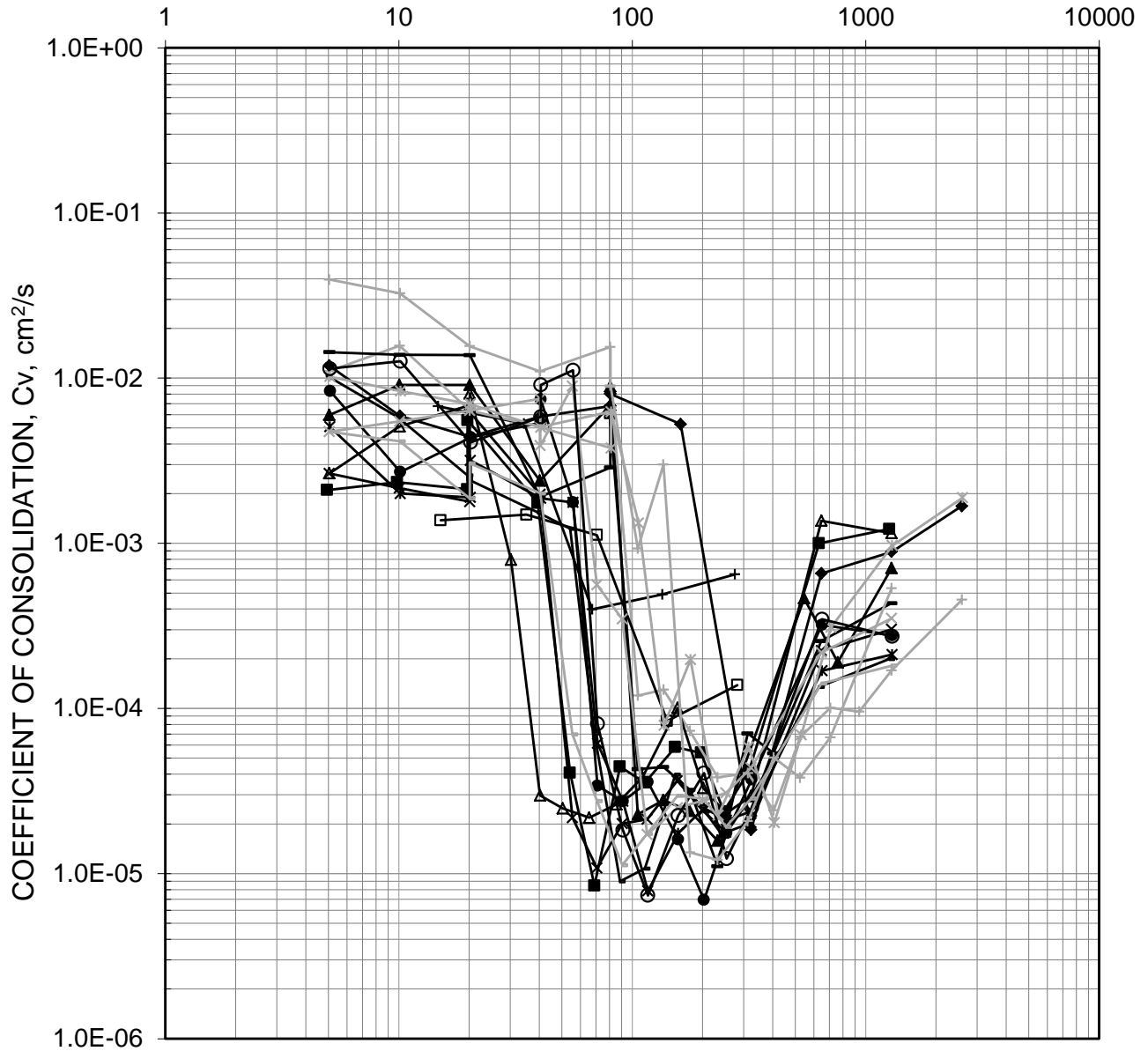




APPENDIX G


Summary of Measured/Interpreted Coefficients of Vertical and Horizontal Consolidation

PRESSURE (kilopascals)

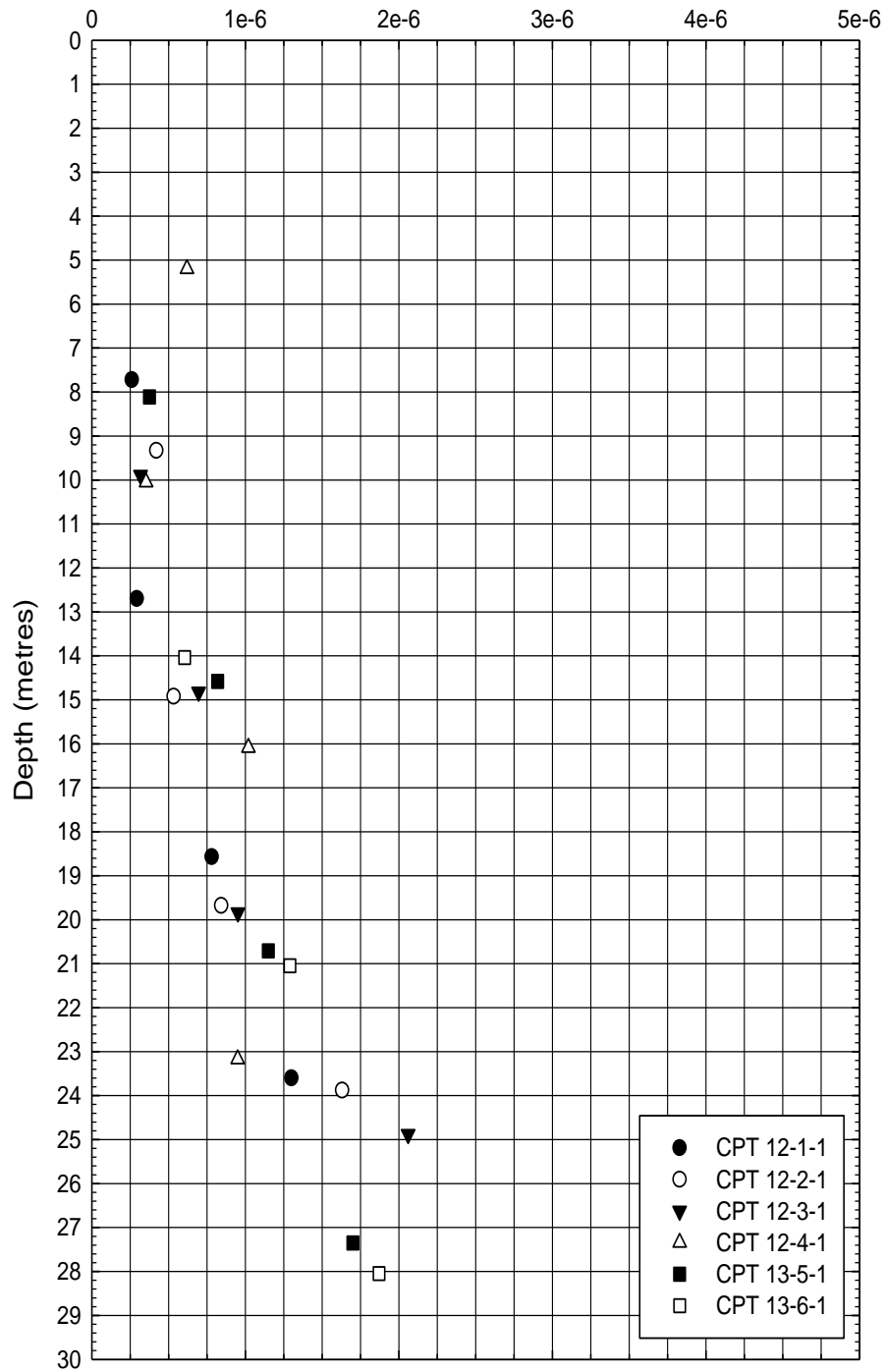


■ 12-1-3 SA 1	—+ 12-1-3 SA 2 LT	● 12-1-3 SA 4
▲ 12-1-3 SA 5	× 12-2-3 SA 1	* 12-2-3 SA 2
+ 12-2-3 SA 6	— 12-3-5 SA 1	□ 12-3-5 SA 1 LT
— 12-3-5 SA 2	◆ 12-3-3 SA 6	△ 12-4-3 SA 1
× 12-4-3 SA 3	* 12-4-3 SA 6	○ 13-6-3 SA 3
+ 13-6-3 SA 4	— 13-6-5 SA 1	

Note : LIR not = 1, use Cv's with caution

	SCALE	AS SHOWN	TITLE SUMMARY OF VERTICAL COEFFICIENTS OF CONSOLIDATION
	DATE	11/28/13	
	CADD	N/A	
	DESIGN	CW	
FILE No.	Consolidation summary	CHECK	SAT
PROJECT No.	12-1125-0045	REV.	0
		REVIEW	MIC
			FIGURE G1

Horizontal Coefficient of Consolidation (m²/s)



SCALE	AS SHOWN
DATE	11/28/13
CADD	N/A
DESIGN	MIC

TITLE	SUMMARY OF HORIZONTAL COEFFICIENTS OF CONSOLIDATION
-------	---

FILE No.	Consolidation summary	CHECK	SAT
PROJECT No.	12-1125-0045	REV.	0
		REVIEW	

FIGURE	G2
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Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position

r: piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

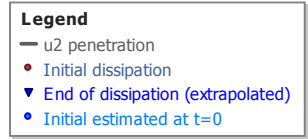
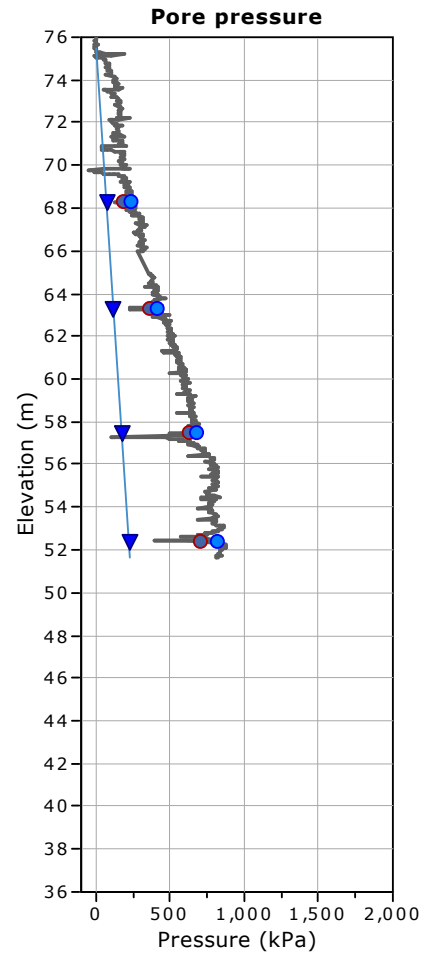
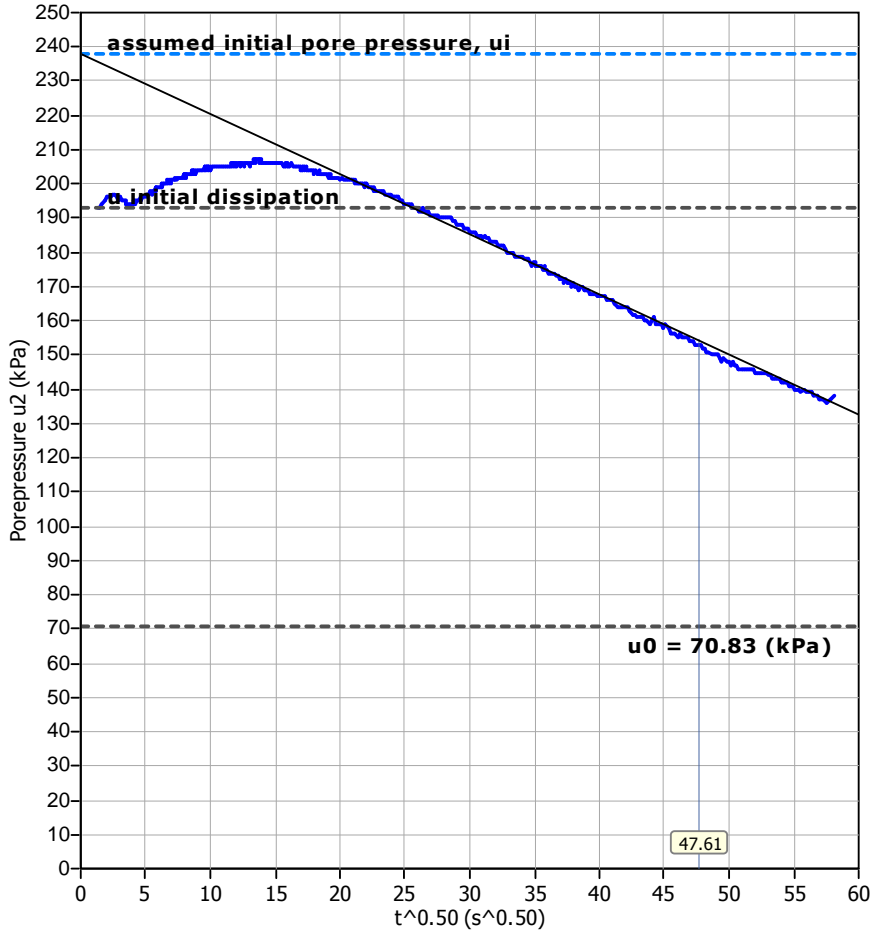
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

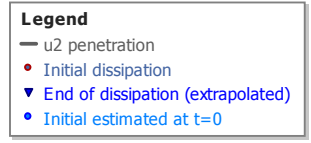
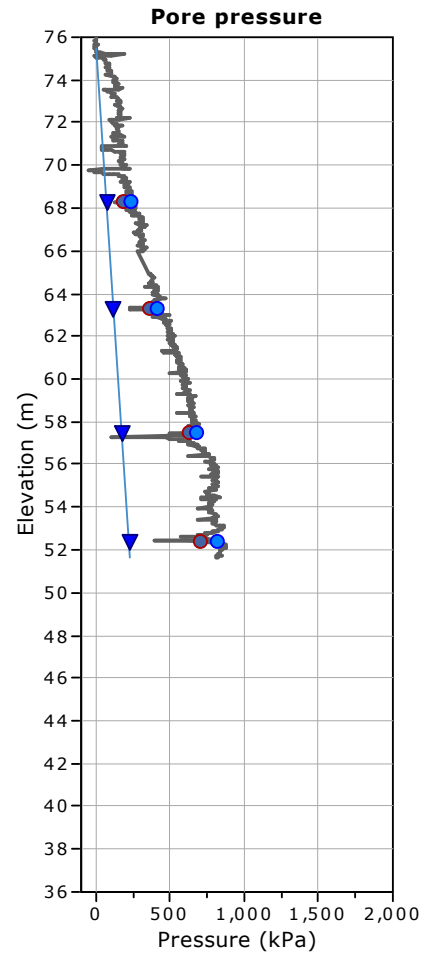
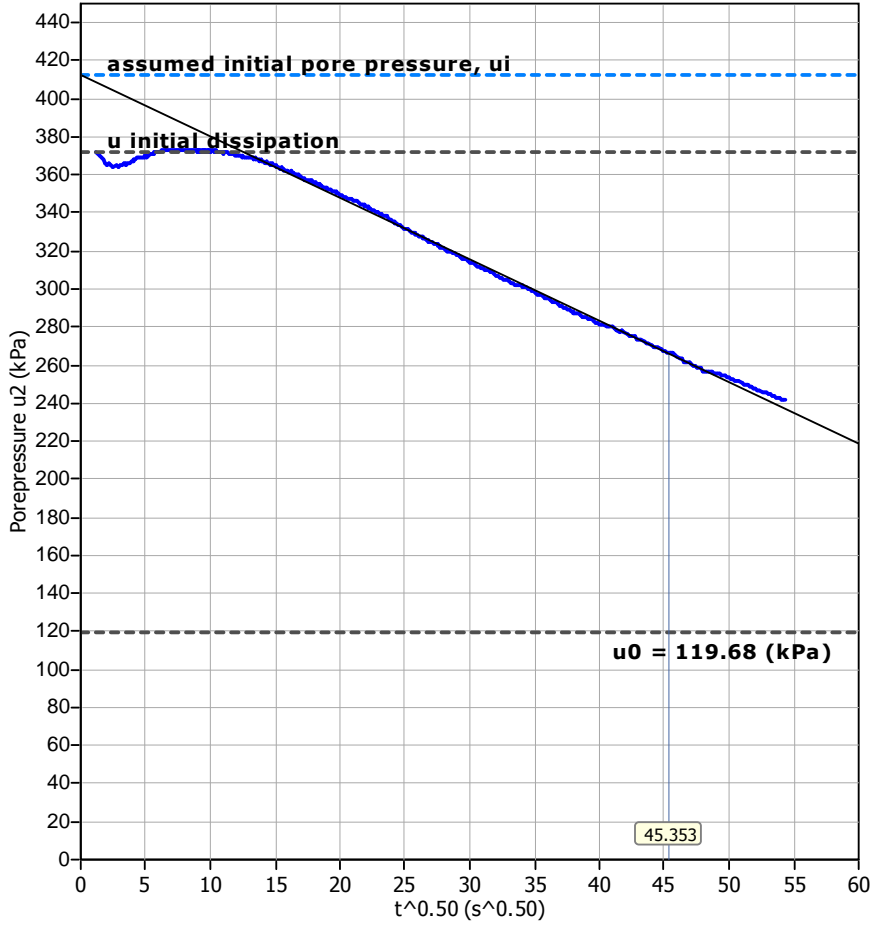
Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
12-1-1 Rev 1	7.72	47.6	2267	7.19E-005	57.00	2.61E-007	8	0.88	2.91E-009
12-1-1 Rev 1	12.70	45.4	2057	6.52E-005	59.00	2.93E-007	9	2.32	1.24E-009
12-1-1 Rev 1	18.57	25.7	659	2.09E-005	43.00	7.81E-007	25	3.71	2.06E-009
12-1-1 Rev 1	23.60	21.8	474	1.50E-005	62.00	1.30E-006	41	3.64	3.51E-009

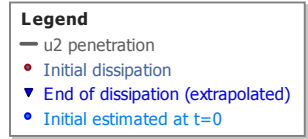
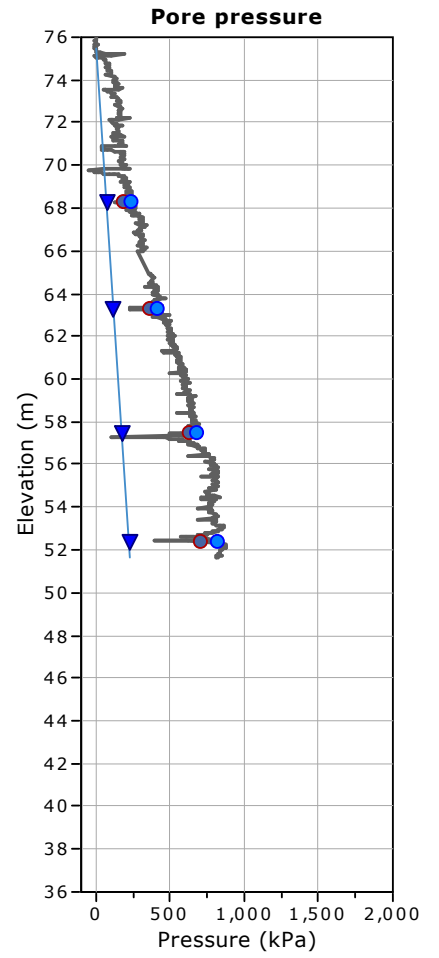
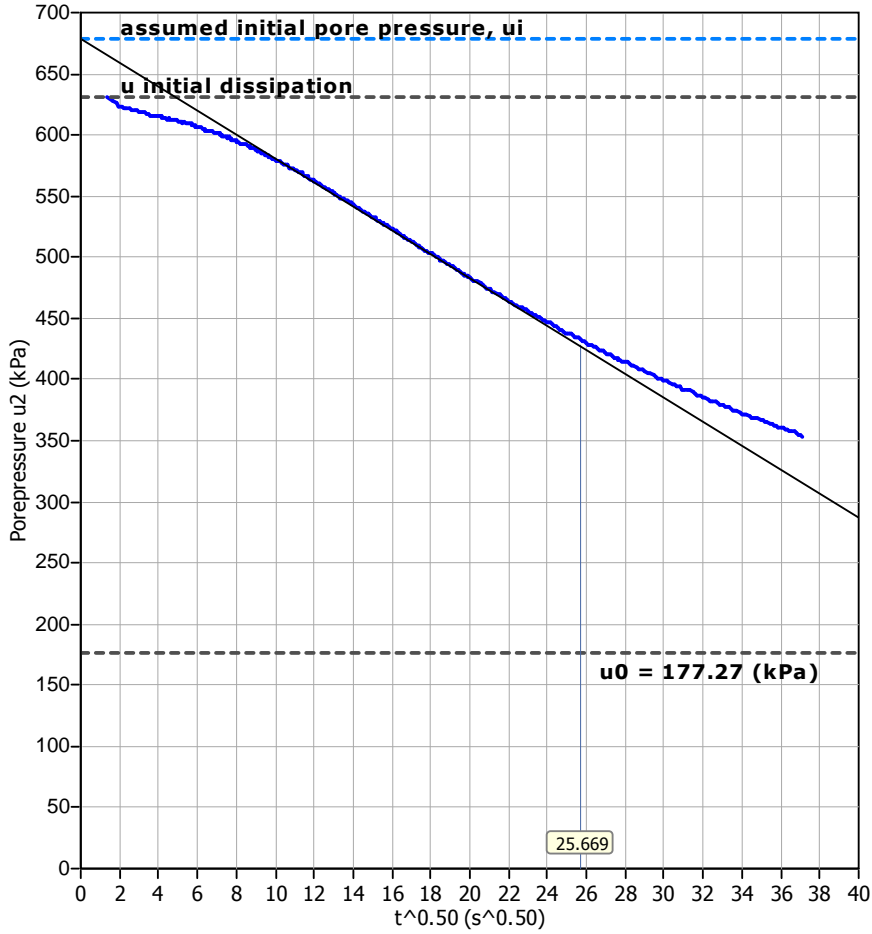
Piezocene Dissipation Test: 12-1-1 Rev 1
Depth: 7.72 (m)



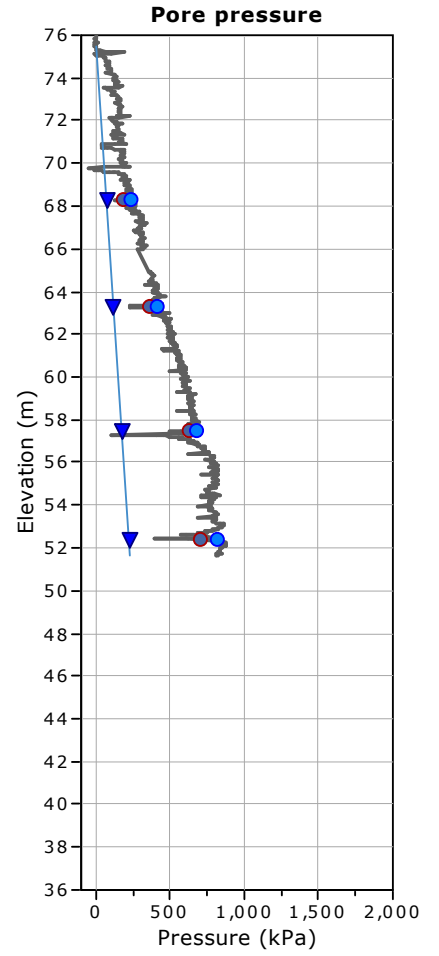
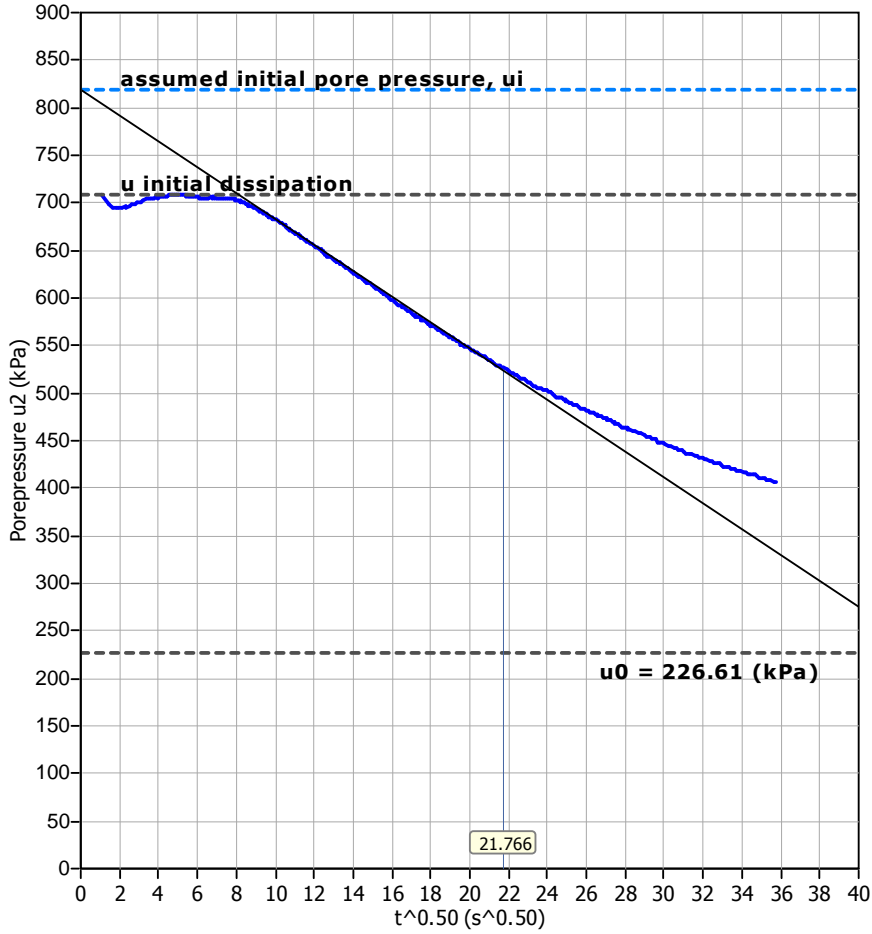
Piezocone Dissipation Test: 12-1-1 Rev 1
Depth: 12.70 (m)



Piezocene Dissipation Test: 12-1-1 Rev 1
Depth: 18.57 (m)



Piezocene Dissipation Test: 12-1-1 Rev 1
Depth: 23.60 (m)



- Legend**
- u_2 penetration
 - Initial dissipation
 - ▼ End of dissipation (extrapolated)
 - Initial estimated at $t=0$



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

- T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
- r: piezocone radius
- I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
- t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

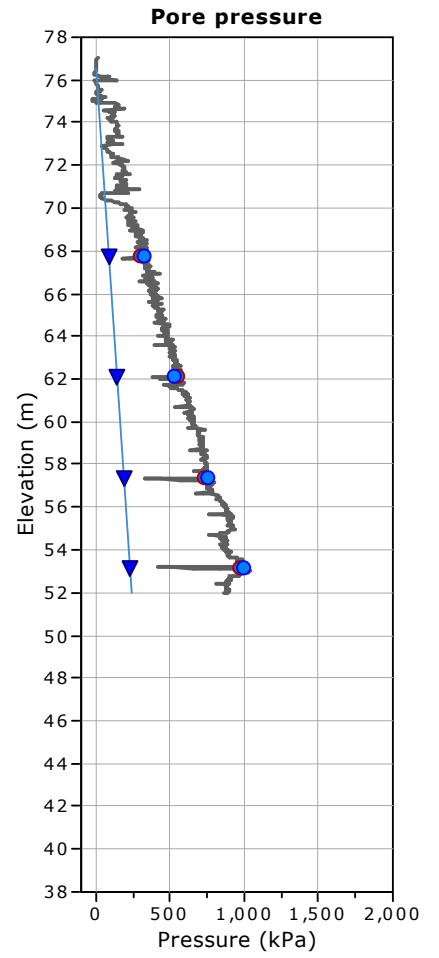
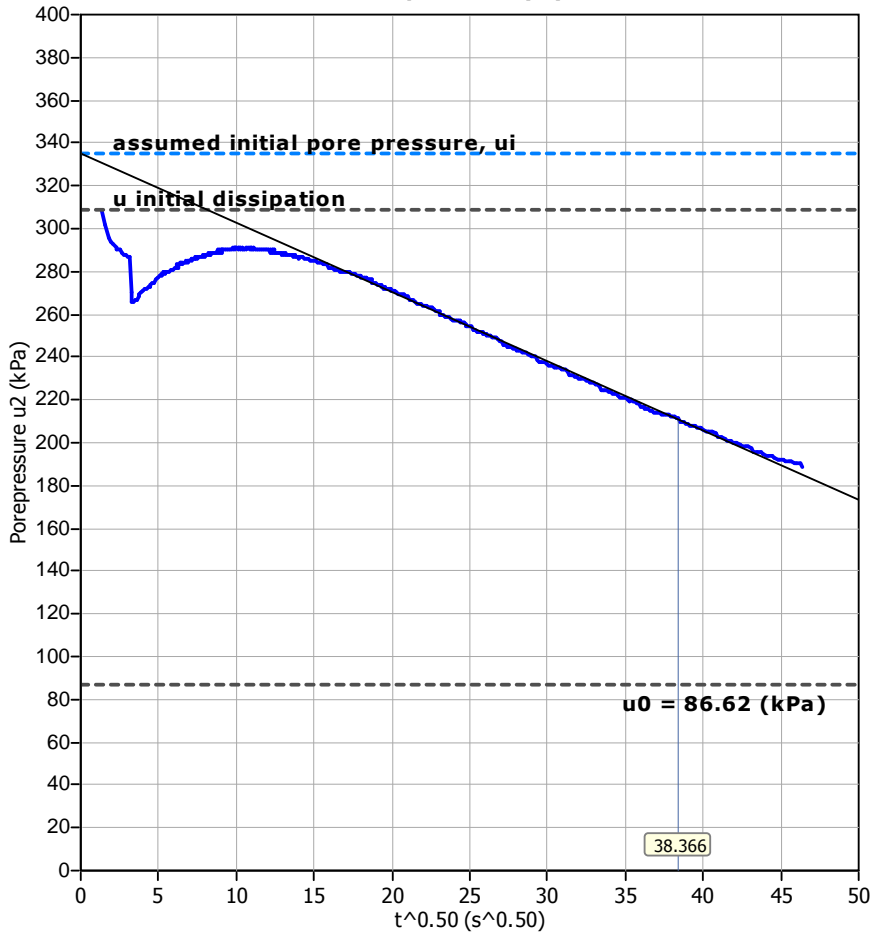
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
12-2-1 Rev 1	9.33	38.4	1472	4.67E-005	62.00	4.20E-007	13	1.57	2.62E-009
12-2-1 Rev 1	14.92	34.7	1206	3.82E-005	67.00	5.33E-007	17	2.99	1.75E-009
12-2-1 Rev 1	19.68	24.7	610	1.94E-005	43.00	8.43E-007	27	3.68	2.24E-009
12-2-1 Rev 1	23.88	19.3	371	1.18E-005	59.00	1.63E-006	51	7.50	2.13E-009

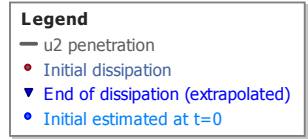
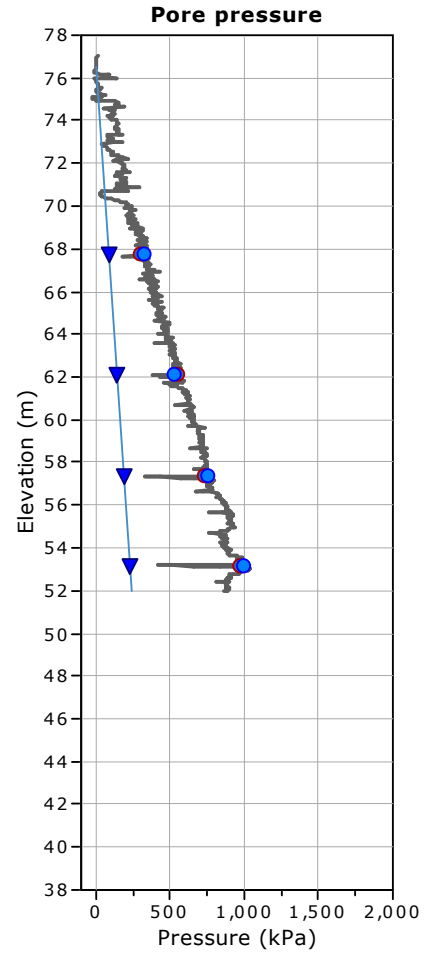
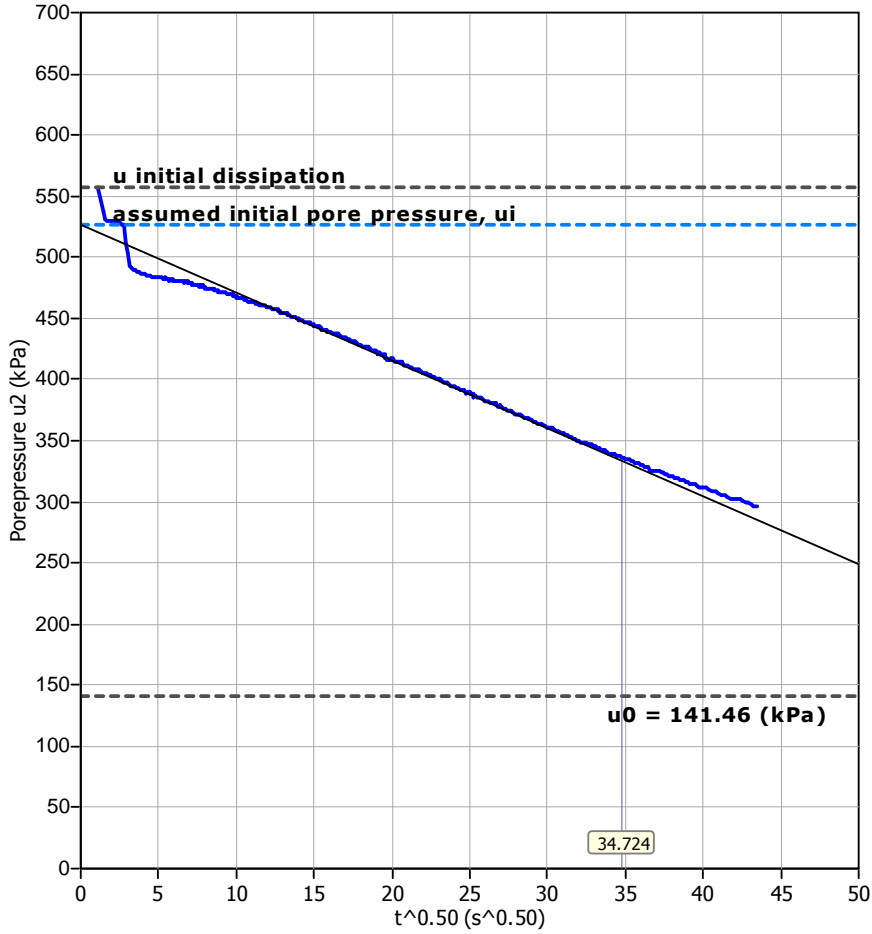
**Piezocene Dissipation Test: 12-2-1 Rev 1
Depth: 9.33 (m)**



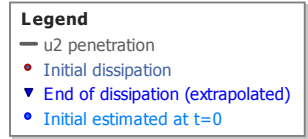
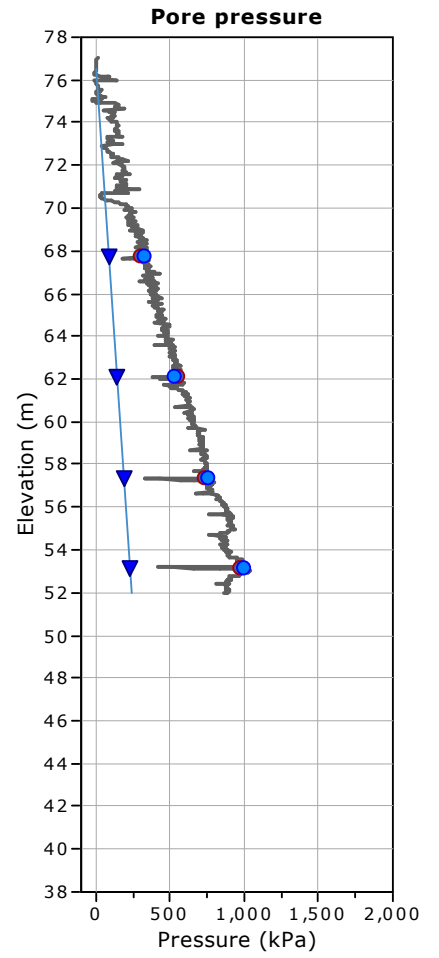
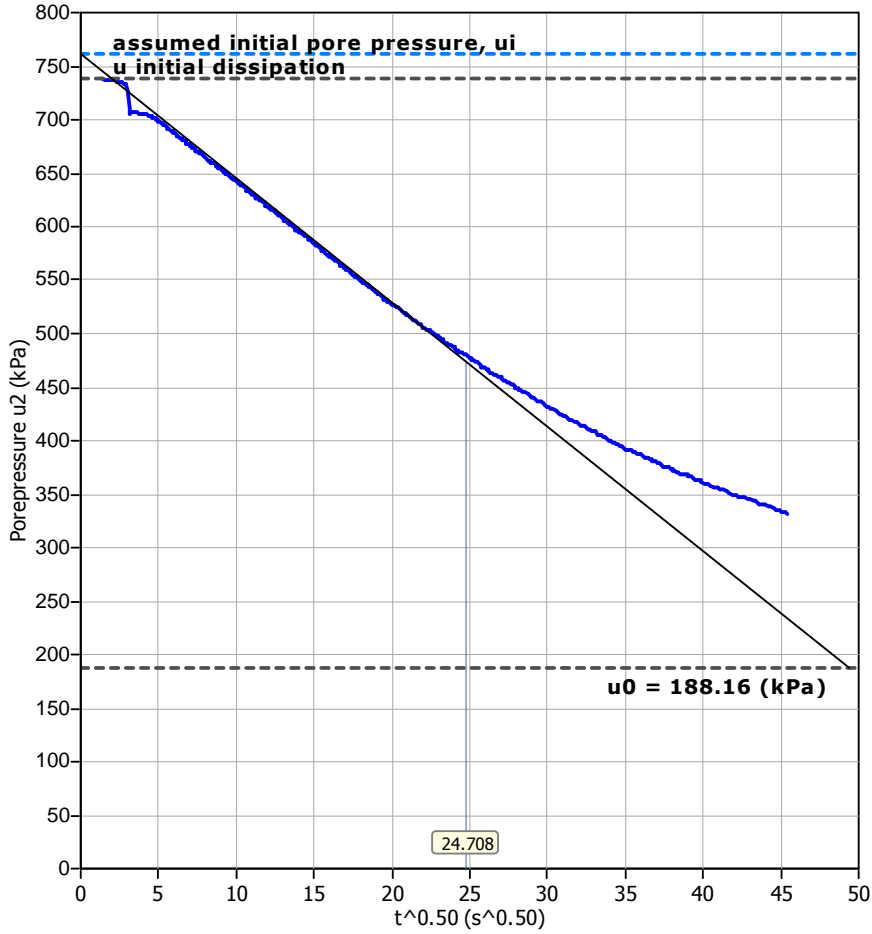
Legend

- u2 penetration
- Initial dissipation
- ▼ End of dissipation (extrapolated)
- Initial estimated at t=0

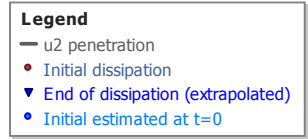
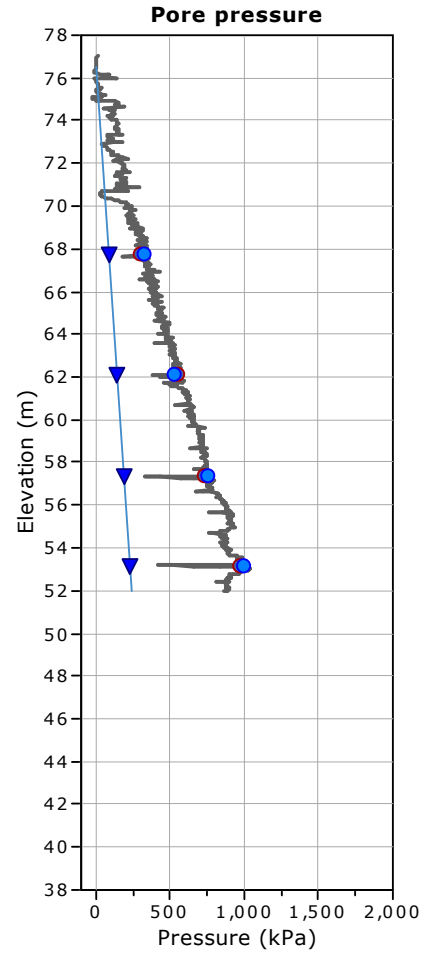
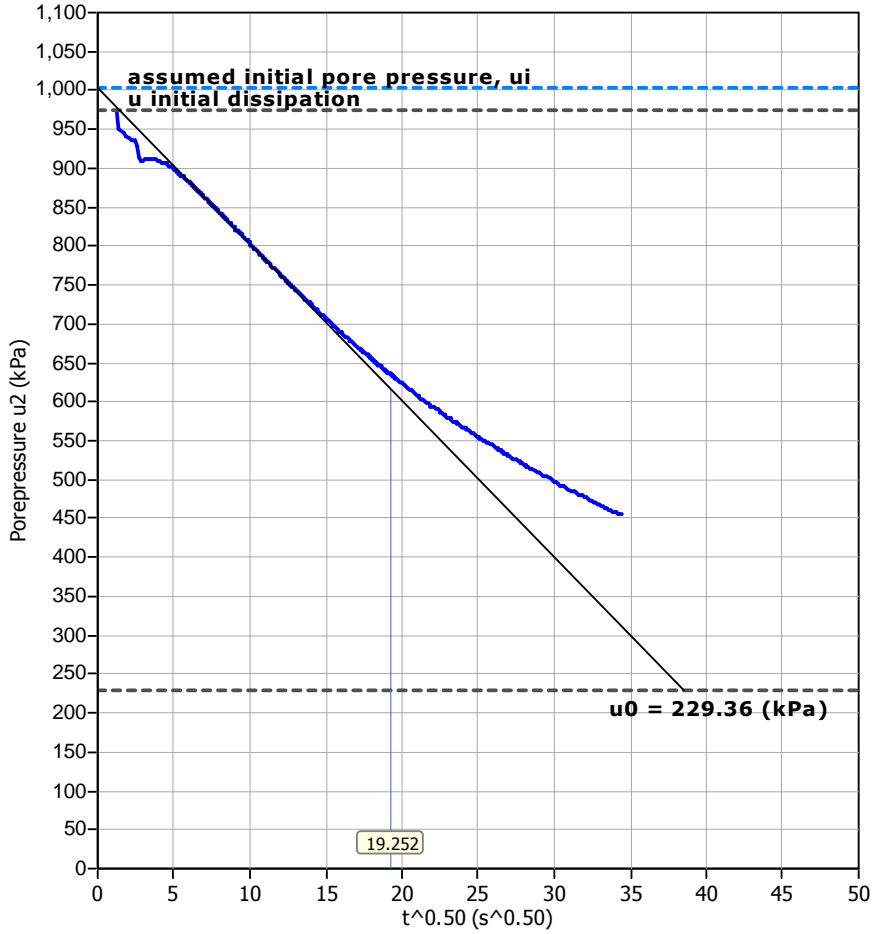
Piezocene Dissipation Test: 12-2-1 Rev 1
Depth: 14.92 (m)



Piezocene Dissipation Test: 12-2-1 Rev 1
Depth: 19.68 (m)



**Piezocene Dissipation Test: 12-2-1 Rev 1
Depth: 23.88 (m)**



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Hously and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Hously and Teh's (1988) theory corresponding to the porepressure position

r: piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

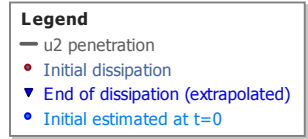
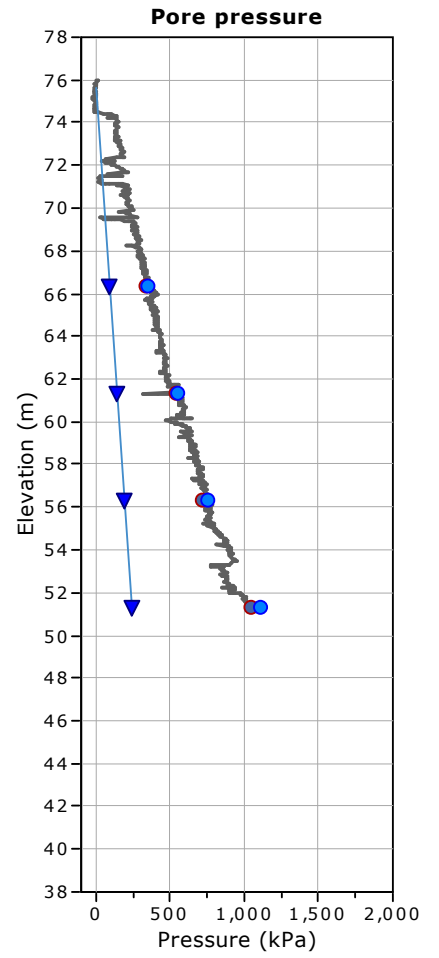
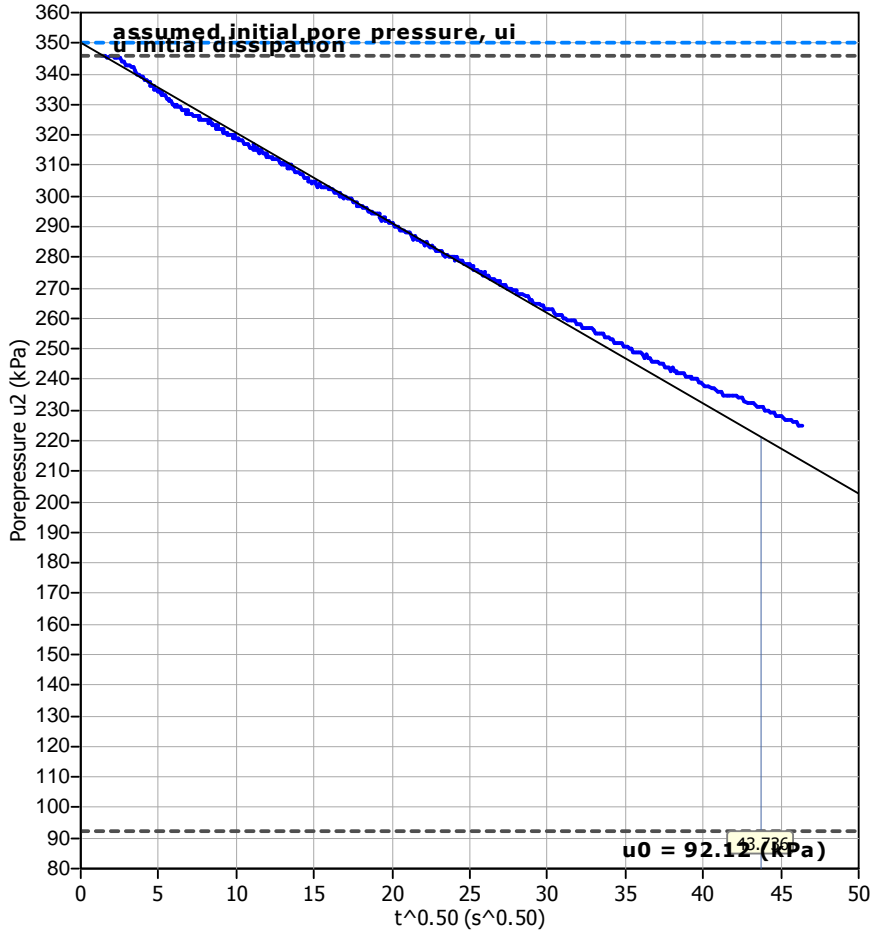
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

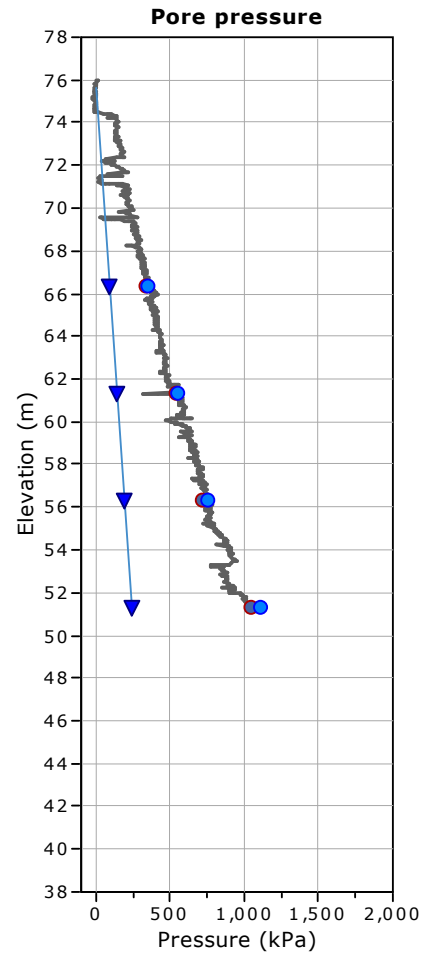
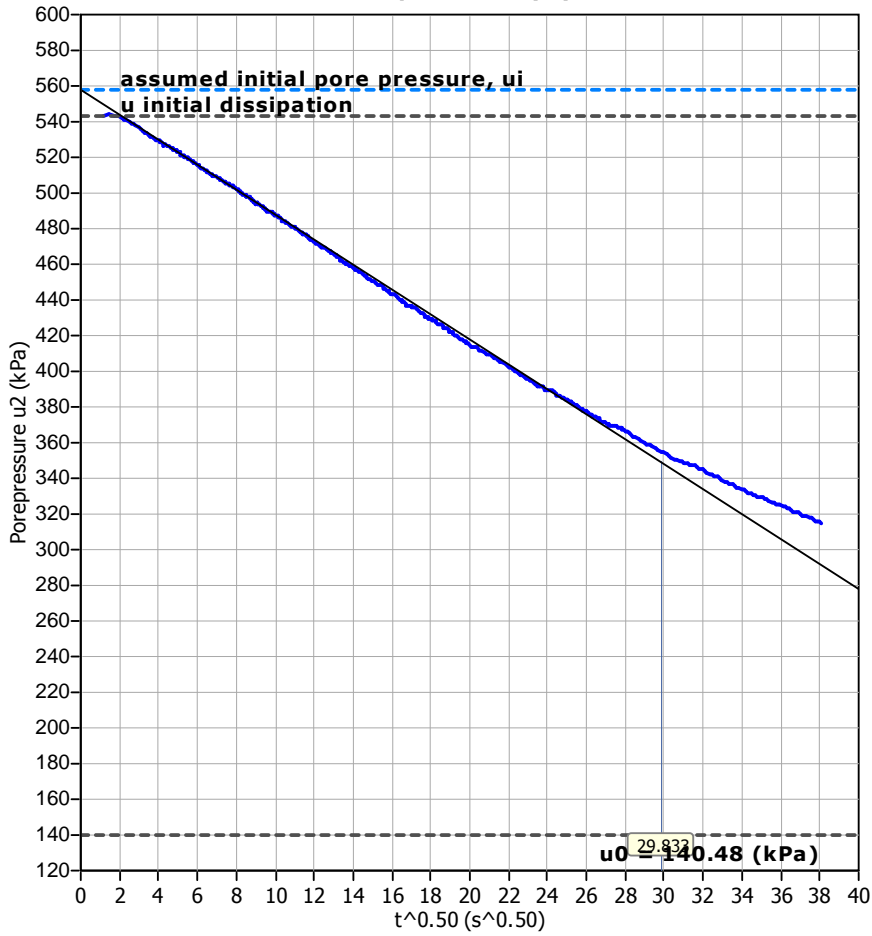
Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
12-3-1 Rev 1	9.89	43.7	1913	6.07E-005	60.00	3.18E-007	10	2.51	1.24E-009
12-3-1 Rev 1	14.82	29.8	890	2.82E-005	62.00	6.95E-007	22	5.09	1.34E-009
12-3-1 Rev 1	19.84	22.8	521	1.65E-005	40.00	9.52E-007	30	6.55	1.43E-009
12-3-1 Rev 1	24.88	16.8	283	8.98E-006	55.00	2.06E-006	65	9.57	2.11E-009

Piezocene Dissipation Test: 12-3-1 Rev 1
Depth: 9.89 (m)



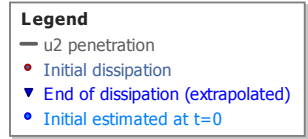
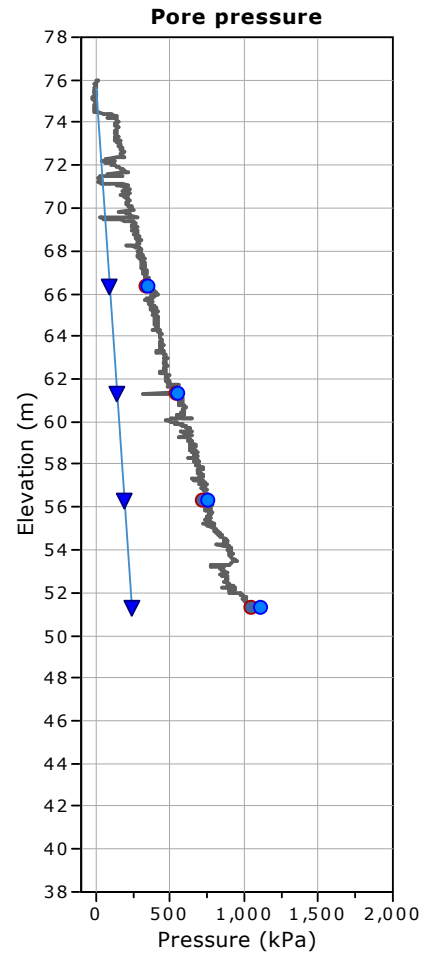
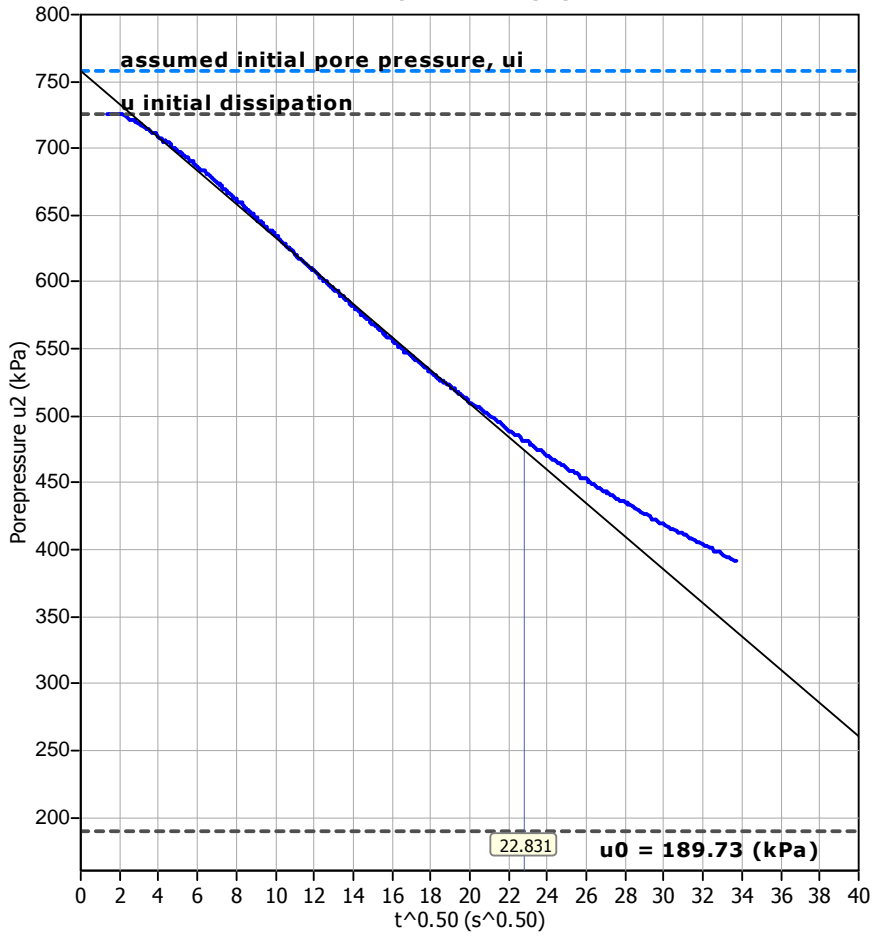
Piezocone Dissipation Test: 12-3-1 Rev 1
Depth: 14.82 (m)



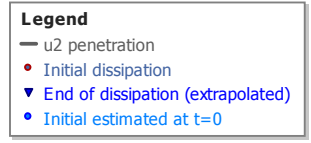
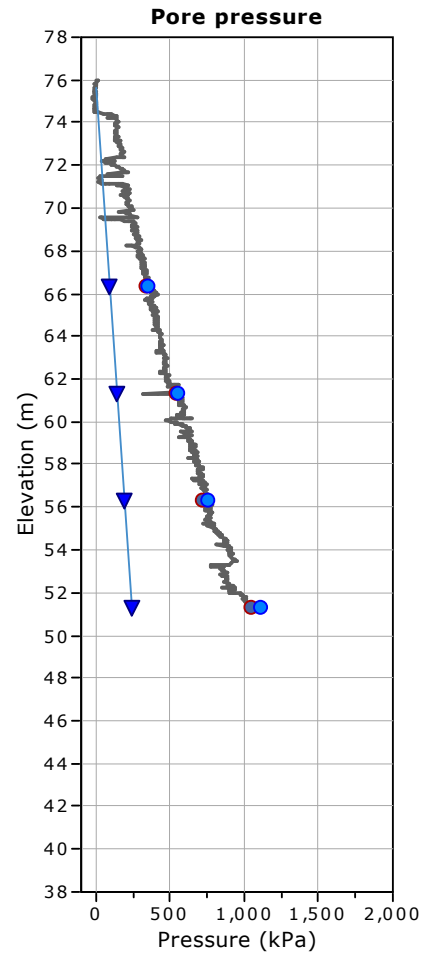
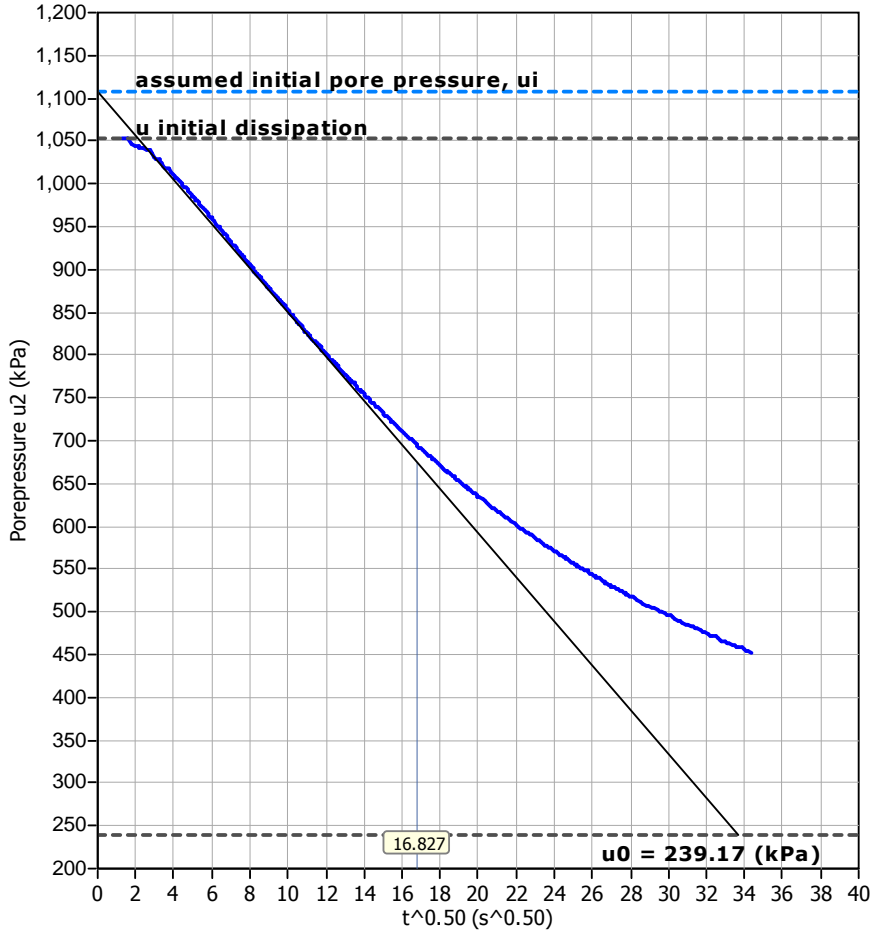
Legend

- u_2 penetration
- Initial dissipation
- ▼ End of dissipation (extrapolated)
- Initial estimated at $t=0$

Piezocene Dissipation Test: 12-3-1 Rev 1
Depth: 19.84 (m)



Piezocene Dissipation Test: 12-3-1 Rev 1
Depth: 24.88 (m)



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Hously and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Hously and Teh's (1988) theory corresponding to the porepressure position

r: piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

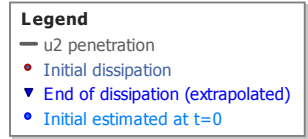
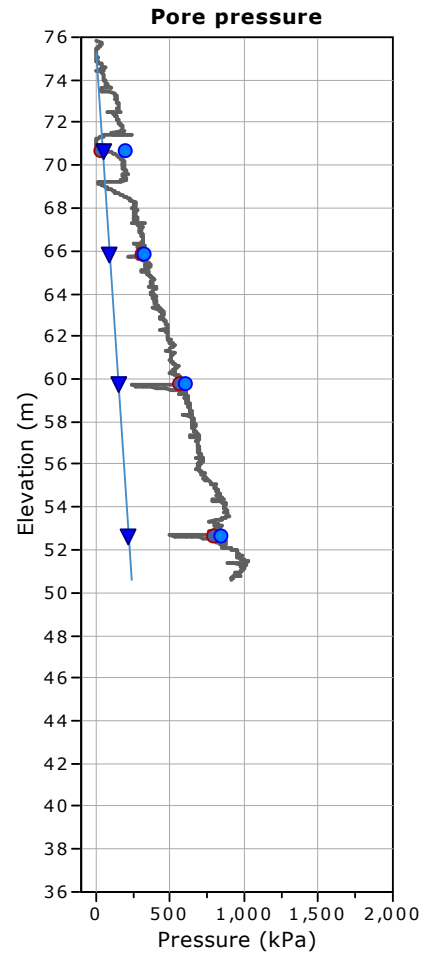
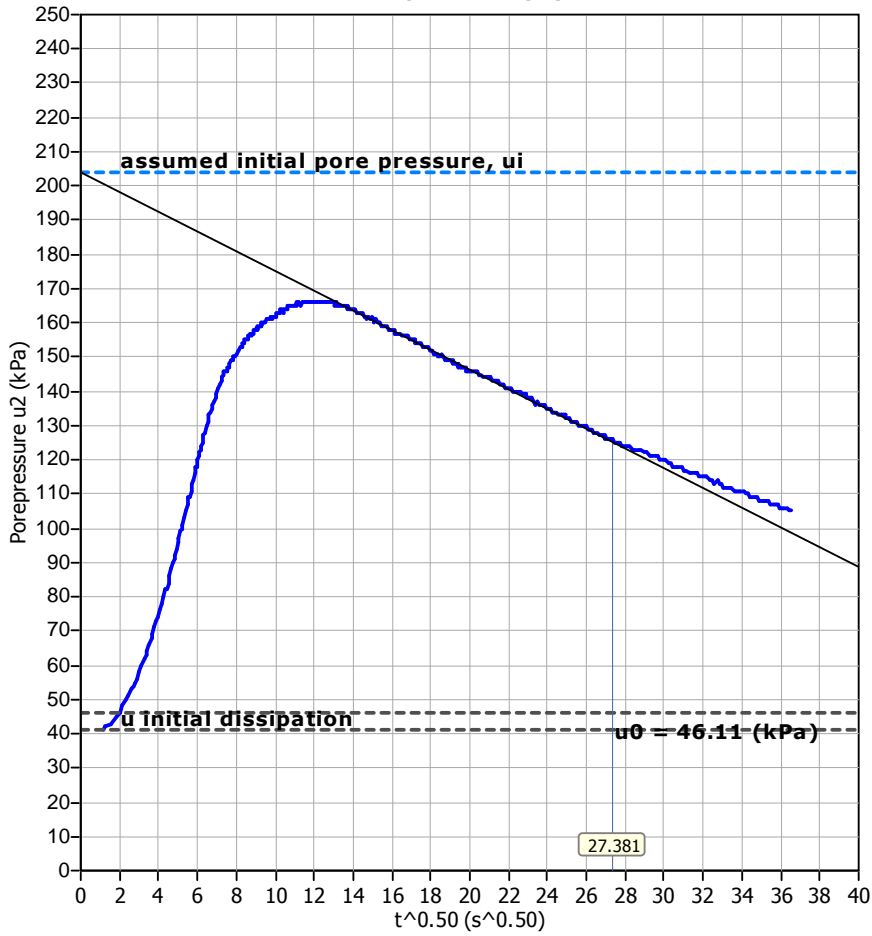
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

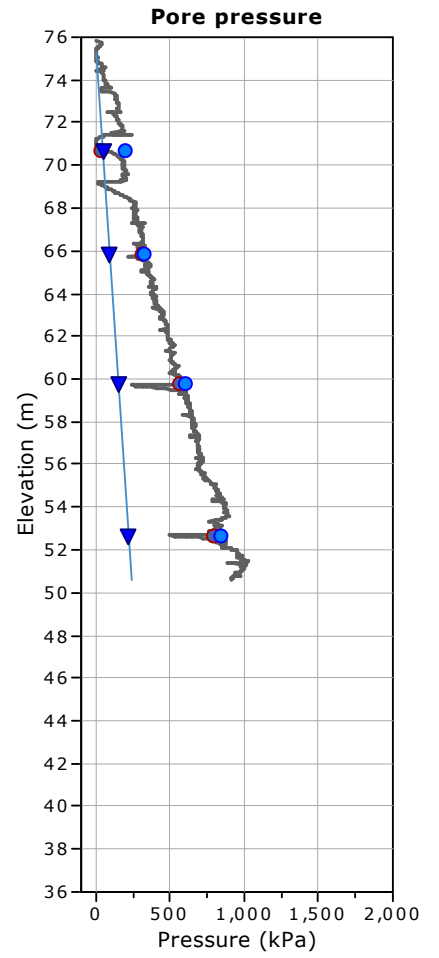
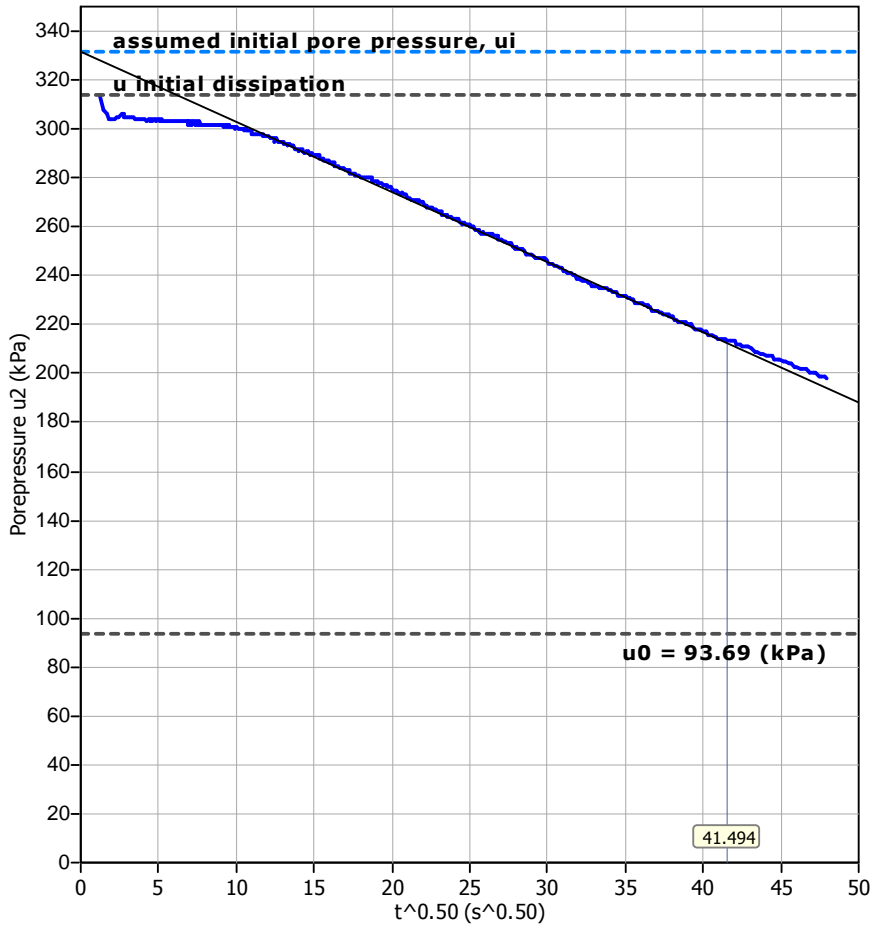
Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
12-4-1 Rev 1	5.20	27.4	750	2.38E-005	35.00	6.19E-007	20	0.43	1.43E-008
12-4-1 Rev 1	10.05	41.5	1722	5.46E-005	60.00	3.53E-007	11	2.26	1.53E-009
12-4-1 Rev 1	16.09	25.0	626	1.99E-005	66.00	1.02E-006	32	3.27	3.06E-009
12-4-1 Rev 1	23.17	25.3	640	2.03E-005	60.00	9.50E-007	30	4.84	1.93E-009

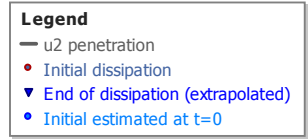
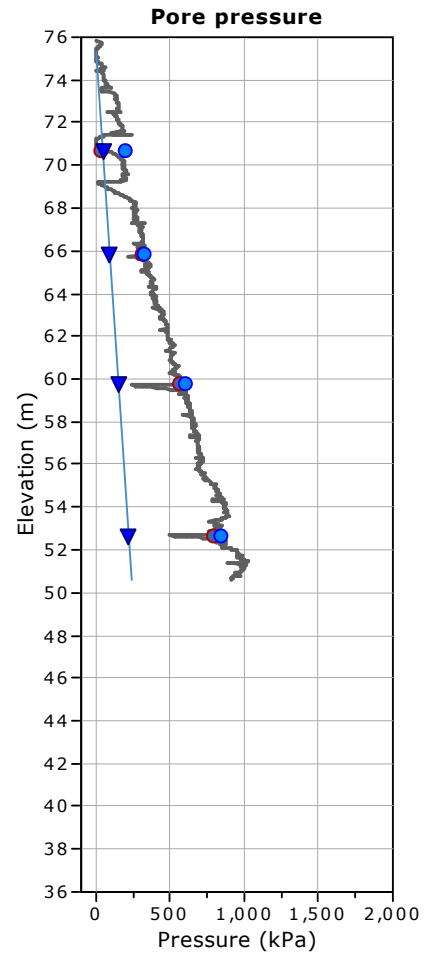
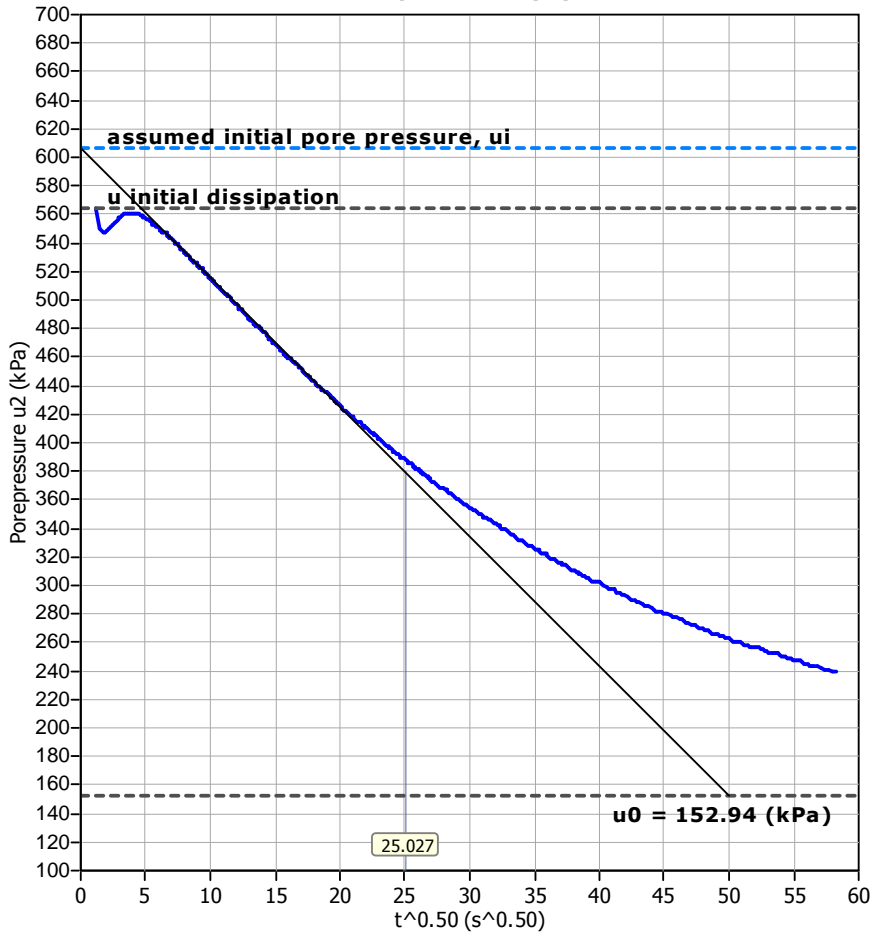
Piezocone Dissipation Test: 12-4-1 Rev 1
Depth: 5.20 (m)



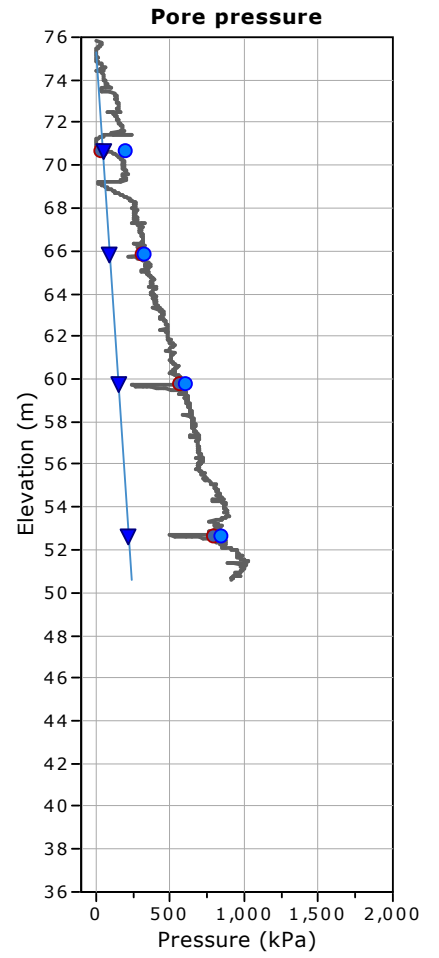
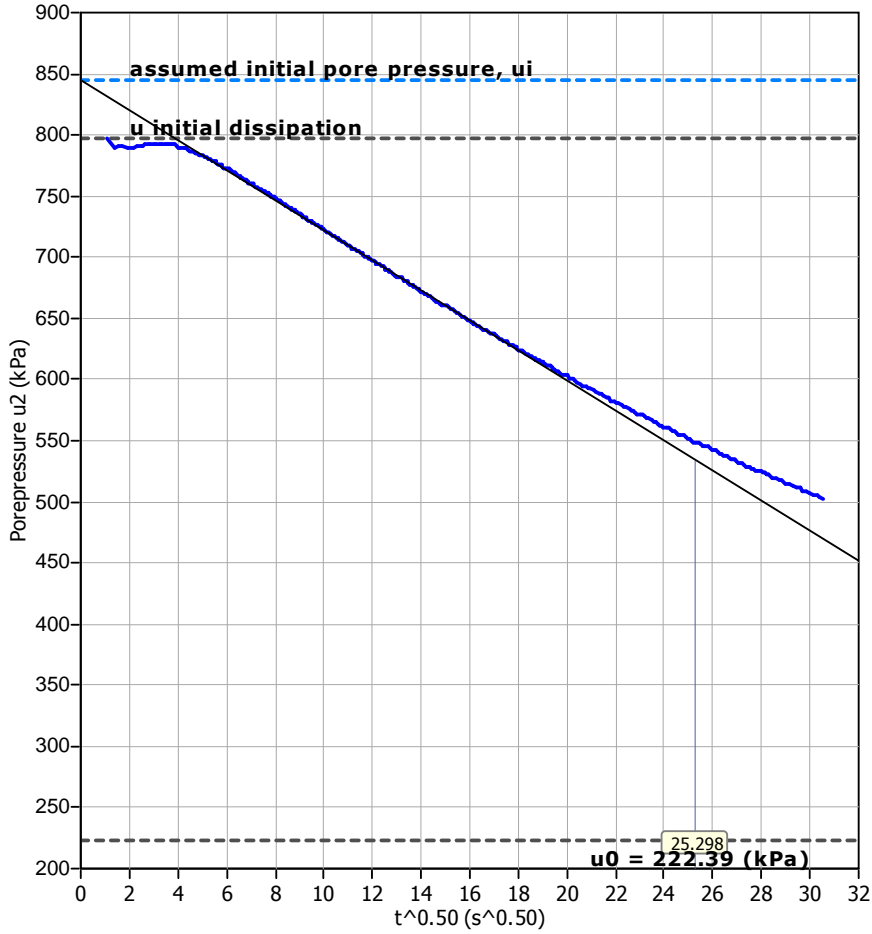
Piezocene Dissipation Test: 12-4-1 Rev 1
Depth: 10.05 (m)



Piezocene Dissipation Test: 12-4-1 Rev 1
Depth: 16.09 (m)



Piezocene Dissipation Test: 12-4-1 Rev 1 Depth: 23.17 (m)



Legend

- u_2 penetration
- Initial dissipation
- ▼ End of dissipation (extrapolated)
- Initial estimated at $t=0$

Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position

r: piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

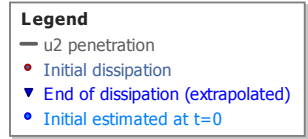
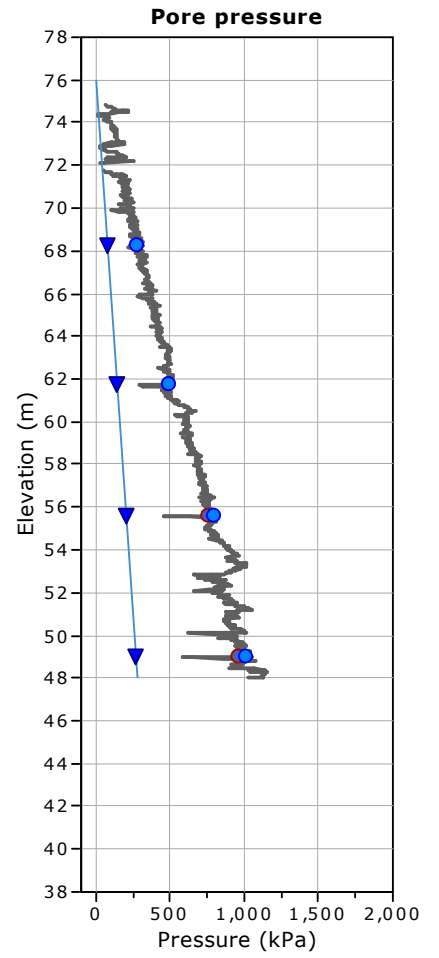
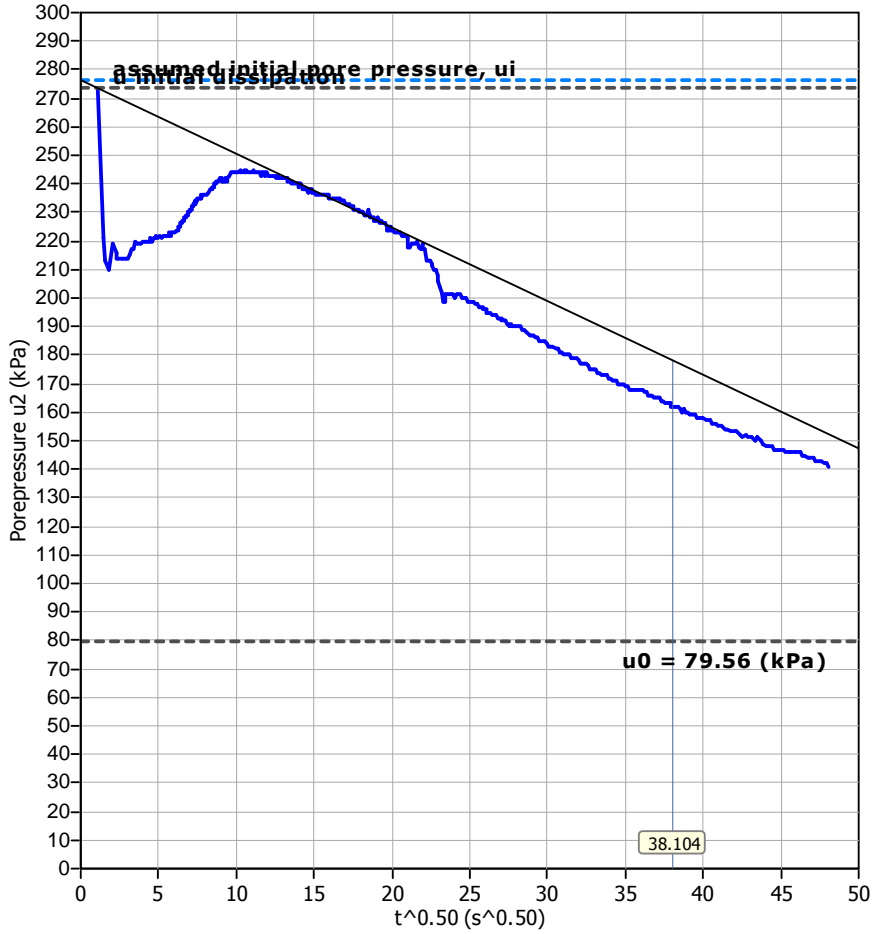
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

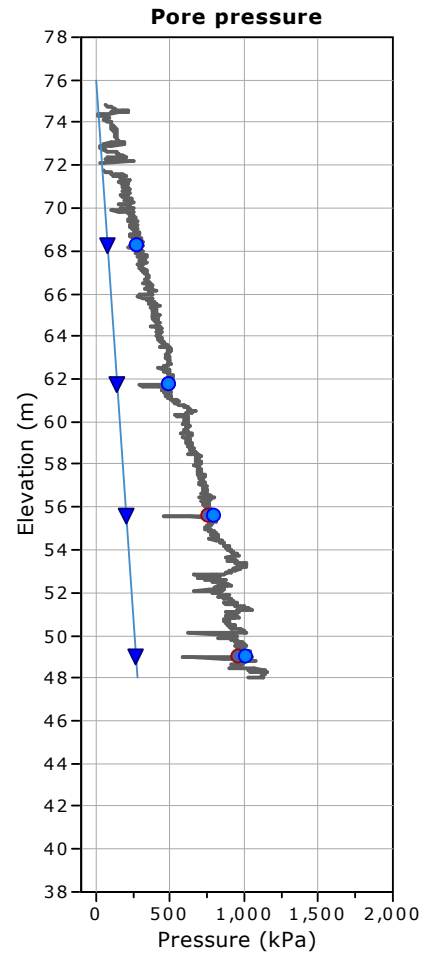
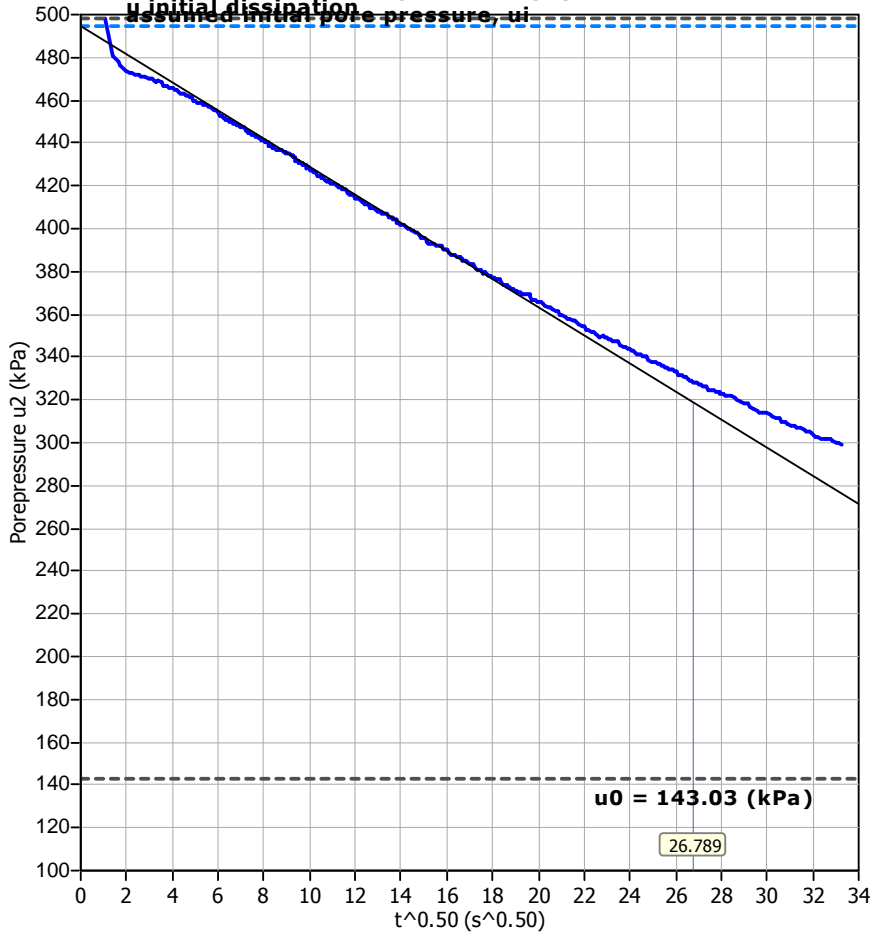
CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
13-5-1 Rev 1	8.11	38.1	1452	4.60E-005	48.00	3.75E-007	12	1.13	3.24E-009
13-5-1 Rev 1	14.58	26.8	718	2.28E-005	56.00	8.19E-007	26	2.46	3.26E-009
13-5-1 Rev 1	20.71	22.0	486	1.54E-005	51.00	1.15E-006	36	3.97	2.85E-009
13-5-1 Rev 1	27.35	21.7	472	1.50E-005	104.00	1.70E-006	53	6.90	2.41E-009

Piezocene Dissipation Test: 13-5-1 Rev 1
Depth: 8.11 (m)



Piezcone Dissipation Test: 13-5-1 Rev 1

Depth: 14.58 (m)

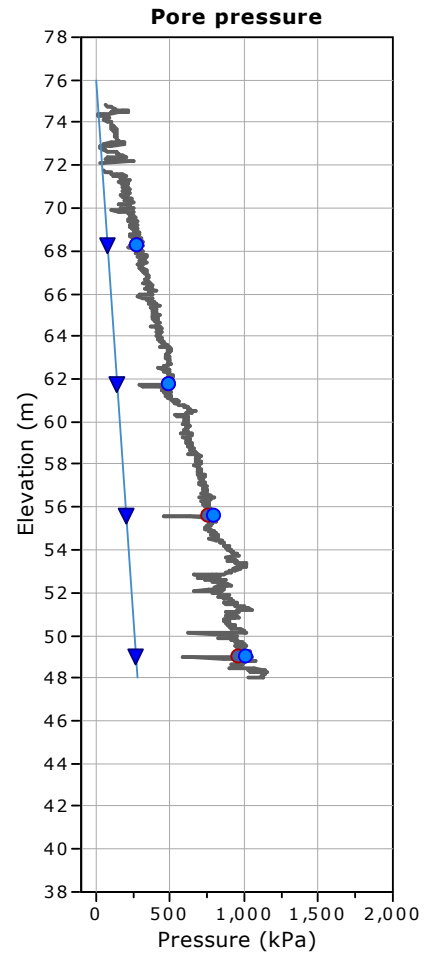
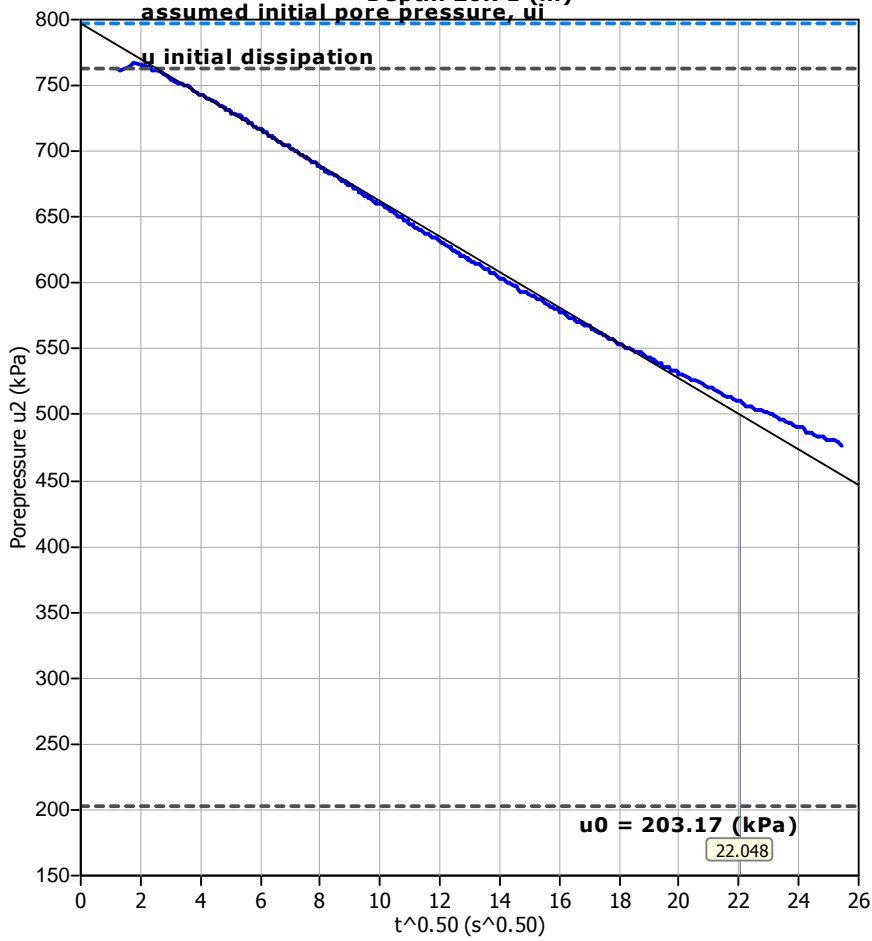


Legend

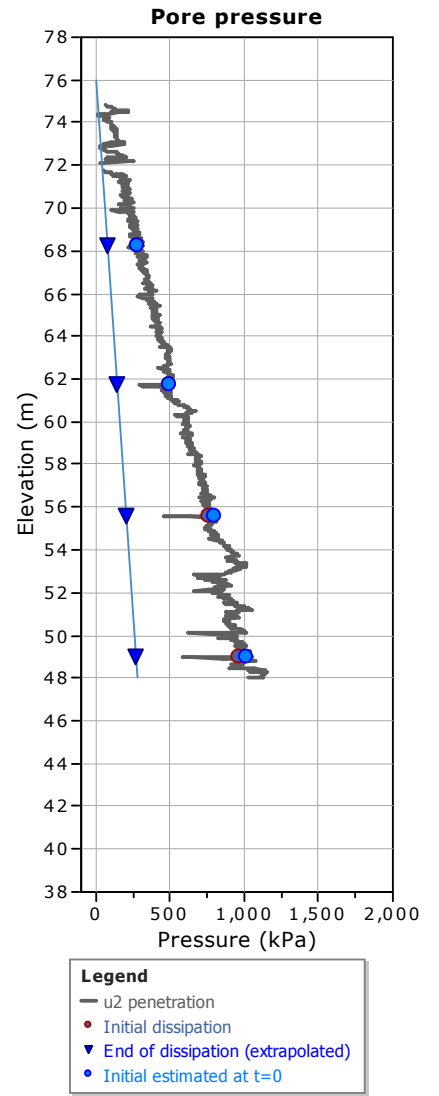
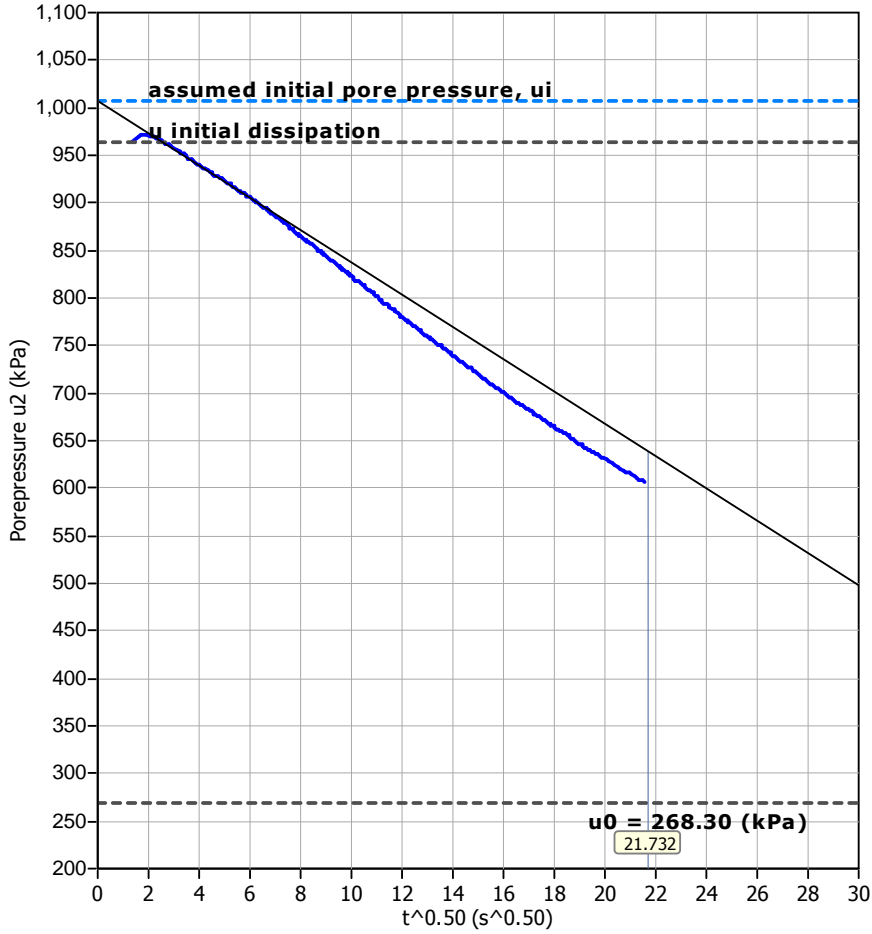
- u2 penetration
- Initial dissipation
- ▼ End of dissipation (extrapolated)
- Initial estimated at t=0

Piezocene Dissipation Test: 13-5-1 Rev 1

Depth: 20.71 (m)



Piezocene Dissipation Test: 13-5-1 Rev 1
Depth: 27.35 (m)





Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

- T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
- r: piezocone radius
- I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
- t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

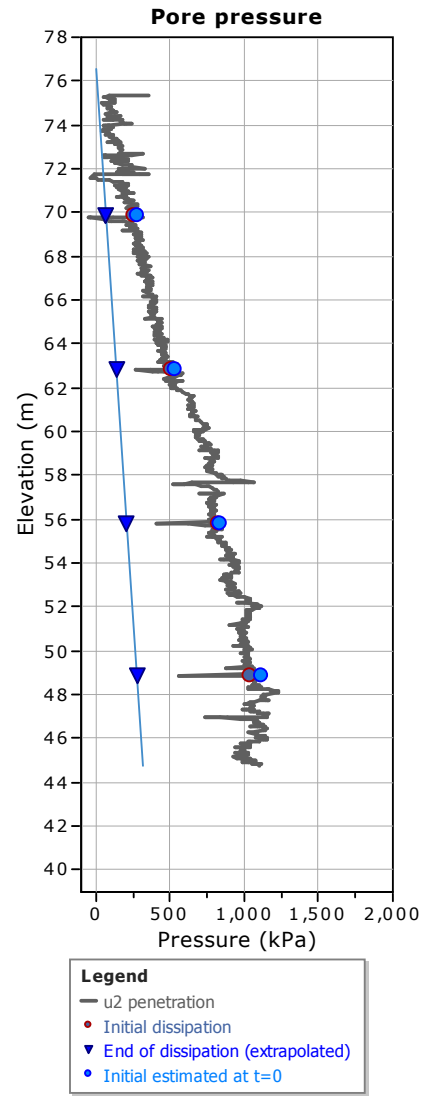
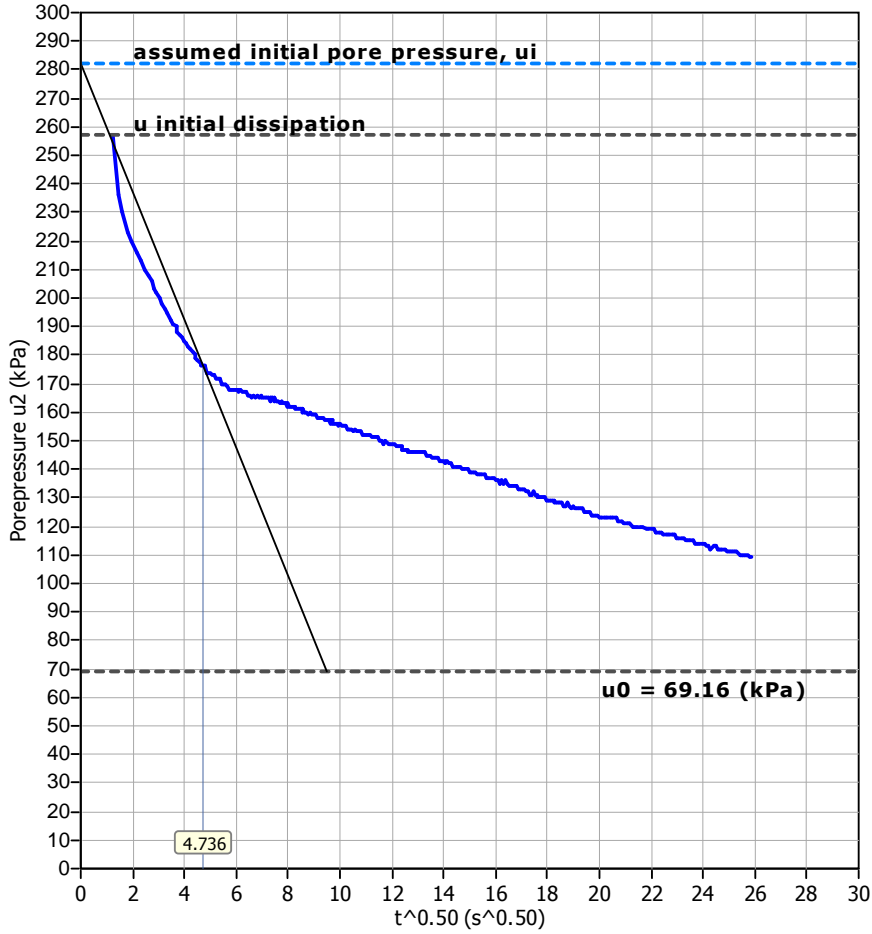
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

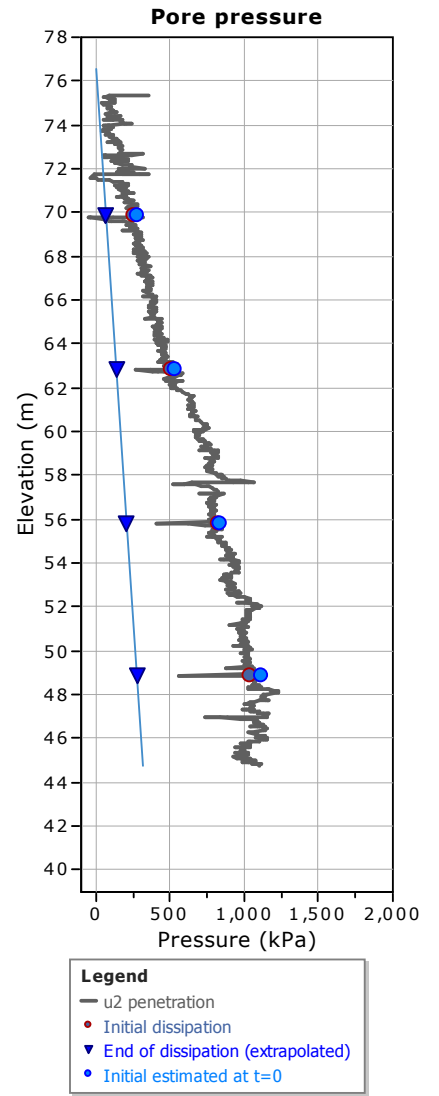
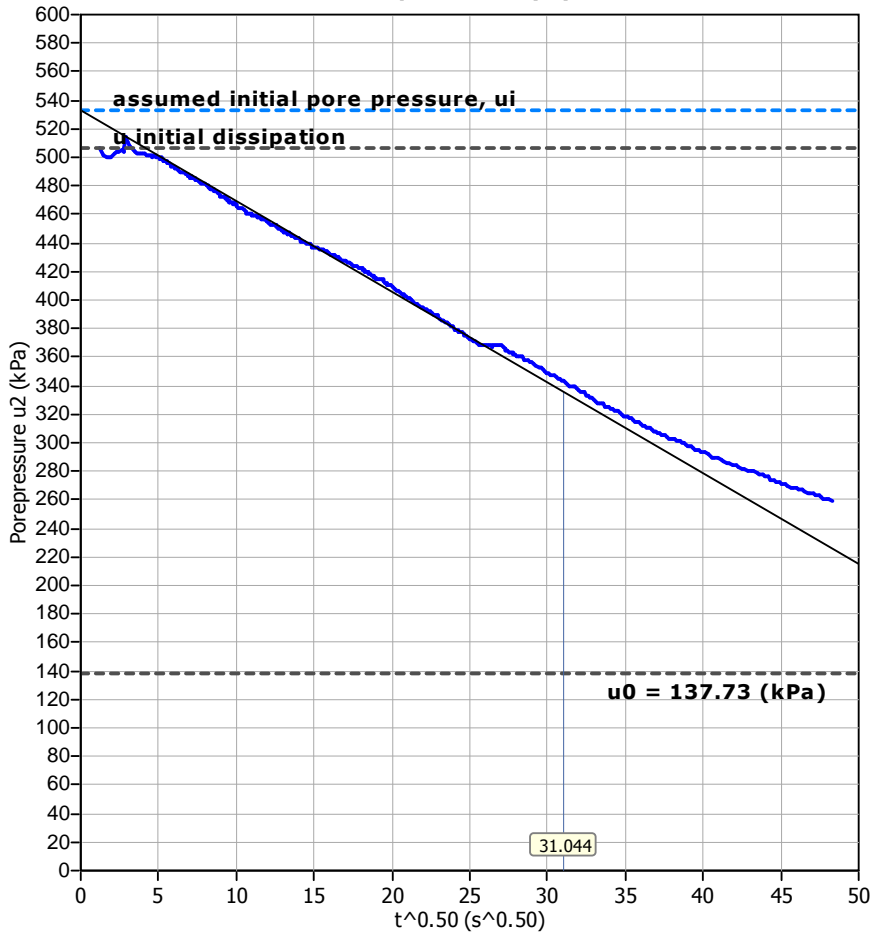
Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
13-6-1 Rev 1	7.05	4.7	22	7.11E-007	72.00	2.97E-005	936	1.61	1.81E-007
13-6-1 Rev 1	14.04	31.0	964	3.06E-005	55.00	6.04E-007	19	3.35	1.77E-009
13-6-1 Rev 1	21.05	21.0	439	1.39E-005	52.00	1.29E-006	41	3.31	3.82E-009
13-6-1 Rev 1	28.05	20.1	402	1.28E-005	92.00	1.87E-006	59	4.97	3.70E-009

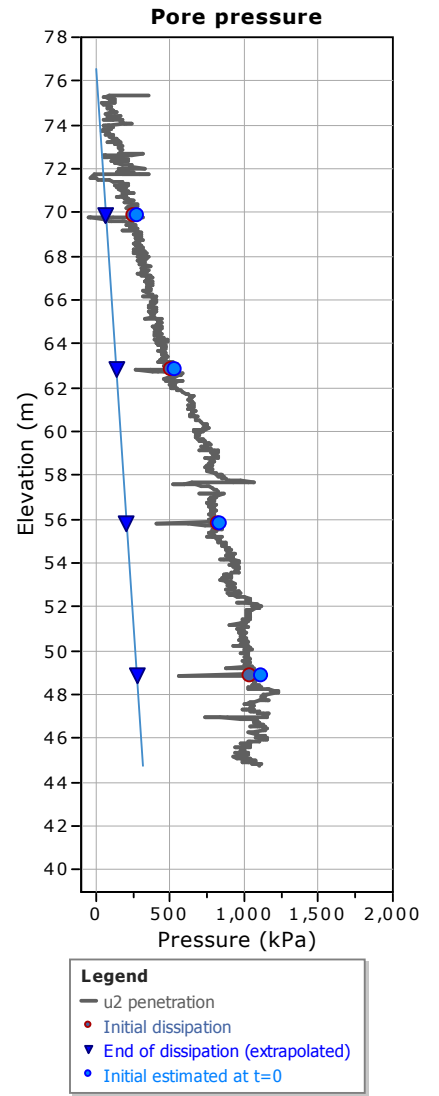
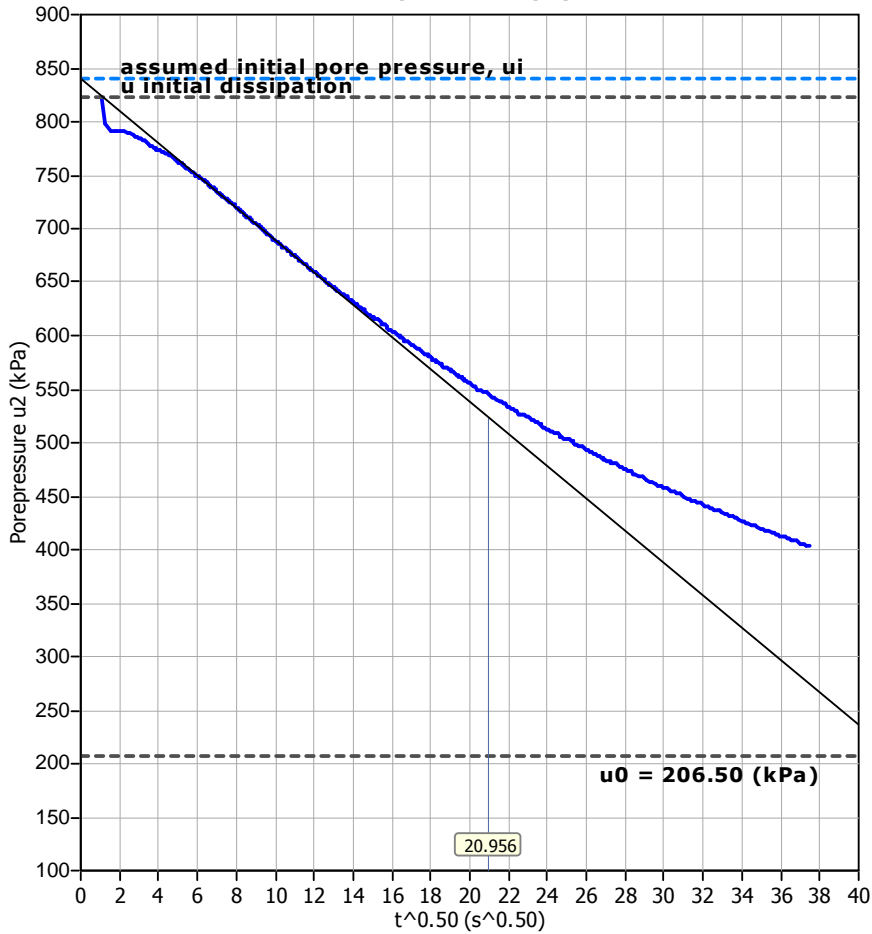
Piezocene Dissipation Test: 13-6-1 Rev 1
Depth: 7.05 (m)



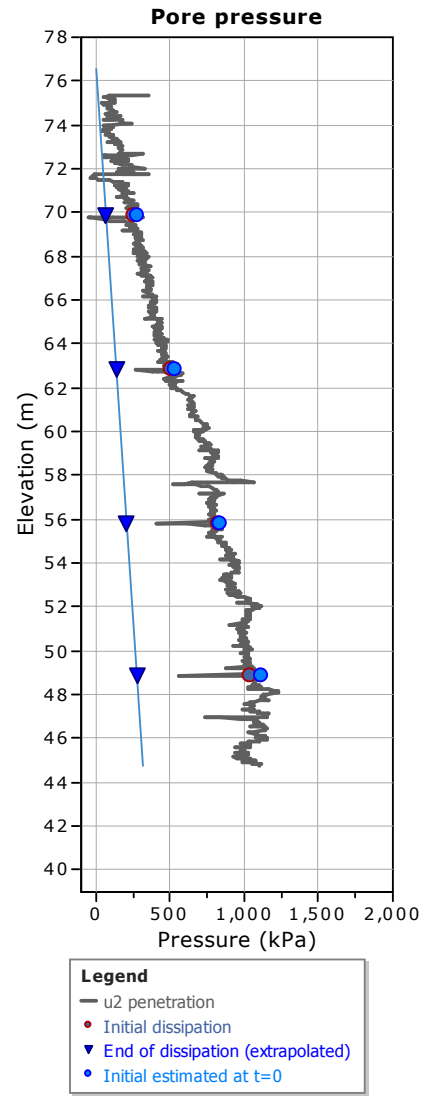
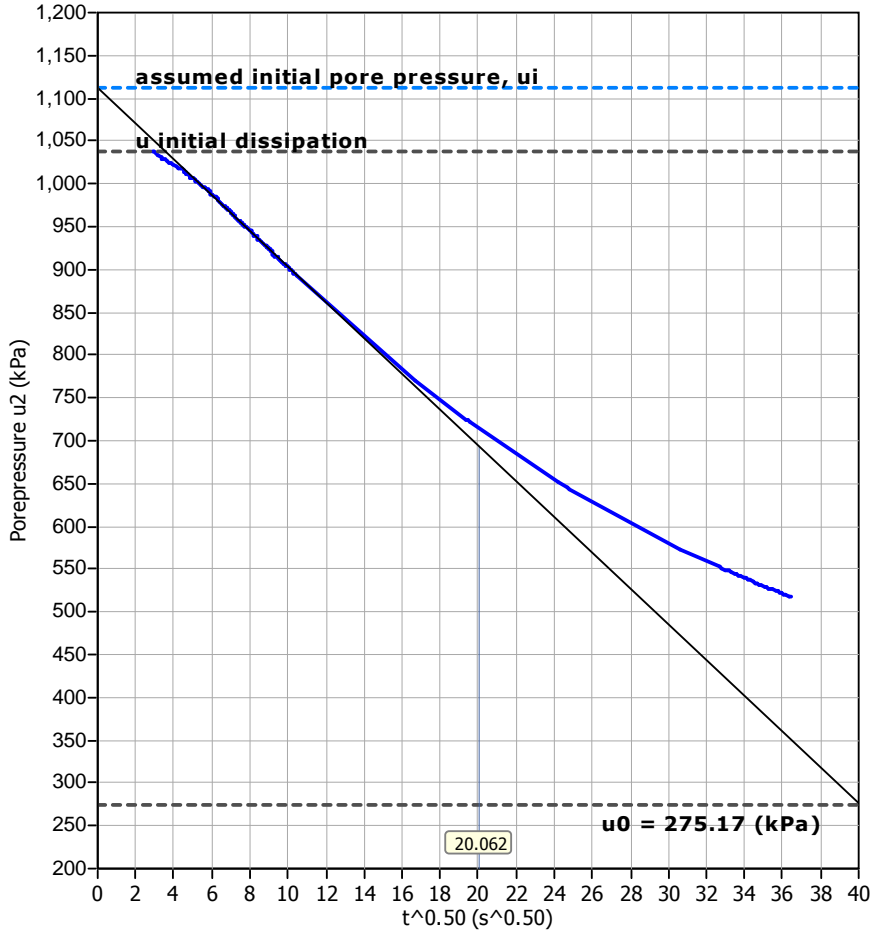
Piezocene Dissipation Test: 13-6-1 Rev 1
Depth: 14.04 (m)



Piezocene Dissipation Test: 13-6-1 Rev 1
Depth: 21.05 (m)



Piezocene Dissipation Test: 13-6-1 Rev 1
Depth: 28.05 (m)



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50} , which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position

r: piezocone radius

I_r : stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).

t_{50} : time corresponding to 50% consolidation

Permeability estimates based on dissipation test

The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

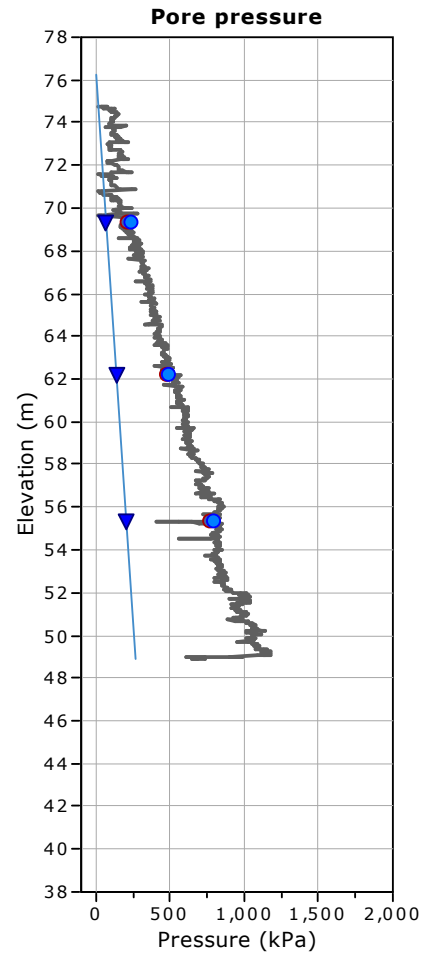
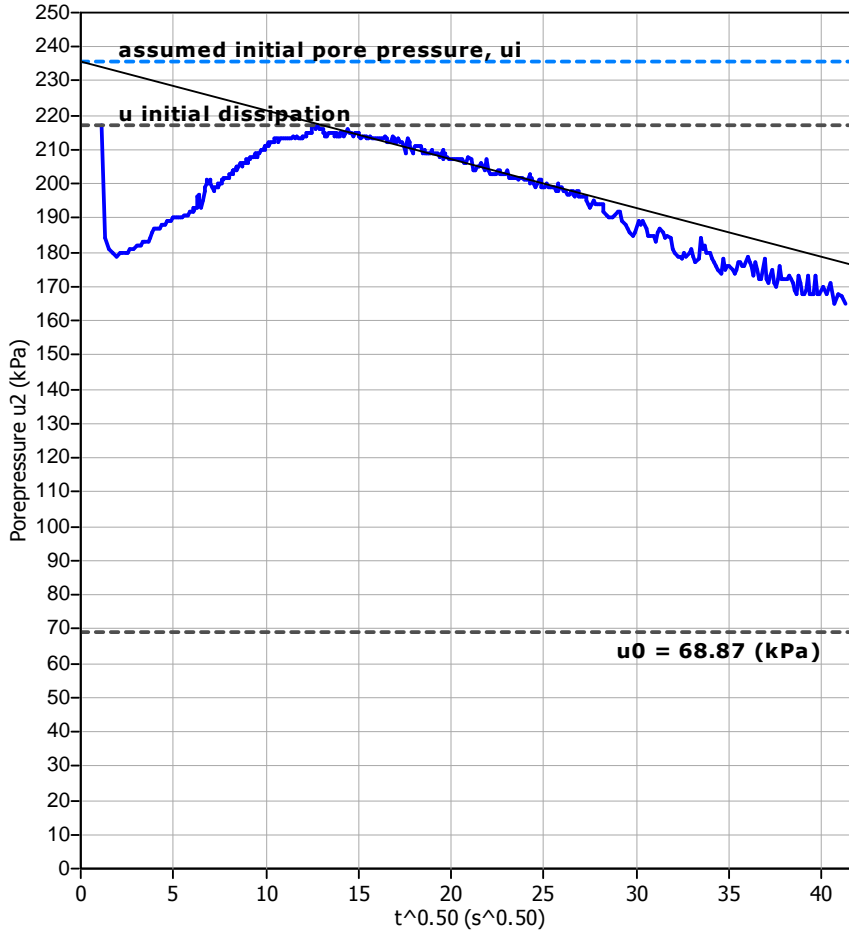
$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (m)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/ S_u	c_h (m^2/s)	c_h ($m^2/year$)	M (MPa)	k_h (m/s)
13-7-1 Rev 1	7.02	58.5	3417	1.08E-004	74.00	1.98E-007	6	0.36	5.37E-009
13-7-1 Rev 1	14.07	28.9	834	2.64E-005	57.00	7.11E-007	22	1.45	4.80E-009
13-7-1 Rev 1	20.97	24.4	596	1.89E-005	52.00	9.50E-007	30	3.07	3.03E-009

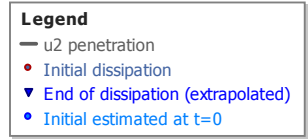
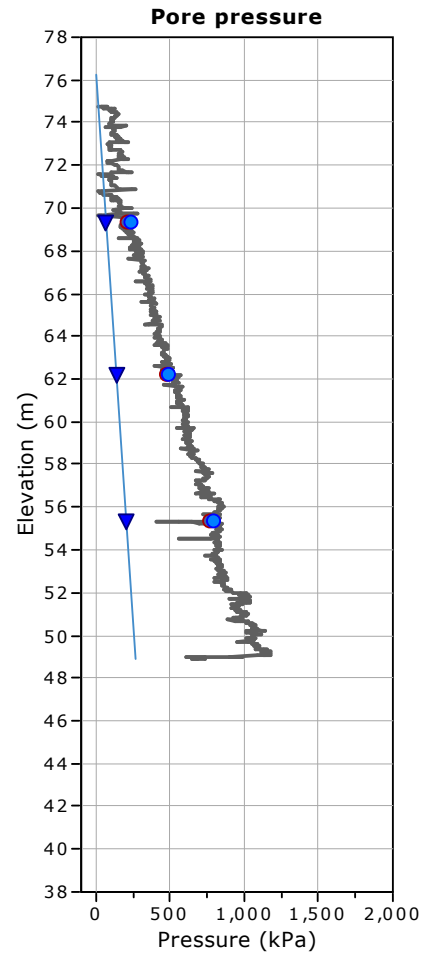
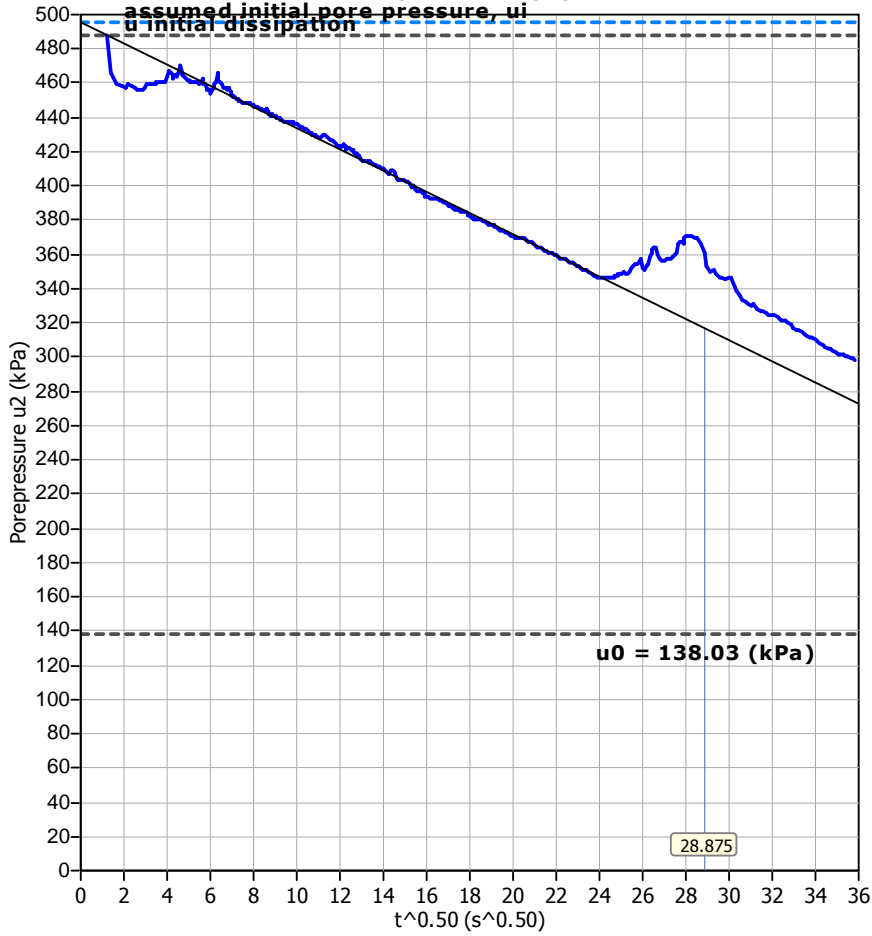
Piezcone Dissipation Test: 13-7-1 Rev 1
Depth: 7.02 (m)



- Legend**
- u2 penetration
 - Initial dissipation
 - ▼ End of dissipation (extrapolated)
 - Initial estimated at t=0

Piezocone Dissipation Test: 13-7-1 Rev 1

Depth: 14.07 (m)



Piezcone Dissipation Test: 13-7-1 Rev 1
Depth: 20.97 (m)

