

D

Measurements Vechtdijk

D.1. Introduction

This appendix treats the results of the grass pull tests that are executed on the Vechtdijk. Measurements were performed at two locations, the first being located at coordinates 52°30'32.8"N 6°14'24.6"E and the second being located at coordinates 52°31'21.2"N 6°11'23.8"E. The dike is characterised by a sandy subsoil. In deep layers, sometimes clay lumps were found during the tests. Four different types of tests have been conducted:

1. Direct pull tests
2. Shear tests
3. Stepwise increased constant load tests
4. Fatigue tests

The tests serve as a means to gain more insight into the physical characteristics of the grass cover, as explained in Chapter 3. Per test type the following graphs have been generated:

- | | |
|---|---|
| <ol style="list-style-type: none">1. Direct pull tests<ul style="list-style-type: none">• Force and displacement over time• Stress-strain diagram• Determination of E-modulus• Root profile (when performed) | <ol style="list-style-type: none">3. Stepwise increased constant load tests<ul style="list-style-type: none">• Force and displacement over time• Stress-strain diagram• Root profile (when performed) |
| <ol style="list-style-type: none">2. Shear tests<ul style="list-style-type: none">• Force and displacement over time• Stress-strain diagram• Determination of G-modulus• Root profile (when performed) | <ol style="list-style-type: none">4. Fatigue tests<ul style="list-style-type: none">• Force and displacement over time• Stress-strain diagram• Strain versus normalized cycles• Mean strain over time• E-modulus versus normalized cycles• Root profile (when performed) |

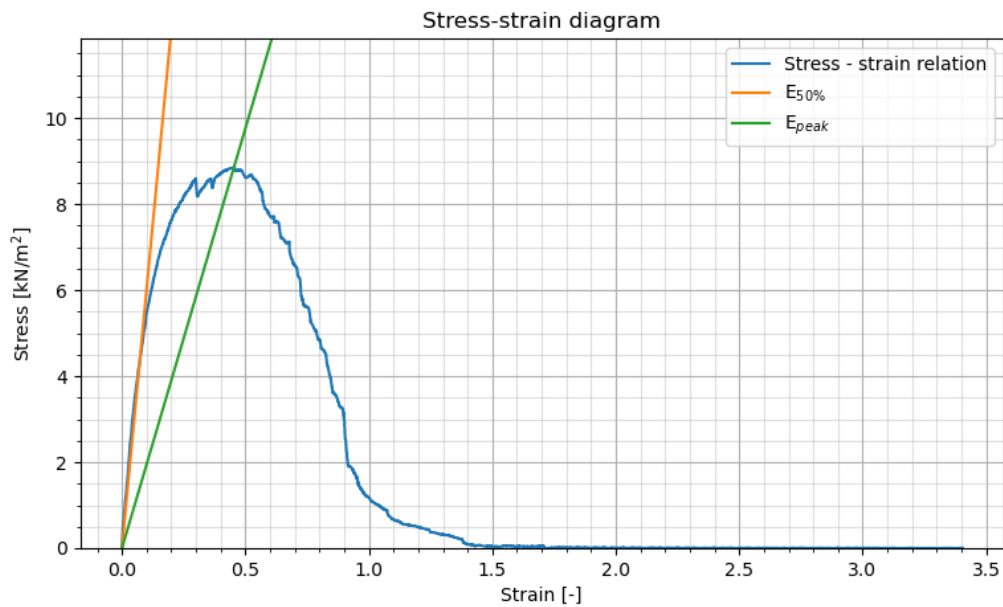
The results for the root profiles may appear inconsistently throughout the results. The process of root counting was found to be time consuming and since measurements did not result in any correlations or trends, it was decided to stop counting. Additionally, note that erroneous tests have been excluded from this overview.

D.2. Direct pull tests - dry

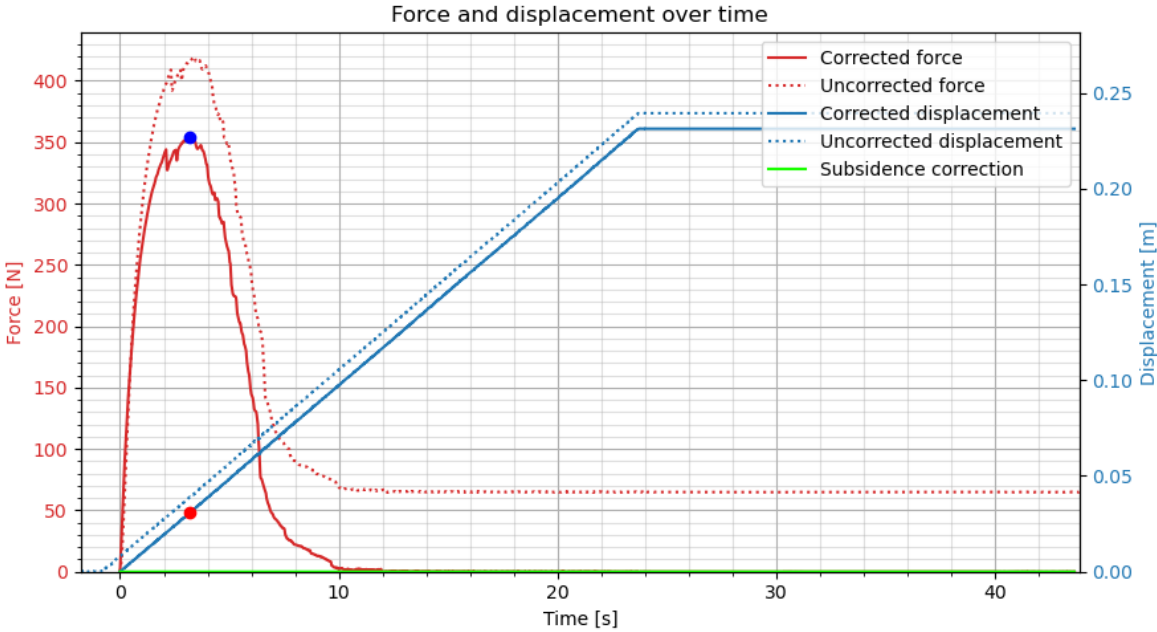
D.2.1. Test01

	Value 1	Value 2	Value 3	Mean
Date	18-02-2021			
Time	13:38:00			
Weight [kg]	64.9			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North			
Percentage of occurrence [%]	40	10	50	
Sod thickness [cm]	9	7	5	7
Root length [cm]	3	2	7	4.9
Maximum stress [kN/m ²]	8.85			
Strain at maximum stress [-]	0.45			
E _{50%} [kN/m ²]	60.44			
E _{peak} [kN/m ²]	19.53			
Comments	Failure plane at location of a pin			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Left



(b) Bottom

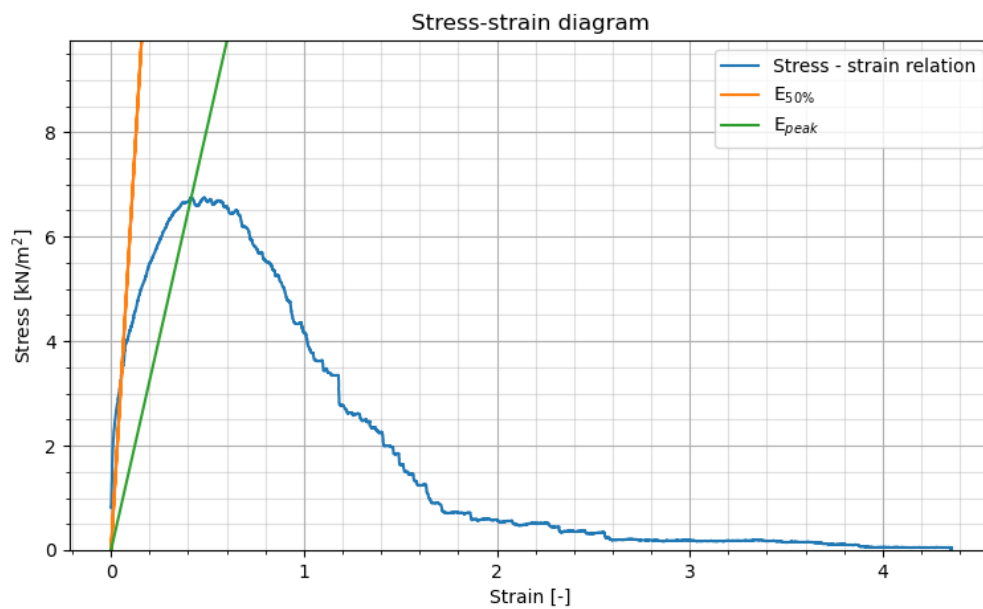


(c) Right

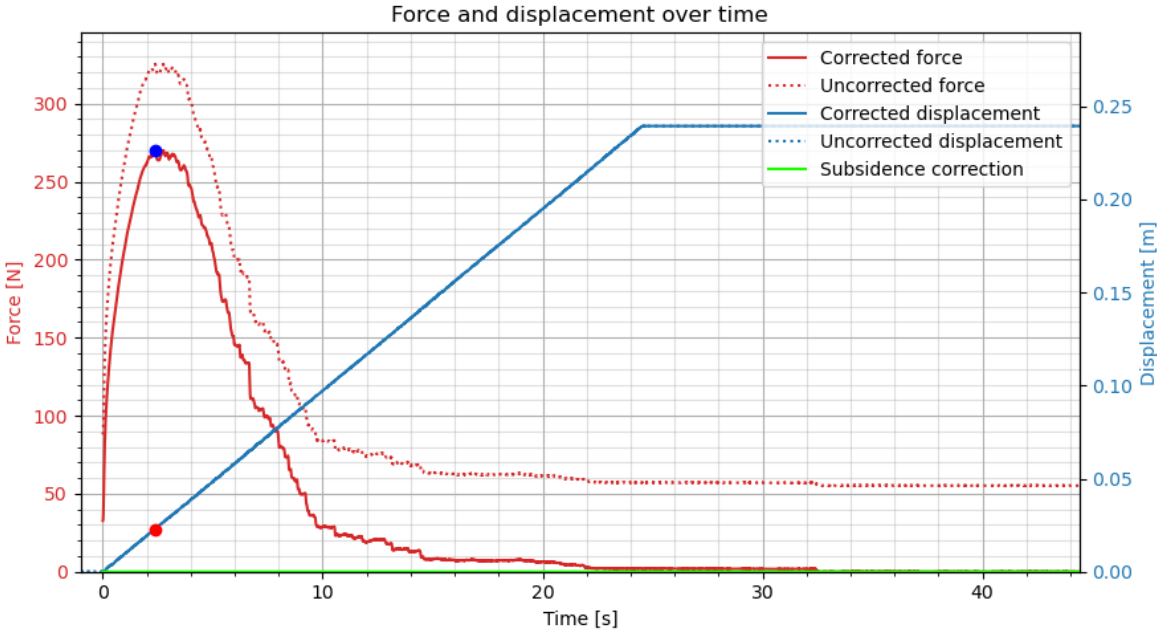
D.2.2. Test02

	Value 1	Value 2	Value 3	Mean
Date	18-02-2021			
Time	15:04:00			
Weight [kg]	55.2			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North			
Percentage of occurrence [%]	40	30	30	
Sod thickness [cm]	7	5	4	6
Root length [cm]	2	3	6	3.5
Maximum stress [kN/m ²]	6.75			
Strain at maximum stress [-]	0.42			
E _{50%} [kN/m ²]	61.62			
E _{peak} [kN/m ²]	16.22			
Comments	Failure plane at location of a pin			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Left



(b) Bottom

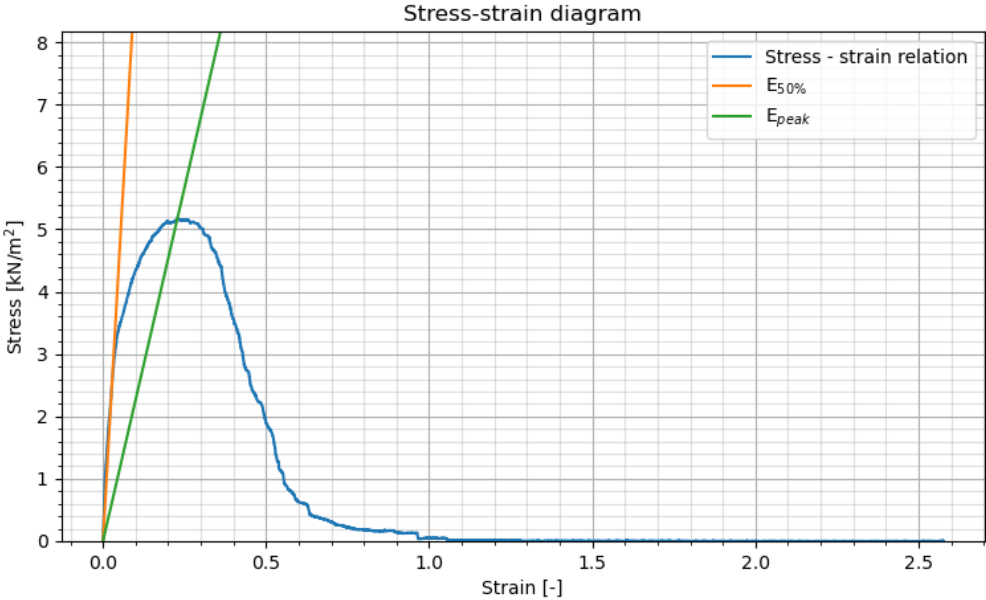


(c) Right

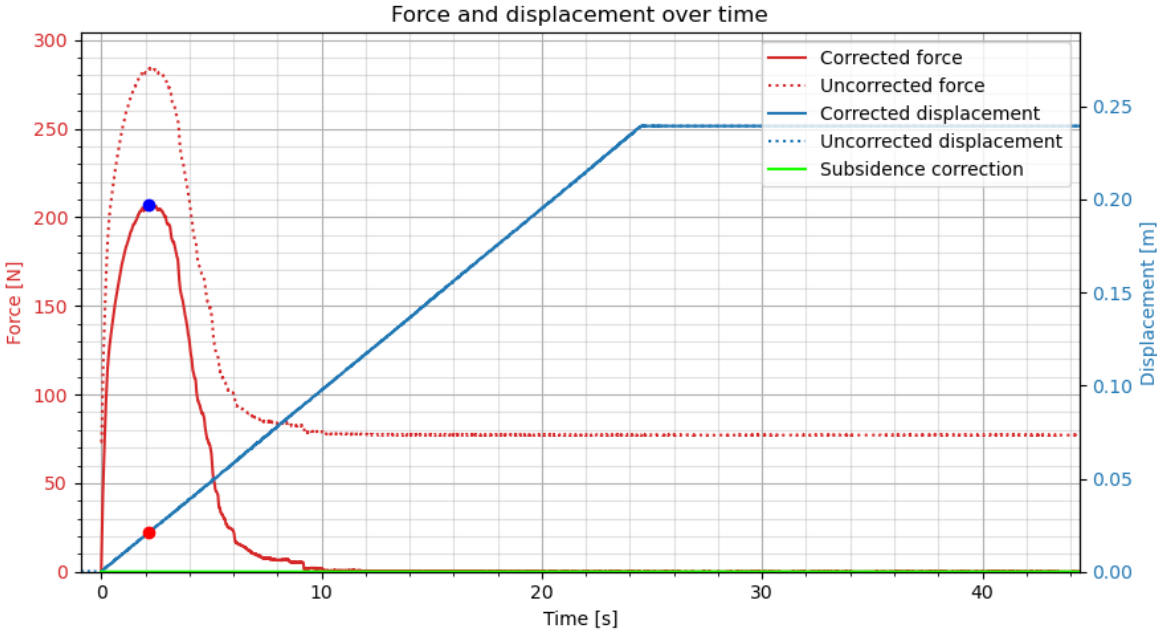
D.2.3. Test03

	Value 1	Value 2	Value 3	Mean
Date	18-02-2021			
Time	15:26:00			
Weight [kg]	77.1			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North			
Percentage of occurrence [%]	50	20	30	
Sod thickness [cm]	12	9	5	9
Root length [cm]	3	4	4	3.5
Maximum stress [kN/m ²]	5.17			
Strain at maximum stress [-]	0.23			
E _{50%} [kN/m ²]	91.35			
E _{peak} [kN/m ²]	22.68			
Comments	Little trouble with connecting pull frame			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Left



(b) Bottom

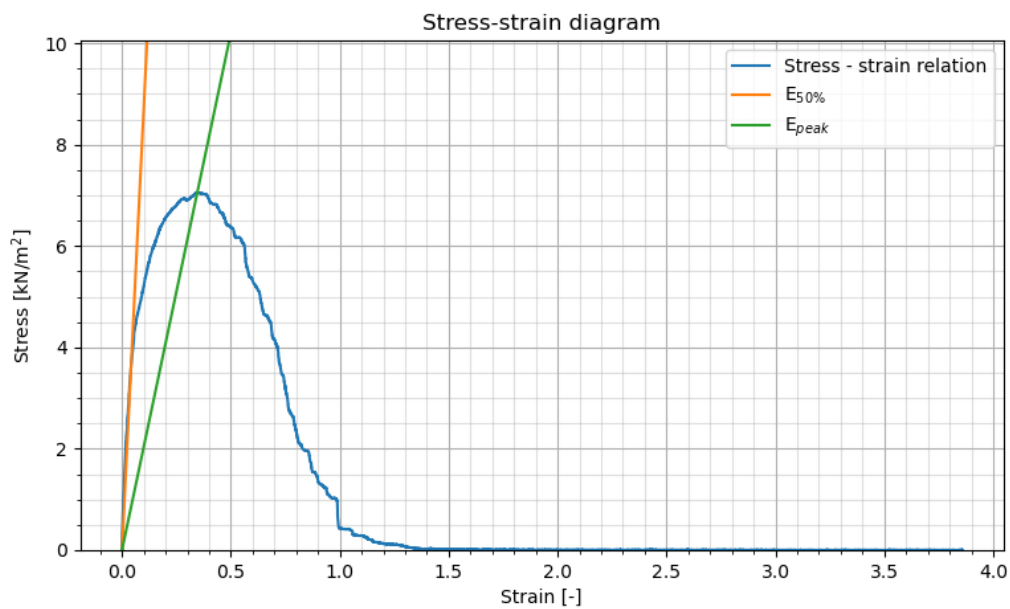


(c) Right

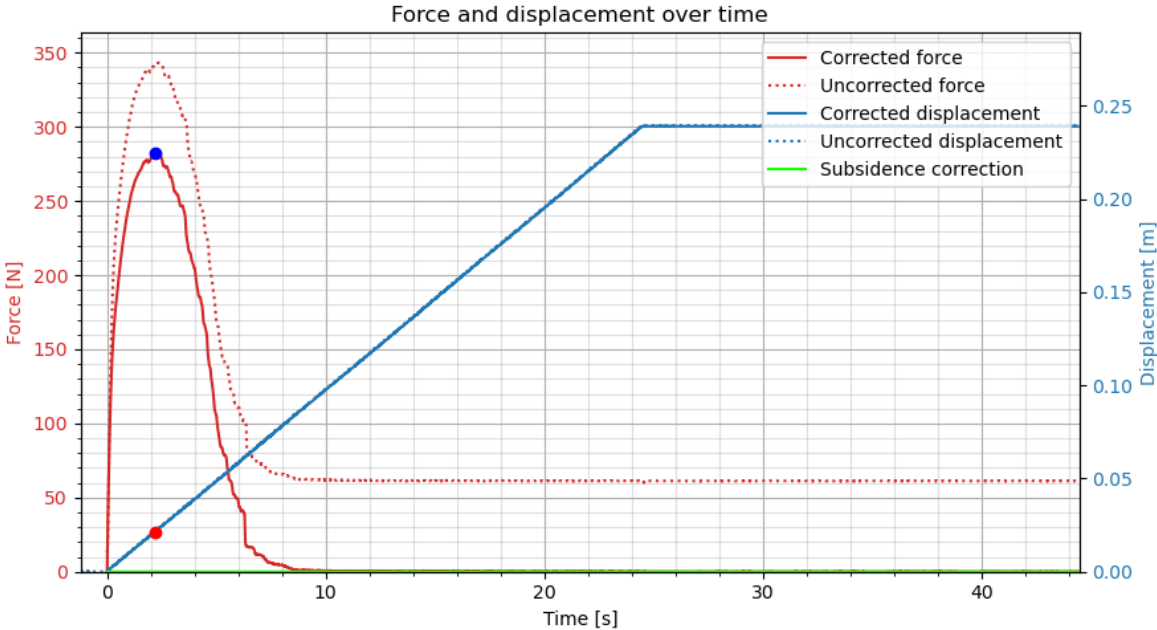
D.2.4. Test04

		Value 1	Value 2	Value 3	Mean
Date		19-02-2021			
Time		15:21:00			
Weight	[kg]	61.2			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	20	20	60	
Sod thickness	[cm]	9	7	5	6
Root length	[cm]	3	5	6	5.2
Maximum stress	[kN/m ²]	7.05			
Strain at maximum stress	[-]	0.35			
E _{50%}	[kN/m ²]	87.29			
E _{peak}	[kN/m ²]	20.41			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

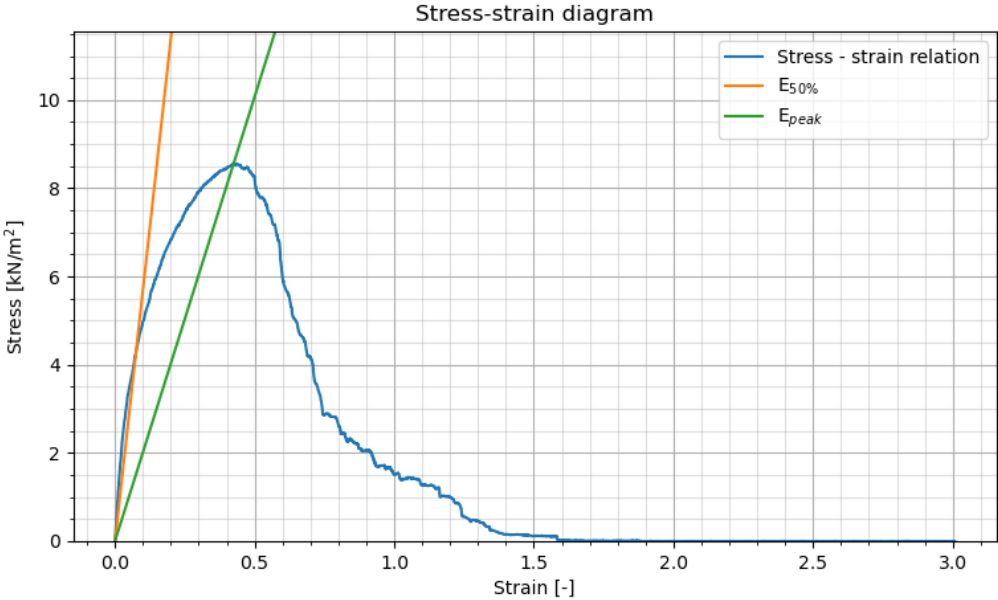


(d) Right

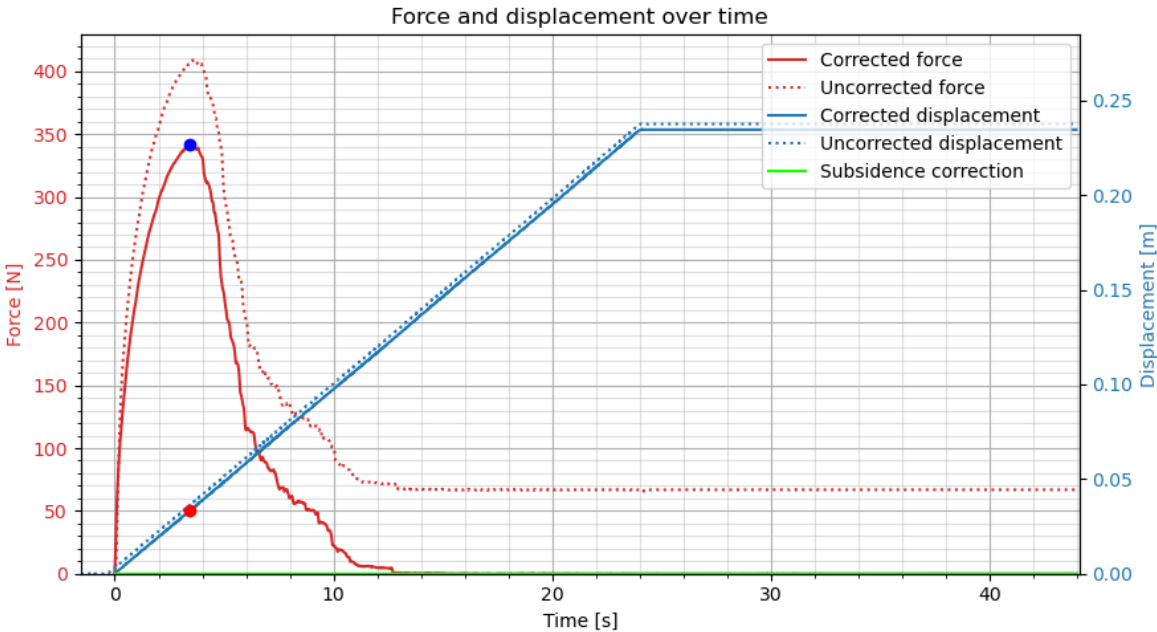
D.2.5. Test05

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		09:52:00			
Weight	[kg]	66.9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	60	10	30	
Sod thickness	[cm]	10	6	4	8
Root length	[cm]	4	6	8	5.4
Maximum stress	[kN/m ²]	8.56			
Strain at maximum stress	[-]	0.42			
E _{50%}	[kN/m ²]	56.94			
E _{peak}	[kN/m ²]	20.15			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

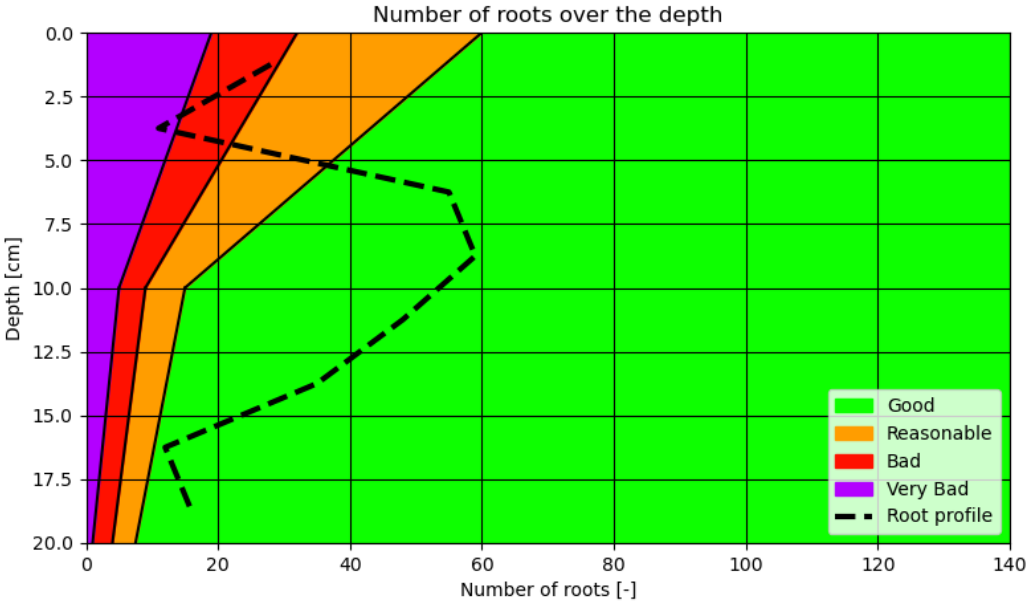


(c) Bottom



(d) Right

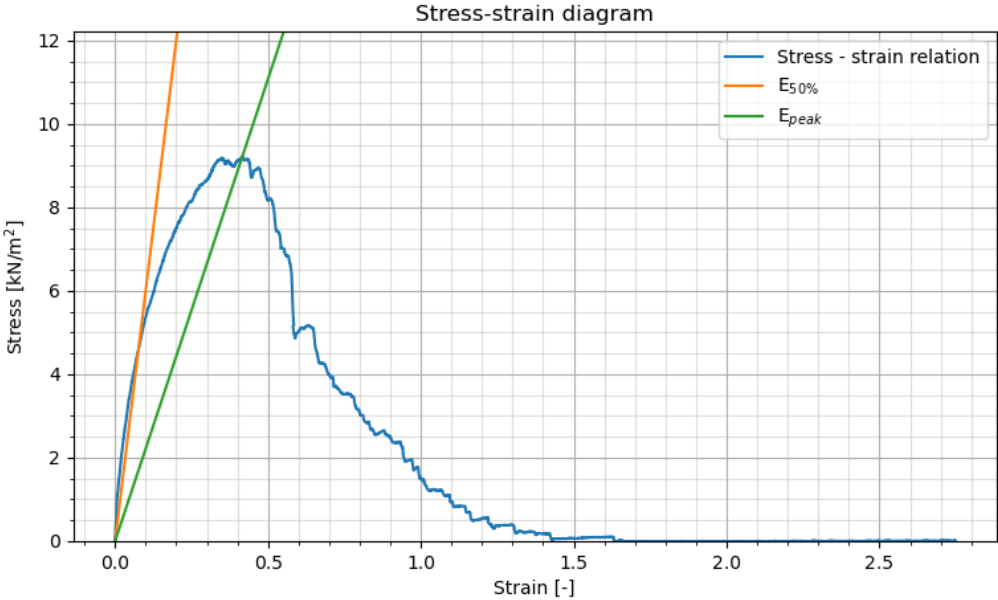
Root profile



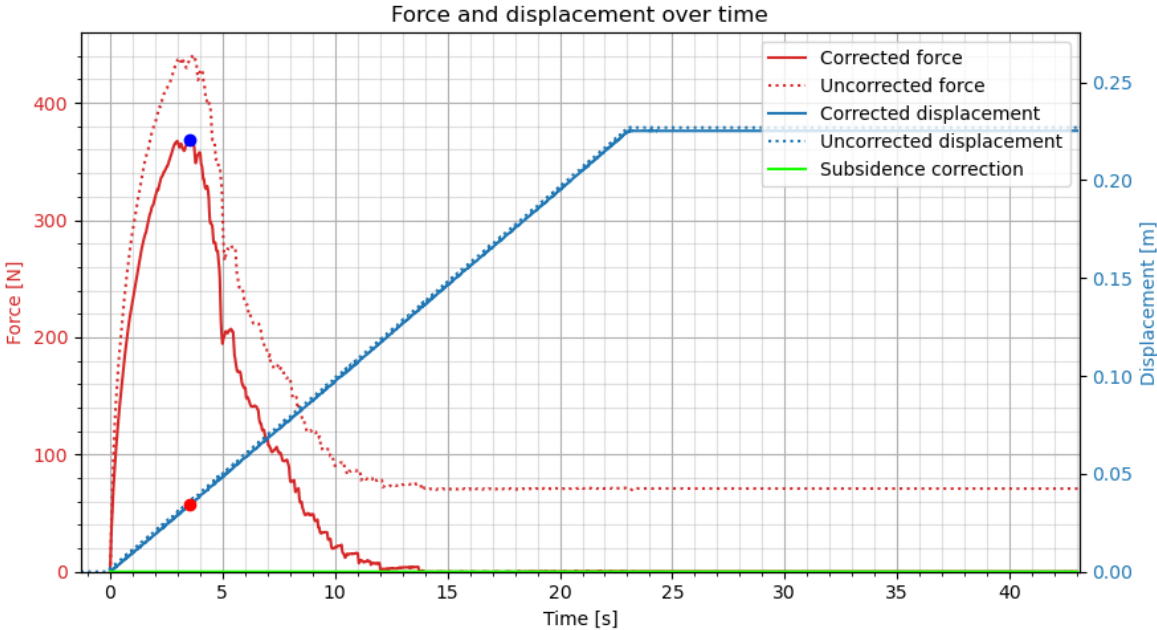
D.2.6. Test06

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		10:03:00			
Weight	[kg]	70.8			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	30	10	60	
Sod thickness	[cm]	12	10	6	8
Root length	[cm]	2	5	4	3.5
Maximum stress	[kN/m ²]	9.22			
Strain at maximum stress	[-]	0.42			
E _{50%}	[kN/m ²]	60.01			
E _{peak}	[kN/m ²]	22.15			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

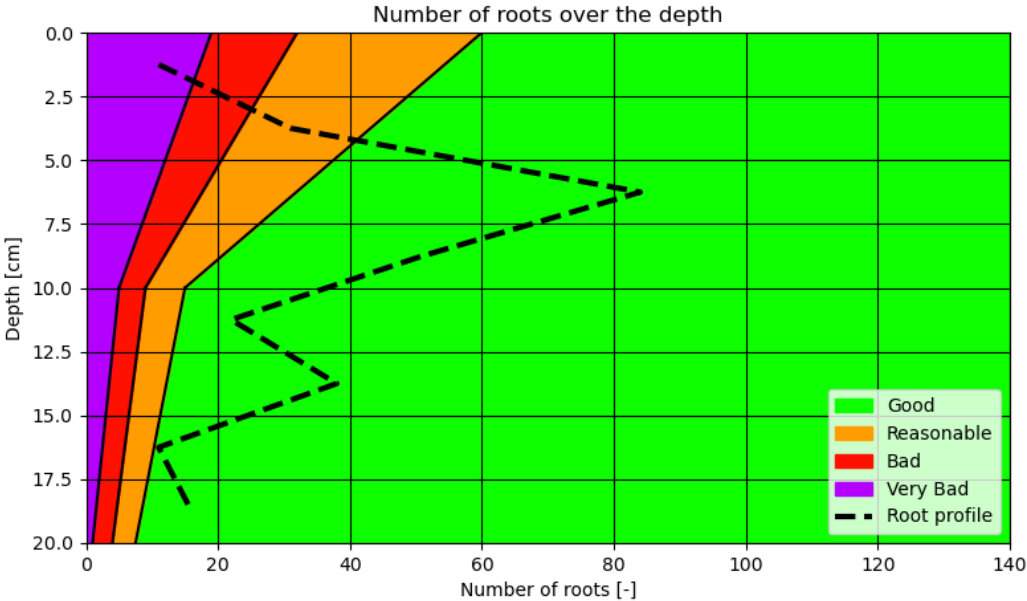


(c) Bottom



(d) Right

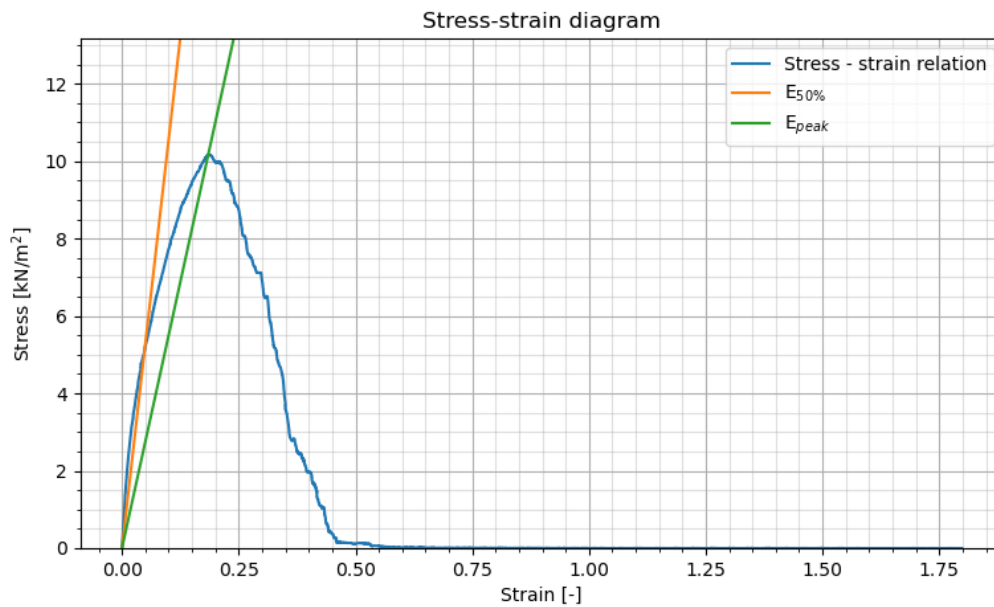
Root profile



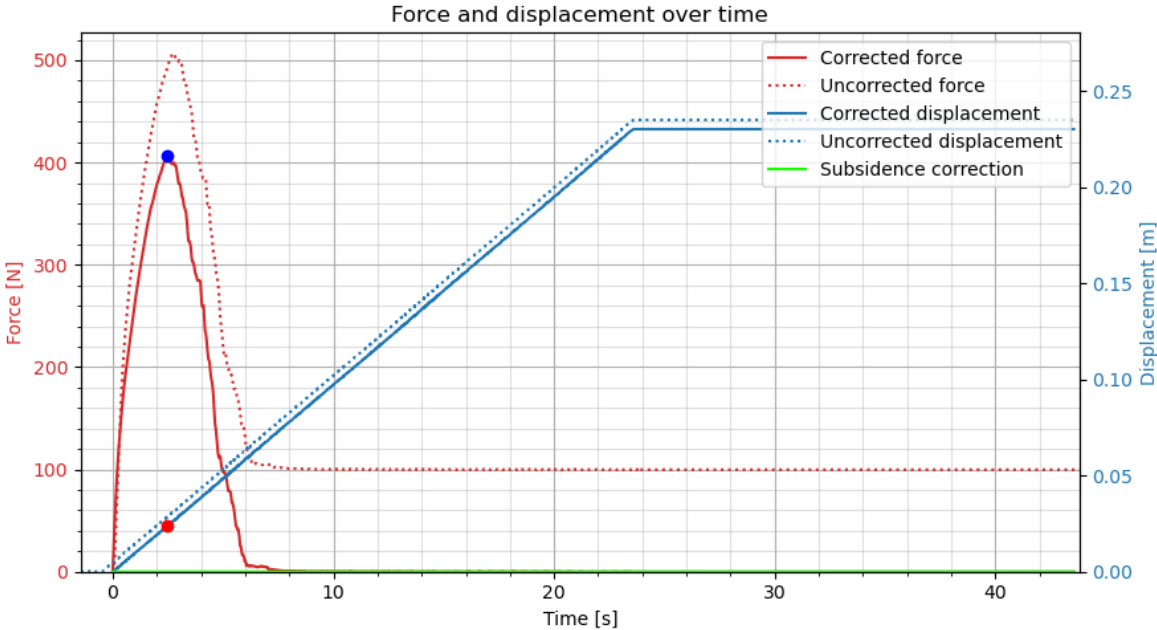
D.2.7. Test08

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		15:49:00			
Weight	[kg]	99.9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	60	20	20	
Sod thickness	[cm]	14	12	10	13
Root length	[cm]	4	4	4	4.0
Maximum stress	[kN/m ²]	10.17			
Strain at maximum stress	[-]	0.18			
E _{50%}	[kN/m ²]	105.64			
E _{peak}	[kN/m ²]	55.05			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

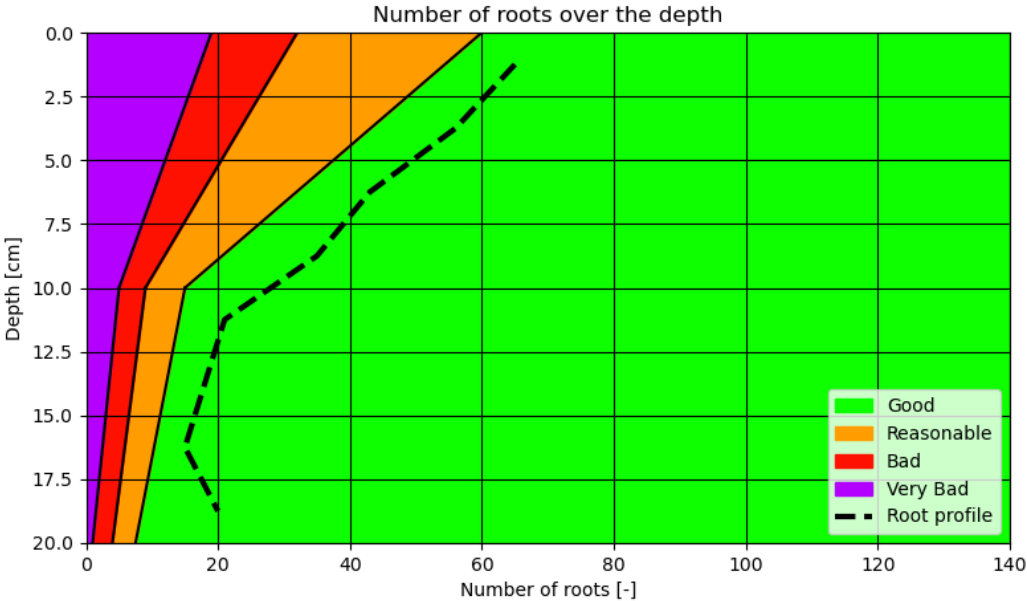


(c) Bottom



(d) Right

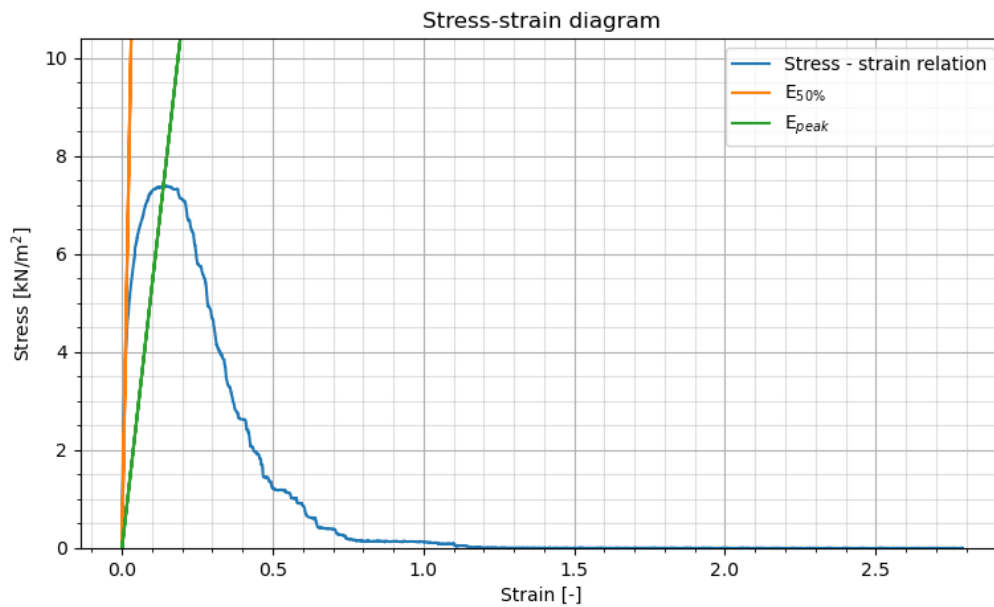
Root profile



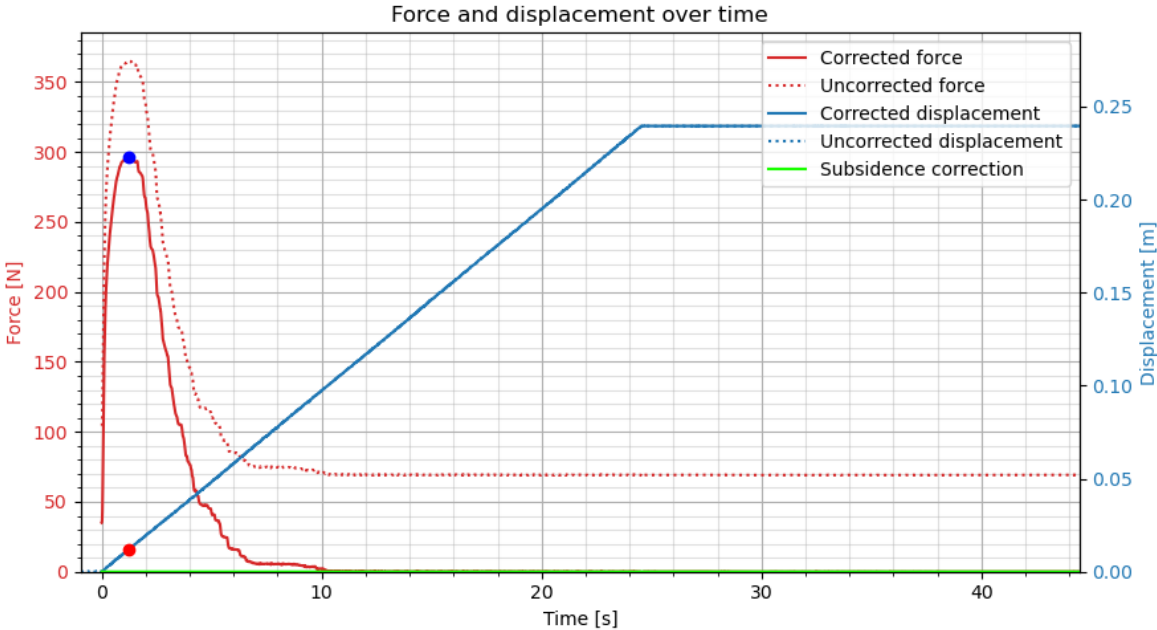
D.2.8. Test09

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		16:10:00			
Weight	[kg]	69.1			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	40	30	30	
Sod thickness	[cm]	11	8	6	9
Root length	[cm]	3	5	4	3.9
Maximum stress	[kN/m ²]	7.4			
Strain at maximum stress	[-]	0.14			
E _{50%}	[kN/m ²]	342.76			
E _{peak}	[kN/m ²]	53.81			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

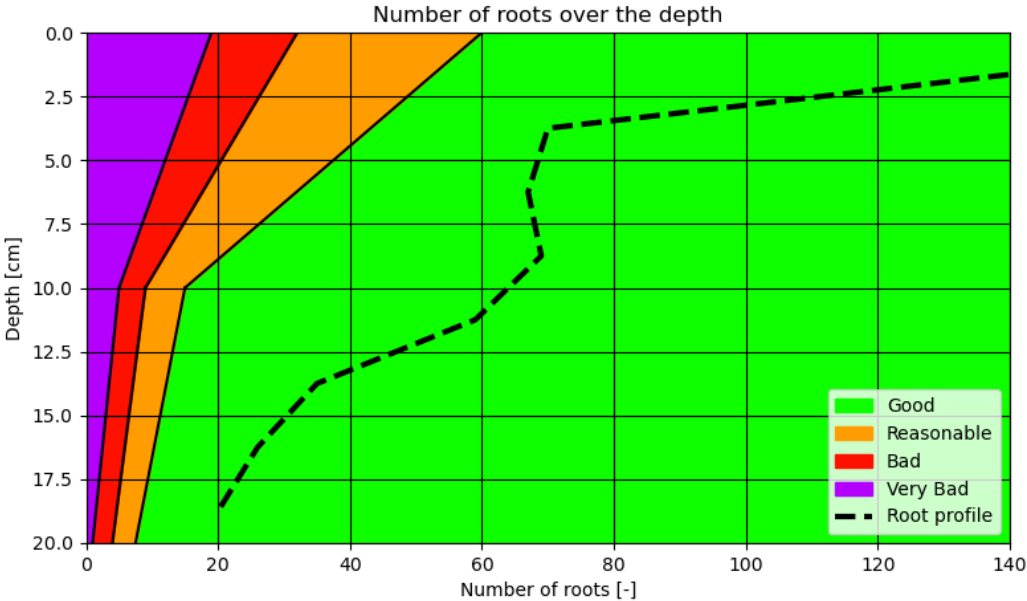


(c) Bottom



(d) Right

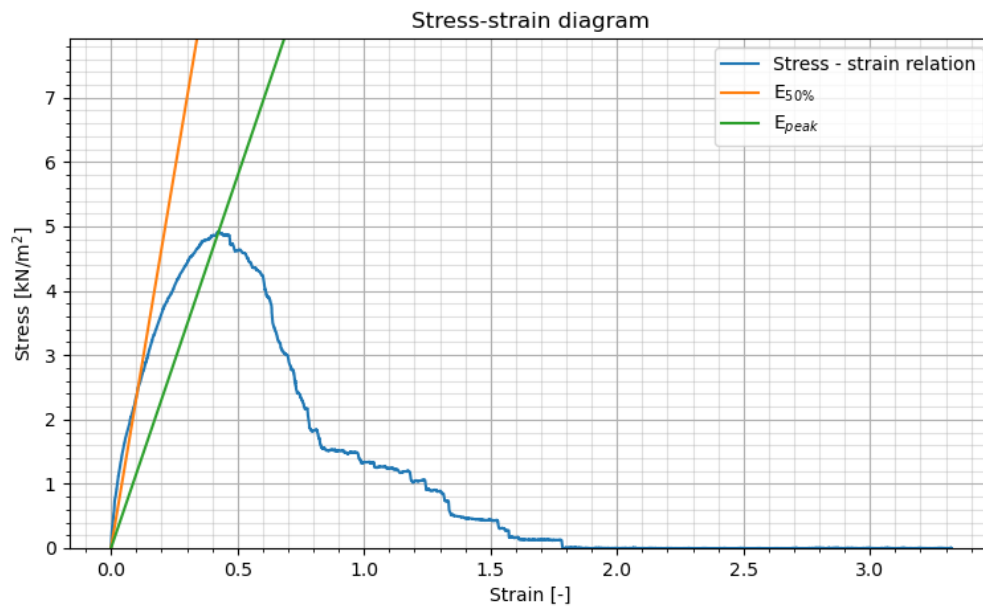
Root profile



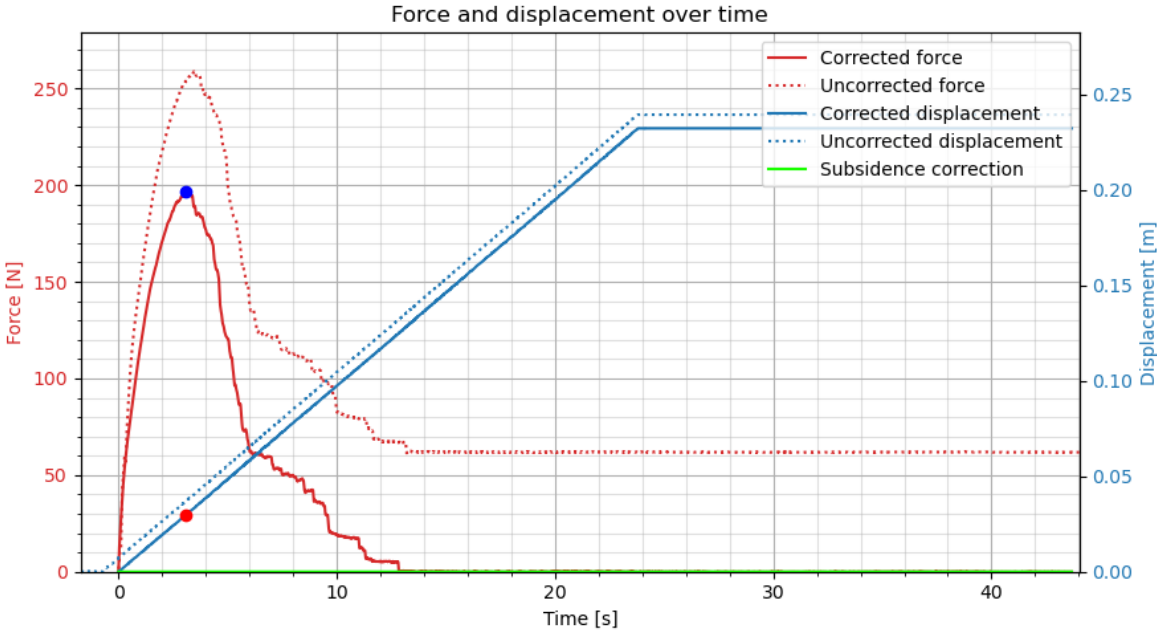
D.2.9. Test10

		Value 1	Value 2	Value 3	Mean
Date		23-02-2021			
Time		10:47:00			
Weight	[kg]	61.9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	20	70	10	
Sod thickness	[cm]	8	7	5	7
Root length	[cm]	4	3	8	3.7
Maximum stress	[kN/m ²]	4.92			
Strain at maximum stress	[-]	0.43			
E _{50%}	[kN/m ²]	23.29			
E _{peak}	[kN/m ²]	11.56			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

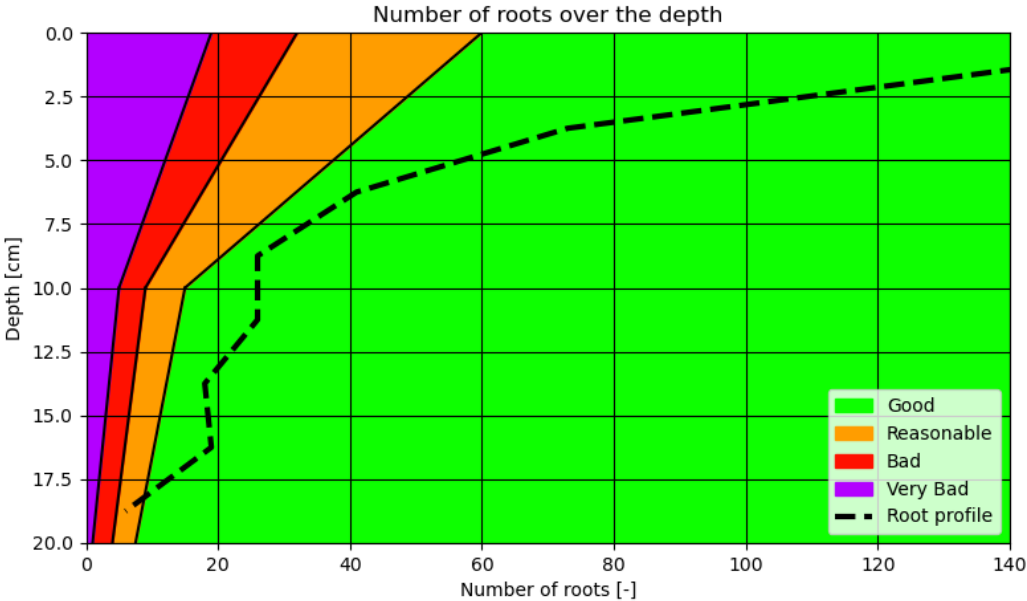


(c) Bottom



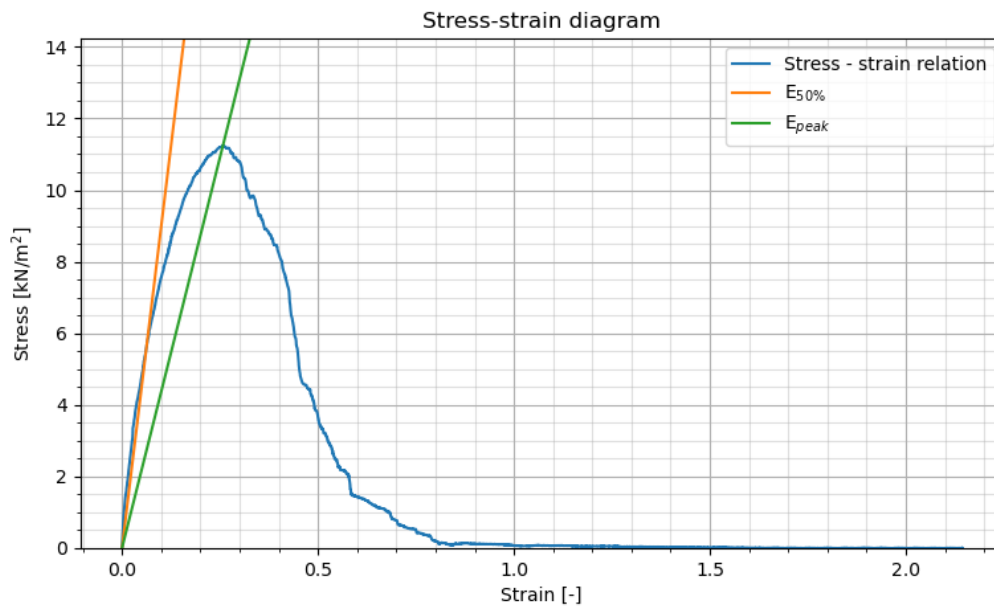
(d) Right

Root profile

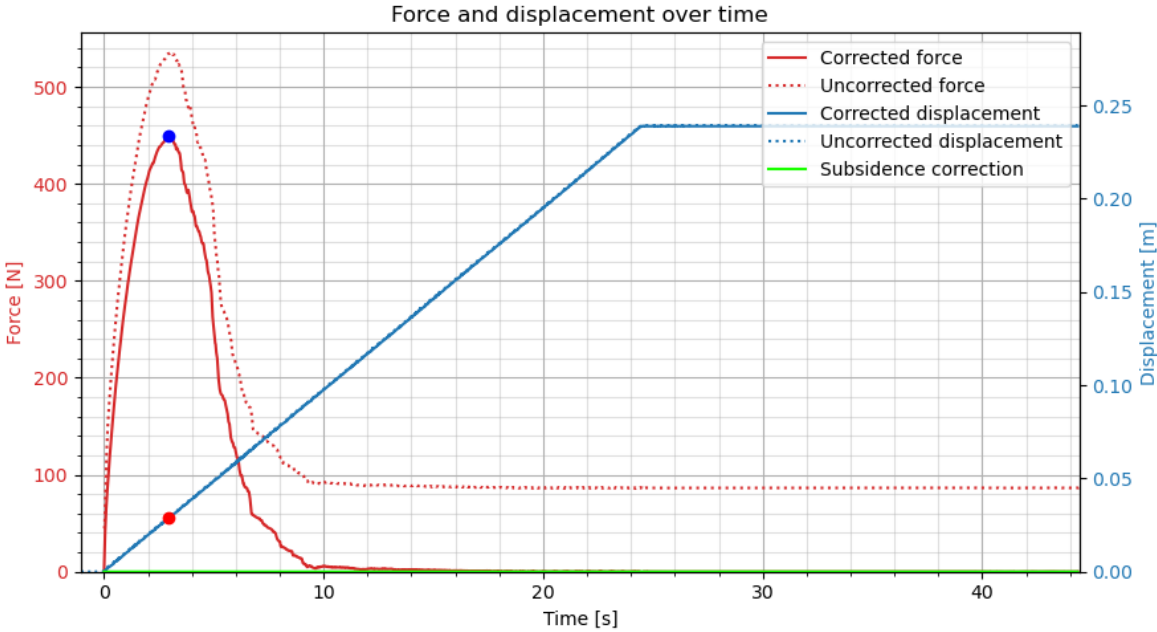


D.2.10. Test11

		Value 1	Value 2	Value 3	Mean
Date		23-02-2021			
Time		12:47:00			
Weight	[kg]	86.4			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	35	60	5	
Sod thickness	[cm]	14	10	5	11
Root length	[cm]	3	7	6	5.55
Maximum stress	[kN/m ²]	11.23			
Strain at maximum stress	[-]	0.26			
E _{50%}	[kN/m ²]	89.8			
E _{peak}	[kN/m ²]	43.64			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

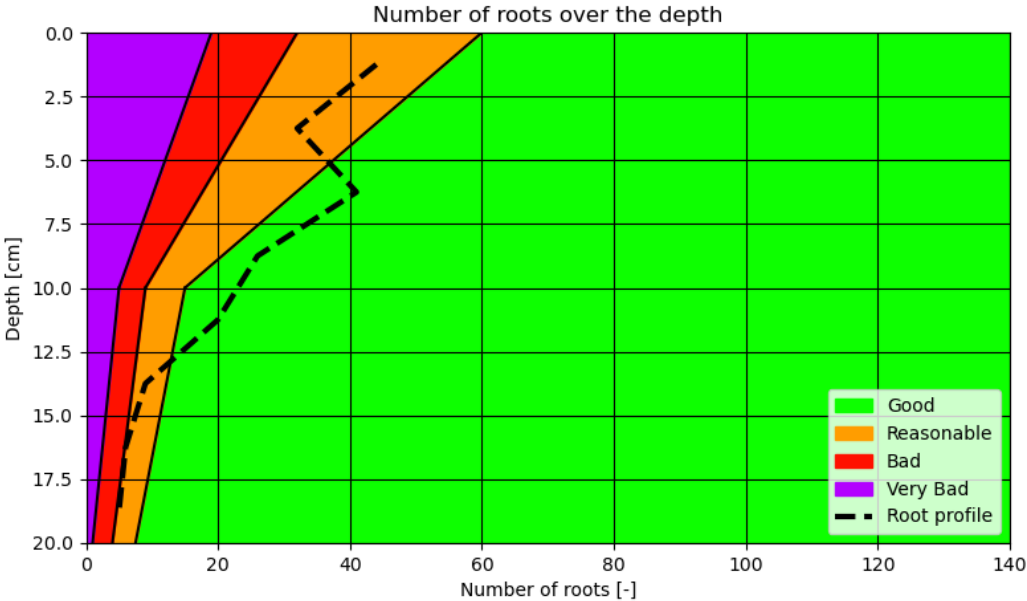


(c) Bottom



(d) Right

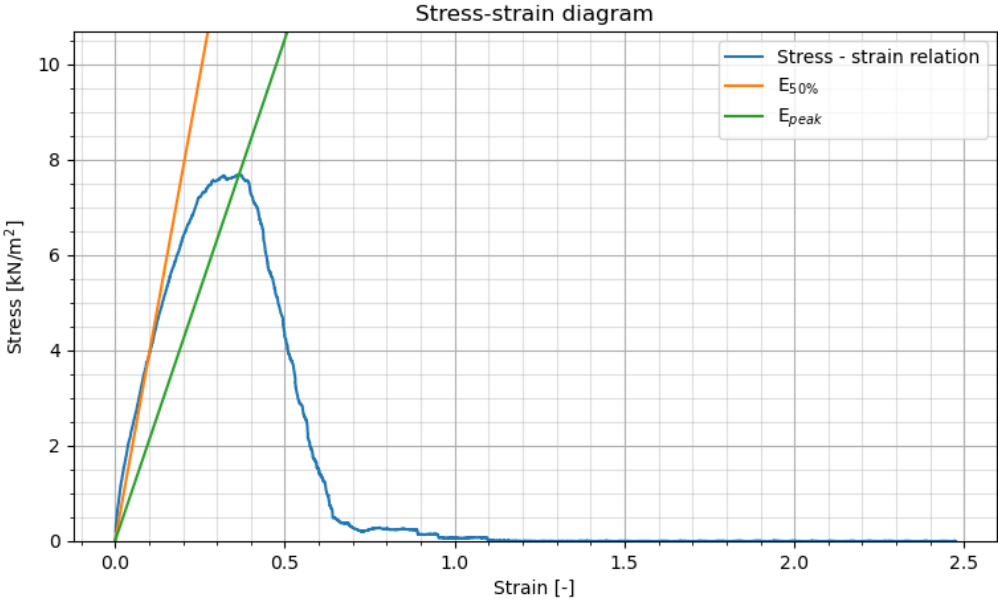
Root profile



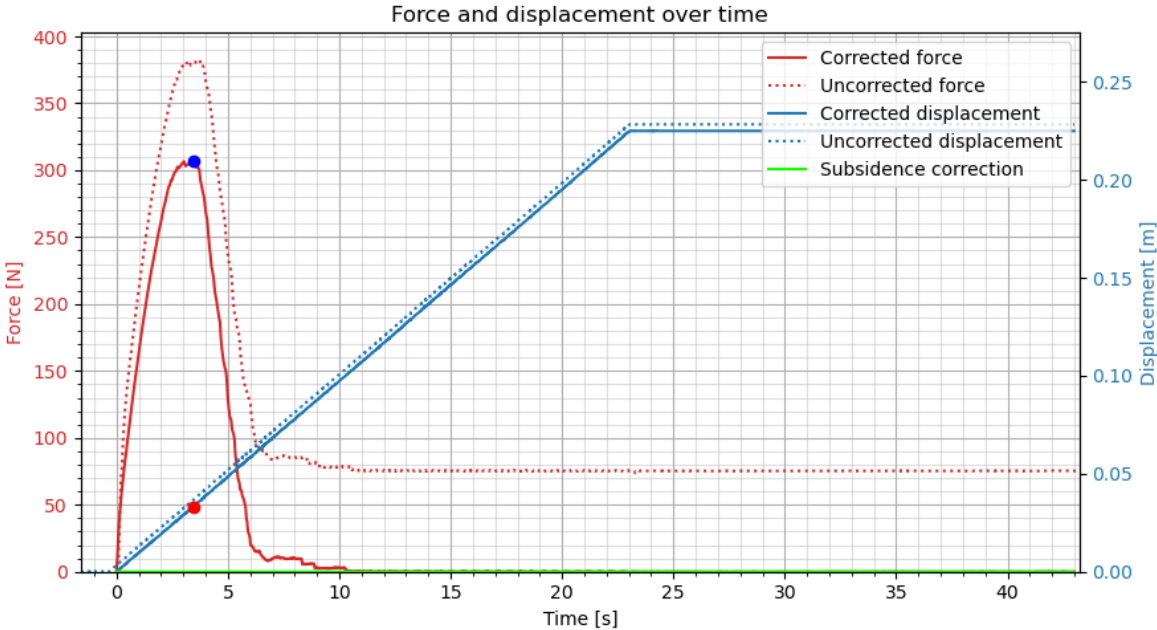
D.2.11. Test12

		Value 1	Value 2	Value 3	Mean
Date		23-02-2021			
Time		15:08:00			
Weight	[kg]	75.4			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	30	30	40	
Sod thickness	[cm]	12	9	7	9
Root length	[cm]	2	4	5	3.8
Maximum stress	[kN/m ²]	7.68			
Strain at maximum stress	[-]	0.37			
E _{50%}	[kN/m ²]	39.03			
E _{peak}	[kN/m ²]	21.04			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

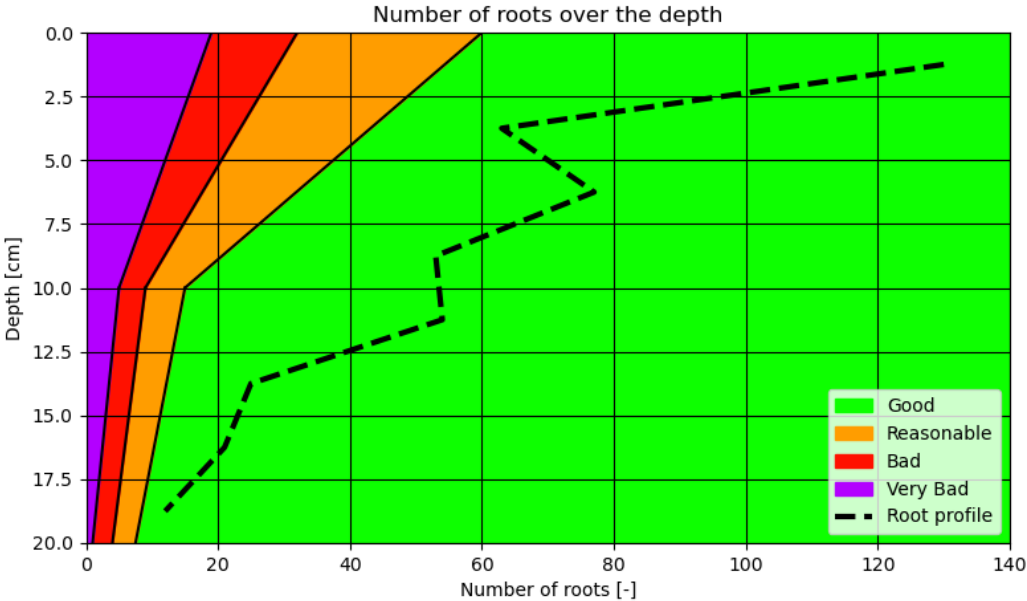


(c) Bottom



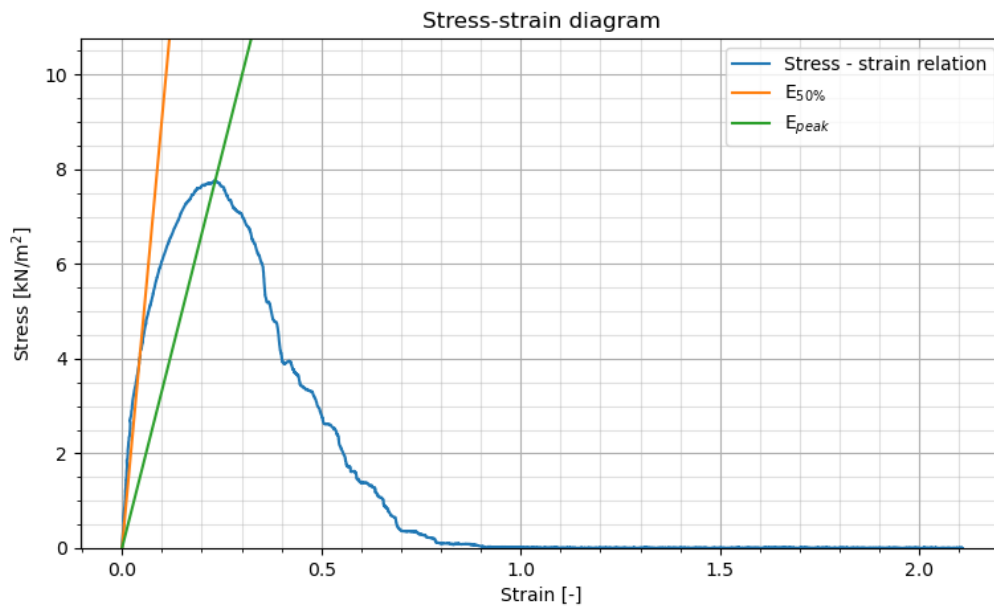
(d) Right

Root profile

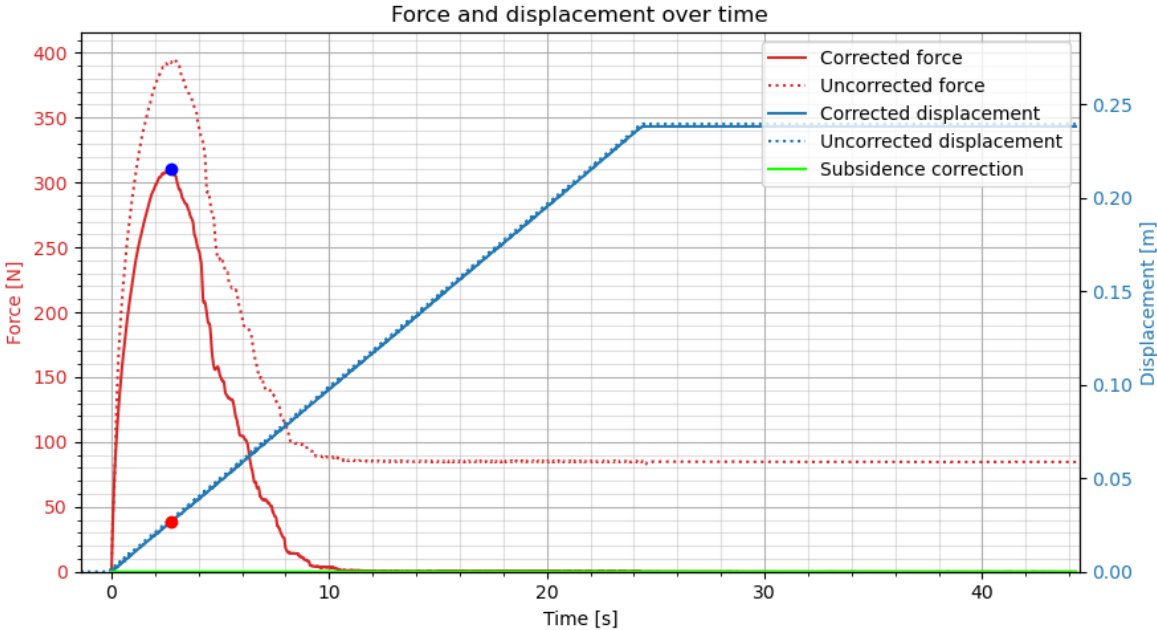


D.2.12. Test13

		Value 1	Value 2	Value 3	Mean
Date		23-02-2021			
Time		15:11:00			
Weight	[kg]	84.7			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	55	30	15	
Sod thickness	[cm]	14	9	6	11
Root length	[cm]	2	4	9	3.65
Maximum stress	[kN/m ²]	7.76			
Strain at maximum stress	[-]	0.23			
E _{50%}	[kN/m ²]	90.45			
E _{peak}	[kN/m ²]	33.19			
Comments		-			

Stress-strain relation

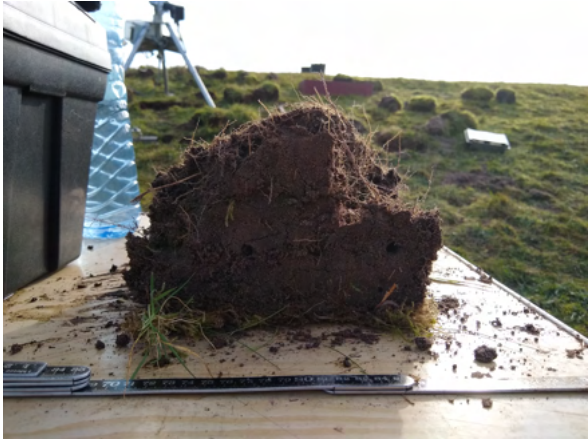
Force and displacement over time



Test sample pictures



(a) Top



(b) Left

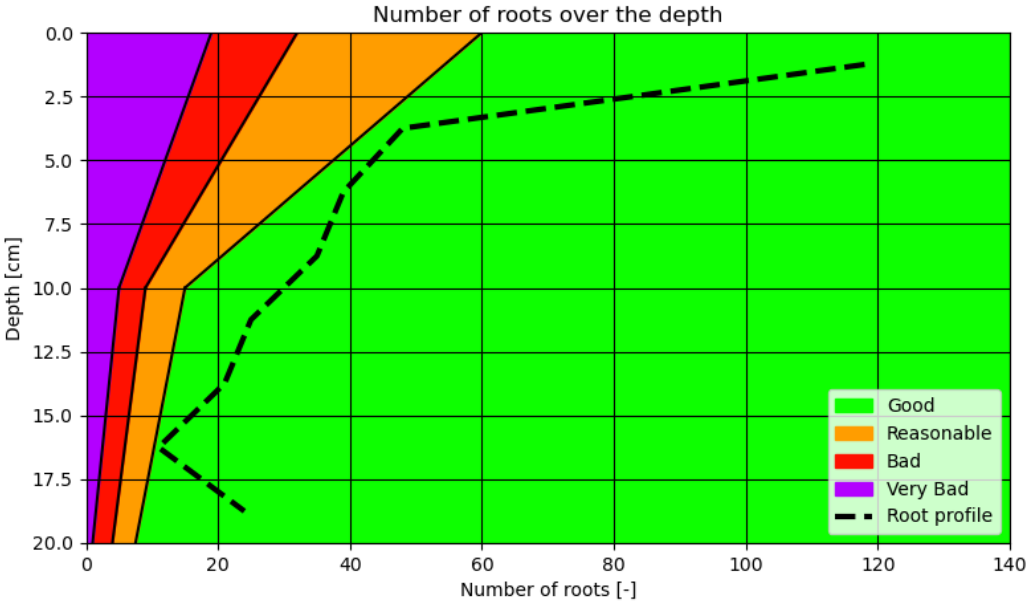


(c) Bottom



(d) Right

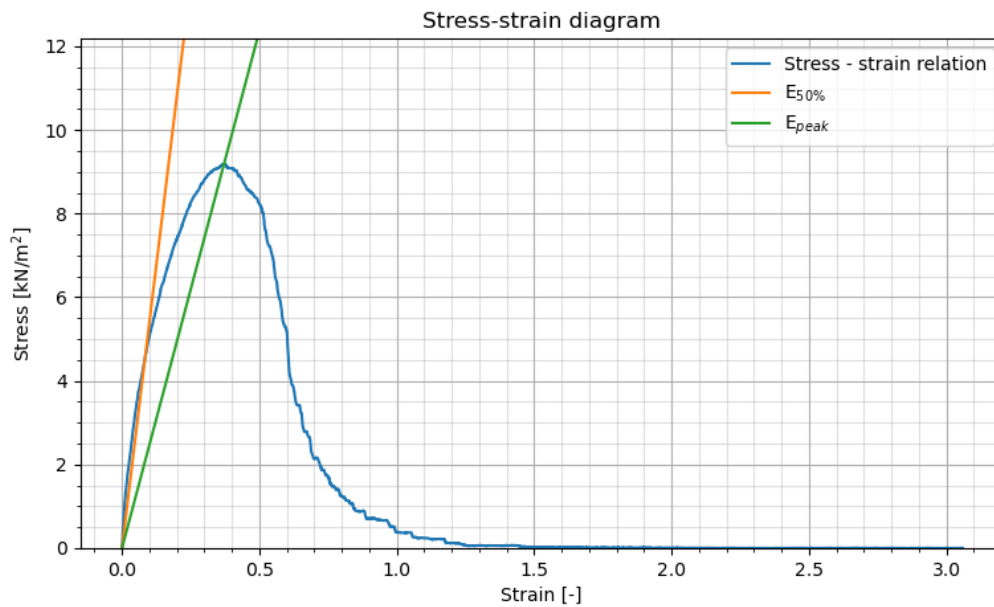
Root profile



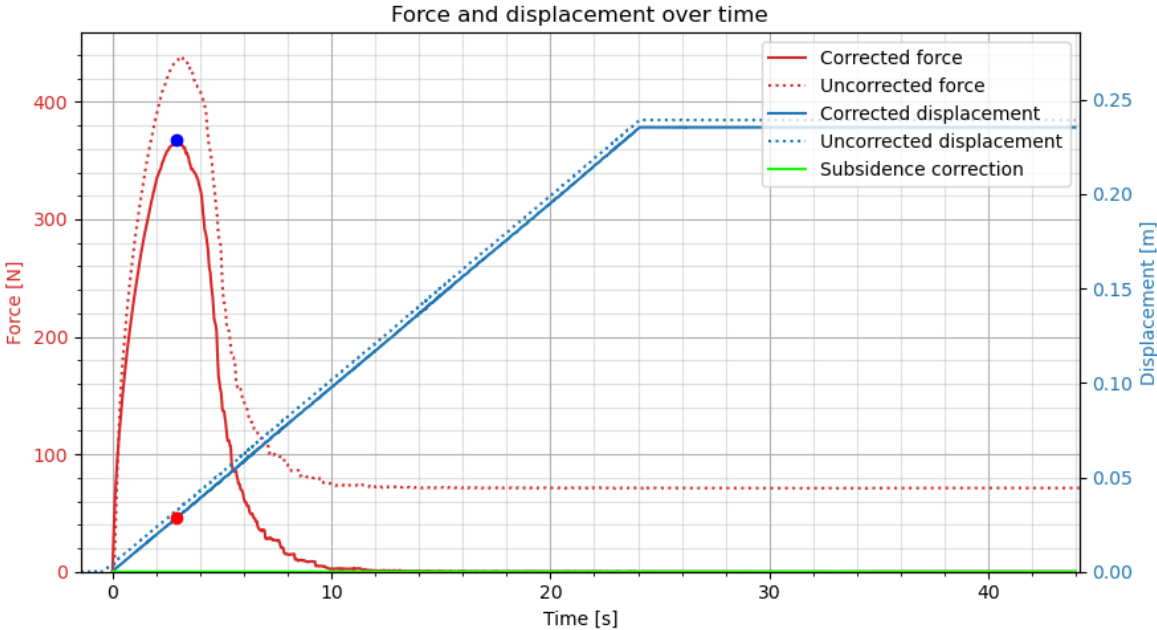
D.2.13. Test14

		Value 1	Value 2	Value 3	Mean
Date		23-02-2021			
Time		14:09:00			
Weight	[kg]	71.2			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	30	40	30	
Sod thickness	[cm]	10	8	5	8
Root length	[cm]	5	5	7	5.6
Maximum stress	[kN/m ²]	9.19			
Strain at maximum stress	[-]	0.37			
E _{50%}	[kN/m ²]	54.13			
E _{peak}	[kN/m ²]	24.74			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

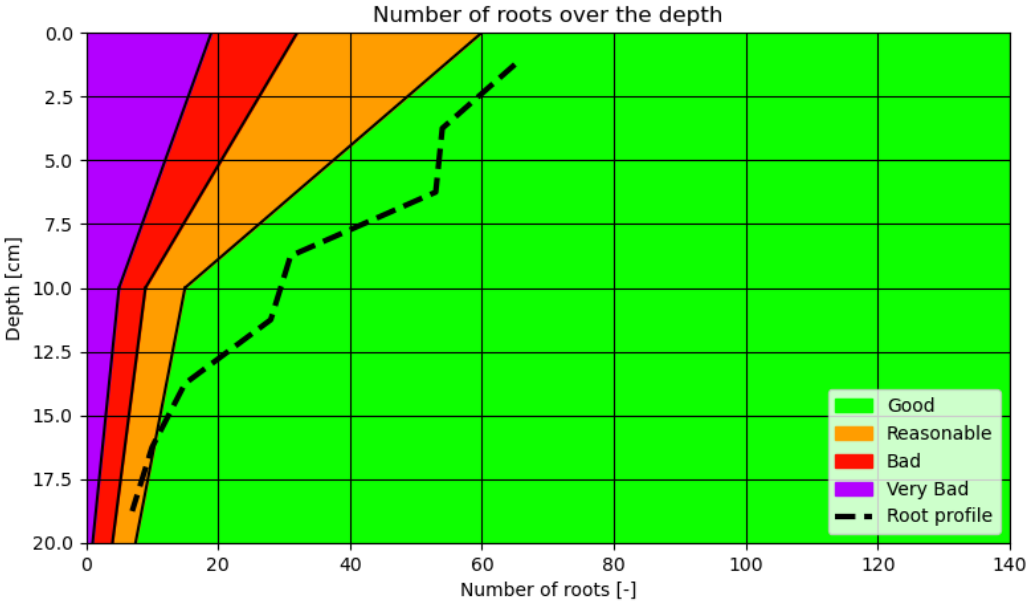


(c) Bottom



(d) Right

Root profile

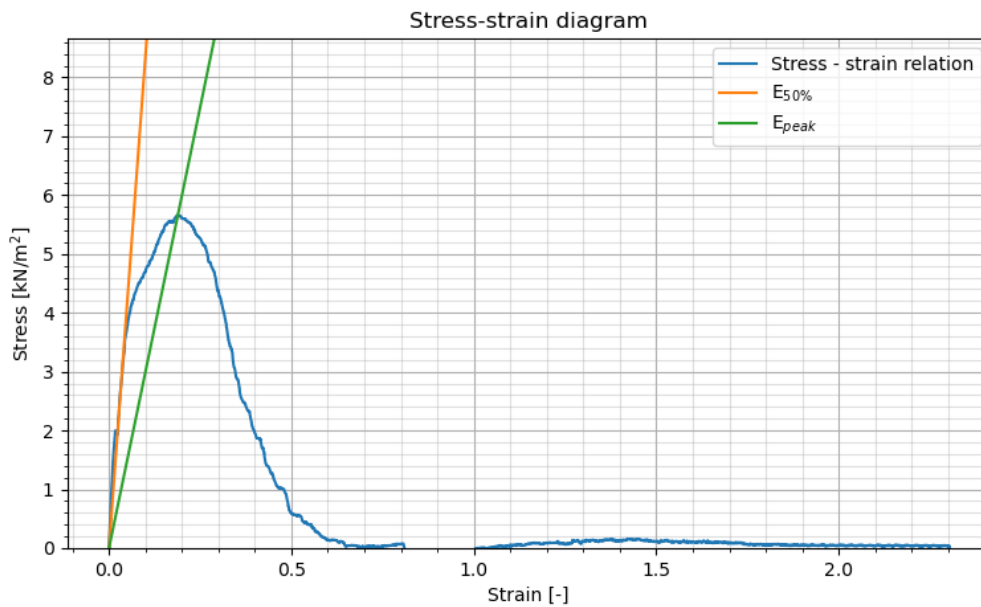


D.3. Direct pull tests - submerged

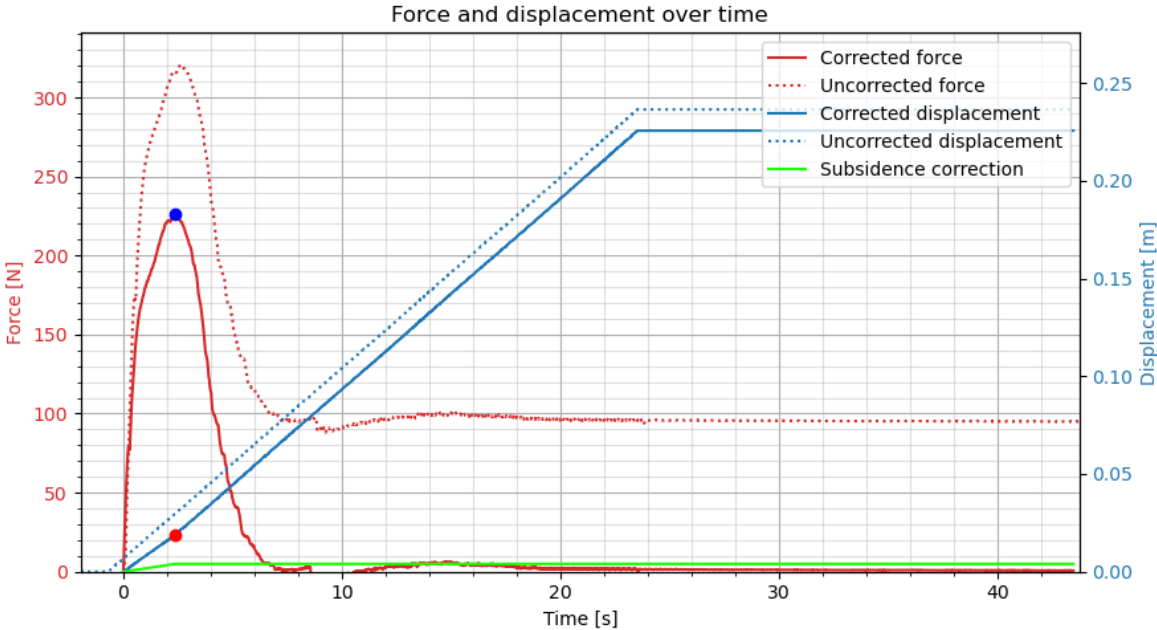
D.3.1. Test01

		Value 1	Value 2	Value 3	Mean
Date		24-02-2021			
Time		13:50:00			
Weight	[kg]	94.3			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	60	40	0	
Sod thickness	[cm]	11	8	0	10
Root length	[cm]	4	5	0	4.4
Maximum stress	[kN/m ²]	5.66			
Strain at maximum stress	[-]	0.19			
E _{50%}	[kN/m ²]	83.69			
E _{peak}	[kN/m ²]	29.98			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

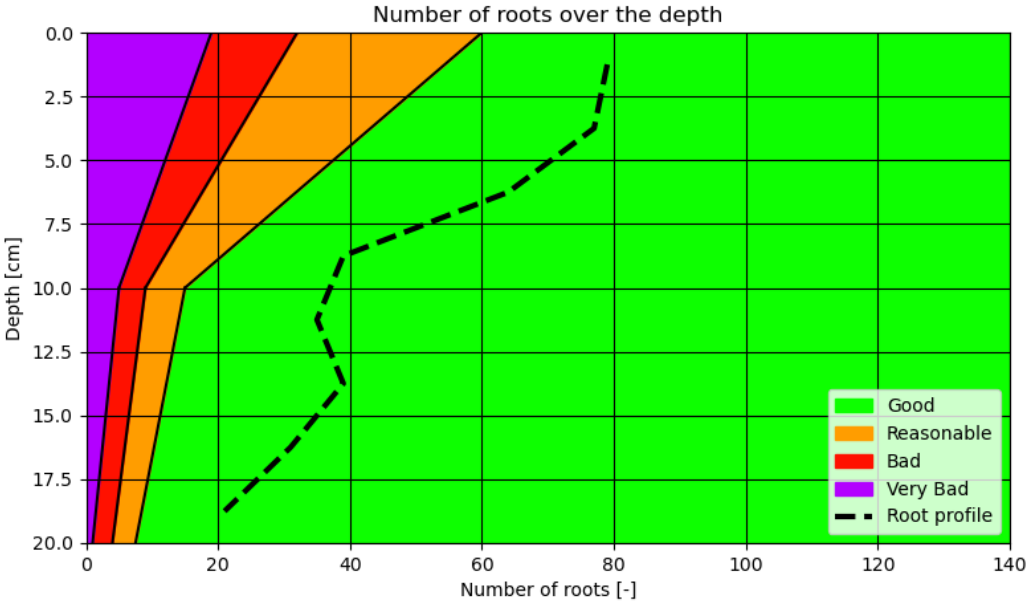


(c) Bottom



(d) Right

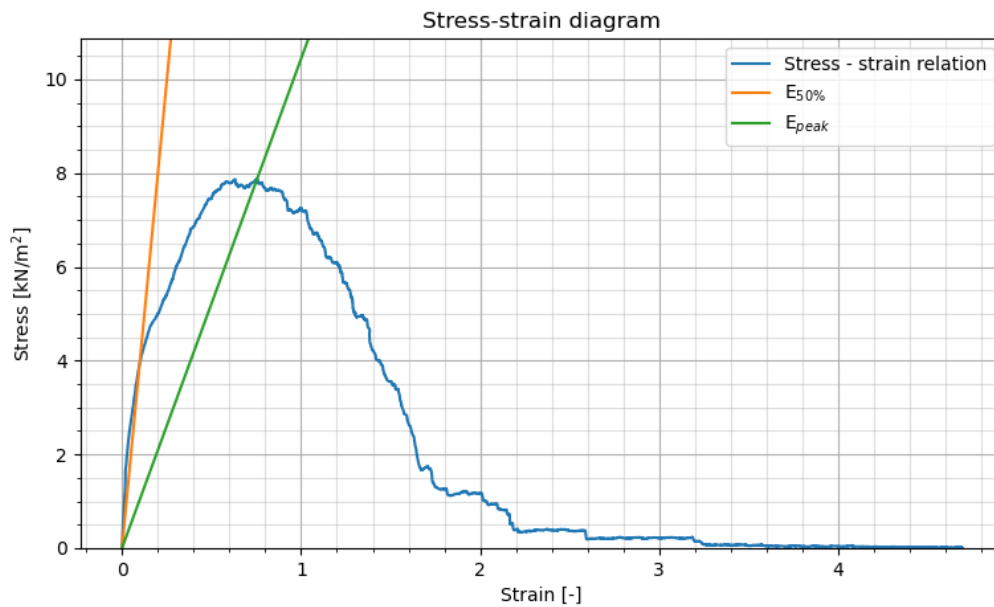
Root profile



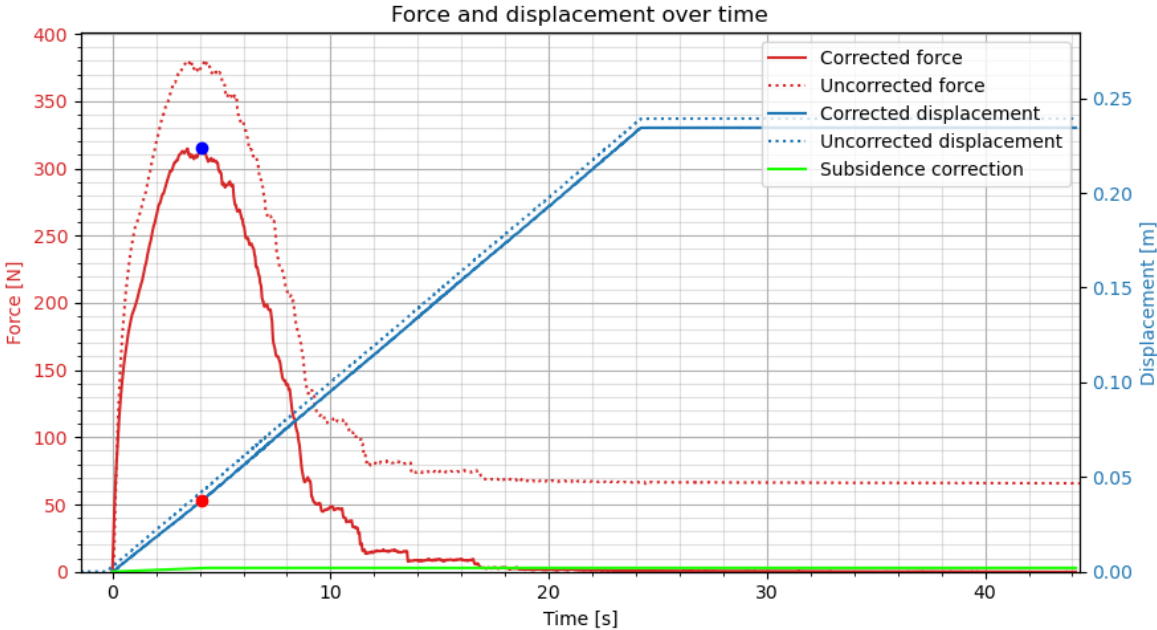
D.3.2. Test02

		Value 1	Value 2	Value 3	Mean
Date		24-02-2021			
Time		14:59:00			
Weight	[kg]	65.9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	50	50	0	
Sod thickness	[cm]	6	4	0	5
Root length	[cm]	10	11	0	10.5
Maximum stress	[kN/m ²]	7.87			
Strain at maximum stress	[-]	0.75			
E _{50%}	[kN/m ²]	39.87			
E _{peak}	[kN/m ²]	10.44			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

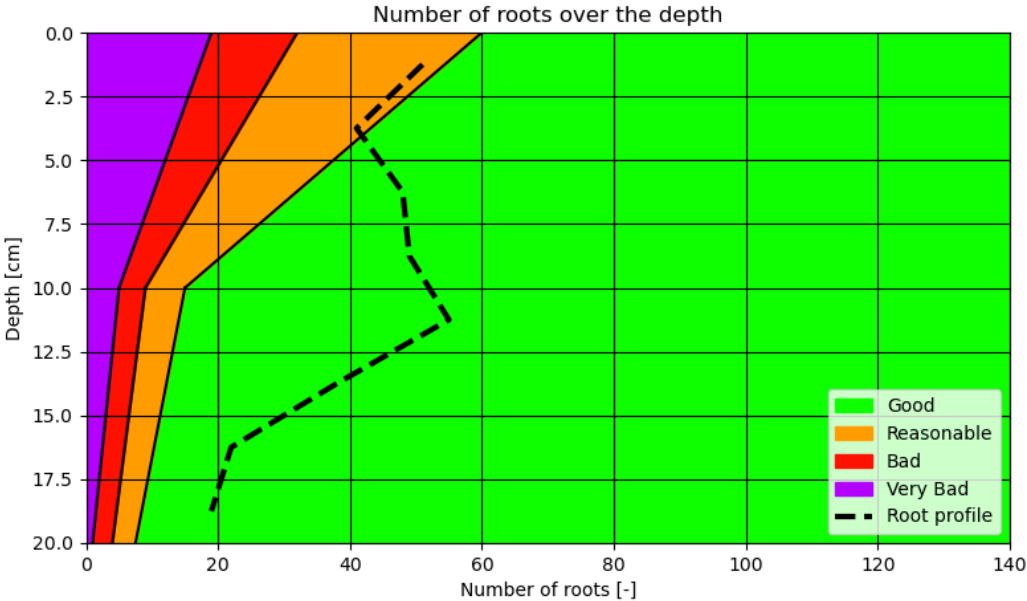


(c) Bottom



(d) Right

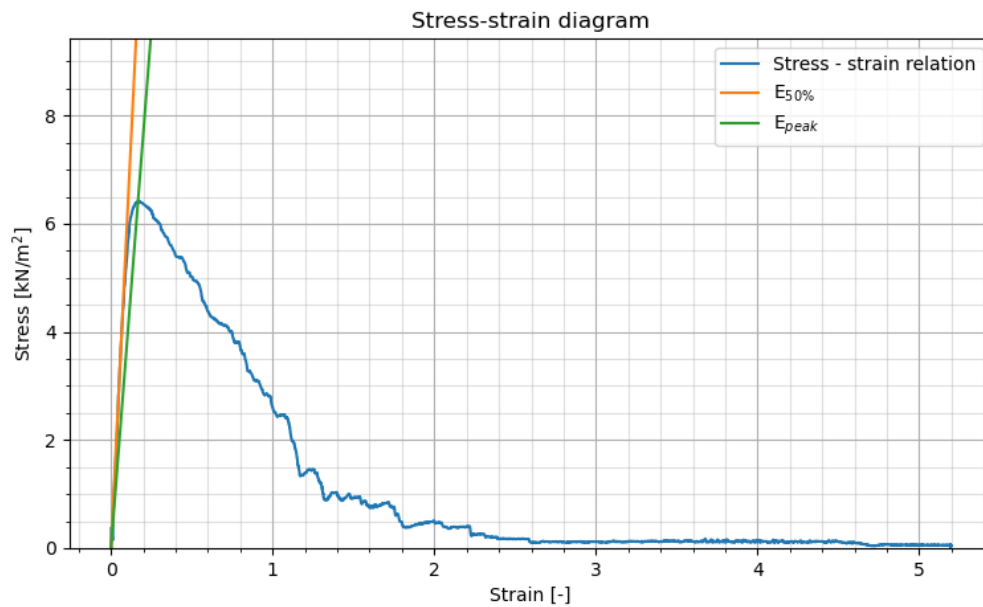
Root profile



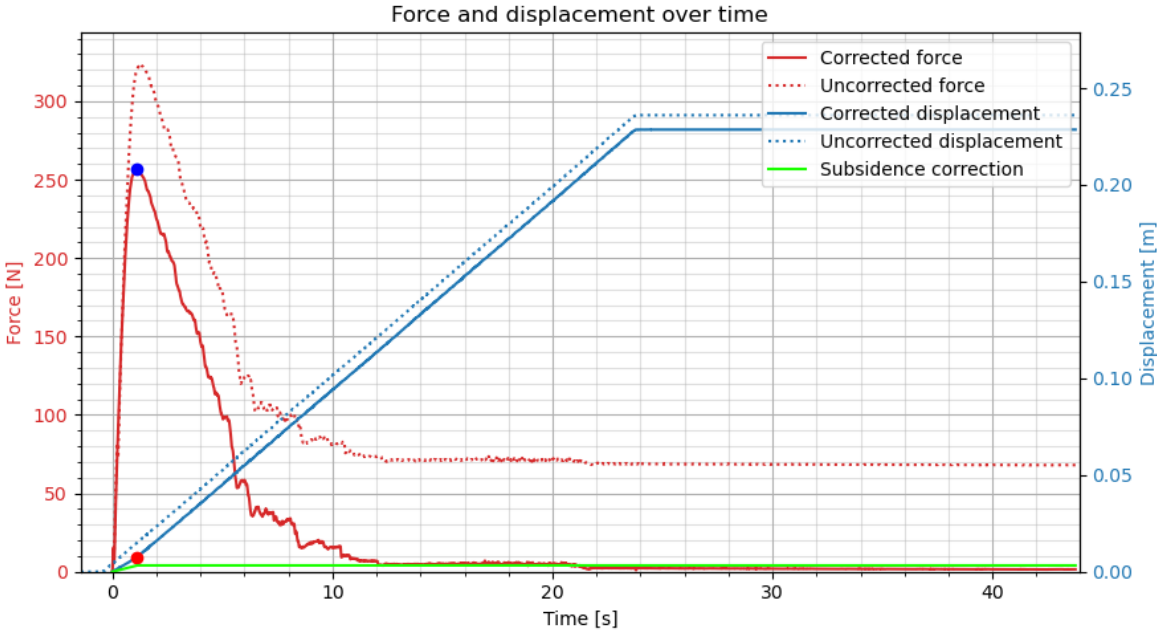
D.3.3. Test03

		Value 1	Value 2	Value 3	Mean
Date		24-02-2021			
Time		15:53:00			
Weight	[kg]	66.5			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	40	60	0	
Sod thickness	[cm]	5	4	0	4
Root length	[cm]	5	9	0	7.4
Maximum stress	[kN/m ²]	6.43			
Strain at maximum stress	[-]	0.17			
E _{50%}	[kN/m ²]	60.79			
E _{peak}	[kN/m ²]	38.4			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

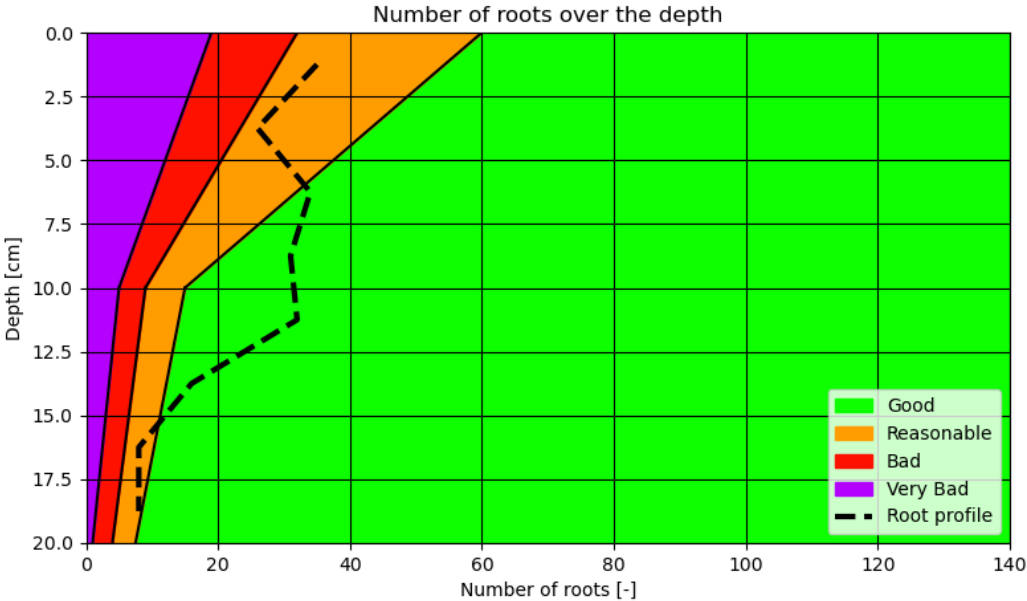


(c) Bottom



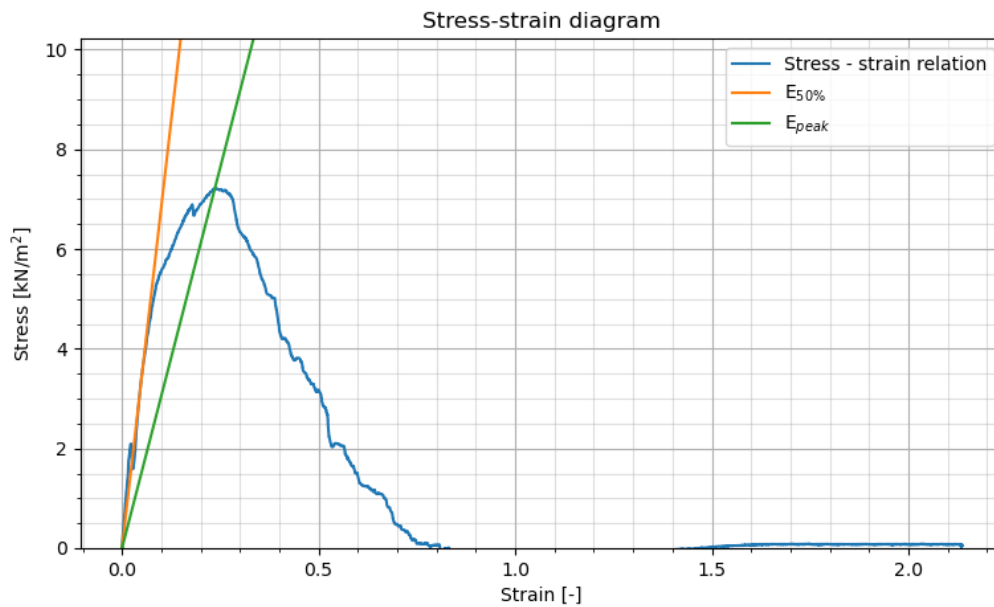
(d) Right

Root profile

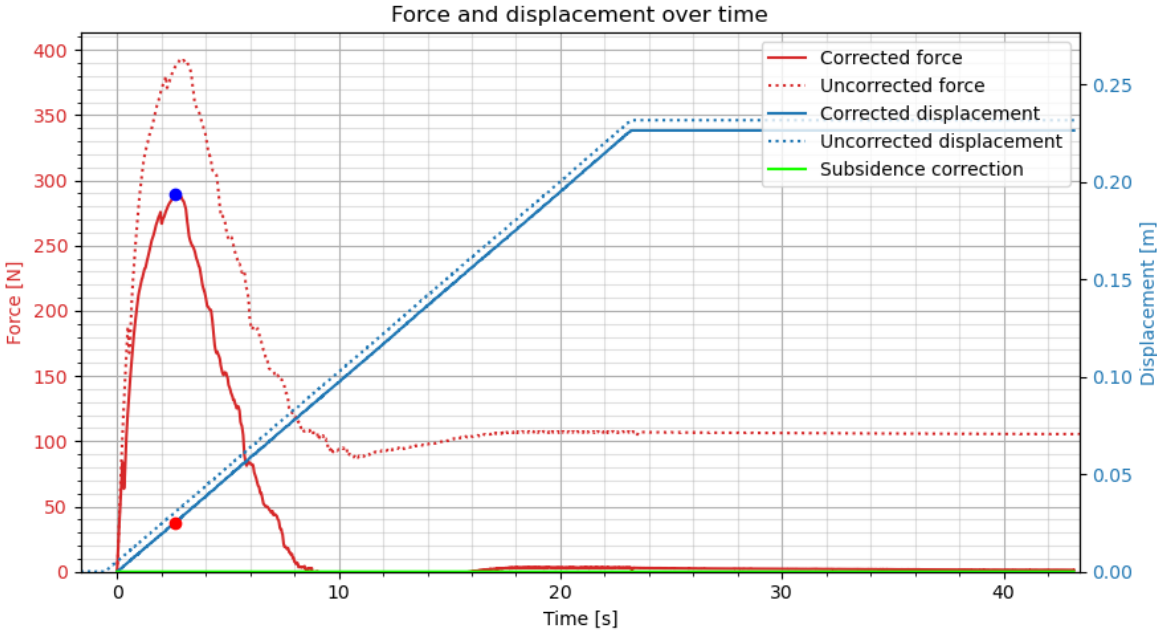


D.3.4. Test04

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	16:10:00			
Weight [kg]	104.1			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North			
Percentage of occurrence [%]	40	40	20	
Sod thickness [cm]	13	10	7	11
Root length [cm]	4	4	5	4.2
Maximum stress [kN/m ²]	7.22			
Strain at maximum stress [-]	0.24			
E _{50%} [kN/m ²]	68.52			
E _{peak} [kN/m ²]	30.56			
Comments	Forgot to measure tripod subsidence			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

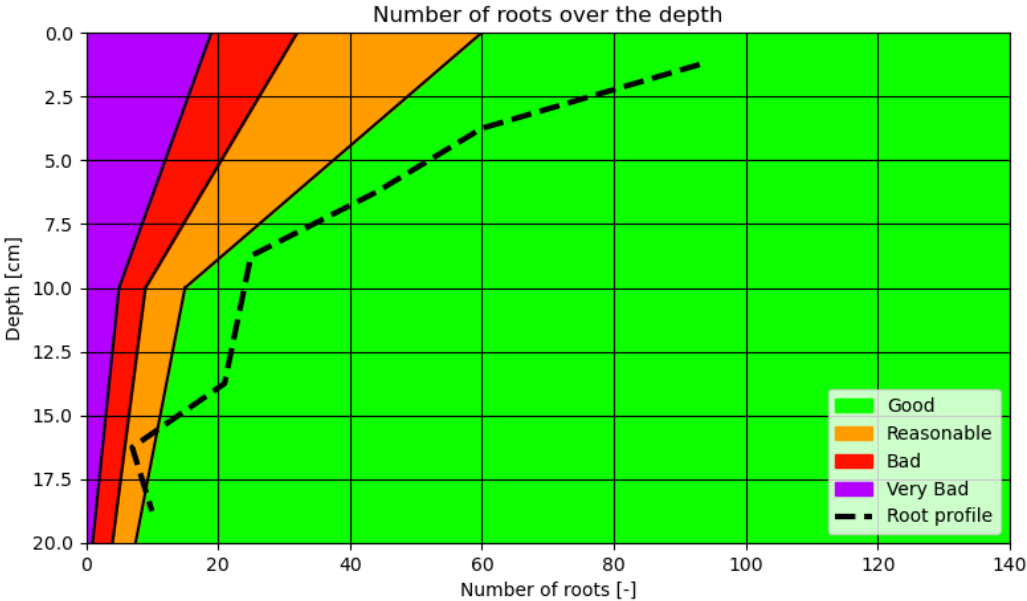


(c) Bottom



(d) Right

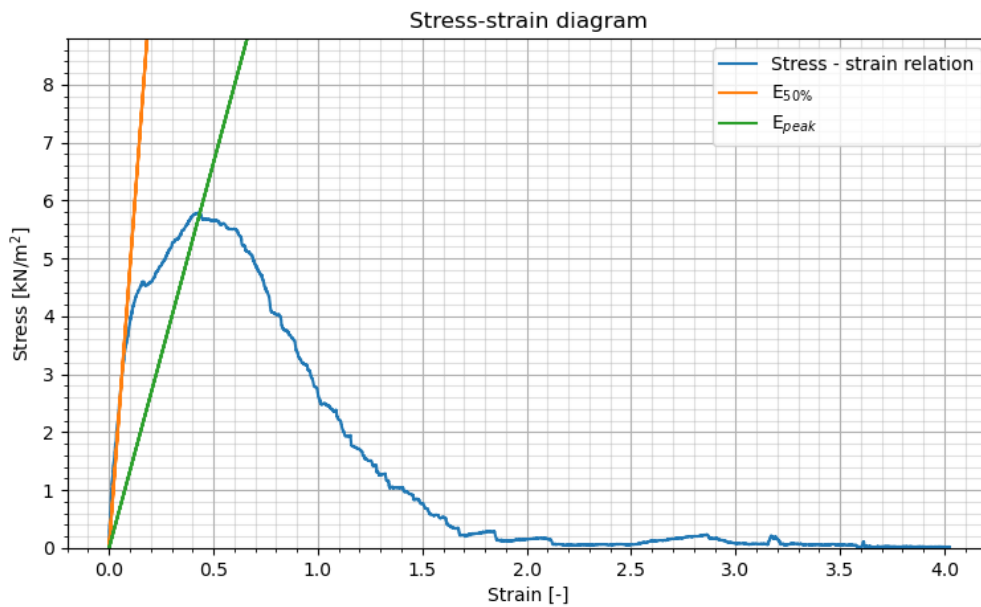
Root profile



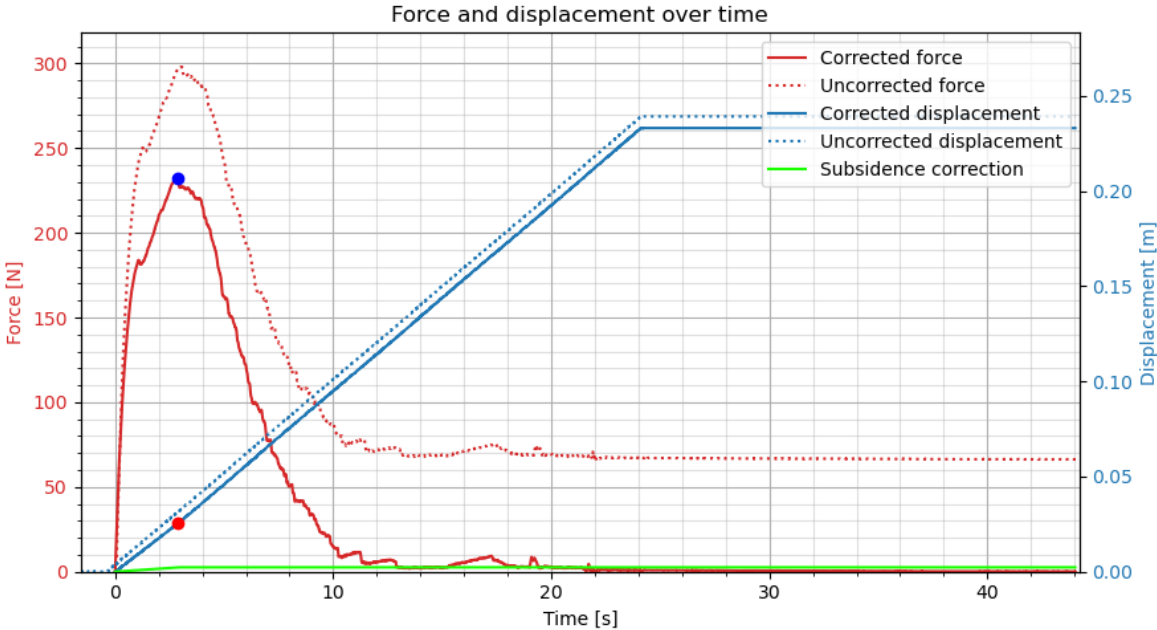
D.3.5. Test05

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		09:52:00			
Weight	[kg]	66.2			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	20	40	40	
Sod thickness	[cm]	7	6	5	6
Root length	[cm]	5	7	10	7.8
Maximum stress	[kN/m ²]	5.8			
Strain at maximum stress	[-]	0.44			
E _{50%}	[kN/m ²]	48.34			
E _{peak}	[kN/m ²]	13.3			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

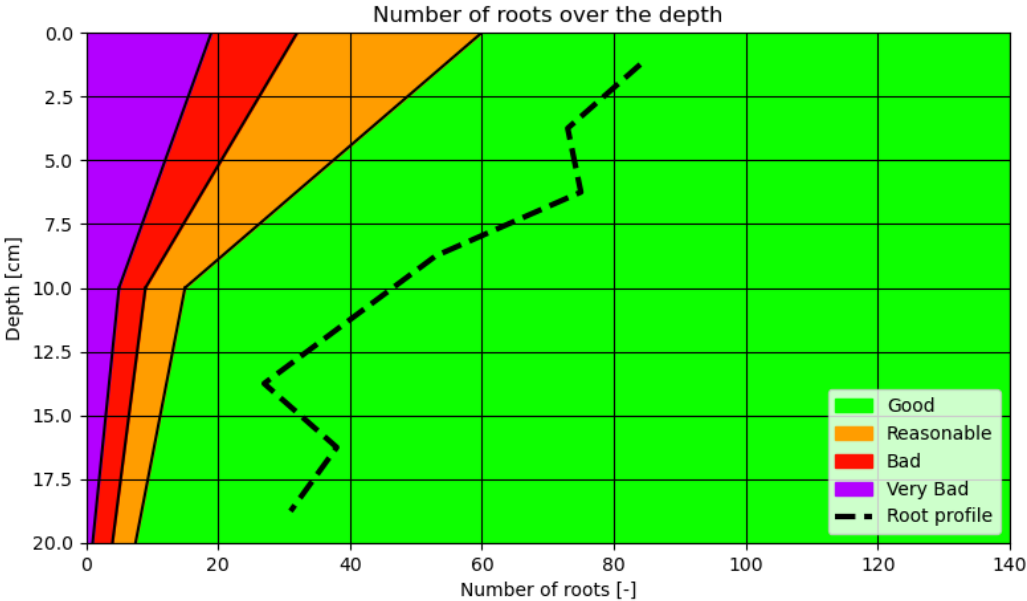


(c) Bottom



(d) Right

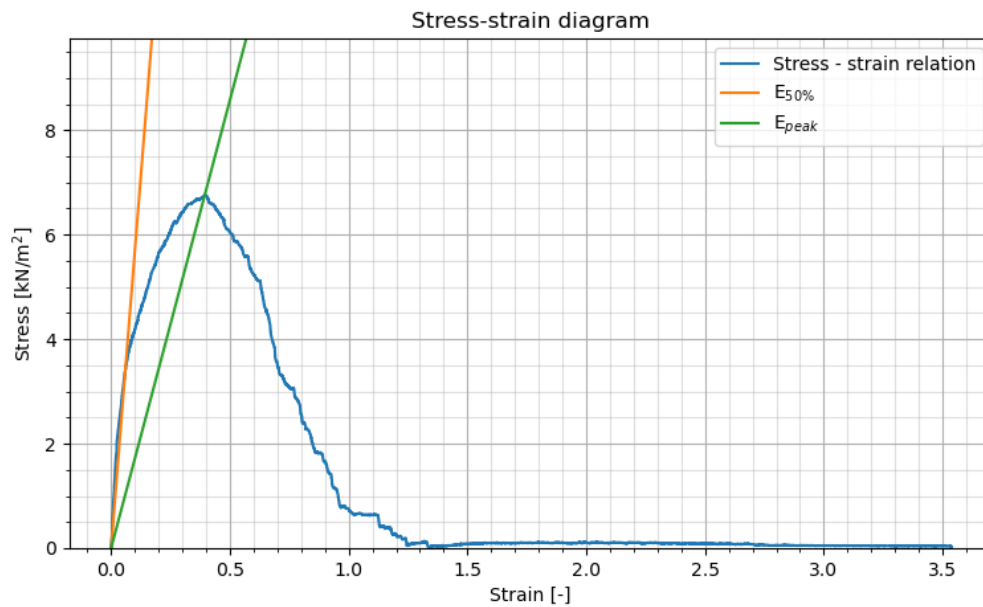
Root profile



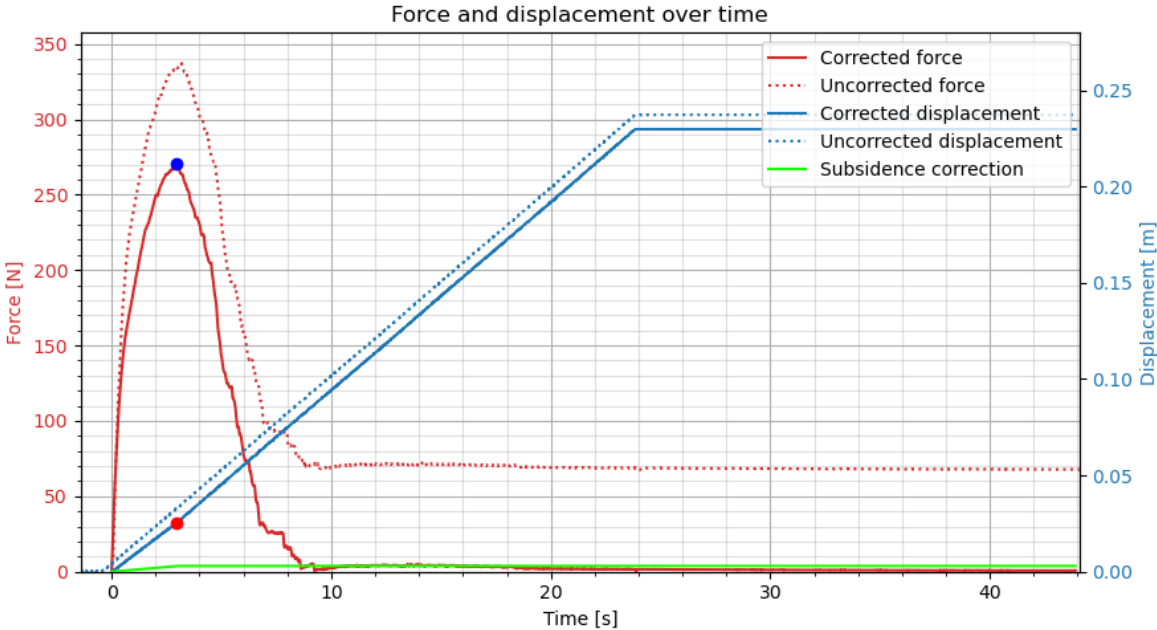
D.3.6. Test06

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		10:35:00			
Weight	[kg]	67.1			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	10	70	20	
Sod thickness	[cm]	8	7	4	6
Root length	[cm]	7	7	3	6.2
Maximum stress	[kN/m ²]	6.75			
Strain at maximum stress	[-]	0.39			
E _{50%}	[kN/m ²]	56.88			
E _{peak}	[kN/m ²]	17.14			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

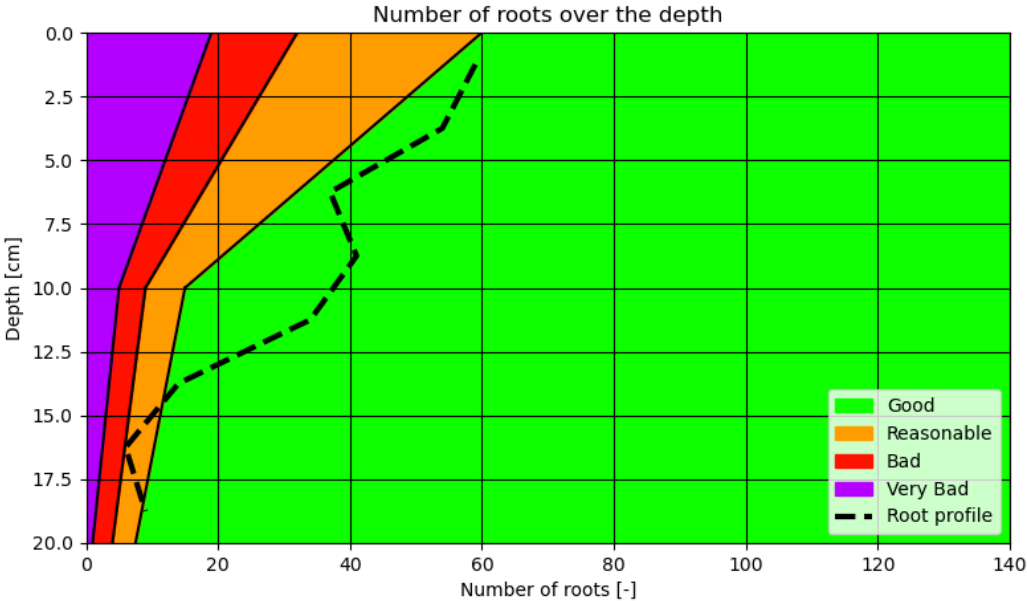


(c) Bottom



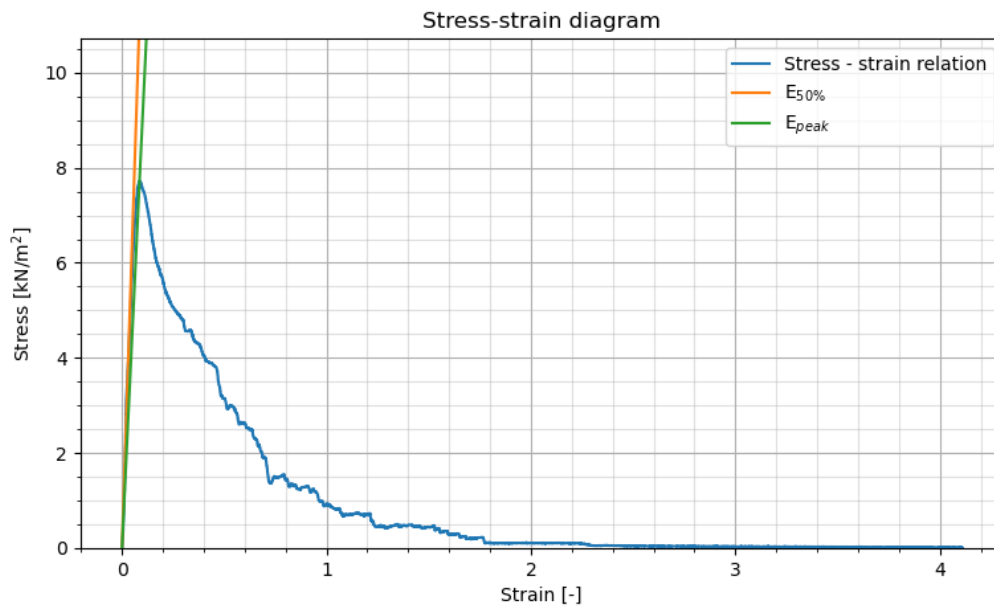
(d) Right

Root profile

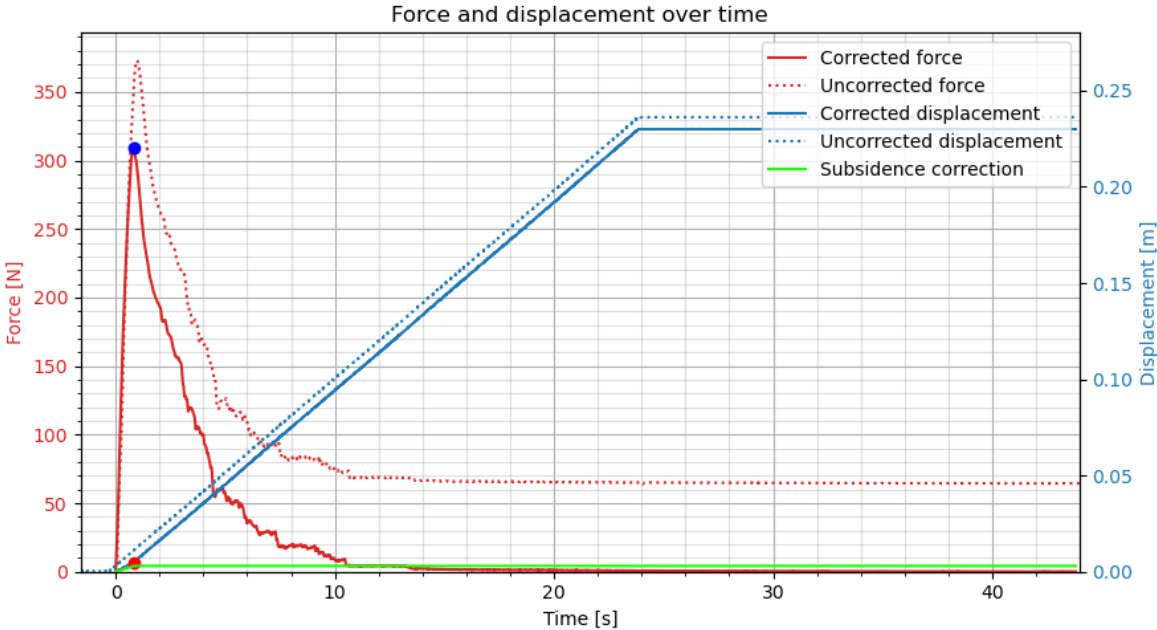


D.3.7. Test07

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		11:01:00			
Weight	[kg]	64.3			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	40	40	20	
Sod thickness	[cm]	7	5	4	6
Root length	[cm]	5	7	7	6.2
Maximum stress	[kN/m ²]	7.72			
Strain at maximum stress	[-]	0.09			
E _{50%}	[kN/m ²]	129.94			
E _{peak}	[kN/m ²]	89.95			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

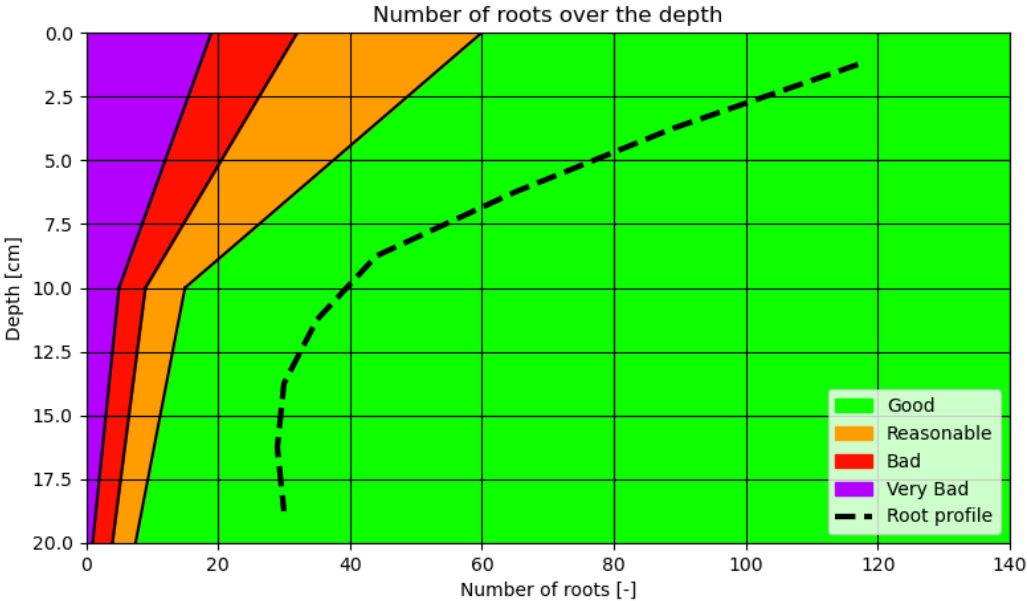


(c) Bottom



(d) Right

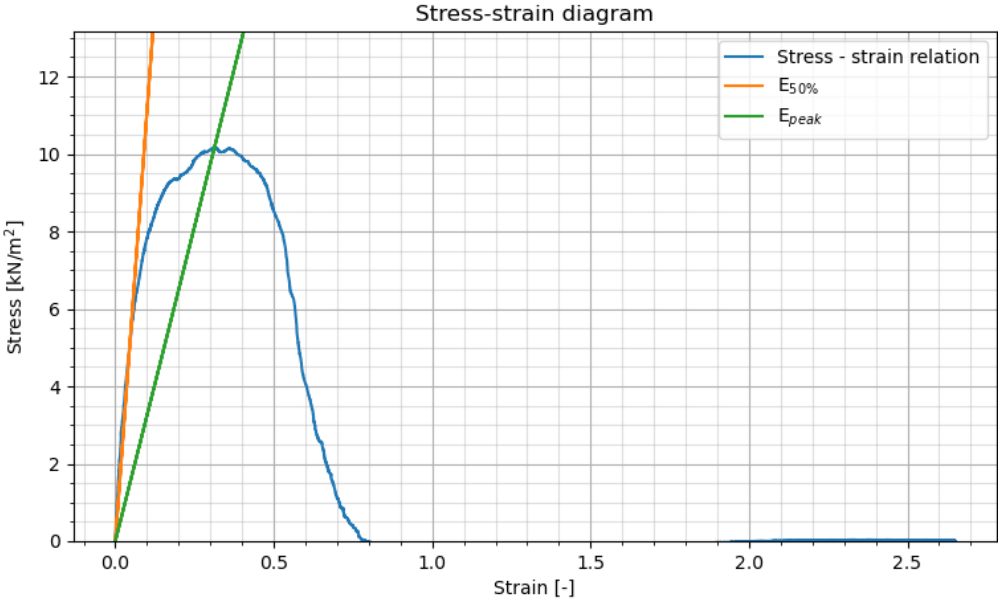
Root profile



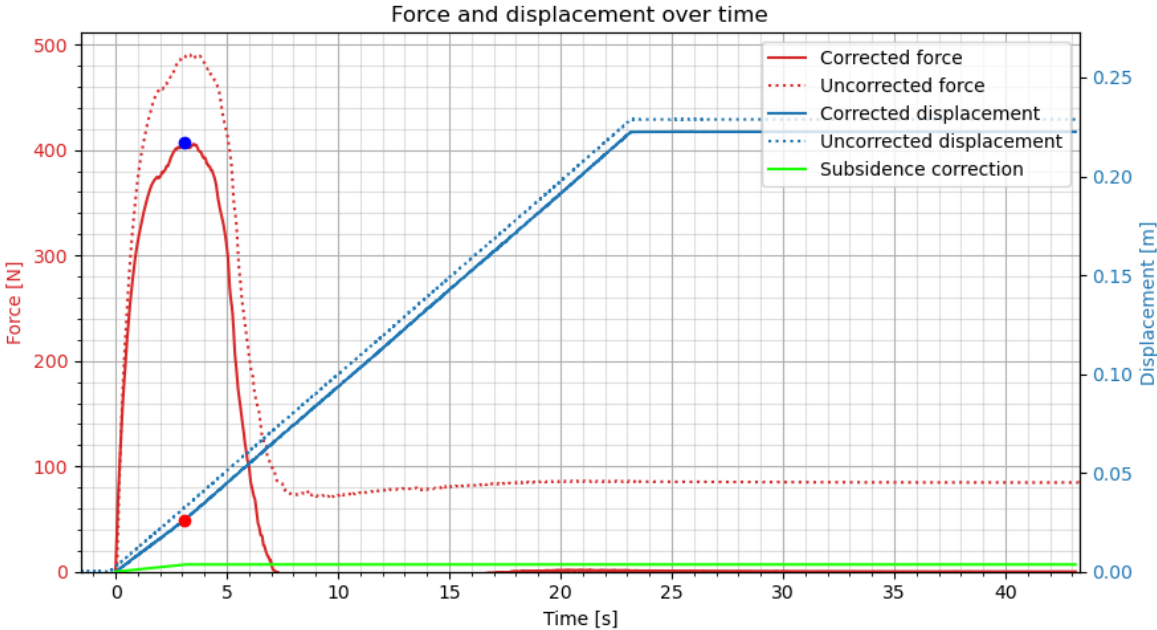
D.3.8. Test08

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		11:35:00			
Weight	[kg]	84.5			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	40	20	40	
Sod thickness	[cm]	12	8	5	8
Root length	[cm]	6	4	7	6.0
Maximum stress	[kN/m ²]	10.17			
Strain at maximum stress	[-]	0.31			
E _{50%}	[kN/m ²]	111.16			
E _{peak}	[kN/m ²]	32.51			
Comments		-			

Stress-strain relation



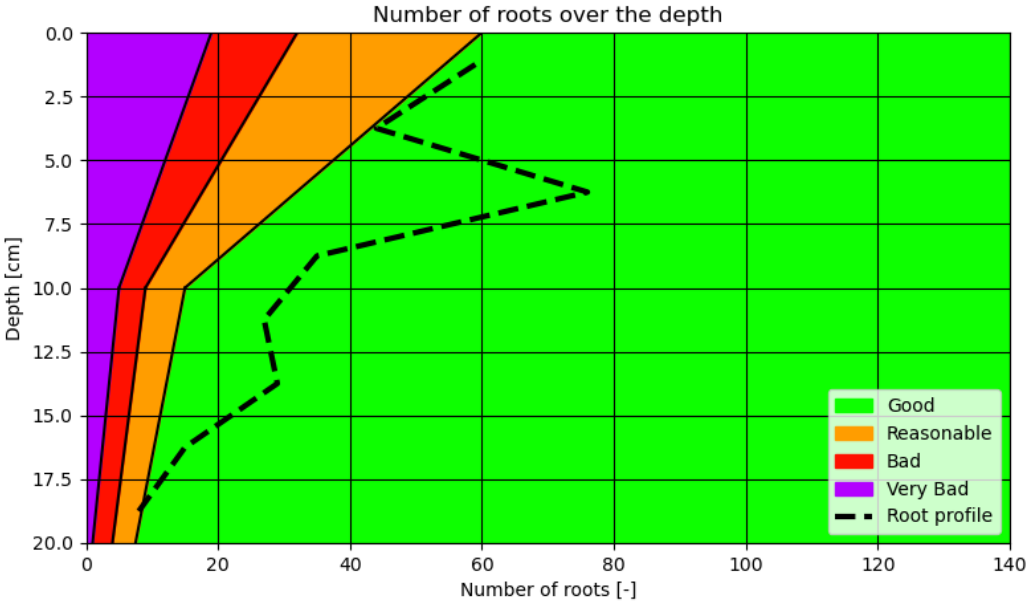
Force and displacement over time



Test sample pictures



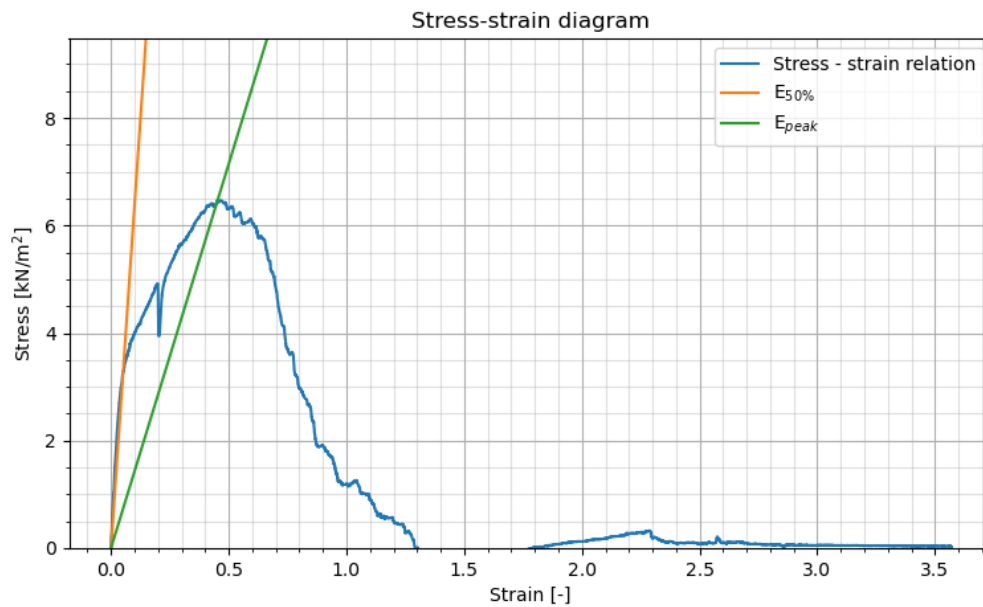
Root profile



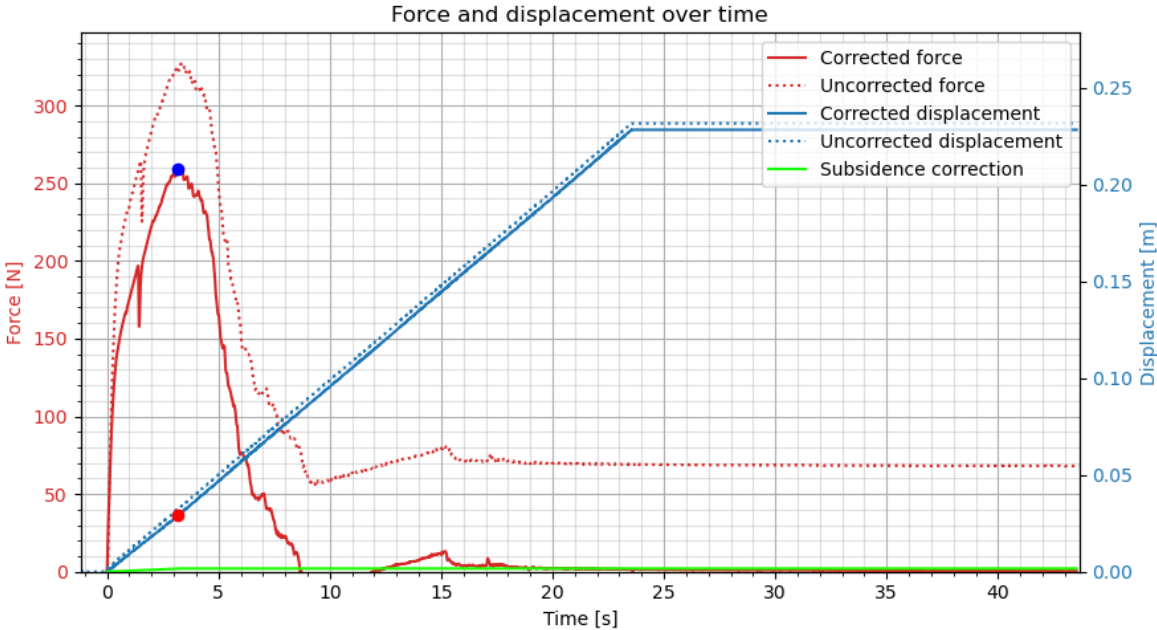
D.3.9. Test09

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		12:18:00			
Weight	[kg]	67.6			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	20	40	40	
Sod thickness	[cm]	8	7	5	6
Root length	[cm]	4	7	6	6.0
Maximum stress	[kN/m ²]	6.48			
Strain at maximum stress	[-]	0.45			
E _{50%}	[kN/m ²]	63.81			
E _{peak}	[kN/m ²]	14.28			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

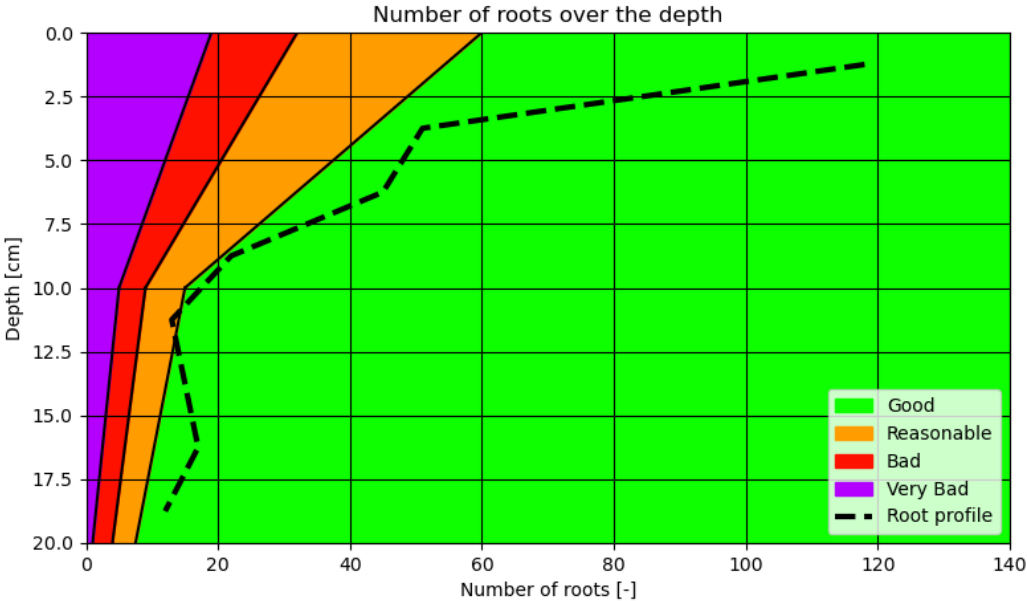


(c) Bottom



(d) Right

Root profile

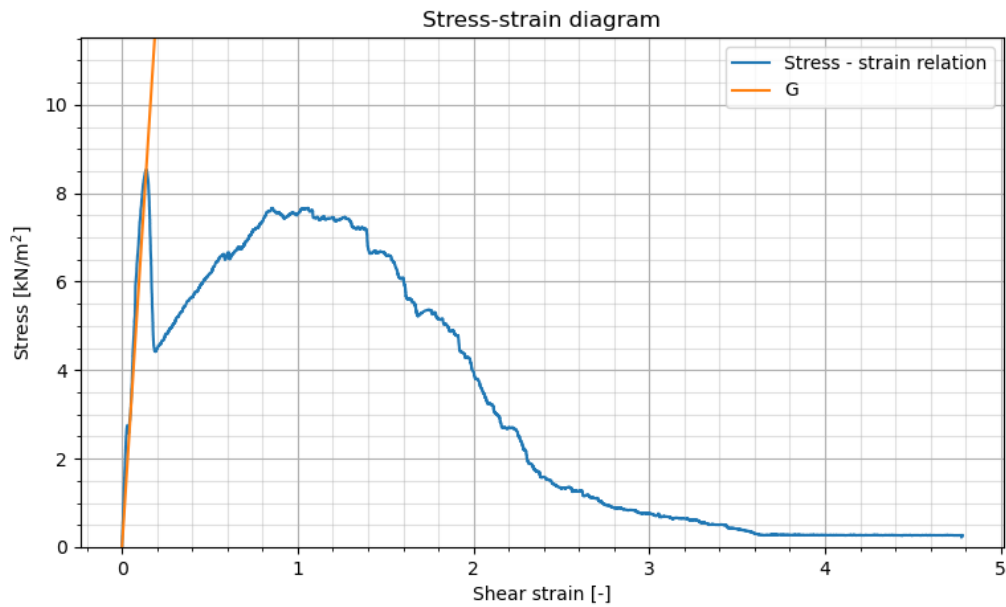


D.1. Shear tests - dry

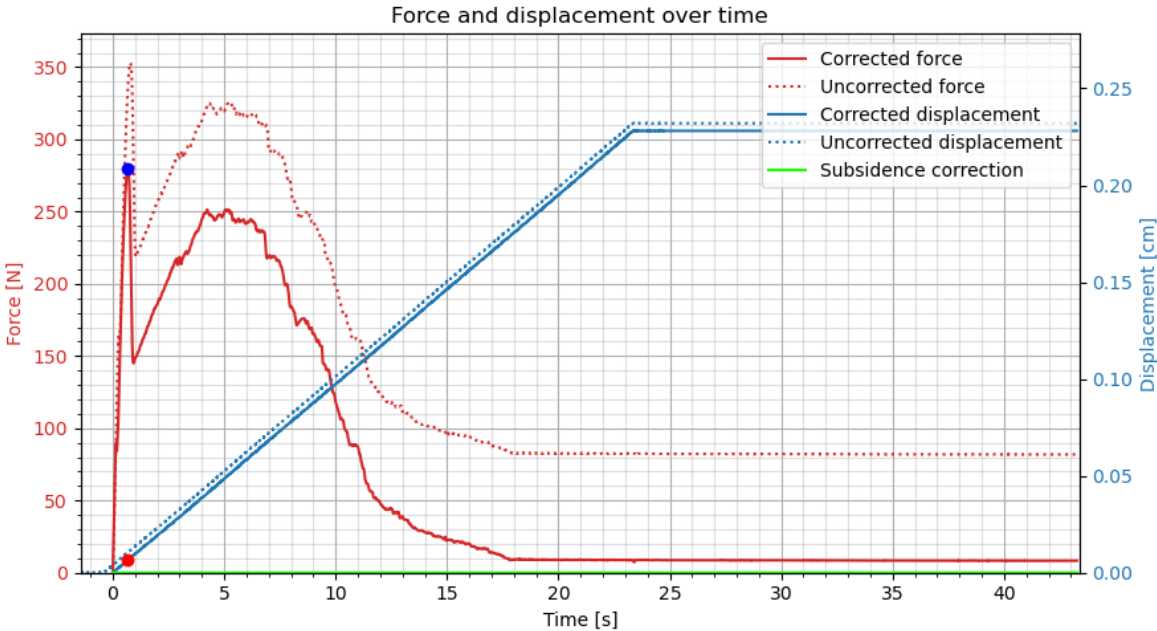
D.1.1. Test01

		Value 1	Value 2	Value 3	Mean
Date		01-03-2021			
Time		11:00:00			
Weight	[kg]	73.6			
Width	[cm]	20.0			
Dike orientation		North			
Shear deformation length	[cm]	4.77			
Percentage of occurrence	[%]	80	20	0	
Sod thickness	[cm]	8	9	0	8
Maximum shear stress	[kN/m ²]	8.52			
Shear strain at maximum shear stress	[-]	0.14			
G	[kN/m ²]	61.85			
Comments		-			

Stress-strain relation



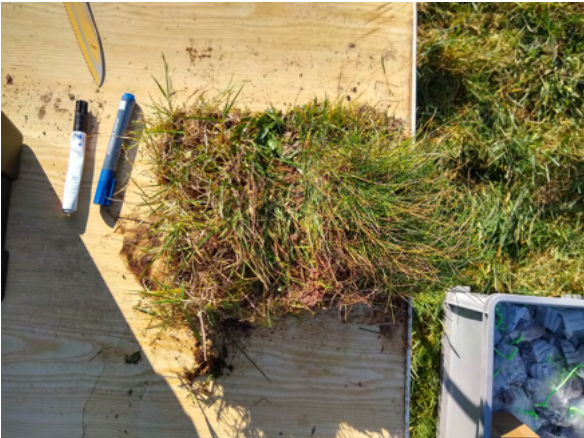
Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



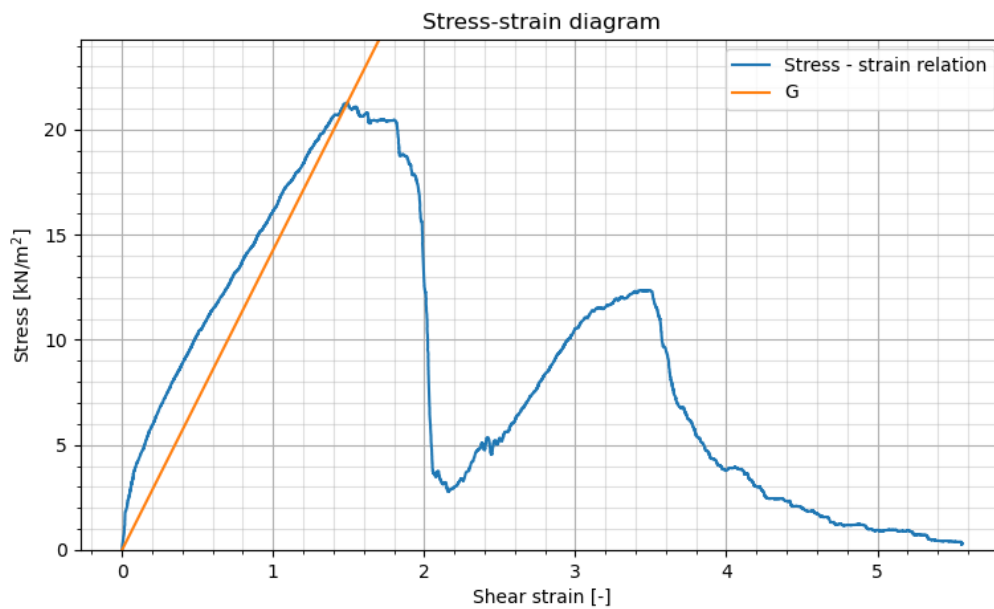
(d) Bottom



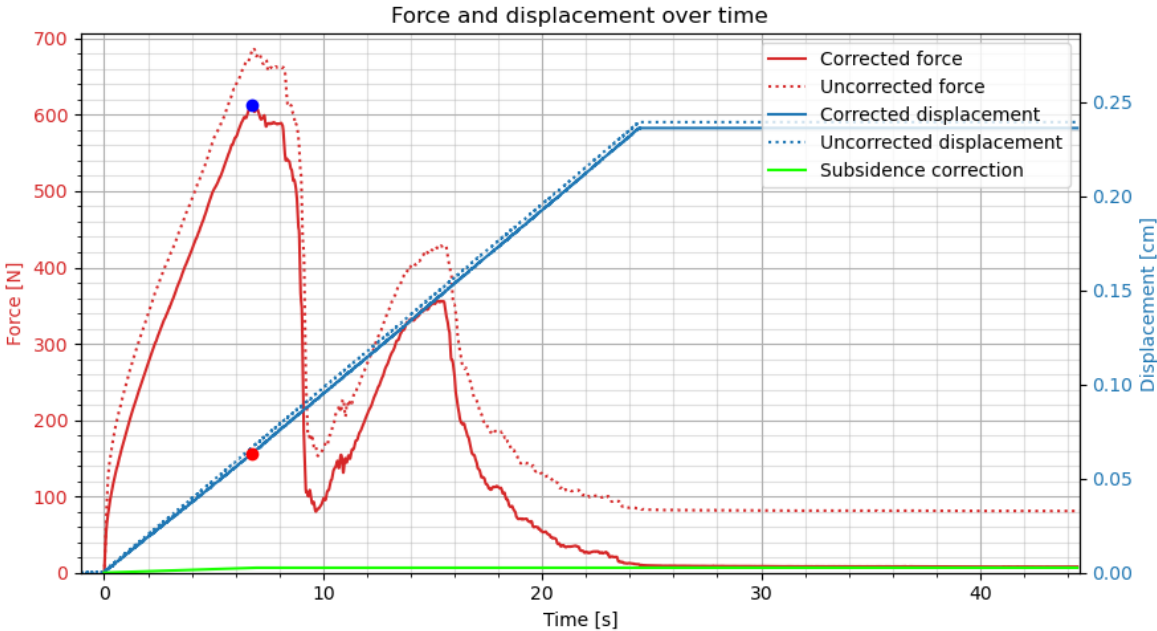
(e) Right

D.1.2. Test02

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		13:57:00			
Weight	[kg]	73.0			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.25			
Percentage of occurrence	[%]	20	80	0	
Sod thickness	[cm]	8	7	0	7
Maximum shear stress	[kN/m ²]	21.29			
Shear strain at maximum shear stress	[-]	1.49			
G	[kN/m ²]	14.27			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



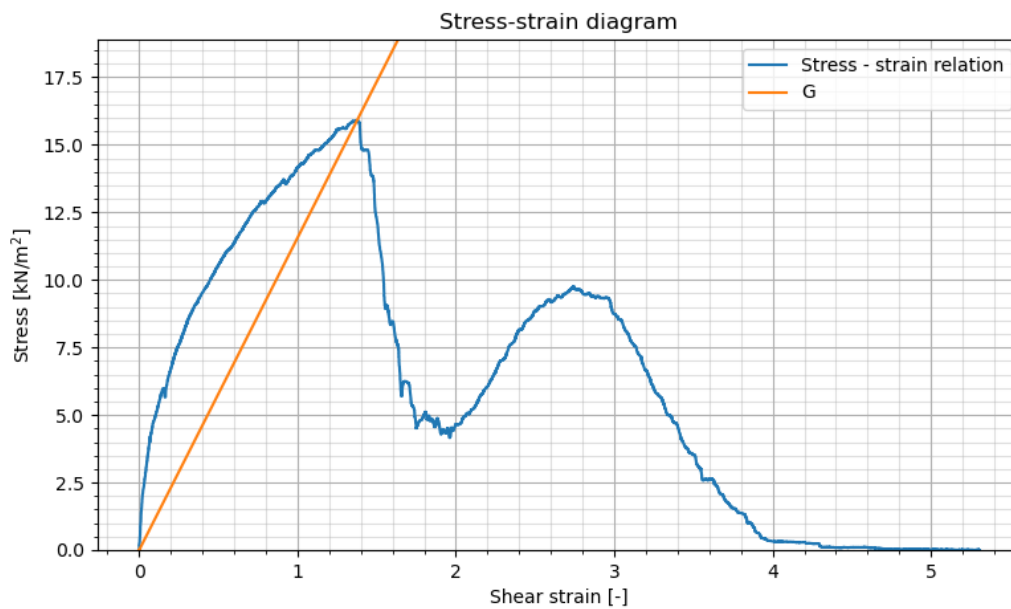
(d) Bottom



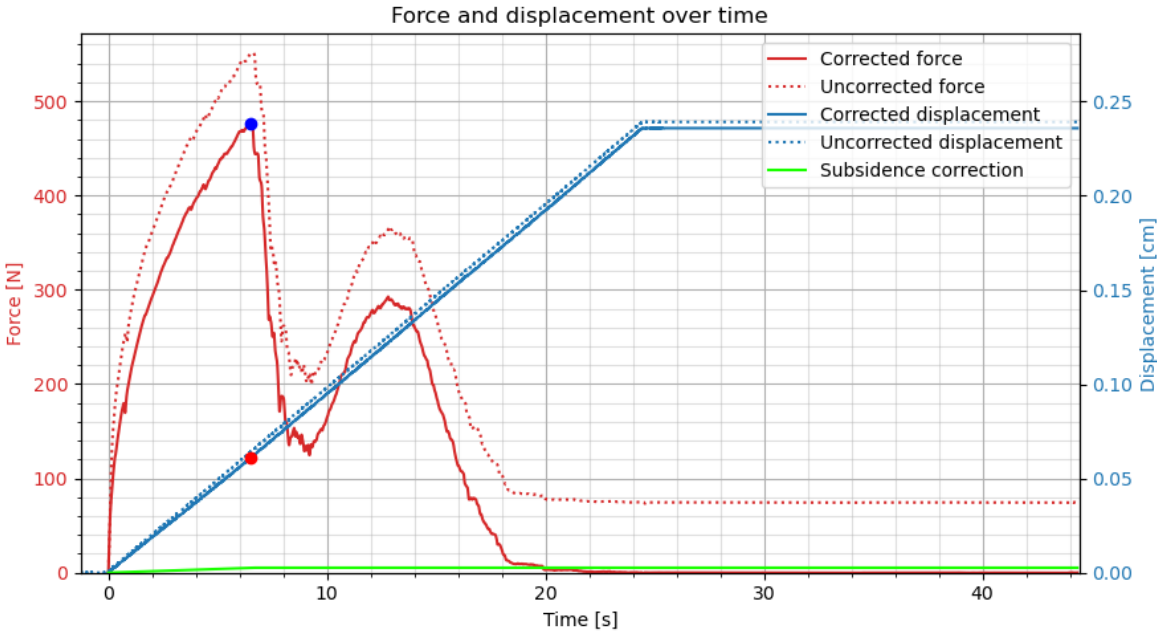
(e) Right

D.1.3. Test04

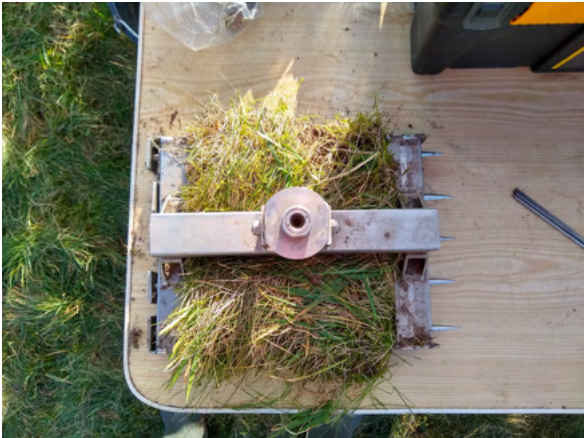
		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		15:33:00			
Weight	[kg]	74.5			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.45			
Percentage of occurrence	[%]	60	30	10	
Sod thickness	[cm]	8	7	6	8
Maximum shear stress	[kN/m ²]	15.9			
Shear strain at maximum shear stress	[-]	1.38			
G	[kN/m ²]	11.56			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



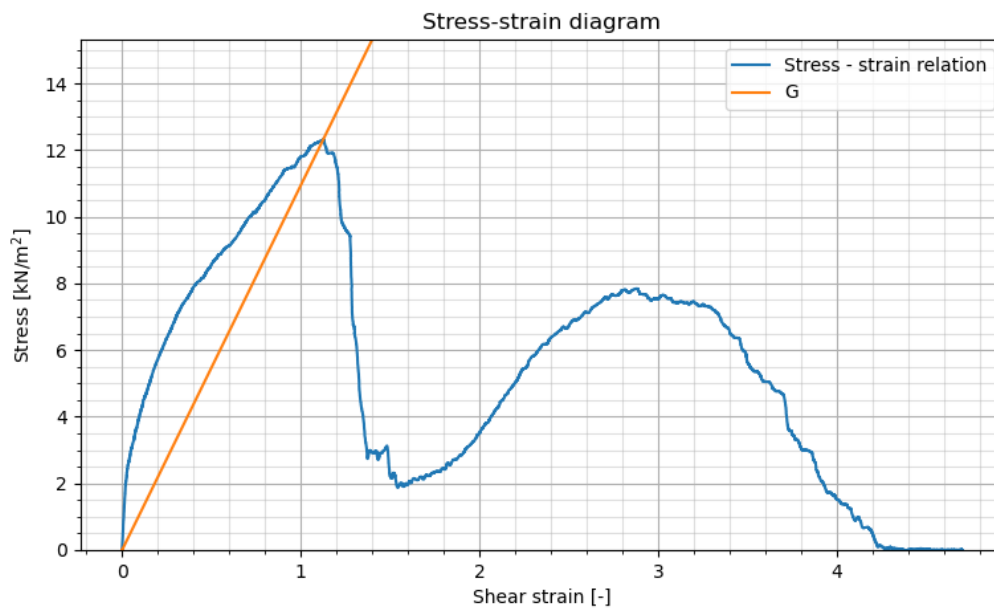
(d) Bottom



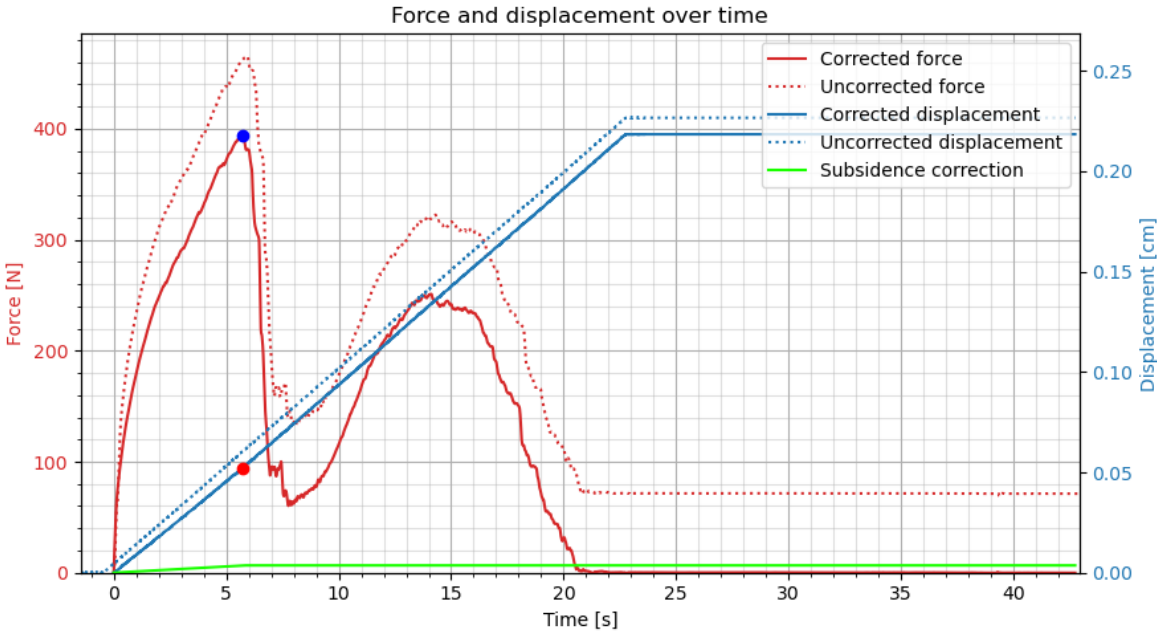
(e) Right

D.1.4. Test05

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		16:06:00			
Weight	[kg]	71.3			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.65			
Percentage of occurrence	[%]	100	0	0	
Sod thickness	[cm]	8	0	0	8
Maximum shear stress	[kN/m ²]	12.32			
Shear strain at maximum shear stress	[-]	1.13			
G	[kN/m ²]	10.94			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



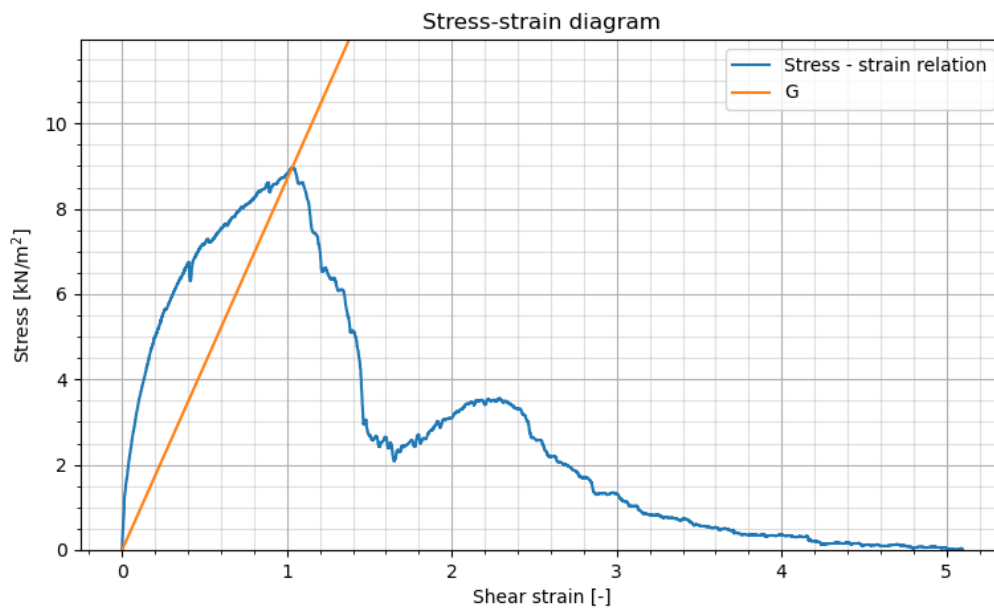
(d) Bottom



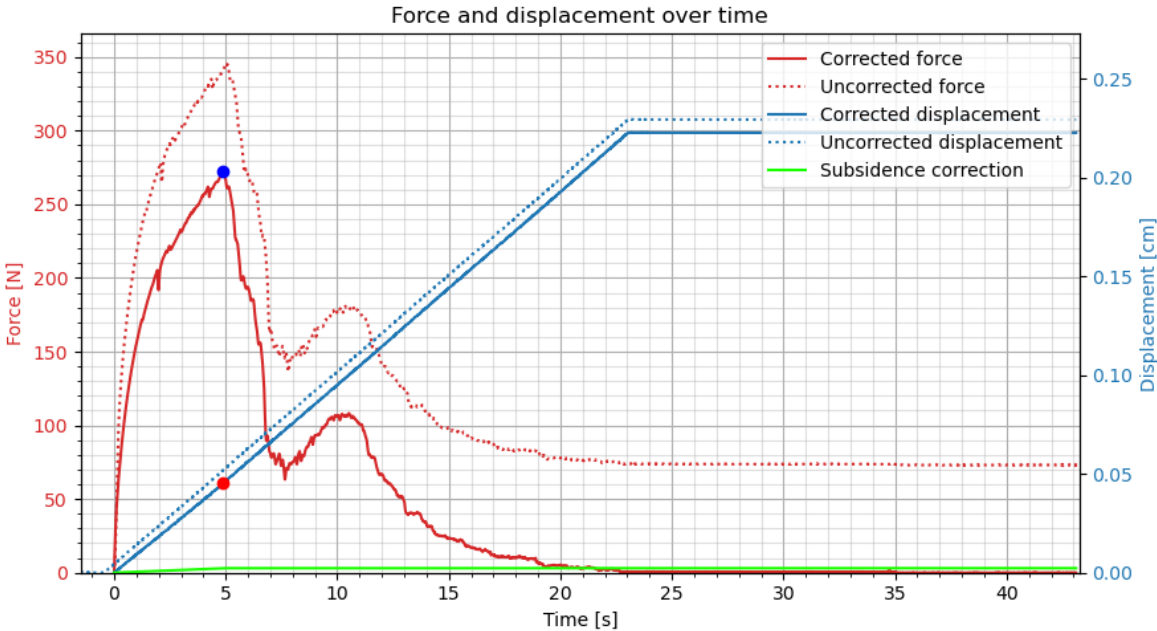
(e) Right

D.1.5. Test06

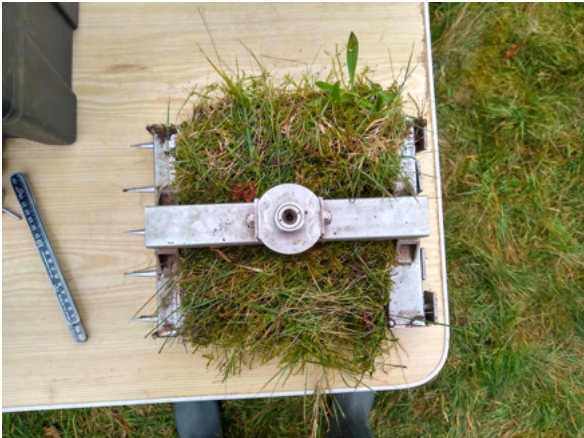
		Value 1	Value 2	Value 3	Mean
Date		08-03-2021			
Time		09:06:00			
Weight	[kg]	73.1			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.37			
Percentage of occurrence	[%]	50	40	10	
Sod thickness	[cm]	7	8	9	8
Maximum shear stress	[kN/m ²]	8.97			
Shear strain at maximum shear stress	[-]	1.03			
G	[kN/m ²]	8.69			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



(d) Bottom

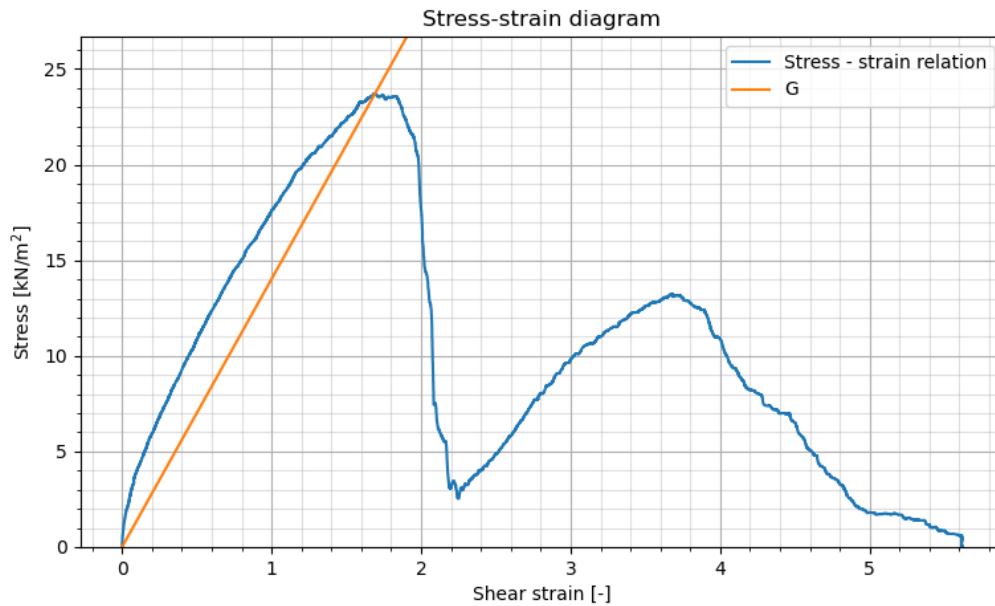


(e) Right

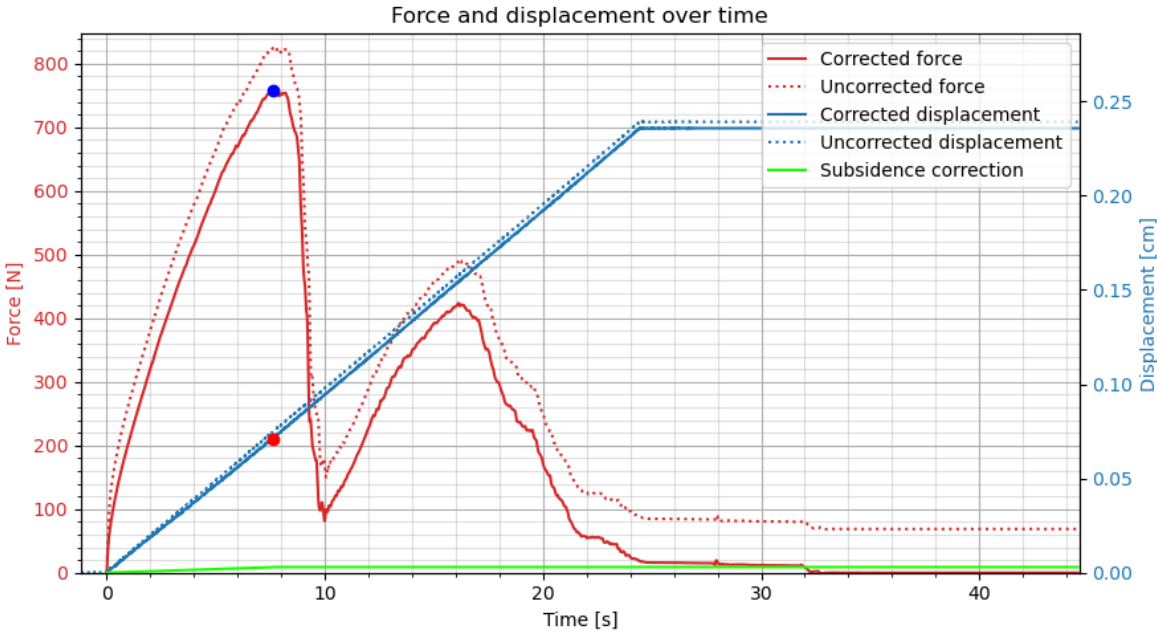
D.1.6. Test07

	Value 1	Value 2	Value 3	Mean
Date	08-03-2021			
Time	09:43:00			
Weight [kg]	68.8			
Width [cm]	20.0			
Dike orientation	North-West			
Shear deformation length [cm]	4.2			
Percentage of occurrence [%]	30	40	30	
Sod thickness [cm]	9	8	7	8
Maximum shear stress [kN/m ²]	23.69			
Shear strain at maximum shear stress [-]	1.69			
G [kN/m ²]	14.01			
Comments	Second failure plane did not fail entirely			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



(d) Bottom

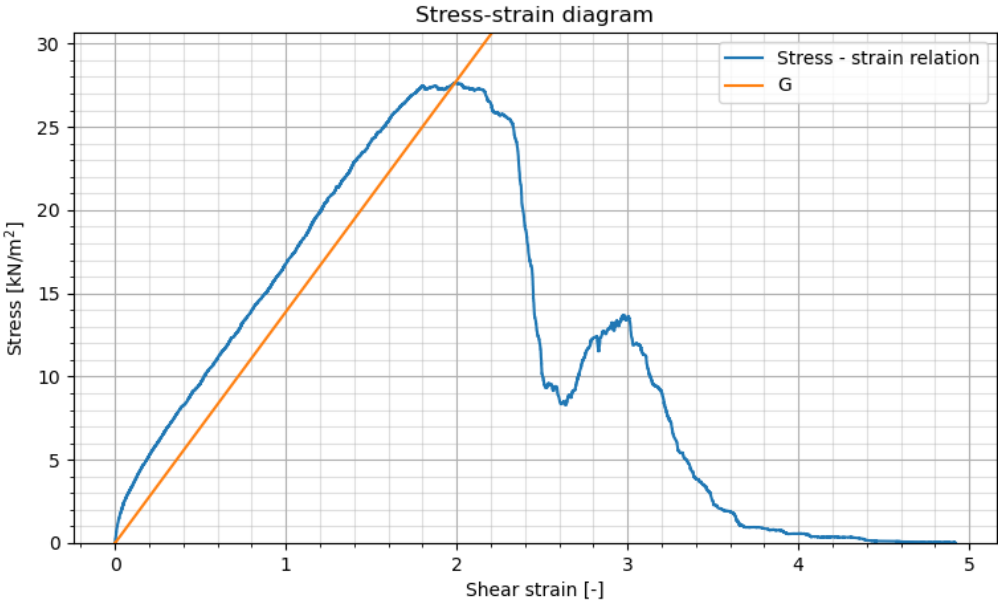


(e) Right

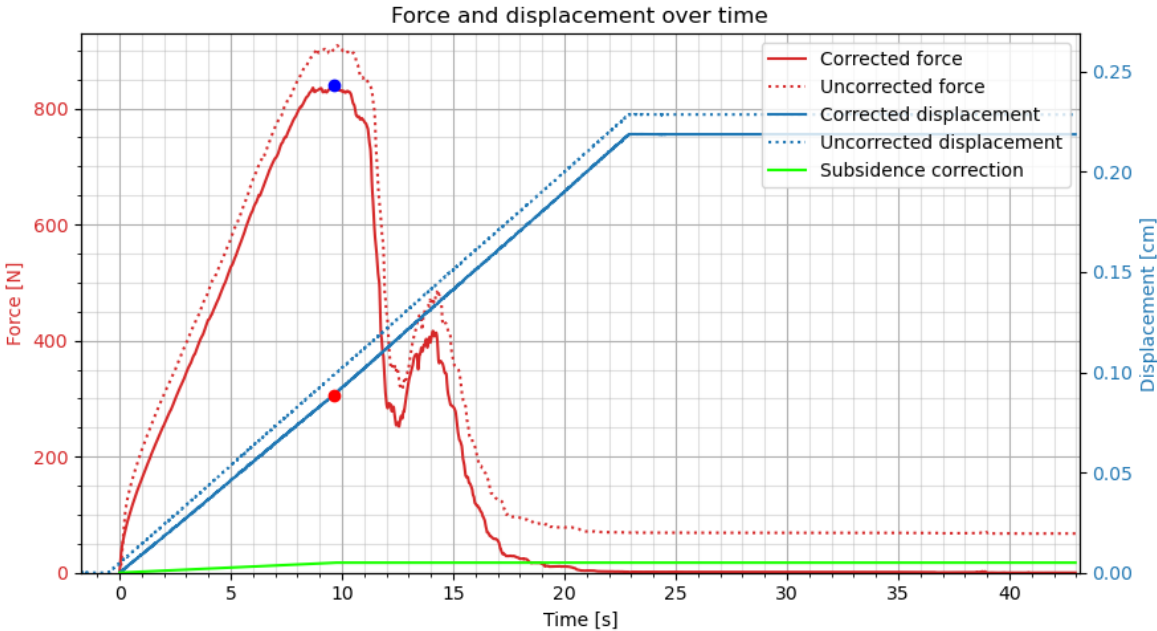
D.1.7. Test08

		Value 1	Value 2	Value 3	Mean
Date		08-03-2021			
Time		10:07:00			
Weight	[kg]	67.5			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.45			
Percentage of occurrence	[%]	60	40	0	
Sod thickness	[cm]	8	7	0	8
Maximum shear stress	[kN/m ²]	27.66			
Shear strain at maximum shear stress	[-]	1.99			
G	[kN/m ²]	13.89			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



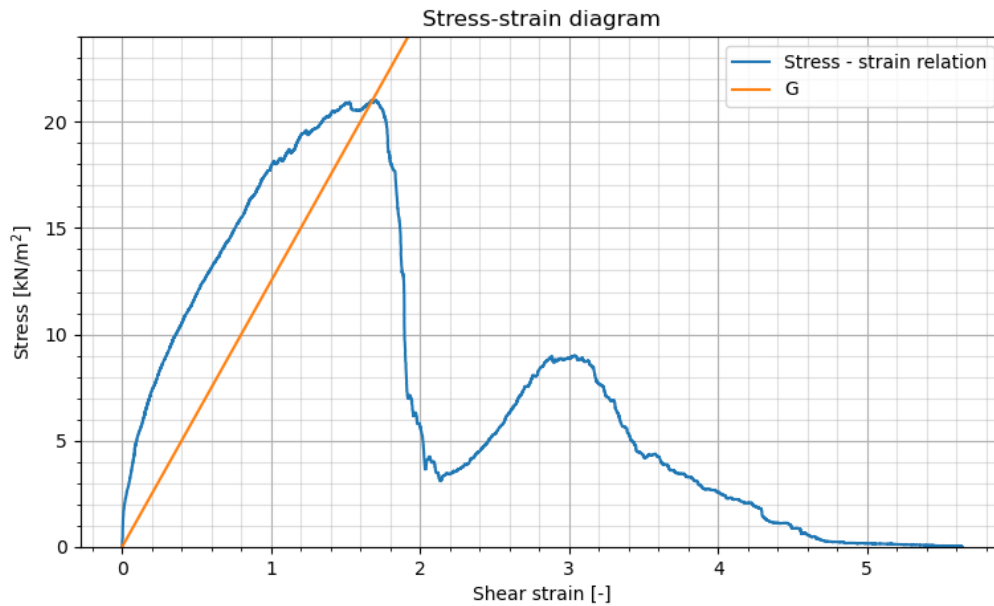
(d) Bottom



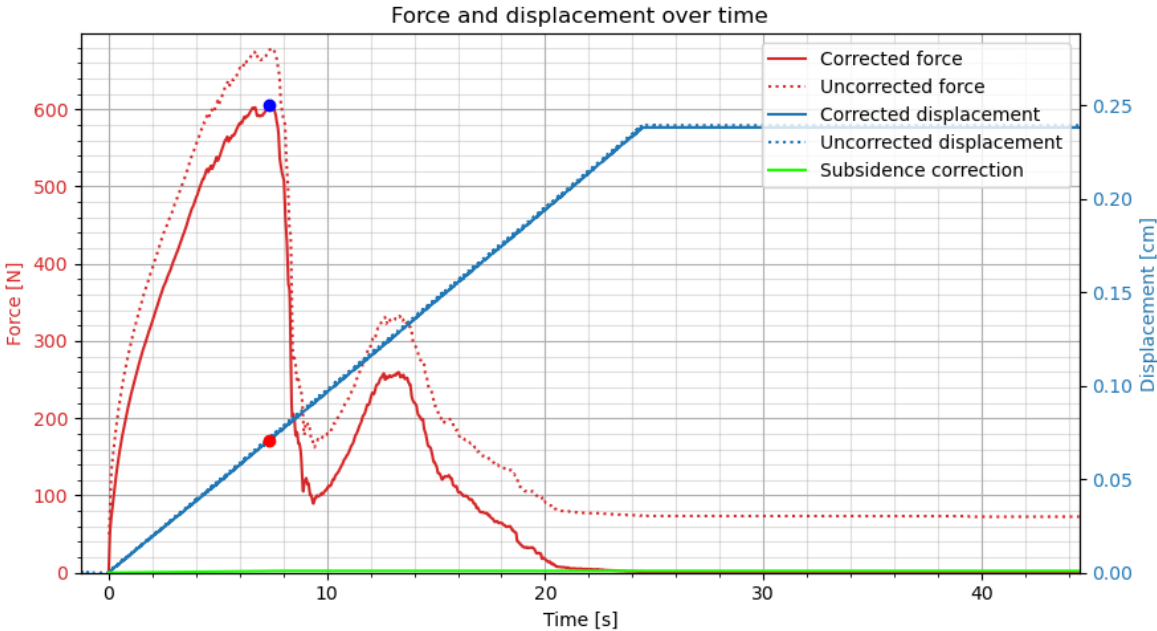
(e) Right

D.1.8. Test09

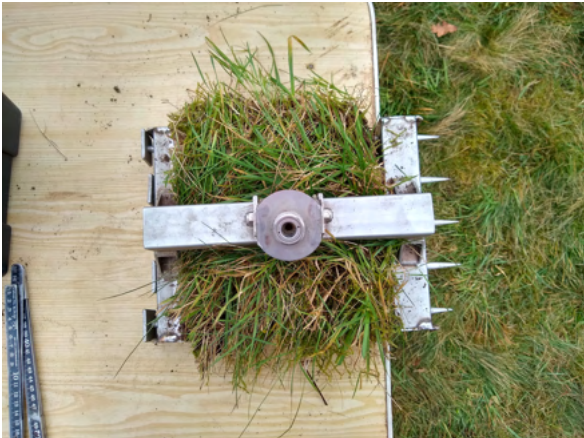
	Value 1	Value 2	Value 3	Mean
Date	08-03-2021			
Time	11:03:00			
Weight	[kg] 72.7			
Width	[cm] 20.0			
Dike orientation	North-West			
Shear deformation length	[cm] 4.22			
Percentage of occurrence	[%] 60	20	20	
Sod thickness	[cm] 8	7	5	7
Maximum shear stress	[kN/m ²] 21.0			
Shear strain at maximum shear stress	[-] 1.68			
G	[kN/m ²] 12.5			
Comments	Difficulty with installing pins			

Stress-strain relation

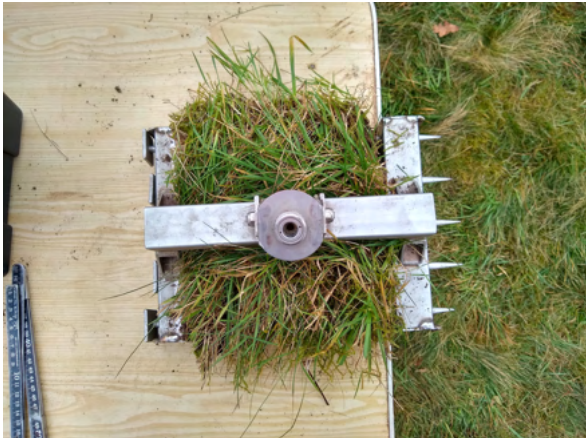
Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



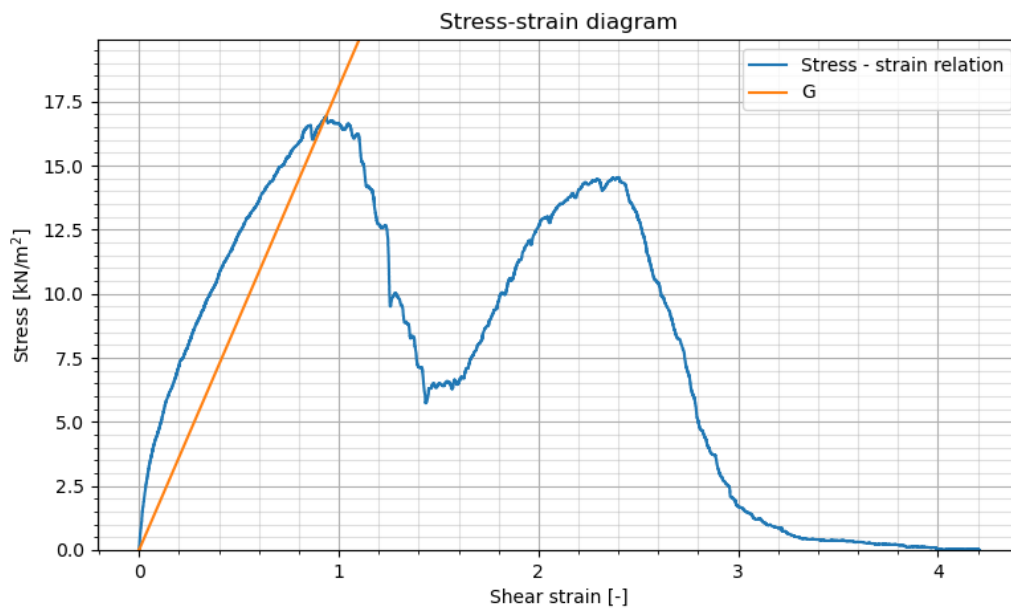
(d) Bottom



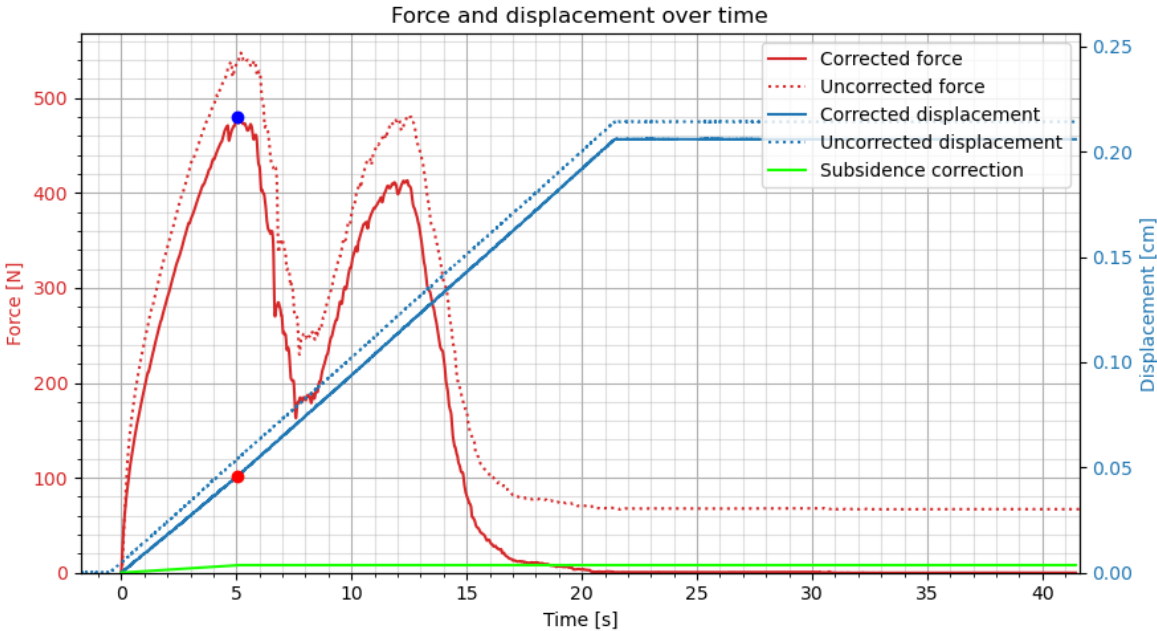
(e) Right

D.1.9. Test10

		Value 1	Value 2	Value 3	Mean
Date		08-03-2021			
Time		11:31:00			
Weight	[kg]	67.0			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	4.9			
Percentage of occurrence	[%]	30	50	20	
Sod thickness	[cm]	8	7	6	7
Maximum shear stress	[kN/m ²]	16.92			
Shear strain at maximum shear stress	[-]	0.94			
G	[kN/m ²]	18.08			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



(d) Bottom



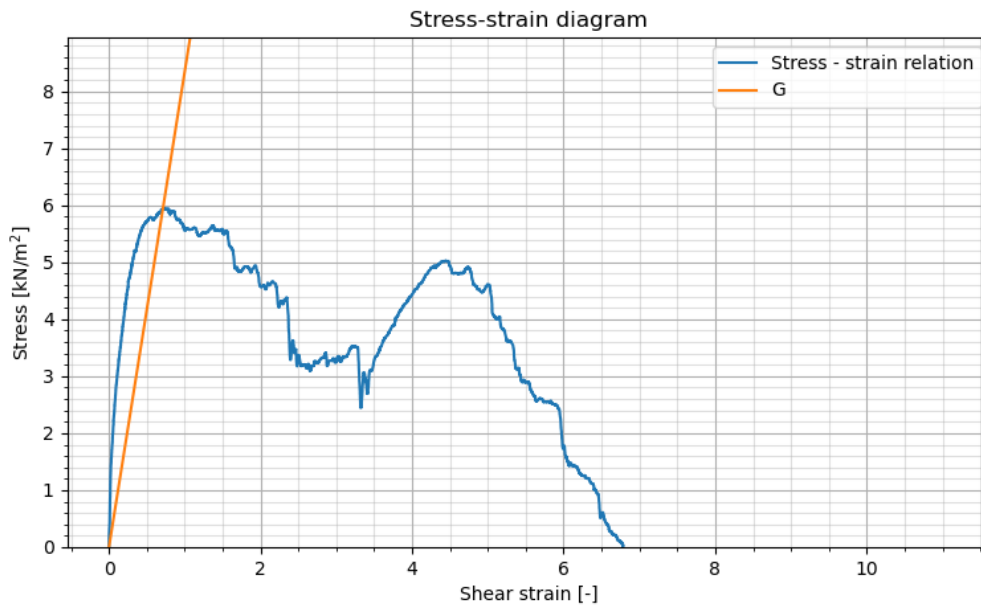
(e) Right

D.2. Shear tests - submerged

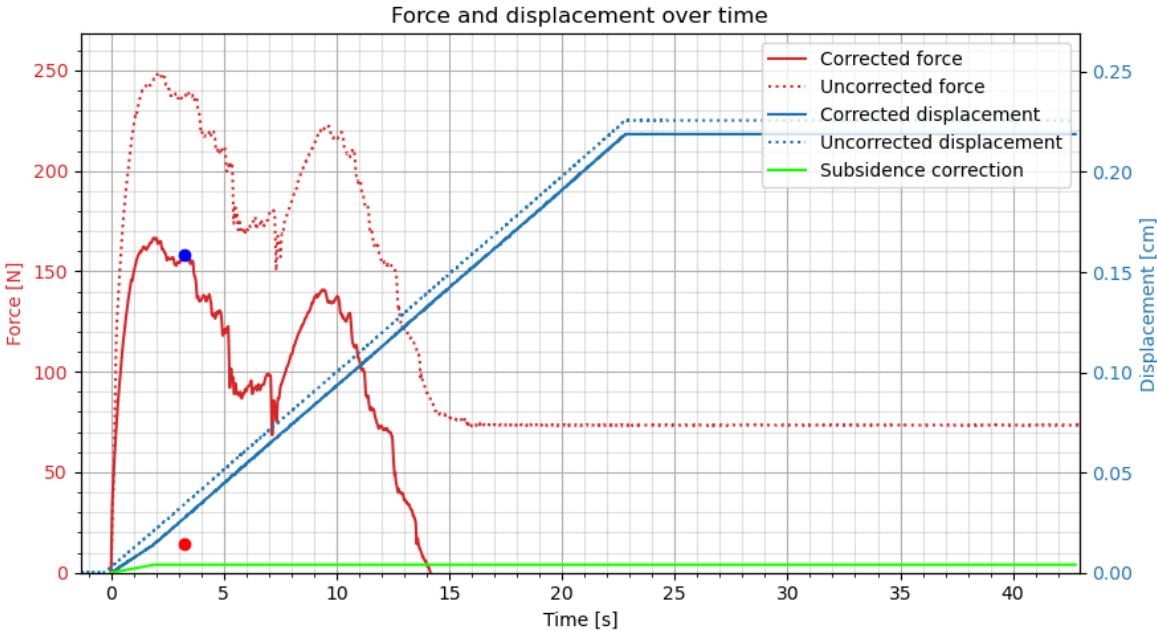
D.2.1. Test01

		Value 1	Value 2	Value 3	Mean
Date		01-03-2021			
Time		10:33:00			
Weight	[kg]	81.7			
Width	[cm]	20.0			
Dike orientation		North			
Shear deformation length	[cm]	1.97			
Percentage of occurrence	[%]	60	20	20	
Sod thickness	[cm]	7	6	8	7
Maximum shear stress	[kN/m ²]	5.95			
Shear strain at maximum shear stress	[-]	0.71			
G	[kN/m ²]	8.35			
Comments		Box was leaking			

Stress-strain relation



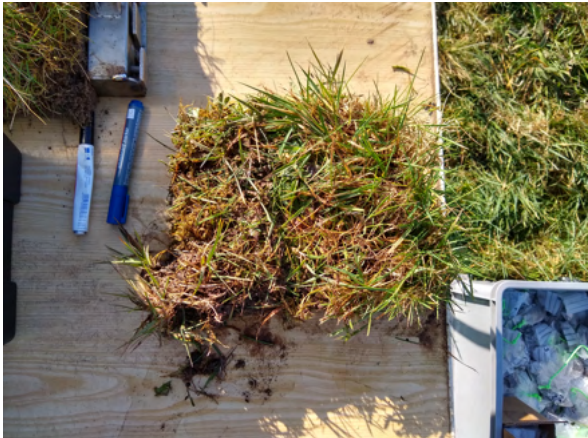
Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



(d) Bottom

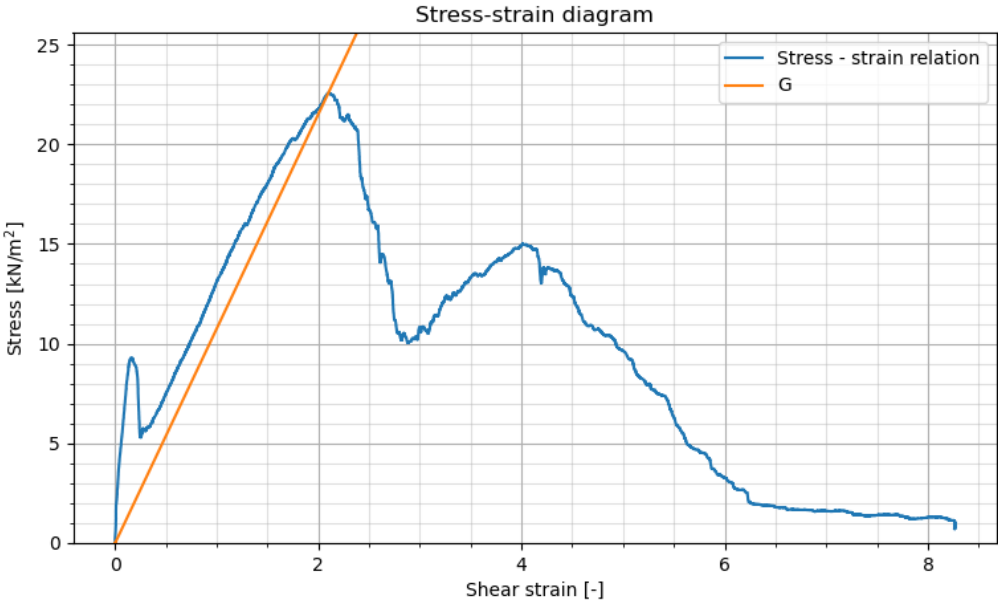


(e) Right

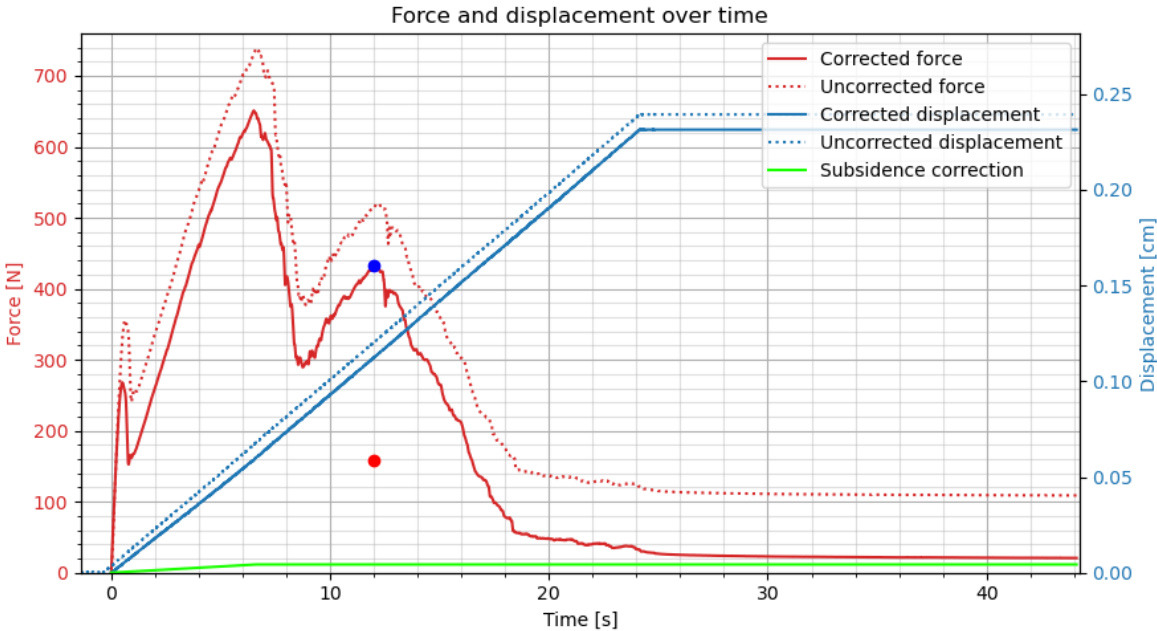
D.2.2. Test05

		Value 1	Value 2	Value 3	Mean
Date		09-03-2021			
Time		11:31:00			
Weight	[kg]	88.1			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	2.8			
Percentage of occurrence	[%]	20	80	0	
Sod thickness	[cm]	8	7	0	7
Maximum shear stress	[kN/m ²]	22.61			
Shear strain at maximum shear stress	[-]	2.1			
G	[kN/m ²]	10.76			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



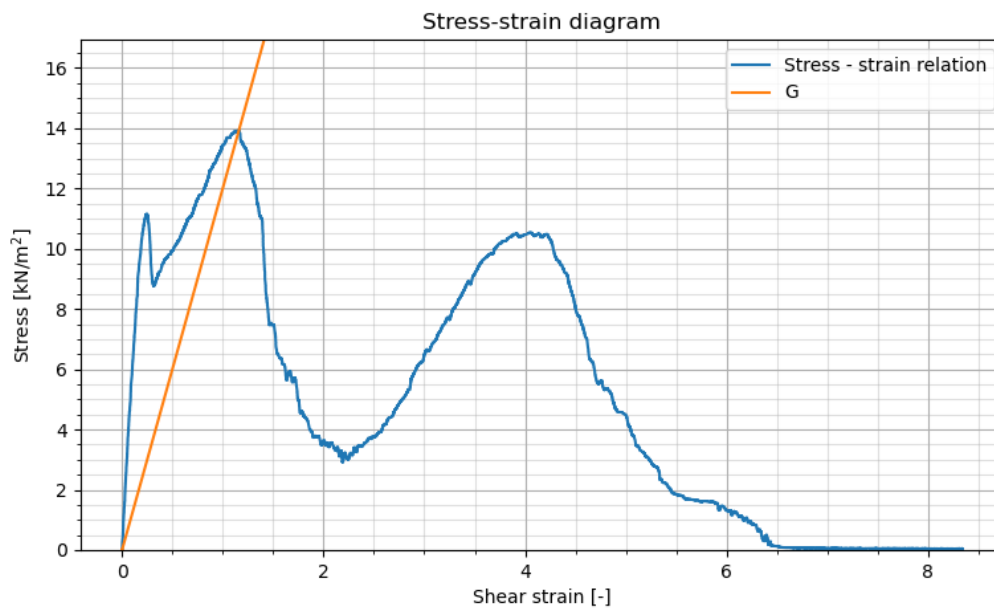
(d) Bottom



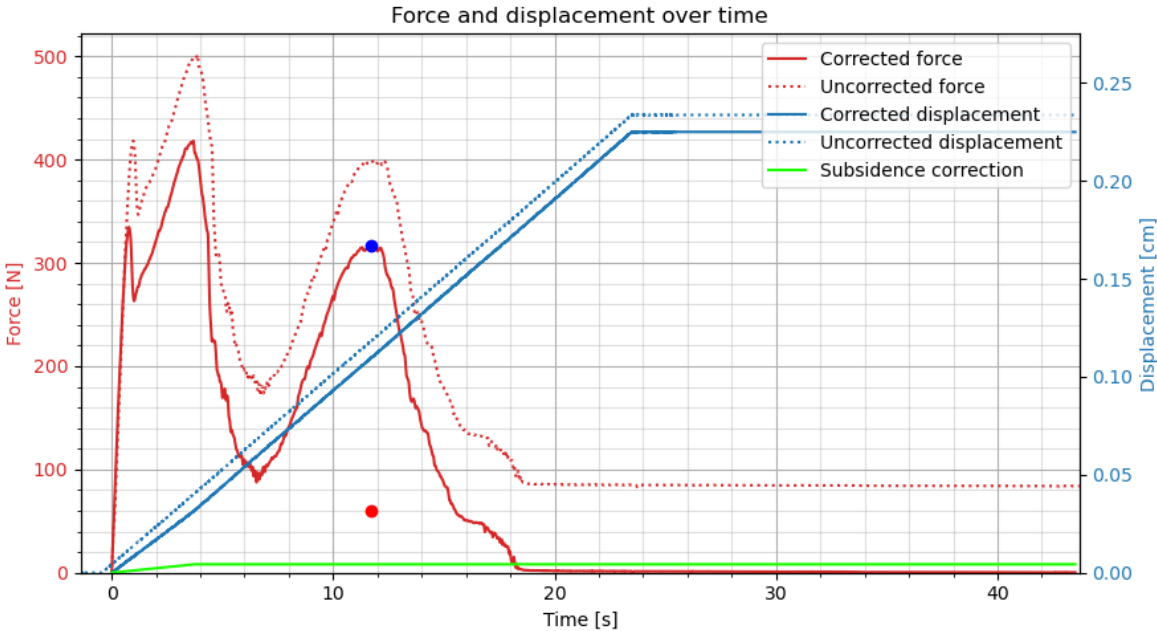
(e) Right

D.2.3. Test06

		Value 1	Value 2	Value 3	Mean
Date		09-03-2021			
Time		13:40:00			
Weight	[kg]	83.6			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	2.7			
Percentage of occurrence	[%]	60	30	10	
Sod thickness	[cm]	8	7	6	8
Maximum shear stress	[kN/m ²]	13.94			
Shear strain at maximum shear stress	[-]	1.16			
G	[kN/m ²]	12.01			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



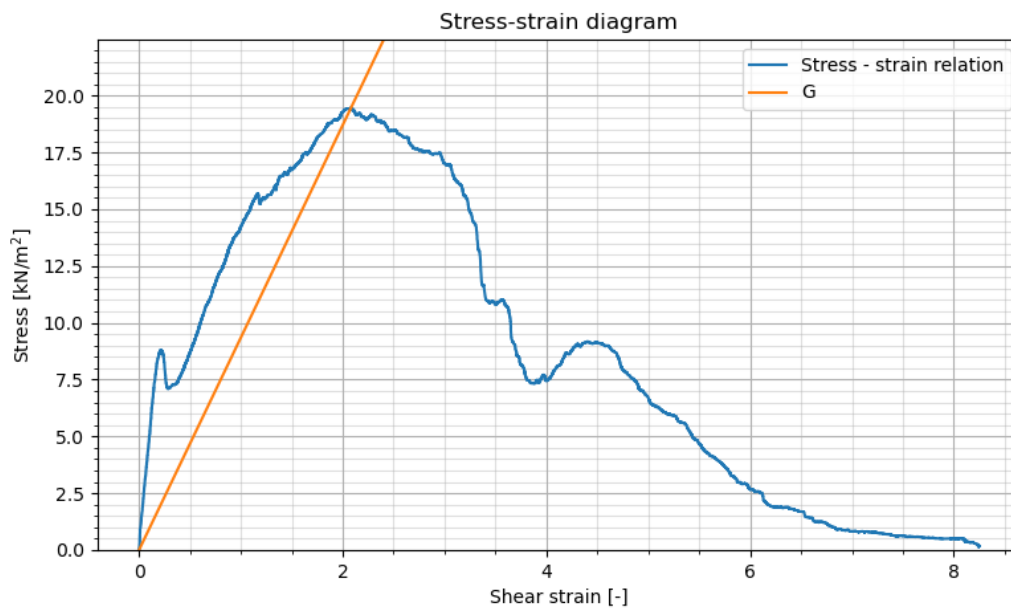
(d) Bottom



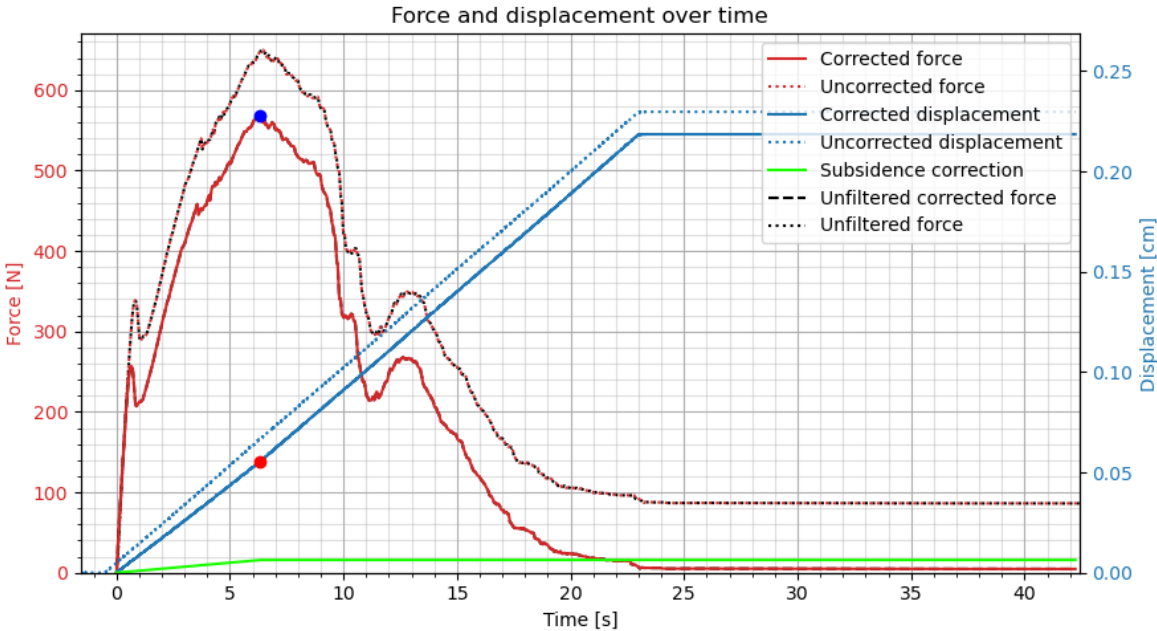
(e) Right

D.2.4. Test07

		Value 1	Value 2	Value 3	Mean
Date		09-03-2021			
Time		14:24:00			
Weight	[kg]	81.6			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	2.65			
Percentage of occurrence	[%]	50	30	20	
Sod thickness	[cm]	8	7	6	7
Maximum shear stress	[kN/m ²]	19.47			
Shear strain at maximum shear stress	[-]	2.08			
G	[kN/m ²]	9.35			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



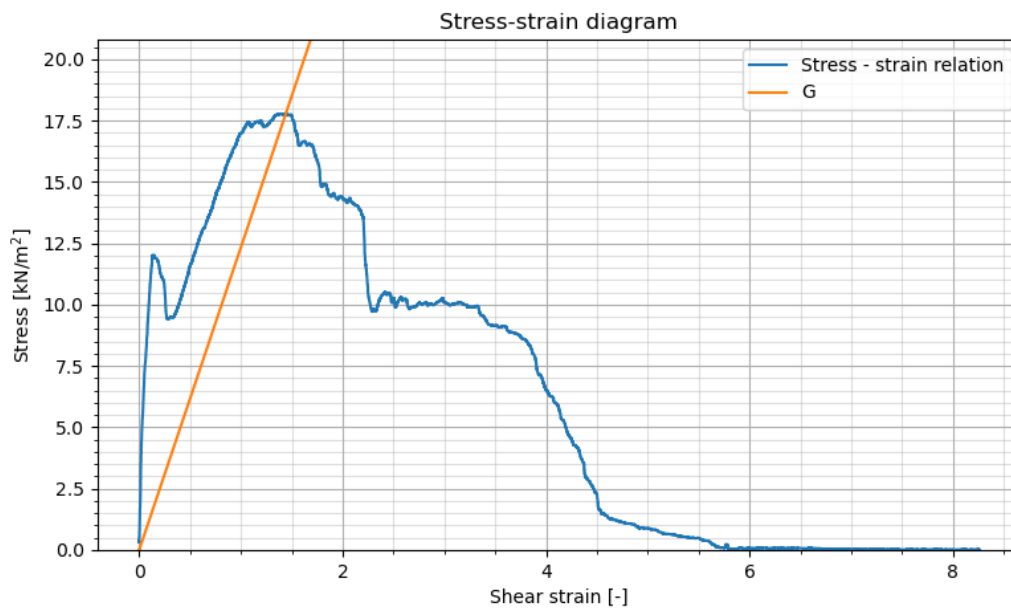
(d) Bottom



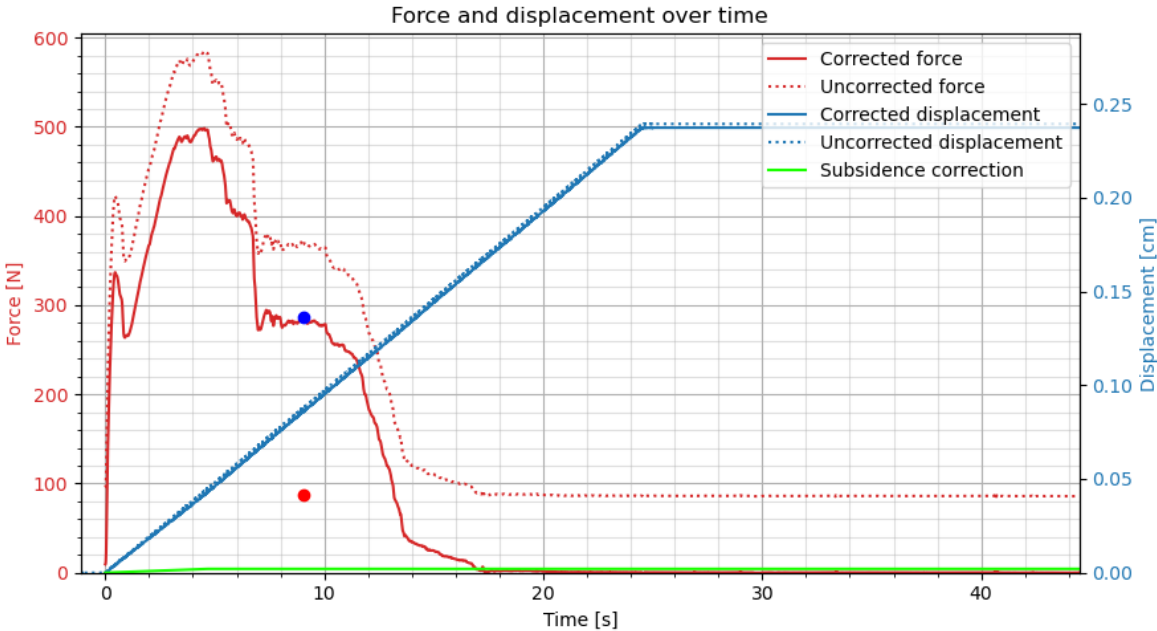
(e) Right

D.2.5. Test08

		Value 1	Value 2	Value 3	Mean
Date		09-03-2021			
Time		15:00:00			
Weight	[kg]	85.8			
Width	[cm]	20.0			
Dike orientation		North-West			
Shear deformation length	[cm]	2.88			
Percentage of occurrence	[%]	30	40	30	
Sod thickness	[cm]	8	7	6	7
Maximum shear stress	[kN/m ²]	17.8			
Shear strain at maximum shear stress	[-]	1.44			
G	[kN/m ²]	12.34			
Comments		-			

Stress-strain relation

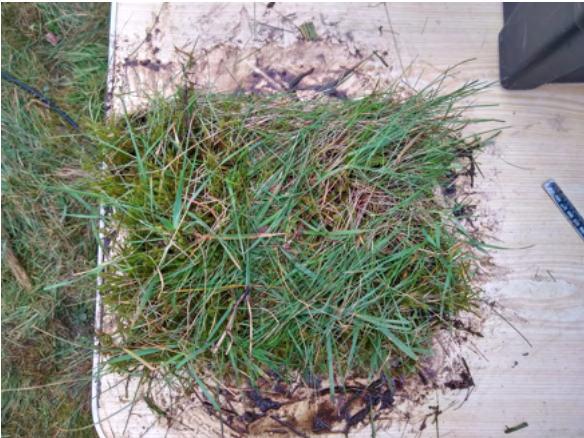
Force and displacement over time



Test sample pictures



(a) Frame



(b) Top



(c) Left



(d) Bottom



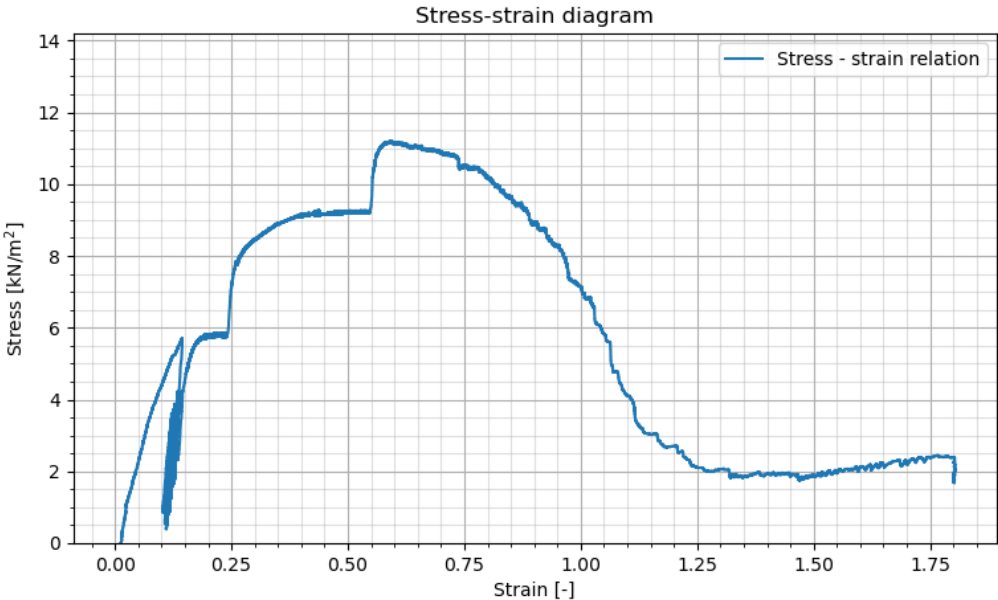
(e) Right

D.1. Stepwise increased constant load tests - dry

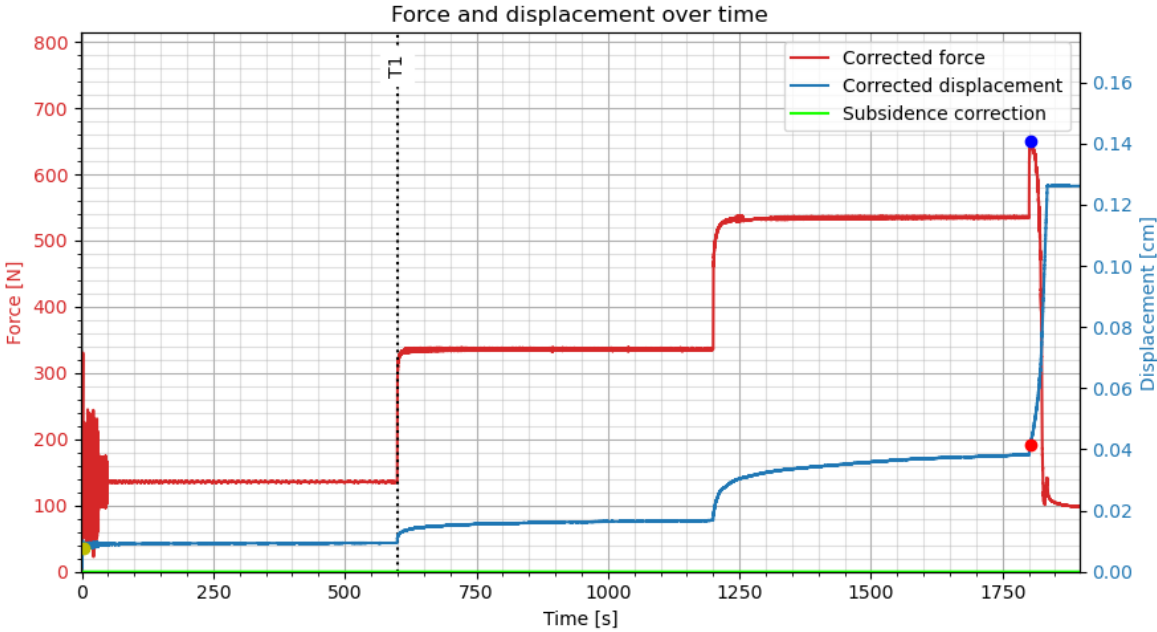
D.1.1. Test02

	Value 1	Value 2	Value 3	Mean
Date	22-02-2021			
Time	09:13:00			
Weight [kg]	64.3			
Width [cm]	20.0			
Length [cm]	29			
Dike orientation	North			
Percentage of occurrence [%]	40	20	40	
Sod thickness [cm]	9	7	5	7
Root length [cm]	7	5	5	5.8
Maximum stress [kN/m ²]	11.19			
Strain at maximum stress [-]	0.59			
Comments	Wiggles at start due to bad calibration			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

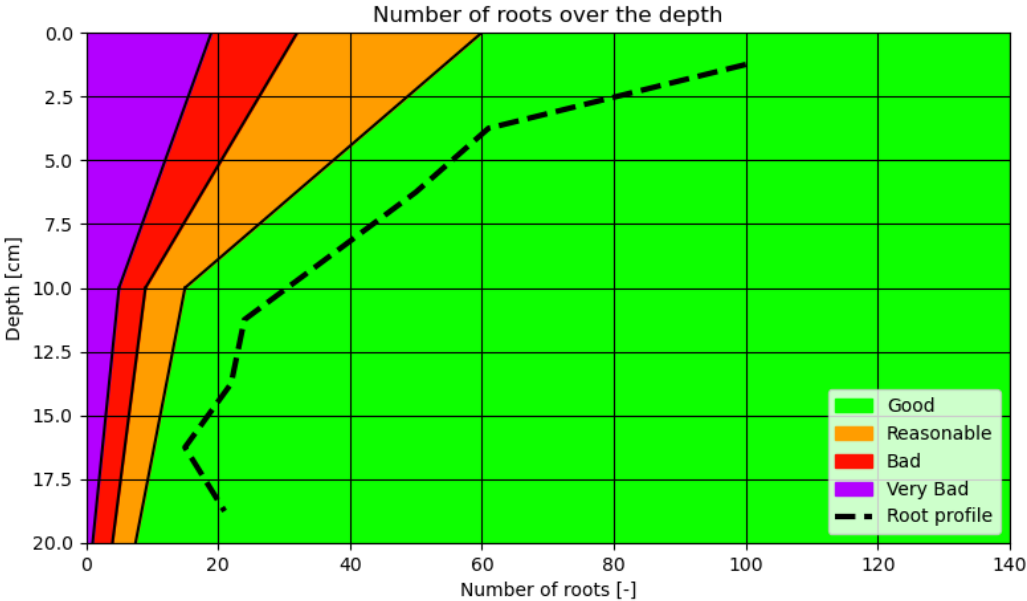


(c) Bottom



(d) Right

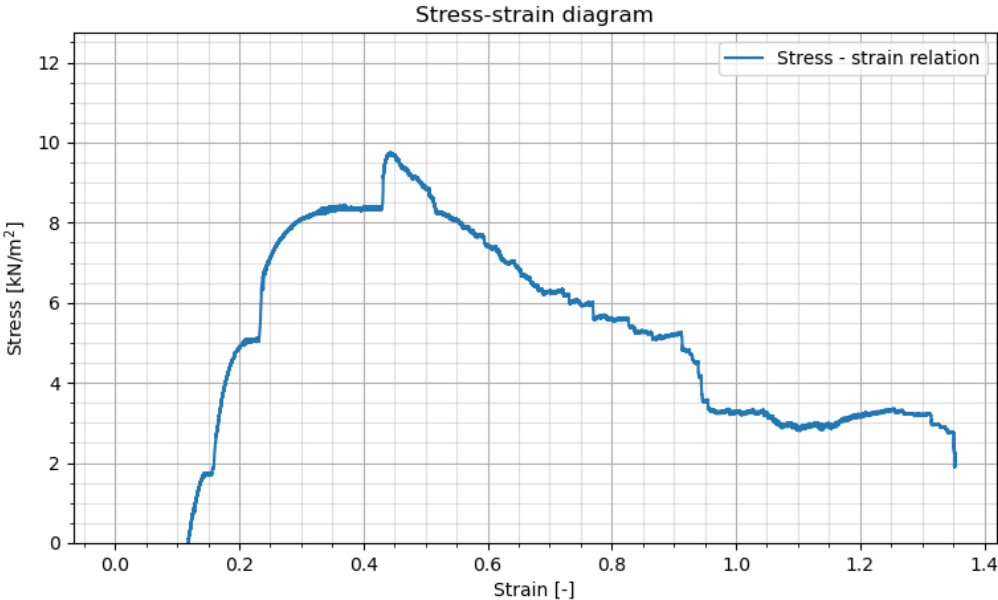
Root profile



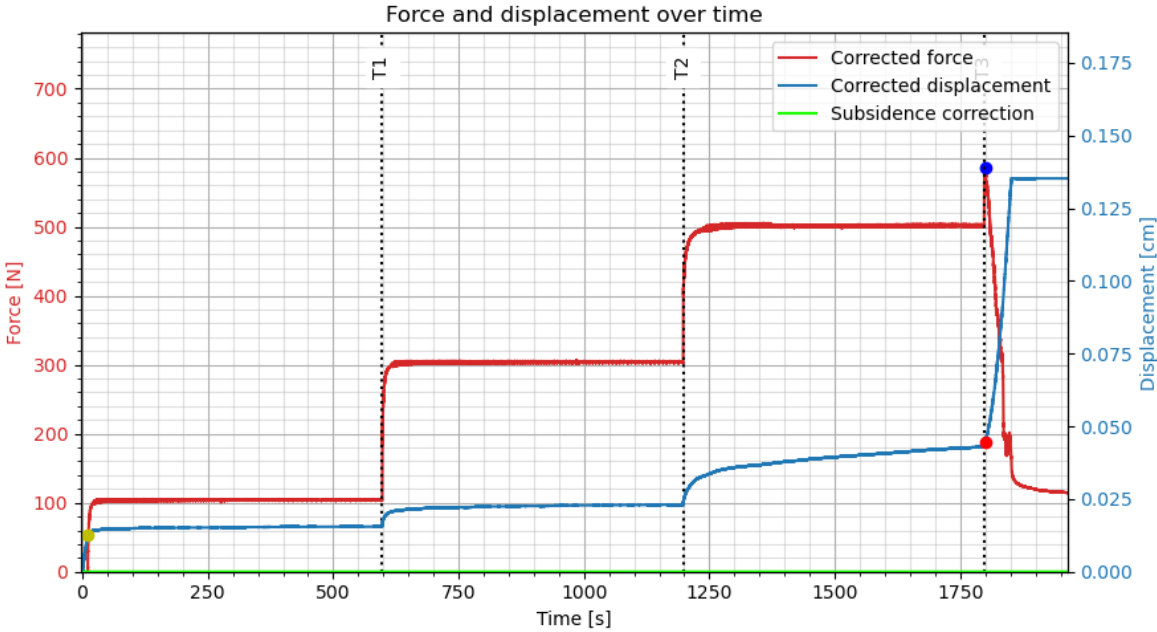
D.1.2. Test03

	Value 1	Value 2	Value 3	Mean
Date	22-02-2021			
Time	10:23:00			
Weight [kg]	96.2			
Width [cm]	20.0			
Length [cm]	30			
Dike orientation	North			
Percentage of occurrence [%]	50	30	20	
Sod thickness [cm]	13	9	4	10
Root length [cm]	3	3	8	4.0
Maximum stress [kN/m ²]	9.75			
Strain at maximum stress [-]	0.44			
Comments	-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

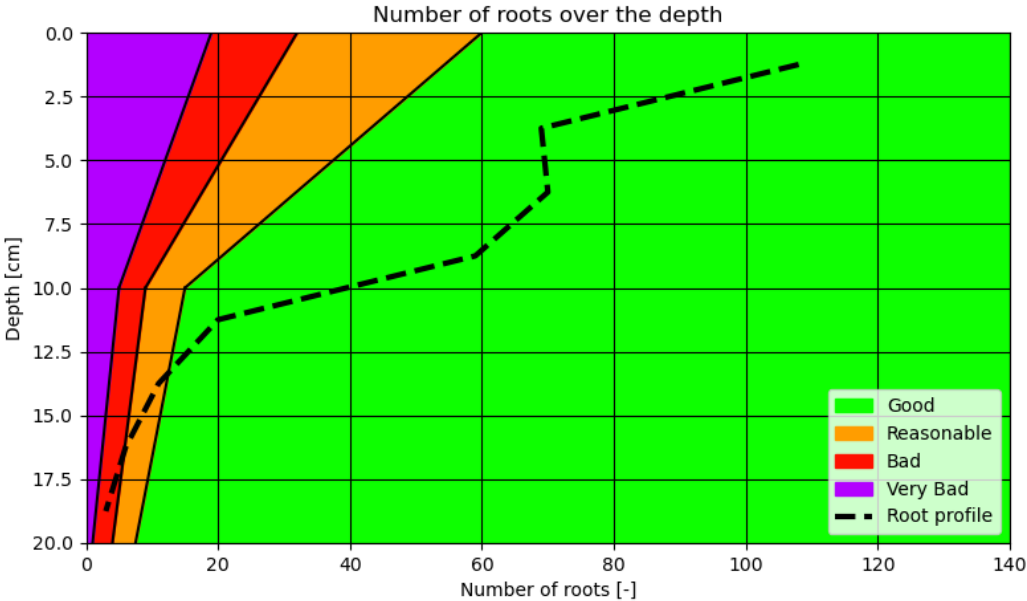


(c) Bottom



(d) Right

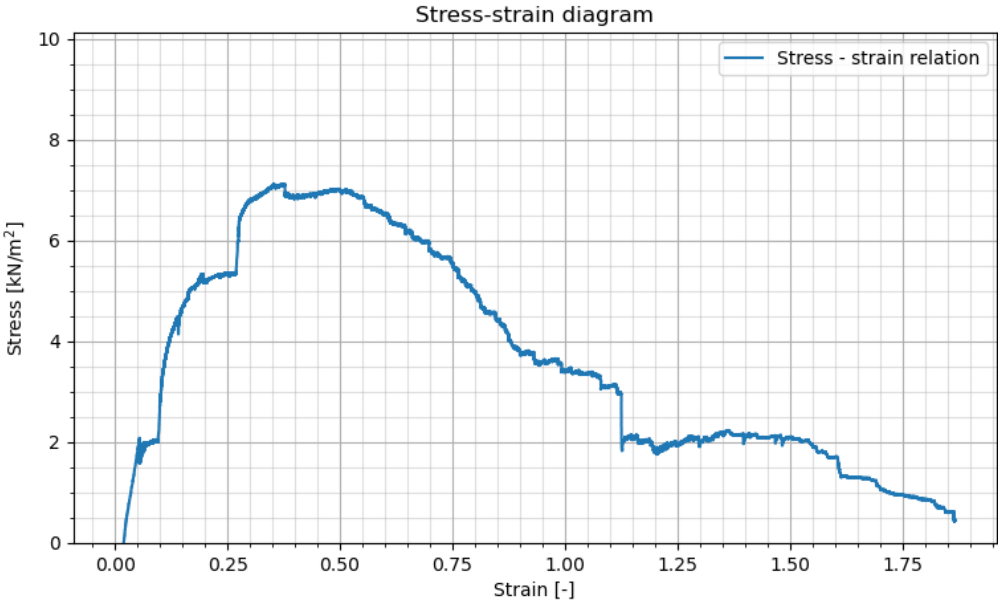
Root profile



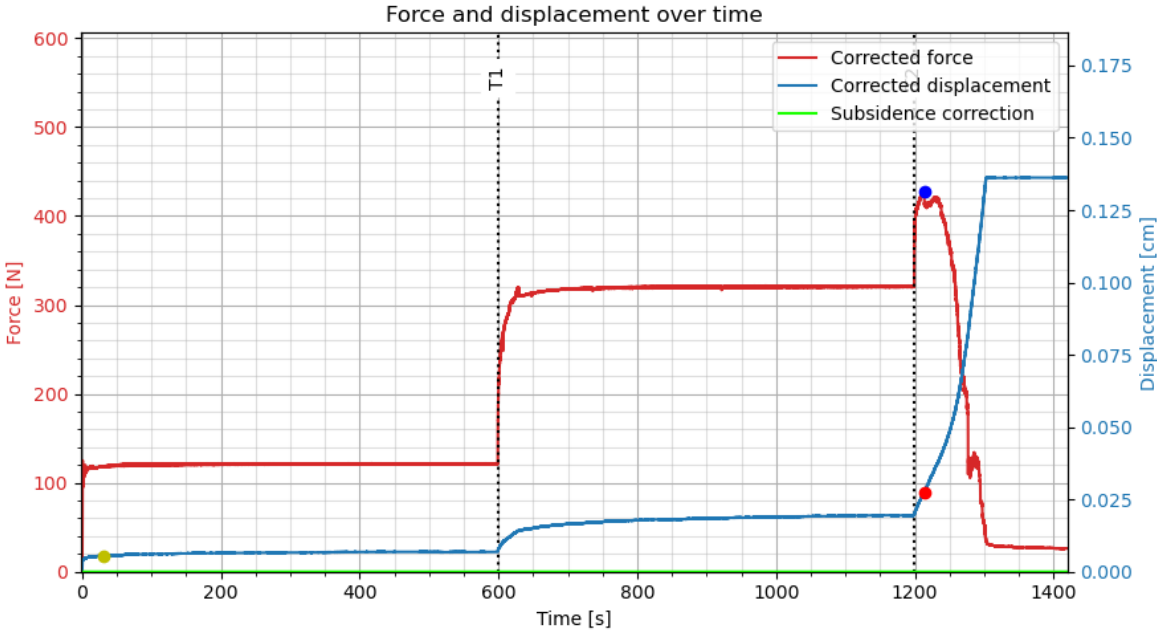
D.1.3. Test04

	Value 1	Value 2	Value 3	Mean
Date	22-02-2021			
Time	11:07:00			
Weight [kg]	78.7			
Width [cm]	20.0			
Length [cm]	30			
Dike orientation	North			
Percentage of occurrence [%]	30	30	40	
Sod thickness [cm]	11	8	4	7
Root length [cm]	3	6	5	4.7
Maximum stress [kN/m ²]	7.12			
Strain at maximum stress [-]	0.37			
Comments	-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

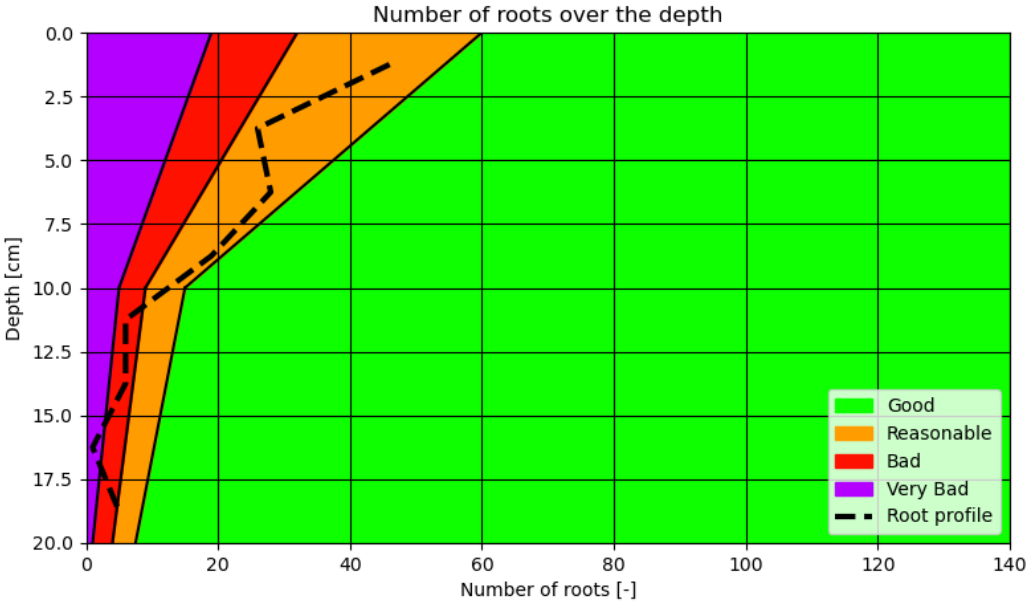


(c) Bottom



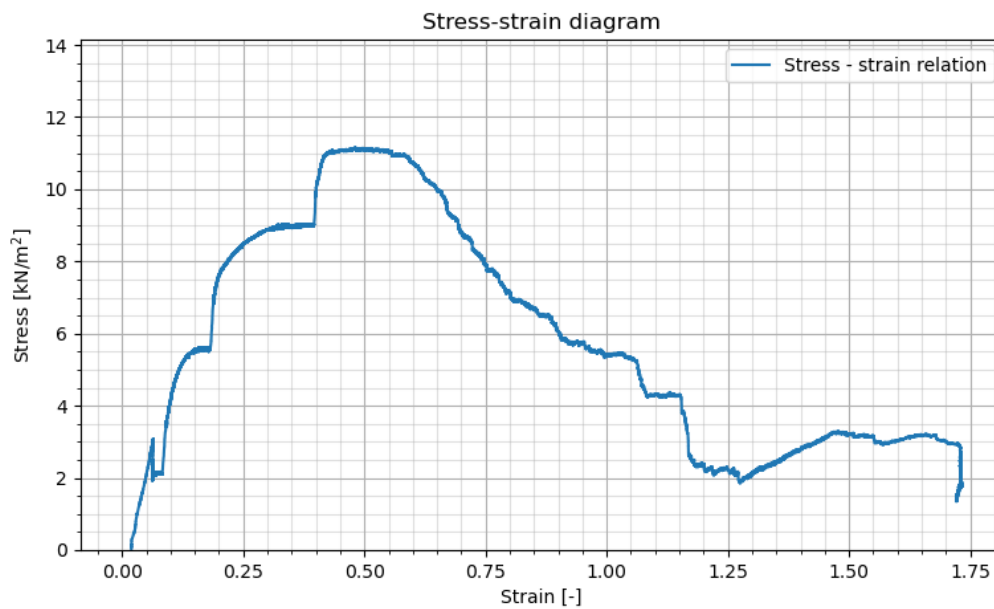
(d) Right

Root profile

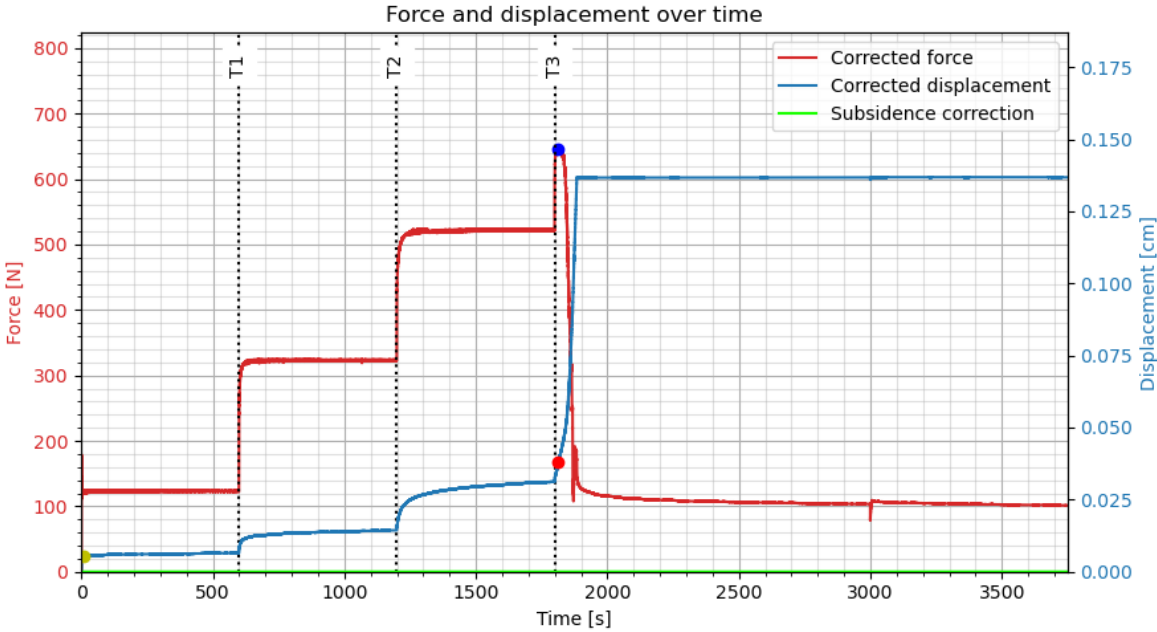


D.1.4. Test05

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		11:38:00			
Weight	[kg]	76.8			
Width	[cm]	20.0			
Length	[cm]	29			
Dike orientation		North			
Percentage of occurrence	[%]	10	70	20	
Sod thickness	[cm]	11	8	6	8
Root length	[cm]	3	5	8	5.4
Maximum stress	[kN/m ²]	11.15			
Strain at maximum stress	[-]	0.48			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

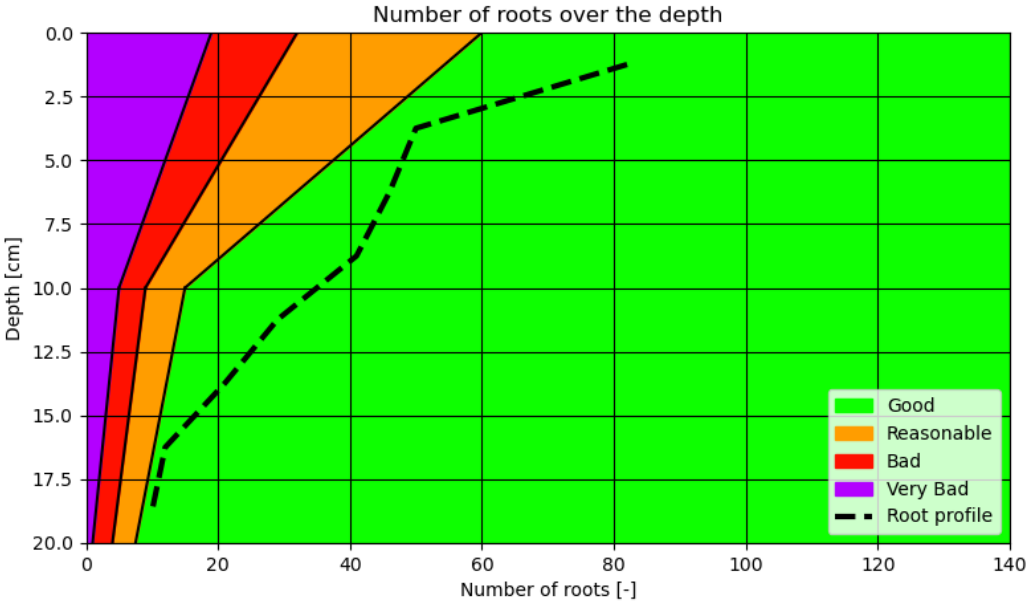


(c) Bottom



(d) Right

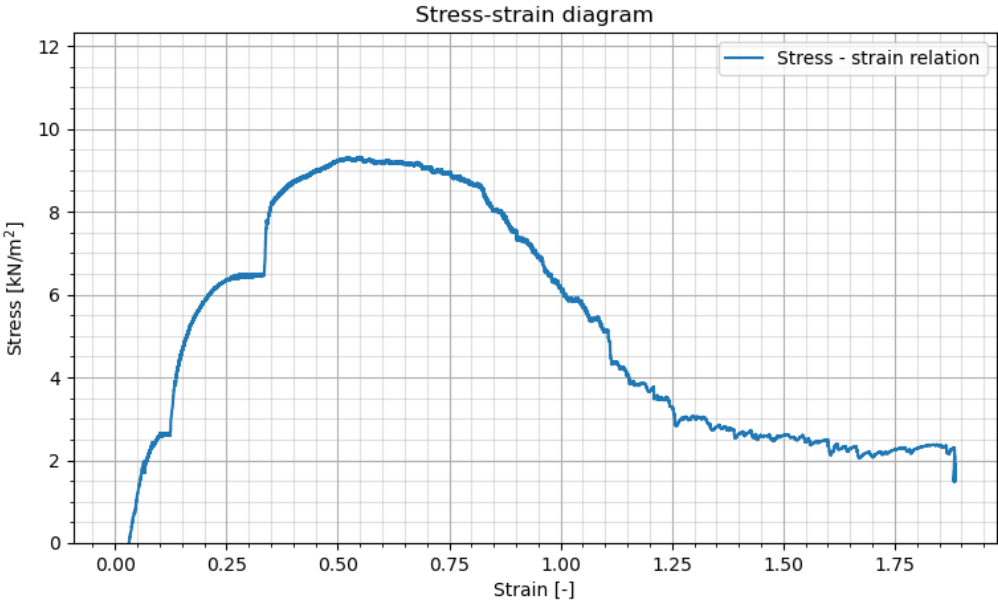
Root profile



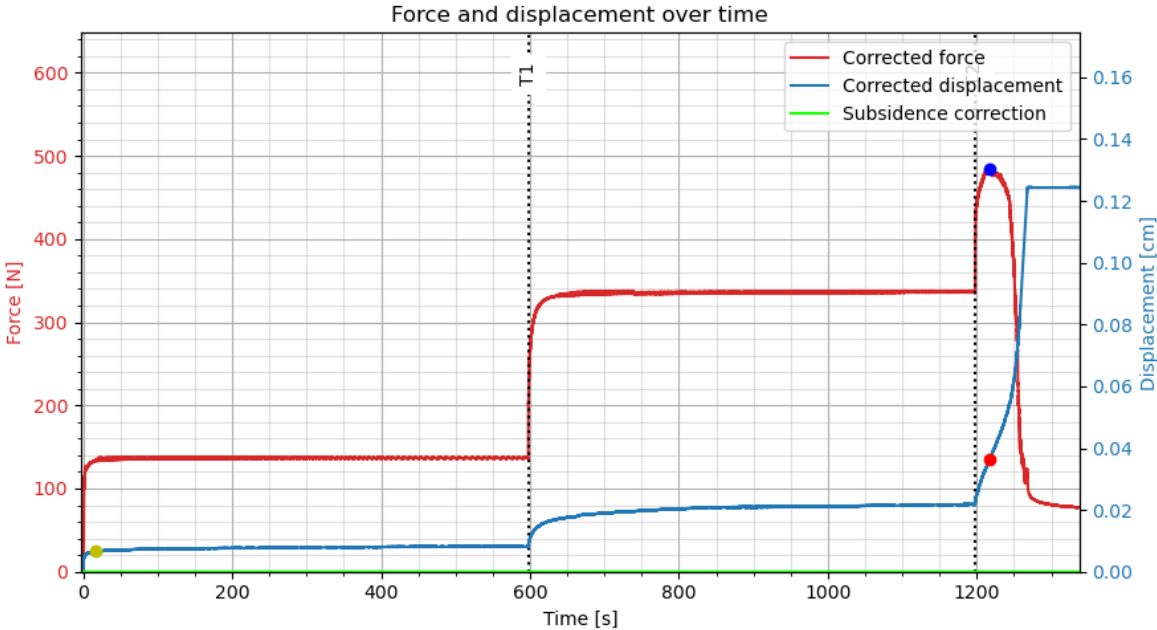
D.1.5. Test06

	Value 1	Value 2	Value 3	Mean
Date	22-02-2021			
Time	12:45:00			
Weight [kg]	63.1			
Width [cm]	20.0			
Length [cm]	26			
Dike orientation	North			
Percentage of occurrence [%]	30	20	50	
Sod thickness [cm]	9	7	5	7
Root length [cm]	5	4	8	6.3
Maximum stress [kN/m ²]	9.32			
Strain at maximum stress [-]	0.55			
Comments	Cut a bit under sod with shovel			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

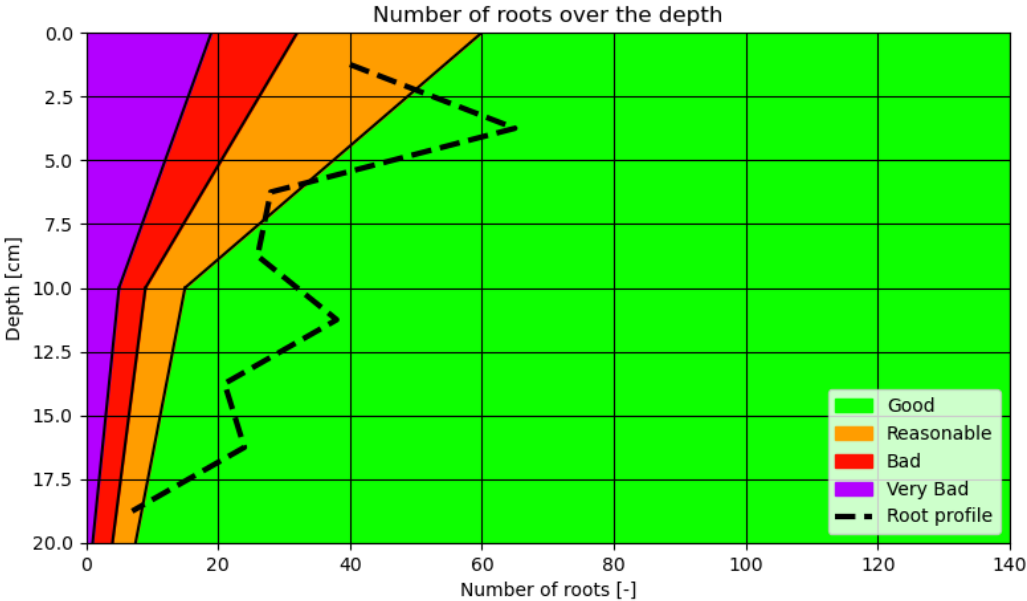


(c) Bottom



(d) Right

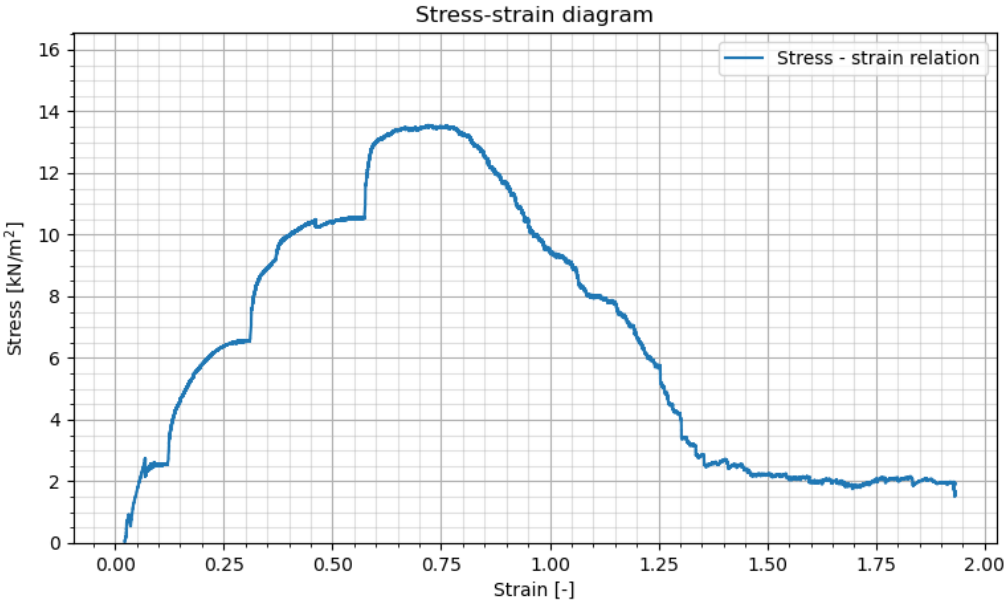
Root profile



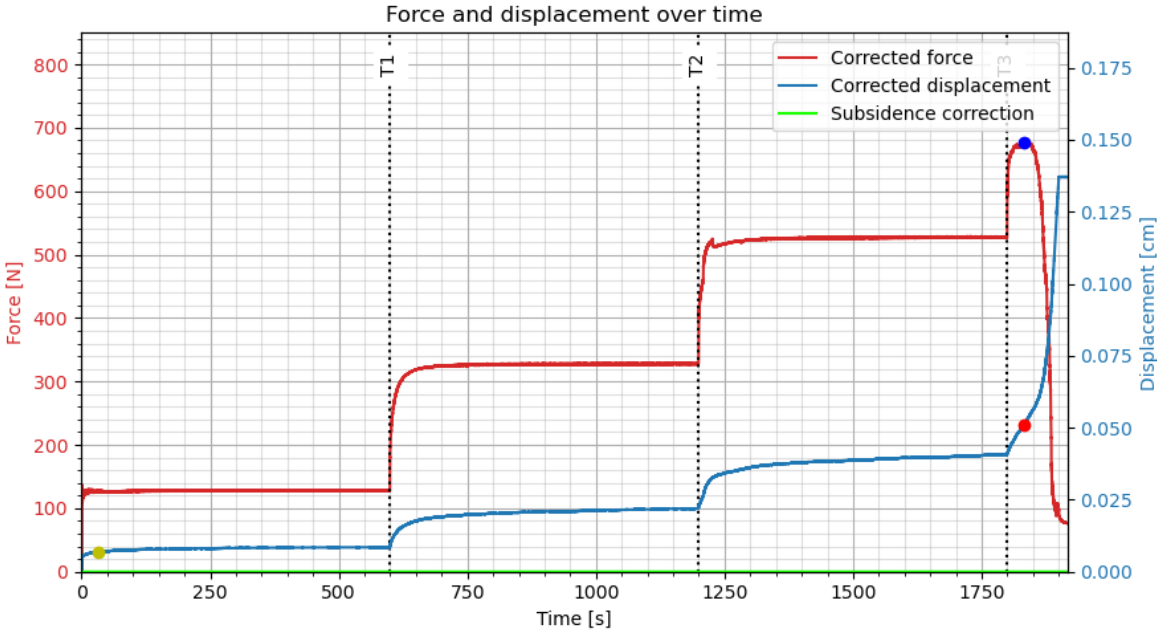
D.1.6. Test07

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		13:19:00			
Weight	[kg]	71.8			
Width	[cm]	20.0			
Length	[cm]	25			
Dike orientation		North			
Percentage of occurrence	[%]	20	30	50	
Sod thickness	[cm]	11	8	5	7
Root length	[cm]	4	5	7	5.8
Maximum stress	[kN/m ²]	13.56			
Strain at maximum stress	[-]	0.72			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

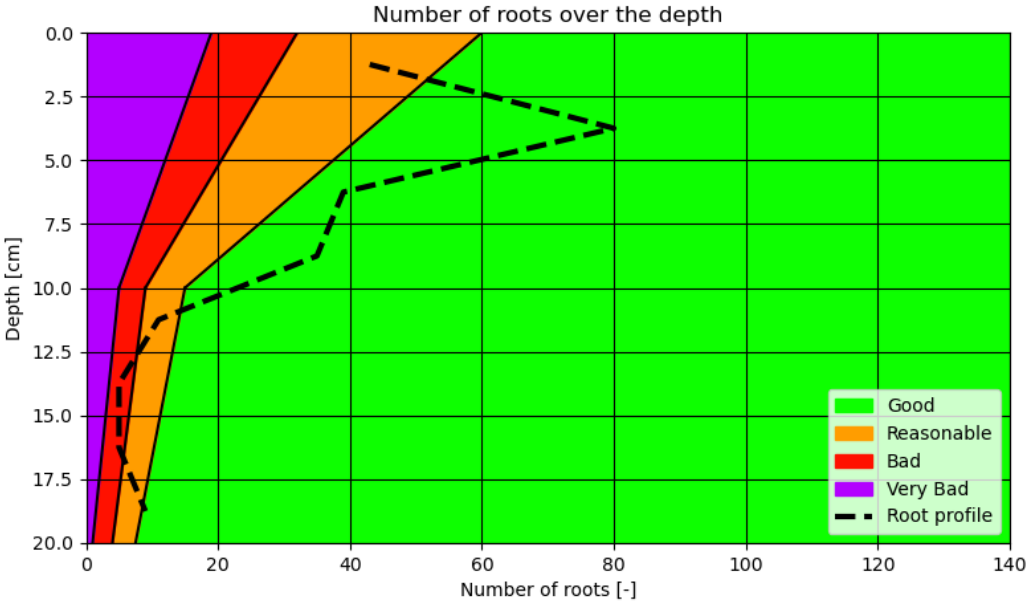


(c) Bottom



(d) Right

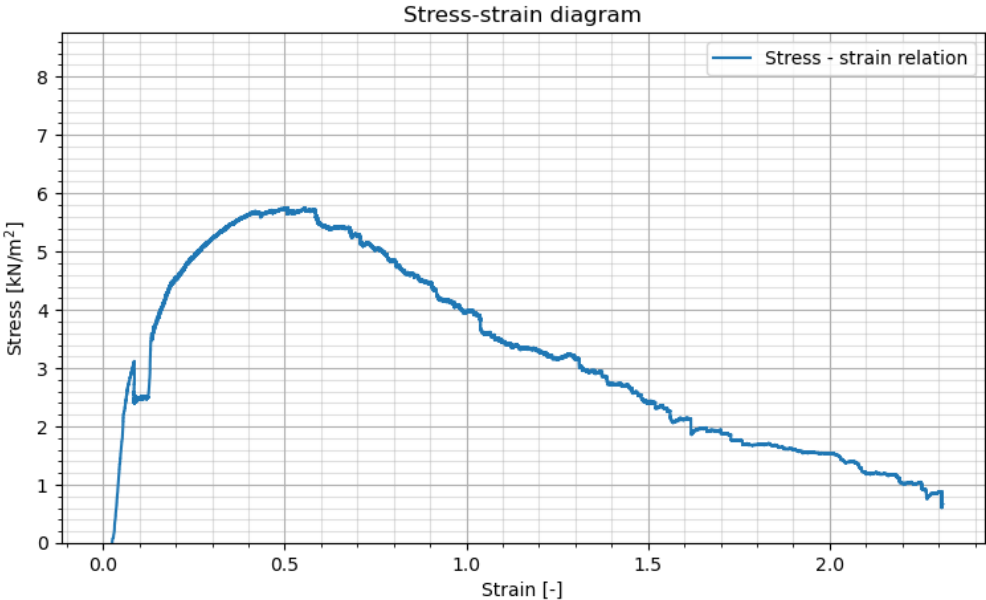
Root profile



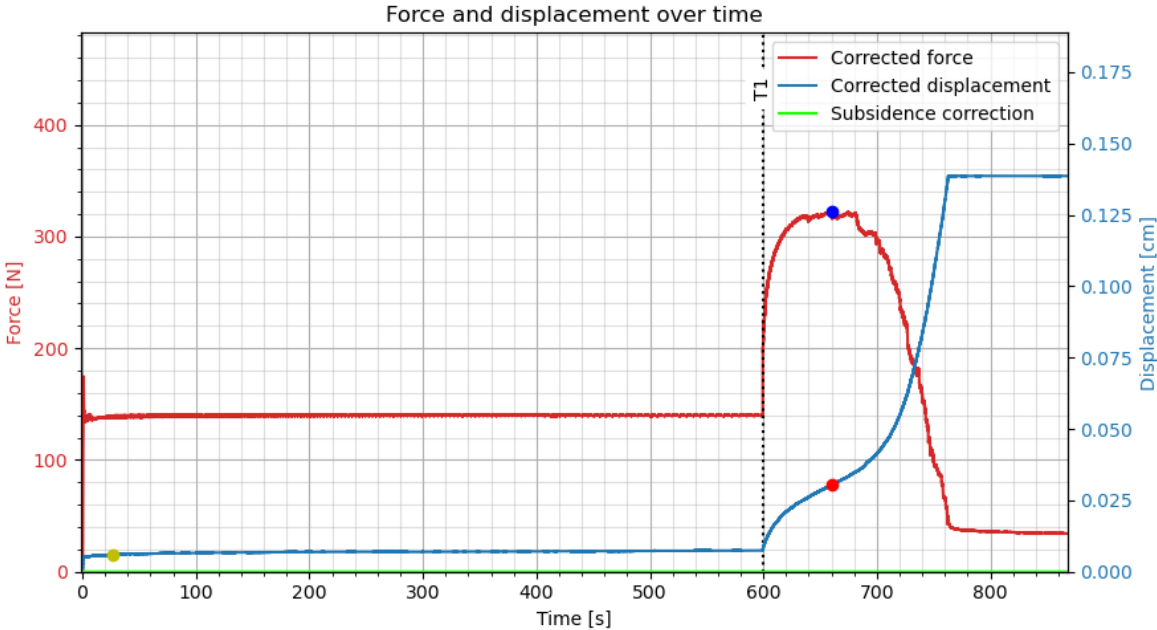
D.1.7. Test08

	Value 1	Value 2	Value 3	Mean
Date	22-02-2021			
Time	13:56:00			
Weight [kg]	59.9			
Width [cm]	20.0			
Length [cm]	28			
Dike orientation	North			
Percentage of occurrence [%]	50	50	0	
Sod thickness [cm]	6	6	0	6
Root length [cm]	6	7	0	6.5
Maximum stress [kN/m ²]	5.76			
Strain at maximum stress [-]	0.51			
Comments	-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

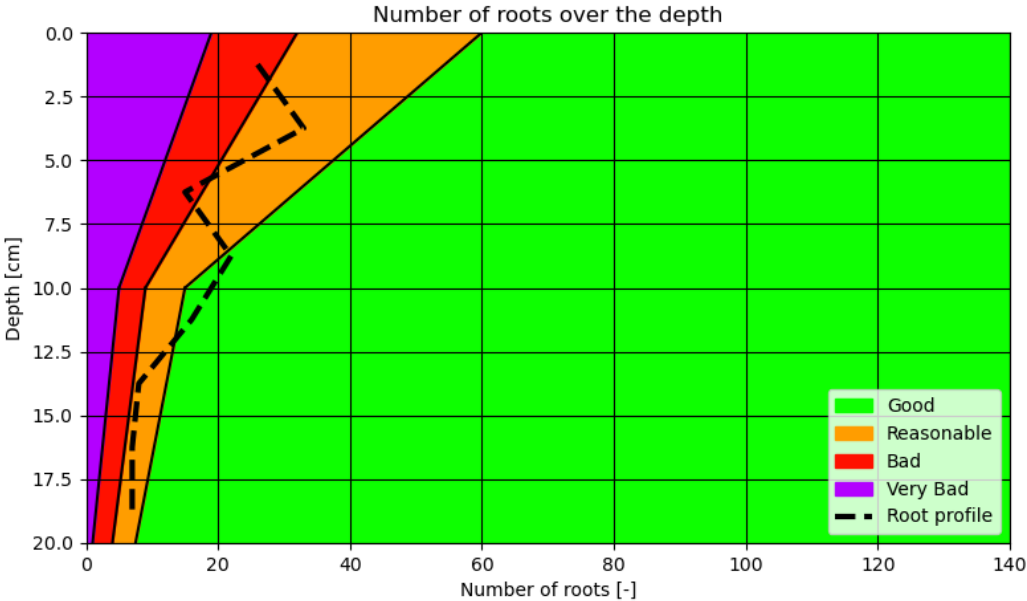


(c) Bottom



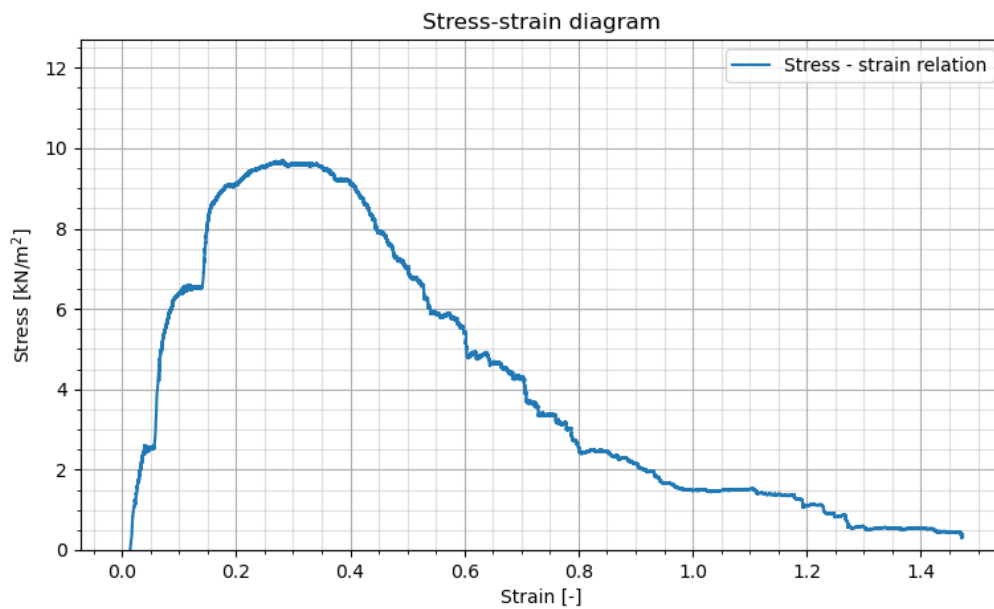
(d) Right

Root profile

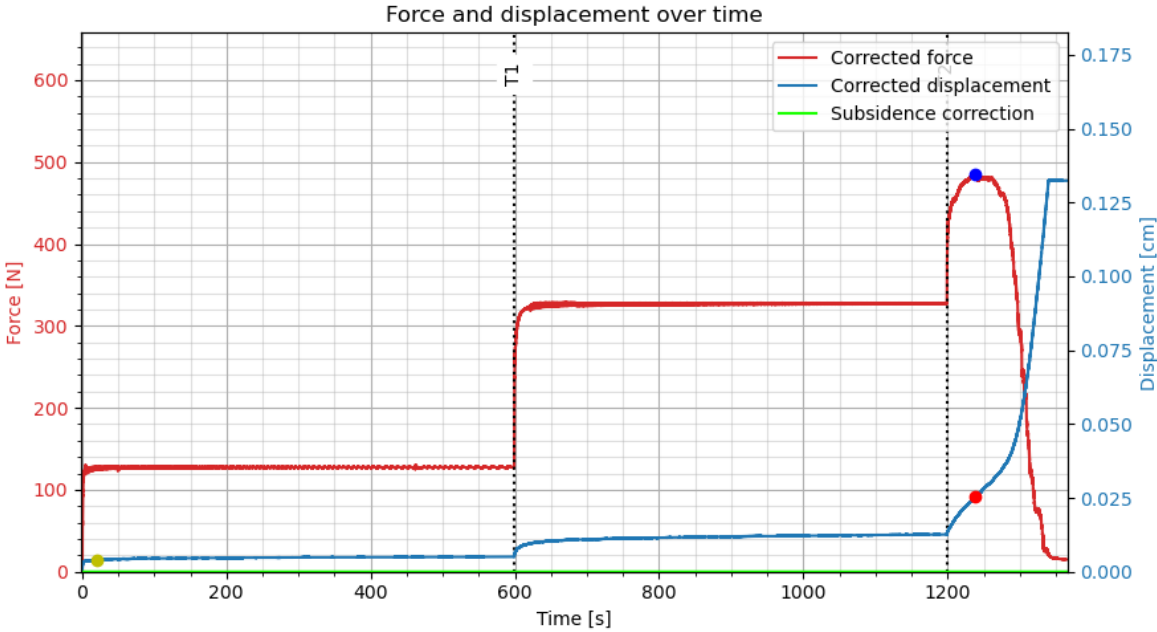


D.1.8. Test09

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		14:38:00			
Weight	[kg]	72.5			
Width	[cm]	20.0			
Length	[cm]	25			
Dike orientation		North			
Percentage of occurrence	[%]	40	50	10	
Sod thickness	[cm]	10	9	5	9
Root length	[cm]	2	4	7	3.5
Maximum stress	[kN/m ²]	9.7			
Strain at maximum stress	[-]	0.28			
Comments		-			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

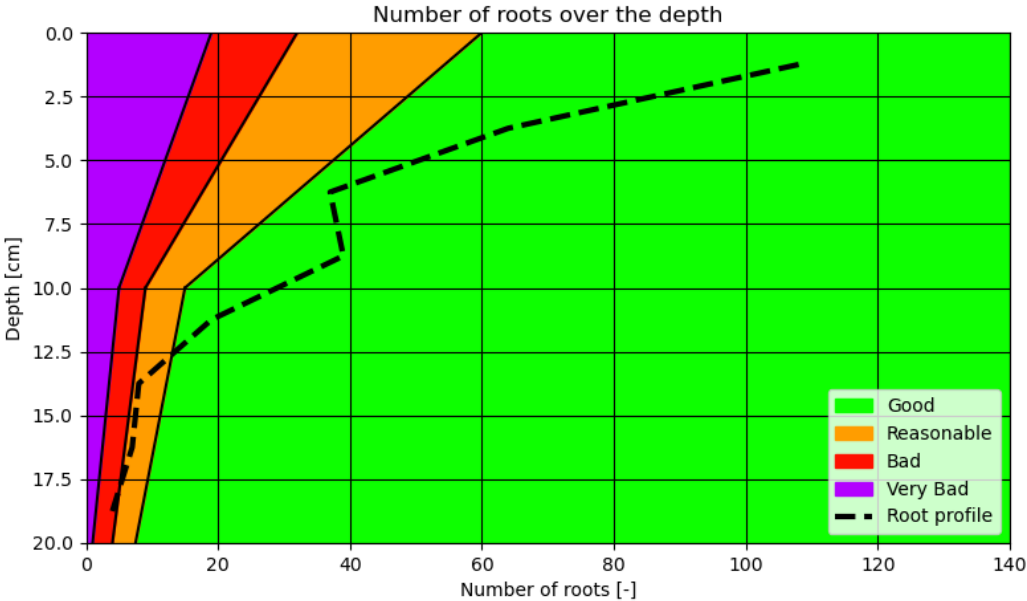


(c) Bottom



(d) Right

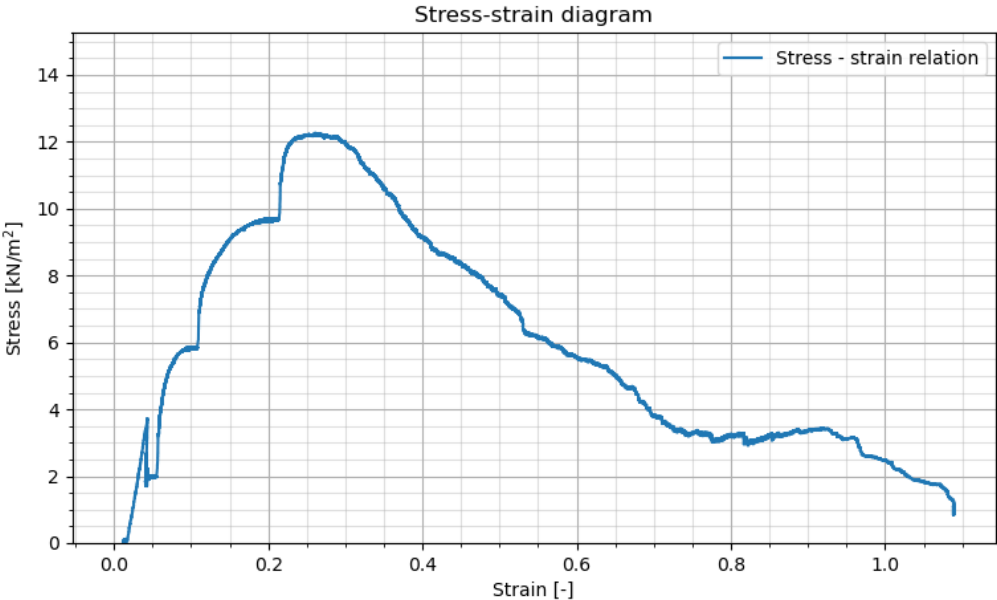
Root profile



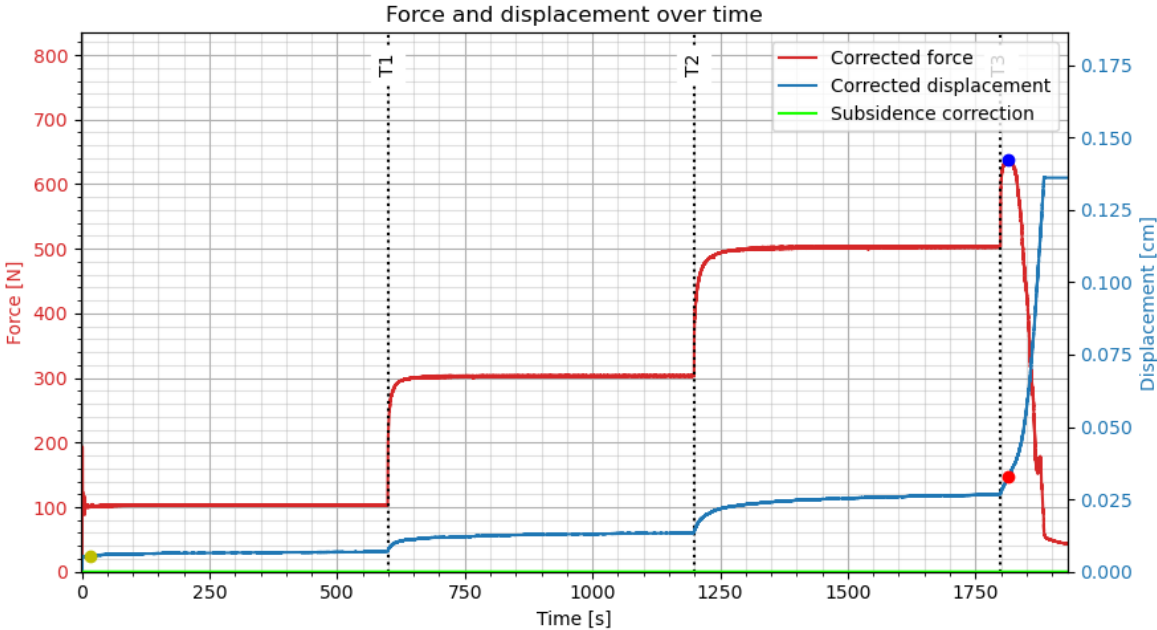
D.1.9. Test10

		Value 1	Value 2	Value 3	Mean
Date		22-02-2021			
Time		15:11:00			
Weight	[kg]	96.5			
Width	[cm]	20.0			
Length	[cm]	26			
Dike orientation		North			
Percentage of occurrence	[%]	70	20	10	
Sod thickness	[cm]	14	11	5	12
Root length	[cm]	4	4	4	4.0
Maximum stress	[kN/m ²]	12.26			
Strain at maximum stress	[-]	0.26			
Comments		-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

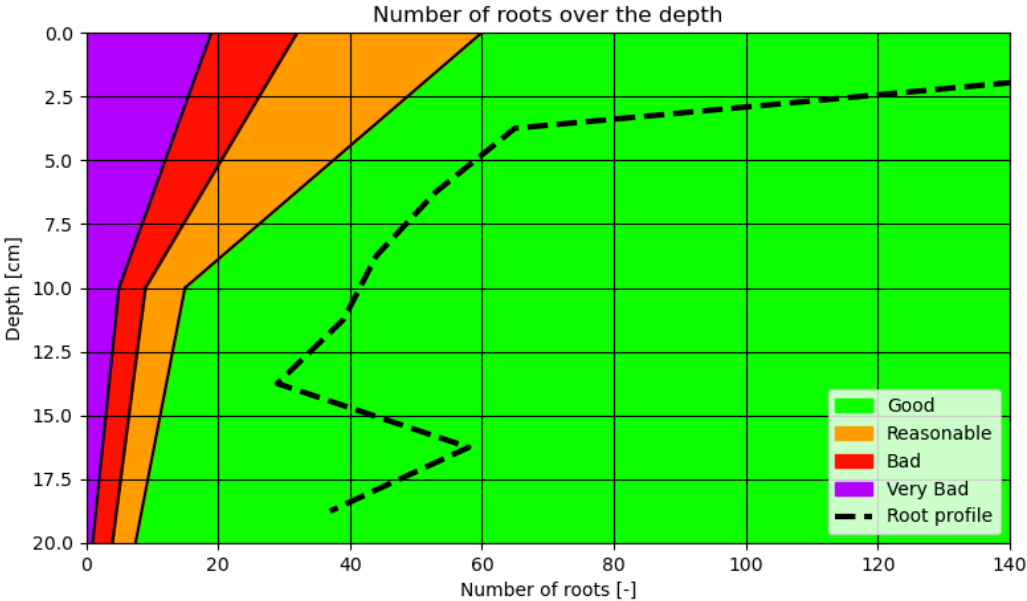


(c) Bottom



(d) Right

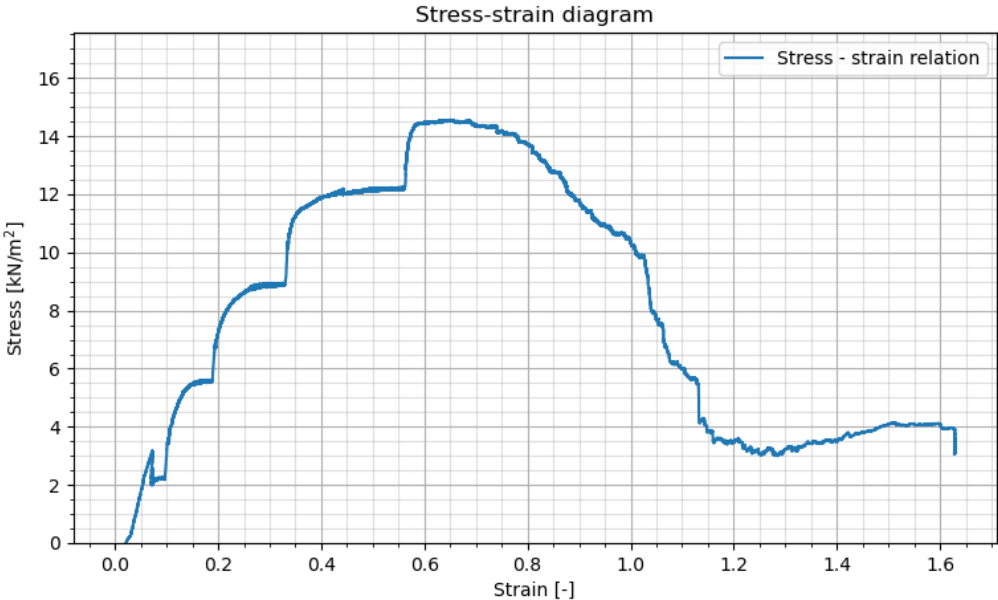
Root profile



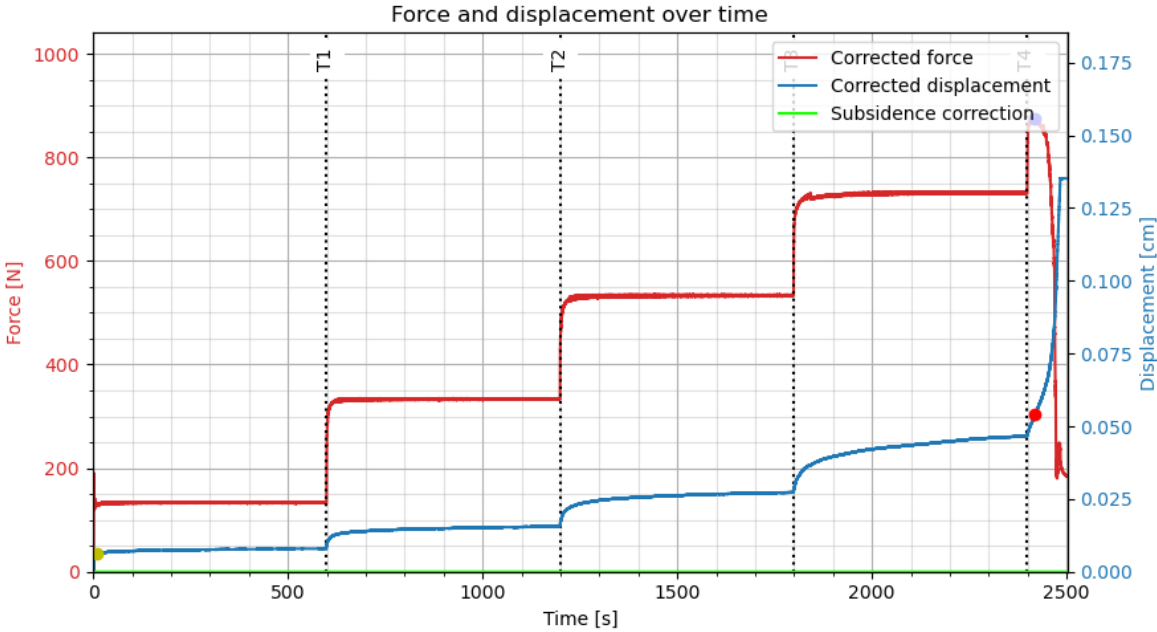
D.1.10. Test11

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	08:54:00			
Weight [kg]	66.7			
Width [cm]	20.0			
Length [cm]	30			
Dike orientation	North			
Percentage of occurrence [%]	10	60	30	
Sod thickness [cm]	11	9	6	8
Root length [cm]	7	7	9	7.6
Maximum stress [kN/m ²]	14.56			
Strain at maximum stress [-]	0.65			
Comments	-			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom



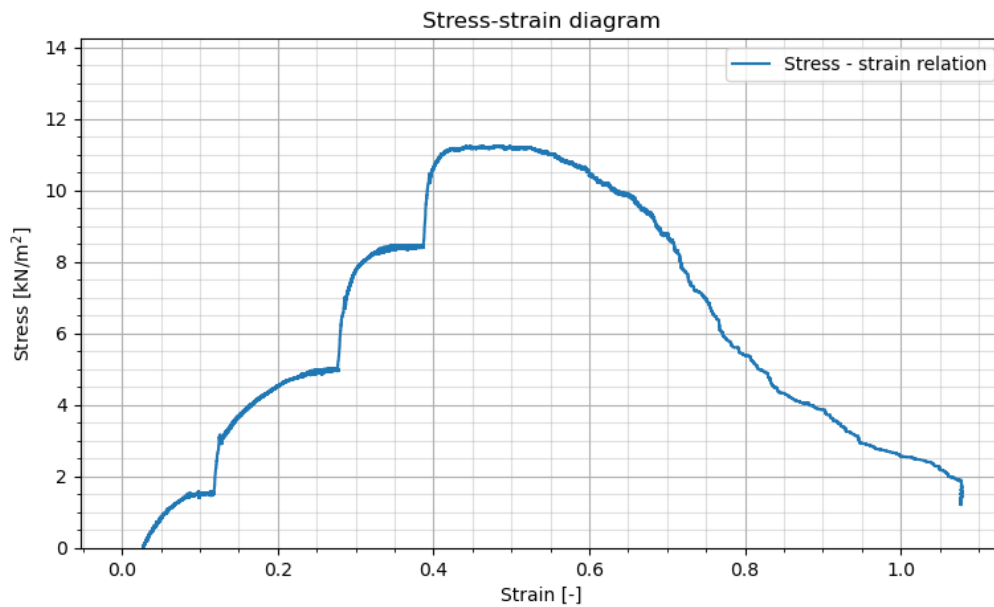
(d) Right

D.2. Stepwise increased constant load tests - submerged

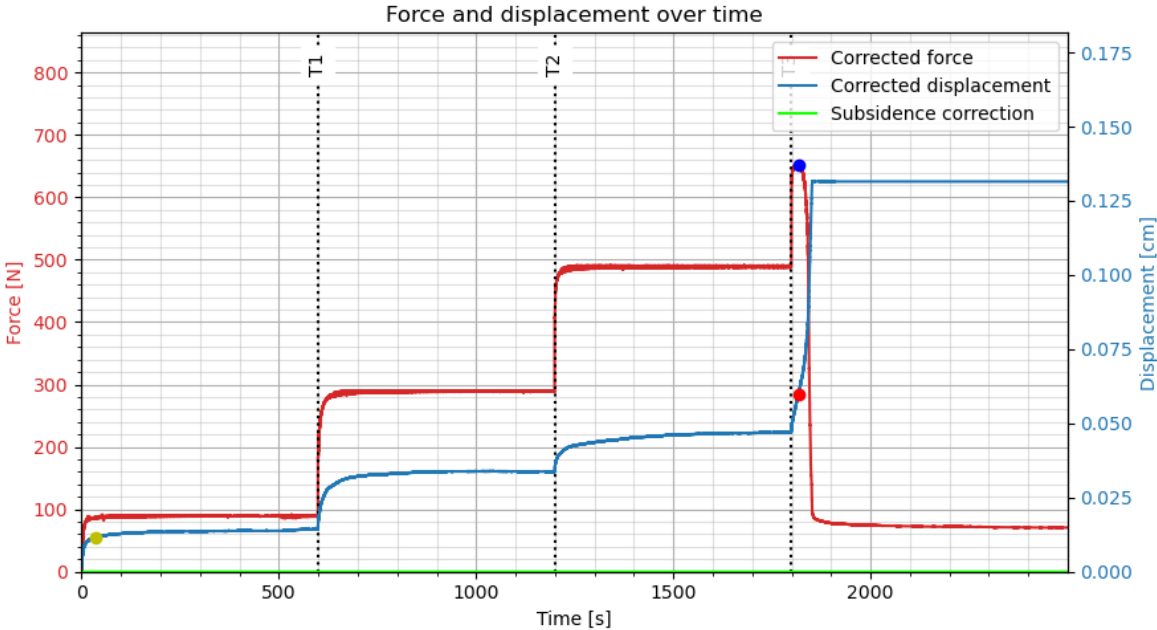
D.2.1. Test01

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	09:41:00			
Weight [kg]	111.0			
Width [cm]	20.0			
Length [cm]	29			
Dike orientation	North			
Percentage of occurrence [%]	40	40	20	
Sod thickness [cm]	17	10	7	12
Root length [cm]	4	5	5	4.6
Maximum stress [kN/m ²]	11.25			
Strain at maximum stress [-]	0.49			
Comments	Box was leaking, so sod could not be submerged all time, forgot to measure tripod subsidence			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

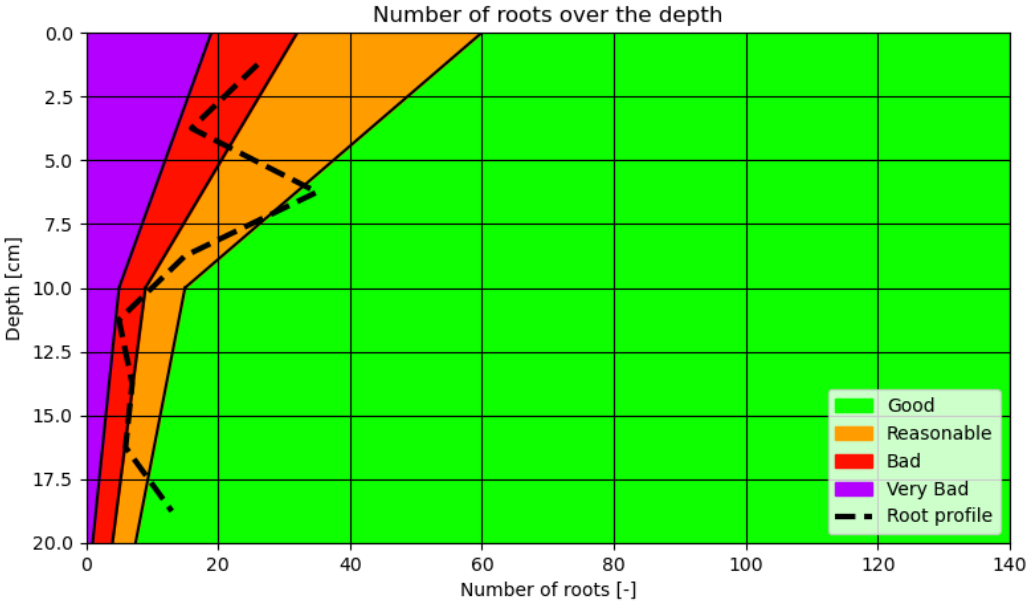


(c) Bottom



(d) Right

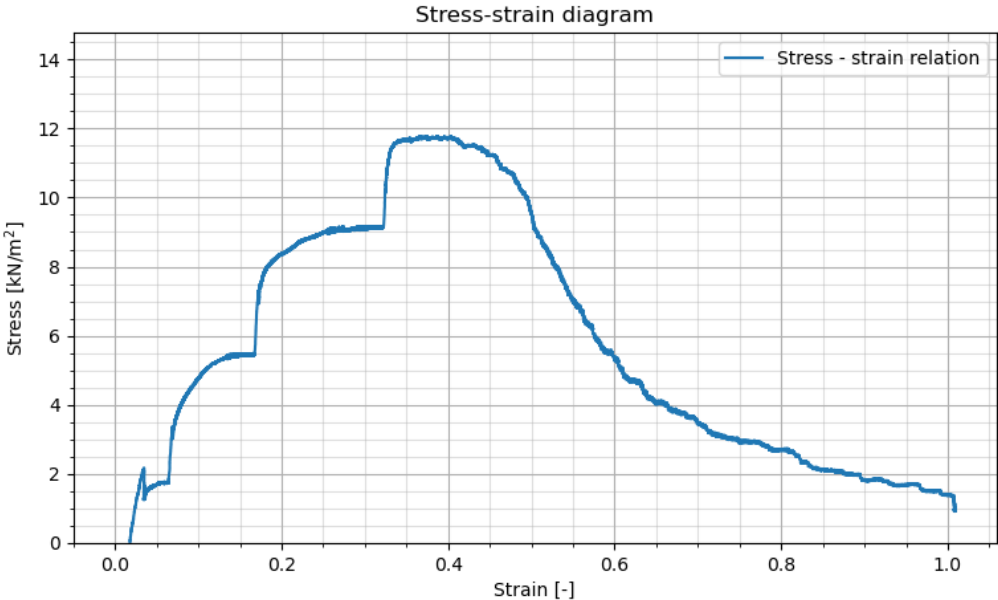
Root profile



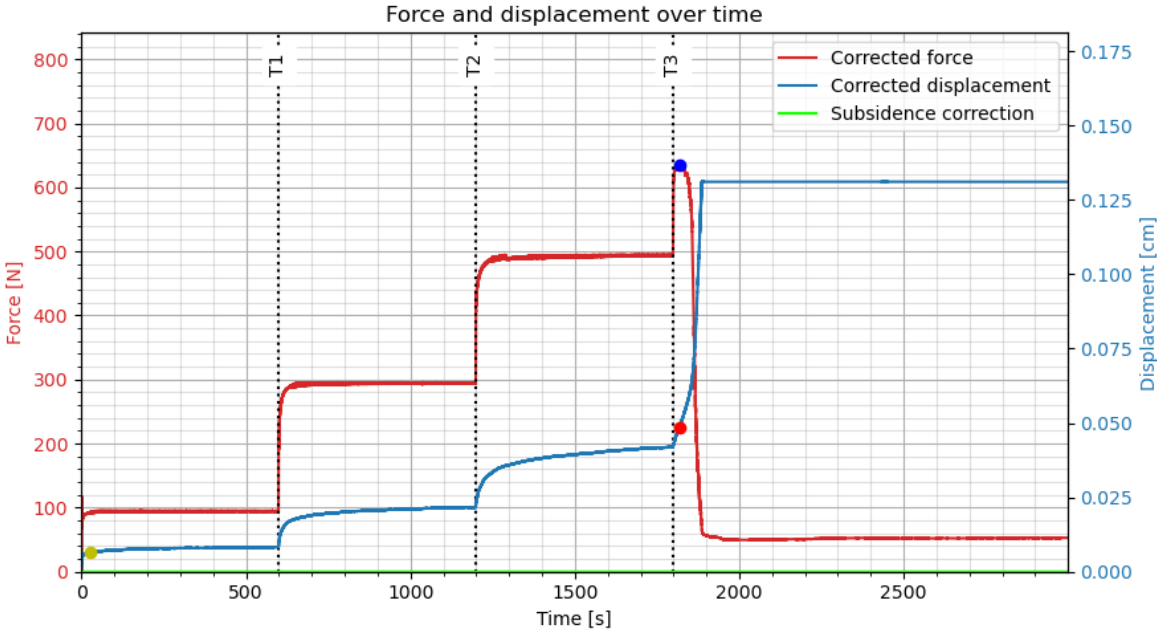
D.2.2. Test02

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	11:29:00			
Weight [kg]	105.4			
Width [cm]	20.0			
Length [cm]	27			
Dike orientation	North			
Percentage of occurrence [%]	70	20	10	
Sod thickness [cm]	15	10	5	13
Root length [cm]	4	6	11	5.1
Maximum stress [kN/m ²]	11.78			
Strain at maximum stress [-]	0.37			
Comments	Forgot to measure tripod subsidence			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

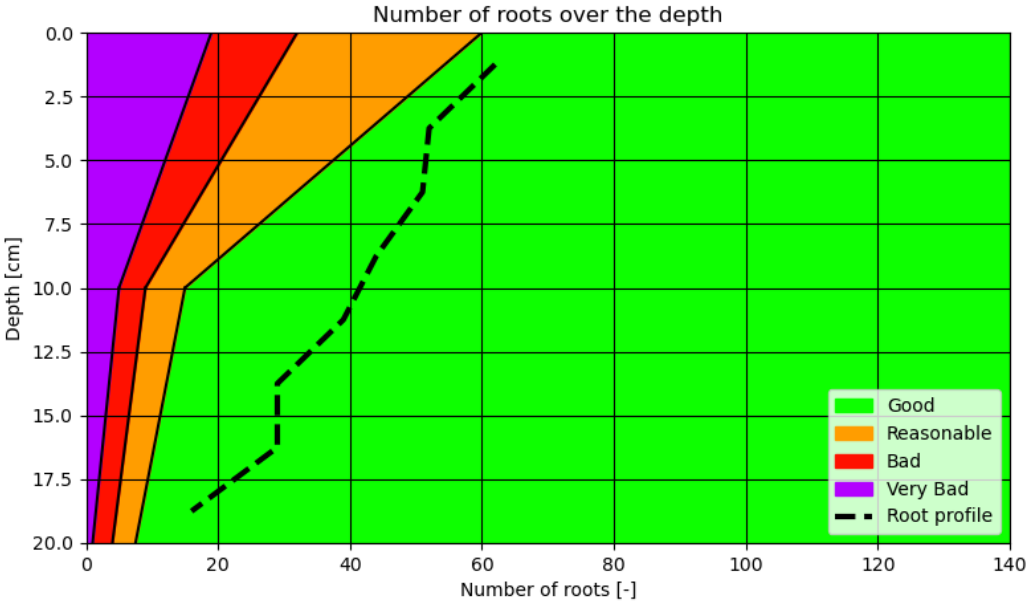


(c) Bottom



(d) Right

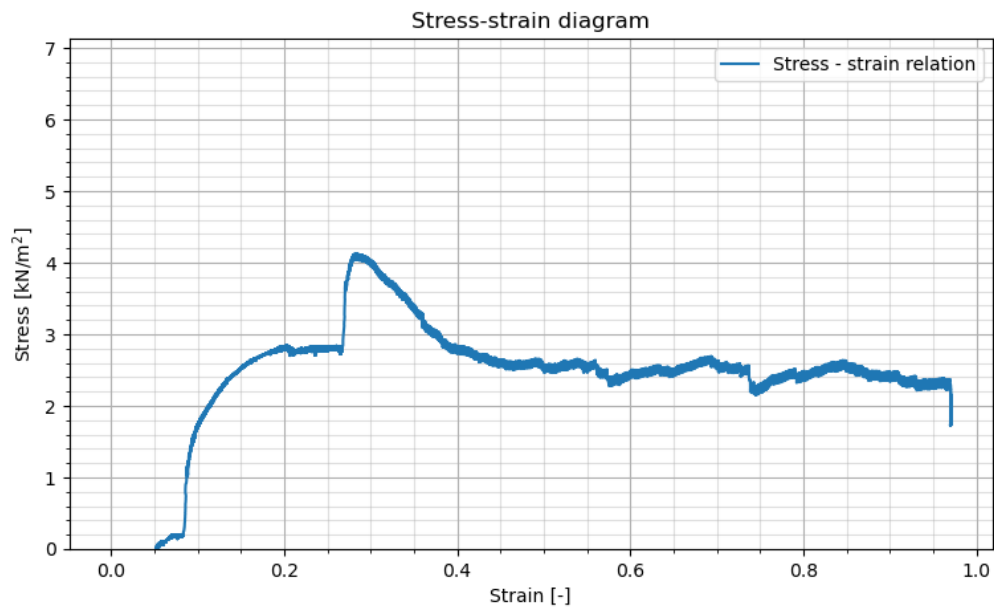
Root profile



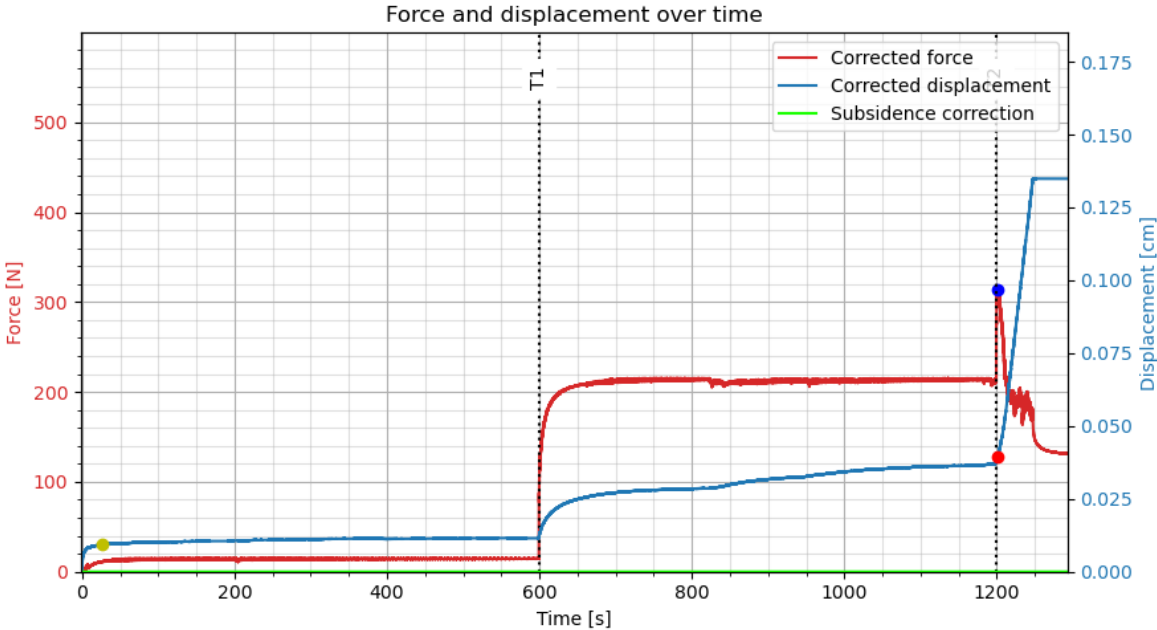
D.2.3. Test03

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	13:25:00			
Weight [kg]	185.5			
Width [cm]	20.0			
Length [cm]	38			
Dike orientation	North			
Percentage of occurrence [%]	50	40	10	
Sod thickness [cm]	16	13	7	14
Root length [cm]	6	9	13	7.9
Maximum stress [kN/m ²]	4.13			
Strain at maximum stress [-]	0.28			
Comments	Sod was so large, the legs of the pull device had to be jacked up to measure the weight. Failure plane at locations where pull box was cut through the grass. Forgot to measure tripod subsidence			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

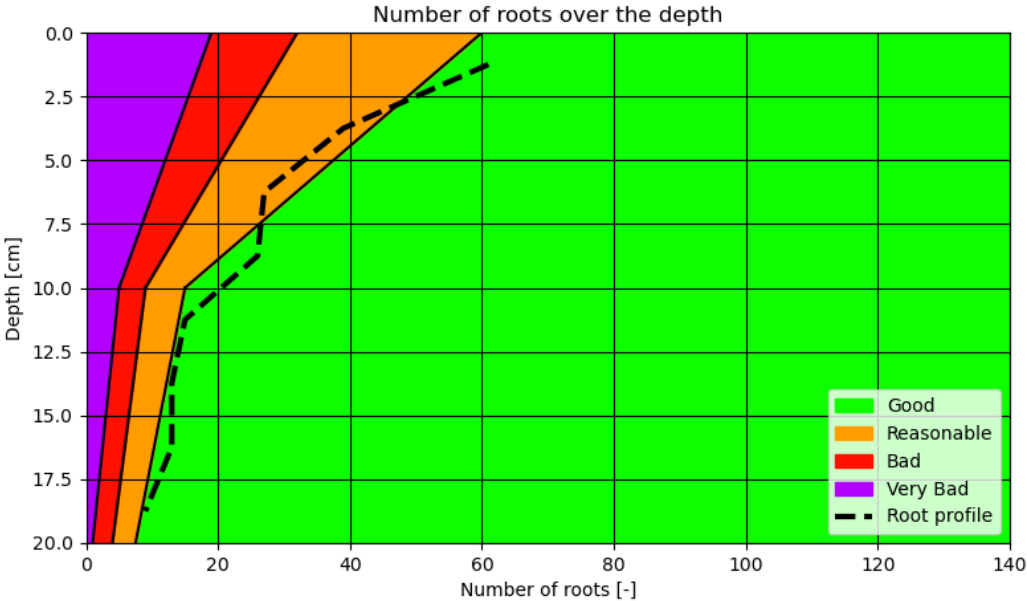


(c) Bottom



(d) Right

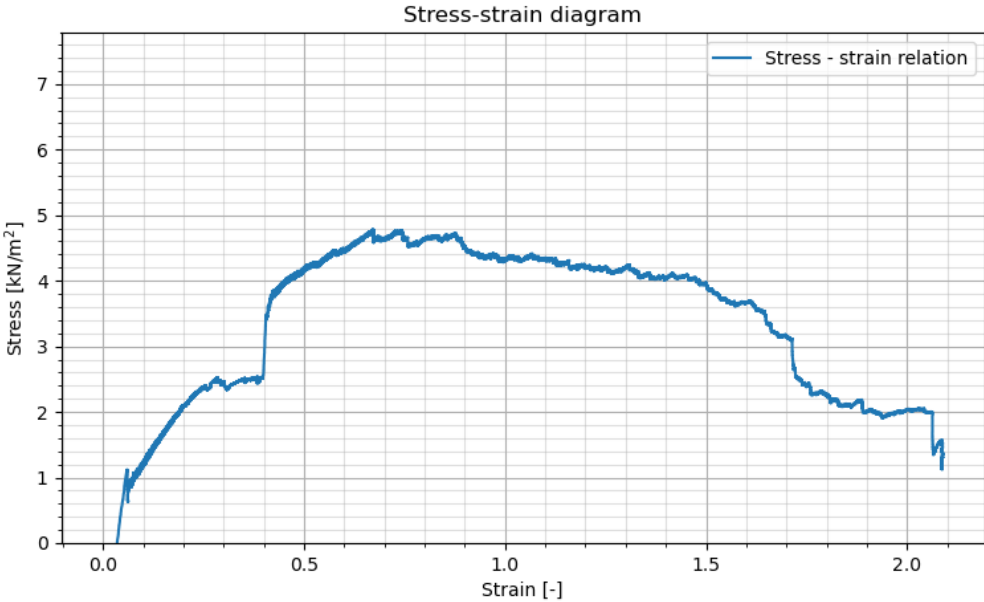
Root profile



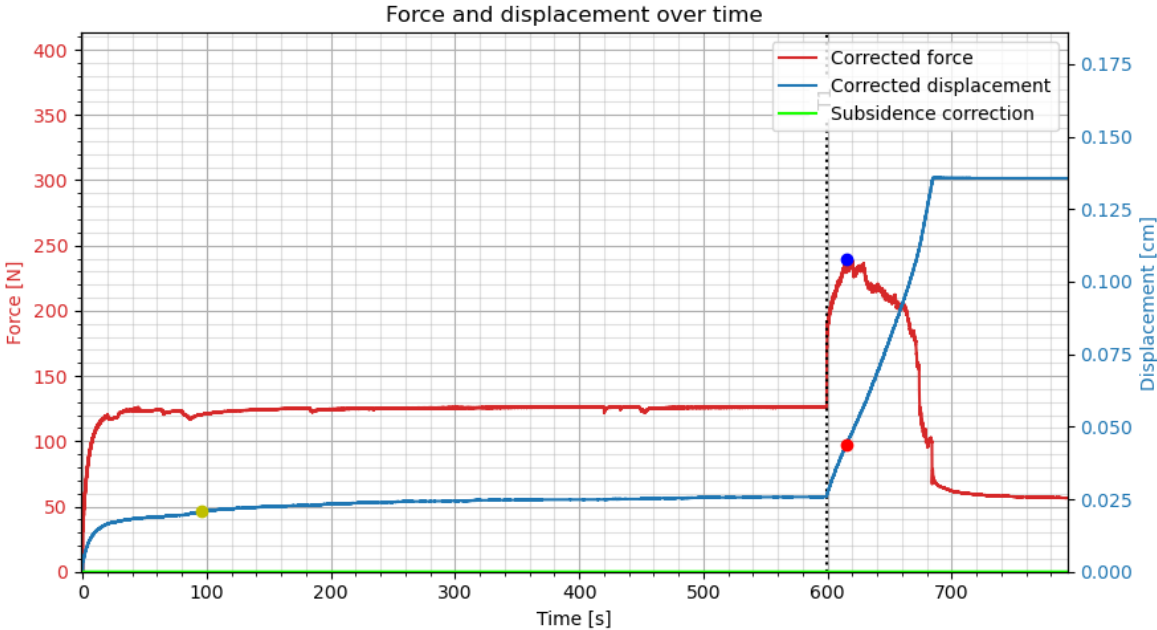
D.2.4. Test04

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	14:08:00			
Weight [kg]	73.7			
Width [cm]	20.0			
Length [cm]	25			
Dike orientation	North			
Percentage of occurrence [%]	50	50	0	
Sod thickness [cm]	8	5	0	6
Root length [cm]	11	11	0	11.0
Maximum stress [kN/m ²]	4.78			
Strain at maximum stress [-]	0.67			
Comments	Forgot to measure tripod subsidence			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

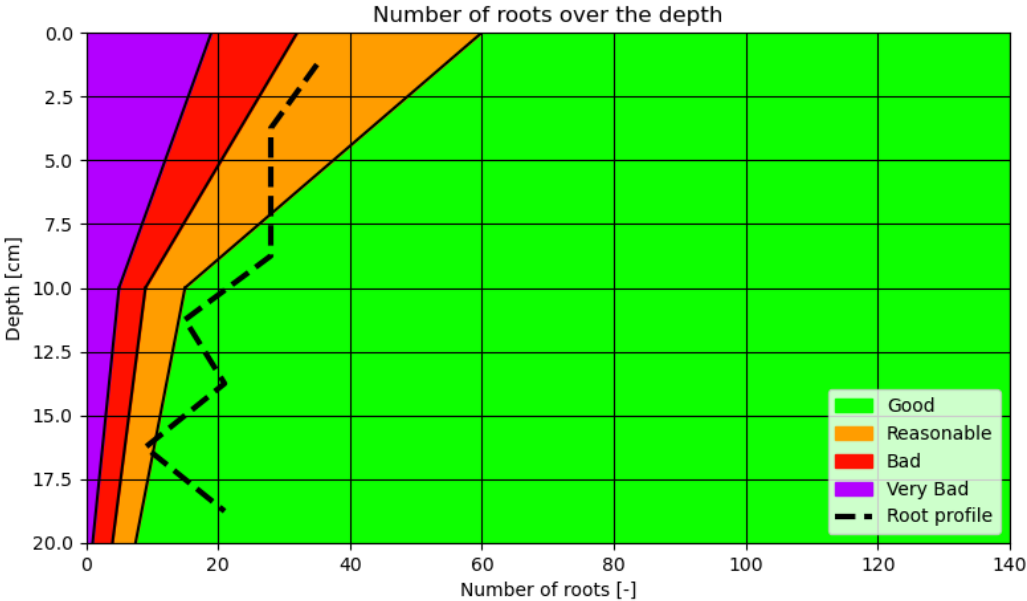


(c) Bottom



(d) Right

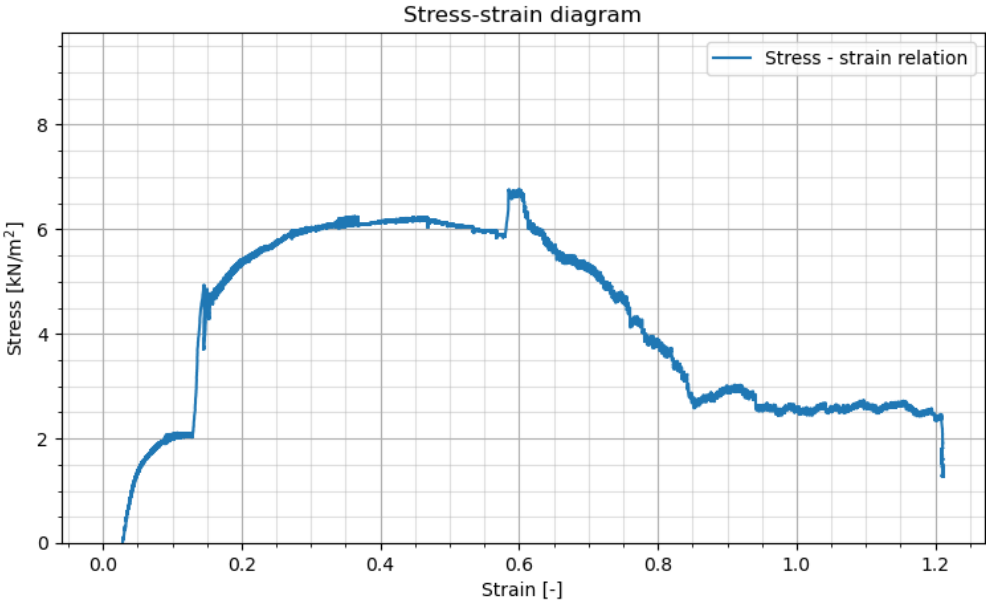
Root profile



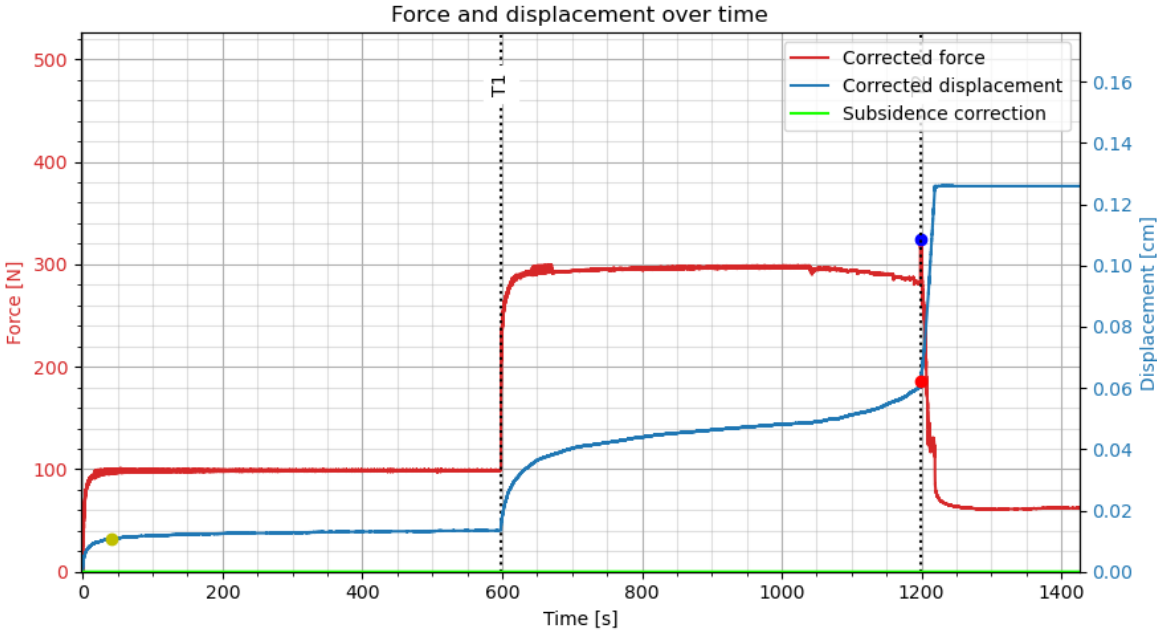
D.2.5. Test05

	Value 1	Value 2	Value 3	Mean
Date	23-02-2021			
Time	15:40:00			
Weight [kg]	101.3			
Width [cm]	20.0			
Length [cm]	24			
Dike orientation	North			
Percentage of occurrence [%]	45	45	10	
Sod thickness [cm]	12	10	5	10
Root length [cm]	6	8	11	7.4
Maximum stress [kN/m ²]	6.76			
Strain at maximum stress [-]	0.6			
Comments	Forgot to measure tripod subsidence			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

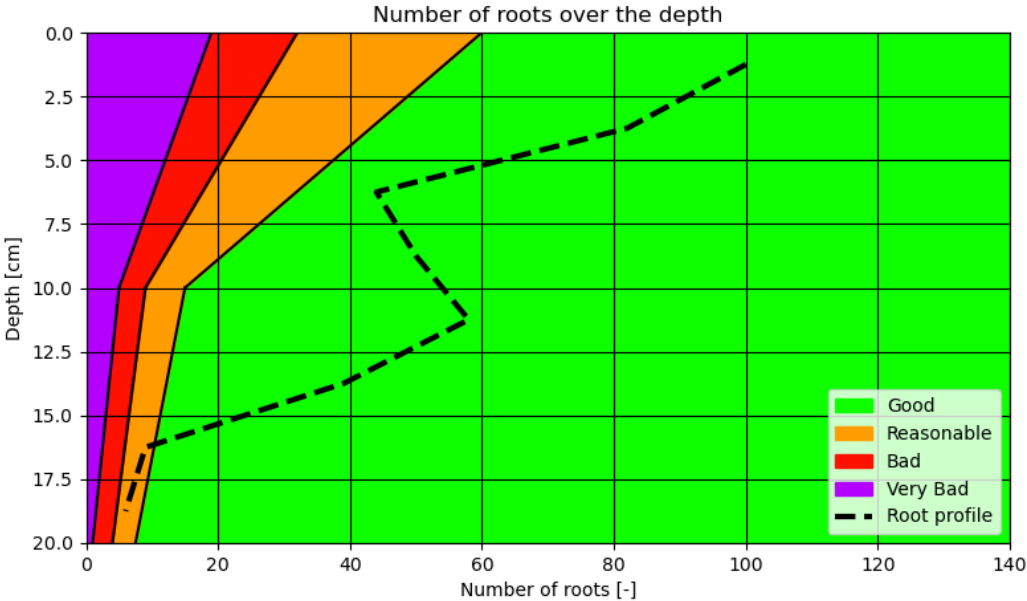


(c) Bottom



(d) Right

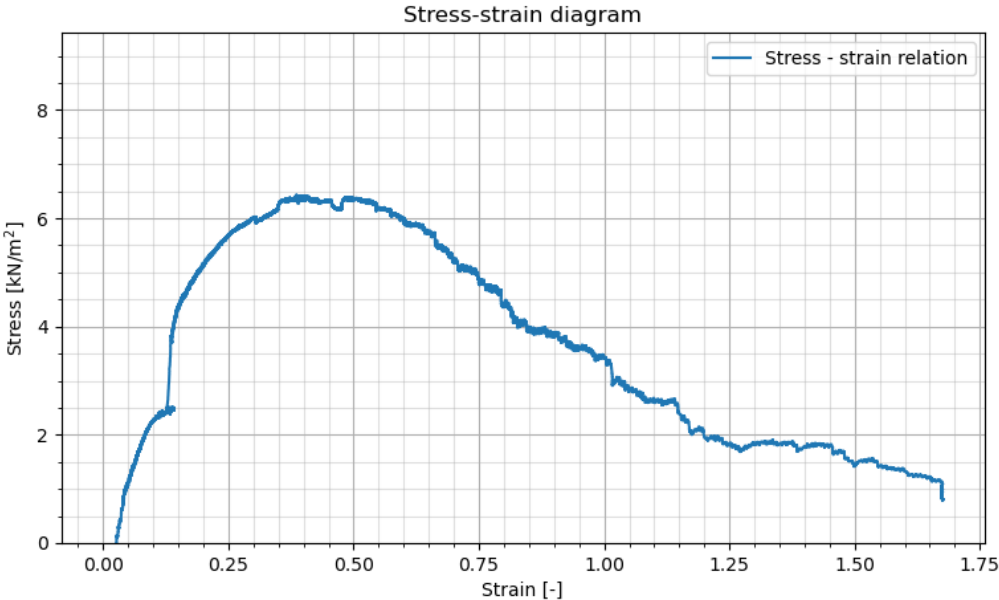
Root profile



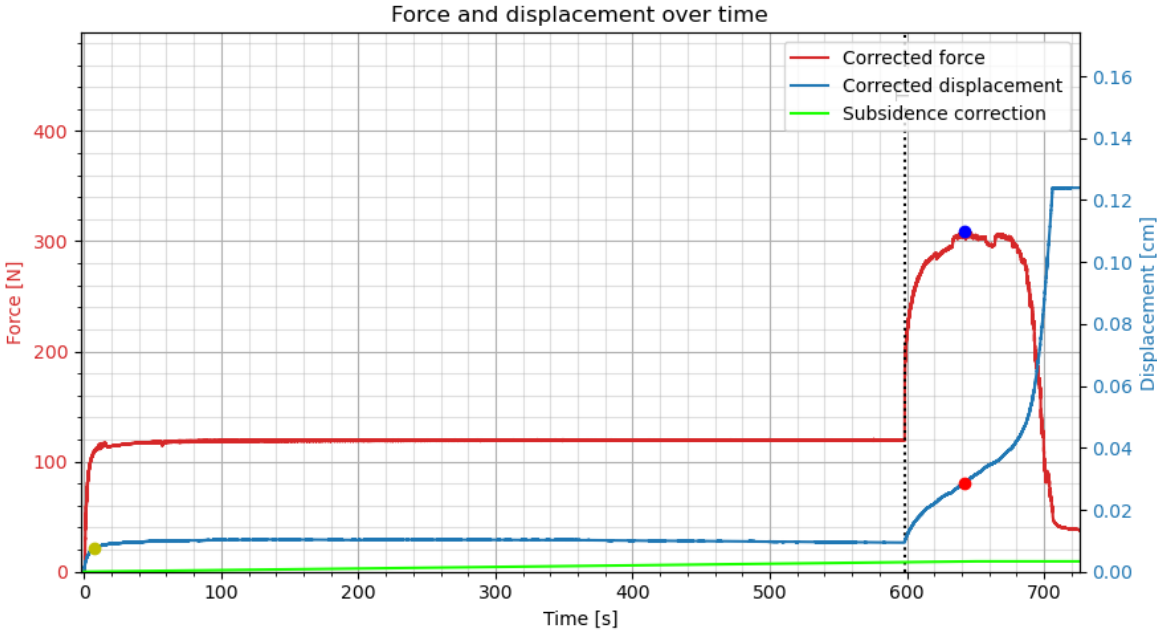
D.2.6. Test06

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	09:21:00			
Weight [kg]	80.4			
Width [cm]	20.0			
Length [cm]	24			
Dike orientation	North			
Percentage of occurrence [%]	30	40	30	
Sod thickness [cm]	10	8	4	7
Root length [cm]	6	6	8	6.6
Maximum stress [kN/m ²]	6.43			
Strain at maximum stress [-]	0.39			
Comments	Trouble with installing pull frame			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

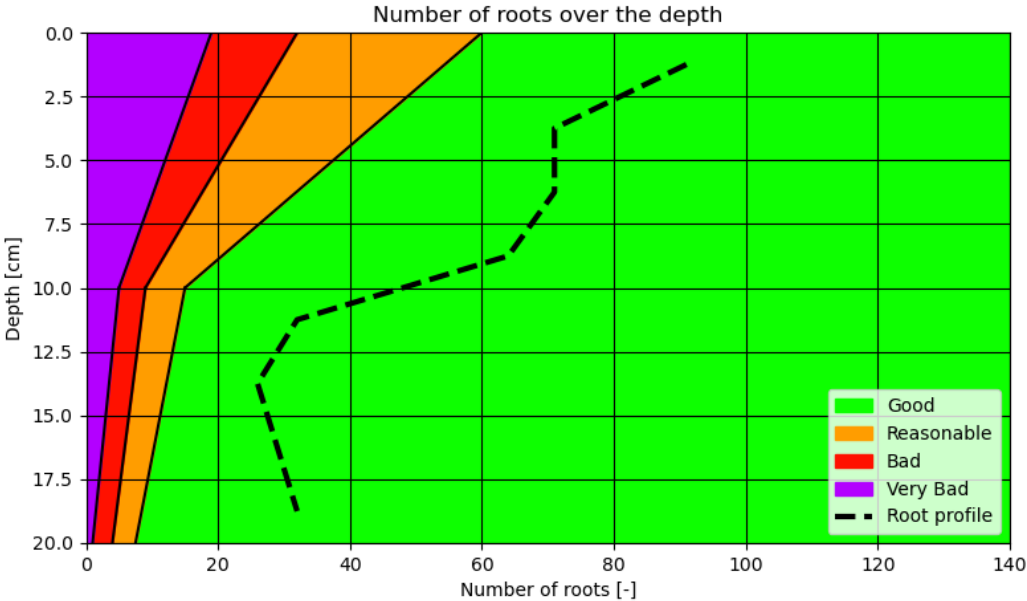


(c) Bottom



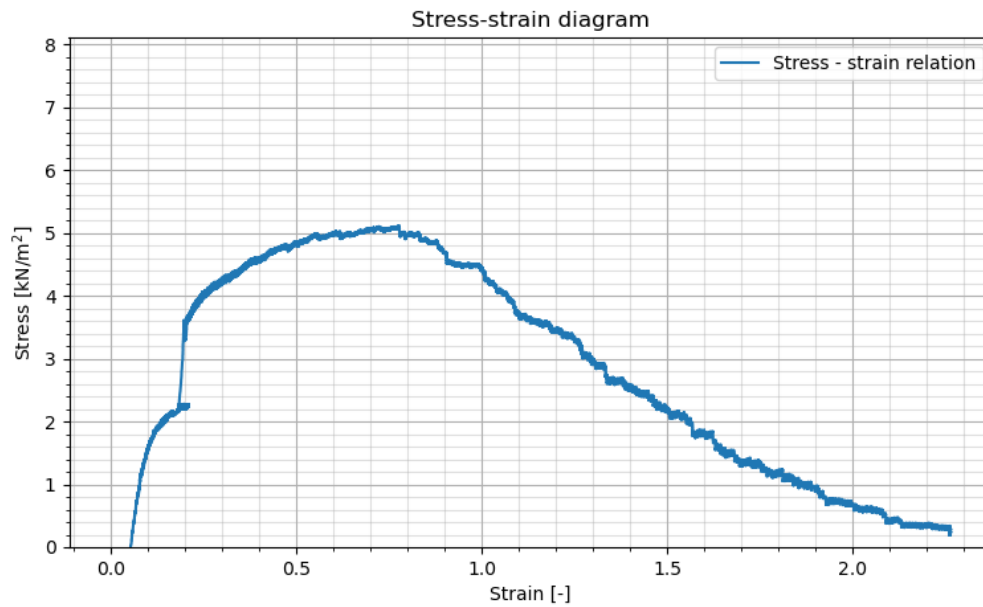
(d) Right

Root profile

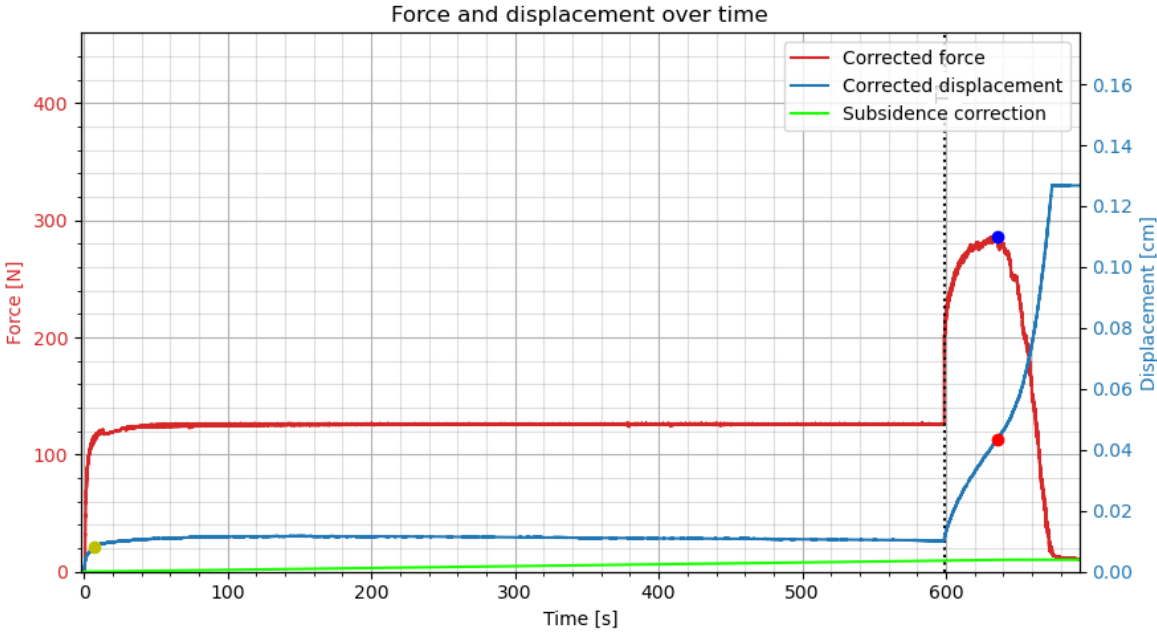


D.2.7. Test07

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	10:15:00			
Weight [kg]	73.9			
Width [cm]	20.0			
Length [cm]	28			
Dike orientation	North			
Percentage of occurrence [%]	10	40	50	
Sod thickness [cm]	7	6	5	6
Root length [cm]	7	14	8	10.3
Maximum stress [kN/m ²]	5.11			
Strain at maximum stress [-]	0.78			
Comments	Pullframe installed close to corners submerged box, failure plane at this spot			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left



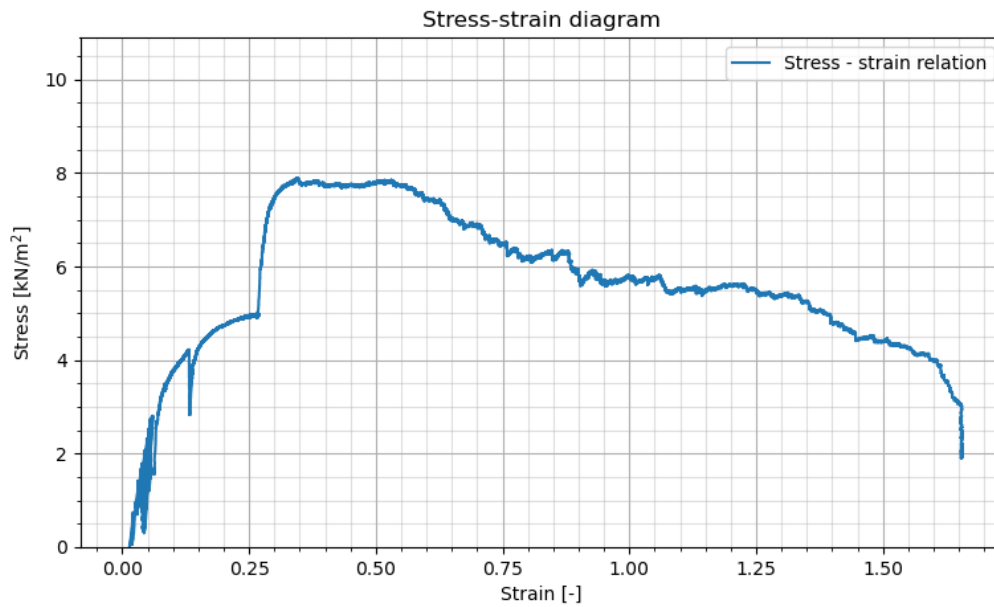
(c) Bottom



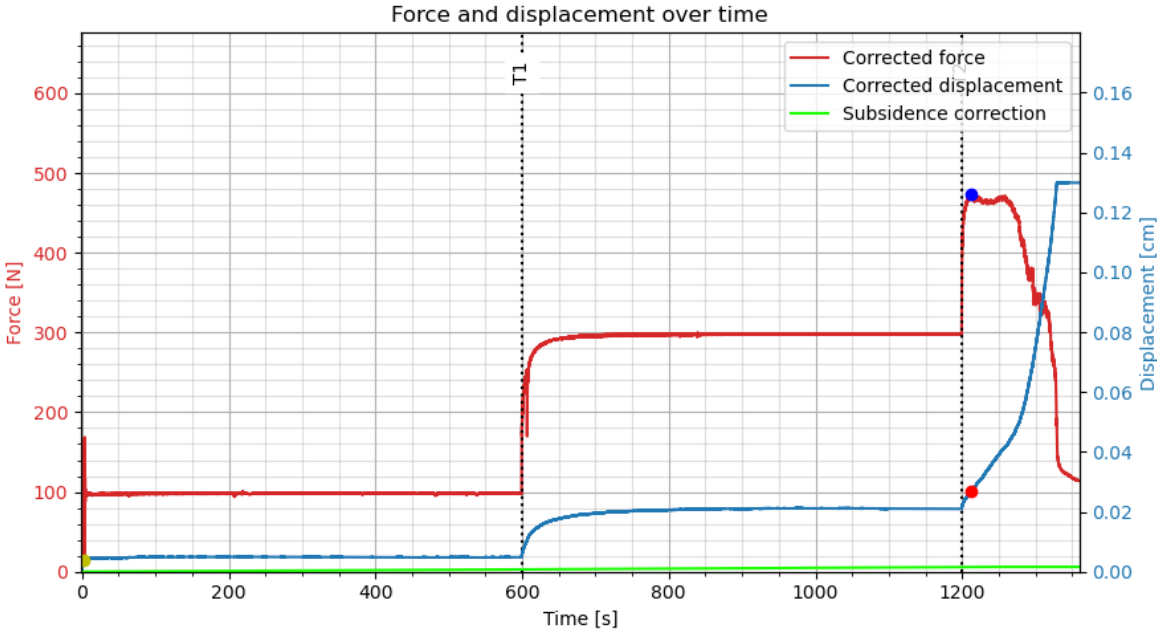
(d) Right

D.2.8. Test08

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	10:53:00			
Weight [kg]	101.9			
Width [cm]	20.0			
Length [cm]	30			
Dike orientation	North			
Percentage of occurrence [%]	35	25	40	
Sod thickness [cm]	11	8	5	8
Root length [cm]	7	5	8	6.9
Maximum stress [kN/m ²]	7.9			
Strain at maximum stress [-]	0.35			
Comments	Sod became dry during end of test, subsidence measured with steel plates			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

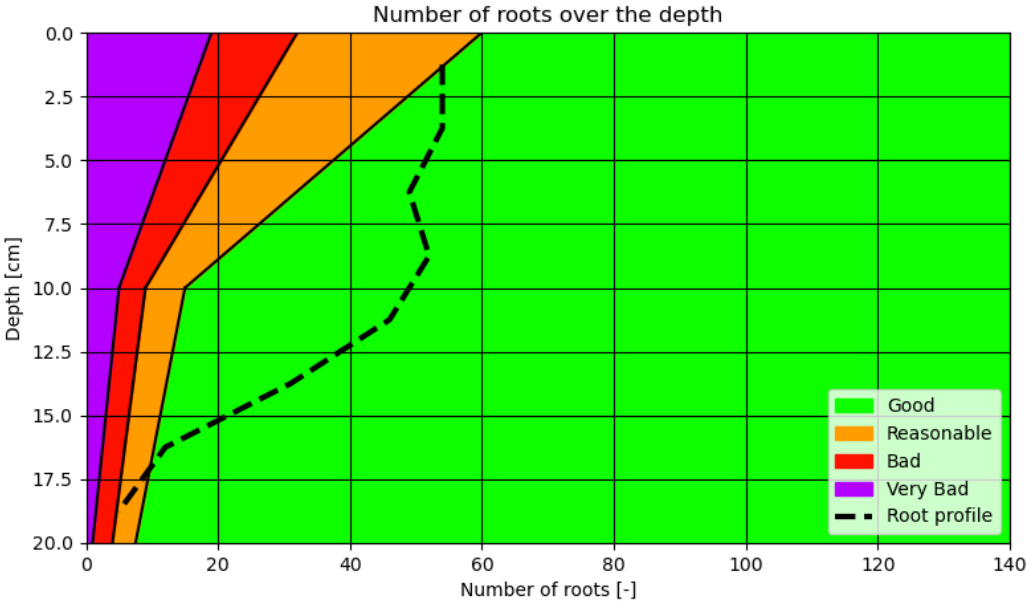


(c) Bottom



(d) Right

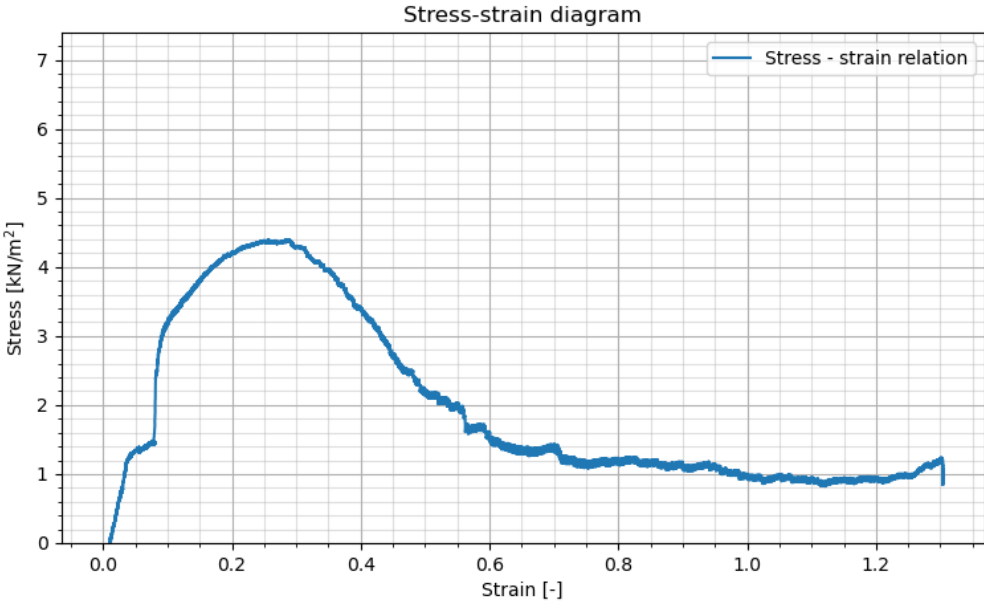
Root profile



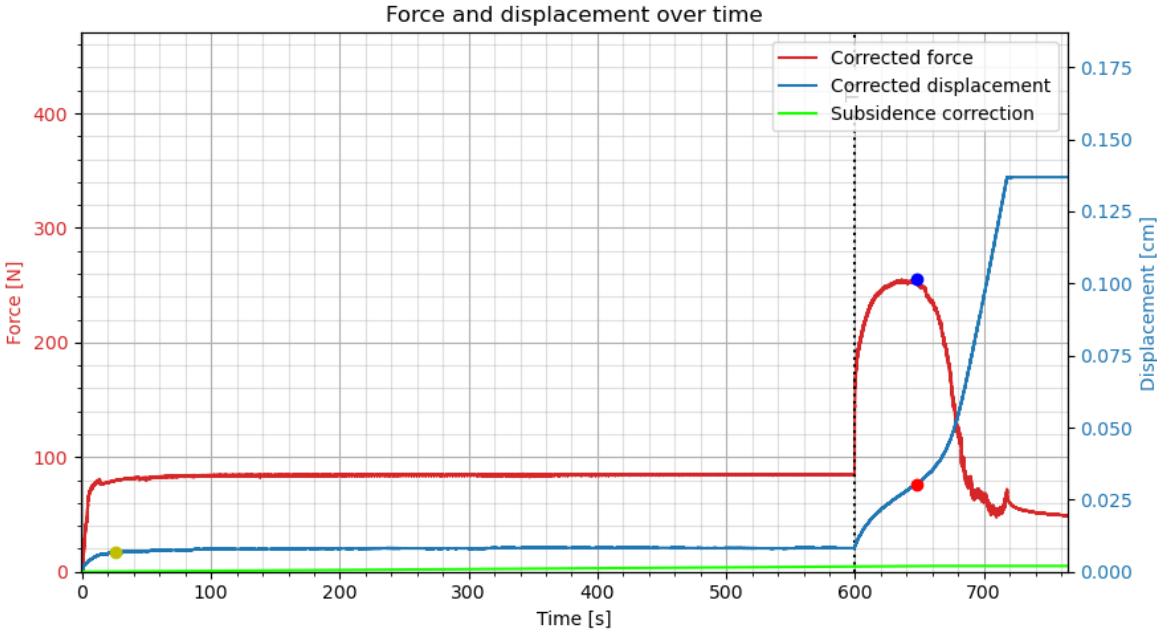
D.2.9. Test09

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	11:42:00			
Weight [kg]	115.4			
Width [cm]	20.0			
Length [cm]	29			
Dike orientation	North			
Percentage of occurrence [%]	70	20	10	
Sod thickness [cm]	12	8	5	10
Root length [cm]	3	4	7	3.6
Maximum stress [kN/m ²]	4.39			
Strain at maximum stress [-]	0.29			
Comments	Subsidence measured with steel plates			

Stress-strain relation



Force and displacement over time



Test sample pictures



(a) Top



(b) Left

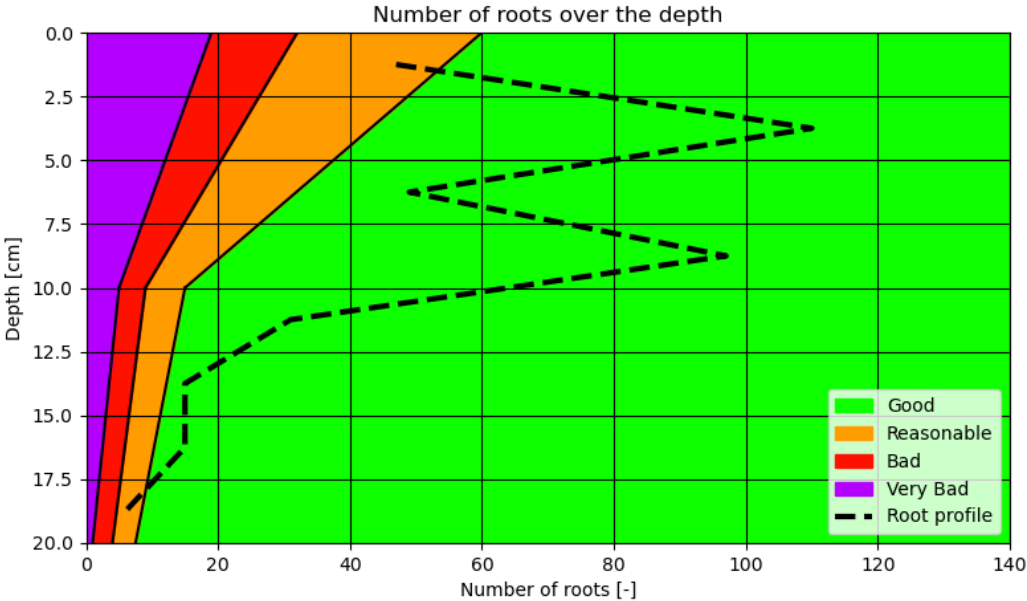


(c) Bottom



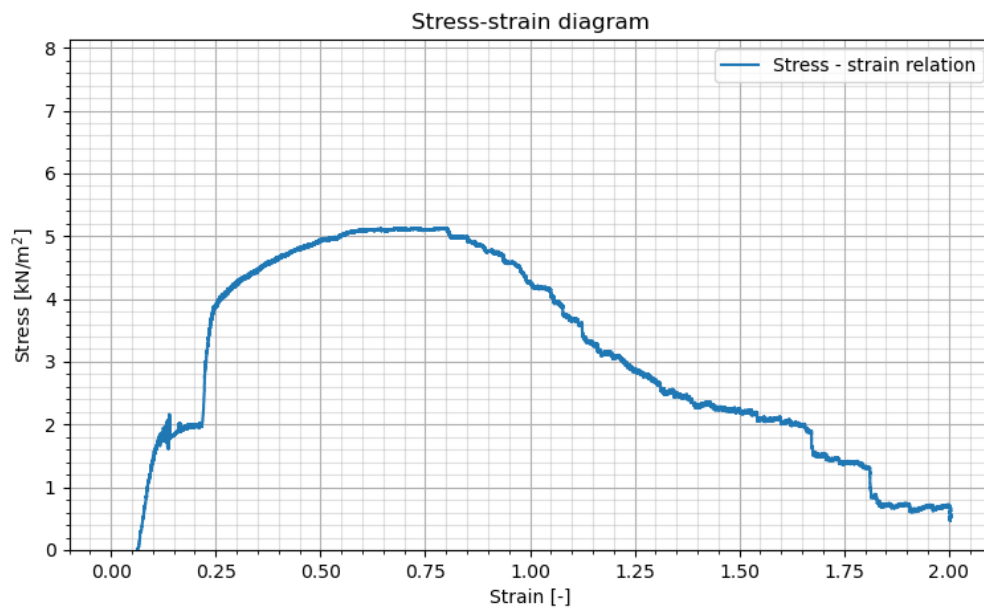
(d) Right

Root profile

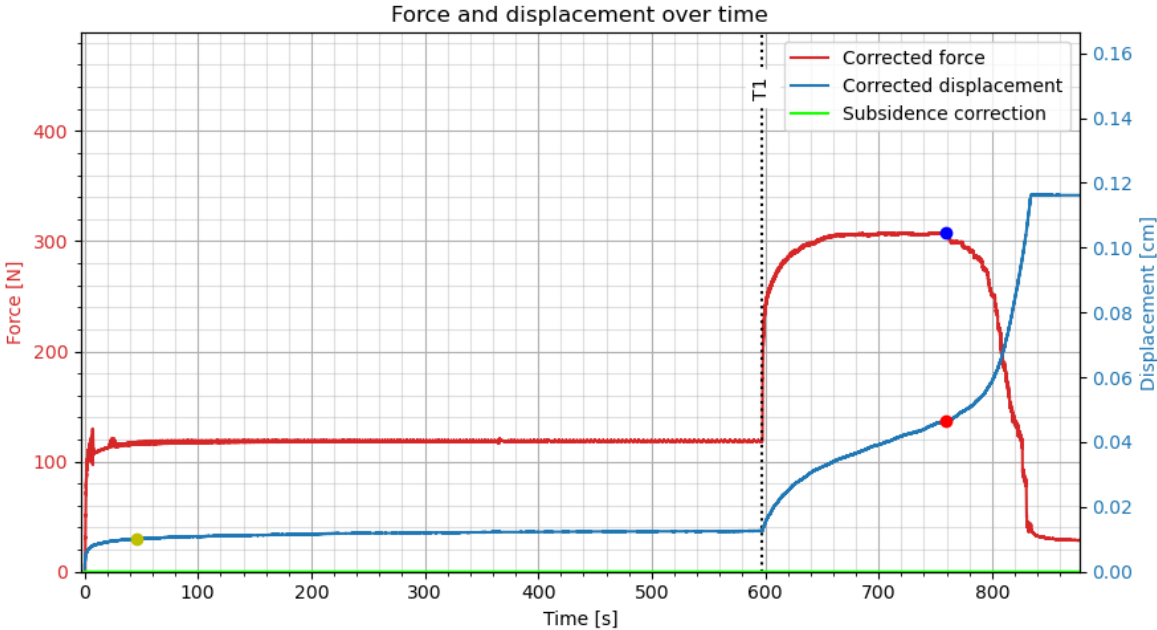


D.2.10. Test10

	Value 1	Value 2	Value 3	Mean
Date	24-02-2021			
Time	12:38:00			
Weight [kg]	81.2			
Width [cm]	20.0			
Length [cm]	30			
Dike orientation	North			
Percentage of occurrence [%]	60	40	0	
Sod thickness [cm]	7	4	0	6
Root length [cm]	7	10	0	8.2
Maximum stress [kN/m ²]	5.13			
Strain at maximum stress [-]	0.8			
Comments	Forgot to measure tripod subsidence			

Stress-strain relation

Force and displacement over time



Test sample pictures



(a) Top



(b) Left

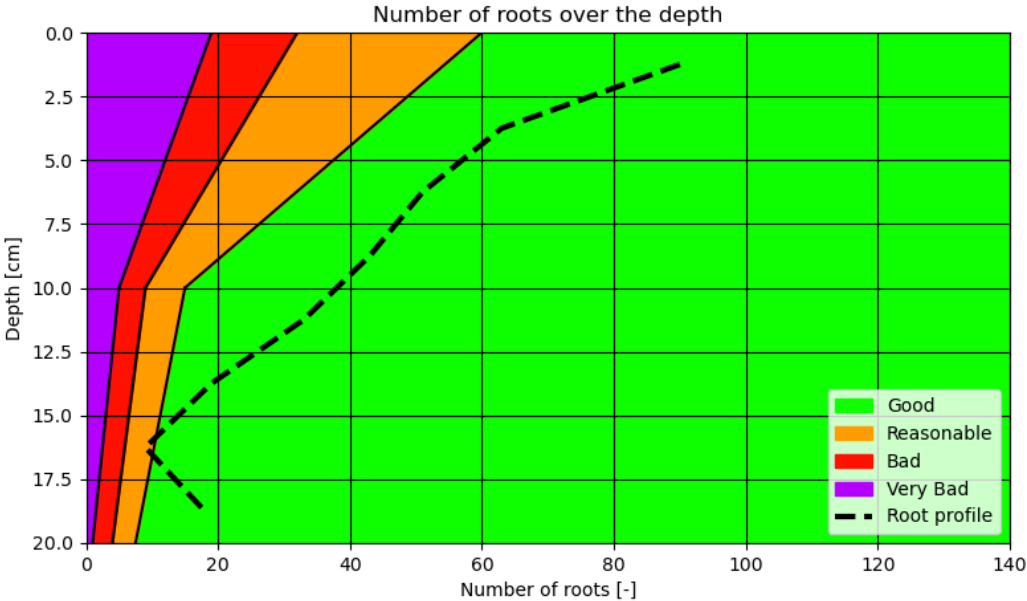


(c) Bottom



(d) Right

Root profile

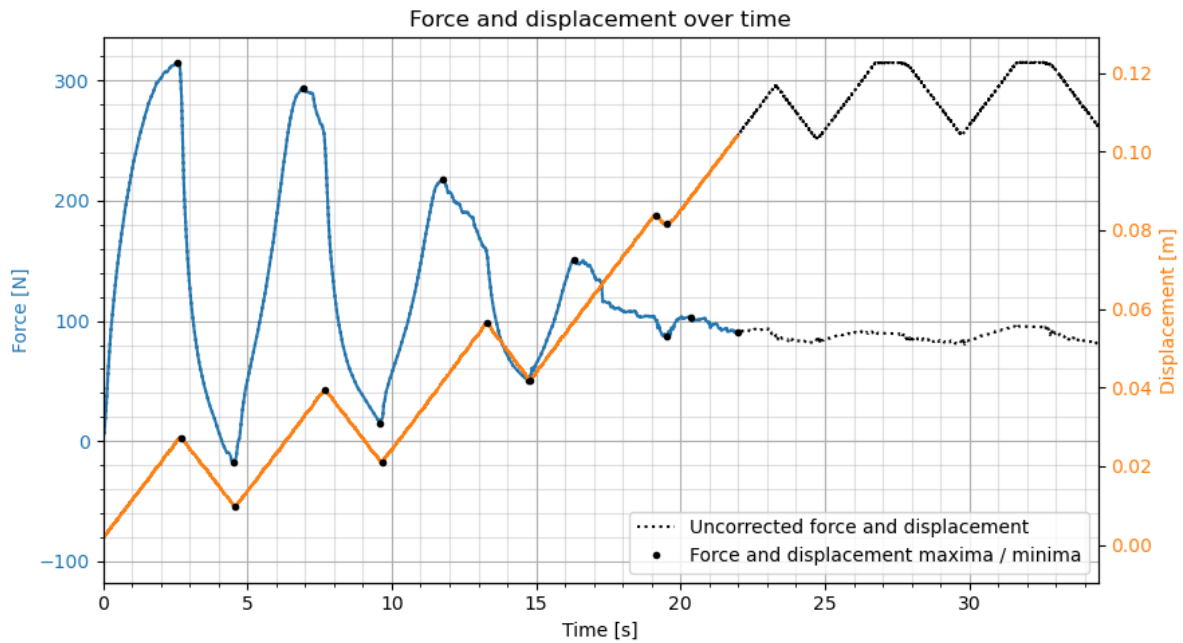


D.1. Fatigue tests - condition 4 submerged

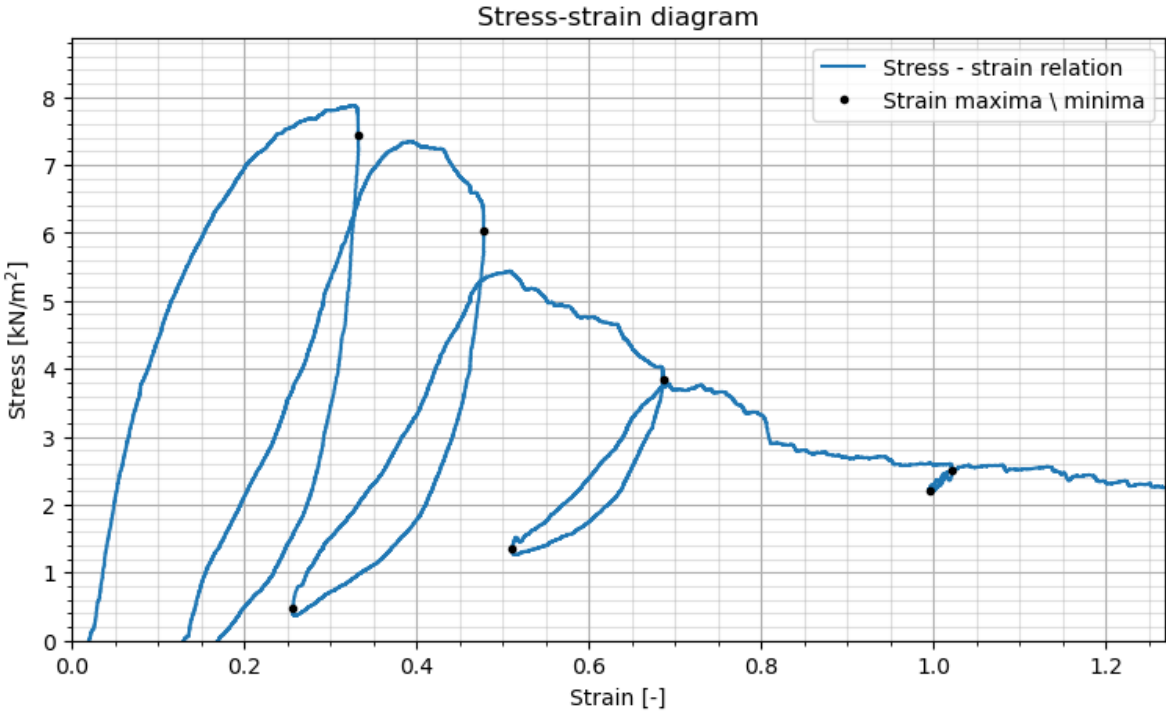
D.1.1. Test01

		Value 1	Value 2	Value 3	Mean
Date		04-03-2021			
Time		11:23:00			
Cyclic Load regime	[N]	300			
Weight	[kg]	9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	60	20	20	
Sod thickness	[cm]	9	8	6	8
Root length	[cm]	6	9	6	6.6
Mean peak stress	[kN/m ²]	5.4			
Maximum number of cycles	[-]	5			
Comments		Failed quickly			

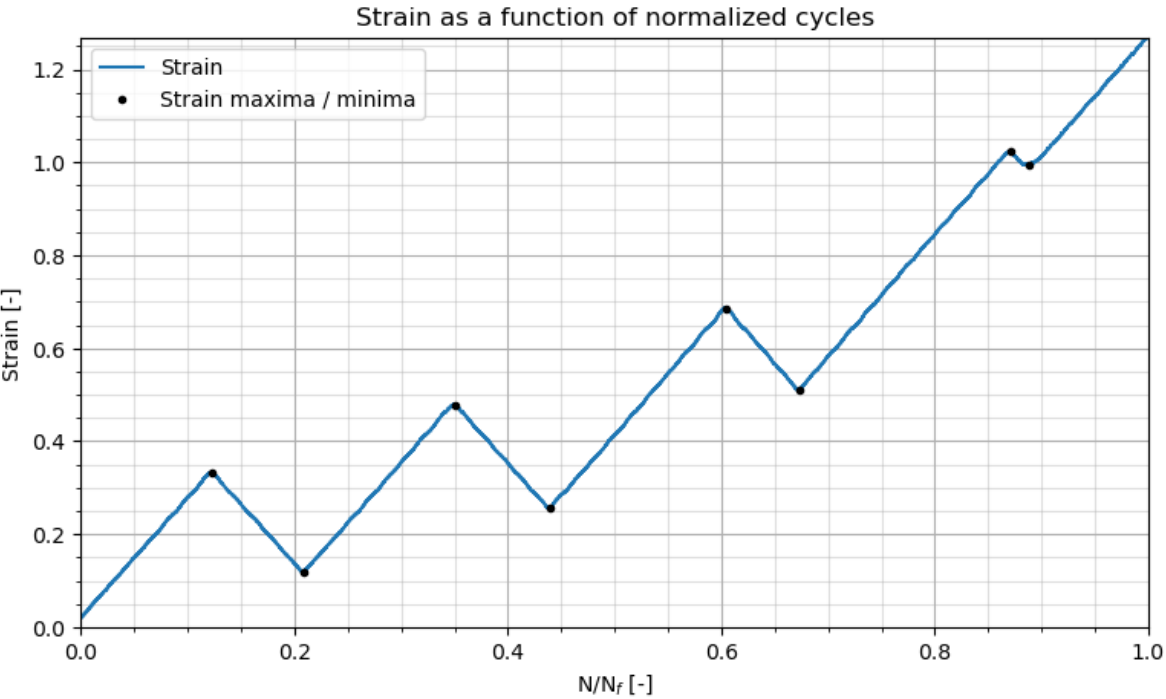
Force and displacement over time



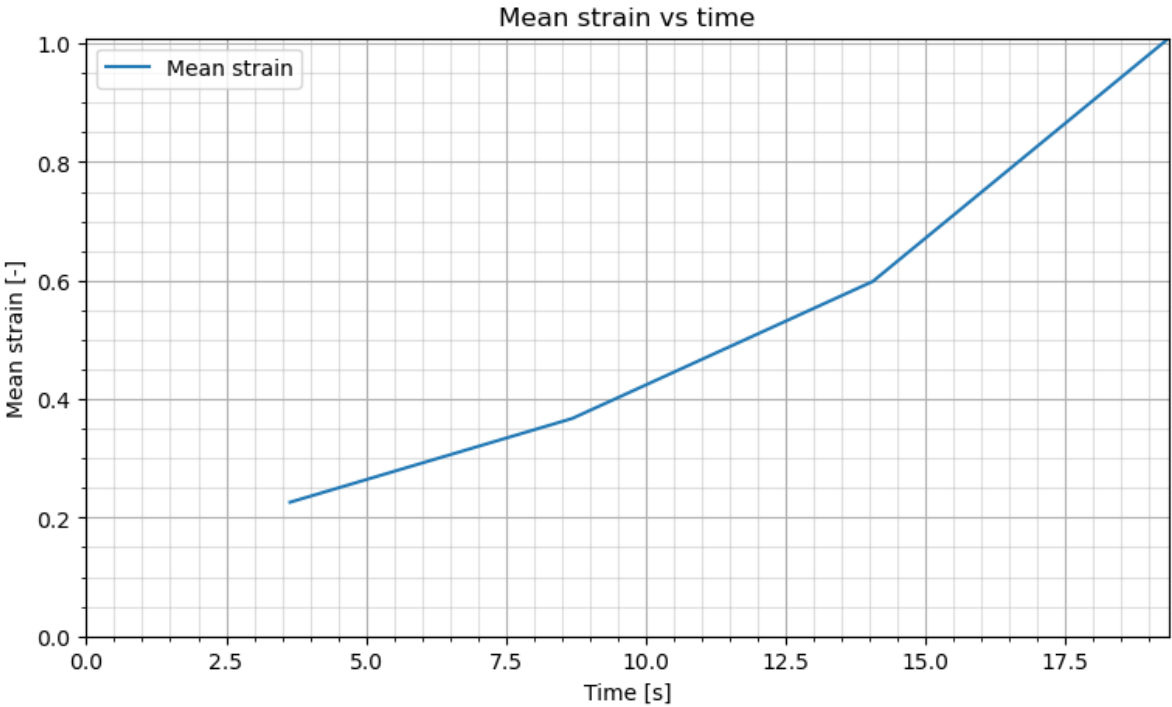
Stress-strain relation



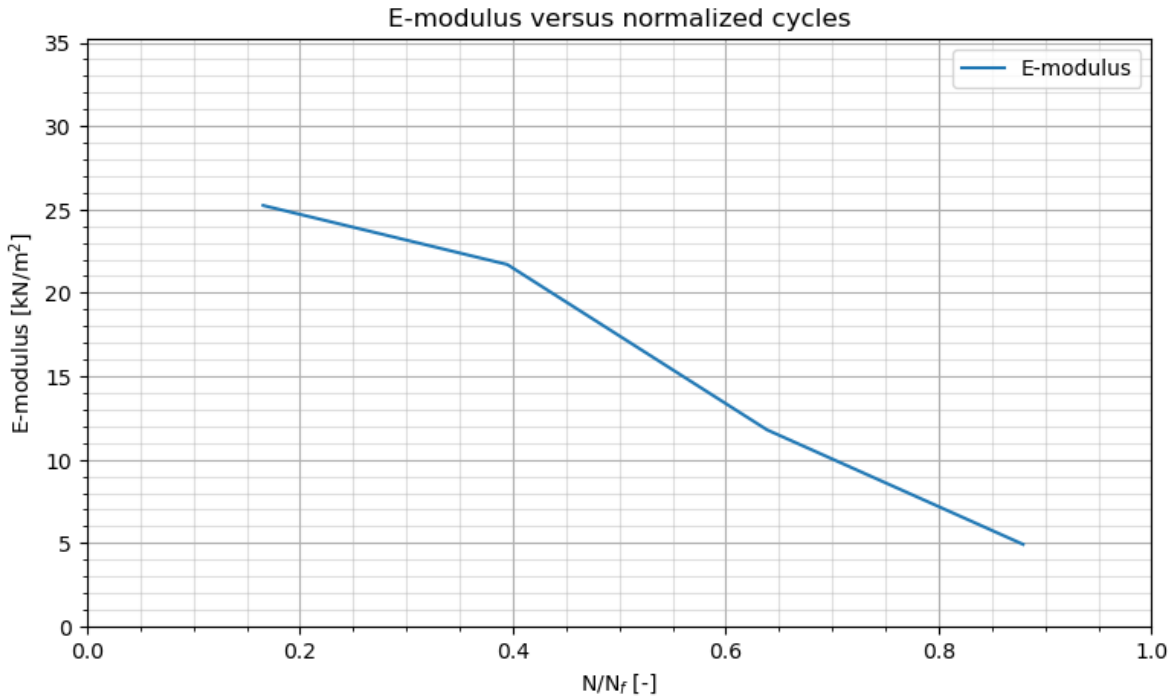
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

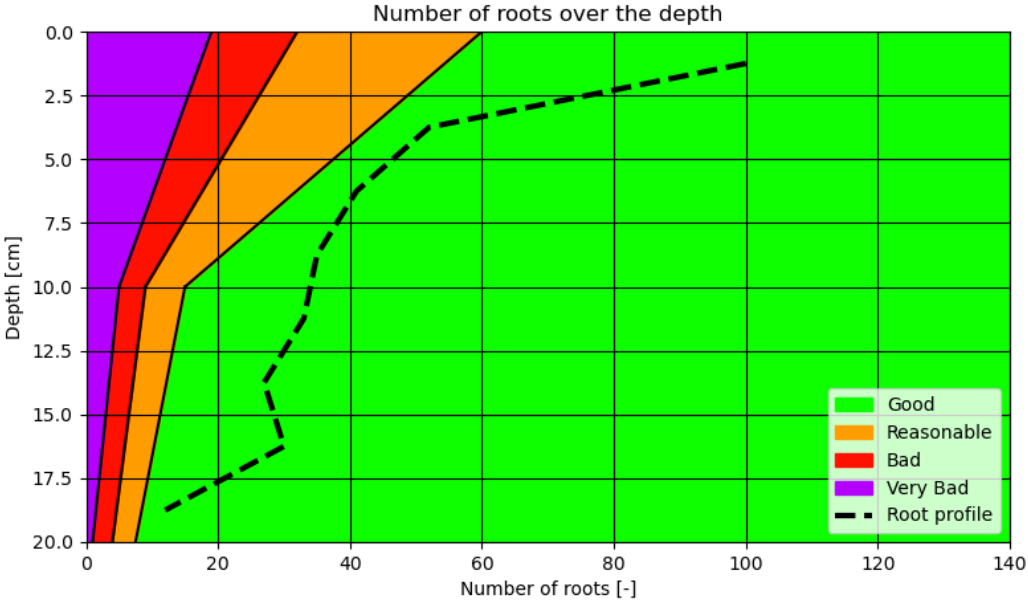


(c) Bottom



(d) Right

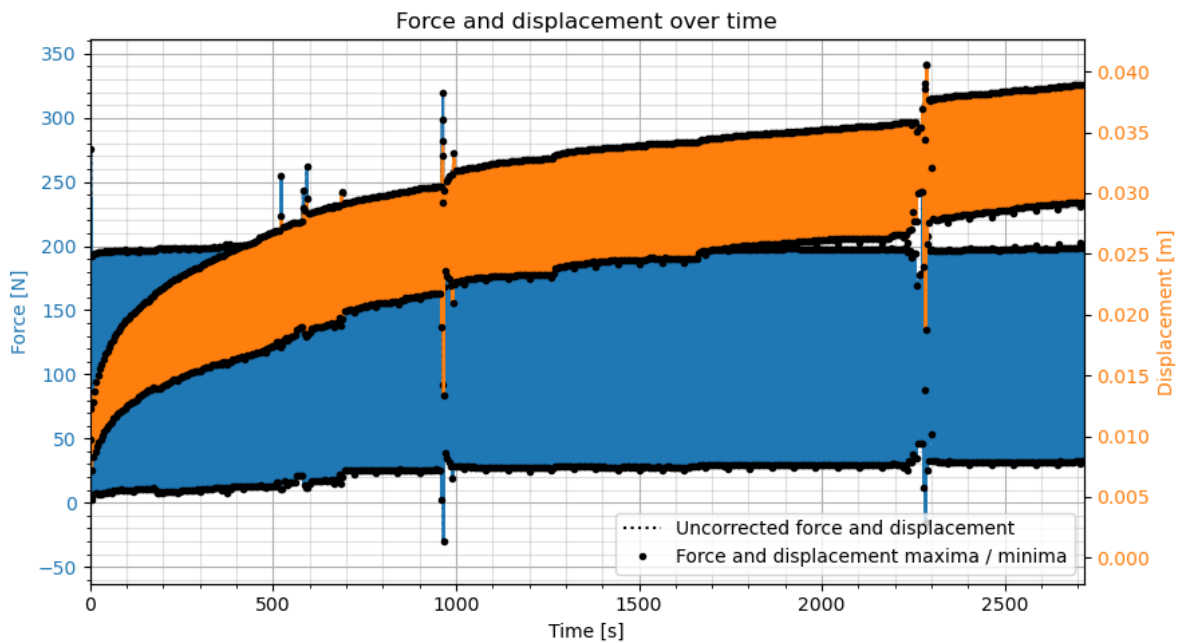
Root profile



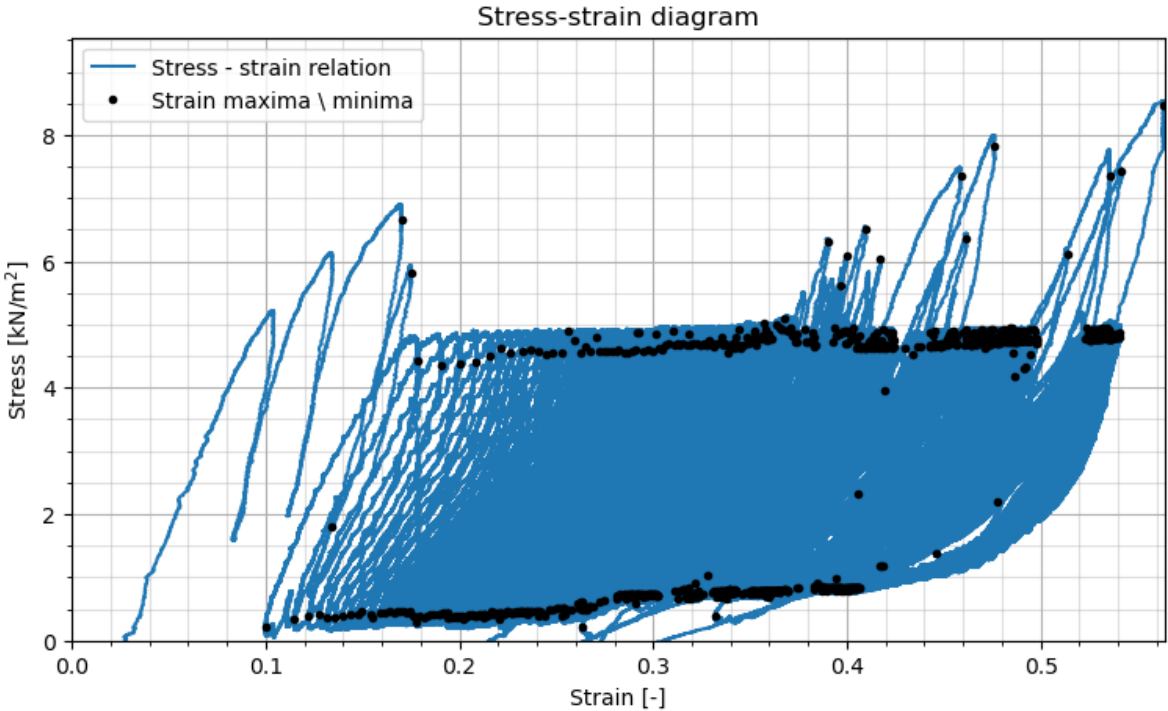
D.1.2. Test02

	Value 1	Value 2	Value 3	Mean
Date	04-03-2021			
Time	12:44:00			
Cyclic Load regime [N]	200			
Weight [kg]	9			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	40	30	30	
Sod thickness [cm]	9	7	5	7
Root length [cm]	6	11	6	7.5
Mean peak stress [kN/m ²]	4.98			
Maximum number of cycles [-]	544			
Comments	Did not fail			

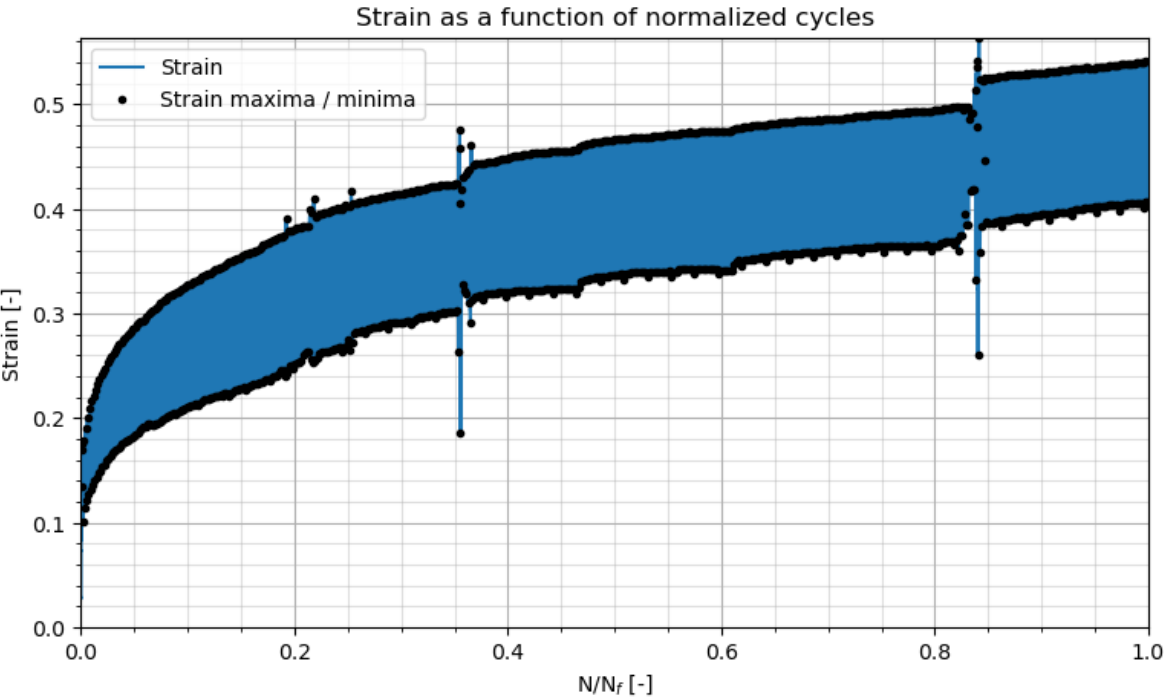
Force and displacement over time



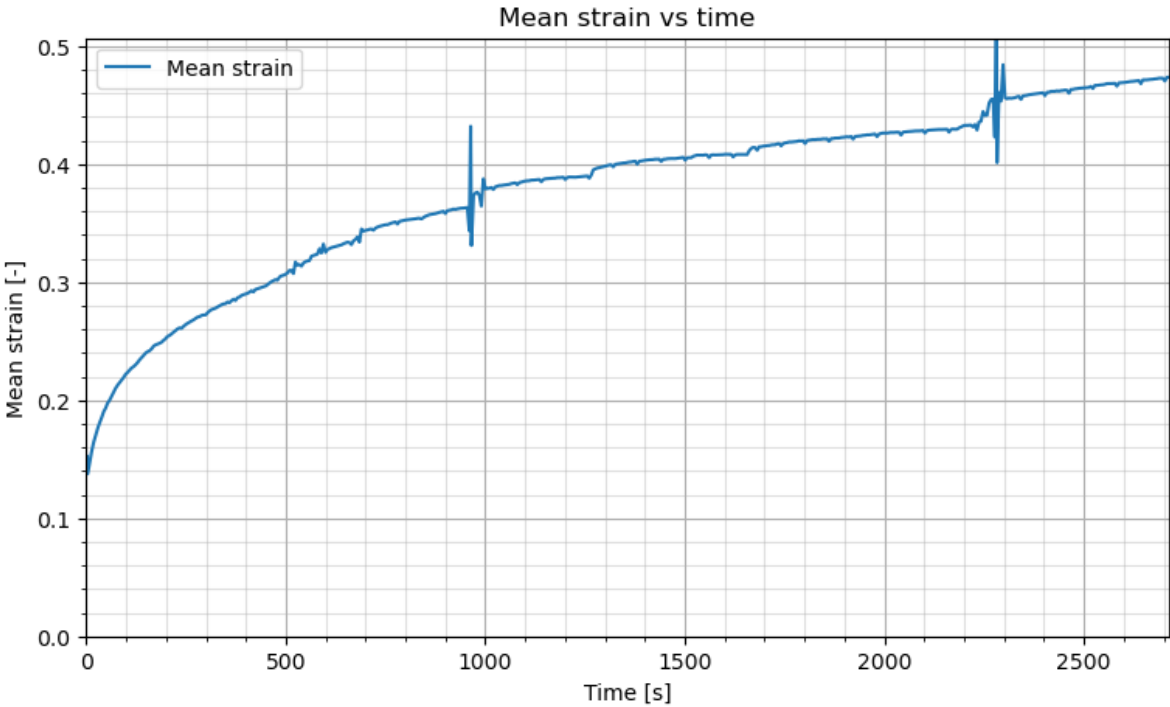
Stress-strain relation



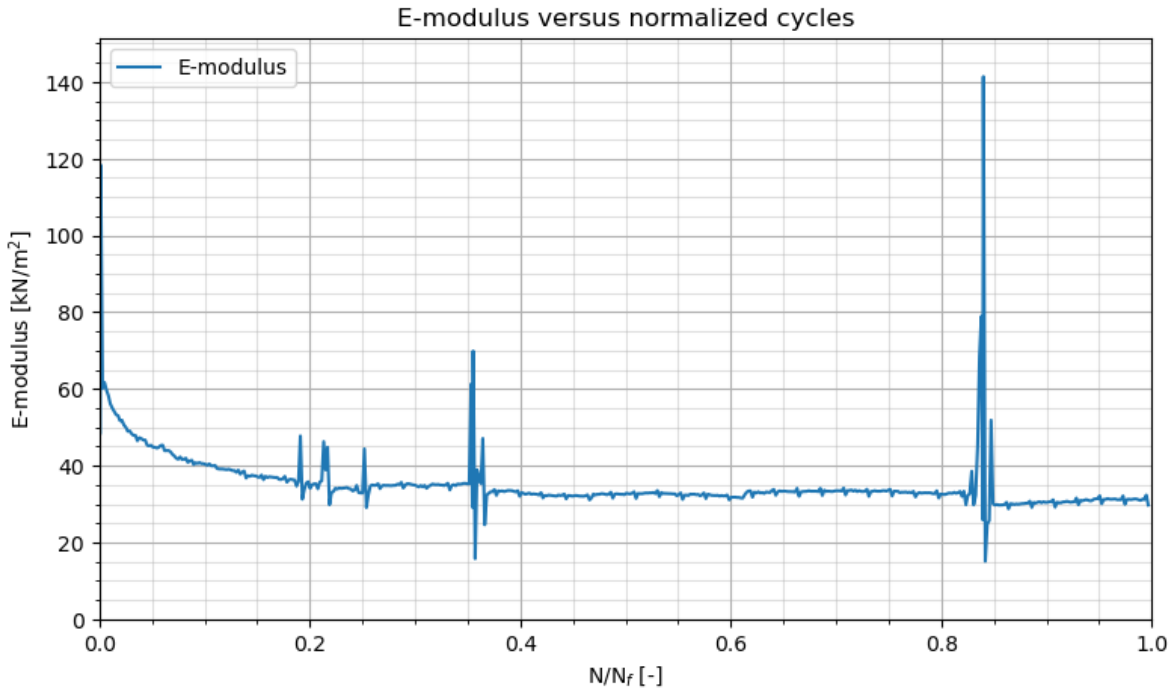
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

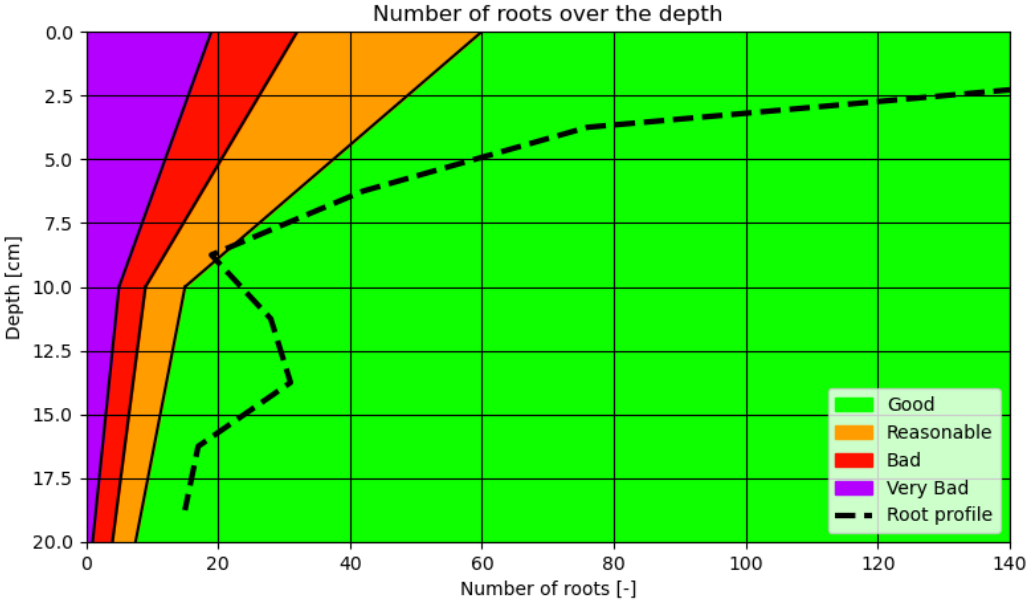


(c) Bottom



(d) Right

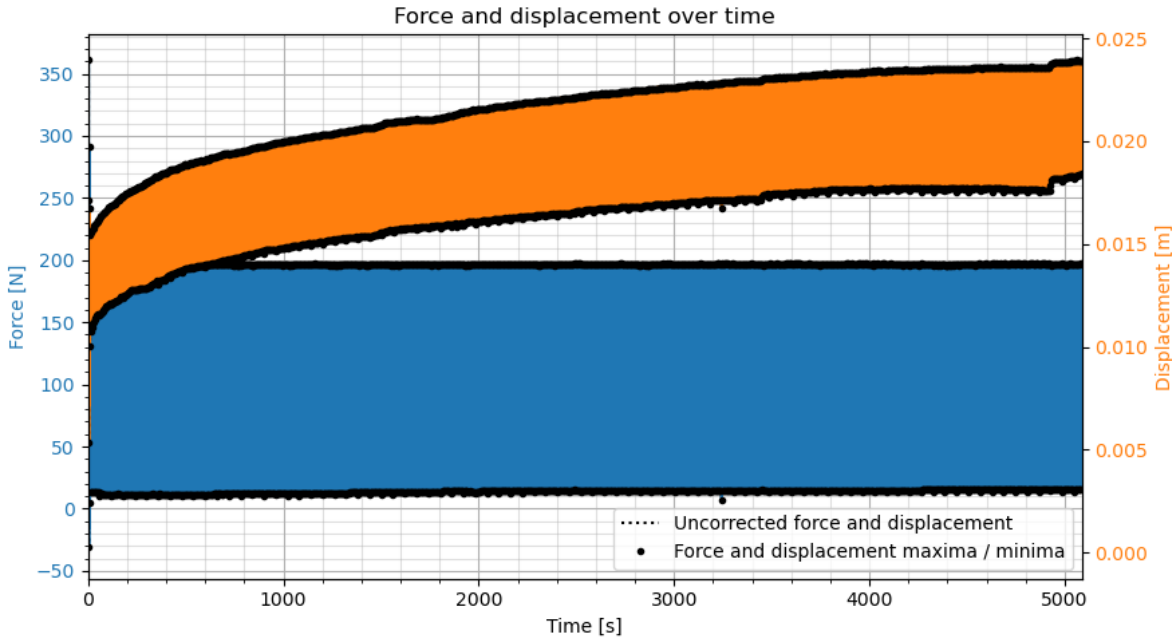
Root profile



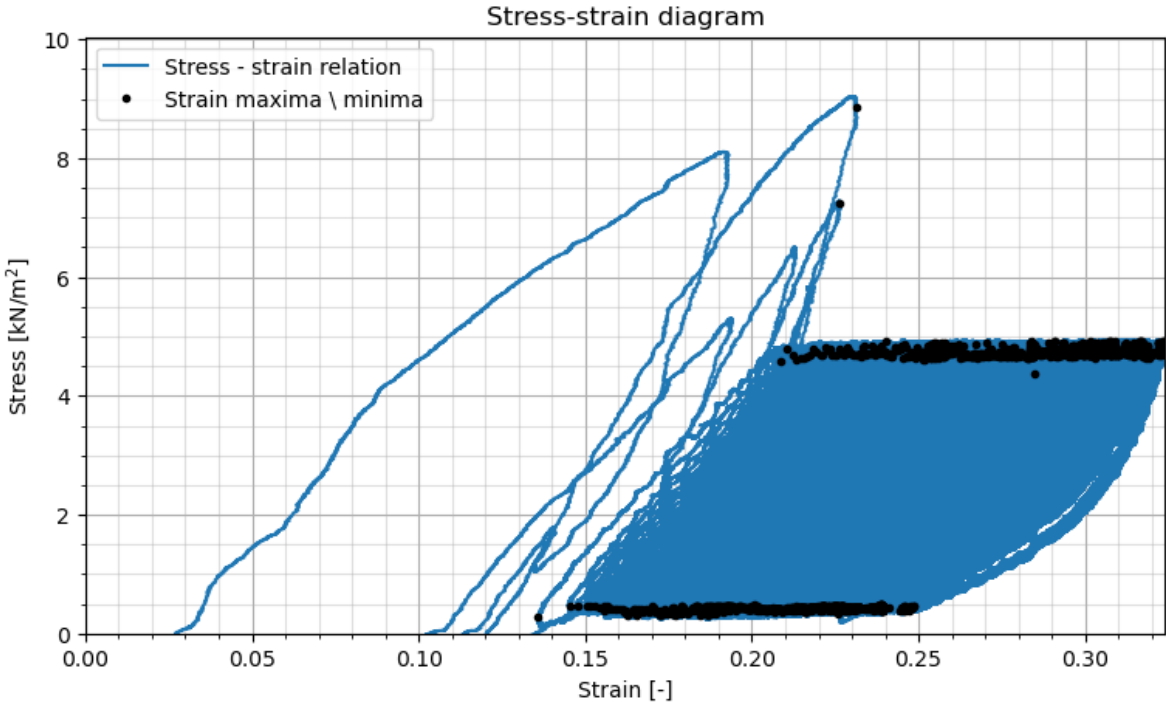
D.1.3. Test03

	Value 1	Value 2	Value 3	Mean
Date	04-03-2021			
Time	13:37:00			
Cyclic Load regime [N]	200			
Weight [kg]	8			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	60	30	10	
Sod thickness [cm]	8	7	5	7
Root length [cm]	5	8	3	5.7
Mean peak stress [kN/m ²]	4.92			
Maximum number of cycles [-]	1018			
Comments	Did not fail			

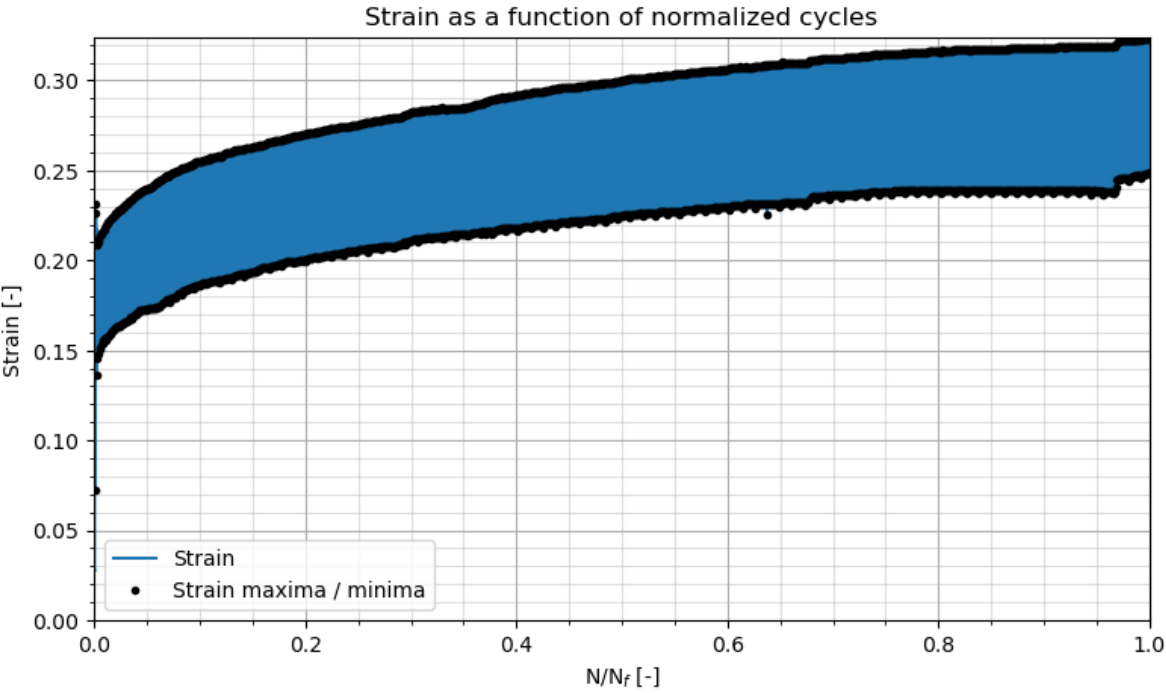
Force and displacement over time



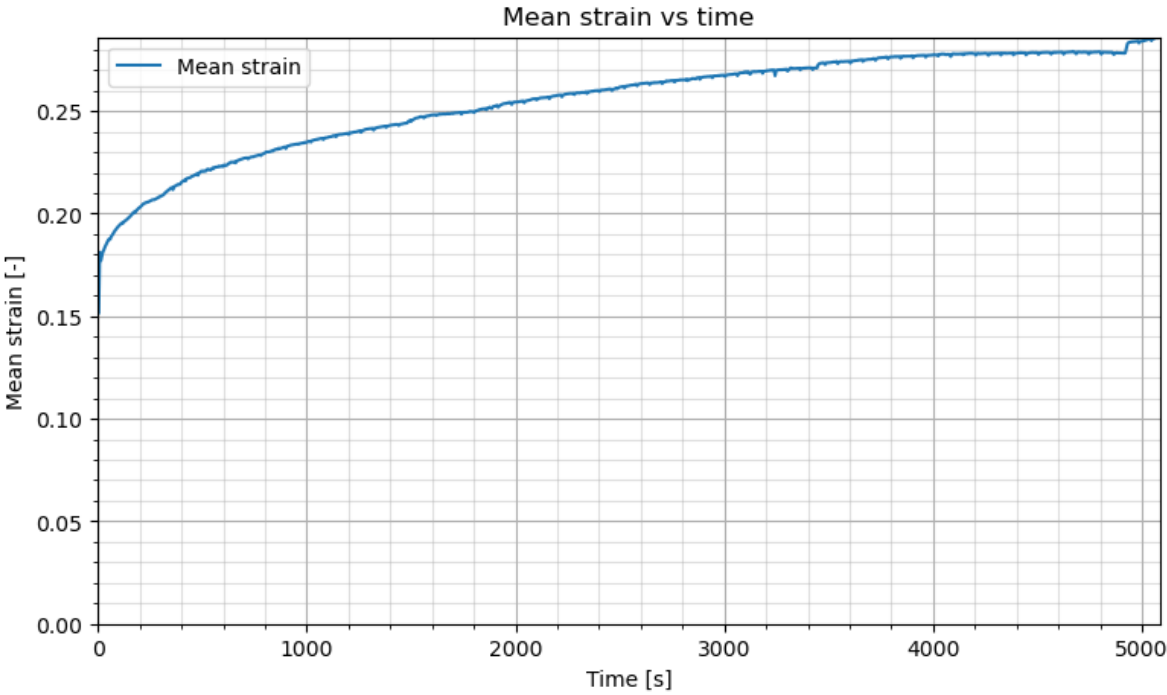
Stress-strain relation



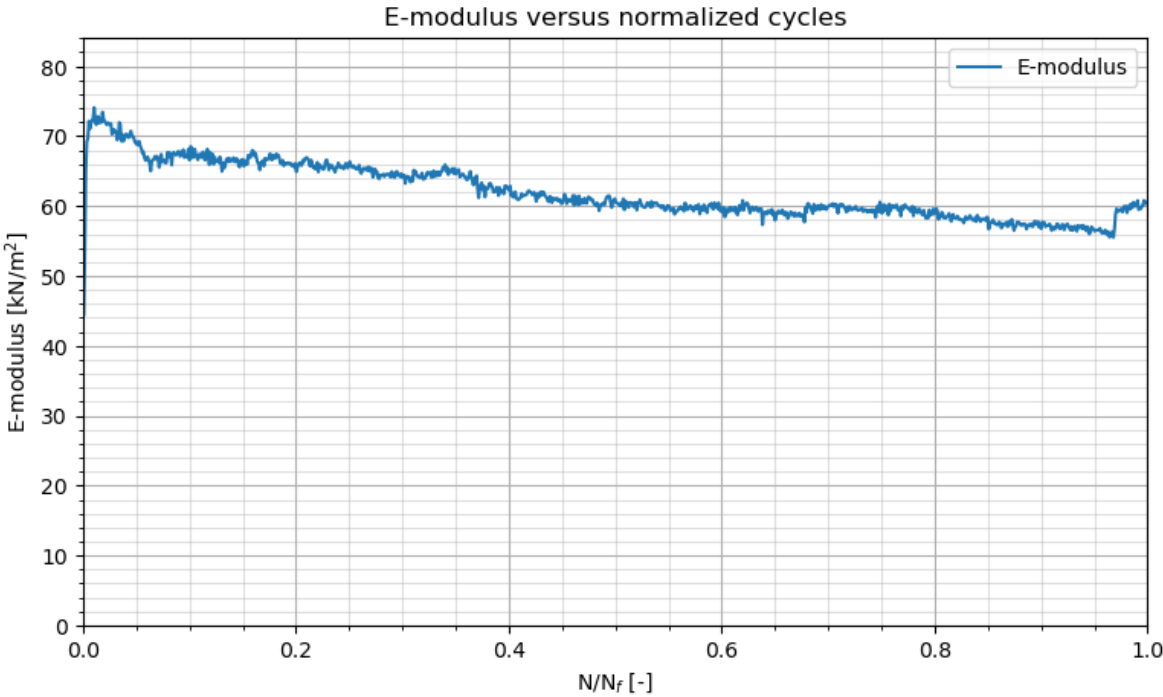
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

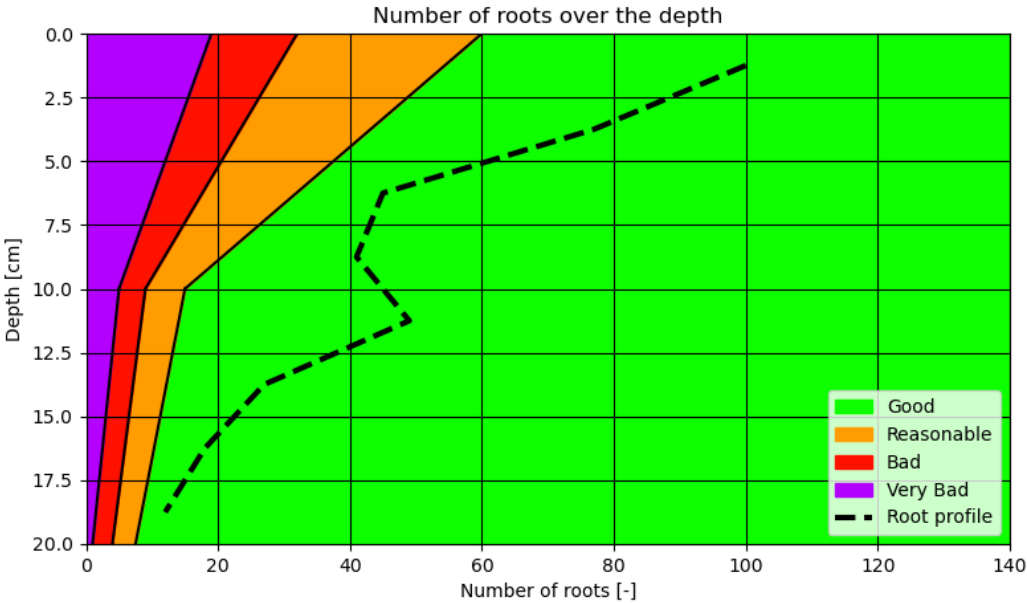


(c) Bottom



(d) Right

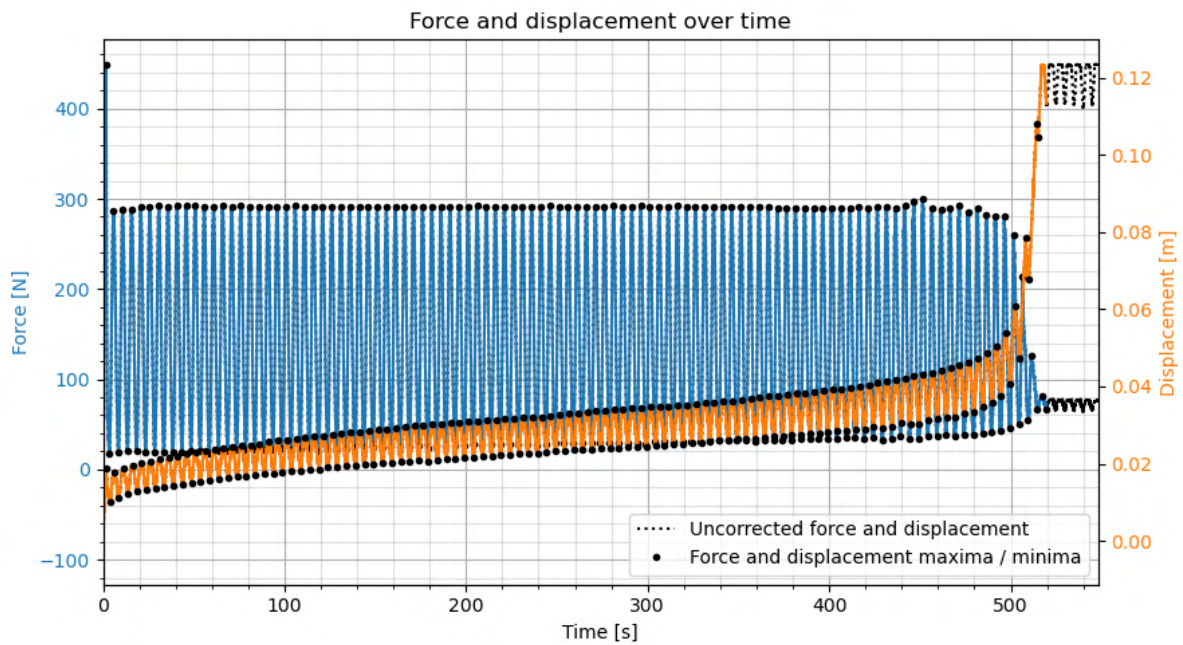
Root profile



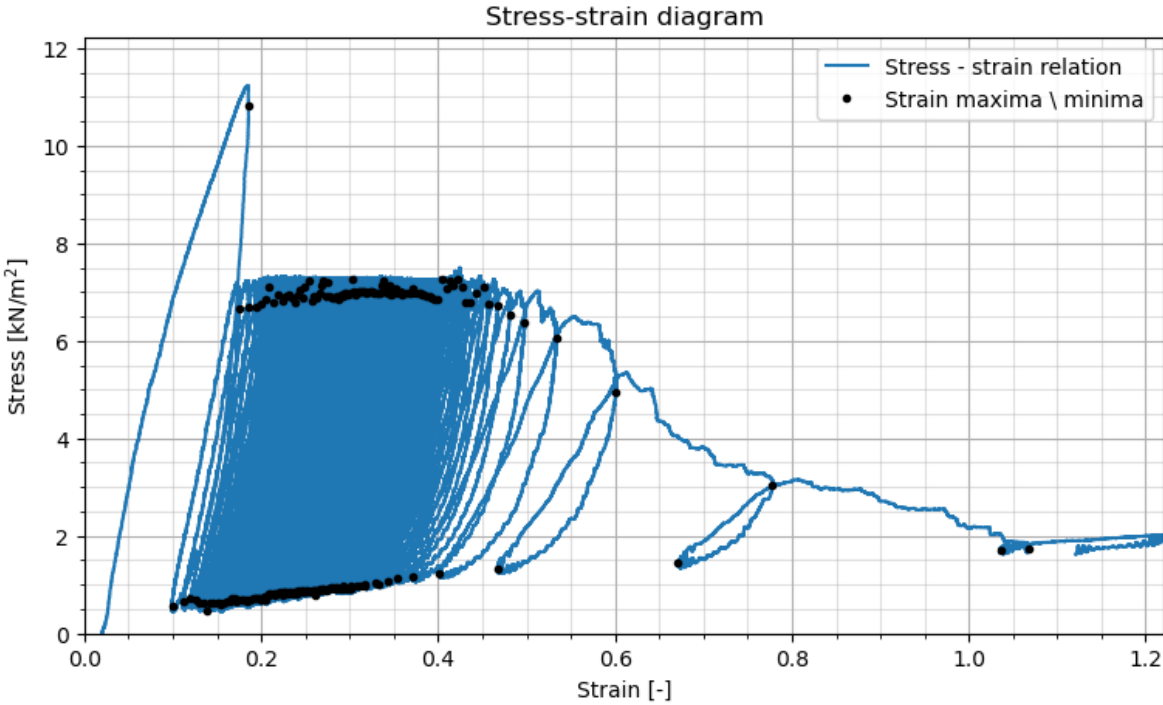
D.1.4. Test04

	Value 1	Value 2	Value 3	Mean
Date	04-03-2021			
Time	?			
Cyclic Load regime [N]	300			
Weight [kg]	11			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	50	30	20	
Sod thickness [cm]	11	10	8	10
Root length [cm]	6	8	10	7.4
Mean peak stress [kN/m ²]	7.19			
Maximum number of cycles [-]	104			
Comments	-			

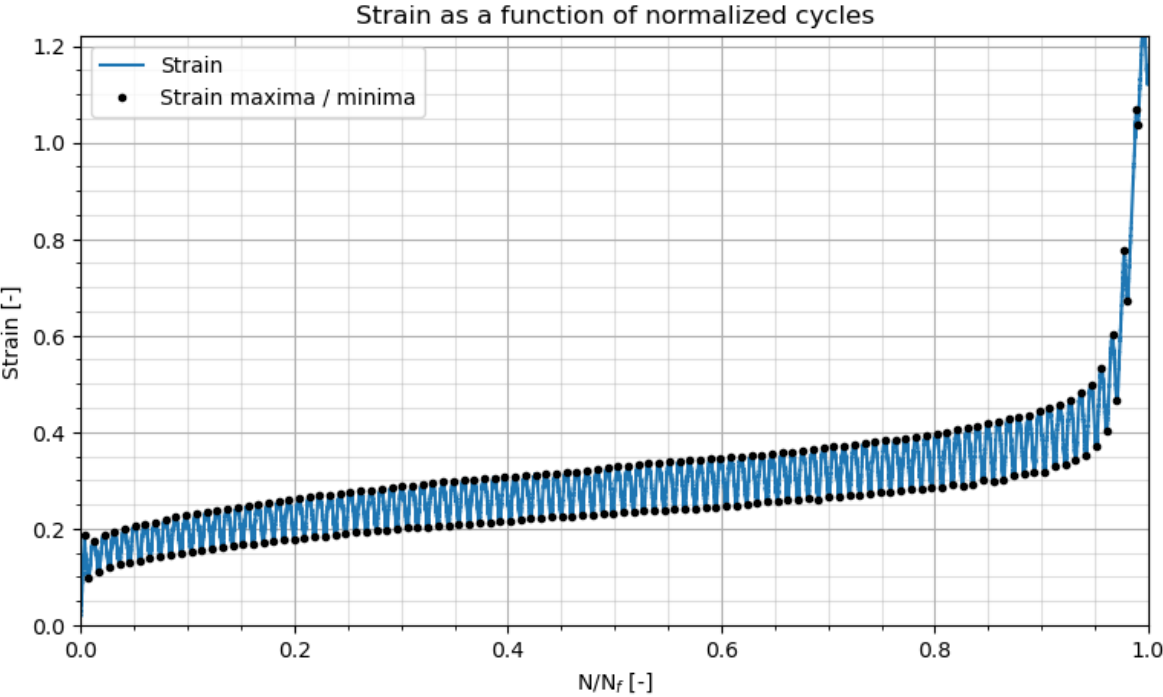
Force and displacement over time



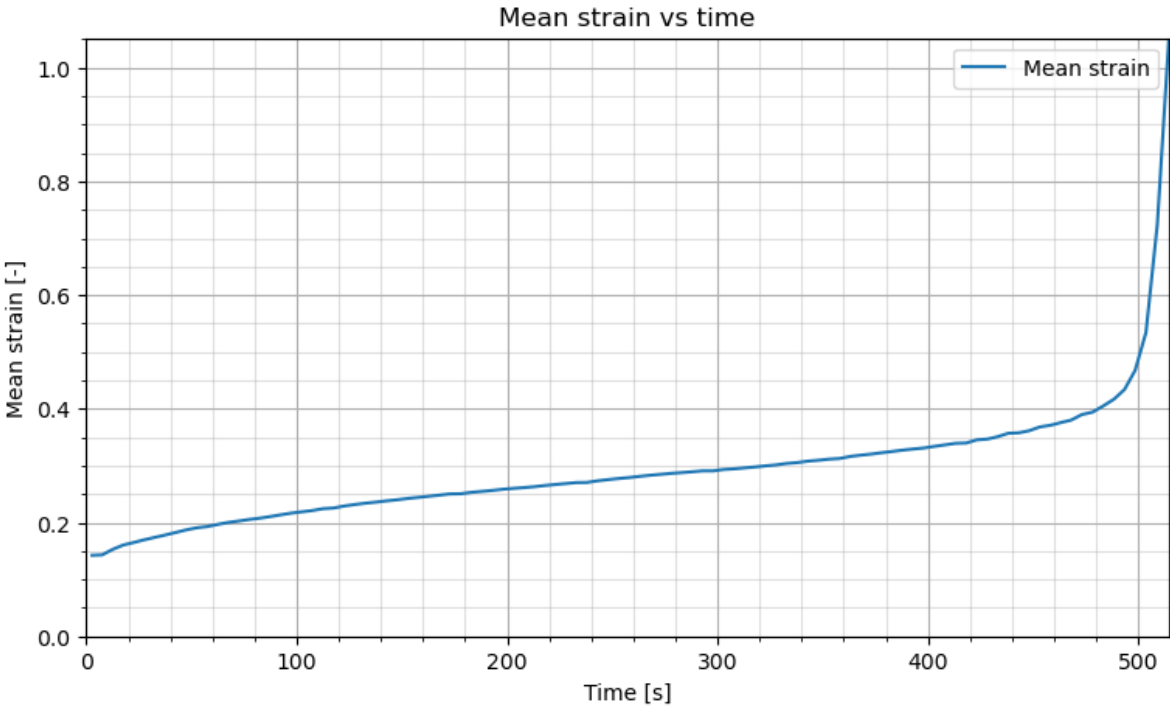
Stress-strain relation



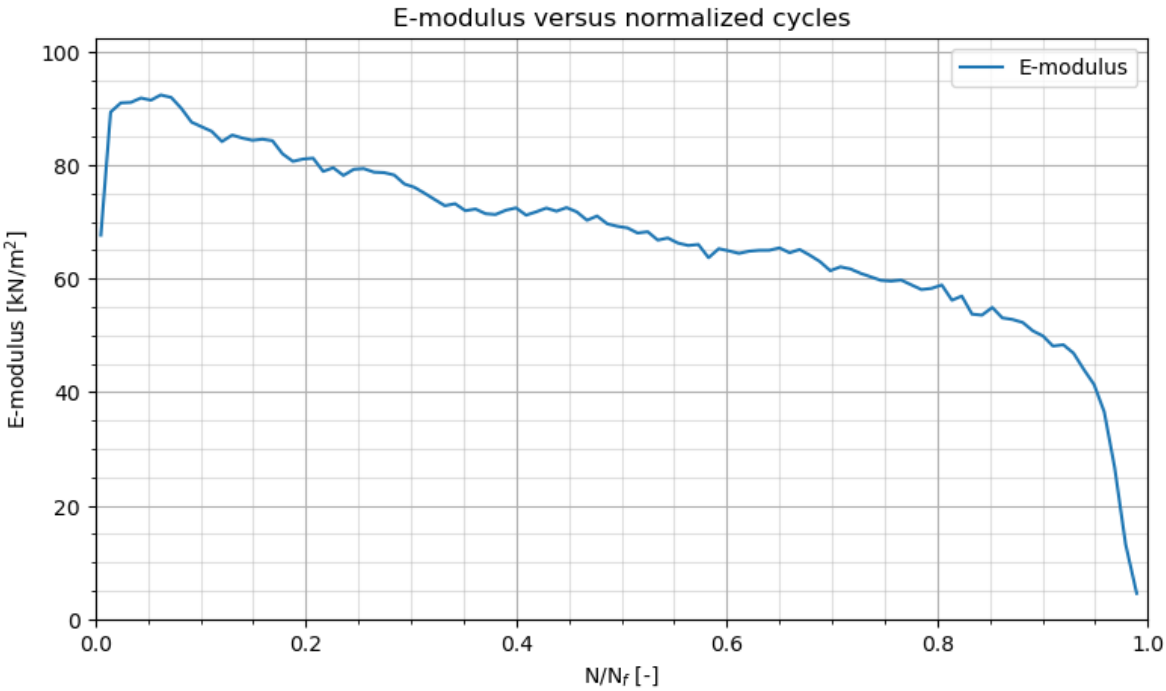
Strain over normalized cycles



Mean strain over time



E-modulus over time



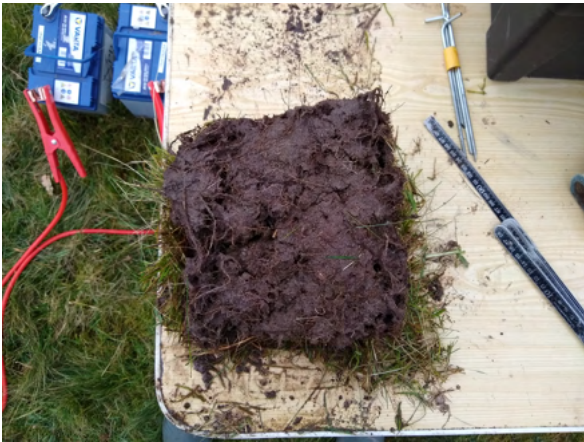
Test sample pictures



(a) Top



(b) Left

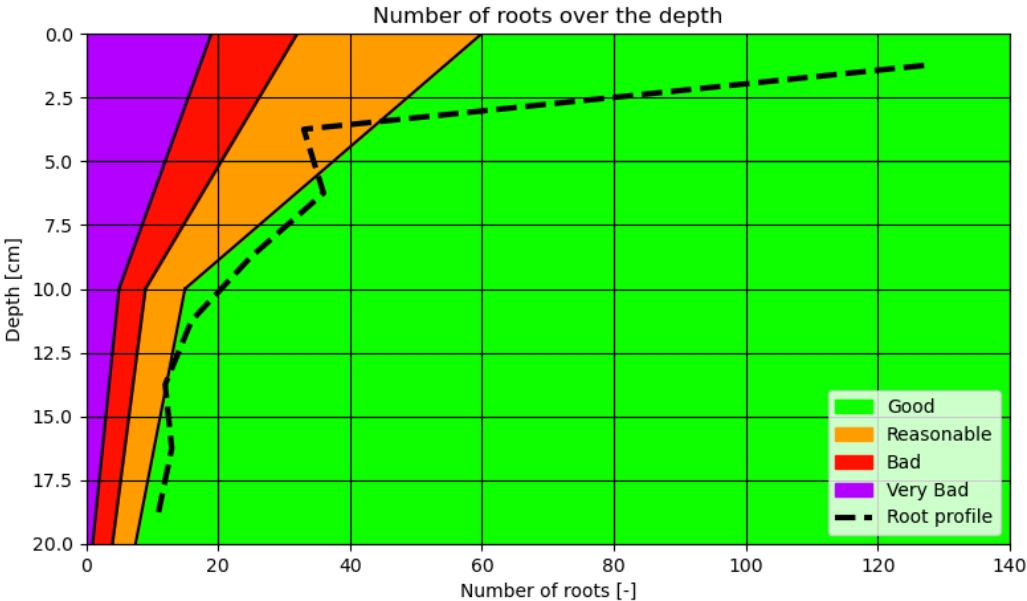


(c) Bottom



(d) Right

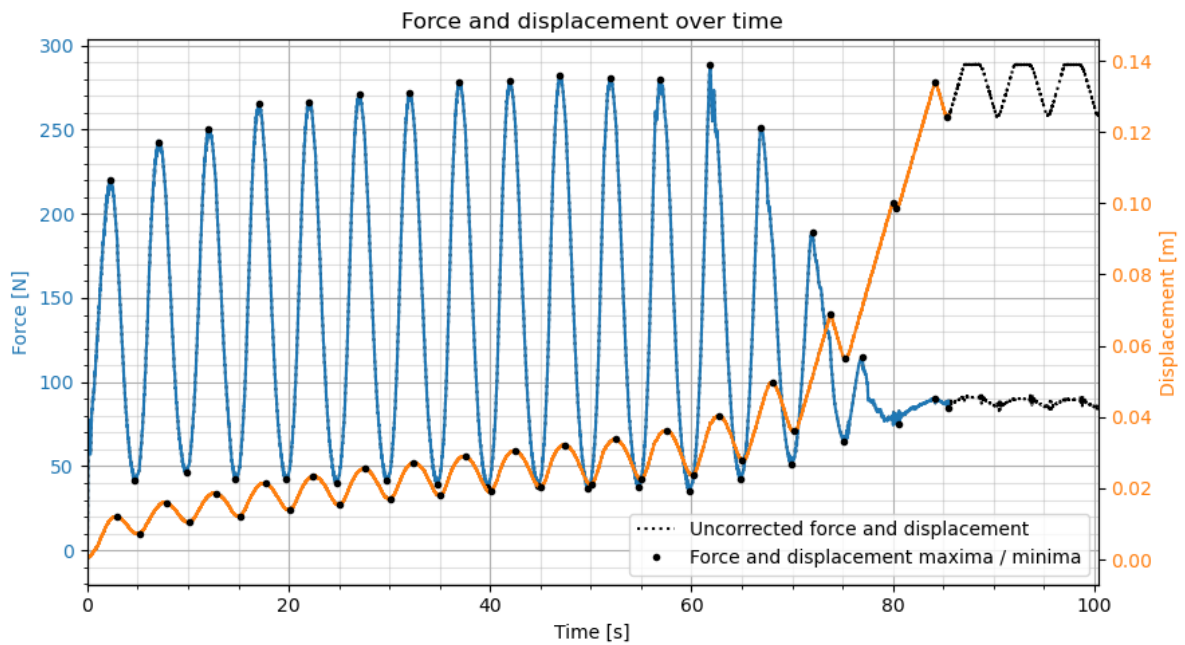
Root profile



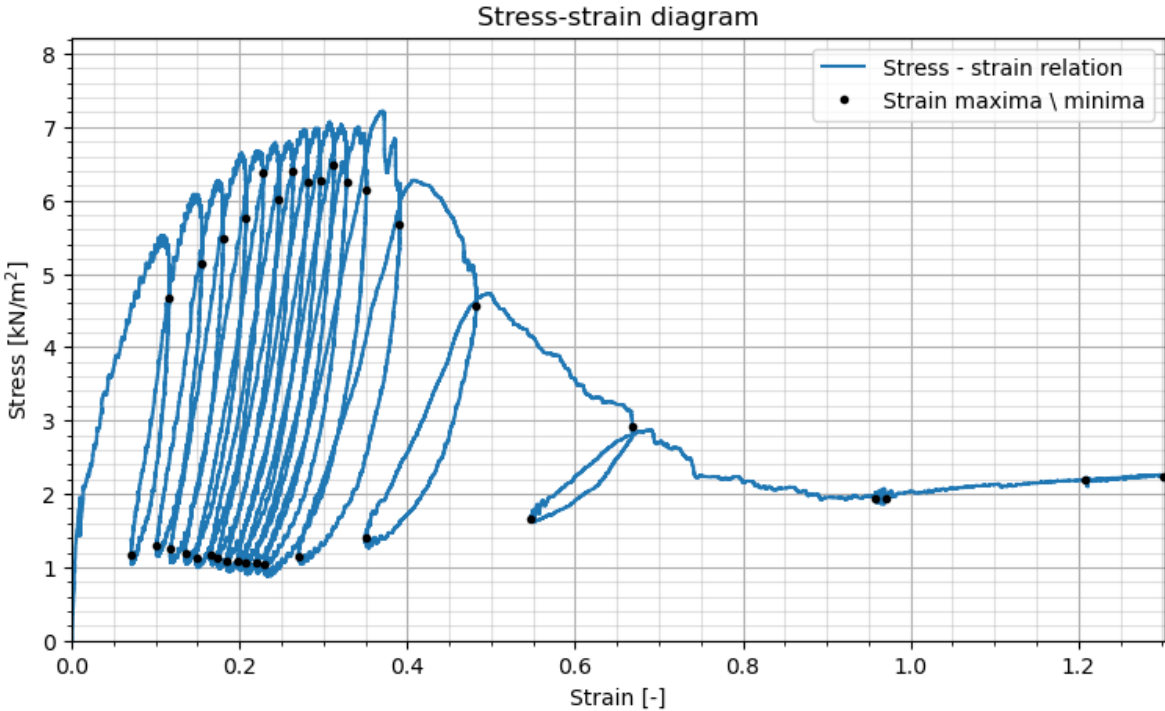
D.1.5. Test05

		Value 1	Value 2	Value 3	Mean
Date		04-03-2021			
Time		?			
Cyclic Load regime	[N]	300			
Weight	[kg]	12			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	50	10	40	
Sod thickness	[cm]	12	11	8	10
Root length	[cm]	6	6	6	6.0
Mean peak stress	[kN/m ²]	6.06			
Maximum number of cycles	[-]	18			
Comments		-			

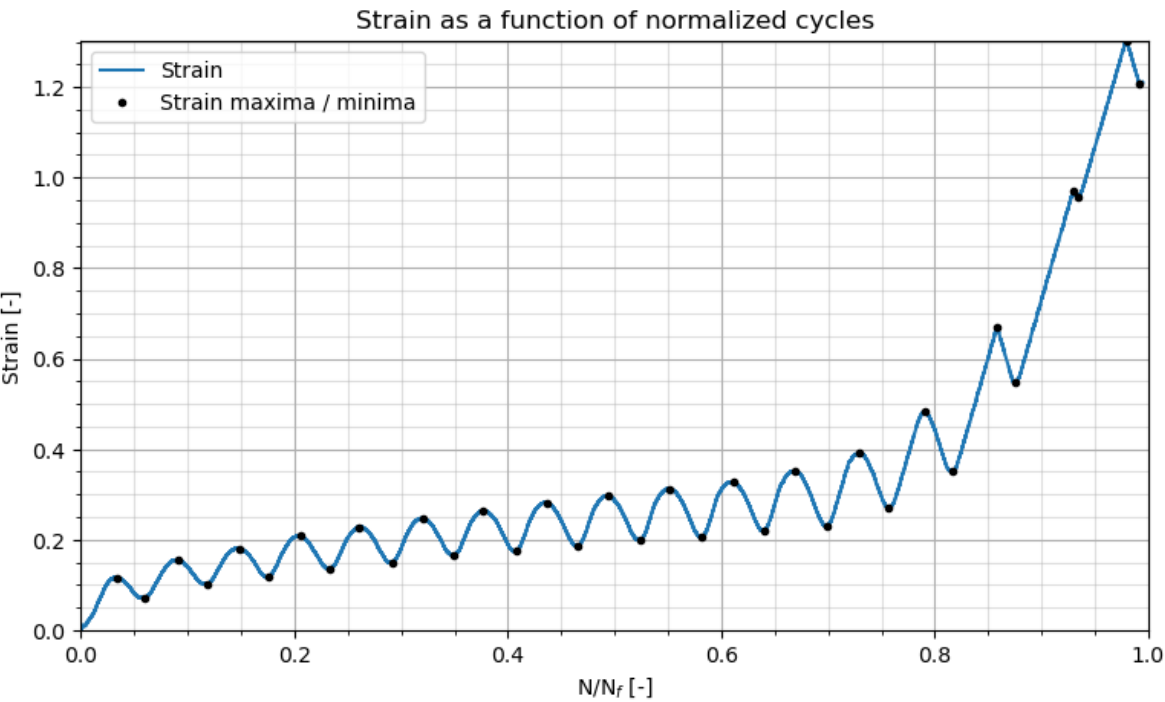
Force and displacement over time



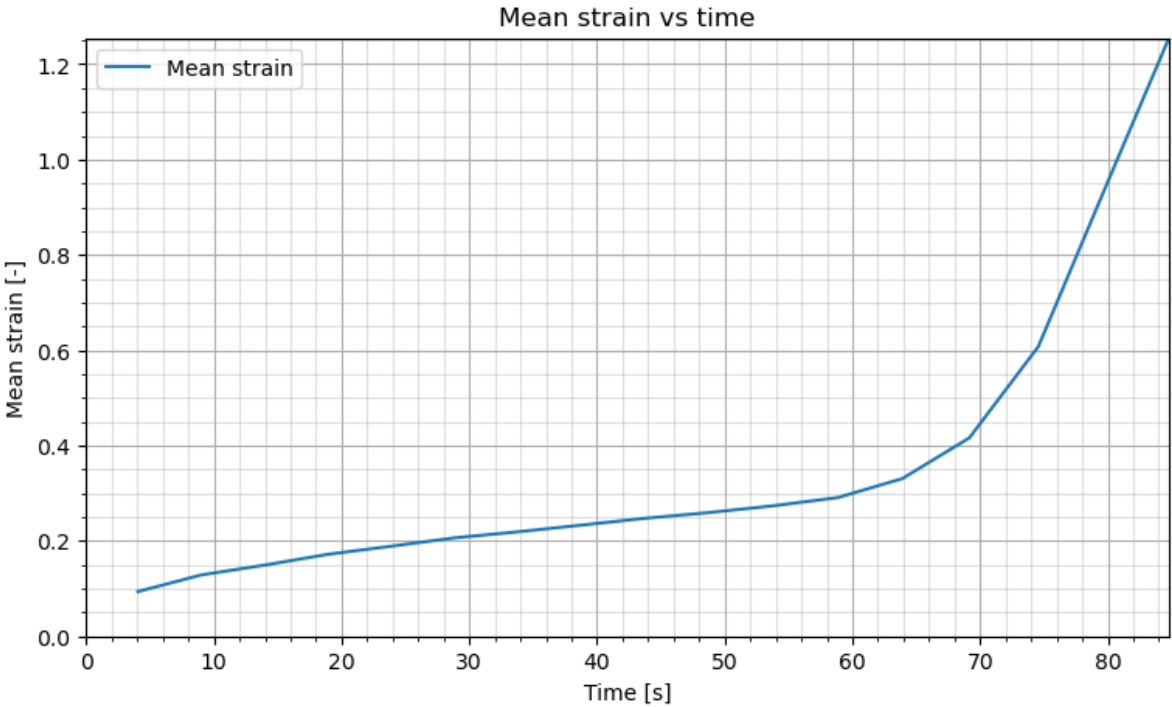
Stress-strain relation



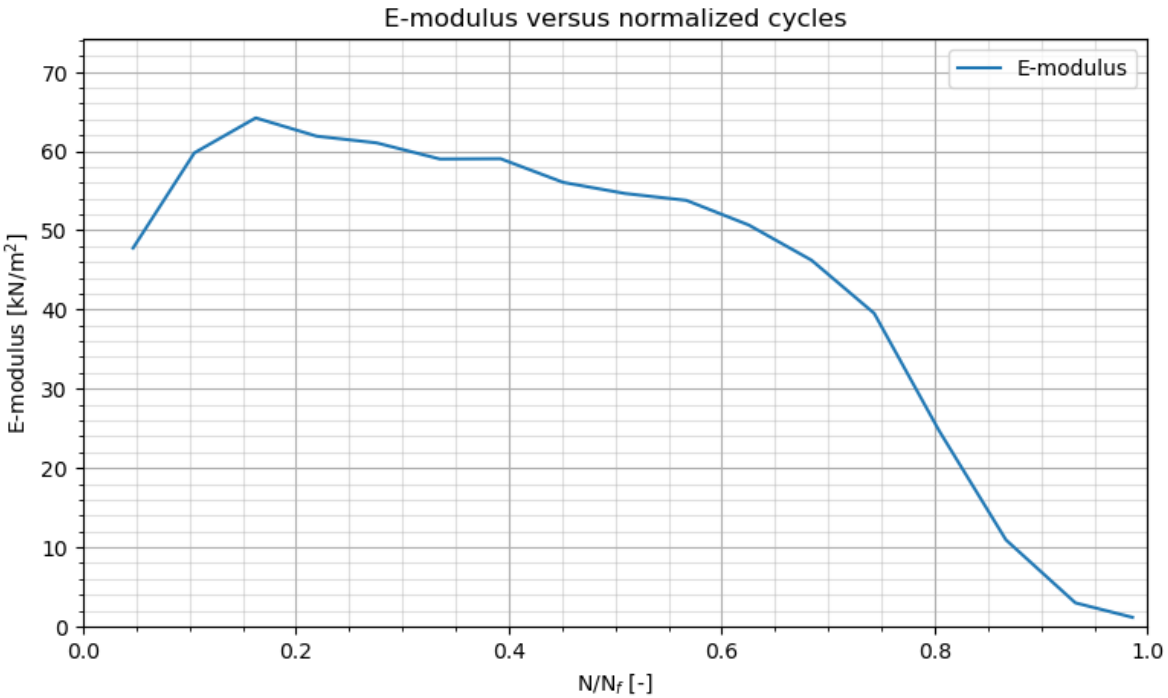
Strain over normalized cycles



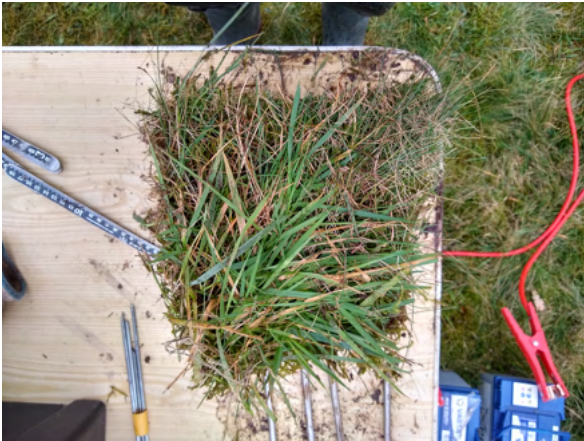
Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

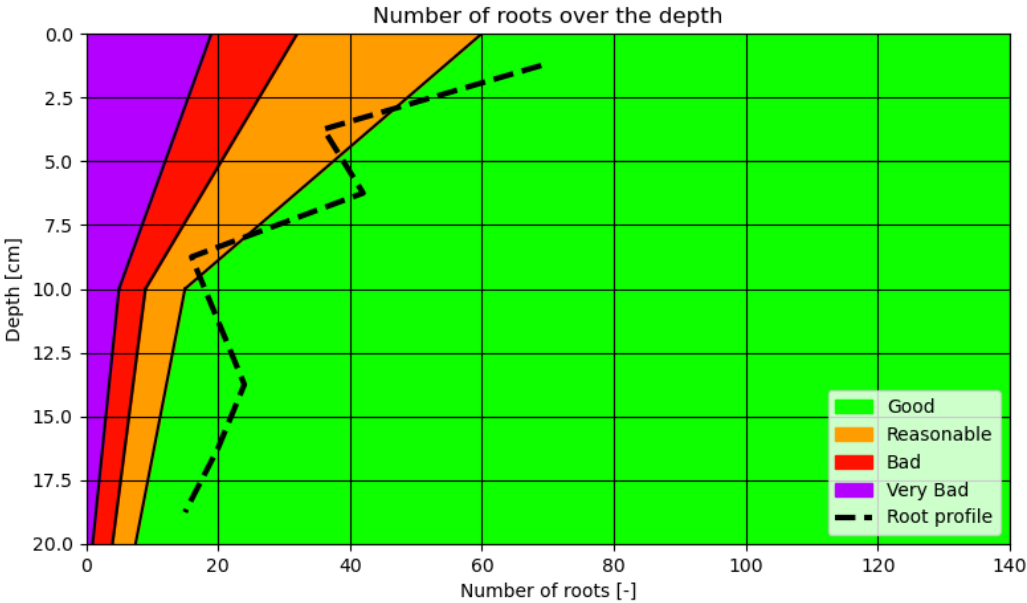


(c) Bottom



(d) Right

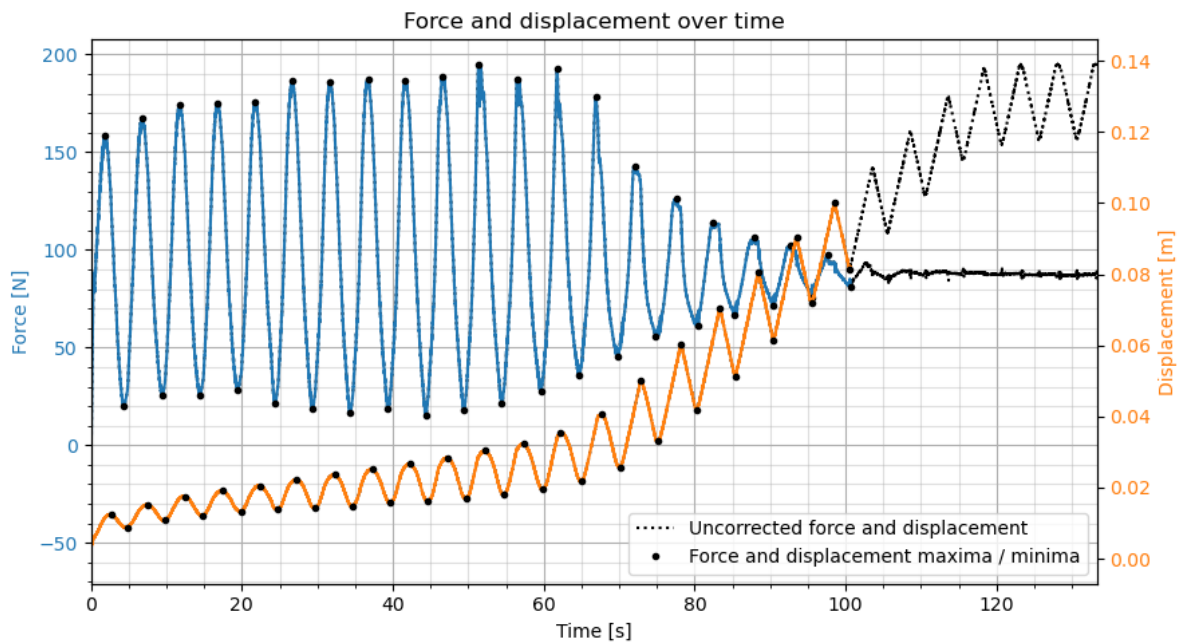
Root profile



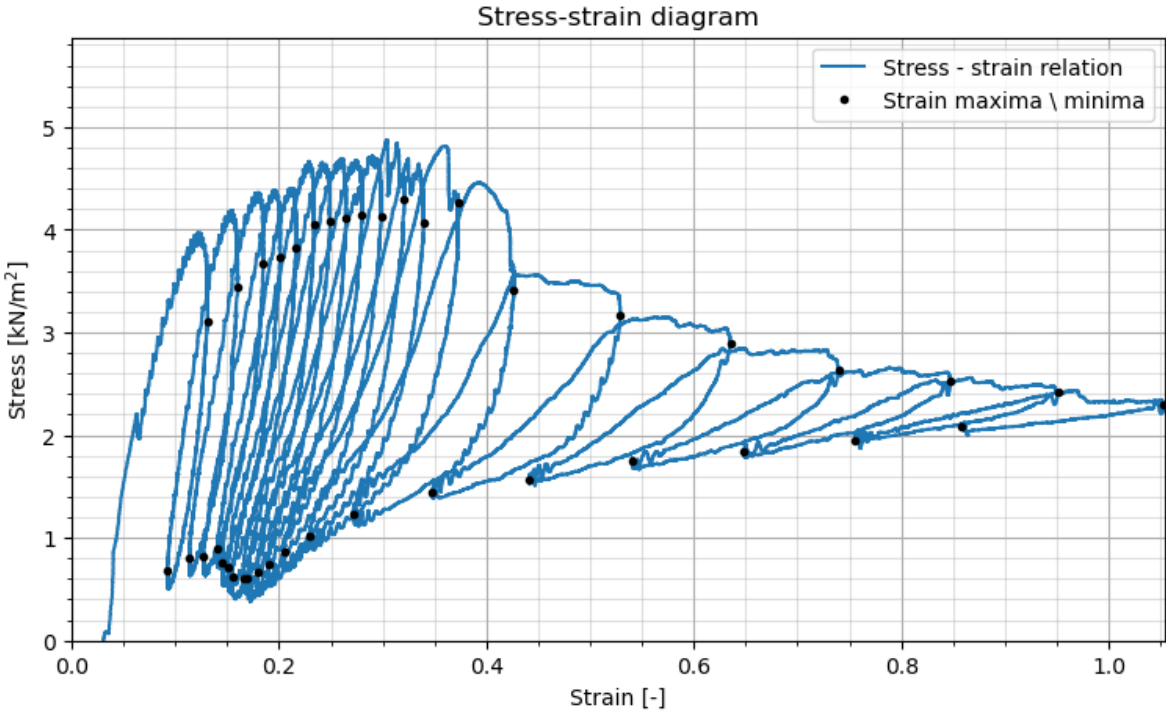
D.1.6. Test06

	Value 1	Value 2	Value 3	Mean
Date	05-03-2021			
Time	09:36:00			
Cyclic Load regime [N]	200			
Weight [kg]	10			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	80	10	10	
Sod thickness [cm]	10	8	7	10
Root length [cm]	6	6	3	5.7
Mean peak stress [kN/m ²]	4.03			
Maximum number of cycles [-]	21			
Comments	-			

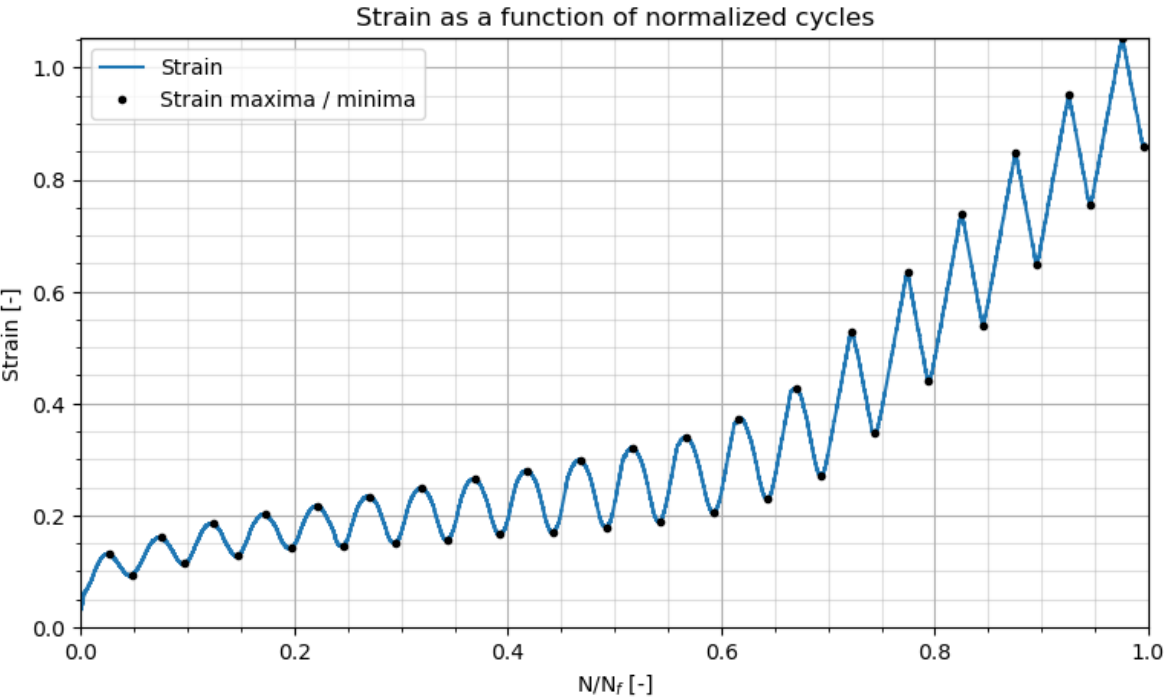
Force and displacement over time



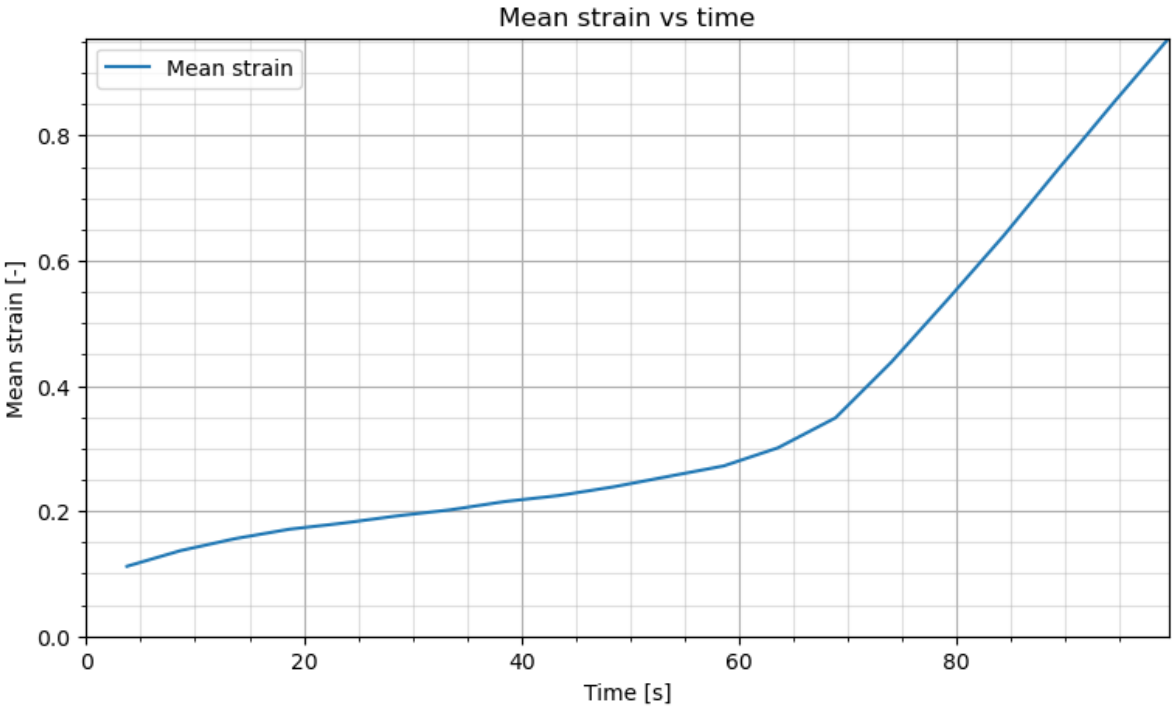
Stress-strain relation



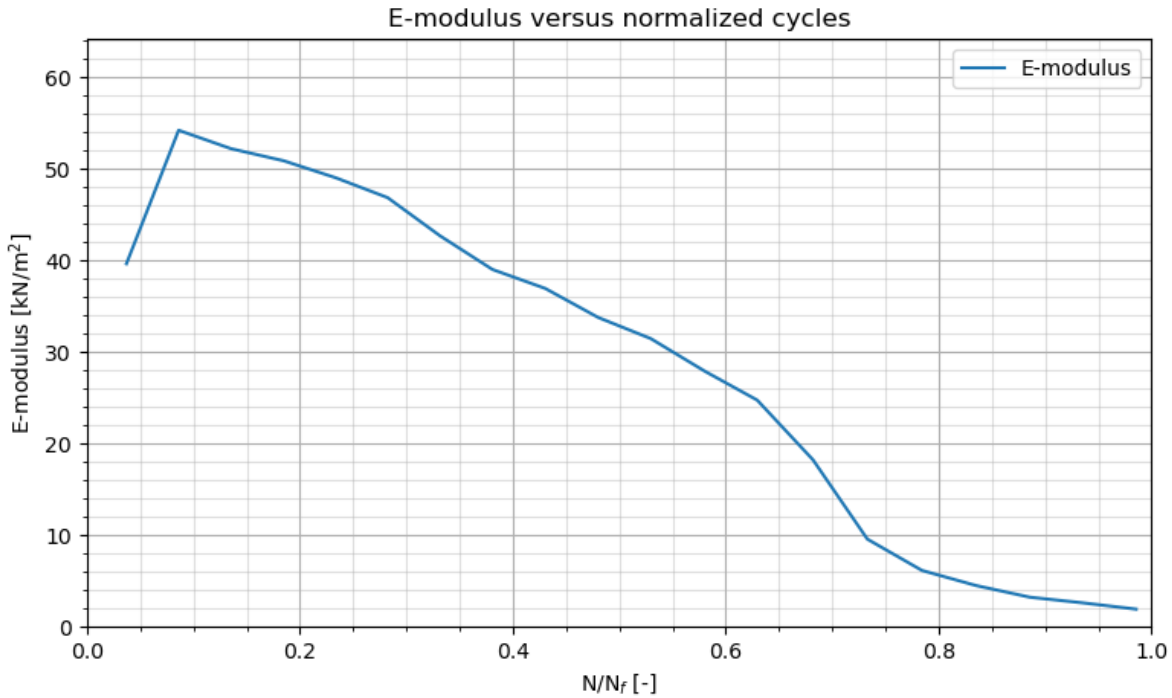
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

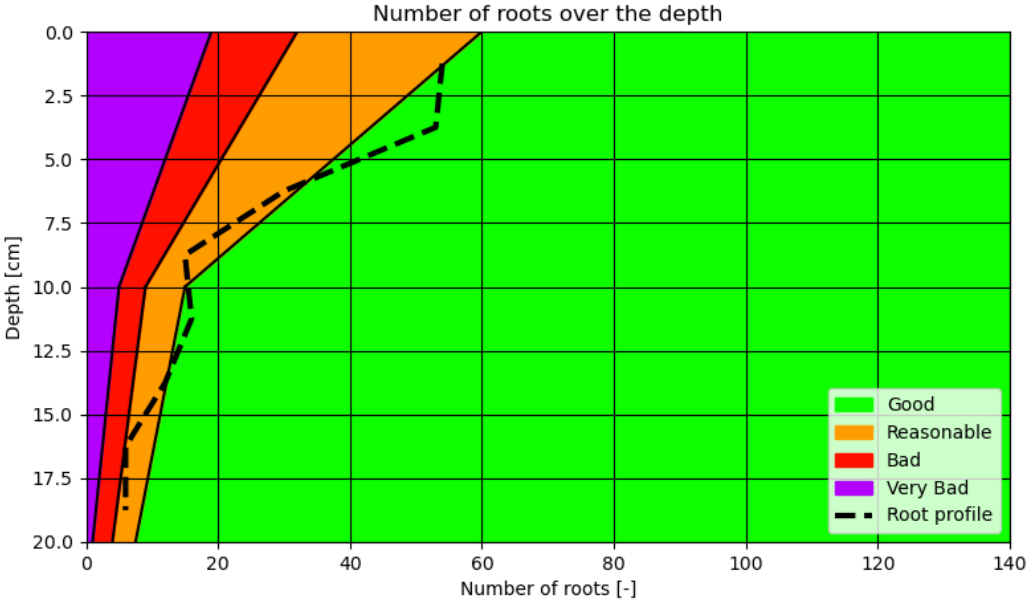


(c) Bottom



(d) Right

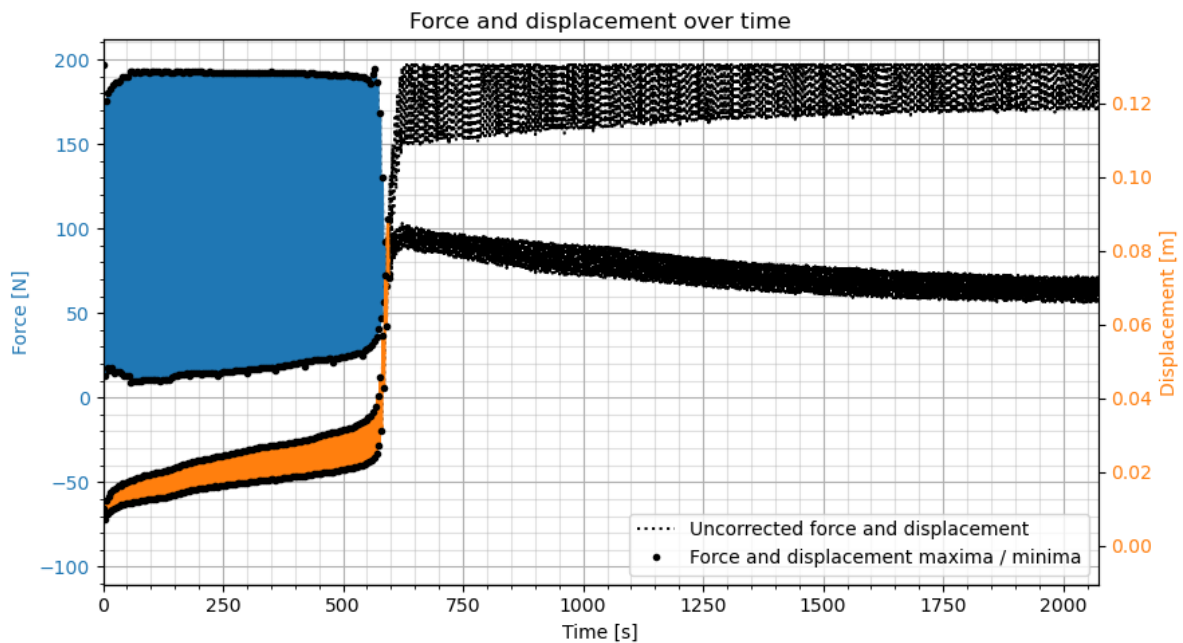
Root profile



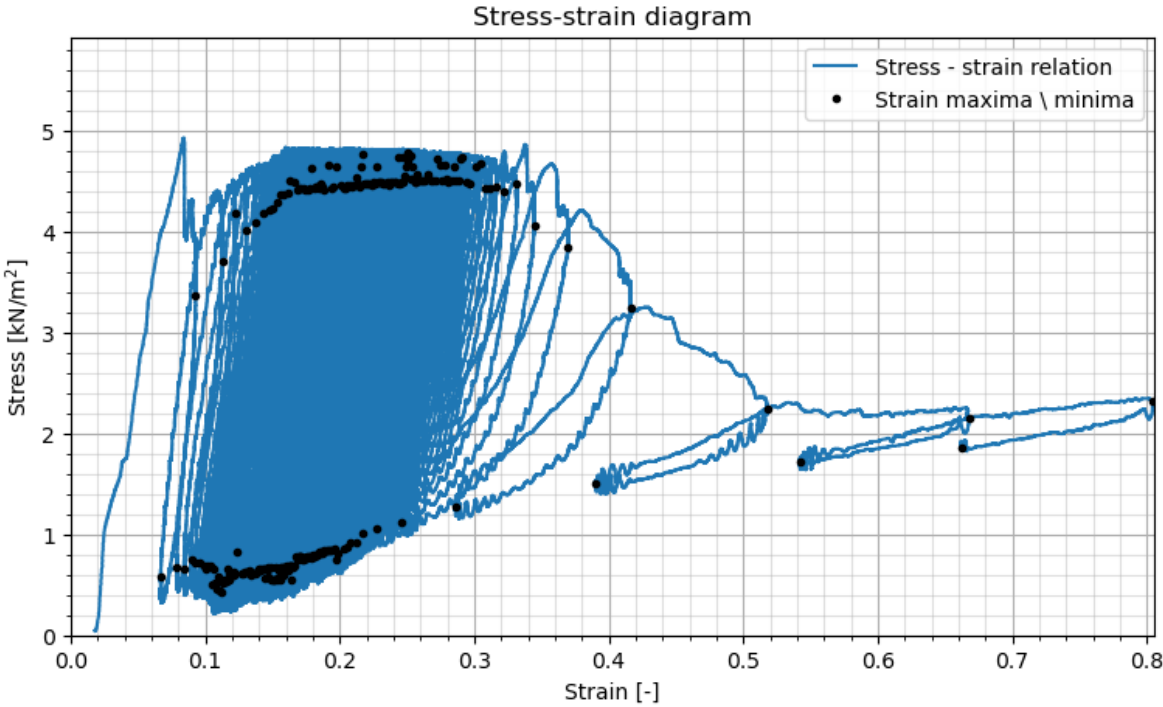
D.1.7. Test07

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		09:50:00			
Cyclic Load regime	[N]	200			
Weight	[kg]	12			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	60	30	10	
Sod thickness	[cm]	12	10	8	11
Root length	[cm]	5	4	5	4.7
Mean peak stress	[kN/m ²]	4.72			
Maximum number of cycles	[-]	120			
Comments		-			

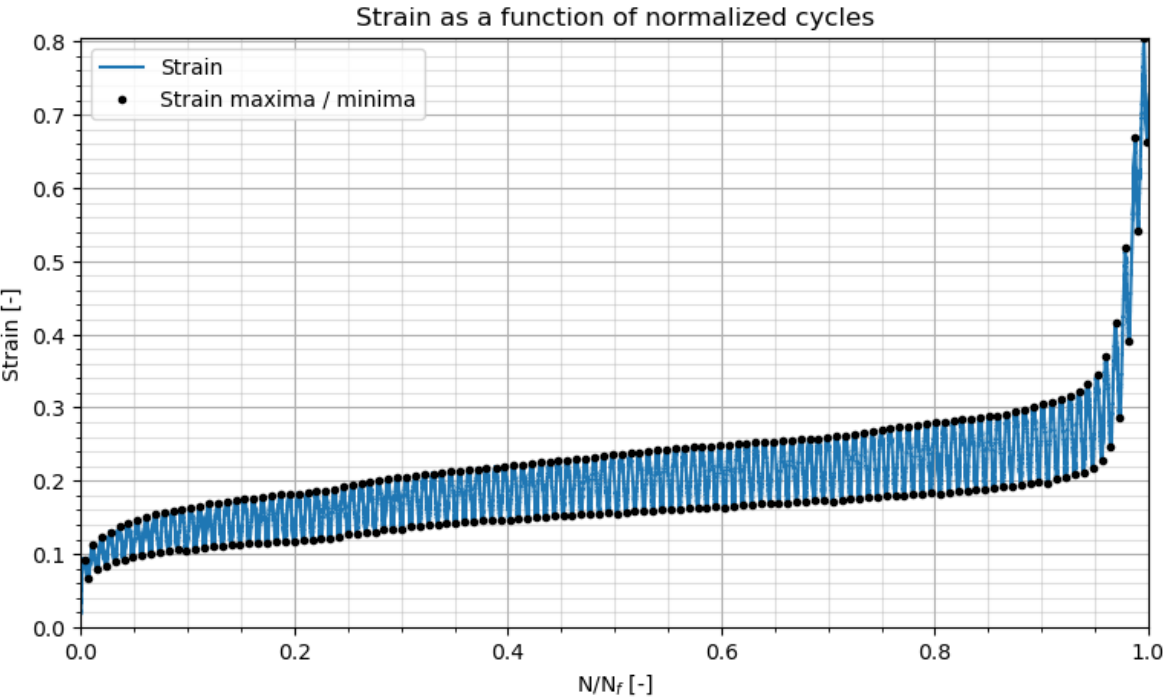
Force and displacement over time



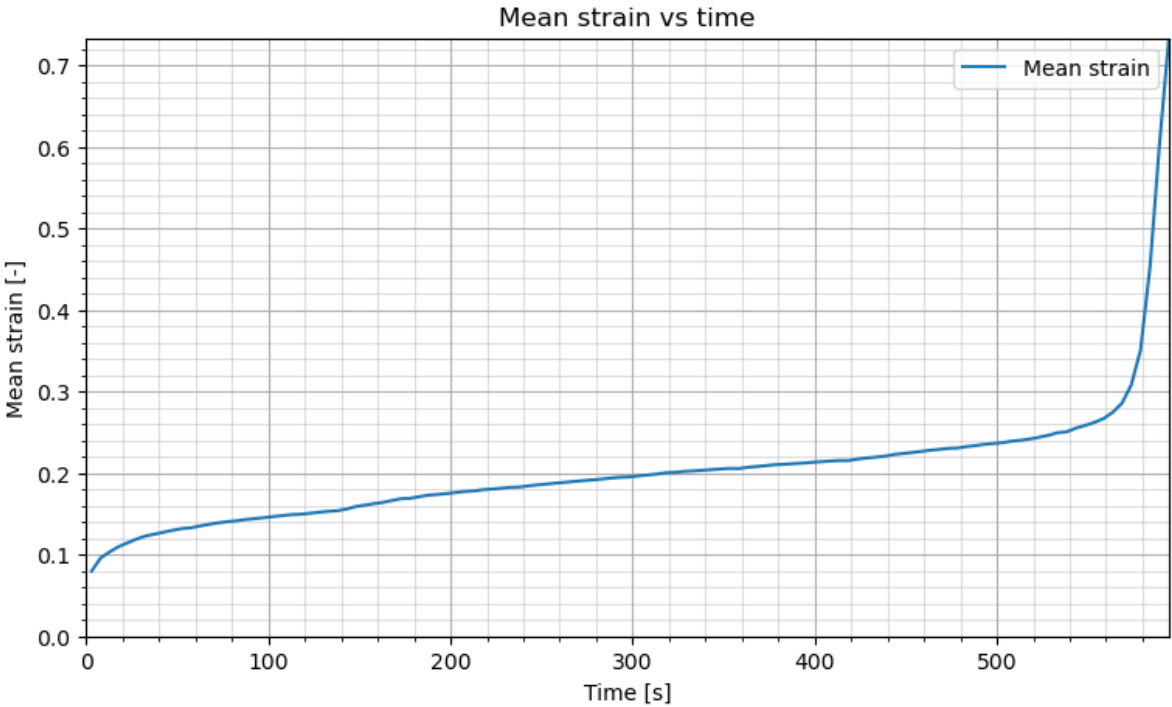
Stress-strain relation



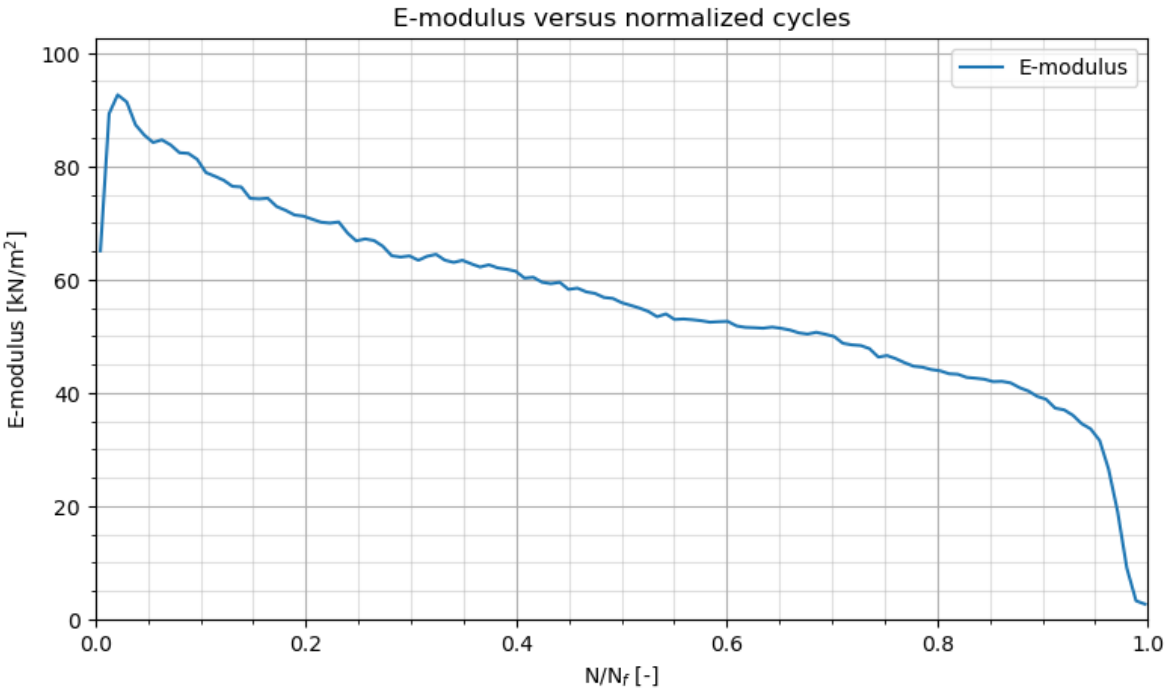
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

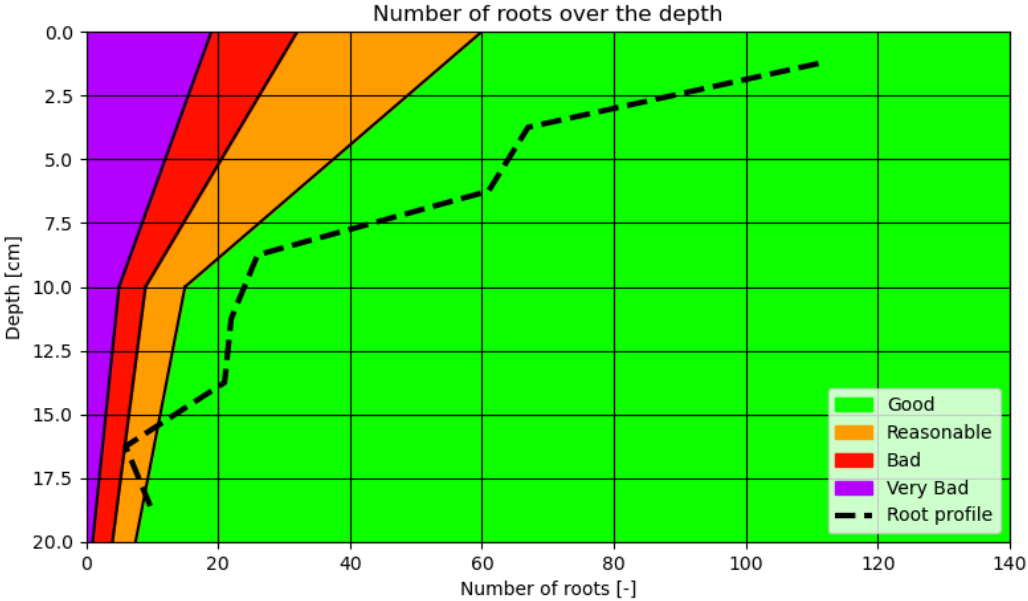


(c) Bottom



(d) Right

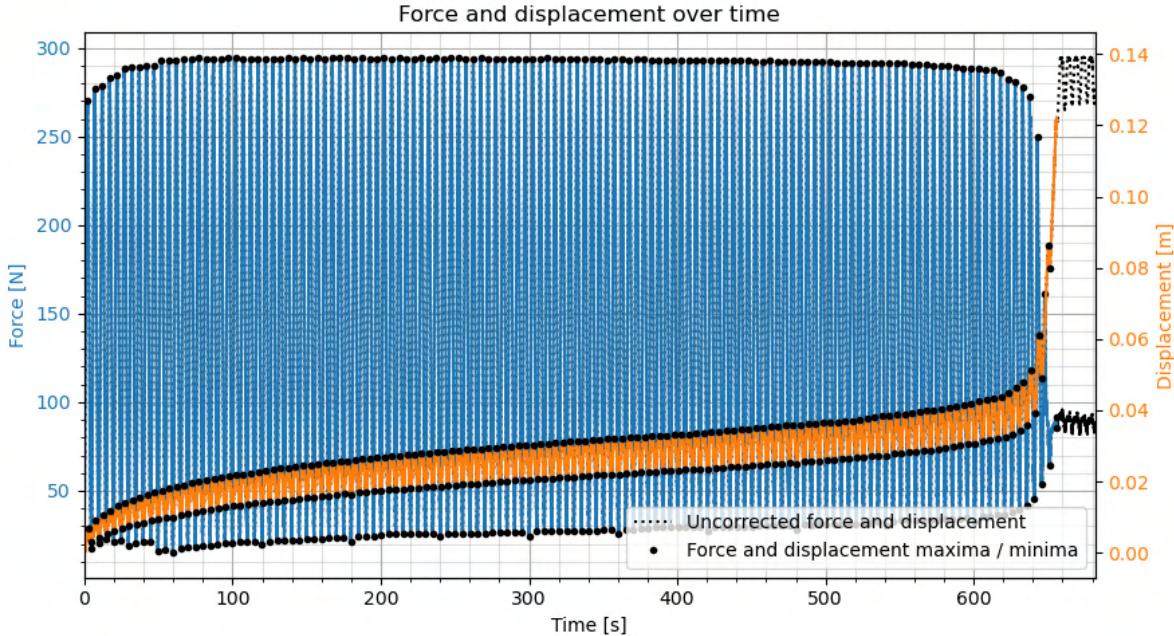
Root profile



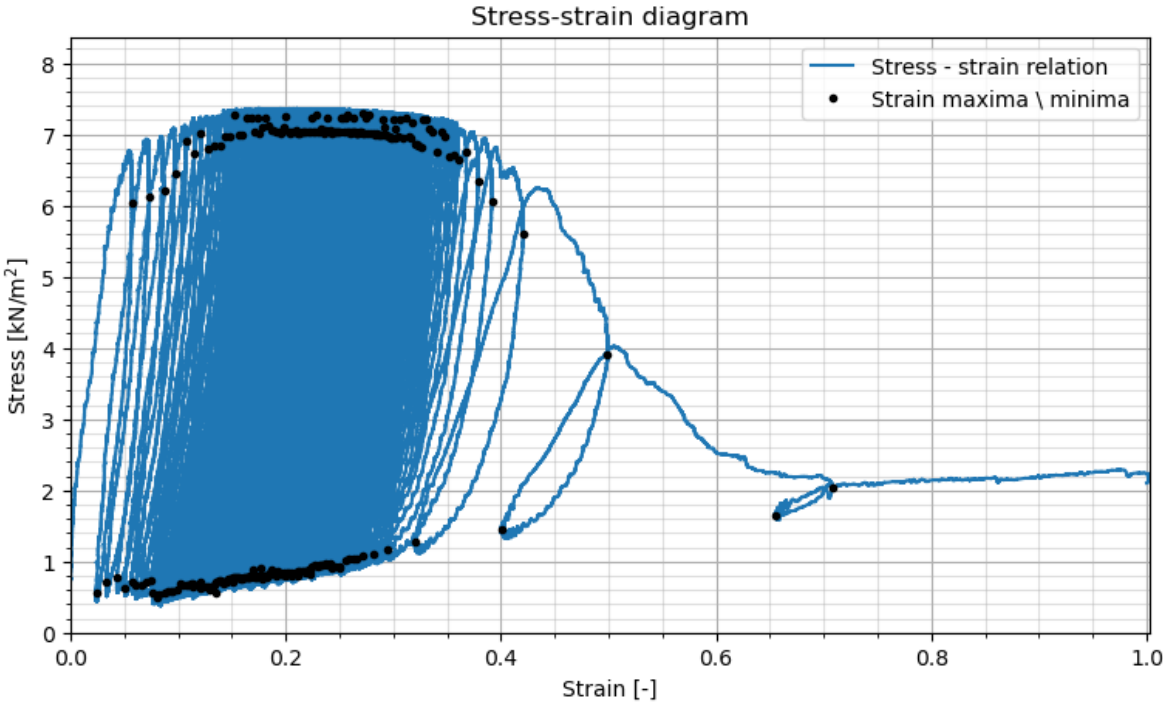
D.1.8. Test08

	Value 1	Value 2	Value 3	Mean
Date	05-03-2021			
Time	10:51:00			
Cyclic Load regime [N]	300			
Weight [kg]	14			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	60	20	20	
Sod thickness [cm]	14	10	9	12
Root length [cm]	5	7	6	5.6
Mean peak stress [kN/m ²]	7.22			
Maximum number of cycles [-]	132			
Comments	-			

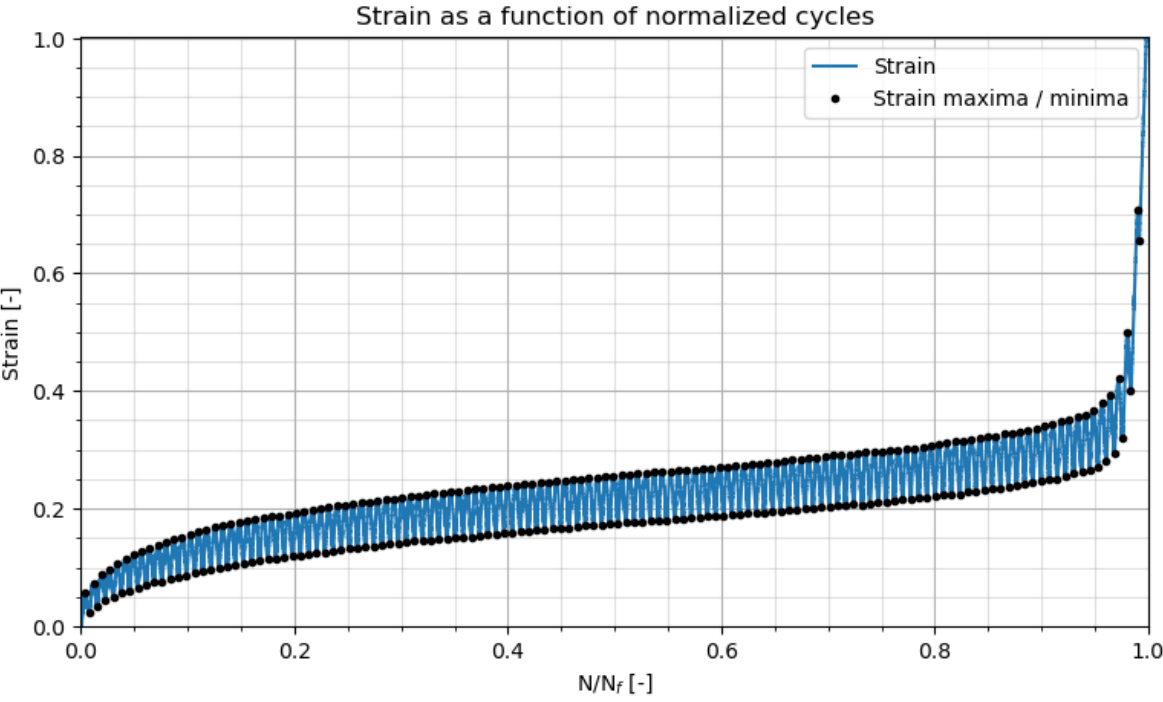
Force and displacement over time



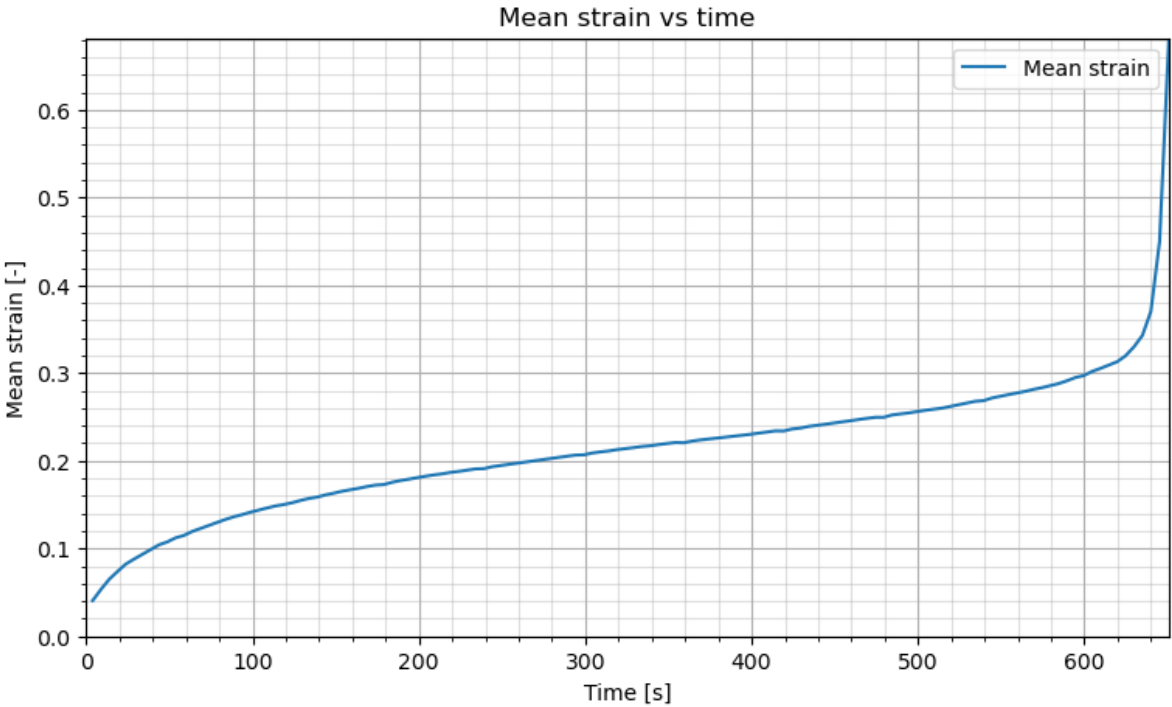
Stress-strain relation



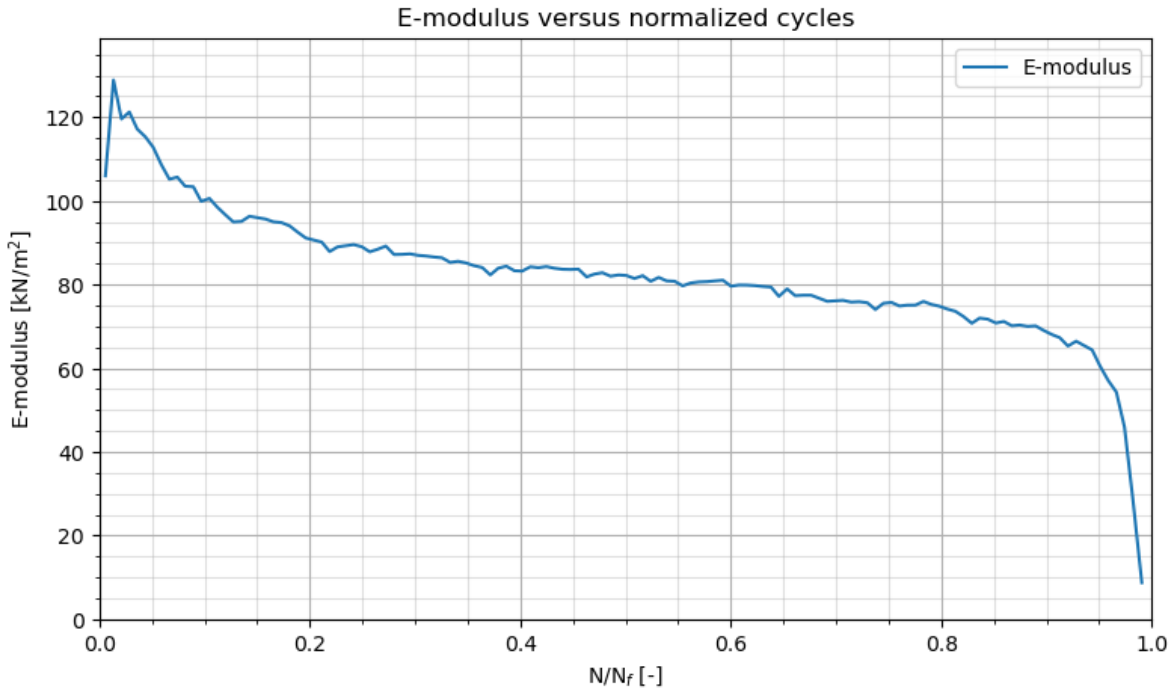
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

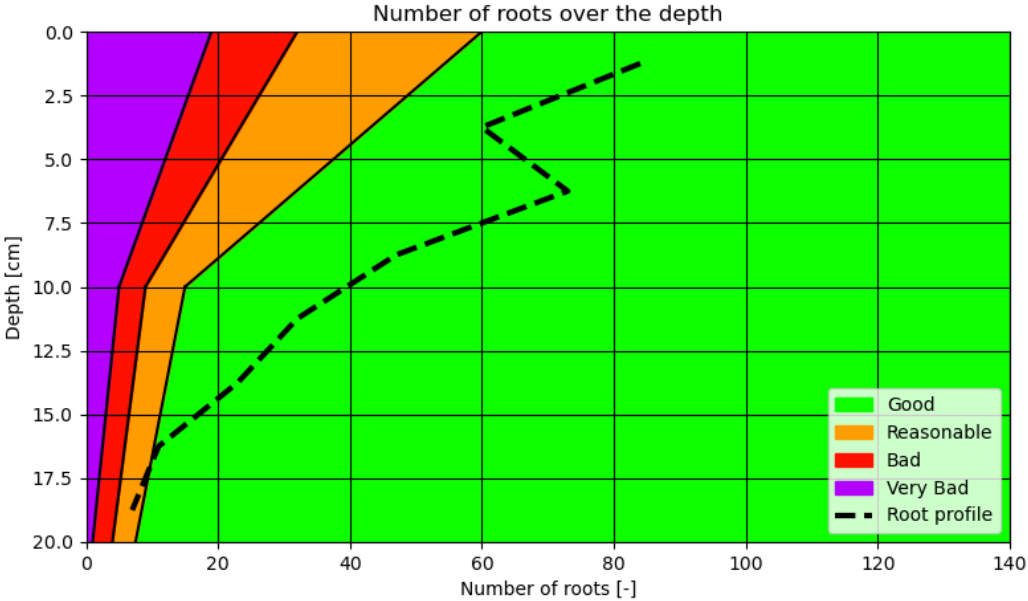


(c) Bottom



(d) Right

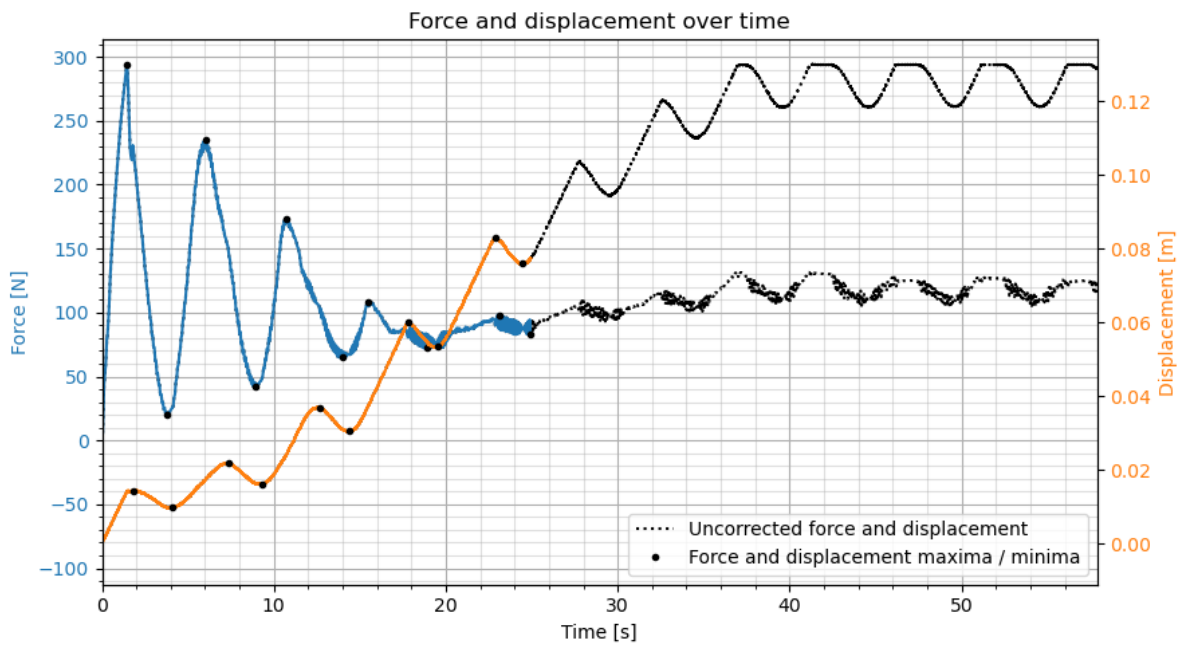
Root profile



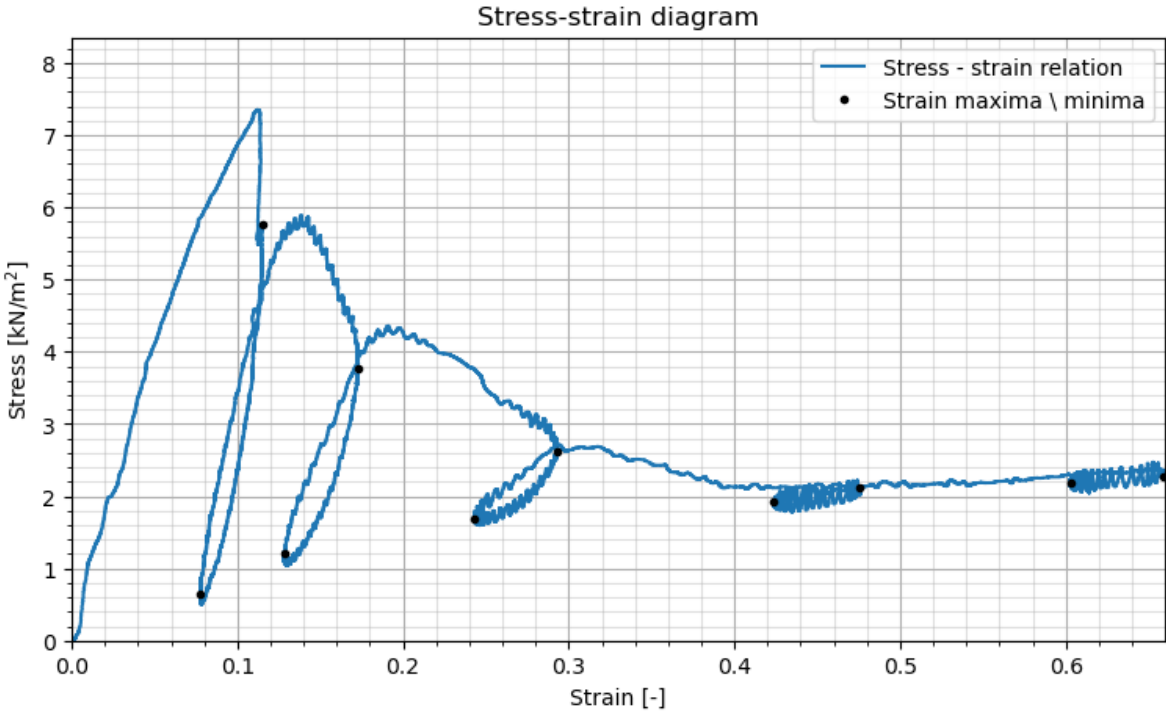
D.1.9. Test09

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		11:33:00			
Cyclic Load regime	[N]	300			
Weight	[kg]	14			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	20	60	20	
Sod thickness	[cm]	14	13	10	13
Root length	[cm]	4	4	3	3.8
Mean peak stress	[kN/m ²]	4.54			
Maximum number of cycles	[-]	5			
Comments		-			

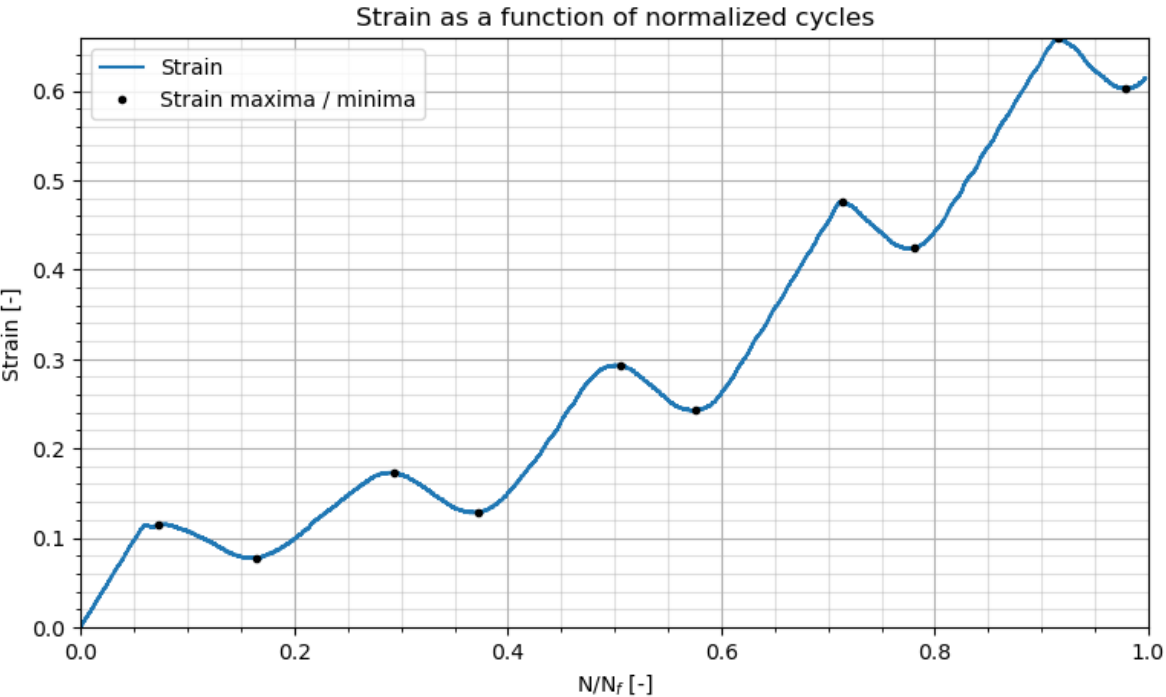
Force and displacement over time



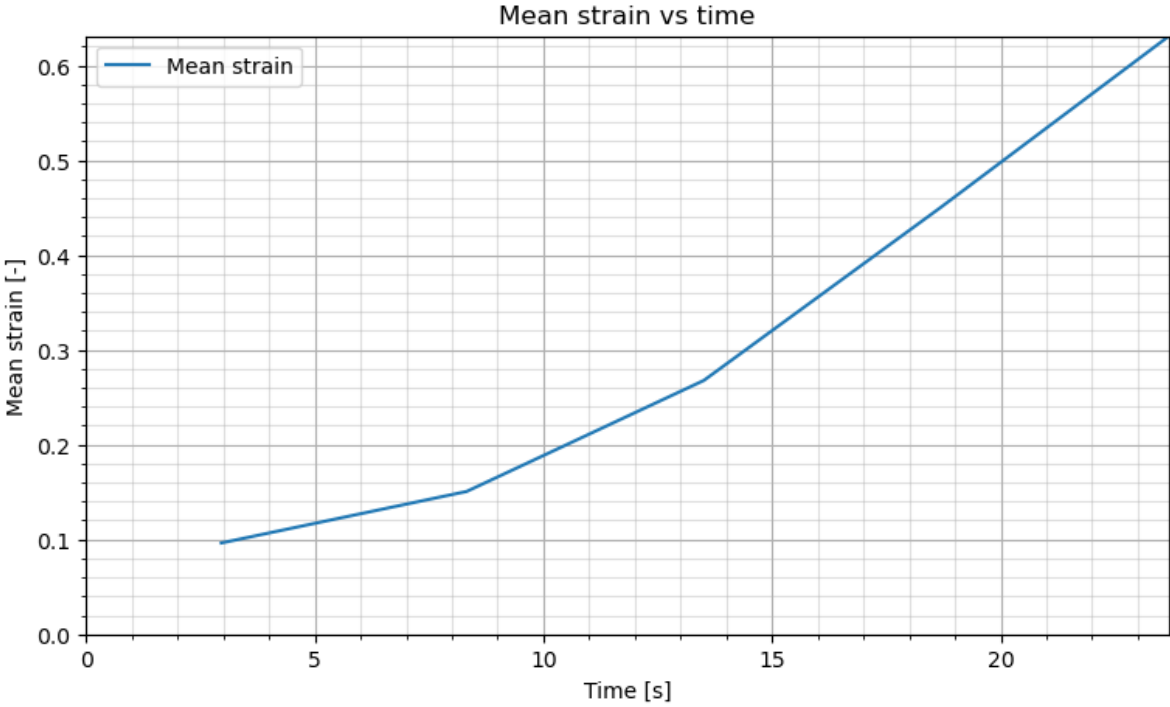
Stress-strain relation



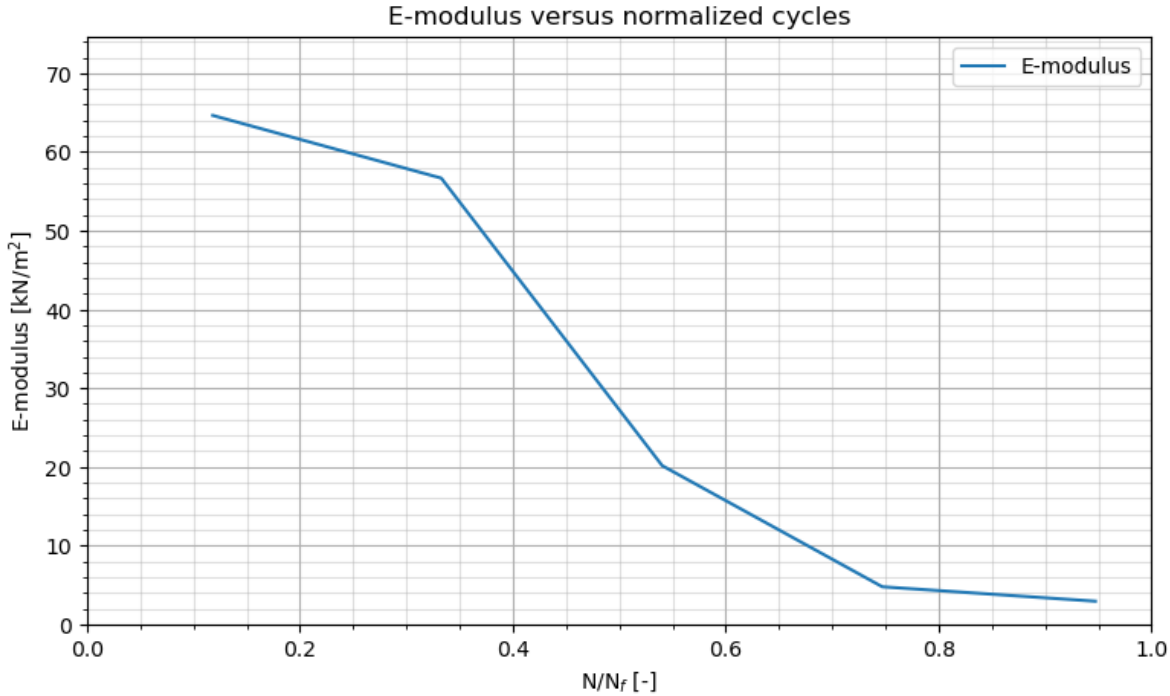
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left

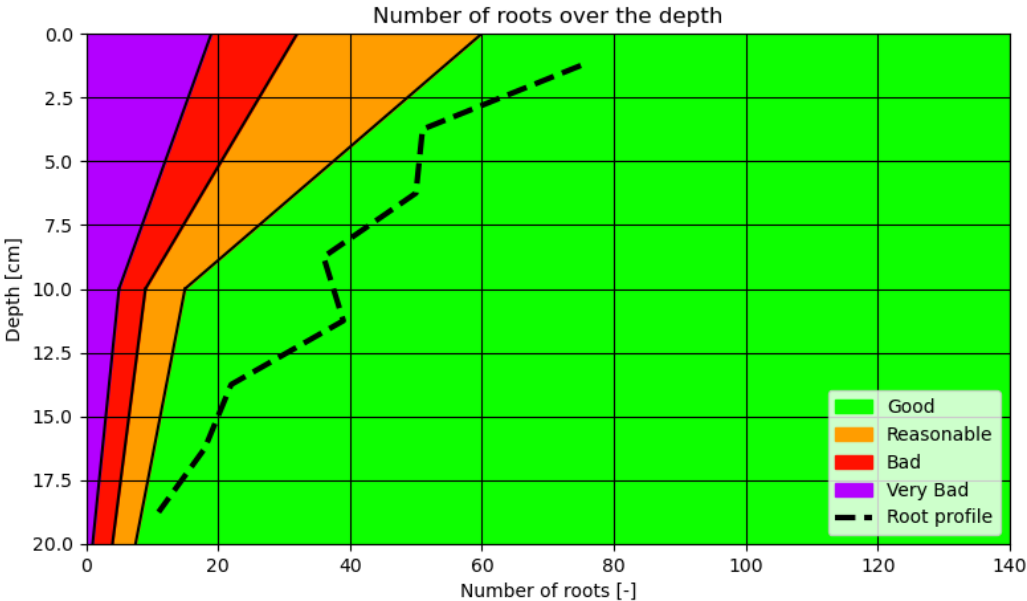


(c) Bottom



(d) Right

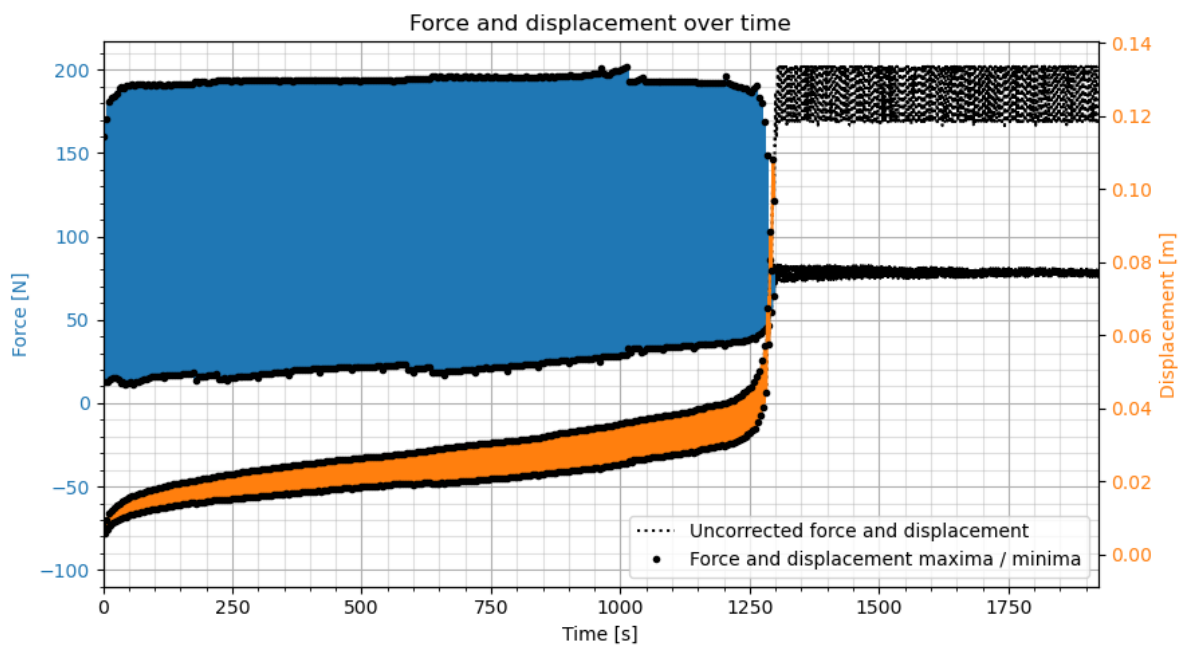
Root profile



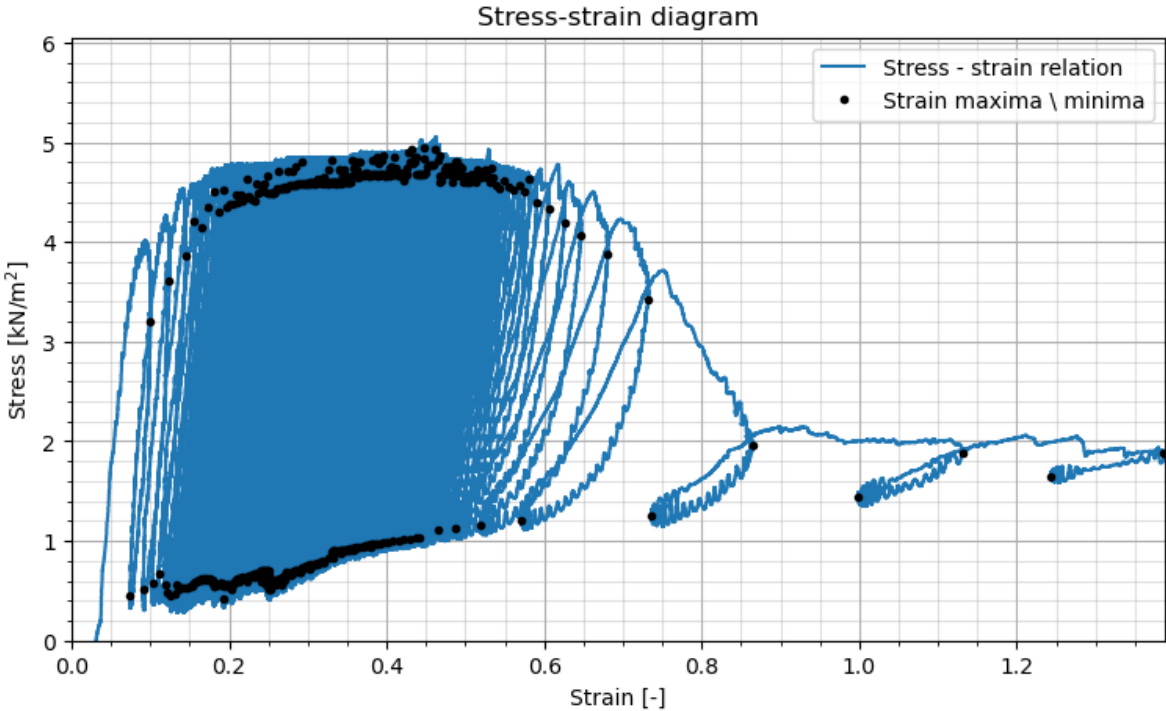
D.1.10. Test10

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		11:54:00			
Cyclic Load regime	[N]	200			
Weight	[kg]	9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	60	20	20	
Sod thickness	[cm]	9	7	5	8
Root length	[cm]	6	5	6	5.8
Mean peak stress	[kN/m ²]	4.81			
Maximum number of cycles	[-]	260			
Comments		-			

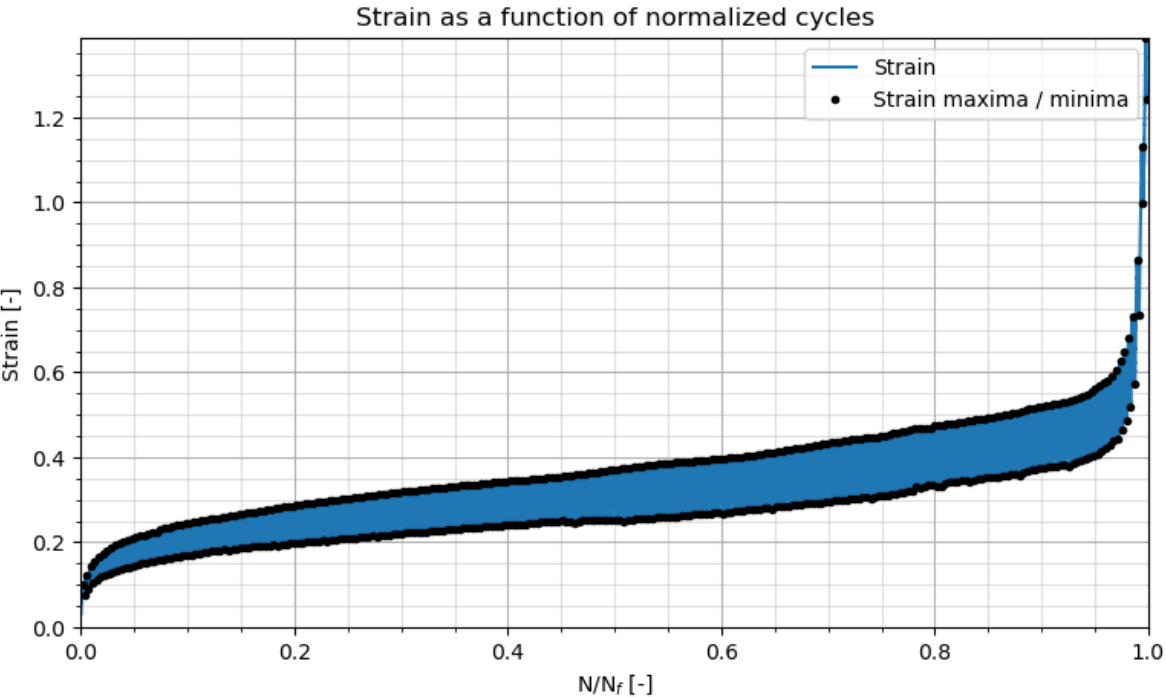
Force and displacement over time



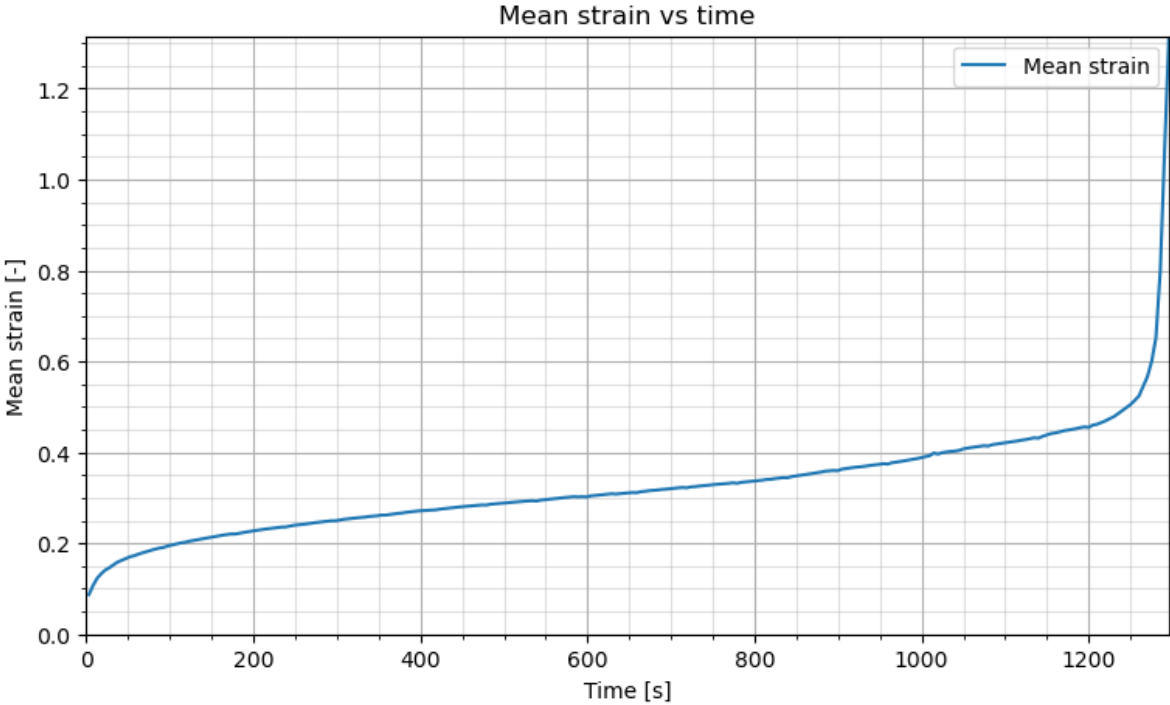
Stress-strain relation



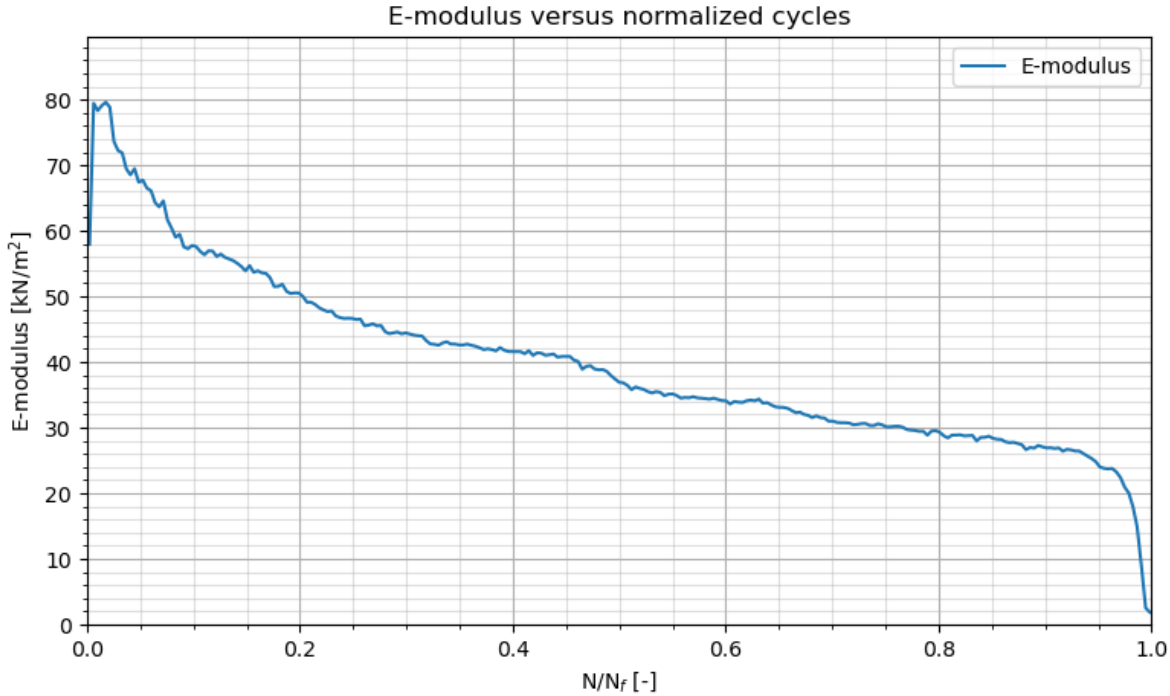
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

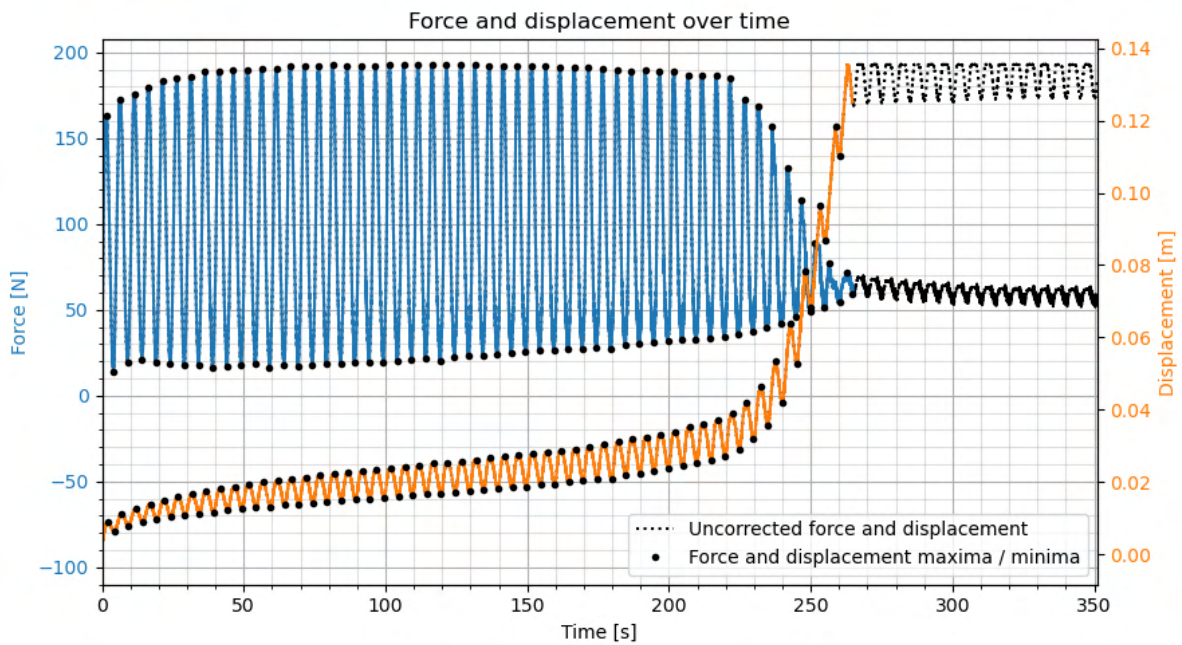


(d) Right

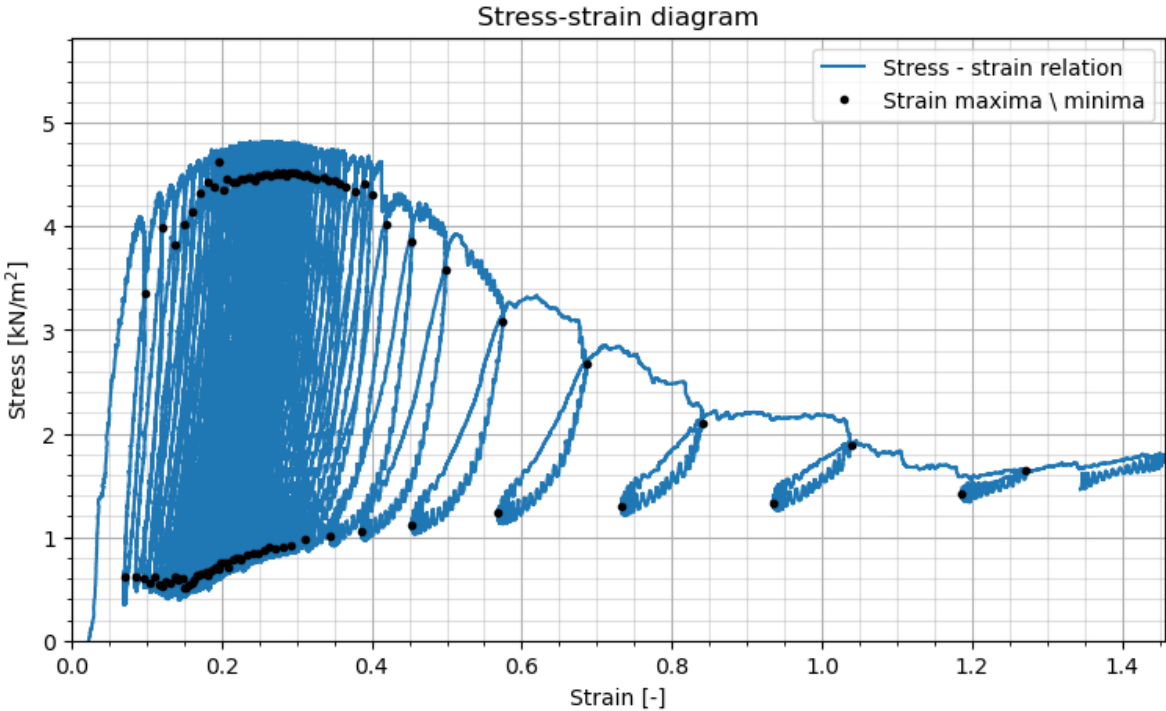
D.1.11. Test11

		Value 1	Value 2	Value 3	Mean
Date		05-03-2021			
Time		13:16:00			
Cyclic Load regime	[N]	200			
Weight	[kg]	10			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	80	10	10	
Sod thickness	[cm]	10	7	6	9
Root length	[cm]	7	11	5	7.2
Mean peak stress	[kN/m ²]	4.47			
Maximum number of cycles	[-]	53			
Comments		-			

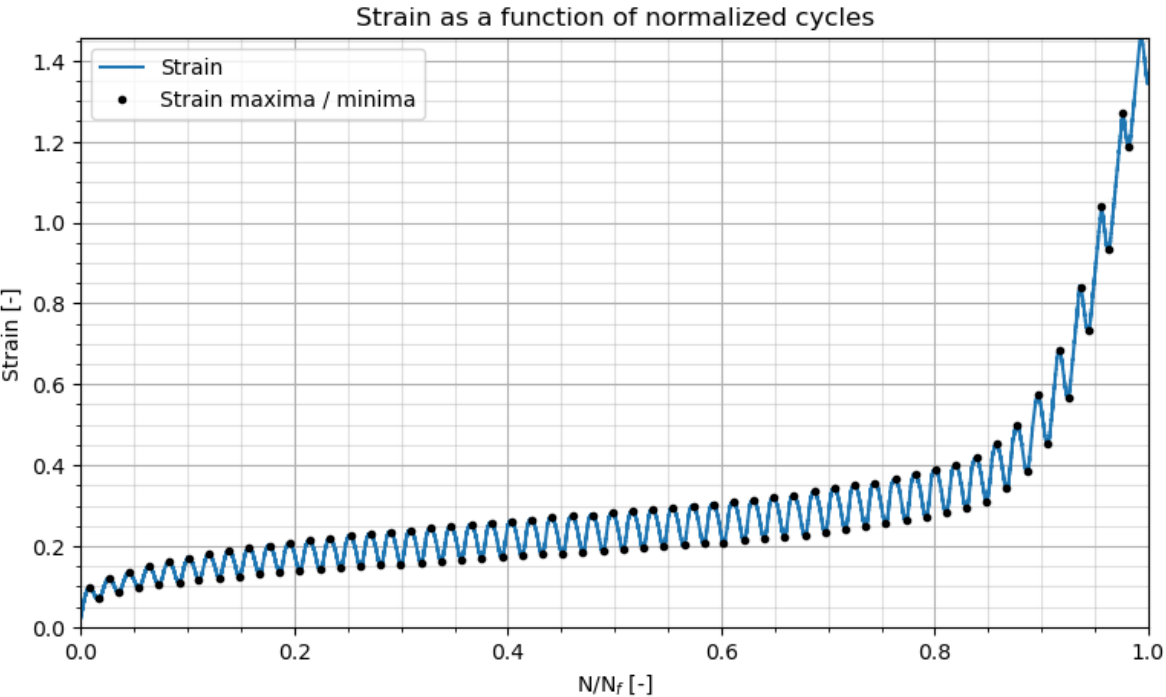
Force and displacement over time



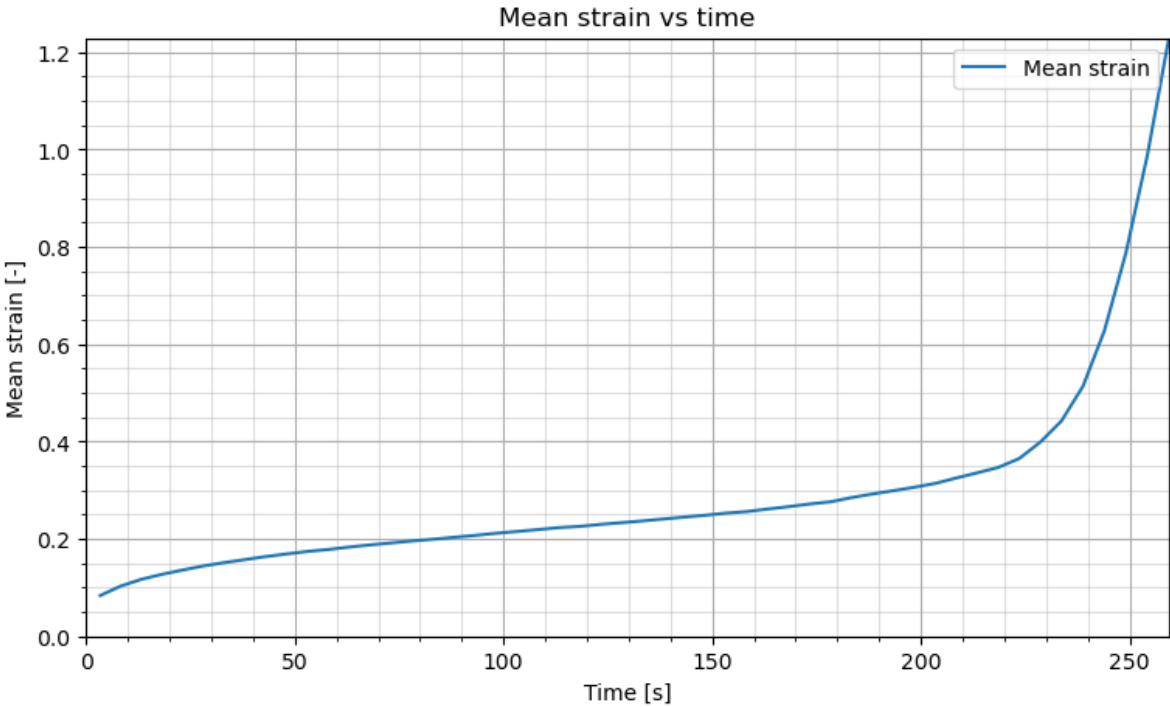
Stress-strain relation



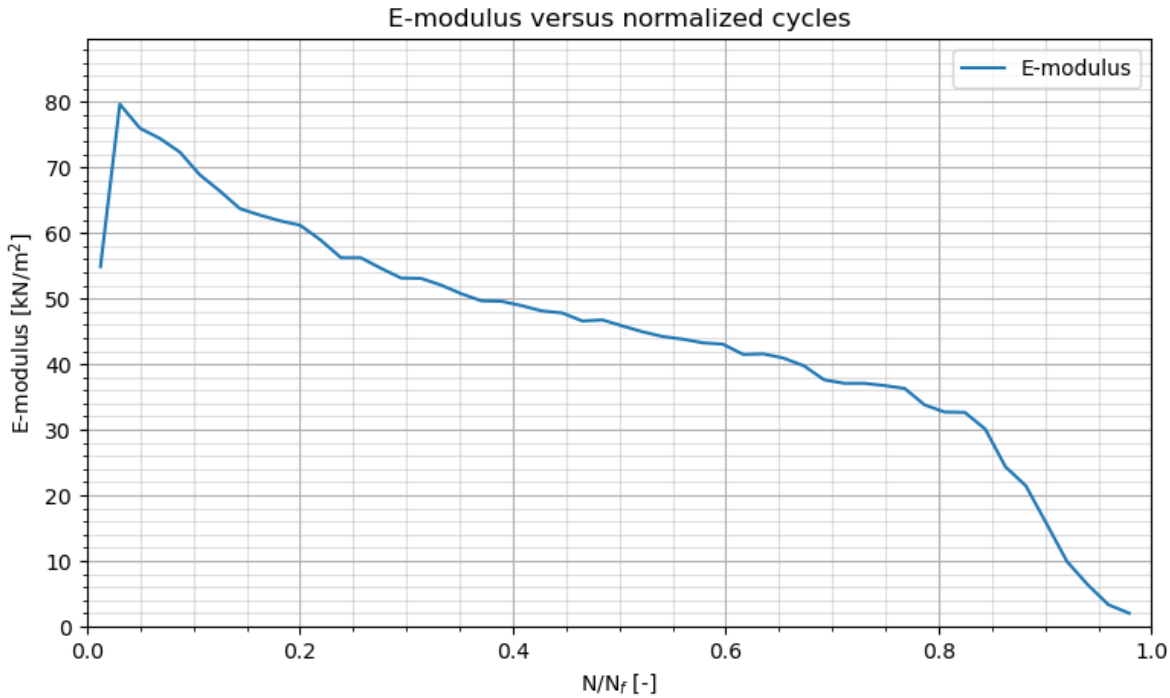
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

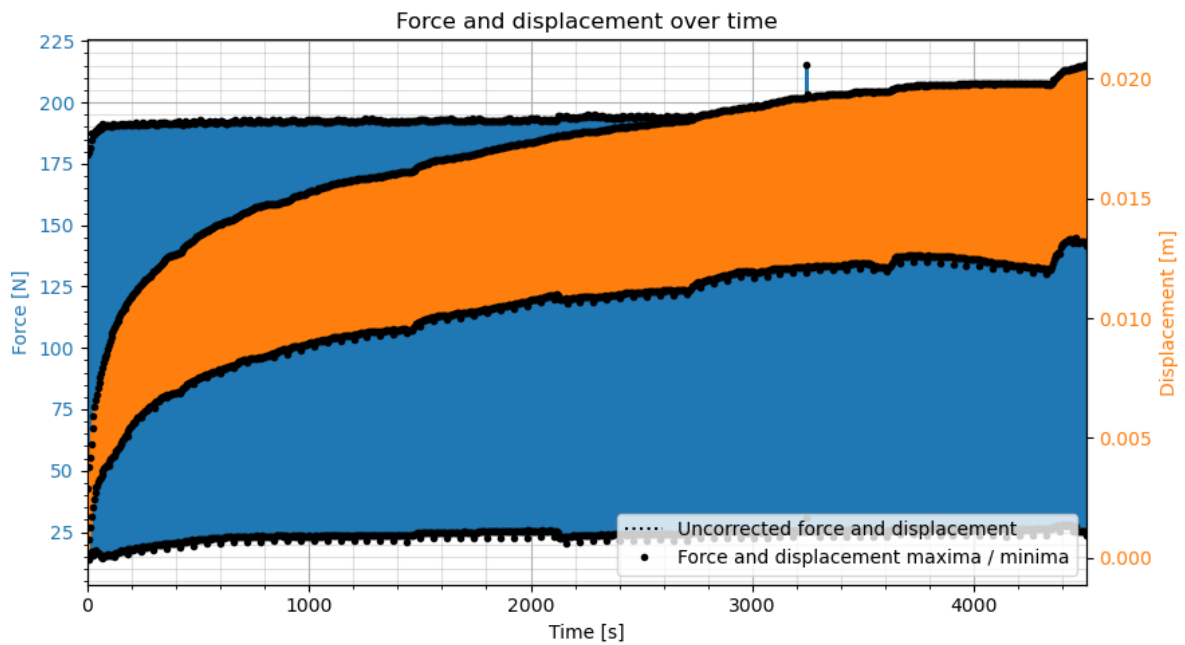


(d) Right

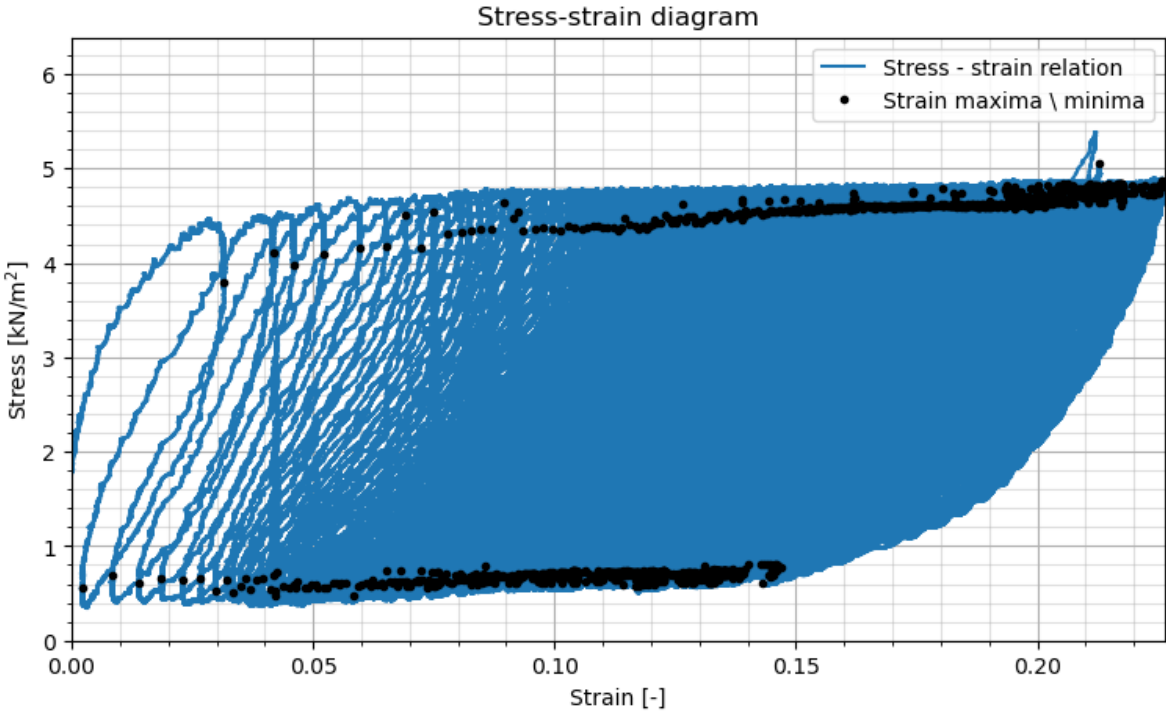
D.1.12. Test13

		Value 1	Value 2	Value 3	Mean
Date		12-03-2021			
Time		09:05:00			
Cyclic Load regime	[N]	200			
Weight	[kg]	10			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	70	20	10	
Sod thickness	[cm]	10	8	5	9
Root length	[cm]	7	9	6	7.3
Mean peak stress	[kN/m ²]	4.83			
Maximum number of cycles	[-]	902			
Comments		Did not fail			

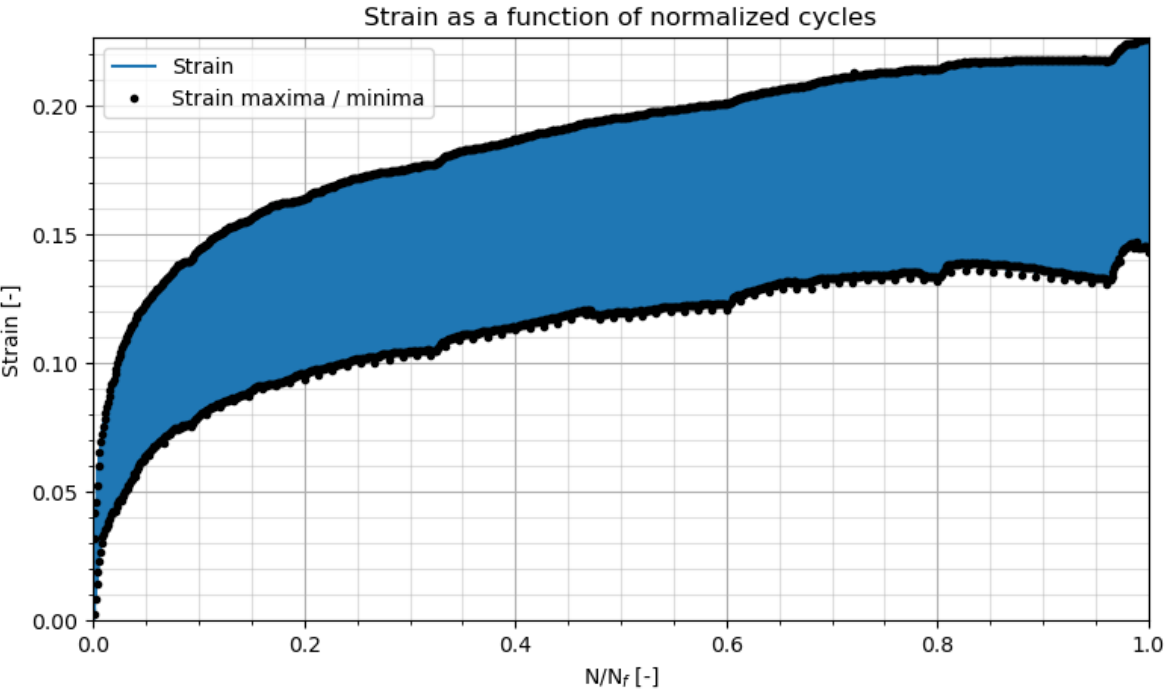
Force and displacement over time



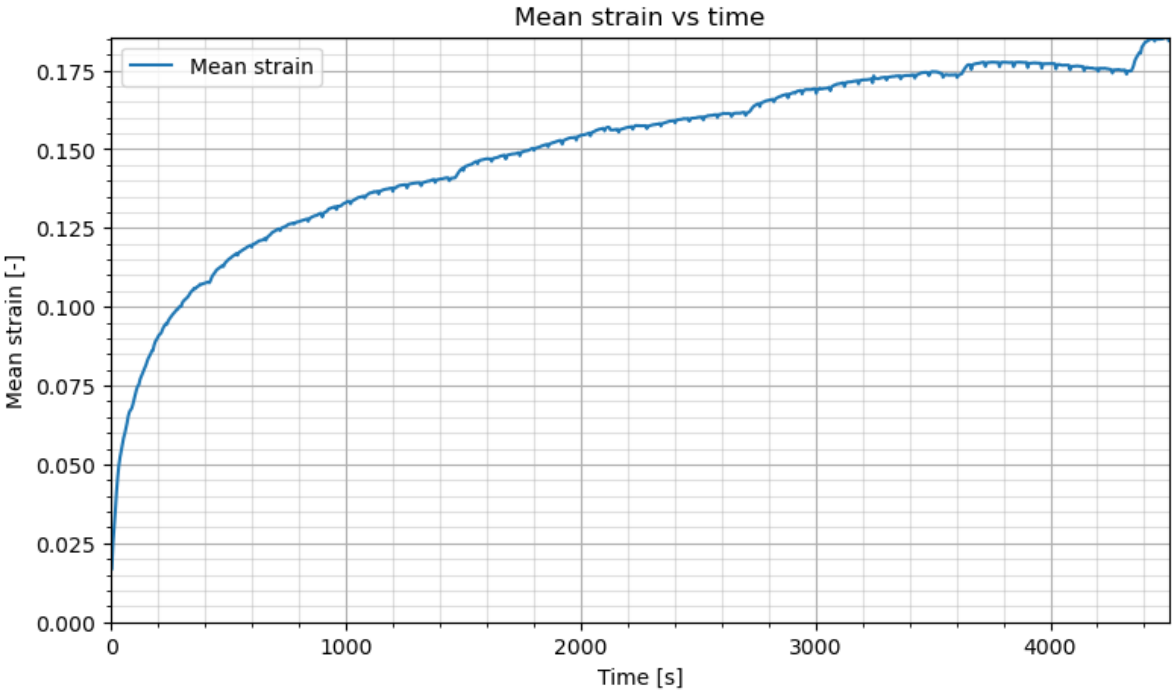
Stress-strain relation



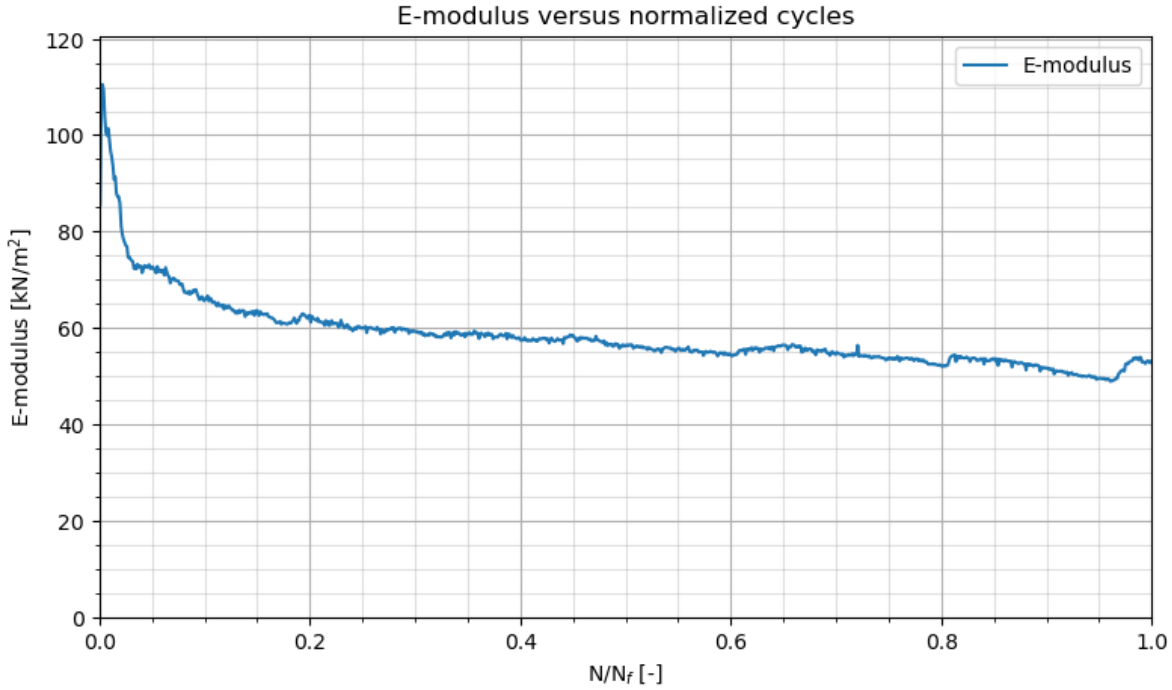
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

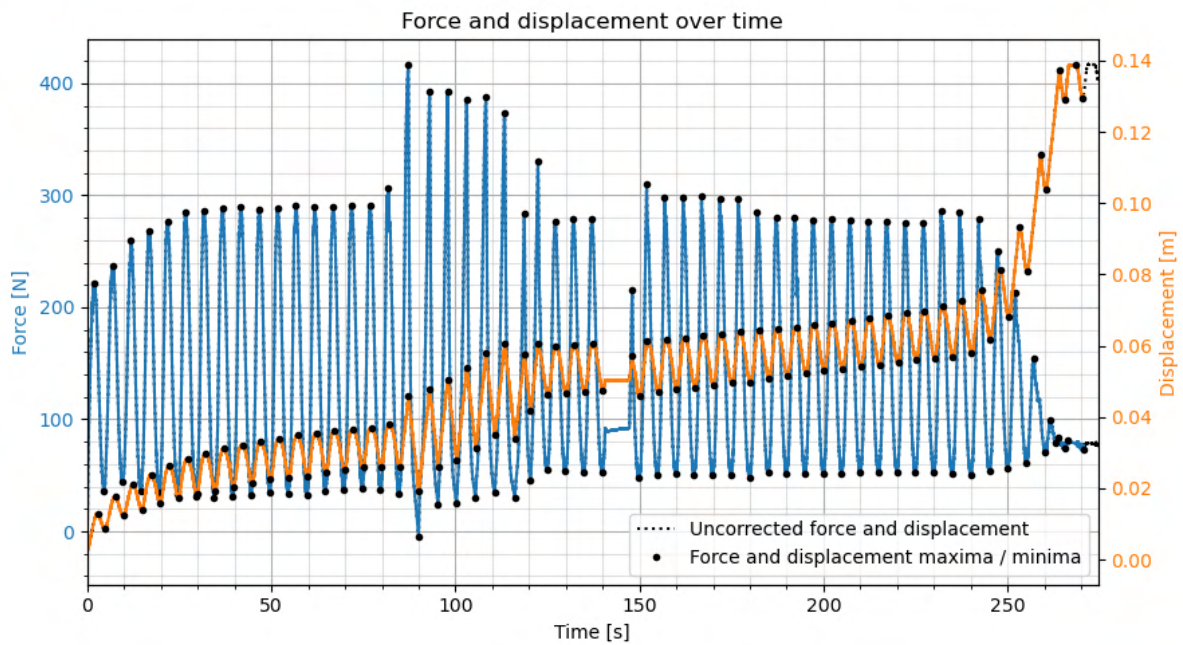


(d) Right

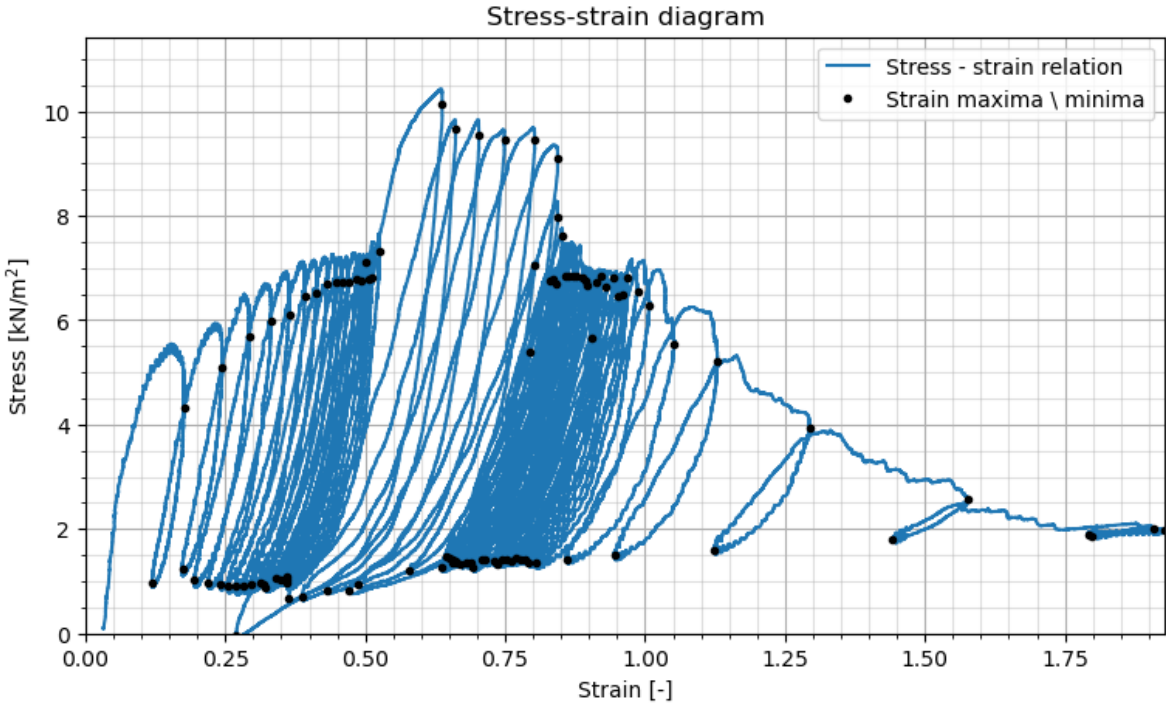
D.1.13. Test14

	Value 1	Value 2	Value 3	Mean
Date	12-03-2021			
Time	10:28:00			
Cyclic Load regime [N]	300			
Weight [kg]	8			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	70	10	20	
Sod thickness [cm]	8	6	5	7
Root length [cm]	14	3	11	12.3
Mean peak stress [kN/m ²]	6.98			
Maximum number of cycles [-]	55			
Comments	-			

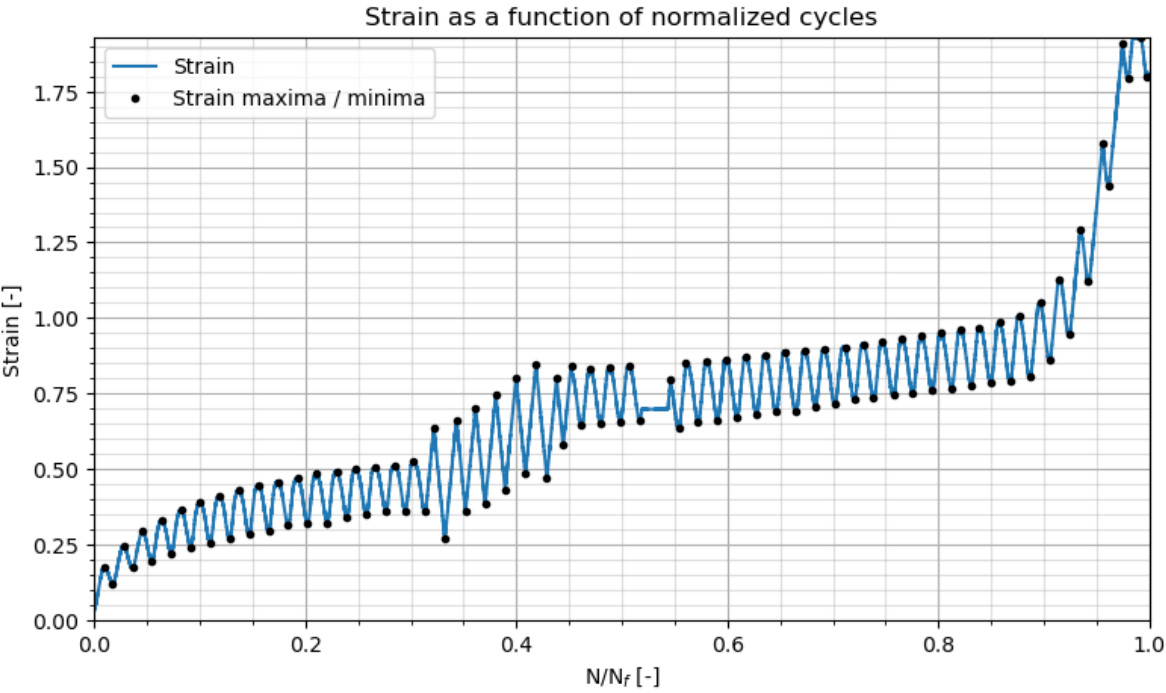
Force and displacement over time



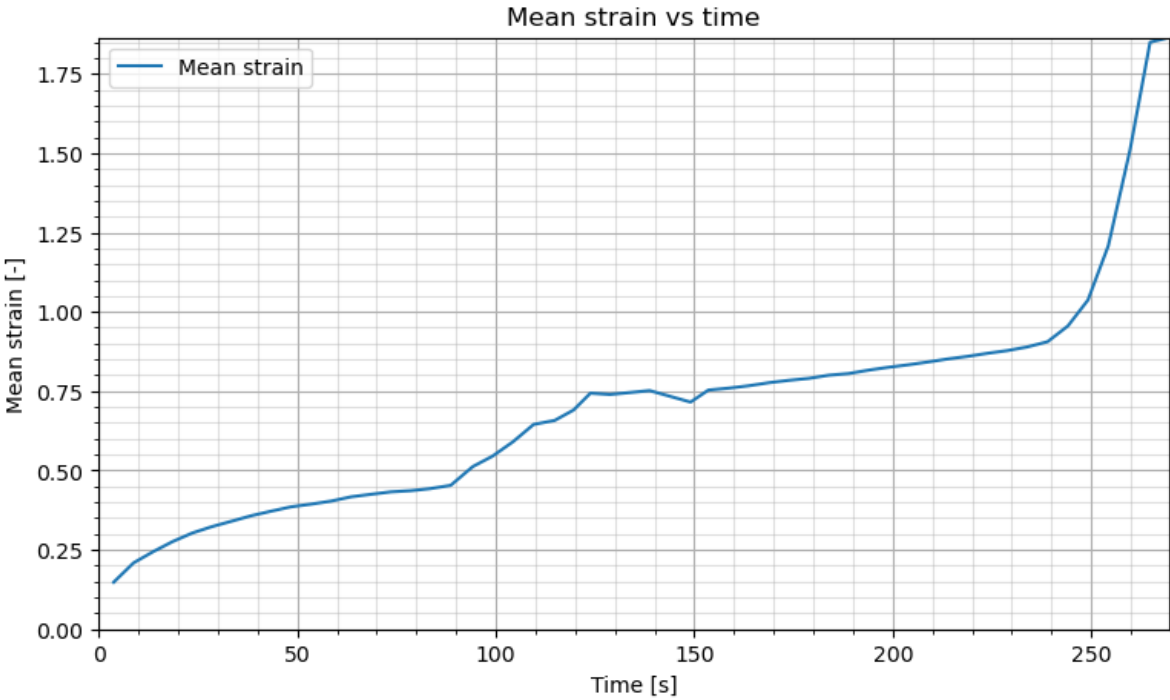
Stress-strain relation



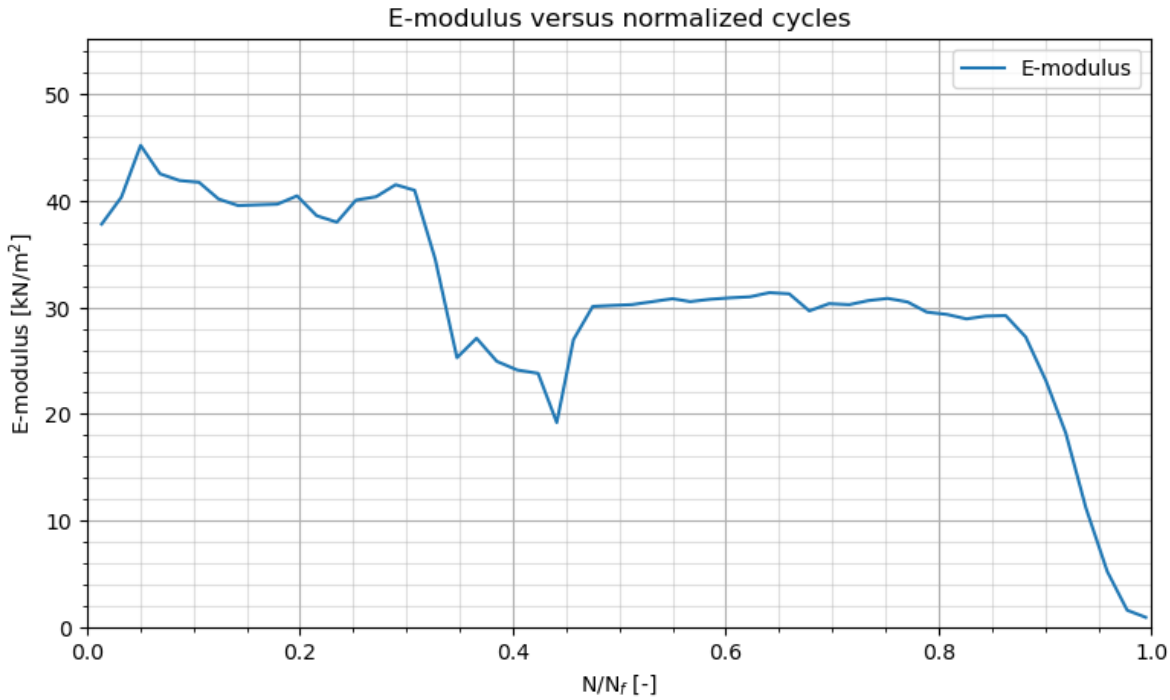
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

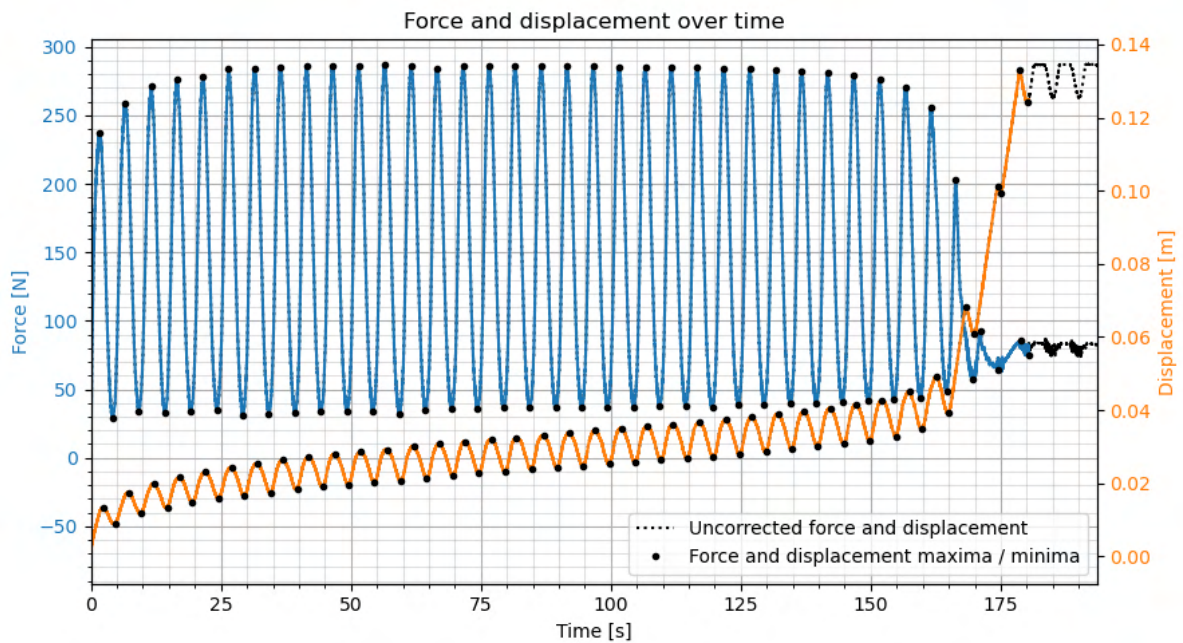


(d) Right

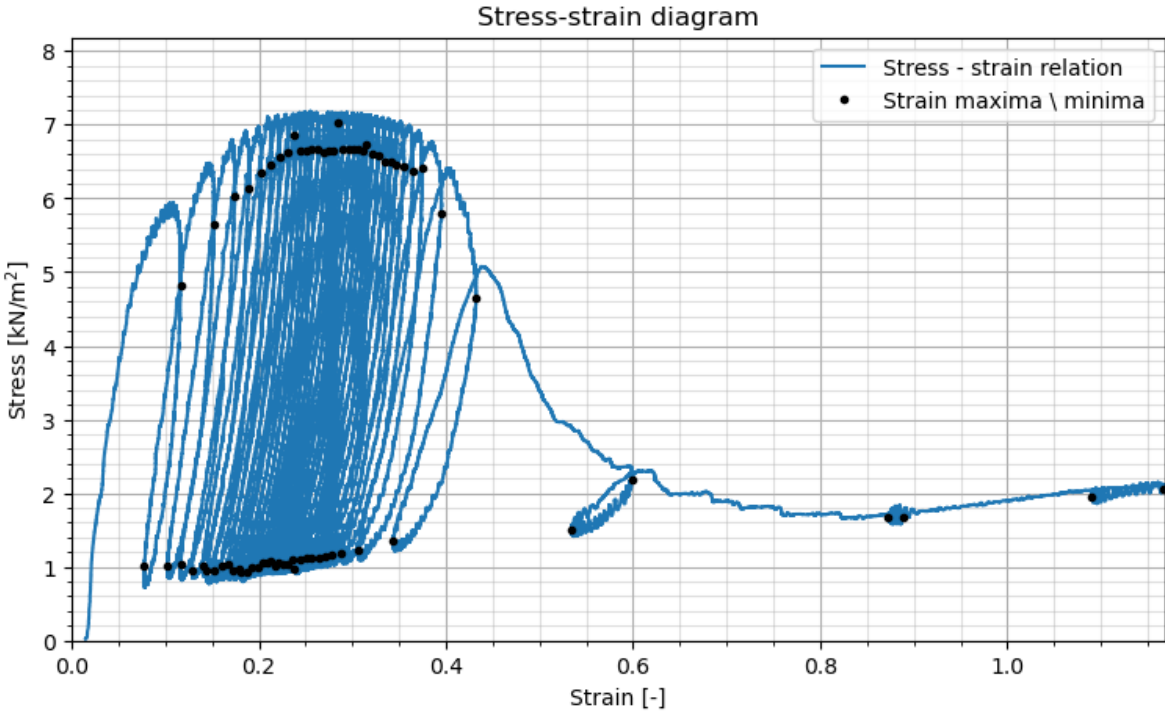
D.1.14. Test15

	Value 1	Value 2	Value 3	Mean
Date	12-03-2021			
Time	10:43:00			
Cyclic Load regime [N]	300			
Weight [kg]	13			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	50	30	20	
Sod thickness [cm]	13	11	8	11
Root length [cm]	5	5	5	5.0
Mean peak stress [kN/m ²]	6.69			
Maximum number of cycles [-]	37			
Comments	-			

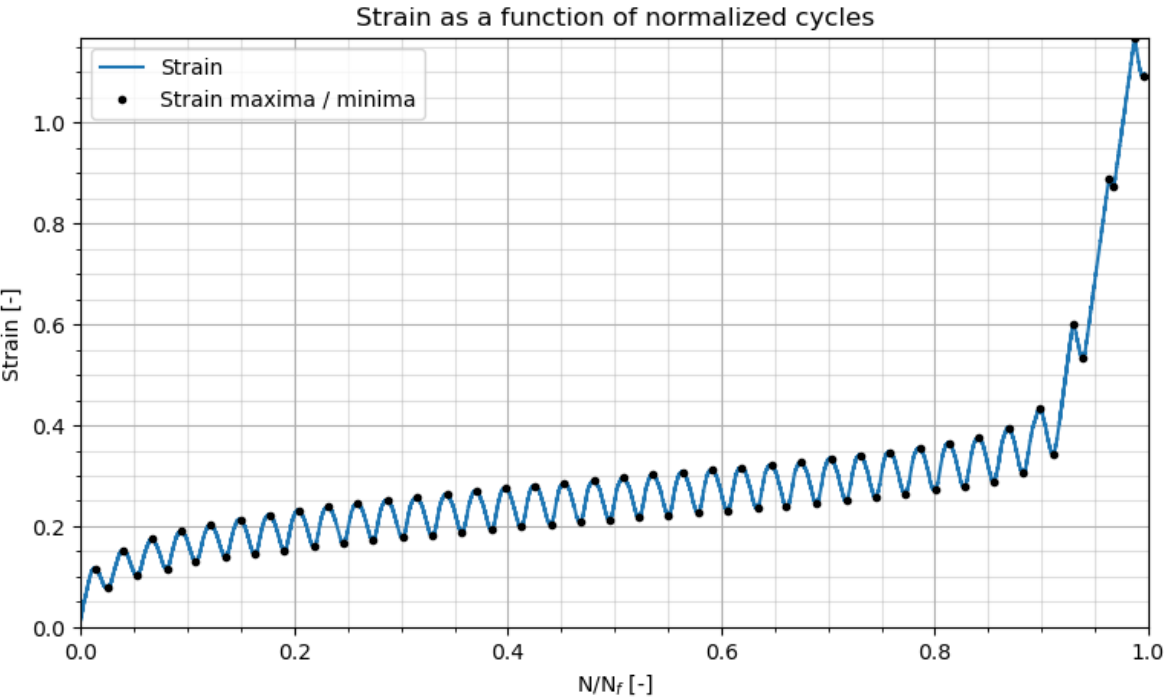
Force and displacement over time



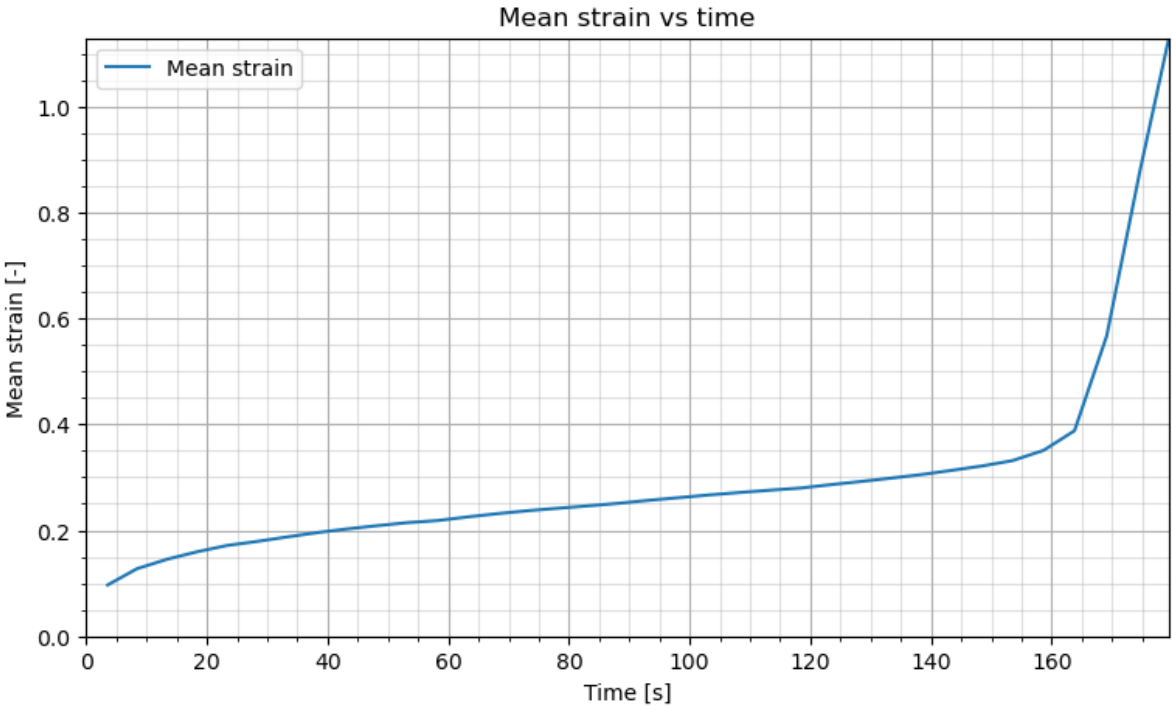
Stress-strain relation



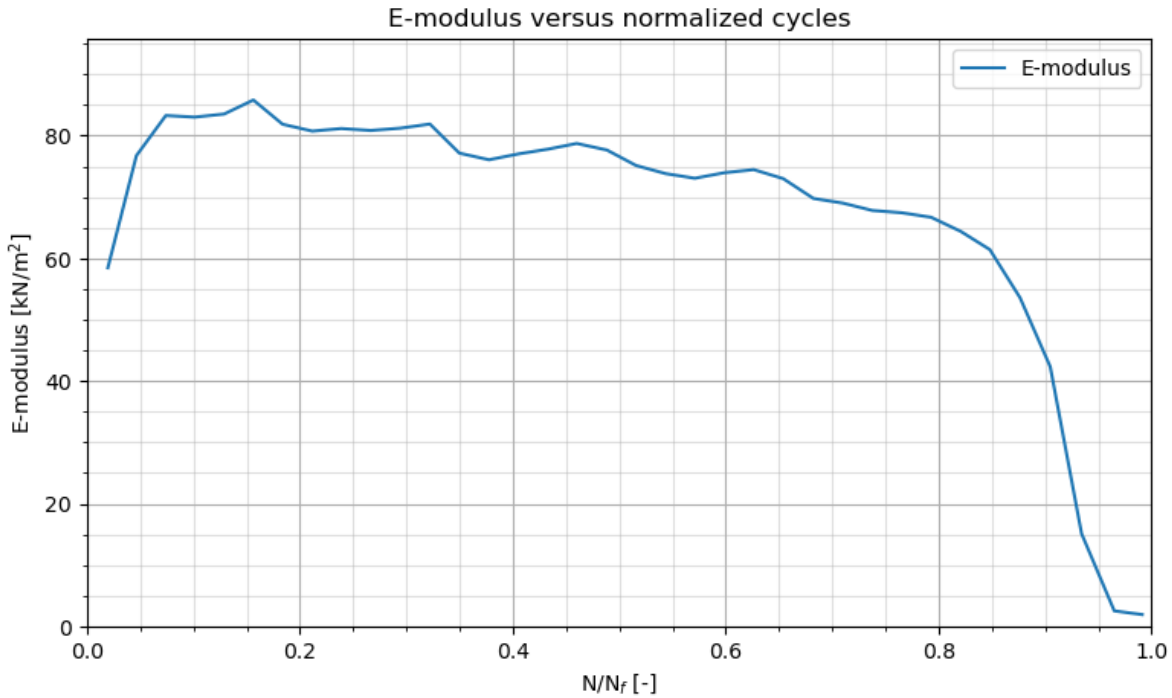
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

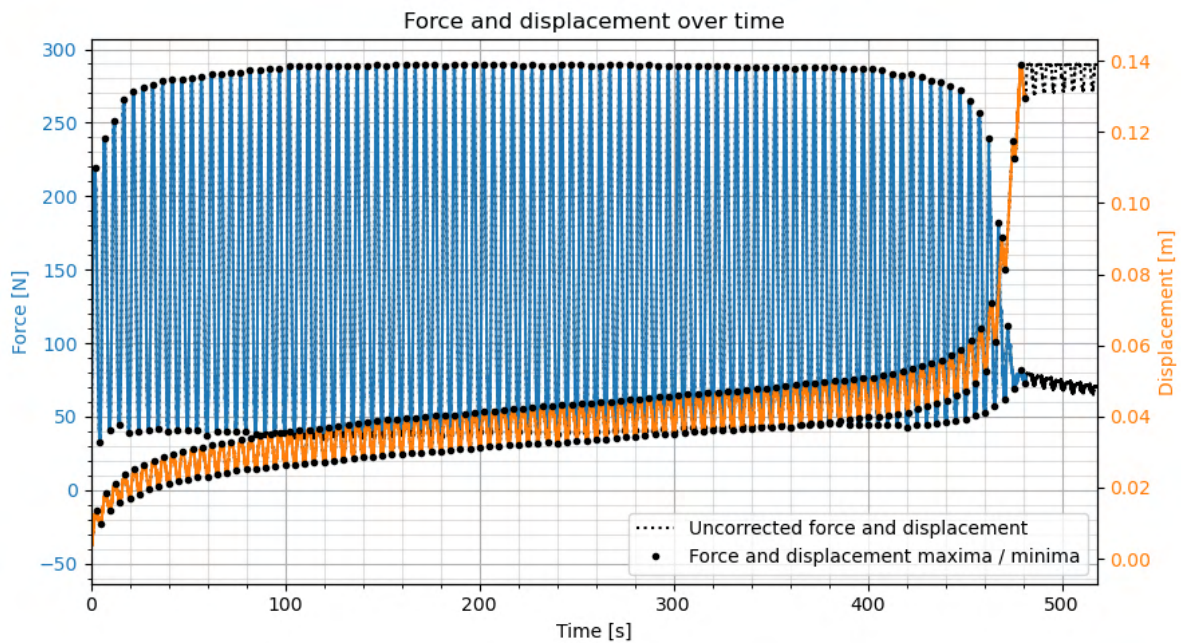


(d) Right

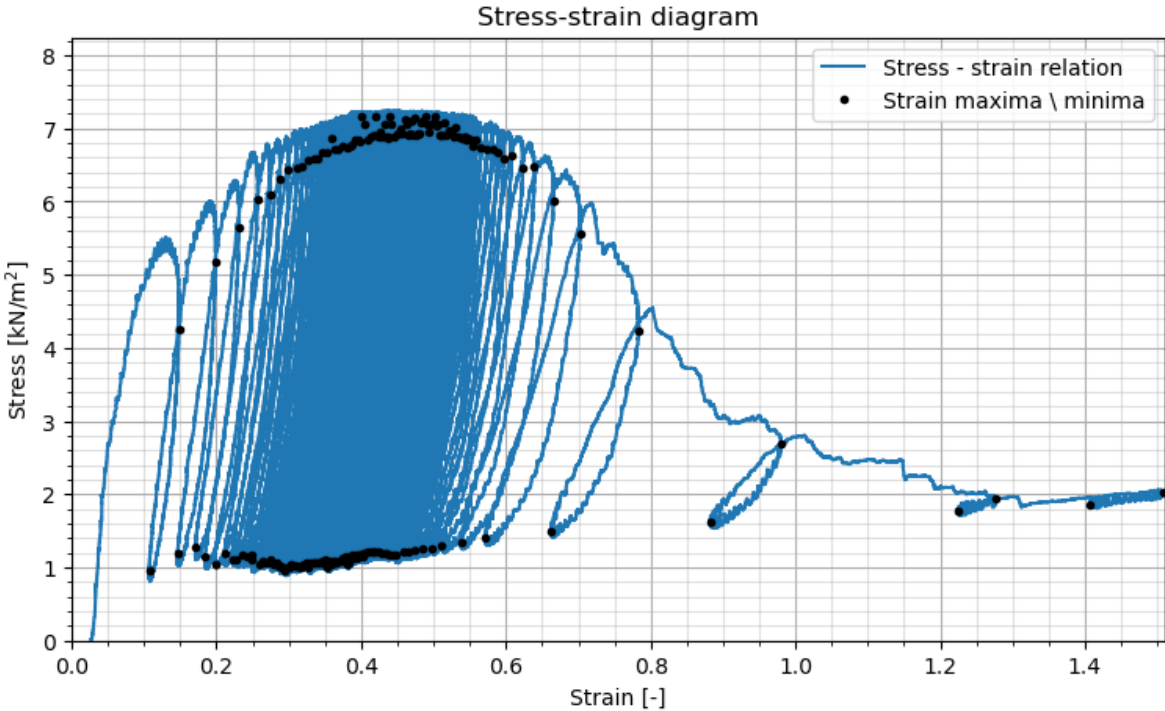
D.1.15. Test16

		Value 1	Value 2	Value 3	Mean
Date		12-03-2021			
Time		10:59:00			
Cyclic Load regime	[N]	200			
Weight	[kg]	10			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	70	20	10	
Sod thickness	[cm]	10	8	6	9
Root length	[cm]	5	4	6	4.9
Mean peak stress	[kN/m ²]	6.96			
Maximum number of cycles	[-]	97			
Comments		-			

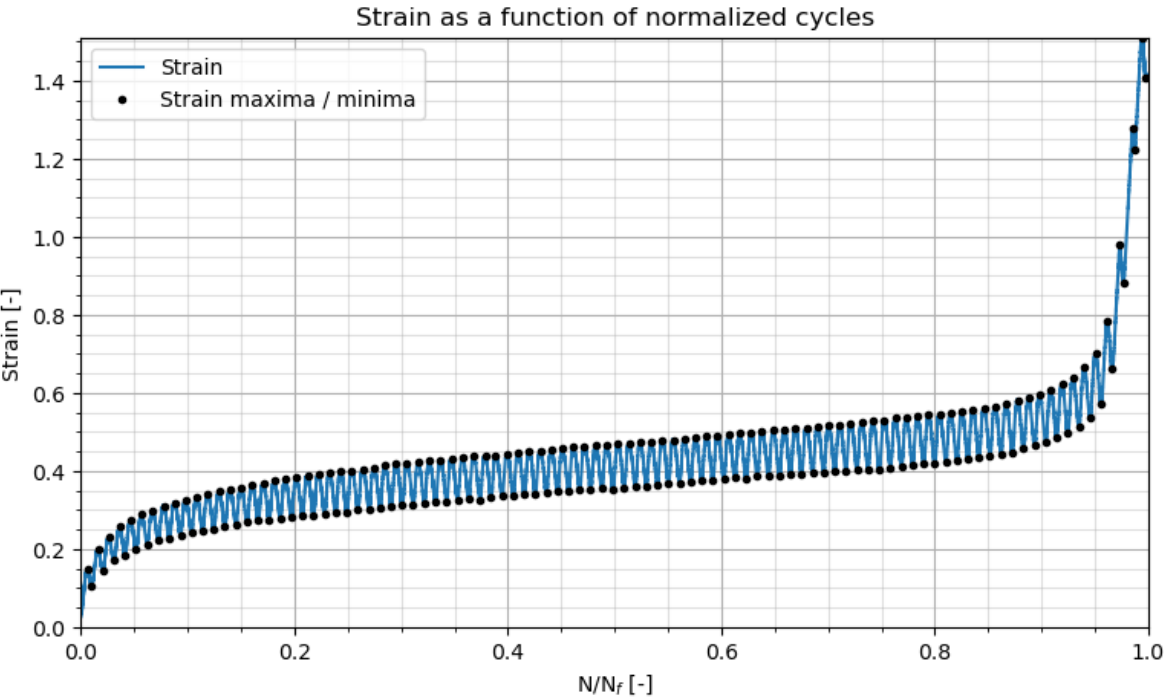
Force and displacement over time



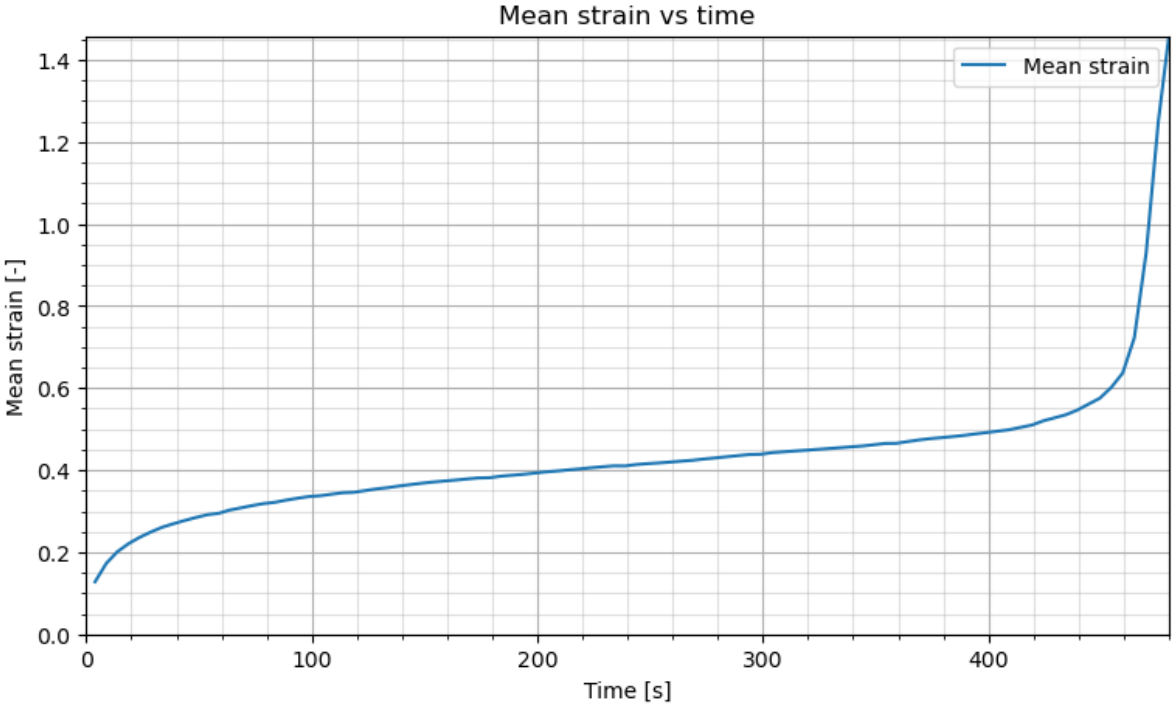
Stress-strain relation



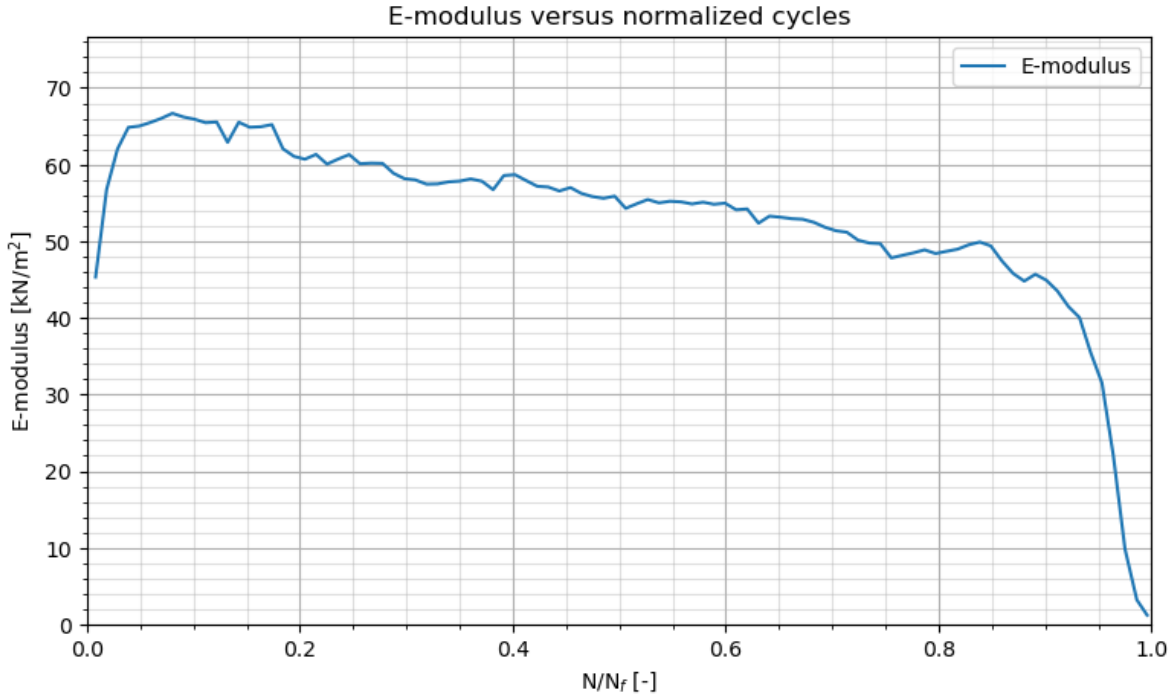
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

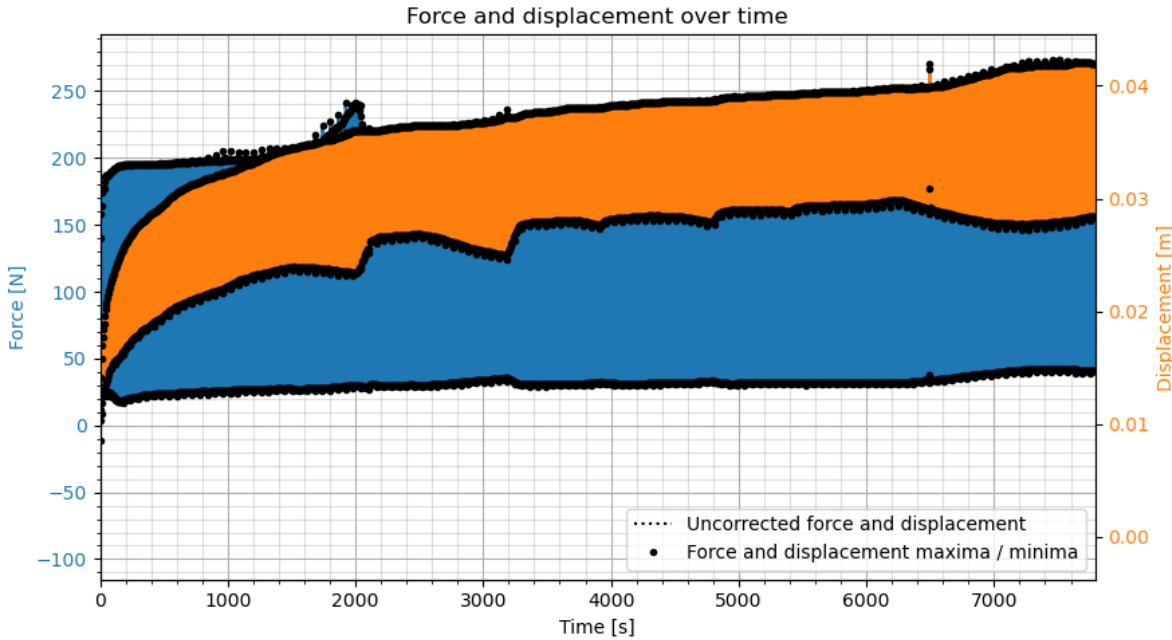


(d) Right

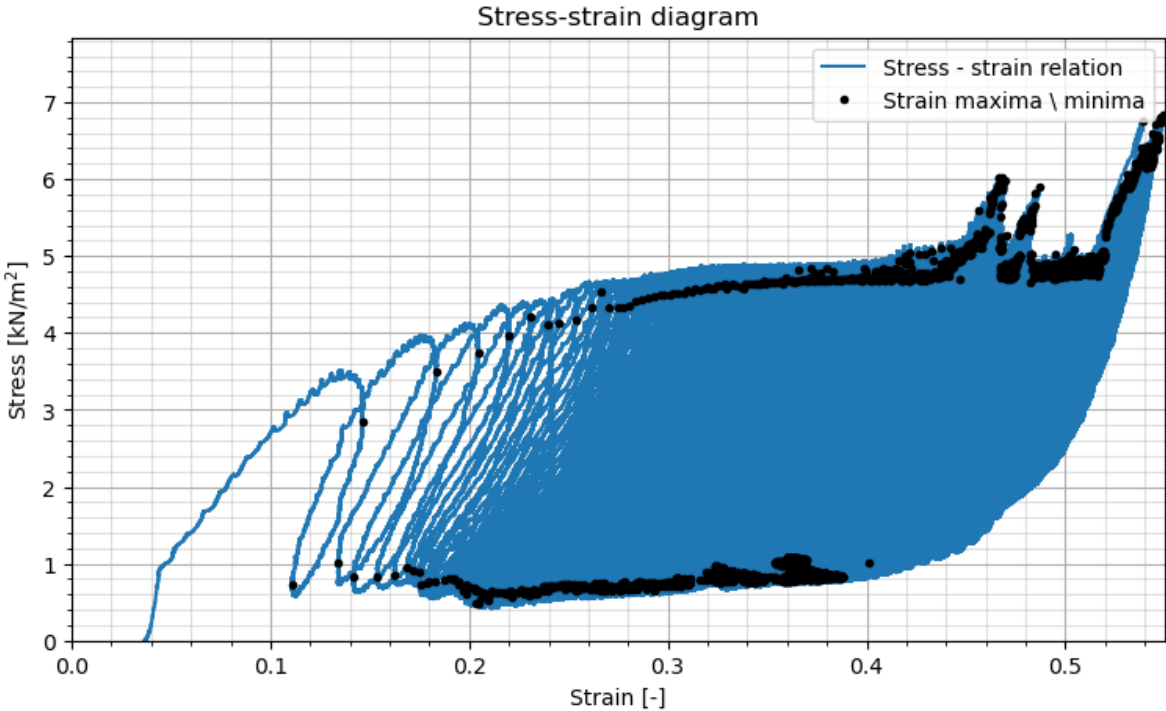
D.1.16. Test17

	Value 1	Value 2	Value 3	Mean
Date	12-03-2021			
Time	11:46:00			
Cyclic Load regime [N]	200			
Weight [kg]	9			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	60	10	30	
Sod thickness [cm]	9	8	5	8
Root length [cm]	12	8	6	9.8
Mean peak stress [kN/m ²]	5.19			
Maximum number of cycles [-]	1559			
Comments	Did not fail			

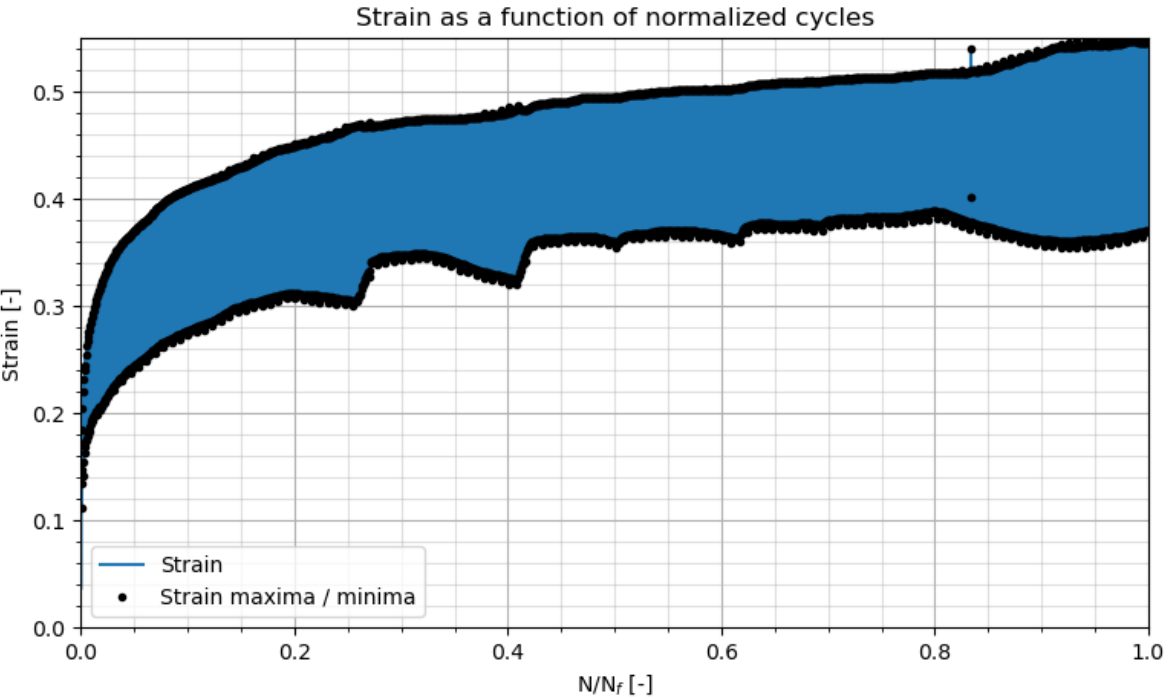
Force and displacement over time



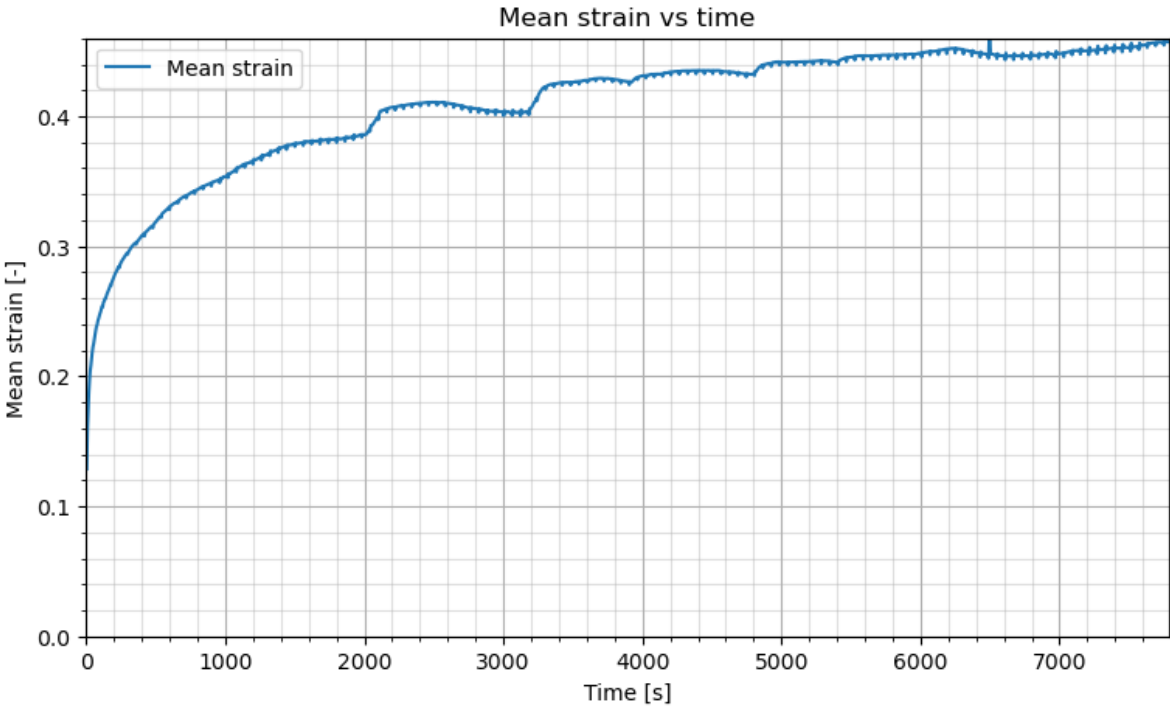
Stress-strain relation



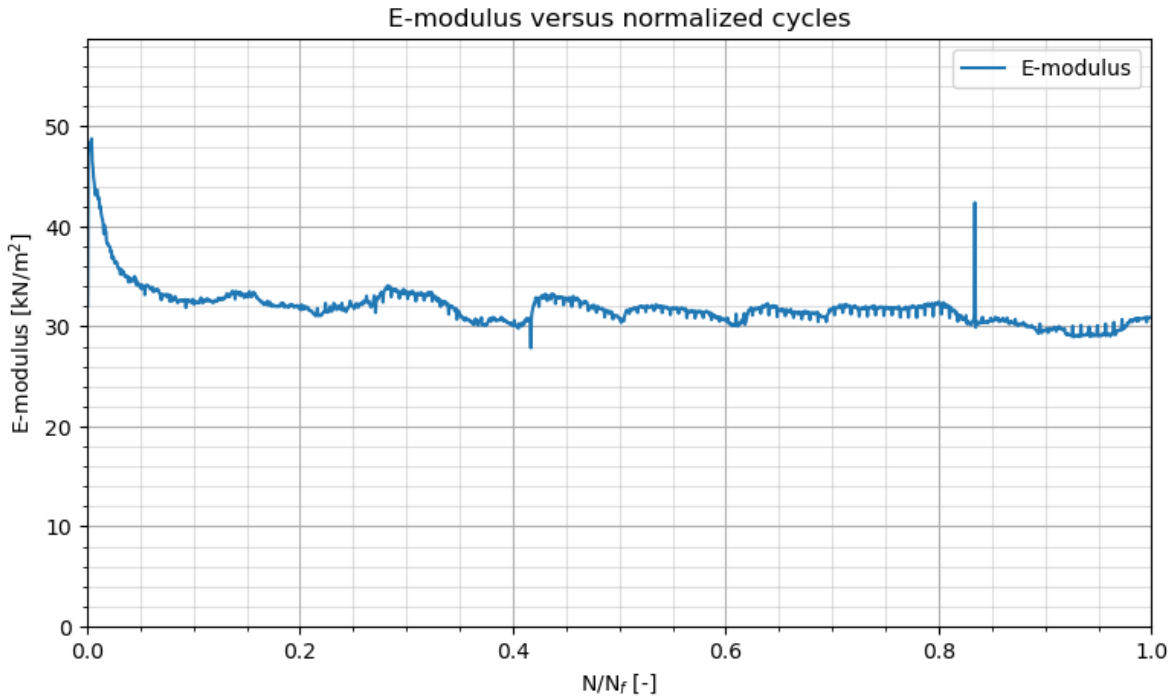
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

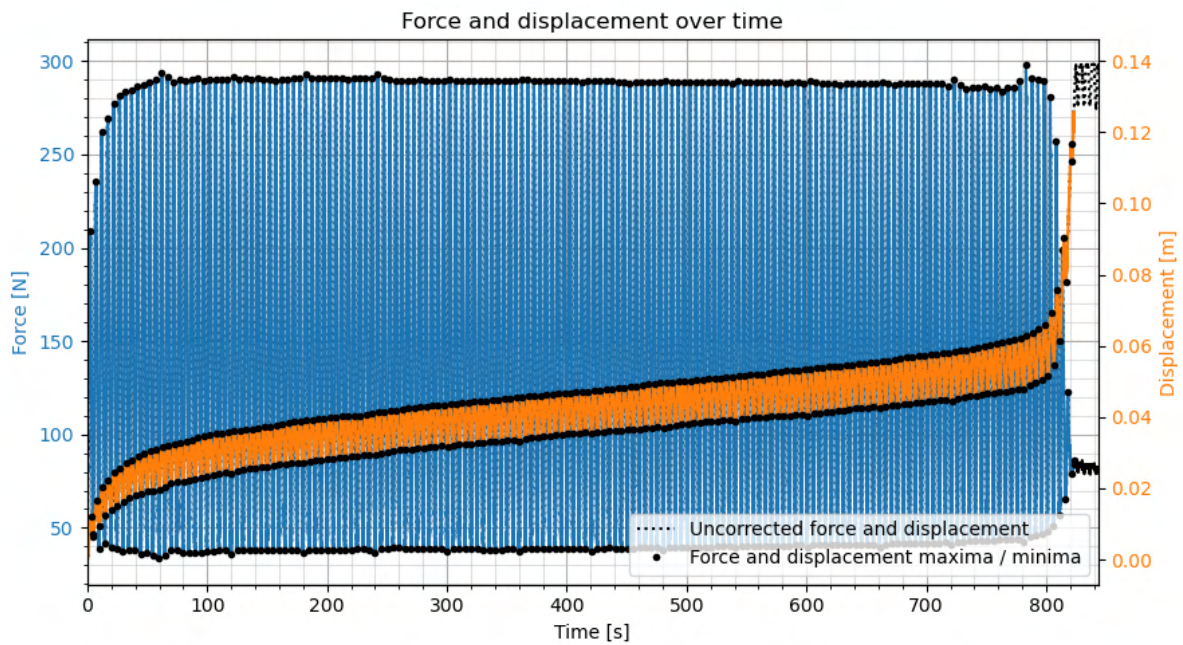


(d) Right

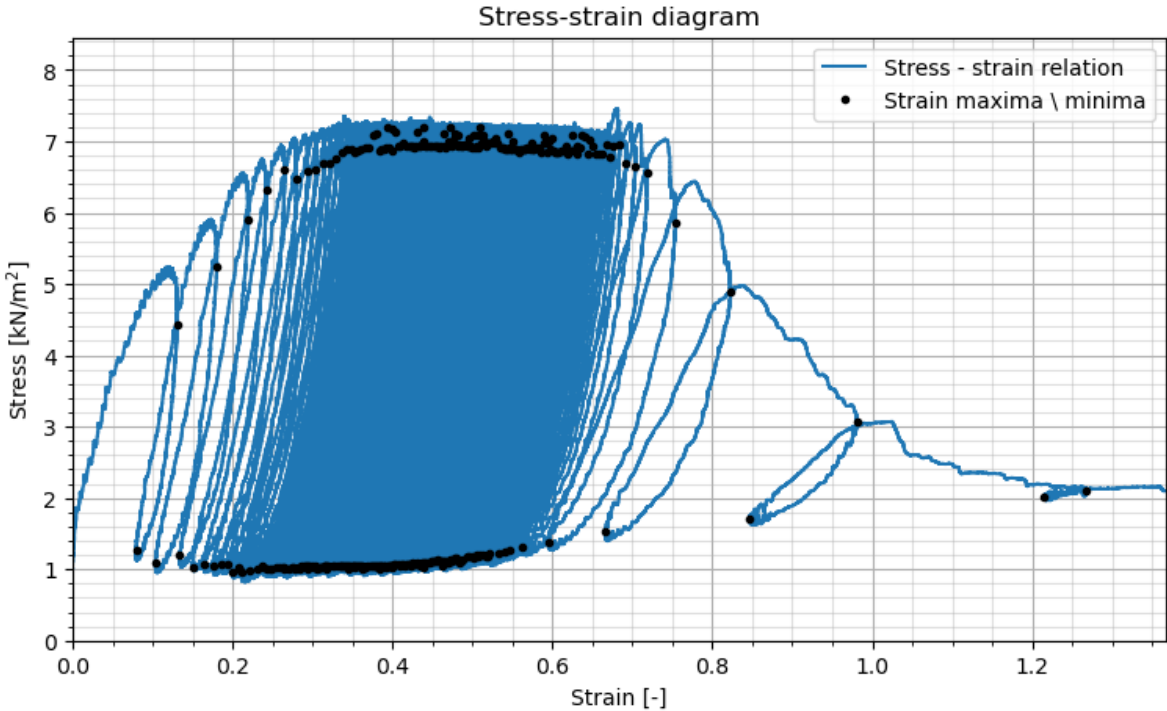
D.1.17. Test18

		Value 1	Value 2	Value 3	Mean
Date		12-03-2021			
Time		?			
Cyclic Load regime	[N]	300			
Weight	[kg]	7			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	40	20	40	
Sod thickness	[cm]	7	12	10	9
Root length	[cm]	7	4	7	6.4
Mean peak stress	[kN/m ²]	7.12			
Maximum number of cycles	[-]	165			
Comments		-			

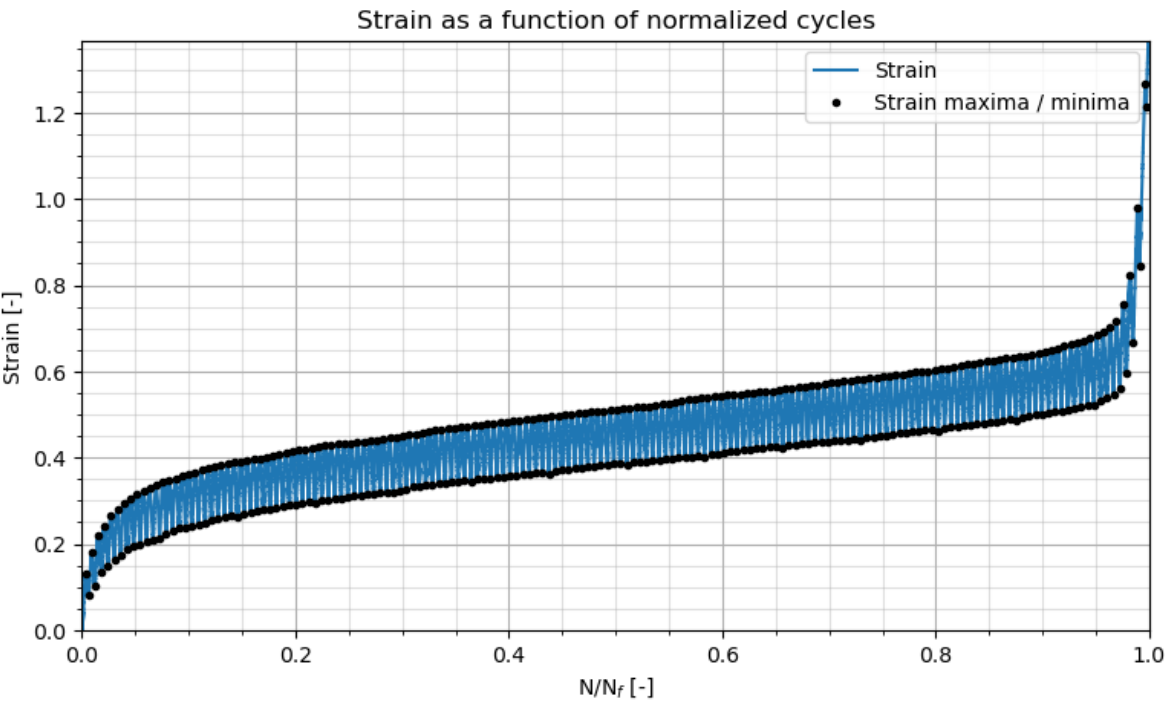
Force and displacement over time



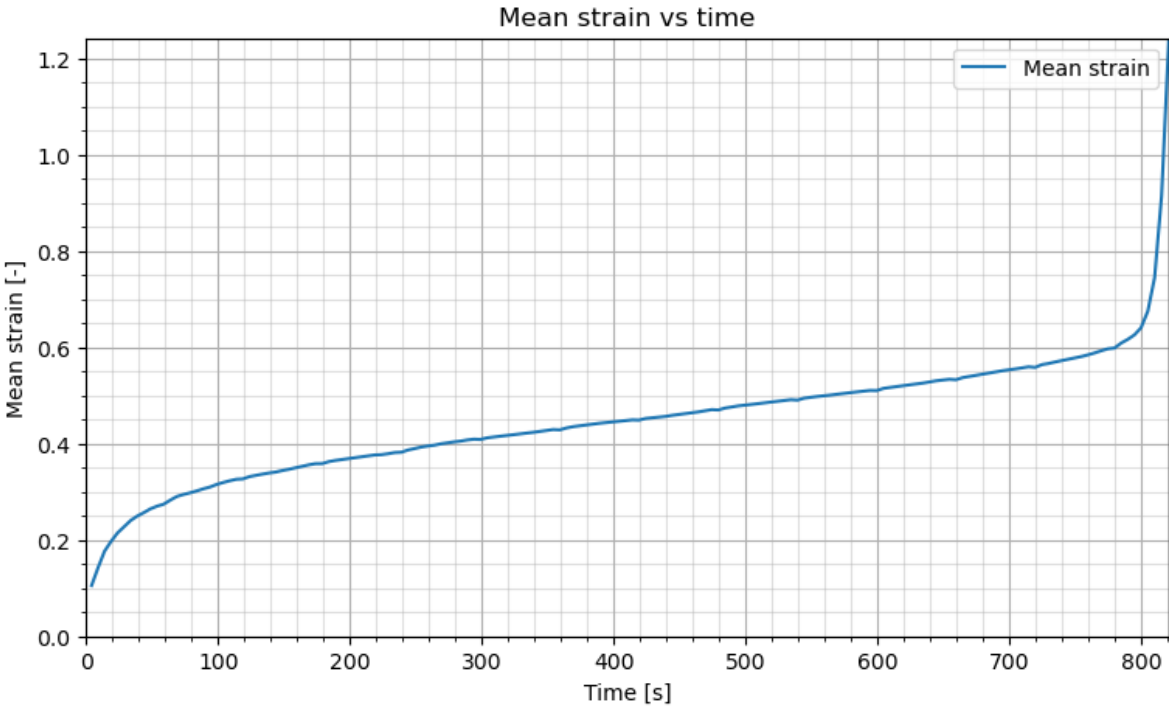
Stress-strain relation



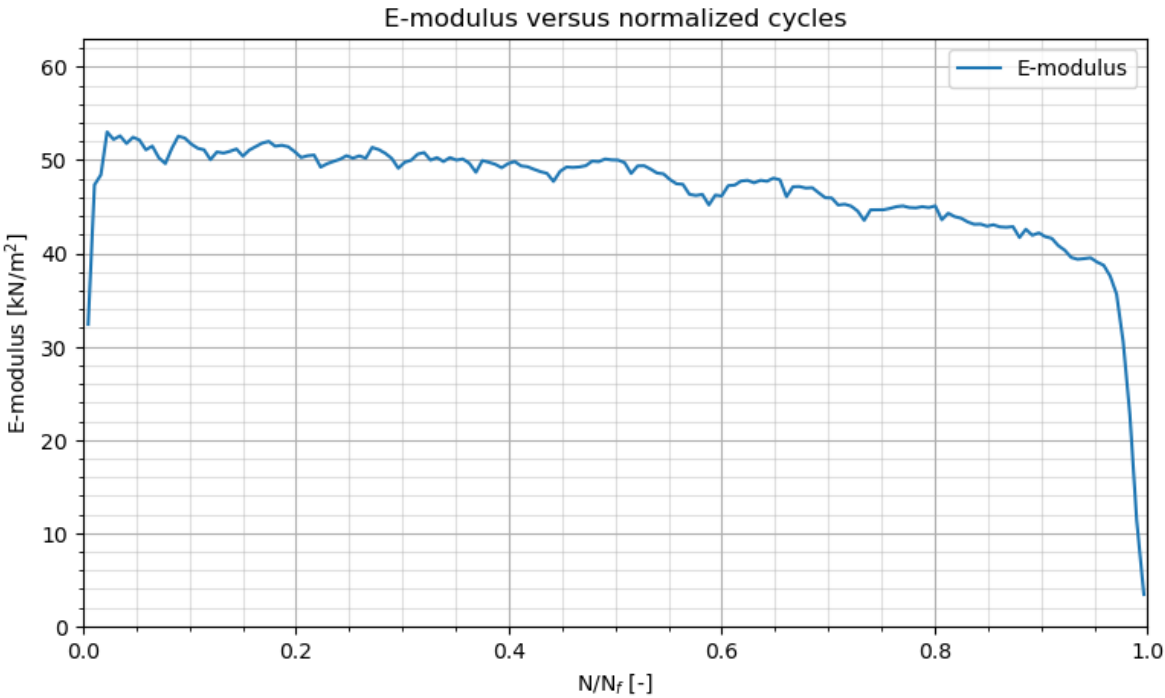
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

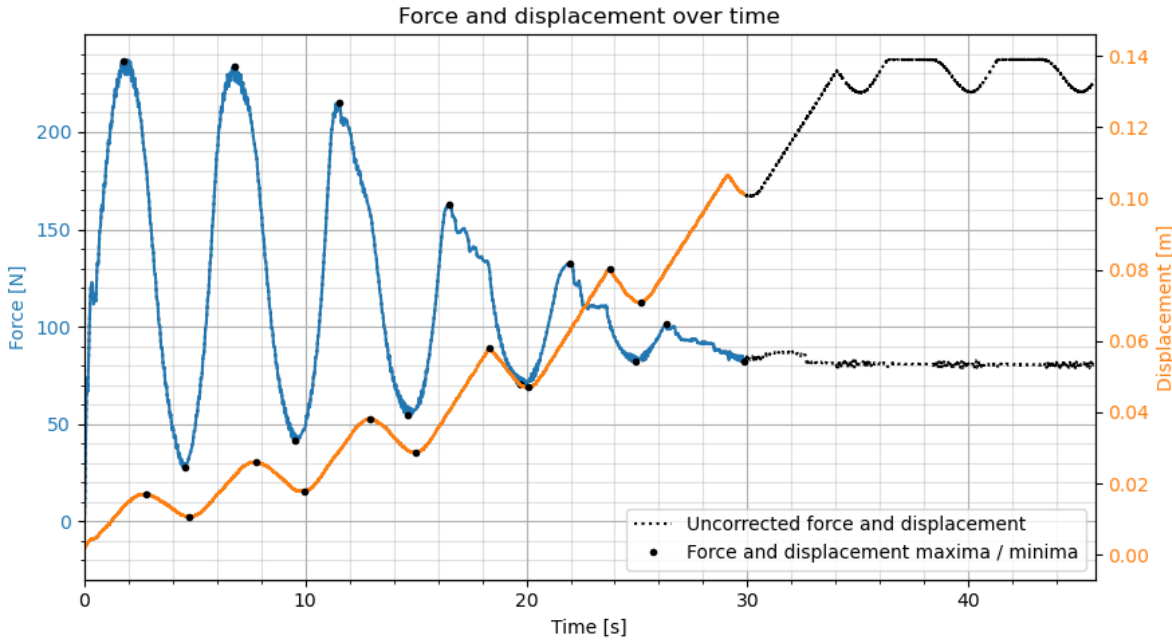


(d) Right

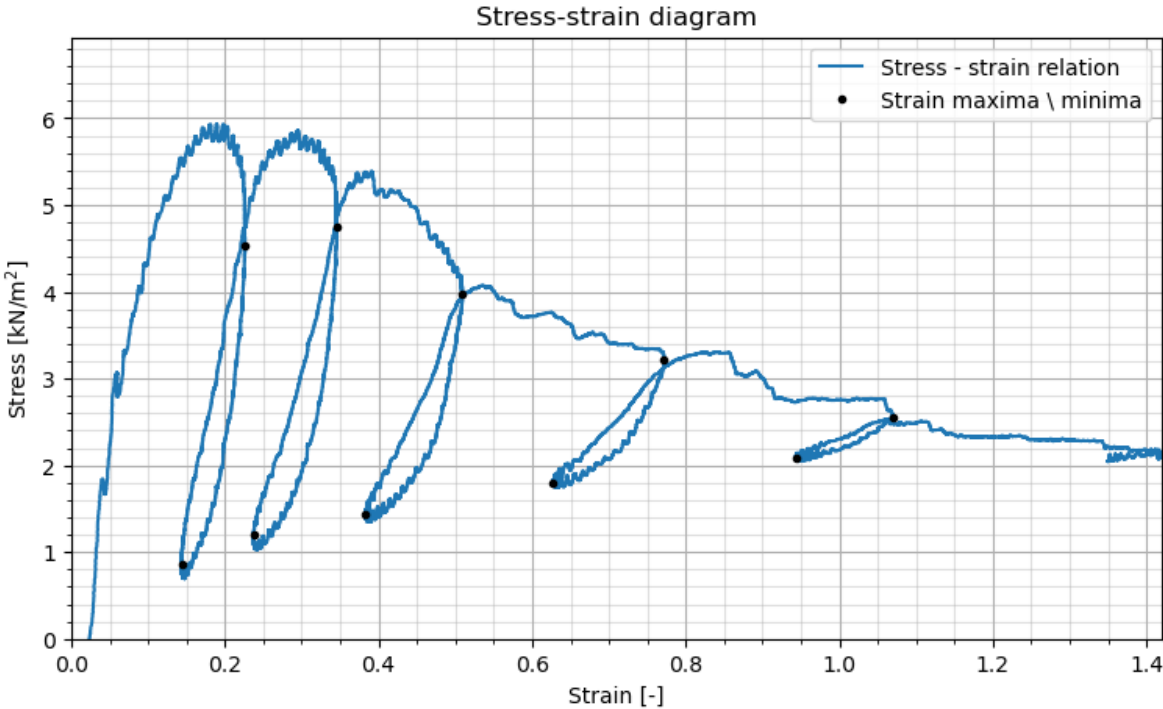
D.1.18. Test19

	Value 1	Value 2	Value 3	Mean
Date	12-03-2021			
Time	?			
Cyclic Load regime [N]	300			
Weight [kg]	8			
Width [cm]	20.0			
Length [cm]	20.0			
Dike orientation	North-East			
Percentage of occurrence [%]	70	20	10	
Sod thickness [cm]	8	7	5	8
Root length [cm]	5	3	6	4.7
Mean peak stress [kN/m ²]	4.51			
Maximum number of cycles [-]	6			
Comments	-			

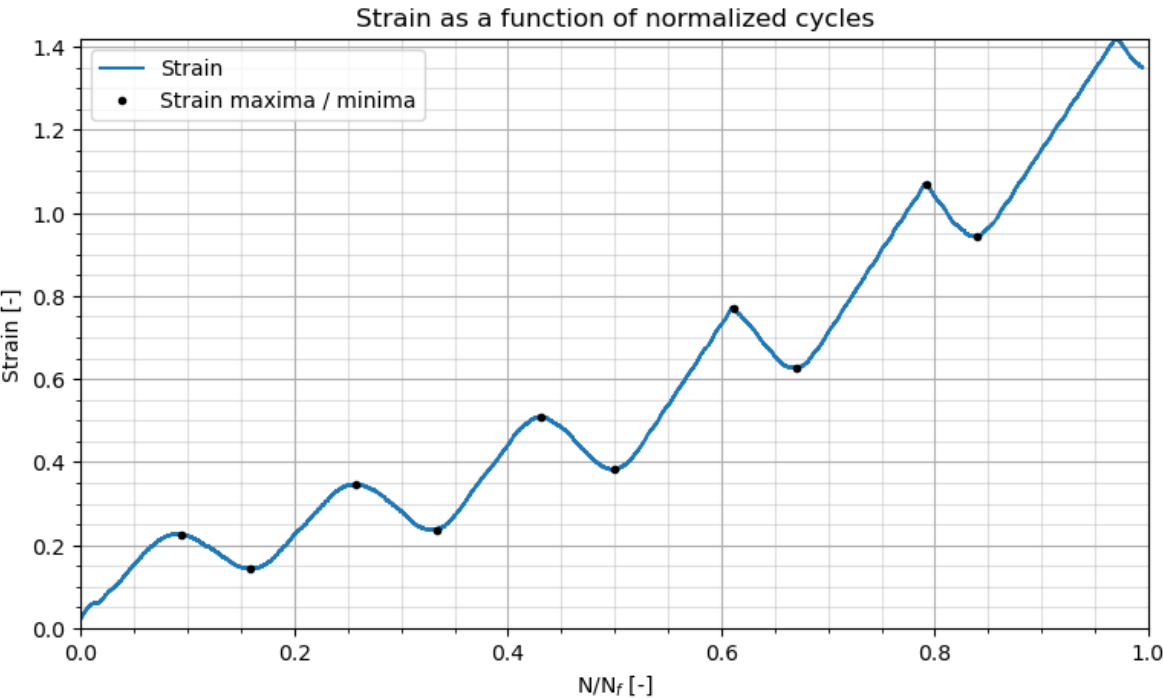
Force and displacement over time



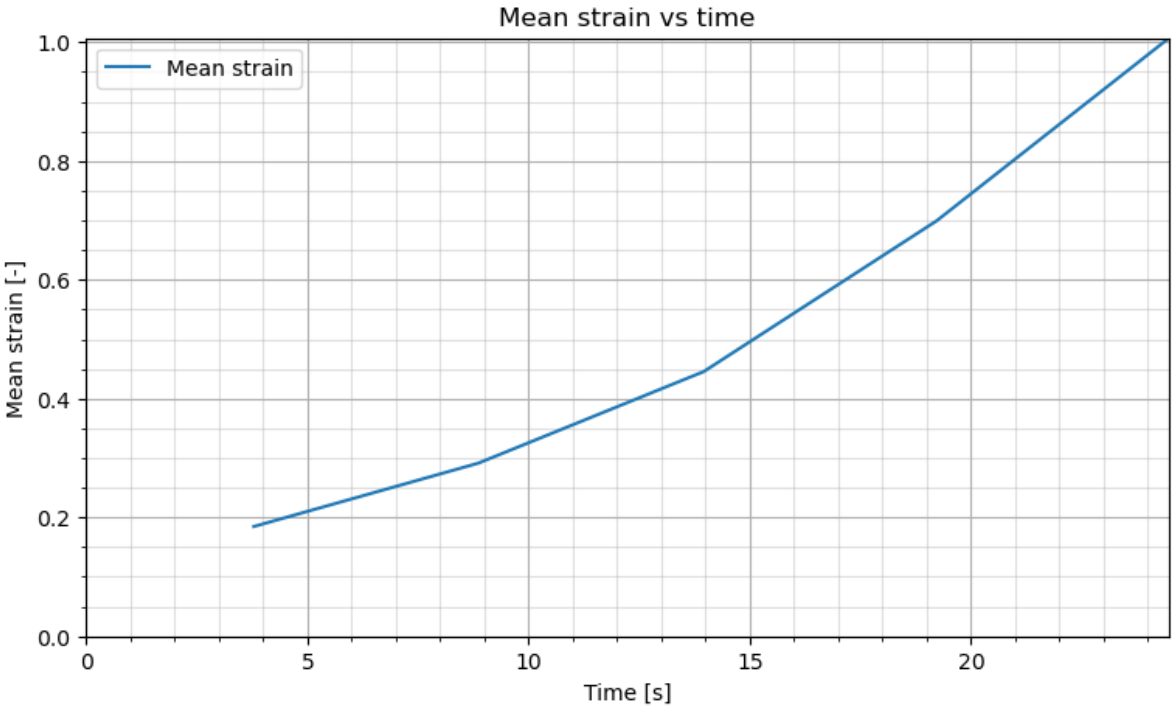
Stress-strain relation



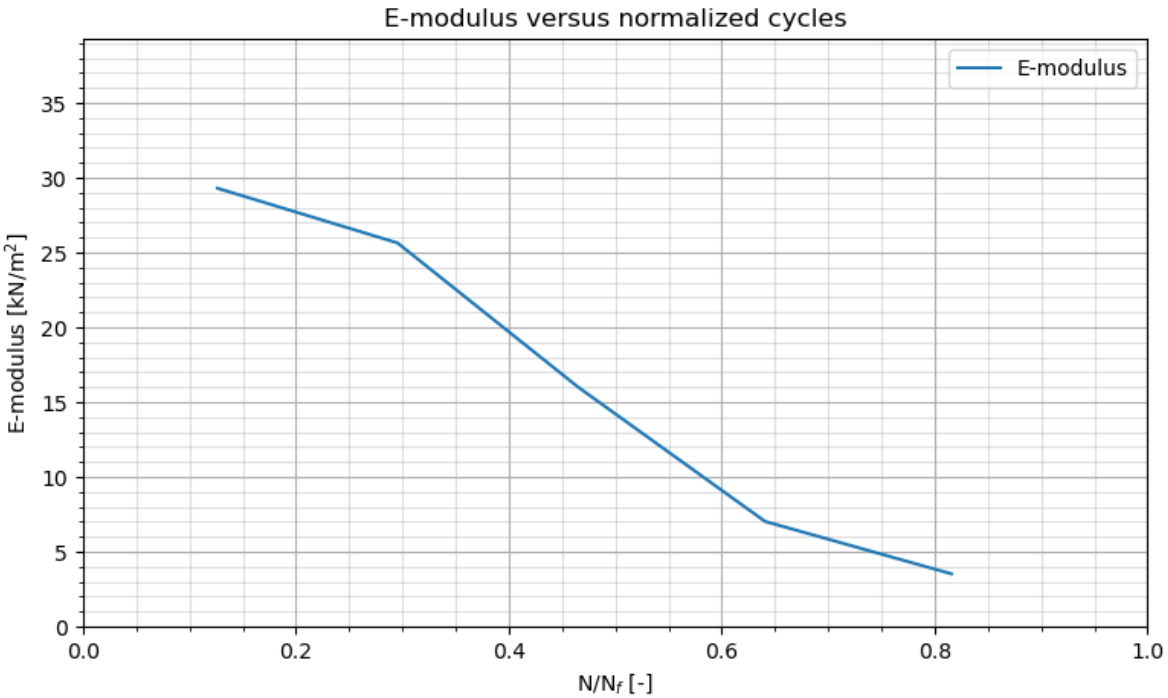
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom



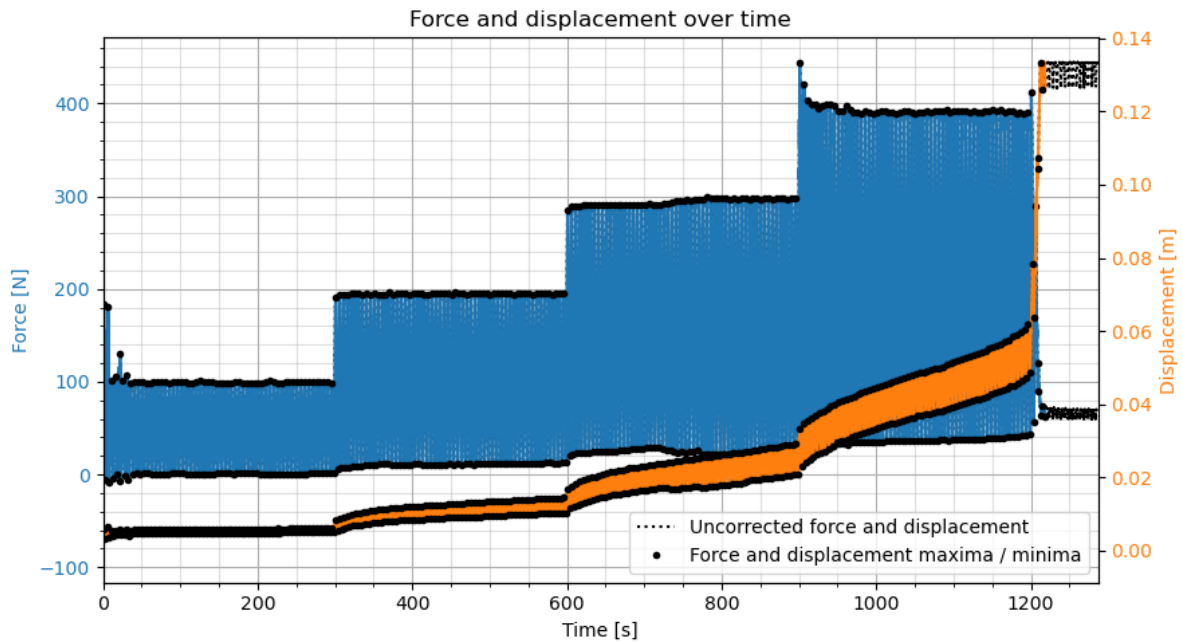
(d) Right

D.2. Fatigue tests - sand stepwise condition 4 submerged

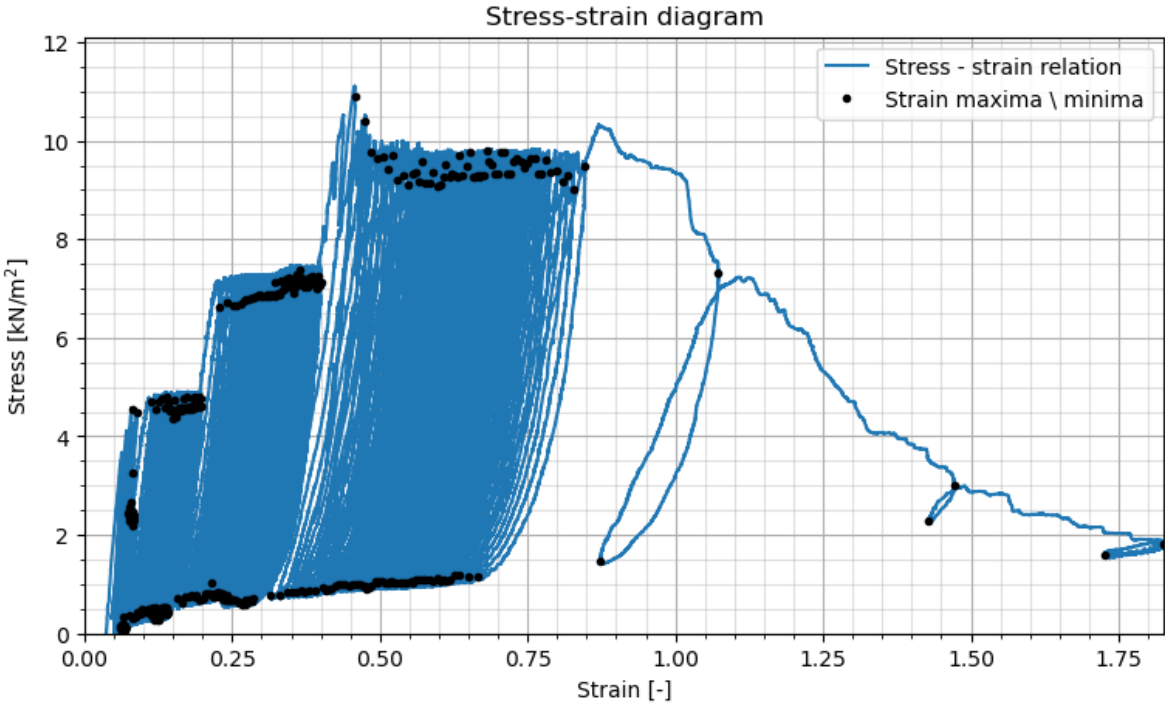
D.2.1. Test01

		Value 1	Value 2	Value 3	Mean
Date		26-02-2021			
Time		13:54:00			
Cyclic Load regime	[N]	stepwise			
Weight	[kg]	12			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	10	80	10	
Sod thickness	[cm]	12	7	5	7
Root length	[cm]	4	5	11	5.5
Mean peak stress	[kN/m ²]	6.15			
Maximum number of cycles	[-]	244			
Comments		-			

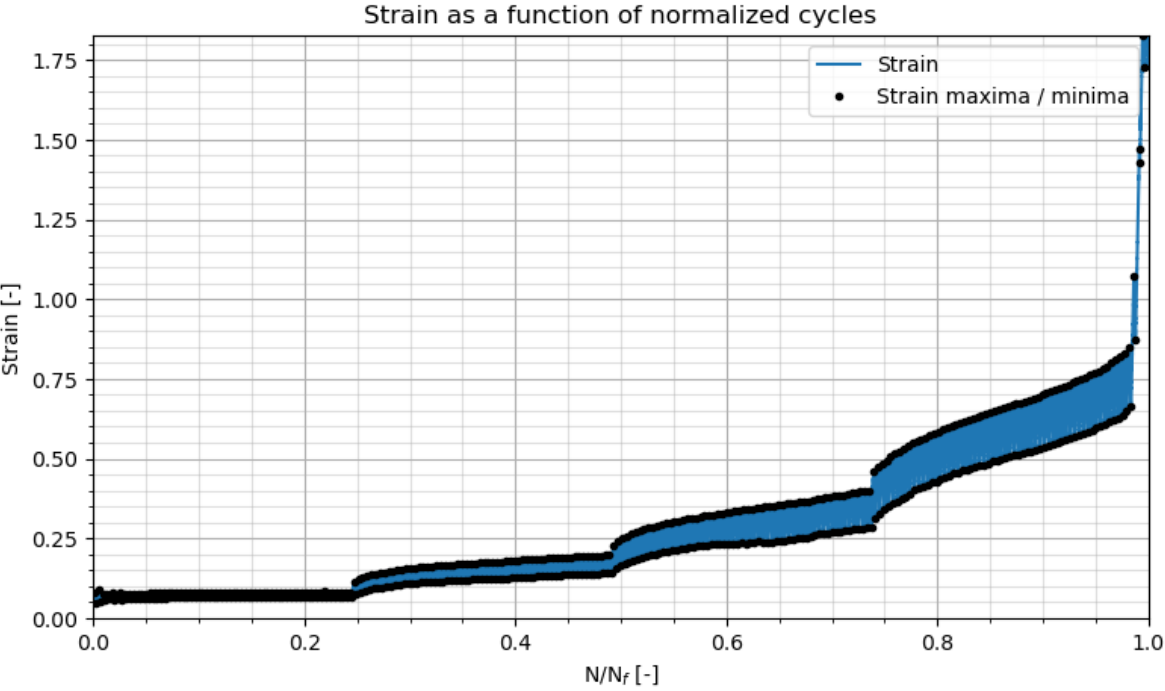
Force and displacement over time



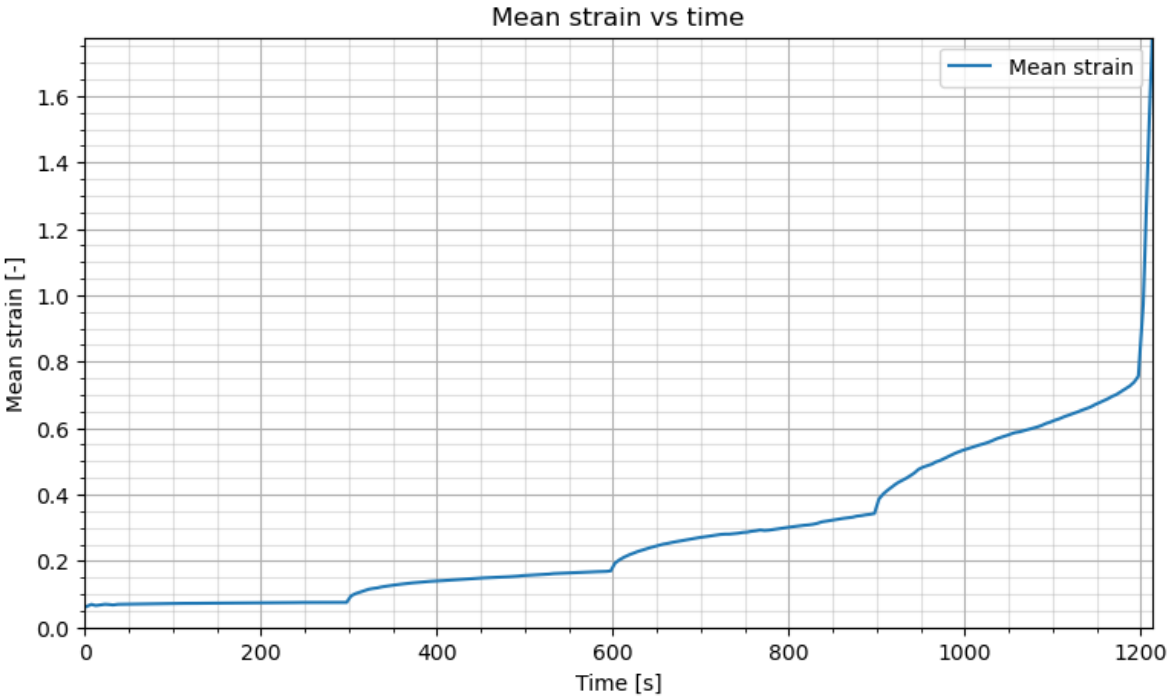
Stress-strain relation



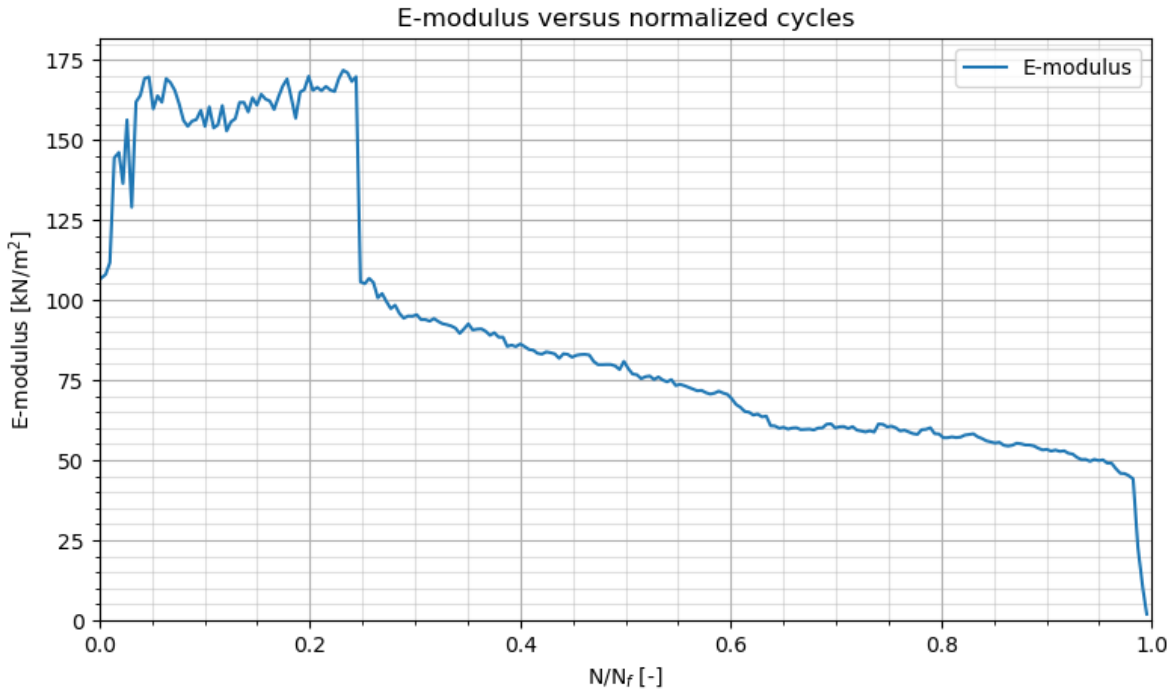
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

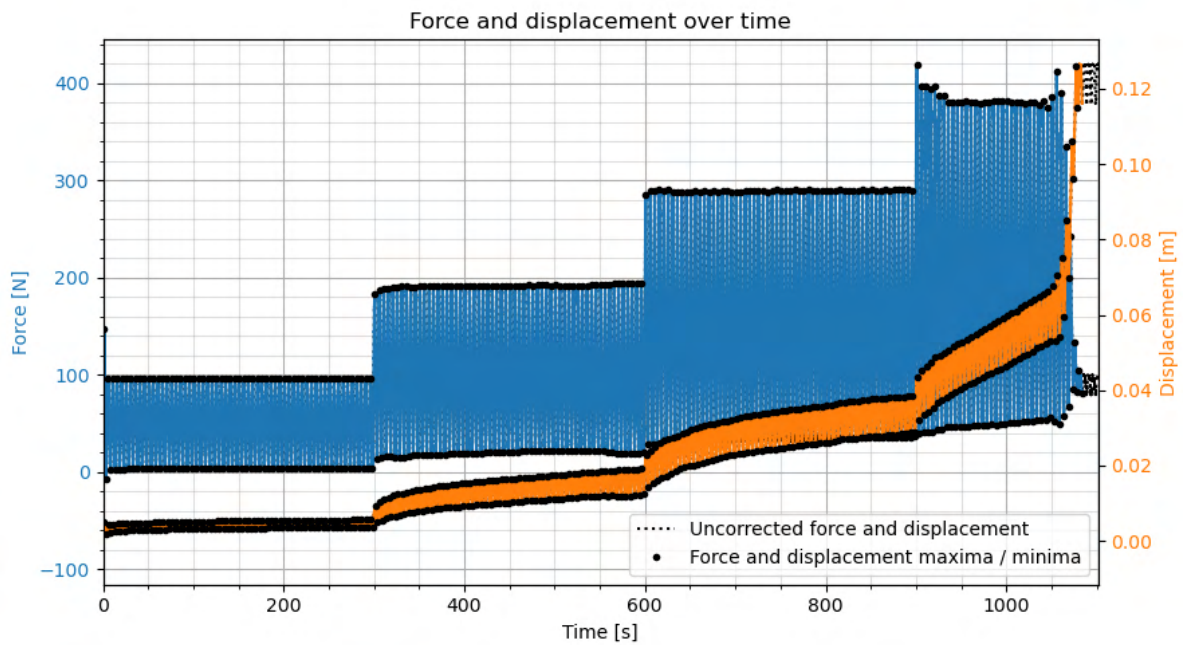


(d) Right

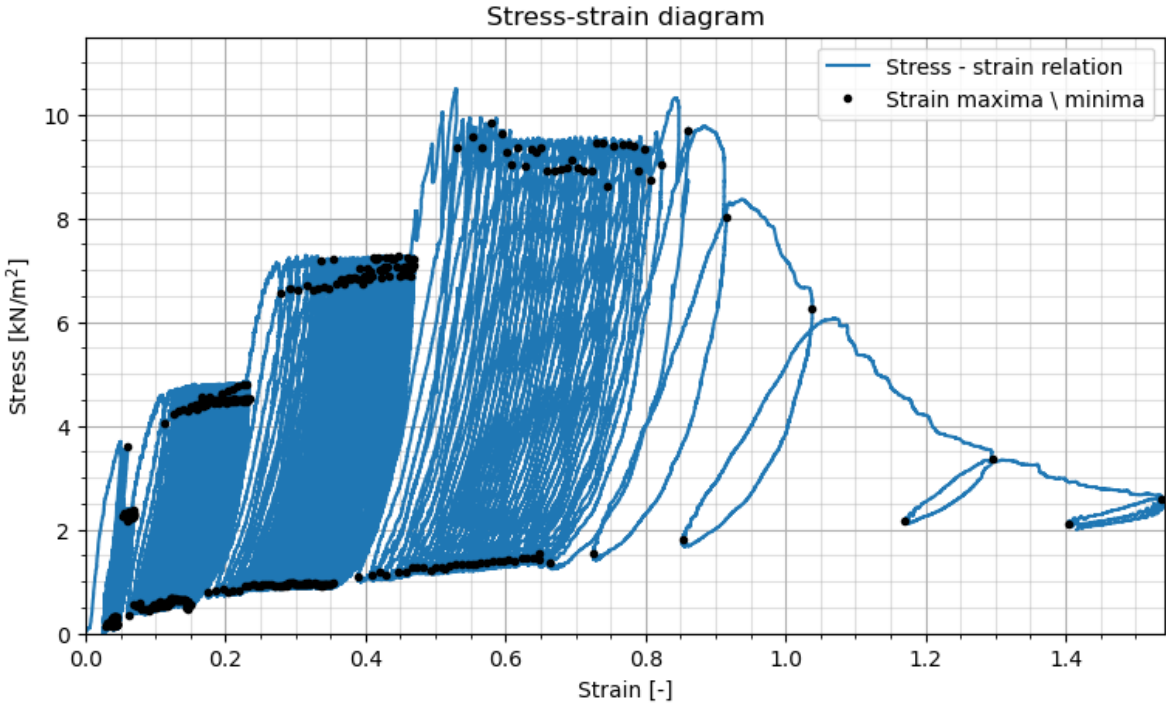
D.2.2. Test02

	Value 1	Value 2	Value 3	Mean	
Date	01-03-2021				
Time	11:37:00				
Cyclic Load regime	[N]	stepwise			
Weight	[kg]	13			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North			
Percentage of occurrence	[%]	30	20	50	
Sod thickness	[cm]	13	9	5	8
Root length	[cm]	6	7	12	9.2
Mean peak stress	[kN/m ²]	5.55			
Maximum number of cycles	[-]	217			
Comments		-			

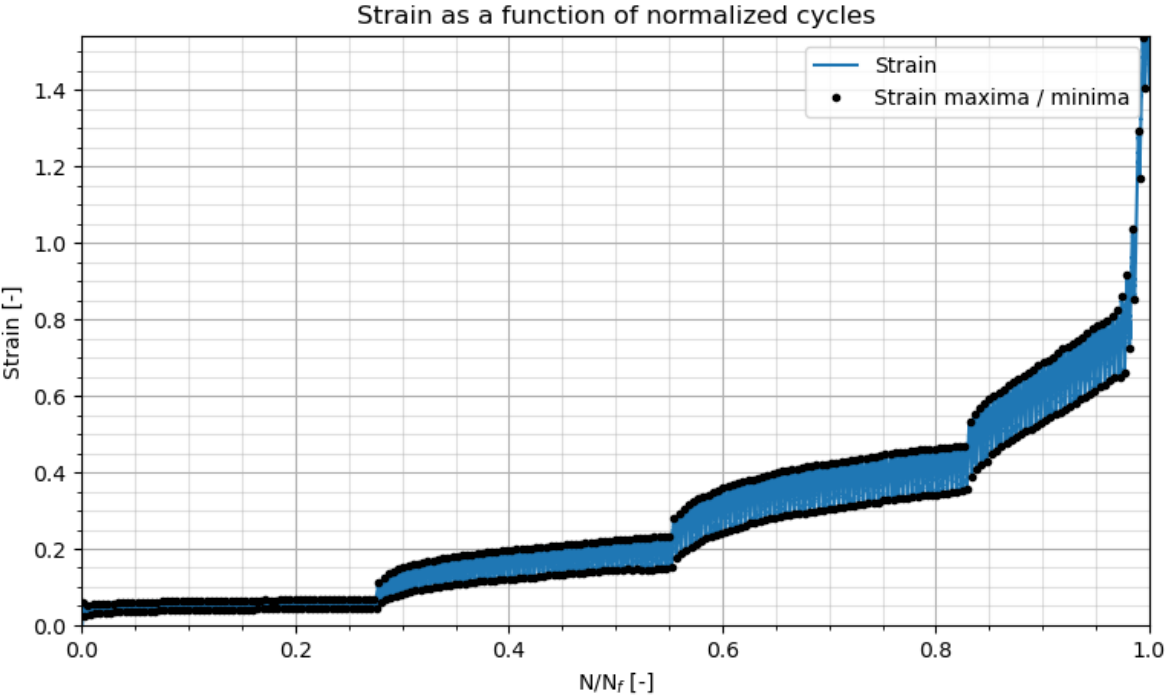
Force and displacement over time



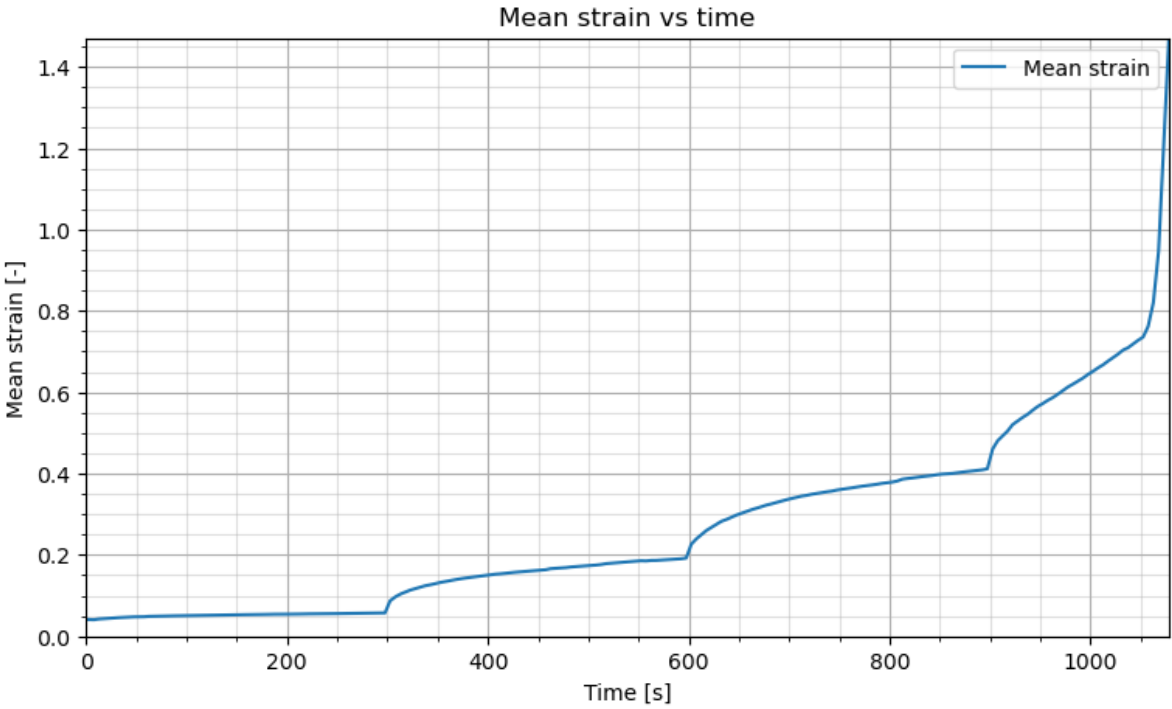
Stress-strain relation



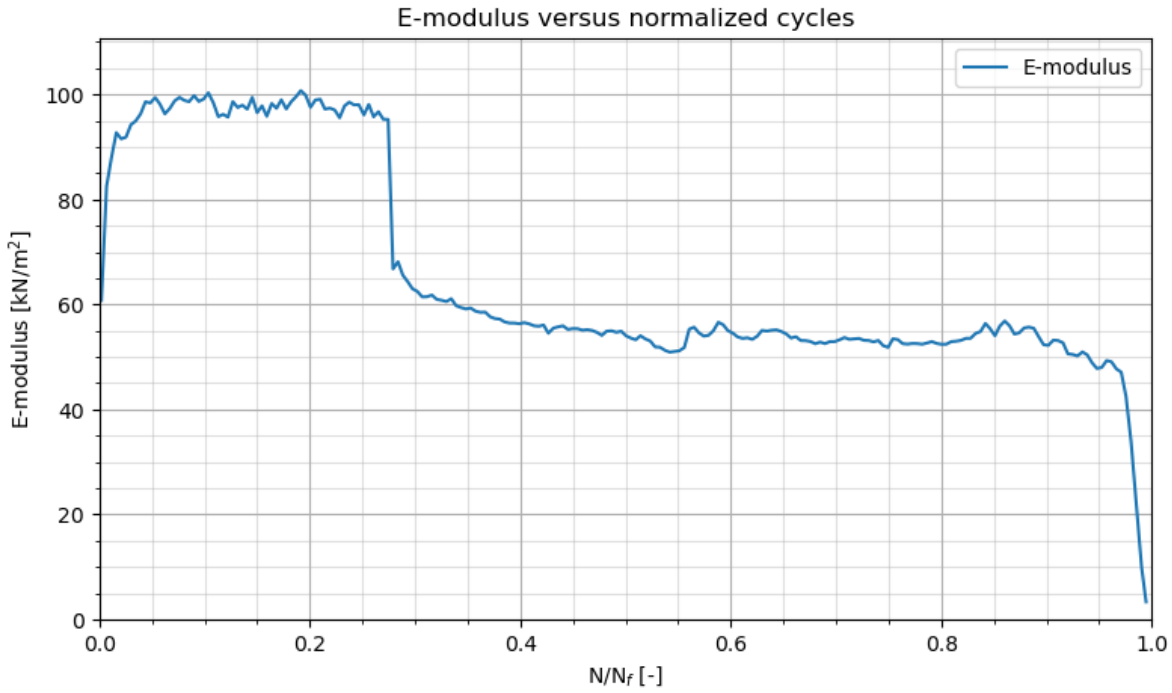
Strain over normalized cycles



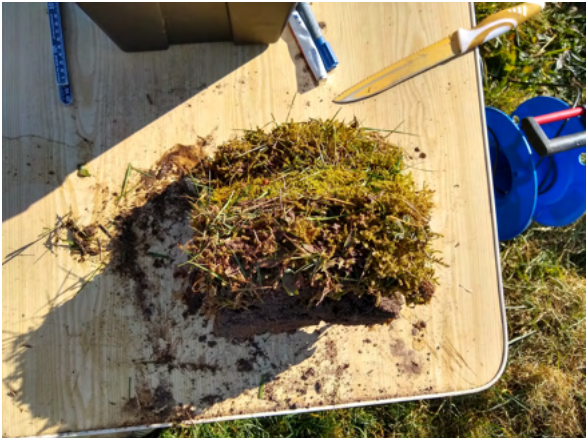
Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom

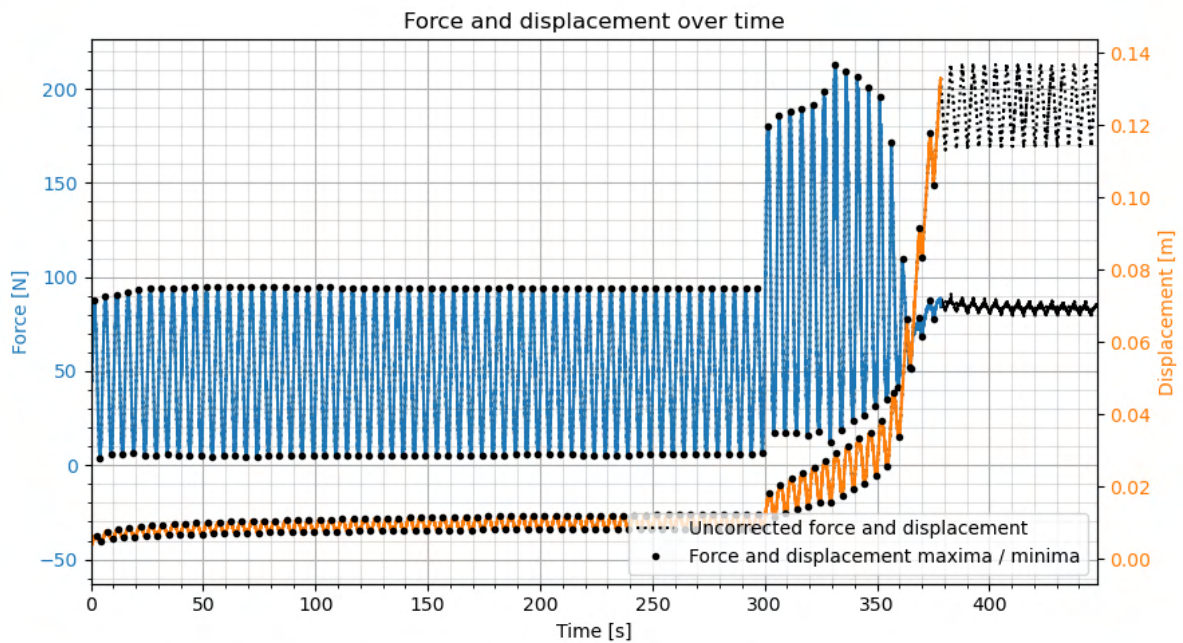


(d) Right

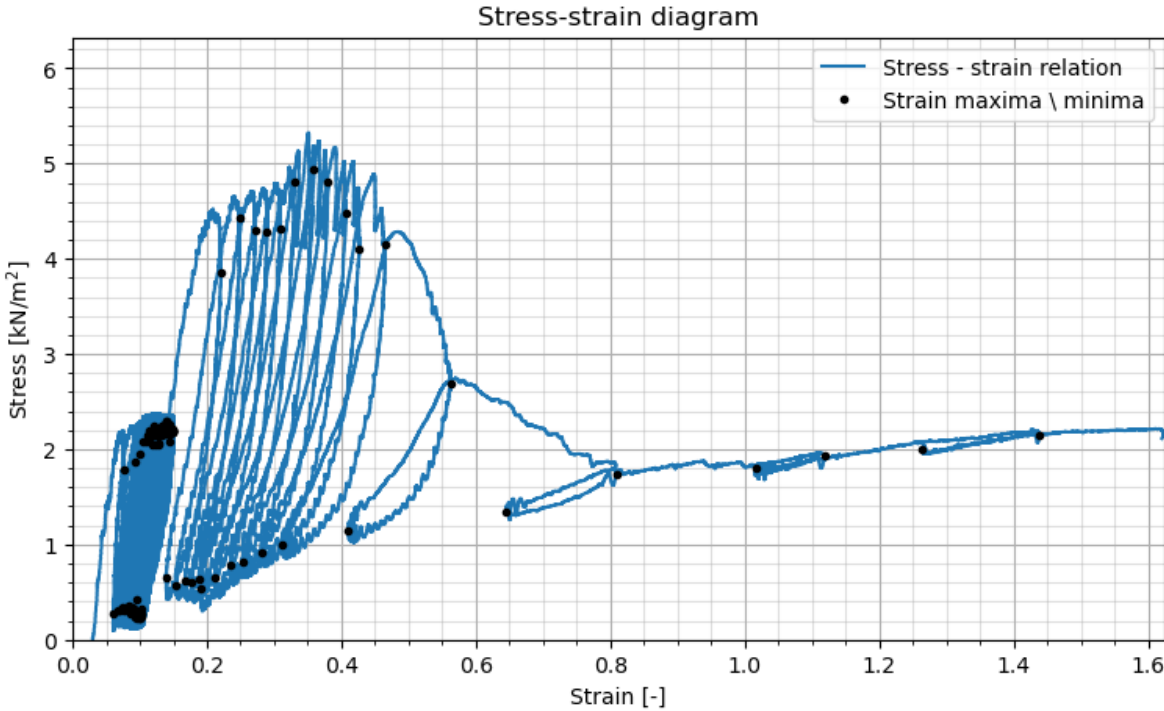
D.2.3. Test03

		Value 1	Value 2	Value 3	Mean
Date		04-03-2021			
Time		10:15:00			
Cyclic Load regime	[N]	stepwise			
Weight	[kg]	9			
Width	[cm]	20.0			
Length	[cm]	20.0			
Dike orientation		North-East			
Percentage of occurrence	[%]	70	20	10	
Sod thickness	[cm]	9	7	5	8
Root length	[cm]	6	5	4	5.6
Mean peak stress	[kN/m ²]	2.75			
Maximum number of cycles	[-]	76			
Comments		Failed quickly			

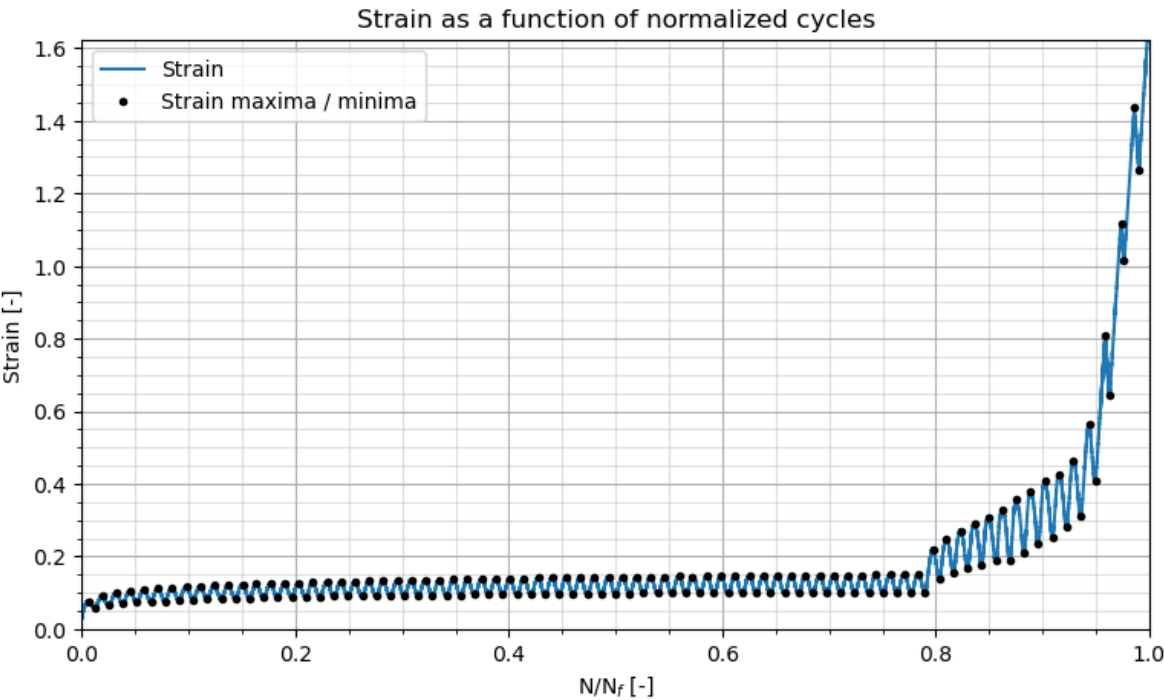
Force and displacement over time



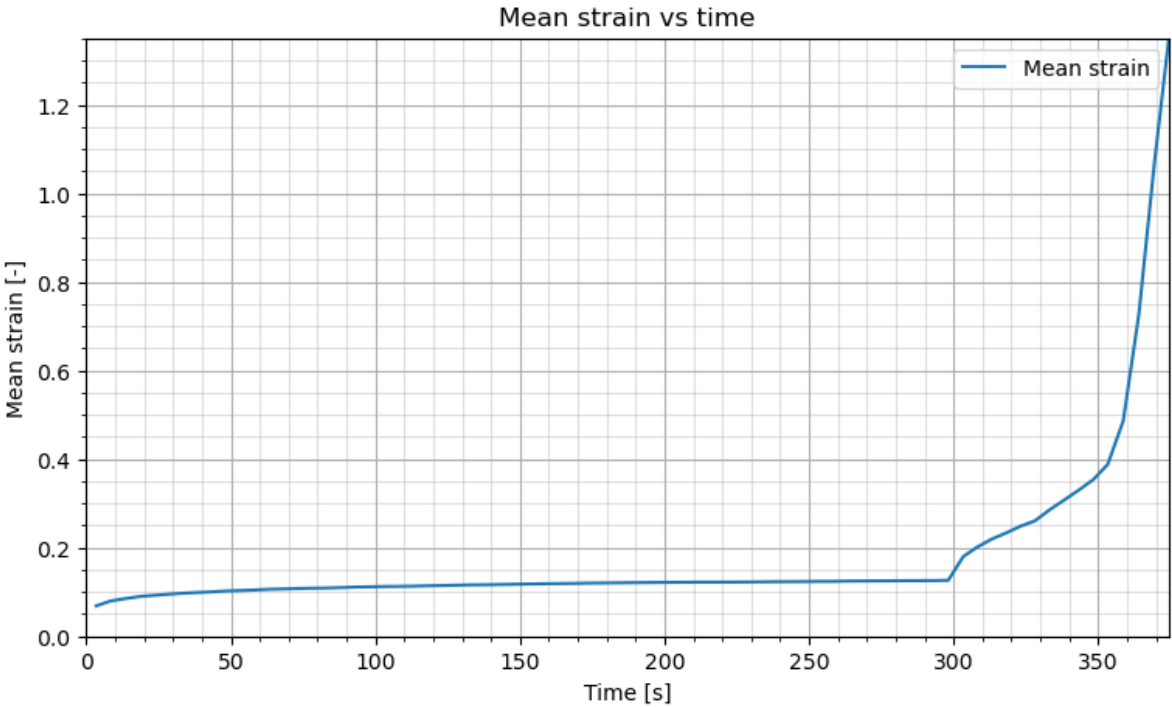
Stress-strain relation



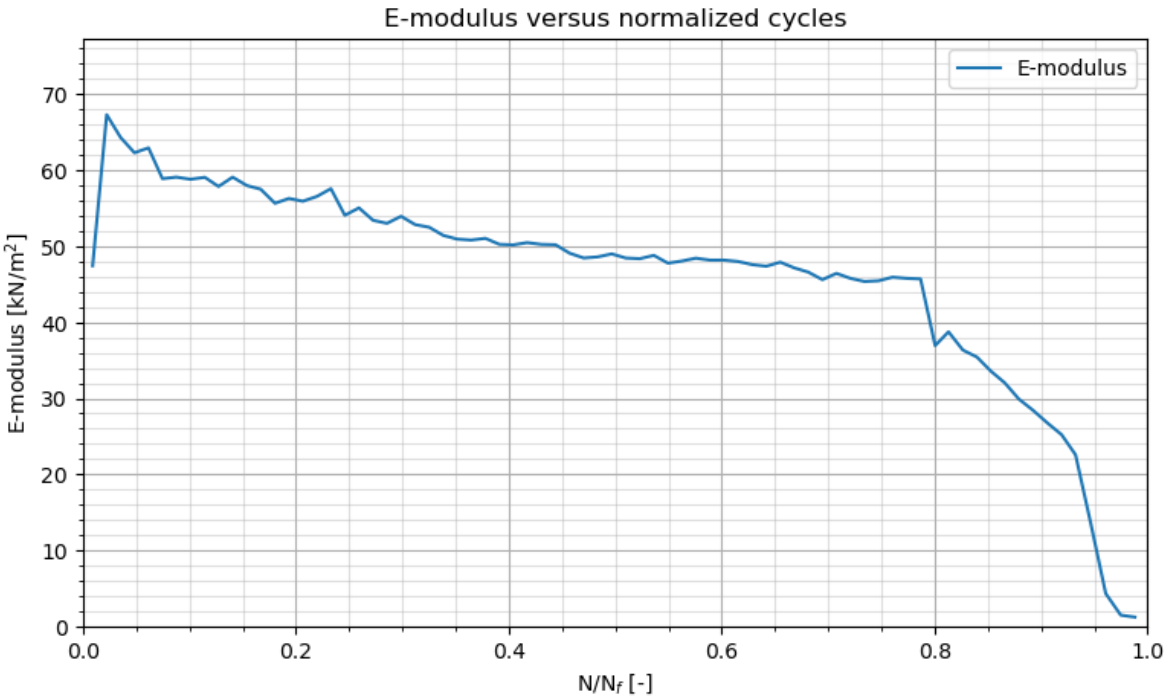
Strain over normalized cycles



Mean strain over time



E-modulus over time



Test sample pictures



(a) Top



(b) Left



(c) Bottom



(d) Right