

Editing a Template in the Laboratory Program

Program:	Laboratory
File:	Demo_manual_52.gsg

This manual describes advanced work with formulas and graphs in templates using the example of editing the Shear Box Test. **Basic formula work is explained in Engineering Manual No. 51. This manual requires the knowledge covered in Manual No. 51.**

Our goal is to determine the values of the angle of internal friction φ_p and cohesion c_p at any point during the test (for the displacement specified by us at the test point x_p).

In our case, we will consider $x_p = 8 mm$.

The calculation procedure is the same as for the standard peak strength. From the stress graph of individual tests, we read the stress values at point x_p .



We then fit a straight line through the obtained points and calculate the values φ_p and c_p .



Note: We usually look for the stated value of the shear parameters in the part of the test beyond its peak in an attempt to find residual shear strength parameters. However, since the shear box test is not suitable for determining the actual residual parameters, we present the derived shear parameters for the selected deformation.

Output report of the shear box test of the template set "Laboratory - EN-Standard" has the following form:

GE05			Shear Box Te	st			
Laboratory	Project: A	partment building "Moonlig	hting" - Survey for	building permit			
Test ID:	Shear box te	st	Project ID: 2022/3548				
Supplier:	GEO5 Labor	atory Ltd.	Customer: Survey ABC Ltd.				
Date of measurement:	27.03.2023		Performed	by: John Young			
Sample							
Field test:	BH5		Sample t	/pe: undisturbed			
Sample index:	VA1/1254		Geotechnical t	/pe: GT2			
Depth from:	7,00 m		Description:				
Depth to:	7, <mark>80 m</mark>		Clay with low plast	icity, stiff, gray-blue o	olor		
Specimen							
Specimen ID: V	A1/1254-12		Consolidation time:	24,0 hour			
Depth: 7	,35 m		Shear rate:	0,001 mm/min			
		Before test	Specimen Nr. 1	Specimen Nr. 2	Specimen Nr. 3		
Dimensions (width/heig	ht) [mm]	-	60,00 / 21,00	60,00 / 21,00	60,00 / 21,00		
Moisture content [%]		22,45	24,40	24,30	22,10		
Consolidation (before t	est) [mm]	=	0,210	0.550	1,170		
Vertical stress [kPa]		-	50	100	200		
Max, shear stress [kPa	1	<u></u>	31,7	71,3	107.2		
Wet unit weight [kg/m ^{3·}	1	1802.0	1848.0	1921.0	1967.0		
Drv unit mass [kg/m ³]		1472,2	1485,5	1545,4	1610,9		
Displacement at failure	[mm]	-	1,530	2,061	3,080		
Measured values and r	esults			L			
105,0	×	100,00 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 180,000 1	20000 200000 20000 20000 20000 20000 20000 20000 20000 20000 2	+0°+ +0°+ +0°2 Horizontal displac	ement Δx [mm]		
Test results:			Angle of internal fr	ction ϕ_{ef} [°]	ohesion c _{ef} [kPa]		
		Peak values:	25,8		13,8		
Notes Specimens were flooded w test specimens is after the EN ISO 17892-01). Specimen supplied by the equipment: hydraulic shear 17892-10. Verified by: Peter F	rith water during end of the test customer, test r r device. Test p ilmer	the test. Moisture content indi (moisture content determined a esults refer to the sample as re erformed in accordance with EM Date of issue: 28.03.2	cated for the ccording to ceived. Test I ISO 2023				
section by. I otel I		Bare 61 18646. 20.00.2		Stamp and s	ignature		

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The required form of the protocol is this:

CEOF		Shear Box Te	st			
Laboratory	not: Anortmont building "Man	directing" Cuprov for	building namit			
Test ID: Shear	box test	Projec				
Supplier: GE05	Laboratory Ltd	Customer: Survey ABC Ltd				
Date of measurement: 27.03.3	2023	Performer	t by: John Young	Ltu.		
	1023	1 enonnee	a by: John Foung			
Sample						
Field test: BH5		Sample t	ype: undisturbed			
Sample index: VA1/12	254	Geotechnical t	ype: GT2			
Depth from: 7,00 m		Description:	inity stiff grow bl			
Depth to. 7,80 m		Ciay with low plast	icity, still, glay-bit			
Specimen		T				
Specimen ID: VA1/125	4-12	Consolidation time	24,0 hour			
Depth: 7,35 m		Shear rate	: 0,001 mm/min			
	Before test	Specimen Nr. 1	Specimen Nr.	.2 Specimen Nr. 3		
Dimensions (width/height) [mm	1] -	60,00 / 21,00	60,00 / 21,0	0 60,00 / 21,00		
Moisture content [%]	22,45	24,40	24,30	22,10		
Consolidation (before test) [mr	n] -	0,210	0,550	1,170		
Vertical stress [kPa]	-	50	100	200		
Max. shear stress [kPa]	5	31,7	71,3	107,2		
Wet unit weight [kg/m ³]	1802,0	1848,0	1921,0	1967,0		
Dry unit mass [kg/m³]	1472,2	1485,5	1545,4	1610,9		
Displacement at failure [mm]	Ξ.	1,530	2,061	3,080		
Measured values and results						
105,0 90,0 75,0 100,0 10,0 100,0	tical stress σ _v [kPa]	4x 100,0 75,0 50,0 50,0 50,0 8 25,0 9 0,00		splacement Δx [mm]		
Test results:		Angle of internal fr	iction φ _{ef} [°]	Cohesion c _{ef} [kPa]		
	Peak value	s: 25,8		13,8		
Post peak	values at displacement 8,0 mi	m: 22,1		8,5		
Notes Specimens were flooded with water test specimens is after the end of th EN ISO 17892-01). Specimen supplied by the customer equipment: hydraulic shear device. 17892-10.	r during the test. Moisture content in the test (moisture content determine r, test results refer to the sample as Test performed in accordance with	ndicated for the d according to s received. Test EN ISO				

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Stamp and signature

Solution:

Edit the template with the demo file - Demo01.gla, which you can find in Fine online examples. Name the newly created template set EM 52 and save it in the Template Administrator for further use. We introduce the term "Post peak parameters" for the required parameters within the solution of this manual.

We will divide the solution of the problem into several parts:

- 1. Define the data type "Displacement for post peak strength" and fill in its value
- 2. Define other data types needed for calculation and plotting in the graph
- 3. Input formulas for automatic calculations
- 4. Edit the output log and desktop preview to include the new data

Part 1

First, open the Demo01.gla file, which contains the data we will be working from. In the Templates frame, check if we have set the template set we want to edit – "Laboratory - EN-Standard". Press the "Edit copy of current template set and add it into the Administrator" button to open the template set editing window.

Assign a name to the created set of templates and save it in the administrator as a user template.

Open the template for the shear box test and add a new local data type into the "Basic data" group, name it **"Displacement for post peak strength"** and assign the following parameters:

- Type: Number
- Unit type: length
- Name: Displacement for post peak strength
- Symbol: -
- Empty text: -
- Metric unit: mm, 1 decimal place
- Imperial unit: in, 3 decimal places

Parameters of data type Type: "Group Name: Bainc data Type Baanceters Name: Bainc data Type Comment: Type Comment: Type Comment: Type Comment: Type Comment: Type Comment	it	data type								
ype: Group v tame:	а	meters of data type								
anne		Group =								
harameters Nome Identifier Type Parameters 10 Date of measurement 0 Date and time Date 1 2 Performed by 0 String 1		Basic data	▼ 🛪 EN Comment:	B	▼ 3A	Identifier :				
No. Name Identifier Type Parameters 1 Date of measurement 0 Date and time Date 2 Performed by 0 String 1 3 Verified by 0 Oate and time Date 4 Date of tisse 0 Date and time 1 5 Notes 0 Date of tisse 1 6 Diplotement for post peak strength Number 8.9 mm 8.9 mm 6 String Number 8.9 mm 8.889 in	H	eters								
1 Date and time Date 2 Performed by 0 4 Date of measurement 0 5 Verified by 0 6 Date and time Date 7 Date of suse 0 6 Displacement for post peak strength 0		Name	2	Identifier	Type	Parameter	rs	Comment		vdd
2 Performed by 0 String Image: String	D	ate of measurement	0		Date and time	Date			1	to the end)
3 Verifie by 0 String Image: 1 4 Date of Issue 0 Date and time Date of Issue Image: 1 6 Displacement for post peak strength 0 Number 8.9 mm 8.889 in Image: 1 6 Displacement for post peak strength 0 Number 8.9 mm Image: 1 Image: 1<	P.4	erformed by	0		String					
4 Date of size: 0 Date and time Date 5 Notes: 6 String Multilite string 6 Displacement for post peak strength 0 Number 8.889 in	v	erified by	o.		String					
5 Notes: o String Multilie string 6 Diplacement for post peak strength Number 8,889 in 8,889 in 8,889 in 8,889 in 8,889 in 8,889 in 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	p	ate of issue	0		Date and time	Date				
E Displacement for post peak strength Number A 9 mm A 9 mm A 8 mm	N	otes	0		String	Multiline string			_	
anges	D	isplacement for post peak streng	th 🖱		Number	8,9 mm 8,889 in				
anges									6)	Copy
anges									31	aste
formula Type connot be calculated Conditional input Asster enumeration : (unspecified) • No enumerations defined for using as master.	e									
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Conditional input Asster enumeration : (unspecified) Vio enumerations defined for using as master.	ç	annot be calculated							Edit	
faster enumeration : (unspecified) v No enumerations defined for using as master.	n	ditional input								
	21	enumeration : (unspecified)	 No enumeration 	ns defined for using as r	naster.					
							1		1	

Note: Creating local data types and basic work with templates is described in detail in Engineering Manual 51.

Save the edited template and proceed into the "shear box test" frame and open the already input test.

In the window, we see a new field for the data type we created, "Displacement for post peak strength". We will fill in 8 mm according to the specifications. We will then use this value in further calculations.

Note: by having this value already filled in, we will see previews of specific calculations when creating formulas. This will make our work easier.

<mark>8 Edit t</mark> est:	<mark>Shear box t</mark>	est	Los estructures						×
Test ID :	Shear I	box test							
Sample ind	ex : VA1/12	254						Select sa	mple 🔻
Basic data	Specimen	Specimen Nr. 1	Specimen Nr. 2	Specimen Nr. 3	Results	Calculations	Attachments	5	
Date of m	easurement	:	27.03.2023						
Performed by :			John Young						
Verified by	<i>ı</i> :		Peter Filmer						
Date of iss	sue :		28.03.2023						
Notes :			Specimens were the test specimer according to EN Specimen supplie	flooded with wate ns is after the end ISO 17892-01). ed by the custome	r during t of the te er, test res	he test. Moist st (moisture co sults refer to th	ure content ir ontent determ ne sample as	ndicated f nined received.	or
Displacem	ent for post	t peak strength :	~	8,0 [mm]					
✓ Recalcul	ate						✔ OK	×c	ancel



Part 2

Now return to the template modification and into group "Specimen Nr. 1" add another local data type "Post peak shear stress" with the following parameters:

- Type: Number
- Unit type: pressure
- Name: Post peak shear stress
- Symbol: τ_{pp}
- Empty text: -
- Metric unit: kPa, 1 decimal place
- Imperial unit: psi, 3 decimal places

This data type will not be entered by the user, but we will assign a formula to it for automatic calculation.

We need the same data type in the group for specimens 2 and 3. To save ourselves the work, we can now copy the created item and press the "OK + down arrow" button to go straight to the "Specimen Nr. 2" group, where we simply paste the item.

避 Edit data type						_ D X
Parameters of data type						
Type : Group 👻						
Name : 40 Specimen Nr. 1 👻 🛪 EN Commen	t: 🗈	 ▼ [*]A 	Identifier :			
Parameters						
No. Name	Identifier	Туре	Parameters	Comment		_ Add
4 Dry unit mass		Number	8,9 kg/m ³ 8,89 lb/ft ³		^	(to the end)
5 Moisture content 6		Number	8,89 % 8,89 %			(before 11)
6 Vertical stress		Number	9 kPa 8,889 psi			Contemporation (number 11)
7 Consolidation (before test) 6		Number	8,889 mm 8,8889 in			Remove (number 11)
8 Displacement at failure 6		Number	8,889 mm 8,8889 in			
9 Shear - measurement 6 Horizontal displacement 6 Vertical displacement 6 Shear stress 6 Mobilized friction angle 6		Table Number Number Number Number	General Number of elements 4			
10 Max. shear stress 6		Number	Symbol: τ _{max} 8,9 kPa 8,889 psi			Move upwards (number 11)
11 Post peak shear stress		Number	Symbol: τ _{pp} 8,9 kPa 8,889 psi		Ţ	(number 11)
Ranges					1	
Formula				/		
Type cannot be calculated					Edi	Ú.
Conditional input						
Master enumeration : (unspecified) * No enumeration	ons defined for using	as master.		¥		
🖹 Local data type			OK	(+ 🕇 OK + 🗍	√ 0	K X Cancel

Continue by also pasting it into the group "Specimen Nr. 3".

Next, we continue by creating data types for the calculations and output logs. In the "Results" group we already have two data types for the results in the peak values. We can now copy and then re-paste these two data types into the same group. The program will warn us that the same data types are already in the group, yet we select to paste them again.

🔒 Edit c	data type			•							
Param	neters of data type										
pe : G	Group 👻										
ame :	Ab Results	▼ XA E	N Comment	: 🖪		▼ X _A	Identifier :				
ramet	ters										
o.	Nam	ne		Identifier		Туре	Paramete	rs	Comment	+	Add
Ang	gle of internal friction		6		Numb	er	Symbol: φ _{ef} 8,9 ° 8,9 °				(to the end)
Col	hesion		6		Numb	er	Symbol: c _{ef} 8,9 kPa 8,889 psi				
	Paste data types									×	:
	Paste data types	ame		Type Number	Paste	Replace	Same as existing data typ	Note be No. 1 "Angle o	f internal	×	
	Paste data types Na Angle of internal friction Cohesion	ame		Type Number Number	Paste V	Replace	Same as existing data ty; friction". Will be pasted a Same as existing data ty; pasted as a new data ty;	Note pe No. 1 "Angle o is a new data type pe No. 2 "Cohesio ie.	f internal 2. n". Will be	×	с ру
	Paste data types Na Angle of internal friction Cohesion	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note pe No. 1 *Angle o is a new data typ pe No. 2 *Cohesio ie.	f internal 2. n". Will be	×	c py ite
nges	Paste data types Na Angle of internal friction Cohesion	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note be No. 1 "Angle o bis a new data typi be No. 2 "Cohesia le.	f internal 2. n°. Will be	×	by .te
nges	Paste data types Na Angle of internal friction Cohesion	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note be No. 1 "Angle o is a new data typ pe No. 2 "Cohesio e.	f internal e. n". Will be	¥ Paste	py ite
nges	Paste data types Angle of internal friction Cohesion	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note pe No. 1 "Angle o pe No. 2 "Cohesio e. •	f internal 2. n". Will be	¥ Paste X Close	py ite
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nges mula pe cai	Paste data types Na Angle of internal friction Cohesion Innot be calculated	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note be No. 1 "Angle o is a new data typ be No. 2 "Cohesio le. •	f internal 2. n". Will be		c py te
nges rmula ı/pe candi	Paste data types Na Angle of internal friction Cohesion nnot be calculated titonal input	ame		Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note be No. 1 "Angle o is a new data typp e No. 2 "Cohesia ie.	f internal 2. n". Will be	 ✓ Paste ✓ Close Edit 	py te
nges rmula pe cau Condi ister c	Paste data types Angle of internal friction Cohesion Cohesion Innot be calculated itional input enumeration : (unspecified)	ame	No enumeratio	Type Number Number	Paste	Replace	Same as existing data typ friction". Will be pasted a Same as existing data typ pasted as a new data typ	Note De No. 1 "Angle o Sa new data typ se No. 2 "Cohesio e.	f internal 2. n". Will be	F Paste Close	y te



Now simply open the newly added items and edit the name and symbol, e.g. by adding "(pp)", referring to post peak strength.

😹 E	dit data type						– 🗆 X
— Pa	arameters of data type						
Туре	: Group 👻						
Nam	ne : 🏟 Results 🔹	🛪 EN Comment : 🚦		▼ X _A	Identifier :		
Para	meters						
No.	Name		Identifier	Туре	Parameters	Comment	🛓 Add
1	Angle of internal friction	0		Number	Symbol: φ _{ef} 8,9 ° 8,9 °		(to the end)
2	Cohesion	0		Number	Symbol: c _{ef} 8,9 kPa 8,889 psi		
3	Angle of internal friction (pp)	B		Number	Symbol: φ _{ef(pp)} 8,9 ° 8,9 °		
4	Cohesion (pp)	12		Number	Symbol: c _{ef(pp)} 8,9 kPa 8,889 psi		_
8							All Copy
							Paste
Rang	ges						
Form	nula						
Тур	e cannot be calculated						Edit
— Ce	onditional input						
Mas	ter enumeration : (unspecified)	 No enumerations of 	defined for using a	s master.			
	Local data type				0	K + 🕇 OK + 🖊 🗸	OK X Cancel



In the same way, copy the tables in the "Calculations" group - and name them "Post peak strength".

😹 Edit data type					_ D X
- Parameters of data type					
Type : Group 👻					
Name : 🚯 Calculations 💌 🛪 EN Co	omment : 🛅	▼ \$	Identifier :		
Parameters					
No. Name	Identifier	Туре	Parameters	Comment	+ Add
1 Peak strength - points (graph) Shear stress Vertical stress	6 6	Table Number Number	General Number of elements 2		(to the end)
2 Peak strength - Tangent line Tangent line slope Tangent line shift Vertical stress Shear stress	6 6 6 6 6	Table Number Number Number Number	General Number of elements 4		
3 Post peak strength - points (graph) Shear stress Vertical stress	6 0	Table Number Number	General Number of elements 2		
4 Post peak strength - Tangent line Tangent line slope Tangent line shift Vertical stress Shear stress	6 6 6 6	Table Number Number Number Number	General Number of elements 4		_
					Copy All
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Type cannot be calculated					Edit
Conditional input					
Master enumeration : (unspecified) * No enu	umerations defined for using a	as master.			
Local data type			OK + 🕇	-	OK X Cancel



Part 3

Now we will continue by entering the formulas.

Note: Basic work with formulas is explained in Engineering Manual 51.

In the tree, find the newly created data "Post peak shear stress" under the group "Specimen Nr. 1" and open the window for adding the formula. Here we press the button to add a function.

Sample index (String) Sasic data (Group)		ft	
> Basic data (Group)			X)
			e. Na sant
Specimen (Group)			nsert
✓ Specimen Nr. 1 (Group)		M	lultilingual text
Width [mm] (Number)		- 0	Calculation unit
Height [mm] (Number) Wet unit weight [kg/m ³] (Number) Dry unit mass [kg/m ³] (Number) Moisture content [%] (Number) Vertical stress [kPa] (Number) Consolidation (before test) [mm] (Number) Displacement at failure [mm] (Number) Shear - measurement (Table)	Result preview	al results	data kPa
Max. shear stress - τ _{max} [kPa] (Number) Post peak shear stress - τ _{pp} [kPa] (Number)			
Specimen Nr. 2 (Group)			

The basic version of the shear box test template works with the "Shear - Measurement" table, in which the user enters the Horizontal displacement, vertical displacement and shear stress. For the peak parameters, the maximum entered shear stress is considered. In the task specification, we have defined that we will consider the surface parameters for the specified horizontal displacement - in this task we consider 8 mm. Using the linear interpolation function, we must therefore calculate the given shear stress for the selected horizontal displacement.

The function can be found in the list under "LINEARINTERPOLATION".

The function calculates the stress value (y) for the specified displacement (x) from the "Shear - Measurement" table.

The variables in the function are:

- x Displacement for post peak strength
- Coordinates x "Horizontal displacement" in the Shear measurement table
- Coordinates y "Shear stress" in the Shear measurement table



The notation of the function is as follows:

Height [mm] (Number)	*	LINEARINTERPOLATION(- Insert function -
Wet unit weight [kg/m ³] (Number)		{Displacement for post peak strength};{Δx\$};{τ\$})	f(x)
Dry unit mass [kg/m ²] (Number)			- Insert
Vertical stress [kPa] (Number)	- 15		Multilingual text
Consolidation (before test) [mm] (Number)		"	- Calculation unit
Displacement at failure [mm] (Number) Shear - measurement (Table) Number of row			By data kPa
Horizontal displacement - Δx [mm] (Number)			
Vertical displacement - Δz [mm] (Number)		Result preview	
Shear stress - τ [kPa] (Number)		Field test : Shear hey test	
Mobilized friction angle - φ _{mob} [°] (Number) Max. shear stress - τ _{max} [kPa] (Number) Post peak shear stress - τ_{pp} [kPa] (Number)		25,7	
Specimen Nr. 2 (Group)			
Specimen Nr. 3 (Group)	45		
Results (Group)	-		

Enter the formulas for the post peak shear stress for specimens 2 and 3 in the same way.



The correctness of the input can be verified at any time in the test input window, where we can see the calculated values of the surface shear stress for our selected displacement of 8 mm.

est ID :	Shear box test						1.1.2.1
amp <mark>le</mark> i	ndex : VA1/1254						Select sample
asic dat	ta Specimen Specimen	Nr. 1 Specimen Nr. 2	Specimen Nr.	3 Results	Calculations	Att	achments
Width :		60,00	[mm]				
Height		21,00	[mm]				
Wet uni	it weight :	1921,0	[kg/m ³]				
Drv uni	t mass :	1545.4	[ka/m ³]				
Moistur	e content :	24 30	1961				
Intical	ctrocc i	100	[kDo]				
- uca	suess .	0.550	[KPd]				
.onsoli	dation (before test) :	0,550	[mm]				
Displac	measurement :	2,061	[mm]				
No.	Horizontal displacement Δx [mm]	Vertical displacement Δz [mm]	Shear stress τ [kPa]	Mobilized Pr	friction angle		+ Add (to the end)
1	0,023	0,000	10,746		6,1	*	
2	0,055	-0,005	10,746		<mark>6</mark> ,1		
3	0,118	-0,014	21,692		12,2		
4	0,172	-0,020	31,542		17,5		
5	0,196	-0,025	34,030		18,8		
7	0,408	-0.044	43,980		21,0		
8	0,520	-0,053	48,259		25,8	-	:= -
Max. sh	ear stress : T _{max} =	71,3	[kPa]				
ost pe	ak shear stress : τ _{pp} =	54,0	[kPa]				

Next, we continue by entering the formulas for plotting the graph. We have prepared two tables in the data. The first plots the points in the graph, the second plots the line (trend line). As we can see in the tree of the formula editing window, the data we copied was copied including the formulas.

We start by editing the table plotting the points. The "Vertical stress" column is the same as the one in the table for the peak parameters, so we don't need to modify it. Therefore we will modify the formula for the "Shear stress" column.

mulas	
Shear stress - τ (Number)	Formula - Shear stress
Mobilized friction angle - φ _{mob} (Number)	if/Pow-1-T [kPal-if/Pow-2-T [kPal-T [kPal))
Max. shear stress - Tmax (Number)	n(now = 1, tmax [kr a], n(now = 2, tmax [kr a], tmax [kr a])
Post peak shear stress - τ _{pp} (Number)	Edit
' Specimen Nr. 3 (Group)	
Width (Number)	
Height (Number)	
Wet unit weight (Number)	
Dry unit mass (Number)	
Moisture content (Number)	
Vertical stress (Number)	
Consolidation (before test) (Number)	
Displacement at failure (Number)	
✓ Shear - measurement (Table)	
Horizontal displacement - Δx (Number)	
Vertical displacement - Δz (Number)	
Shear stress - τ (Number)	
Mobilized friction angle - φ_{mob} (Number)	
Max. shear stress - Tmax (Number)	
Post peak shear stress - Tpp (Number)	
Results (Group)	
Angle of internal friction - φ_{ef} (Number)	
Cohesion - cef (Number)	
Angle of internal friction (pp) - weffer (Number)	
Cohesion (pp) - Cef(np) (Number)	
Calculations (Group)	
V Peak strength - points (graph) (Table)	
Shear stress - τ (Number)	
Vertical stress - σ _v (Number)	
V Peak strength - Tangent line (Table)	
Tangent line slope - k (Number)	
Tangent line shift - c (Number)	
Vertical stress - σ_v (Number)	
Shear stress - τ (Number)	
V Post peak strength - points (graph) (Table)	
Shear stress - τ (Number)	
Vertical stress - σ_v (Number)	
V Post peak strength - Tangent line (Table)	
Tangent line slope - k (Number)	
Tangent line shift - c (Number)	
Vertical stress - a. (Number)	
Shear stress - T (Number)	

Here we see that we use the IF formula to fill the table in a way, so that the first row of the table is filled with the data of the first specimen, the second row with the data of the second specimen, and the third row with the data of the third specimen.

In the formula, we just need to replace the references to Max. shear stress with references to Post peak shear stress, always for the respective specimens. We can do this simply by pressing the left mouse button on the red framed item (which corresponds to the red reference in the formula), holding it down, and moving the mouse to the new item. This will change the link to match the newly selected data type.

Wet unit weight [kg/m ³] (Number)	•	$if({Row}=1;{\tau_{pp}[kPa]};if({Row}=2;{\tau_{max}[kPa]})$	- Insert function
Dry unit mass [kg/m [°]] (Number)		;{τ _{max} [kPa]}))	f(x)
Vertical stress [kPa] (Number)			- Insert
Consolidation (before test) [mm] (Number)			Multilingual text
Displacement at failure [mm] (Number)		»	Calculation and
> Shear - measurement (Table)			- Calculation unit
Max. shear stress - $ au_{max}$ [kPa] (Number)			kPa
Post peak shear stress - τ_{pp} [kPa] (Number) \sum			
' Specimen Nr. 2 (Group) 1 1	14		
Width [mm] (Number)		- Popult proviou	
Height [mm] (Number)		Result preview	
Wet unit weight [kg/m ³] (Number)		Field test : Shear box test 👻 🔤 Partial results	
Dry unit mass [kg/m ³] (Number)		1: 25,700	
Moisture content [%] (Number)		2 : 71,300	
Vertical stress [kPa] (Number)		3 : 107,200	
Consolidation (before test) [mm] (Number)			
Displacement at failure [mm] (Number)			
> Shear - measurement (Table)			
Max. shear stress - Tmax [kPa] (Number)			
Post peak shear stress - τ_{pp} [kPa] (Number)			
Specimen Nr. 3 (Group)			
Width [mm] (Number)	-		



The second option is to right-click on the link in the formula and press the "Change" option to select a new data type from the tree.

rmula - Snear Stress [T]		IF(Test ; Then ; Else) Specifies a logical test to perform	n
Shear - measurement (Table)	-	$if({Row}=1;{\tau_{pp}[kPa]};if({Row}=2;{\tau_{max}[kPa]})$	- Insert functio
Max. shear stress - τ _{max} [kPa] (Number)		:{Tmax[kPa]}))	f(x)
Post peak shear stress - τ _{pp} [kPa] (Number) ✓ Specimen Nr. 3 (Group)		× Remove	- Insert
Width [mm] (Number)	30		Multilingual te
Height [mm] (Number) Wet unit weight (kg/m ³) (Number)	10000		Calculation u
Dry unit mass [kg/m ³] (Number) Moisture content [%] (Number) Vertical stress [kPa] (Number) Consolidation (before test) [mm] (Number) Displacement at failure [mm] (Number)		Result preview	kPa
Max. shear stress - T _{max} [kPa] (Number)		1 : 25 700	
Post peak shear stress - τ _{pp} [kPa] (Number) > Results (Group) < Calculations (Group)	_	2 : 71,300 3 : 107,200	
Peak strength - points (graph) (Table)			
 Peak strength - Tangent line (Table) Post peak strength - points (graph) (Table) Number of row 			
Row number			
	-		

The resulting formula has the following form:

 Shear - measurement (Table) Max. shear stress - τ_{max} [kPa] (Number) 		if({Row}=1;{τ _{pp} [kPa]}; if ({Row}=2;{τ _{pp} [kPa]}; ;{τ _{pp} [kPa]}))	f(x)	ert function
 Post peak shear stress - τ_{pp} [kPa] (Number) ✓ Specimen Nr. 3 (Group) Width [mm] (Number) Height [mm] (Number) Wet unit weight [kg/m³] (Number) Dry unit mass [kg/m³] (Number) 	*		— Ins Mul Cai kPa	ert tilingual text Iculation unit
Moisture content [%] (Number) Vertical stress [kPa] (Number) Consolidation (before test) [mm] (Number) Displacement at failure [mm] (Number) Shear - measurement (Table) Max. shear stress - τ _{max} [kPa] (Number)		Result preview Field test : Shear box test * 1 : 25,700		
Post peak shear stress - τ _{pp} [kPa] (Number) Results (Group) Calculations (Group) Peak strength - points (graph) (Table) Peak strength - Tangent line (Table) Post peak strength - points (graph) (Table) Number of row		2 : 54,000 3 : 88,400		
Row number Shear stress - τ [kPa] (Number)	-			

The formula for the trendline should be adjusted automatically when copying. Nevertheless, we open it and check that the data links match the post peak strength.

Test ID (String)		LINEARTRENDANDPOINTS({\\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	- Insert function
Sample index (String)			f(x)
> Basic data (Group)			Incort
> Specimen (Group)			msert
Specimen Nr. 1 (Group)			Multilingual text
Specimen Nr. 2 (Group)			
Specimen Nr. 3 (Group)			
> Results (Group)			
Calculations (Group)			
> Peak strength - points (graph) (Table)			
> Peak strength - Tangent line (Table)		- Result preview	
 Post peak strength - points (graph) (Table) Number of row 		Field test : Shear box test 👻 📃 Partial results	
Shear stress - τ [kPa] (Number)		2; 0,407428571428571; 8,50000000000004; 0; 8,5000000000004	; NAN; NAN; 200;
Vertical stress - σ _v [kPa] (Number)		89,9857142857143	
Post peak strength - Tangent line (Table) Number of row			
Tangent line slope - k [-] (Number)	*		
			¥ Cancel



The final formulas we need to modify are in the "Results" group. In them, again, we just replace the references from the peak strength table to the post peak strength table.

Shear stress - τ (Number)	 Formula - Angle of internal friction (pp)
Mobilized friction angle - φ _{mob} (Number)	ATAN(k↓)
Max. shear stress - τ _{max} (Number)	
Post peak shear stress - τ _{pp} (Number)	Edit
Specimen Nr. 3 (Group)	
Width (Number)	
Height (Number)	
Wet unit weight (Number)	
Dry unit mass (Number)	
Moisture content (Number)	
Vertical stress (Number)	
Consolidation (before test) (Number)	
Displacement at failure (Number)	
✓ Shear - measurement (Table)	
Horizontal displacement - Δx (Number)	
Vertical displacement - Δz (Number)	
Shear stress - τ (Number)	
Mobilized friction angle - φ_{mob} (Number)	
Max. shear stress - $ au_{max}$ (Number)	
Post peak shear stress - τ _{pp} (Number)	
Results (Group)	
Angle of internal friction - φ _{ef} (Number)	-
Cohesion - c _{ef} (Number)	
Angle of internal friction (pp) - φ _{ef(pp)} (Number)	
Cohesion (pp) - c _{ef(pp)} (Number)	
Calculations (Group)	
Peak strength - points (graph) (Table)	
Shear stress - τ (Number)	
Vertical stress - σ_v (Number)	
Peak strength - Tangent line (Table)	
Tangent line slope - k (Number)	
Tangent line shift - c (Number)	
Vertical stress - σ_v (Number)	
Shear stress - τ (Number)	
Post peak strength - points (graph) (Table)	
Shear stress - τ (Number)	
Vertical stress - σ_v (Number)	
Post peak strength - Tangent line (Table)	
Tangent line slope - k (Number)	
Tangent line shift - c (Number)	
Vertical stress - σ_v (Number)	
Shear stress - τ (Number)	v



This completes the work with formulas. After returning to the test input window, we can check if the calculated values are correct.

😹 Edit test: Shear box test			2						×
Test ID : Shear box test									
Sample index : VA1/1254								Select sam	ple 🔻
Basic data Specimen Specime	n Nr. 1	Specimen Nr. 2	Specimen	Nr. 3	Results	Calculations	Attachments		
Angle of internal friction :	(Opf =		25.8	[°]]				
Cohesion :	C _{ef} =		13,8	[kPa]					
Angle of internal friction (pp) : q	₽ef(pp) =		22,1	[°]					
Cohesion (pp) :	c _{ef(pp)} =		8,5	[kPa]					
✓ Recalculate							V OK	🗙 Car	ncel



Part 4

In the next stage, we modify the graph and protocol to include the newly created data.

Note: Basic log editing work is described in Engineering Manual 51.

We'll start by modifying the protocol:

Edit tem	plate											- D X
ame : Ab	Shear box test 🔹 🛪 E	N Comment : 🛅		• 7 _A								
						Input data					List of output protoco	ðs.
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	cospiacement for post peak siterigen			Noncer	1.000	and the second						BD Dura
4	Specimen			Group	Number of	reiements /						D Miste
	Danih			Mamber							List of output documer	sts
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	Consolidation time	•		Number						2 Documentatio	n - basic	1
	Shear rate	0		Number						3 Documentatio	n - detailed	1
5	Specimen Nr. 1			Group	Number of	f elements 11						
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	Height	•		Number						Previews in left par	of the desktop	EB Deane preview
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	Moisture content			Number								
	Vertical stress	0		Number						Lis	t of mapping for export an	d import
	Consolidation (before test)			Number						No. Name	Comment	+ Add
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	Shear - measurement	0		Table								
	Horizontal displacement	0		Number								
	Vertical displacement			Number								
	Mehilized friction andle	6		Number					C004			
	May shear stress			Number					(B) All			
	Post peak shear stress			Number					(B) -			
-6	Specimen Nr. 2			Group	Number of	Felements 11			D' Paste			
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	Height	•		Number					→ Ittl calt formulas			

In the "Cell grid 6" tab, where the resulting values are shown, add a row.

it protoco													
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urrent section : [1] * + Add +	Name: 40 Protocol	▼ 34 EN 1	Frame Thickness :	0,41 (mm) Color .	▼ Pape	er size : A4	* Тор.	15.0 (nm) Botom :	15,0 (mm)	Arial	•	Fiet	i test :
			Inner lines Thickness :	0,20 Imm] Calor :	▼ Lay	sut : portrait	* Left :	15,0 [cum] Right :	15,0 [mm]			Shear b	ax best * Print pri
		1	Height Row :	5.0 (mm) Font:	3,5 [cereil								
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2,0 (mm) ✓ Frame on the bottom	1 : 1,0	Test re	esults:					Angle of intern	al friction	φef [°]	Cohesion cef [kPa]	GeoClipboard*	
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In the newly created cell, type the text "Post peak values at displacement", modify the formatting and add a link to the displacement data type we have chosen. The number itself can be added via the "Test data - data" option, the unit can be added via the "Test data - name" option. This will ensure that if we change the unit in the data to e.g. cm, there will be a change in the output report as well.

mber of	row : 1 Sottom margin					
em type	: Text					+ Add item (to the end
	$\mathbf{B} \ I \ \underline{\cup} \ \mathbf{e} \mathbf{b} \mathbf{e} \ \underline{\mathbf{A}} \bullet \mathbf{A} \bullet \mathbf{X} \mathbf{X}_2 \mathbf{X}^2 \equiv \Xi \equiv \Xi$	= =			Insert field -	: Insert item
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(Test data - name			×		
	Name	Symbol	Unit			
	Test ID			*		
	Sample index					
	Basic data					
	Basic data → Date of measurement					
	Basic data → Performed by					
	Basic data → Verified by					
	Basic data → Date of issue					
	Basic data → Notes					
	Basic data \rightarrow Displacement for post peak strength		mm			
	Specimen					
	Specimen → Specimen ID					
	Specimen \rightarrow Depth		m			
	Specimen \rightarrow Wet unit weight		kg/m ³			
	Specimen → Dry unit mass		kg/m ³			
	Specimen → Moisture content		%	_		
Item k	Specimen \rightarrow Consolidation time		hour	-		s -
rizont	Specimen → Shear rate		mm/min	1	Vertical text	
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rtical :	Specimen Nr. 1 \rightarrow Width		mm		• troid map	
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dit			¥ Cana			

Note: in case we would like to use the protocol in more languages, it is possible to insert "Multilingual text" via the "Insert field" option, where the text can be translated into other languages.



Then insert the corresponding data into the remaining cells. Select "Test data - data" via the "Insert field" option.

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		Height Row 5,0 (mm) Font : 3,5 (mm	6					
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2.0 [mm]	1 : 1,0	Test results:		Angle of internal frictio	n φ _{ef} [°]	Cohesion cef [kPa]	GeoClipbcard**	
Whole page frame	2 : 1,0		Peak values:	25,8		13,8	⊡ Copy	
	3 : 1,0	Post peak values at d	lisplacement 8,0 mm:	22,1		8,5	=2 Paste	
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							CK (🕹 🖌	OK X Cancel

Using the "Print Preview" button, you can view the modified report in print form. Here we can see that since we have added a line, everything no longer fits on one page.

Print and	export document																	×
	🛶 🚺 Do	cument: Shear box test - Sh	ear box test - Protoco	a - 1957	E Select all	(-) m	📄 🗐 One page											
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	and edit		_			width page	n 🛄 Book							_	 	 	 	
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	Loss of Hostinging 2	1.93.2023	Paritowed	t oy, John Young														
	Field test. 8	115	Semple b	ype: undisturbed		_												
	Sample index 10	A1/1254	Geolechnical P	ype GT2		_												
	Depth to 7	.80 m	Glay with low plast	licity, stiff, gray-blue o	olor .													
	Specimen	an a		11150														
	Specman ID: VA	1/1254-12 5 m	Consolidation Inne Streer rate	24,0 hear 0.001 mmmin		_												
		Before test	Specimen Nr. 1	Specimen Nr.2	Specimen Nr. 3	_												
	Mandane content (%)	22,45	00.00 (21,00 24,40	24,30	22,10	_												
	Consolidation (before ter	d) (em)	9,210	0,550	1,170	_												
	Max. shear stress (kPa)		31,7	71,3	107.2	_												
	Wet unit weight [ligm ³]	1802.0	1648.0	1921,0	1967.0	_												
	Displacement at twomp	am) -	1,530	2,061	3,680													
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11000																		
1	work workshow the authors	(d)	in In serve	A														



To solve this, for example, reduce the size of the graph in the "Grid cell 5" tab - each row by 0.5.

Reduce the size by 0.5 - to 7.8 for both rows.

Row height 1	×
Input mode :	row count 🔻
Height :	7,8 [rows]
✔ ОК	X Cancel

Now we can see that the protocol fits on one page again.

ort document			
Document: Shear box test - Shr	ar box test - Protocol -	Dne page	
Open	Copy It Remove selection	Appe Two III Multiple pages	
and edit Scheme: color	· · · · · · · · · · · · · · · · · · ·	ridth pages 🖾 Book	
TOGEOS	Shear Box Test		
Laboratory Present Agartment building "Mr	enistmen" - Survey for building permit		
TestID: Shear box test	Project ID: 2022/3548		
Suppler: GE05 Laboratory Ltd.	Costoner: Sorvey ABC Ut		
Field test. BHS	Sample type: undisturbed		
Sample index VA1/1254	Geofectrical type: GT2		
Depth for 7,02 m	Glay with low plasticity, stiff, gray-blue color		
pecimen			
Spectrum ID: VA1/1254-12	Consolidation Imme 24,0 bour		
Depth: 7,35 m Refore test	Steeringe 0.001 mmmmi Specimen Nr. 1 Specimen Nr. 2 Specimen Nr. 3		
amensions (width/height) (nm)	00.00 (21.00 00.00 / 21.00 00.00 / 21.00		
distance content (%) 22,45	24,40 24,30 22,10		
etteal stress (sPa)	50 100 200		
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at unit weight [light-] 1002,0 ry unit mass light-] 1472,2	1648.0 1921,0 1987,8 1485.5 1545.4 1610.9		
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estreuite:	Angle of internal triation $\phi_{e1}[1]$ Cohesion $a_{e1}[ePa]$		
Post peek values at displacement 8,0 r	HT 25,8 13,8 HT 22,1 8,6		
inter .			
performing were flooded with useer charing the test. Monitors contant interesting in affective and of the long investigation contant	indicated for the		
\$150 17892.01) per men taggéné for the container, test results infer to the spenic	as received Tool		
ragment bydrauk theor device. Testperformed in accordance wir 7892-10.	n EN 160		
Verified by: Peter Filmer Date of Issue: 31	03 3023 Damp and signature		
(2012) - Lanendry (32 M) (names - 3.2004 M) (hardware key 72807 3) (h	dhe Lauret) Daywydd 5 2006 Pine senii sir o All Pights Reserved) www.hnaudhweisiou(

Last remaining task is to add the new data to the graph. Click on the graph and open the editing window.



Press the "Add serie" button.



Select the table "Post peak strength - points", the main axis "Vertical stress" and the secondary axis "Shear stress".

tem type : Chart		•					+ Add item (to the end
Number	Table	Main a	axis		Side axis	+ Add serie	∃ Insert item (before 1)
1 Calculations / I	Peak strength - points (graph)	Vertical stress	[kPa]	Shear stress	[kPa]	All Edit coria 1	
2 Calculations / I	Peak strength - Tangent line	Vertical stress	[kPa]	Shear stress	[kPa]	← Euit selle 1	
						X Delete serie 1	
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		Data source				Serie 1	
		Table : Calcul	lations / Post pe	eak strength - points	; (graph) 🔻	+_ Edit main axis	
		Main axis : Vertica	al stress		-	Settings	
		Side axis : Shear	stress		-	to Edit settings of	
		- Chart settings -				side axis	
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lorizontal : left	▼ Part of width :	100 [%]					
		100 [94]					
/ertical : center	 Part of neight : 	100 [70]					

Add the post peak strength trendline in the same way. We can see the two new series in the graph:





Finally, we modify the visualization of the two new series to suit our requirements:

Note: The editing of graphical visualization of the graphs is explained in Engineering Manual 51.



This modified protocol corresponds to the specification.

GE05			Shear Box Te	st		
Laboratory	Drojaat: Ana	rtmont building "Moonli	abting" Suprov for	huilding normit		
TostID	Project. Apa	intinent building Moonii	griting - Survey for I			
Supplier:	GE05 Laborato	vrv I td	Custor	D. 2022/3340	td	
Date of measurement: 27.03.2023			Customer: Survey ABC Ltd.			
Date of measurement.	21.03.2023		Periolilleu	by, John Foung		
Sample						
Field test:	BH5		Sample ty	pe: undisturbed		
Sample index:	VA1/1254		Geotechnical ty	pe: GT2		
Depth from:	7,00 m		Description:			
Depth to:	7,80 m		Clay with low plasti	city, stiff, gray-blue	color	
Specimen						
Specimen ID: V	A1/1254-12		Consolidation time:	24,0 hour		
Depth: 7	,35 m		Shear rate:	0,001 mm/min		
		Before test	Specimen Nr. 1	Specimen Nr. 2	Specimen Nr. 3	
Dimensions (width/heig	ht) [mm]	-	60,00 / 21,00	60,00 / 21,00	60,00 / 21,00	
Moisture content [%]		22,45	24,40	24,30	22,10	
Consolidation (before to	est) [mm]	-	0,210	0,550	1,170	
Vertical stress [kPa]		<u> </u>	50	100	200	
	1	-	31,7	71,3	107,2	
Max. shear stress [kPa]	1					
Max. shear stress [kPa Wet unit weight [kg/m ³]	1	1802,0	1848,0	1921,0	1967,0	
Max. shear stress [kPa Wet unit weight [kg/m ³] Dry unit mass [kg/m ³]		1802,0 1472,2	1848,0 1485,5	1921,0 1545,4	1967,0 1610,9	
Max. shear stress [kPa Wet unit weight [kg/m ³] Dry unit mass [kg/m ³] Displacement at failure Measured values and r 120,0	j [mm] esults	1802,0 1472,2 -	1848,0 1485,5 1,530	1921,0 1545,4 2,061	1967,0 1610,9 3,080	
Max. shear stress [kPa Wet unit weight [kg/m ³] Dry unit mass [kg/m ³] Displacement at failure Measured values and r 120,0 105,0 90,0 75,0 75,0 15,0 15,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0	[mm] esults		1848,0 1485,5 1,530 1,500	1921,0 1545,4 2,061	1967,0 1610,9 3,080 	
Max. shear stress [kPa Wet unit weight [kg/m ³] Dry unit mass [kg/m ³] Displacement at failure Measured values and r 120,0 105,0 75,0 75,0 15,0 15,0 15,0 15,0 15,0 15,0 15,0 1	[mm] esults	1802,0 1472,2 - - - - - - - - - - - - -	1848,0 1485,5 1,530 1,500	1921,0 1545,4 2,061	1967,0 1610,9 3,080	

test specimens is after the end of the test (moisture content determined according to EN ISO 17892-01). Specimen supplied by the customer, test results refer to the sample as received. Test equipment: hydraulic shear device. Test performed in accordance with EN ISO 17892-10. Verified by: Peter Filmer Date of issue: 28.03.2023 Stamp and signature

[GEO5 - Laboratory (32 bit) | version 5.2024.19.0 | hardware key 7288 / 3 | Ondřej Laurin | Copyright © 2024 Fine spol. s r.o. All Rights Reserved | www.finesoftware.eu]



However, if we go back to the main program window, we see that the graph has remained unchanged. The graph here is displayed from the output protocol called "Desktop Preview", so we need to modify it as well.



Just copy and paste the graph and the result table into the preview.







Other protocols can be modified in the same way.