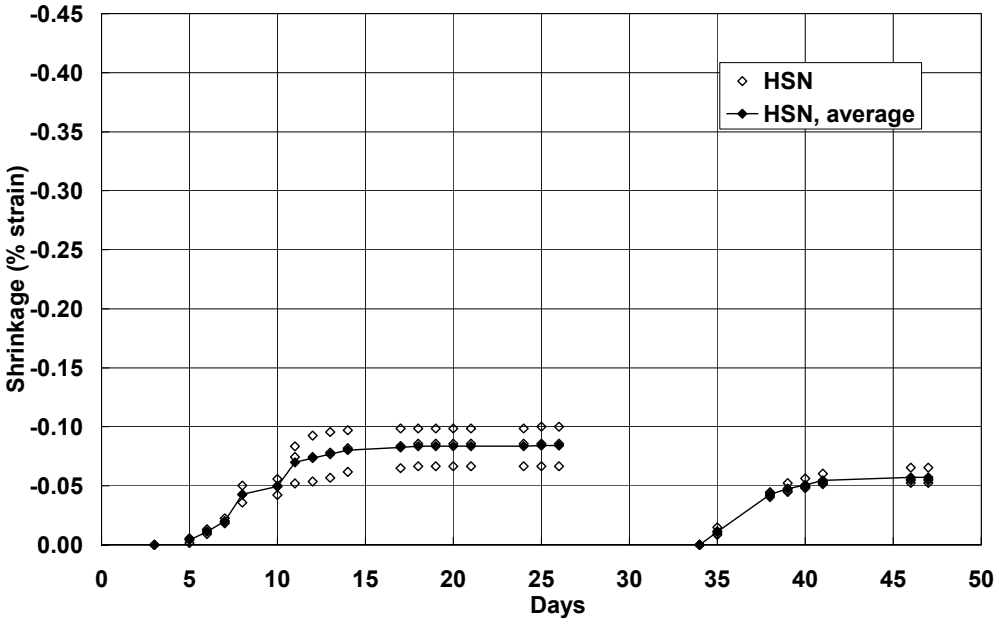


Figure H.2. Mix treated with 1 % cement (HSN)

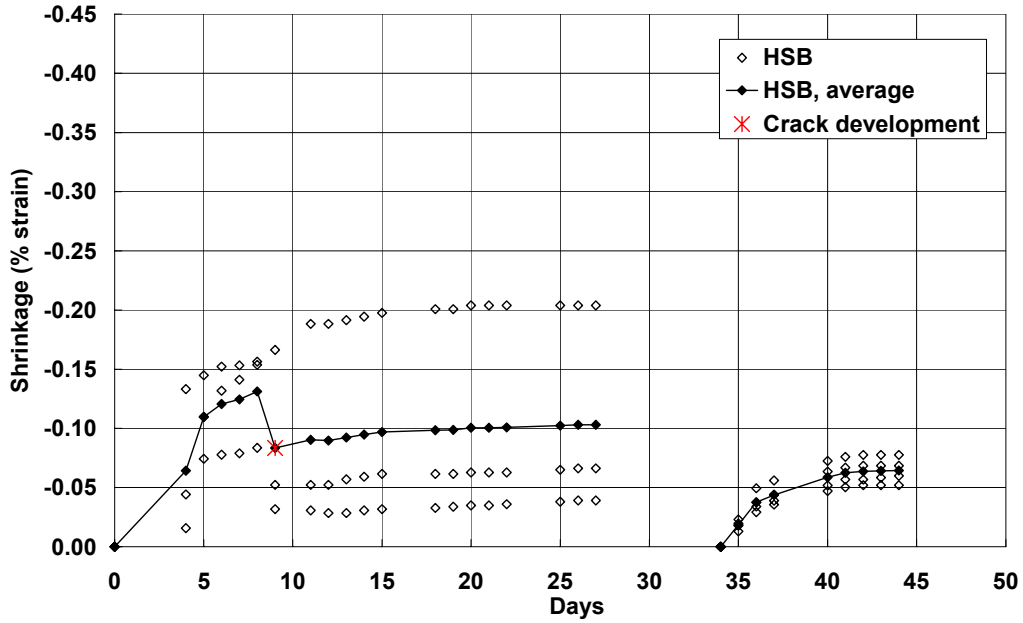


Figure H.3. Mix treated with 1% Cement and 1.5% Foamed Bitumen (HSB)

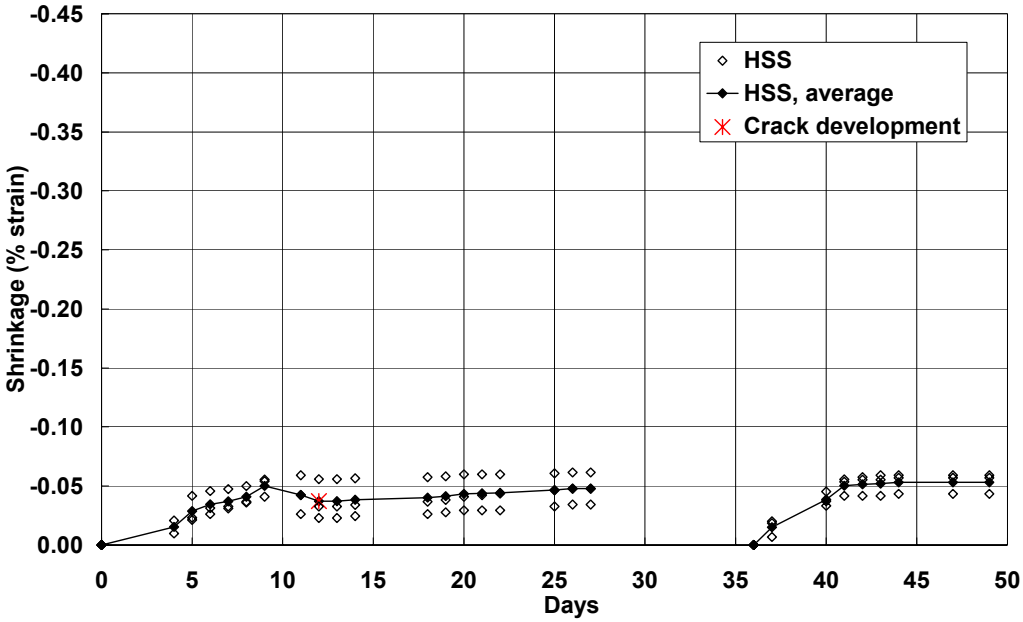


Figure H.4. Mix treated with 1% Cement and 2.25% Foamed Bitumen (HSS)

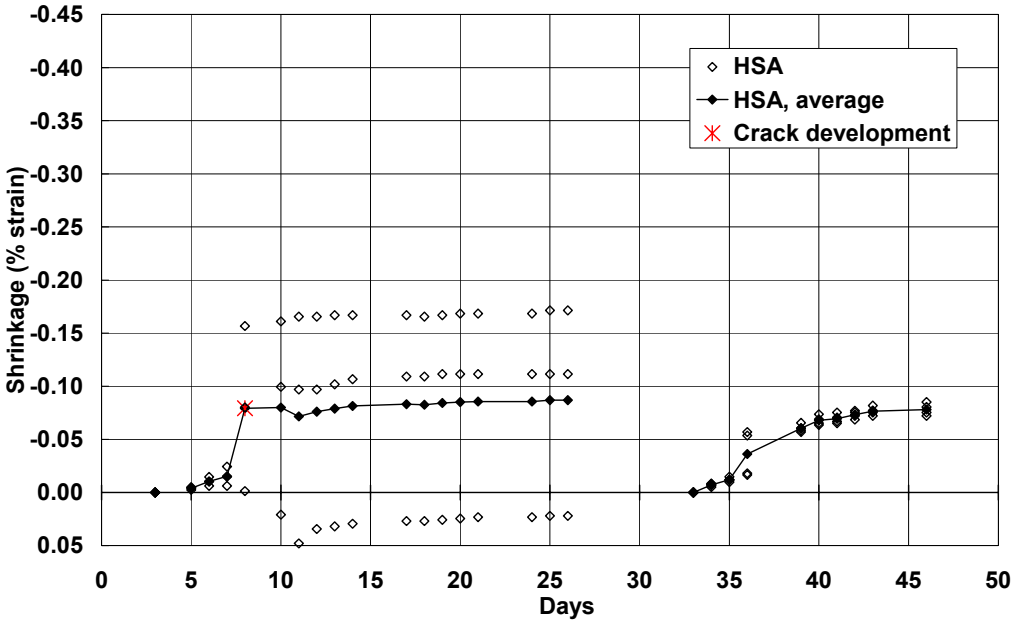


Figure H.5. Mix treated with 1% Cement and 3.00% Foamed Bitumen (HSA)

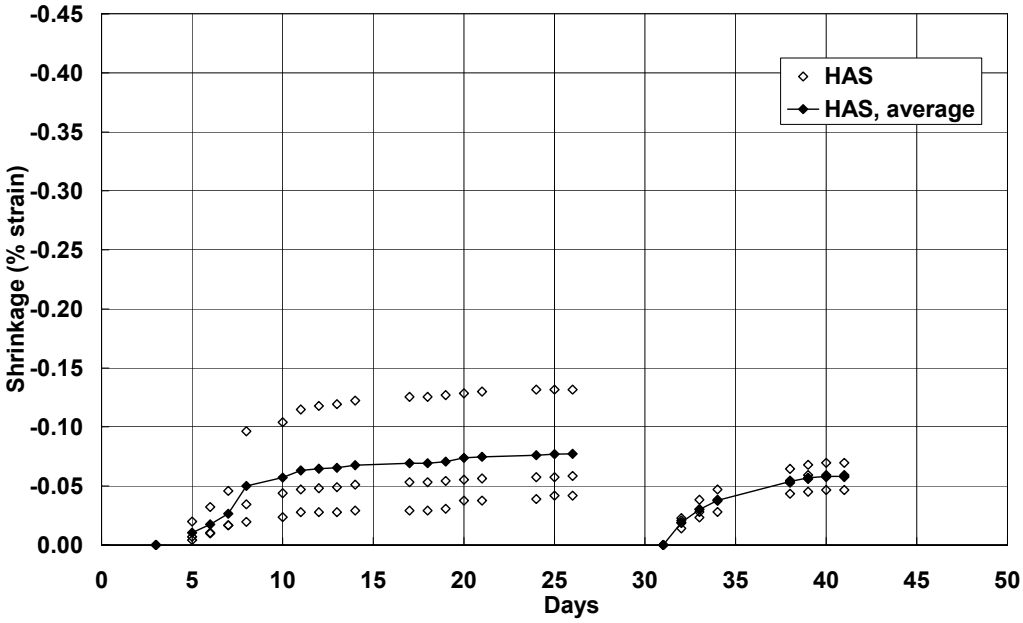


Figure H.5. Mix treated with 2% Cement and 2.25% Foamed Bitumen (HAS)