

Comune di Cesenatico
Provincia di Forlì-Cesena

**PROGETTO DEFINITIVO ED ESECUTIVO PER LA
NUOVA COSTRUZIONE DI EDIFICIO DI EDILIZIA
RESIDENZIALE PUBBLICA COMPRENDENTE N. 18
ALLOGGI NELL'AREA "EX COLONIA PREALPI" IN VIA
GALILEO GALILEI, VALVERDE DI CESENATICO**

COMMITTENTE:

ACER Azienda Casa Emilia Romagna
della Provincia di Forlì-Cesena
Viale Giacomo Matteotti 44
47121 Forlì (FC)
C. F. e P. IVA 00139940407

STUDIO REDATTO DA:

ANTONIAZZI STUDIO ASSOCIATO
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COLLABORATORI E SPECIALISTI:

- Dott. Geol. Maurizio Moroni

Elaborato n°

3

Scala:

-:-

Data:

AGOSTO 2018

Estremi autorizzativi:

Oggetto:

**PROVE IN SITO
E DI LABORATORIO**

Revisioni

<div><div>SOGEO[®] S.R.L. INDAGINI GEOGNOSTICHE ED AMBIENTALI Via S. Potito n. 43 - 48022 S. Potito di LUGO (RA) Tel. 054522042 - Fax 054534443 - E-mail: sogeo@sogeo-srl.com Concessione Ministero Infrastrutture e Trasporti - Settore C Decr. n. 005754 del 05/07/2010</div></div>		COMMITTENTE: Studio Ass. Antoniazzi		SOND.N°: S.1		PROF.(m): 15.00	
		CANTIERE: Ex Colonia Prealpi - Cesenatico (FC)		QUOTA (m): p.d.c.			
		PERFORATRICE: Ellettari EK200/STR		LATITUDINE (°):			
		METODO PERFORAZ.: Carotaggio continuo		LONGITUDINE (°):			
RIVESTIMENTO: Ø 127 mm		ATTREZZO PERFORAZ.: Carotiere semplice Ø 101 mm				DATA INIZ-FINE: 05/06/2018-05/06/2018	
PIEZOMETRO:						SCALA: 1:100	
RIF.PREV.N°: 122-18	CERTIFICATO N°: C18-040-1	RAPPORTO N°: -----		DATA DI EMISSIONE: 06/06/2018		PAGINA N°: 1 di 1	

scala	P.P. I [daN/cm²]	Vane Test [daN/cm²]	Profondita'	Stratigrafia	Descrizione	Campioni	Campioni Rim.	S.P.T. [n. colpi] P.A.	Falda	Pz.Norton	Inclinometro
1.00			0.80		Sabbia fine di colore nocciola, con ghiaia fine, arrotondata, fino a -040 m. Presenza di frustoli organici						
2.00					Sabbia fine, talora fine-media, addensata, di colore nocciola-giallastro, umida						
3.00			3.00			3.00					
			3.50		Campione indisturbato	C.I.1					
4.00					Sabbia fine, talora fine-media, addensata, di colore nocciola-giallastro, umida. Da -4.20 a -4.40 m livello di colore grigio con sostanza organica di colore marrone scuro						
5.00			5.20								
			5.50		Sabbia fine di colore grigio, con abbondanti bioclasti. Presenti, talora, livelli centimetrici di sabbia fine limosa di colore grigio-marrone	5.50					
6.00			6.10		Campione indisturbato	C.I.2					
7.00					Sabbia fine di colore grigio, con abbondanti bioclasti. Presenti, talora, livelli centimetrici di sabbia fine limosa di colore grigio-marrone	6.10					
8.00			8.20								
9.00	0.3	0.10			Limo argilloso, debolmente sabbioso, di colore marrone-giallastro con variegature grigio chiaro						
	0.5	0.20									
	2.1	1.00	9.60								
10.00	1.5	0.70	10.00		Limo e argilla, talora argilla con limo, di colore marrone-giallastro con variegature grigio chiaro. Presenza di calcinelli da millimetrici a centimetrici	10.00					
			10.60		Campione indisturbato	C.I.3					
11.00	1.7	0.80			Limo e argilla, talora argilla con limo, di colore marrone-giallastro con variegature grigio chiaro. Presenza di calcinelli da millimetrici a centimetrici	10.60					
	1.4	0.70	11.70								
12.00	0.6	0.30			Limo con sabbia fine, talora debolmente argilloso, di colore grigio con variegature bruno- ocra						
	0.5	0.20	12.70								
13.00	1.7	0.90			Argilla e limo di colore grigio con zonature bruno-ocra. Presenza di calcinelli e, da -13.20 a -13.30 m, di un livello di sabbia fine debolmente limosa						
	2.0	0.90									
14.00	1.9	1.00									
	2.2	1.10									
15.00	2.4	1.20	15.00								
16.00											
17.00											
18.00											

C.I. = campioni indisturbati

Lo Sperimentatore

Il Direttore del Laboratorio



SOGEO
S.R.L.

INDAGINI GEOGNOSTICHE ED AMBIENTALI

Via S. Potito n. 43 - 48022 S. Potito di Lugo (RA)

Tel. 054522042 - Fax 054534443 - E-mail: sogeo@sogeo-srl.com

COMMITTENTE: Studio Ass. Antoniazzi

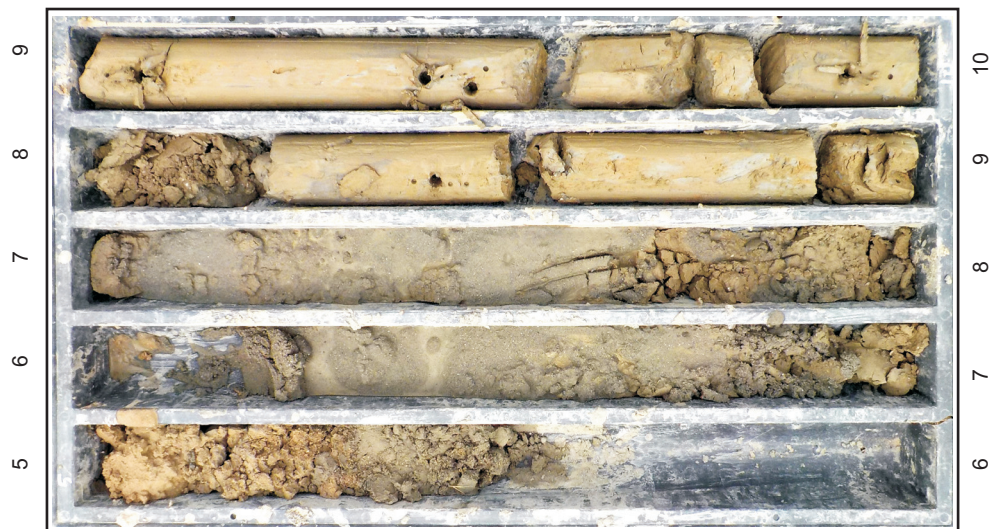
LOCALITA': Ex Colonia Prealpi - Cesenatico (FC)

SONDAGGIO N: S.1

RIF. N° : 122-18

ALLEGATO A: C18-040-1

DATA: 05/06/2018



Cassa 2 da -5.0 a -10.0 m



Posizionamento



Cassa 1 da 0.0 a -5.0 m

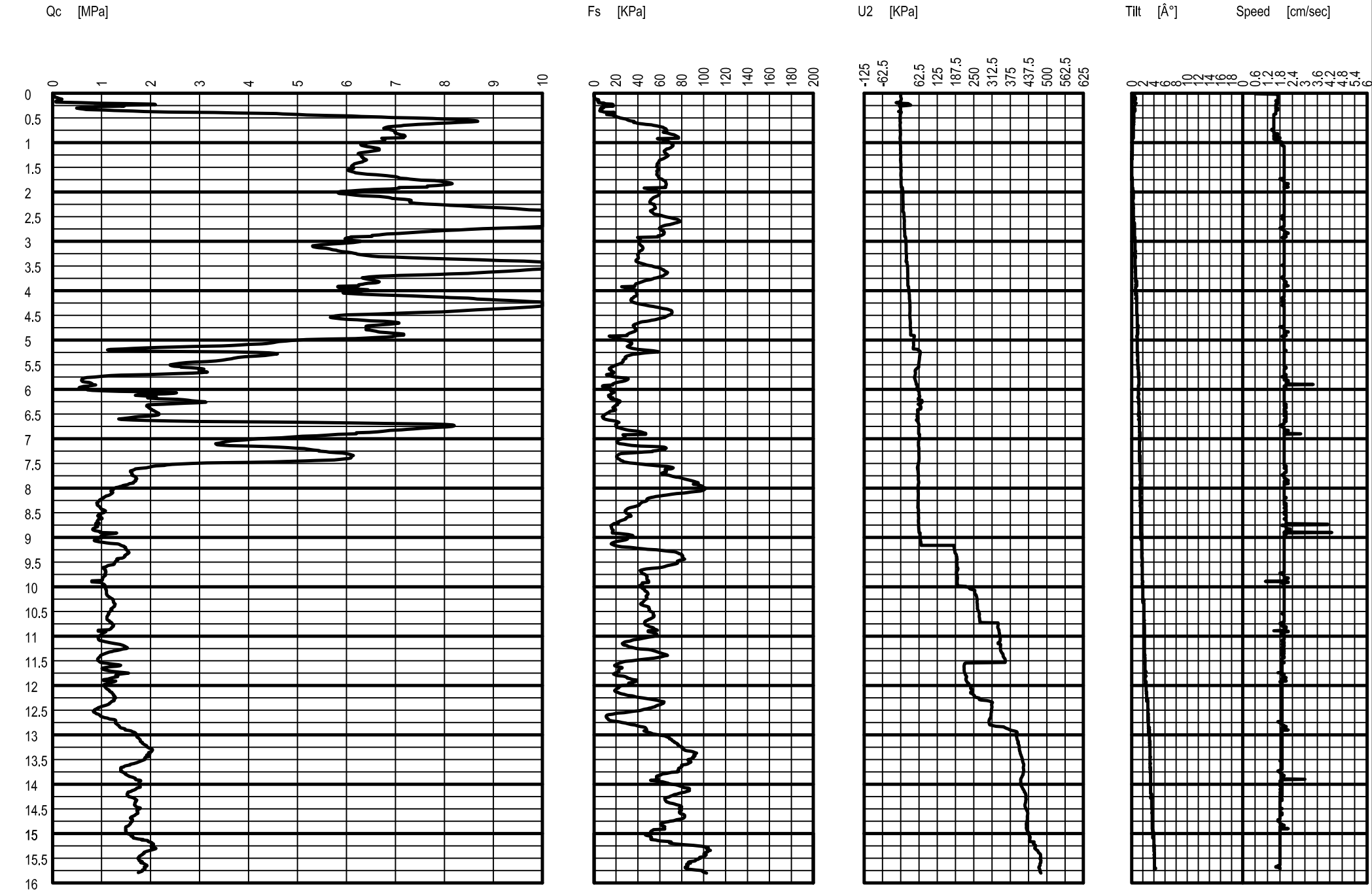


Cassa 3 da -10.0 a -15.0 m

MORONI DOTT. MAURIZIO - GEOLOGO

Cone Penetration Test (CPTU) 1

Site: EX COLONIA PREALPI CESENATICO (Fc)



MORONI DOTT. MAURIZIO - GEOLOGO

Cone Penetration Test (CPTU) 2

Site: EX COLONIA PREALPI CESENATICO (Fc)

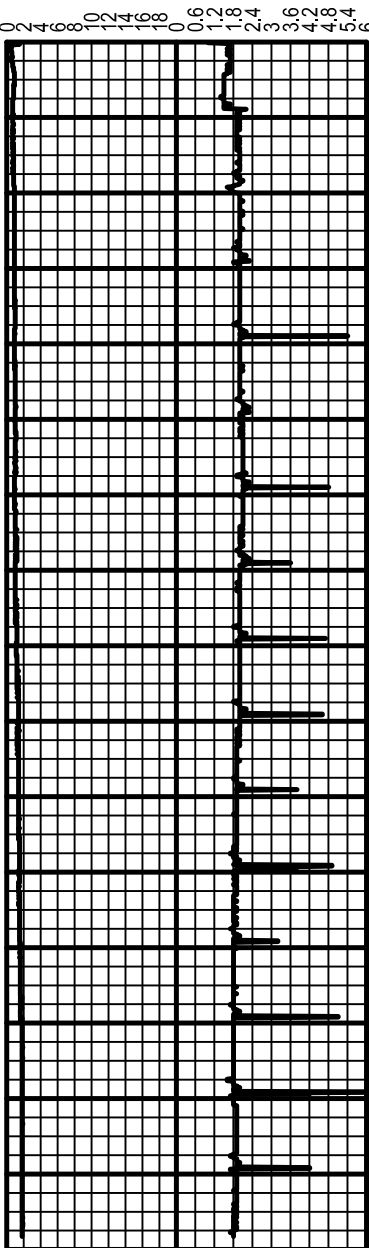
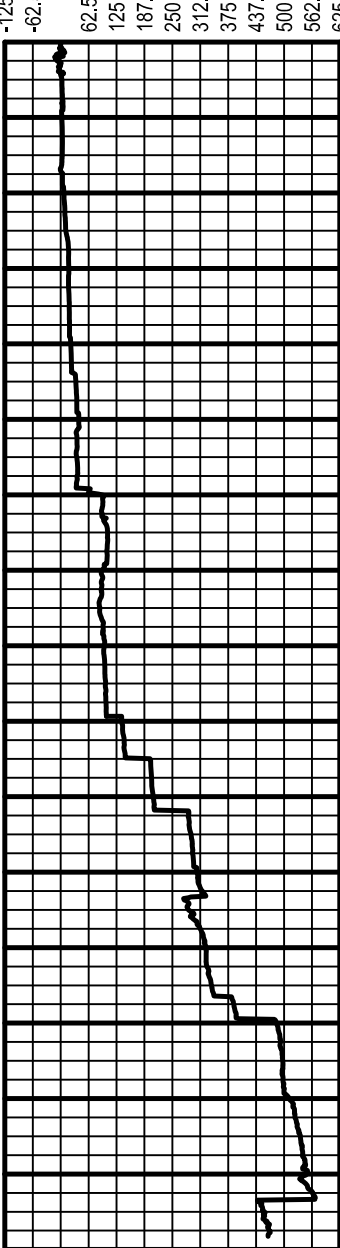
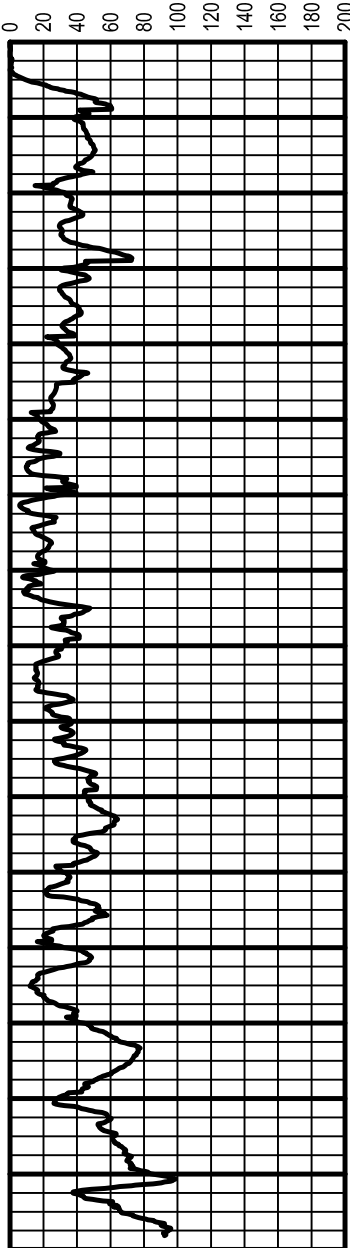
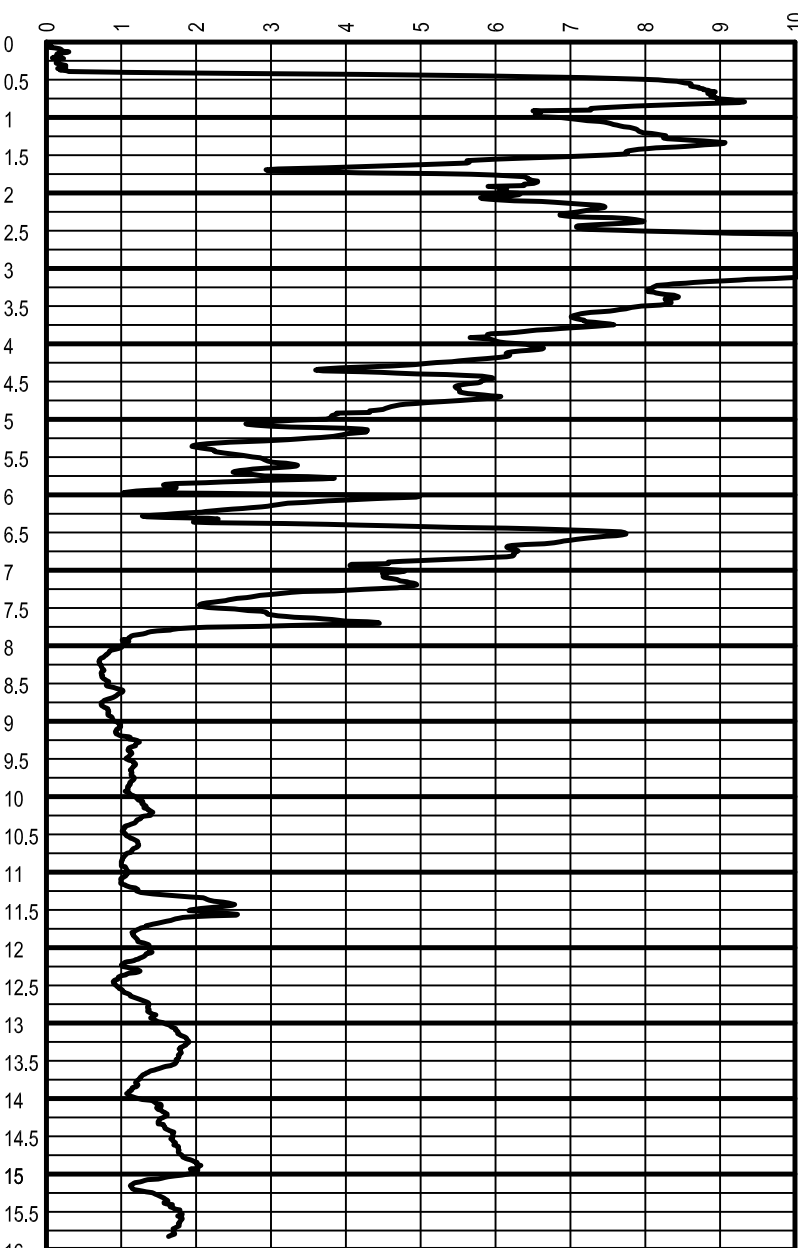
Qc [MPa]

Fs [KPa]

U2 [KPa]

Tilt [°]

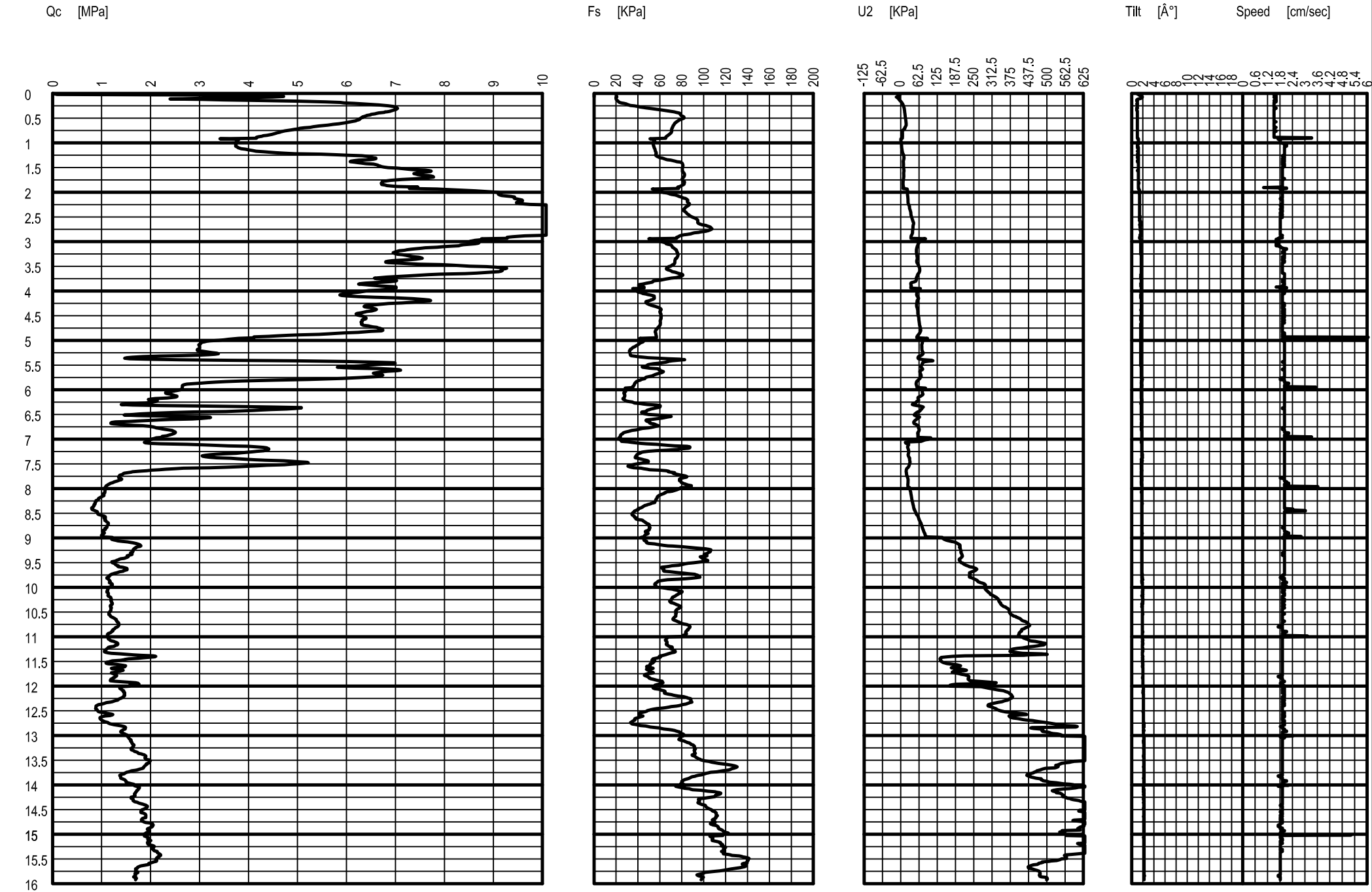
Speed [cm/sec]



MORONI DOTT. MAURIZIO - GEOLOGO

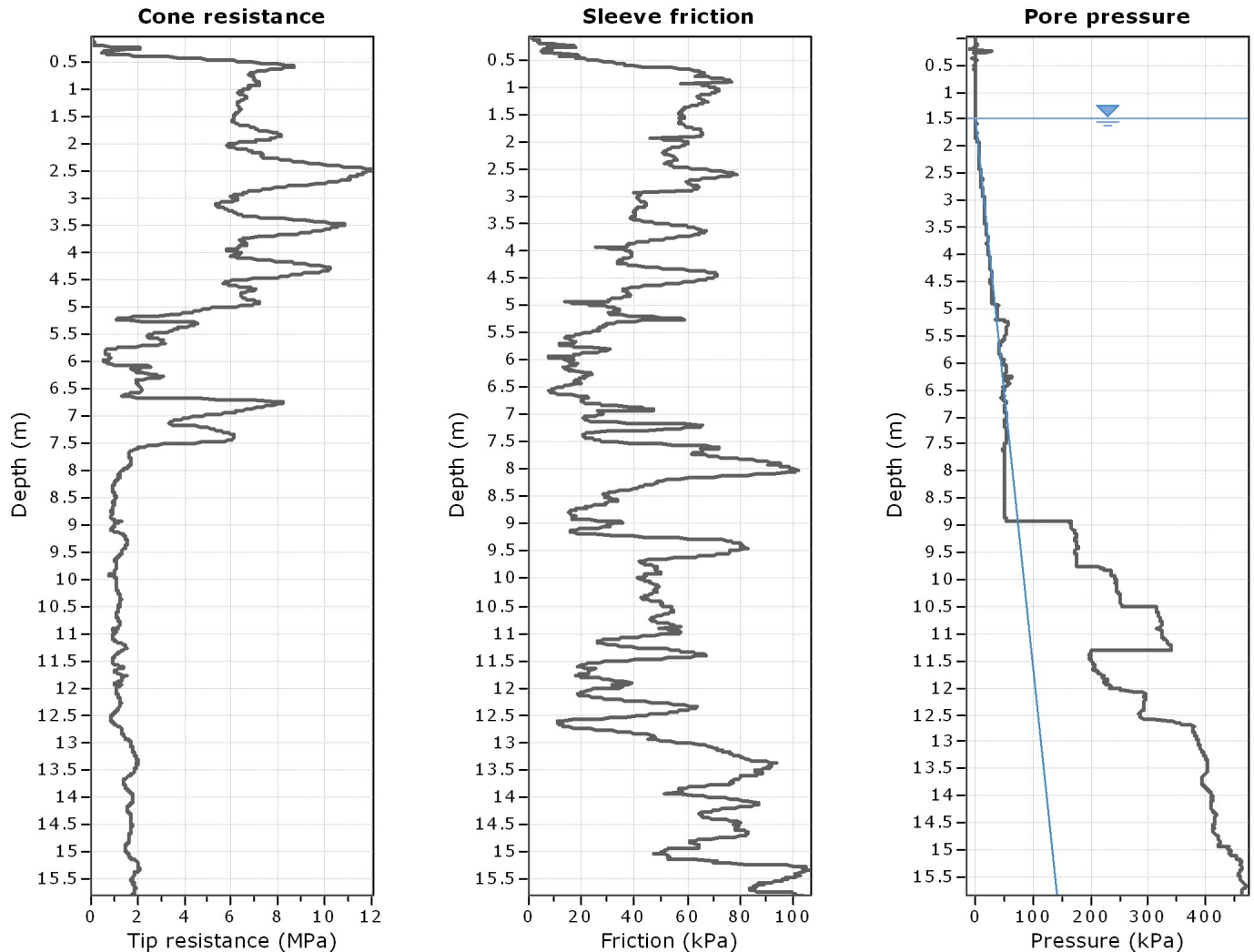
Cone Penetration Test (CPTU) 3

Site: EX COLONIA PREALPI CESENATICO (Fc)



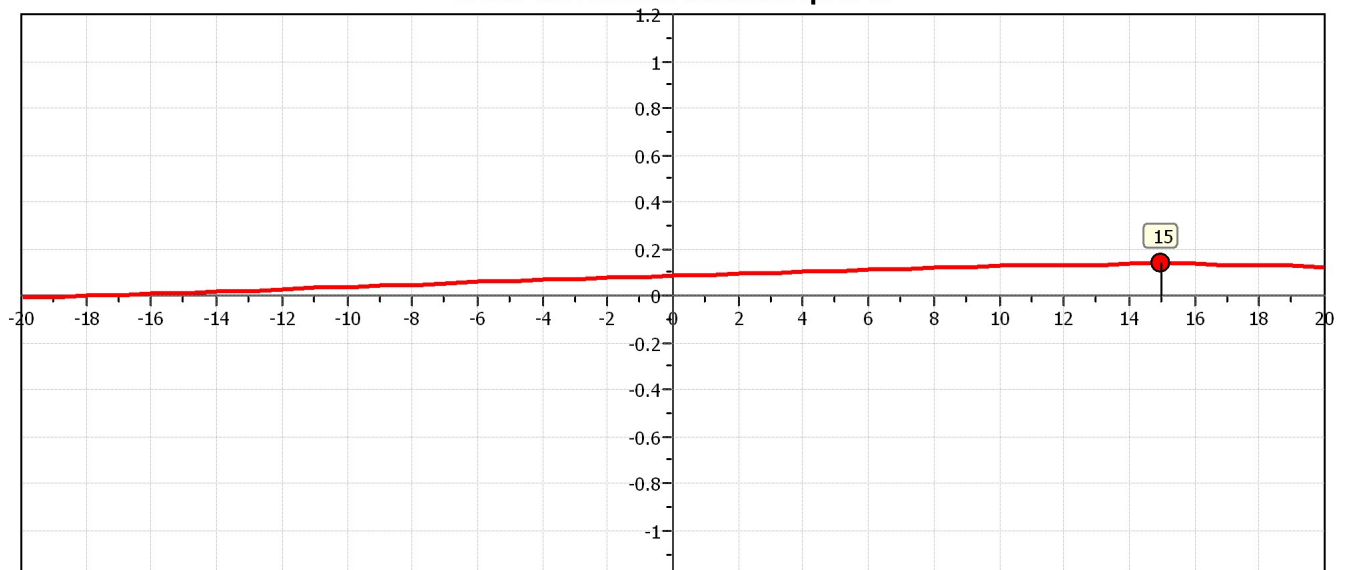
Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

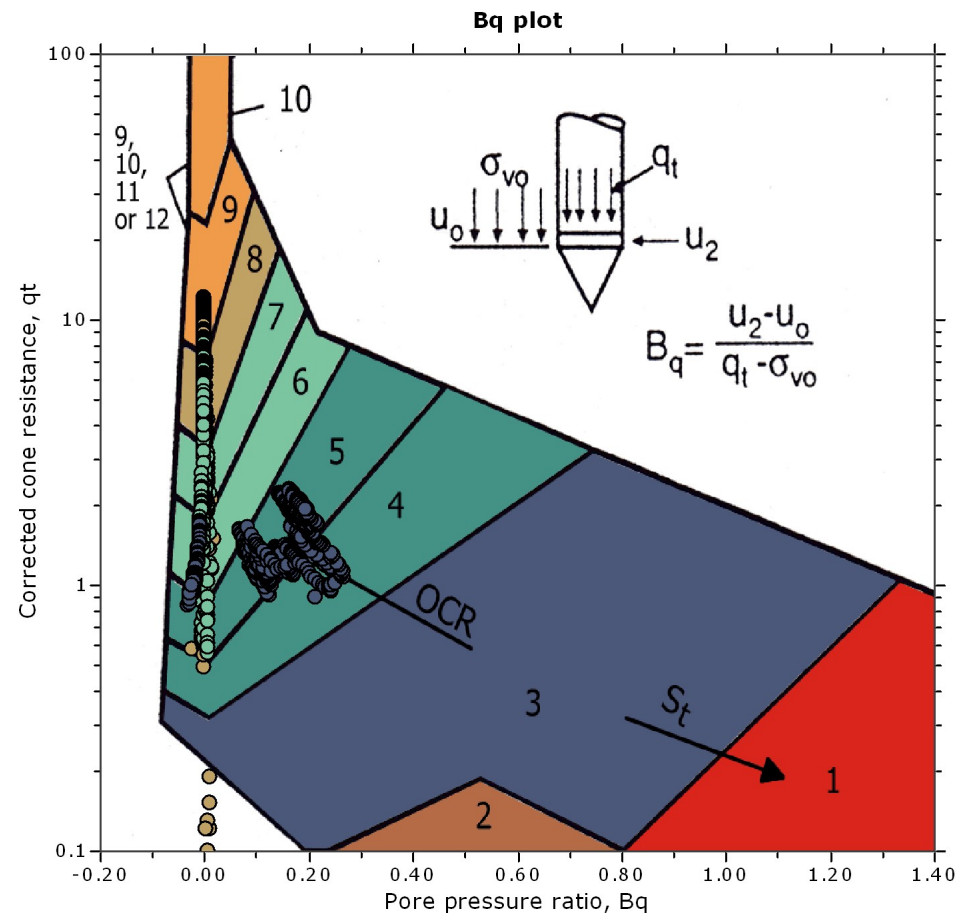
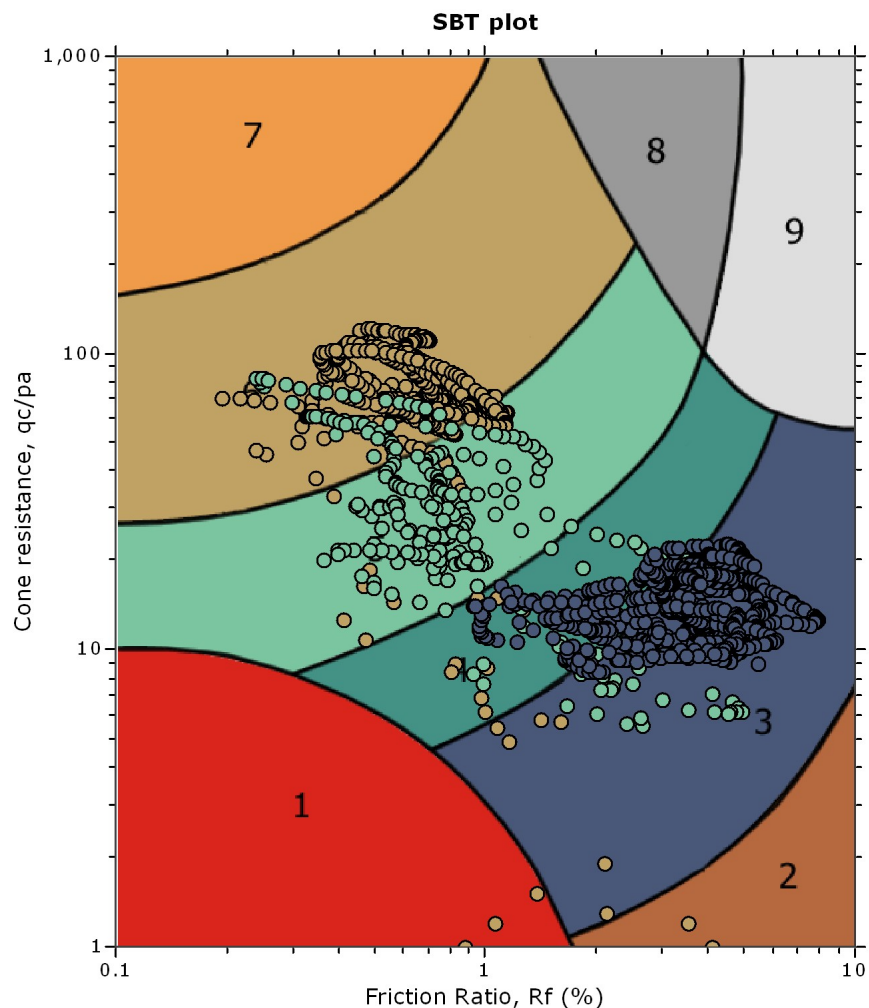


The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).

Cross correlation between qc & fs



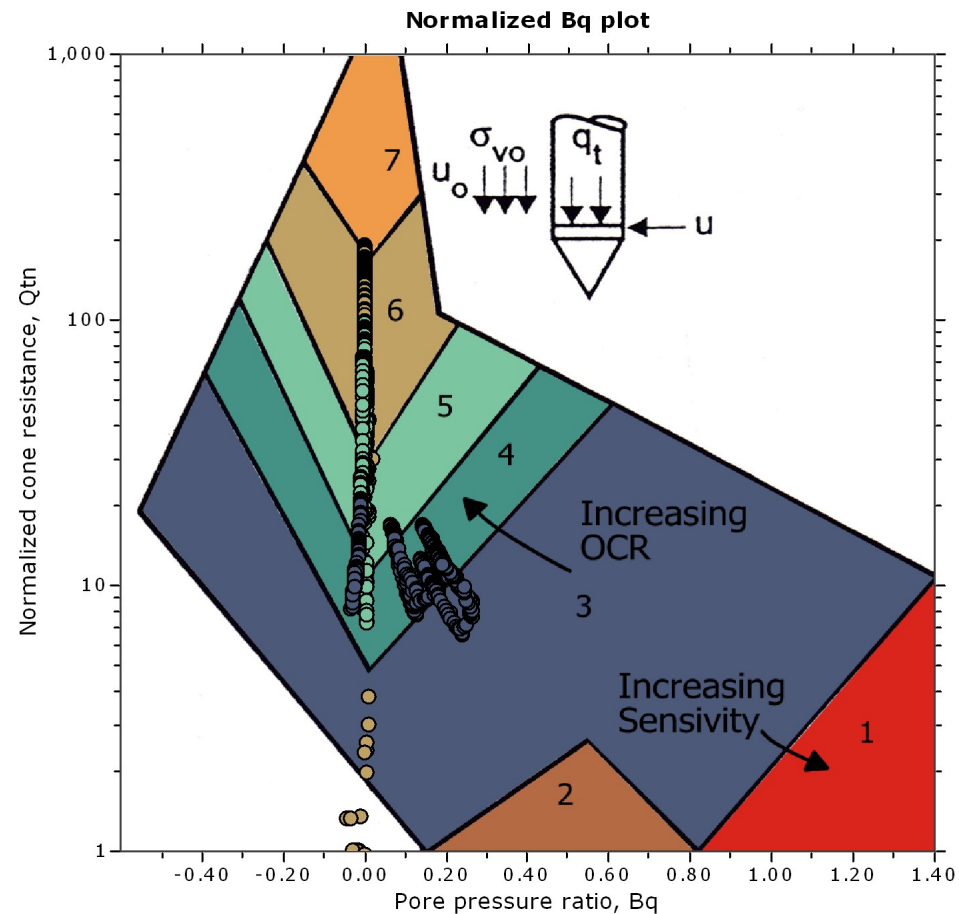
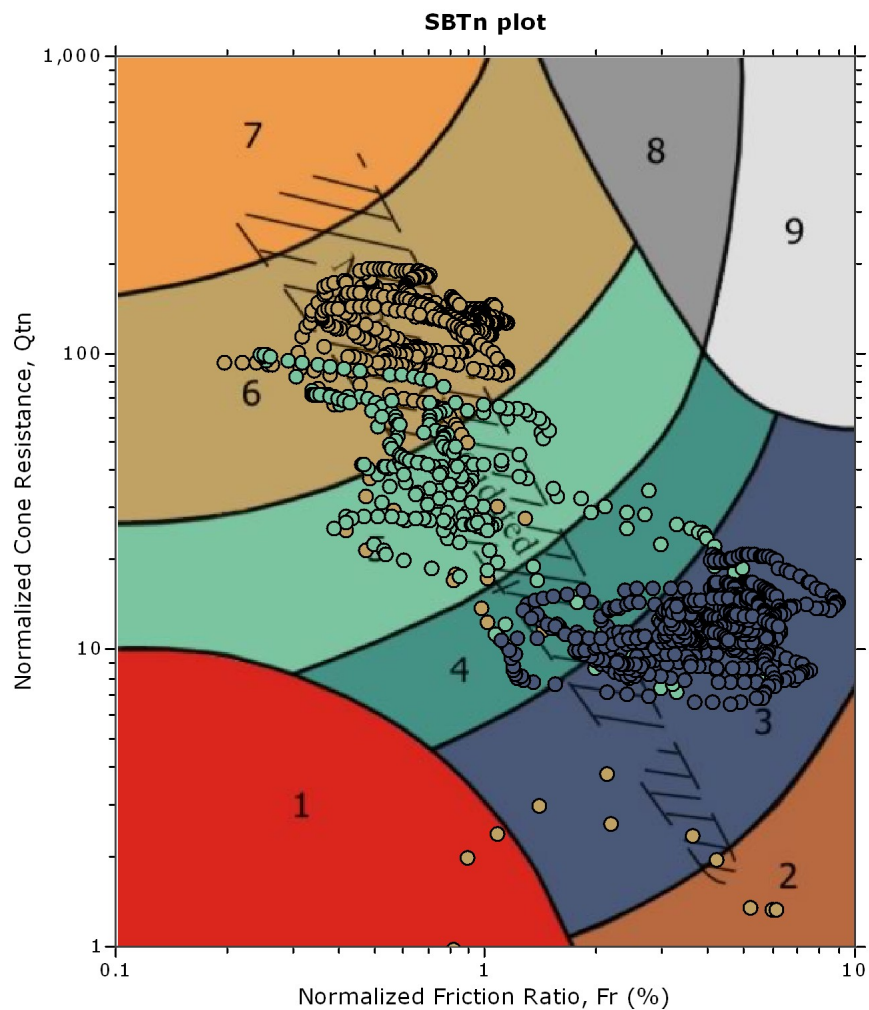
SBT - Bq plots



SBT legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

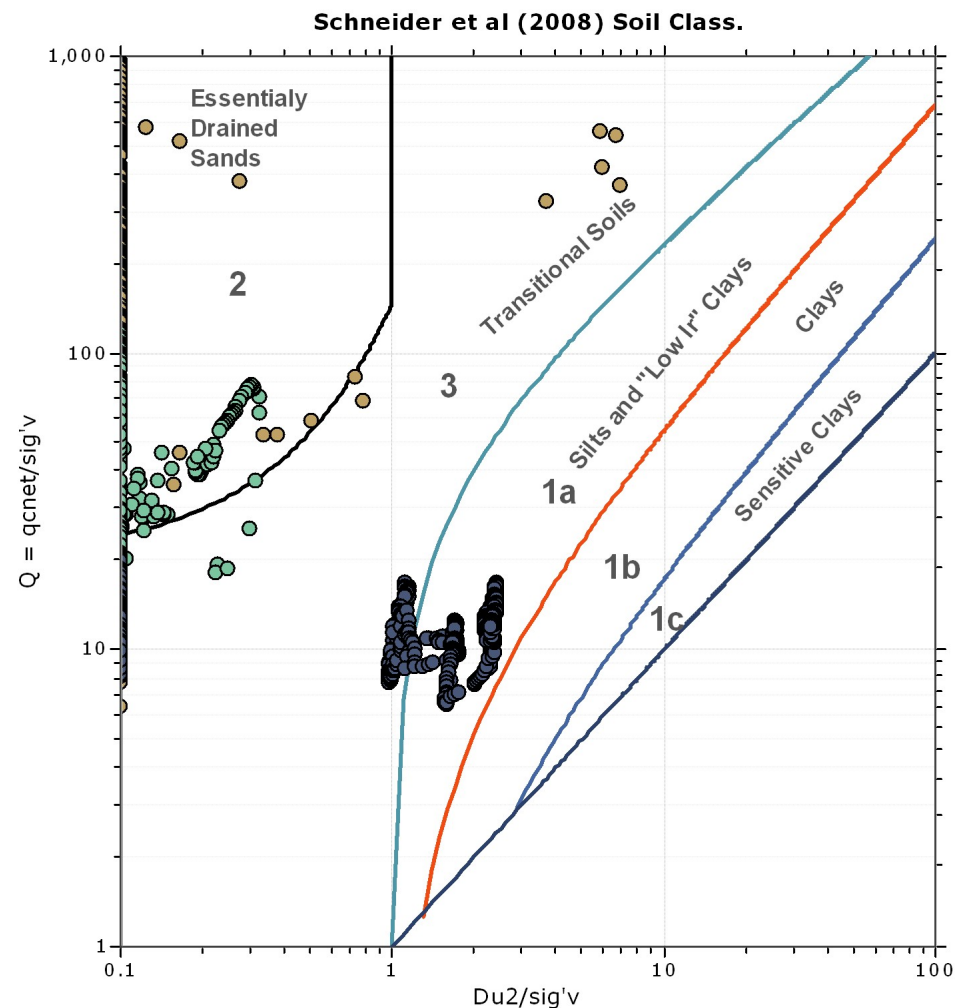
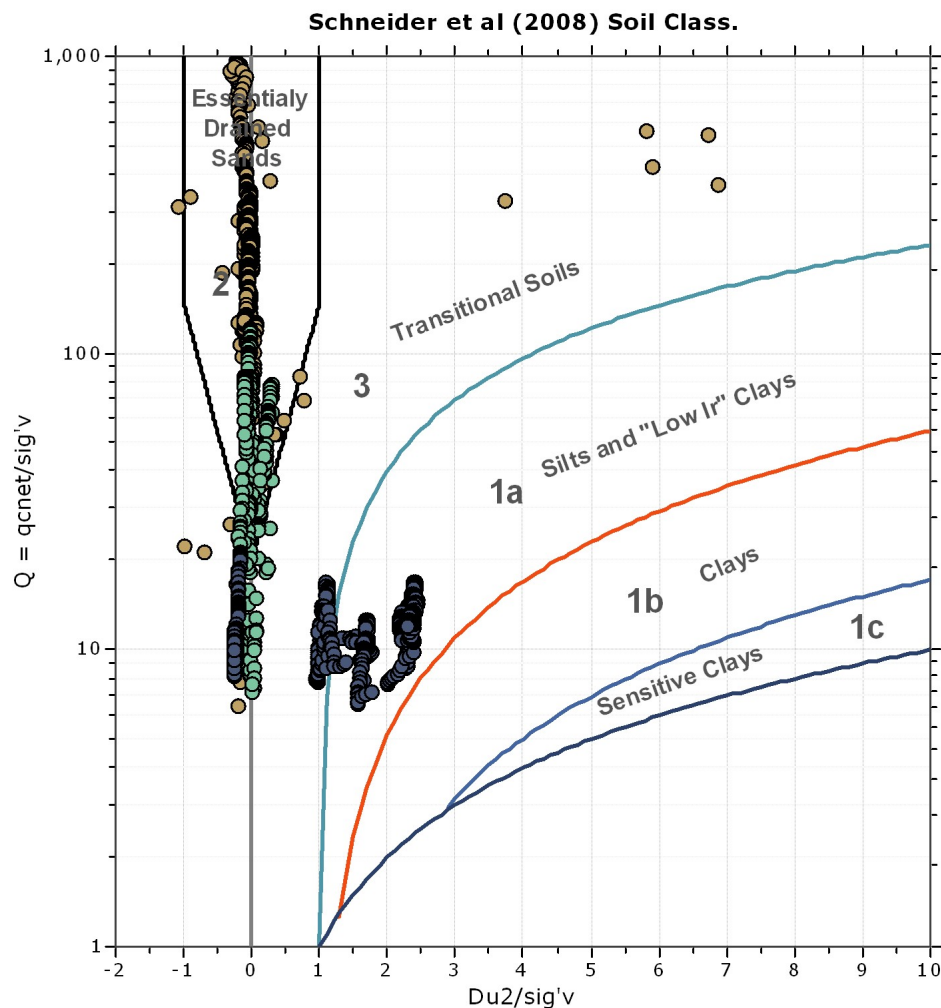
SBT - Bq plots (normalized)

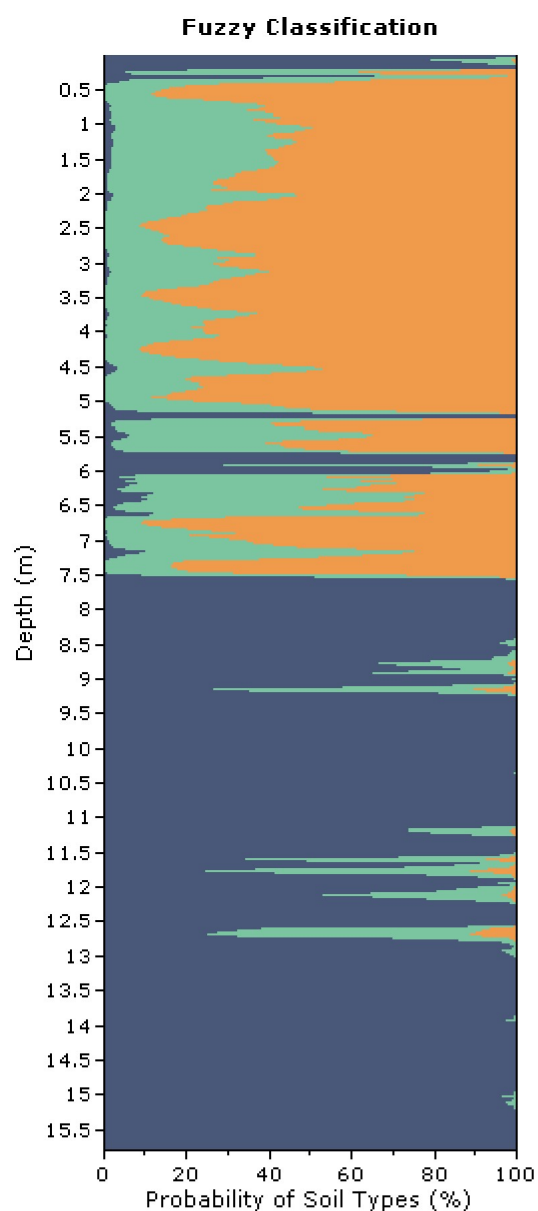
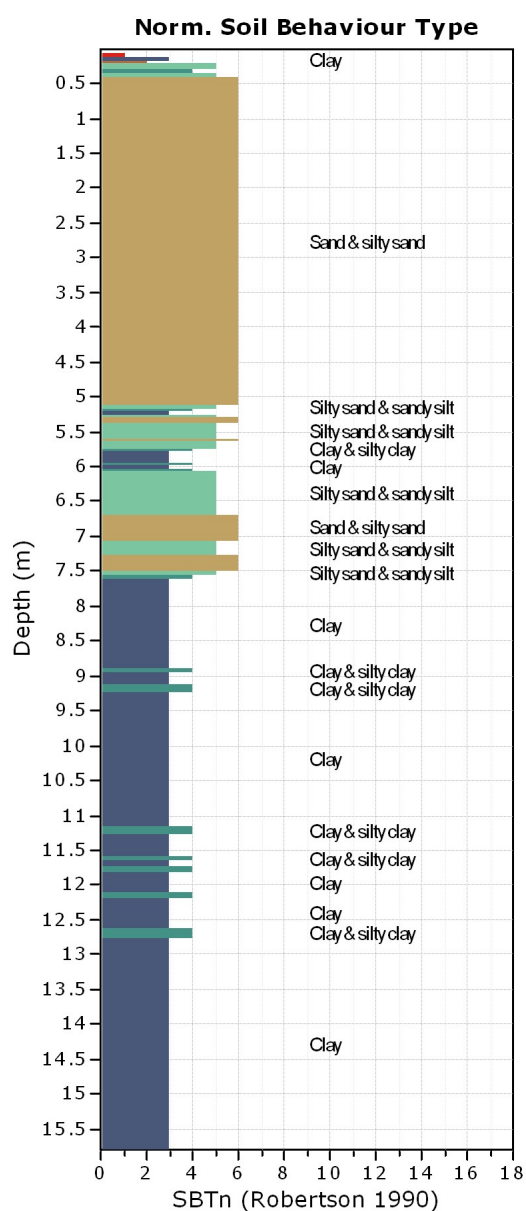


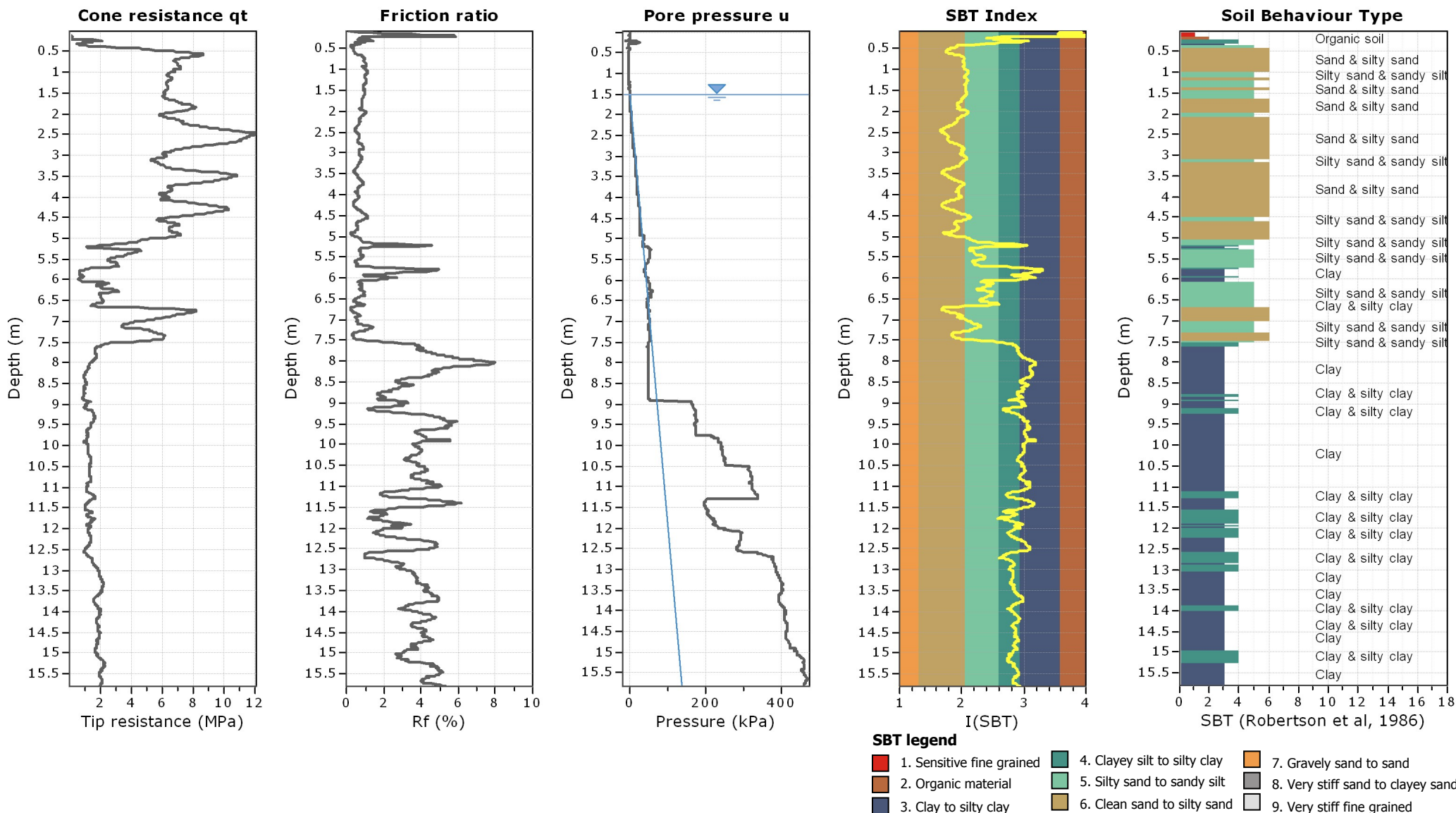
SBTn legend

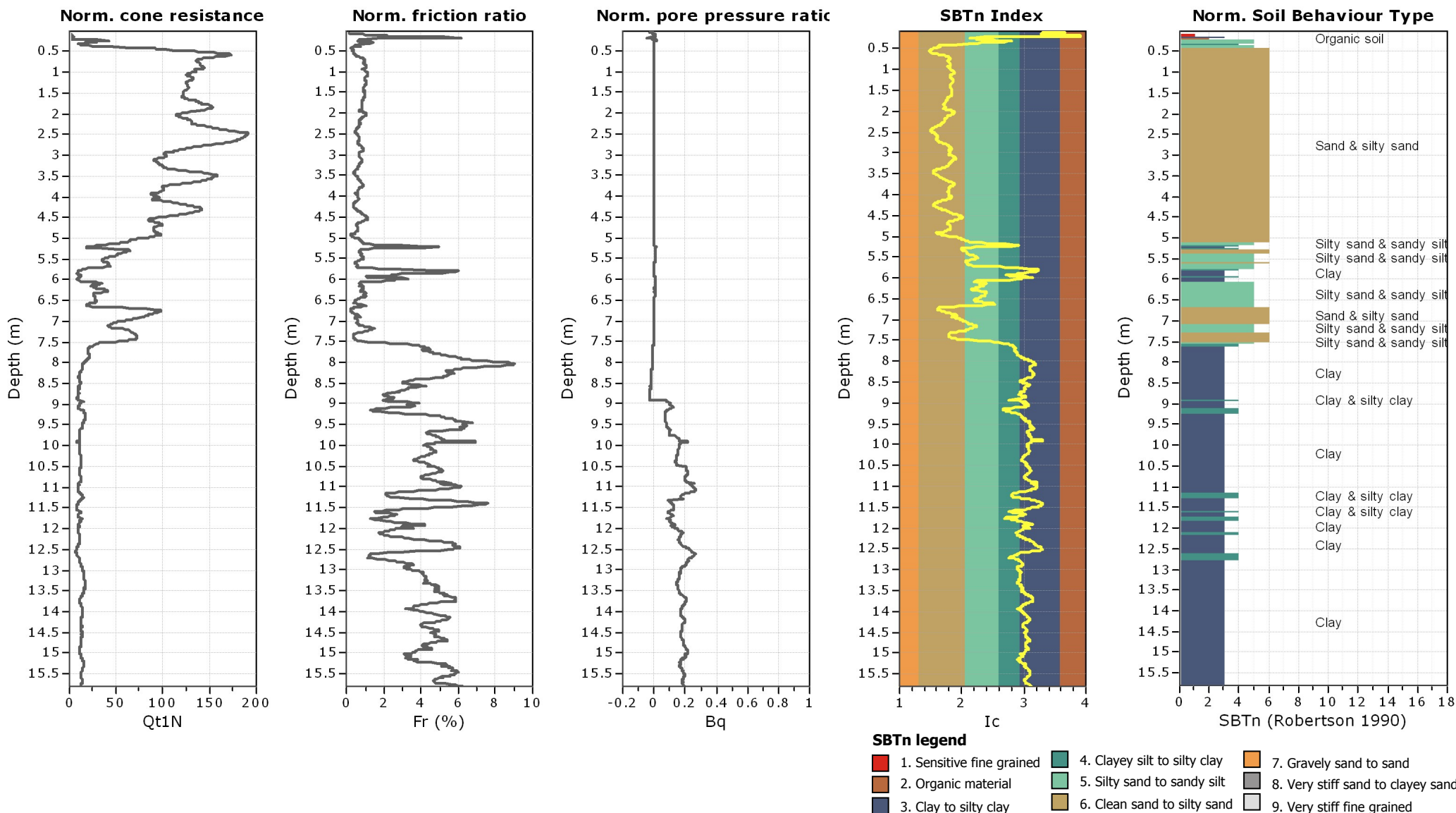
- | | | |
|---------------------------|------------------------------|-----------------------------------|
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| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

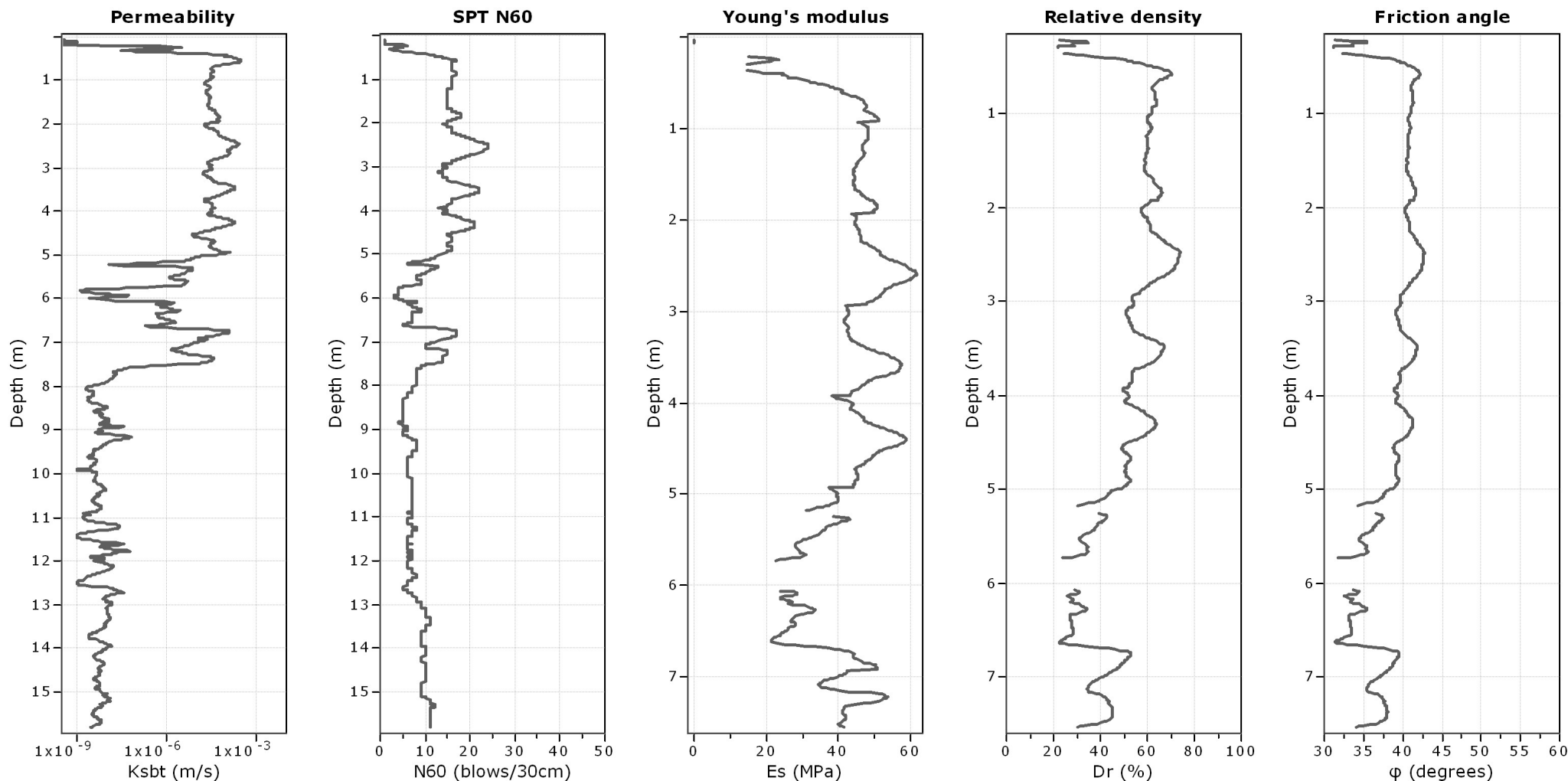
Bq plots (Schneider)











Calculation parameters

Permeability: Based on SBT_n

SPT N₆₀: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-01

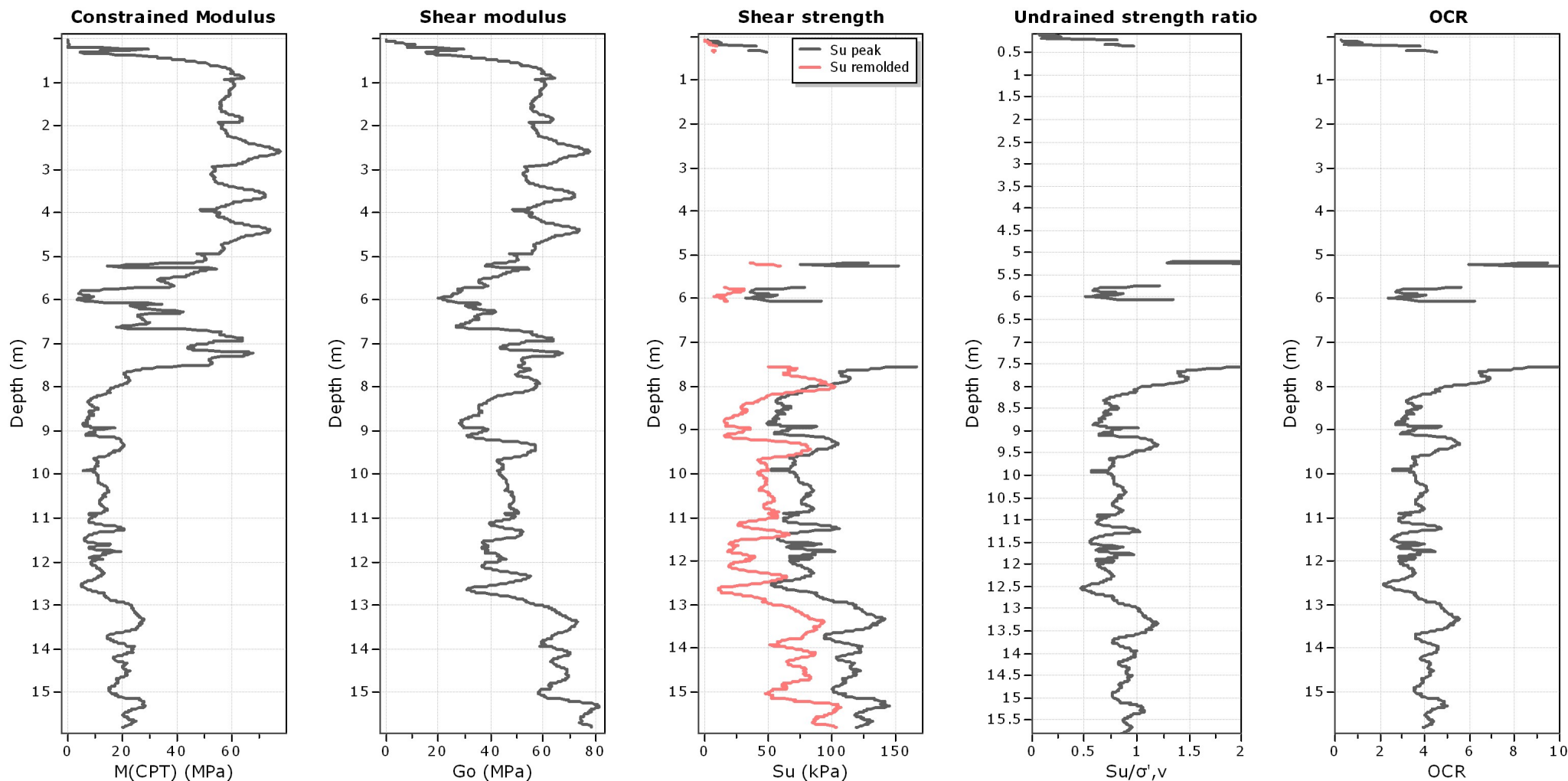
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Calculation parameters

Constrained modulus: Based on variable α using I_c and Q_m (Robertson, 2009)

Go: Based on variable α using I_c (Robertson, 2009)

Undrained shear strength cone factor for clays, N_{kt} : 14

OCR factor for clays, N_{kt} : 0.33

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-01

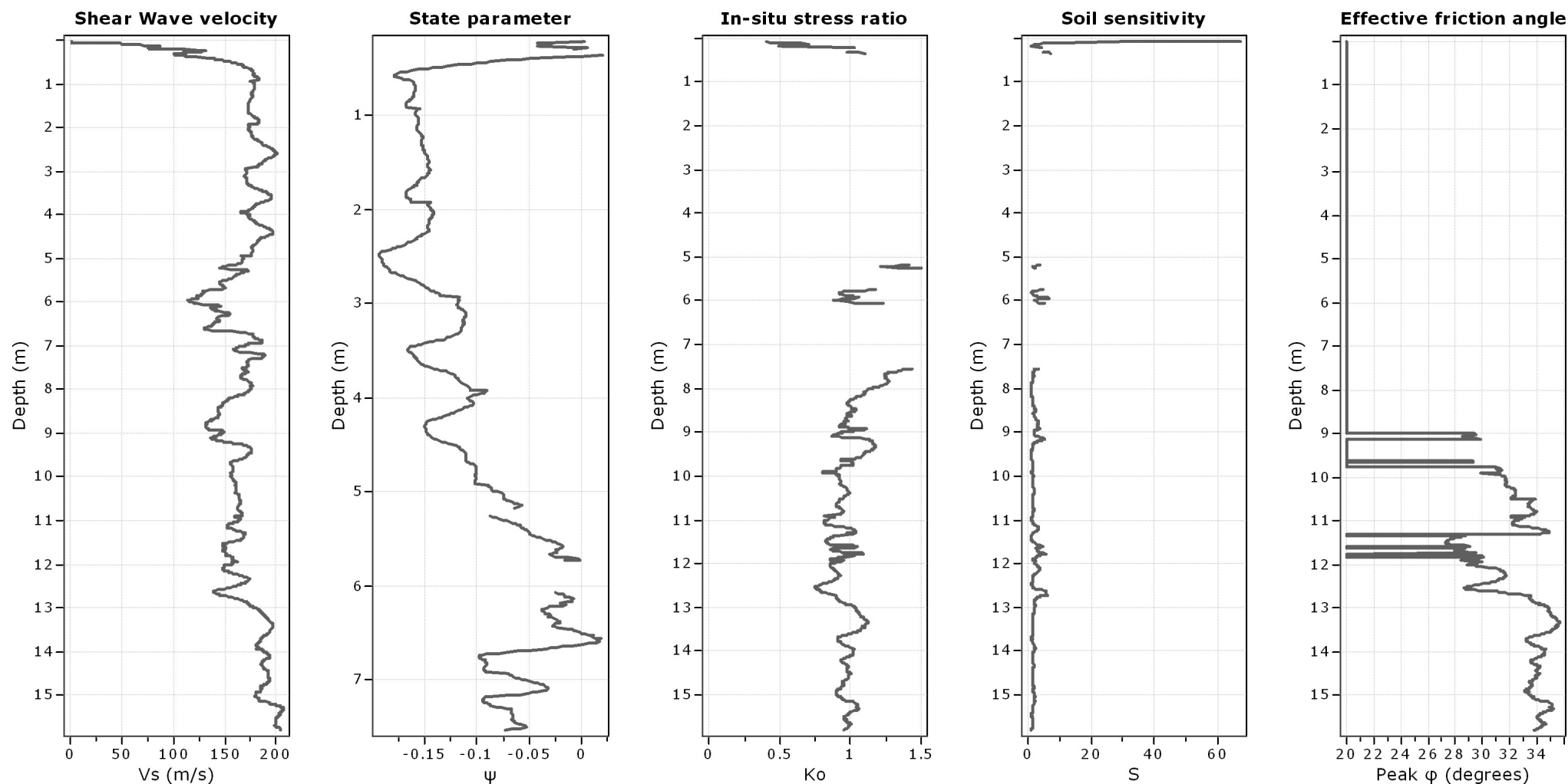
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Calculation parameters

Soil Sensitivity factor, N_s : 7.00

—●— User defined estimation data



GeoLogismiki

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Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-01

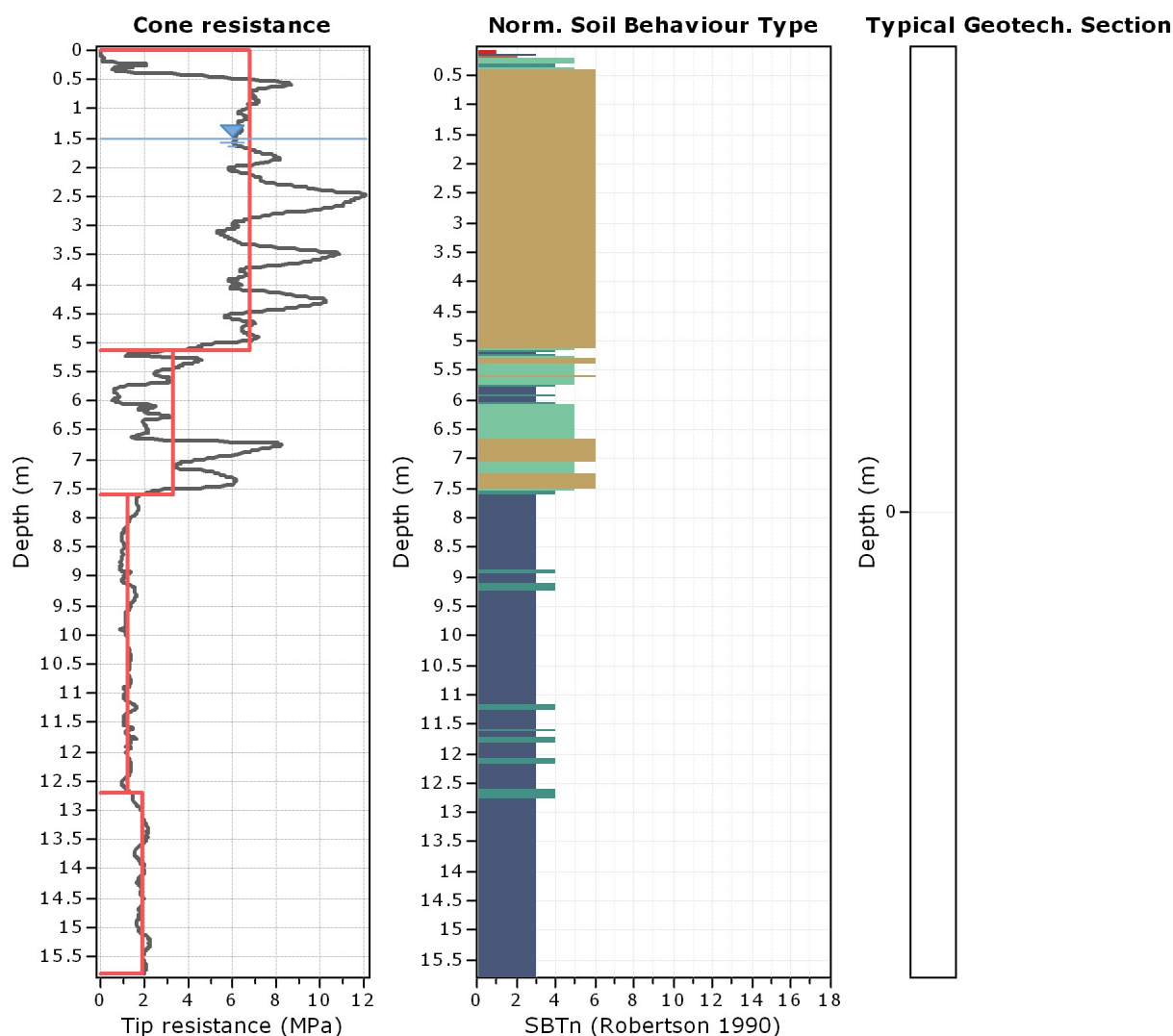
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Tabular results

::: Layer No: 1 :::

Code: 1 **Start depth:** 0.00 (m), **End depth:** 5.14 (m)

Description: sabbia limosa mediamente densa

Basic results

Total cone resistance: 6.82 ± 2.44 MPa

Sleeve friction: 48.38 ± 18.69 kPa

SBT_n: 6

SBT_n description: Sand & silty sand

Estimation results

Permeability: $5.62E-05 \pm 5.87E-05$ m/s

N₆₀: 15.88 ± 4.27 blows

Es: 46.65 ± 7.66 MPa

Dr (%): 58.17 ± 8.45

ö (degrees): 40.29 ± 1.63 °

Unit weight: 18.02 ± 0.96 kN/m³

Constrained Mod.: 55.72 ± 15.44 MPa

Go: 56.11 ± 14.24 MPa

Su: 0.00 ± 0.00 kPa

Su ratio: 0.00 ± 0.00

O.C.R.: 0.00 ± 0.00

::: Layer No: 2 :::**Code:** 2 **Start depth:** 5.14 (m), **End depth:** 7.62 (m)**Description:** sabbia limosa mediamente densa con livelli di limo ed argilla**Basic results**

Total cone resistance: 3.33 ±1.97 MPa

Sleeve friction: 26.48 ±14.49 kPa

SBT_n: 5SBT_n description: Silty sand & sandy silt**Estimation results**

Permeability: 9.65E-06 ±2.17E-05 m/s

N60: 9.55 ±3.89 blows

Es: 35.67 ±8.51 MPa

Dr (%): 36.60 ±7.79

ö (degrees): 35.76 ±2.05 °

Unit weight: 16.99 ±0.71 kN/m³

Constrained Mod.: 36.56 ±16.92 MPa

Go: 42.30 ±11.86 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

::: Layer No: 3 :::**Code:** 3 **Start depth:** 7.62 (m), **End depth:** 12.70 (m)**Description:** limo argilloso ed argilla limosa da molle a mediamente consistente**Basic results**

Total cone resistance: 1.24 ±0.21 MPa

Sleeve friction: 45.65 ±20.75 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 8.27E-09 ±9.38E-09 m/s

N60: 6.50 ±0.96 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 17.33 ±0.60 kN/m³

Constrained Mod.: 12.04 ±4.45 MPa

Go: 44.26 ±7.49 MPa

Su: 76.07 ±15.42 kPa

Su ratio: 0.82 ±0.22

O.C.R.: 3.80 ±1.02

::: Layer No: 4 :::**Code:** 4 **Start depth:** 12.70 (m), **End depth:** 15.80 (m)**Description:** limo argilloso ed argilla limosa mediamente consistente**Basic results**

Total cone resistance: 1.88 ±0.20 MPa

Sleeve friction: 73.45 ±18.30 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 7.38E-09 ±4.32E-09 m/s

N60: 9.78 ±1.09 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 18.12 ±0.40 kN/m³

Constrained Mod.: 20.87 ±4.08 MPa

Go: 66.05 ±8.34 MPa

Su: 116.34 ±13.76 kPa

Su ratio: 0.93 ±0.11

O.C.R.: 4.28 ±0.51

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

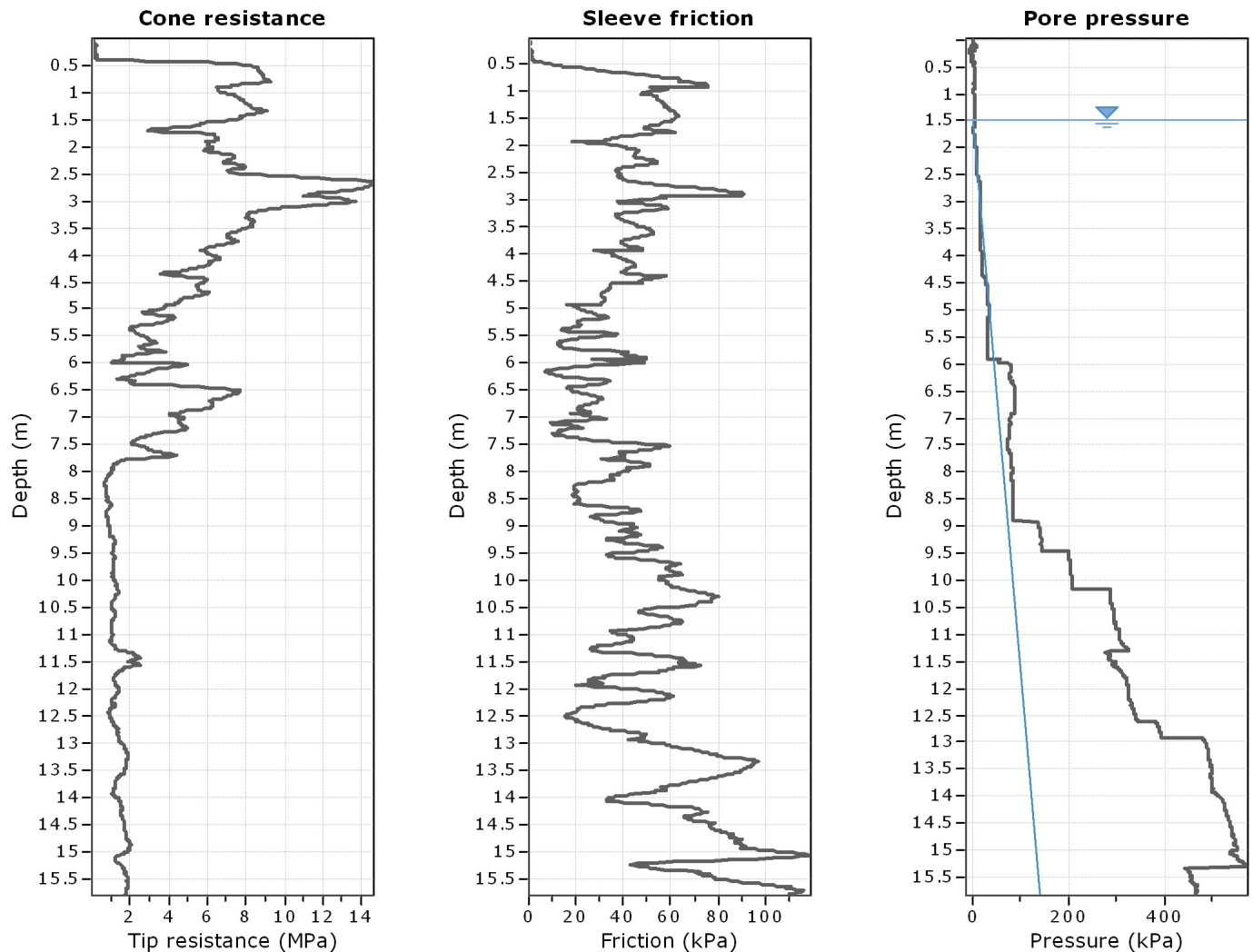
Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT _{N60} (blows/30cm)	E _s (MPa)	D _r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G _o (MPa)	Undrained strength, S _u (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m ³)
0.00	5.14	5.62E-05	15.9	46.6	58.2	40.3	55.7	56.1	0.0	0.0	0.0	18.0
5.14		(±5.87E-05)	(±4.3)	(±7.7)	(±8.5)	(±1.6)	(±15.4)	(±14.2)	(±0.0)	(±0.0)	(±0.0)	(±1.0)
5.14	2.48	9.65E-06	9.6	35.7	36.6	35.8	36.6	42.3	0.0	0.0	0.0	17.0
7.62		(±2.17E-05)	(±3.9)	(±8.5)	(±7.8)	(±2.0)	(±16.9)	(±11.9)	(±0.0)	(±0.0)	(±0.0)	(±0.7)
7.62	5.08	8.27E-09	6.5	0.0	0.0	0.0	12.0	44.3	76.1	0.8	3.8	17.3
12.70		(±9.38E-09)	(±1.0)	(±0.0)	(±0.0)	(±0.0)	(±4.5)	(±7.5)	(±15.4)	(±0.2)	(±1.0)	(±0.6)
12.70	3.10	7.38E-09	9.8	0.0	0.0	0.0	20.9	66.1	116.3	0.9	4.3	18.1
15.80		(±4.32E-09)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±4.1)	(±8.3)	(±13.8)	(±0.1)	(±0.5)	(±0.4)

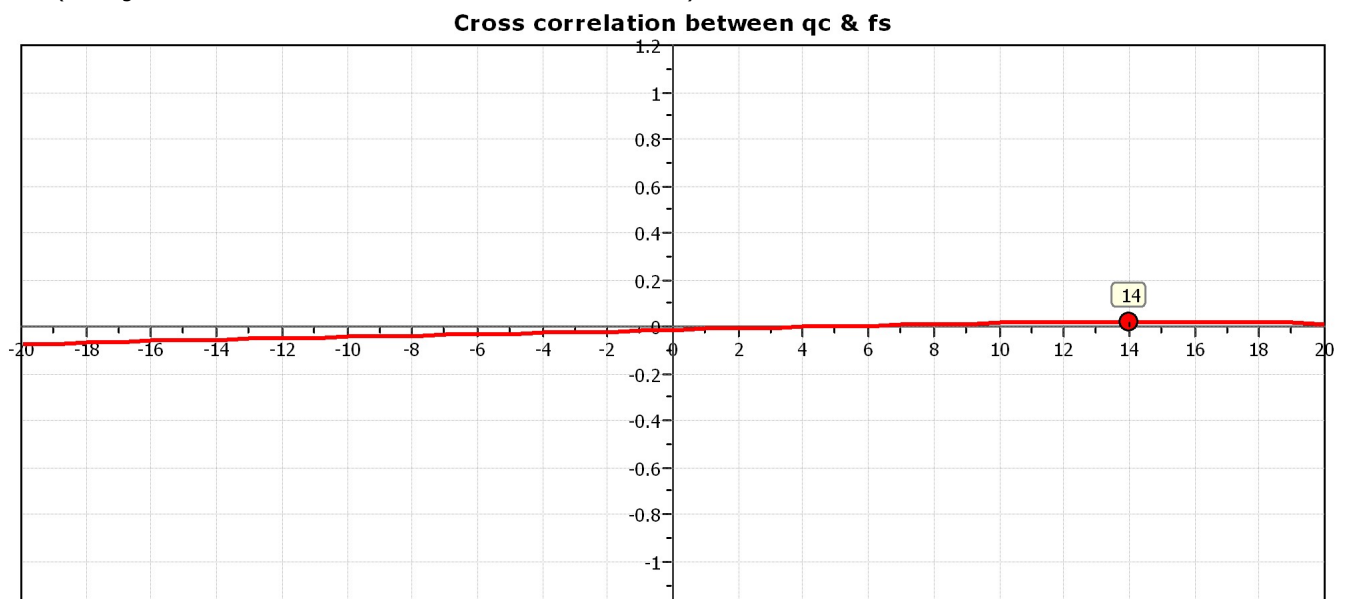
Depth values presented in this table are measured from free ground surface

Project: INDAGINE GEOLOGICA

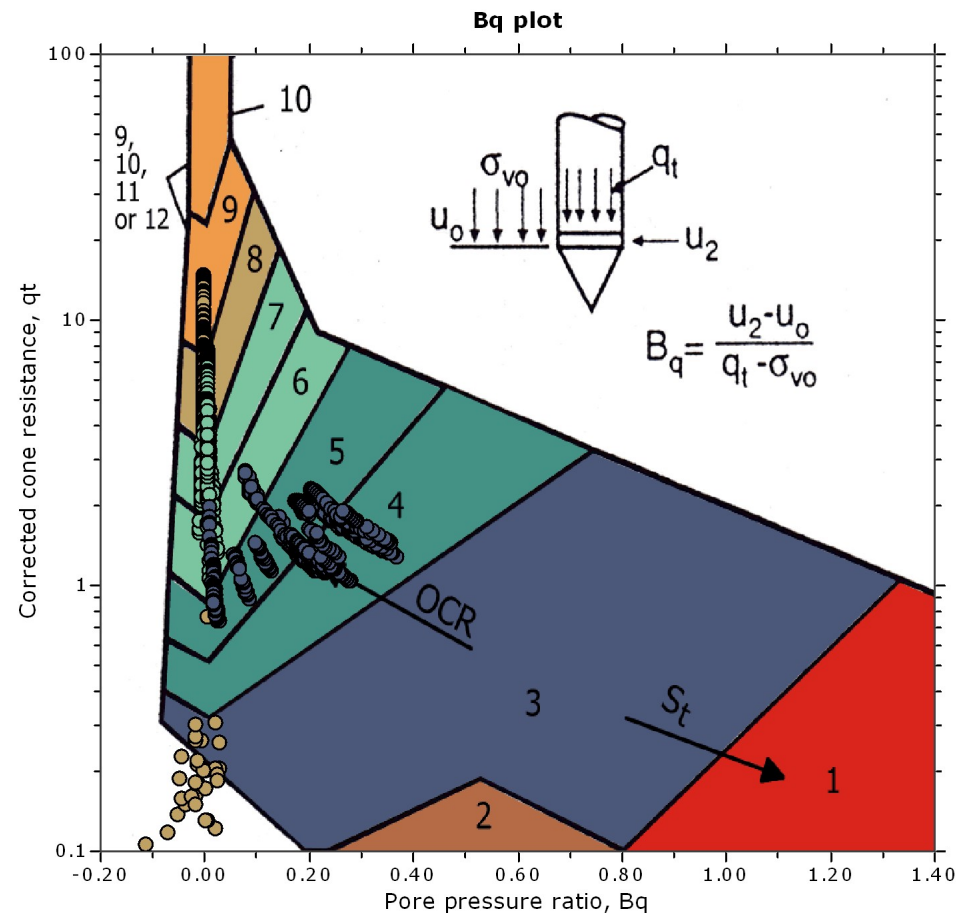
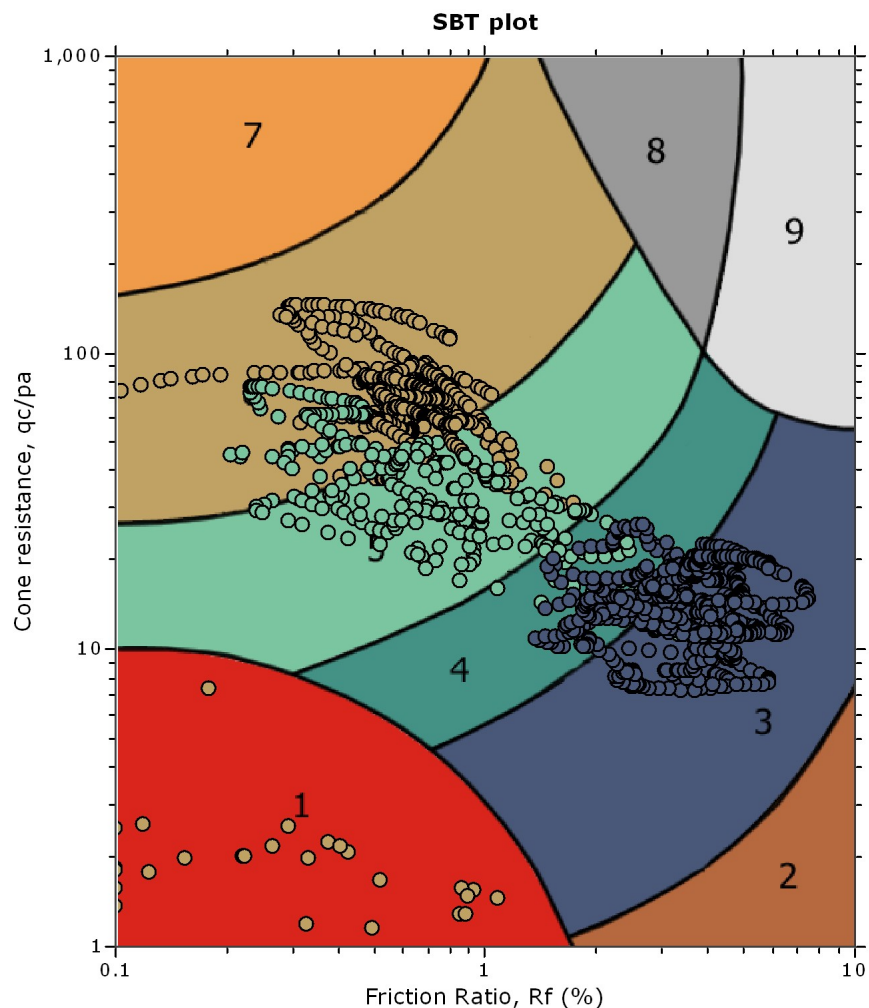
Location: CESENATICO - EX COLONIA PREALPI



The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



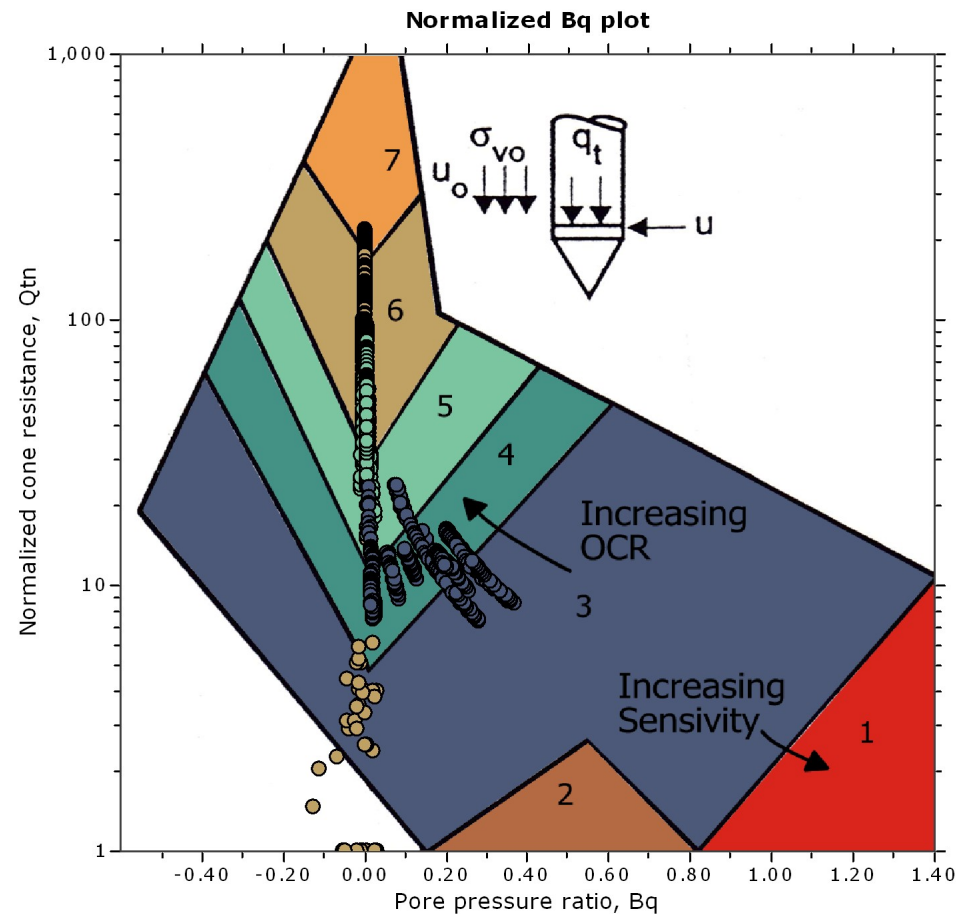
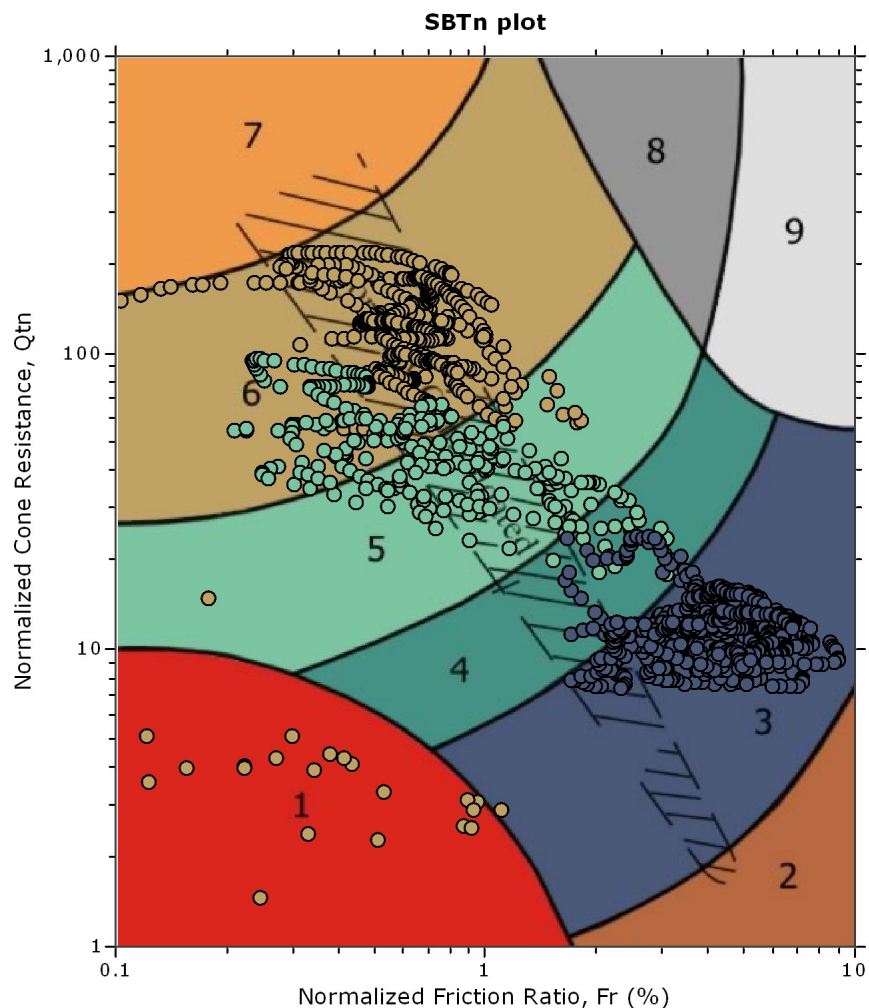
SBT - Bq plots



SBT legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

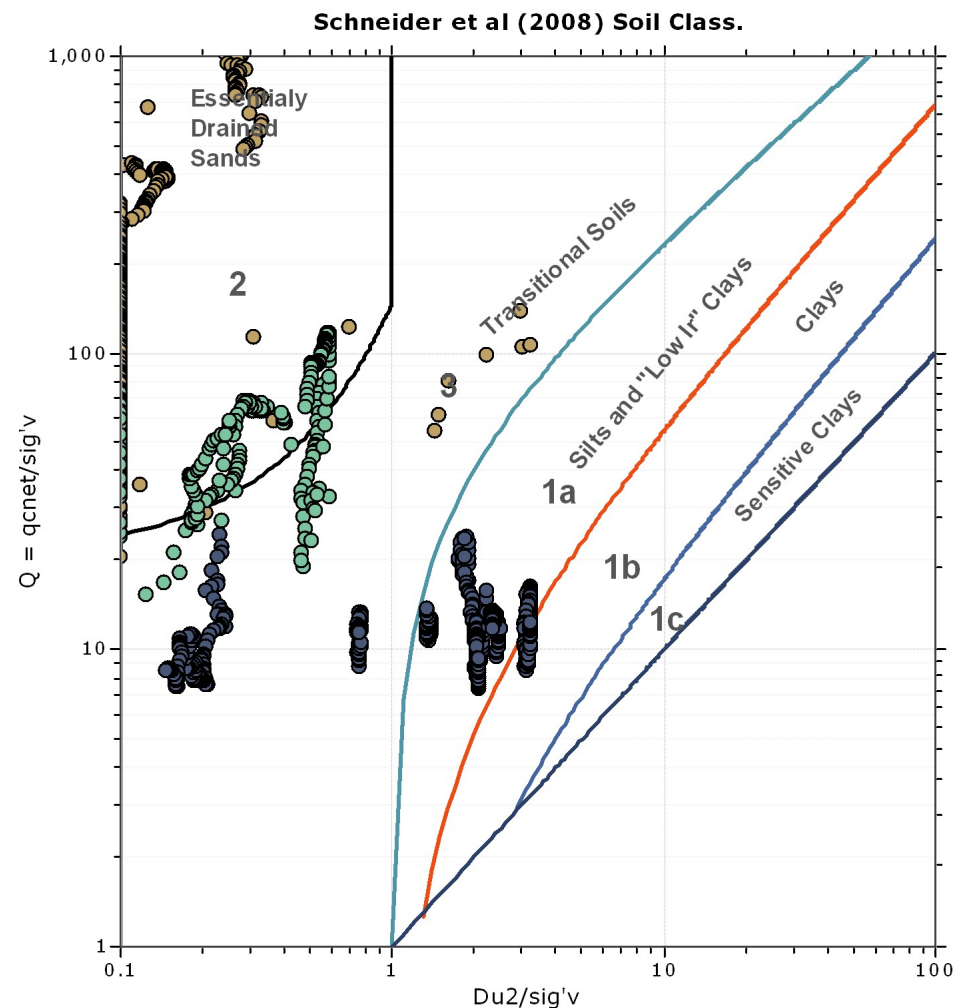
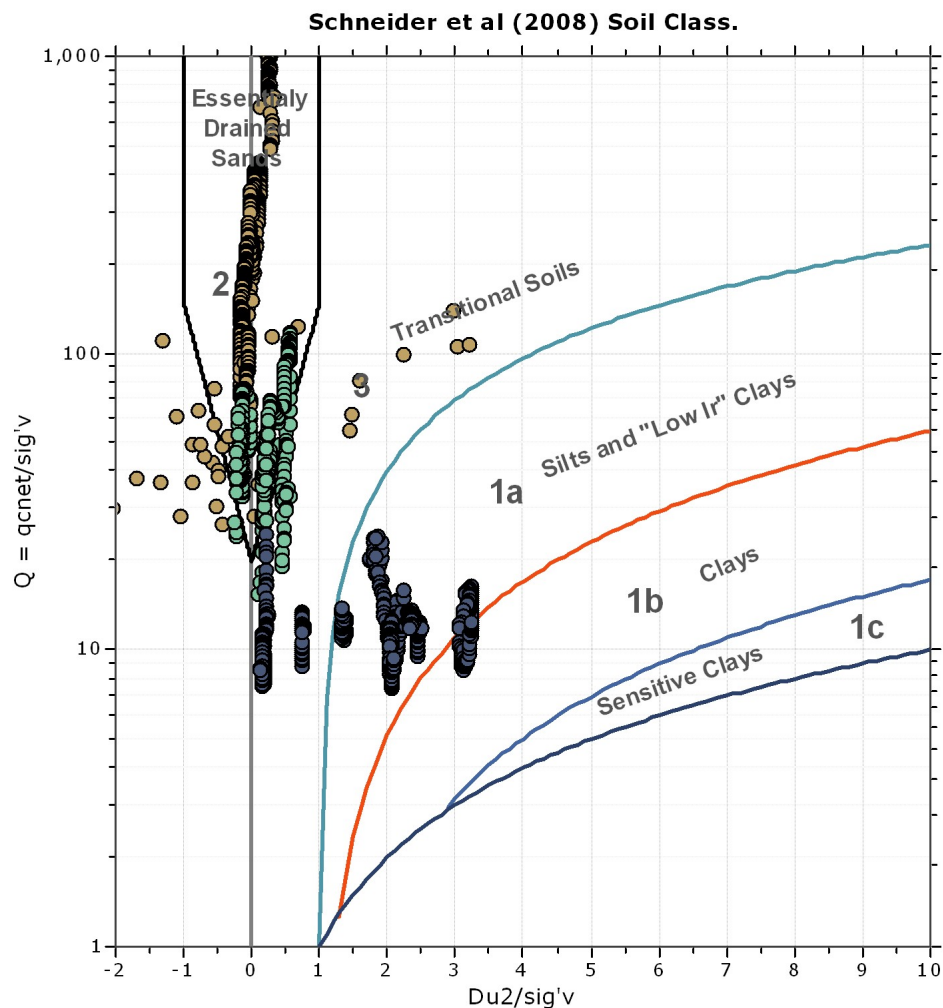
SBT - Bq plots (normalized)

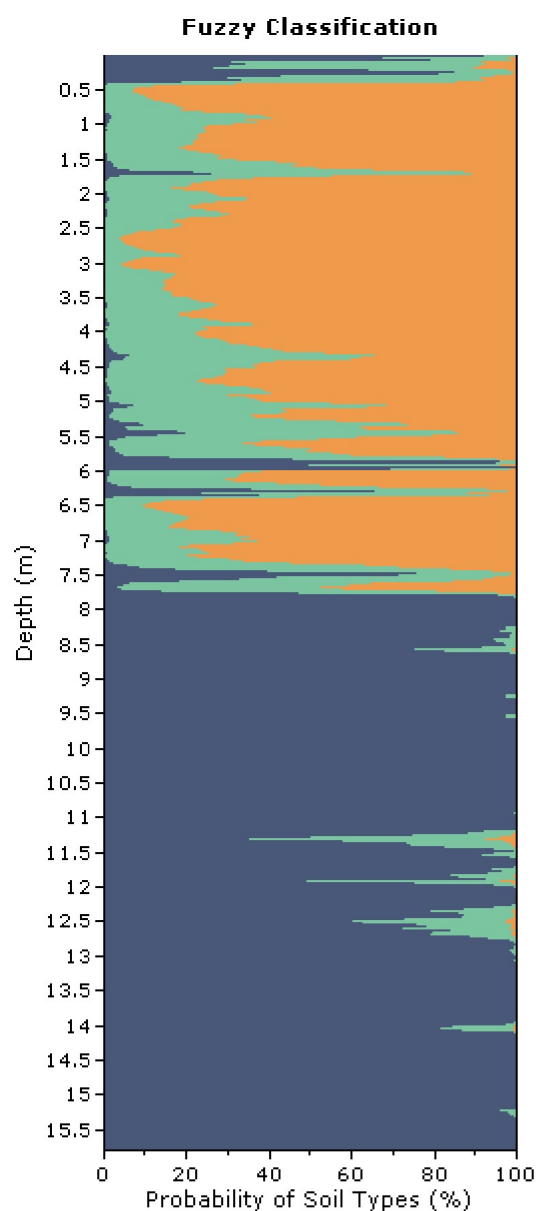
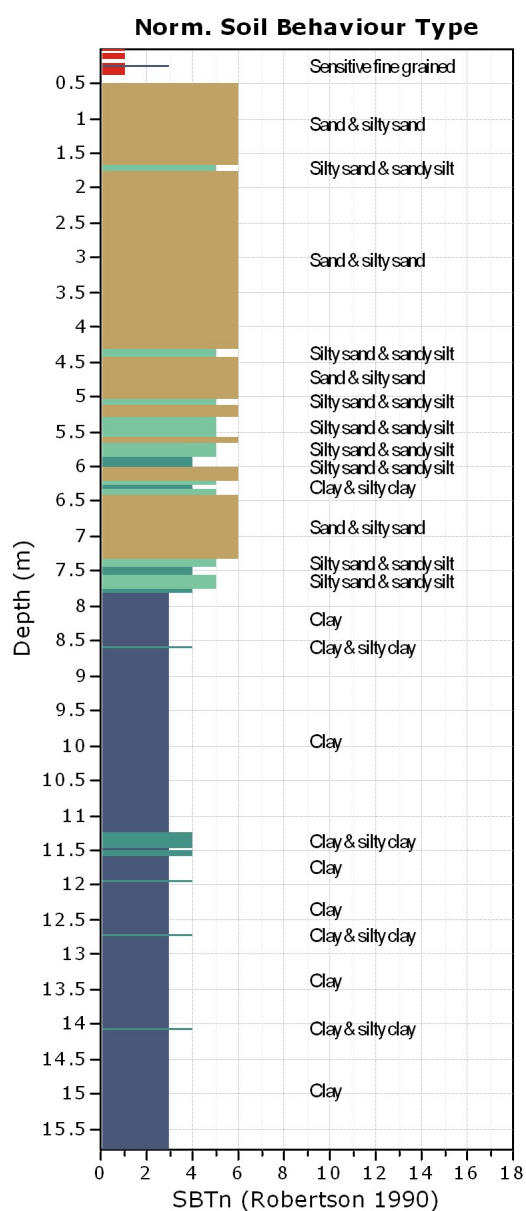


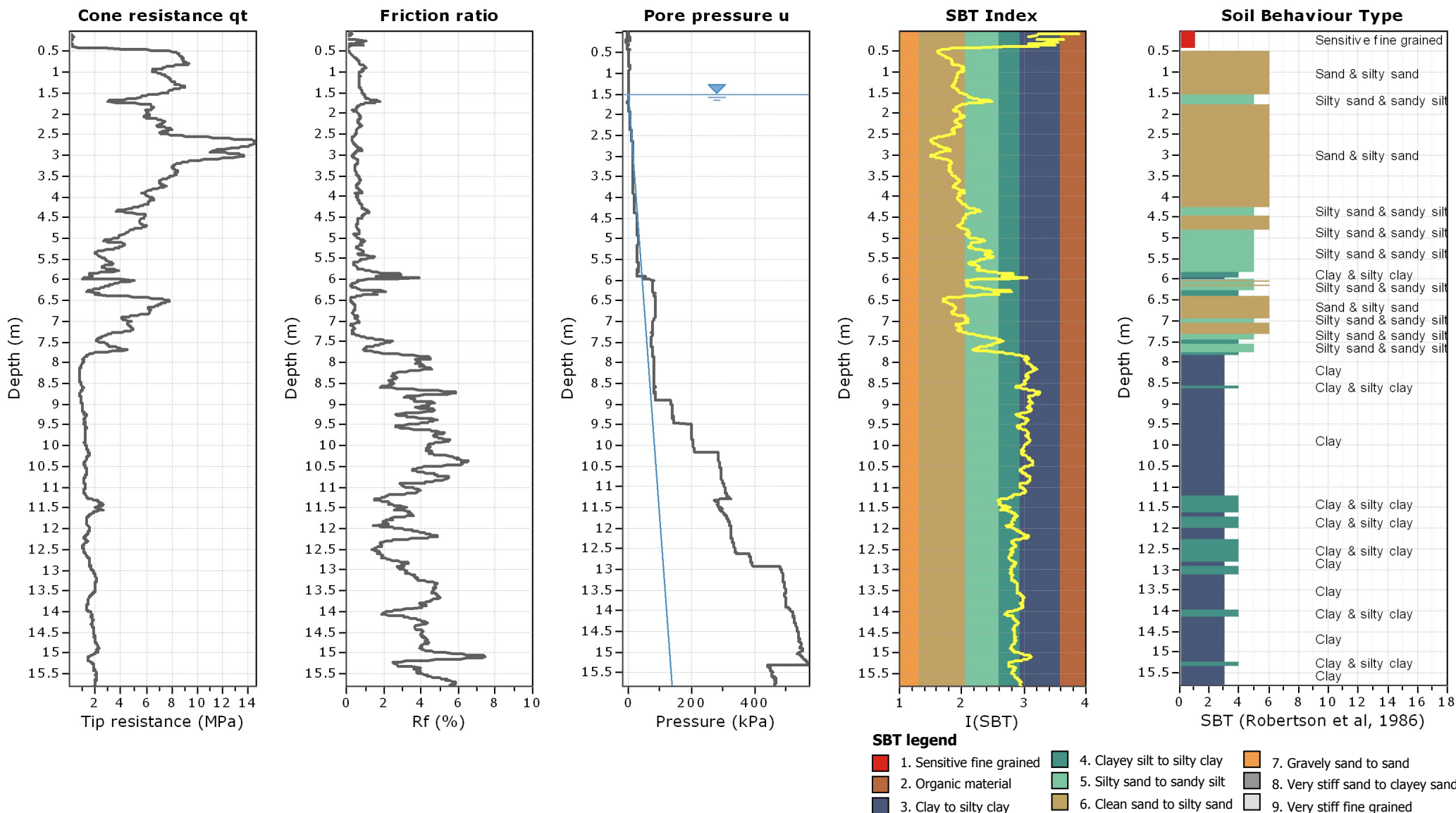
SBTn legend

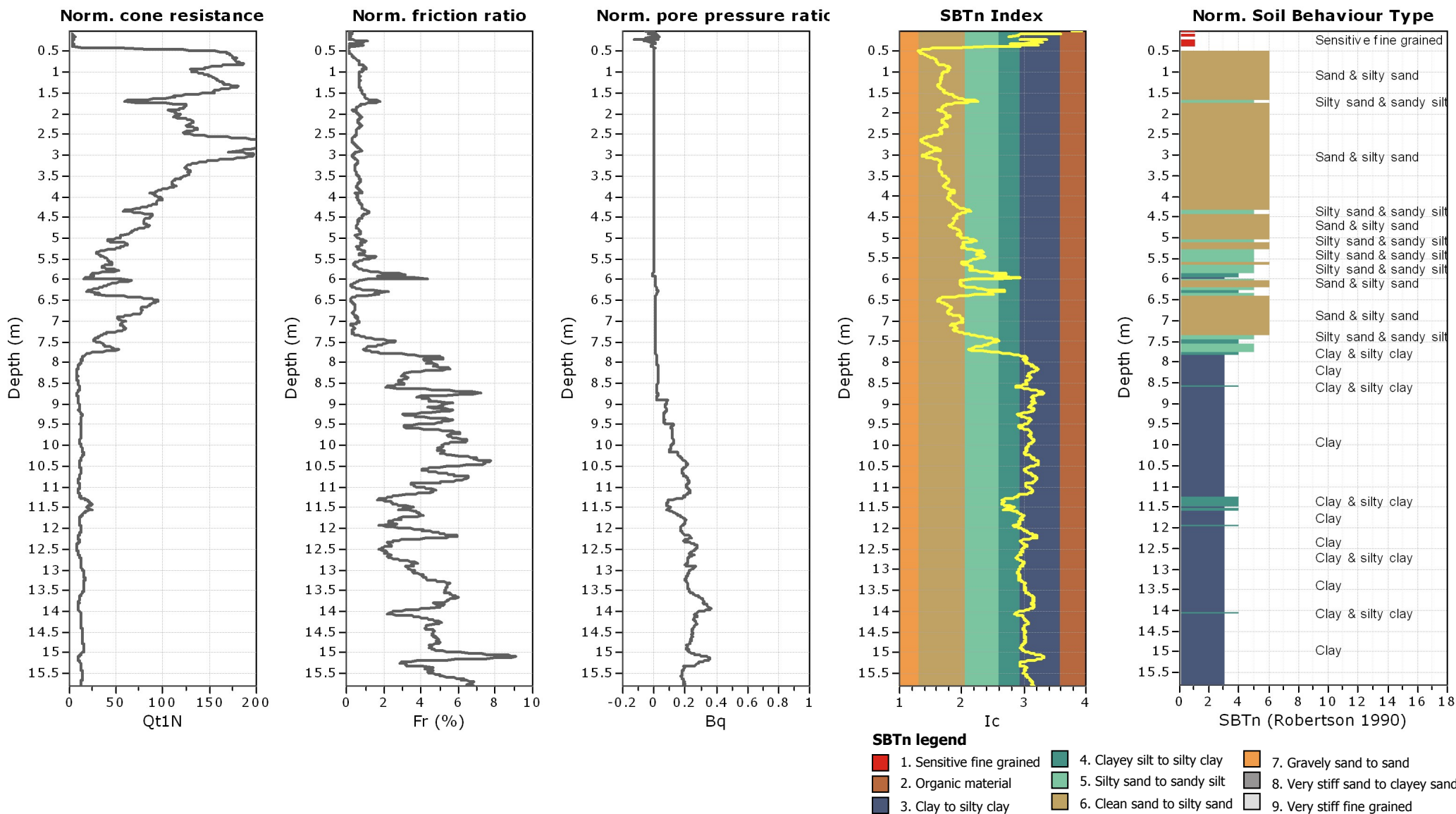
- | | | |
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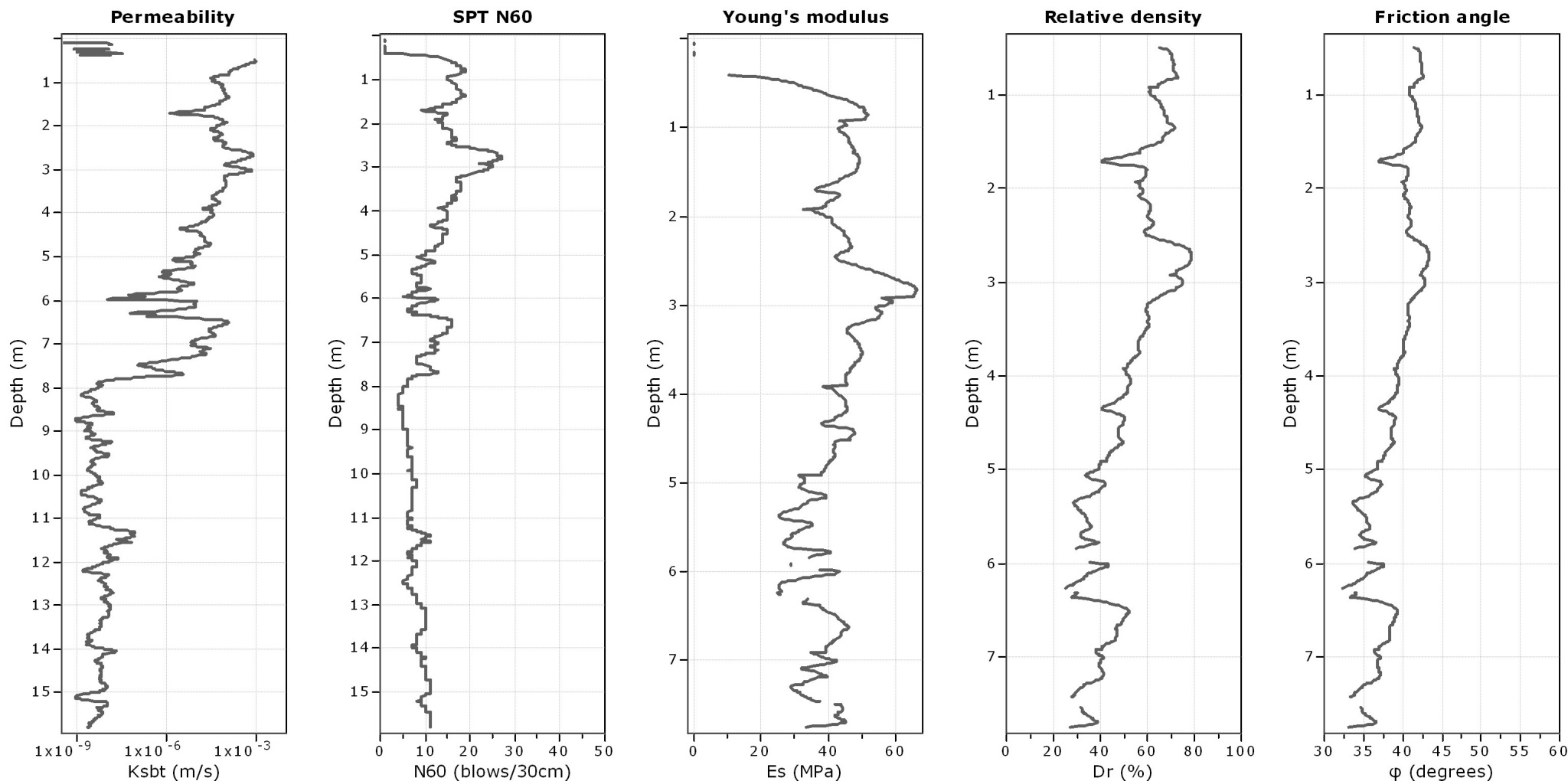
Bq plots (Schneider)











Calculation parameters

Permeability: Based on SBT_n

SPT N_{60} : Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr} : 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-02

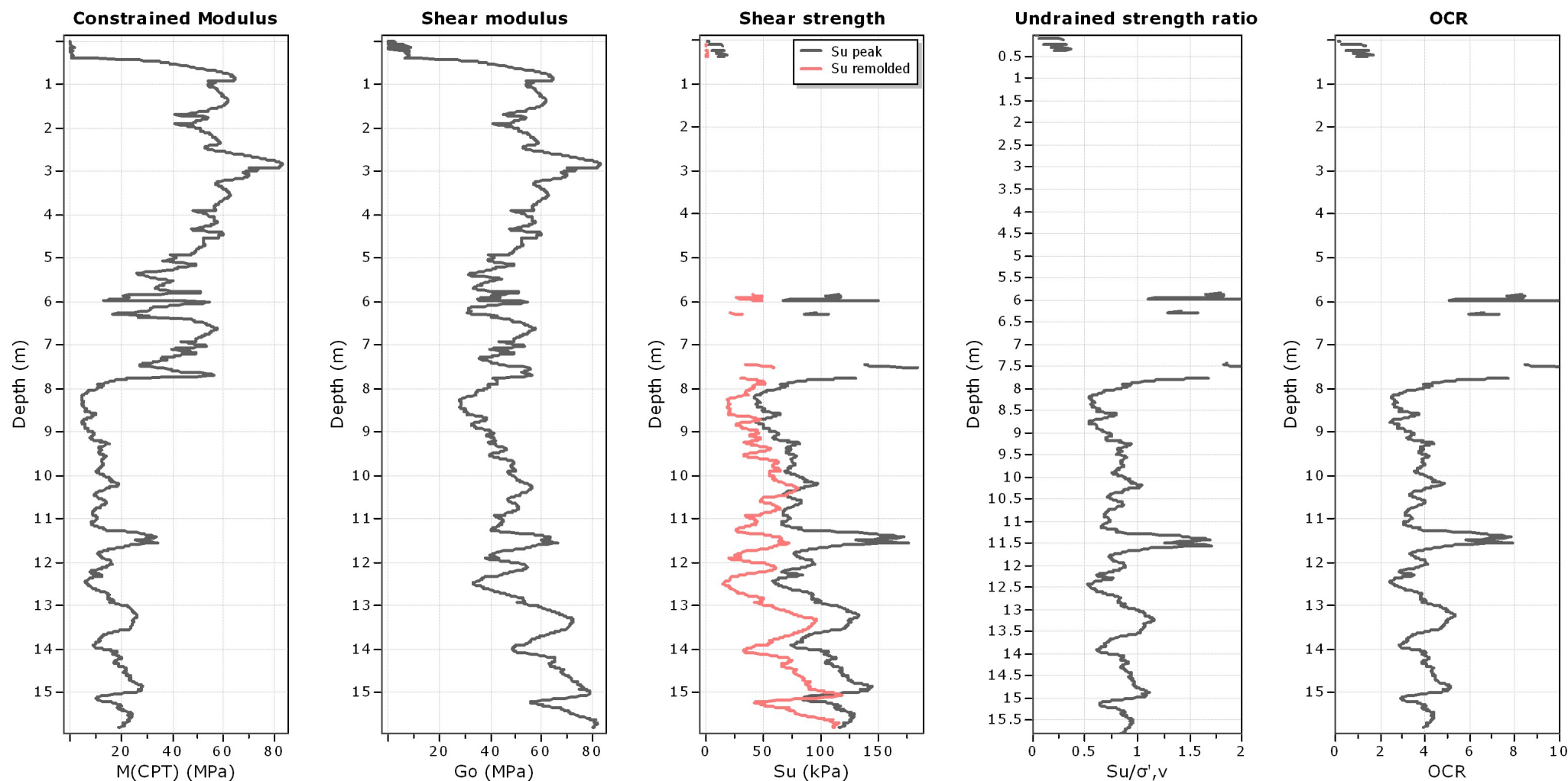
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Calculation parameters

Constrained modulus: Based on variable α using I_c and Q_m (Robertson, 2009)

Go: Based on variable α using I_c (Robertson, 2009)

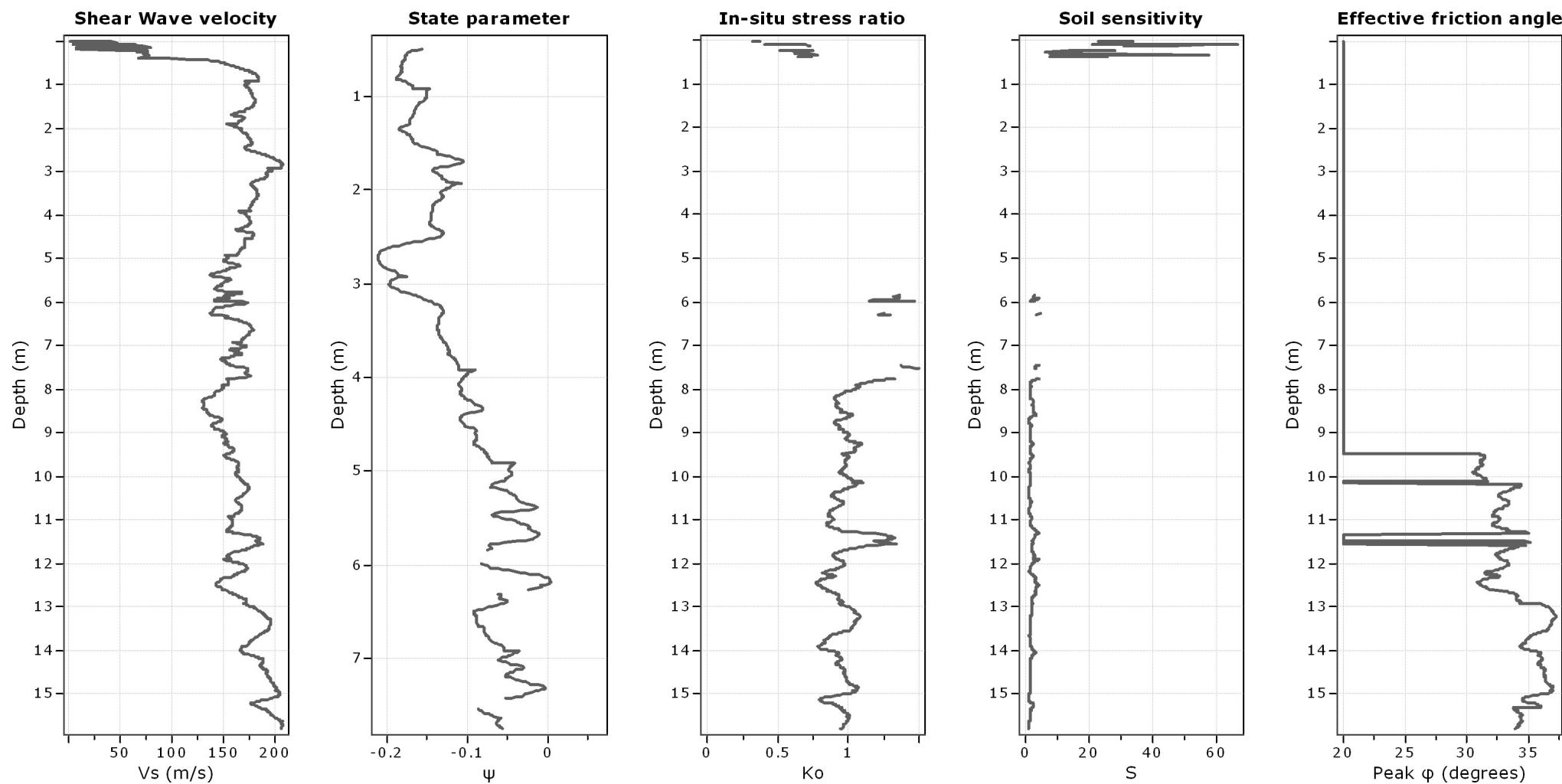
Undrained shear strength cone factor for clays, N_{kt} : 14

OCR factor for clays, N_{kt} : 0.33

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI



Calculation parameters

Soil Sensitivity factor, N_s : 7.00

—●— User defined estimation data



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Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-02

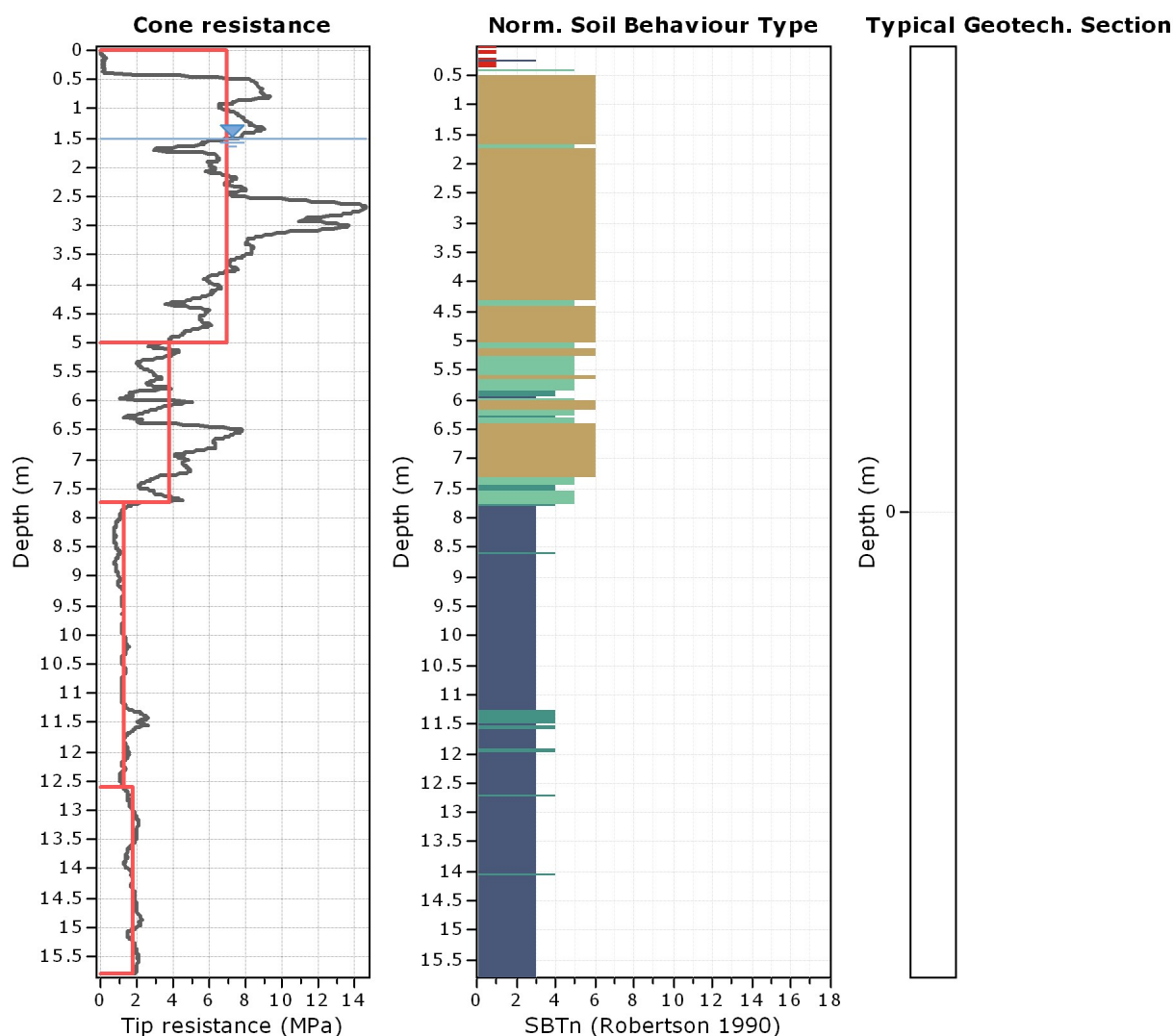
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Tabular results

::: Layer No: 1 :::

Code: 1 **Start depth:** 0.00 (m), **End depth:** 5.00 (m)

Description: sabbia limosa mediamente densa

Basic results

Total cone resistance: 6.93 ± 3.12 MPa

Sleeve friction: 42.13 ± 18.63 kPa

SBT_n: 6

SBT_n description: Sand & silty sand

Estimation results

Permeability: $1.08E-04 \pm 1.72E-04$ m/s

N₆₀: 15.61 ± 5.10 blows

Es: 45.75 ± 6.94 MPa

Dr (%): 59.69 ± 9.93

ö (degrees): 40.51 ± 1.68 °

Unit weight: 17.81 ± 1.20 kN/m³

Constrained Mod.: 52.35 ± 17.77 MPa

Go: 52.76 ± 16.68 MPa

Su: 0.00 ± 0.00 kPa

Su ratio: 0.00 ± 0.00

O.C.R.: 0.00 ± 0.00

::: Layer No: 2 :::**Code:** 2 **Start depth:** 5.00 (m), **End depth:** 7.75 (m)**Description:** sabbia limosa mediamente densa con livelli di limo ed argilla**Basic results**

Total cone resistance: 3.74 ±1.59 MPa

Sleeve friction: 26.06 ±11.49 kPa

SBT_n: 5SBT_n description: Silty sand & sandy silt**Estimation results**

Permeability: 1.22E-05 ±2.13E-05 m/s

N60: 10.36 ±2.78 blows

Es: 35.50 ±6.01 MPa

Dr (%): 37.59 ±6.38

ö (degrees): 36.10 ±1.60 °

Unit weight: 17.10 ±0.53 kN/m³

Constrained Mod.: 40.37 ±10.22 MPa

Go: 44.28 ±7.49 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

::: Layer No: 3 :::**Code:** 3 **Start depth:** 7.75 (m), **End depth:** 12.60 (m)**Description:** limo argilloso ed argilla limosa da molle a mediamente consistente**Basic results**

Total cone resistance: 1.24 ±0.36 MPa

Sleeve friction: 44.34 ±16.20 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 9.64E-09 ±1.82E-08 m/s

N60: 6.49 ±1.38 blows

Es: 33.09 ±33.09 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 17.33 ±0.52 kN/m³

Constrained Mod.: 12.12 ±5.95 MPa

Go: 43.90 ±8.34 MPa

Su: 75.99 ±24.43 kPa

Su ratio: 0.81 ±0.23

O.C.R.: 3.76 ±1.05

::: Layer No: 4 :::**Code:** 4 **Start depth:** 12.60 (m), **End depth:** 15.80 (m)**Description:** limo argilloso ed argilla limosa mediamente consistente**Basic results**

Total cone resistance: 1.80 ±0.25 MPa

Sleeve friction: 72.70 ±23.14 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 6.69E-09 ±3.55E-09 m/s

N60: 9.39 ±1.24 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 18.07 ±0.46 kN/m³

Constrained Mod.: 19.46 ±5.18 MPa

Go: 64.60 ±10.10 MPa

Su: 111.06 ±17.67 kPa

Su ratio: 0.89 ±0.14

O.C.R.: 4.13 ±0.63

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

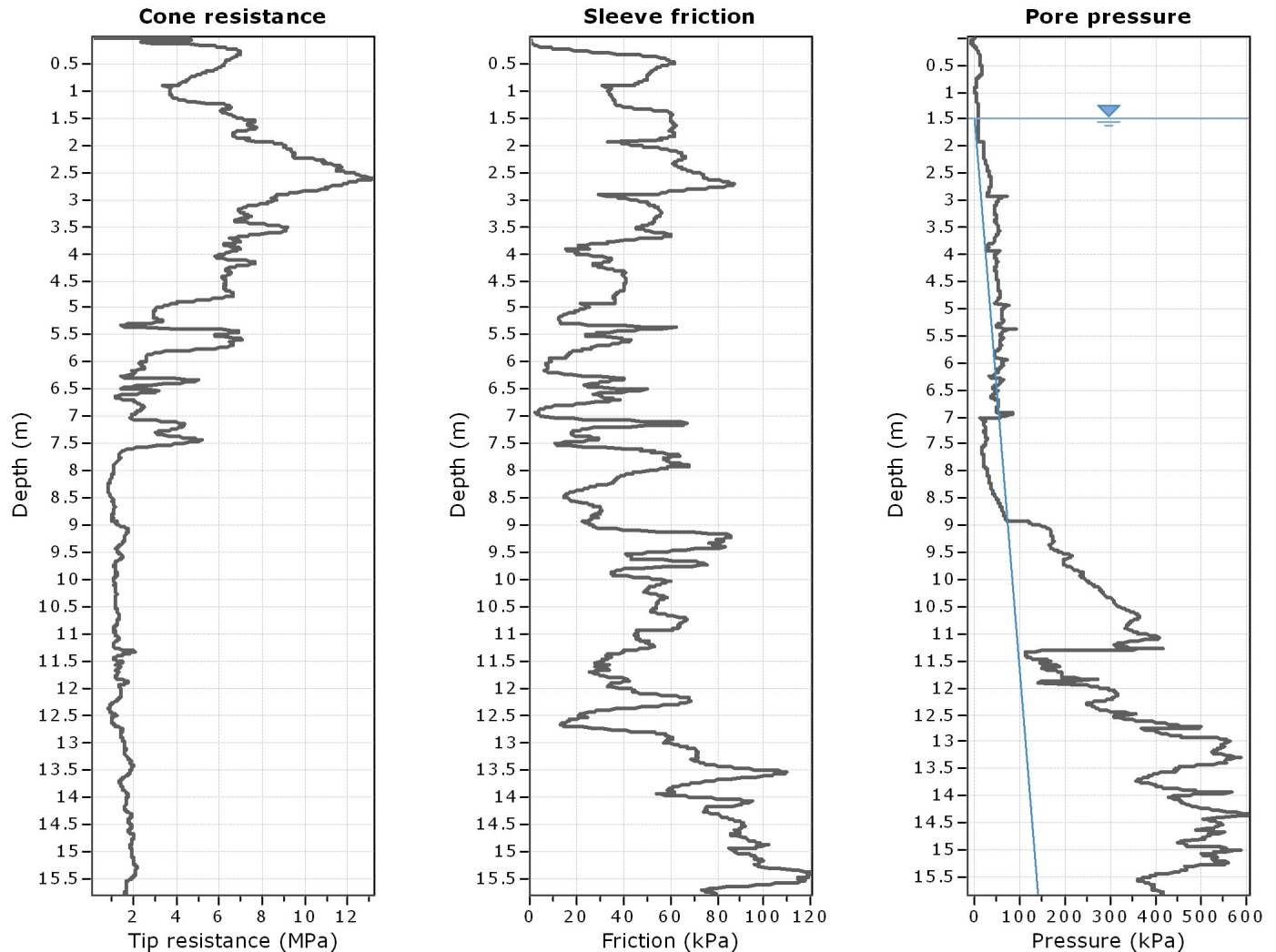
Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT _{N60} (blows/30cm)	E _s (MPa)	D _r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G _o (MPa)	Undrained strength, S _u (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m ³)
0.00	5.00	1.08E-04	15.6	45.7	59.7	40.5	52.4	52.8	0.0	0.0	0.0	17.8
5.00		(±1.72E-04)	(±5.1)	(±6.9)	(±9.9)	(±1.7)	(±17.8)	(±16.7)	(±0.0)	(±0.0)	(±0.0)	(±1.2)
5.00	2.75	1.22E-05	10.4	35.5	37.6	36.1	40.4	44.3	0.0	0.0	0.0	17.1
7.75		(±2.13E-05)	(±2.8)	(±6.0)	(±6.4)	(±1.6)	(±10.2)	(±7.5)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
7.75	4.85	9.64E-09	6.5	33.1	0.0	0.0	12.1	43.9	76.0	0.8	3.8	17.3
12.60		(±1.82E-08)	(±1.4)	(±33.1)	(±0.0)	(±0.0)	(±6.0)	(±8.3)	(±24.4)	(±0.2)	(±1.0)	(±0.5)
12.60	3.20	6.69E-09	9.4	0.0	0.0	0.0	19.5	64.6	111.1	0.9	4.1	18.1
15.80		(±3.55E-09)	(±1.2)	(±0.0)	(±0.0)	(±0.0)	(±5.2)	(±10.1)	(±17.7)	(±0.1)	(±0.6)	(±0.5)

Depth values presented in this table are measured from free ground surface

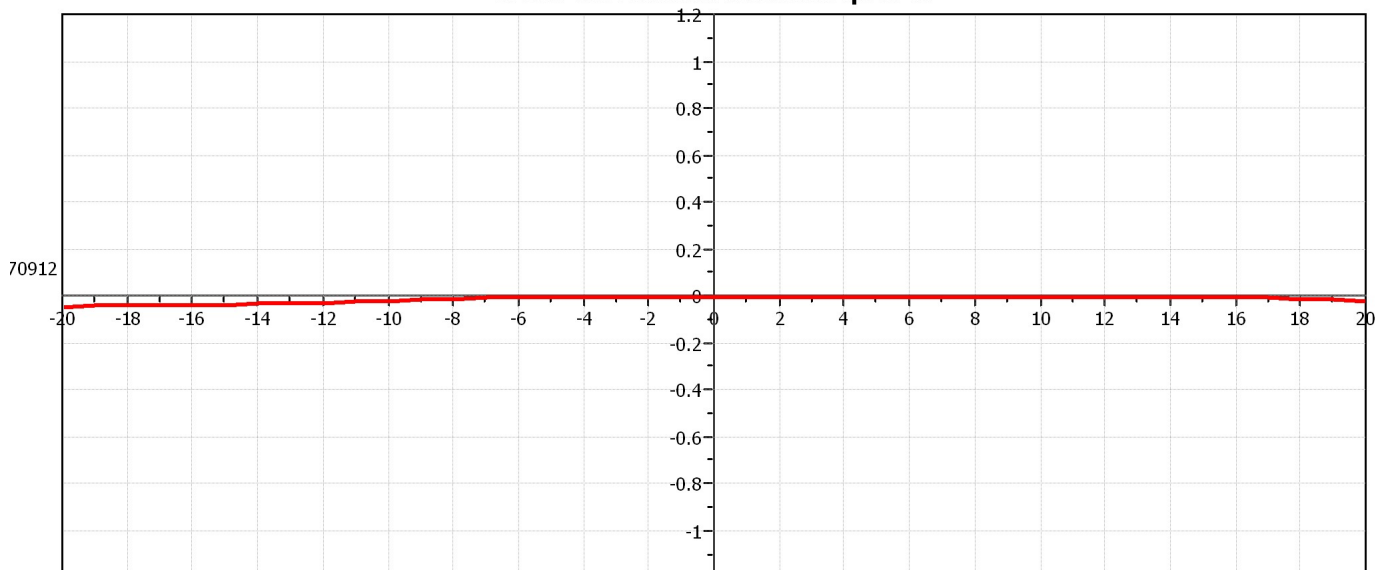
Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

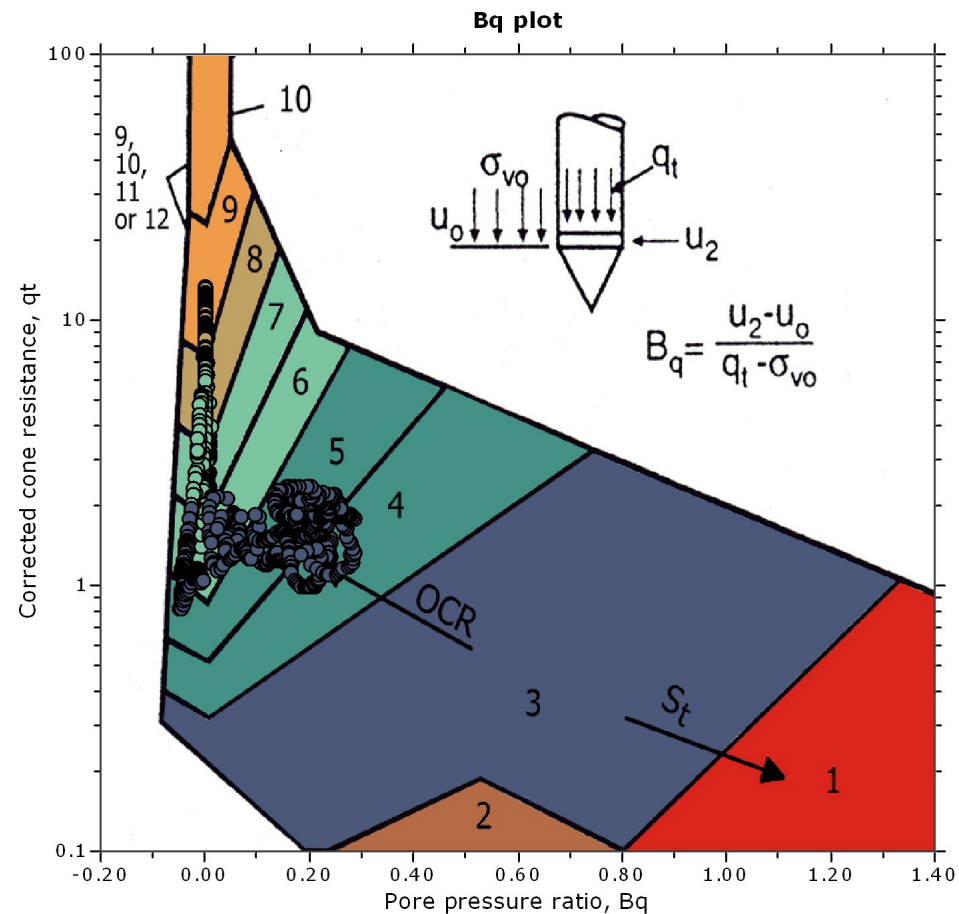
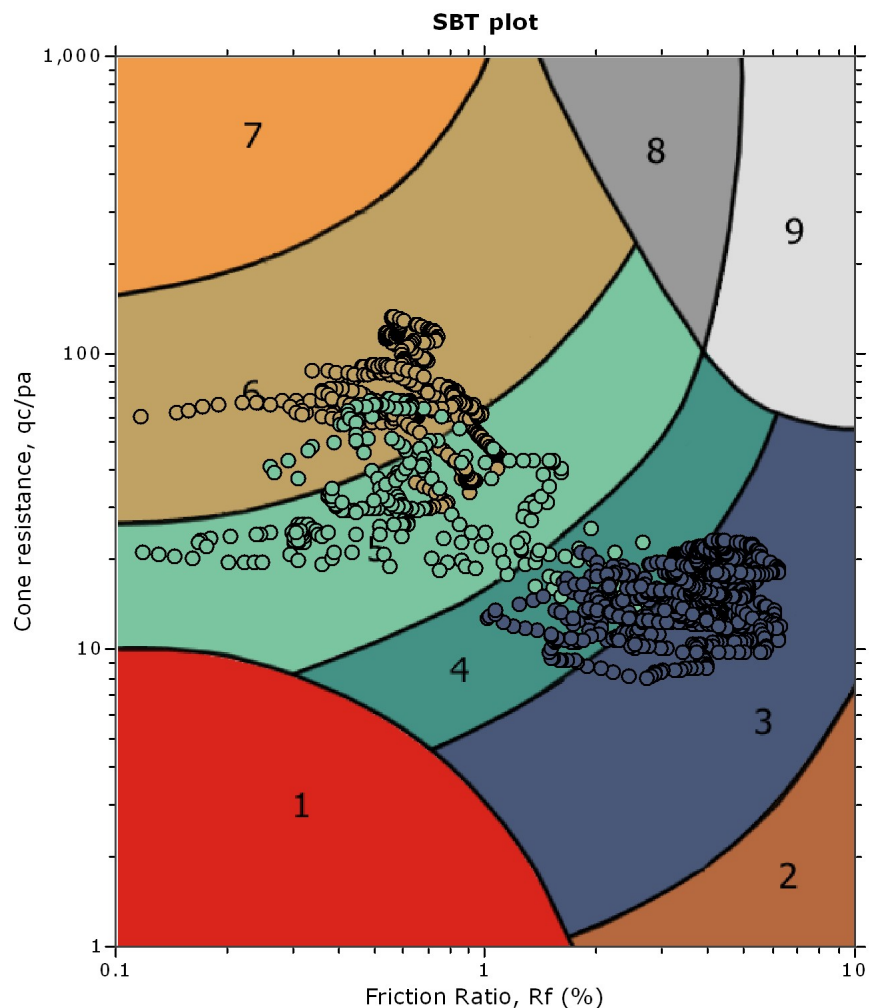


The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).

Cross correlation between qc & fs



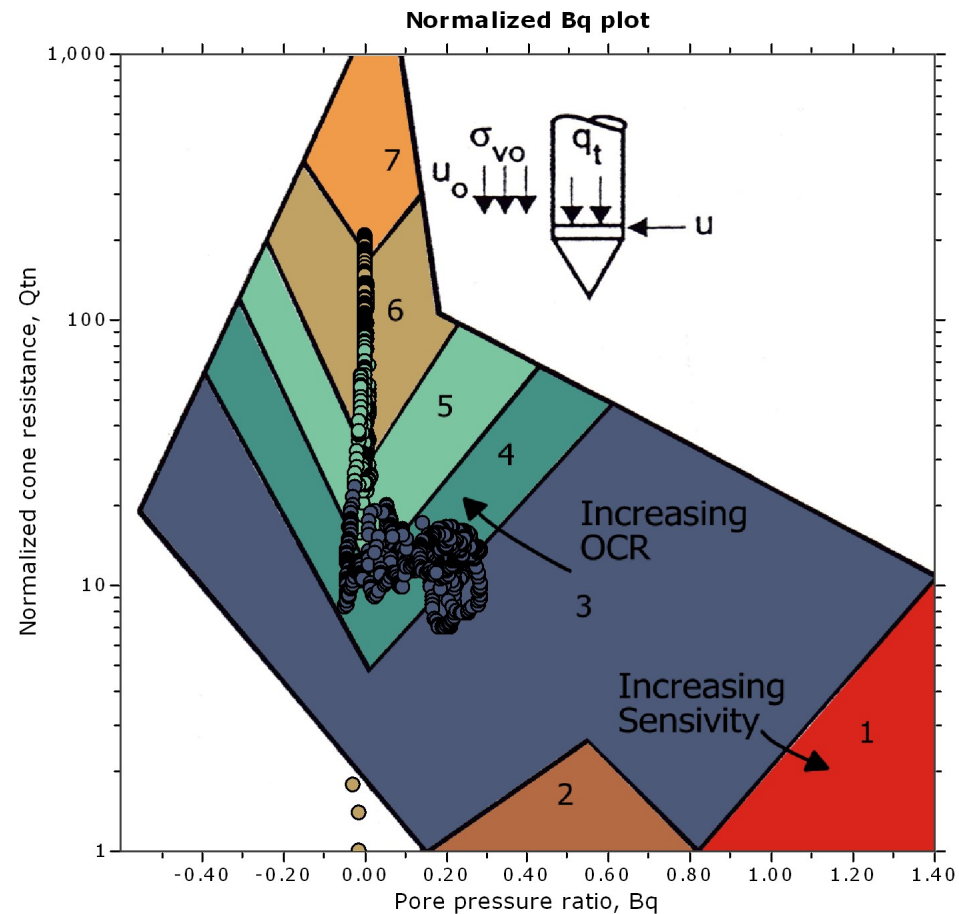
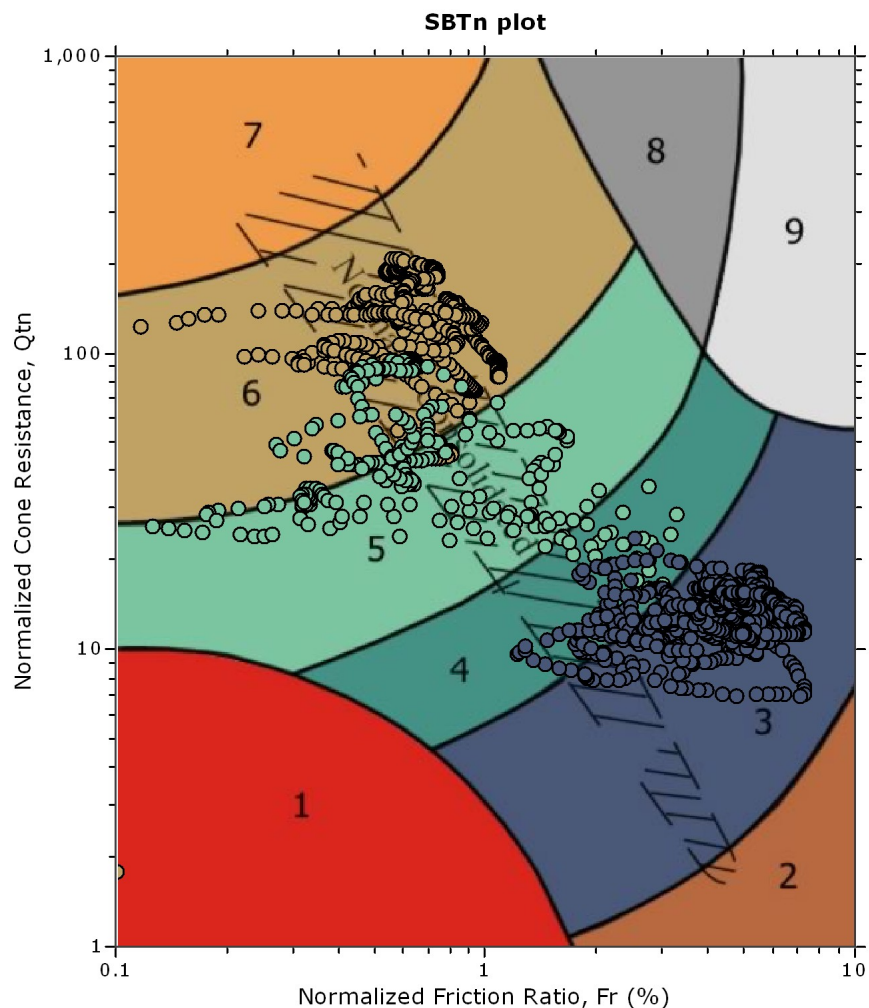
SBT - Bq plots



SBT legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

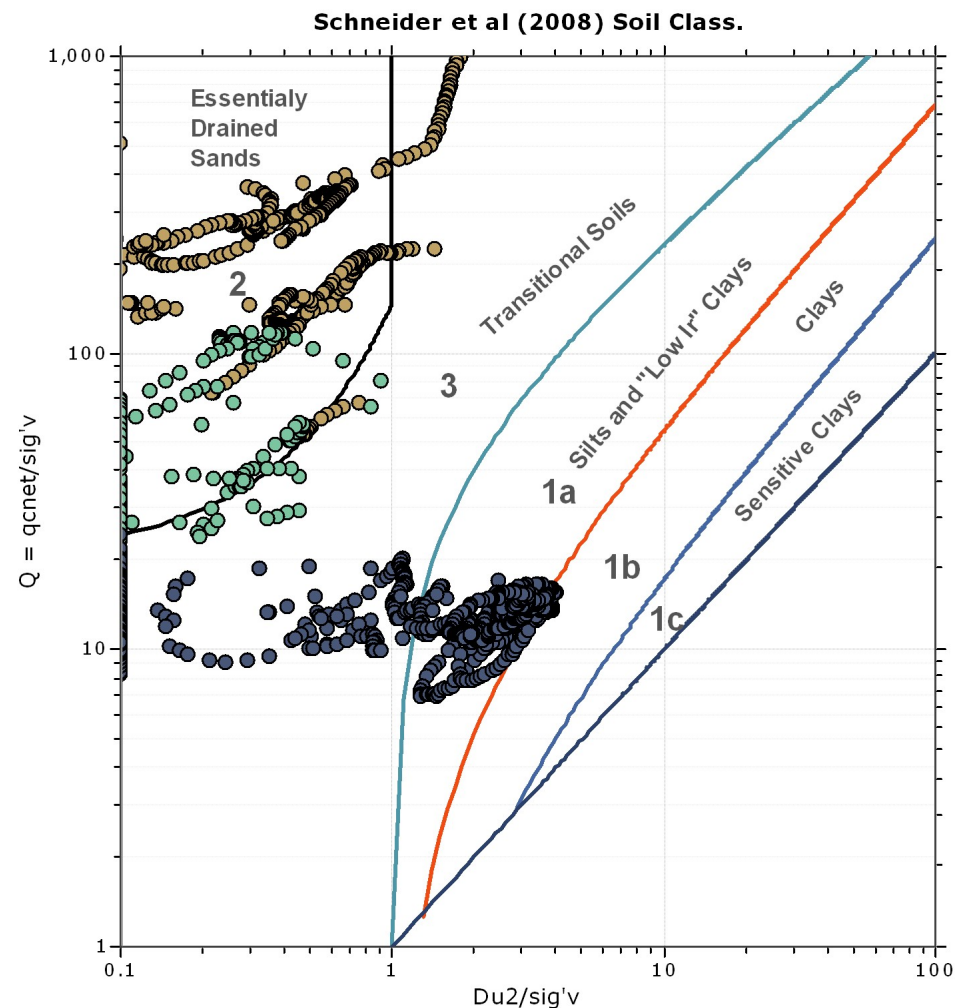
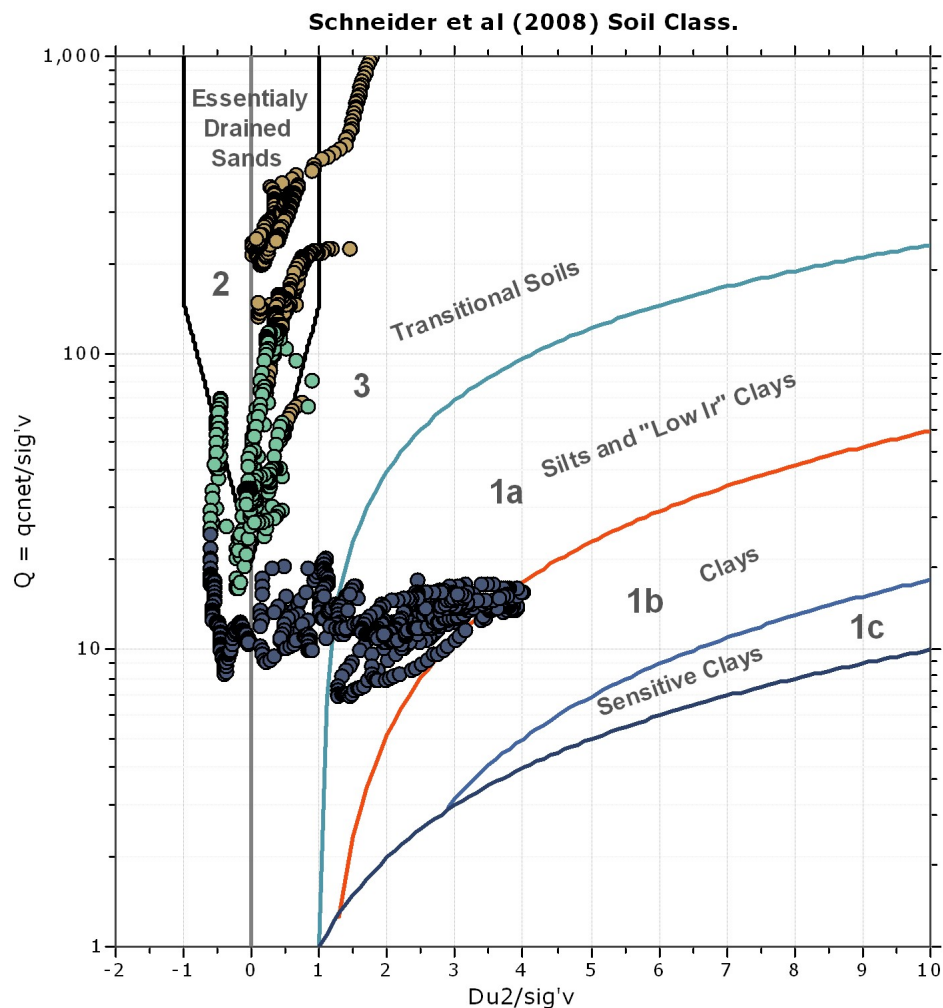
SBT - Bq plots (normalized)

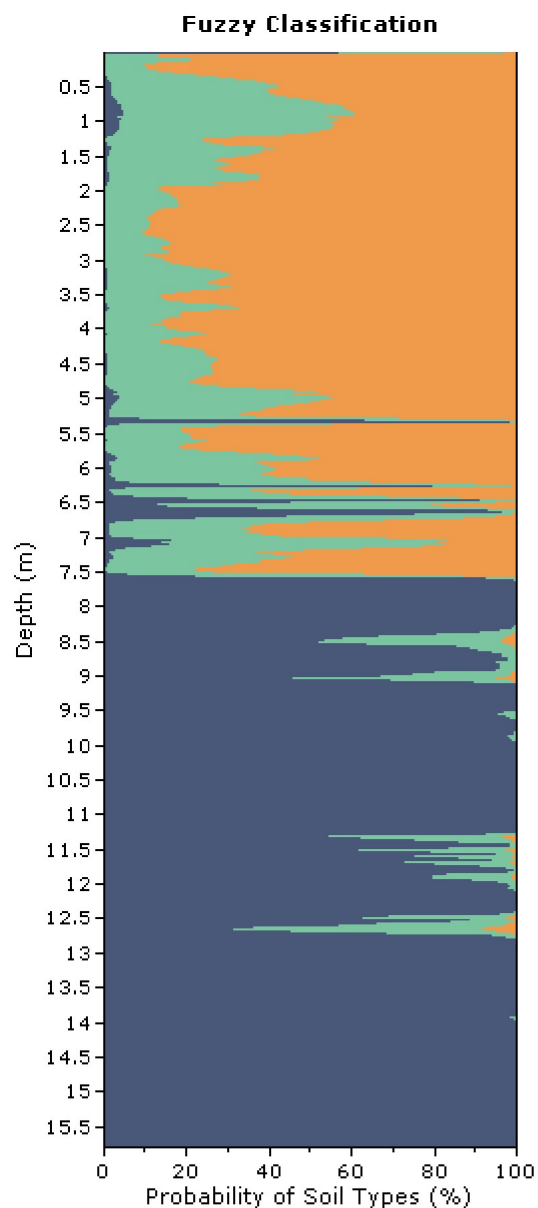
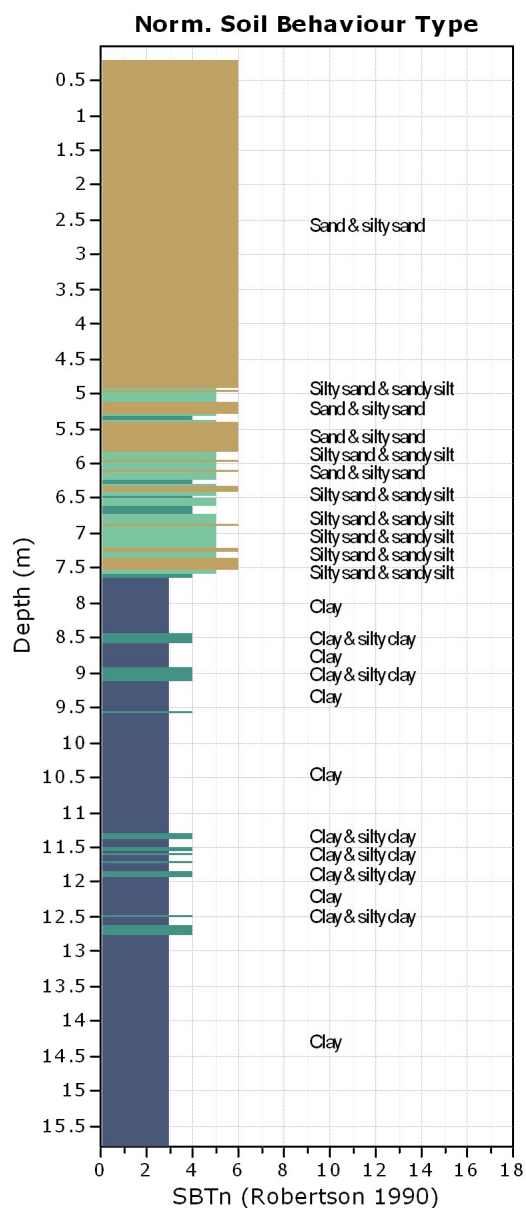


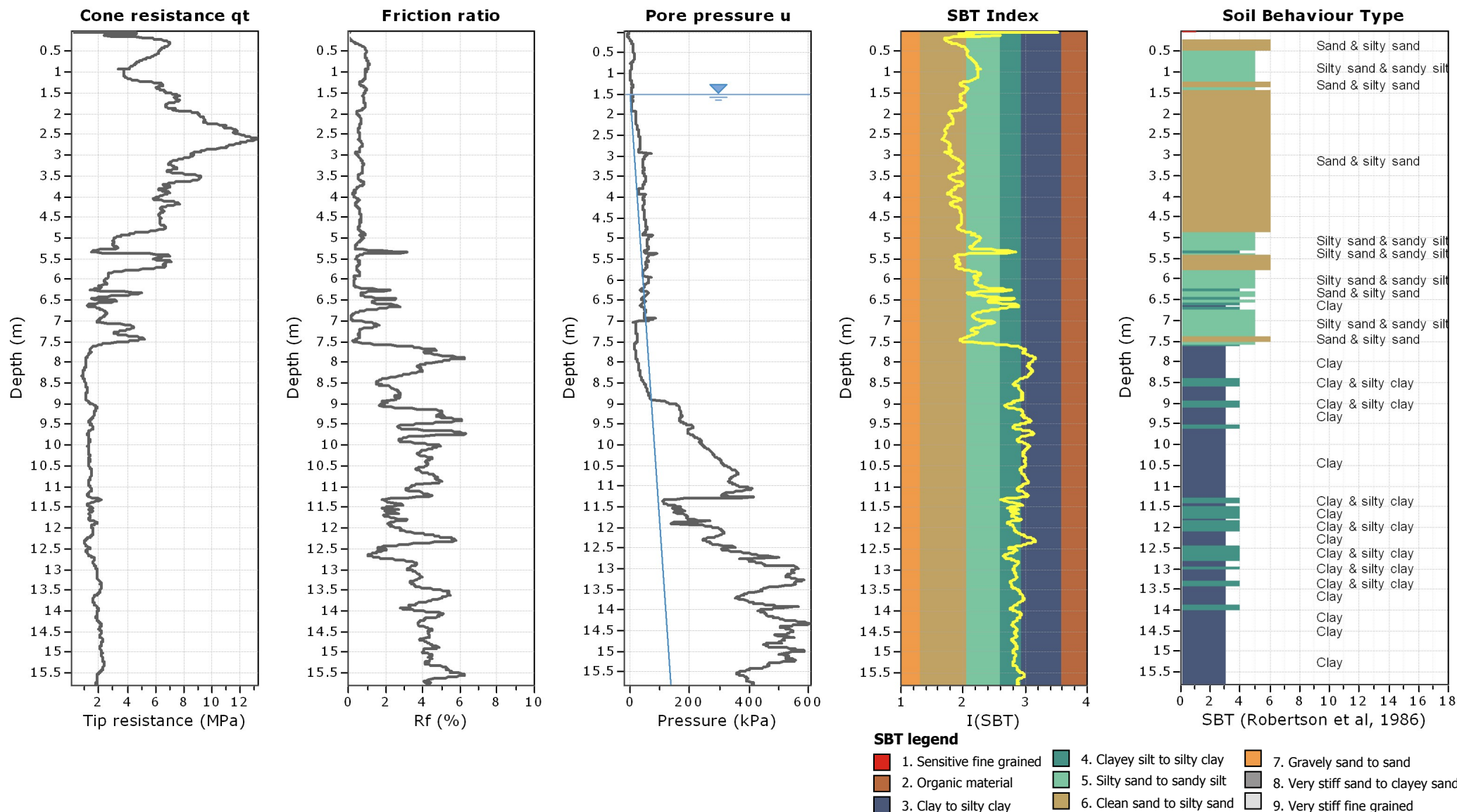
SBTn legend

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravely sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

Bq plots (Schneider)

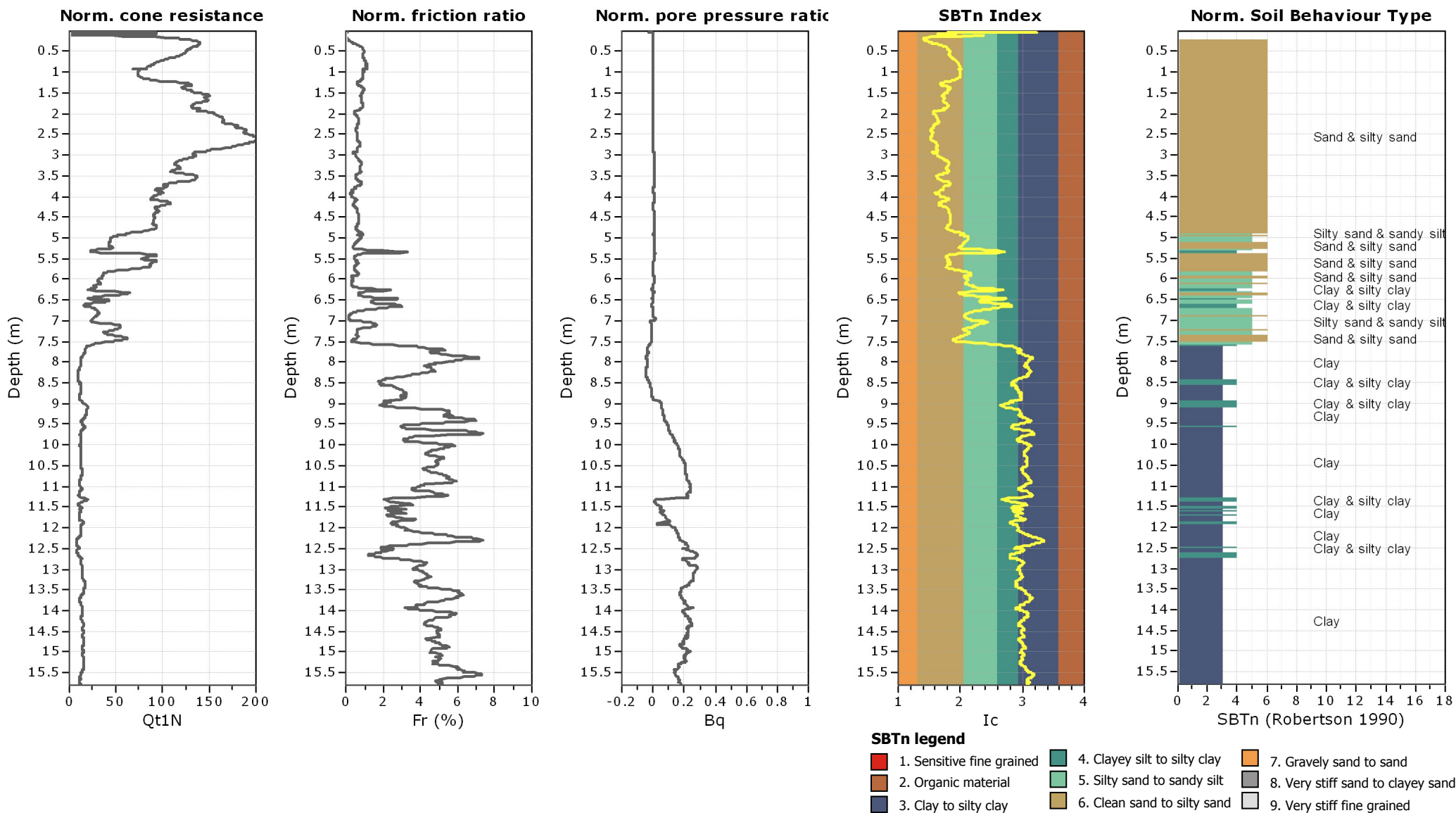






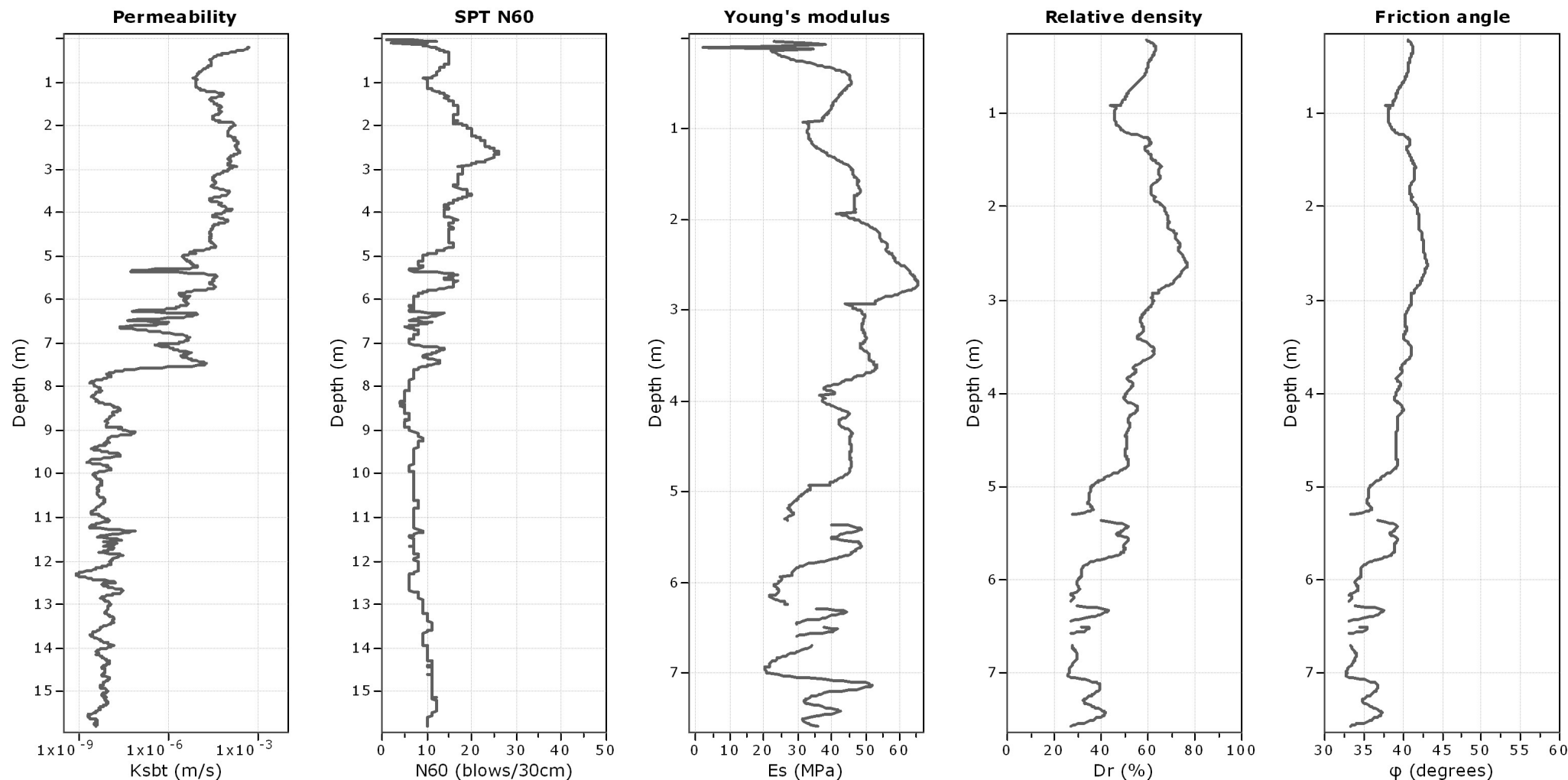
Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI



Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60} : Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

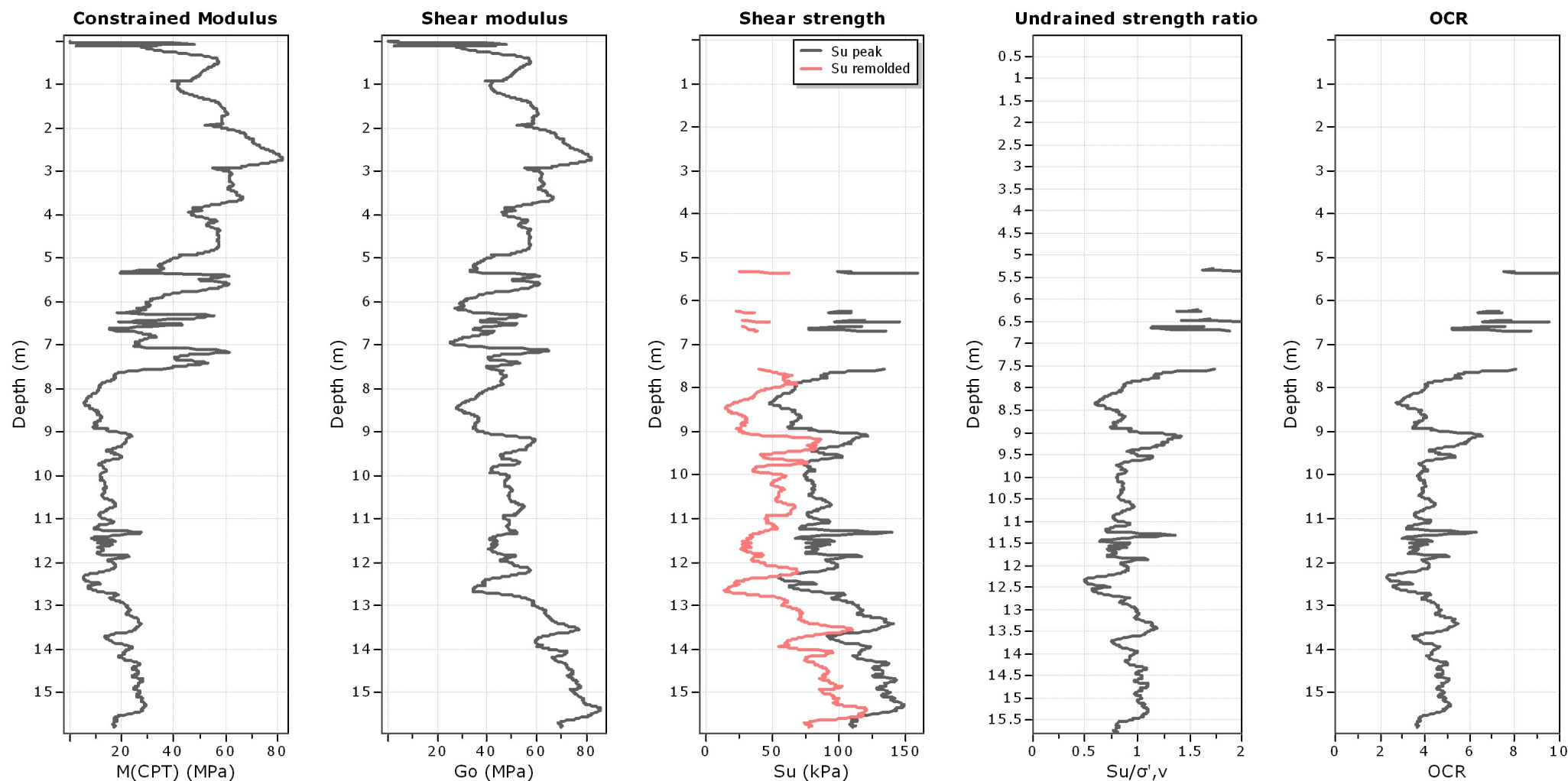
Relative density constant, C_{Dr} : 350.0

Phi: Based on Kulhawy & Mayne (1990)

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI



Calculation parameters

Constrained modulus: Based on variable α using I_c and Q_m (Robertson, 2009)

Go: Based on variable α using I_c (Robertson, 2009)

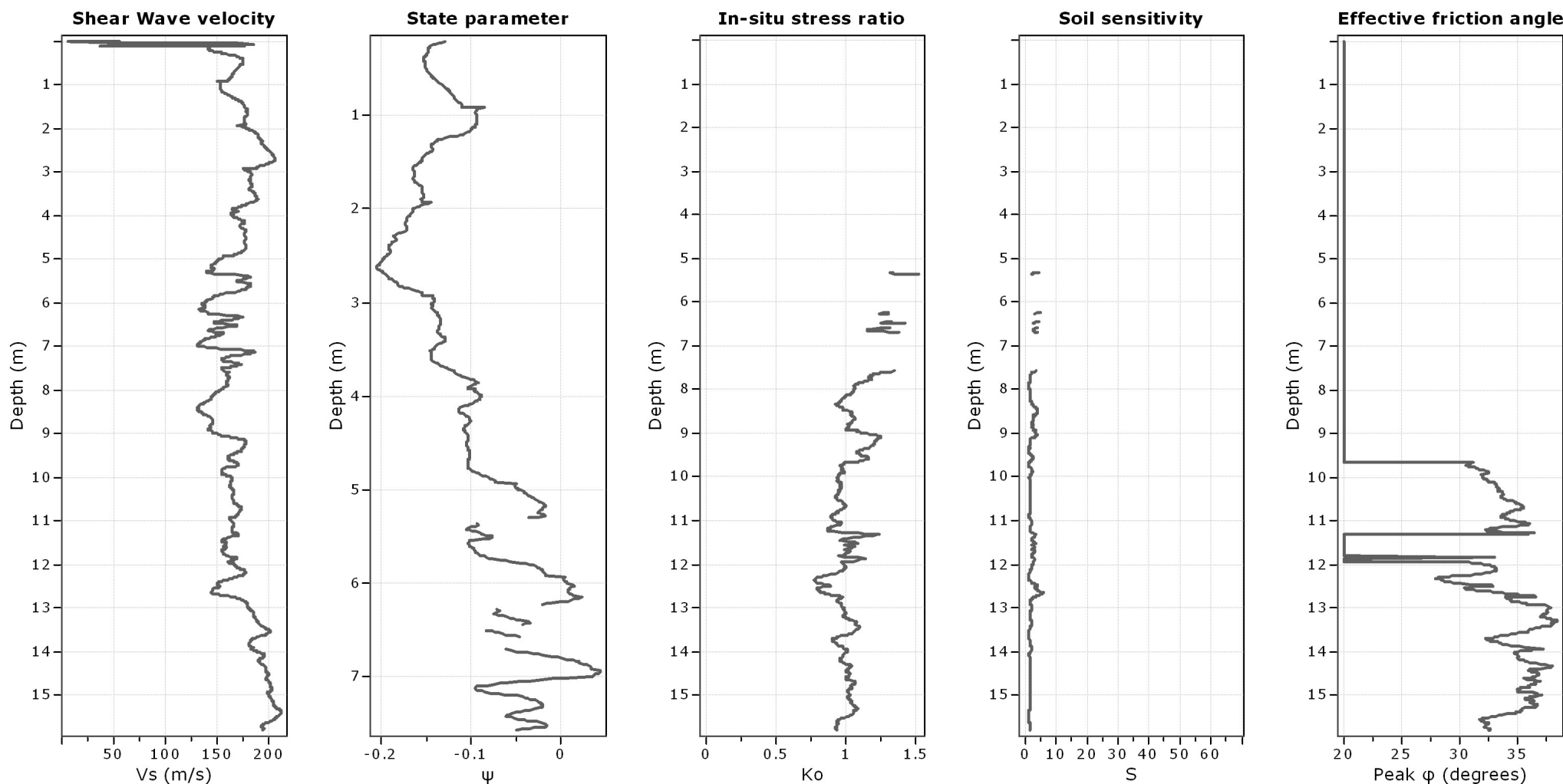
Undrained shear strength cone factor for clays, N_{kt} : 14

OCR factor for clays, N_{kt} : 0.33

—●— User defined estimation data

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI



Calculation parameters

Soil Sensitivity factor, N_s : 7.00

—●— User defined estimation data



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Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

CPT: CPTU-03

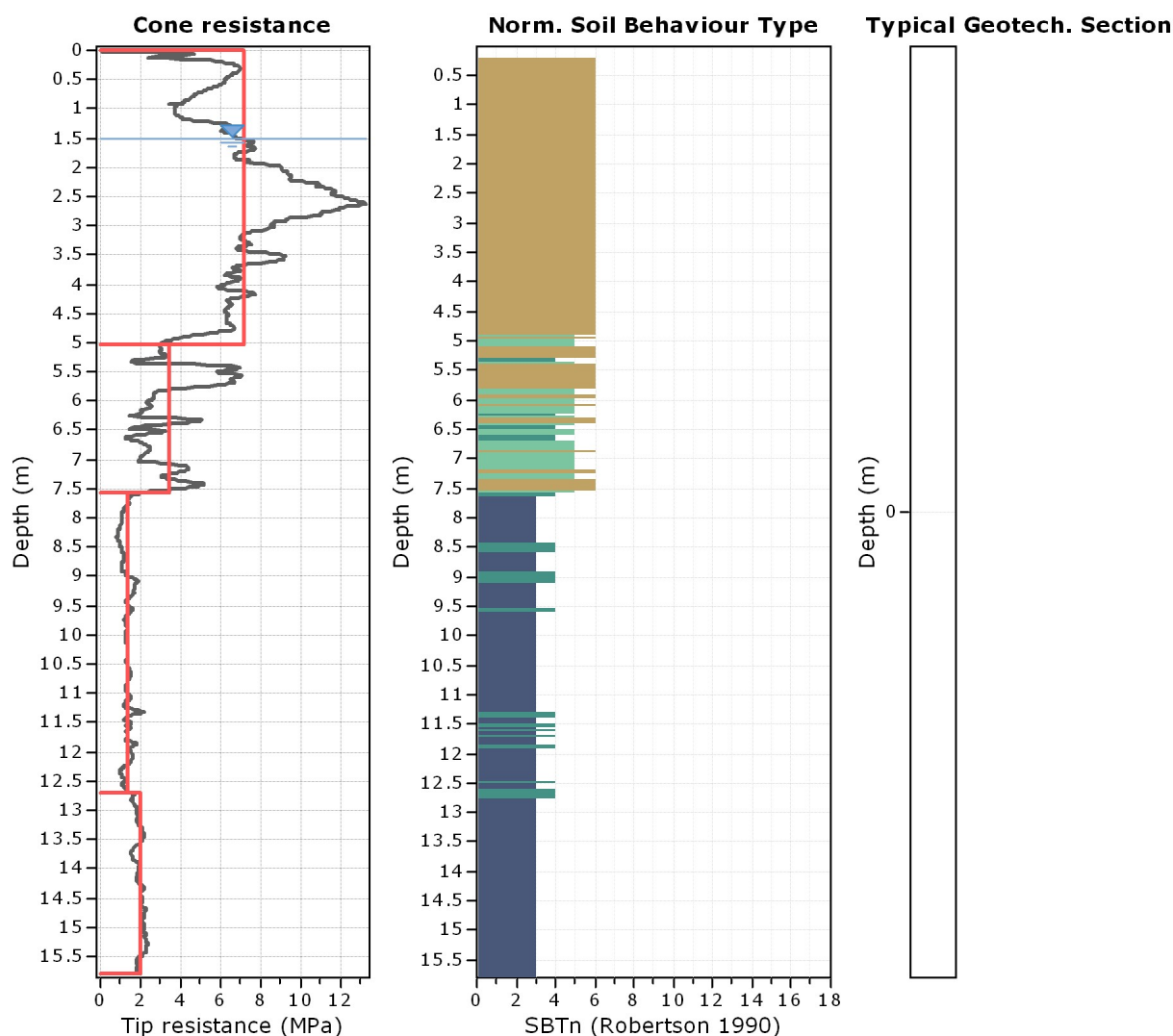
Total depth: 15.80 m, Date: 06/06/2018

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Unknown

Cone Operator: Unknown



Tabular results

::: Layer No: 1 :::

Code: 1 **Start depth:** 0.00 (m), **End depth:** 5.03 (m)

Description: sabbia limosa mediamente densa

Basic results

Total cone resistance: 7.13 ± 2.32 MPa

Sleeve friction: 46.31 ± 17.58 kPa

SBT_n: 6

SBT_n description: Sand & silty sand

Estimation results

Permeability: $6.66E-05 \pm 6.63E-05$ m/s

N₆₀: 16.03 ± 4.05 blows

Es: 46.06 ± 7.85 MPa

Dr (%): 58.46 ± 8.68

ö (degrees): 40.35 ± 1.45 °

Unit weight: 17.99 ± 0.89 kN/m³

Constrained Mod.: 56.42 ± 11.94 MPa

Go: 56.46 ± 11.83 MPa

Su: 0.00 ± 0.00 kPa

Su ratio: 0.00 ± 0.00

O.C.R.: 0.00 ± 0.00

::: Layer No: 2 :::**Code:** 2 **Start depth:** 5.03 (m), **End depth:** 7.58 (m)**Description:** sabbia limosa mediamente densa con livelli di limo ed argilla**Basic results**

Total cone resistance: 3.40 ±1.56 MPa

Sleeve friction: 24.29 ±14.31 kPa

SBT_n: 5SBT_n description: Silty sand & sandy silt**Estimation results**

Permeability: 7.28E-06 ±1.01E-05 m/s

N60: 9.67 ±3.19 blows

Es: 33.77 ±8.59 MPa

Dr (%): 35.84 ±7.33

ö (degrees): 35.59 ±1.87 °

Unit weight: 16.85 ±0.88 kN/m³

Constrained Mod.: 38.35 ±12.26 MPa

Go: 41.94 ±10.31 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

::: Layer No: 3 :::**Code:** 3 **Start depth:** 7.58 (m), **End depth:** 12.69 (m)**Description:** limo argilloso ed argilla limosa da molle a mediamente consistente**Basic results**

Total cone resistance: 1.31 ±0.24 MPa

Sleeve friction: 45.50 ±17.33 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 1.03E-08 ±1.20E-08 m/s

N60: 6.71 ±1.02 blows

Es: 35.82 ±35.82 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 17.38 ±0.52 kN/m³

Constrained Mod.: 13.55 ±4.45 MPa

Go: 44.92 ±7.32 MPa

Su: 80.71 ±16.48 kPa

Su ratio: 0.87 ±0.20

O.C.R.: 4.04 ±0.90

::: Layer No: 4 :::**Code:** 4 **Start depth:** 12.69 (m), **End depth:** 15.80 (m)**Description:** limo argilloso ed argilla limosa mediamente consistente**Basic results**

Total cone resistance: 1.96 ±0.22 MPa

Sleeve friction: 82.74 ±19.22 kPa

SBT_n: 3SBT_n description: Clay**Estimation results**

Permeability: 7.20E-09 ±3.91E-09 m/s

N60: 10.21 ±1.11 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

ö (degrees): 0.00 ±0.00 °

Unit weight: 18.28 ±0.35 kN/m³

Constrained Mod.: 22.80 ±4.23 MPa

Go: 69.63 ±8.63 MPa

Su: 122.16 ±14.90 kPa

Su ratio: 0.97 ±0.10

O.C.R.: 4.50 ±0.48

Project: INDAGINE GEOLOGICA

Location: CESENATICO - EX COLONIA PREALPI

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT _{N60} (blows/30cm)	E _s (MPa)	D _r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G _o (MPa)	Undrained strength, S _u (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m ³)
0.00	5.03	6.66E-05	16.0	46.1	58.5	40.3	56.4	56.5	0.0	0.0	0.0	18.0
5.03		(±6.63E-05)	(±4.1)	(±7.9)	(±8.7)	(±1.5)	(±11.9)	(±11.8)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
5.03	2.55	7.28E-06	9.7	33.8	35.8	35.6	38.3	41.9	0.0	0.0	0.0	16.9
7.58		(±1.01E-05)	(±3.2)	(±8.6)	(±7.3)	(±1.9)	(±12.3)	(±10.3)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
7.58	5.11	1.03E-08	6.7	35.8	0.0	0.0	13.6	44.9	80.7	0.9	4.0	17.4
12.69		(±1.20E-08)	(±1.0)	(±35.8)	(±0.0)	(±0.0)	(±4.4)	(±7.3)	(±16.5)	(±0.2)	(±0.9)	(±0.5)
12.69	3.11	7.20E-09	10.2	0.0	0.0	0.0	22.8	69.6	122.2	1.0	4.5	18.3
15.80		(±3.91E-09)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±4.2)	(±8.6)	(±14.9)	(±0.1)	(±0.5)	(±0.3)

Depth values presented in this table are measured from free ground surface

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log\left(\frac{q_t}{p_a}\right) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$$I_c < 3.27 \text{ and } I_c > 1.00 \text{ then } k = 10^{0.952 - 3.04 \cdot I_c}$$

$$I_c \leq 4.00 \text{ and } I_c > 3.27 \text{ then } k = 10^{-4.52 - 1.37 \cdot I_c}$$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{p_a} \right) \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

:: Young's Modulus, E_s (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}} \quad \text{(applicable only to } SBT_n: 5, 6, 7 \text{ and } 8 \text{ or } I_c < I_{c_cutoff})$$

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, ϕ (°) ::

$$\phi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to $SBT_n: 5, 6, 7 \text{ and } 8$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
 $\alpha = 14$ for $Q_{tn} > 14$
 $\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
 $M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$
 $M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Small strain shear Modulus, G_0 (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, V_s (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, S_u (kPa) ::

$$N_{kt} = 10.50 + 7 \cdot \log(F_r) \text{ or user defined}$$

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to $SBT_n: 1, 2, 3, 4 \text{ and } 9$ or $I_c > I_{c_cutoff}$)

:: Remolded undrained shear strength, $S_{u(rem)}$ (kPa) ::

$$S_{u(rem)} = f_s \quad \text{(applicable only to } SBT_n: 1, 2, 3, 4 \text{ and } 9 \text{ or } I_c > I_{c_cutoff})$$

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))} \right]^{-1.25} \text{ or user defined}$$

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to $SBT_n: 1, 2, 3, 4 \text{ and } 9$ or $I_c > I_{c_cutoff}$)

:: In situ Stress Ratio, K_0 ::

$$K_0 = 0.1 \cdot \left(\frac{q_t - \sigma_v}{\sigma'_{vo}} \right)$$

(applicable only to $SBT_n: 1, 2, 3, 4 \text{ and } 9$ or $I_c > I_{c_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_s}{F_r}$$

(applicable only to $SBT_n: 1, 2, 3, 4 \text{ and } 9$ or $I_c > I_{c_cutoff}$)

:: Effective Stress Friction Angle, ϕ' (°) ::

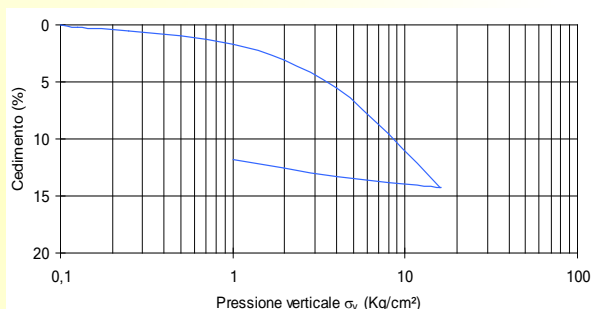
$$\phi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

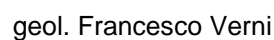
References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 4th Edition, July 2010
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

LOCALITA' : VIA GALILEI - CESENATICO (FC)



PROVE DI LABORATORIO



Riepilogo prove di laboratorio
Via Galilei - Cesenatico (FC)

Campione			Proprietà indice			Taglio CD		Edometro ($\sigma = 1,0 \text{ kg/cm}^2$)		
Sond.	Camp.	Profondità	w	γ	γ_d	φ'	c'	E	c_v	K
n°	n°	m	%	t/m ³	t/m ³	°	kg/cm ²	kg/cm ²	cm ² /s	cm/s
1	1	3,00-3,50	23,4	2,01	1,63	33,5	0,0	81	6,02E-03	7,43E-08
1	2	5,50-6,10	29,1	1,92	1,49	32	0,0	51	3,46E-03	6,79E-08
1	3	10,00-10,60	30,4	1,88	1,44	22	0,12	35	1,28E-04	3,66E-09

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 1
Profondità : 3,00-3,50

CARATTERISTICHE FISICO - MECCANICHE

Descrizione del campione: Sabbia limosa di colore nocciola-grigio

Classe di qualità: Q5

PROPRIETA' INDICE

Contenuto in acqua	$w = 23,4 \%$
Peso di volume umido	$\gamma = 2,01 \text{ g/cm}^3$
Peso di volume secco	$\gamma_d = 1,63 \text{ g/cm}^3$
Peso specifico reale	$\gamma_s = 2,65 \text{ g/cm}^3$
Indice dei vuoti	$e = 0,626$
Grado di saturazione	$S = 99 \%$

LIMITI DI ATTERBERG

Limite liquido	$w_L =$
Limite plastico	$w_P =$
Limite di ritiro	$w_S =$
Indice plastico	$i_P =$
Indice di consistenza	$i_C =$
Attività	$A =$

GRANULOMETRIA

Ghiaia (> 2 mm)	=
Sabbia (2 - 0,06 mm)	=
Limo (0,06 - 0,002 mm)	=
Argilla (< 0,002 mm)	=

COMPRESSIONE

Compressione semplice	$c_u =$
	$\varepsilon =$
Pocket penetrometer	$q =$
Vane test	$c_u =$

PROVA DI TAGLIO (C.D.)

Angolo di attrito	$\phi' = 33,5^\circ$
Coesione	$c' = 0,0 \text{ kg/cm}^2$

PROVA DI TAGLIO (Residuo)

Angolo di attrito	$\phi_r =$
Coesione	$c_r =$

PROVA TRIASSIALE

Angolo di attrito (U.U.)	$\phi_{uu} =$	Coesione (U.U.)	$c_{uu} =$
Angolo di attrito (C.I.U.)	$\phi_{cu} =$	Coesione (C.I.U.)	$c_{cu} =$
Angolo di attrito (C.I.D.)	$\phi_{cd} =$	Coesione (C.I.D.)	$c_{cd} =$

PROVA EDOMETRICA

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità K (cm/s)
0,50 / 1,00	6,02E-03	81	1,23E-02	7,43E-08
1,00 / 2,00	5,92E-03	111	9,01E-03	5,33E-08
2,00 / 4,00	5,31E-03	173	5,78E-03	3,07E-08
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

Osservazioni:

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 1
Profondità : 3,00-3,50

TAGLIO DIRETTO

(pagina 1 di 2)

consolidazione

Umidità iniziale	Wi = 23,3 %
Peso di volume	$\gamma = 2,01 \text{ g/cm}^3$
Carico verticale	$\sigma = 1,0 \text{ kg/cm}^2$
Cedimento	$\Delta h = 0,40 \text{ mm}$

provino 1

Tipo di prova
consolidata - drenata

Umidità iniziale	Wi = 23,5 %
Peso di volume	$\gamma = 2,01 \text{ g/cm}^3$
Carico verticale	$\sigma = 2,0 \text{ kg/cm}^2$
Cedimento	$\Delta h = 0,75 \text{ mm}$

provino 2

Velocità di prova
0,005 mm/min

Umidità iniziale	Wi = 23,2 %
Peso di volume	$\gamma = 2,00 \text{ g/cm}^3$
Carico verticale	$\sigma = 3,0 \text{ kg/cm}^2$
Cedimento	$\Delta h = 1,02 \text{ mm}$

provino 3

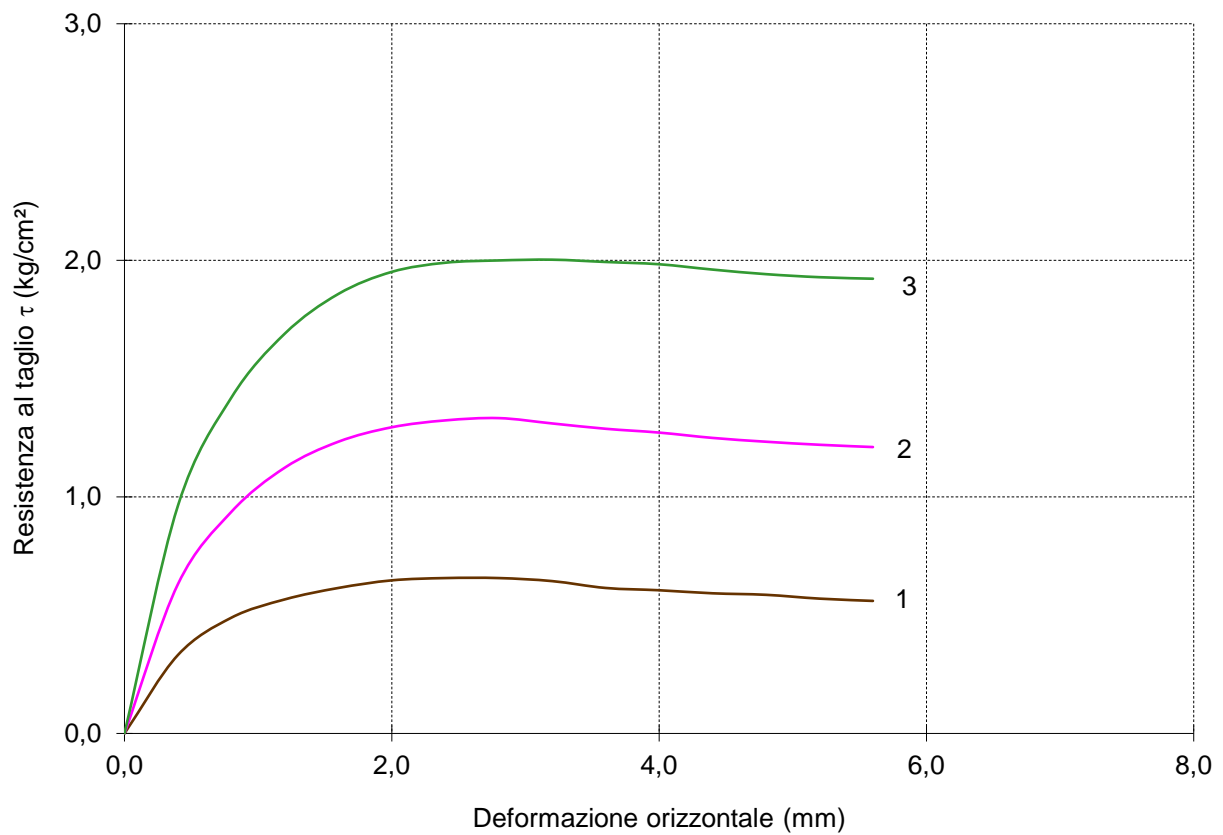
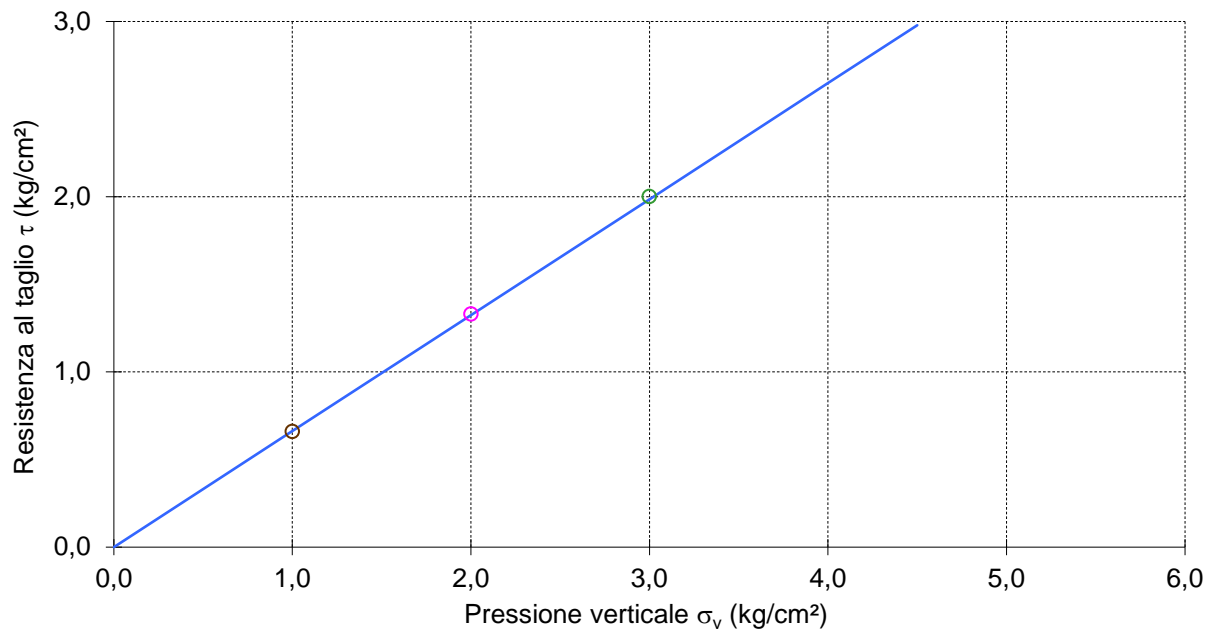
Dimensioni provino
Altezza 2,00 cm
Diametro 6,35 cm
Sezione 31,67 cm ²

rottura

	provino 1		provino 2		provino 3	
Deform. mm	$\tau 1$ kg/cm ²	$\tau 1$ kPa	$\tau 2$ kg/cm ²	$\tau 2$ kPa	$\tau 3$ kg/cm ²	$\tau 3$ kPa
0,0	0	0	0	0	0	0
0,4	0,33	32,5	0,63	61,9	0,96	94,4
0,8	0,49	48,0	0,94	91,9	1,42	139,2
1,2	0,57	55,6	1,12	110,2	1,69	165,8
1,6	0,61	60,3	1,23	120,9	1,86	182,2
2,0	0,65	63,5	1,29	126,9	1,95	191,3
2,4	0,66	64,4	1,32	129,8	1,99	195,1
2,8	0,66	64,4	1,33	130,7	2,00	196,1
3,2	0,64	63,2	1,31	128,5	2,00	196,4
3,6	0,61	60,3	1,29	126,3	1,99	195,5
4,0	0,61	59,4	1,27	124,7	1,98	194,5
4,4	0,59	58,1	1,25	122,5	1,96	192,3
4,8	0,59	57,5	1,23	120,9	1,94	190,4
5,2	0,57	55,9	1,22	119,7	1,93	189,1
5,6	0,56	54,9	1,21	118,7	1,92	188,5
6,0						
6,4						
6,8						
7,2						
7,6						
8,0						
8,4						
8,8						
9,2						
9,6						
10,0						
10,4						
10,8						
11,2						
11,6						
12,0						
12,4						
12,8						
13,2						
13,6						
14,0						
14,4						
14,8						
15,2						
15,6						
16,0						
16,4						
16,8						
17,2						
17,6						
18,0						
18,4						
18,8						
19,2						
19,6						
20,0						

TAGLIO DIRETTO

(pagina 2 di 2)



Valori di picco		Valori residui	
coesione intercetta	$c' = 0,0 \text{ kg/cm}^2$	coesione intercetta	$c_r =$
angolo di attrito	$\phi' = 33,5^\circ$	angolo di attrito	$\phi_r =$

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 1
Profondità : 3,00-3,50

EDOMETRIA

(pagina 1 di 3)

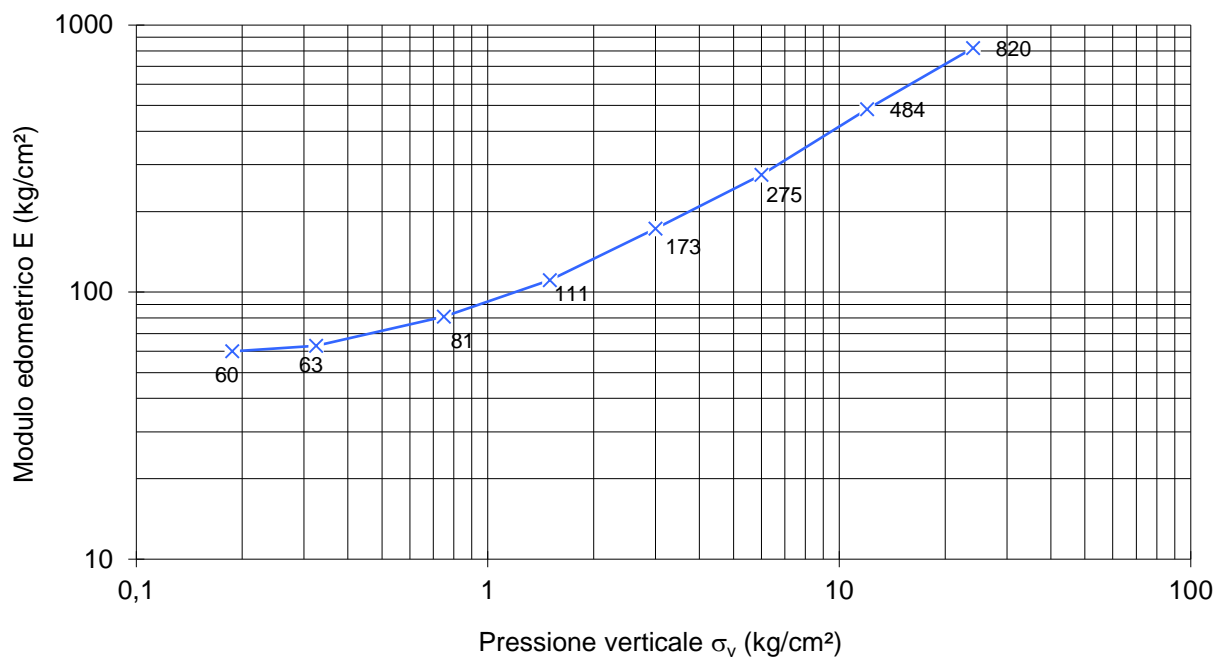
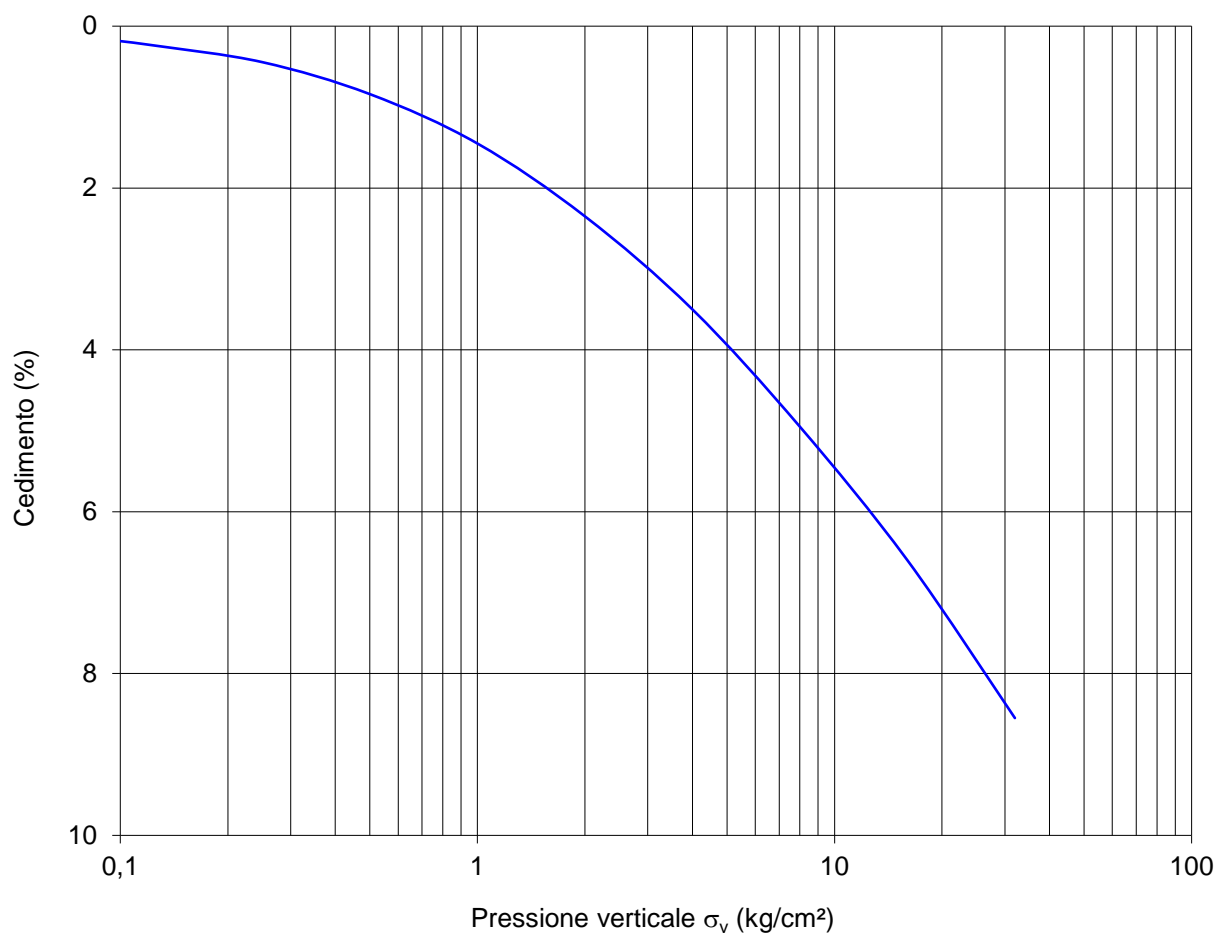
Valori iniziali		Valori finali	
Peso specifico dei grani	$\gamma_s = 2,65 \text{ g/cm}^3$	Peso specifico dei grani	$\gamma_s = 2,65 \text{ g/cm}^3$
Peso di volume	$\gamma_i = 2,01 \text{ g/cm}^3$	Peso di volume	$\gamma_f = 2,11 \text{ g/cm}^3$
Densità secca	$\gamma_{di} = 1,63 \text{ g/cm}^3$	Densità secca	$\gamma_{df} = 1,78 \text{ g/cm}^3$
Umidità	$W_i = 23,4 \%$	Umidità	$W_f = 18,4 \%$
Grado di saturazione	$S_i = 99 \%$	Grado di saturazione	$S_f = 100 \%$
Altezza provino	$H_i = 2,0 \text{ cm}$	Altezza provino	$H_f = 1,829 \text{ cm}$

Pressione		Abbassamenti		Modulo edometrico	Coeff. di compress.	Coeff. di consolidaz.	Coeff. di permeab.
σ_v kg/cm ²	σ_v kPa	δh cm	ε %	E kg/cm ²	m_v cm ² /kg	c_v cm ² /s	k cm/s
0,125	12,26	0,0048	0,24	60			
0,250	24,52	0,0089	0,45	63			
0,500	49,03	0,0168	0,84	81	1,23E-02	6,02E-03	7,43E-08
1,000	98,07	0,0290	1,45	111	9,01E-03	5,92E-03	5,33E-08
2,000	196,13	0,0470	2,35	173	5,78E-03	5,31E-03	3,07E-08
4,000	392,27	0,0700	3,50	275			
8,000	784,53	0,0990	4,95	484			
16,000	1569,06	0,1320	6,60	820			
32,000	3138,13	0,1710	8,55				
64,000	6276,26						
32,000	3138,13						
16,000	1569,06						
8,000	784,53						
4,000	392,27						
2,000	196,13						
1,000	98,07						
0,500	49,03						
0,250	24,52						

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità k (cm/s)
0,50 / 1,00	6,02E-03	81	1,23E-02	7,43E-08
1,00 / 2,00	5,92E-03	111	9,01E-03	5,33E-08
2,00 / 4,00	5,31E-03	173	5,78E-03	3,07E-08
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

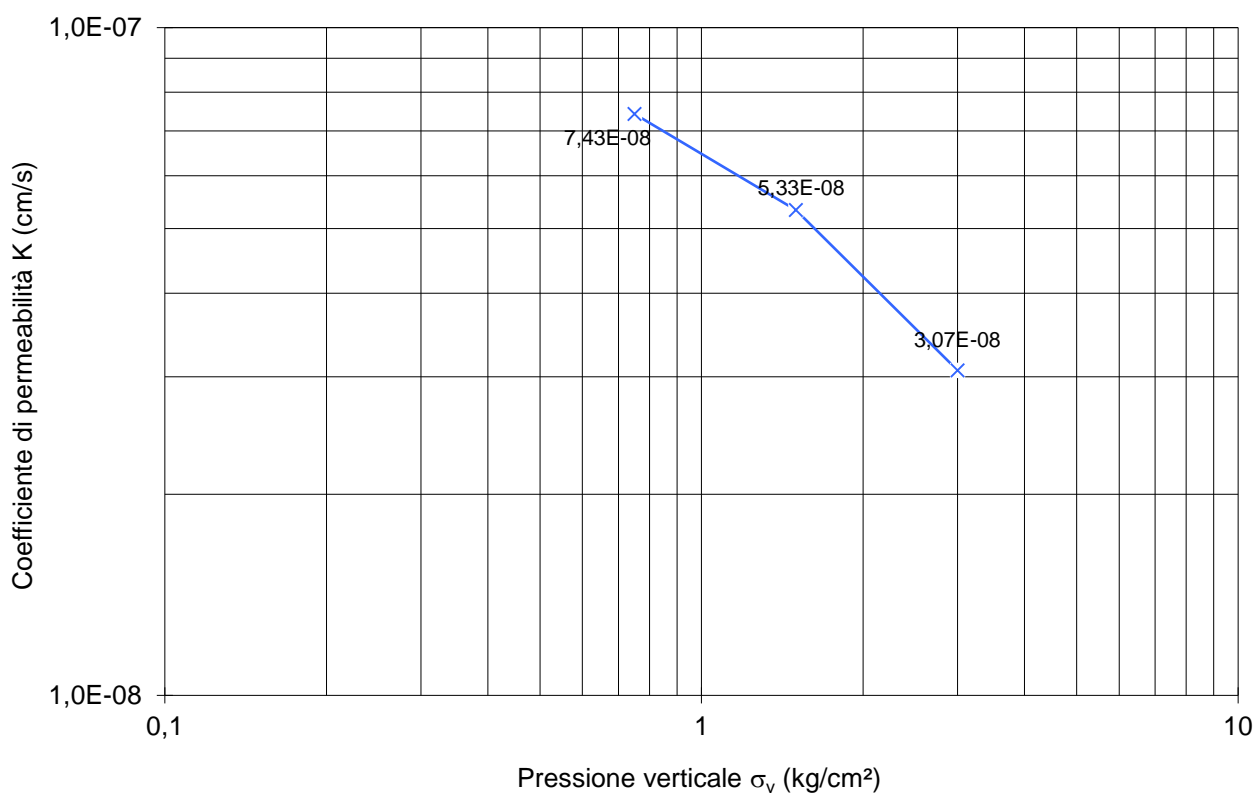
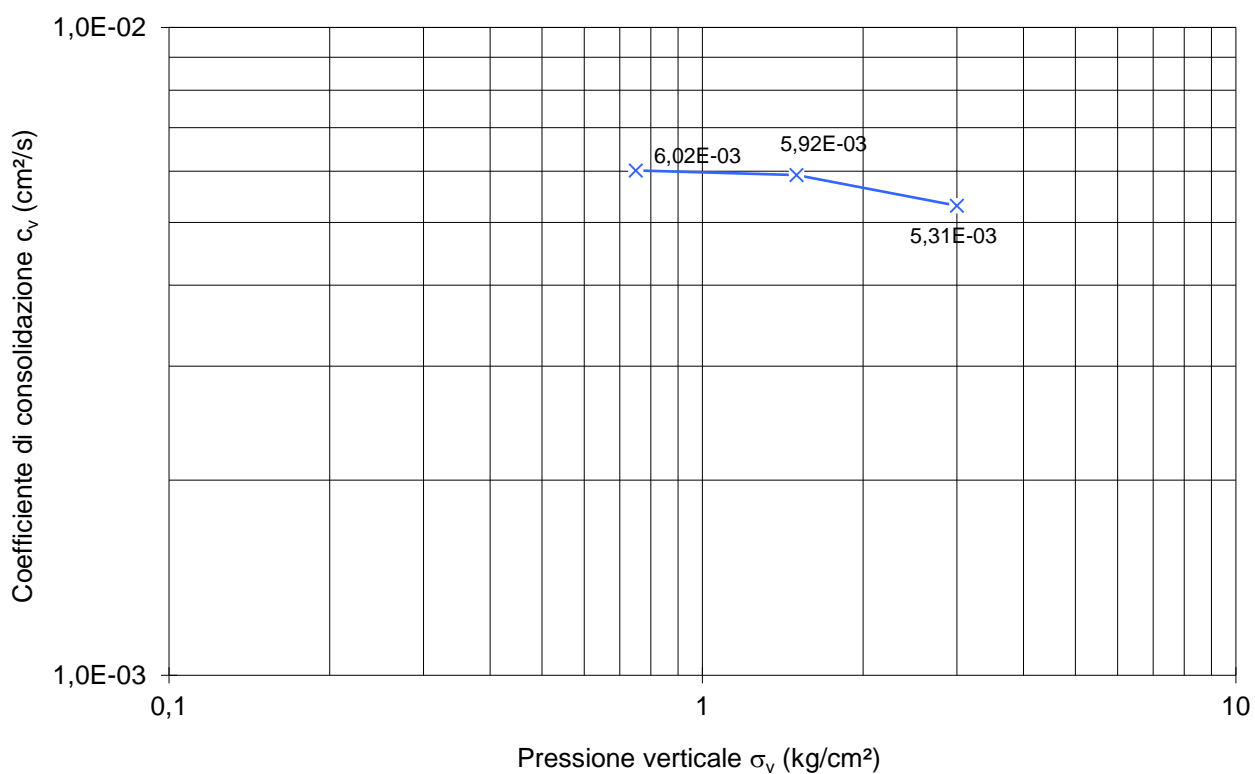
EDOMETRIA

(pagina 2 di 3)



EDOMETRIA

(pagina 3 di 3)



Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 2
Profondità : 5,50-6,10

CARATTERISTICHE FISICO - MECCANICHE

Descrizione del campione: Sabbia limosa di colore grigio

Classe di qualità: Q5

PROPRIETA' INDICE

Contenuto in acqua	$w = 29,1 \%$
Peso di volume umido	$\gamma = 1,92 \text{ g/cm}^3$
Peso di volume secco	$\gamma_d = 1,49 \text{ g/cm}^3$
Peso specifico reale	$\gamma_s = 2,67 \text{ g/cm}^3$
Indice dei vuoti	$e = 0,792$
Grado di saturazione	$S = 98 \%$

LIMITI DI ATTERBERG

Limite liquido	$w_L =$
Limite plastico	$w_P =$
Limite di ritiro	$w_S =$
Indice plastico	$i_P =$
Indice di consistenza	$i_C =$
Attività	$A =$

GRANULOMETRIA

Ghiaia (> 2 mm)	=
Sabbia (2 - 0,06 mm)	=
Limo (0,06 - 0,002 mm)	=
Argilla (< 0,002 mm)	=

COMPRESSIONE

Compressione semplice	$c_u =$
	$\varepsilon =$
Pocket penetrometer	$q =$
Vane test	$c_u =$

PROVA DI TAGLIO (C.D.)

Angolo di attrito	$\phi' = 32^\circ$
Coesione	$c' = 0,0 \text{ kg/cm}^2$

PROVA DI TAGLIO (Residuo)

Angolo di attrito	$\phi_r =$
Coesione	$c_r =$

PROVA TRIASSIALE

Angolo di attrito (U.U.)	$\phi_{uu} =$	Coesione (U.U.)	$c_{uu} =$
Angolo di attrito (C.I.U.)	$\phi_{cu} =$	Coesione (C.I.U.)	$c_{cu} =$
Angolo di attrito (C.I.D.)	$\phi_{cd} =$	Coesione (C.I.D.)	$c_{cd} =$

PROVA EDOMETRICA

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità K (cm/s)
0,50 / 1,00	3,46E-03	51	1,96E-02	6,79E-08
1,00 / 2,00	3,08E-03	62	1,61E-02	4,97E-08
2,00 / 4,00	3,16E-03	90	1,11E-02	3,51E-08
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

Osservazioni:

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 2
Profondità : 5,50-6,10

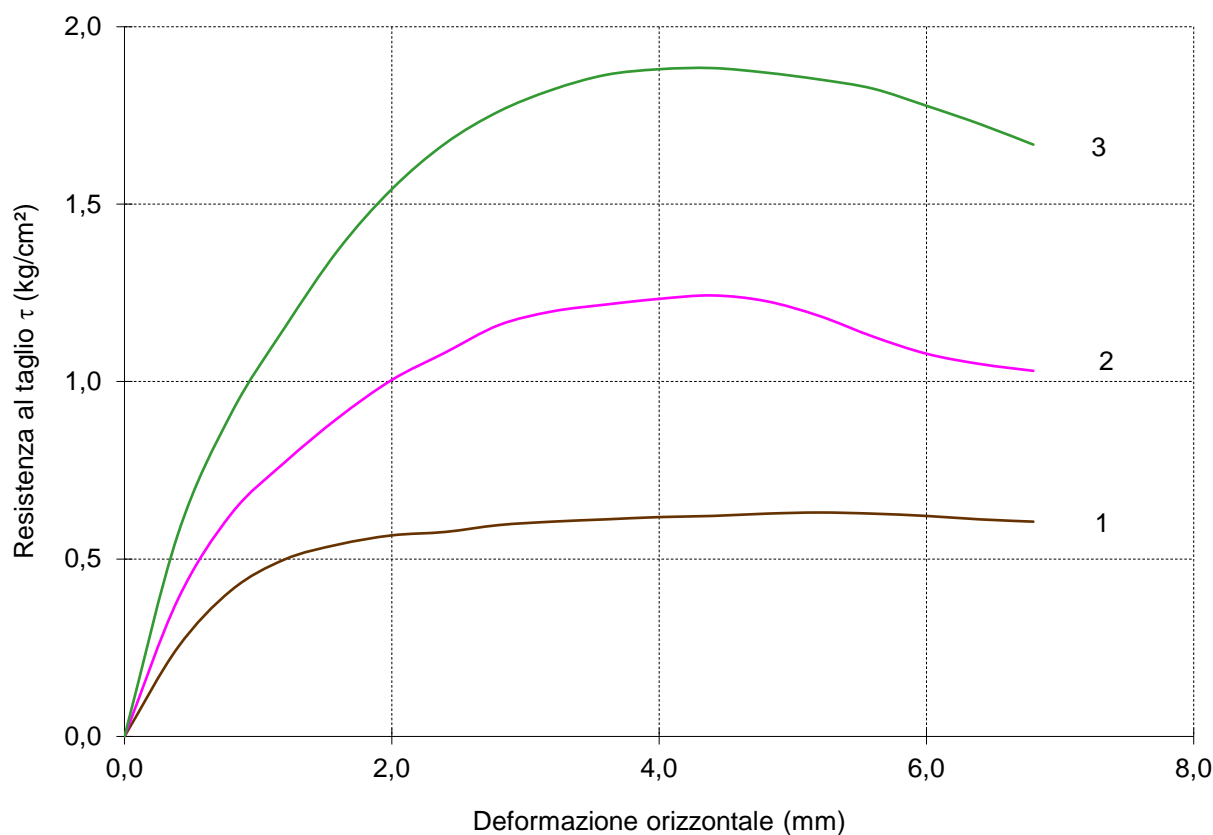
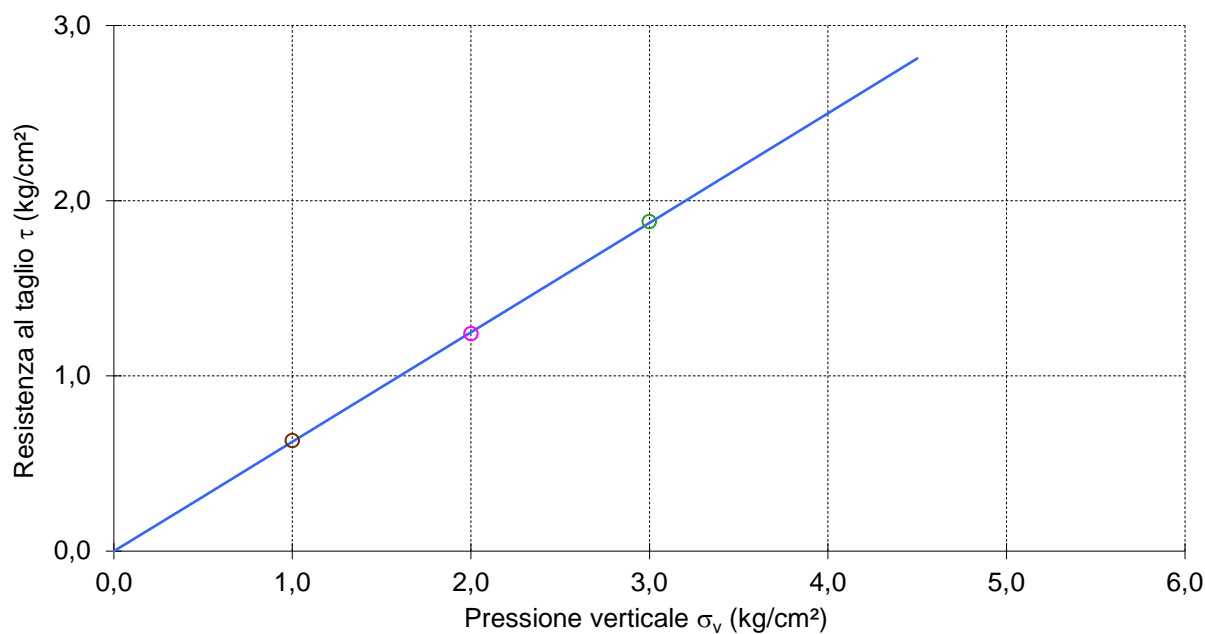
TAGLIO DIRETTO

(pagina 1 di 2)

consolidazione	provino 1		provino 2		provino 3	
	Umidità iniziale	Wi = 29,4 %	Umidità iniziale	Wi = 29,0 %	Umidità iniziale	Wi = 29,2 %
	Peso di volume	$\gamma = 1,93 \text{ g/cm}^3$	Peso di volume	$\gamma = 1,92 \text{ g/cm}^3$	Peso di volume	$\gamma = 1,92 \text{ g/cm}^3$
	Carico verticale	$\sigma = 1,0 \text{ kg/cm}^2$	Carico verticale	$\sigma = 2,0 \text{ kg/cm}^2$	Carico verticale	$\sigma = 3,0 \text{ kg/cm}^2$
	Cedimento	$\Delta h = 0,39 \text{ mm}$	Cedimento	$\Delta h = 0,71 \text{ mm}$	Cedimento	$\Delta h = 0,92 \text{ mm}$
	Tipo di prova		Velocità di prova		Dimensioni provino	
	consolidata - drenata		0,005 mm/min		Altezza 2,00 cm	
					Diametro 6,35 cm	
					Sezione 31,67 cm ²	
rottura	provino 1		provino 2		provino 3	
	Deform. mm	$\tau 1 \text{ kg/cm}^2$	$\tau 1 \text{ kPa}$	$\tau 2 \text{ kg/cm}^2$	$\tau 2 \text{ kPa}$	$\tau 3 \text{ kg/cm}^2$
	0,0	0	0	0	0	0
	0,4	0,25	24,6	0,39	37,9	0,57
	0,8	0,41	40,4	0,63	61,6	0,91
	1,2	0,50	48,9	0,77	75,8	1,15
	1,6	0,54	53,0	0,90	88,1	1,37
	2,0	0,57	55,6	1,00	98,5	1,54
	2,4	0,58	56,5	1,08	106,1	1,67
	2,8	0,60	58,4	1,16	113,7	1,76
	3,2	0,61	59,4	1,20	117,5	1,82
	3,6	0,61	60,0	1,22	119,4	1,86
	4,0	0,62	60,6	1,23	120,9	1,88
	4,4	0,62	60,9	1,24	121,9	1,88
	4,8	0,63	61,6	1,23	120,3	1,87
	5,2	0,63	61,9	1,18	116,2	1,85
	5,6	0,63	61,6	1,13	110,5	1,83
	6,0	0,62	60,9	1,08	105,8	1,78
	6,4	0,61	60,0	1,05	102,9	1,73
	6,8	0,61	59,4	1,03	101,0	1,67
	7,2					
	7,6					
	8,0					
	8,4					
	8,8					
	9,2					
	9,6					
	10,0					
	10,4					
	10,8					
	11,2					
	11,6					
	12,0					
	12,4					
	12,8					
	13,2					
	13,6					
	14,0					
	14,4					
	14,8					
	15,2					
	15,6					
	16,0					
	16,4					
	16,8					
	17,2					
	17,6					
	18,0					
	18,4					
	18,8					
	19,2					
	19,6					
	20,0					

TAGLIO DIRETTO

(pagina 2 di 2)



Valori di picco		Valori residui	
coesione intercetta	$c' = 0,0 \text{ kg/cm}^2$	coesione intercetta	$c_r =$
angolo di attrito	$\phi' = 32^\circ$	angolo di attrito	$\phi_r =$

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 2
Profondità : 5,50-6,10

EDOMETRIA

(pagina 1 di 3)

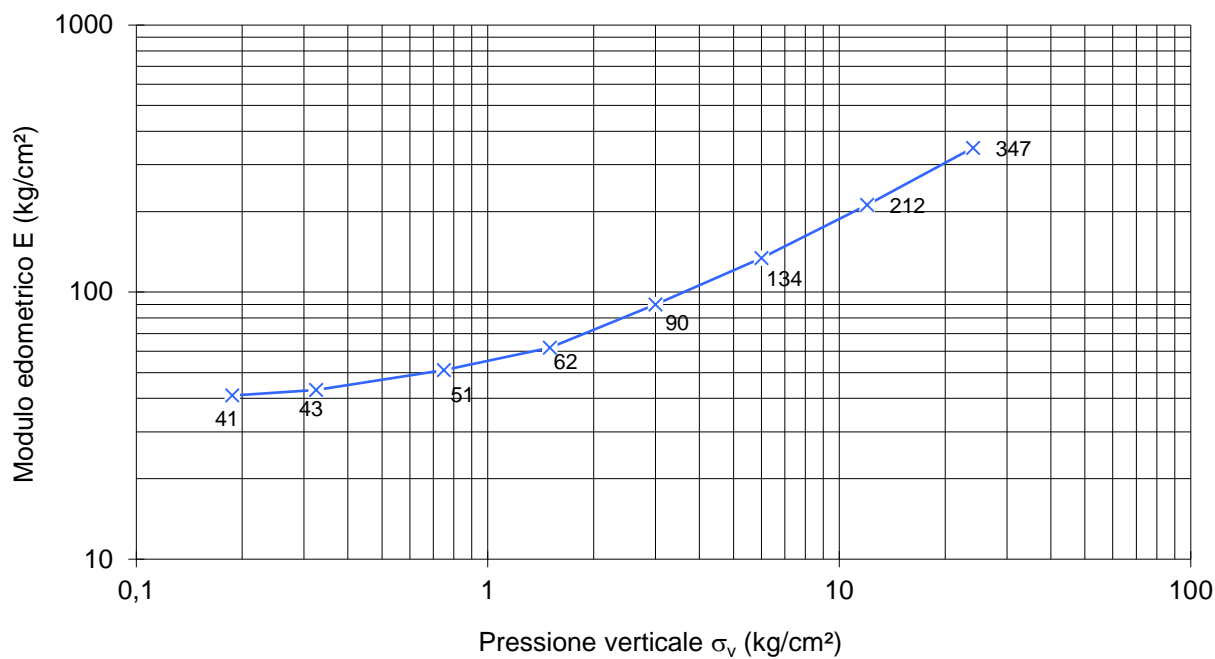
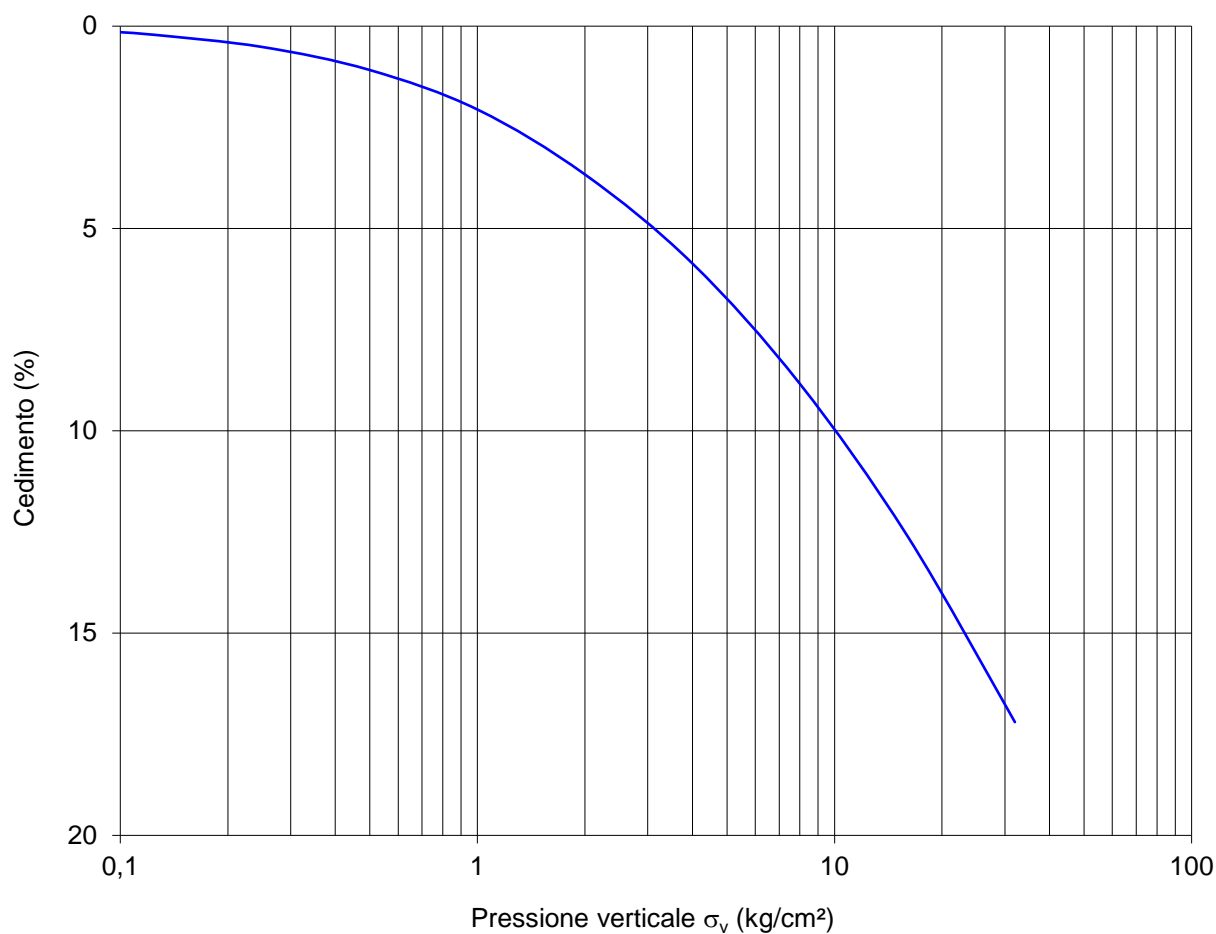
Valori iniziali		Valori finali	
Peso specifico dei grani	$\gamma_s = 2,67 \text{ g/cm}^3$	Peso specifico dei grani	$\gamma_s = 2,67 \text{ g/cm}^3$
Peso di volume	$\gamma_i = 1,92 \text{ g/cm}^3$	Peso di volume	$\gamma_f = 2,12 \text{ g/cm}^3$
Densità secca	$\gamma_{di} = 1,49 \text{ g/cm}^3$	Densità secca	$\gamma_{df} = 1,80 \text{ g/cm}^3$
Umidità	$W_i = 29,1 \%$	Umidità	$W_f = 18,1 \%$
Grado di saturazione	$S_i = 98 \%$	Grado di saturazione	$S_f = 100 \%$
Altezza provino	$H_i = 2,0 \text{ cm}$	Altezza provino	$H_f = 1,656 \text{ cm}$

Pressione		Abbassamenti		Modulo edometrico	Coeff. di compress.	Coeff. di consolidaz.	Coeff. di permeab.
σ_v kg/cm ²	σ_v kPa	δh cm	ε %	E kg/cm ²	m_v cm ² /kg	c_v cm ² /s	k cm/s
0,125	12,26	0,0043	0,22	41			
0,250	24,52	0,0103	0,52	43			
0,500	49,03	0,0217	1,09	51	1,96E-02	3,46E-03	6,79E-08
1,000	98,07	0,0412	2,06	62	1,61E-02	3,08E-03	4,97E-08
2,000	196,13	0,0733	3,67	90	1,11E-02	3,16E-03	3,51E-08
4,000	392,27	0,1173	5,87	134			
8,000	784,53	0,1768	8,84	212			
16,000	1569,06	0,2520	12,60	347			
32,000	3138,13	0,3440	17,20				
64,000	6276,26						
32,000	3138,13						
16,000	1569,06						
8,000	784,53						
4,000	392,27						
2,000	196,13						
1,000	98,07						
0,500	49,03						
0,250	24,52						

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità k (cm/s)
0,50 / 1,00	3,46E-03	51	1,96E-02	6,79E-08
1,00 / 2,00	3,08E-03	62	1,61E-02	4,97E-08
2,00 / 4,00	3,16E-03	90	1,11E-02	3,51E-08
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

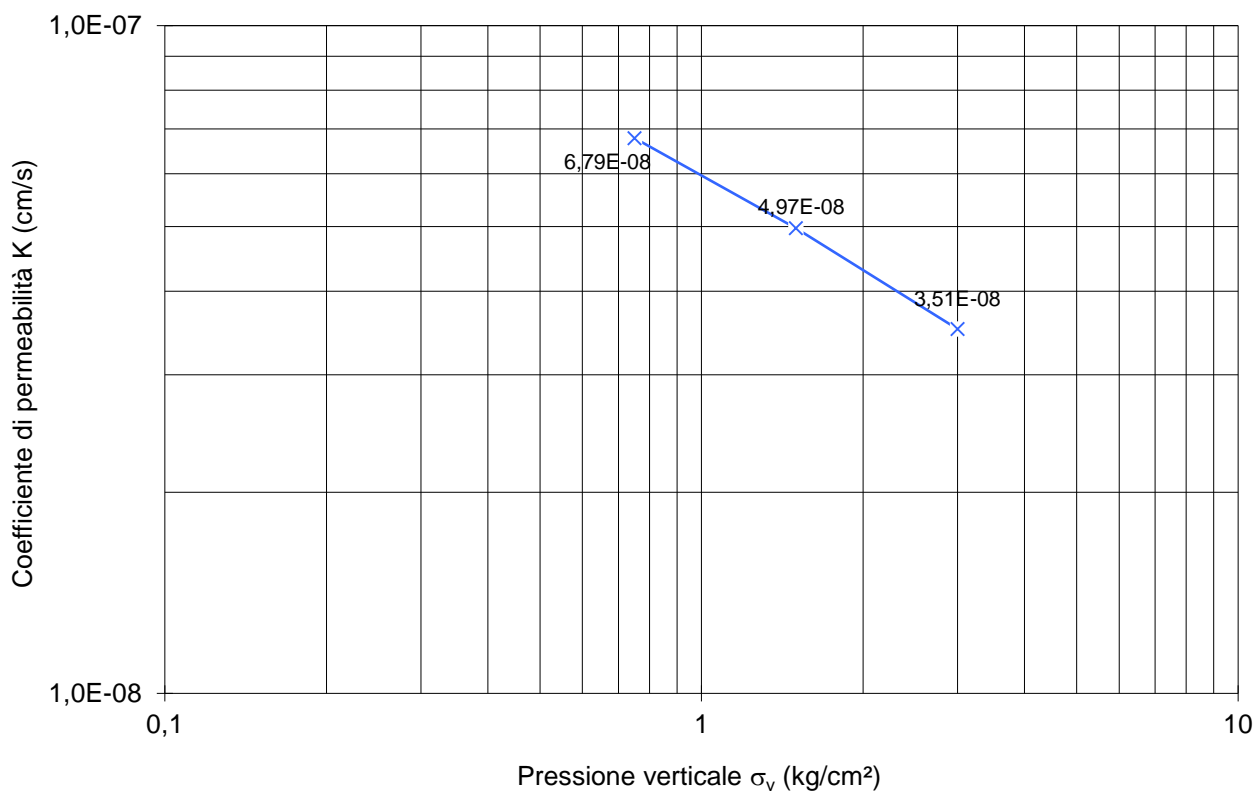
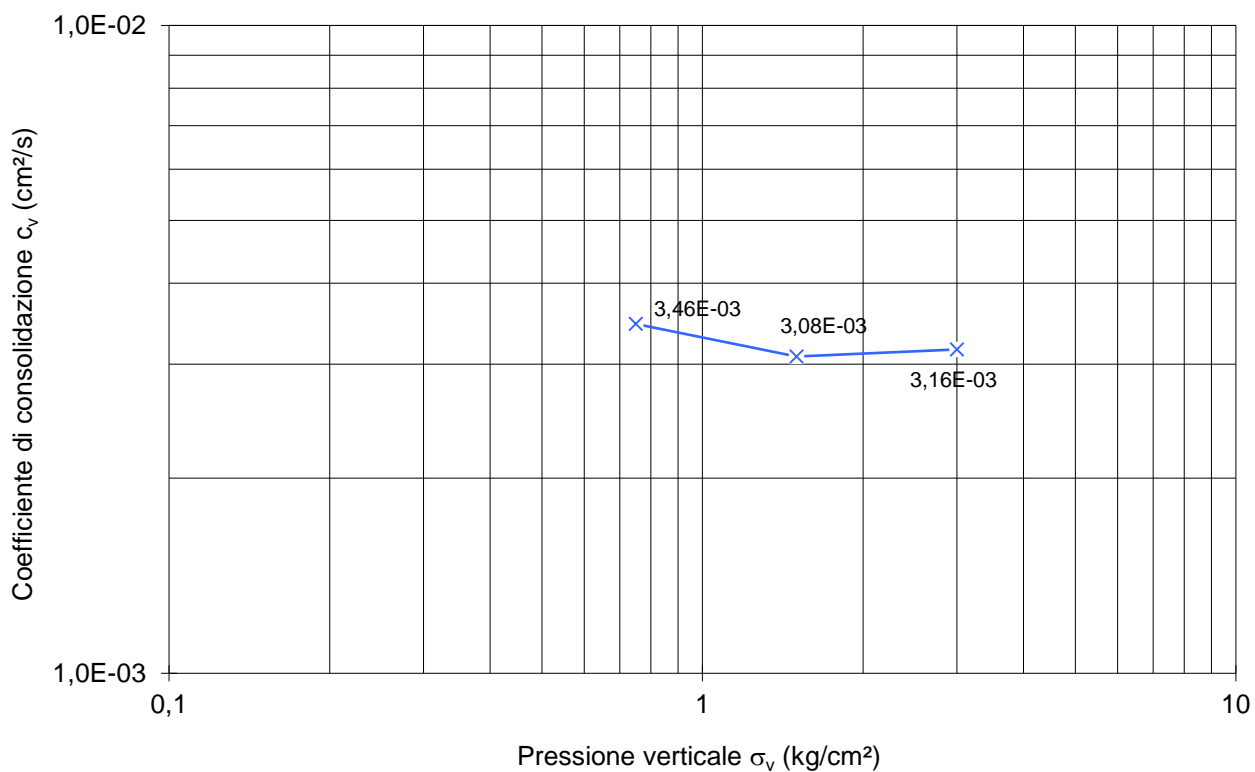
EDOMETRIA

(pagina 2 di 3)



EDOMETRIA

(pagina 3 di 3)



Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 3
Profondità : 10,00-10,60

CARATTERISTICHE FISICO - MECCANICHE

Descrizione del campione: Argilla limosa di colore marrone-grigio

Classe di qualità: Q5

PROPRIETA' INDICE

Contenuto in acqua	$w = 34,3 \%$
Peso di volume umido	$\gamma = 1,88 \text{ g/cm}^3$
Peso di volume secco	$\gamma_d = 1,40 \text{ g/cm}^3$
Peso specifico reale	$\gamma_s = 2,74 \text{ g/cm}^3$
Indice dei vuoti	$e = 0,957$
Grado di saturazione	$S = 98 \%$

LIMITI DI ATTERBERG

Limite liquido	$w_L =$
Limite plastico	$w_P =$
Limite di ritiro	$w_S =$
Indice plastico	$i_P =$
Indice di consistenza	$i_C =$
Attività	$A =$

GRANULOMETRIA

Ghiaia (> 2 mm)	=
Sabbia (2 - 0,06 mm)	=
Limo (0,06 - 0,002 mm)	=
Argilla (< 0,002 mm)	=

COMPRESSIONE

Compressione semplice	$c_u =$
	$\varepsilon =$
Pocket penetrometer	$q = 1,2 - 1,3 \text{ kg/cm}^2$
Vane test	$c_u = 0,60 \text{ kg/cm}^2$

PROVA DI TAGLIO (C.D.)

Angolo di attrito	$\phi' = 22^\circ$
Coesione	$c' = 0,12 \text{ kg/cm}^2$

PROVA DI TAGLIO (Residuo)

Angolo di attrito	$\phi_r =$
Coesione	$c_r =$

PROVA TRIASSIALE

Angolo di attrito (U.U.)	$\phi_{uu} =$	Coesione (U.U.)	$c_{uu} =$
Angolo di attrito (C.I.U.)	$\phi_{cu} =$	Coesione (C.I.U.)	$c_{cu} =$
Angolo di attrito (C.I.D.)	$\phi_{cd} =$	Coesione (C.I.D.)	$c_{cd} =$

PROVA EDOMETRICA

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità K (cm/s)
0,50 / 1,00	1,28E-04	35	2,86E-02	3,66E-09
1,00 / 2,00	1,14E-04	38	2,63E-02	3,00E-09
2,00 / 4,00	1,06E-04	50	2,00E-02	2,12E-09
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

Osservazioni:

Committente : Antoniazzi Studio Associato
Località : Via Galilei - Cesenatico (FC)

Sondaggio : 1
Campione : 3
Profondità : 10,00-10,60

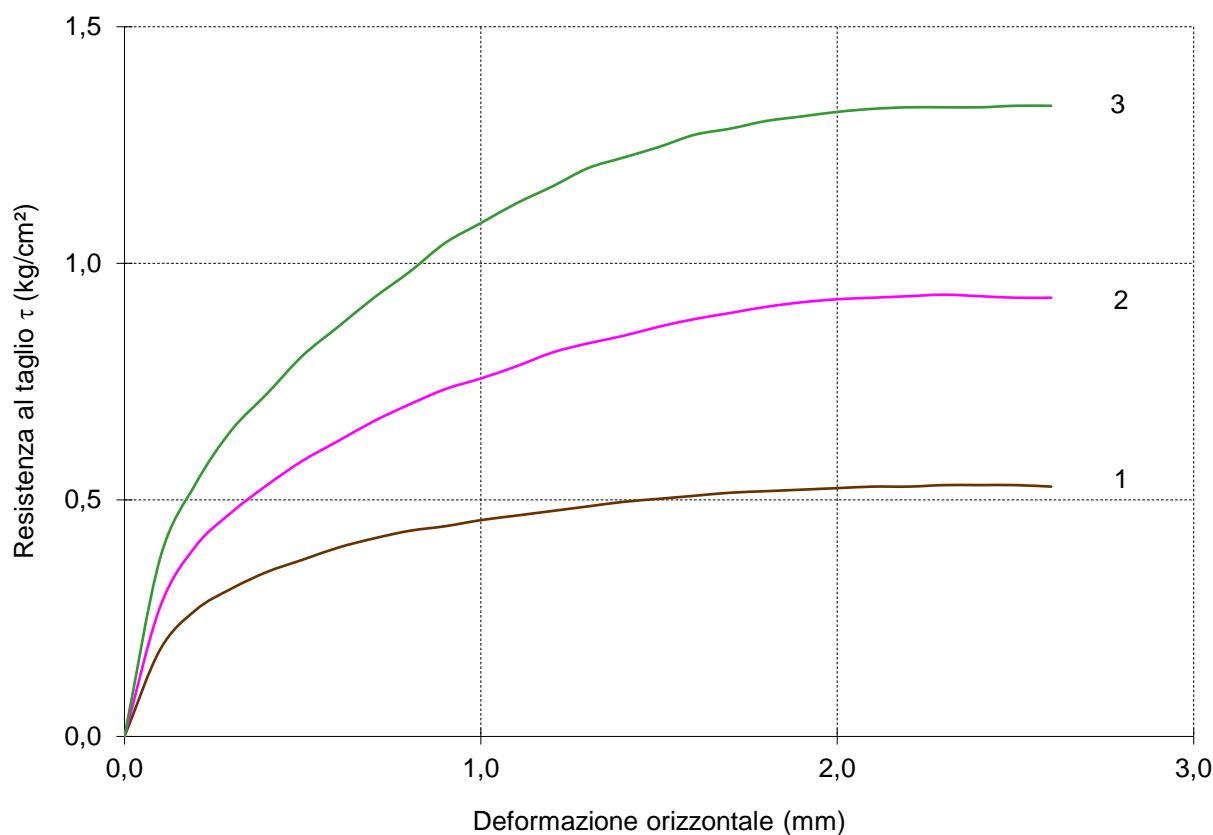
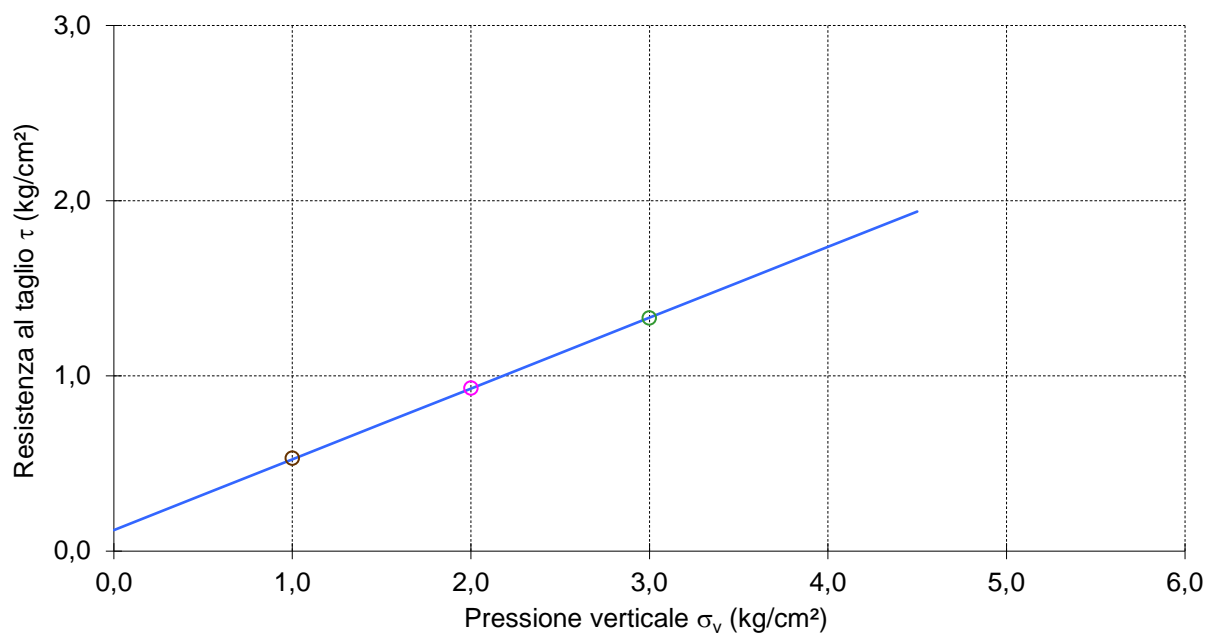
TAGLIO DIRETTO

(pagina 1 di 2)

consolidazione	provino 1		provino 2		provino 3	
	Umidità iniziale	Wi = 34,2 %	Umidità iniziale	Wi = 34,0 %	Umidità iniziale	Wi = 34,4 %
	Peso di volume	γ = 1,88 g/cm³	Peso di volume	γ = 1,87 g/cm³	Peso di volume	γ = 1,88 g/cm³
	Carico verticale	σ = 1,0 kg/cm²	Carico verticale	σ = 2,0 kg/cm²	Carico verticale	σ = 3,0 kg/cm²
	Cedimento	Δh = 0,37 mm	Cedimento	Δh = 0,87 mm	Cedimento	Δh = 1,36 mm
	Tipo di prova		Velocità di prova		Dimensioni provino	
	consolidata - drenata		0,0025 mm/min		Altezza 2,00 cm	
					Diametro 6,35 cm	
					Sezione 31,67 cm²	
rottura	provino 1		provino 2		provino 3	
	Deform. mm	τ 1 kg/cm² τ 1 kPa	τ 2 kg/cm² τ 2 kPa	τ 3 kg/cm² τ 3 kPa	τ 3 kg/cm² τ 3 kPa	τ 3 kPa
	0,0	0 0	0 0	0 0	0 0	0
	0,1	0,18 18,0	0,27 26,8	0,38 36,9	0,38 36,9	36,9
	0,2	0,27 26,2	0,40 39,5	0,53 52,4	0,53 52,4	52,4
	0,3	0,31 30,6	0,47 46,4	0,65 63,5	0,65 63,5	63,5
	0,4	0,35 34,1	0,53 52,1	0,72 71,0	0,72 71,0	71,0
	0,5	0,37 36,6	0,58 57,2	0,80 78,9	0,80 78,9	78,9
	0,6	0,40 39,2	0,62 61,3	0,87 84,9	0,87 84,9	84,9
	0,7	0,42 41,0	0,67 65,4	0,93 90,9	0,93 90,9	90,9
	0,8	0,43 42,6	0,70 68,8	0,98 96,3	0,98 96,3	96,3
	0,9	0,44 43,6	0,73 72,0	1,04 102,3	1,04 102,3	102,3
	1,0	0,46 44,8	0,76 74,2	1,09 106,4	1,09 106,4	106,4
	1,1	0,47 45,8	0,78 76,7	1,13 110,5	1,13 110,5	110,5
	1,2	0,48 46,7	0,81 79,6	1,16 114,0	1,16 114,0	114,0
	1,3	0,49 47,7	0,83 81,5	1,20 117,8	1,20 117,8	117,8
	1,4	0,50 48,6	0,85 83,0	1,22 120,0	1,22 120,0	120,0
	1,5	0,50 49,3	0,87 84,9	1,25 122,2	1,25 122,2	122,2
	1,6	0,51 49,9	0,88 86,5	1,27 124,7	1,27 124,7	124,7
	1,7	0,52 50,5	0,90 87,8	1,28 126,0	1,28 126,0	126,0
	1,8	0,52 50,8	0,91 89,0	1,30 127,6	1,30 127,6	127,6
	1,9	0,52 51,2	0,92 90,0	1,31 128,5	1,31 128,5	128,5
	2,0	0,52 51,5	0,92 90,6	1,32 129,5	1,32 129,5	129,5
	2,1	0,53 51,8	0,93 90,9	1,33 130,1	1,33 130,1	130,1
	2,2	0,53 51,8	0,93 91,3	1,33 130,4	1,33 130,4	130,4
	2,3	0,53 52,1	0,93 91,6	1,33 130,4	1,33 130,4	130,4
	2,4	0,53 52,1	0,93 91,3	1,33 130,4	1,33 130,4	130,4
	2,5	0,53 52,1	0,93 90,9	1,33 130,7	1,33 130,7	130,7
	2,6	0,53 51,8	0,93 90,9	1,33 130,7	1,33 130,7	130,7
	2,7					
	2,8					
	2,9					
	3,0					
	3,1					
	3,2					
	3,3					
	3,4					
	3,5					
	3,6					
	3,7					
	3,8					
	3,9					
	4,0					
	4,1					
	4,2					
	4,3					
	4,4					
	4,5					
	4,6					
	4,7					
	4,8					
	4,9					
	5,0					

TAGLIO DIRETTO

(pagina 2 di 2)



Valori di picco		Valori residui	
coesione intercetta	$c' = 0,12 \text{ kg/cm}^2$	coesione intercetta	$c_r =$
angolo di attrito	$\phi' = 22^\circ$	angolo di attrito	$\phi_r =$

Committente : Antoniazzi Studio Associato
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EDOMETRIA

(pagina 1 di 3)

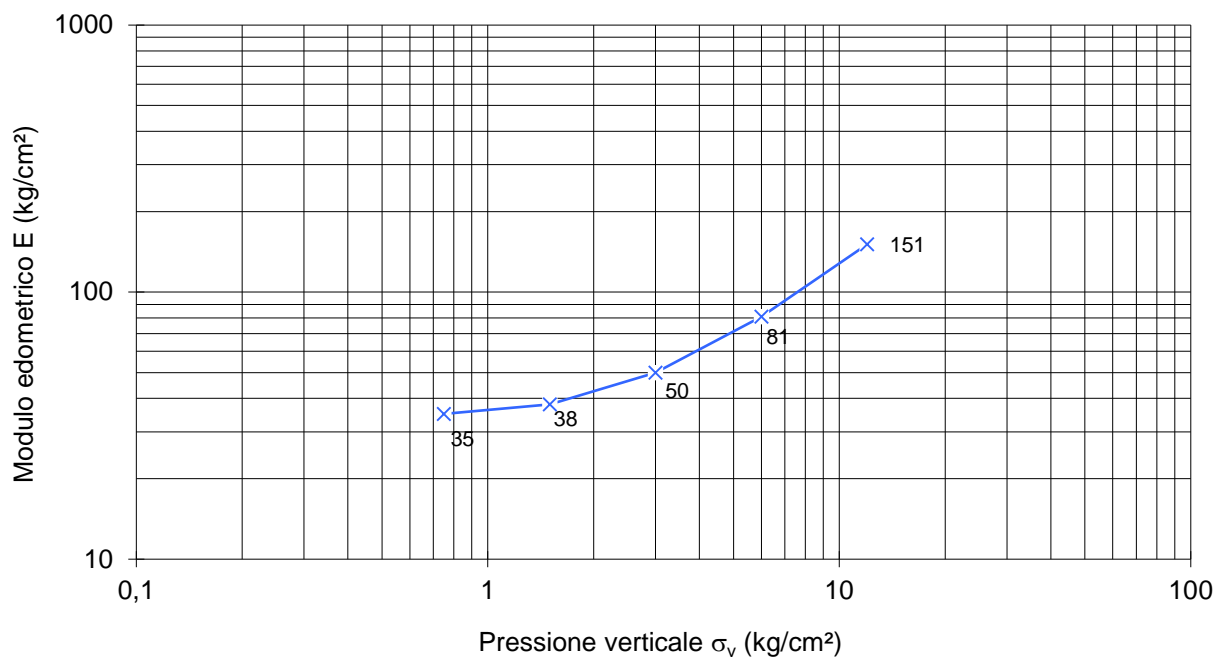
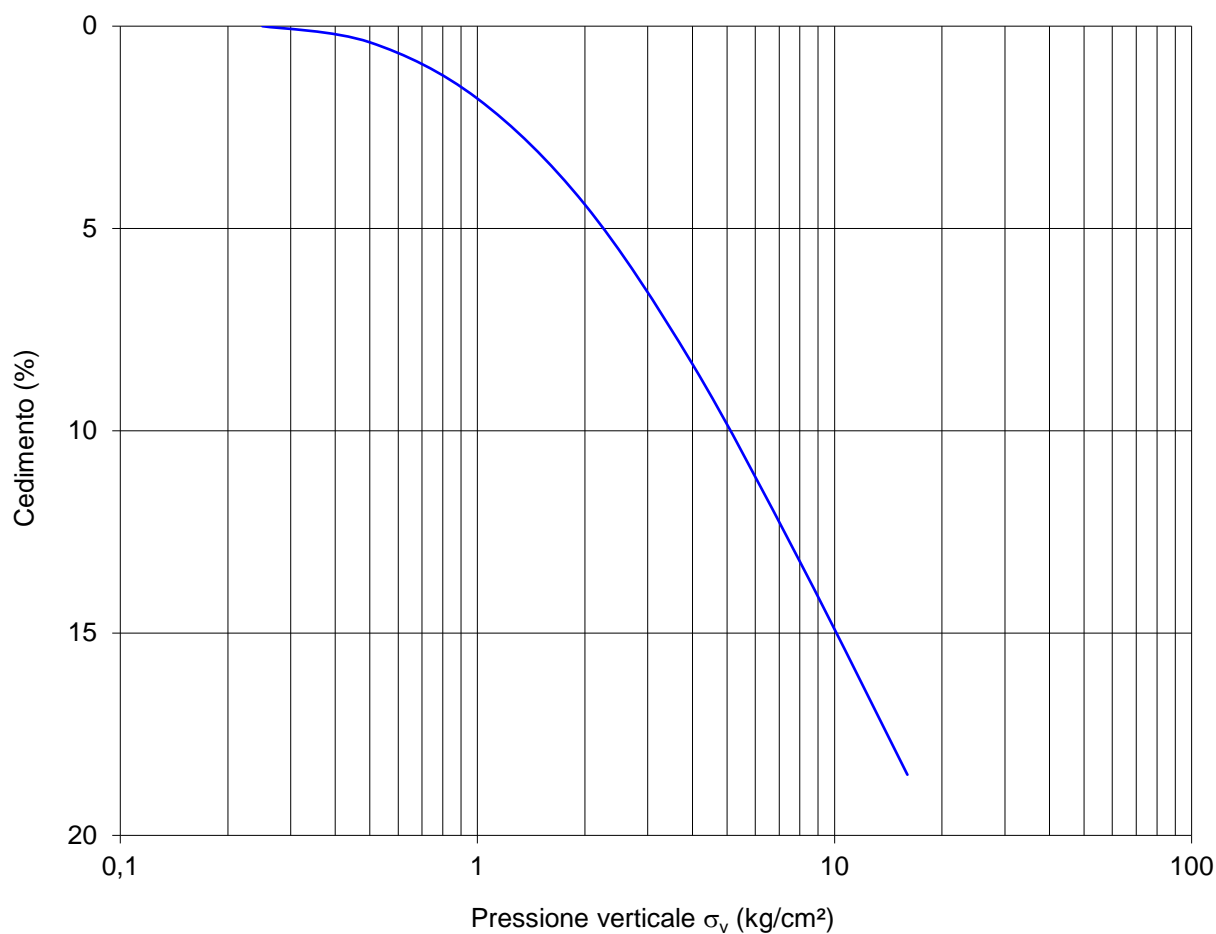
Valori iniziali		Valori finali	
Peso specifico dei grani	$\gamma_s = 2,74 \text{ g/cm}^3$	Peso specifico dei grani	$\gamma_s = 2,74 \text{ g/cm}^3$
Peso di volume	$\gamma_i = 1,88 \text{ g/cm}^3$	Peso di volume	$\gamma_f = 2,09 \text{ g/cm}^3$
Densità secca	$\gamma_{di} = 1,40 \text{ g/cm}^3$	Densità secca	$\gamma_{df} = 1,71 \text{ g/cm}^3$
Umidità	$W_i = 34,3 \%$	Umidità	$W_f = 21,9 \%$
Grado di saturazione	$S_i = 98 \%$	Grado di saturazione	$S_f = 100 \%$
Altezza provino	$H_i = 2,0 \text{ cm}$	Altezza provino	$H_f = 1,630 \text{ cm}$

Pressione		Abbassamenti		Modulo edometrico	Coeff. di compress.	Coeff. di consolidaz.	Coeff. di permeab.
σ_v kg/cm ²	σ_v kPa	δh cm	ε %	E kg/cm ²	m_v cm ² /kg	c_v cm ² /s	k cm/s
0,125	12,26						
0,250	24,52	0,0000	0,00				
0,500	49,03	0,0080	0,40	35	2,86E-02	1,28E-04	3,66E-09
1,000	98,07	0,0358	1,79	38	2,63E-02	1,14E-04	3,00E-09
2,000	196,13	0,0882	4,41	50	2,00E-02	1,06E-04	2,12E-09
4,000	392,27	0,1670	8,35	81			
8,000	784,53	0,2647	13,24	151			
16,000	1569,06	0,3700	18,50				
32,000	3138,13						
64,000	6276,26						
32,000	3138,13						
16,000	1569,06						
8,000	784,53						
4,000	392,27						
2,000	196,13						
1,000	98,07						
0,500	49,03						
0,250	24,52						

Intervallo pressione σ_v (Kg/cm ²)	Coefficiente di consolidazione c_v (cm ² /s)	Modulo edometrico E (kg/cm ²)	Coefficiente di compressibilità m_v (cm ² /kg)	Coefficiente di permeabilità k (cm/s)
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1,00 / 2,00	1,14E-04	38	2,63E-02	3,00E-09
2,00 / 4,00	1,06E-04	50	2,00E-02	2,12E-09
4,00 / 8,00				
8,00 / 16,0				
16,0 / 32,0				

EDOMETRIA

(pagina 2 di 3)



EDOMETRIA

(pagina 3 di 3)

