

## S.S. 309 "ROMEA"

### INTERVENTI DI RAZIONALIZZAZIONE ED ADEGUAMENTO DELLE INTERSEZIONI A RASO LUNGO LA S.S. 309 II STRALCIO DAL KM 35+500 al KM 55+100

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## RELAZIONE GEOLOGICA-GEOTECNICA

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ED ADEGUAMENTO  
DELLE INTERSEZIONI A RASO LUNGO LA S.S. 309  
II STRALCIO  
DAL KM 35+500 AL KM 55+100**

**PROGETTO DEFINITIVO**

**RELAZIONE GEOLOGICA-GEOTECNICA**

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## 1 PREMESSA

Il progetto definitivo in oggetto, è volto a migliorare il sistema viabilistico della Strada Statale 309 "Romea", per mezzo di interventi di razionalizzazione ed adeguamento delle intersezioni a raso, lungo il tratto di **S.S. 309** che va dal **km 35+500** al **km 55+100**, **Il STRALCIO**.

Scopo del progetto è quello di migliorare le condizioni di sicurezza e di operatività del tracciato andando ad intervenire sulle intersezioni esistenti, riducendo i punti di conflitto fra le traiettorie delle manovre elementari.

Gli interventi prevedono la manutenzione straordinaria della sede stradale modificando la configurazione attuale delle intersezioni a raso.

Gli interventi, in breve sintesi, prevedono le seguenti modifiche:

- eliminazione delle svolte a sinistra più critiche;
- inserimento di corsie specializzate di entrata ed accumulo;
- modifica e sistemazione di intersezioni a T;
- eliminazione dei punti di intersezione più critici inserendo un'intersezione a rotatoria;
- inserimento e adeguamento delle barriere stradali;
- adeguamento della segnaletica stradale;
- rifacimento e regolarizzazione degli elementi di arredo e illuminazione.

L'oggetto dell'intervento denominato **Il STRALCIO** comprende l'adeguamento delle seguenti intersezioni:

| Int. N. | Denominazione progetto                                 | PK     | Comune    | Località       |
|---------|--|--------|-----------|----------------|
| 14      | Intersezione strada Lagosanto – via Valli Basse        | 35+500 | Comacchio | Lagosanto      |
| 15      | Intersezione SP 55 Lagosanto – Rotta Zambusi           | 36+000 | Comacchio | Lagosanto      |
| 16      | Rotatoria intersezione SP21 Vaccolino                  | 40+000 | Comacchio | Vaccolino      |
| 17      | Rotatoria intersezione località Diavolo e SP 54 Volano | 42+600 | Codigoro  | Lido di Volano |
| 22      | Intersezione Via Motte SP11                            | 54+000 | Mesola    | Mesola         |
| 23      | Rotatoria intersezione via Garibaldi                   | 54+500 | Mesola    | Mesola         |
| 24      | Chiusura accesso via Vinicio Migliorini                | 54+900 | Mesola    | Mesola         |
| 25      | Intersezione via XXV Aprile                            | 55+100 | Mesola    | Mesola         |

Nella seguente relazione, per completezza d'indagine, è stato preso in considerazione un tratto più ampio di S.S. 309 che va dal km 24+300 al km 55+300, comprensivo anche degli interventi del I Stralcio. Le indagini sono state eseguite in corrispondenza degli interventi e in alcuni punti compresi fra un intervento e l'altro, in modo da avere una "visione" generale di tutta la tratta.

Gli interventi sono stati individuati dal *"Progetto di fattibilità tecnica ed economica, nell'ambito generale del Piano Straordinario di Potenziamento e Riqualificazione dell'itinerario E45/E55 - SS 309 e 309dir "Romea" - Tratta Emiliano - Romagnola"* redatto da PROTECO engineering con EFarm.

L'interpretazione geologico-geotecnica contenuta nella presente relazione fa riferimento alle indagini geognostiche e sismiche eseguite lungo il tracciato di interesse della S.S. 309 "Romea", i cui esiti sono contenuti nei rapporti tecnici redatti dalle ditte GIA Exploring S.r.l. e I.P.G. s.n.c.

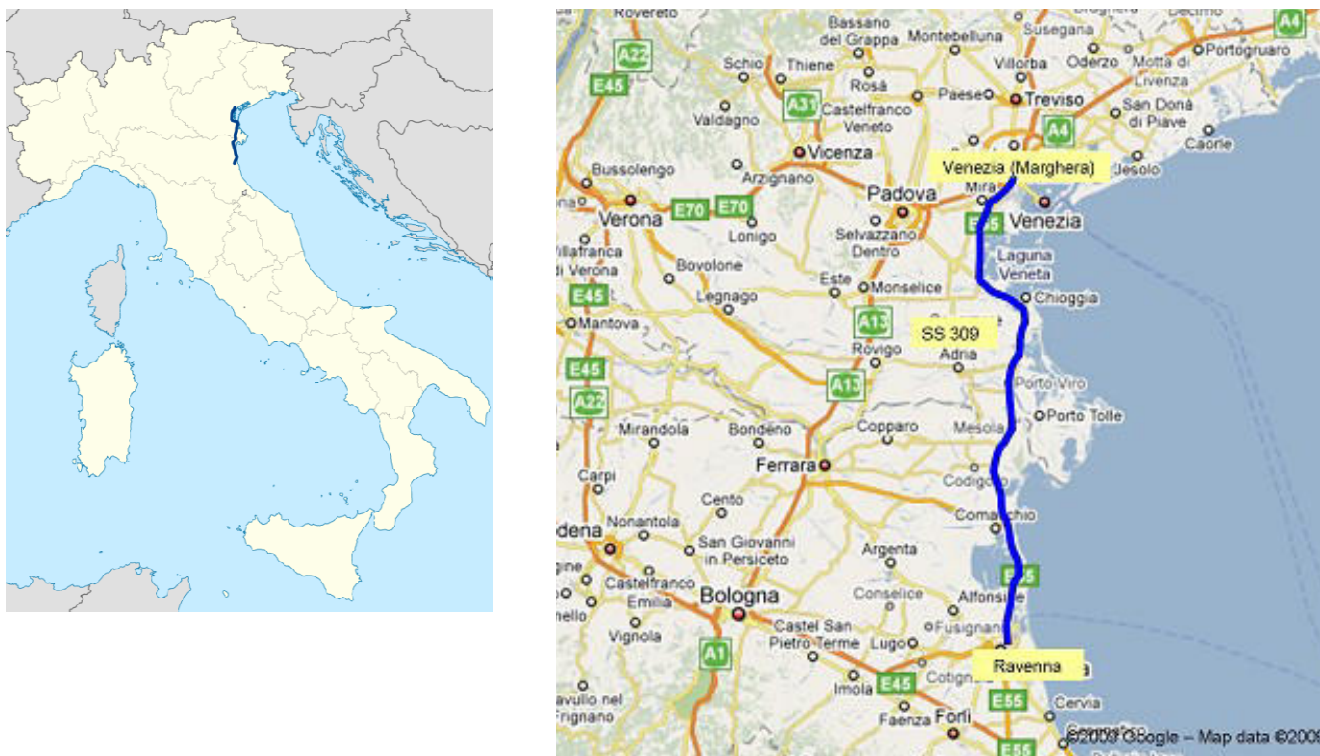
## 2 RELAZIONE GEOLOGICA

### 2.1 Inquadramento territoriale

La strada statale 309 Romea (S.S. 309), nota semplicemente come strada Romea, è una strada statale italiana, che collega Ravenna a Mestre, seguendo il litorale Adriatico a poca distanza dal mare, gestita da ANAS S.p.A..

La SS 309 fa parte della strada europea E55, dorsale che collega il nord al sud dell' Europa, da Helsingborg in Svezia a Kalamáta in Grecia. Essa costituisce un importantissimo asse viario in direzione nord-sud per le comunicazioni dall'Emilia-Romagna e dalla Riviera romagnola verso il Veneto. Interessa le province di Ravenna, Ferrara, Rovigo, Padova e Venezia attraversando da sud verso nord i lidi Ravennati, le Valli di Comacchio, il delta del Po, lambendo infine tutta la parte meridionale della laguna di Venezia superando Po, Adige, Brenta e numerosi canali artificiali.

L'estremità più meridionale della S.S. 309, si trova in provincia di Ravenna, dove si connette con la strada europea E45, che costituisce l'altra dorsale europea nord/sud, mentre la sua estremità più settentrionale è posta in corrispondenza di una rotatoria che la connette con lo svincolo di Marghera della tangenziale di Mestre.



**Figura 1** – Il tracciato della S.S. 309 sul territorio nazionale e tra le province di Ravenna e Venezia

**S.S. 309 "Romea" – Interventi di razionalizzazione ed adeguamento delle intersezioni a raso lungo la S.S. 309**

**Il STRALCIO dal km 35+500 al km 55+100**



## 2.2 Lineamenti geologici e geomorfologici

Il tracciato della S.S. 309 "Romea", attraversa tre territori comunali, ovvero Comacchio, Codigoro e Mesola.

L'intero tracciato rientra nel contesto geomorfologico della pianura padana, nella sua parte più orientale, prossima al litorale ferrarese del Mare Adriatico.

Dal punto di vista strutturale, durante il Mesozoico, l'area che attualmente corrisponde alla pianura padana rappresentava una zona di avampaese delle catene montuose alpina ed appenninica, assumendo sempre di più la conformazione di un bacino in subsidenza, profondamente modificato dai movimenti tettonici, quest'ultimi legati in particolare alla progressione della subduzione che dal Creataceo spinge la placca africana al di sotto della placca euroasiatica.

Tale movimento tettonico ha quindi comportato, per l'area del bacino padano, l'instaurarsi di un regime di tipo compressivo, e risulta ancora oggi attivo.

Già a partire dall'Eocene, il bacino padano ha visto il continuo deposito di sedimenti provenienti sia dalla catena alpina, sia da quella appenninica, che hanno quindi via via portato al colmamento del bacino subsidente.

Durante la sua storia evolutiva, il bacino padano ha visto l'alternarsi di fenomeni di ingressione del mare, e conseguente deposito di materiali di origine marina, e processi di regressione marina ed aumento degli apporti continentali, con conseguente incremento dello spessore della coltre alluvionale ed aggradazione delle linee di costa.

I sedimenti che costituiscono l'attuale pianura padana, quindi, a Nord ricoprono parte della catena alpina, e a Sud parte della catena appenninica; la pianura risulta pertanto caratterizzata da imponenti coltri di sedimenti alluvionali e fluvio-glaciali che ricoprono il substrato roccioso profondo, strutturalmente modificato dall'evoluzione geodinamica pre-quadernaria.

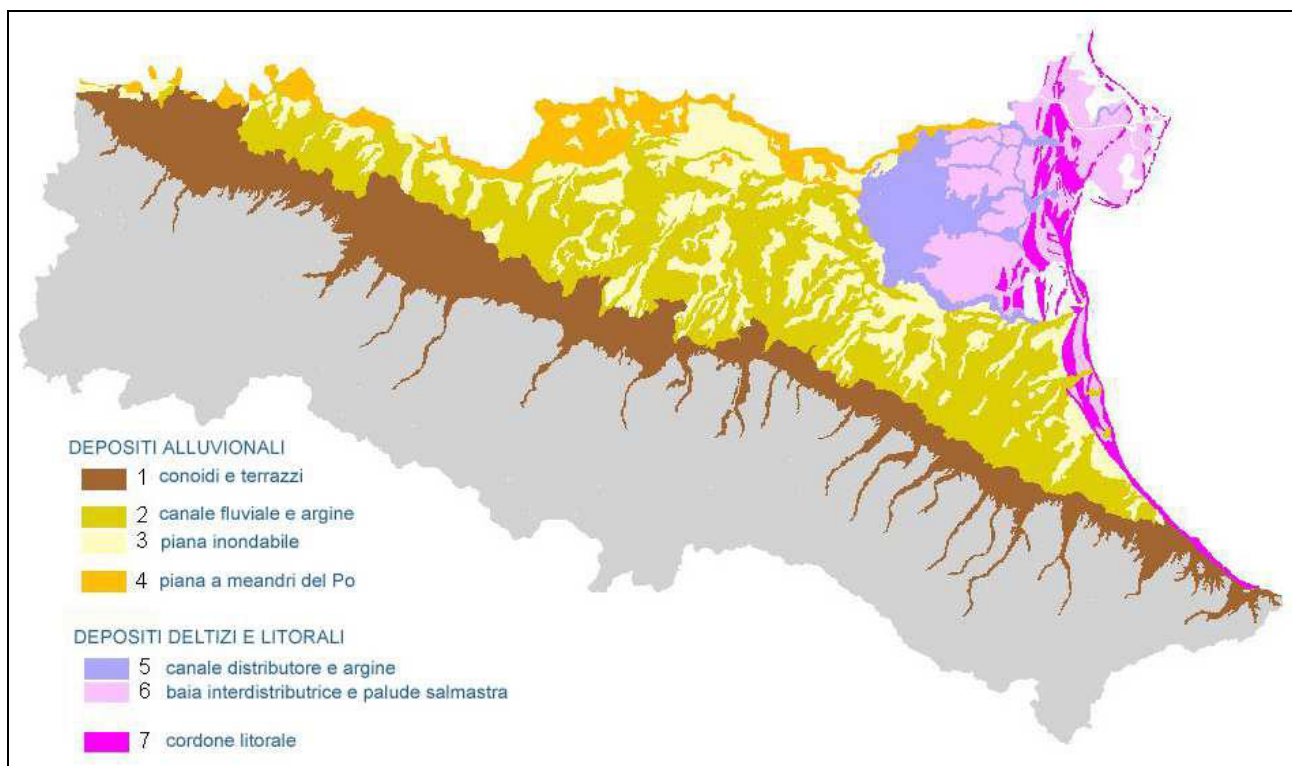
I molteplici cambiamenti dell'assetto tettonico del bacino, il deposito di sedimenti derivanti dalle intense attività fluviali quadernarie che hanno fatto seguito all'ultima glaciazione del Würm, ed infine l'intenso intervento antropico, hanno contribuito a definire le attuali caratteristiche e la conformazione odierna della pianura padana.



## 2.3 Litologia

Come si evince dalla seguente figura (Carta del paesaggio geologico, estrapolata dal sito del portale cartografico della Regione Emilia-Romagna), nelle aree più ad Est della pianura padana, in parte interessate dal tracciato della Romea, in prossimità del litorale ferrarese, affiorano depositi deltizi, legati all'attività del Fiume Po, e sono inoltre presenti cordoni litorali lungo la fascia costiera, legati all'azione e modellamento delle correnti marine.

Quindi, le aree attraversate dal tracciato di interesse della Romea, dal punto di vista geologico e litologico, sono caratterizzate dall'interazione e coalescenza dei depositi deltizi più recenti del Fiume Po con il contesto marino.

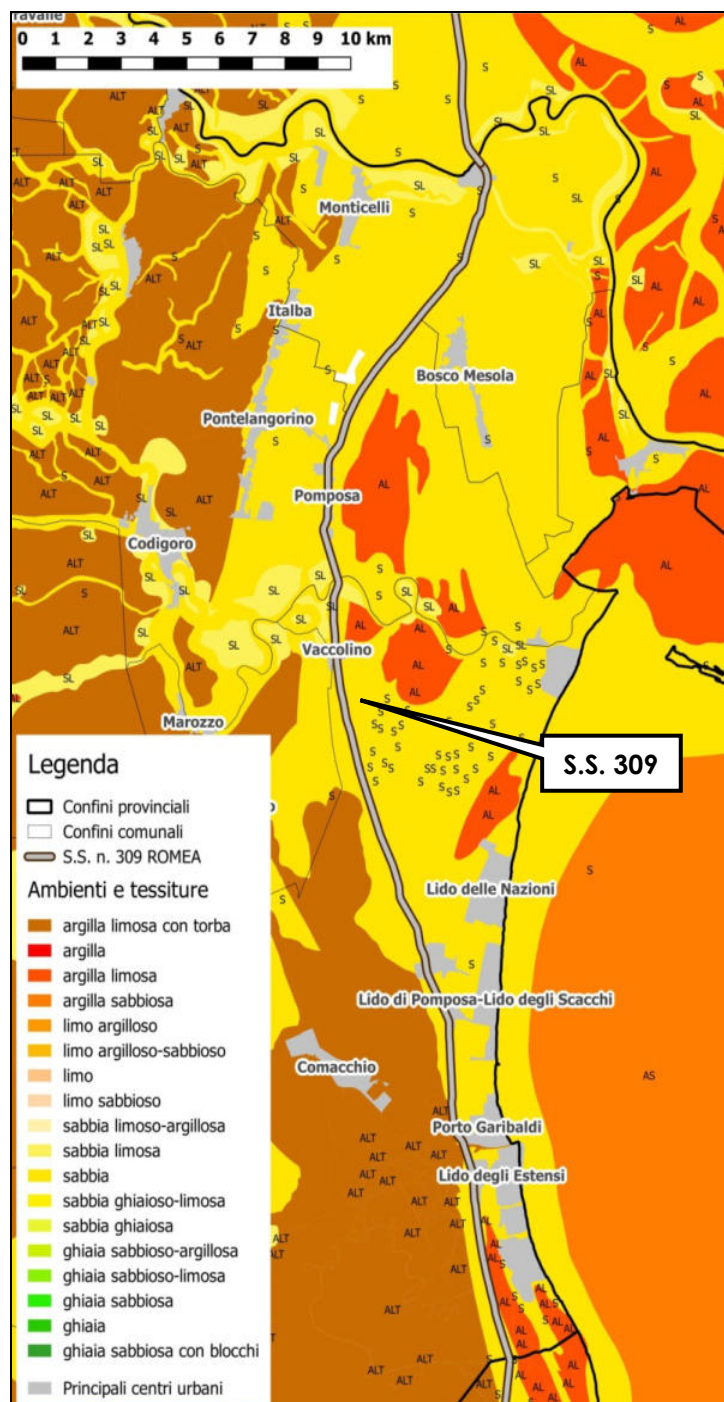


**Figura 3** – Carta del paesaggio geologico dell'Emilia Romagna (fonte: geoportale Emilia-Romagna)

La cartografia riportata di seguito, deriva invece dall'elaborazione dello *shapefile* relativo al tematismo degli ambienti deposizionali e tessiture dei sedimenti, liberamente scaricabile dal suddetto geoportale dell'Emilia-Romagna.

Il sedime della S.S. n. 309 "Romea", relativo al tratto in oggetto, come detto in precedenza, interessa aree in prossimità della linea costiera del Mare Adriatico, soggette a dinamiche deposizionali recenti condizionate dalle divagazioni fluviali, in particolare del Fiume Po.

Dal punto di vista litologico il tracciato di interesse si stende su sedimenti affioranti caratterizzati da granulometrie da medio-fini a molto fini, di natura prevalentemente sabbiosa, con limitati intercalazioni di argille limose, talora torbose, affioranti in particolar modo nella porzione meridionale dell'area su cui si sviluppa il tracciato stradale.

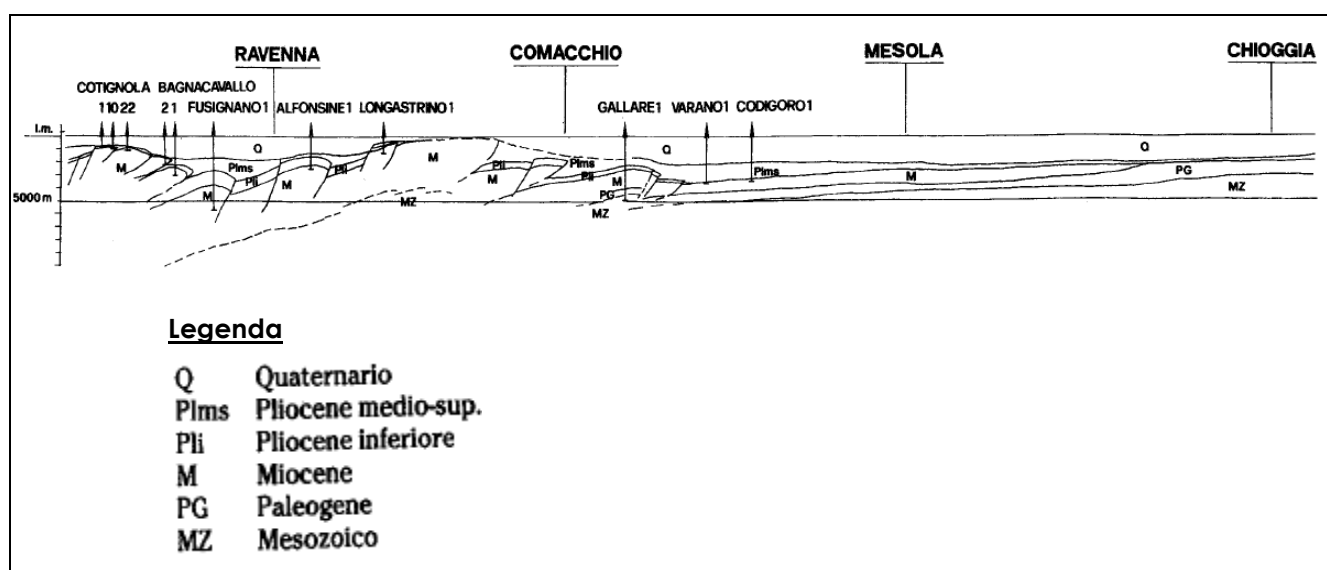


**Figura 4 – Carta delle tessiture dei sedimenti**

**S.S. 309 "Romea" – Interventi di razionalizzazione ed adeguamento delle intersezioni a raso lungo la S.S. 309**

**Il STRALCIO dal km 35+500 al km 55+100**

La sezione geologica della bassa pianura padana, di seguito riportata, interessa i territori di Comacchio e Mesola, e mette quindi in evidenza come tutto il tracciato della Romea interessato dagli interventi in oggetto, si appoggi su depositi recenti appartenenti cronologicamente al Quaternario, che possono presentare spessori fino a circa 2000 m, al di sotto dei quali si evidenzia il passaggio ai sedimenti litificati del Pliocene.



**Figura 5** – Sezione geologica della bassa pianura padana rappresentativa delle aree interessate dal tracciato

Le successioni verticali sono sicuramente molto variabili, con probabili alternanze e interdigitazioni di depositi di origine continentale, a composizione prevalente sabbiosa, limosa ed argillosa, testimoni dei processi di aggradazione e divagazione del delta fluviale del Po, e di depositi di origine marina, dovuti a fenomeni di ingressione.

I rapporti verticali e le variazioni laterali dei depositi di interesse, sono stati indagati mediante specifiche indagini geognostiche, eseguite localmente nell'ambito degli interventi in oggetto previsti lungo il tratto di interesse della Romea.



## 2.4 Aree depresse

Questa porzione di territorio di pianura, nell'entroterra ferrarese più vicino alla costa adriatica, si caratterizza inoltre per il fatto che una buona parte dell'estensione territoriale si trova, topograficamente, in posizione depressa, ovvero al di sotto del livello del medio mare, con ordini di grandezza pari a qualche metro.

In modo non dissimile rispetto ad altre zone dell'entroterra padano, molte di queste aree che in epoca passata risultavano periodicamente allagate, sono state oggetto di imponenti interventi di bonifica agraria, adottando opere di regimazione ed arginatura dei corsi d'acqua, conclusi nella seconda metà del 1900: tali interventi hanno quindi permesso un recupero agricolo importante di vaste aree del territorio in esame, regolarizzato da canali di scolo artificiali ed impiegando idrovore a sollevamento meccanico.

Si ritrovano tipici esempi locali di aree vallive costituenti zone umide di impaludamento, nelle vicinanze dell'area di studio. Tra queste si citano le Valli di Comacchio e la Valle Bertuzzi, poste rispettivamente appena a Sud e ad Est rispetto al tracciato interessato dagli interventi; inizialmente oggetto di ristagni di acqua dolce derivata dalle divagazioni e dalle rotte fluviali, successivamente sono state soggette ad infiltrazioni di acqua salata proveniente dal Mare Adriatico.

Queste zone vallive umide si sono formate in età medievale, per effetto combinato del fenomeno della subsidenza che interessa questa parte di territorio ed in generale tutta la fascia costiera nord-adriatica, nonché a causa della diminuzione degli apporti di sedimenti da parte dell'antico ramo principale del Po (Po di Volano); a seguito, infatti, di importanti rotte fluviali, già a partire dalla fine del medioevo, il corso idrico principale del Po si è progressivamente spostato nella posizione occupata dall'alveo attuale, con la conseguente riduzione delle portate del ramo del Po di Volano e diminuzione degli apporti sedimentari nelle aree di interesse.

Queste zone vallive sono state anch'esse sottoposte ad interventi di bonifica, che ne hanno stabilizzato e definito i confini attuali.

Tutto il tracciato della S.S. 309 Romea interessato dagli interventi in oggetto, risulta ubicato lungo porzioni di territorio con quote topografiche al di sotto del livello del medio mare.

## 2.5 Caratteristiche idrogeologiche

In generale, l'evoluzione naturale della struttura idrogeologica della pianura ferrarese è stata fortemente influenzata da fattori antropici e, in particolare, dagli emungimenti delle falde, spesso non regolamentati, che ne hanno provocato fenomeni di subsidenza e di ingressione del cuneo salino, andando spesso a compromettere la qualità delle acque sotterranee del territorio.

La caratteristica principale degli acquiferi ferraresi è rappresentata dalla presenza di acqua salmastra o salata per la presenza di sedimenti sabbiosi marini che passano senza soluzione di continuità a sedimenti fluviali-deltizi saturi in acqua dolce.

La superficie di contatto tra acqua dolce ed acqua salata è caratterizzata da un gradiente di salinità non stazionario e soggetto a fluttuazioni che corrispondono alle variazioni piezometriche proprie dei diversi acquiferi.

Il limite tra acqua dolce e salmastra definisce la base degli acquiferi utili per l'uso idropotabile e agricolo-industriale.

Il primo orizzonte di saturazione è comunque sempre piuttosto superficiale, con soggiacenze variabili all'incirca tra -0,5 ÷ -3,5 m da p.c., come desunto dalle indagini eseguite. Il livello freatico potrebbe comunque subire oscillazioni stagionali ed in rapporto all'intensità delle precipitazioni meteoriche.

## 2.6 Suoli

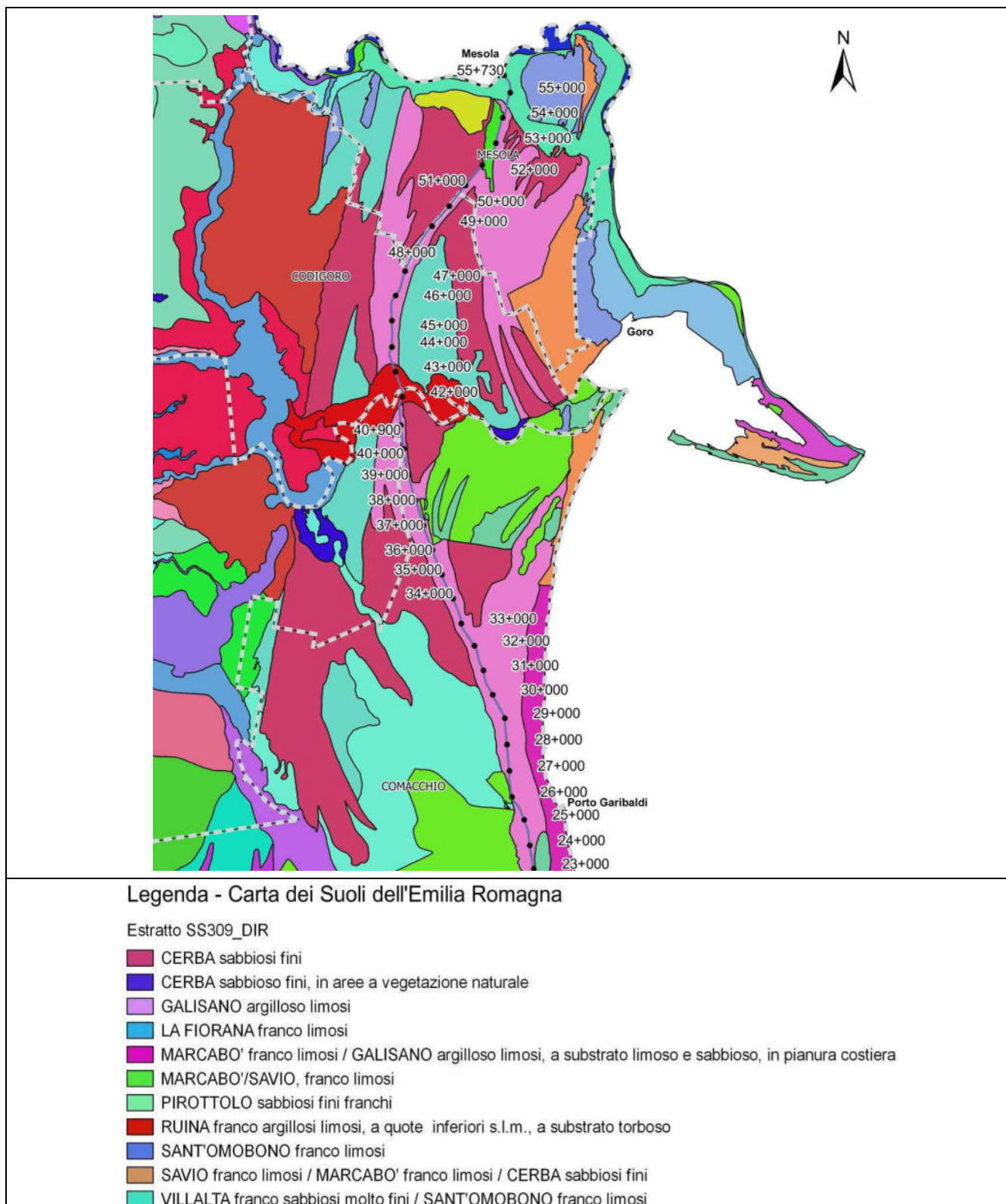
Il tratto della Statale interessato dal progetto si estende interamente nella provincia di Ferrara, tra i territori comunali di Comacchio, Codigoro e Mesola.

È stata condotta un'analisi geologica preliminare, basata sulla cartografia dei suoli prodotta dalla Regione con una campagna di rilievi e sondaggi che è iniziata negli anni '80 del secolo scorso. L'indagine è stata estesa tuttavia a profondità che interessano all'incirca lo strato pedologico del terreno e quindi con un limite alla conoscenza degli strati più profondi. Non è quindi possibile escludere a priori l'esistenza in profondità di strati di natura diversa e con maggiore comprimibilità, non consolidatisi in relazione all'età deposizionale. Con la ricognizione documentale eseguita, sono stati comunque individuati anche "complessi di suoli" con caratteristiche geo-litologiche omogenee, che raggruppano in categorie più gestibili le caratteristiche geo-meccaniche dei primi strati del suolo localmente molto variabili. È stata così possibile considerare una categorizzazione degli stessi che rende possibile descriverne qualitativamente il comportamento sotto carico. In questo senso, tale cartografia ben si presta alla valutazione delle caratteristiche principali dei terreni che interessano l'infrastruttura oggetto d'indagine, nonché gli ambiti che possono essere interessati dalla realizzazione delle opere attraverso le quali si possono risolvere alcune delle criticità funzionali rilevate.

Si osserva, innanzitutto, che la stratificazione geologica su cui poggiano sia l'attuale tracciato della SS 309, è caratterizzata da suoli di tipo a matrice eminentemente sabbiosa, intrusione di terreni franco sabbiosi nella zona centrale e di tipo franco - argilloso a nord.

Tra le chilometriche 23+000 e 52+00 circa, la S.S. 309 si trova su suoli della consociazione Galisano, argilloso limosi sono molto profondi, molto calcarei e moderatamente alcalini; leggermente salini ed a tessitura argillosa limosa nella parte superiore, da leggermente a moderatamente salini ed a tessitura argillosa limosa o argillosa in quella inferiore.

Il substrato è costituito da alluvioni a tessitura fine. I suoli Galisano argilloso limosi sono in depressioni morfologiche della pianura alluvionale, fino al più recente passato per buona parte occupate da acque palustri, prosciugate con opere di bonifica idraulica nel corso dei vari secoli. In queste terre la pendenza varia da 0.01 a 0.1%.



**Figura 6** – Legenda ed estratto della Carta dei Suoli della Regione Emilia Romagna nell'ambito relativo al tracciato della S.S. 309 tra Comacchio e Mesola

Tra le chilometriche 42+000 e 43+000 circa, all'interno della precedente classificazione, la S.S. 309 si trova su suoli della consociazione Ruina, franco argilloso limosi, a quote topografiche, inferiori al livello del mare, a substrato argilloso e torboso.

Questi suoli sono pianeggianti, con pendenza che varia tipicamente da 0,05 a 0,1%; molto profondi, su alluvioni a tessitura media e fine; a moderata disponibilità di ossigeno. Tipicamente sono molto calcarei e moderatamente alcalini fino ad oltre un metro e mezzo di profondità. Hanno orizzonti superficiali, spessi circa 50 cm, a tessitura franca argillosa limosa o franca limosa; gli orizzonti profondi, spessi circa 25 cm, sono a tessitura franca argillosa limosa o franca limosa; il substrato è costituito da sottili stratificazioni franco limose ed argilloso limose.

Tra le chilometriche 52+000 e 54+100, sono presenti suoli del complesso denominato Maracabò/Savio, sono molto profondi, massivi, se umidi, ma incoerenti da secchi o bagnati. Generalmente sono saturi d'acqua in certi periodi dell'anno, molto calcarei, moderatamente alcalini, di tessitura da franco-limosa a franca, con salinità da assente a leggera nella parte superiore, da assente a moderata in quella inferiore. Lo scheletro è costituito da sedimenti marini a tessitura grossolana. I suoli SAVIO franco-limosi si trovano nella pianura costiera, in ambiente di piana di fango a cordoni, su depositi di modesto spessore dovuti a processi fluviali successivi ai processi marini tipici di questo ambiente. In queste terre la pendenza è inferiore allo 0,2%.

Tra le chilometriche 54+100 e 55+730 circa, ovvero sino al confine settentrionale del comune di Mesola, la SS309 si snoda su suoli denominati Pirottolo, di tessitura sabbiosa fine franca o franco-sabbiosa fine, molto profondi, da molto scarsamente a moderatamente calcarei con pH variabile da neutro a moderatamente alcalino; da non salini a moderatamente salini.

Il substrato è costituito da sedimenti marini a tessitura grossolana. Si trovano nella pianura costiera, in depressioni interdunali, con pendenze variabili da 0,05 a 0,1%.

In sintesi, la litologia dei suoli può definirsi tipica delle zone peri-lagunari, e a ridosso del mare, ove si depositano le frazioni fini dei sedimenti fluviali che si rimescolano con quelli marini nel corso dell'evoluzione del limite costiero.

Le intrusioni di tipo franco limoso ed argilloso trovano invece spiegazione nel processo di divagazione del delta fluviale del Po, che ha lasciato tracce di sedimenti molto fini in corrispondenza di alvei successivamente abbandonati dal fiume.

In particolare, in quest'ambito, non si può escludere la presenza di strati comprimibili non ancora consolidati in profondità, in relazione al periodo di deposizione relativamente recente dei sedimenti che hanno formato questa zona della pianura padana.

Nel complesso, come evidenziato nelle descrizioni puntuali dei terreni, il tracciato della SS 309 nel comparto settentrionale si sviluppa però sopra suoli di matrice eminentemente sabbiosa, con modesti tratti ove sono presenti tessiture più fini e quindi suoli di tipo franco-limoso e franco-argilloso. In queste aree l'attenzione alle caratteristiche geologiche dei suoli dovrà essere maggiore che altrove.



### 3 RELAZIONE GEOTECNICA

Al fine di definire le caratteristiche geotecniche e sismiche dei terreni interessati dagli interventi previsti lungo il tracciato in oggetto della strada "Romea", sono state eseguite le seguenti prove geognostiche e sismiche:

- n. 38 prove penetrometriche statiche con piezocono (prove CPTu);
- n. 2 sondaggi geognostici con realizzazione di n. 6 prove SPT in foro;
- n. 32 prove di geofisica MASW.

Si tenga presente che la modellazione geologica, geotecnica e della categoria di sottosuolo, è stata eseguita solamente considerando le indagini afferenti l'ambito dei siti di intervento previsti in questa fase del progetto (cfr. successivo capitolo 4).

#### 3.1 Prove penetrometriche CPTu

Nel tratto tra le progressive chilometriche Km 24+900 a Km 32+300, sono state eseguite **n. 11 prove dalla ditta GIA Exploring S.r.l.**, mentre nel tratto tra Km 33+100 e Km 55+100, sono state eseguite **n. 27 prove dall'Istituto Prove Geotecniche I.P.G. s.n.c.**

Entrambe le ditte, hanno condotto le prove utilizzando un penetrometro statico Pagani, a comando idraulico, con spinta massima nominale di 200 KN, tramite infissione nel terreno della punta elettrica TECNOPENTA CPL2IN, dotata di sensore per la misura delle pressioni interstiziali (piezocono); le caratteristiche tecniche principali sono di seguito elencate:

- diametro punta conica meccanica  $\varnothing = 35,7$  mm;
- angolo di apertura punta =  $60^\circ$ ;
- area punta = 10 cm<sup>2</sup>;
- superficie manicotto per lettura attrito laterale = 150 cm<sup>2</sup>.

La punta viene infissa nel terreno ad una velocità di circa 2 cm/sec, e grazie a sensori elettrici collegati tramite cavo ad una unità di acquisizione digitale posta in superficie, si può verificare in tempo reale il comportamento della strumentazione, tramite la lettura ed acquisizione dei seguenti parametri principali, con passo di avanzamento pari a 2 cm:

- resistenza alla punta ( $q_c$ ), in MPa;
- attrito sul manicotto laterale ( $f_s$ ), in kPa;
- pressione interstiziale dei pori ( $u_2$ ), in kPa;
- deviazione dalla verticale di infissione - Tilt ( $^\circ$ ).

Le tabelle seguenti riportano le coordinate delle prove eseguite rispettivamente da GIA Exploring S.r.l. (n. 11 prove) e I.P.G. s.n.c. (n. 27 prove):

| N. | NOME PROVA          | LATITUDINE<br>WGS 84 | LONGITUDINE<br>WGS 84 |
|----|---------------------|----------------------|-----------------------|
| 1  | CPTu 1 (Km 24+900)  | 44.673553            | 12.228500             |
| 2  | CPTu 2 (Km 24+900)  | 44.673975            | 12.228314             |
| 3  | CPTu 3 (Km 25+300)  | 44.677778            | 12.226197             |
| 4  | CPTu 4 (Km 25+300)  | 44.678086            | 12.226064             |
| 5  | CPTu 5 (Km 26+000)  | 44.680397            | 12.224006             |
| 6  | CPTu 6 (Km 27+300)  | 44.691642            | 12.222733             |
| 7  | CPTu 7 (Km 28+200)  | 44.700217            | 12.222828             |
| 8  | CPTu 8 (Km 29+200)  | 44.708864            | 12.221569             |
| 9  | CPTu 9 (Km 31+000)  | 44.724103            | 12.212225             |
| 10 | CPTu 10 (Km 31+000) | 44.724294            | 12.212892             |
| 11 | CPTu 11 (Km 32+300) | 44.735267            | 12.206547             |

**Tabella 1** – Elenco prove CPTu eseguite dalla ditta GIA Exploring S.r.l.

| N. | NOME PROVA         | LATITUDINE<br>WGS 84 | LONGITUDINE<br>WGS 84 |
|----|--------------------|----------------------|-----------------------|
| 1  | CPTu Km 33+100     | 44.741212            | 12.202932             |
| 2  | CPTu Km 33+500     | 44.744605            | 12.201383             |
| 3  | CPTu Km 35+500     | 44.761497            | 12.192237             |
| 4  | CPTu Km 36+000     | 44.765533            | 12.190320             |
| 5  | CPTu Km 36+500     | 44.769812            | 12.188580             |
| 6  | CPTu Km 39+600     | 44.797144            | 12.179360             |
| 7  | CPTu Km 40+300     | 44.803166            | 12.178438             |
| 8  | CPTu Km 42+400     | 44.823080            | 12.178416             |
| 9  | CPTu Km 42+600     | 44.823130            | 12.177701             |
| 10 | CPTu Km 42+900     | 44.825905            | 12.176451             |
| 11 | CPTu Km 43+900     | 44.834212            | 12.174646             |
| 12 | CPTu Km 44+300     | 44.837674            | 12.175420             |
| 13 | CPTu Km 45+900     | 44.852193            | 12.177099             |
| 14 | CPTu Km 48+100     | 44.869980            | 12.189944             |
| 15 | CPTu Km 48+400     | 44.871585            | 12.191658             |
| 16 | CPTu Km 48+800     | 44.873898            | 12.194575             |
| 17 | CPTu Km 49+200     | 44.877258            | 12.198120             |
| 18 | CPTu Km 50+500     | 44.887163            | 12.210513             |
| 19 | CPTu Km 50+700     | 44.887298            | 12.211225             |
| 20 | CPTu Km 52+600     | 44.899758            | 12.226448             |
| 21 | CPTu Km 52+800     | 44.900677            | 12.227736             |
| 22 | CPTu Km 53+900     | 44.910607            | 12.231981             |
| 23 | CPTu Km 54+000     | 44.912587            | 12.232972             |
| 24 | CPTu Km 54+500     | 44.915326            | 12.234709             |
| 25 | CPTu Km 54+600     | 44.915892            | 12.234530             |
| 26 | CPTu Km 54+600_BIS | 44.915897            | 12.234774             |
| 27 | CPTu Km 55+100     | 44.920900            | 12.236488             |

**Tabella 2** – Elenco prove CPTu eseguite dalla ditta I.P.G. s.n.c.



Delle indagini penetrometriche sopra elencate, in questa fase del progetto si prendono in considerazione solamente quelle relative alle aree di intervento in oggetto, come indicato nella tabella seguente, dove per ciascun intervento, sono riportate le rispettive indagini CPTu ad esso associate (i numeri si riferiscono alla numerazione progressiva resa nelle Tabelle 1 e 2, sopra riportate).

| Intervento n. | Denominazione intervento                                    | Progressiva km | Comune    | Indagini CPTu GIA Explor. | Indagini CPTu I.P.G. |
|---------------|---|----------------|-----------|---------------------------|----------------------|
| 6             | Intersezione via Dante Alighieri                            | 24+300         | Comacchio | -                         | -                    |
| 7             | Corsia di decelerazione di via Cagliari                     | 24+900         | Comacchio | 1, 2                      | -                    |
| 8             | Corsia di decelerazione via Acciaioli                       | 25+300         | Comacchio | 3, 4                      | -                    |
| 11            | Rotatoria via Delle Arti                                    | 31+000         | Comacchio | 9, 10                     | -                    |
| <b>14</b>     | Intersezione canalizzata strada Lagosanto – via Valli Basse | 35+500         | Comacchio | -                         | 3                    |
| <b>15</b>     | Intersezione canalizzata SP 55 Lagosanto – Rotta Zambusi    | 36+000         | Comacchio | -                         | 4, 5                 |
| <b>16</b>     | Rotatoria intersezione SP21 Vaccolino                       | 40+000         | Comacchio | -                         | 6, 7                 |
| <b>17</b>     | Rotatoria intersezione località Diavolo e SP 54 Volano      | 42+600         | Codigoro  | -                         | 8, 9                 |
| 18            | Rotatoria Via della Cooperazione                            | 45+900         | Codigoro  | -                         | 13                   |
| 19            | Rotatoria via delle Riforme – SP 27 "Romea Goro Cristina"   | 50+700         | Mesola    | -                         | 18, 19               |
| 20            | Intersezione via Dell'artigianato                           | 51+300         | Mesola    | -                         | -                    |
| 21            | Intersezione SP 51 nuova Corriera                           | 52+800         | Mesola    | -                         | 20, 21               |
| <b>22</b>     | Intersezione via Motte SP11                                 | 54+000         | Mesola    | -                         | 23                   |
| <b>23</b>     | Rotatoria intersezione via Garibaldi                        | 54+500         | Mesola    | -                         | 24, 25, 26           |
| <b>24</b>     | Chiusura accesso via Vinicio Migliorini                     | 54+900         | Mesola    | -                         | -                    |
| <b>25</b>     | Intersezione via XXV Aprile                                 | 55+100         | Mesola    | -                         | 27                   |

**Tabella 3** – Elenco degli interventi previsti e le relative indagini CPTu associate

Gli interventi 6-7-8-11-18-19-20-21 fanno parte del I STRALCIO, mentre gli interventi **14, 15, 16, 17, 22, 23, 24 e 25** fanno parte del **II STRALCIO** oggetto del presente progetto definitivo.

### 3.2 Sondaggi geognostici e prove SPT

In prossimità della progressiva 50+700 (intervento n. 19), sono stati realizzati **n. 2 sondaggi geognostici a carotaggio continuo, dalla ditta I.P.G. s.n.c..**

I due sondaggi sono stati spinti entrambi fino a -20 m di profondità dal p.c., e all'interno dei rispettivi perfori sono state realizzate n. 3 prove geognostiche SPT per ciascun sondaggio, per un totale di n. 6 prove SPT. Sono stati inoltre prelevati n. 6 campioni rimaneggiati.

I sondaggi sono stati realizzati entrambi con una sonda CMV MK-600 potenziata, utilizzando un diametro di perforazione in avanzamento pari a  $\varnothing = 101$  mm; le prove SPT sono state eseguite secondo le modalità standard dell'A.G.I. (Associazione Geotecnica Italiana).

La prova SPT si effettua facendo penetrare nel terreno, a percussione, una punta aperta di tipo Raymond, montata all'estremità di una batteria di aste cave, attraverso una massa battente di peso e altezza di caduta standardizzate.

La prova SPT consiste nel rilevare il numero di colpi (rispettivamente N1, N2 e N3) necessari per infiggere la punta per tre tratti successivi di 15 cm ciascuno.

La resistenza alla penetrazione è caratterizzata dal numero di colpi richiesti per l'attraversamento degli ultimi due tratti, per complessivi 30 cm ( $N_{SPT} = N2 + N3$ ). Il dispositivo di infissione è costituito da un maglio del peso di 63,5 Kg, che cade liberamente da un'altezza di 76 cm.

La prova penetrometrica dinamica viene interrotta in presenza di una delle seguenti condizioni (rifiuto):

$$N1 > 50 \text{ colpi}$$

$$N2 + N3 > 100 \text{ colpi}$$

Il numero di colpi ottenuto per infiggere il campionatore ( $N_{SPT}$ ) permette di valutare lo stato di addensamento e/o la consistenza dei depositi attraversati dal sondaggio e, quindi, mediante le opportune correlazioni esistenti, di caratterizzare geotecnicamente gli stessi.

La valutazione dei parametri geotecnici può essere affinata attraverso la normalizzazione dei risultati della prova con l'introduzione di fattori correttivi che tengono conto della pressione efficace del terreno sovrastante, del dispositivo utilizzato per la prova, della lunghezza del dispositivo di prova e delle caratteristiche del foro e del campionatore. L'insieme di questi fattori concorre a determinare il valore dell'effettiva energia trasmessa dal maglio al campionatore e, pertanto, l'esito della prova stessa; assumendo un

rendimento energetico medio dei macchinari pari al 60% e normalizzando i dati ottenuti ad un rapporto energetico standard del 60% si ricavano i valori denominati  $N'_{SPT60}$ .

Si riportano di seguito le tabelle relative ai sondaggi effettuati e alle prove SPT, con indicati i rispettivi valori del parametro  $N_{SPT}$ , corrispondente al numero di colpi rilevati dato dalla somma di  $N_2 + N_3$ .

| N. | NOME SONDAGGIO | LATITUDINE<br>WGS 84 | LONGITUDINE<br>WGS 84 |
|----|----------------|----------------------|-----------------------|
| 1  | S1             | 44.887144            | 12.210753             |
| 2  | S2             | 44.887267            | 12.211199             |

**Tabella 4** – Elenco sondaggi geognostici eseguiti dalla ditta I.P.G. s.n.c.

| SONDAGGIO | N. SPT | PROFONDITA'<br>(m da p.c.) | $N_{SPT}$ |
|-----------|--------|----------------------------|-----------|
| S1        | SPT 1  | 5,0                        | 8         |
|           | SPT 2  | 10,5                       | 25        |
|           | SPT 3  | 15,0                       | 8         |
| S2        | SPT 1  | 4,5                        | 12        |
|           | SPT 2  | 9,0                        | 2         |
|           | SPT 3  | 15,0                       | 12        |

**Tabella 5** – Elenco prove SPT eseguite nei fori di sondaggio dalla ditta I.P.G. s.n.c. e numero di colpi rilevato

### 3.3 Prove di geofisica MASW

Nel tratto tra le progressive chilometriche Km 24+900 a Km 32+300, sono state eseguite **n. 8 prove MASW dalla ditta GIA Exploring S.r.l.**, mentre nel tratto tra Km 33+100 e Km 55+100, sono state eseguite **n. 24 prove MASW dall'Istituto Prove Geotecniche I.P.G. s.n.c.**

Le prove MASW (*Multichannel Analysis of Surface Waves*) consistono in stendimenti geofonici per ottenere una prospezione sismica di superficie. Tale metodologia è una tecnica di indagine indiretta del sottosuolo, finalizzata ad individuare quindi il profilo di velocità delle onde di taglio verticali  $V_s$ , basandosi sulla misura delle onde superficiali fatta in corrispondenza di diversi geofoni, ovvero sensori posizionati ad intervalli regolari lungo uno stendimento sulla superficie.

Le onde di Rayleigh forniscono il contributo maggiore alle onde superficiali; tali onde viaggiano nel sottosuolo con una velocità che varia in funzione della rigidità e del grado di addensamento del terreno interessato dalla propagazione delle onde.

La proprietà fondamentale delle onde superficiali di Rayleigh è definita dalla loro natura dispersiva, che si manifesta quando esse si propagano in mezzi stratificati. Su tale proprietà si basa l'analisi per la determinazione delle velocità delle onde di taglio verticali  $V_s$ .

Nel caso in esame sono state adottate le seguenti configurazioni:

- per le n. 8 acquisizioni realizzate da **GIA Exploring S.r.l.**, la metodologia MASW utilizzata è stata di tipo "attivo" con una energizzazione manuale del segnale sismico, generata con mazza battente su una piastra di alluminio su un punto del suolo, e misurata da n. 24 geofoni verticali GS11D con frequenza di oscillazione pari a 4,5 Hz, interspaziati di 2 m, collegati ad un sismografo multicanale SARA DoReMi.
- per le n. 24 acquisizioni realizzate da **I.P.G. s.n.c.**, la metodologia MASW utilizzata è stata di tipo "attivo" con una energizzazione manuale del segnale sismico, generata su un punto del suolo e misurata da n. 12 geofoni verticali con frequenza di oscillazione pari a 4,5 Hz, interspaziati di 5 m, collegati ad un sismografo multicanale AMBROGEO mod. Echo 24/2002 Seismic UNIT.

Le tabelle seguenti riportano le ubicazioni delle indagini. Per gli stendimenti MASW realizzati da GIA Exploring S.r.l. (n. 8 prove), la ditta ha reso disponibili le coordinate dei punti di inizio e fine degli stendimenti (ovvero corrispondenti ai geofoni n. 1 e n. 24).

| N. | GEOFONO | LATITUDINE | LONGITUDINE |
|----|---------|------------|-------------|
| 1  | 1       | 44,6733667 | 12,228381   |
|    | 24      | 44,6737889 | 12,228036   |
| 2  | 1       | 44,6784083 | 12,225200   |
|    | 24      | 44,6780722 | 12,225731   |
| 3  | 1       | 44,6804917 | 12,223953   |
|    | 24      | 44,6799944 | 12,224061   |
| 4  | 1       | 44,6915556 | 12,223069   |
|    | 24      | 44,6920472 | 12,223028   |
| 5  | 1       | 44,6995472 | 12,222500   |
|    | 24      | 44,7000472 | 12,222467   |
| 6  | 1       | 44,7087361 | 12,221433   |
|    | 24      | 44,7092278 | 12,221294   |
| 7  | 1       | 44,7238417 | 12,212703   |
|    | 24      | 44,7233500 | 12,212850   |
| 8  | 1       | 44,7352750 | 12,206575   |
|    | 24      | 44,7347917 | 12,206769   |

**Tabella 6** – Elenco prove MASW eseguite dalla ditta GIA Exploring S.r.l.

Per gli stendimenti realizzati da I.P.G. s.n.c. (n. 24 prove), le uniche indicazioni sull'ubicazione rese disponibili dalla ditta sono le rispettive progressive chilometriche di riferimento.

| N. MASW | PROGRESSIVA CHILOMETRICA |
|---------|--------------------------|
| 1       | 33+100                   |
| 2       | 33+500                   |
| 3       | 35+500                   |
| 4       | 36+00                    |
| 5       | 36+500                   |
| 6       | 39+600                   |
| 7       | 40+000                   |
| 8       | 40+300                   |
| 9       | 42+500                   |
| 10      | 42+900                   |
| 11      | 43+900                   |
| 12      | 44+300                   |
| 13      | 45+500                   |
| 14      | 45+900                   |
| 15      | 48+100                   |
| 16      | 48+400                   |
| 17      | 48+800                   |
| 18      | 49+200                   |
| 19      | 50+700                   |
| 20      | 52+700                   |
| 21      | 54+100                   |
| 22      | 54+500                   |
| 23      | 55+100                   |
| 24      | 55+500                   |

**Tabella 7** – Elenco prove MASW eseguite dalla ditta I.P.G. s.n.c.

Delle indagini geofisiche sopra elencate, in questa fase del progetto si prendono in considerazione solamente quelle relative alle aree di intervento in oggetto, come indicato nella tabella seguente, dove per ciascun intervento, sono riportate le rispettive indagini MASW ad esso associate (i numeri si riferiscono alla numerazione progressiva resa nelle Tabelle 6 e 7, sopra riportate).

| Intervento n. | Denominazione intervento                                    | Progressiva km | Comune    | Indagini MASW GIA Explor. | Indagini MASW I.P.G. |
|---------------|---|----------------|-----------|---------------------------|----------------------|
| 6             | Intersezione via Dante Alighieri                            | 24+300         | Comacchio | -                         | -                    |
| 7             | Corsia di decelerazione di via Cagliari                     | 24+900         | Comacchio | 1                         | -                    |
| 8             | Corsia di decelerazione via Acciaioli                       | 25+300         | Comacchio | 2                         | -                    |
| 11            | Rotatoria via Delle Arti                                    | 31+000         | Comacchio | 7                         | -                    |
| 14            | Intersezione canalizzata strada Lagosanto – via Valli Basse | 35+500         | Comacchio | -                         | 3                    |
| 15            | Intersezione canalizzata SP 55 Lagosanto – Rotta Zambusi    | 36+000         | Comacchio | -                         | 4, 5                 |
| 16            | Rotatoria intersezione SP21 Vaccolino                       | 40+000         | Comacchio | -                         | 6, 7, 8              |
| 17            | Rotatoria intersezione località Diavolo e SP 54 Volano      | 42+600         | Codigoro  | -                         | 9                    |
| 18            | Rotatoria Via della Cooperazione                            | 45+900         | Codigoro  | -                         | 13, 14               |
| 19            | Rotatoria via delle Riforme – SP 27 "Romea Goro Cristina"   | 50+700         | Mesola    | -                         | 19                   |
| 20            | Intersezione via Dell'artigianato                           | 51+300         | Mesola    | -                         | -                    |
| 21            | Intersezione SP 51 nuova Corriera                           | 52+800         | Mesola    | -                         | 20                   |
| 22            | Intersezione via Motte SP11                                 | 54+000         | Mesola    | -                         | 21                   |
| 23            | Rotatoria intersezione via Garibaldi                        | 54+500         | Mesola    | -                         | 22                   |
| 24            | Chiusura accesso via Vinicio Migliorini                     | 54+900         | Mesola    | -                         | -                    |
| 25            | Intersezione via XXV Aprile                                 | 55+100         | Mesola    | -                         | 23                   |

**Tabella 8** – Elenco degli interventi previsti e le relative indagini MASW associate

Gli interventi 6-7-8-11-18-19-20-21 fanno parte del I STRALCIO, mentre gli interventi **14, 15, 16, 17, 22, 23, 24 e 25** fanno parte del II STRALCIO oggetto del presente progetto definitivo.

## 4 ESITI DELLE INDAGINI NELL'AMBITO DEGLI INTERVENTI IN PROGETTO

Nel presente capitolo vengono illustrate le interpretazioni dei dati raccolti nel corso delle indagini sopra descritte, per ciascuno dei siti di intervento previsti in questa fase del progetto.

Per ciascun sito di intervento, si riporta l'elenco delle indagini geognostiche e sismiche eseguite nell'area di riferimento e l'ubicazione delle indagini su ortofoto; viene inoltre proposto un modello geologico indicativo e rappresentativo delle litologie dell'area di indagine, oltre al relativo modello geotecnico, ottenuto dalle risultanze interpretate delle indagini. Il modello geotecnico rappresenta uno schema rappresentativo della parametrizzazione ottenuta dall'elaborazione dei dati raccolti durante le indagini, in cui sono riportate indicazioni sulle condizioni stratigrafiche e sulla caratterizzazione fisico-meccanica dei terreni.

La figura seguente riporta le ubicazioni dei **n. 16 interventi previsti nel I e nel II Stralcio, 8 dei quali da realizzare in questa fase del progetto definitivo denominato II STRALCIO, lungo il tratto di interesse della S.S. 309 "Romea" (dal Km 35+500 al Km 55+100)**, descritti nei successivi paragrafi. In *Allegato 1* a fine testo, è invece riportata una planimetria con ubicazione delle indagini eseguite lungo la tratta di interesse.

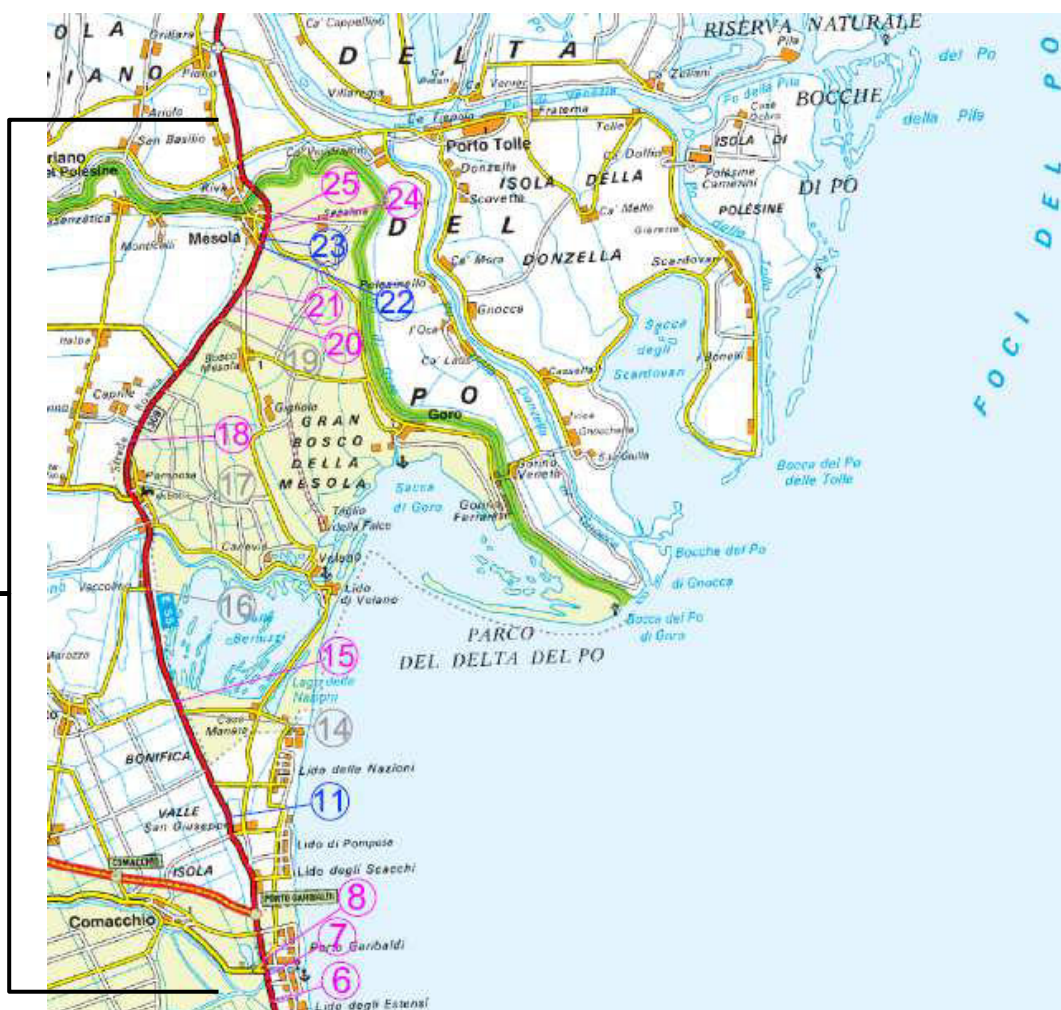
Gli interventi **14, 15, 16, 17, 22, 23, 24 e 25** fanno parte del **II STRALCIO** oggetto del presente progetto definitivo.



# INTERVENTI

DAL km 24+300

AL km 55+300



**Figura 7** – Interventi sulla S.S. 309 dal km 24+300 al km 55+300

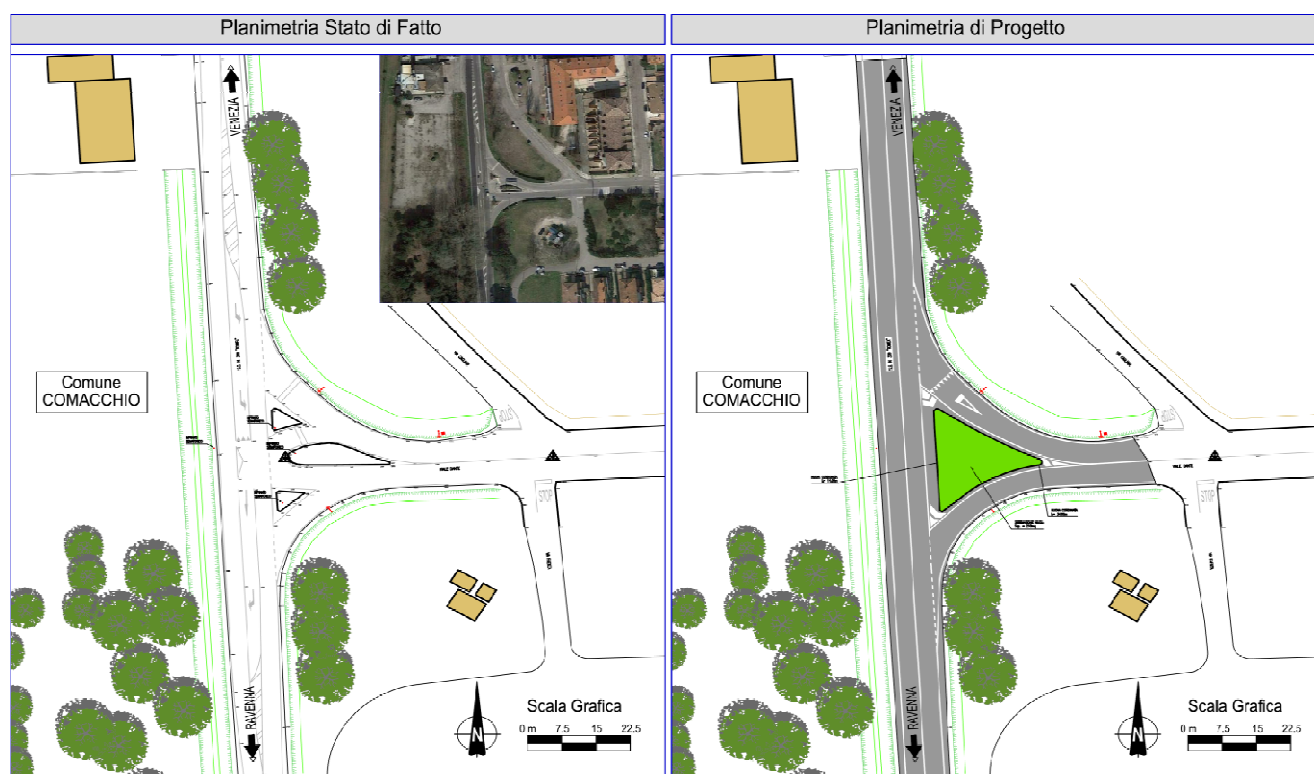


## 4.1 Intervento n. 6 – Intersezione S.C. D. Alighieri – Lido degli Estensi al km 24+300

L'intervento n. 6, sito in Comune di Comacchio, in località Lido degli Estensi all'intersezione fra la S.S. 309 e Via Dante, prevede l'adeguamento dell'intersezione a raso a T esistente eliminando le corsie di svolta a sinistra. Sulla carreggiata della S.S. 309 saranno eliminate la corsia specializzata di accumulo per la svolta a sinistra verso Viale Dante, e la corsia di immissione in uscita da Viale Dante, in direzione Ravenna. L'intersezione modificata avrà un solo ramo di ingresso, per i veicoli provenienti da Ravenna che svoltano su via Dante, ed un solo ramo di uscita per i veicoli che da Via Dante imbocciano la S.S. 309 in direzione Venezia.

Sarà ricostruita l'isola divisoria con una nuova cordonata, mantenendo i vertici delle aiuole spartitraffico esistenti, l'aiuola al suo interno sarà sistemata a verde.

Nell'area interessata all'intervento n. 6 non sono state realizzate prove geognostiche e sismiche.

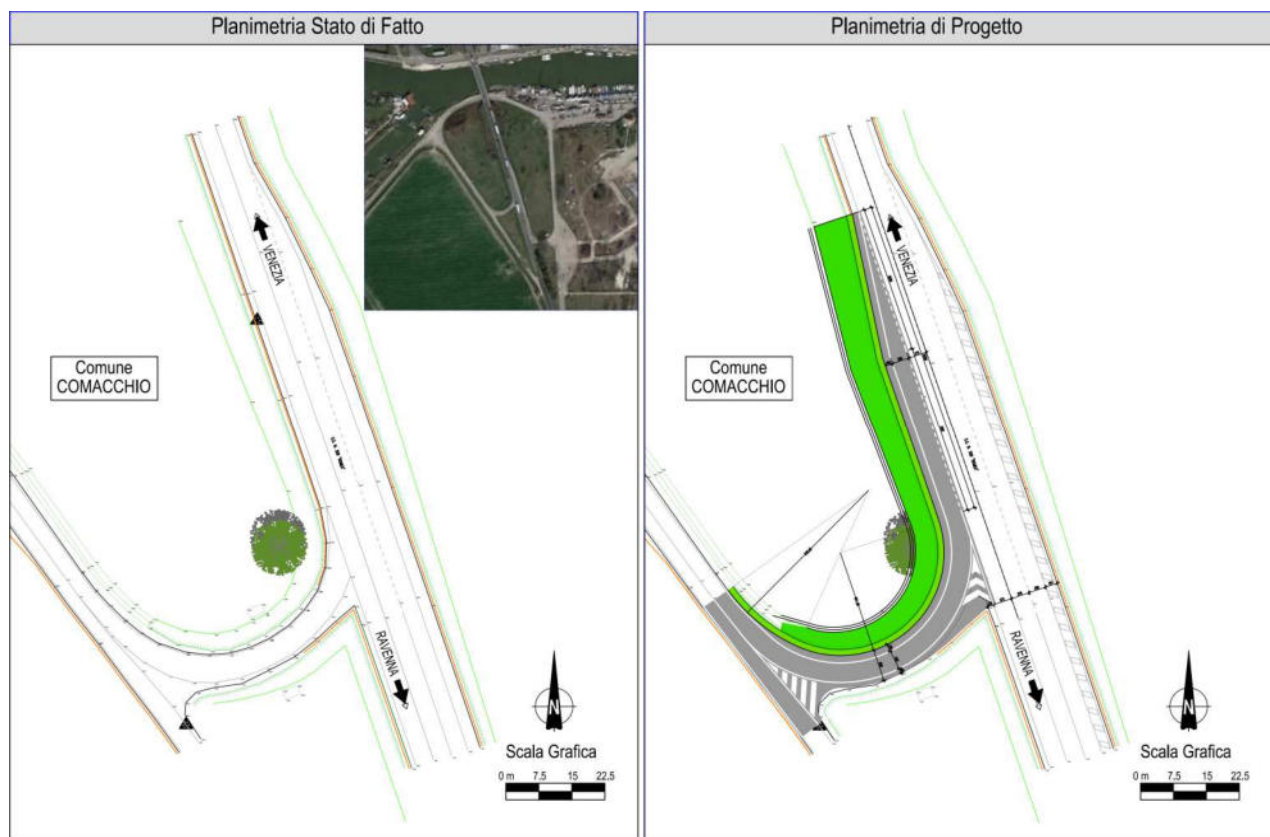


**Figura 8 – Intervento n. 6 – Planimetria Stato di Fatto e di Progetto**

## 4.2 Intervento n. 7 – Intersezione S.C. Cagliari al km 24+900

L'intervento n. 7, sito in Comune di Comacchio, in località Lido degli Estensi all'intersezione fra la S.S. 309 e Via Cagliari, prevede l'inserimento di una corsia specializzata di uscita dalla S.S. 309 in direzione Ravenna, per imboccare Via Cagliari.

L'intervento prevede di realizzare un nuovo tratto di rilevato in allargamento alla sede stradale esistente, di lunghezza pari a 85 m circa, per una larghezza massima inferiore a 3 m, che si raccorda al rilevato esistente.



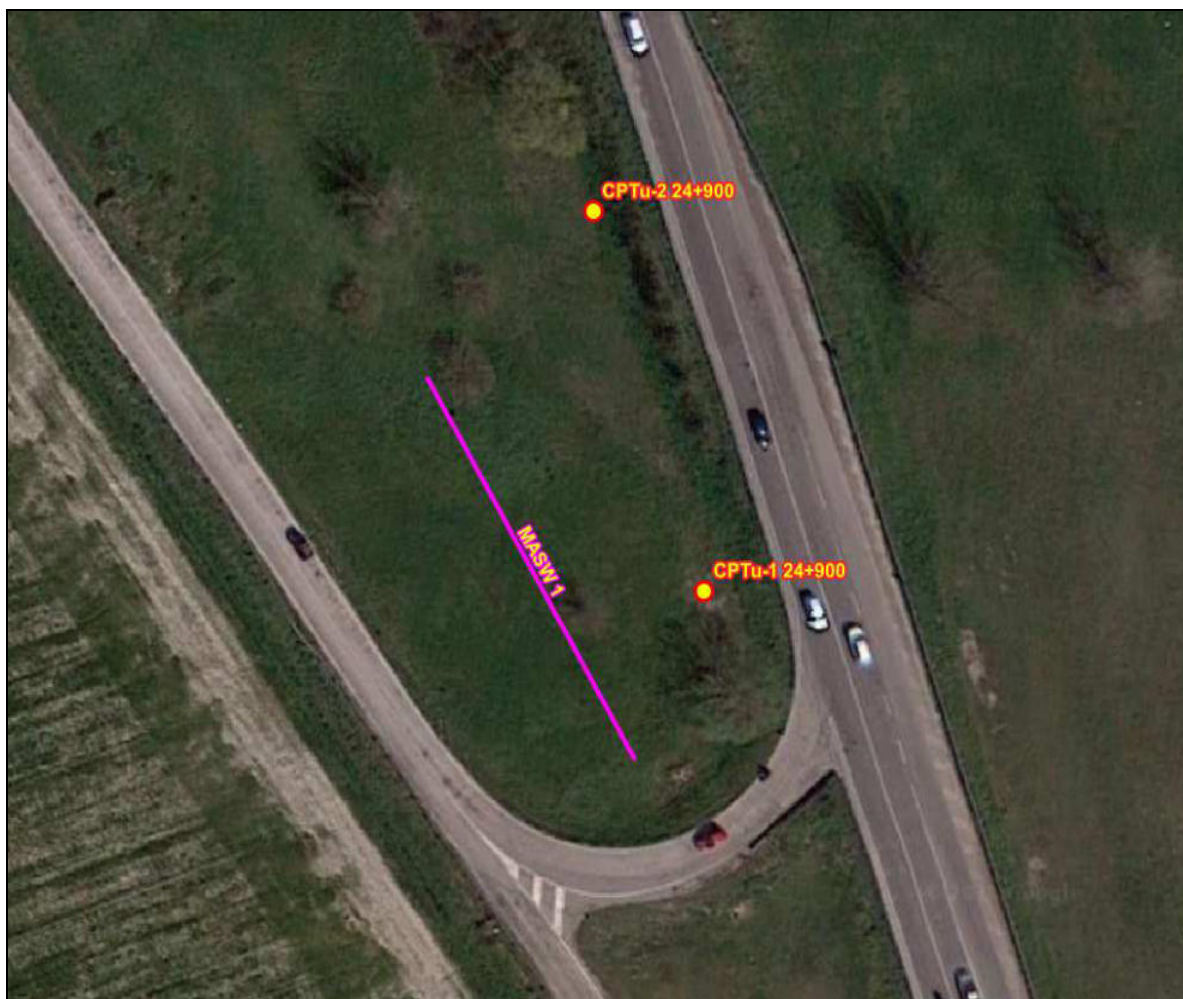
**Figura 9 – Intervento n. 7 – Planimetria Stato di Fatto e di Progetto**

#### 4.2.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 1 stendimento MASW, eseguiti da **GIA Exploring S.r.l.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME               |
|-----------------|----------|--------------------|
| CPTu            | 1        | CPTu 1 (Km 24+900) |
|                 | 2        | CPTu 2 (Km 24+900) |
| MASW            | 1        | MASW 1             |

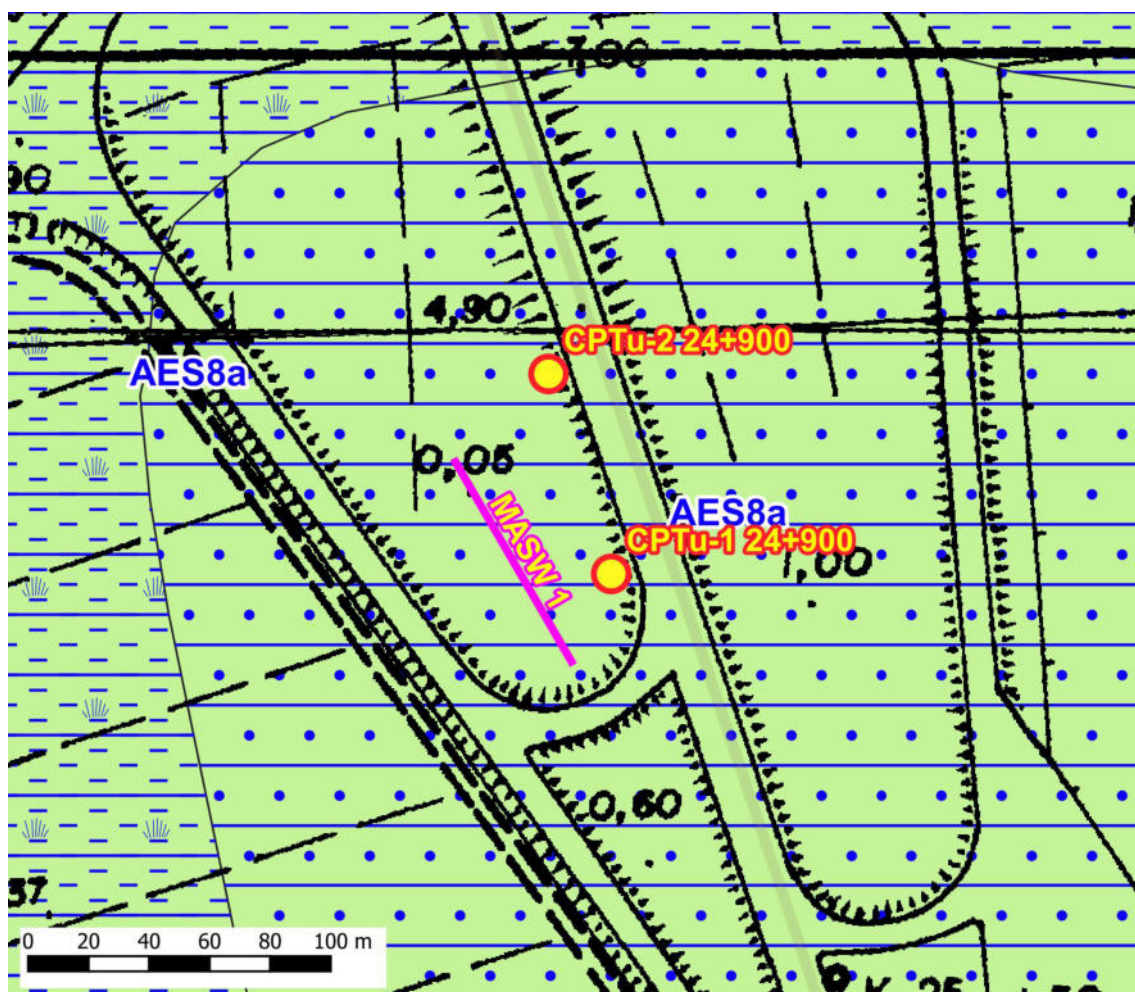
**Tabella 9** – Prove eseguite nell'area relativa all'intervento n. 7 (GIA Exploring S.r.l.)



**Figura 10** – Ubicazione indagini nell'area relativa all'intervento n. 7



## 4.2.2 Modello geologico e geotecnico locale



|                                |                          |
|--------------------------------|--------------------------|
| ● Sondaggi                     | TESSITURA                |
| ● CPTu                         | Argilla Limosa con Torba |
| — MASW                         | Argilla Limosa           |
| COPERTURE QUATERNARIE          | Argilla Sabbiosa         |
| ■ AES8 - Subsistema di Ravenna | Limo Argilloso con Torba |
| ■ AES8a - Unità di Modena      | Sabbia Limosa            |
| ■ h3 - Cava                    | Sabbia                   |

Figura 11 – Inquadramento geologico dell'area relativa all'intervento n. 7

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 7, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI           |
|-----------|----------------------------|---|--------------------------|
| 1         | 0,0 - 6,8                  | Sabbia limosa e limo sabbioso, con intercalazioni di argilla e limo | falda a ~ -0,5 m da p.c. |
| 2         | 6,8 - 11,0                 | Sabbia e sabbia limosa  | ✓                        |
| 3         | 11,0 - 12,0                | Argilla e argilla limosa  | ✓                        |
| 4         | 12,0 - 14,2                | Sabbia e sabbia limosa  | ✓                        |
| 5         | 14,2 - >19,0               | Argilla con intercalazioni di limo sabbioso                         | ✓                        |

Tabella 10 - Modello geologico relativo all'intervento n. 7

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 - 6,8                  | Sabbia limosa e limo sabbioso, con intercalazioni di argilla e limo | 35         | -           | 22          | 34        |
| 2         | 6,8 - 11,0                 | Sabbia e sabbia limosa  | 37         | -           | 54          | 100       |
| 3         | 11,0 - 12,0                | Argilla e limo sabbioso   | -          | 109         | -           | 33        |
| 4         | 12,0 - 14,2                | Sabbia e sabbia limosa  | 35         | -           | 53          | 105       |
| 5         | 14,2 - >19,0               | Argilla con intercalazioni di limo sabbioso                         | -          | 57          | -           | 7         |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

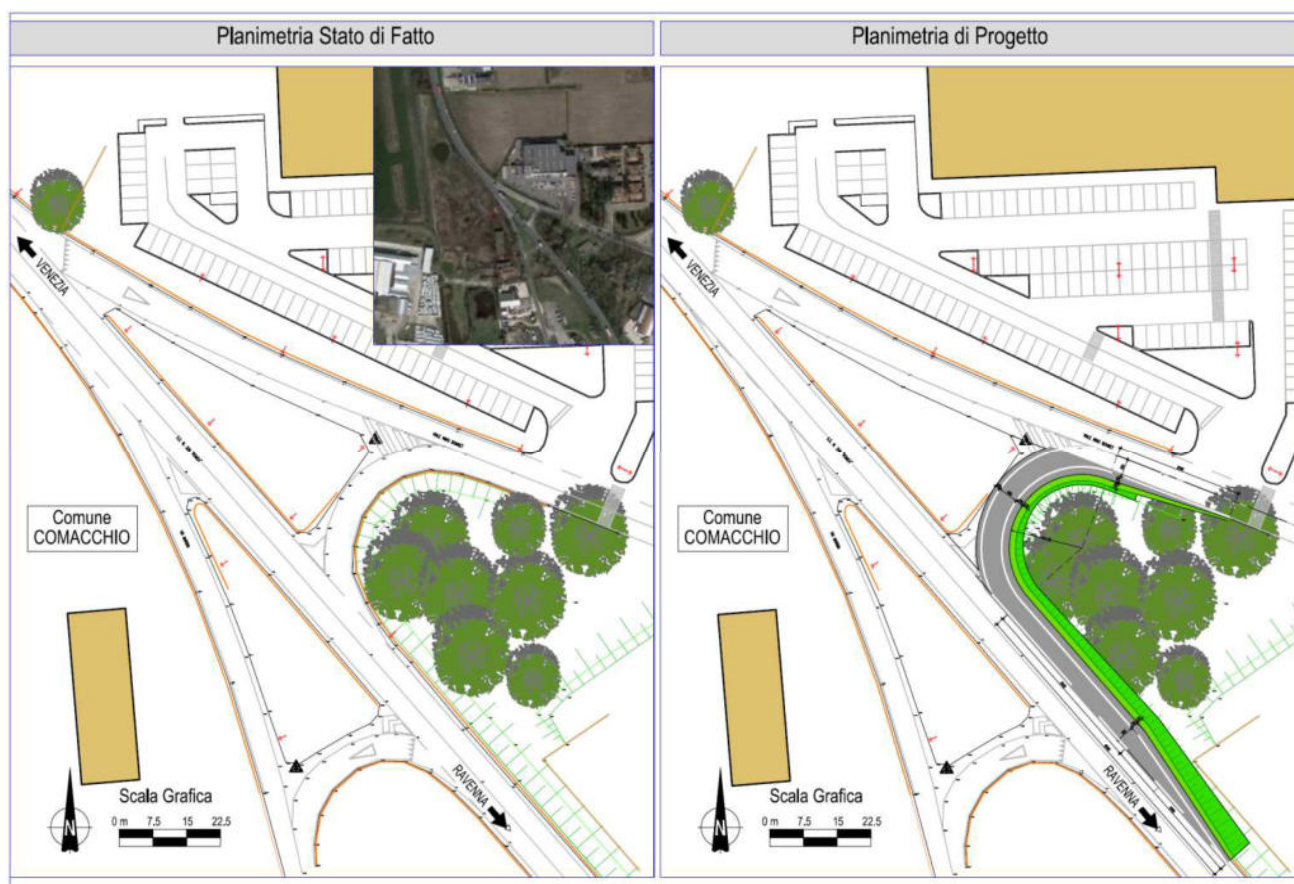
Tabella 11 - Modello geotecnico relativo all'intervento n. 7

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una categoria di sottosuolo di tipo D (rif. NTC 2018).

### 4.3 Intervento n. 8 – Intersezione S.C. Acciaiuoli al km 25+300

L'intervento n. 8, sito in Comune di Comacchio, in località Porto Garibaldi all'intersezione fra la S.S. 309, Via Marina e Viale Nino Bonnet, prevede l'inserimento di una corsia specializzata di svolta destra, per uscire dalla S.S. 309 ed imboccare Viale Nino Bonnet.

L'intervento prevede di realizzare un nuovo tratto di rilevato in allargamento alla sede stradale esistente, di lunghezza pari a 135 m circa, per una larghezza massima inferiore ai 4 m, che si raccorda al rilevato esistente.



**Figura 12 – Intervento n. 8 – Planimetria Stato di Fatto e di Progetto**

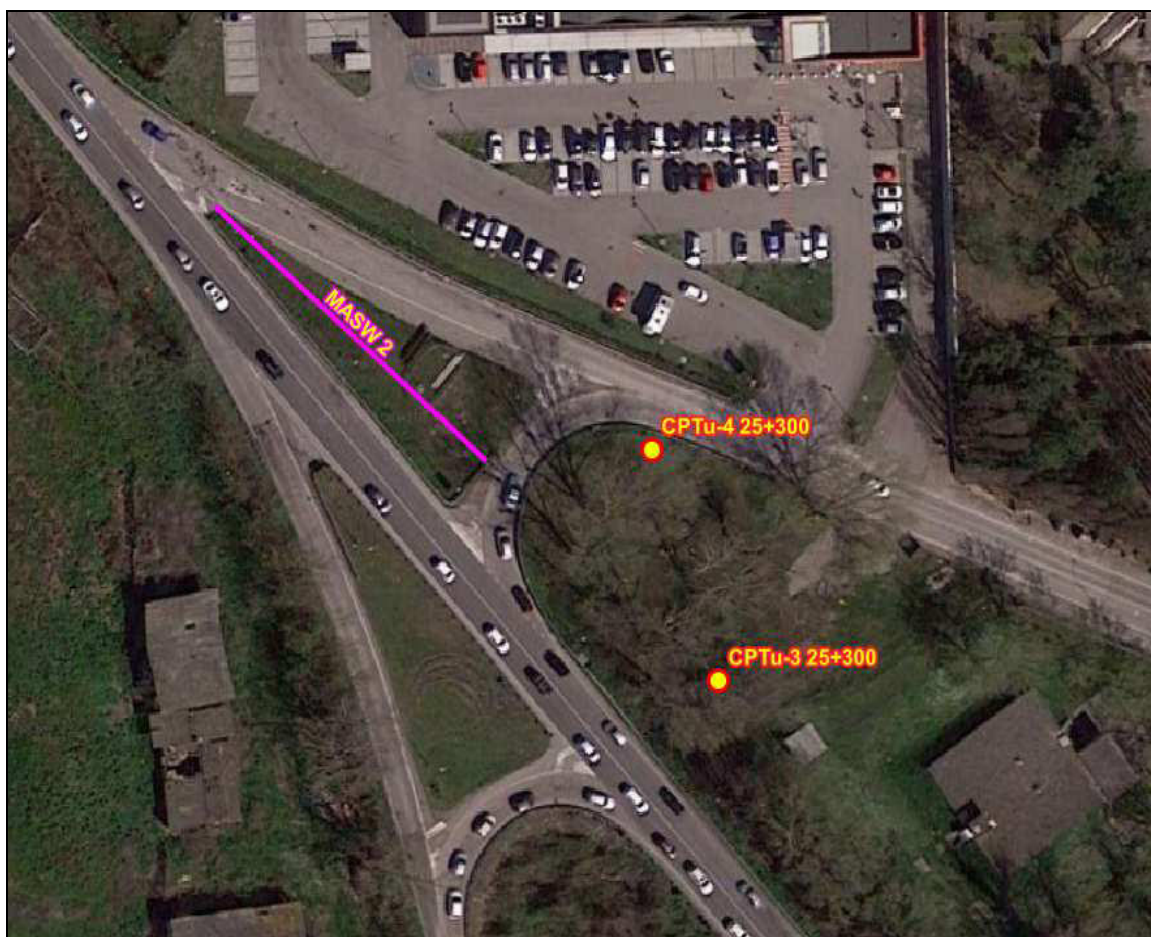


### 4.3.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 1 stendimento MASW, eseguiti da **GIA Exploring S.r.l.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME               |
|-----------------|----------|--------------------|
| CPTu            | 3        | CPTu 3 (Km 25+300) |
|                 | 4        | CPTu 4 (Km 25+300) |
| MASW            | 2        | MASW 2             |

**Tabella 12** – Prove eseguite nell'area relativa all'intervento n. 8 (GIA Exploring S.r.l.)



**Figura 13** – Ubicazione indagini nell'area relativa all'intervento n. 8

#### 4.3.2 Modello geologico e geotecnico locale

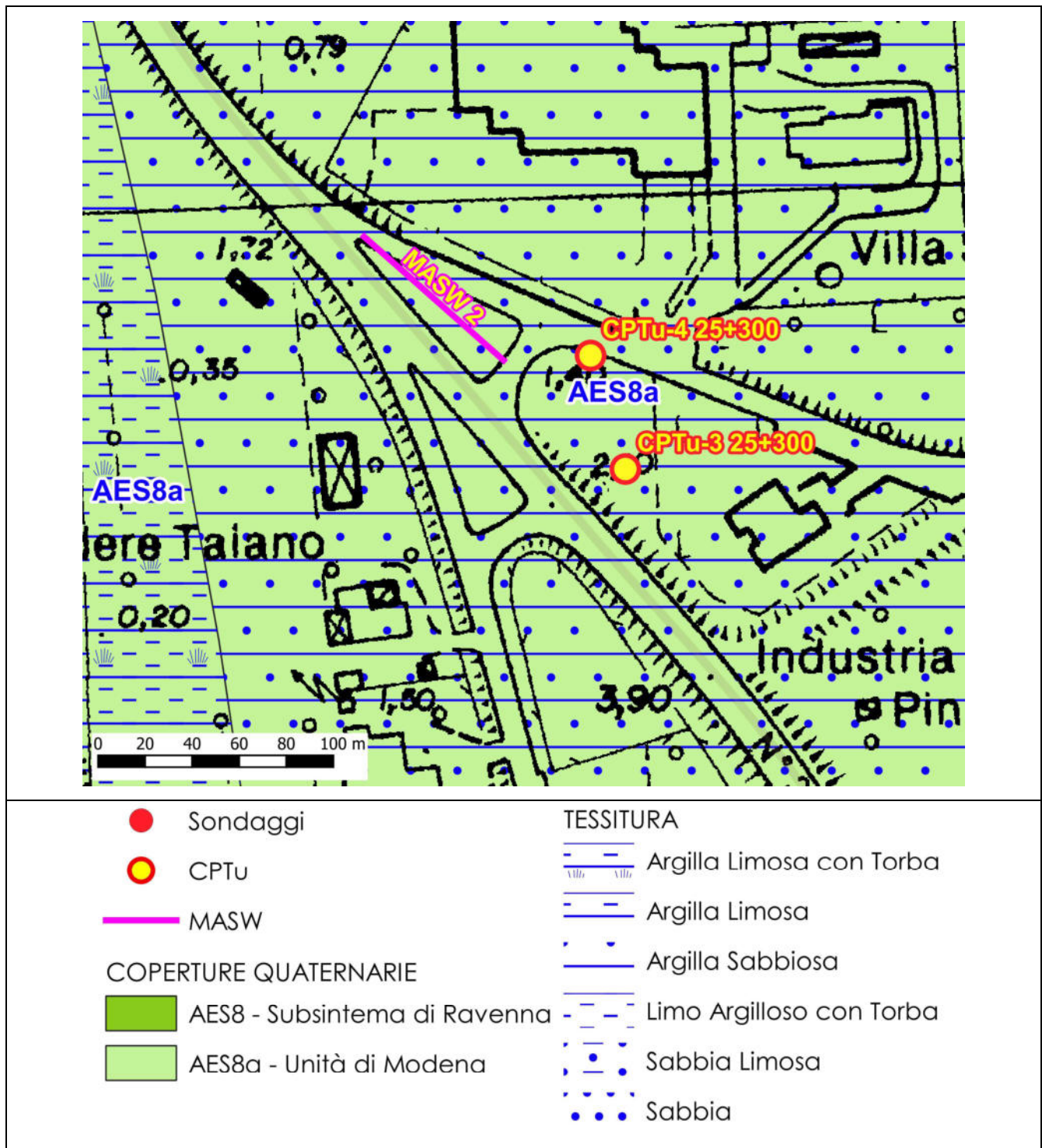


Figura 14 – Inquadramento geologico dell'area relativa all'intervento n. 8



Sulla base degli esiti delle indagini considerate per il sito di intervento n. 8, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI                |
|-----------|----------------------------|---|-------------------------------|
| 1         | 0,0 - 4,5                  | Sabbia e sabbia limosa                                      | falda ~ -0,5 ÷ -1,5 m da p.c. |
| 2         | 4,5 - (5,1 ÷ 5,3)          | Argilla   | ✓                             |
| 3         | (5,1 ÷ 5,3) - 6,8          | Sabbia limosa e limo sabbioso                               | ✓                             |
| 4         | 6,8 - (8,4 ÷ 9,7)          | Sabbia e sabbia limosa con intercalazioni di argilla e limo | ✓                             |
| 5         | (8,4 ÷ 9,7) - 10,9         | Sabbia limosa e limo sabbioso                               | ✓                             |
| 6         | 10,9 - (14,3 ÷ 14,9)       | Sabbia e sabbia limosa                                      | ✓                             |
| 7         | (14,3 ÷ 14,9) - >17,0      | Argilla   | ✓                             |

**Tabella 13** – Modello geologico relativo all'intervento n. 8

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE   | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|--|------------|-------------|-------------|-----------|
| 1         | 0,0 - 4,5                  | Sabbia e sabbia limosa                                       | 36         | -           | 27          | 51        |
| 2         | 4,5 - (5,1 ÷ 5,3)          | Argilla  | -          | 36          | -           | 6         |
| 3         | (5,1 ÷ 5,3) - 6,8          | Sabbia limosa e limo sabbioso                                | 35         | -           | 35          | 36        |
| 4         | 6,8 - (8,4 ÷ 9,7)          | Sabbia e sabbia limosa, con intercalazioni di argilla e limo | 36         | -           | 49          | 98        |
| 5         | (8,4 ÷ 9,7) - 10,9         | Sabbia limosa e limo sabbioso                                | 34         | -           | 44          | 48        |
| 6         | 10,9 - (14,3 ÷ 14,9)       | Sabbia e sabbia limosa                                       | 35         | -           | 55          | 110       |
| 7         | (14,3 ÷ 14,9) - >17,0      | Argilla  | -          | 52          | -           | 7         |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

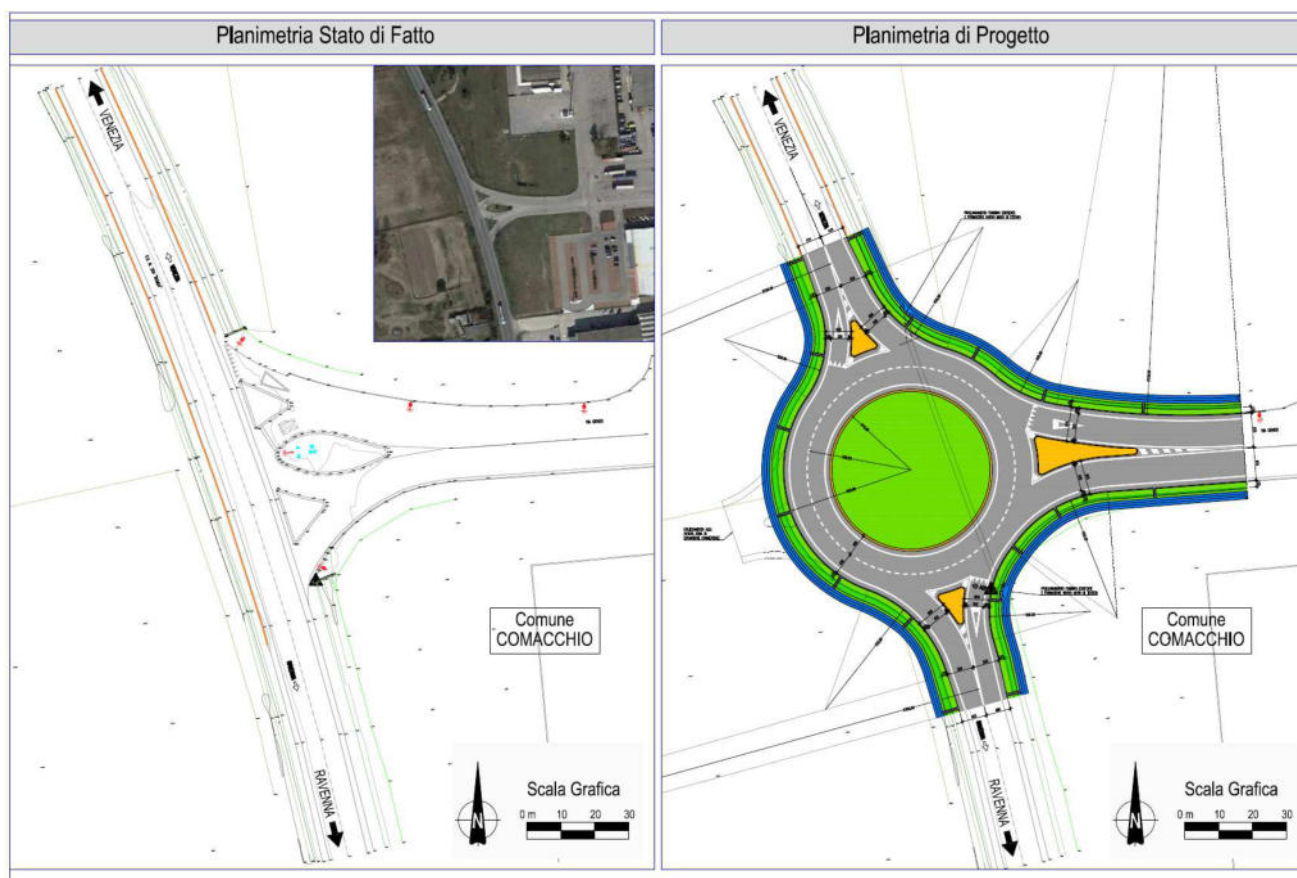
**Tabella 14** – Modello geotecnico relativo all'intervento n. 8

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo D** (rif. NTC 2018).

## 4.4 Intervento n. 11 – Intersezione Via Delle Arti al km 31+000

L'intervento n. 11 prevede la sostituzione di un'intersezione a 'T' su Via Acciaioli, situata in Comune di Comacchio, località Lido di Pomposa, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è la "rotatoria convenzionale" a due corsie di larghezza pari a 3,5 m e banchine laterali da 1 m, caratterizzata da un diametro esterno compreso tra 40 e 50 m e da un'isola centrale di diametro 32 m.



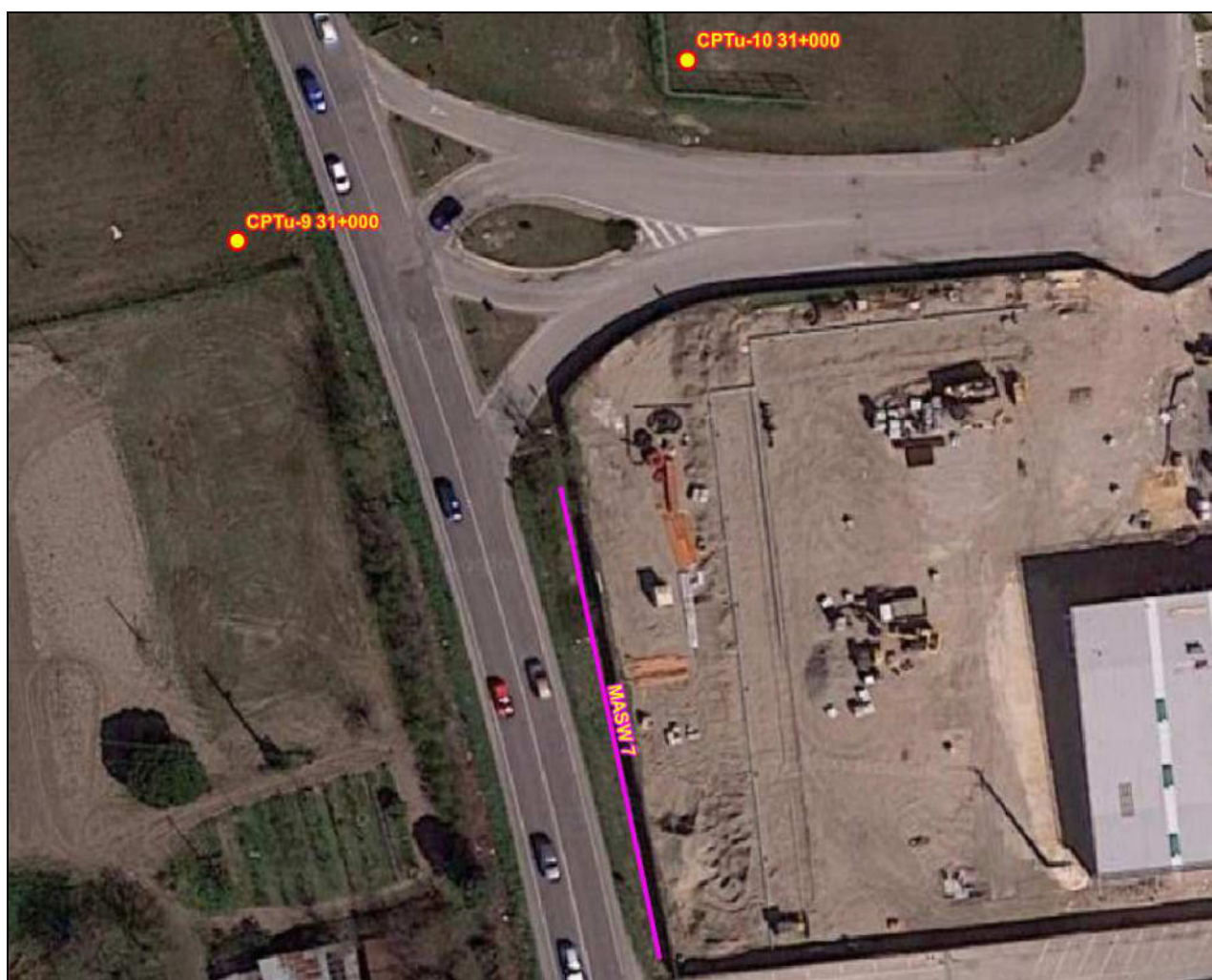
**Figura 15** – Intervento n. 11 – Planimetria Stato di Fatto e di Progetto

#### 4.4.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 1 stendimento MASW, eseguiti da **GIA Exploring S.r.l.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| CPTu            | 9        | CPTu 9 (Km 31+000)  |
|                 | 10       | CPTu 10 (Km 31+000) |
| MASW            | 7        | MASW 7              |

**Tabella 15** – Prove eseguite nell'area relativa all'intervento n. 11 (GIA Exploring S.r.l.)



**Figura 16** – Ubicazione indagini nell'area relativa all'intervento n. 11



#### 4.4.2 Modello geologico e geotecnico locale

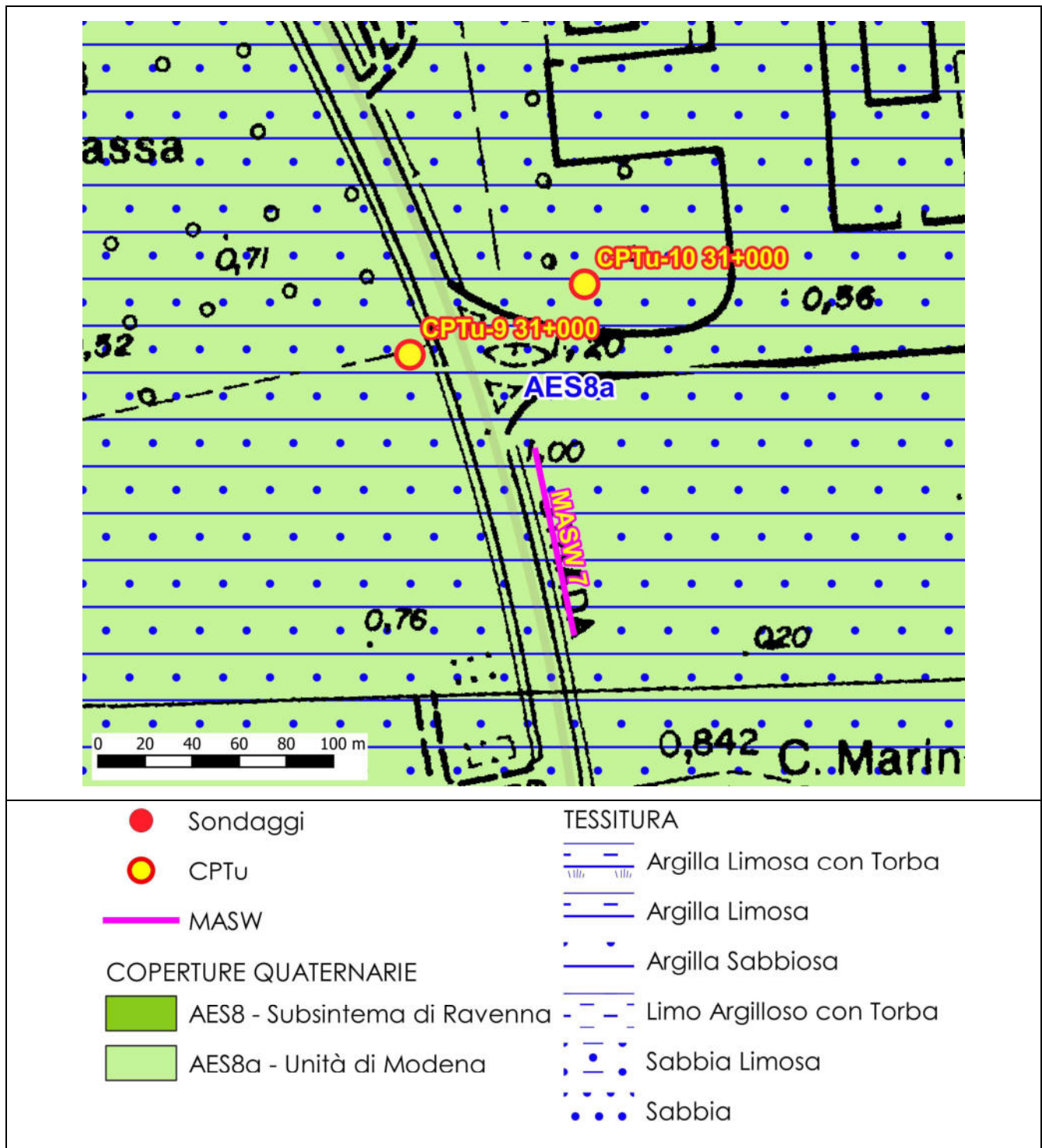


Figura 17 – Inquadramento geologico dell'area relativa all'intervento n. 11

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 11, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE          | LIVELLI SATURI           |
|-----------|----------------------------|-------------------------------|--------------------------|
| -         | 0,0 - 0,7                  | <i>dato non disponibile</i>   | falda a ~ -0,7 m da p.c. |
| 1         | 0,7 - 2,1                  | Sabbia e sabbia limosa        | ✓                        |
| 2         | 2,1 - (5,8 ÷ 7,5)          | Sabbia e sabbia limosa        | ✓                        |
| 3         | (5,8 ÷ 7,5) - (6,8 ÷ 9,7)  | Sabbia limosa e limo sabbioso | ✓                        |
| 4         | (6,8 ÷ 9,7) - >12,0        | Sabbia e sabbia limosa        | ✓                        |

**Tabella 16** – Modello geologico relativo all'intervento n. 11

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE          | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|-------------------------------|------------|-------------|-------------|-----------|
| -         | 0,0 - 0,7                  | <i>dato non disponibile</i>   | -          | -           | -           | -         |
| 1         | 0,7 - 2,1                  | Sabbia e sabbia limosa        | 38         | -           | 30          | 60        |
| 2         | 2,1 - (5,8 ÷ 7,5)          | Sabbia e sabbia limosa        | 37         | -           | 43          | 85        |
| 3         | (5,8 ÷ 7,5) - (6,8 ÷ 9,7)  | Sabbia limosa e limo sabbioso | 34         | -           | 36          | 62        |
| 4         | (6,8 ÷ 9,7) - >12,0        | Sabbia e sabbia limosa        | 36         | -           | 55          | 105       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

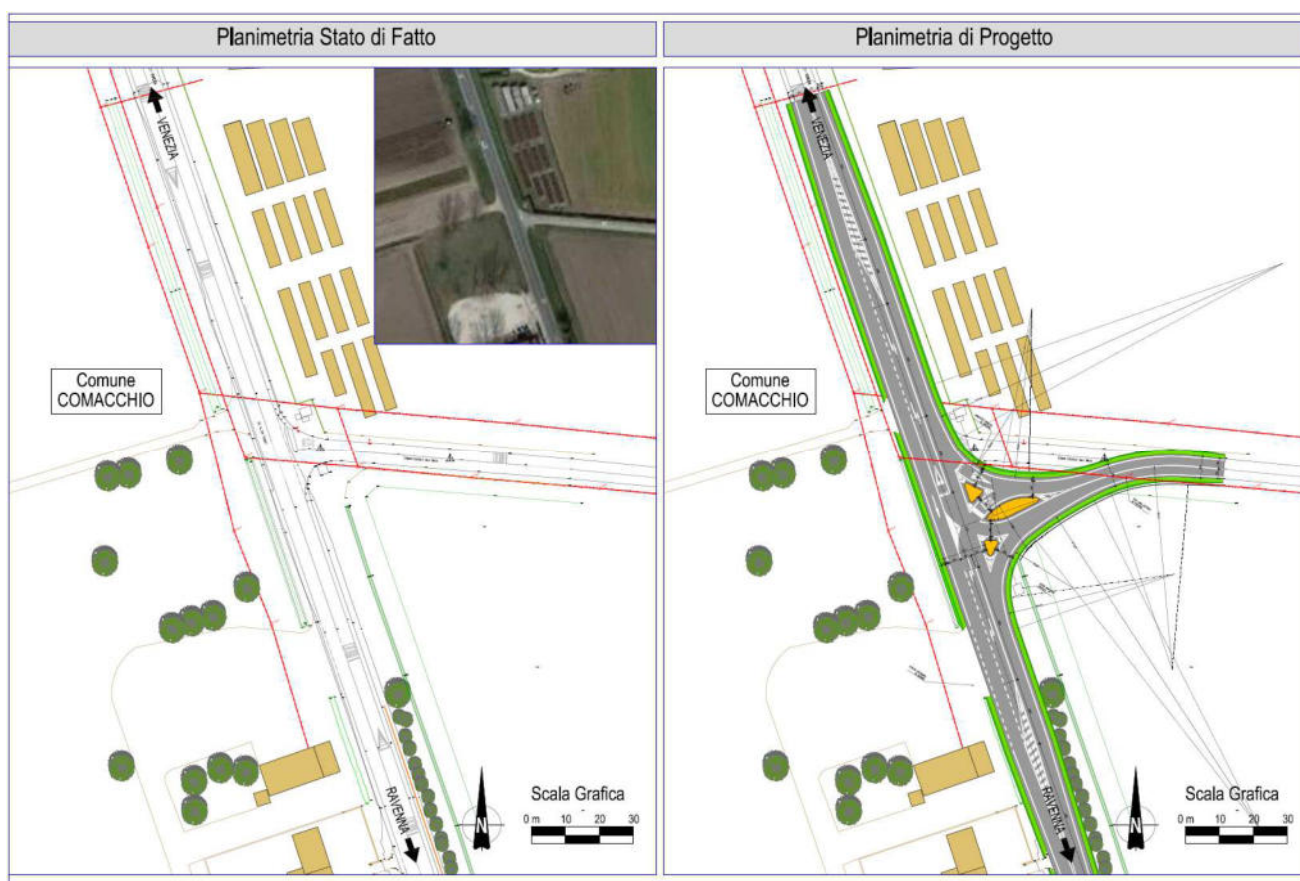
**Tabella 17** – Modello geotecnico relativo all'intervento n. 11

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo D**, al limite con la categoria C (rif. NTC 2018).

## 4.5 Intervento n.14 – Intersezione Strada poderale Lagosanto – Via Strade basse al km 35+500

L'intervento n. 14, sito in Comune di Comacchio, in località Lagosanto, all'intersezione fra la S.S. 309 e la Strada Poderale Valli Basse, prevede l'adeguamento dell'intersezione a raso a 'T' esistente, con una nuova intersezione a 'T' a tre braccia, con l'inserimento di un'isola a goccia e due isole triangolari. Vengono inoltre inserite una corsia di decelerazione ed accumulo per la svolta sulla Strada Poderale Valli Basse, provenendo sulla S.S. 309 da Venezia, ed una corsia di accumulo ed immissione per i mezzi che escono dalla Strada Poderale Valli Basse e si immettono in direzione Ravenna.

L'intersezione modificata avrà due rami in ingresso sulla Strada Poderale Valli Basse e due rami di uscita dalla stessa strada per immettersi sulla S.S. 309, sia in direzione Venezia che in direzione Ravenna.



**Figura 18 – Intervento n. 14 – Planimetria Stato di Fatto e di Progetto**

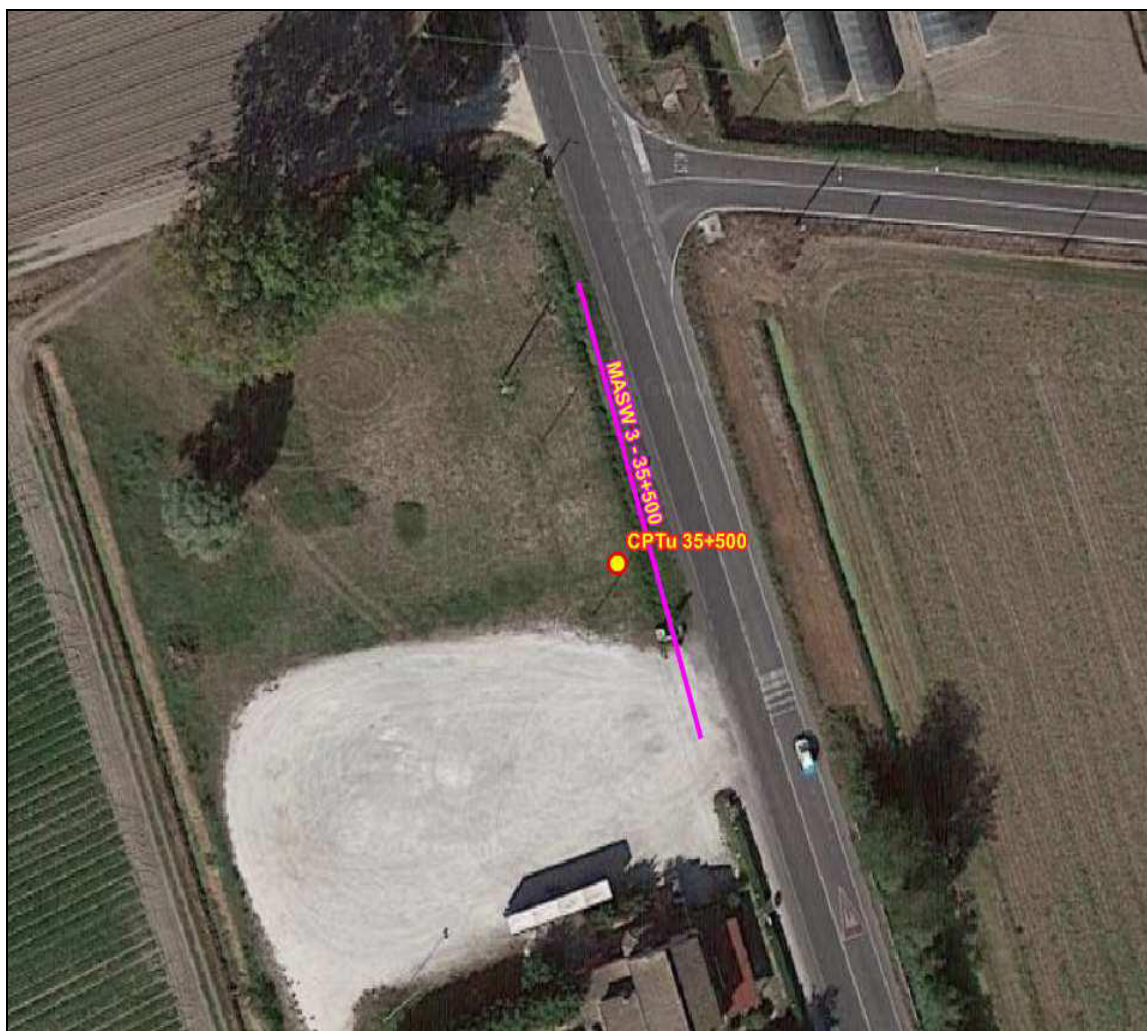


#### 4.5.1 Indagini eseguite

Nell'area interessata dall'opera, è stata effettuata n. 1 prova CPTu n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME               |
|-----------------|----------|--------------------|
| CPTu            | 3        | CPTu Km 35+500     |
| MASW            | 3        | MASW 3 - Km 35+500 |

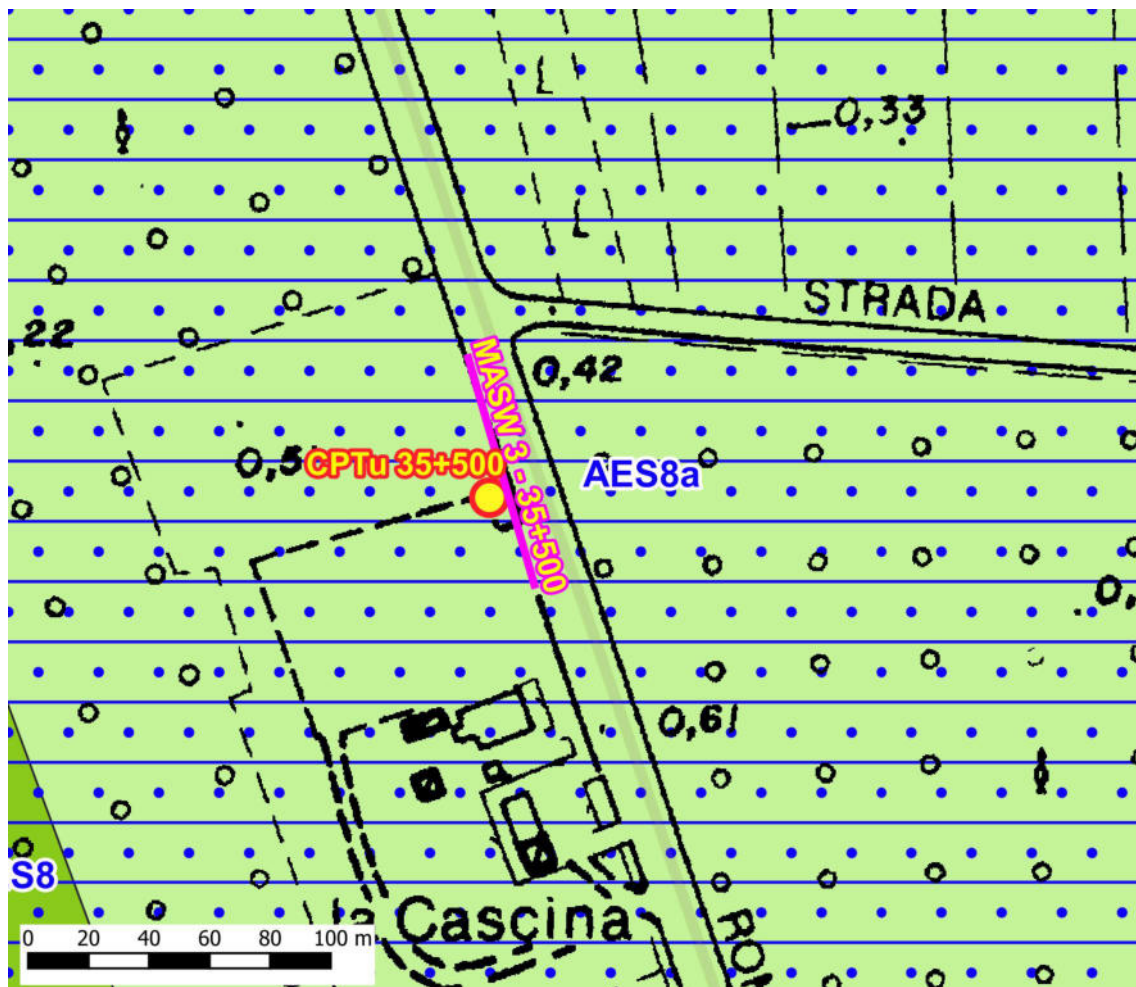
**Tabella 18** – Prove eseguite nell'area relativa all'intervento n. 14 (I.P.G. s.n.c.)



**Figura 19** – Ubicazione indagini nell'area relativa all'intervento n. 14



## 4.5.2 Modello geologico e geotecnico locale



● Sondaggi

● CPTu

— MASW

COPERTURE QUATERNARIE

■ AES8 - Subsistema di Ravenna

■ AES8a - Unità di Modena

TESSITURA

— Argilla Limosa con Torba

— Argilla Limosa

— Argilla Sabbiosa

— Limo Argilloso con Torba

● Sabbia Limosa

● Sabbia

Figura 20 – Inquadramento geologico dell'area relativa all'intervento n. 14

Sulla base degli esiti dell'indagine considerata per il sito di intervento n. 14, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI           |
|-----------|----------------------------|---|--------------------------|
| 1         | 0,0 – 1,4                  | Sabbia e sabbia limosa                                      | falda a ~ -1,2 m da p.c. |
| 2         | 1,4 – 2,1                  | Sabbia e sabbia limosa                                      | ✓                        |
| 3         | 2,1 – 3,1                  | Sabbia  | ✓                        |
| 4         | 3,1 – 5,8                  | Sabbia e sabbia limosa                                      | ✓                        |
| 5         | 5,8 – 8,8                  | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso | ✓                        |
| 6         | 8,8 – >10,0                | Sabbia e sabbia limosa                                      | ✓                        |

**Tabella 19** – Modello geologico relativo all'intervento n. 14

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 – 1,4                  | Sabbia e sabbia limosa                                      | 38         | -           | 20          | 40        |
| 2         | 1,4 – 2,1                  | Sabbia e sabbia limosa                                      | 40         | -           | 45          | 91        |
| 3         | 2,1 – 3,1                  | Sabbia  | 44         | -           | 75          | 150       |
| 4         | 3,1 – 5,8                  | Sabbia e sabbia limosa                                      | 40         | -           | 64          | 128       |
| 5         | 5,8 – 8,8                  | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso | 36         | -           | 53          | 103       |
| 6         | 8,8 – >10,0                | Sabbia e sabbia limosa                                      | 36         | -           | 62          | 124       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

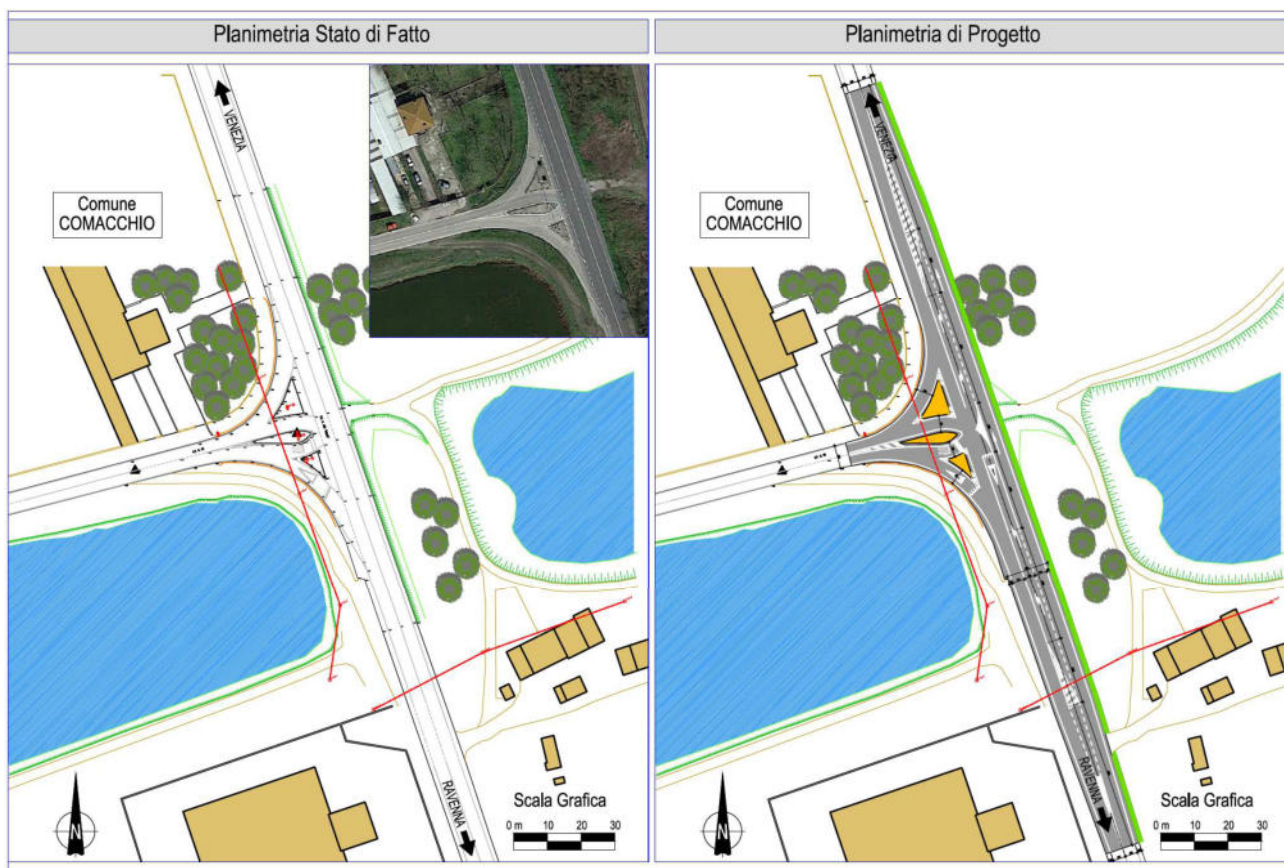
**Tabella 20** – Modello geotecnico relativo all'intervento n. 14

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo C** (rif. NTC 2018).

## 4.6 Intervento n.15 – Intersezione S.P. 55 Lagosanto – Rotta Zambusi al km 36+000

L'intervento n. 15, sito in Comune di Comacchio, in località Rotta Zambusi all'intersezione fra la S.S. 309 e la Strada Provinciale 55, prevede la sistemazione dell'intersezione a raso a 'T' esistente, con l'inserimento di una corsia di decelerazione ed accumulo per chi svolta sulla S.P. 55, provenendo sulla S.S. 309 da Ravenna, ed una corsia di accumulo ed immissione per i mezzi che escono dalla S.P. 55 e si immettono sulla S.S. 309 in direzione Venezia.

L'intersezione modificata conserverà i due rami in ingresso sulla S.P. 55 ed i due rami di uscita dalla stessa strada, per immettersi sulla S.S. 309 sia in direzione Venezia che in direzione Ravenna.



**Figura 21 – Intervento n. 15 – Planimetria Stato di Fatto e di Progetto**



#### 4.6.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 2 stendimenti MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

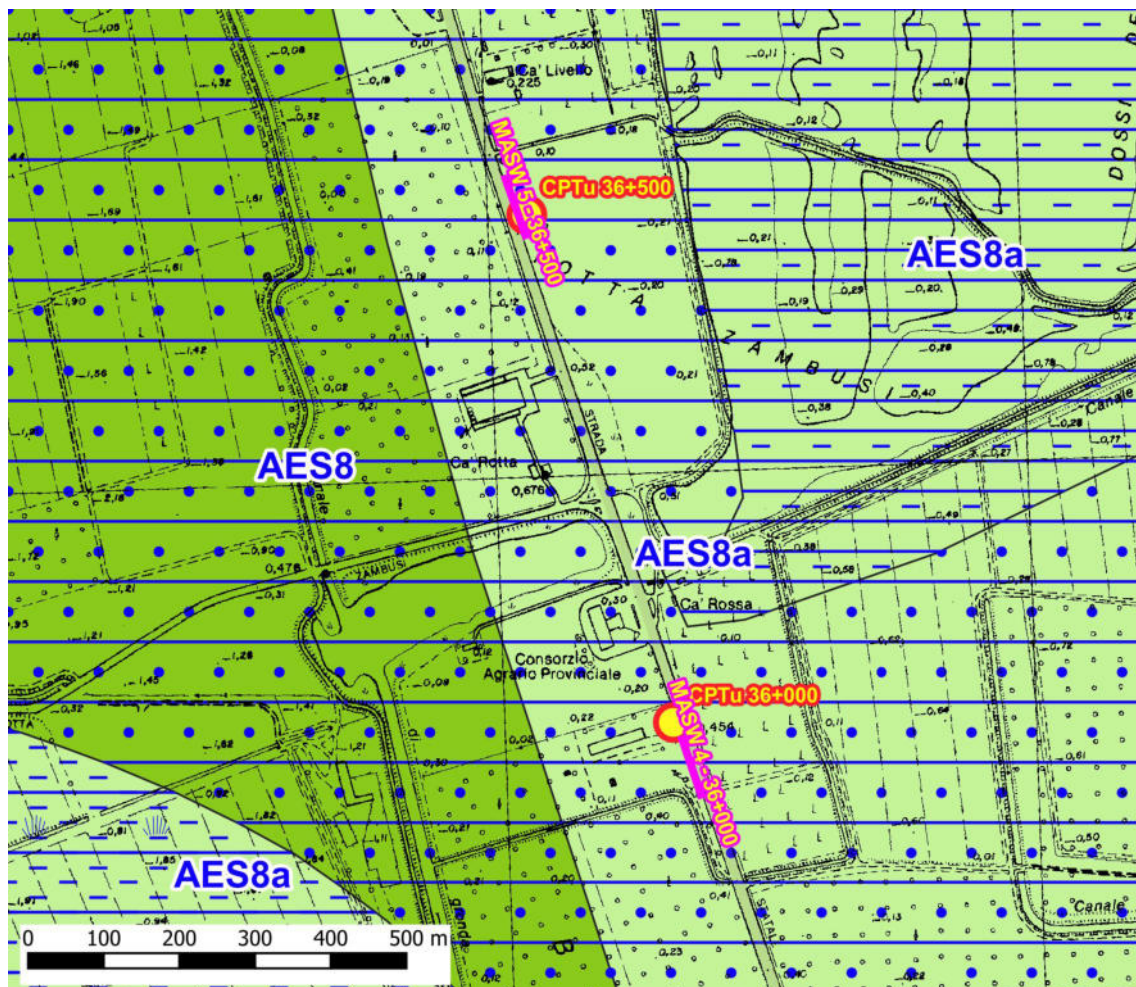
| TIPOLOGIA PROVA | N. PROVA | NOME            |
|-----------------|----------|-----------------|
| CPTu            | 4        | CPTu Km 36+000  |
|                 | 5        | CPTu Km 36+500  |
| MASW            | 4        | MASW 4 - 36+000 |
|                 | 5        | MASW 5 - 36+500 |

**Tabella 21** – Prove eseguite nell'area relativa all'intervento n. 15 (I.P.G. s.n.c.)



**Figura 22** – Ubicazione indagini nell'area relativa all'intervento n. 15

#### 4.6.2 Modello geologico e geotecnico locale



|   |                          |
|---|--------------------------|
| <span style="color: red;">●</span> Sondaggi | <b>TESSITURA</b>         |
| <span style="color: yellow;">●</span> CPTu  | Argilla Limosa con Torba |
| <span style="color: magenta;">—</span> MASW | Argilla Limosa           |
| <b>COPERTURE QUATERNARIE</b>                | Argilla Sabbiosa         |
| AES8 - Subsistema di Ravenna                | Limo Argilloso con Torba |
| AES8a - Unità di Modena                     | Sabbia Limosa            |
|   | Sabbia                   |

Figura 23 – Inquadramento geologico dell'area relativa all'intervento n. 15

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 15, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI                |
|-----------|----------------------------|---|-------------------------------|
| 1         | 0,0 – 2,4                  | Sabbia e sabbia limosa  | falda ~ -0,8 ÷ -1,0 m da p.c. |
| 2         | 2,4 – (4,6 ÷ 5,8)          | Sabbia e sabbia limosa  | ✓                             |
| 3         | (4,6 ÷ 5,8) – (7,9 ÷ 8,5)  | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso           | ✓                             |
| 4         | (7,9 ÷ 8,5) – 9,6          | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso e argilla | ✓                             |
| 5         | 9,6 – >10,0                | Sabbia limosa e limo sabbioso   | ✓                             |

**Tabella 22** – Modello geologico relativo all'intervento n. 15

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 – 2,4                  | Sabbia e sabbia limosa                                      | 37         | -           | 25          | 50        |
| 2         | 2,4 – (4,6 ÷ 5,8)          | Sabbia e sabbia limosa                                      | 40         | -           | 60          | 125       |
| 3         | (4,6 ÷ 5,8) – (7,9 ÷ 8,5)  | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso | 36         | -           | 50          | 95        |
| 4         | (7,9 ÷ 8,5) – 9,6          | Sabbia e sabbia limosa, con intercalazioni di argilla       | 37         | -           | 63          | 120       |
| 5         | 9,6 – >10,0                | Sabbia limosa e limo sabbioso                               | 35         | -           | 55          | 110       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 23** – Modello geotecnico relativo all'intervento n. 15

Le indagini MASW eseguite hanno permesso di determinare, per il sito di intervento, una categoria di sottosuolo di tipo C (rif. NTC 2018).

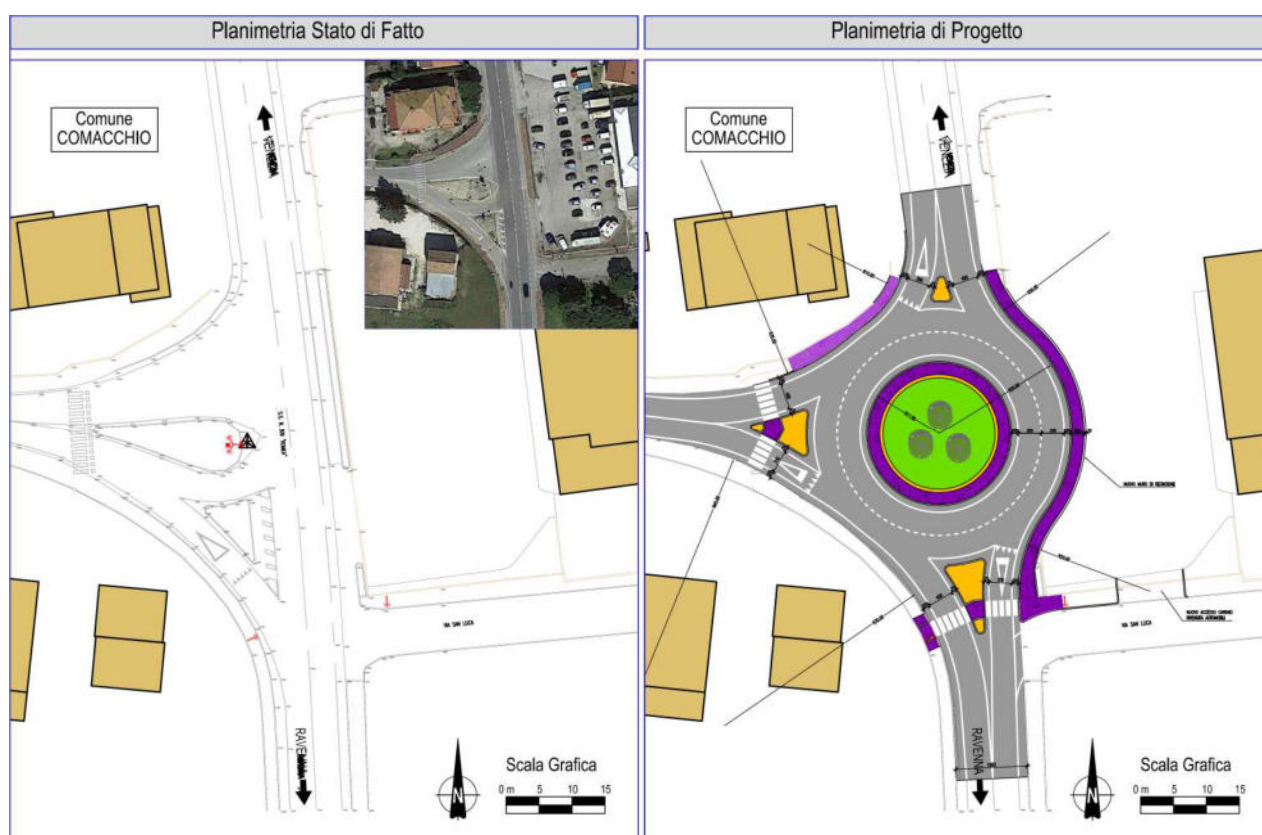


## 4.7 Intervento n.16 – Intersezione S.P. N. 21 “Vaccolino” al km 40+000

L'intervento n. 16 prevede la sostituzione di un'intersezione a 'T' con la S.P. 21, in comune di Comacchio, località Vaccolino, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è la “rotatoria convenzionale” caratterizzata da un diametro esterno compreso tra 40 e 50 m, da un'isola centrale di diametro di 22 m, dotata di una fascia sormontabile di larghezza 1,8 m.

Per garantire un ottimo livello di sicurezza anche per i pedoni saranno realizzati, su due rami della rotatoria, degli attraversamenti pedonali.



**Figura 24** – Intervento n. 16 – Planimetria Stato di Fatto e di Progetto

#### 4.7.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 3 stendimenti MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME               |
|-----------------|----------|--------------------|
| <b>CPTu</b>     | 6        | CPTu Km 39+600     |
|                 | 7        | CPTu Km 40+300     |
| <b>MASW</b>     | 6        | MASW 6 - Km 39+600 |
|                 | 7        | MASW 7 - Km 40+000 |
|                 | 8        | MASW 8 - Km 40+300 |

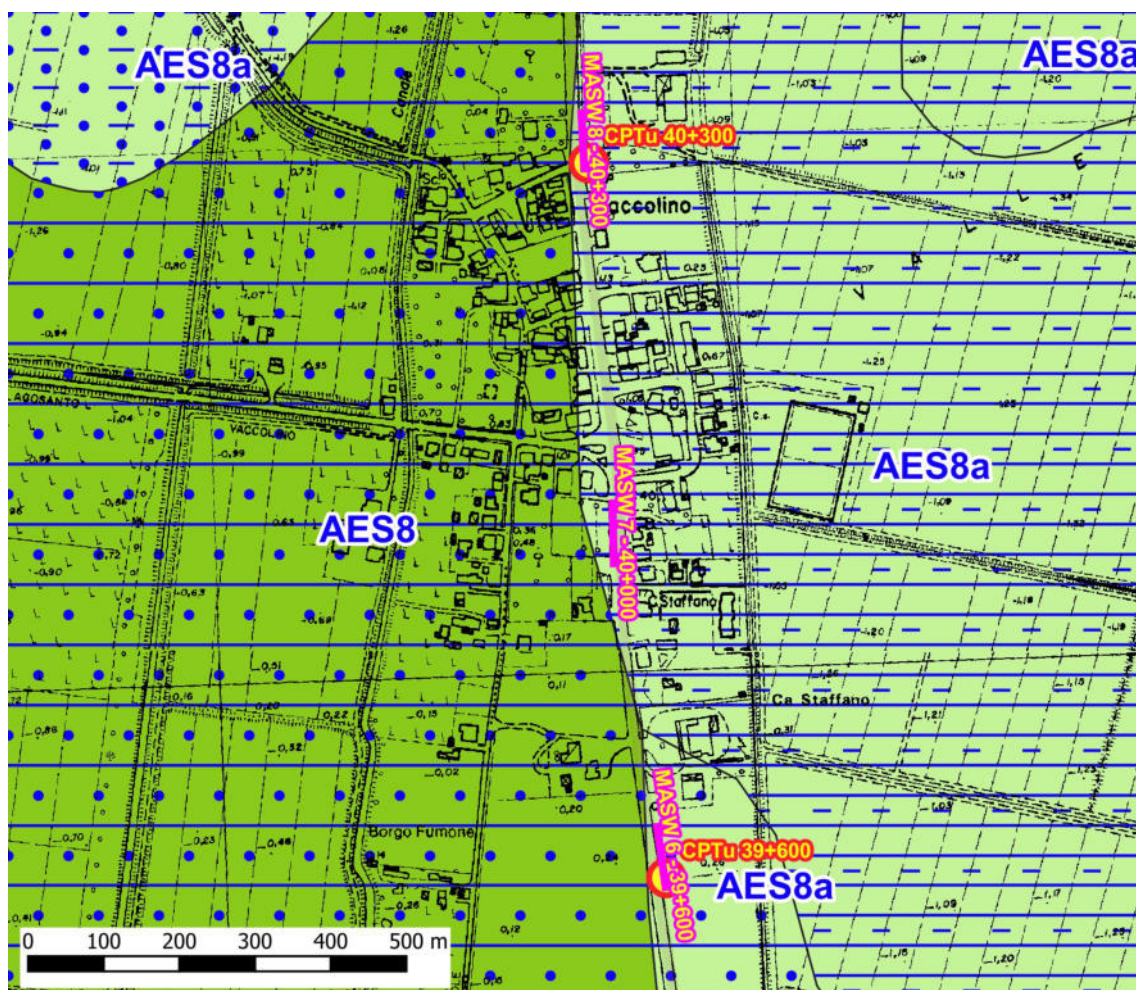
**Tabella 24** – Prove eseguite nell'area relativa all'intervento n. 16 (I.P.G. s.n.c.)



**Figura 25** – Ubicazione indagini nell'area relativa all'intervento n. 16



## 4.7.2 Modello geologico e geotecnico locale



|  |                              |                          |
|--|------------------------------|--------------------------|
| <span style="color: red;">●</span>     | Sondaggi                     | <b>TESSITURA</b>         |
| <span style="color: orange;">●</span>  | CPTu                         | Argilla Limosa con Torba |
| <span style="color: magenta;">—</span> | MASW                         | Argilla Limosa           |
| <b>COPERTURE QUATERNARIE</b>           |                              | Argilla Sabbiosa         |
|  | AES8 - Subsistema di Ravenna | Limo Argilloso con Torba |
|  | AES8a - Unità di Modena      | Sabbia Limosa            |
|  |                              | Sabbia                   |

Figura 26 – Inquadramento geologico dell'area relativa all'intervento n. 16

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 16, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE   | LIVELLI SATURI                |
|-----------|----------------------------|--|-------------------------------|
| 1         | 0,0 – (2,7 ÷ 3,3)          | Sabbia e sabbia limosa                                       | falda ~ -1,5 ÷ -2,3 m da p.c. |
| 2         | (2,7 ÷ 3,3) – (4,3 ÷ 5,0)  | Sabbia e sabbia limosa                                       | ✓                             |
| 3         | (4,3 ÷ 5,0) – (7,7 ÷ 7,9)  | Sabbia e sabbia limosa                                       | ✓                             |
| 4         | (7,7 ÷ 7,9) – >10,0        | Sabbia e sabbia limosa, con intercalazioni di limo e argilla | ✓                             |

**Tabella 25** – Modello geologico relativo all'intervento n. 16

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE   | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|--|------------|-------------|-------------|-----------|
| 1         | 0,0 – (2,7 ÷ 3,3)          | Sabbia e sabbia limosa                                       | 37         | -           | 30          | 59        |
| 2         | (2,7 ÷ 3,3) – (4,3 ÷ 5,0)  | Sabbia e sabbia limosa                                       | 39         | -           | 58          | 118       |
| 3         | (4,3 ÷ 5,0) – (7,7 ÷ 7,9)  | Sabbia e sabbia limosa                                       | 37         | -           | 60          | 115       |
| 4         | (7,7 ÷ 7,9) – >10,0        | Sabbia e sabbia limosa, con intercalazioni di limo e argilla | 36         | -           | 56          | 80        |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

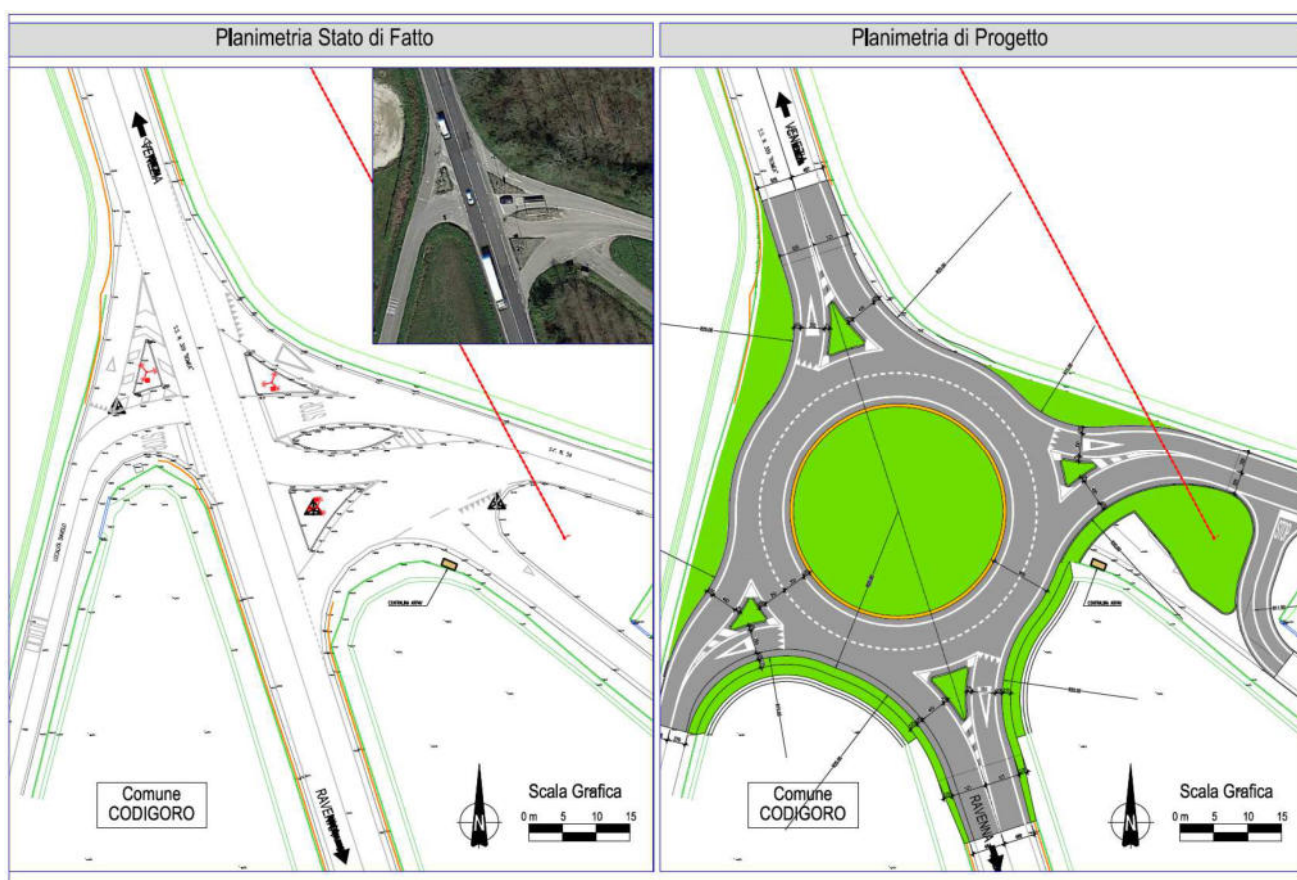
**Tabella 26** – Modello geotecnico relativo all'intervento n. 16

L'indagine MASW n. 7 - Km 40+000 eseguita in corrispondenza dell'area di intervento, ha evidenziato una categoria di sottosuolo di tipo D; le indagini MASW n. 6 - Km 39+600 e n. 8 - Km 40+300, distanziate rispetto all'area di intervento, hanno invece evidenziato una categoria di sottosuolo di tipo C. Si consiglia di adottare la **categoria di sottosuolo di tipo D** (rif. NTC 2018).

## 4.8 Intervento n.17 – Intersezione S.C. Prove e S.C. Volano al km 42+600

L'intervento n. 17 prevede la sostituzione di un'intersezione a cinque rami, in Comune di Codigoro, località Lido di Volano, in prossimità dell'innesto della Strada Provinciale S.P. 54, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è la "rotatoria convenzionale" a due corsie, di larghezza pari a 3,5 m e banchine laterali da 1 m, caratterizzata da un diametro esterno compreso tra 40 e 50 m e da un'isola centrale di diametro pari a 32 m.



**Figura 27 – Intervento n. 17 – Planimetria Stato di Fatto e di Progetto**

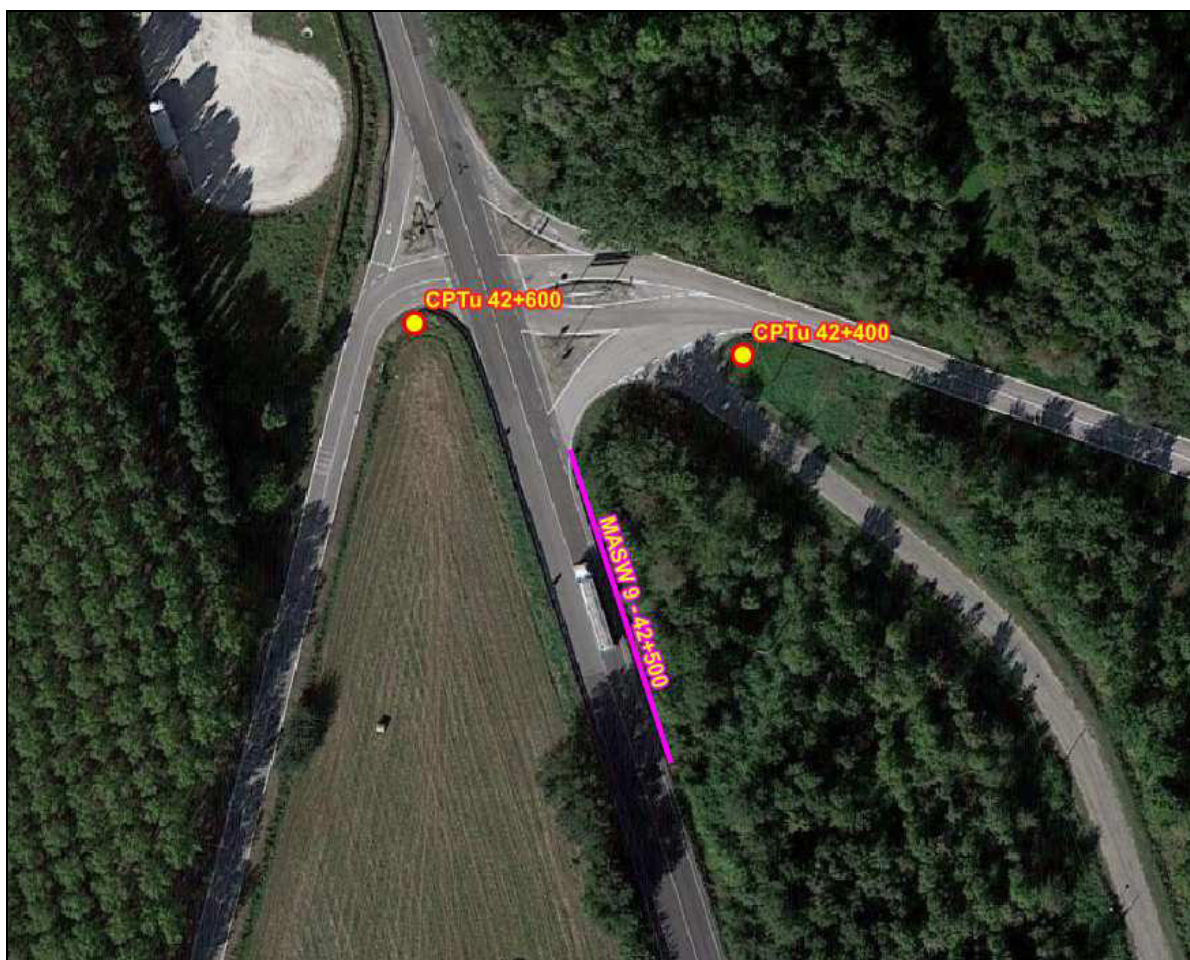


#### 4.8.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME               |
|-----------------|----------|--------------------|
| CPTu            | 8        | CPTu Km 42+400     |
|                 | 9        | CPTu Km 42+600     |
| MASW            | 9        | MASW 9 - Km 42+500 |

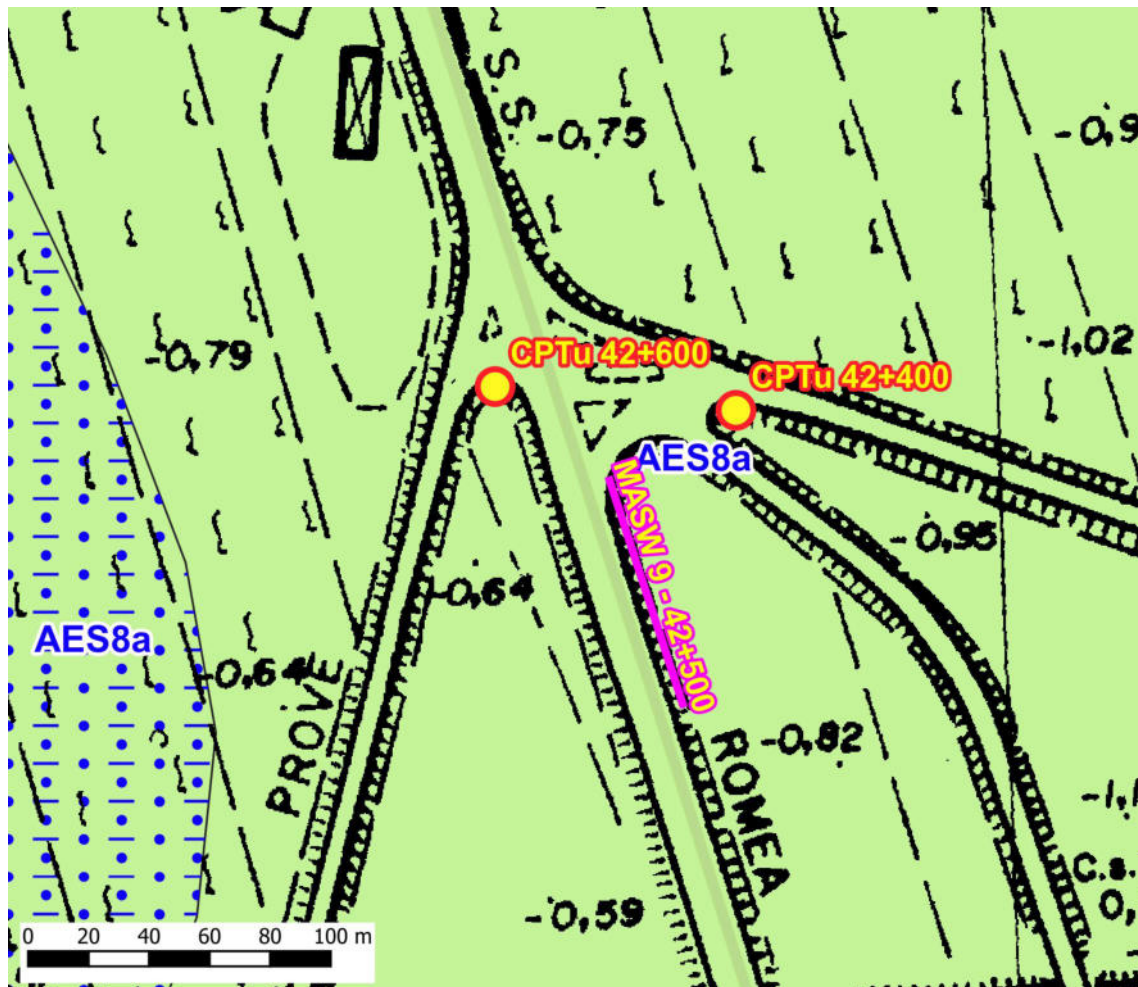
**Tabella 27** – Prove eseguite nell'area relativa all'intervento n. 17 (I.P.G. s.n.c.)



**Figura 28** – Ubicazione indagini nell'area relativa all'intervento n. 17



## 4.8.2 Modello geologico e geotecnico locale



|                                |                                |
|--------------------------------|--------------------------------|
| ● Sondaggi                     | TESSITURA                      |
| ● CPTu                         | — — — Argilla Limosa con Torba |
| — MASW                         | — — — Argilla Limosa           |
| COPERTURE QUATERNARIE          | — — — Argilla Sabbiosa         |
| ■ AES8 - Subsistema di Ravenna | — — — Lino Argilloso con Torba |
| ■ AES8a - Unità di Modena      | — — — Sabbia Limosa            |
|                                | — — — Sabbia                   |

Figura 29 – Inquadramento geologico dell'area relativa all'intervento n. 17

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 17, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE   | LIVELLI SATURI           |
|-----------|----------------------------|--|--------------------------|
| 1         | 0,0 - 0,7                  | Sabbia limosa e limo sabbioso                                | -                        |
| 2         | 0,7 - (2,0 ÷ 2,7)          | Argilla e argilla limosa                                     | falda a ~ -1,9 m da p.c. |
| 3         | (2,0 ÷ 2,7) - (3,7 ÷ 5,0)  | Argilla e argilla limosa, con intercalazioni sabbioso-limose | ✓                        |
| 4         | (3,7 ÷ 5,0) - 7,6          | Sabbia e sabbia limosa                                       | ✓                        |
| 5         | 7,6 - >10,0                | Sabbia e sabbia limosa                                       | ✓                        |

**Tabella 28** – Modello geologico relativo all'intervento n. 17

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE   | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|--|------------|-------------|-------------|-----------|
| 1         | 0,0 - 0,7                  | Sabbia limosa e limo sabbioso                                | 39         | -           | 15          | 20        |
| 2         | 0,7 - (2,0 ÷ 2,7)          | Argilla e argilla limosa                                     | -          | 60          | -           | 12        |
| 3         | (2,0 ÷ 2,7) - (3,7 ÷ 5,0)  | Argilla e argilla limosa, con intercalazioni sabbioso-limose | -          | 25          | -           | 3         |
| 4         | (3,7 ÷ 5,0) - 7,6          | Sabbia e sabbia limosa                                       | 33         | -           | 32          | 60        |
| 5         | 7,6 - >10,0                | Sabbia e sabbia limosa                                       | 34         | -           | 40          | 80        |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 29** – Modello geotecnico relativo all'intervento n. 17

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una categoria di sottosuolo di tipo C (rif. NTC 2018).

## 4.9 Intervento n.18 – Intersezione Via della Cooperazione al km 45+900

L'intervento n. 18 prevede la sostituzione di un'intersezione a 'T' a raso, in Comune di Codigoro, nella frazione di Pomposa, in località Lovara, in prossimità dell'accesso alla Zona Industriale Caprile, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è una rotatoria a cinque braccia, a due corsie di larghezza pari a 3,5 m e banchine laterali da 1 m, caratterizzata da un diametro esterno di 60 m e da un'isola centrale di diametro 42 m.

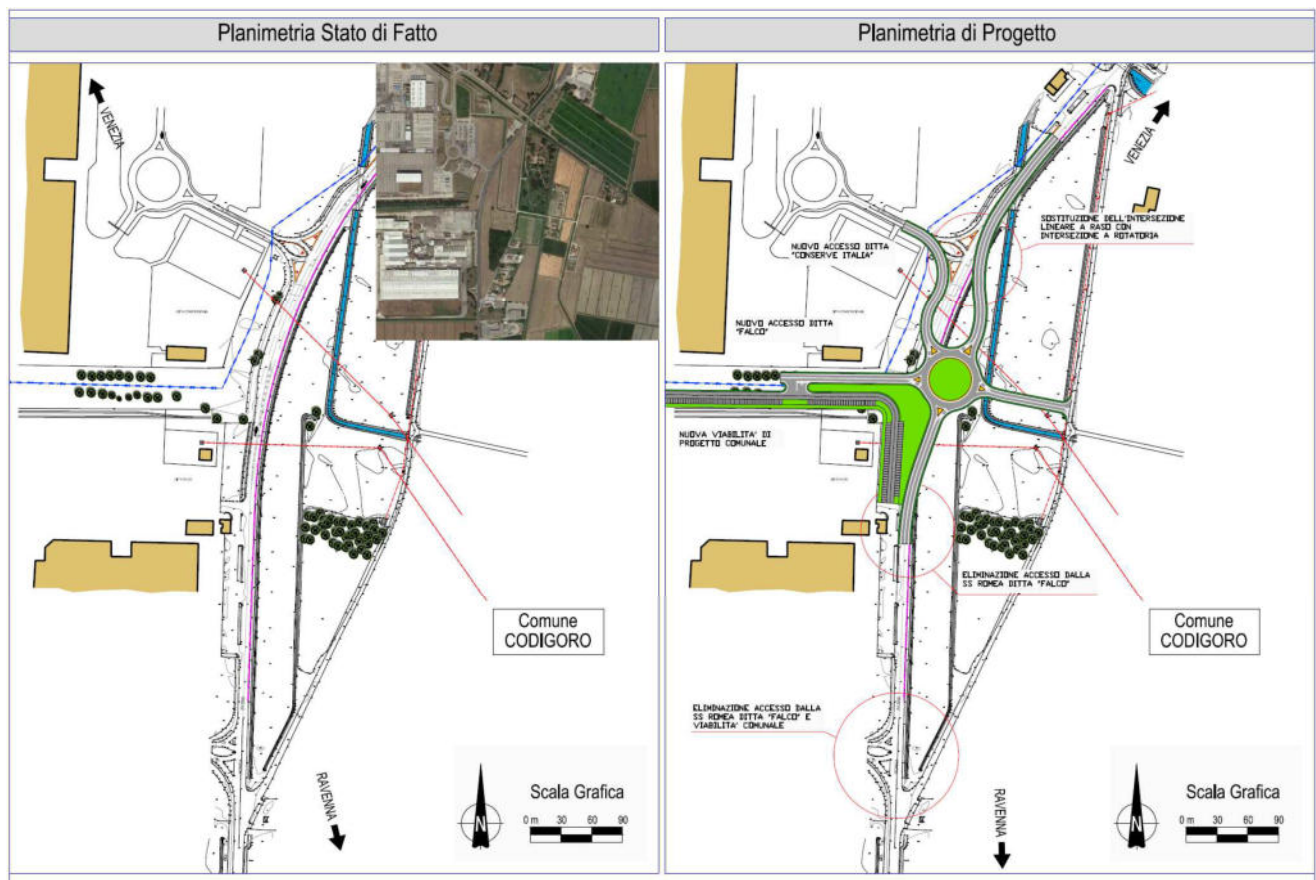


Figura 30 – Intervento n. 18 – Planimetria Stato di Fatto e di Progetto



#### 4.9.1 Indagini eseguite

Nell'area interessata dall'opera, è stata effettuata n. 1 prova CPTu e n. 2 stendimenti MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| CPTu            | 13       | CPTu Km 45+900      |
| MASW            | 13       | MASW 13 - Km 45+500 |
|                 | 14       | MASW 14 - Km 45+900 |

**Tabella 30** – Prove eseguite nell'area relativa all'intervento n. 18 (I.P.G. s.n.c.)



**Figura 31** – Ubicazione indagini nell'area relativa all'intervento n. 18



## 4.9.2 Modello geologico e geotecnico locale

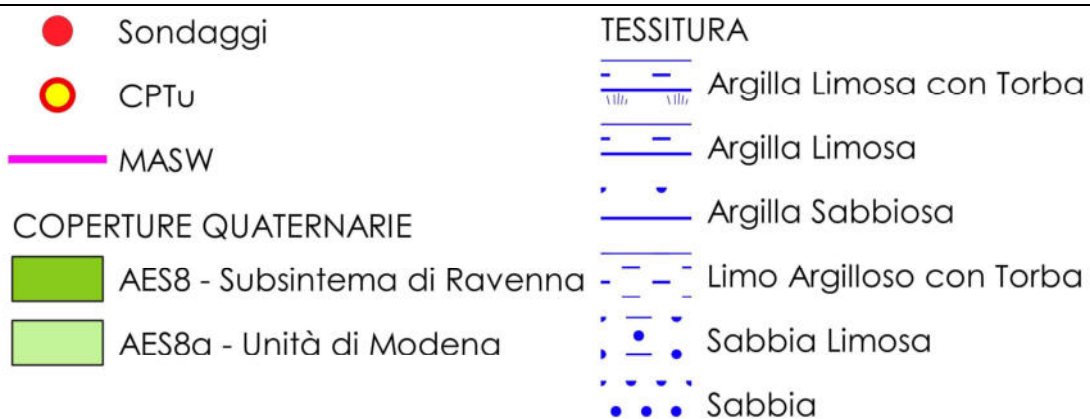
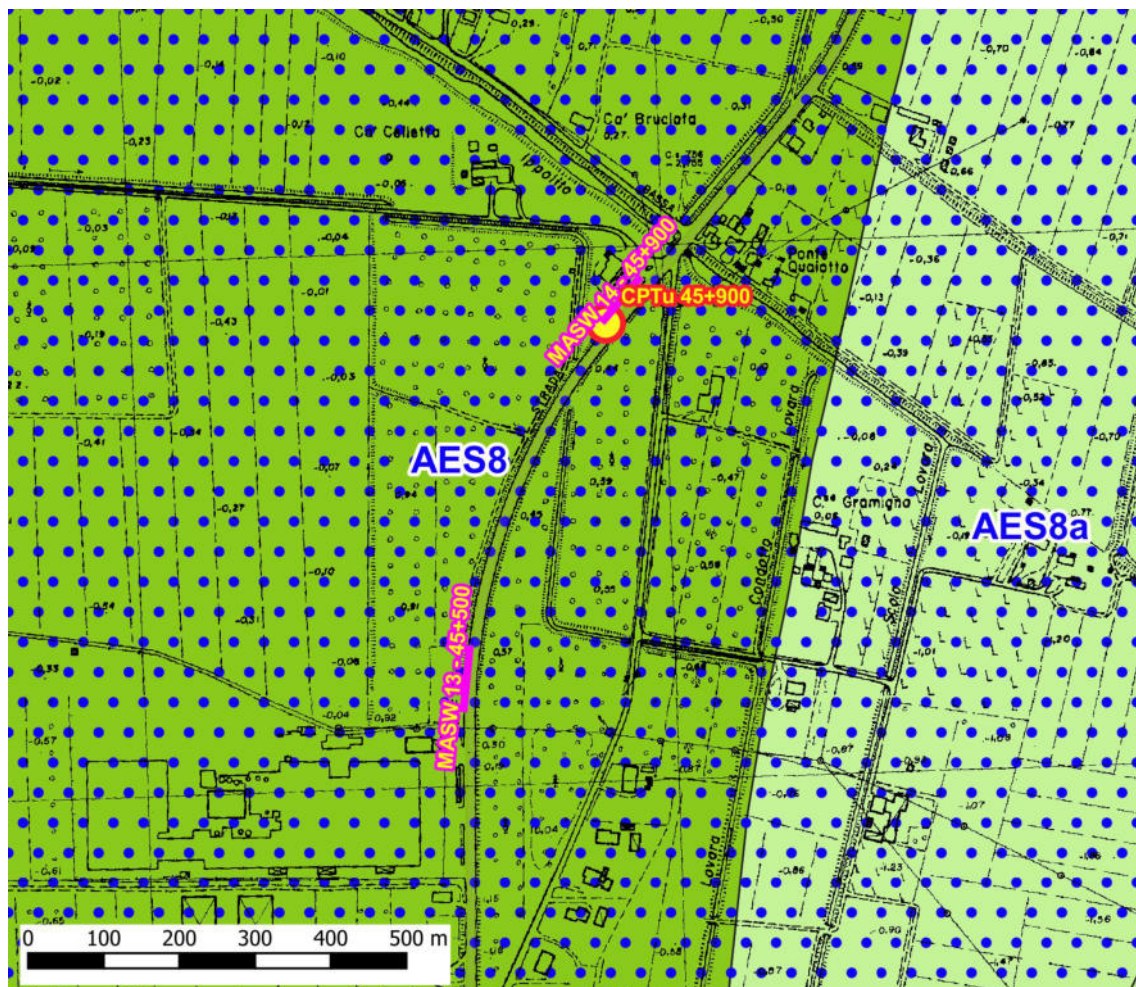


Figura 32 – Inquadramento geologico dell'area relativa all'intervento n. 18



Sulla base degli esiti dell'indagine considerata per il sito di intervento n. 18, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE          | LIVELLI SATURI           |
|-----------|----------------------------|-------------------------------|--------------------------|
| 1         | 0,0 – 1,4                  | Sabbia e sabbia limosa        | -                        |
| 2         | 1,4 – 5,1                  | Sabbia e sabbia limosa        | falda a ~ -2,4 m da p.c. |
| 3         | 5,1 – 6,1                  | Sabbia limosa e limo sabbioso | ✓                        |
| 4         | 6,1 – 8,3                  | Sabbia e sabbia limosa        | ✓                        |
| 5         | 8,3 – 10,0                 | Sabbia e sabbia limosa        | ✓                        |

**Tabella 31** – Modello geologico relativo all'intervento n. 18

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE          | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|-------------------------------|------------|-------------|-------------|-----------|
| 1         | 0,0 – 1,4                  | Sabbia e sabbia limosa        | 38         | -           | 22          | 43        |
| 2         | 1,4 – 5,1                  | Sabbia e sabbia limosa        | 36         | -           | 42          | 81        |
| 3         | 5,1 – 6,1                  | Sabbia limosa e limo sabbioso | 34         | -           | 38          | 61        |
| 4         | 6,1 – 8,3                  | Sabbia e sabbia limosa        | 35         | -           | 50          | 101       |
| 5         | 8,3 – 10,0                 | Sabbia e sabbia limosa        | 36         | -           | 61          | 123       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 32** – Modello geotecnico relativo all'intervento n. 18

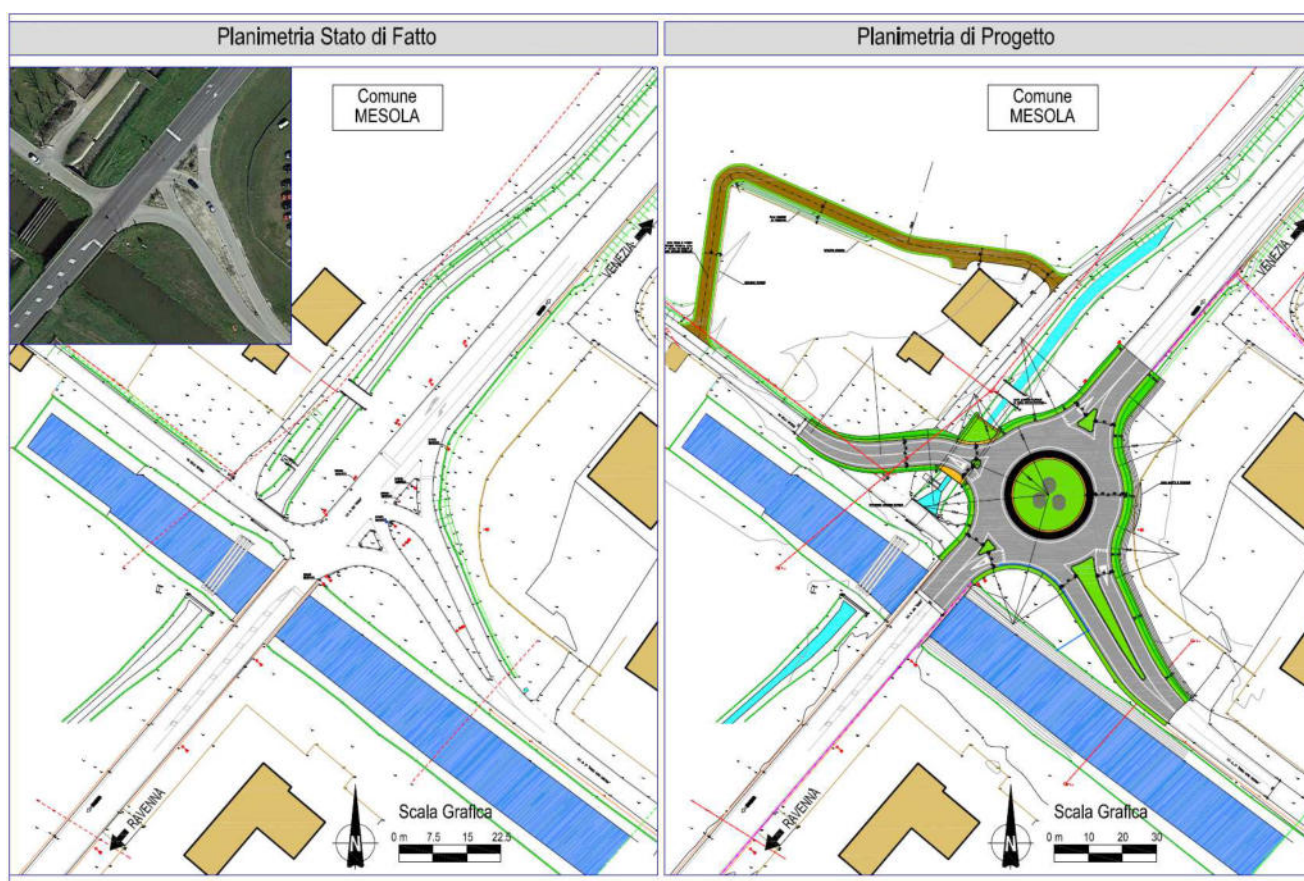
Le indagini MASW eseguite hanno permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo C** (rif. NTC 2018).

## 4.10 Intervento n. 19 – Intersezione S.C. Cristina al km 50+700

L'intervento n. 19 prevede la sostituzione di un'intersezione a raso, in prossimità dell'innesto della Strada Provinciale S.P. 27 "Roma Goro Cristina", in Comune di Mesola, località Santa Cristina, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è la "rotatoria convenzionale" a due corsie di larghezza pari a 3,5 m e banchine laterali da 1 m, caratterizzata da un diametro esterno compreso tra 40 e 50 m e da un'isola centrale di diametro 26 m.

Sarà realizzata anche una nuova strada di accesso a delle proprietà private, della larghezza di 4.00 m, con finitura in misto naturale stabilizzato.



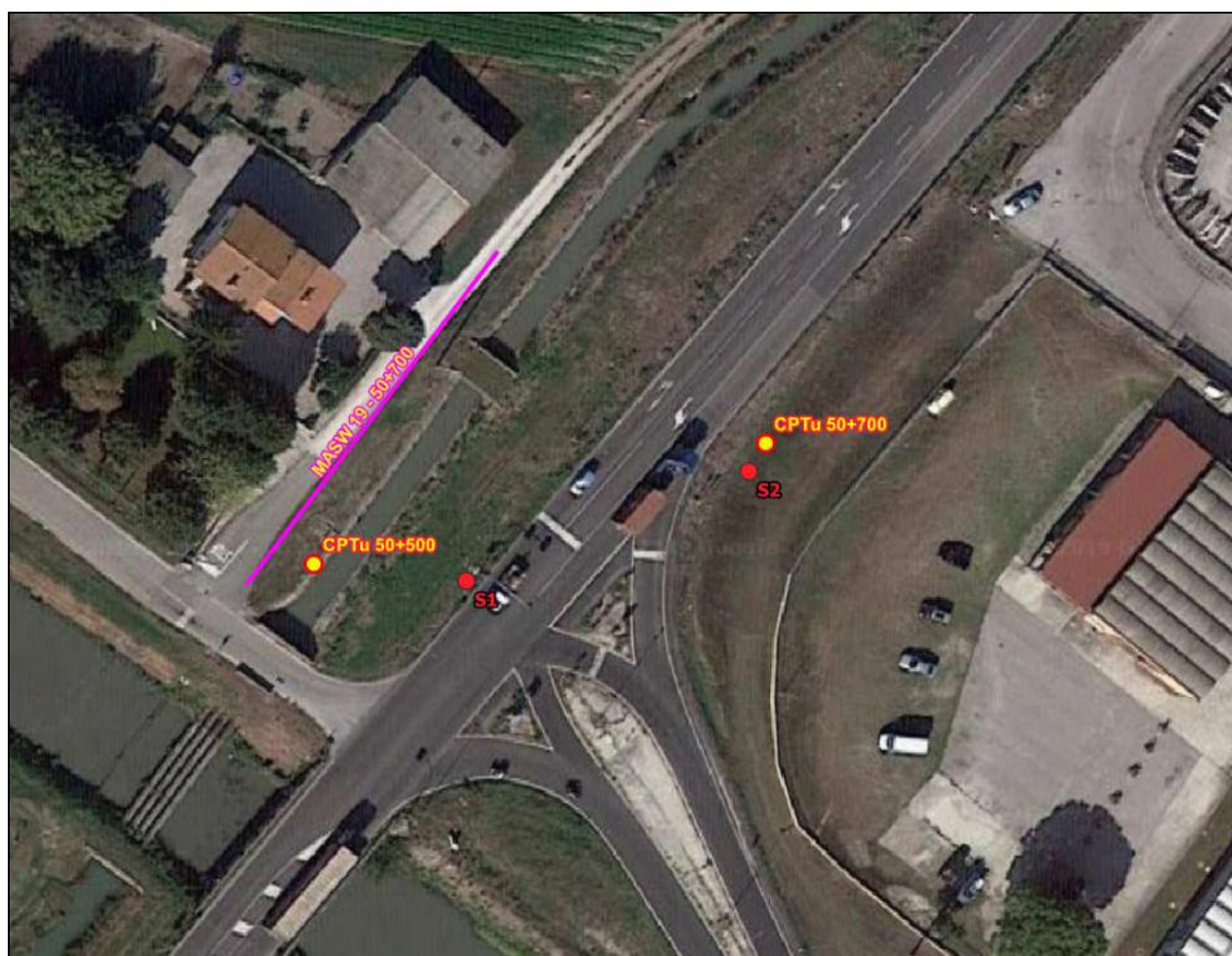
**Figura 33** – Intervento n. 19 – Planimetria Stato di Fatto e di Progetto

#### 4.10.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu, n. 2 sondaggi con SPT, e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| CPTu            | 18       | CPTu Km 50+500      |
|                 | 19       | CPTu Km 50+700      |
| SONDAGGIO       | 1        | S1                  |
|                 | 2        | S2                  |
| MASW            | 19       | MASW 19 - Km 50+700 |

**Tabella 33** – Prove eseguite nell'area relativa all'intervento n. 19 (I.P.G. s.n.c.)



**Figura 34** – Ubicazione indagini nell'area relativa all'intervento n. 19



#### 4.10.2 Modello geologico e geotecnico locale

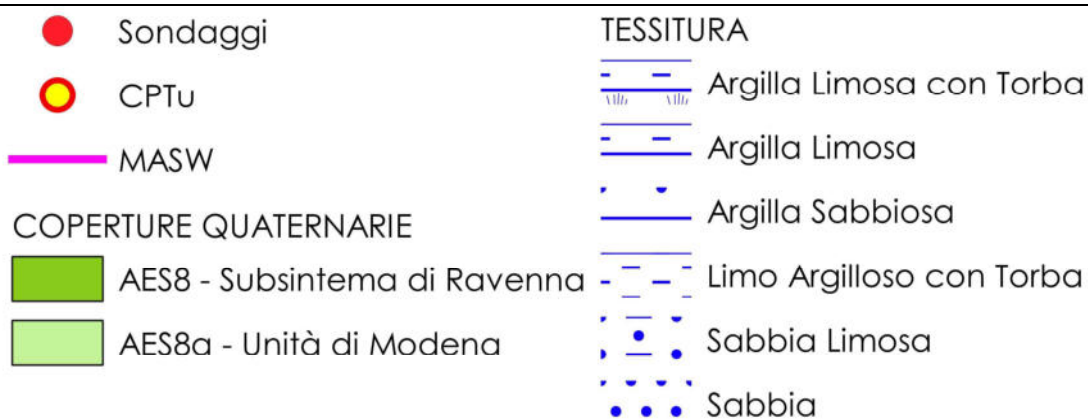


Figura 35 – Inquadramento geologico dell'area relativa all'intervento n. 19

Sulla base degli esiti delle indagini considerate per il sito di intervento n. 19, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m)  | LITOLOGIA PREVALENTE   | LIVELLI SATURI                |
|-----------|-----------------------------|--|-------------------------------|
| 1         | 0,0 - 1,8                   | Sabbia e sabbia limosa   | -                             |
| 2         | 1,8 - 8,6                   | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso talvolta con torba   | falda ~ -2,2 ÷ -2,7 m da p.c. |
| 3         | 8,6 - (9,0 ÷ 9,6)           | Argilla e limo con torba (maggiormente presente nella prova n. 18 Km 50+500 e in assottigliamento nella prova n. 19 Km 50+700) | ✓                             |
| 4         | (9,0 ÷ 9,6) - (11,2 ÷ 11,8) | Sabbia e sabbia limosa   | ✓                             |
| 5         | (11,2 ÷ 11,8) - 13,6        | Sabbia limosa e limo sabbioso con intercalazioni di argilla  | ✓                             |
| 6         | 13,6 - >20,0                | Argilla con intercalazioni di sabbia limosa e limo sabbioso e limo argilloso   | ✓                             |

Tabella 34 - Modello geologico relativo all'intervento n. 19

| STRATO N. | PROFONDITA' da (m) - a (m)  | LITOLOGIA PREVALENTE   | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|-----------------------------|--|------------|-------------|-------------|-----------|
| 1         | 0,0 - 1,8                   | Sabbia e sabbia limosa   | 36         | -           | 22          | 40        |
| 2         | 1,8 - 8,6                   | Sabbia e sabbia limosa, con intercalazioni di limo sabbioso talvolta con torba | 37         | -           | 48          | 92        |
| 3         | 8,6 - (9,0 ÷ 9,6)           | Argilla e limo con torba   | -          | 22          | -           | 1         |
| 4         | (9,0 ÷ 9,6) - (11,2 ÷ 11,8) | Sabbia e sabbia limosa   | 35         | -           | 56          | 107       |
| 5         | (11,2 ÷ 11,8) - 13,6        | Sabbia limosa e limo sabbioso con intercalazioni argillose                     | 34         | -           | 58          | 45        |
| 6         | 13,6 - >20,0                | Argilla con intercalazioni di sabbia limosa e limo sabbioso e limo argilloso   | -          | 50          | -           | 5         |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

Tabella 35 - Modello geotecnico relativo all'intervento n. 19

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una categoria di sottosuolo di tipo C (rif. NTC 2018).



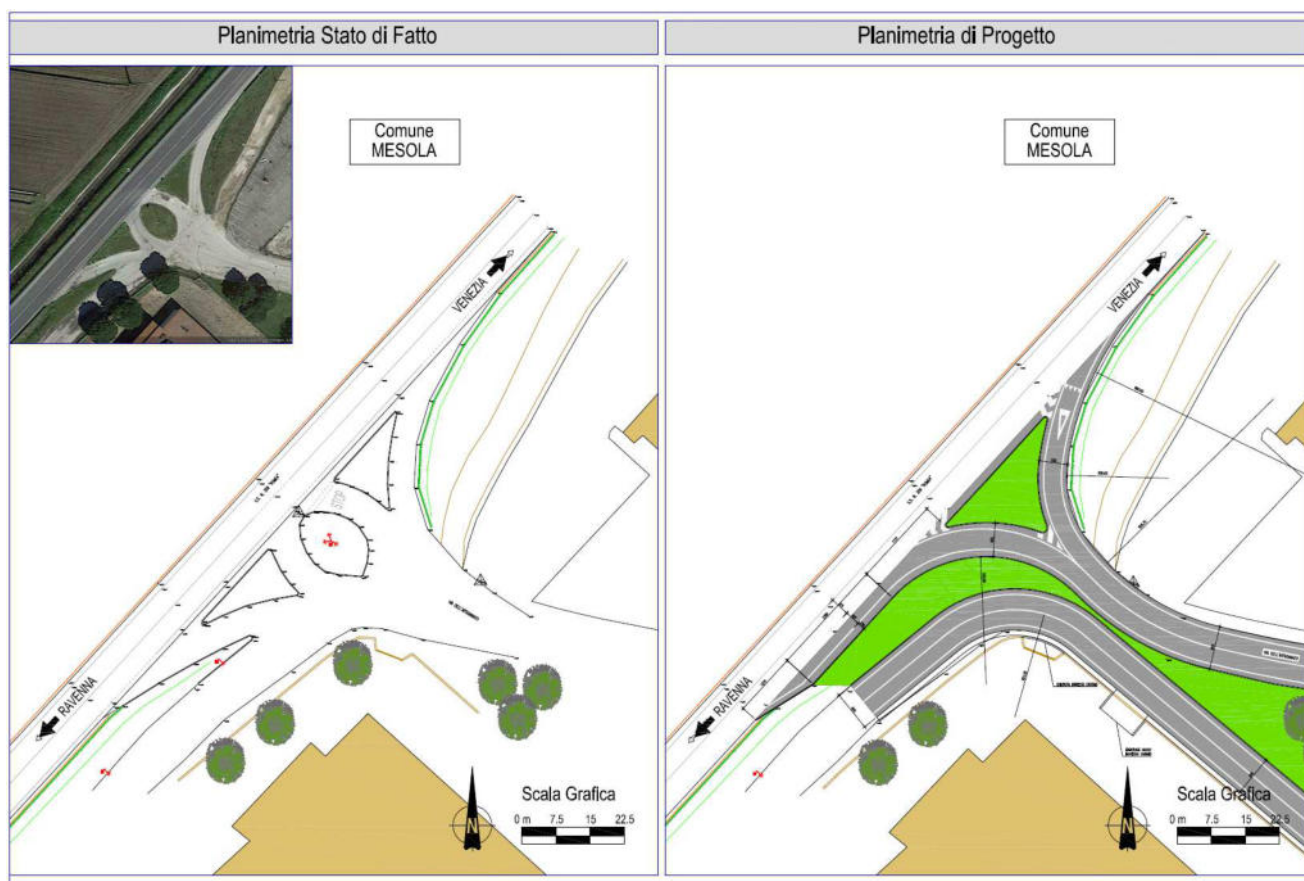
## 4.11 Intervento n. 20 – Intersezione S.C. Dell'Artigianato al km 51+300

L'intervento n°20, sito in Comune di Mesola, in località Ribaldesca all'intersezione fra la S.S.309 e Via Dell'Artigianato, prevede l'adeguamento dell'intersezione a raso a T esistente eliminando le corsie di svolta a sinistra, e chiudendo l'accesso all'intersezione di una viabilità locale minore, che viene prolungata verso una strada interna alla Zona Industriale.

L'intersezione modificata avrà un solo ramo d'ingresso, per i veicoli provenienti da Ravenna che svoltano su via Dell'Artigianato, ed un solo ramo di uscita per i veicoli che da Via Dell'Artigianato imboccano la S.S. 309 in direzione Venezia.

L'isola divisoria sarà ricostruita con una nuova cordonata, mantenendo i vertici delle aiuole spartitraffico esistenti, e l'aiuola al suo interno sarà sistemata a verde.

Nell'area interessata all'intervento n. 20 non sono state realizzate prove geognostiche e sismiche.

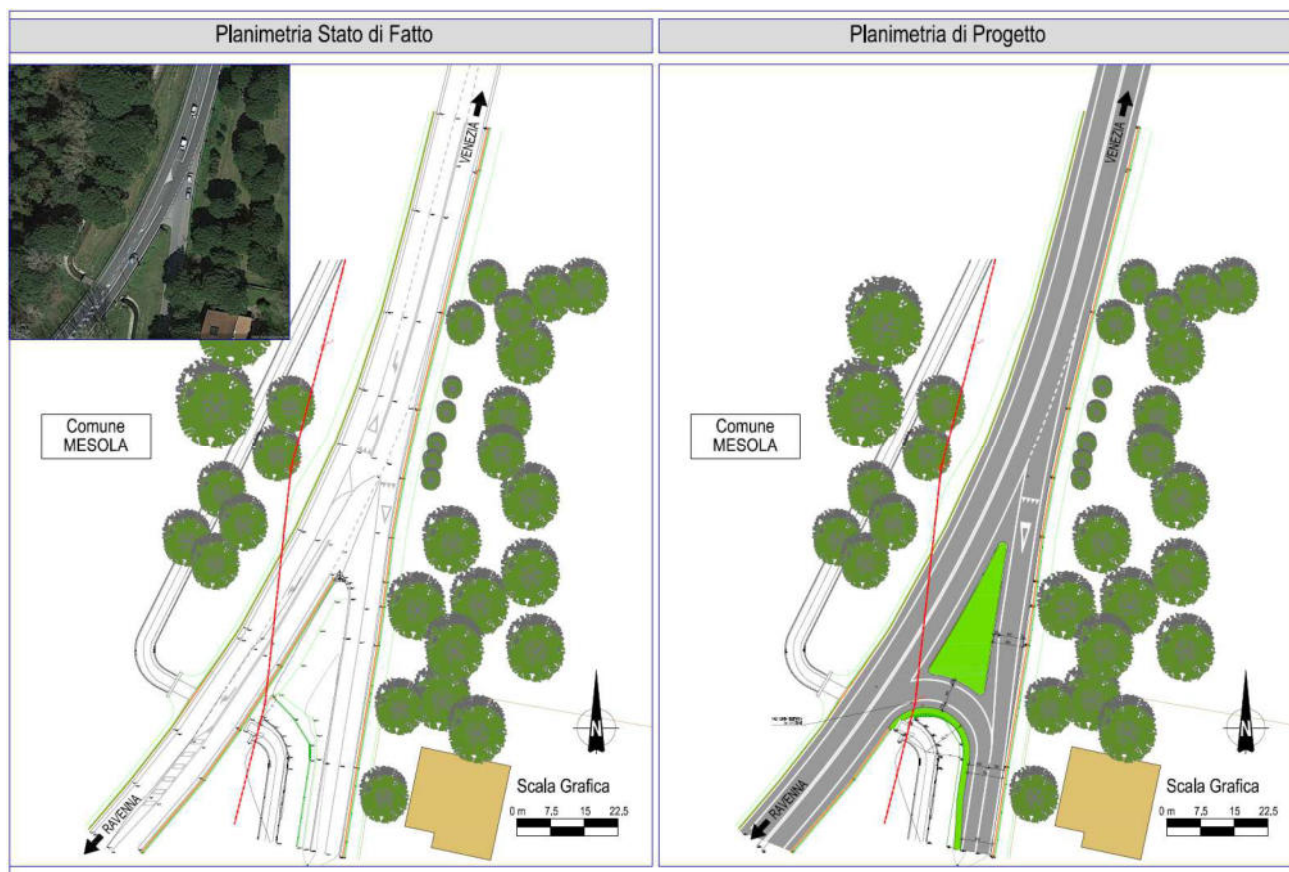


**Figura 36 – Intervento n. 20 – Planimetria Stato di Fatto e di Progetto**

## 4.12 Intervento n. 21 – Intersezione S.P.N. 51 al km 52+800

L'intervento n. 21, sito in Comune di Mesola, in località Ribaldesca all'intersezione fra la S.S.309, e la Strada Provinciale S.P. 51, prevede l'inserimento di una corsia specializzata di svolta a sinistra, per uscire dalla S.P. 51 ed imboccare la S.S. 309 in direzione Ravenna. Sarà eliminata anche la corsia specializzata di accumulo e svolta a sinistra, per i mezzi che percorrendo la S.S. 309 in direzione Ravenna si immettono sulla S.P. 51.

L'intervento prevede di realizzare la corsia di svolta su un terreno a piano campagna, che non necessita di rilevati, di lunghezza di circa 25 m, per una larghezza di 6,5 m, che si raccorda alla pavimentazione esistente.



**Figura 37 – Intervento n. 21 – Planimetria Stato di Fatto e di Progetto**

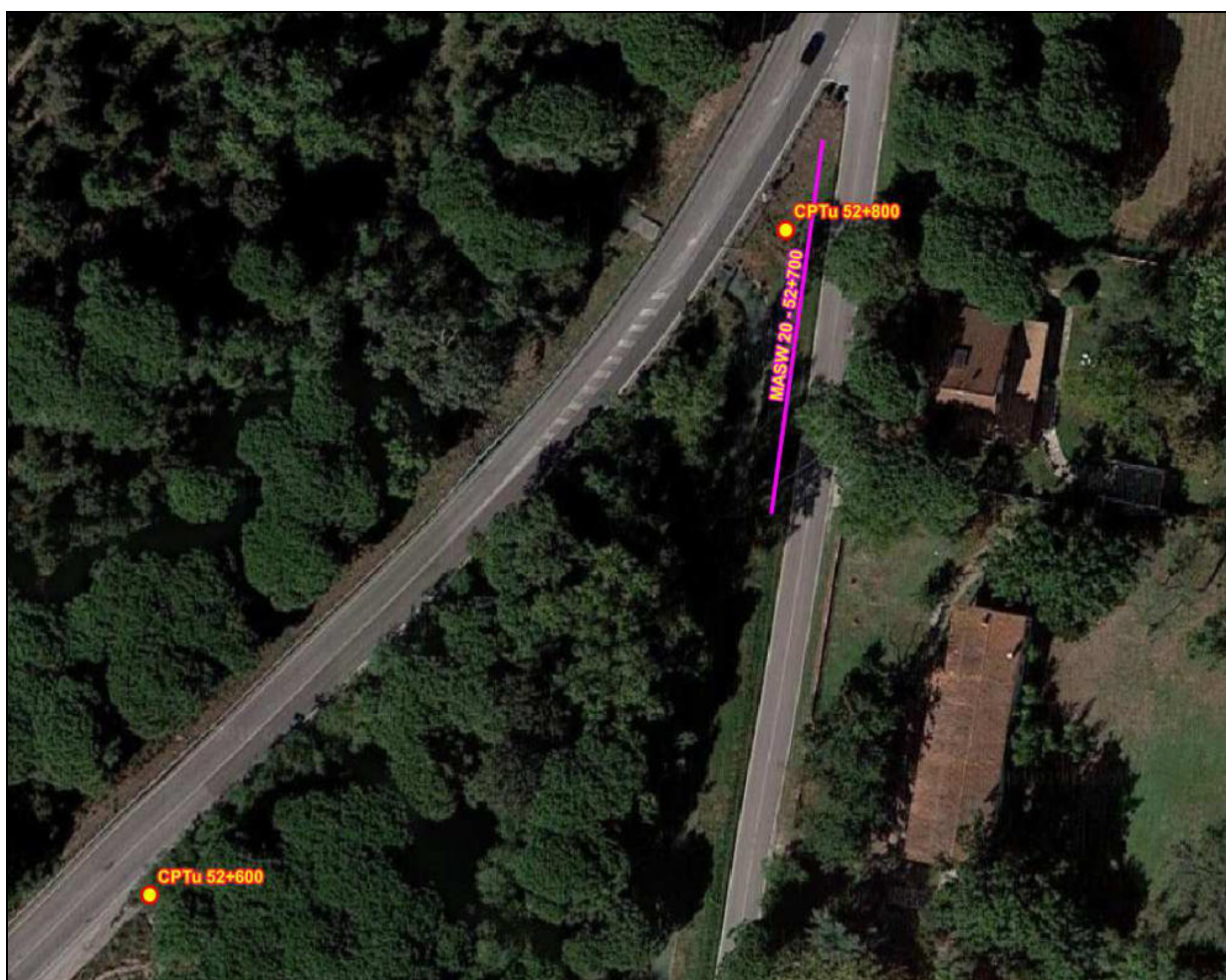


#### 4.12.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 2 prove CPTu e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. | NOME                |
|-----------------|----|---------------------|
| CPTu            | 20 | CPTu Km 52+600      |
|                 | 21 | CPTu Km 52+800      |
| MASW            | 20 | MASW 20 - Km 52+700 |

**Tabella 36** – Prove eseguite nell'area relativa all'intervento n. 21 (I.P.G. s.n.c.)



**Figura 38** – Ubicazione indagini nell'area relativa all'intervento n. 21

#### 4.12.2 Modello geologico e geotecnico locale

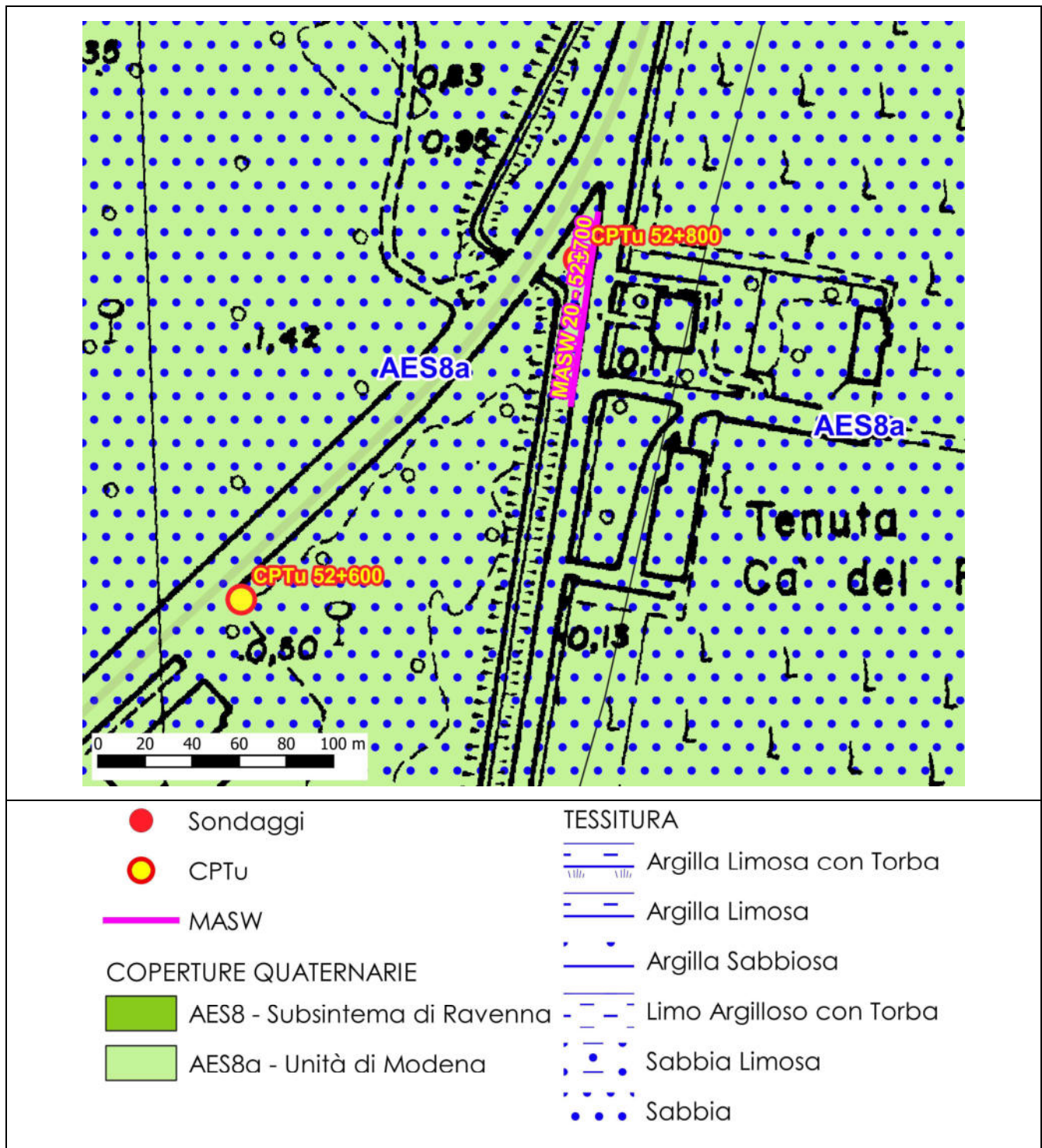


Figura 39 – Inquadramento geologico dell'area relativa all'intervento n. 21



Sulla base degli esiti delle indagini considerate per il sito di intervento n. 21, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI                |
|-----------|----------------------------|---|-------------------------------|
| 1         | 0,0 - 1,5                  | Sabbia e sabbia limosa  | falda ~ -1,4 ÷ -1,5 m da p.c. |
| 2         | 1,5 - 2,5                  | Sabbia, sabbia limosa e limo sabbioso (maggiormente presente nella prova n. 21 Km 52+800 e in assottigliamento nella prova n. 20 Km 52+600) | ✓                             |
| 3         | 2,5 - (6,3 ÷ 7,1)          | Sabbia e sabbia limosa con intercalazioni di limo e limo sabbioso   | ✓                             |
| 4         | (6,3 ÷ 7,1) - (8,0 ÷ 8,7)  | Sabbia limosa e limo sabbioso   | ✓                             |
| 5         | (8,0 ÷ 8,7) - (8,9 ÷ 9,1)  | Argilla e argilla limosa (maggiormente presente nella prova n. 21 Km 52+800 e in assottigliamento nella prova n. 20 Km 52+600)              | ✓                             |
| 6         | (8,9 ÷ 9,1) - >10          | Sabbia e sabbia limosa  | ✓                             |

**Tabella 37** – Modello geologico relativo all'intervento n. 21

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 - 1,5                  | Sabbia e sabbia limosa  | 38         | -           | 24          | 48        |
| 2         | 1,5 - 2,5                  | Sabbia, sabbia limosa e limo sabbioso                             | 37         | -           | 36          | 72        |
| 3         | 2,5 - (6,3 ÷ 7,1)          | Sabbia e sabbia limosa con intercalazioni di limo e limo sabbioso | 37         | -           | 44          | 82        |
| 4         | (6,3 ÷ 7,1) - (8,0 ÷ 8,7)  | Sabbia limosa e limo sabbioso                                     | 35         | -           | 44          | 63        |
| 5         | (8,0 ÷ 8,7) - (8,9 ÷ 9,1)  | Argilla e argilla limosa  | -          | 70          | -           | 17        |
| 6         | (8,9 ÷ 9,1) - >10          | Sabbia e sabbia limosa  | 36         | -           | 54          | 108       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

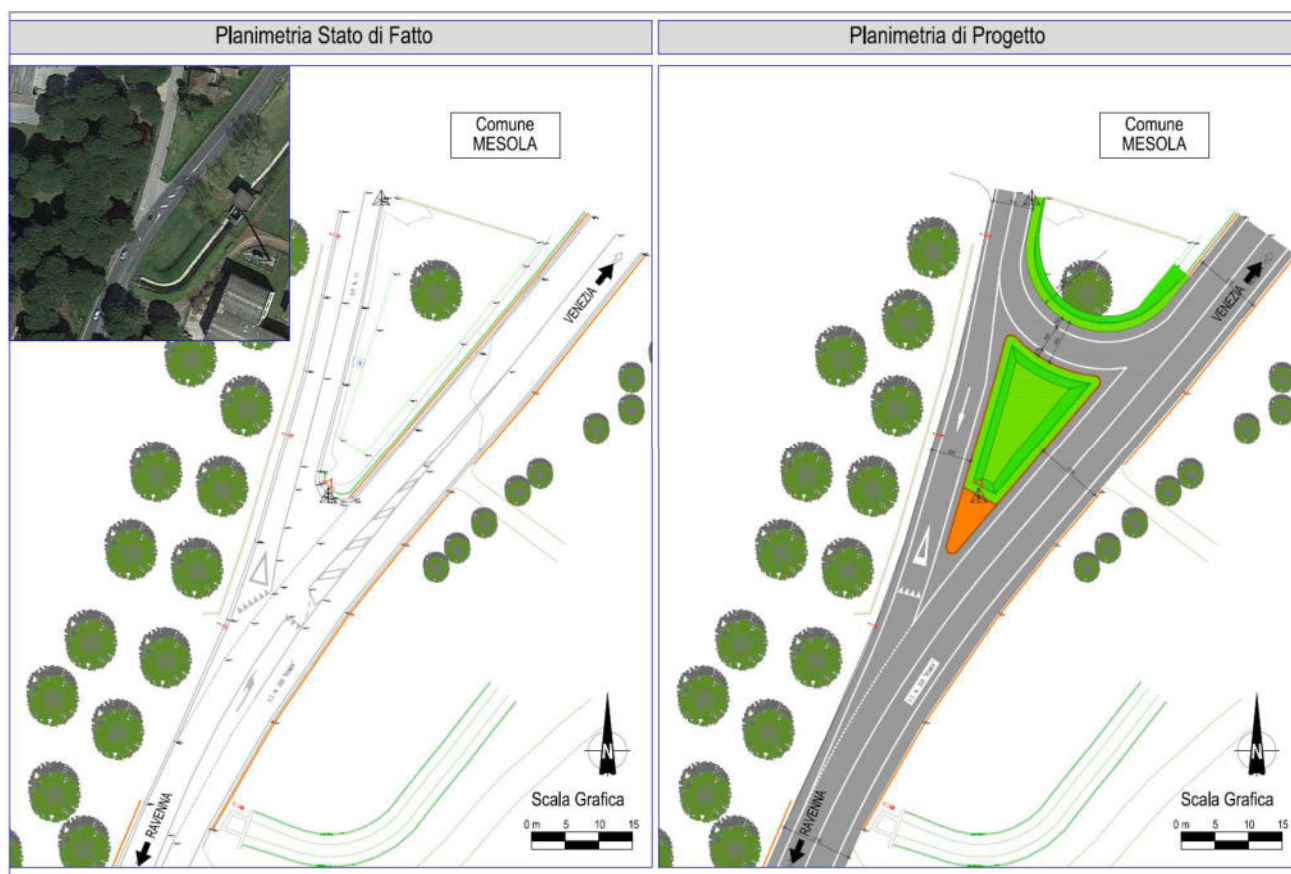
**Tabella 38** – Modello geotecnico relativo all'intervento n. 21

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo C**, al limite con una categoria D (rif. NTC 2018).

## 4.13 Intervento n. 22 – Intersezione S.C. Motte al km 54+000

L'intervento n. 22, sito in Comune di Mesola all'intersezione fra la S.S. 309, e la Strada Provinciale S.P. 11, prevede l'inserimento di una corsia specializzata di svolta a destra, per i mezzi che provengono dalla S.S.309 in direzione Ravenna ed imboucano la S.P. 11. Sarà eliminata anche la corsia specializzata di accumulo e svolta a sinistra, per i mezzi che percorrendo la S.S. 309 in direzione Venezia si immettono sulla S.P. 11.

L'intervento prevede di realizzare la corsia di svolta su un terreno a piano campagna, che non necessita di rilevati, di lunghezza di circa 27 m, per una larghezza di 6,5 m, che si raccorda alla pavimentazione esistente.



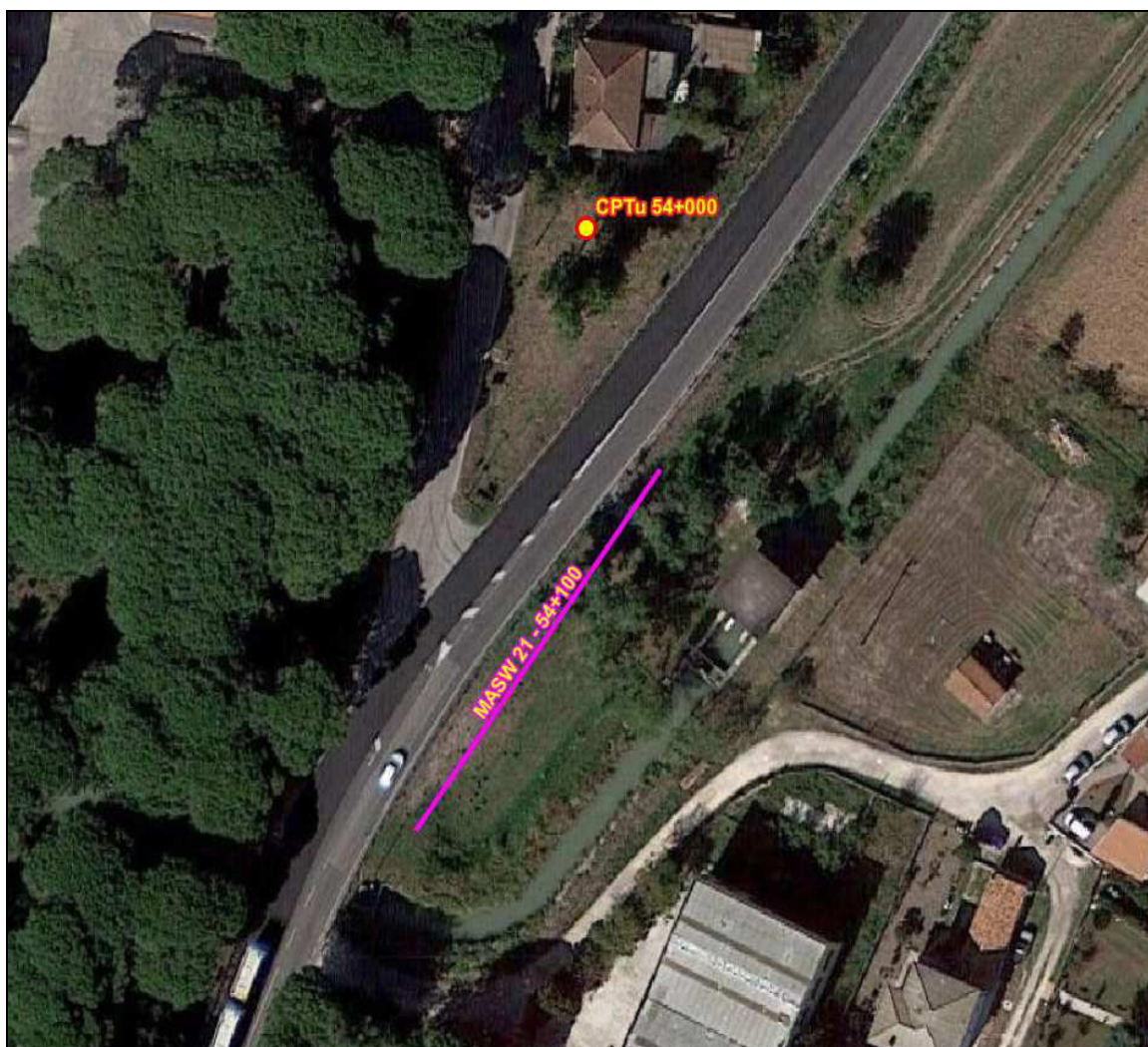
**Figura 40** – Intervento n. 22 – Planimetria Stato di Fatto e di Progetto

#### 4.13.1 Indagini eseguite

Nell'area interessata dall'opera, è stata effettuata n. 1 prova CPTu e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| CPTu            | 23       | CPTu Km 54+000      |
| MASW            | 21       | MASW 21 - Km 54+100 |

**Tabella 39** – Prove eseguite nell'area relativa all'intervento n. 22 (I.P.G. s.n.c.)



**Figura 41** – Ubicazione indagini nell'area relativa all'intervento n. 22



#### 4.13.2 Modello geologico e geotecnico locale



|                                |                            |
|--------------------------------|----------------------------|
| ● Sondaggi                     | TESSITURA                  |
| ● CPTu                         | — Argilla Limosa con Torba |
| — MASW                         | — Argilla Limosa           |
| COPERTURE QUATERNARIE          | — Argilla Sabbiosa         |
| ■ AES8 - Subsistema di Ravenna | — Limo Argilloso con Torba |
| ■ AES8a - Unità di Modena      | ● Sabbia Limosa            |
|                                | ● Sabbia                   |

Figura 42 – Inquadramento geologico dell'area relativa all'intervento n. 22



Sulla base degli esiti delle indagini considerate per il sito di intervento n. 22, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI           |
|-----------|----------------------------|---|--------------------------|
| 1         | 0,0 – 1,0                  | Sabbia e sabbia limosa                                      | -                        |
| 2         | 1,0 – 2,2                  | Sabbia e sabbia limosa                                      | falda a ~ -1,9 m da p.c. |
| 3         | 2,2 – 5,5                  | Sabbia e sabbia limosa                                      | ✓                        |
| 4         | 5,5 – 7,1                  | Sabbia e sabbia limosa con intercalazioni di argilla e limo | ✓                        |
| 5         | 7,1 – 8,9                  | Argilla   | ✓                        |
| 6         | 8,9 – >10,0                | Sabbia e sabbia limosa                                      | ✓                        |

**Tabella 40** – Modello geologico relativo all'intervento n. 22

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 – 1,0                  | Sabbia e sabbia limosa                                      | 37         | -           | 16          | 33        |
| 2         | 1,0 – 2,2                  | Sabbia e sabbia limosa                                      | 37         | -           | 34          | 69        |
| 3         | 2,2 – 5,5                  | Sabbia e sabbia limosa                                      | 38         | -           | 48          | 95        |
| 4         | 5,5 – 7,1                  | Sabbia e sabbia limosa con intercalazioni di argilla e limo | 36         | -           | 45          | 60        |
| 5         | 7,1 – 8,9                  | Argilla   | -          | 40          | -           | 6         |
| 6         | 8,9 – >10,0                | Sabbia e sabbia limosa                                      | 37         | -           | 63          | 126       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

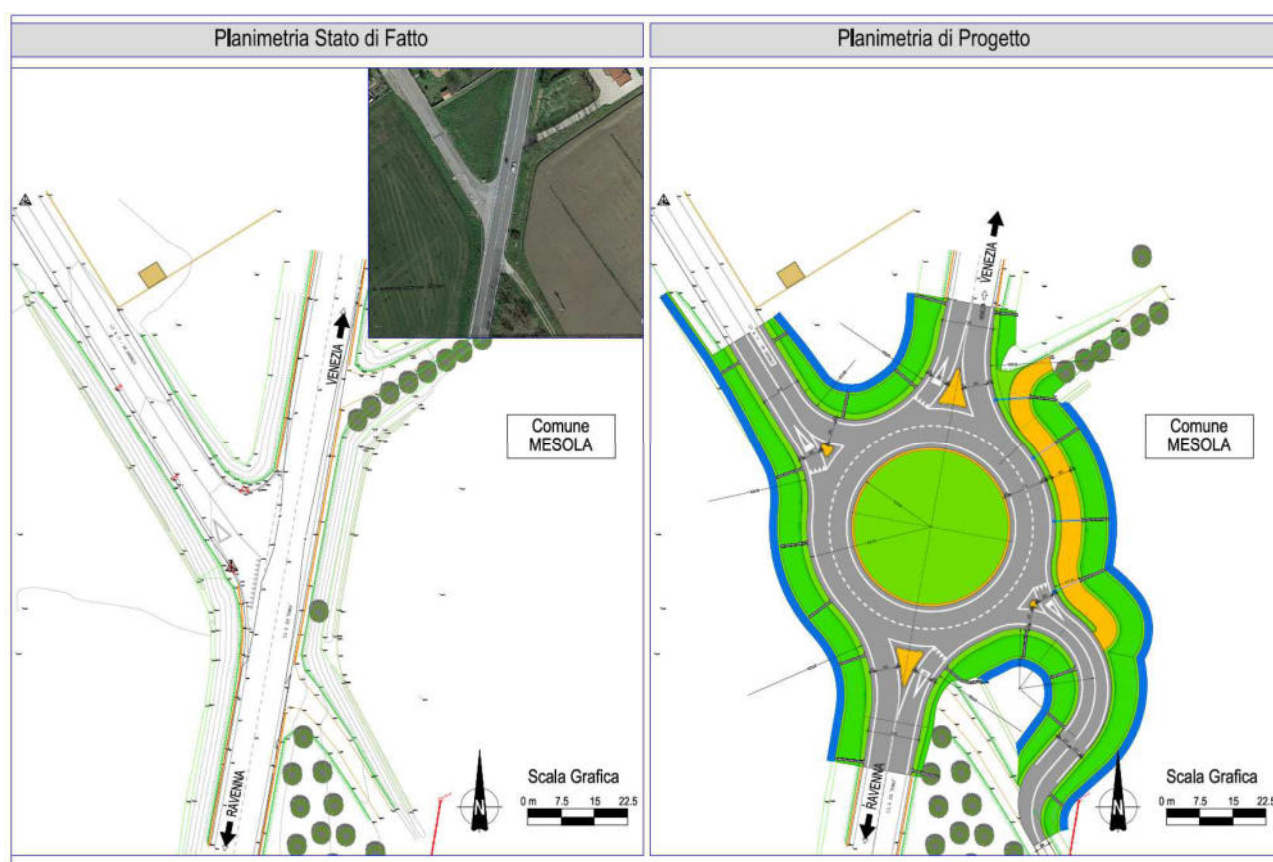
**Tabella 41** – Modello geotecnico relativo all'intervento n. 22

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo D** (rif. NTC 2018).

#### 4.14 Intervento n. 23 – Intersezione S.P. 11 Via Garibaldi al km 54+500

L'intervento n. 23 prevede la sostituzione di un'intersezione a 'T', ubicata in comune di Mesola, in prossimità dell'innesto della Strada Provinciale S.P. 11 - Via Garibaldi, con una nuova rotatoria.

La tipologia di rotatoria scelta per questo intervento è la "rotatoria convenzionale" a due corsie di larghezza pari a 3,5 m e banchine laterali da 1 m, caratterizzata da un diametro esterno compreso tra 40 e 50 m e da un'isola centrale di diametro 32 m.



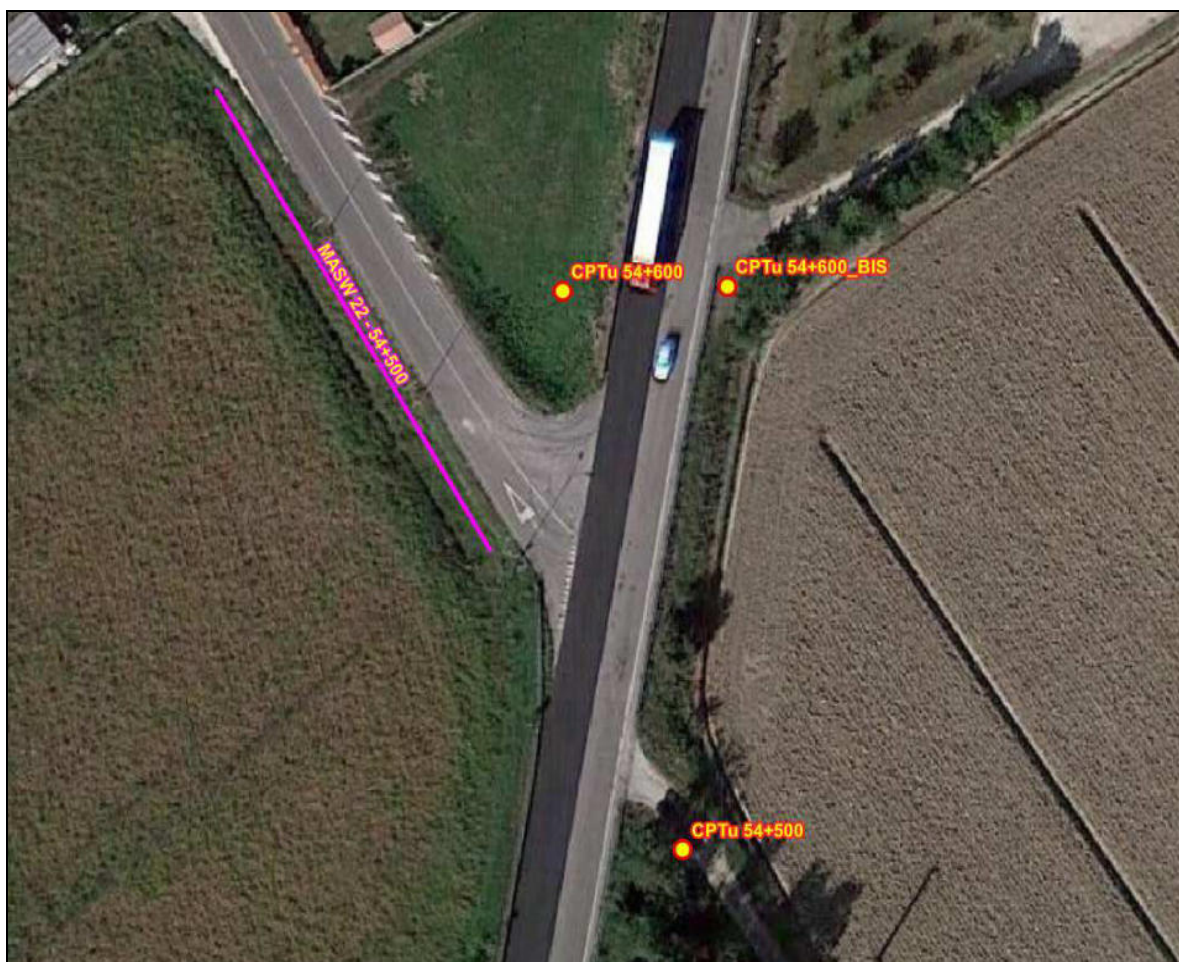
**Figura 43** – Intervento n. 23 – Planimetria Stato di Fatto e di Progetto

#### 4.14.1 Indagini eseguite

Nell'area interessata dall'opera, sono state effettuate n. 3 prove CPTu e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| <b>CPTu</b>     | 24       | CPTu Km 54+500      |
|                 | 25       | CPTu Km 54+600      |
|                 | 26       | CPTu Km 54+600_BIS  |
| <b>MASW</b>     | 22       | MASW 22 - Km 54+500 |

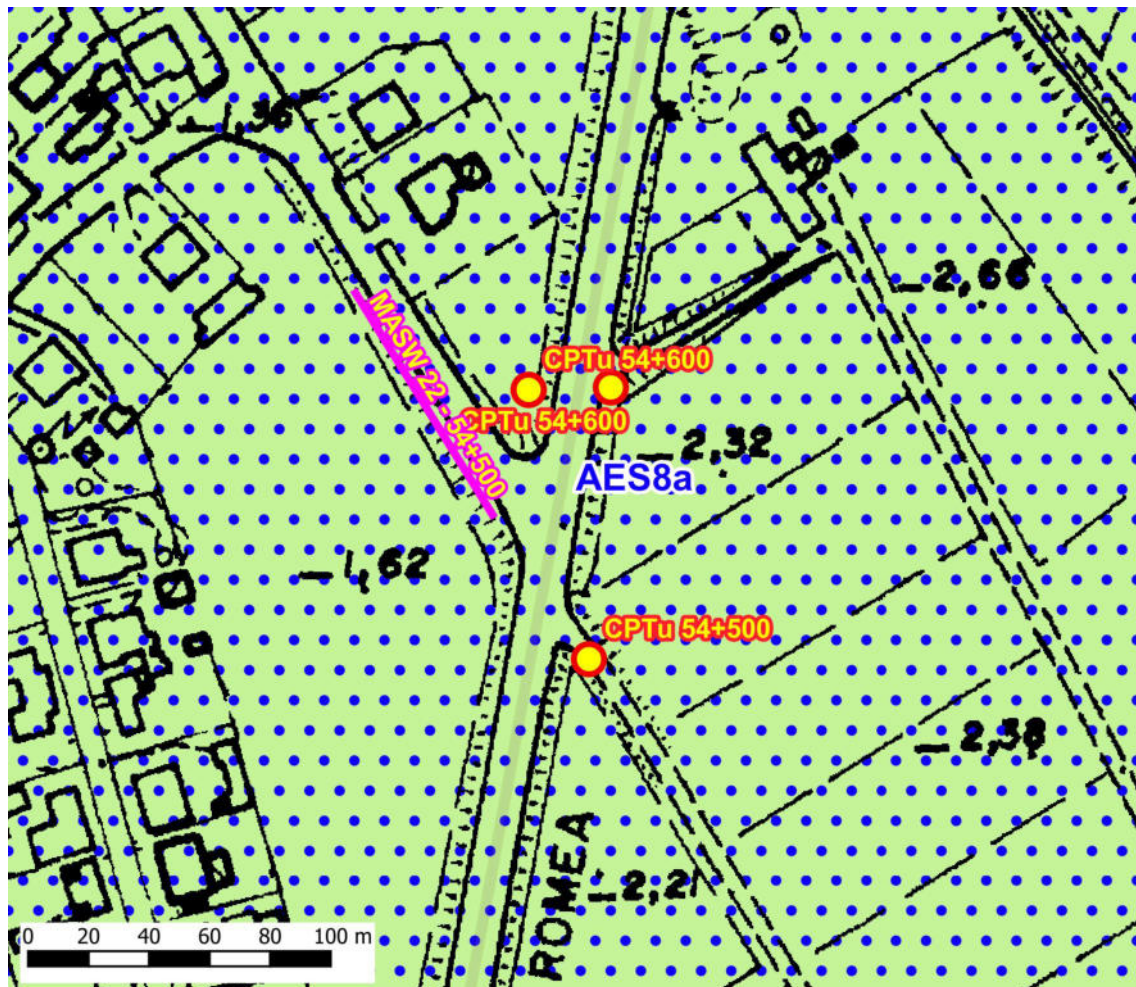
**Tabella 42** – Prove eseguite nell'area relativa all'intervento n. 23 (I.P.G. s.n.c.)



**Figura 44** – Ubicazione indagini nell'area relativa all'intervento n. 23



#### 4.14.2 Modello geologico e geotecnico locale











|  |  |
|--|--|
| <span style="color: red;">●</span> Sondaggi  | TESSITURA  |
| <span style="color: red; border: 1px solid yellow; border-radius: 50%; padding: 2px;">●</span> CPTu              |  Argilla Limosa con Torba |
| <span style="color: magenta;">—</span> MASW  |  Argilla Limosa           |
| <b>COPERTURE QUATERNARIE</b>   |  Argilla Sabbiosa         |
|  AES8 - Subsintema di Ravenna |  Limo Argilloso con Torba |
|  AES8a - Unità di Modena      |  Sabbia Limosa            |
|  |  Sabbia                   |

Figura 45 – Inquadramento geologico dell'area relativa all'intervento n. 23



Sulla base degli esiti delle indagini considerate per il sito di intervento n. 23, sono stati definiti due differenti modelli geologici e due differenti modelli geotecnici: infatti, le n. 3 prove considerate, hanno manifestato alcune differenze litologiche importanti, che si è ritenuto opportuno evidenziare con modellazioni differenti, una per l'area interessata dalle prove n. 25 e n. 26, entrambe al Km 54+600, ed una per l'area interessata dalla prova n. 24 al Km 54+500, ubicata ad una certa distanza rispetto alle restanti (cfr. Figura 45).

### **Modelli per la prova n. 24 al Km 54+500**

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE          | LIVELLI SATURI           |
|-----------|----------------------------|-------------------------------|--------------------------|
| 1         | 0,0 – 1,6                  | Sabbia e sabbia limosa        | -                        |
| 2         | 1,6 – 2,5                  | Argilla                       | -                        |
| 3         | 2,5 – 4,8                  | Sabbia limosa e limo sabbioso | falda a ~ -2,6 m da p.c. |
| 4         | 4,8 – 6,3                  | Sabbia e sabbia limosa        | ✓                        |
| 5         | 6,3 – 9,1                  | Argilla e argilla limosa      | ✓                        |
| 6         | 9,1 – 10,0                 | Sabbia e sabbia limosa        | ✓                        |

**Tabella 43** – Modello geologico relativo all'intervento n. 23 – prova n. 24 al Km 54+500

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE          | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|-------------------------------|------------|-------------|-------------|-----------|
| 1         | 0,0 – 1,6                  | Sabbia e sabbia limosa        | 38         | -           | 20          | 30        |
| 2         | 1,6 – 2,5                  | Argilla                       | -          | 73          | -           | 16        |
| 3         | 2,5 – 4,8                  | Sabbia limosa e limo sabbioso | 34         | -           | 32          | 49        |
| 4         | 4,8 – 6,3                  | Sabbia e sabbia limosa        | 35         | -           | 43          | 86        |
| 5         | 6,3 – 9,1                  | Argilla e argilla limosa      | -          | 40          | -           | 10        |
| 6         | 9,1 – 10,0                 | Sabbia e sabbia limosa        | 36         | -           | 60          | 120       |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 44** – Modello geotecnico relativo all'intervento n. 23 – prova n. 24 al Km 54+500

## Modelli per le prove n. 25 e n. 26 al Km 54+600

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | LIVELLI SATURI                |
|-----------|----------------------------|---|-------------------------------|
| 1         | 0,0 - (0,9 ÷ 1,3)          | Sabbia limosa e limo sabbioso                                 | -                             |
| 2         | (0,9 ÷ 1,3) - 4,4          | Sabbia e sabbia limosa, con intercalazioni limoso sabbiose    | falda ~ -1,4 ÷ -2,3 m da p.c. |
| 3         | 4,4 - 6,7                  | Sabbia e sabbia limosa, con intercalazioni argillose e limose | ✓                             |
| 4         | 6,7 - 7,7                  | Argilla e argilla limosa                                      | ✓                             |
| 5         | 7,7 - >10,0                | Sabbia e sabbia limosa, con intercalazioni limoso sabbiose    | ✓                             |

**Tabella 45** – Modello geologico relativo all'intervento n. 23 – prova n. 24 al Km 54+500

| STRATO N. | PROFONDITA' da (m) - a (m) | LITOLOGIA PREVALENTE  | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 - (0,9 ÷ 1,3)          | Sabbia limosa e limo sabbioso                                 | 38         | -           | 16          | 24        |
| 2         | (0,9 ÷ 1,3) - 4,4          | Sabbia e sabbia limosa, con intercalazioni limoso sabbiose    | 36         | -           | 30          | 55        |
| 3         | 4,4 - 6,7                  | Sabbia e sabbia limosa, con intercalazioni argillose e limose | 36         | -           | 47          | 90        |
| 4         | 6,7 - 7,7                  | Argilla e argilla limosa                                      | -          | 65          | -           | 14        |
| 5         | 7,7 - >10,0                | Sabbia e sabbia limosa, con intercalazioni limoso sabbiose    | 35         | -           | 50          | 93        |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 46** – Modello geotecnico relativo all'intervento n. 23 – prova n. 24 al Km 54+500

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo D** (rif. NTC 2018).

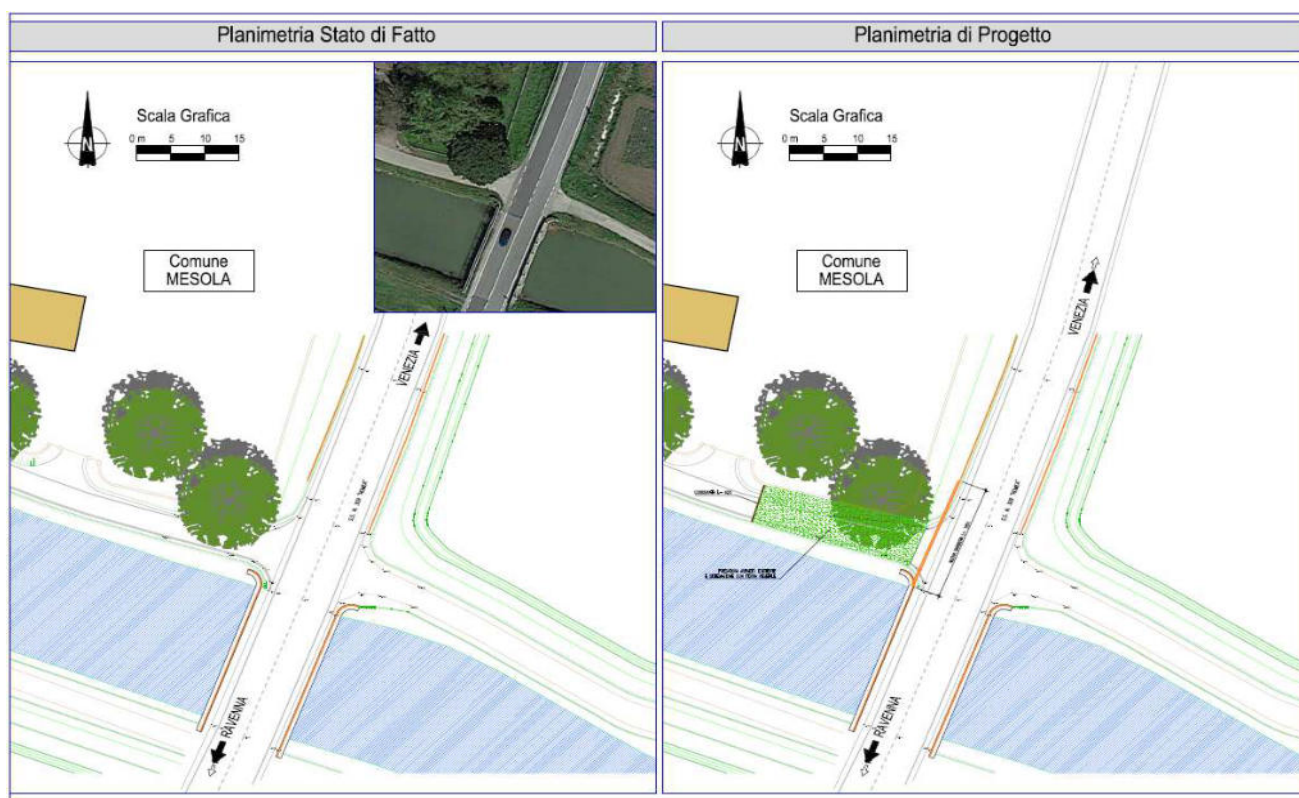
## 4.15 Intervento n. 24 – Intersezione S.C. per Goro al km 54+900

L'intervento n. 24 prevede la chiusura dell'innesto di Via Vinicio Migliorini, sulla S.S. 309, in Comune di Mesola.

Il tratto finale di Via Vinicio Migliorini, della lunghezza di 25 m, sarà fresato e sistemato a verde con terreno vegetale.

Sul lato lungo la S.S. 309 sarà installata una barriera guard-rail bordo laterale, che prevede l'installazione del profilo salva motociclisti, e che andrà raccordata alla barriera esistente.

Nell'area interessata all'intervento n. 24 non sono state realizzate prove geognostiche e sismiche.



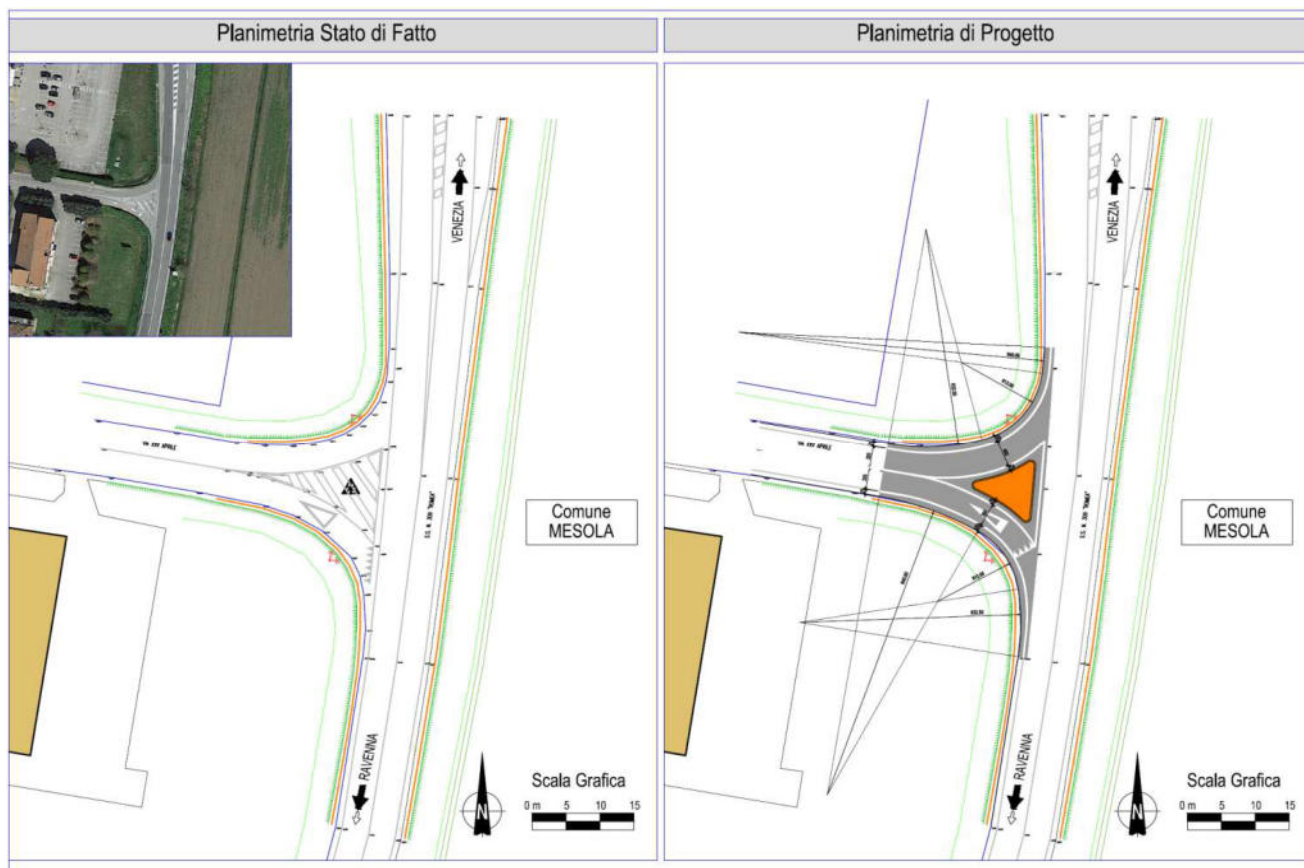
**Figura 46** – Intervento n. 24 – Planimetria Stato di Fatto e di Progetto



## 4.16 Intervento n. 25 – Intersezione S.C. XXV Aprile al km 55+100

L'intervento n. 25, sito in Comune di Mesola, all'intersezione tra la S.S. 309 e Via XXV Aprile, prevede la sistemazione dell'intersezione a raso a 'T' esistente.

Sarà realizzata un'isola spartitraffico con una cordonata, finita con elementi autobloccanti.



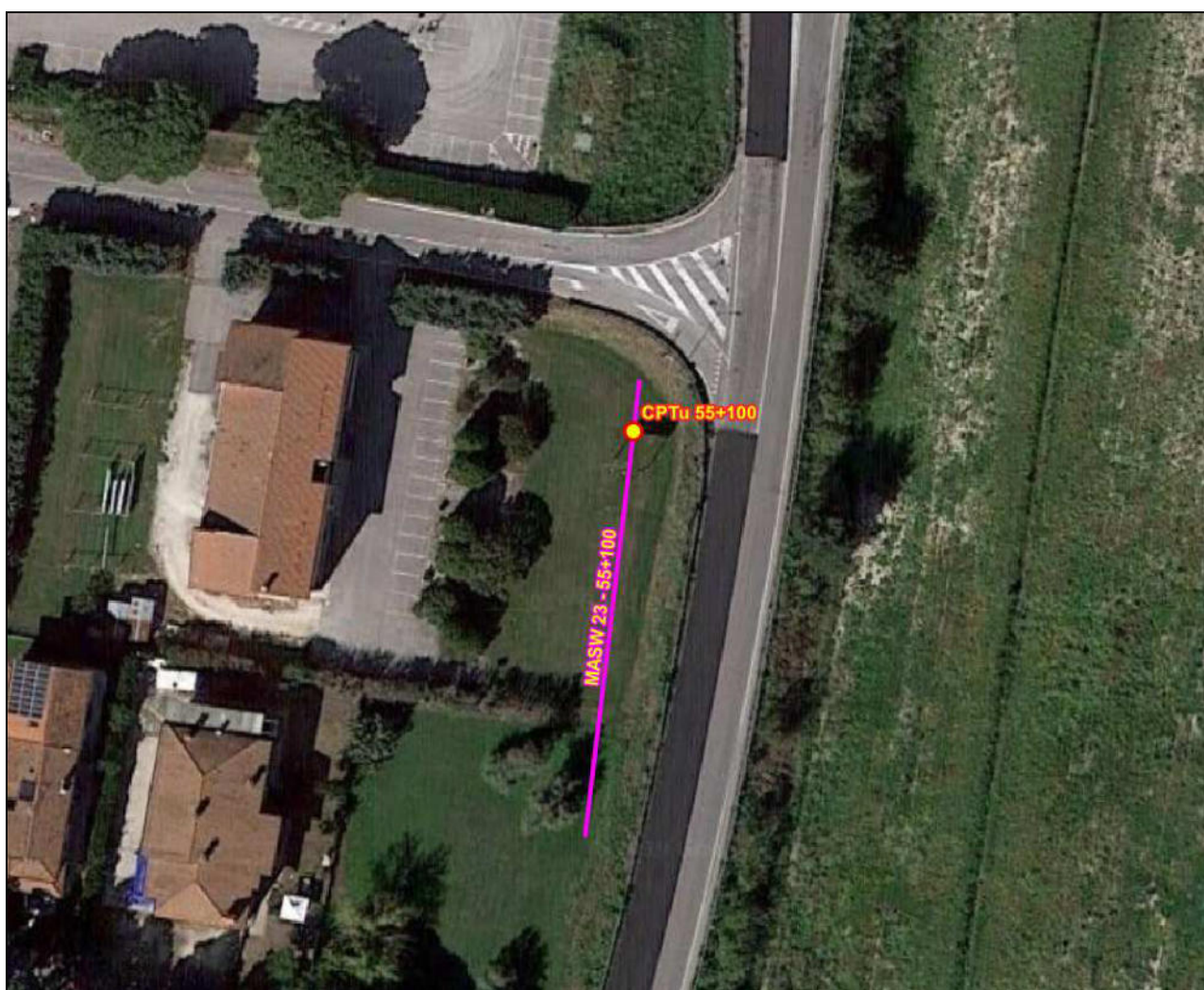
**Figura 47 – Intervento n. 25 – Planimetria Stato di Fatto e di Progetto**

#### 4.16.1 Indagini eseguite

Nell'area interessata dall'opera, è stata effettuata n. 1 prova CPTu e n. 1 stendimento MASW, eseguiti da **I.P.G. s.n.c.**, come di seguito indicato:

| TIPOLOGIA PROVA | N. PROVA | NOME                |
|-----------------|----------|---------------------|
| <b>CPTu</b>     | 27       | CPTu Km 55+100      |
| <b>MASW</b>     | 23       | MASW 23 - Km 55+100 |

**Tabella 47** – Prova eseguita nell'area relativa all'intervento n. 25 (I.P.G. s.n.c.)



**Figura 48** – Ubicazione indagini nell'area relativa all'intervento n. 25



#### 4.16.2 Modello geologico e geotecnico locale

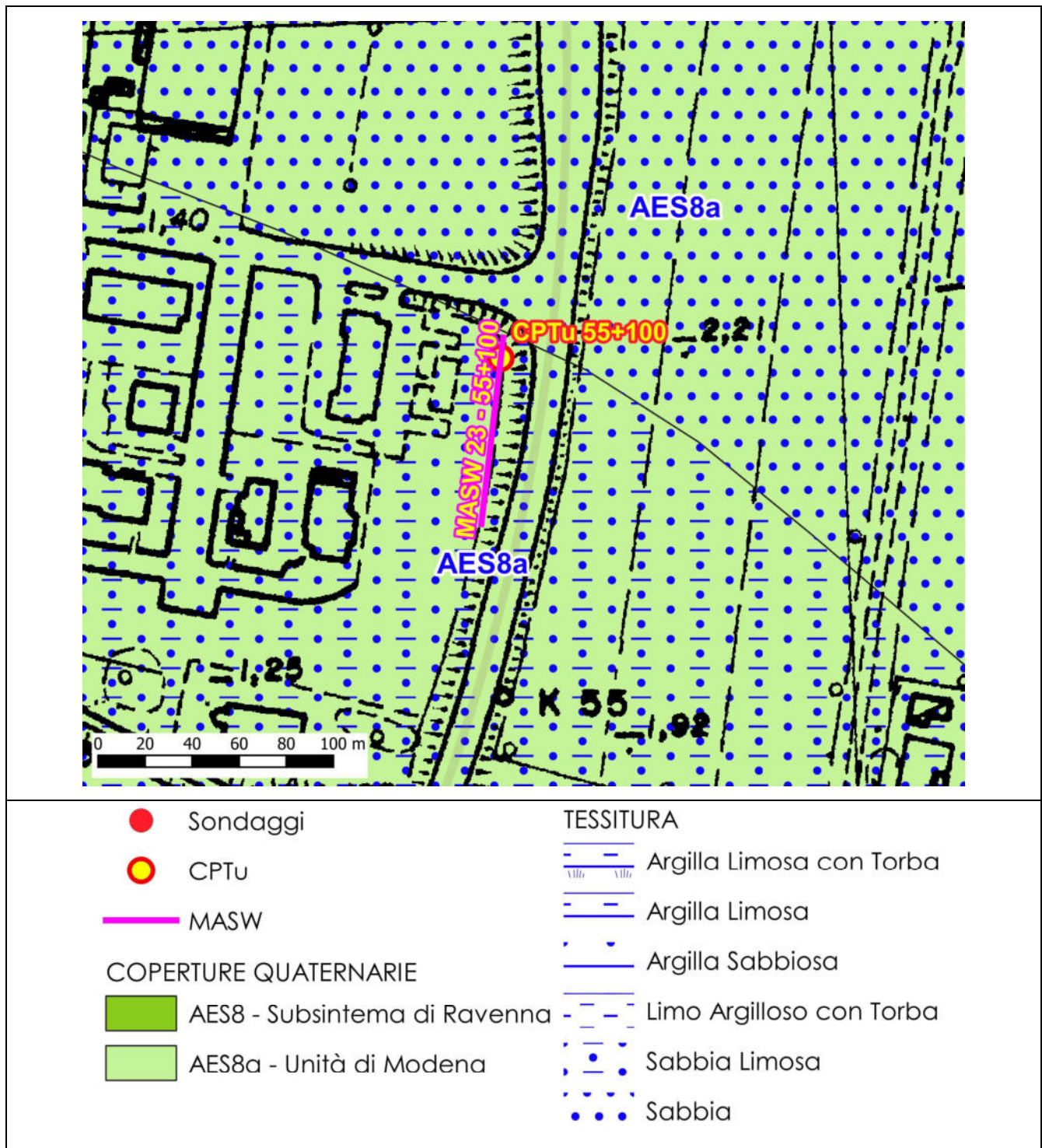


Figura 49 – Inquadramento geologico dell'area relativa all'intervento n. 25



Sulla base degli esiti delle indagini considerate per il sito di intervento n. 25, si definiscono il modello geologico ed il modello geotecnico locali:

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE                              | LIVELLI SATURI           |
|-----------|----------------------------|---|--------------------------|
| 1         | 0,0 – 0,5                  | Sabbia e sabbia limosa                            | -                        |
| 2         | 0,5 – 1,9                  | Argilla   | falda a ~ -1,2 m da p.c. |
| 3         | 1,9 – 3,7                  | Sabbia e sabbia limosa                            | ✓                        |
| 4         | 3,7 – 4,4                  | Argilla   | ✓                        |
| 5         | 4,4 – 6,5                  | Sabbia e sabbia limosa                            | ✓                        |
| 6         | 6,5 – 7,0                  | Argilla   | ✓                        |
| 7         | 7,0 – 8,2                  | Sabbia e sabbia limosa, con intercalazioni limose | ✓                        |
| 8         | 8,2 – 9,7                  | Argilla   | ✓                        |
| 9         | 9,7 – >10,0                | Sabbia e sabbia limosa                            | ✓                        |

**Tabella 48** – Modello geologico relativo all'intervento n. 25

| STRATO N. | PROFONDITA' da (m) – a (m) | LITOLOGIA PREVALENTE                              | $\Phi$ (°) | $S_u$ (kPa) | $E_s$ (MPa) | $M$ (MPa) |
|-----------|----------------------------|---|------------|-------------|-------------|-----------|
| 1         | 0,0 – 0,5                  | Sabbia e sabbia limosa                            | 39         | -           | 14          | 28        |
| 2         | 0,5 – 1,9                  | Argilla   | -          | 55          | -           | 11        |
| 3         | 1,9 – 3,7                  | Sabbia e sabbia limosa                            | 35         | -           | 31          | 61        |
| 4         | 3,7 – 4,4                  | Argilla   | -          | 40          | -           | 7         |
| 5         | 4,4 – 6,5                  | Sabbia e sabbia limosa                            | 36         | -           | 44          | 85        |
| 6         | 6,5 – 7,0                  | Argilla   | -          | 46          | -           | 6         |
| 7         | 7,0 – 8,2                  | Sabbia e sabbia limosa, con intercalazioni limose | 37         | -           | 53          | 70        |
| 8         | 8,2 – 9,7                  | Argilla   | -          | 24          | -           | 2         |
| 9         | 9,7 – >10,0                | Sabbia e sabbia limosa                            | 35         | -           | 47          | 72        |

$\Phi$  = angolo di attrito;  $S_u$  = coesione non drenata;  $E_s$  = modulo elastico di Young;  $M$  = modulo edometrico

**Tabella 49** – Modello geotecnico relativo all'intervento n. 25

L'indagine MASW eseguita ha permesso di determinare, per il sito di intervento, una **categoria di sottosuolo di tipo C** (rif. NTC 2018).

## 5 ALLEGATI

### ALL. 1

---

**Planimetria generale delle indagini**

### ALL. 2

---

**Report grafici di tutte le prove CPTu**

### ALL. 3

---

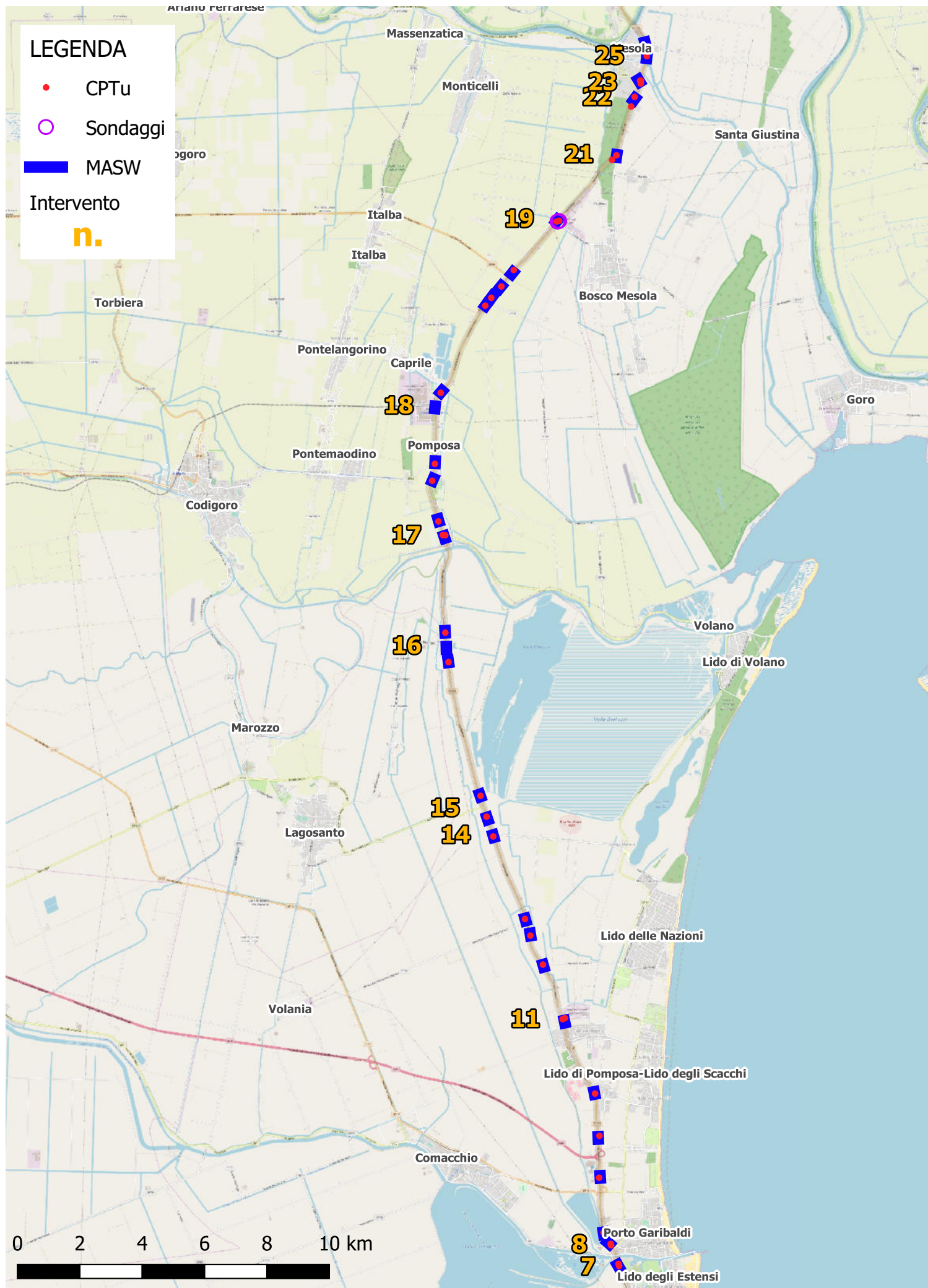
**Log geotecnici semplificati delle prove CPTu relative alle aree di intervento**

# ALLEGATO 1

## Planimetria generale delle indagini



# PLANIMETRIA GENERALE DELLE INDAGINI



## ALLEGATO 2

### Report grafici di tutte le prove CPTu

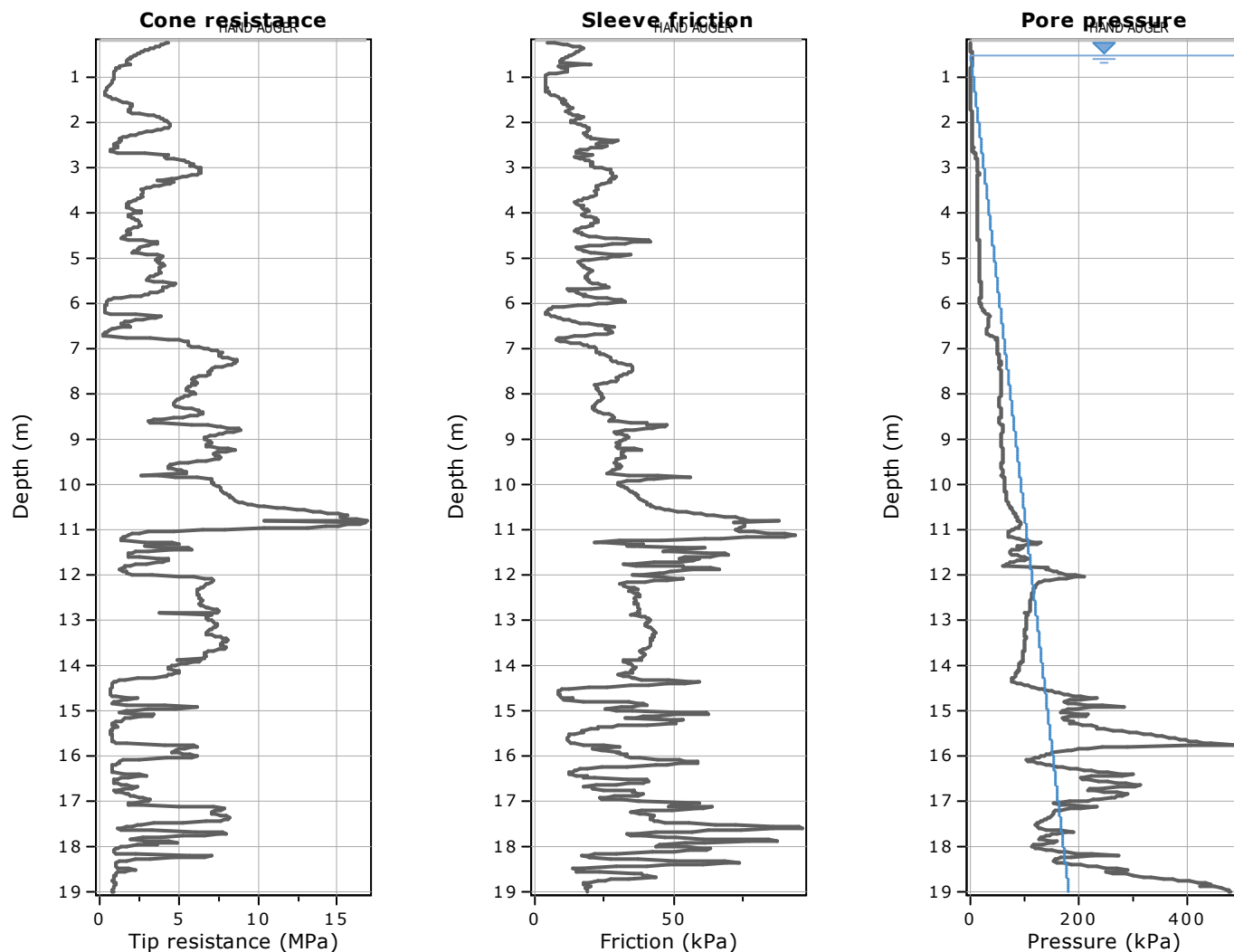
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

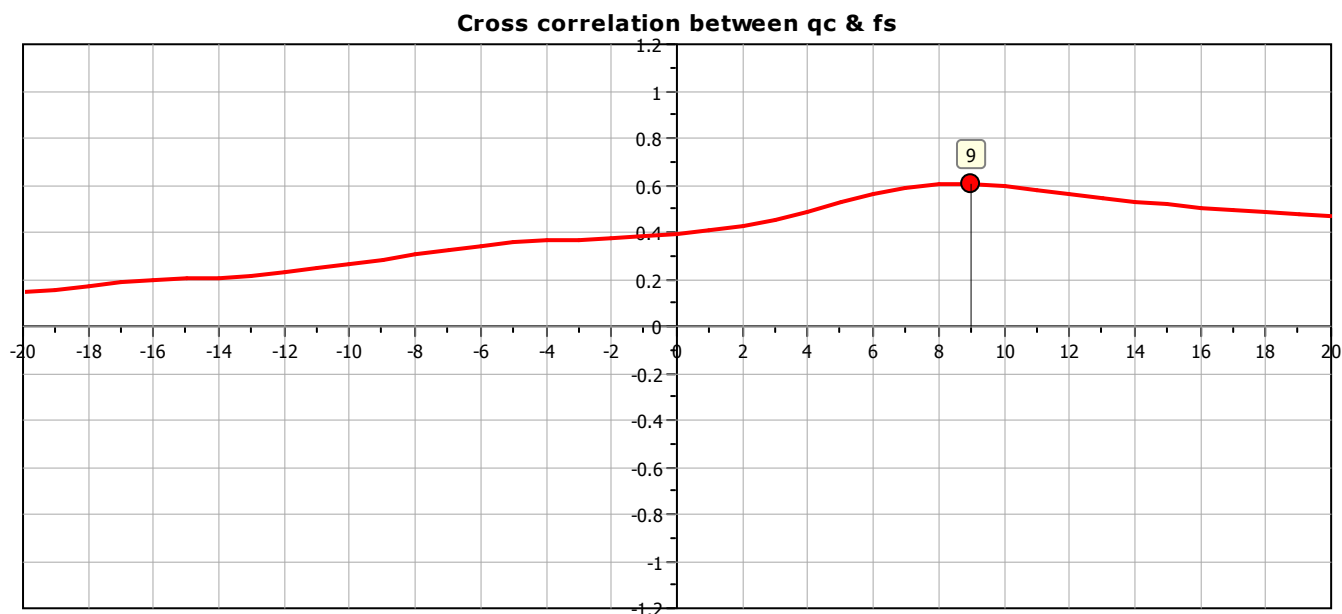
**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°

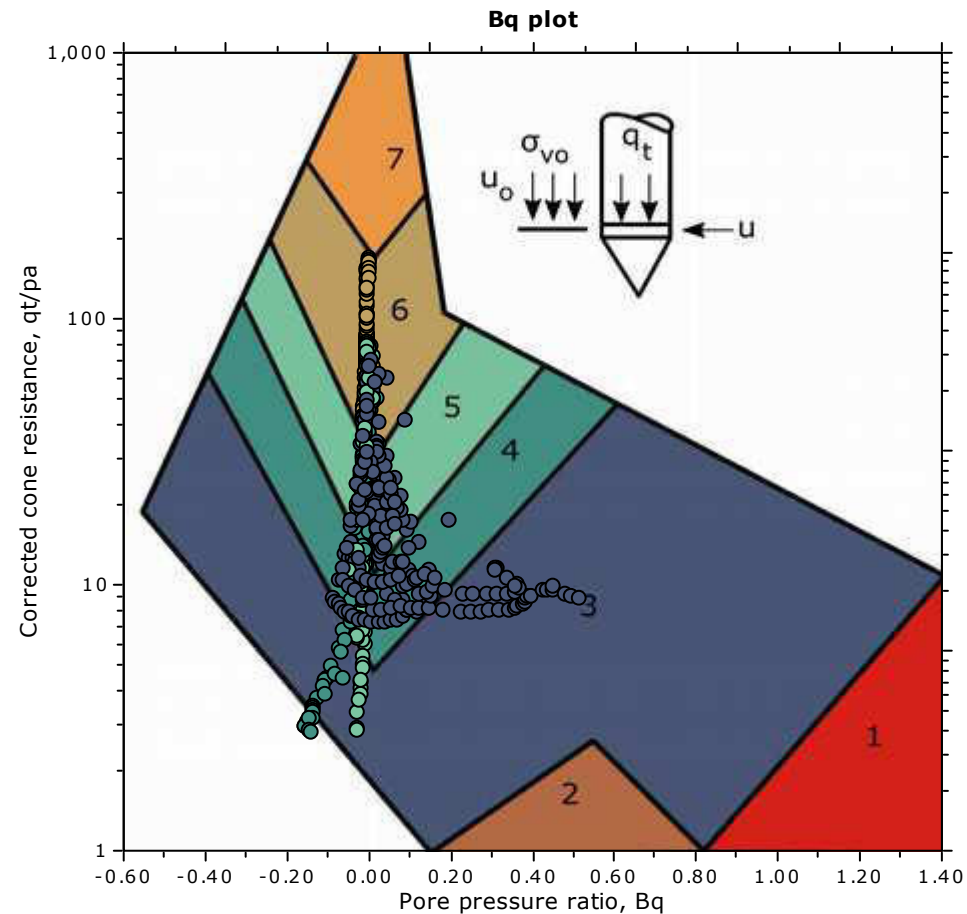
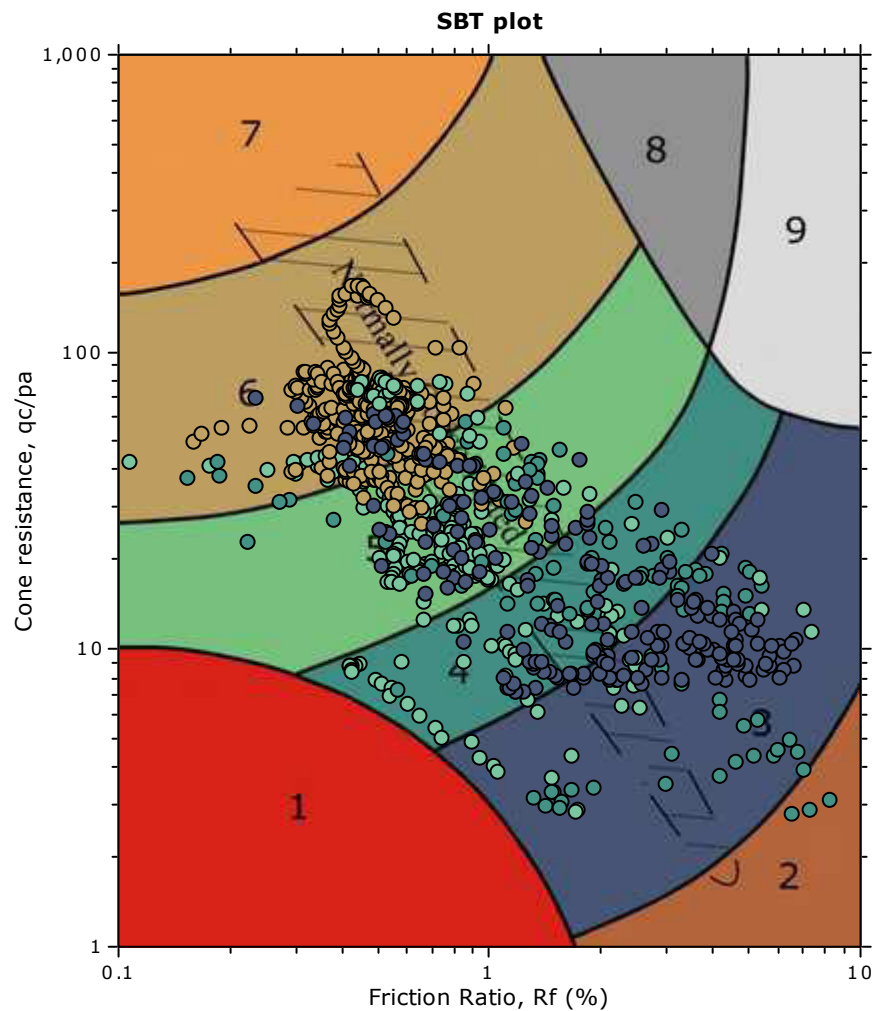


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





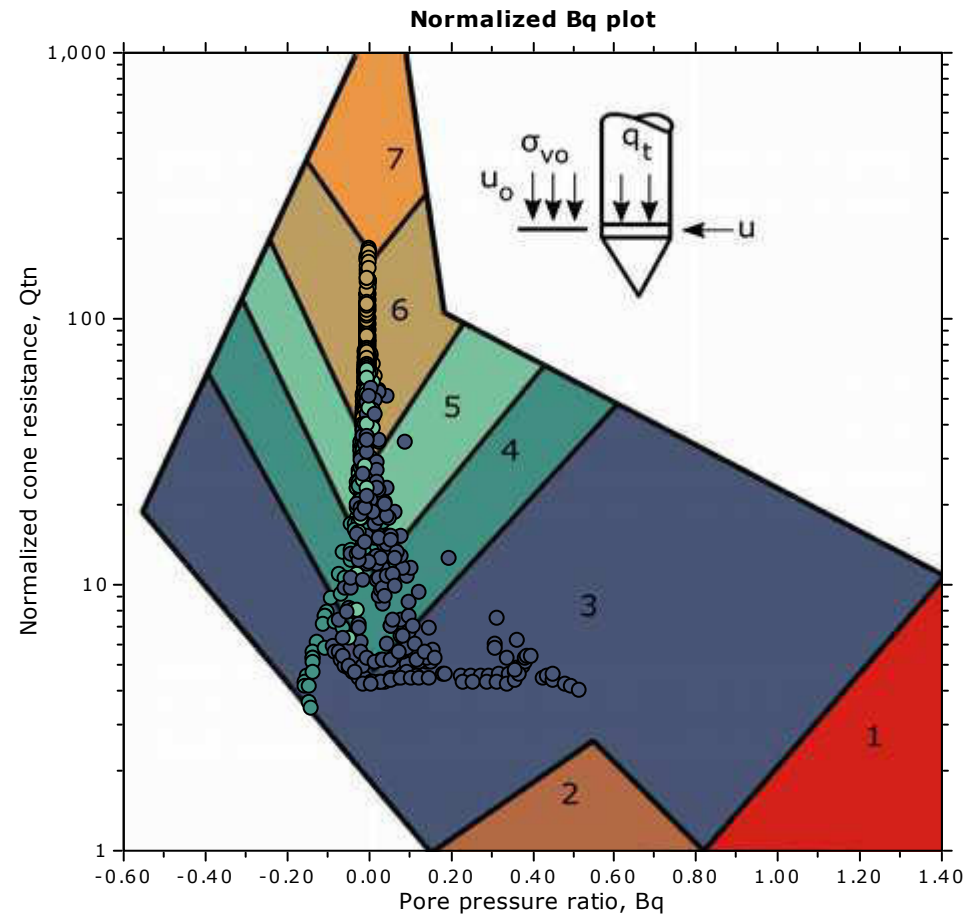
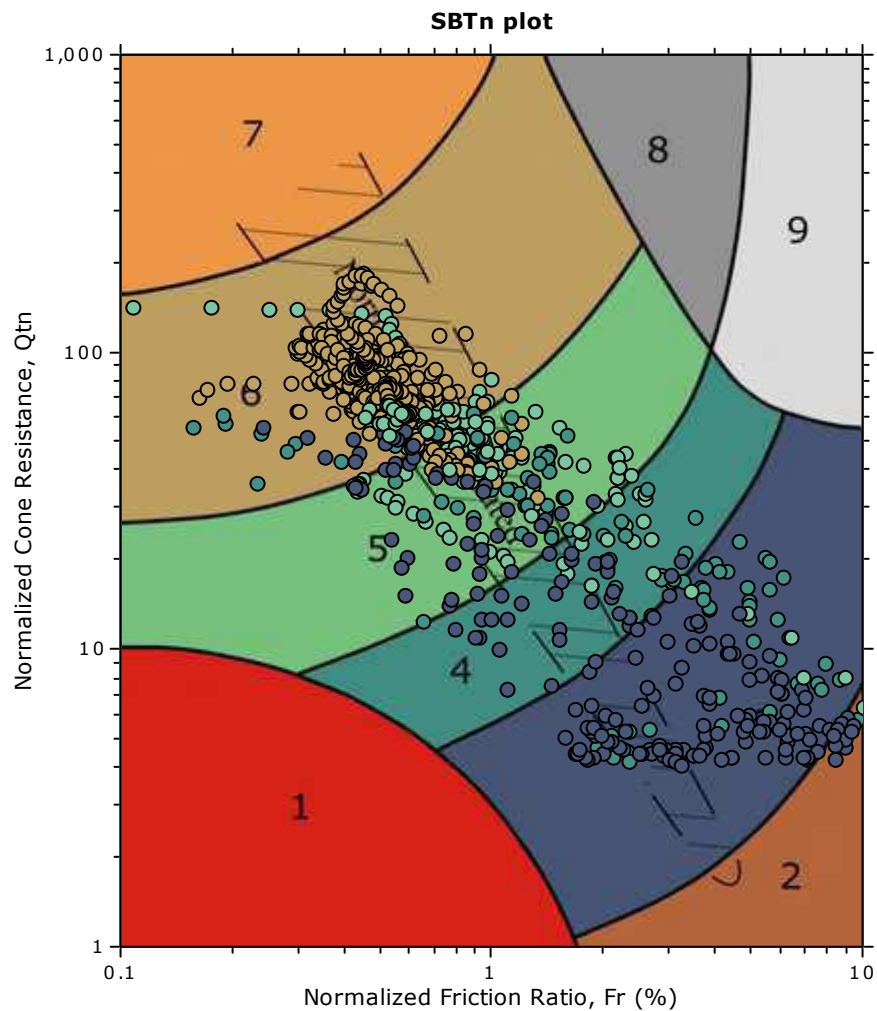
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

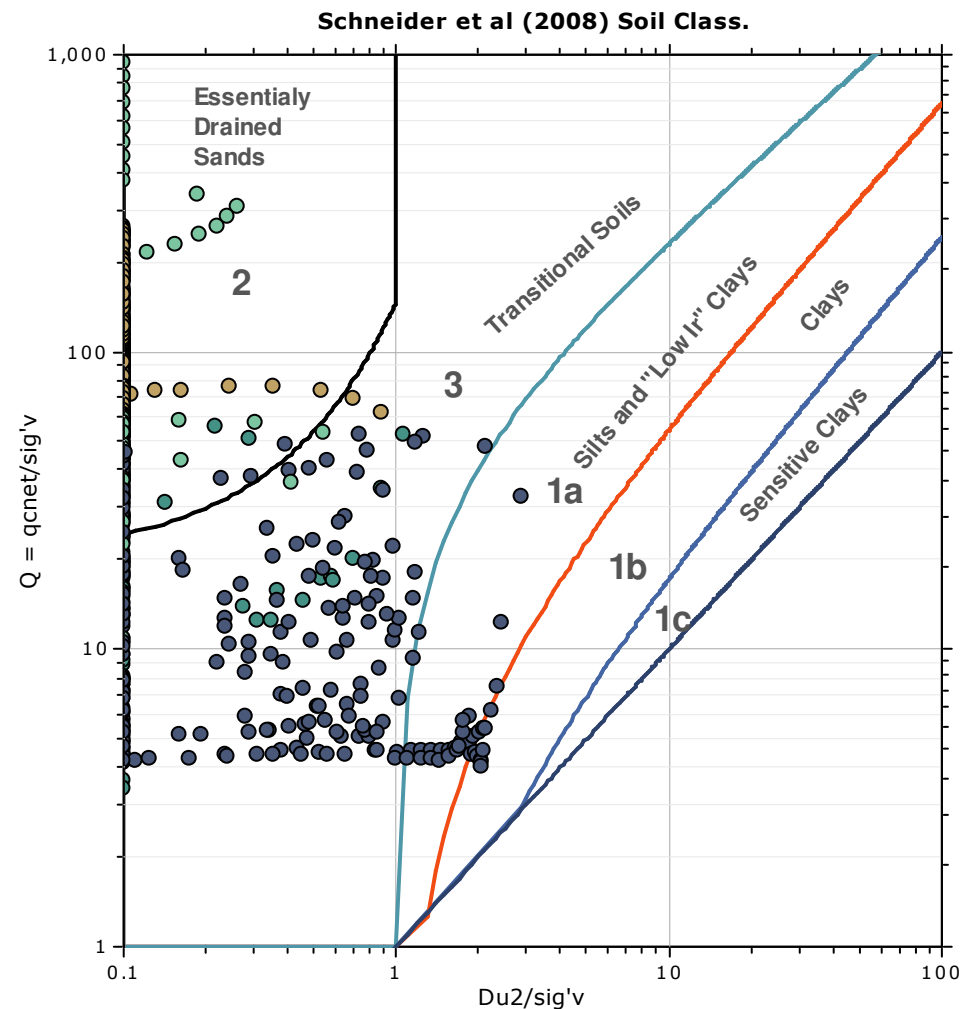
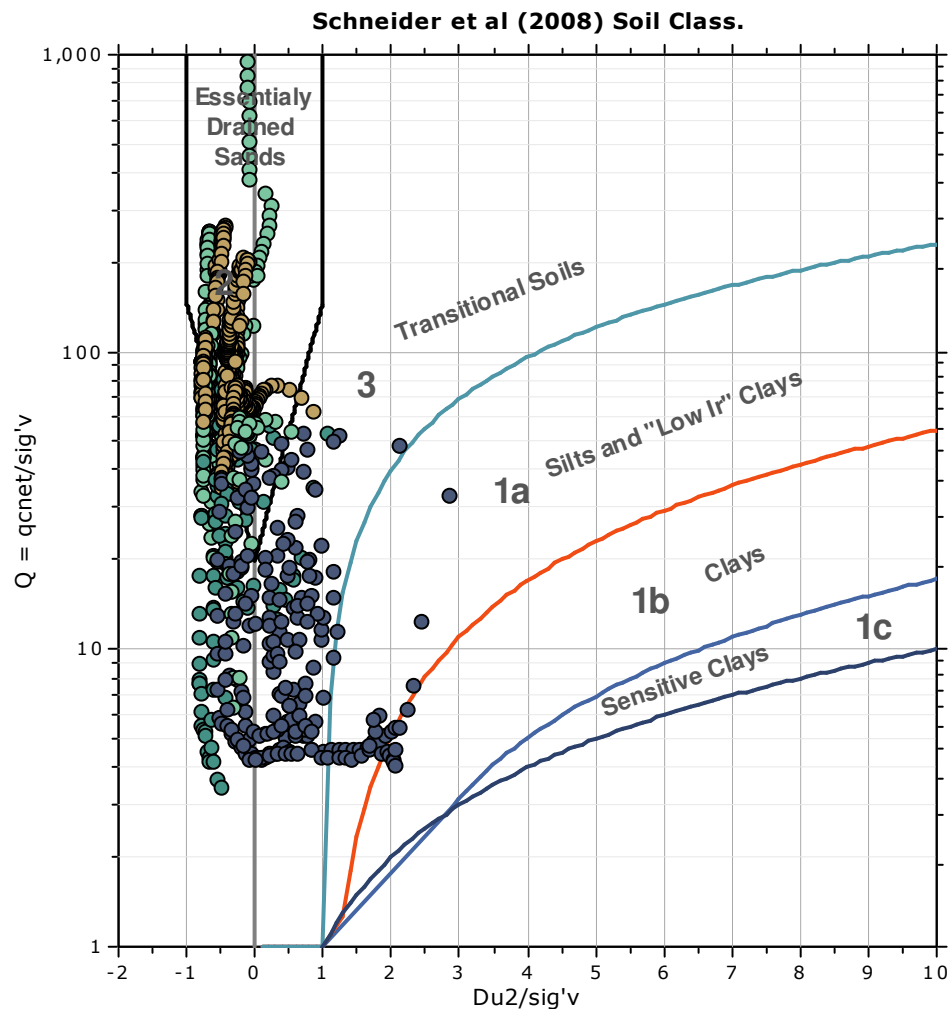
**SBT - Bq plots (normalized)**



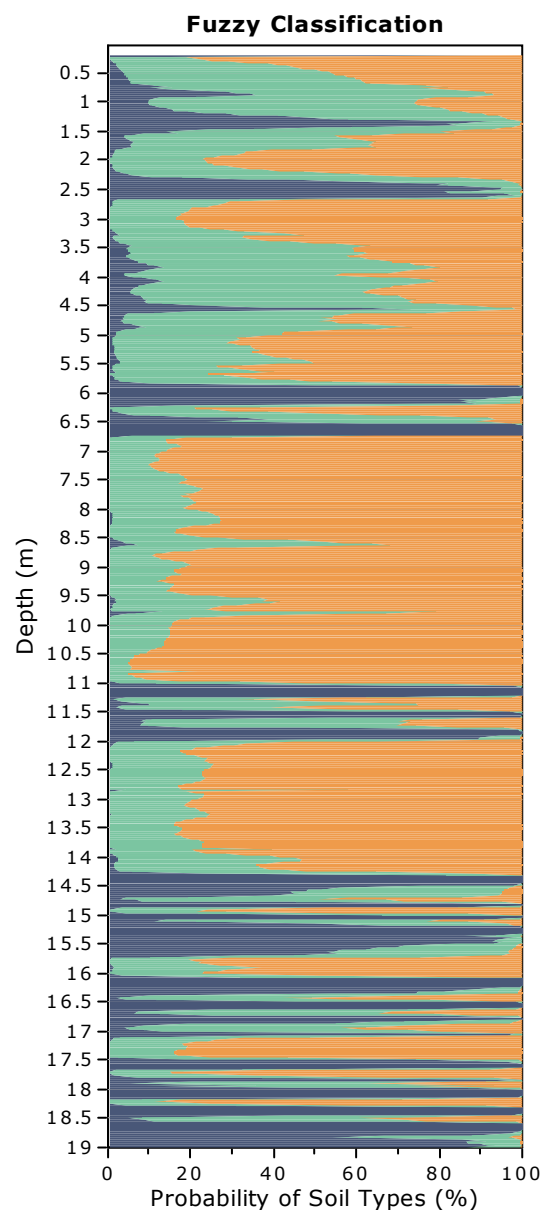
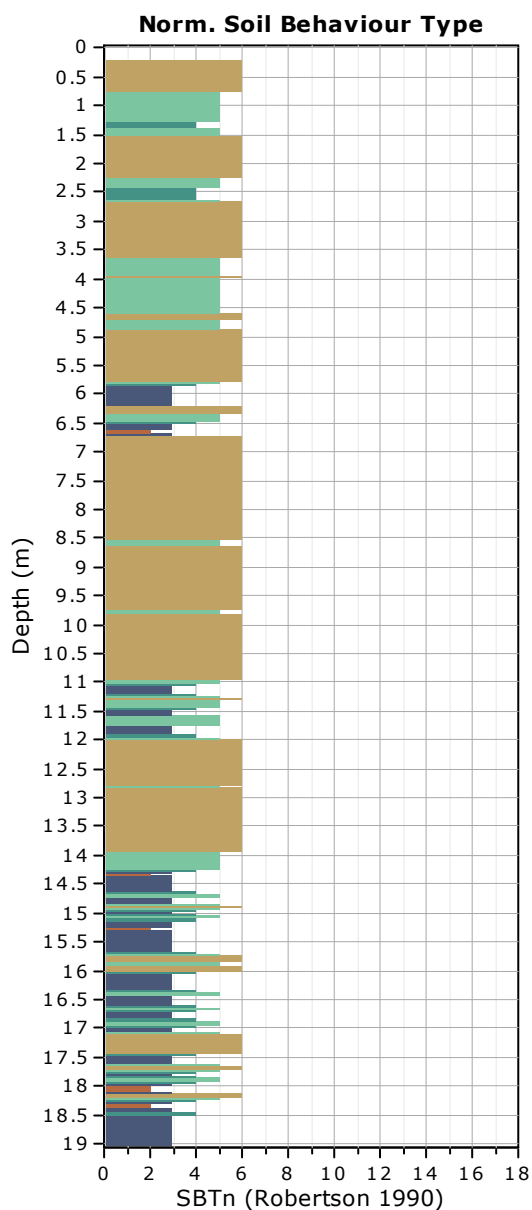
**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)**







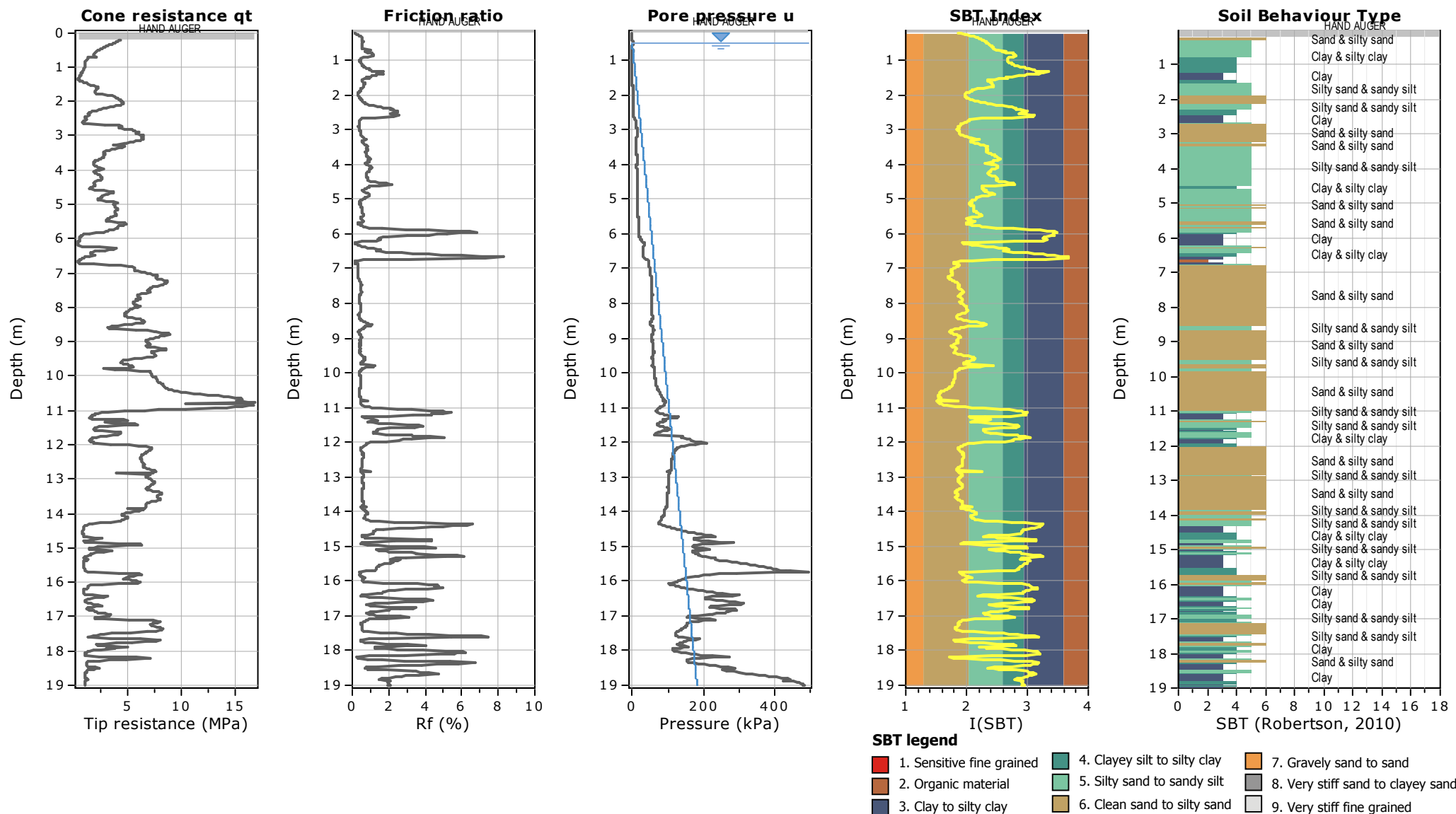
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°



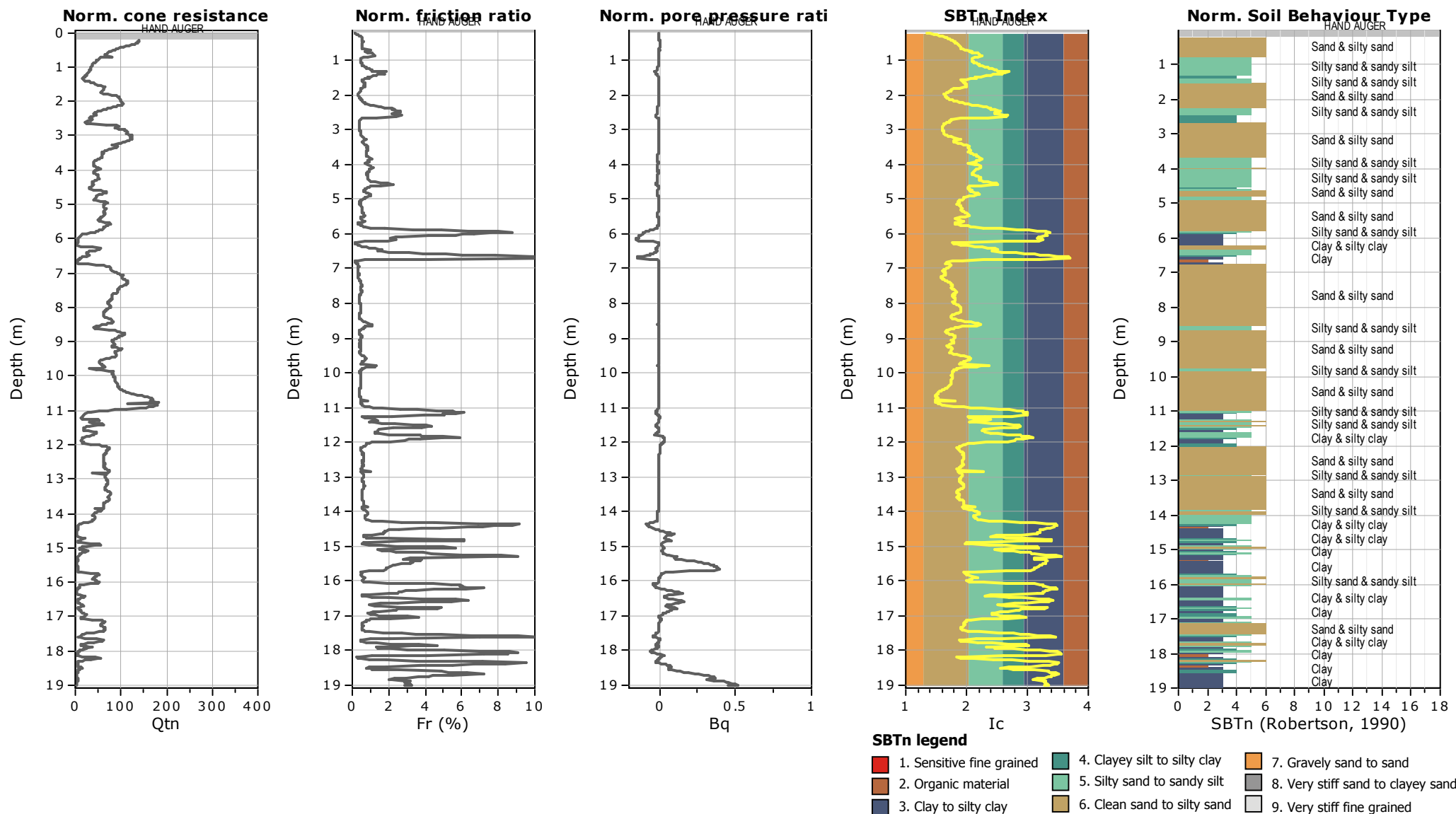
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°



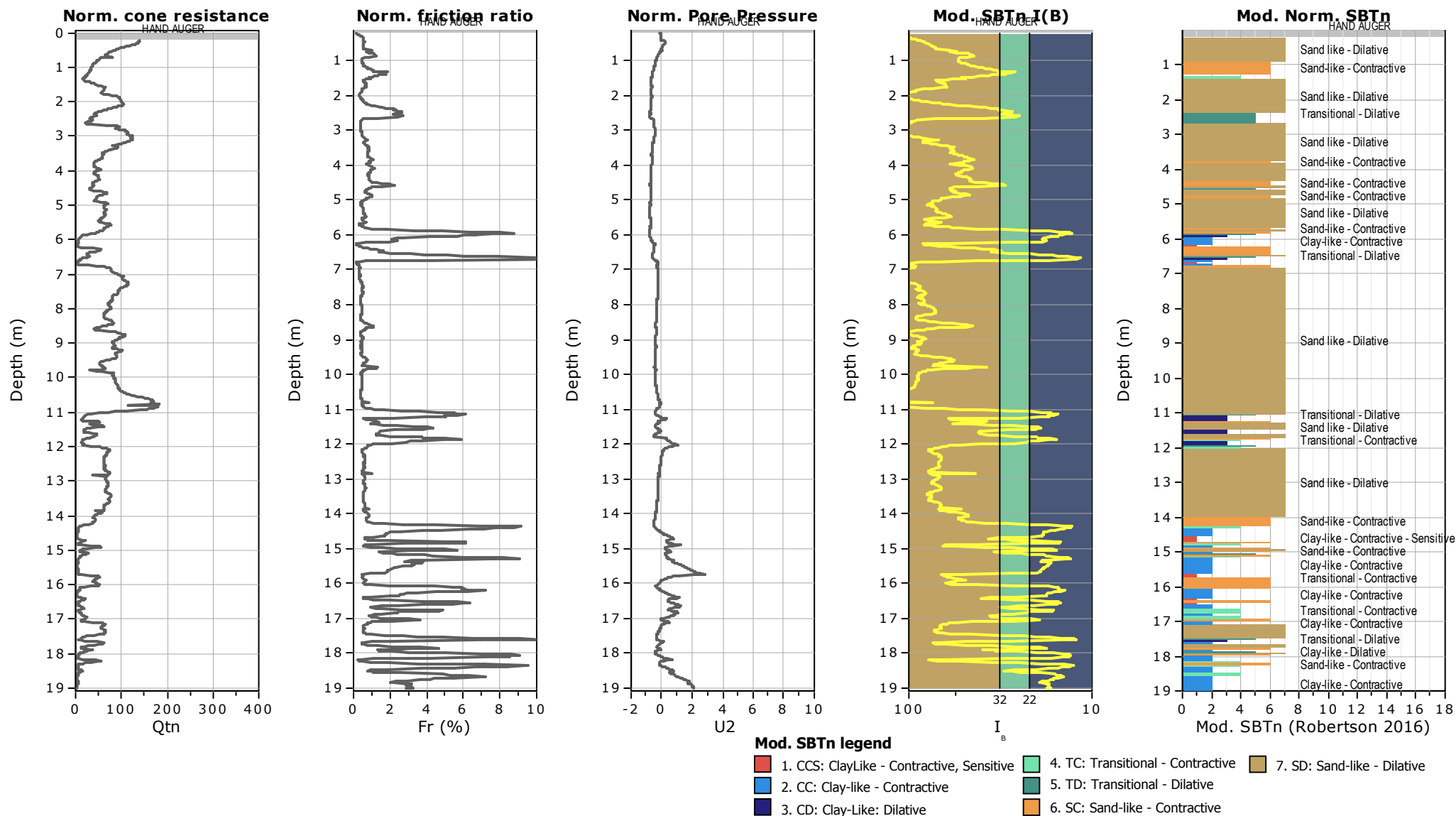
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

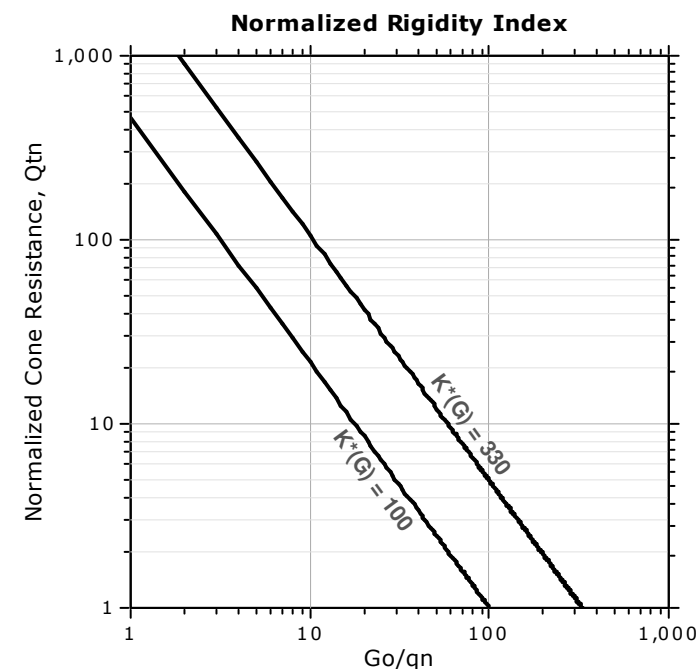
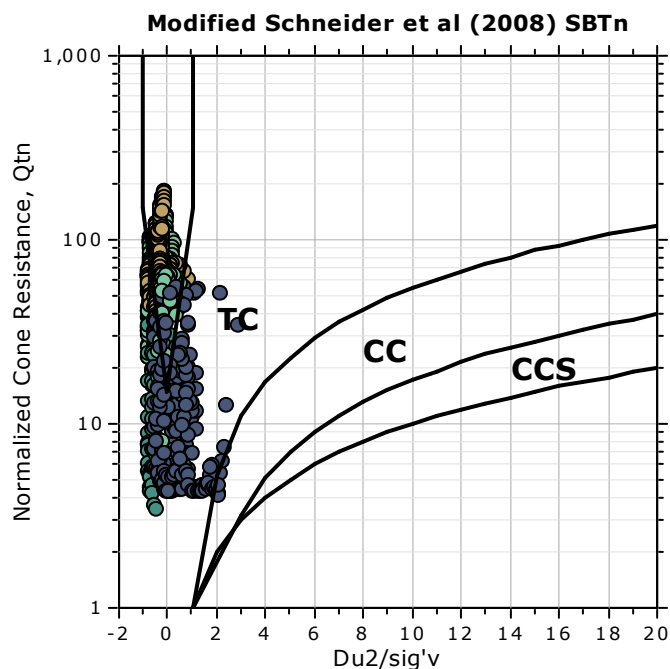
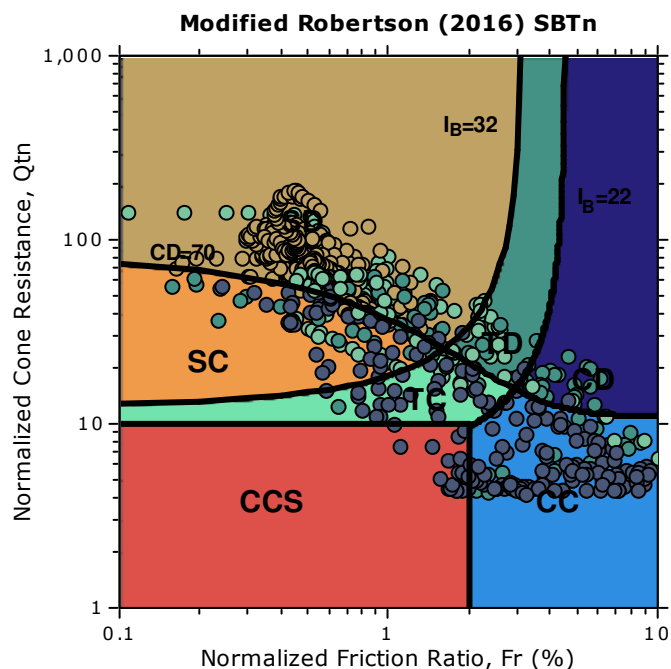
Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°





### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

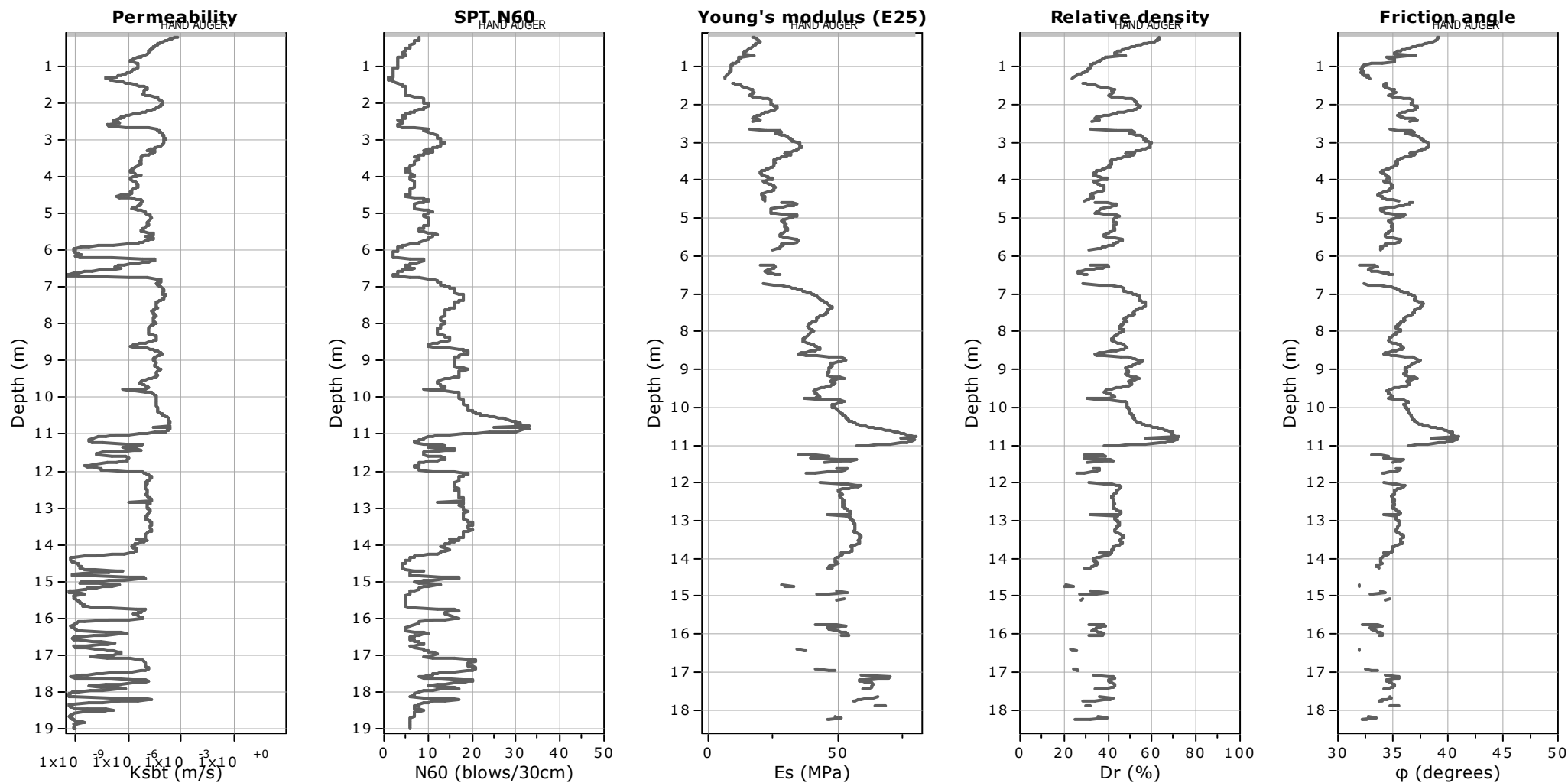
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

● User defined estimation data

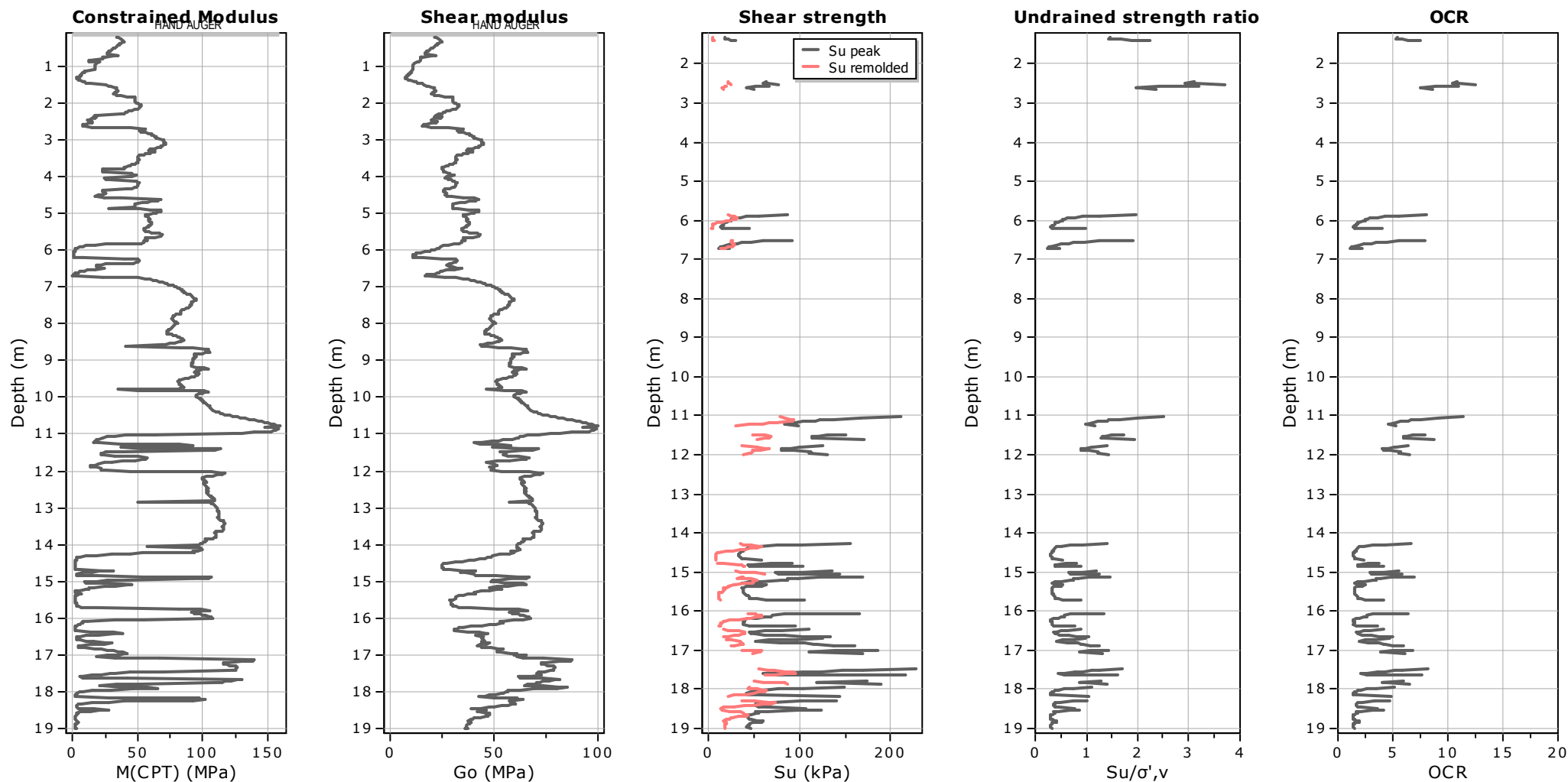
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data



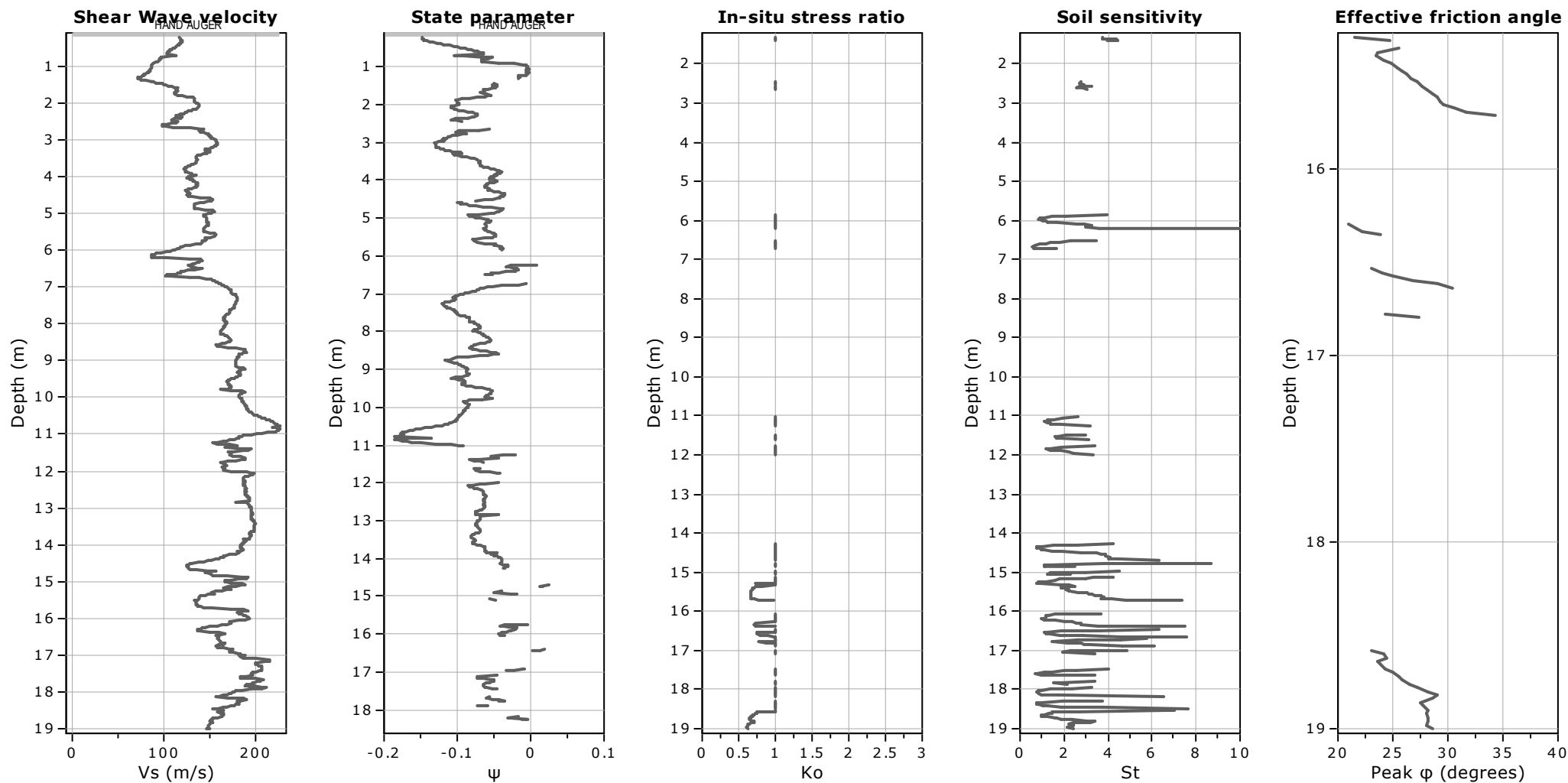
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

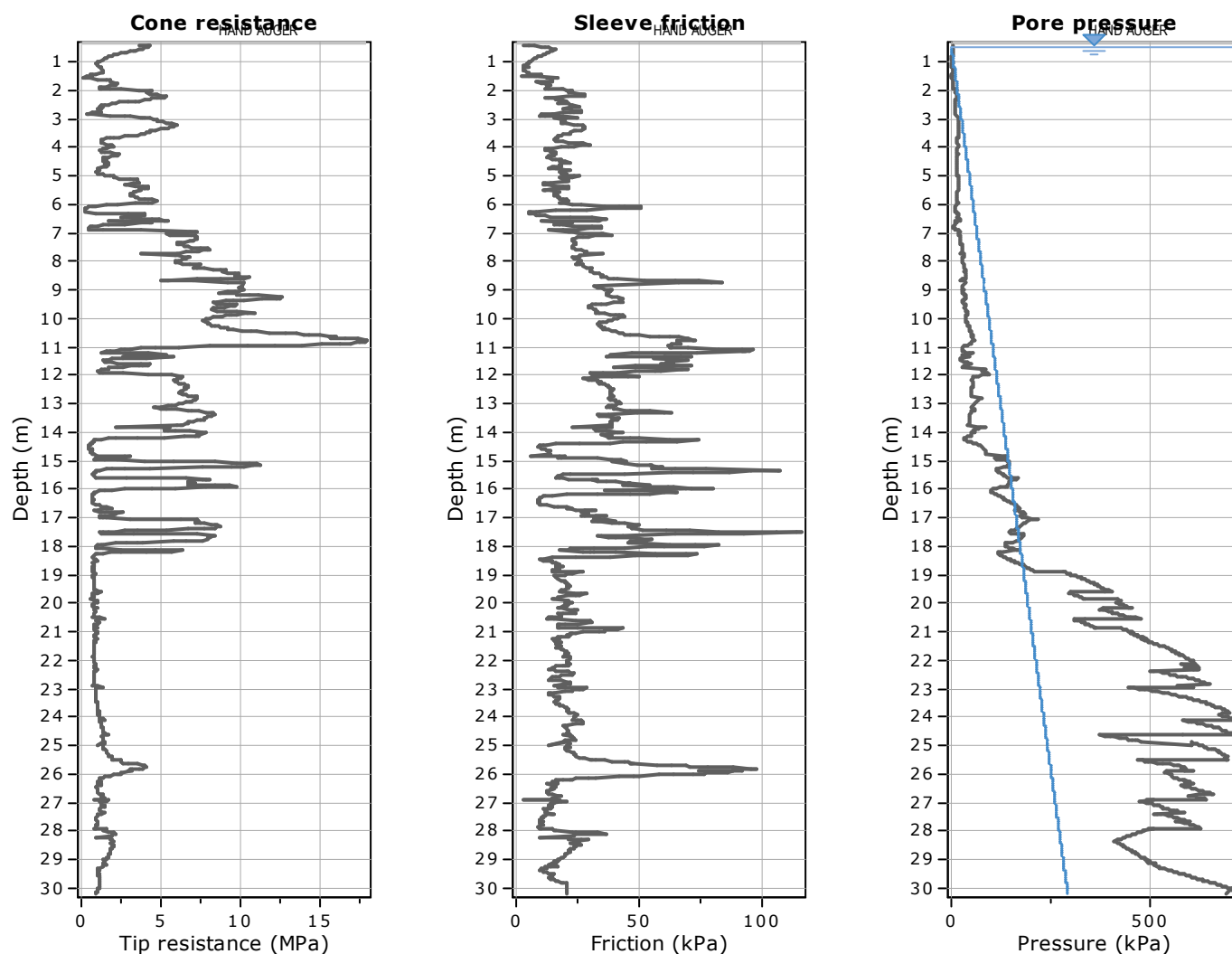
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**Location:** S.S. 309 - ROMEA

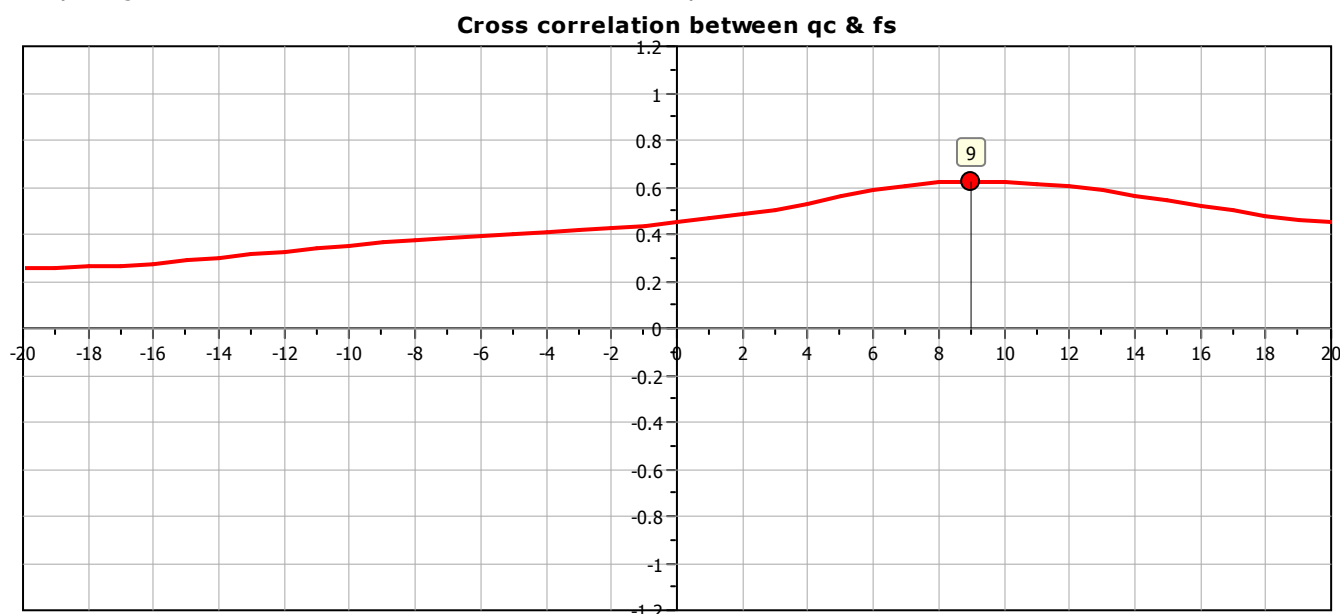
**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

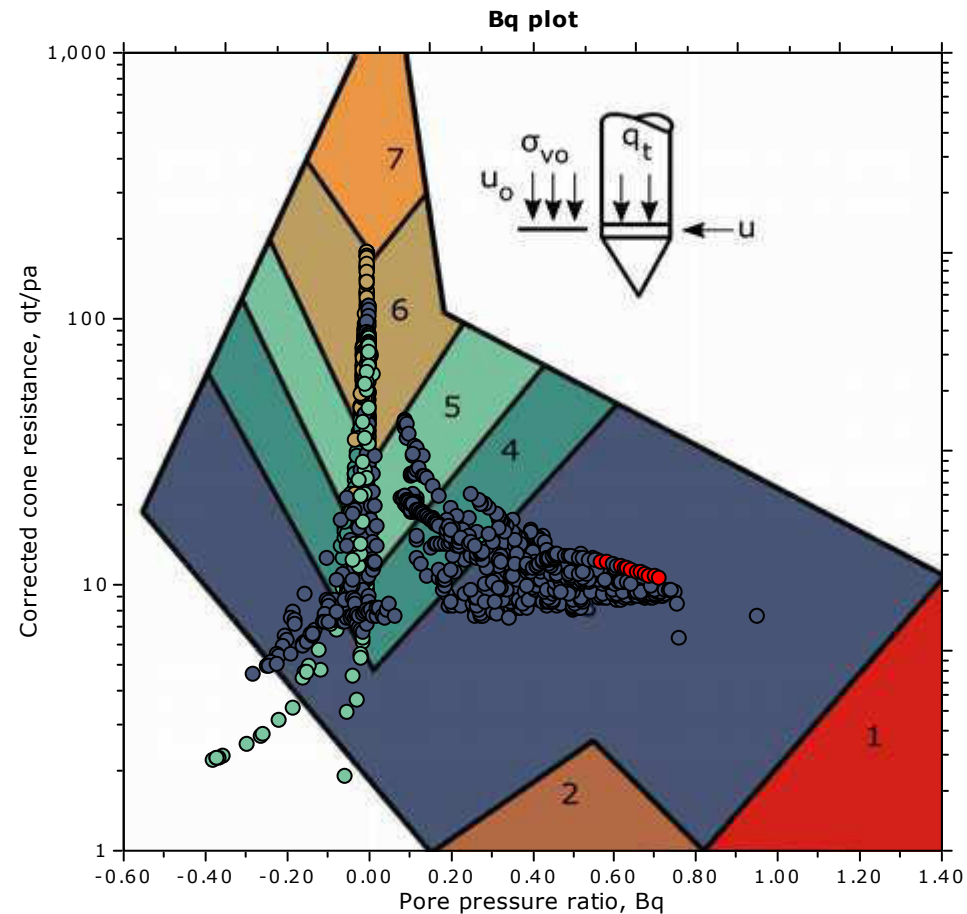
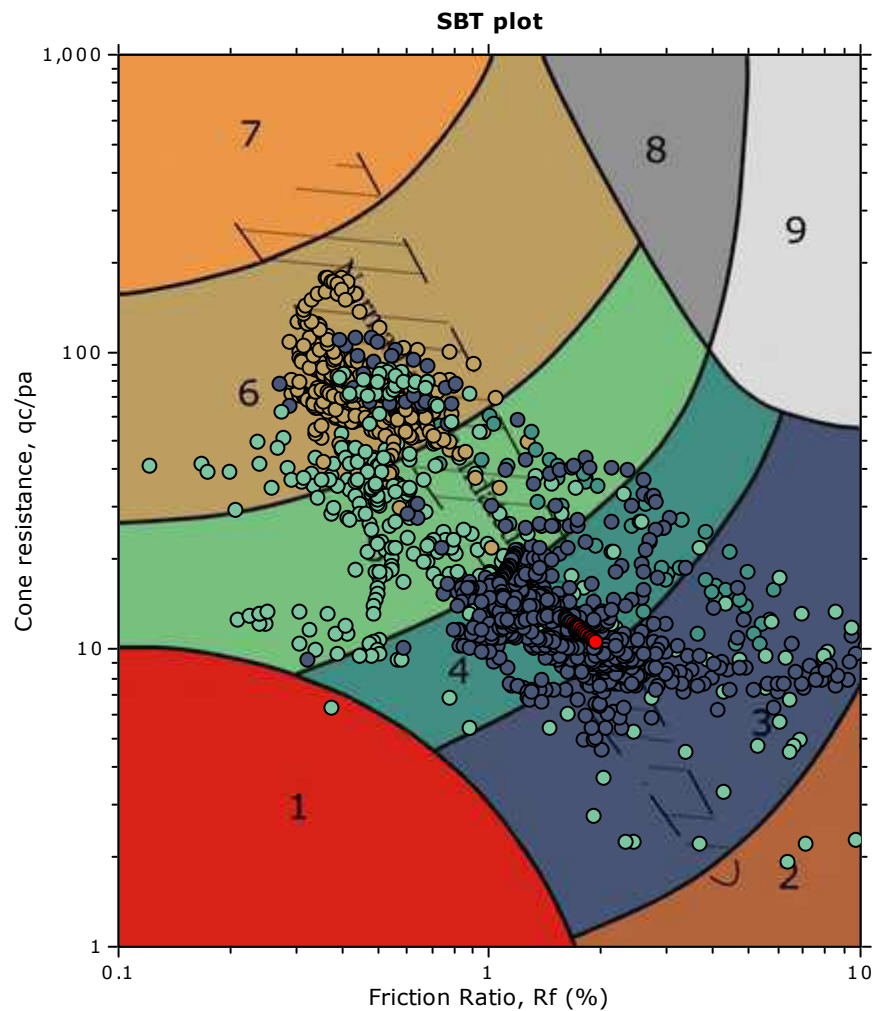
Coords: lat 44.673975° lon 12.228314°



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

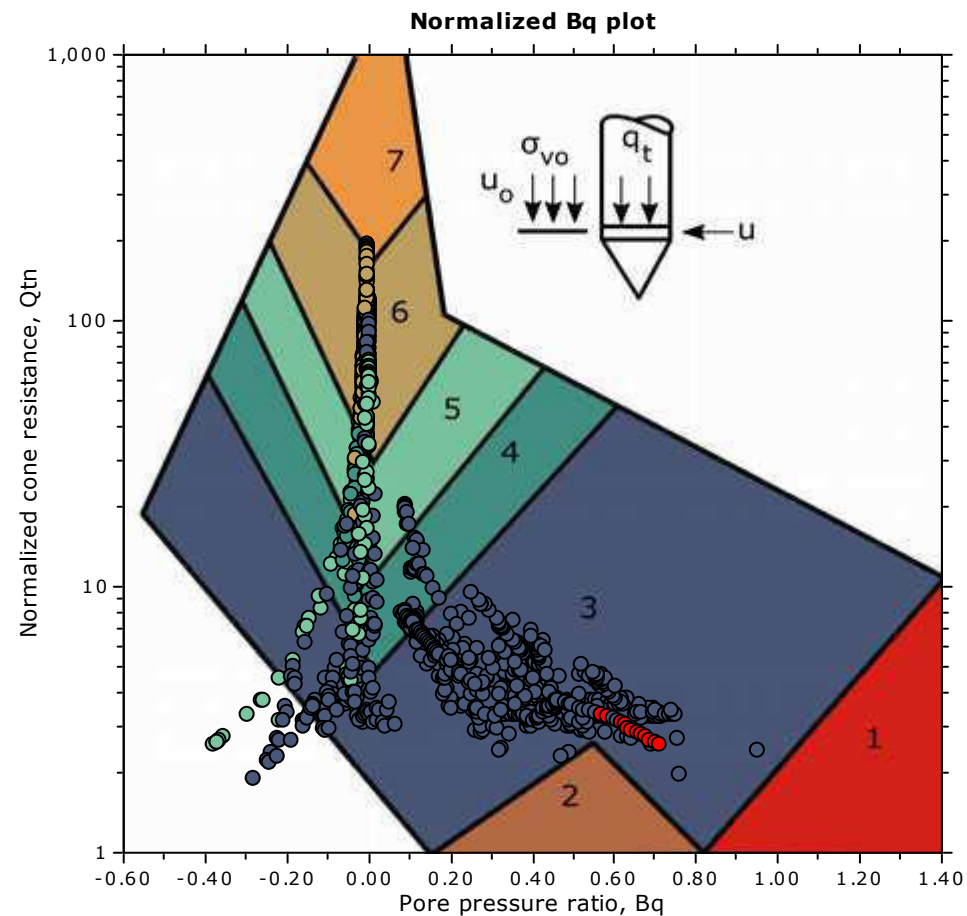
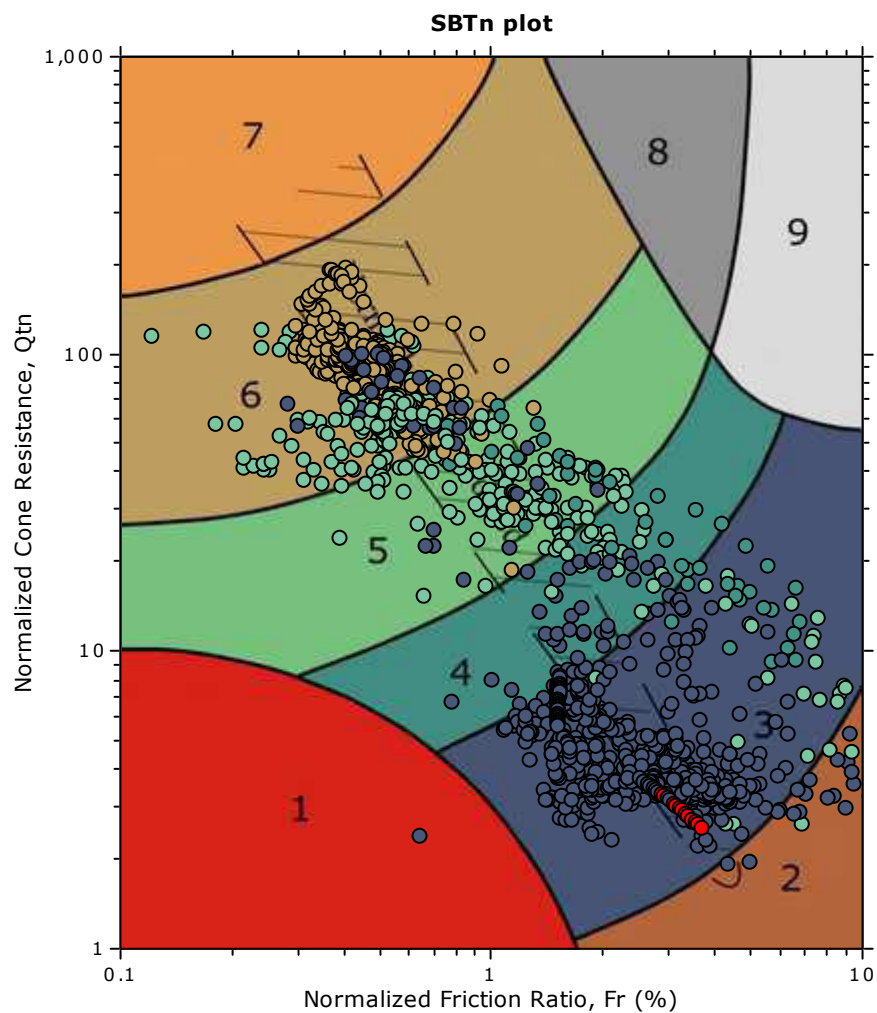


#### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 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        |



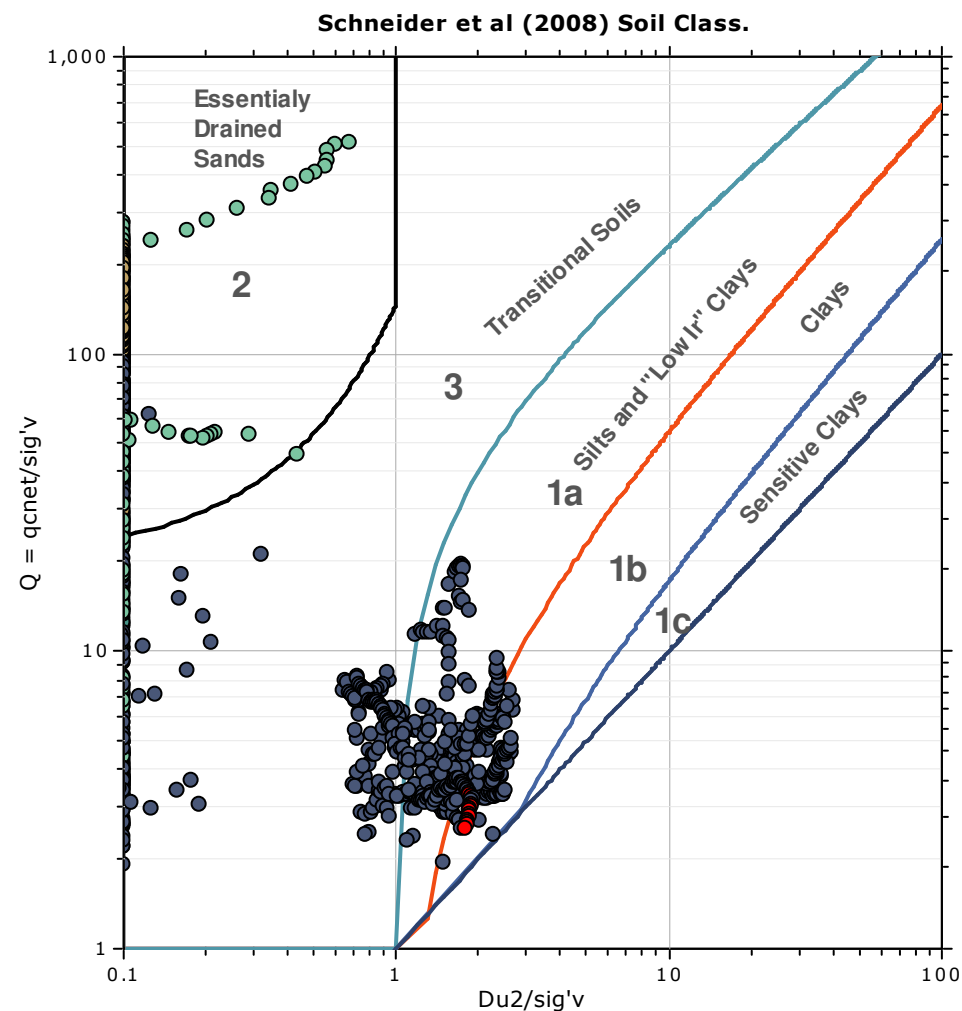
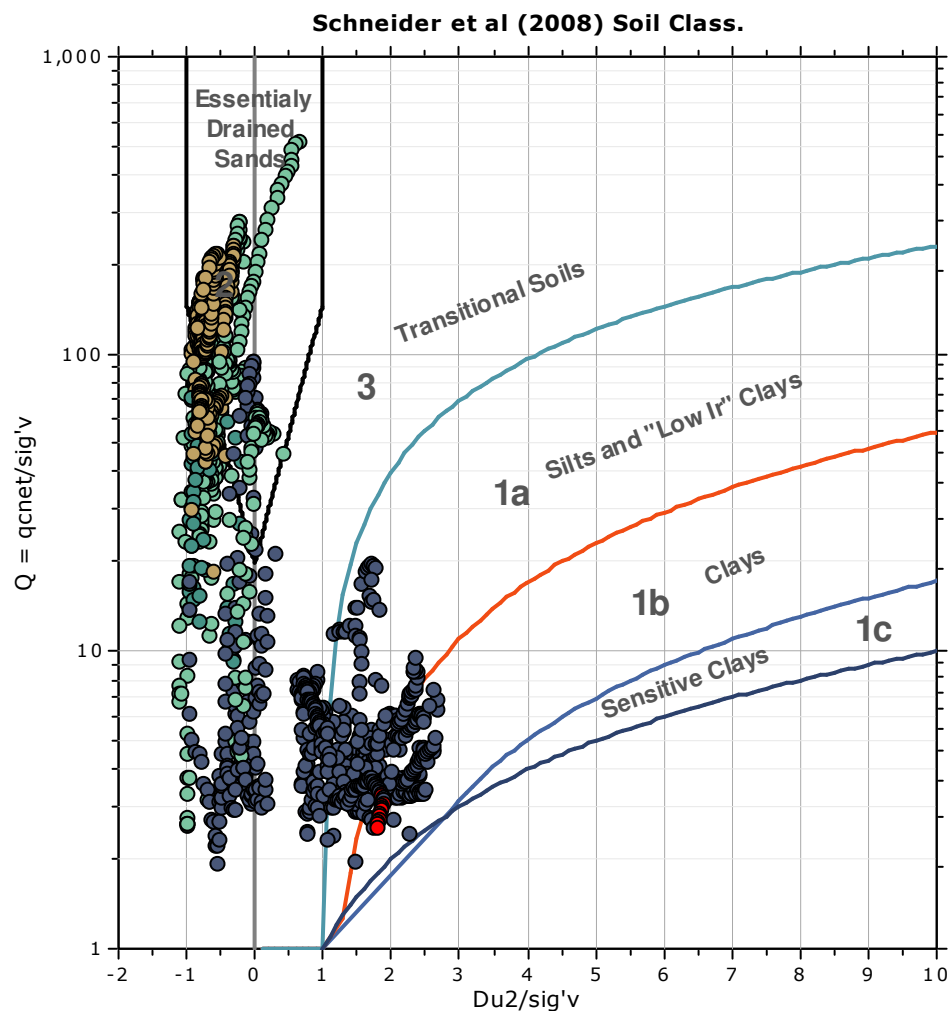
**SBT - Bq plots (normalized)**

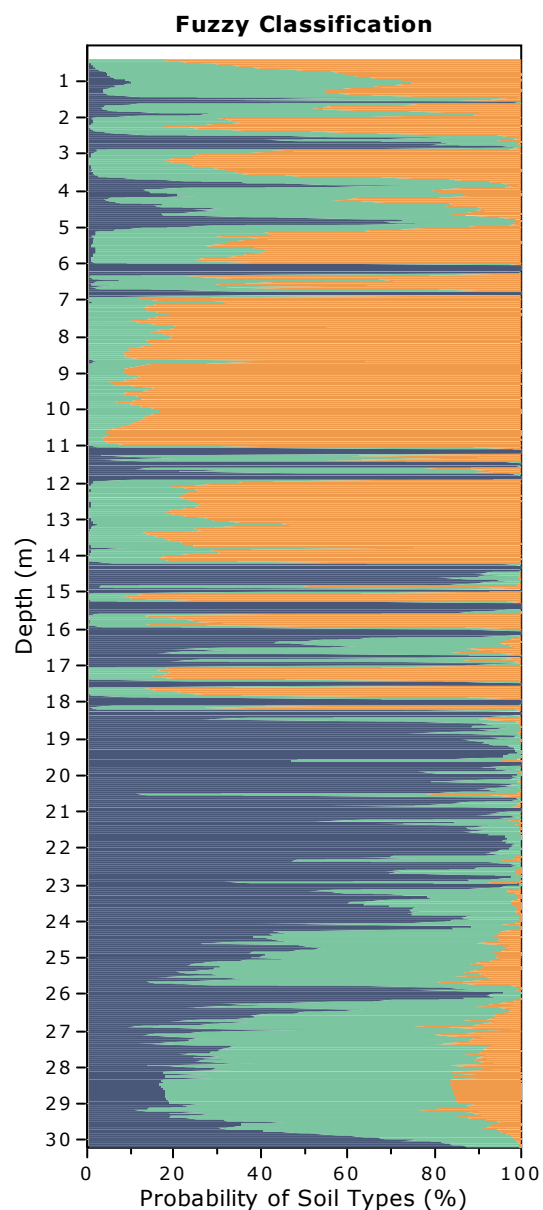
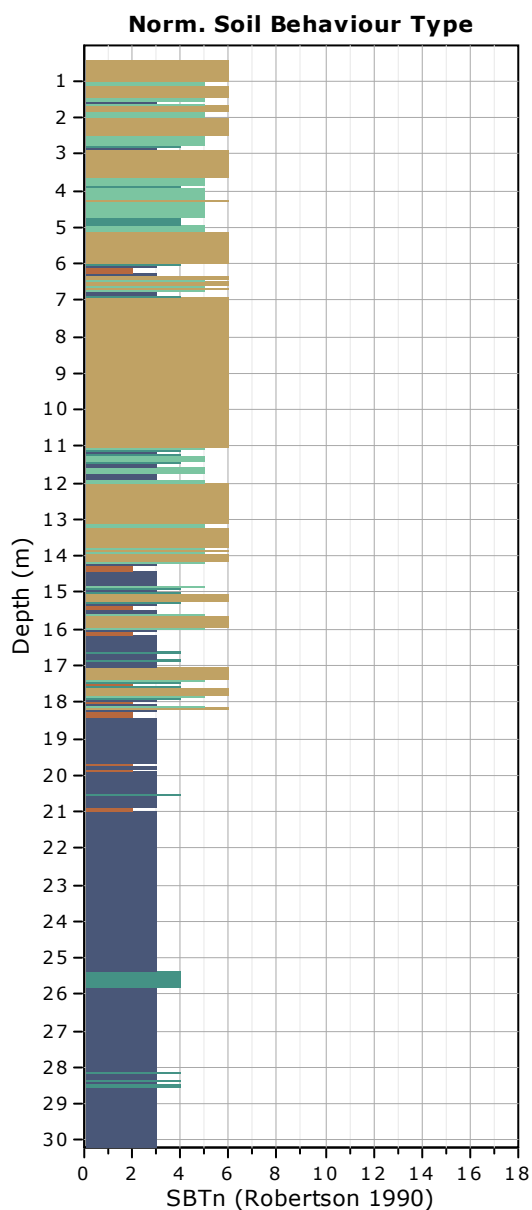


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







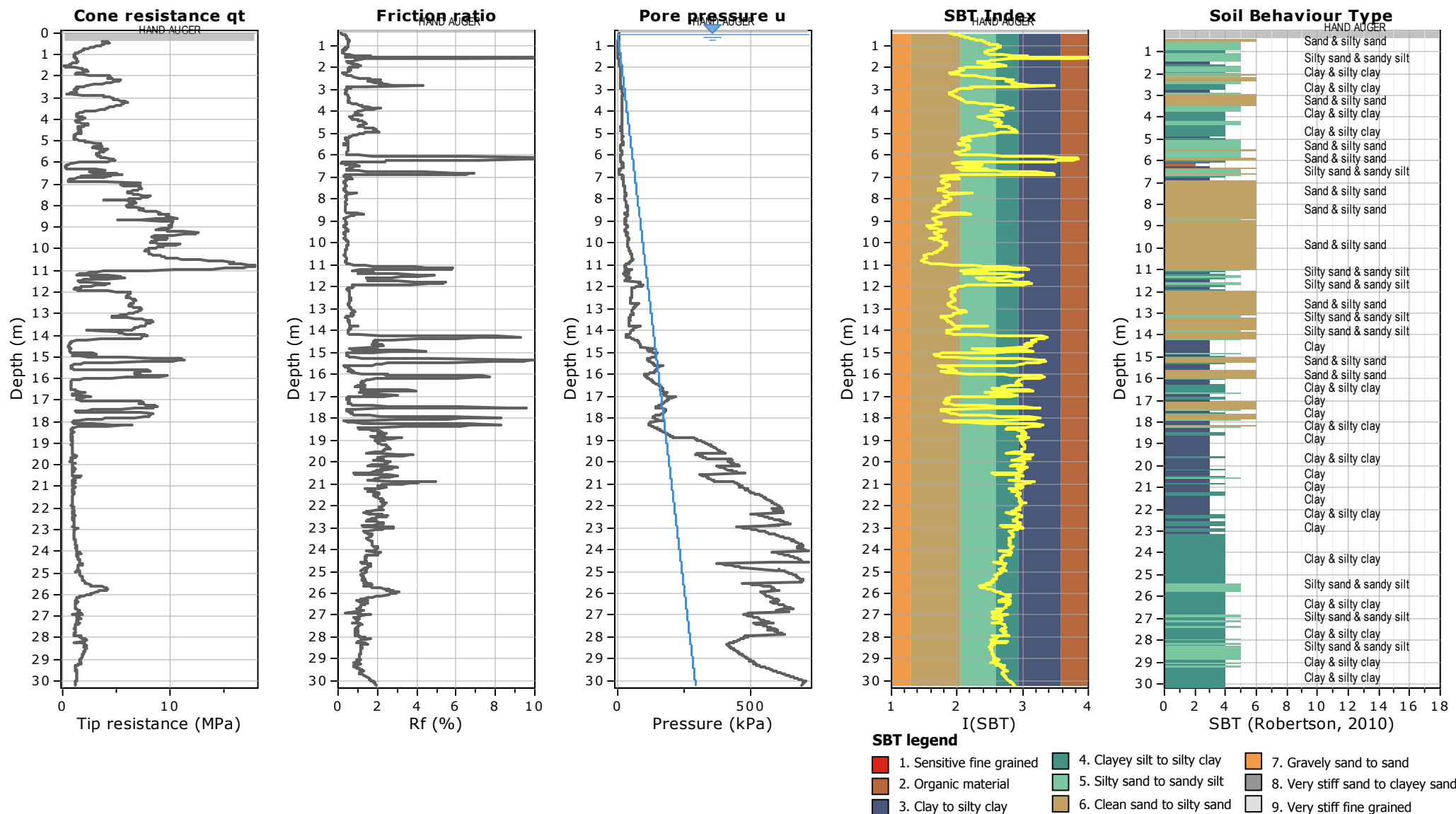
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



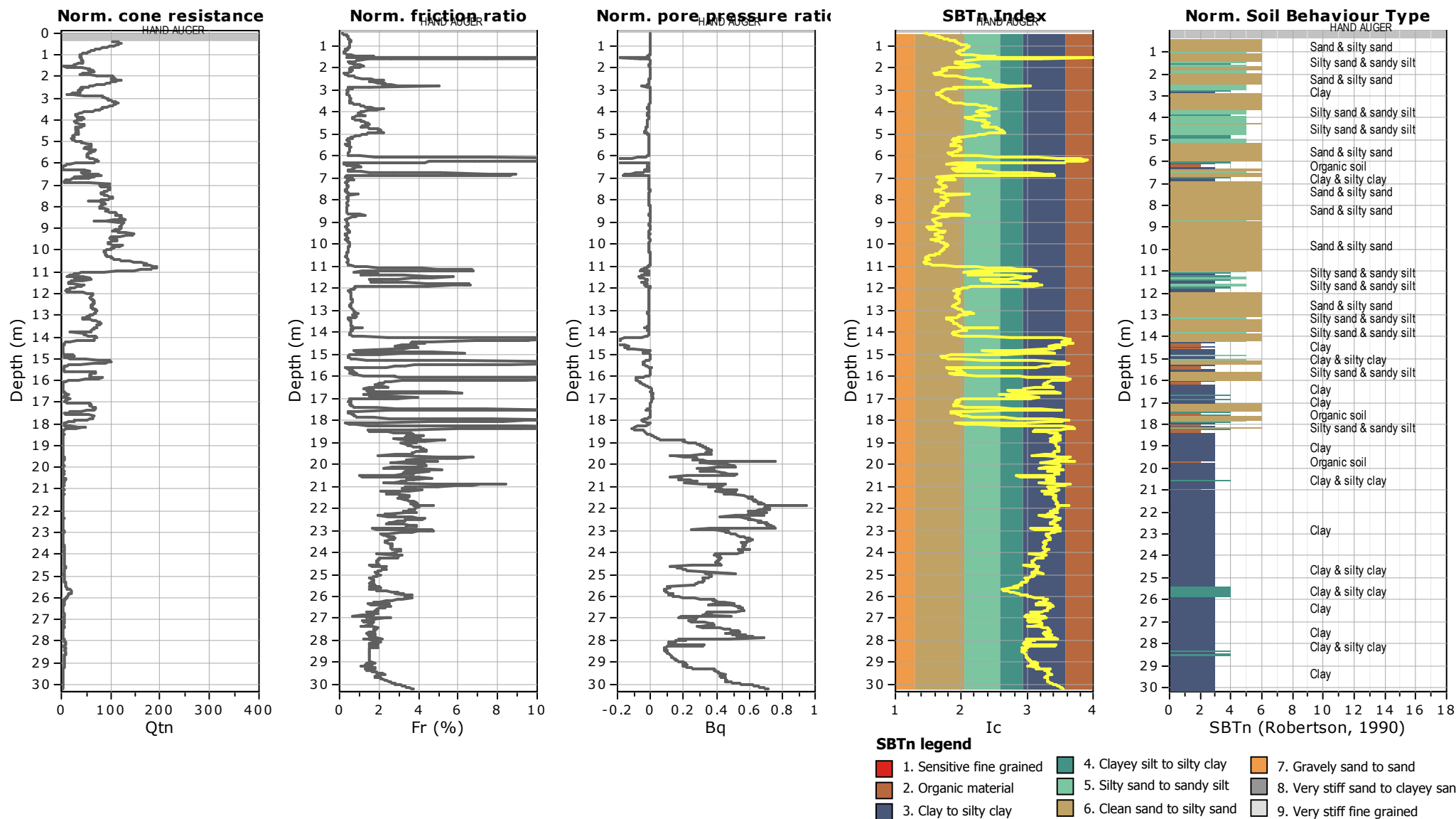
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



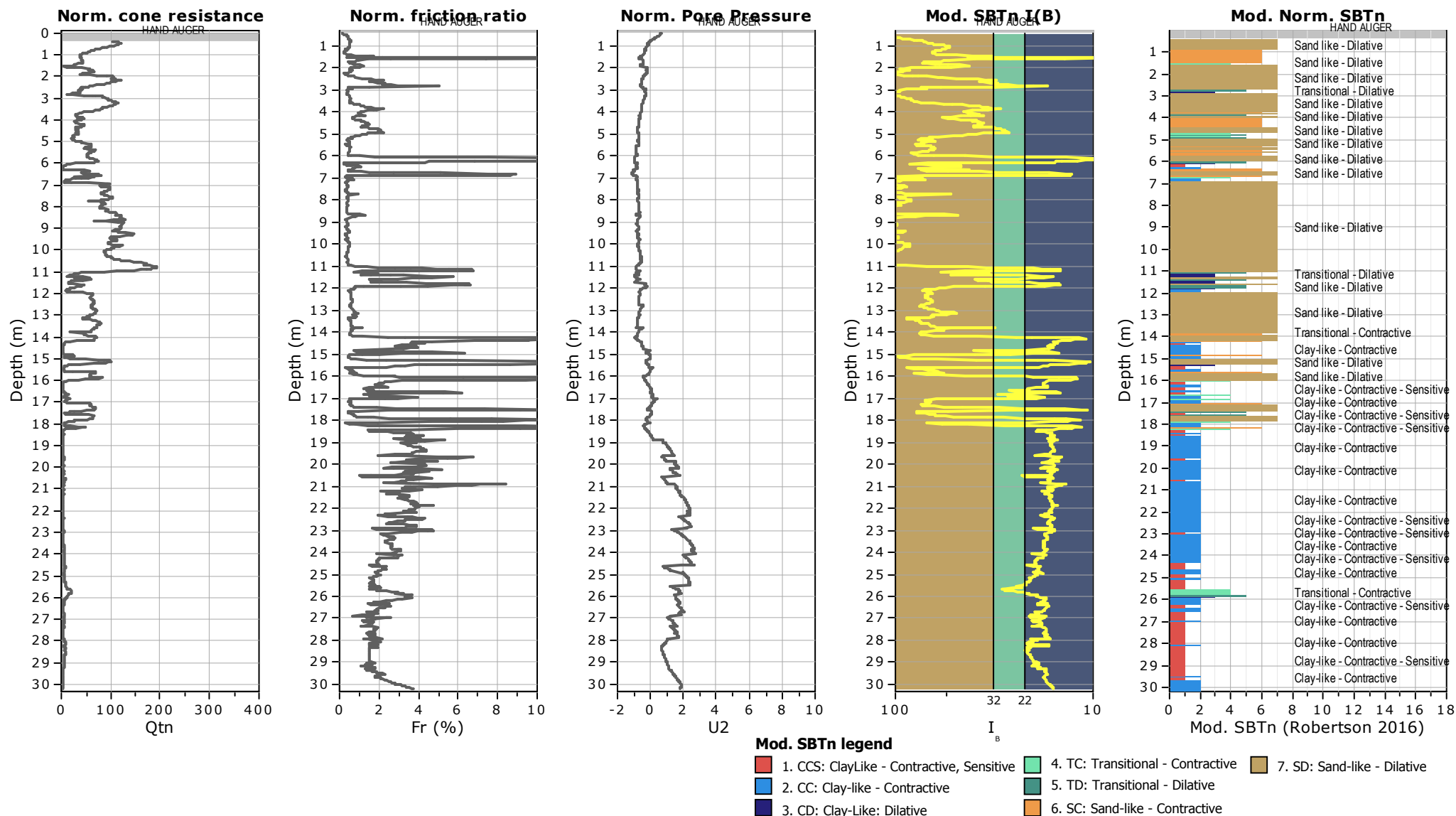
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

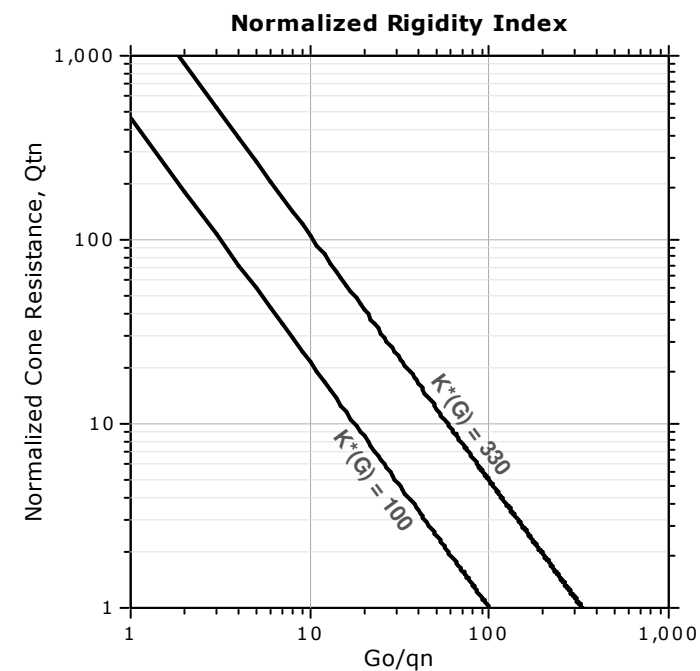
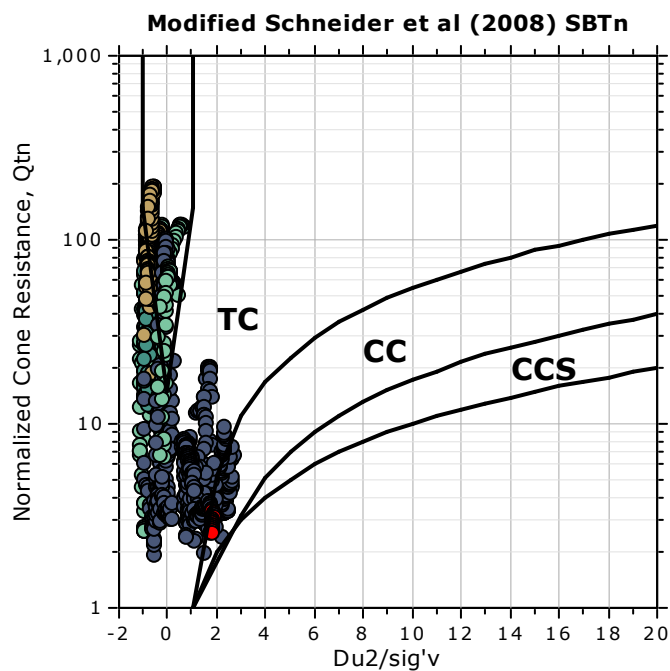
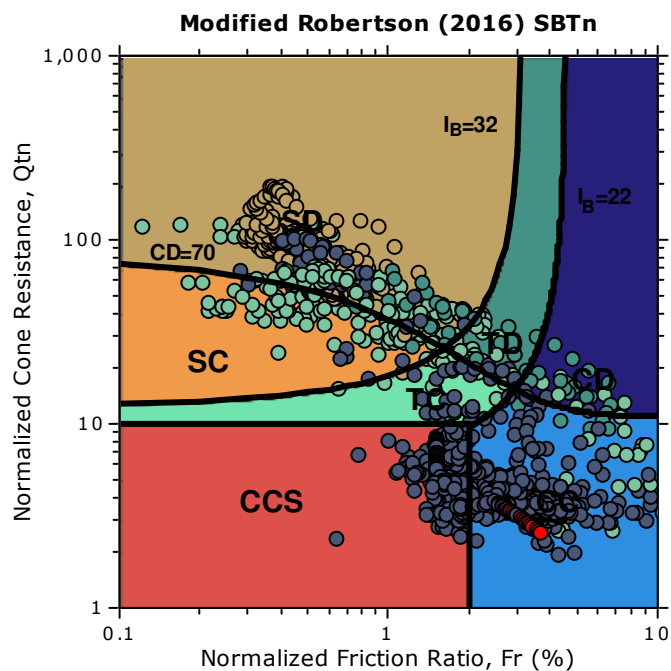
**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



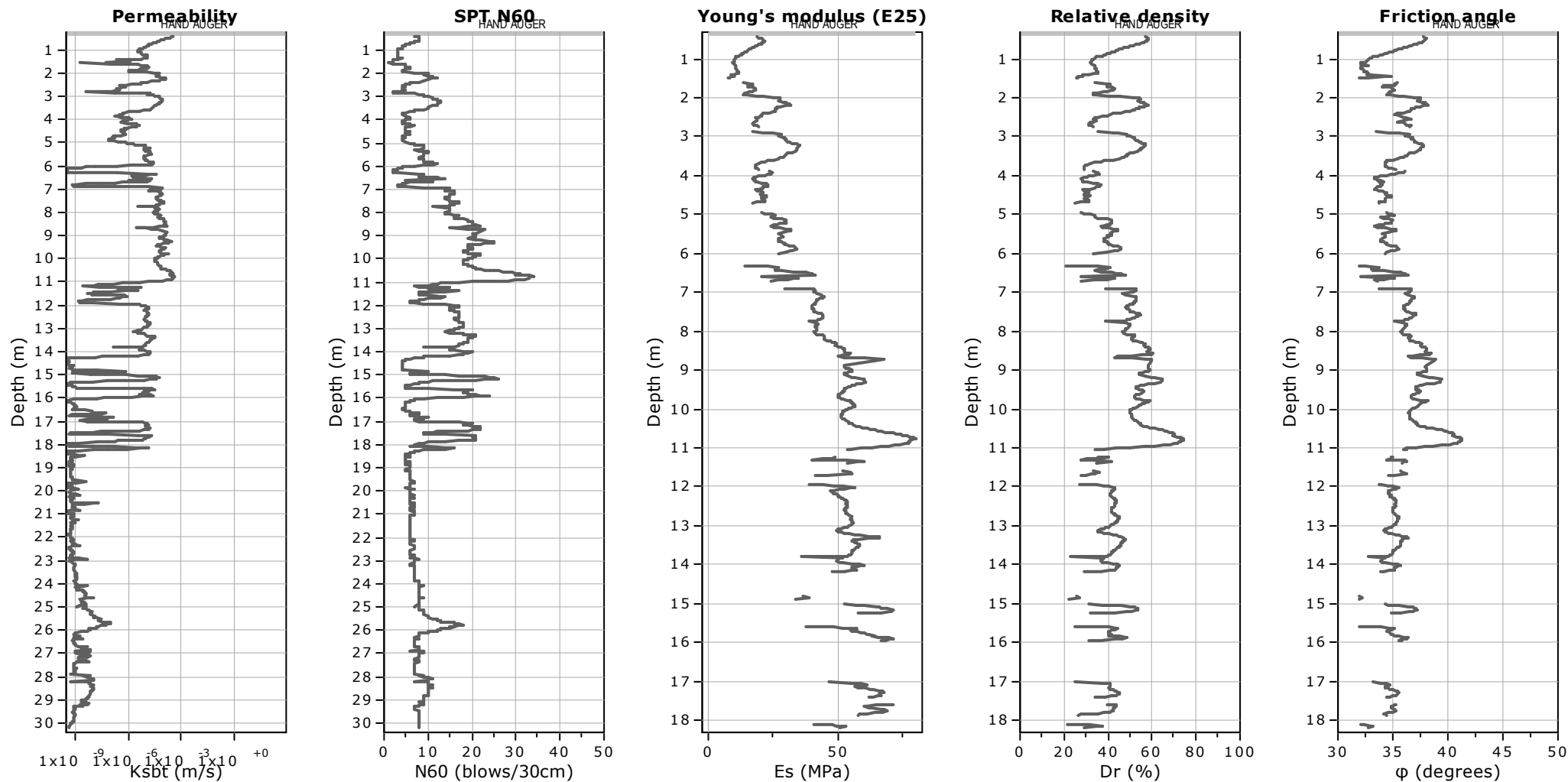
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

● User defined estimation data

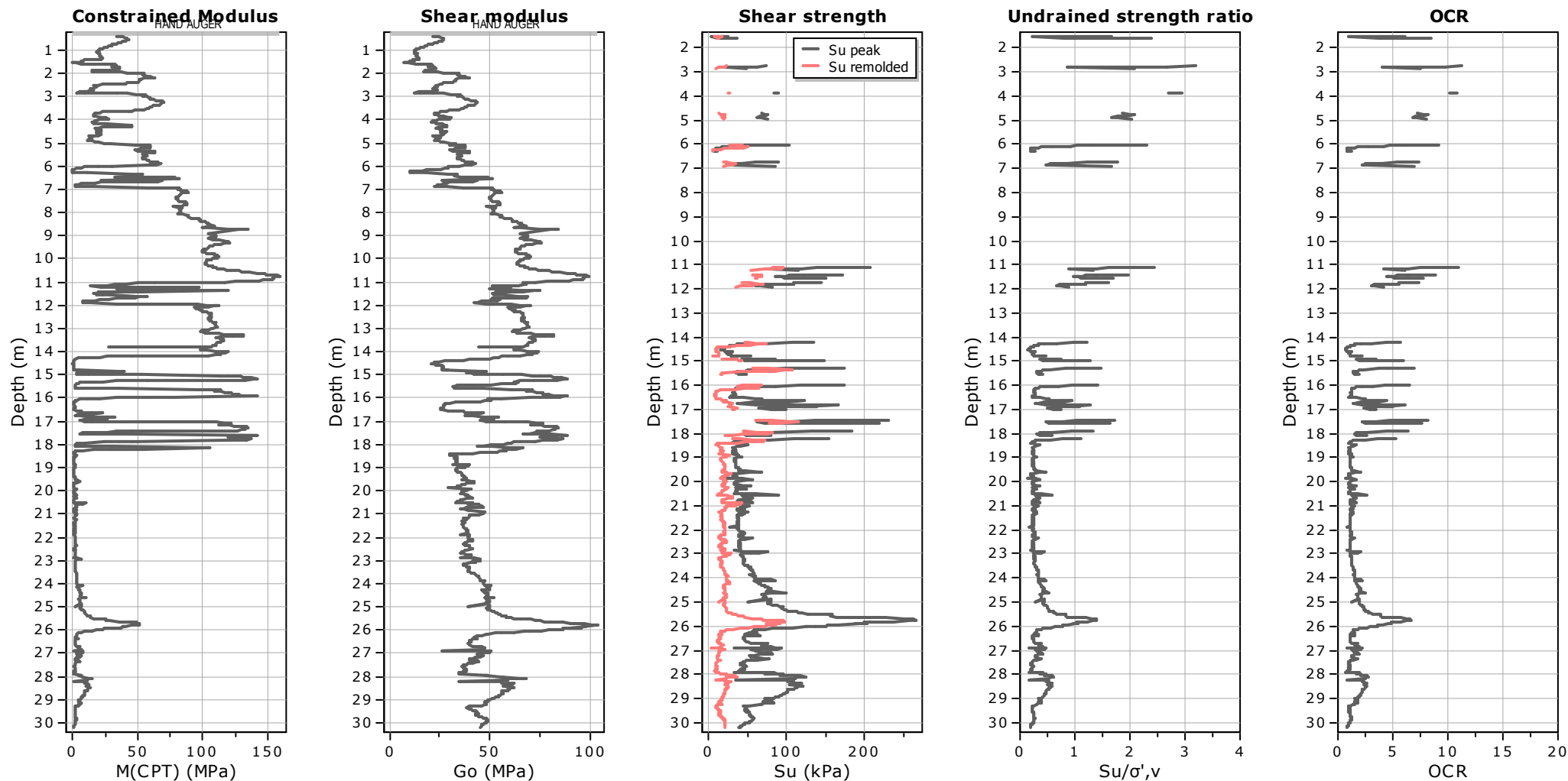
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

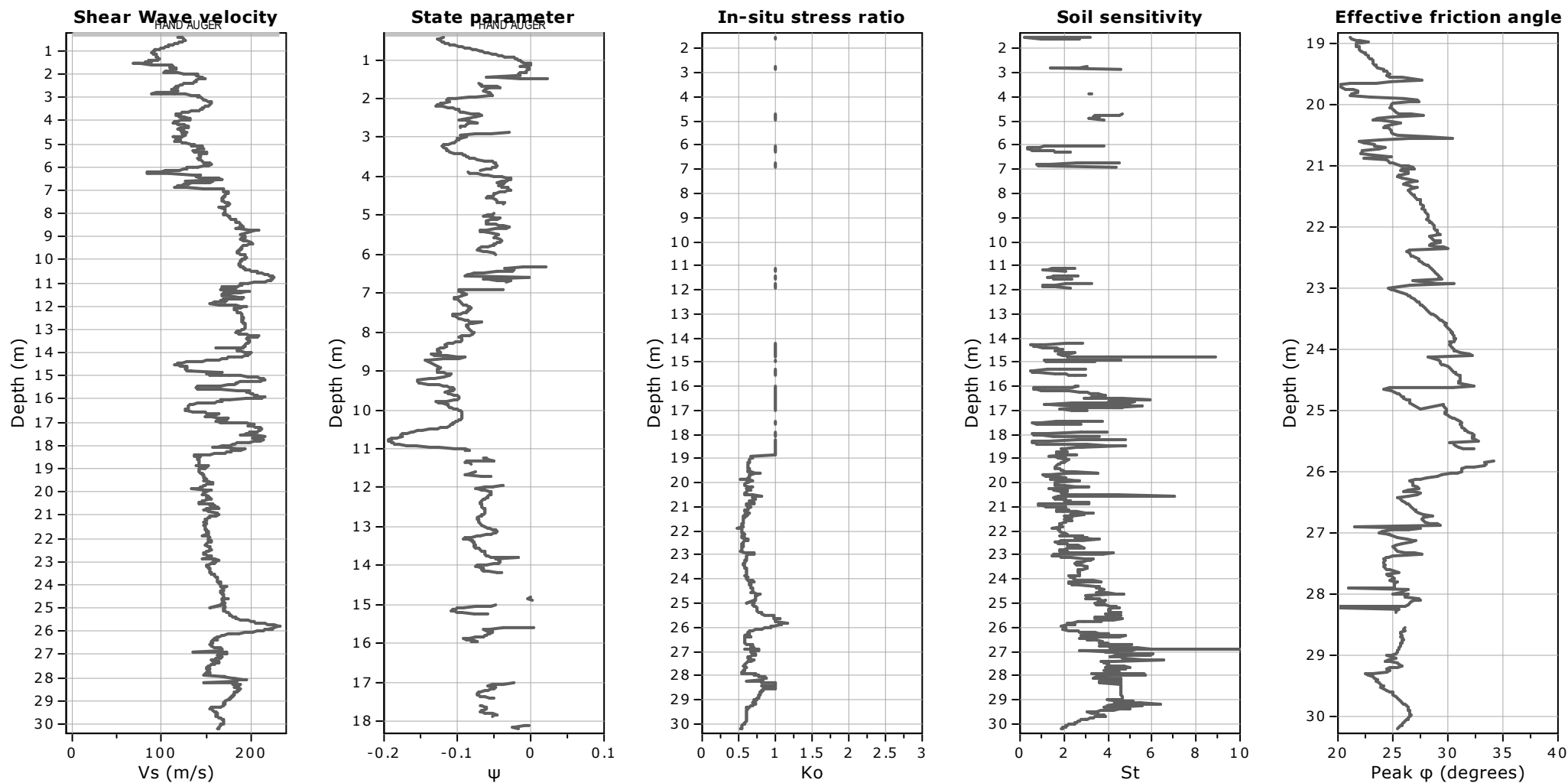
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°



**Calculation parameters**

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

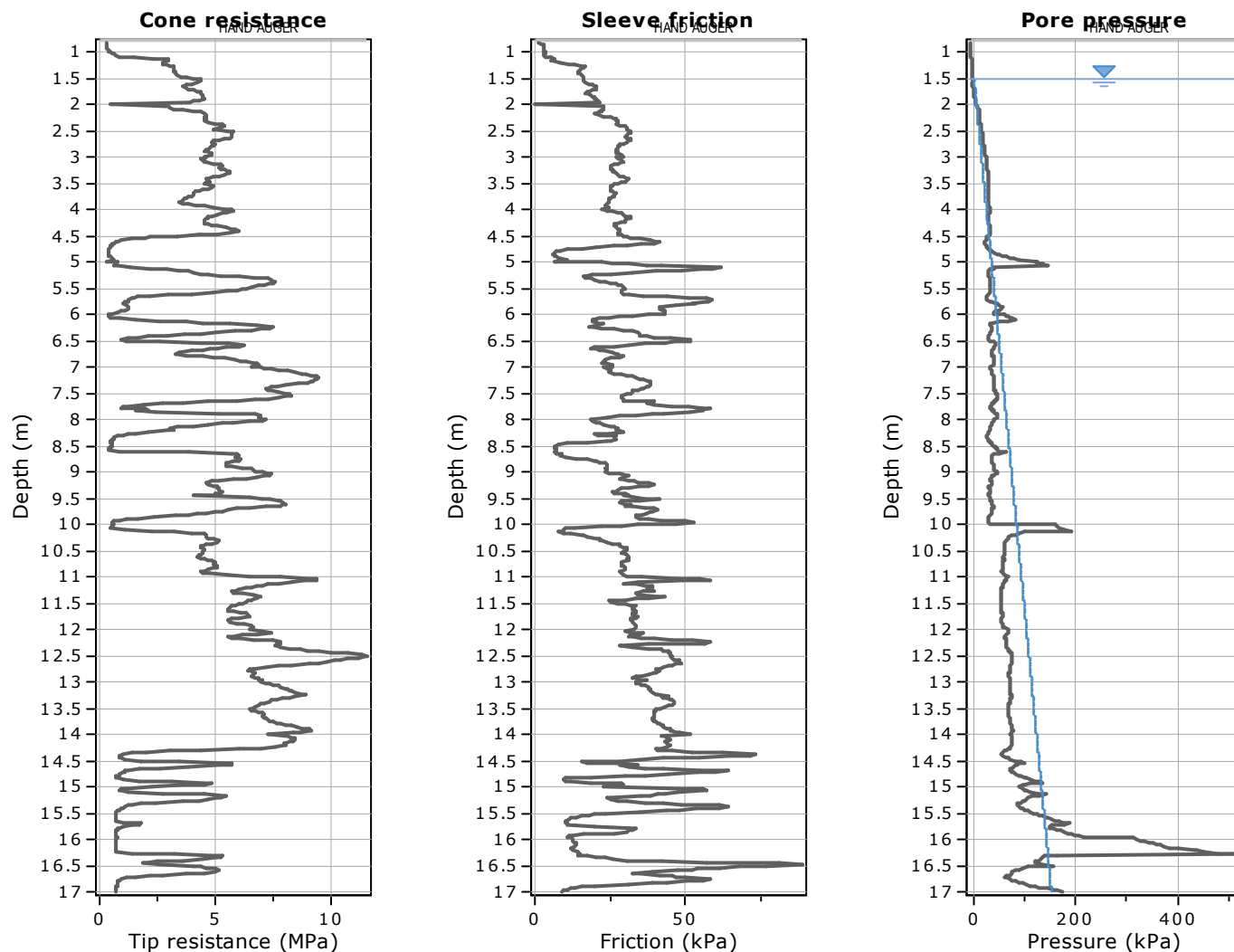
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**Location:** S.S. 309 - ROMEA

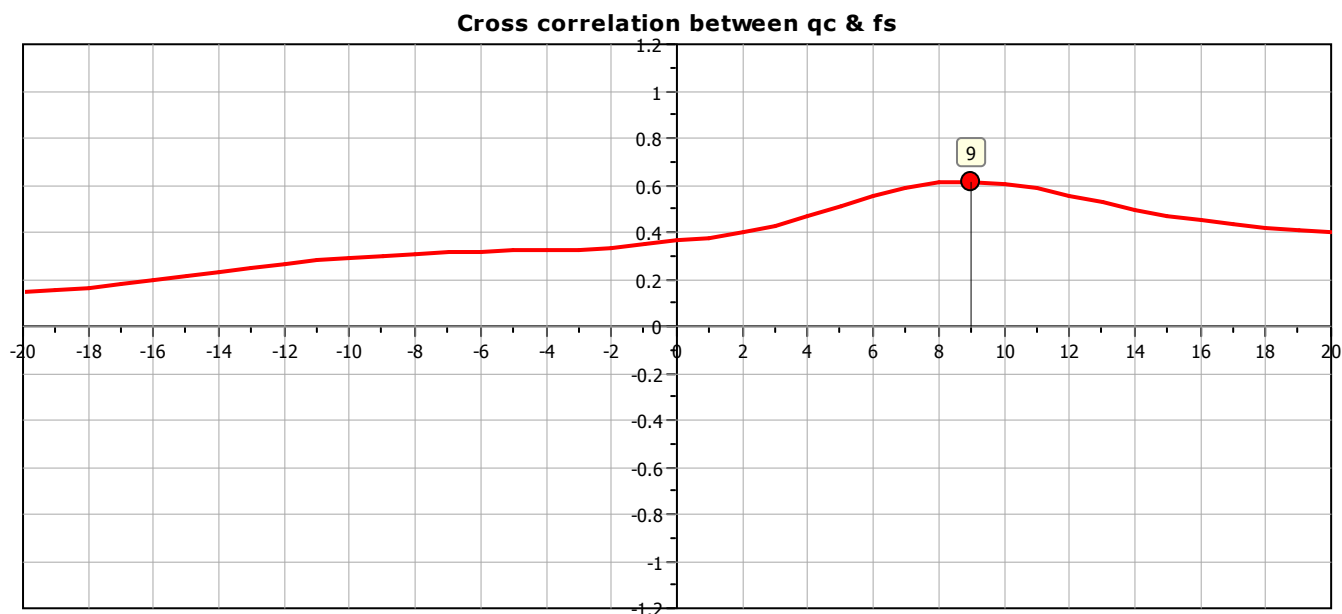
**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°

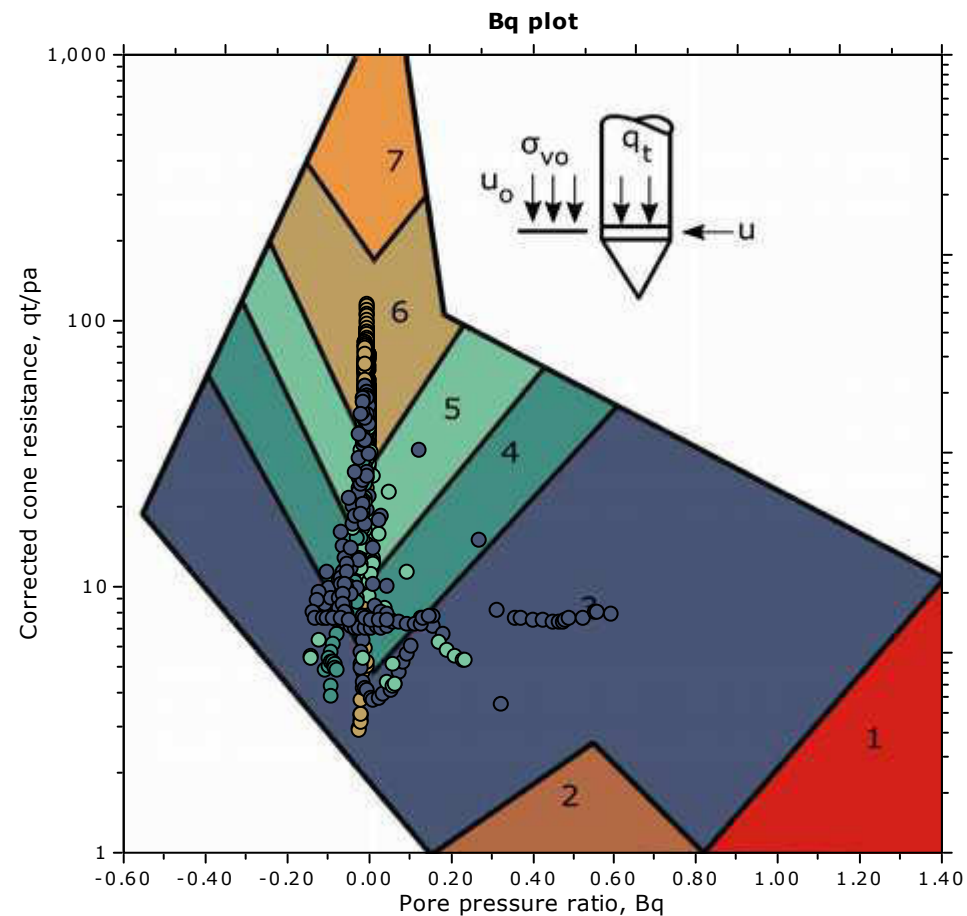
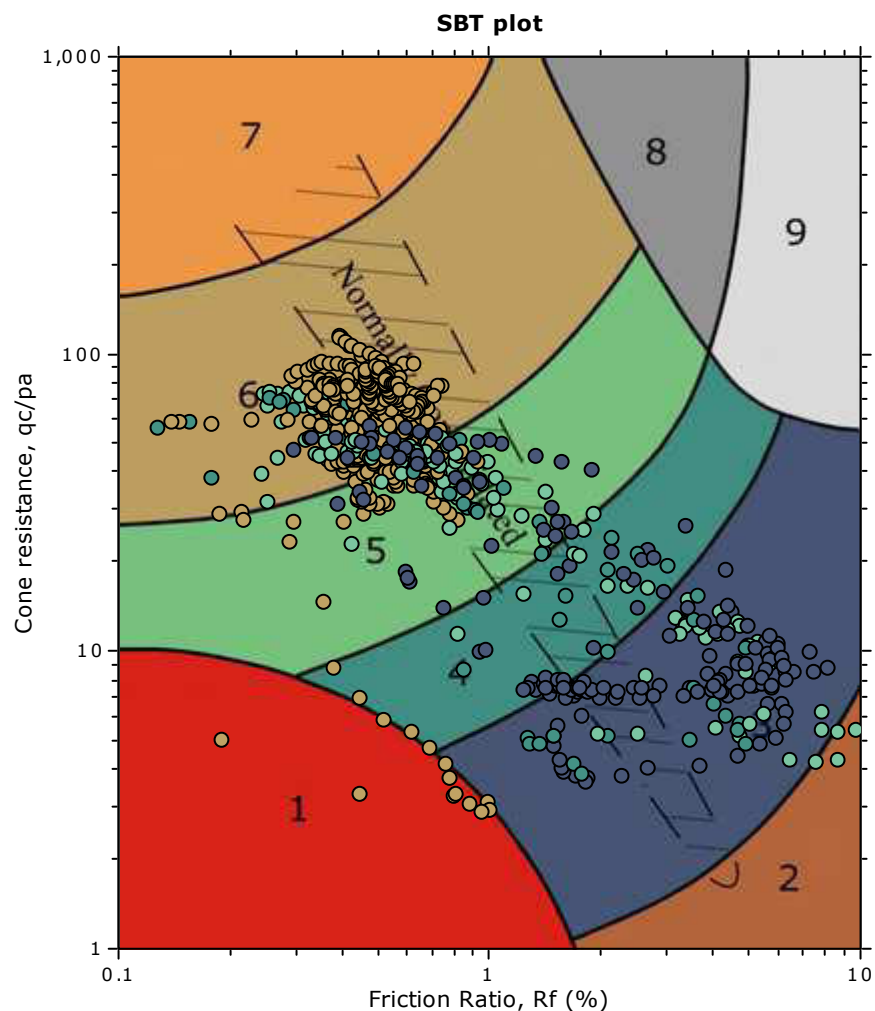


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





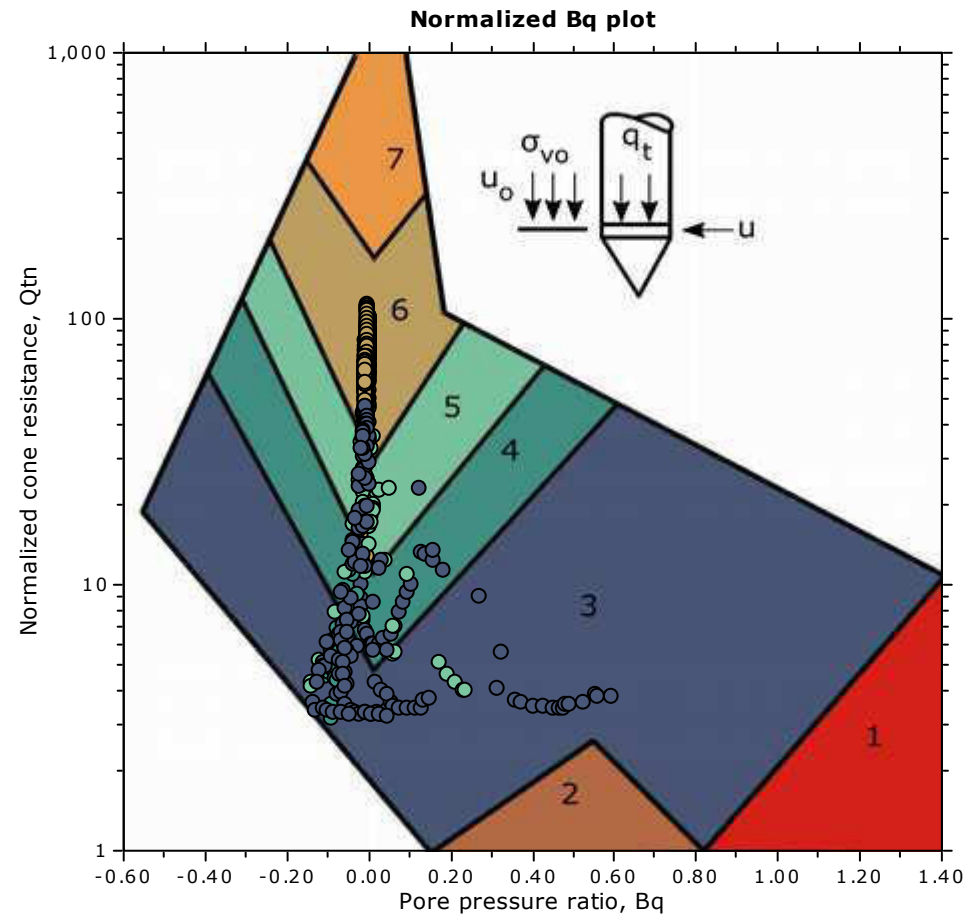
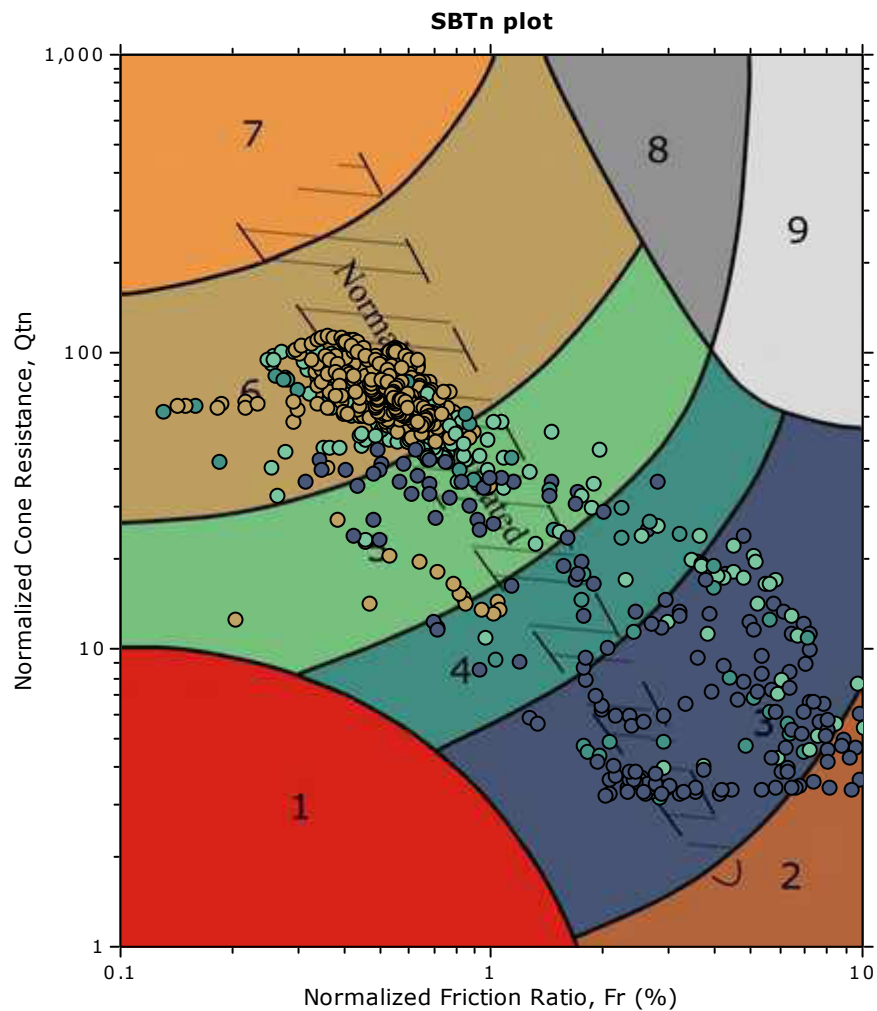
### SBT - Bq plots



#### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

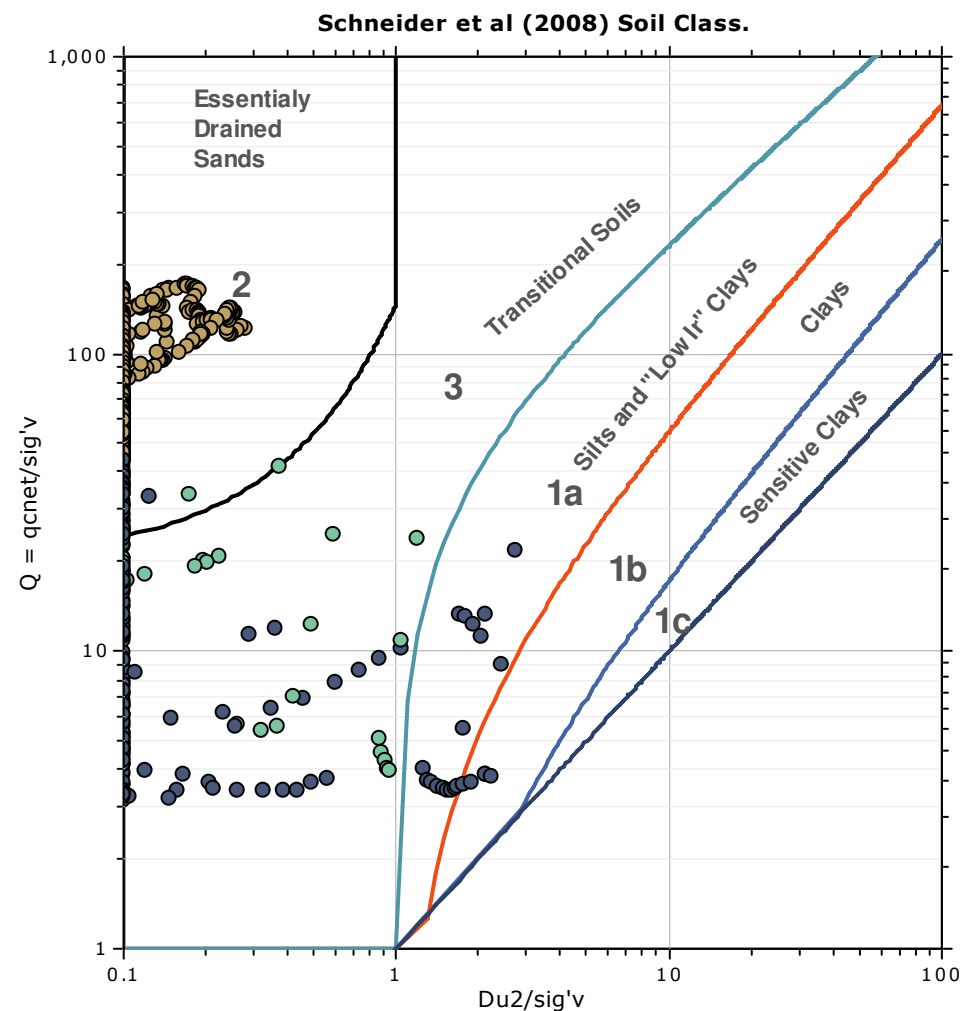
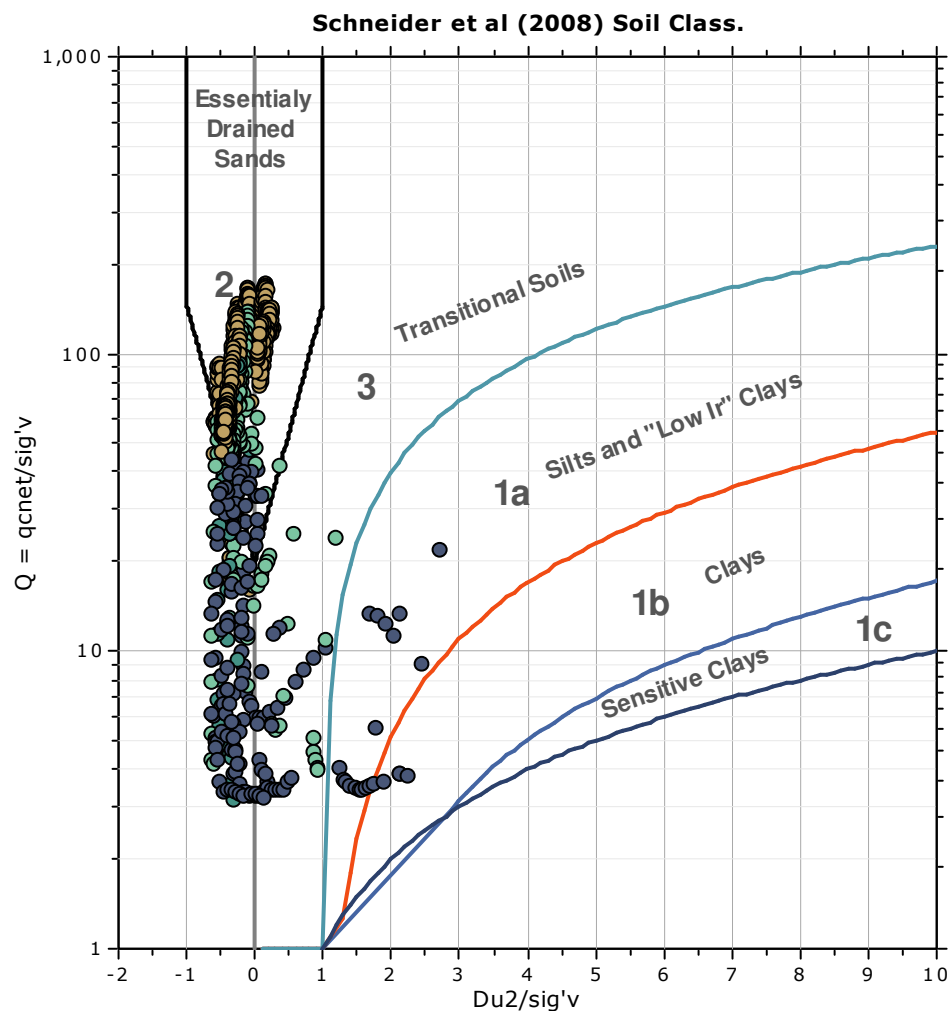
**SBT - Bq plots (normalized)**

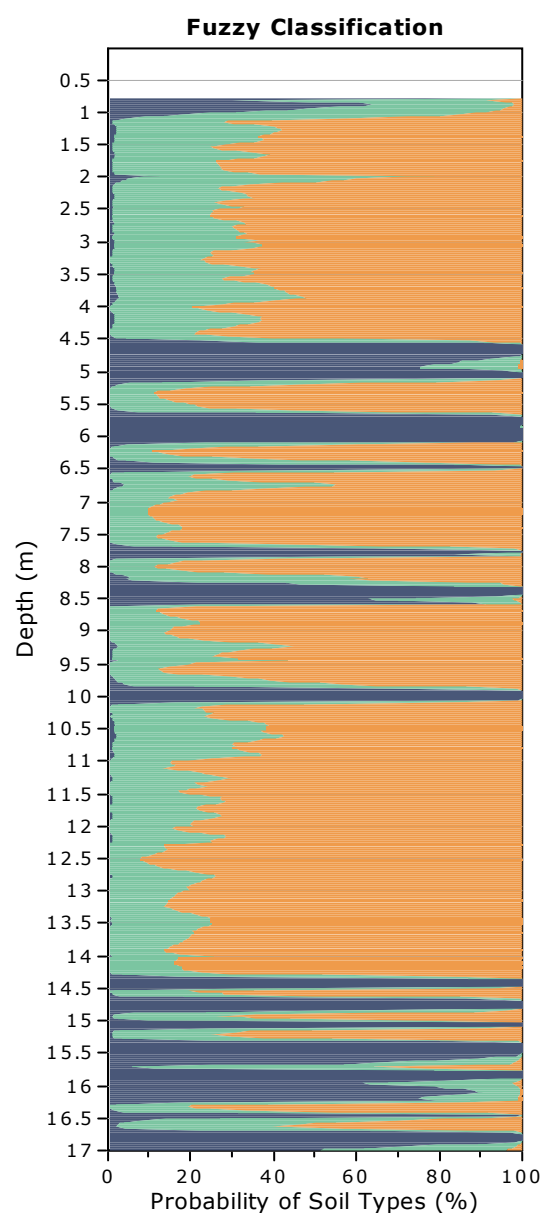
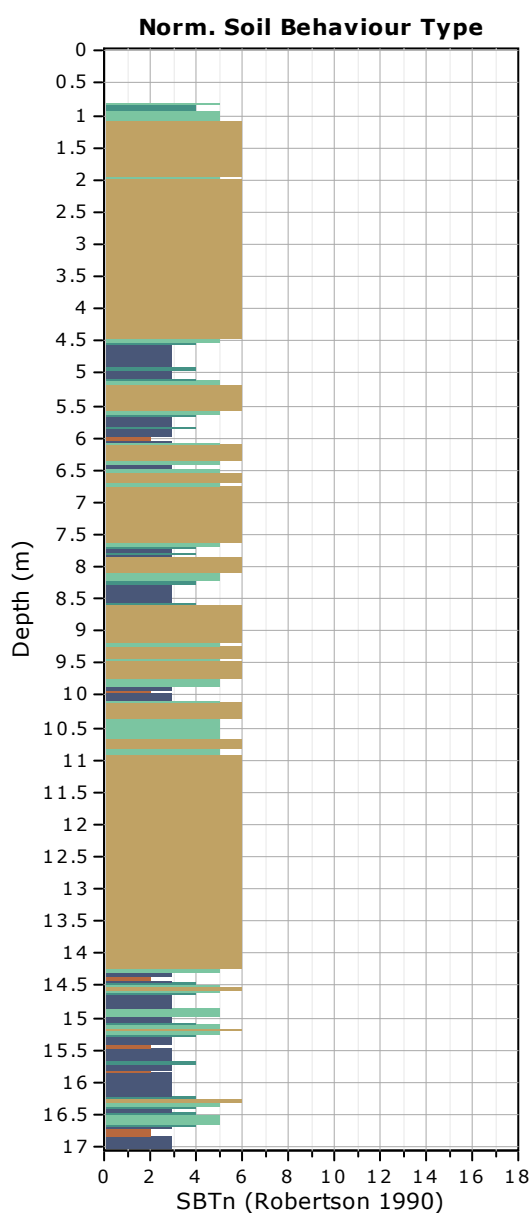


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







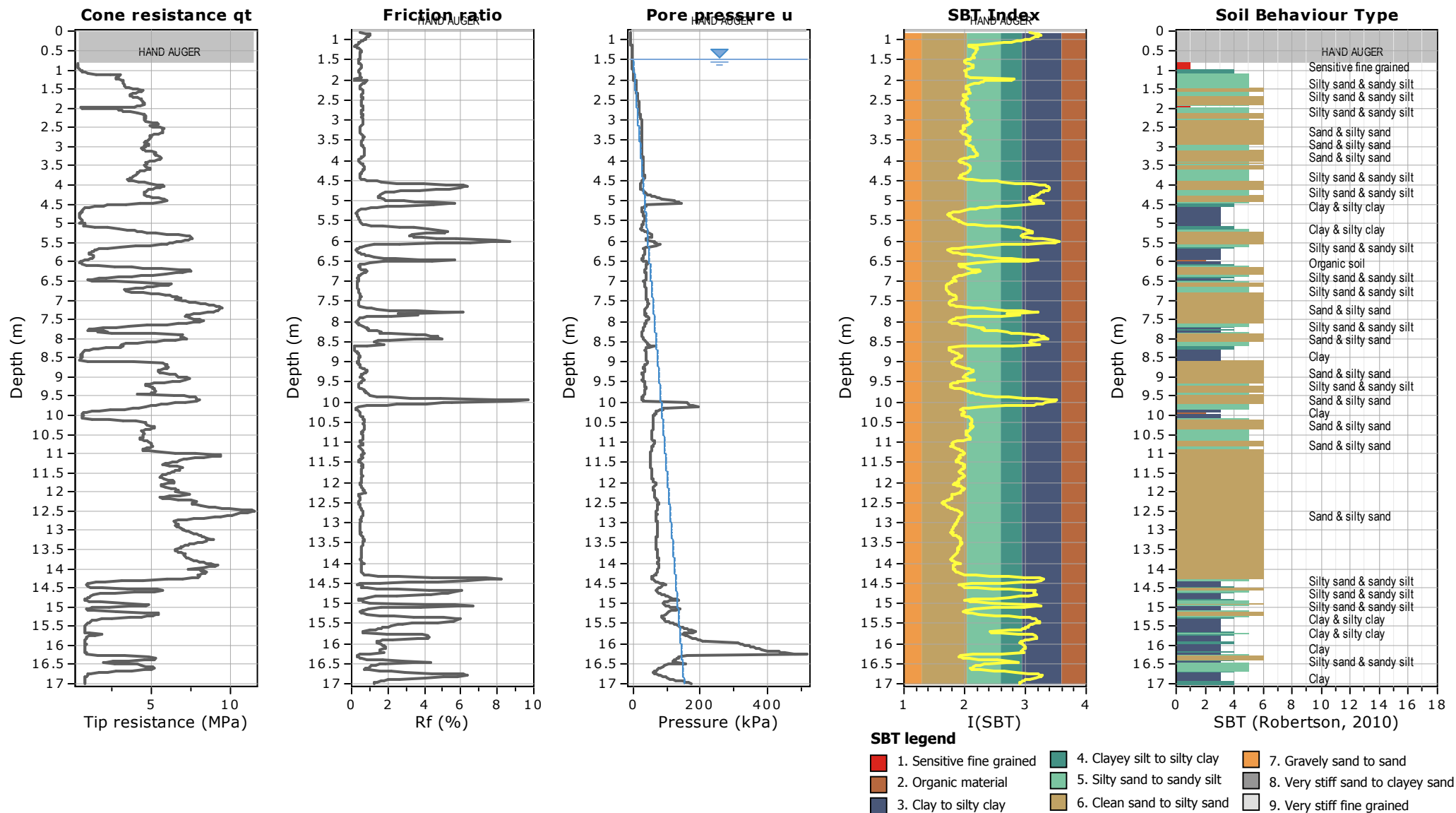
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



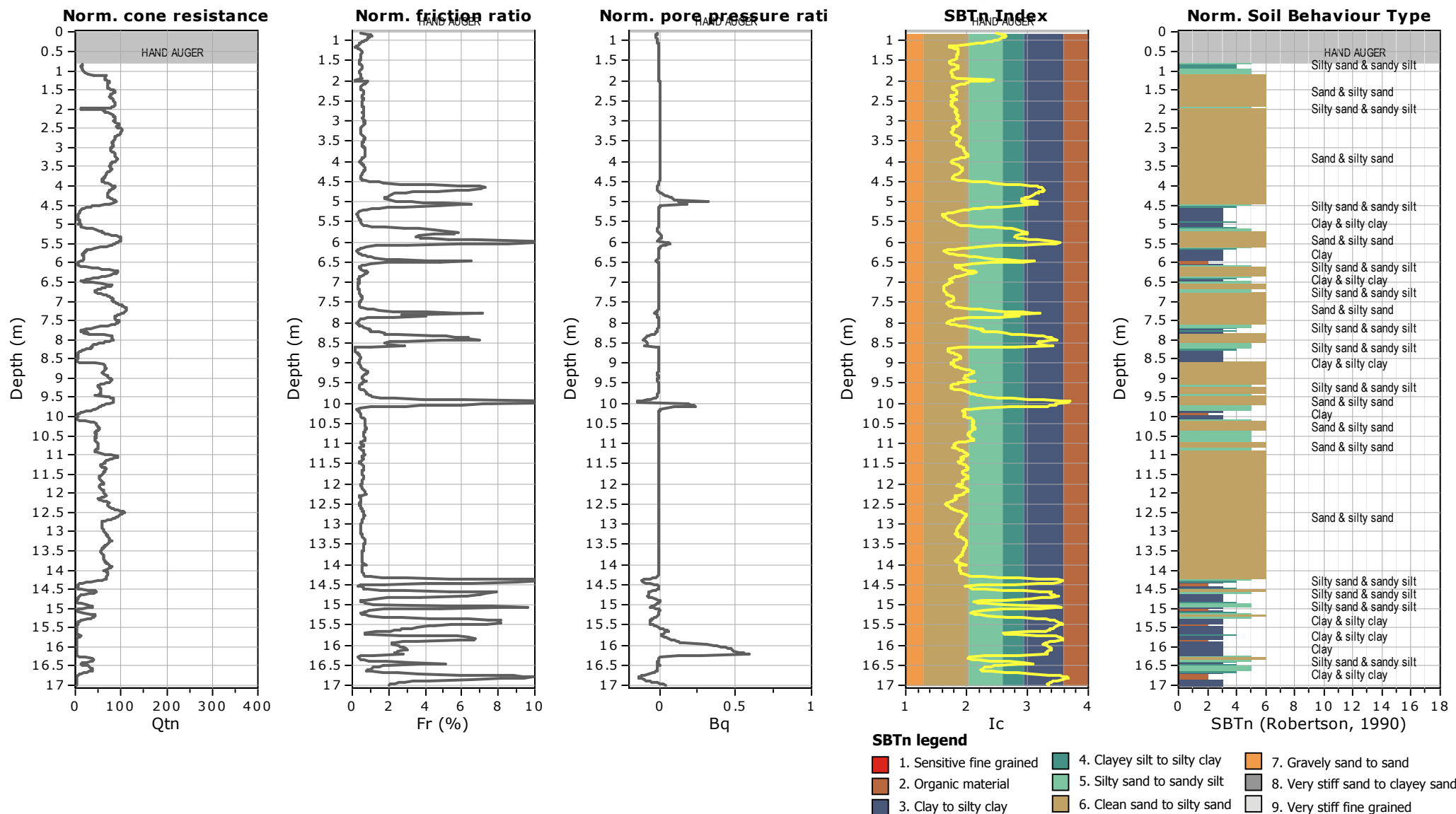
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



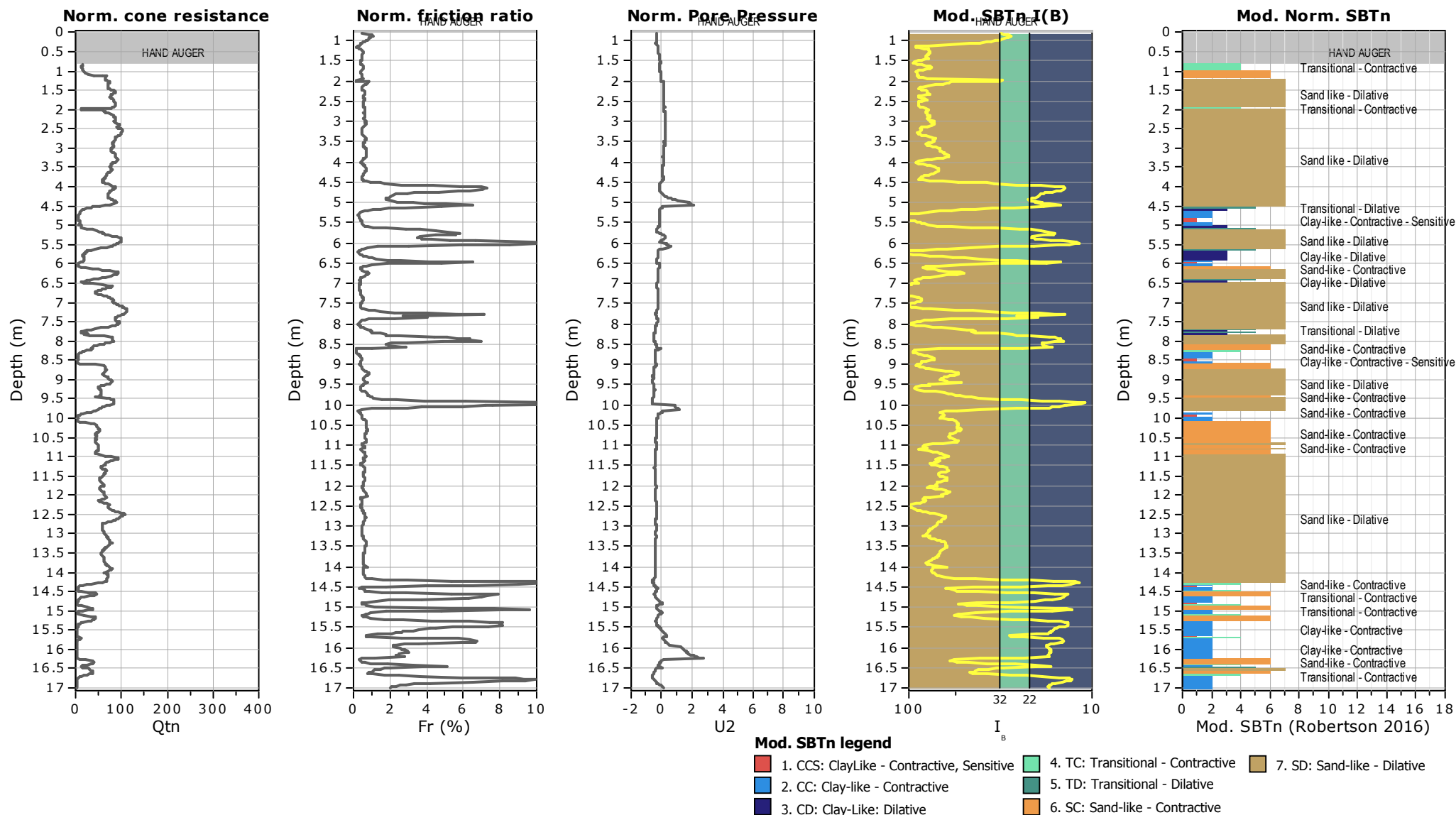
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

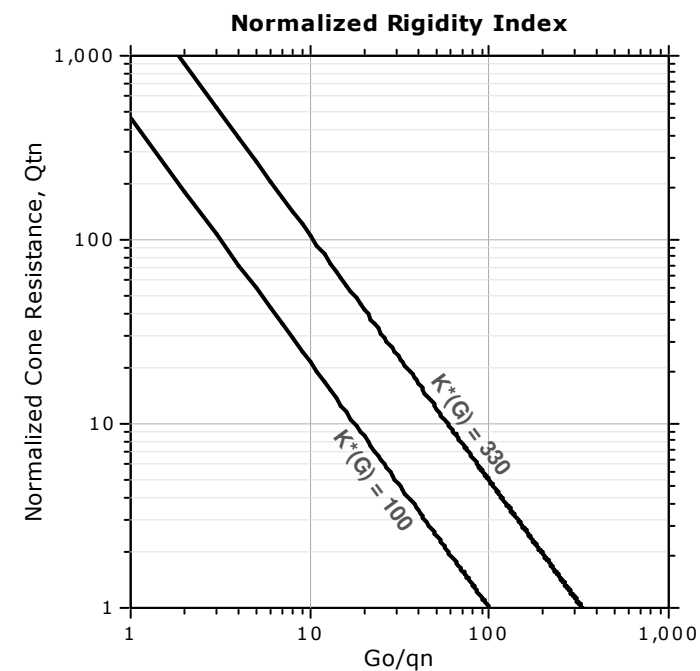
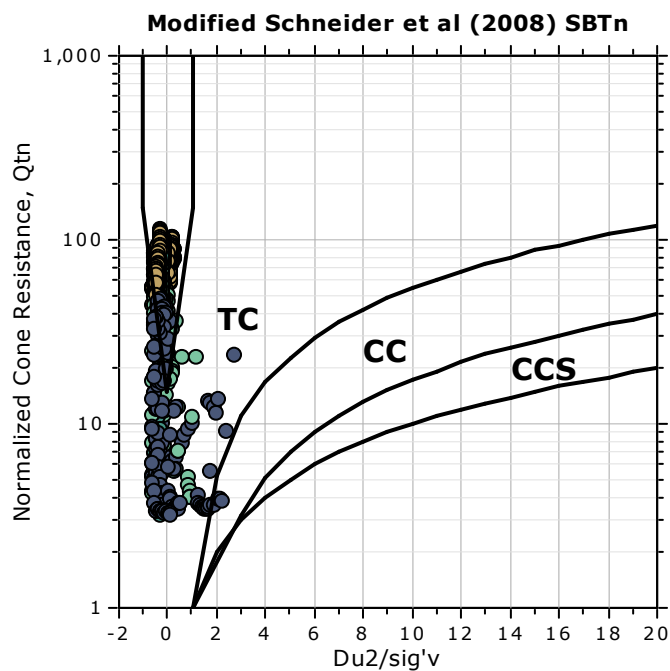
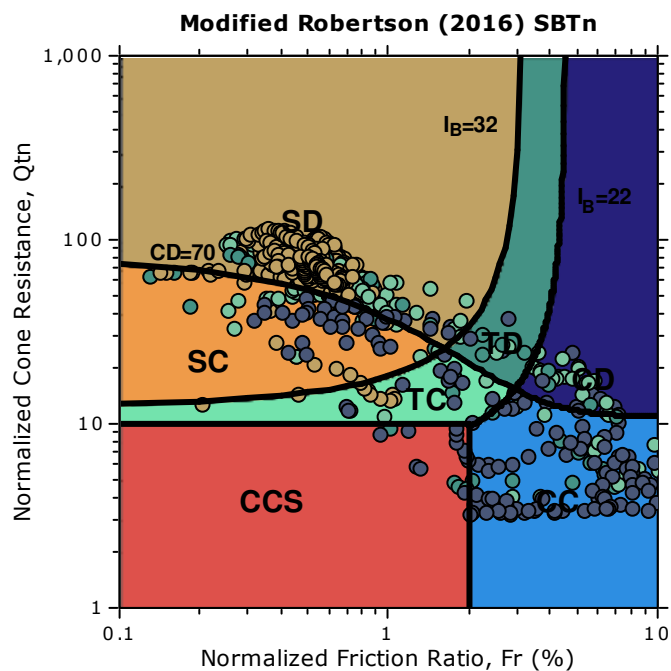
**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



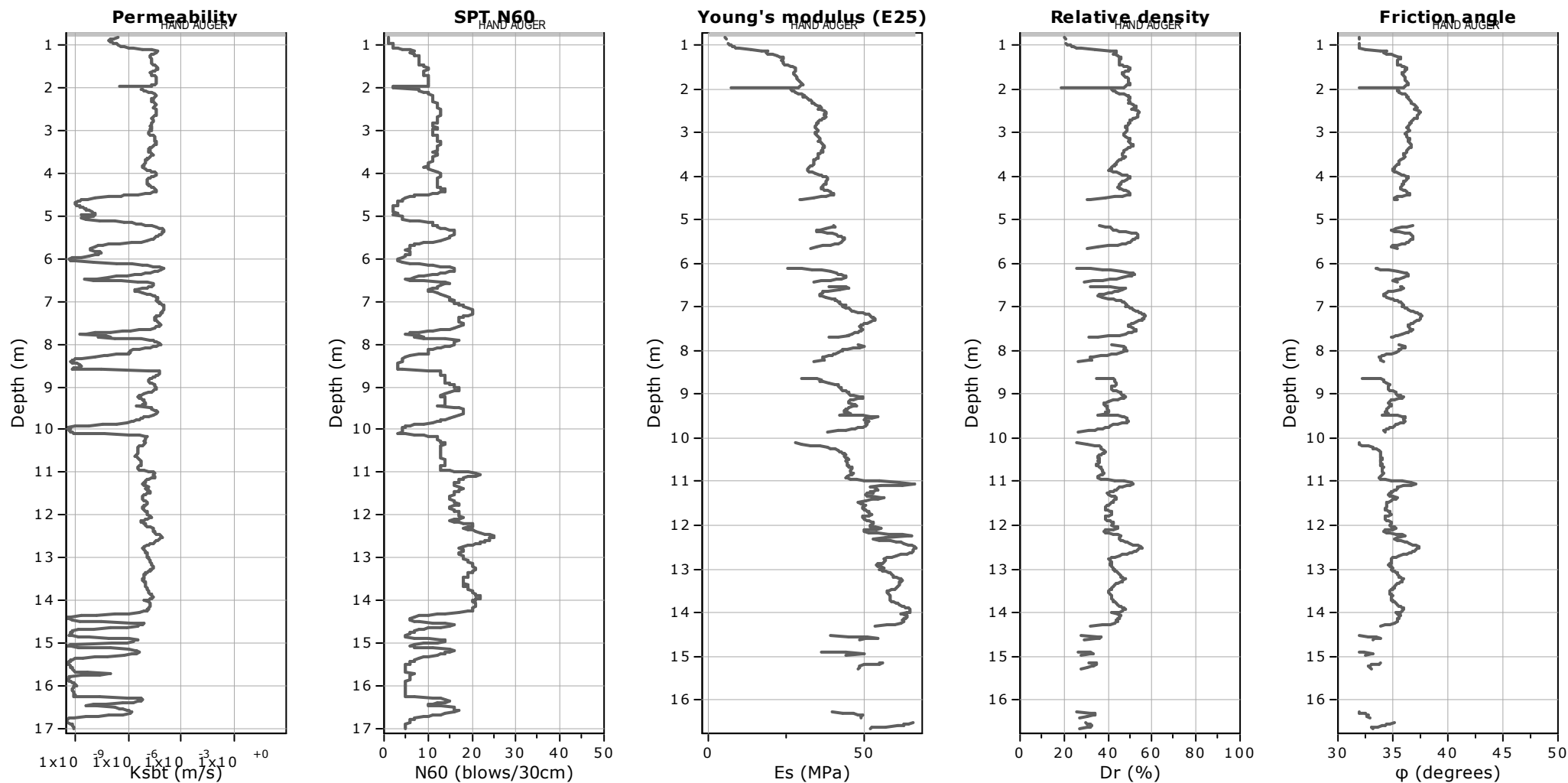
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



**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 Kulhavy & Mayne (1990)

● User defined estimation data

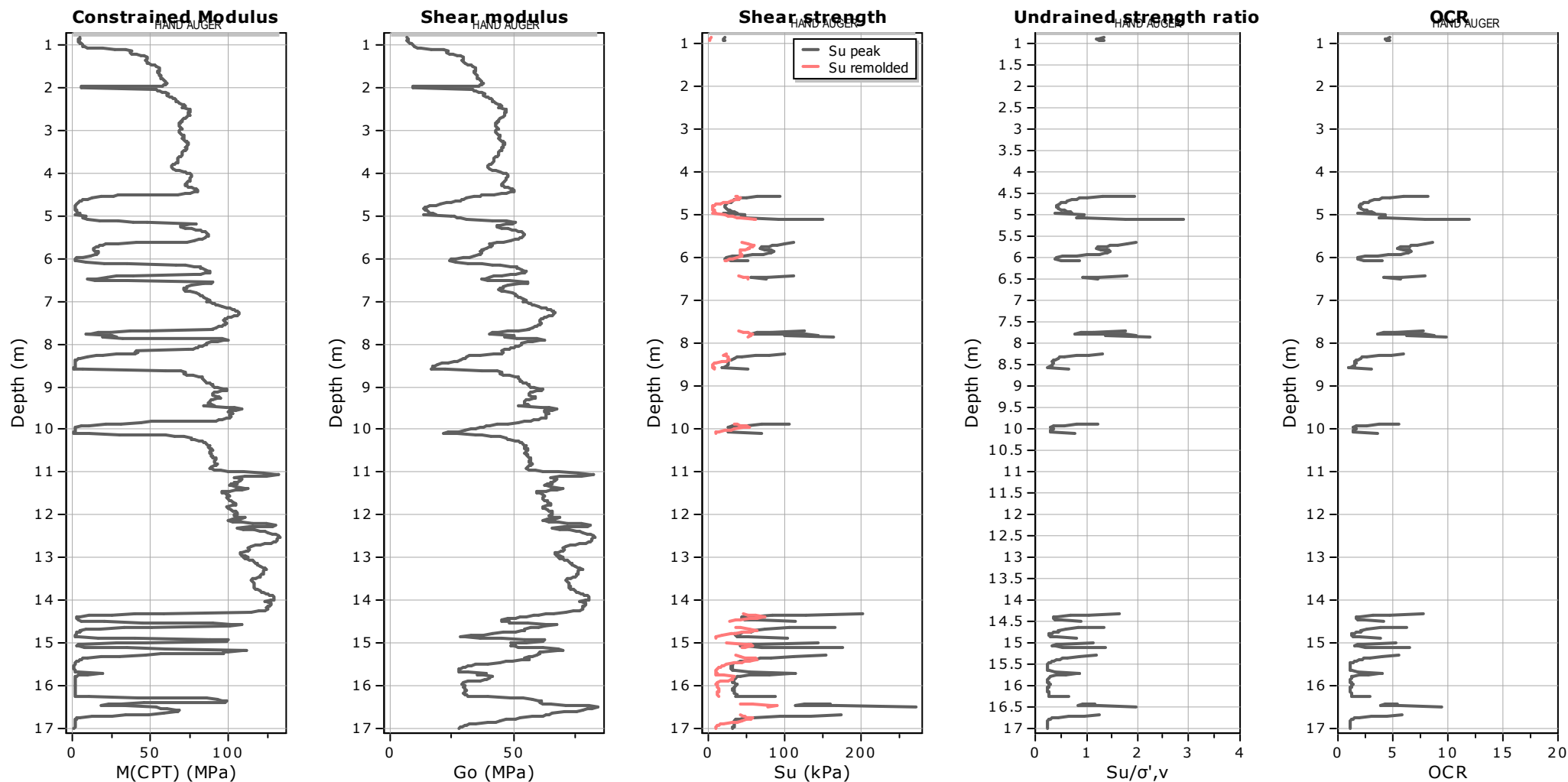
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

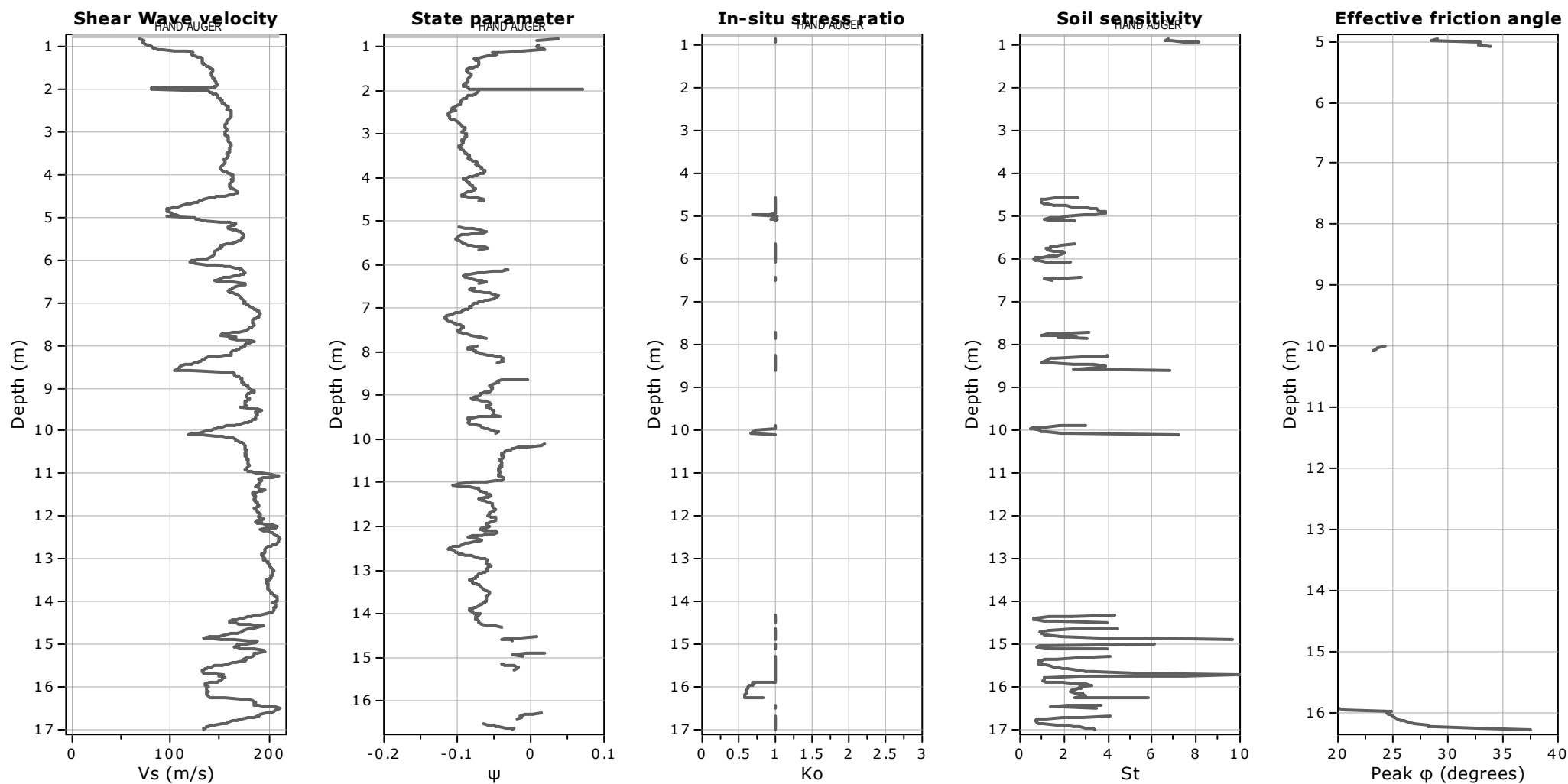
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

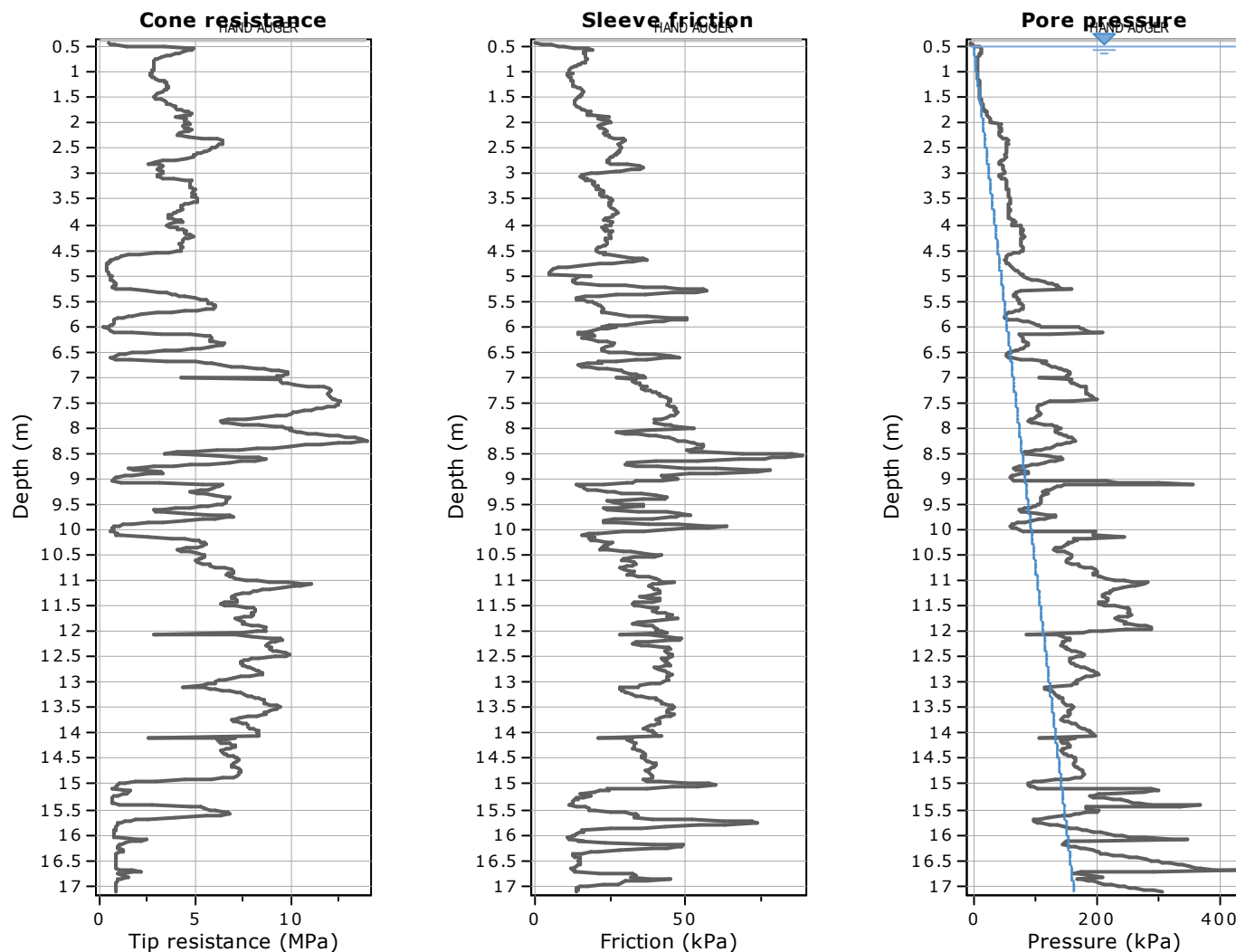
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

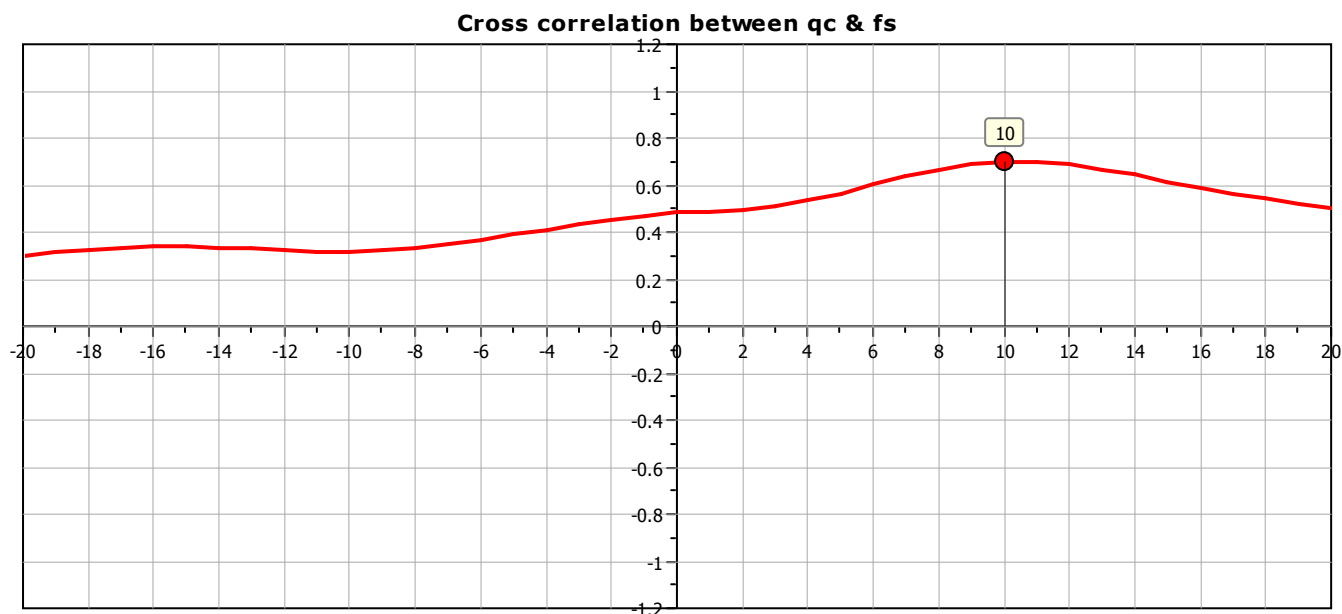
**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°

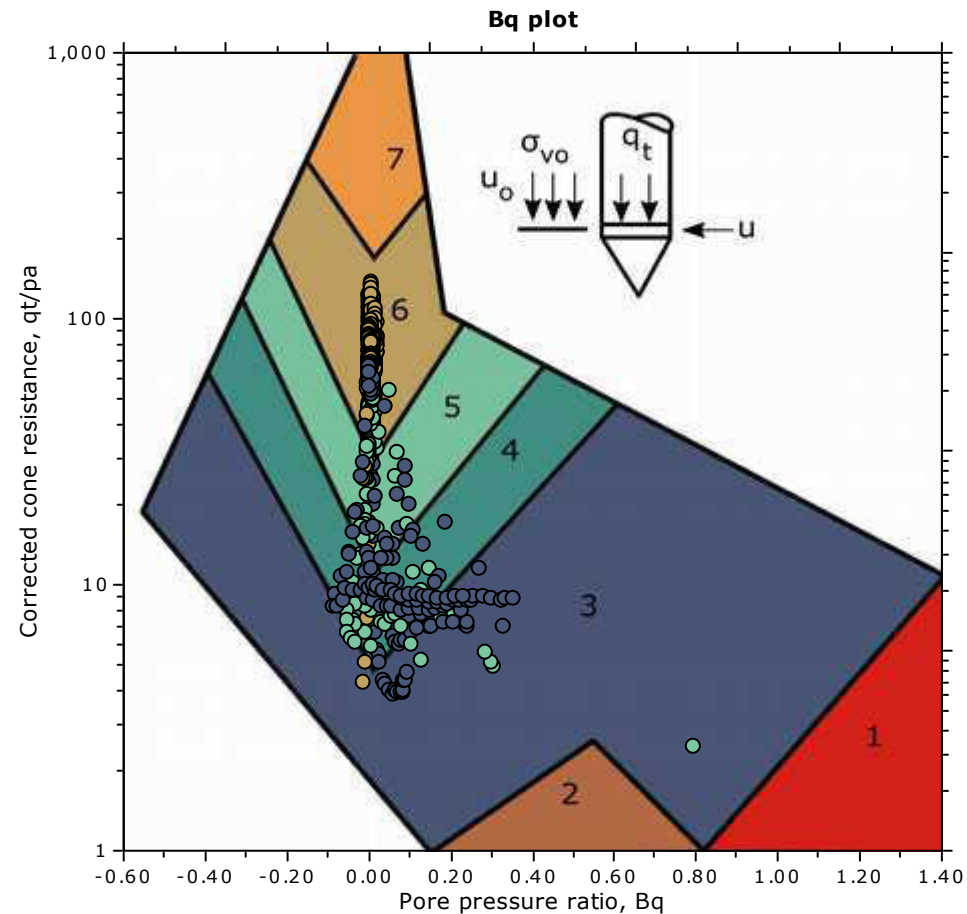
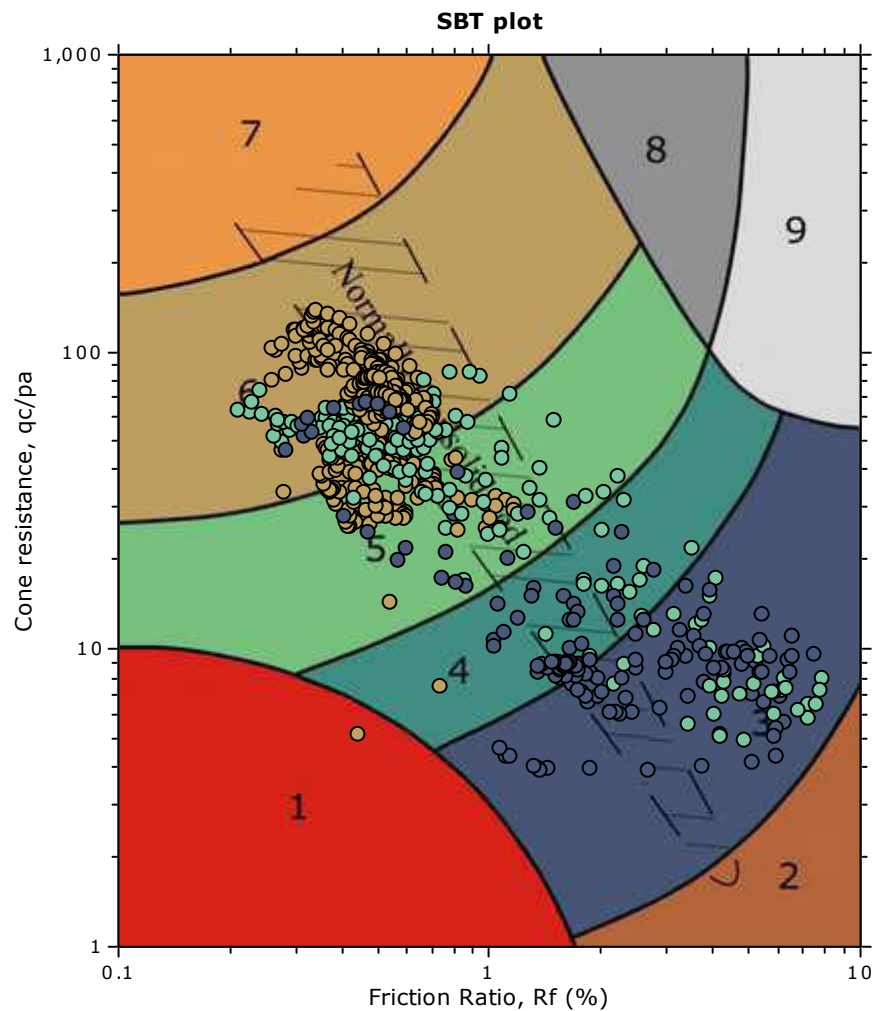


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





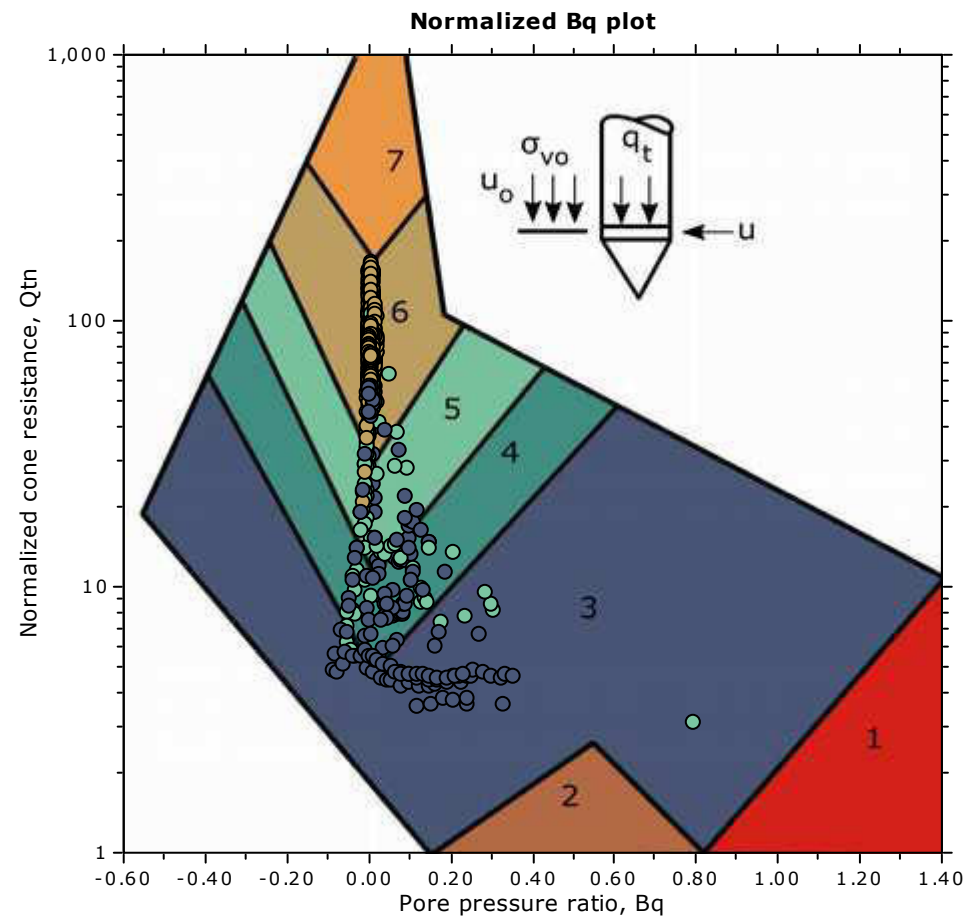
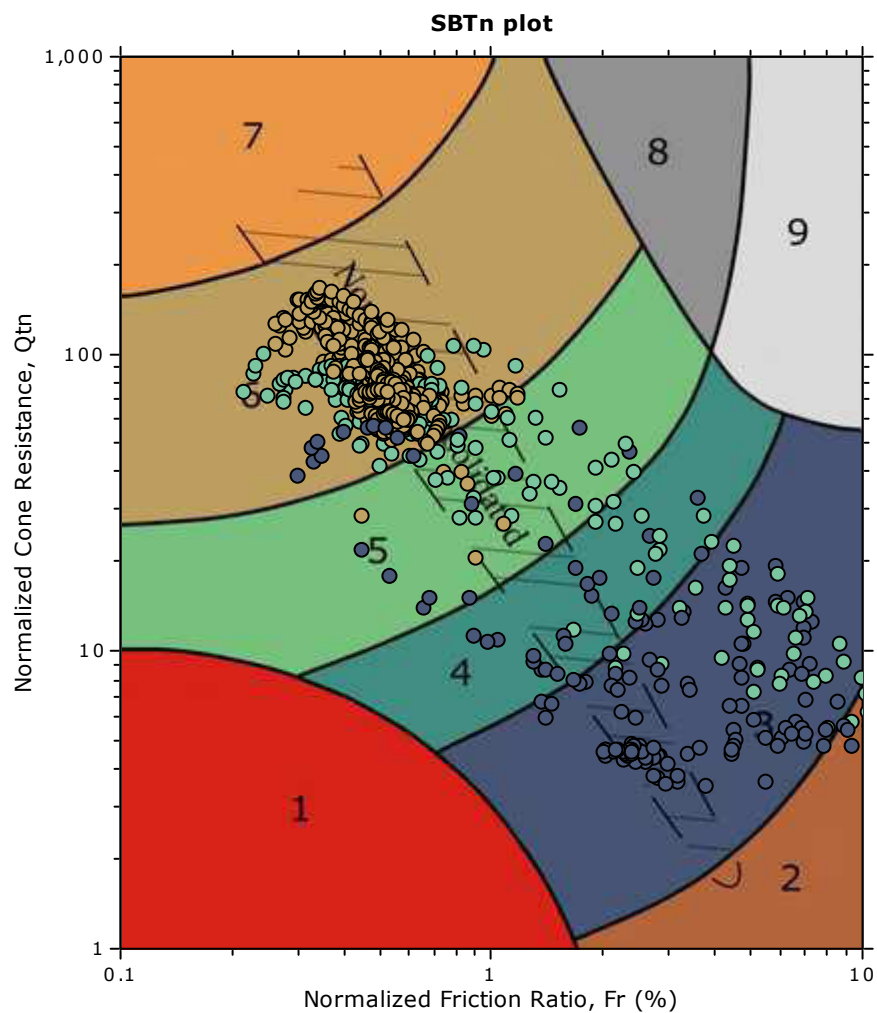
### SBT - Bq plots



#### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

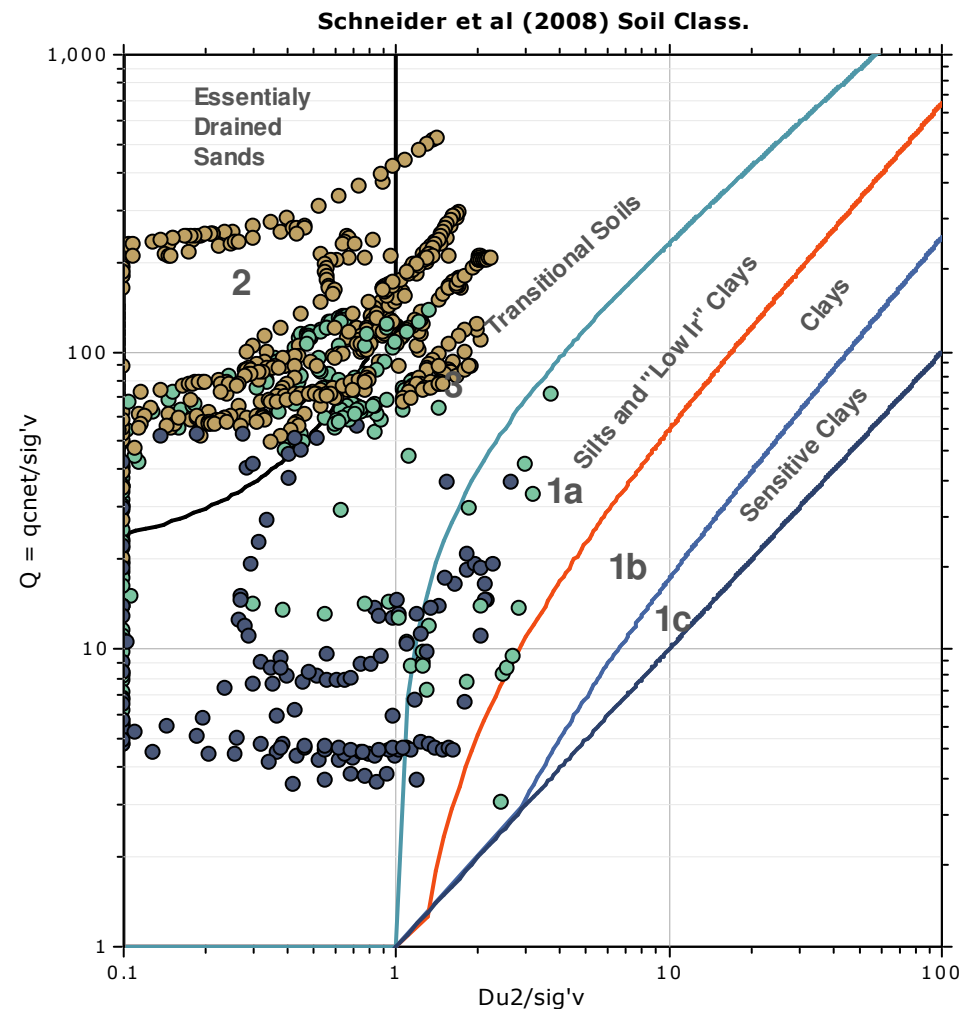
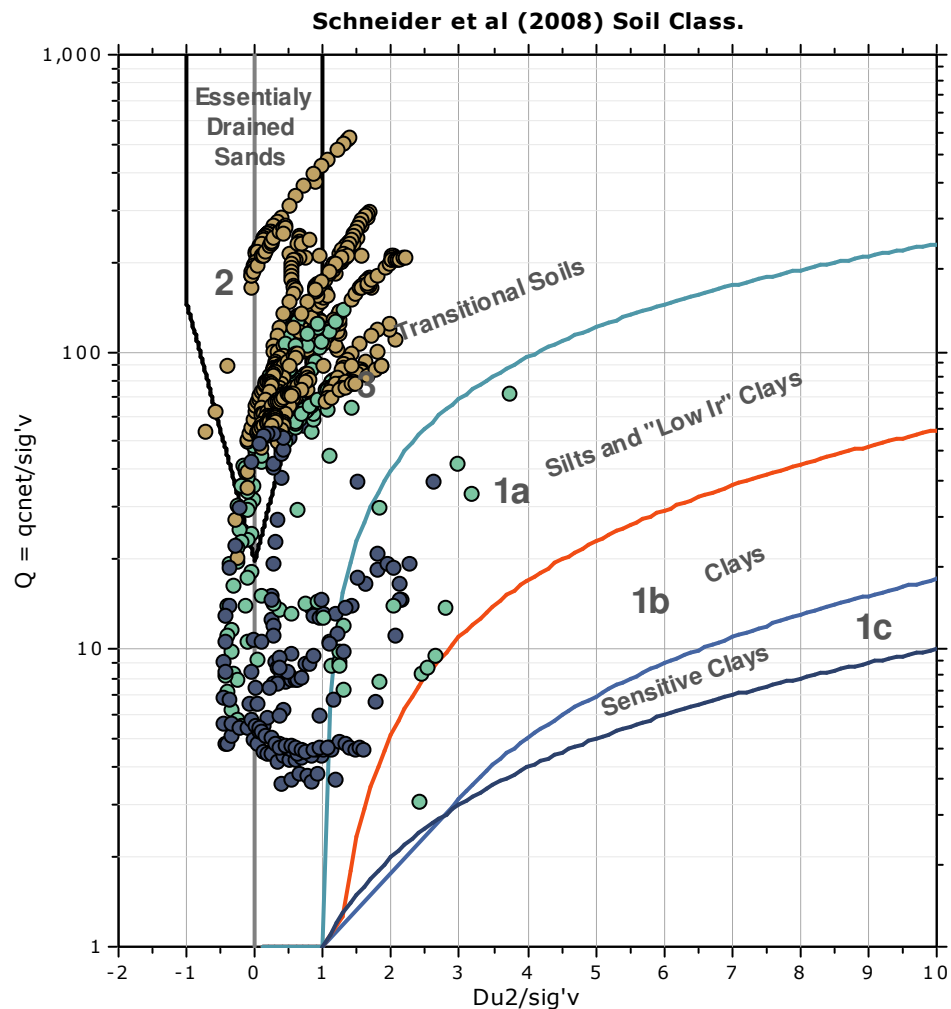
**SBT - Bq plots (normalized)**



**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)



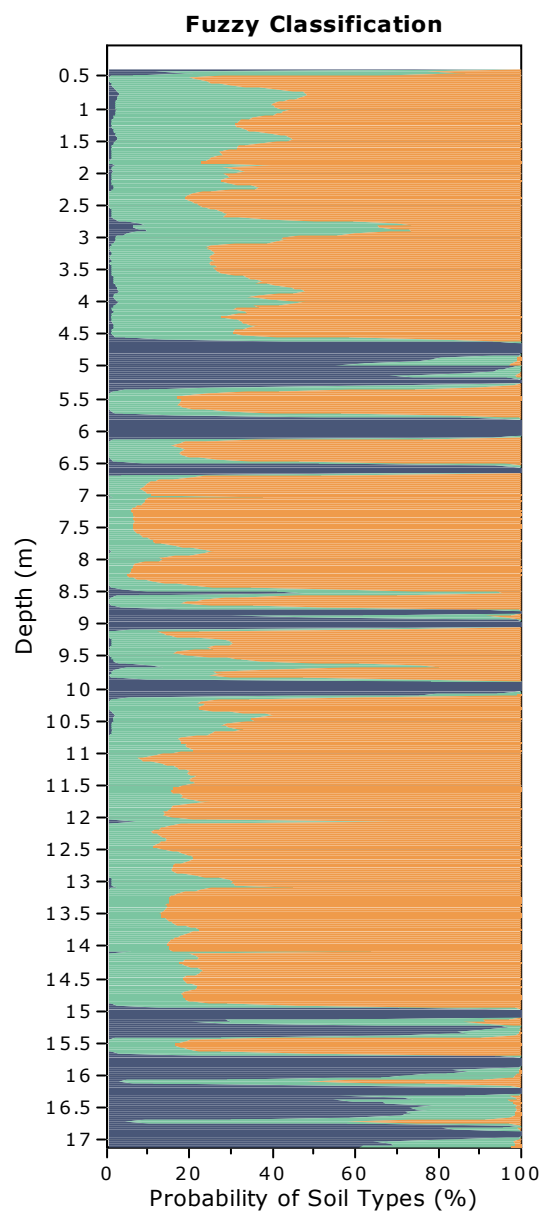
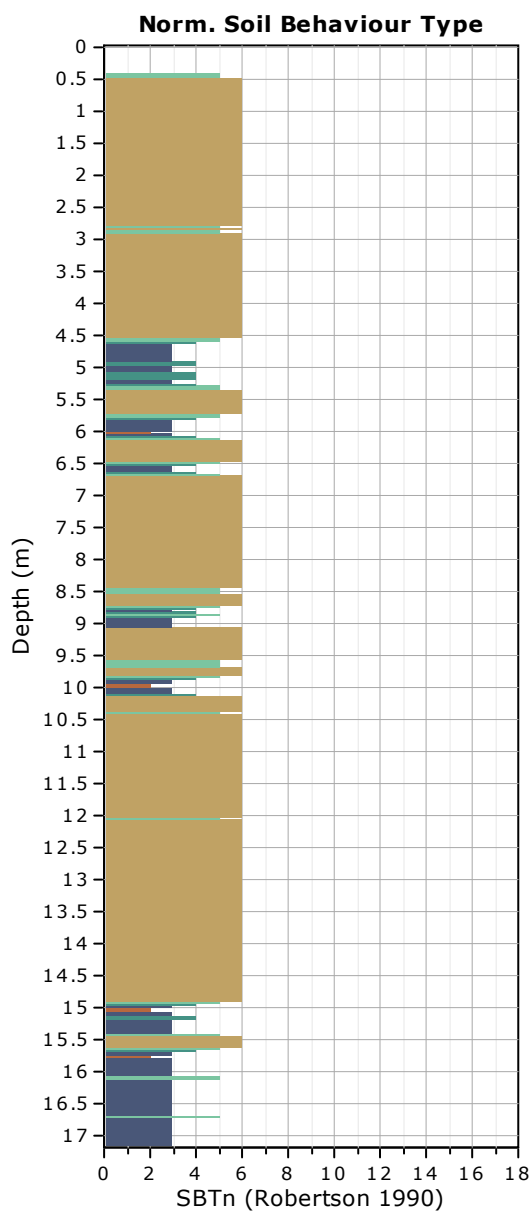
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°





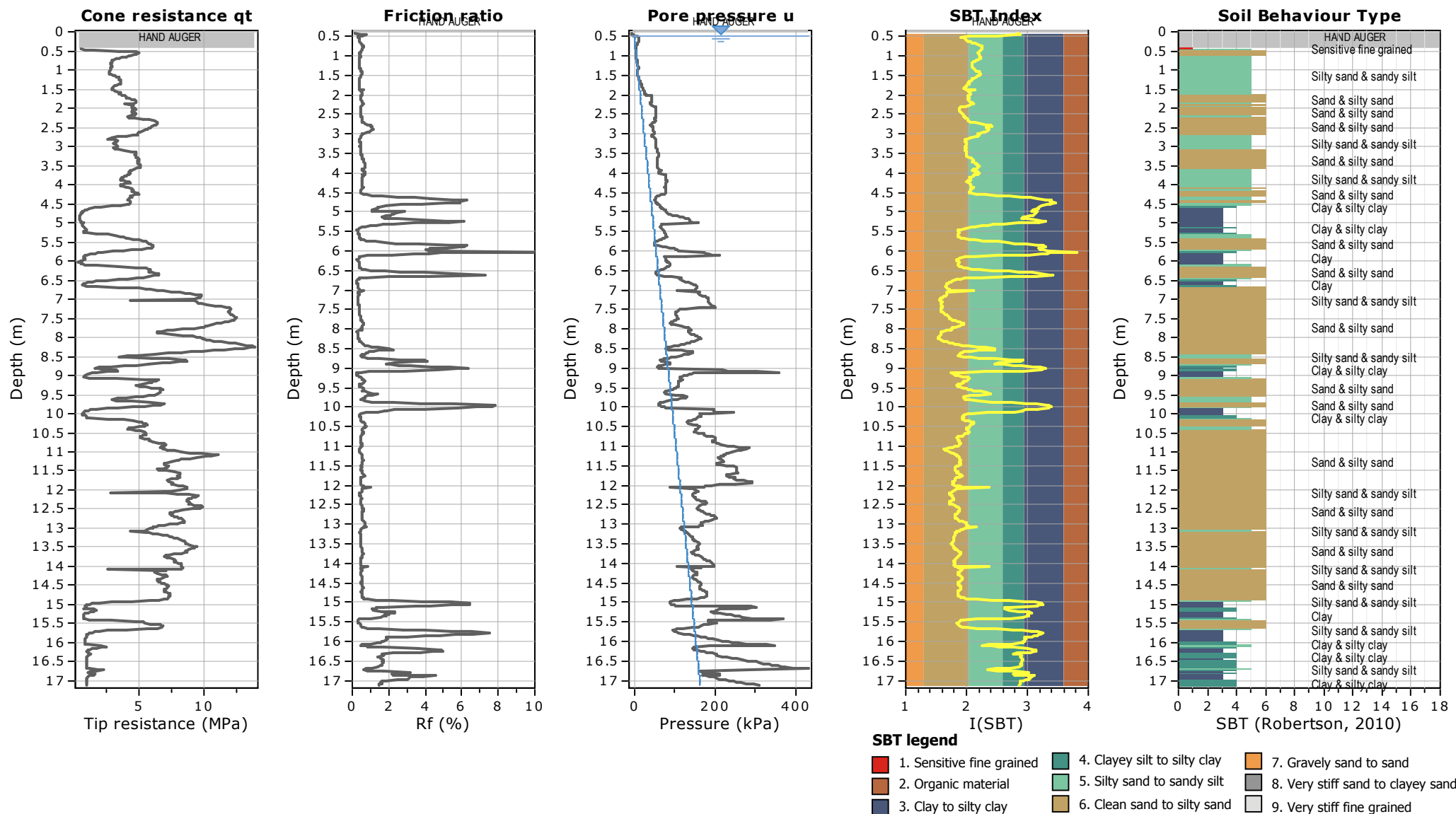
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°



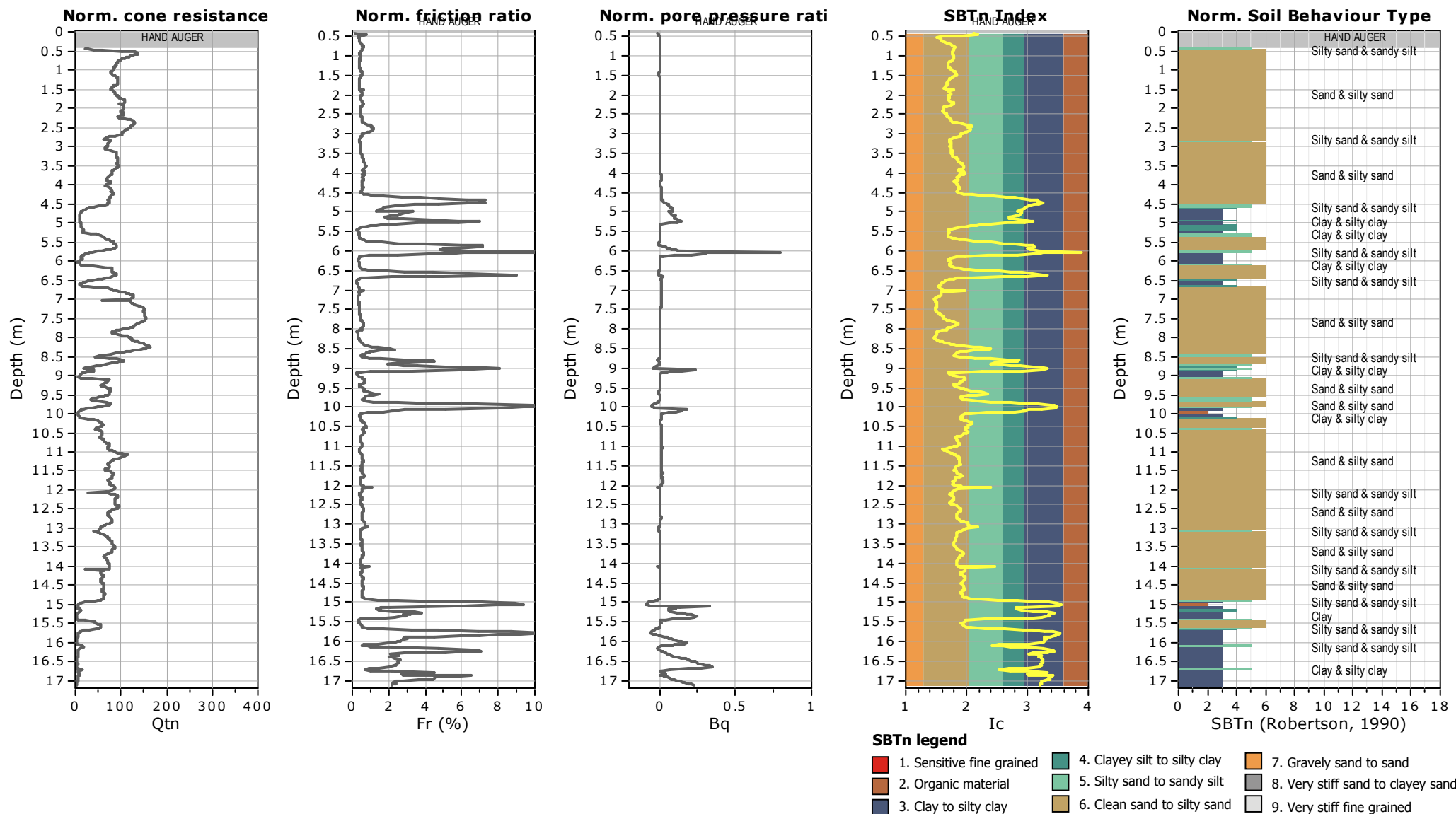
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°



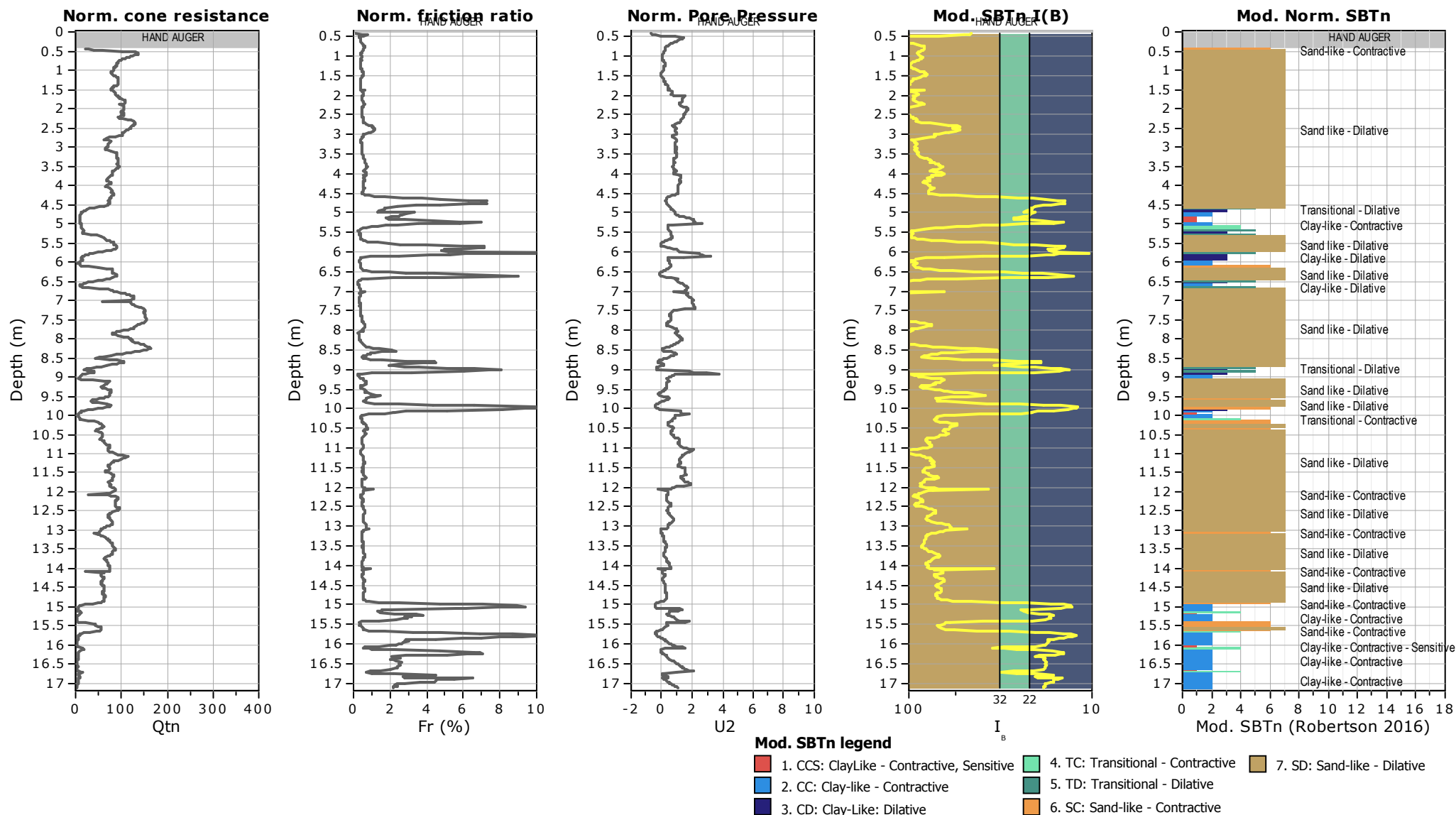
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

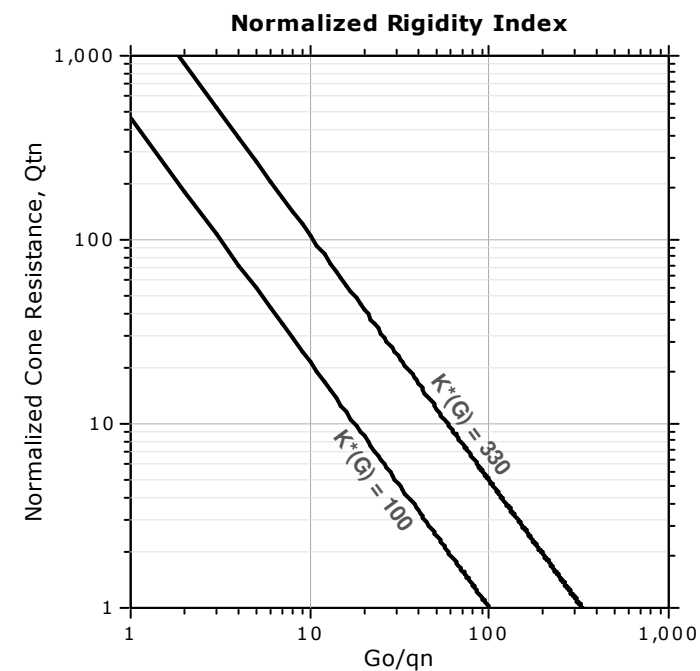
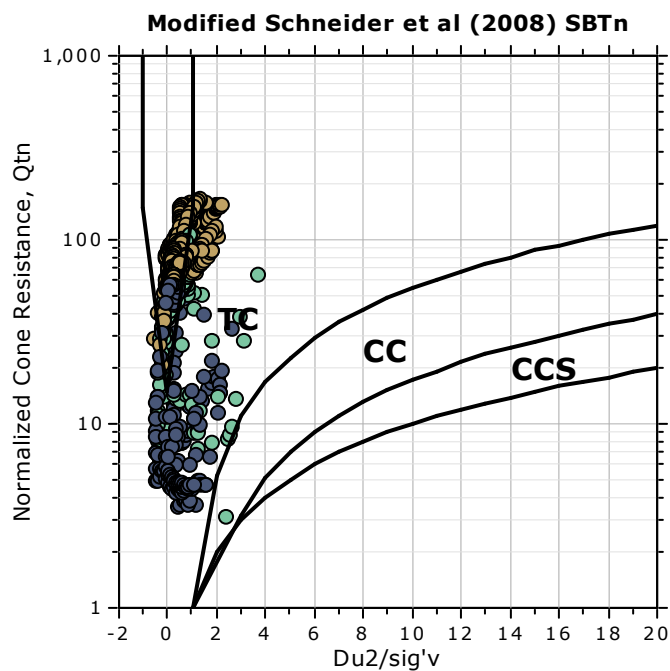
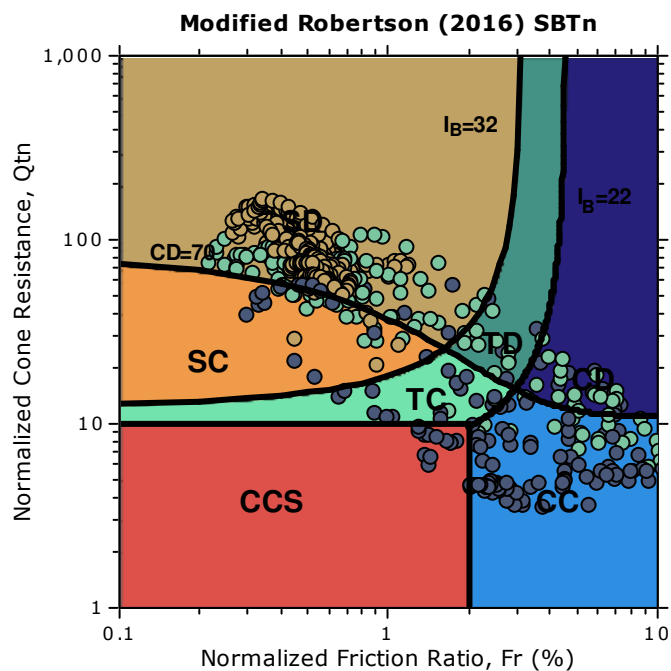
**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



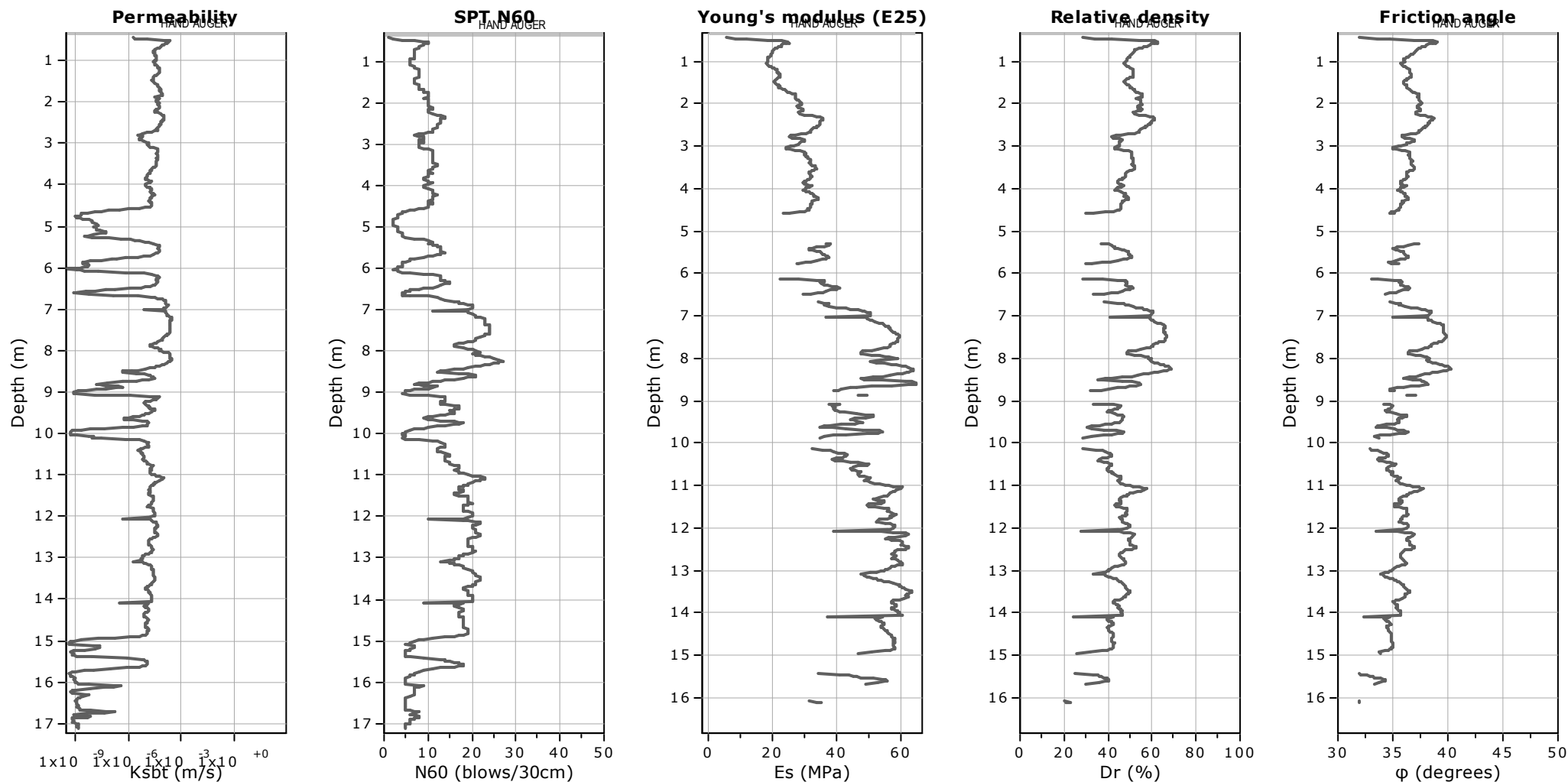
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

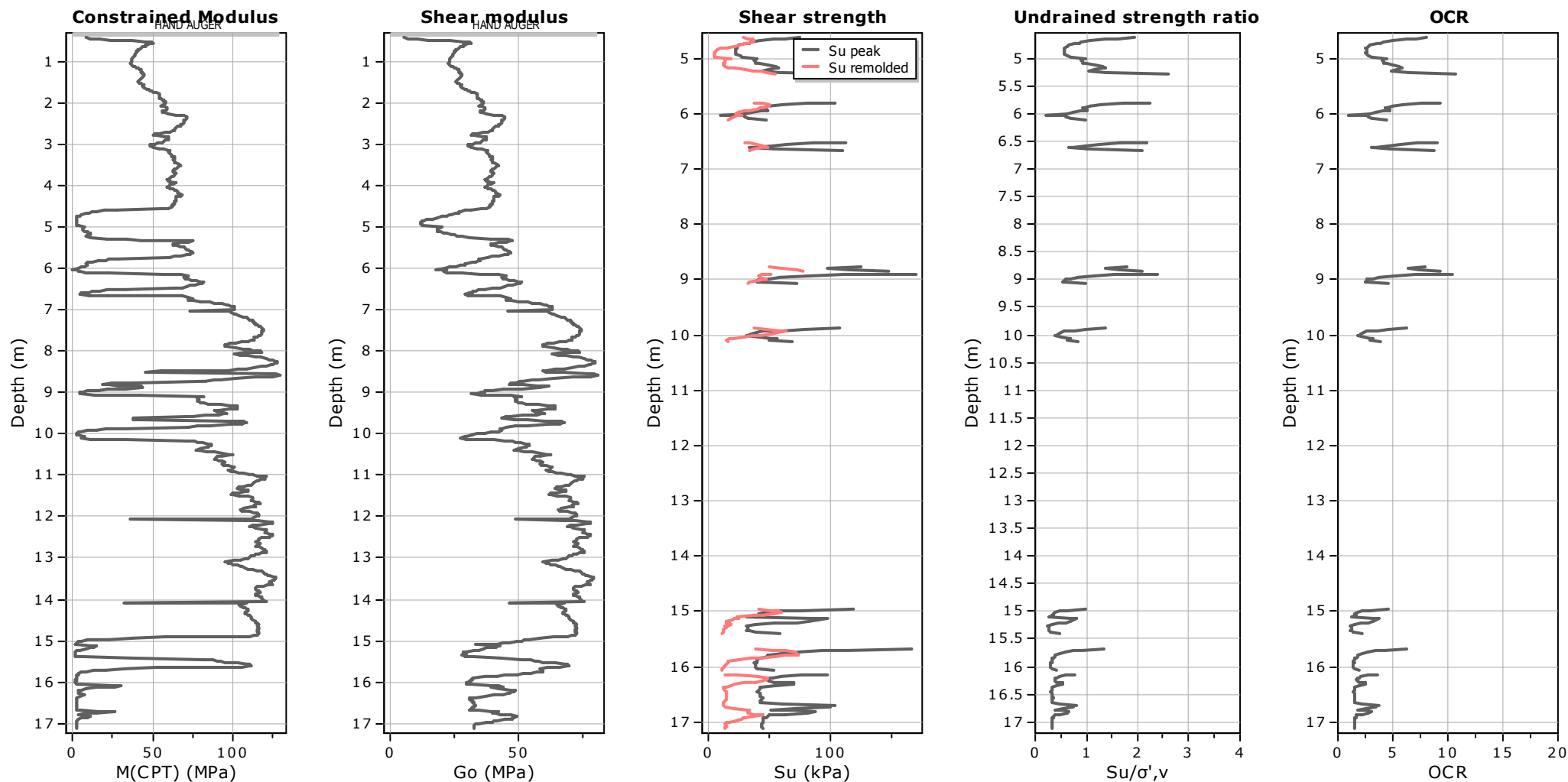
SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

● User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

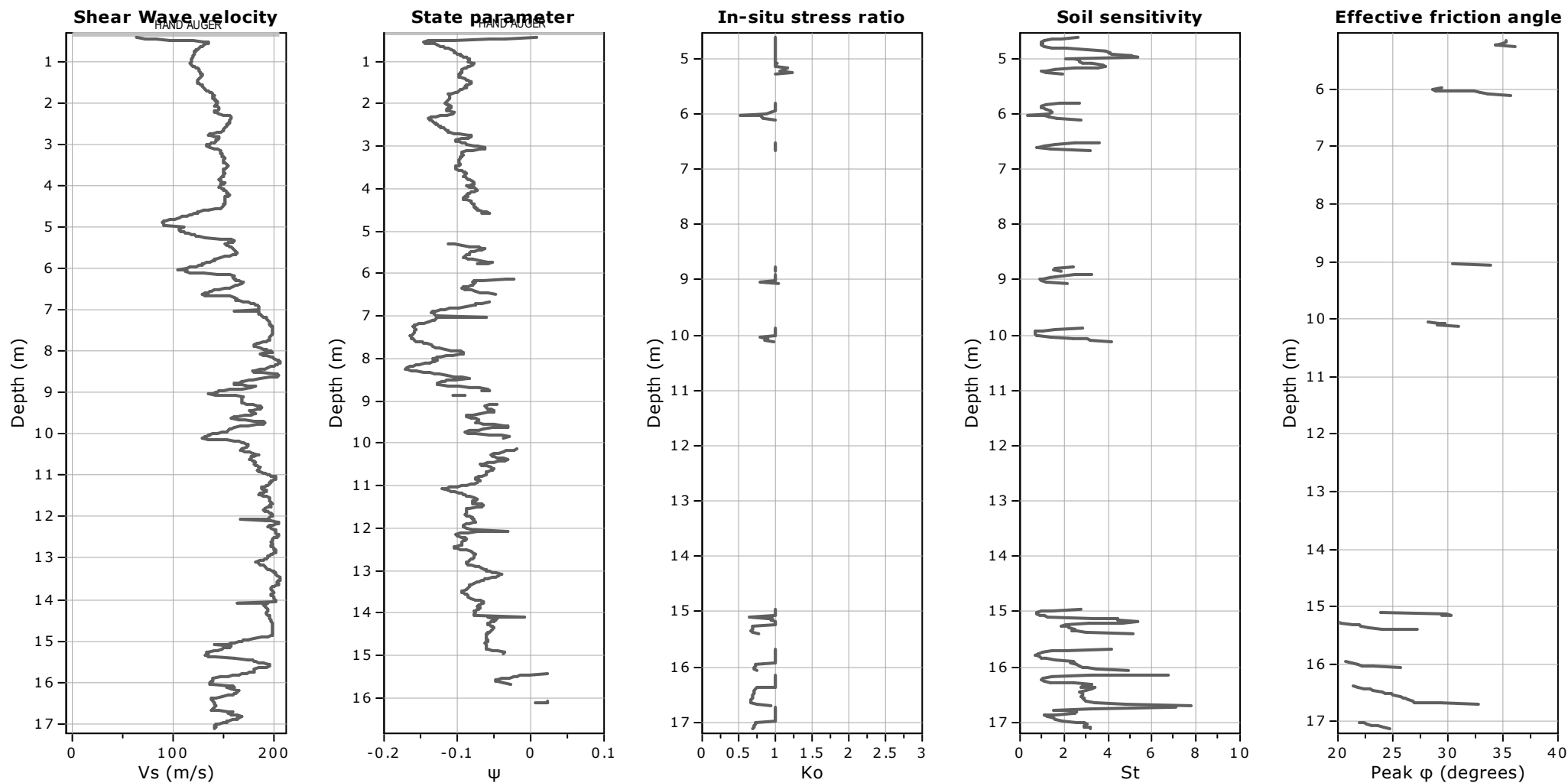
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

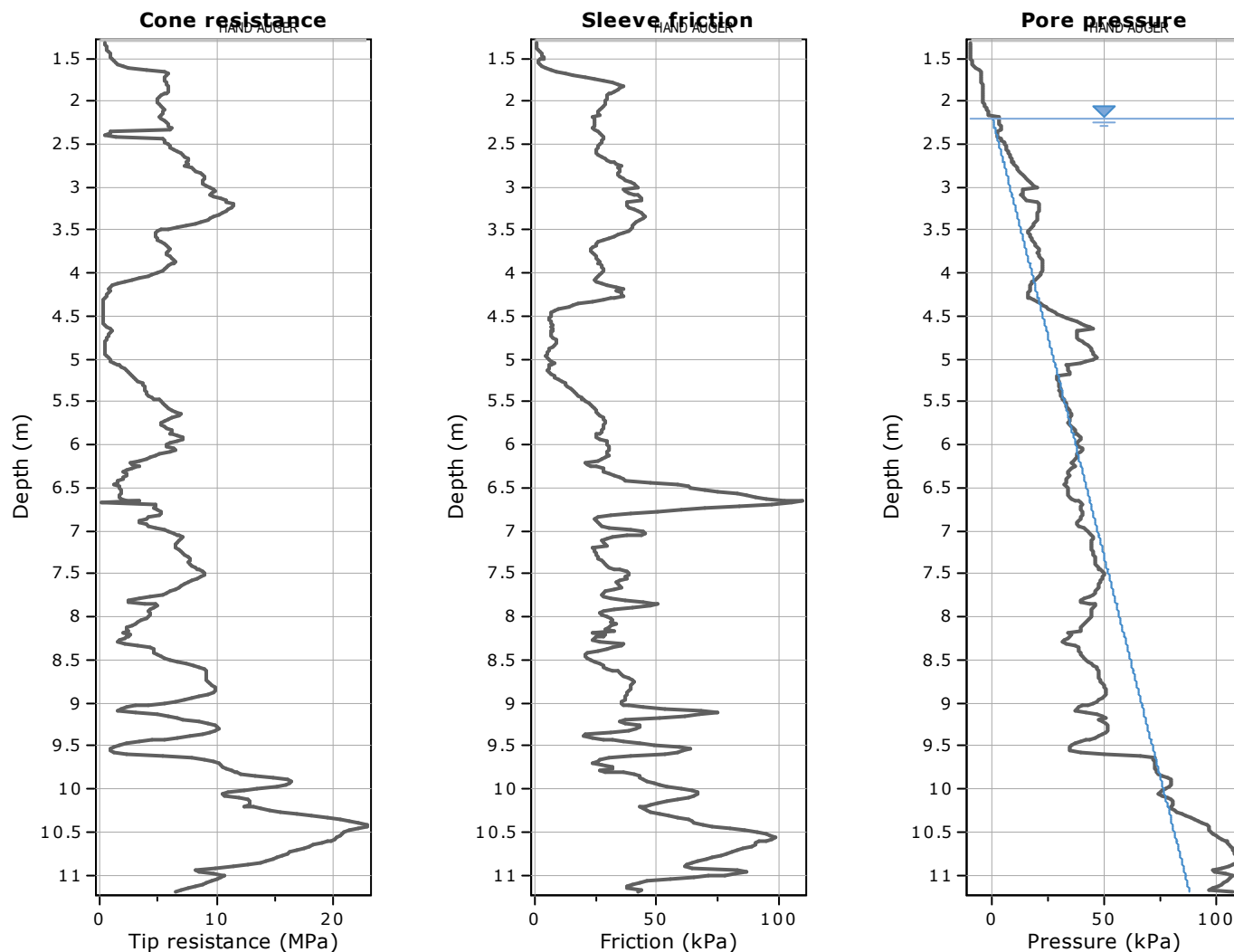
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

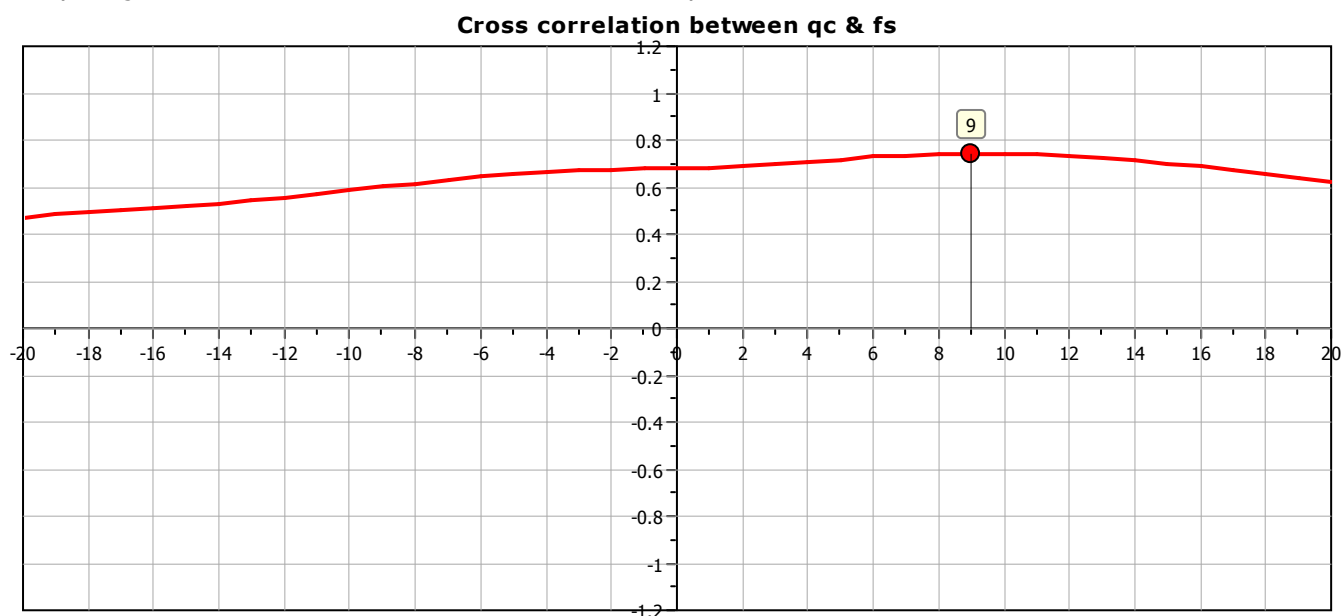
**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°

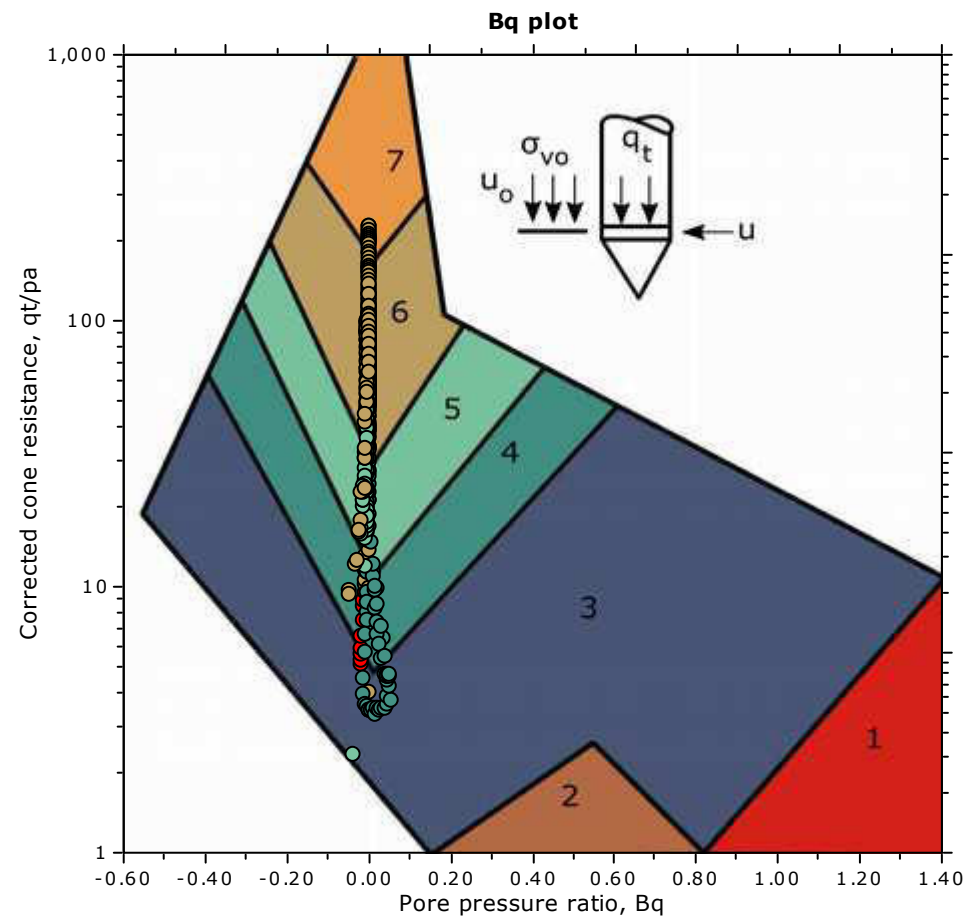
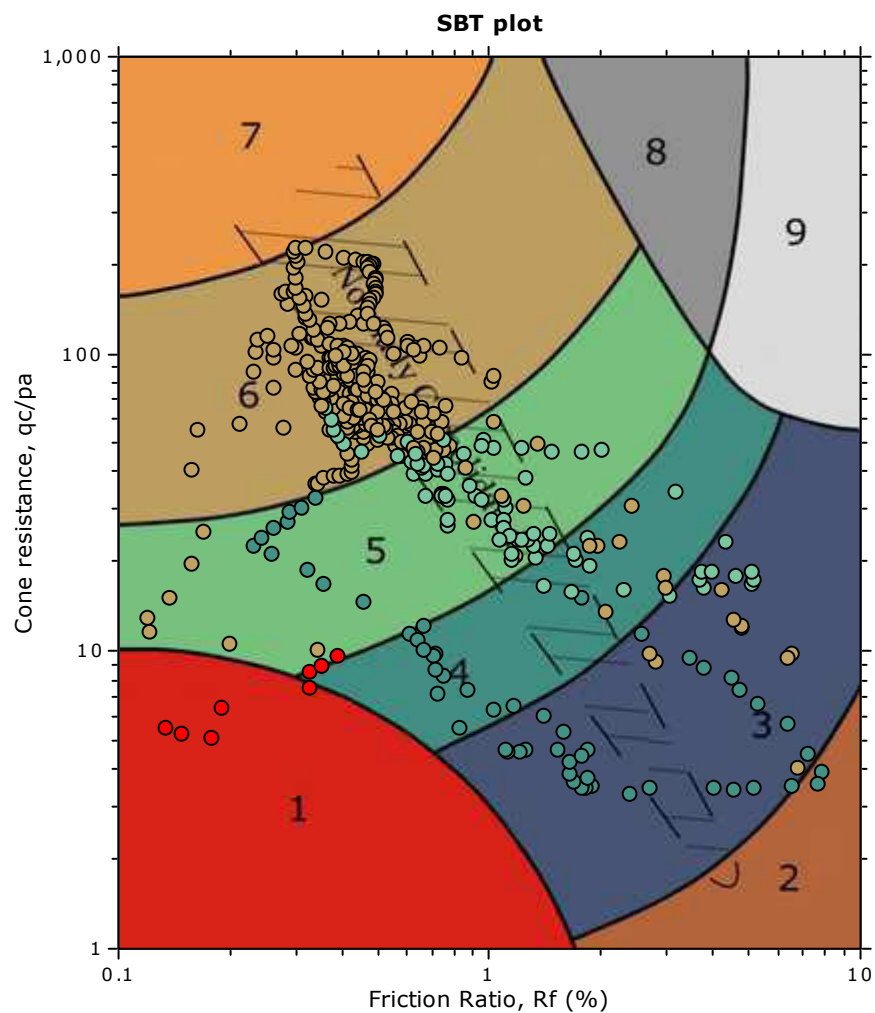


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





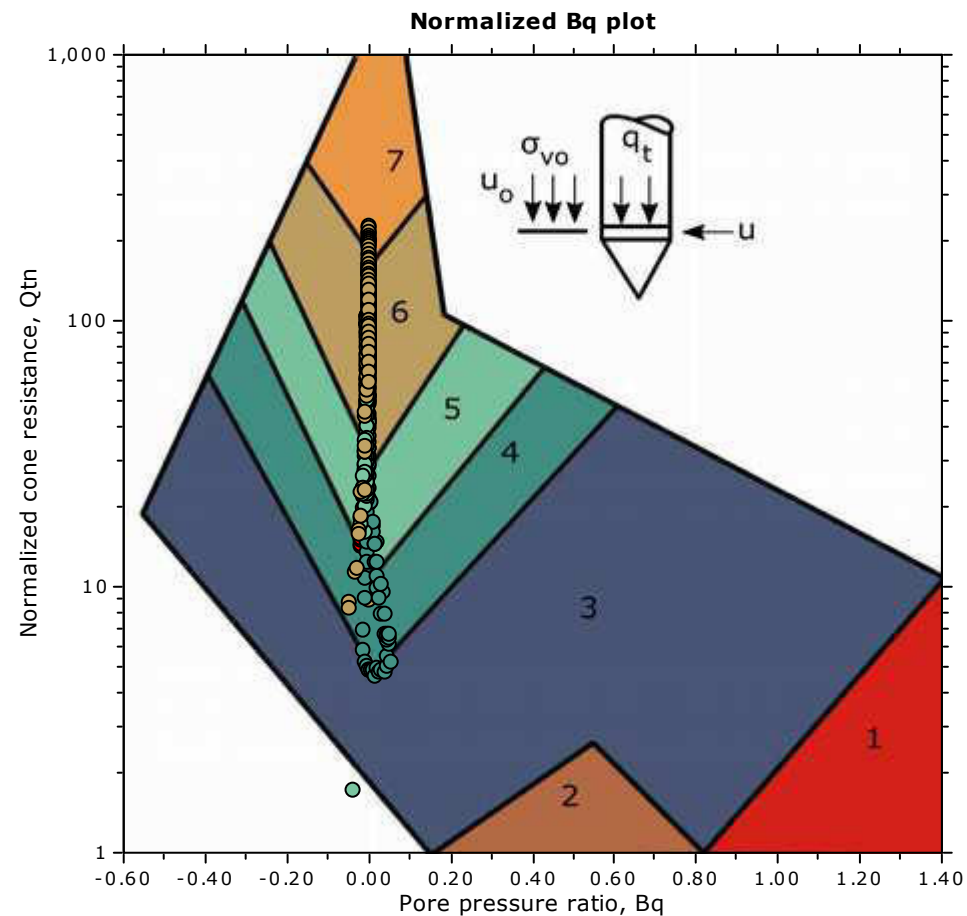
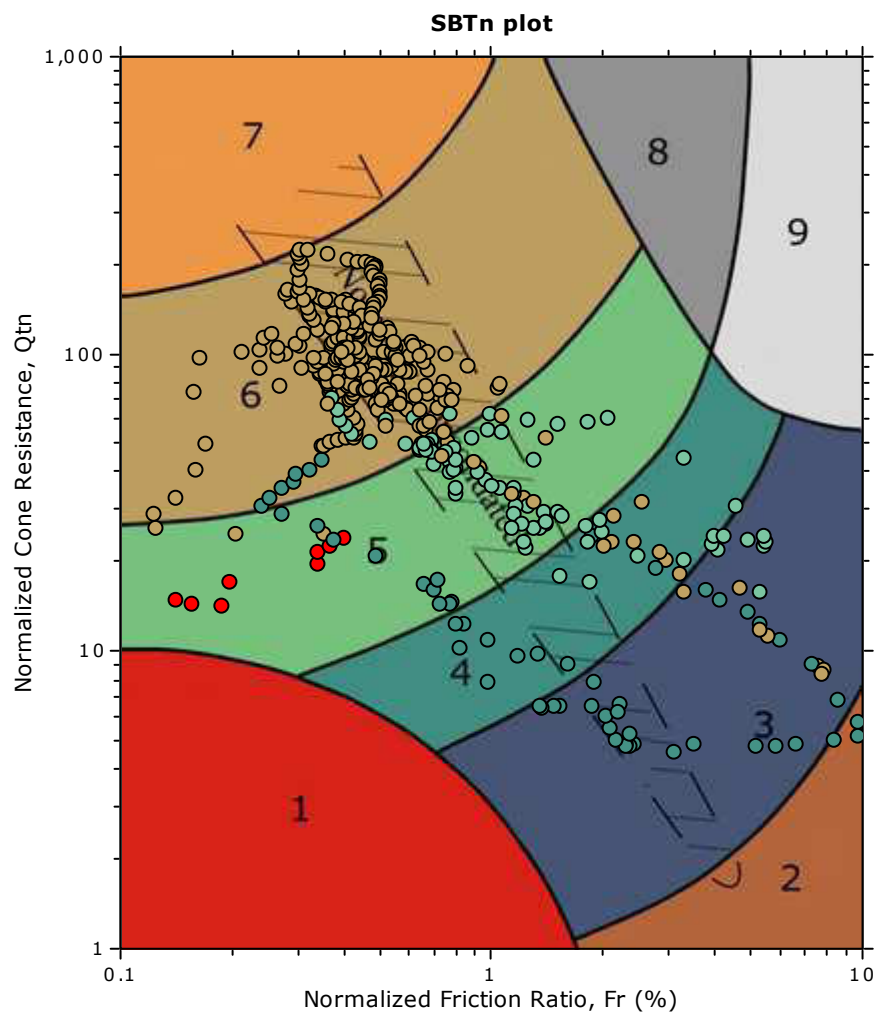
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

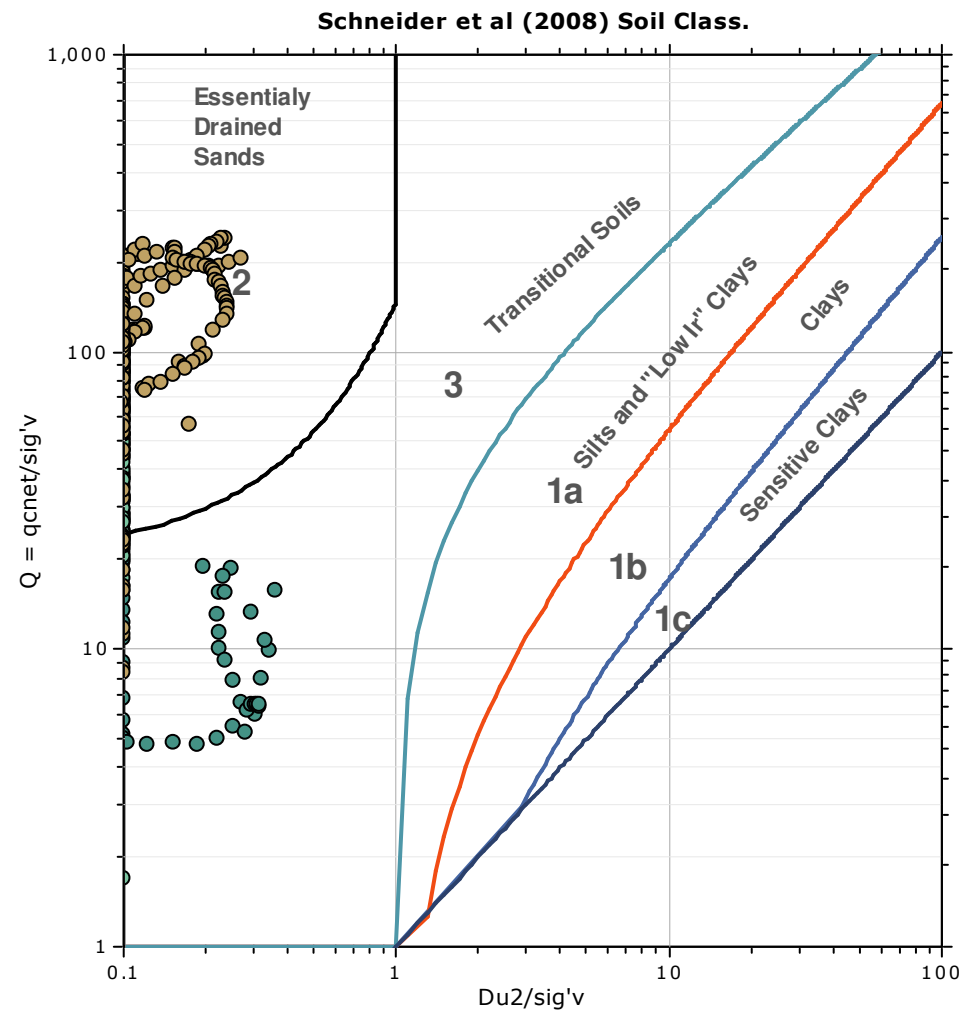
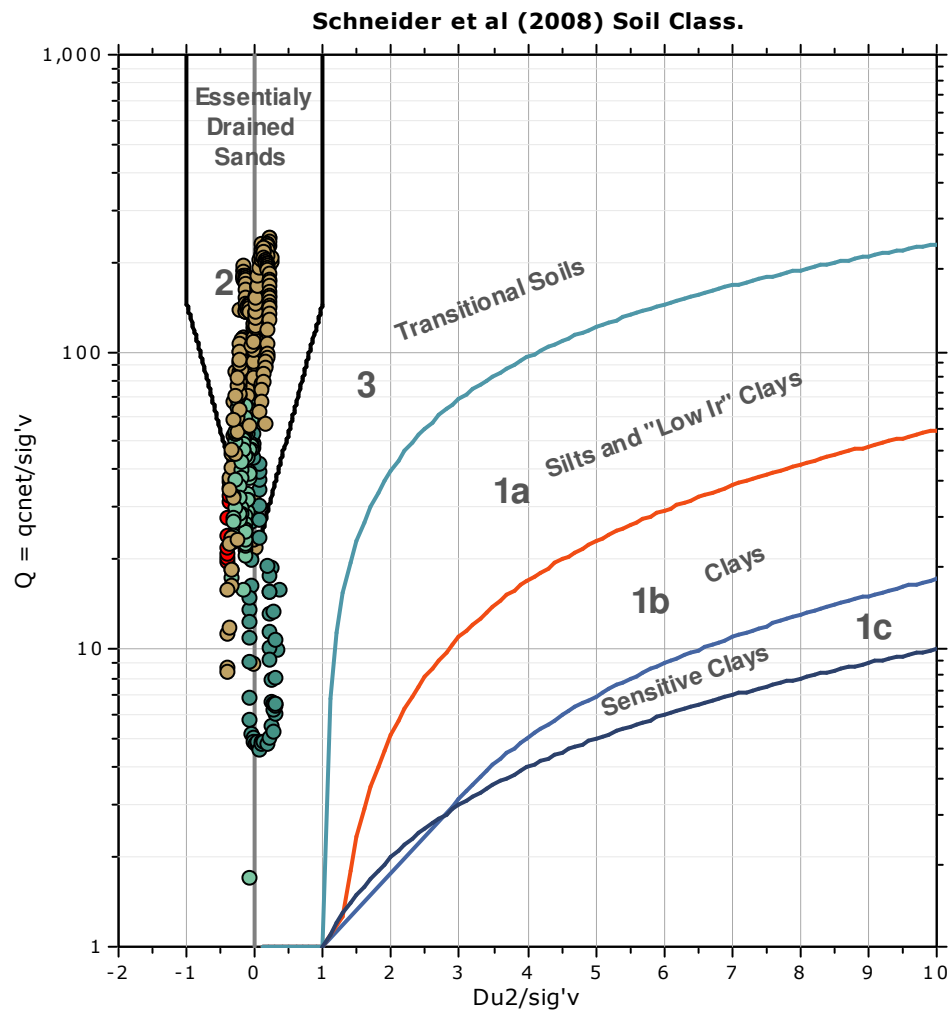
**SBT - Bq plots (normalized)**

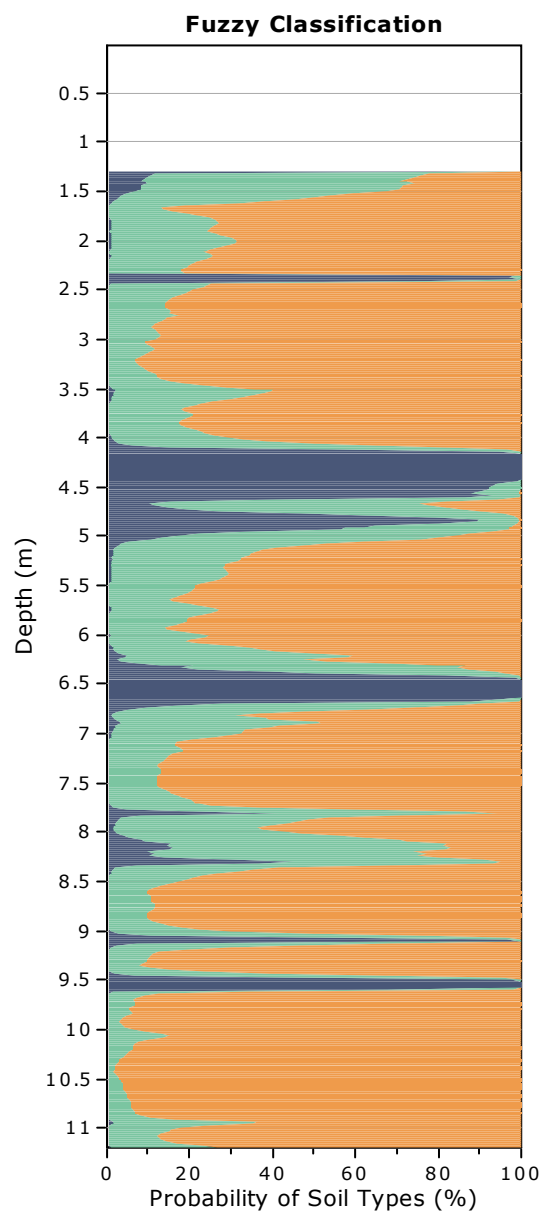
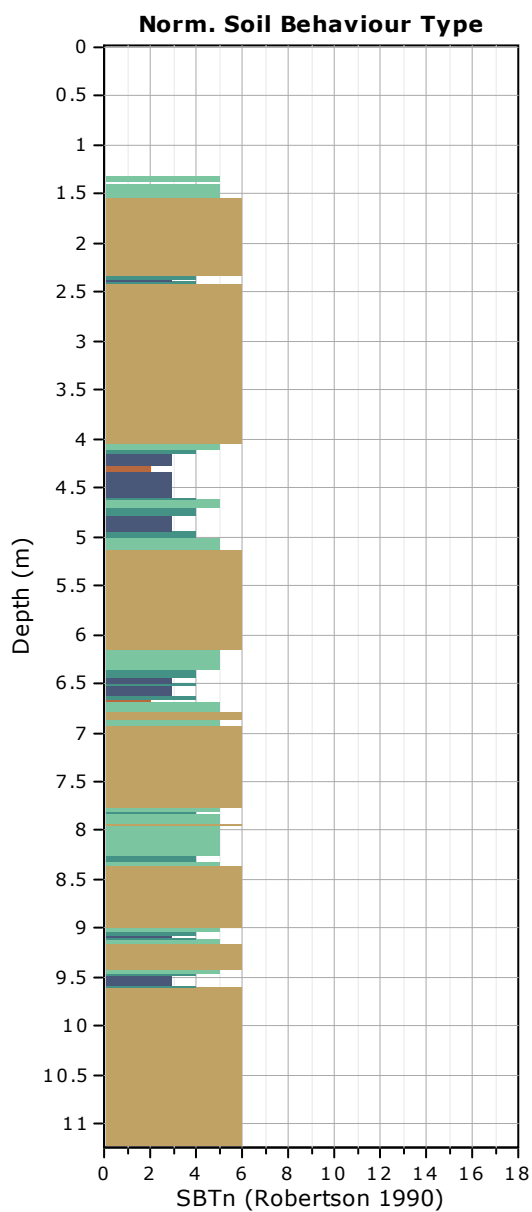


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







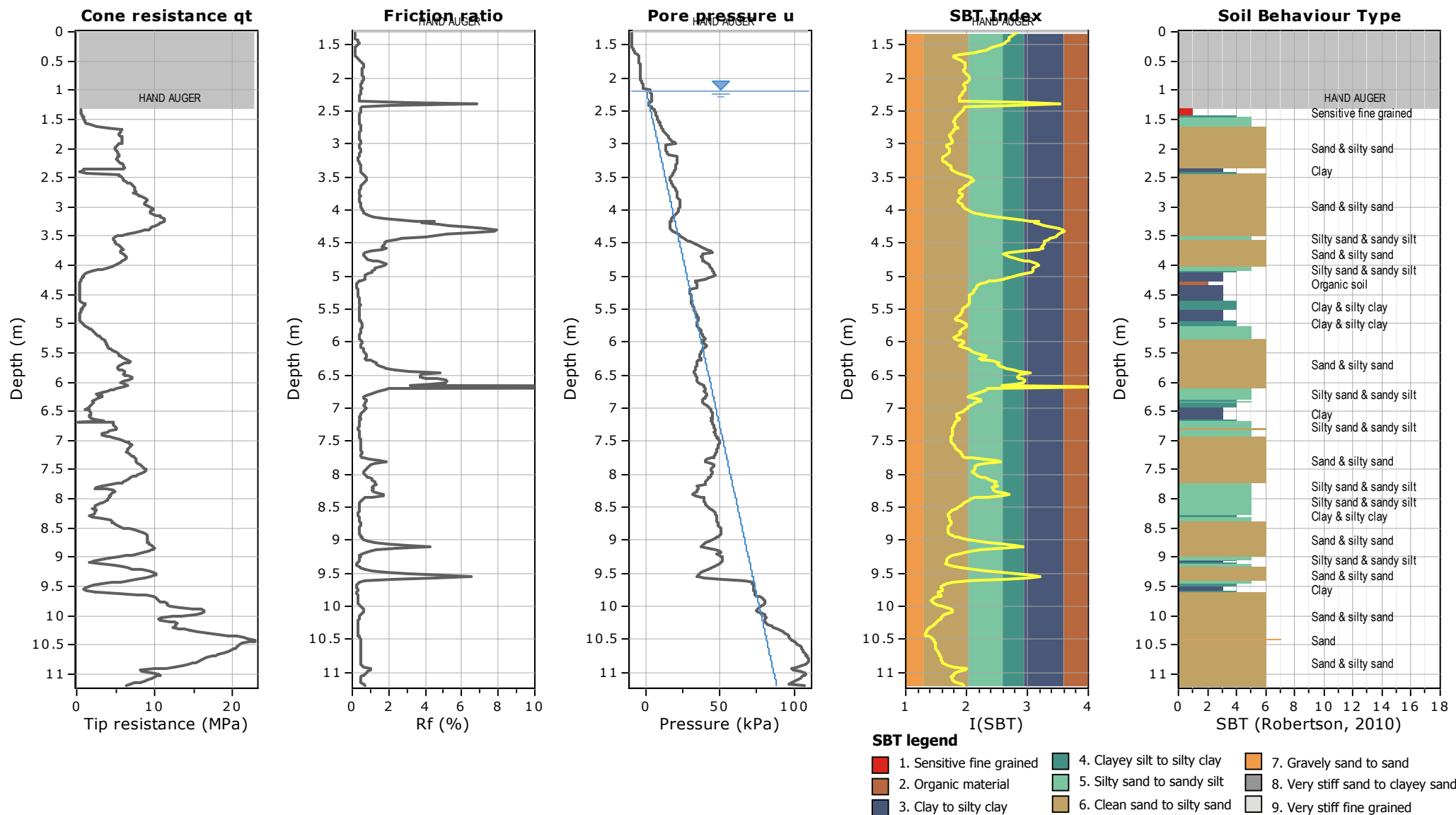
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°



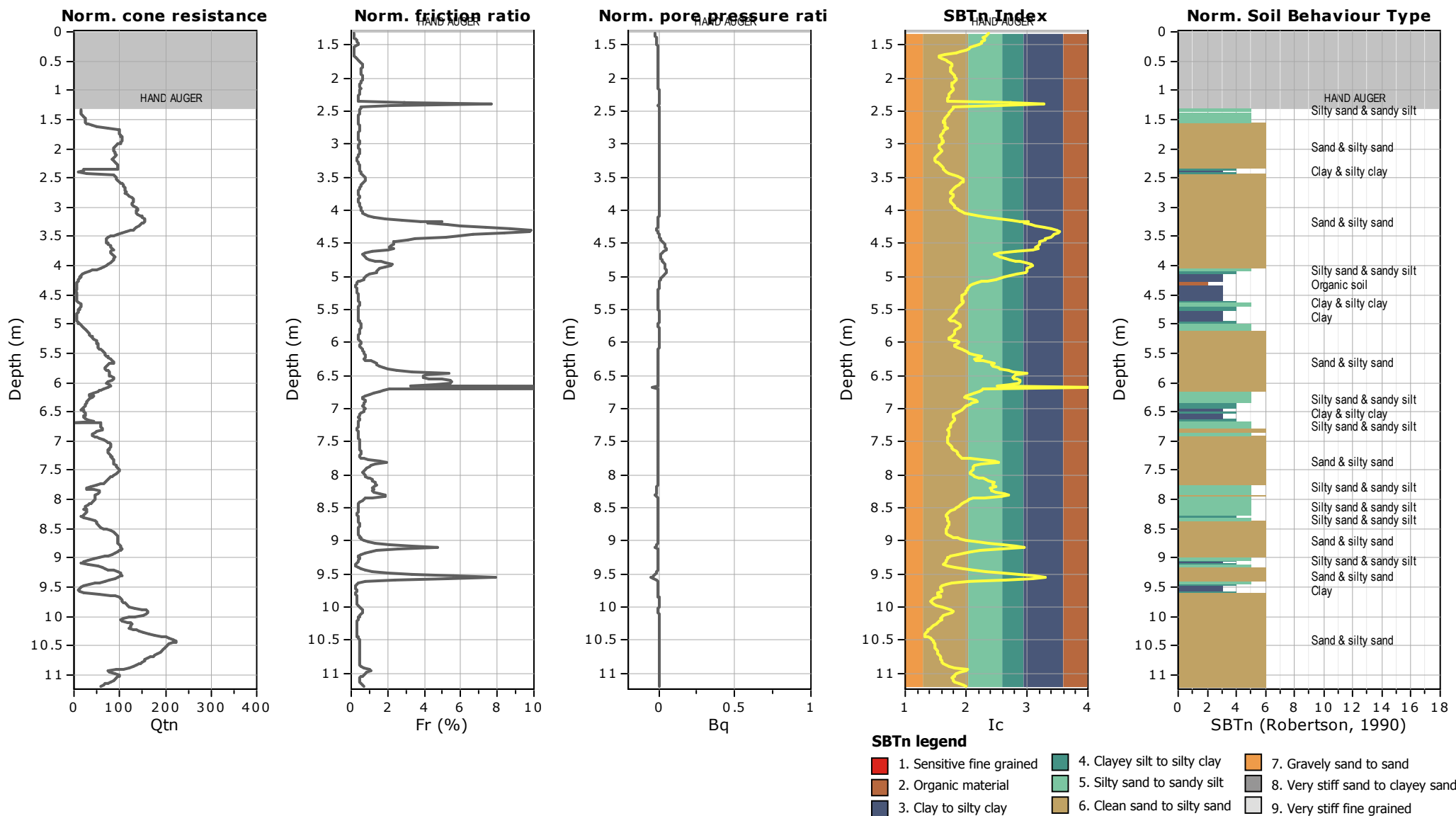
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°



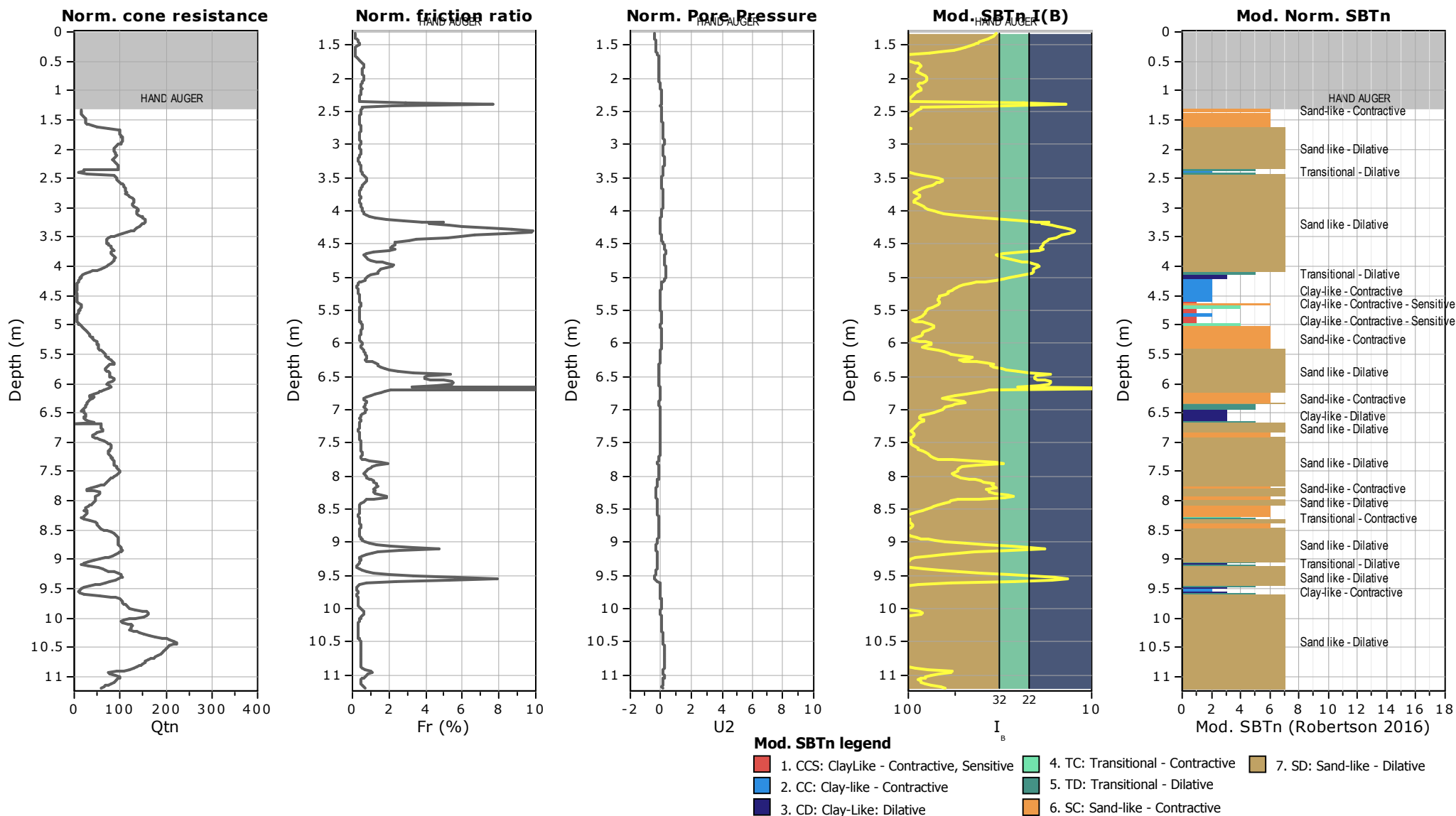
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

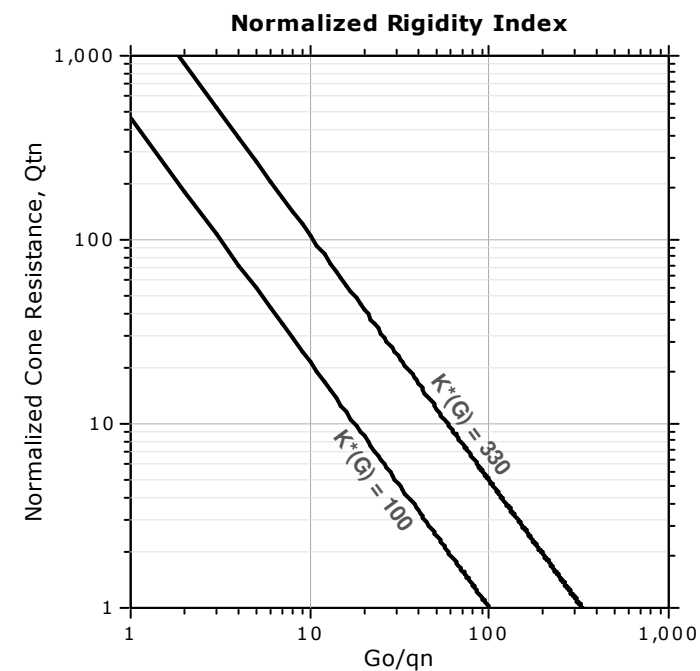
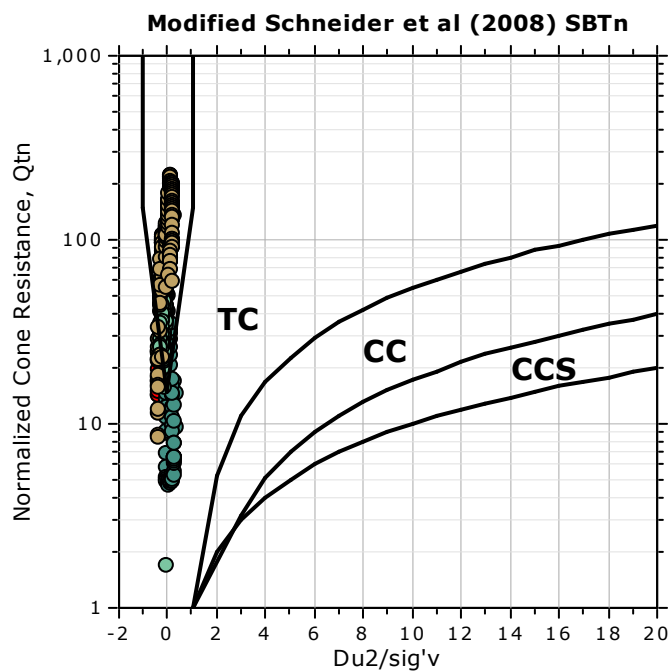
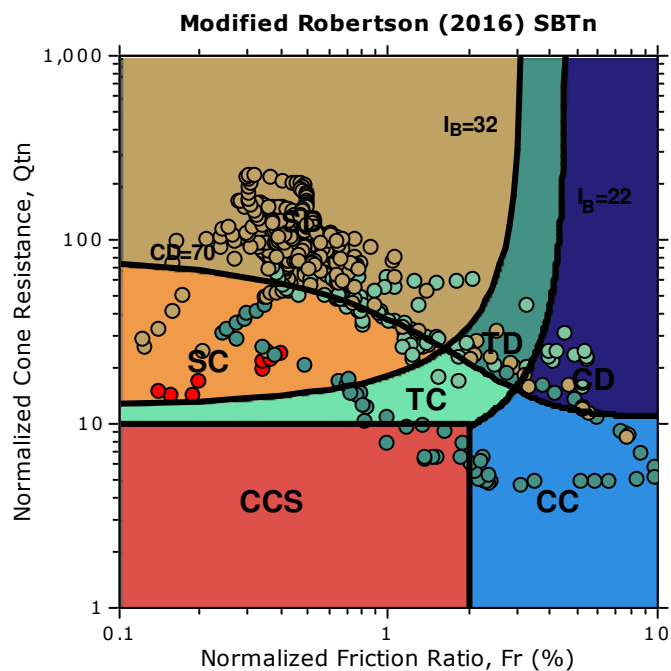
**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



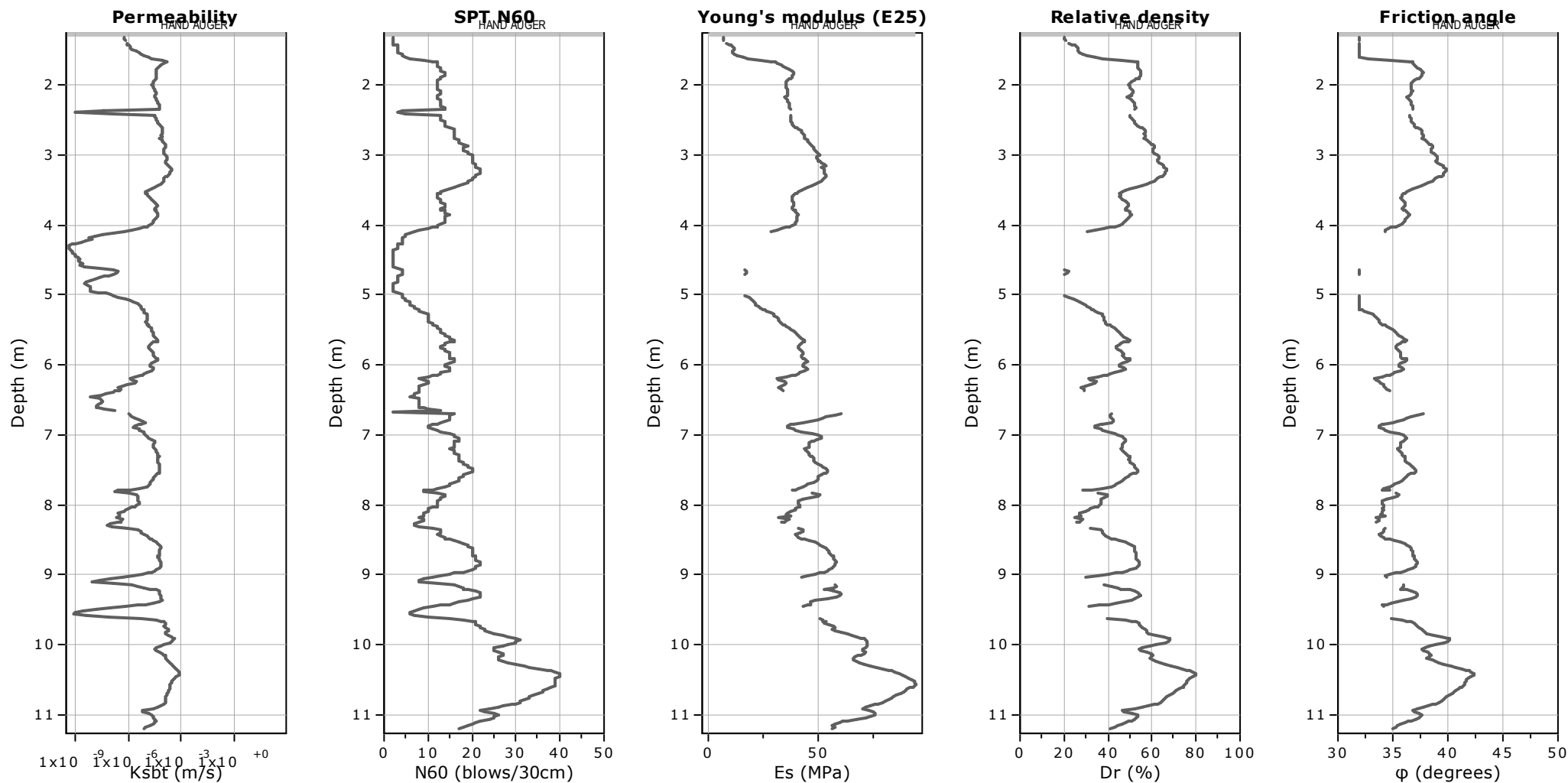
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°



**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 Kulhavy & Mayne (1990)

● User defined estimation data



Constrained modulus: Based on variable *alpha* using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable *alpha* 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

—●— Flat Dilatometer Test data

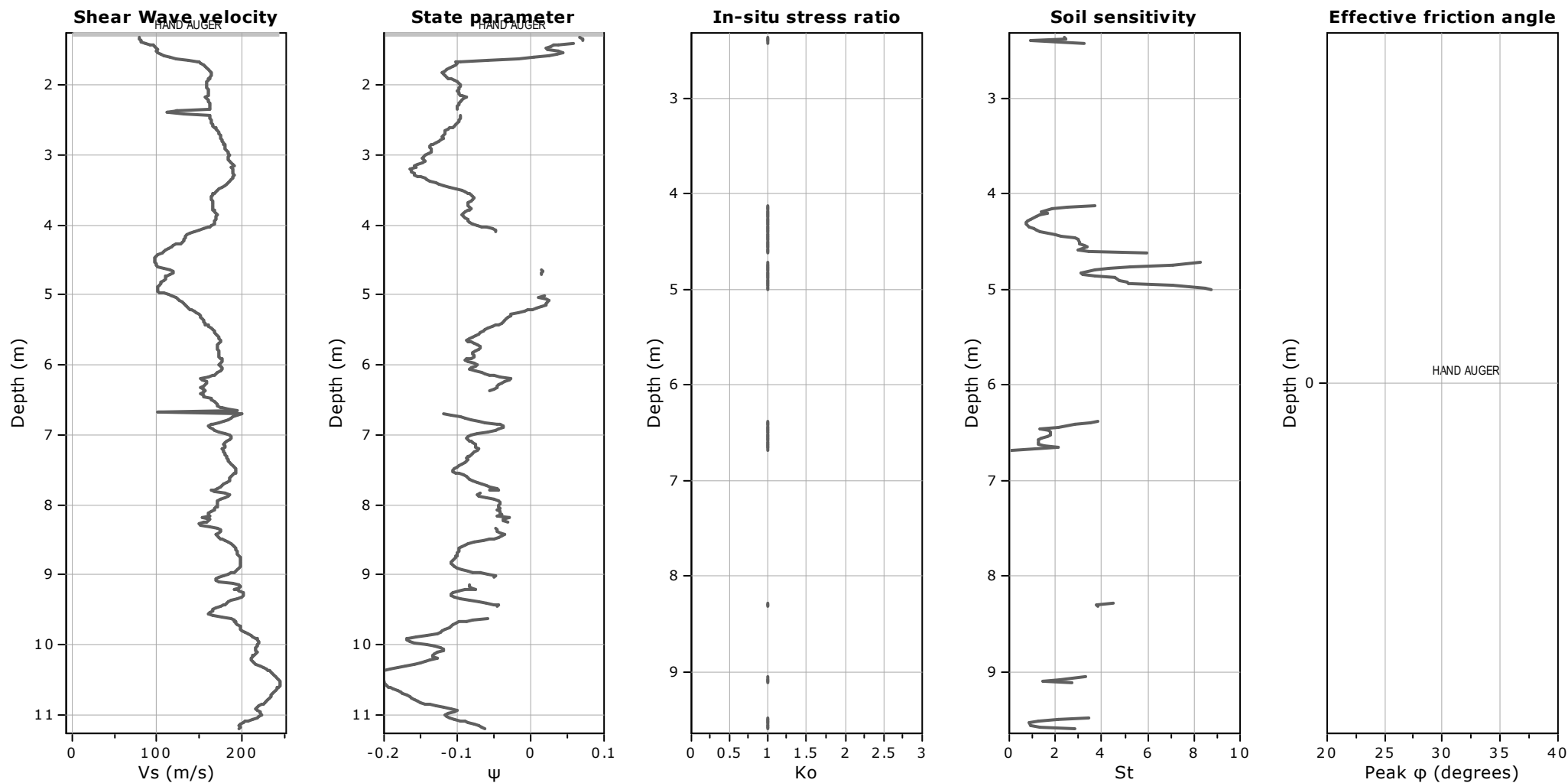
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 5 (Km 26.0)**

Total depth: 11.20 m

Coords: lat 44.680397° lon 12.224006°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

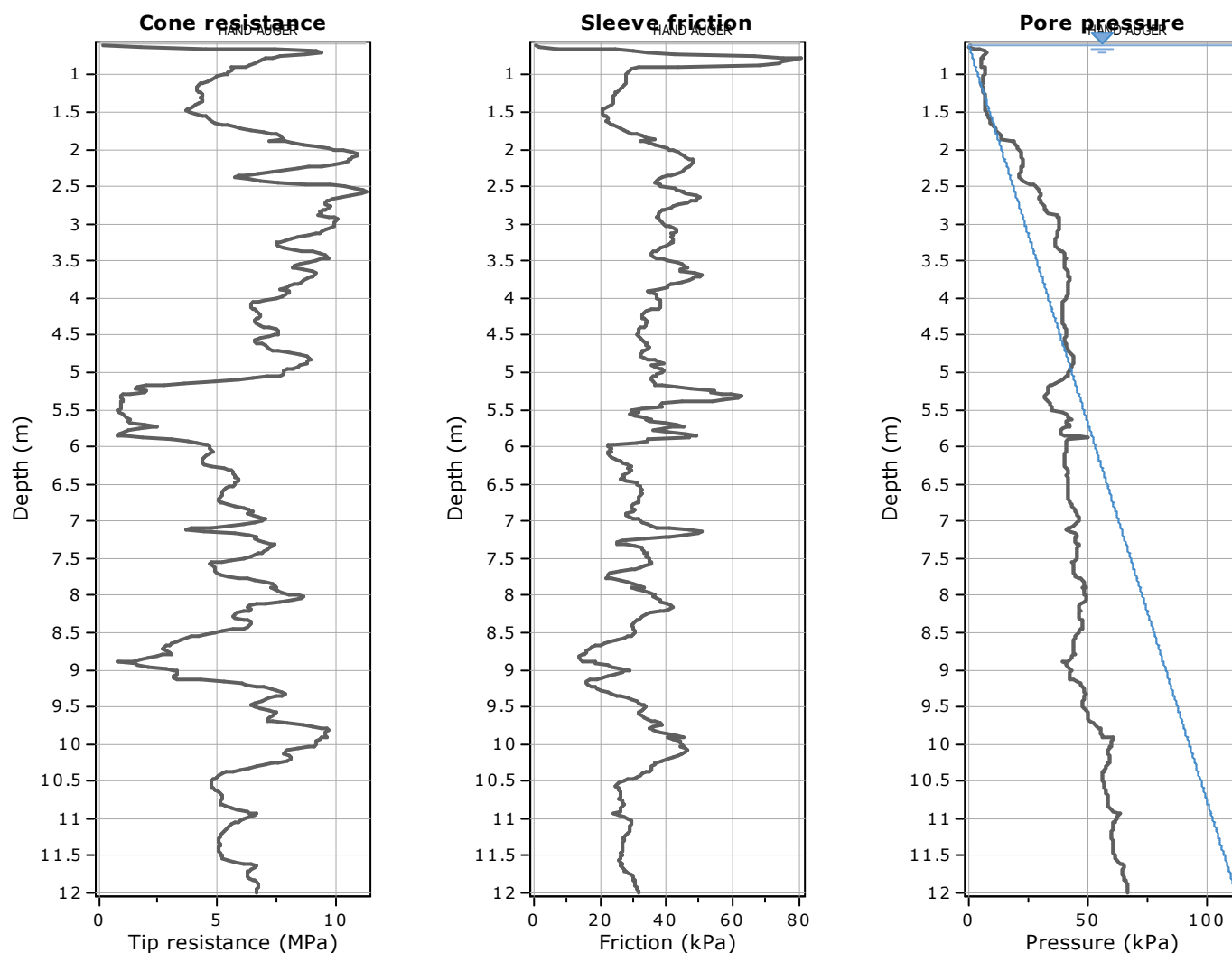
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

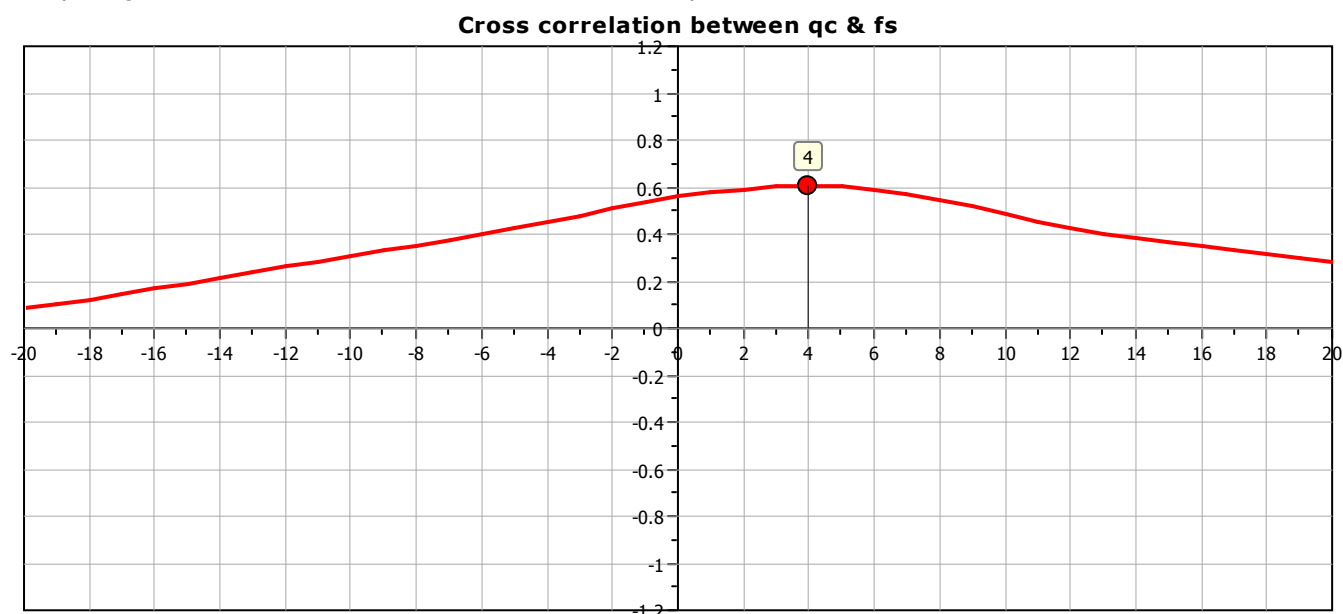
**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°

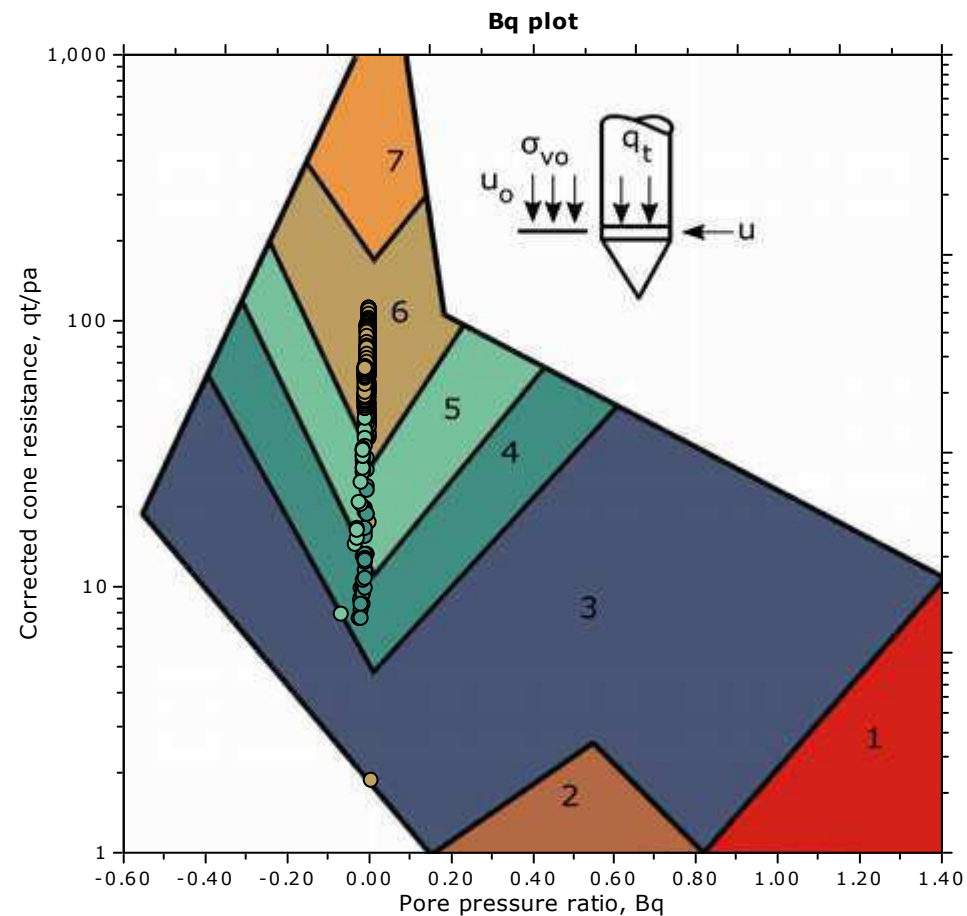
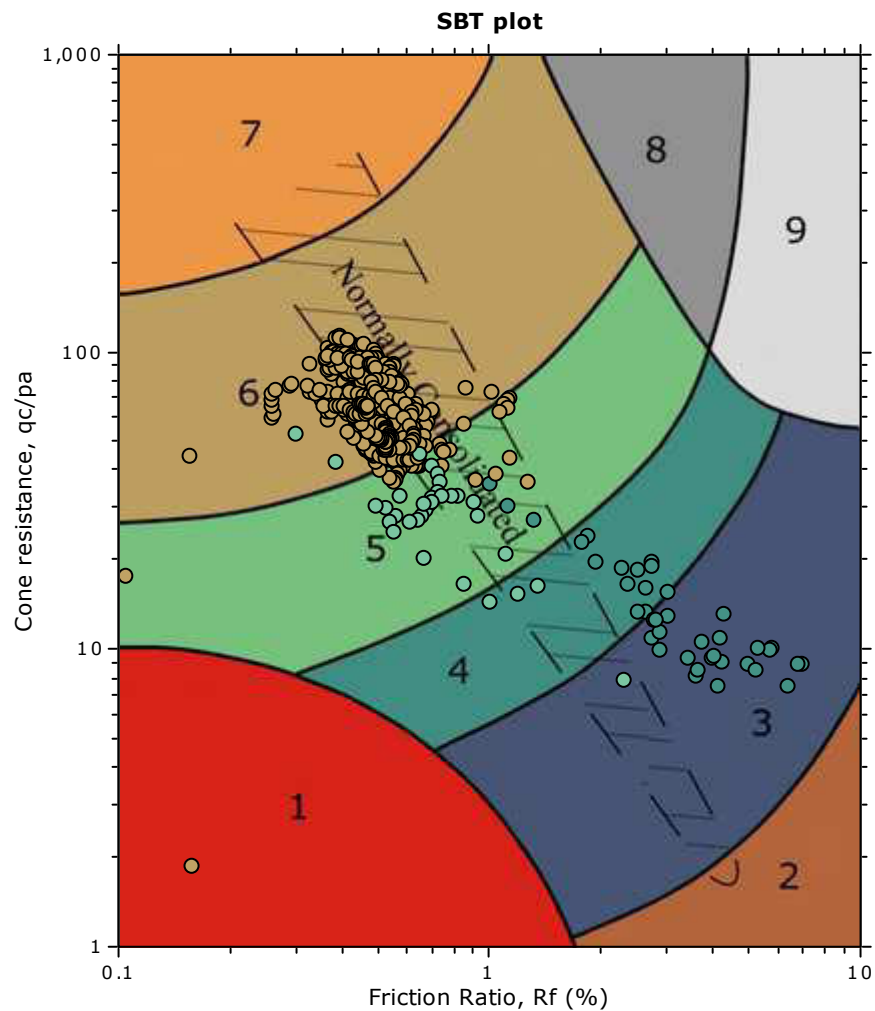


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





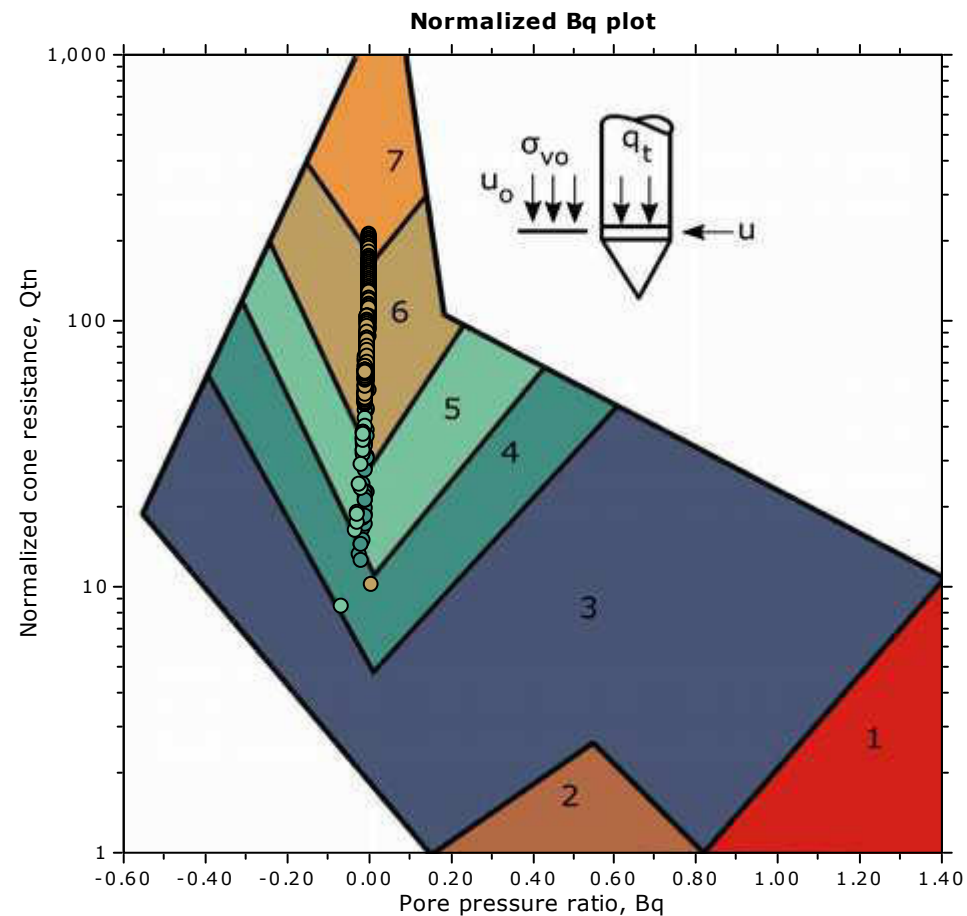
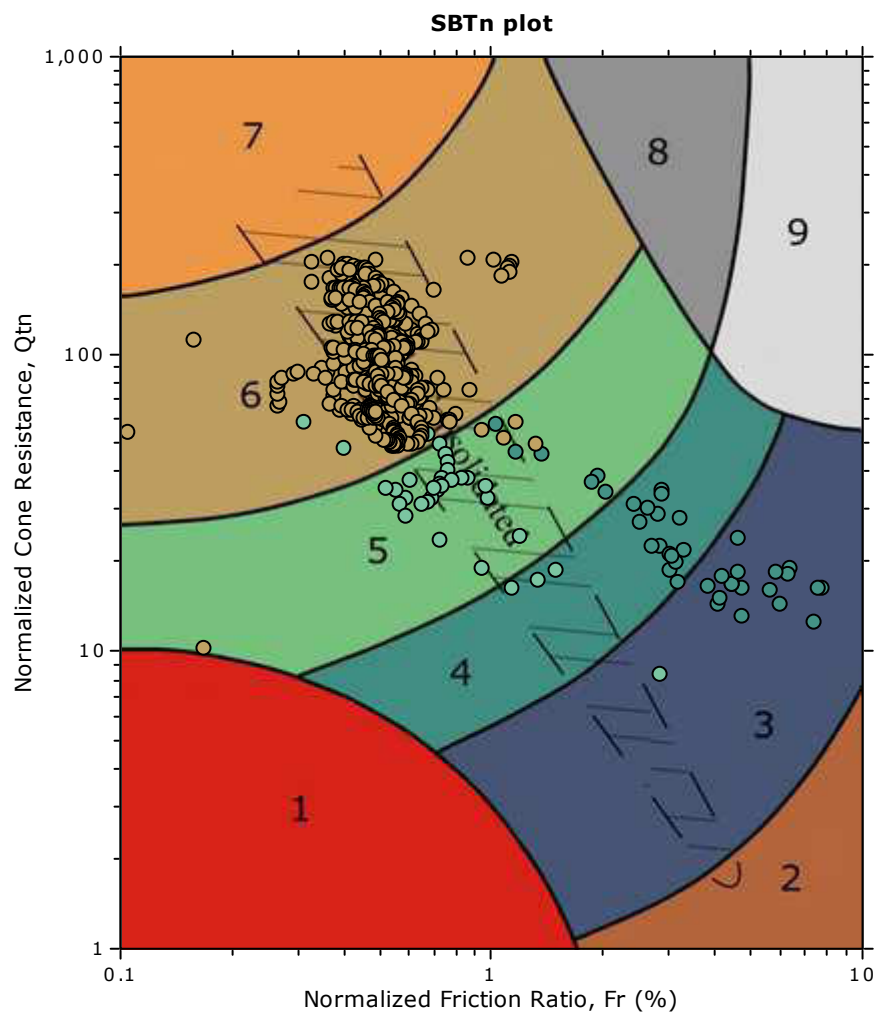
## SBT - Bq plots



### 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        |

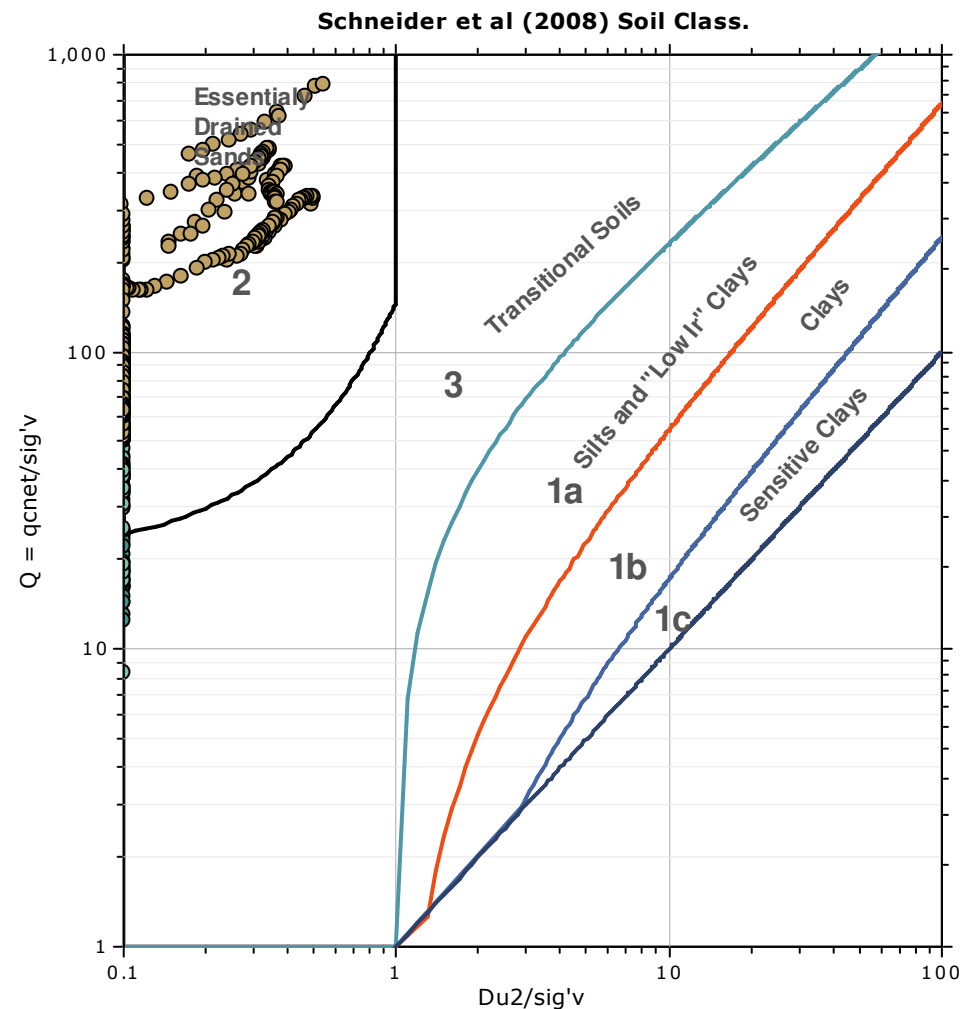
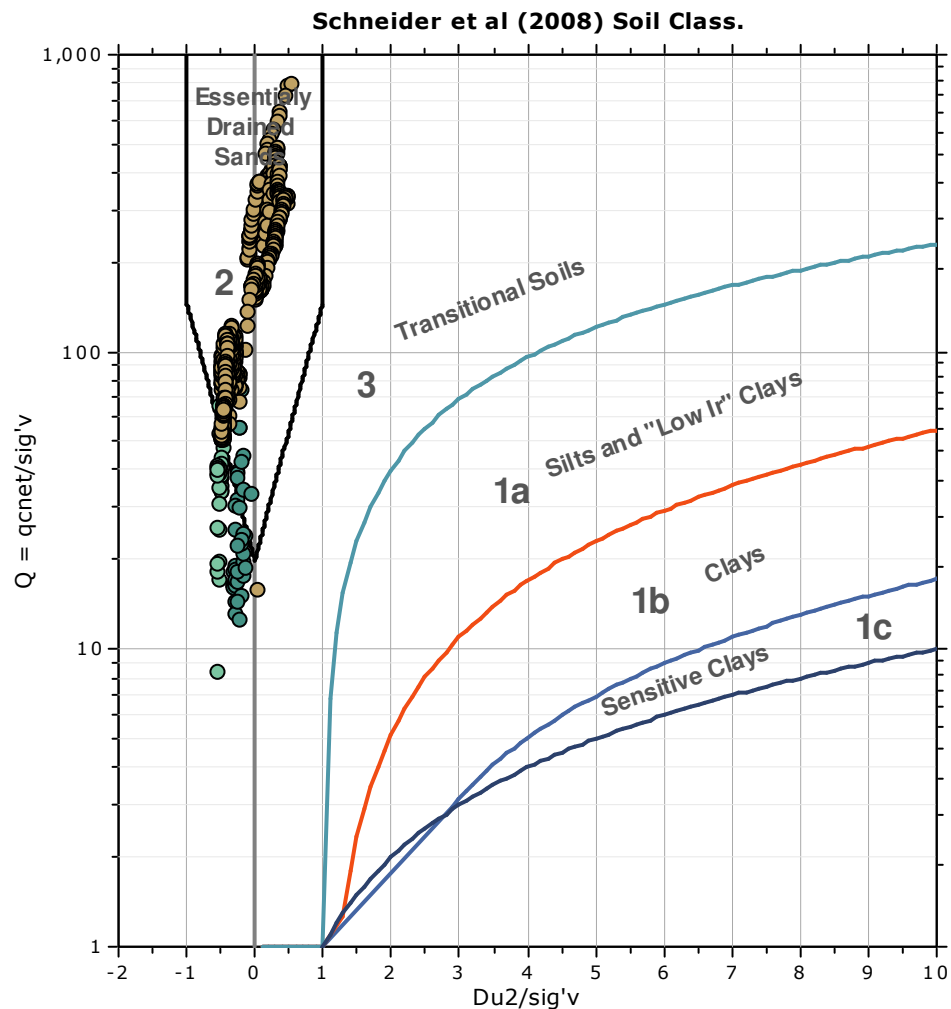
**SBT - Bq plots (normalized)**

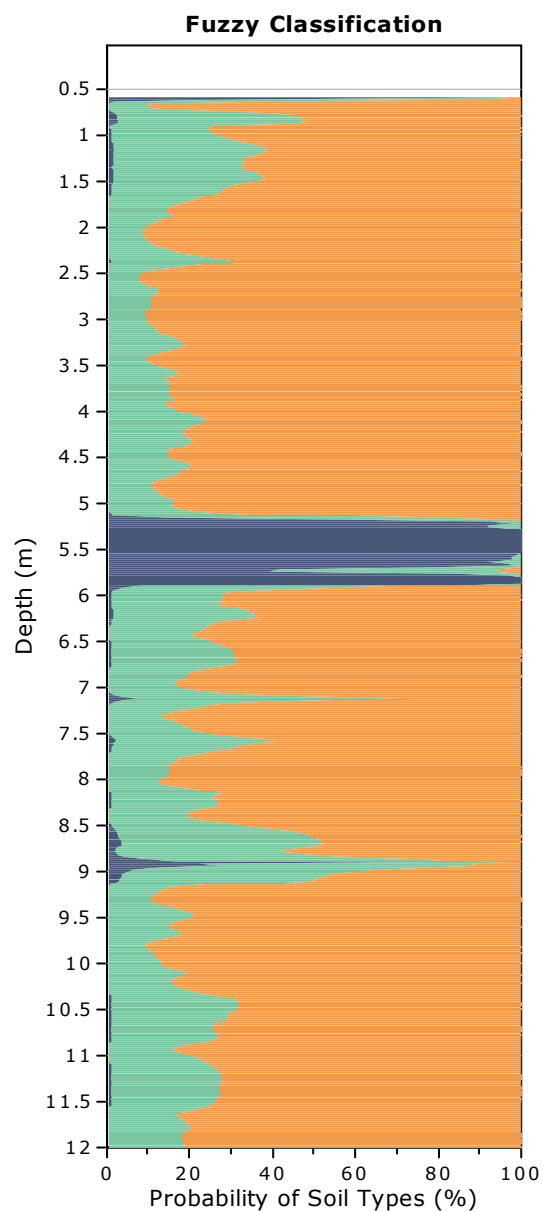
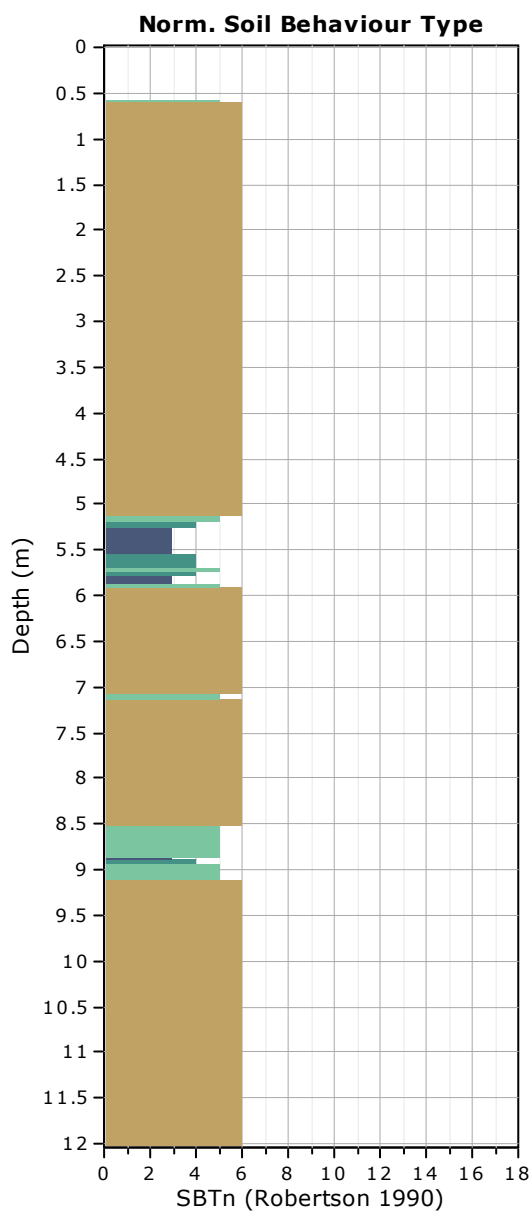


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







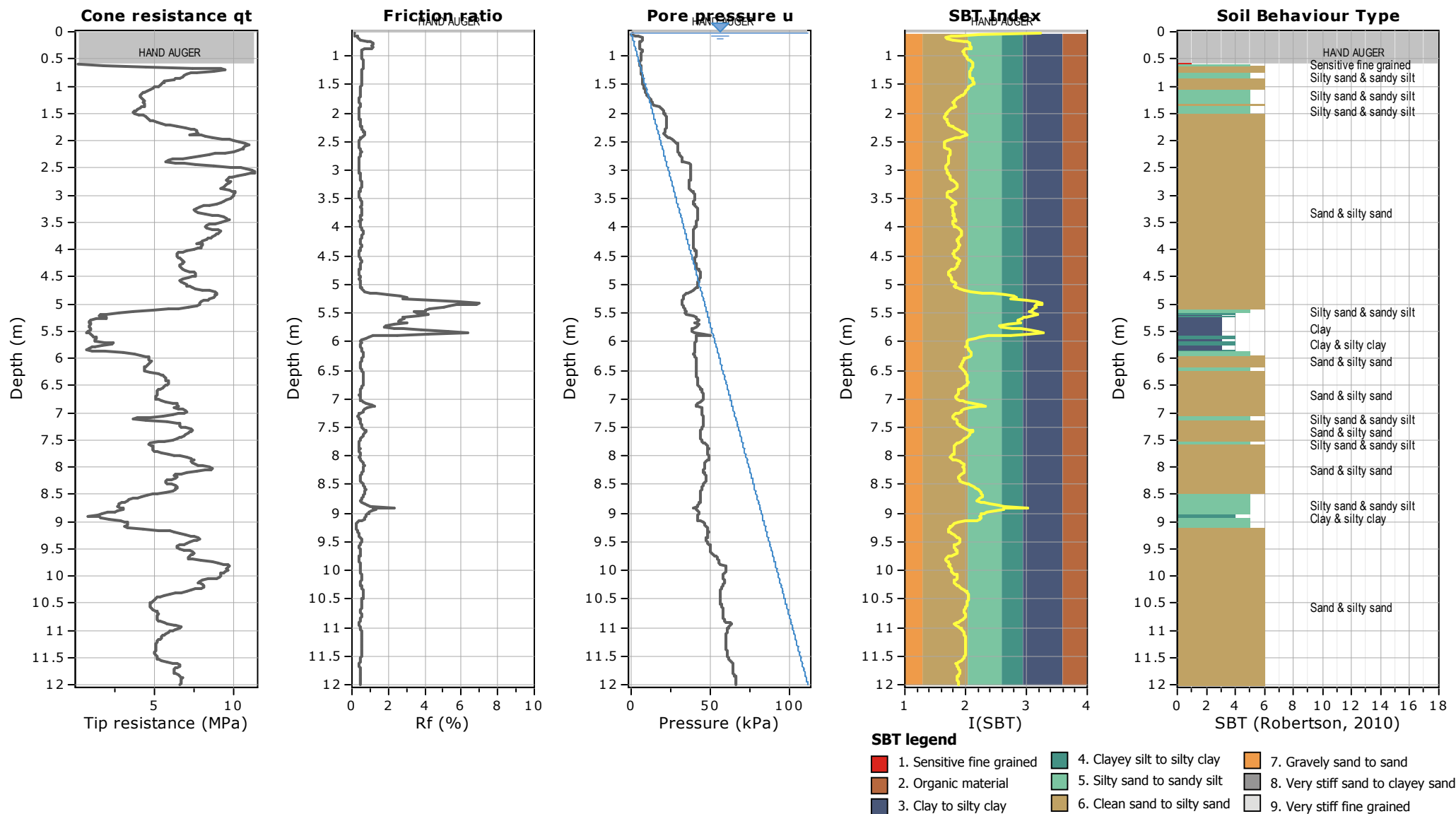
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°



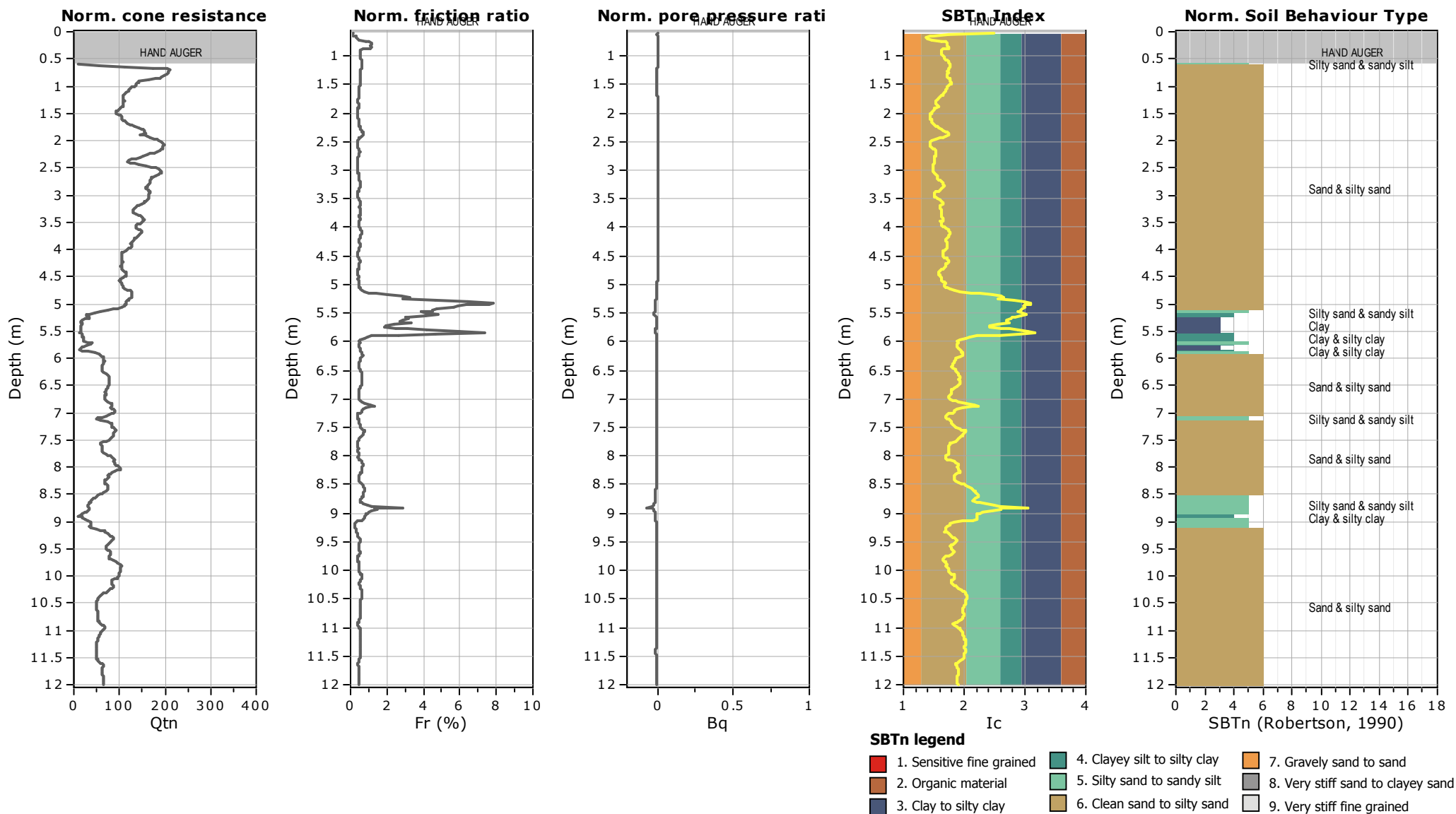
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°



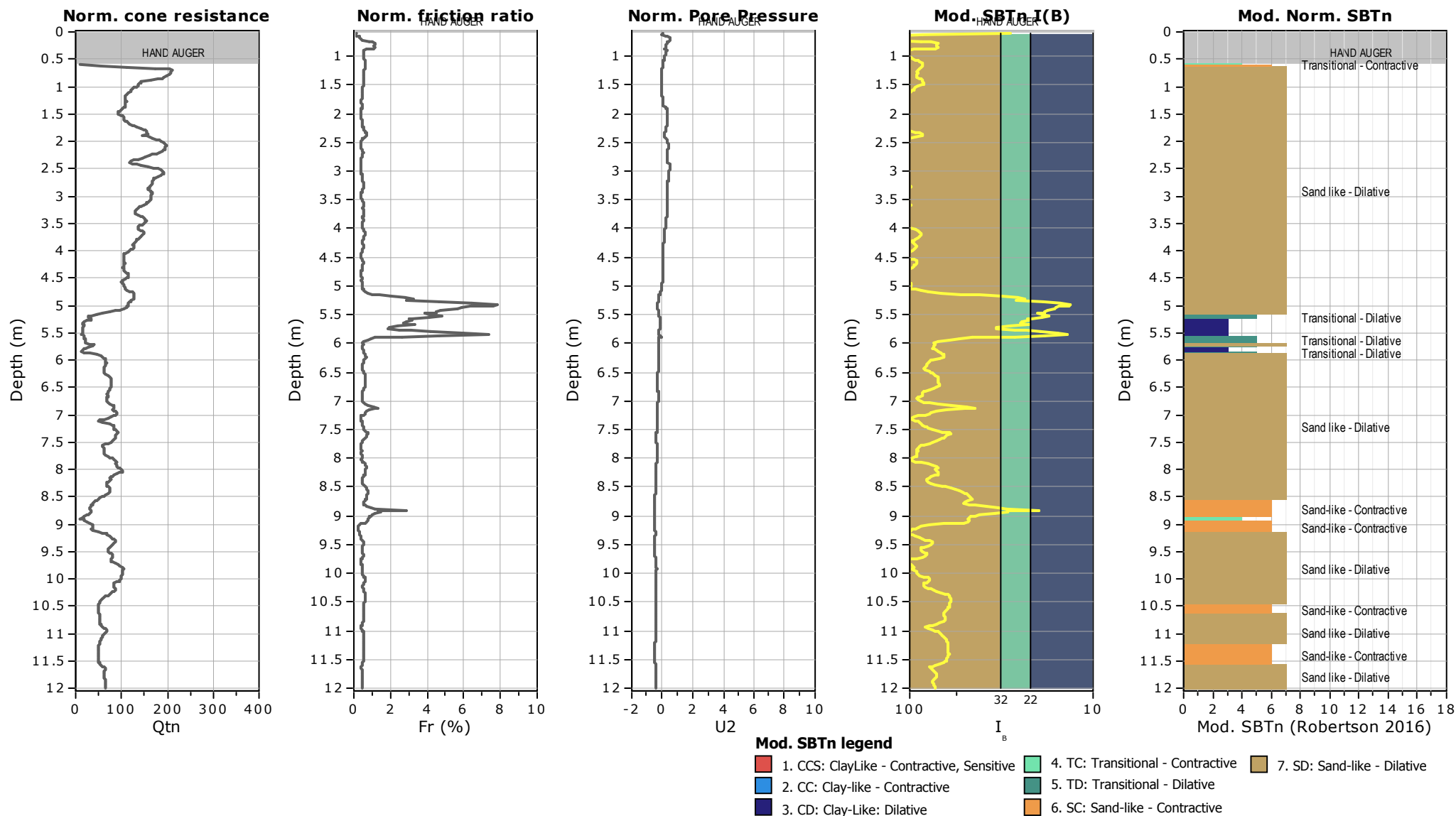
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

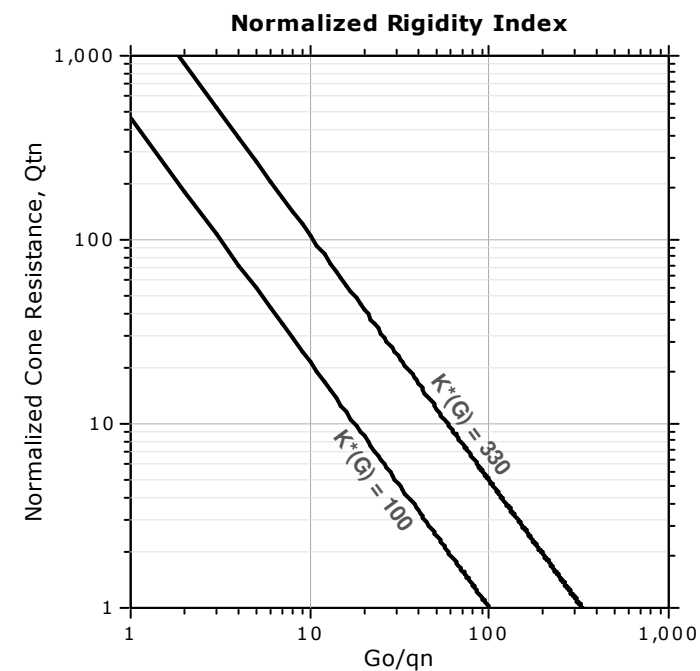
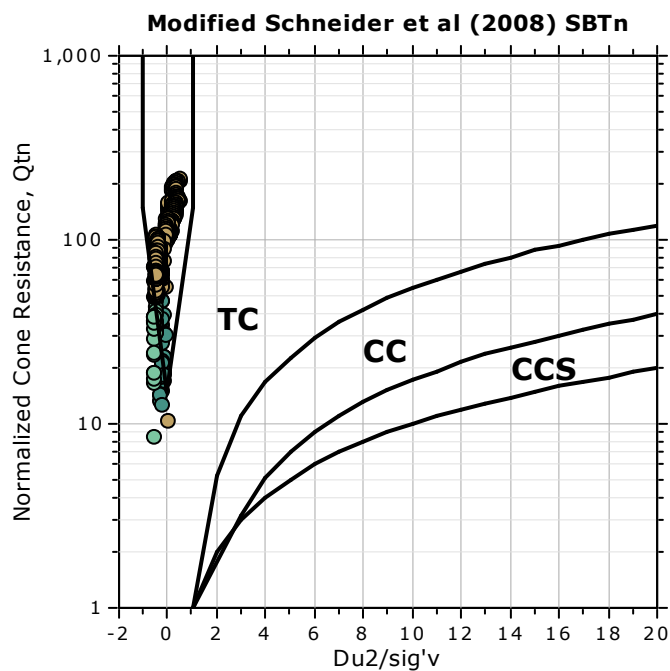
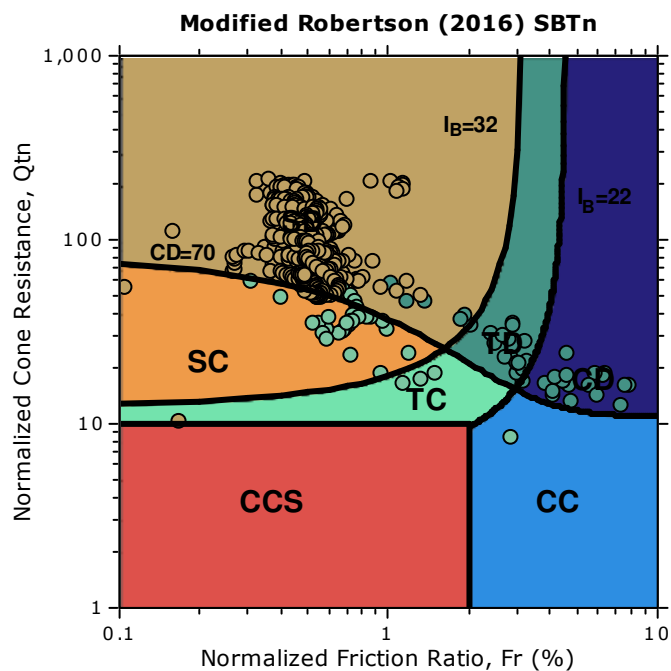
**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



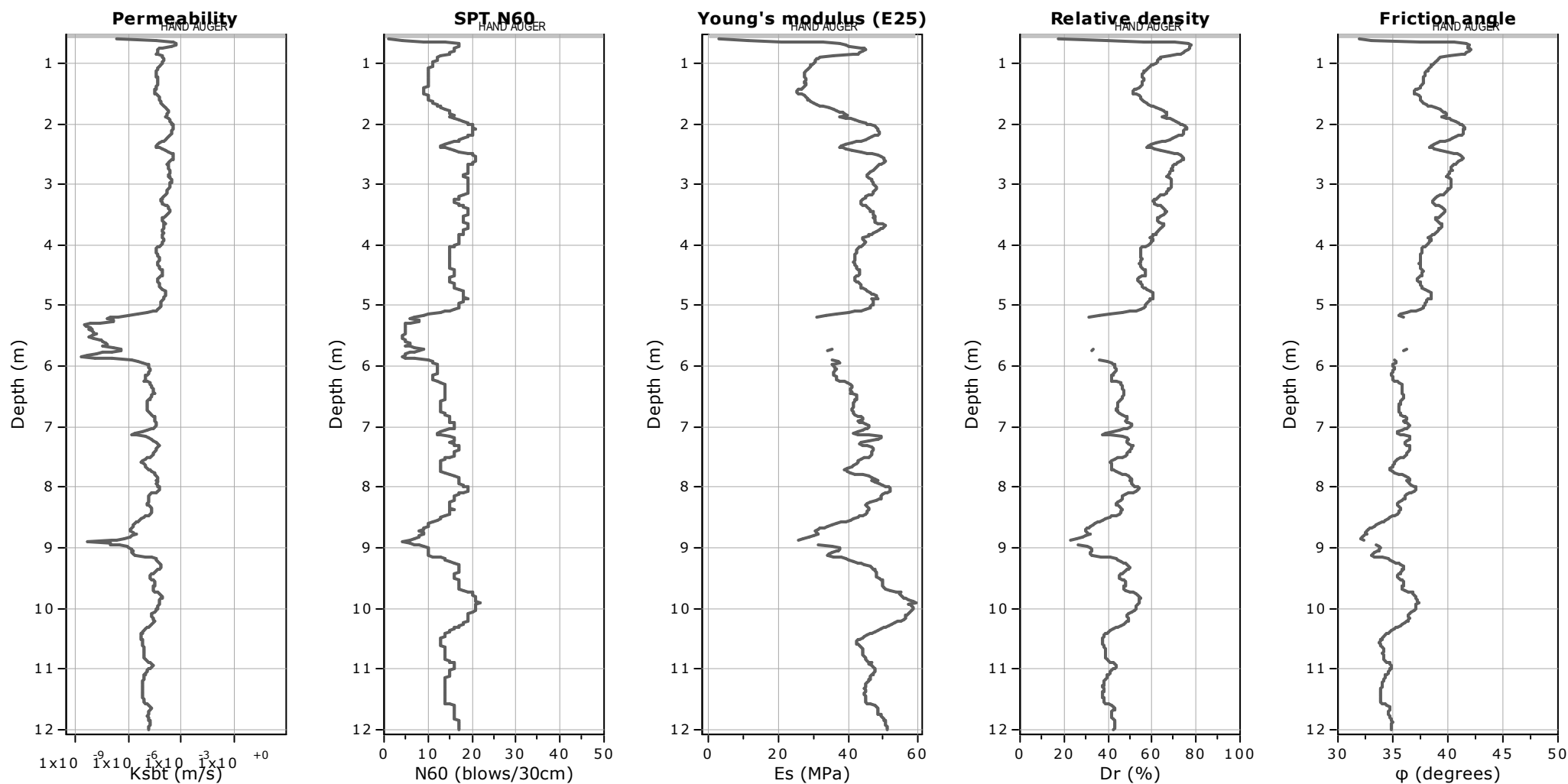
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°



**Calculation parameters**

Permeability: Based on  $SBT_n$

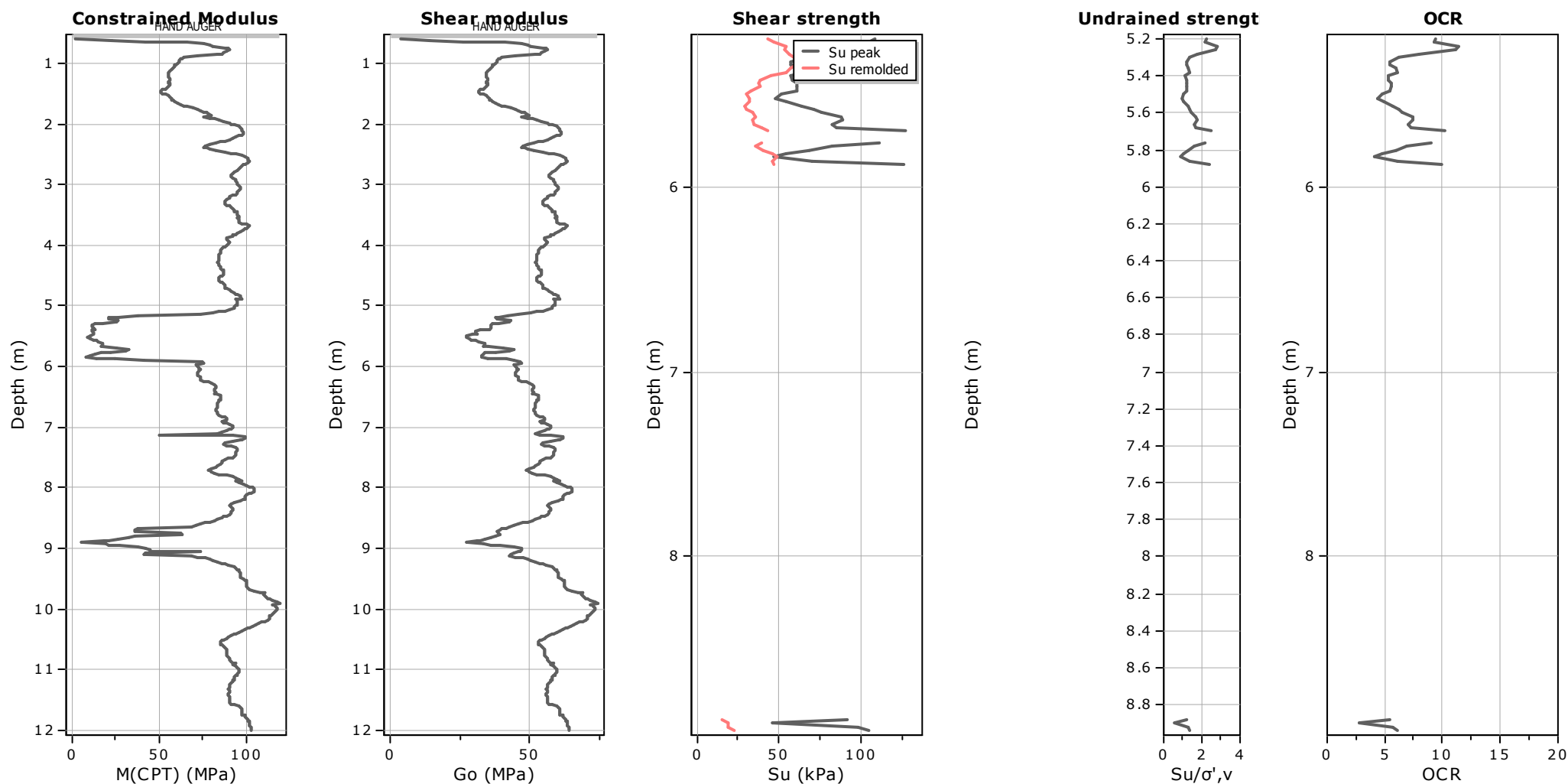
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



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

—●— Flat Dilatometer Test data

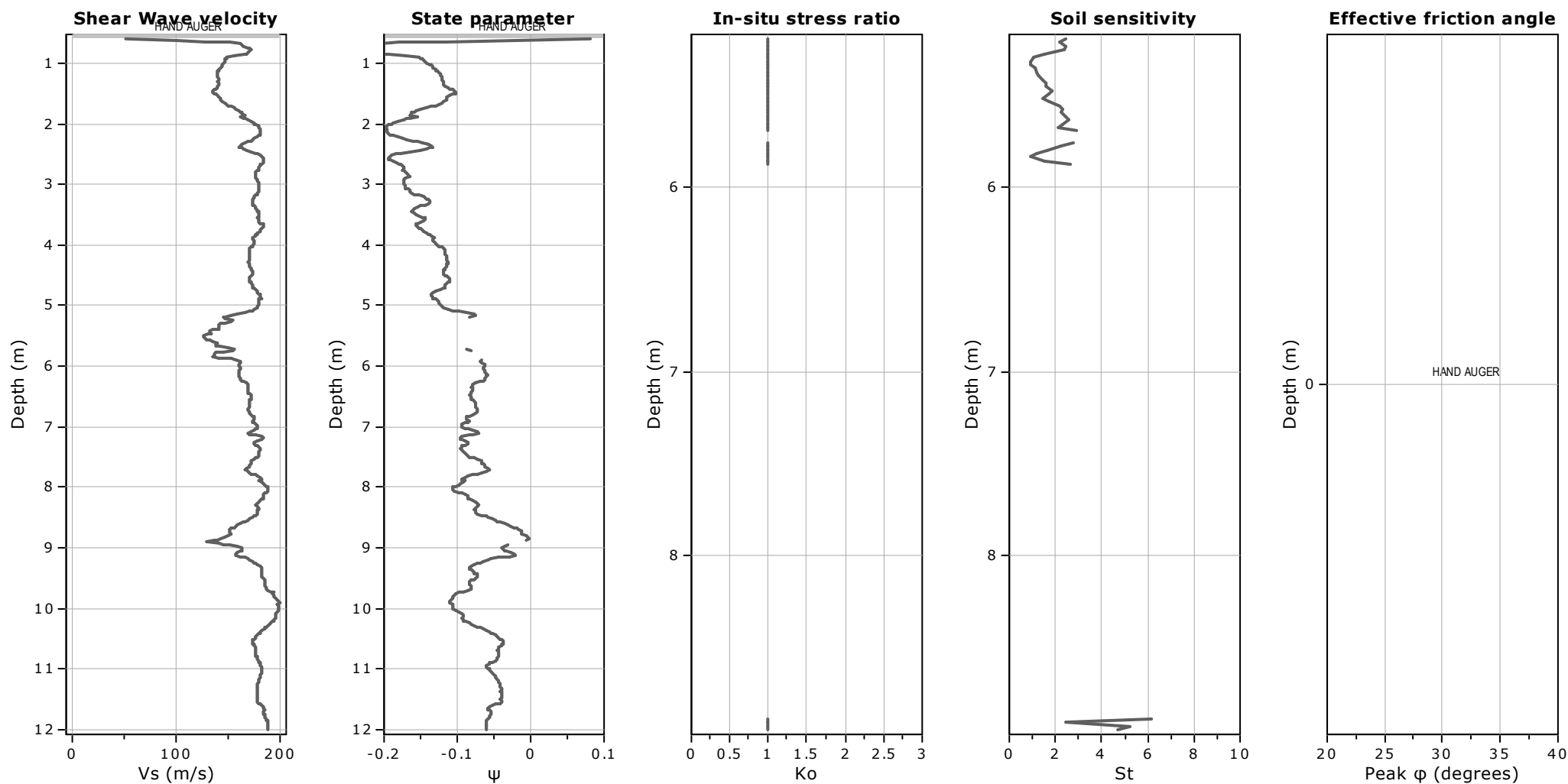
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 6 (Km 27.3)**

Total depth: 12.00 m

Coords: lat 44.691642° lon 12.222733°



**Calculation parameters**

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

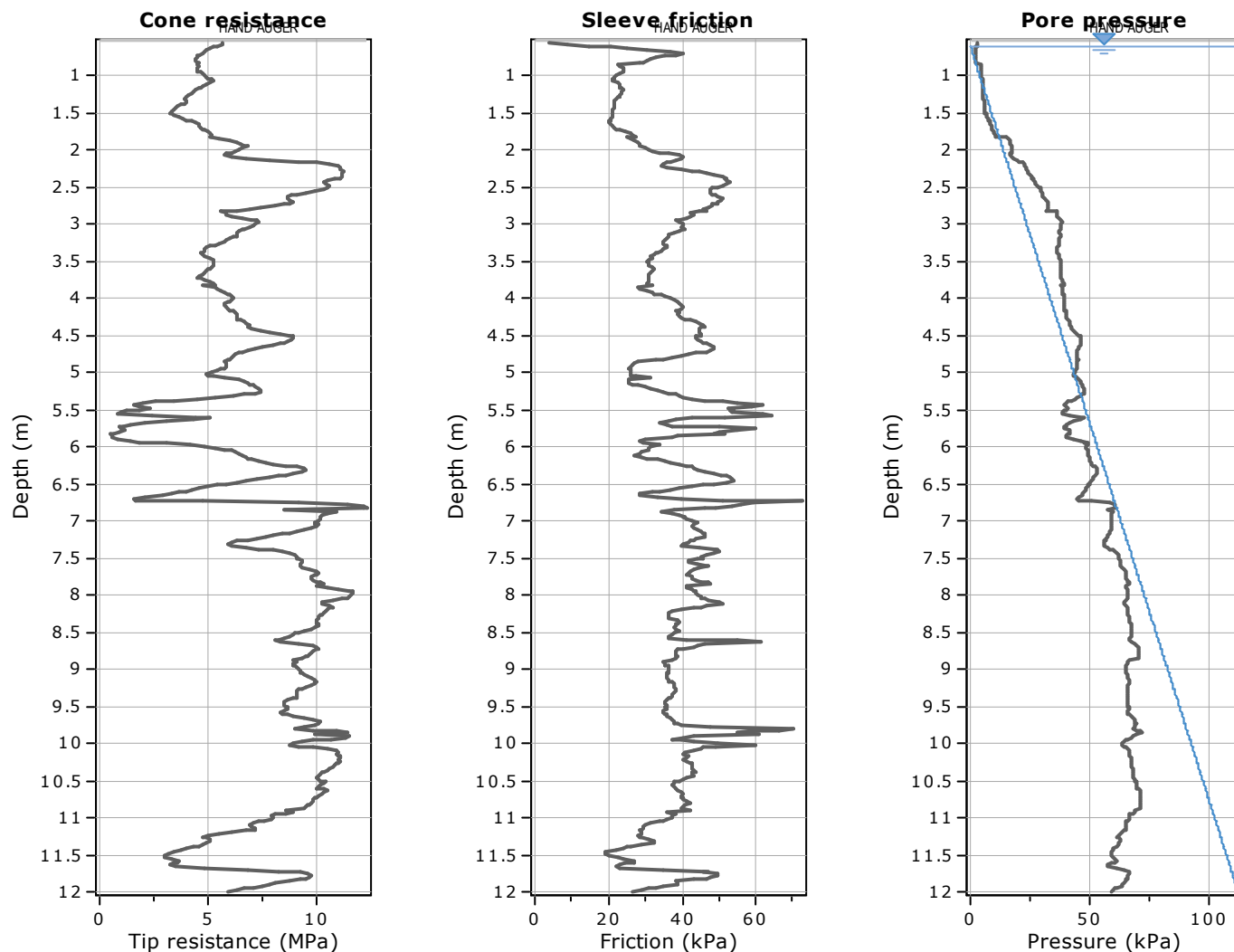
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

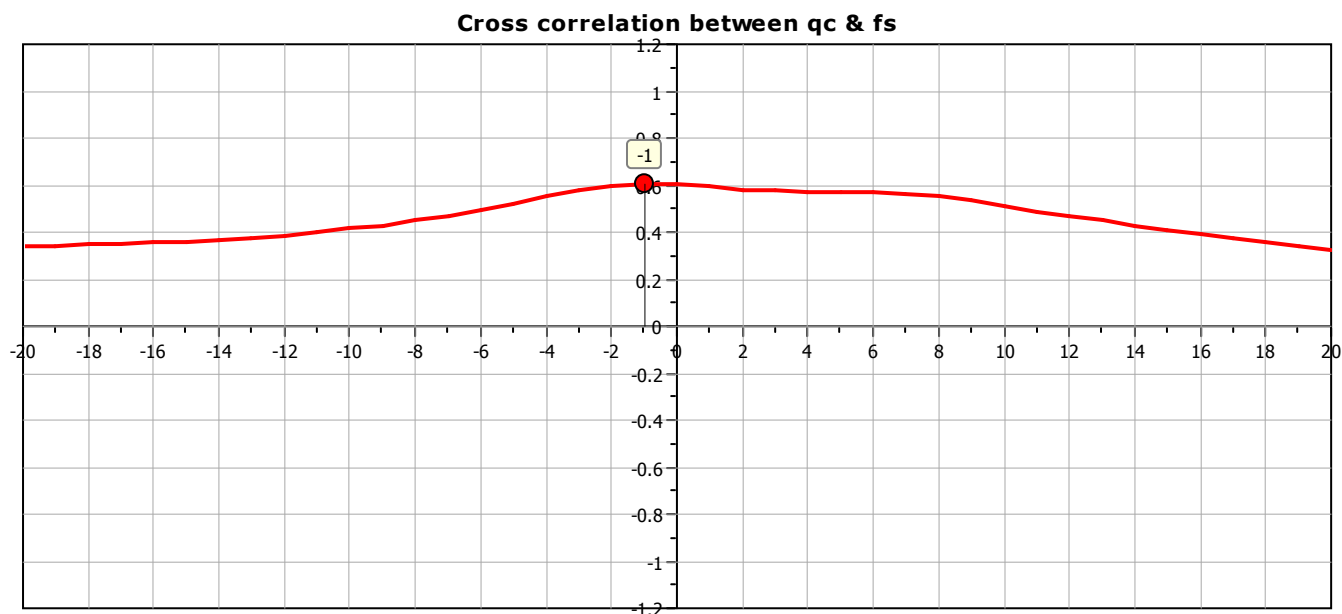
**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°

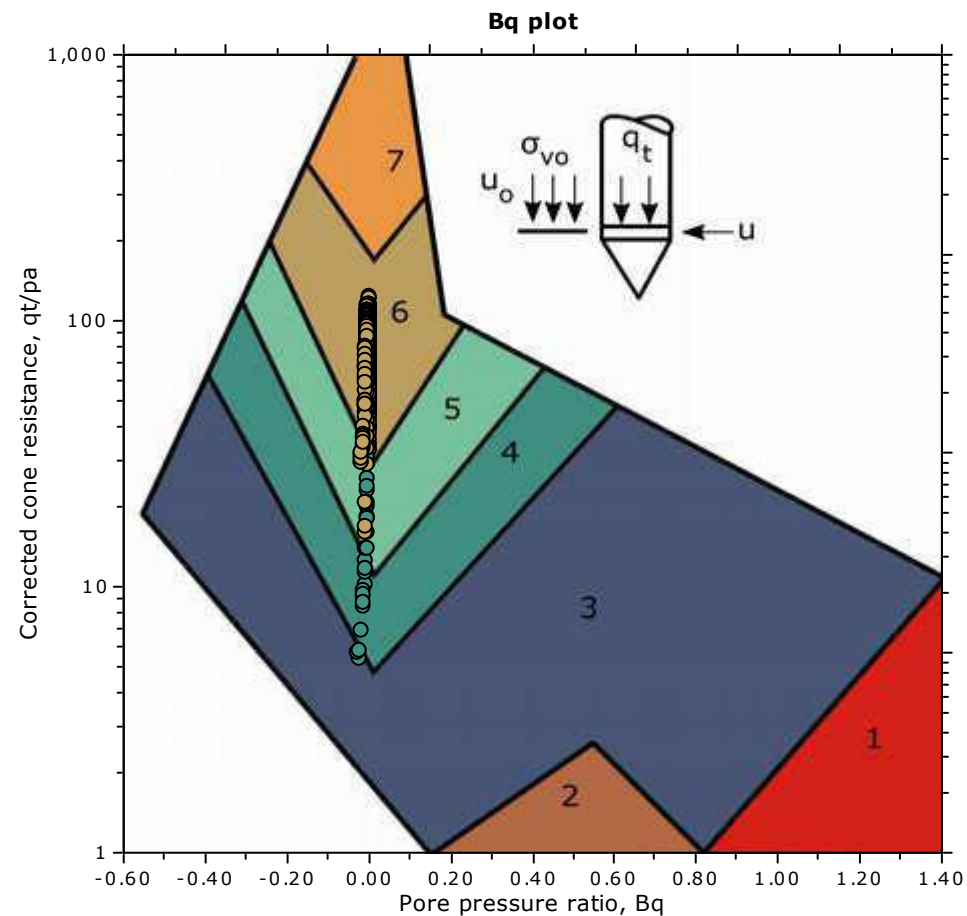
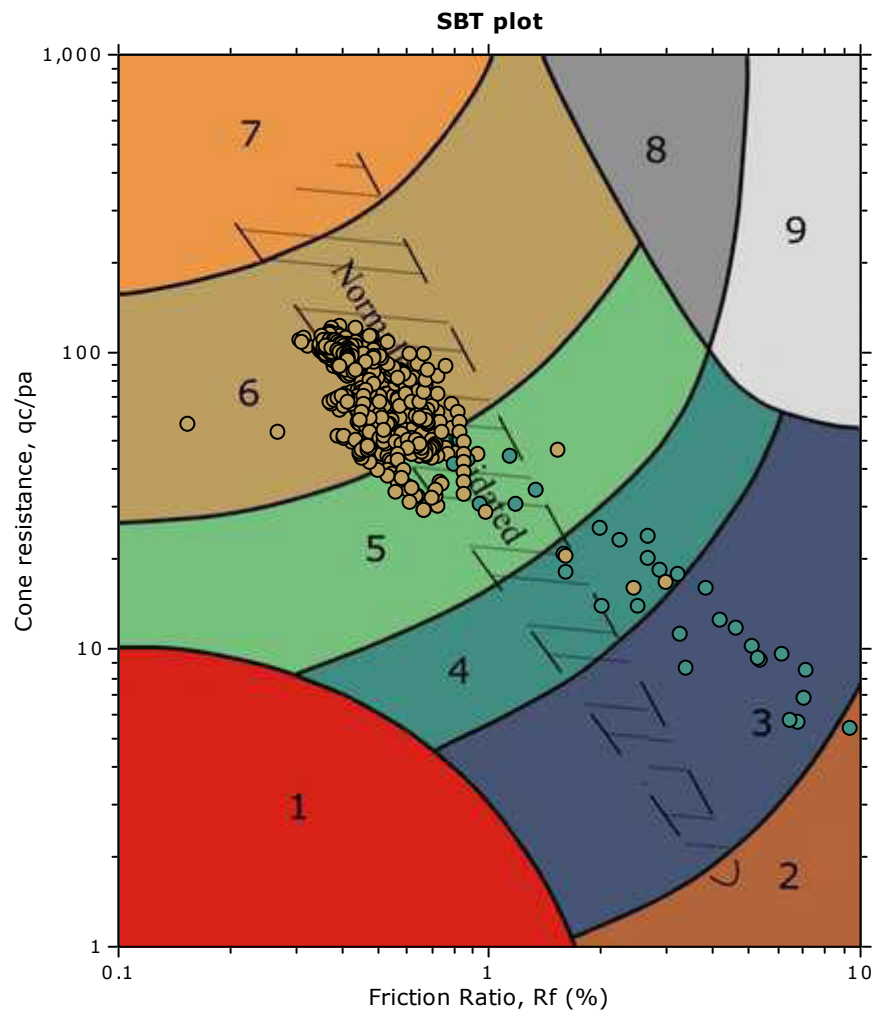


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





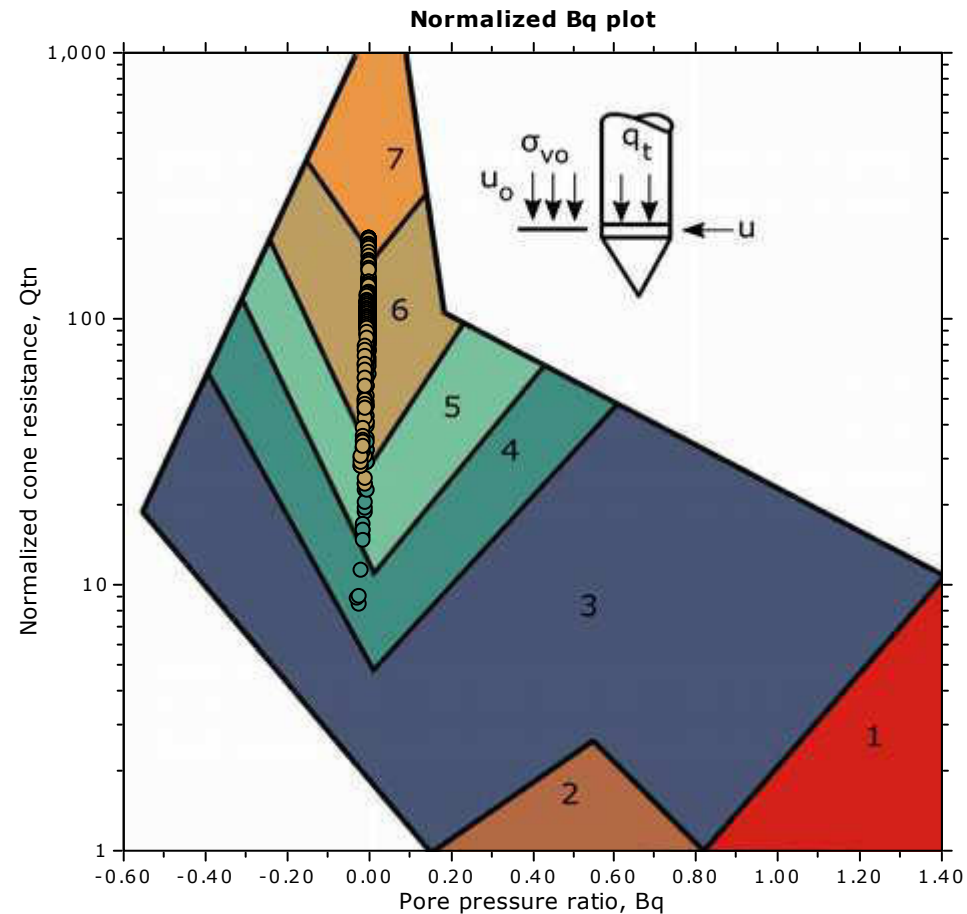
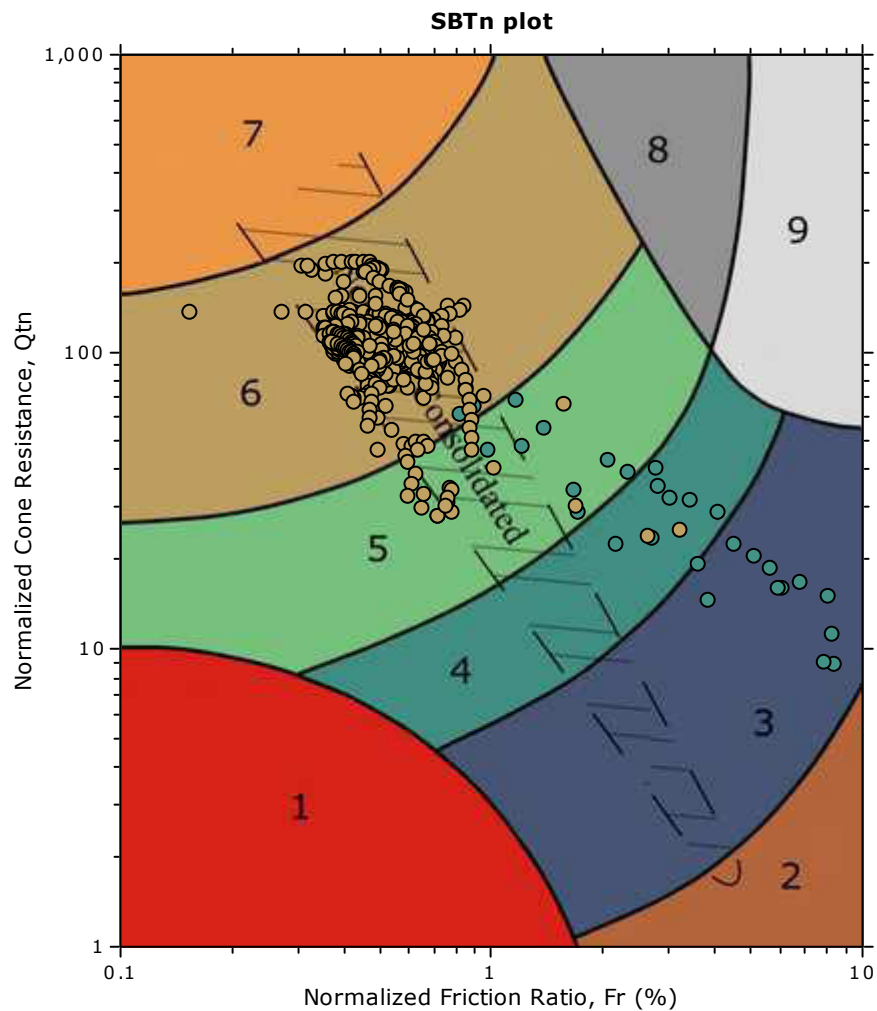
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

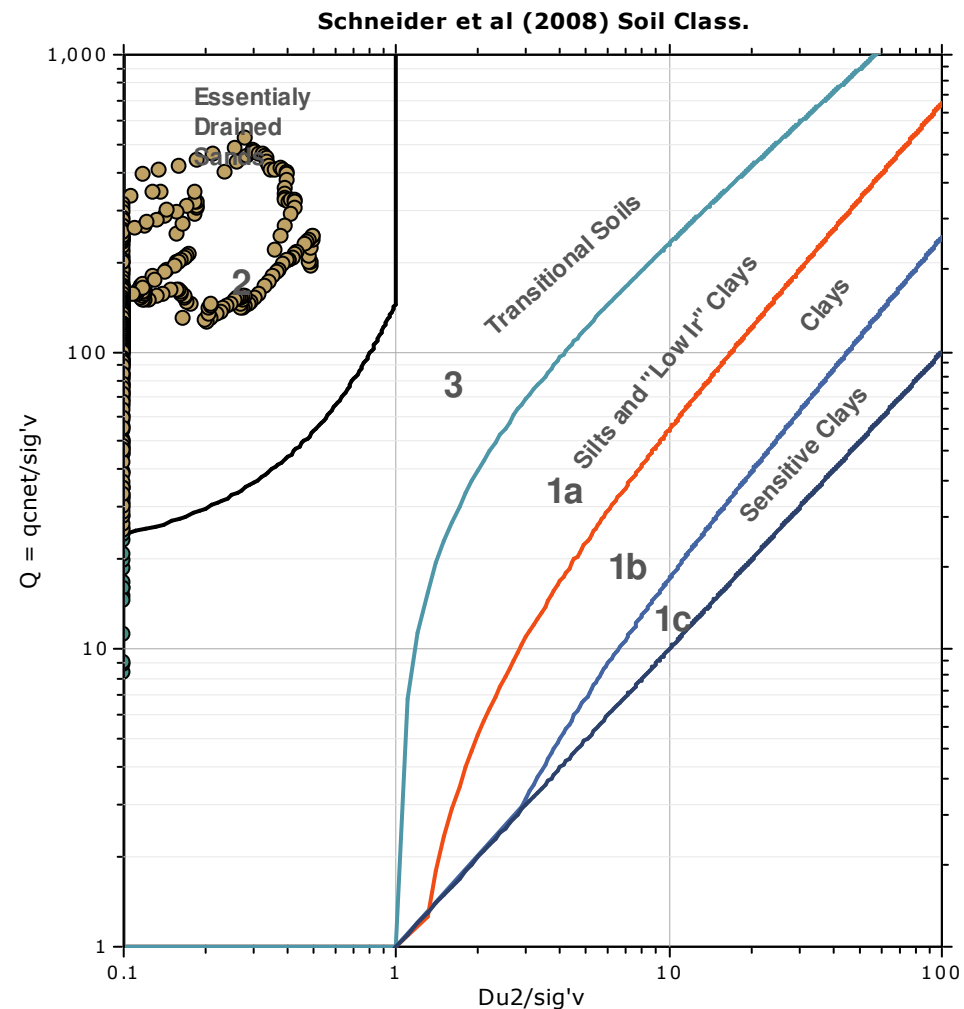
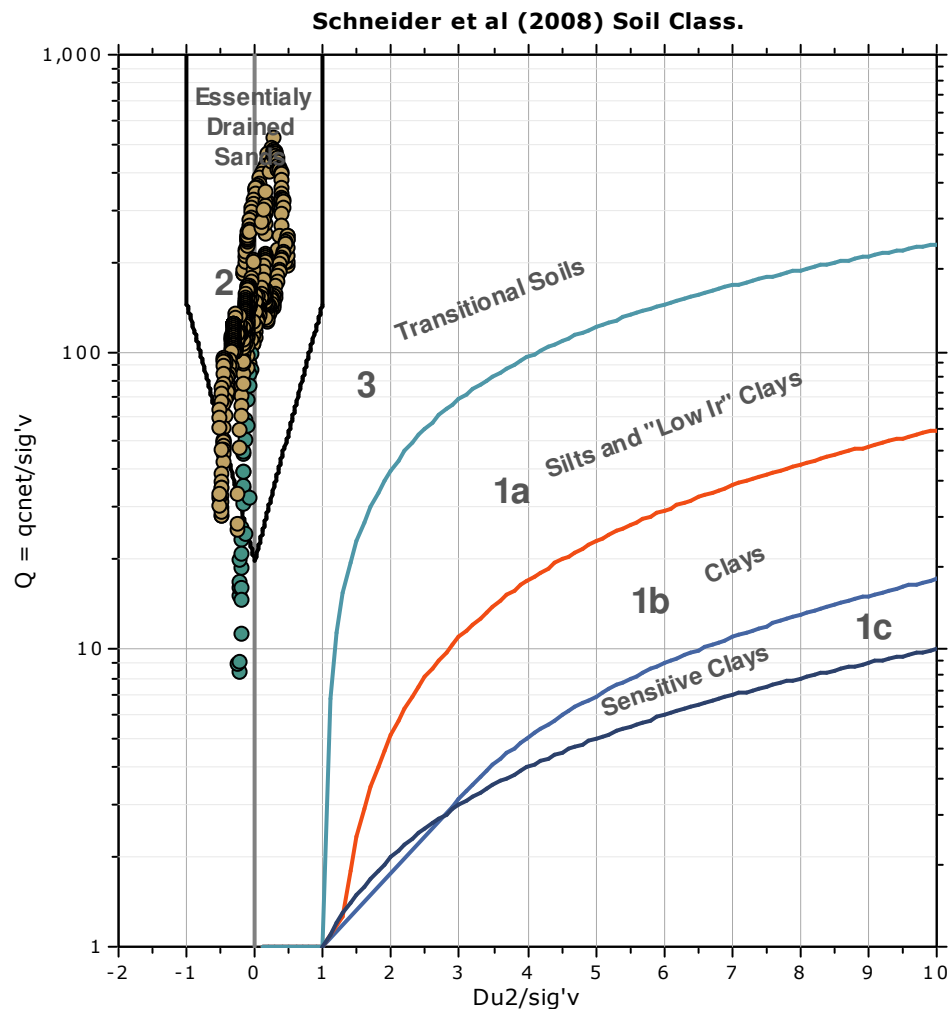
**SBT - Bq plots (normalized)**

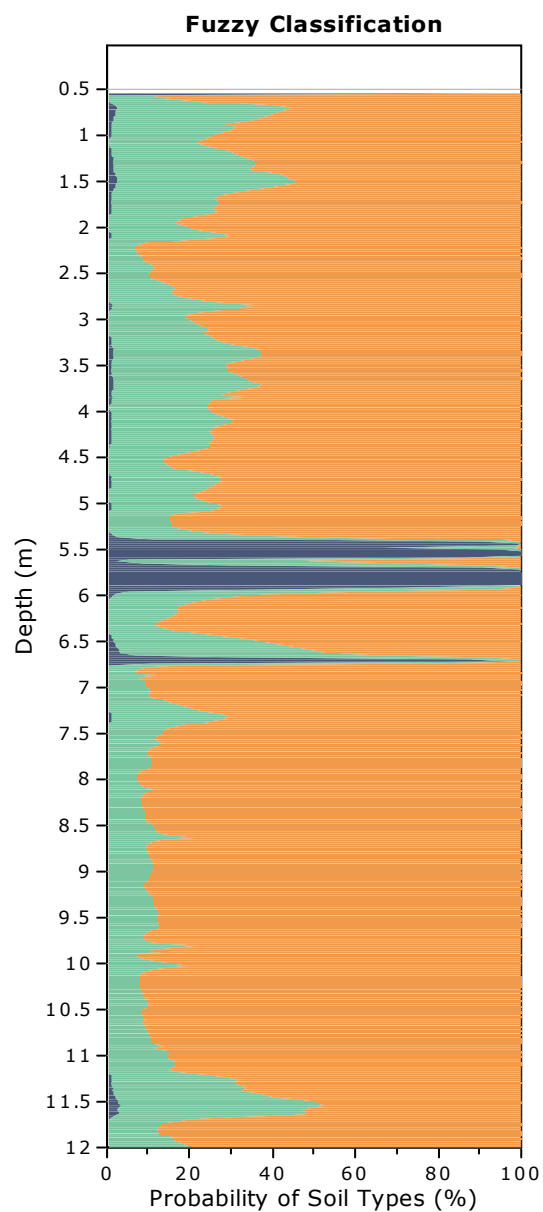
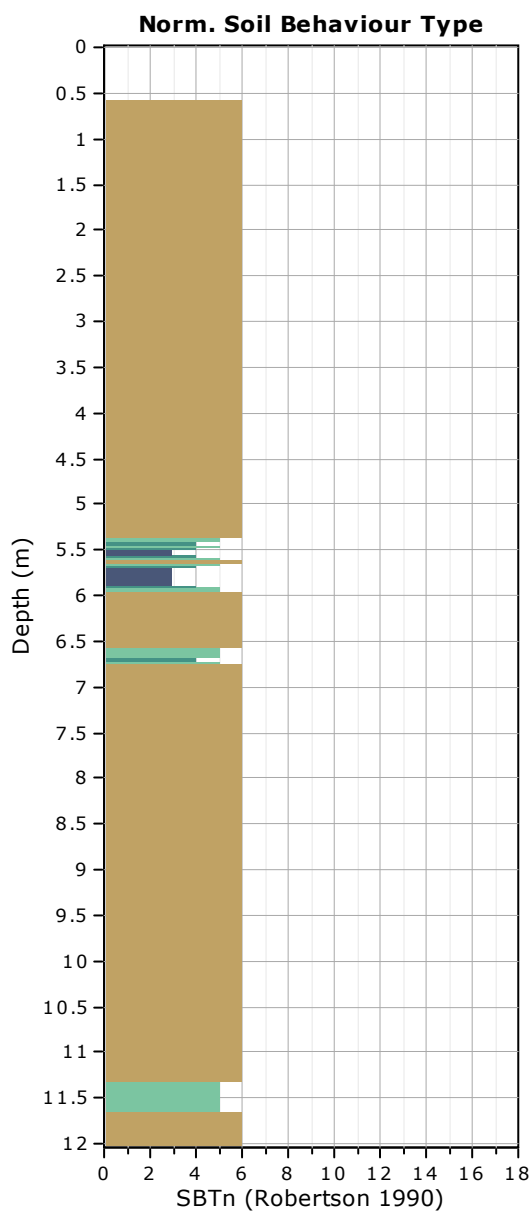


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







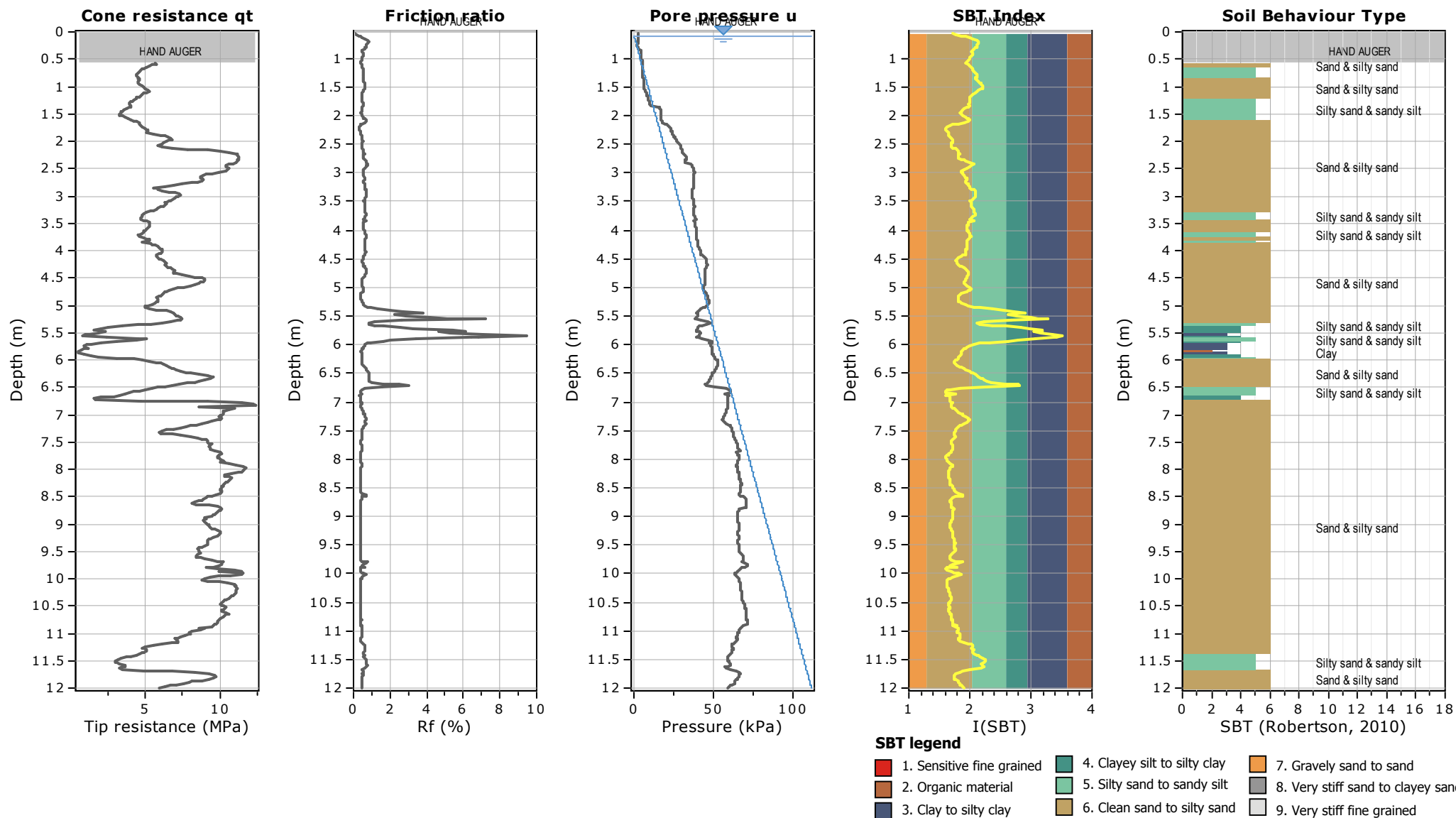
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



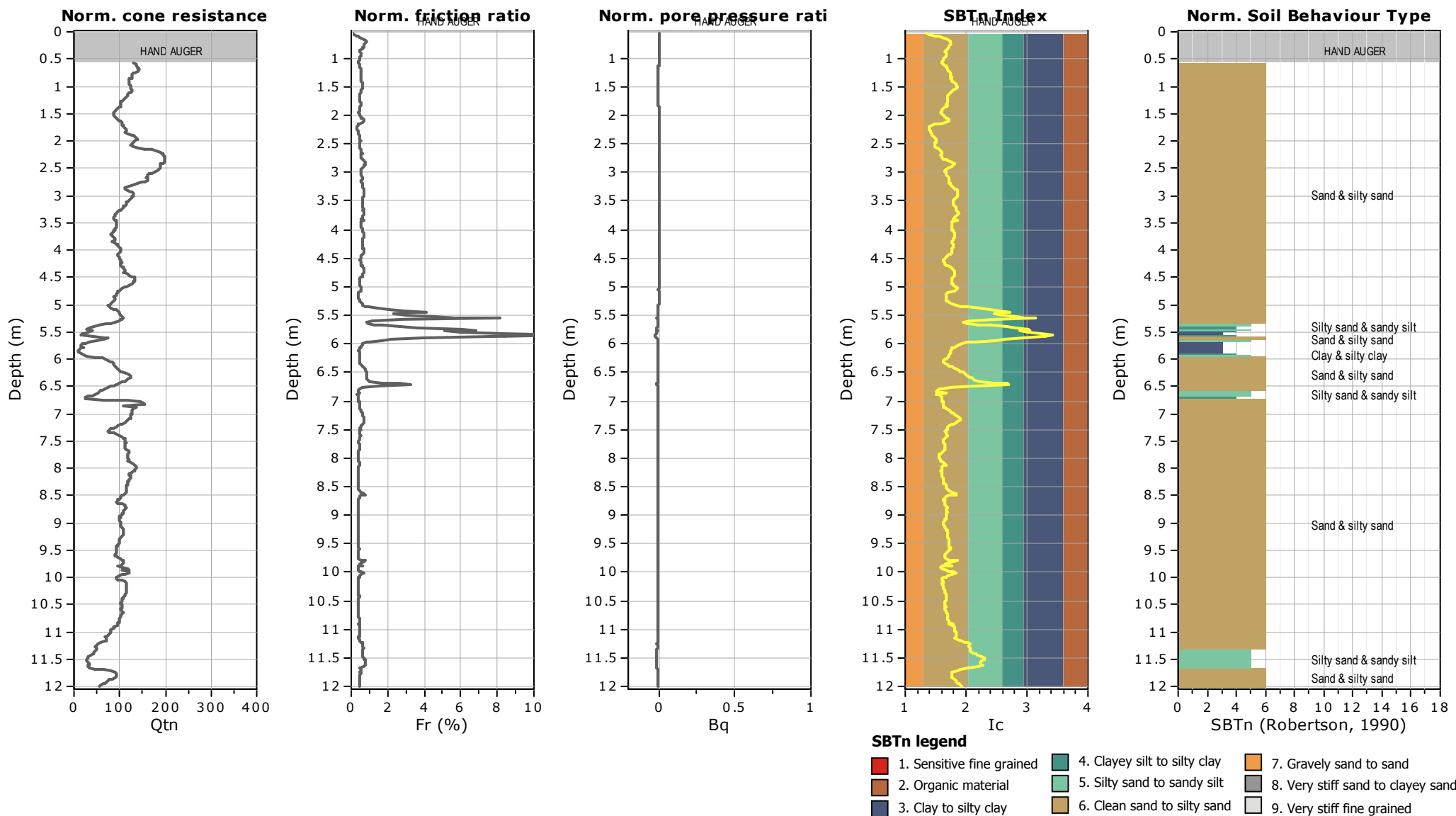
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



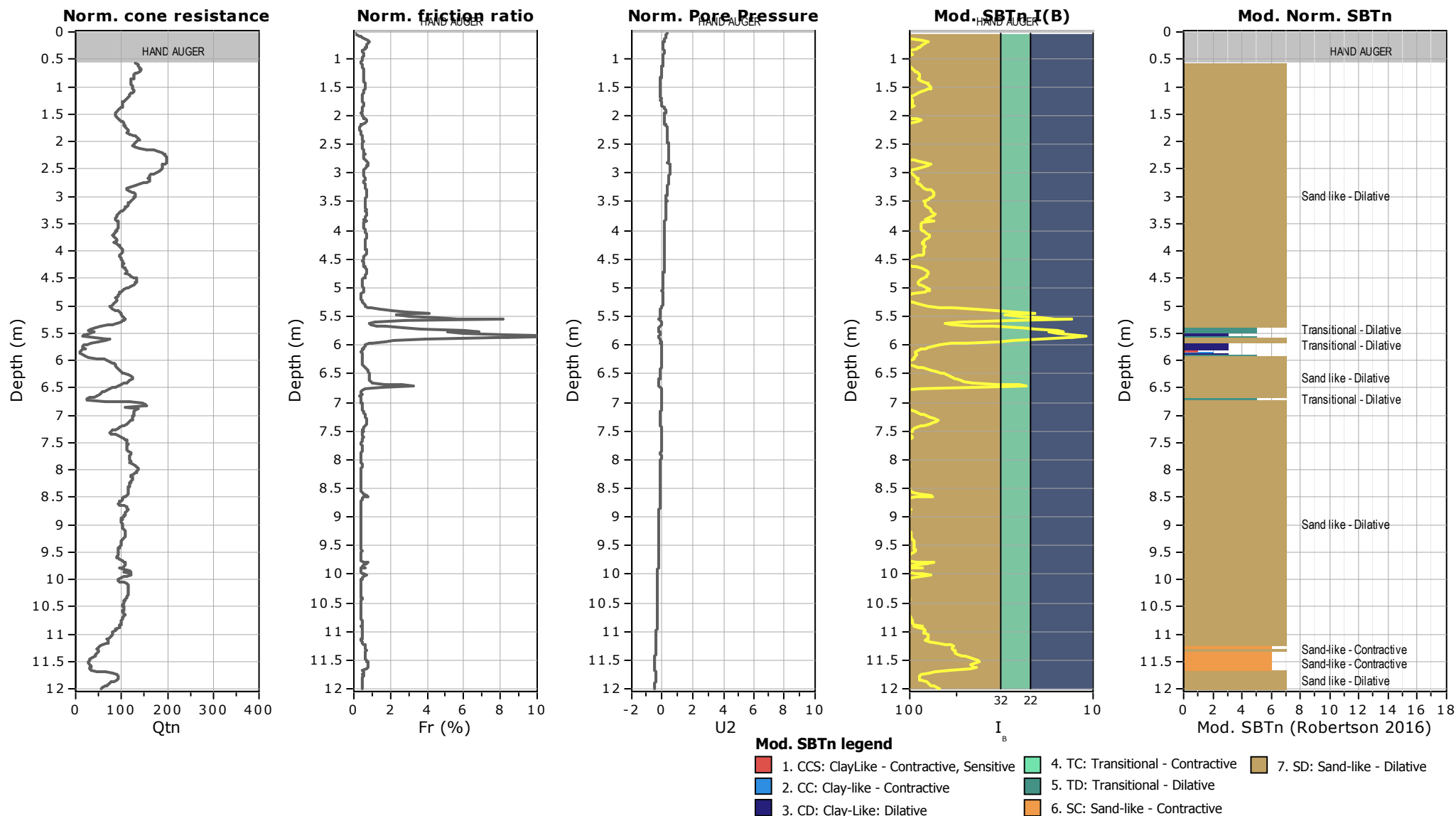
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

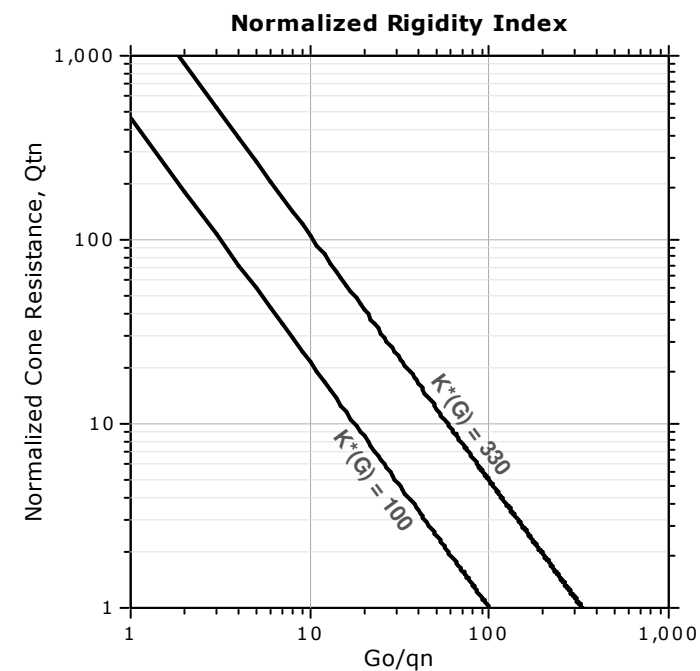
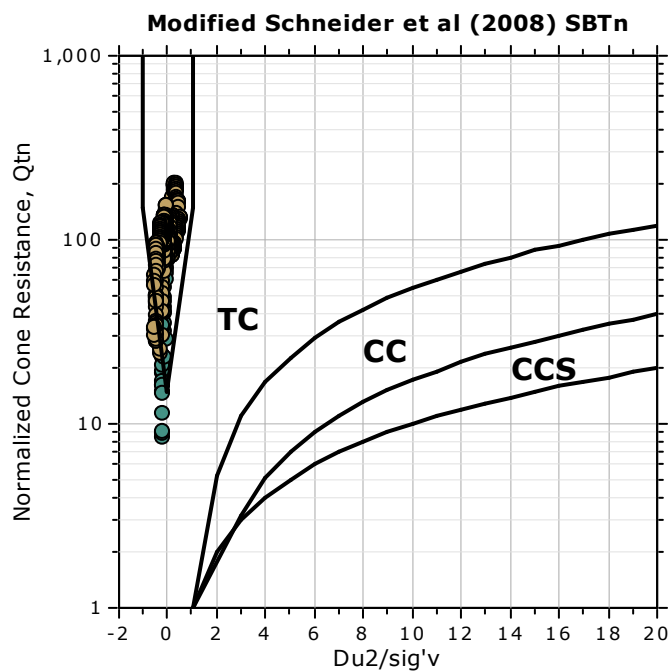
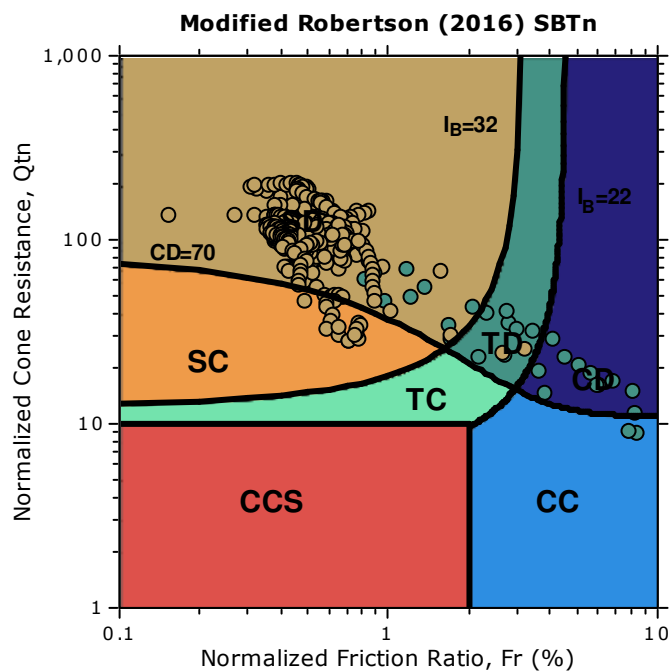
**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



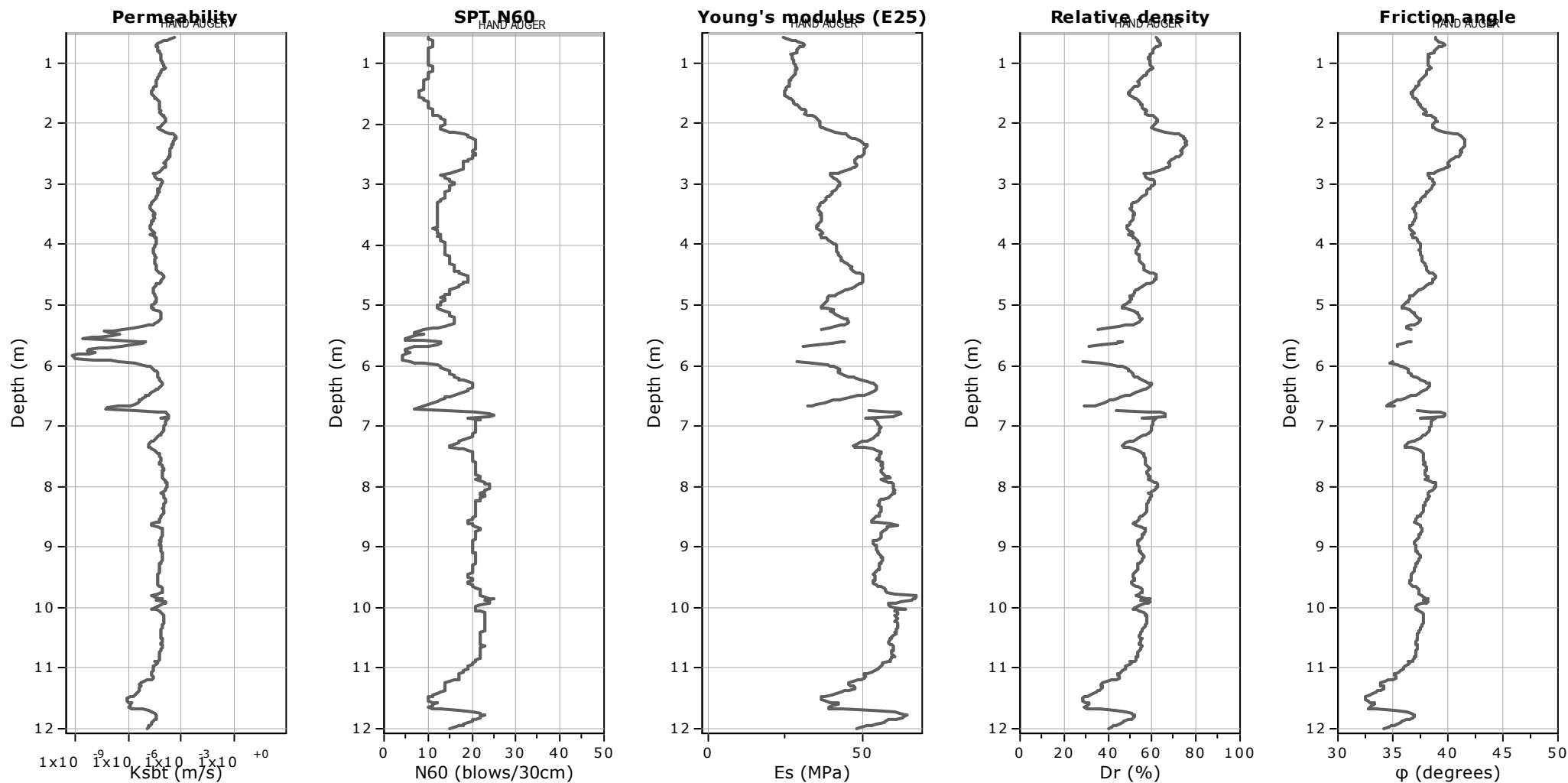
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data

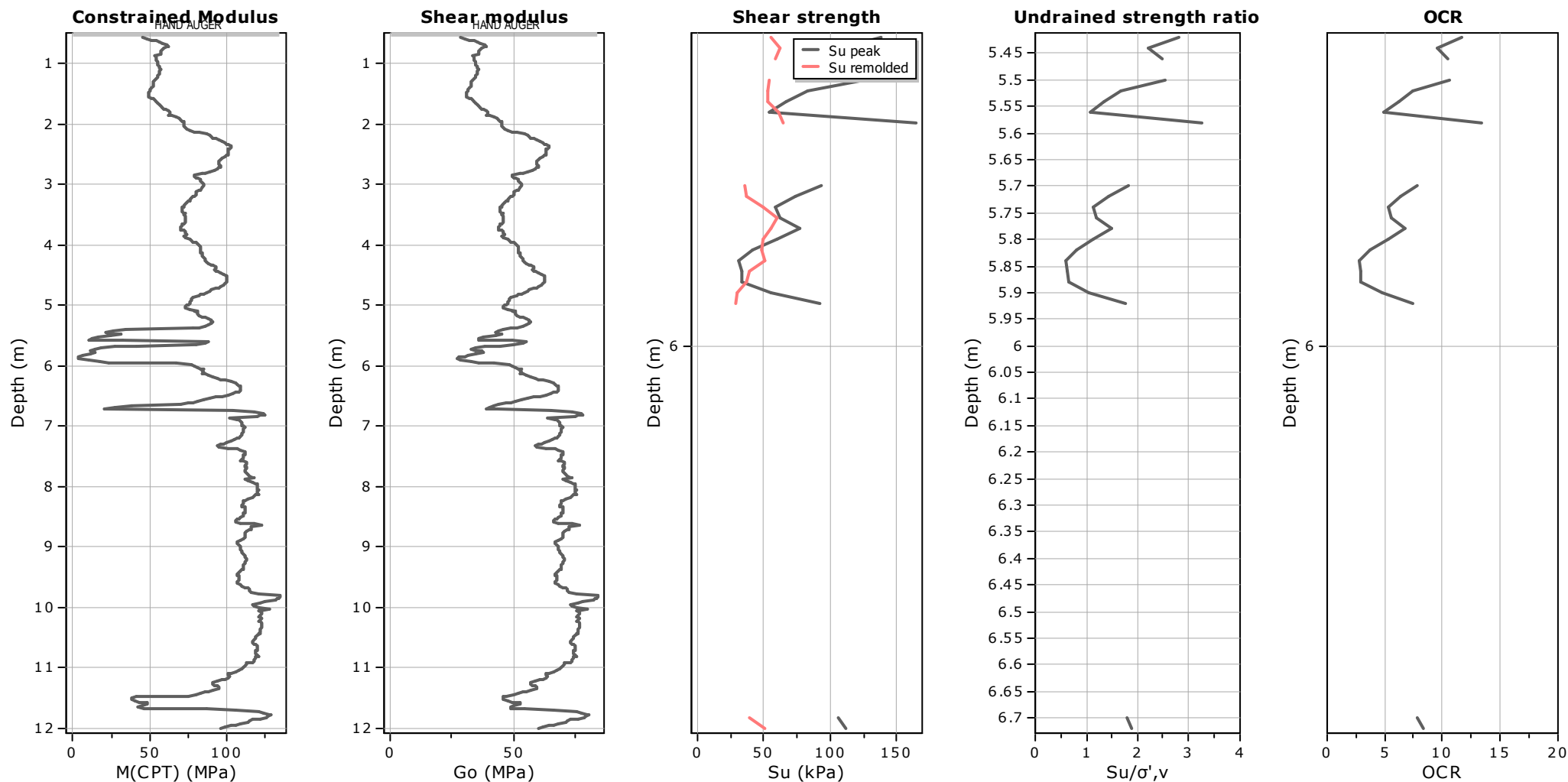
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

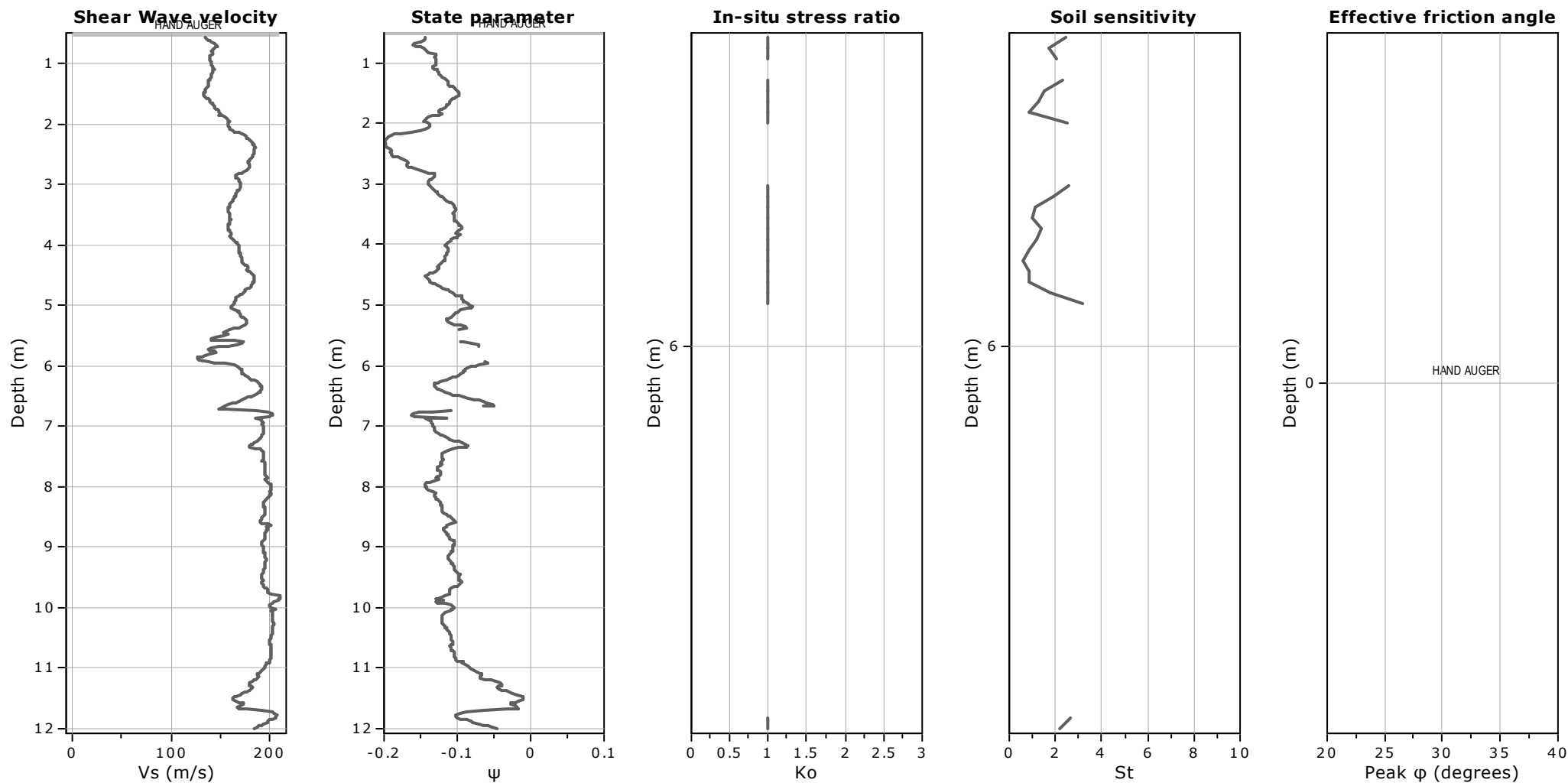
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 7 (Km 28.2)**

Total depth: 12.00 m

Coords: lat 44.700217° lon 12.222828°



**Calculation parameters**

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

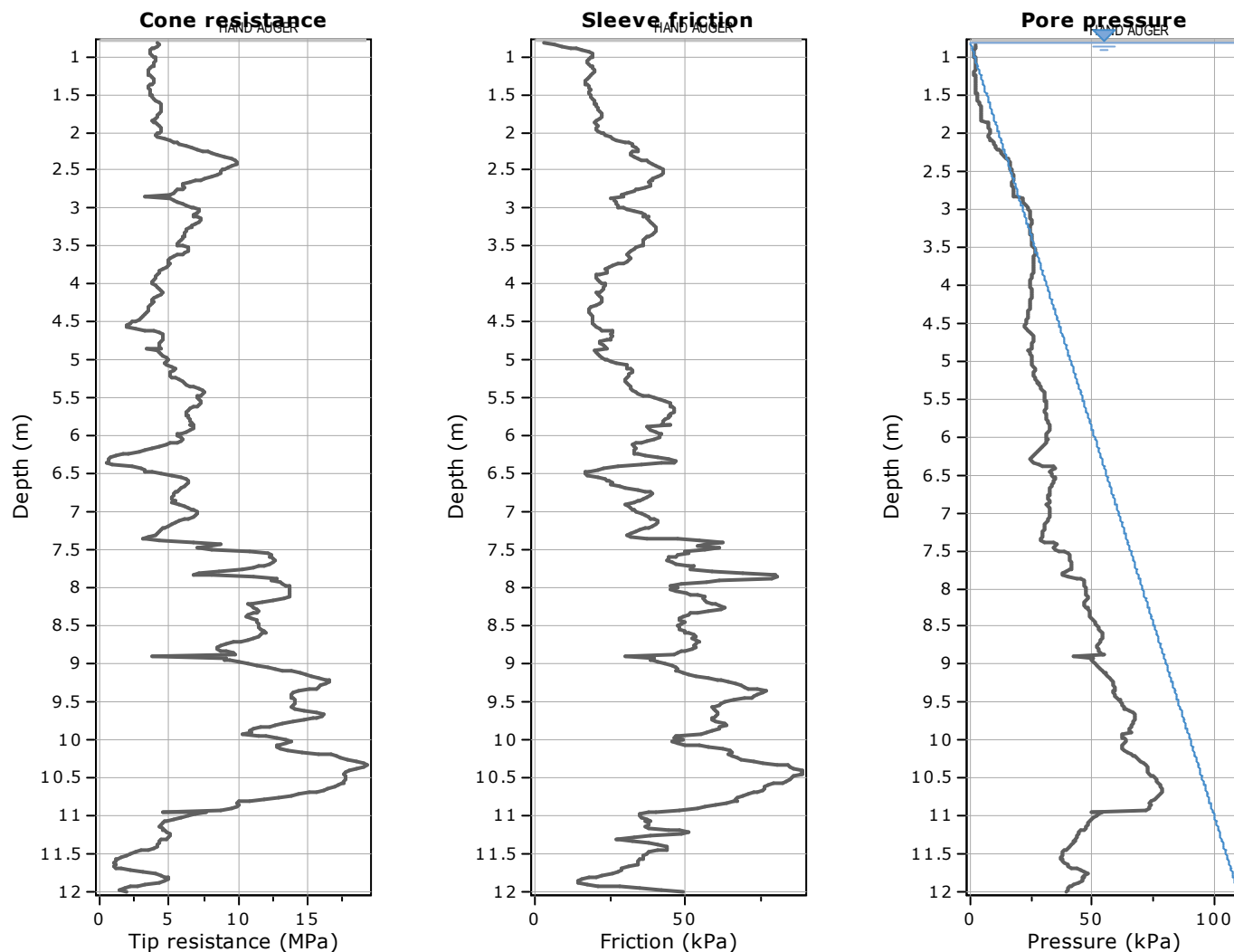
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

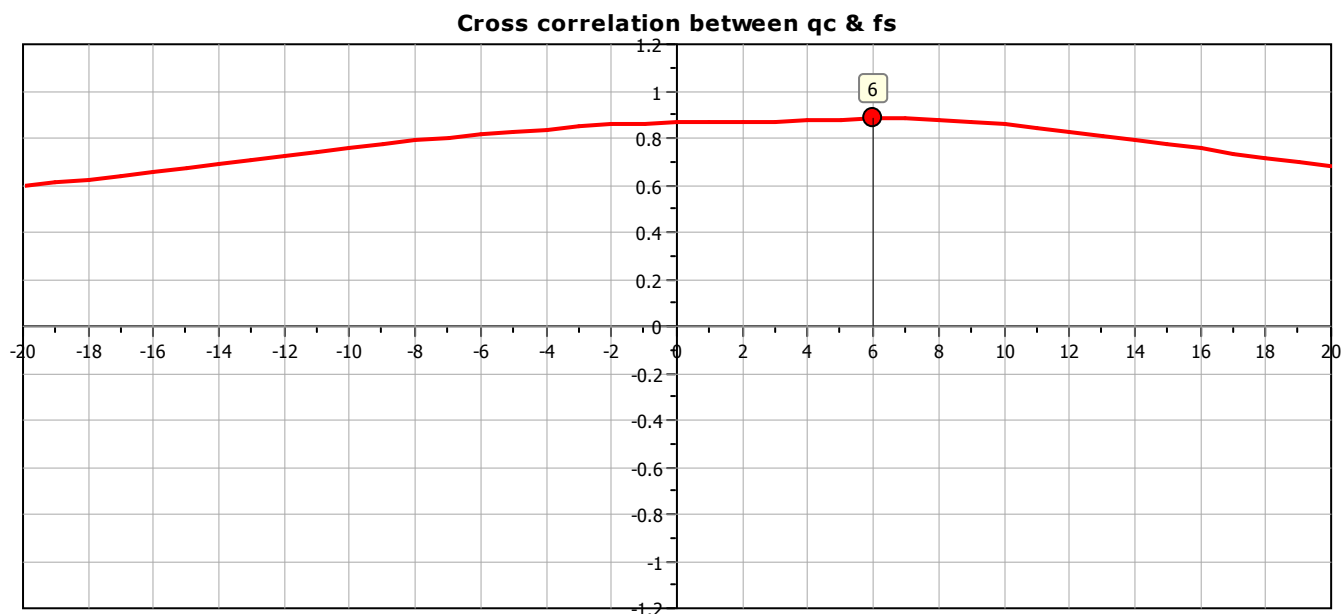
**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

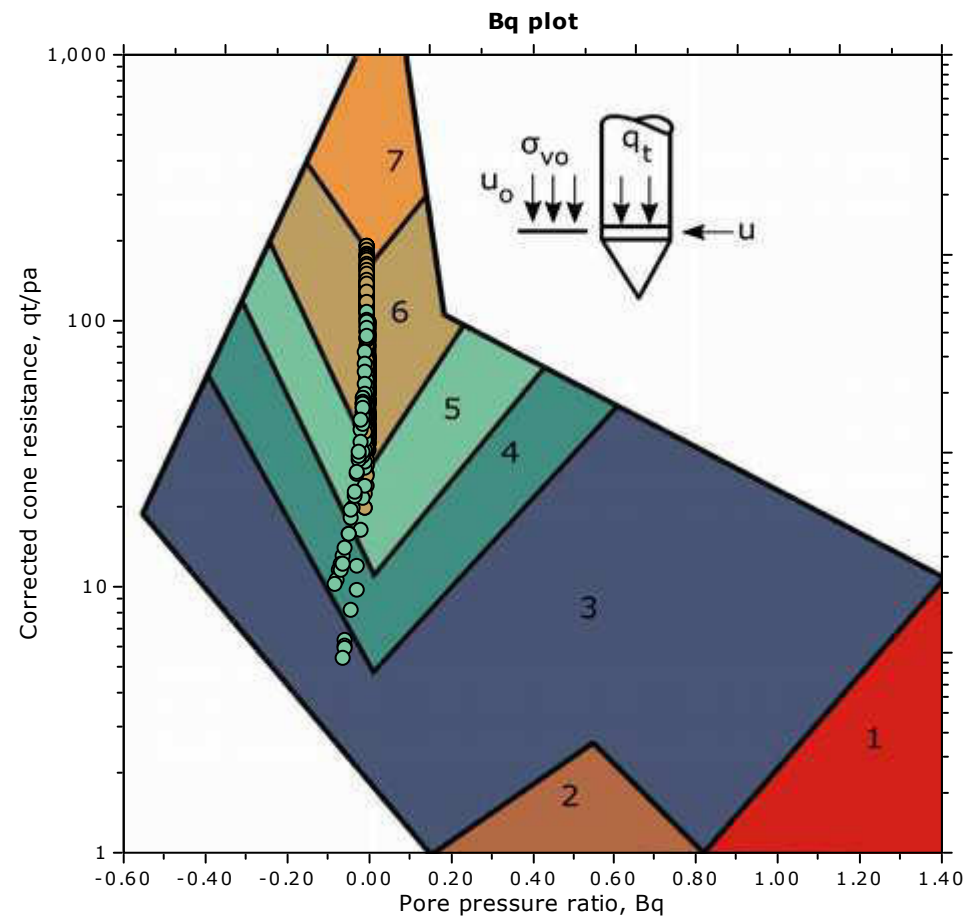
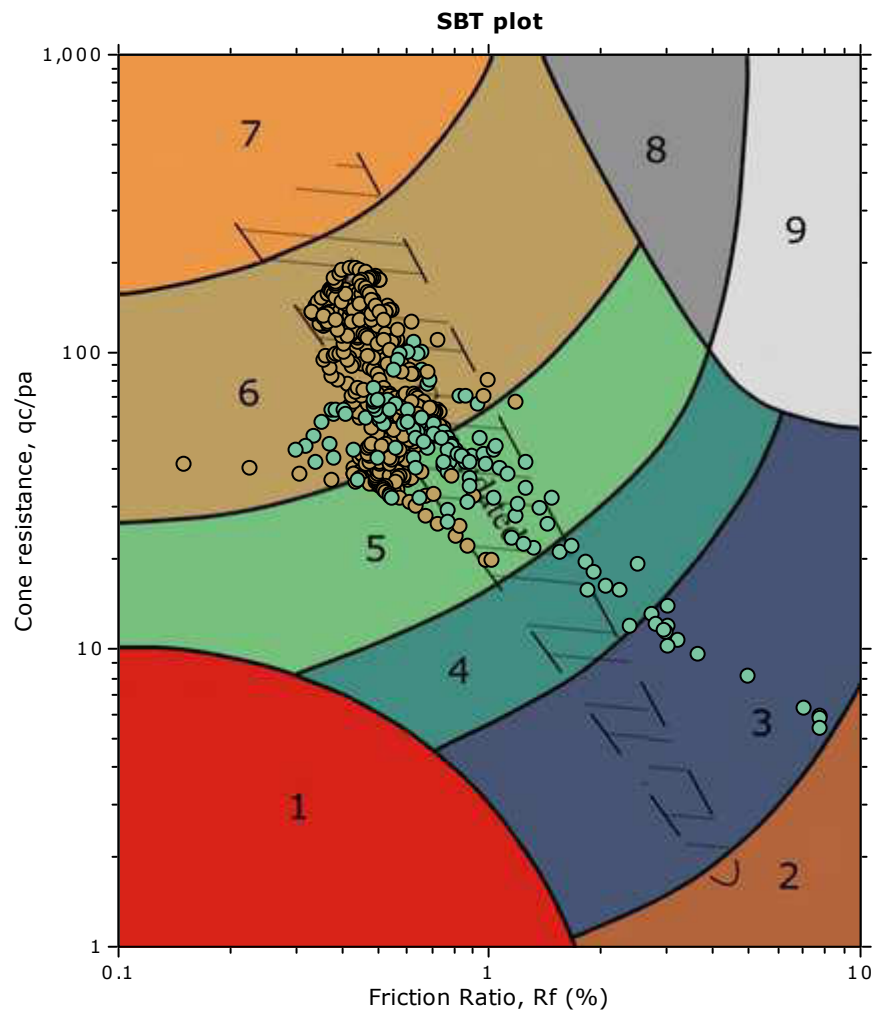
Coords: lat 44.708864° lon 12.221569°



The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  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

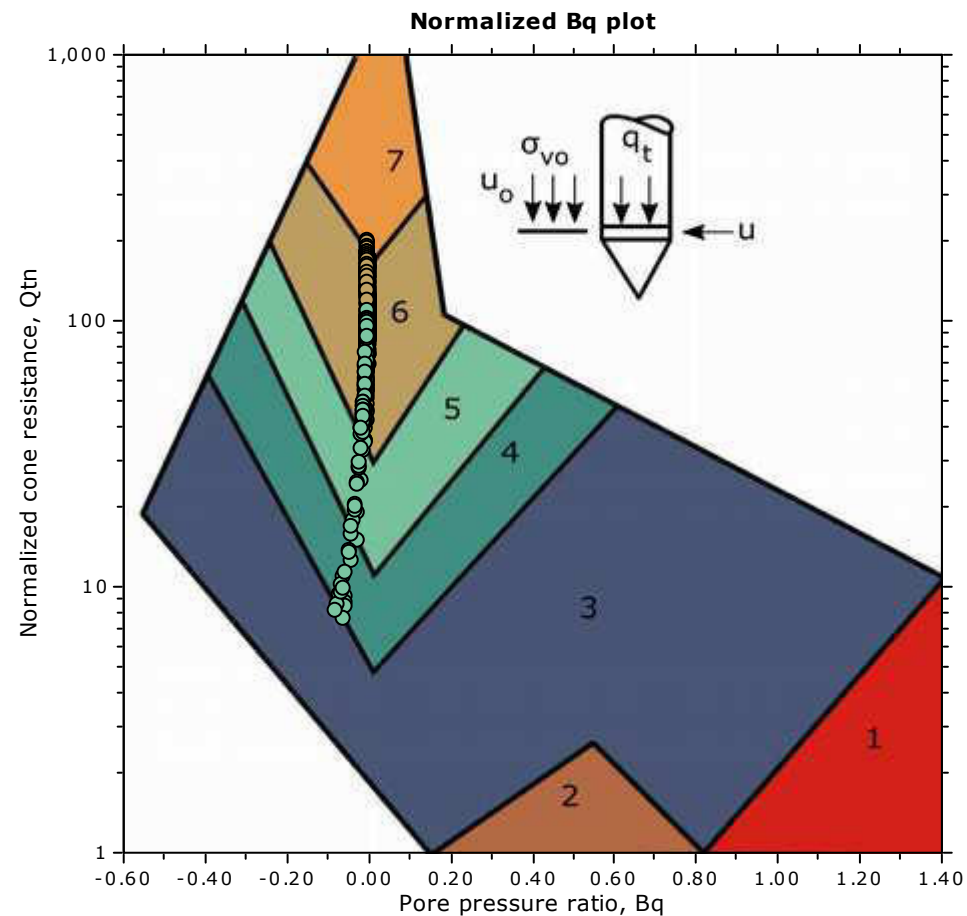
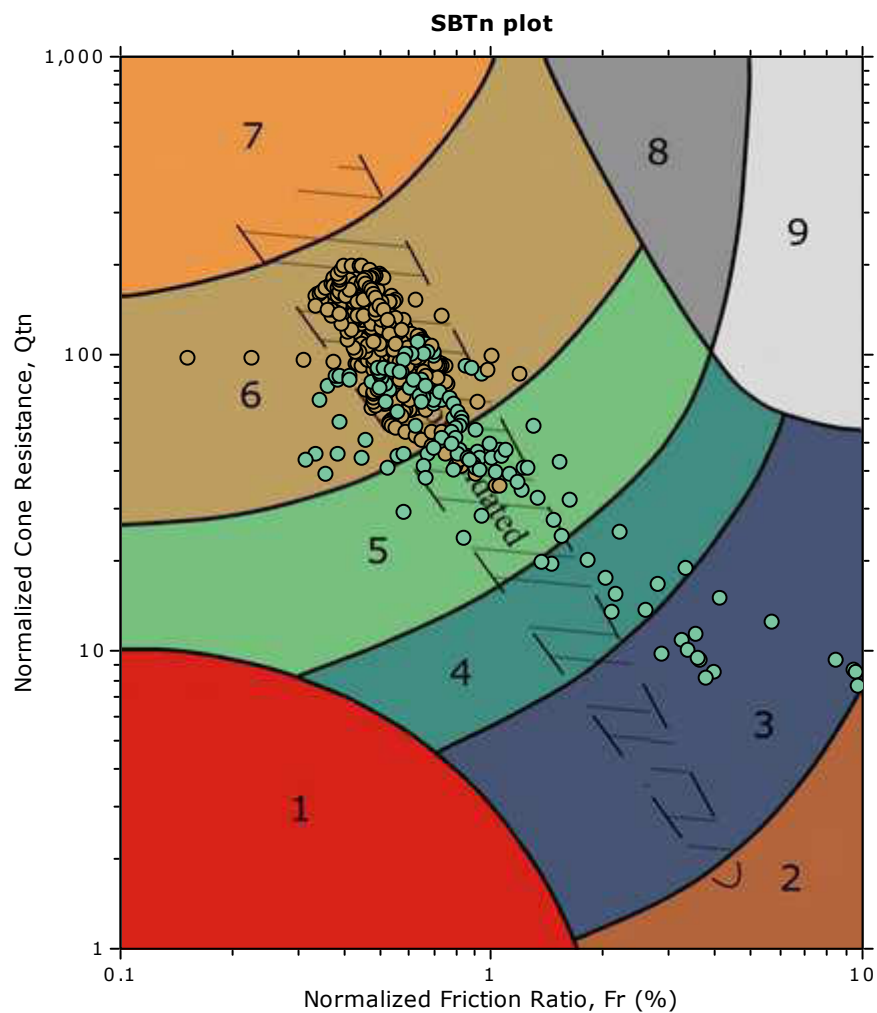


### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |



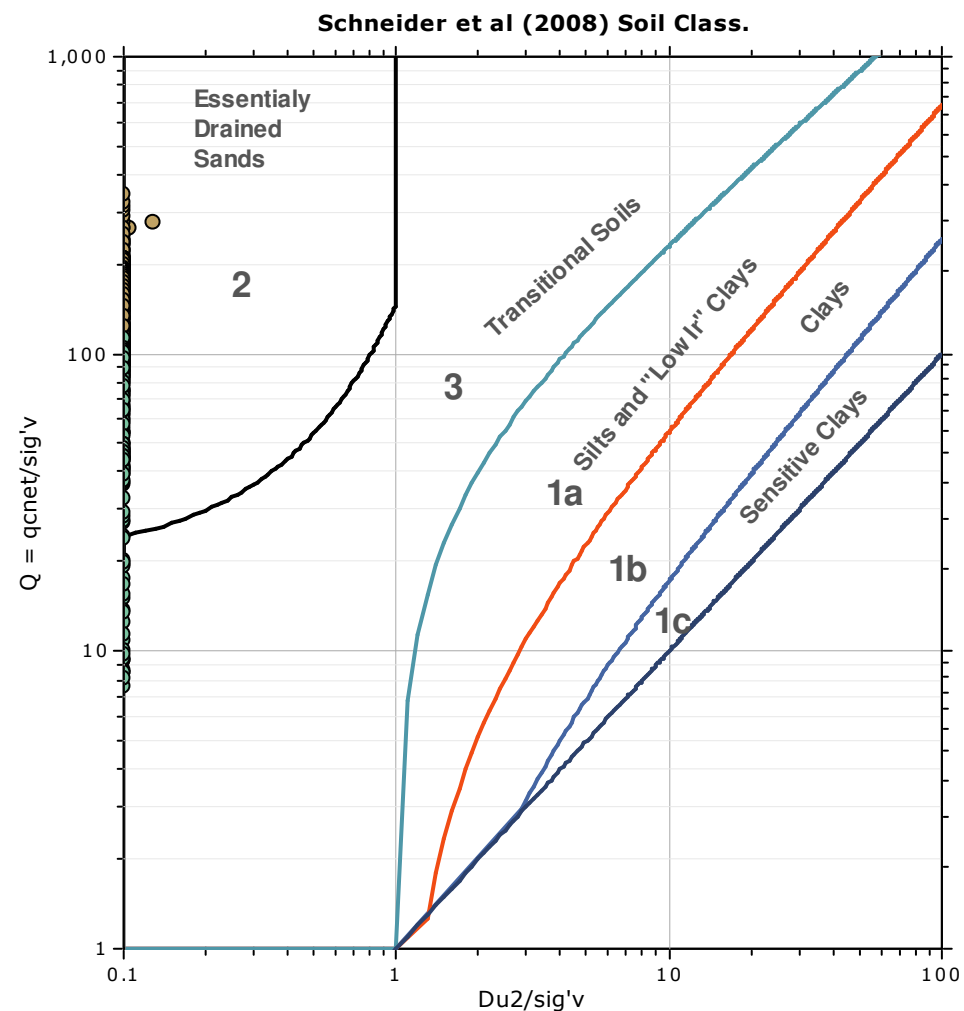
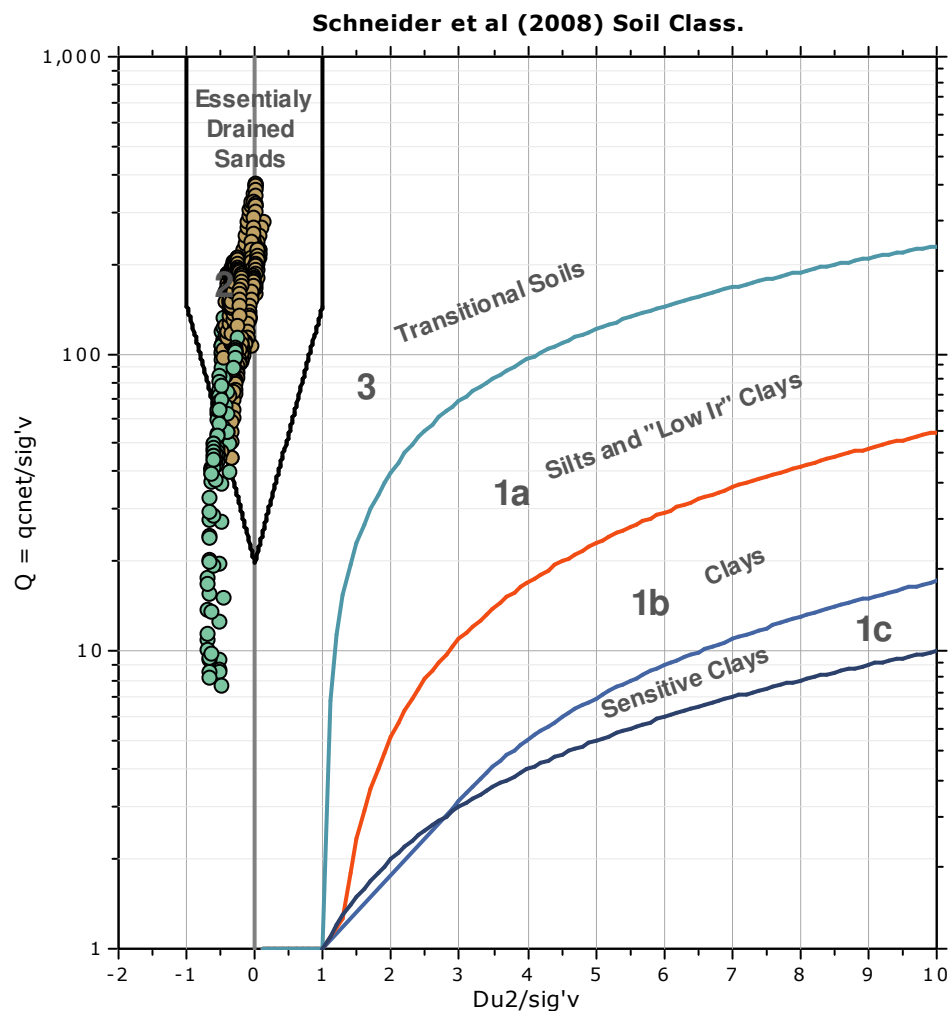
**SBT - Bq plots (normalized)**

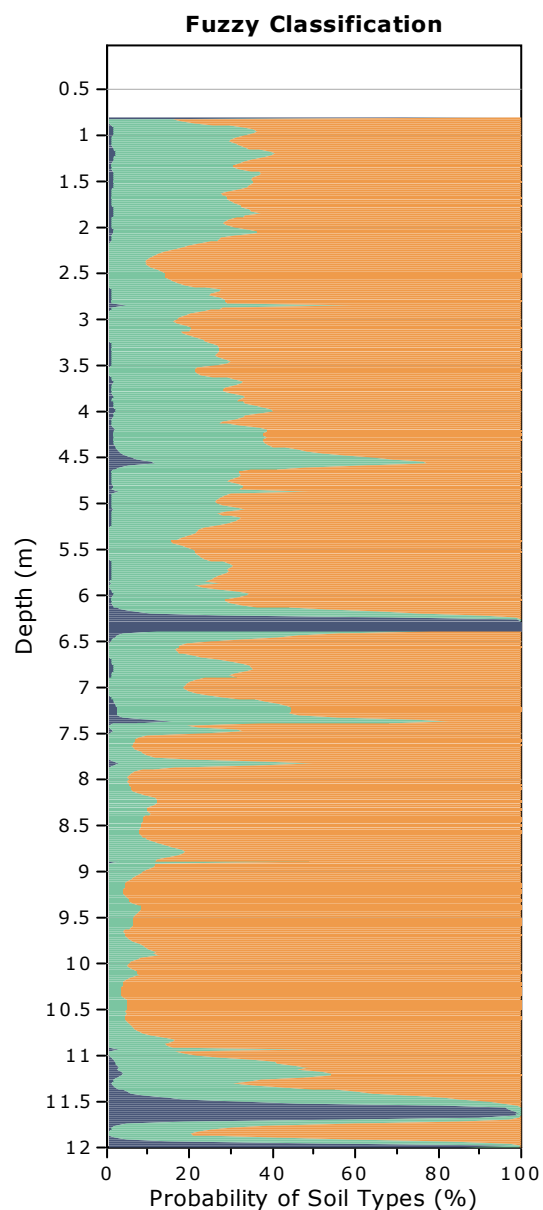
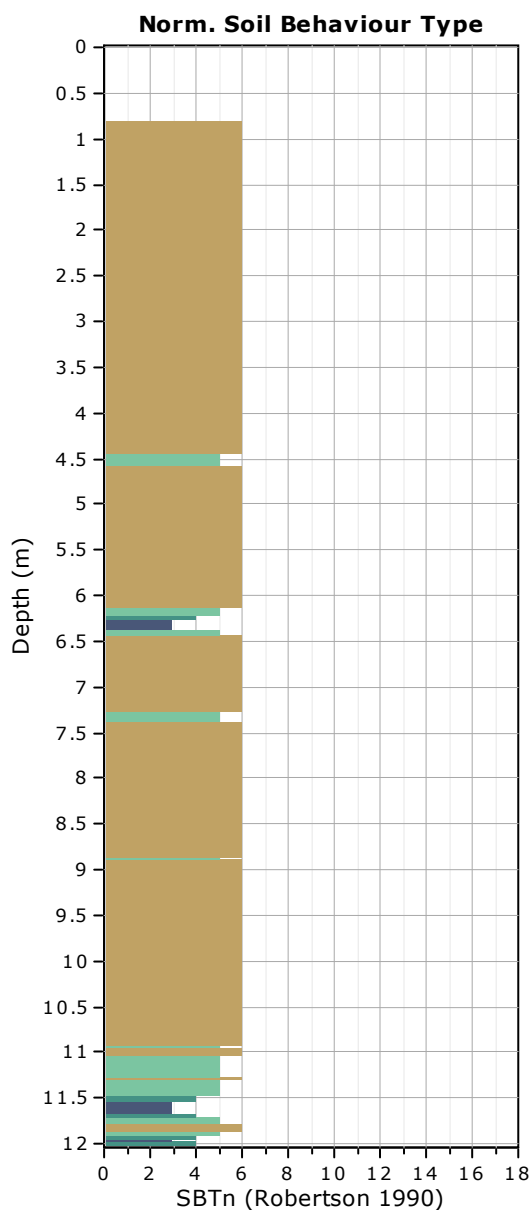


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





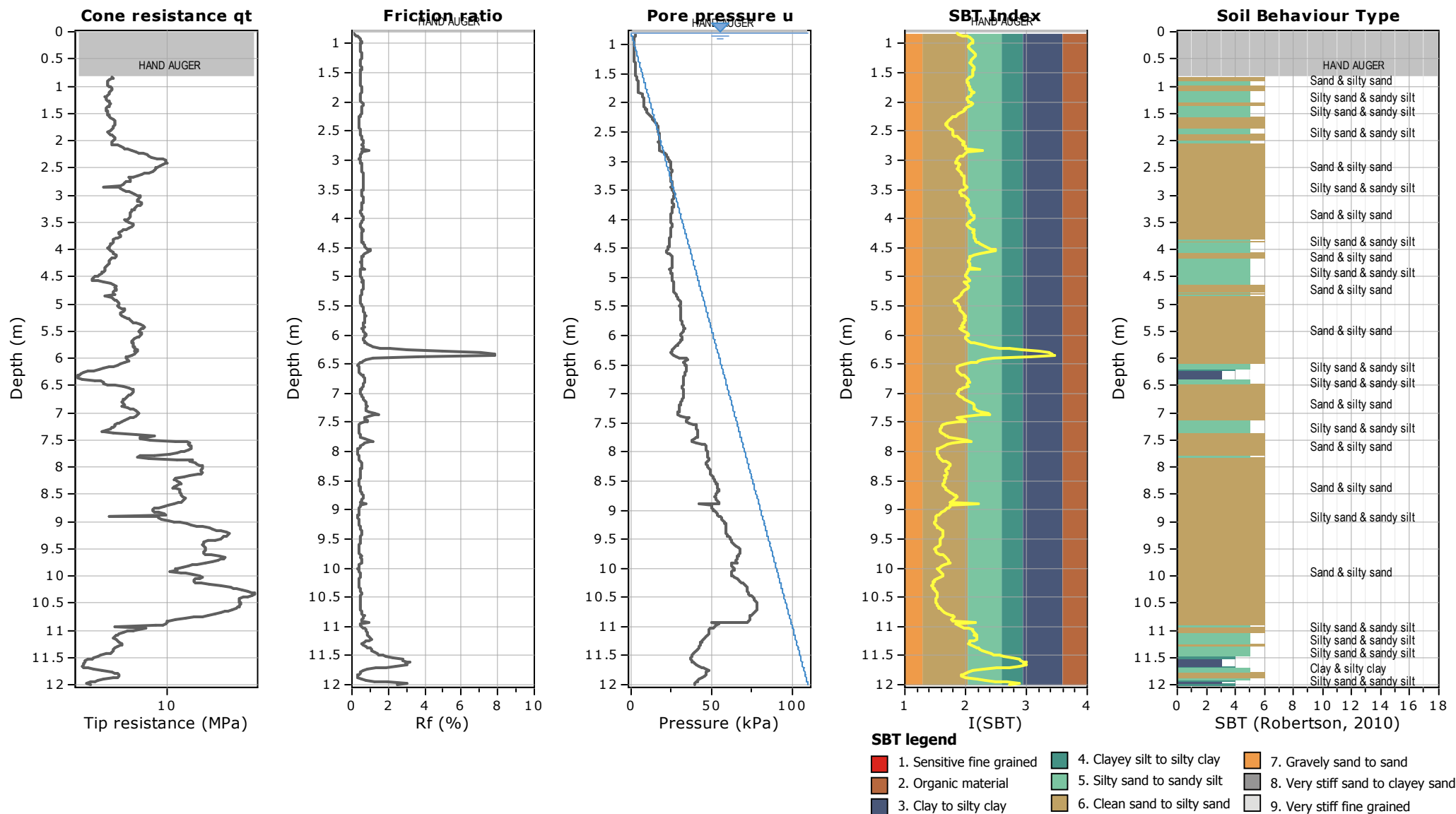
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°



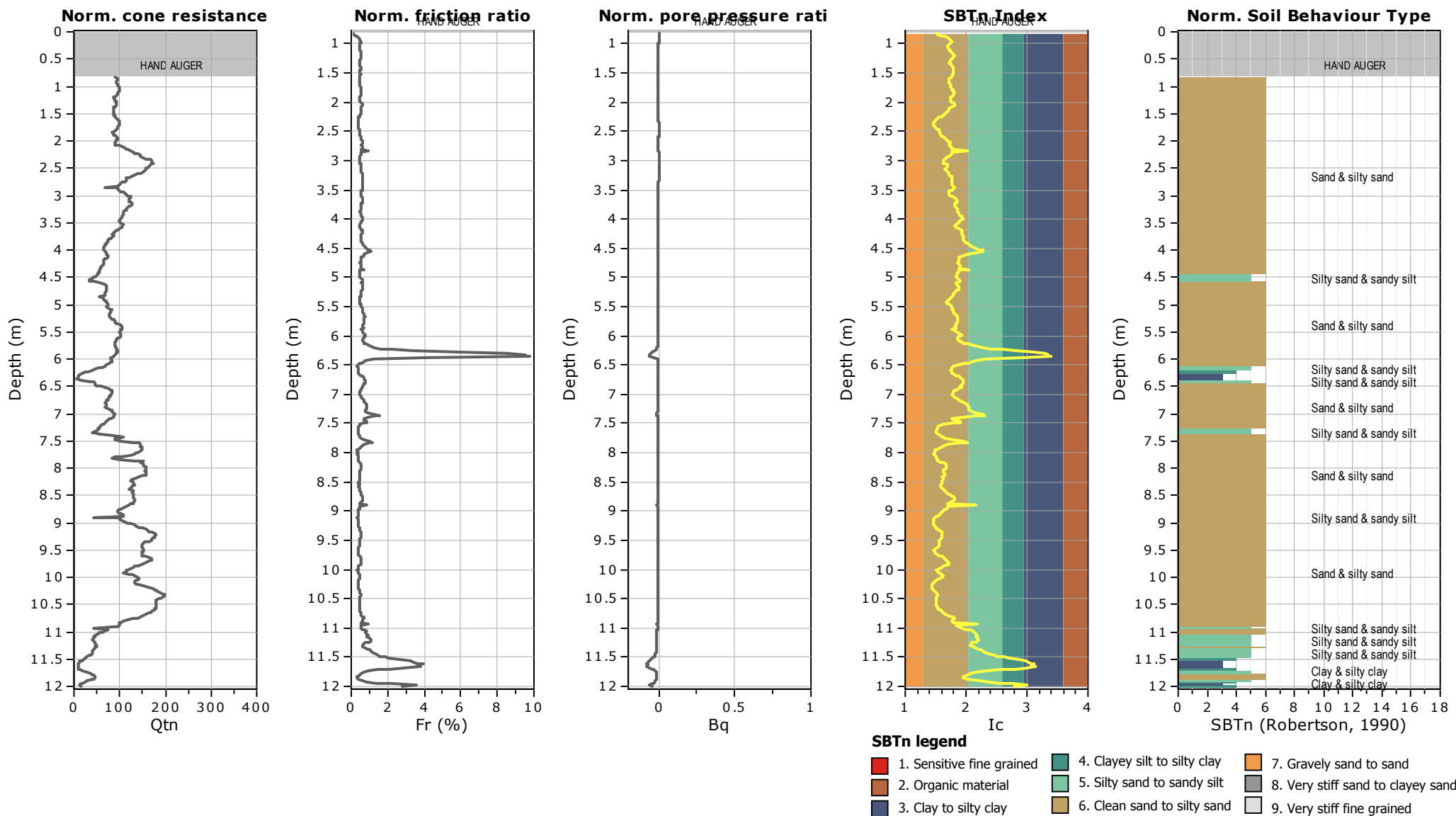
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°





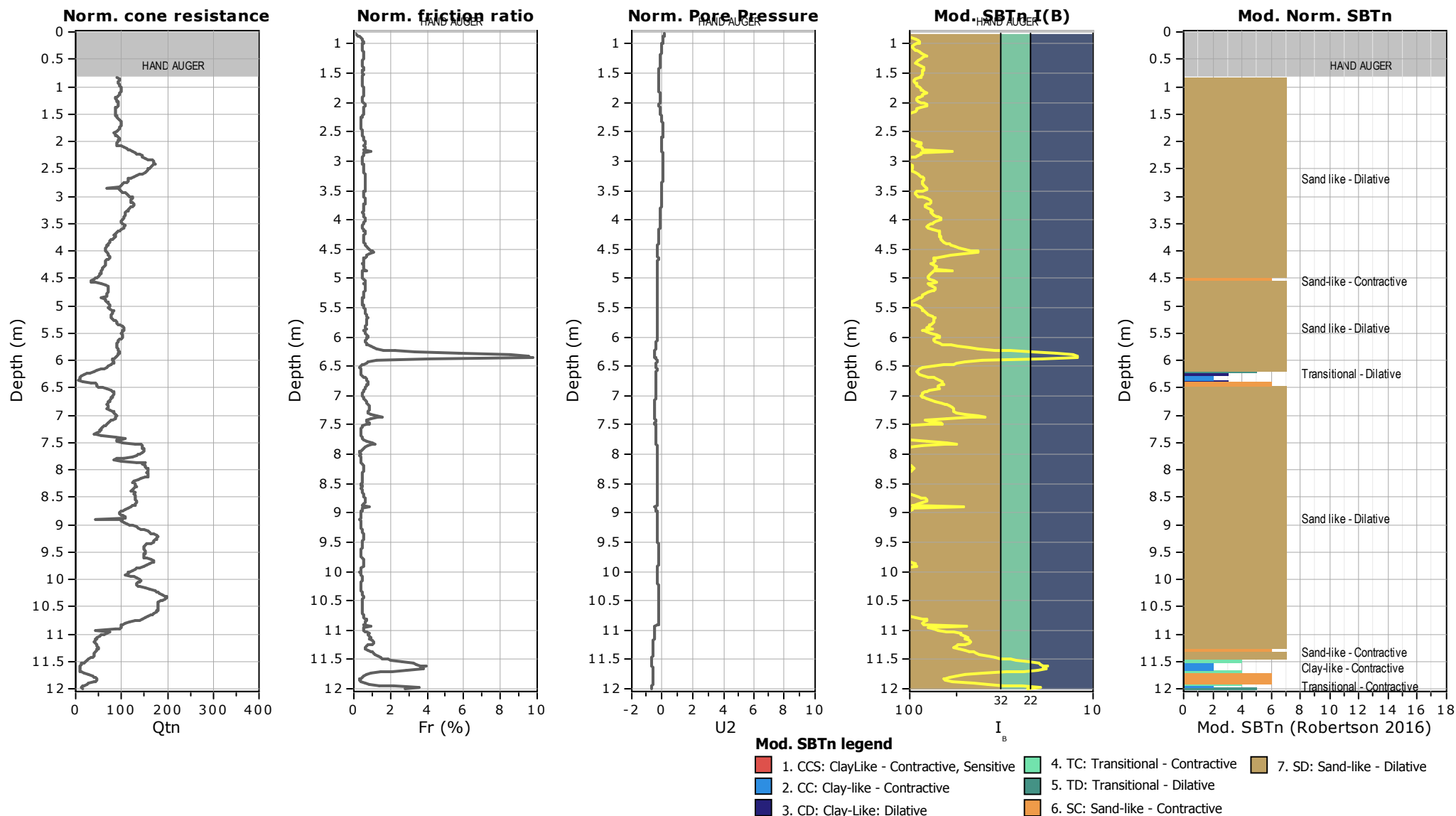
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

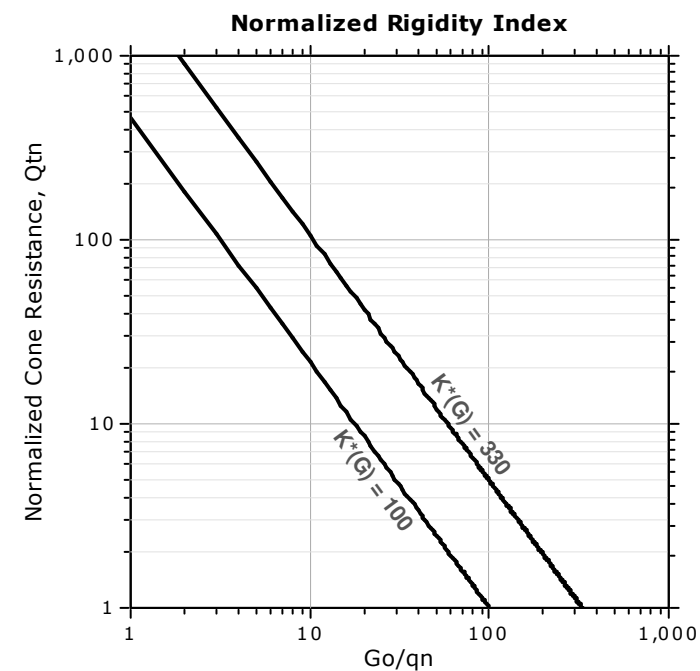
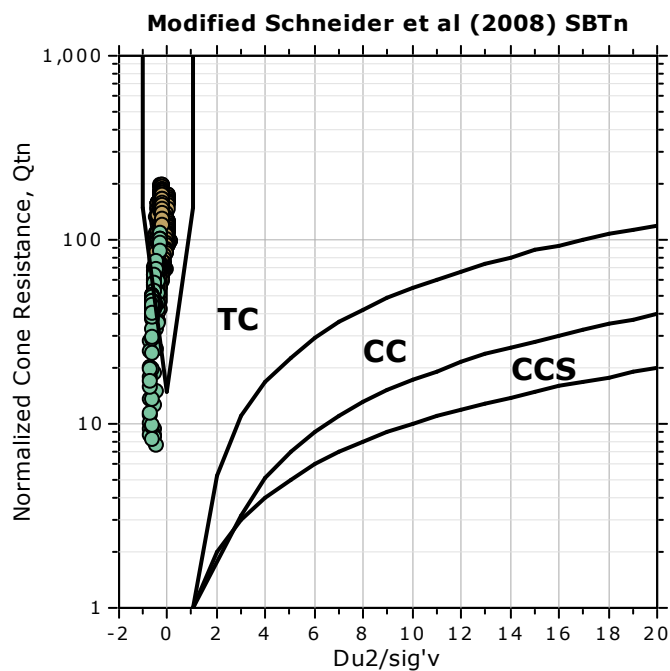
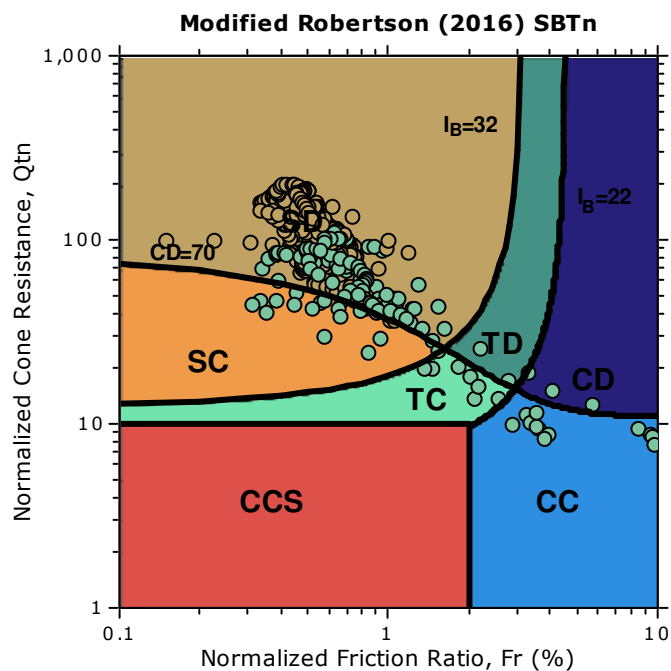
**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

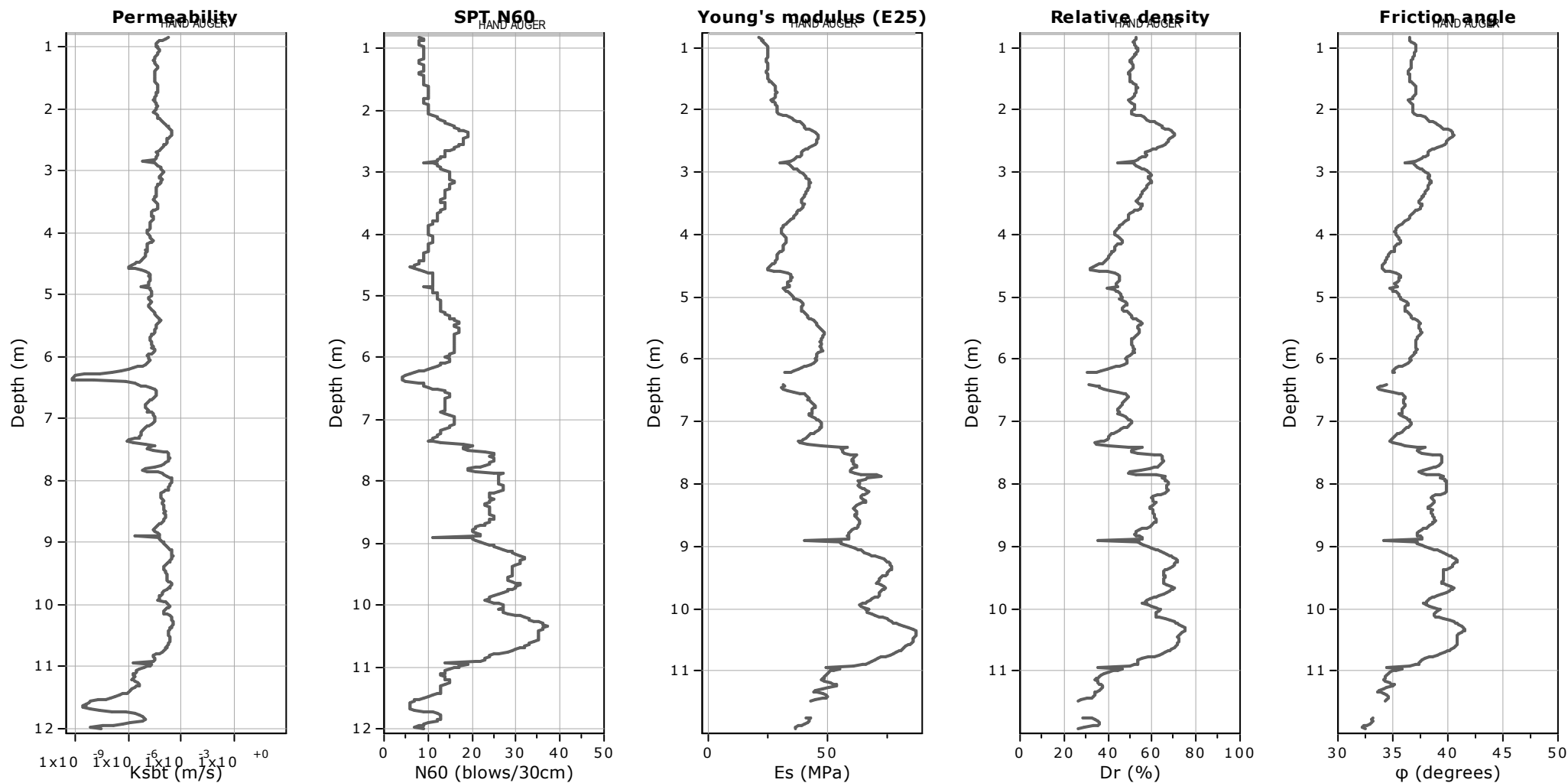
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

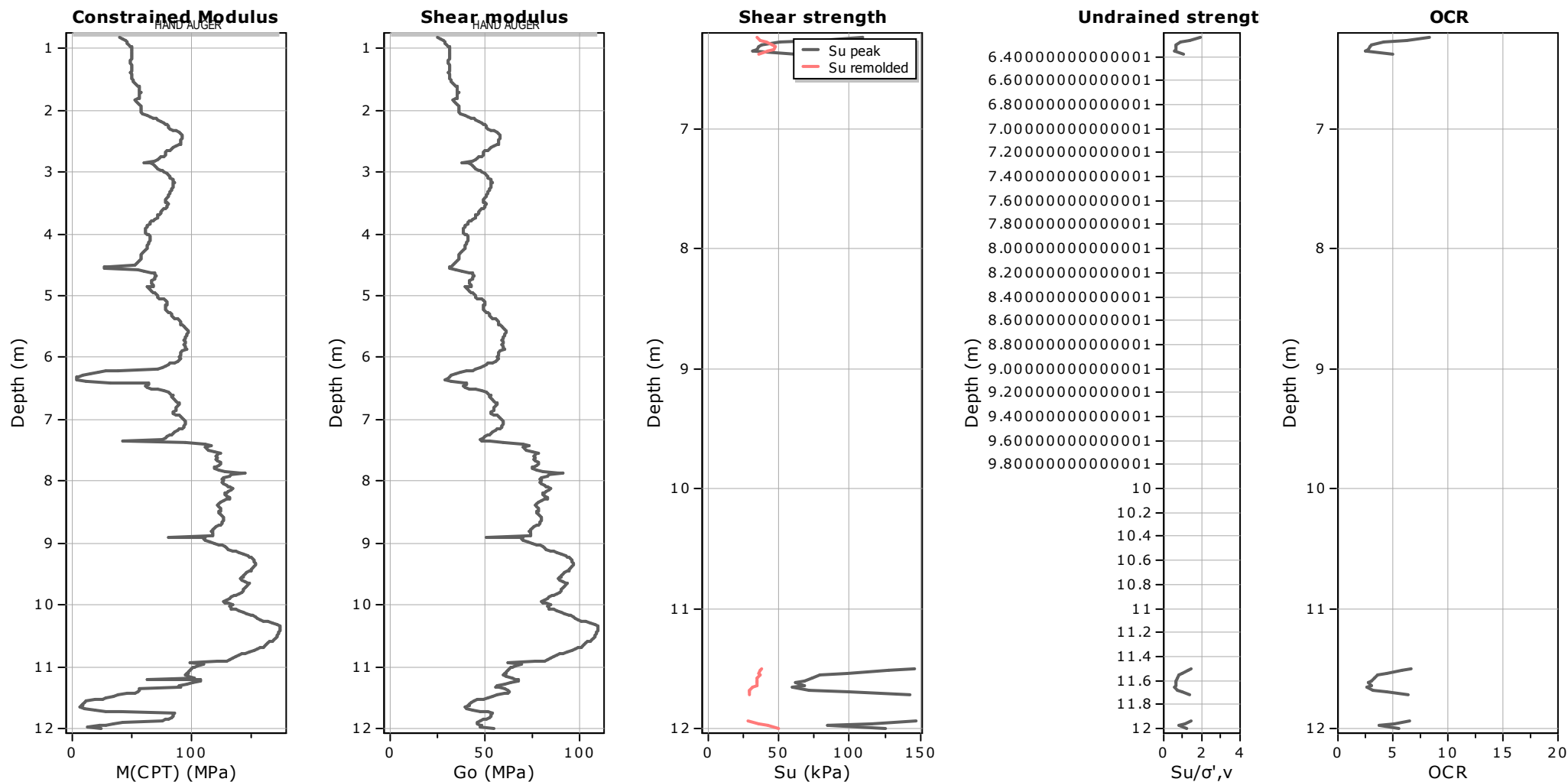
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

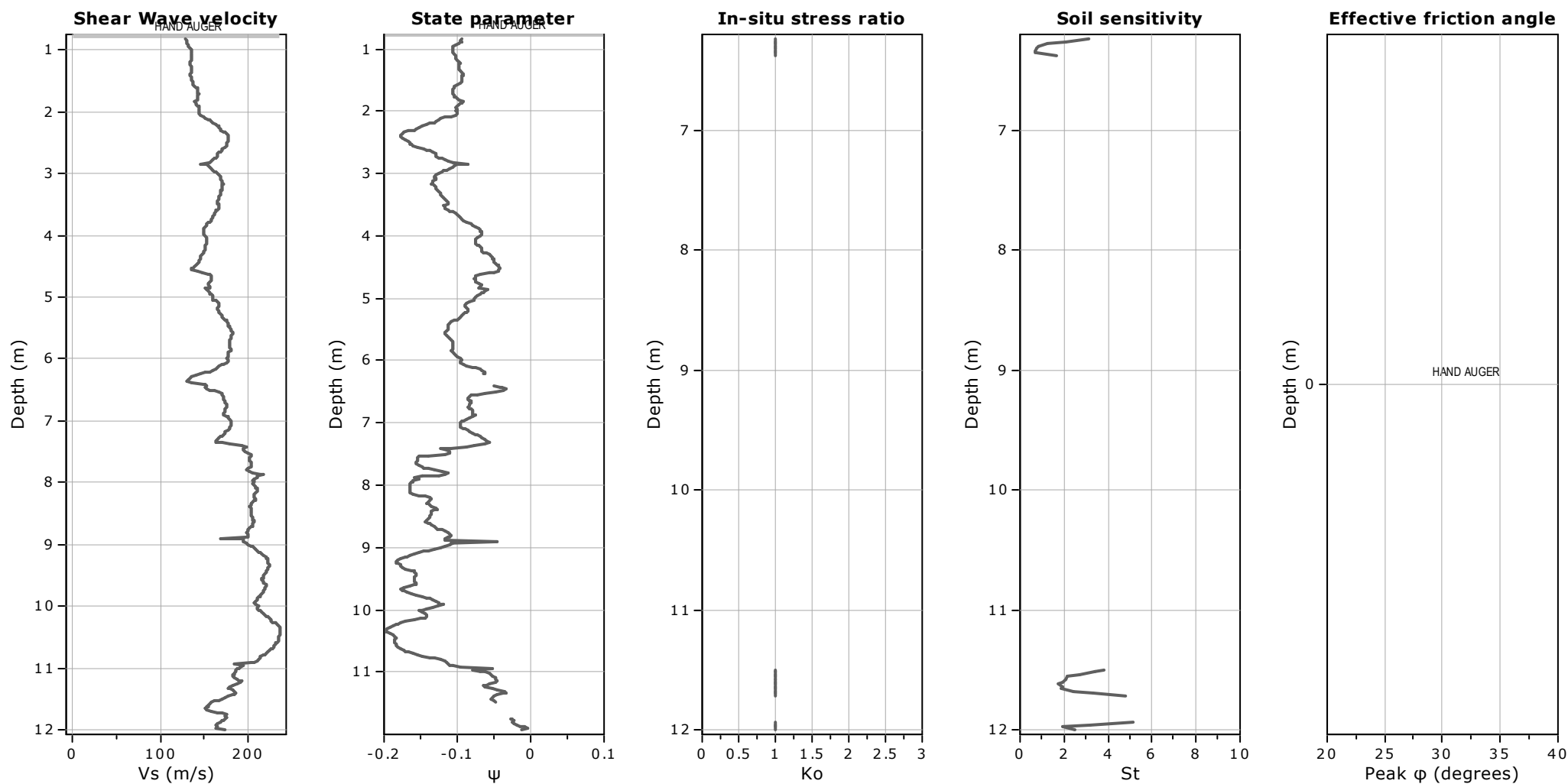
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 8 (Km 29.2)**

Total depth: 12.00 m

Coords: lat 44.708864° lon 12.221569°



**Calculation parameters**

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data



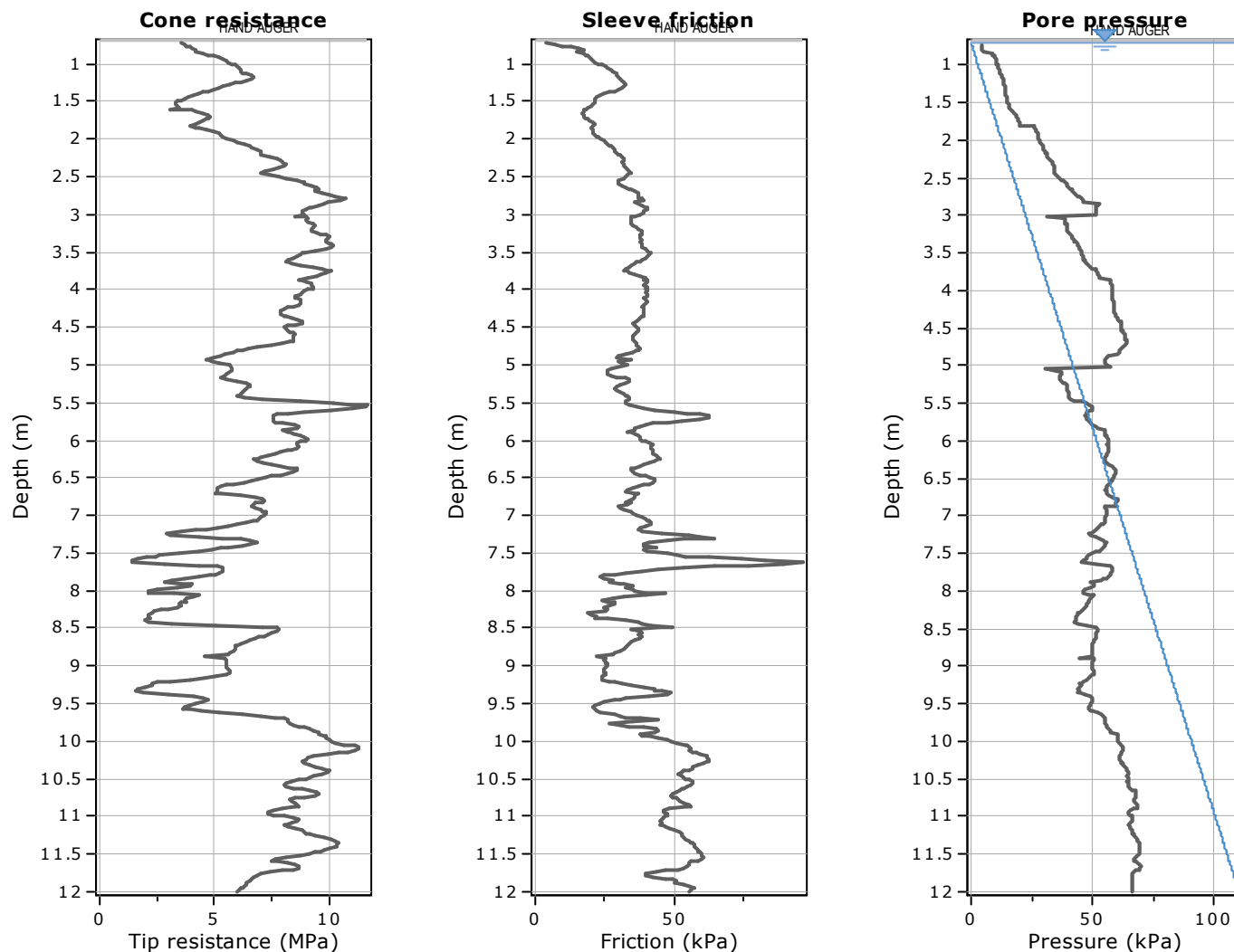
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

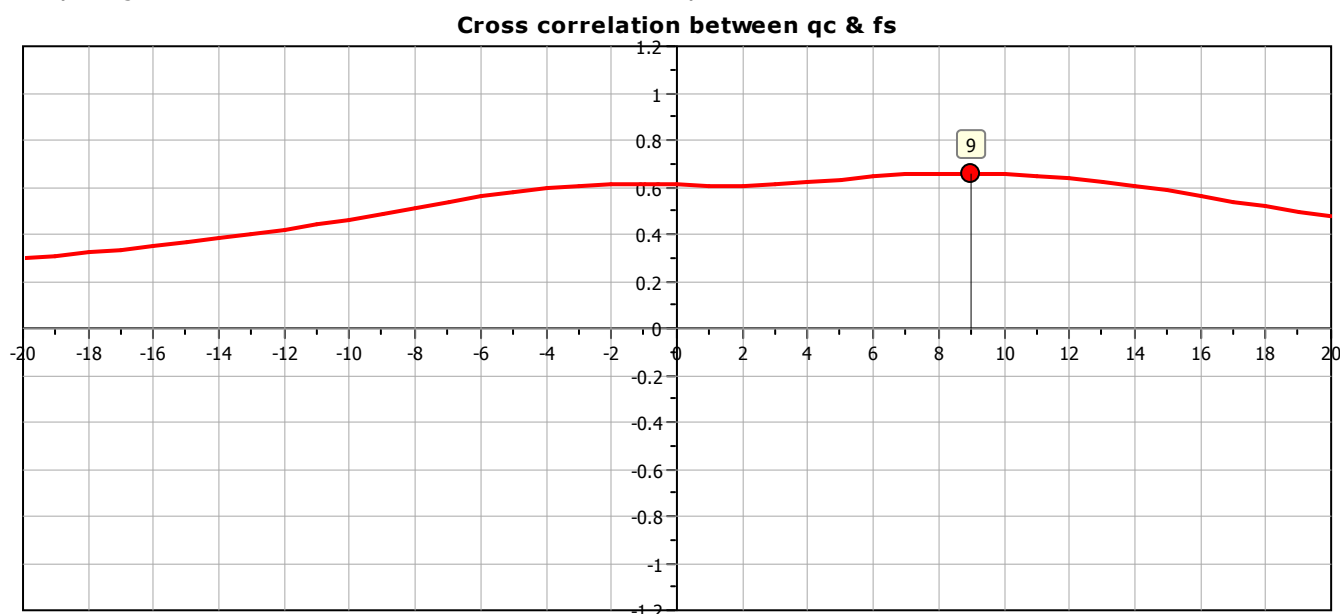
**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

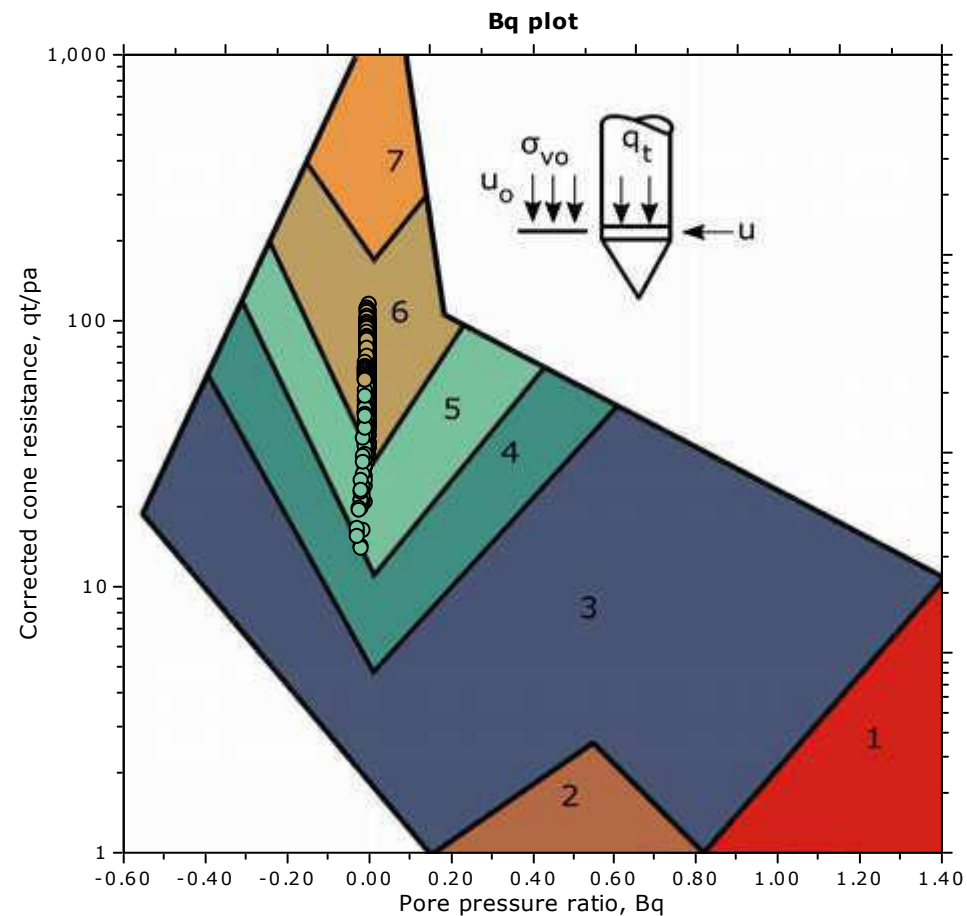
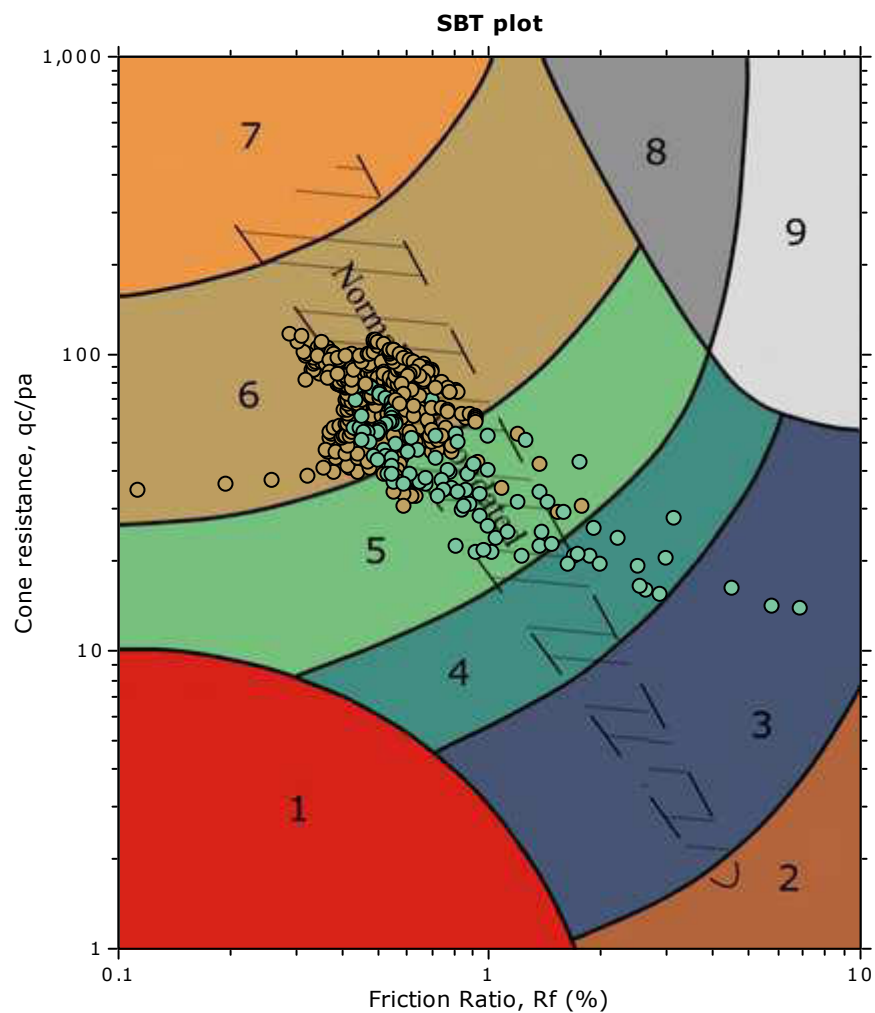
Coords: lat 44.724103° lon 12.212225°



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



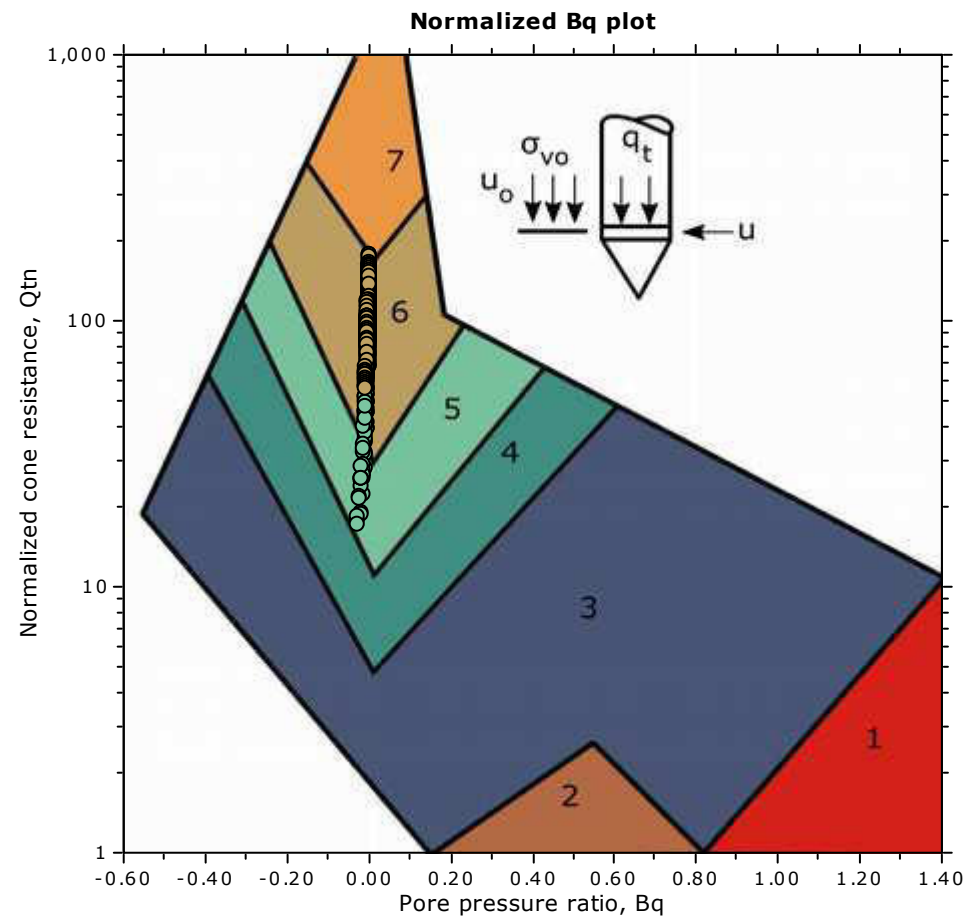
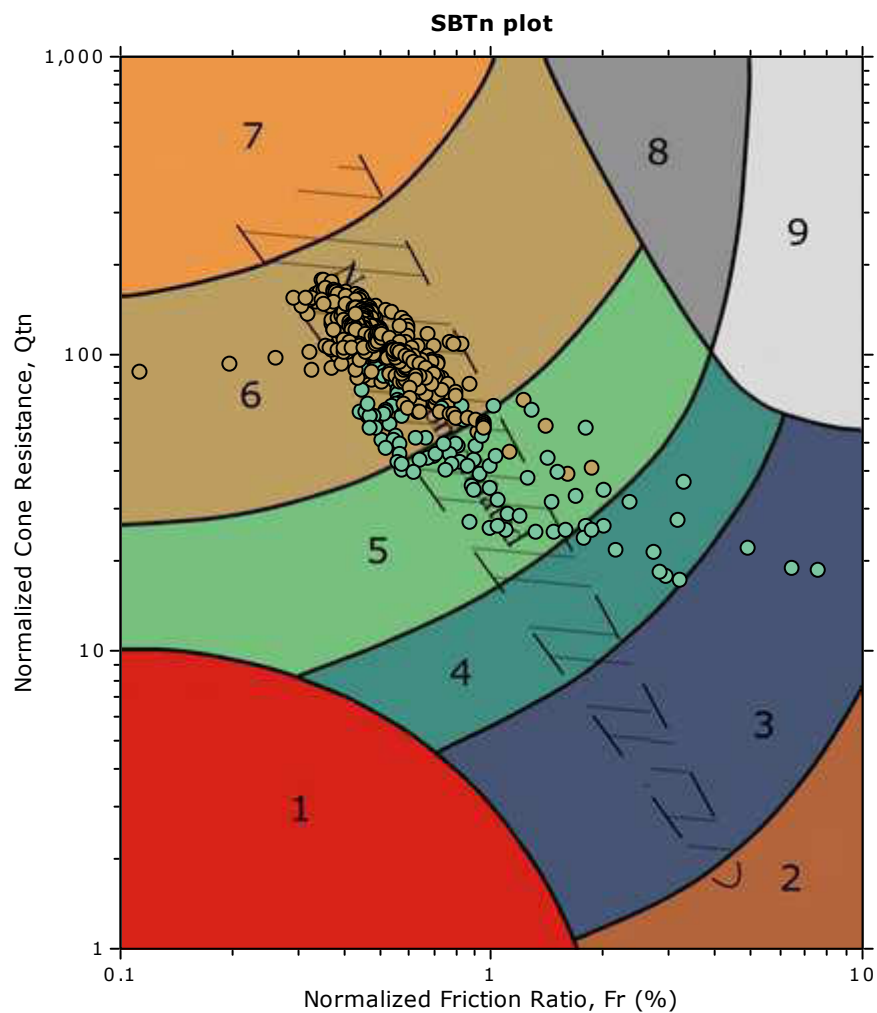
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

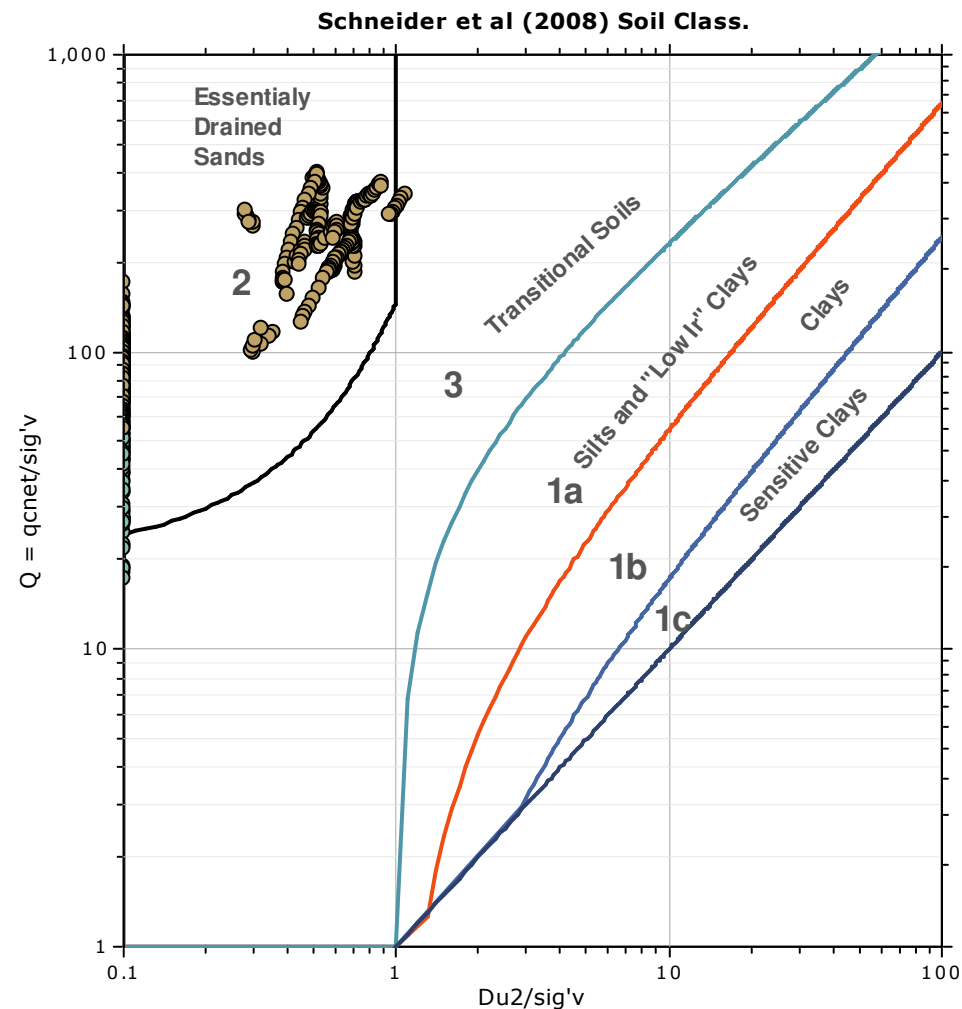
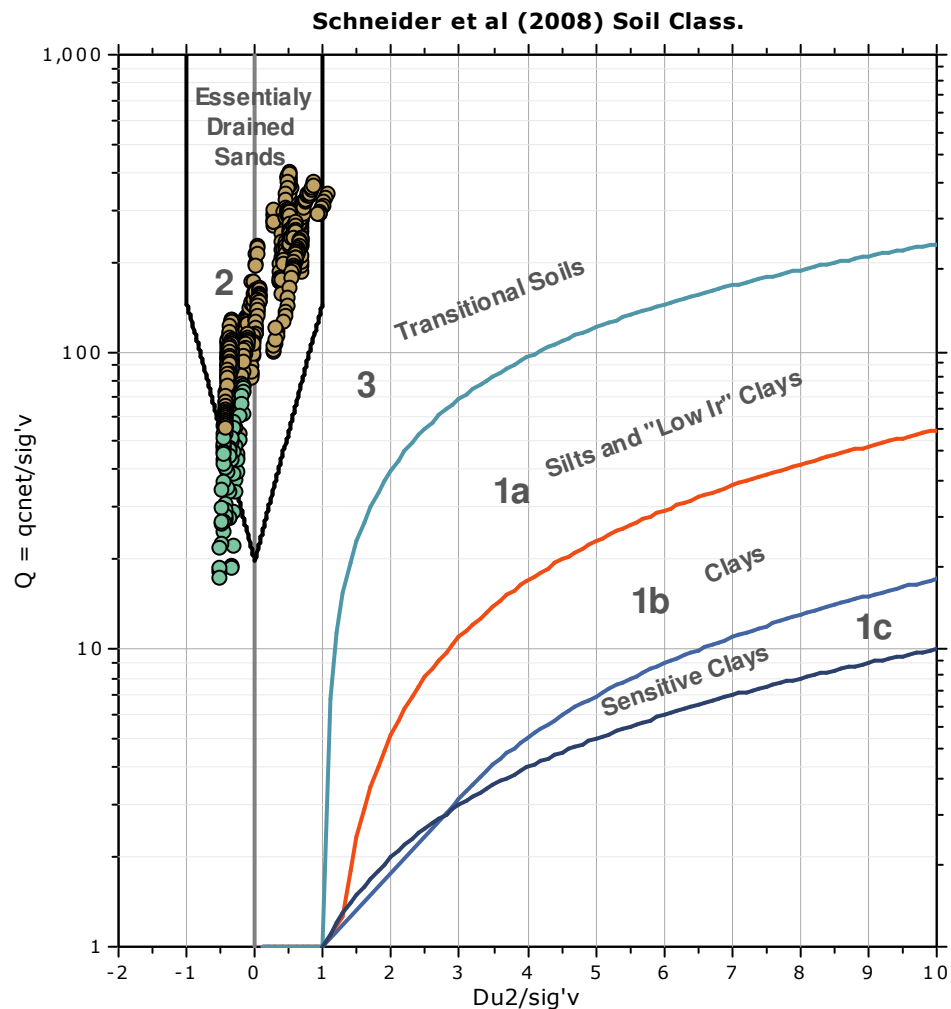
**SBT - Bq plots (normalized)**

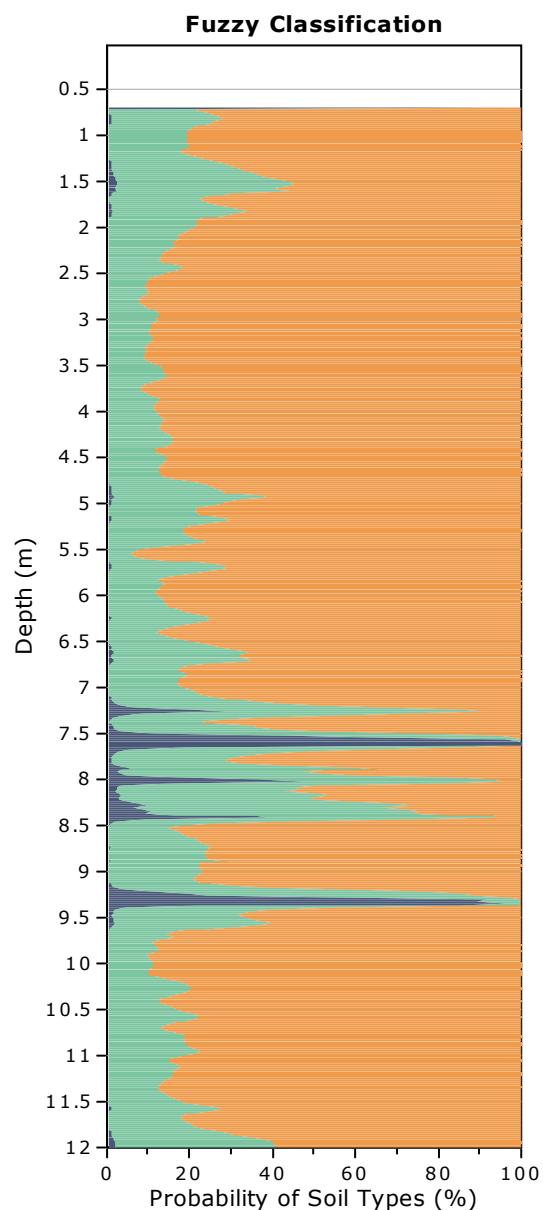
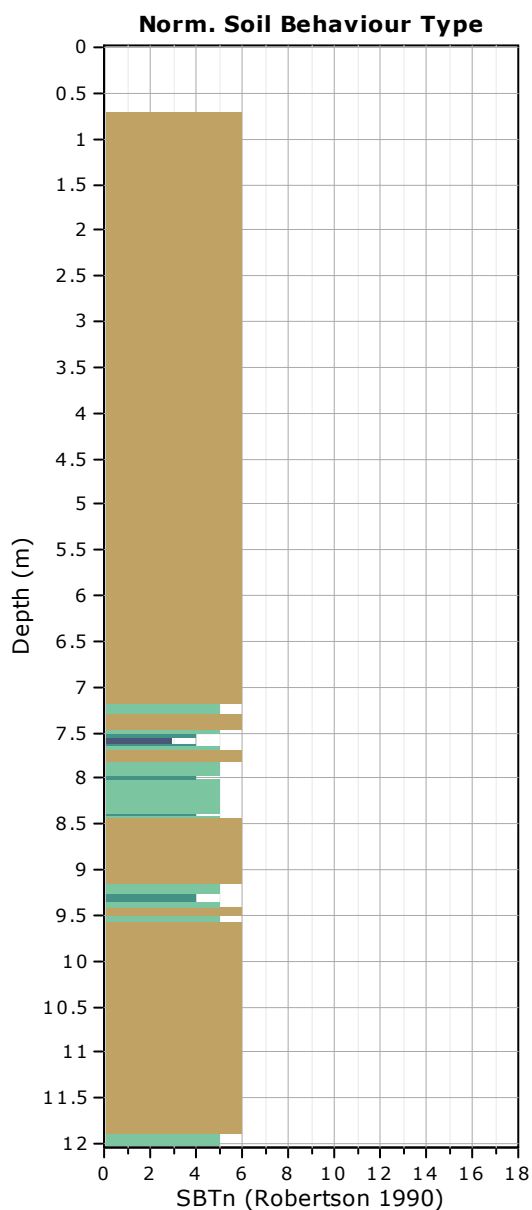


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







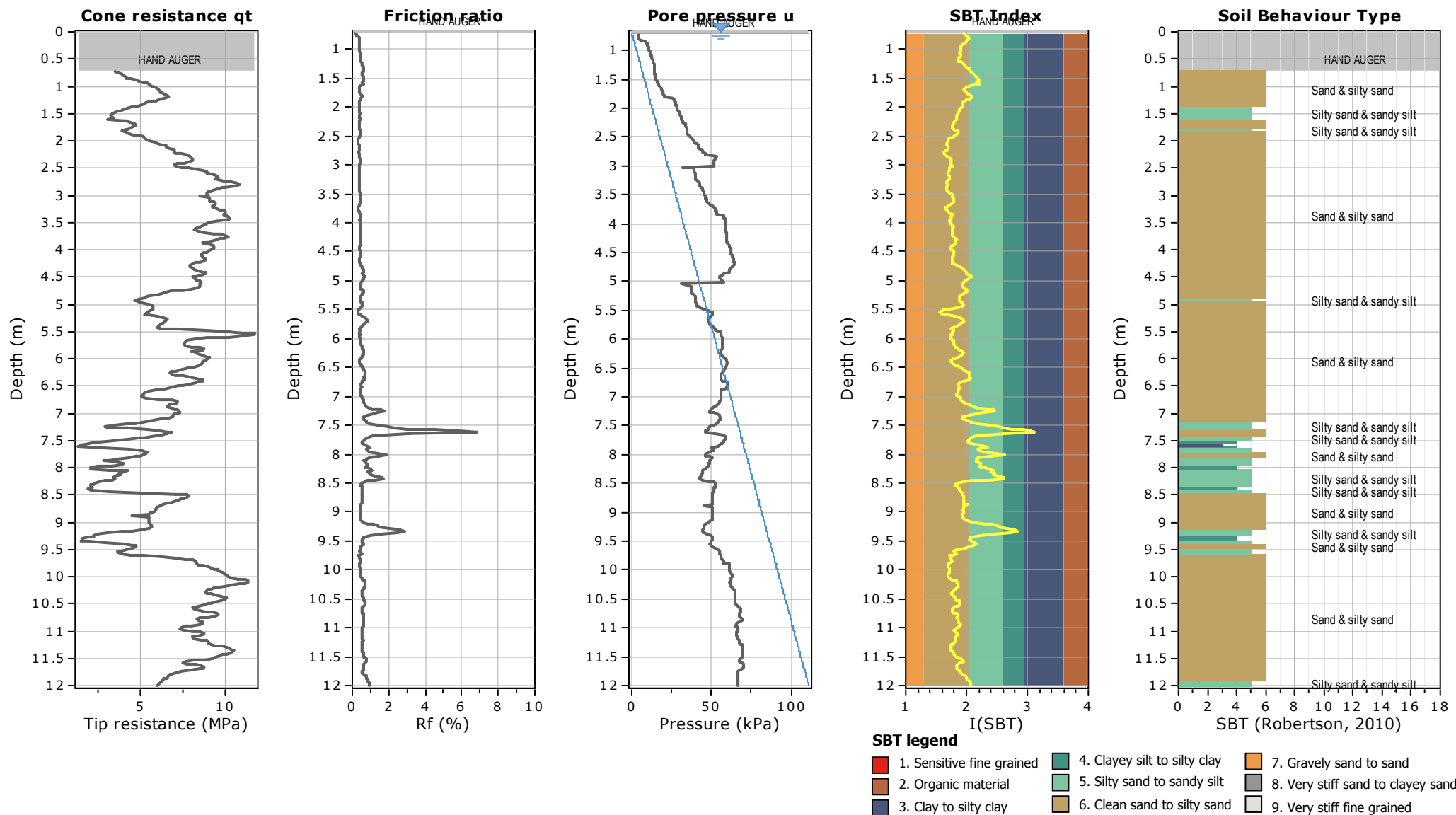
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



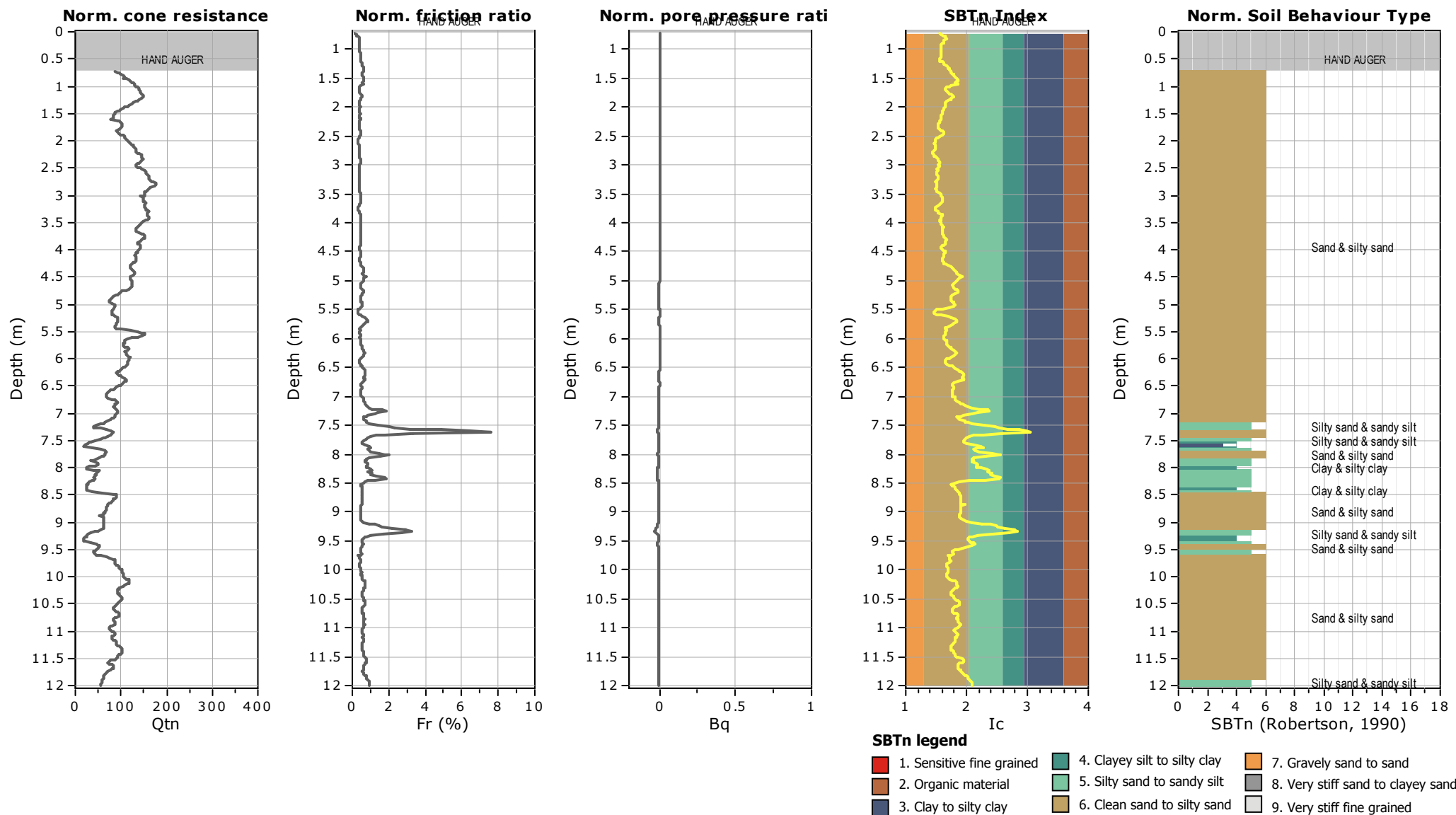
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



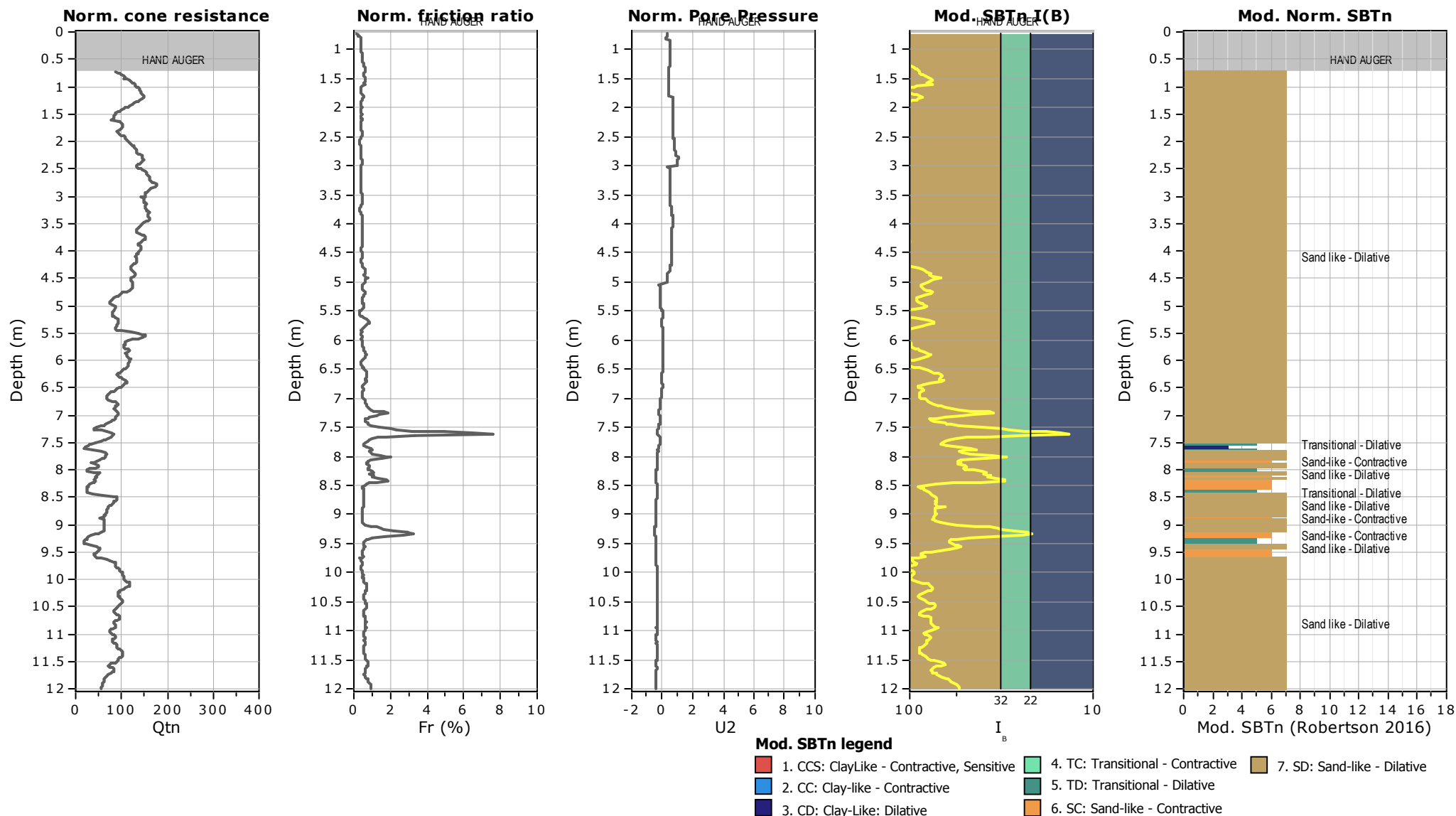
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

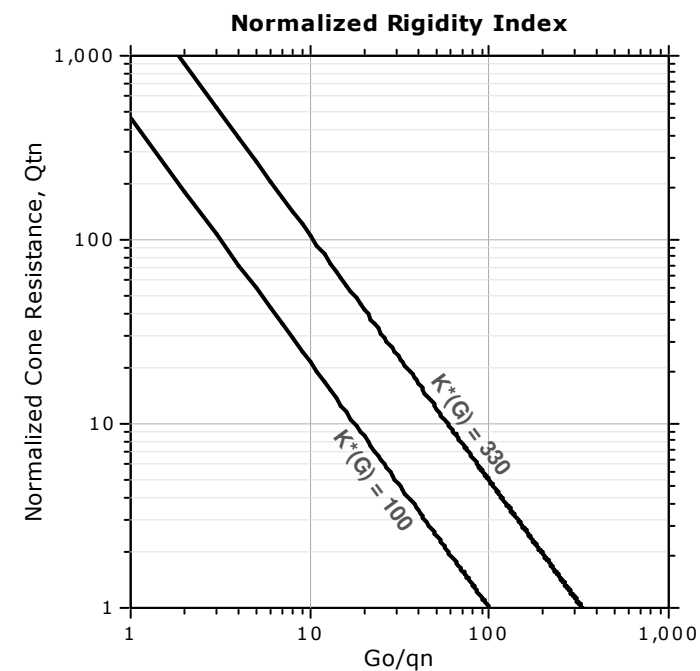
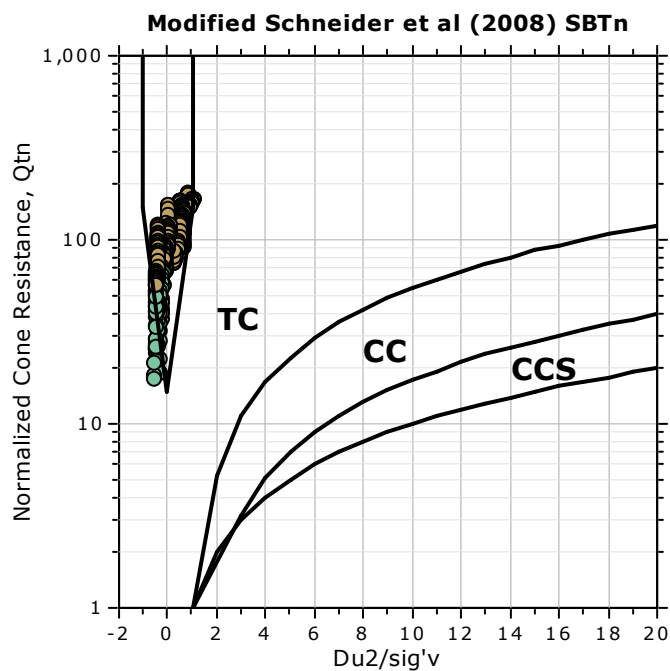
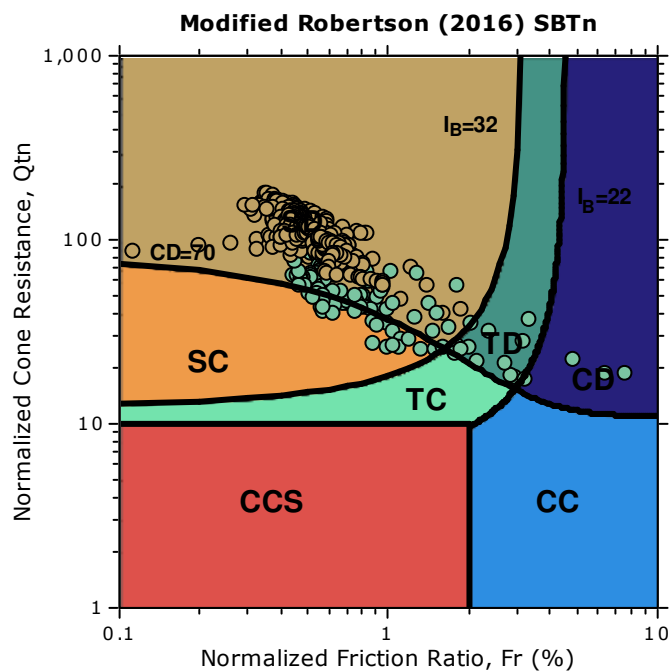
**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

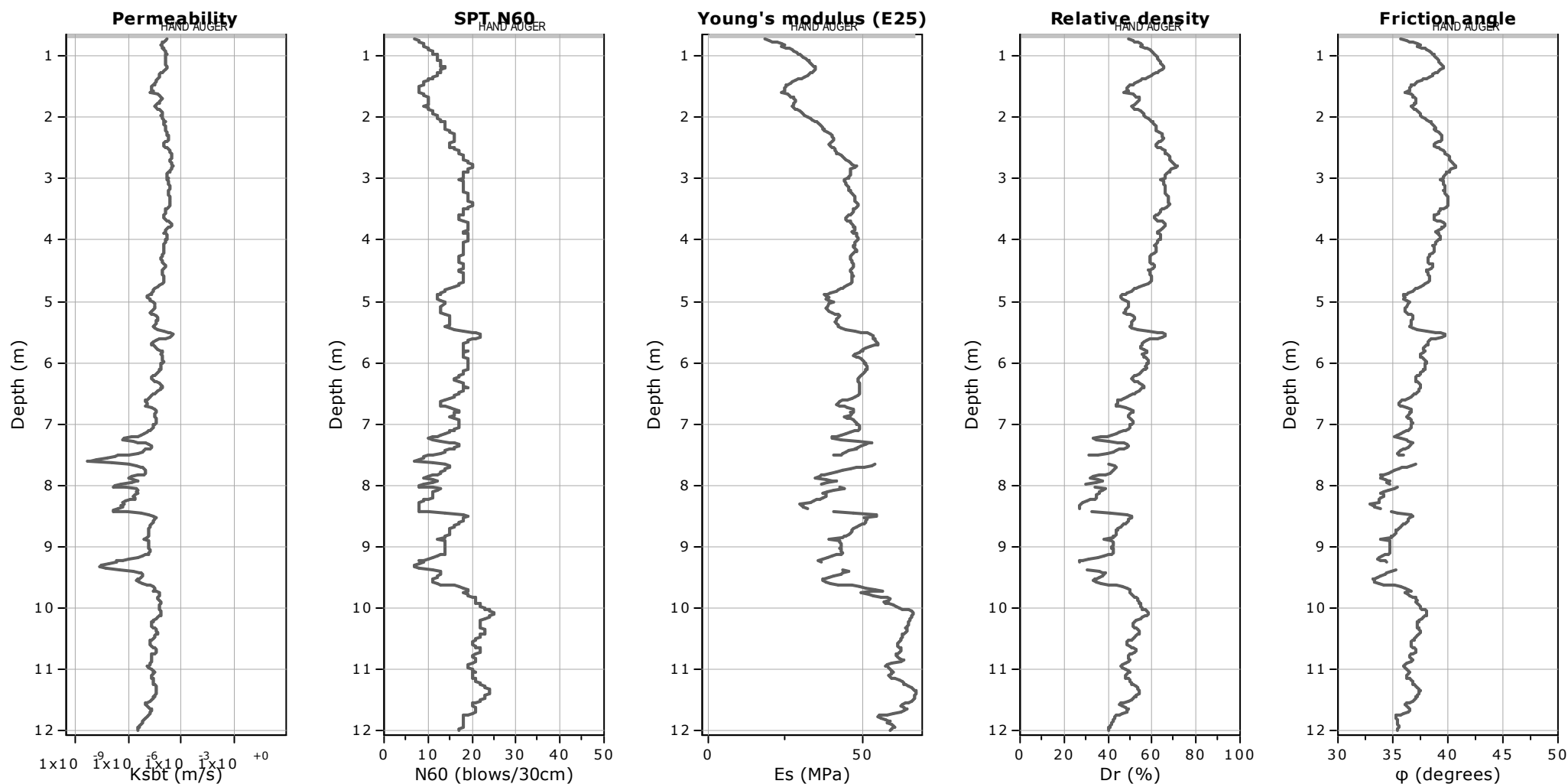
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



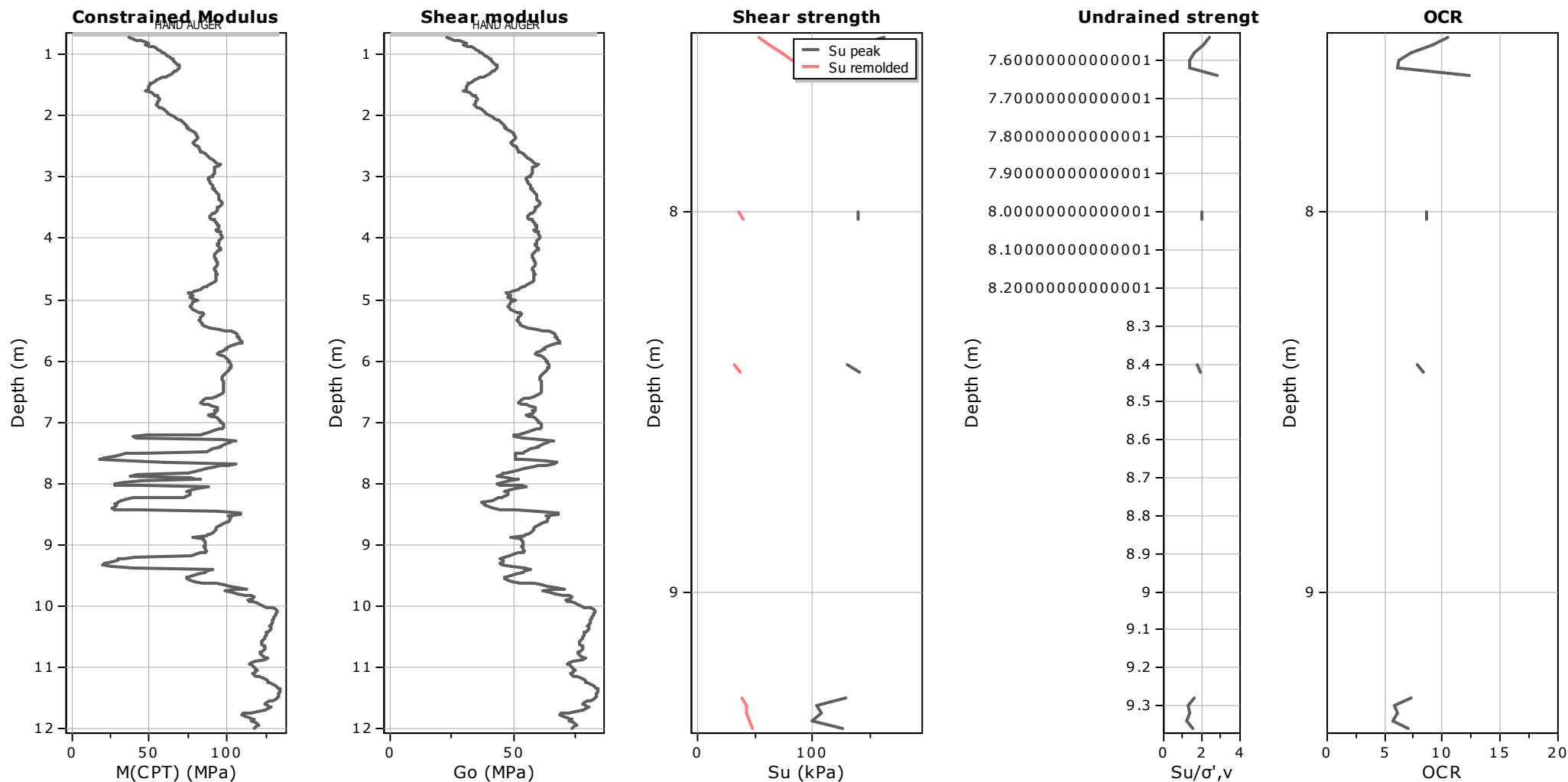
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**Location:** S.S. 309 - ROMEA

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

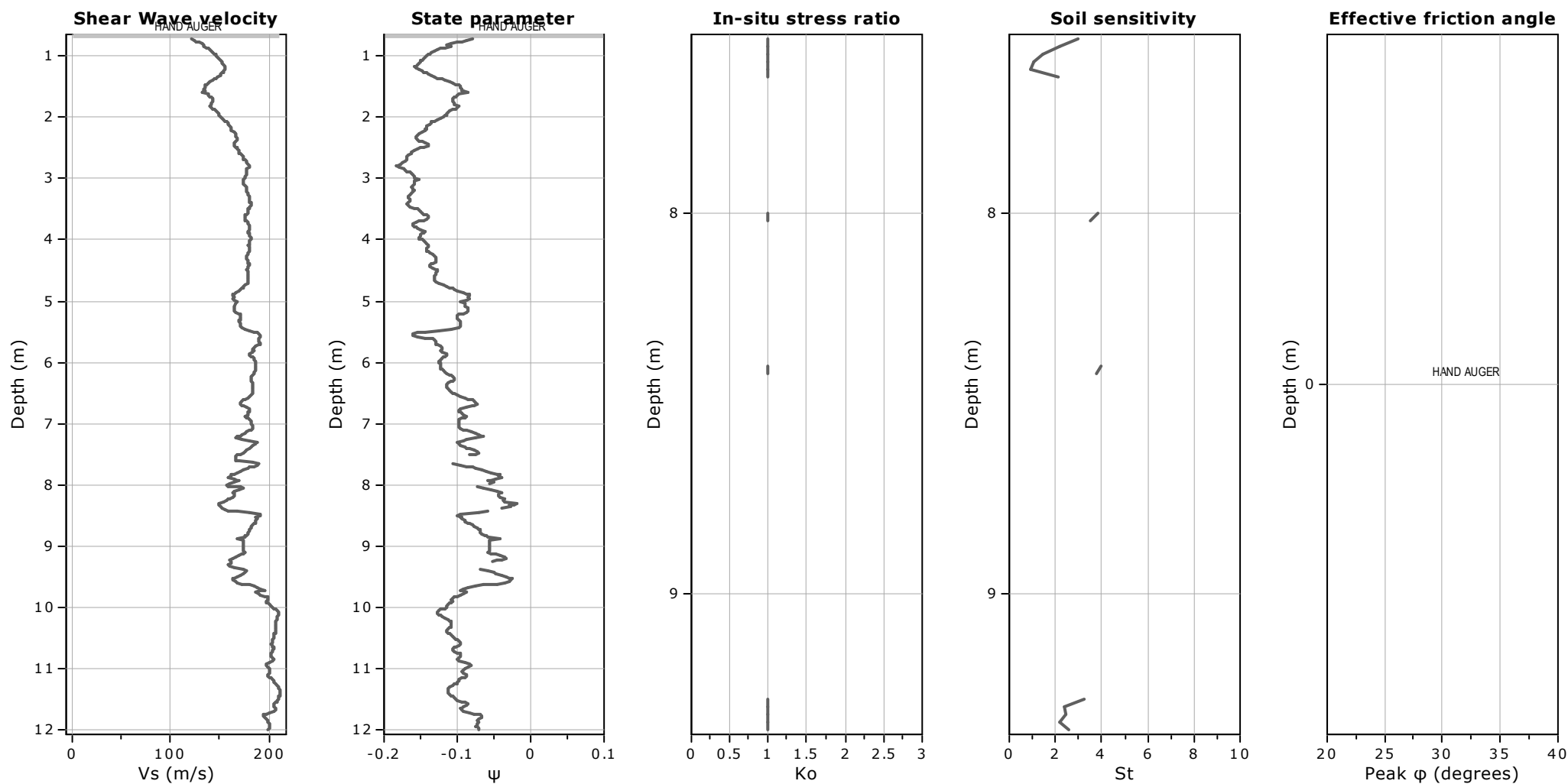
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

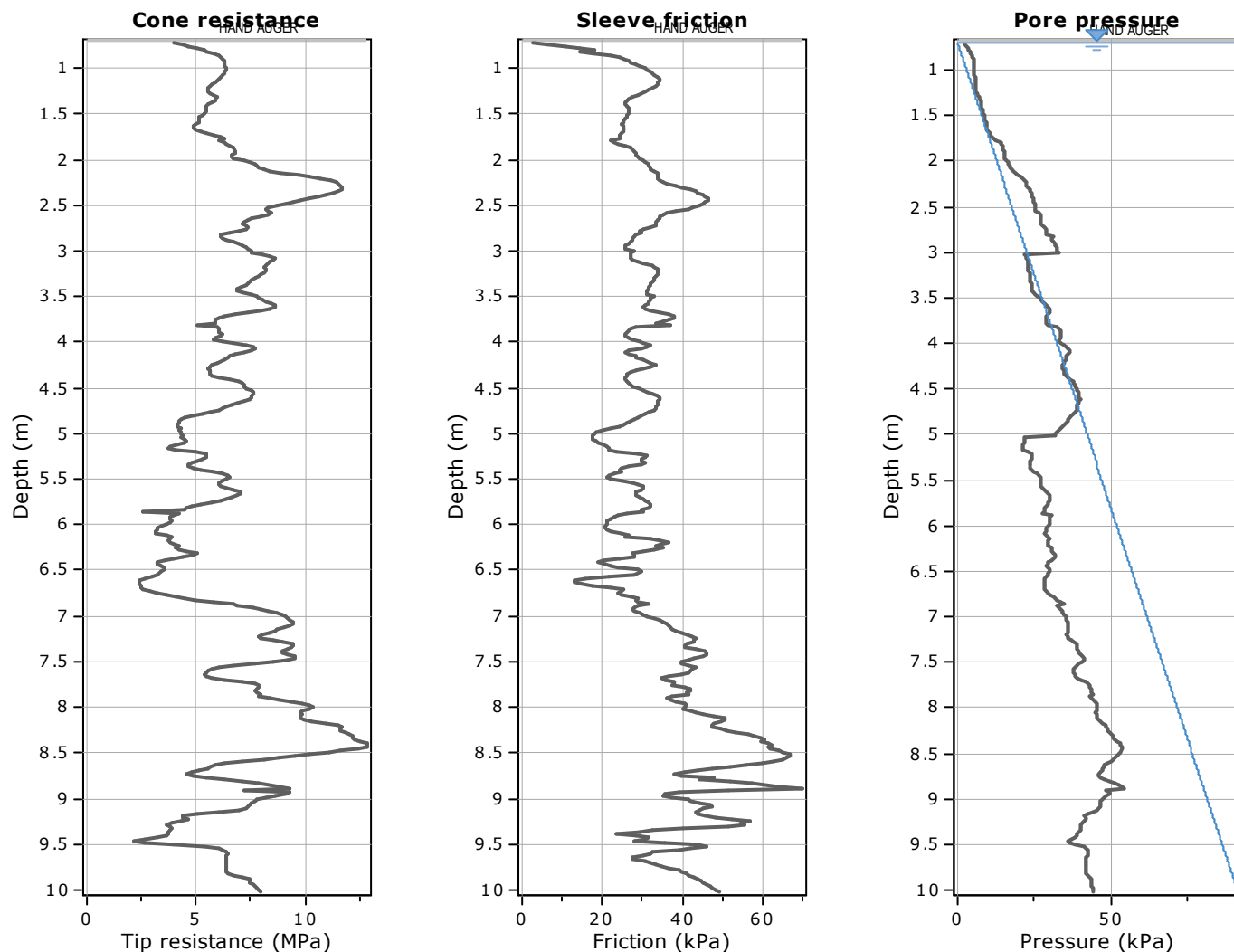
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

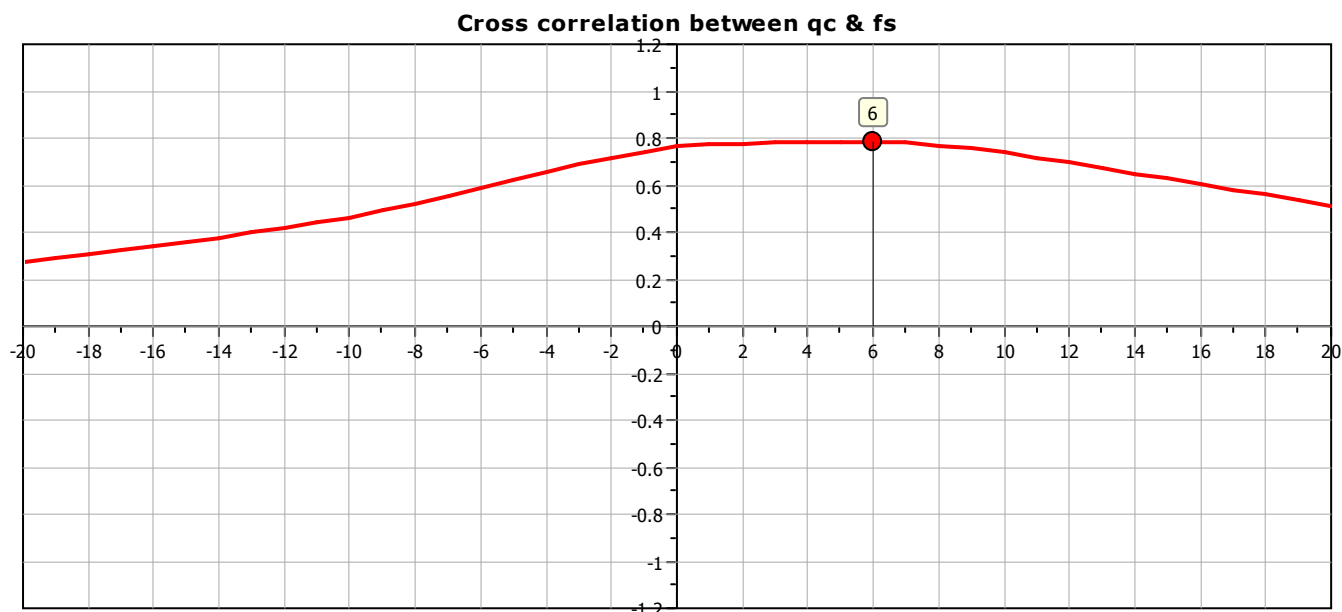
**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

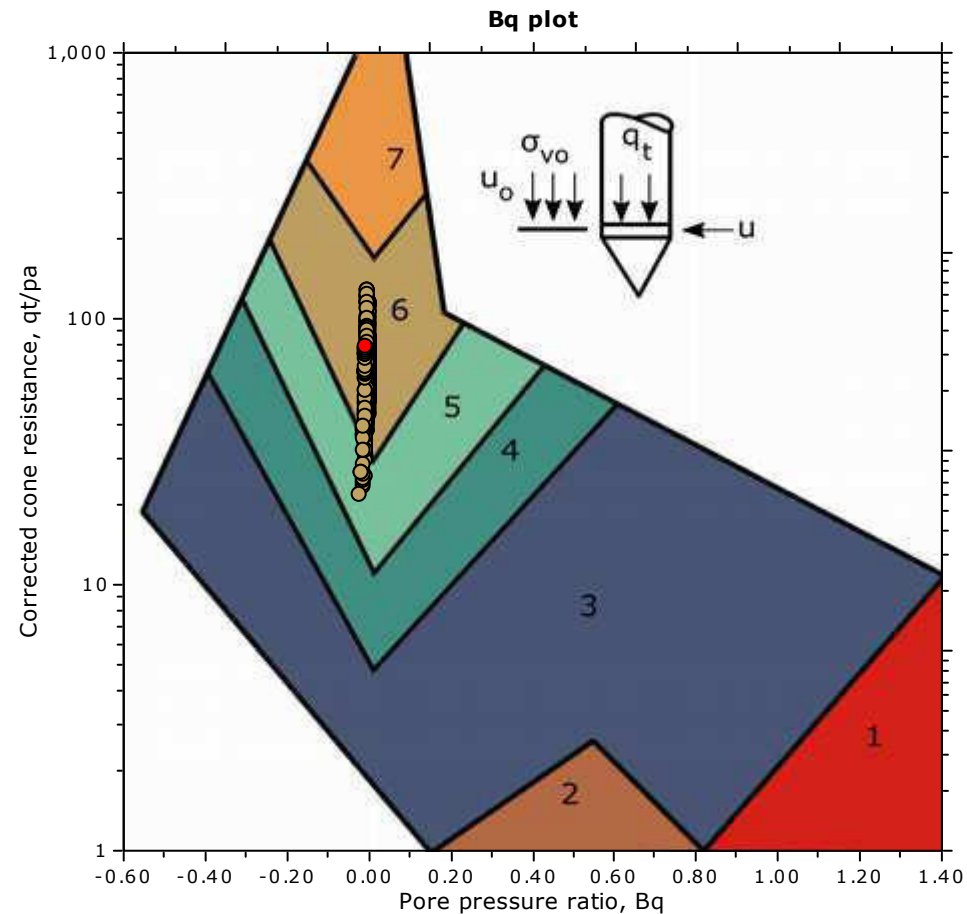
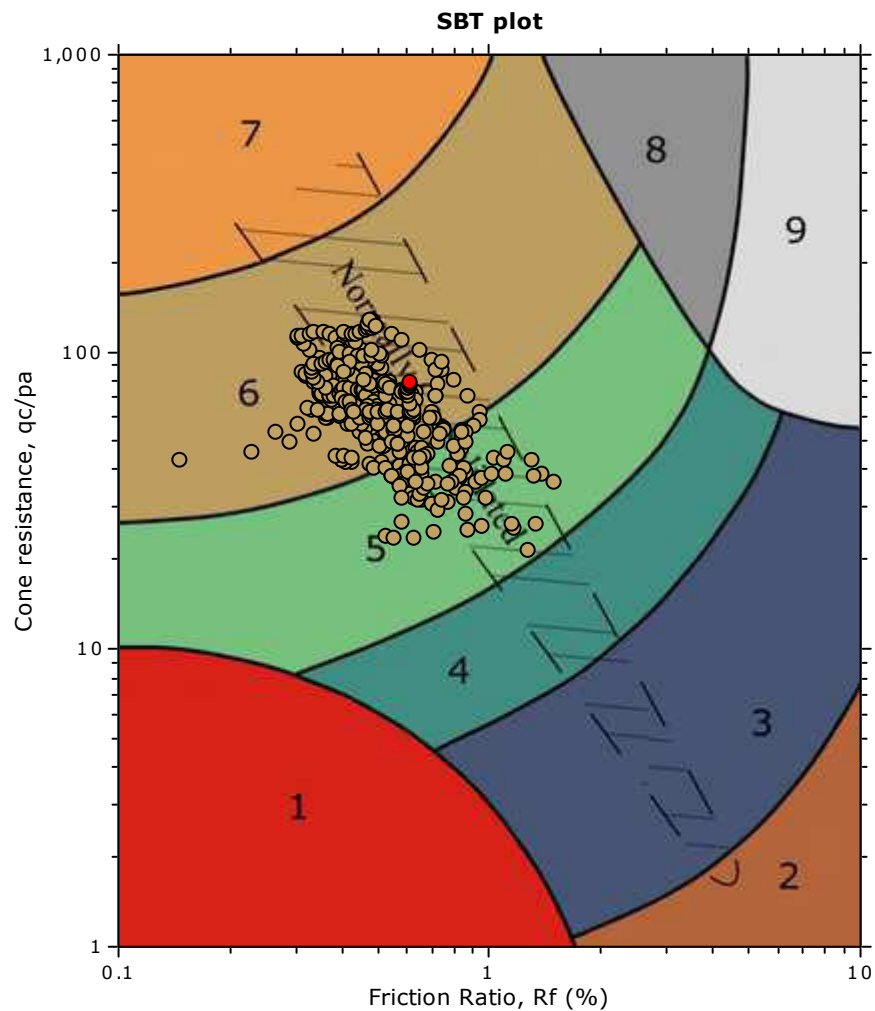
Coords: lat 44.724294° lon 12.212892°



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



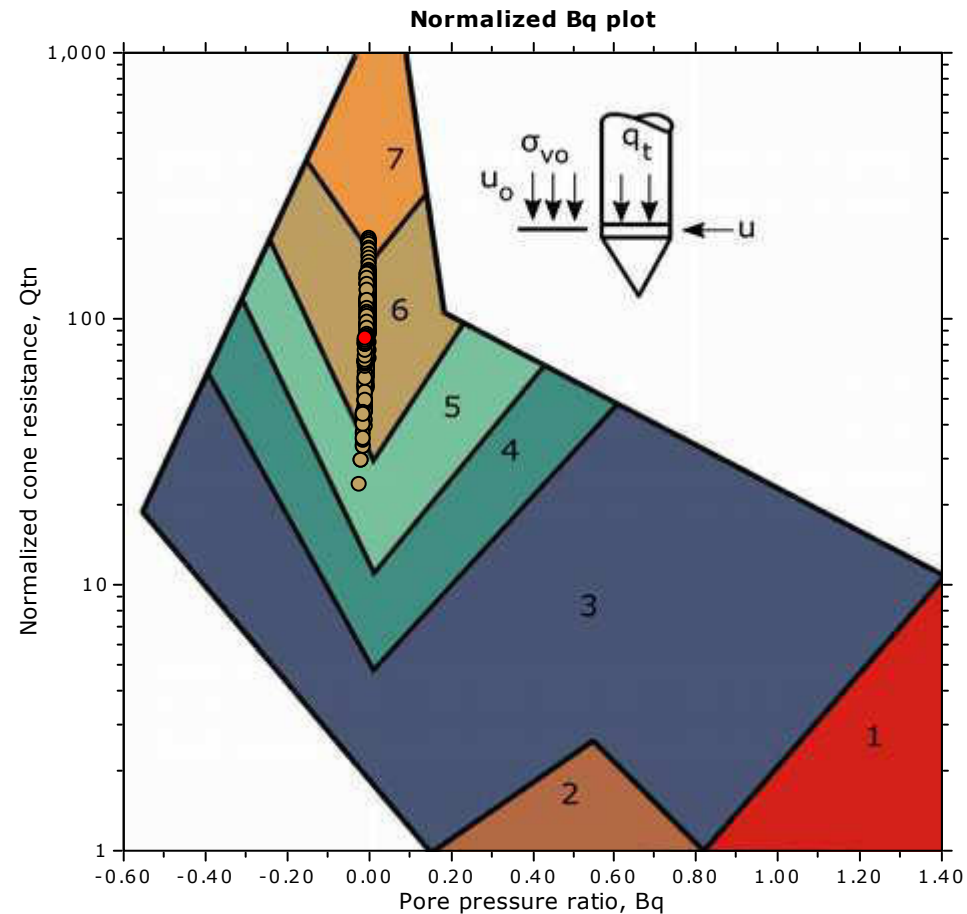
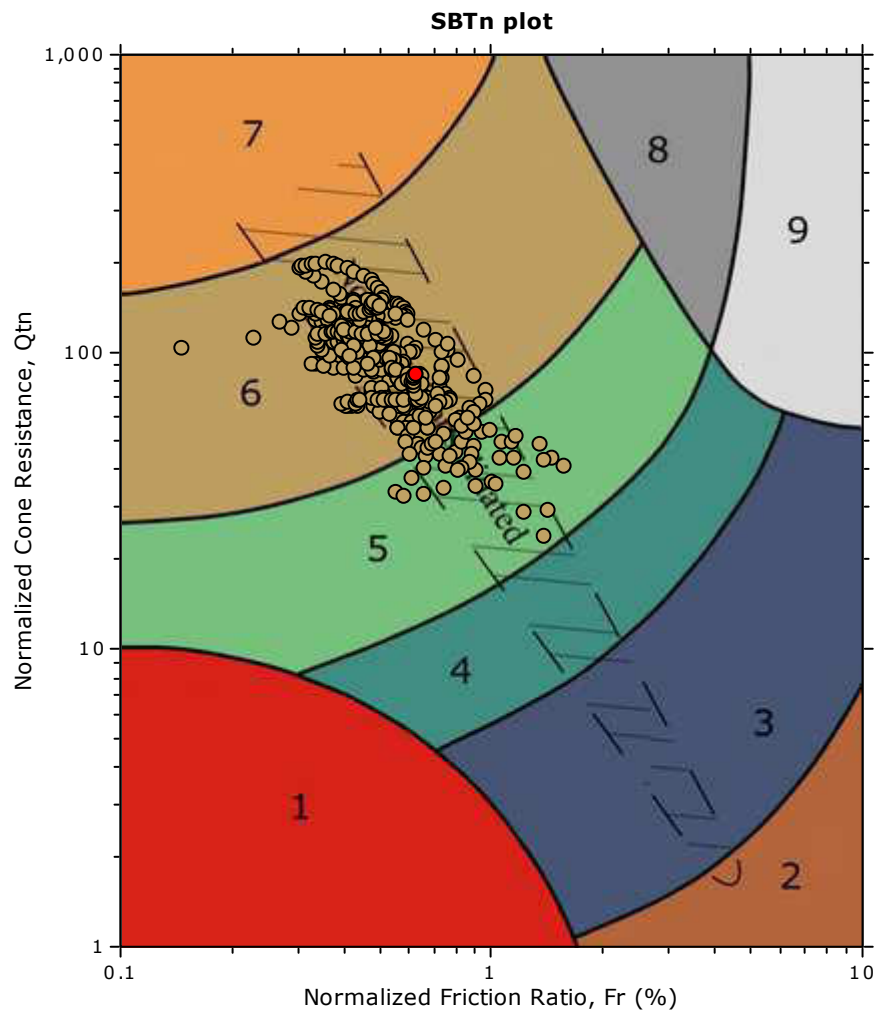
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)**

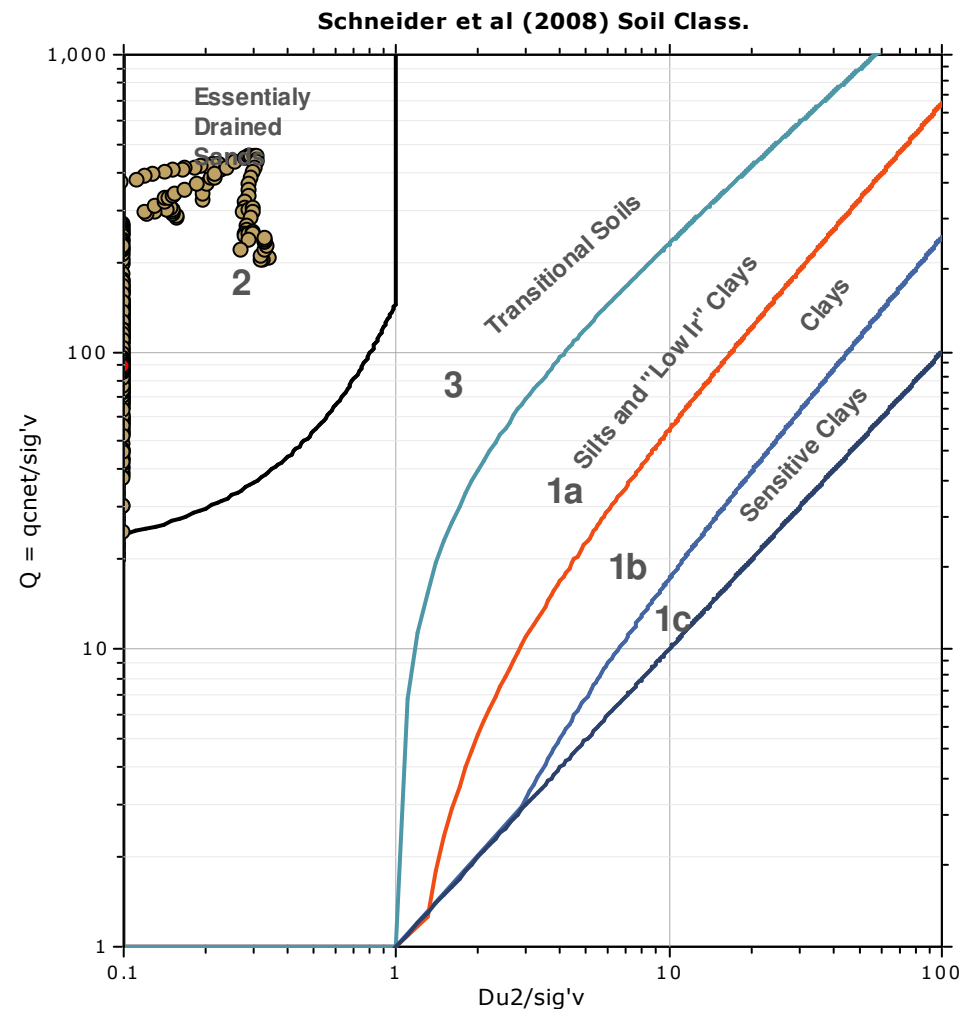
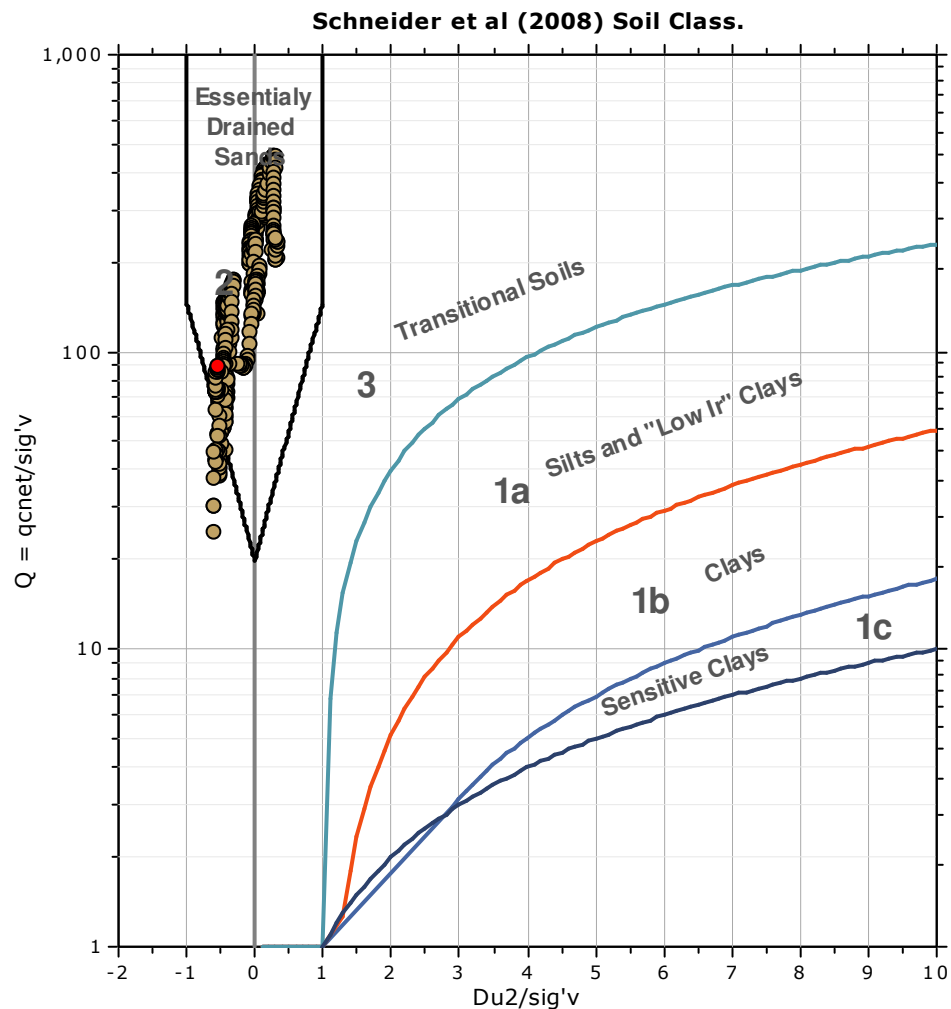


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)



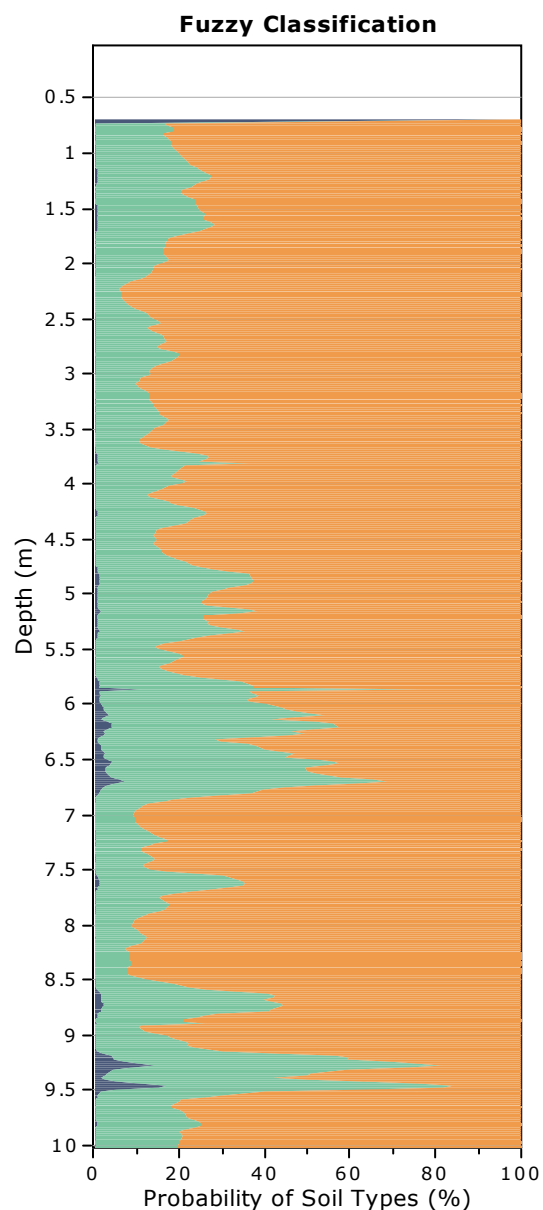
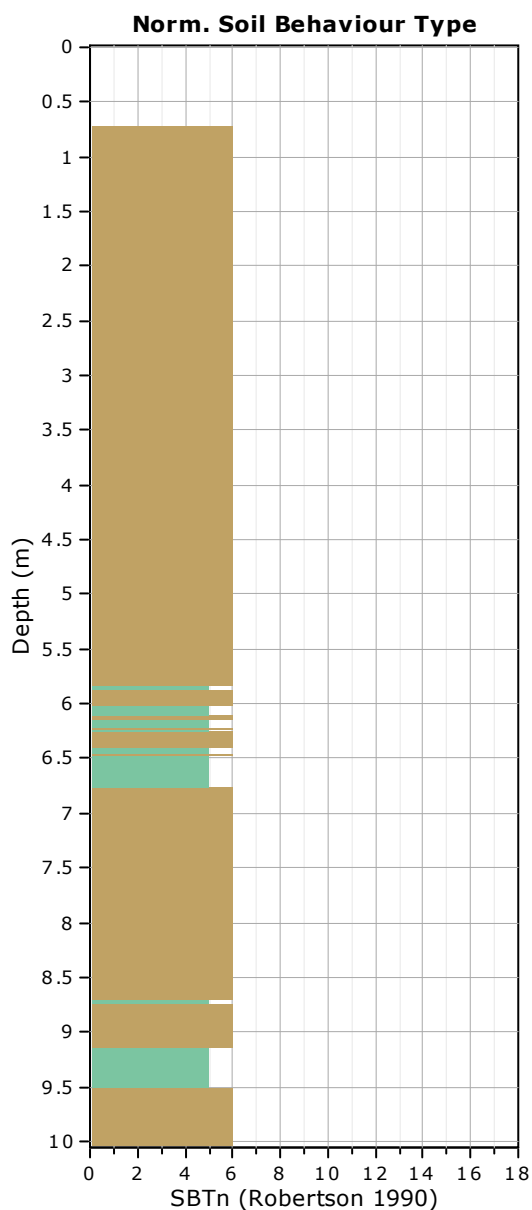
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



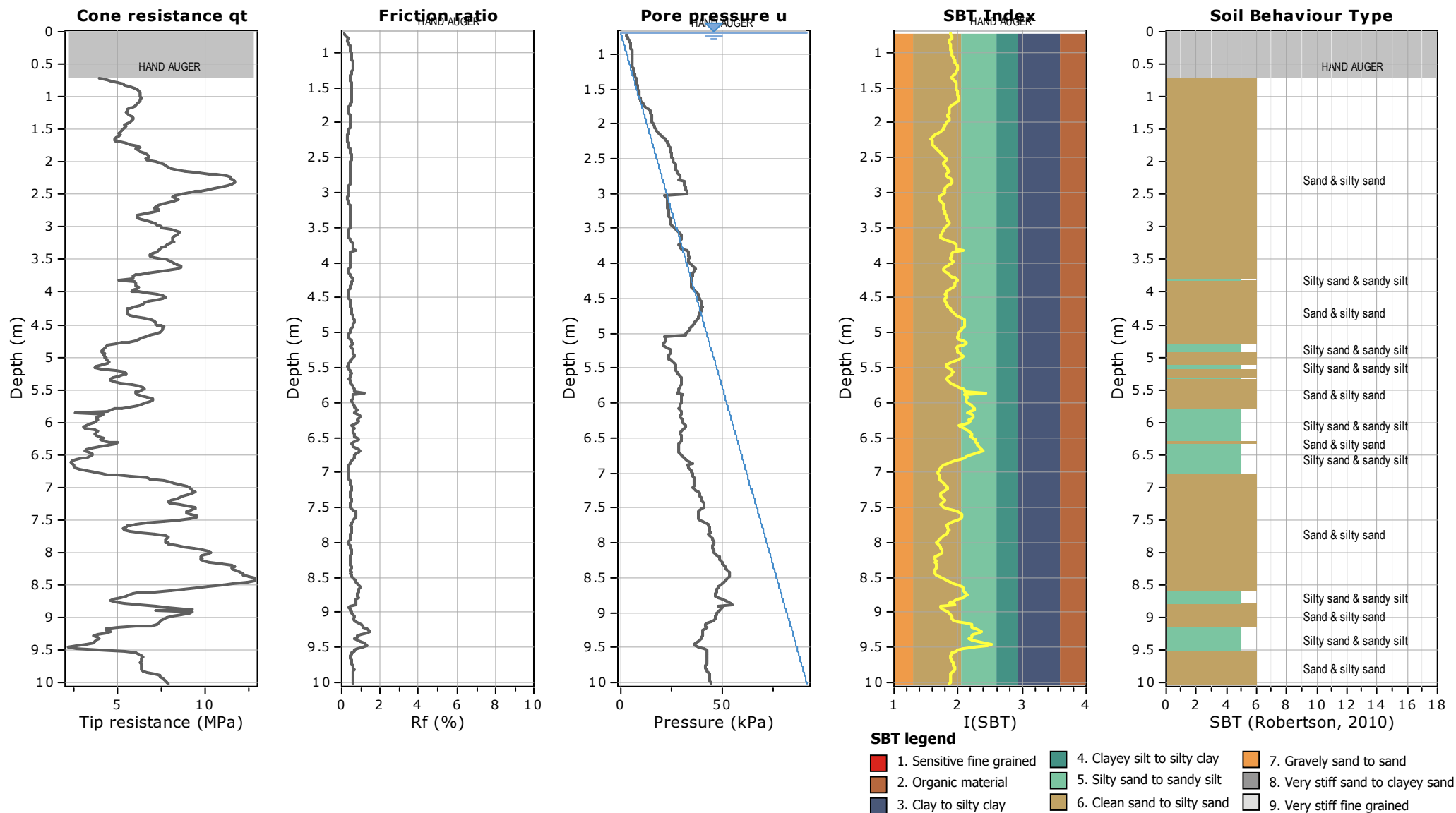
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



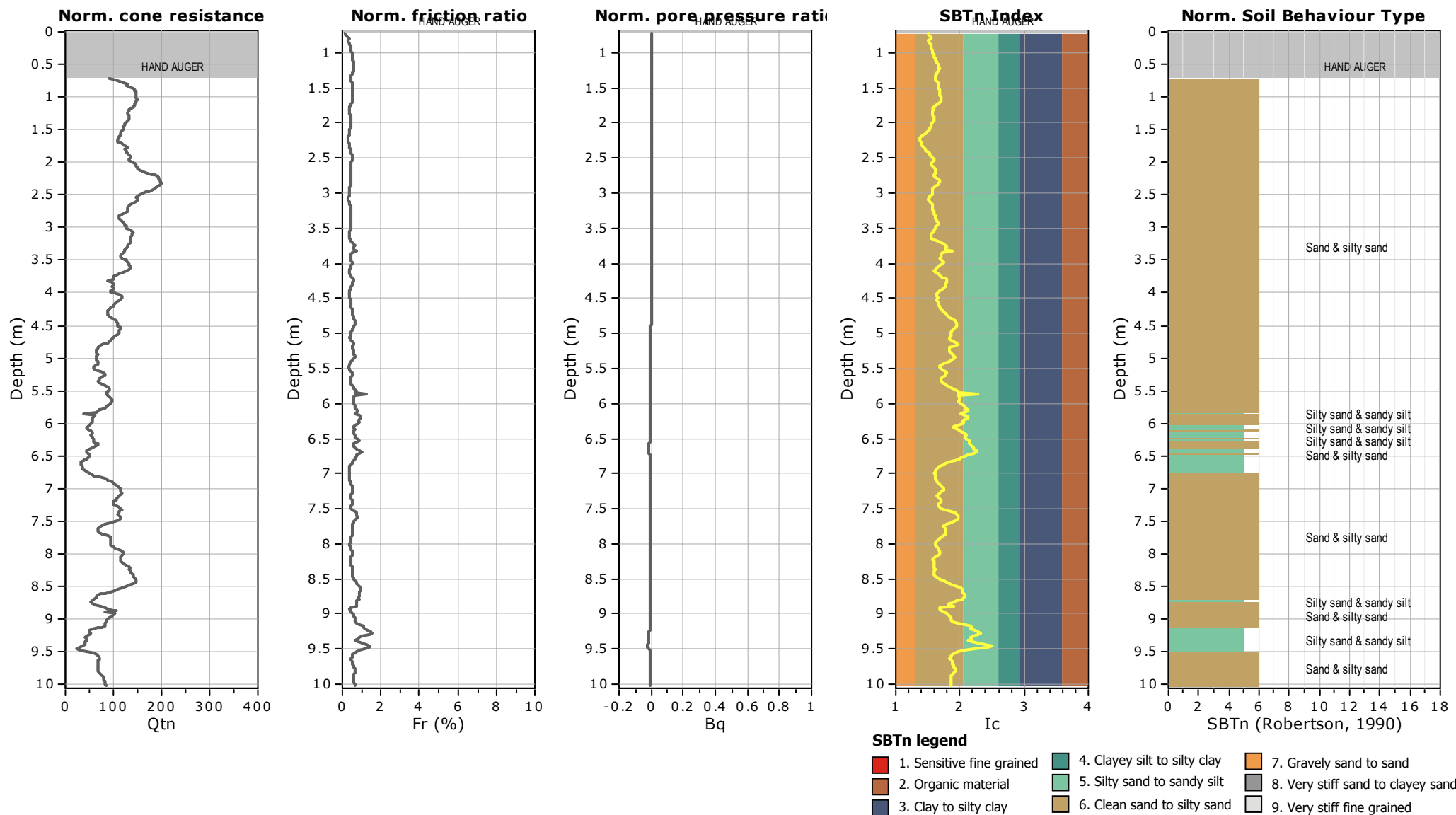
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



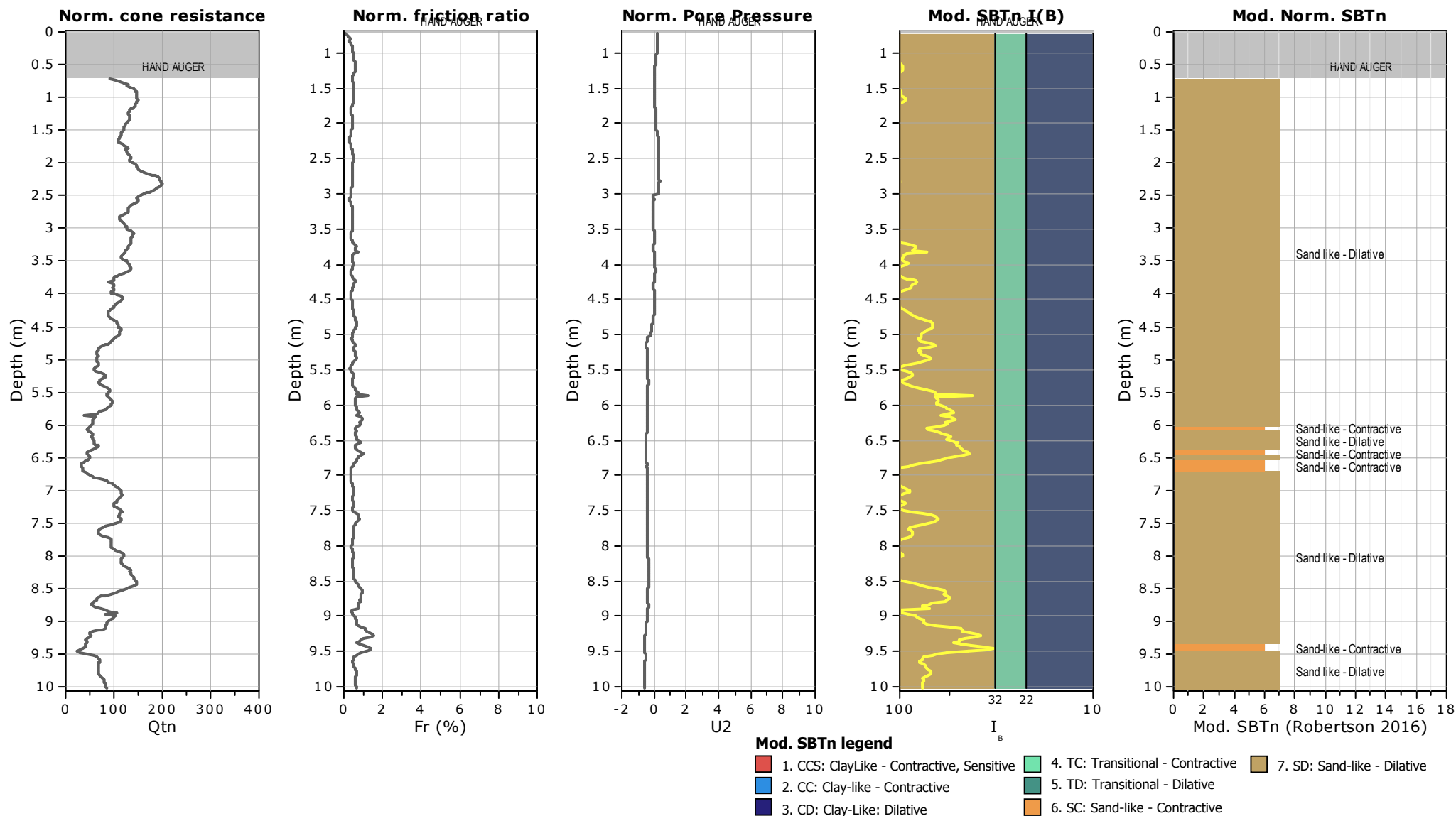
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

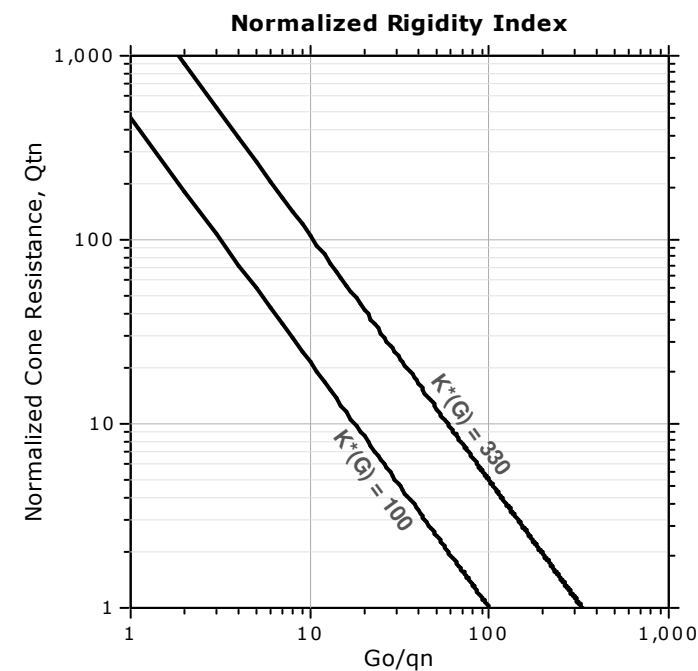
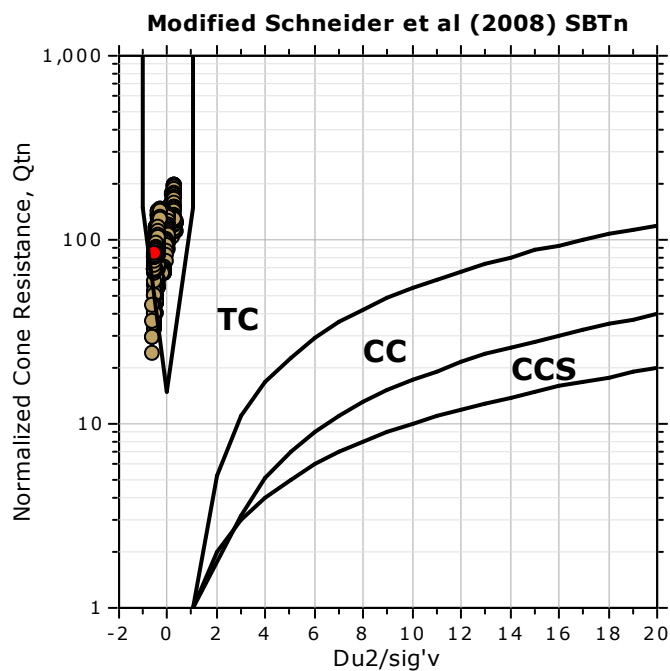
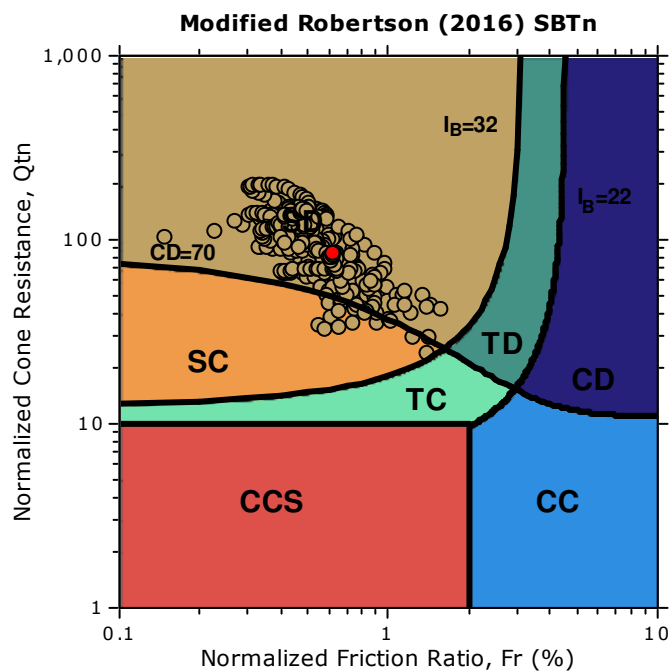
Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°





### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

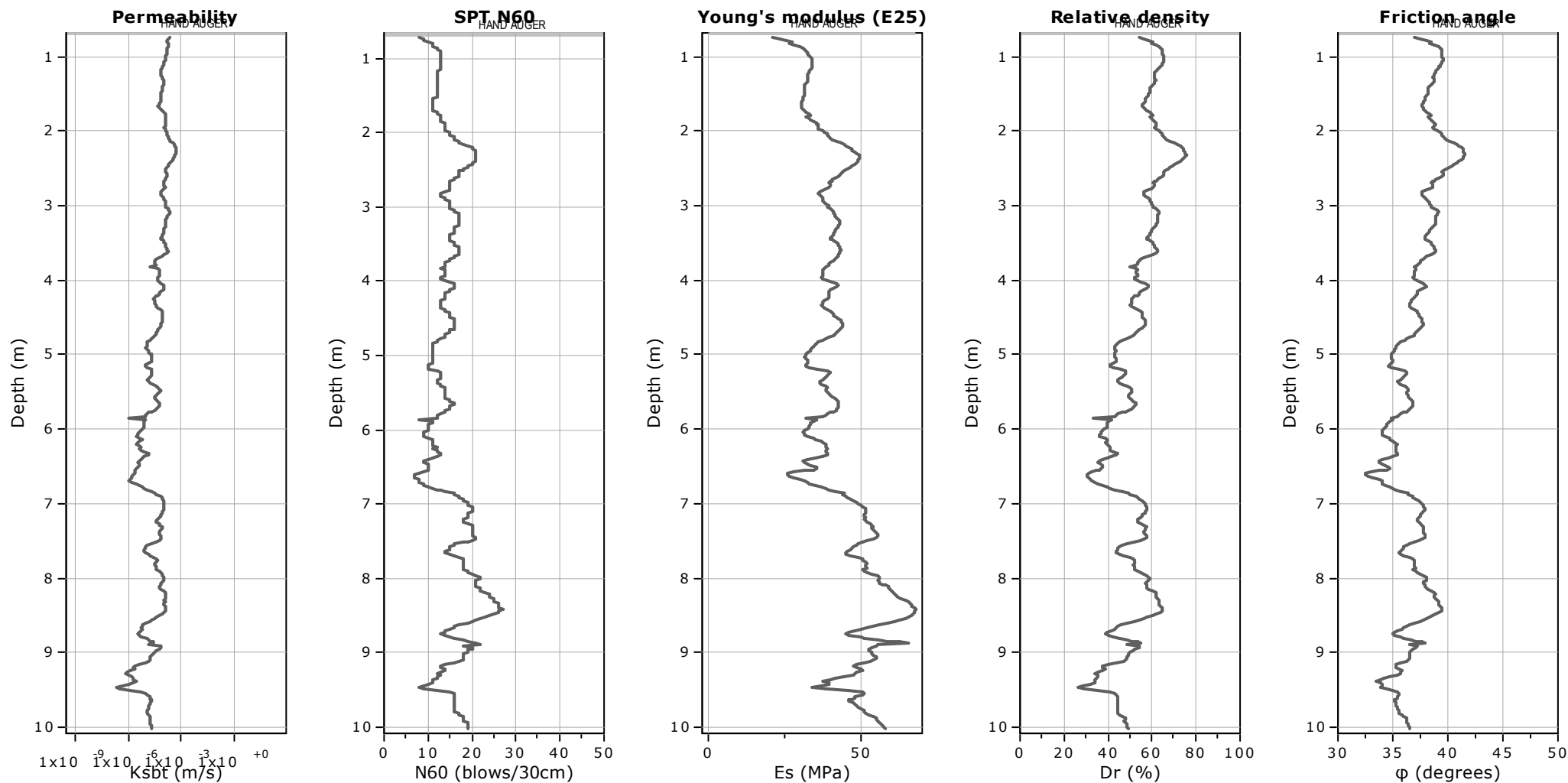
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data

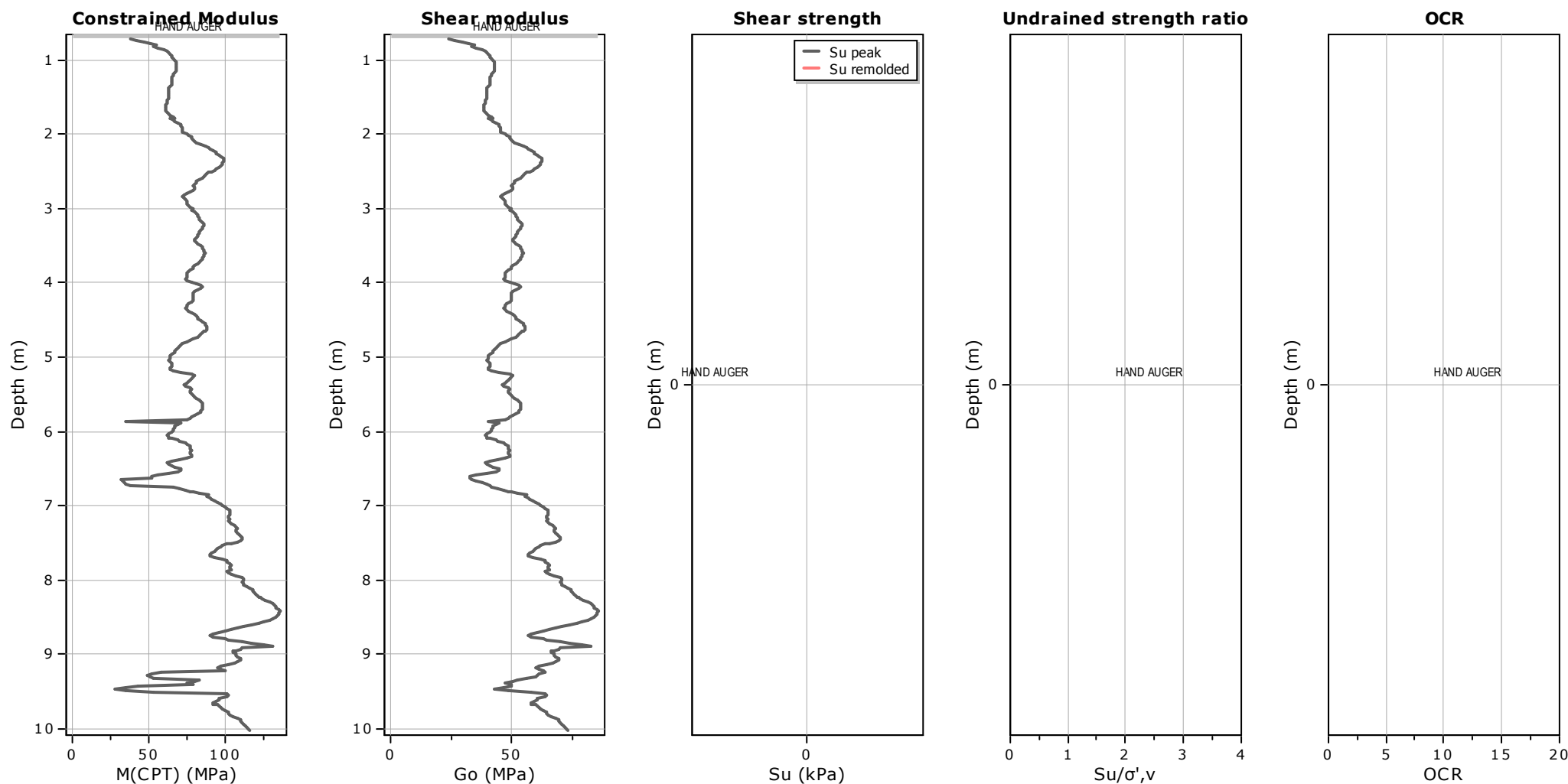
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

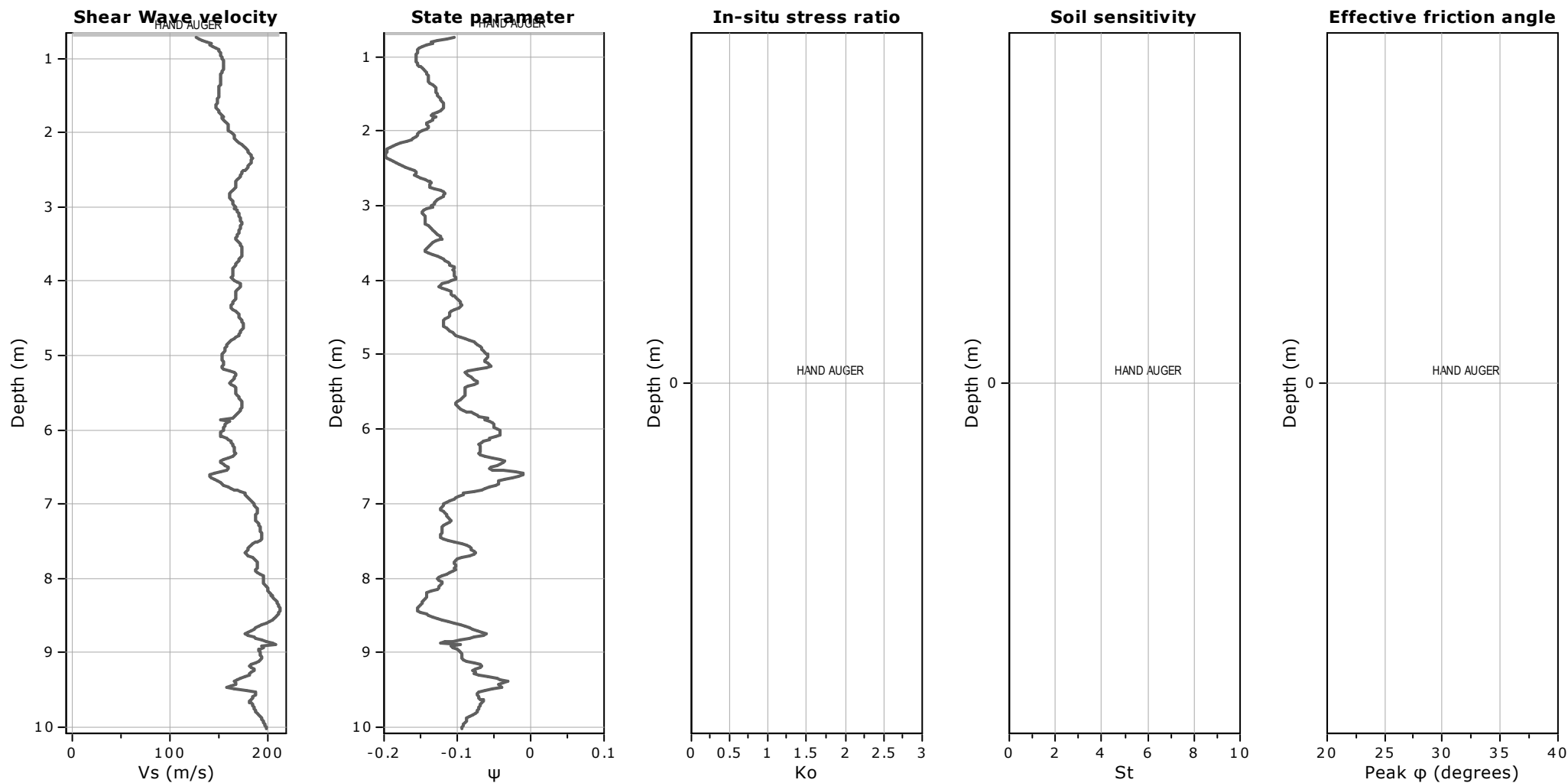
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

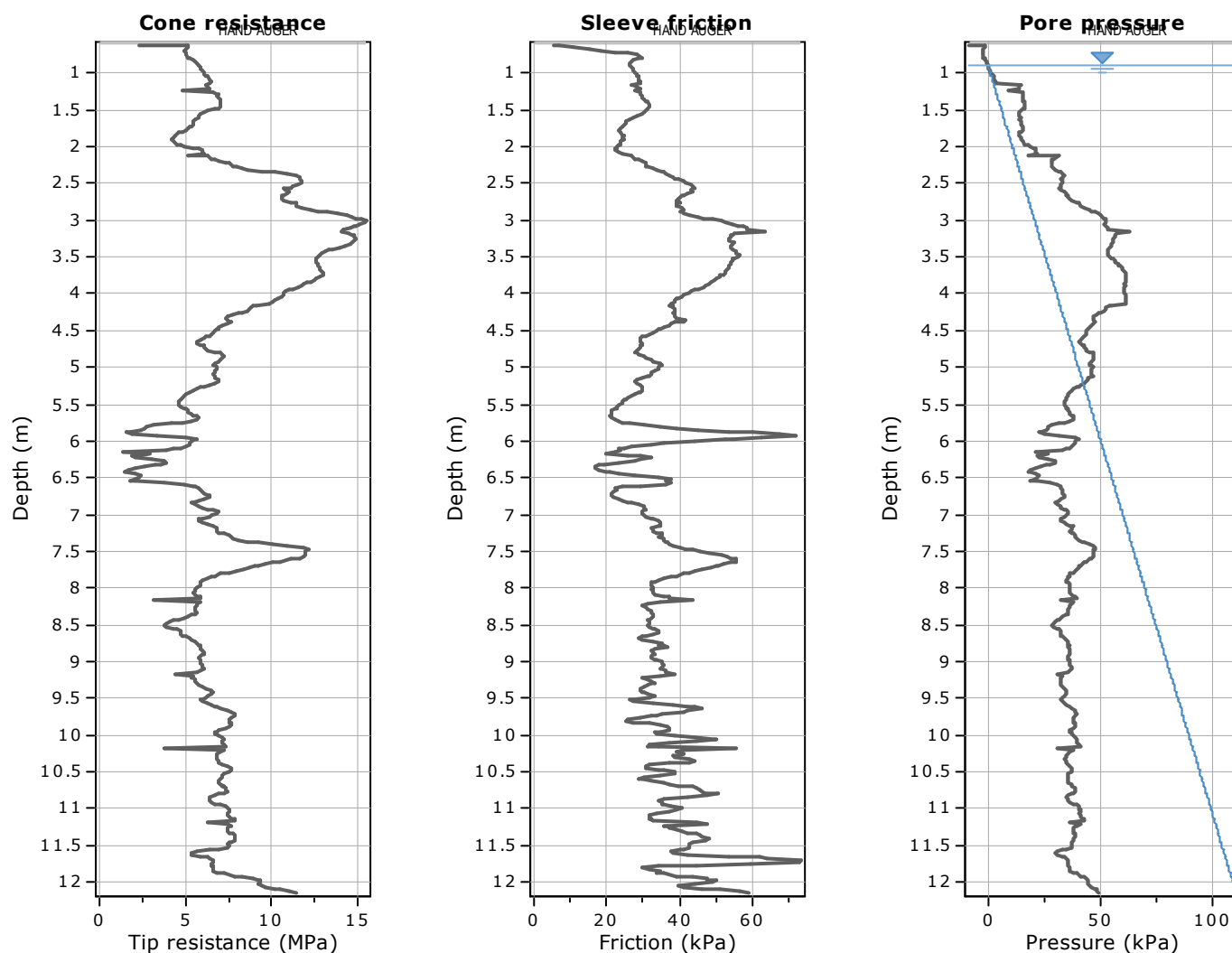
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

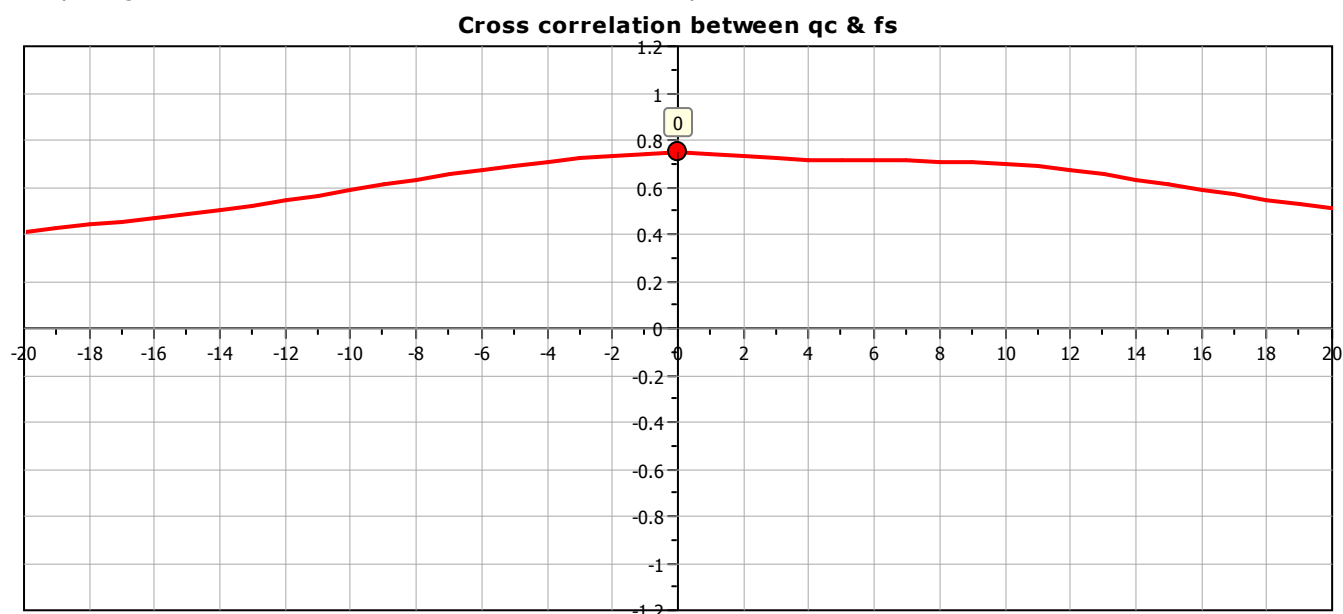
**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°

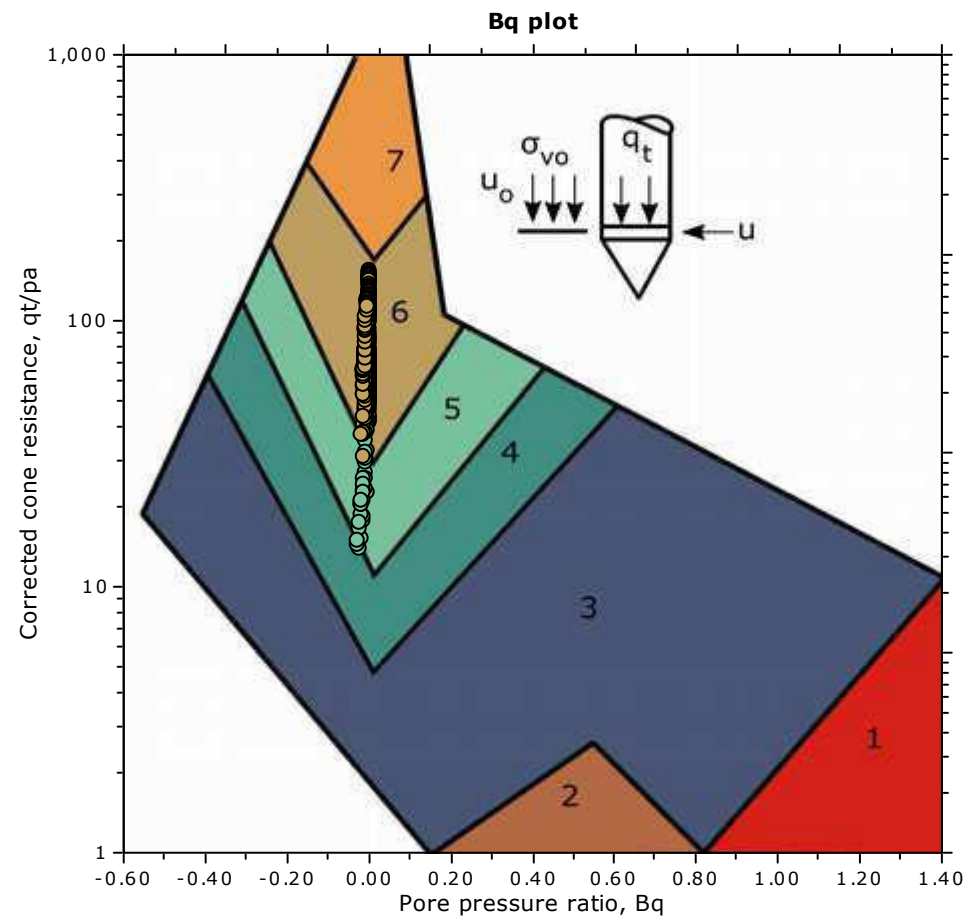
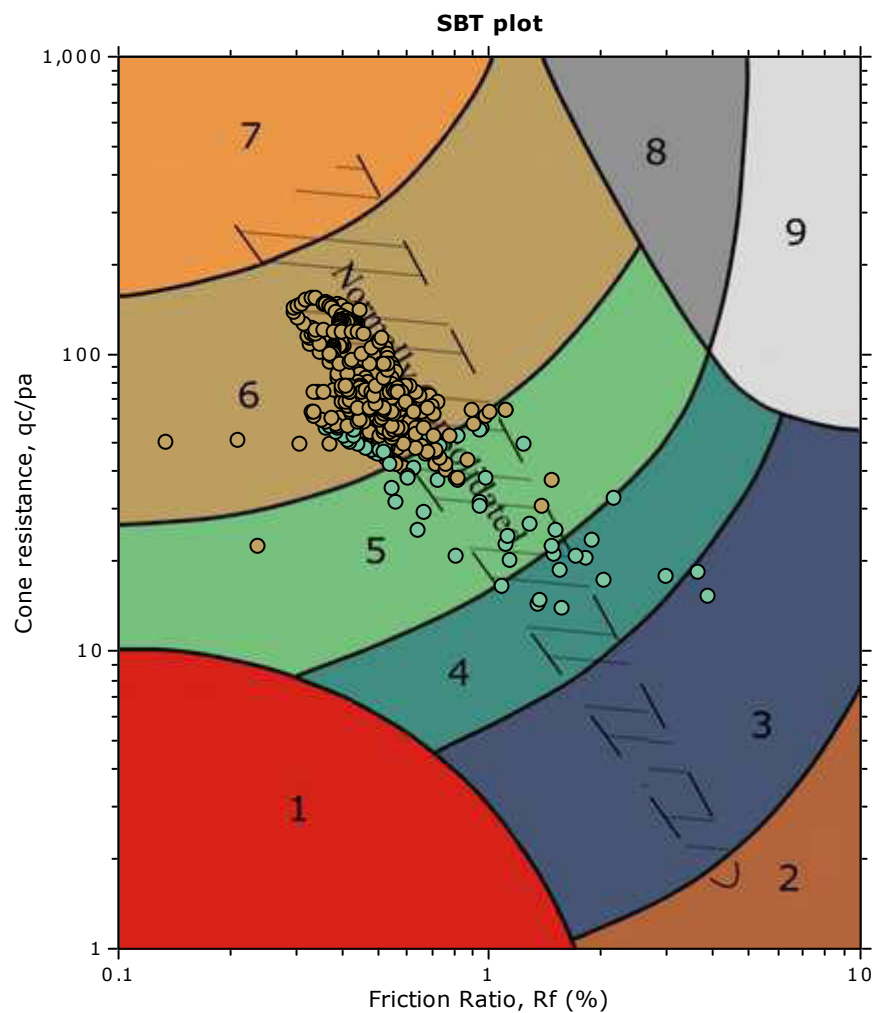


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





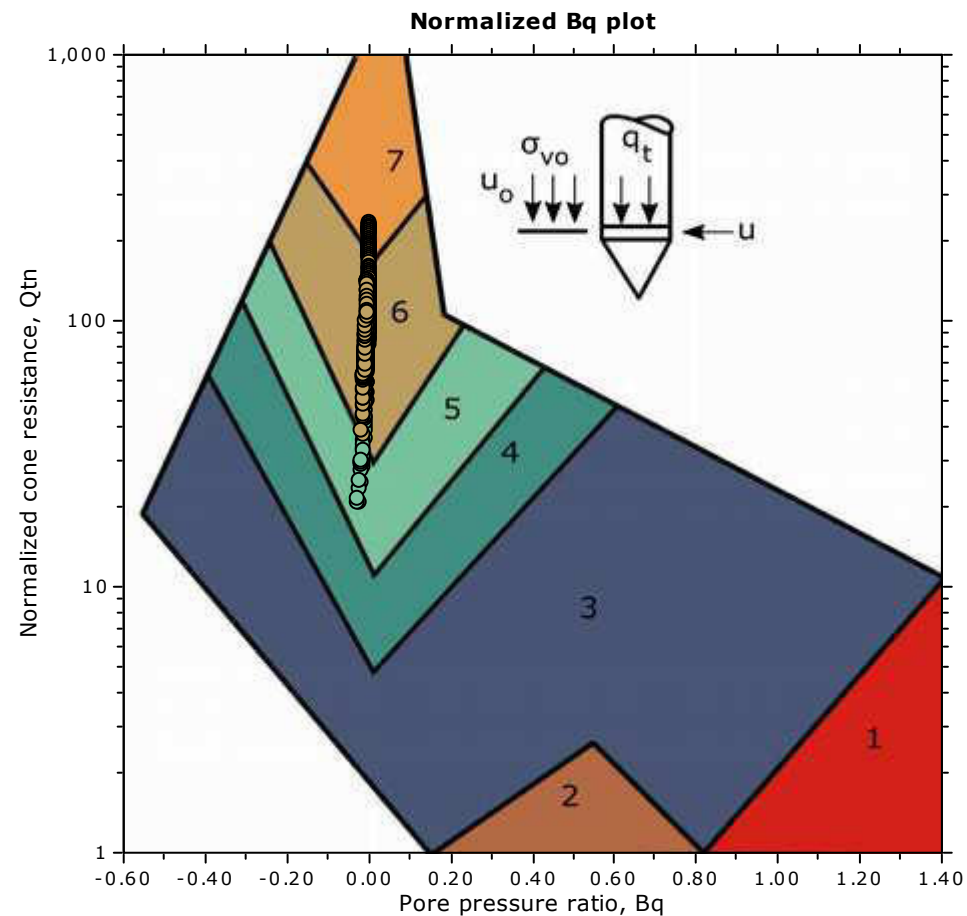
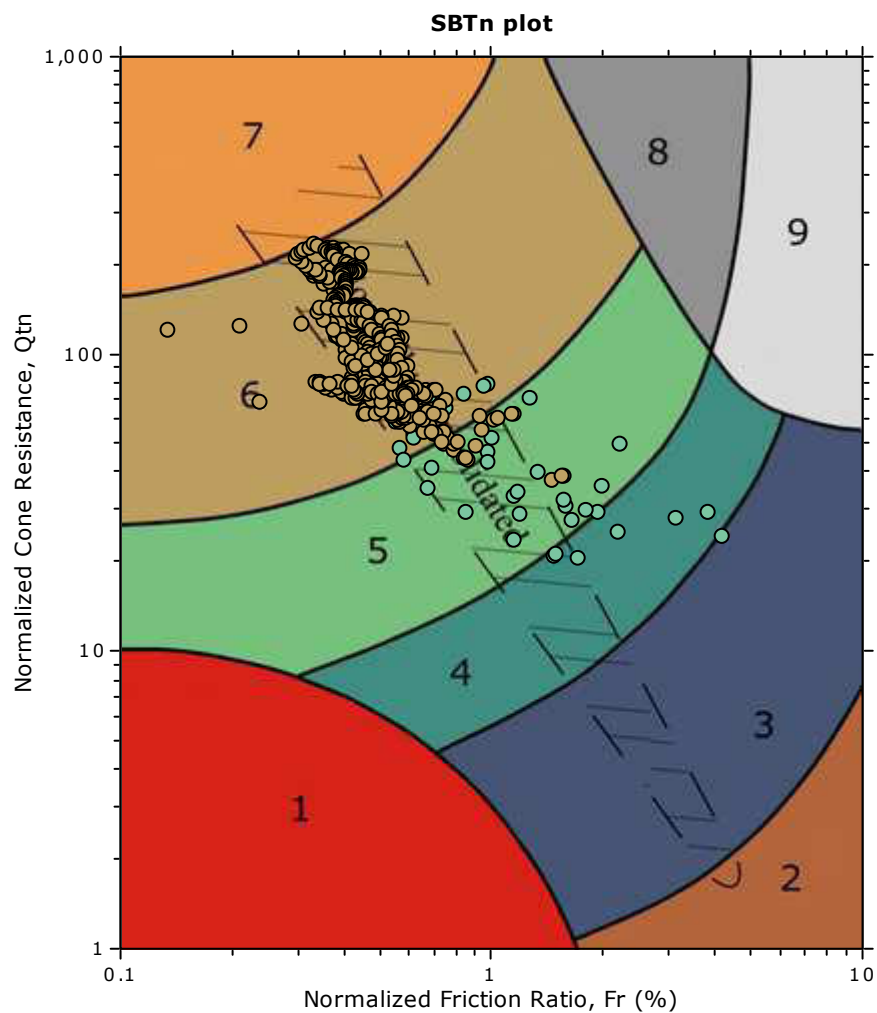
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

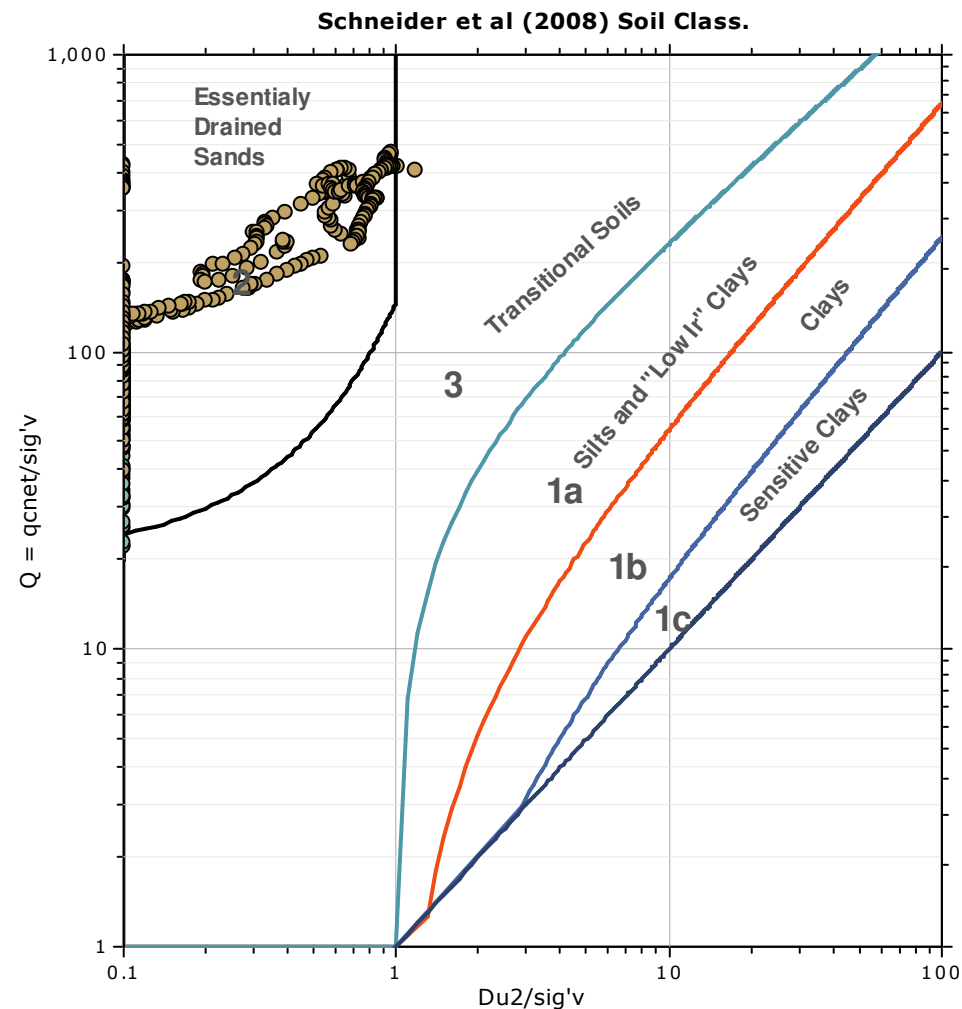
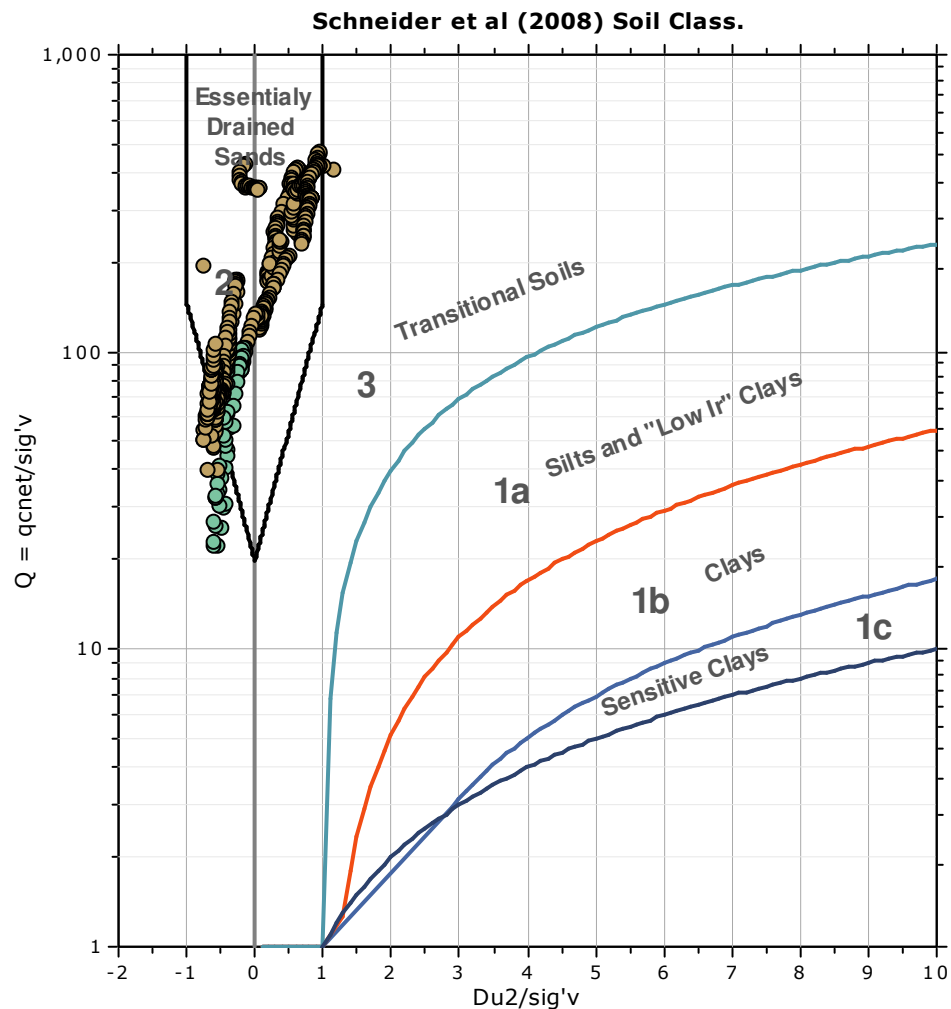
**SBT - Bq plots (normalized)**

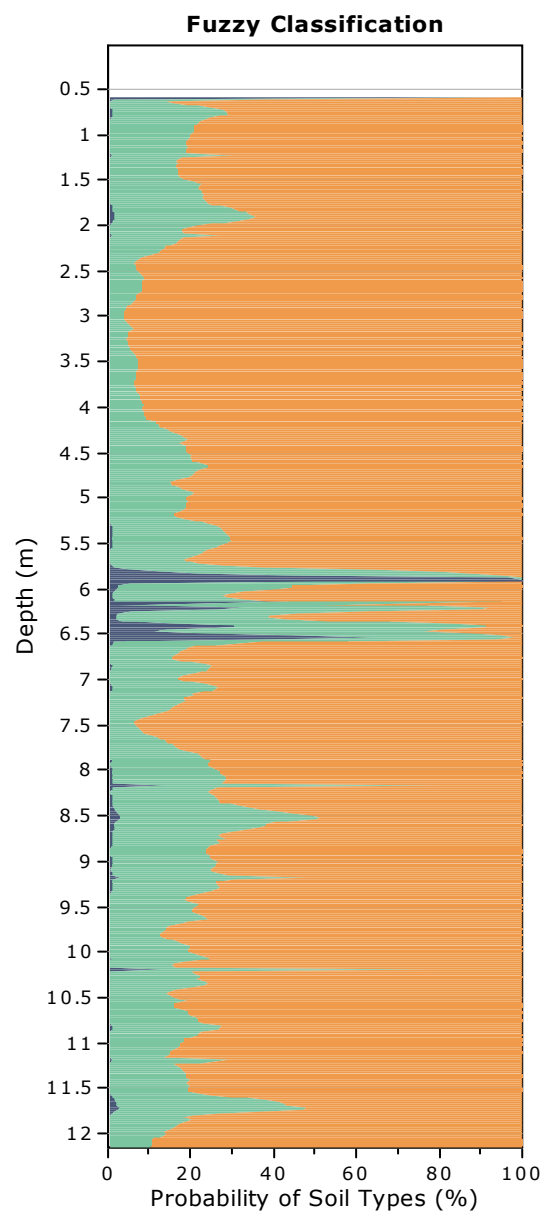
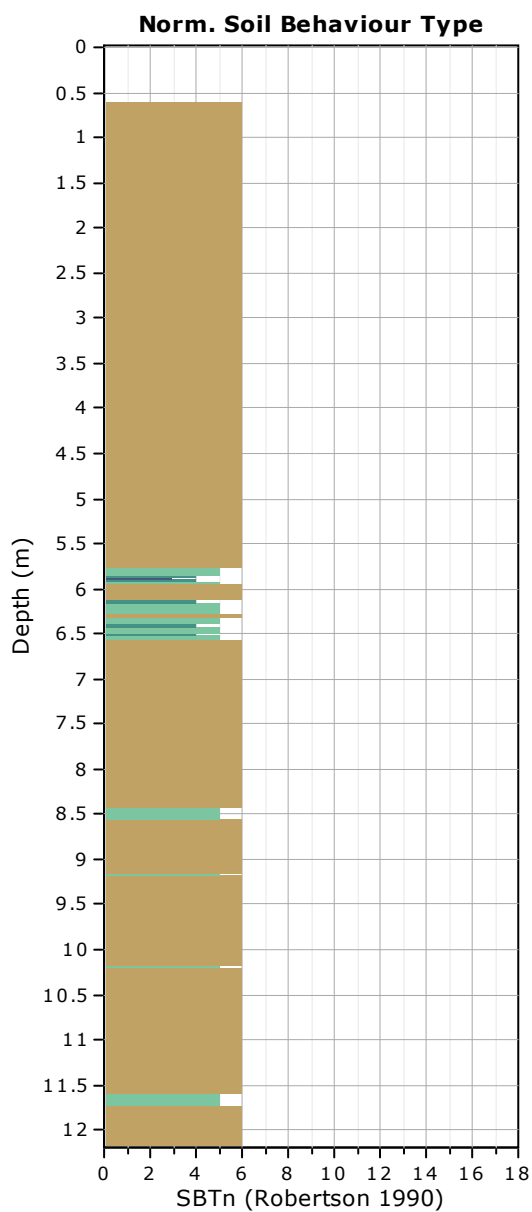


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





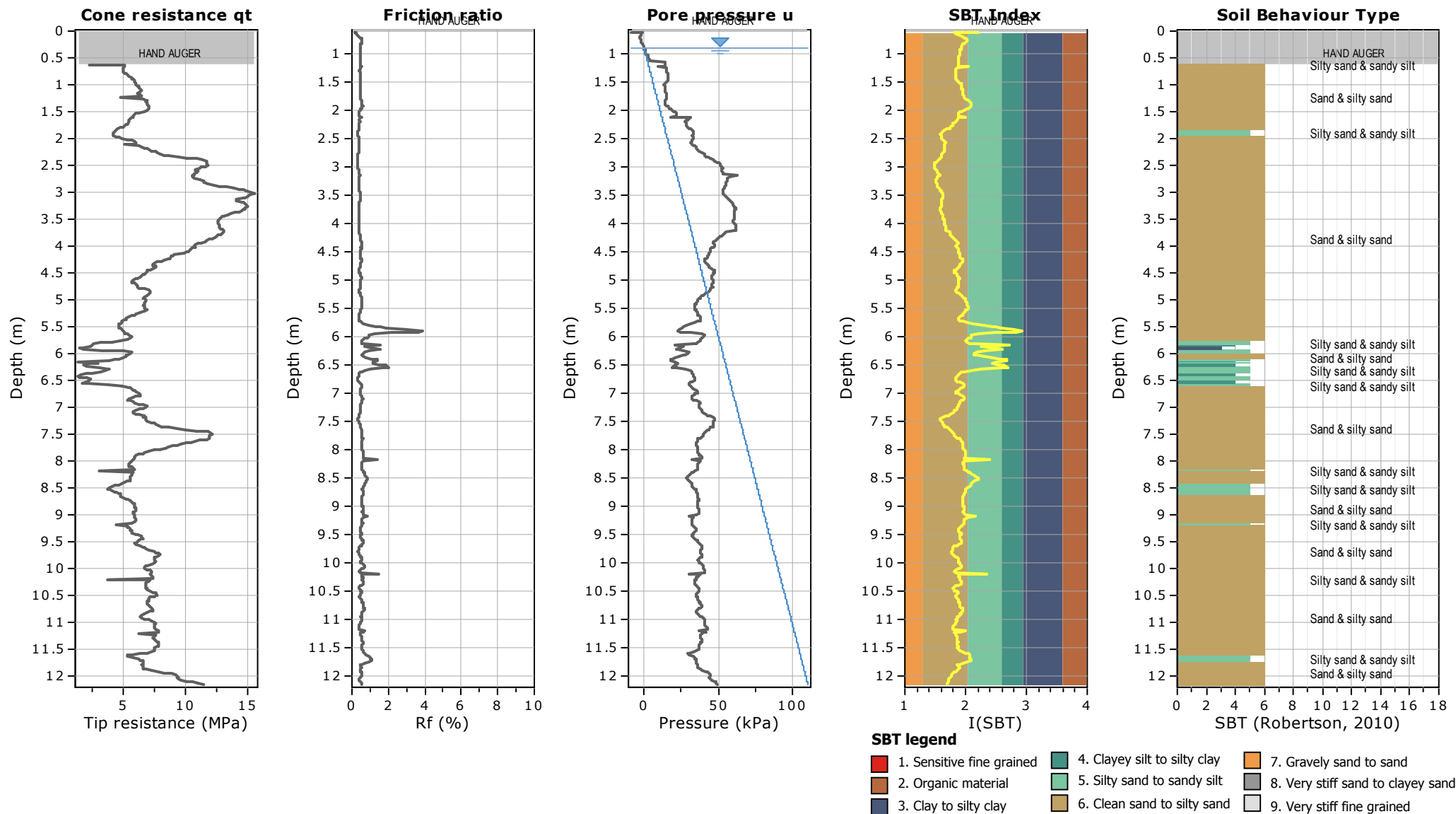
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°





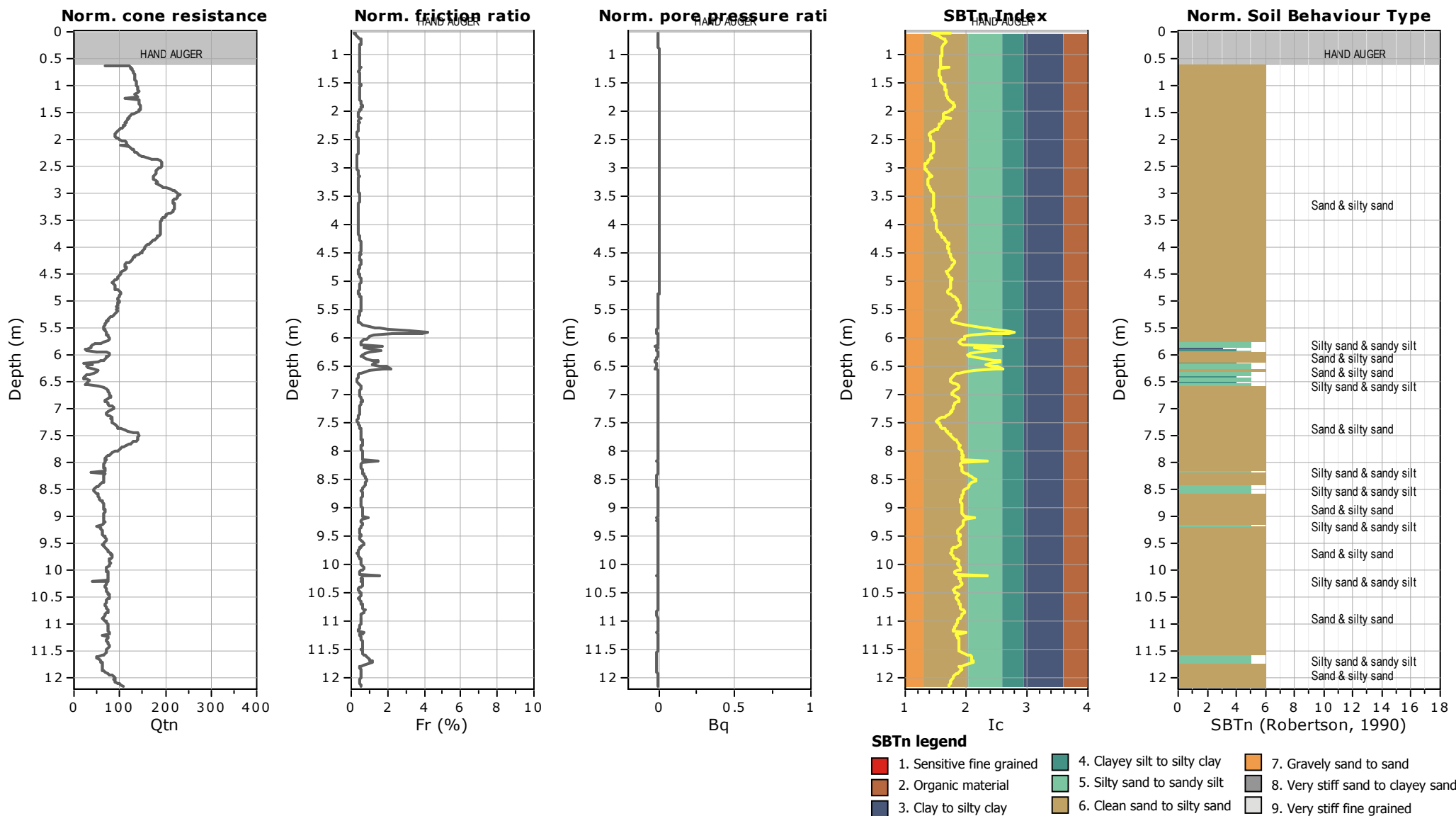
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°



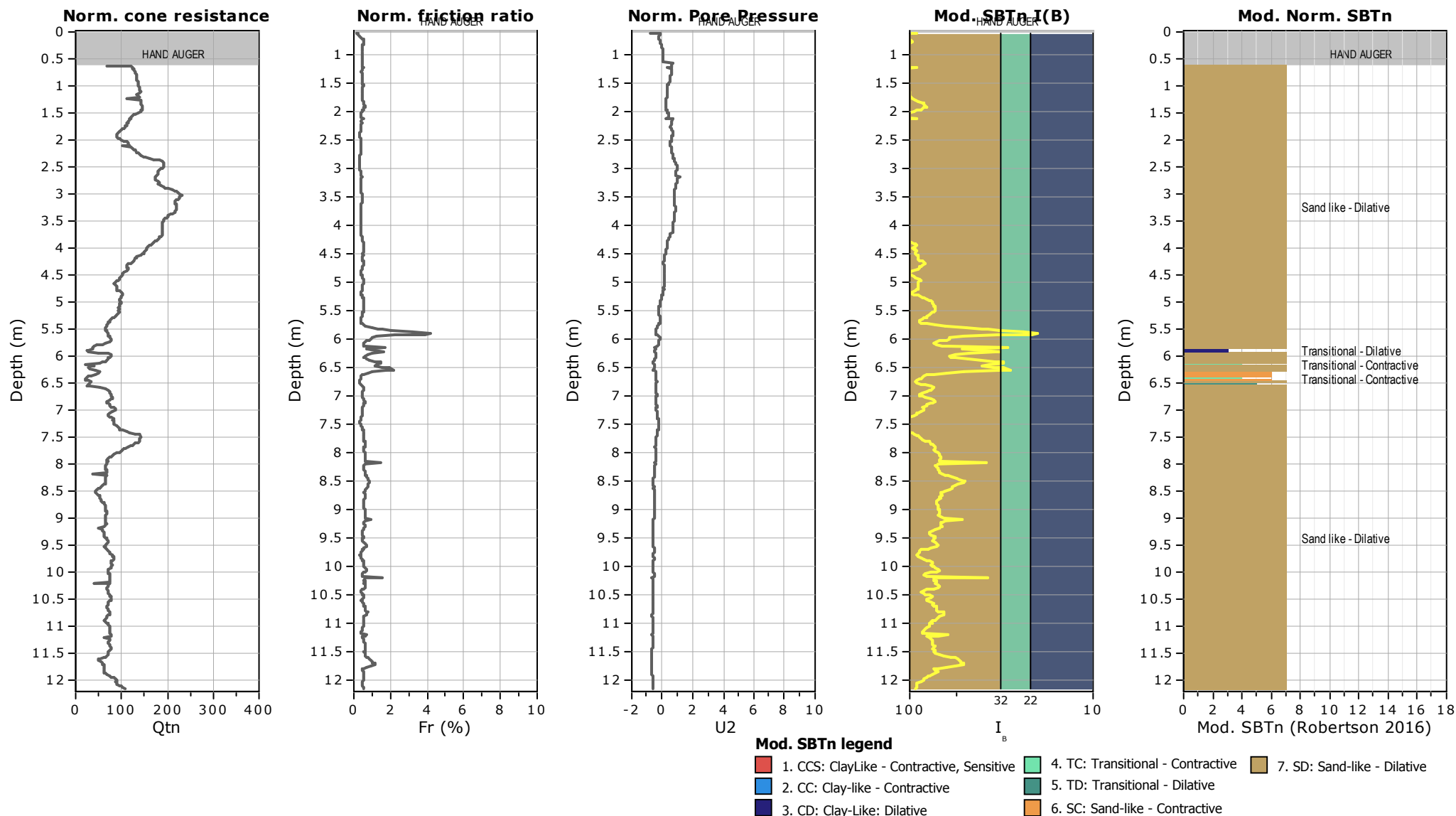
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

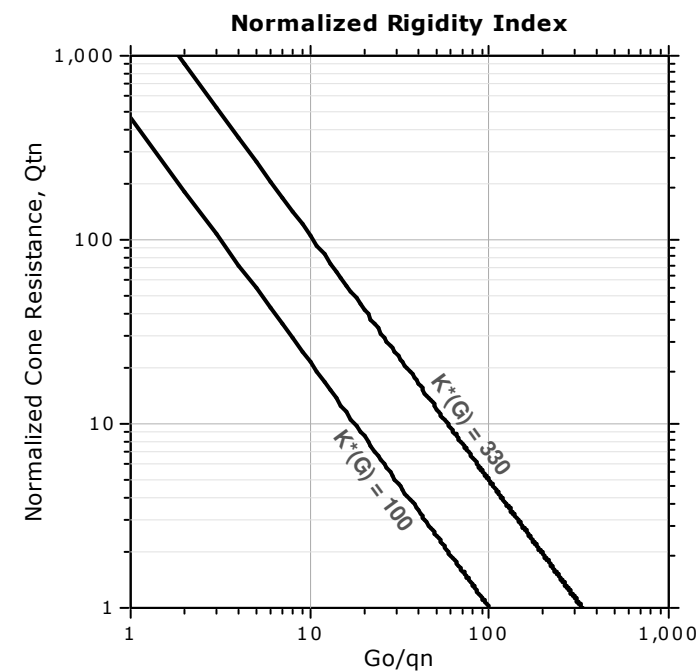
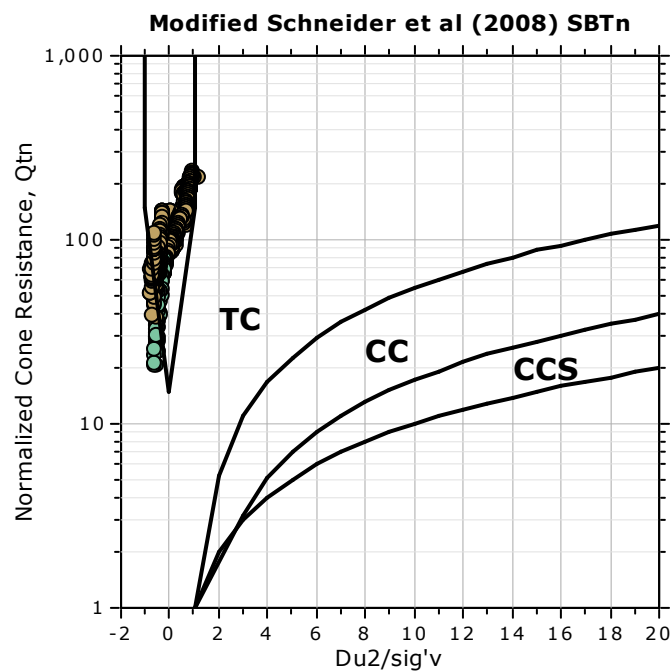
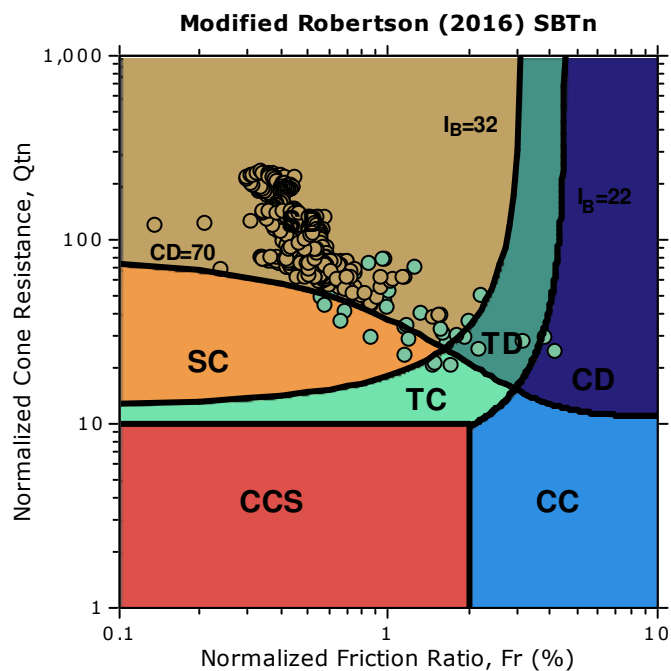
**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
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$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

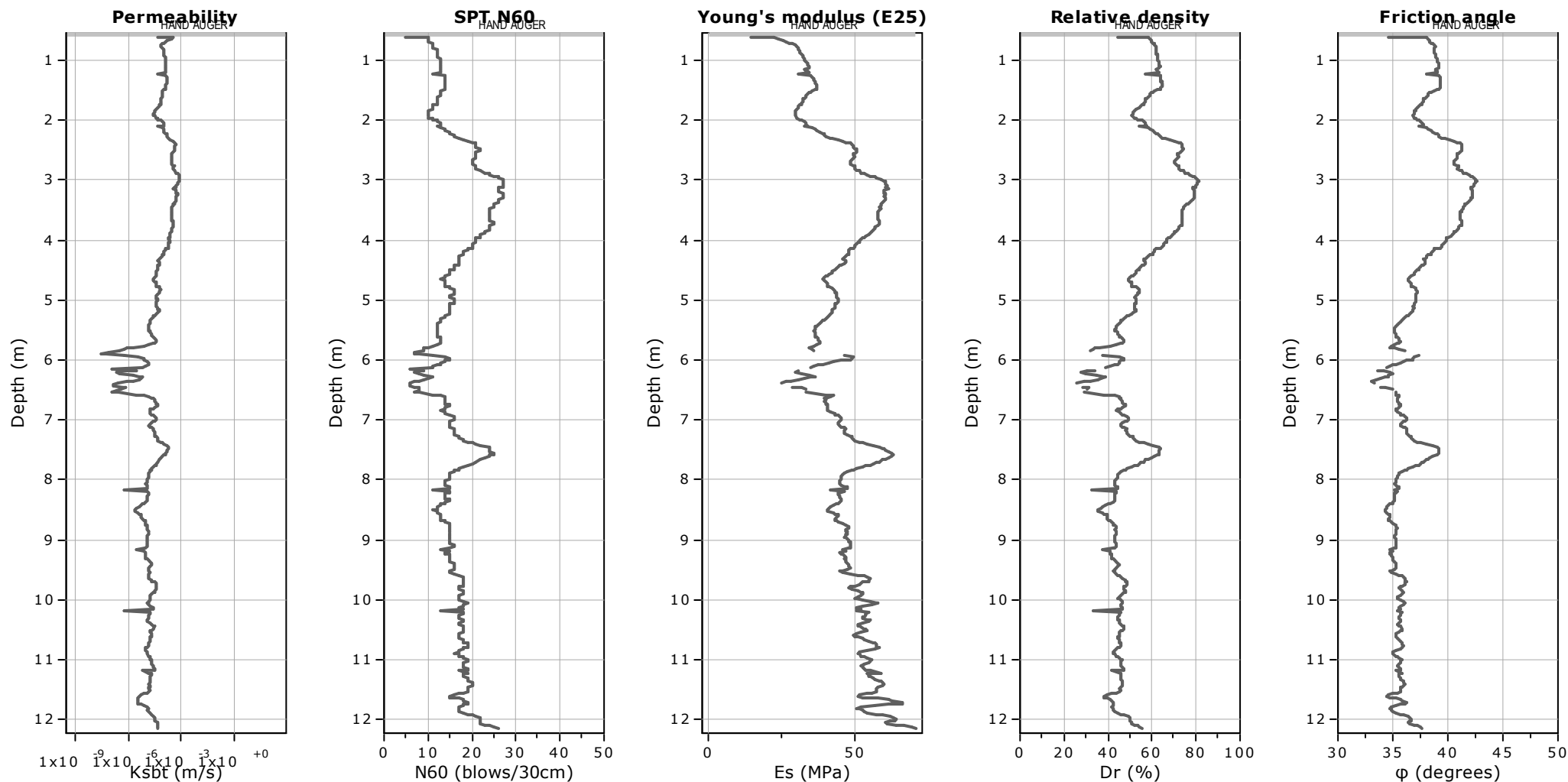
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data

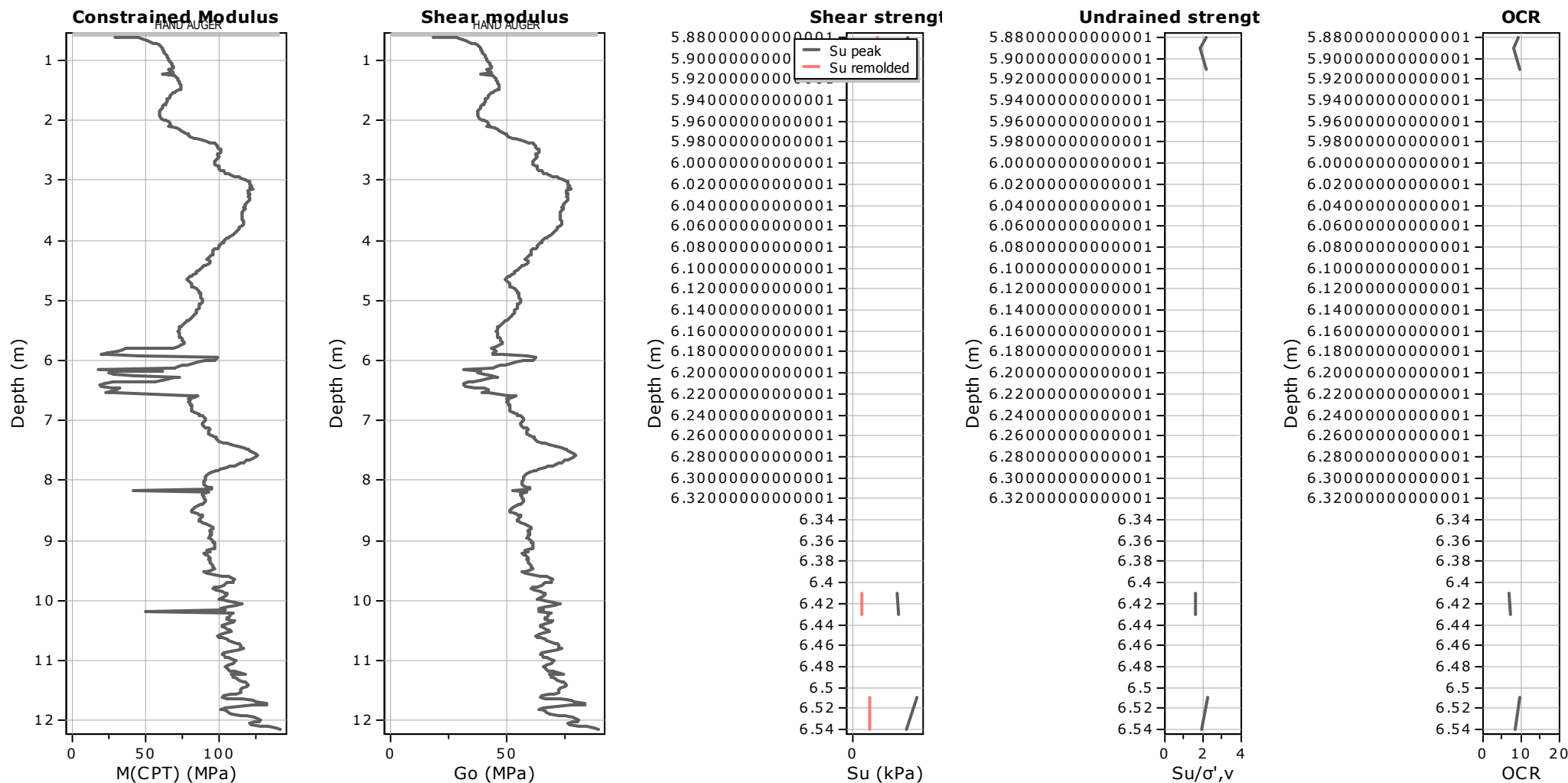
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data



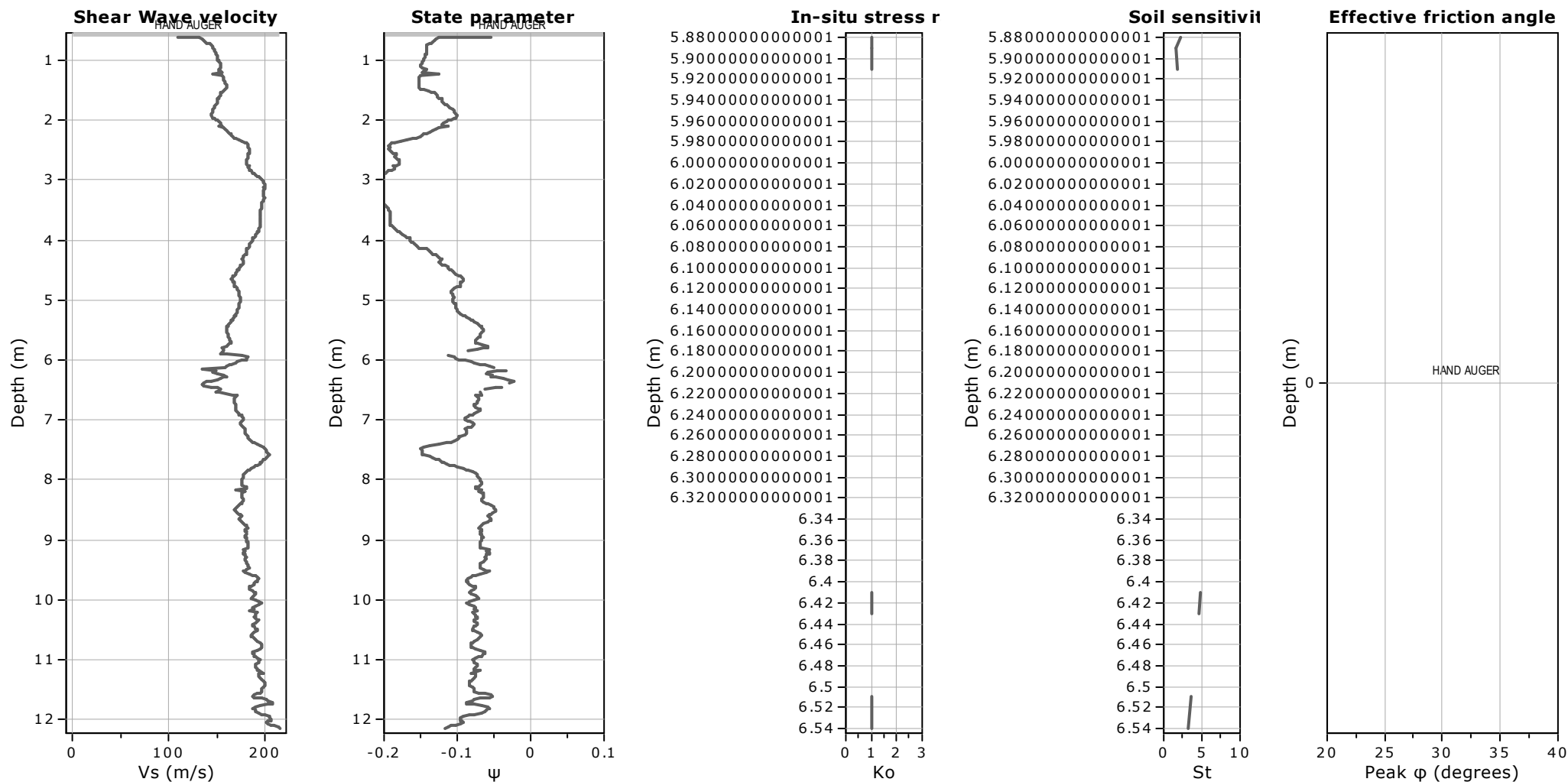
**Project:** Indagini CPTu - ditta GIA Exploring S.r.l.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU 11 (Km 32.3)**

Total depth: 12.15 m

Coords: lat 44.735267° lon 12.206547°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

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/m<sup>3</sup>) ::

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

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, $\psi$ ::

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

#### :: Drained Friction Angle, $\phi$ (°) ::

$$\phi = \phi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT<sub>n</sub>: 5, 6, 7 and 8 or  $I_c < I_{c\_cutoff}$ )

#### :: 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  $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

#### :: 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<sub>n</sub>: 1, 2, 3, 4 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<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

#### :: In situ Stress Ratio, $K_0$ ::

$$K_0 = (1 - \sin \phi') \cdot OCR^{\sin \phi'}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

#### :: Soil Sensitivity, $S_t$ ::

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

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

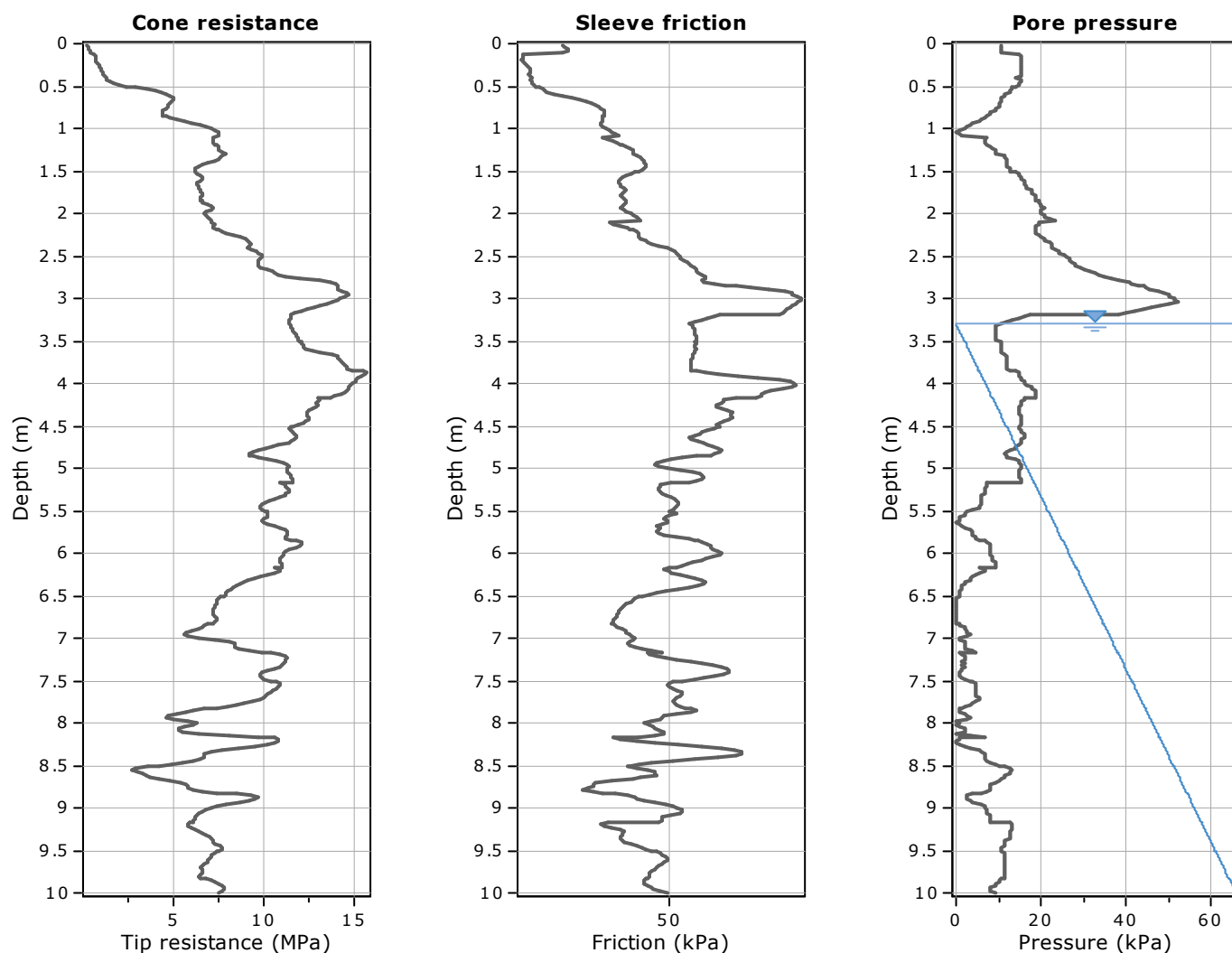
#### :: Peak Friction Angle, $\phi'$ (°) ::

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

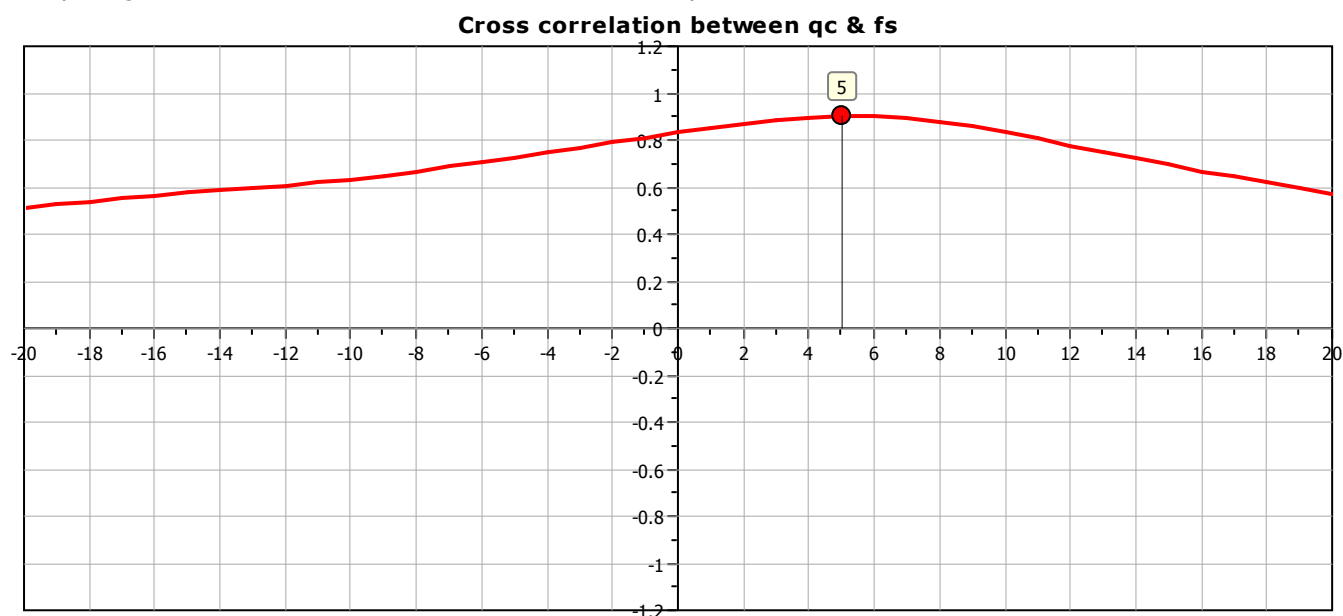
(applicable for  $0.10 < B_q < 1.00$ )

## References

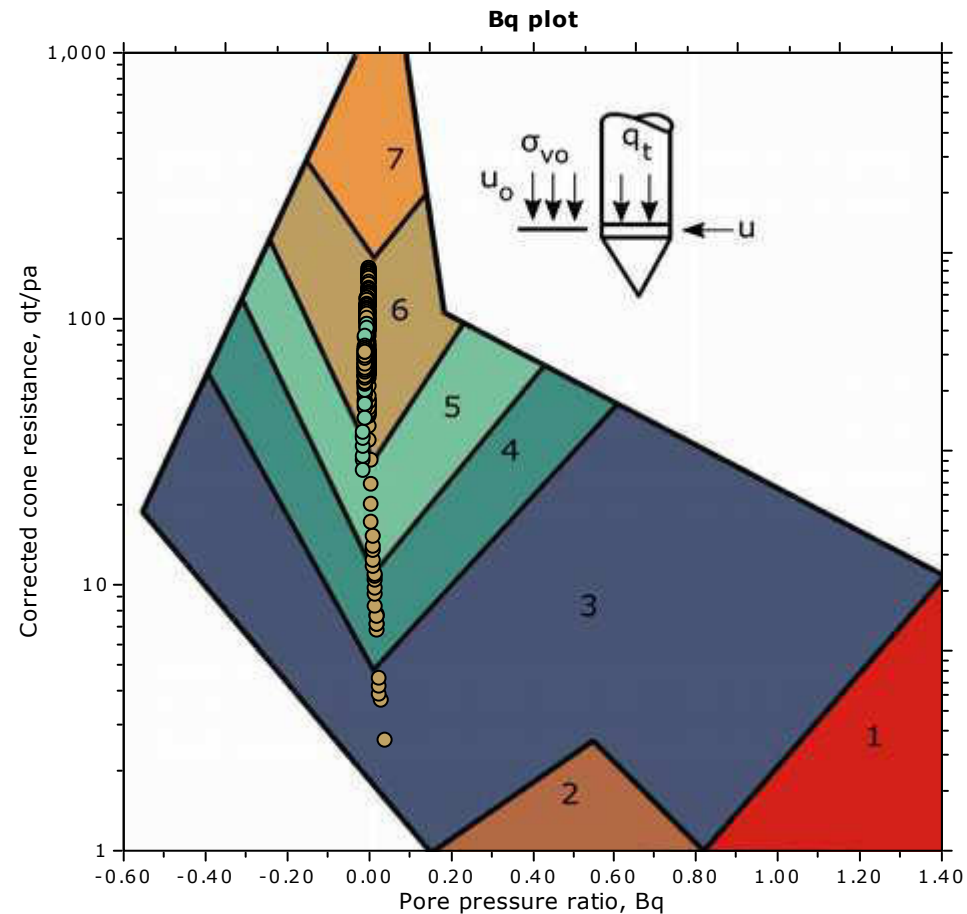
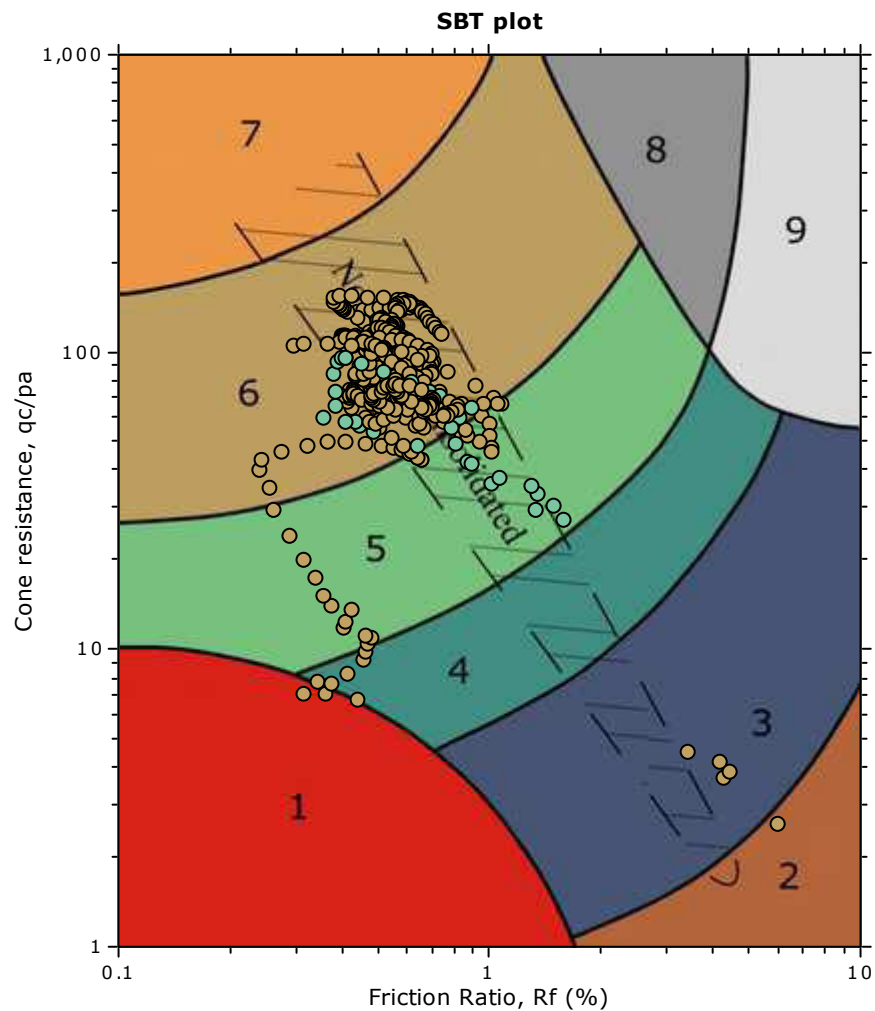
- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5<sup>th</sup> Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)



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



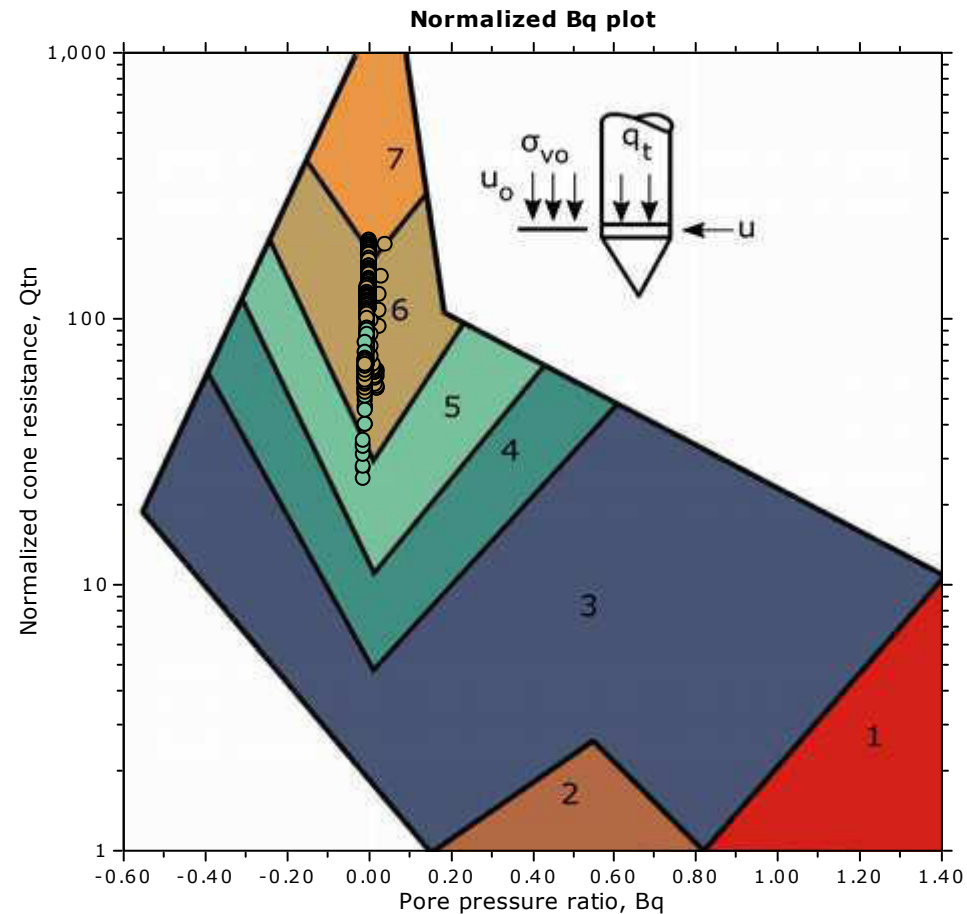
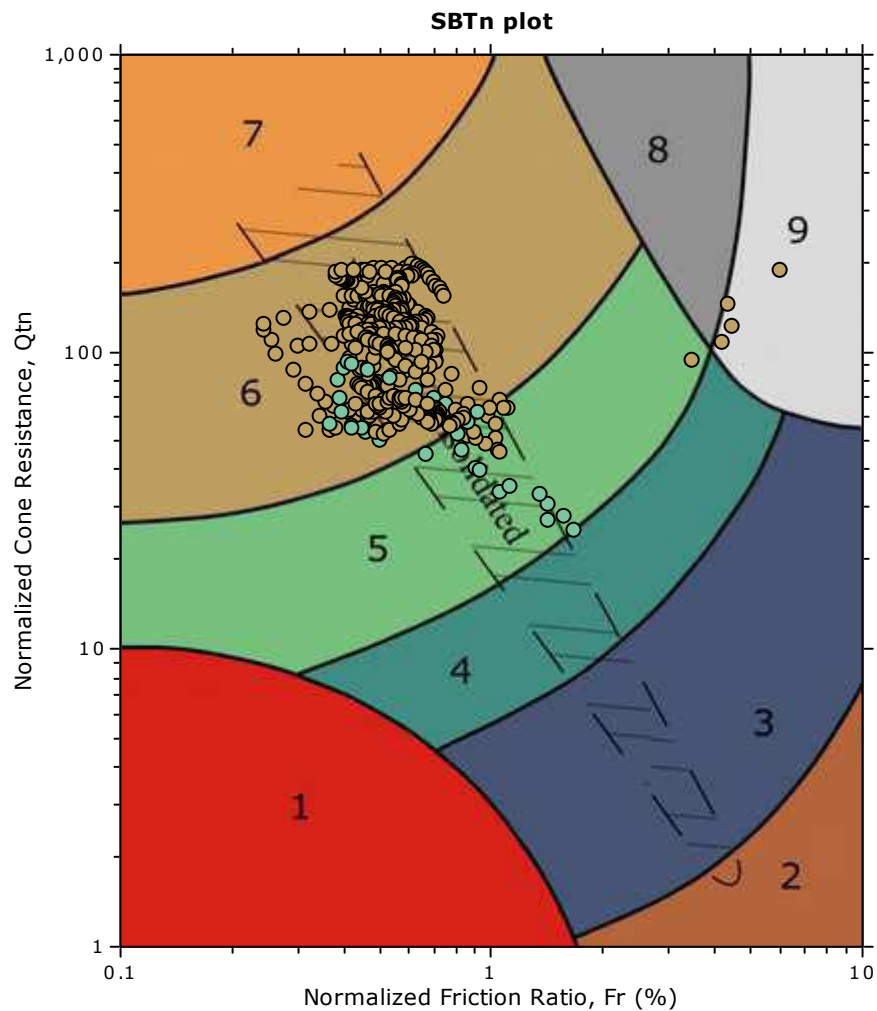
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)**

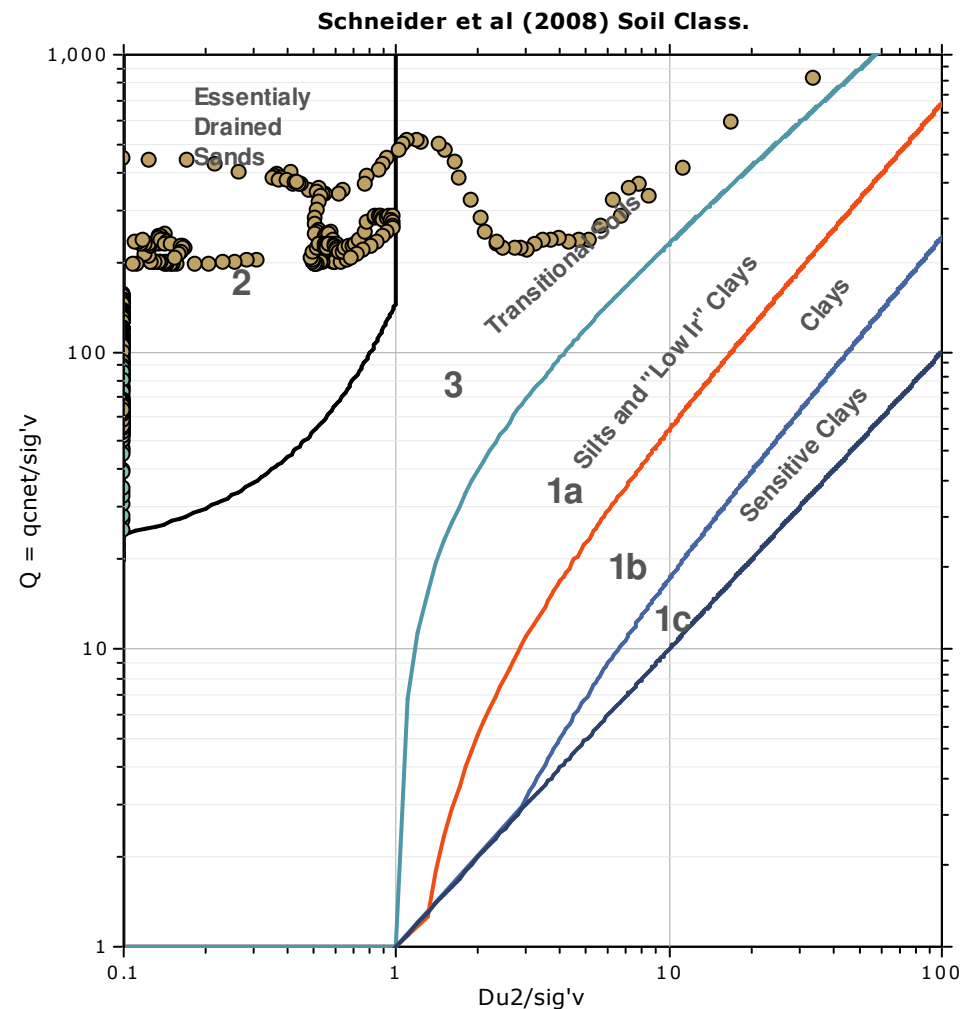
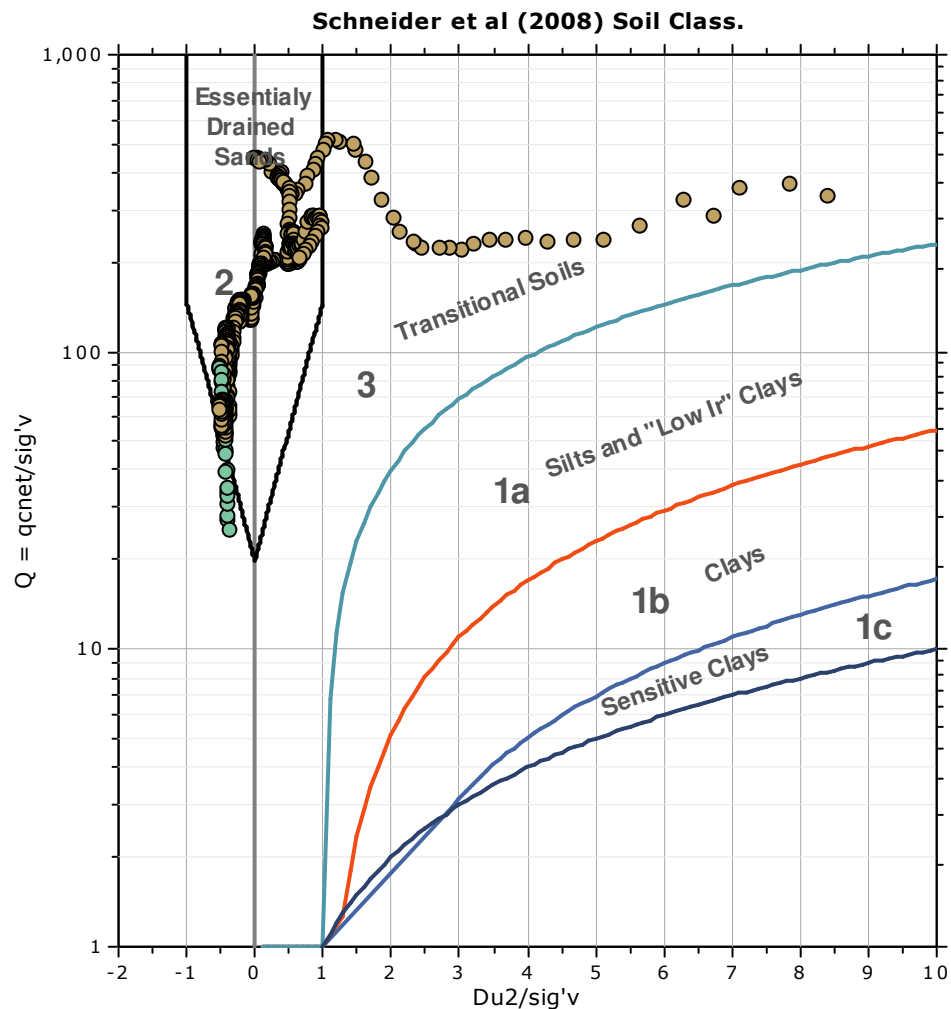


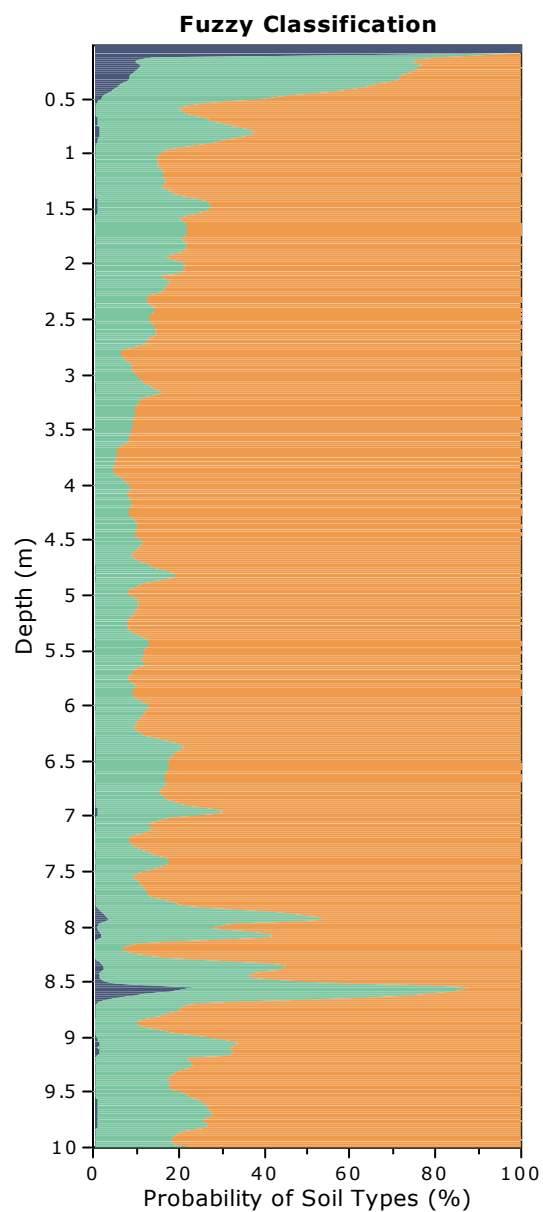
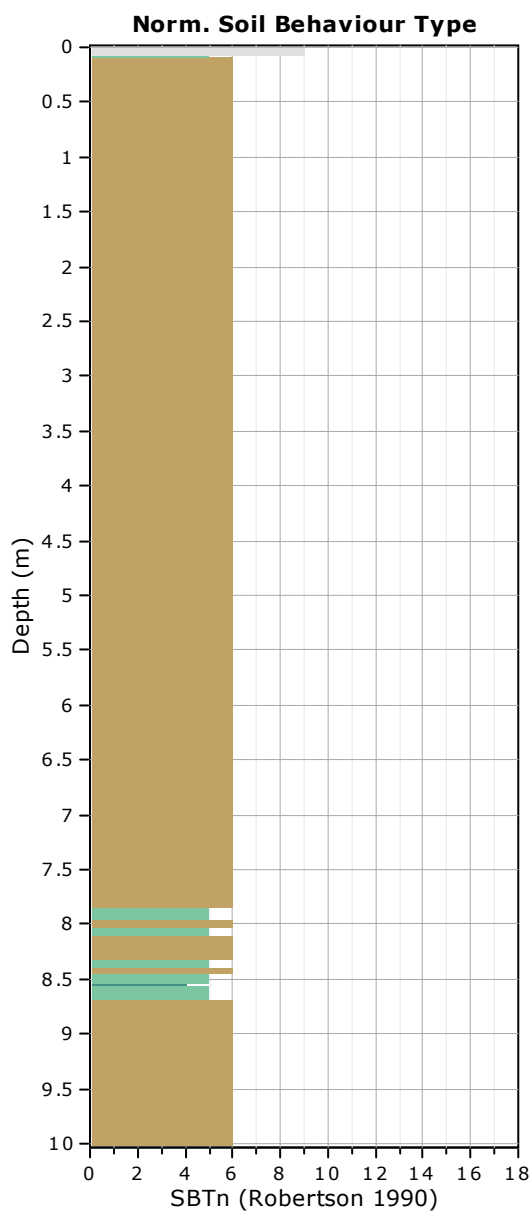
**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





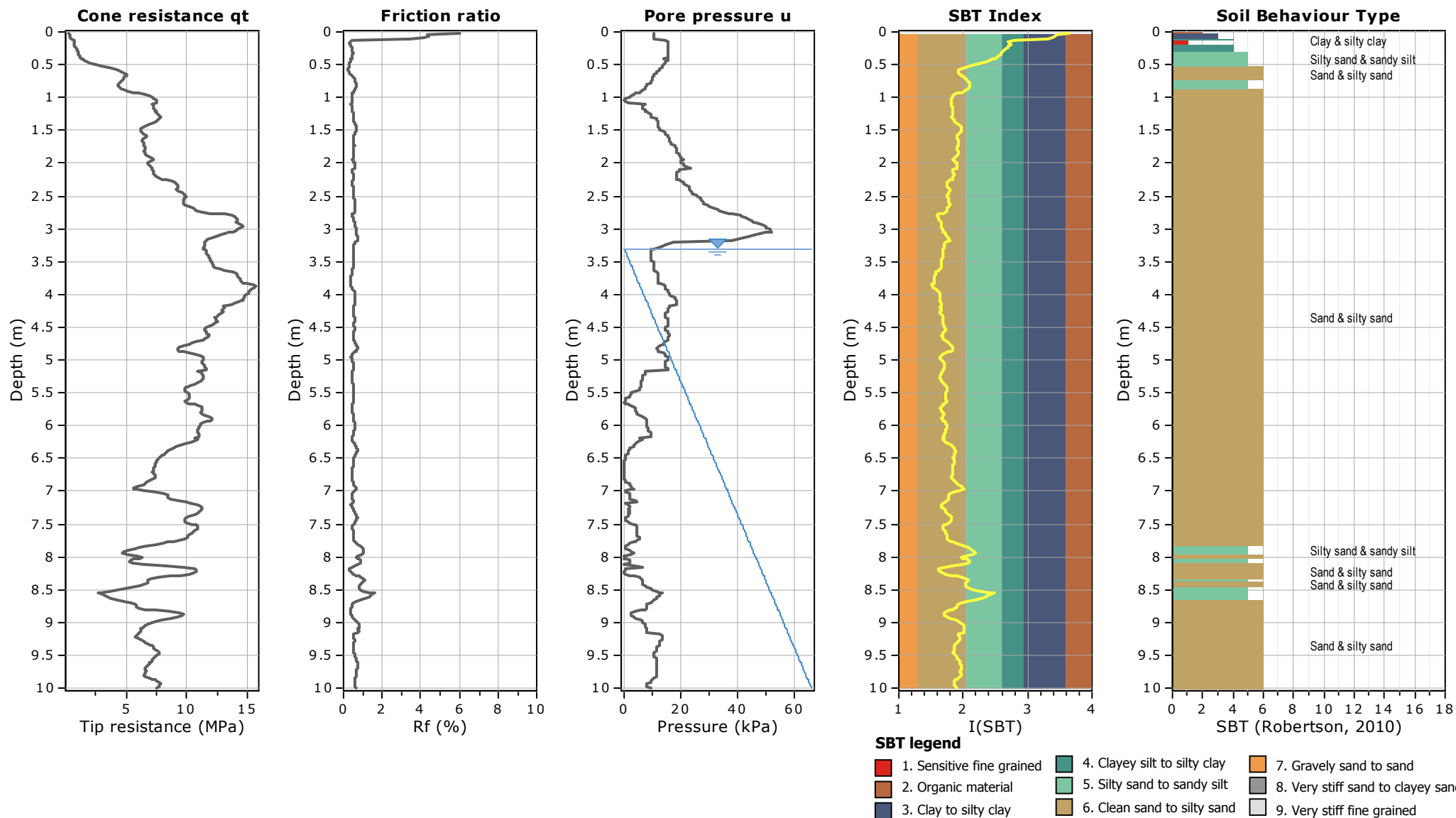
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+100**

Total depth: 10.00 m

Coords: lat 44.741212° lon 12.202932°



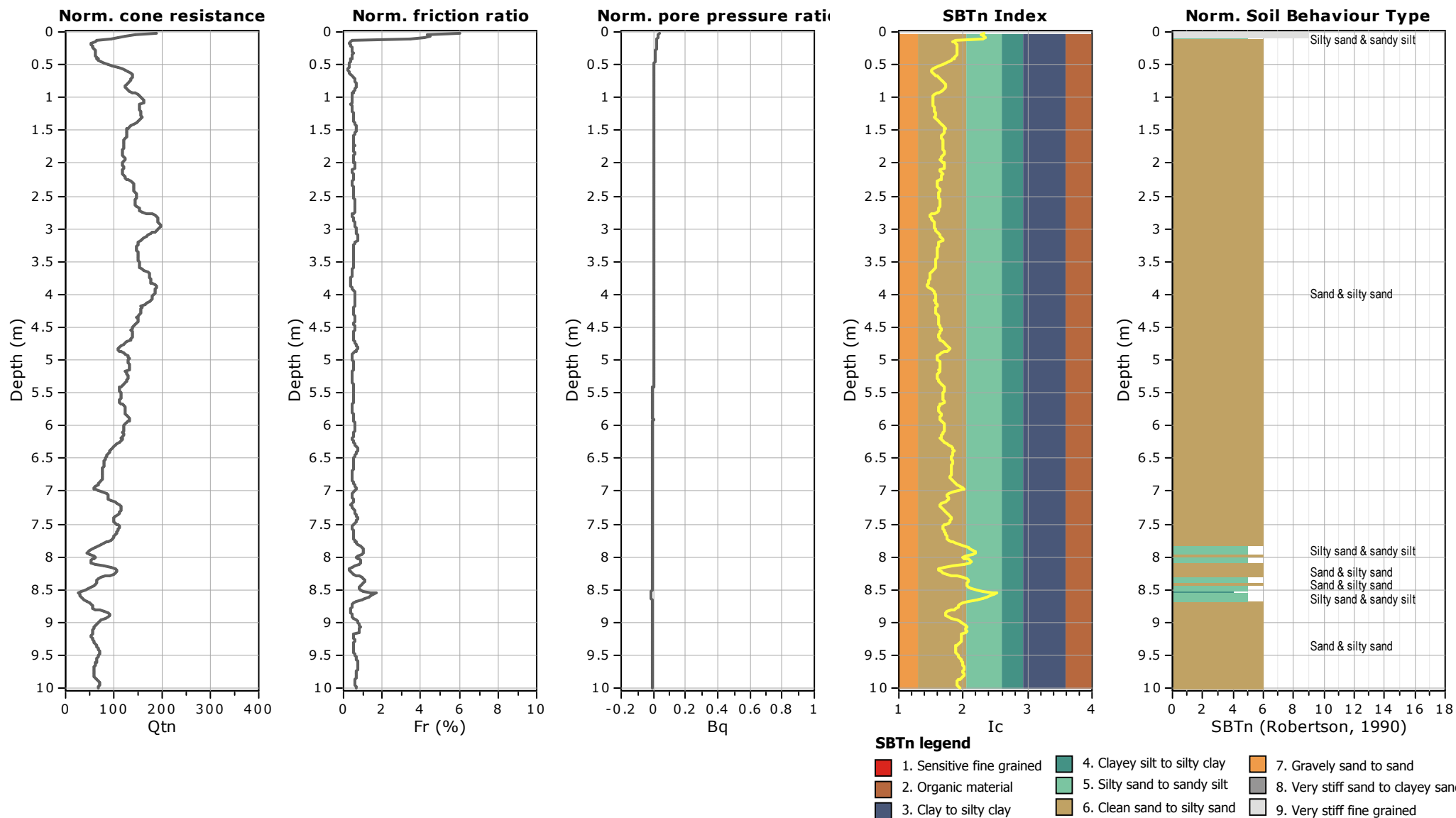
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+100**

Total depth: 10.00 m

Coords: lat 44.741212° lon 12.202932°



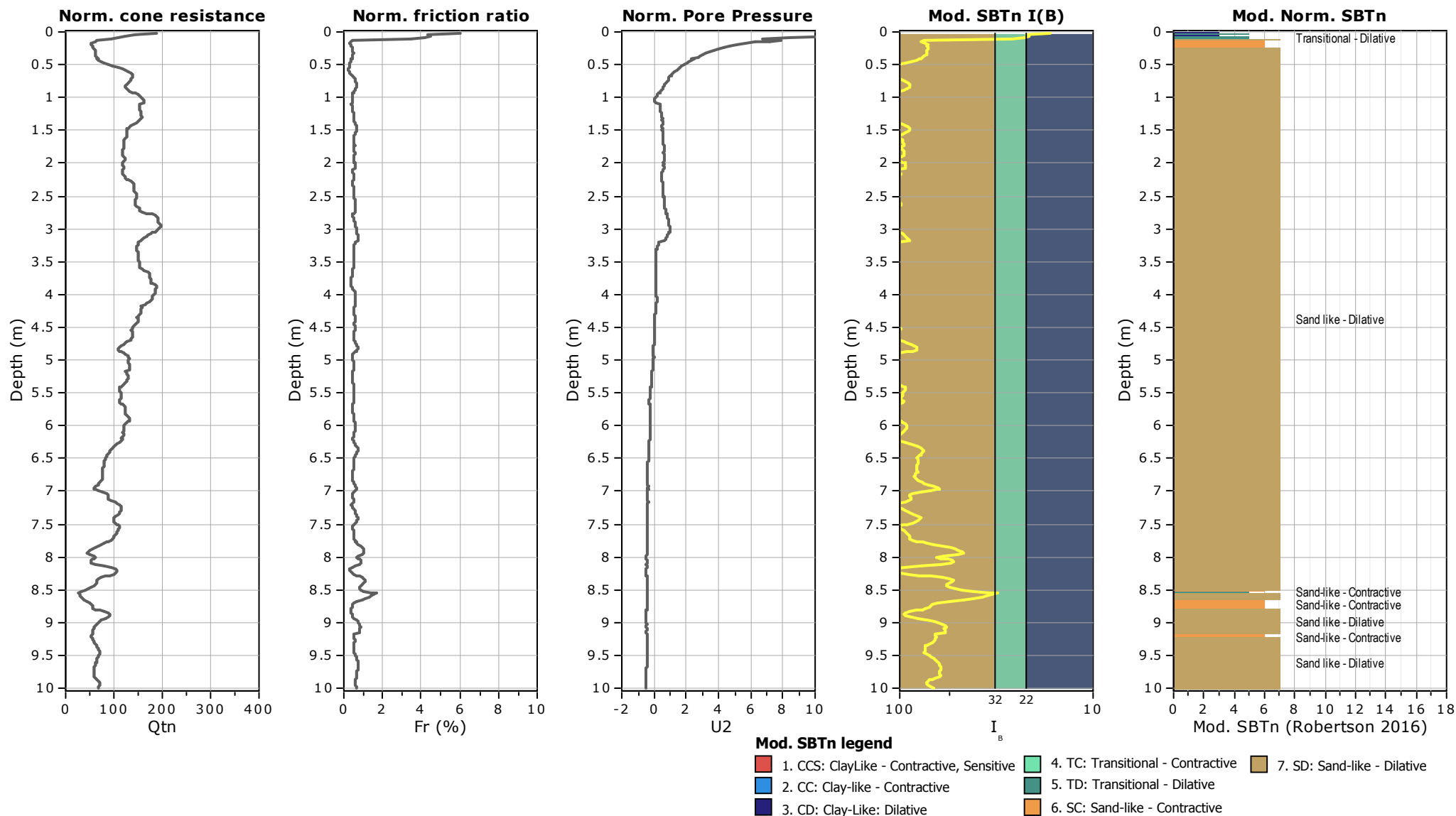
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+100**

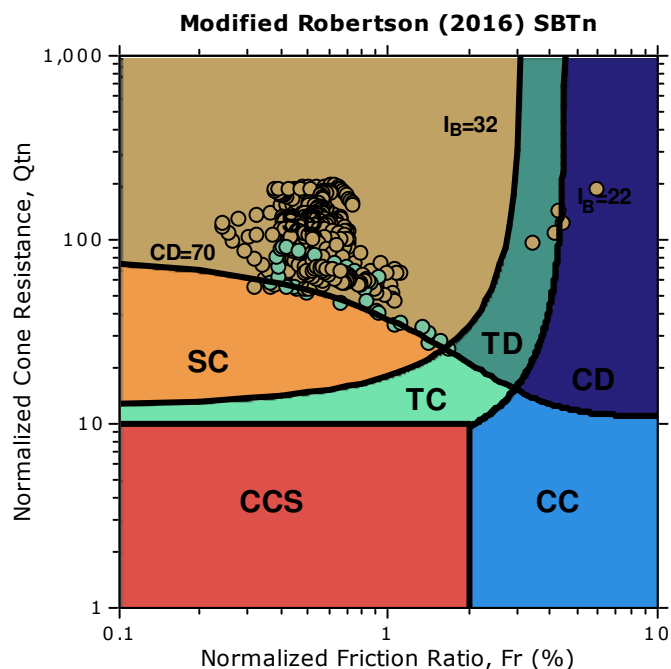
Total depth: 10.00 m

Coords: lat 44.741212° lon 12.202932°

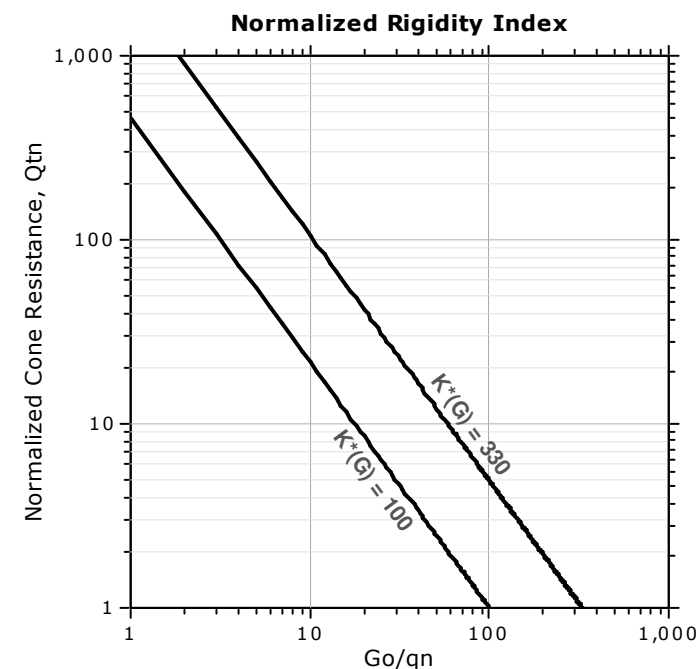
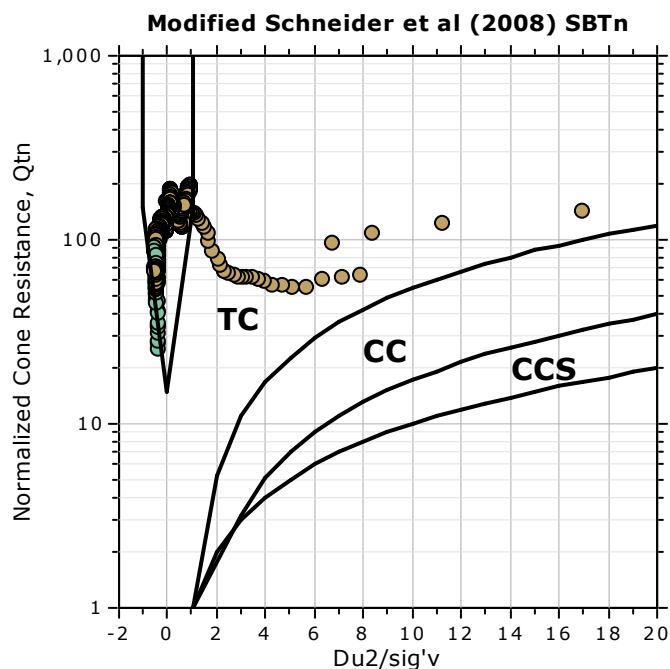




### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative



$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

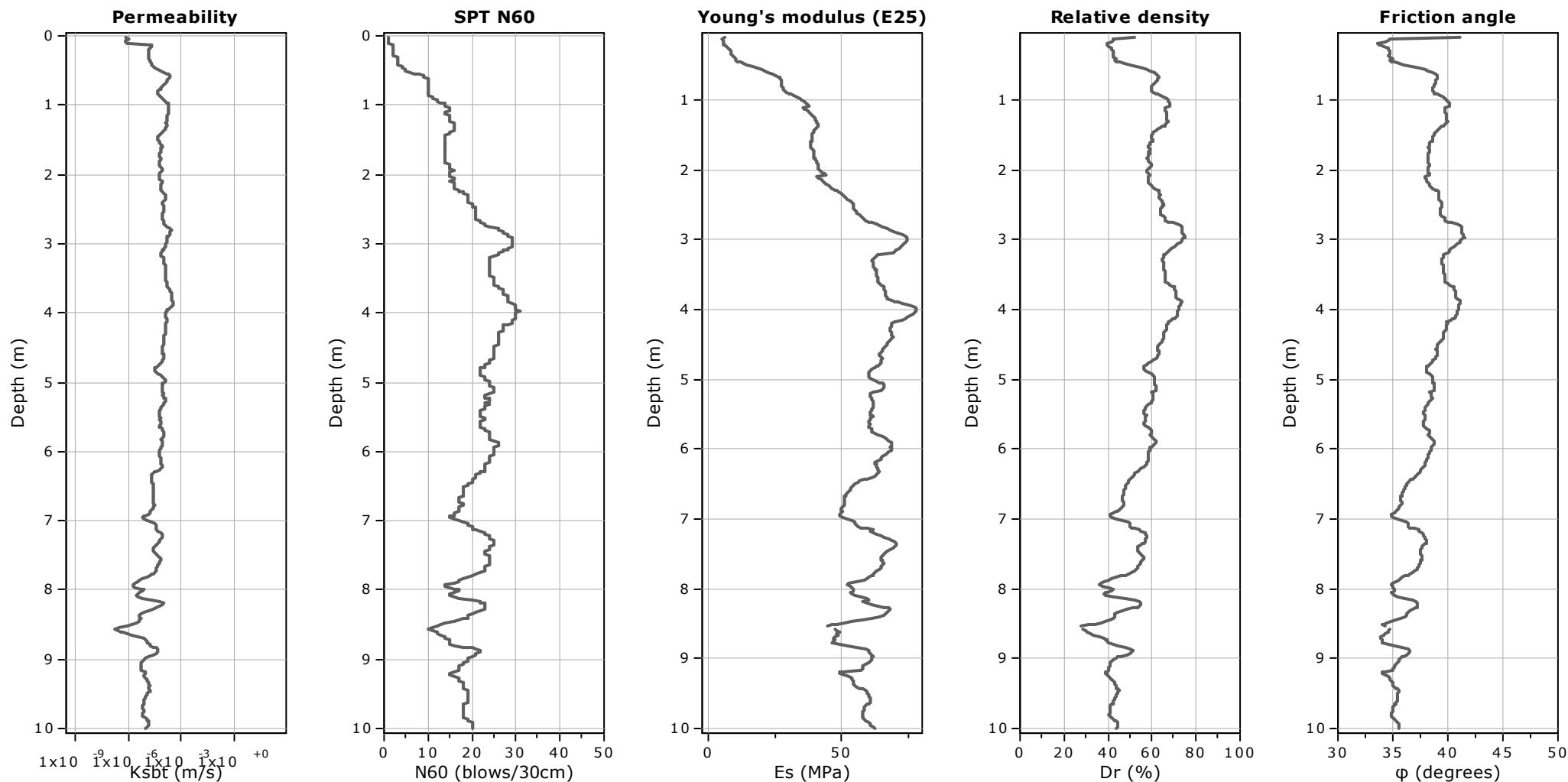
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+100**

Total depth: 10.00 m

Coords: lat 44.741212° lon 12.202932°



#### Calculation parameters

Permeability: Based on  $SBT_n$

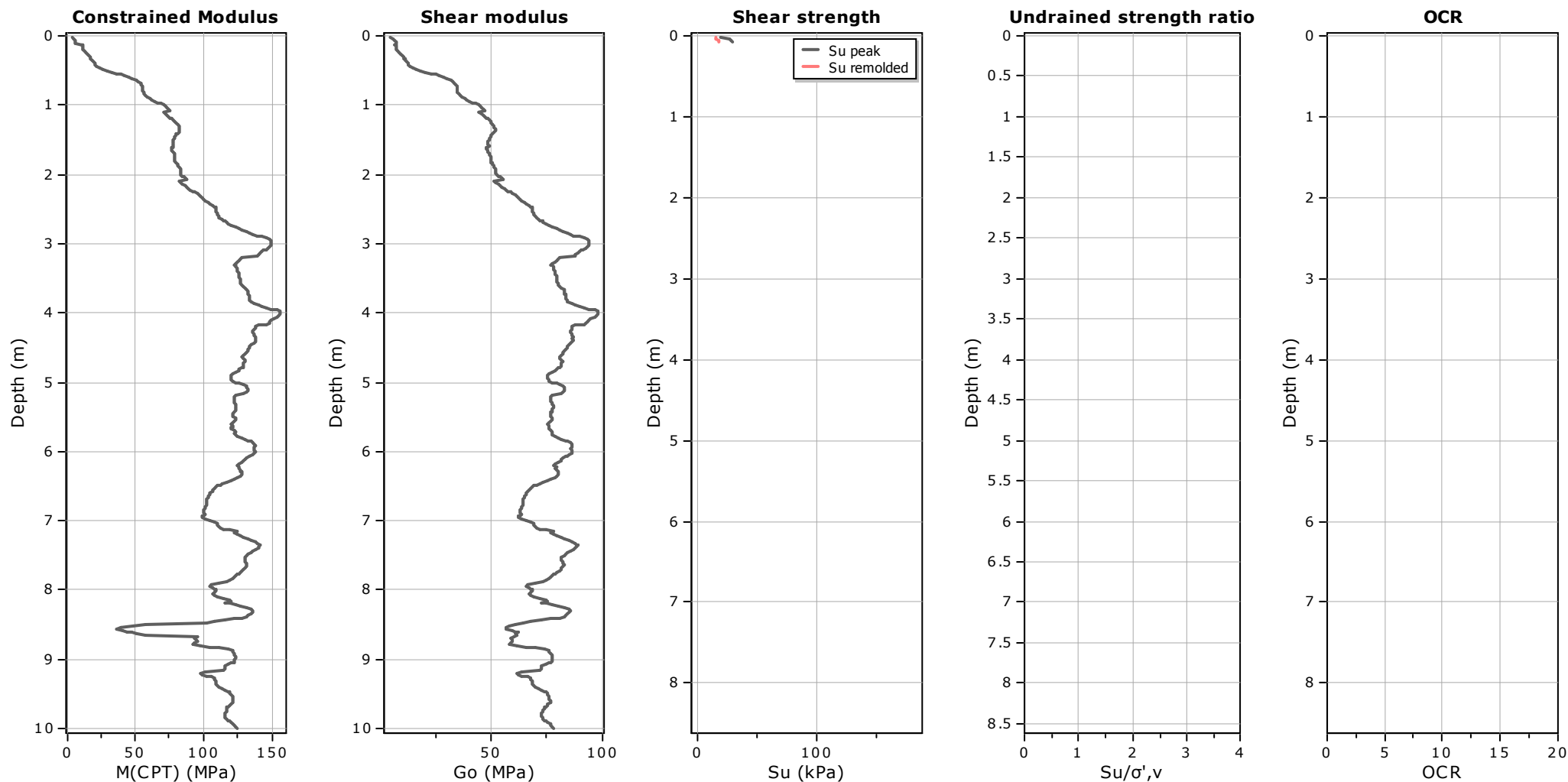
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

$G_o$ : Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

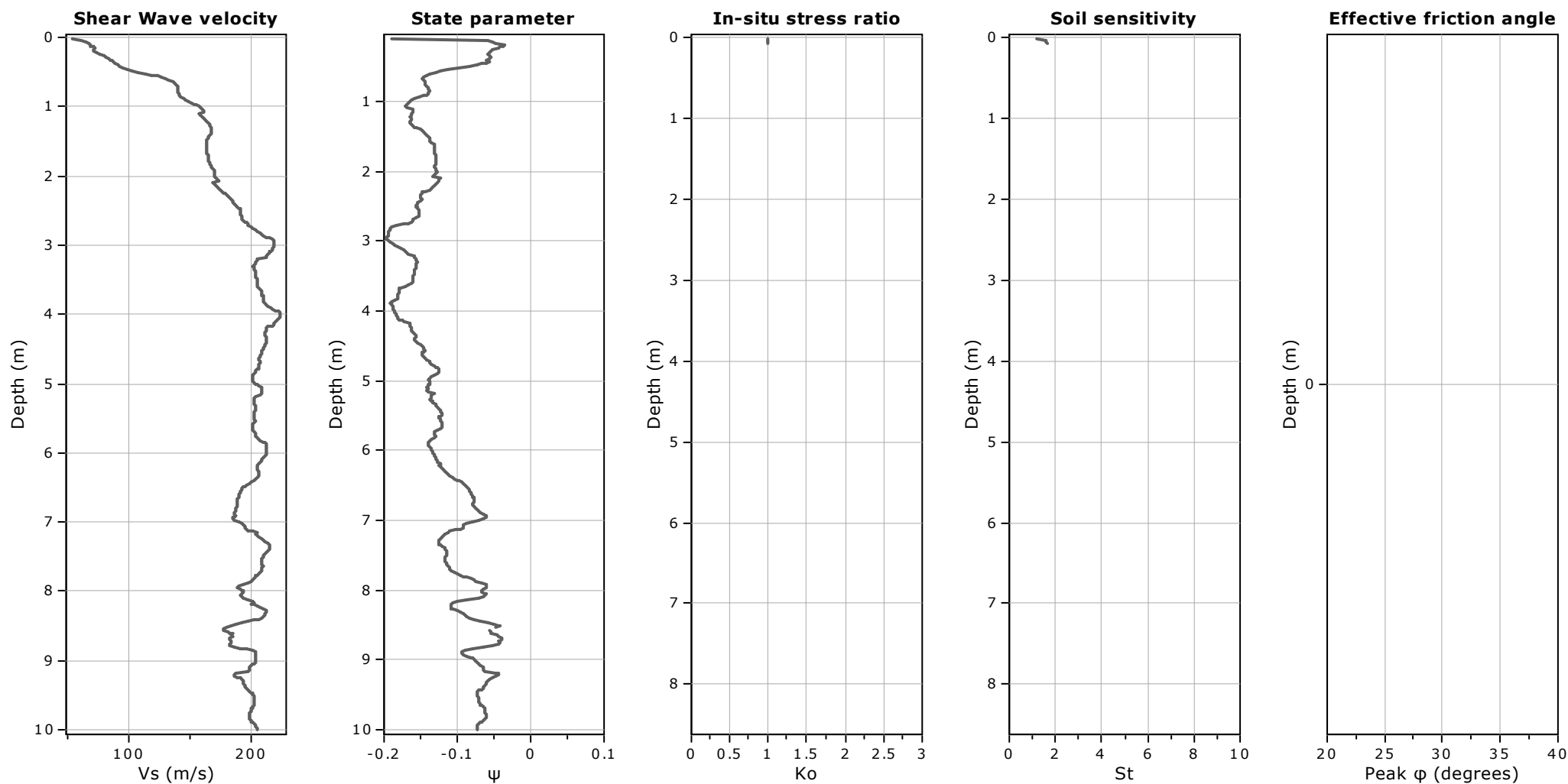
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+100**

Total depth: 10.00 m

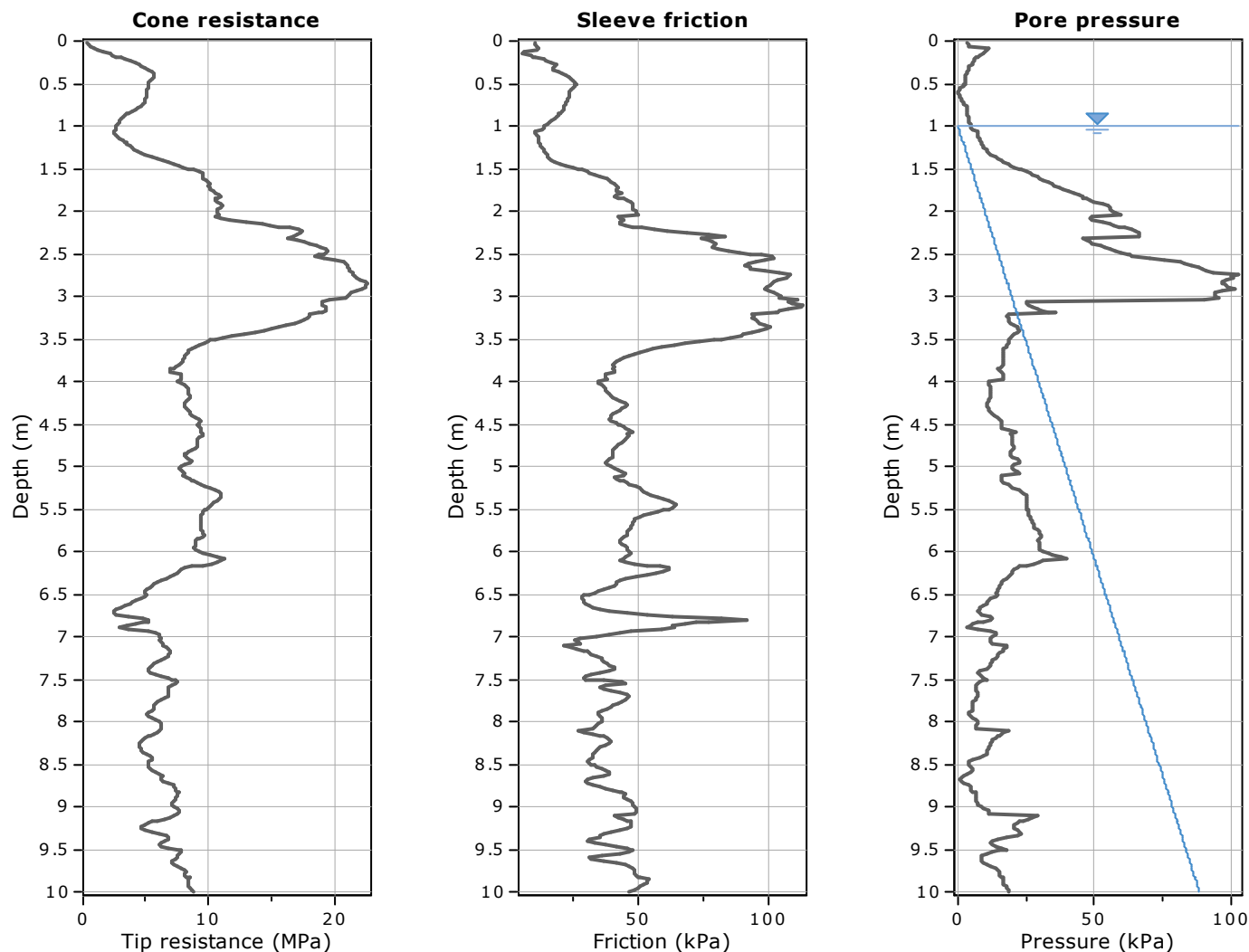
Coords: lat 44.741212° lon 12.202932°



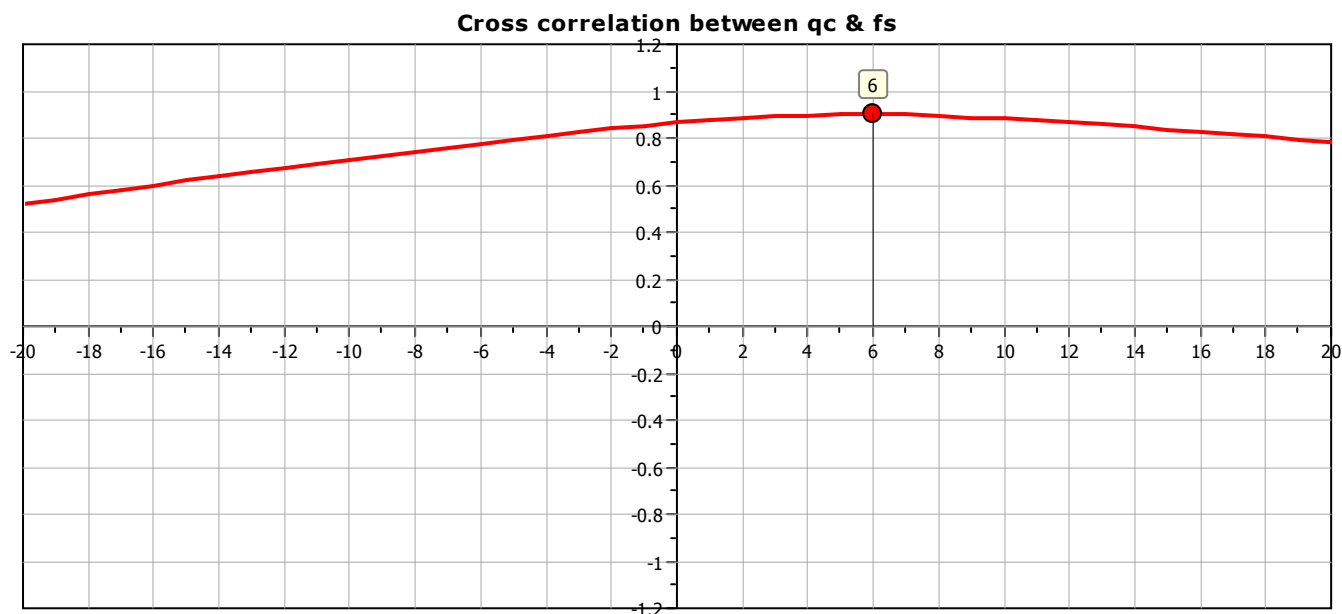
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

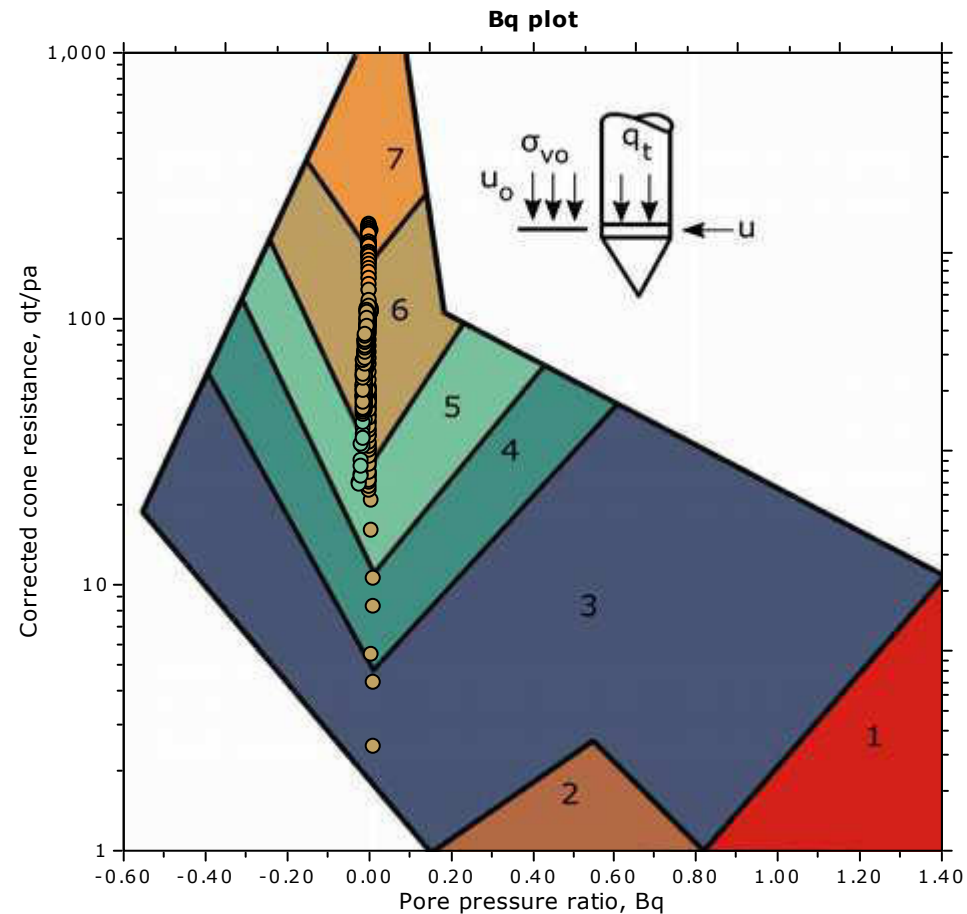
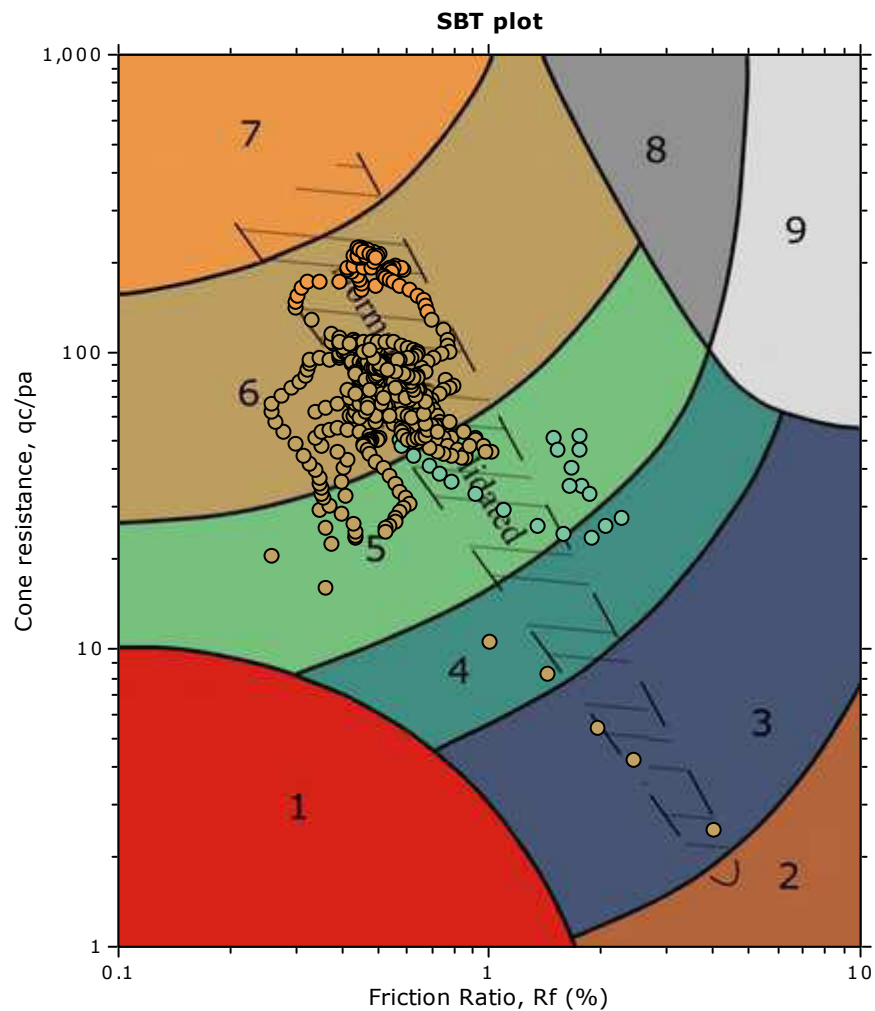


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





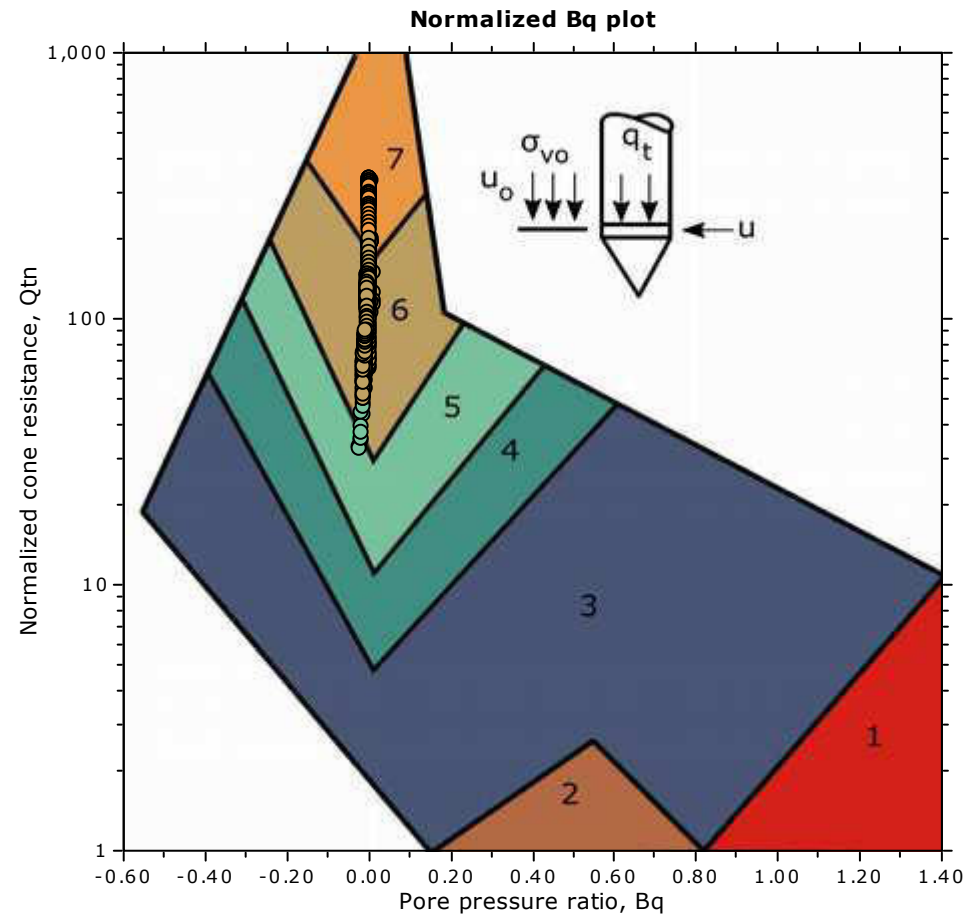
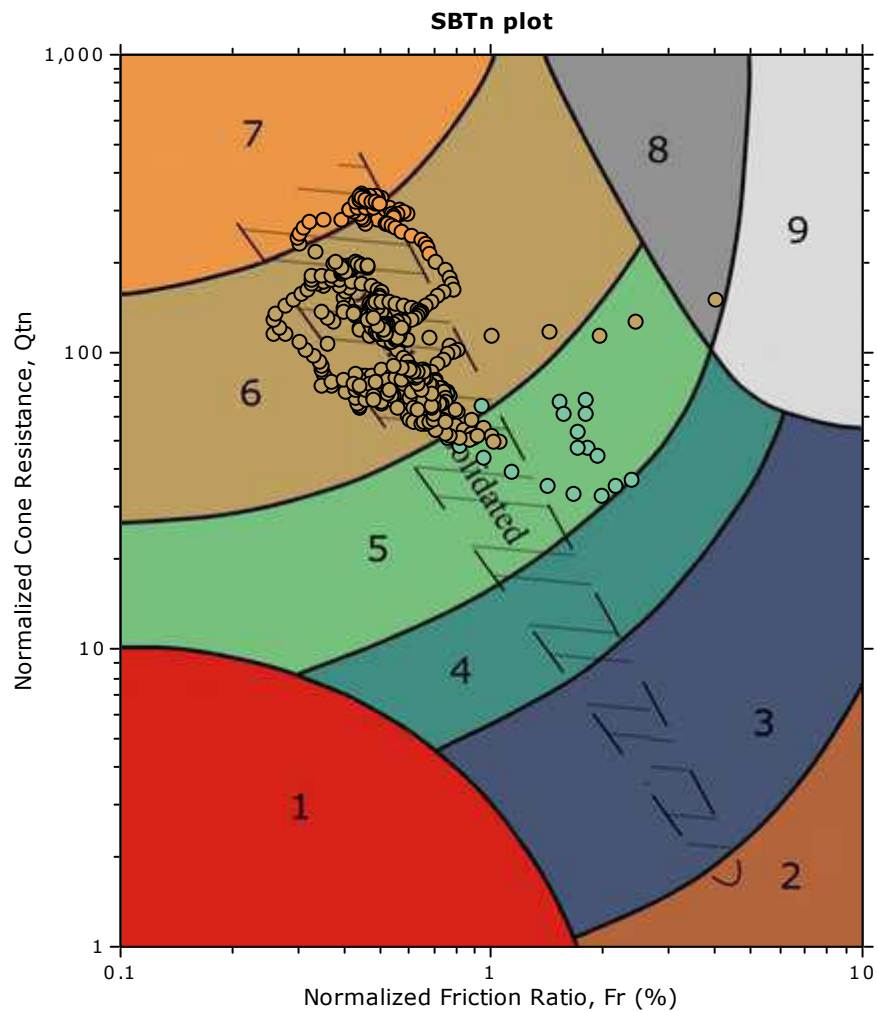
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

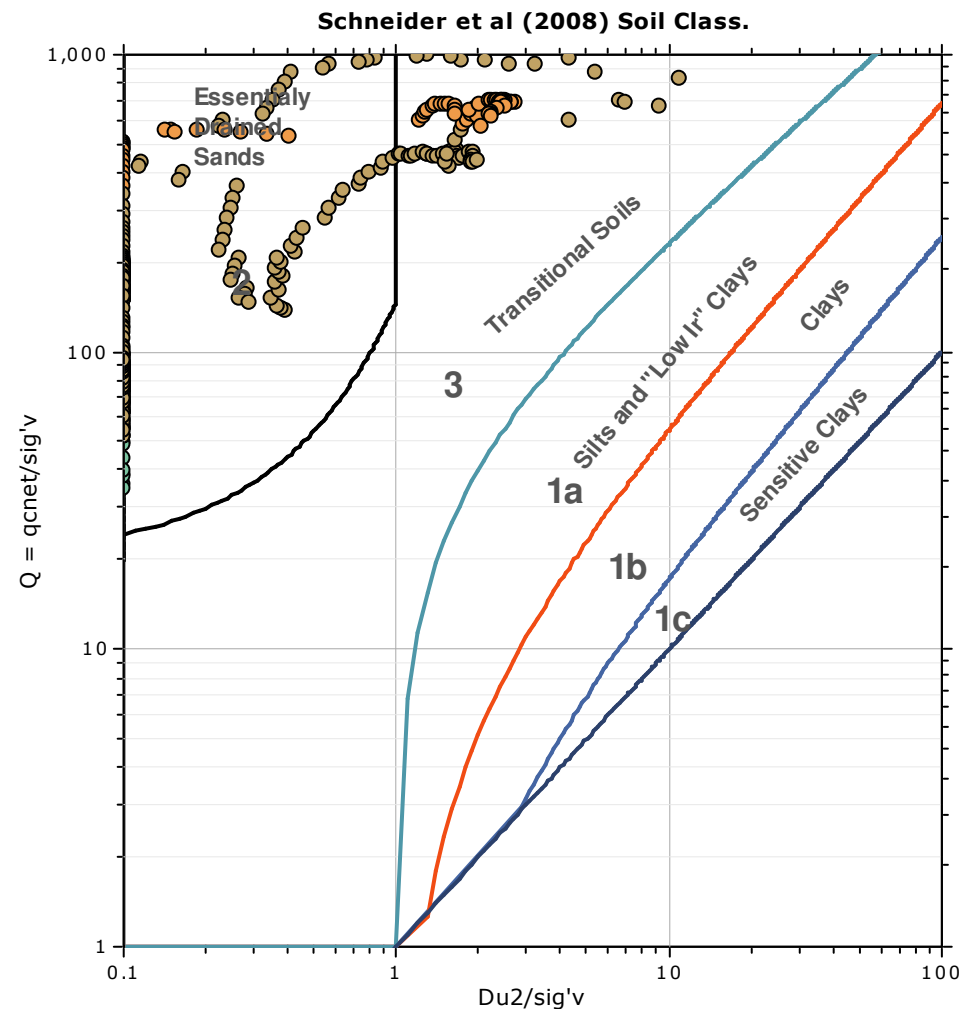
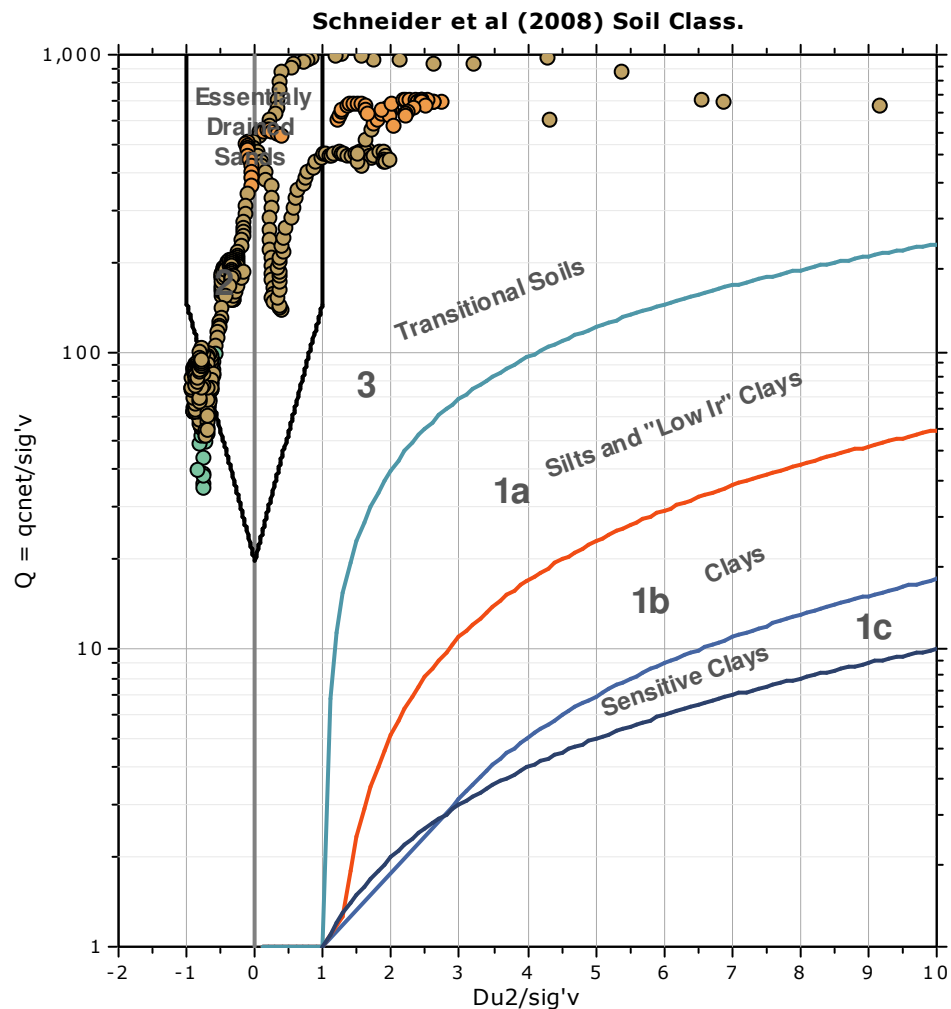
**SBT - Bq plots (normalized)**

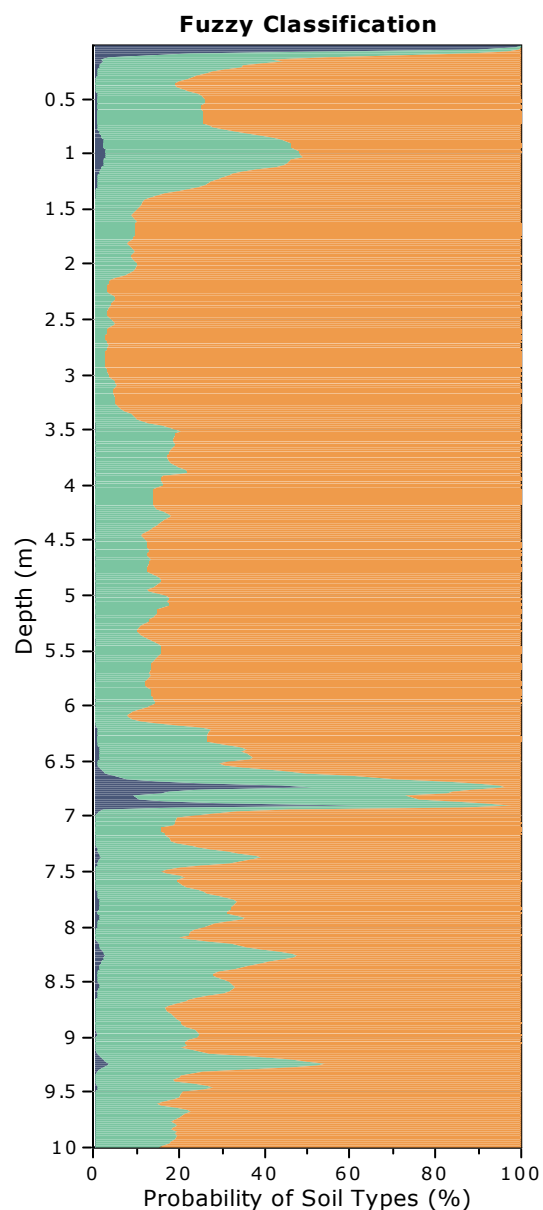
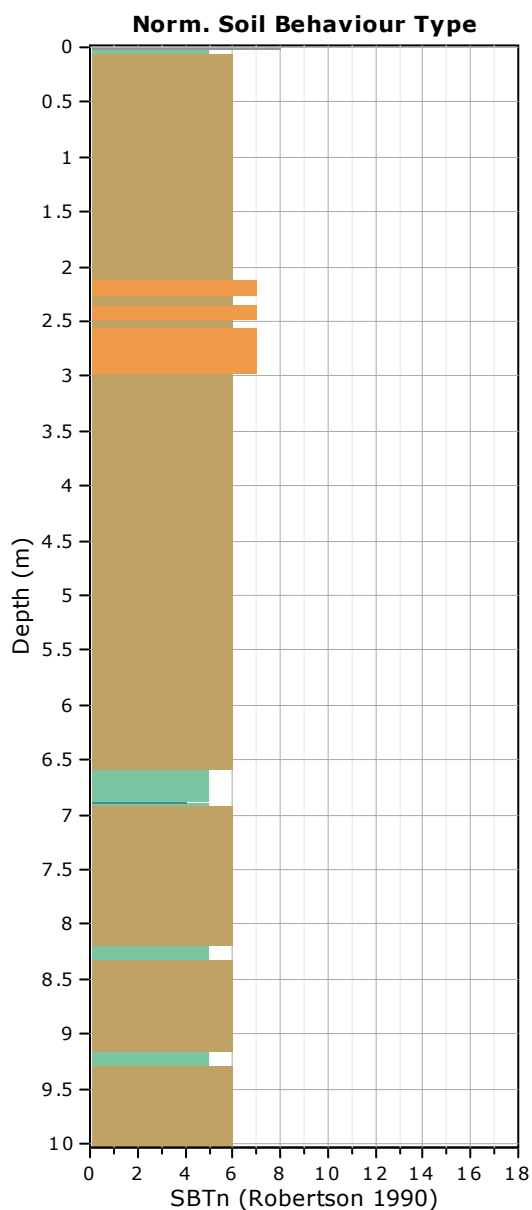


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





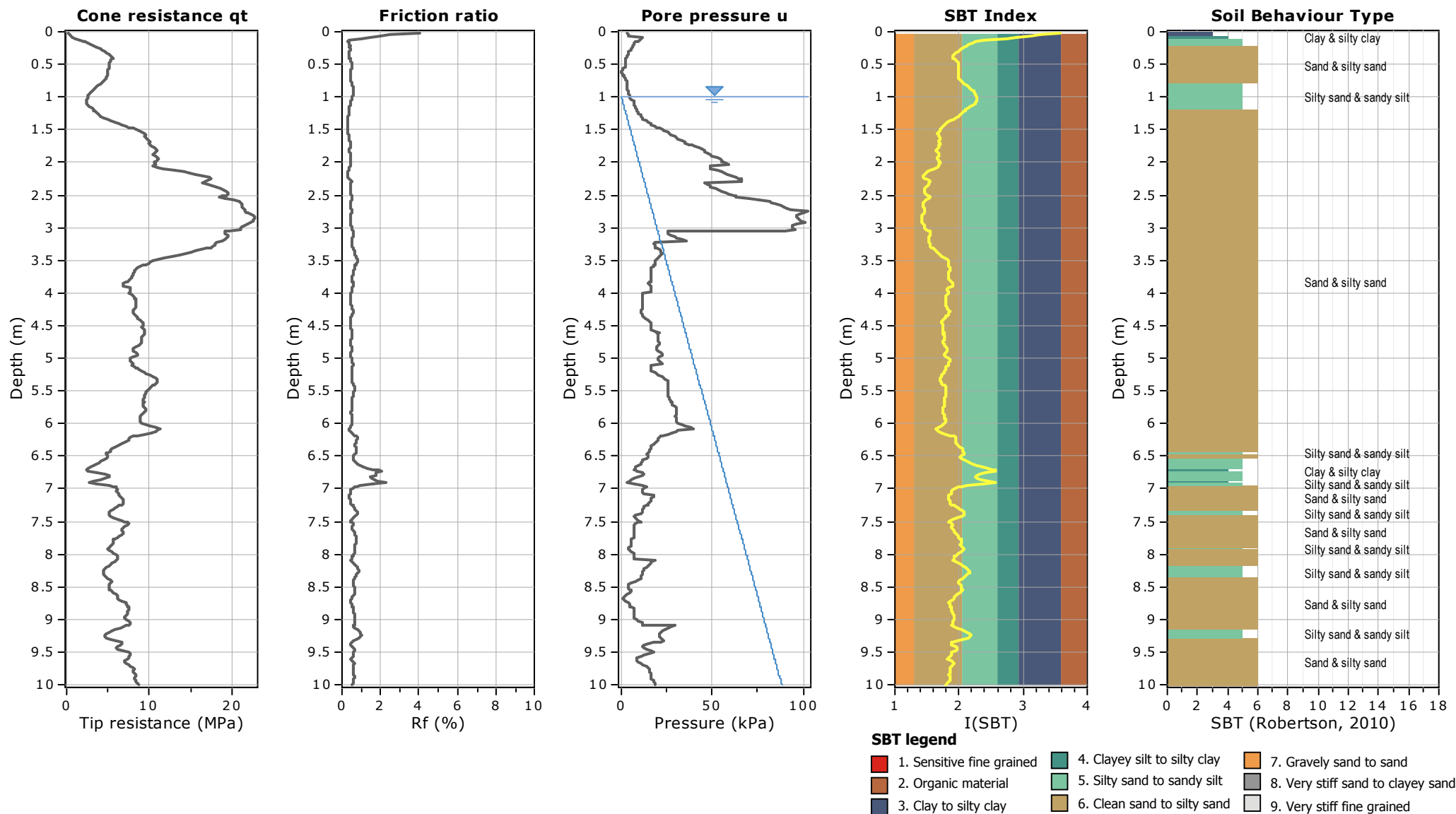
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+500**

Total depth: 10.00 m

Coords: lat 44.744605° lon 12.201383°





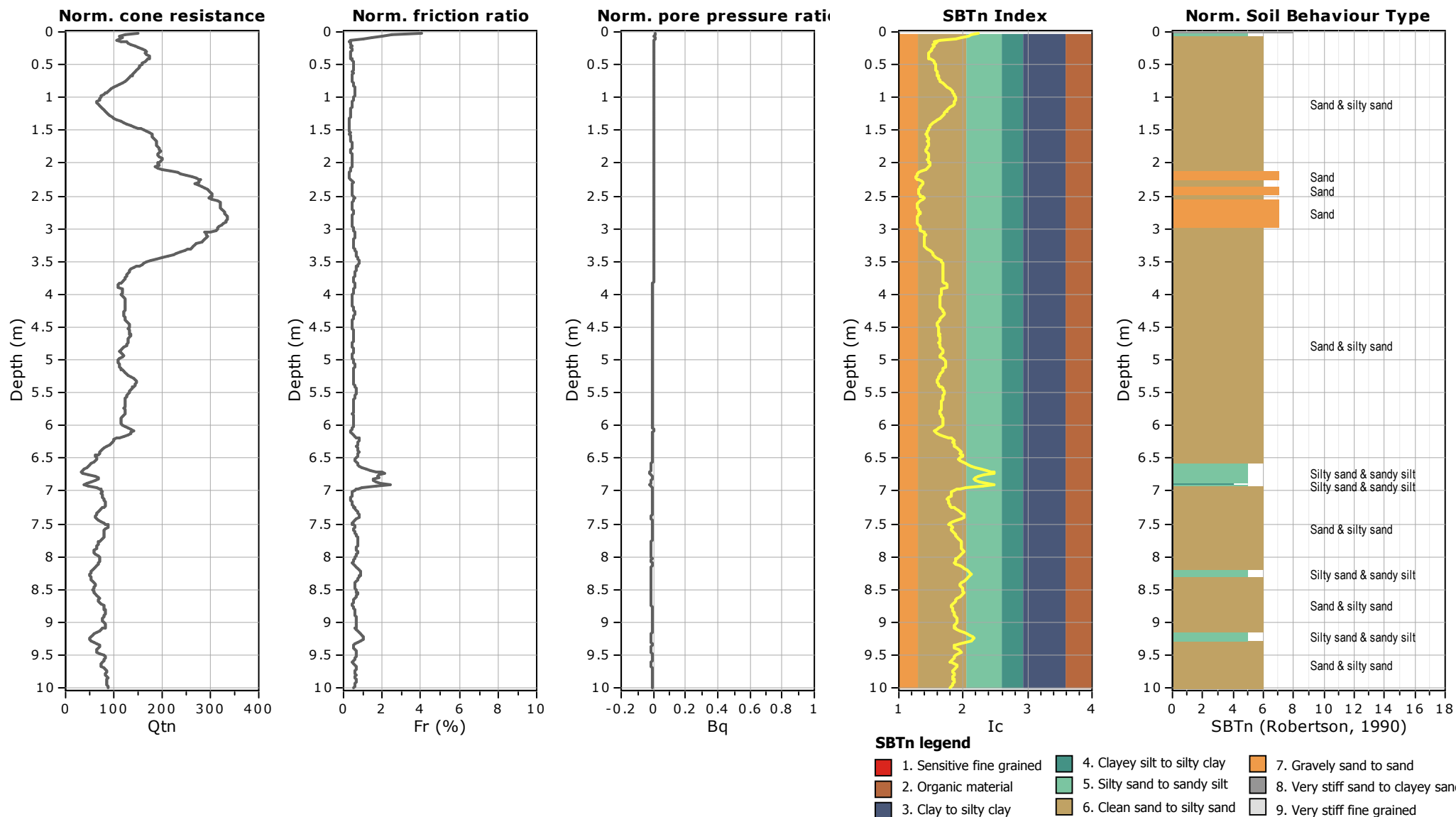
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+500**

Total depth: 10.00 m

Coords: lat 44.744605° lon 12.201383°



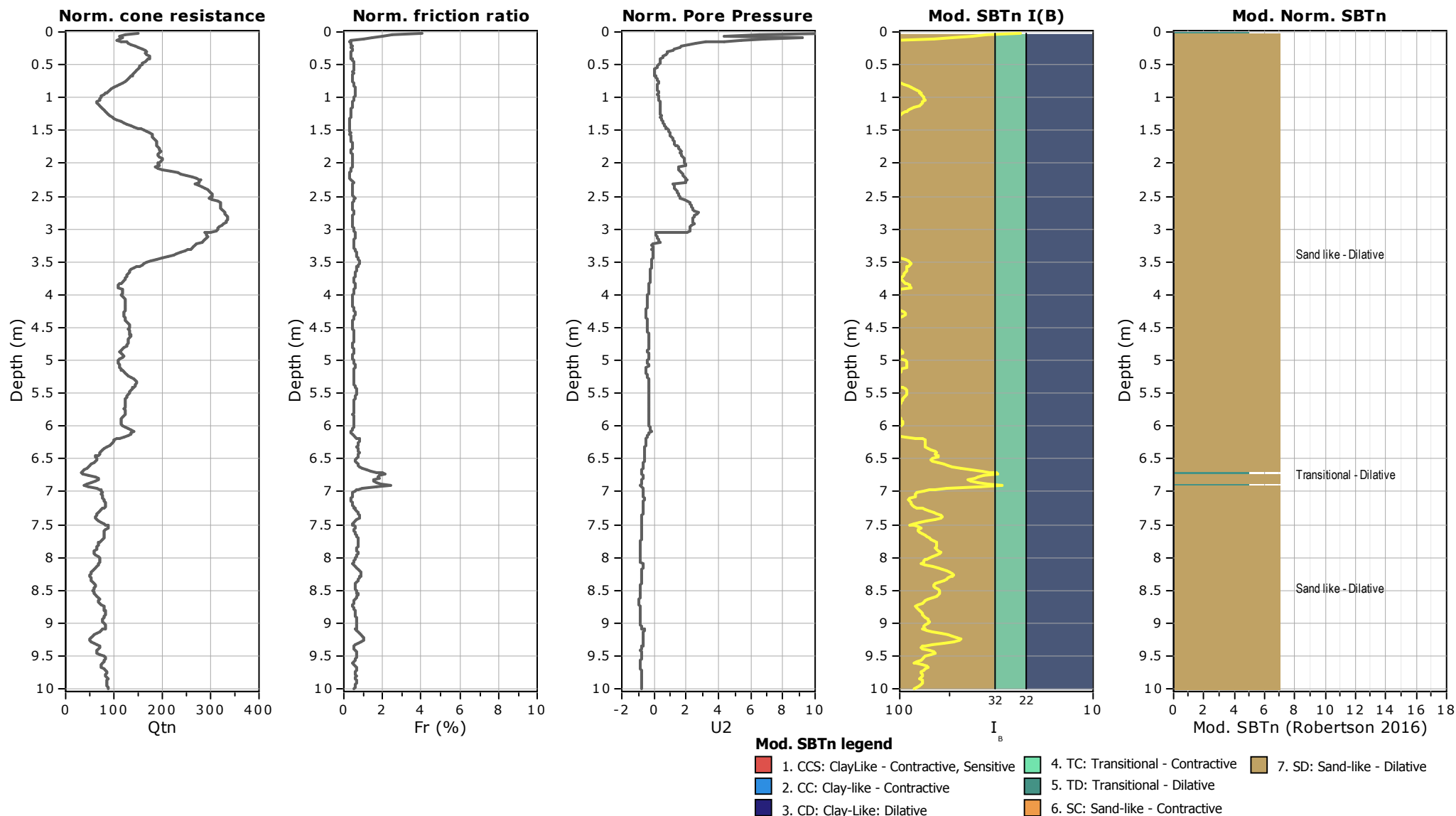
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

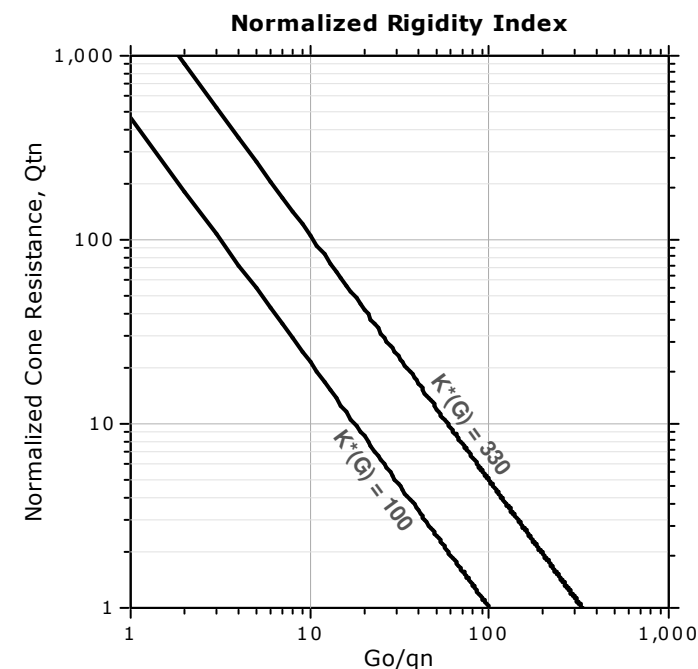
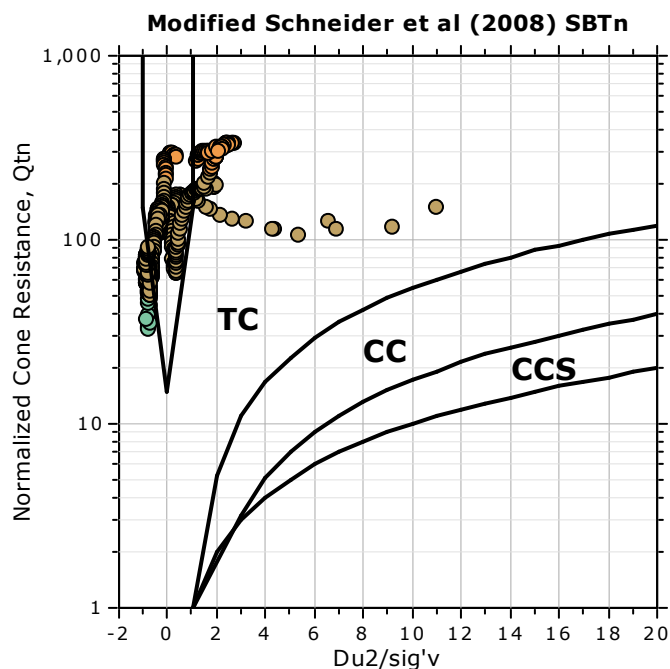
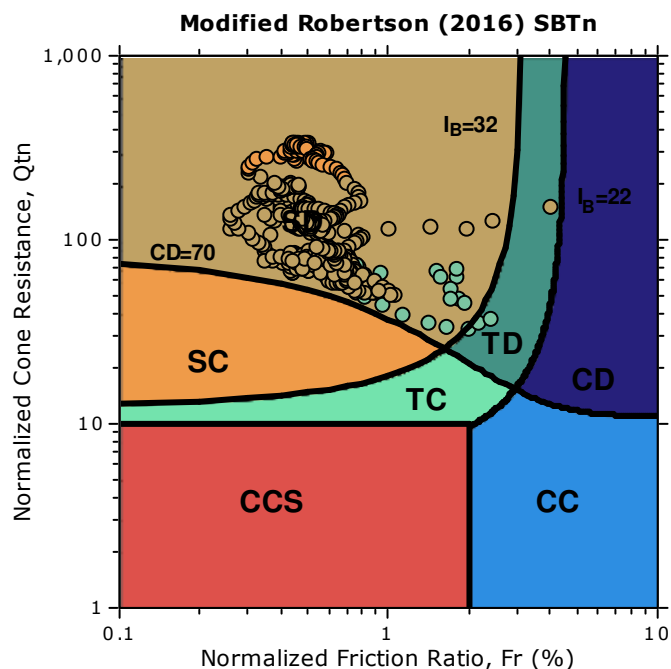
**CPT: CPTU km33+500**

Total depth: 10.00 m

Coords: lat 44.744605° lon 12.201383°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

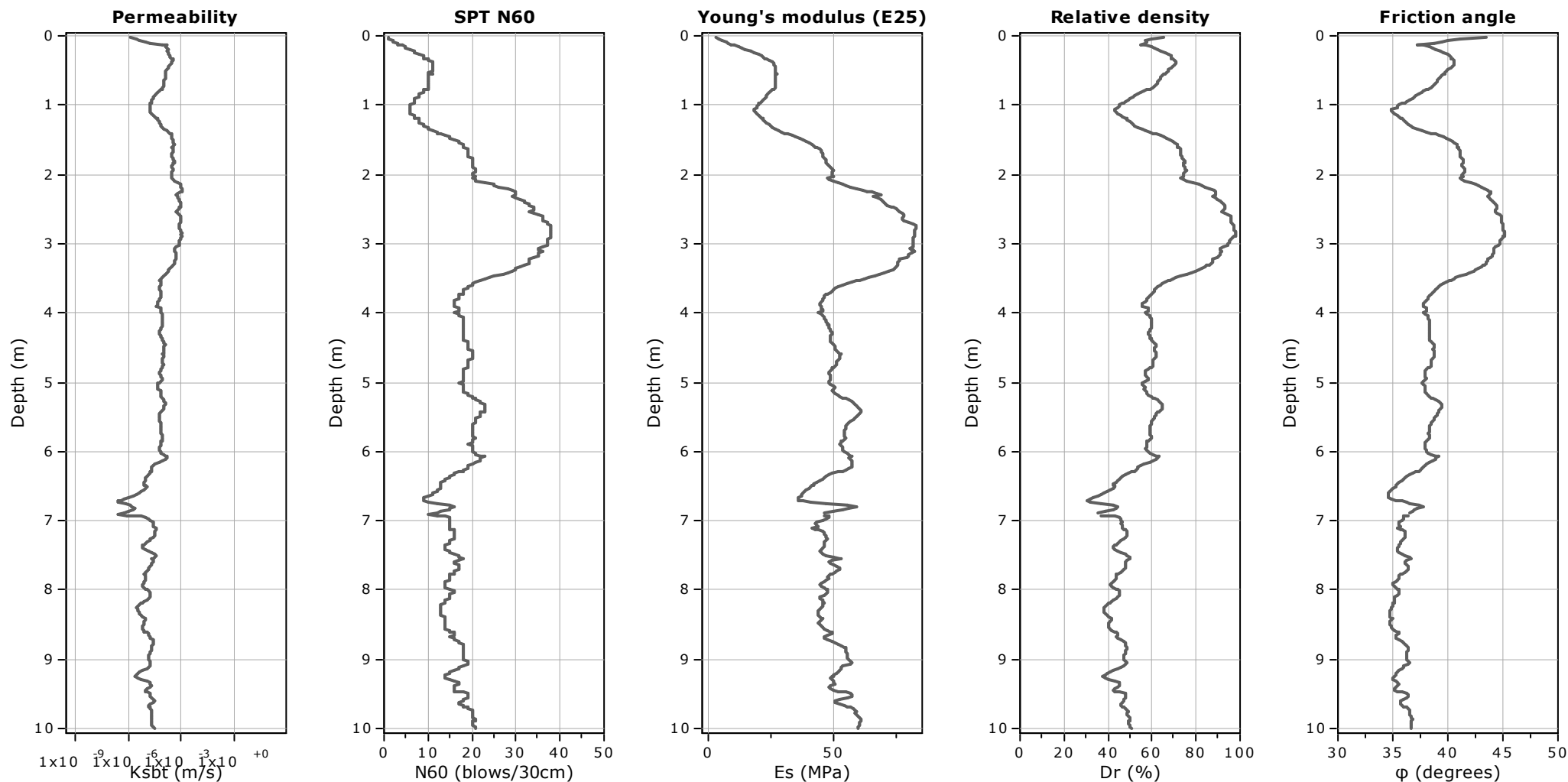
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+500**

Total depth: 10.00 m

Coords: lat 44.744605° lon 12.201383°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

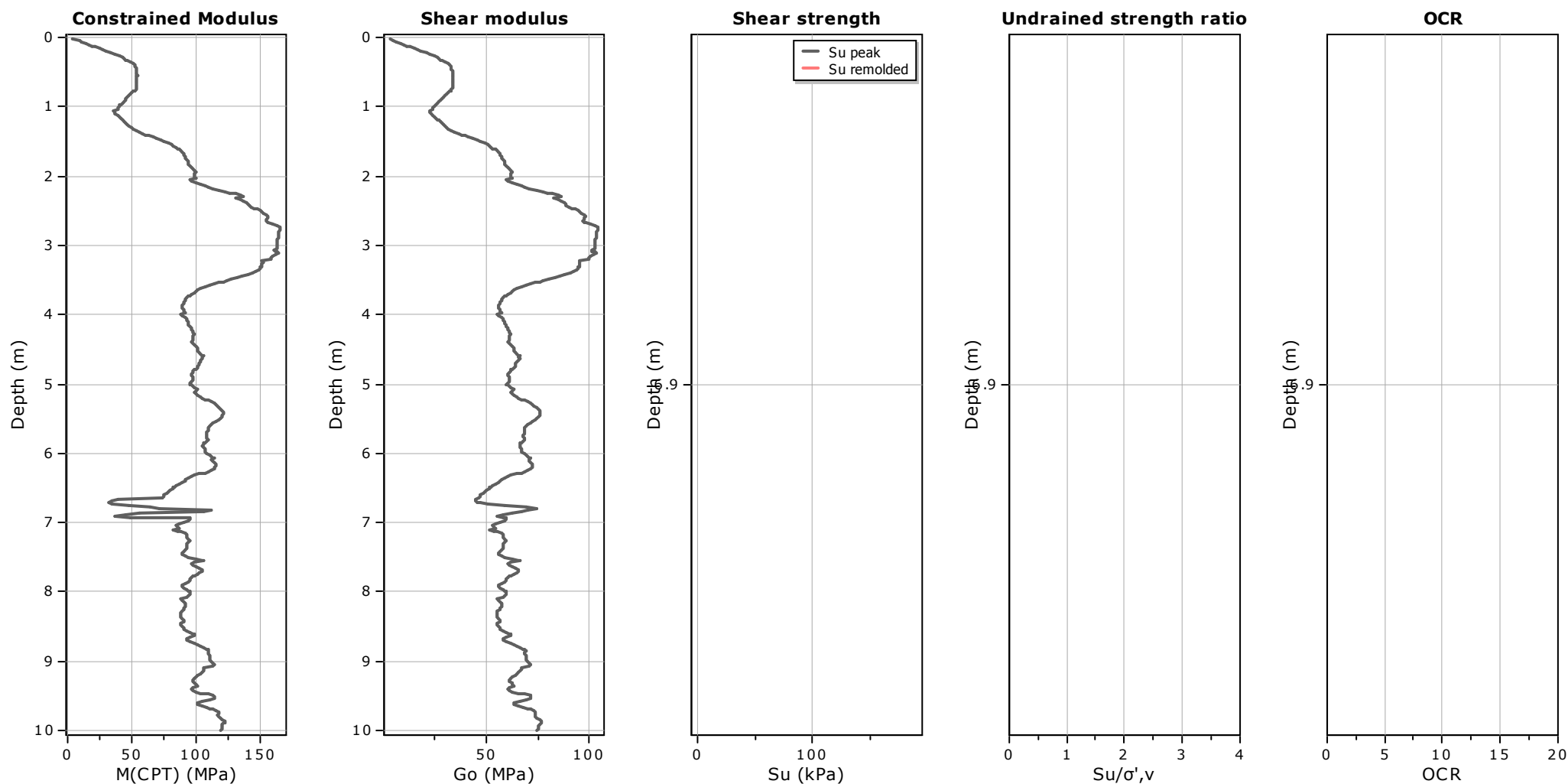
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+500**

Total depth: 10.00 m

Coords: lat 44.744605° lon 12.201383°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data



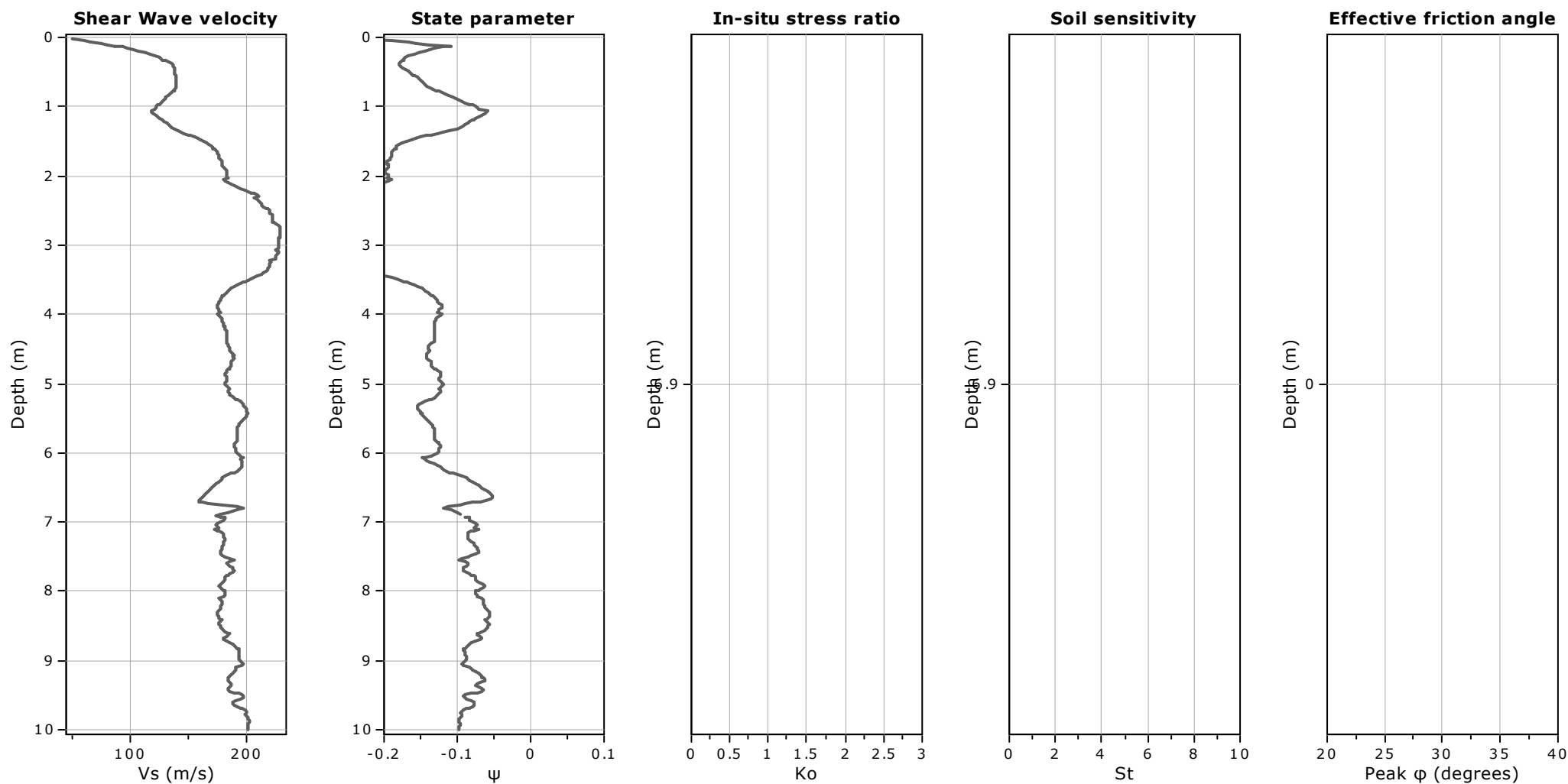
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km33+500**

Total depth: 10.00 m

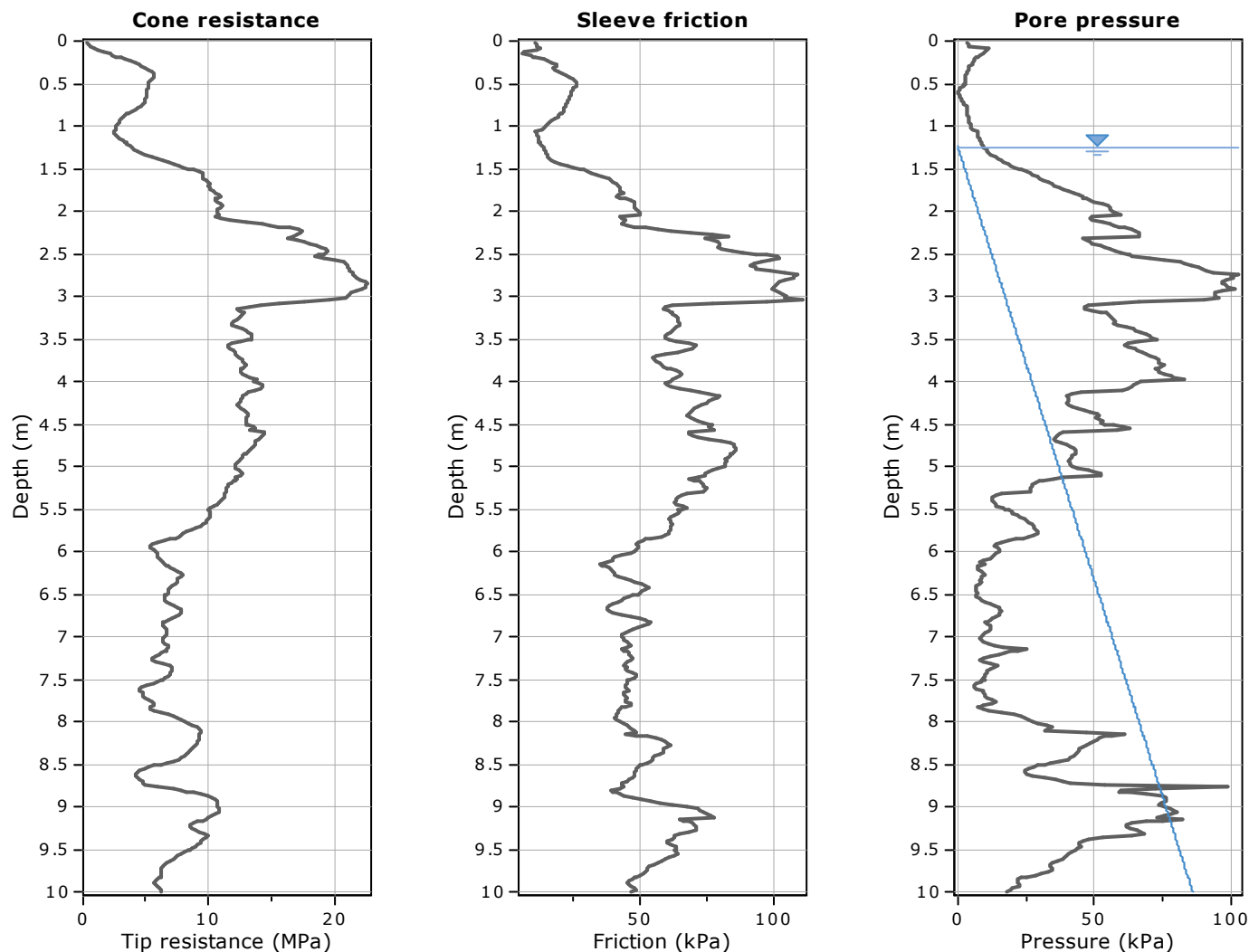
Coords: lat 44.744605° lon 12.201383°



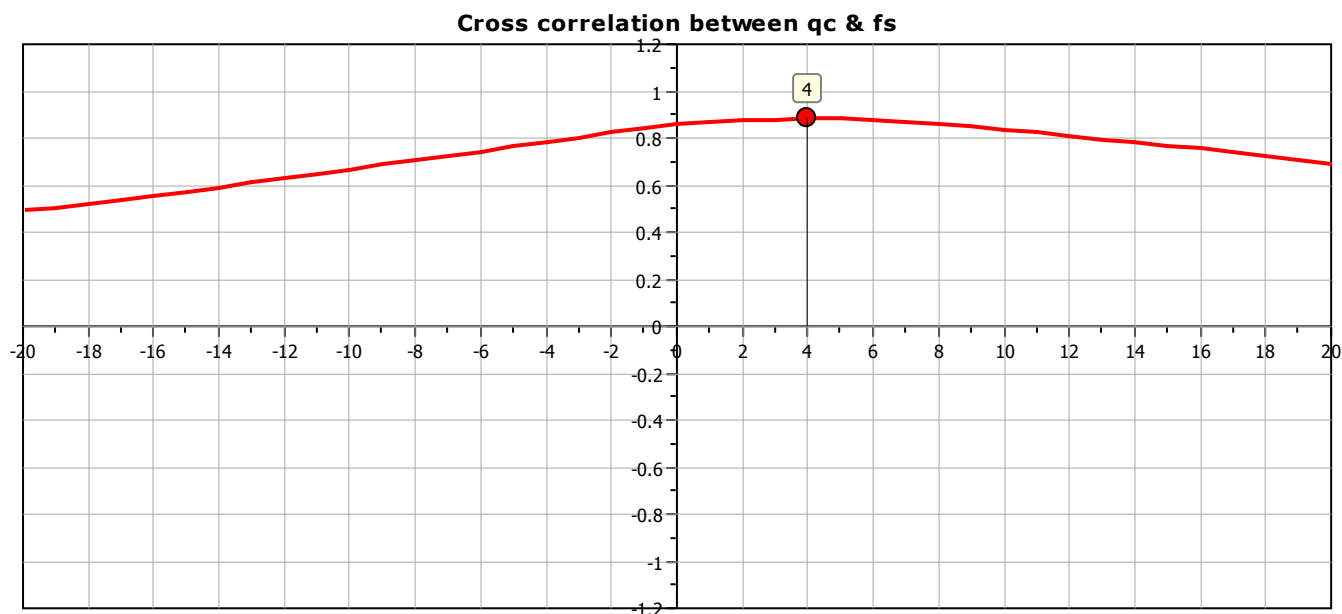
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

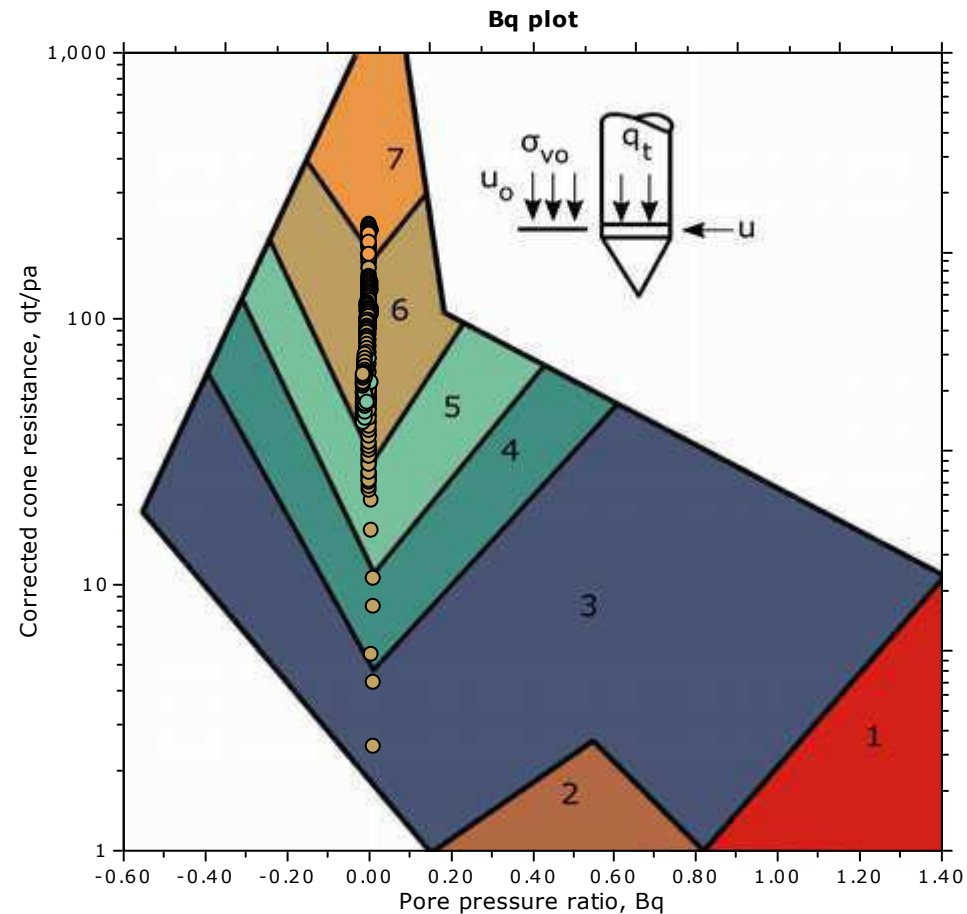
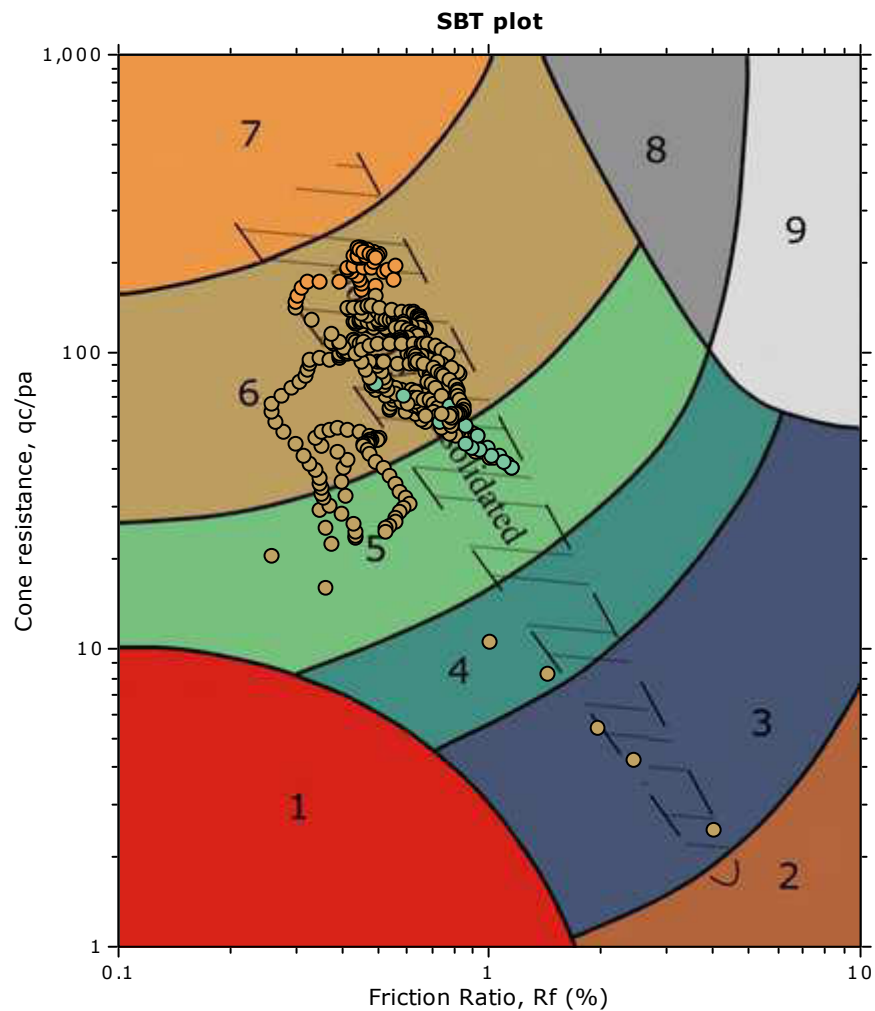
—●— User defined estimation data



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



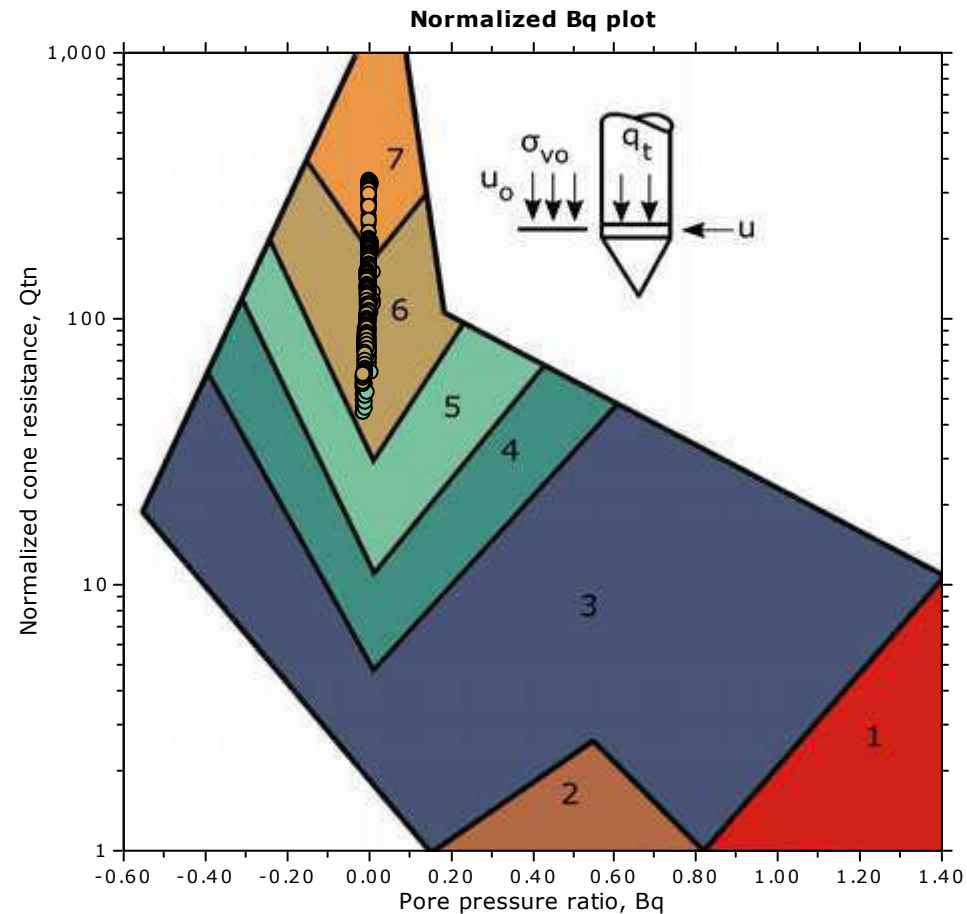
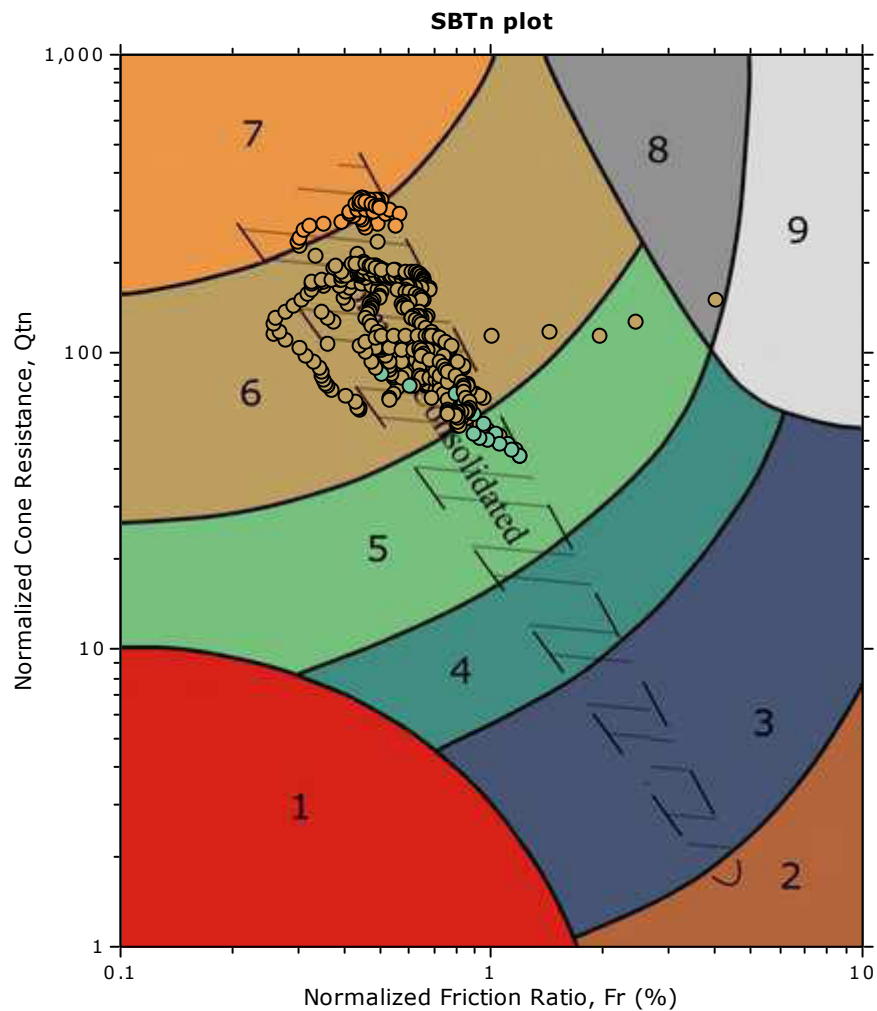
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

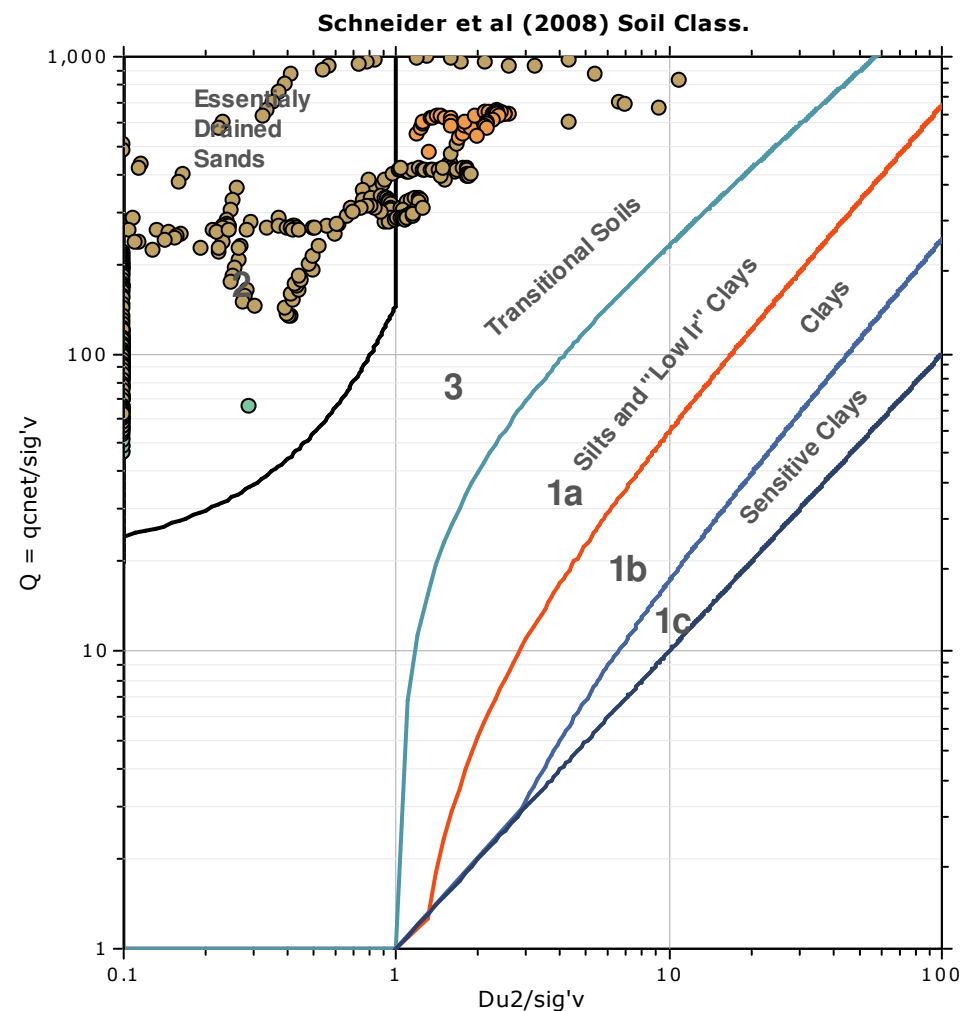
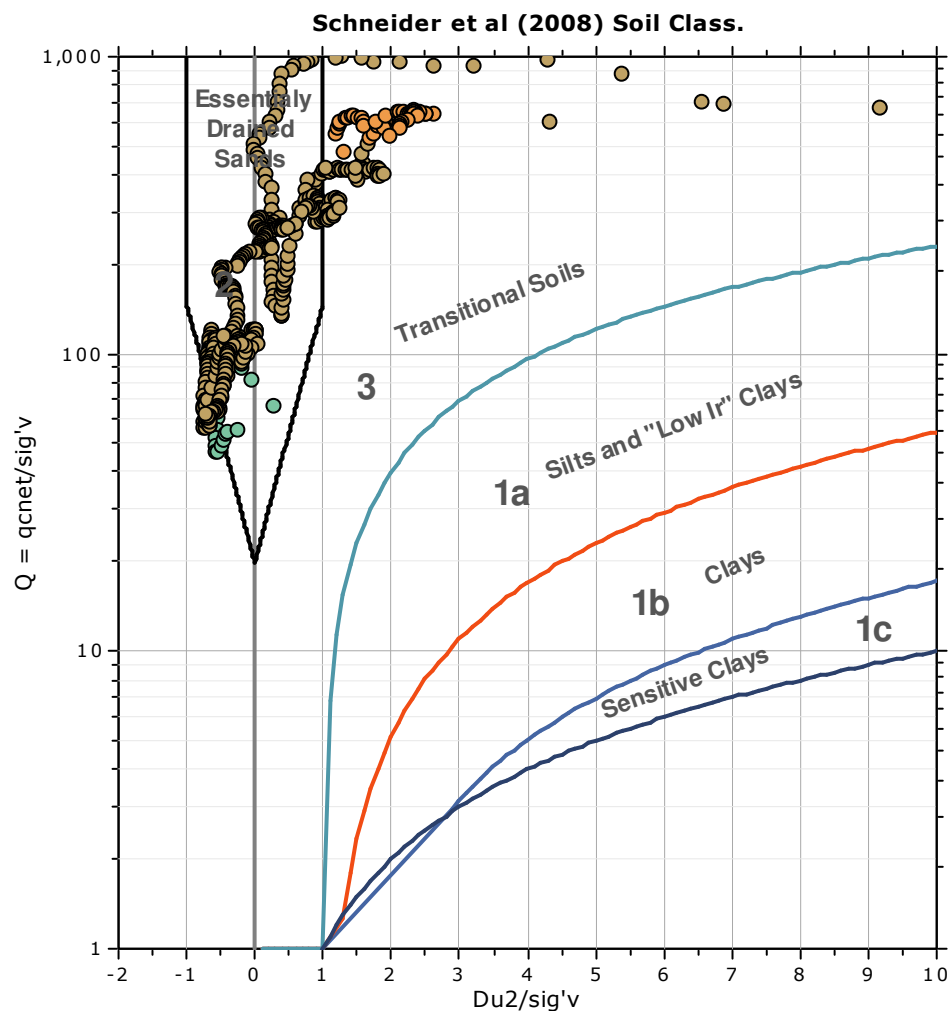
**SBT - Bq plots (normalized)**



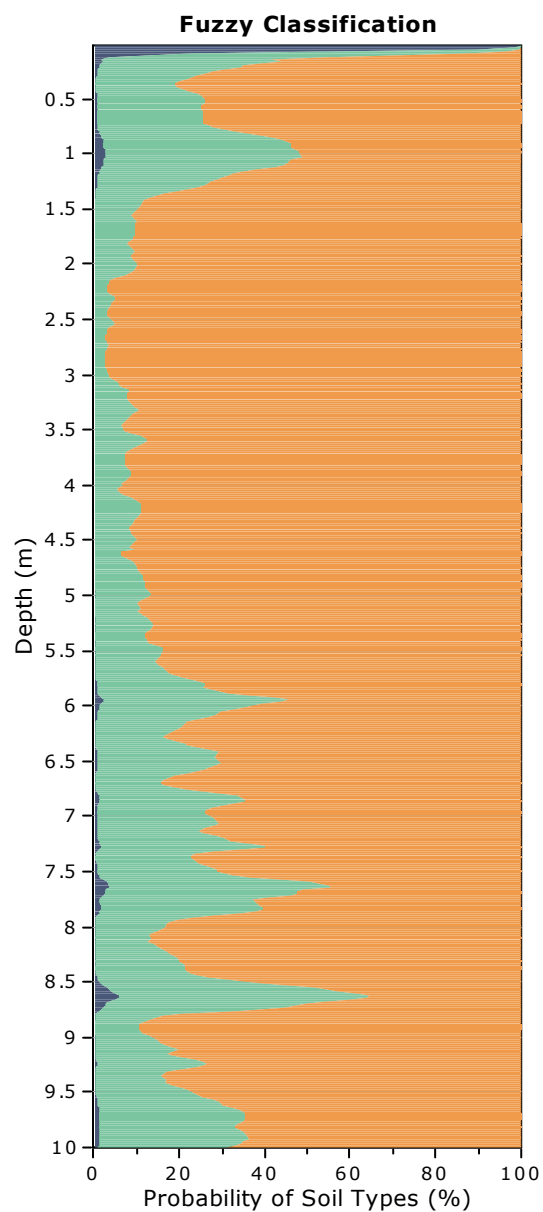
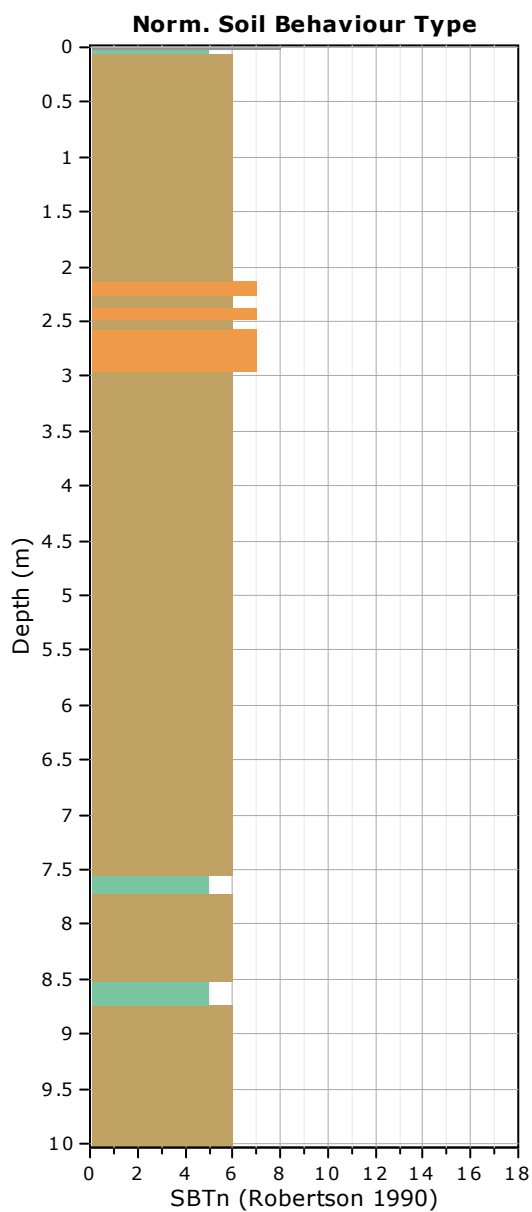
**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







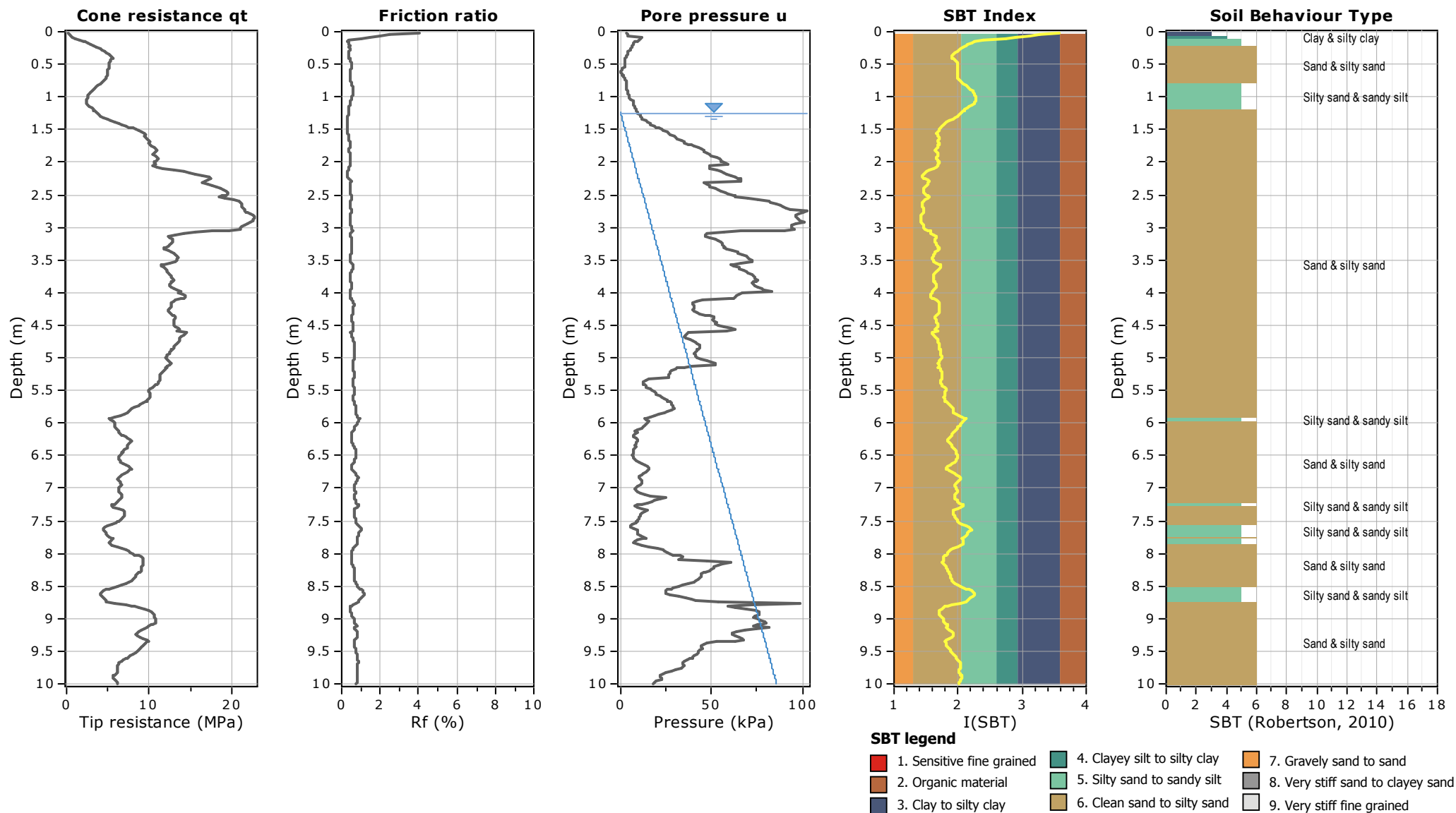
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km35+500**

Total depth: 10.00 m

Coords: lat 44.761497° lon 12.192237°



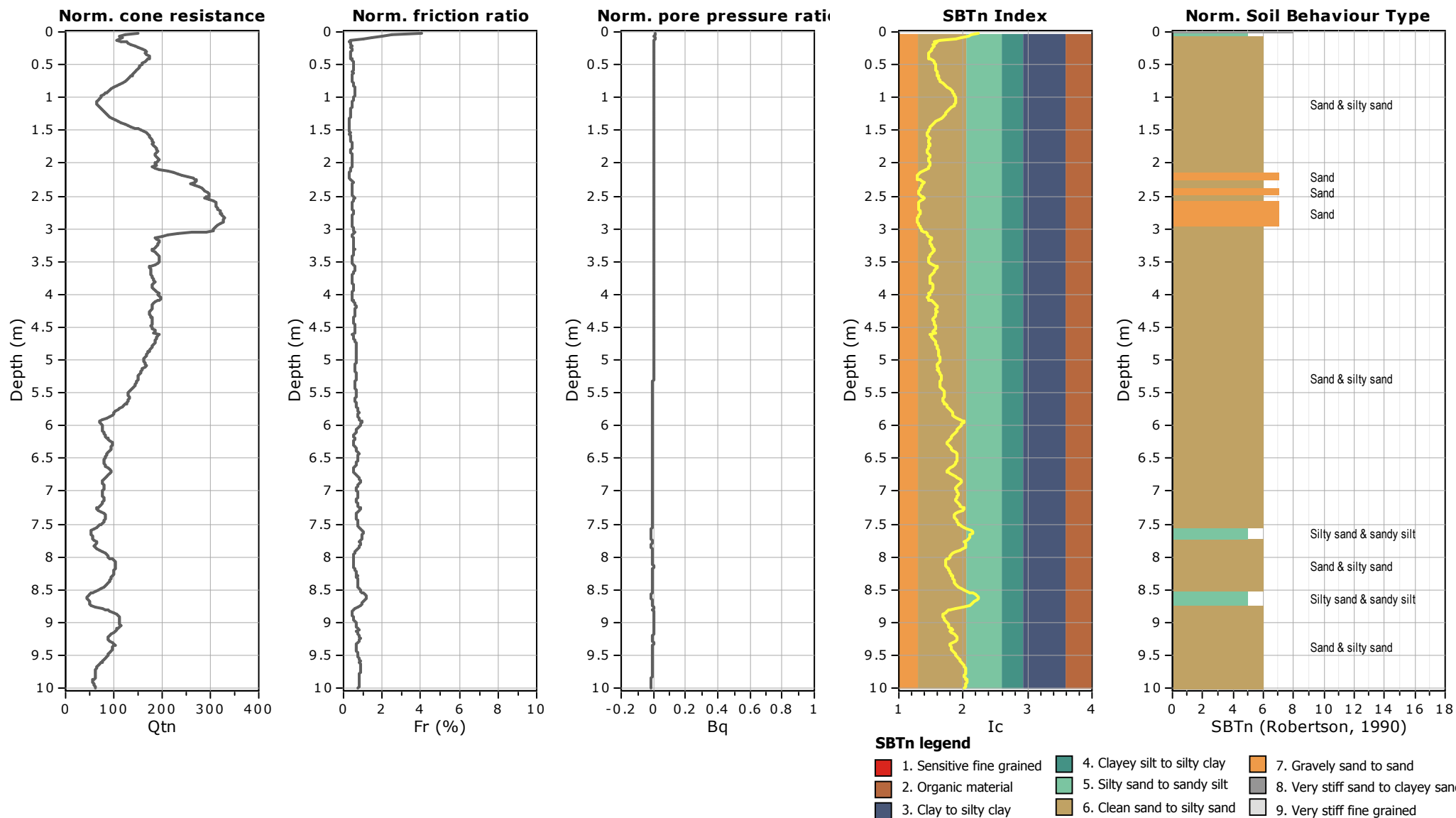
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km35+500**

Total depth: 10.00 m

Coords: lat 44.761497° lon 12.192237°



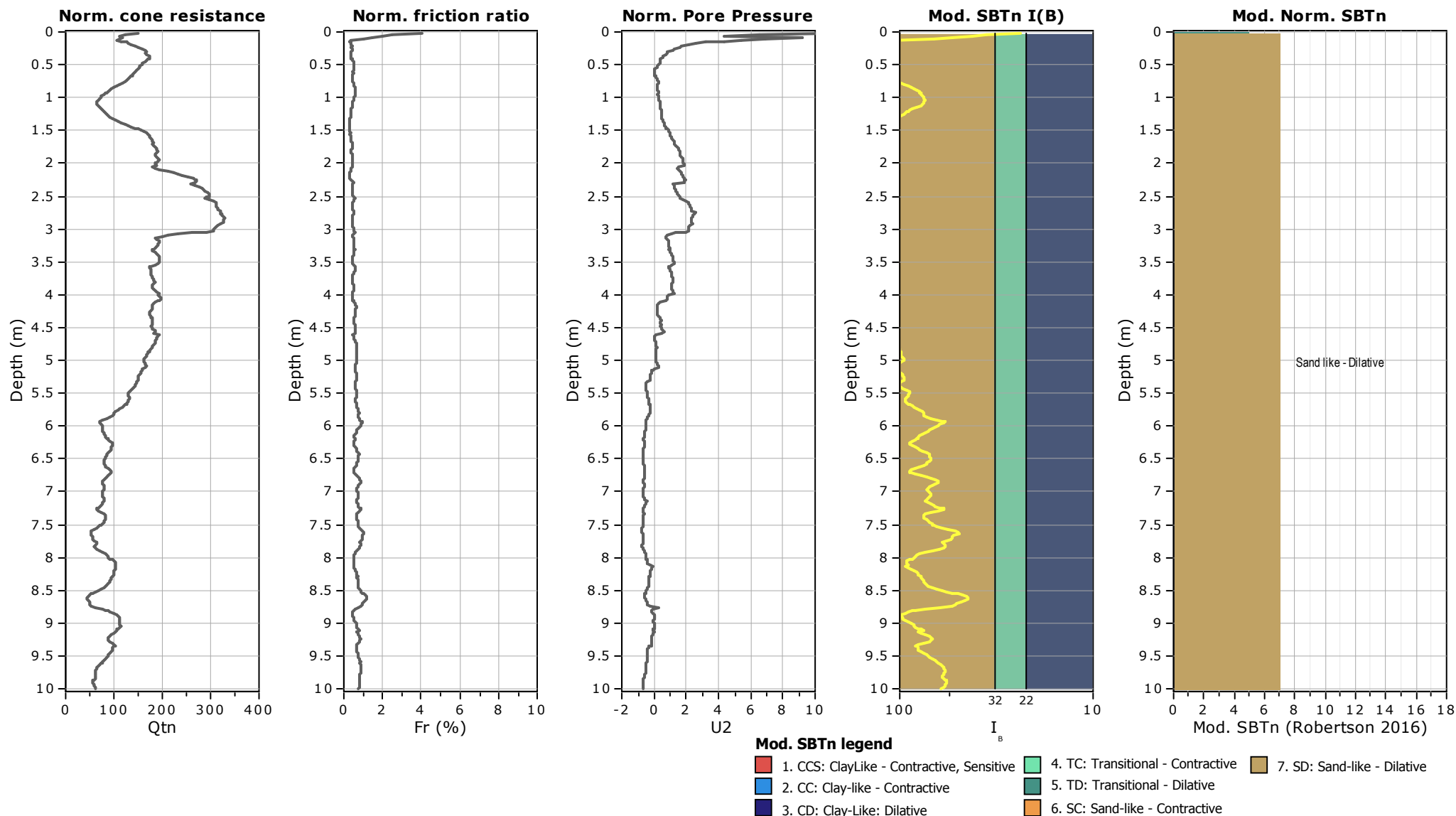
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

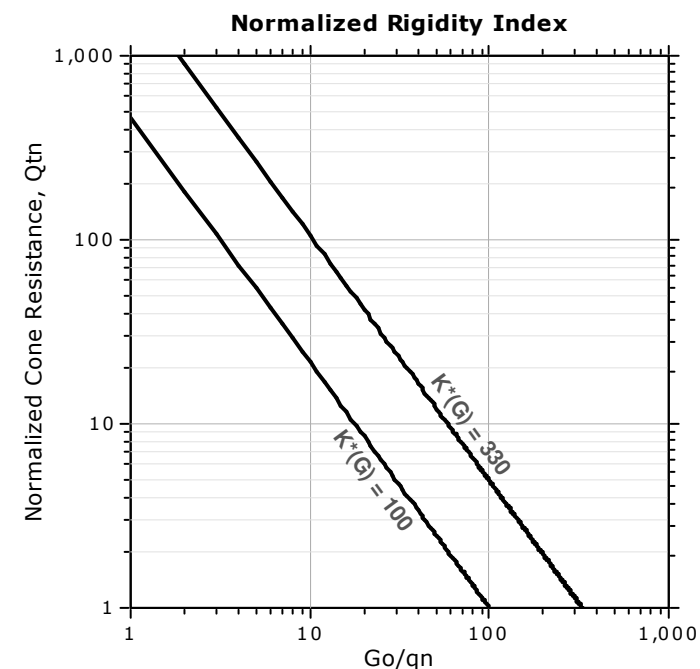
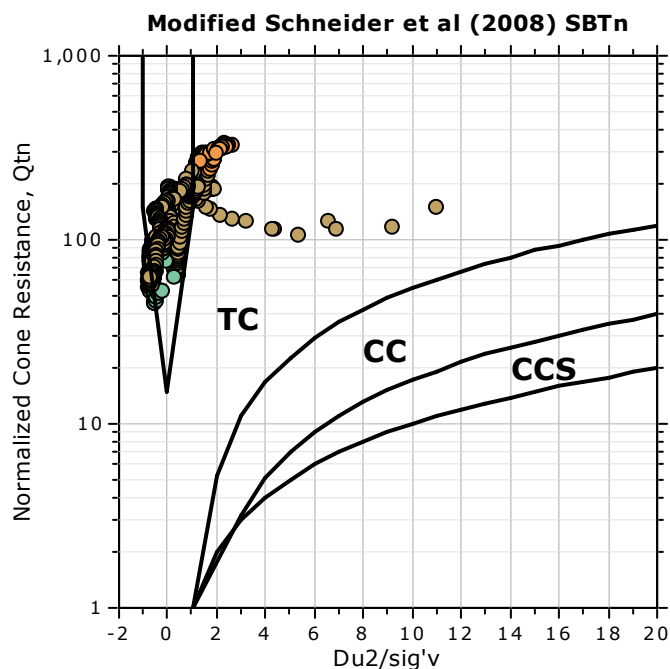
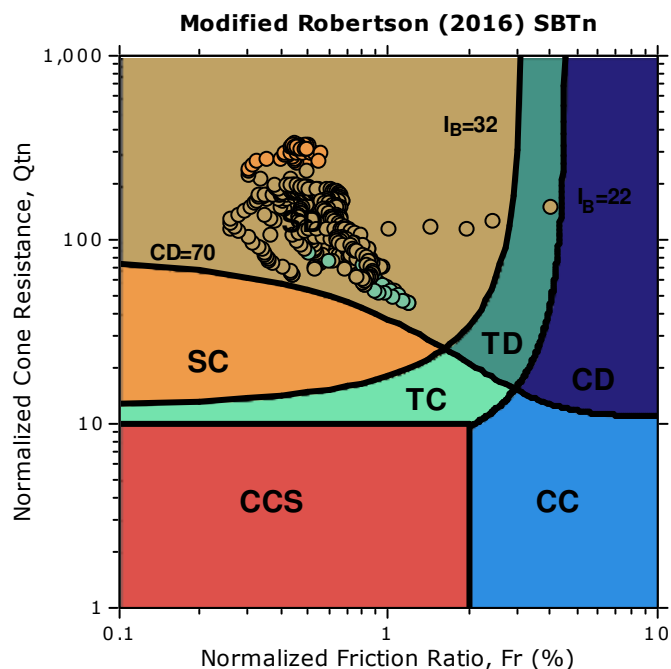
**CPT: CPTU km35+500**

Total depth: 10.00 m

Coords: lat 44.761497° lon 12.192237°



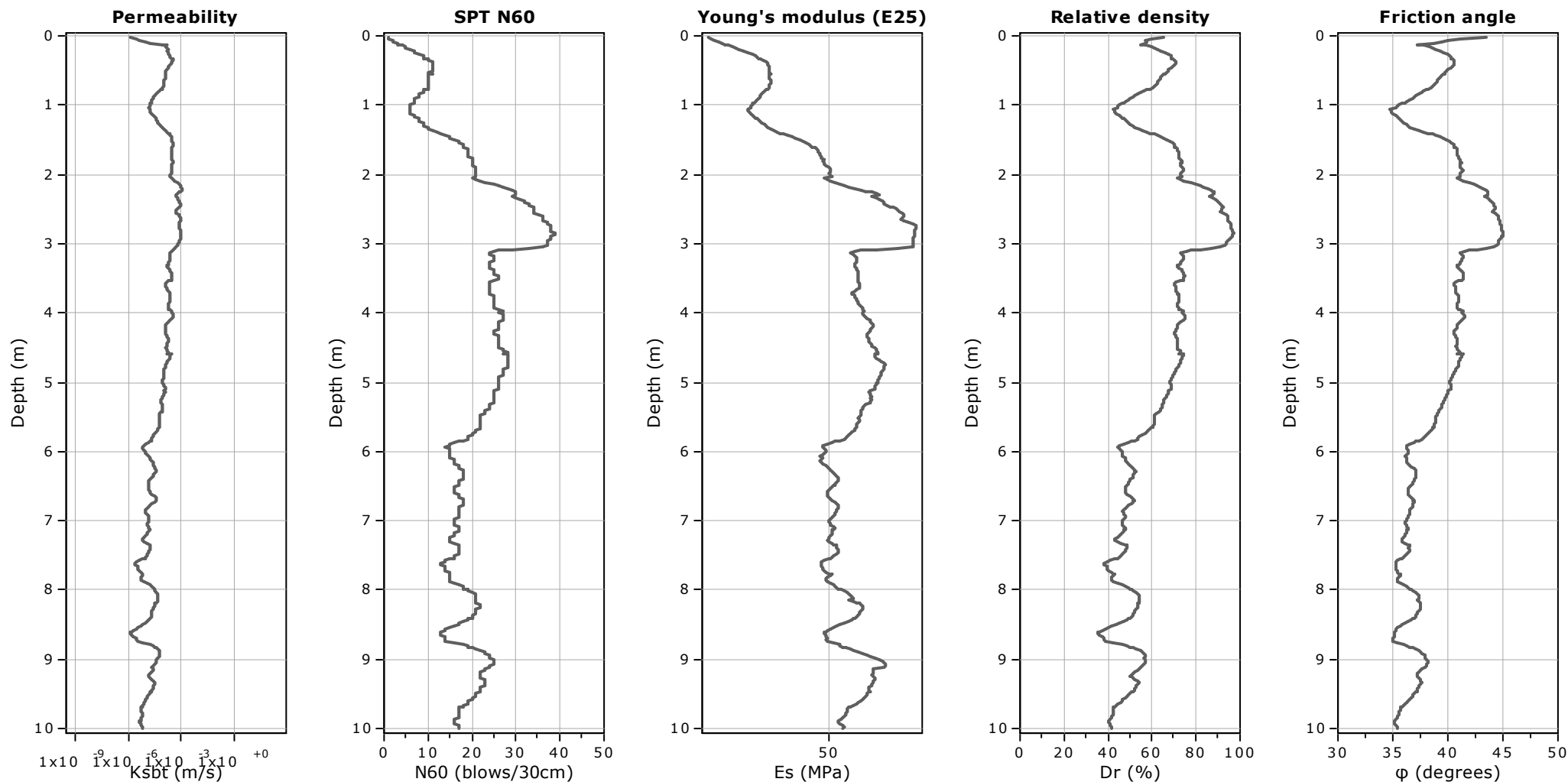
## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)





**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

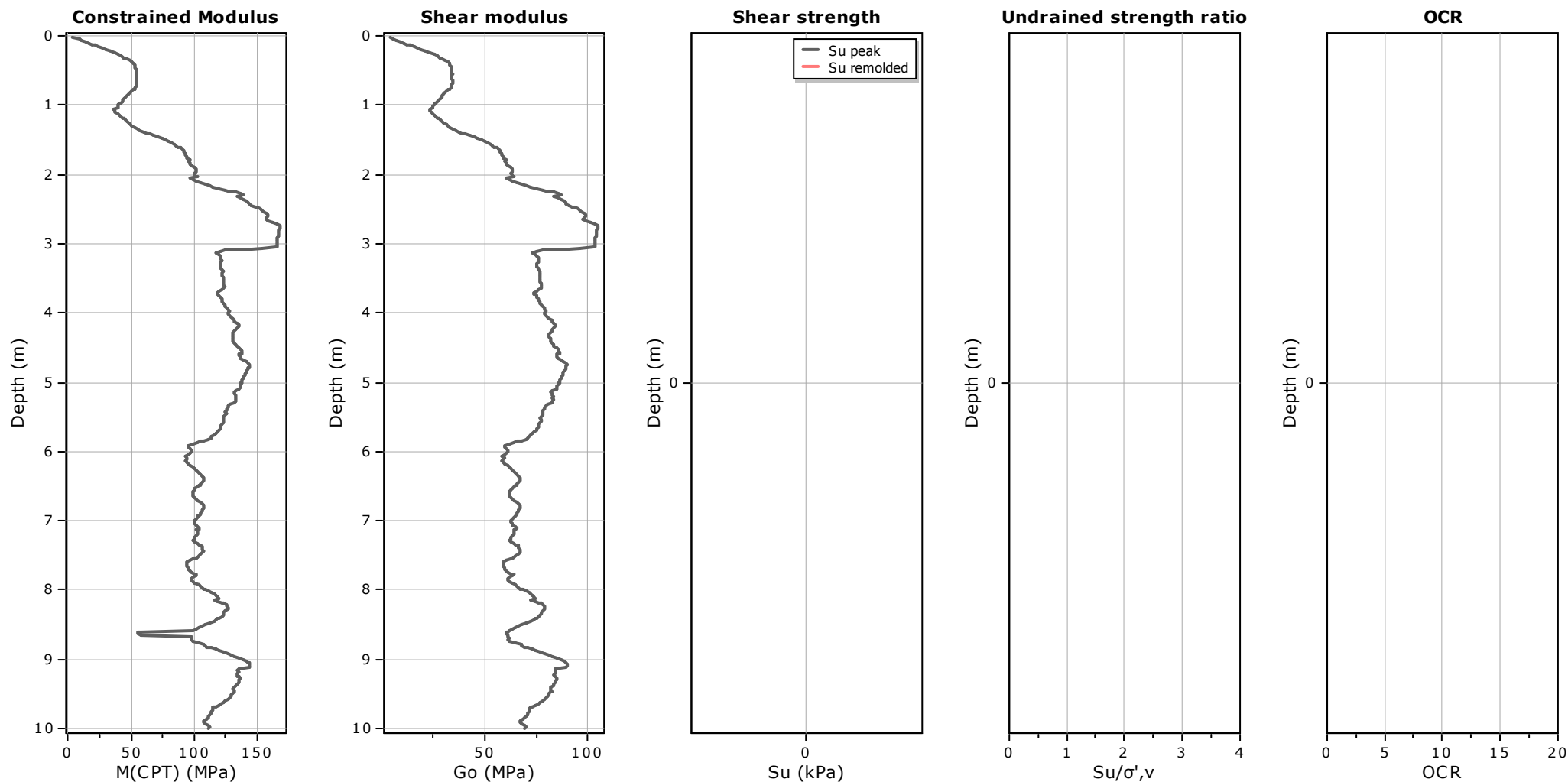
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km35+500**

Total depth: 10.00 m

Coords: lat 44.761497° lon 12.192237°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

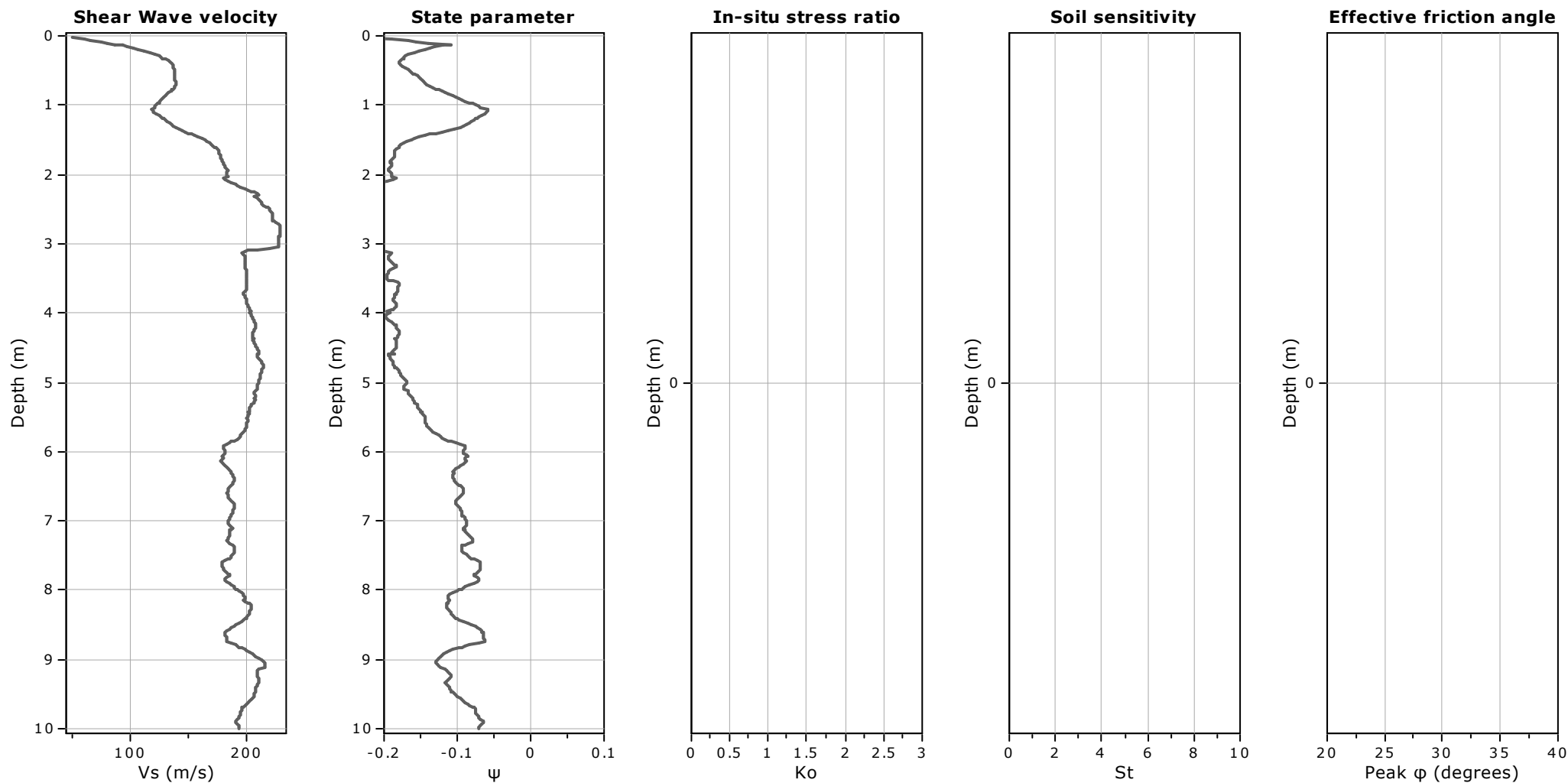
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km35+500**

Total depth: 10.00 m

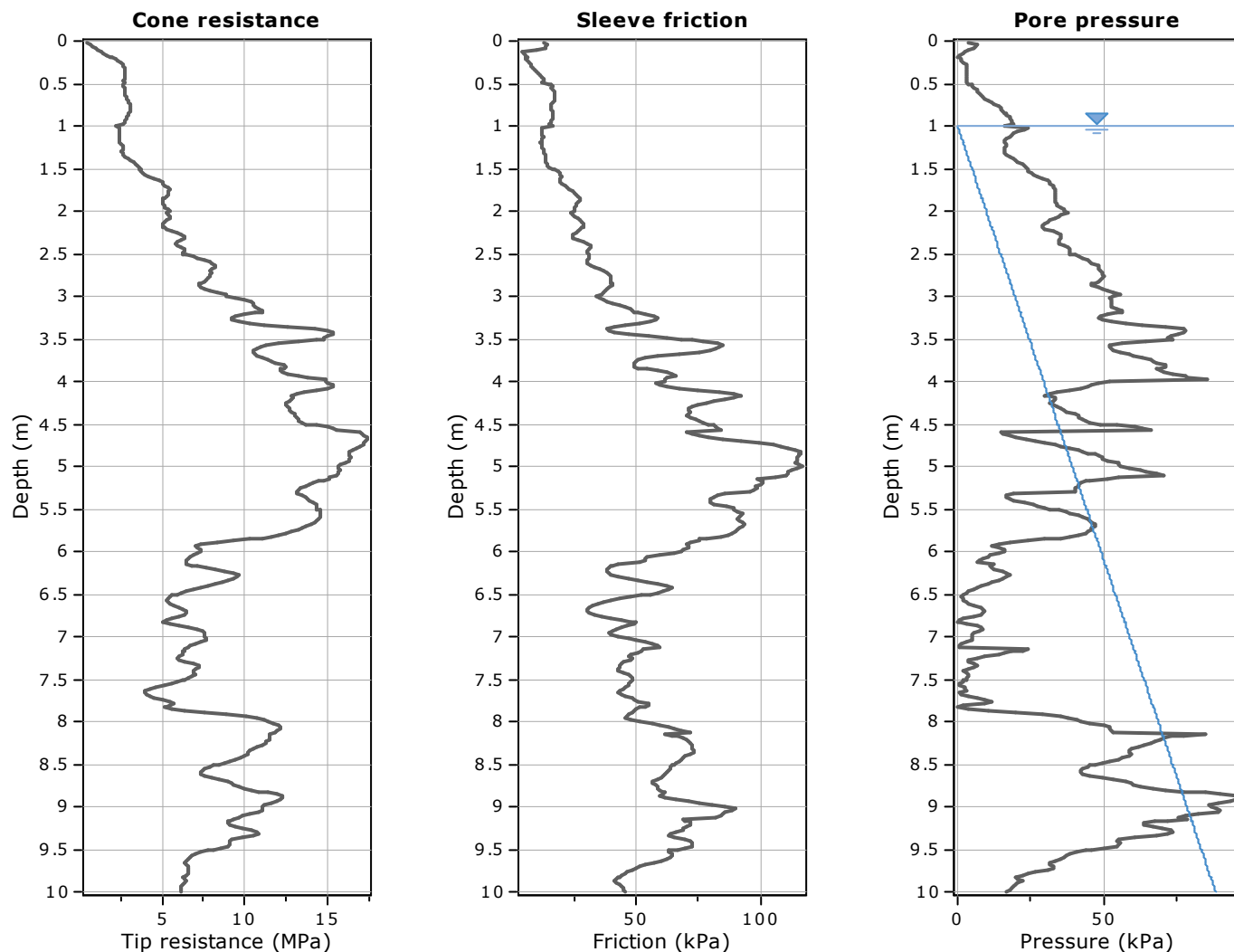
Coords: lat 44.761497° lon 12.192237°



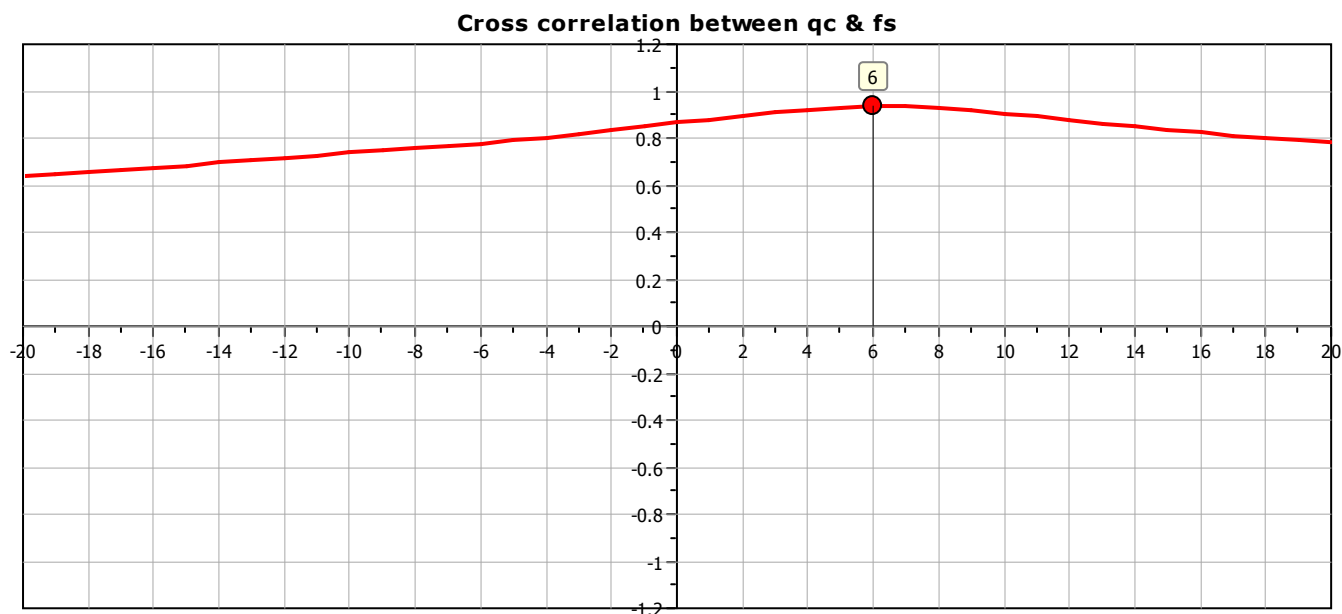
**Calculation parameters**

Soil Sensitivity factor,  $N_s$ : 7.00

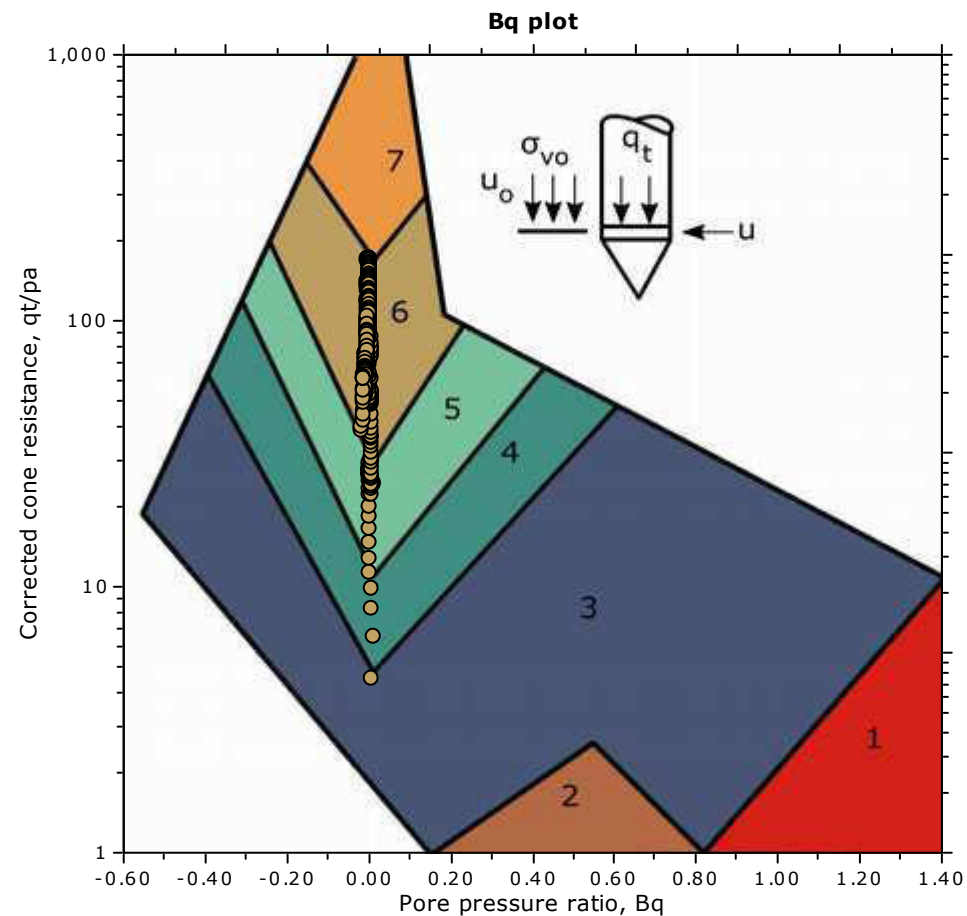
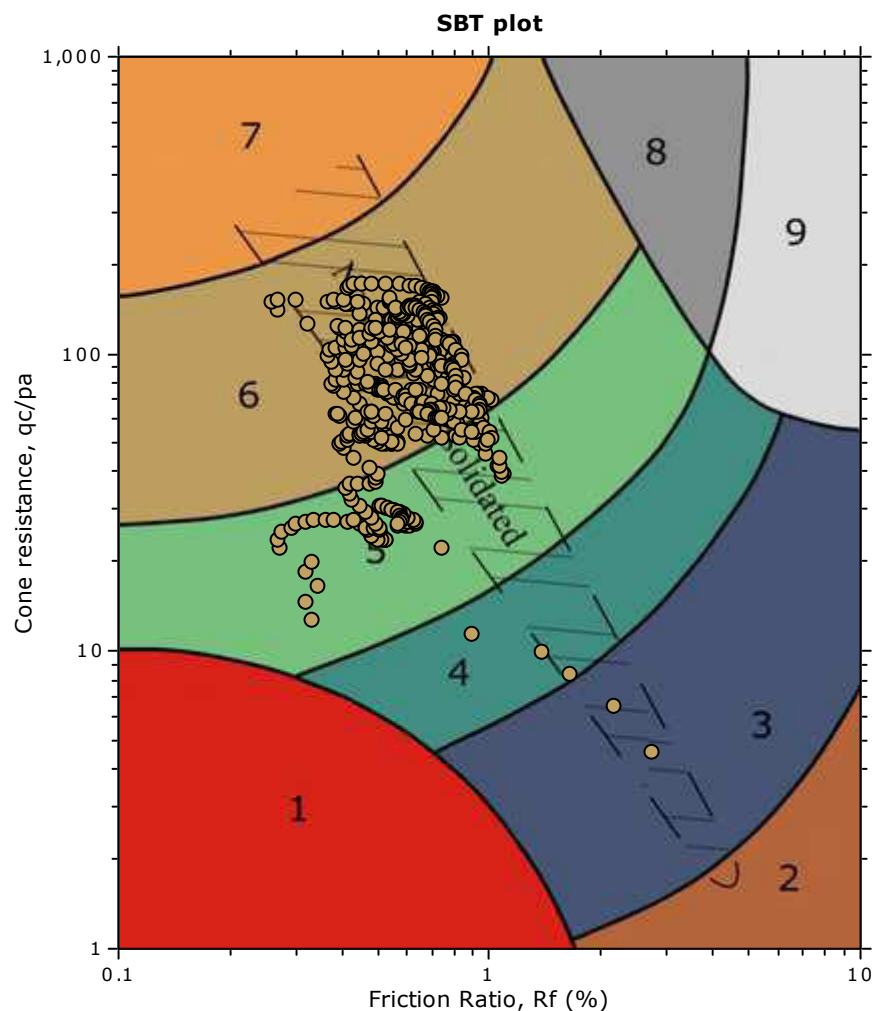
—●— User defined estimation data



The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  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

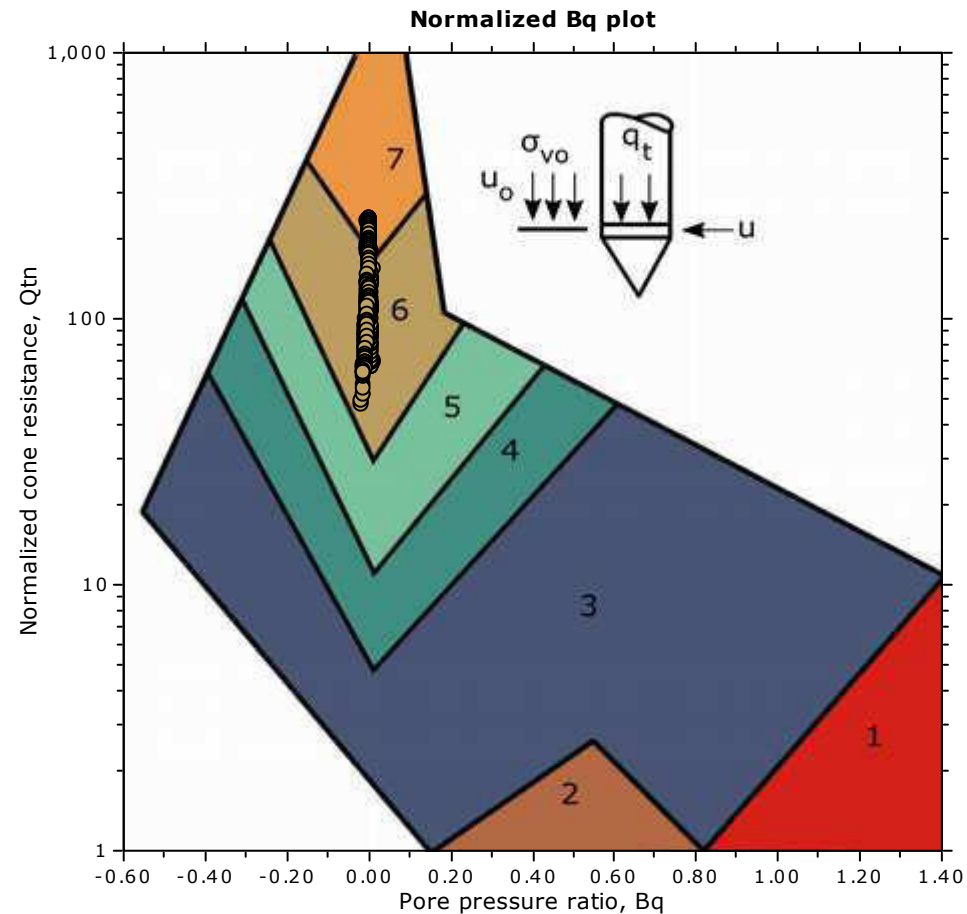
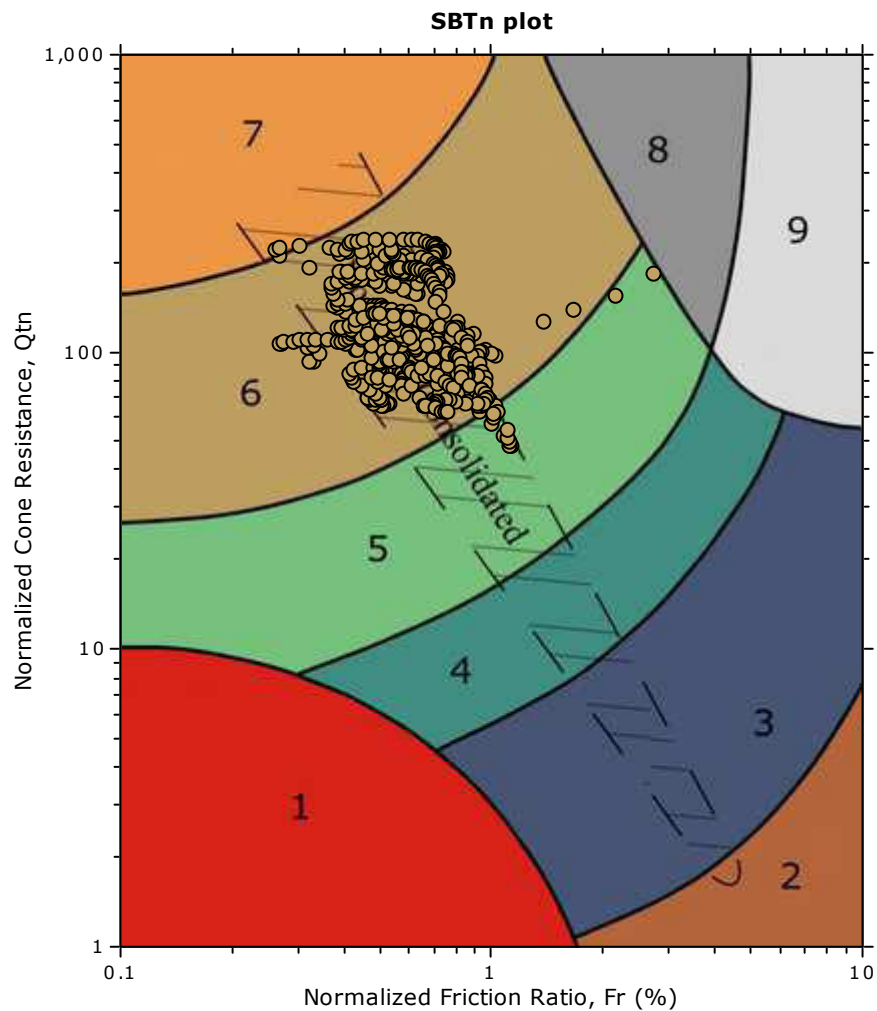


### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |



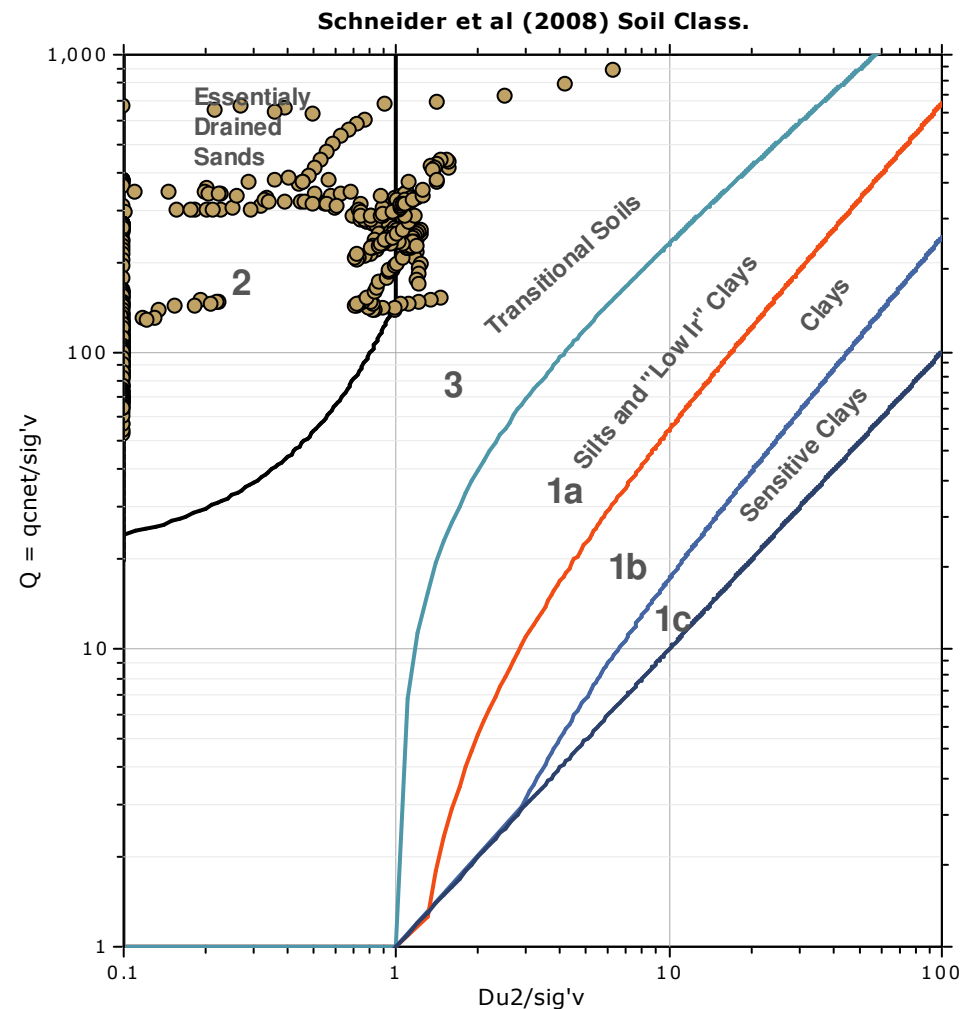
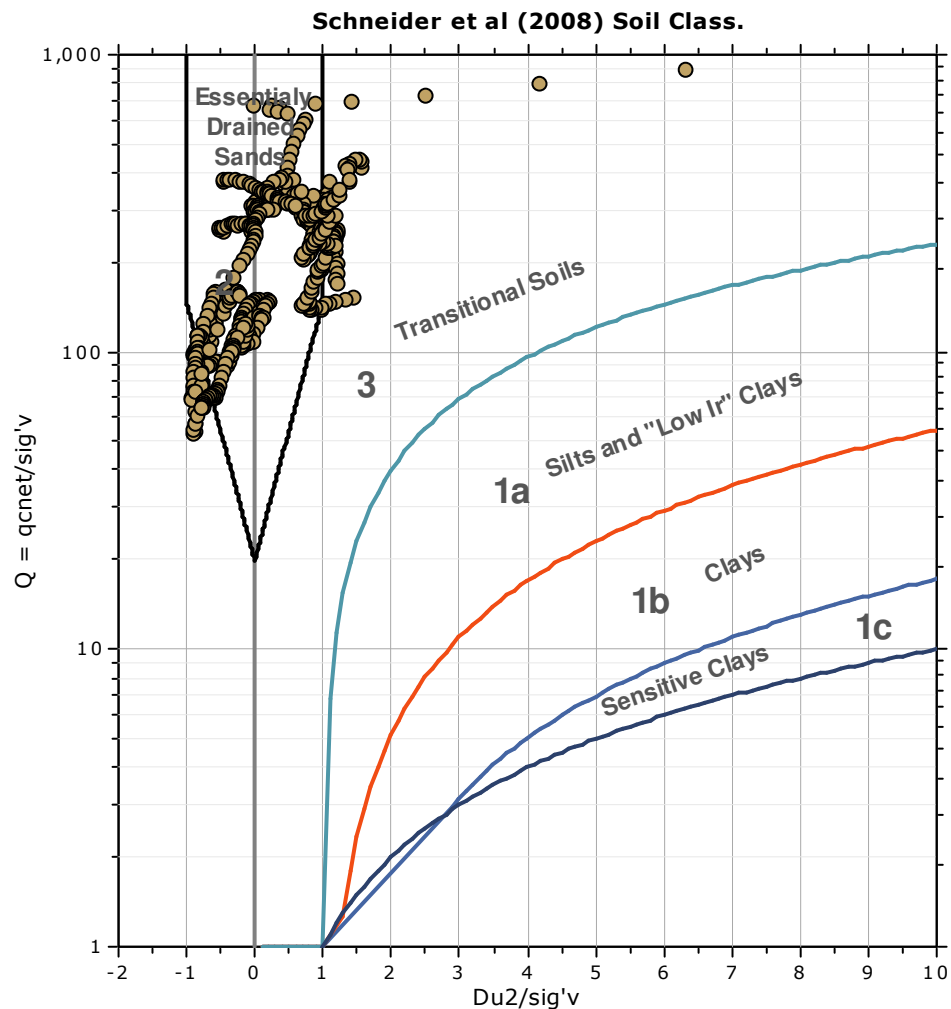
**SBT - Bq plots (normalized)**

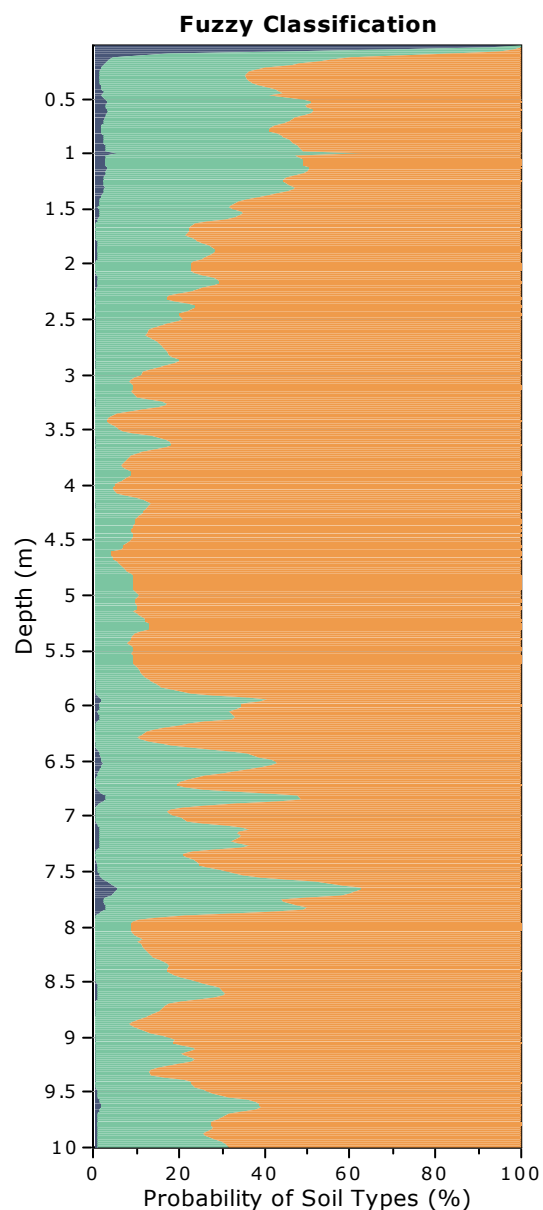
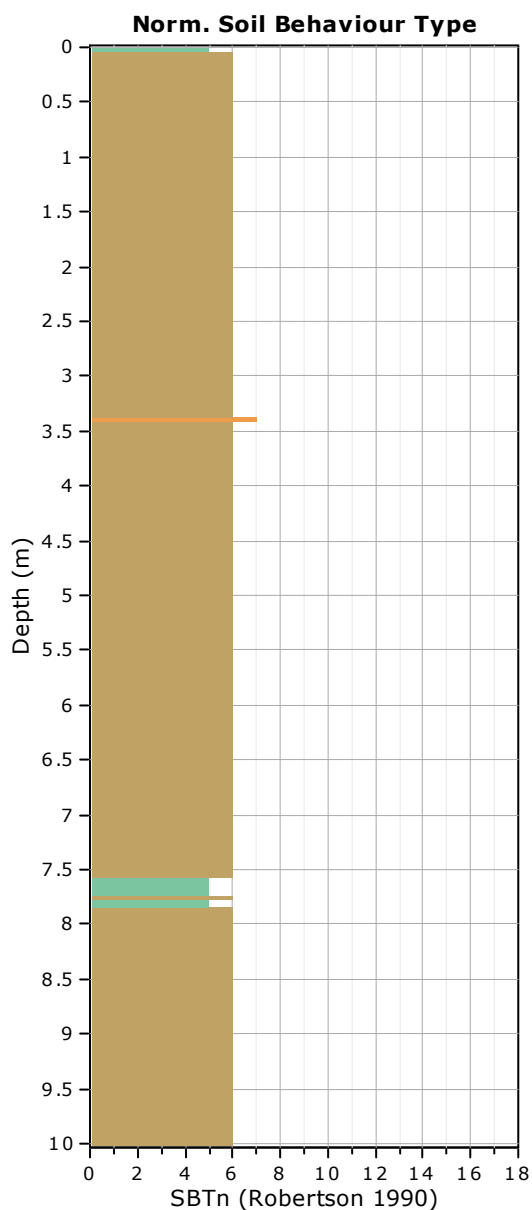


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





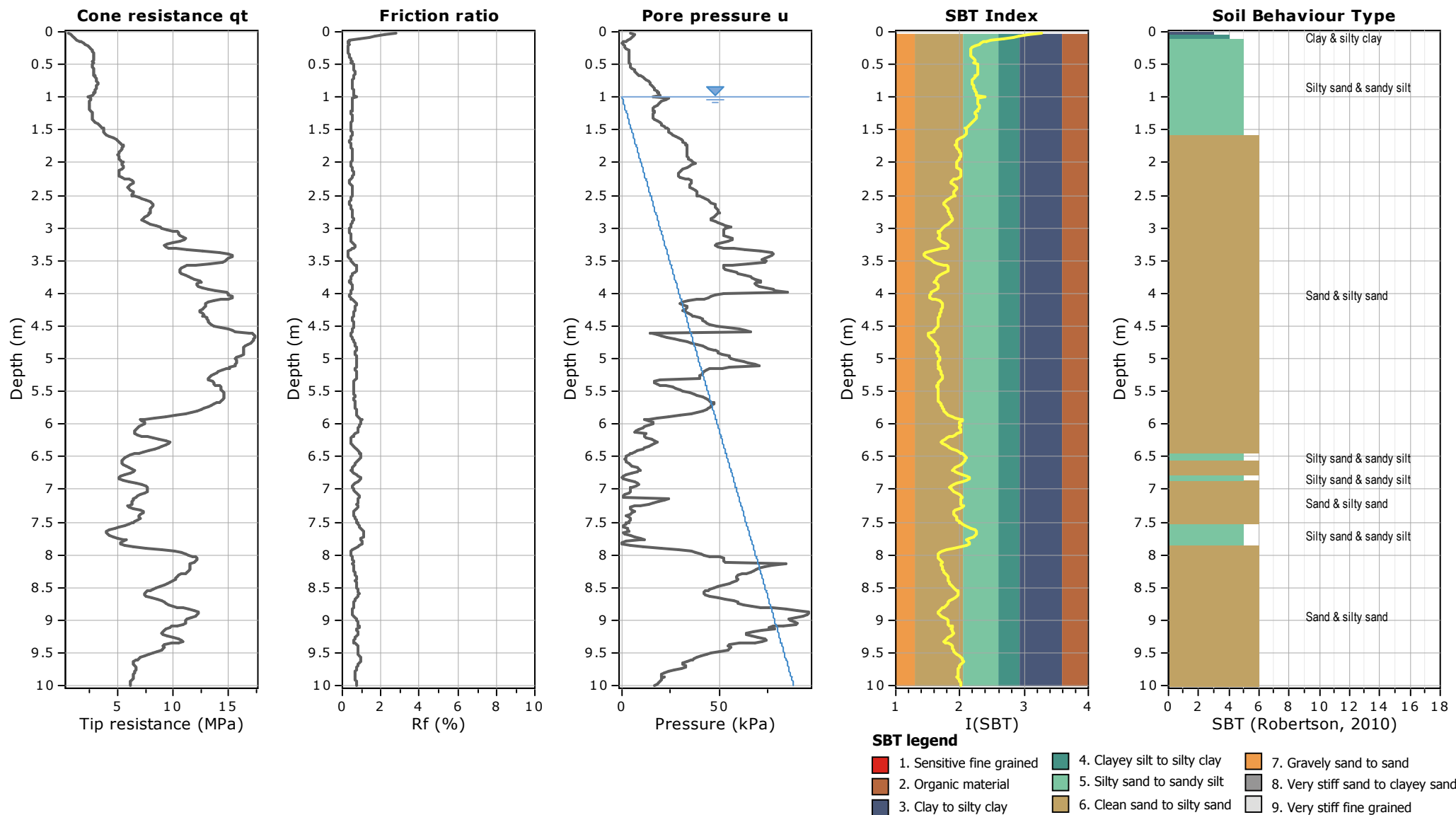
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°



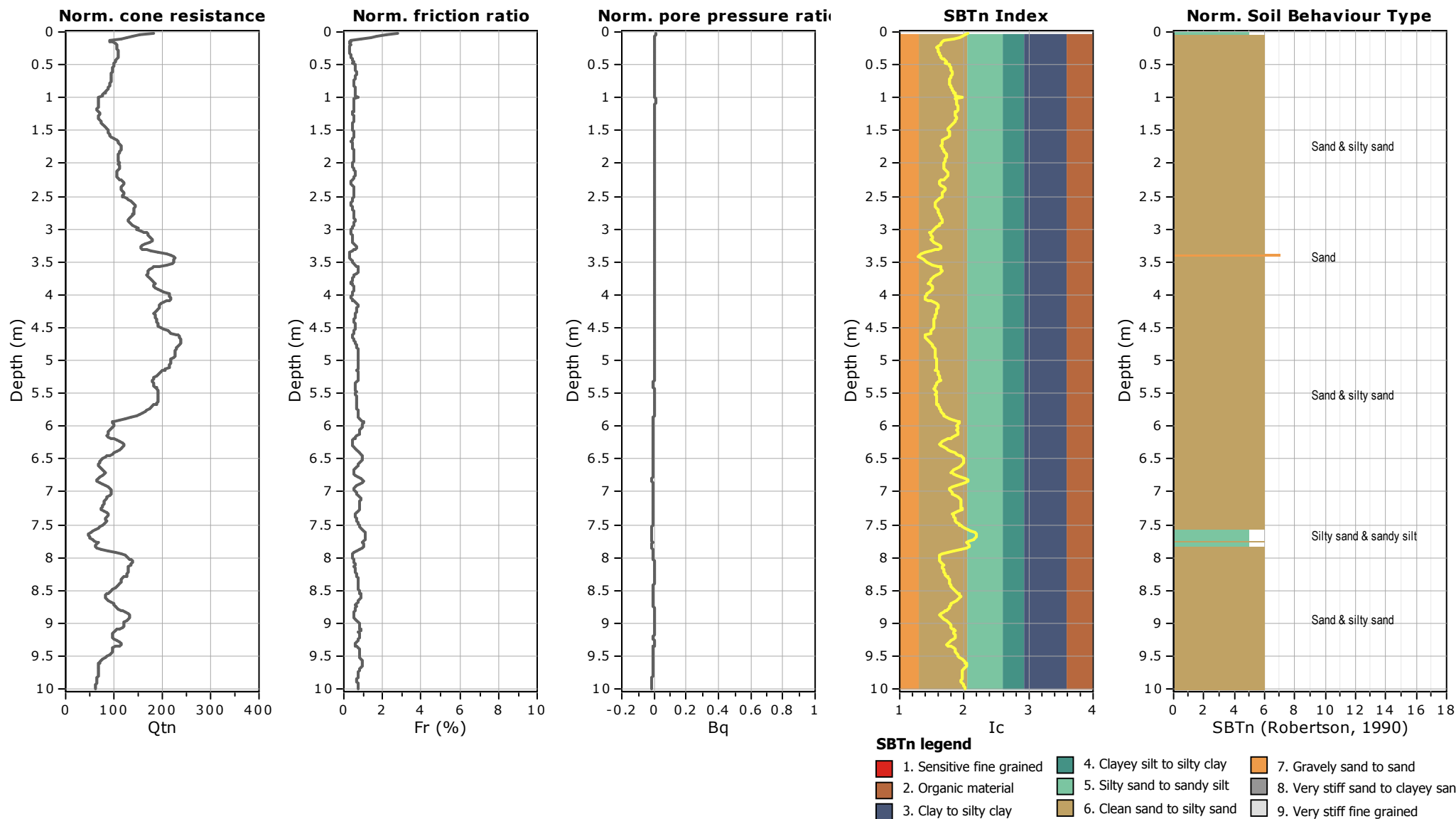
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°





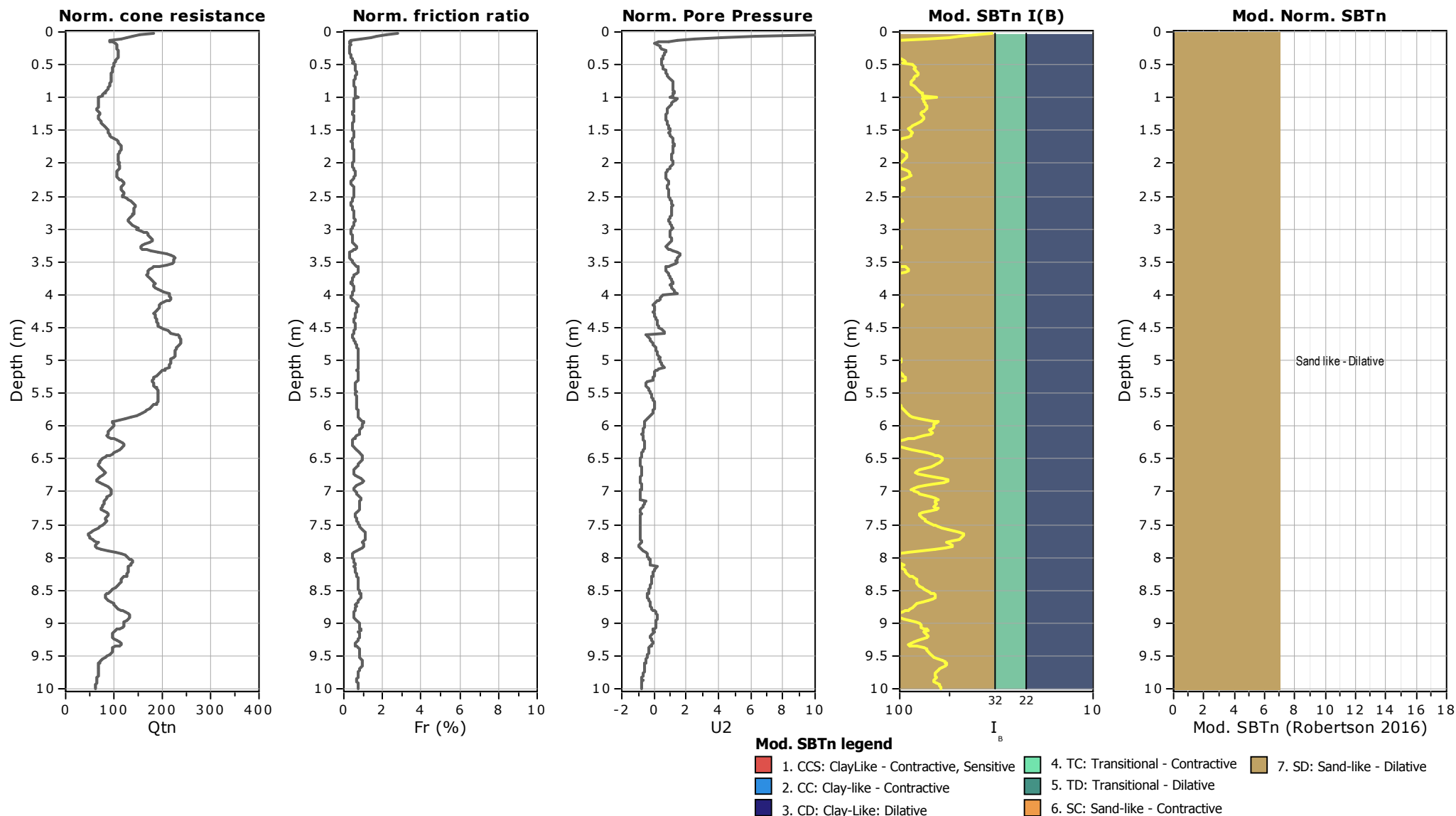
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

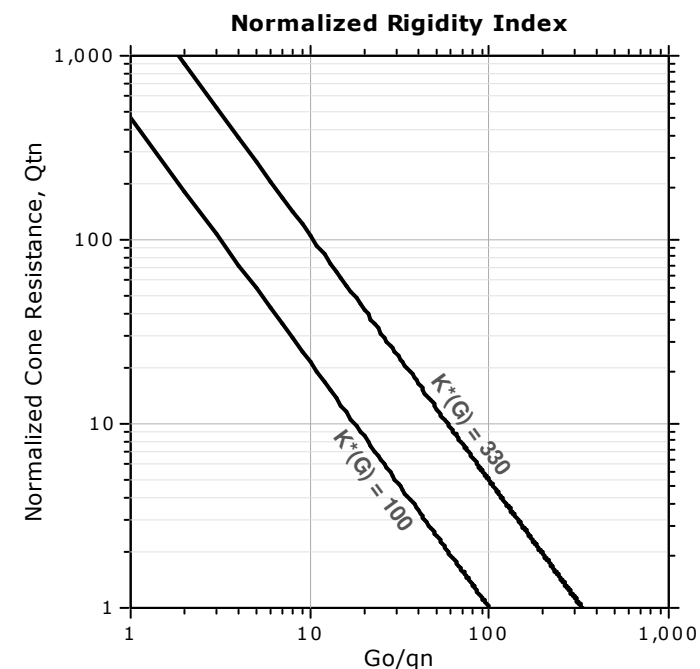
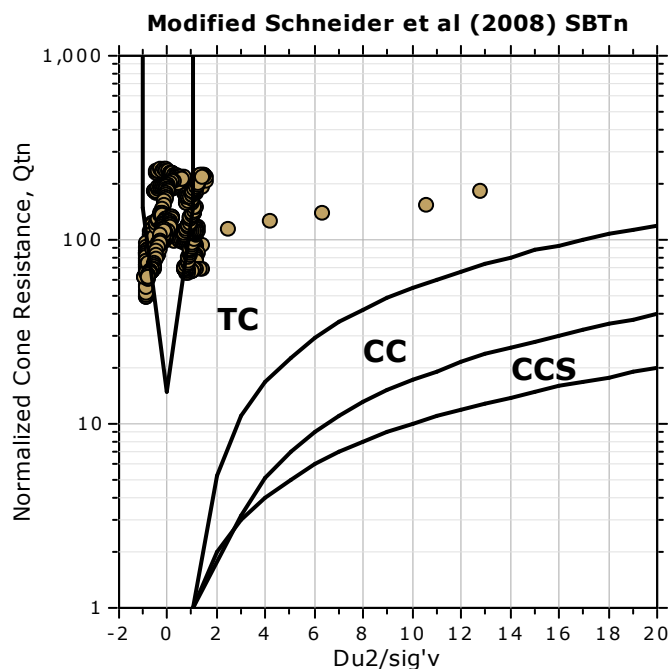
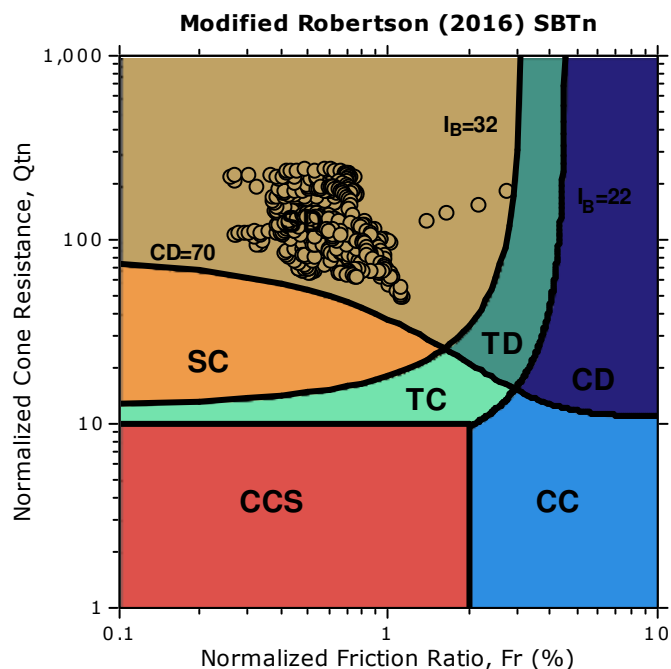
**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

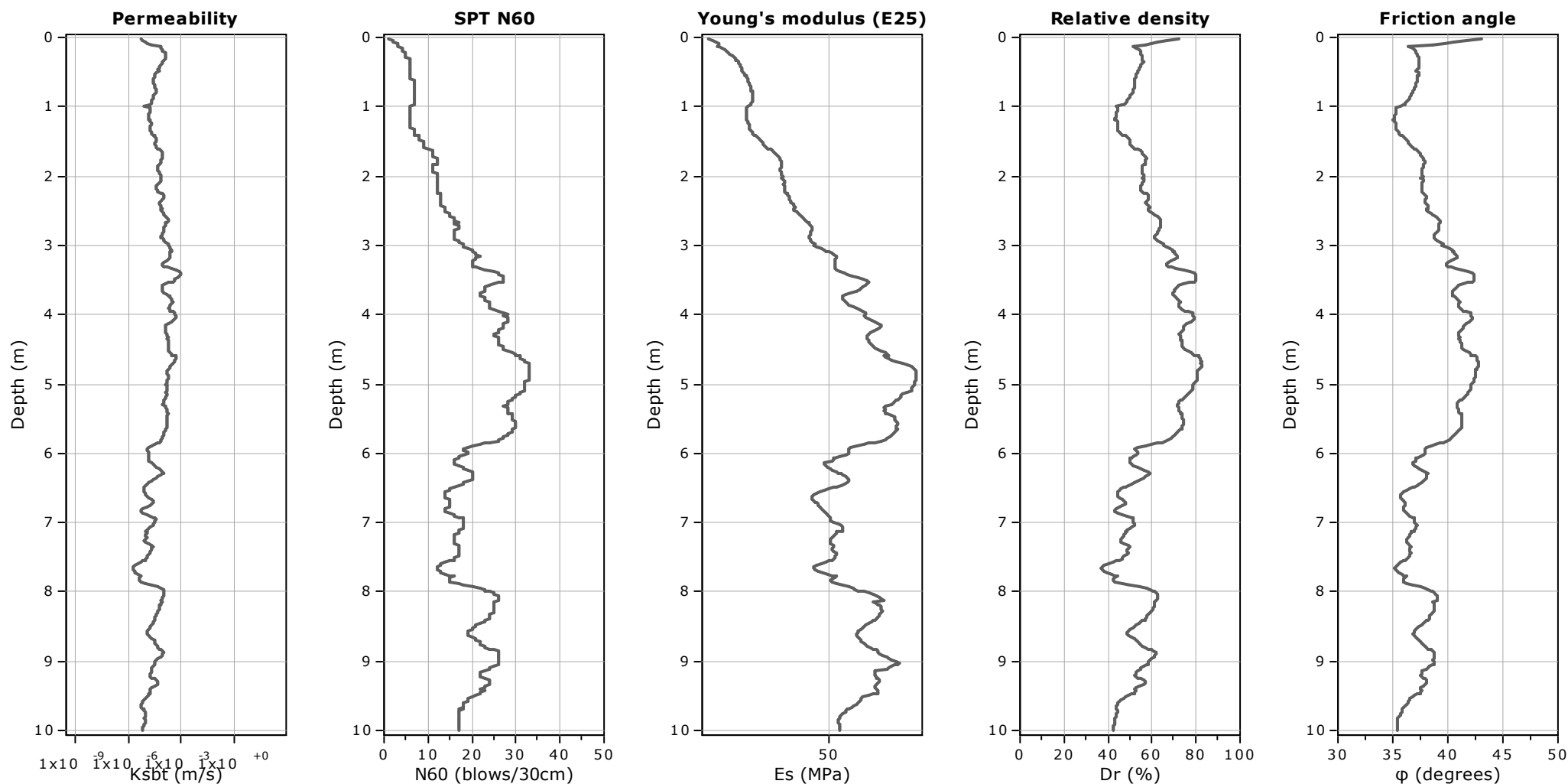
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

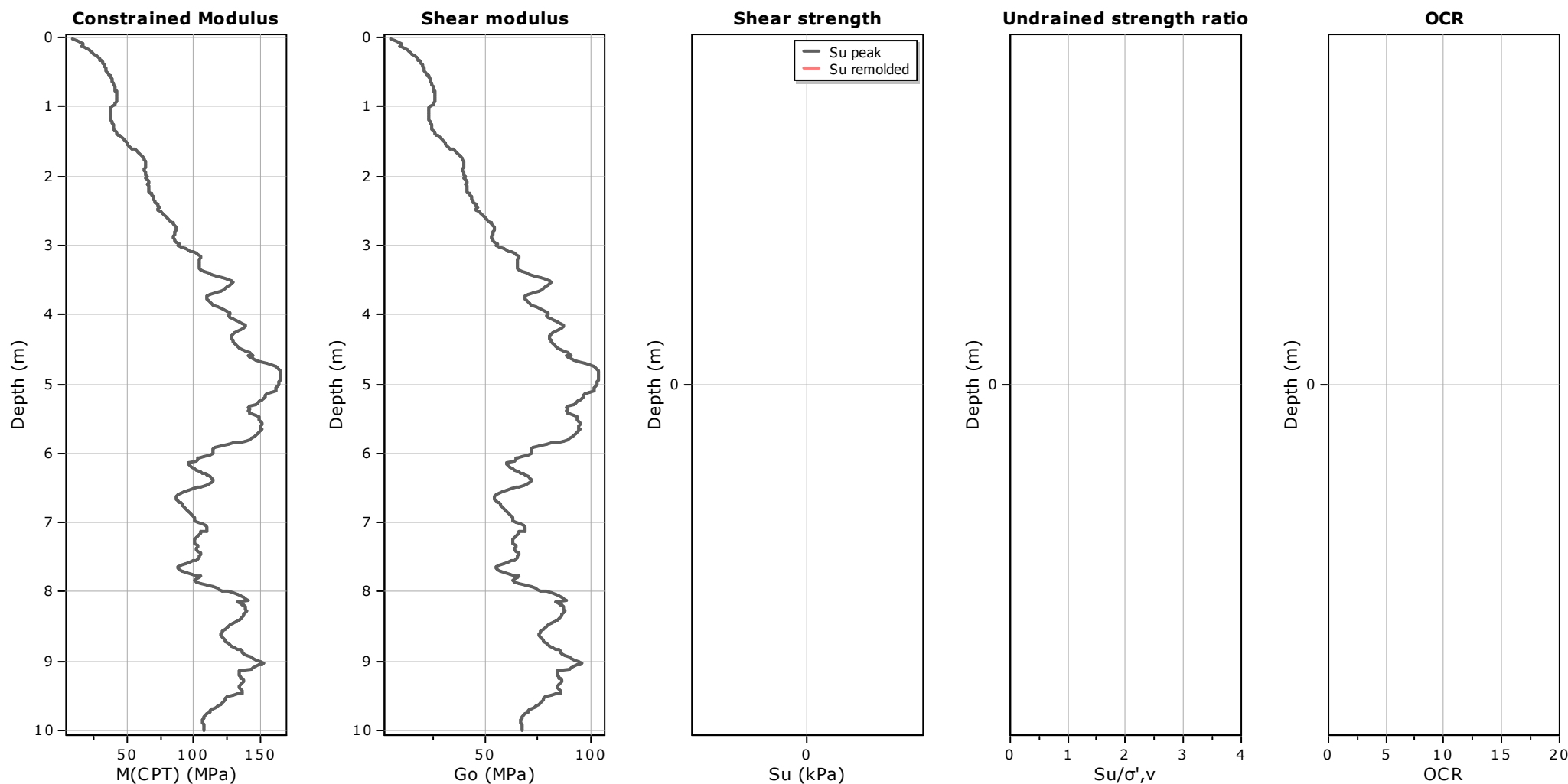
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

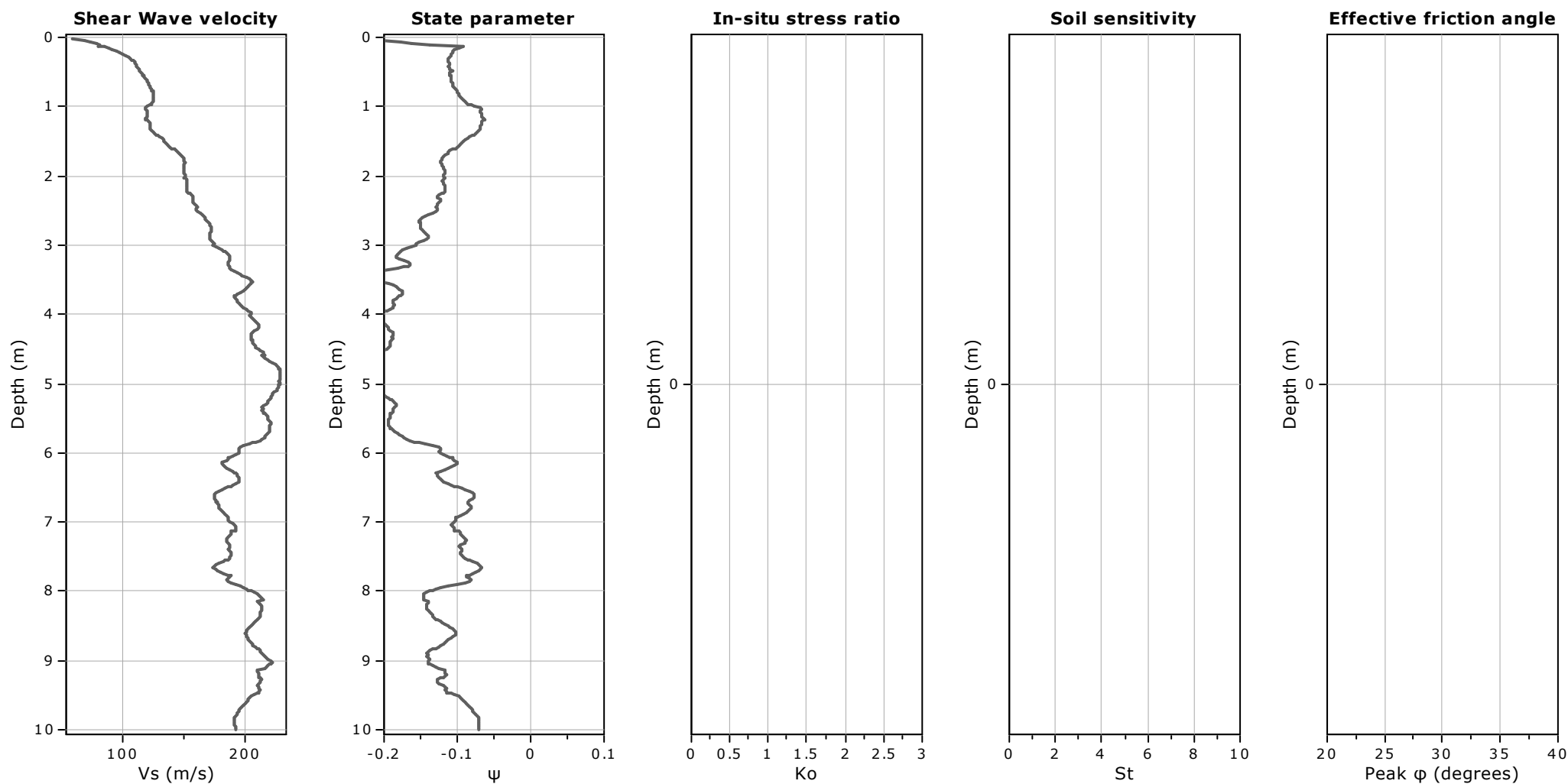
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+000**

Total depth: 10.00 m

Coords: lat 44.765533° lon 12.19032°

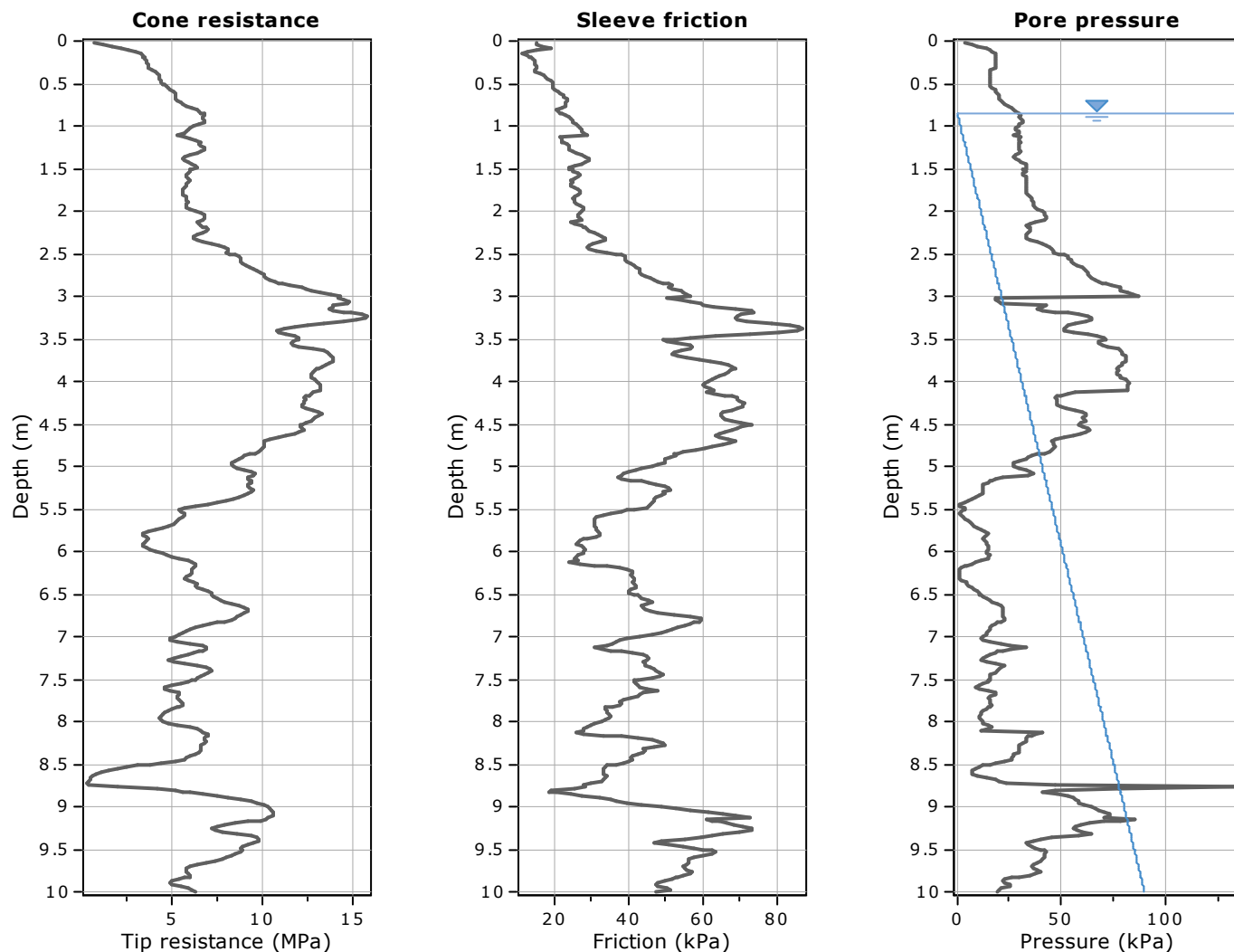


#### Calculation parameters

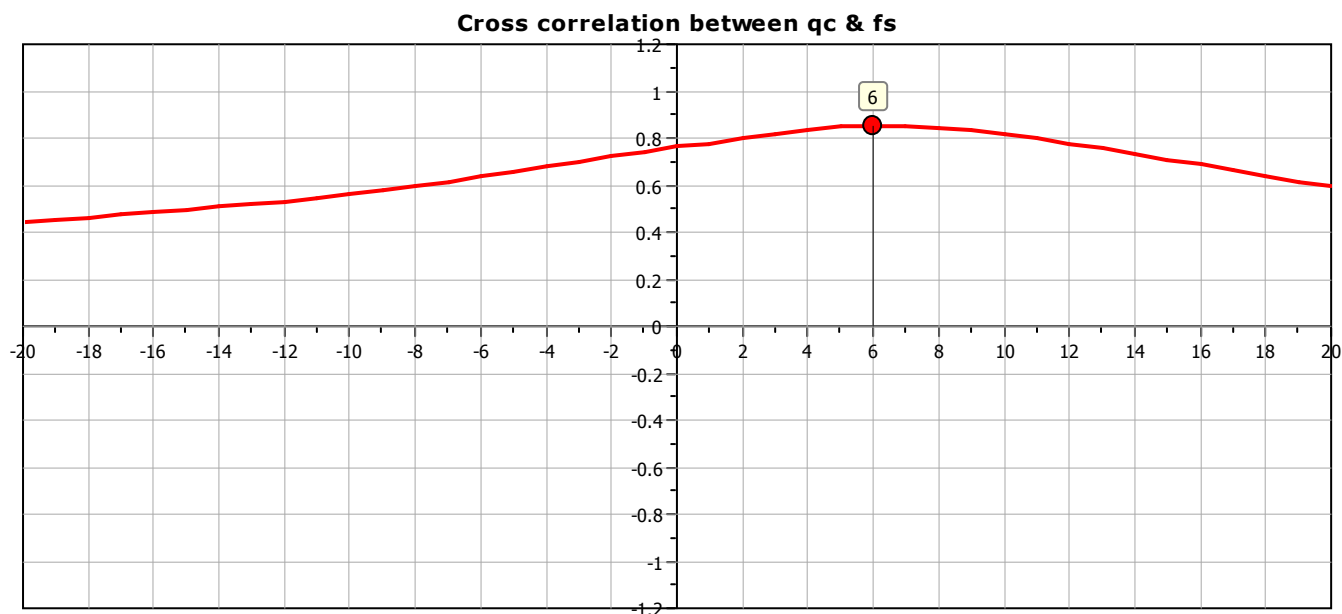
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

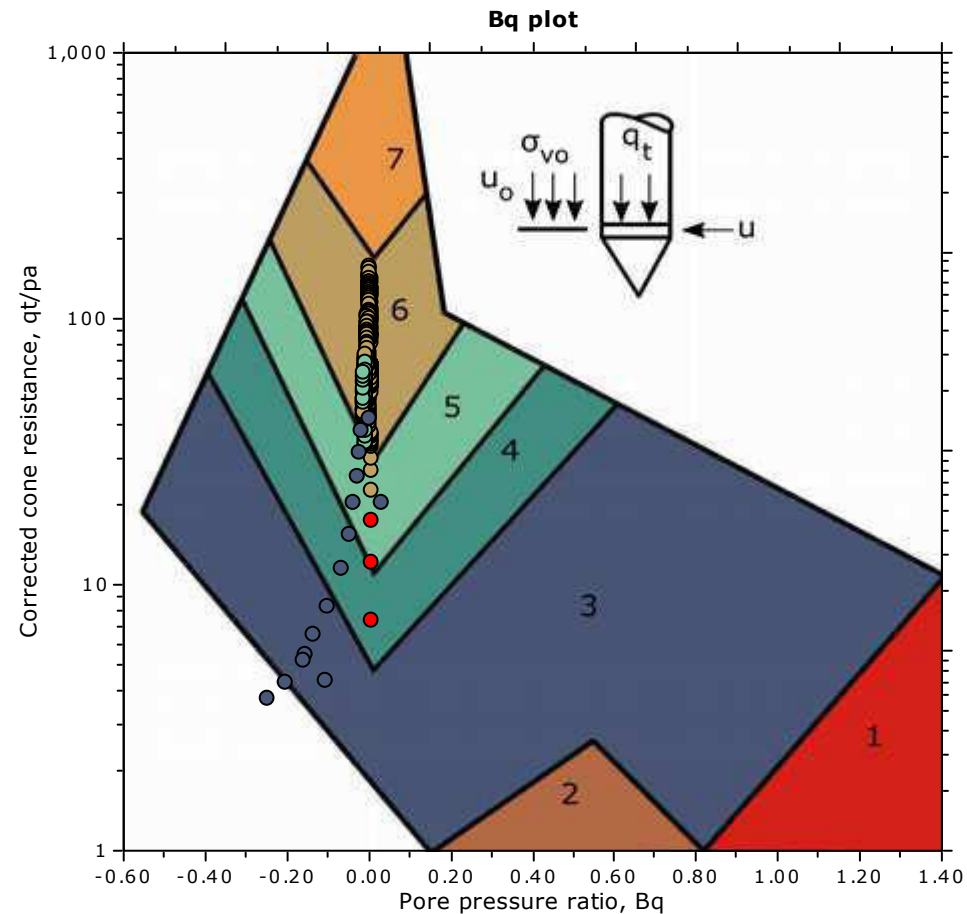
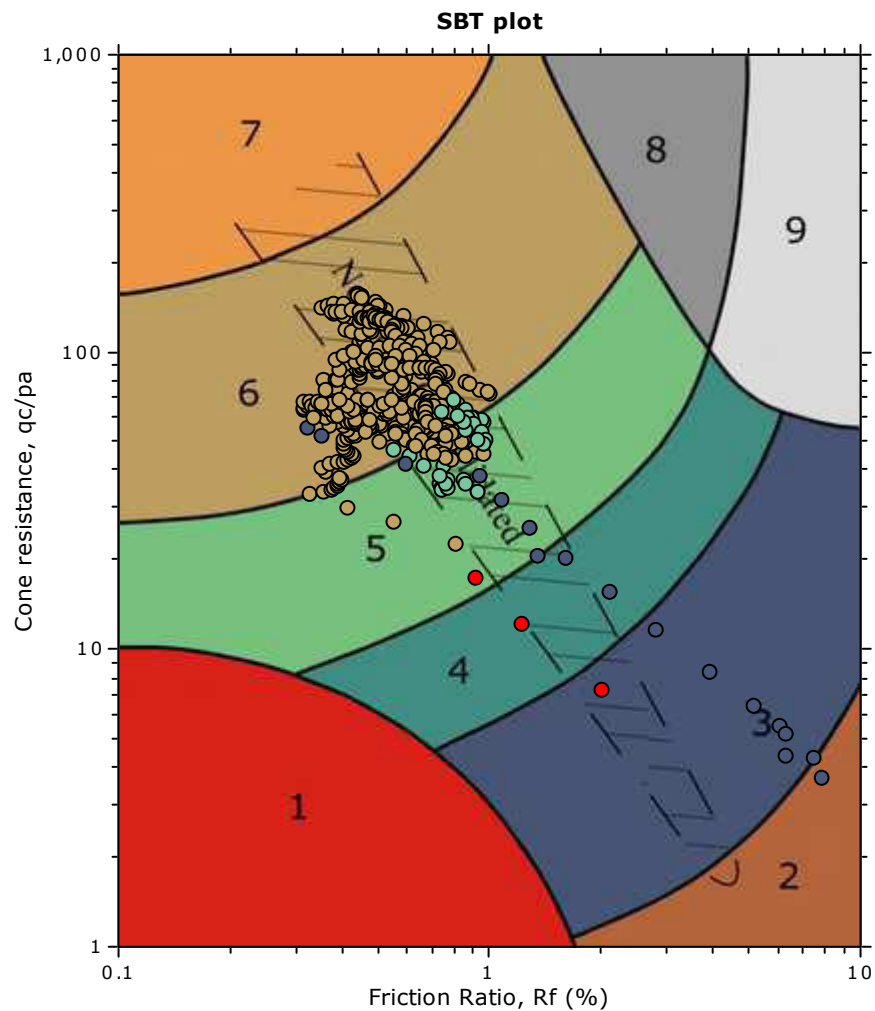




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



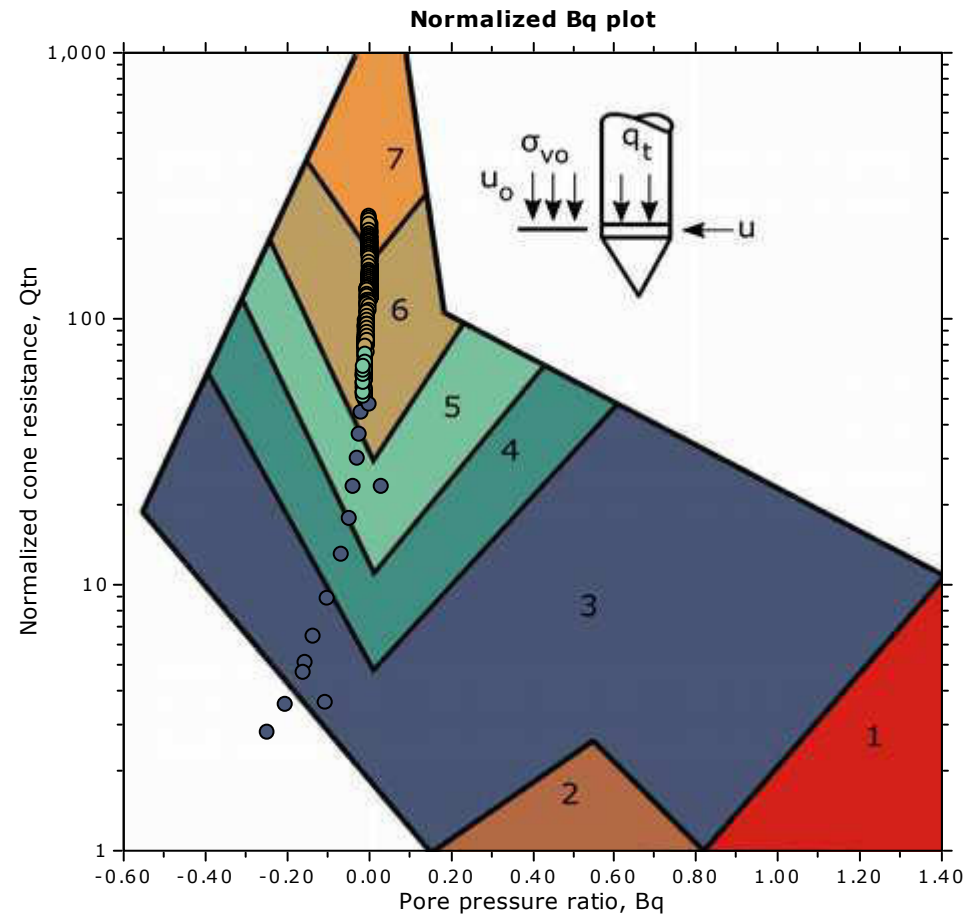
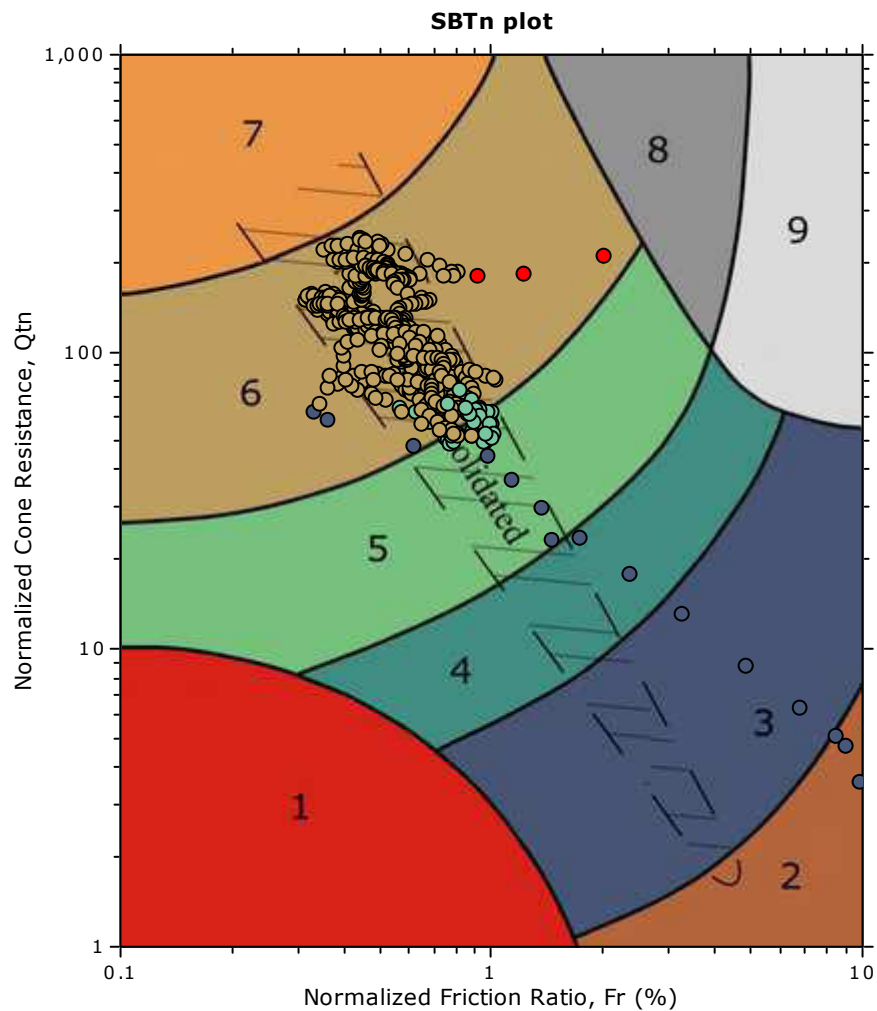
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

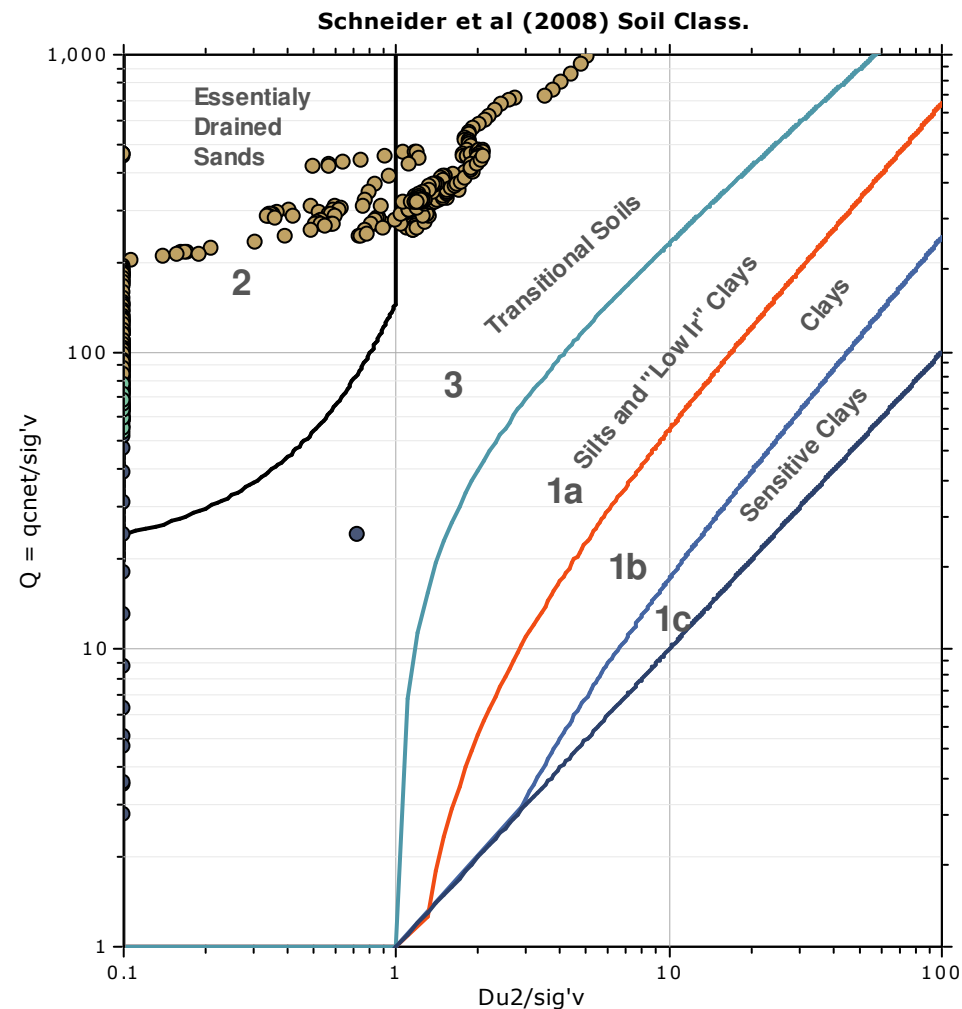
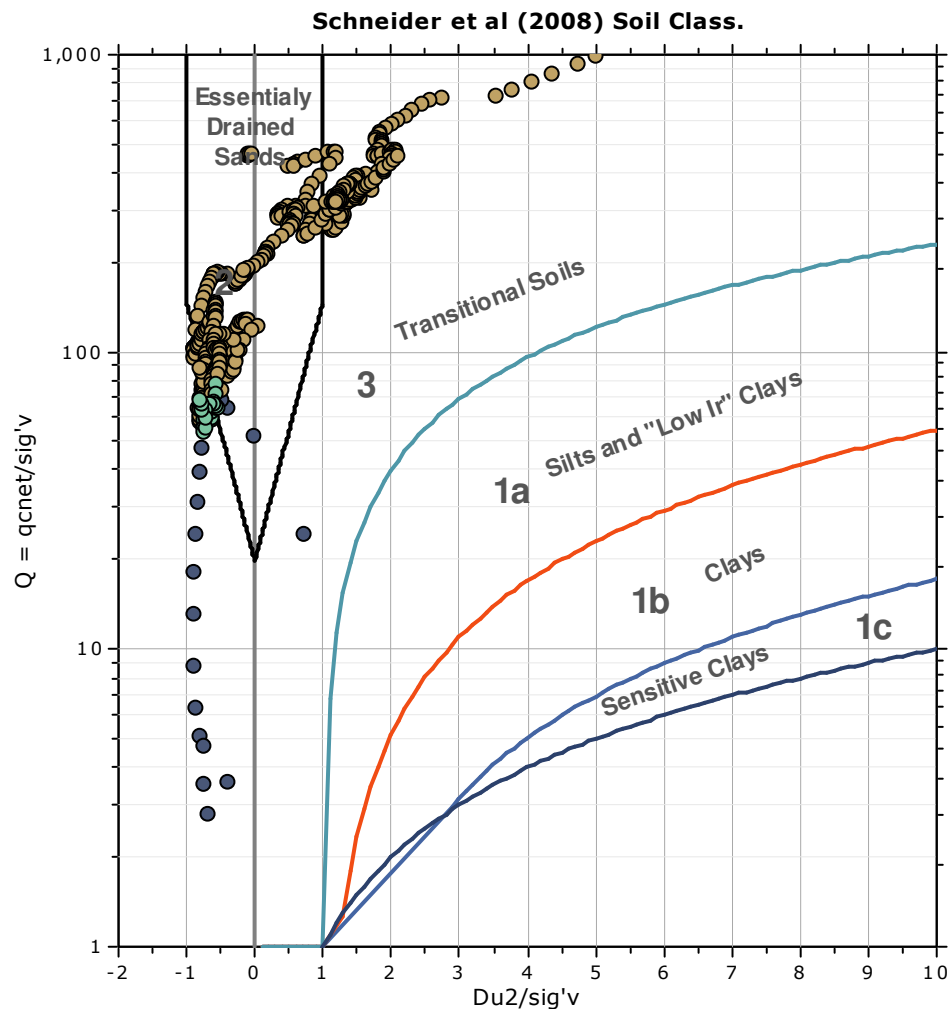
**SBT - Bq plots (normalized)**

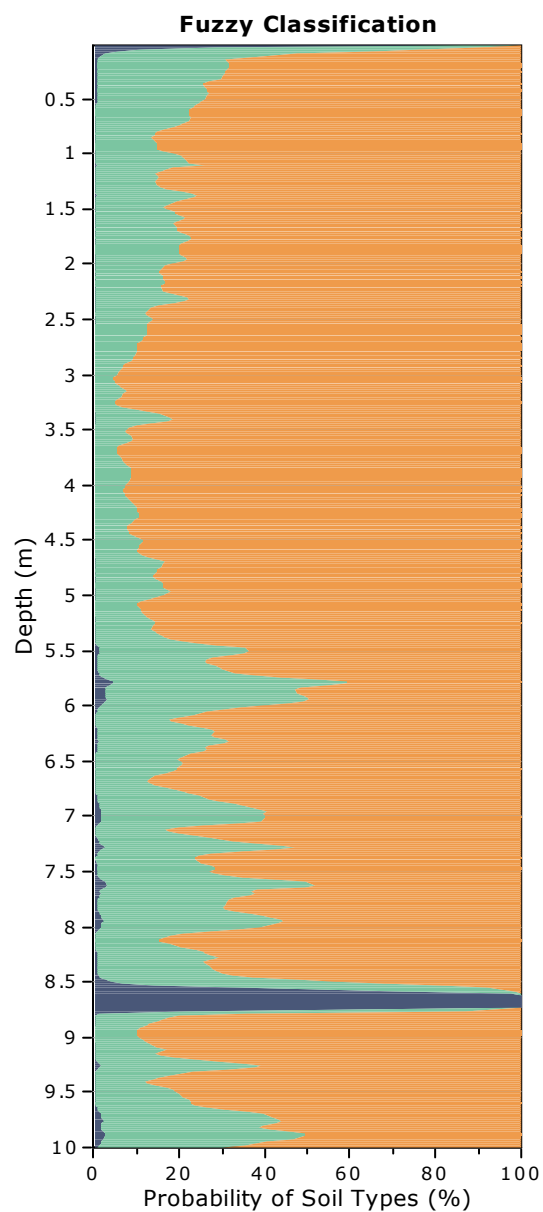
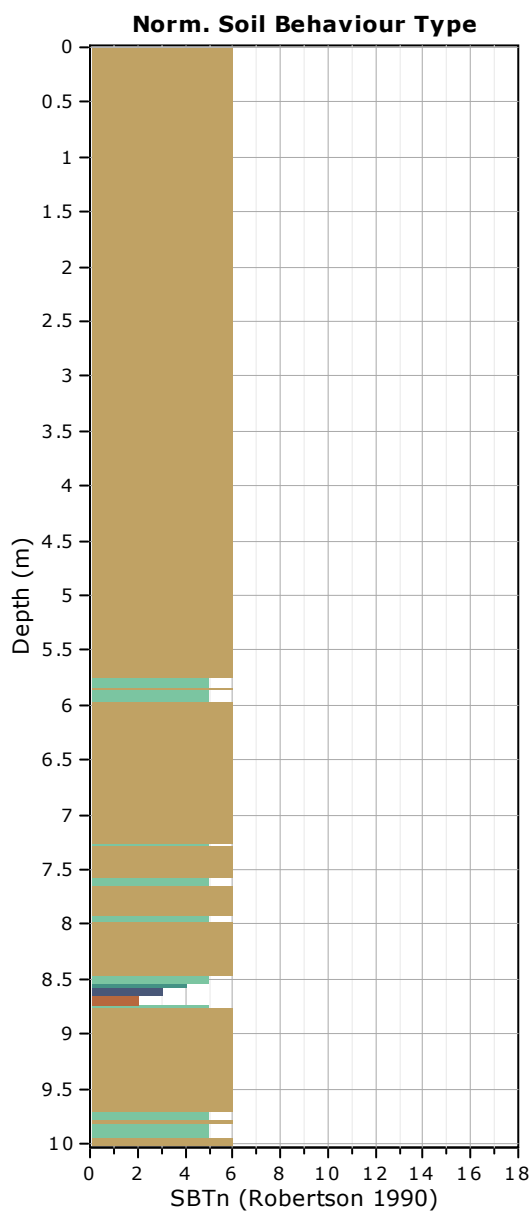


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





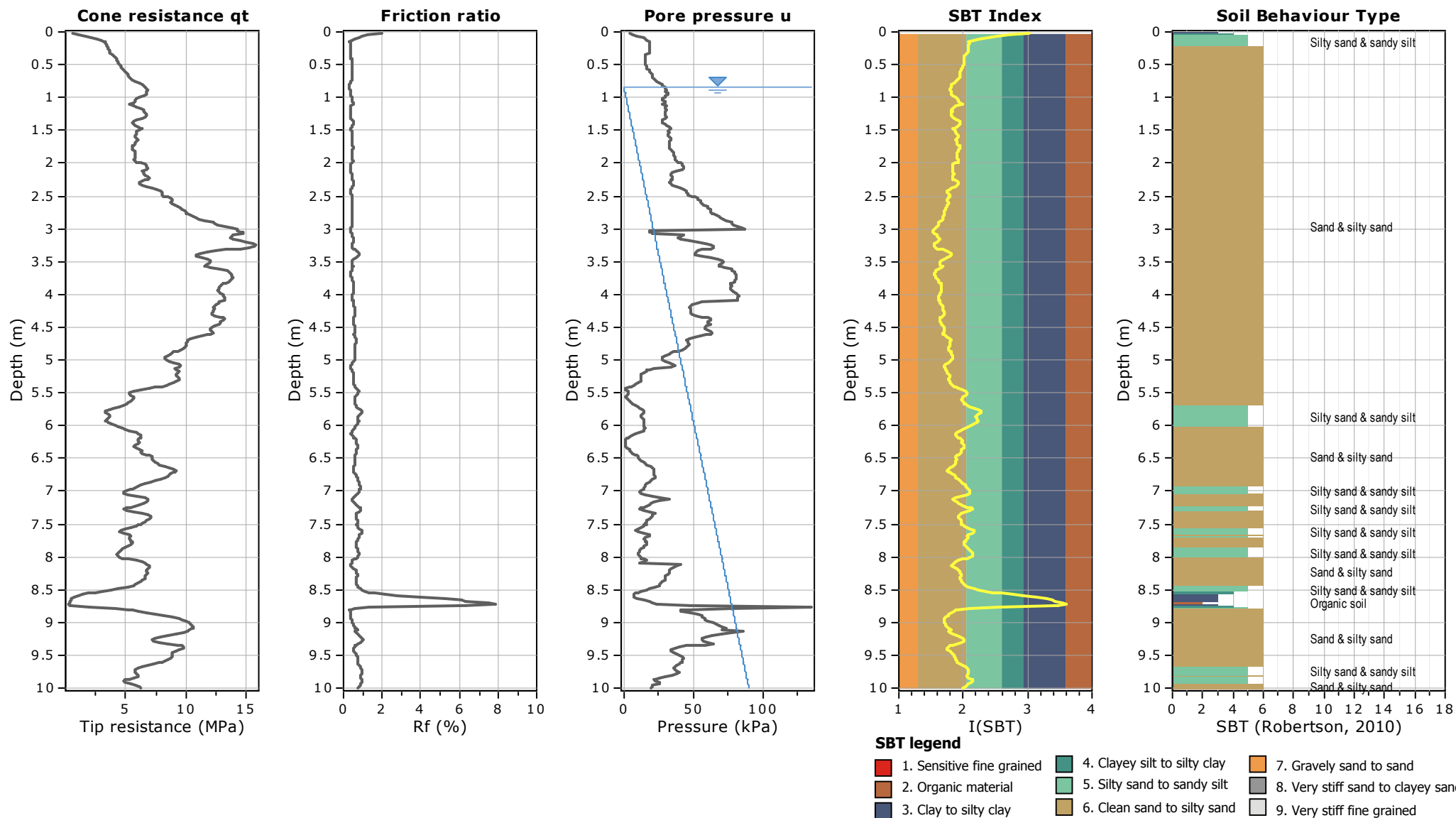
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+500**

Total depth: 10.00 m

Coords: lat 44.769812° lon 12.18858°





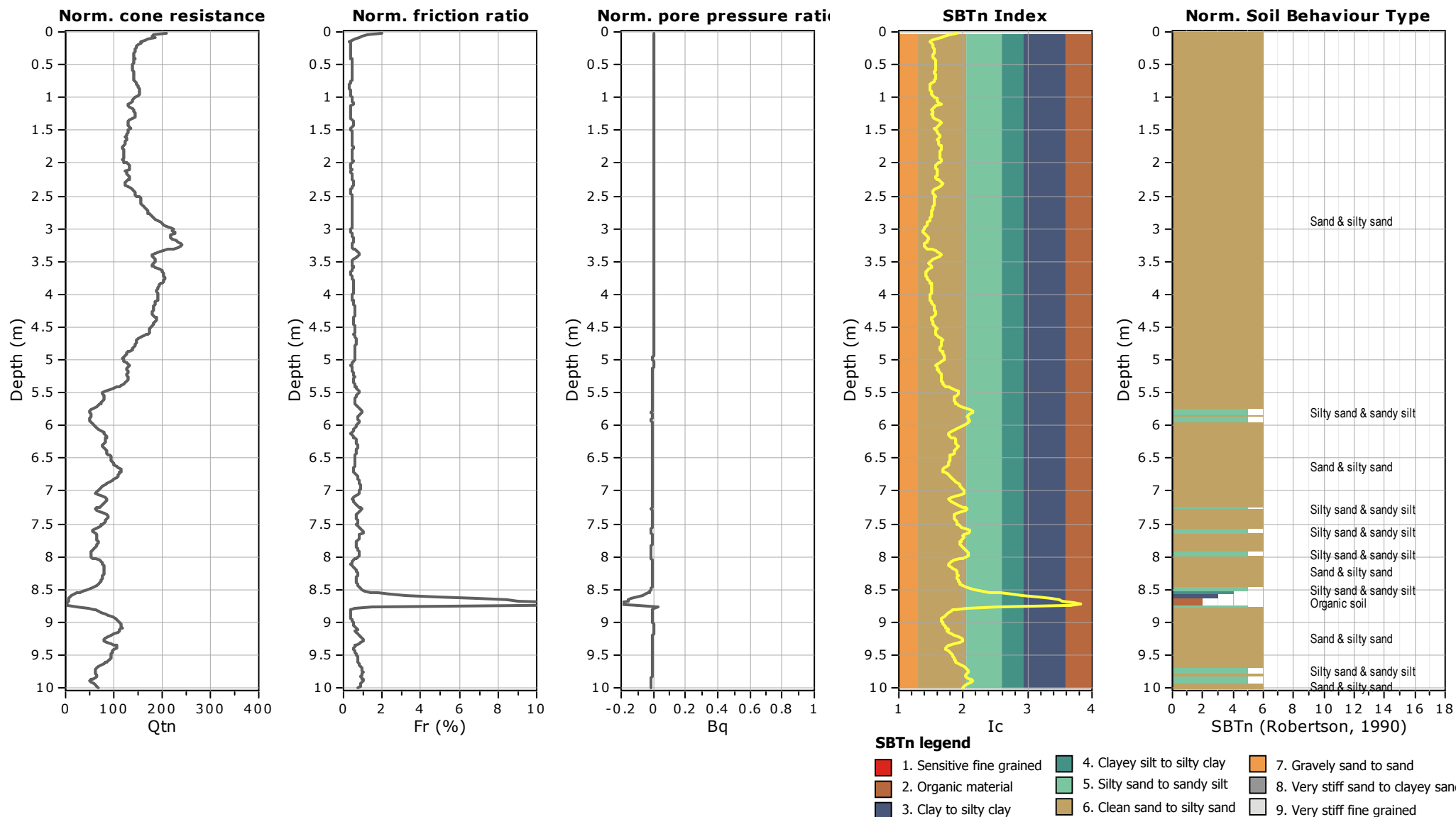
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+500**

Total depth: 10.00 m

Coords: lat 44.769812° lon 12.18858°



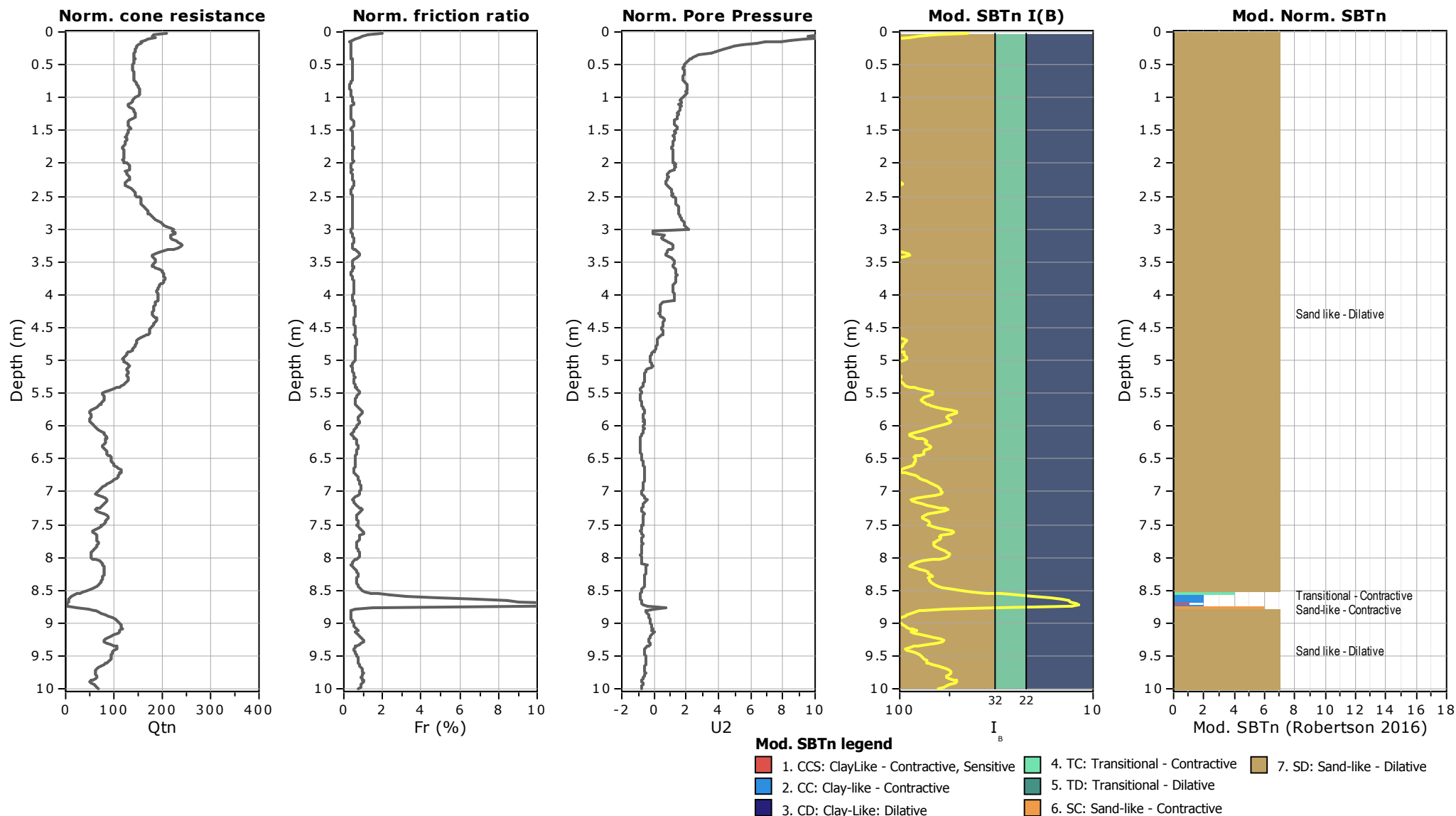
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

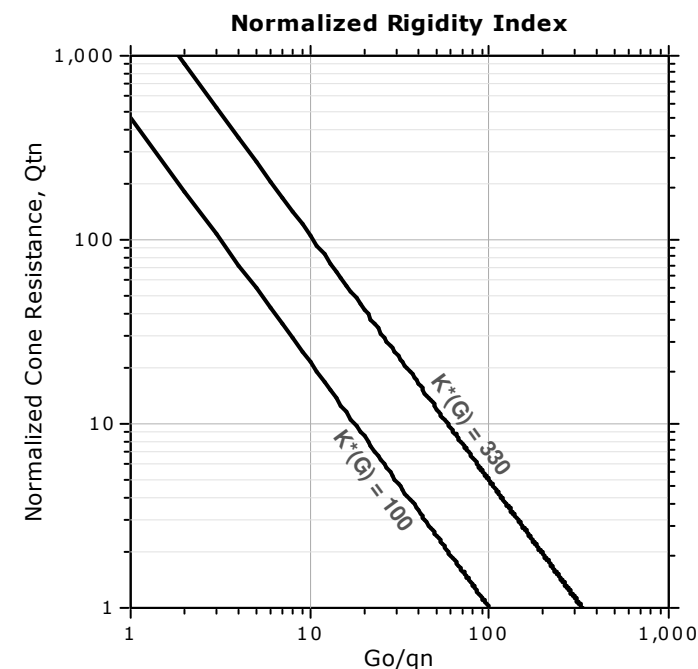
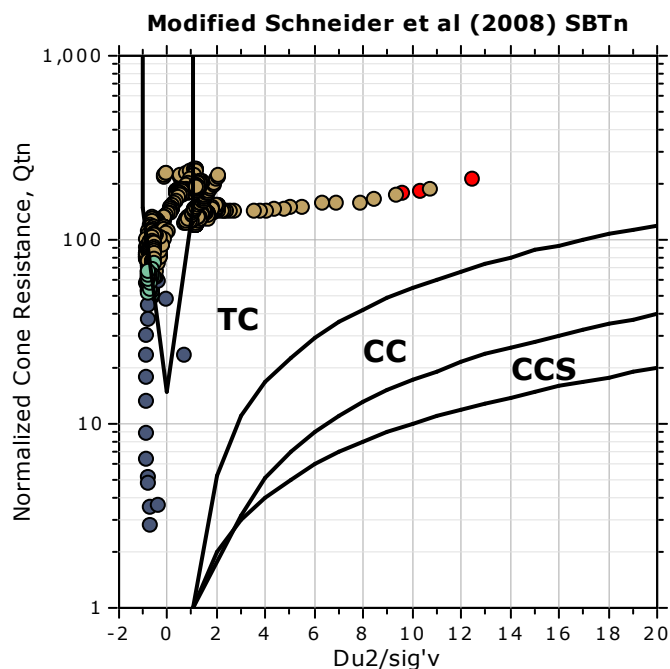
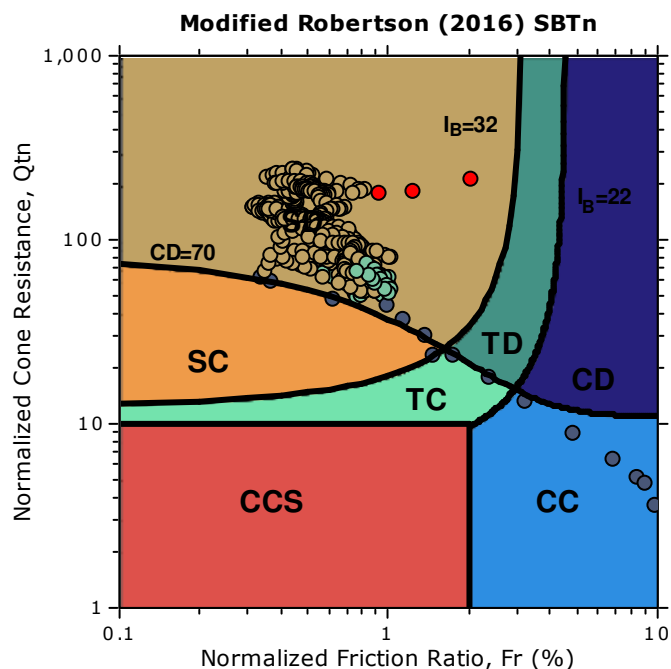
**CPT: CPTU km36+500**

Total depth: 10.00 m

Coords: lat 44.769812° lon 12.18858°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

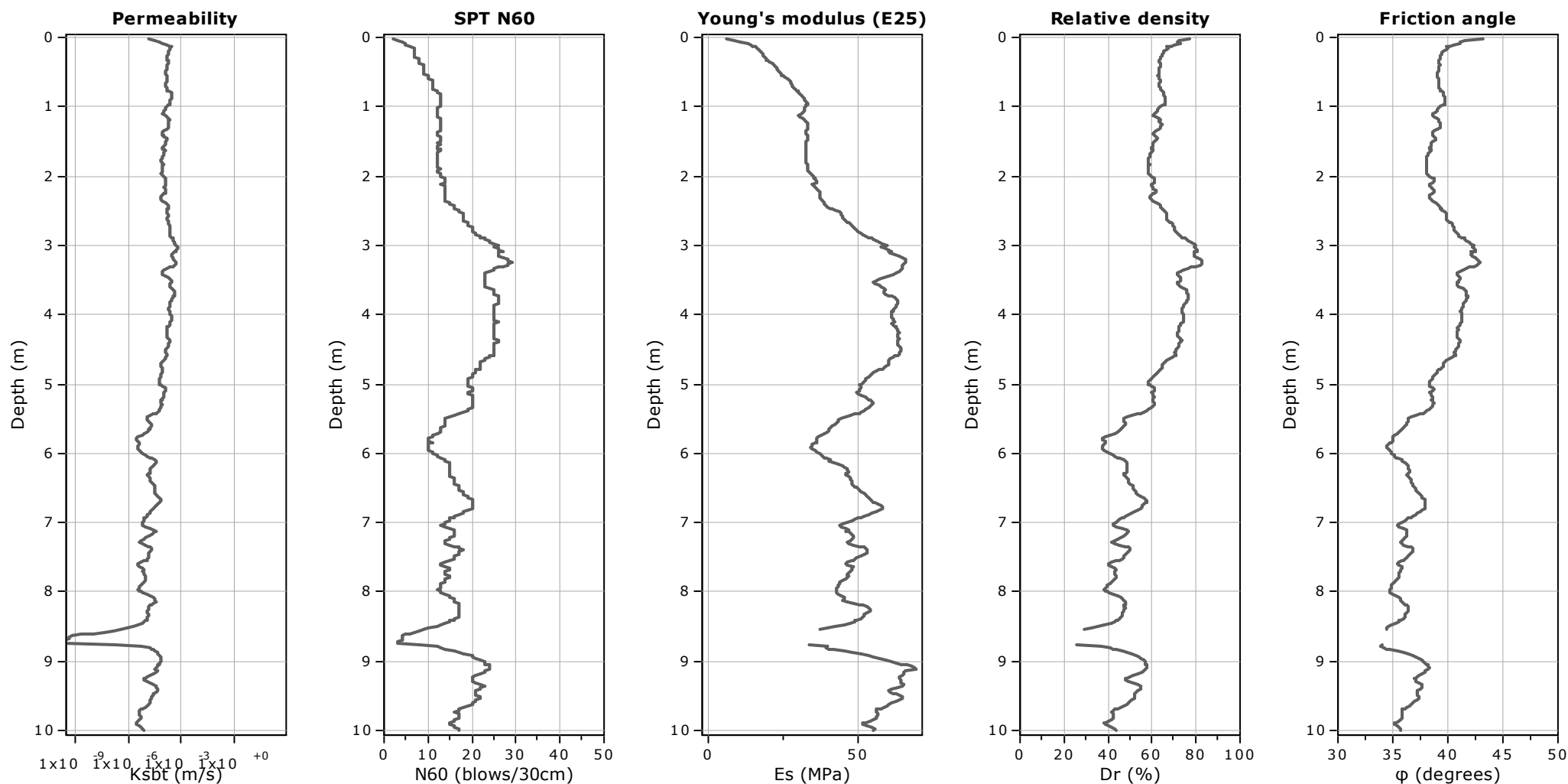
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+500**

Total depth: 10.00 m

Coords: lat 44.769812° lon 12.18858°



**Calculation parameters**

Permeability: Based on  $SBT_n$

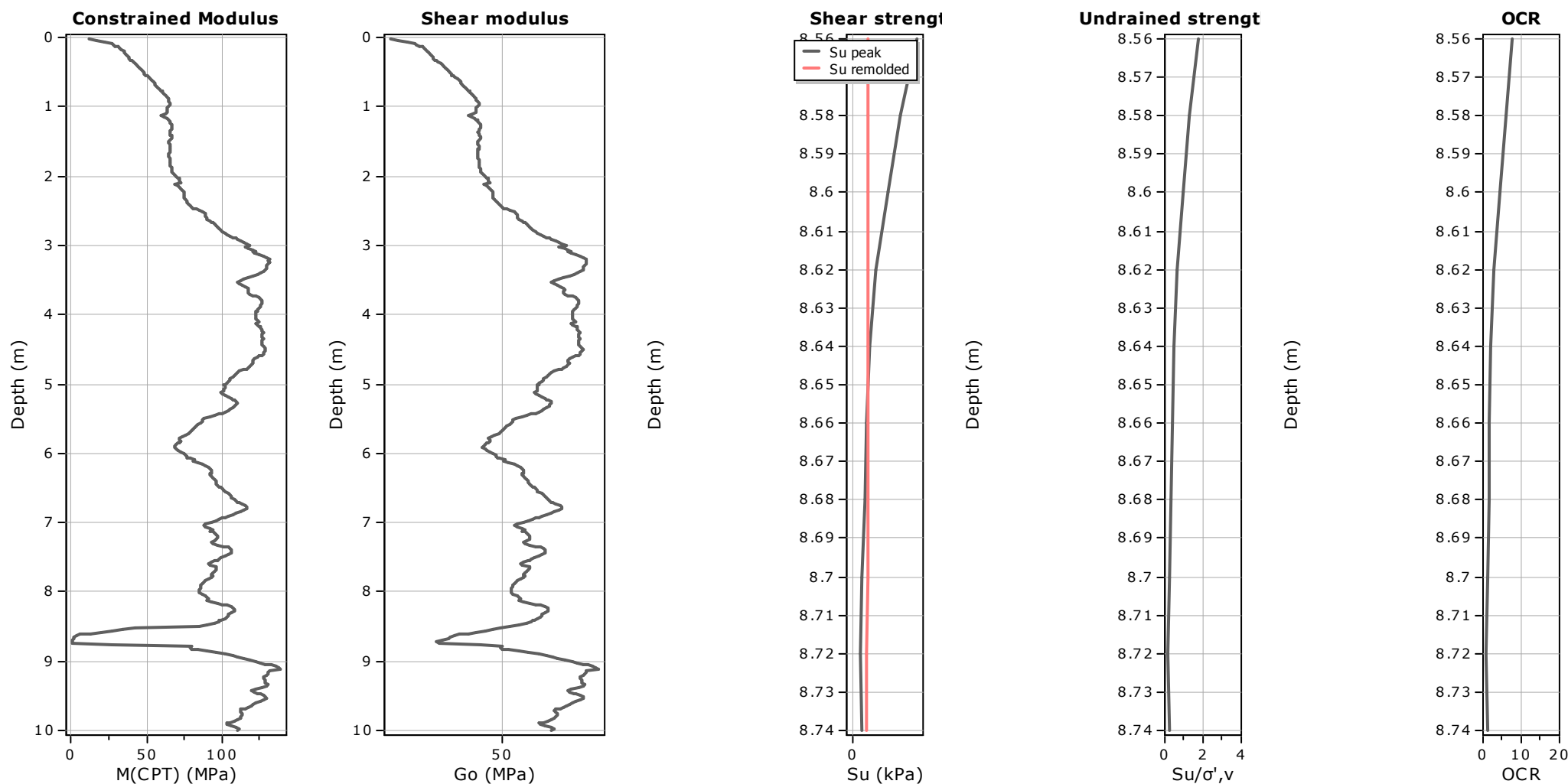
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

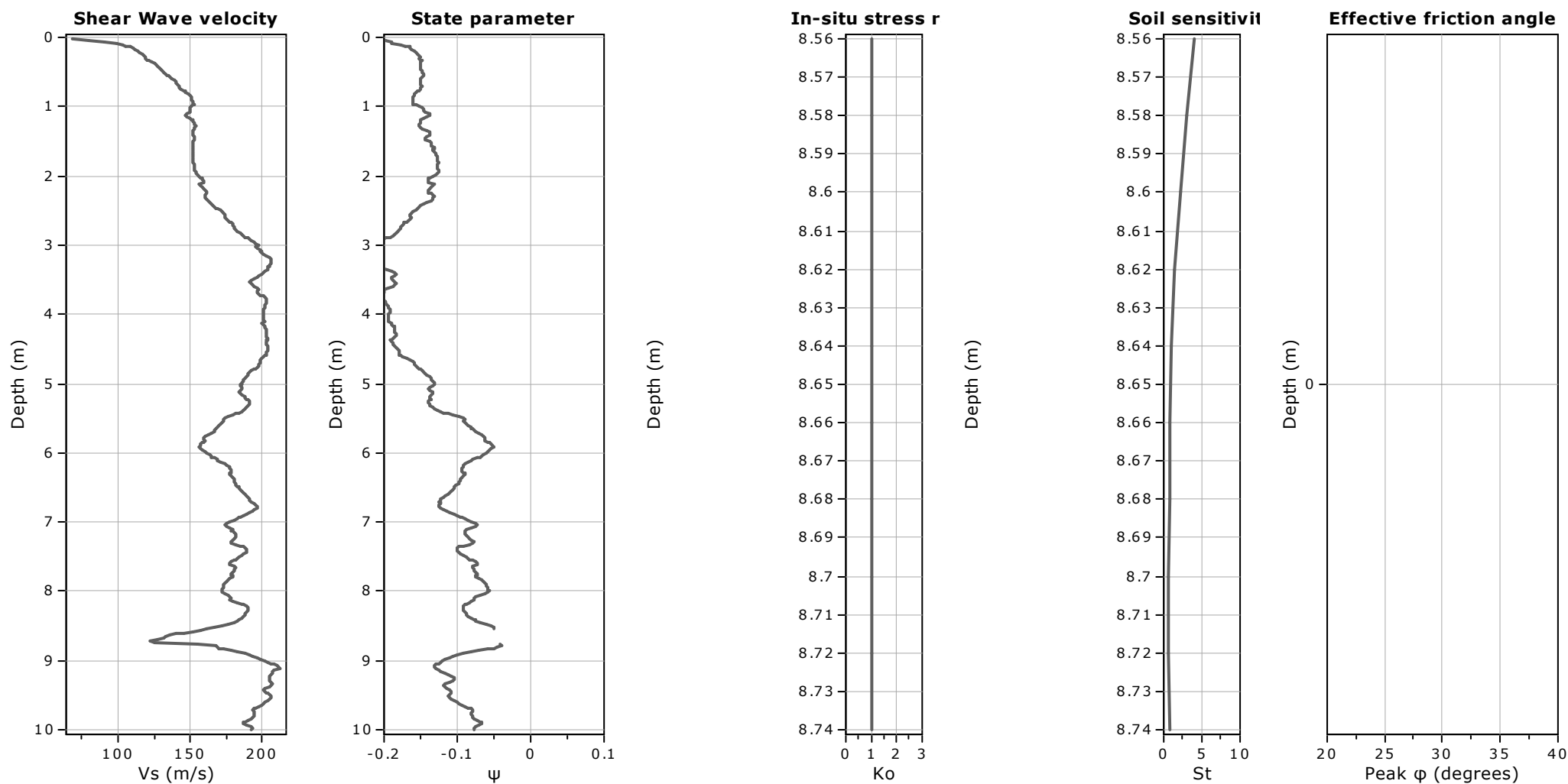
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km36+500**

Total depth: 10.00 m

Coords: lat 44.769812° lon 12.18858°

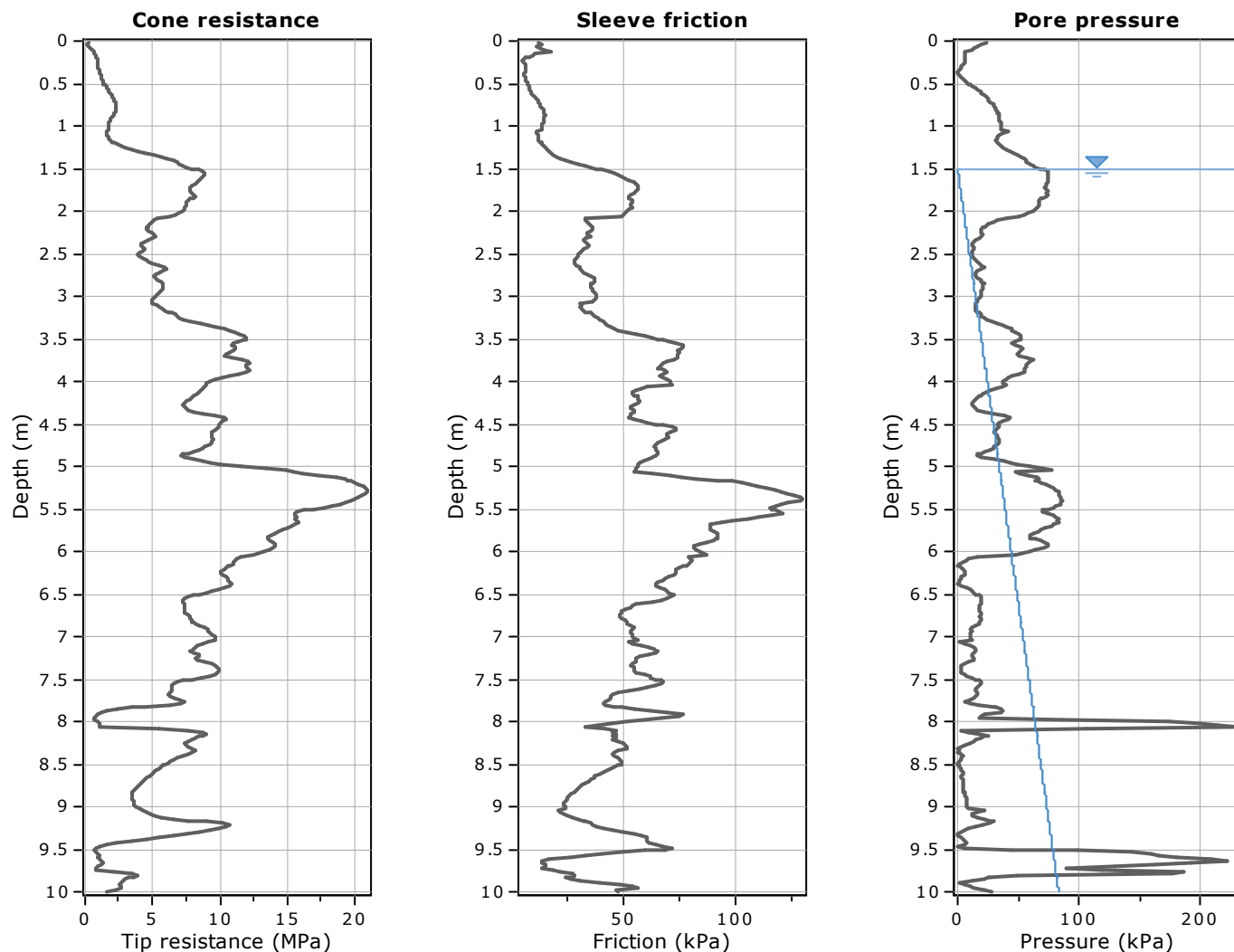


**Calculation parameters**

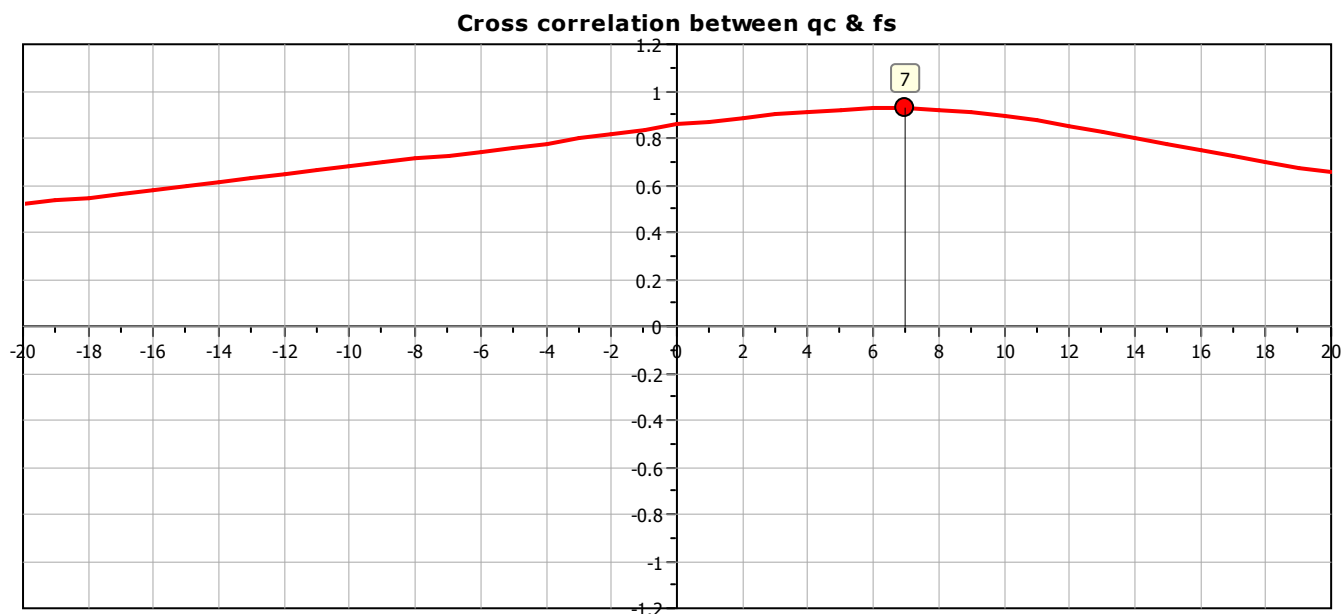
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

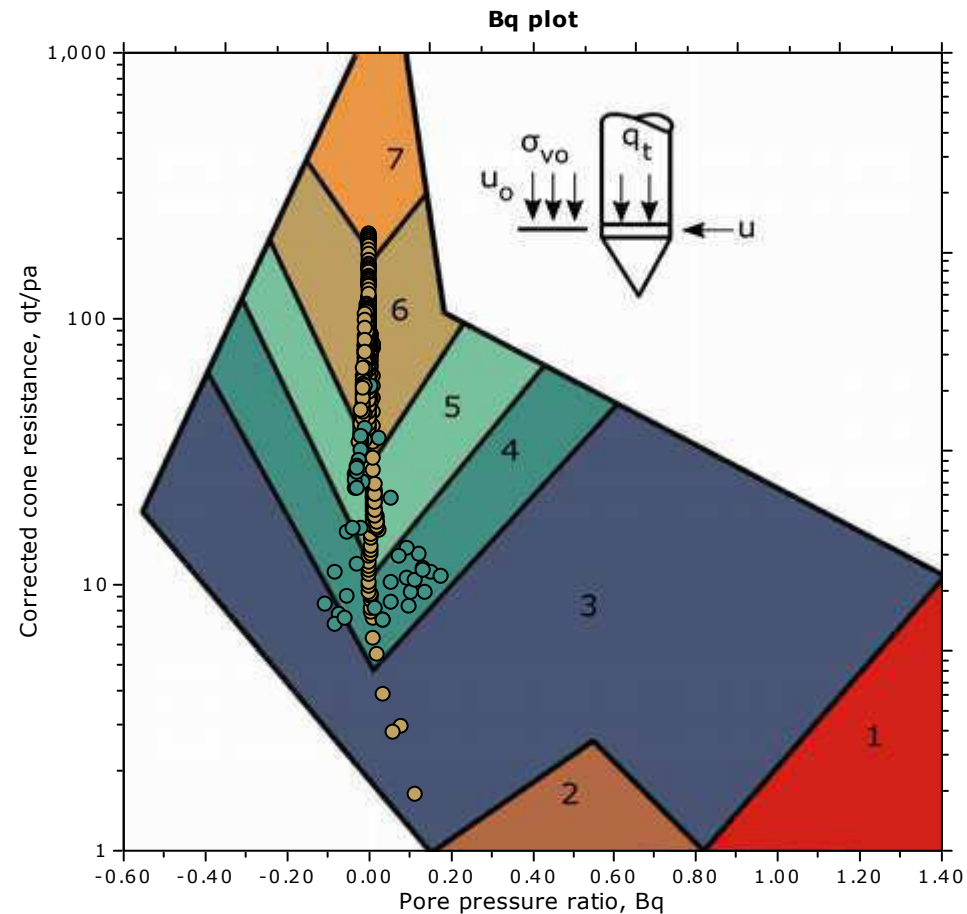
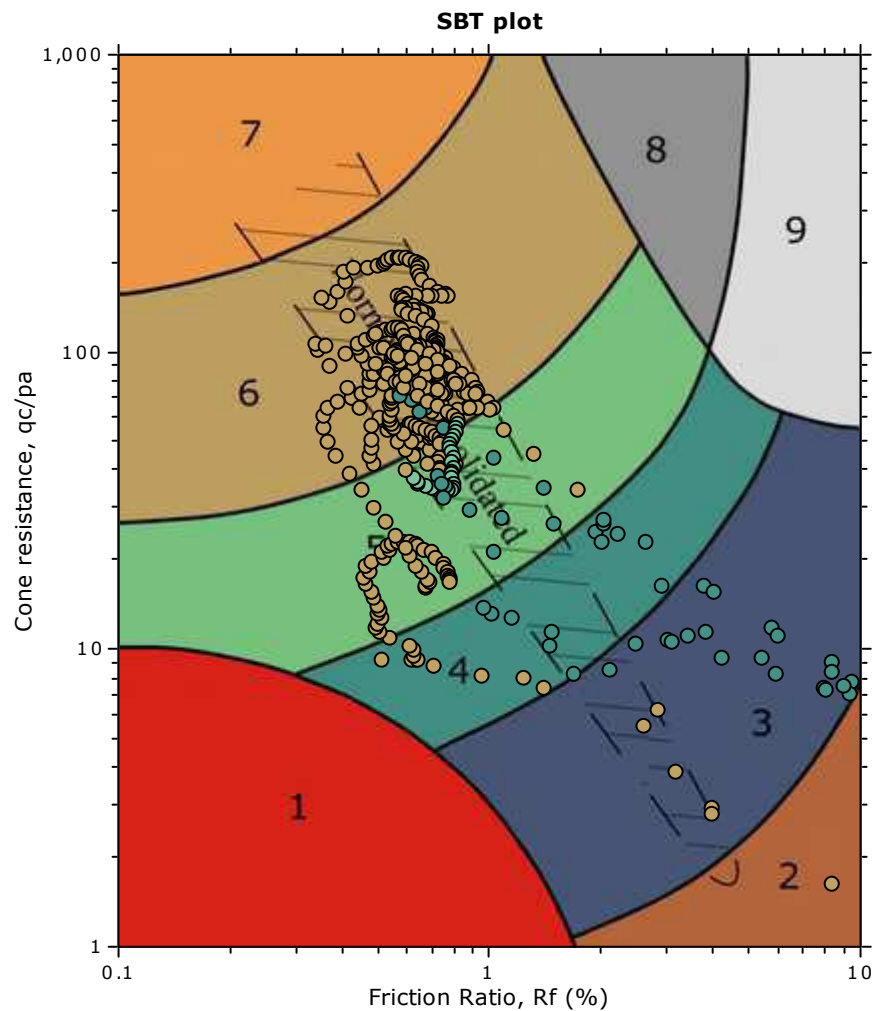




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



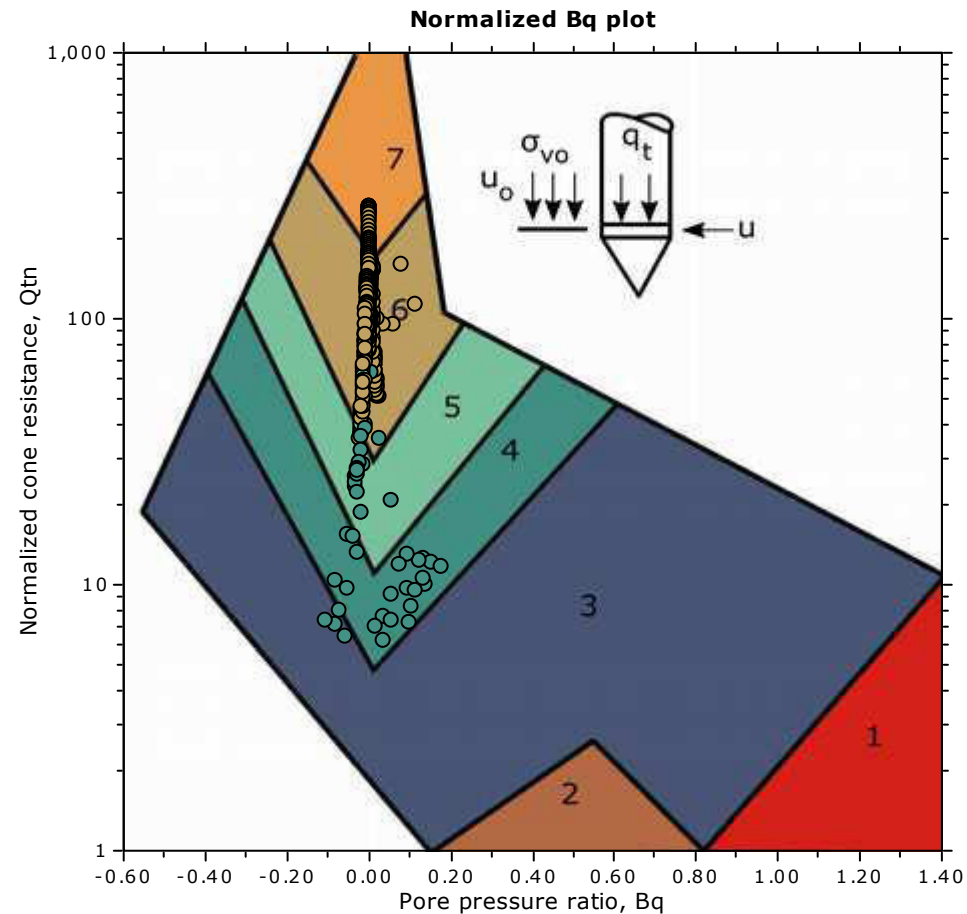
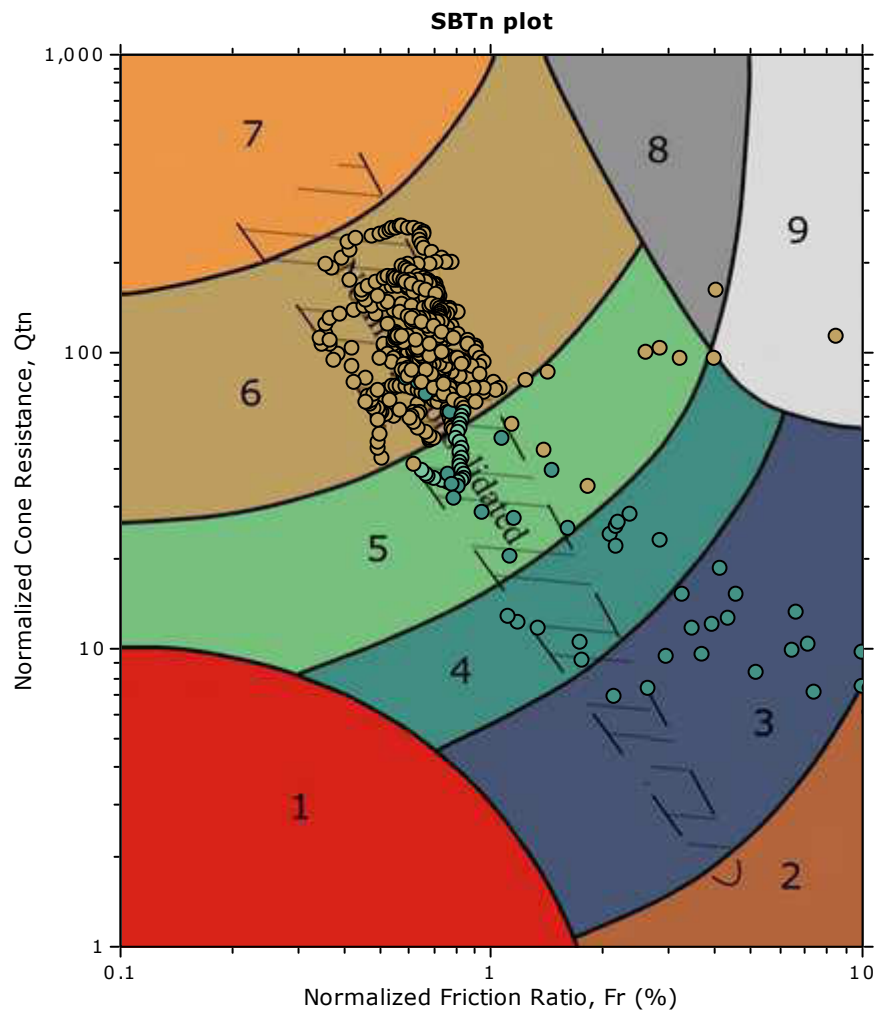
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

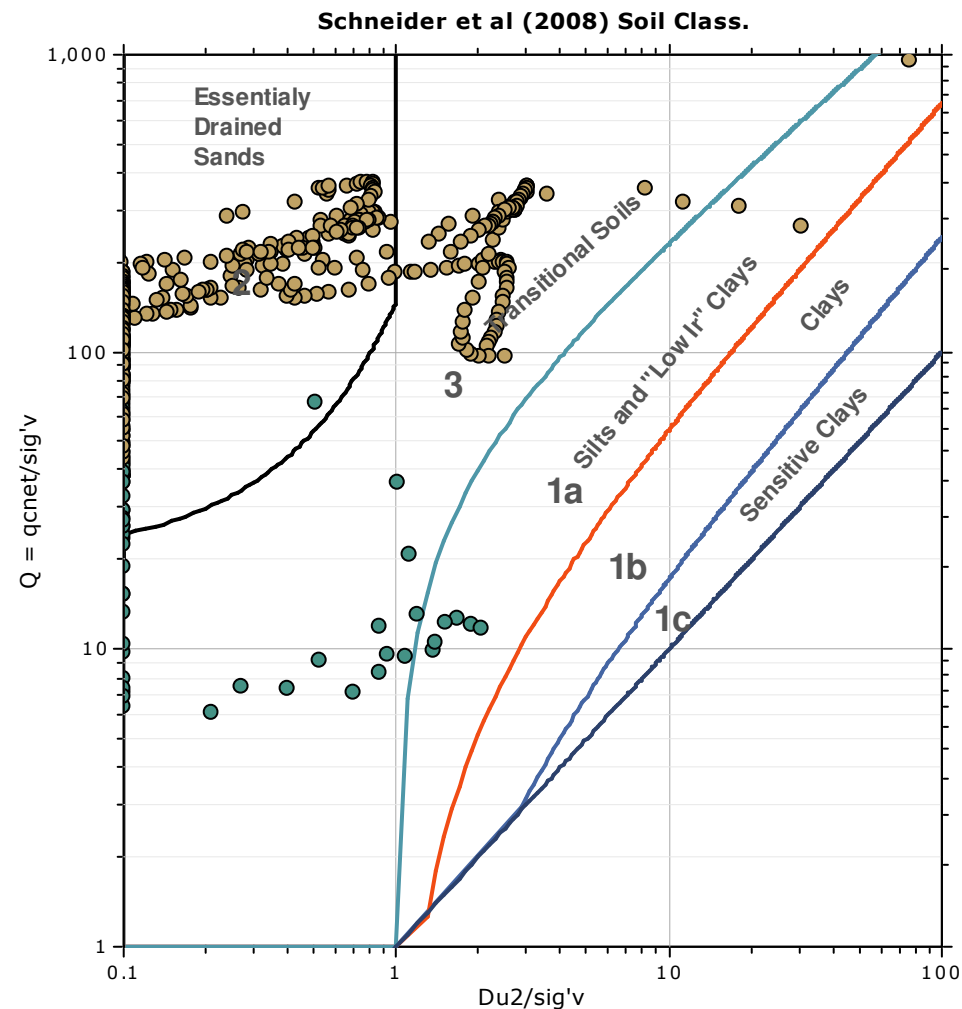
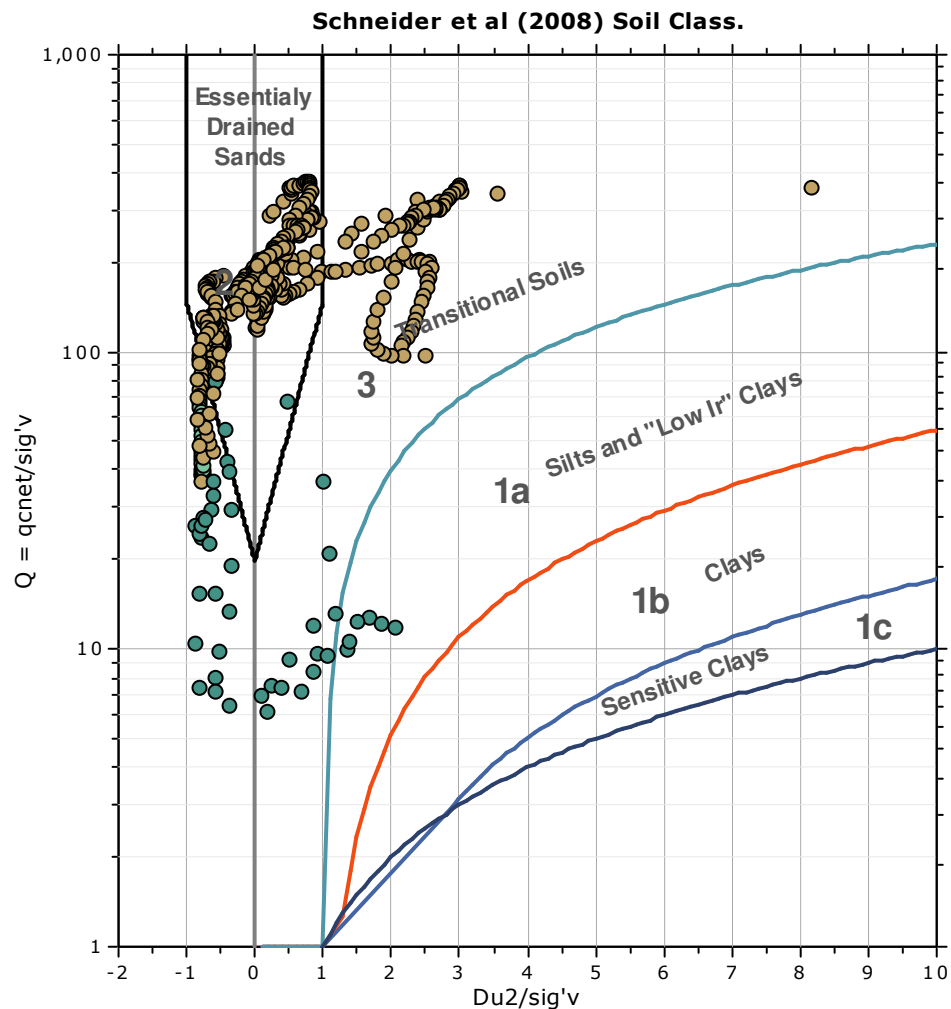
**SBT - Bq plots (normalized)**

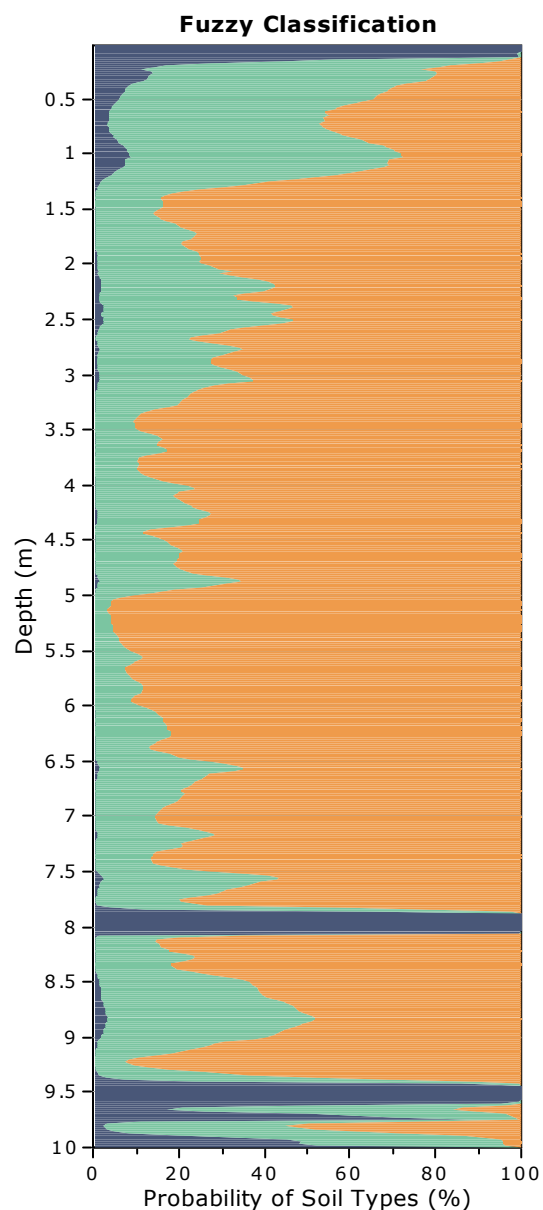
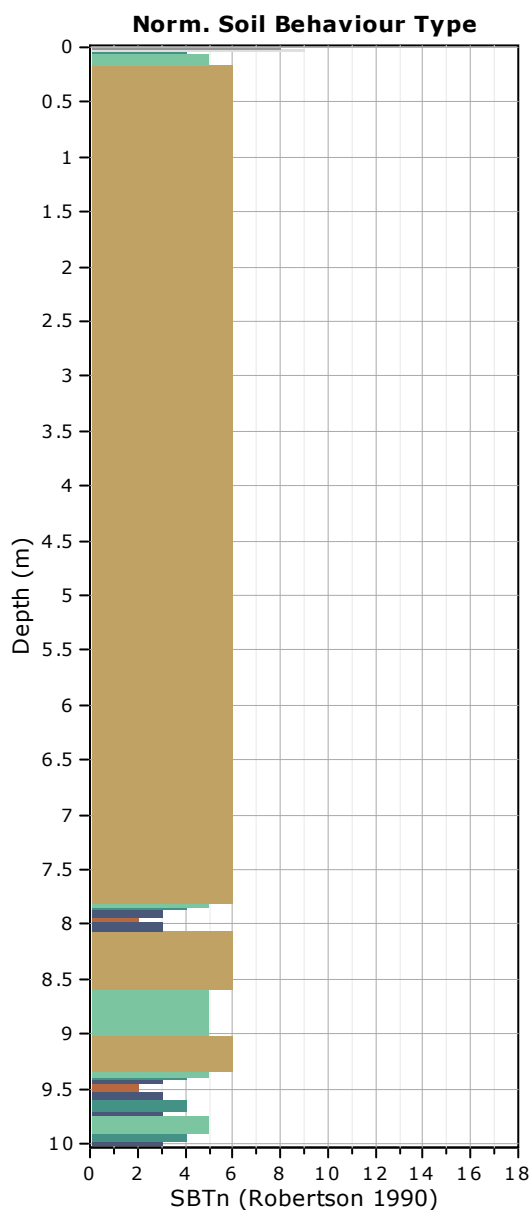


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





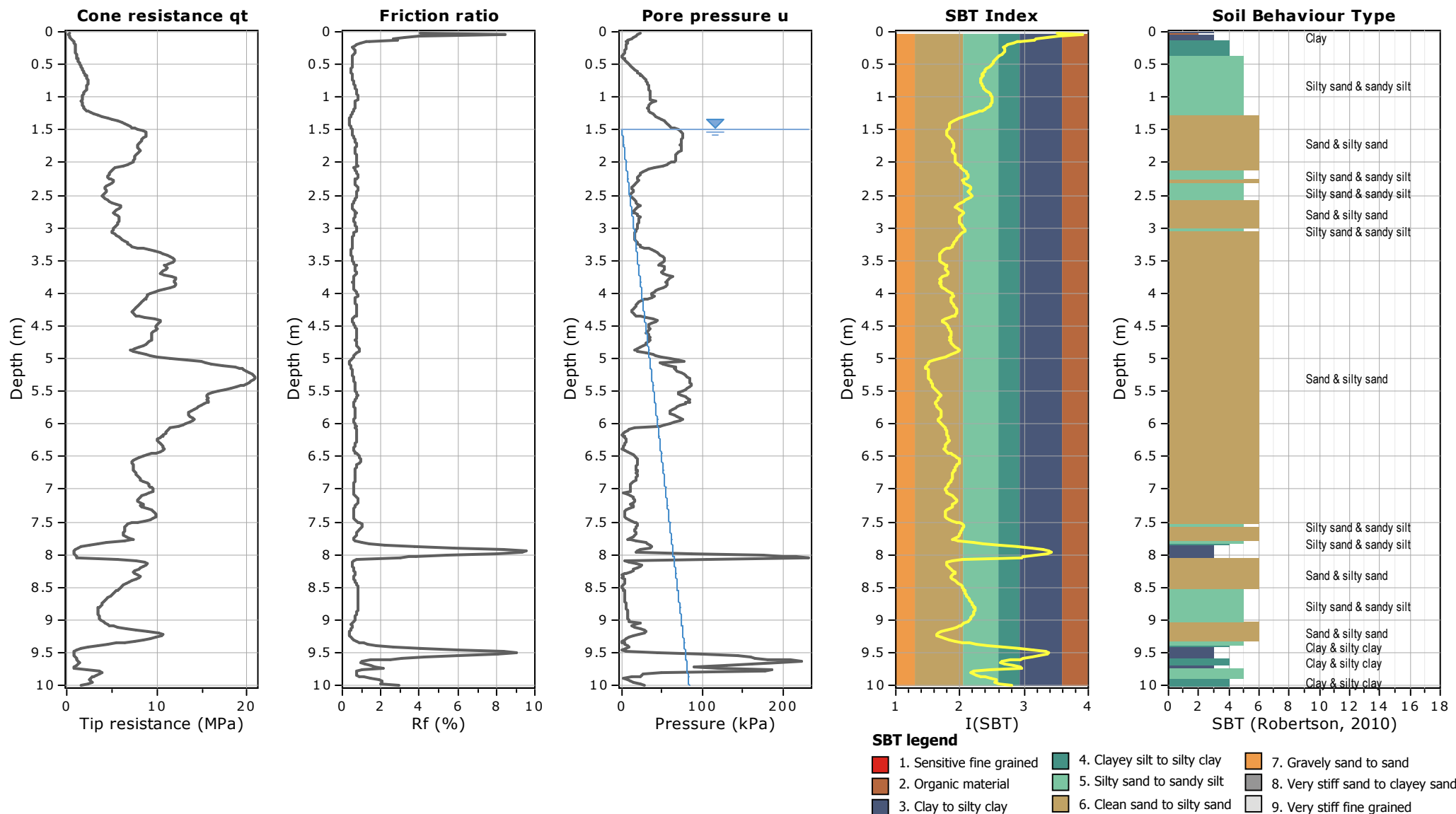
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km39+600**

Total depth: 10.00 m

Coords: lat 44.797144° lon 12.17936°





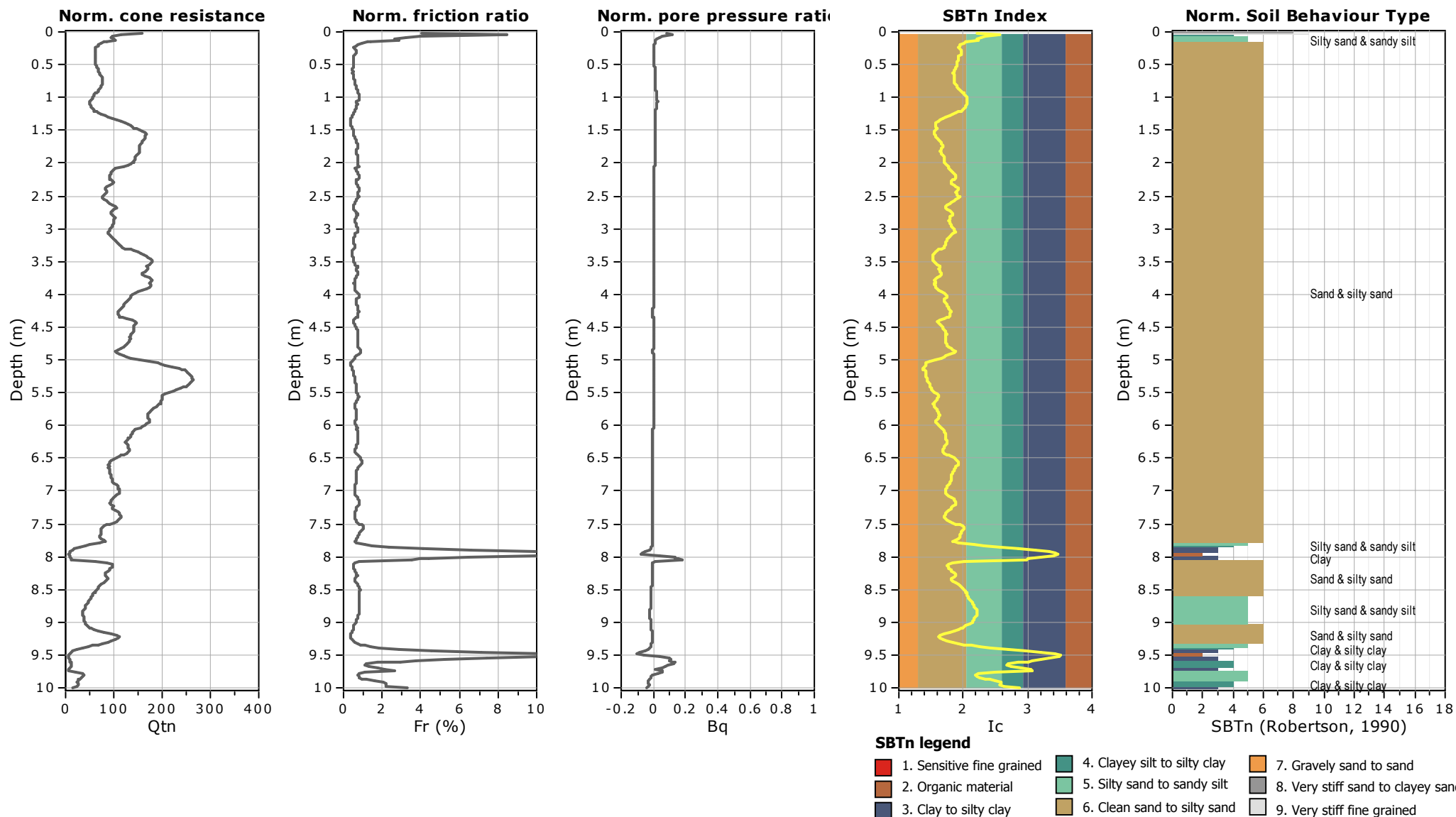
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km39+600**

Total depth: 10.00 m

Coords: lat 44.797144° lon 12.17936°



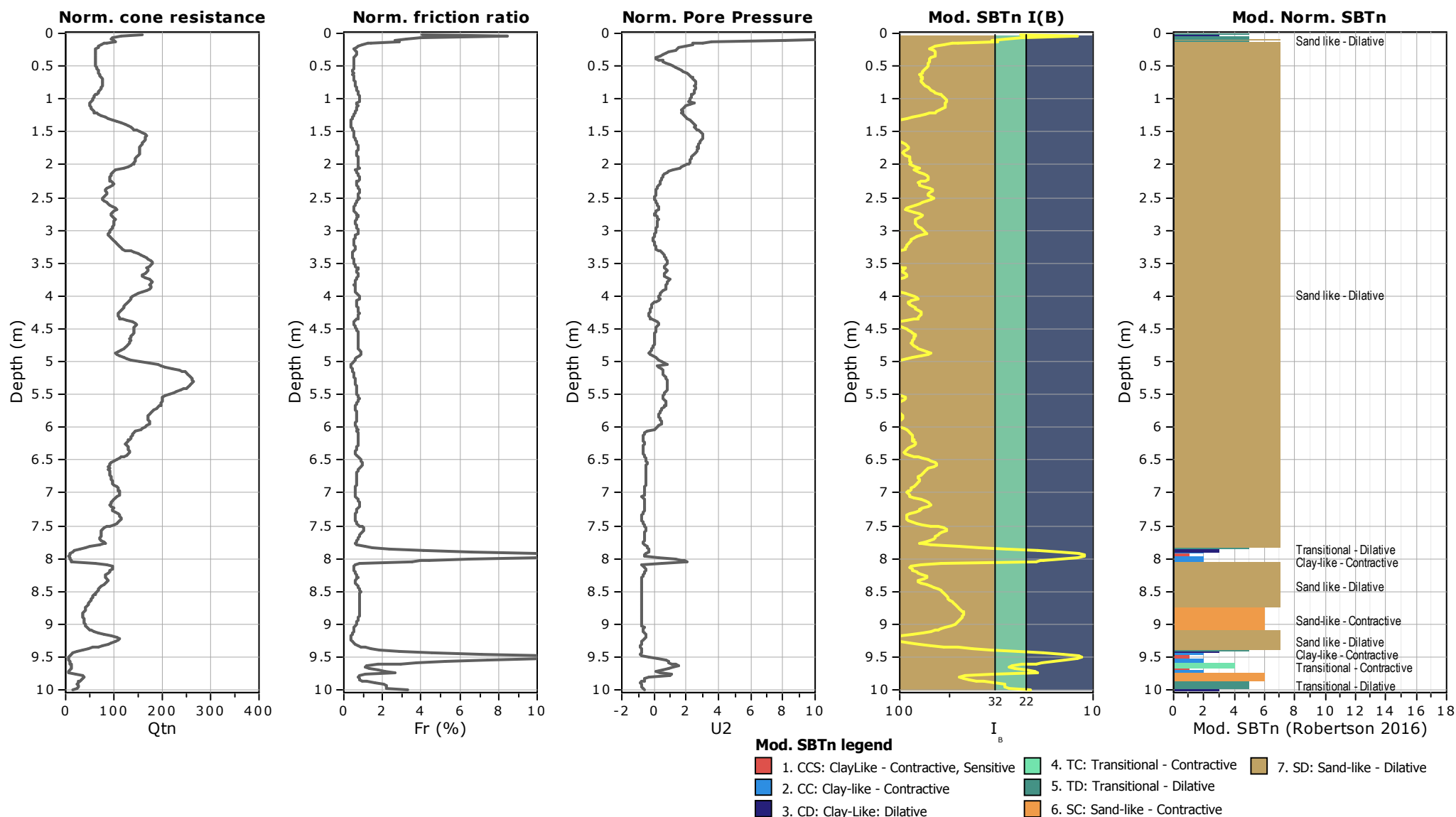
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

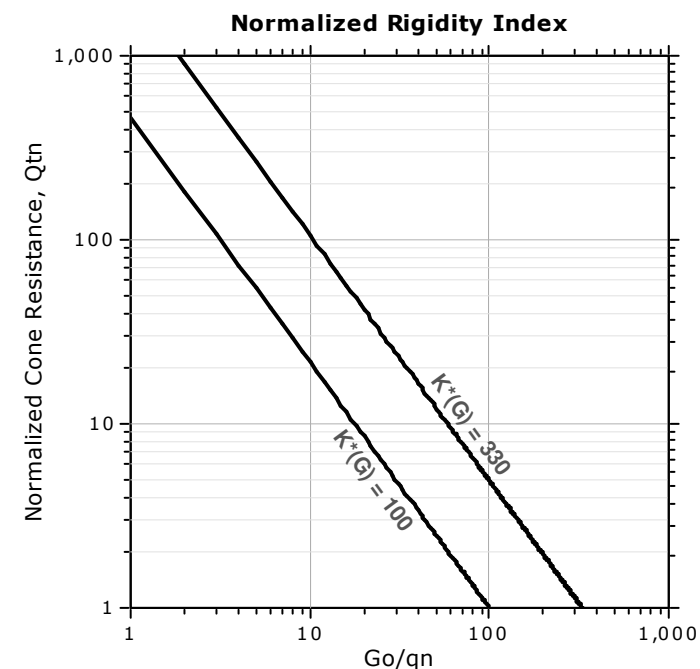
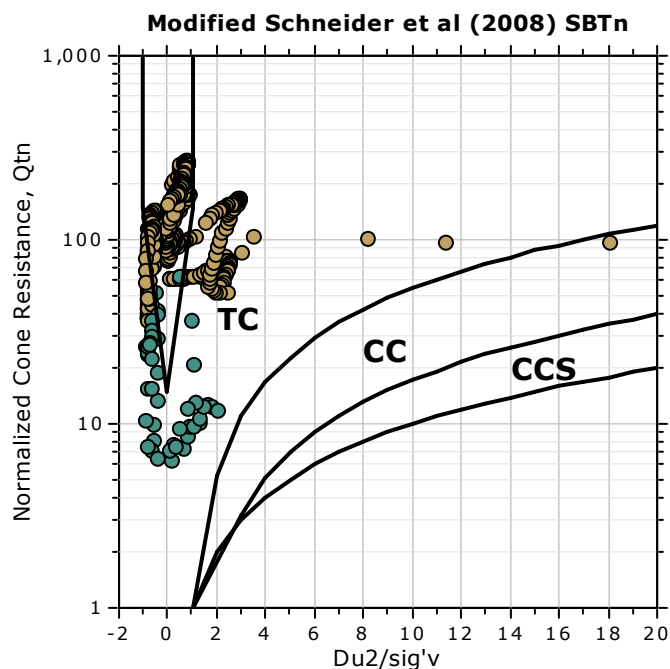
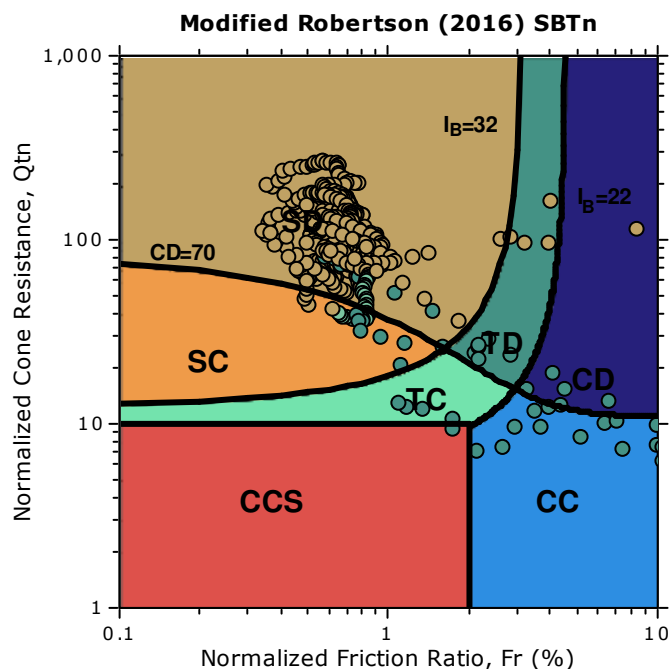
**CPT: CPTU km39+600**

Total depth: 10.00 m

Coords: lat 44.797144° lon 12.17936°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

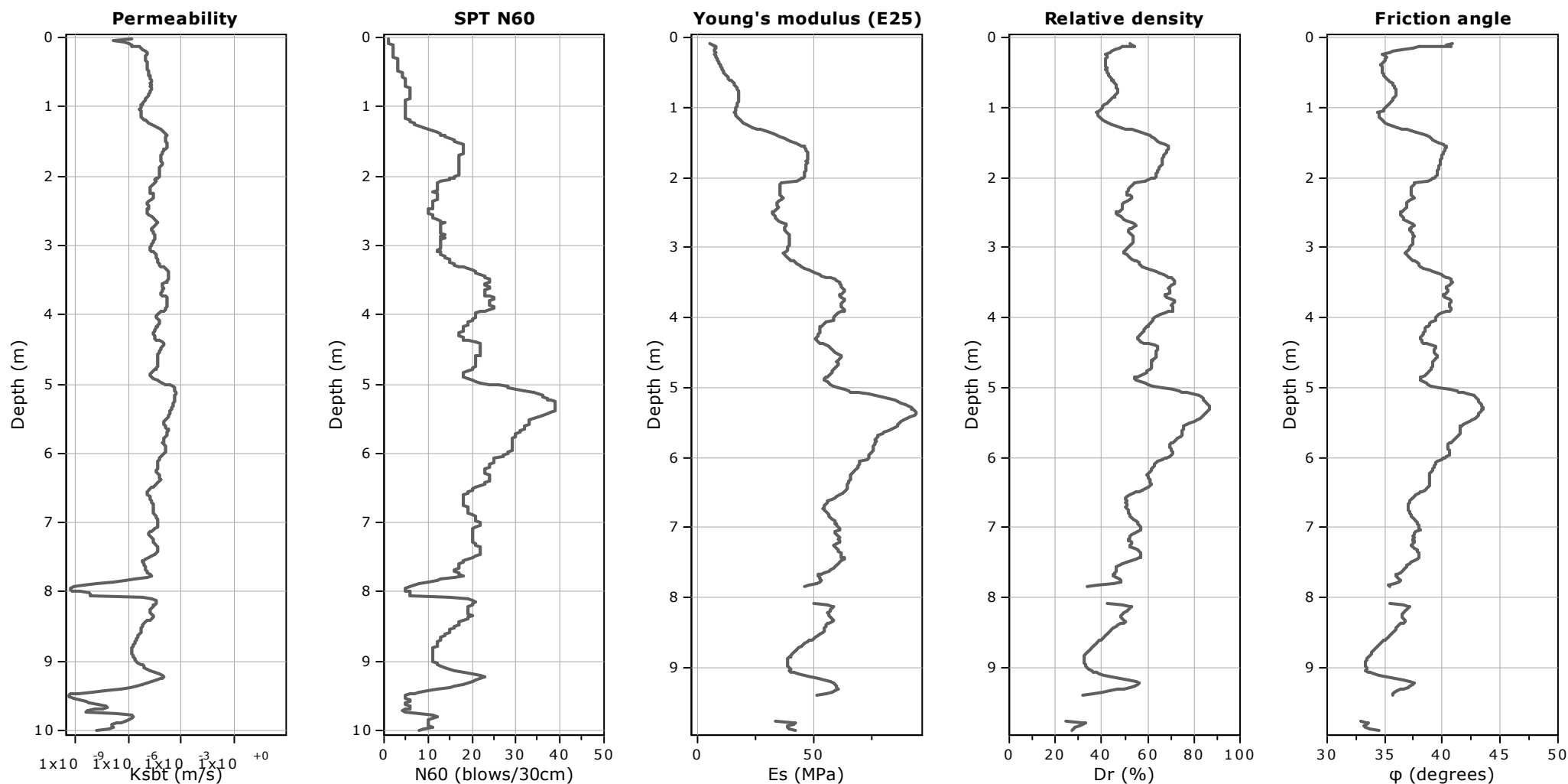
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km39+600**

Total depth: 10.00 m

Coords: lat 44.797144° lon 12.17936°



#### Calculation parameters

Permeability: Based on  $SBT_n$

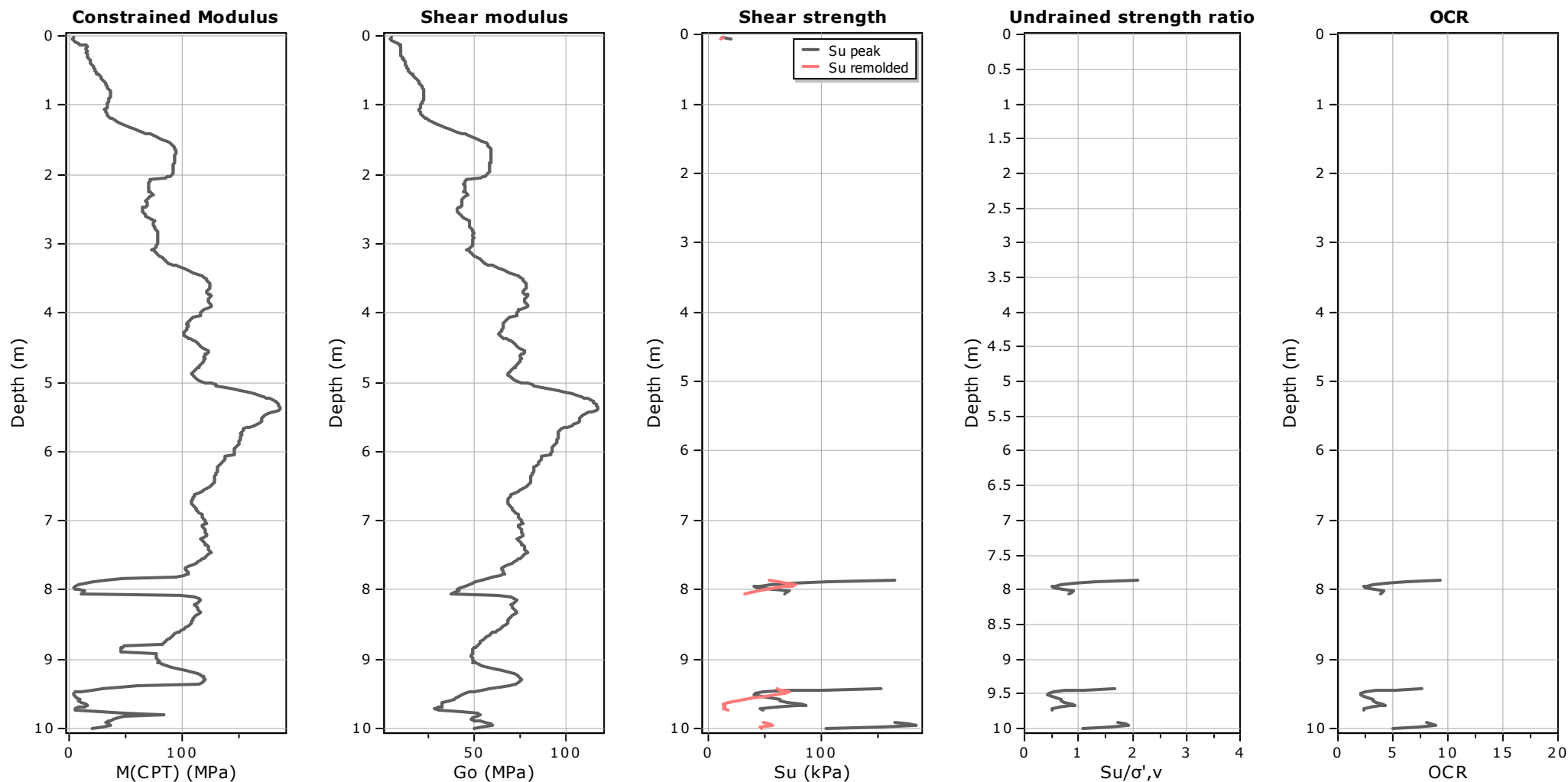
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

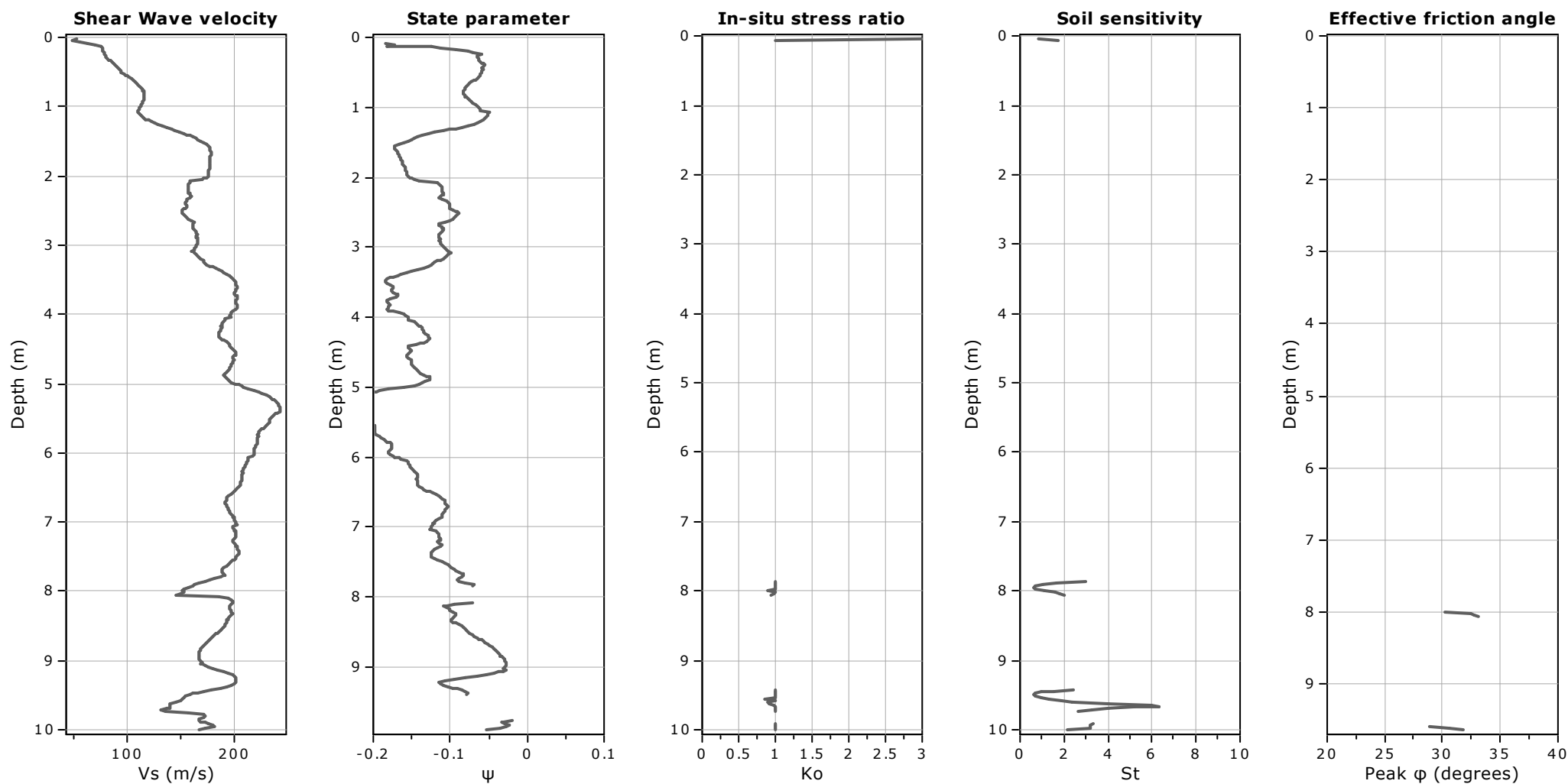
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km39+600**

Total depth: 10.00 m

Coords: lat 44.797144° lon 12.17936°

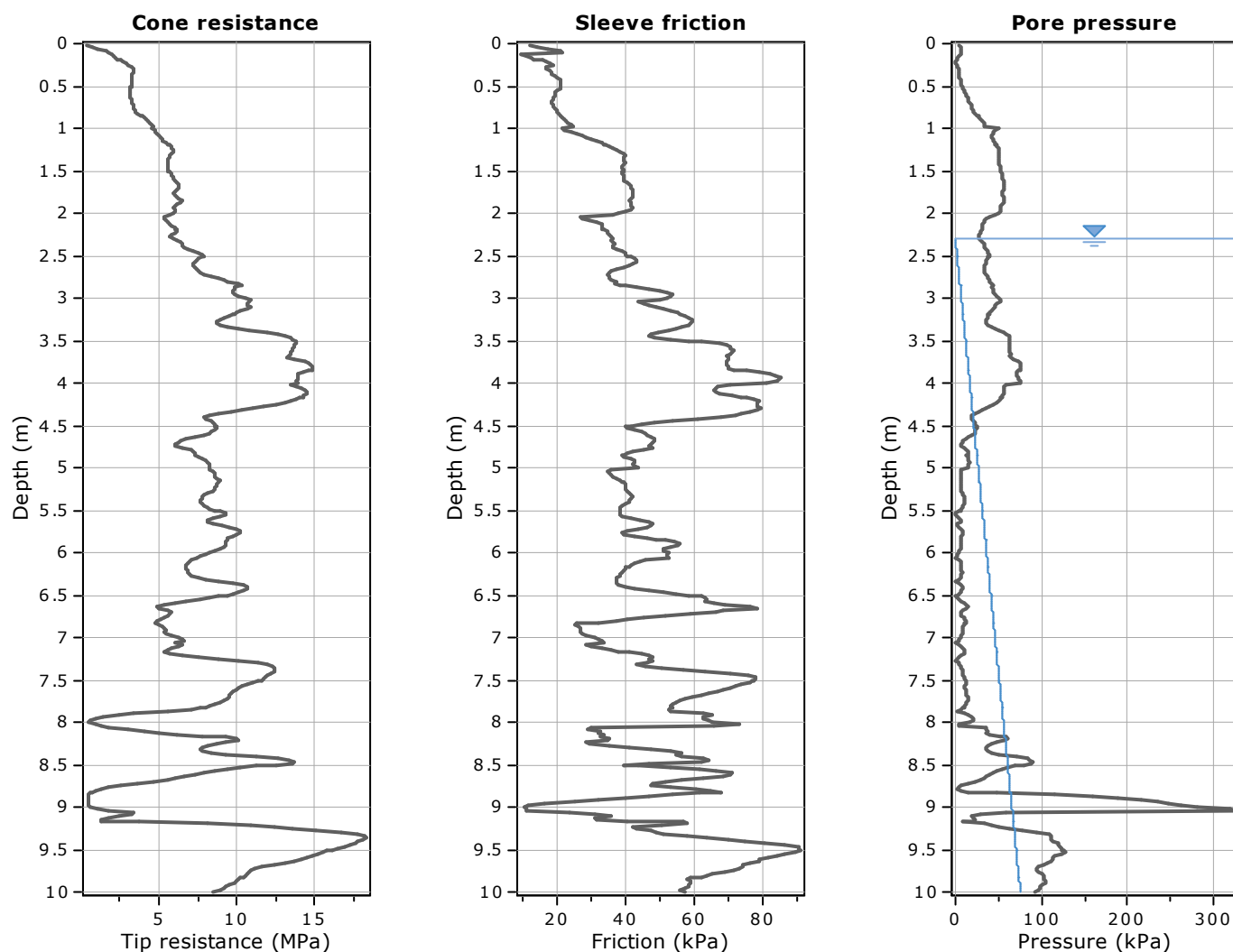


#### Calculation parameters

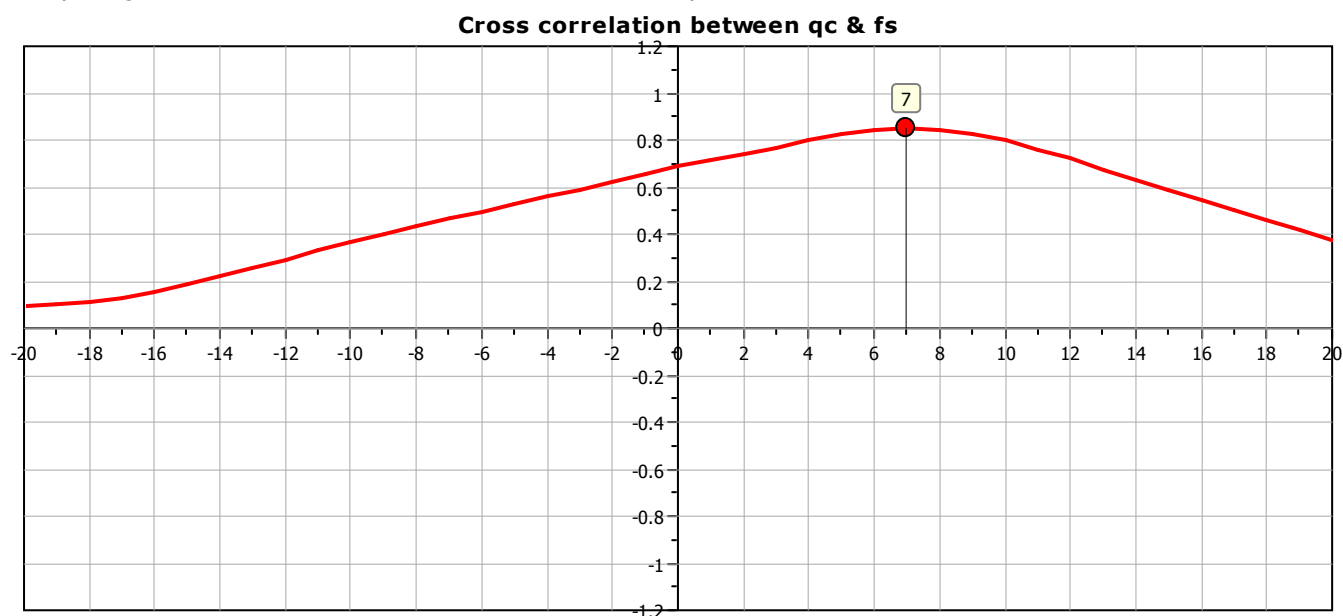
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

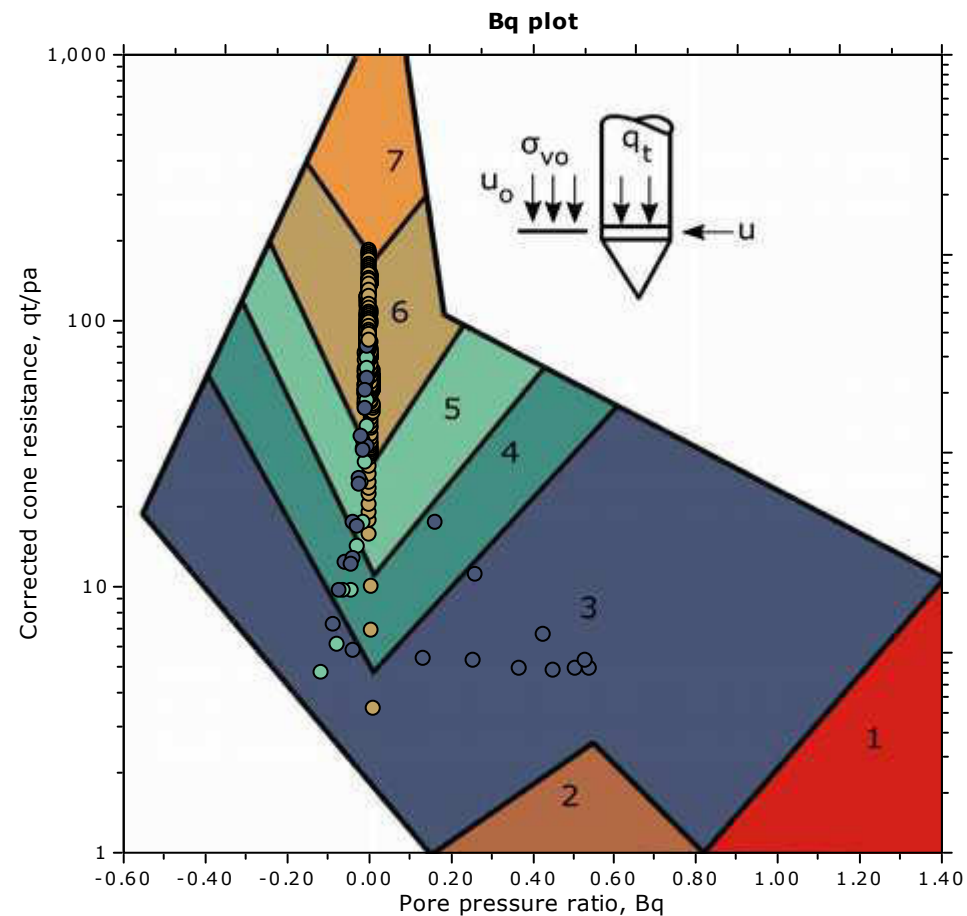
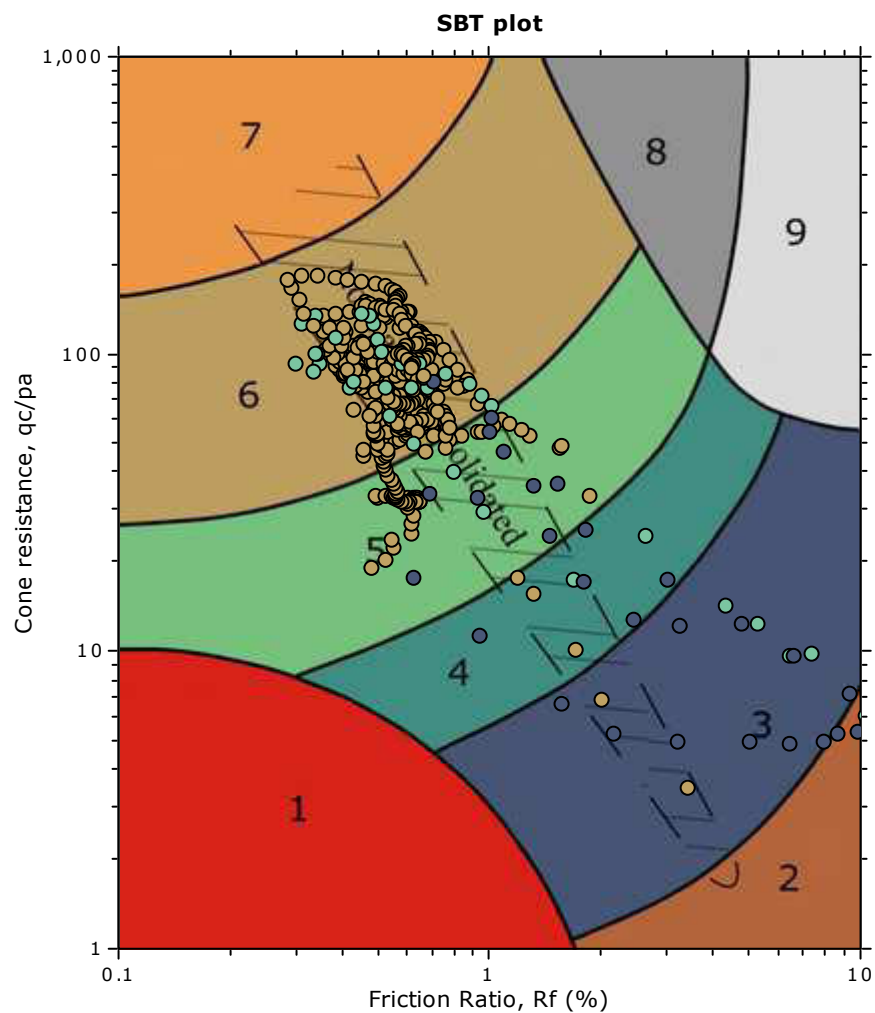




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



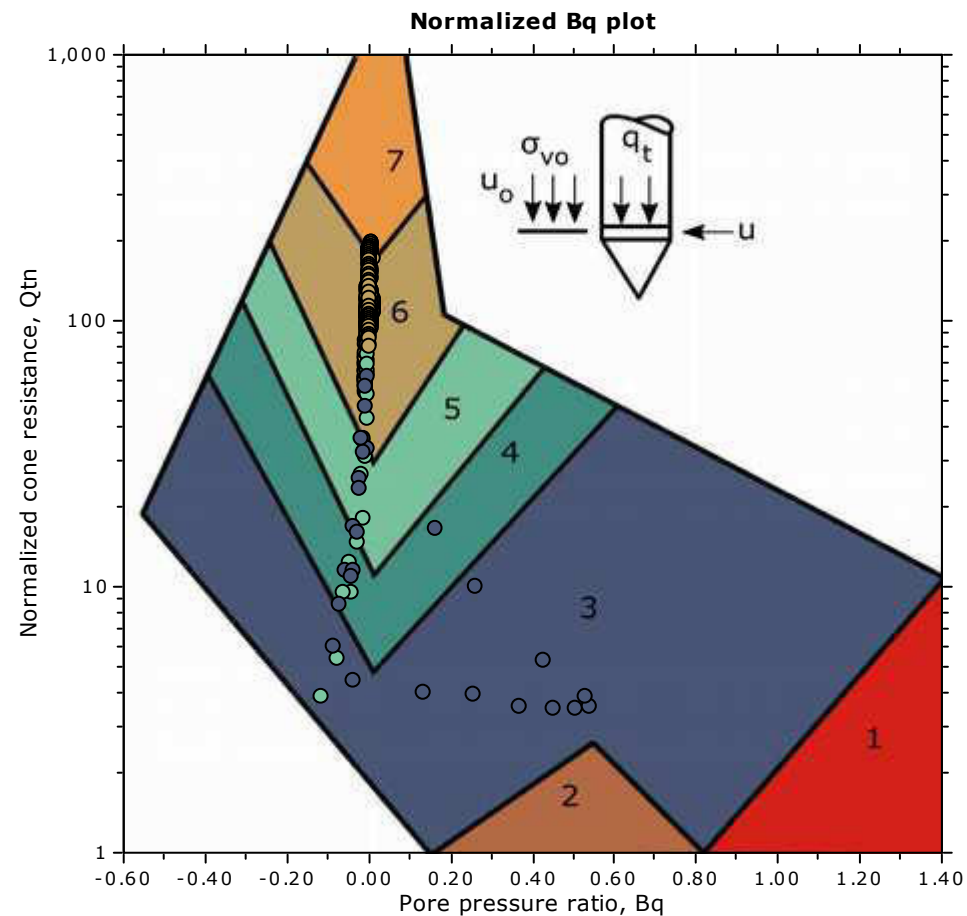
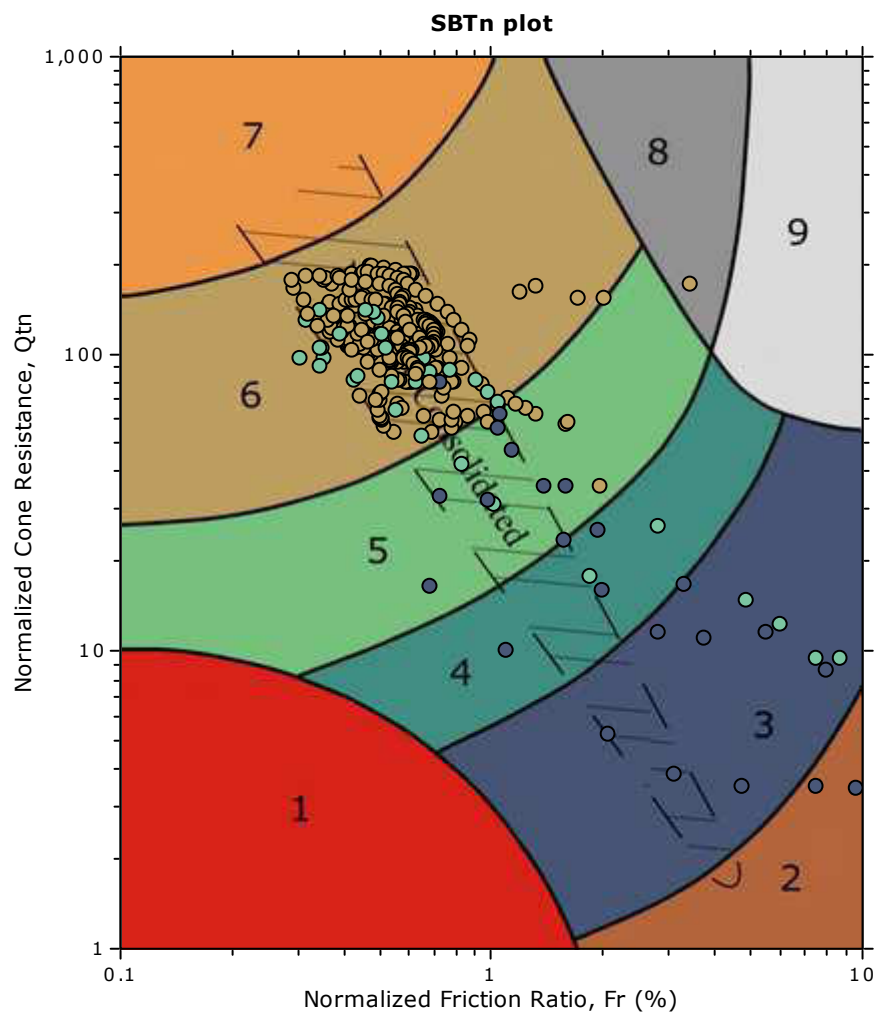
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

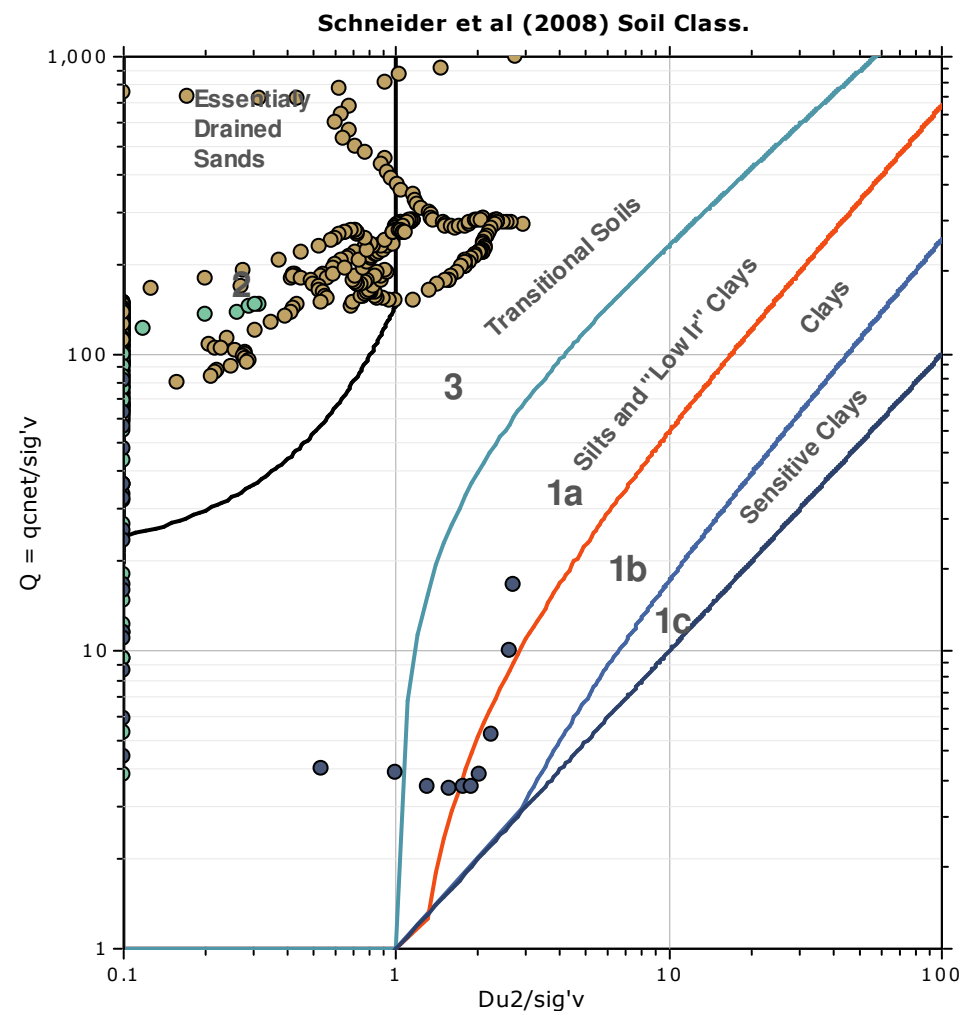
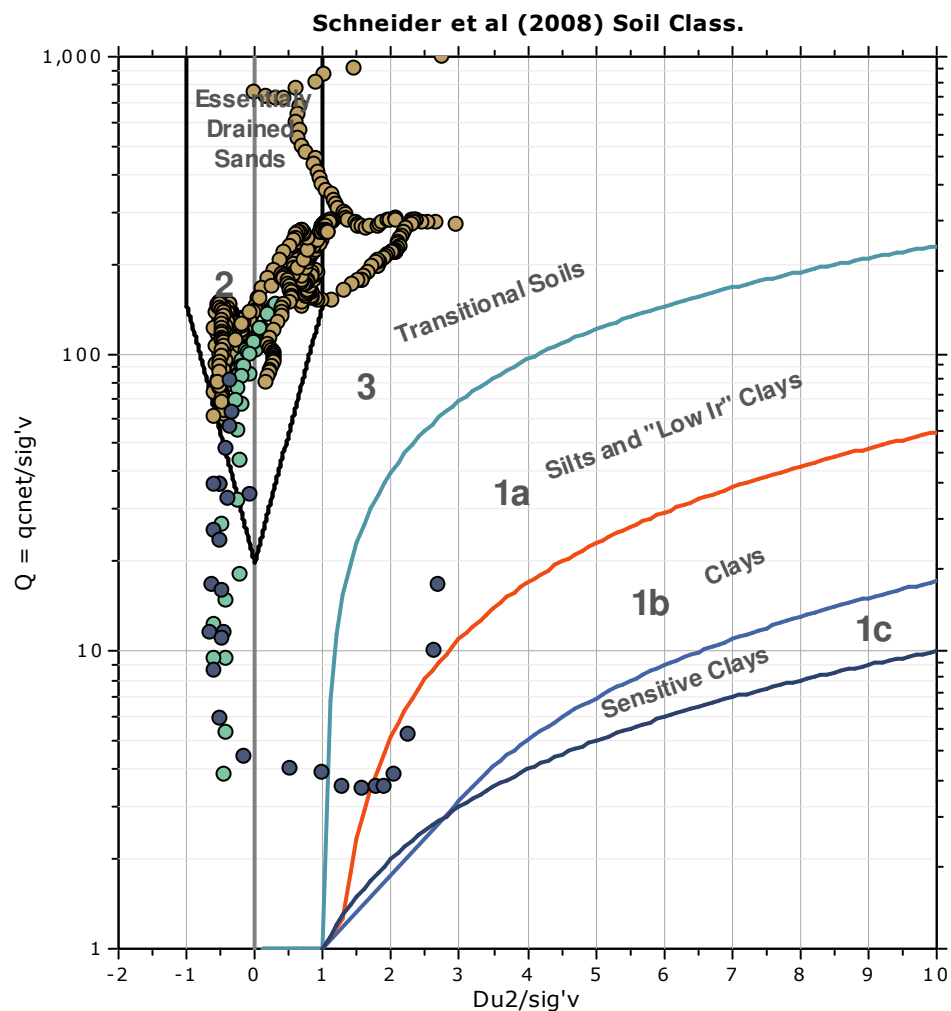
**SBT - Bq plots (normalized)**

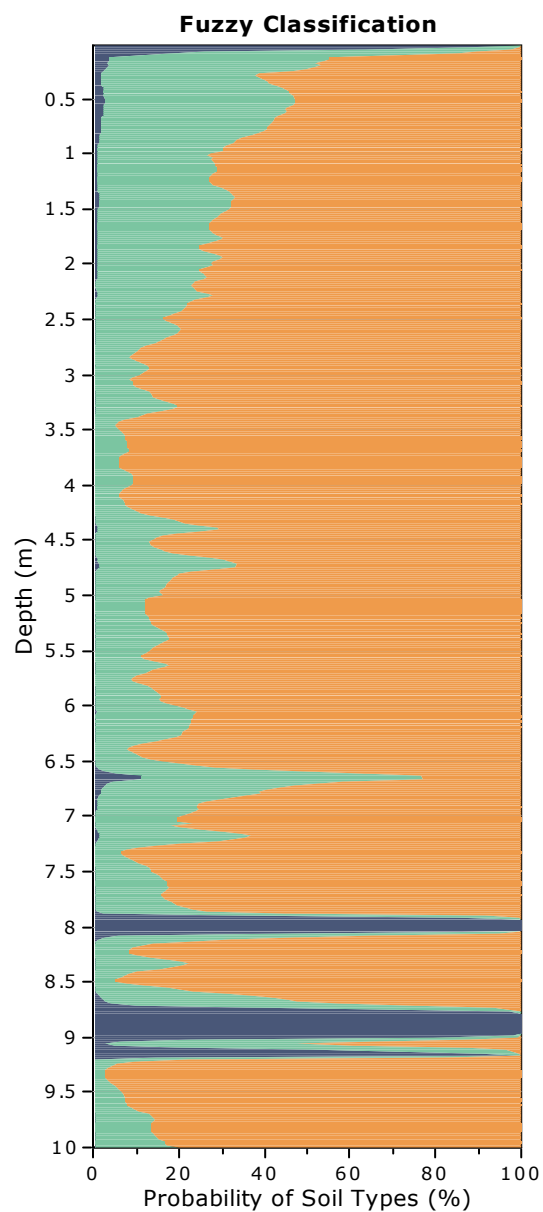
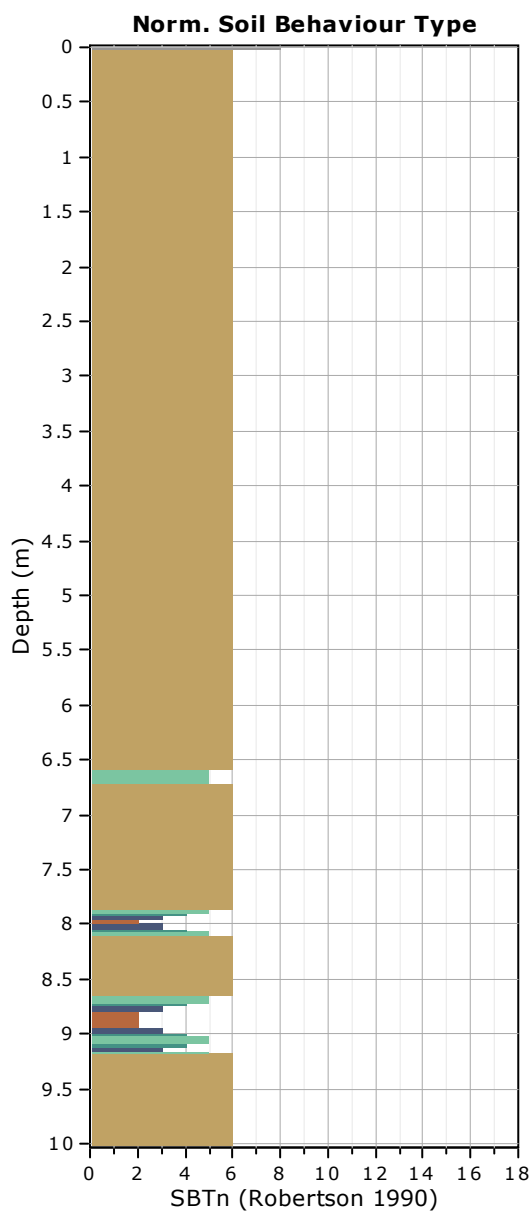


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





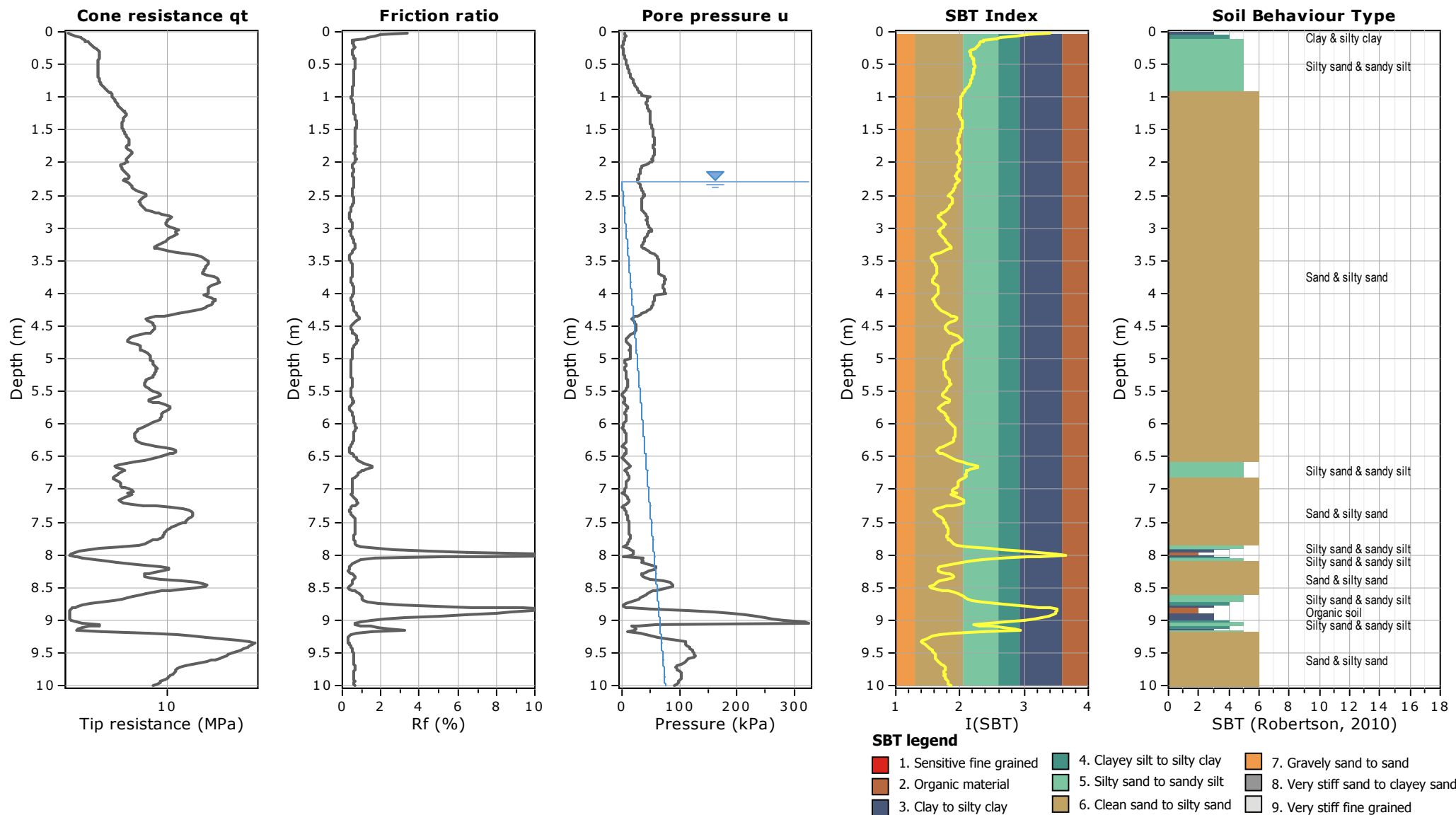
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

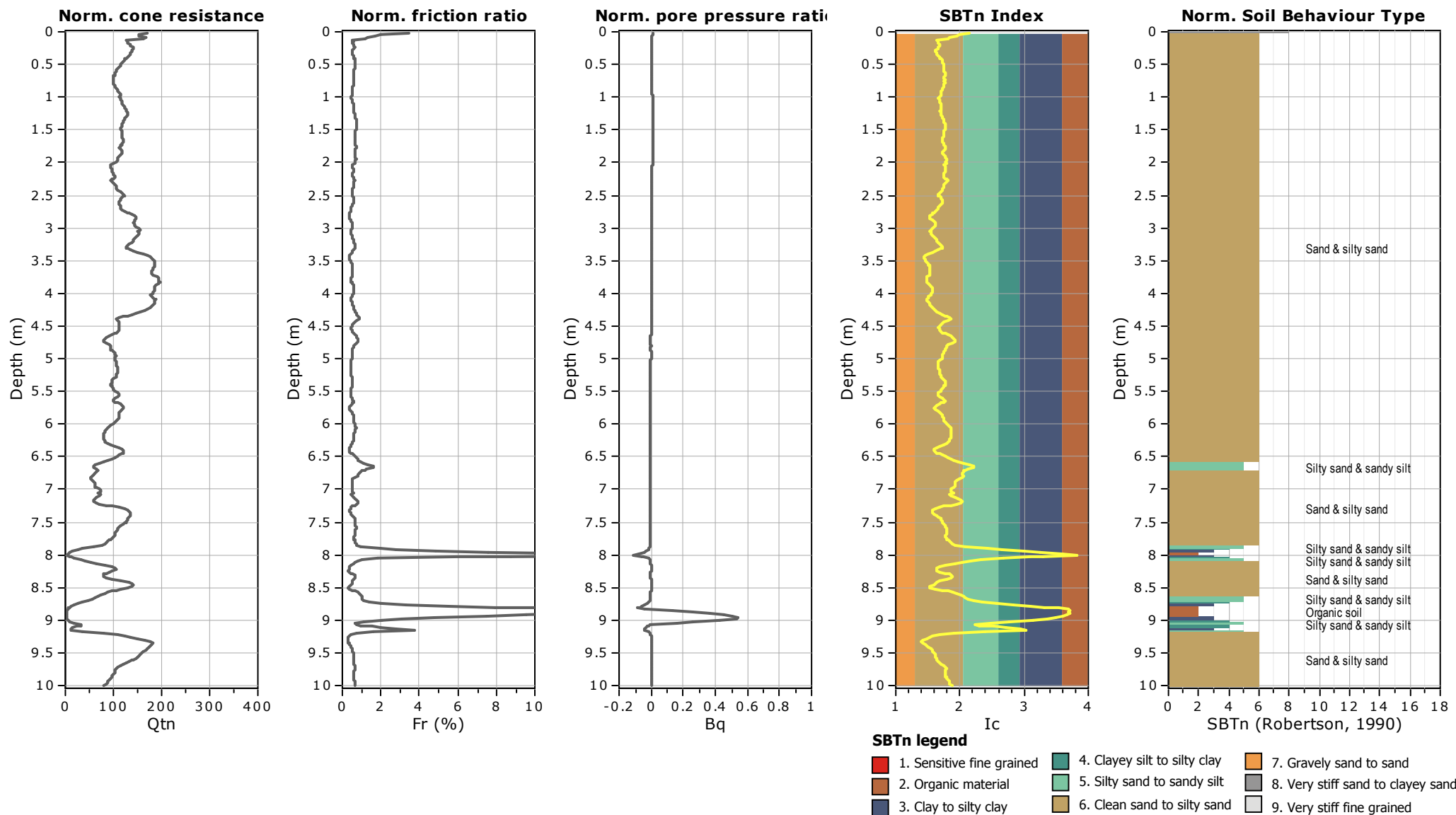
**CPT: CPTU km40+300**

Total depth: 10.00 m

Coords: lat 44.803166° lon 12.178438°







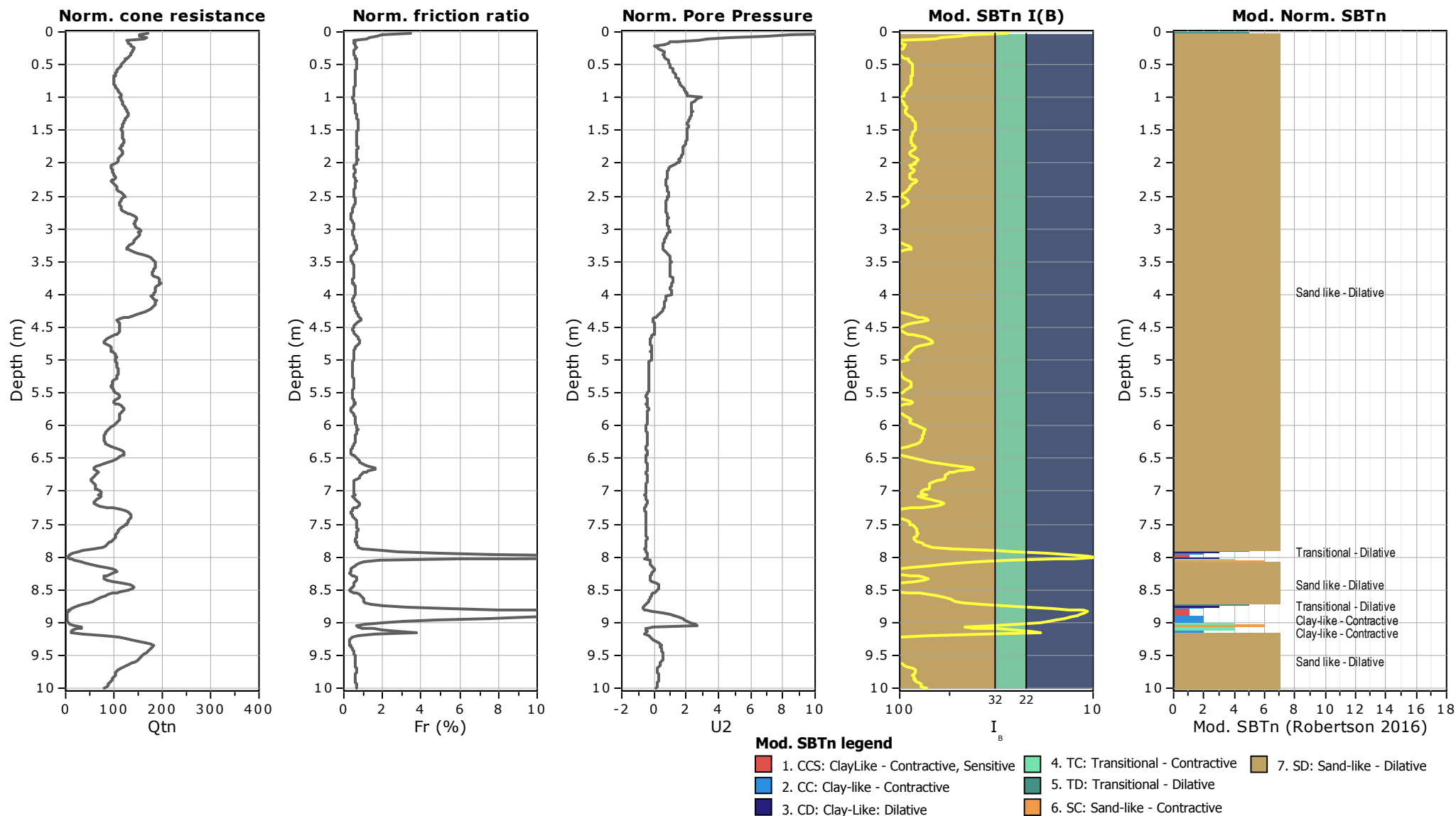
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

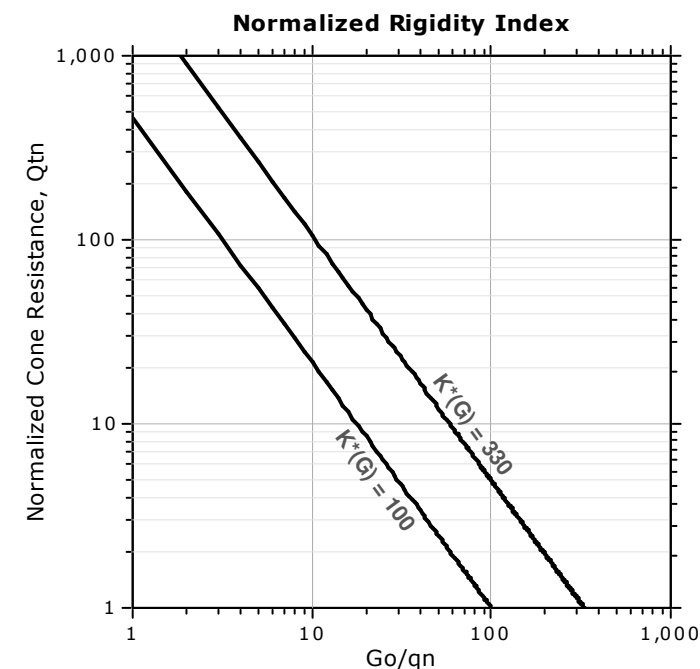
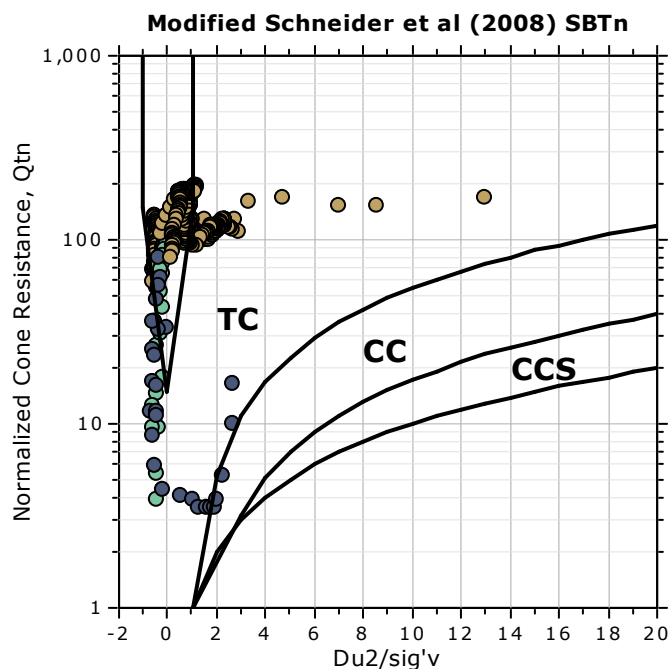
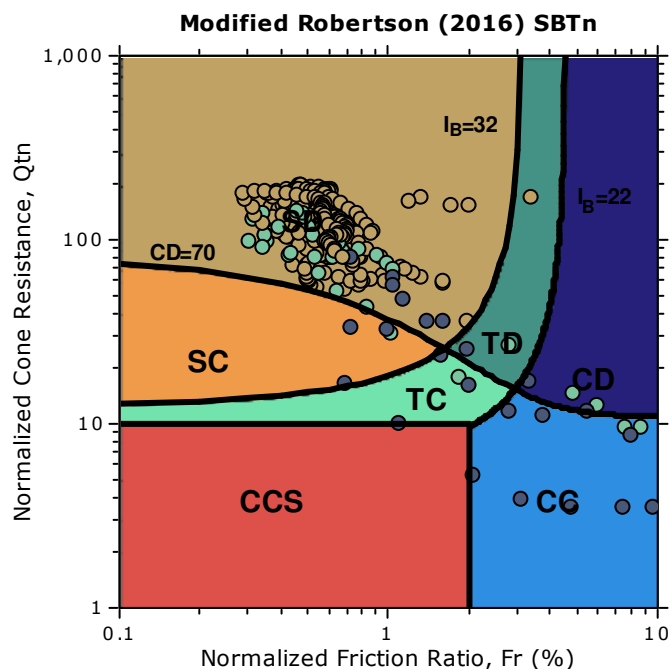
**CPT: CPTU km40+300**

Total depth: 10.00 m

Coords: lat 44.803166° lon 12.178438°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

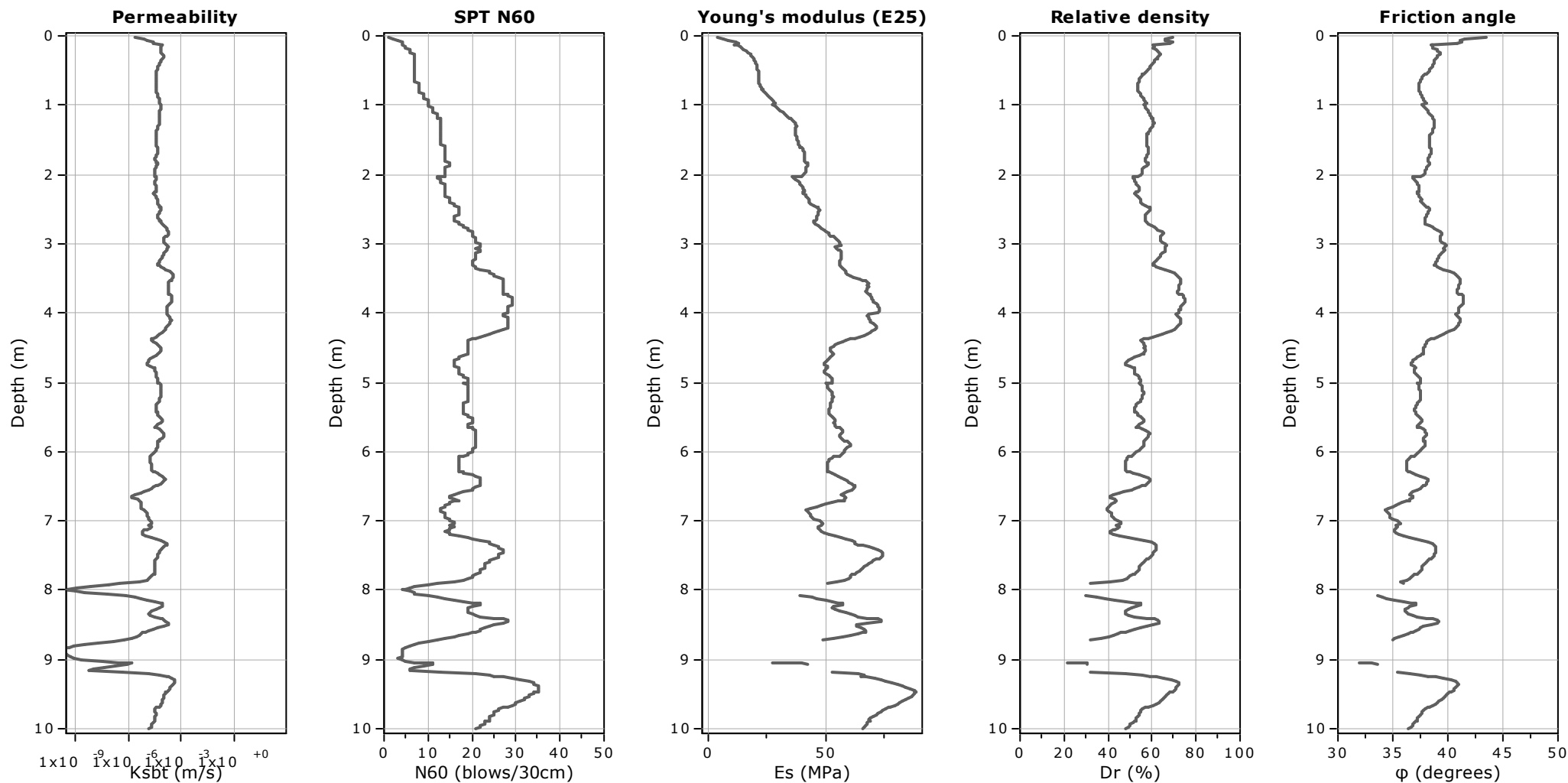
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km40+300**

Total depth: 10.00 m

Coords: lat 44.803166° lon 12.178438°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

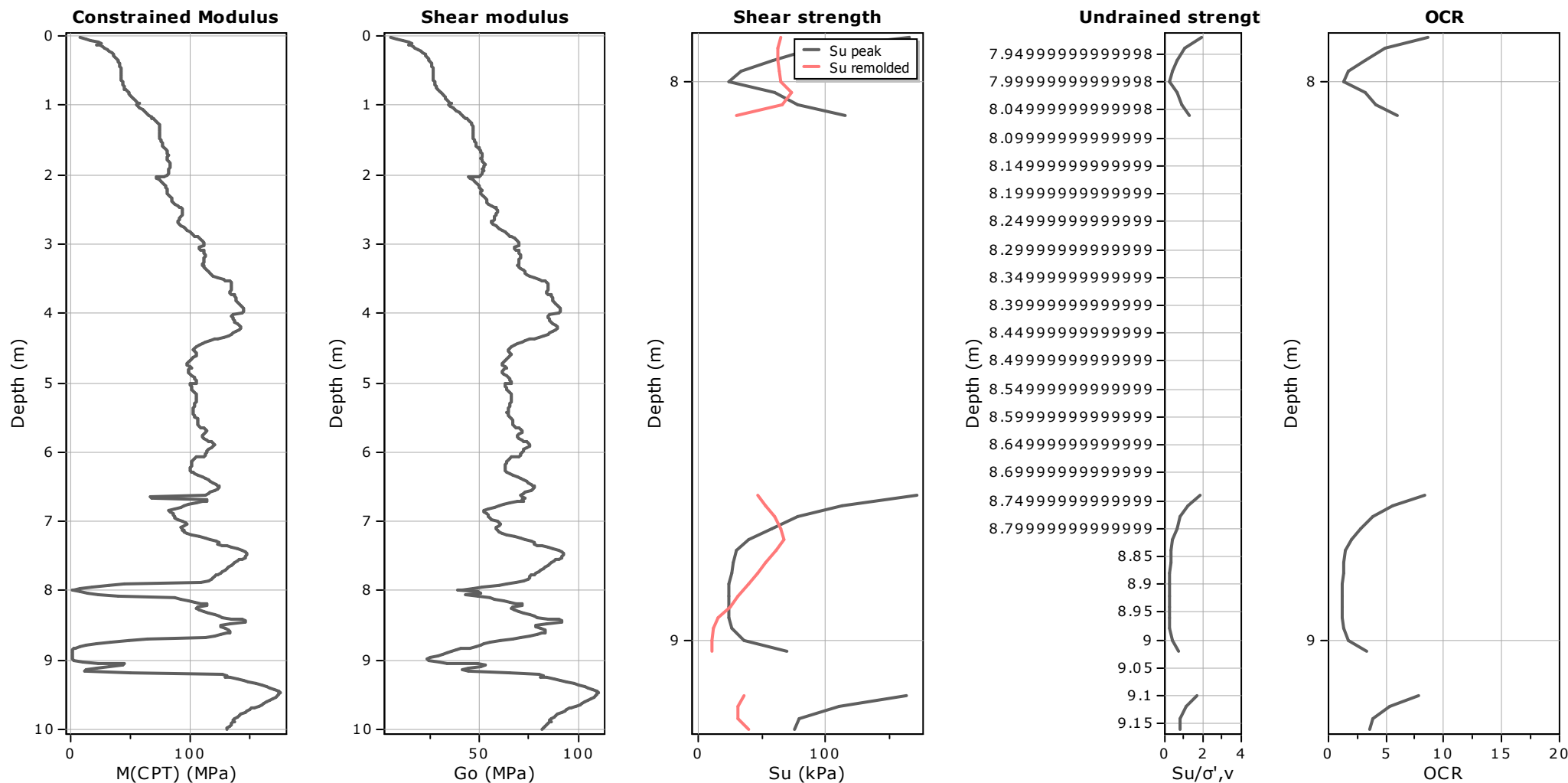
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km40+300**

Total depth: 10.00 m

Coords: lat 44.803166° lon 12.178438°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

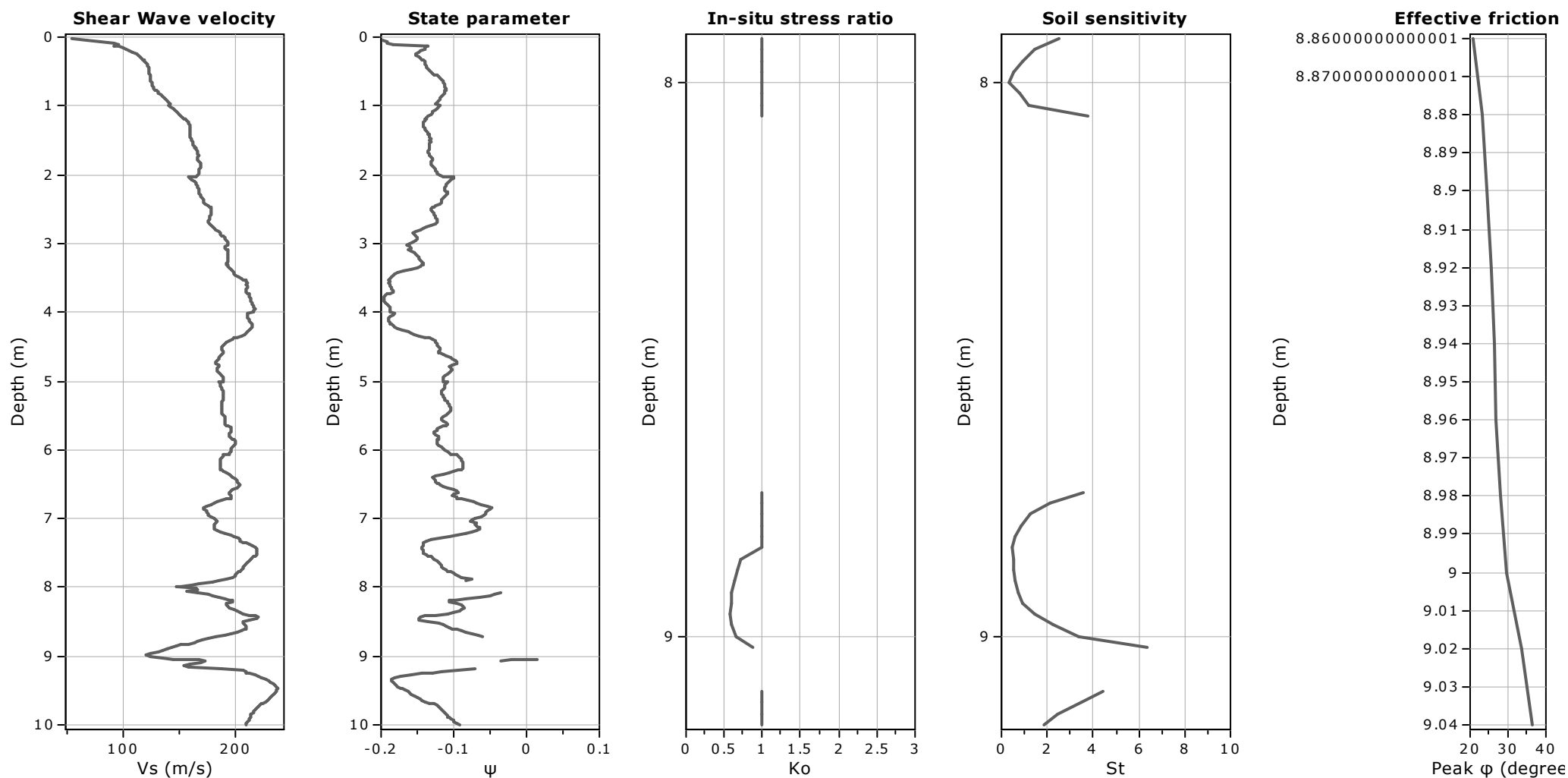
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km40+300**

Total depth: 10.00 m

Coords: lat 44.803166° lon 12.178438°

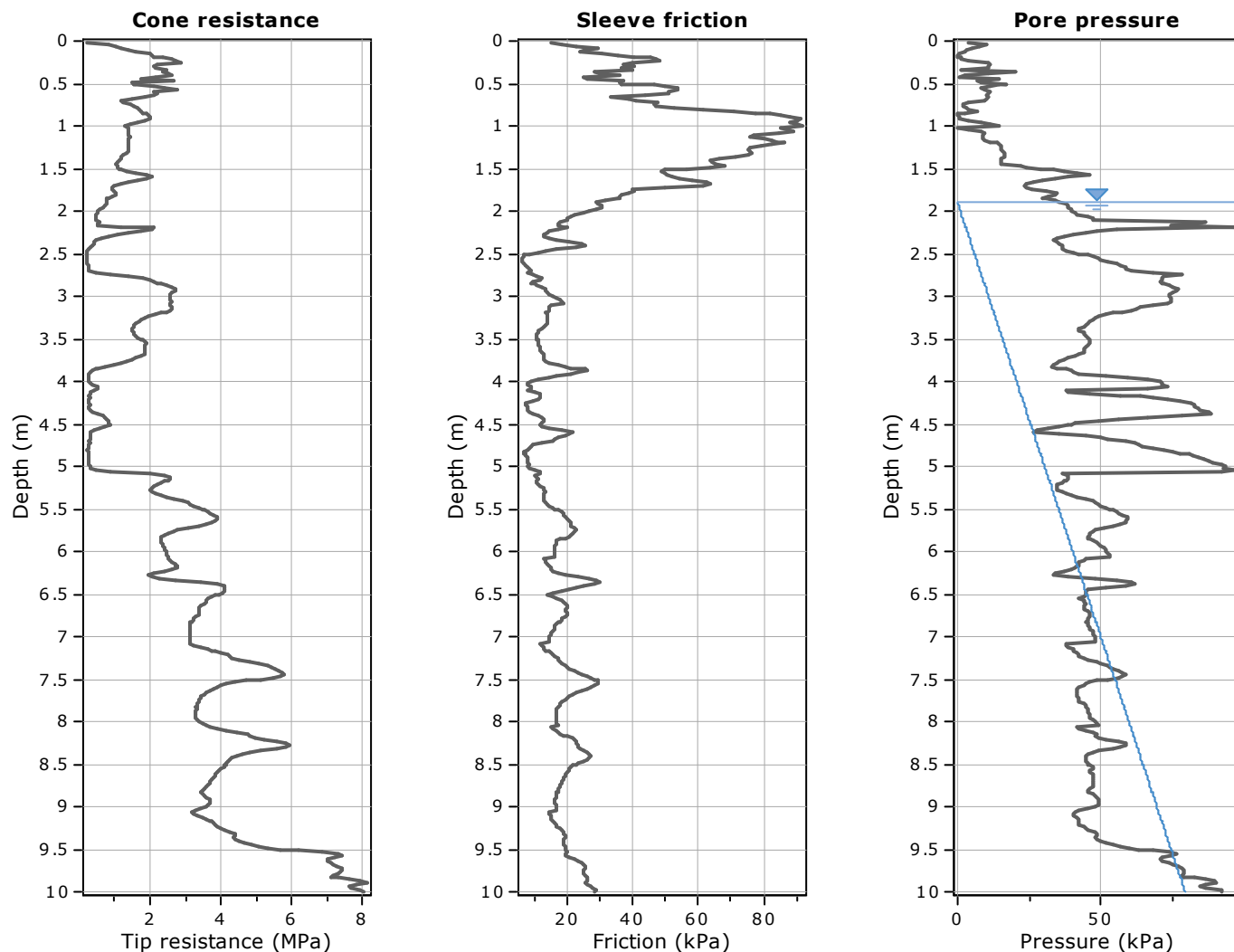


#### Calculation parameters

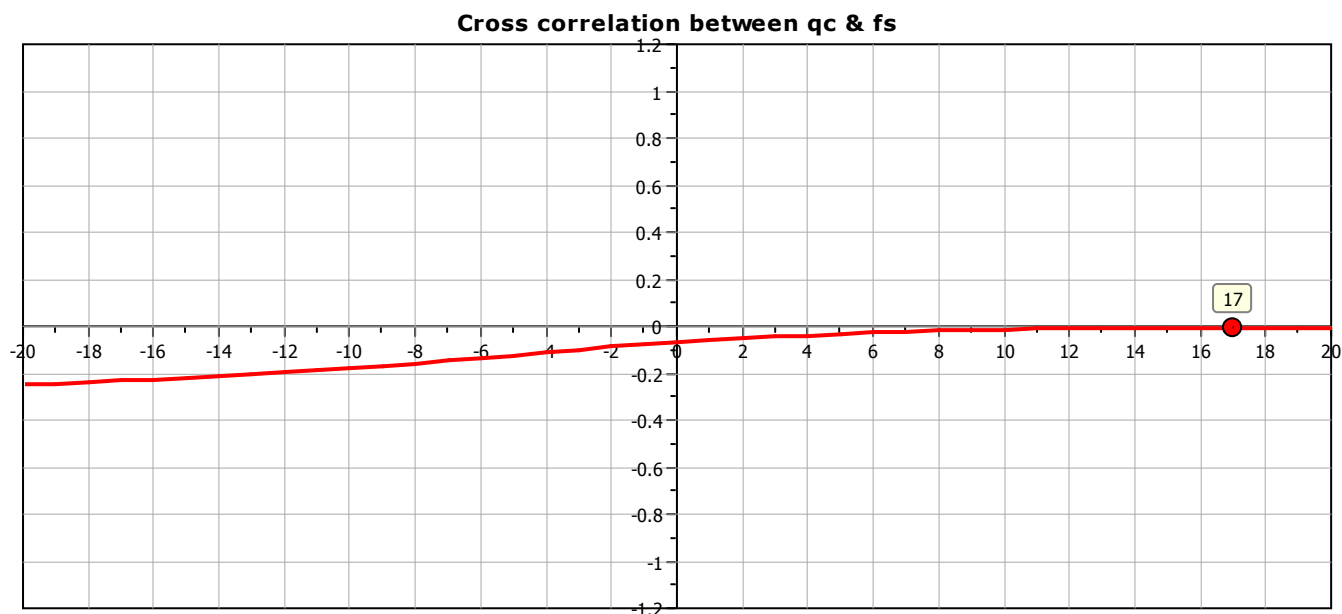
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

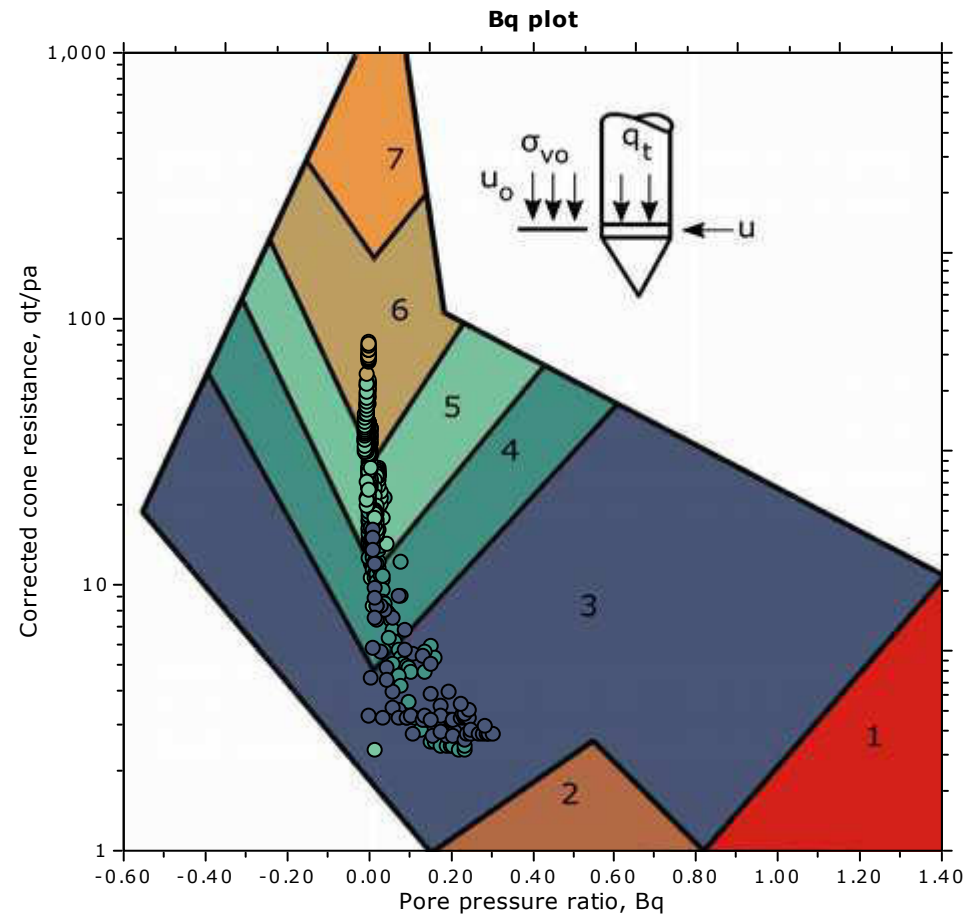
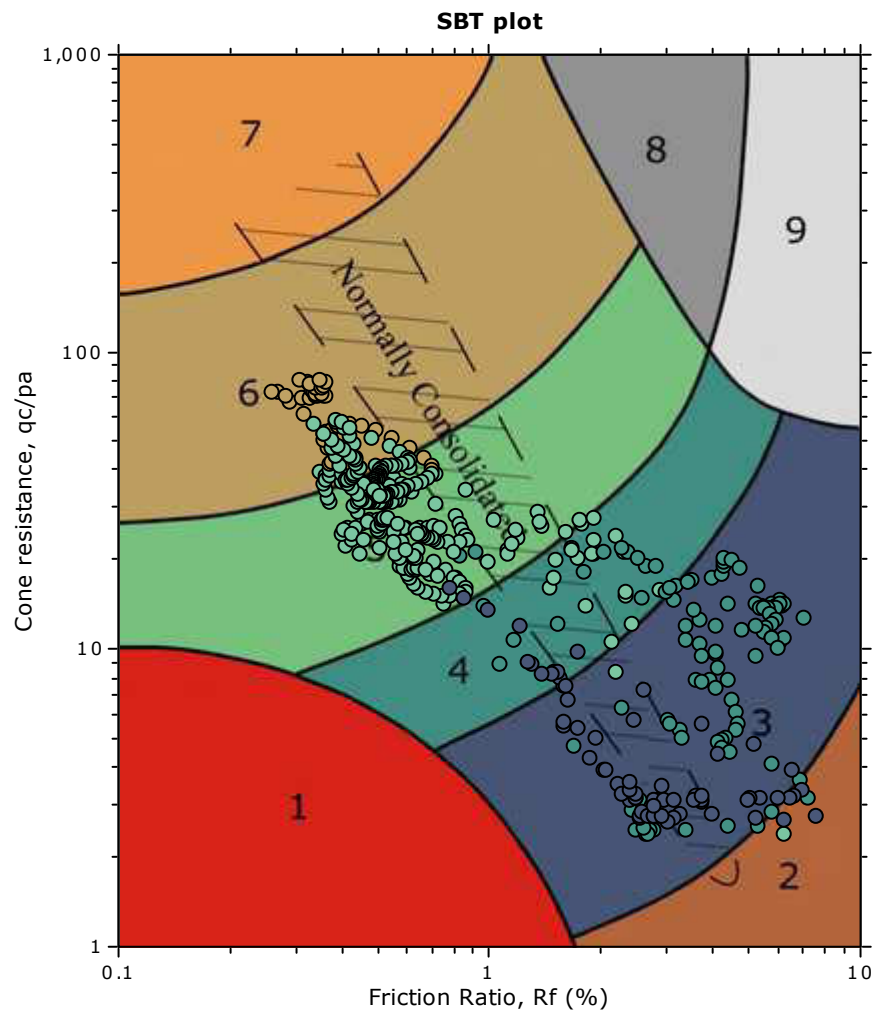




The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



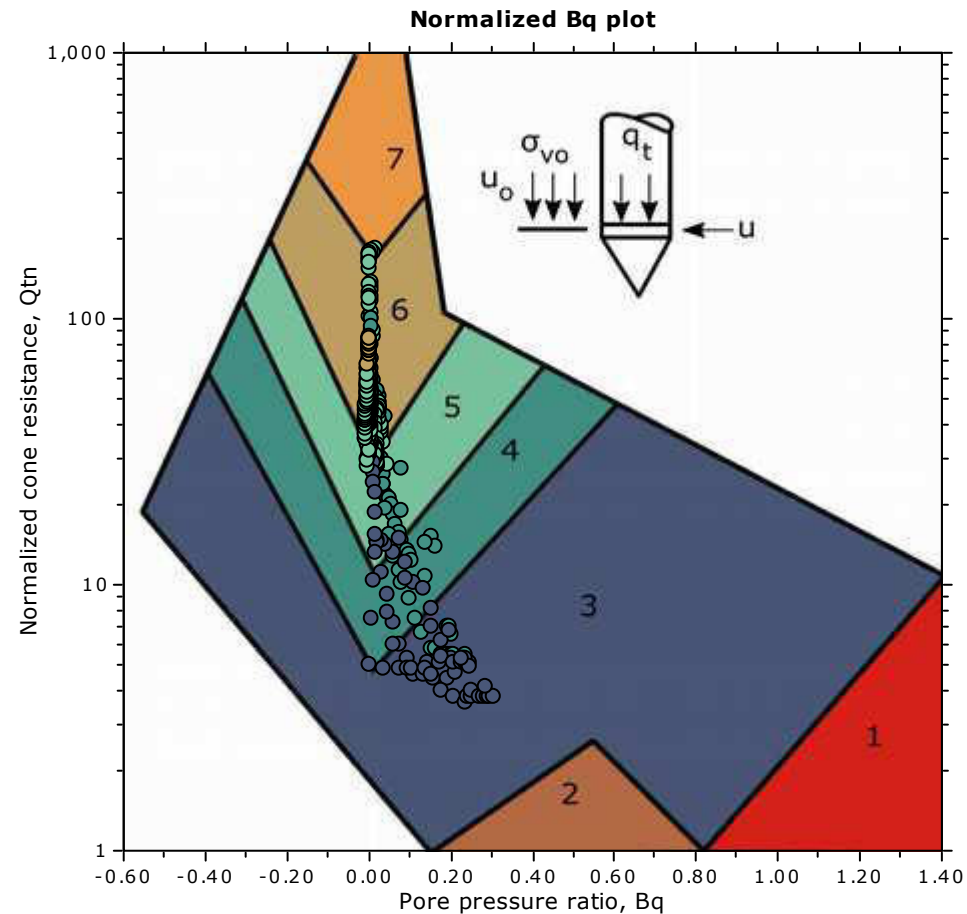
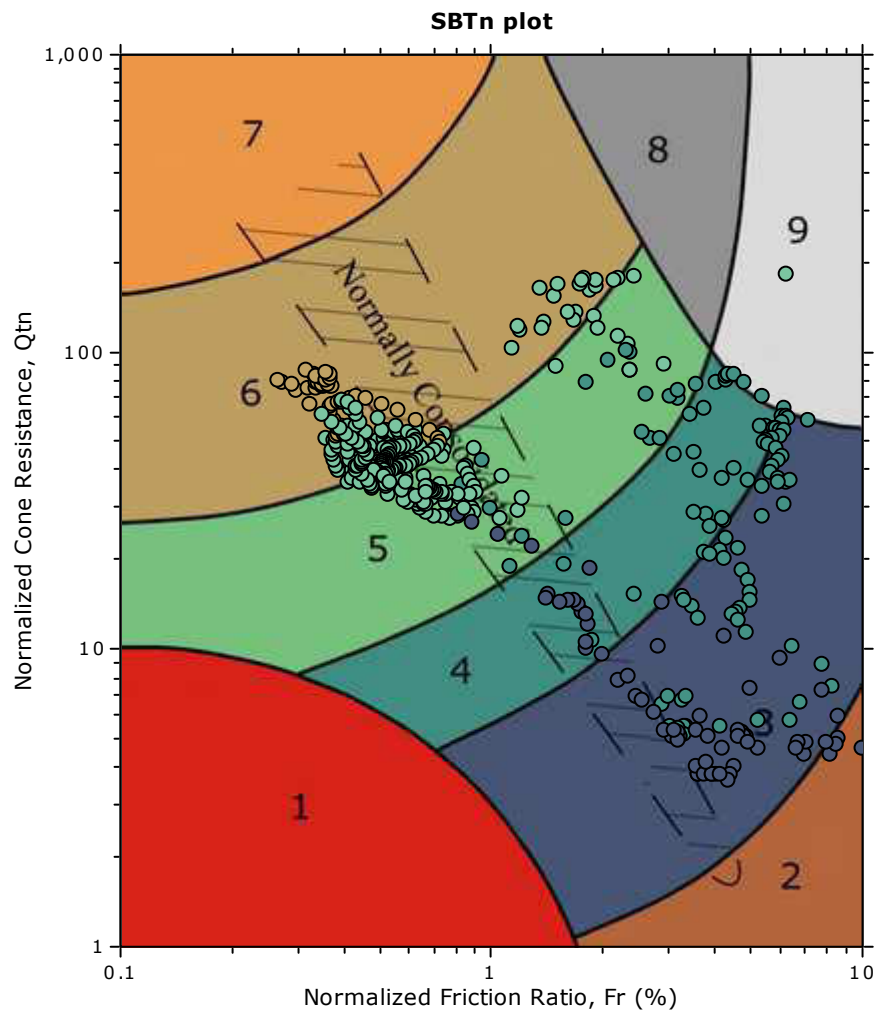
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

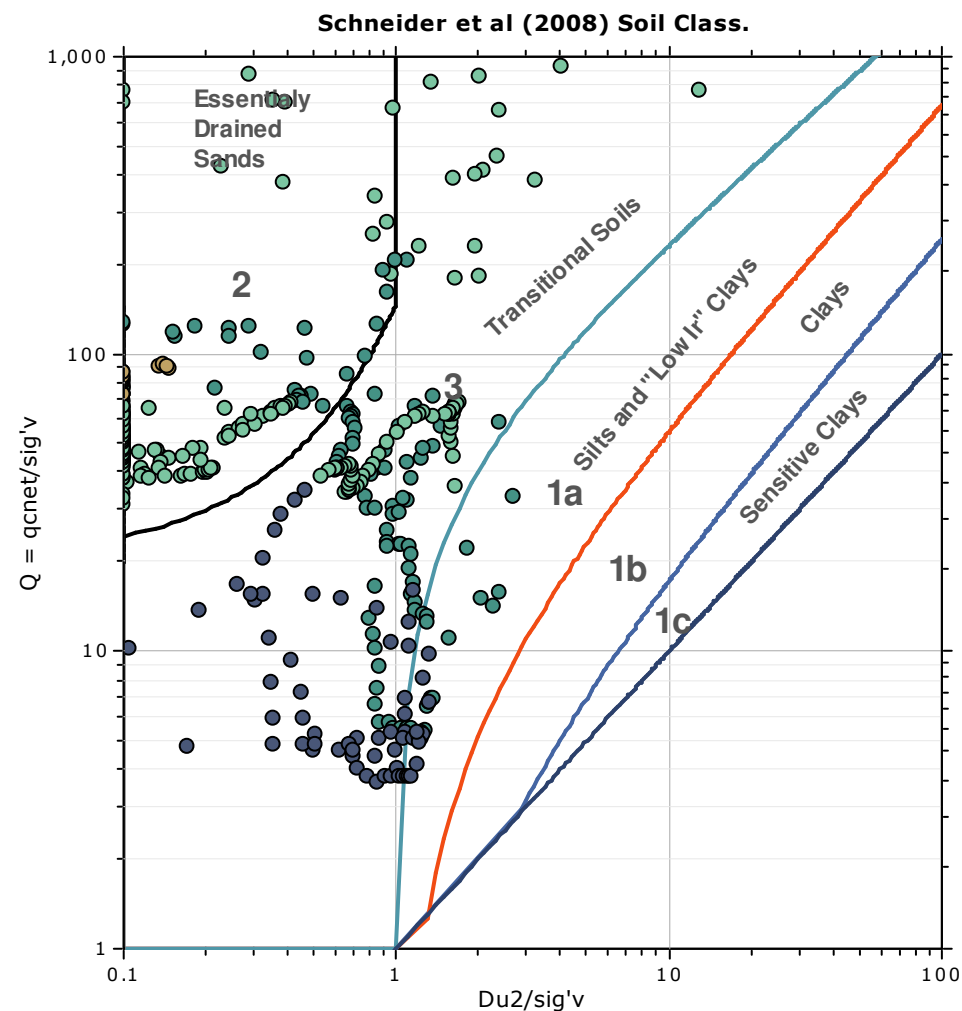
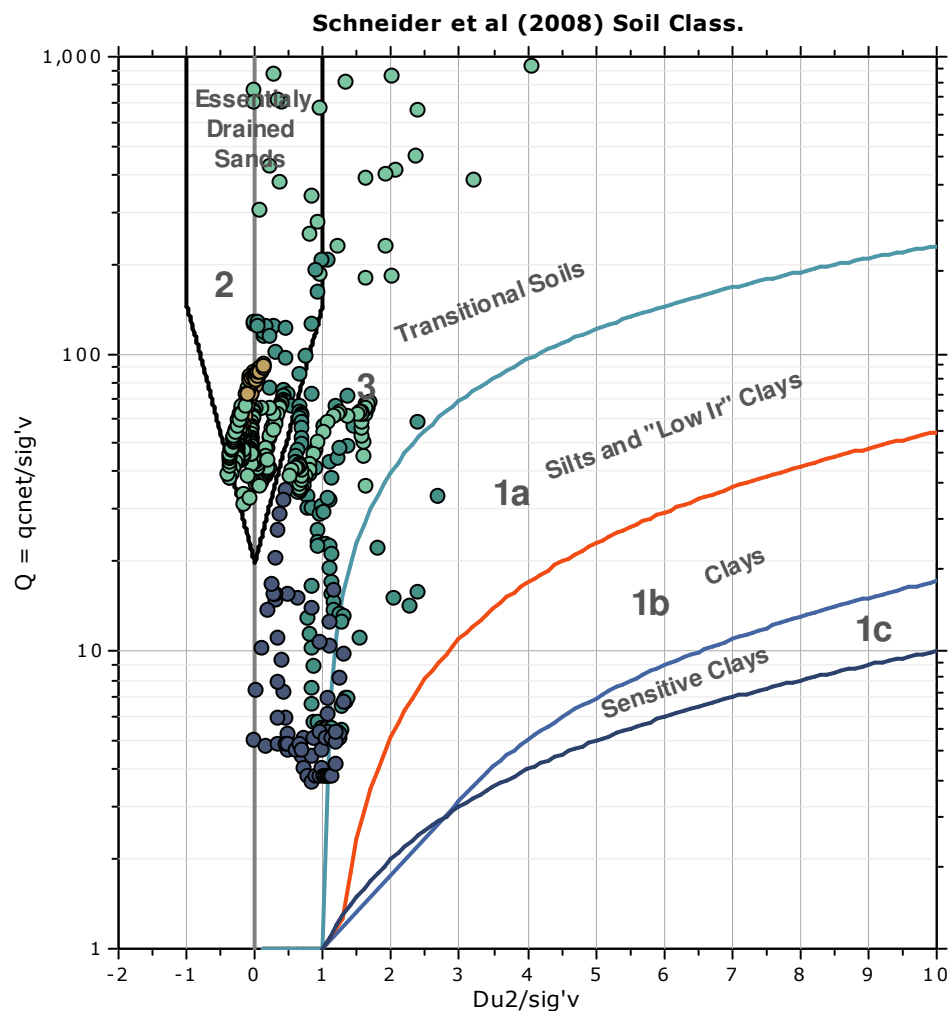
**SBT - Bq plots (normalized)**

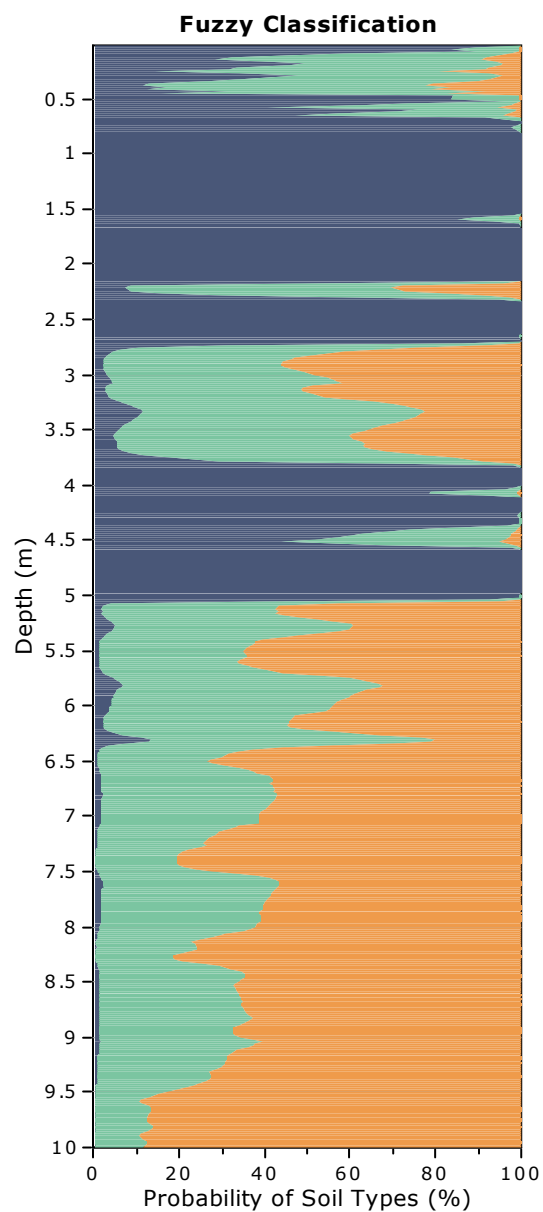
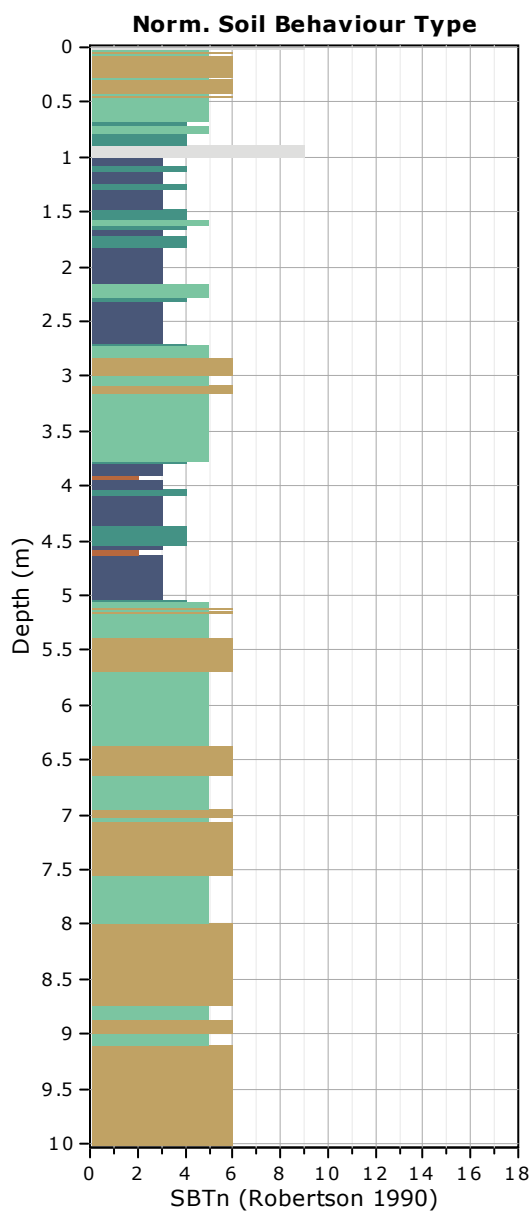


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





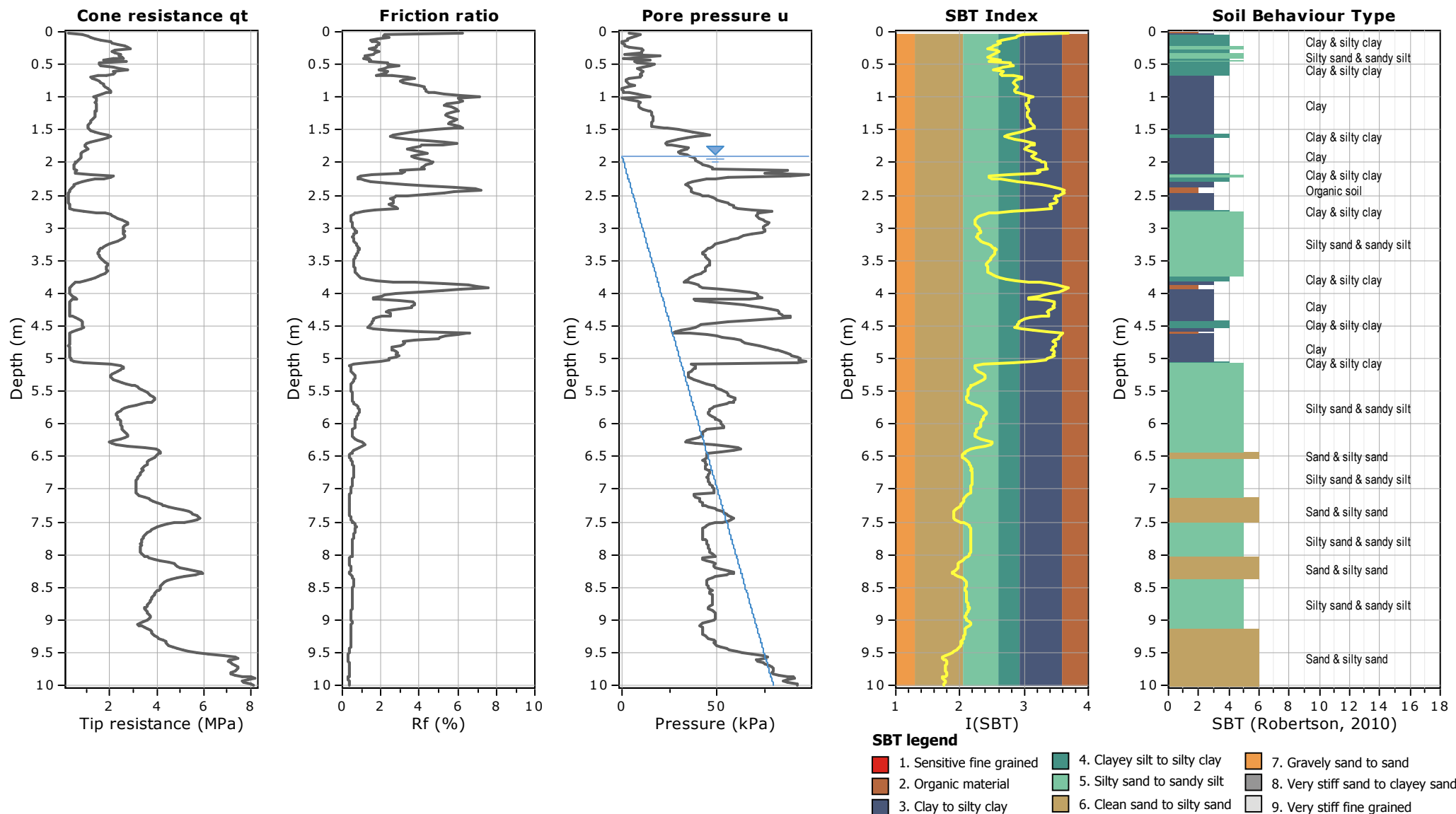
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°





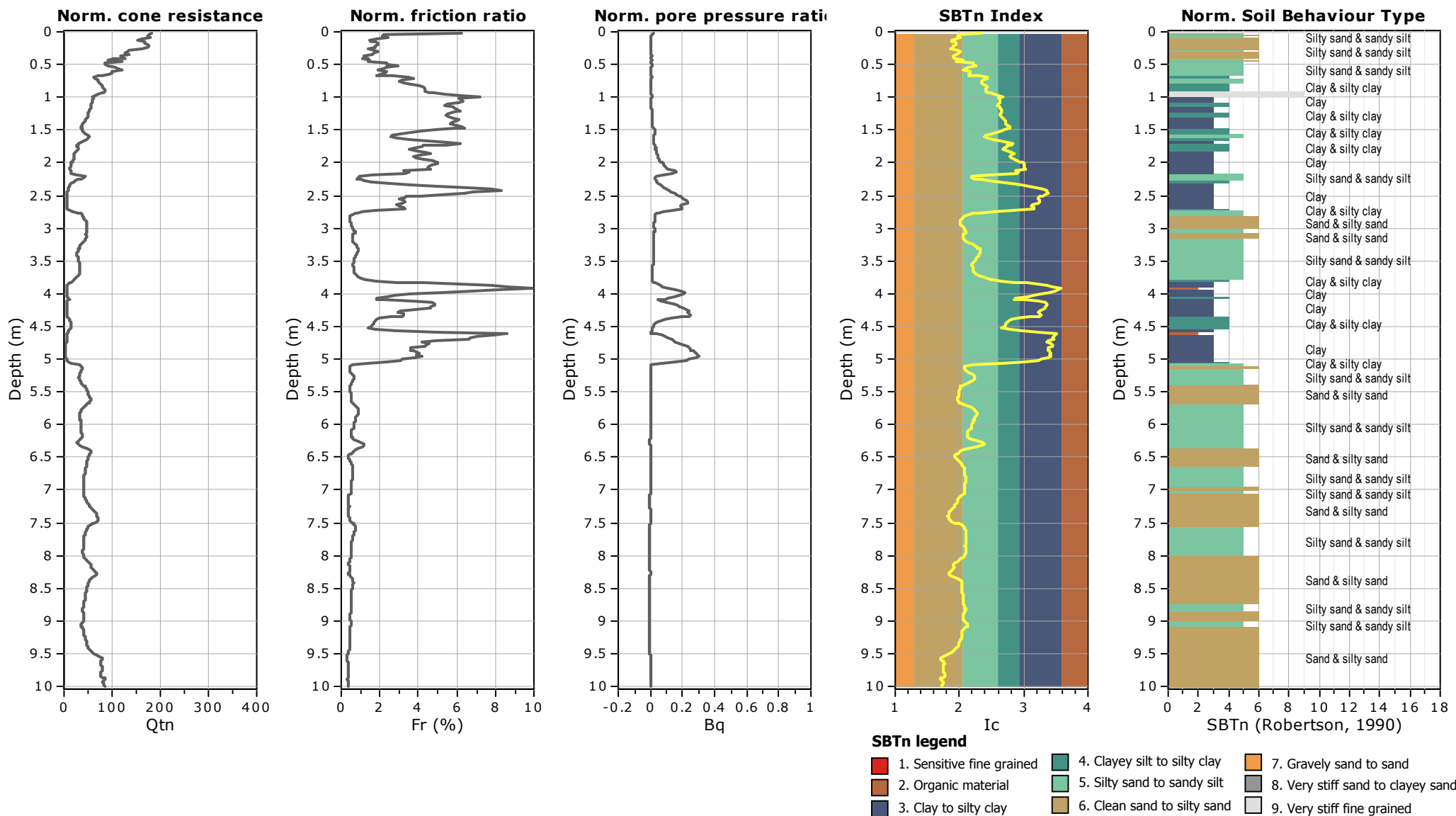
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°



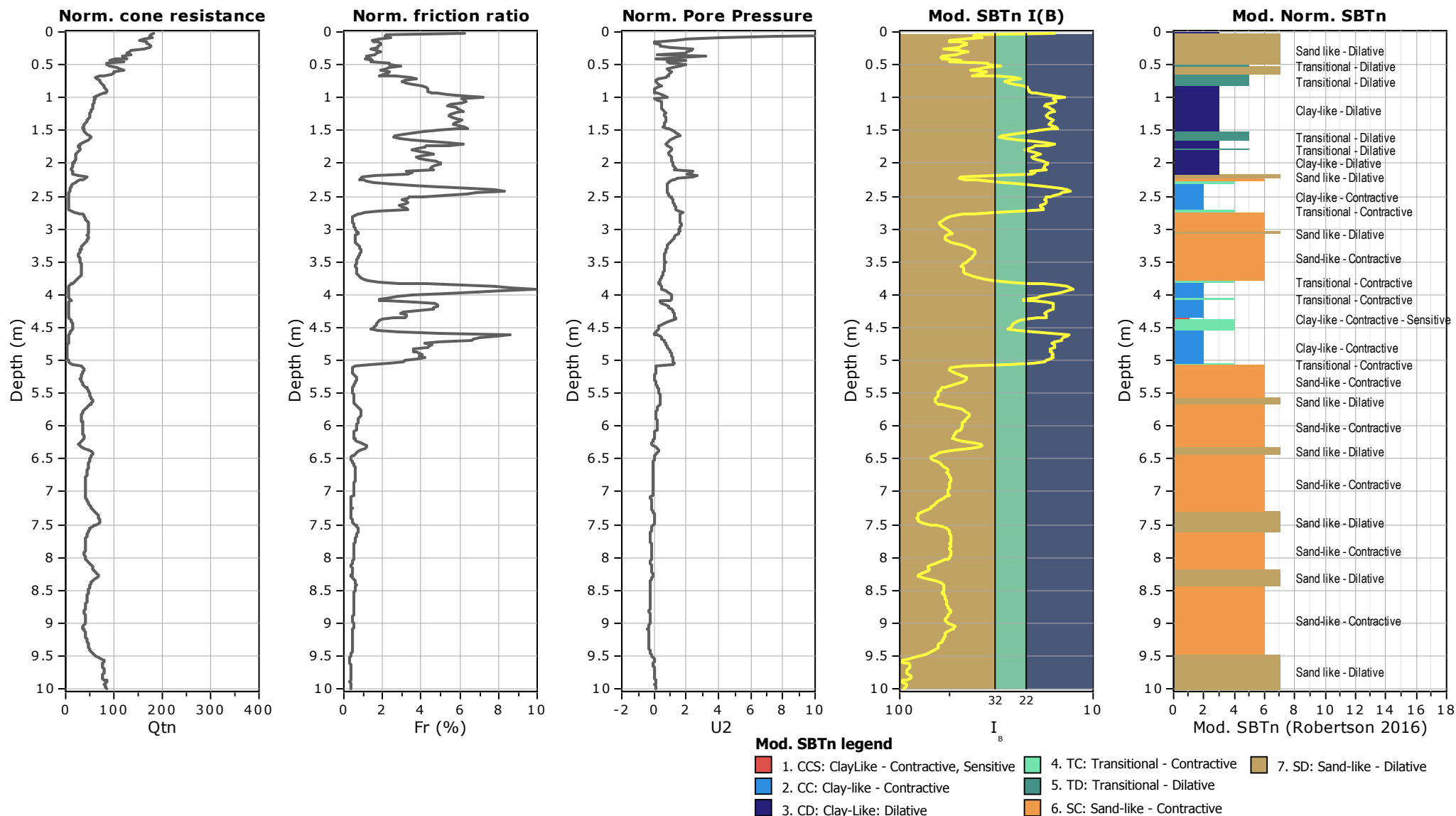
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

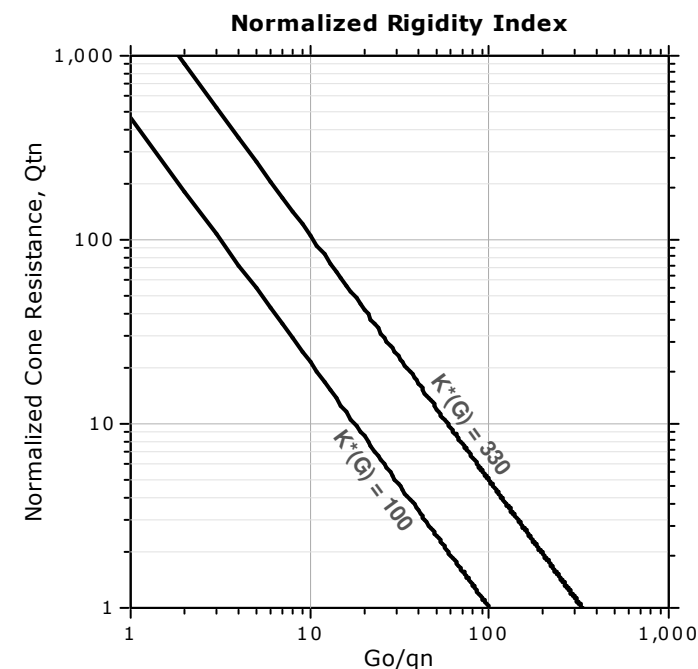
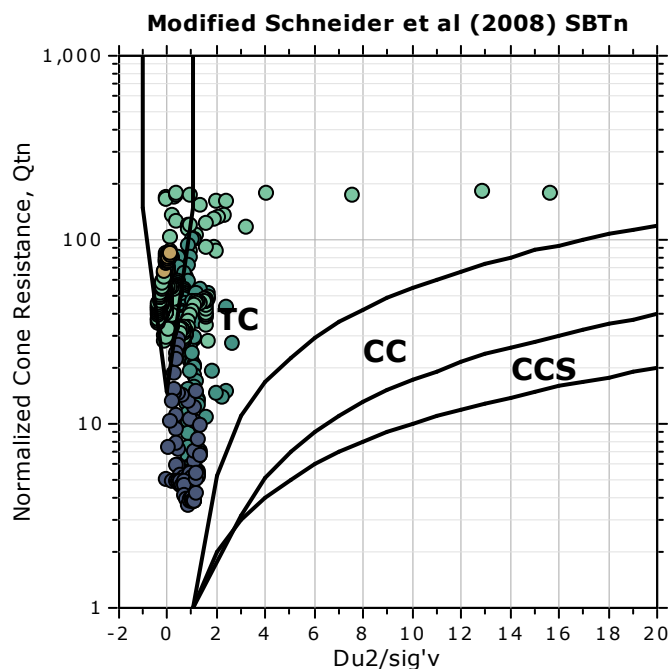
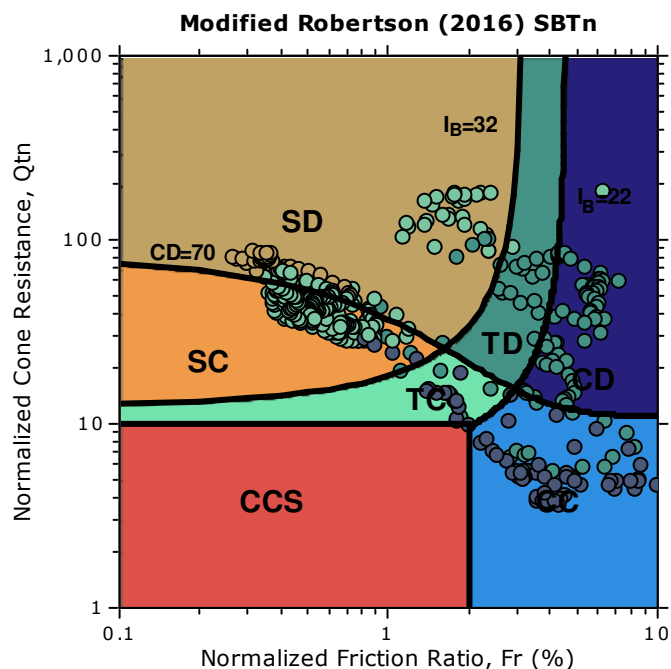
**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

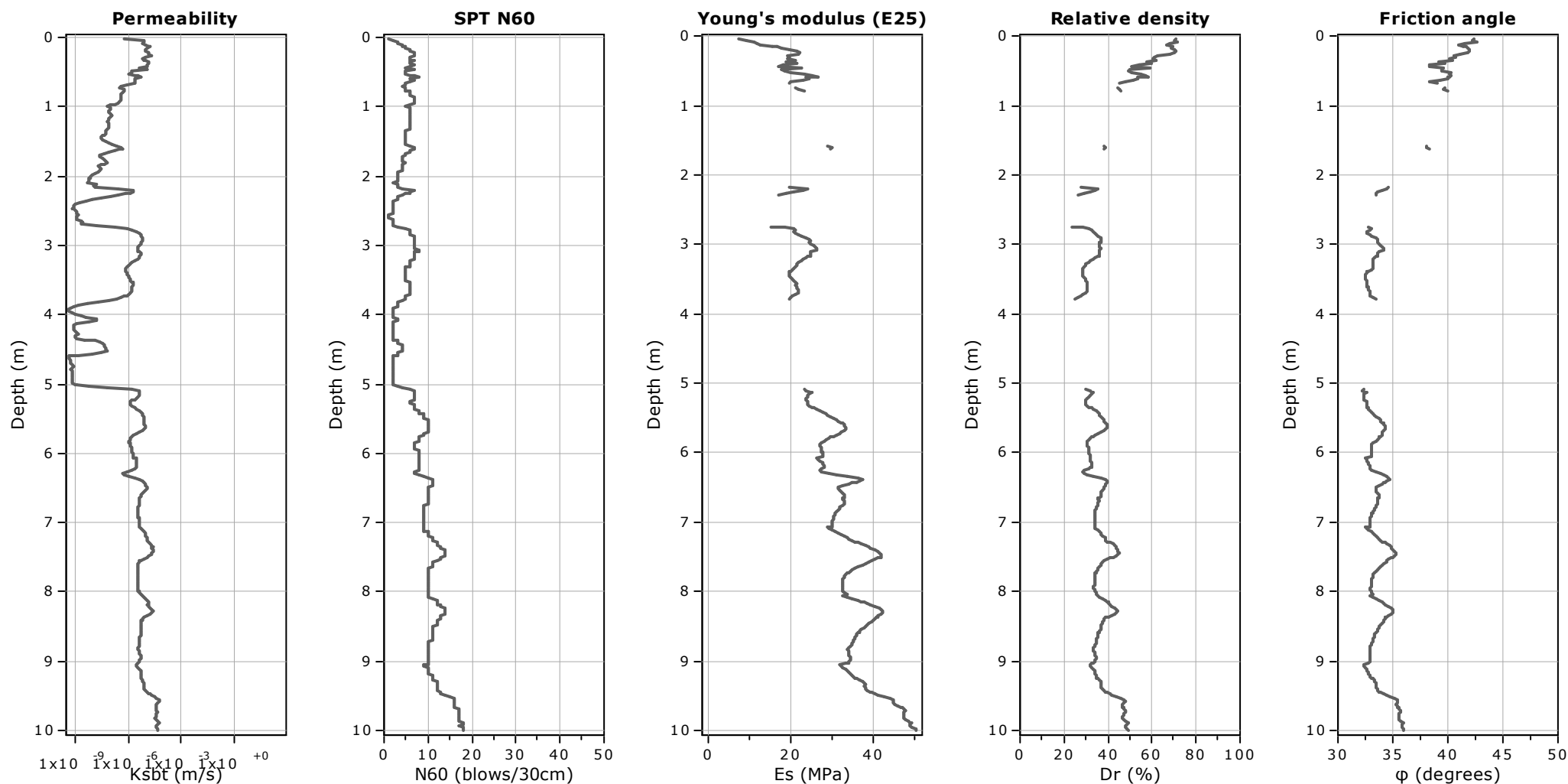
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°



#### 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 Kulhavy & Mayne (1990)

—●— User defined estimation data

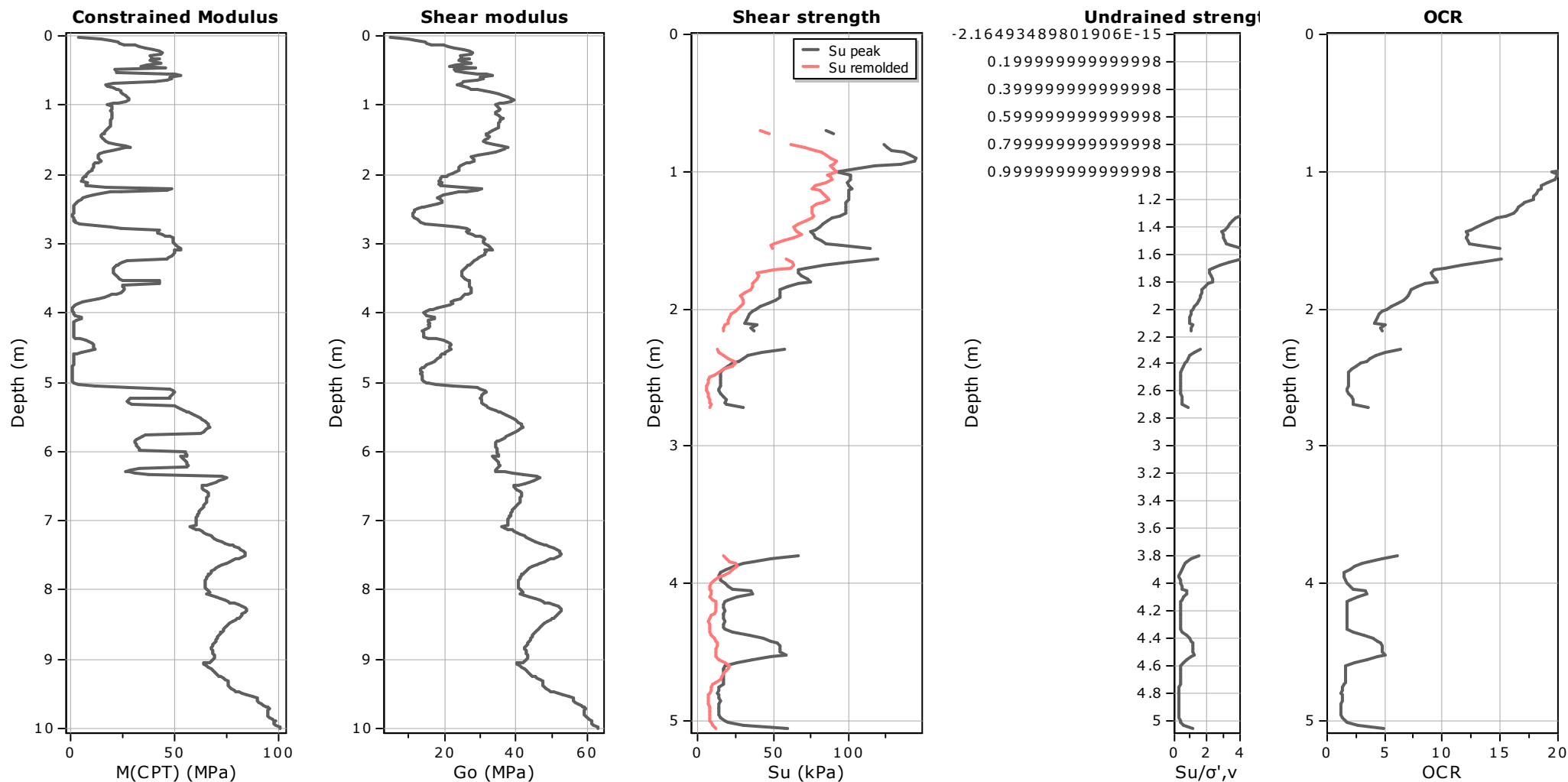
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

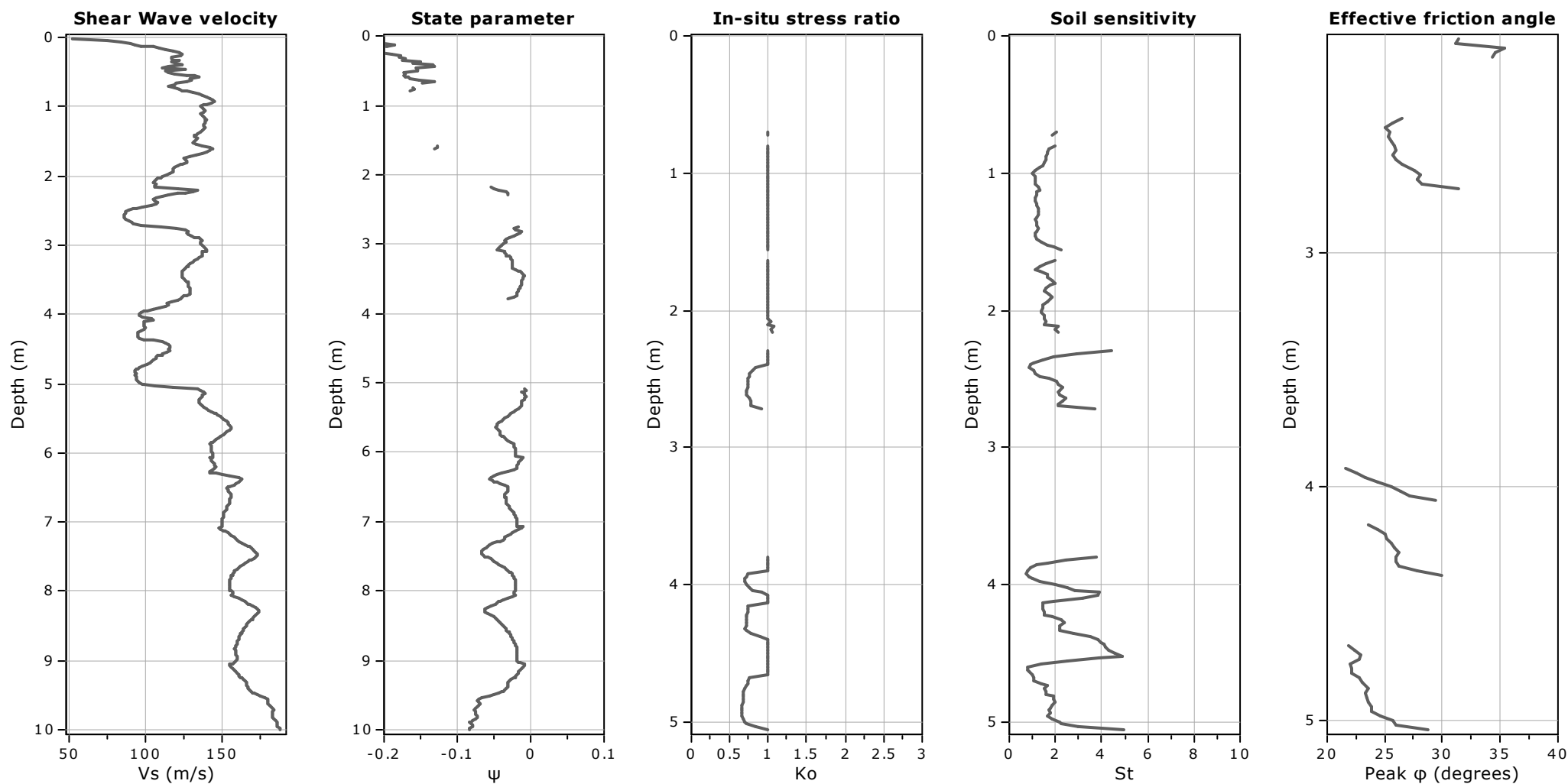
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+400**

Total depth: 10.00 m

Coords: lat 44.82308° lon 12.178416°

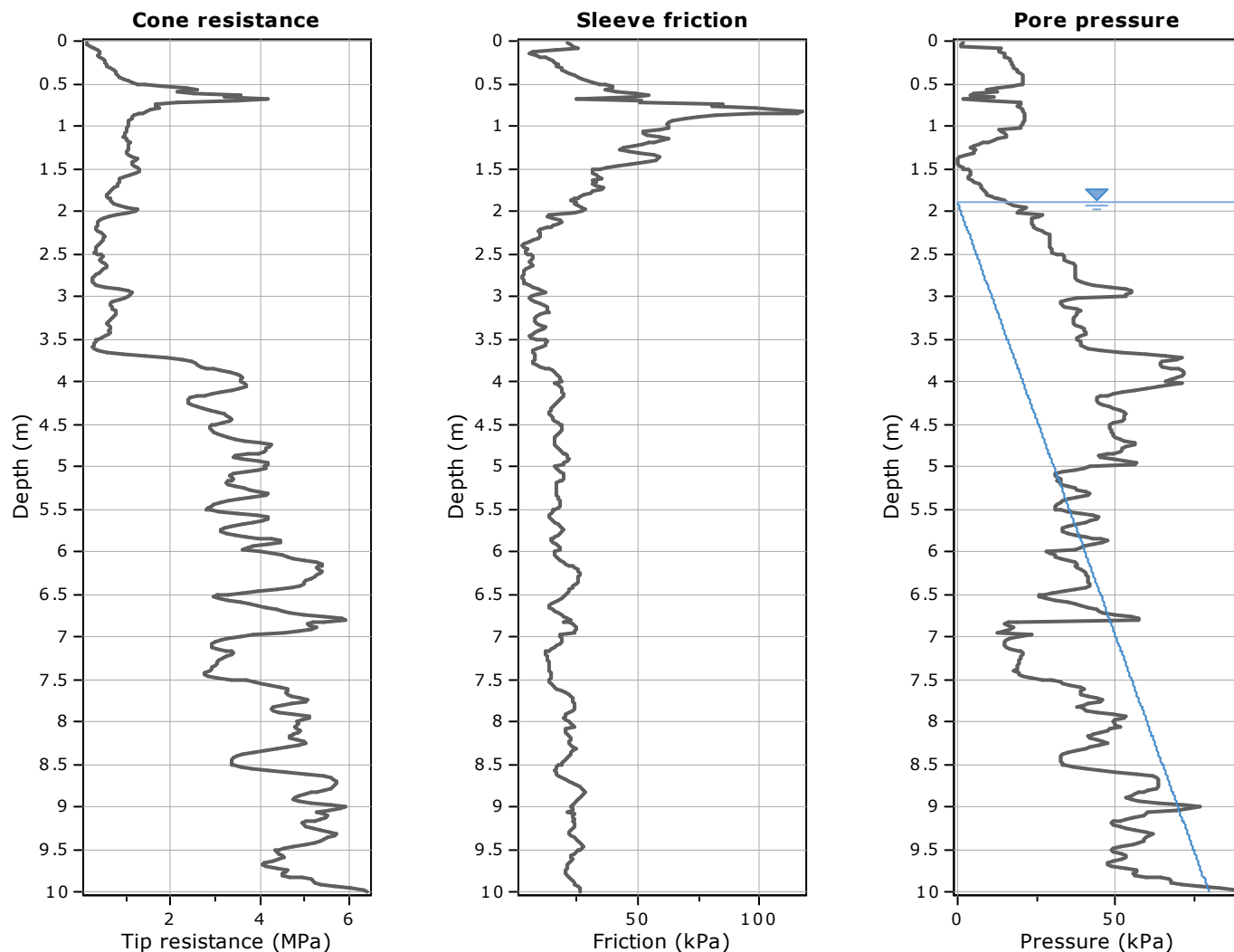


#### Calculation parameters

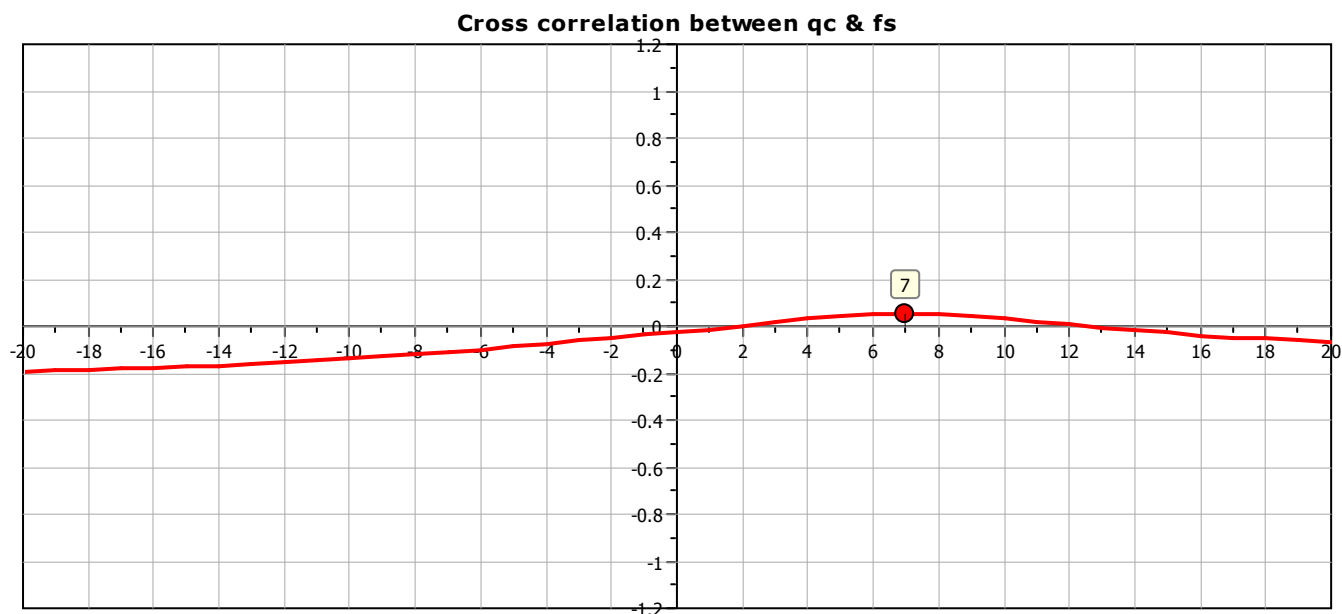
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

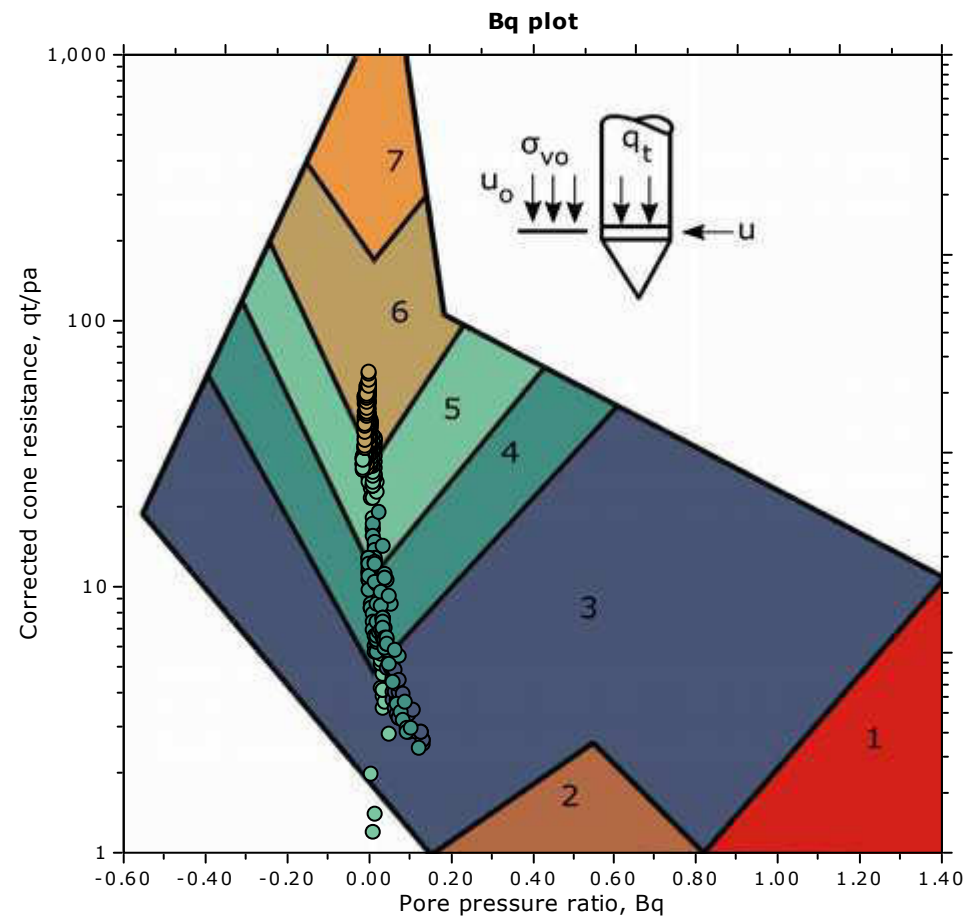
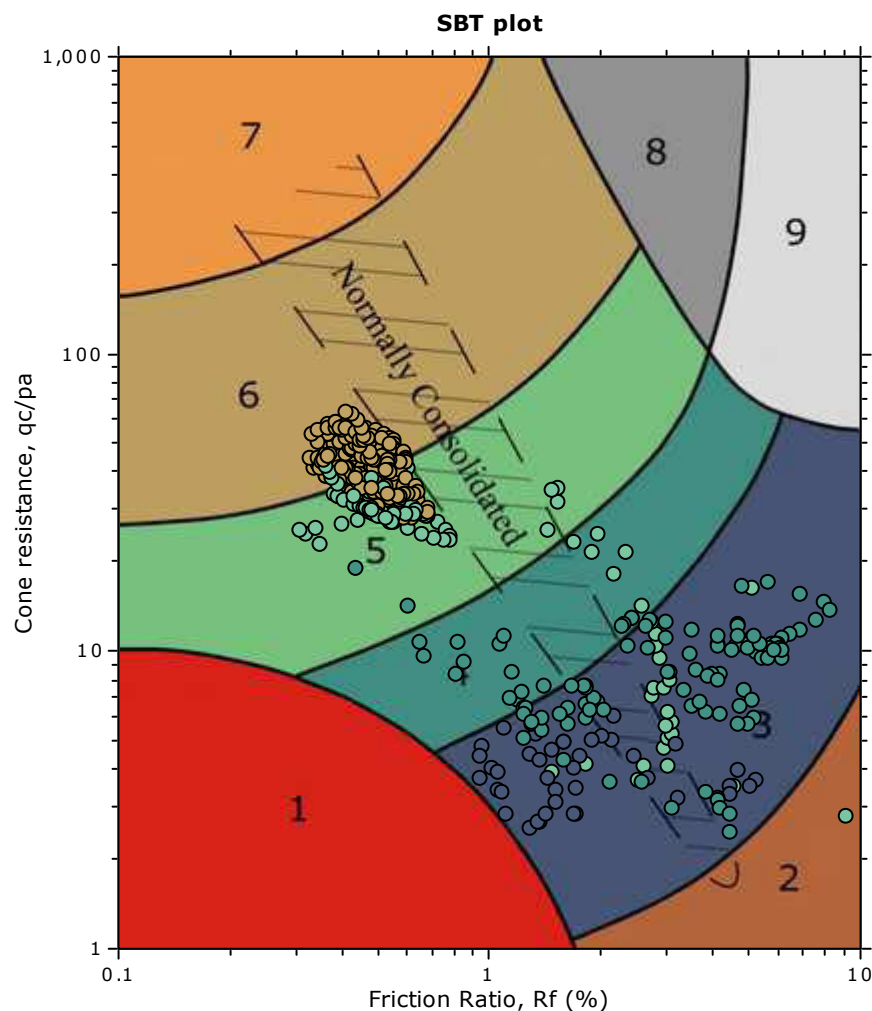




The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



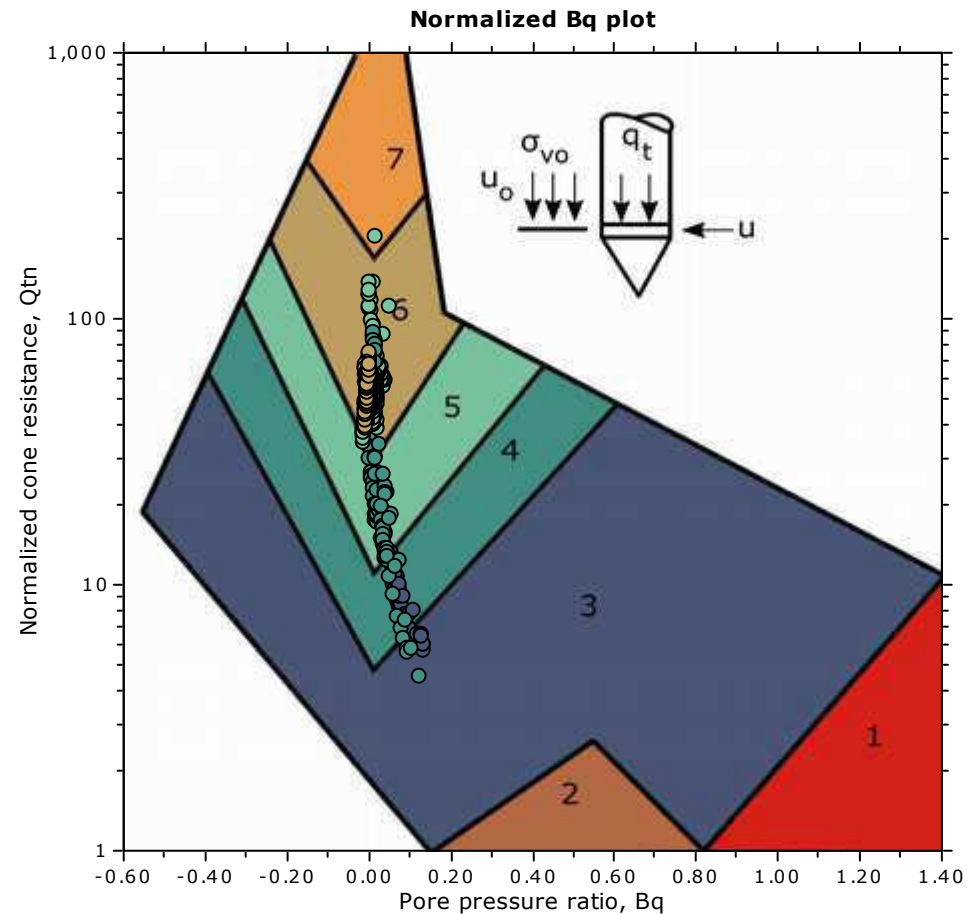
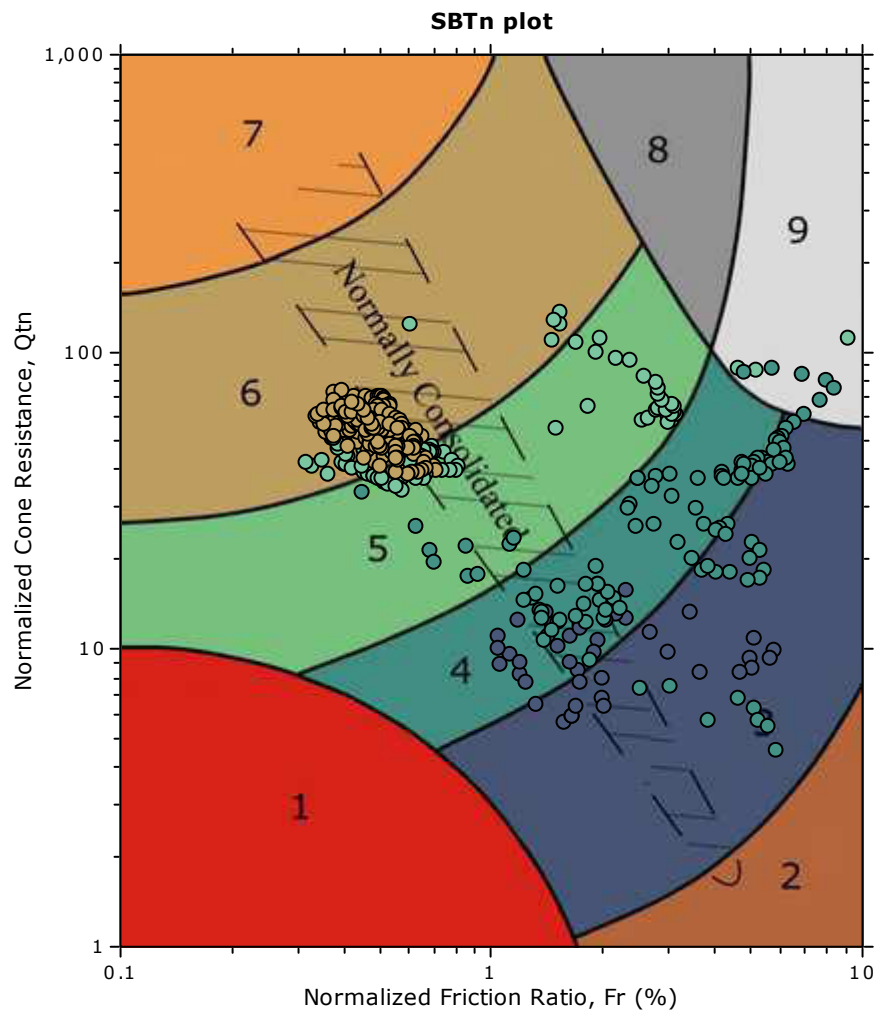
## SBT - Bq plots



### 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        |

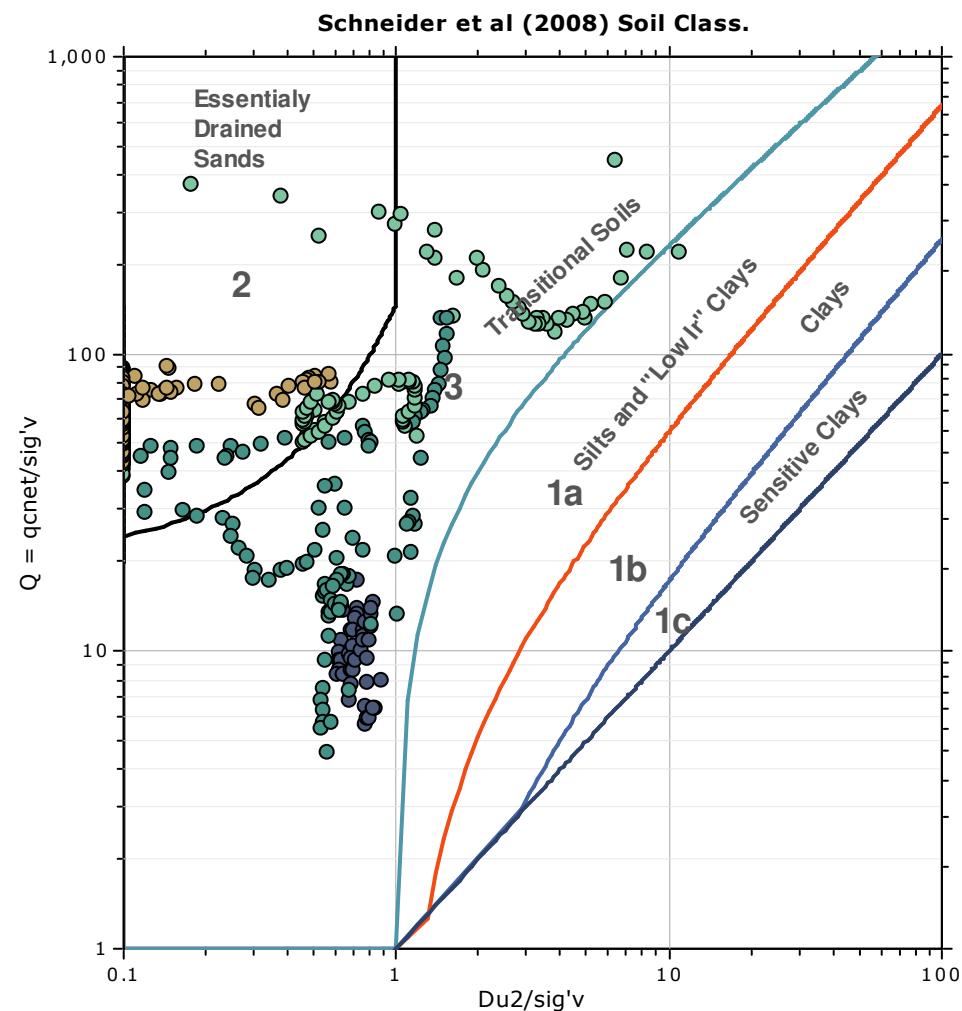
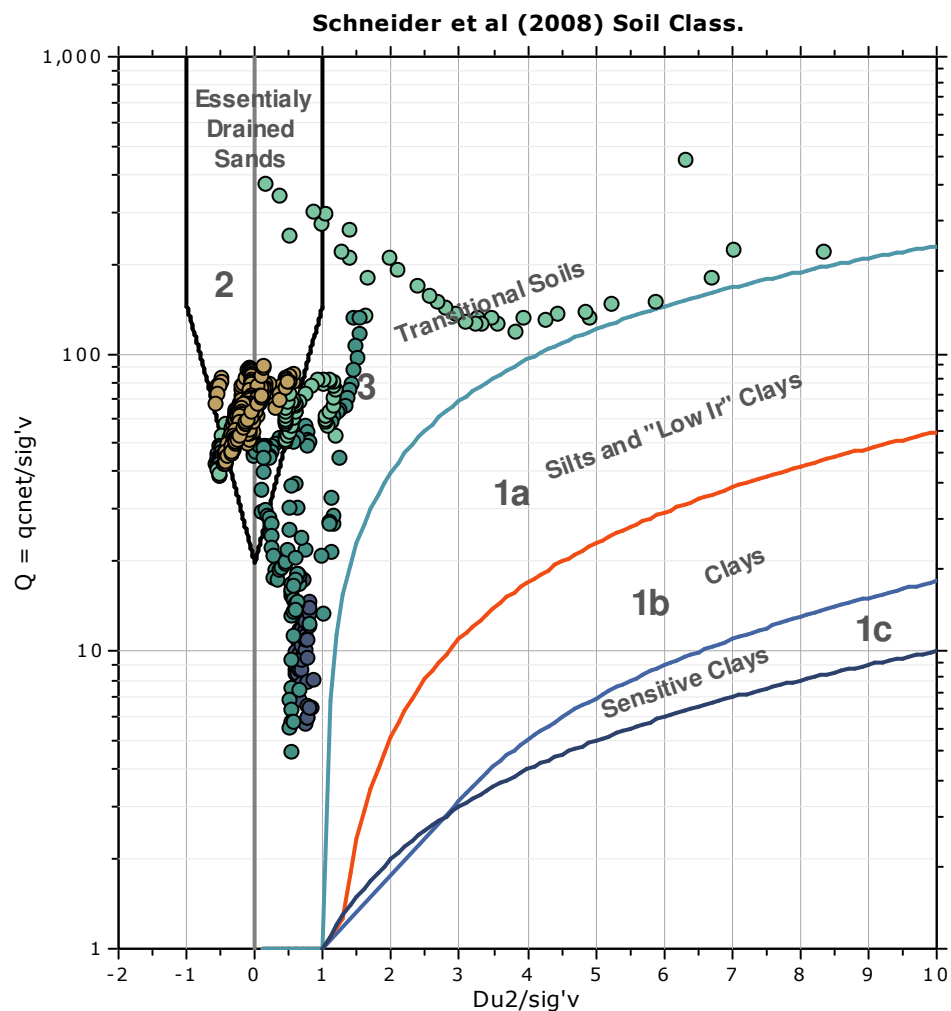
**SBT - Bq plots (normalized)**

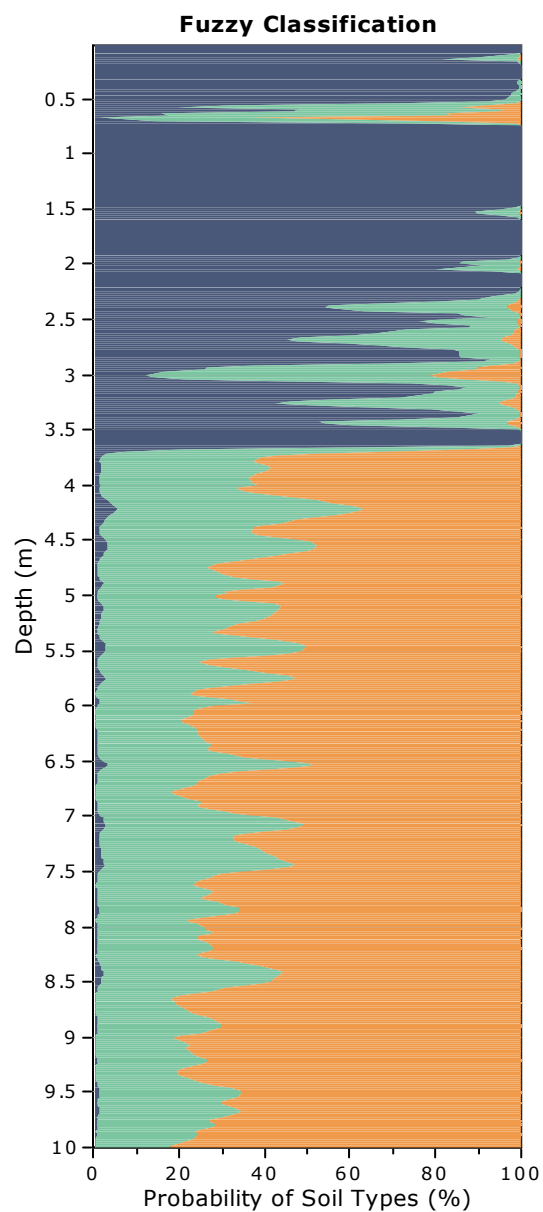
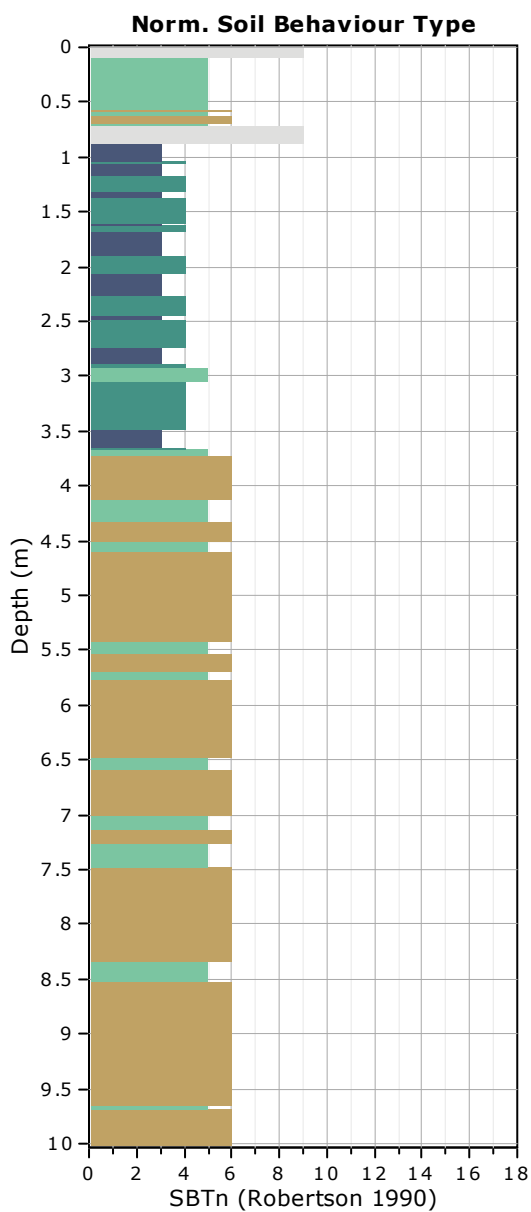


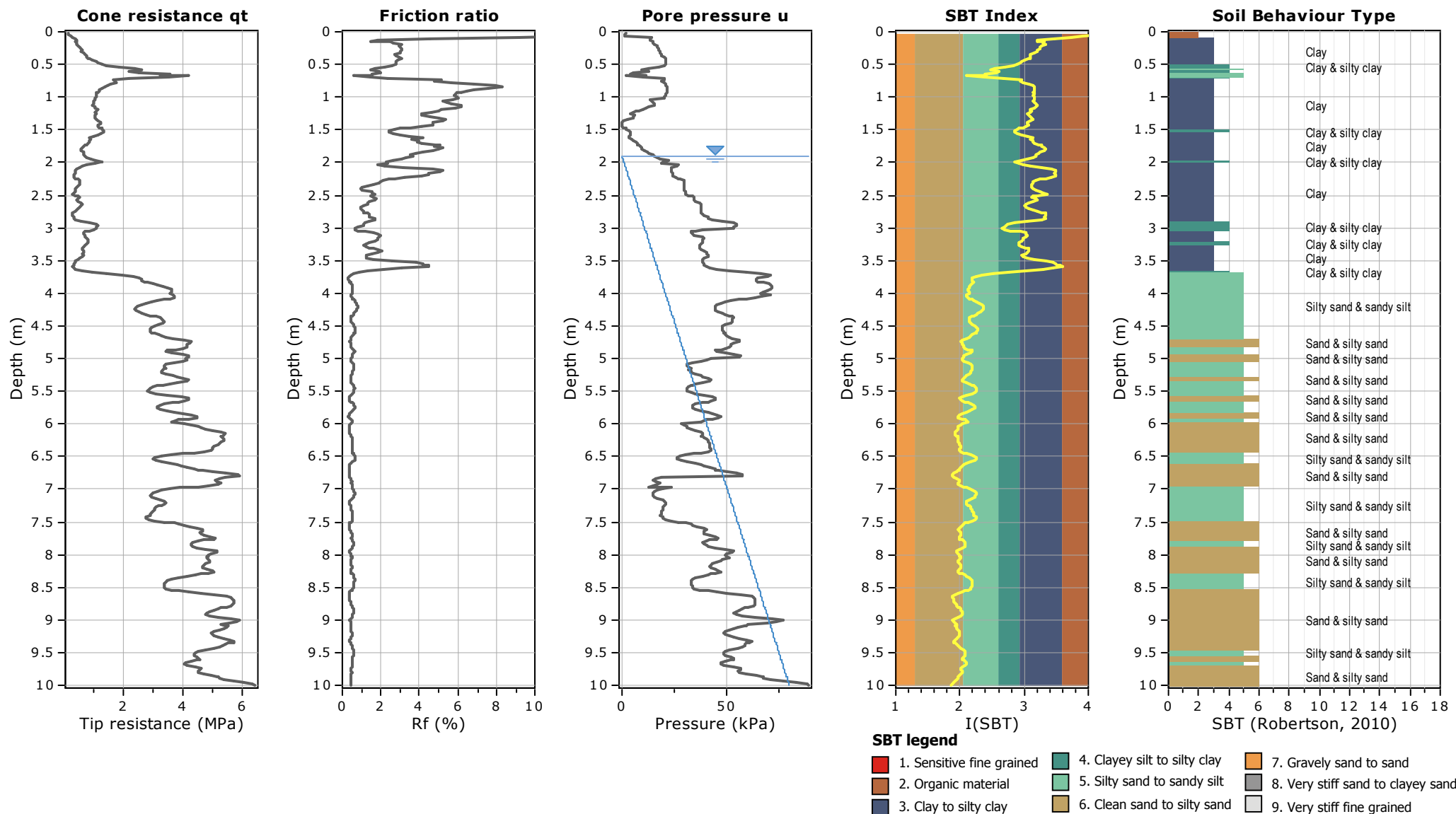
**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)









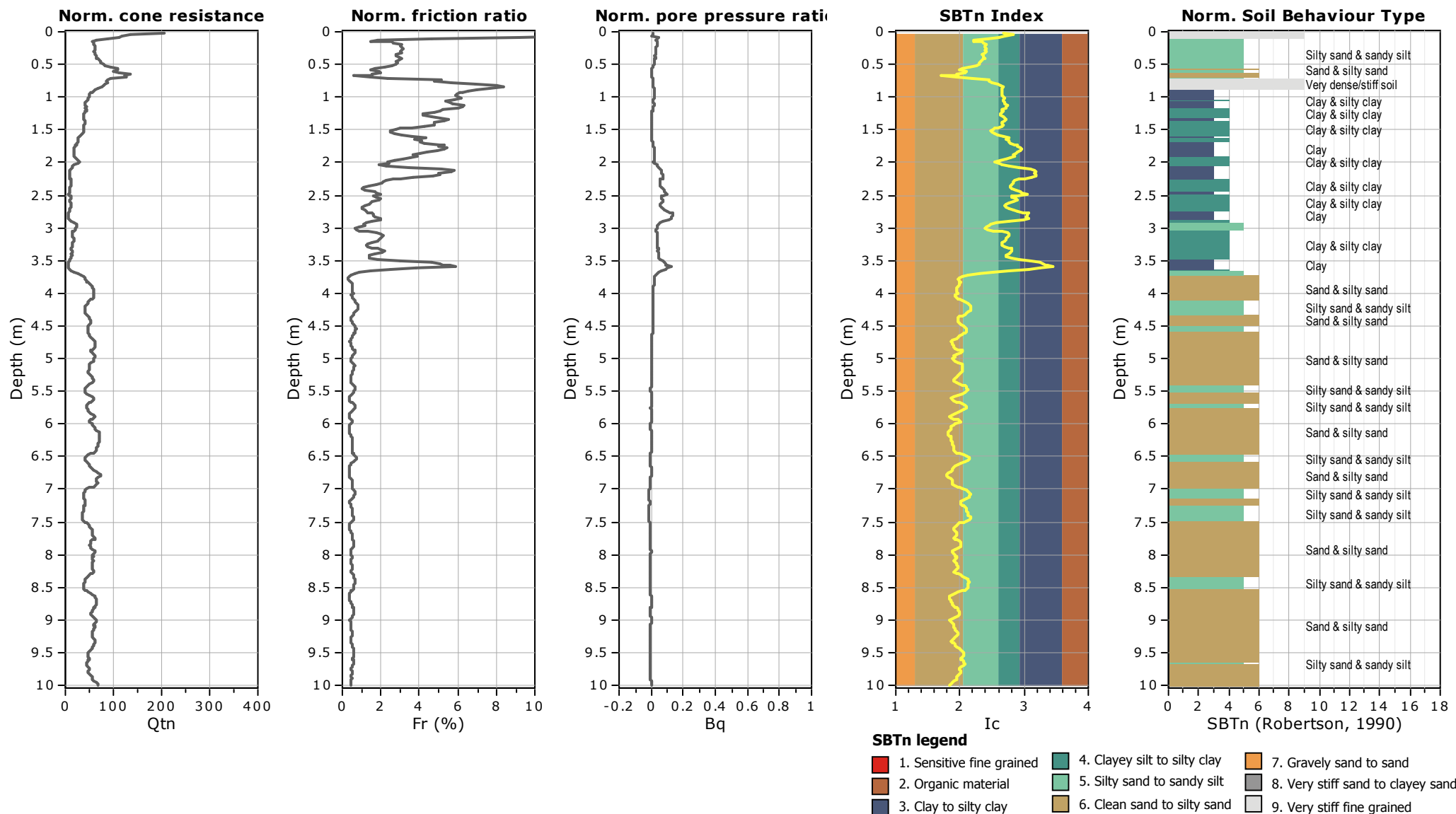
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+600**

Total depth: 10.00 m

Coords: lat 44.82313° lon 12.177701°



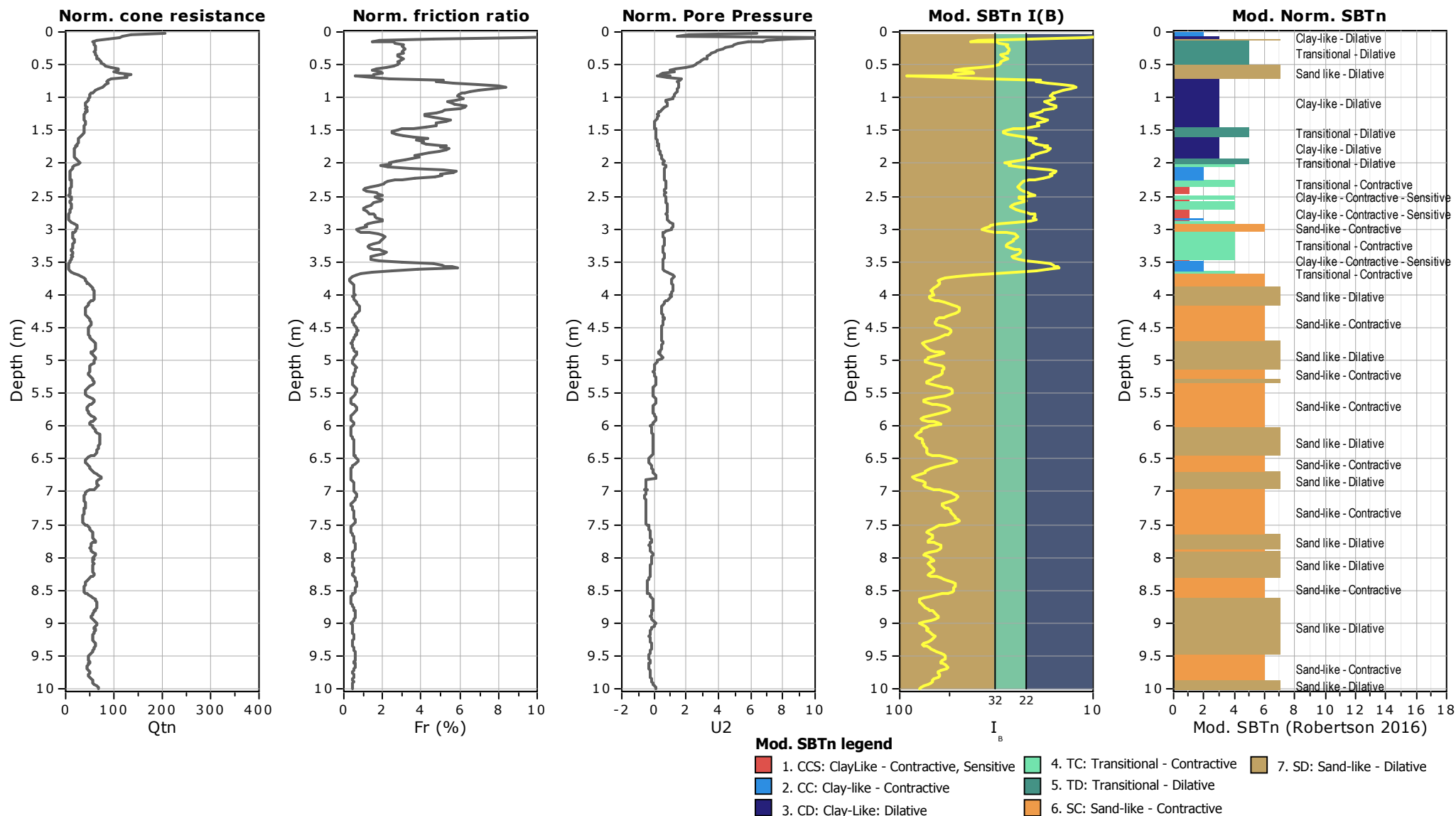
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

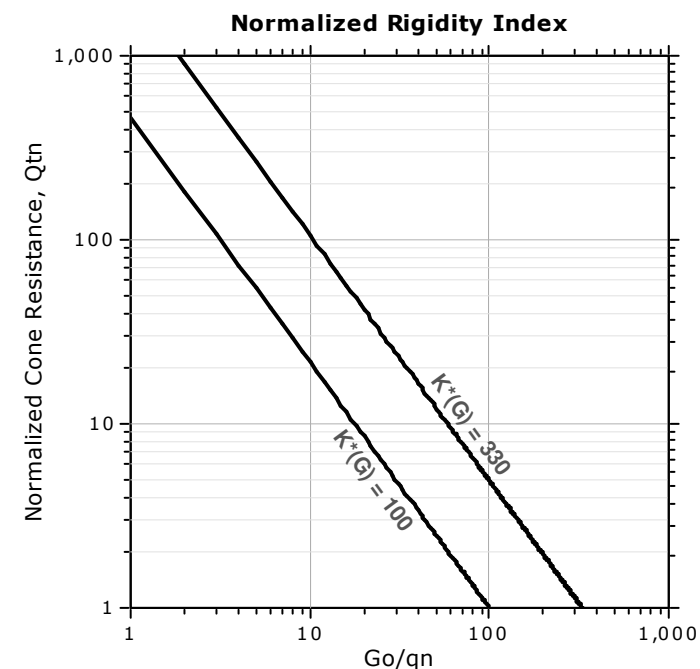
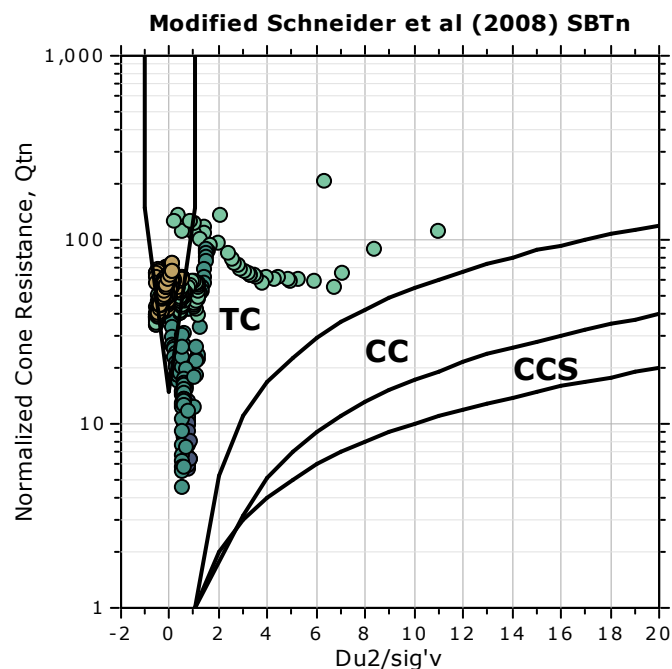
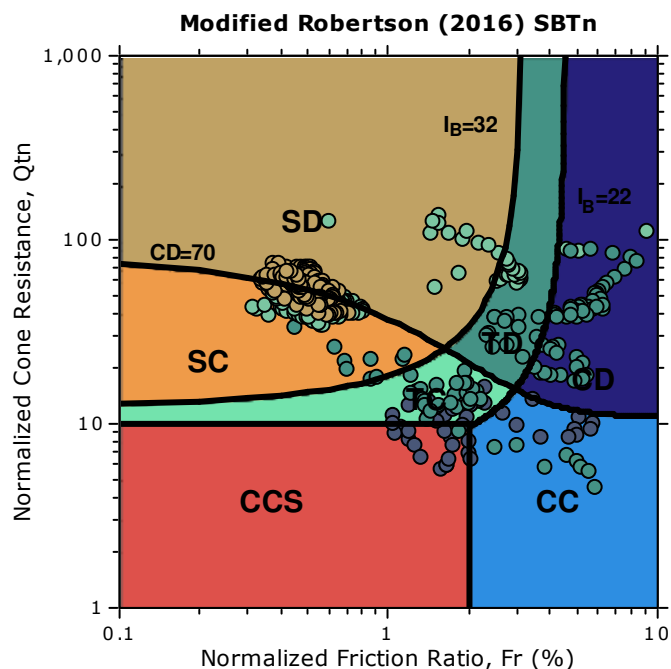
**CPT: CPTU km42+600**

Total depth: 10.00 m

Coords: lat 44.82313° lon 12.177701°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

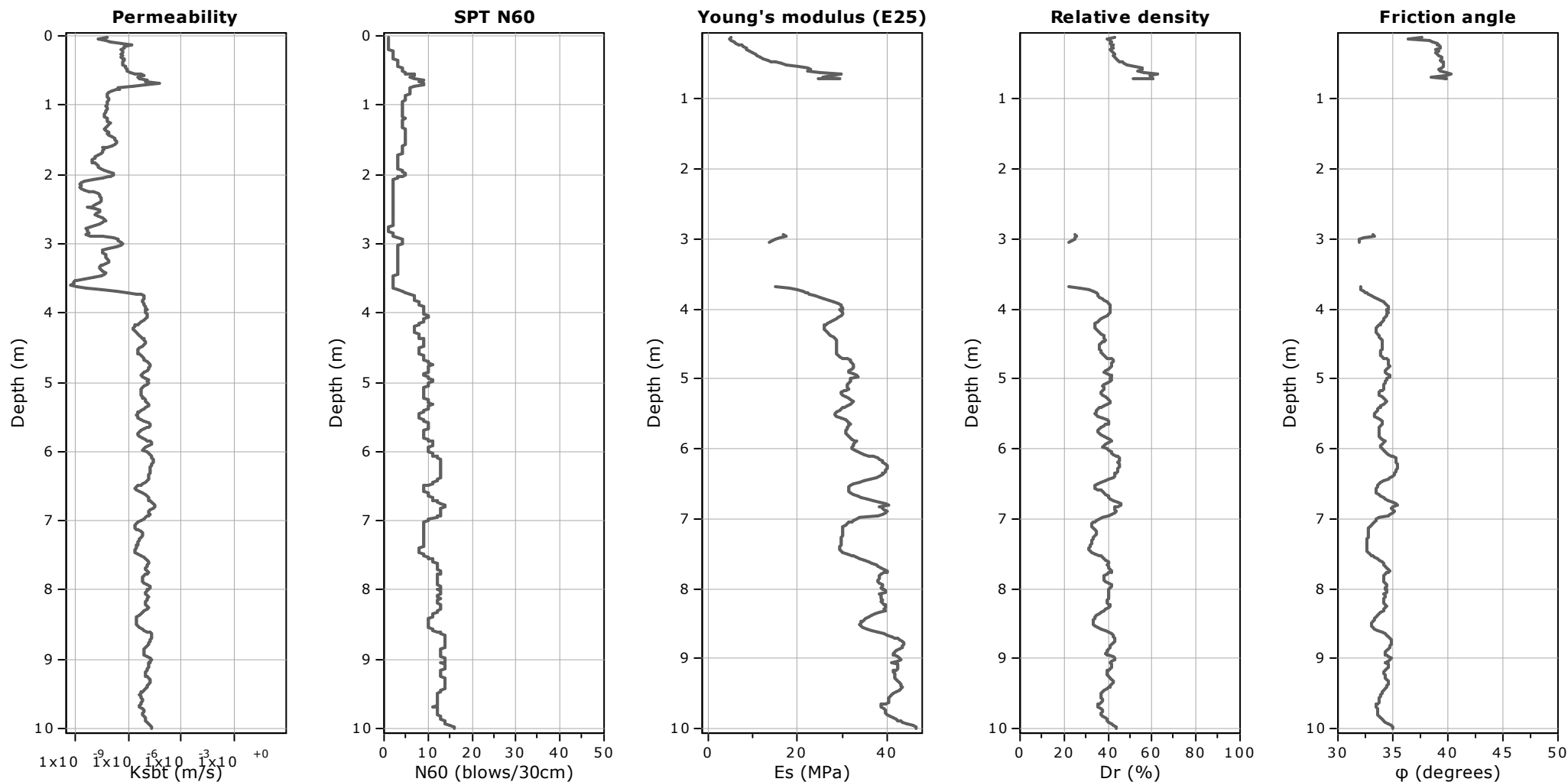
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+600**

Total depth: 10.00 m

Coords: lat 44.82313° lon 12.177701°



#### 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 Kulhavy & Mayne (1990)

—●— User defined estimation data

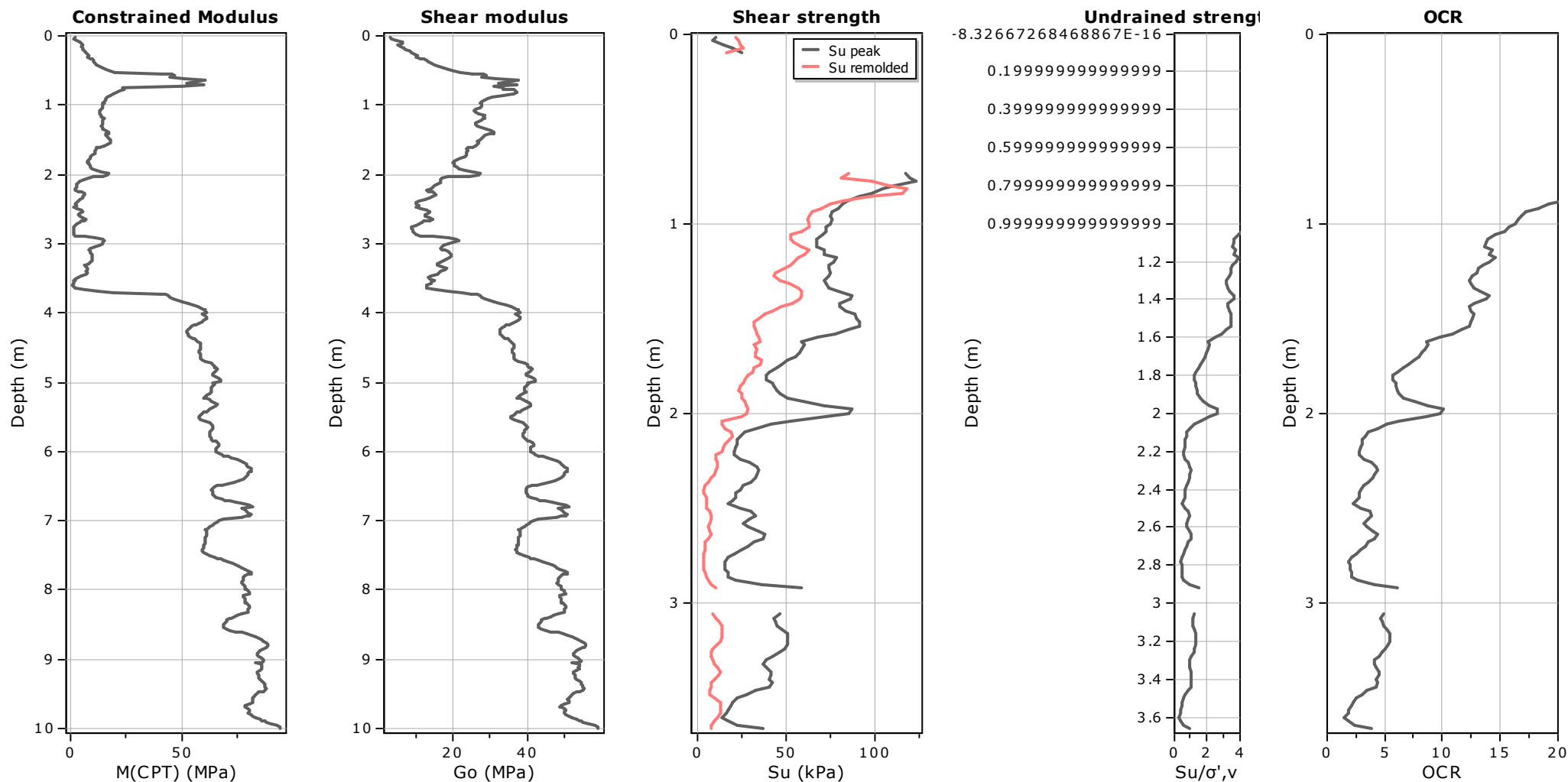
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+600**

Total depth: 10.00 m

Coords: lat 44.82313° lon 12.177701°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

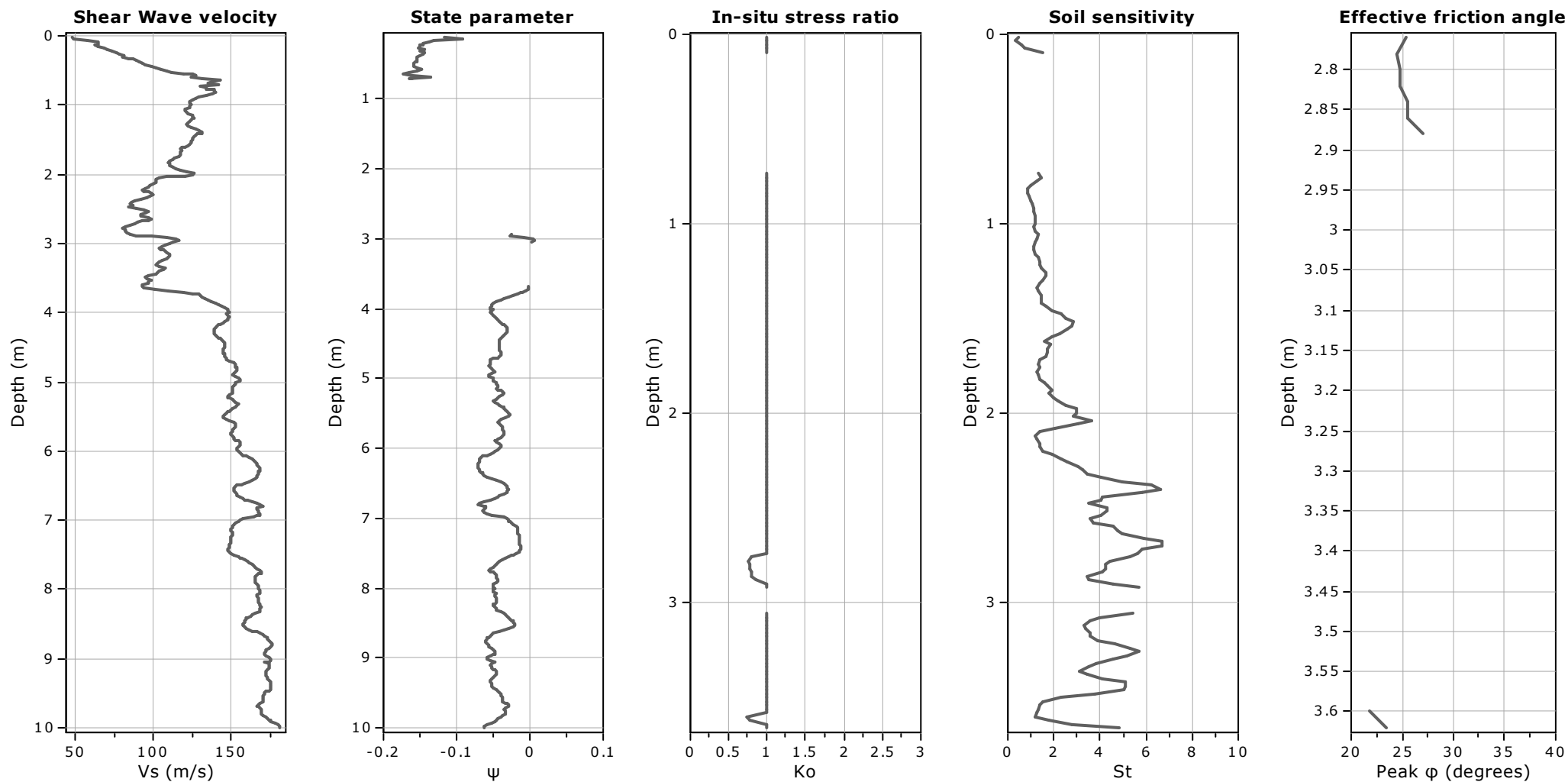
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+600**

Total depth: 10.00 m

Coords: lat 44.82313° lon 12.177701°

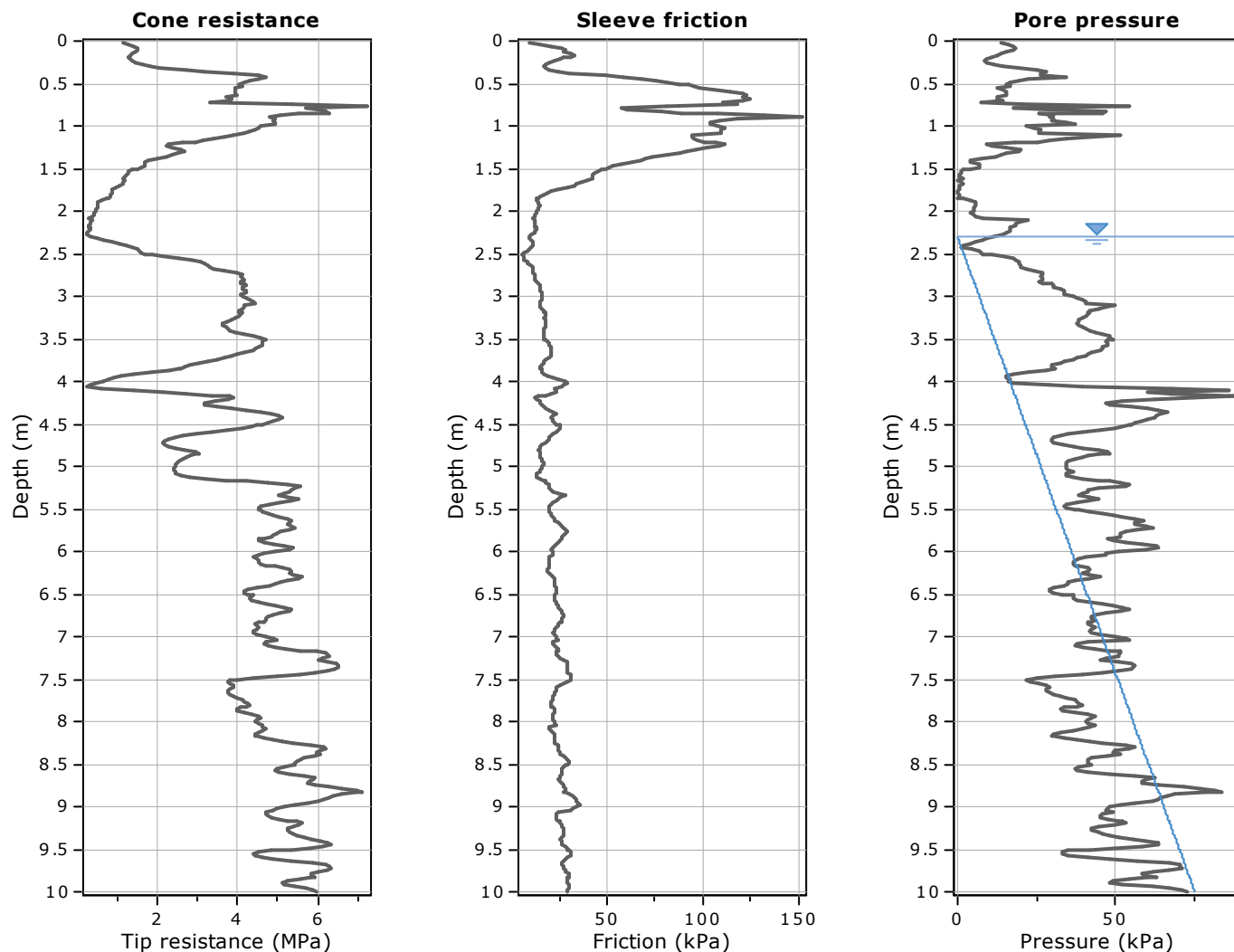


#### Calculation parameters

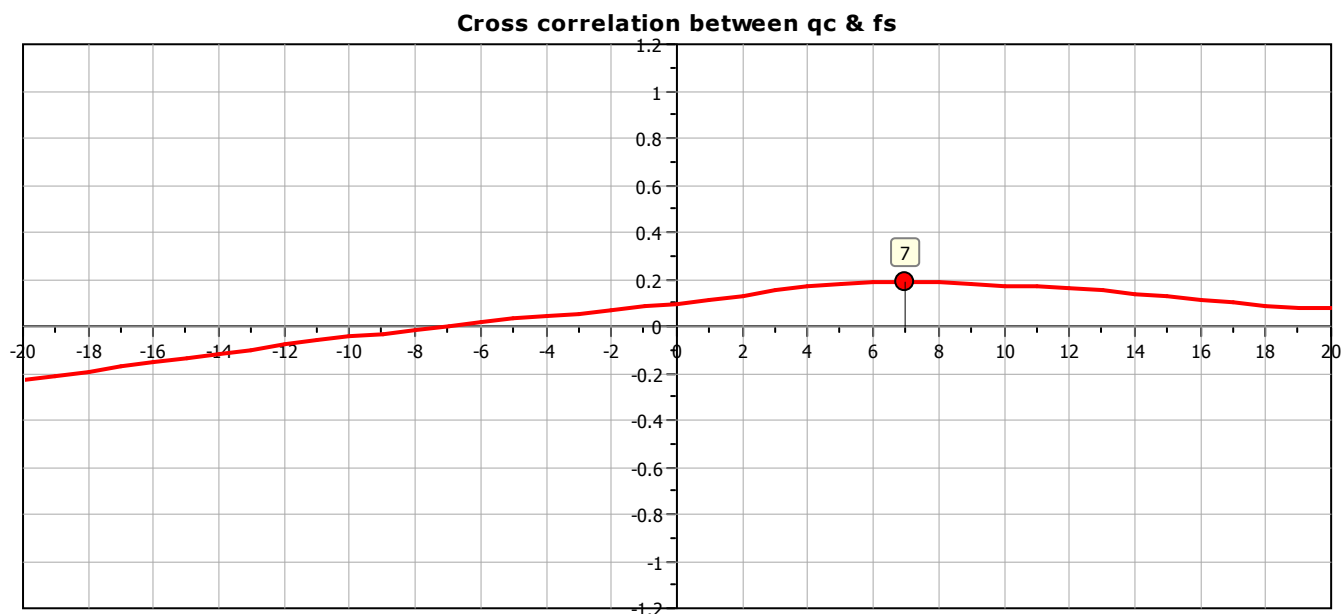
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

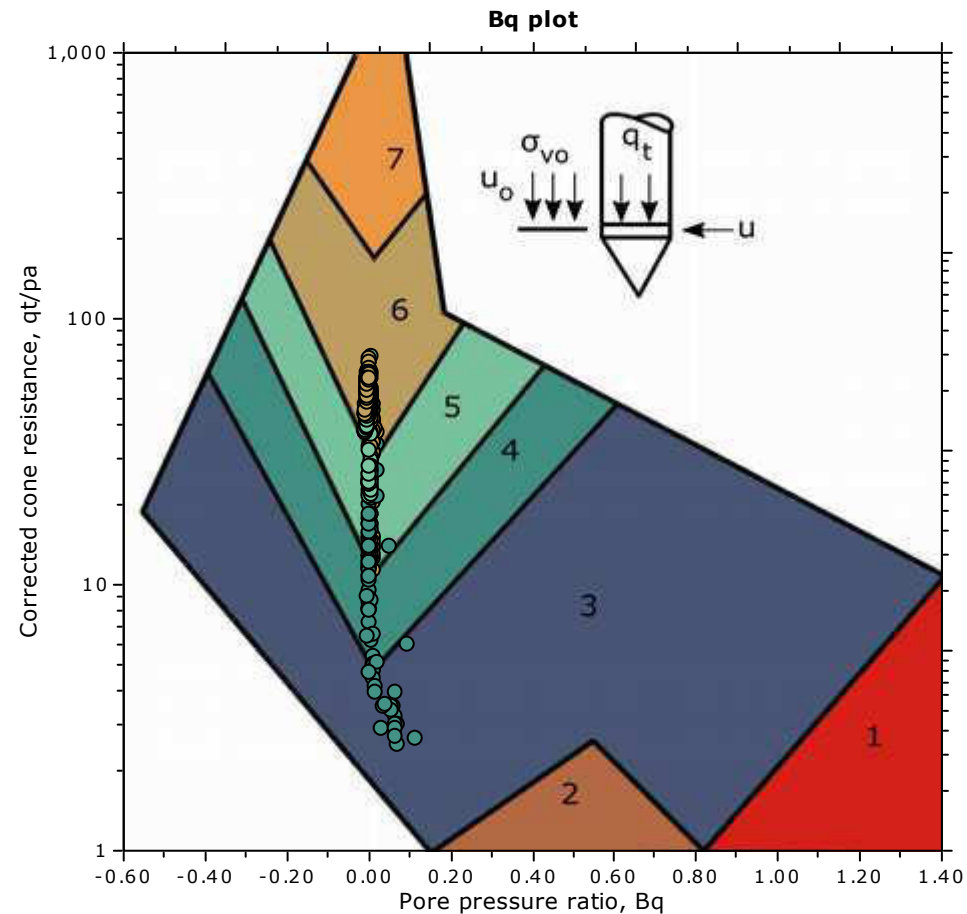
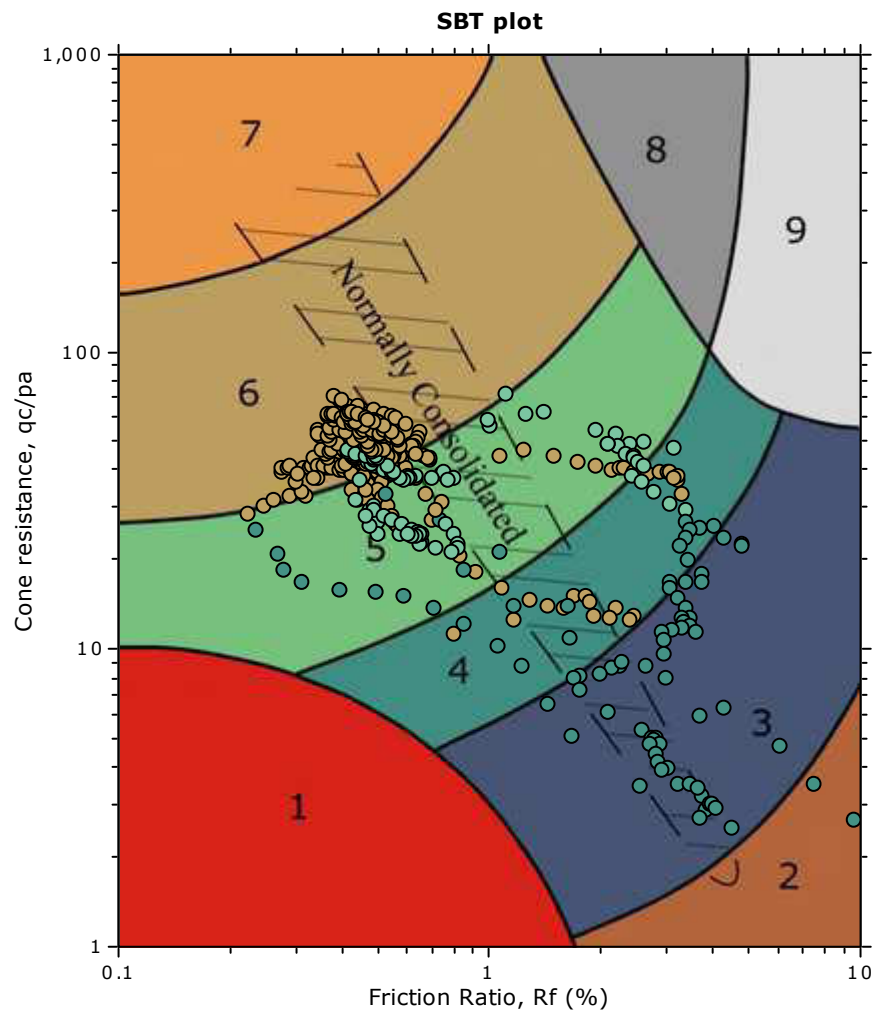




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



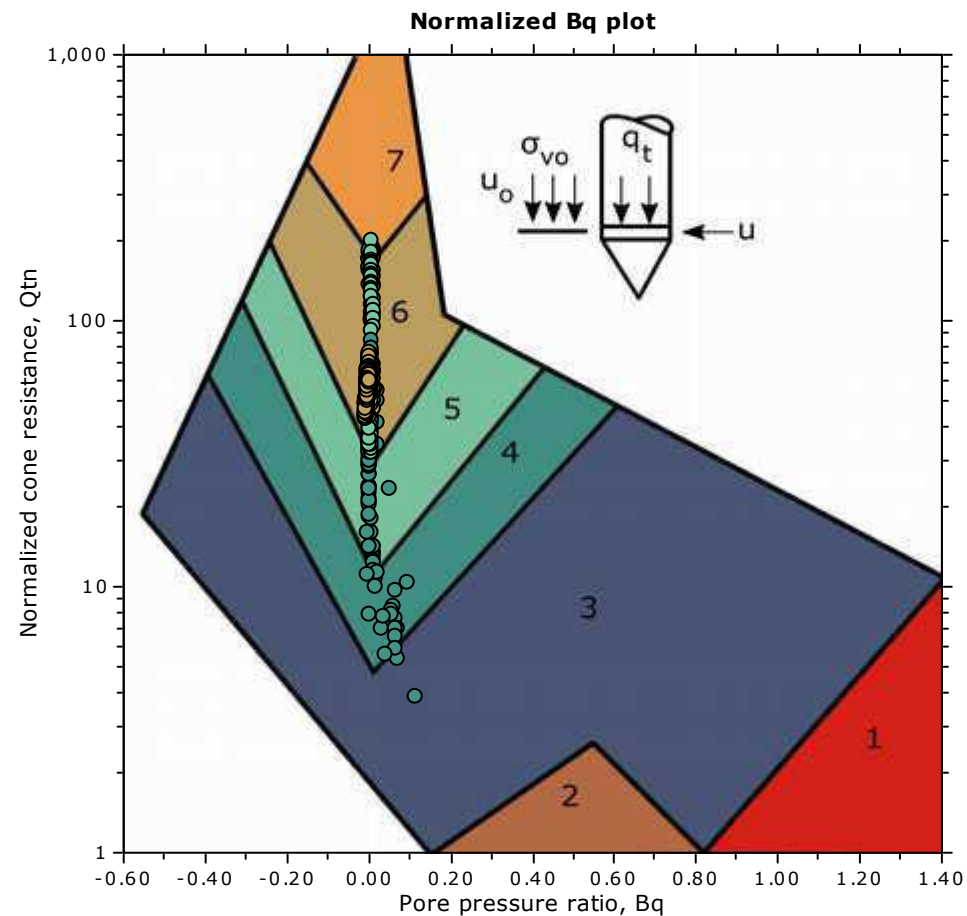
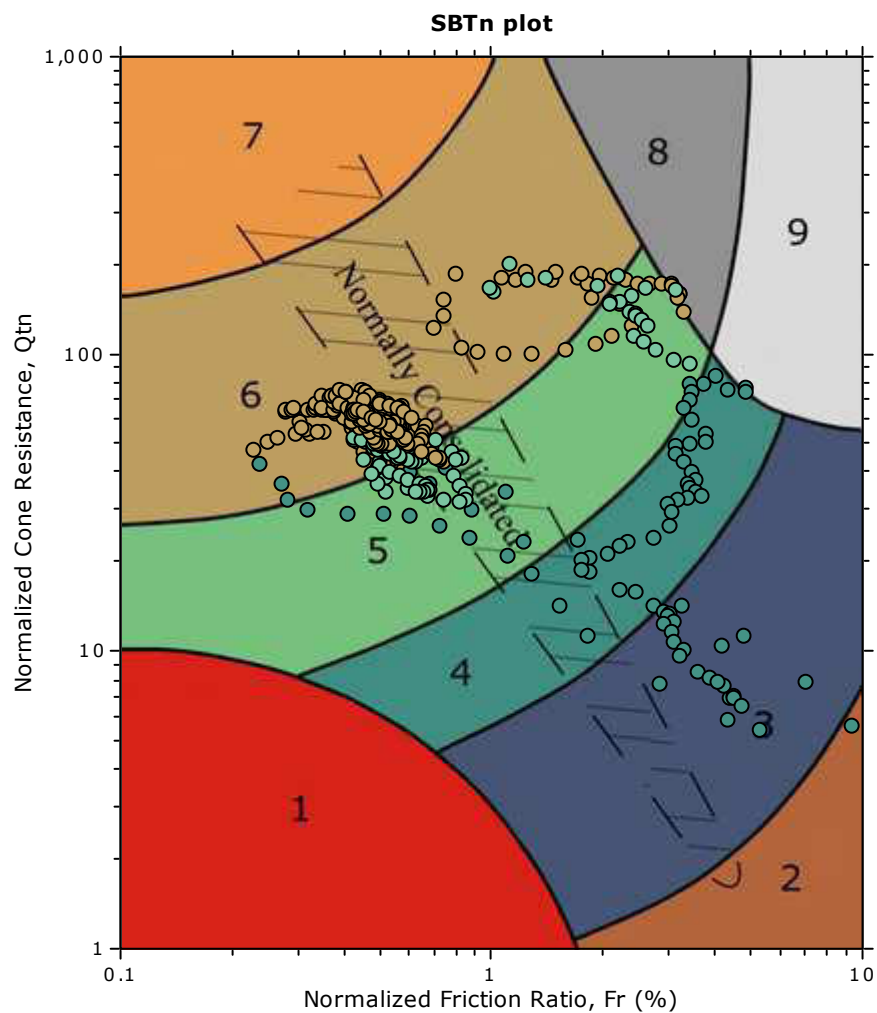
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

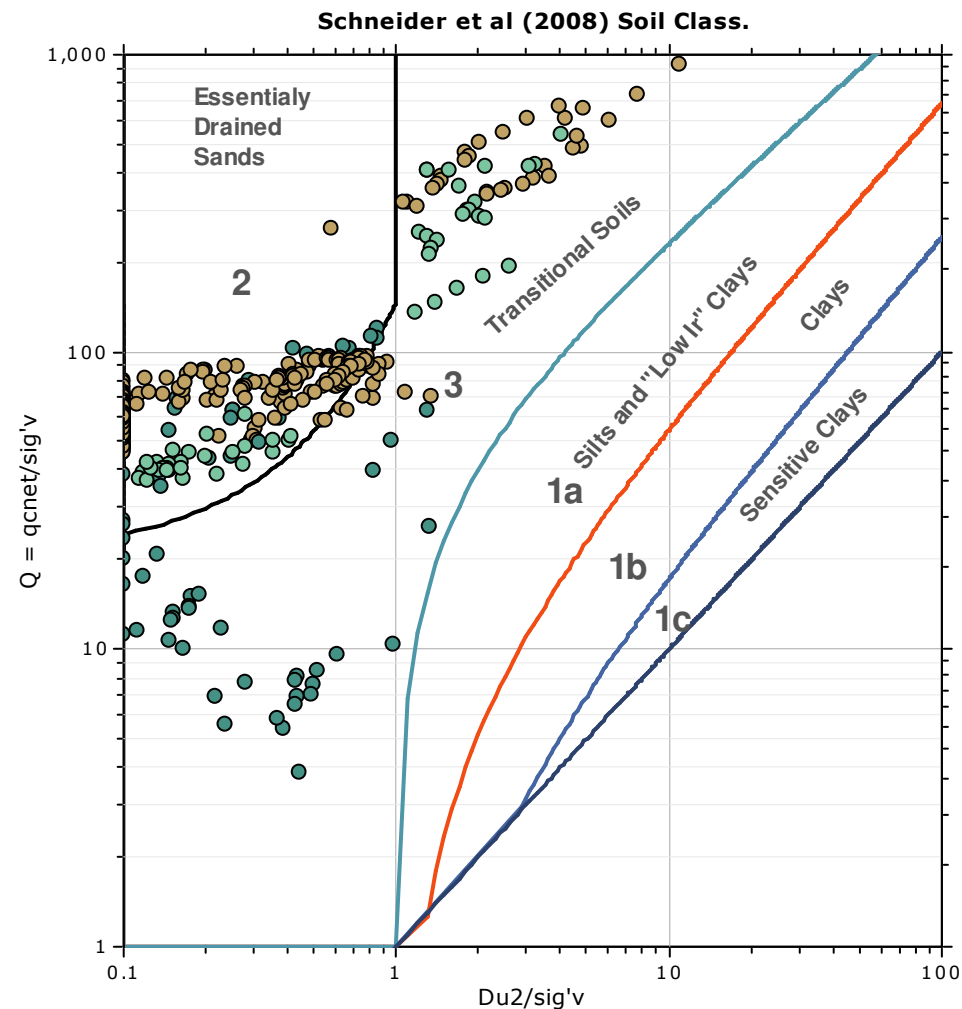
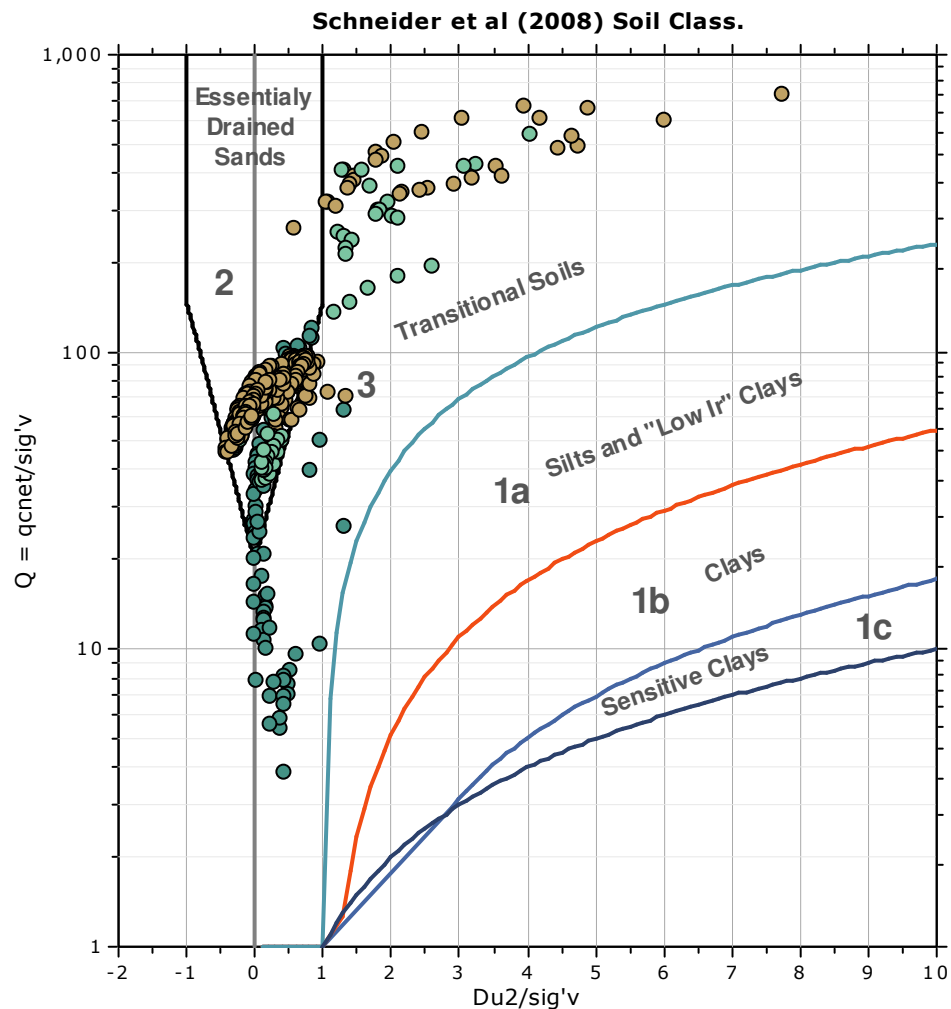
**SBT - Bq plots (normalized)**

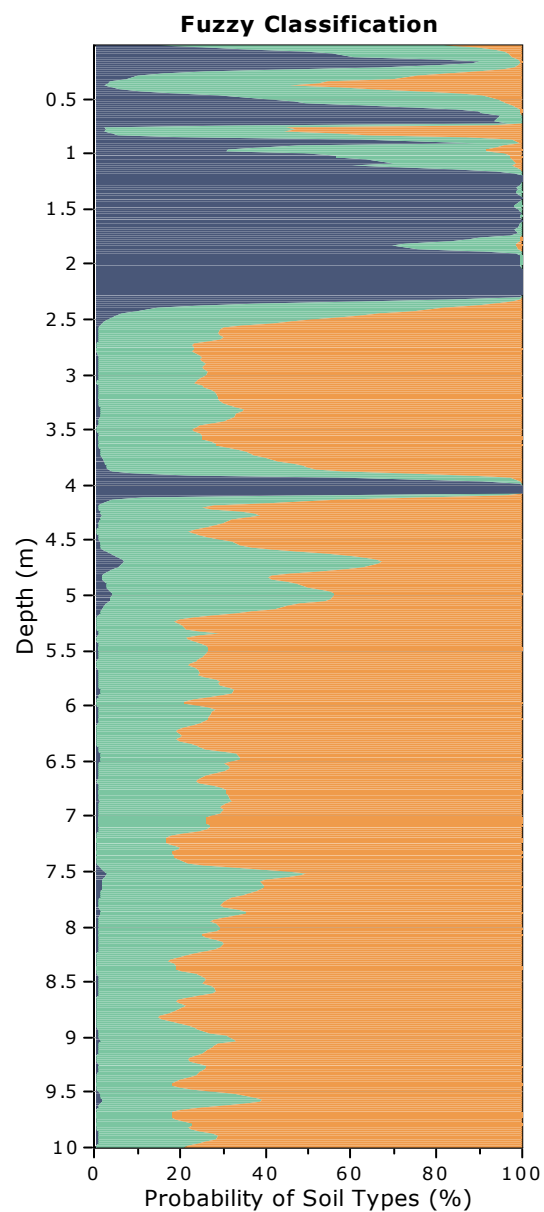
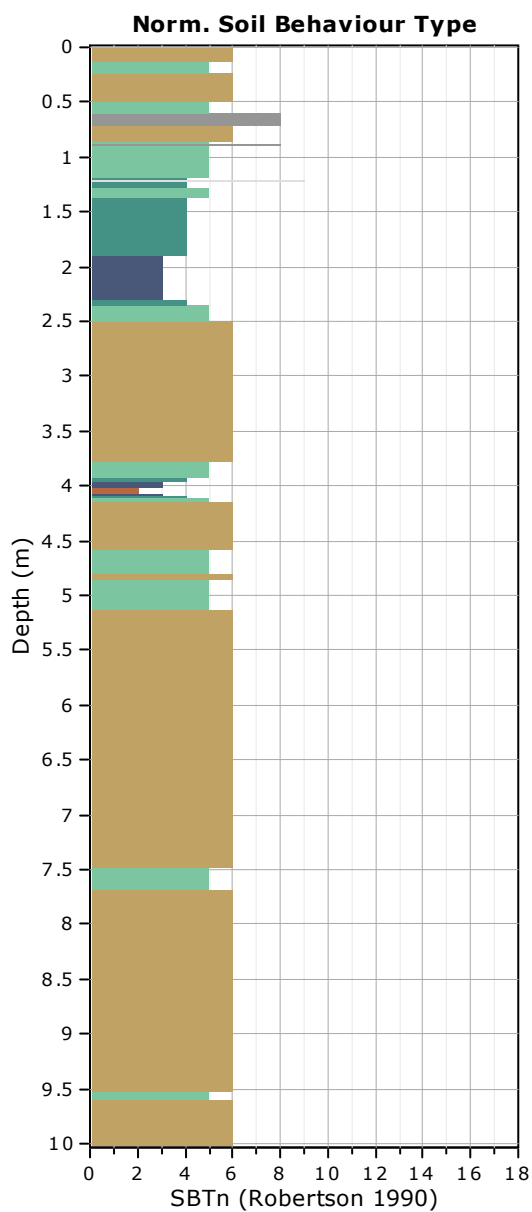


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





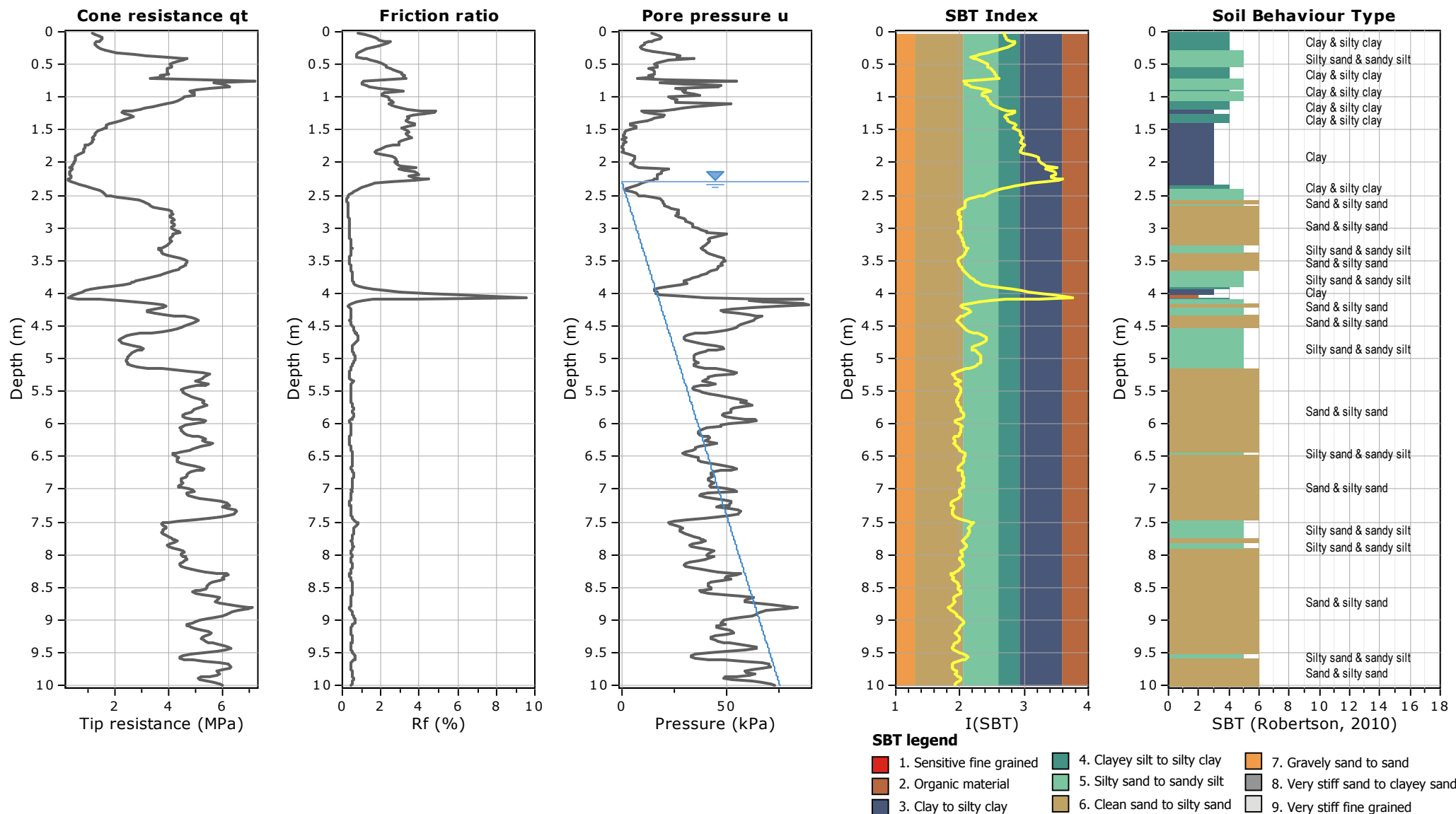
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+900**

Total depth: 10.00 m

Coords: lat 44.825905° lon 12.176451°





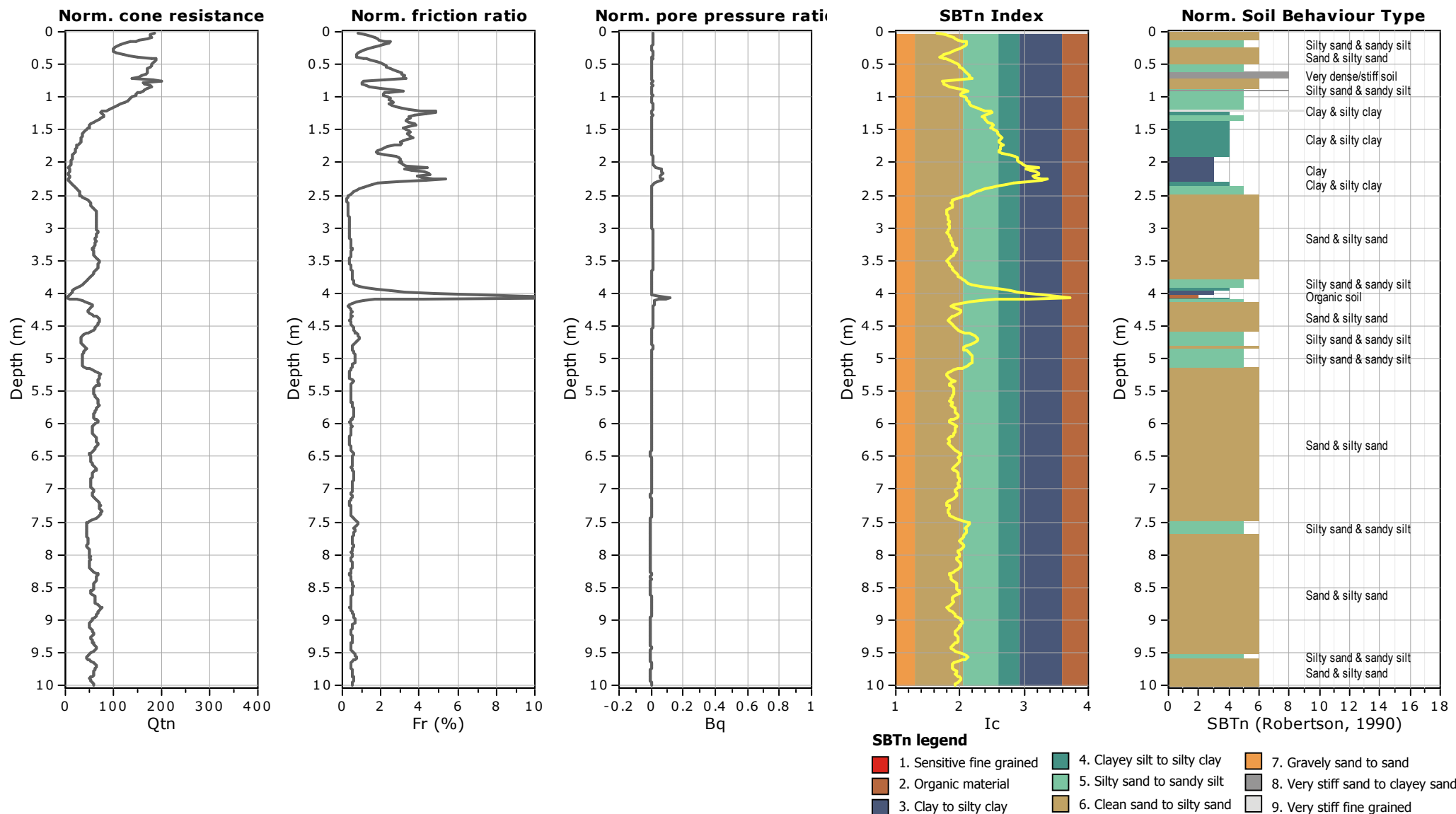
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+900**

Total depth: 10.00 m

Coords: lat 44.825905° lon 12.176451°



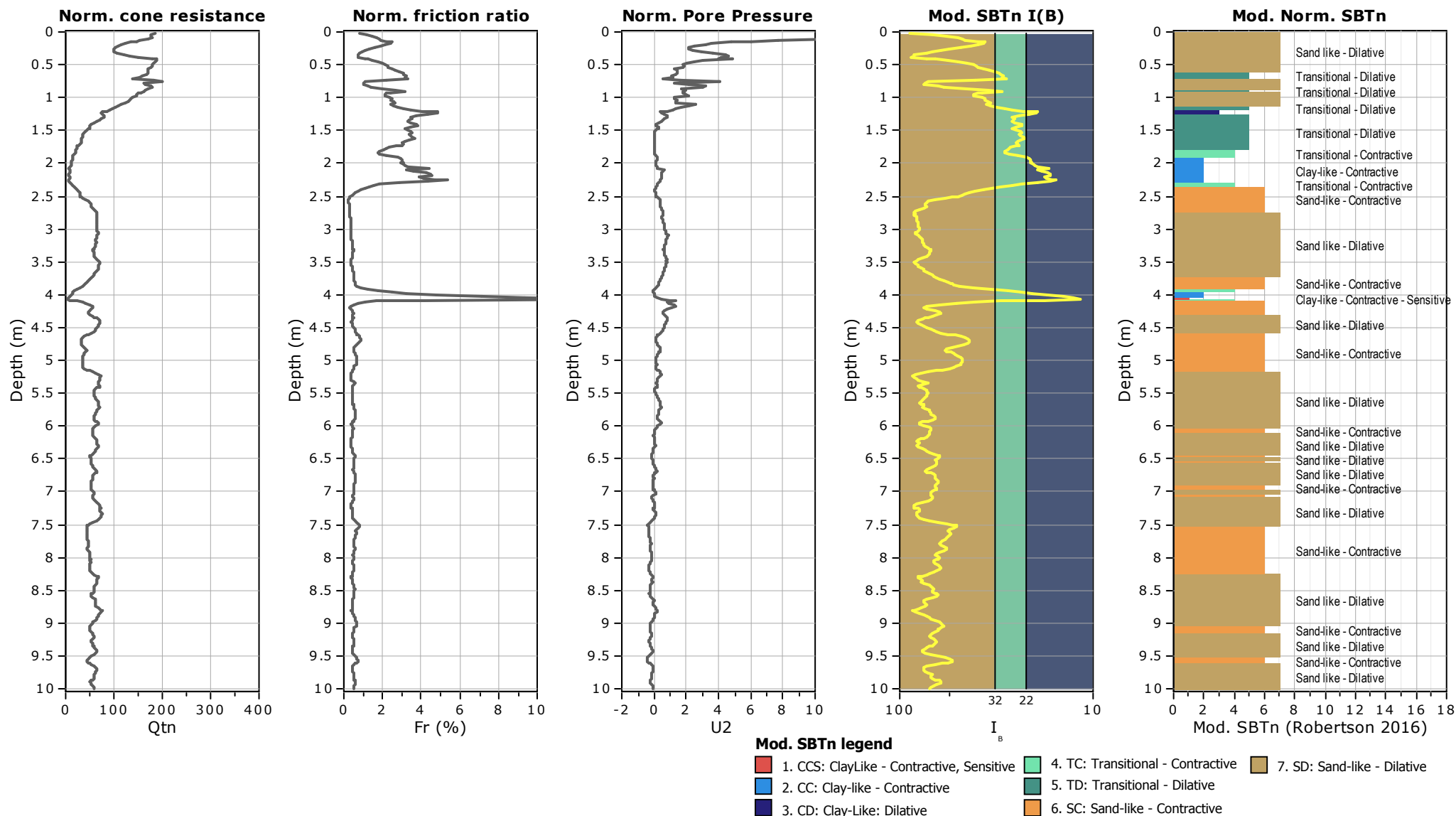
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

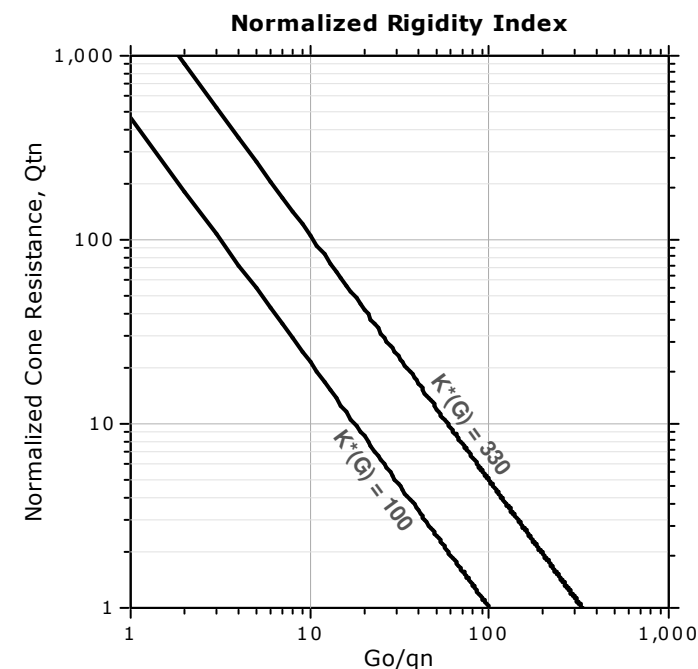
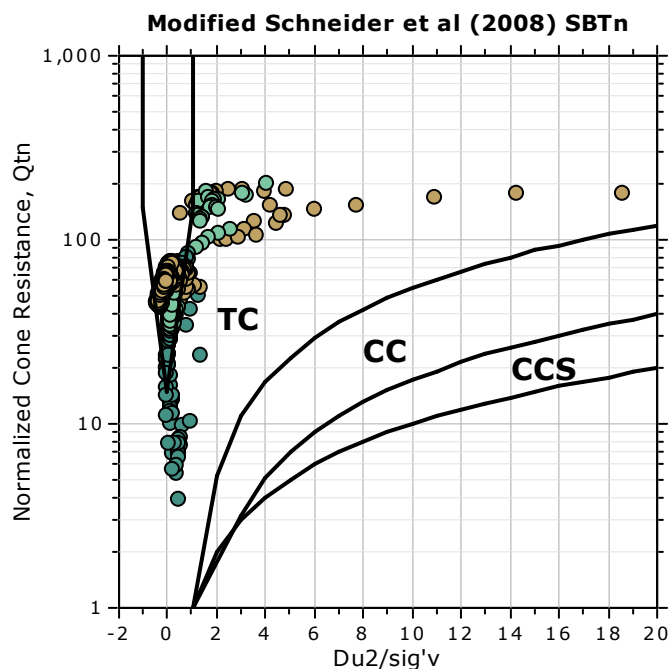
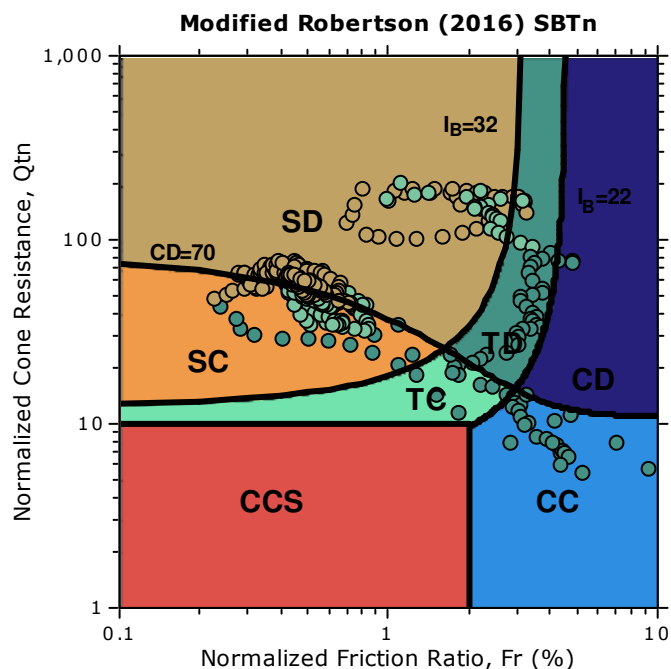
**CPT: CPTU km42+900**

Total depth: 10.00 m

Coords: lat 44.825905° lon 12.176451°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

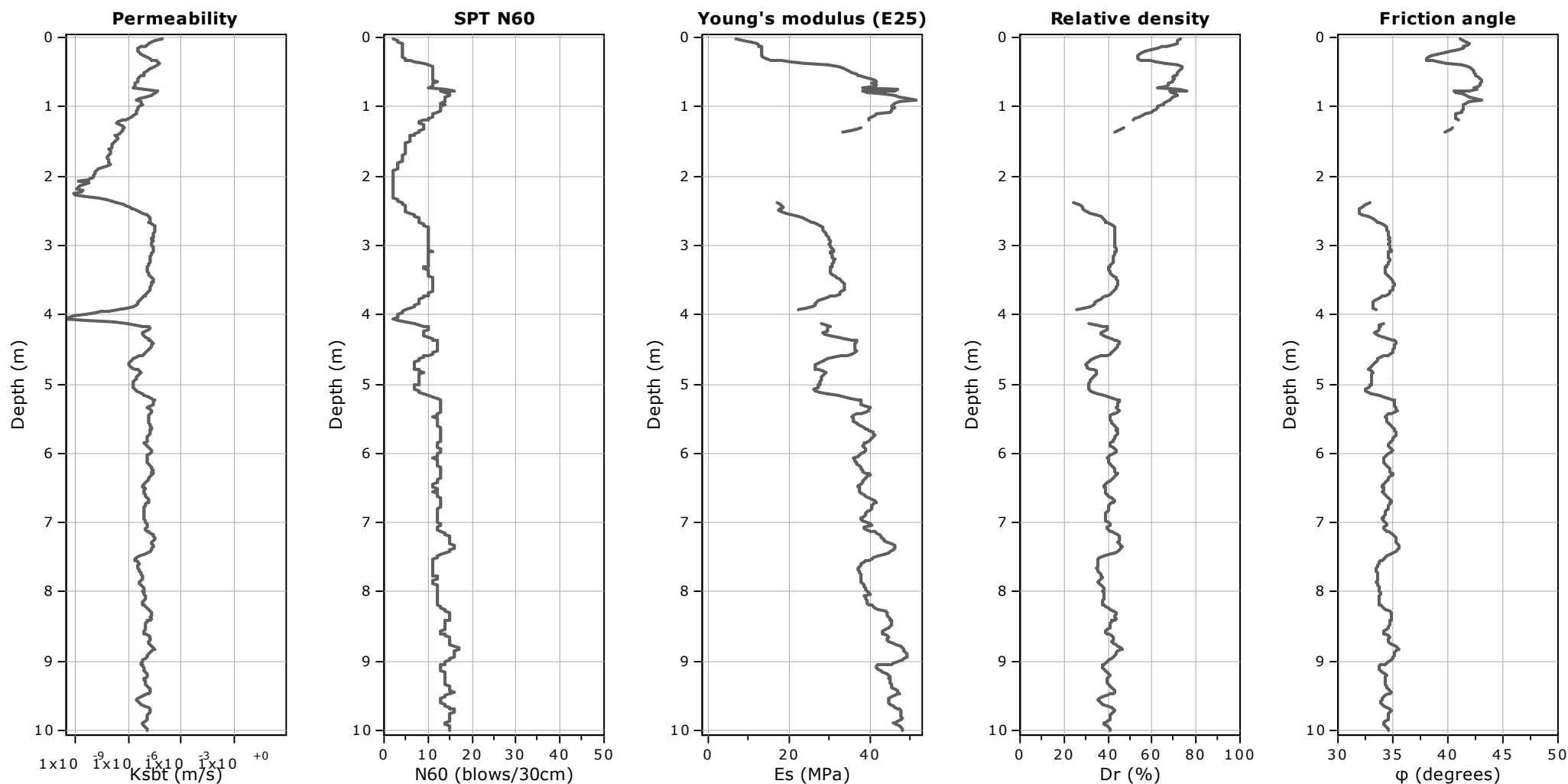
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+900**

Total depth: 10.00 m

Coords: lat 44.825905° lon 12.176451°



**Calculation parameters**

Permeability: Based on  $SBT_n$

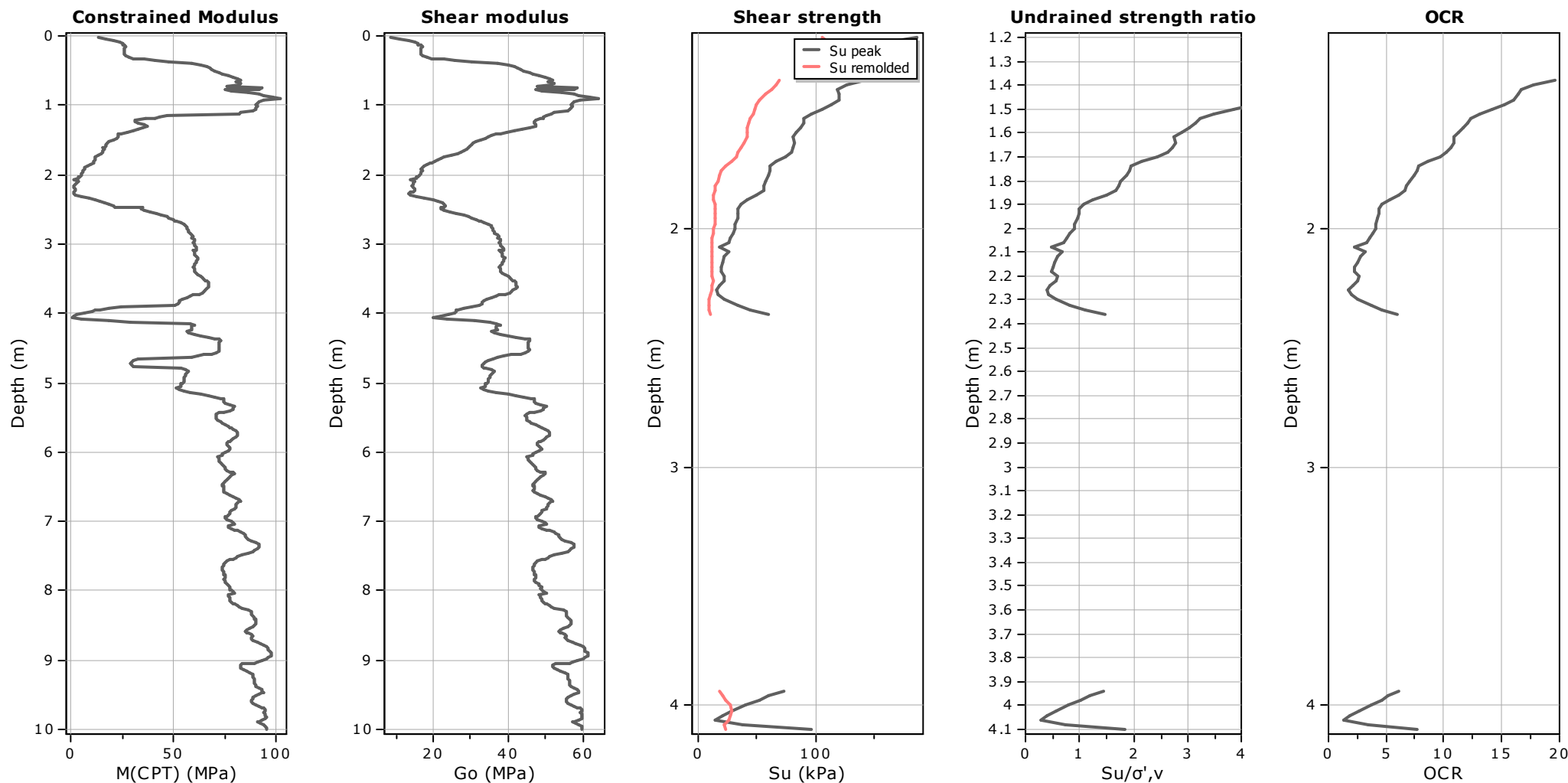
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

$G_0$ : Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

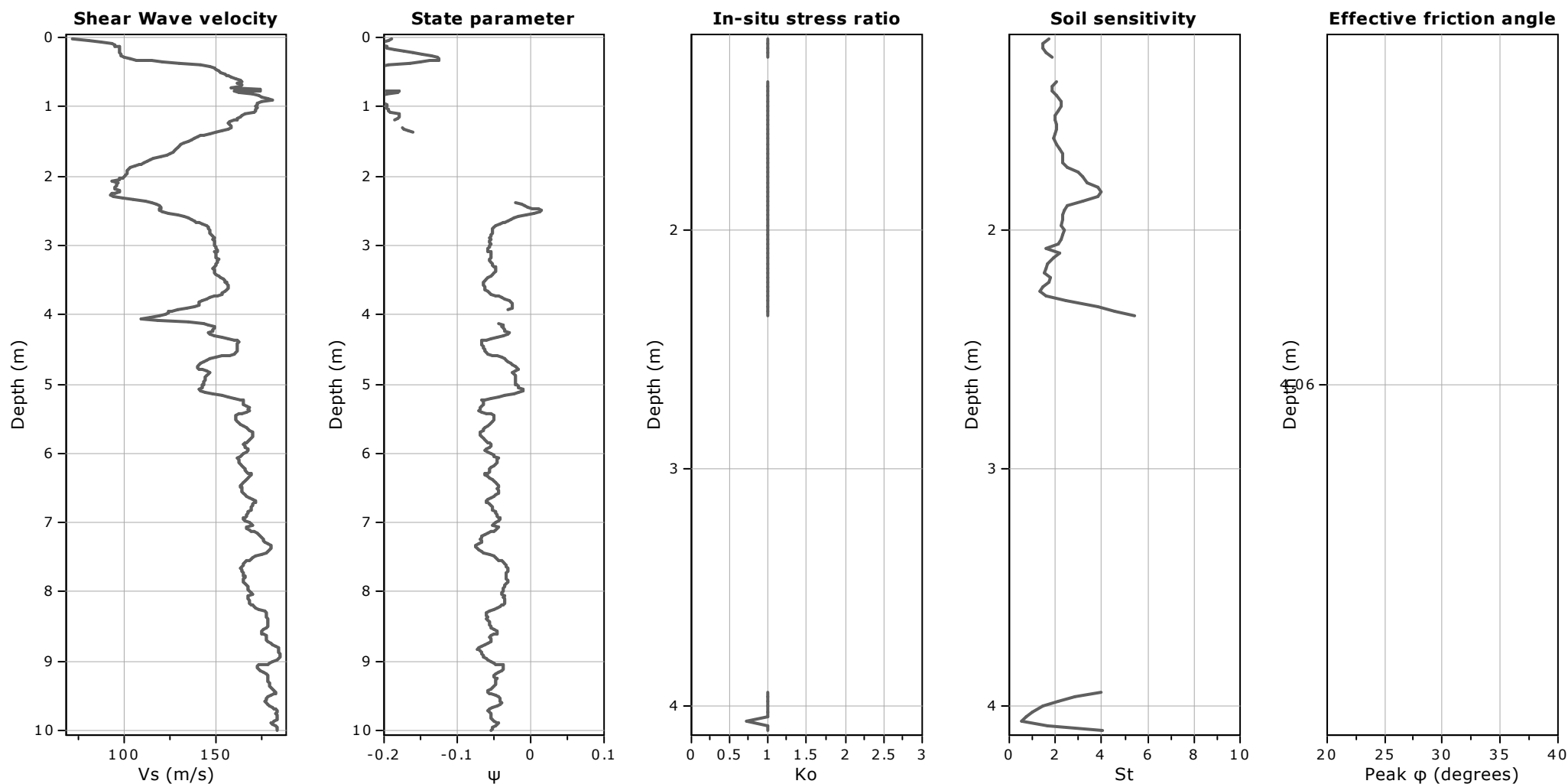
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km42+900**

Total depth: 10.00 m

Coords: lat 44.825905° lon 12.176451°

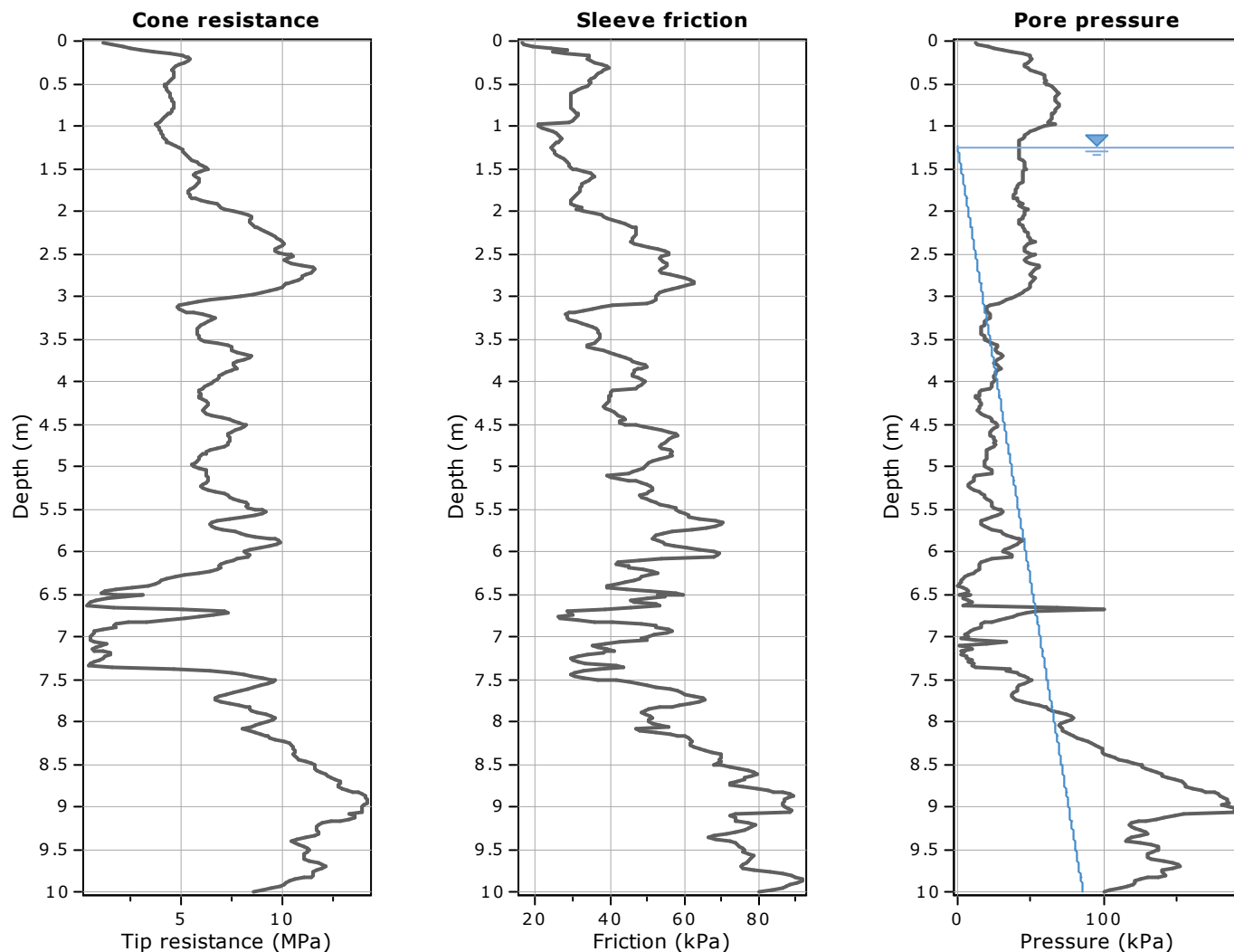


#### Calculation parameters

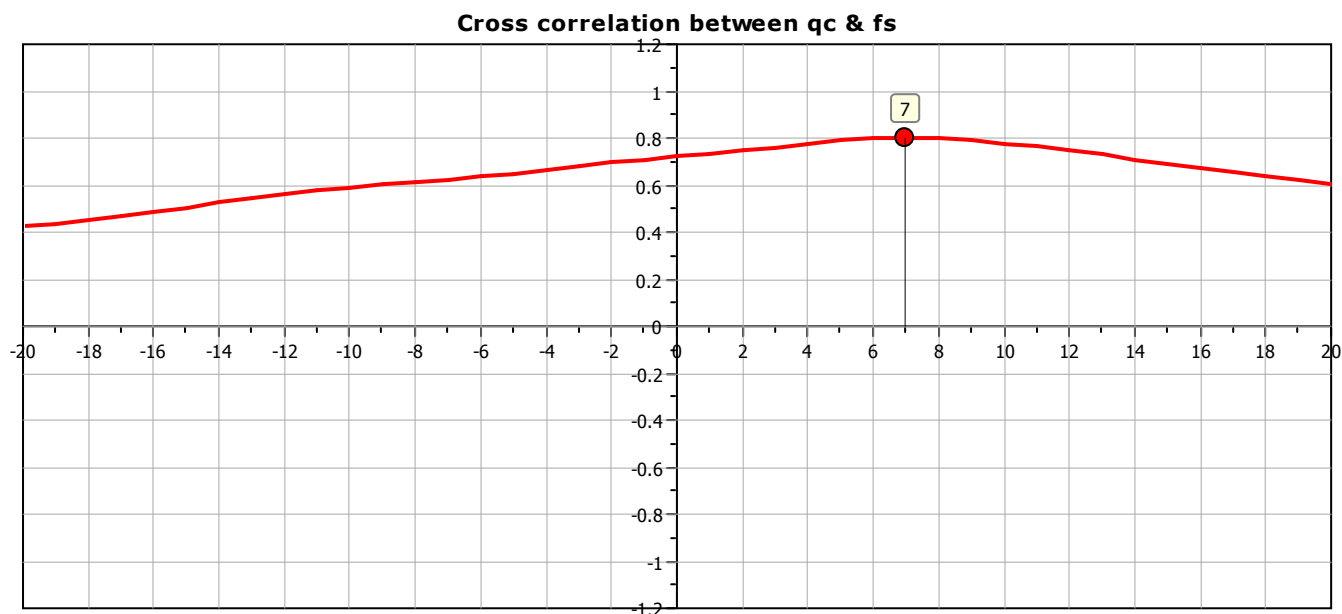
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

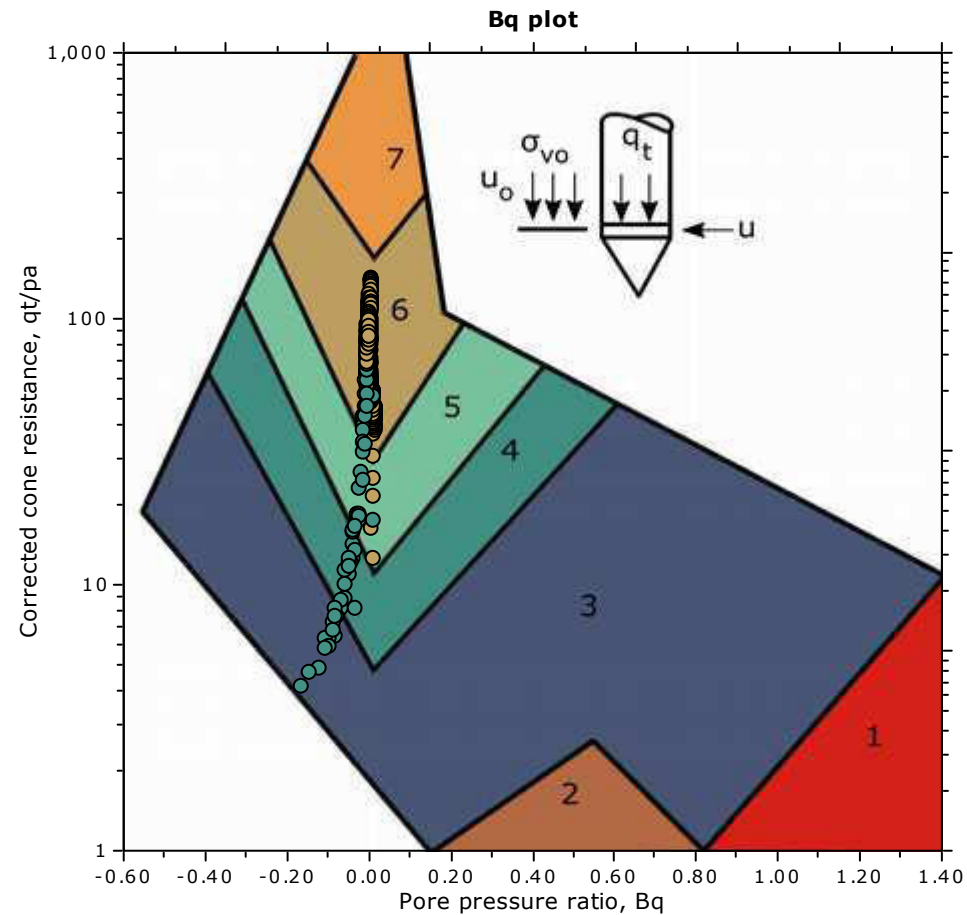
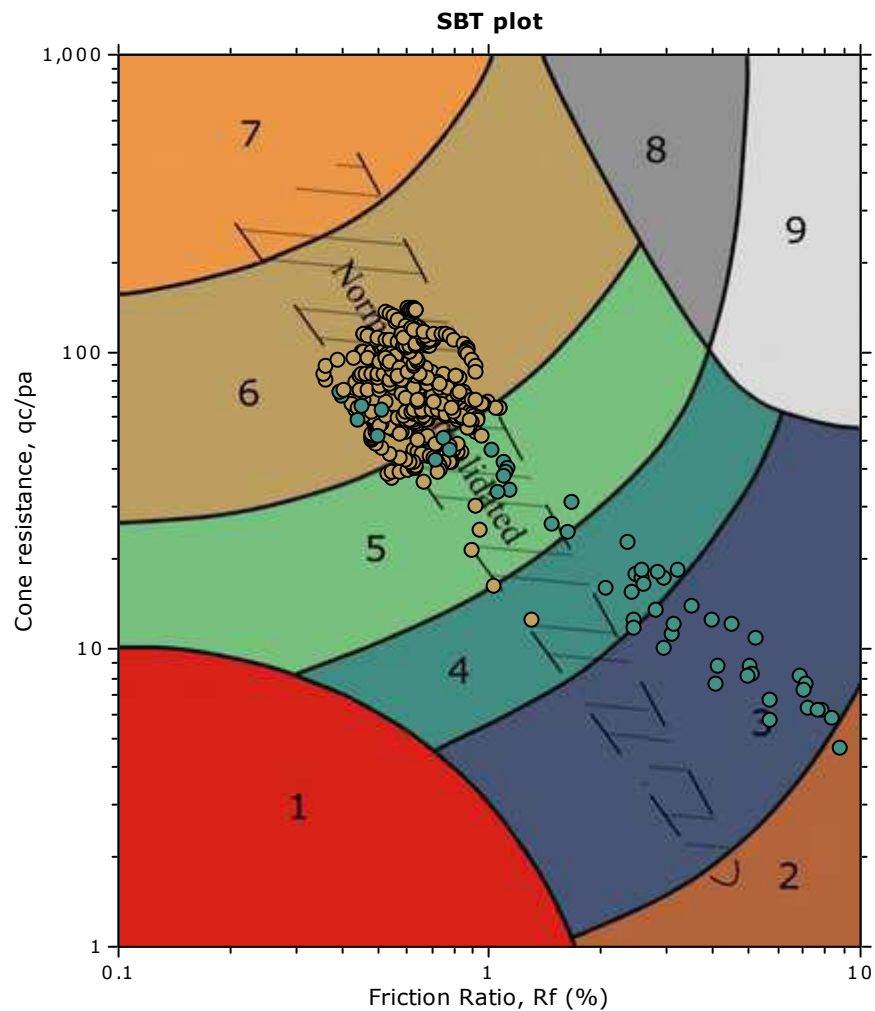




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



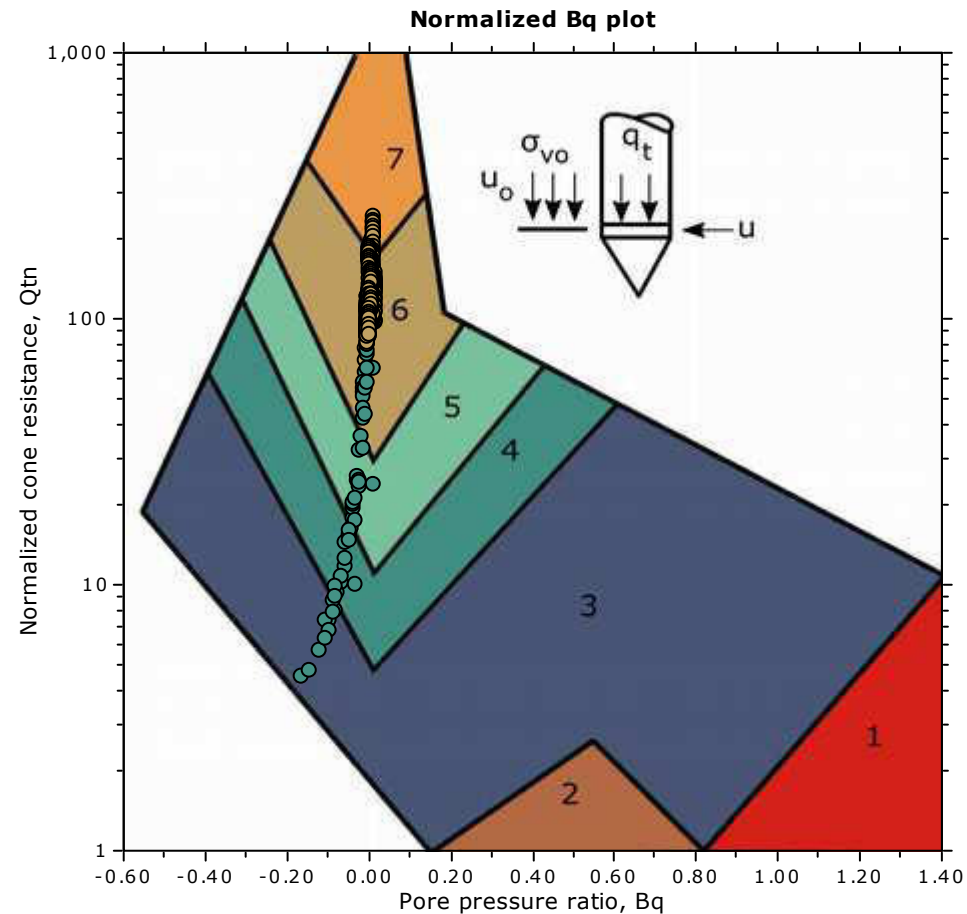
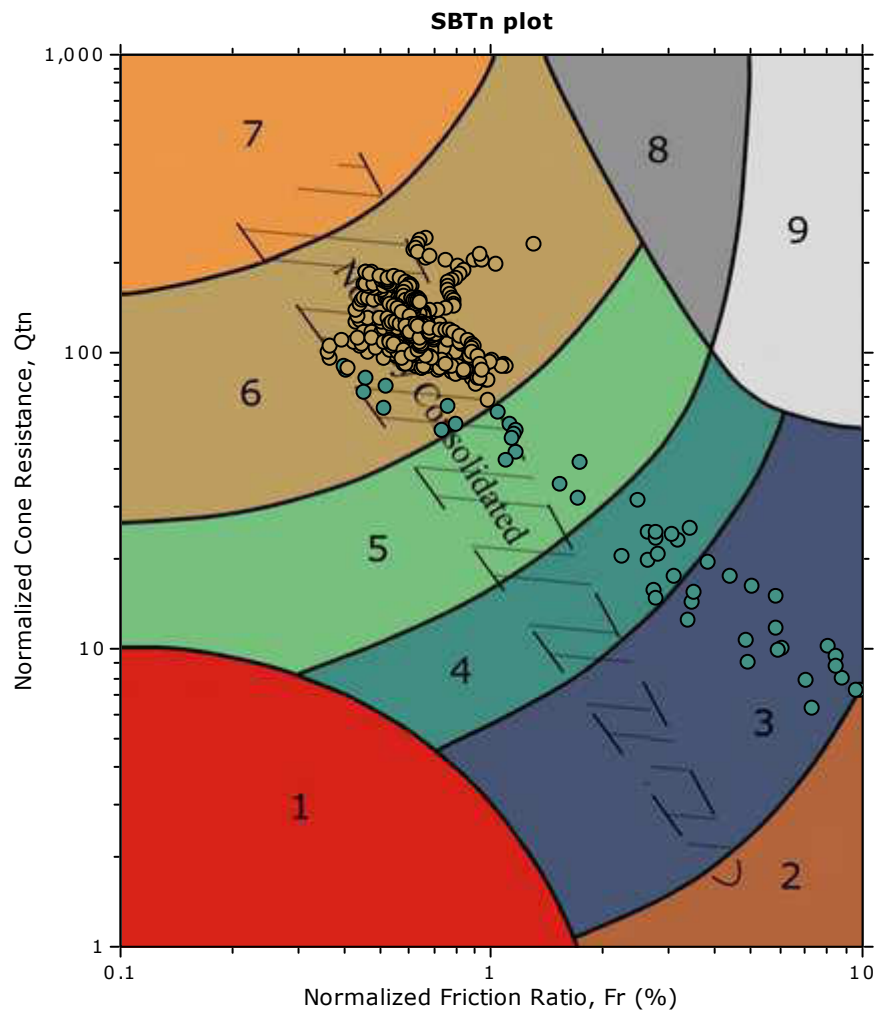
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

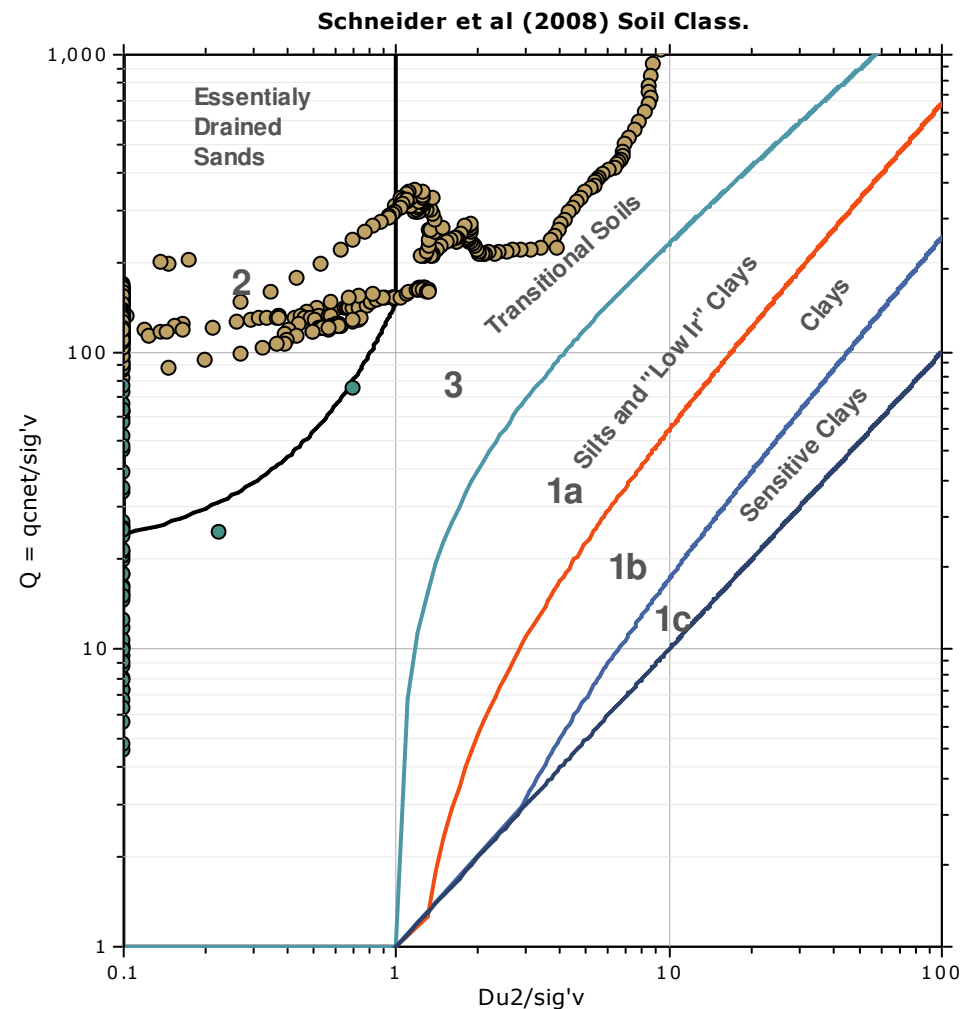
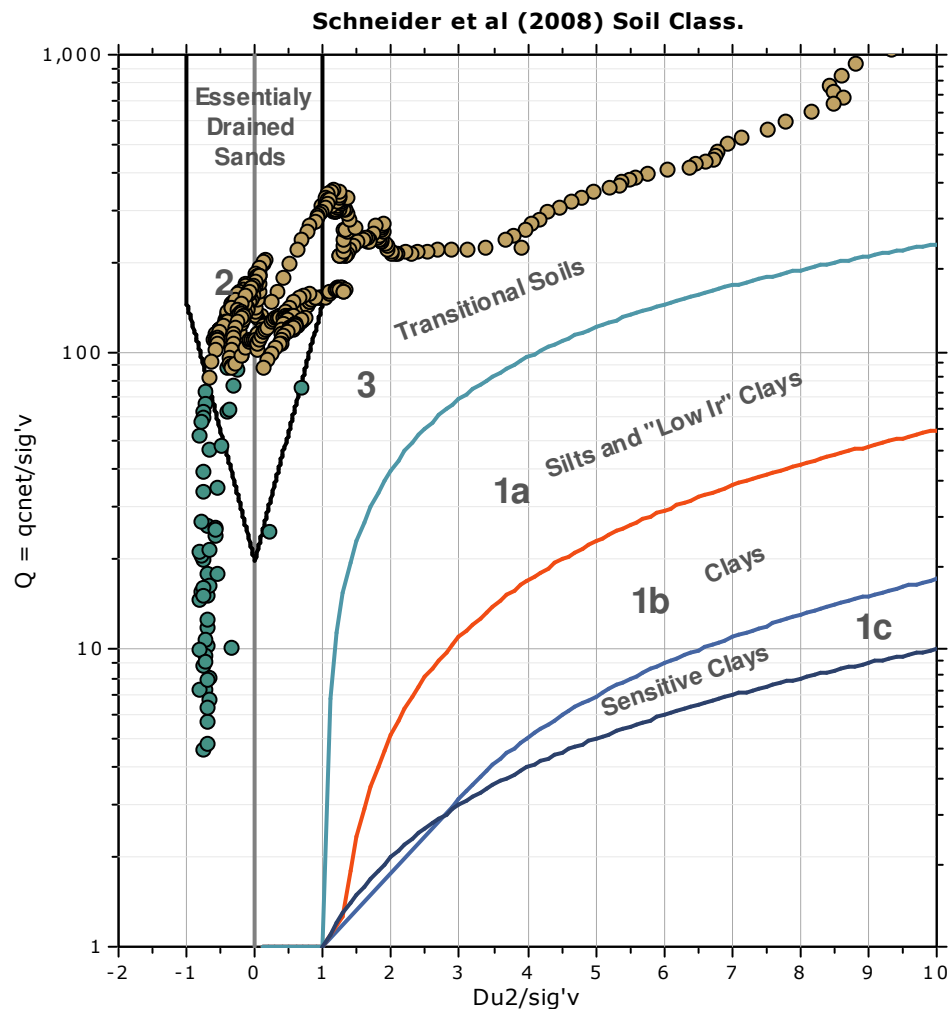
**SBT - Bq plots (normalized)**

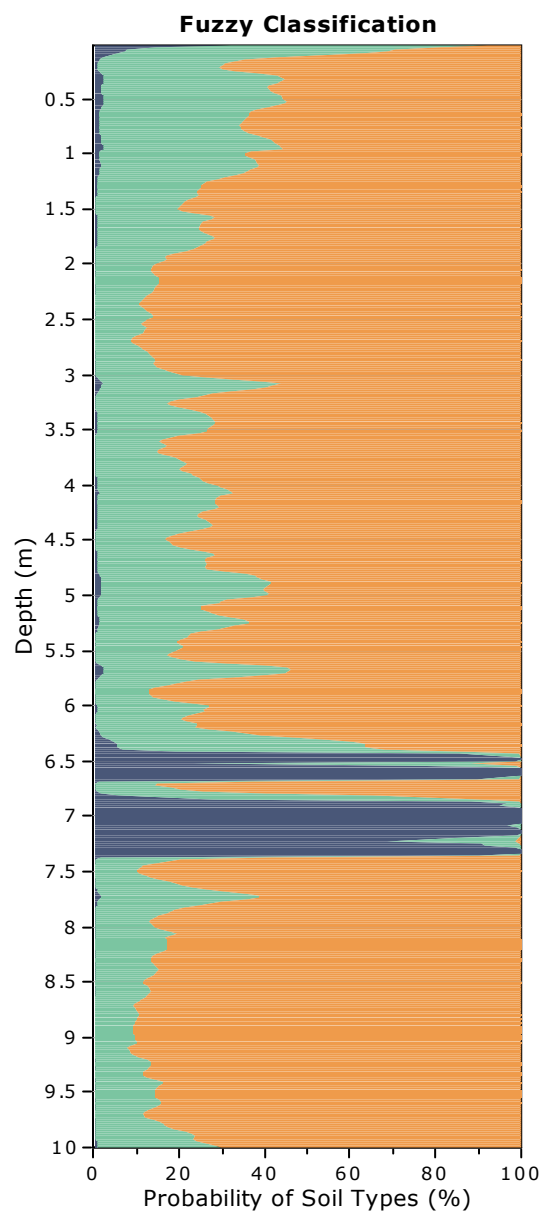
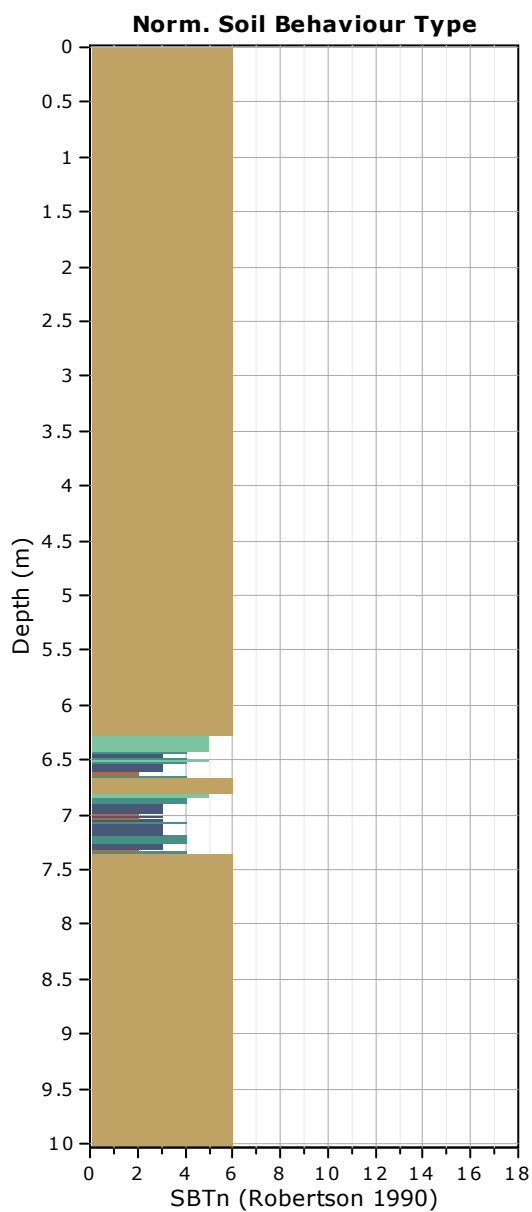


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





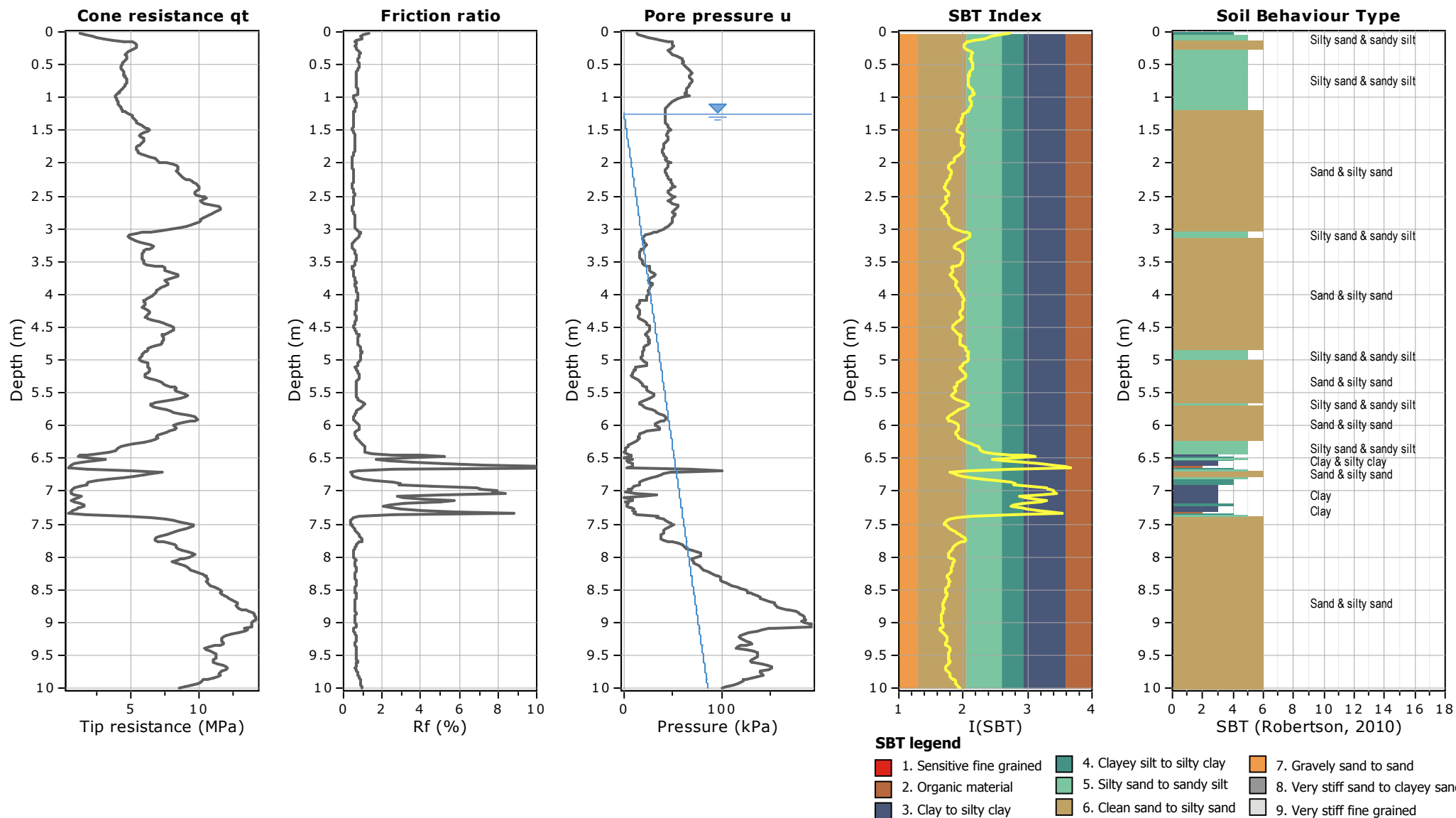
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°





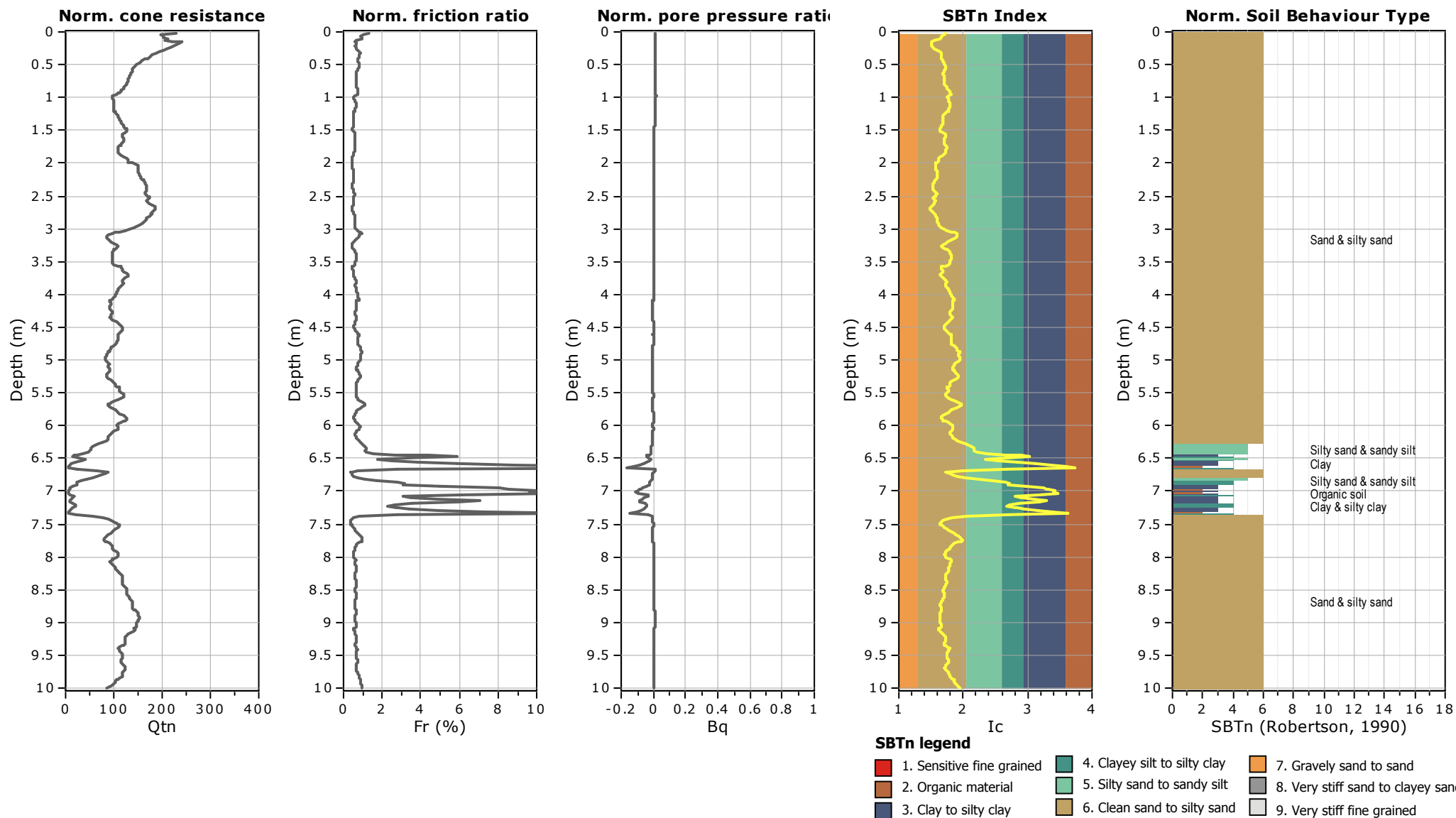
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°



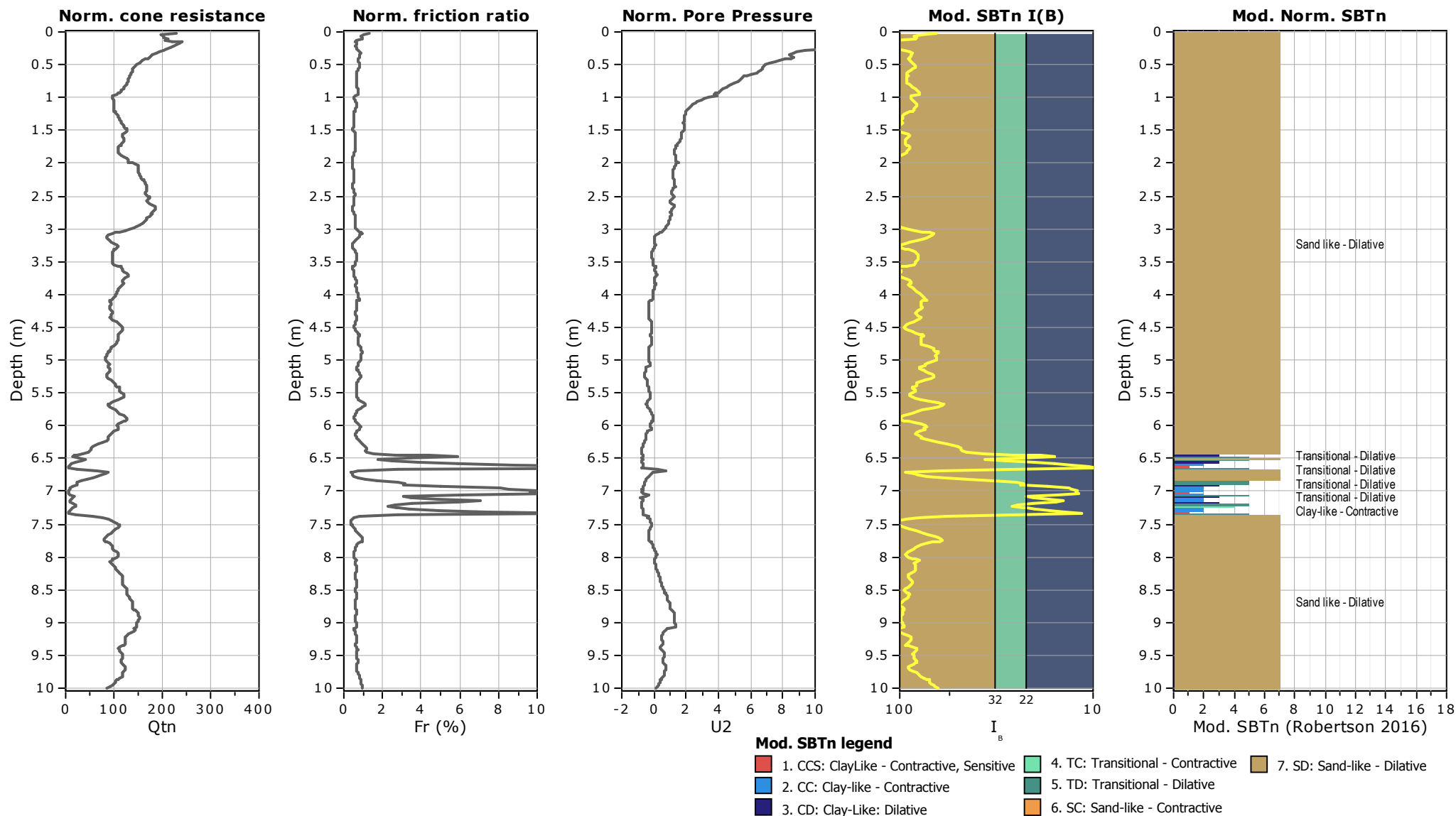
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

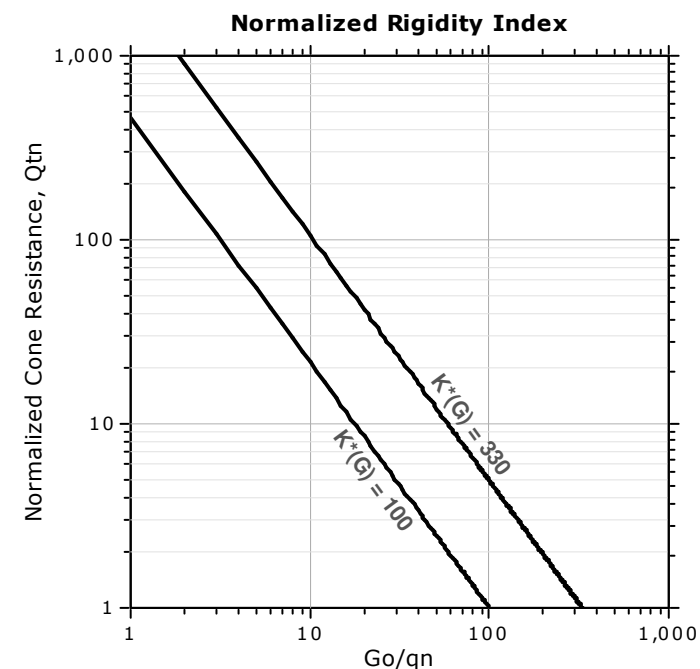
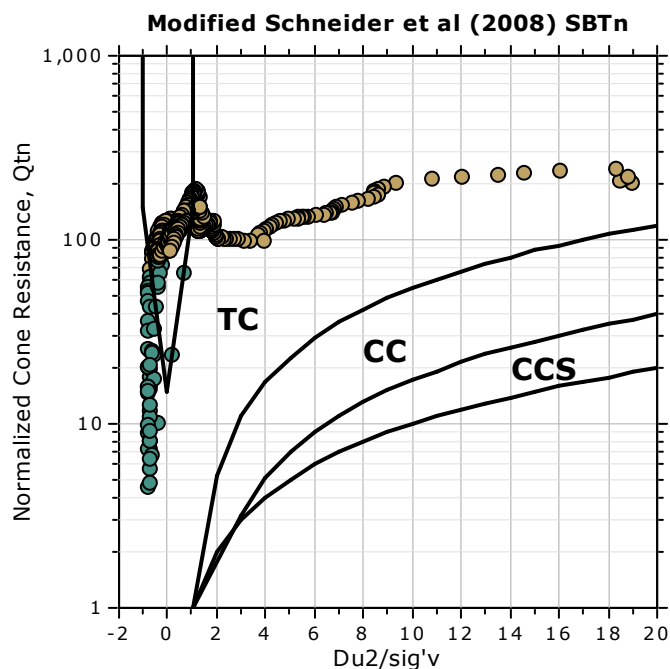
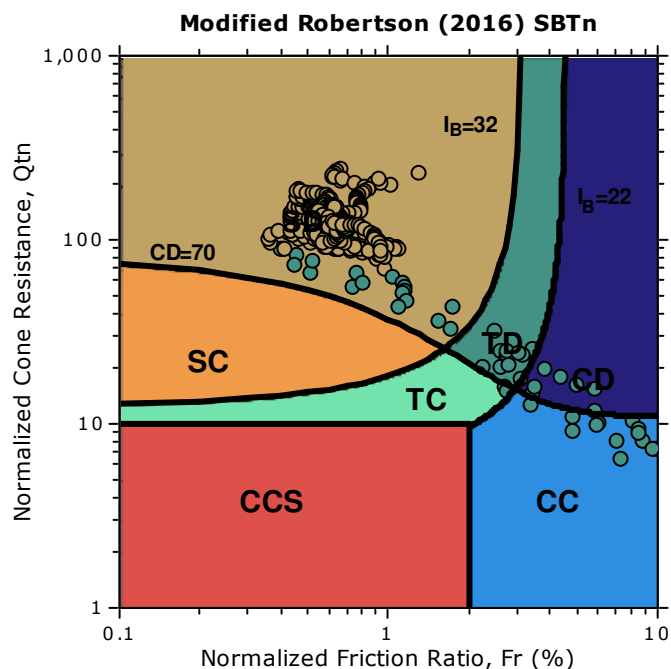
**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

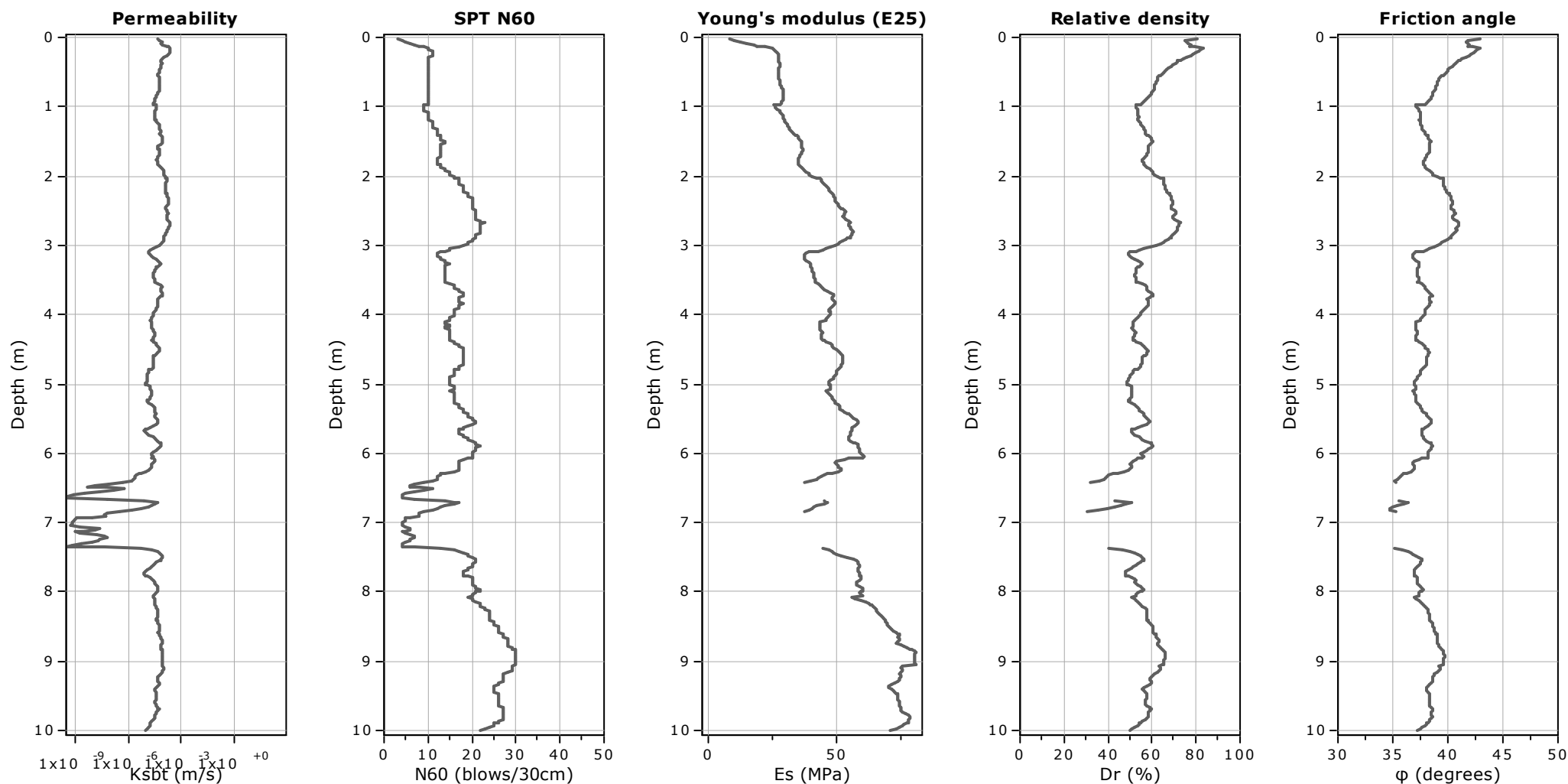
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

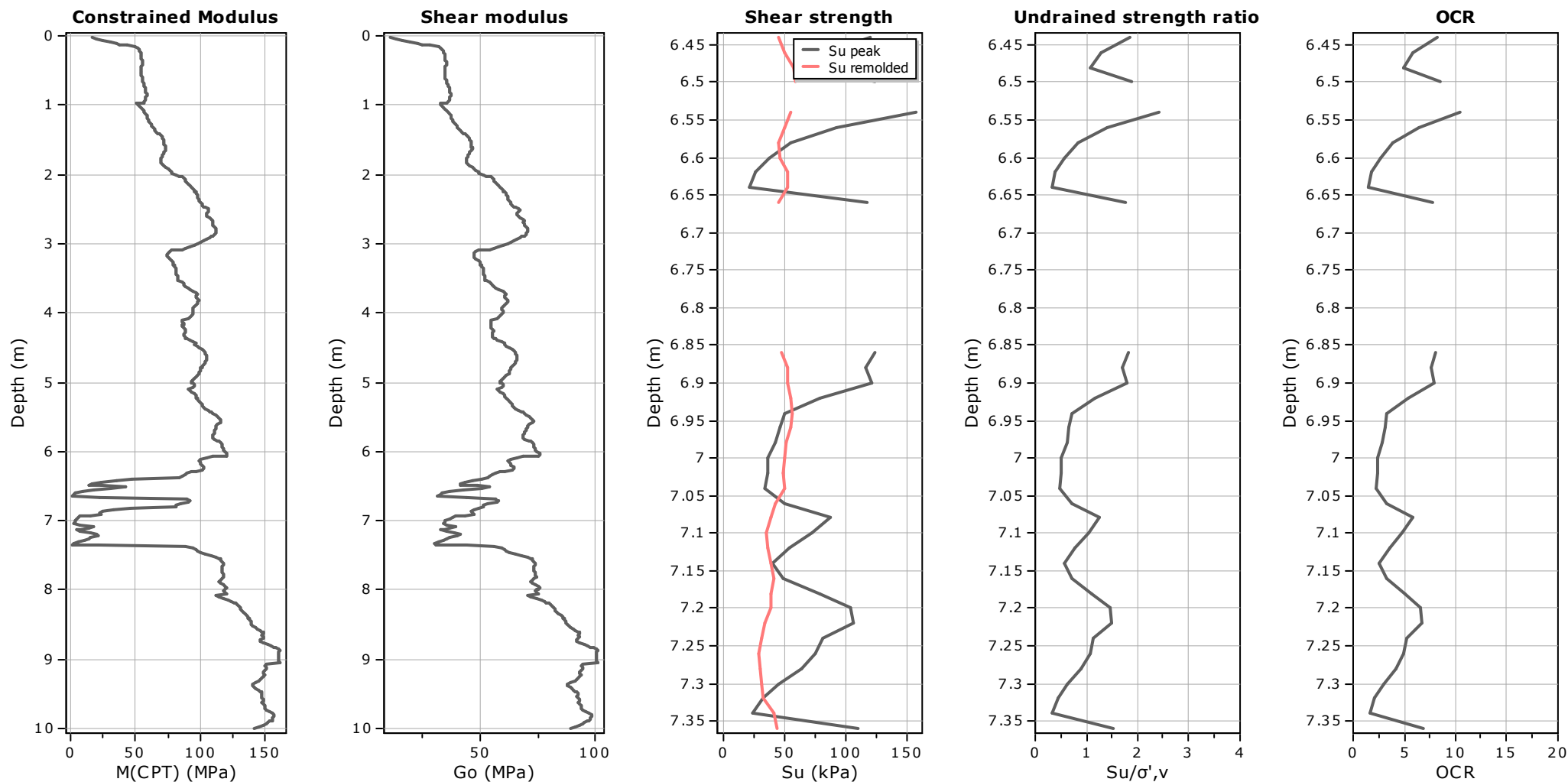
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

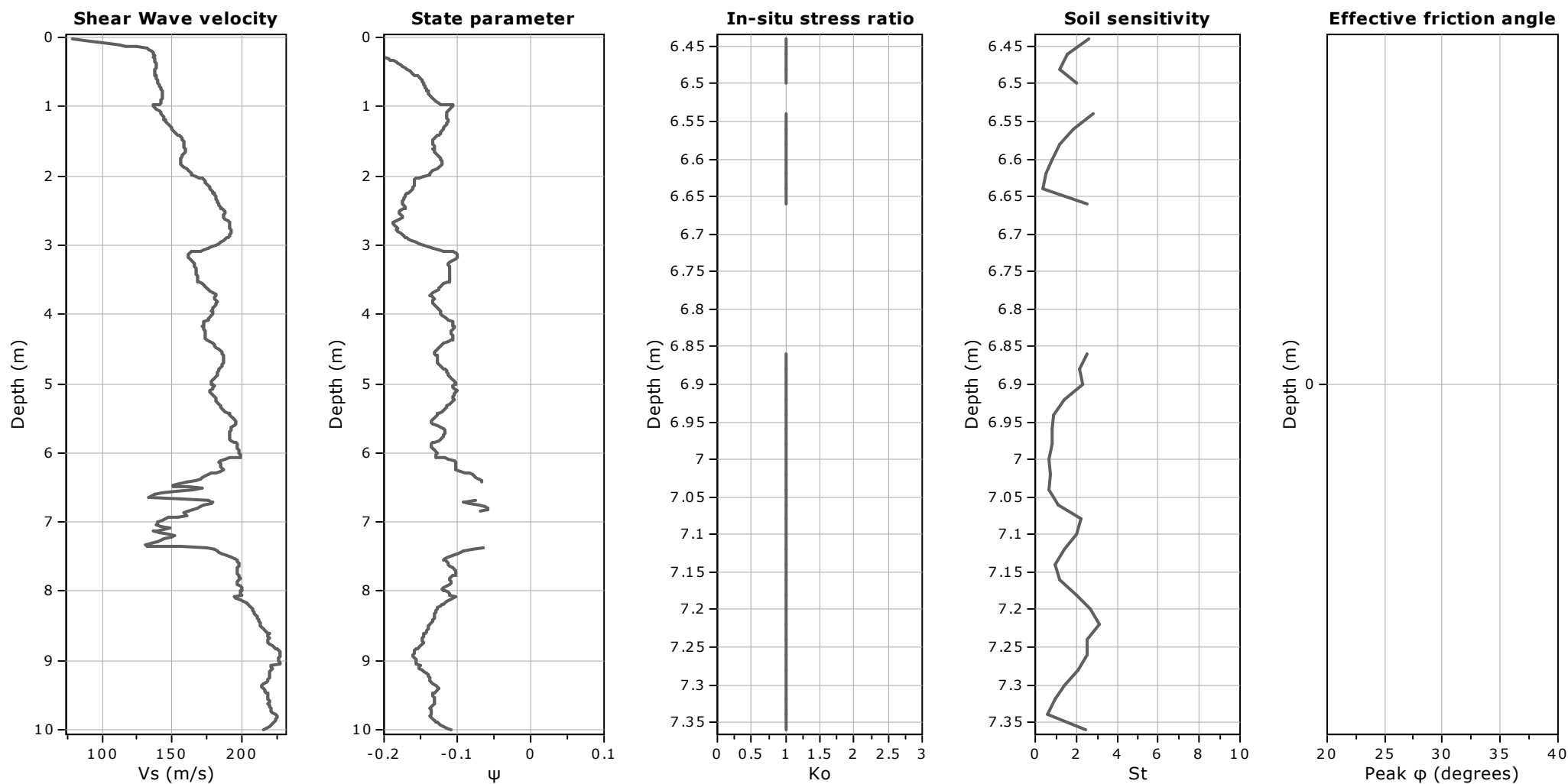
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km43+900**

Total depth: 10.00 m

Coords: lat 44.834212° lon 12.174646°

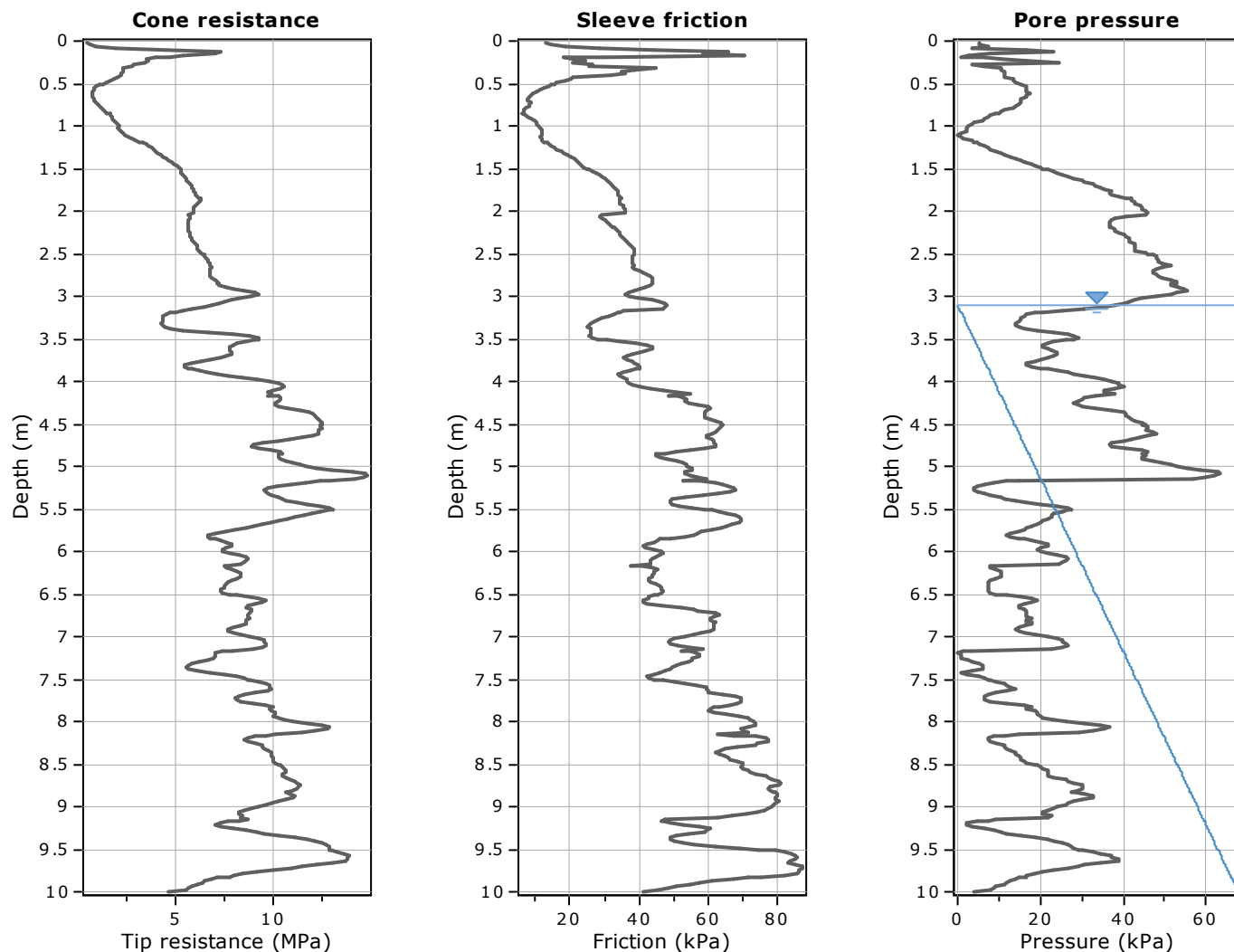


#### Calculation parameters

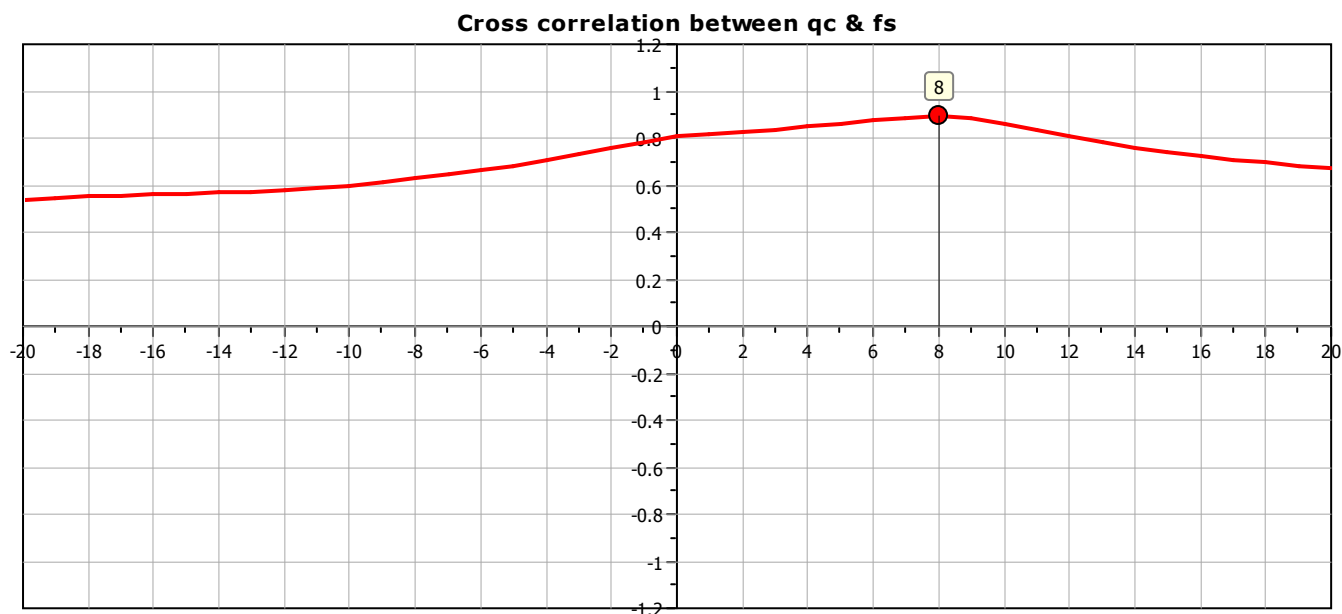
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

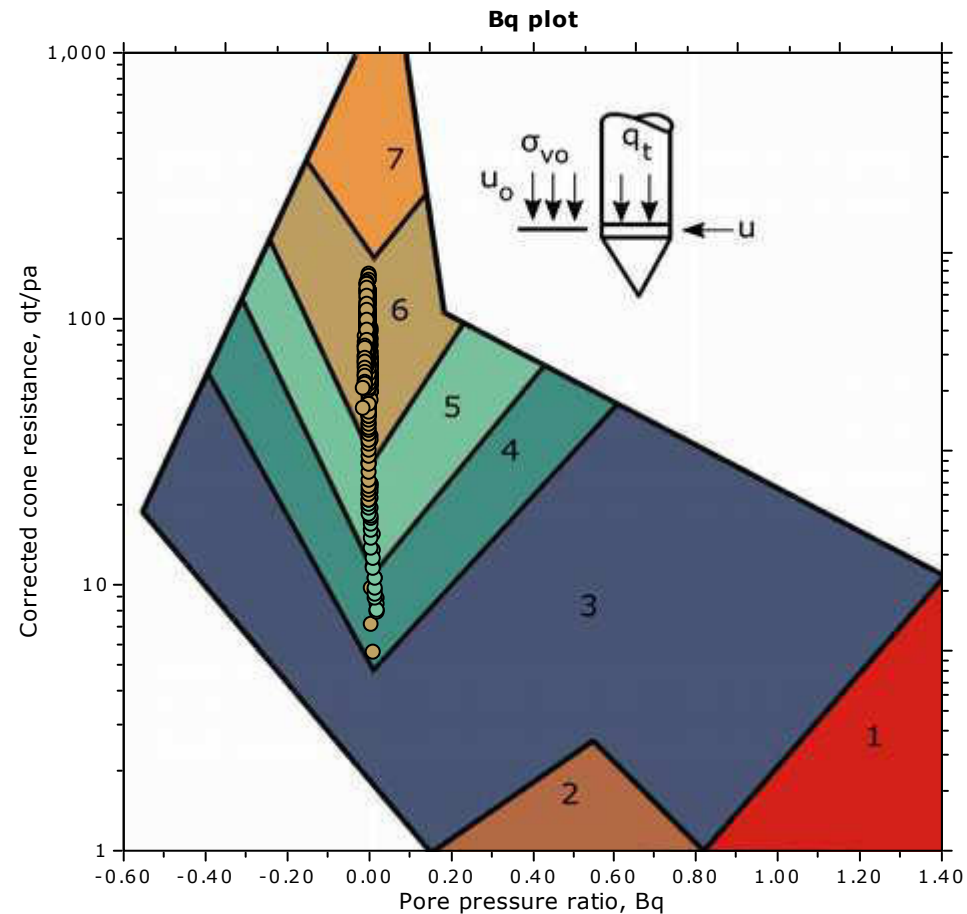
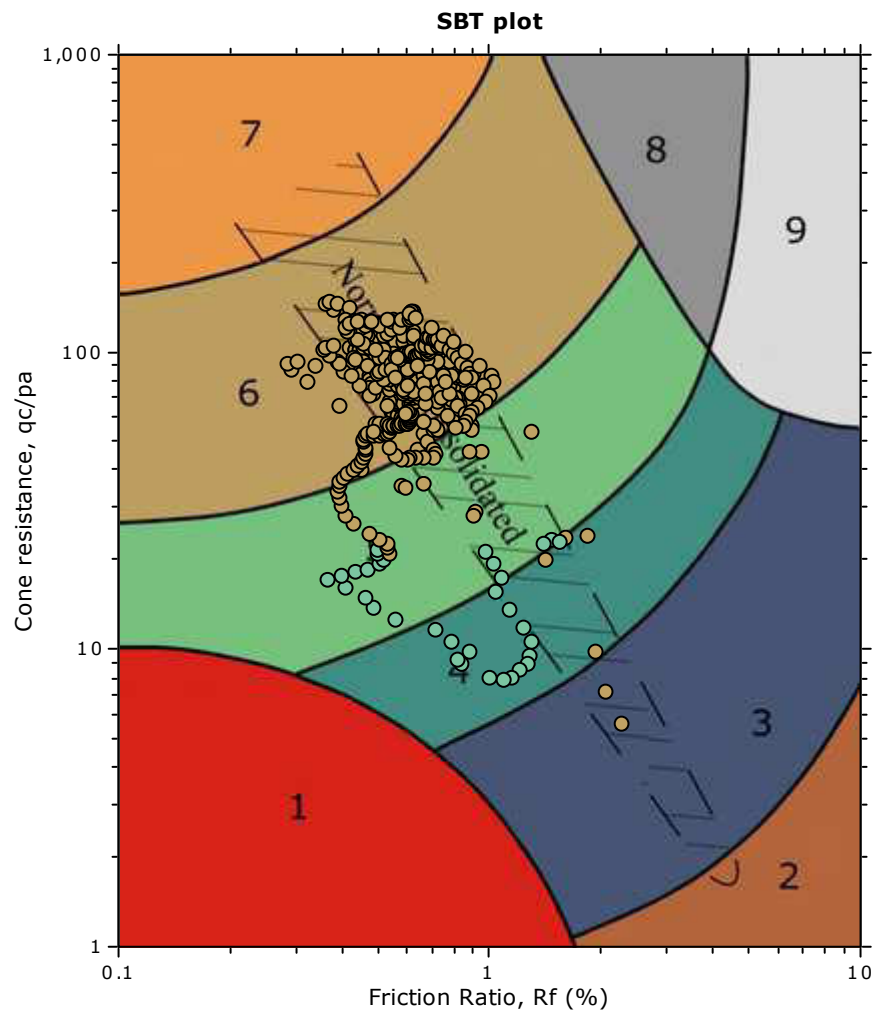




The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



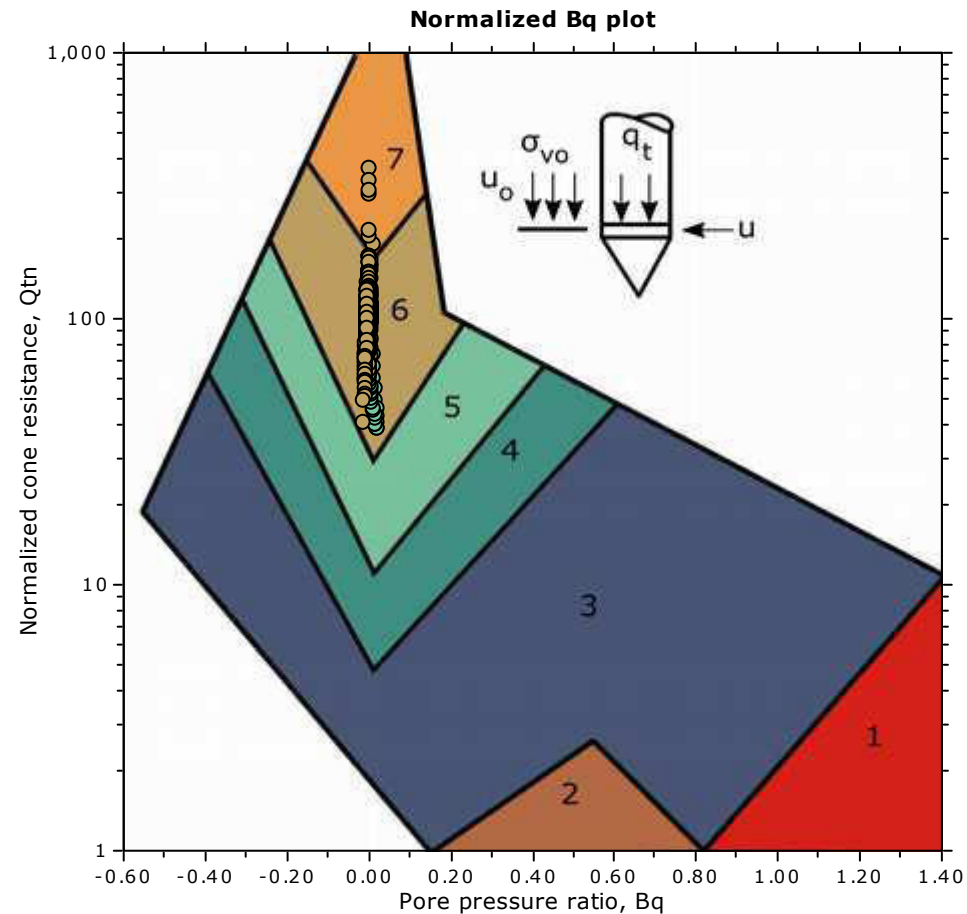
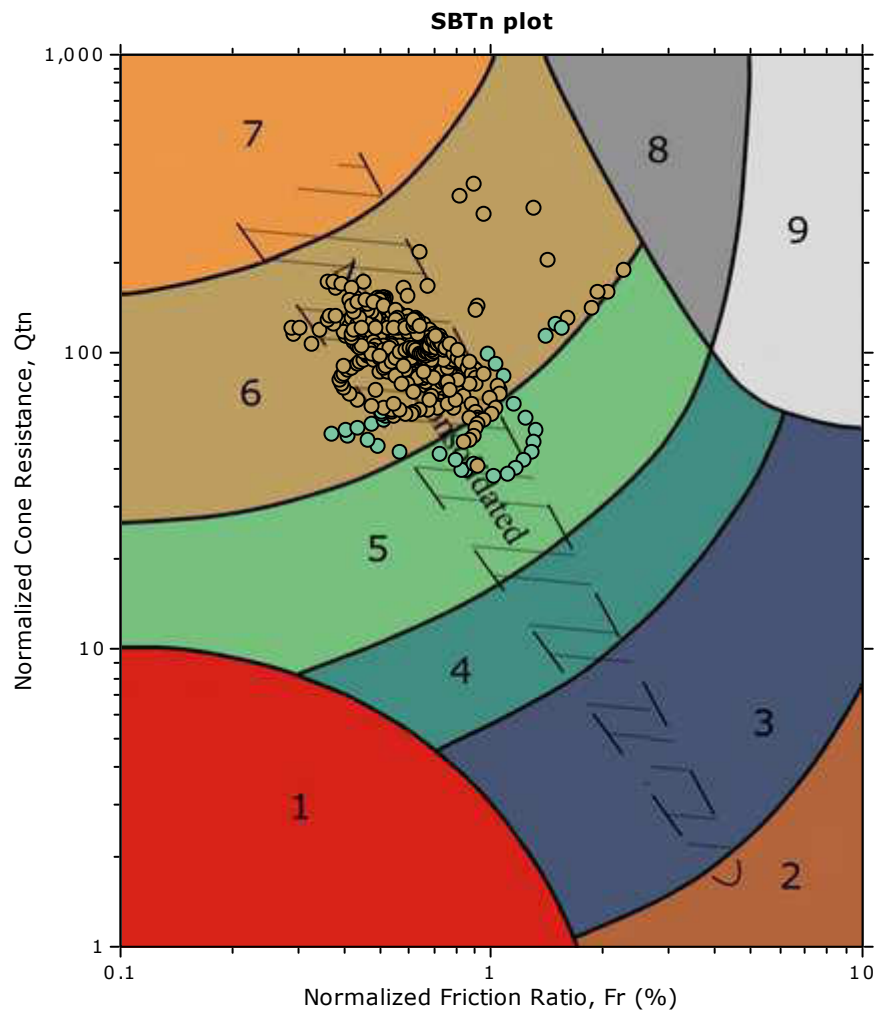
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

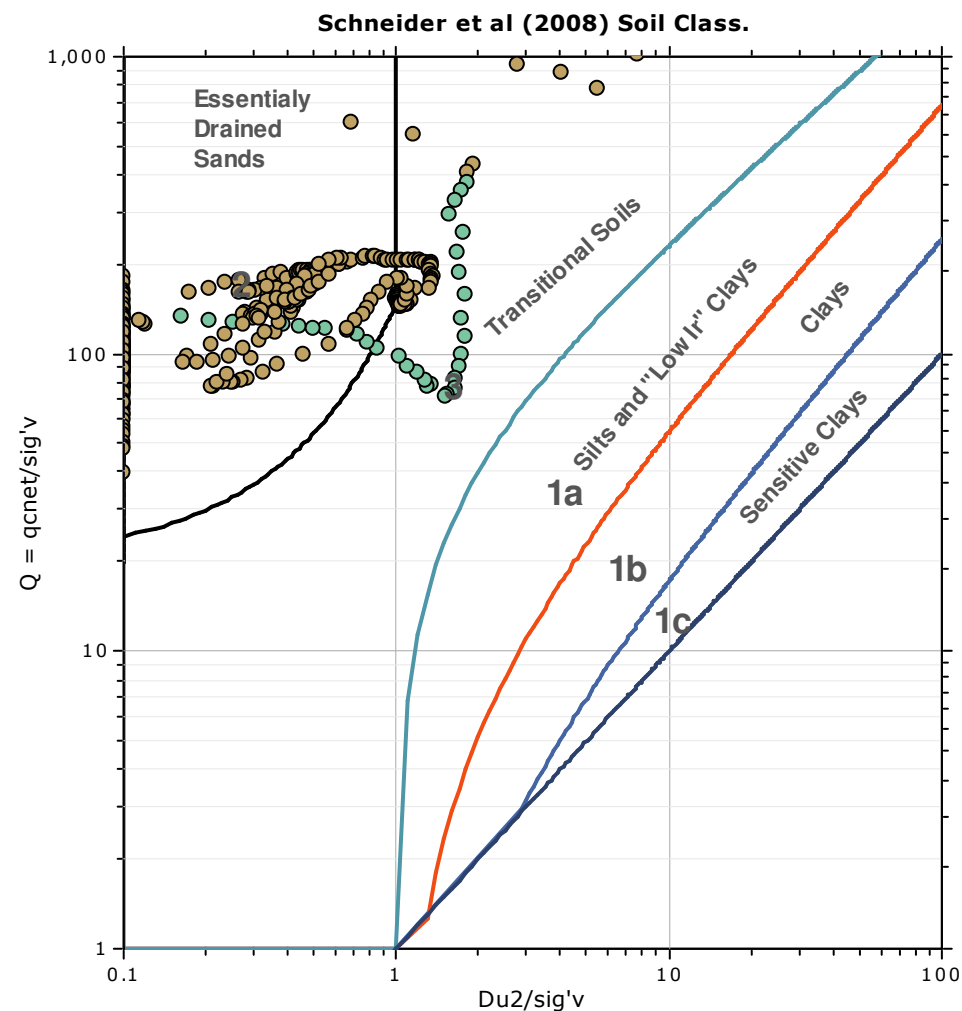
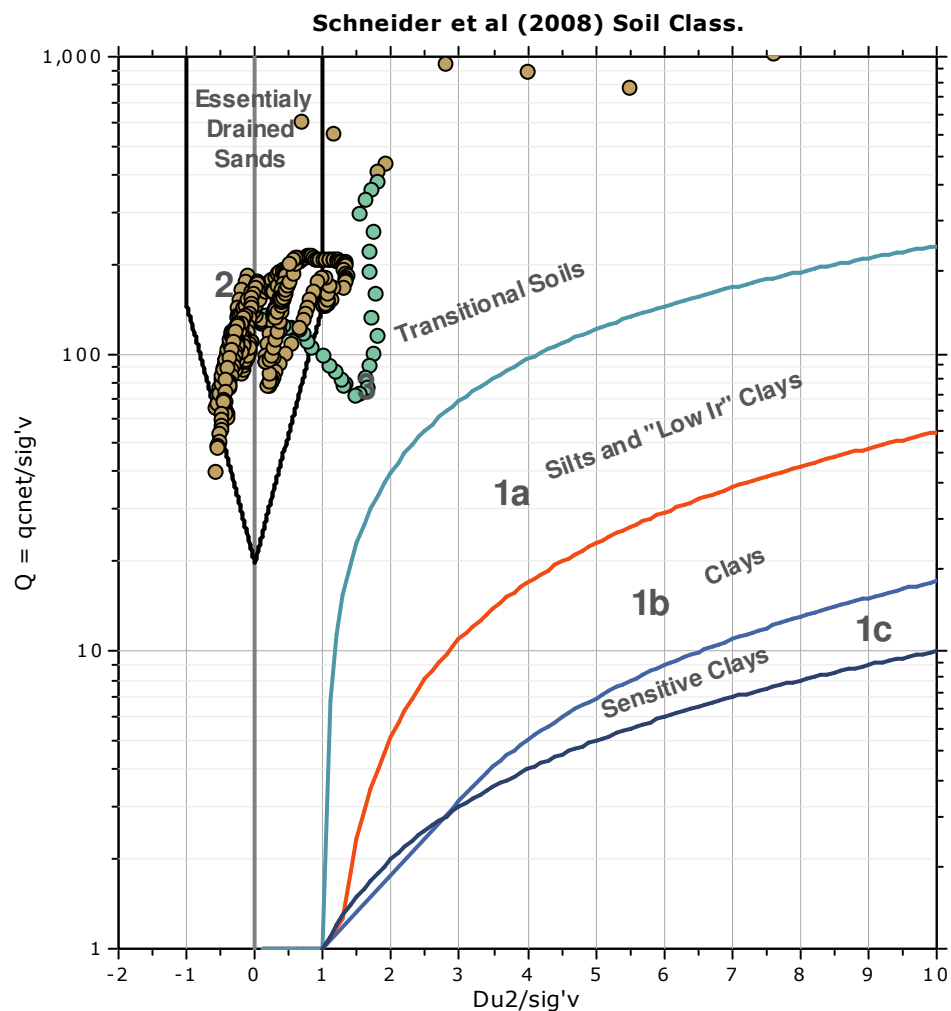
**SBT - Bq plots (normalized)**

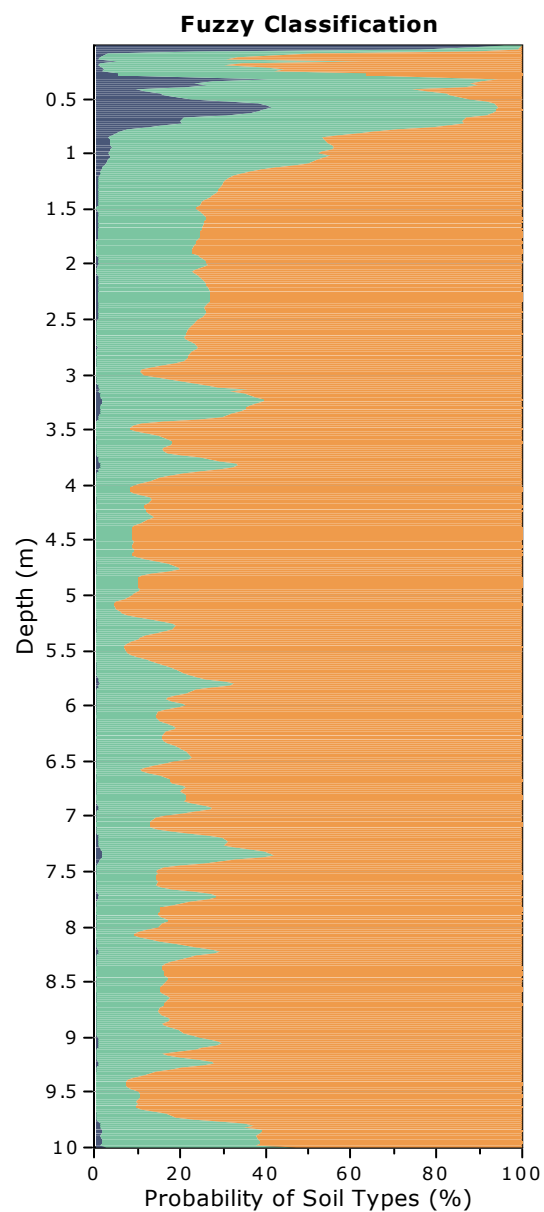
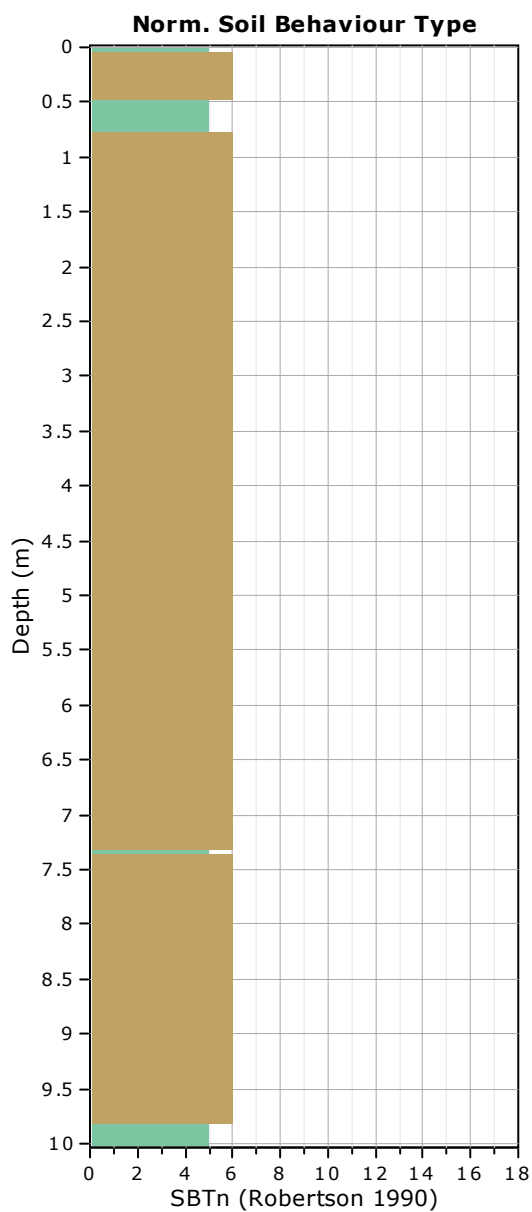


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





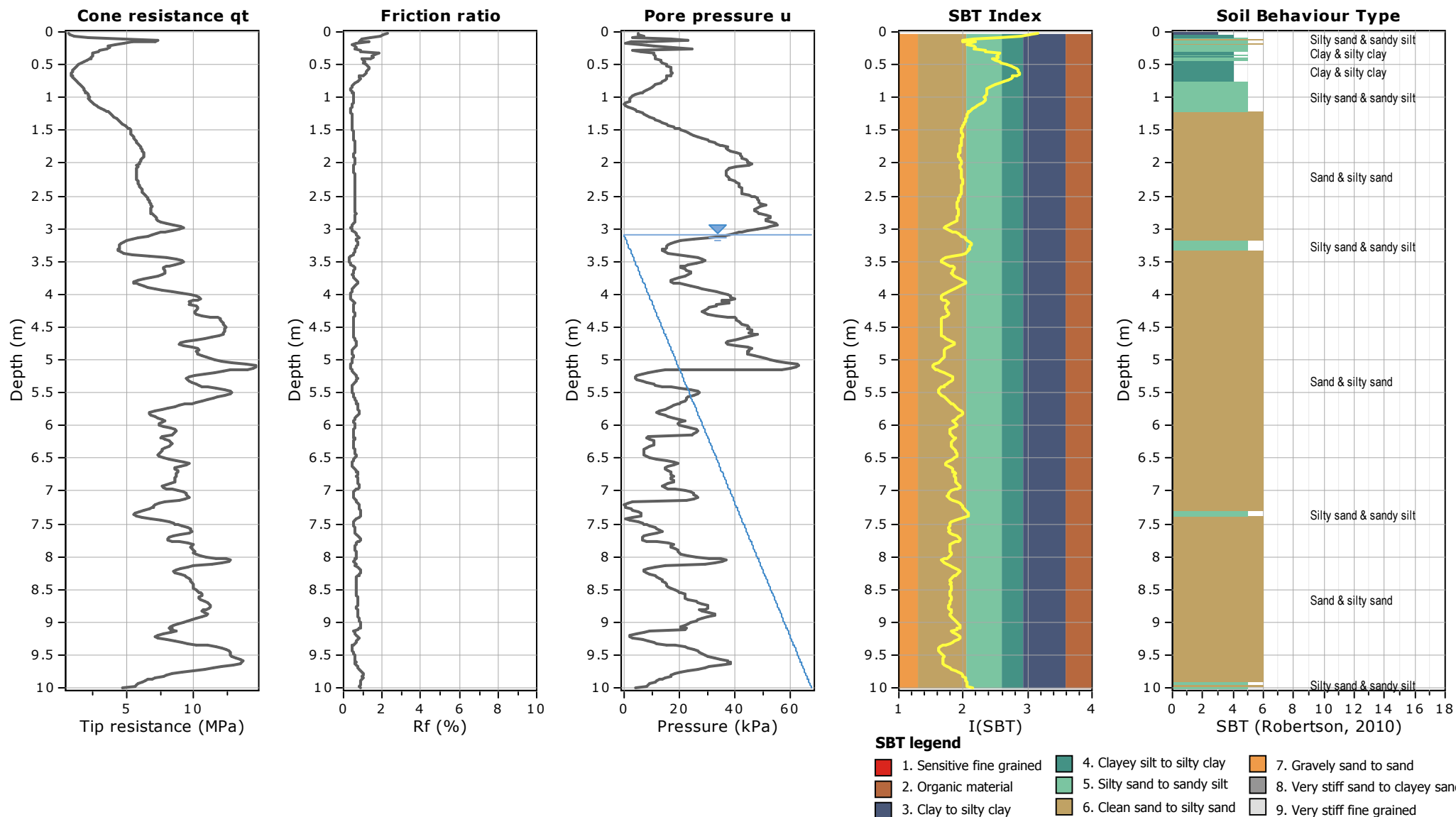
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°





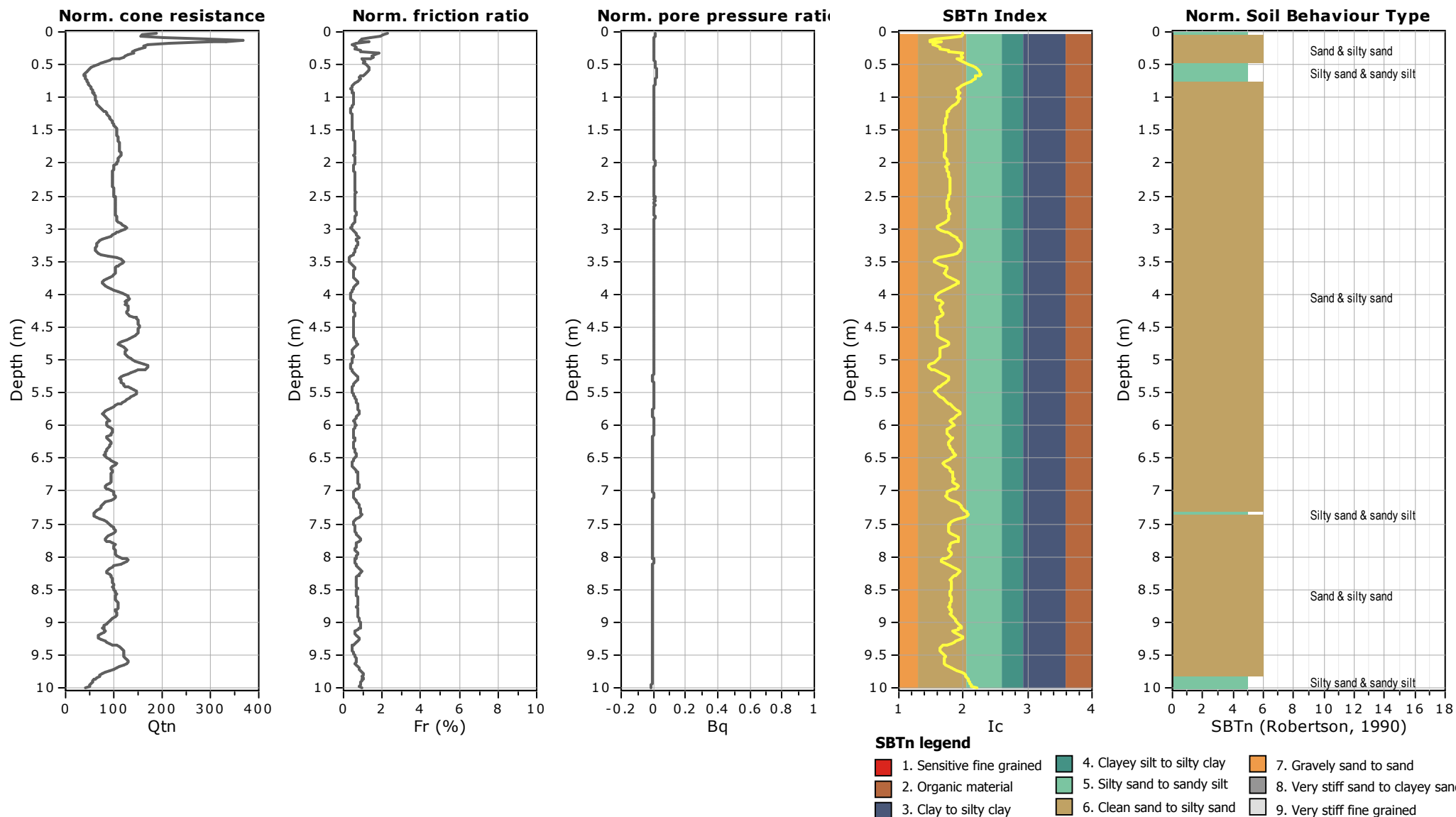
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°



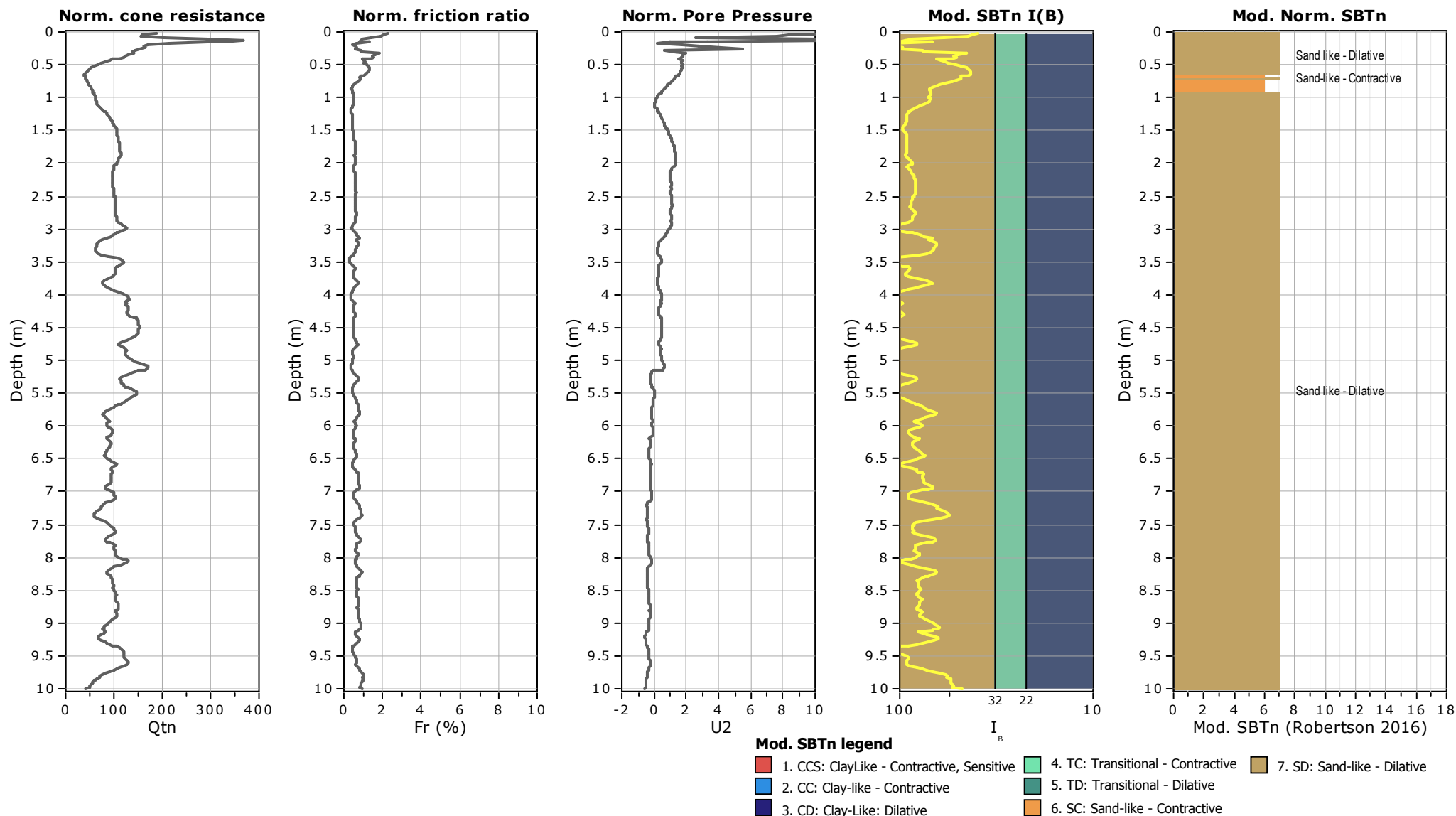
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

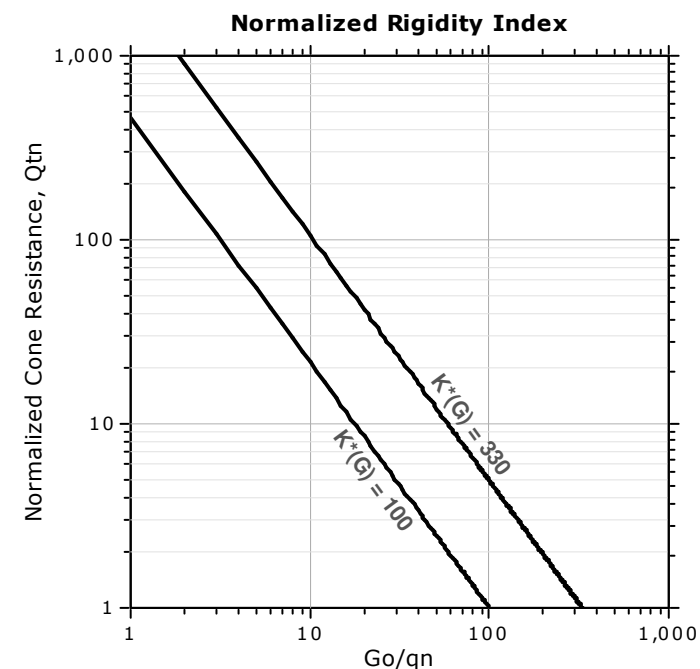
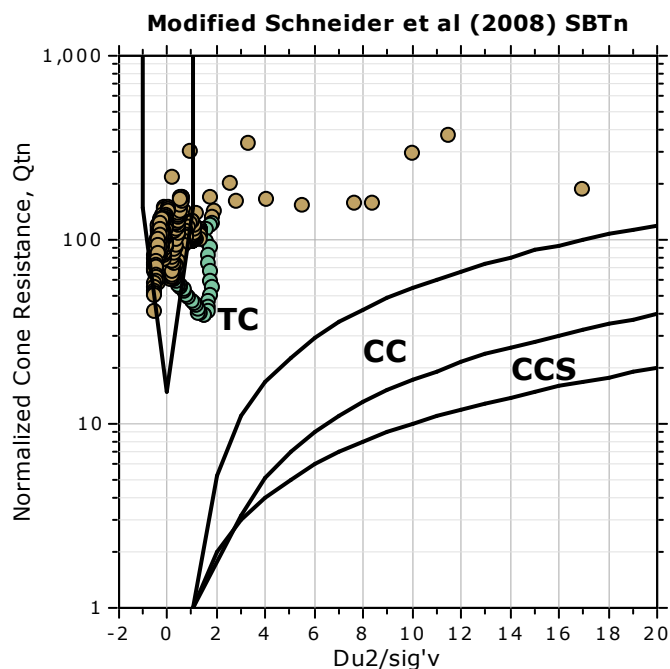
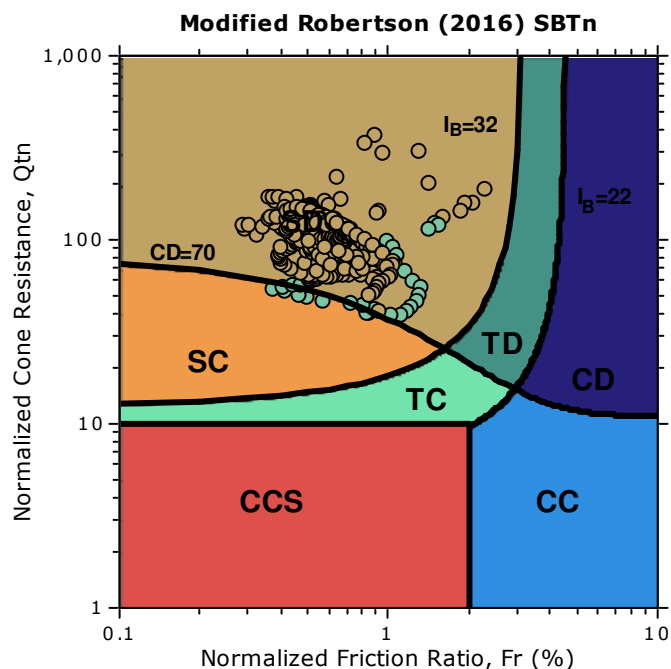
**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

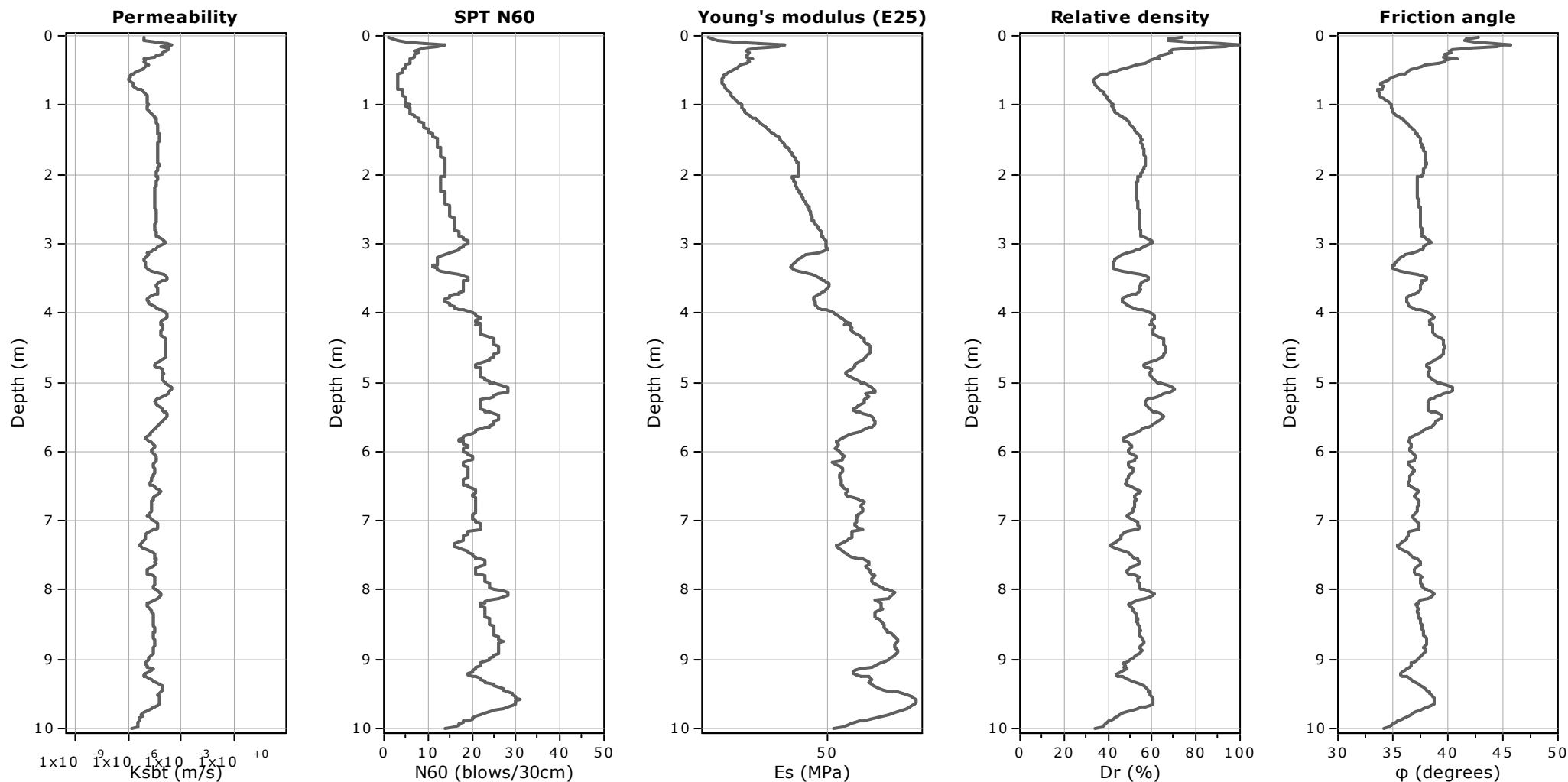
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°



**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 Kulhavy & Mayne (1990)

● User defined estimation data

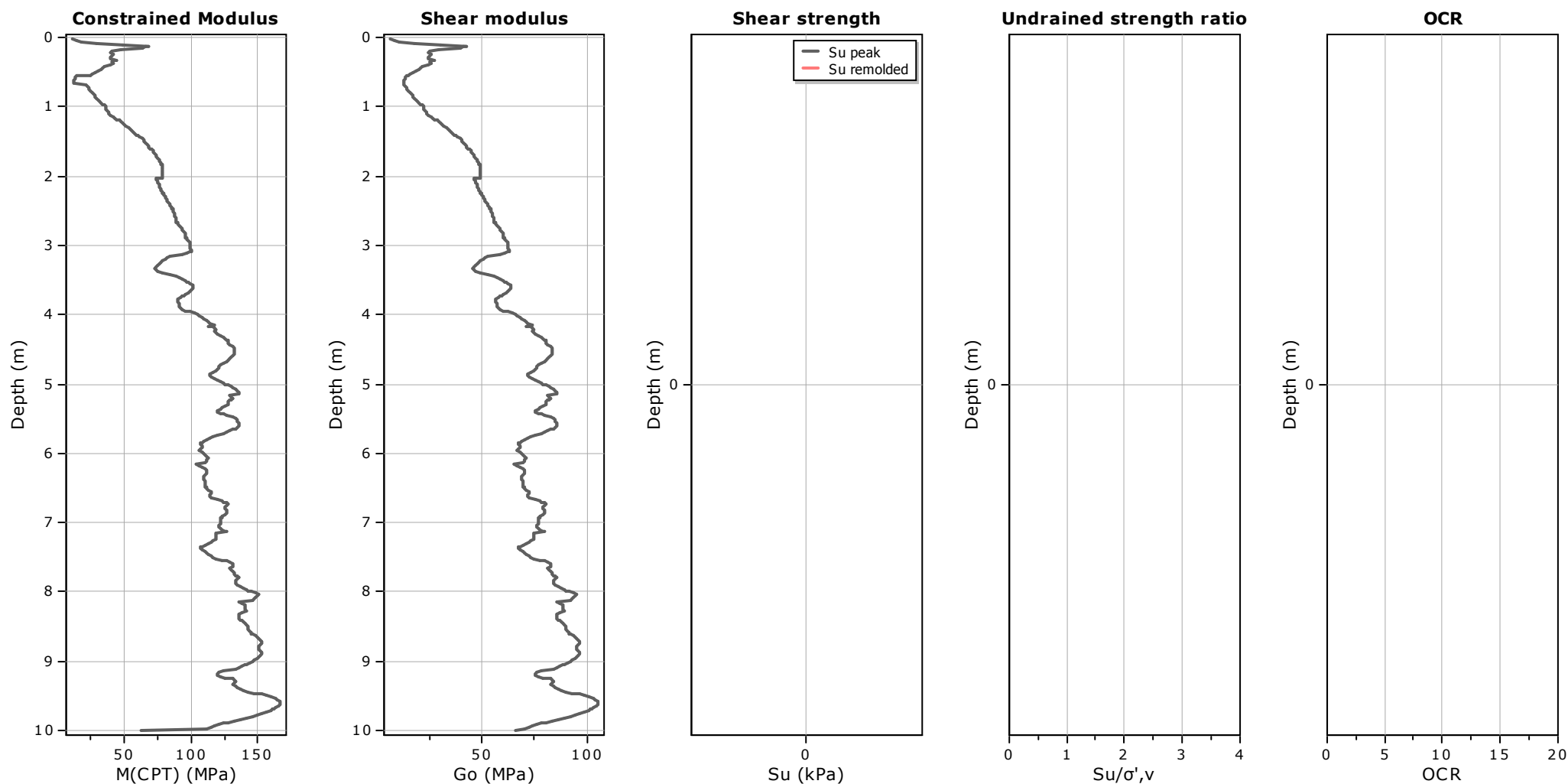
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

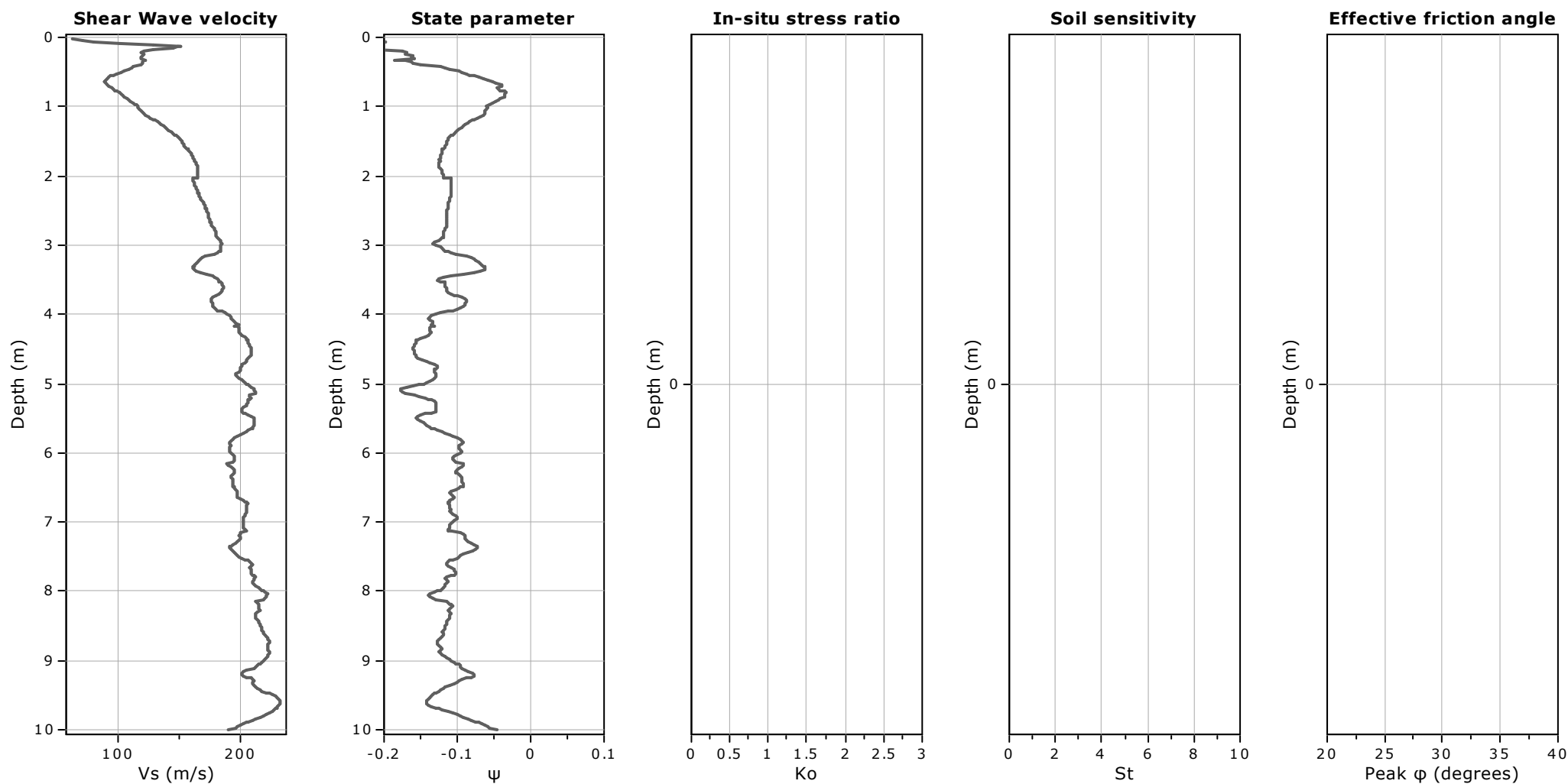
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km44+300**

Total depth: 10.00 m

Coords: lat 44.837674° lon 12.17542°

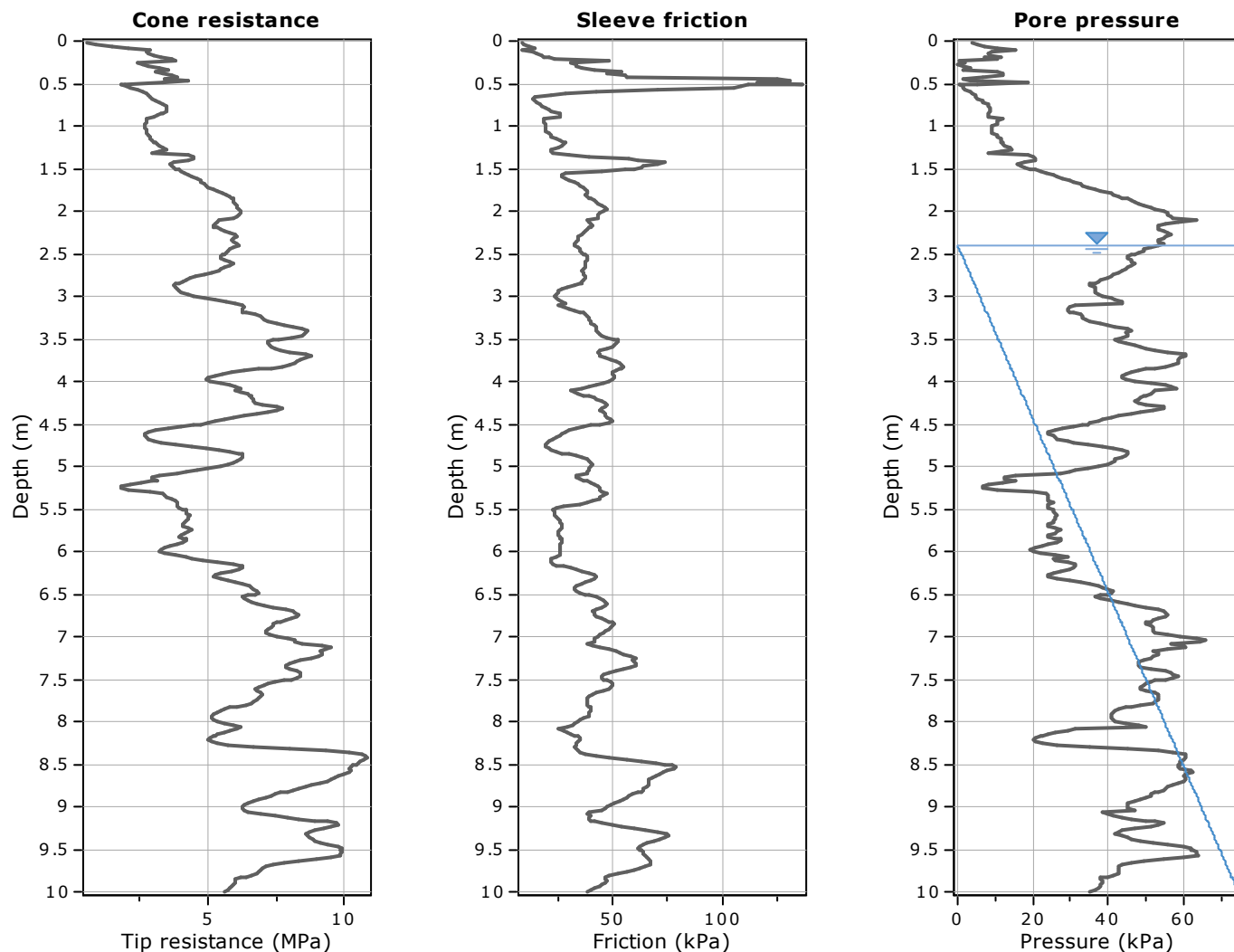


#### Calculation parameters

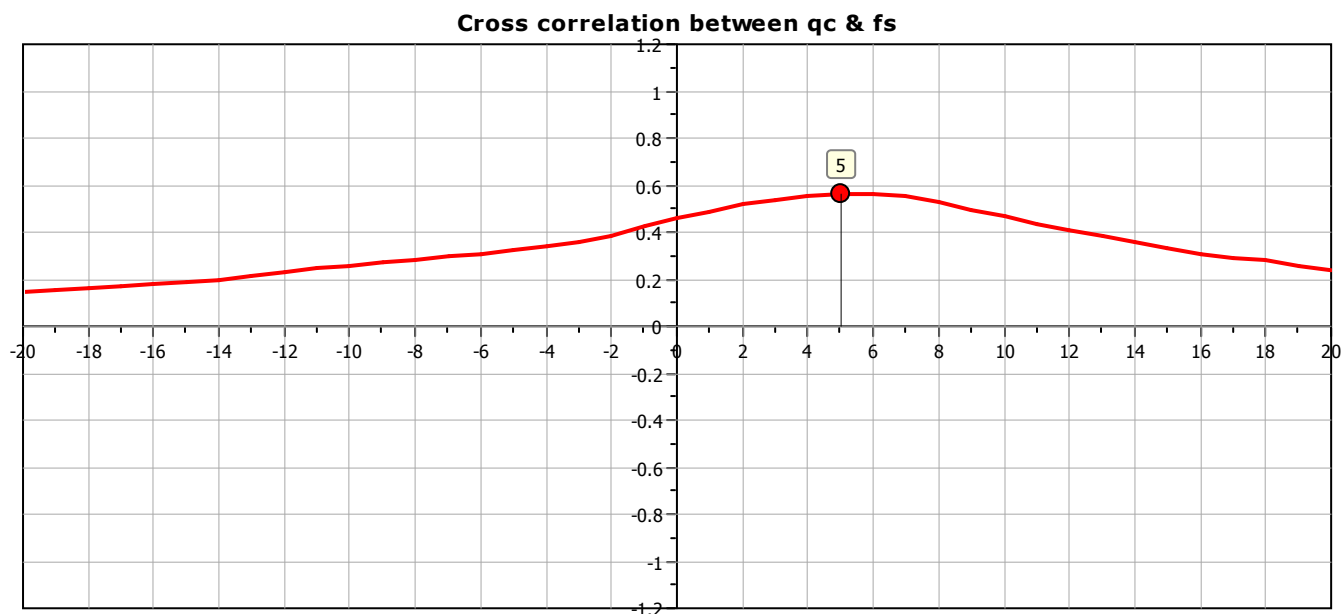
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

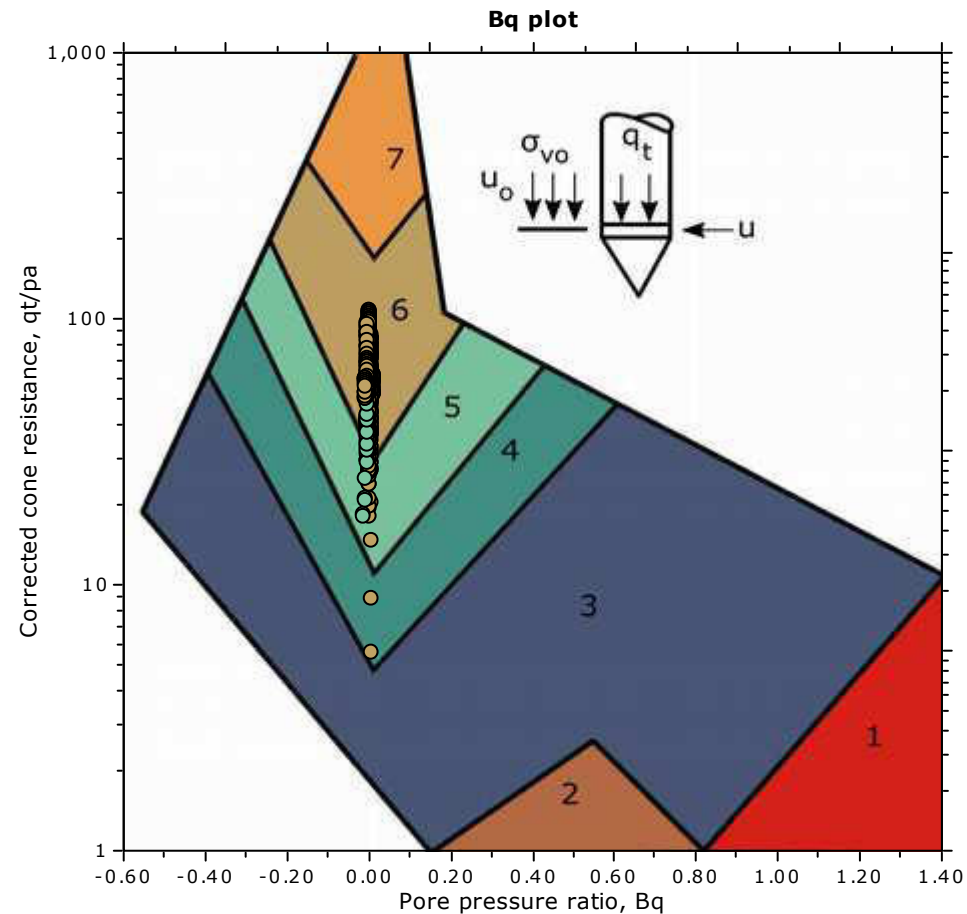
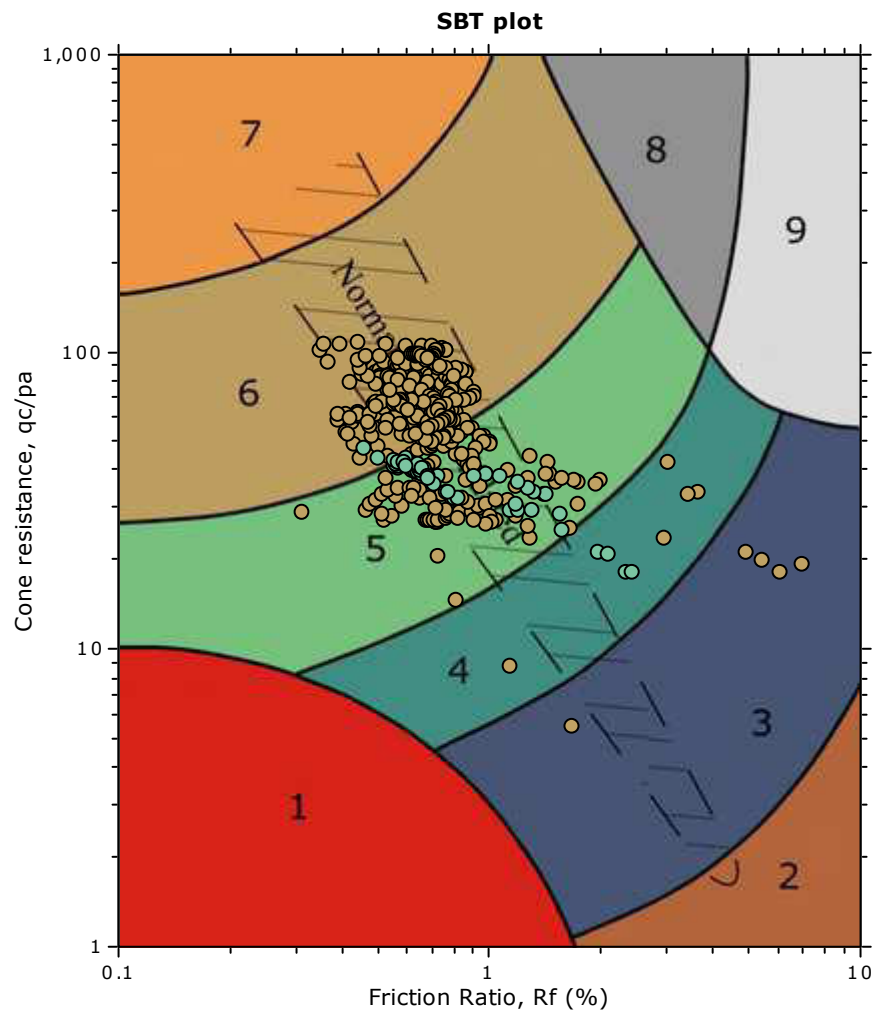




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



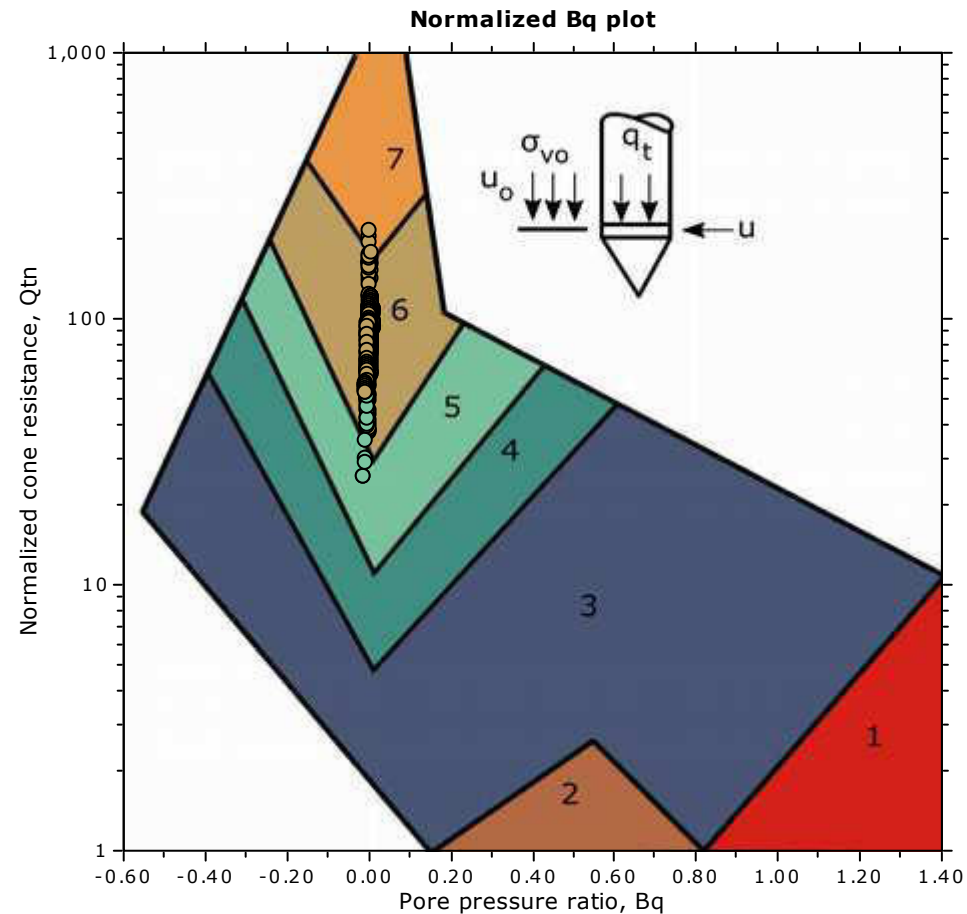
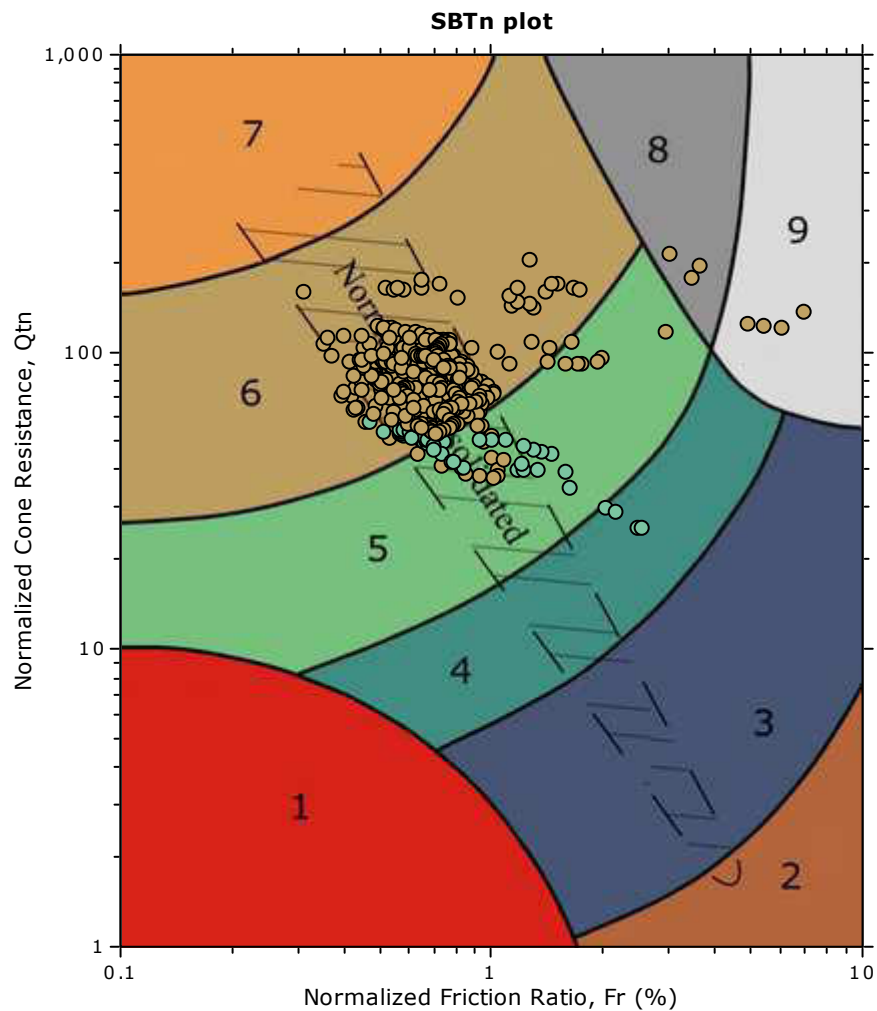
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

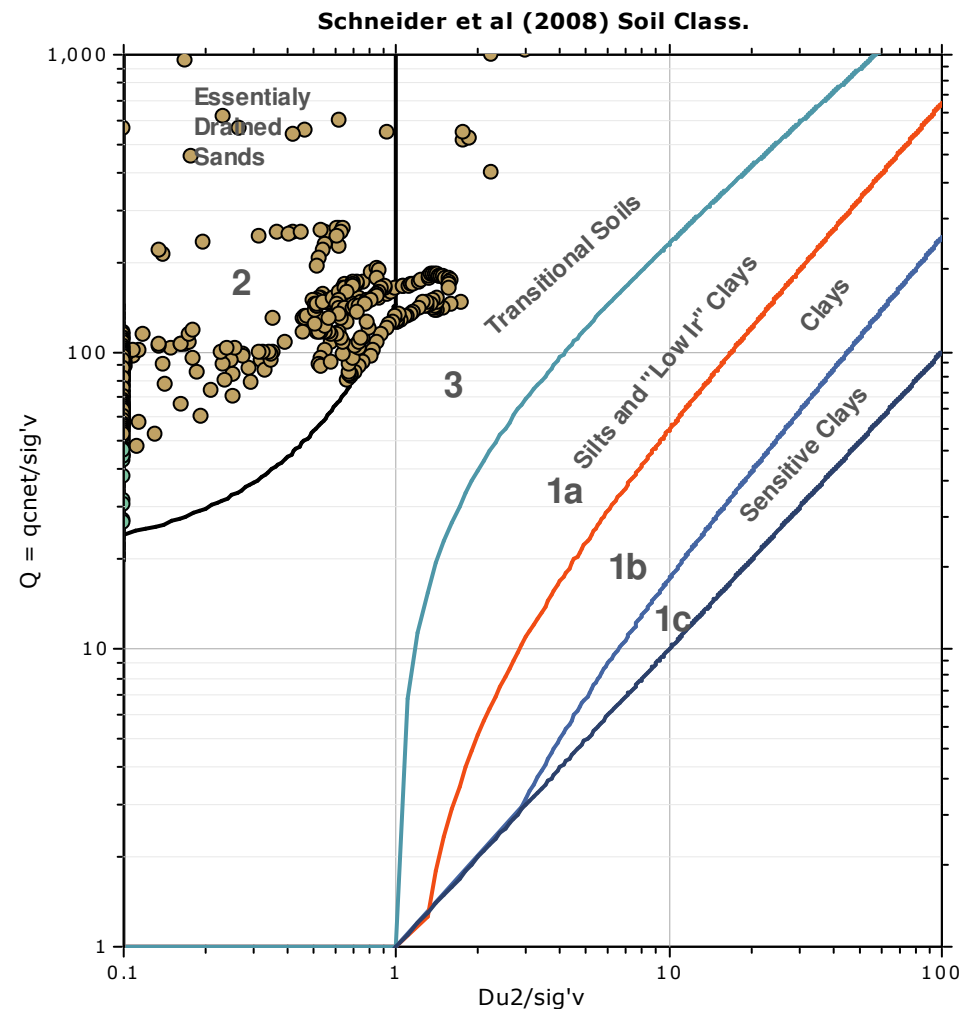
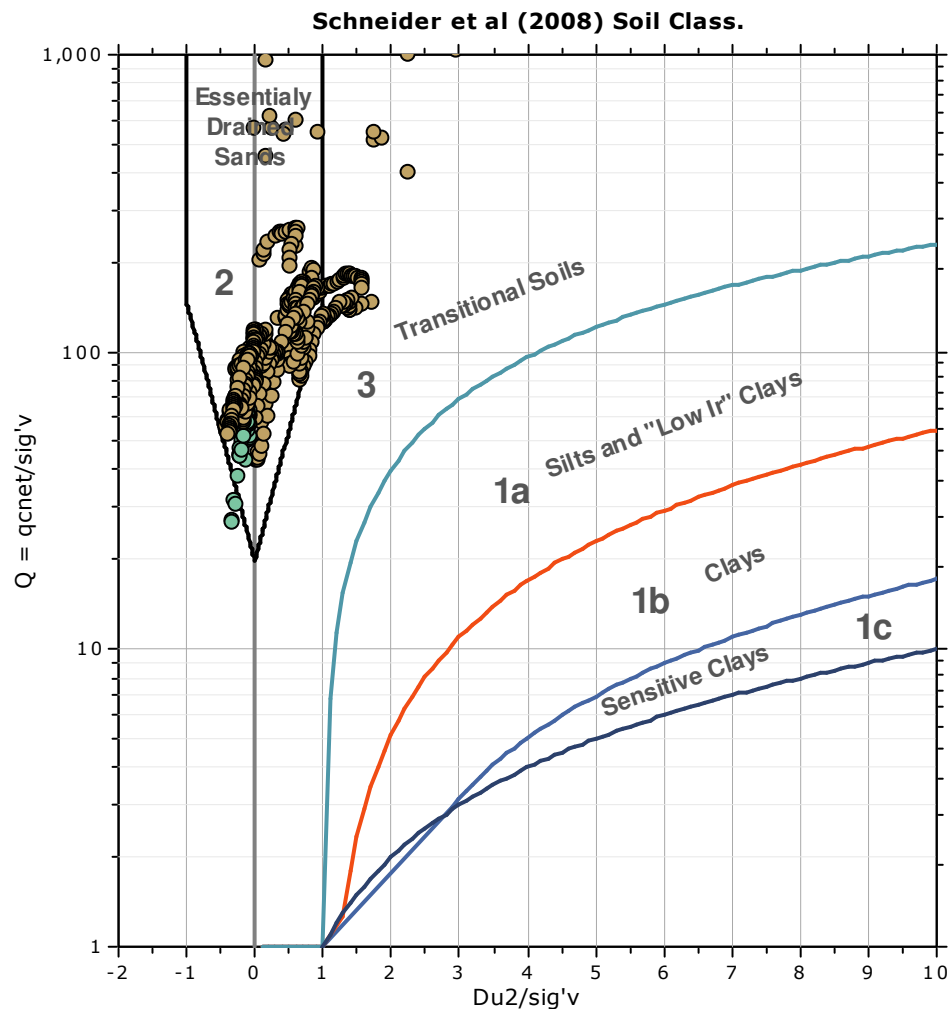
**SBT - Bq plots (normalized)**

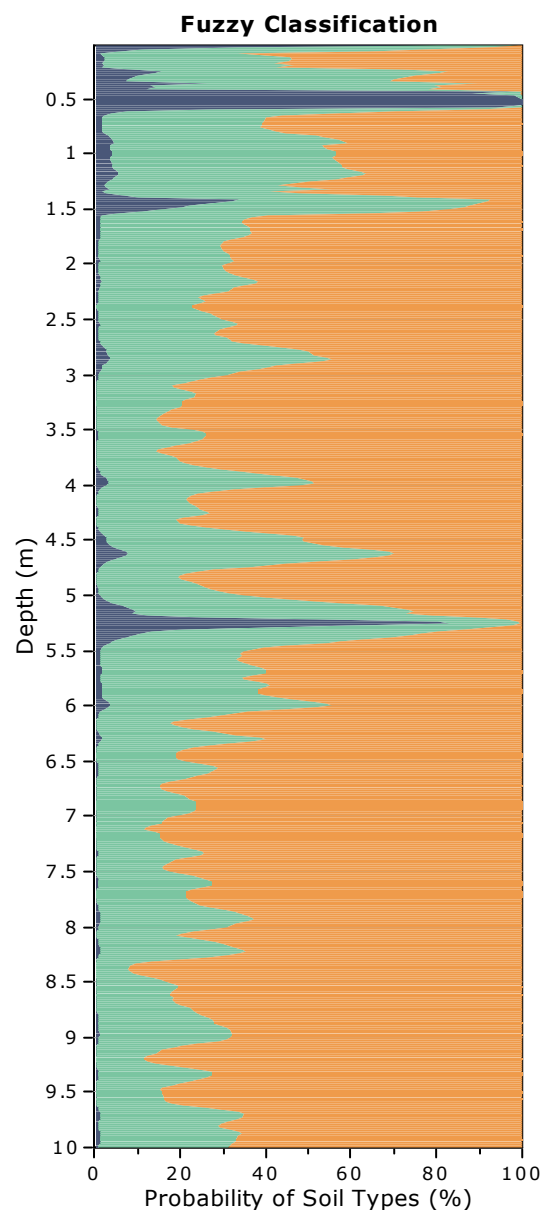
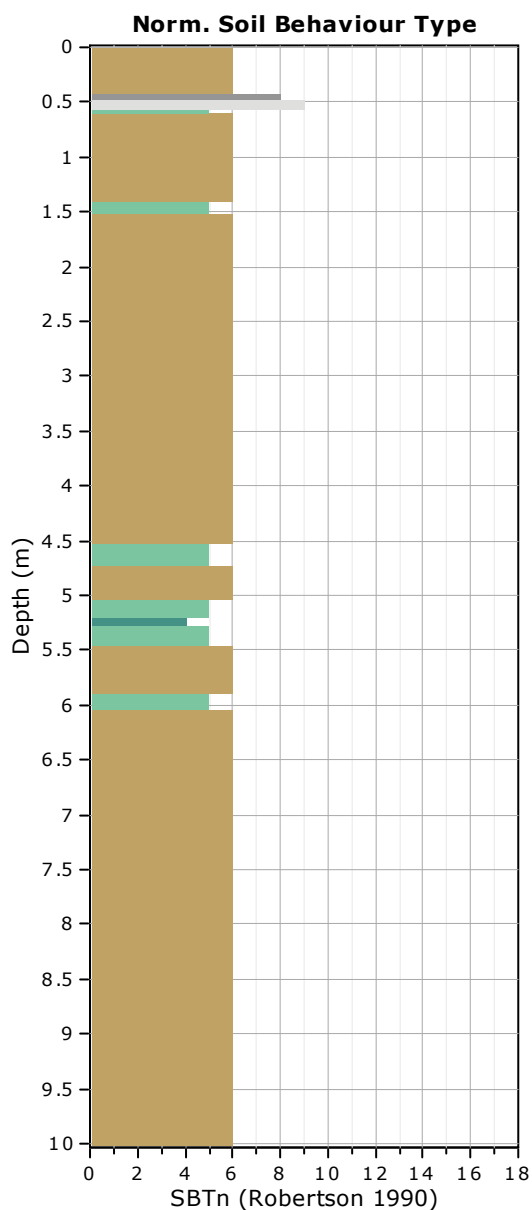


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





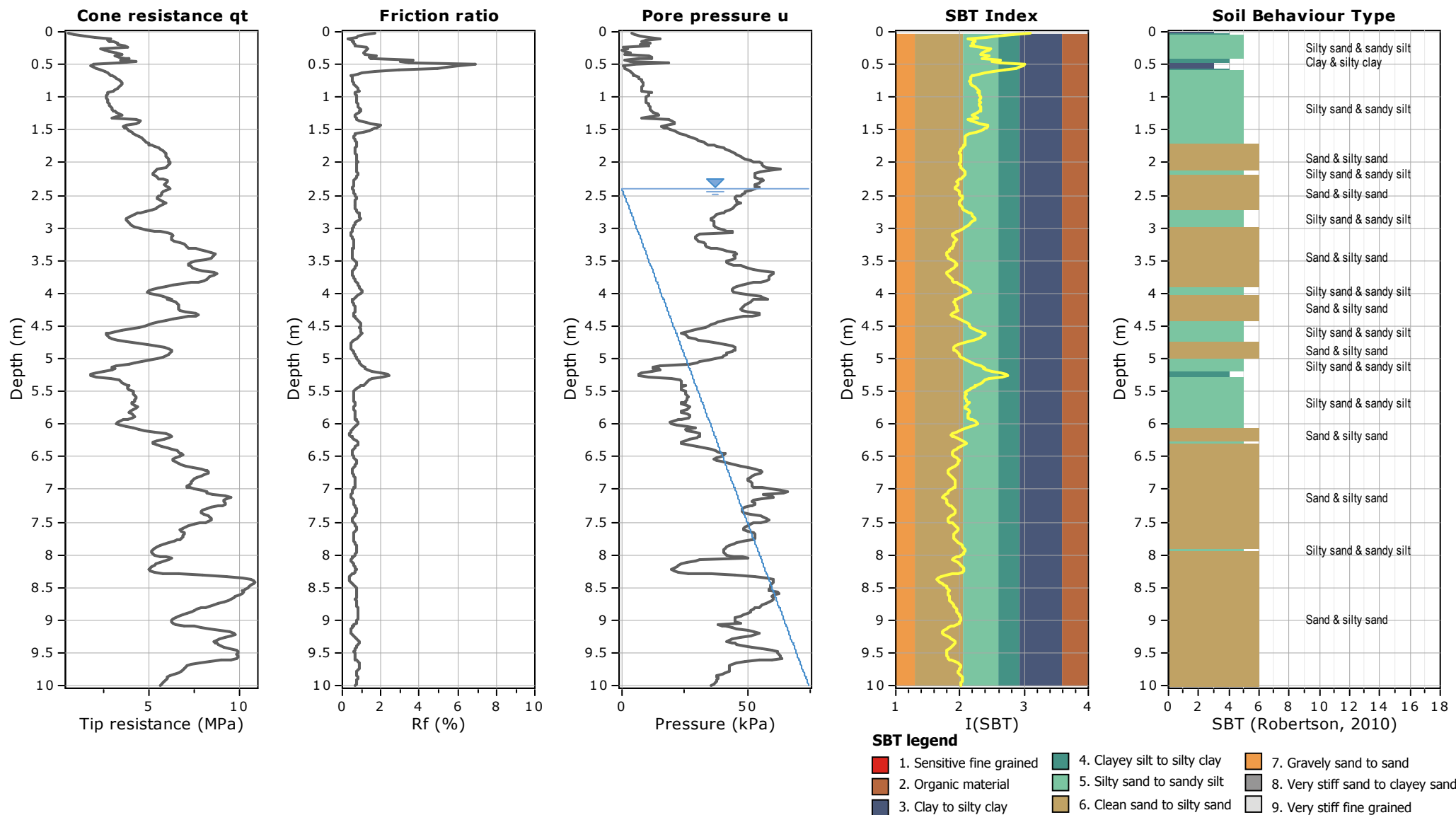
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km45+900**

Total depth: 10.00 m

Coords: lat 44.852193° lon 12.177099°





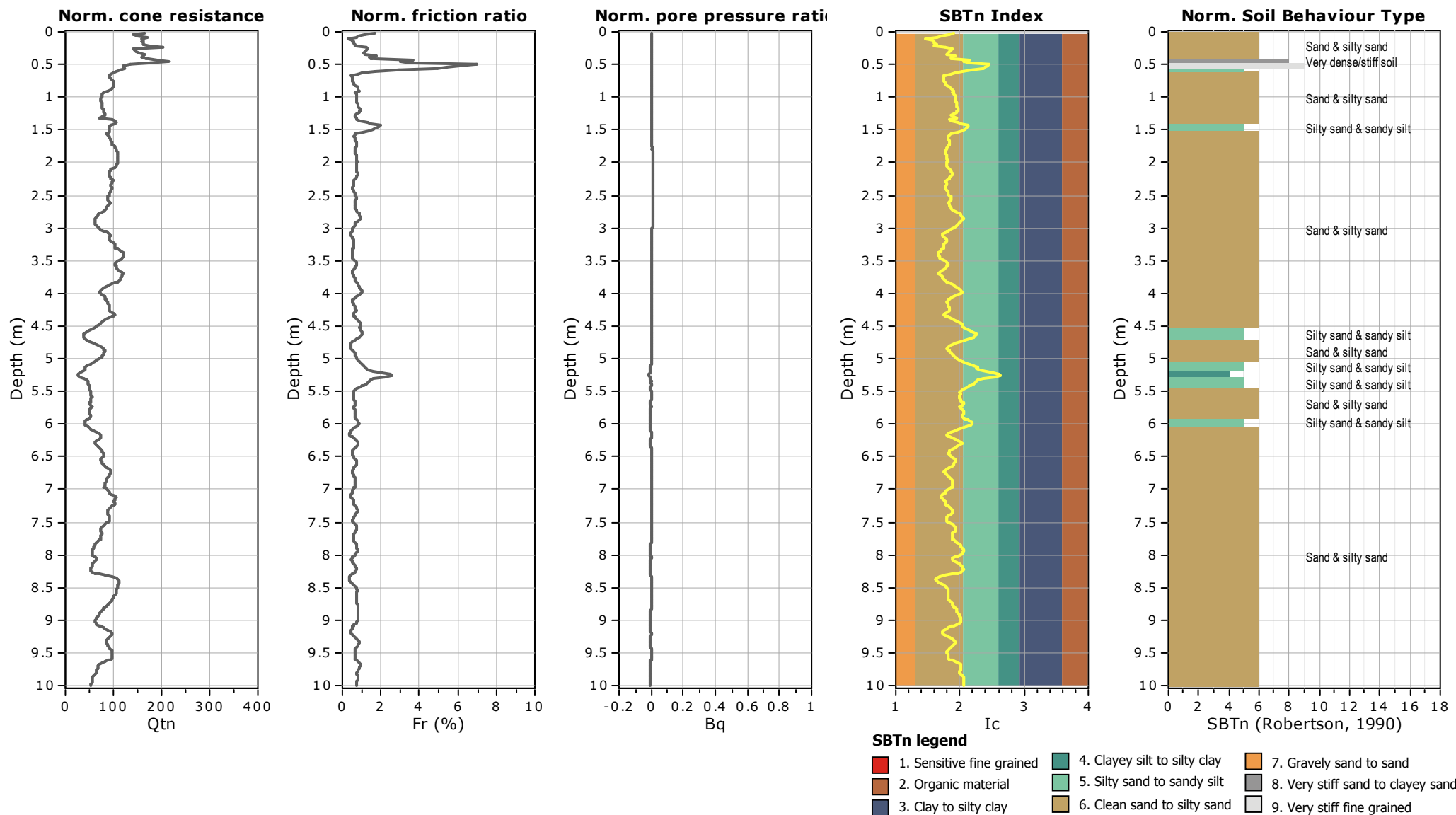
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km45+900**

Total depth: 10.00 m

Coords: lat 44.852193° lon 12.177099°



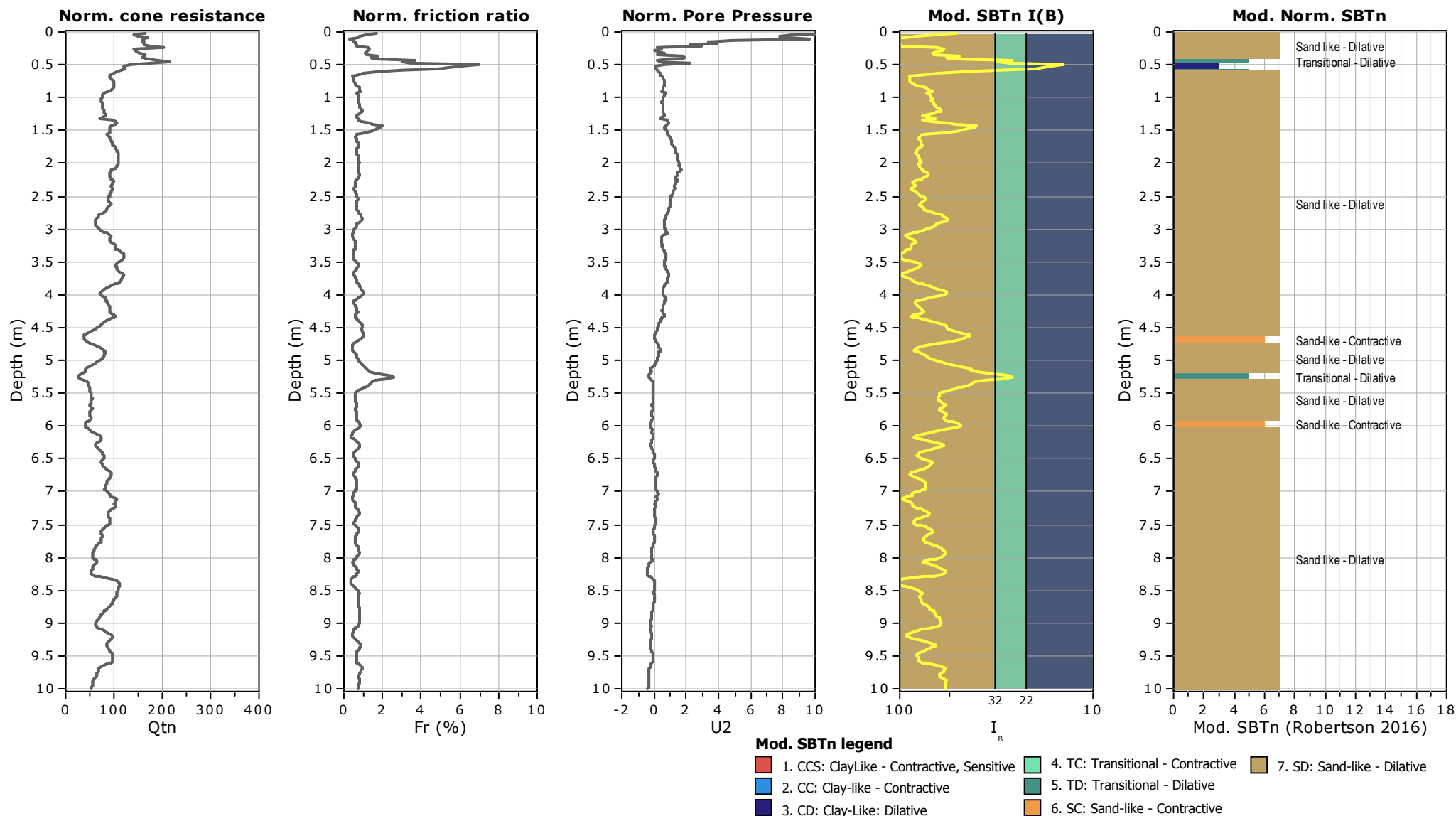
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

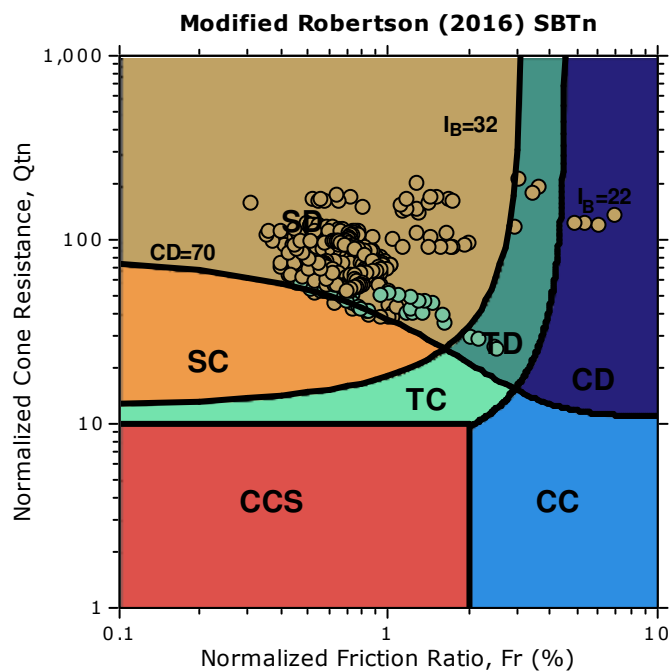
**CPT: CPTU km45+900**

Total depth: 10.00 m

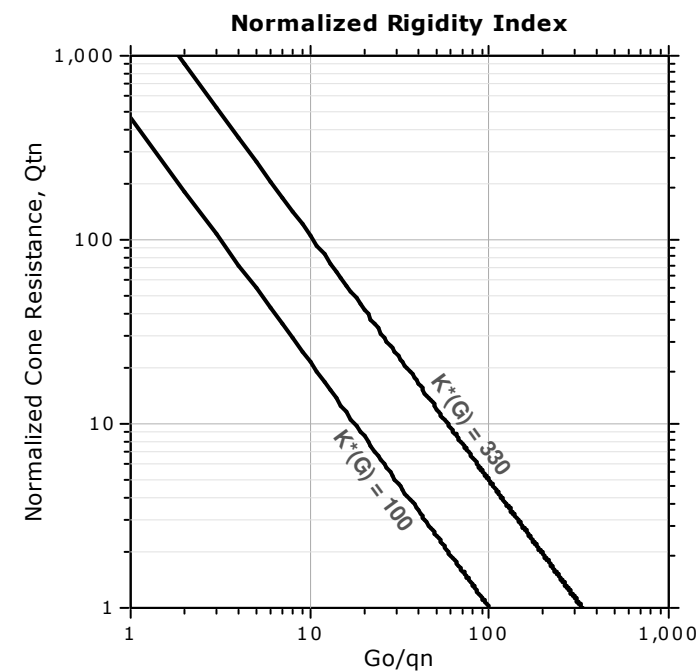
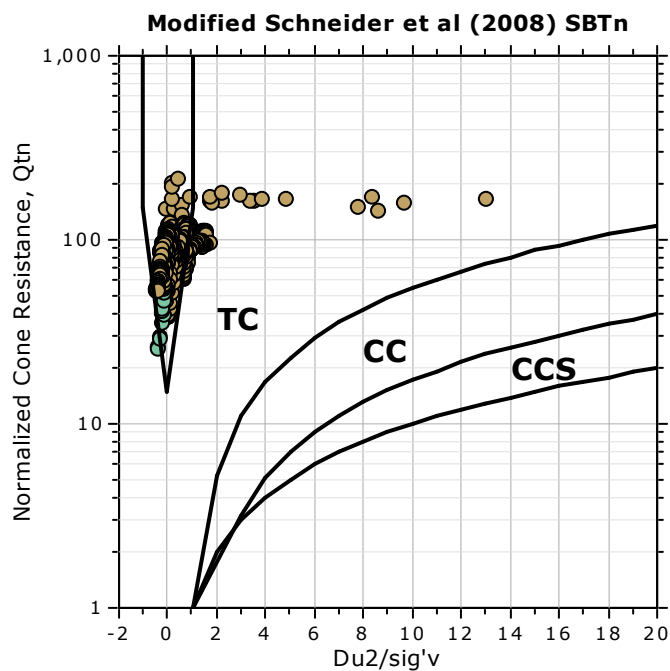
Coords: lat 44.852193° lon 12.177099°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative



$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

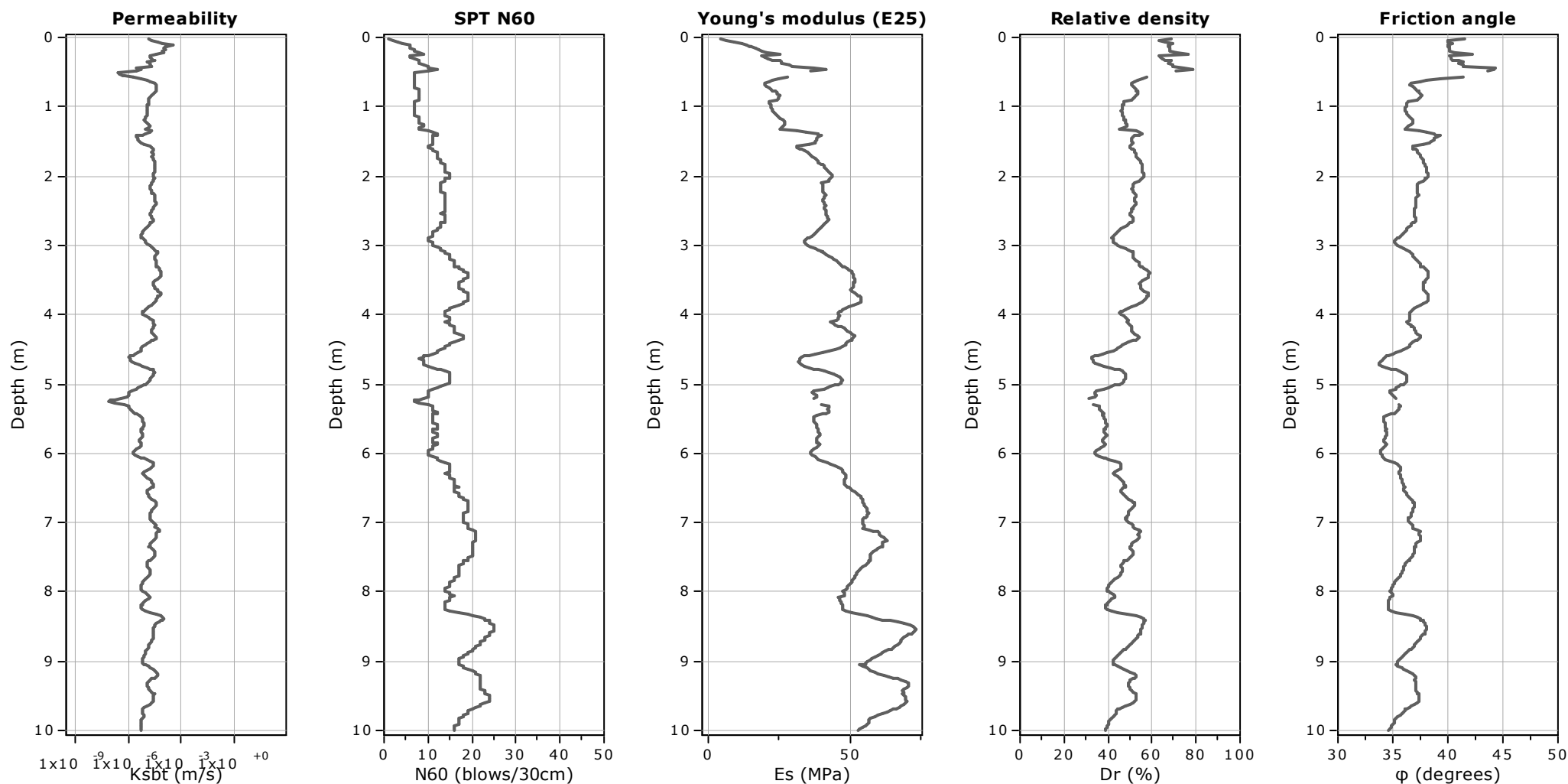
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km45+900**

Total depth: 10.00 m

Coords: lat 44.852193° lon 12.177099°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

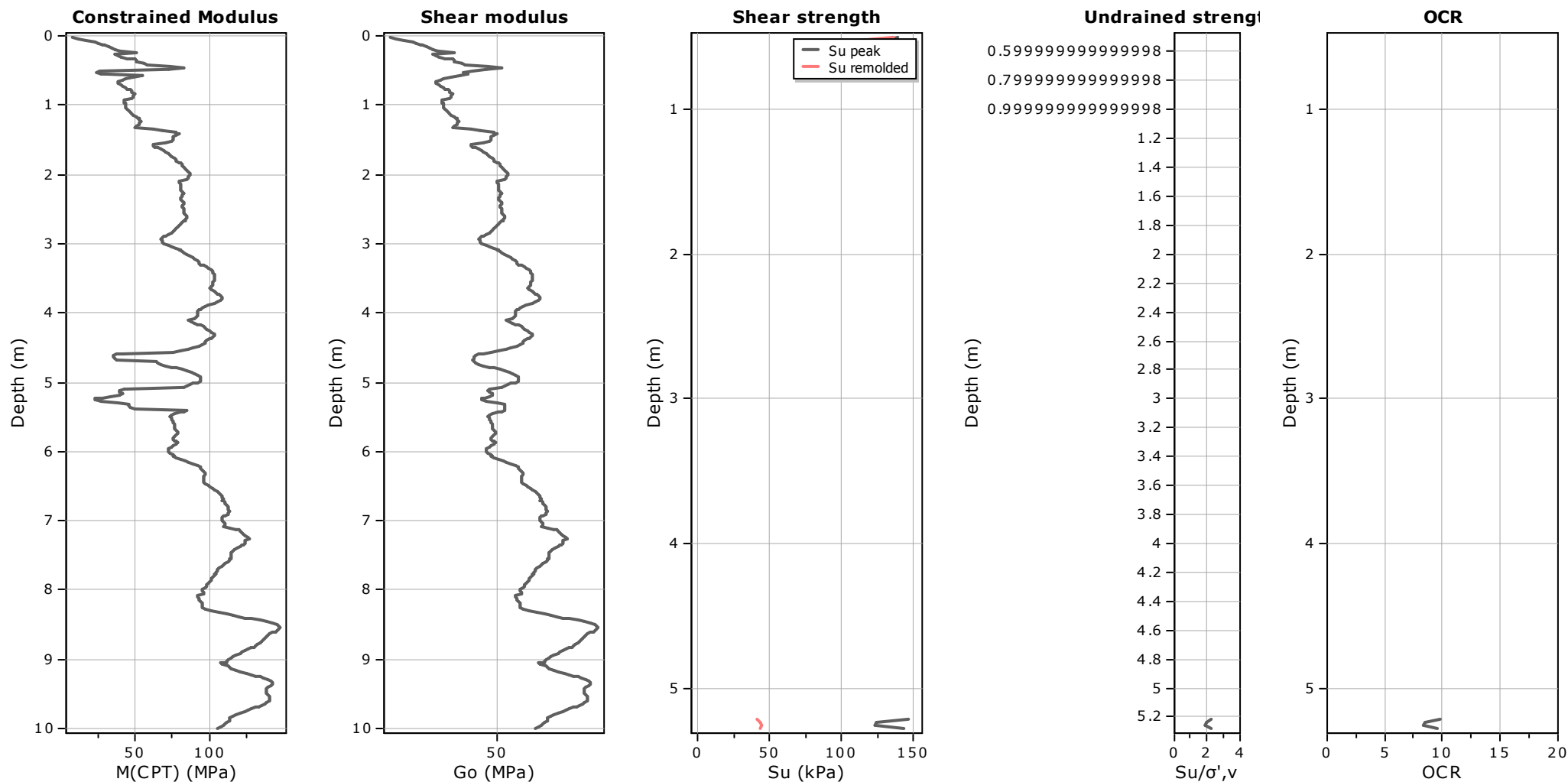
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km45+900**

Total depth: 10.00 m

Coords: lat 44.852193° lon 12.177099°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

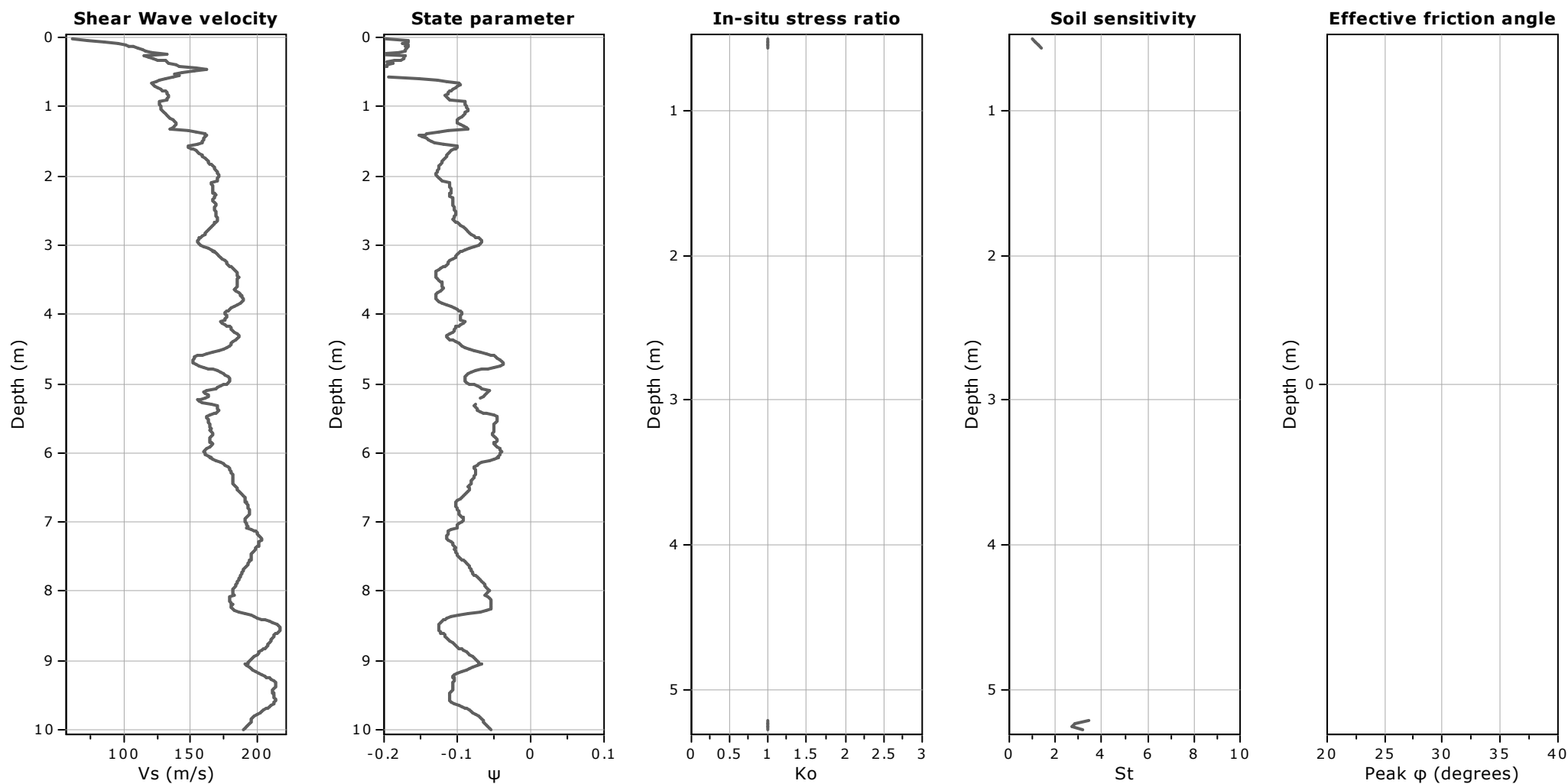
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km45+900**

Total depth: 10.00 m

Coords: lat 44.852193° lon 12.177099°

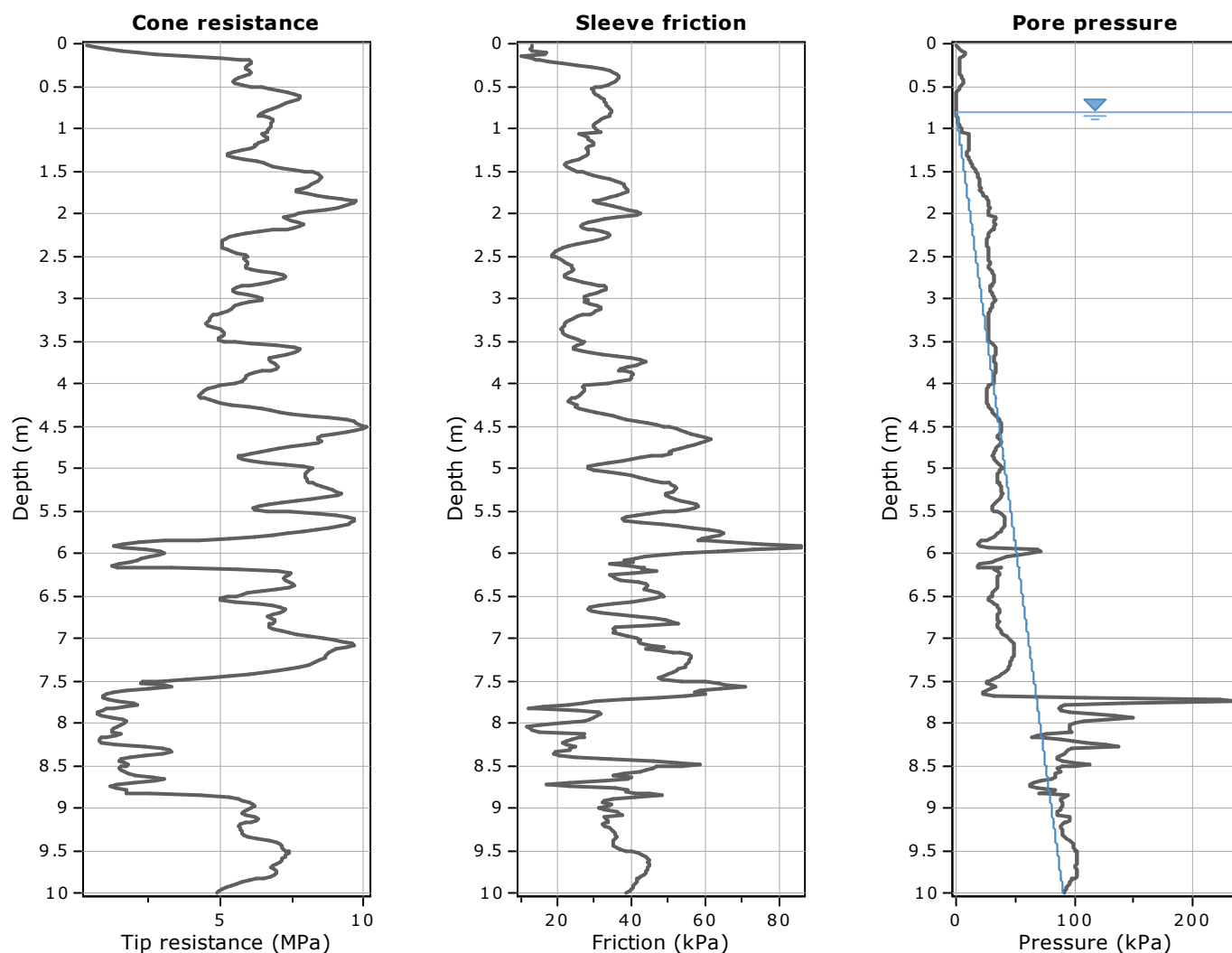


#### Calculation parameters

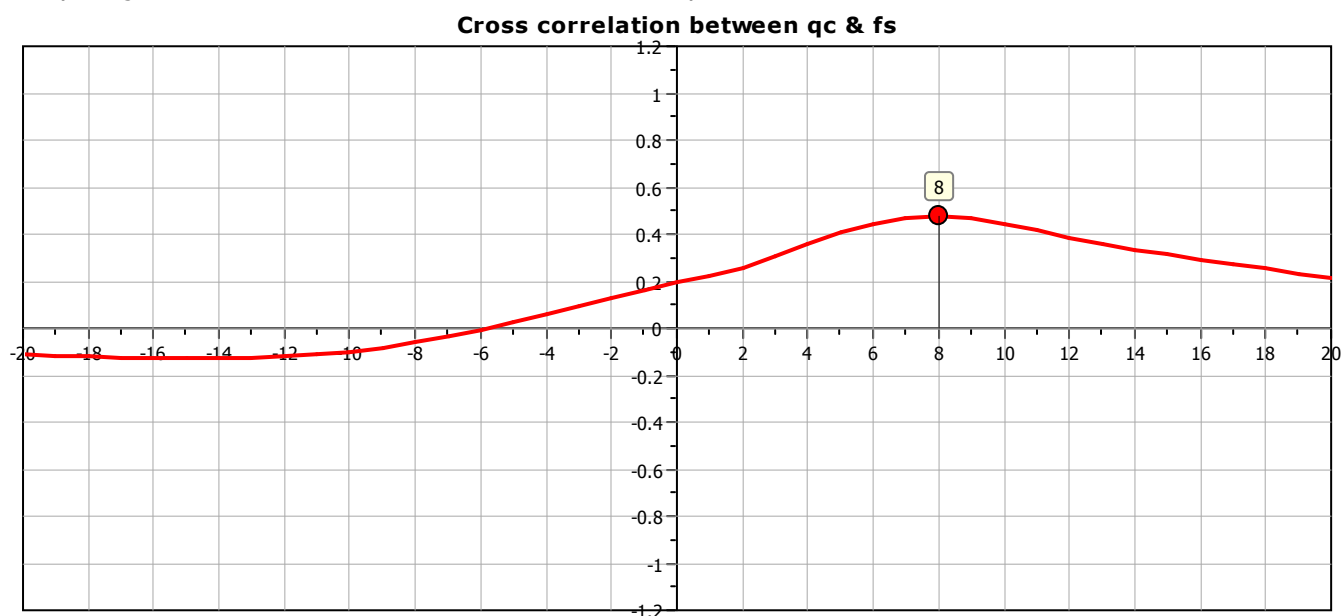
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

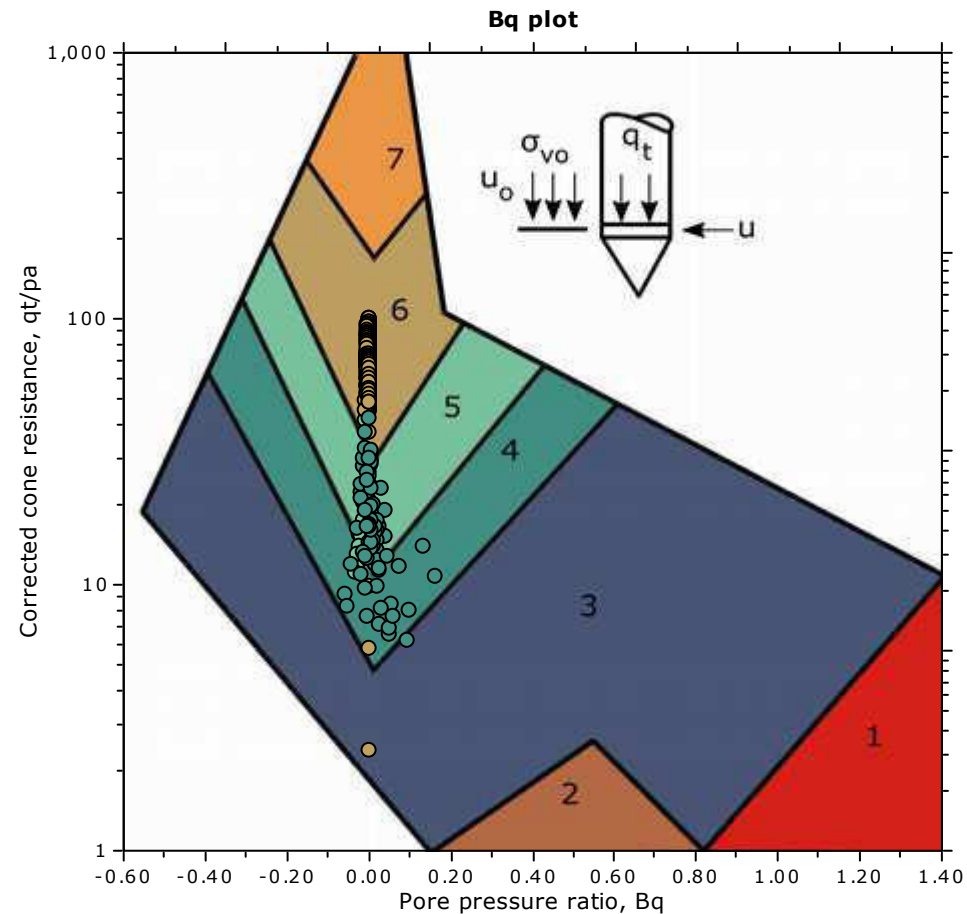
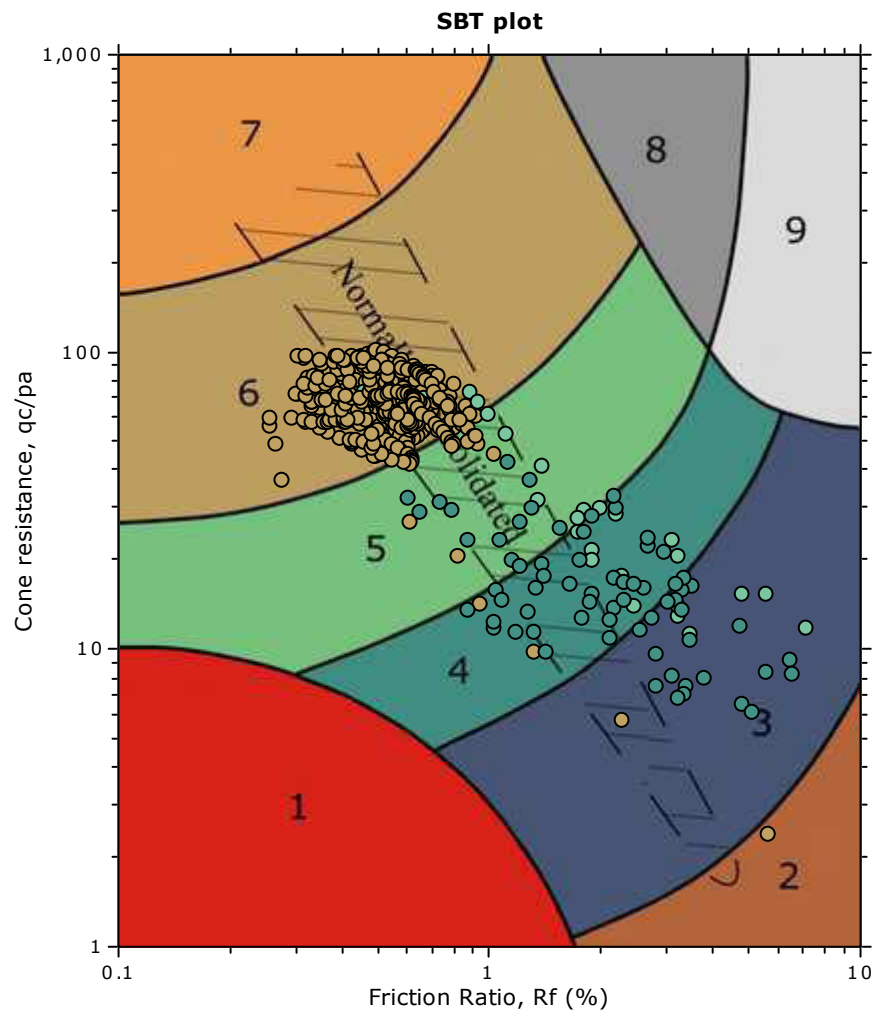




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



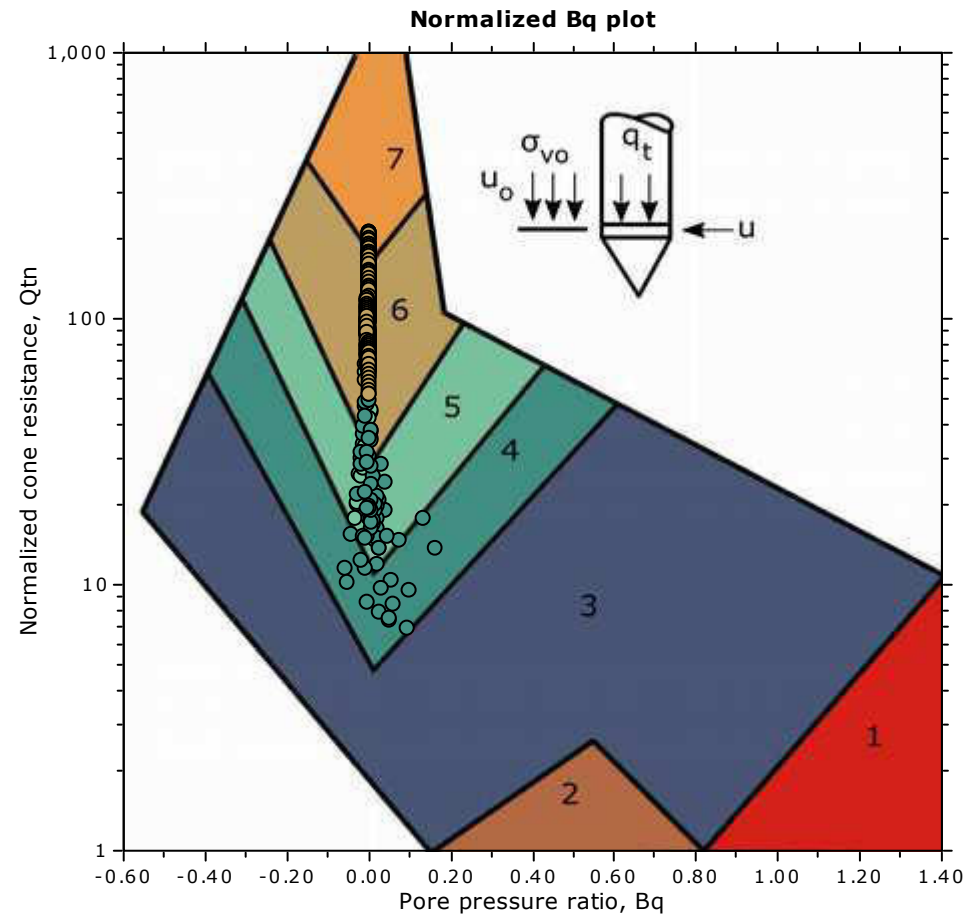
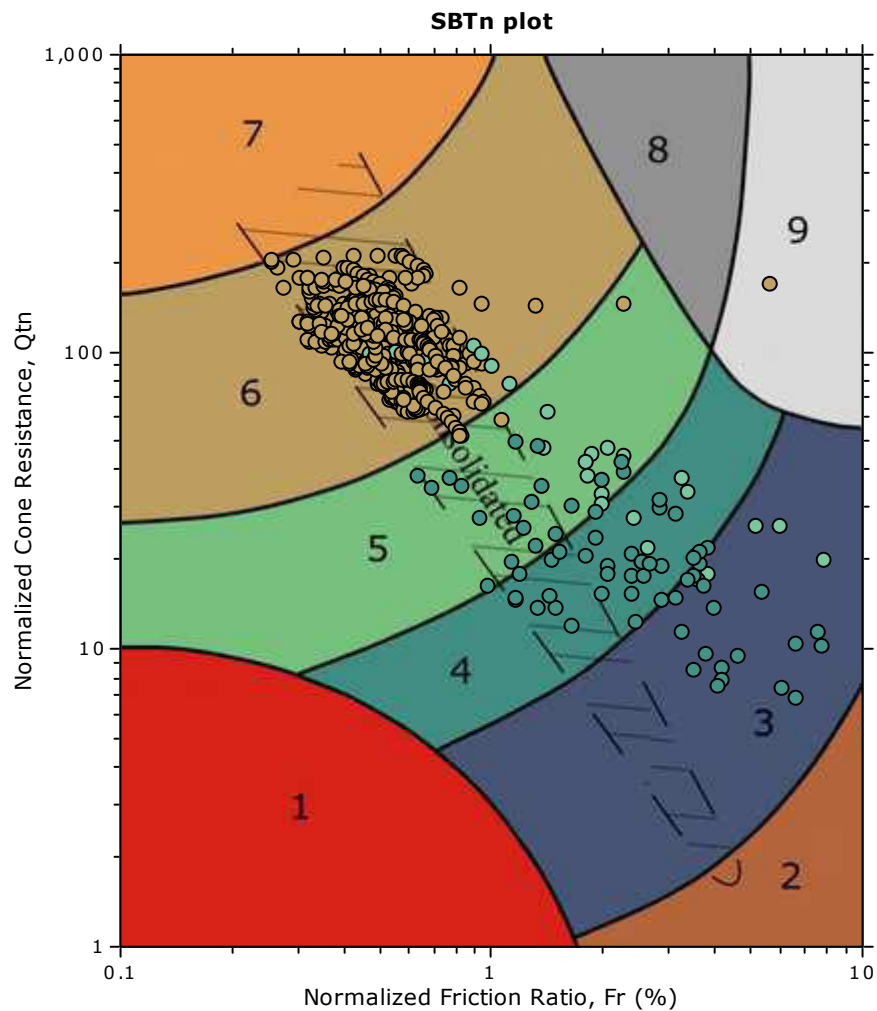
## SBT - Bq plots



### 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        |

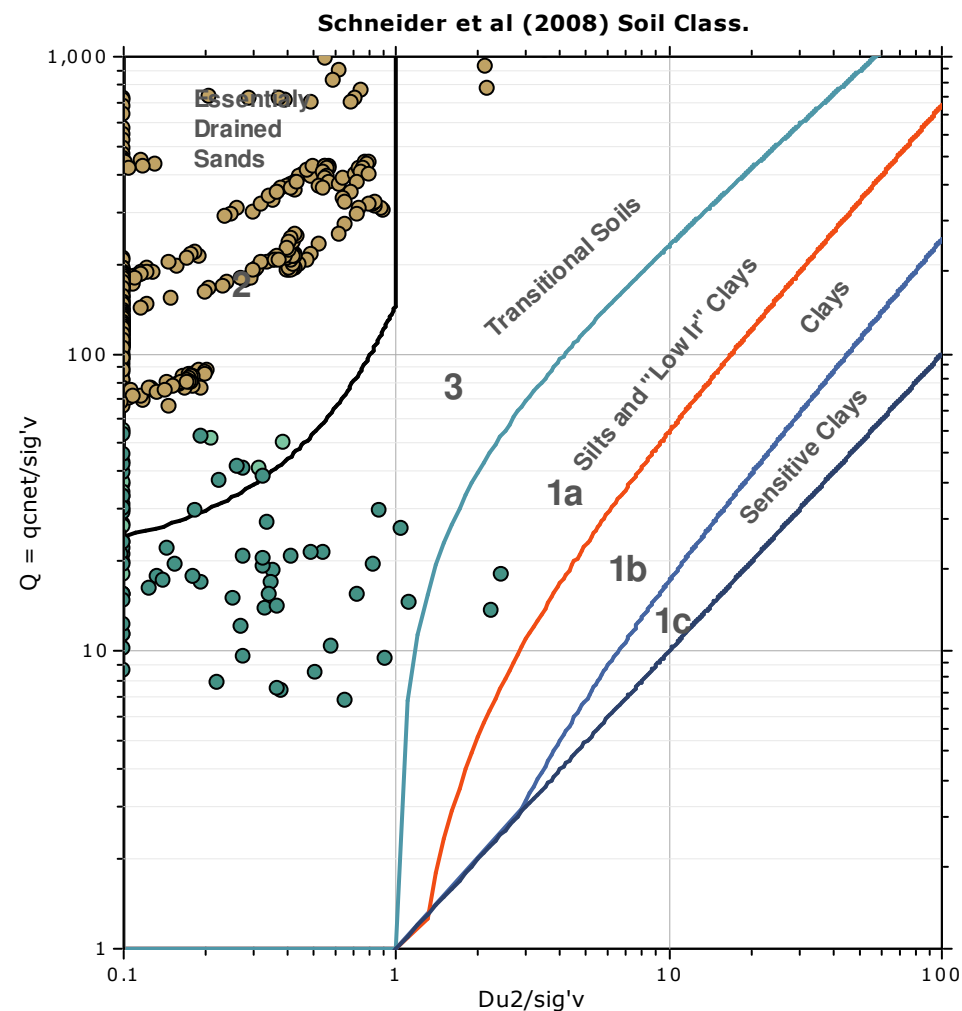
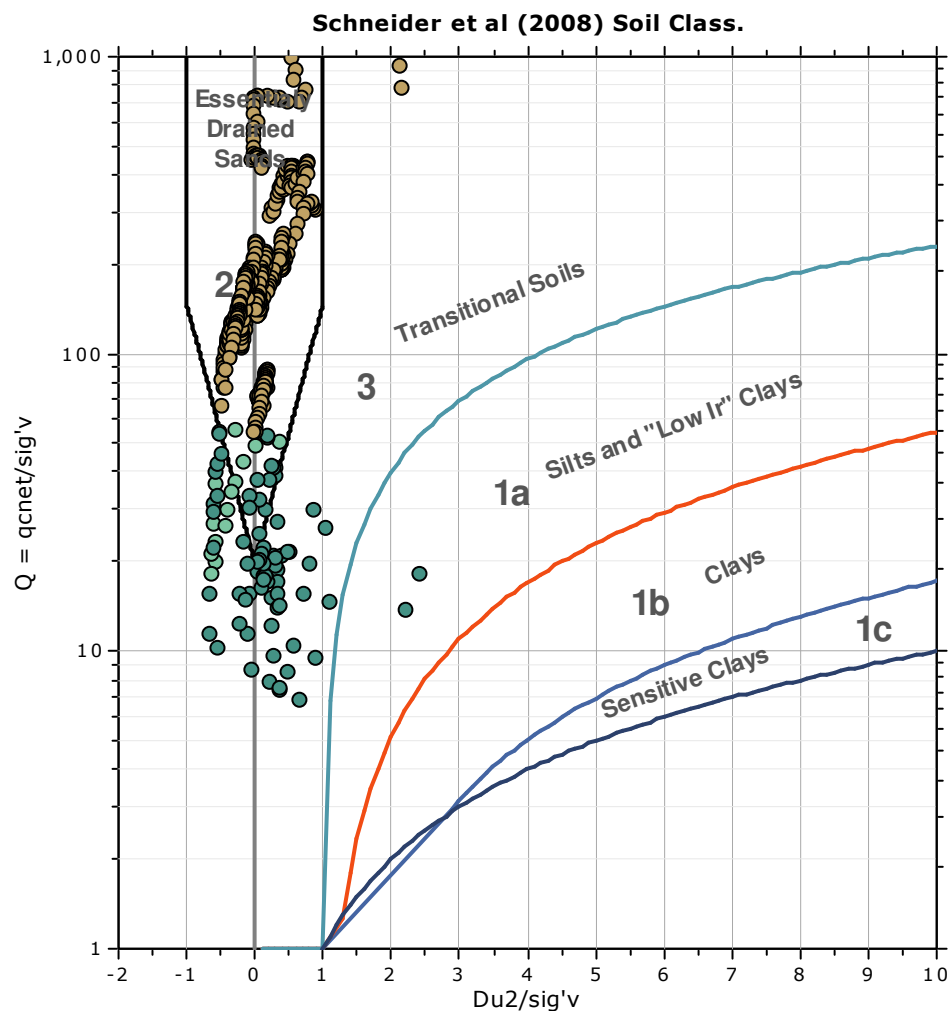
**SBT - Bq plots (normalized)**

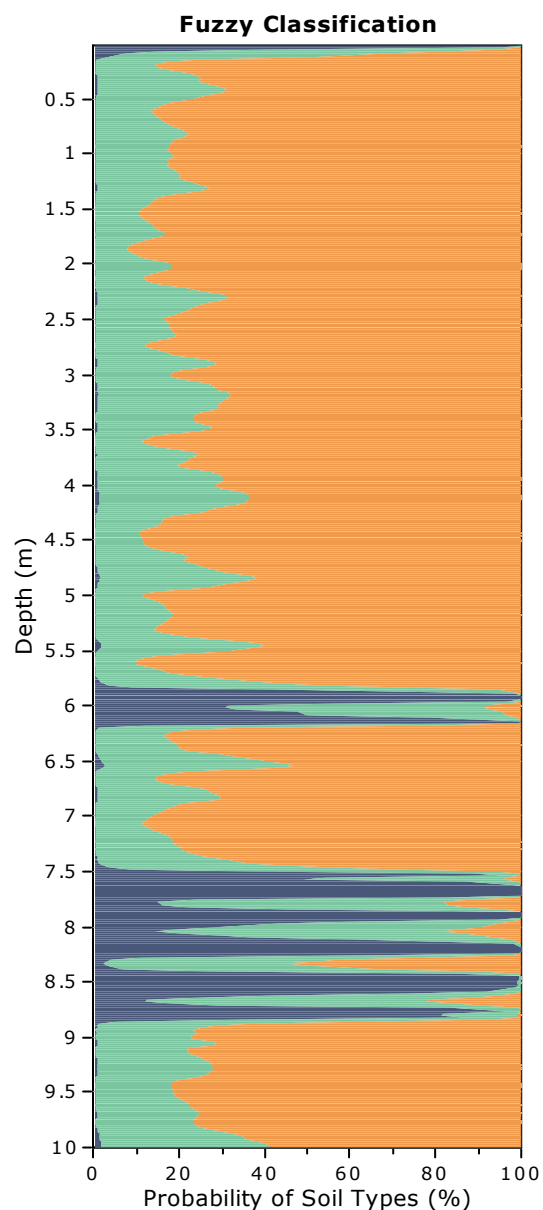
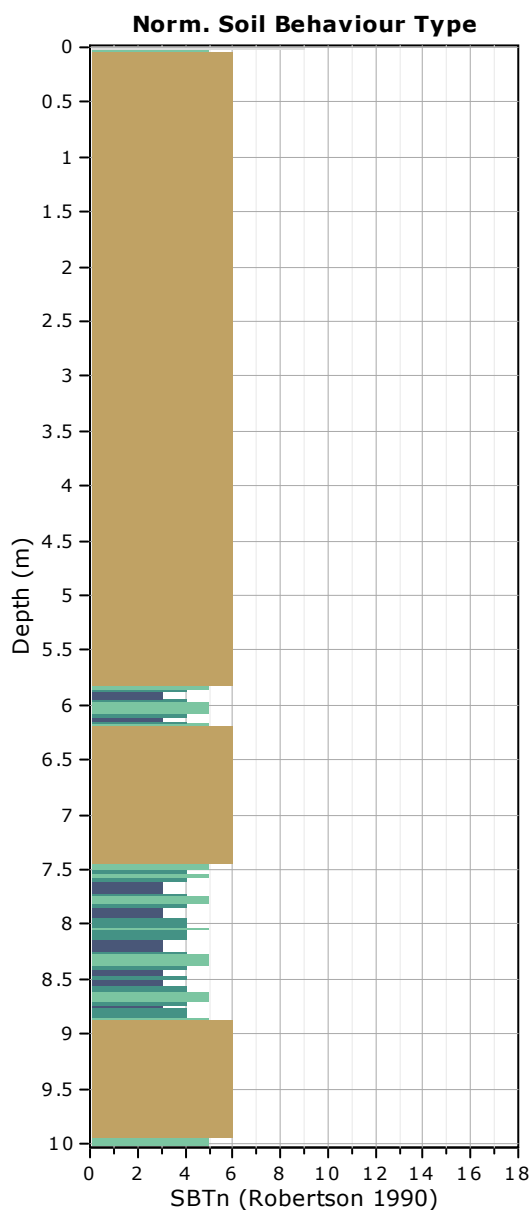


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





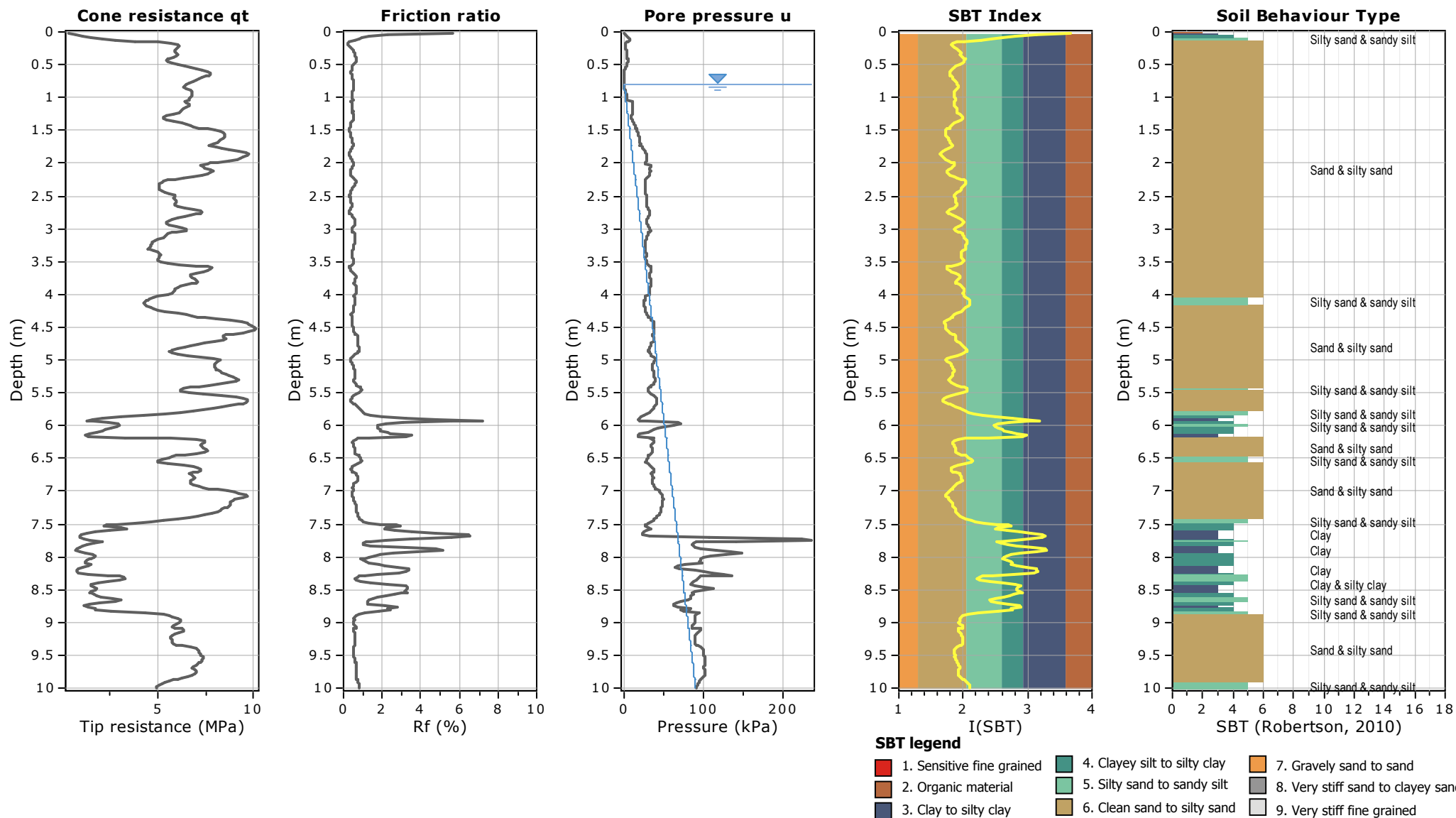
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+100**

Total depth: 10.00 m

Coords: lat 44.86998° lon 12.189944°





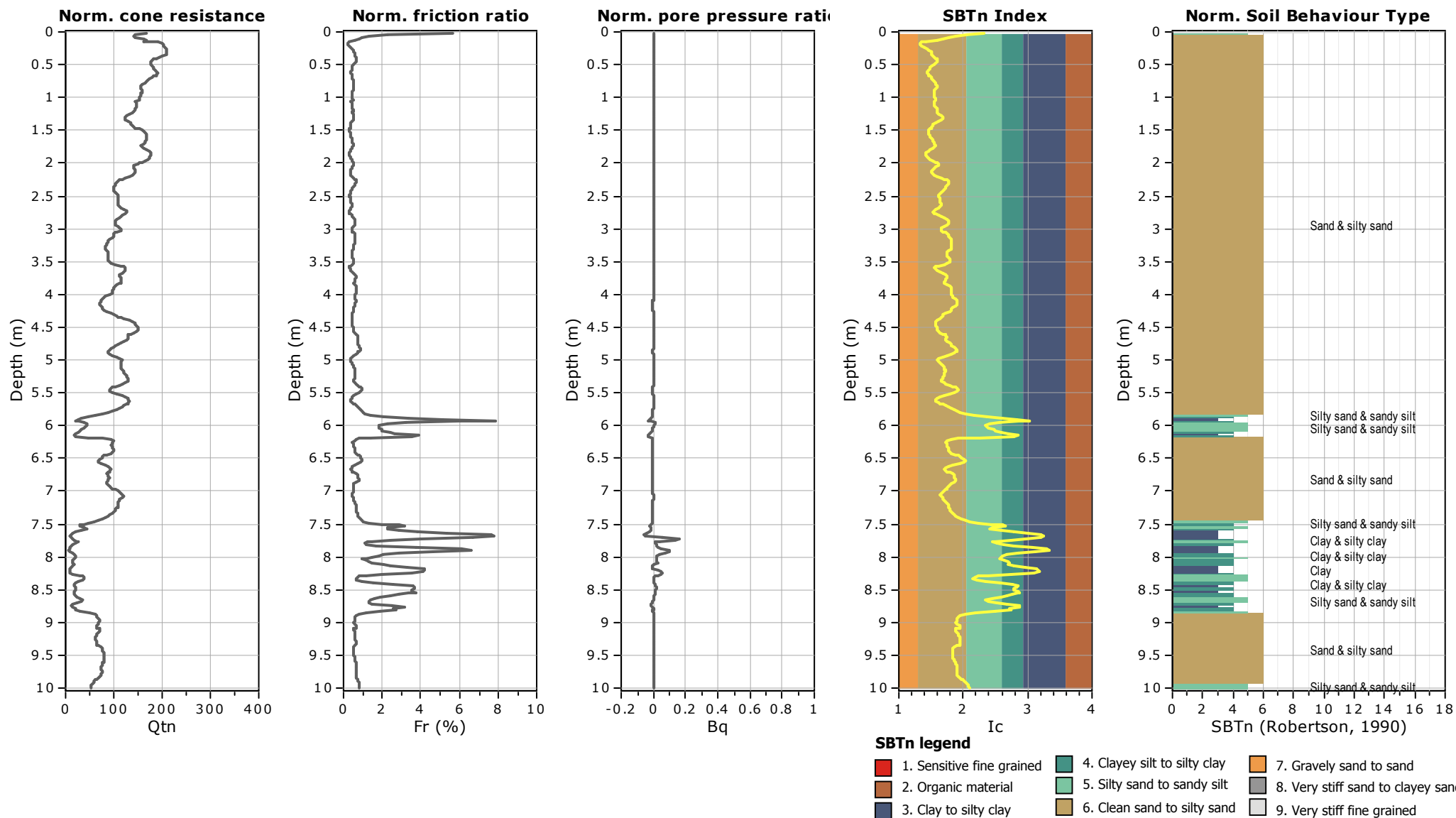
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+100**

Total depth: 10.00 m

Coords: lat 44.86998° lon 12.189944°



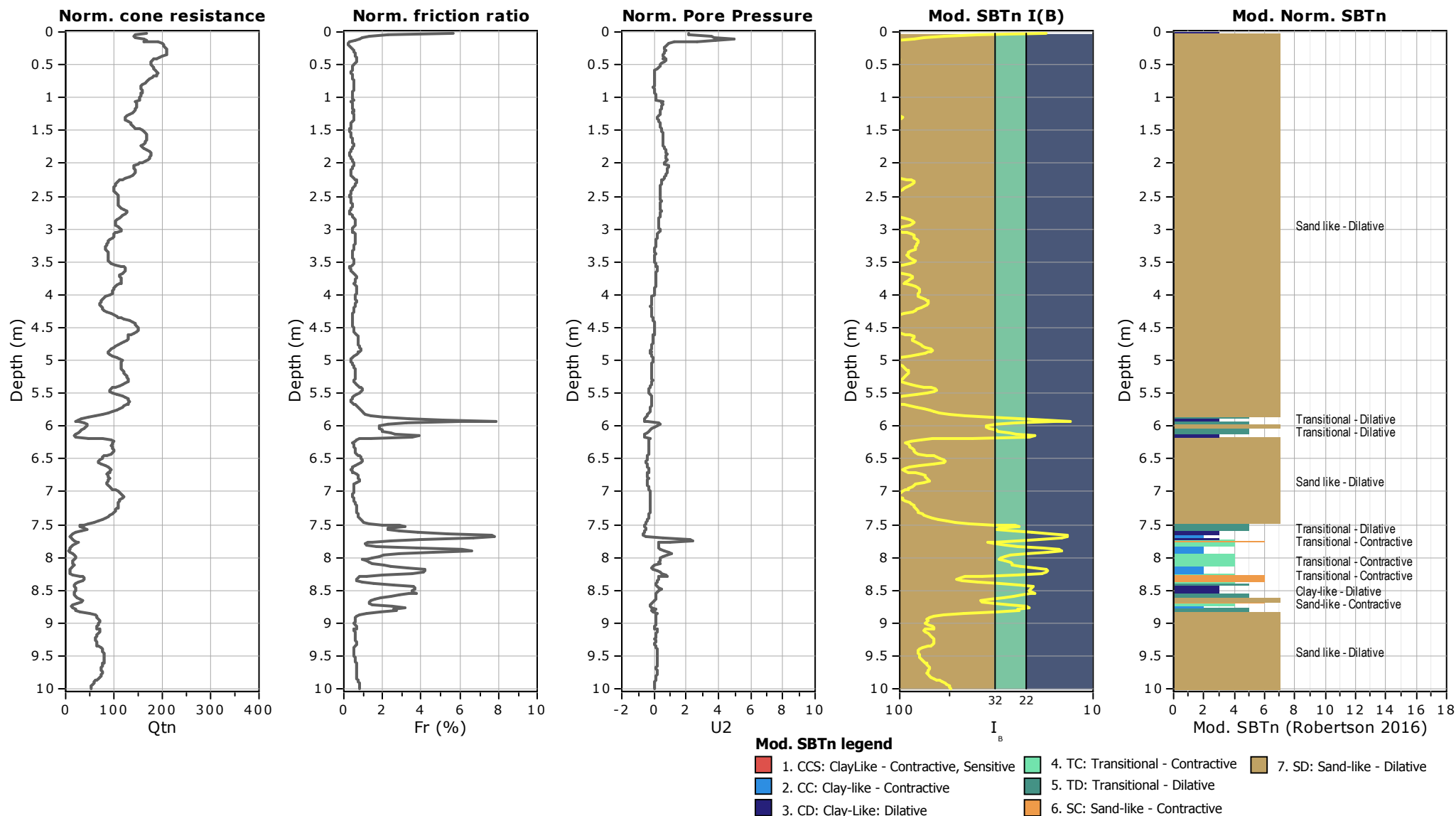
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

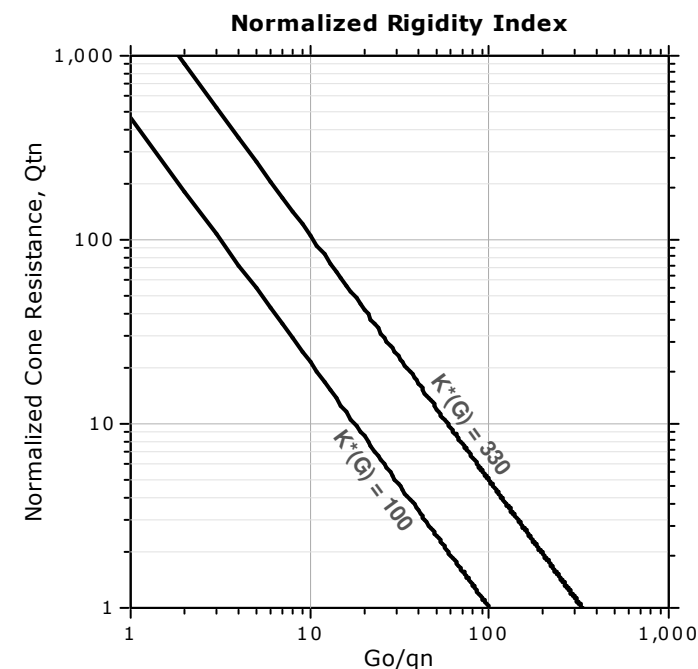
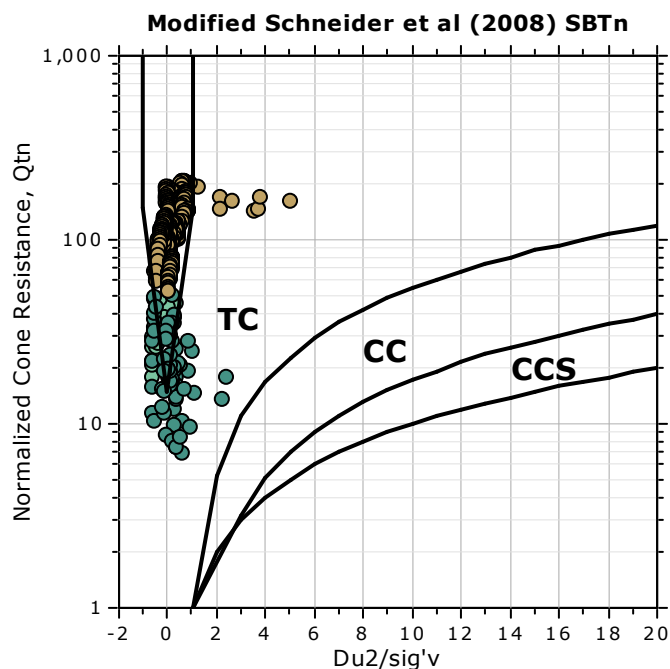
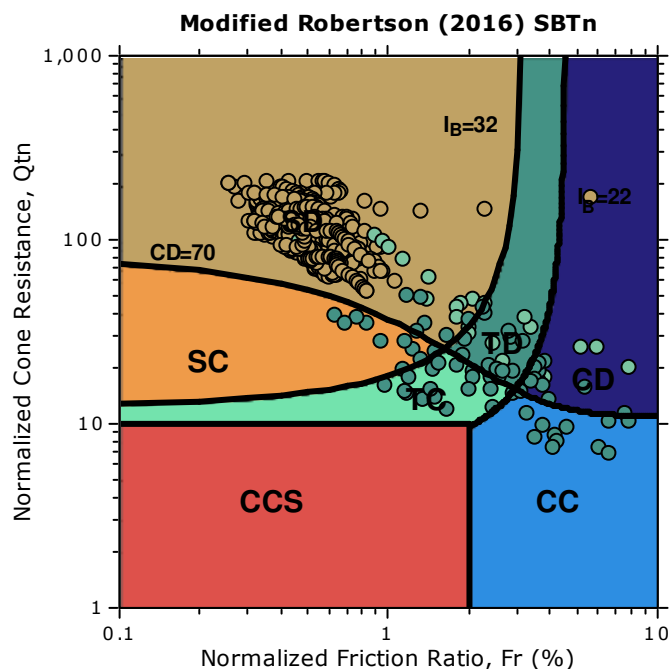
**CPT: CPTU km48+100**

Total depth: 10.00 m

Coords: lat 44.86998° lon 12.189944°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

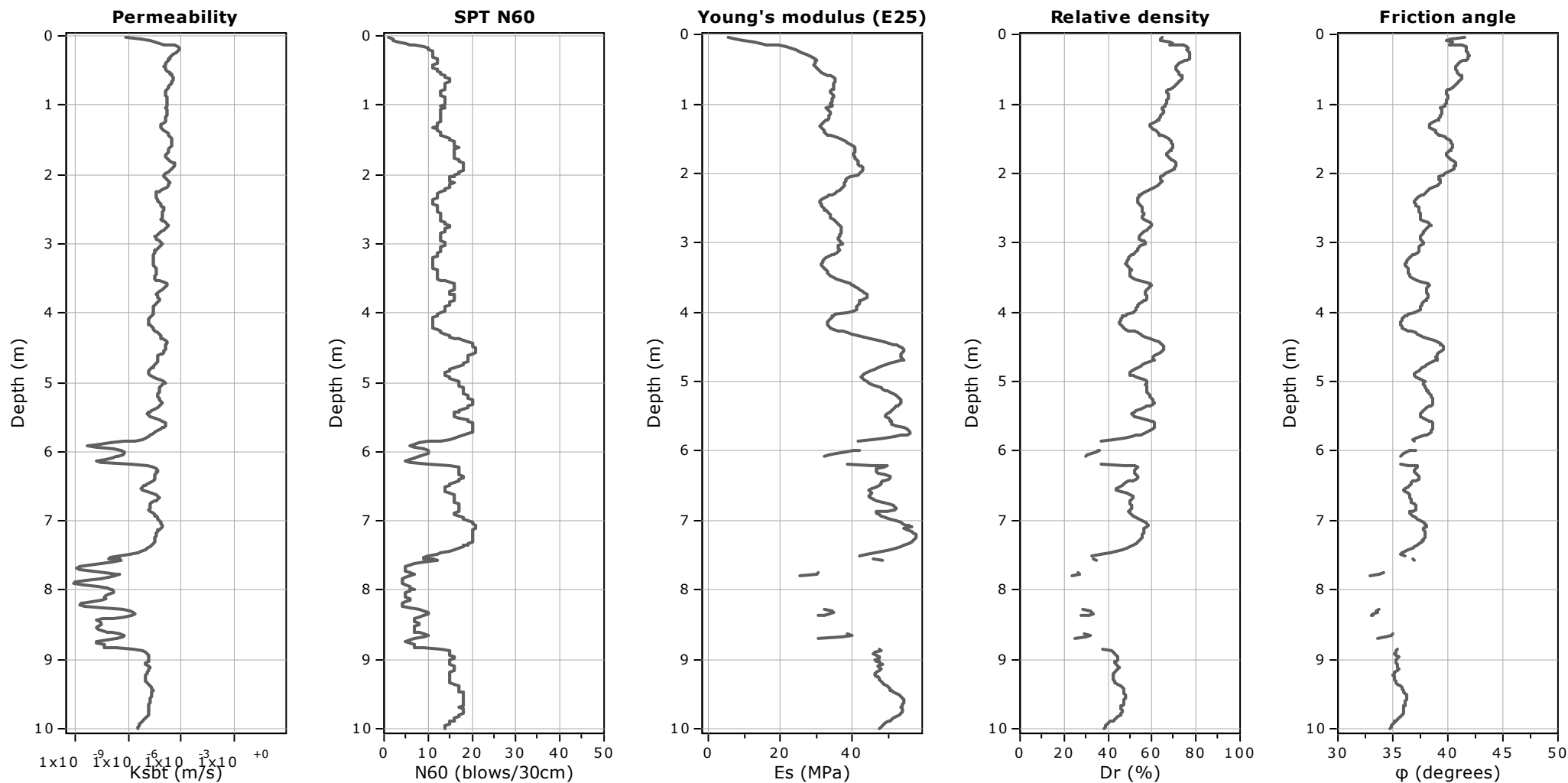
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+100**

Total depth: 10.00 m

Coords: lat 44.86998° lon 12.189944°



**Calculation parameters**

Permeability: Based on  $SBT_n$

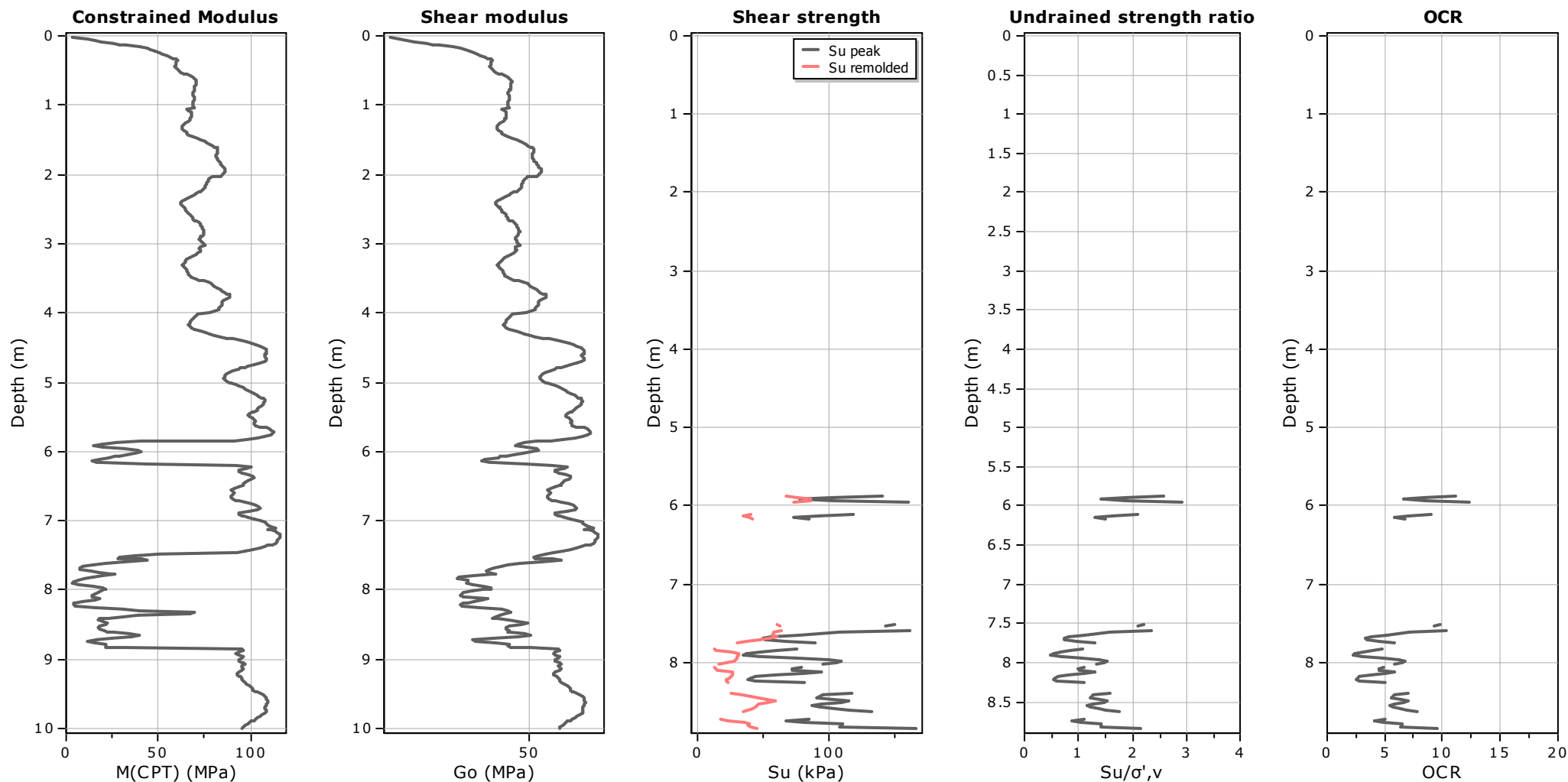
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

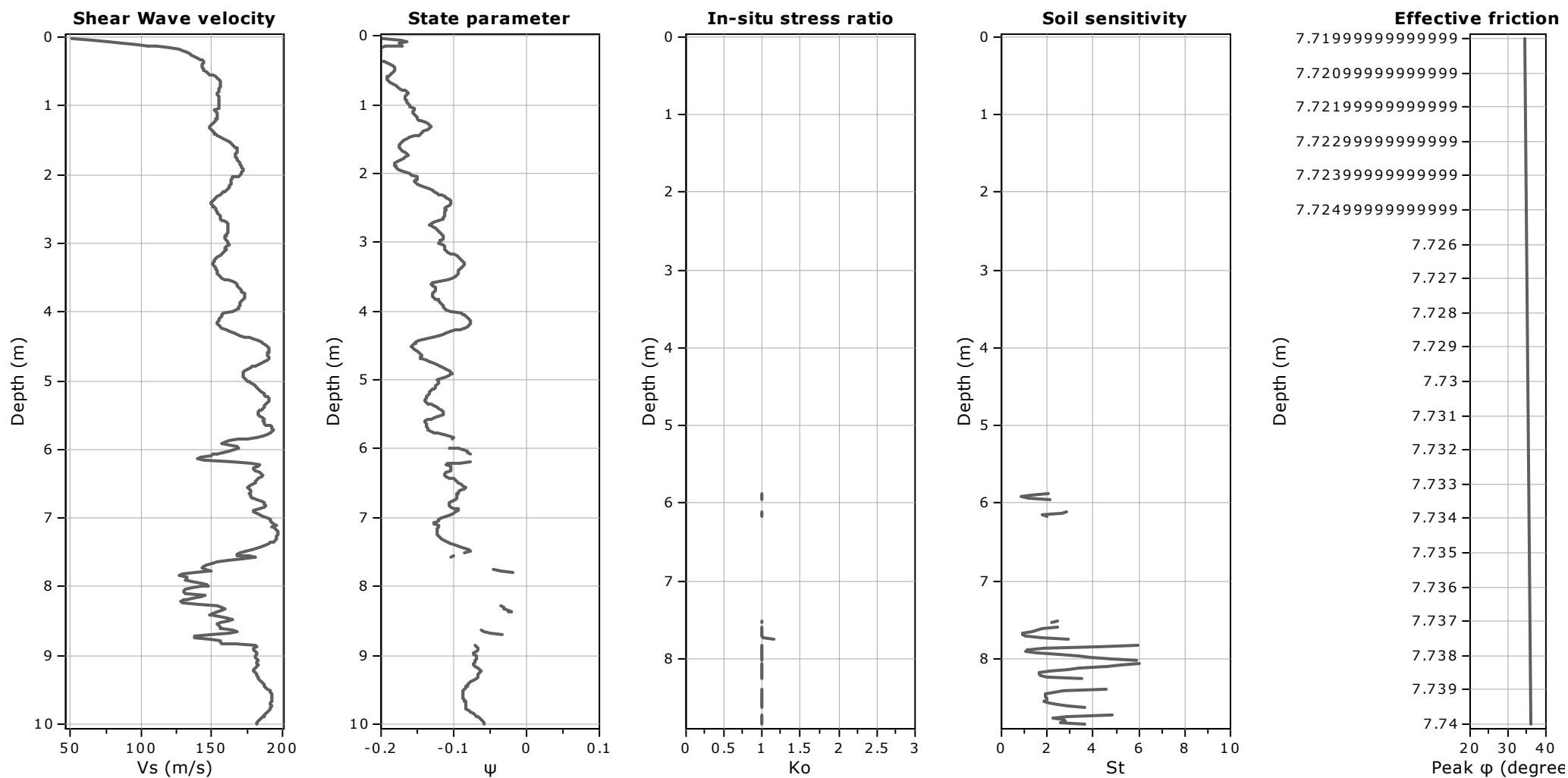
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+100**

Total depth: 10.00 m

Coords: lat 44.86998° lon 12.189944°

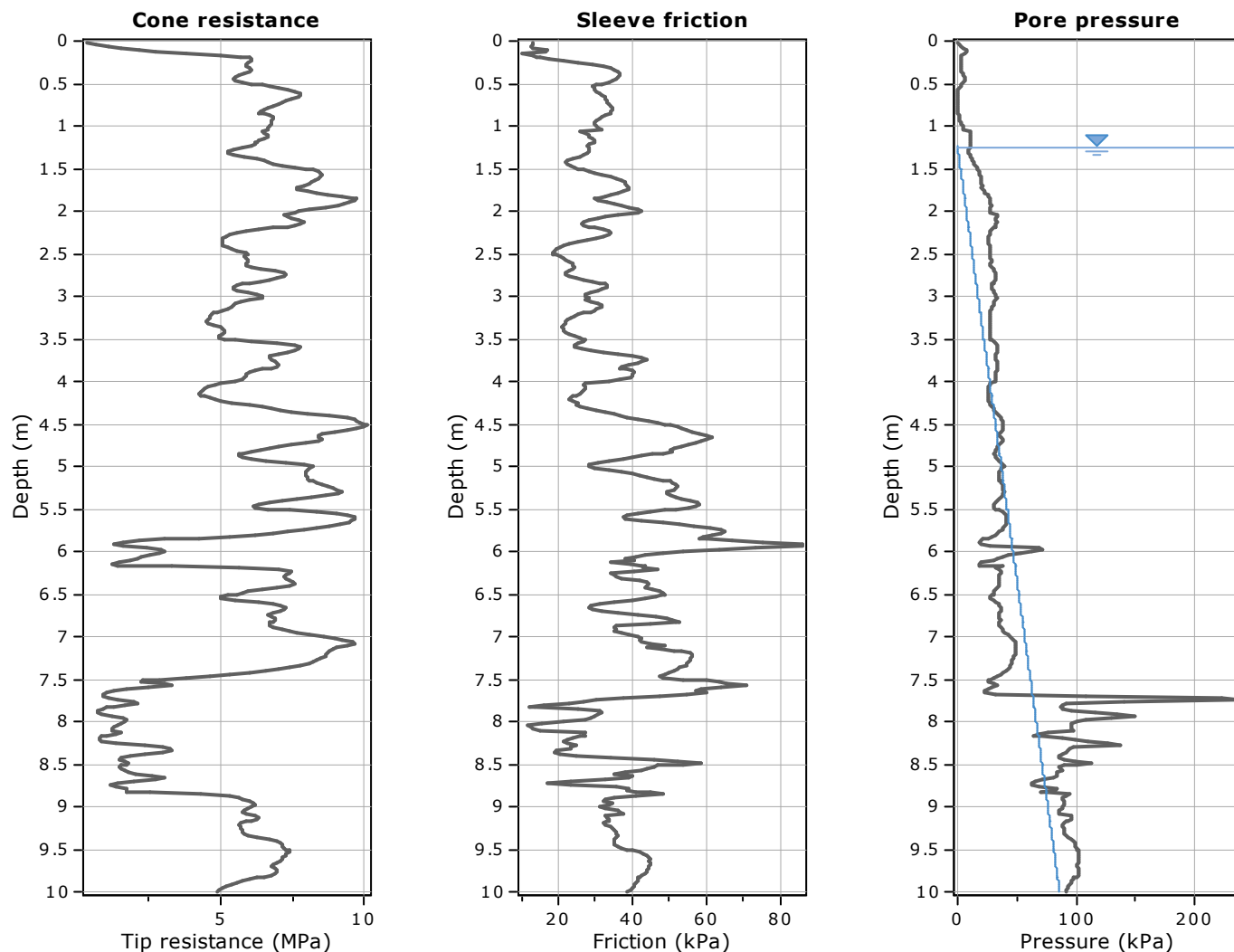


#### Calculation parameters

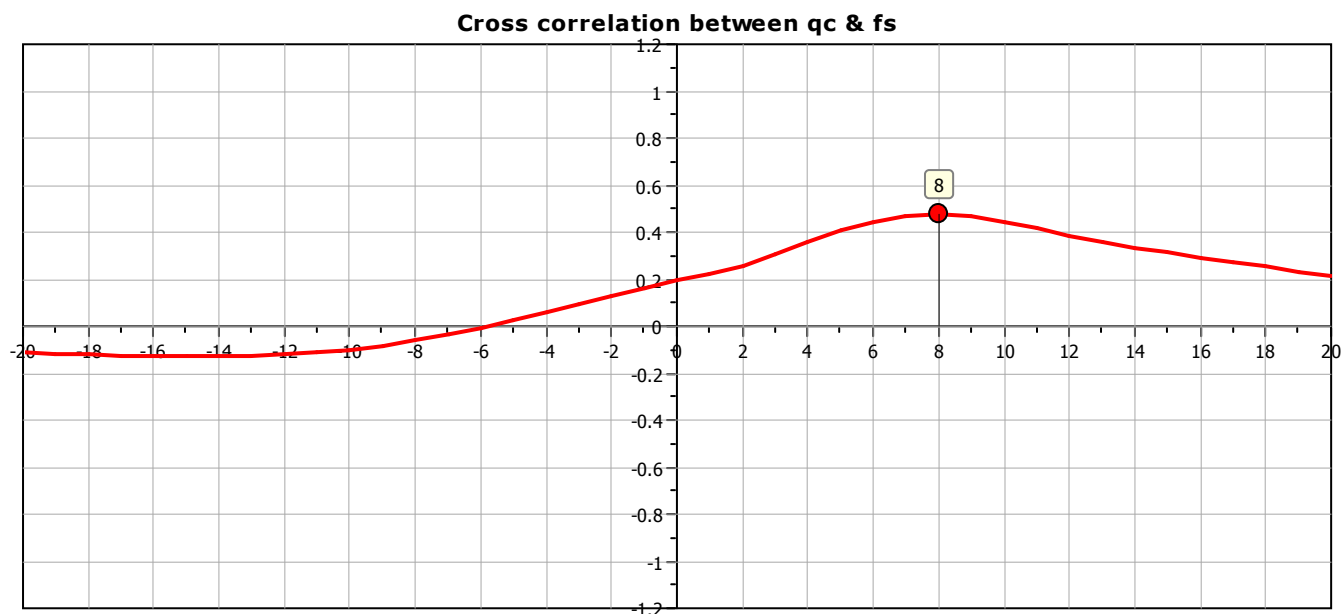
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

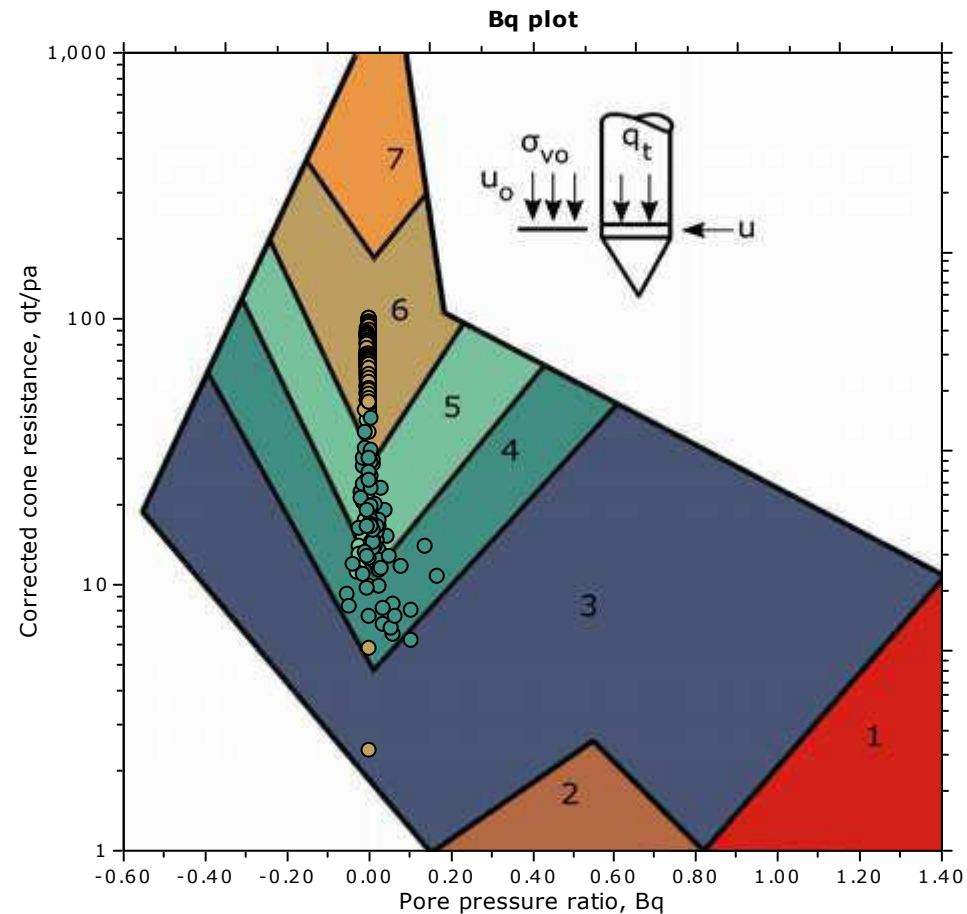
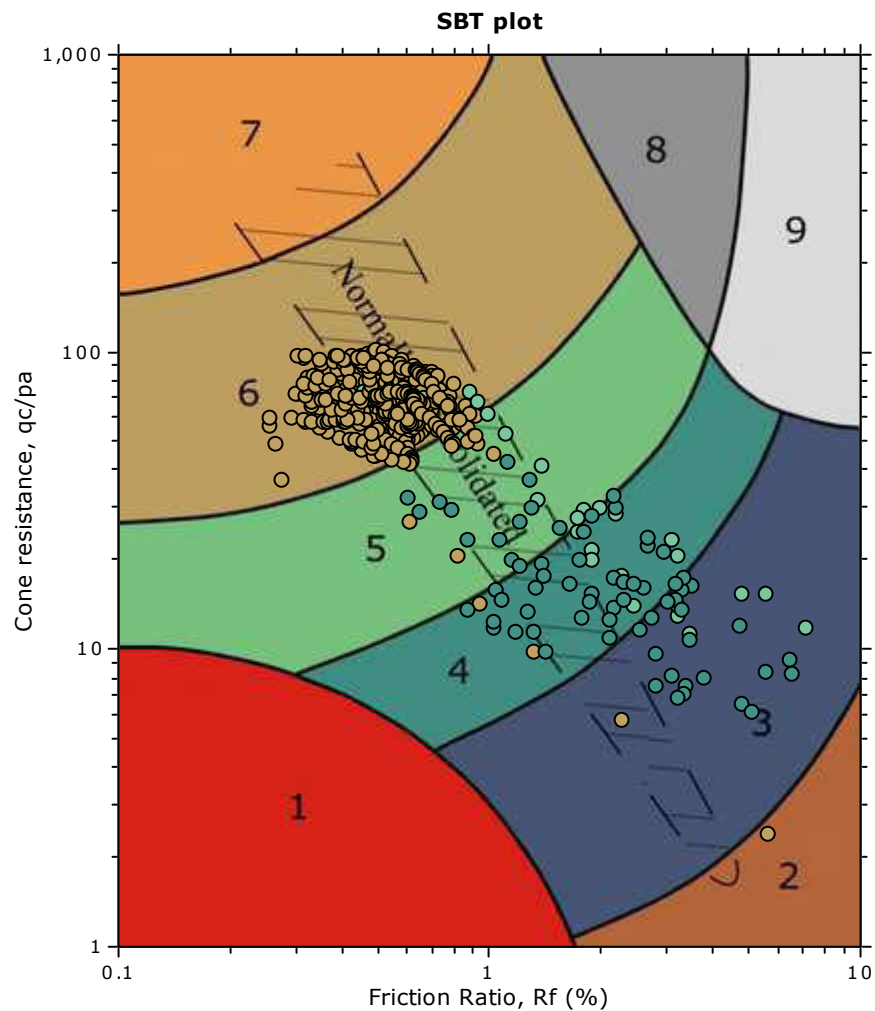




The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



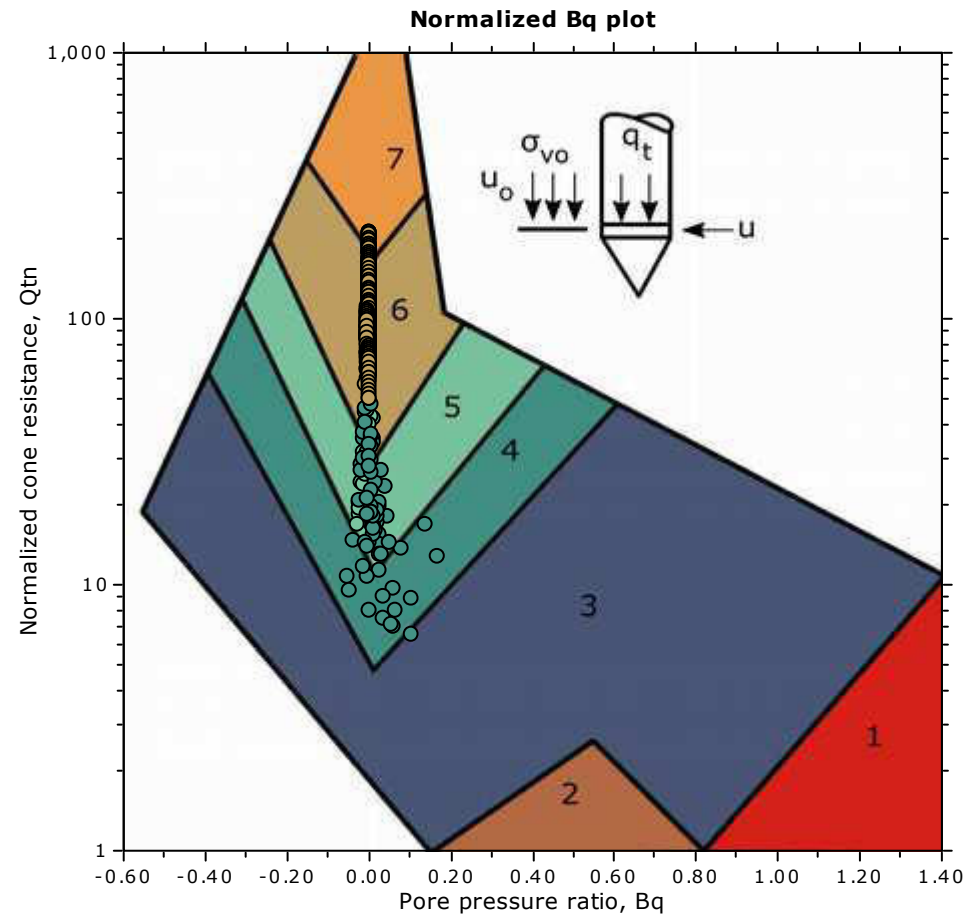
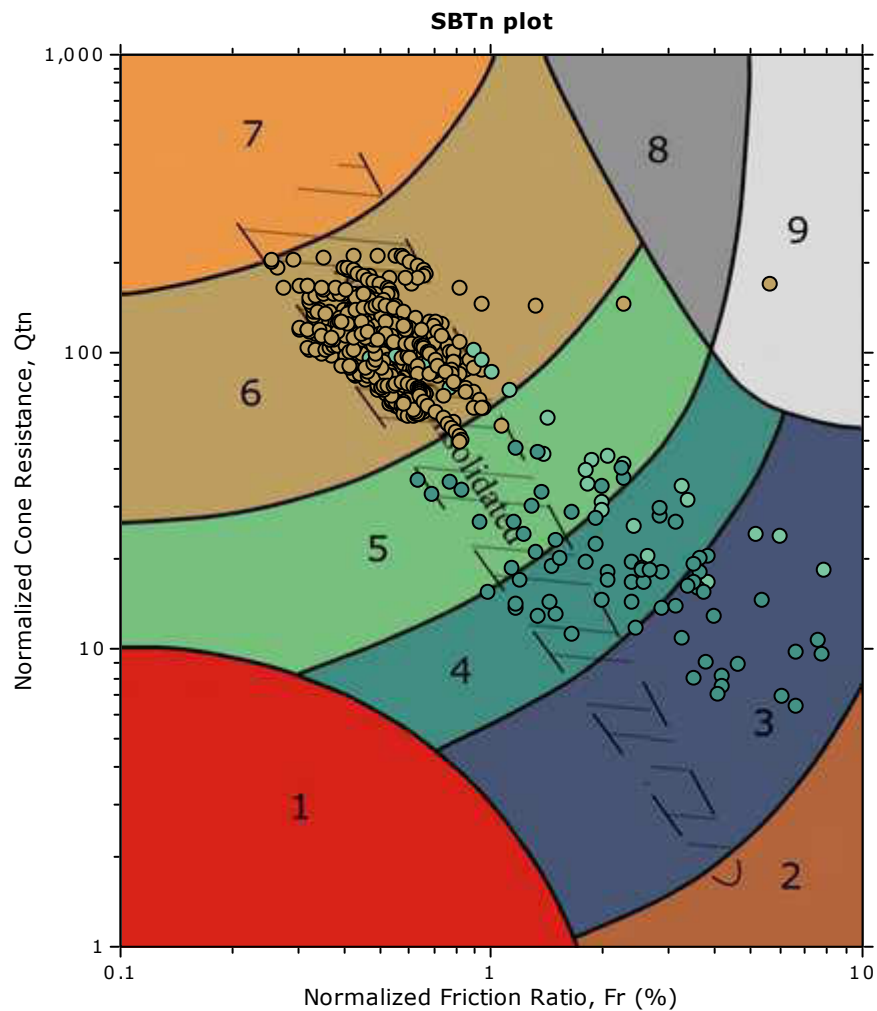
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

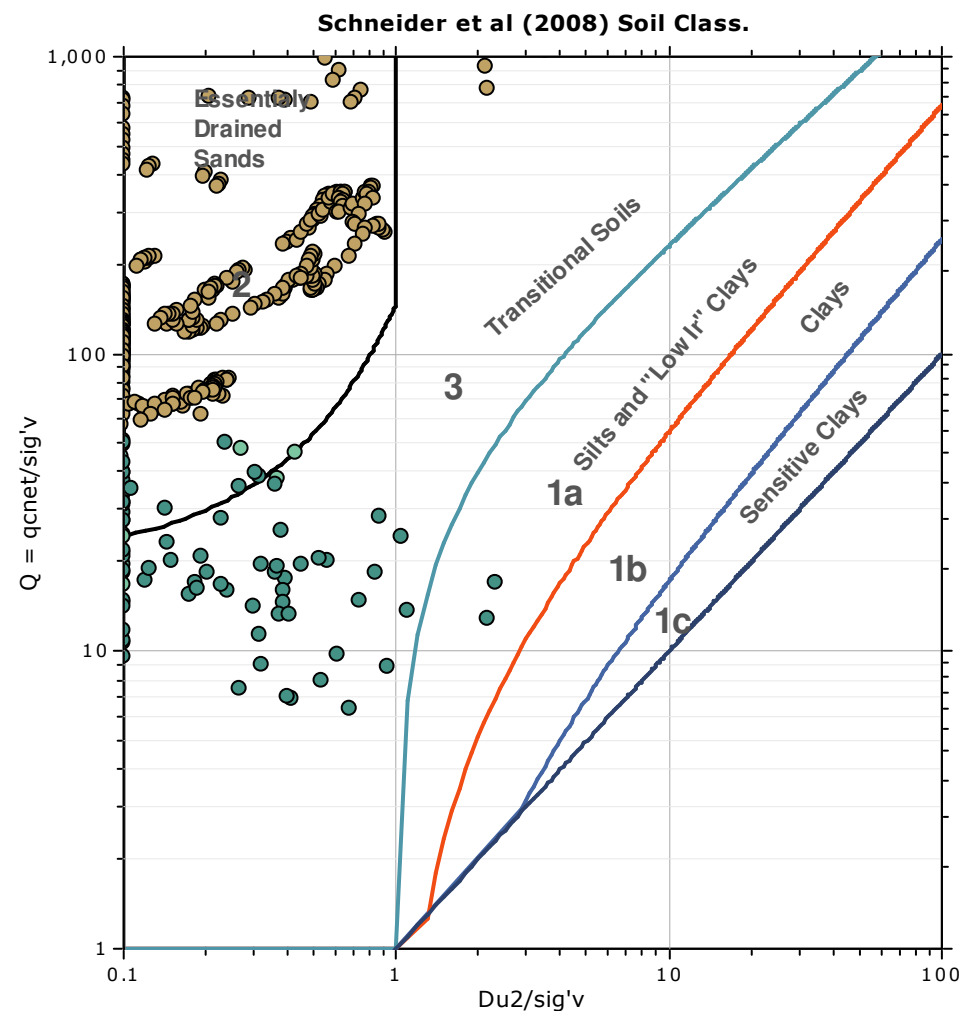
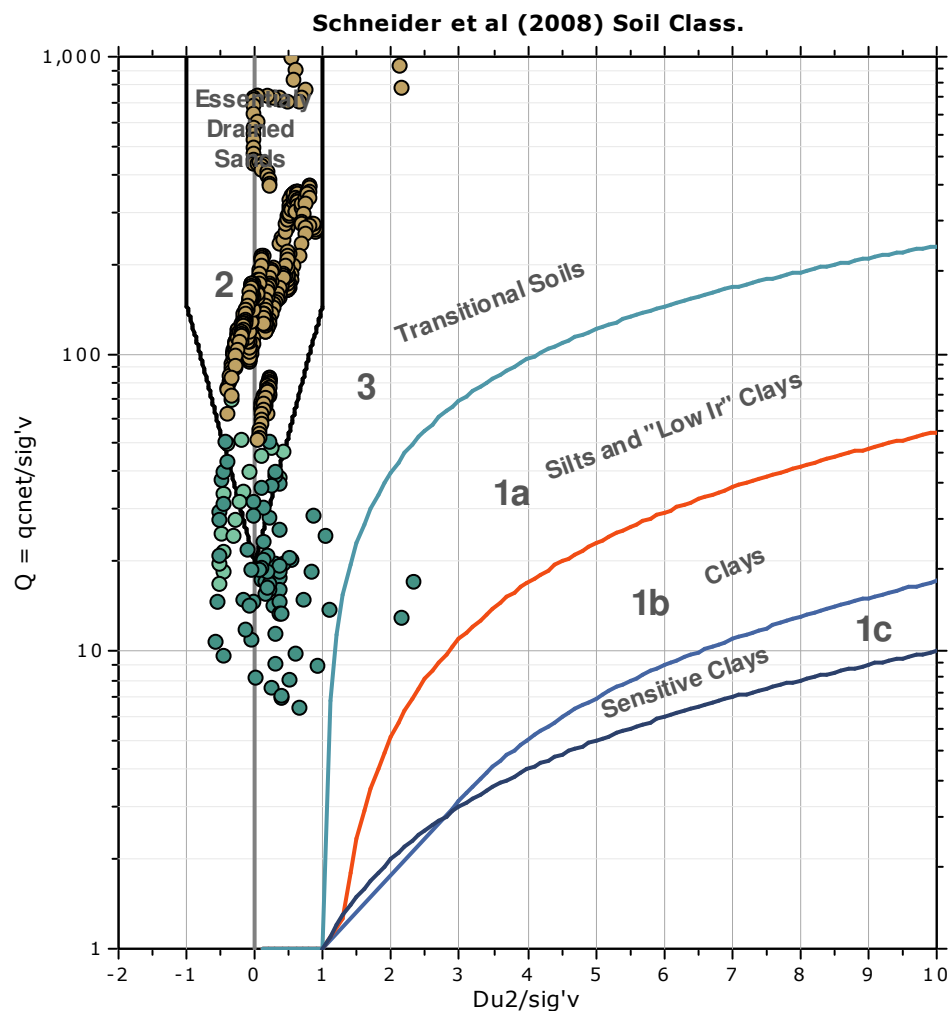
**SBT - Bq plots (normalized)**

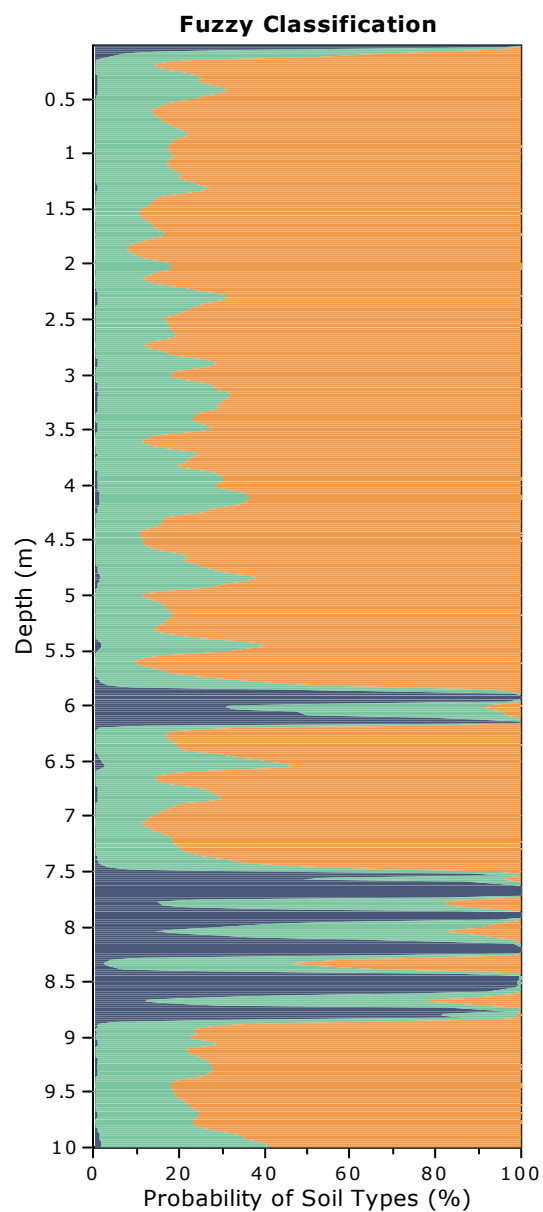
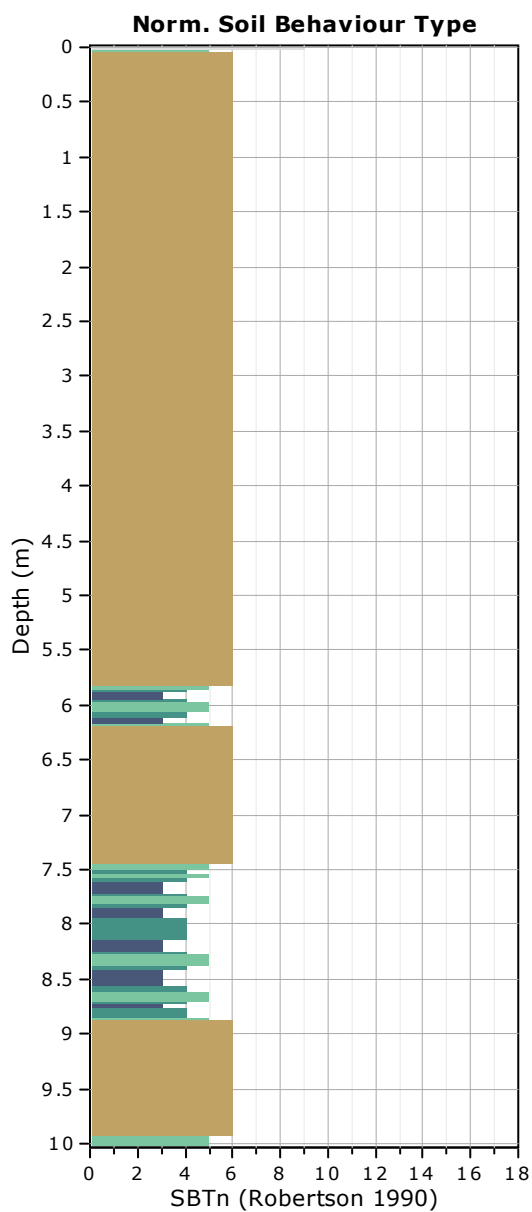


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





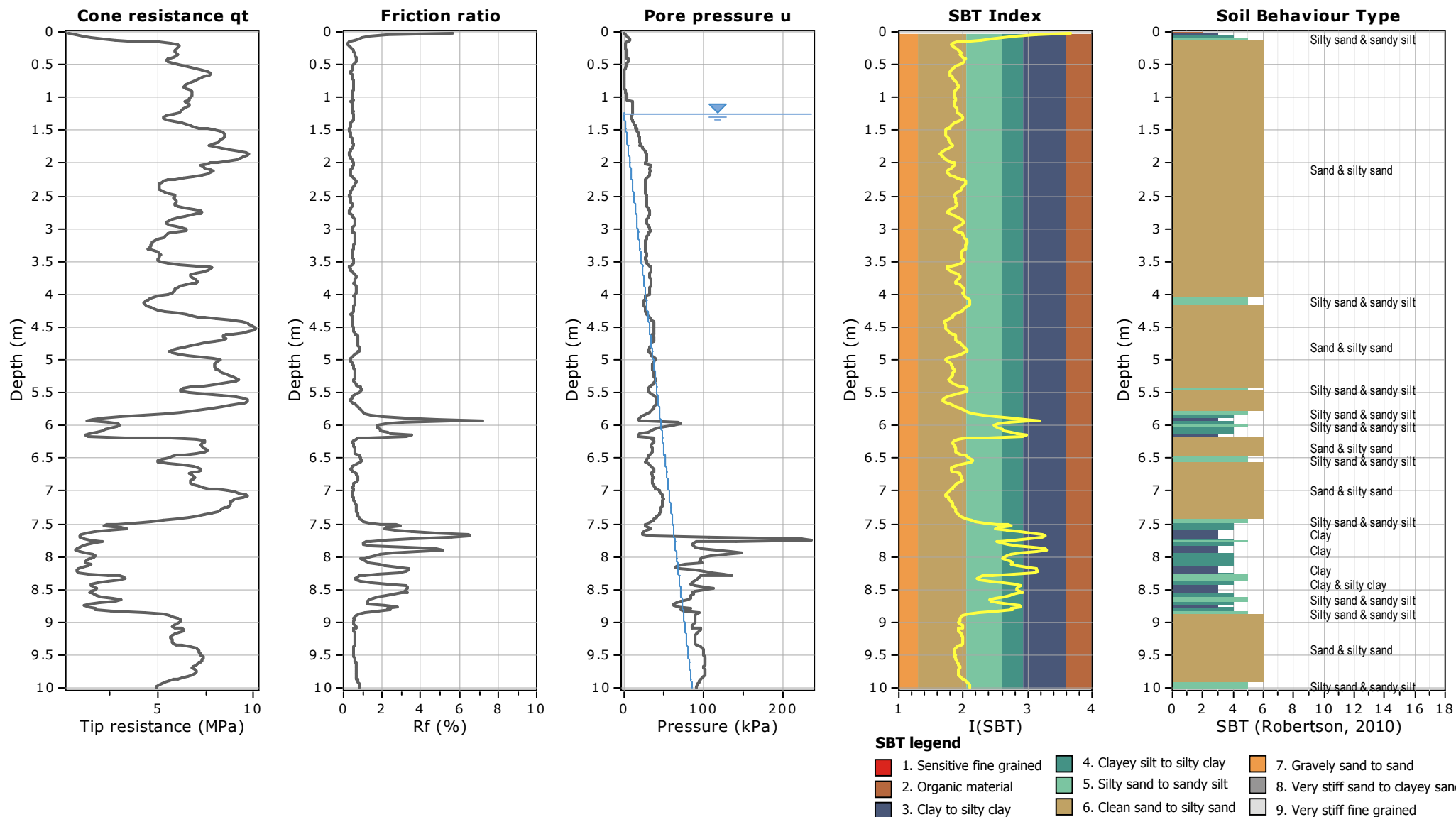
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+400**

Total depth: 10.00 m

Coords: lat 44.871585° lon 12.191658°





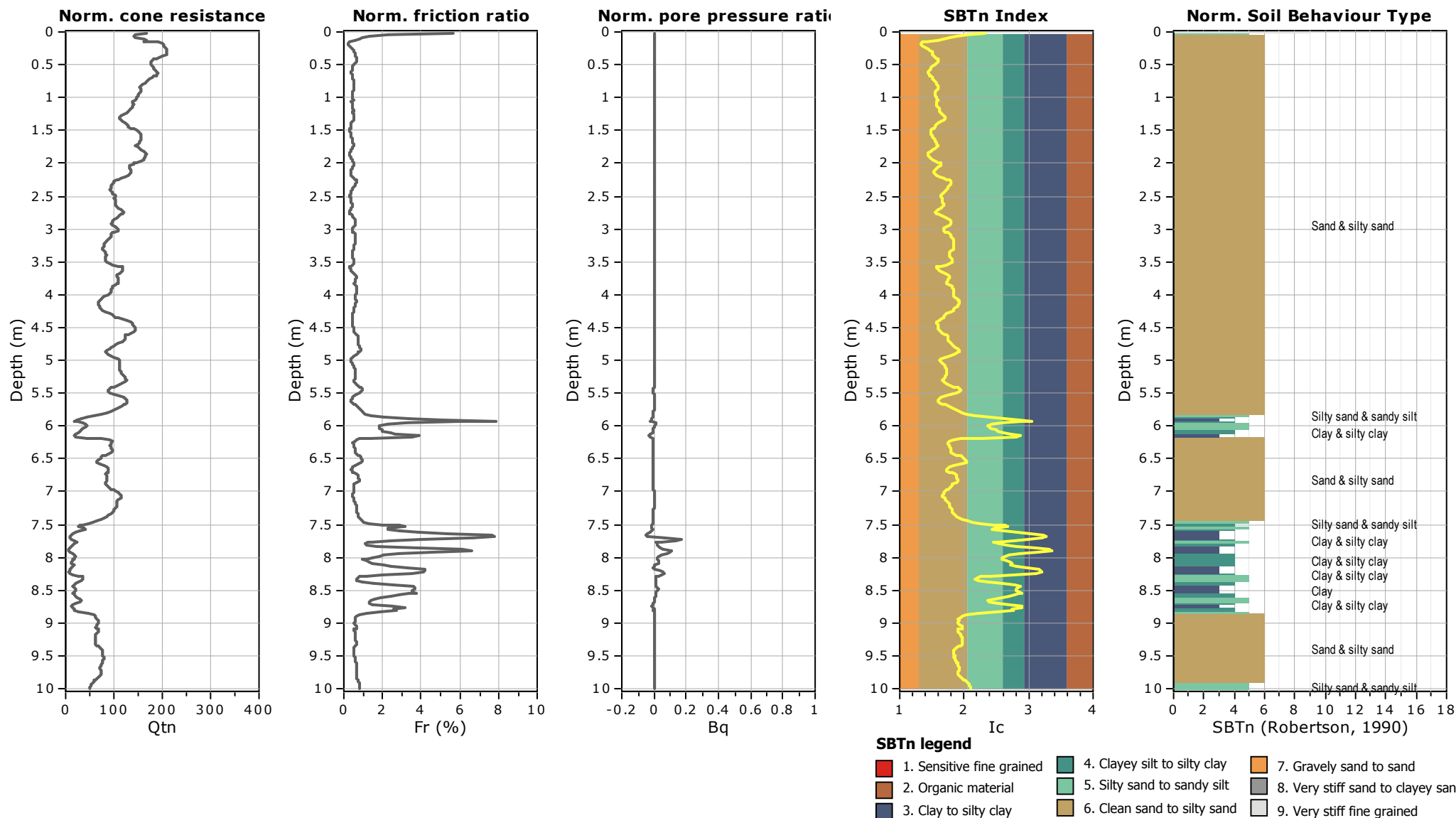
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+400**

Total depth: 10.00 m

Coords: lat 44.871585° lon 12.191658°



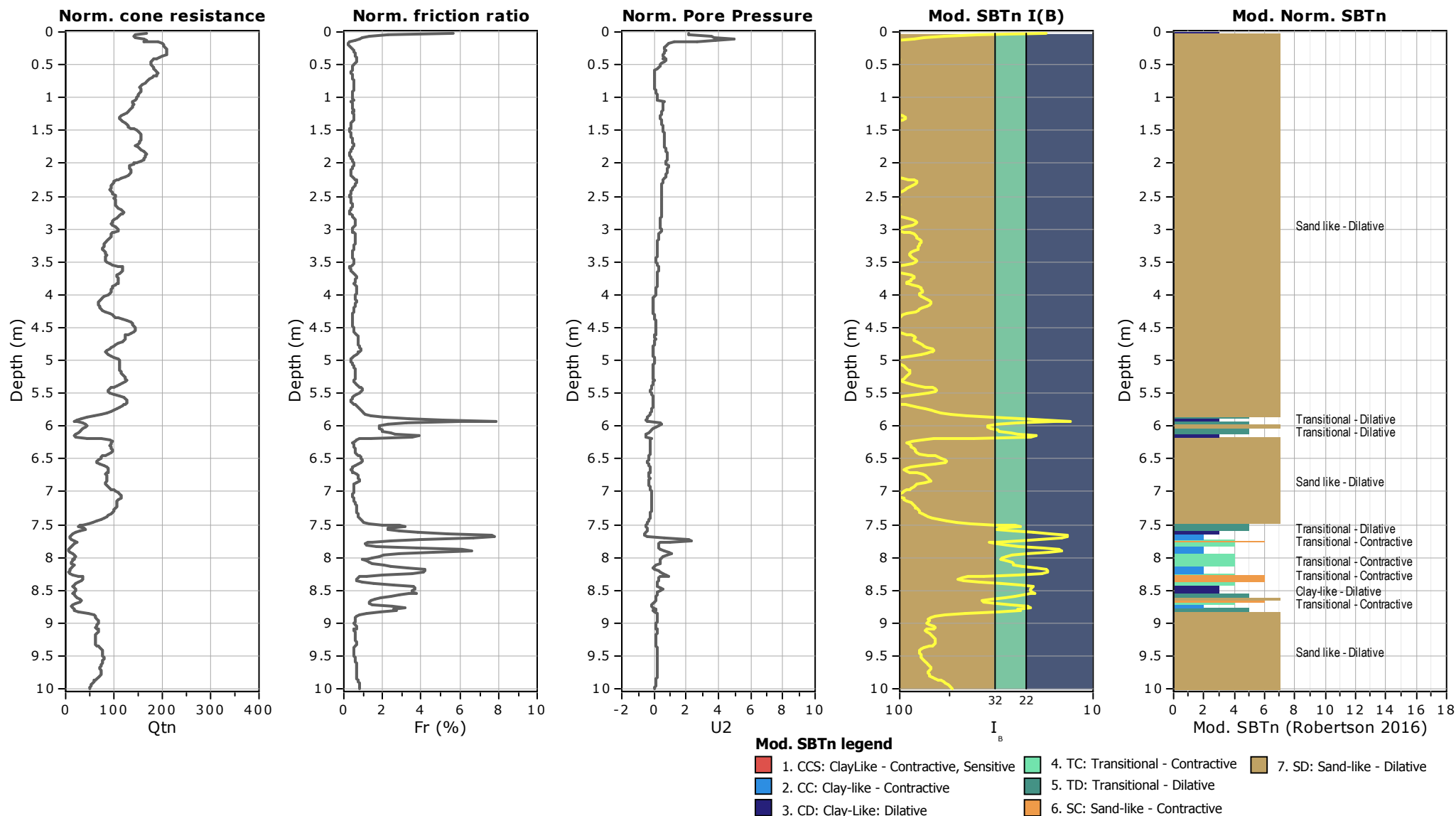
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

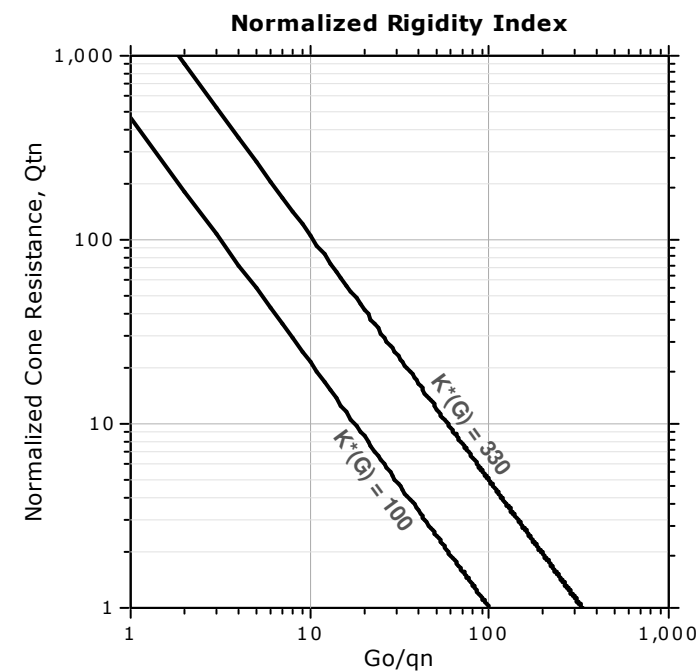
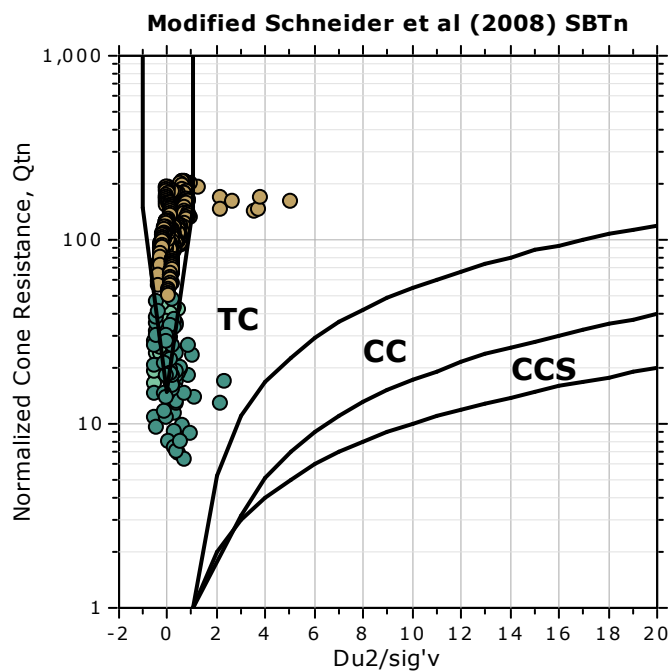
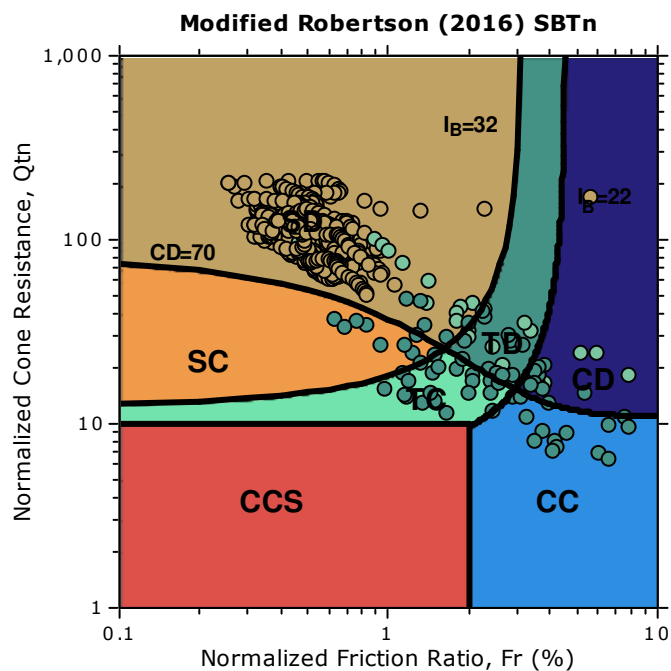
**CPT: CPTU km48+400**

Total depth: 10.00 m

Coords: lat 44.871585° lon 12.191658°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

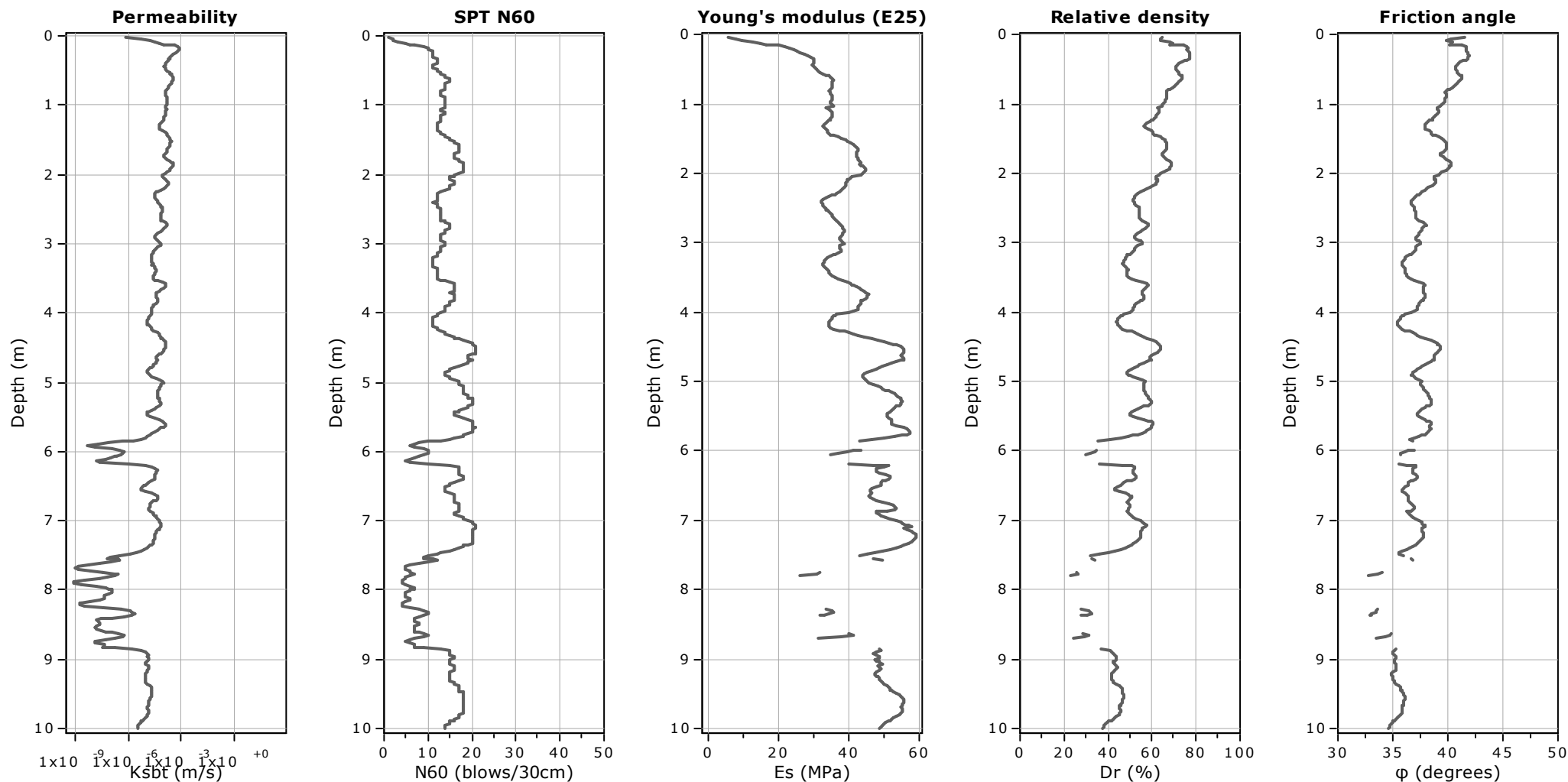
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+400**

Total depth: 10.00 m

Coords: lat 44.871585° lon 12.191658°



**Calculation parameters**

Permeability: Based on  $SBT_n$

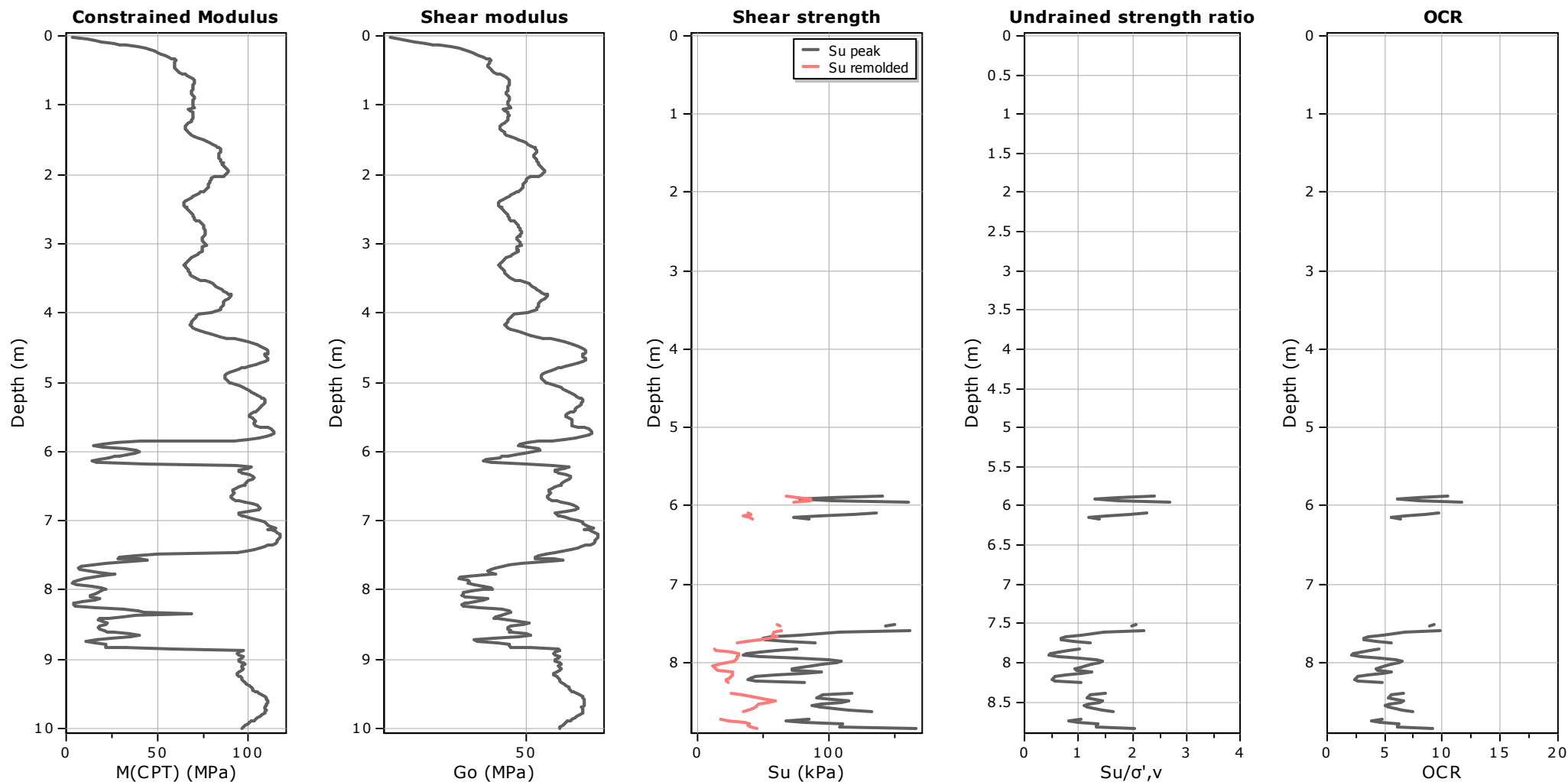
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

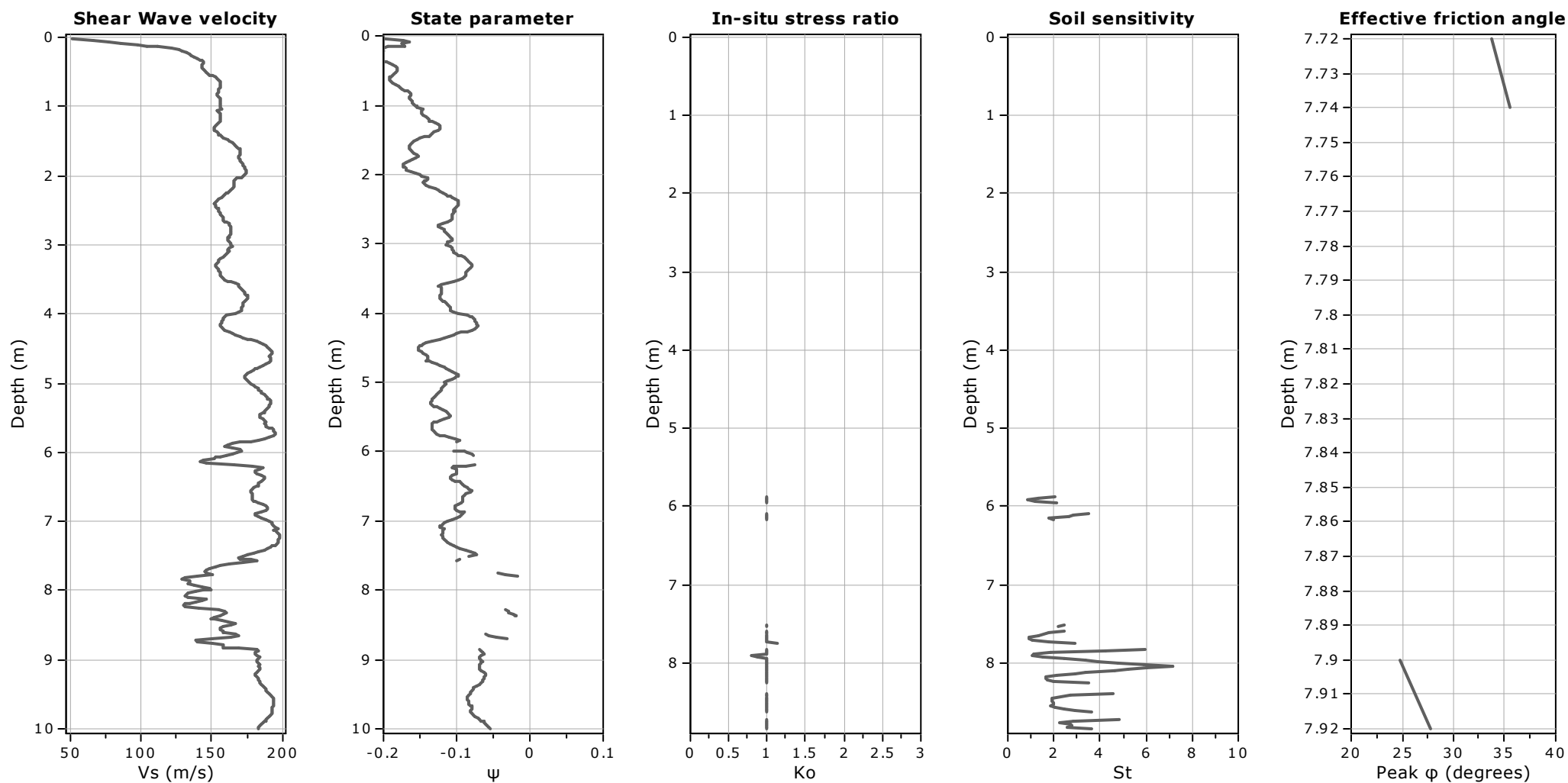
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+400**

Total depth: 10.00 m

Coords: lat 44.871585° lon 12.191658°

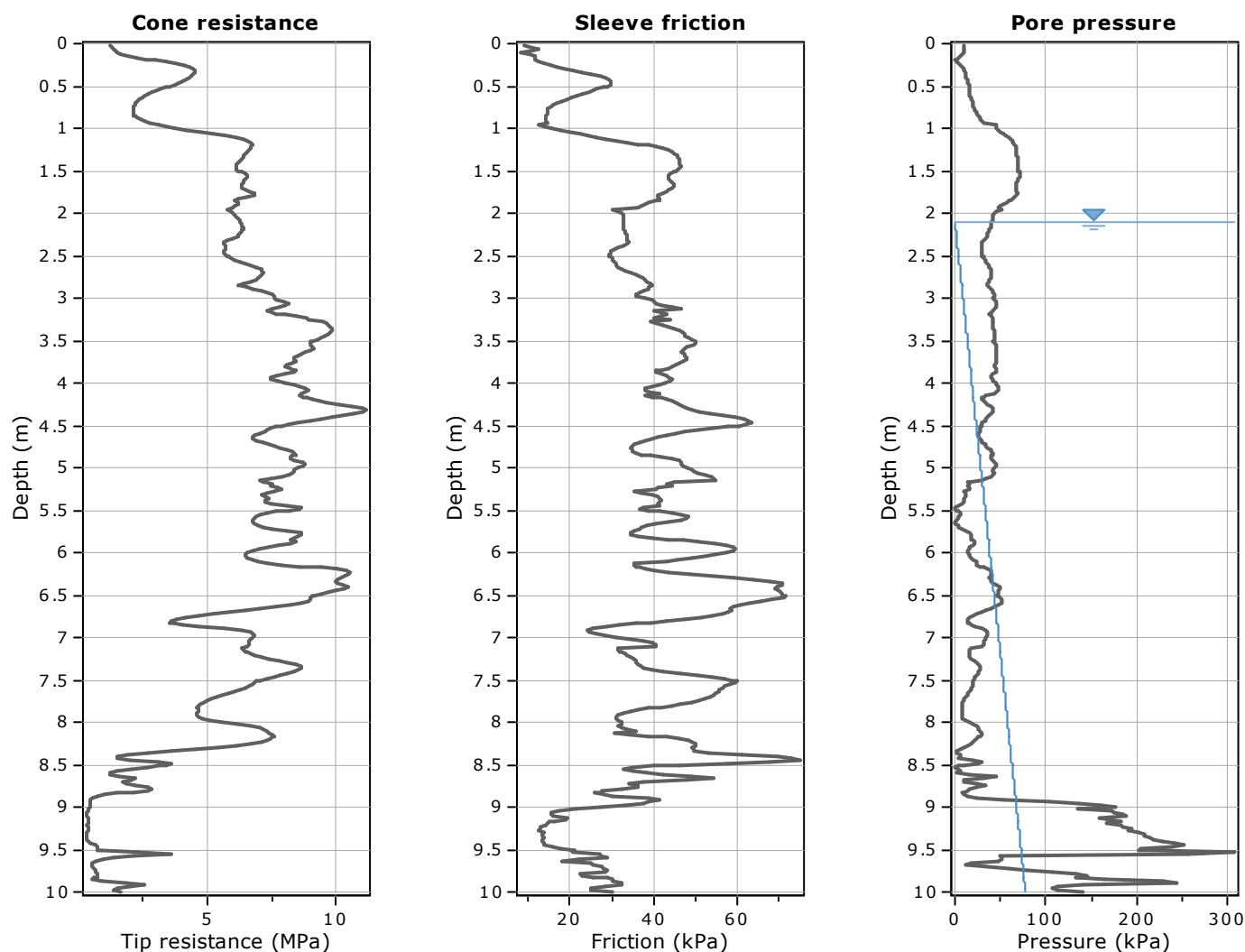


#### Calculation parameters

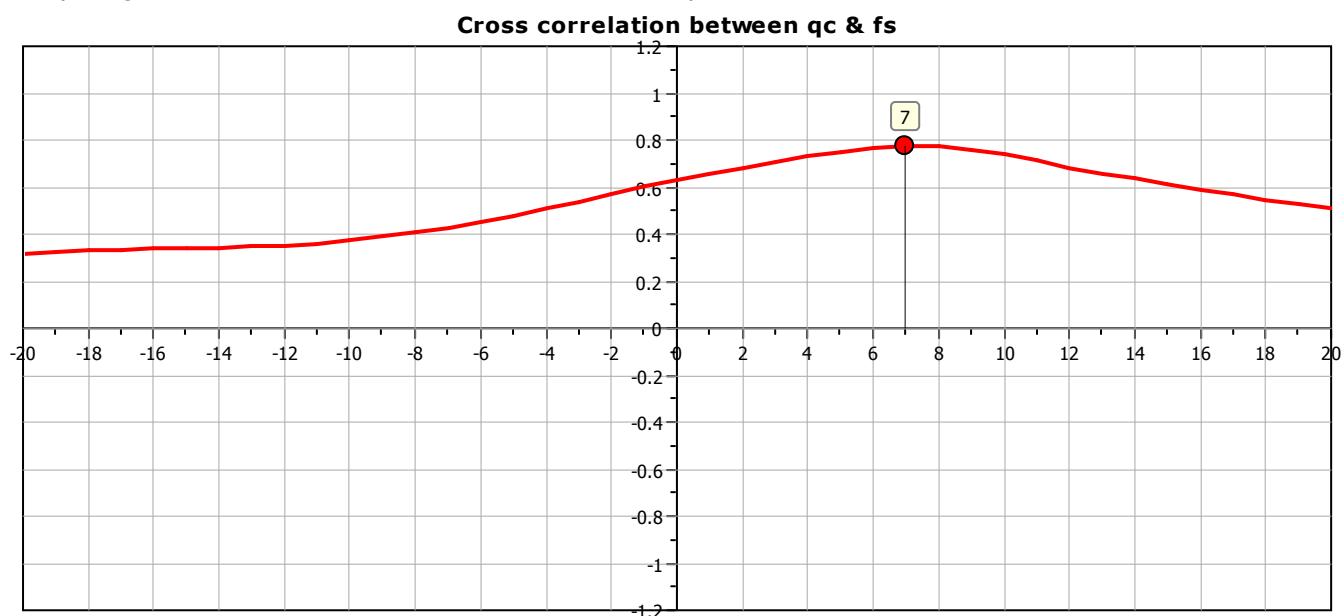
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

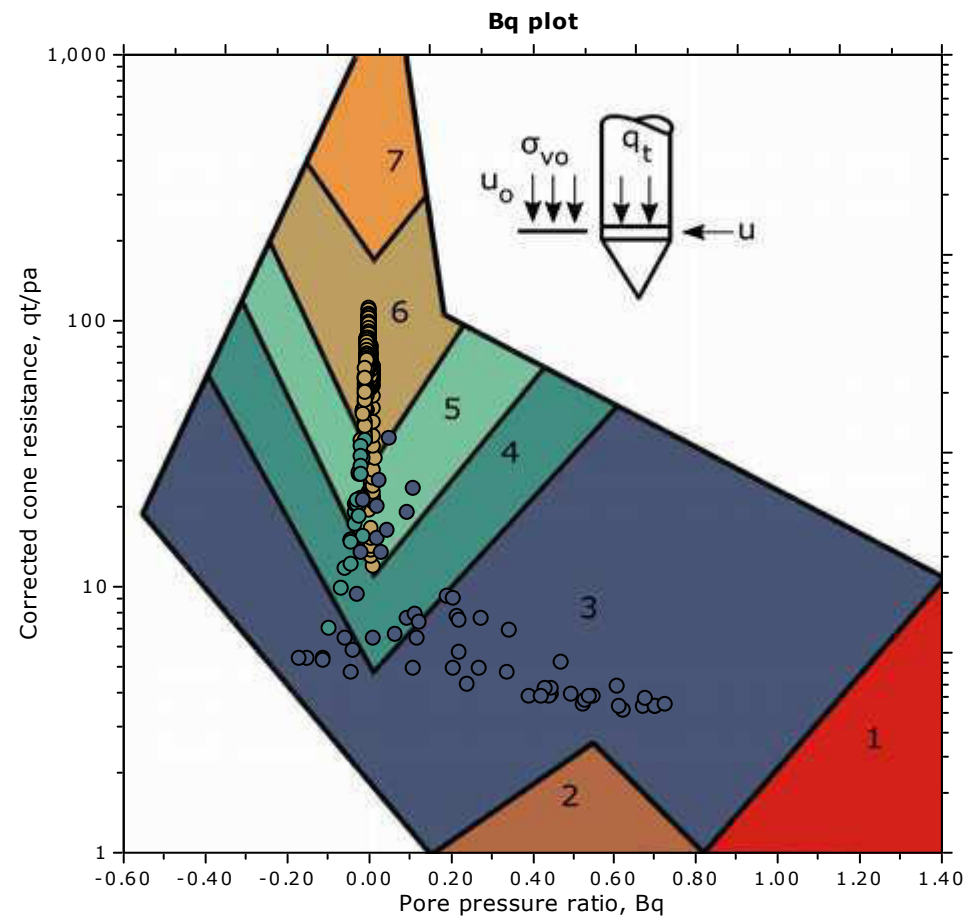
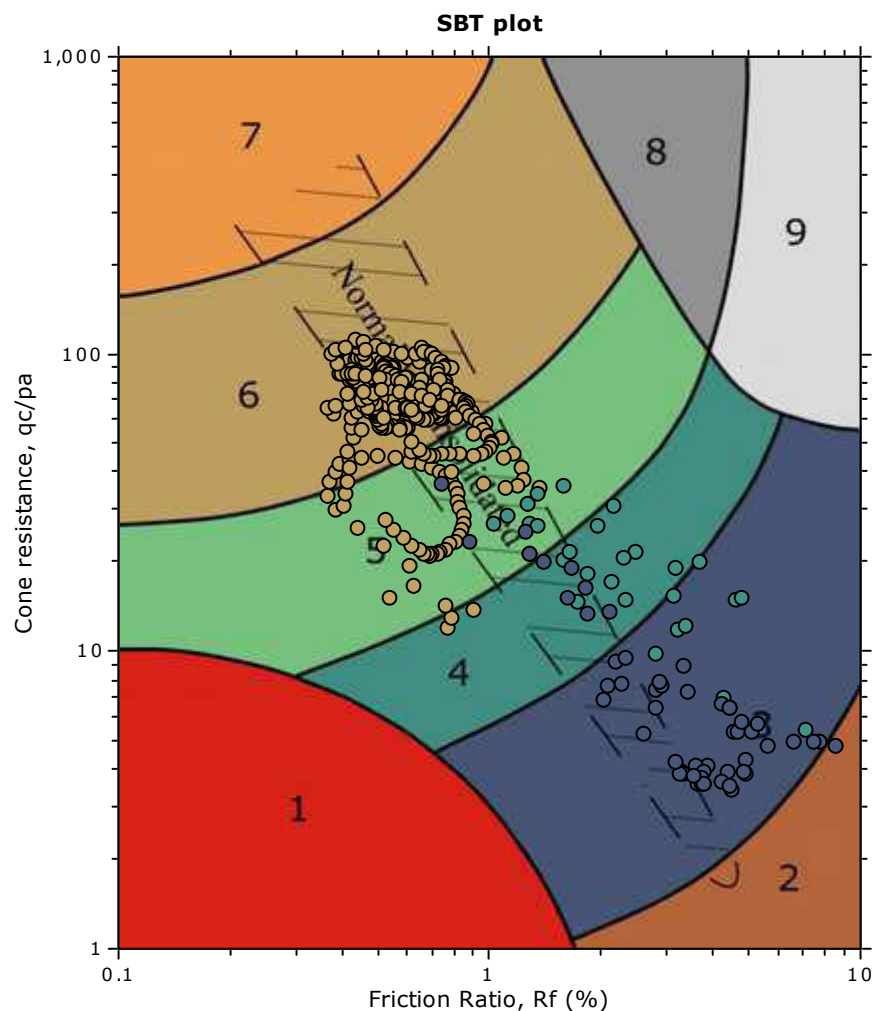




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



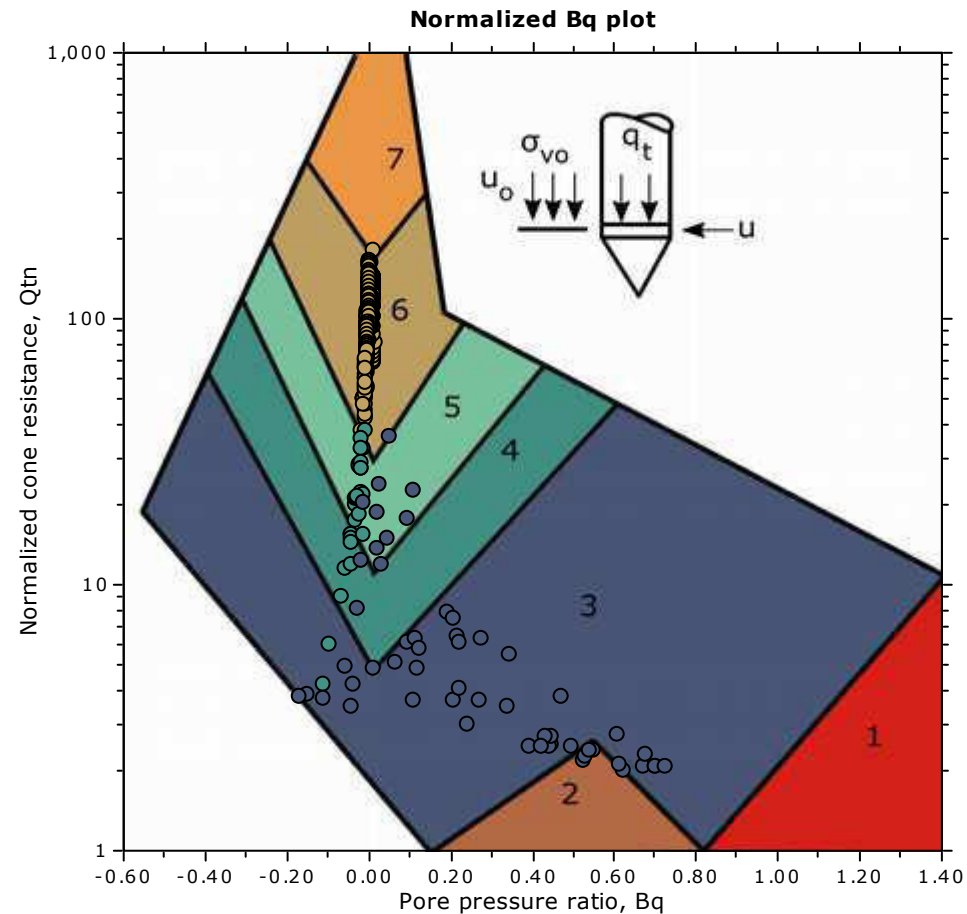
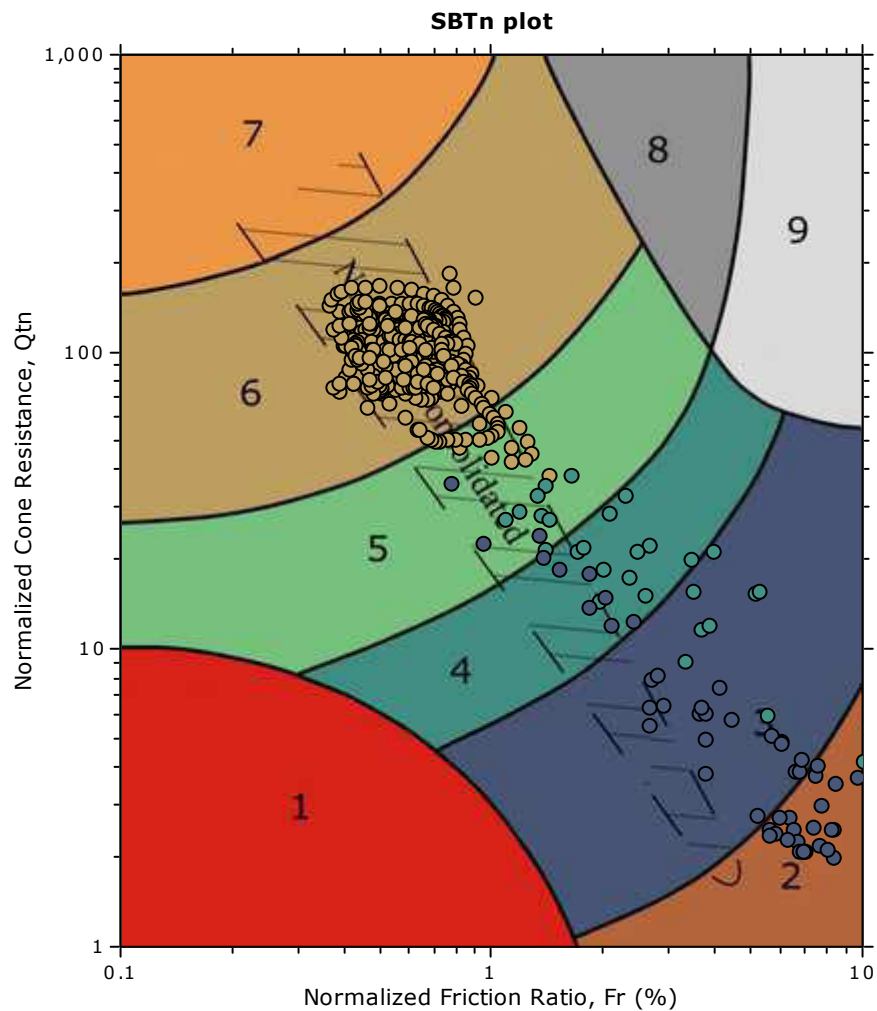
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

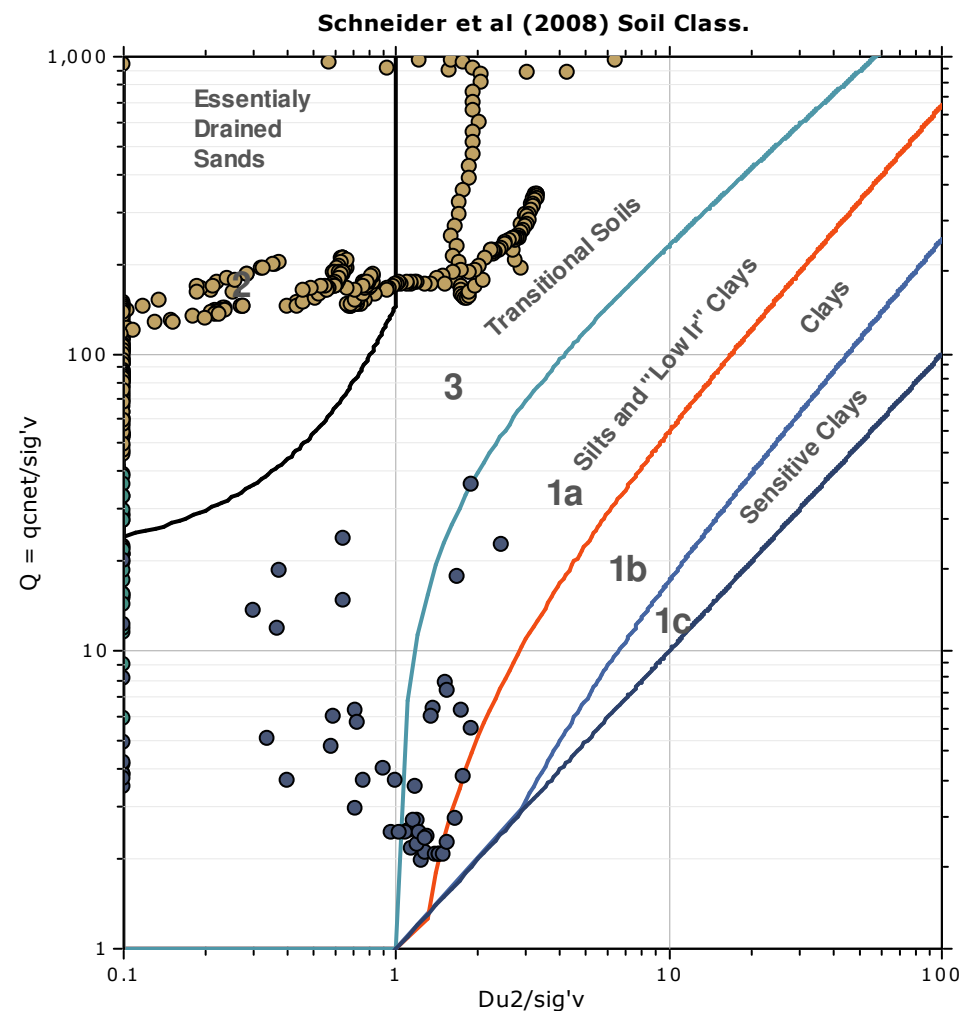
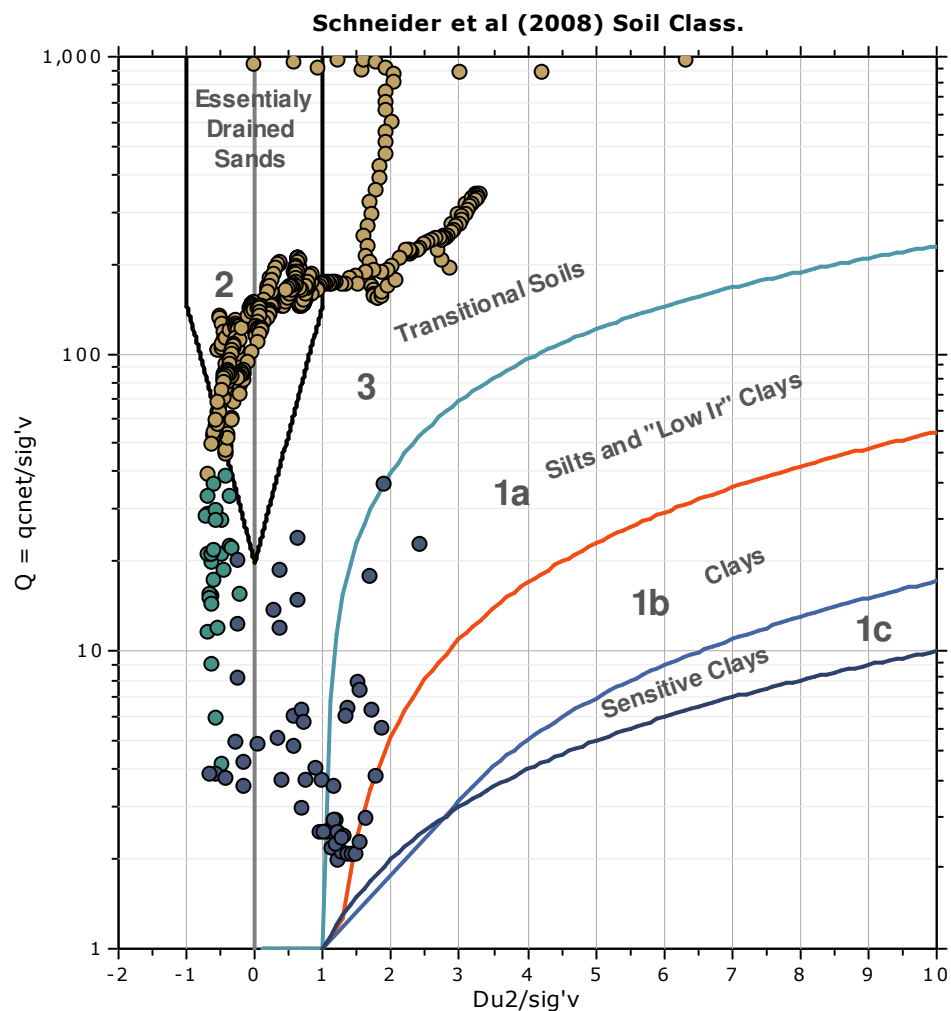
**SBT - Bq plots (normalized)**

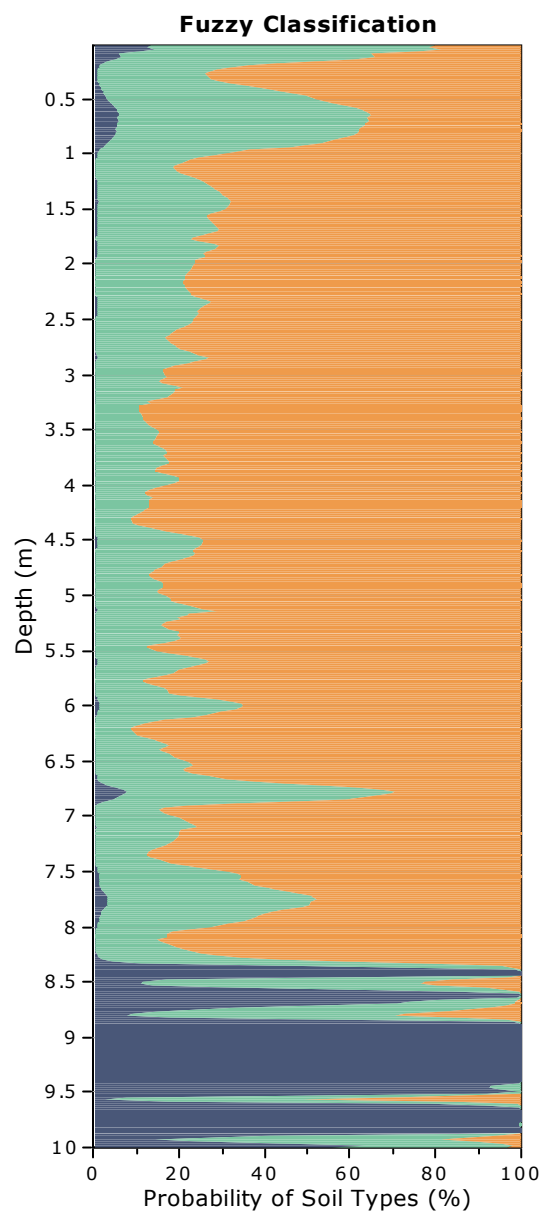
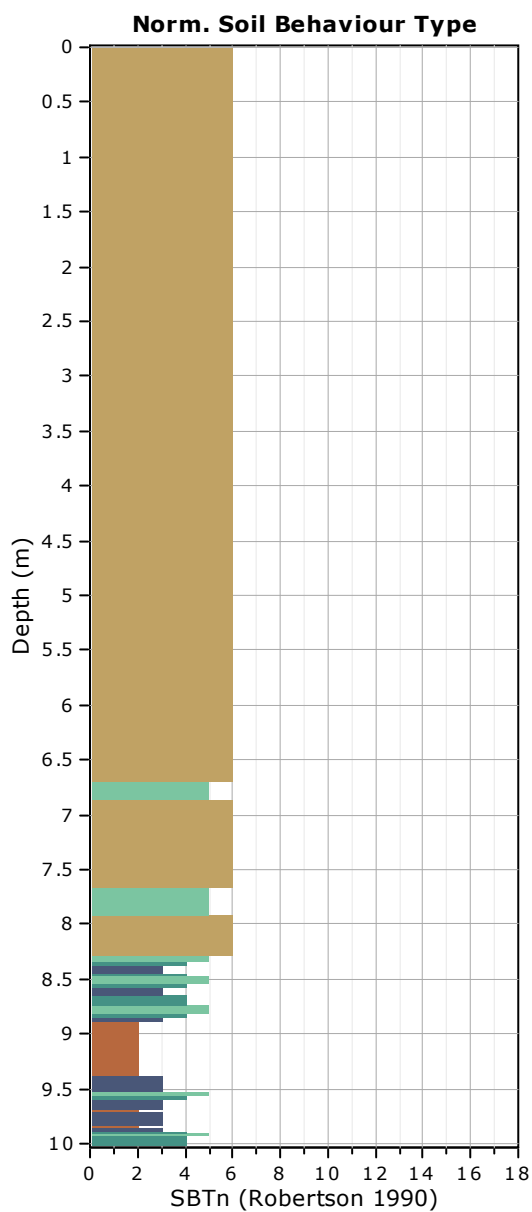


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





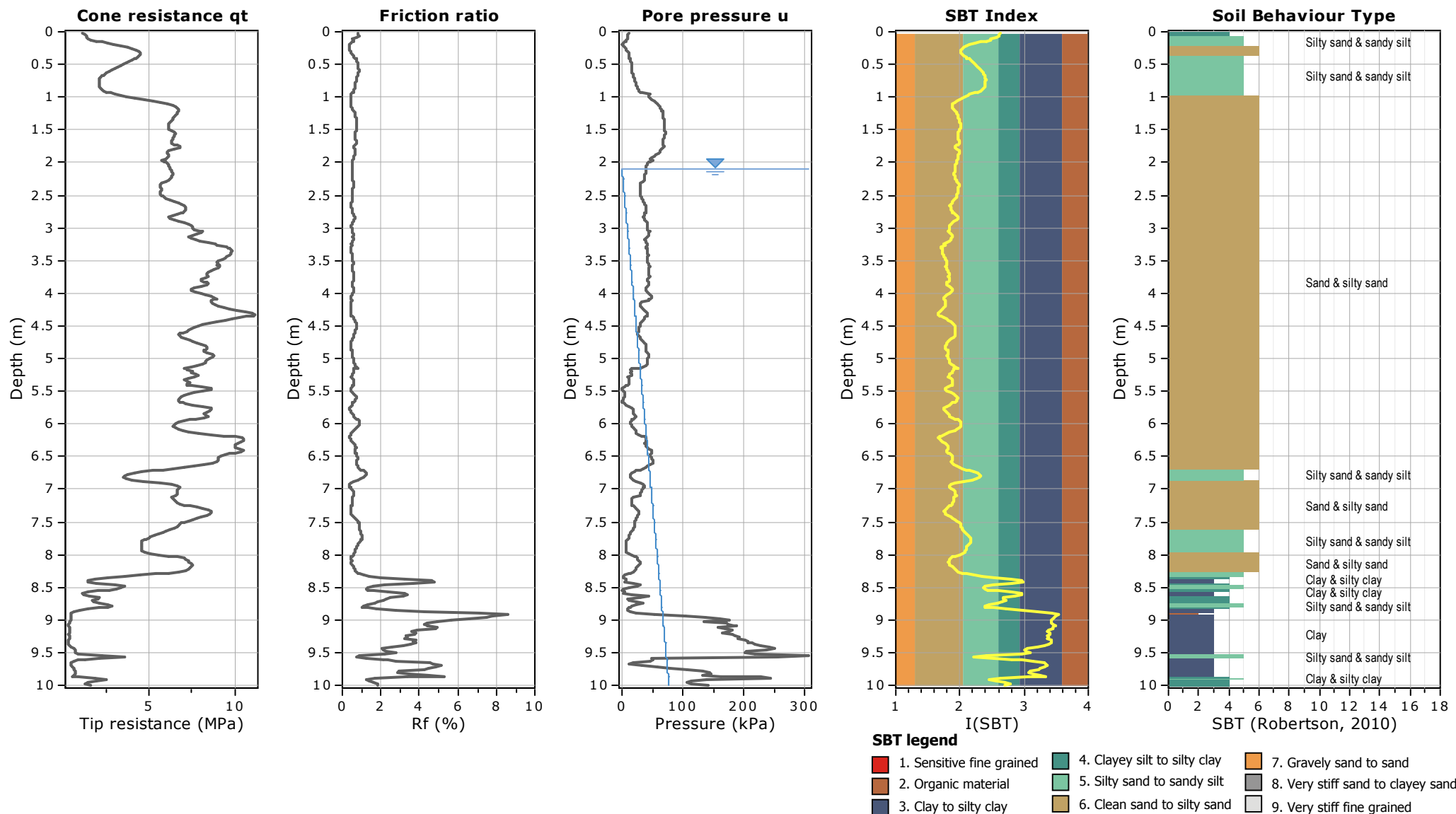
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

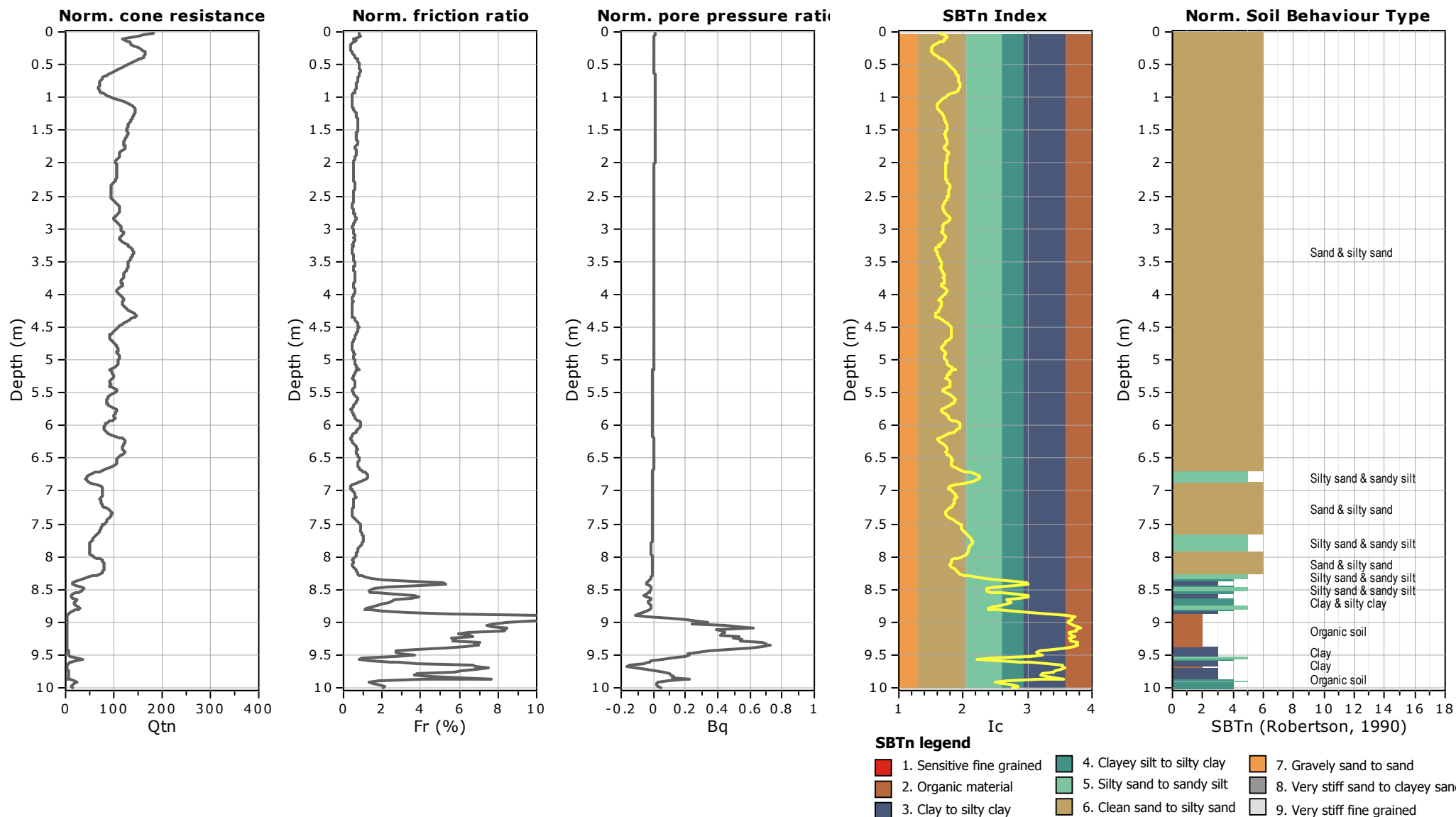
**CPT: CPTU km48+800**

Total depth: 10.00 m

Coords: lat 44.873898° lon 12.194575°







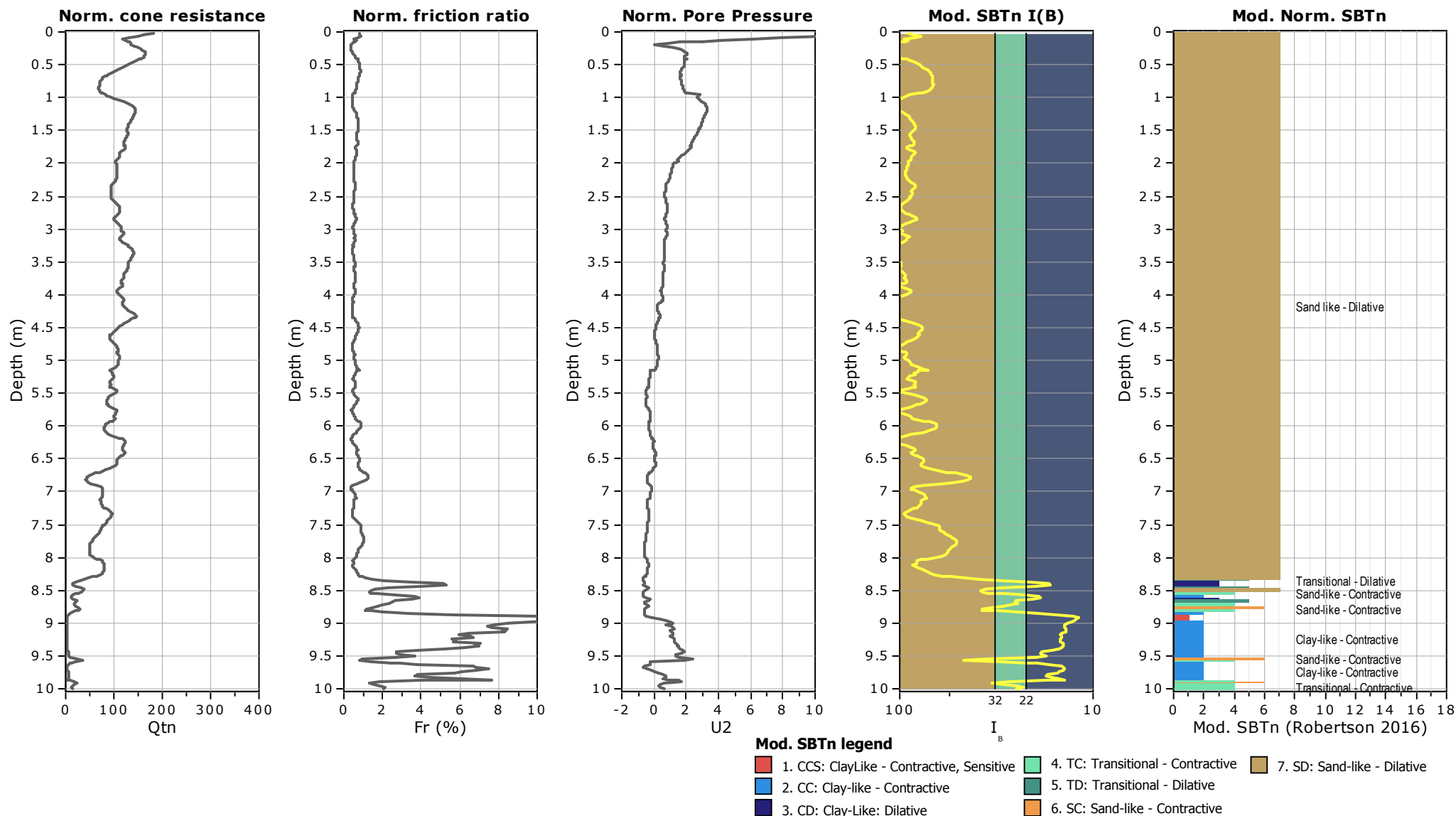
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

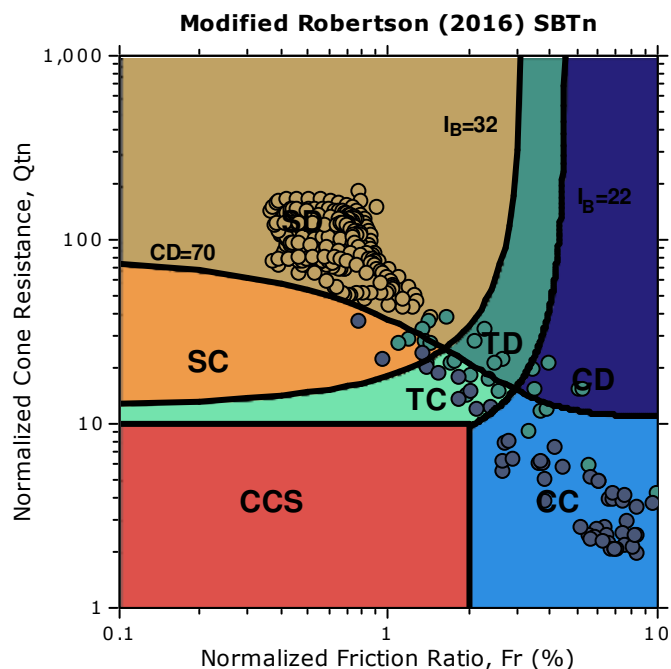
**CPT: CPTU km48+800**

Total depth: 10.00 m

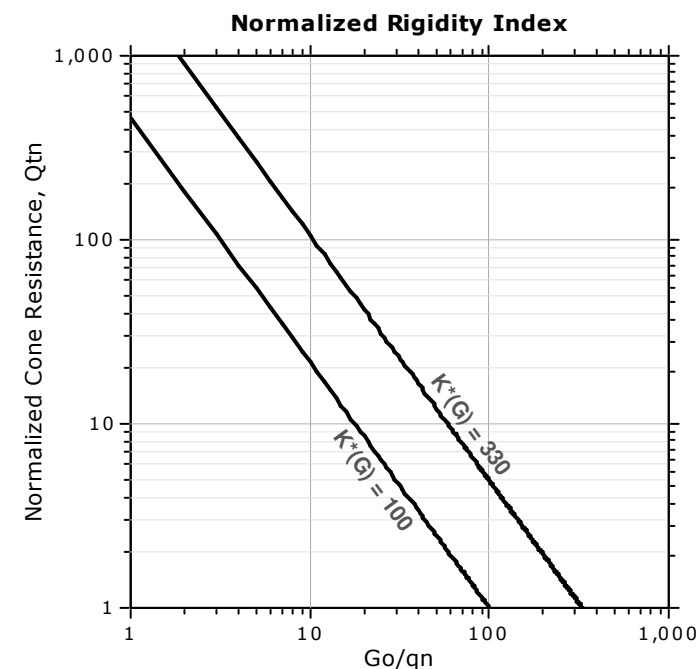
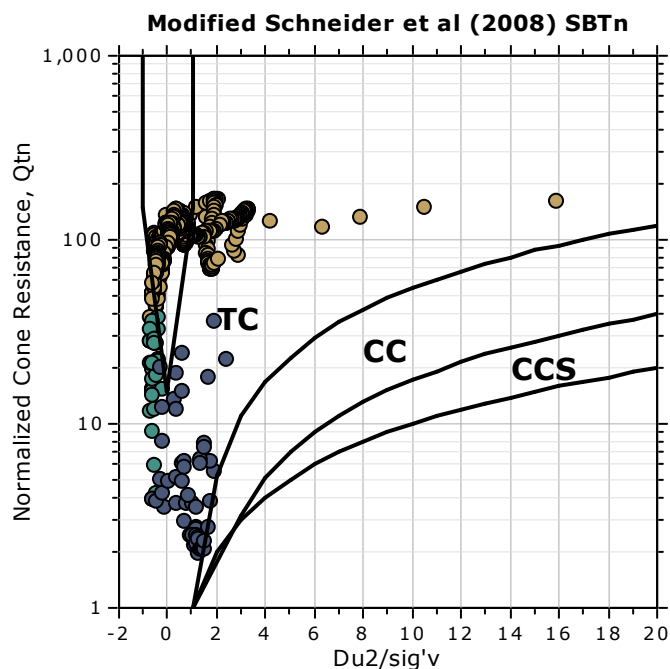
Coords: lat 44.873898° lon 12.194575°



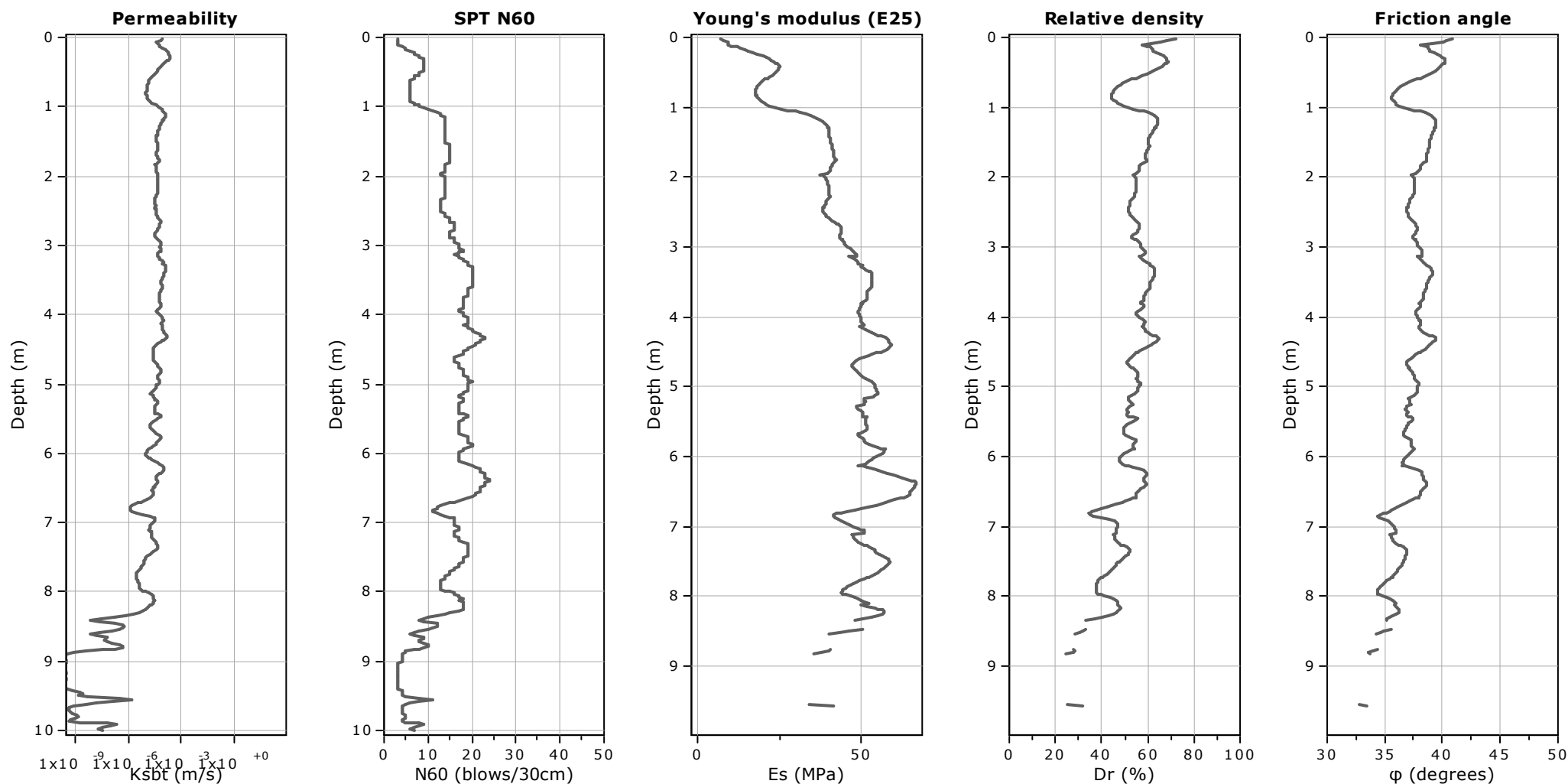
### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative



$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



**Calculation parameters**

Permeability: Based on  $SBT_n$

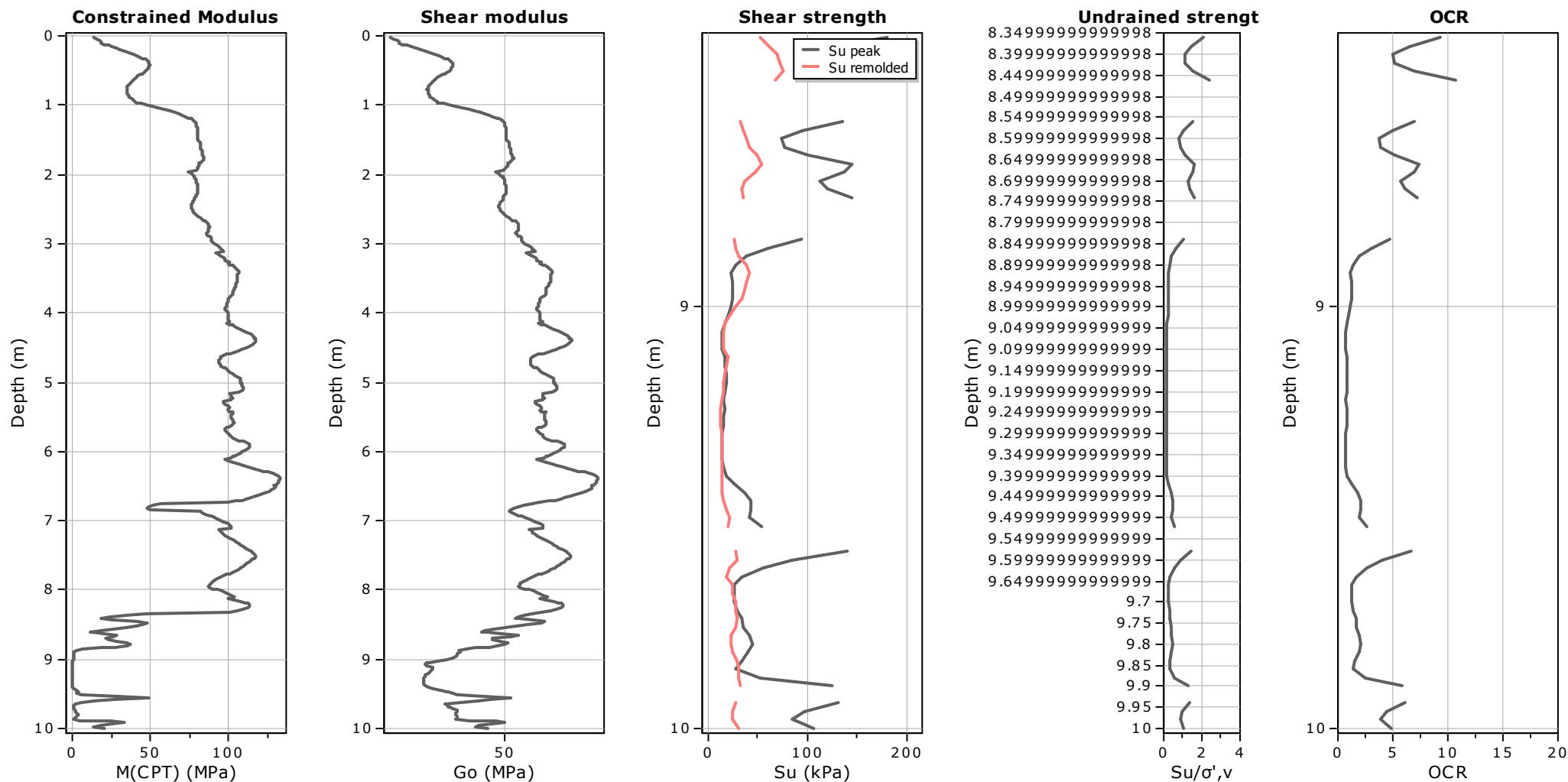
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

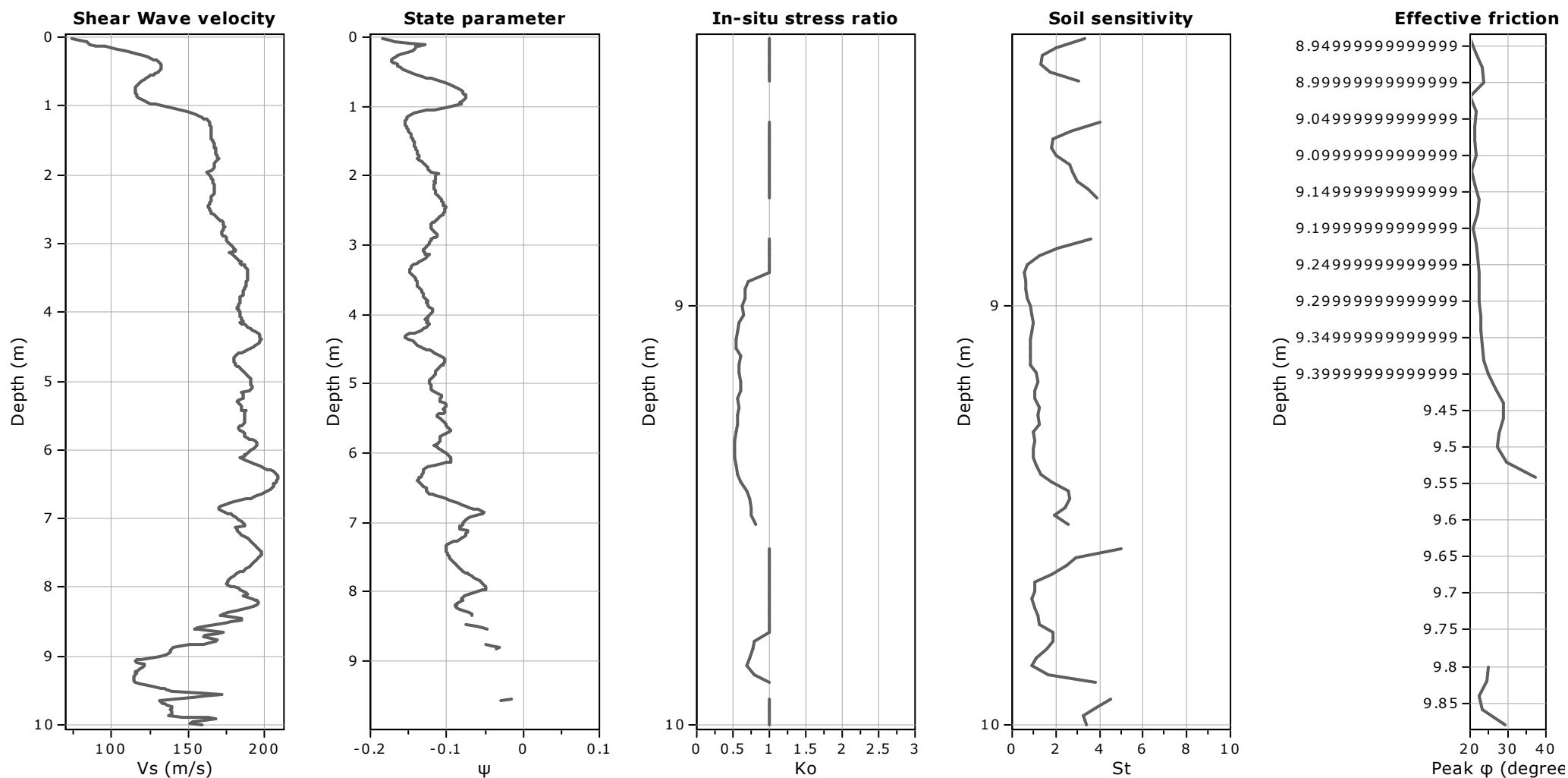
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km48+800**

Total depth: 10.00 m

Coords: lat 44.873898° lon 12.194575°

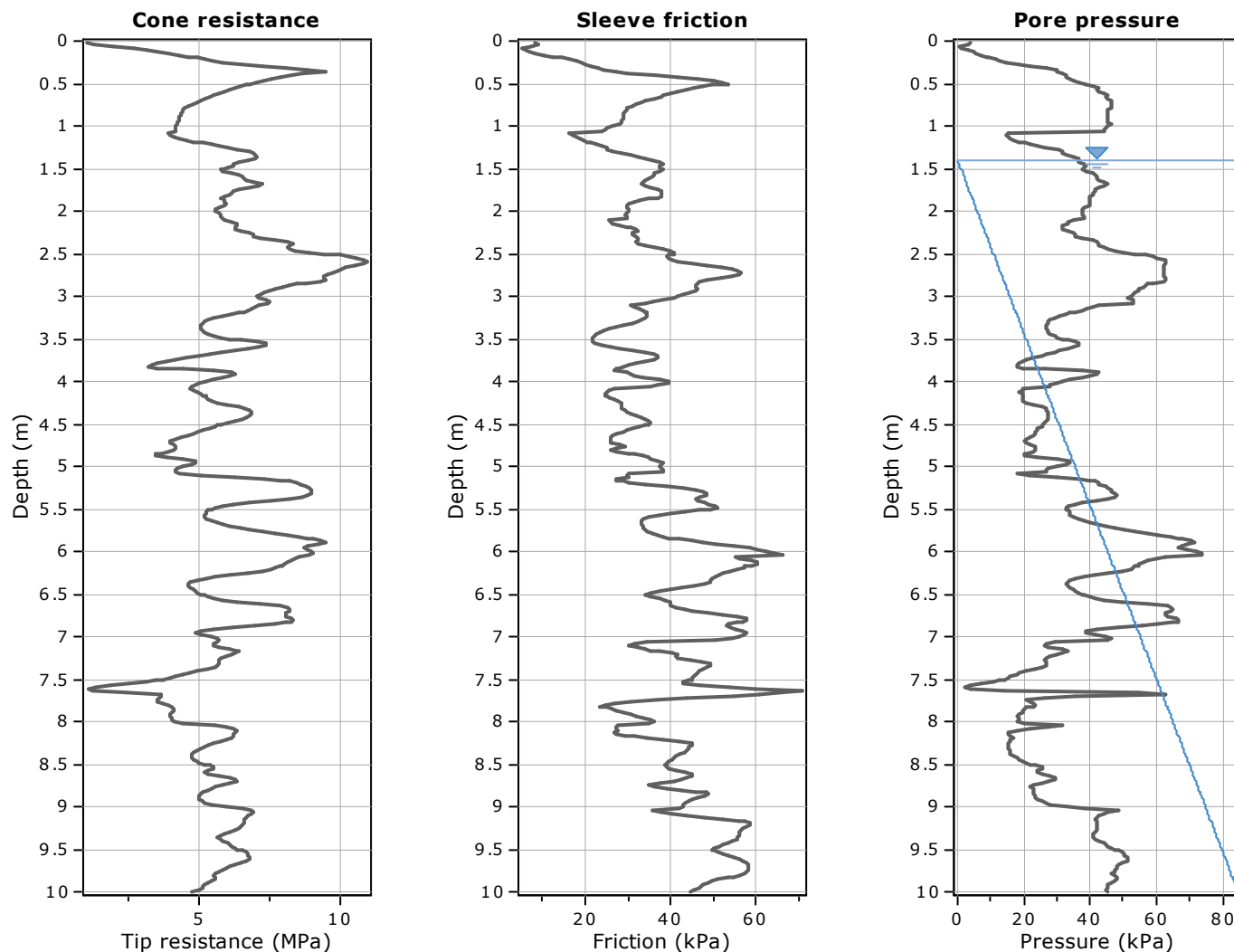


#### Calculation parameters

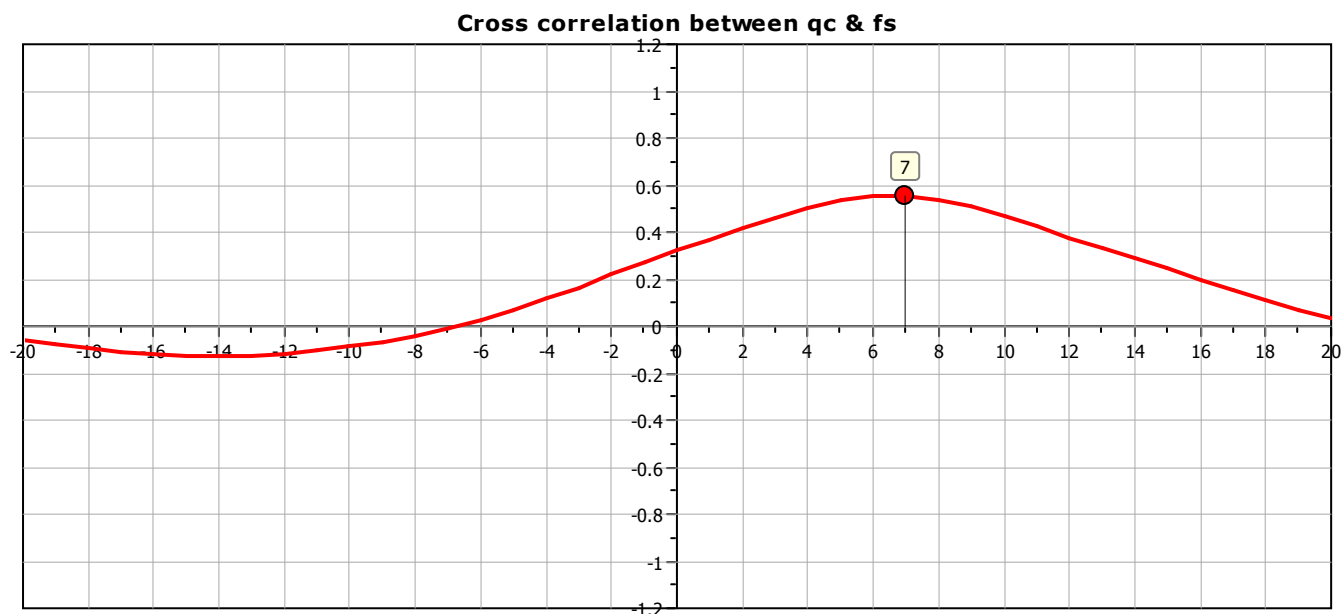
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

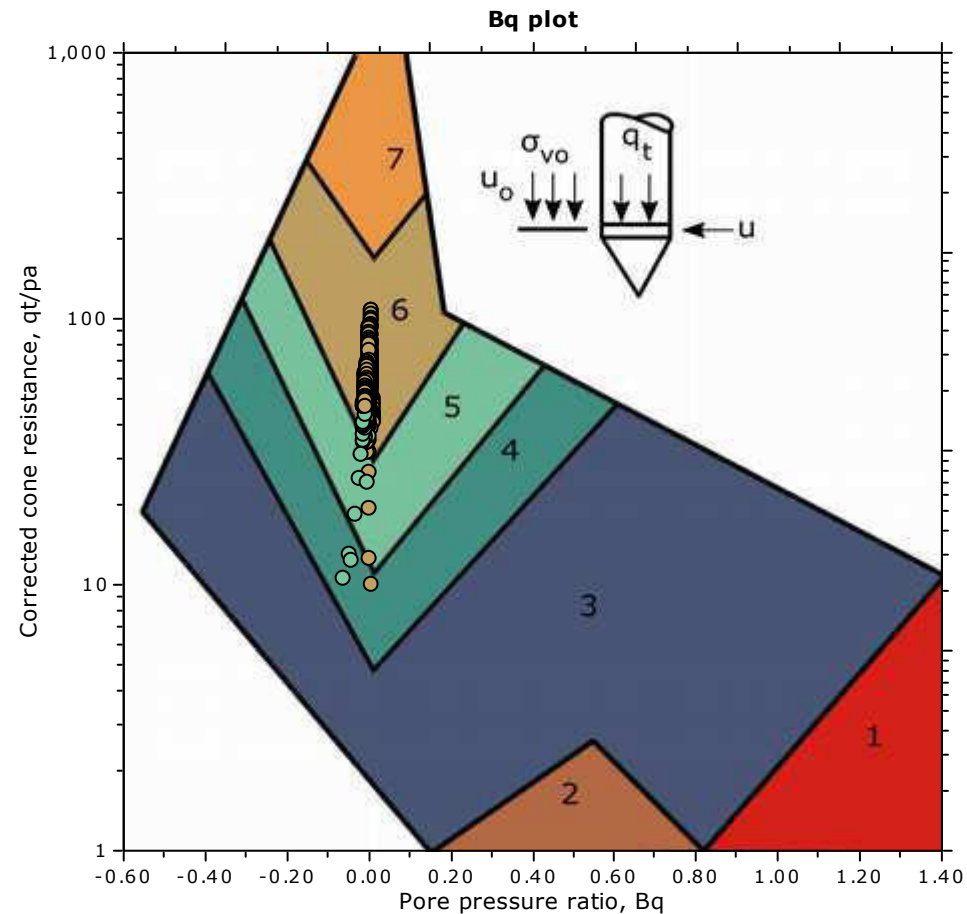
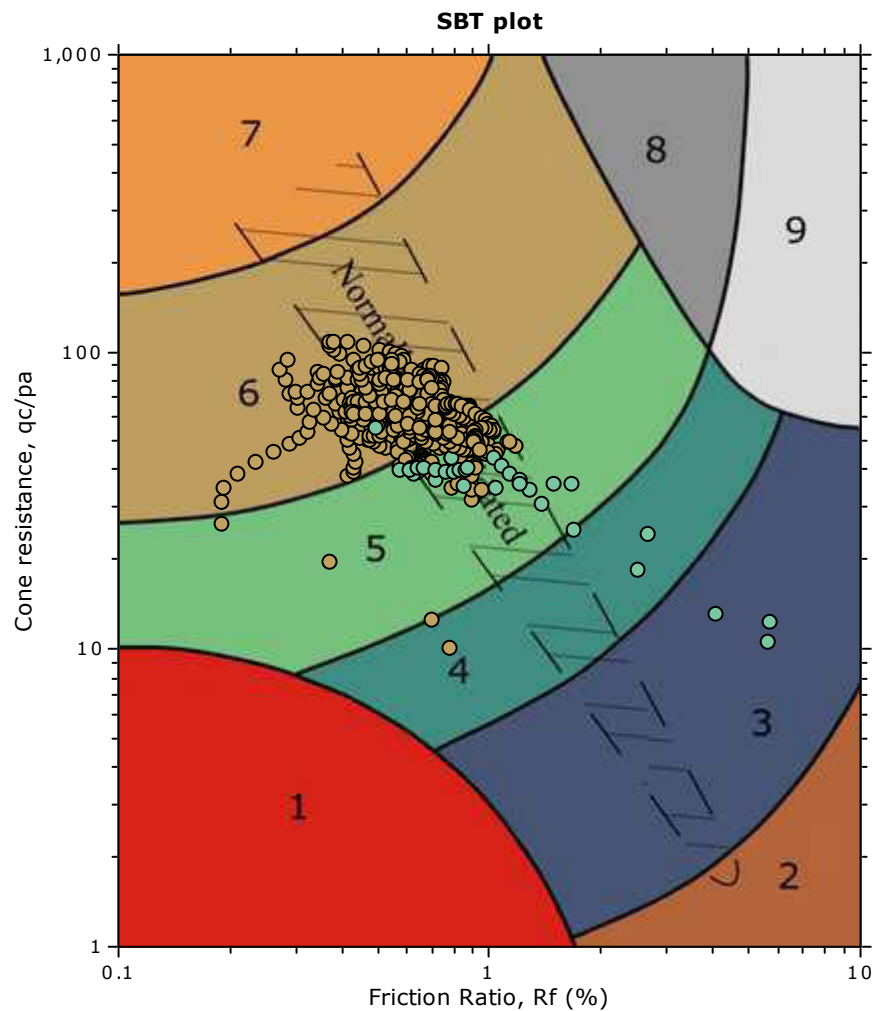




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



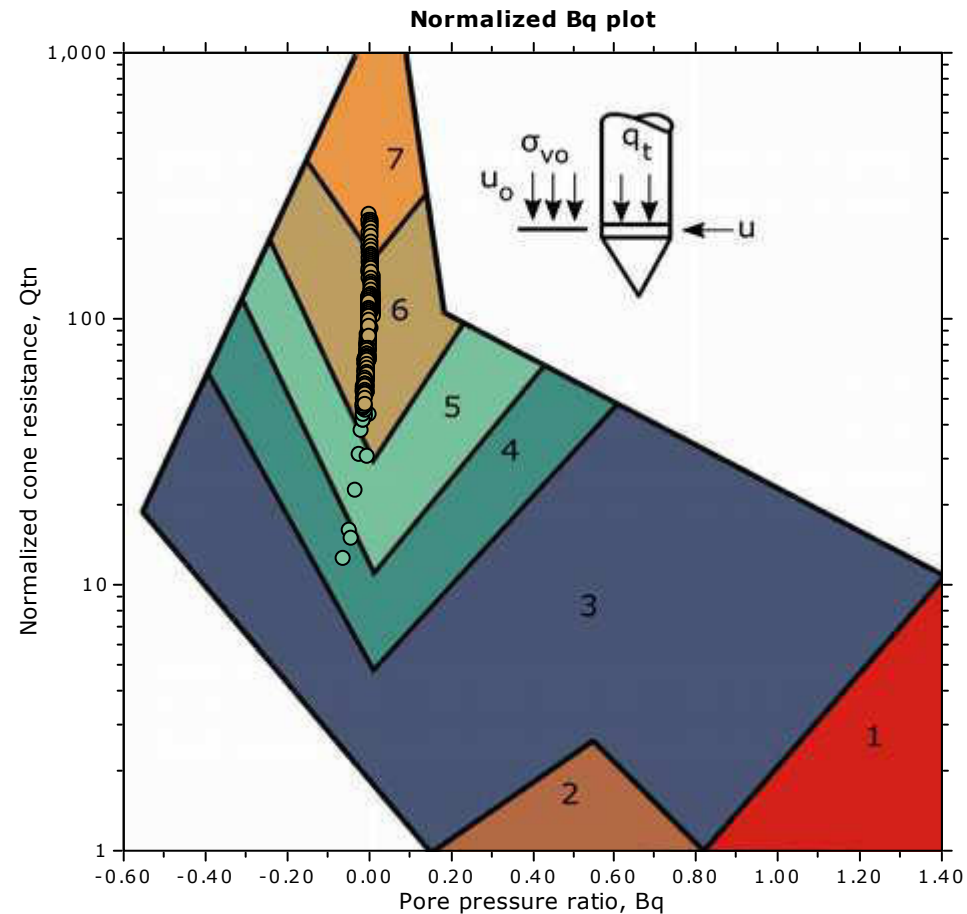
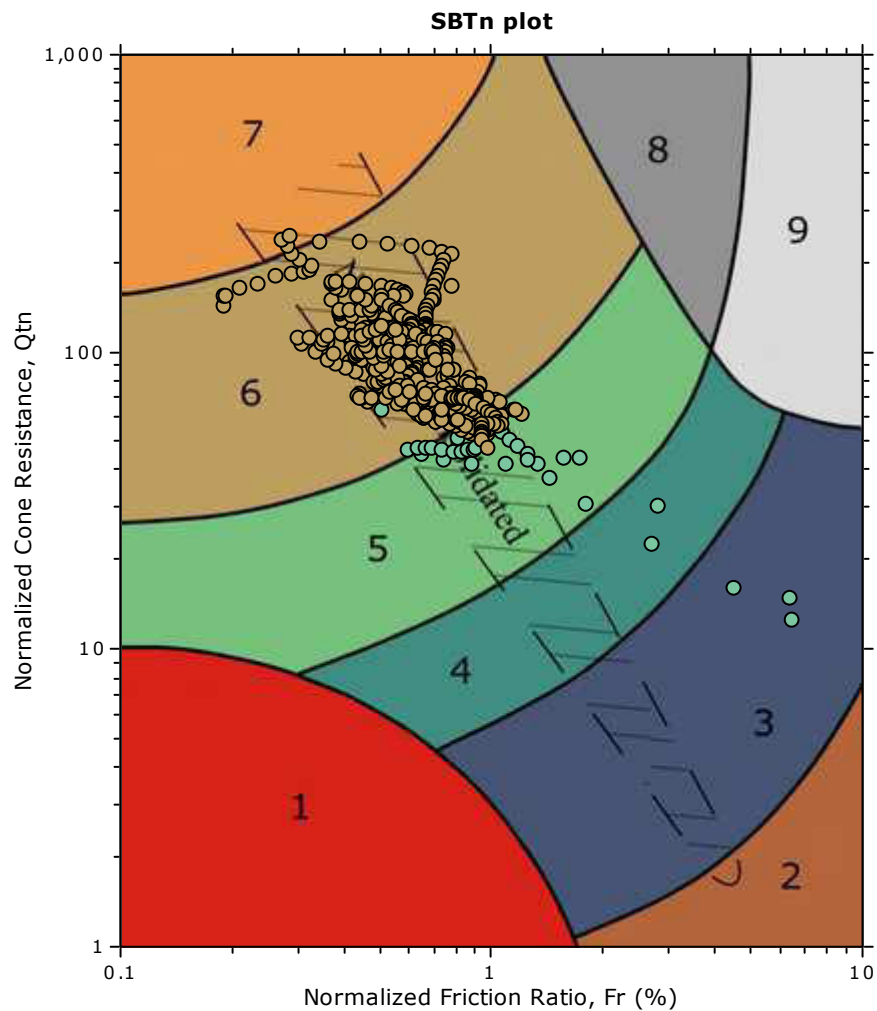
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

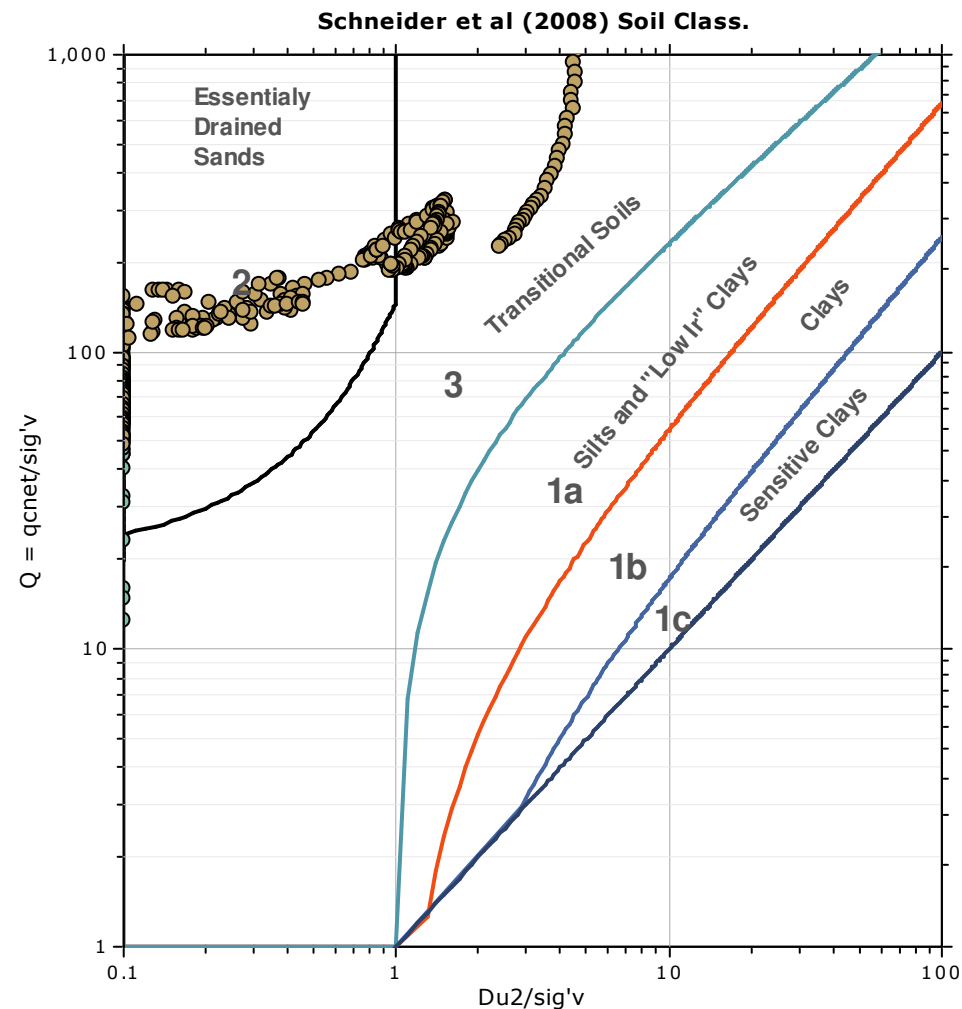
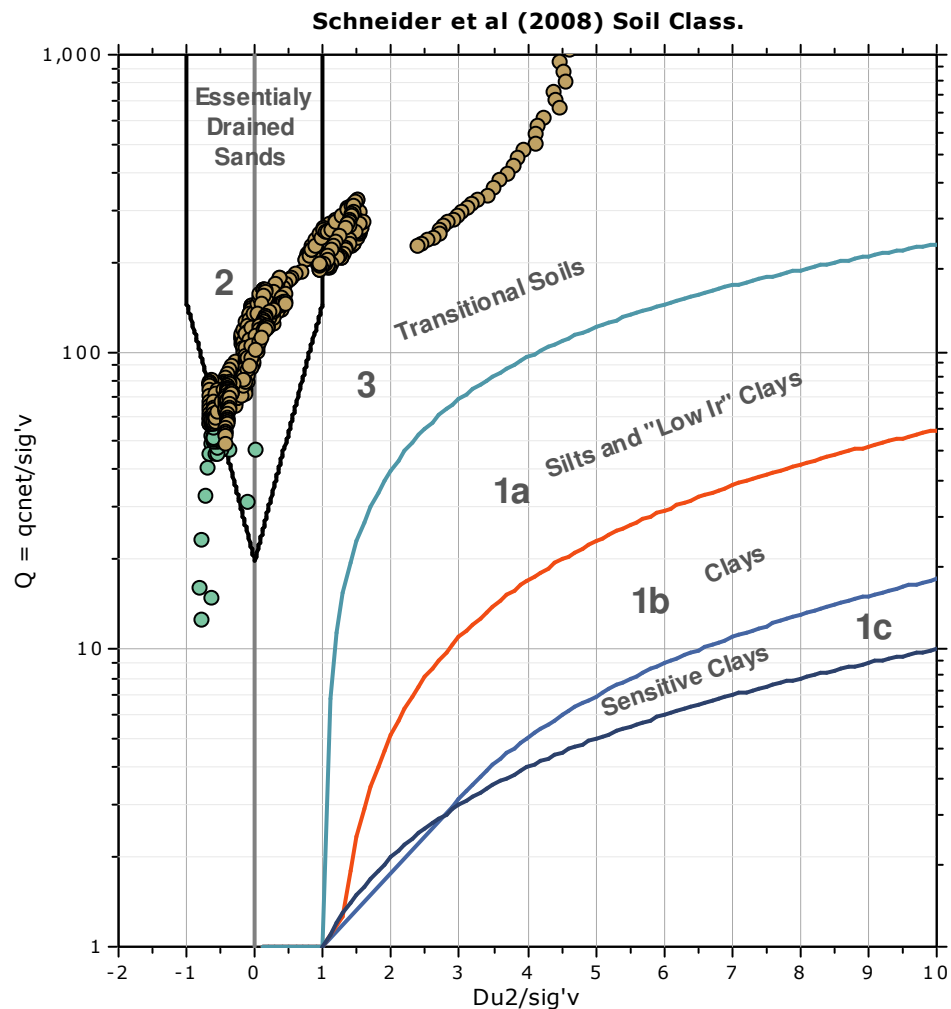
**SBT - Bq plots (normalized)**

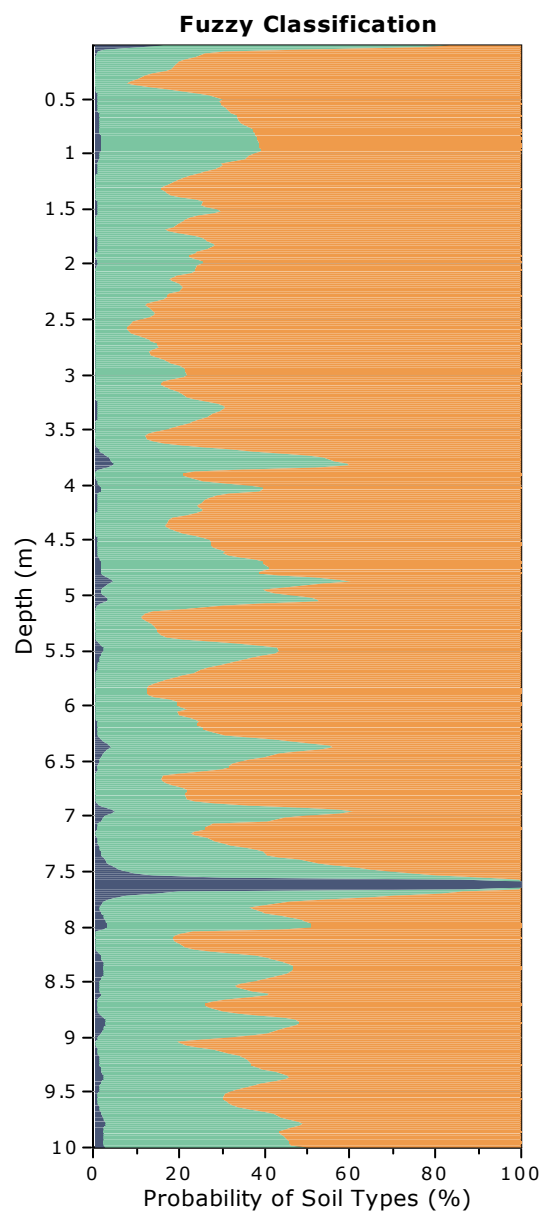
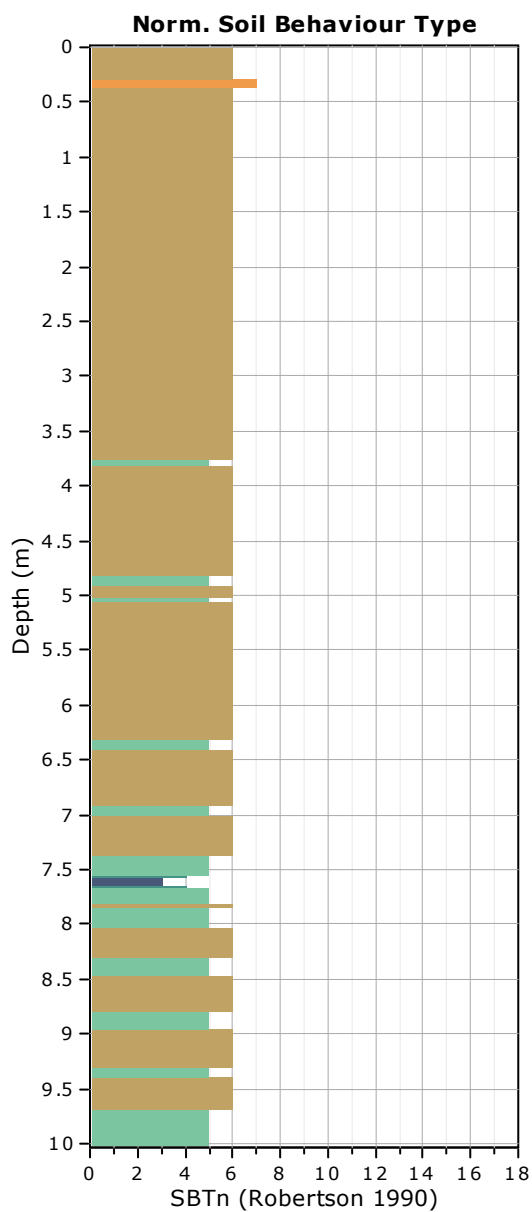


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





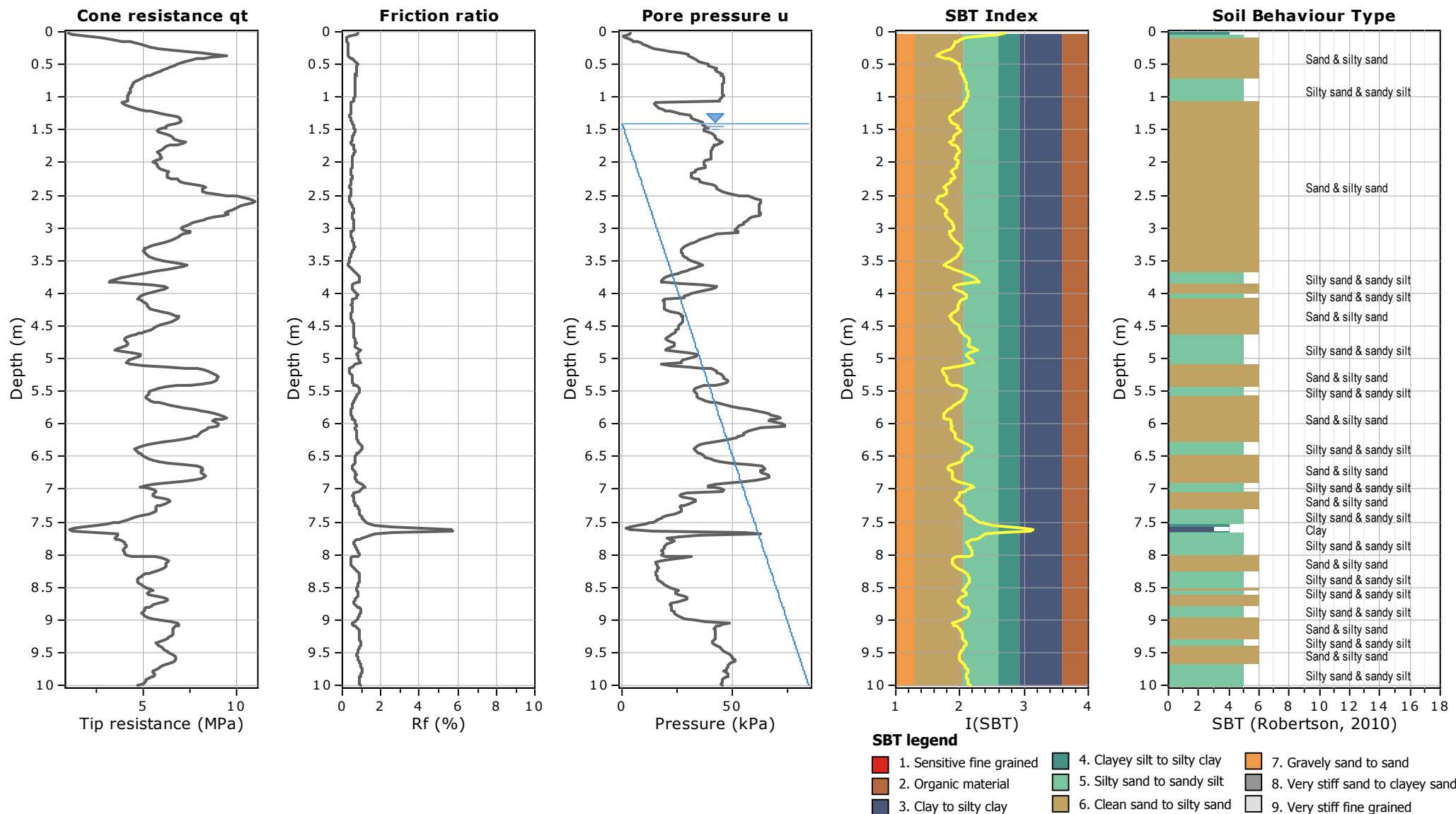
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°





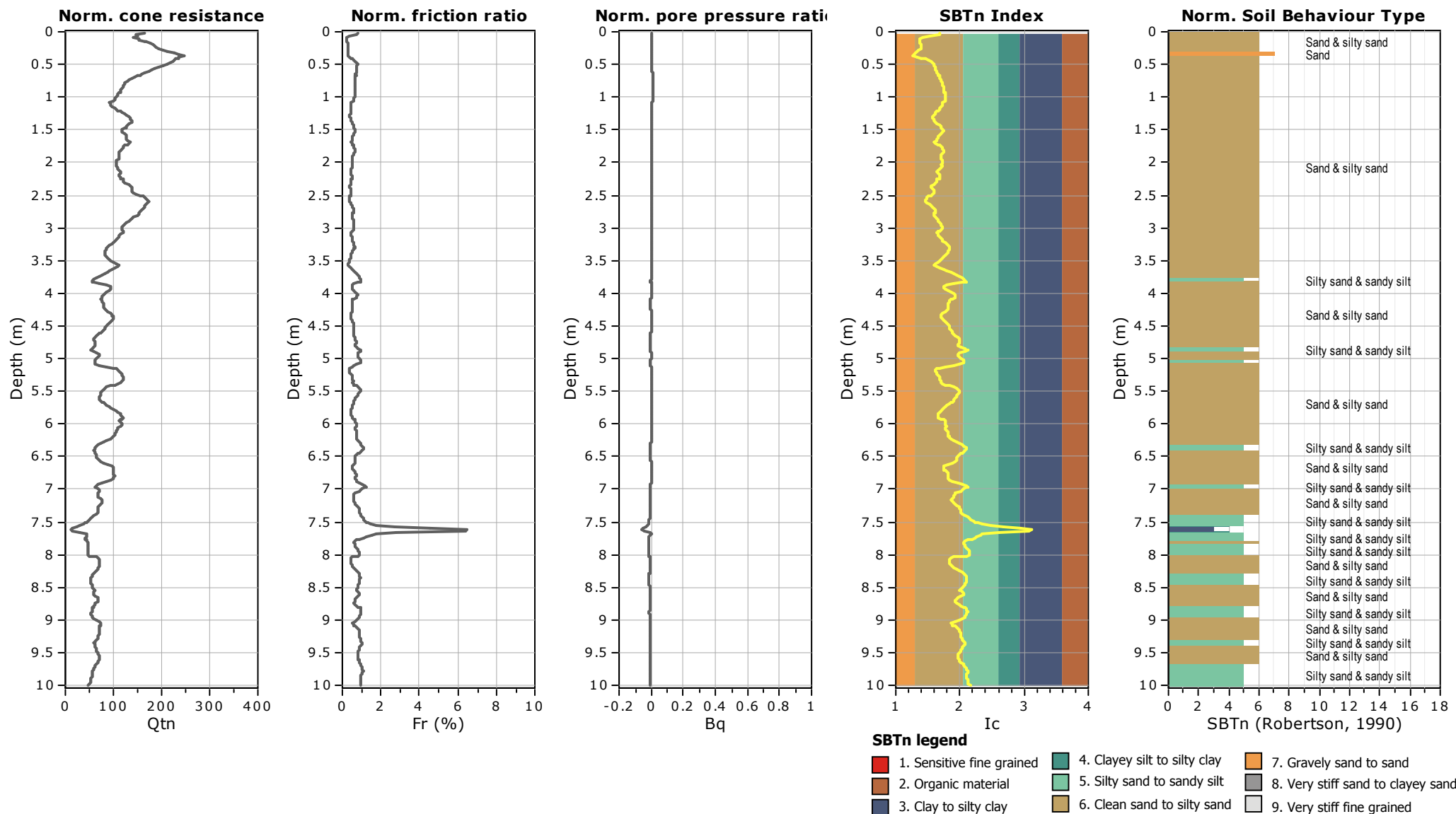
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°



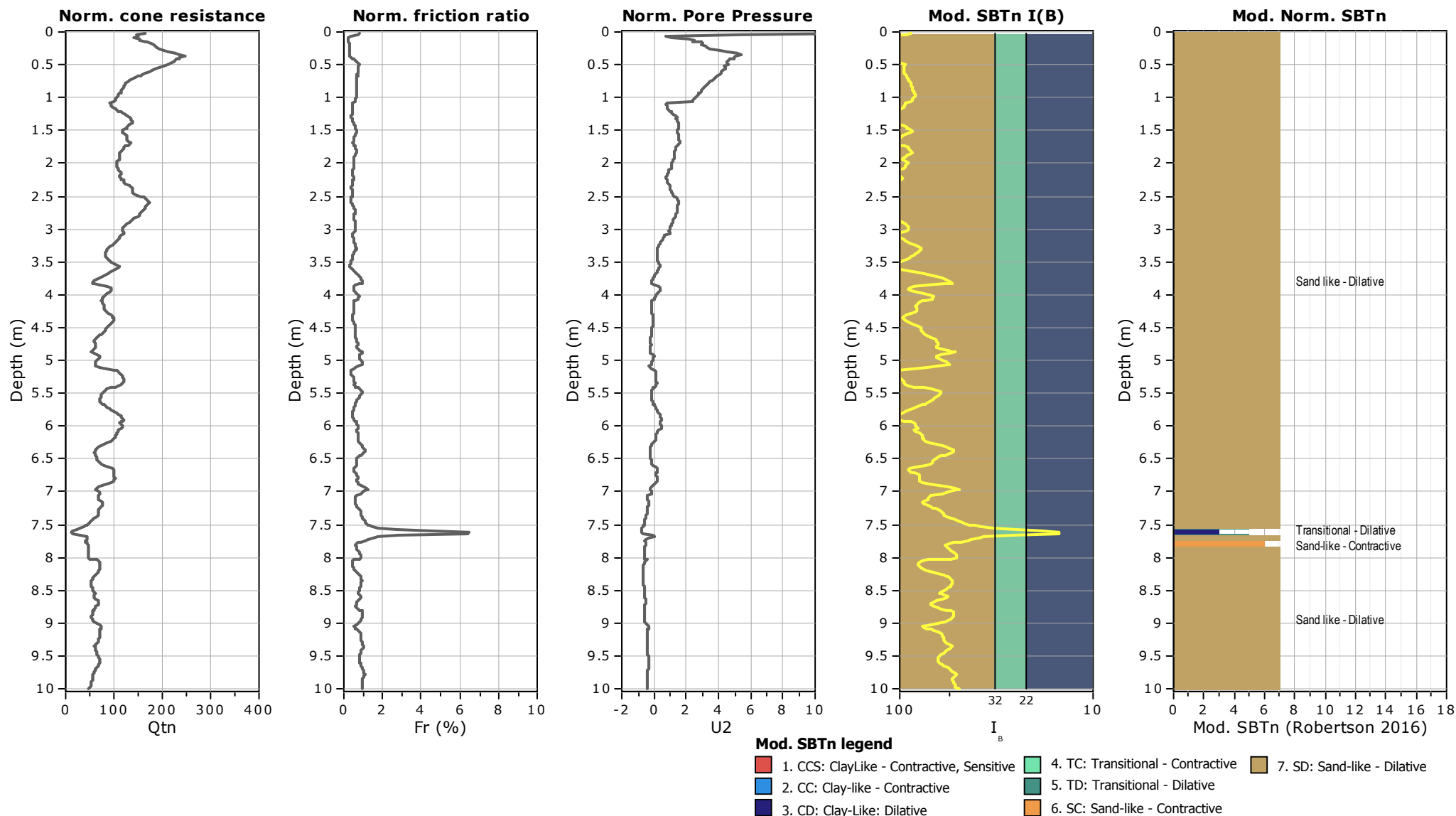
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

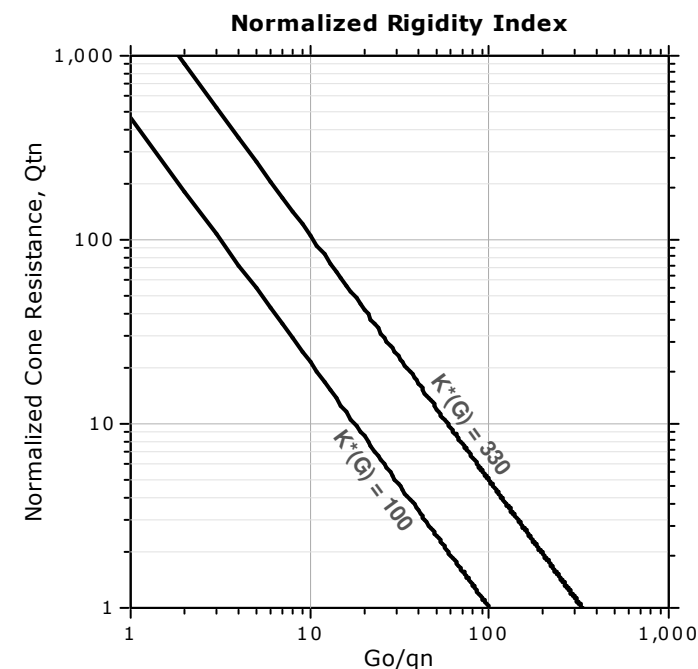
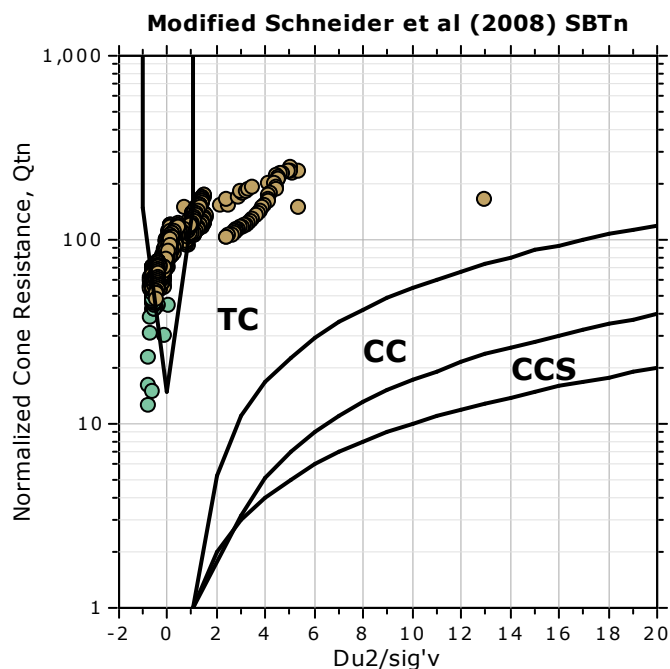
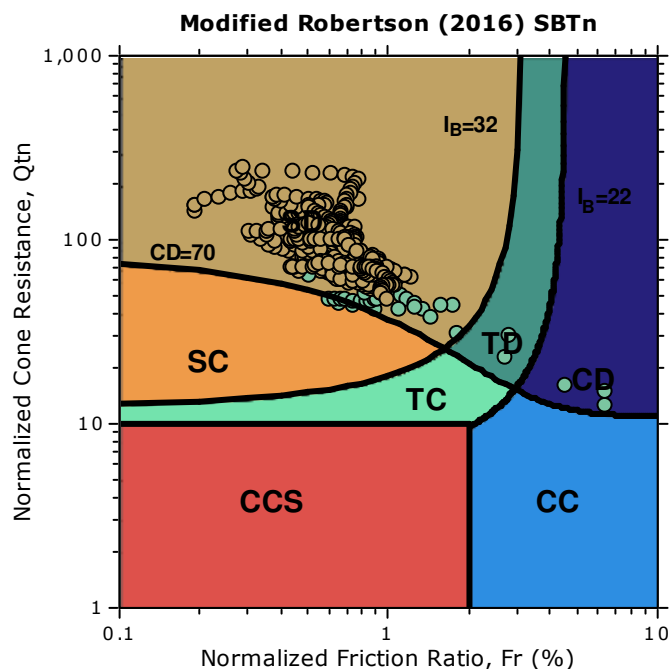
**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

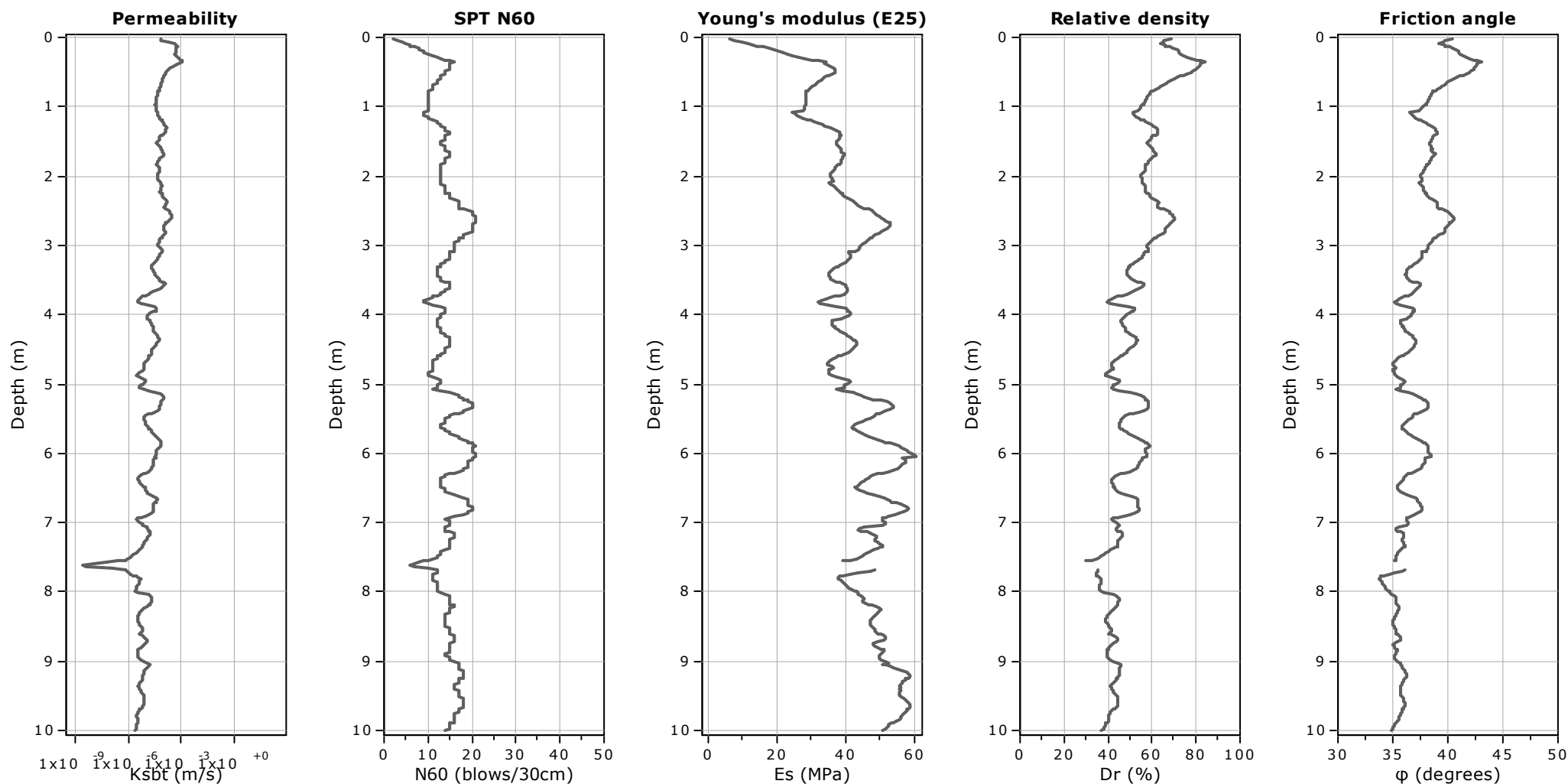
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

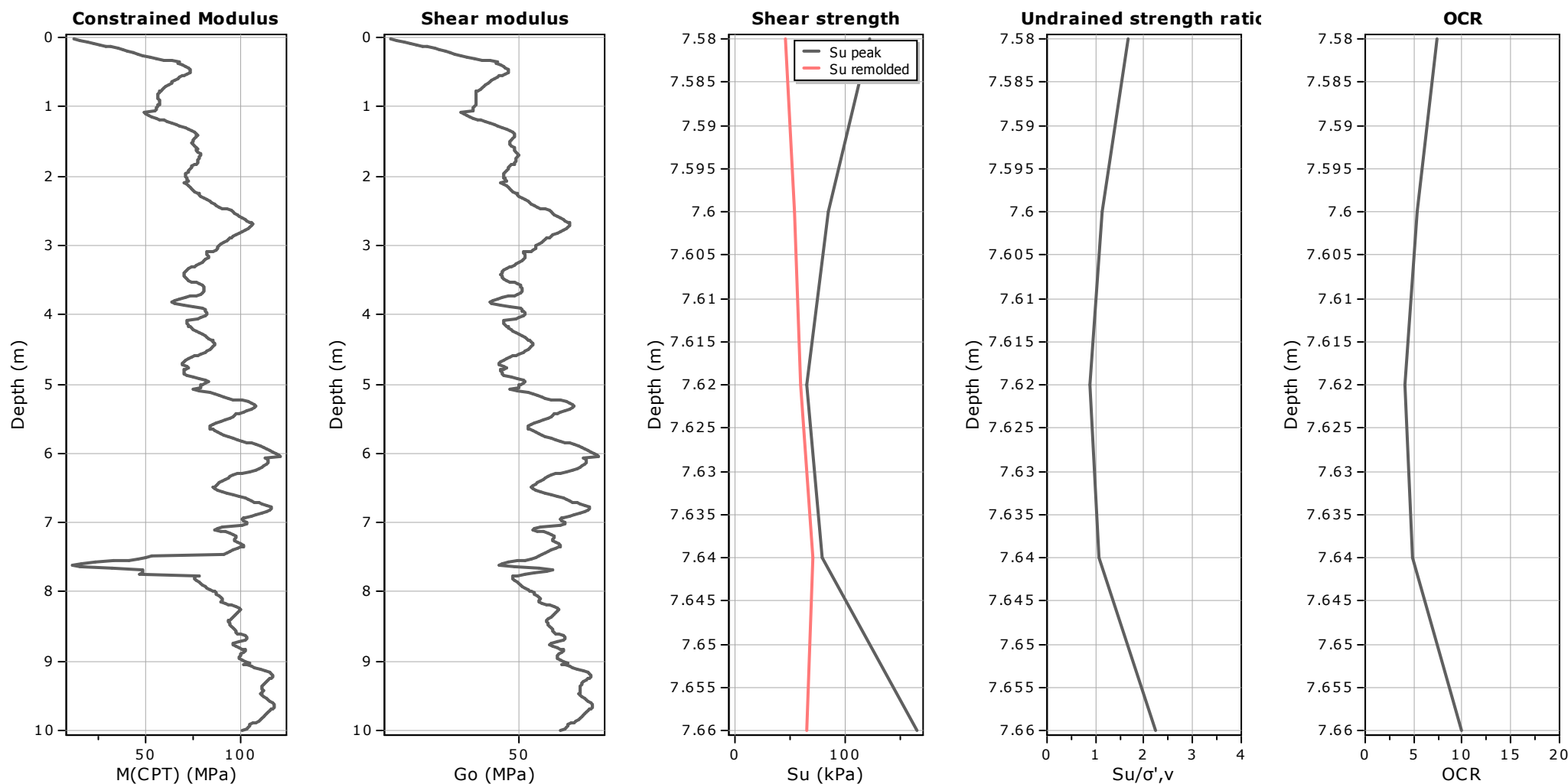
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

$G_0$ : Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

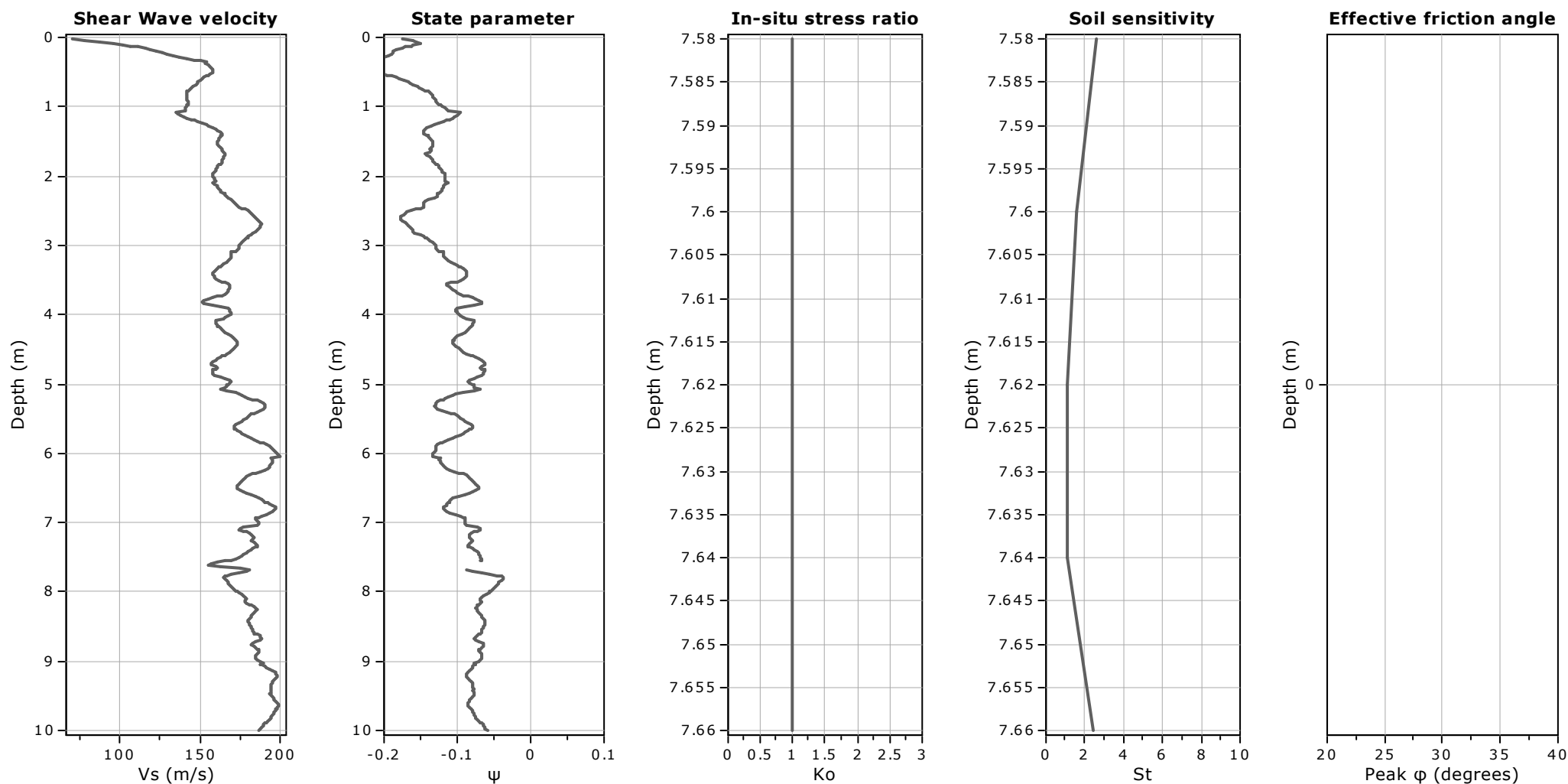
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km49+200**

Total depth: 10.00 m

Coords: lat 44.877258° lon 12.19812°

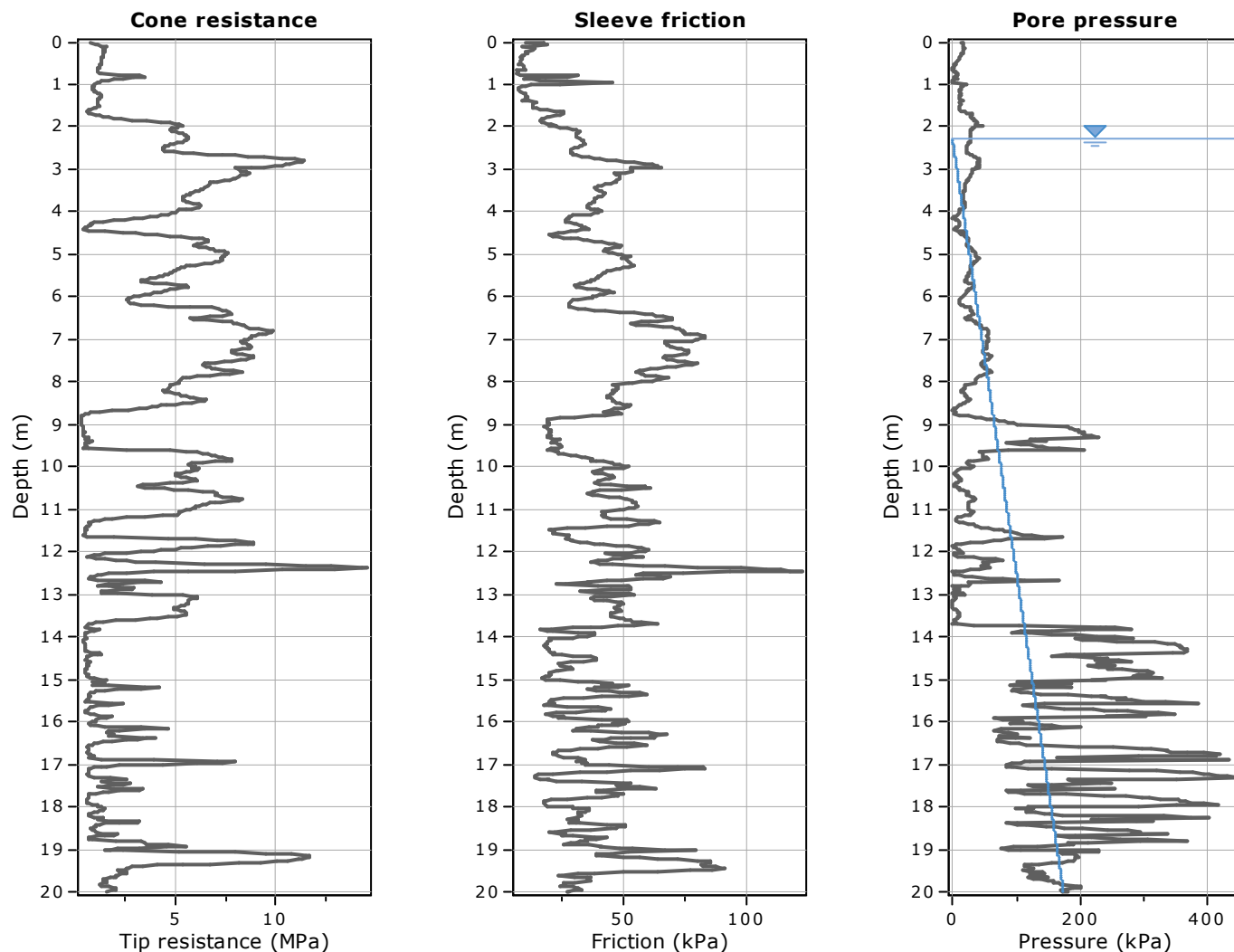


**Calculation parameters**

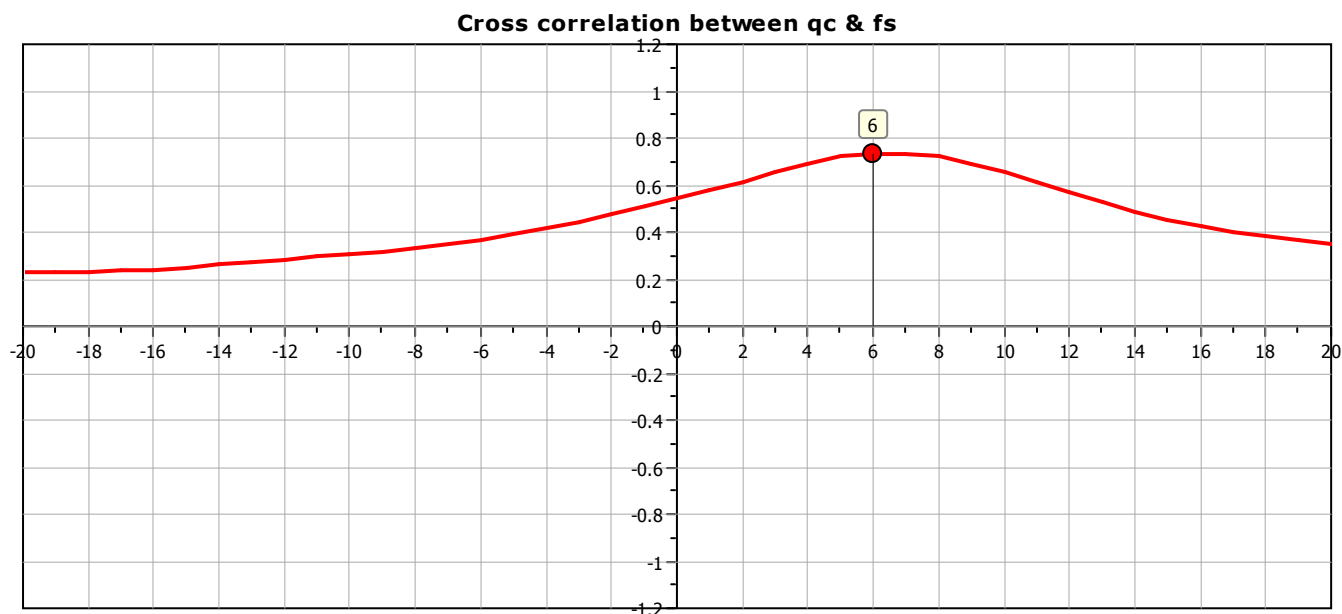
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

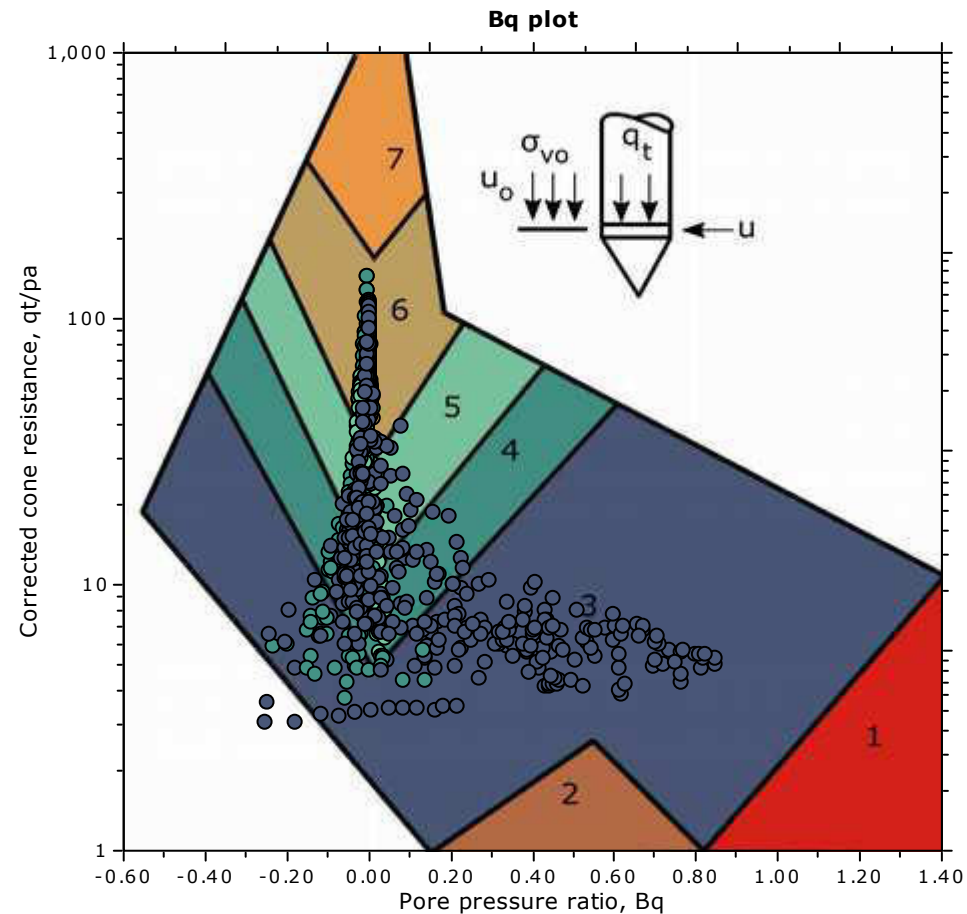
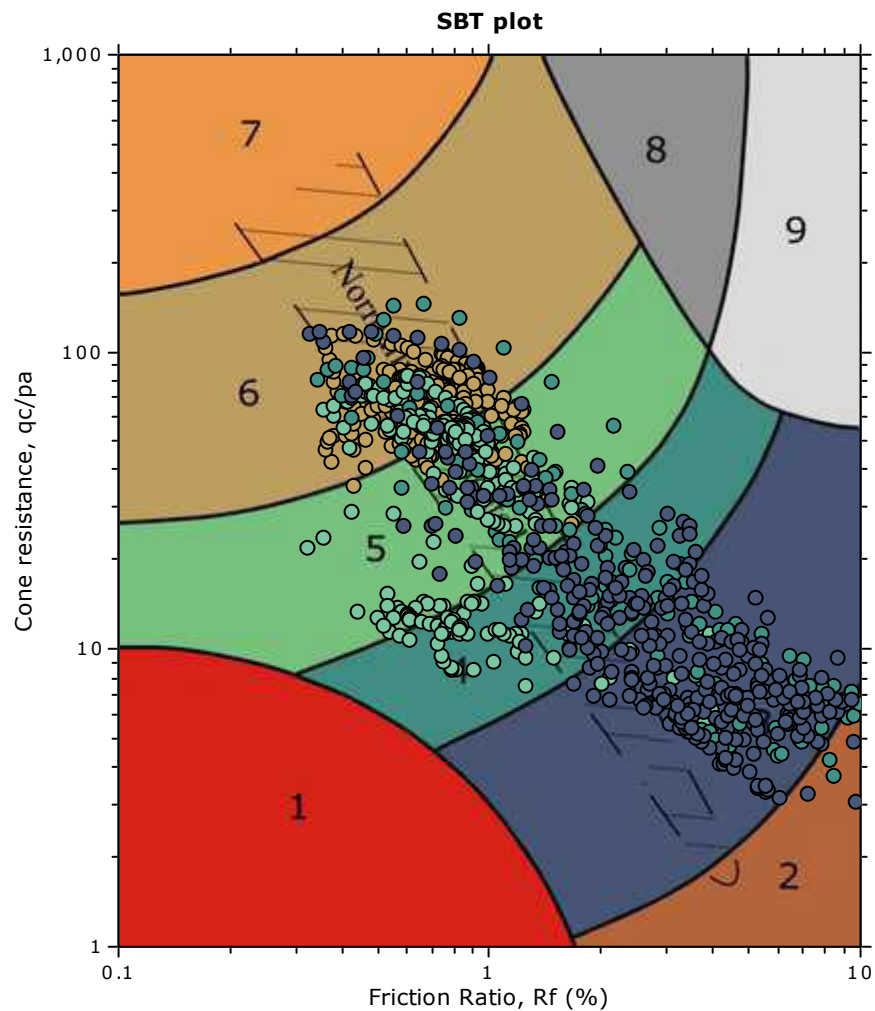




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



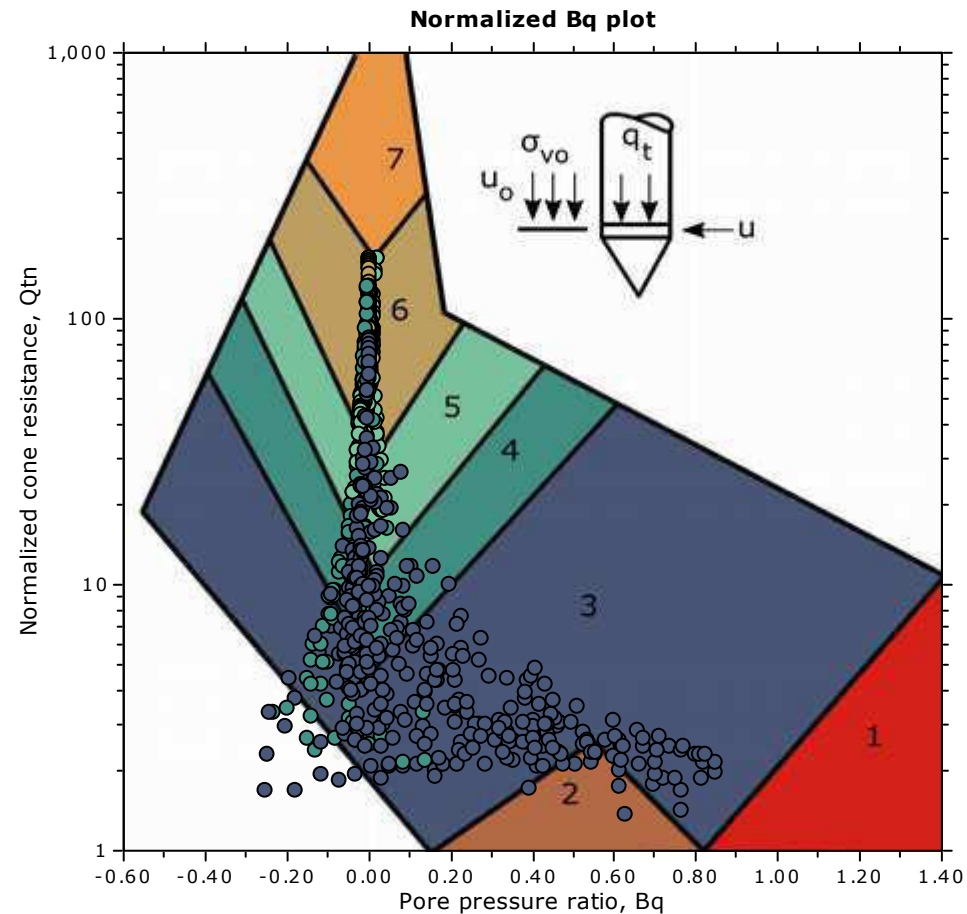
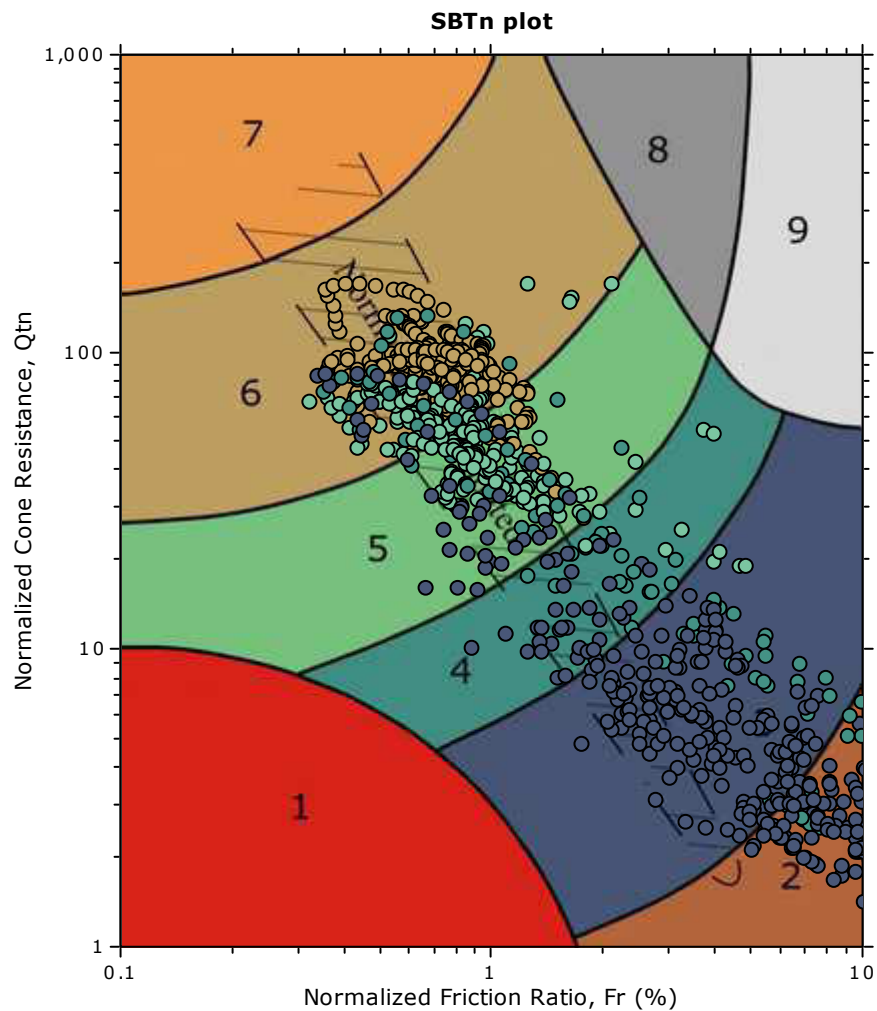
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

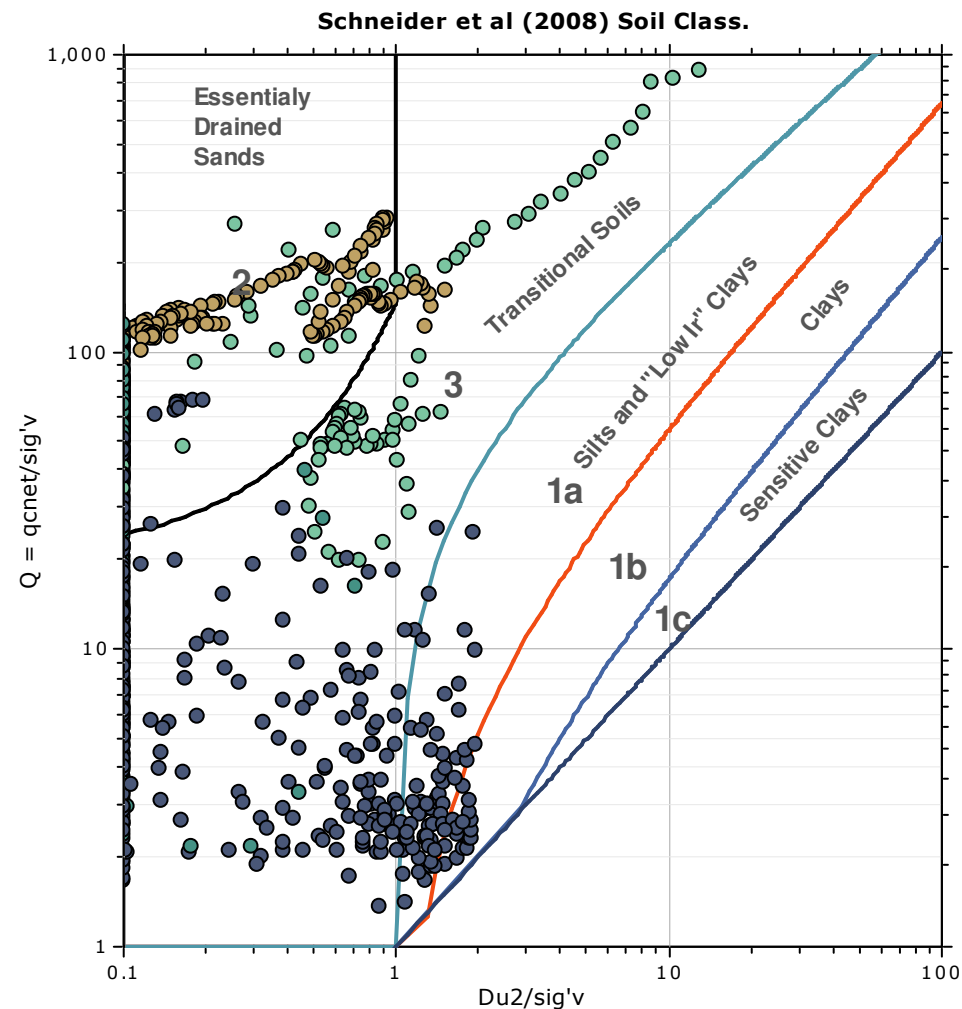
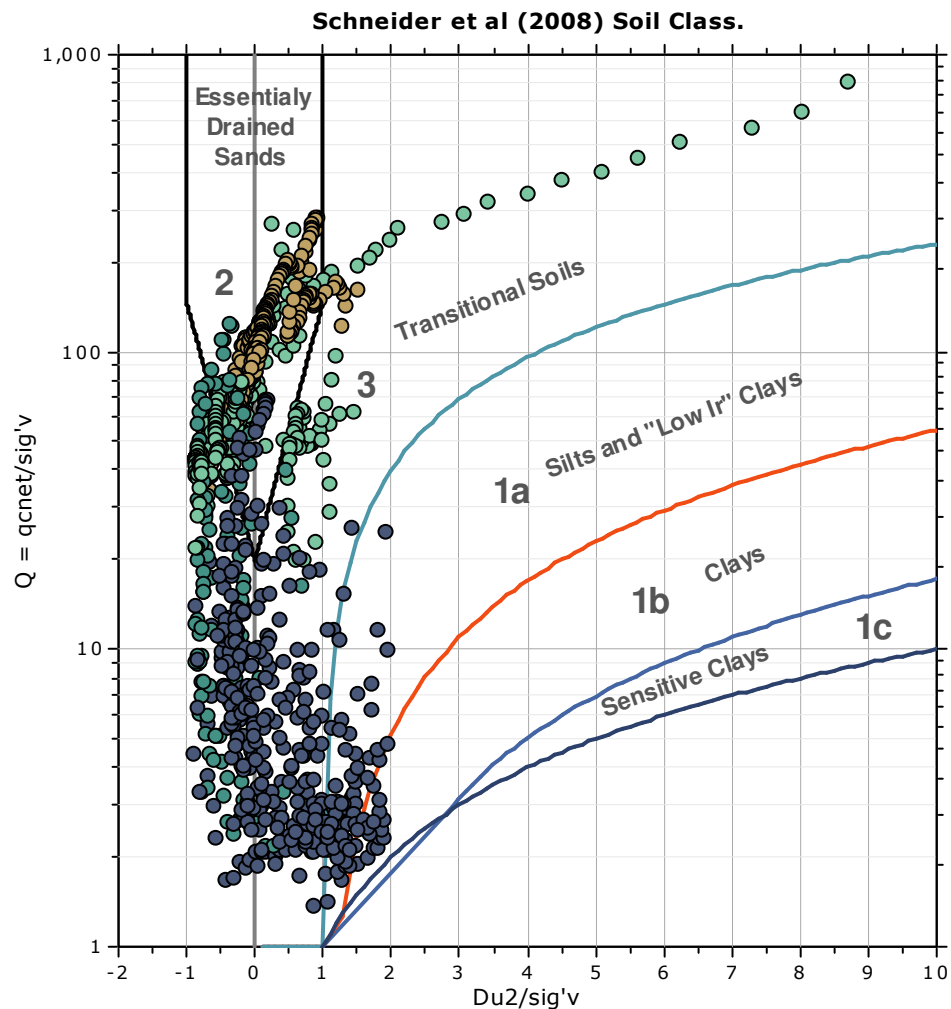
**SBT - Bq plots (normalized)**

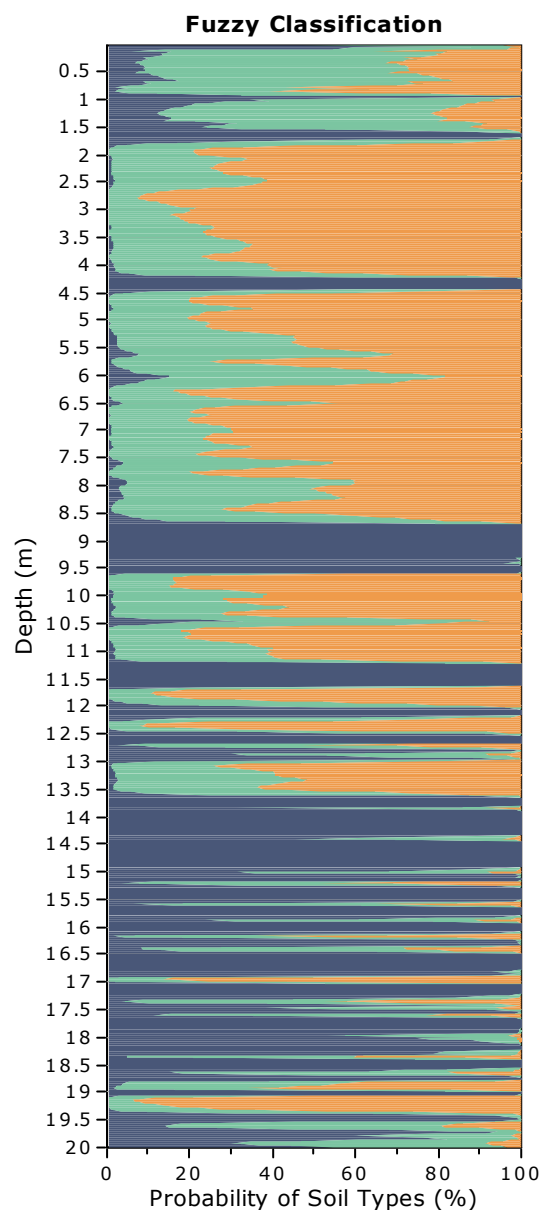
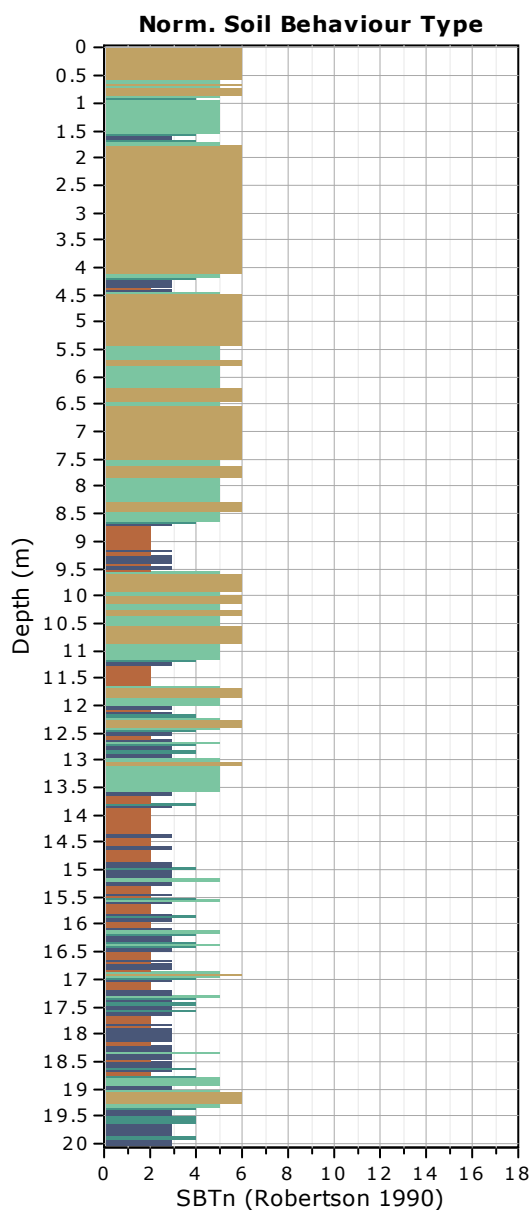


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





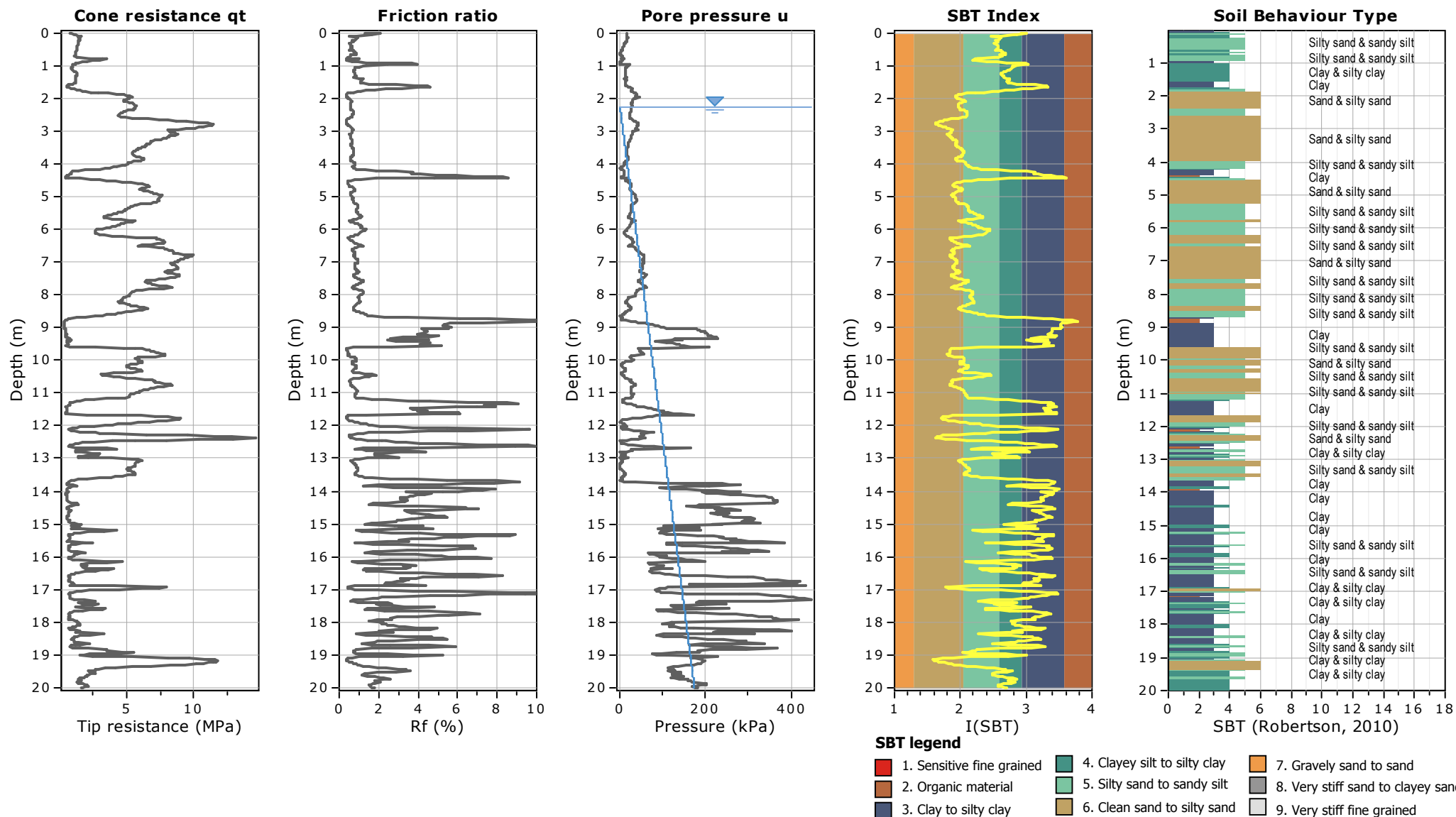
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

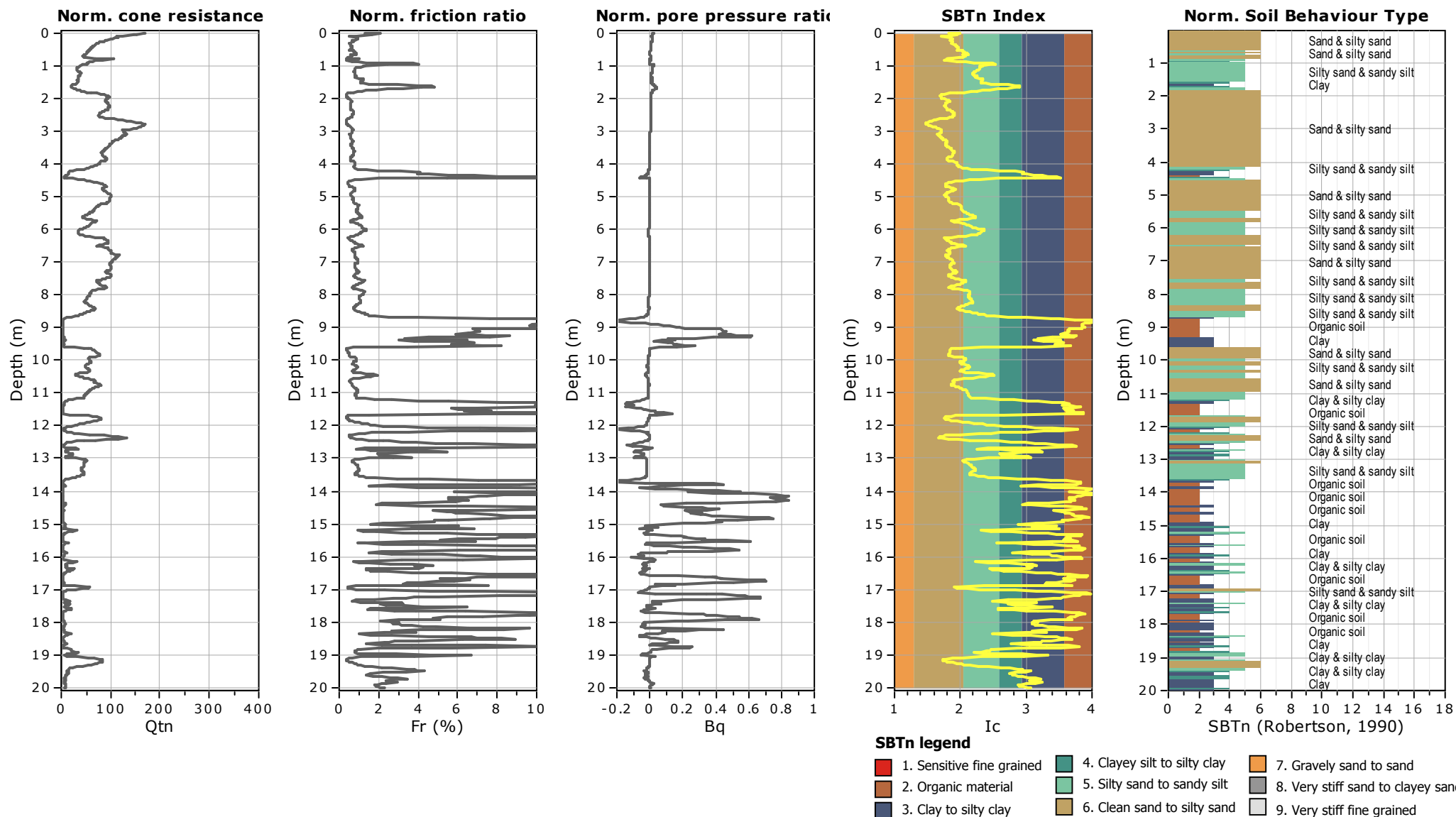
**CPT: CPTU km50+500**

Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°







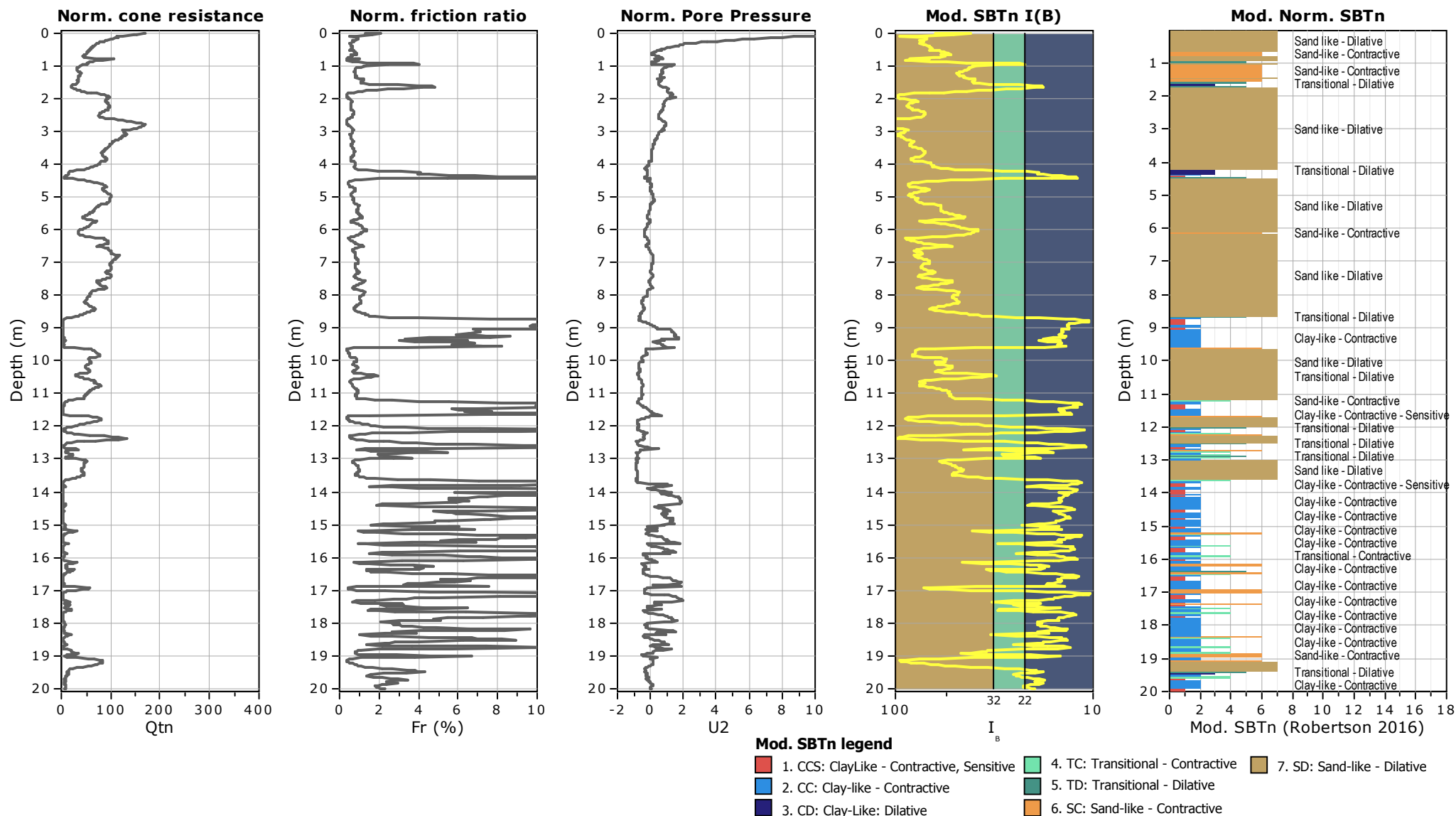
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

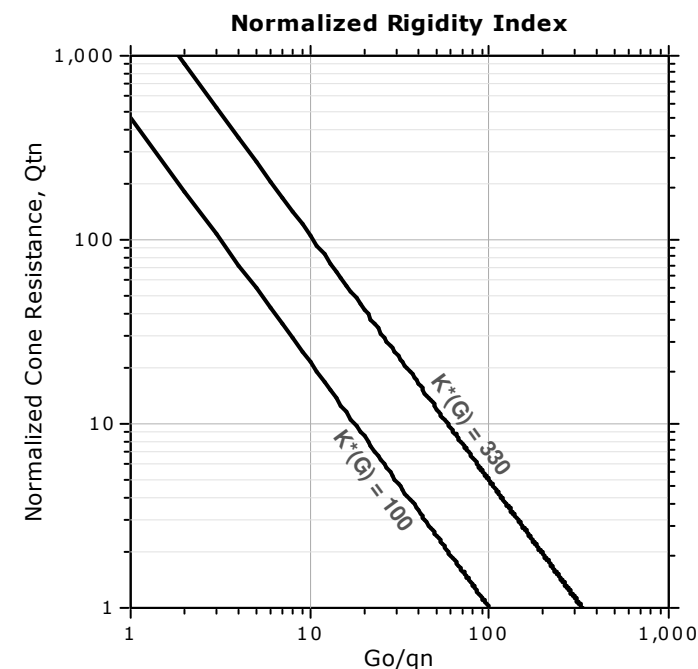
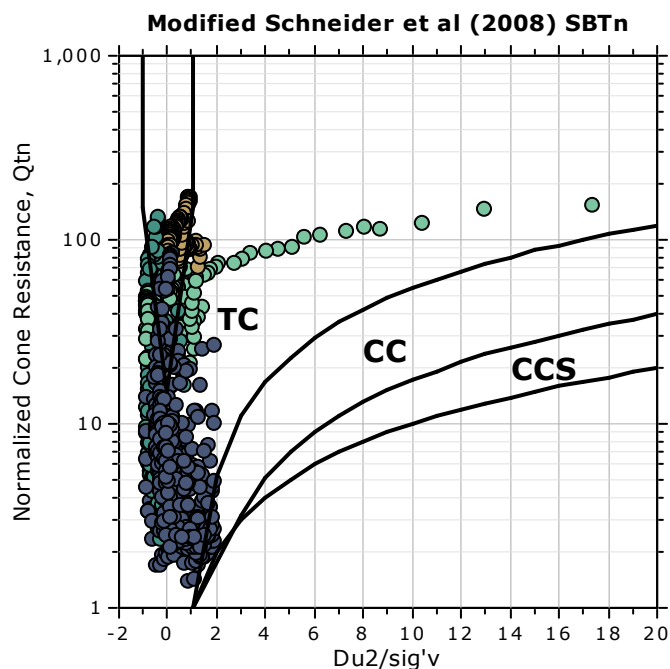
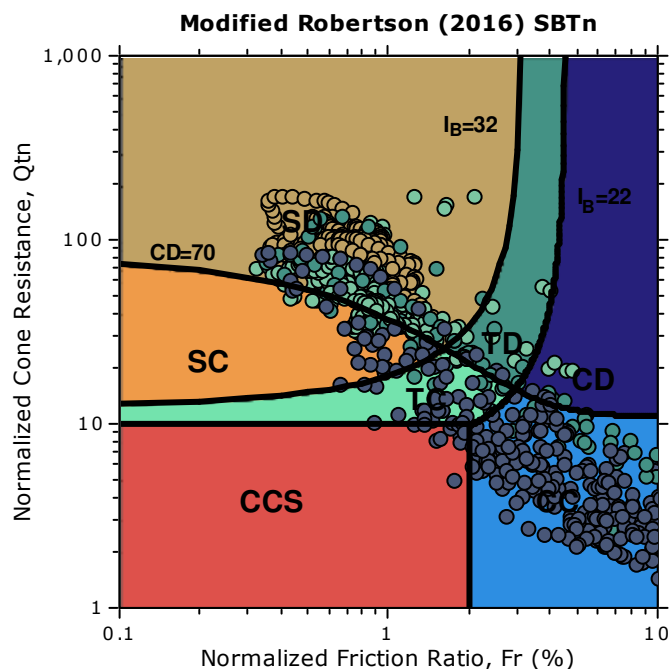
**CPT: CPTU km50+500**

Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

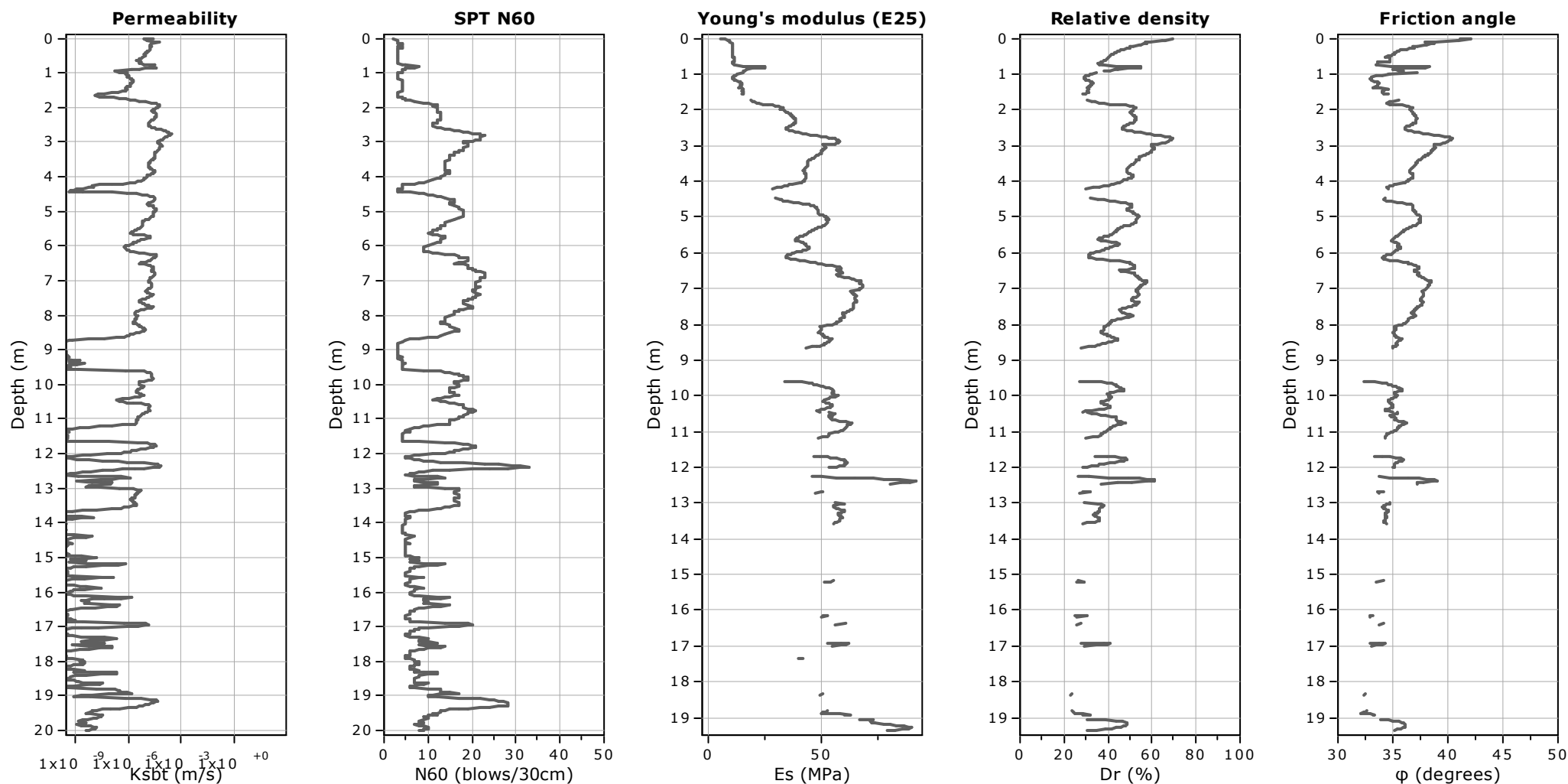
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+500**

Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°



**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 Kulhavy & Mayne (1990)

● User defined estimation data

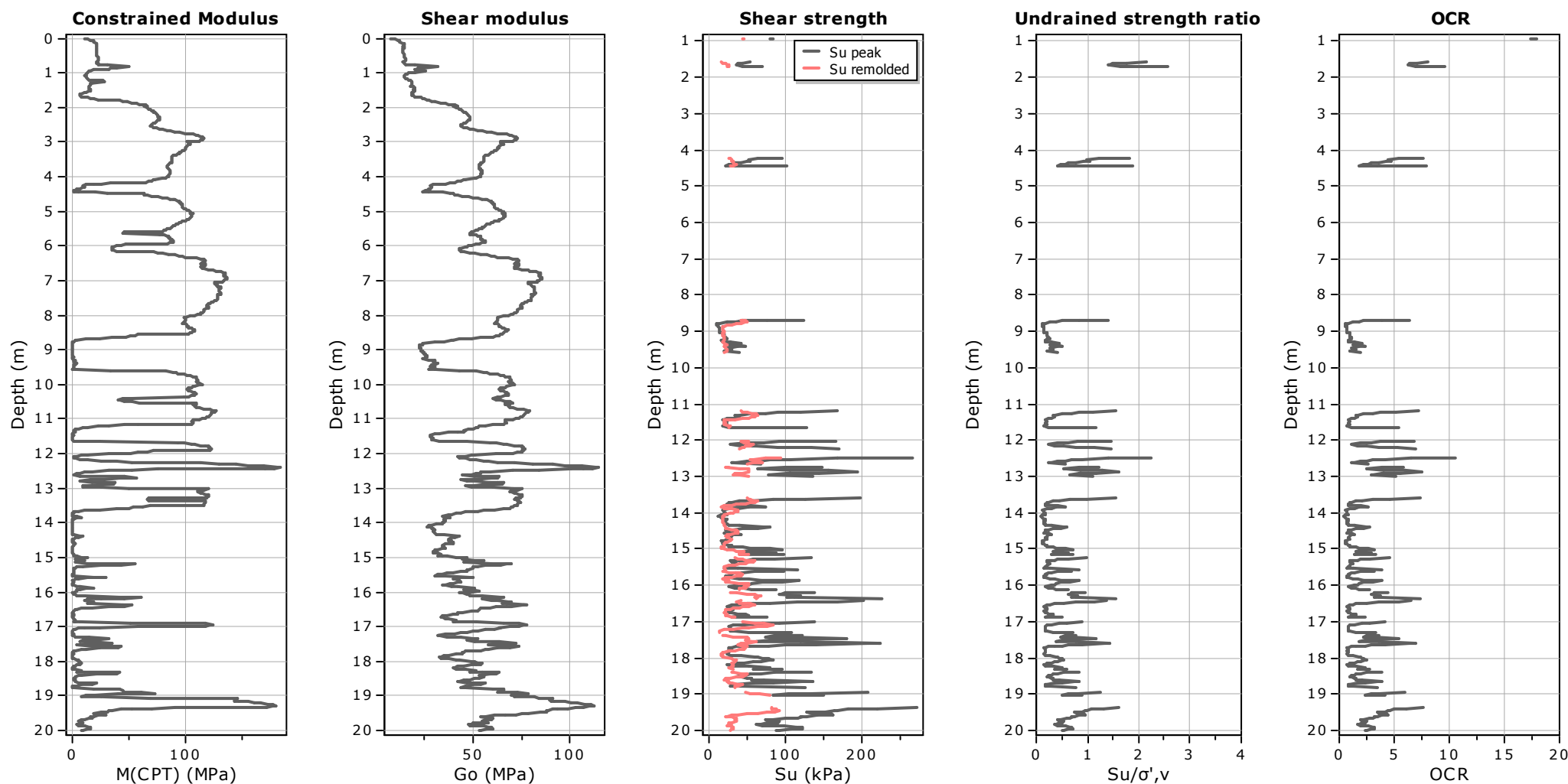
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+500**

Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

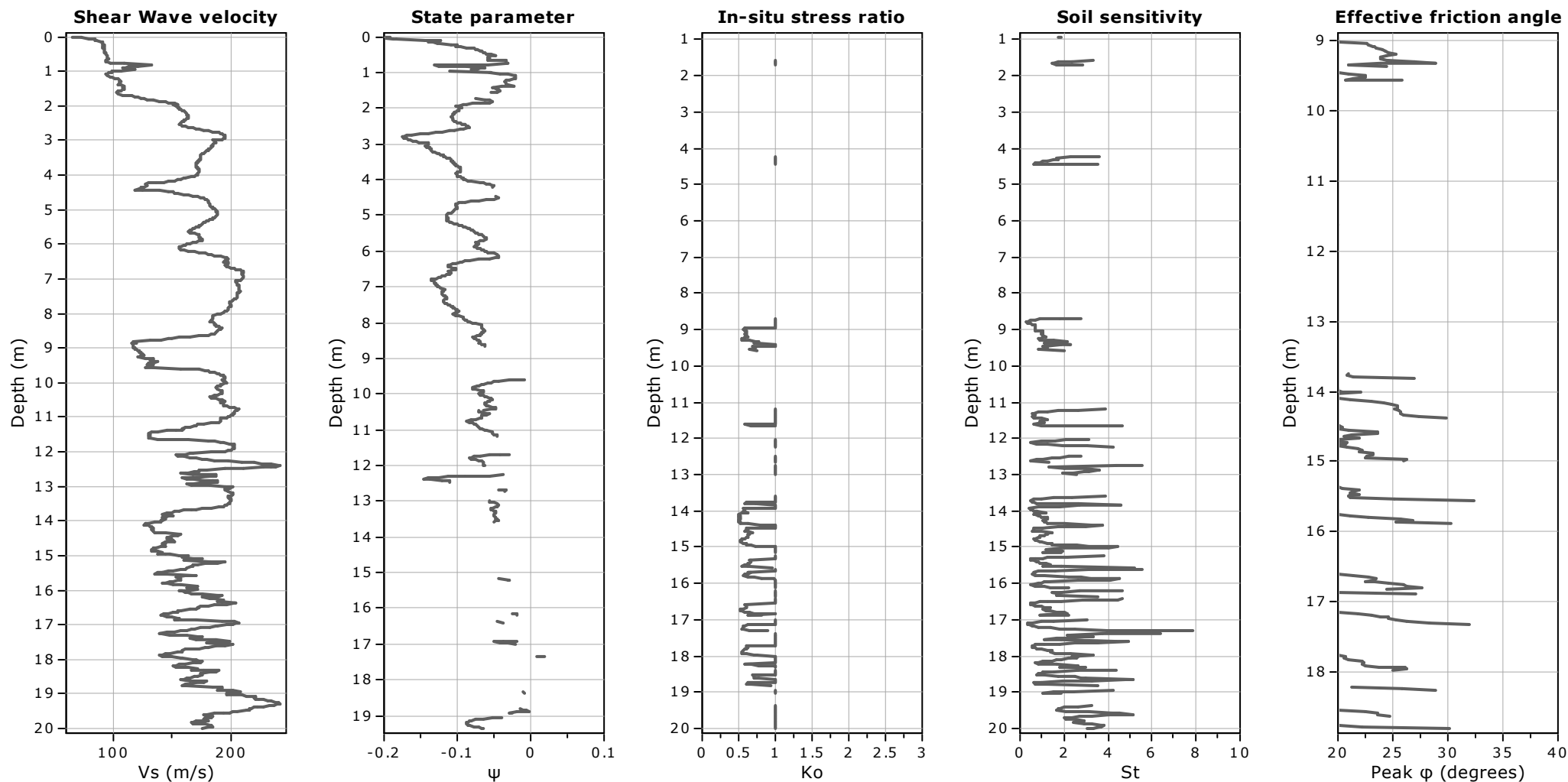
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+500**

Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°

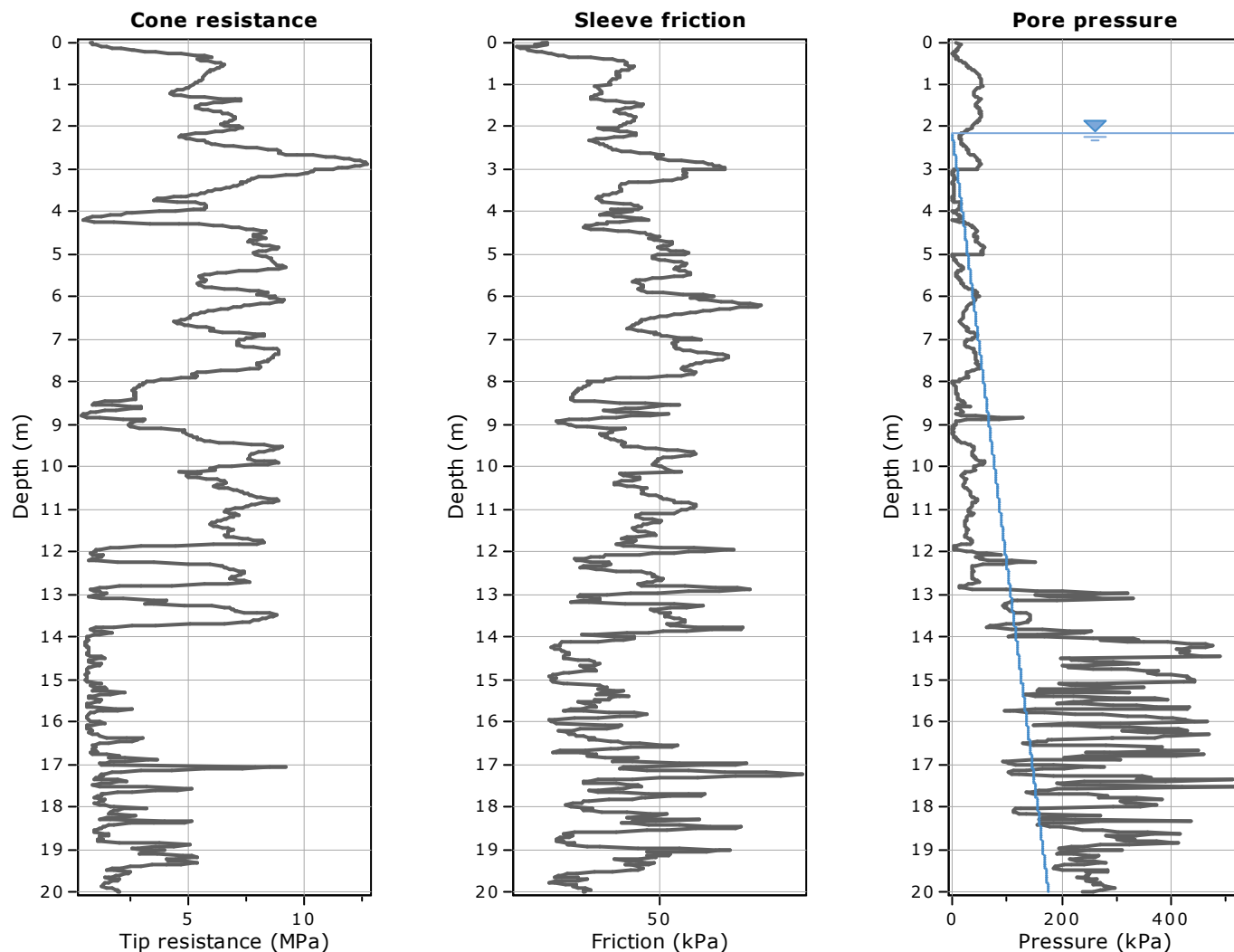


#### Calculation parameters

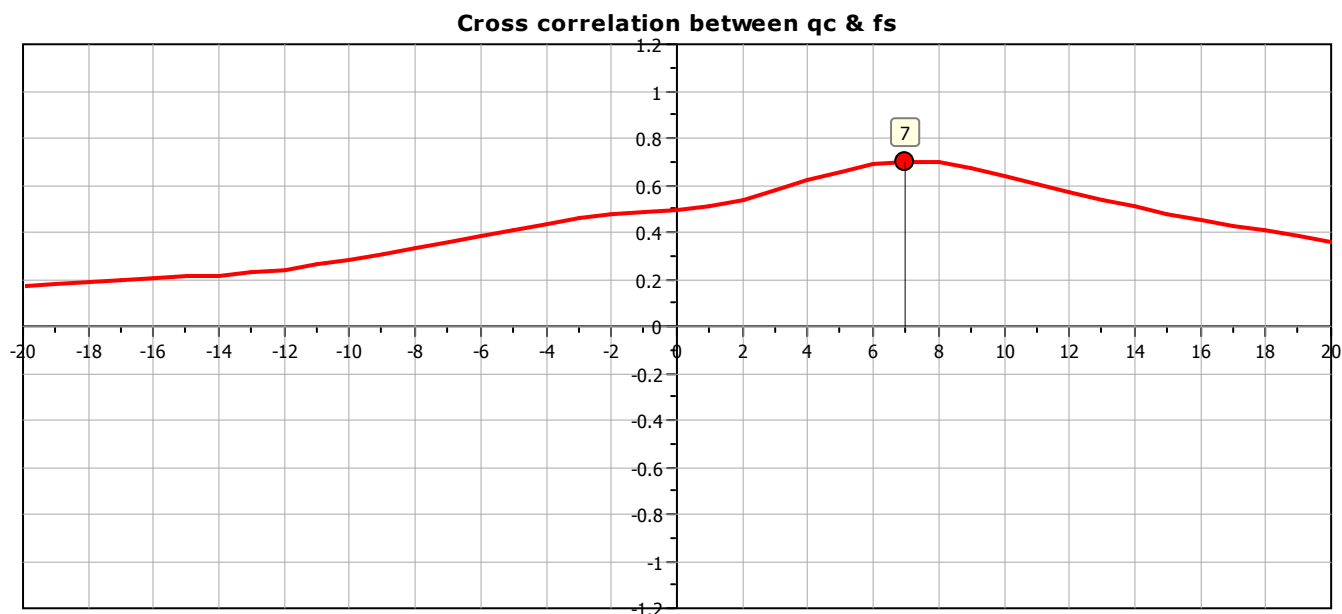
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

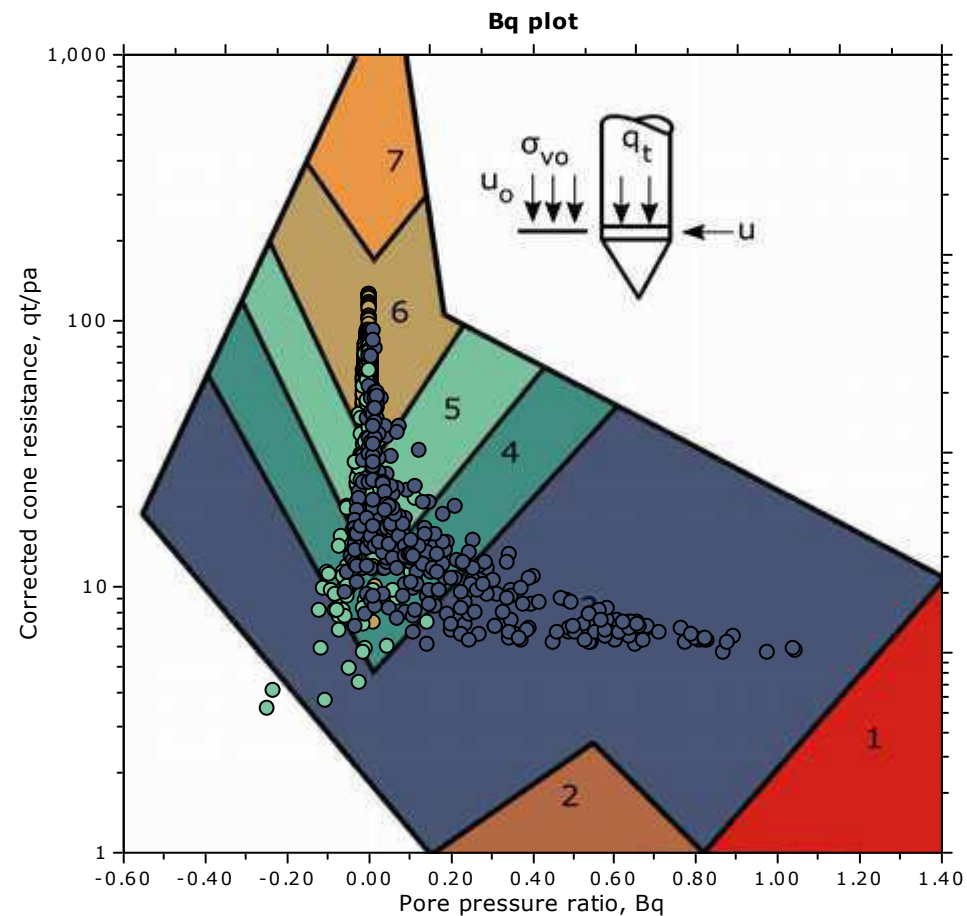
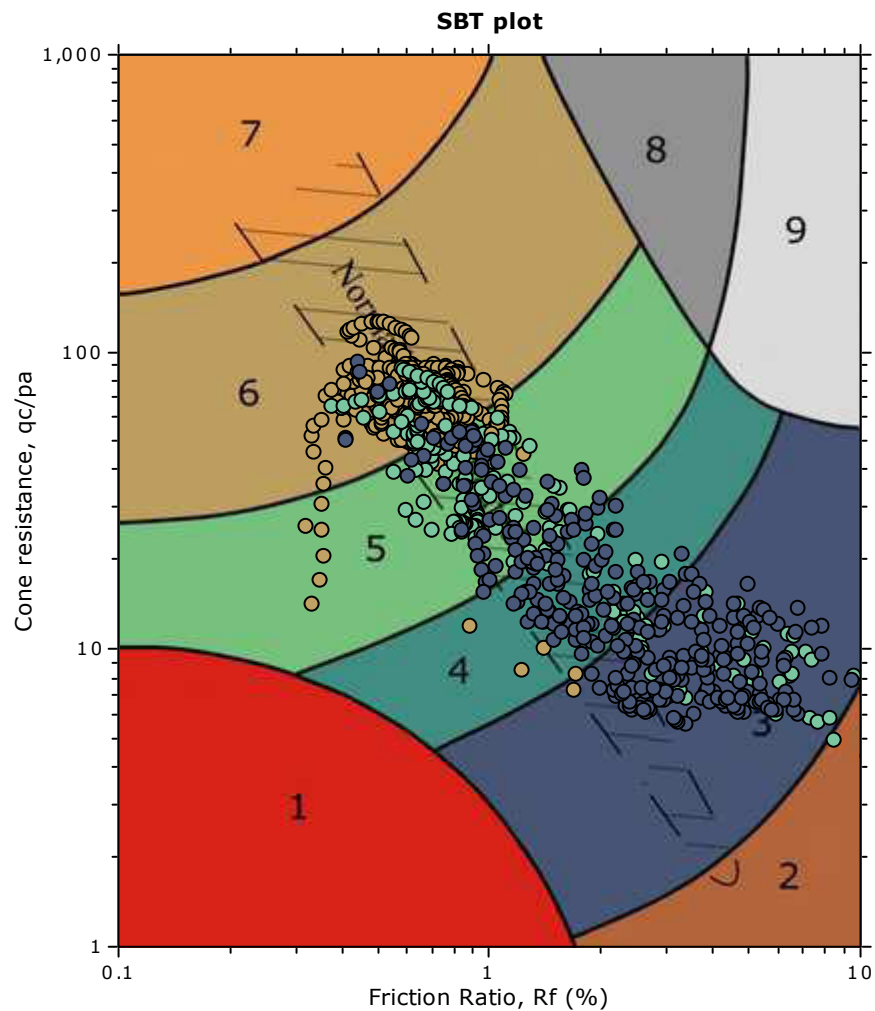




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



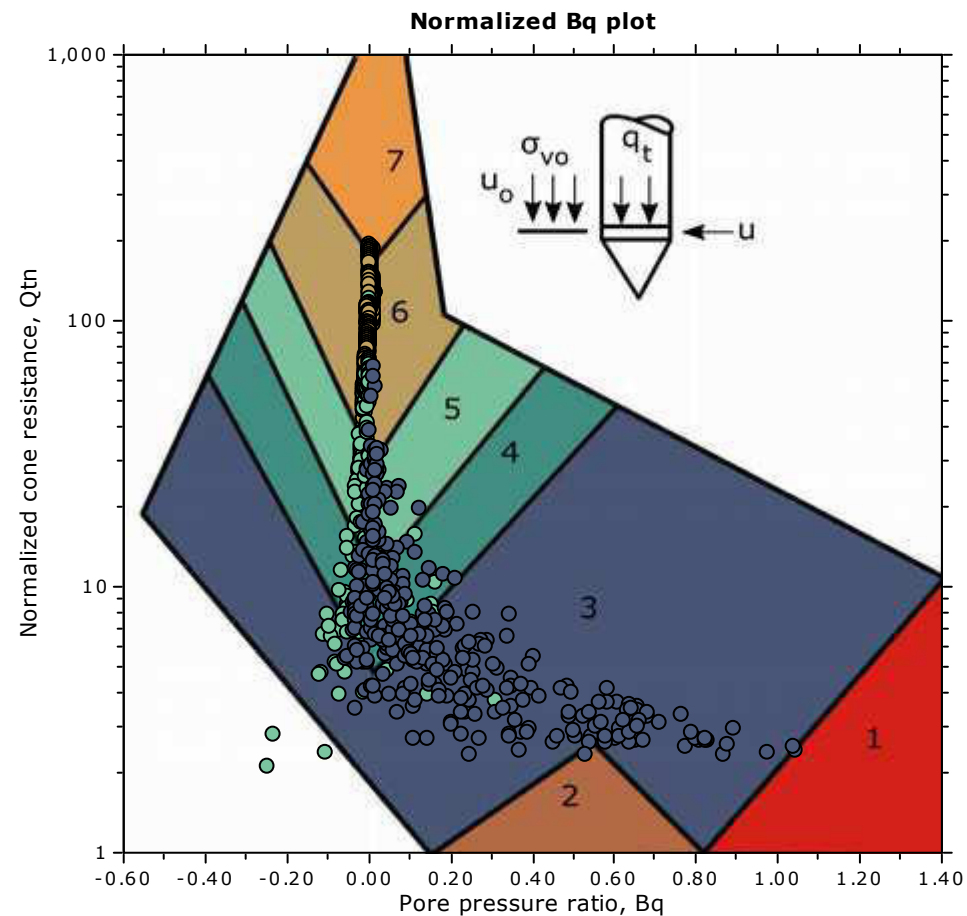
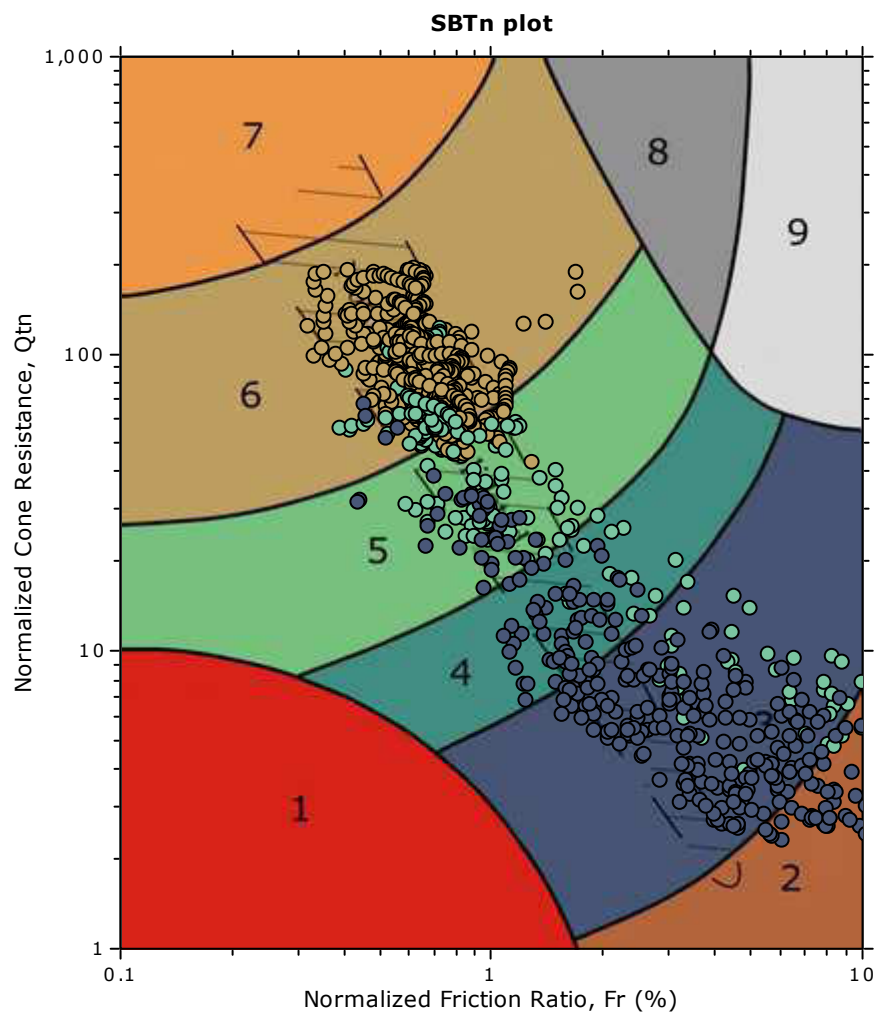
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

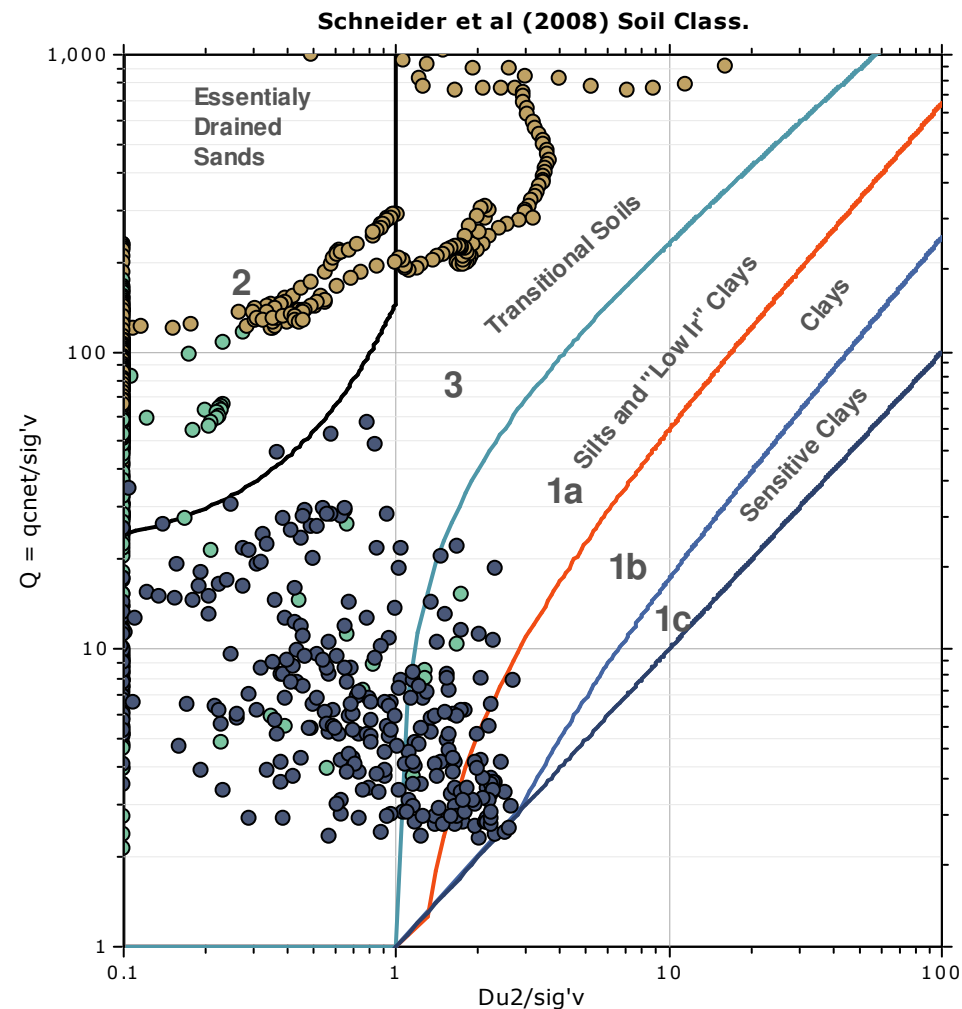
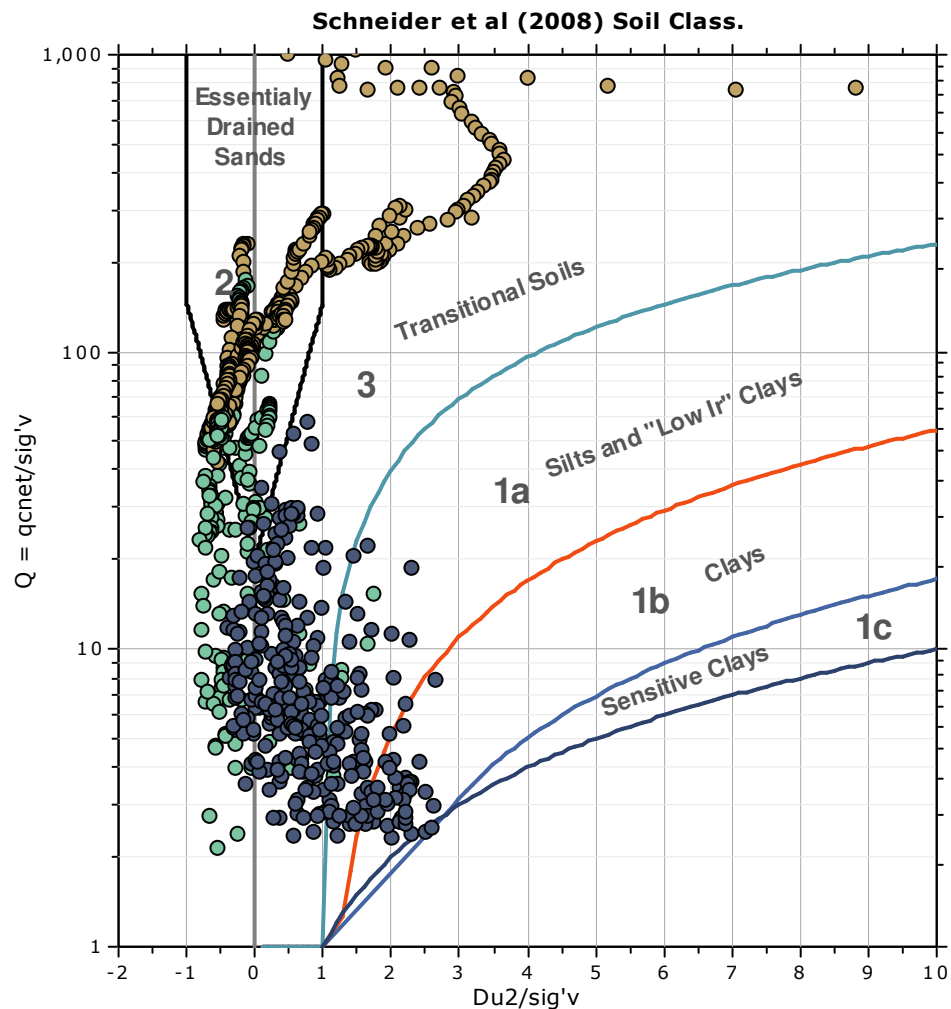
**SBT - Bq plots (normalized)**

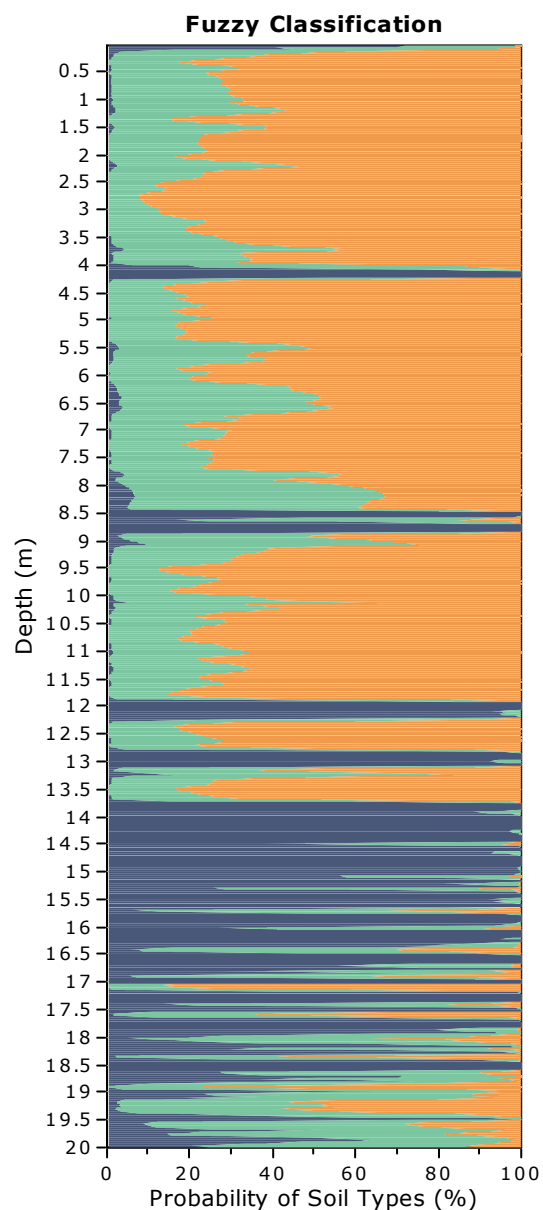
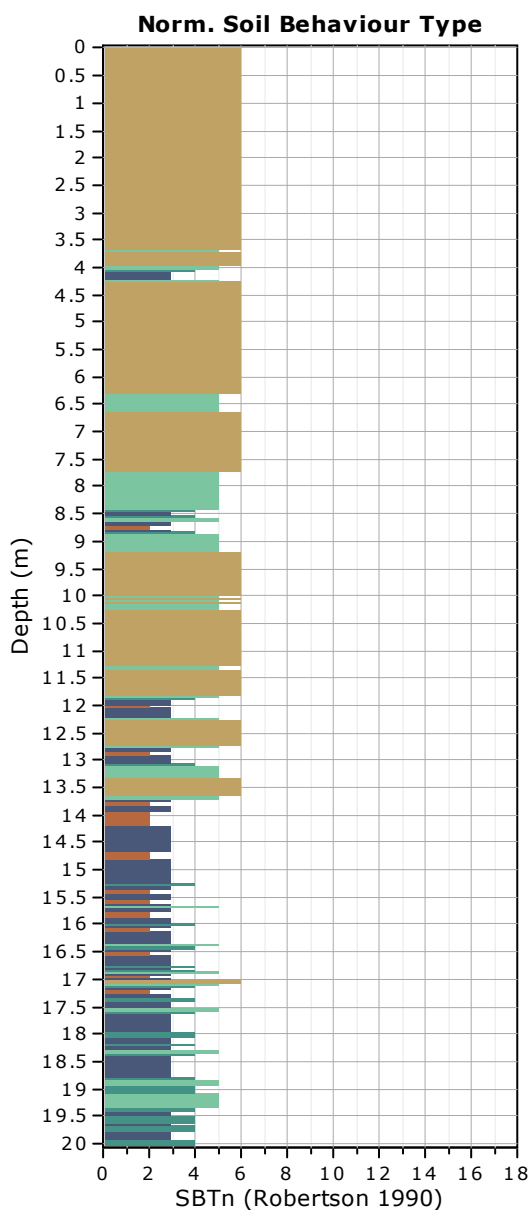


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





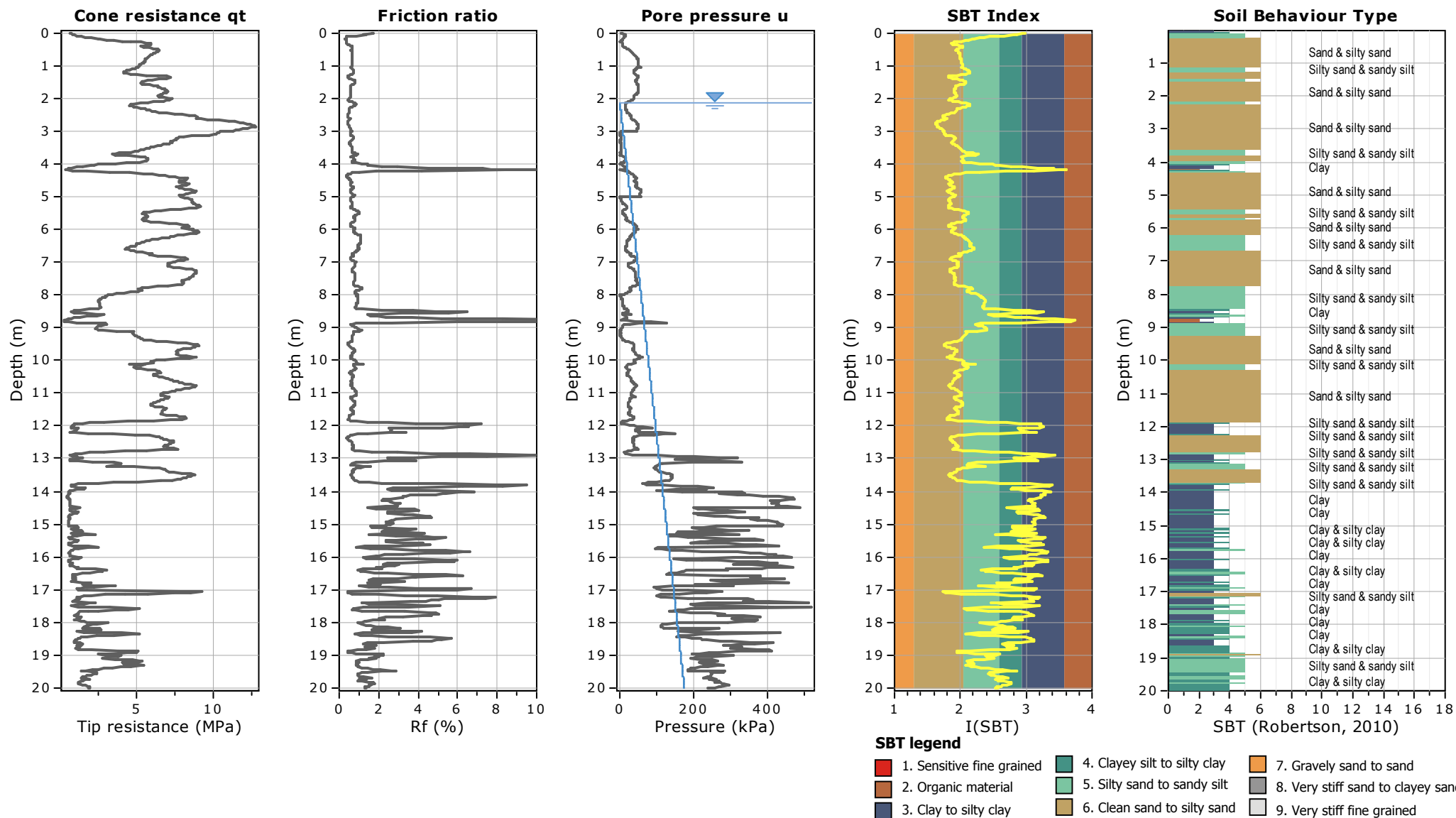
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

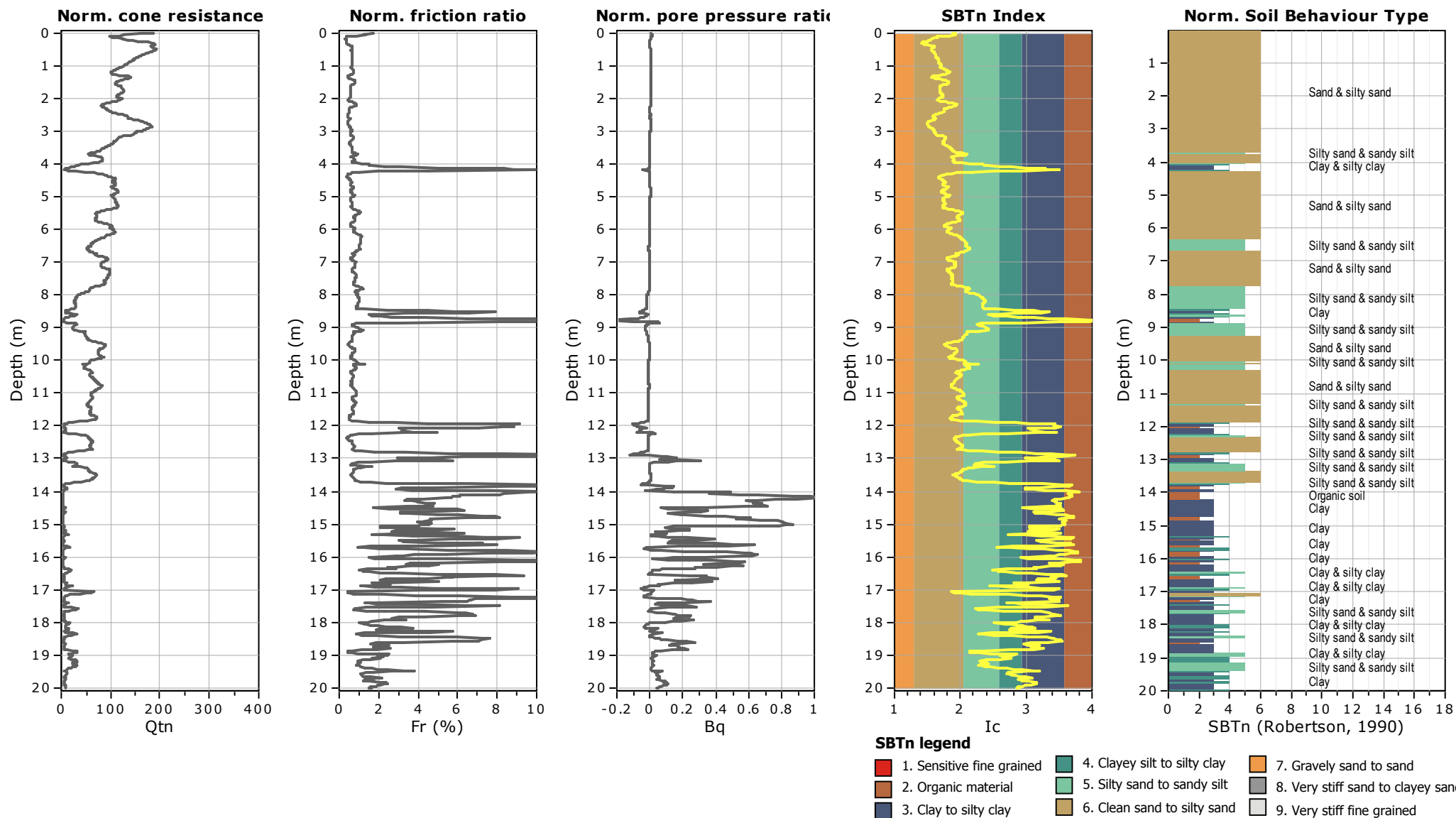
**CPT: CPTU km50+700**

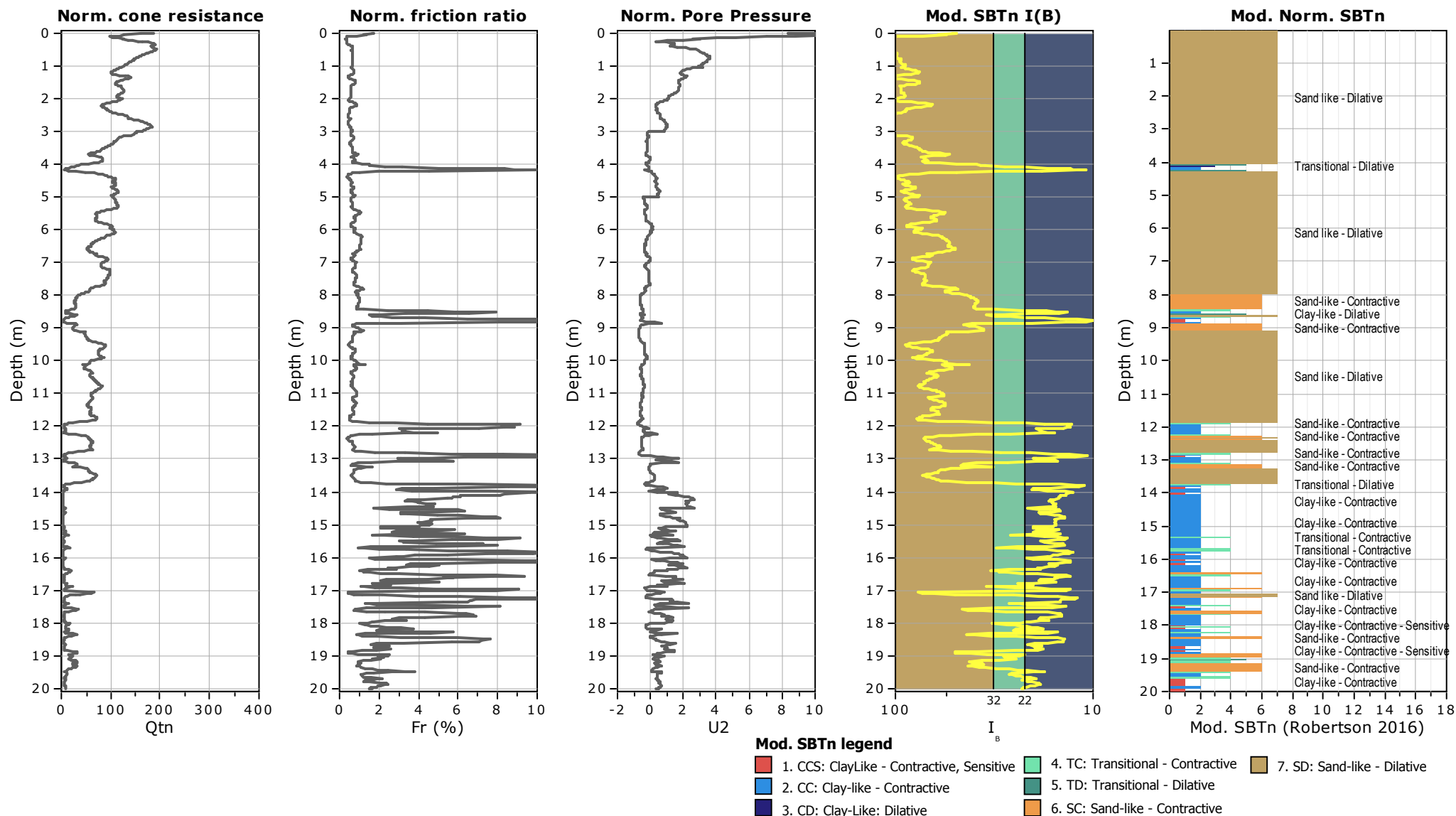
Total depth: 20.00 m

Coords: lat 44.887298° lon 12.211225°

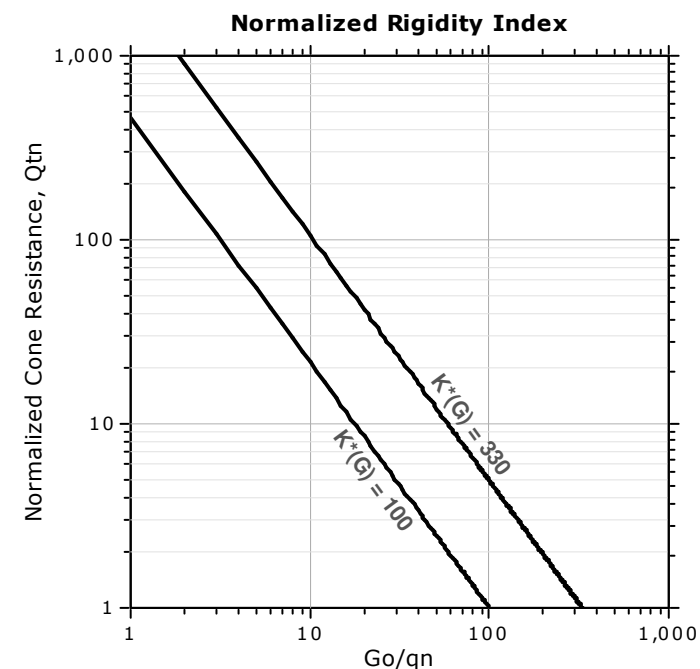
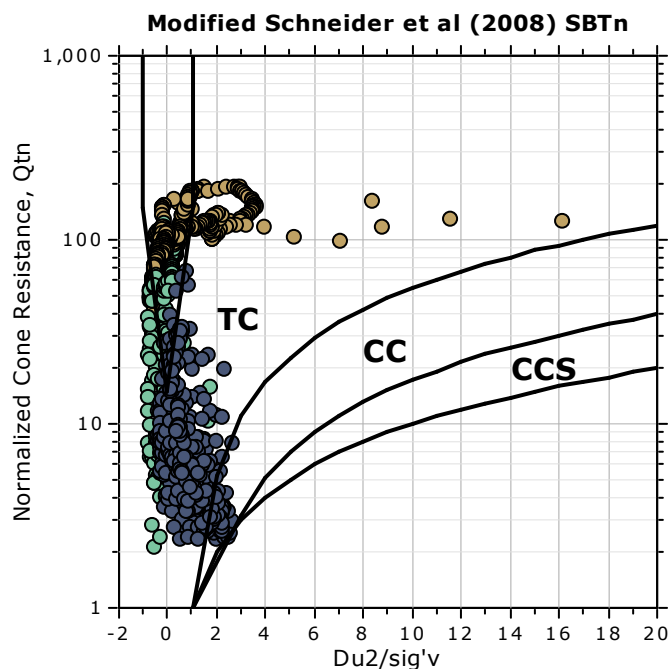
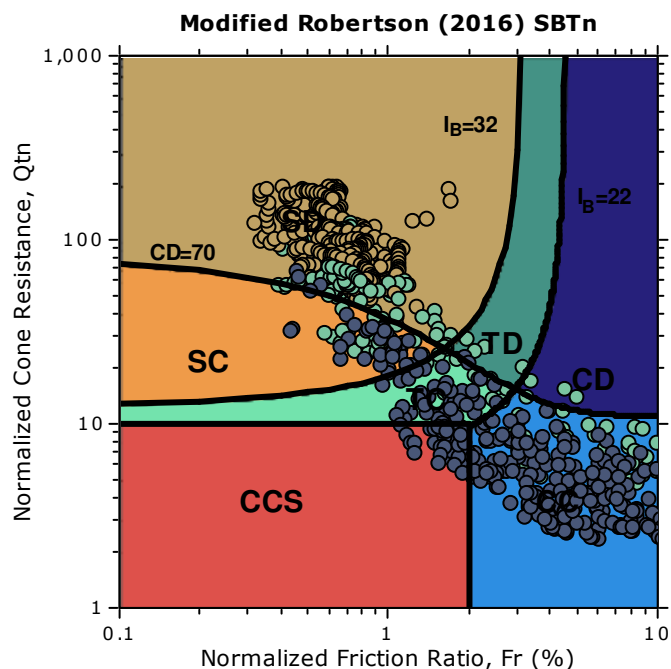








## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

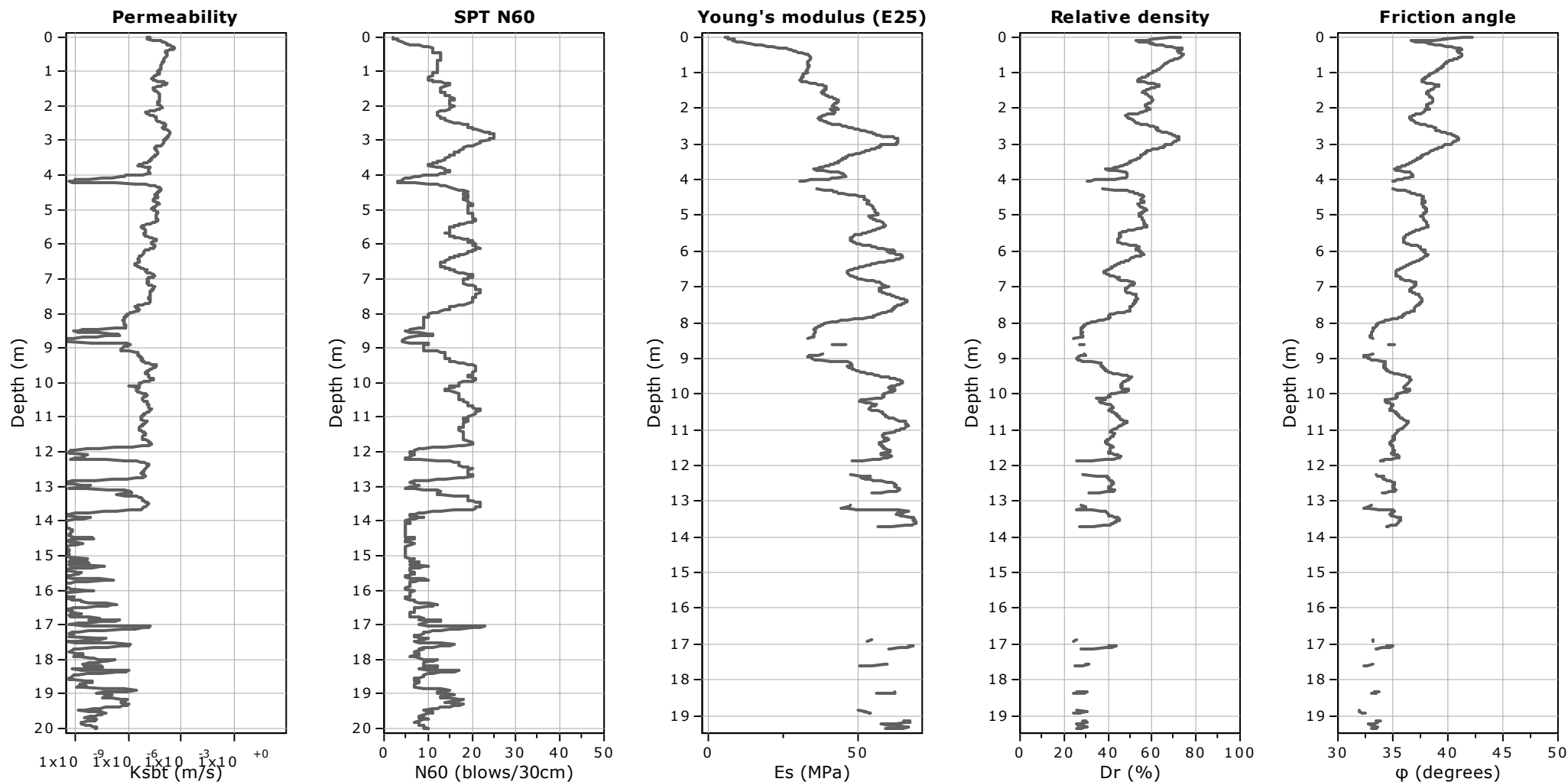
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+700**

Total depth: 20.00 m

Coords: lat 44.887298° lon 12.211225°



**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 Kulhavy & Mayne (1990)

● User defined estimation data

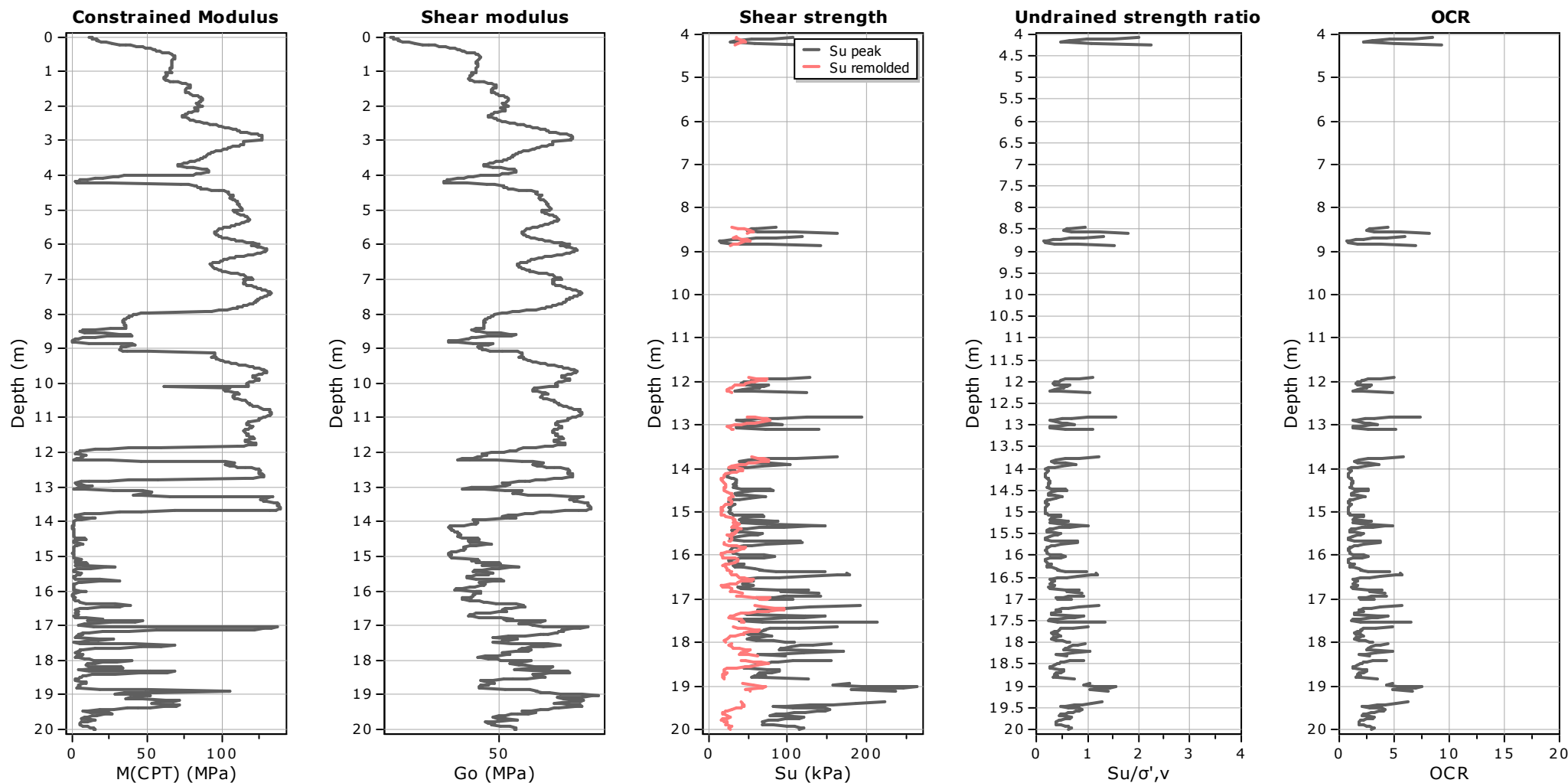
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+700**

Total depth: 20.00 m

Coords: lat 44.887298° lon 12.211225°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

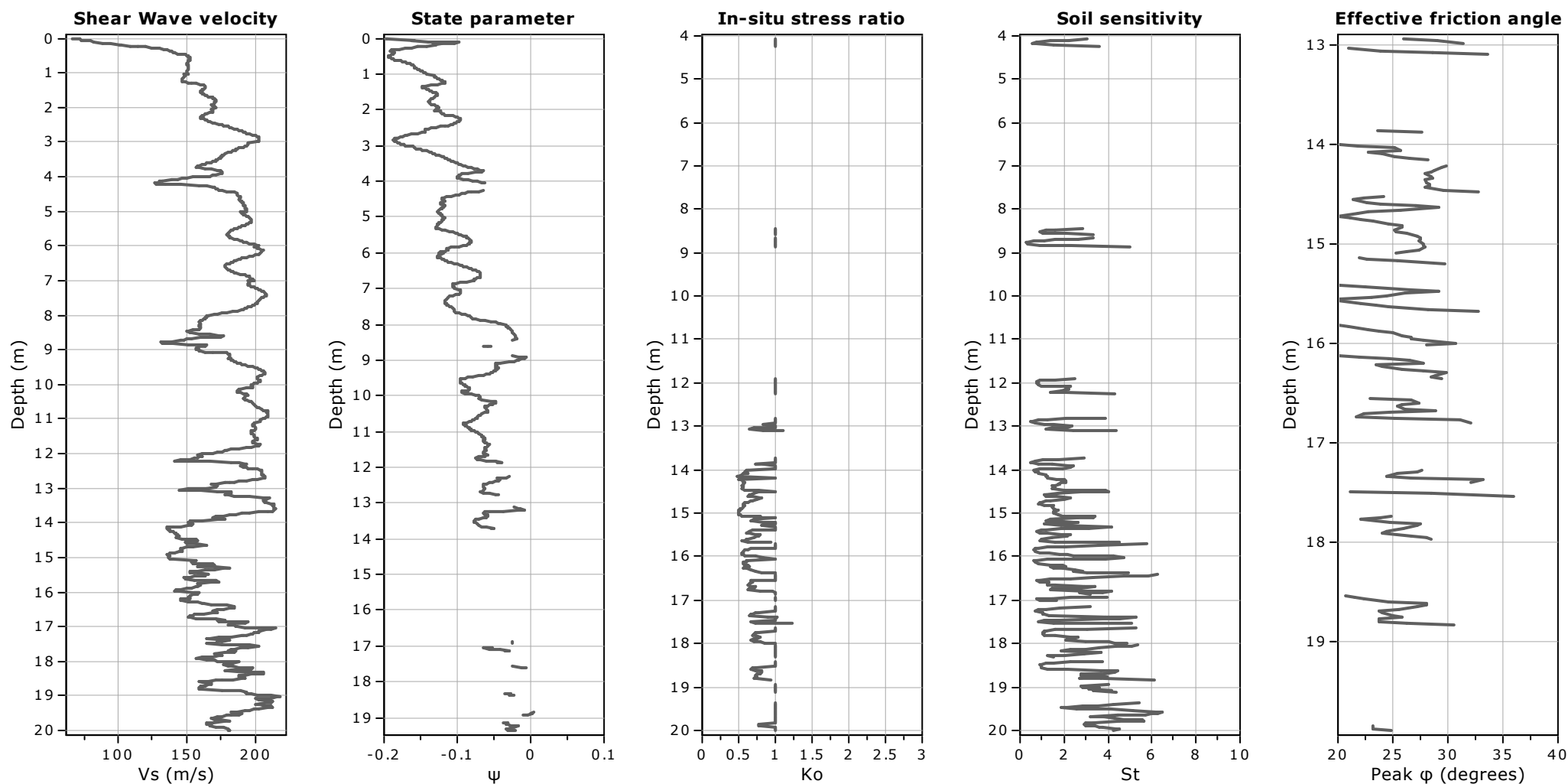
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km50+700**

Total depth: 20.00 m

Coords: lat 44.887298° lon 12.211225°

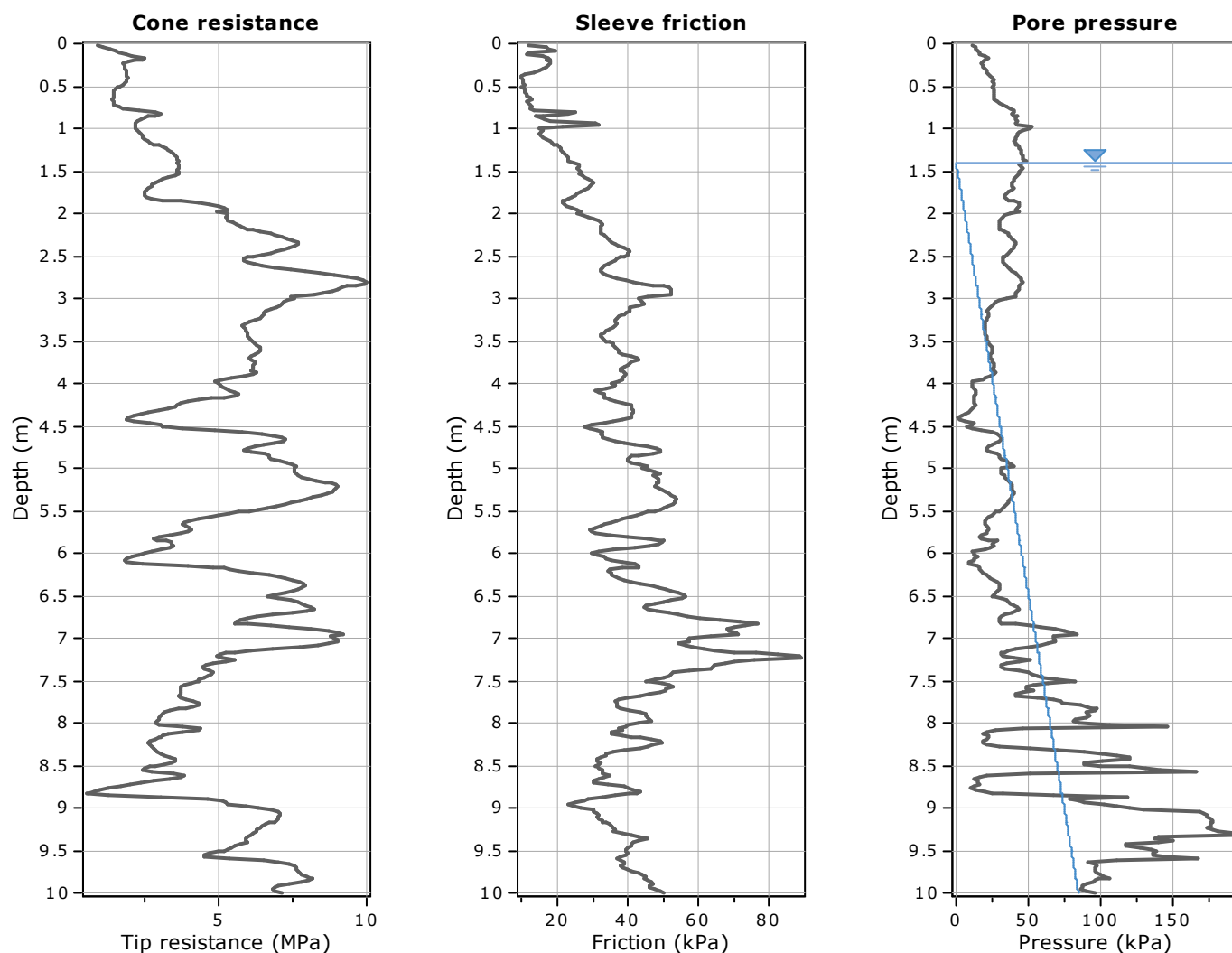


#### Calculation parameters

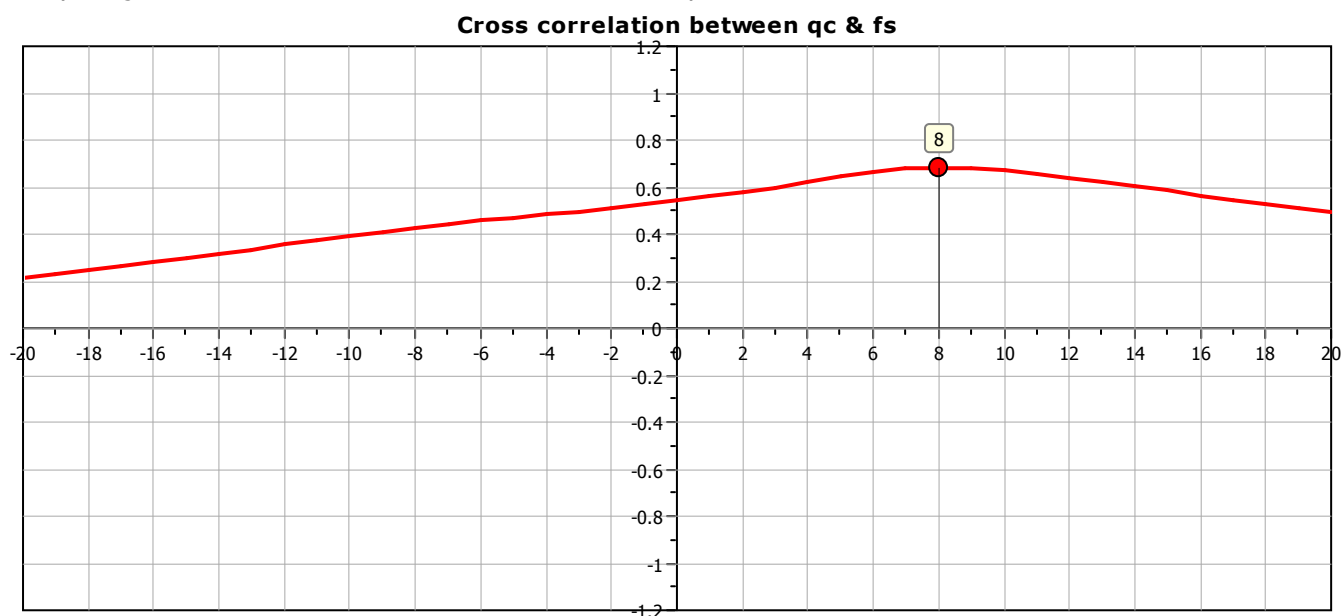
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

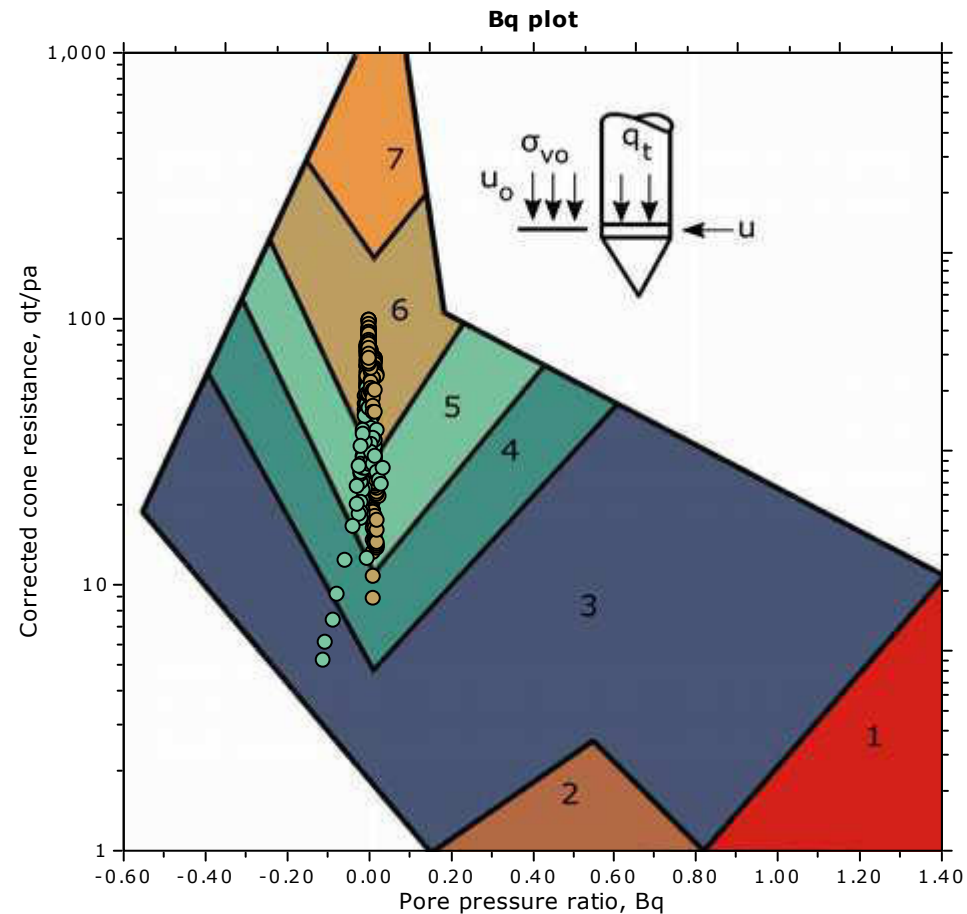
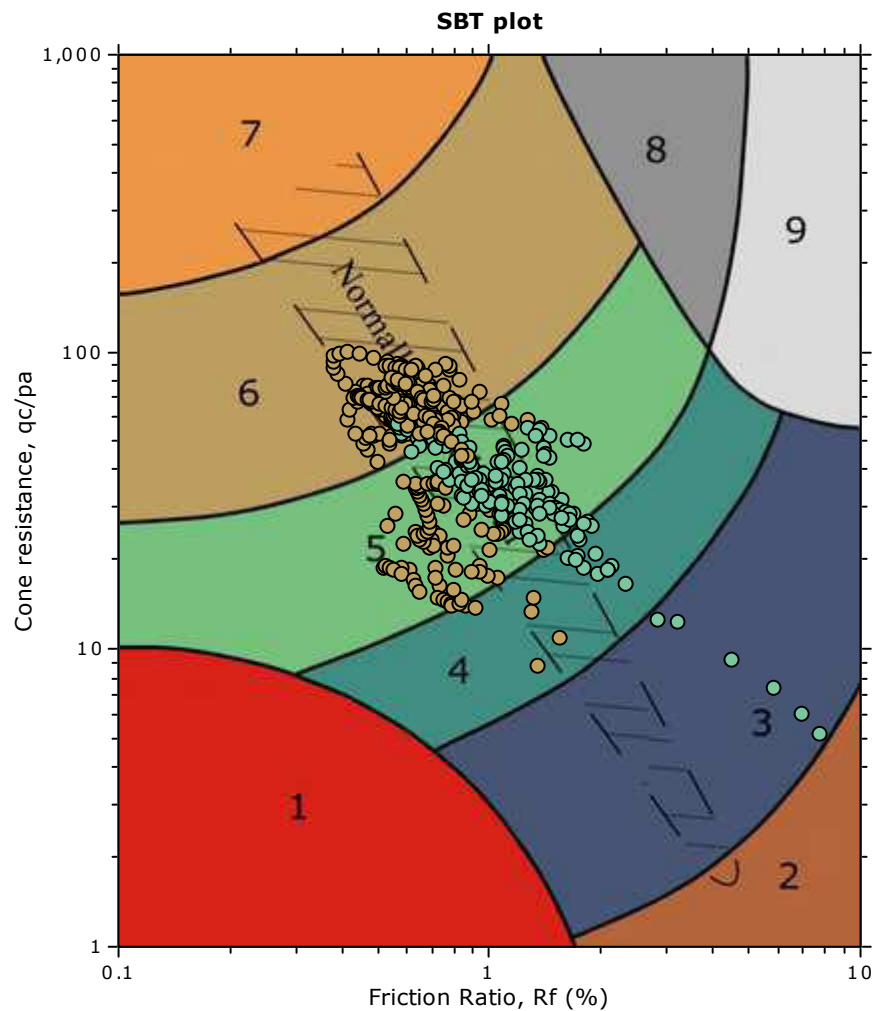




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



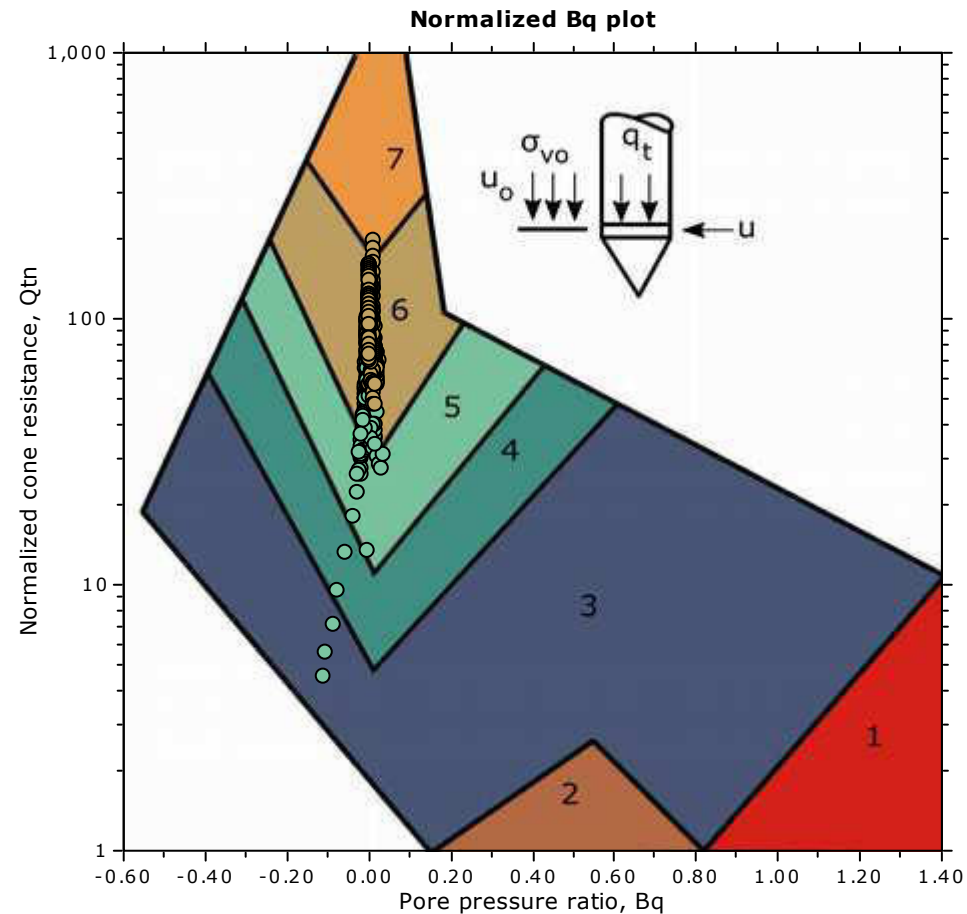
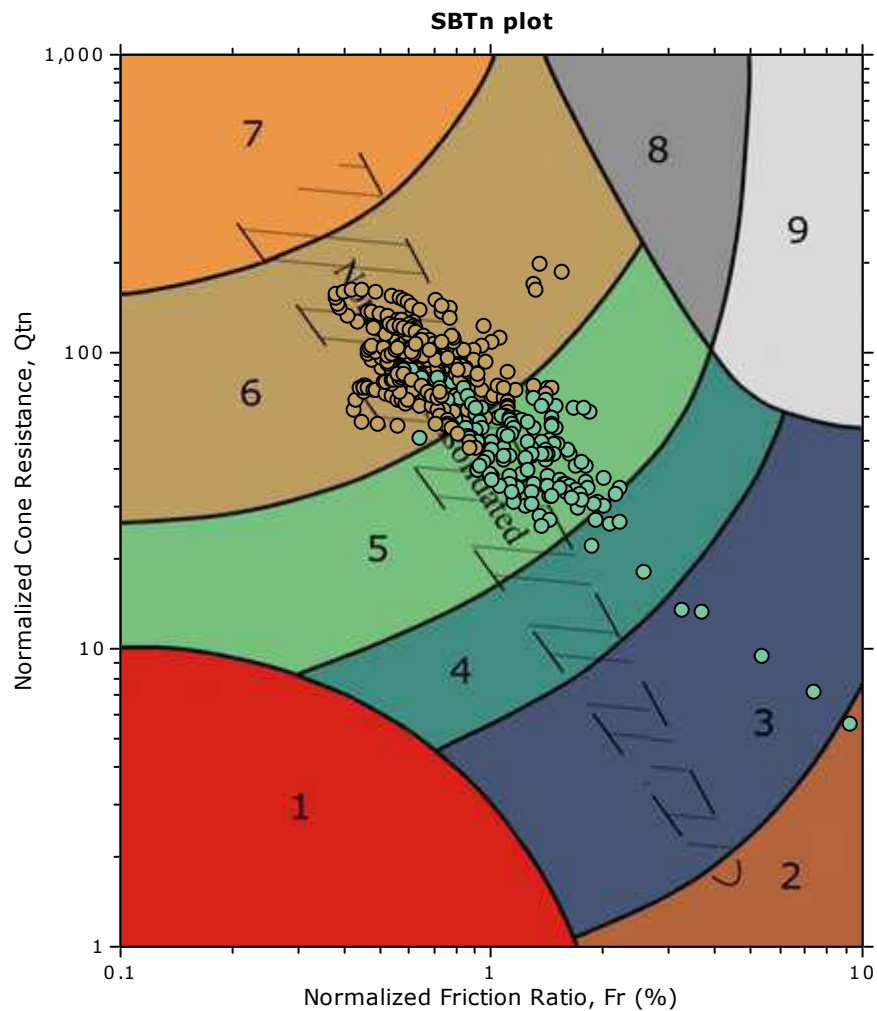
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

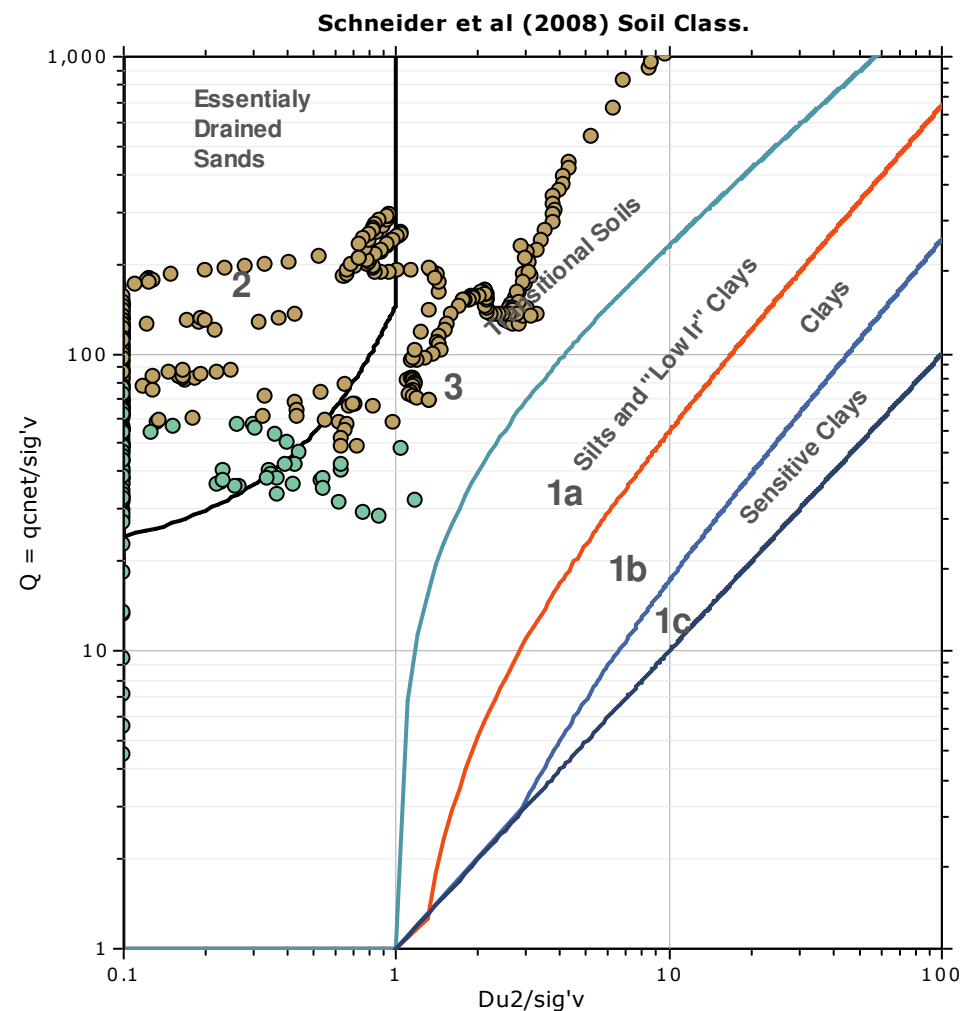
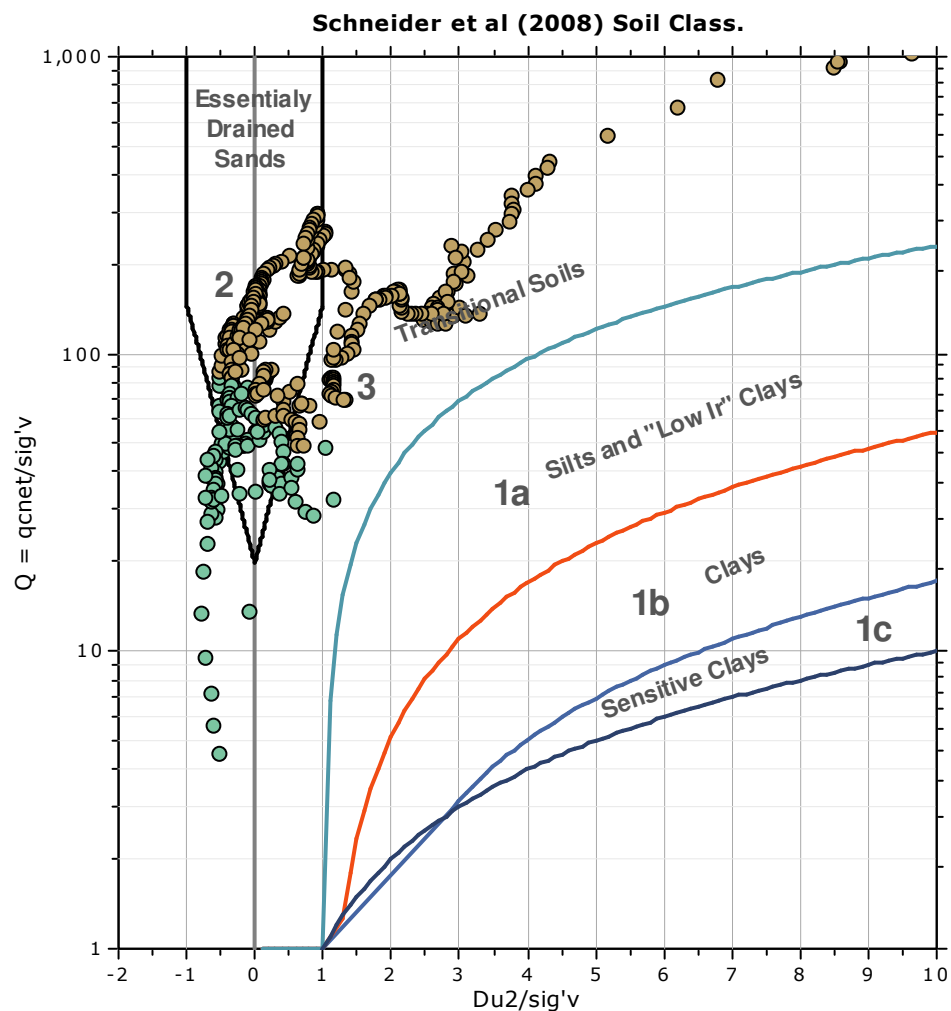
**SBT - Bq plots (normalized)**

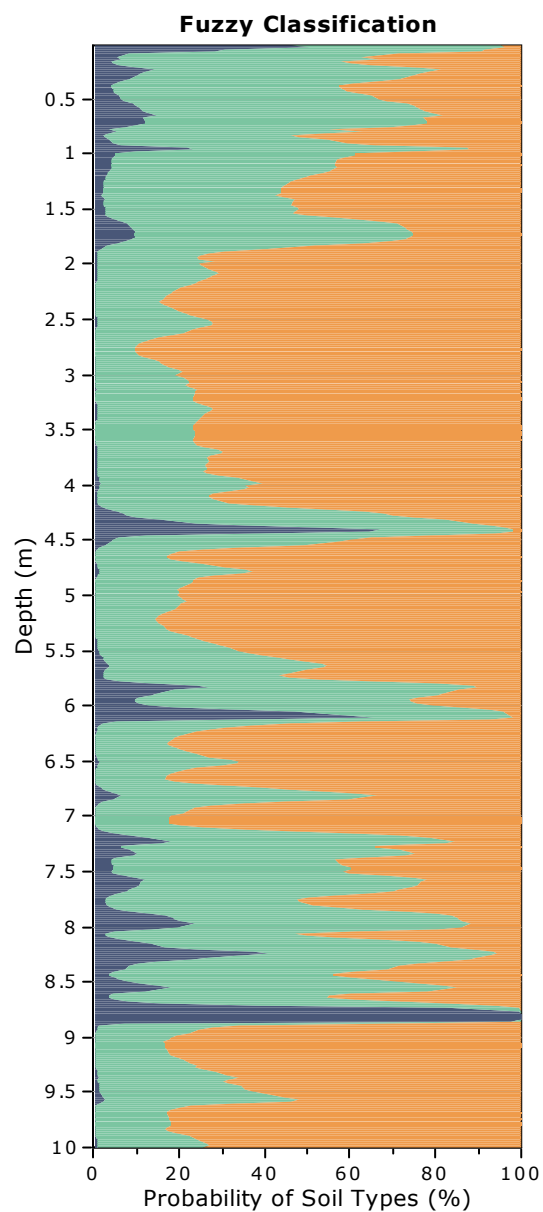
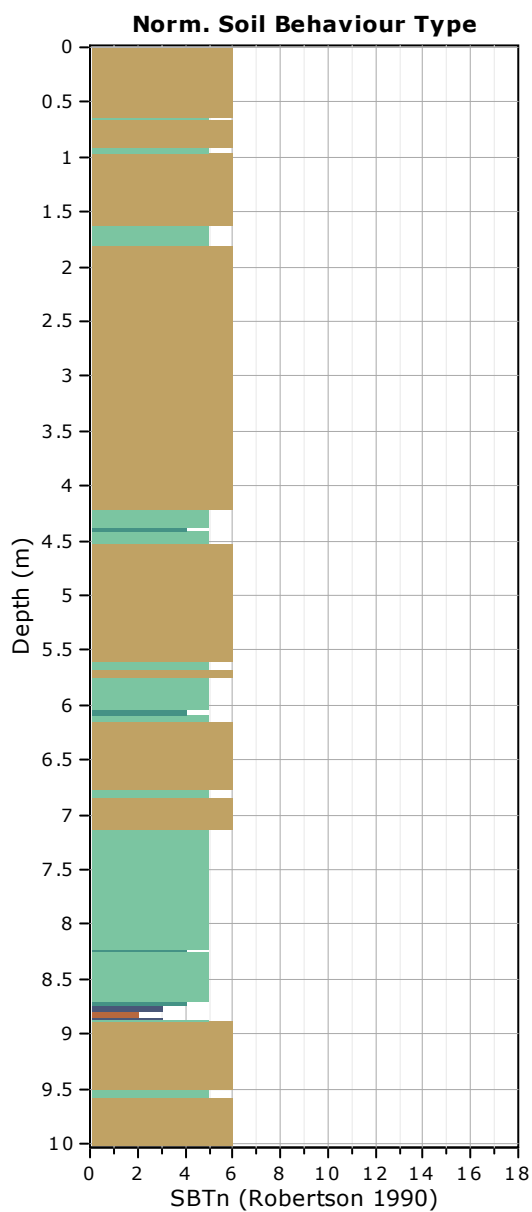


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





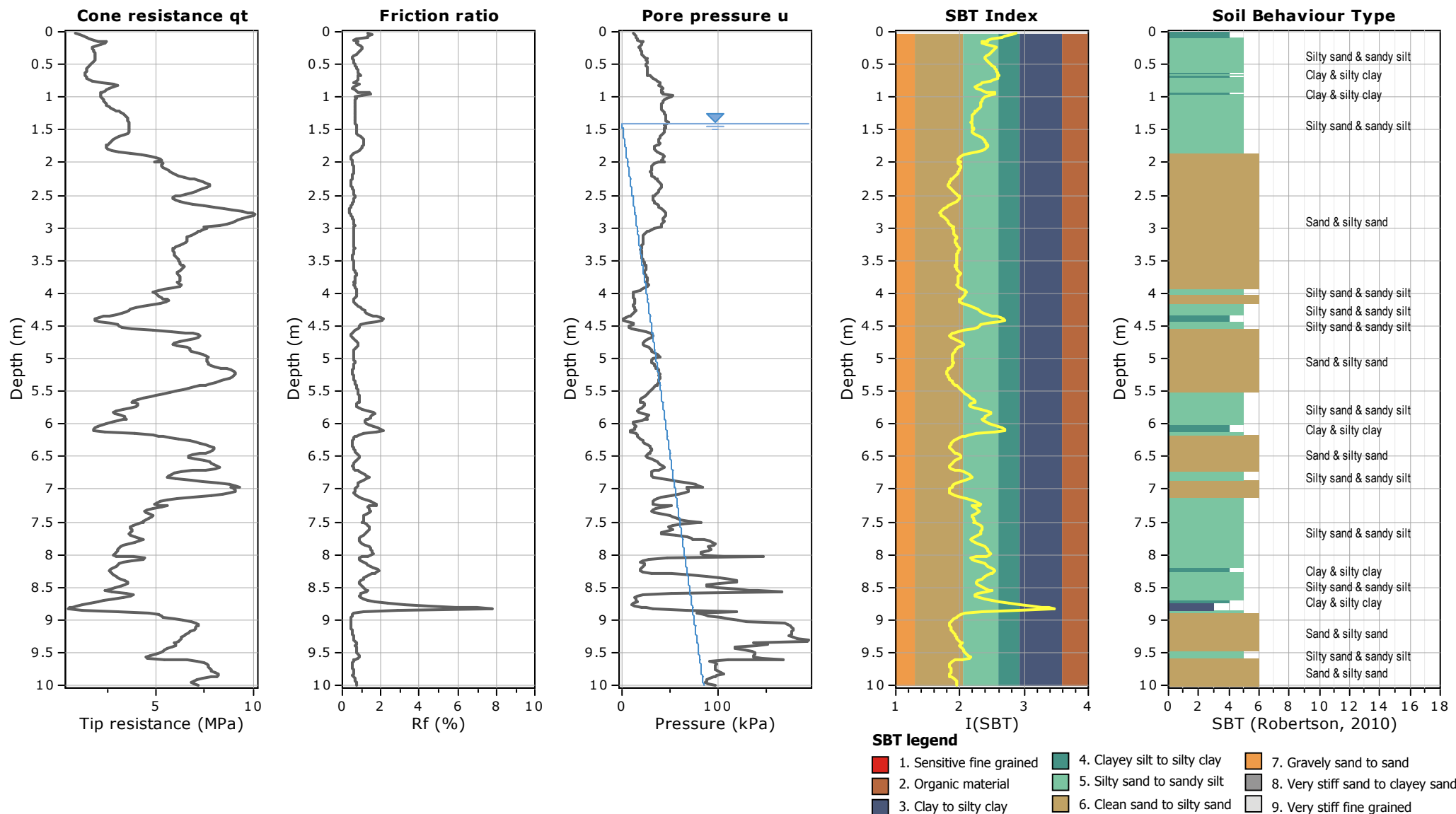
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+600**

Total depth: 10.00 m

Coords: lat 44.899758° lon 12.226448°





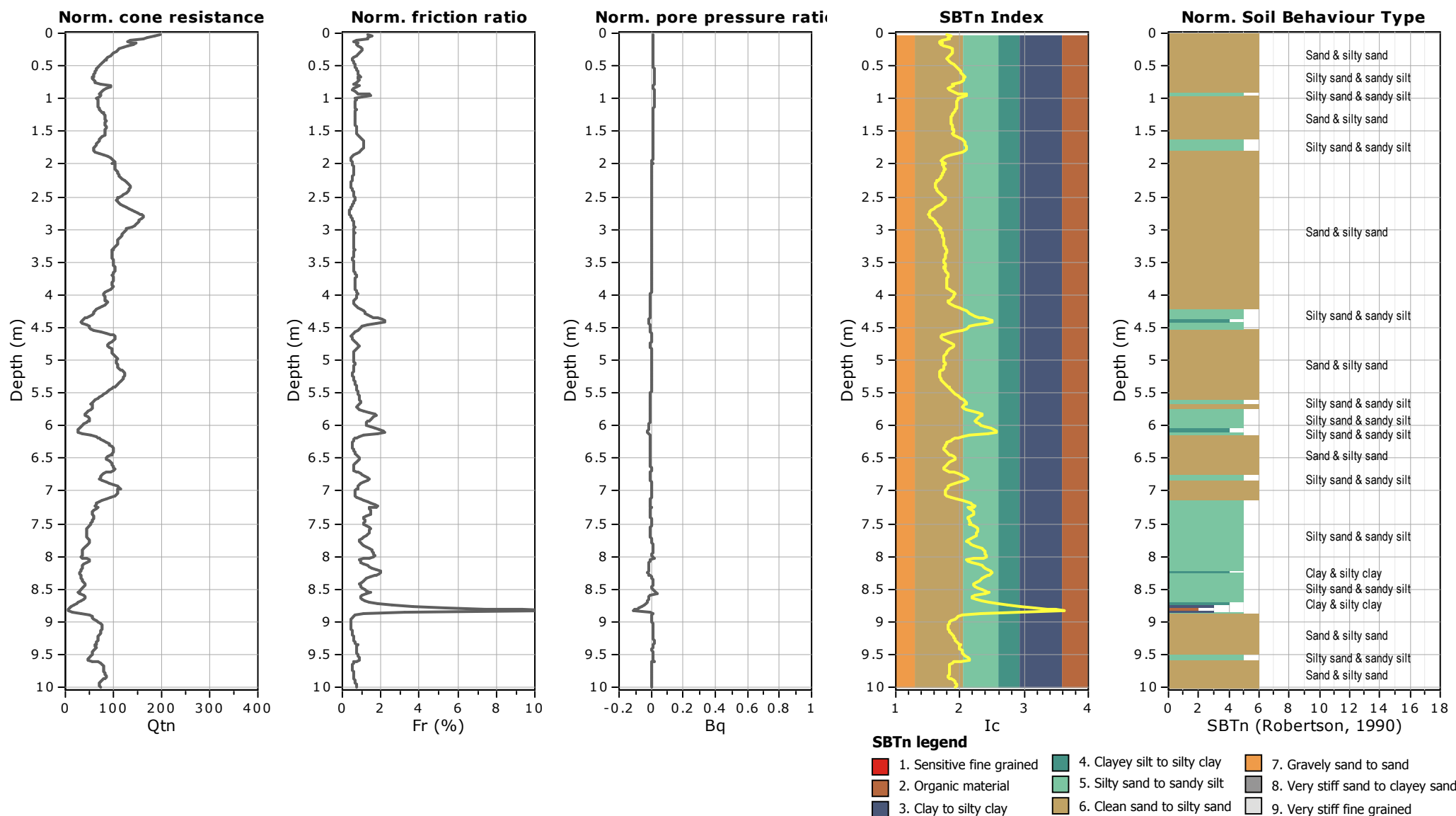
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+600**

Total depth: 10.00 m

Coords: lat 44.899758° lon 12.226448°



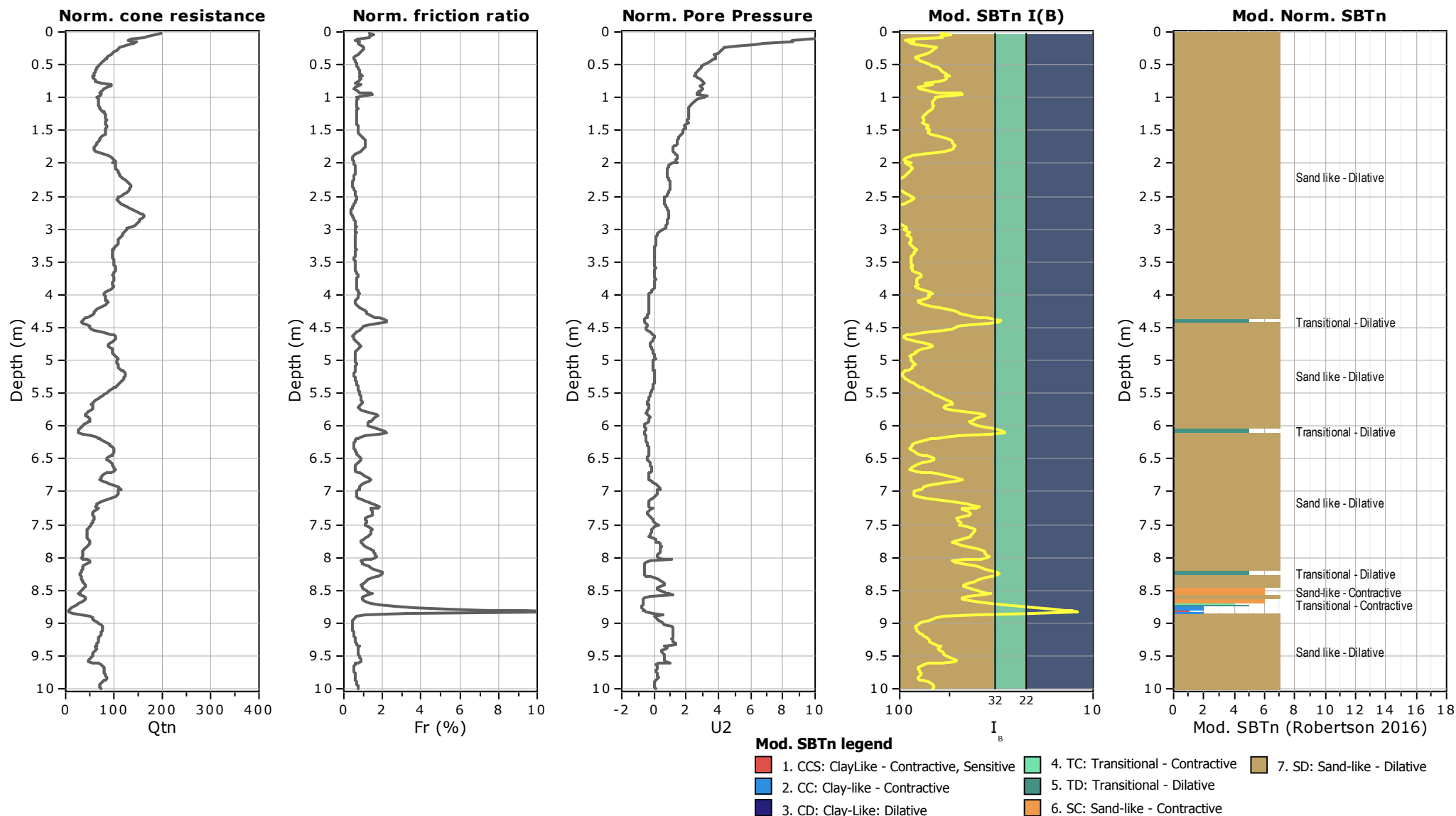
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

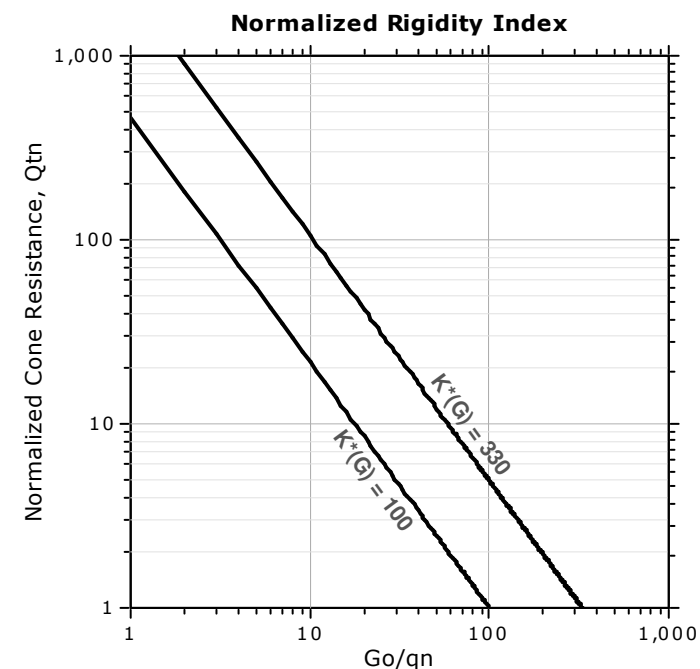
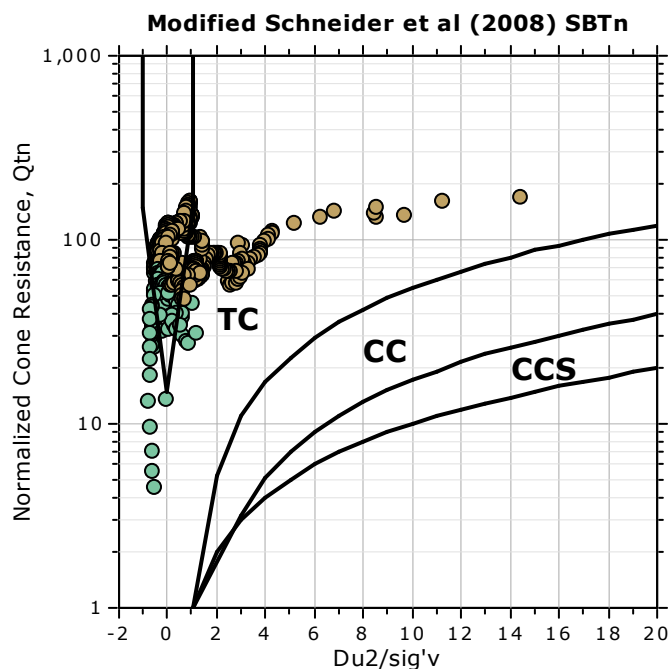
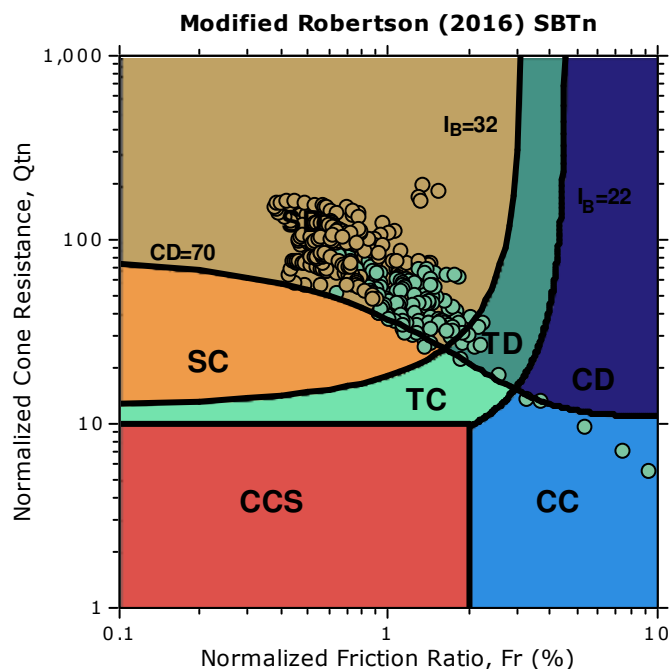
**CPT: CPTU km52+600**

Total depth: 10.00 m

Coords: lat 44.899758° lon 12.226448°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

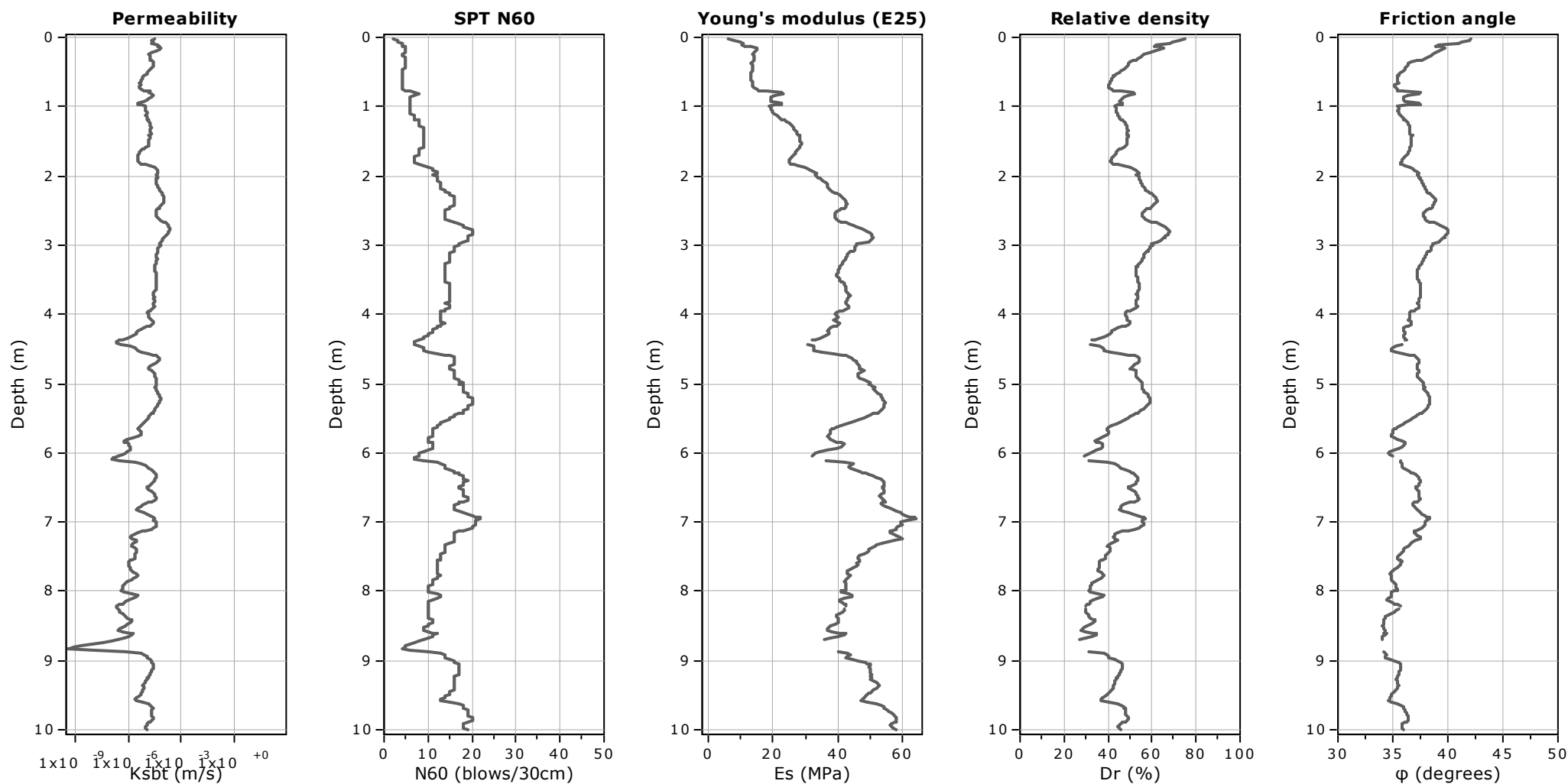
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+600**

Total depth: 10.00 m

Coords: lat 44.899758° lon 12.226448°



**Calculation parameters**

Permeability: Based on  $SBT_n$

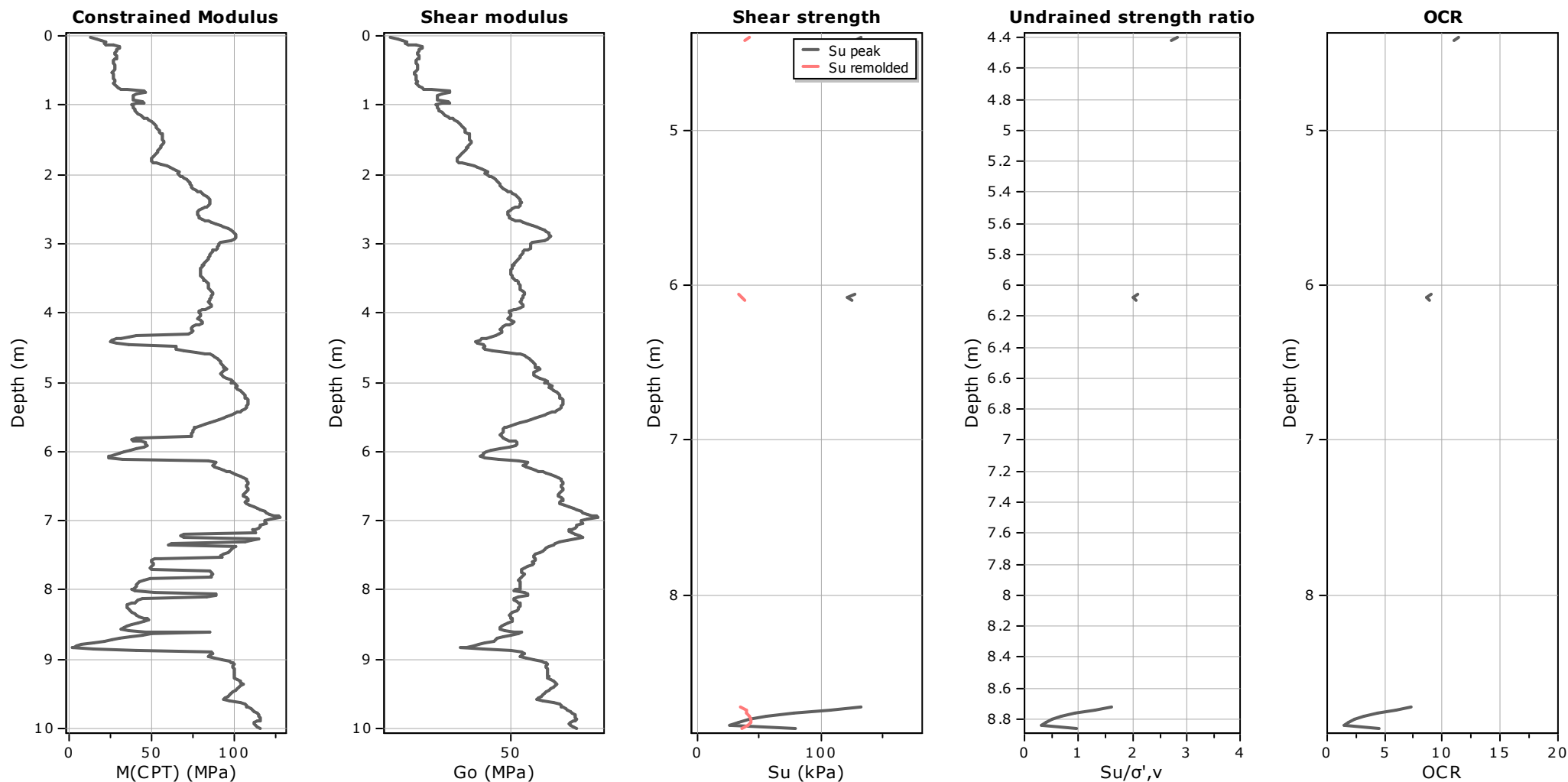
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

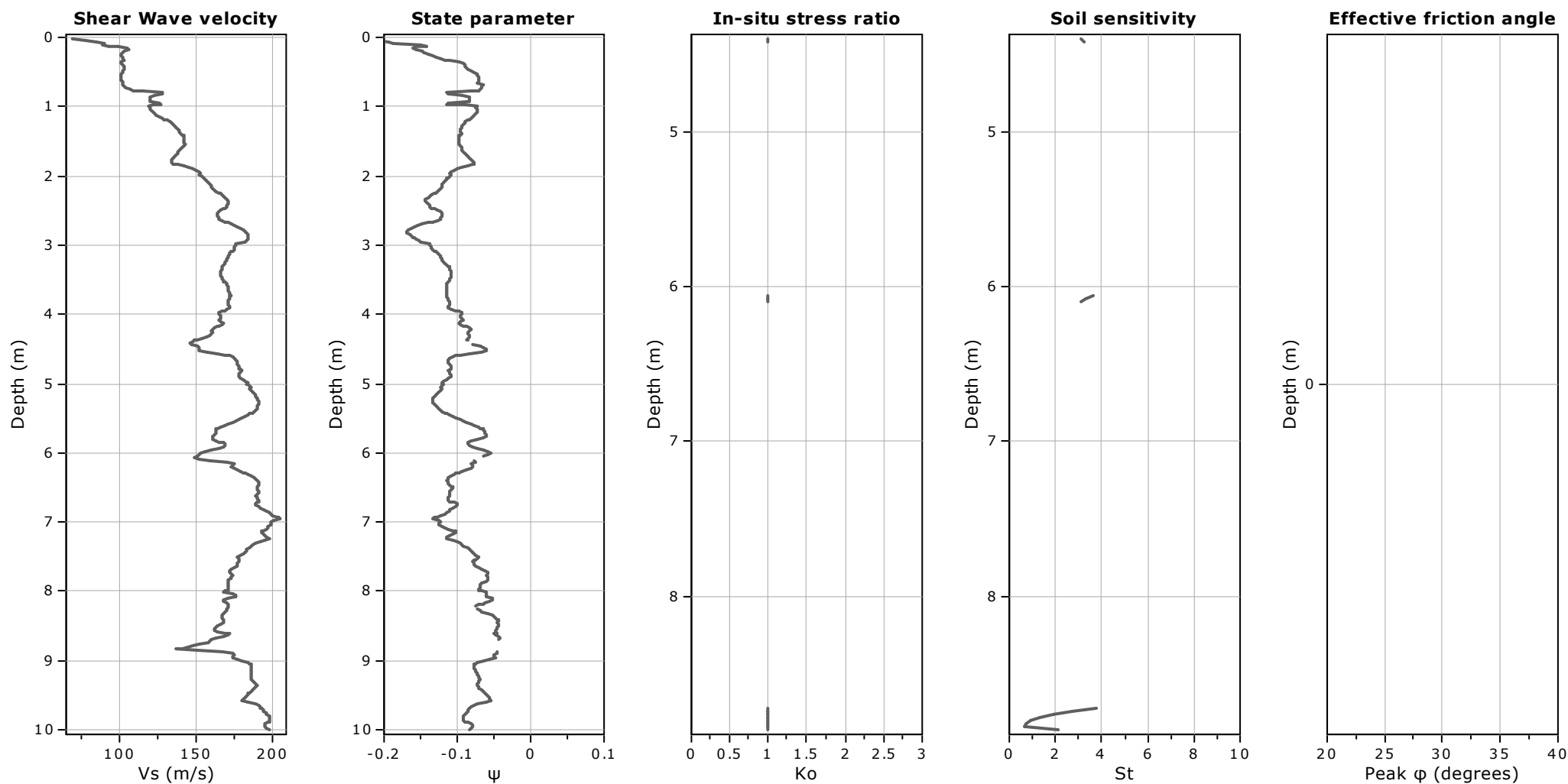
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+600**

Total depth: 10.00 m

Coords: lat 44.899758° lon 12.226448°

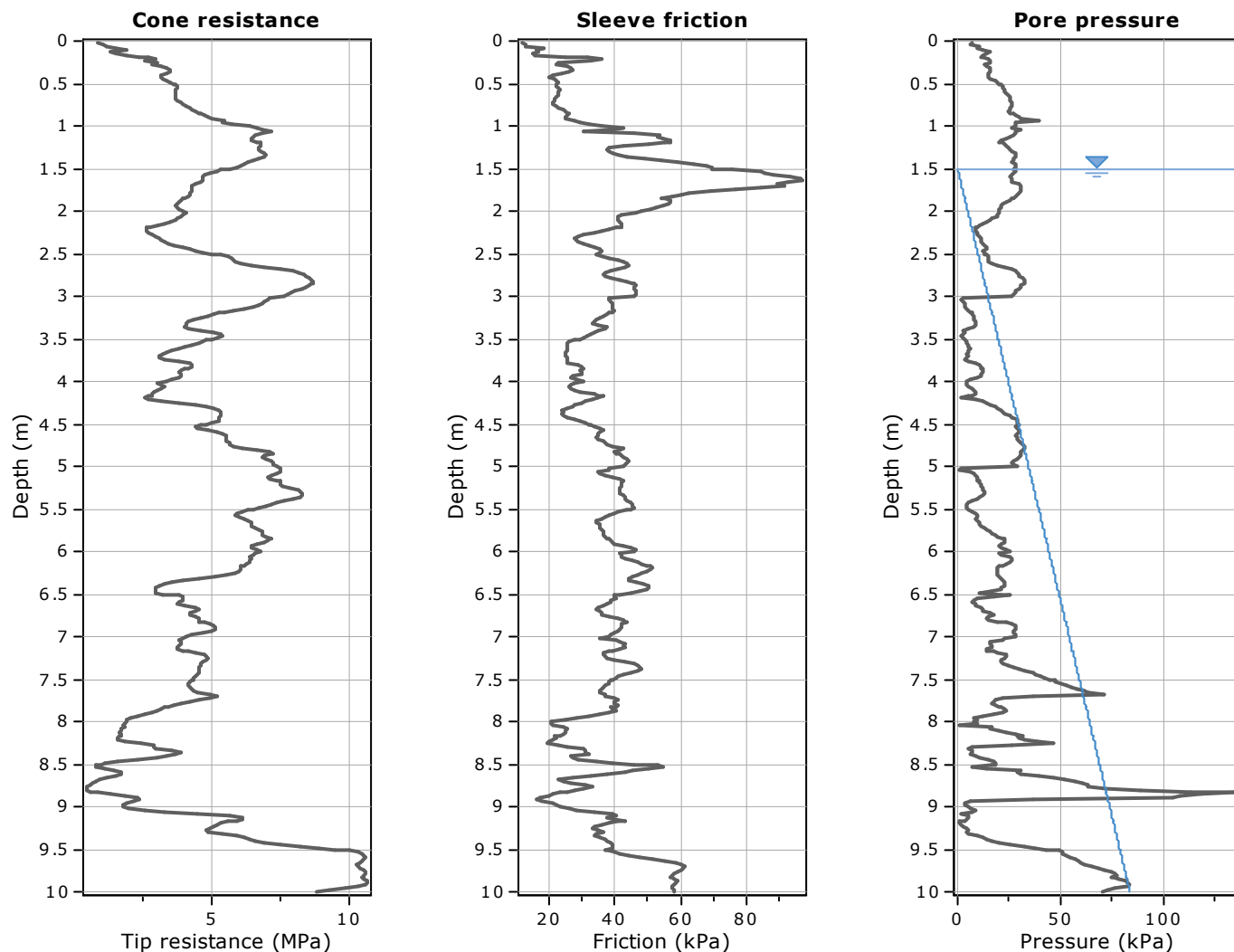


**Calculation parameters**

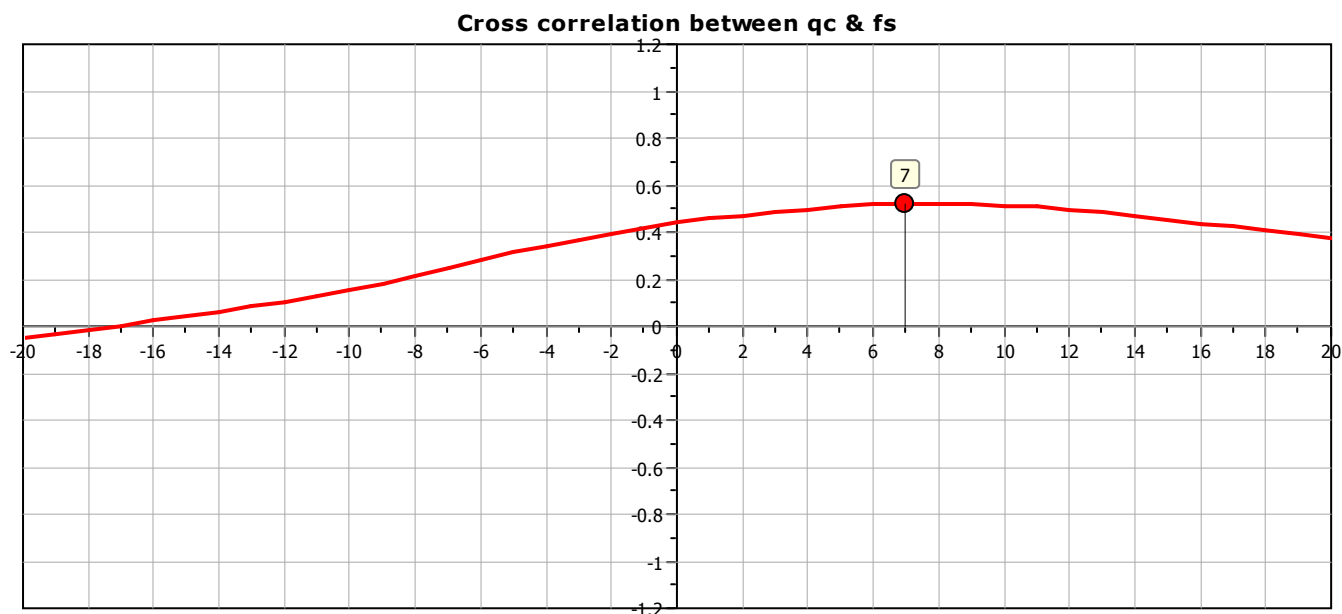
Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

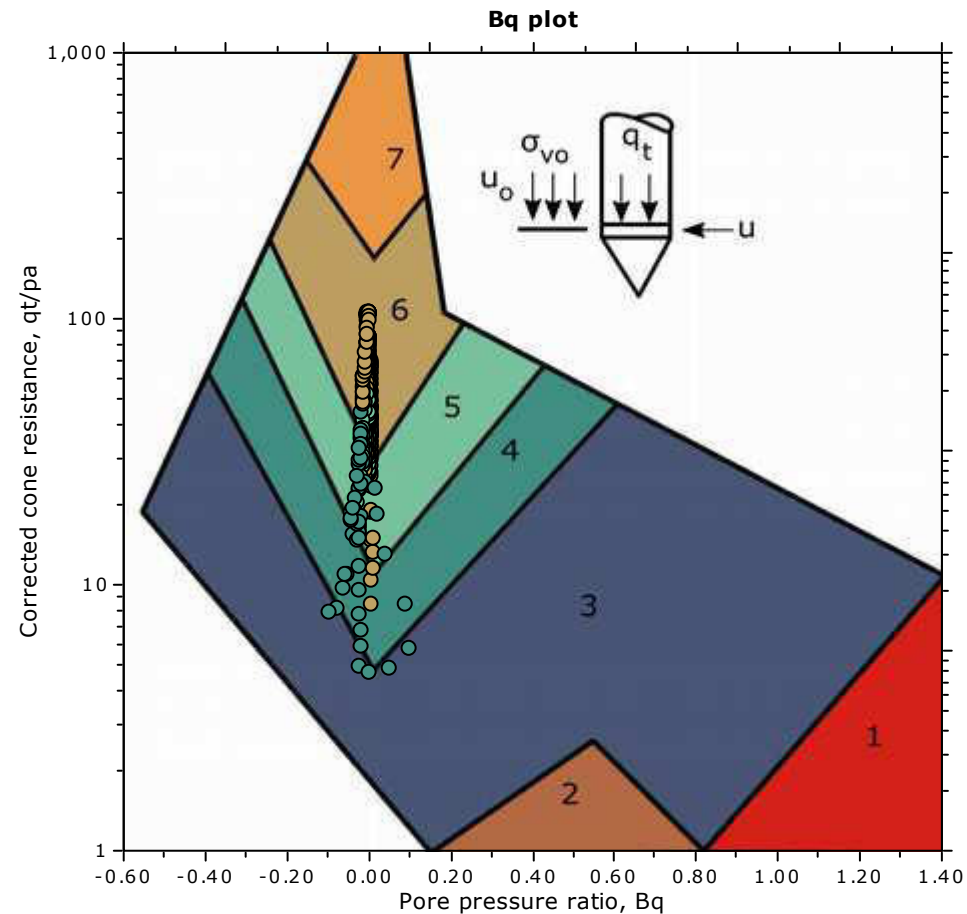
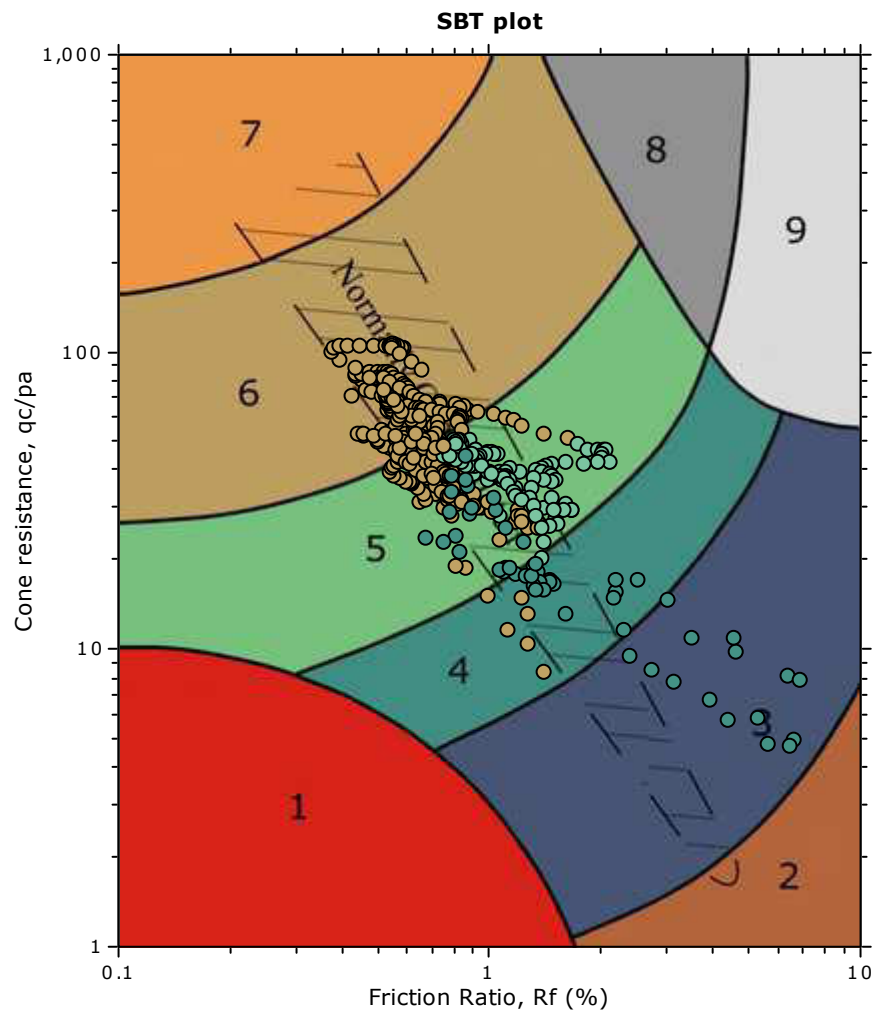




The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).



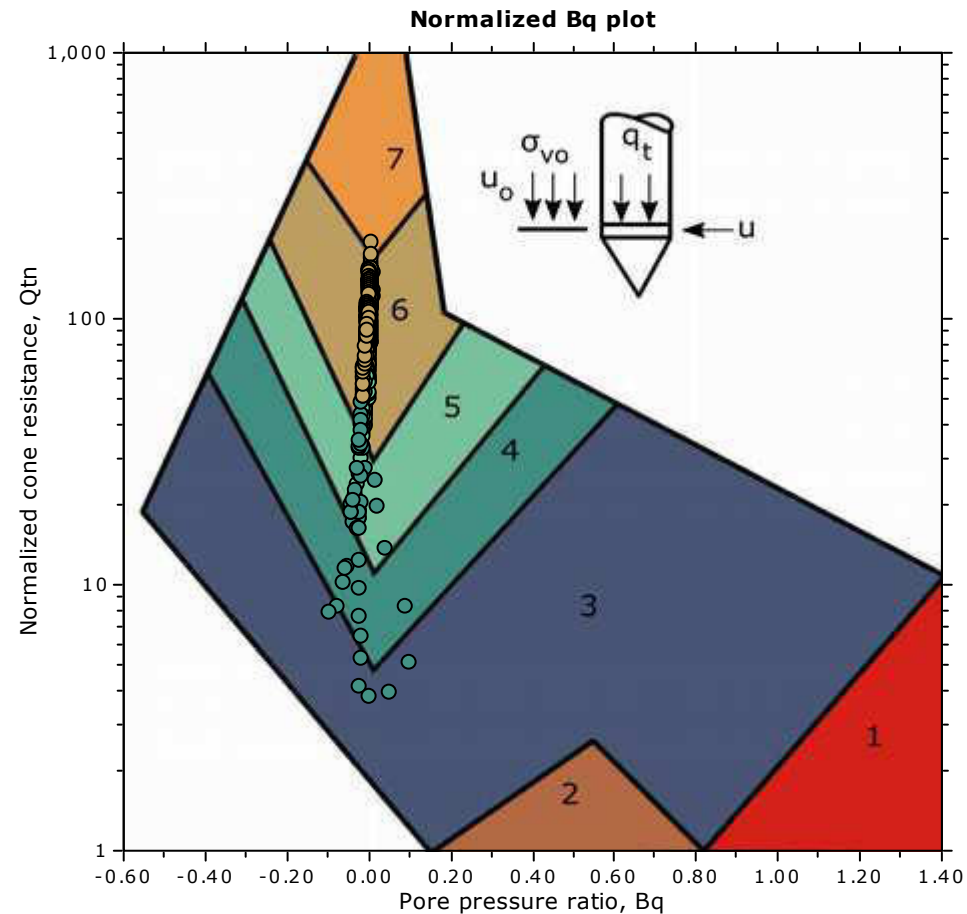
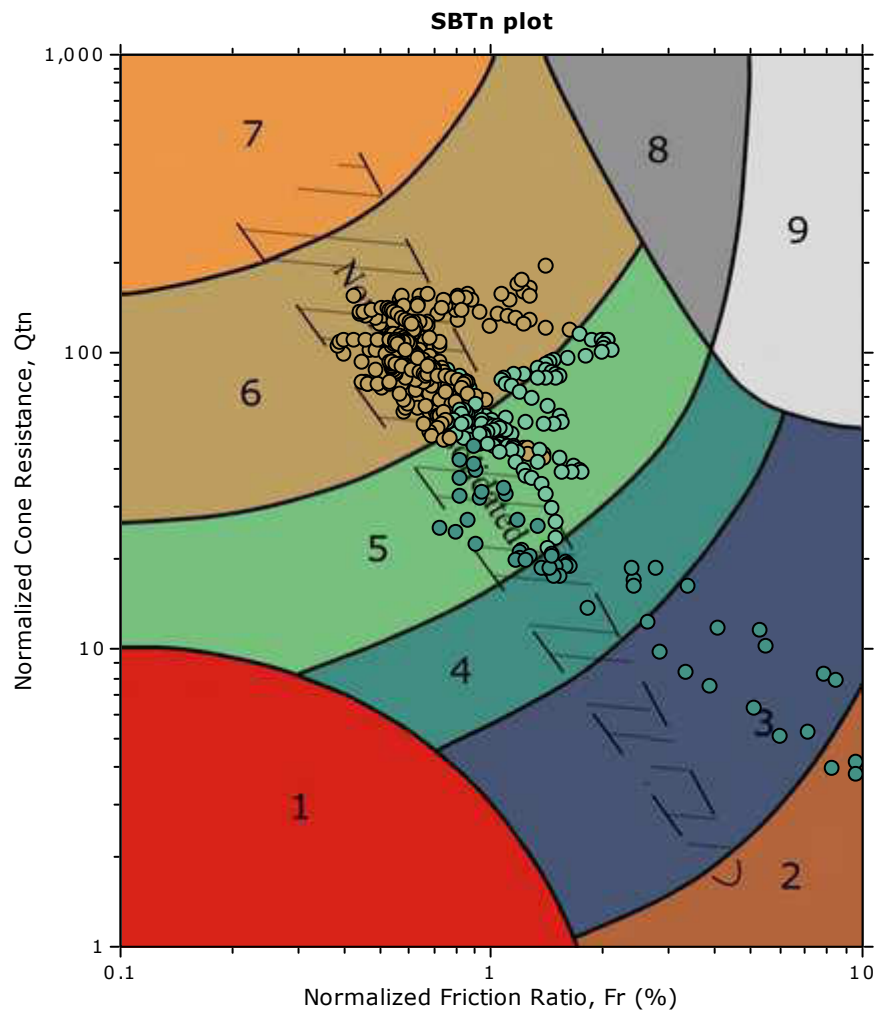
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

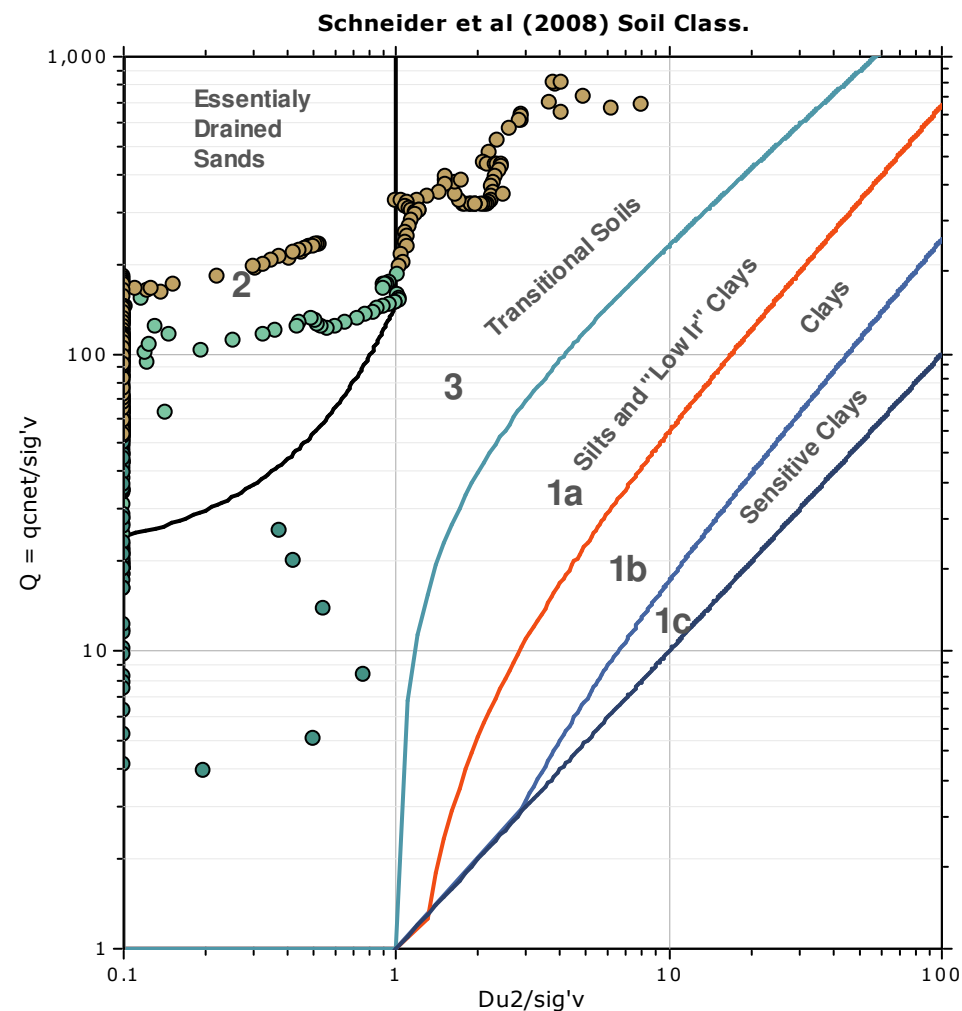
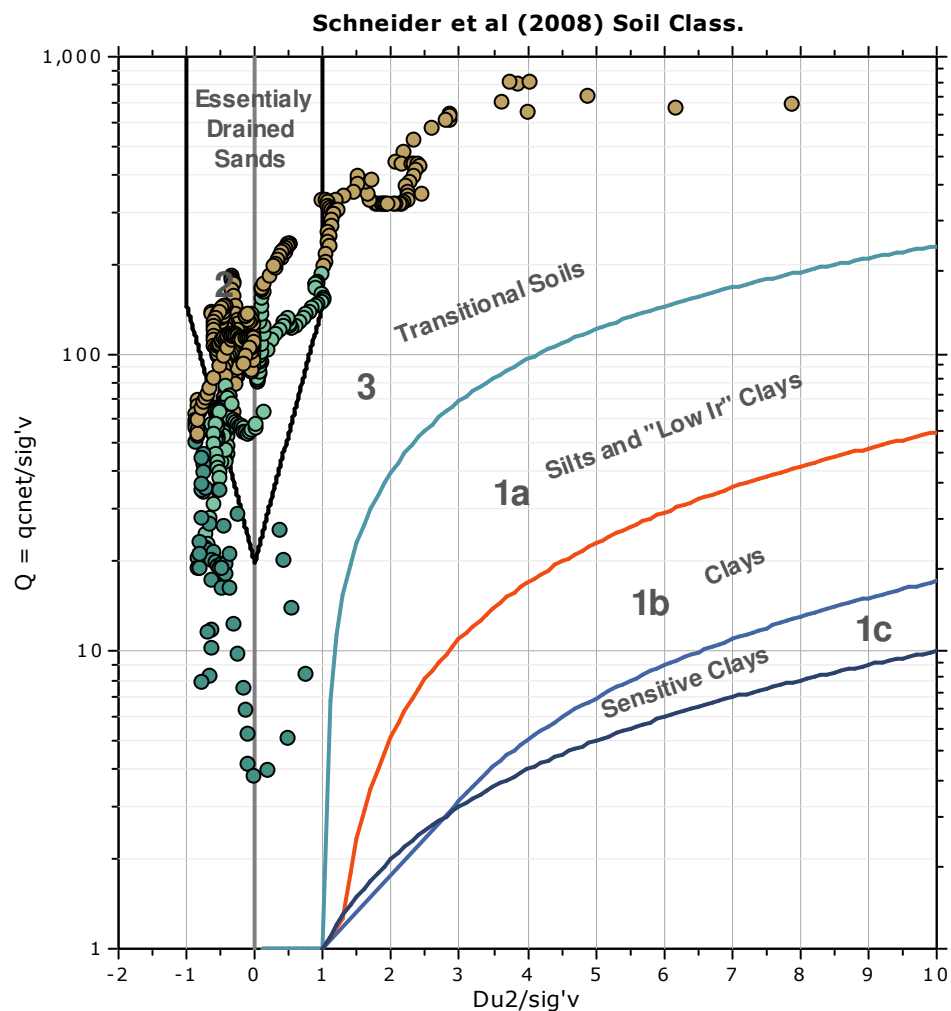
**SBT - Bq plots (normalized)**

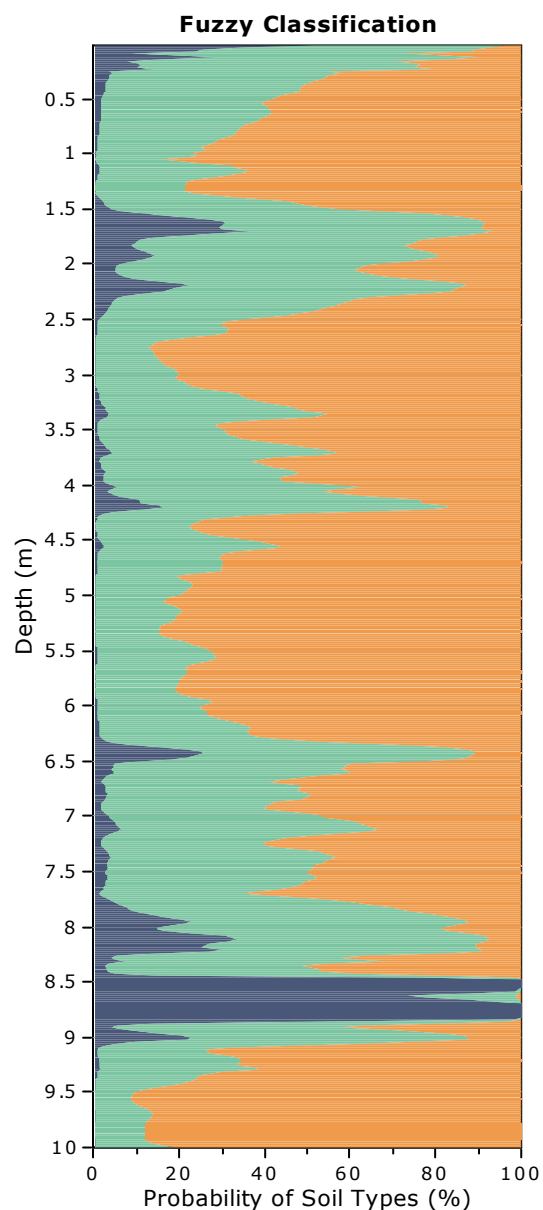
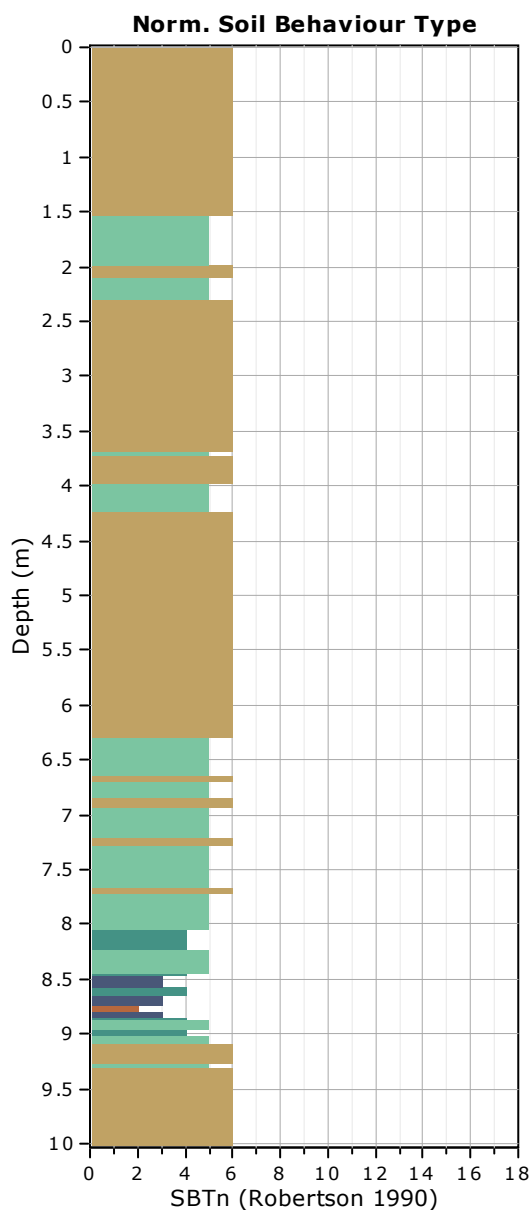


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





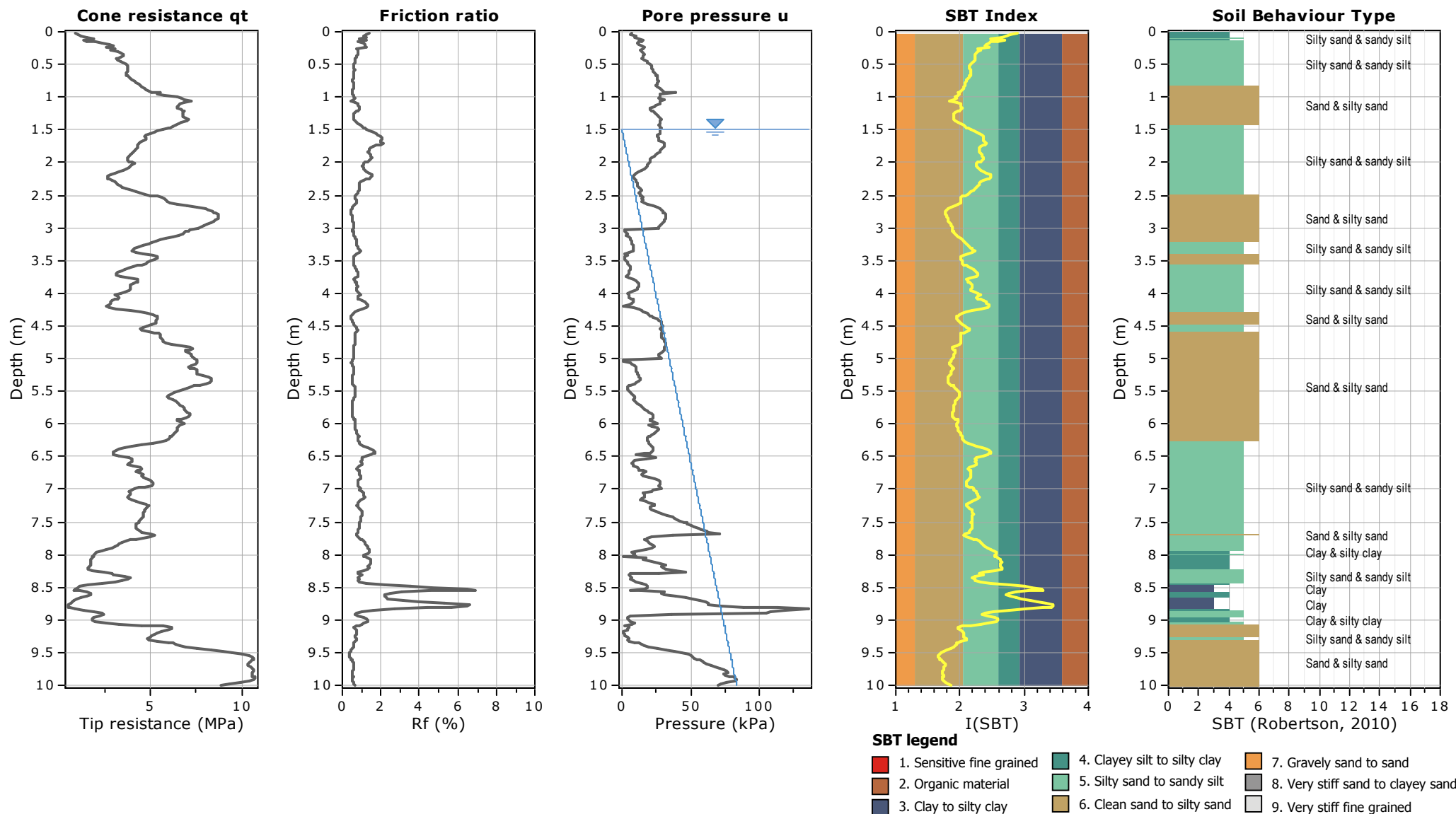
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+800**

Total depth: 10.00 m

Coords: lat 44.900677° lon 12.227736°



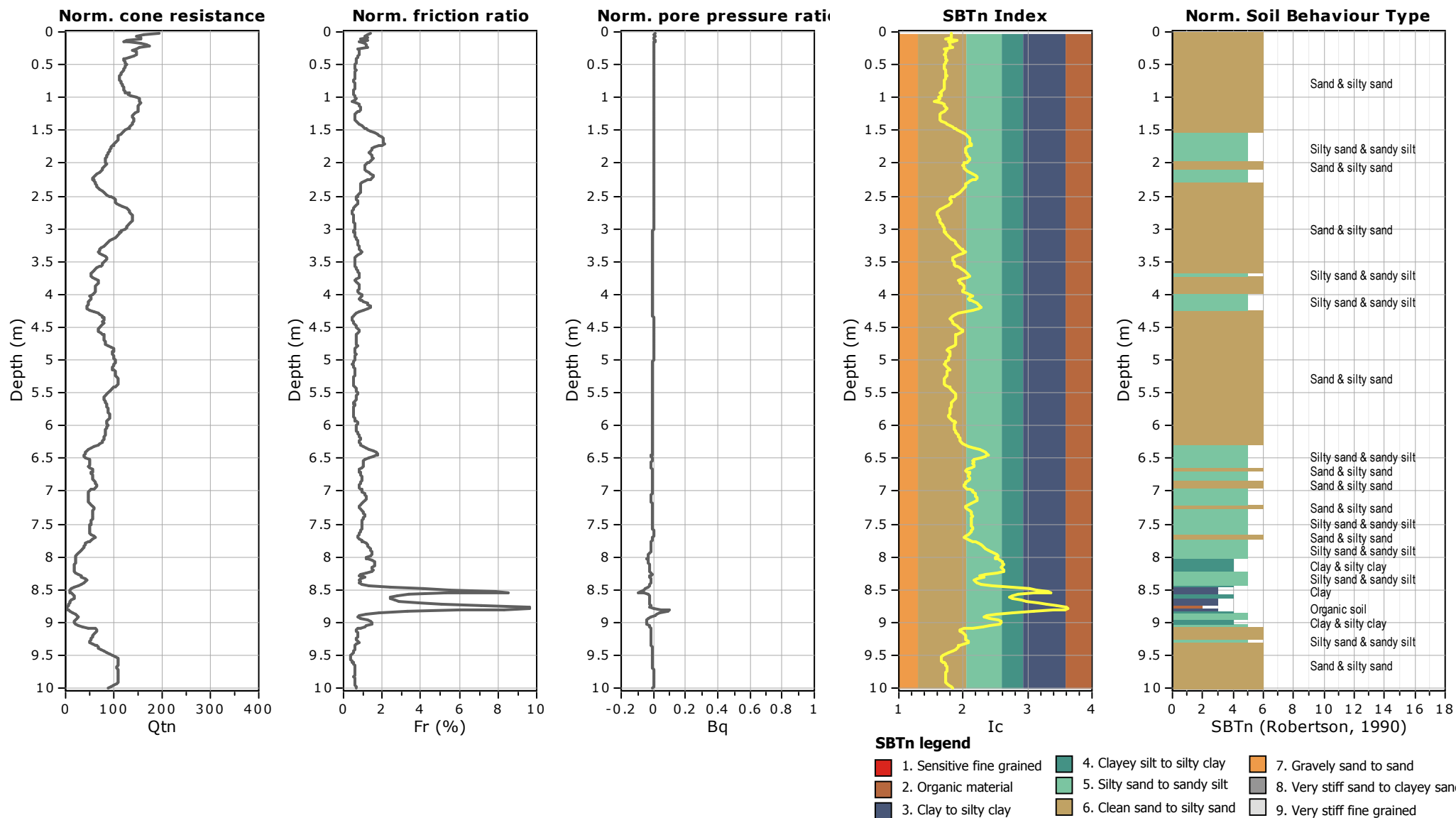
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+800**

Total depth: 10.00 m

Coords: lat 44.900677° lon 12.227736°





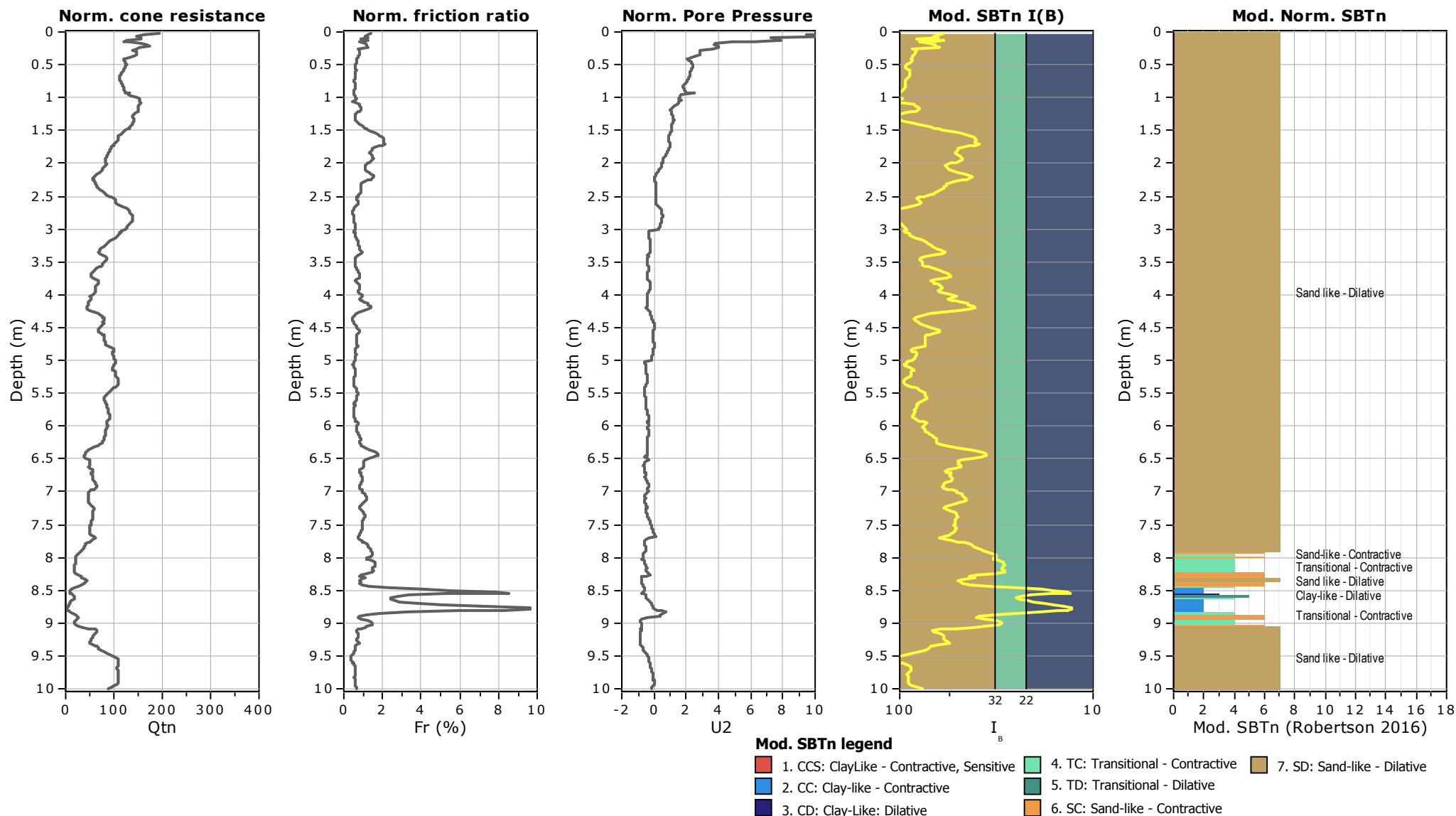
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

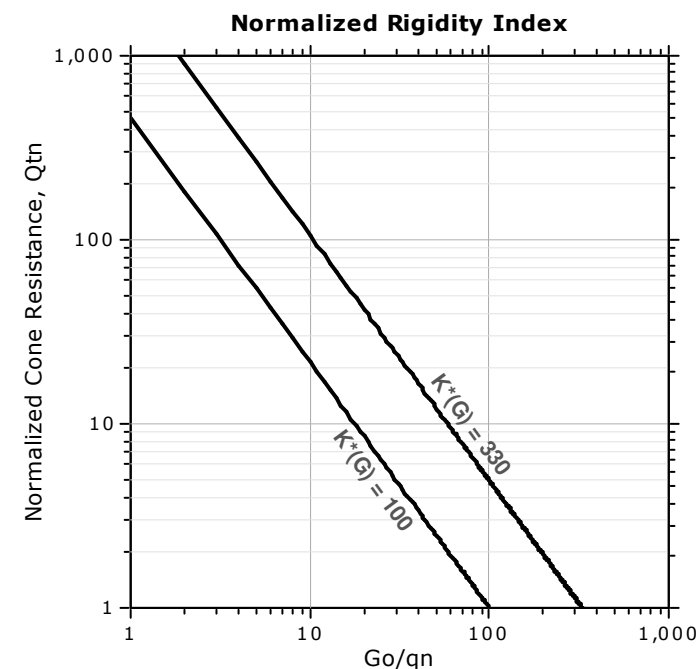
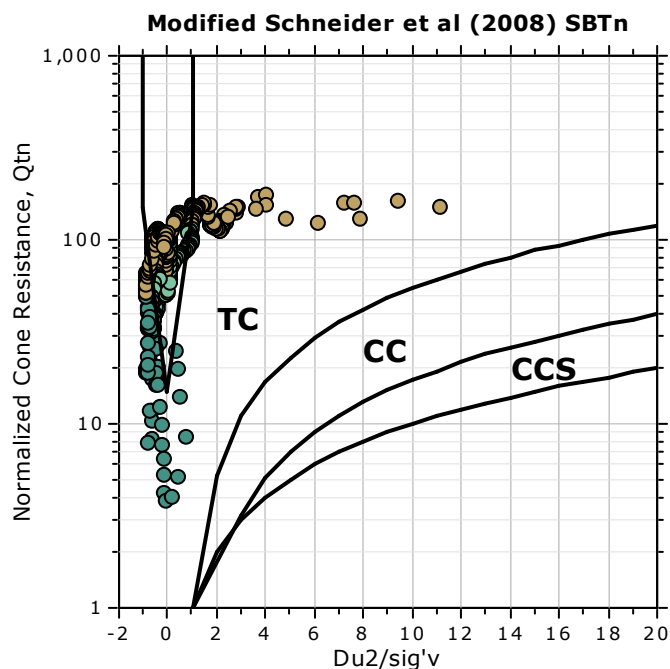
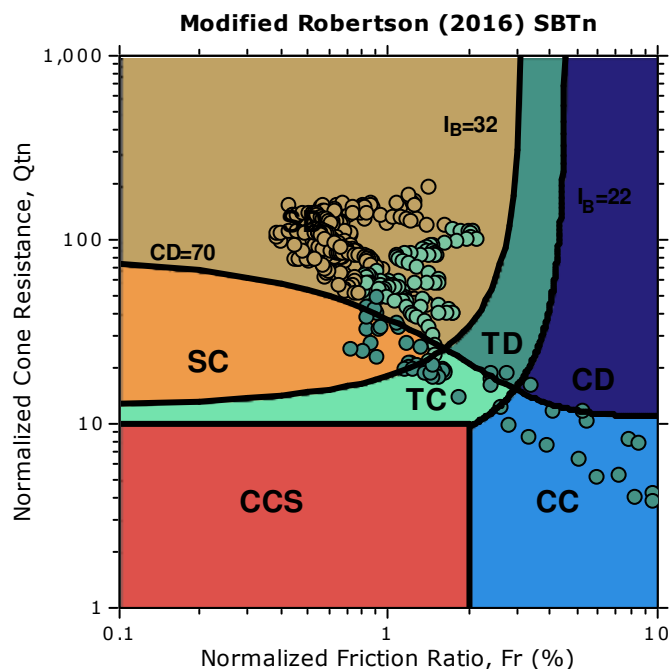
**CPT: CPTU km52+800**

Total depth: 10.00 m

Coords: lat 44.900677° lon 12.227736°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

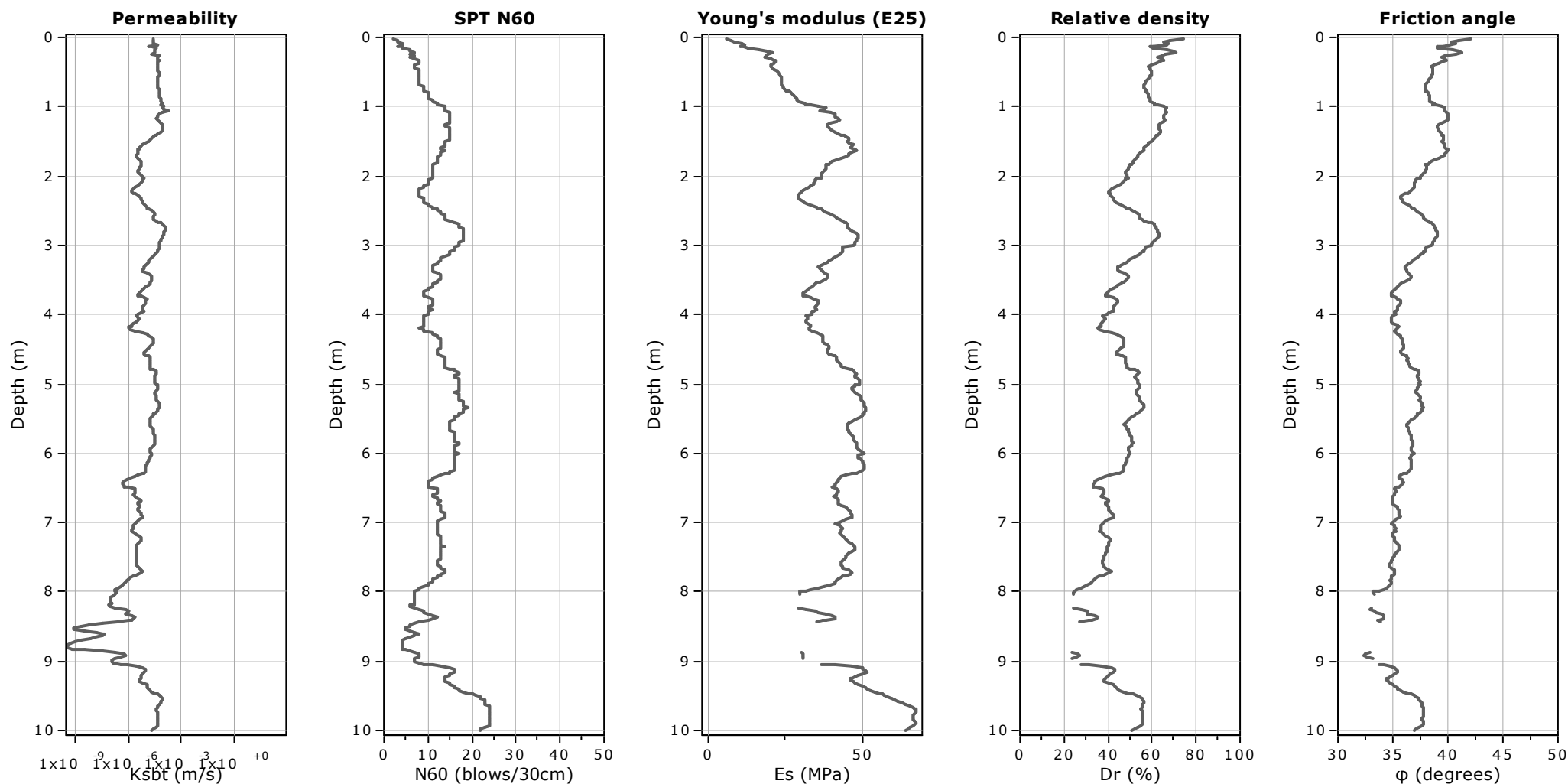
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+800**

Total depth: 10.00 m

Coords: lat 44.900677° lon 12.227736°



**Calculation parameters**

Permeability: Based on  $SBT_n$

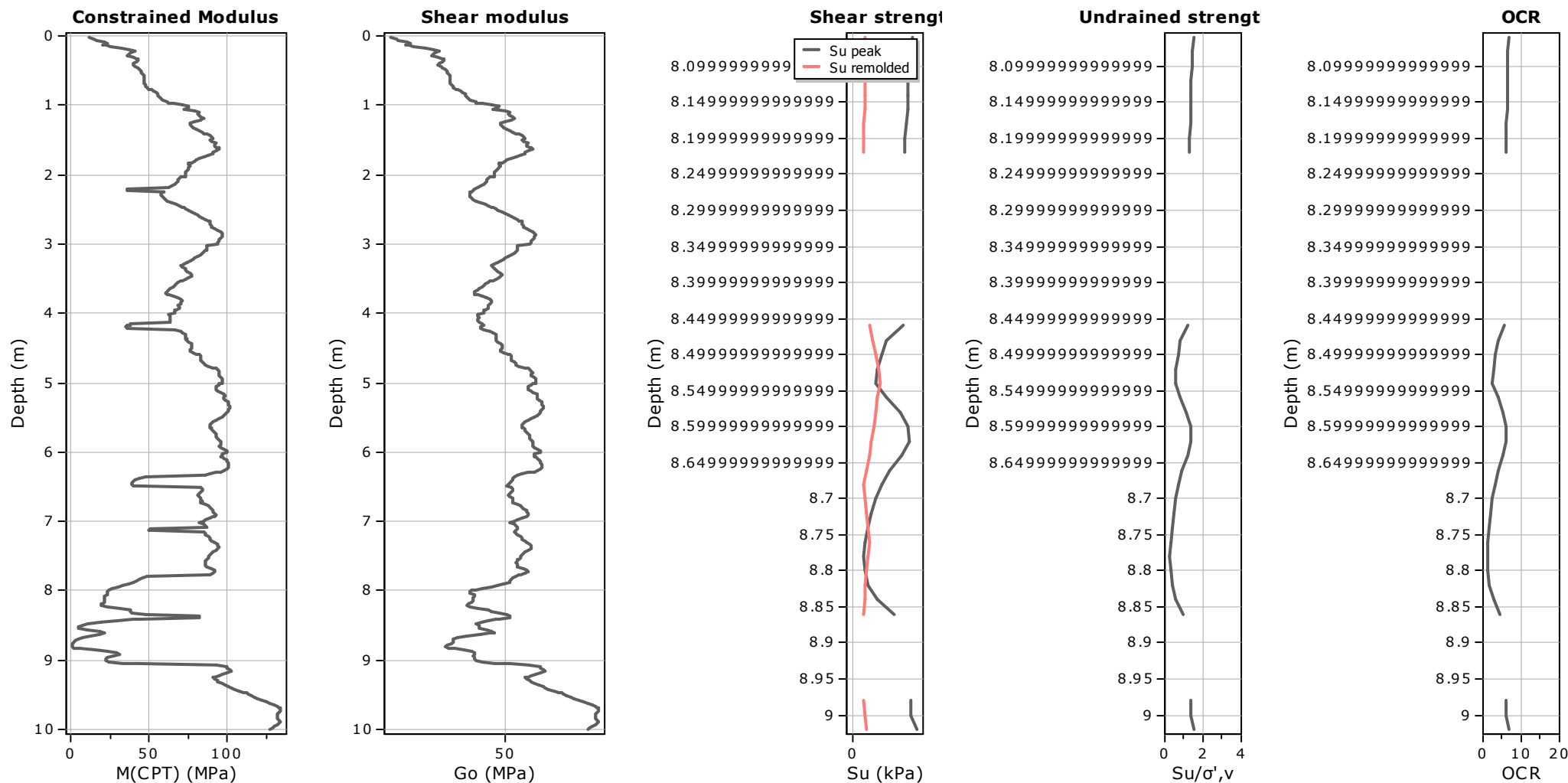
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

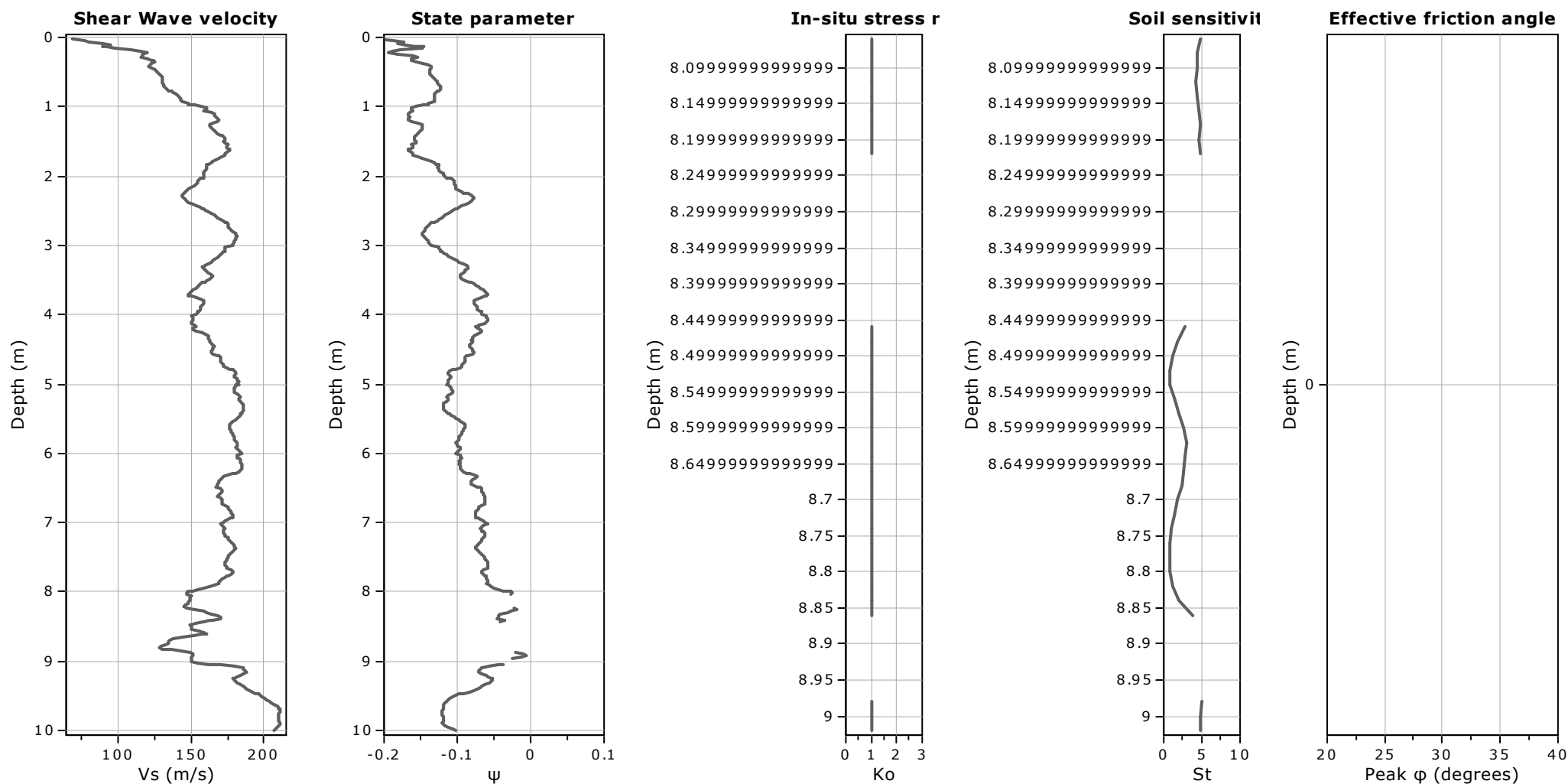
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km52+800**

Total depth: 10.00 m

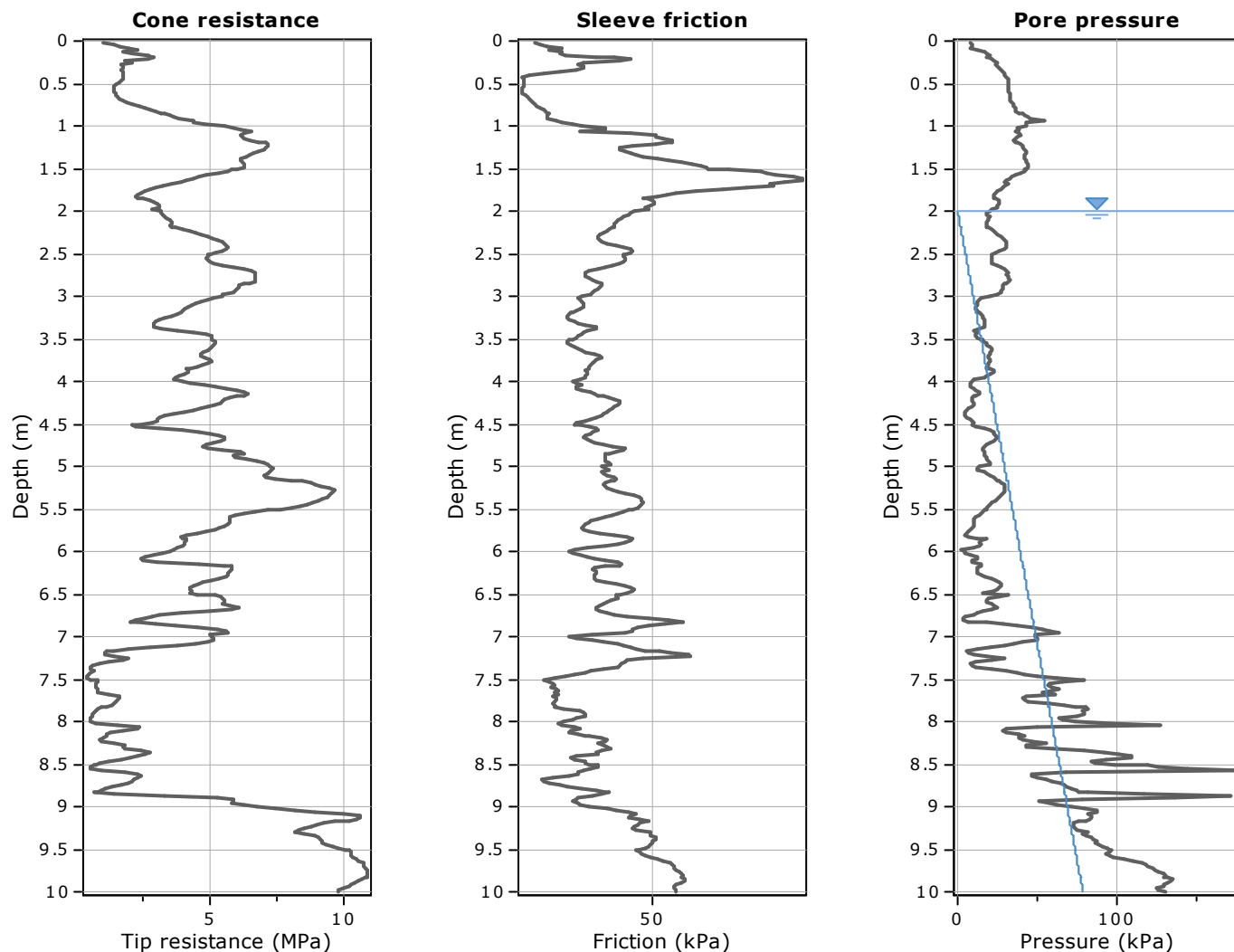
Coords: lat 44.900677° lon 12.227736°



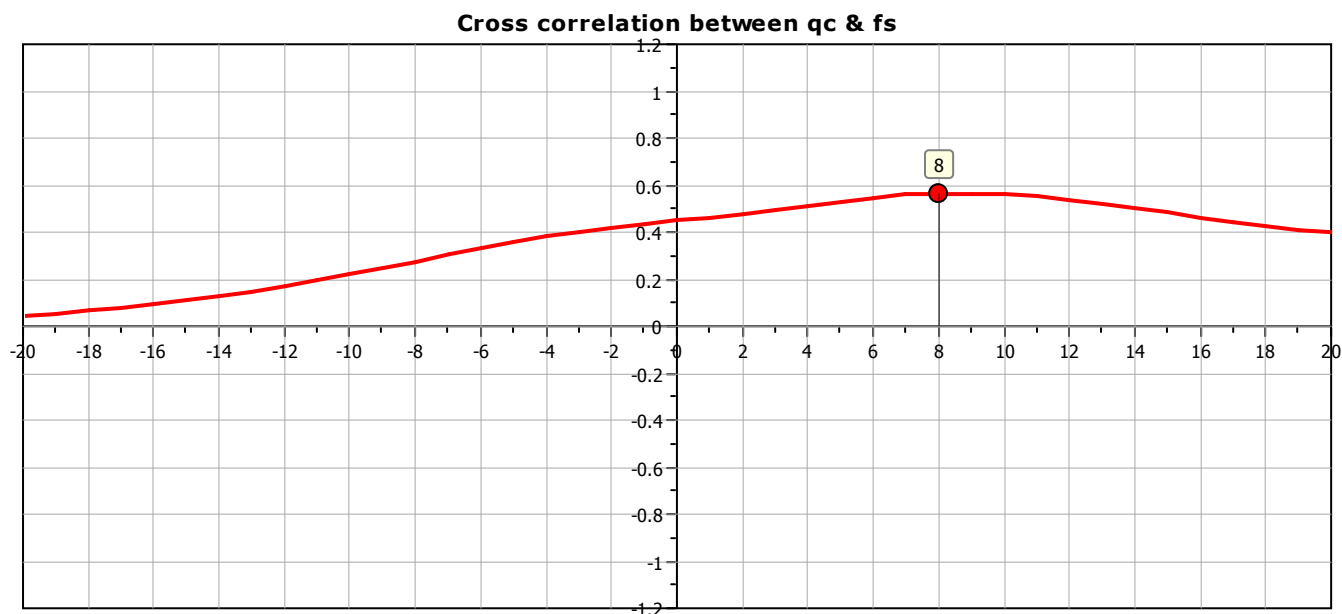
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

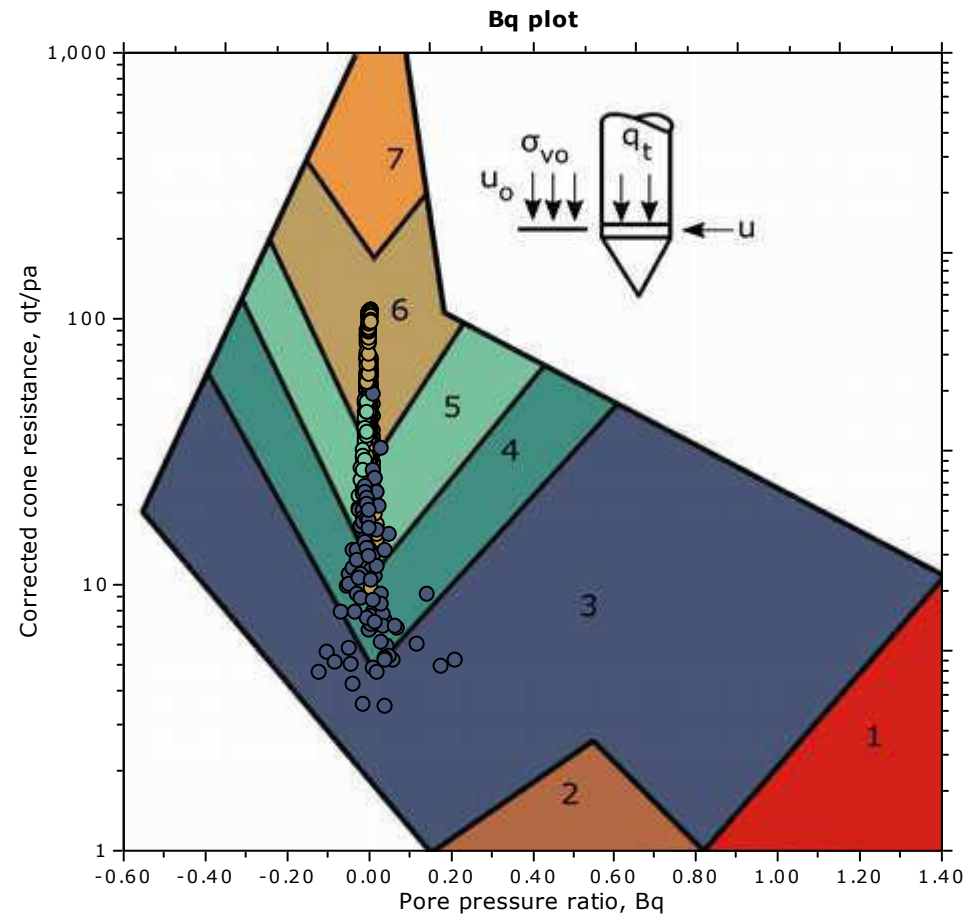
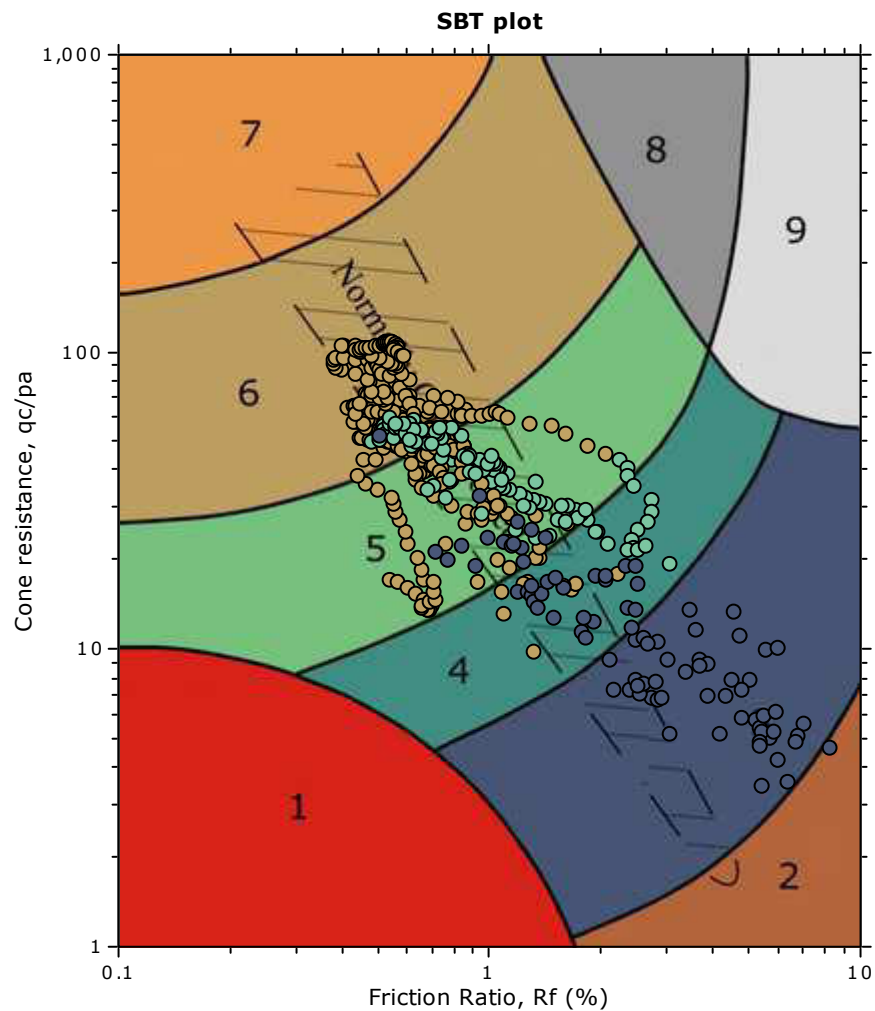
—●— User defined estimation data



The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  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

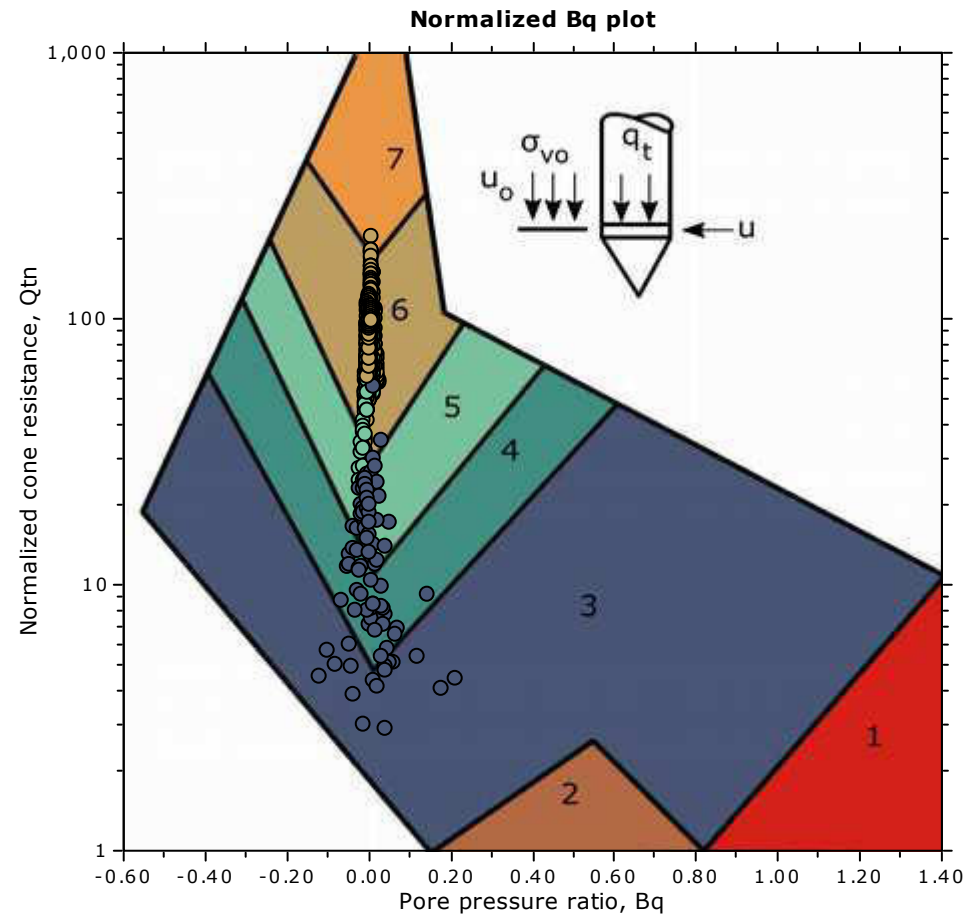
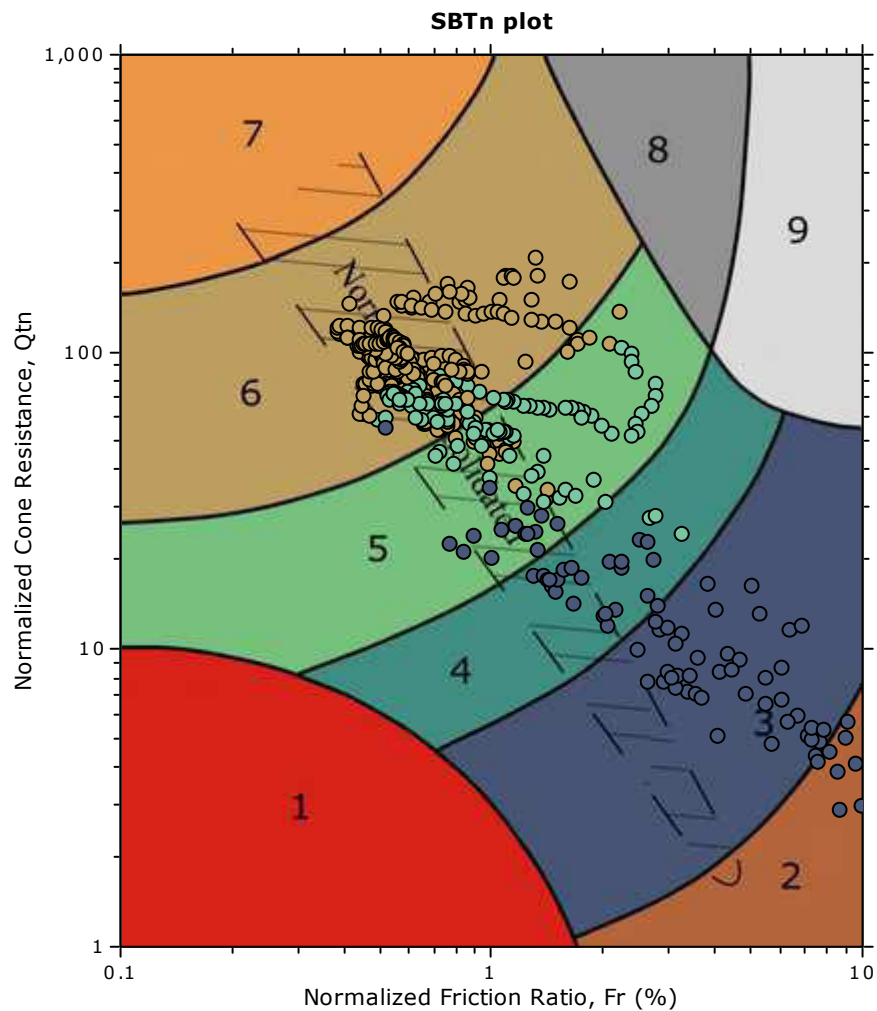


### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |



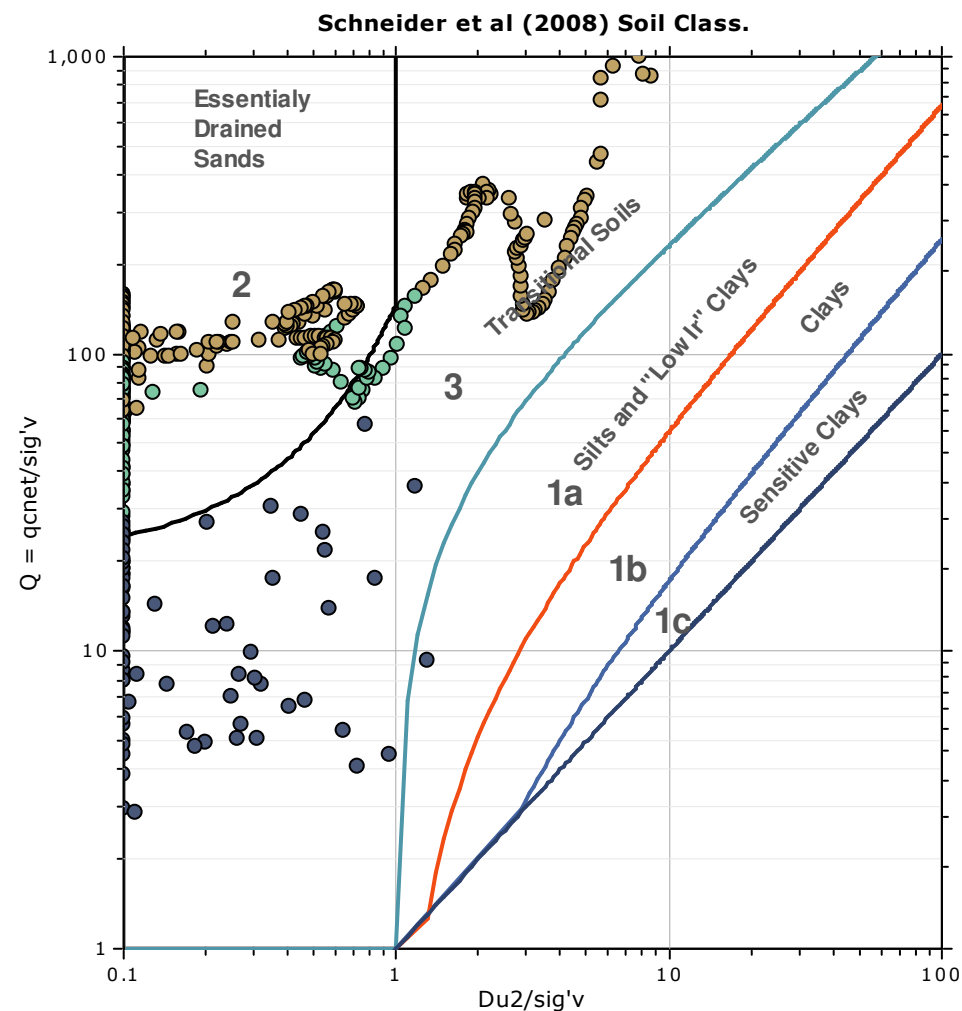
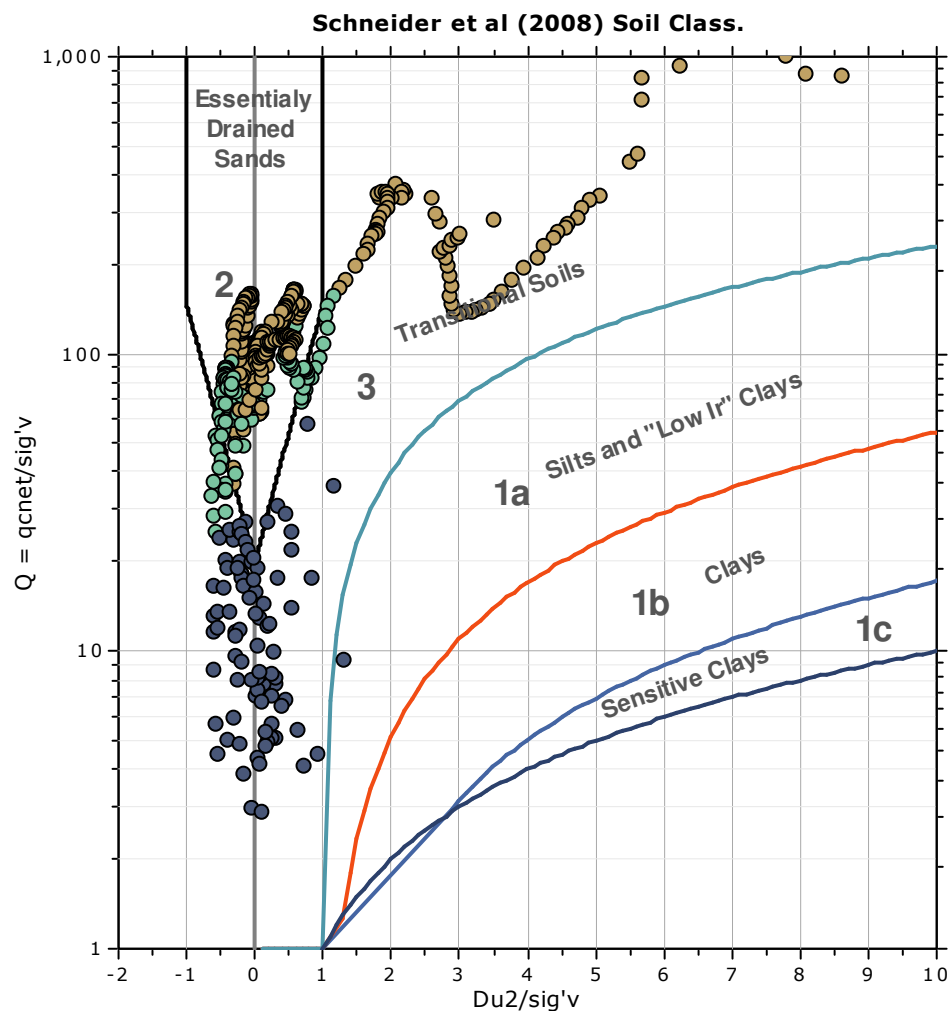
**SBT - Bq plots (normalized)**

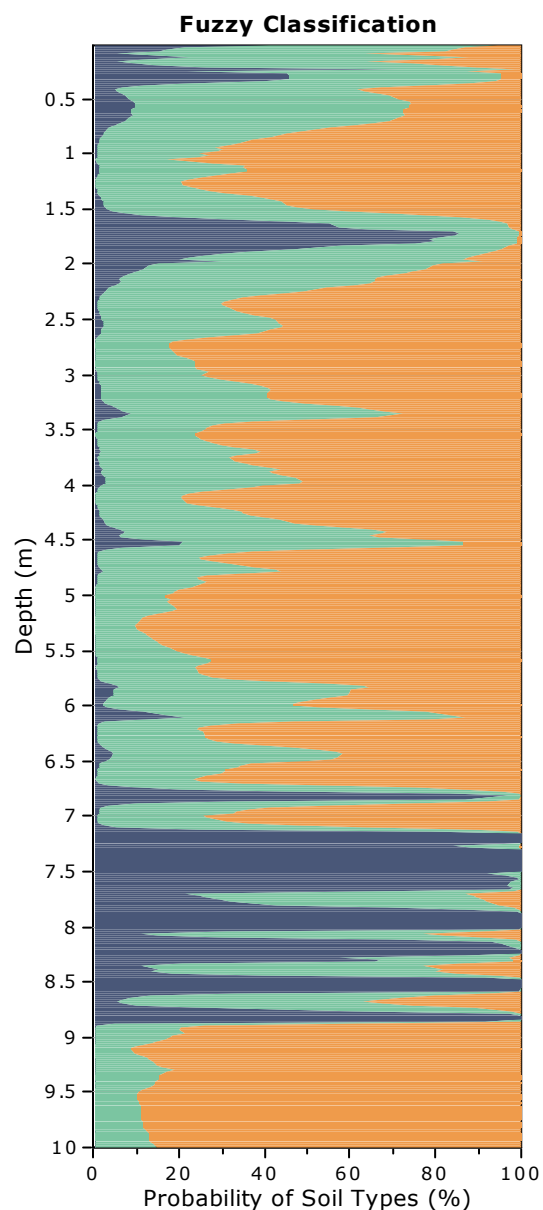
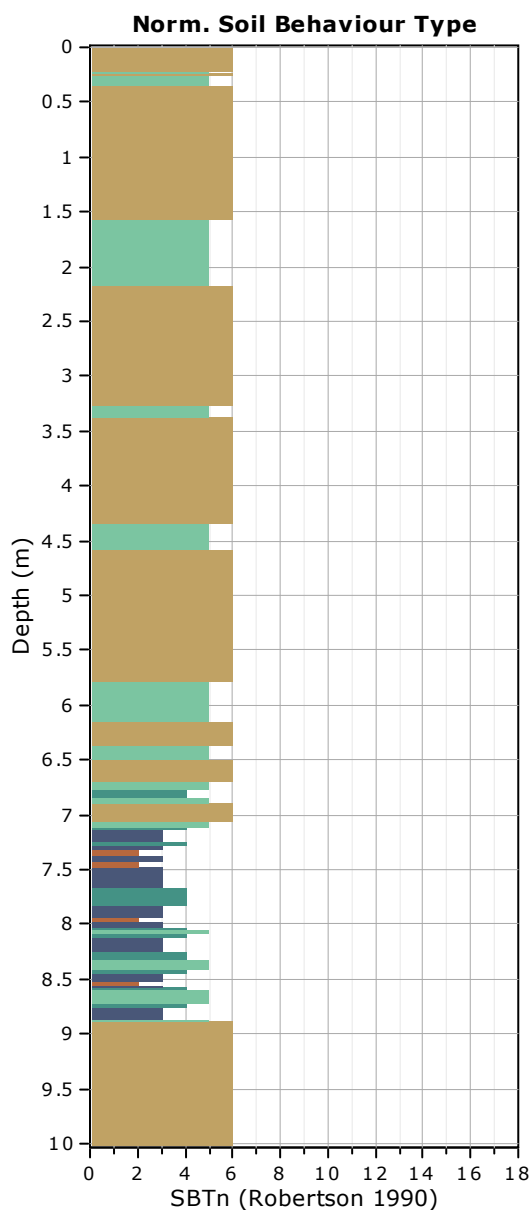


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





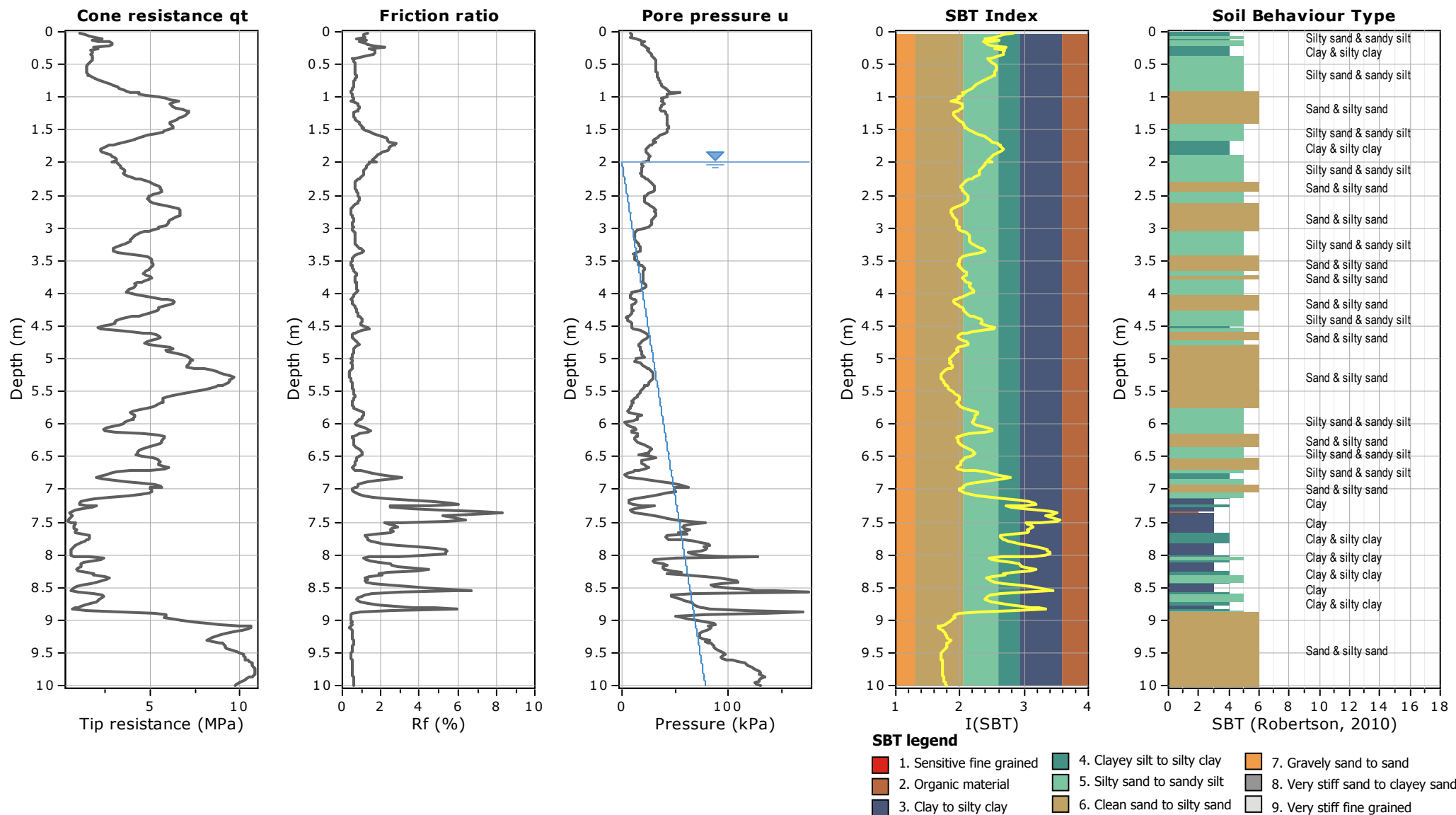
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km53+900**

Total depth: 10.00 m

Coords: lat 44.910607° lon 12.231981°



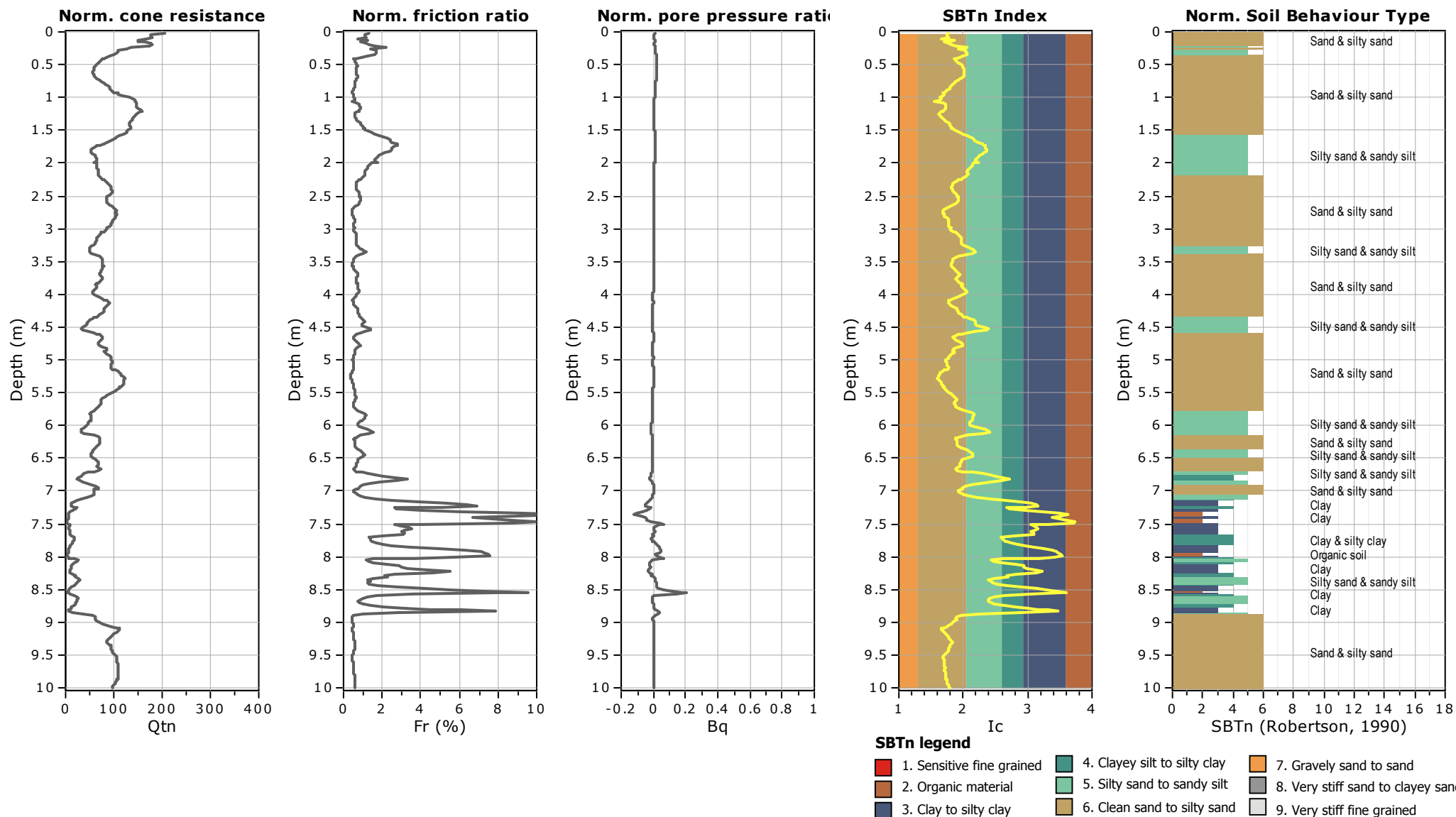
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km53+900**

Total depth: 10.00 m

Coords: lat 44.910607° lon 12.231981°



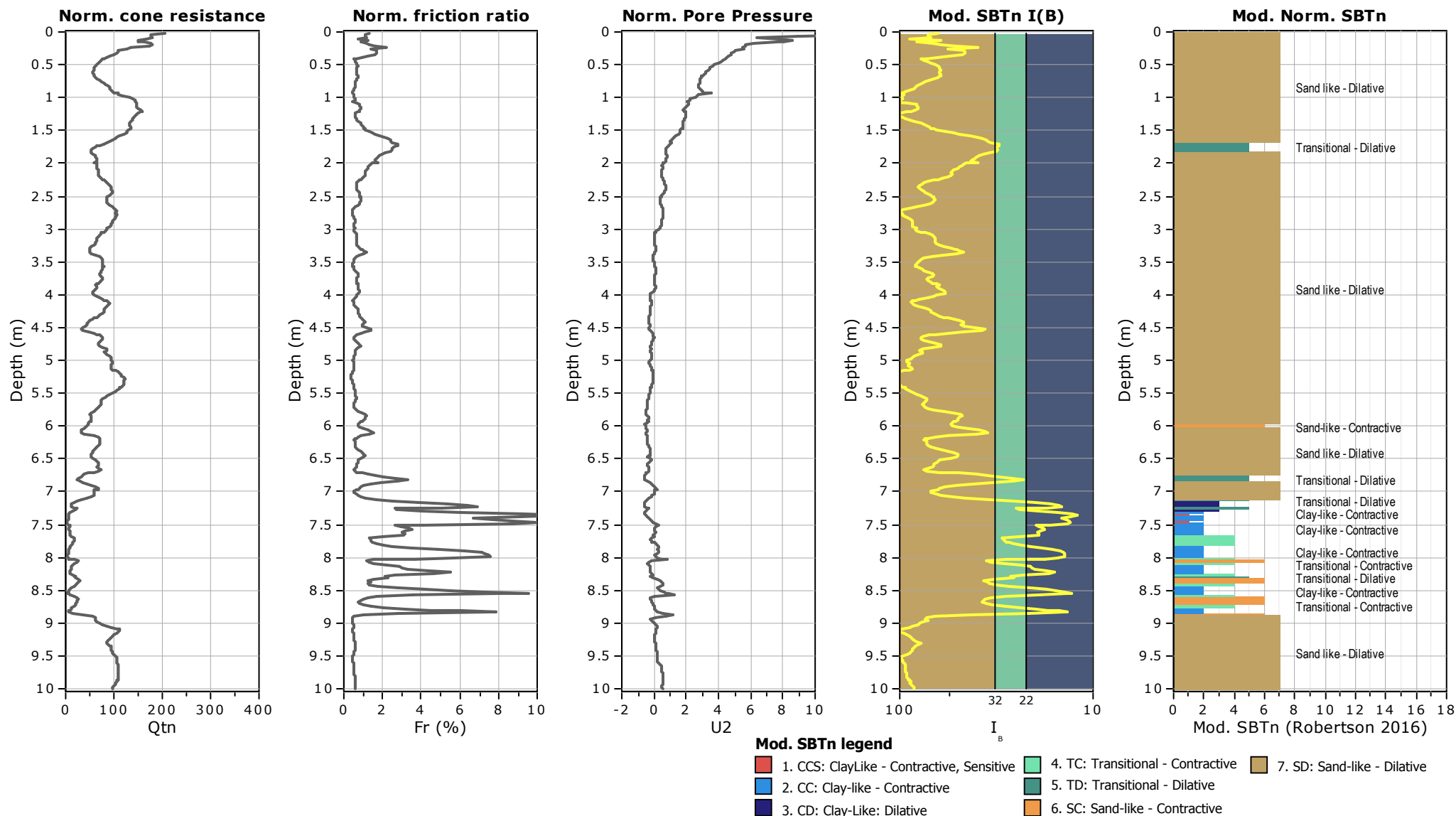
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

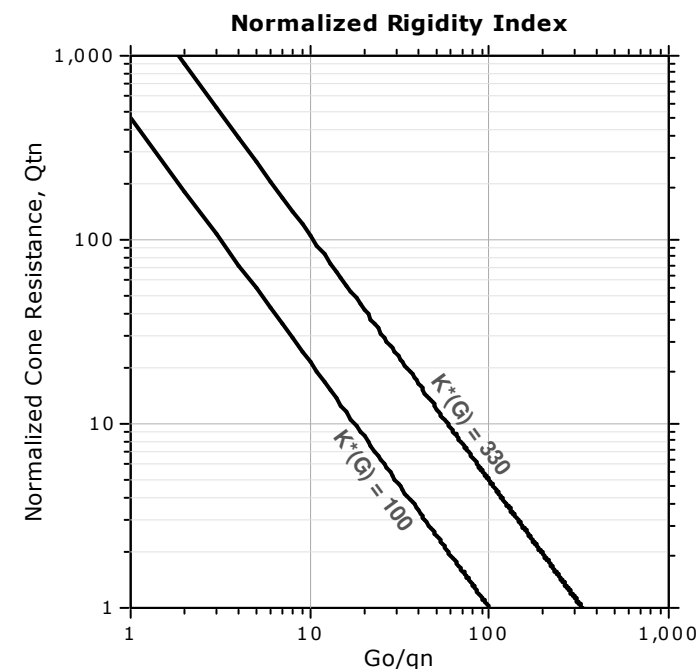
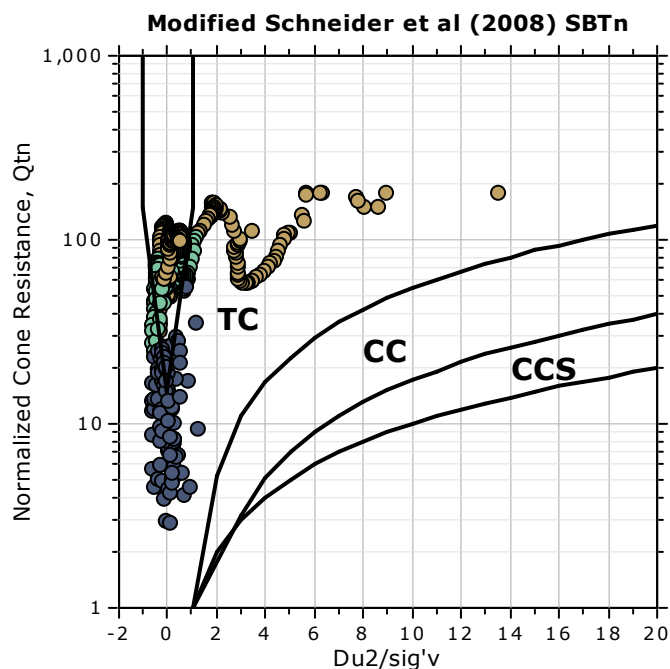
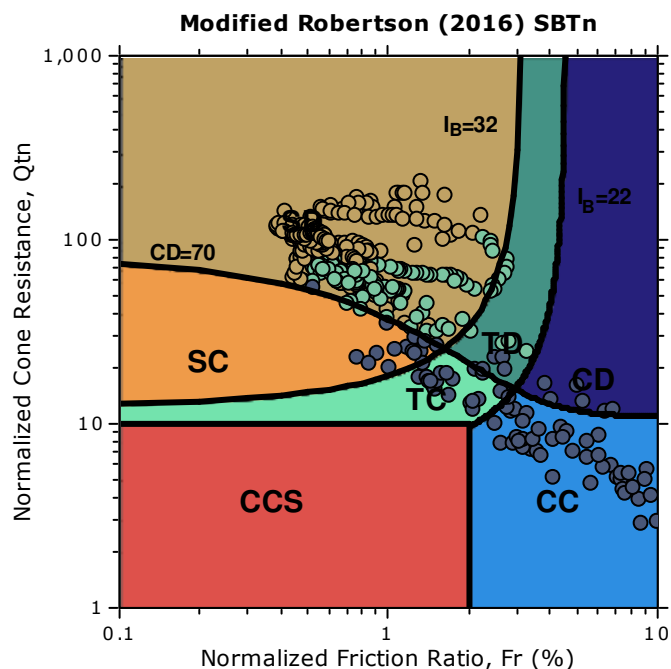
**CPT: CPTU km53+900**

Total depth: 10.00 m

Coords: lat 44.910607° lon 12.231981°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



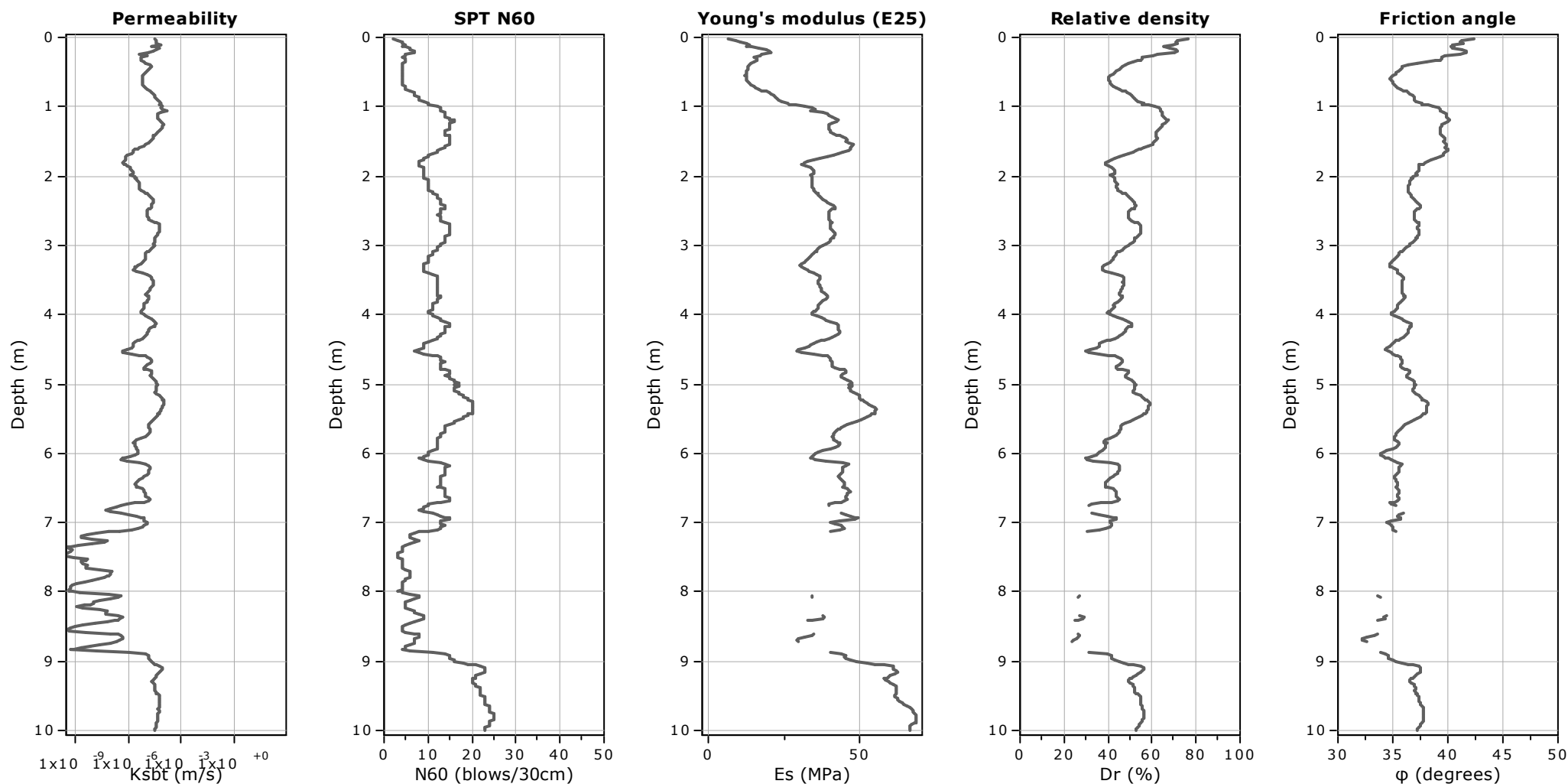
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km53+900**

Total depth: 10.00 m

Coords: lat 44.910607° lon 12.231981°



**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 Kulhavy & Mayne (1990)

—●— User defined estimation data

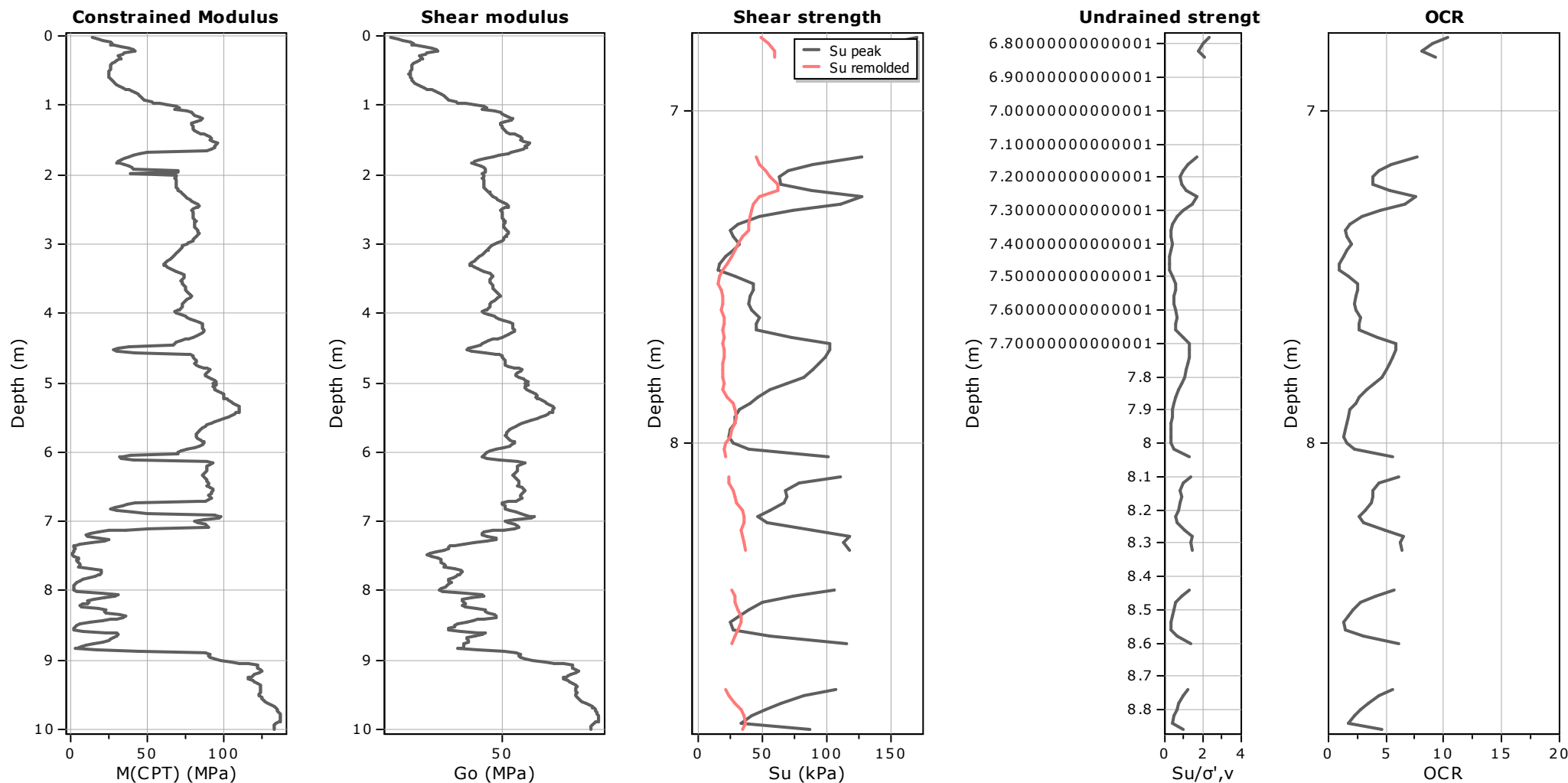
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km53+900**

Total depth: 10.00 m

Coords: lat 44.910607° lon 12.231981°



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

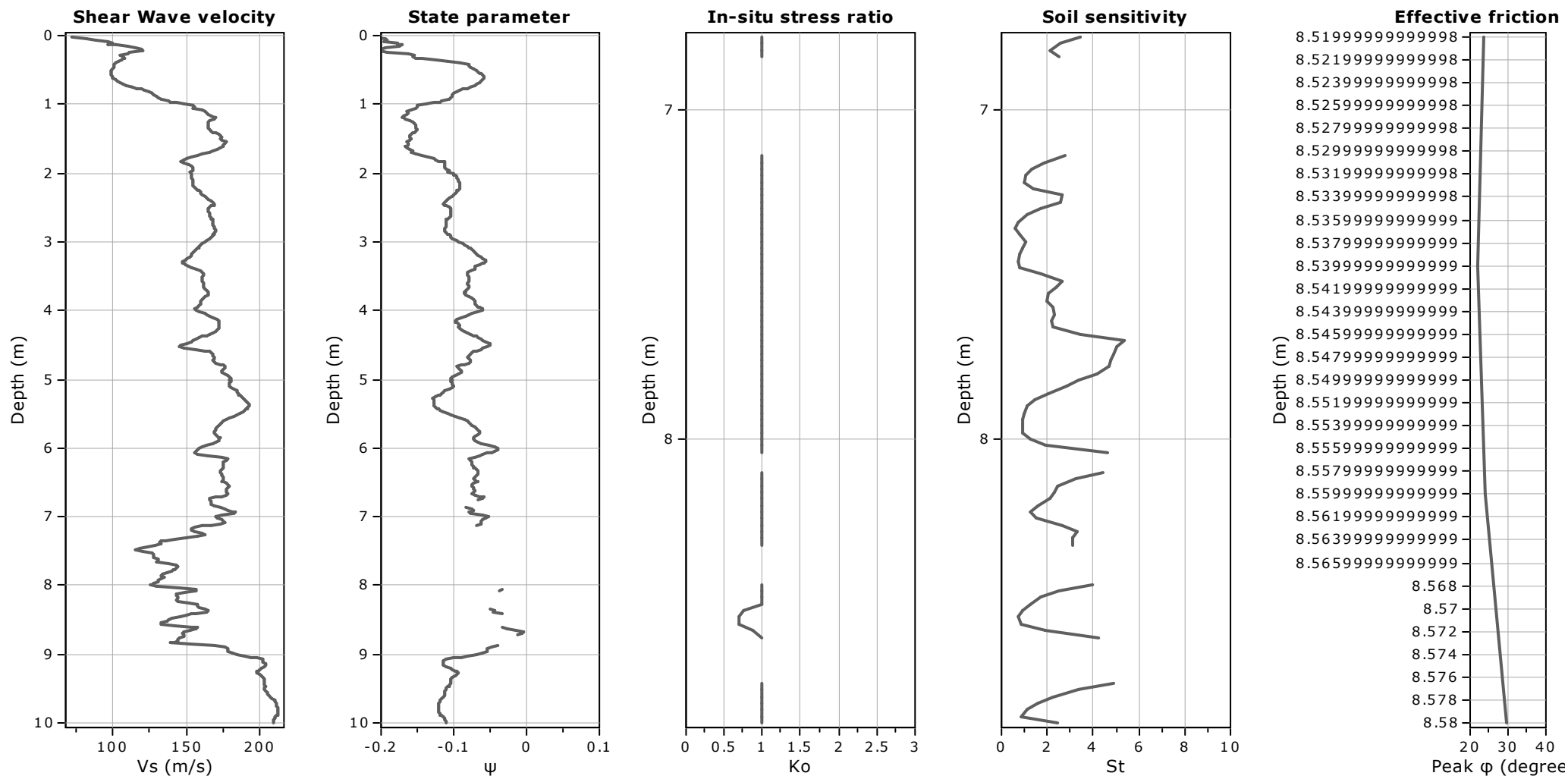
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km53+900**

Total depth: 10.00 m

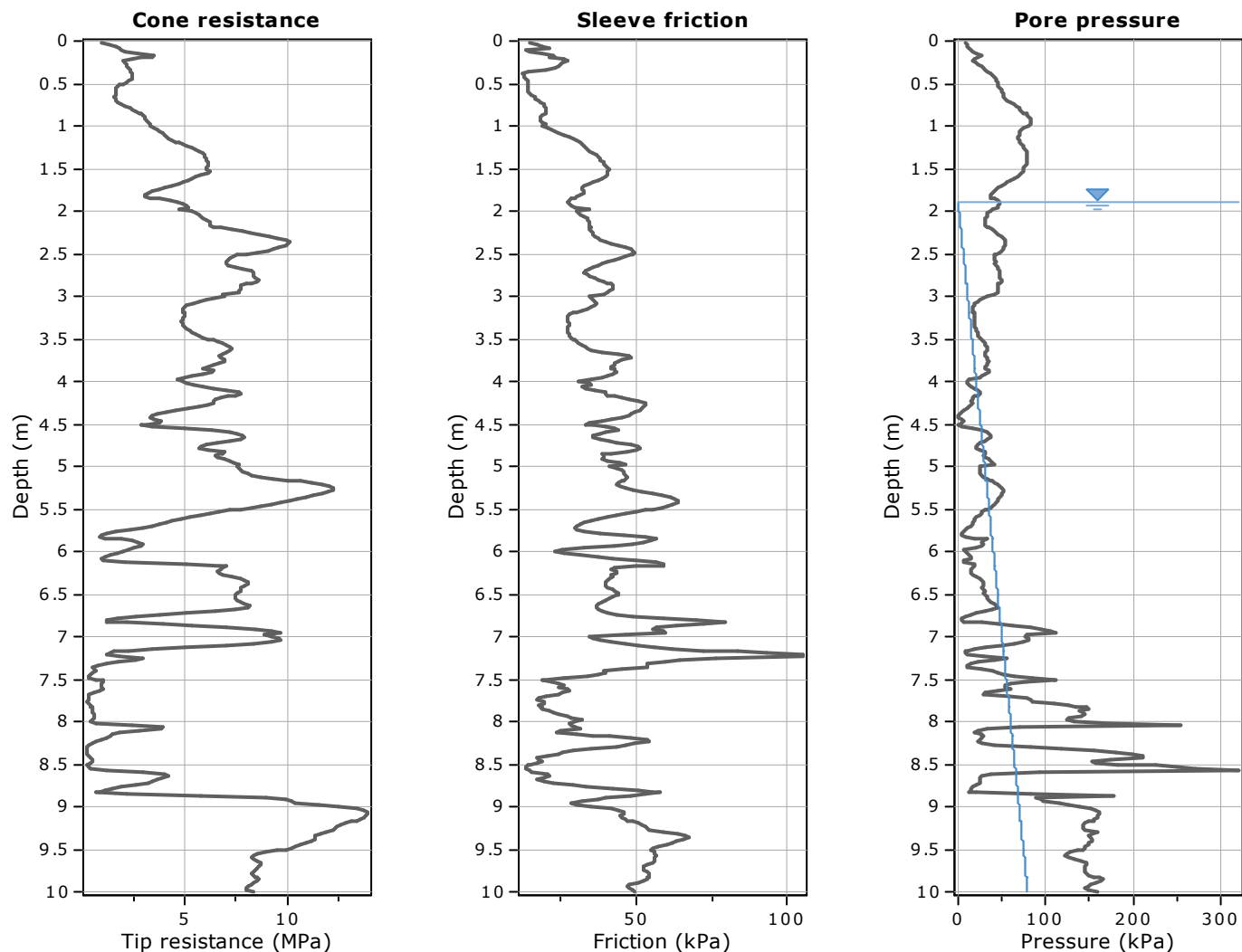
Coords: lat 44.910607° lon 12.231981°



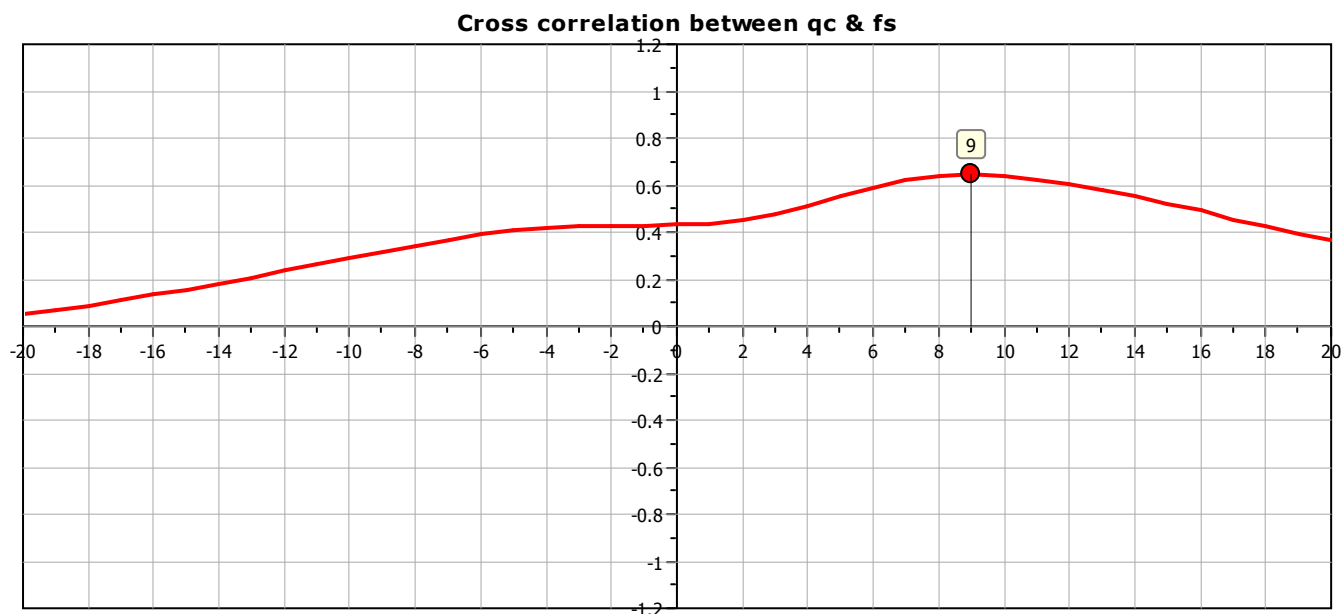
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

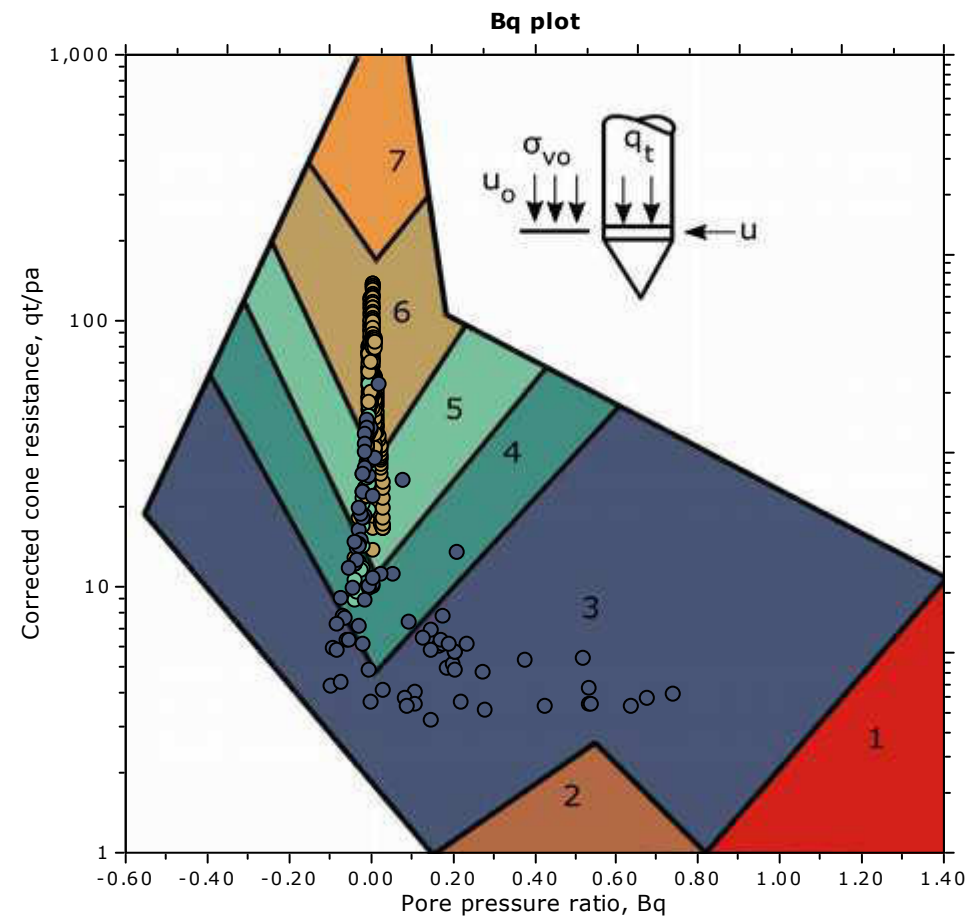
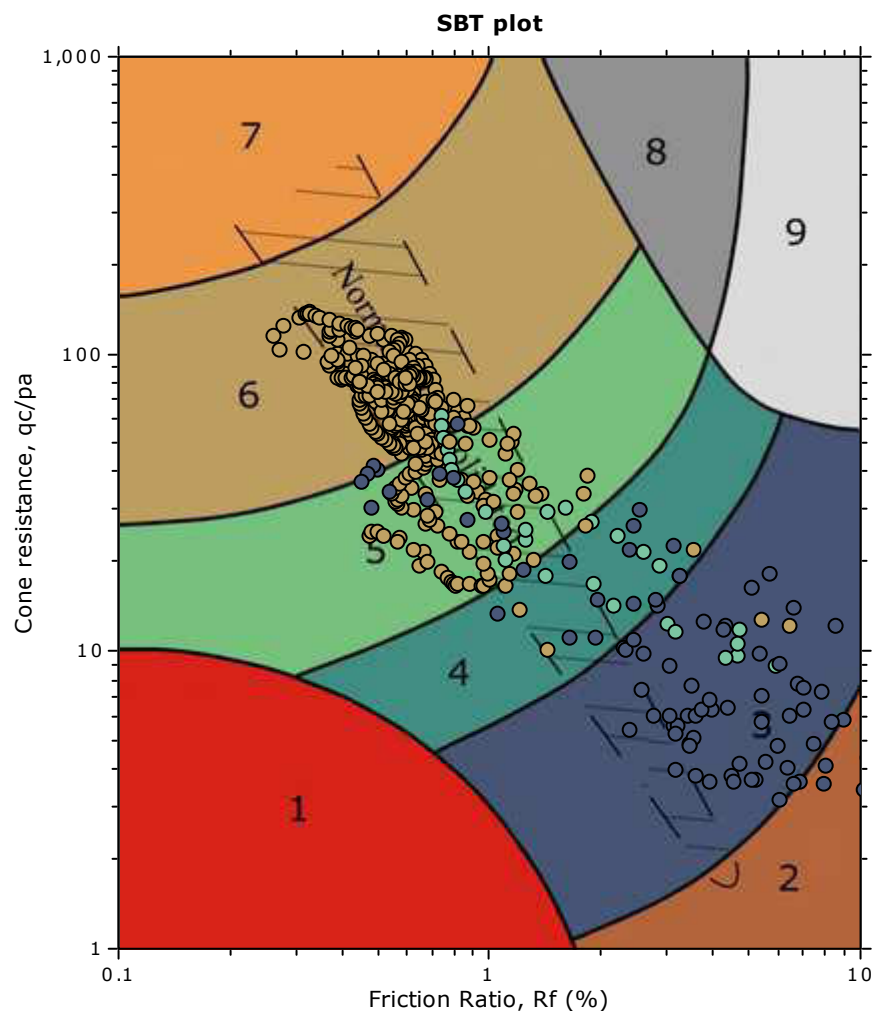
—●— User defined estimation data



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



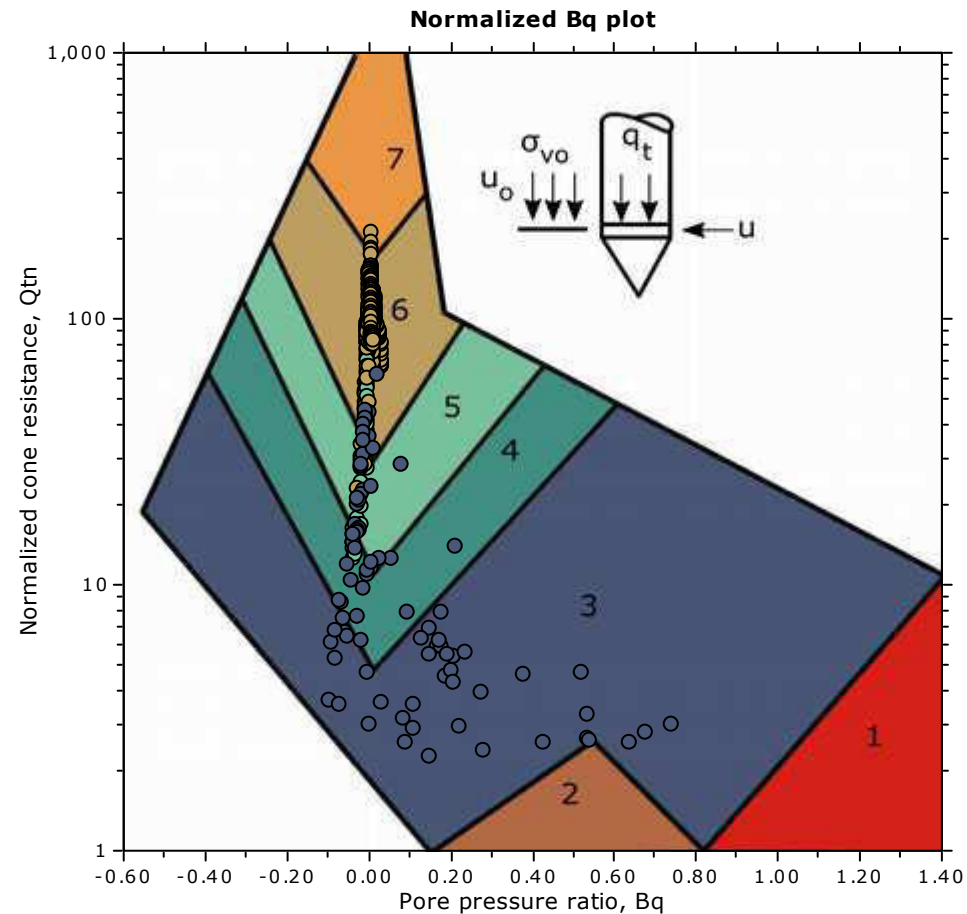
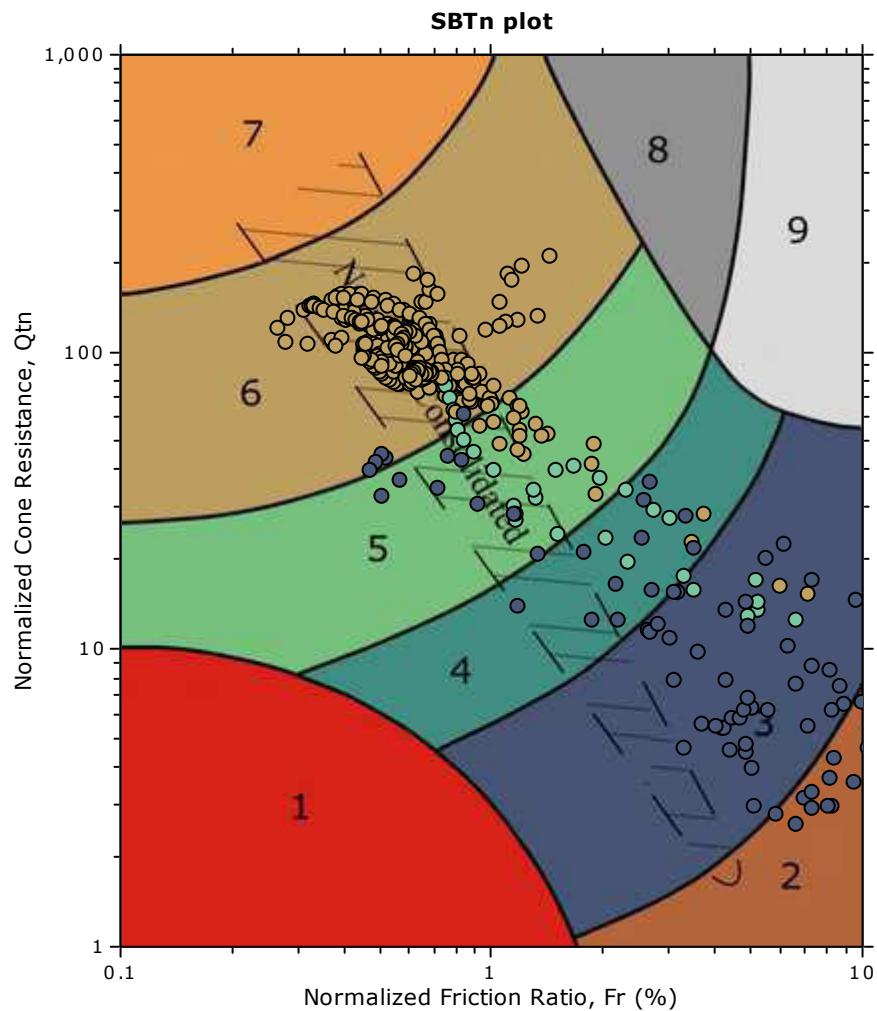
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

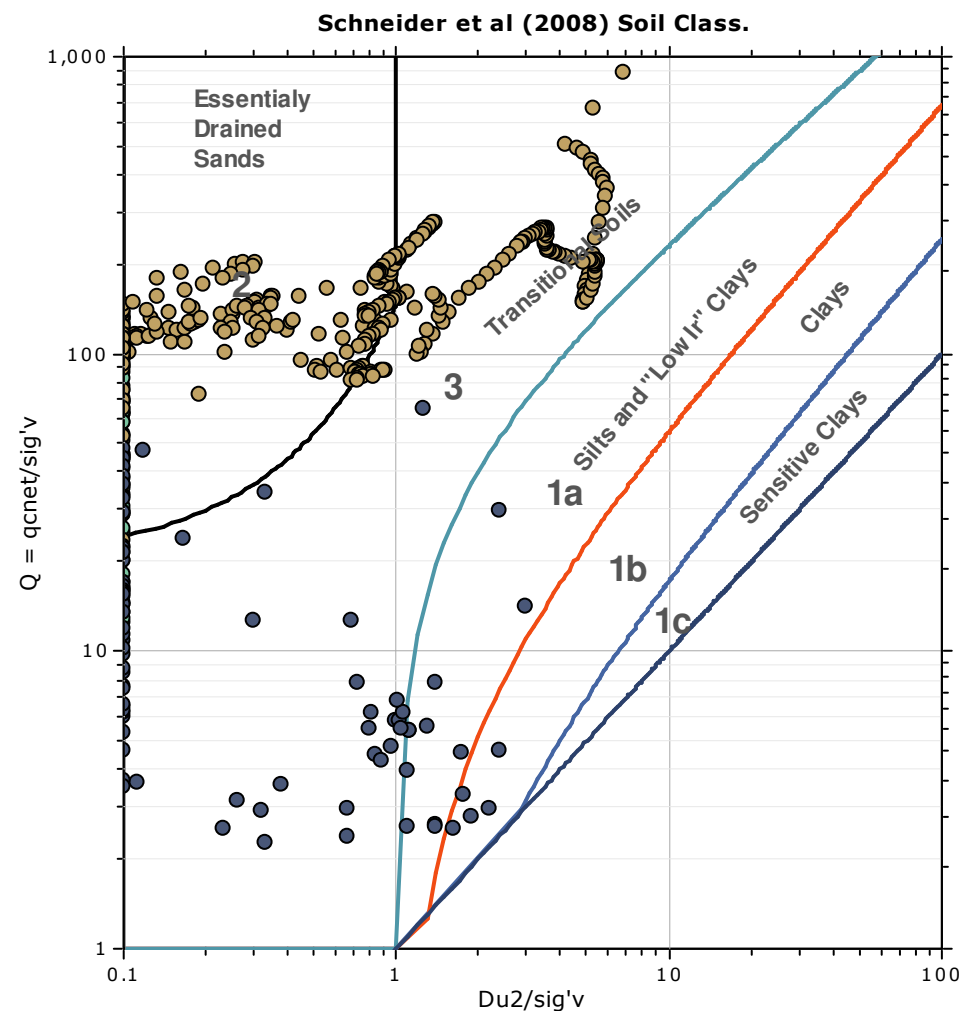
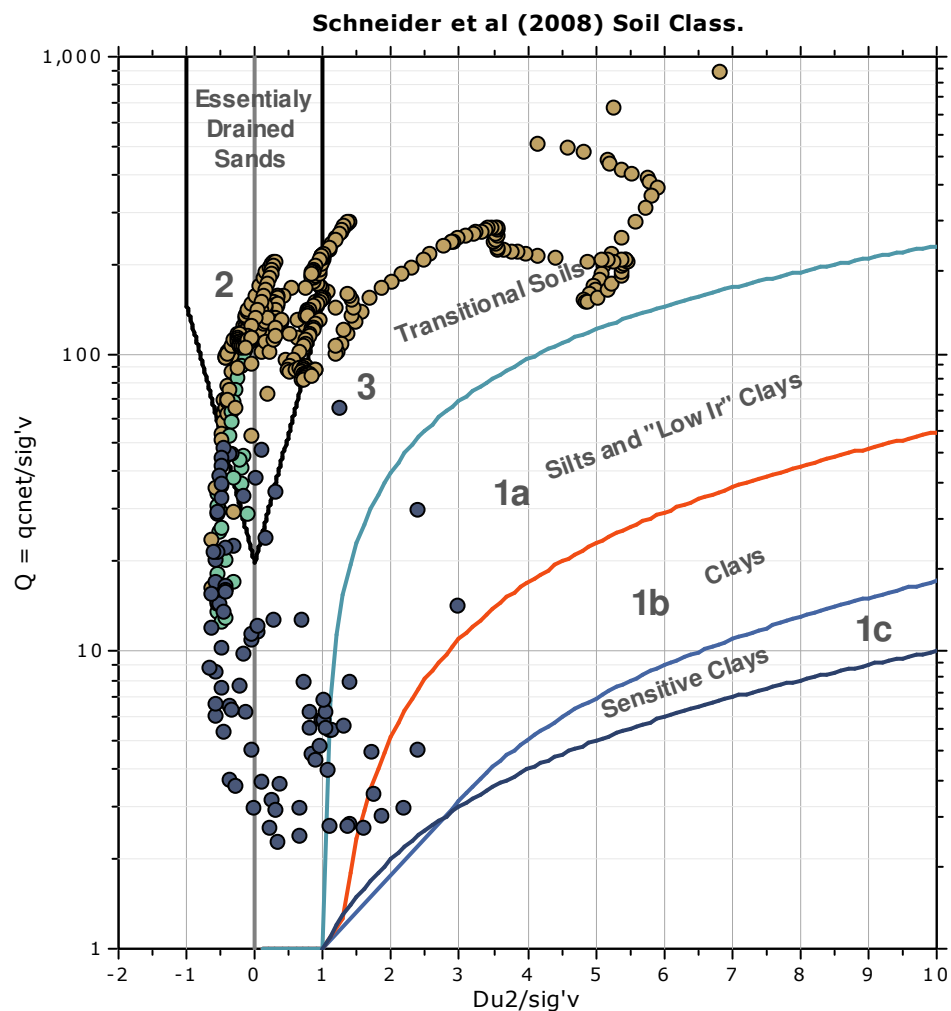
**SBT - Bq plots (normalized)**



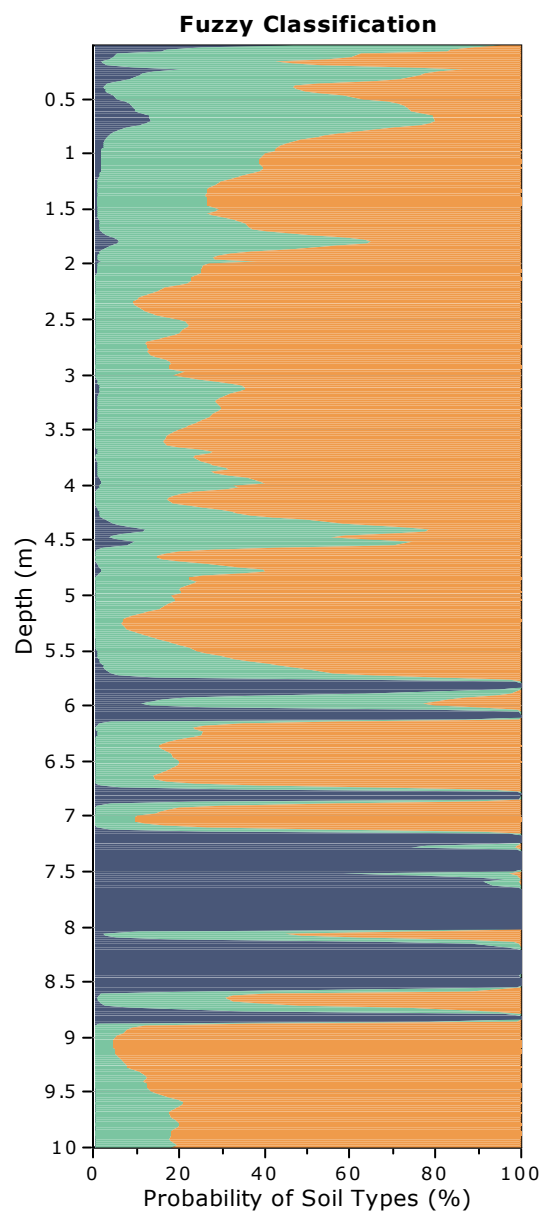
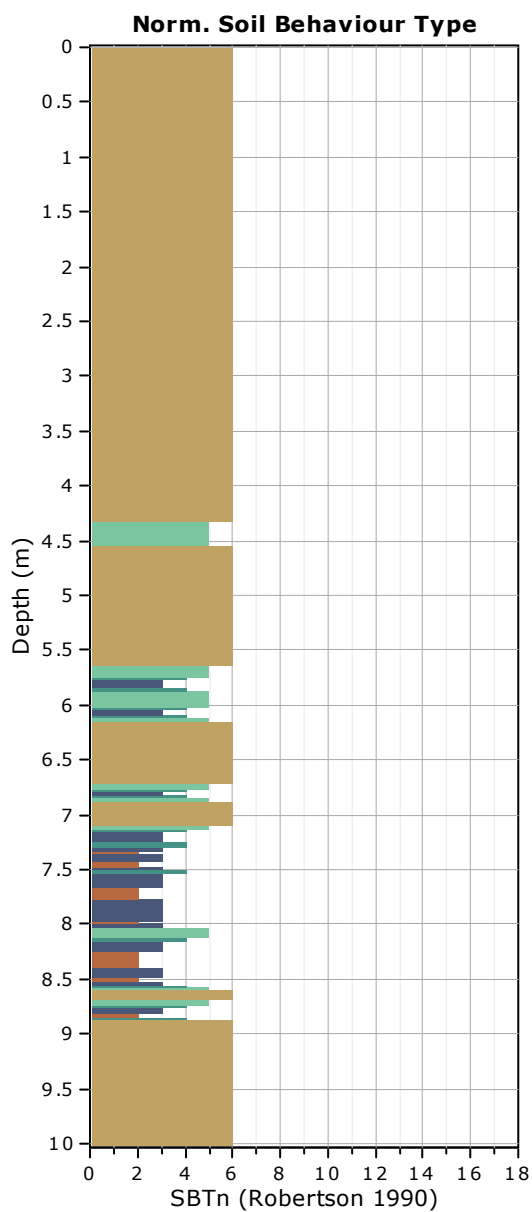
**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







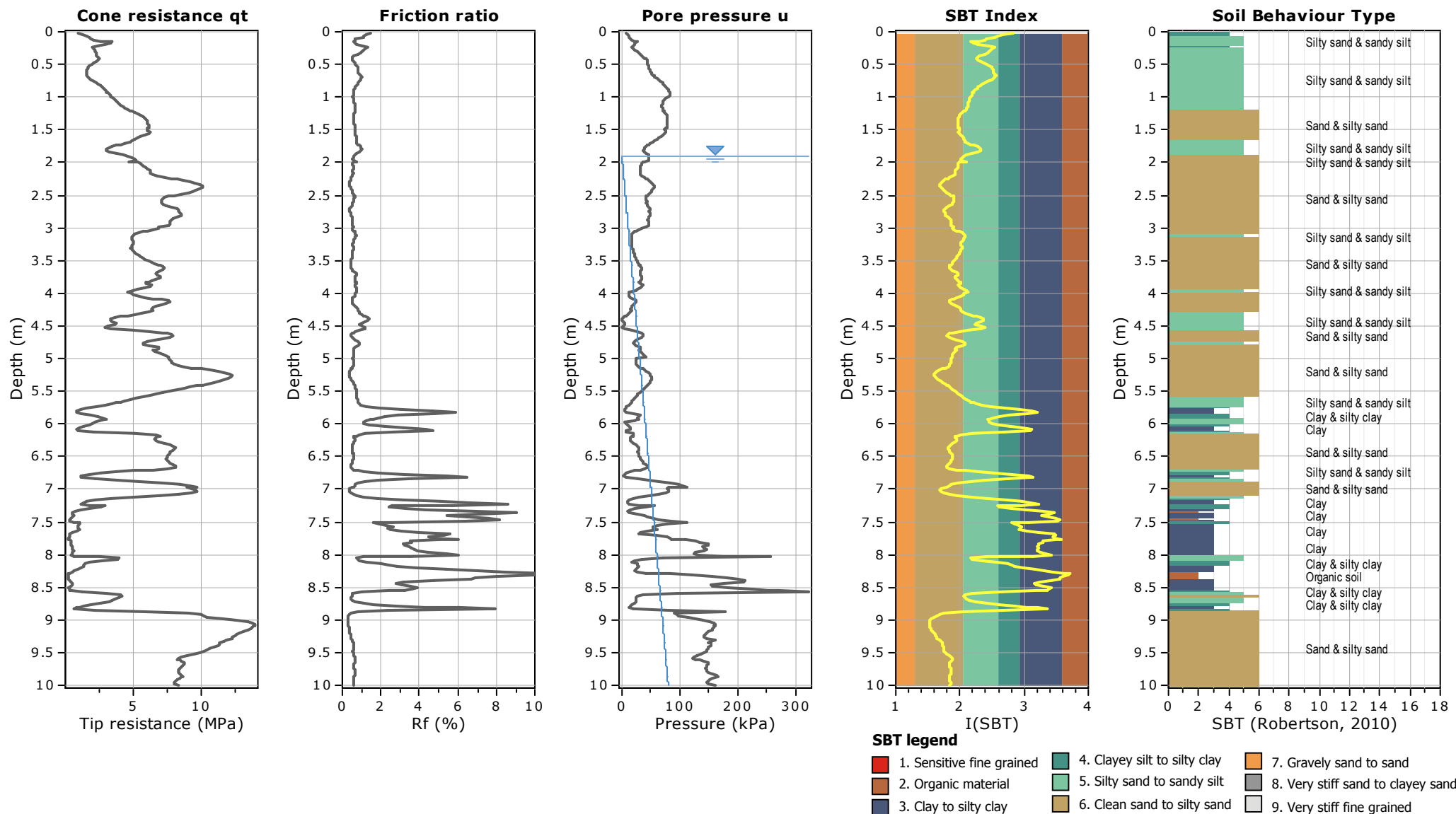
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+000**

Total depth: 10.00 m

Coords: lat 44.912587° lon 12.232972°



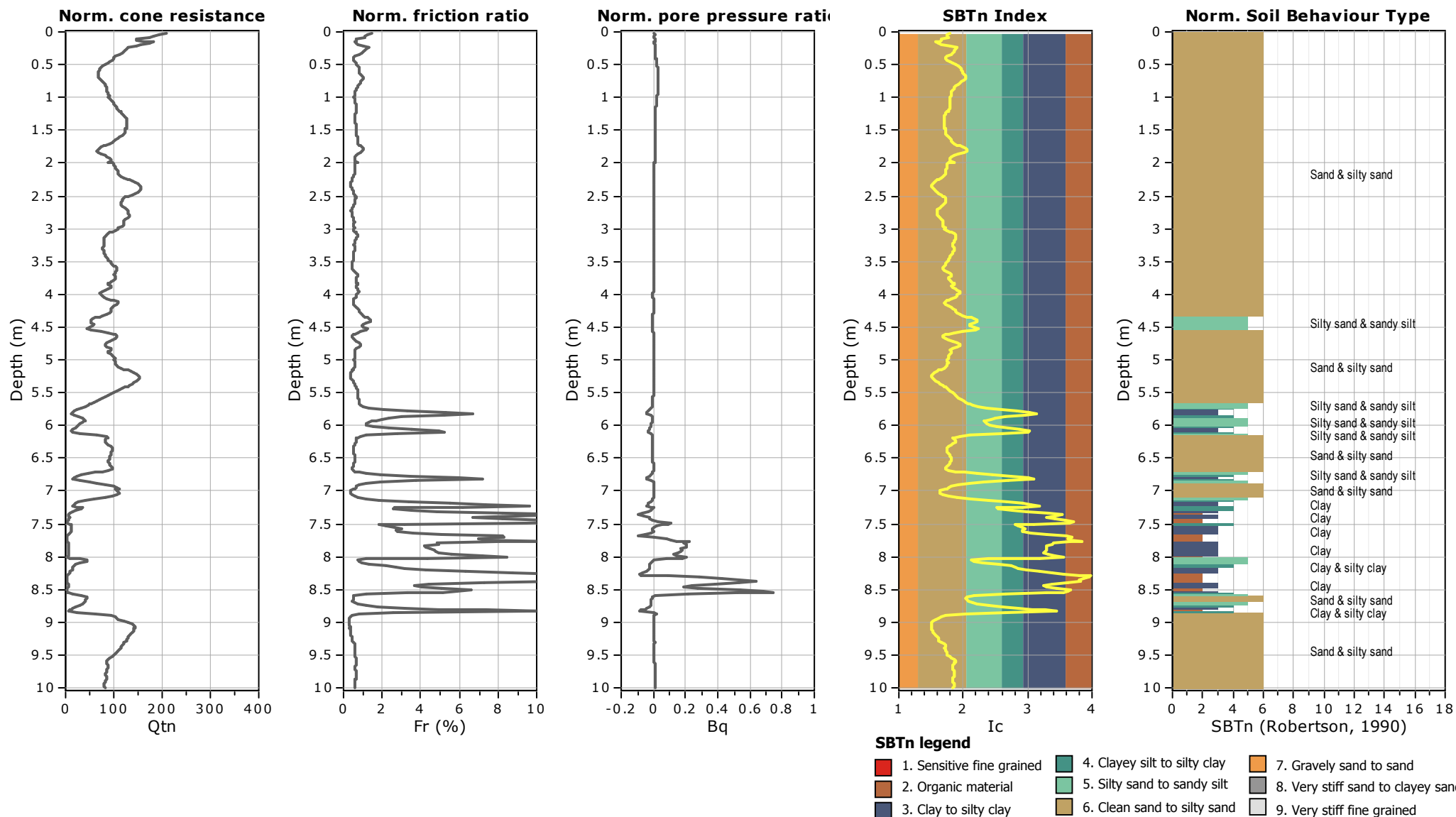
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+000**

Total depth: 10.00 m

Coords: lat 44.912587° lon 12.232972°



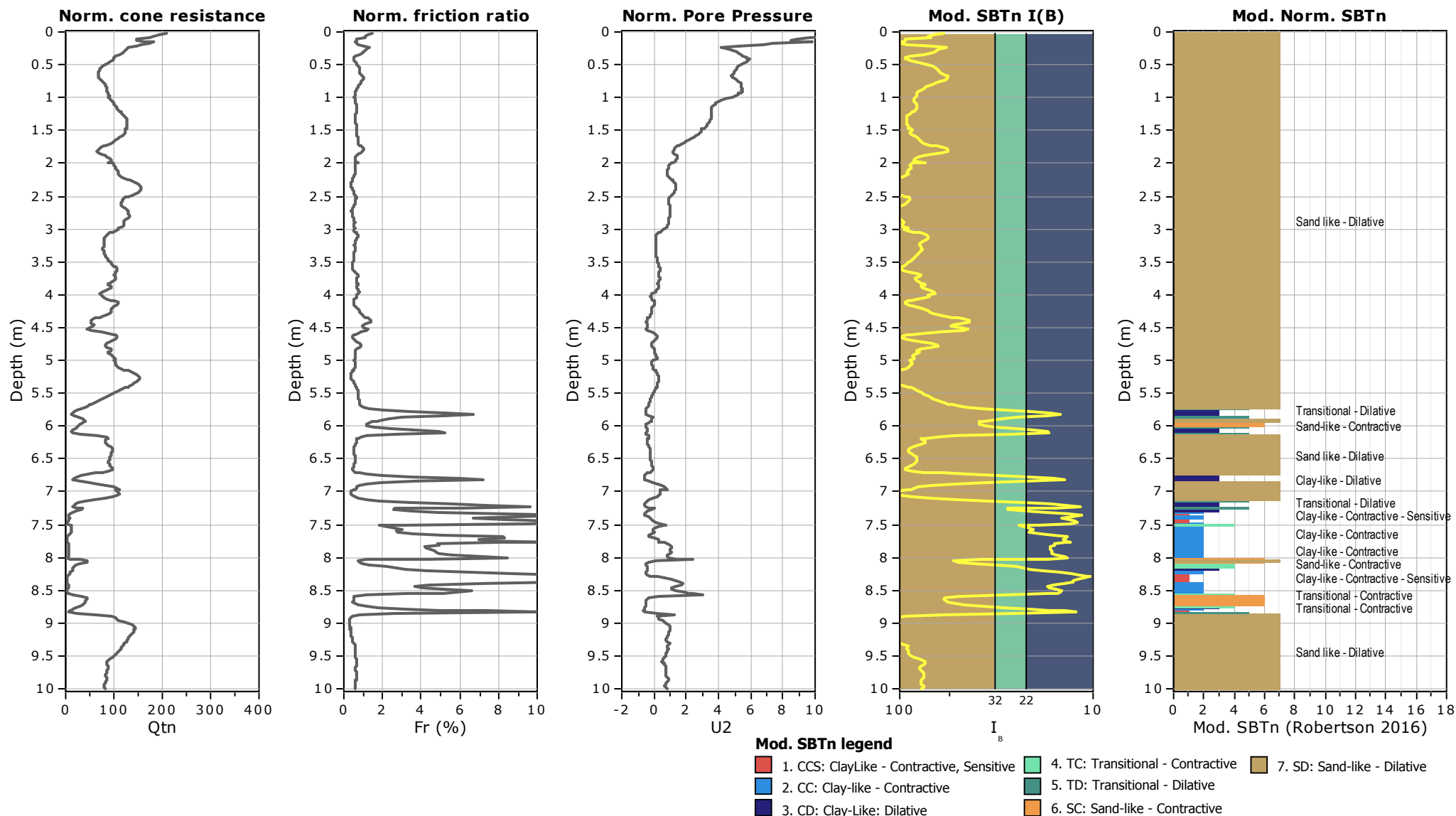
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

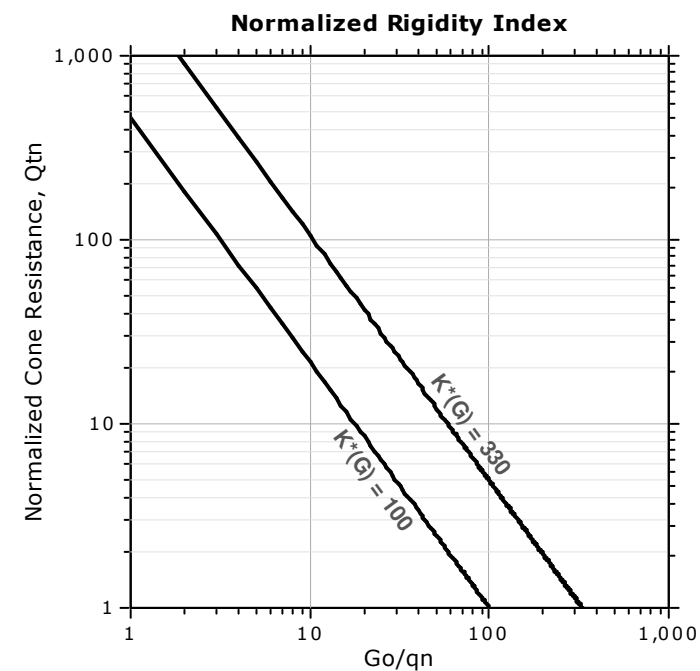
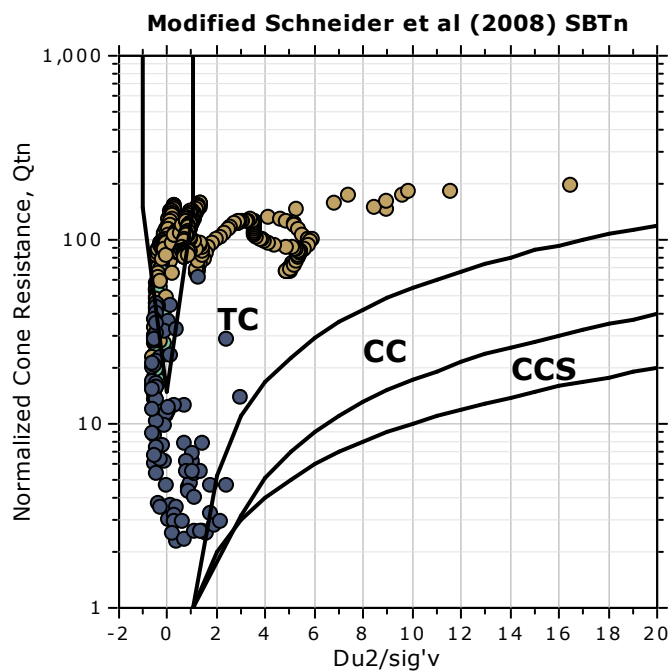
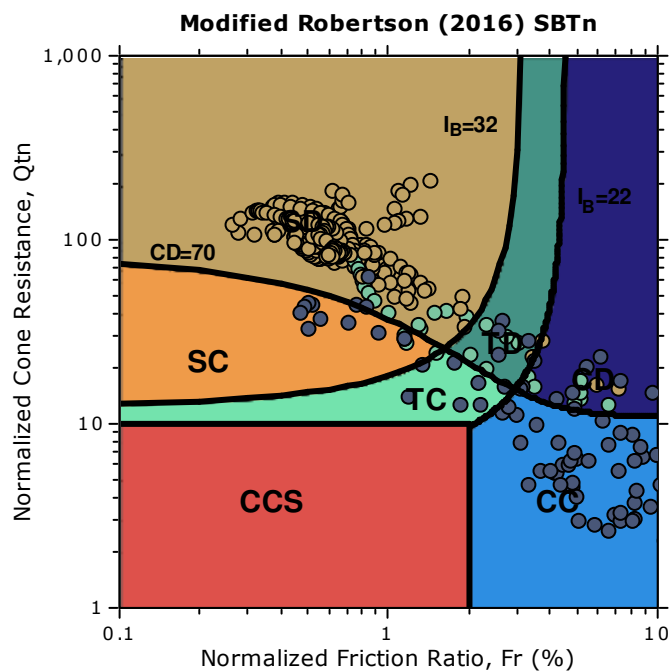
**CPT: CPTU km54+000**

Total depth: 10.00 m

Coords: lat 44.912587° lon 12.232972°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

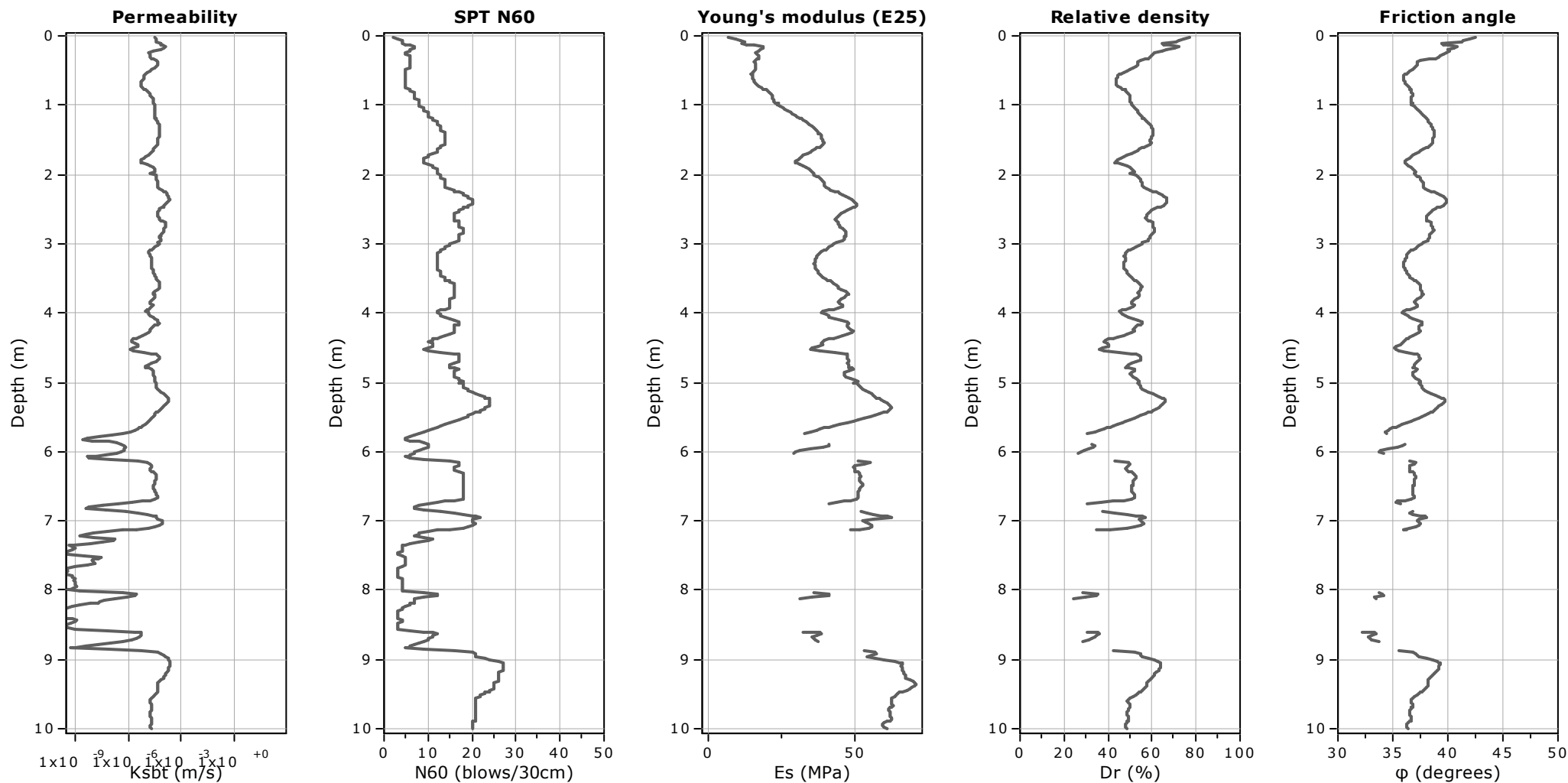
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+000**

Total depth: 10.00 m

Coords: lat 44.912587° lon 12.232972°



**Calculation parameters**

Permeability: Based on  $SBT_n$

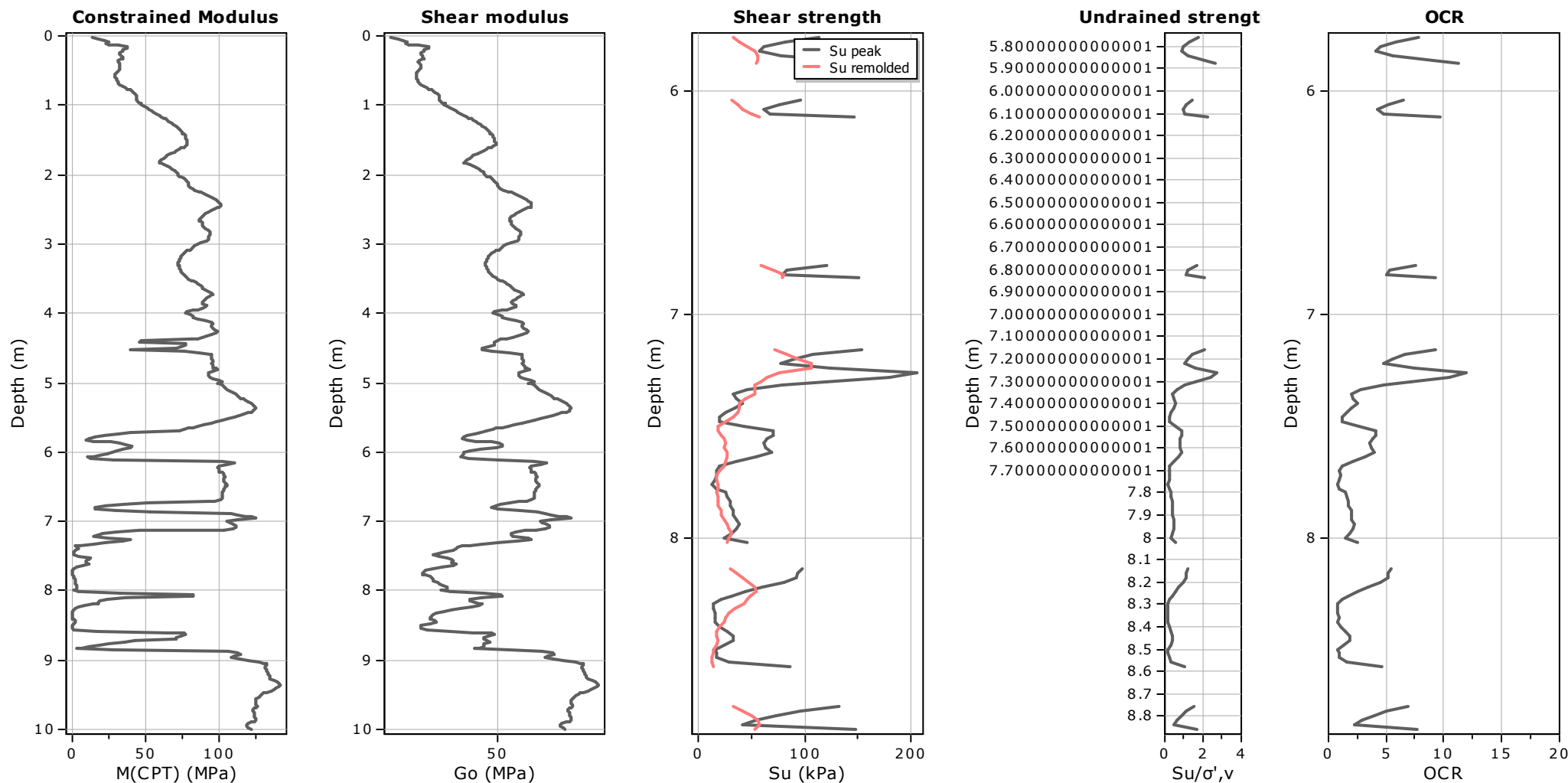
SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

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

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data



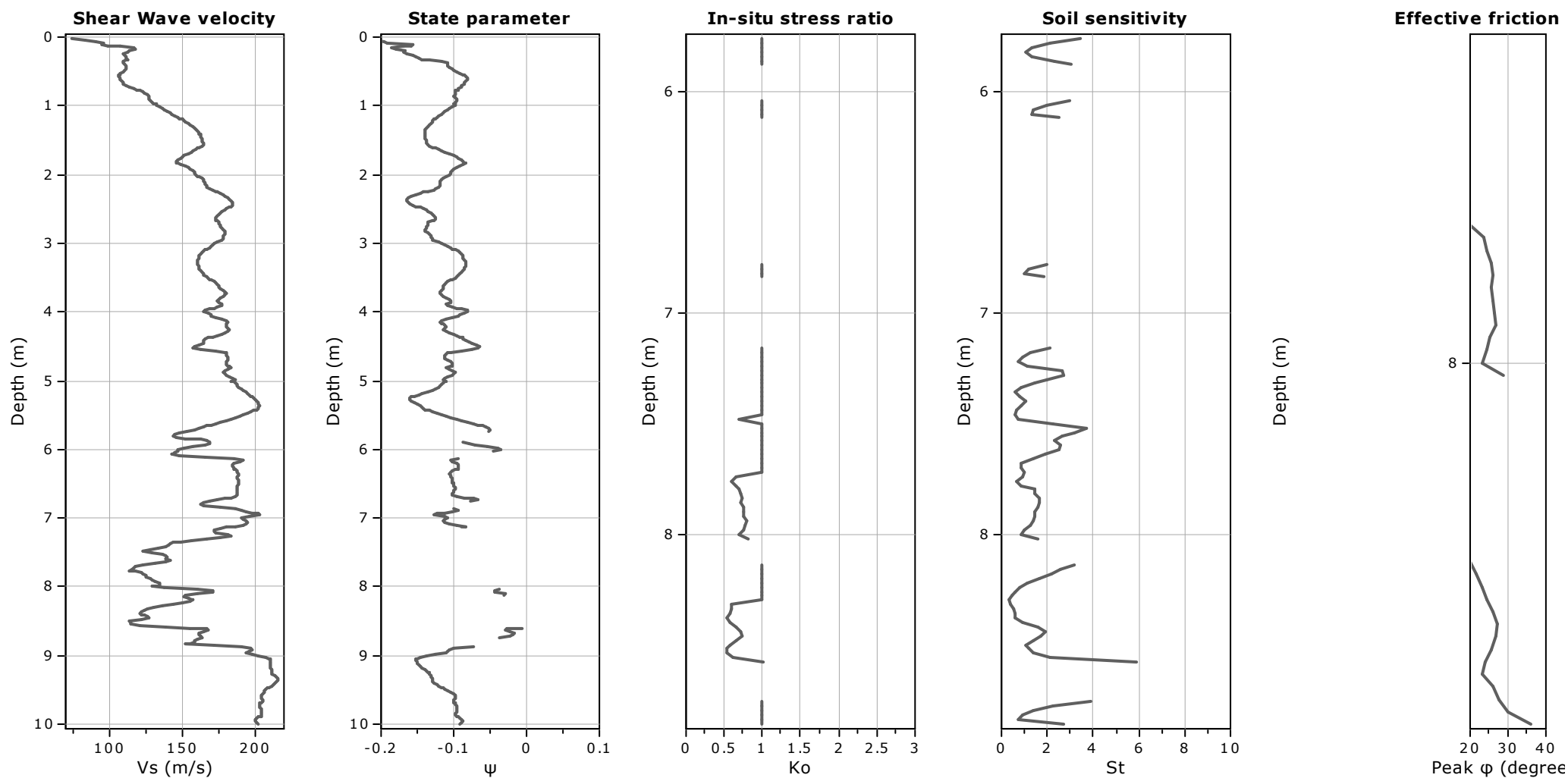
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+000**

Total depth: 10.00 m

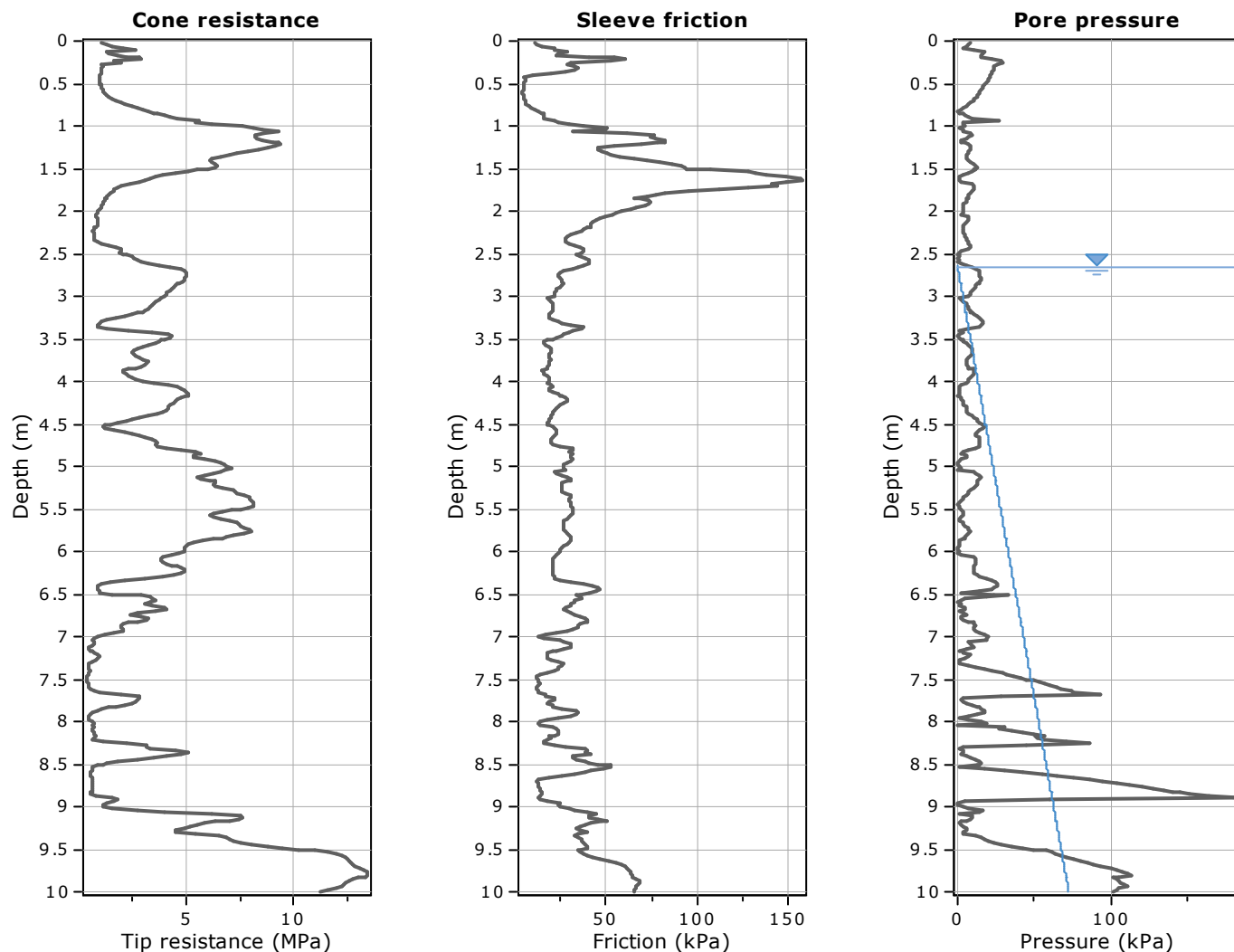
Coords: lat 44.912587° lon 12.232972°



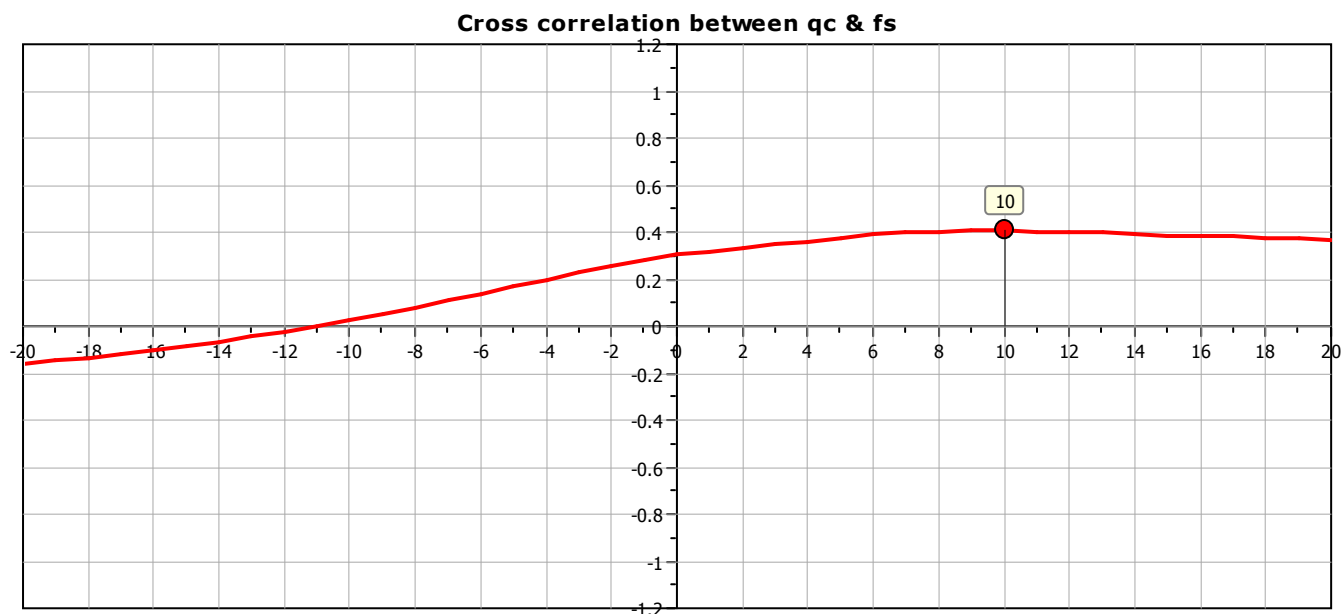
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

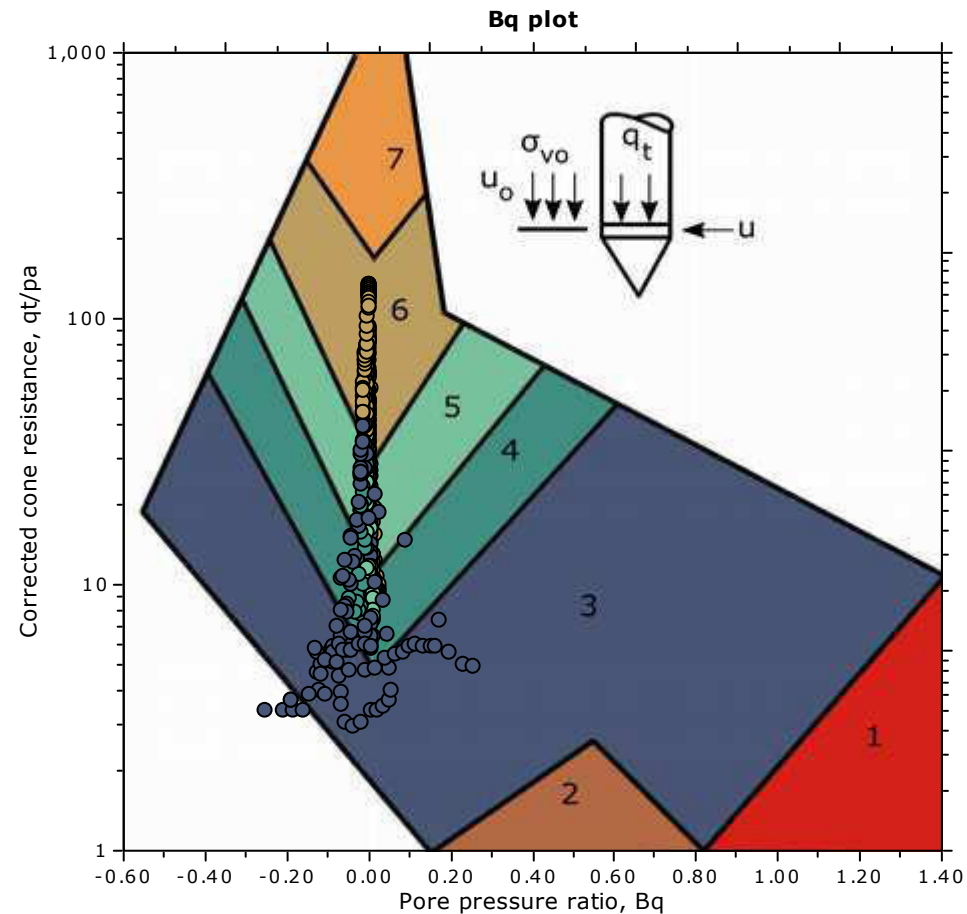
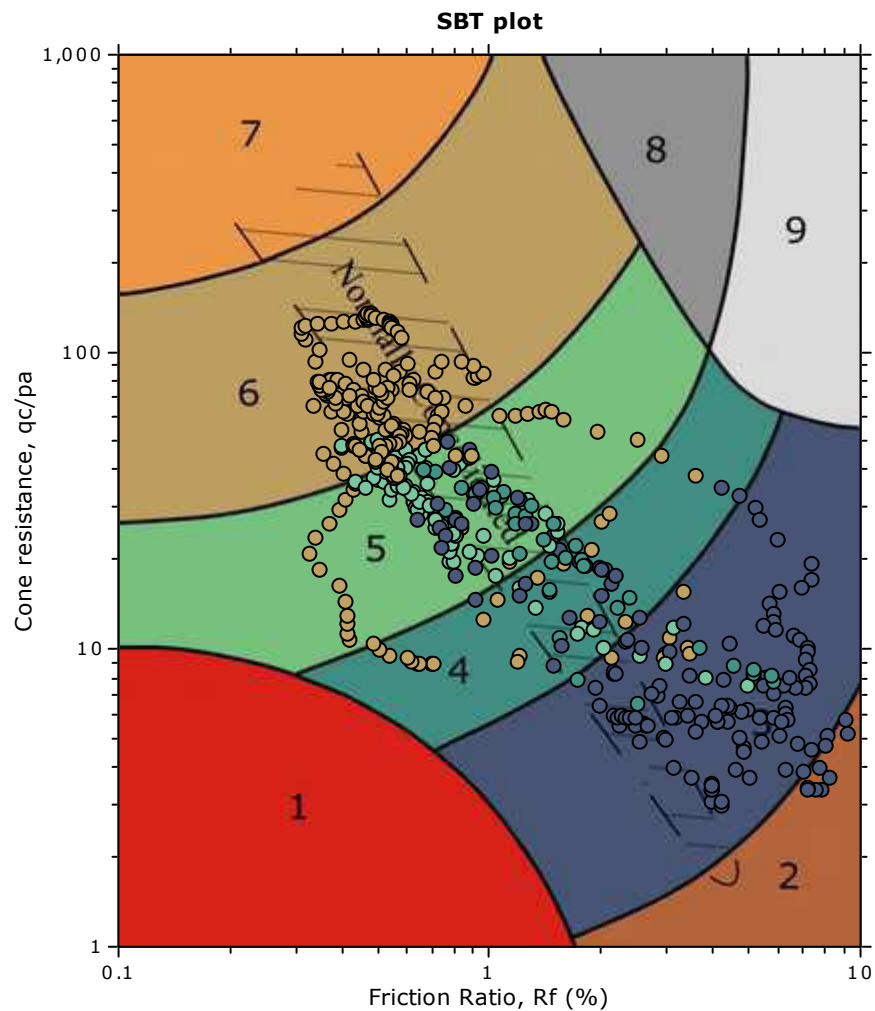
—●— User defined estimation data



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



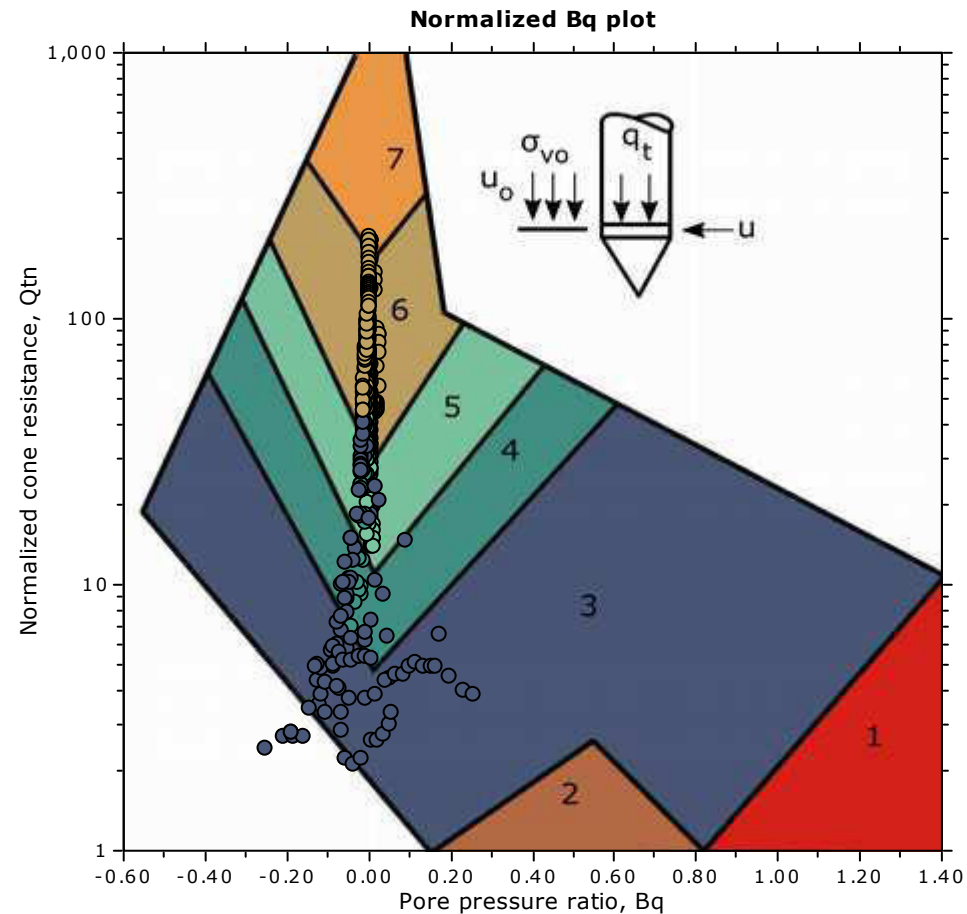
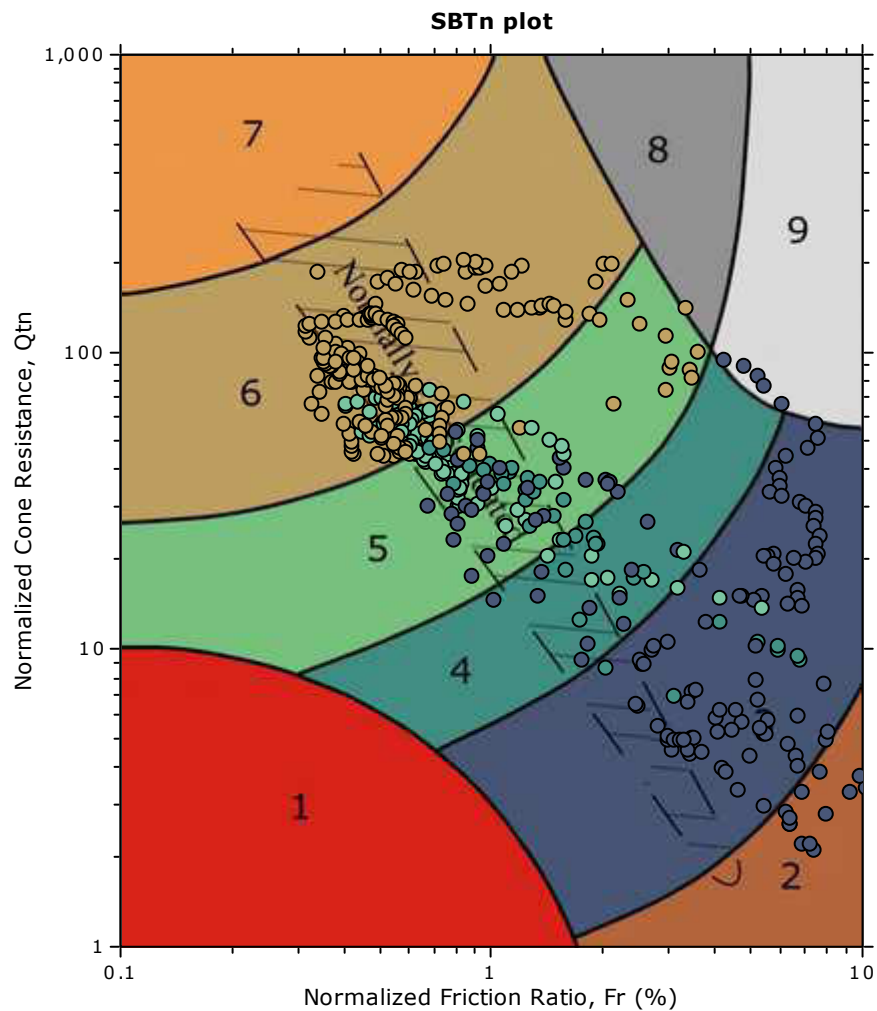
## SBT - Bq plots



### 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        |

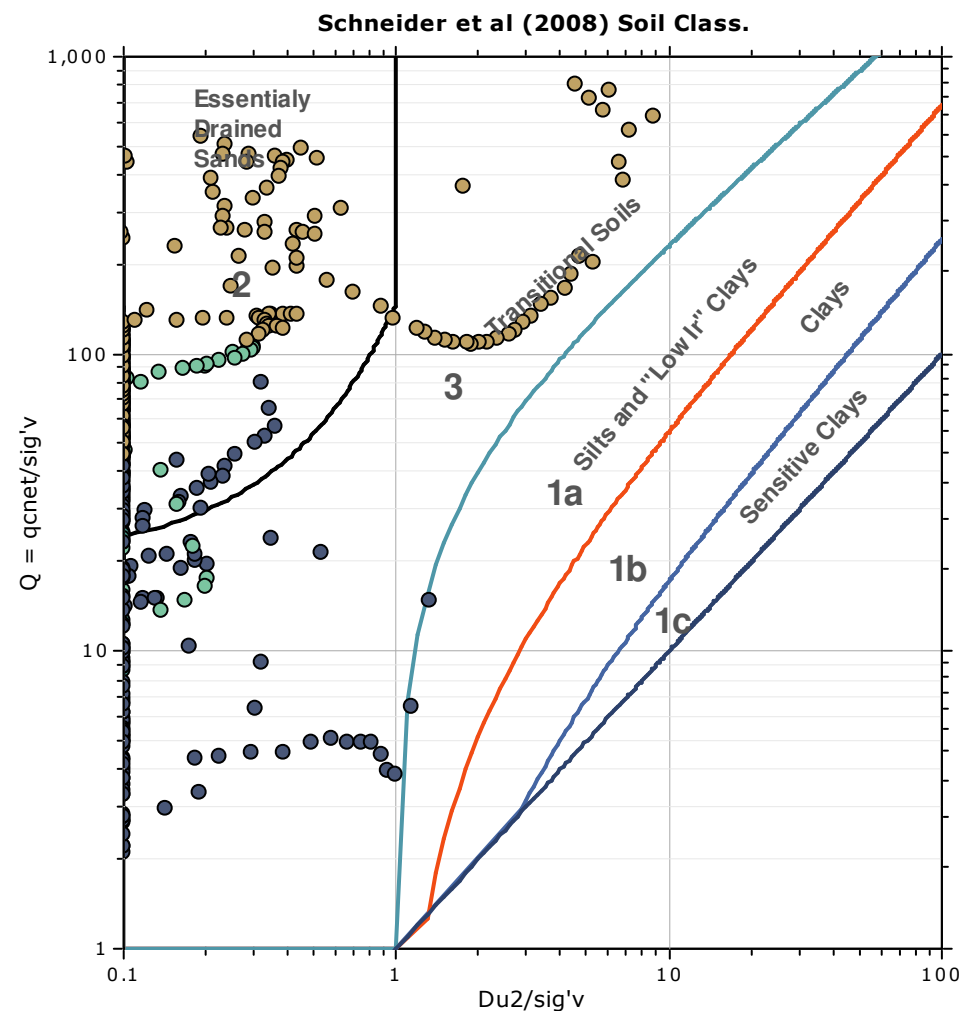
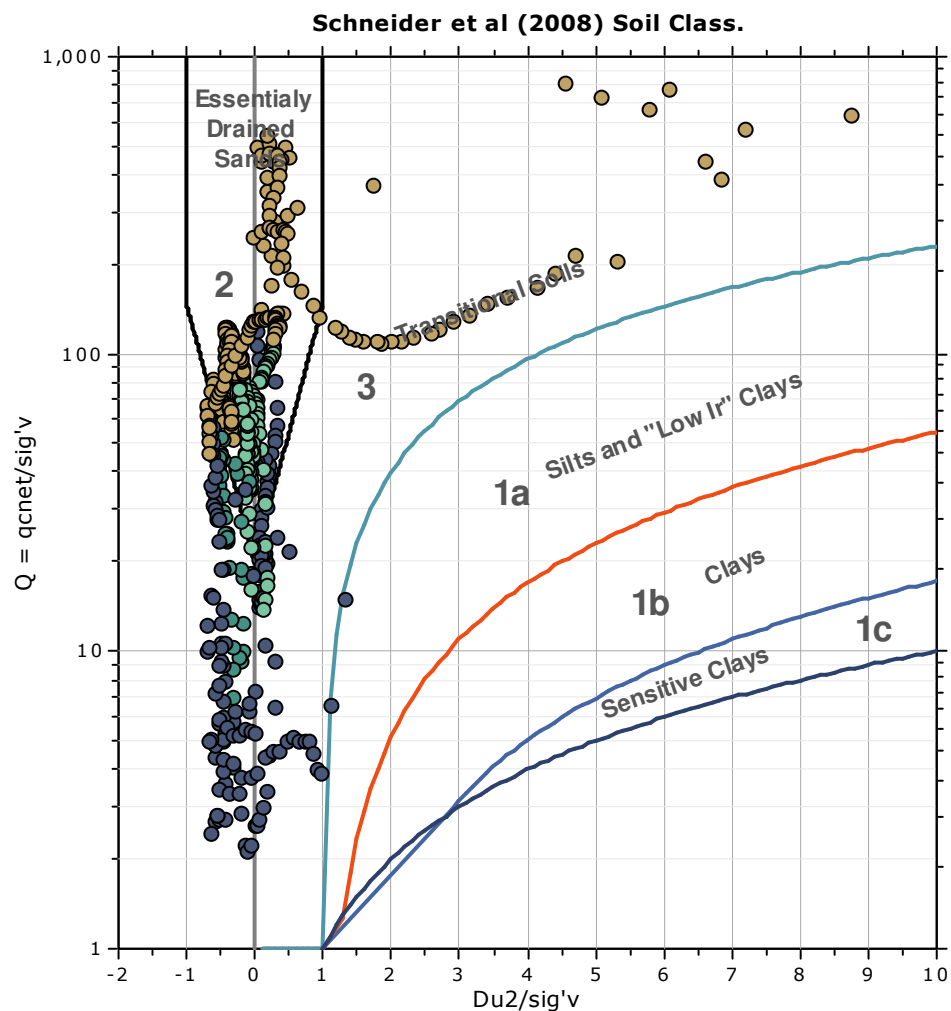
**SBT - Bq plots (normalized)**

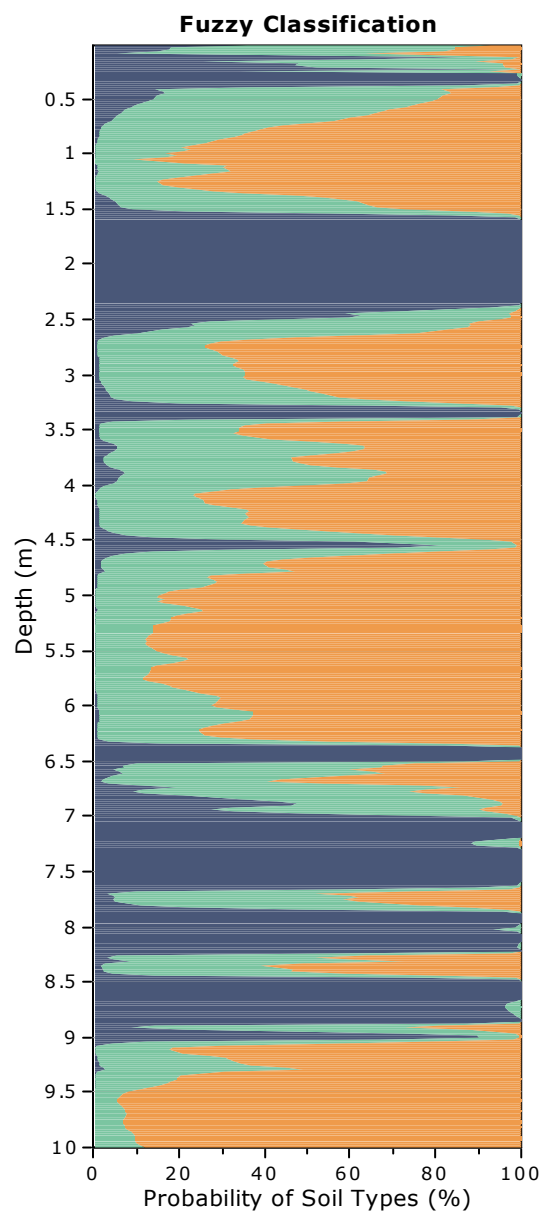
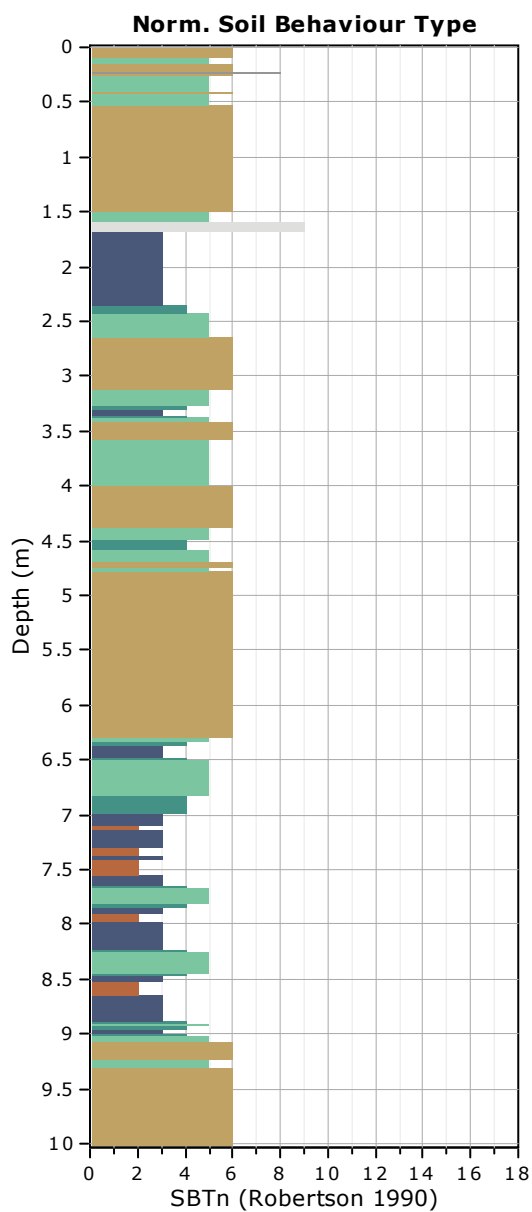


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





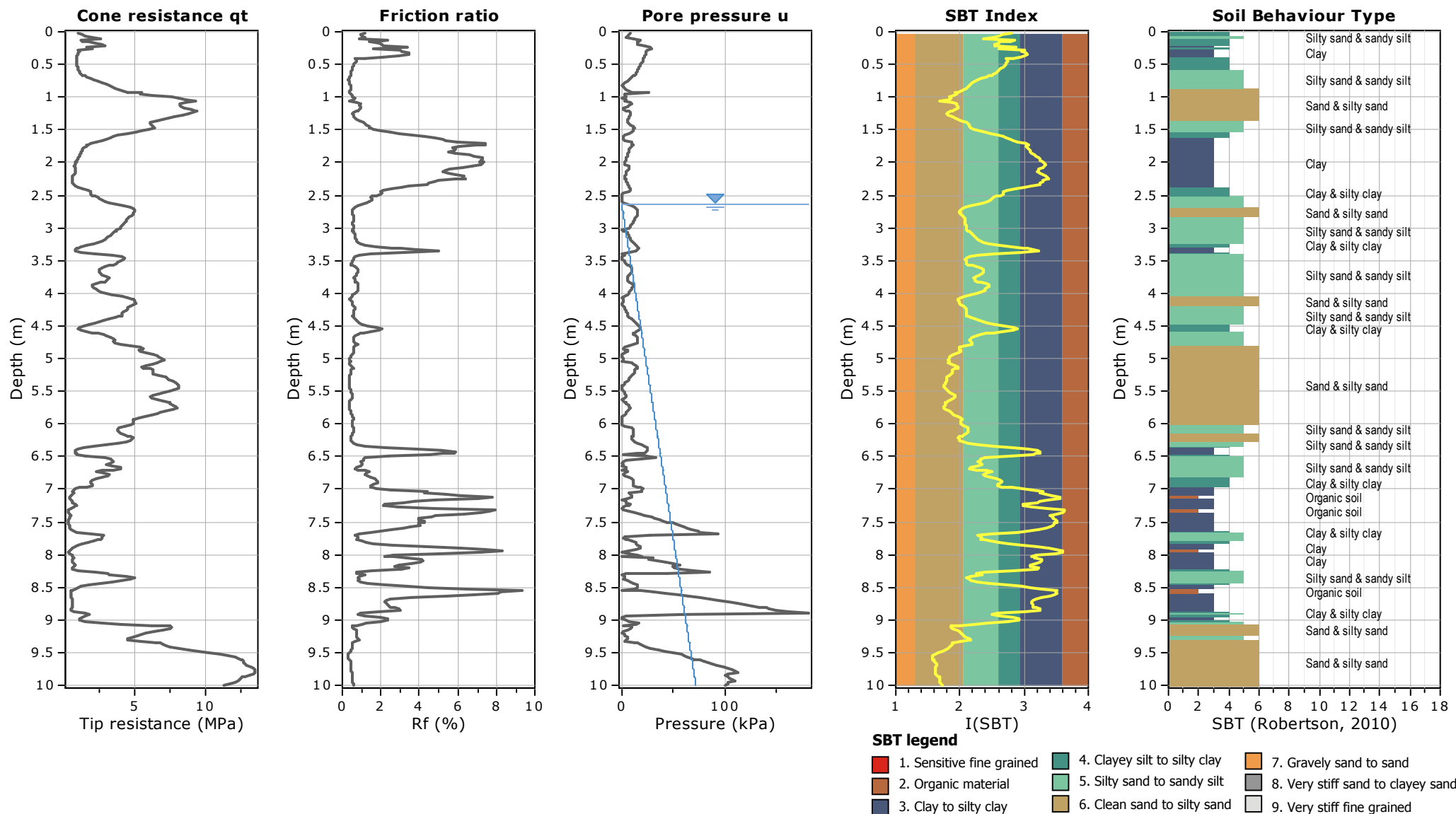
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+500**

Total depth: 10.00 m

Coords: lat 44.915326° lon 12.234709°





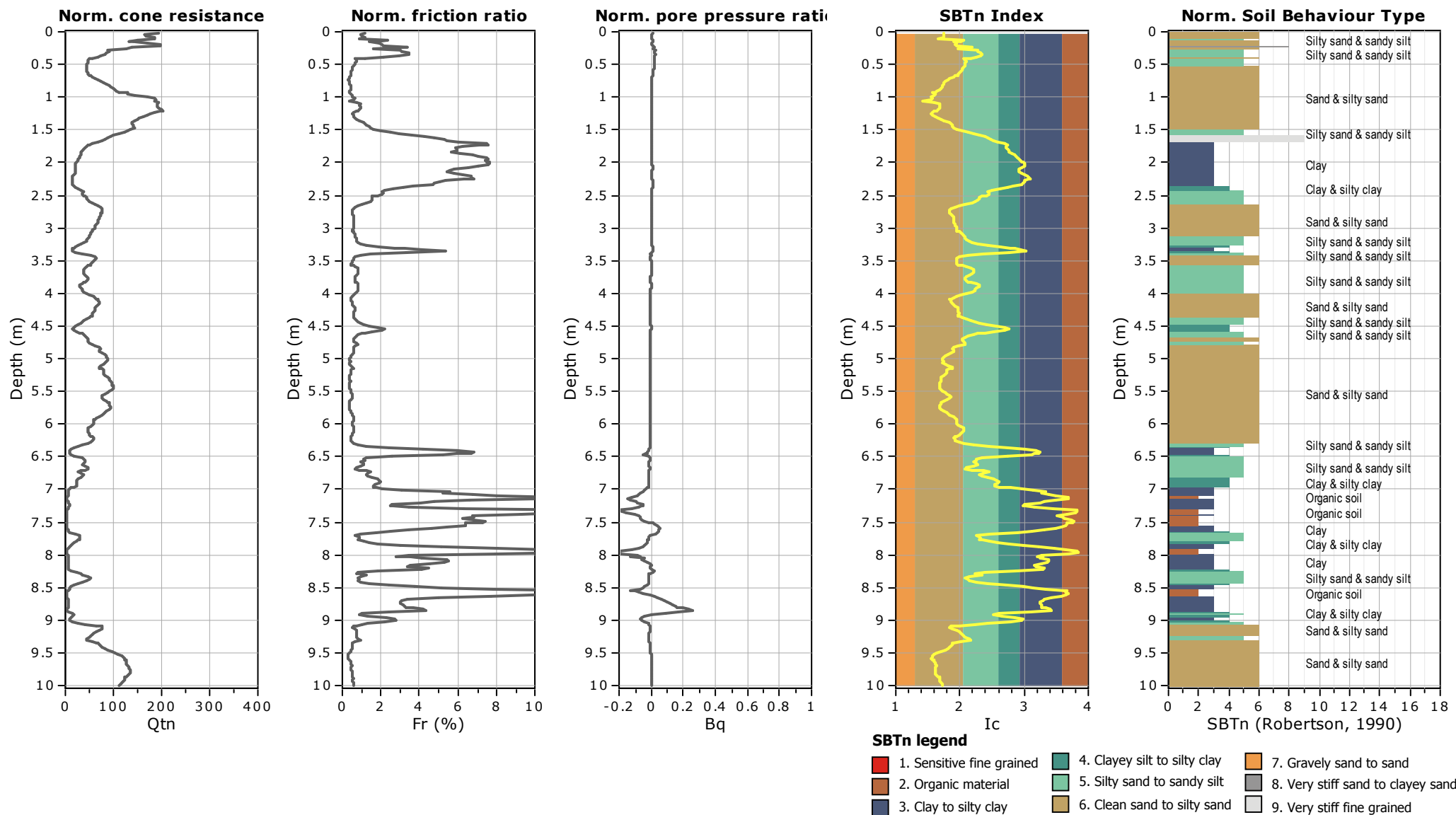
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+500**

Total depth: 10.00 m

Coords: lat 44.915326° lon 12.234709°



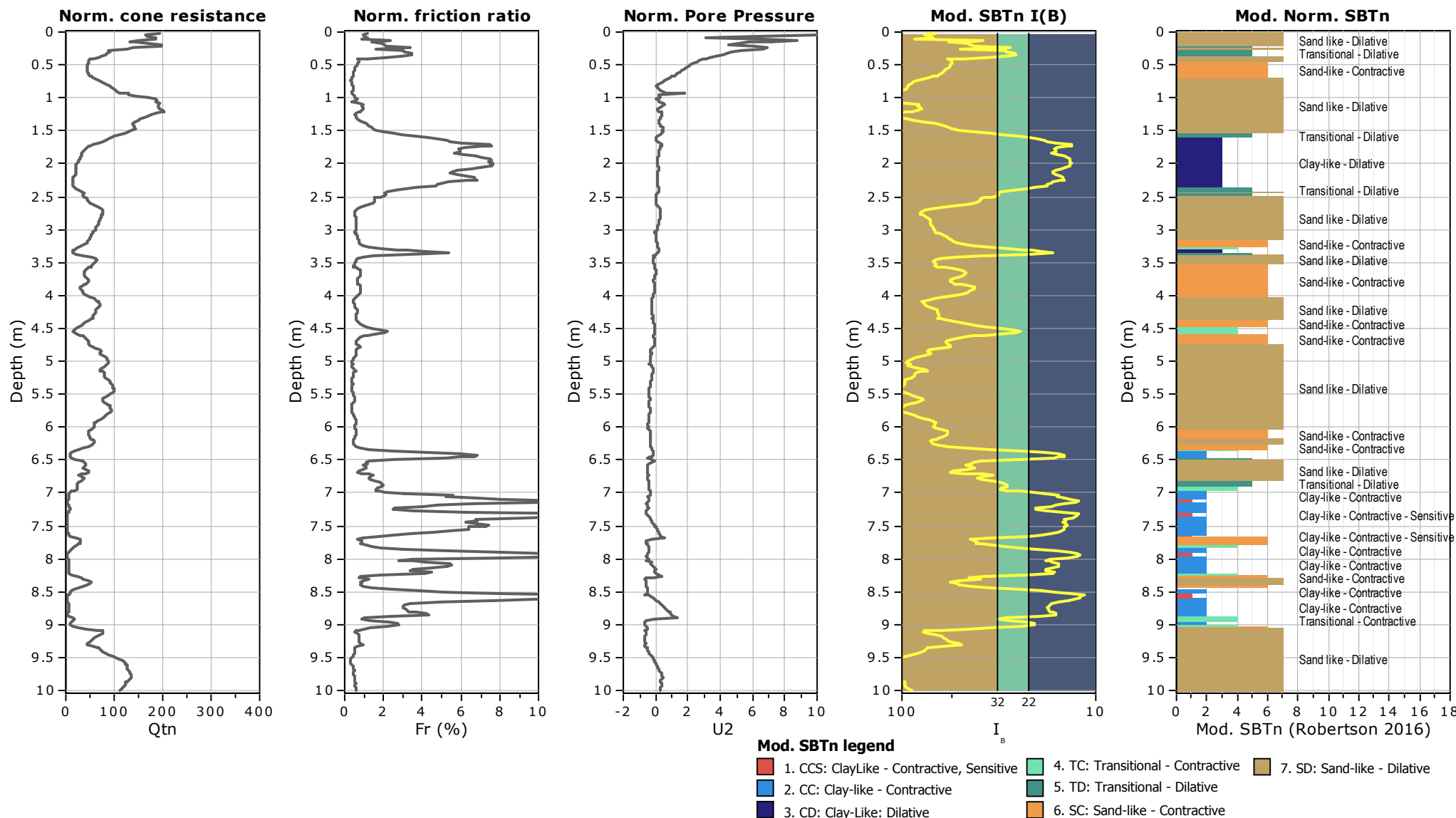
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

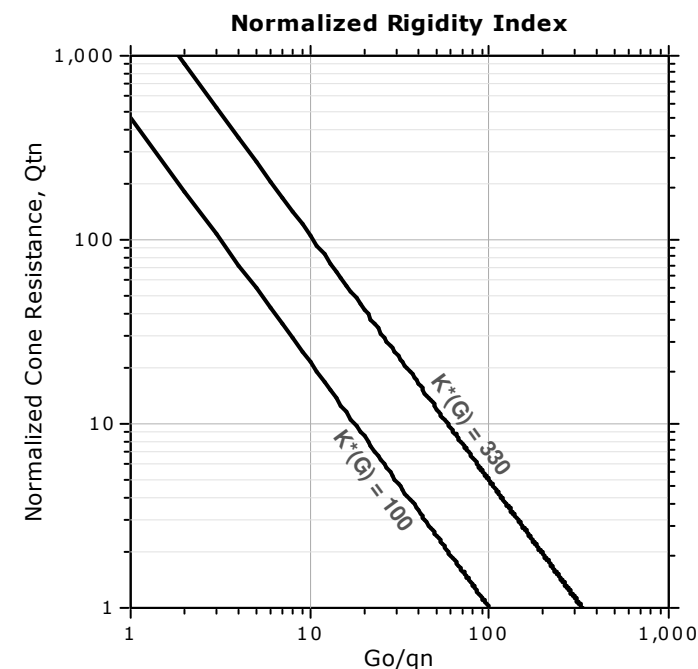
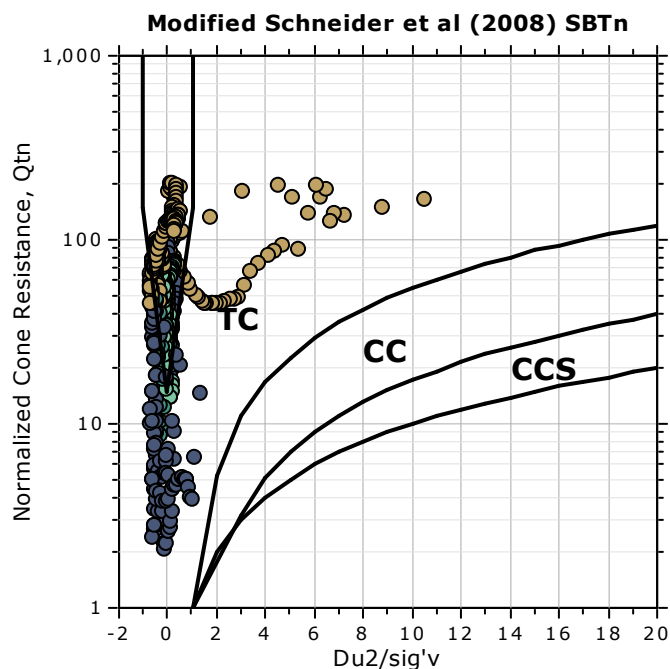
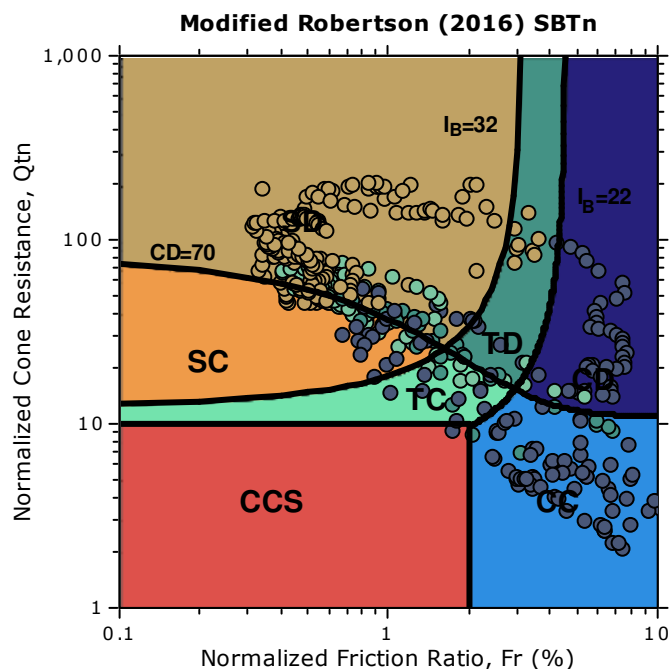
**CPT: CPTU km54+500**

Total depth: 10.00 m

Coords: lat 44.915326° lon 12.234709°



## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

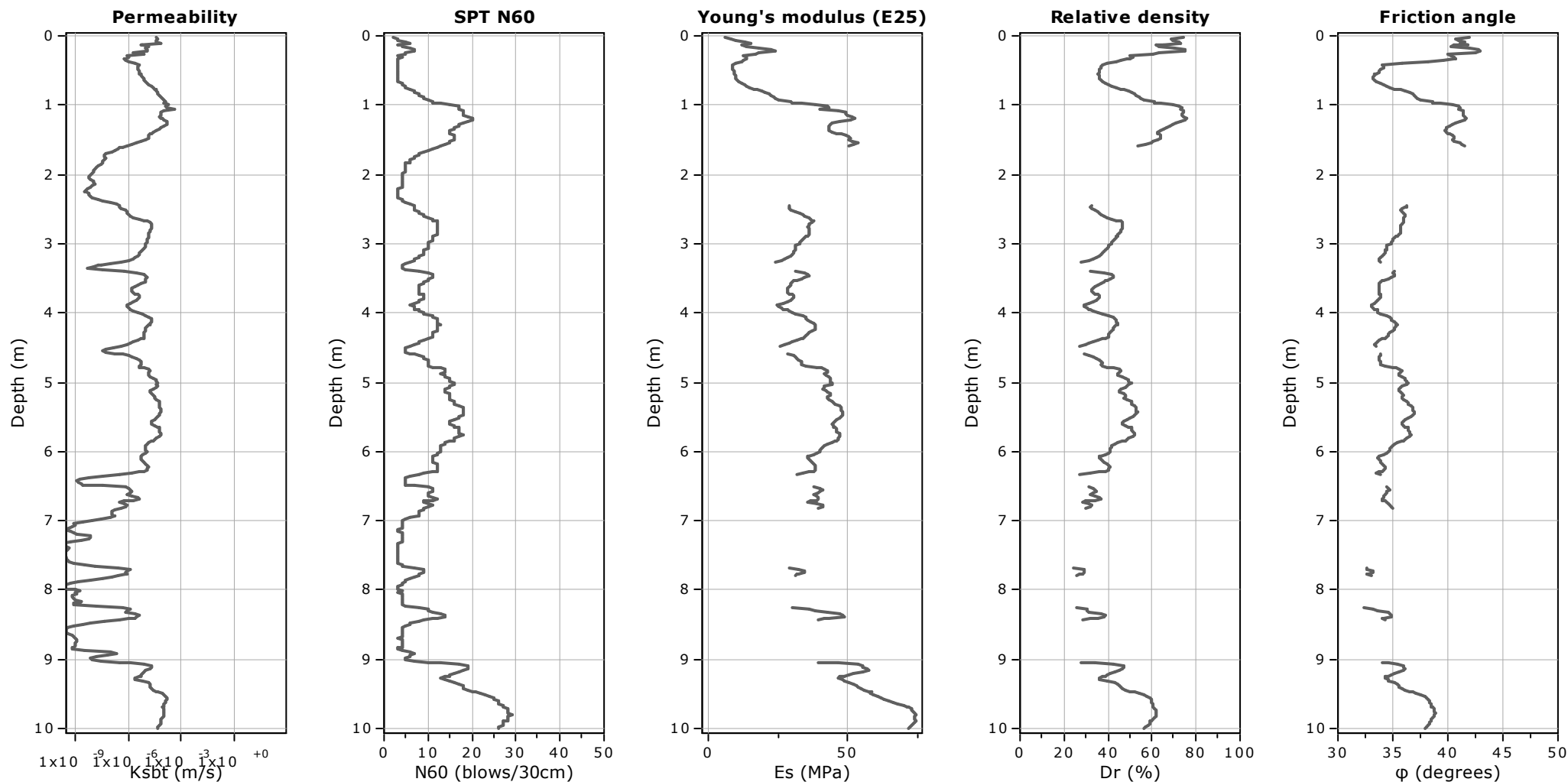
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+500**

Total depth: 10.00 m

Coords: lat 44.915326° lon 12.234709°



**Calculation parameters**

Permeability: Based on SBT<sub>n</sub>

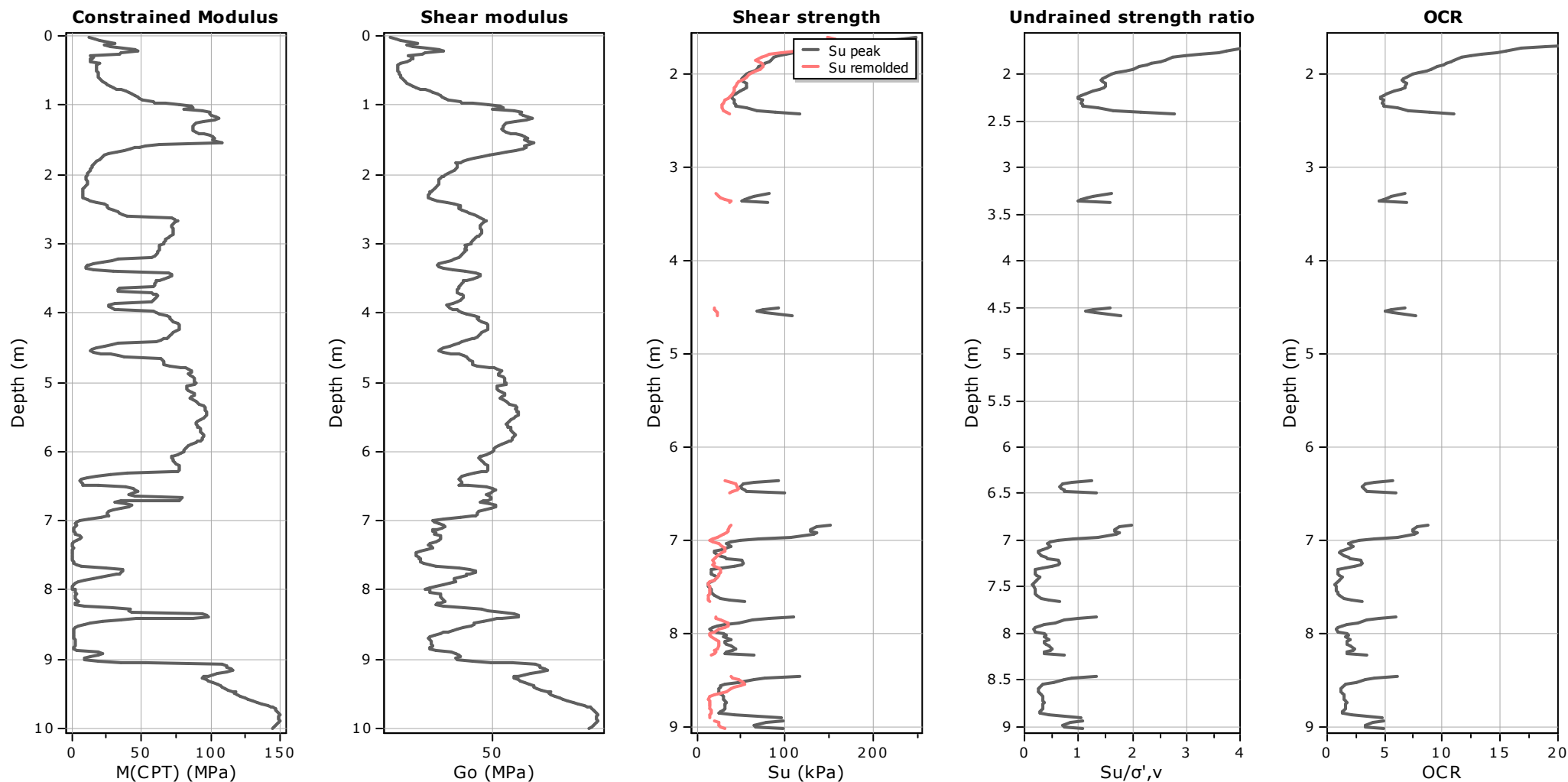
SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

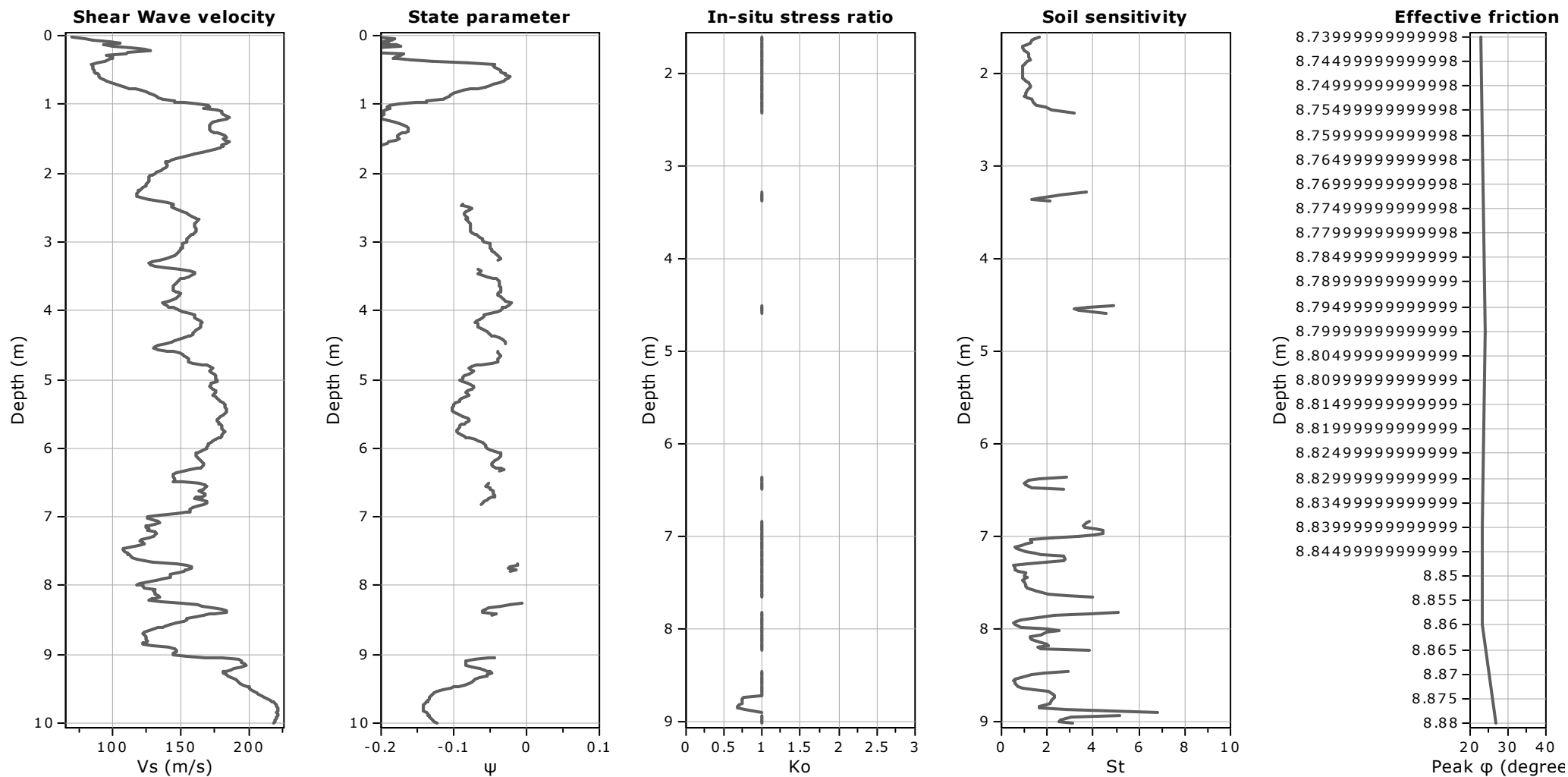
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+500**

Total depth: 10.00 m

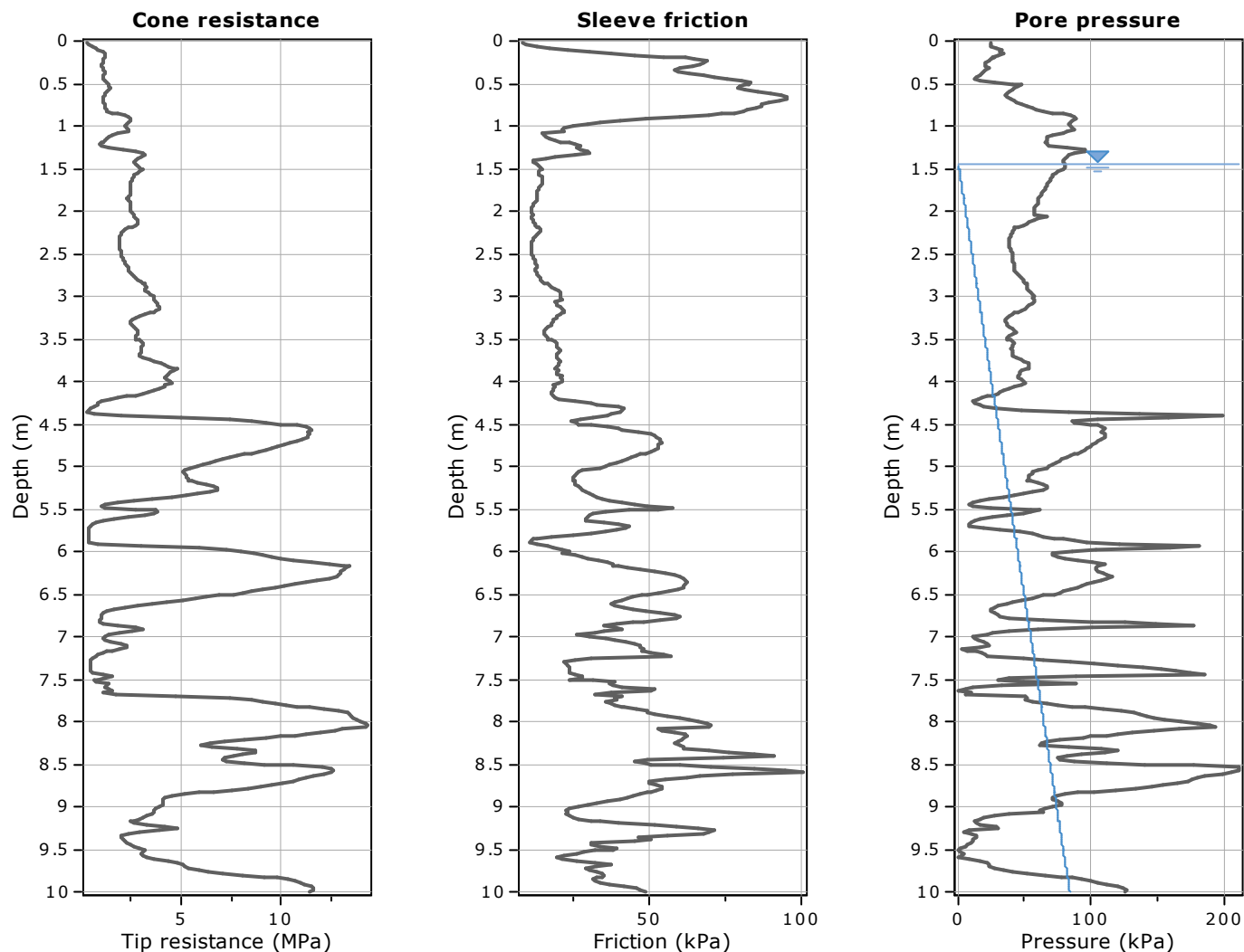
Coords: lat 44.915326° lon 12.234709°



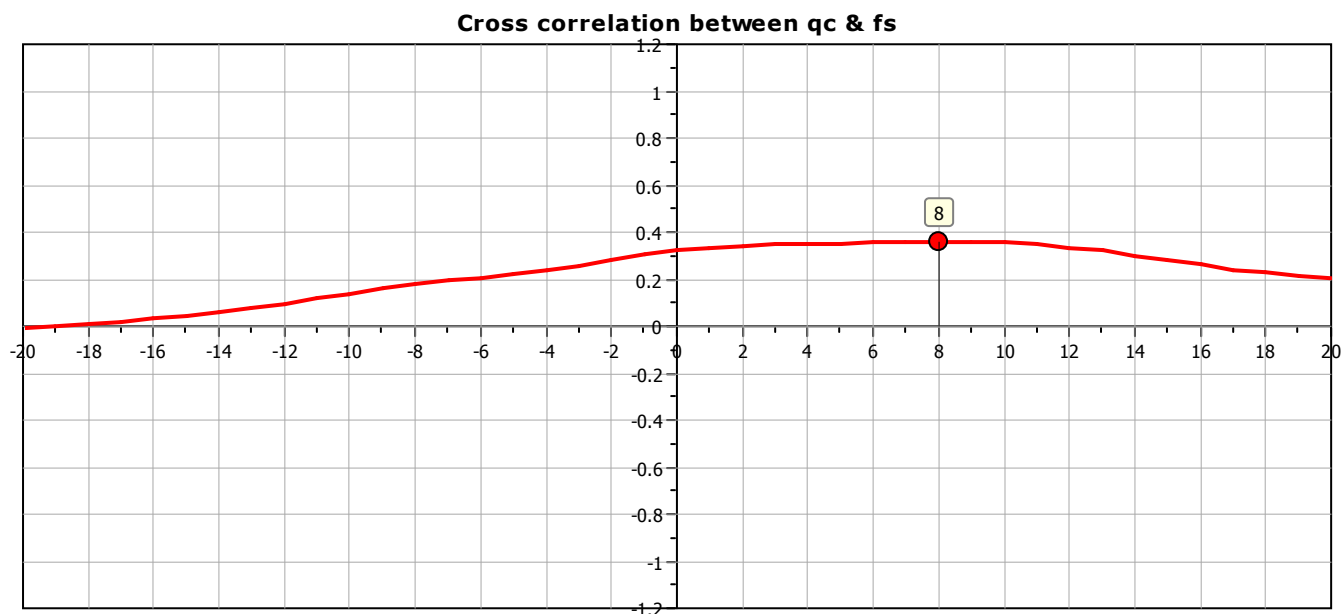
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data

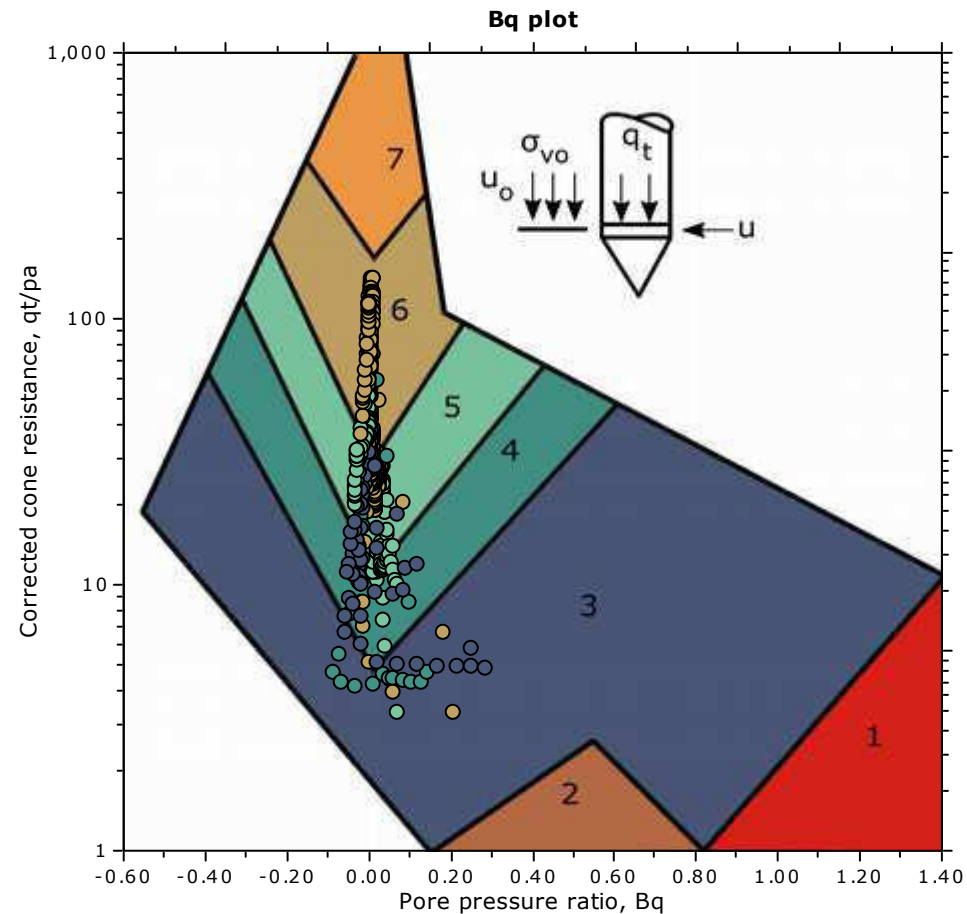
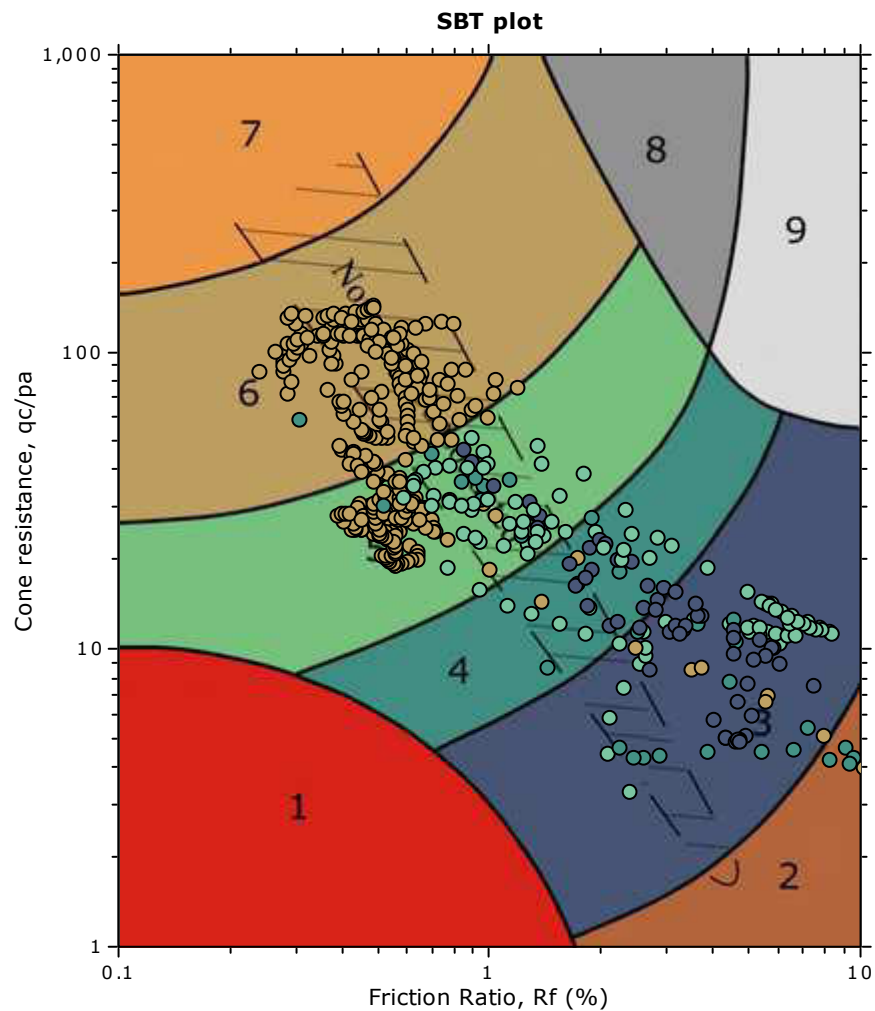


The plot below presents the cross correlation coefficient between the raw  $q_c$  and  $f_s$  values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





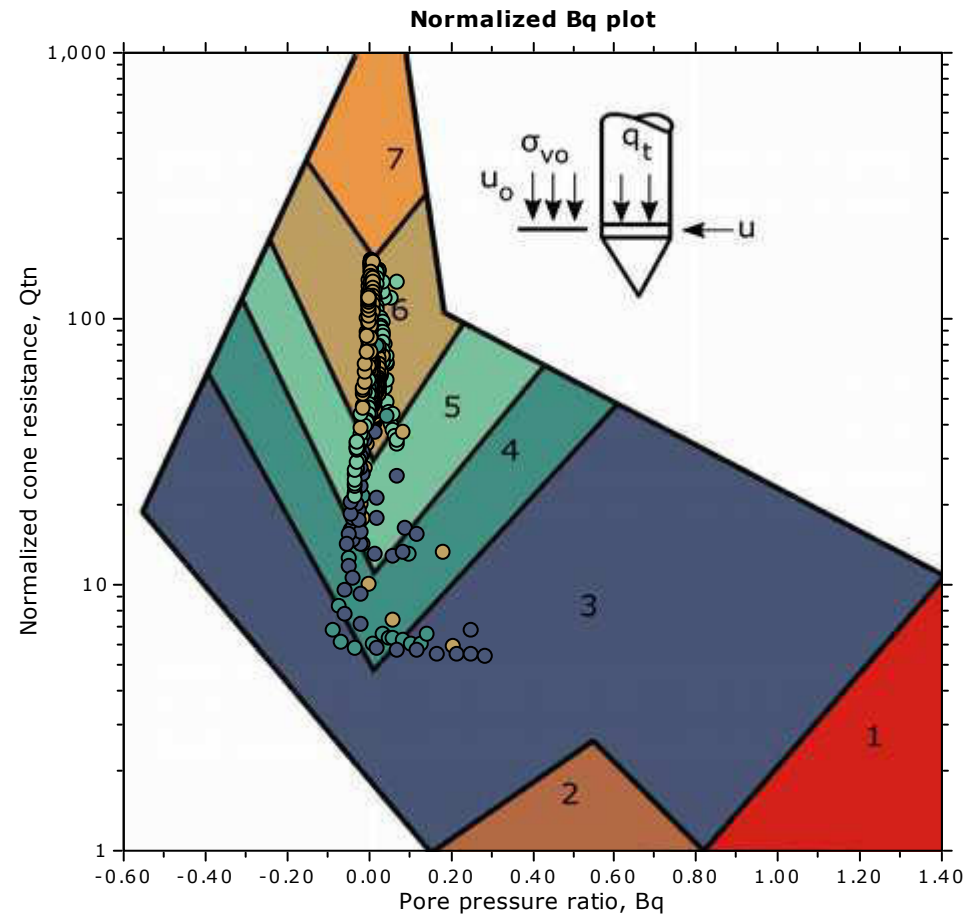
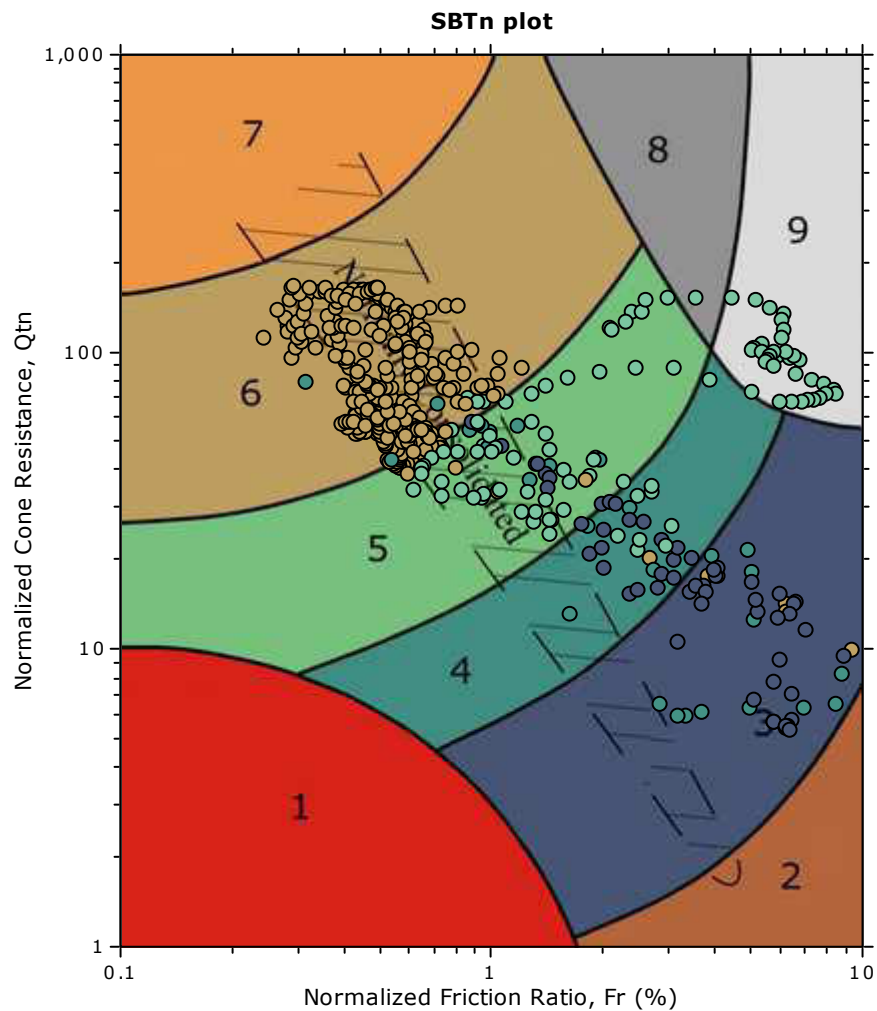
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

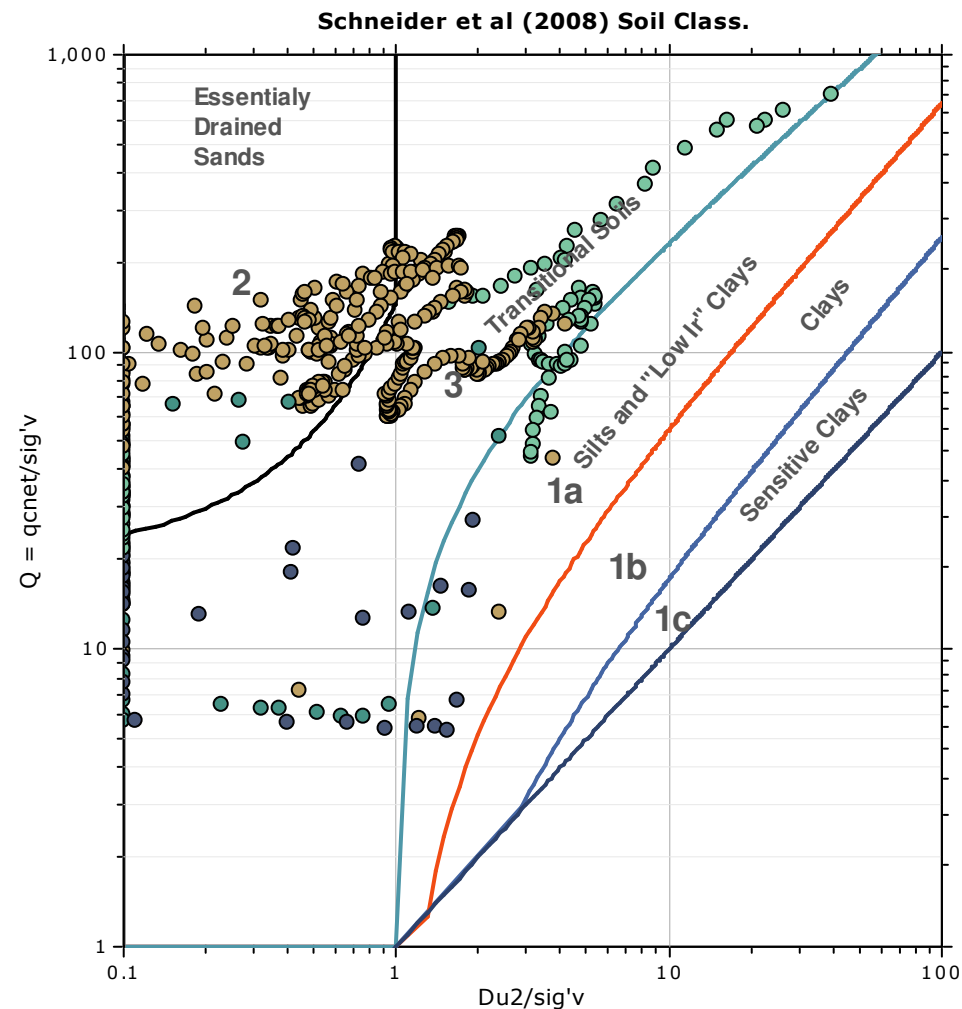
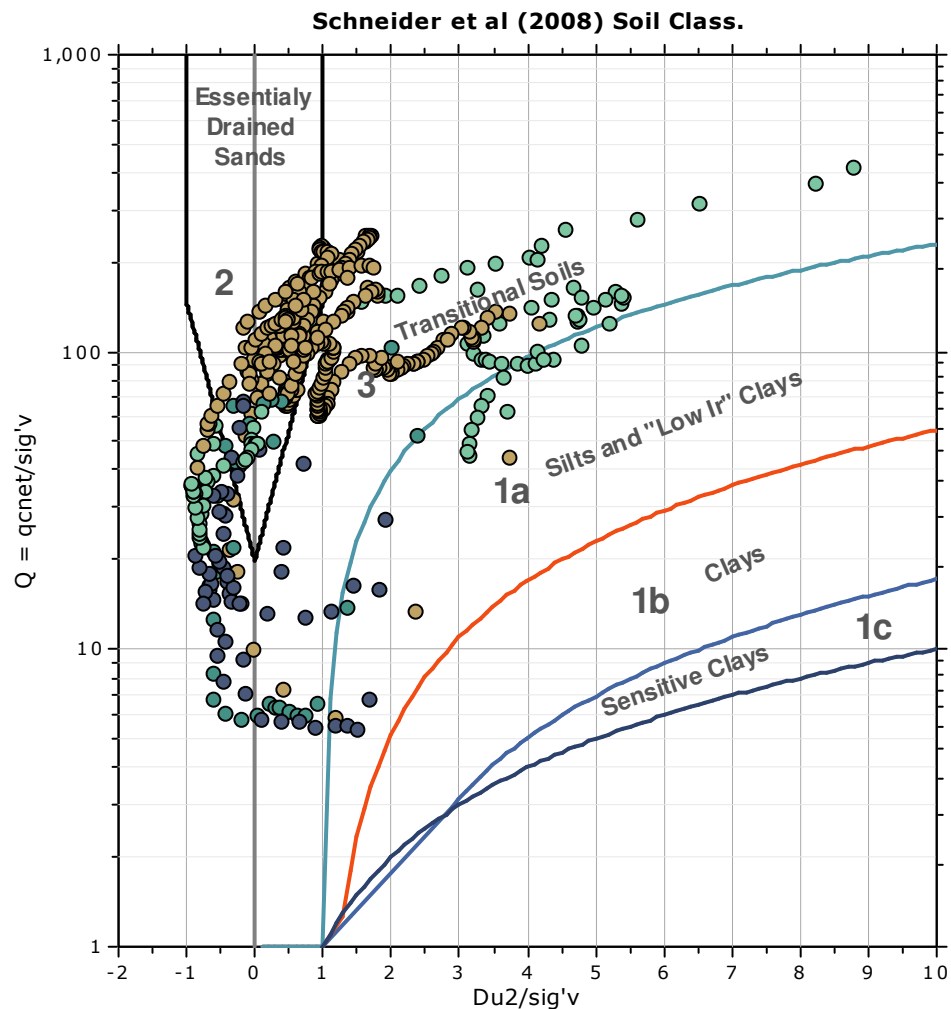
**SBT - Bq plots (normalized)**

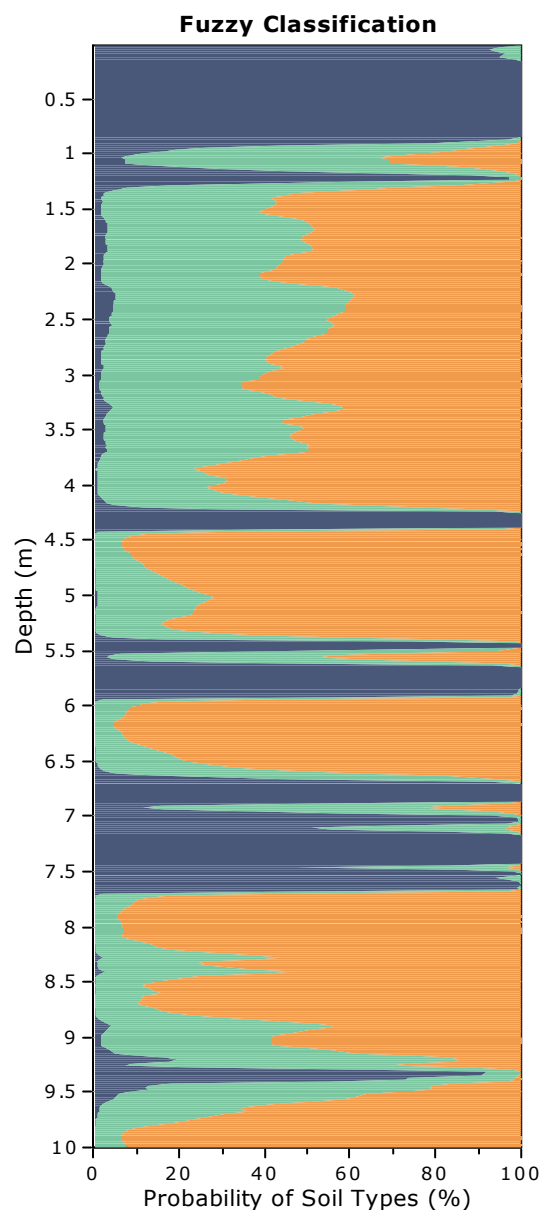
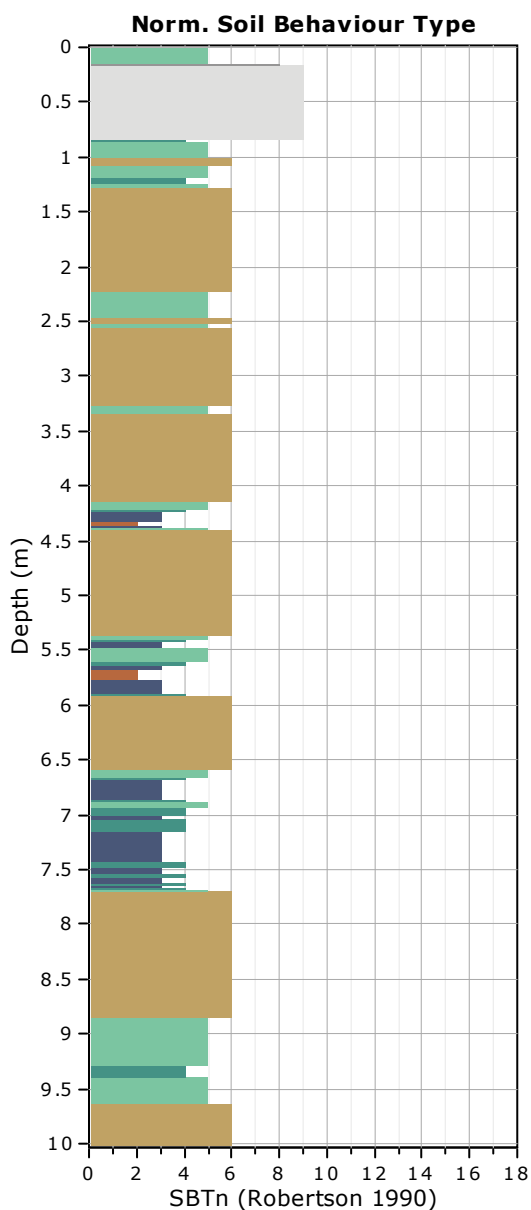


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





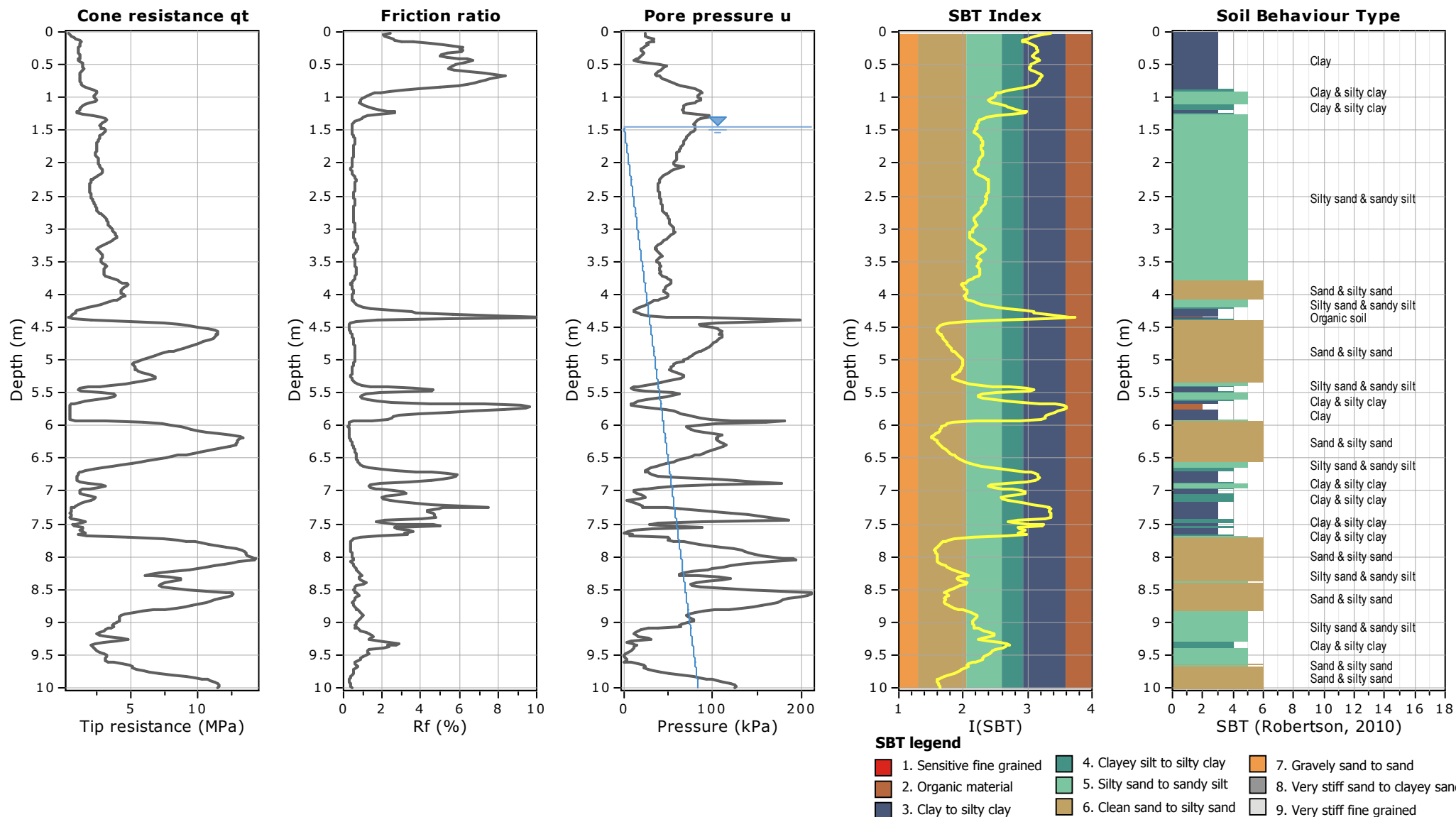
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

Total depth: 10.00 m

Coords: lat 44.915892° lon 12.23453°



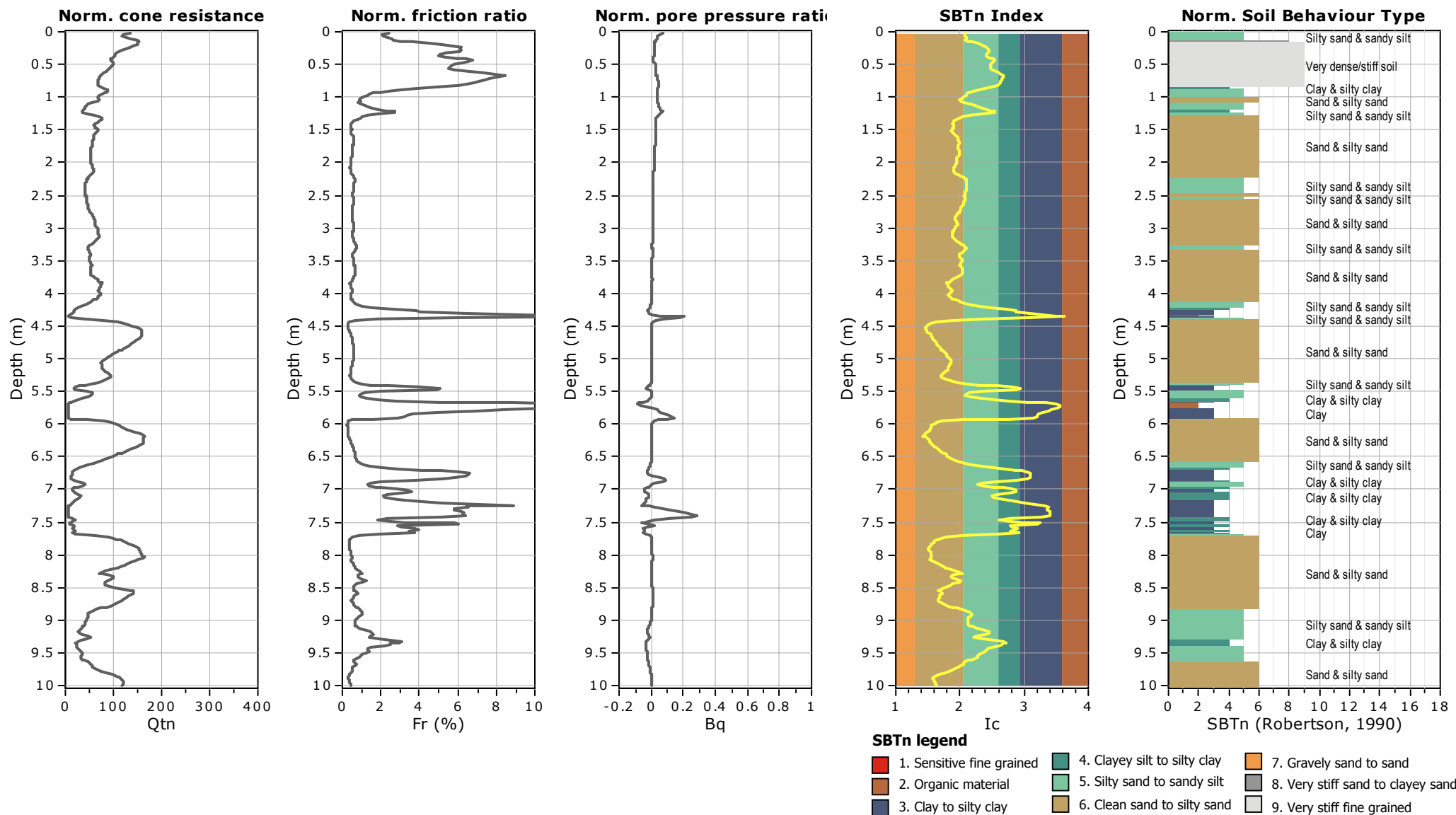
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

Total depth: 10.00 m

Coords: lat 44.915892° lon 12.23453°





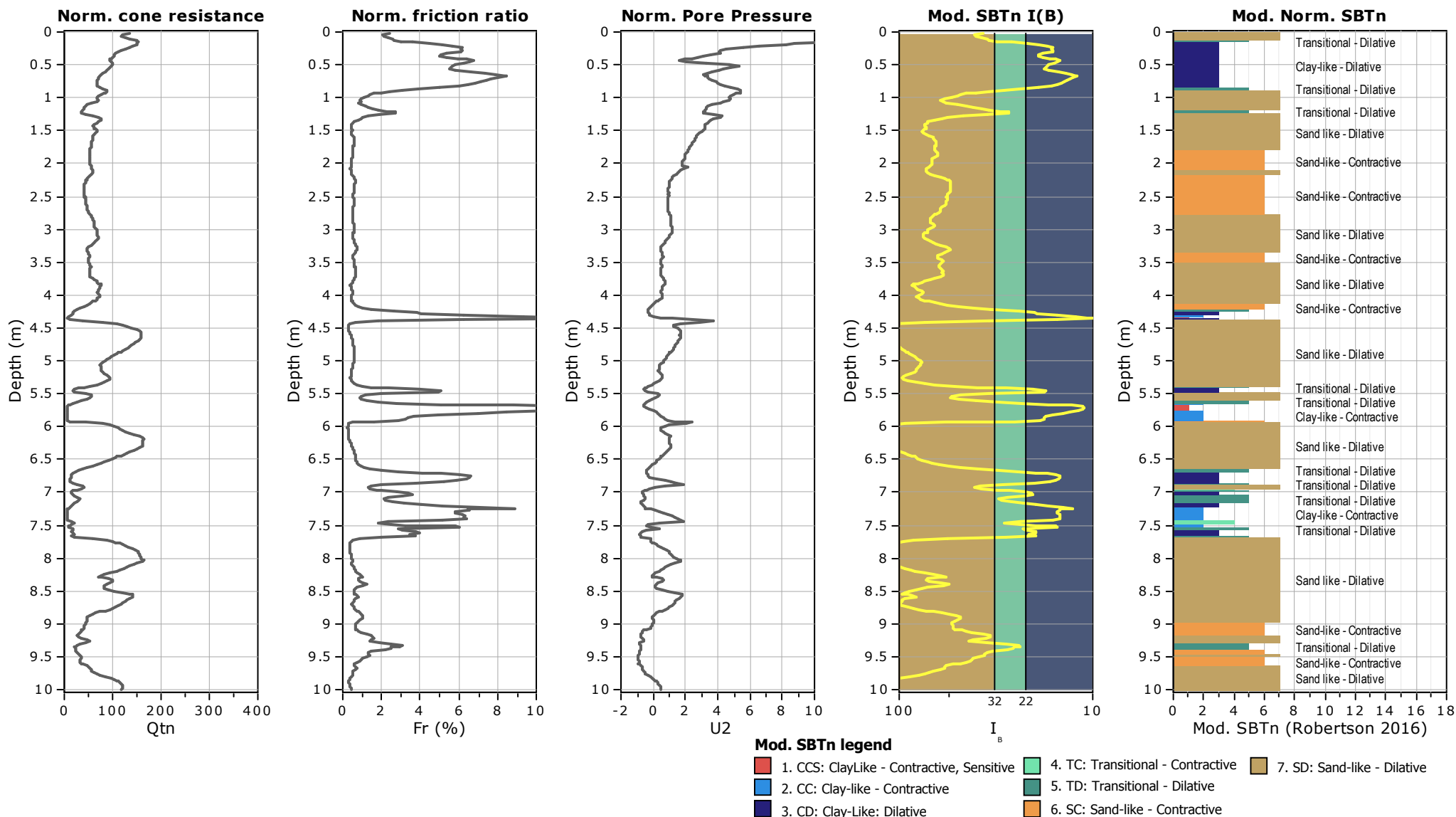
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

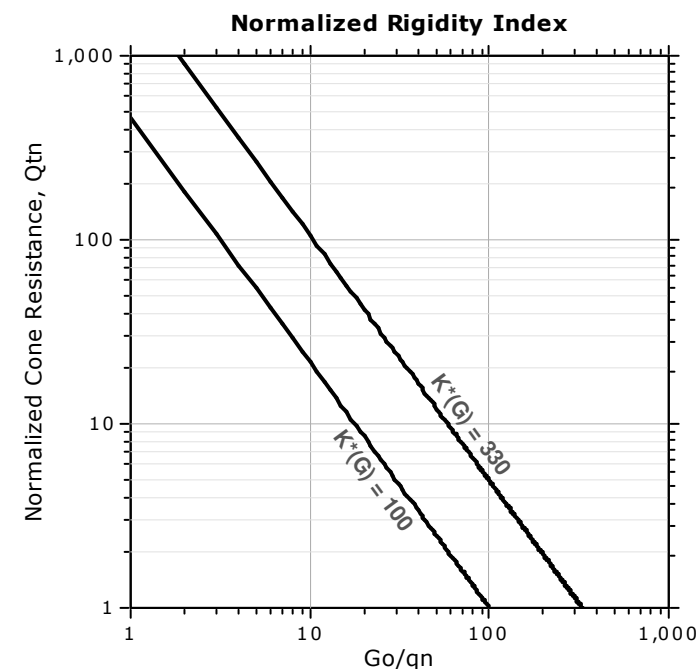
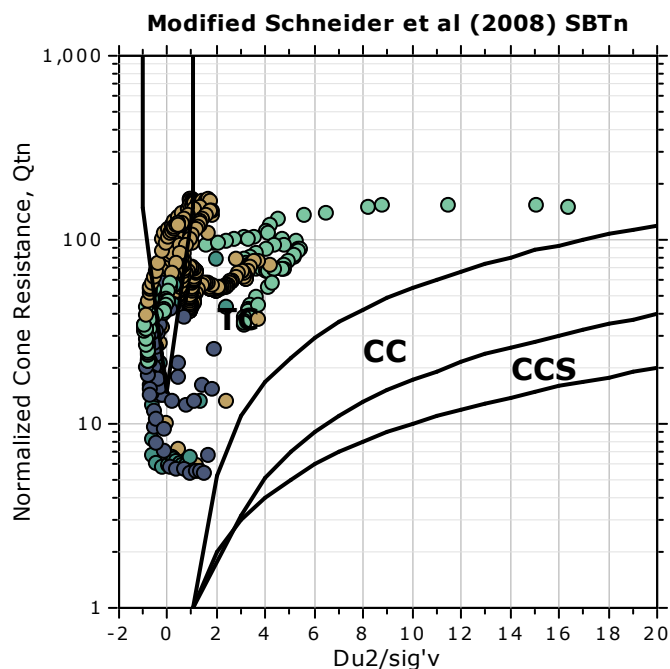
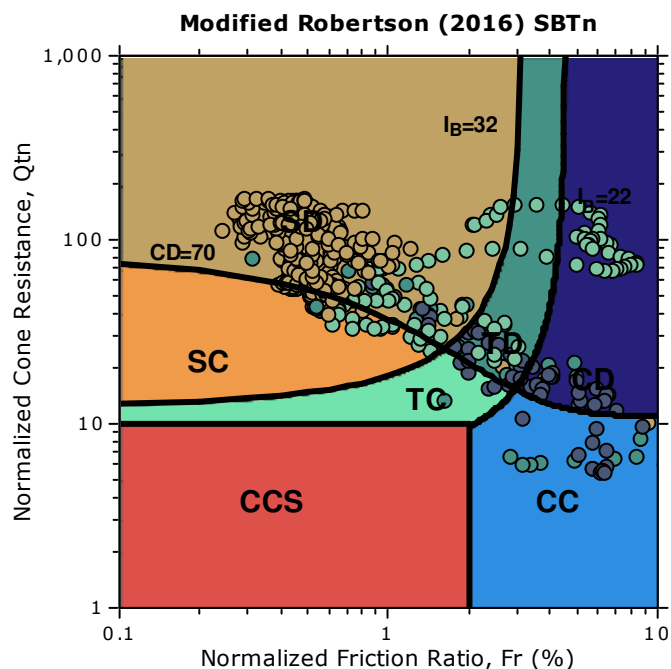
Total depth: 10.00 m

Coords: lat 44.915892° lon 12.23453°





## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

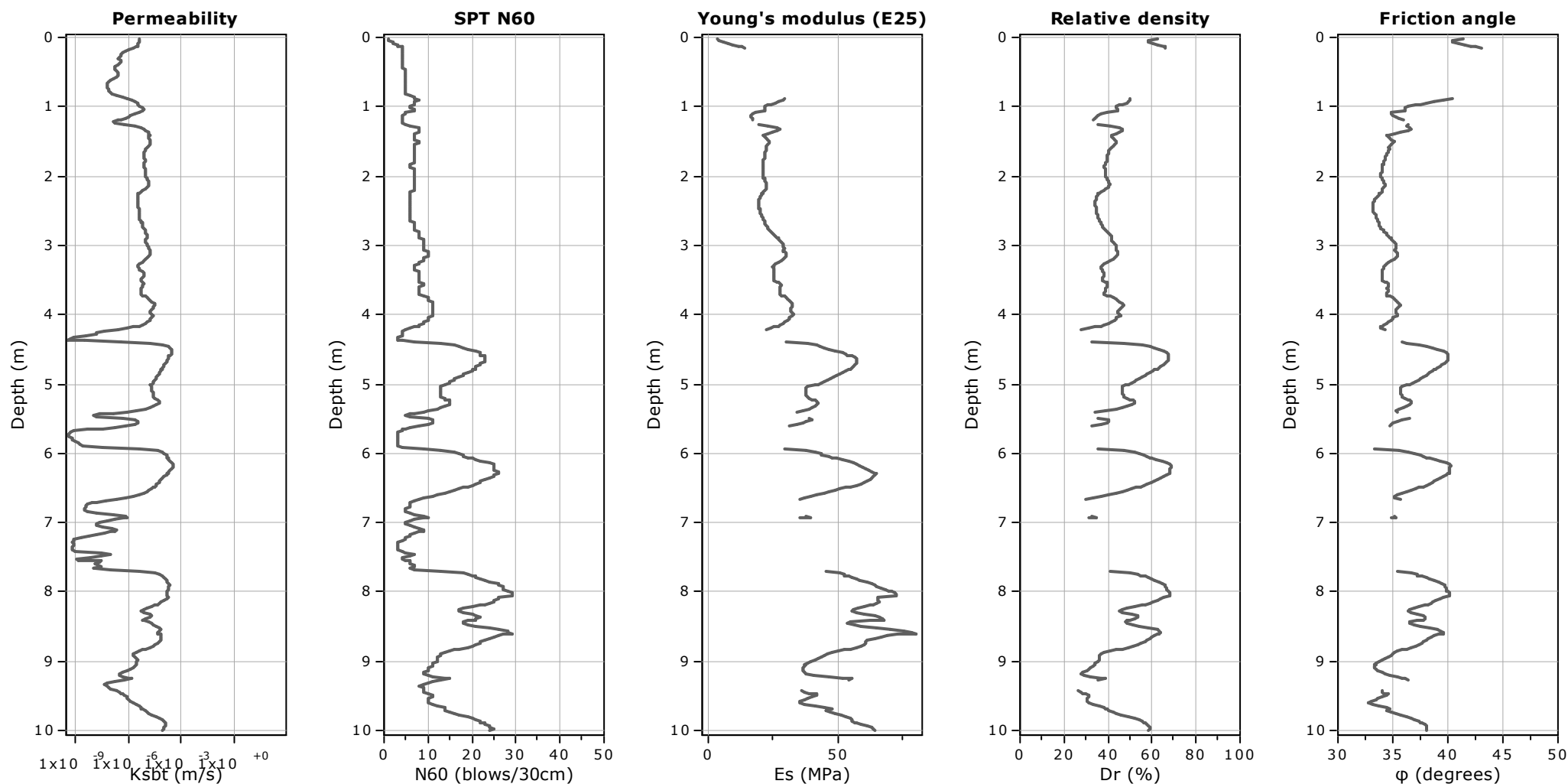
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

Total depth: 10.00 m

Coords: lat 44.915892° lon 12.23453°



#### Calculation parameters

Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

● User defined estimation data

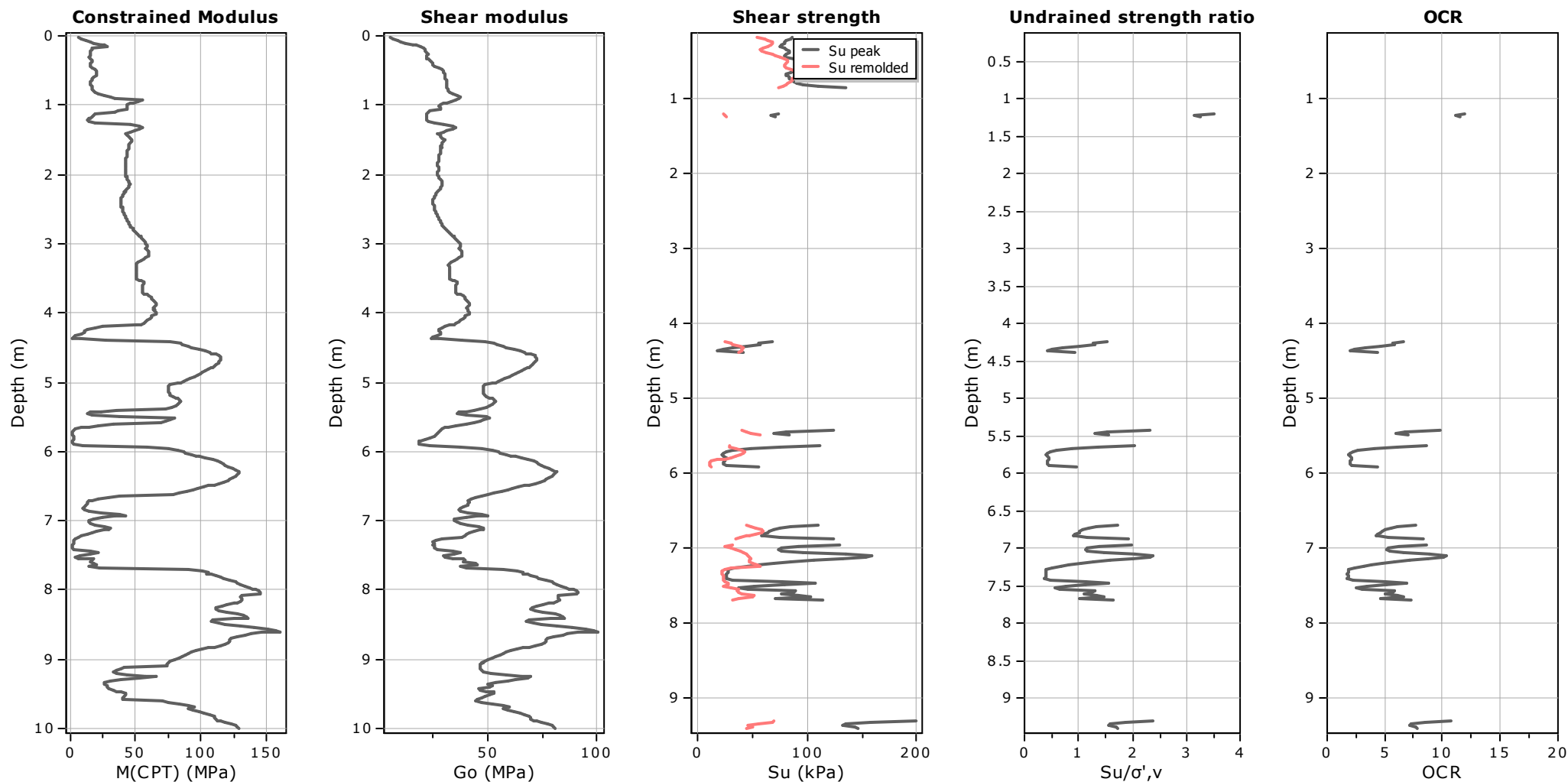
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

Total depth: 10.00 m

Coords: lat 44.915892° lon 12.23453°



#### Calculation parameters

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

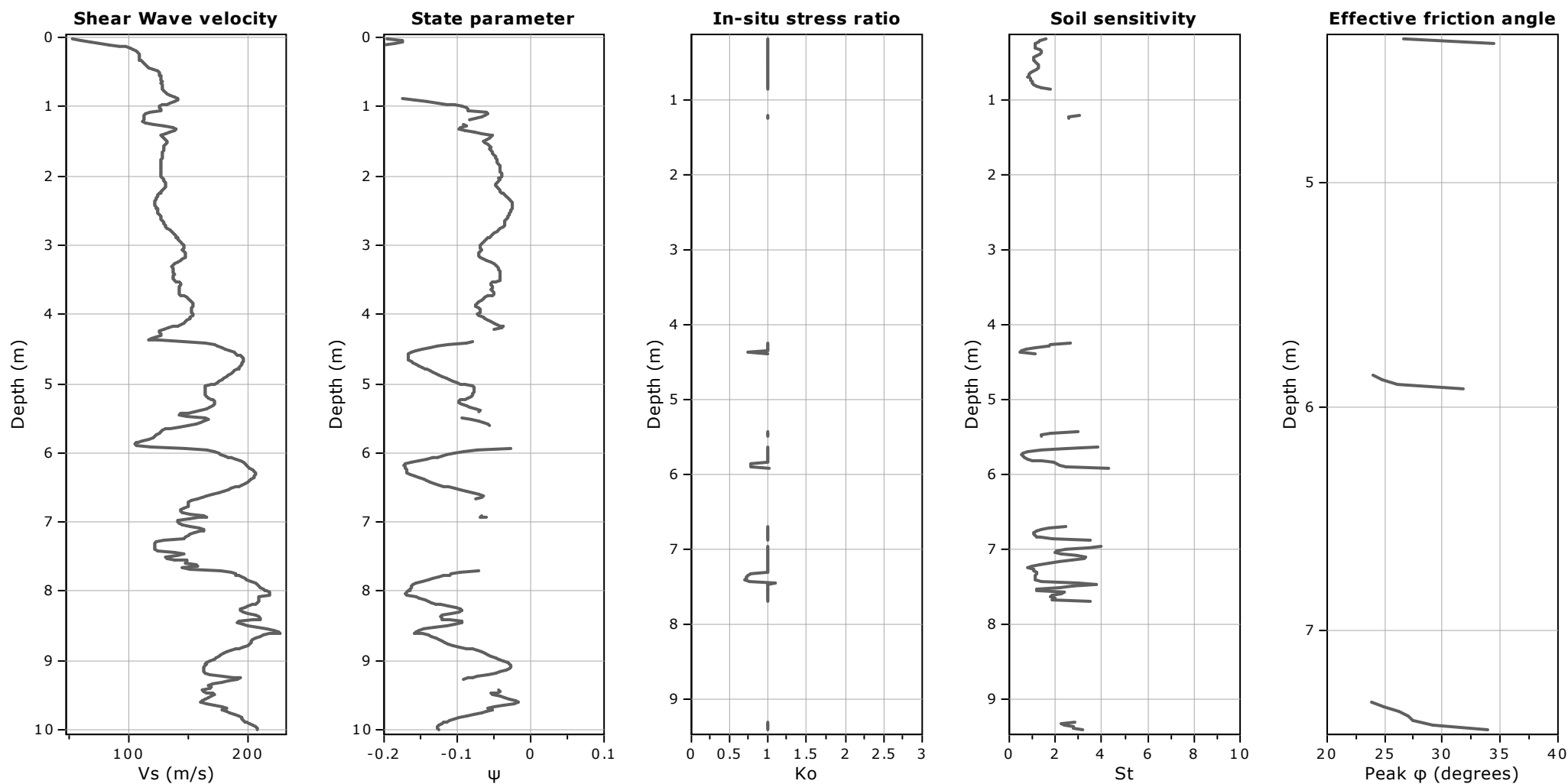
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600**

Total depth: 10.00 m

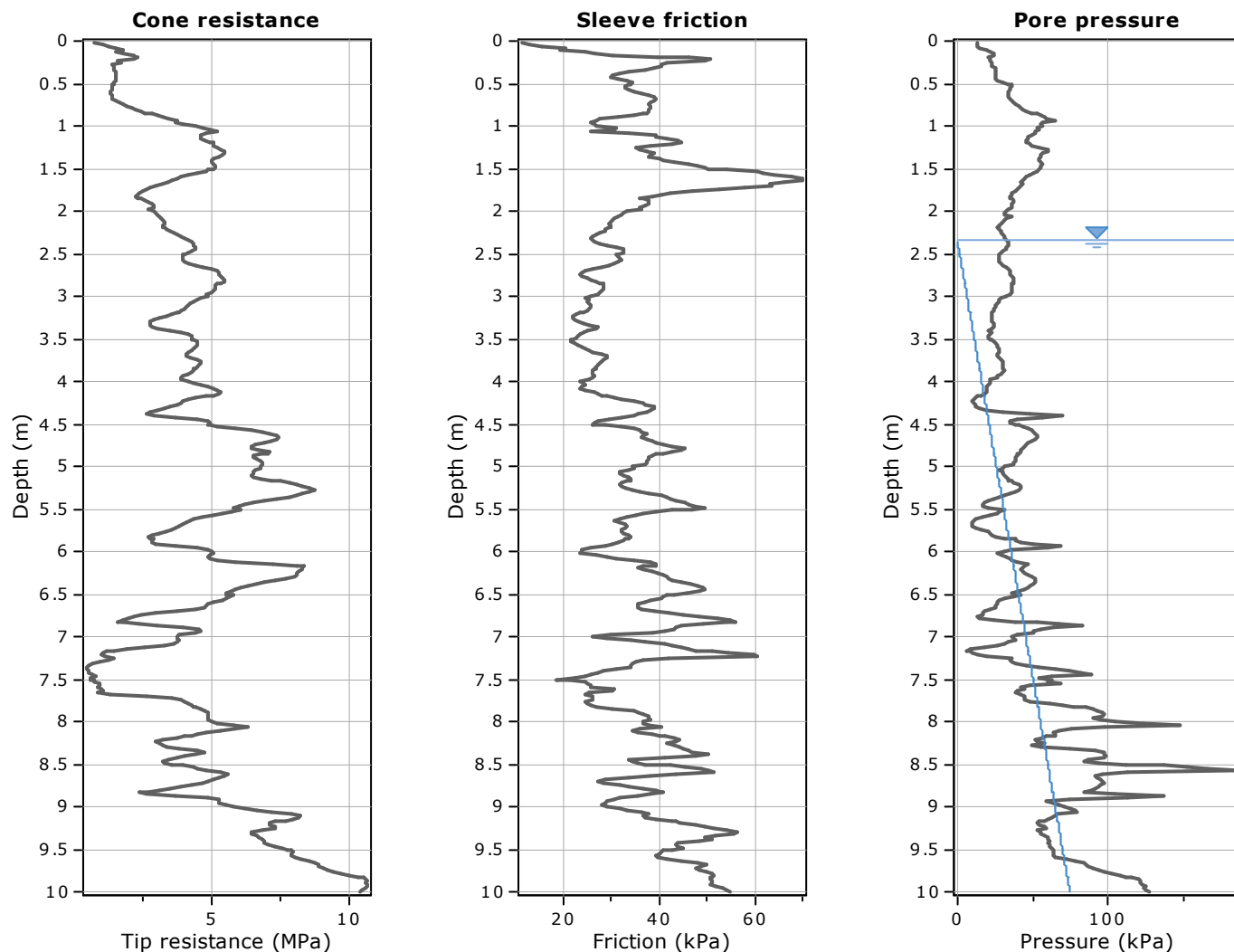
Coords: lat 44.915892° lon 12.23453°



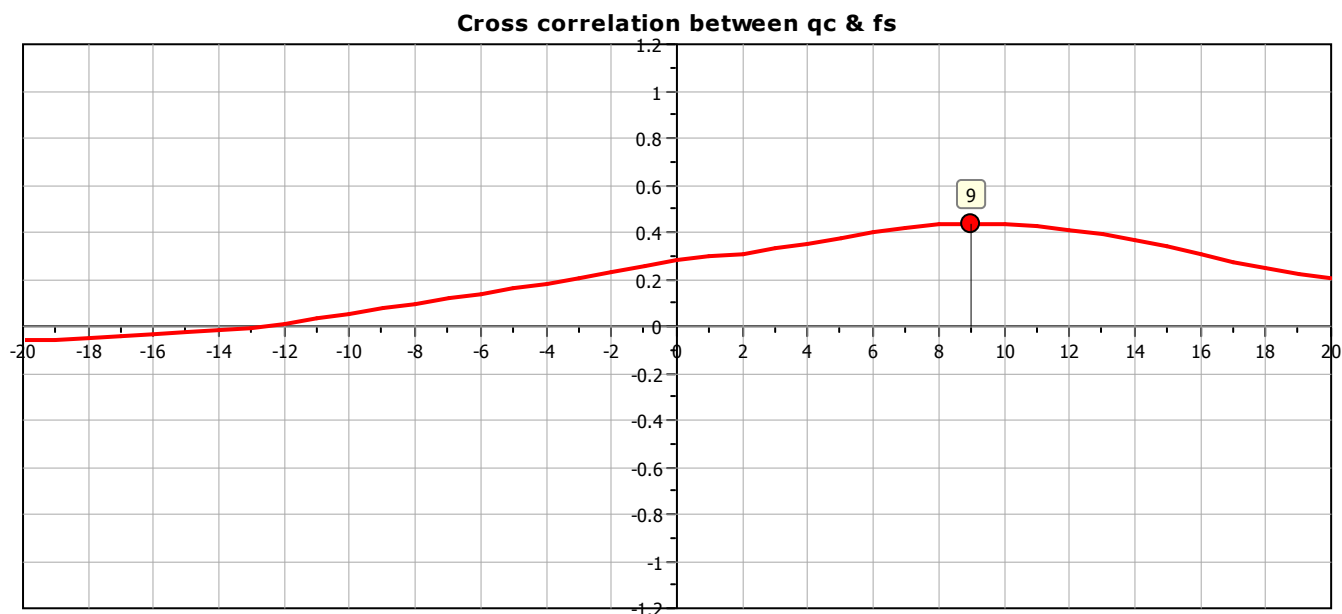
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

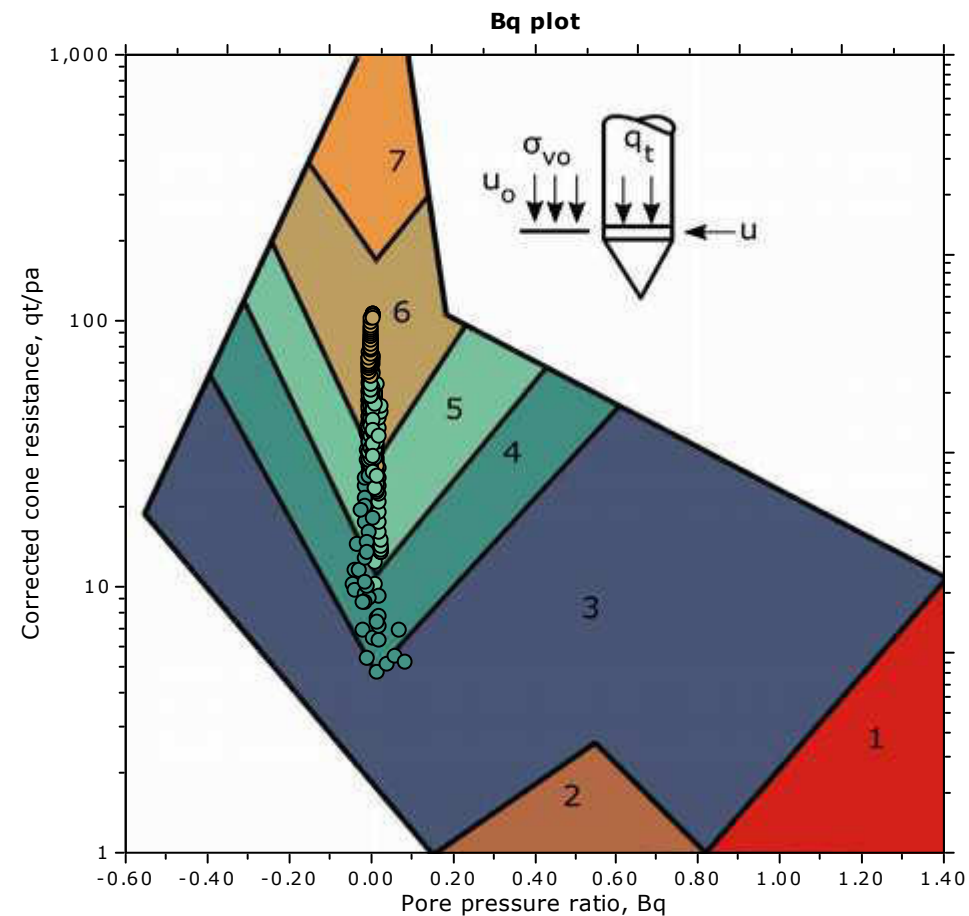
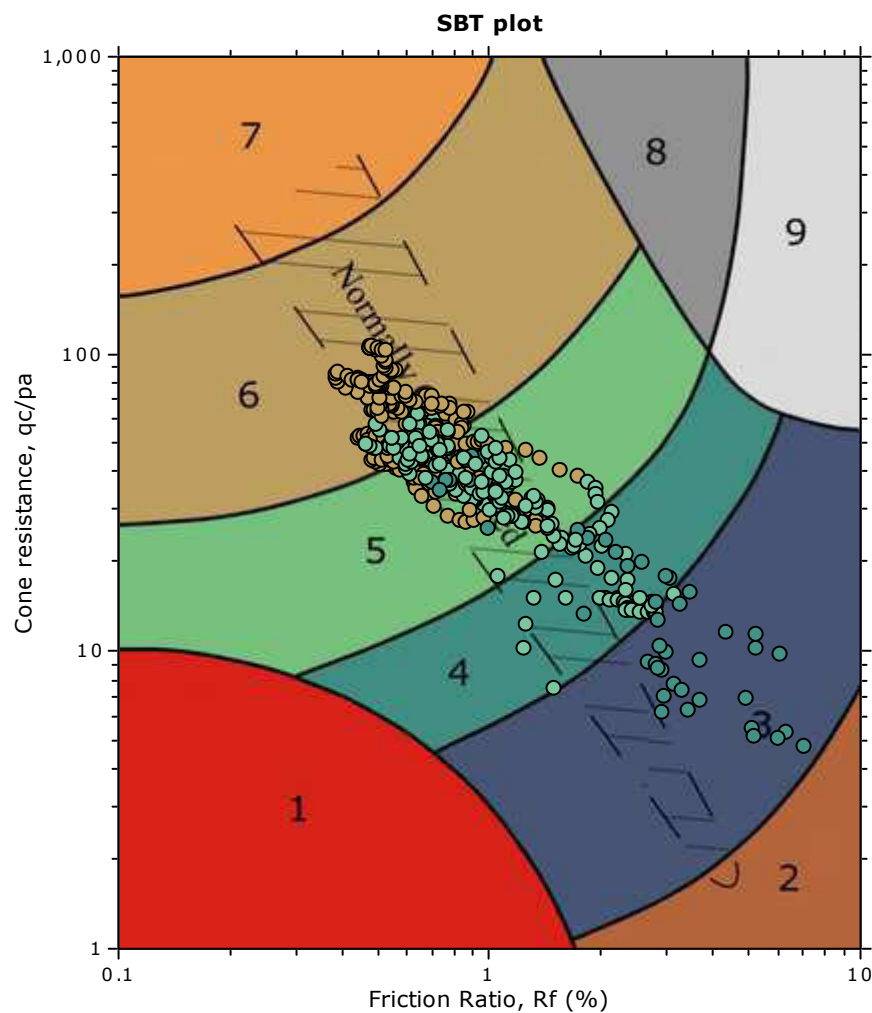
—●— User defined estimation data



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



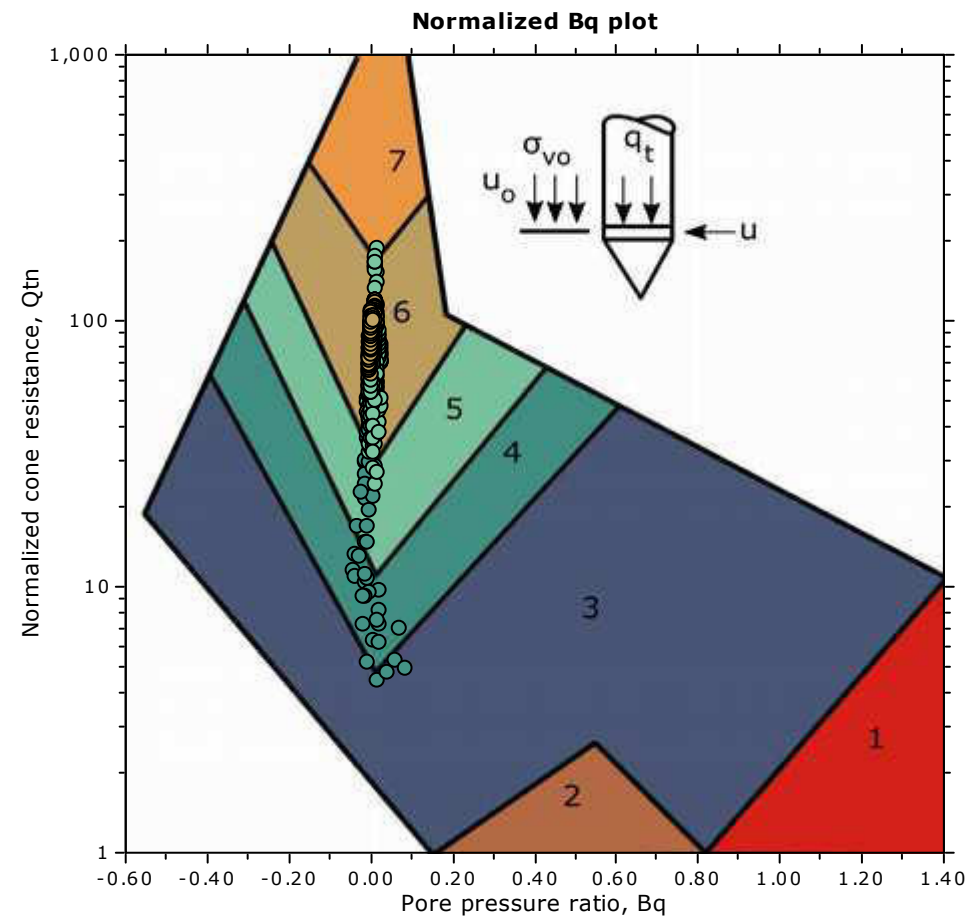
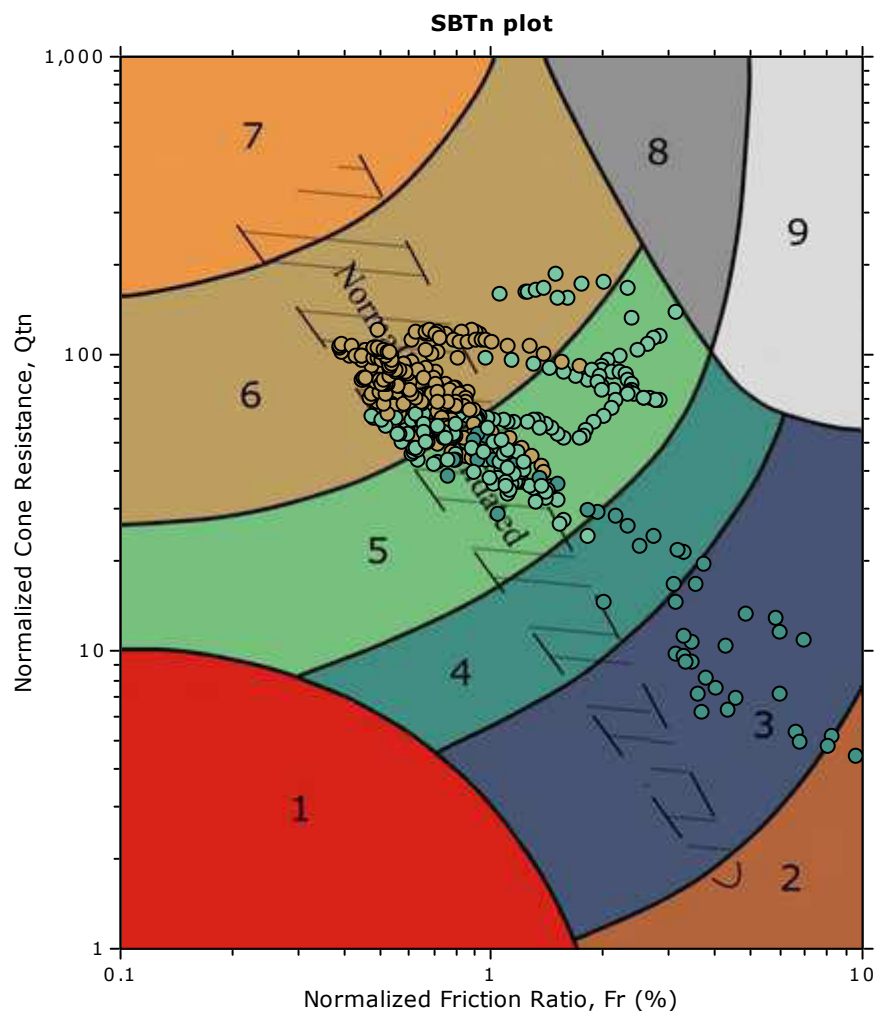
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)

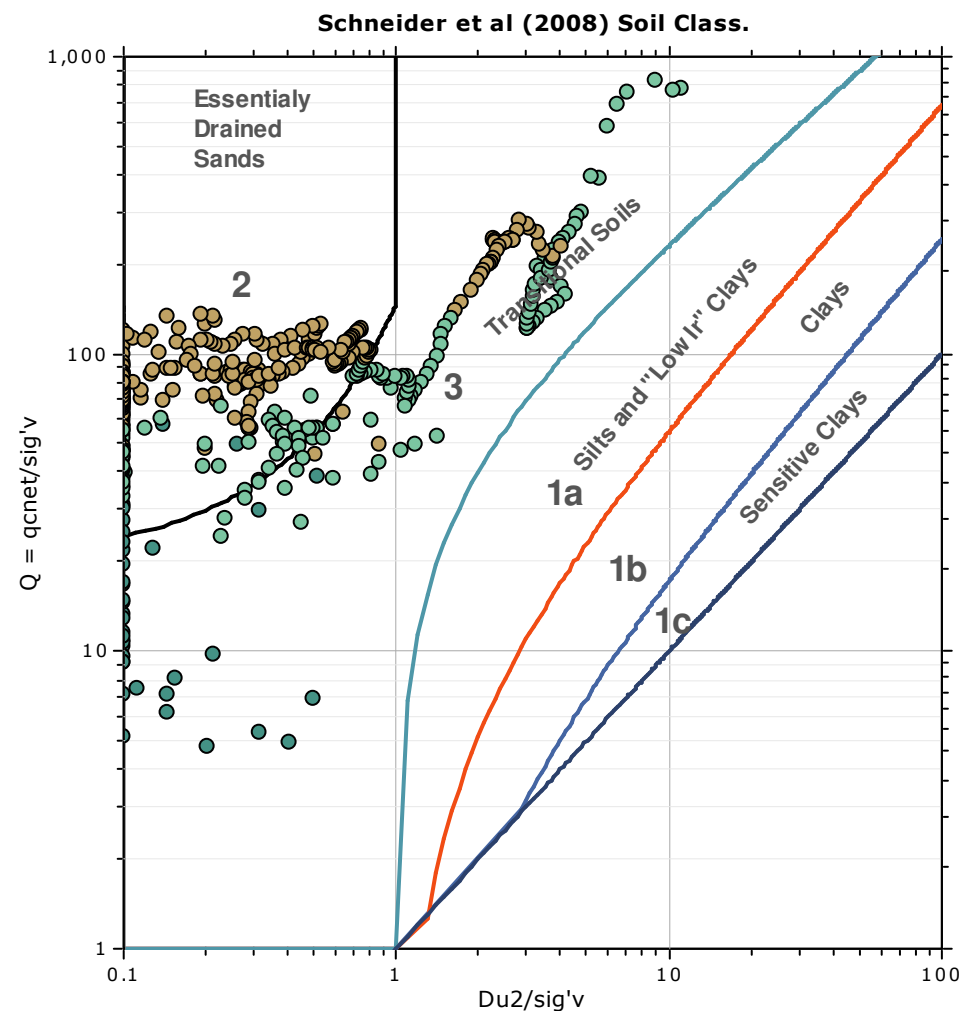
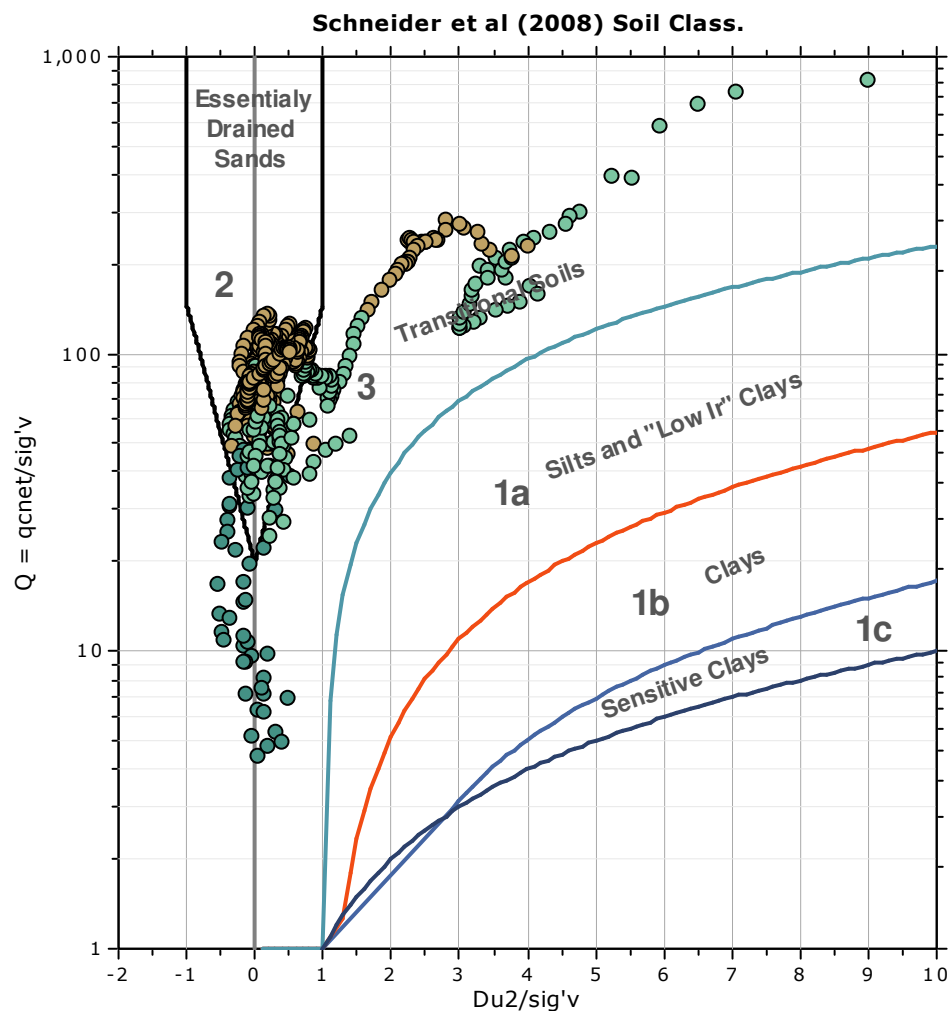


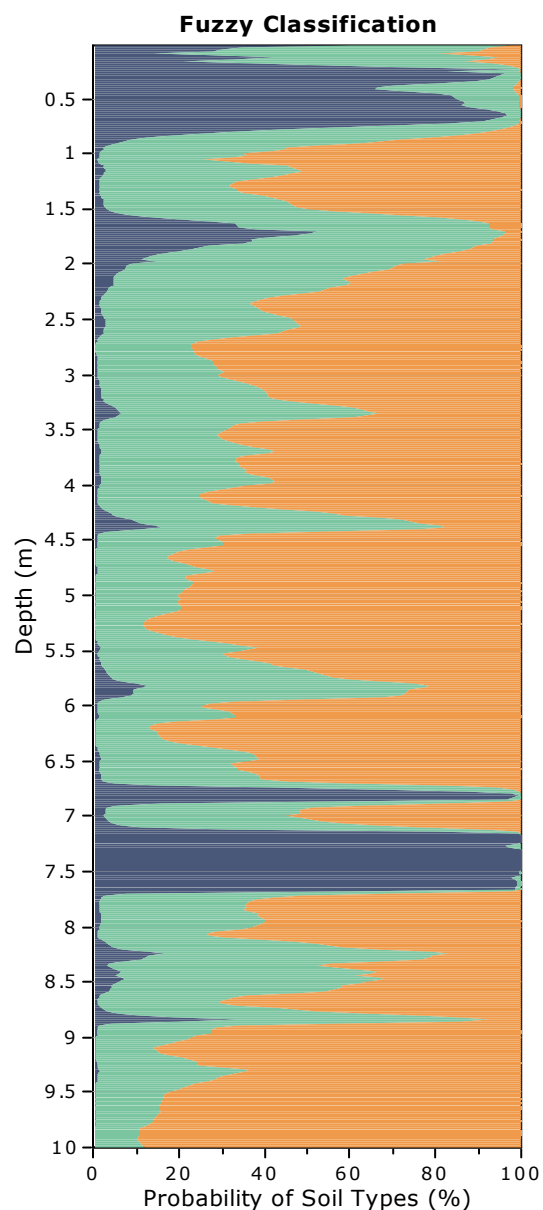
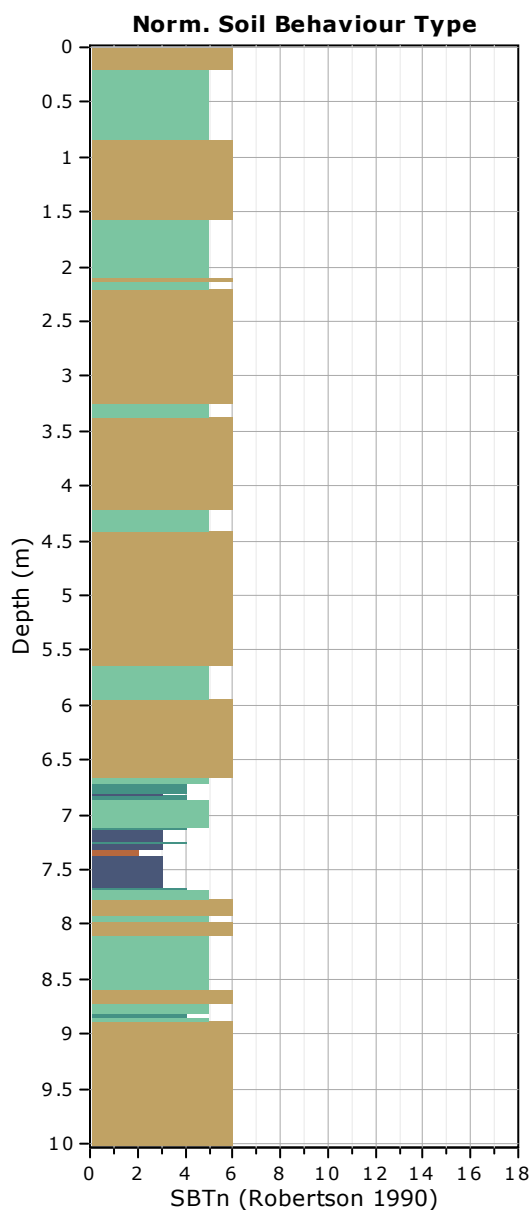
#### SBTn legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)





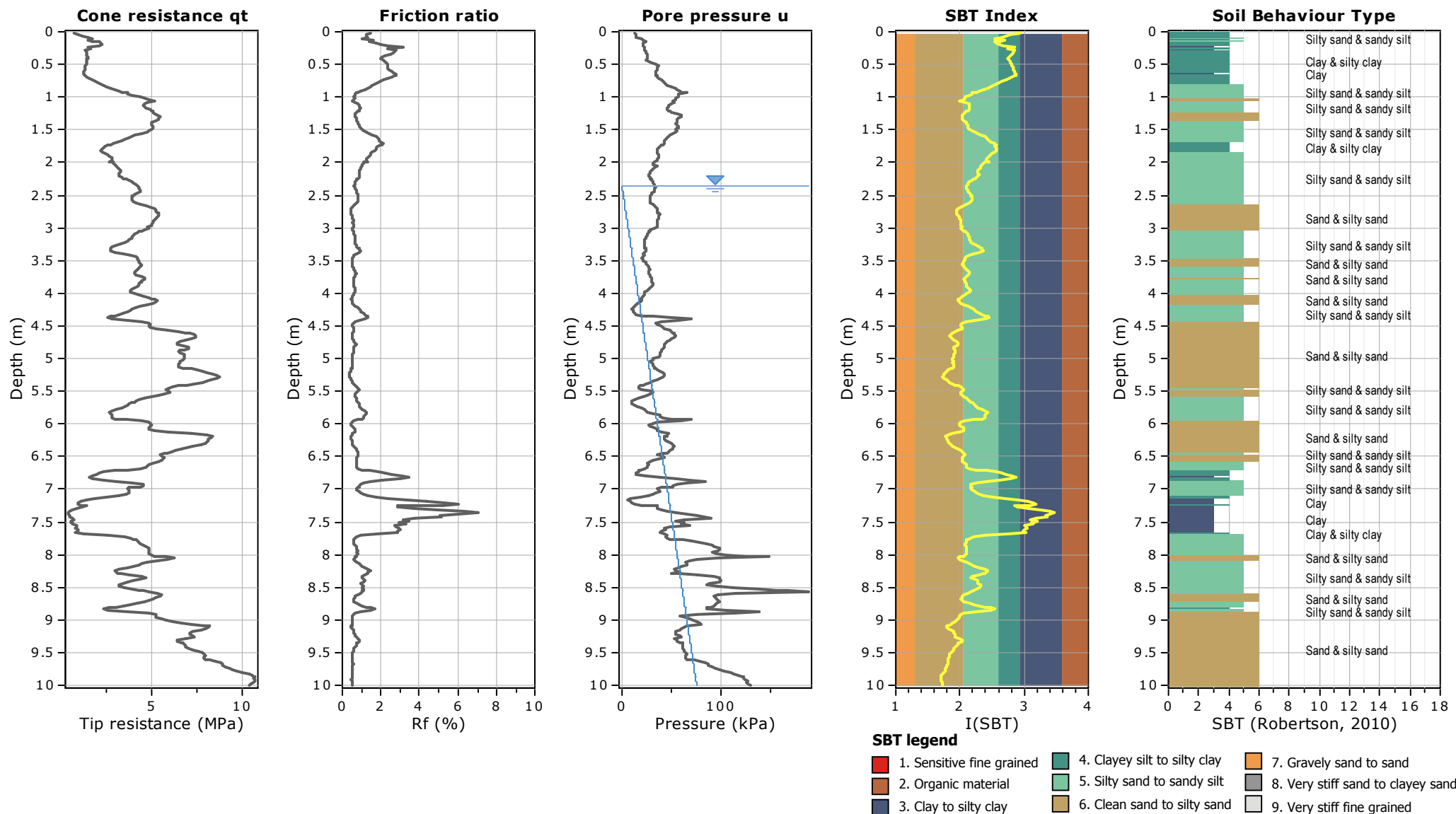
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600\_BIS**

Total depth: 10.00 m

Coords: lat 44.915897° lon 12.234774°



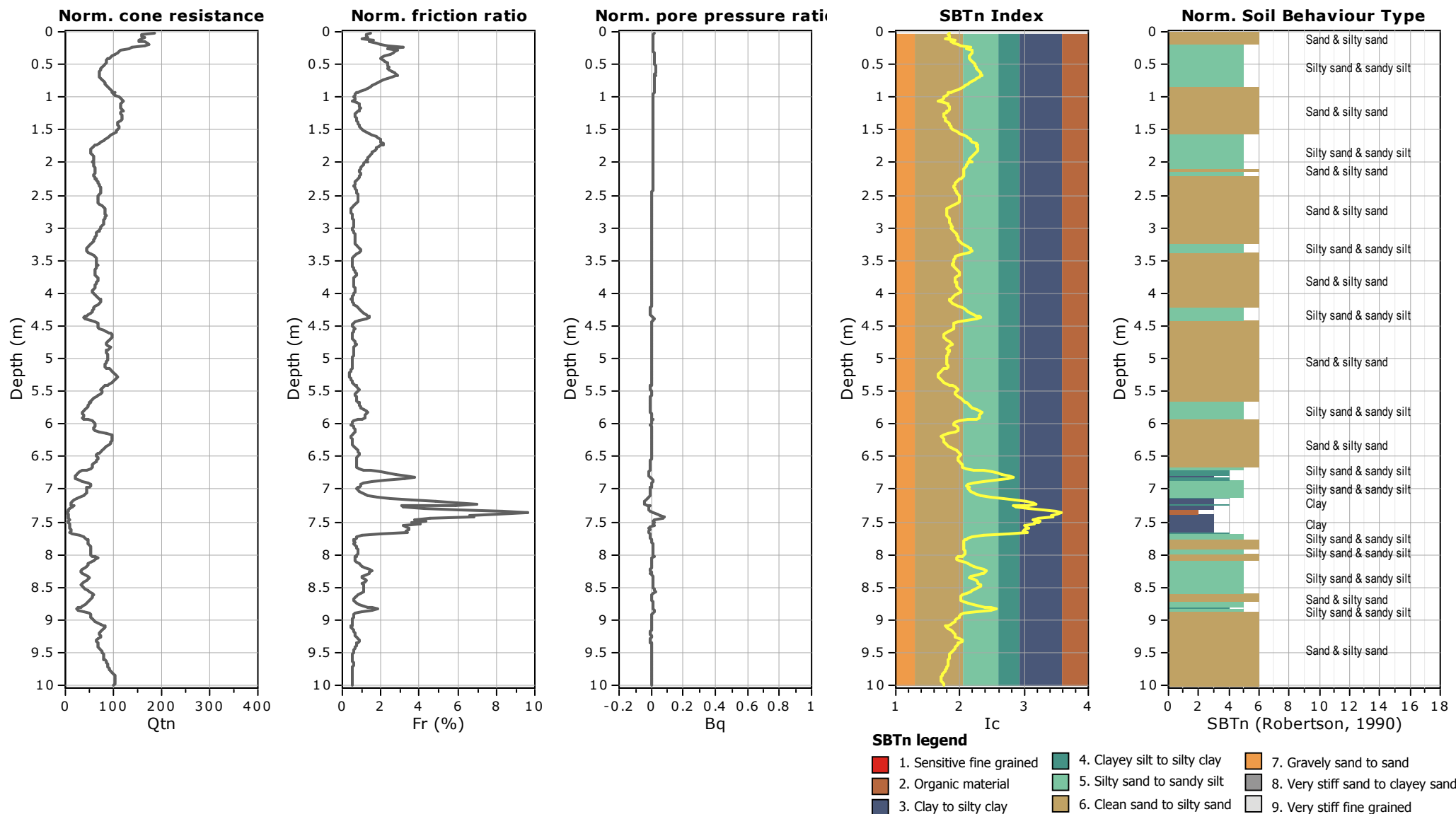
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600\_BIS**

Total depth: 10.00 m

Coords: lat 44.915897° lon 12.234774°



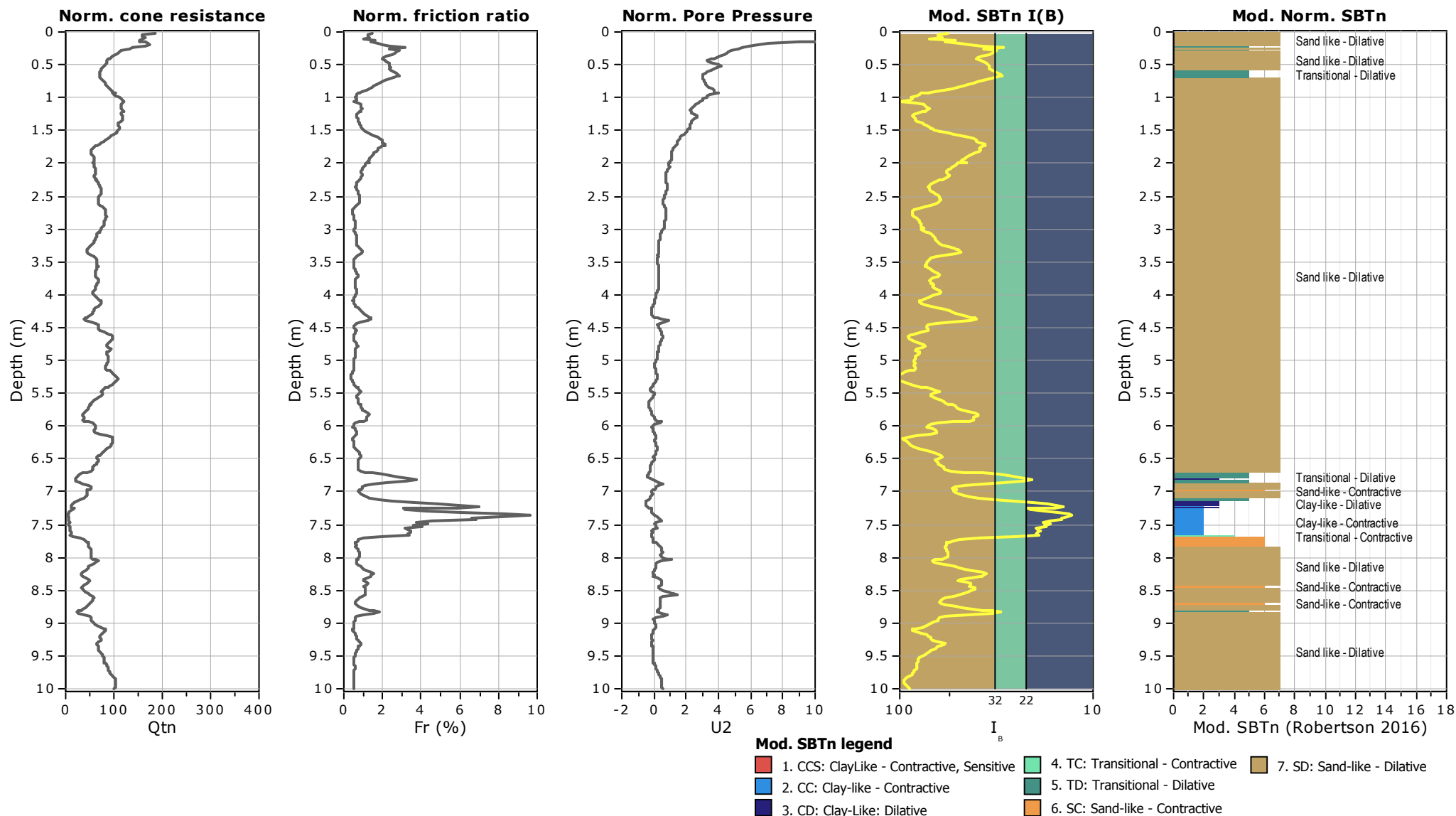
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

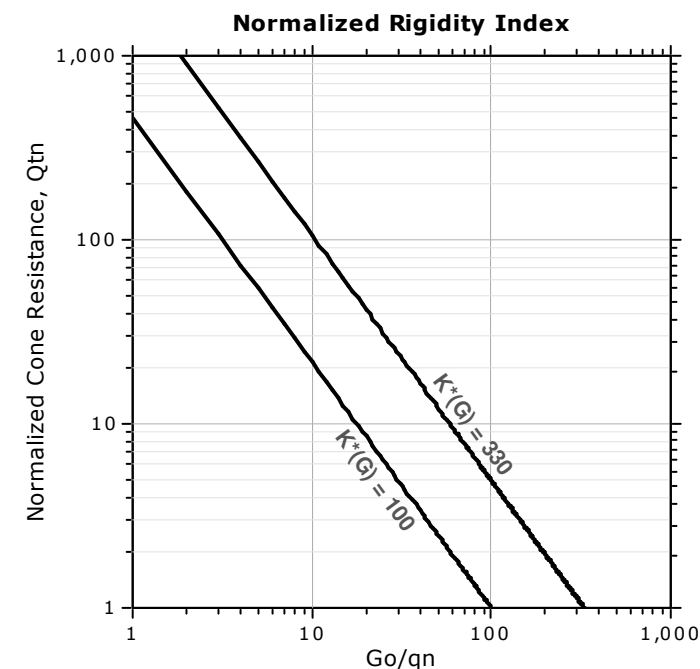
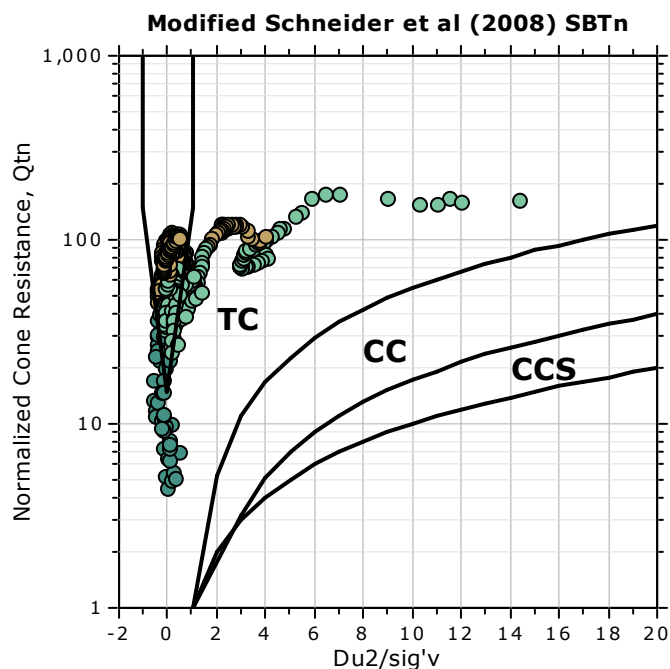
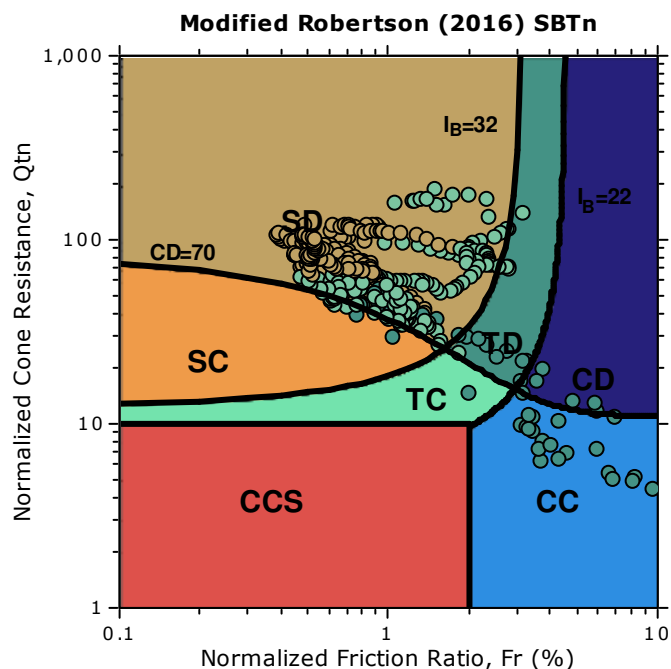
**CPT: CPTU km54+600\_BIS**

Total depth: 10.00 m

Coords: lat 44.915897° lon 12.234774°

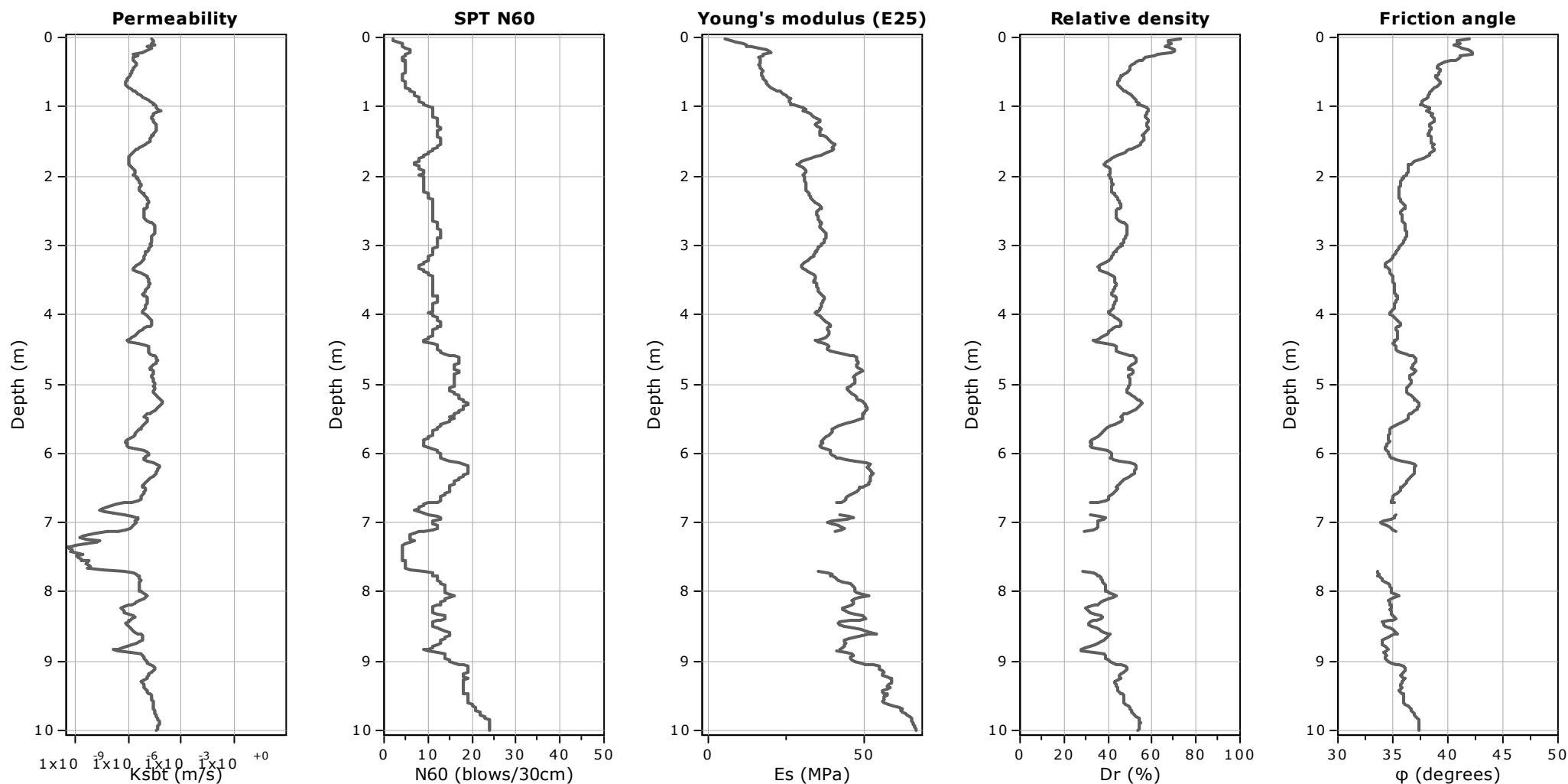


## Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K^*(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)



**Calculation parameters**

Permeability: Based on  $SBT_n$

SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

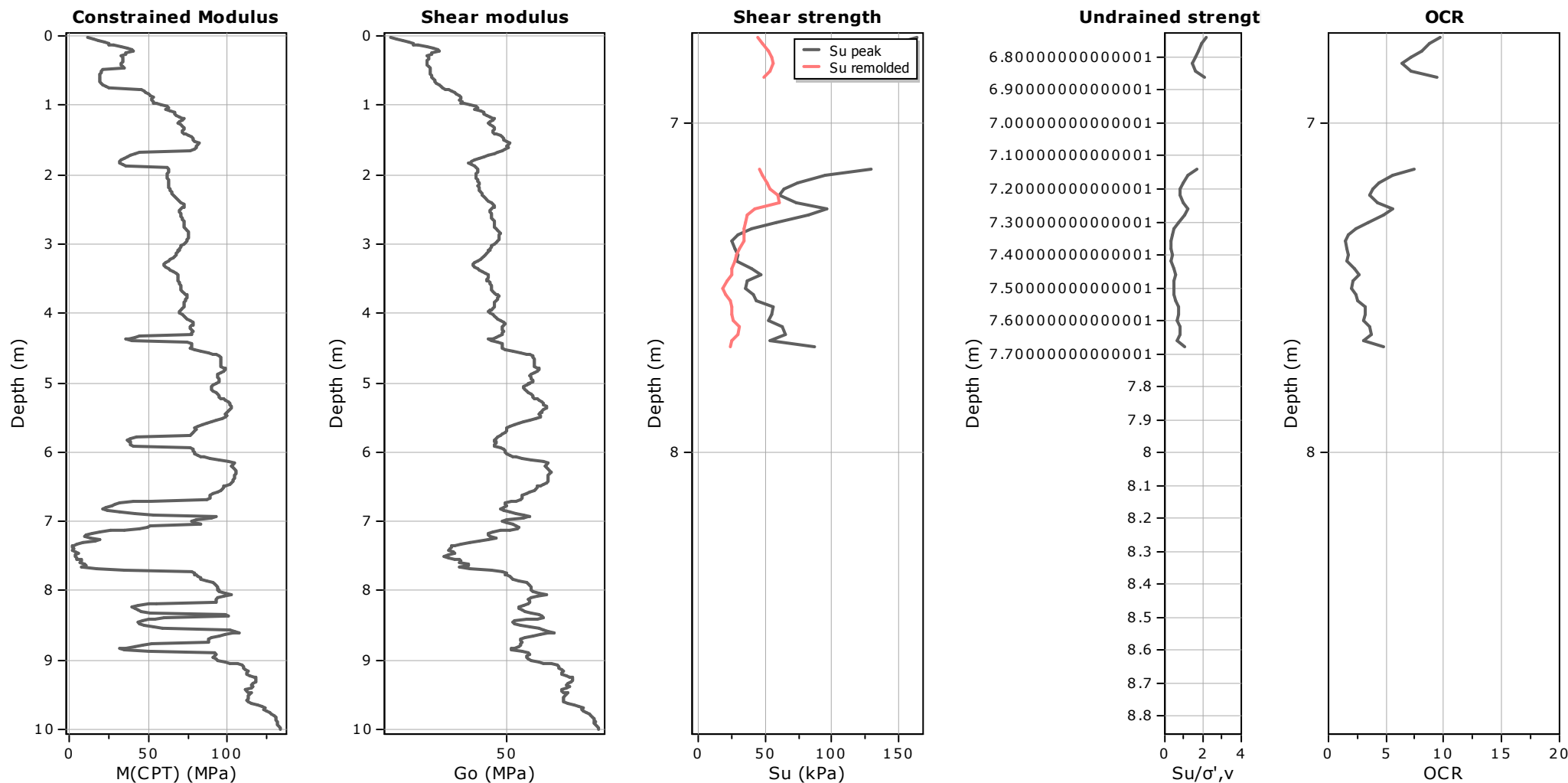
Young's modulus: Based on variable alpha using  $I_c$  (Robertson, 2009)

Relative density constant,  $C_{Dr}$ : 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data





**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

—●— Flat Dilatometer Test data

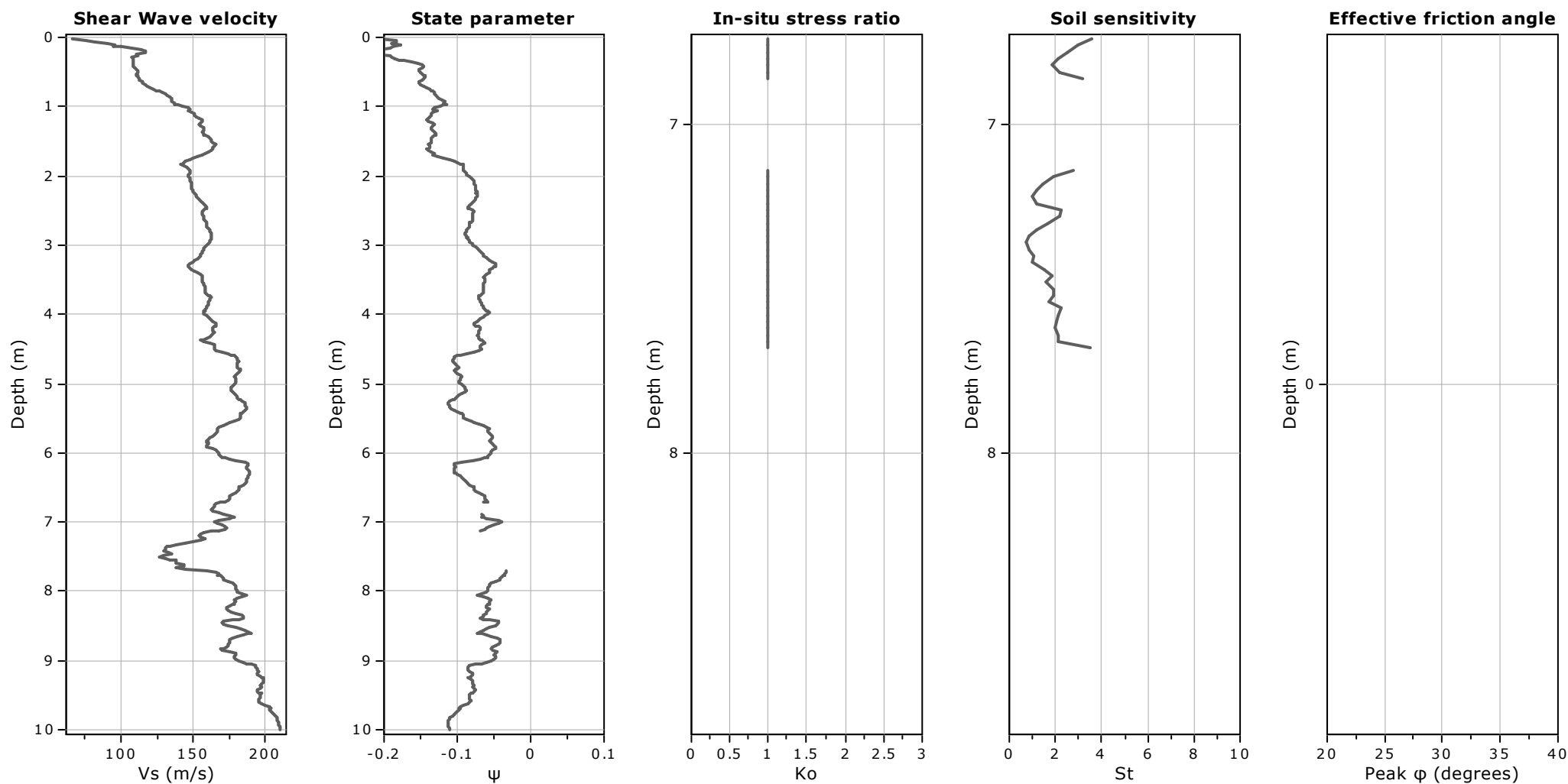
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km54+600\_BIS**

Total depth: 10.00 m

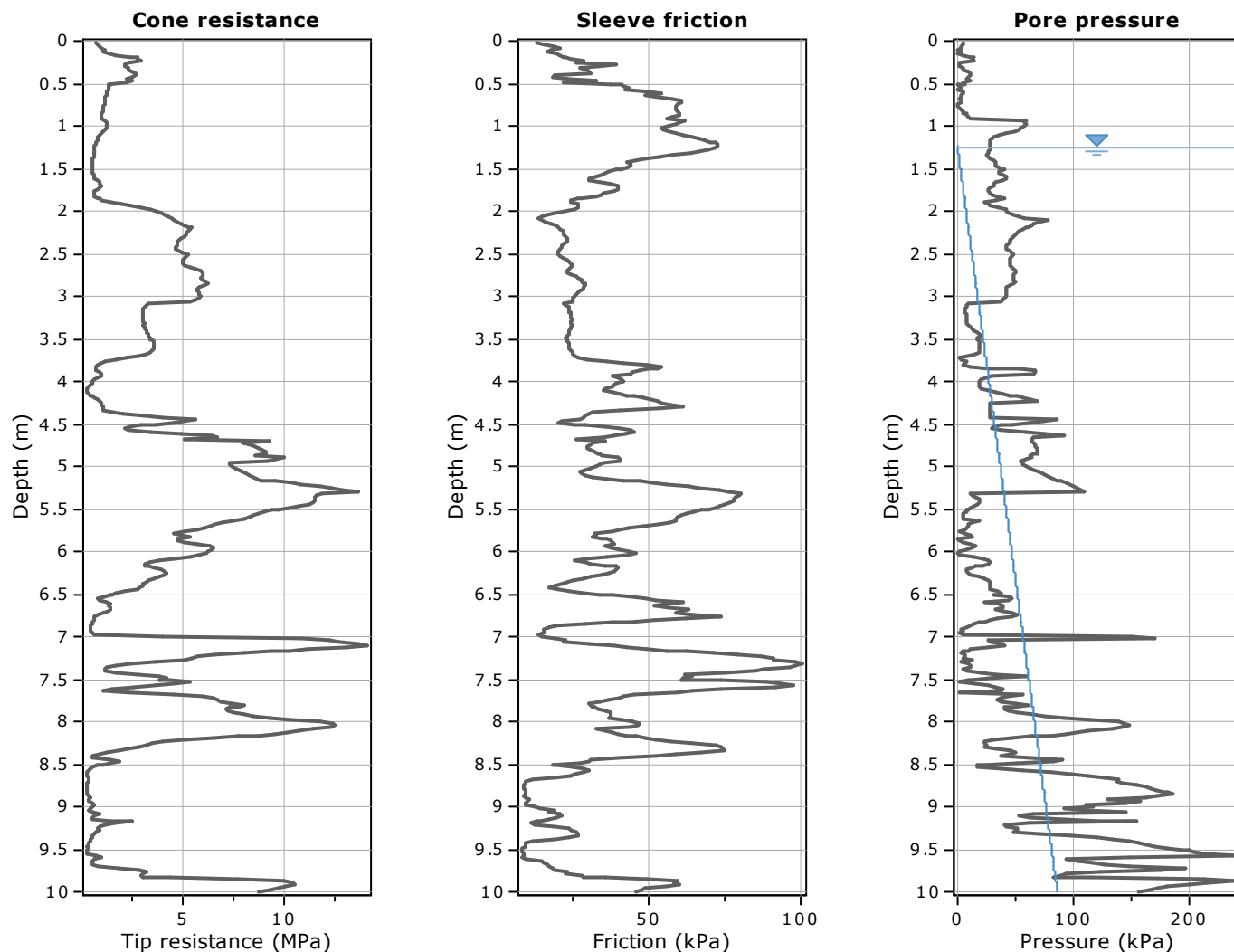
Coords: lat 44.915897° lon 12.234774°



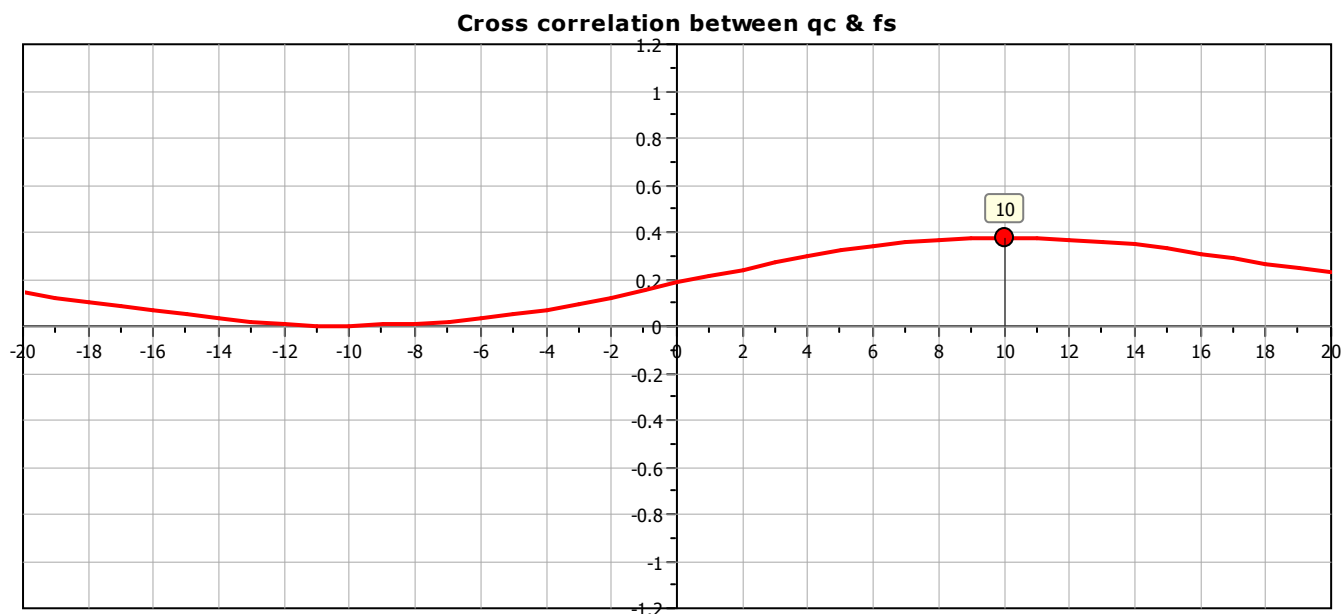
#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

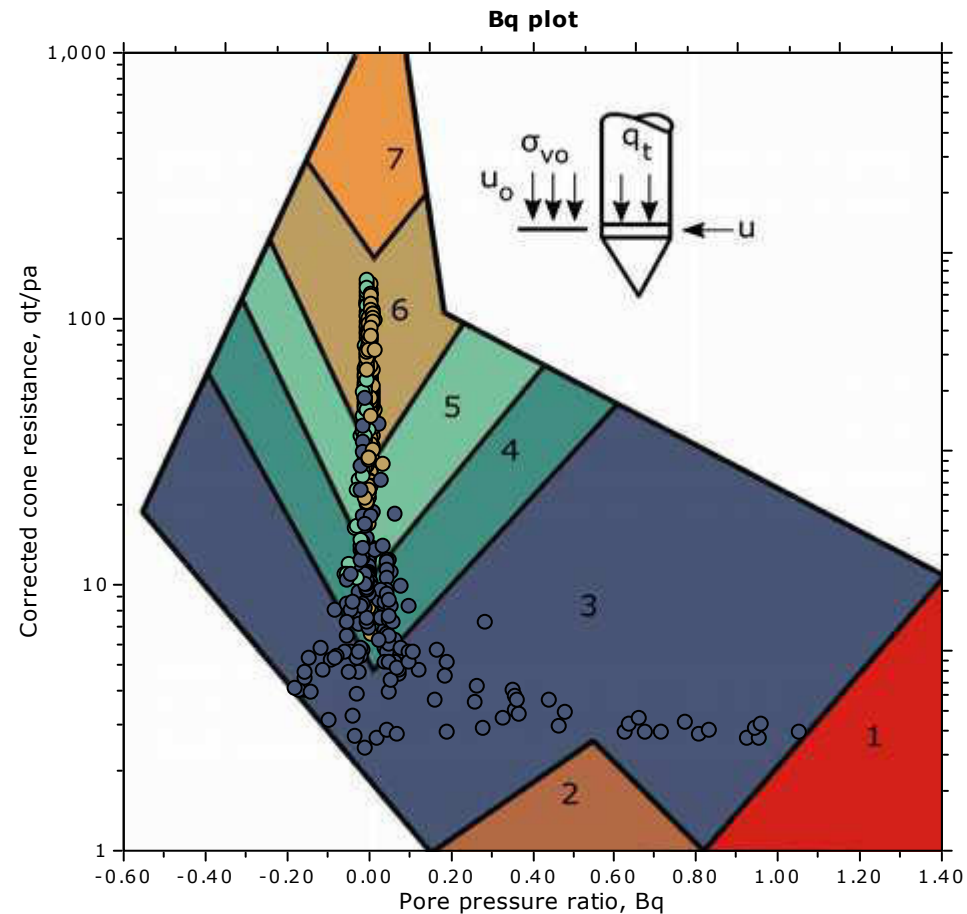
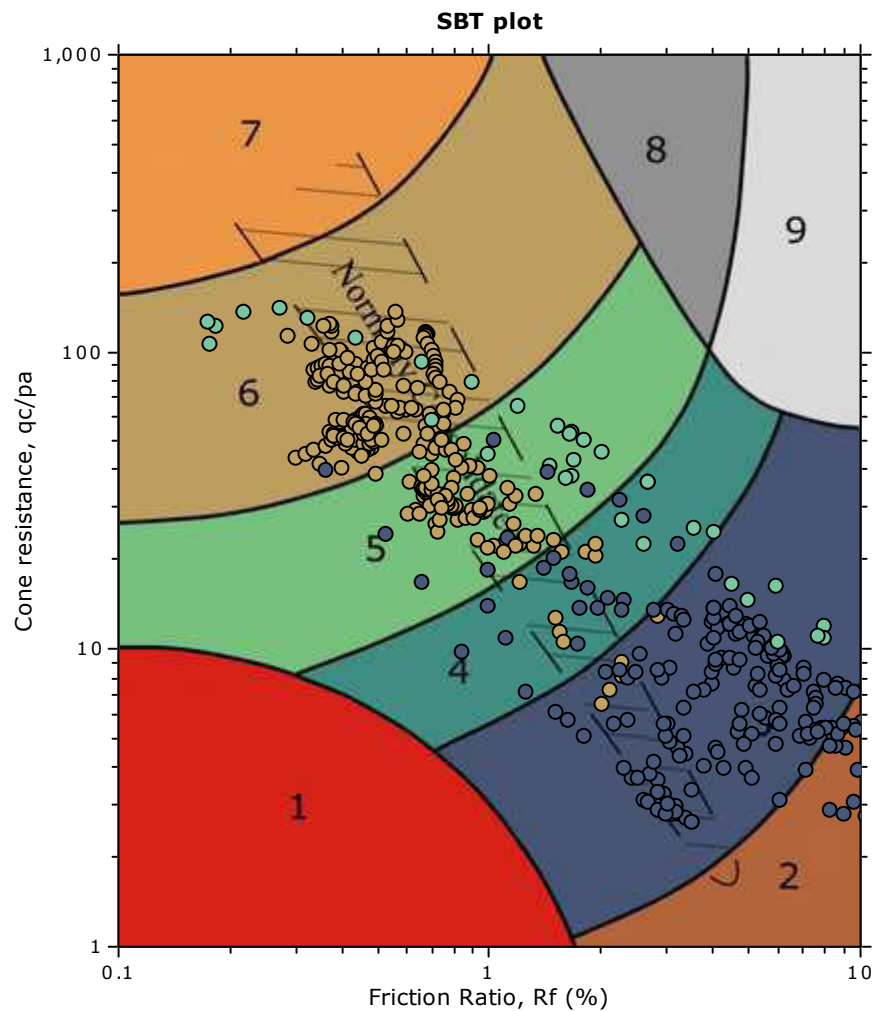
—●— User defined estimation data



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



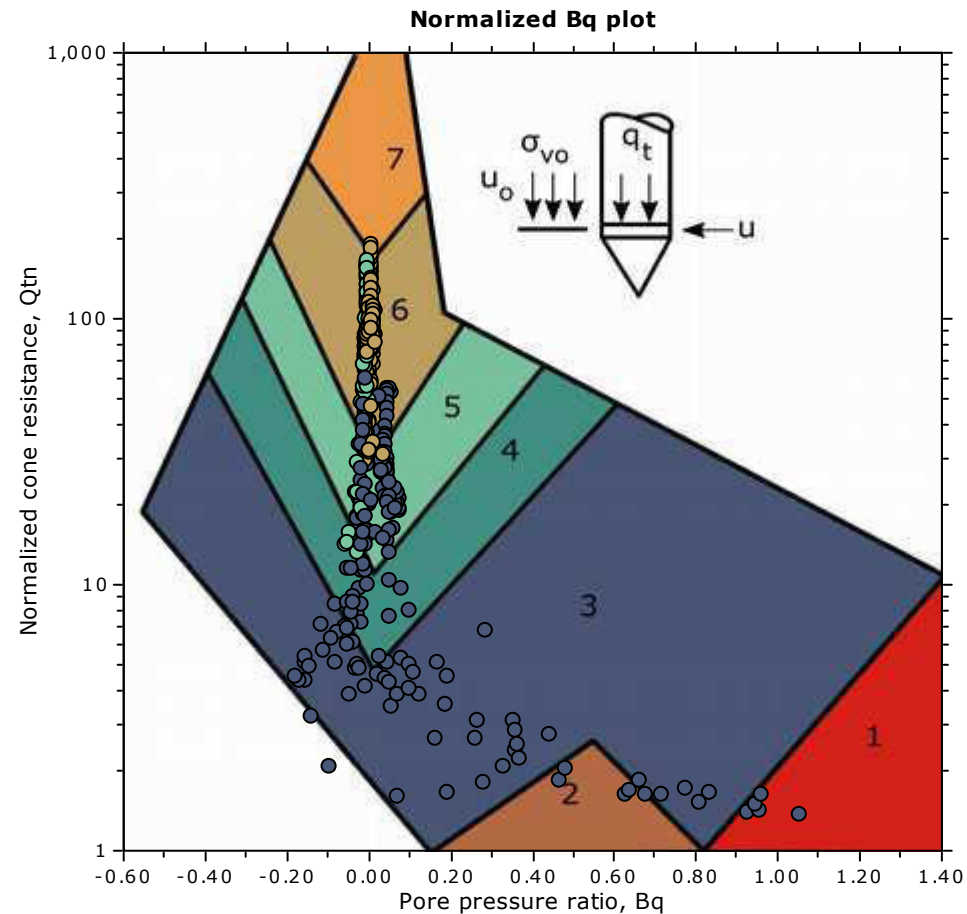
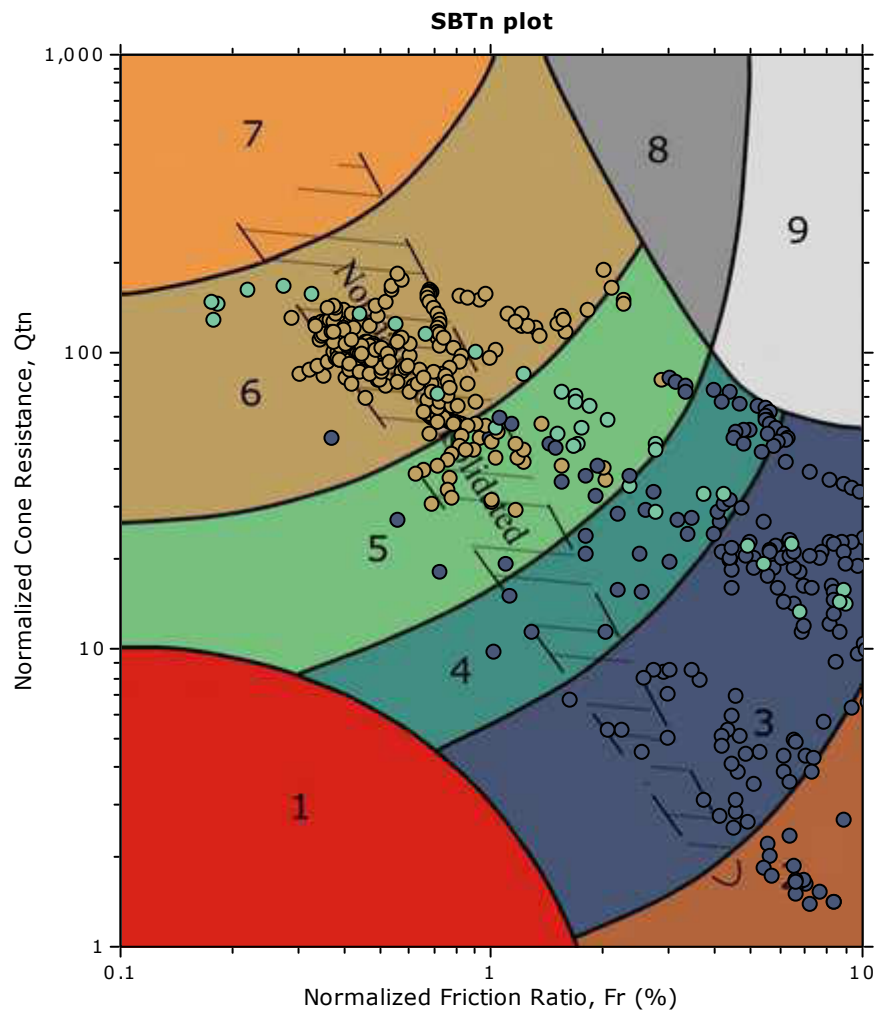
## SBT - Bq plots



### SBT legend

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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        |

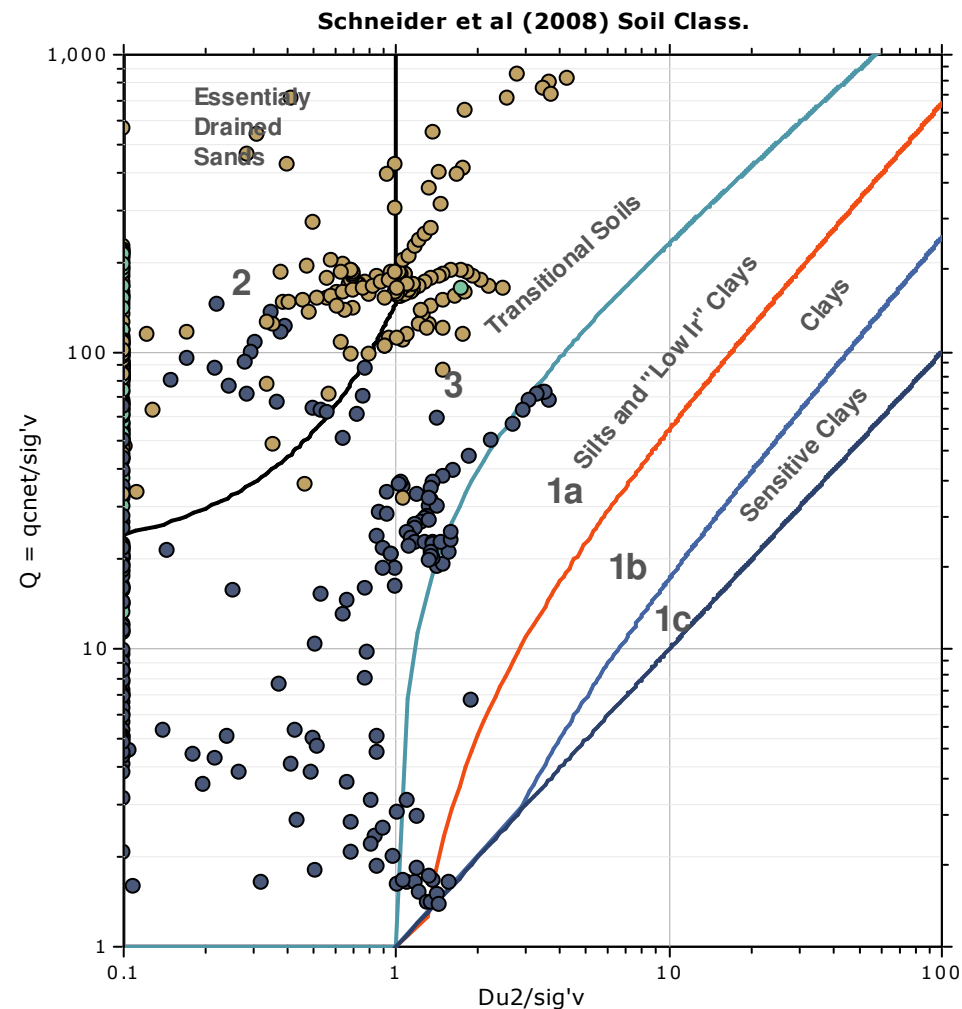
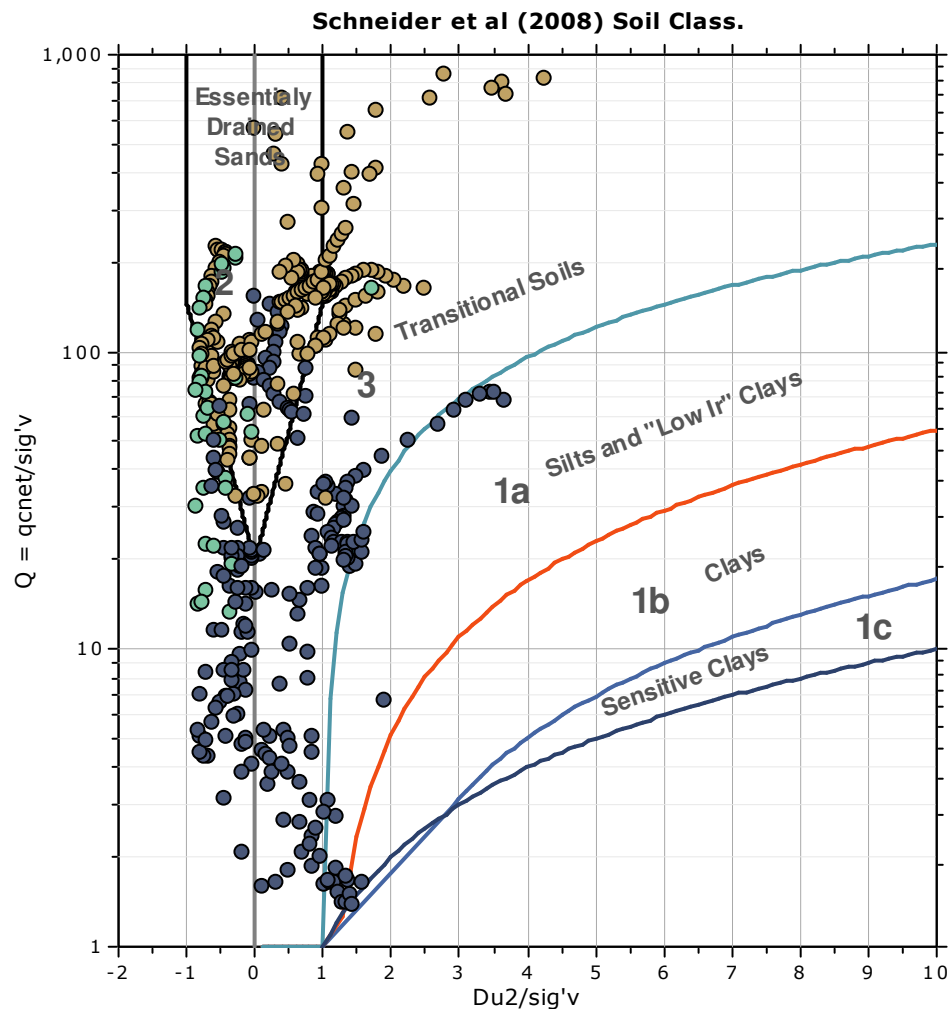
**SBT - Bq plots (normalized)**

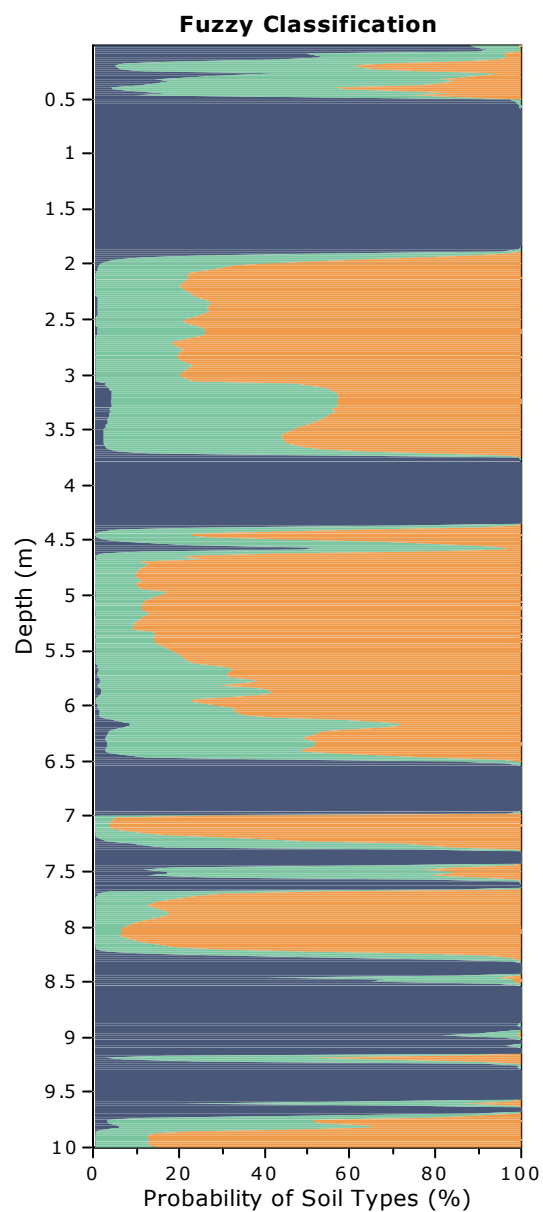
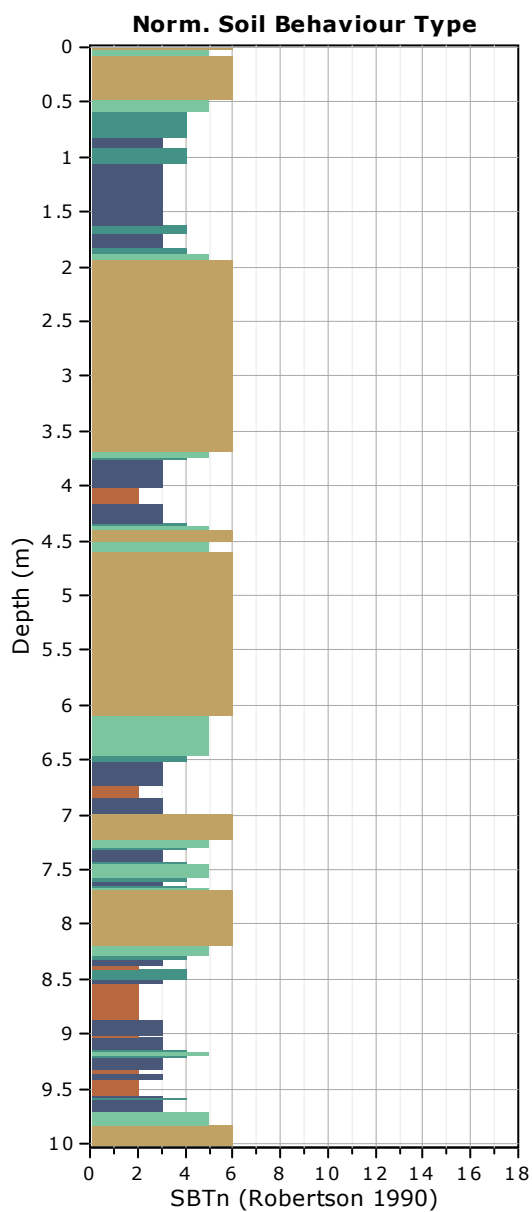


**SBTn legend**

- |                           |                              |                                   |
|---------------------------|------------------------------|-----------------------------------|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly 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)







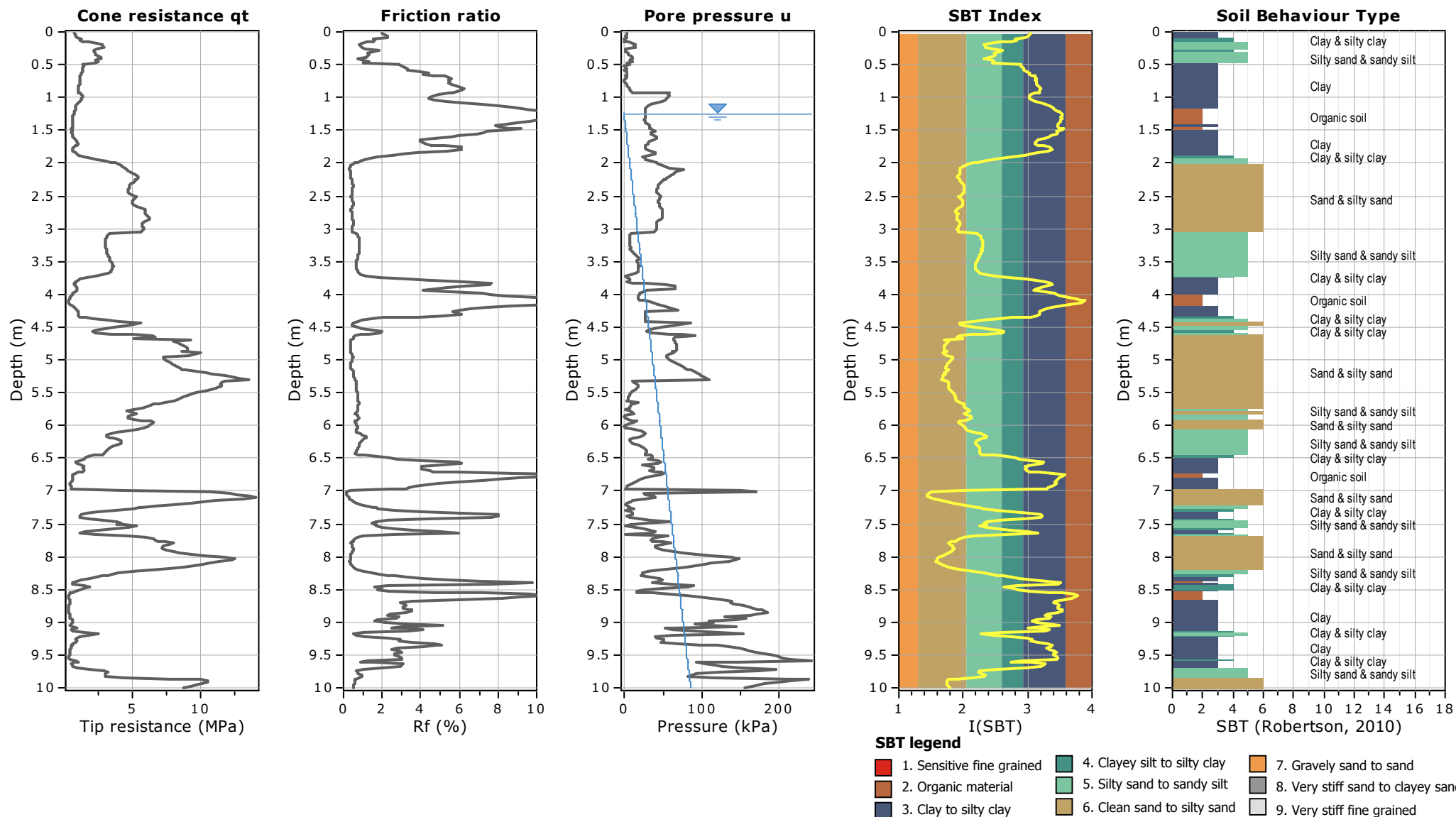
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

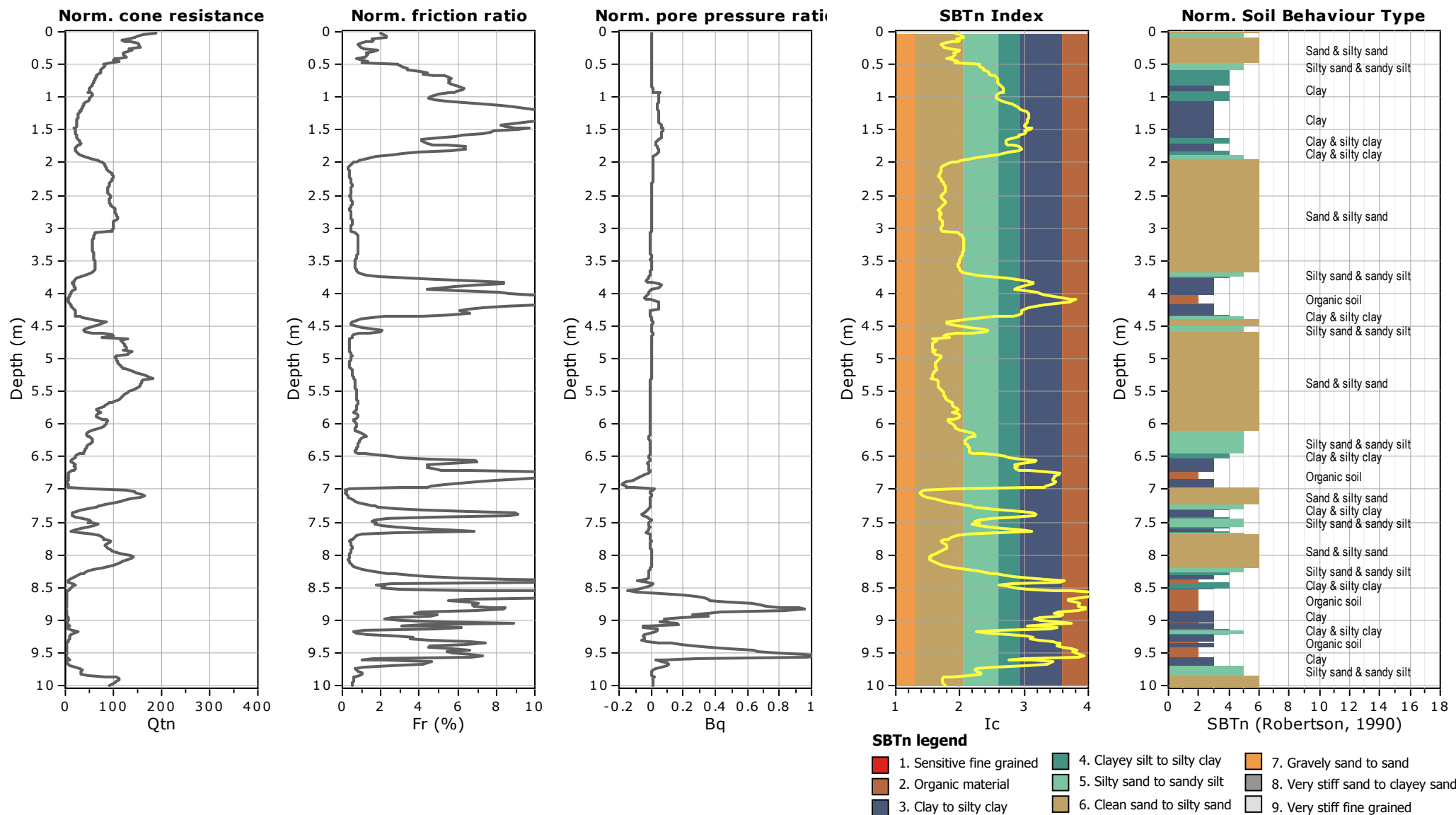
**Location:** S.S. 309 - ROMEA

**CPT: CPTU km55+100**

Total depth: 10.00 m

Coords: lat 44.9209° lon 12.236488°





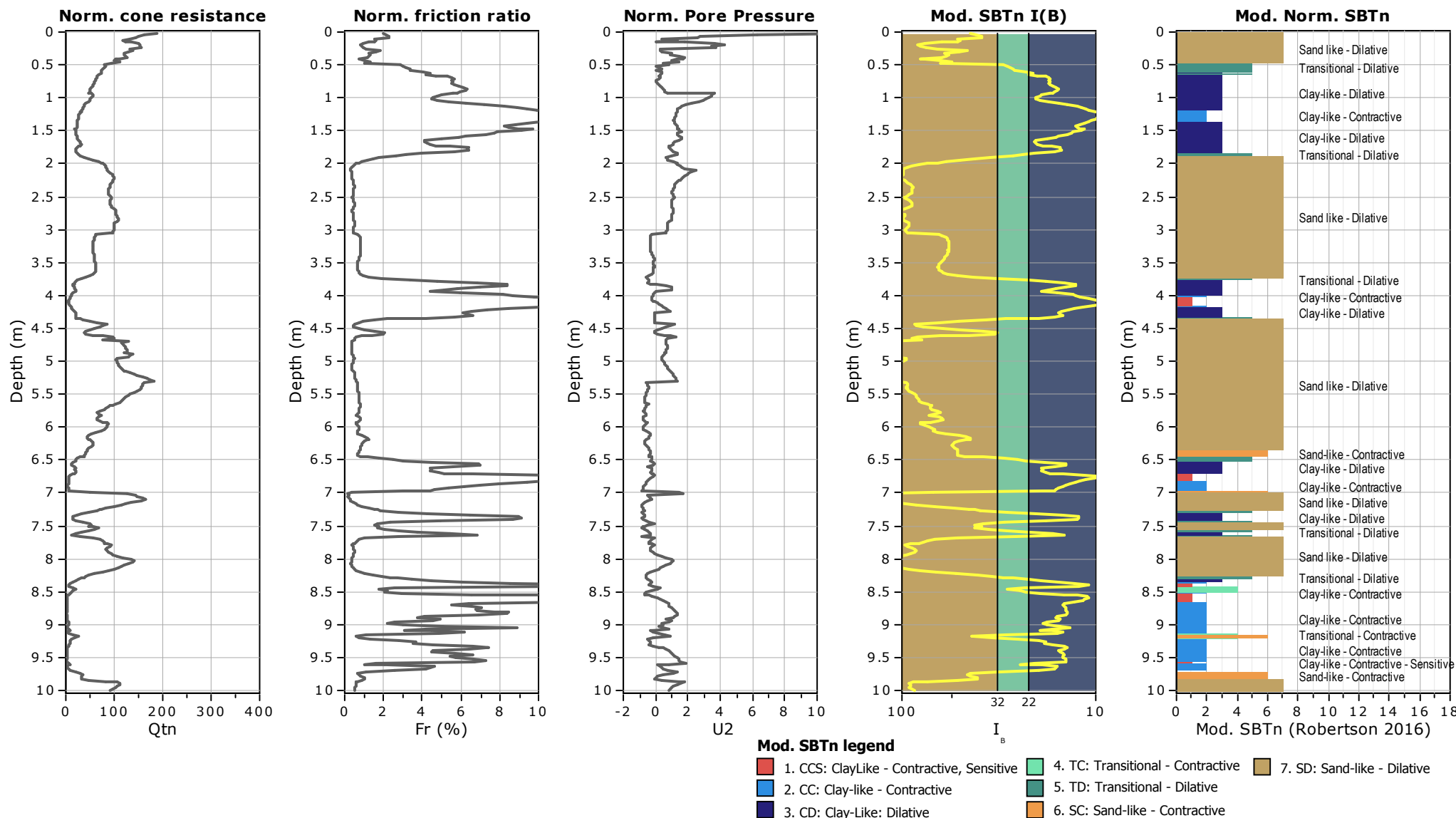
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

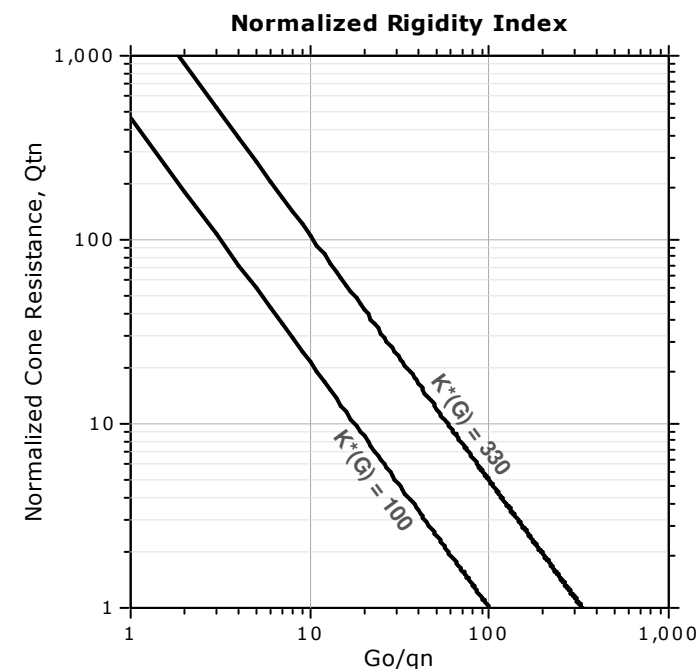
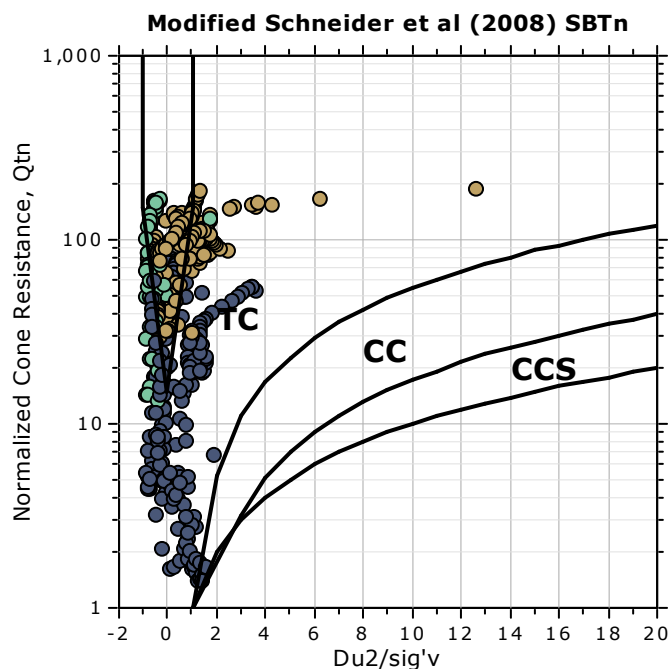
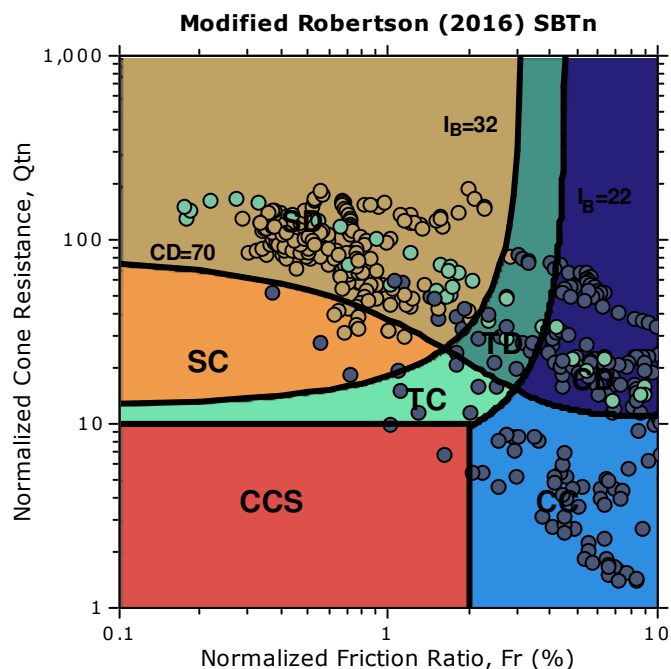
**CPT: CPTU km55+100**

Total depth: 10.00 m

Coords: lat 44.9209° lon 12.236488°



### Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive  
CC: Clay-like - Contractive  
CD: Clay-like - Dilative  
TC: Transitional - Contractive  
TD: Transitional - Dilative  
SC: Sand-like - Contractive  
SD: Sand-like - Dilative

$K(G) > 330$ : Soils with significant microstructure  
(e.g. age/cementation)

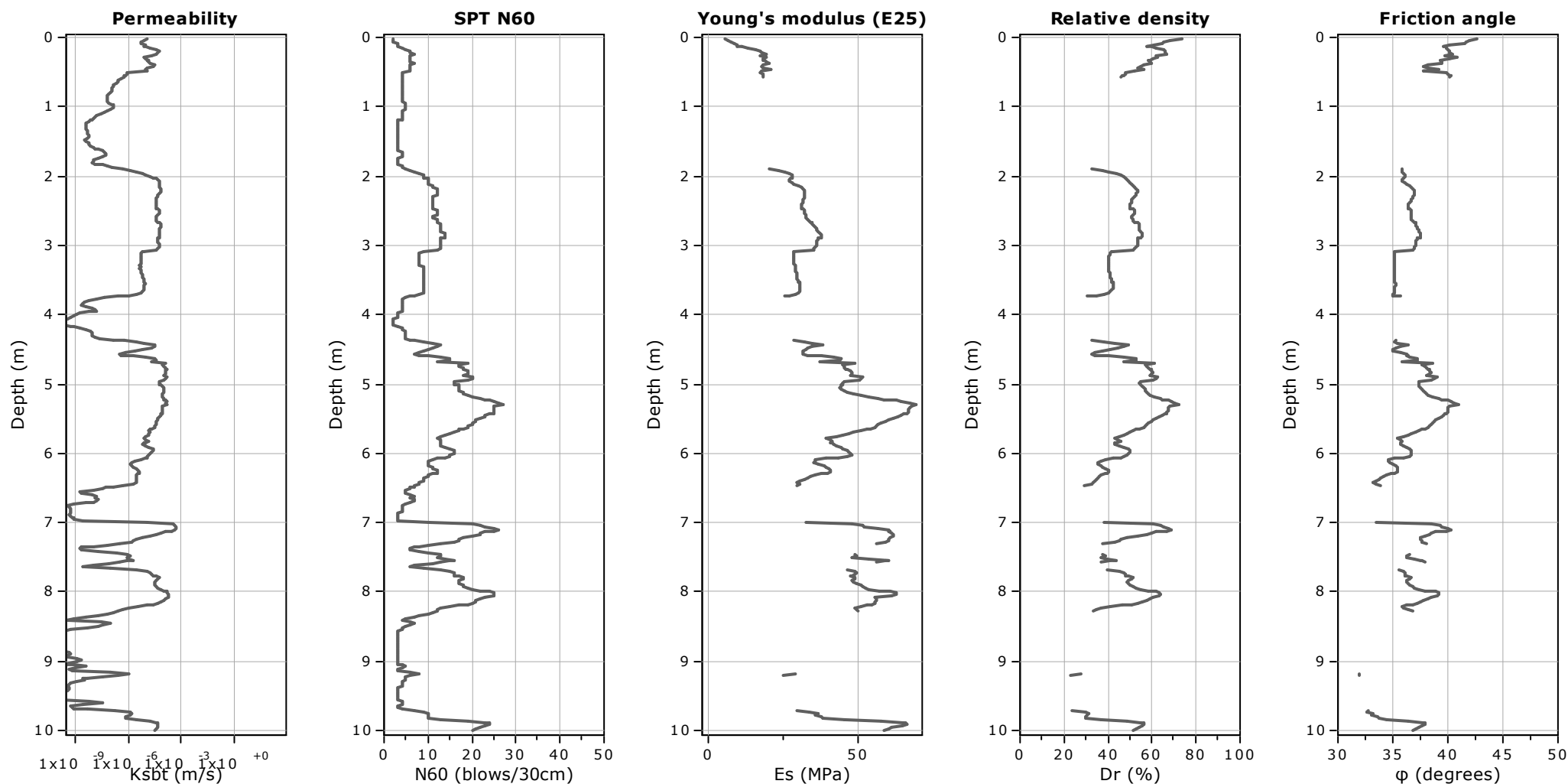
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km55+100**

Total depth: 10.00 m

Coords: lat 44.9209° lon 12.236488°



#### Calculation parameters

Permeability: Based on SBT<sub>n</sub>

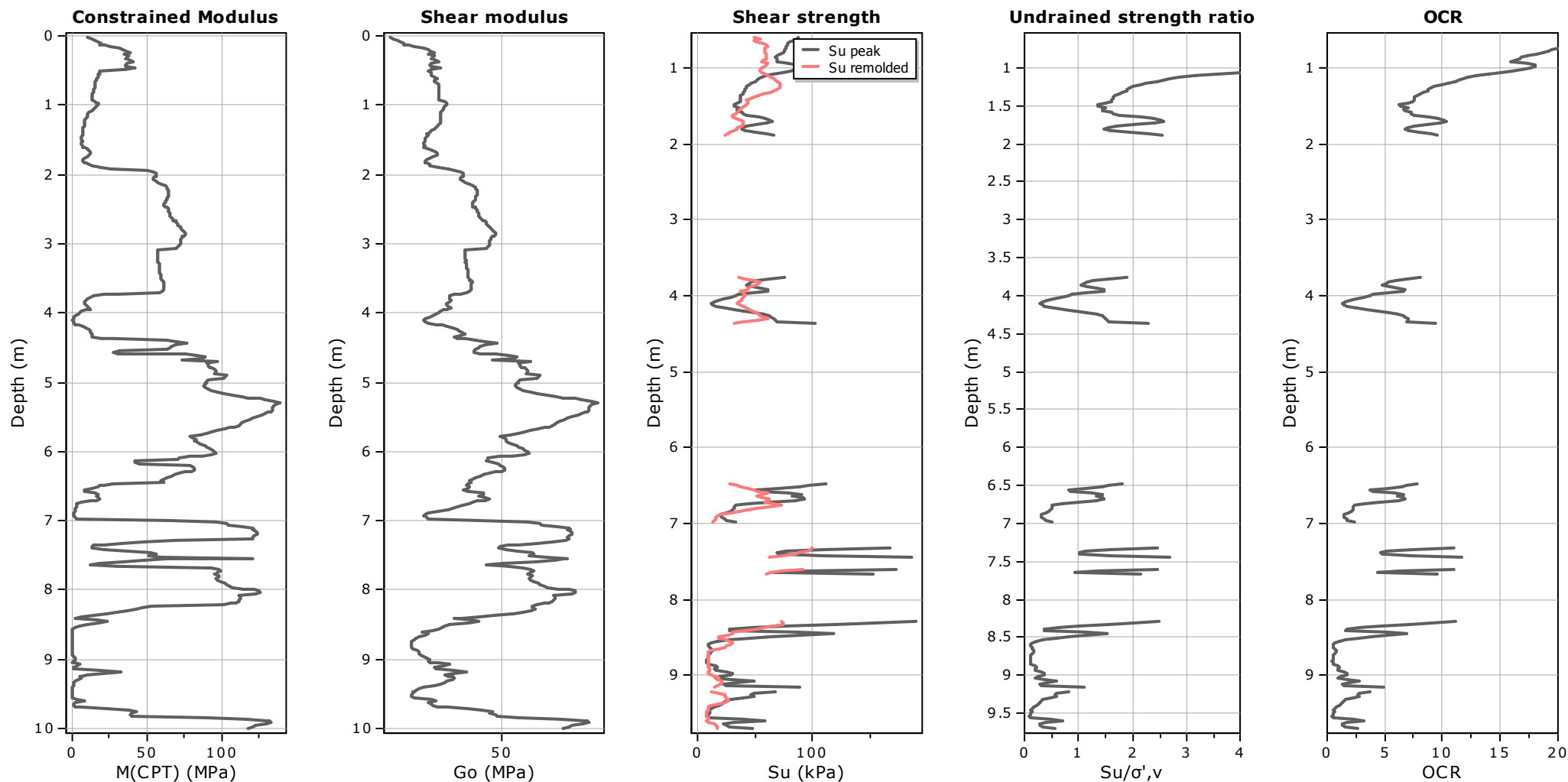
SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhavy & Mayne (1990)

—●— User defined estimation data



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{in}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  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

● Flat Dilatometer Test data

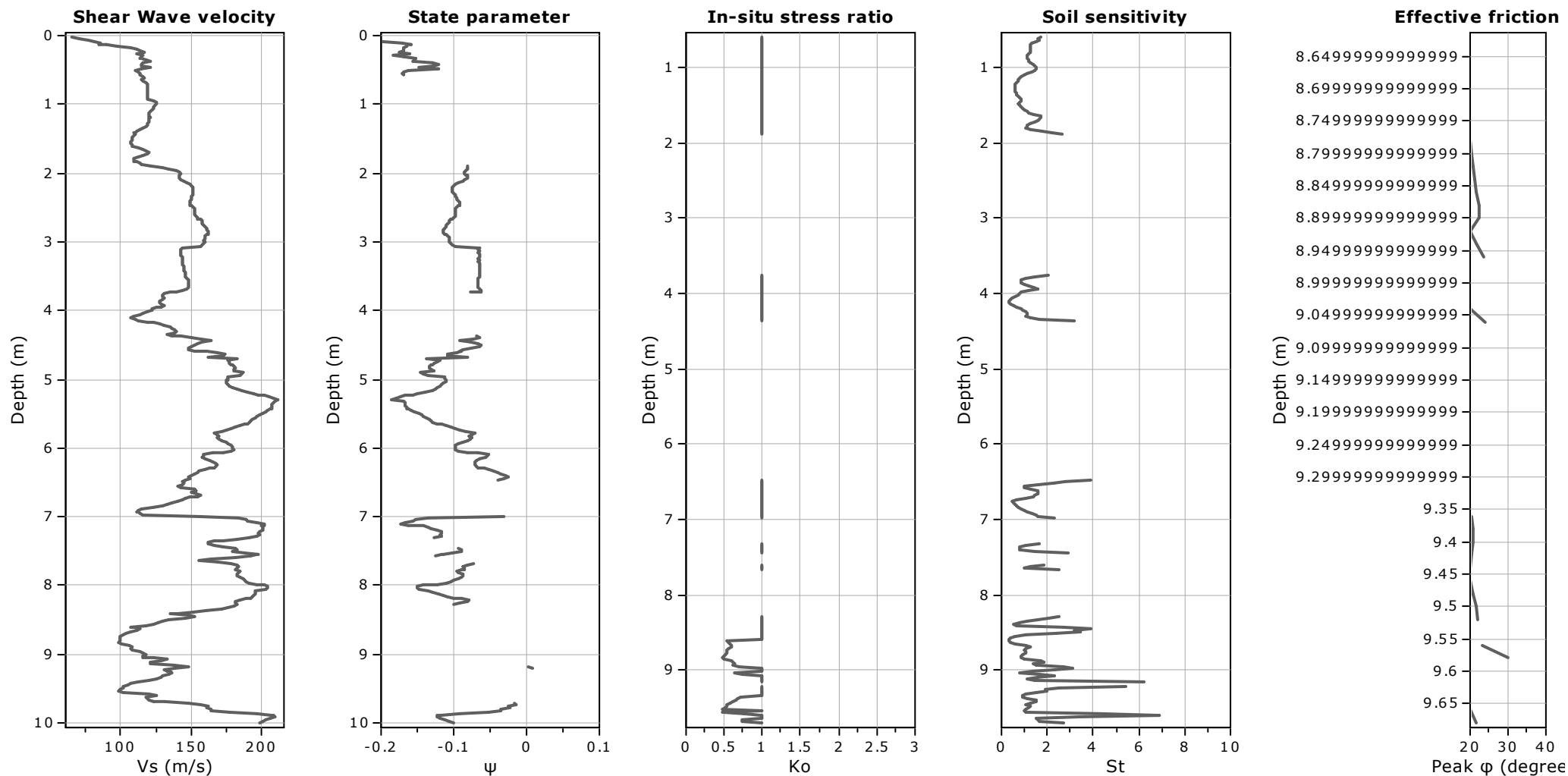
**Project:** Indagini CPTu - ditta I.P.G. s.n.c.

**Location:** S.S. 309 - ROMEA

**CPT: CPTU km55+100**

Total depth: 10.00 m

Coords: lat 44.9209° lon 12.236488°



#### Calculation parameters

Soil Sensitivity factor,  $N_s$ : 7.00

—●— User defined estimation data



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/m<sup>3</sup>) ::

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

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, $\psi$ ::

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

#### :: Drained Friction Angle, $\phi$ (°) ::

$$\phi = \phi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT<sub>n</sub>: 5, 6, 7 and 8 or  $I_c < I_{c\_cutoff}$ )

#### :: 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  $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

#### :: 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<sub>n</sub>: 1, 2, 3, 4 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<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

#### :: In situ Stress Ratio, $K_0$ ::

$$K_0 = (1 - \sin \phi') \cdot OCR^{\sin \phi'}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

#### :: Soil Sensitivity, $S_t$ ::

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

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

#### :: Peak Friction Angle, $\phi'$ (°) ::

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

(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., 5<sup>th</sup> Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

## ALLEGATO 3

### Log geotecnici semplificati delle prove CPTu relative alle aree di intervento

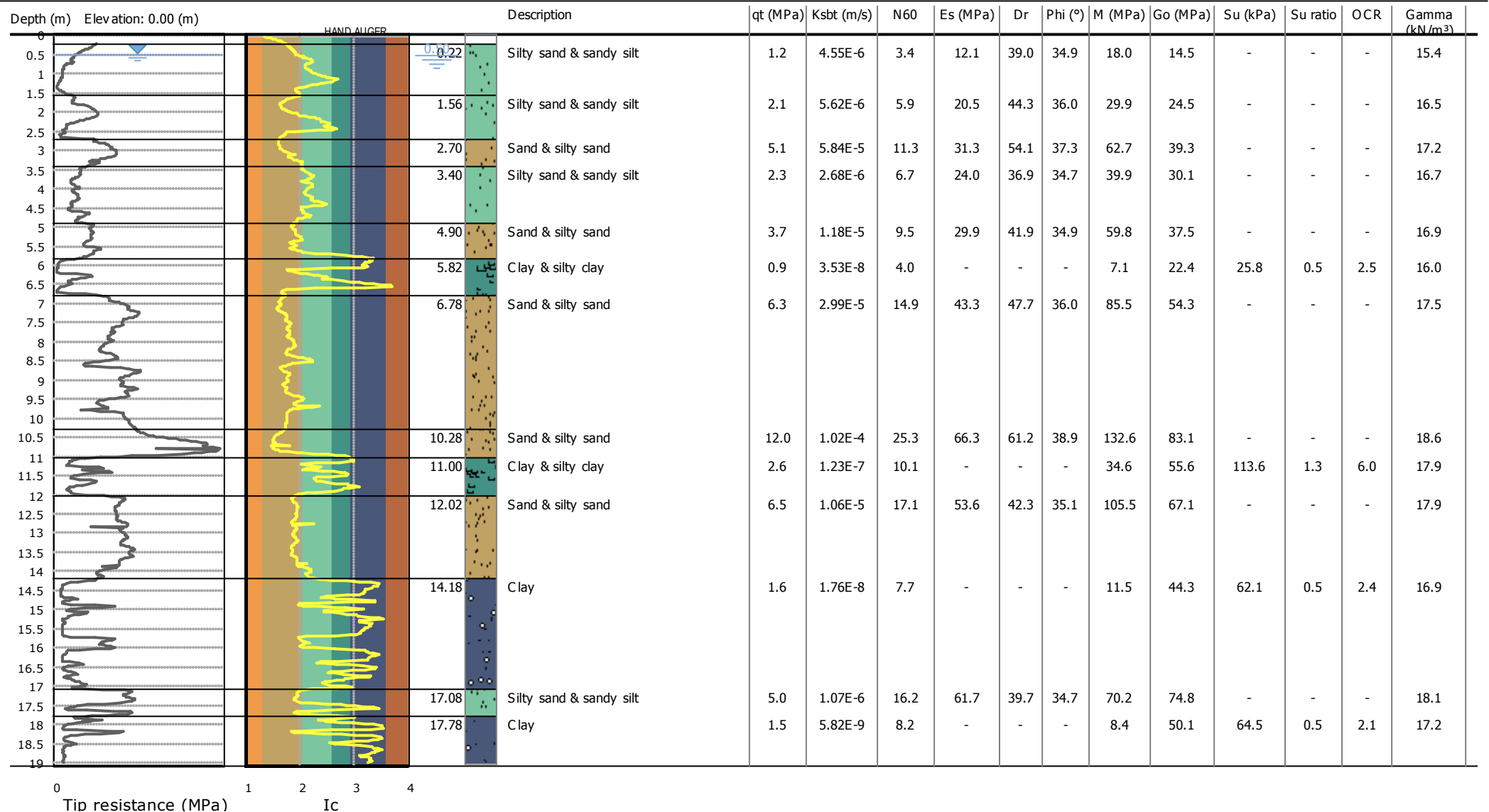
**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m

Coords: lat 44.673553° lon 12.2285°

**Project:**

**Location:**





O.C.R.: 0.00 ±0.00

**::: Layer No: 2 :::****Code:** Layer\_2     **Start depth:** 1.56 (m), **End depth:** 2.70 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.10 ±1.32 MPa

Sleeve friction: 16.75 ±4.57 kPa

Ic: 2.02 ±0.33

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.62E-06 ±3.54E-05 m/s

N<sub>60</sub>: 5.85 ±2.32 blows

Es: 20.54 ±3.78 MPa

Dr (%): 44.30 ±7.10

φ (degrees): 36.04 ±0.86 °

Unit weight: 16.51 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 29.91 ±15.61 MPa

Go: 24.48 ±5.21 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3     **Start depth:** 2.70 (m), **End depth:** 3.40 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.08 ±0.94 MPa

Sleeve friction: 23.07 ±4.18 kPa

Ic: 1.70 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.84E-05 ±3.96E-05 m/s

N<sub>60</sub>: 11.27 ±1.46 blows

Es: 31.33 ±2.97 MPa

Dr (%): 54.14 ±4.04

φ (degrees): 37.30 ±0.70 °

Unit weight: 17.22 ±0.25 kN/m<sup>3</sup>

Constrained Mod.: 62.67 ±5.94 MPa

Go: 39.27 ±3.72 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4     **Start depth:** 3.40 (m), **End depth:** 4.90 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.27 ±0.52 MPa

Sleeve friction: 19.91 ±5.75 kPa

Ic: 2.14 ±0.11

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.68E-06 ±2.48E-06 m/s

N<sub>60</sub>: 6.75 ±1.17 blows

Es: 23.99 ±3.16 MPa

Dr (%): 36.92 ±3.64

φ (degrees): 34.73 ±0.72 °

Unit weight: 16.74 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 39.94 ±13.18 MPa

Go: 30.05 ±3.93 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5     **Start depth:** 4.90 (m), **End depth:** 5.82 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 3.69 ±0.48 MPa

Sleeve friction: 19.42 ±4.61 kPa

Ic: 1.93 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.18E-05 ±6.44E-06 m/s

N<sub>60</sub>: 9.55 ±0.97 blows

Es: 29.90 ±2.21 MPa

Dr (%): 41.93 ±2.48

φ (degrees): 34.88 ±0.56 °

Unit weight: 16.90 ±0.27 kN/m<sup>3</sup>

Constrained Mod.: 59.80 ±4.42 MPa

Go: 37.47 ±2.77 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 5.82 (m), **End depth:** 6.78 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 0.88 ±1.21 MPa

Sleeve friction: 14.10 ±9.54 kPa

Ic: 2.72 ±0.59

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 3.53E-08 ±1.01E-05 m/s

N<sub>60</sub>: 3.98 ±2.44 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 15.98 ±0.81 kN/m<sup>3</sup>

Constrained Mod.: 7.07 ±21.21 MPa

Go: 22.39 ±7.37 MPa

Su: 25.80 ±21.21 kPa

Su ratio: 0.54 ±0.41

O.C.R.: 2.51 ±1.88

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 6.78 (m), **End depth:** 10.28 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.31 ±1.36 MPa

Sleeve friction: 28.08 ±7.13 kPa

Ic: 1.80 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.99E-05 ±3.02E-05 m/s

N<sub>60</sub>: 14.95 ±2.37 blows

Es: 43.33 ±5.21 MPa

Dr (%): 47.65 ±5.10

φ (degrees): 36.00 ±0.89 °

Unit weight: 17.53 ±0.36 kN/m<sup>3</sup>

Constrained Mod.: 85.48 ±12.32 MPa

Go: 54.30 ±6.53 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 10.28 (m), **End depth:** 11.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 11.97 ±3.22 MPa

Sleeve friction: 56.19 ±16.02 kPa

Ic: 1.62 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.02E-04 ±9.27E-05 m/s

N<sub>60</sub>: 25.31 ±4.98 blows

Es: 66.31 ±9.43 MPa

Dr (%): 61.18 ±7.87

φ (degrees): 38.85 ±1.51 °

Unit weight: 18.57 ±0.40 kN/m<sup>3</sup>

Constrained Mod.: 132.63 ±18.86 MPa

Go: 83.11 ±11.82 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 11.00 (m), **End depth:** 12.02 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.56 ±1.41 MPa

Sleeve friction: 52.10 ±17.79 kPa

Ic: 2.56 ±0.33

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.23E-07 ±1.68E-06 m/s

N<sub>60</sub>: 10.11 ±2.88 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.90 ±0.39 kN/m<sup>3</sup>

Constrained Mod.: 34.55 ±30.17 MPa

Go: 55.62 ±7.97 MPa

Su: 113.61 ±29.55 kPa

Su ratio: 1.29 ±0.35

O.C.R.: 5.96 ±1.60

**:: Layer No: 10 ::****Code:** Layer\_10 **Start depth:** 12.02 (m), **End depth:** 14.18 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.55 ±0.96 MPa

Sleeve friction: 38.15 ±3.95 kPa

Ic: 1.95 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.06E-05 ±5.87E-06 m/s

N<sub>60</sub>: 17.14 ±1.67 blows

Es: 53.58 ±3.06 MPa

Dr (%): 42.34 ±3.56

φ (degrees): 35.13 ±0.57 °

Unit weight: 17.90 ±0.15 kN/m<sup>3</sup>

Constrained Mod.: 105.54 ±10.42 MPa

Go: 67.15 ±3.84 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 11 ::****Code:** Layer\_11 **Start depth:** 14.18 (m), **End depth:** 17.08 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.62 ±1.64 MPa

Sleeve friction: 25.97 ±14.96 kPa

Ic: 2.84 ±0.47

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.76E-08 ±2.19E-06 m/s

N<sub>60</sub>: 7.68 ±3.58 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.92 ±0.74 kN/m<sup>3</sup>

Constrained Mod.: 11.52 ±35.74 MPa

Go: 44.26 ±12.25 MPa

Su: 62.11 ±39.00 kPa

Su ratio: 0.52 ±0.32

O.C.R.: 2.41 ±1.48

**:: Layer No: 12 ::****Code:** Layer\_12 **Start depth:** 17.08 (m), **End depth:** 17.78 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.01 ±2.57 MPa

Sleeve friction: 49.89 ±17.51 kPa

Ic: 2.24 ±0.49

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.07E-06 ±7.77E-06 m/s

N<sub>60</sub>: 16.20 ±4.31 blows

Es: 61.66 ±3.81 MPa

Dr (%): 39.73 ±3.83

φ (degrees): 34.73 ±0.47 °

Unit weight: 18.10 ±0.20 kN/m<sup>3</sup>

Constrained Mod.: 70.17 ±51.44 MPa

Go: 74.83 ±6.04 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 13 ::****Code:** Layer\_13 **Start depth:** 17.78 (m), **End depth:** 19.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.53 ±1.51 MPa

Sleeve friction: 33.28 ±20.35 kPa

Ic: 3.02 ±0.45

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 5.82E-09 ±3.76E-06 m/s

N<sub>60</sub>: 8.19 ±3.22 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.18 ±0.66 kN/m<sup>3</sup>

Constrained Mod.: 8.44 ±28.06 MPa

Go: 50.10 ±12.36 MPa

Su: 64.55 ±41.96 kPa

Su ratio: 0.46 ±0.32

O.C.R.: 2.13 ±1.46



**Project:**

**Location:**

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m, Date: 19/06/2019

Coords: lat 44.673553° lon 12.2285°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.22                          | 1.34             | 4.55E-06              | 3.4                                | 12.1                    | 39.0                  | 34.9              | 18.0                               | 14.5                                      | 0.0  | 0.0                            | 0.0    | 15.4                                |
| 1.56                          |                  | (±1.18E-04)           | (±2.1)                             | (±4.1)                  | (±11.9)               | (±2.2)            | (±12.0)                            | (±5.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.8)                              |
| 1.56                          | 1.14             | 5.62E-06              | 5.9                                | 20.5                    | 44.3                  | 36.0              | 29.9                               | 24.5                                      | 0.0  | 0.0                            | 0.0    | 16.5                                |
| 2.70                          |                  | (±3.54E-05)           | (±2.3)                             | (±3.8)                  | (±7.1)                | (±0.9)            | (±15.6)                            | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 2.70                          | 0.70             | 5.84E-05              | 11.3                               | 31.3                    | 54.1                  | 37.3              | 62.7                               | 39.3                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 3.40                          |                  | (±3.96E-05)           | (±1.5)                             | (±3.0)                  | (±4.0)                | (±0.7)            | (±5.9)                             | (±3.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.40                          | 1.50             | 2.68E-06              | 6.7                                | 24.0                    | 36.9                  | 34.7              | 39.9                               | 30.1                                      | 0.0  | 0.0                            | 0.0    | 16.7                                |
| 4.90                          |                  | (±2.48E-06)           | (±1.2)                             | (±3.2)                  | (±3.6)                | (±0.7)            | (±13.2)                            | (±3.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 4.90                          | 0.92             | 1.18E-05              | 9.5                                | 29.9                    | 41.9                  | 34.9              | 59.8                               | 37.5                                      | 0.0  | 0.0                            | 0.0    | 16.9                                |
| 5.82                          |                  | (±6.44E-06)           | (±1.0)                             | (±2.2)                  | (±2.5)                | (±0.6)            | (±4.4)                             | (±2.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 5.82                          | 0.96             | 3.53E-08              | 4.0                                | 0.0                     | 0.0                   | 0.0               | 7.1                                | 22.4                                      | 25.8   | 0.5                            | 2.5    | 16.0                                |
| 6.78                          |                  | (±1.01E-05)           | (±2.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±21.2)                            | (±7.4)                                    | (±21.2)  | (±0.4)                         | (±1.9) | (±0.8)                              |
| 6.78                          | 3.50             | 2.99E-05              | 14.9                               | 43.3                    | 47.7                  | 36.0              | 85.5                               | 54.3                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 10.28                         |                  | (±3.02E-05)           | (±2.4)                             | (±5.2)                  | (±5.1)                | (±0.9)            | (±12.3)                            | (±6.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 10.28                         | 0.72             | 1.02E-04              | 25.3                               | 66.3                    | 61.2                  | 38.9              | 132.6                              | 83.1                                      | 0.0  | 0.0                            | 0.0    | 18.6                                |
| 11.00                         |                  | (±9.27E-05)           | (±5.0)                             | (±9.4)                  | (±7.9)                | (±1.5)            | (±18.9)                            | (±11.8)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 11.00                         | 1.02             | 1.23E-07              | 10.1                               | 0.0                     | 0.0                   | 0.0               | 34.6                               | 55.6                                      | 113.6  | 1.3                            | 6.0    | 17.9                                |
| 12.02                         |                  | (±1.68E-06)           | (±2.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±30.2)                            | (±8.0)                                    | (±29.5)  | (±0.3)                         | (±1.6) | (±0.4)                              |
| 12.02                         | 2.16             | 1.06E-05              | 17.1                               | 53.6                    | 42.3                  | 35.1              | 105.5                              | 67.1                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 14.18                         |                  | (±5.87E-06)           | (±1.7)                             | (±3.1)                  | (±3.6)                | (±0.6)            | (±10.4)                            | (±3.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 14.18                         | 2.90             | 1.76E-08              | 7.7                                | 0.0                     | 0.0                   | 0.0               | 11.5                               | 44.3                                      | 62.1   | 0.5                            | 2.4    | 16.9                                |
| 17.08                         |                  | (±2.19E-06)           | (±3.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±35.7)                            | (±12.3)                                   | (±39.0)  | (±0.3)                         | (±1.5) | (±0.7)                              |
| 17.08                         | 0.70             | 1.07E-06              | 16.2                               | 61.7                    | 39.7                  | 34.7              | 70.2                               | 74.8                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 17.78                         |                  | (±7.77E-06)           | (±4.3)                             | (±3.8)                  | (±3.8)                | (±0.5)            | (±51.4)                            | (±6.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

**Project:**

**Location:**

**CPT: CPTU 1 (Km 24.9)**

Total depth: 19.00 m, Date: 19/06/2019

Coords: lat 44.673553° lon 12.2285°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 17.78                         | 1.22             | 5.82E-09              | 8.2                                | 0.0                     | 0.0                   | 0.0               | 8.4                                | 50.1                                      | 64.5   | 0.5                            | 2.1    | 17.2                                |
| 19.00                         |                  | (±3.76E-06)           | (±3.2)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±28.1)                            | (±12.4)                                   | (±42.0)  | (±0.3)                         | (±1.5) | (±0.7)                              |

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

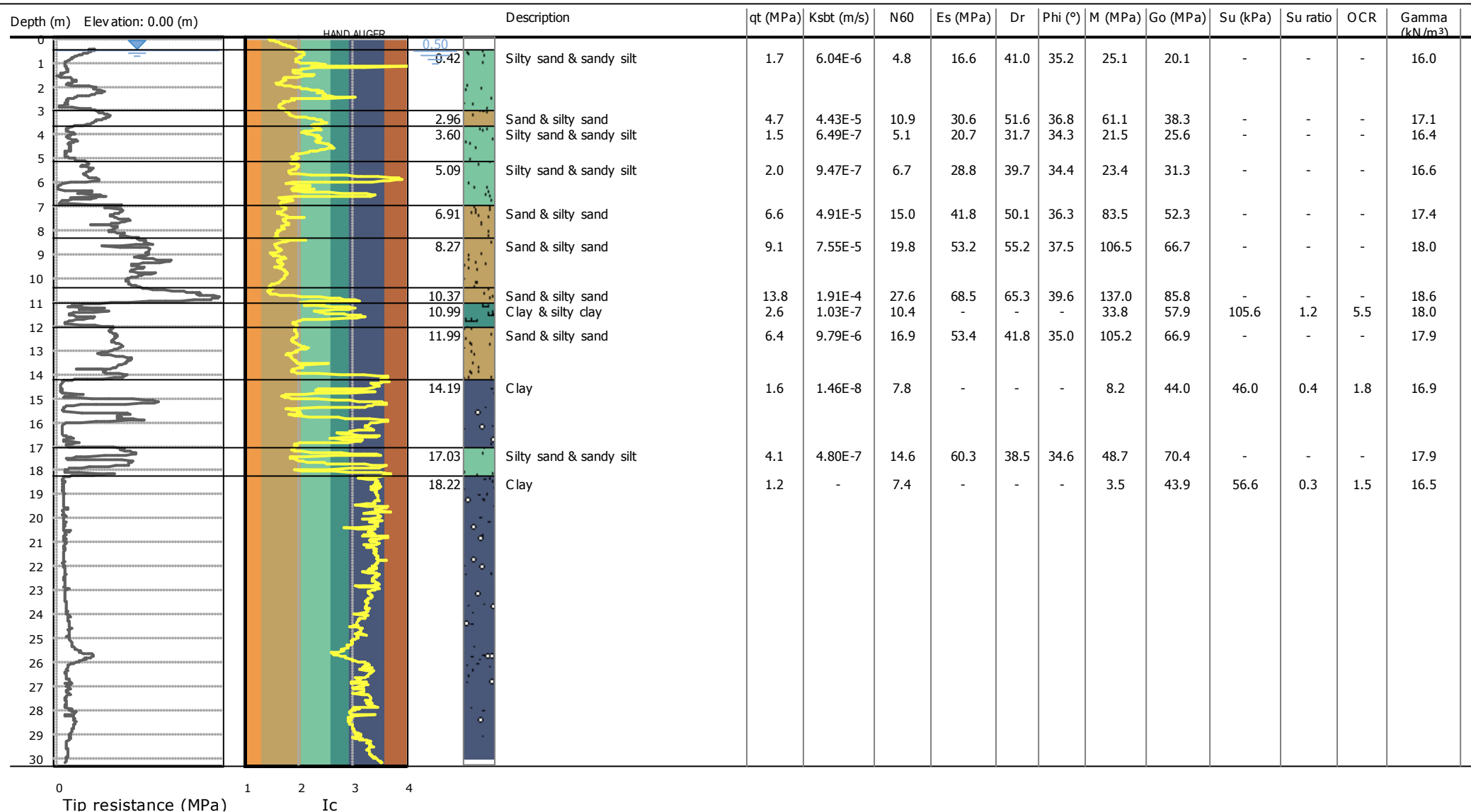
**CPT: CPTU 2 (Km 24.9)**

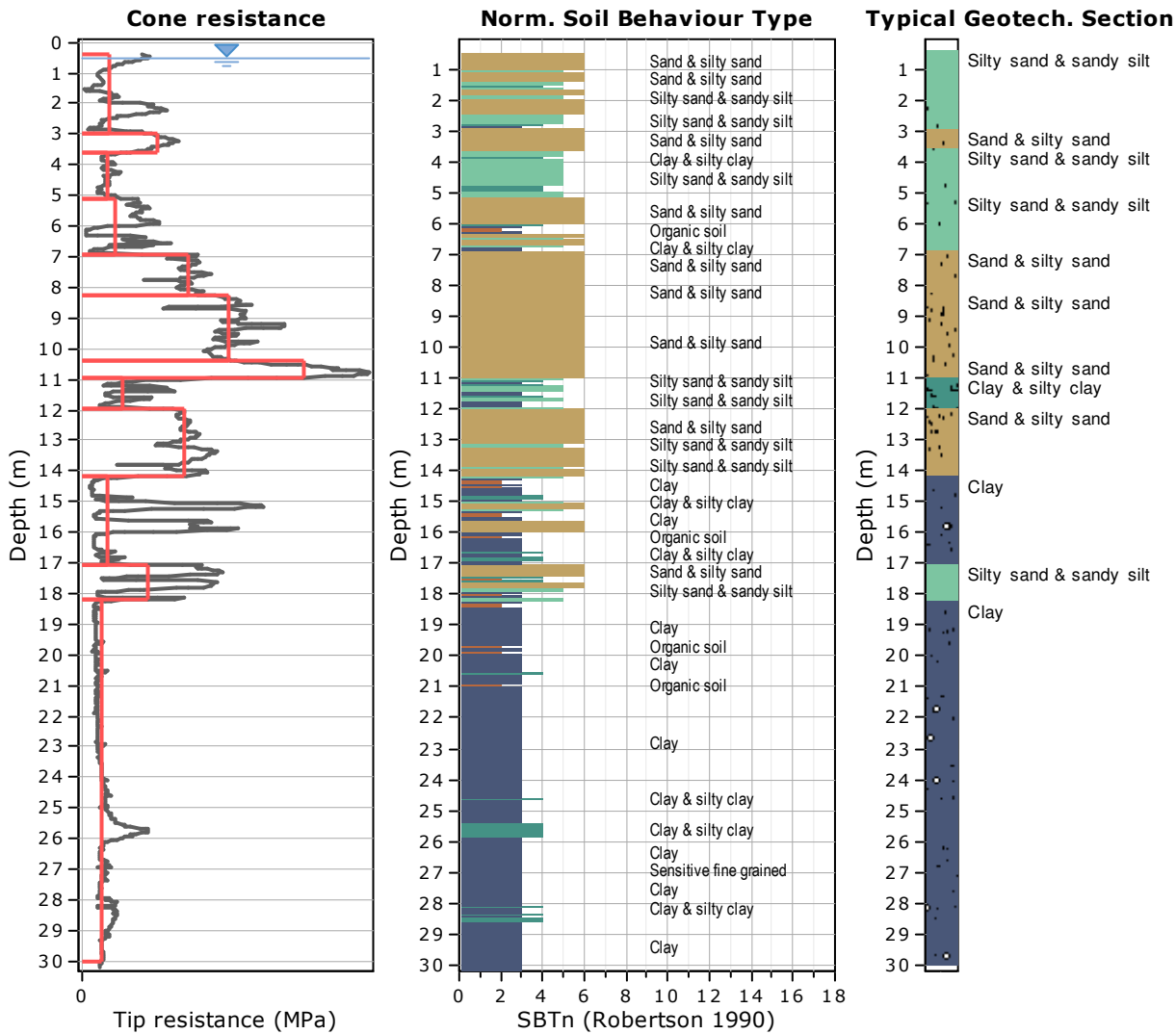
Total depth: 30.20 m

Coords: lat 44.673975° lon 12.228314°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1     **Start depth:** 0.42 (m), **End depth:** 2.96 (m)

**Description:** Silty sand & sandy silt

#### Basic results

Total cone resistance:  $1.73 \pm 1.43$  MPa

Sleeve friction:  $11.17 \pm 7.50$  kPa

Ic:  $2.01 \pm 0.37$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $6.04E-06 \pm 5.97E-05$  m/s

N<sub>60</sub>:  $4.81 \pm 2.72$  blows

Es:  $16.64 \pm 6.27$  MPa

Dr (%):  $41.02 \pm 9.37$

$\phi$  (degrees):  $35.18 \pm 1.85$  °

Unit weight:  $15.97 \pm 0.89$  kN/m<sup>3</sup>

Constrained Mod.:  $25.08 \pm 16.45$  MPa

Go:  $20.13 \pm 7.96$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 2.96 (m), **End depth:** 3.60 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.73 ±0.80 MPa

Sleeve friction: 21.87 ±3.77 kPa

Ic: 1.74 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.43E-05 ±2.68E-05 m/s

N<sub>60</sub>: 10.85 ±1.37 blows

Es: 30.57 ±2.78 MPa

Dr (%): 51.64 ±3.80

φ (degrees): 36.78 ±0.71 °

Unit weight: 17.13 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 61.14 ±5.55 MPa

Go: 38.32 ±3.48 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 3.60 (m), **End depth:** 5.09 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 1.53 ±0.44 MPa

Sleeve friction: 17.50 ±4.06 kPa

Ic: 2.34 ±0.16

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 6.49E-07 ±1.82E-06 m/s

N<sub>60</sub>: 5.10 ±1.04 blows

Es: 20.68 ±2.46 MPa

Dr (%): 31.68 ±3.29

φ (degrees): 34.28 ±0.61 °

Unit weight: 16.44 ±0.28 kN/m<sup>3</sup>

Constrained Mod.: 21.55 ±10.73 MPa

Go: 25.55 ±2.99 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 5.09 (m), **End depth:** 6.91 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.04 ±1.67 MPa

Sleeve friction: 18.26 ±10.28 kPa

Ic: 2.25 ±0.66

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 9.47E-07 ±1.23E-05 m/s

N<sub>60</sub>: 6.73 ±3.19 blows

Es: 28.75 ±4.46 MPa

Dr (%): 39.69 ±4.57

φ (degrees): 34.40 ±0.88 °

Unit weight: 16.60 ±0.65 kN/m<sup>3</sup>

Constrained Mod.: 23.37 ±31.82 MPa

Go: 31.32 ±8.69 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 6.91 (m), **End depth:** 8.27 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.63 ±0.82 MPa

Sleeve friction: 25.47 ±3.82 kPa

Ic: 1.73 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.91E-05 ±2.47E-05 m/s

N<sub>60</sub>: 14.99 ±1.31 blows

Es: 41.76 ±2.39 MPa

Dr (%): 50.09 ±2.89

φ (degrees): 36.31 ±0.51 °

Unit weight: 17.44 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 83.52 ±4.79 MPa

Go: 52.34 ±3.00 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 8.27 (m), **End depth:** 10.37 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.12 ±1.29 MPa

Sleeve friction: 37.16 ±9.41 kPa

Ic: 1.67 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 7.55E-05 ±5.56E-05 m/s

N<sub>60</sub>: 19.81 ±1.83 blows

Es: 53.25 ±3.49 MPa

Dr (%): 55.24 ±3.98

φ (degrees): 37.49 ±0.75 °

Unit weight: 17.99 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 106.50 ±6.98 MPa

Go: 66.74 ±4.37 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 10.37 (m), **End depth:** 10.99 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 13.81 ±3.05 MPa

Sleeve friction: 54.55 ±12.49 kPa

Ic: 1.53 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.91E-04 ±1.22E-04 m/s

N<sub>60</sub>: 27.59 ±4.54 blows

Es: 68.49 ±8.20 MPa

Dr (%): 65.27 ±7.09

φ (degrees): 39.58 ±1.44 °

Unit weight: 18.59 ±0.34 kN/m<sup>3</sup>

Constrained Mod.: 136.97 ±16.39 MPa

Go: 85.83 ±10.27 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 10.99 (m), **End depth:** 11.99 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.59 ±1.66 MPa

Sleeve friction: 57.83 ±16.77 kPa

Ic: 2.58 ±0.38

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.03E-07 ±2.70E-06 m/s

N<sub>60</sub>: 10.39 ±3.42 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 18.02 ±0.37 kN/m<sup>3</sup>

Constrained Mod.: 33.83 ±34.32 MPa

Go: 57.89 ±8.94 MPa

Su: 105.61 ±39.25 kPa

Su ratio: 1.19 ±0.46

O.C.R.: 5.48 ±2.12

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 11.99 (m), **End depth:** 14.19 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.44 ±1.00 MPa

Sleeve friction: 37.86 ±5.35 kPa

Ic: 1.96 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.79E-06 ±6.65E-06 m/s

N<sub>60</sub>: 16.88 ±1.78 blows

Es: 53.38 ±3.79 MPa

Dr (%): 41.83 ±3.59

φ (degrees): 35.05 ±0.55 °

Unit weight: 17.88 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 105.16 ±11.66 MPa

Go: 66.90 ±4.75 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10 **Start depth:** 14.19 (m), **End depth:** 17.03 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.58 ±3.25 MPa

Sleeve friction: 26.85 ±23.37 kPa

Ic: 2.86 ±0.63

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 1.46E-08 ±1.27E-05 m/s

N<sub>60</sub>: 7.84 ±6.45 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.95 ±1.05 kN/m<sup>3</sup>

Constrained Mod.: 8.24 ±53.71 MPa

Go: 43.96 ±20.24 MPa

Su: 46.05 ±37.38 kPa

Su ratio: 0.38 ±0.31

O.C.R.: 1.77 ±1.42

**:: Layer No: 11 ::****Code:** Layer\_11 **Start depth:** 17.03 (m), **End depth:** 18.22 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.14 ±3.08 MPa

Sleeve friction: 46.52 ±21.51 kPa

Ic: 2.35 ±0.60

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 4.80E-07 ±8.72E-06 m/s

N<sub>60</sub>: 14.57 ±5.43 blows

Es: 60.27 ±6.86 MPa

Dr (%): 38.53 ±5.93

φ (degrees): 34.56 ±0.87 °

Unit weight: 17.95 ±0.44 kN/m<sup>3</sup>

Constrained Mod.: 48.66 ±61.80 MPa

Go: 70.38 ±11.55 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 12 ::****Code:** Layer\_12 **Start depth:** 18.22 (m), **End depth:** 30.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.22 ±0.56 MPa

Sleeve friction: 19.68 ±13.06 kPa

Ic: 3.25 ±0.20

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 0.00E+00 ±1.11E-08 m/s

N<sub>60</sub>: 7.39 ±2.05 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.49 ±0.54 kN/m<sup>3</sup>

Constrained Mod.: 3.51 ±8.01 MPa

Go: 43.94 ±11.84 MPa

Su: 56.62 ±38.57 kPa

Su ratio: 0.32 ±0.19

O.C.R.: 1.47 ±0.90



**Project:**

**Location:**

**CPT: CPTU 2 (Km 24.9)**

Total depth: 30.20 m, Date: 19/06/2019

Coords: lat 44.673975° lon 12.228314°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.42                          | 2.54             | 6.04E-06              | 4.8                                | 16.6                    | 41.0                  | 35.2              | 25.1                               | 20.1                                      | 0.0  | 0.0                            | 0.0    | 16.0                                |
| 2.96                          |                  | (±5.97E-05)           | (±2.7)                             | (±6.3)                  | (±9.4)                | (±1.9)            | (±16.4)                            | (±8.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.9)                              |
| 2.96                          | 0.64             | 4.43E-05              | 10.9                               | 30.6                    | 51.6                  | 36.8              | 61.1                               | 38.3                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 3.60                          |                  | (±2.68E-05)           | (±1.4)                             | (±2.8)                  | (±3.8)                | (±0.7)            | (±5.6)                             | (±3.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.60                          | 1.49             | 6.49E-07              | 5.1                                | 20.7                    | 31.7                  | 34.3              | 21.5                               | 25.6                                      | 0.0  | 0.0                            | 0.0    | 16.4                                |
| 5.09                          |                  | (±1.82E-06)           | (±1.0)                             | (±2.5)                  | (±3.3)                | (±0.6)            | (±10.7)                            | (±3.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 5.09                          | 1.82             | 9.47E-07              | 6.7                                | 28.8                    | 39.7                  | 34.4              | 23.4                               | 31.3                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 6.91                          |                  | (±1.23E-05)           | (±3.2)                             | (±4.5)                  | (±4.6)                | (±0.9)            | (±31.8)                            | (±8.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.7)                              |
| 6.91                          | 1.36             | 4.91E-05              | 15.0                               | 41.8                    | 50.1                  | 36.3              | 83.5                               | 52.3                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 8.27                          |                  | (±2.47E-05)           | (±1.3)                             | (±2.4)                  | (±2.9)                | (±0.5)            | (±4.8)                             | (±3.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.27                          | 2.10             | 7.55E-05              | 19.8                               | 53.2                    | 55.2                  | 37.5              | 106.5                              | 66.7                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 10.37                         |                  | (±5.56E-05)           | (±1.8)                             | (±3.5)                  | (±4.0)                | (±0.8)            | (±7.0)                             | (±4.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 10.37                         | 0.62             | 1.91E-04              | 27.6                               | 68.5                    | 65.3                  | 39.6              | 137.0                              | 85.8                                      | 0.0  | 0.0                            | 0.0    | 18.6                                |
| 10.99                         |                  | (±1.22E-04)           | (±4.5)                             | (±8.2)                  | (±7.1)                | (±1.4)            | (±16.4)                            | (±10.3)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 10.99                         | 1.00             | 1.03E-07              | 10.4                               | 0.0                     | 0.0                   | 0.0               | 33.8                               | 57.9                                      | 105.6  | 1.2                            | 5.5    | 18.0                                |
| 11.99                         |                  | (±2.70E-06)           | (±3.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±34.3)                            | (±8.9)                                    | (±39.3)  | (±0.5)                         | (±2.1) | (±0.4)                              |
| 11.99                         | 2.20             | 9.79E-06              | 16.9                               | 53.4                    | 41.8                  | 35.0              | 105.2                              | 66.9                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 14.19                         |                  | (±6.65E-06)           | (±1.8)                             | (±3.8)                  | (±3.6)                | (±0.5)            | (±11.7)                            | (±4.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 14.19                         | 2.84             | 1.46E-08              | 7.8                                | 0.0                     | 0.0                   | 0.0               | 8.2                                | 44.0                                      | 46.0   | 0.4                            | 1.8    | 16.9                                |
| 17.03                         |                  | (±1.27E-05)           | (±6.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±53.7)                            | (±20.2)                                   | (±37.4)  | (±0.3)                         | (±1.4) | (±1.1)                              |
| 17.03                         | 1.19             | 4.80E-07              | 14.6                               | 60.3                    | 38.5                  | 34.6              | 48.7                               | 70.4                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 18.22                         |                  | (±8.72E-06)           | (±5.4)                             | (±6.9)                  | (±5.9)                | (±0.9)            | (±61.8)                            | (±11.6)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 18.22                         | 11.78            | 0.00E+00              | 7.4                                | 0.0                     | 0.0                   | 0.0               | 3.5                                | 43.9                                      | 56.6   | 0.3                            | 1.5    | 16.5                                |
| 30.00                         |                  | (±1.11E-08)           | (±2.0)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±8.0)                             | (±11.8)                                   | (±38.6)  | (±0.2)                         | (±0.9) | (±0.5)                              |

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

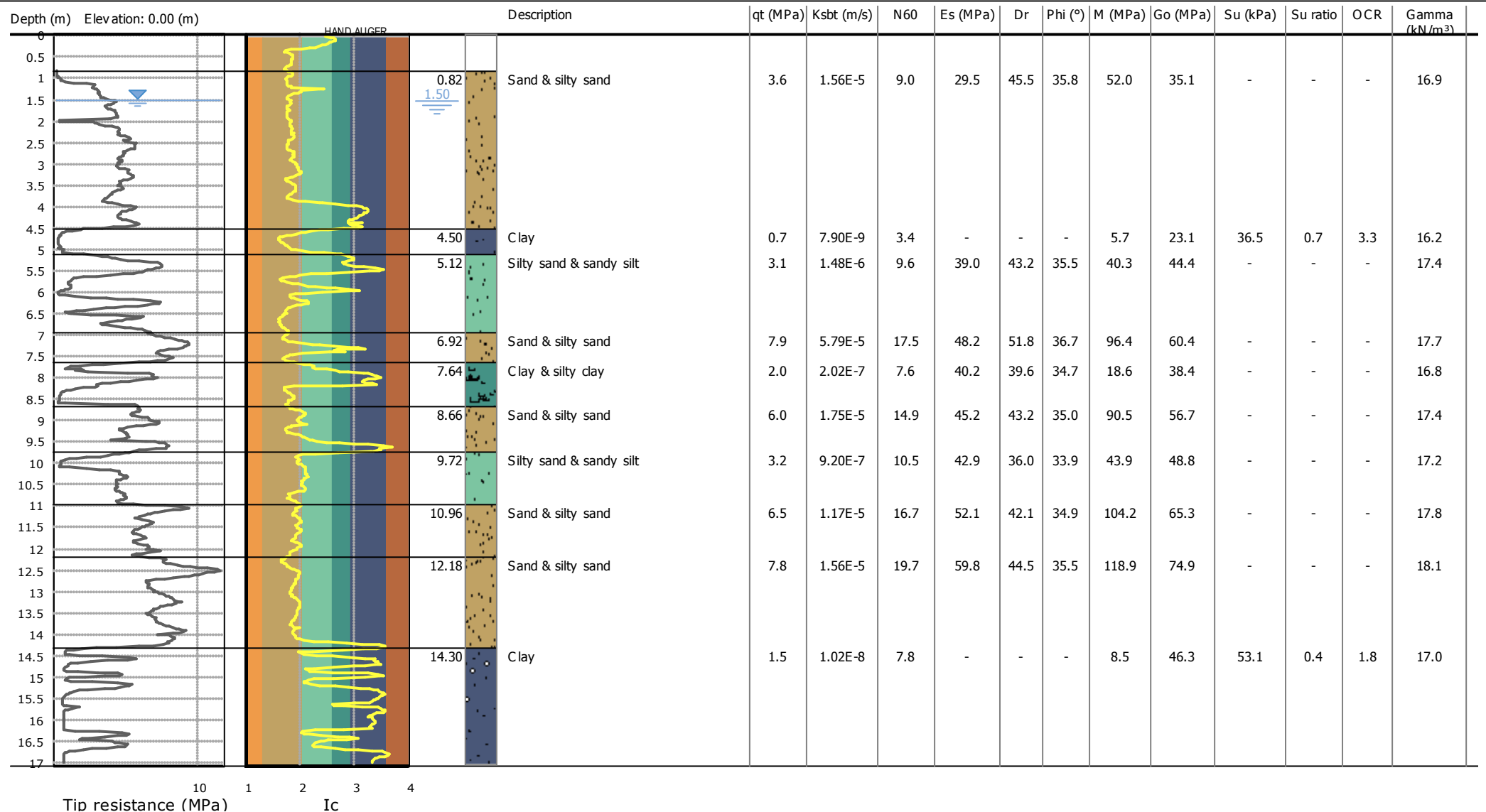
**CPT: CPTU 3 (Km 25.3)**

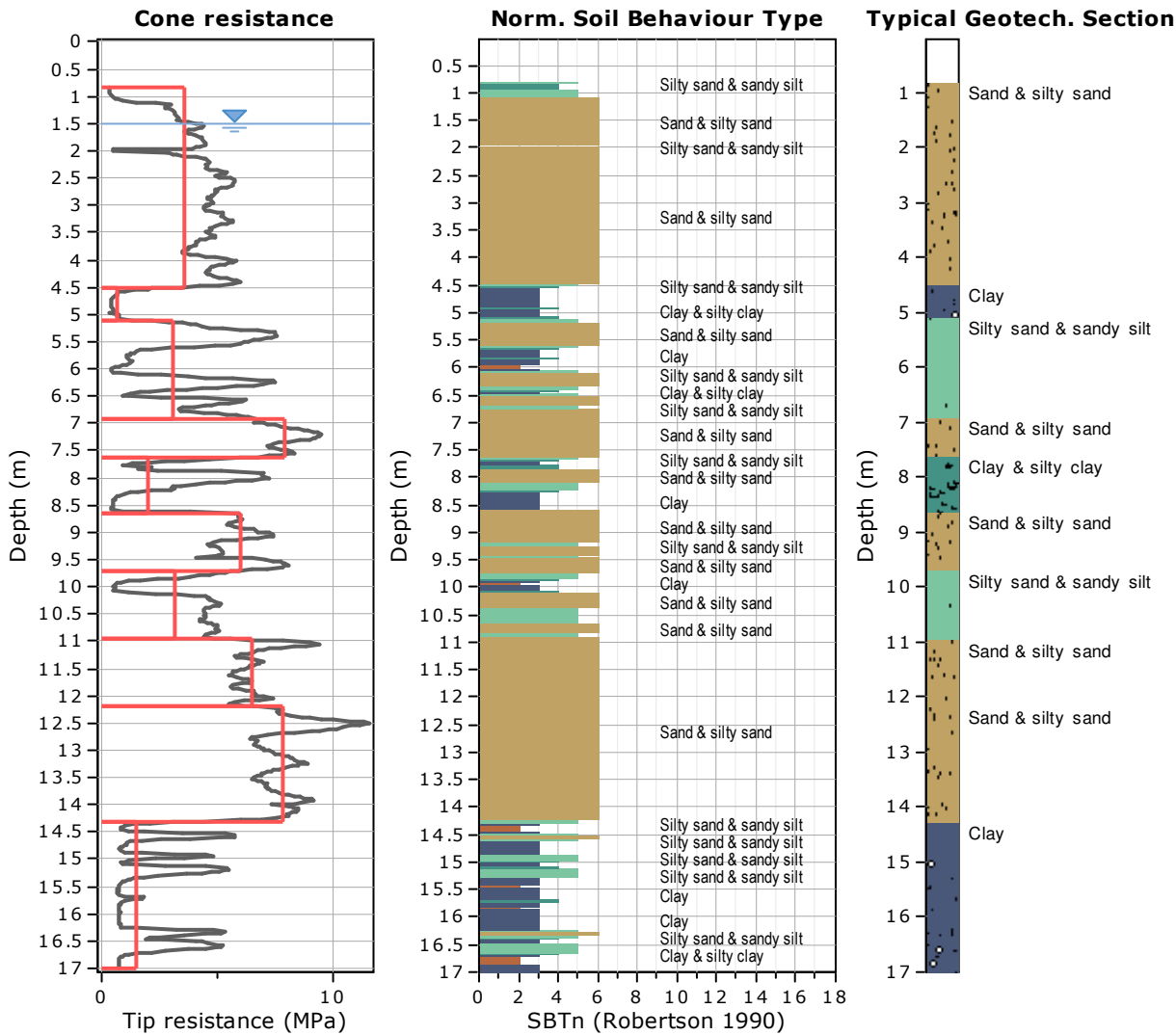
Total depth: 17.00 m

Coords: lat 44.677778° lon 12.226197°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.82 (m), **End depth:** 4.50 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $3.58 \pm 1.49$  MPa

Sleeve friction:  $19.09 \pm 9.08$  kPa

Ic:  $1.89 \pm 0.20$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $1.56E-05 \pm 1.50E-05$  m/s

N<sub>60</sub>:  $8.97 \pm 3.31$  blows

Es:  $29.49 \pm 7.84$  MPa

Dr (%):  $45.52 \pm 6.61$

φ (degrees):  $35.83 \pm 1.16$  °

Unit weight:  $16.90 \pm 1.02$  kN/m<sup>3</sup>

Constrained Mod.:  $52.00 \pm 20.88$  MPa

Go:  $35.11 \pm 11.34$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 4.50 (m), **End depth:** 5.12 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.69 ±0.71 MPa

Sleeve friction: 19.21 ±17.05 kPa

Ic: 2.96 ±0.28

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 7.90E-09 ±6.82E-07 m/s

N<sub>60</sub>: 3.45 ±2.03 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.24 ±1.06 kN/m<sup>3</sup>

Constrained Mod.: 5.75 ±13.86 MPa

Go: 23.07 ±9.66 MPa

Su: 36.52 ±28.67 kPa

Su ratio: 0.72 ±0.50

O.C.R.: 3.31 ±2.31

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 5.12 (m), **End depth:** 6.92 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.06 ±2.49 MPa

Sleeve friction: 30.79 ±11.97 kPa

Ic: 2.18 ±0.55

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.48E-06 ±3.70E-05 m/s

N<sub>60</sub>: 9.60 ±4.18 blows

Es: 39.01 ±3.84 MPa

Dr (%): 43.21 ±6.85

φ (degrees): 35.52 ±0.87 °

Unit weight: 17.36 ±0.33 kN/m<sup>3</sup>

Constrained Mod.: 40.25 ±35.01 MPa

Go: 44.37 ±8.05 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 6.92 (m), **End depth:** 7.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.86 ±0.95 MPa

Sleeve friction: 30.60 ±5.18 kPa

Ic: 1.71 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.79E-05 ±2.72E-05 m/s

N<sub>60</sub>: 17.52 ±1.59 blows

Es: 48.20 ±3.28 MPa

Dr (%): 51.80 ±3.01

φ (degrees): 36.67 ±0.59 °

Unit weight: 17.71 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 96.40 ±6.56 MPa

Go: 60.41 ±4.11 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 7.64 (m), **End depth:** 8.66 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.98 ±2.58 MPa

Sleeve friction: 22.33 ±15.20 kPa

Ic: 2.45 ±0.62

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.02E-07 ±2.25E-05 m/s

N<sub>60</sub>: 7.58 ±4.87 blows

Es: 40.19 ±4.94 MPa

Dr (%): 39.60 ±6.76

φ (degrees): 34.71 ±0.95 °

Unit weight: 16.82 ±0.94 kN/m<sup>3</sup>

Constrained Mod.: 18.57 ±41.92 MPa

Go: 38.35 ±13.68 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6 **Start depth:** 8.66 (m), **End depth:** 9.72 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.00 ±1.03 MPa

Sleeve friction: 26.36 ±8.11 kPa

Ic: 1.87 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.75E-05 ±1.78E-05 m/s

N<sub>60</sub>: 14.95 ±1.70 blows

Es: 45.25 ±4.34 MPa

Dr (%): 43.17 ±3.52

φ (degrees): 35.01 ±0.63 °

Unit weight: 17.44 ±0.43 kN/m<sup>3</sup>

Constrained Mod.: 90.49 ±8.67 MPa

Go: 56.71 ±5.44 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7 **Start depth:** 9.72 (m), **End depth:** 10.96 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.16 ±1.73 MPa

Sleeve friction: 26.69 ±9.62 kPa

Ic: 2.27 ±0.52

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 9.20E-07 ±4.59E-06 m/s

N<sub>60</sub>: 10.45 ±3.66 blows

Es: 42.92 ±4.32 MPa

Dr (%): 36.01 ±2.76

φ (degrees): 33.86 ±0.61 °

Unit weight: 17.21 ±0.55 kN/m<sup>3</sup>

Constrained Mod.: 43.92 ±42.06 MPa

Go: 48.83 ±10.16 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8 **Start depth:** 10.96 (m), **End depth:** 12.18 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.46 ±0.93 MPa

Sleeve friction: 34.65 ±5.86 kPa

Ic: 1.93 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.17E-05 ±7.49E-06 m/s

N<sub>60</sub>: 16.69 ±1.63 blows

Es: 52.12 ±3.57 MPa

Dr (%): 42.06 ±3.18

φ (degrees): 34.92 ±0.65 °

Unit weight: 17.78 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 104.24 ±7.14 MPa

Go: 65.32 ±4.47 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 9 :::****Code:** Layer\_9 **Start depth:** 12.18 (m), **End depth:** 14.30 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.80 ±1.25 MPa

Sleeve friction: 41.94 ±4.89 kPa

Ic: 1.89 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.56E-05 ±1.59E-05 m/s

N<sub>60</sub>: 19.68 ±1.98 blows

Es: 59.80 ±3.51 MPa

Dr (%): 44.45 ±3.88

φ (degrees): 35.46 ±0.69 °

Unit weight: 18.07 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 118.92 ±9.14 MPa

Go: 74.95 ±4.40 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 14.30 (m), **End depth:** 17.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.53 ±1.75 MPa

Sleeve friction: 27.53 ±19.97 kPa

Ic: 2.93 ±0.54

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 1.02E-08 ±1.67E-06 m/s

N<sub>60</sub>: 7.84 ±3.92 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.96 ±0.84 kN/m<sup>3</sup>

Constrained Mod.: 8.54 ±37.51 MPa

Go: 46.25 ±14.89 MPa

Su: 53.05 ±47.47 kPa

Su ratio: 0.40 ±0.37

O.C.R.: 1.85 ±1.70

**Project:**

**Location:**

**CPT: CPTU 3 (Km 25.3)**

Total depth: 17.00 m, Date: 19/06/2019

Coords: lat 44.677778° lon 12.226197°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.82                          | 3.68             | 1.56E-05              | 9.0                                | 29.5                    | 45.5                  | 35.8              | 52.0                               | 35.1                                      | 0.0  | 0.0                            | 0.0    | 16.9                                |
| 4.50                          |                  | (±1.50E-05)           | (±3.3)                             | (±7.8)                  | (±6.6)                | (±1.2)            | (±20.9)                            | (±11.3)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±1.0)                              |
| 4.50                          | 0.62             | 7.90E-09              | 3.4                                | 0.0                     | 0.0                   | 0.0               | 5.7                                | 23.1                                      | 36.5   | 0.7                            | 3.3    | 16.2                                |
| 5.12                          |                  | (±6.82E-07)           | (±2.0)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±13.9)                            | (±9.7)                                    | (±28.7)  | (±0.5)                         | (±2.3) | (±1.1)                              |
| 5.12                          | 1.80             | 1.48E-06              | 9.6                                | 39.0                    | 43.2                  | 35.5              | 40.3                               | 44.4                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 6.92                          |                  | (±3.70E-05)           | (±4.2)                             | (±3.8)                  | (±6.8)                | (±0.9)            | (±35.0)                            | (±8.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.92                          | 0.72             | 5.79E-05              | 17.5                               | 48.2                    | 51.8                  | 36.7              | 96.4                               | 60.4                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 7.64                          |                  | (±2.72E-05)           | (±1.6)                             | (±3.3)                  | (±3.0)                | (±0.6)            | (±6.6)                             | (±4.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.64                          | 1.02             | 2.02E-07              | 7.6                                | 40.2                    | 39.6                  | 34.7              | 18.6                               | 38.4                                      | 0.0  | 0.0                            | 0.0    | 16.8                                |
| 8.66                          |                  | (±2.25E-05)           | (±4.9)                             | (±4.9)                  | (±6.8)                | (±0.9)            | (±41.9)                            | (±13.7)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.9)                              |
| 8.66                          | 1.06             | 1.75E-05              | 14.9                               | 45.2                    | 43.2                  | 35.0              | 90.5                               | 56.7                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 9.72                          |                  | (±1.78E-05)           | (±1.7)                             | (±4.3)                  | (±3.5)                | (±0.6)            | (±8.7)                             | (±5.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 9.72                          | 1.24             | 9.20E-07              | 10.5                               | 42.9                    | 36.0                  | 33.9              | 43.9                               | 48.8                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 10.96                         |                  | (±4.59E-06)           | (±3.7)                             | (±4.3)                  | (±2.8)                | (±0.6)            | (±42.1)                            | (±10.2)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 10.96                         | 1.22             | 1.17E-05              | 16.7                               | 52.1                    | 42.1                  | 34.9              | 104.2                              | 65.3                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 12.18                         |                  | (±7.49E-06)           | (±1.6)                             | (±3.6)                  | (±3.2)                | (±0.7)            | (±7.1)                             | (±4.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 12.18                         | 2.12             | 1.56E-05              | 19.7                               | 59.8                    | 44.5                  | 35.5              | 118.9                              | 74.9                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 14.30                         |                  | (±1.59E-05)           | (±2.0)                             | (±3.5)                  | (±3.9)                | (±0.7)            | (±9.1)                             | (±4.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 14.30                         | 2.70             | 1.02E-08              | 7.8                                | 0.0                     | 0.0                   | 0.0               | 8.5                                | 46.3                                      | 53.1   | 0.4                            | 1.8    | 17.0                                |
| 17.00                         |                  | (±1.67E-06)           | (±3.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±37.5)                            | (±14.9)                                   | (±47.5)  | (±0.4)                         | (±1.7) | (±0.8)                              |

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



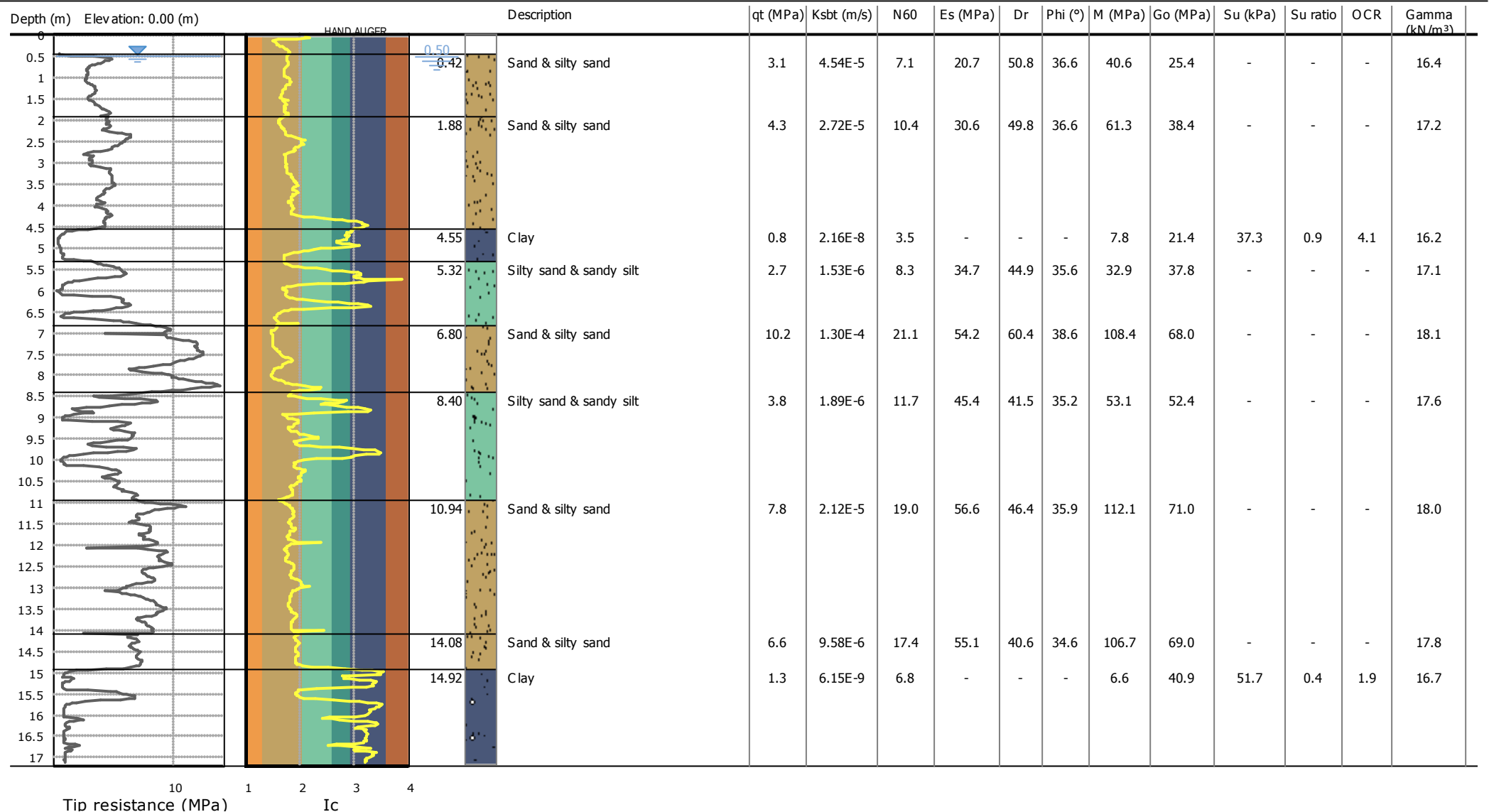
**CPT: CPTU 4 (Km 25.3)**

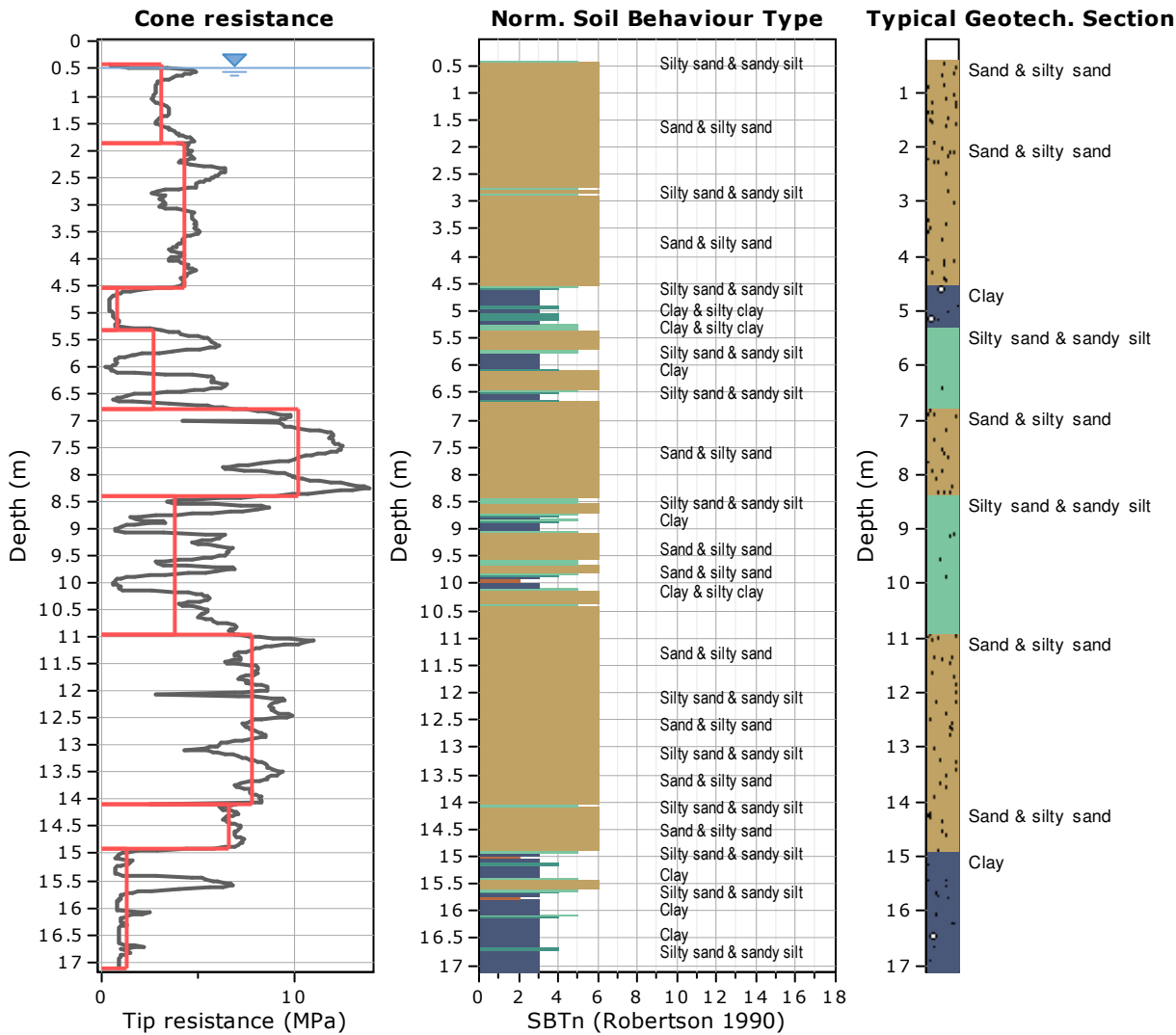
Total depth: 17.12 m

Coords: lat 44.678086° lon 12.226064°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.42 (m), **End depth:** 1.88 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $3.11 \pm 0.91$  MPa

Sleeve friction:  $13.15 \pm 3.70$  kPa

Ic:  $1.74 \pm 0.11$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $4.54E-05 \pm 4.15E-05$  m/s

N<sub>60</sub>:  $7.15 \pm 1.75$  blows

Es:  $20.72 \pm 3.62$  MPa

Dr (%):  $50.85 \pm 5.17$

φ (degrees):  $36.60 \pm 1.02$  °

Unit weight:  $16.42 \pm 0.56$  kN/m<sup>3</sup>

Constrained Mod.:  $40.58 \pm 8.23$  MPa

Go:  $25.43 \pm 5.16$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 1.88 (m), **End depth:** 4.55 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.34 ±0.82 MPa

Sleeve friction: 24.13 ±3.72 kPa

Ic: 1.81 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.72E-05 ±2.62E-05 m/s

N<sub>60</sub>: 10.36 ±1.36 blows

Es: 30.65 ±2.49 MPa

Dr (%): 49.77 ±4.89

φ (degrees): 36.62 ±0.88 °

Unit weight: 17.21 ±0.20 kN/m<sup>3</sup>

Constrained Mod.: 61.30 ±4.99 MPa

Go: 38.41 ±3.13 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 4.55 (m), **End depth:** 5.32 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.76 ±0.82 MPa

Sleeve friction: 18.08 ±15.60 kPa

Ic: 2.82 ±0.31

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 2.16E-08 ±1.83E-06 m/s

N<sub>60</sub>: 3.51 ±2.18 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.21 ±1.01 kN/m<sup>3</sup>

Constrained Mod.: 7.76 ±14.45 MPa

Go: 21.42 ±9.20 MPa

Su: 37.26 ±18.98 kPa

Su ratio: 0.89 ±0.40

O.C.R.: 4.12 ±1.85

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 5.32 (m), **End depth:** 6.80 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.67 ±2.45 MPa

Sleeve friction: 24.77 ±10.26 kPa

Ic: 2.16 ±0.60

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.53E-06 ±3.73E-05 m/s

N<sub>60</sub>: 8.33 ±4.21 blows

Es: 34.75 ±3.65 MPa

Dr (%): 44.89 ±5.82

φ (degrees): 35.59 ±0.77 °

Unit weight: 17.06 ±0.36 kN/m<sup>3</sup>

Constrained Mod.: 32.87 ±33.45 MPa

Go: 37.80 ±8.72 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 6.80 (m), **End depth:** 8.40 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.20 ±1.97 MPa

Sleeve friction: 39.82 ±8.15 kPa

Ic: 1.59 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.30E-04 ±9.26E-05 m/s

N<sub>60</sub>: 21.08 ±2.93 blows

Es: 54.22 ±5.48 MPa

Dr (%): 60.44 ±5.47

φ (degrees): 38.60 ±1.07 °

Unit weight: 18.12 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 108.44 ±10.96 MPa

Go: 67.95 ±6.87 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 8.40 (m), **End depth:** 10.94 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.83 ±2.29 MPa  
 Sleeve friction: 34.28 ±16.44 kPa  
 Ic: 2.16 ±0.48  
 SBT<sub>n</sub>: 5  
 SBT<sub>n</sub> description: Silty sand & sandy silt

**Estimation results**

Permeability: 1.89E-06 ±1.44E-05 m/s  
 N<sub>60</sub>: 11.75 ±4.34 blows  
 Es: 45.38 ±6.59 MPa  
 Dr (%): 41.55 ±5.56  
 φ (degrees): 35.20 ±1.14 °  
 Unit weight: 17.57 ±0.52 kN/m<sup>3</sup>

Constrained Mod.: 53.11 ±40.04 MPa  
 Go: 52.43 ±11.13 MPa  
 Su: 0.00 ±0.00 kPa  
 Su ratio: 0.00 ±0.00  
 O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 10.94 (m), **End depth:** 14.08 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.79 ±1.23 MPa  
 Sleeve friction: 40.00 ±4.78 kPa  
 Ic: 1.85 ±0.10  
 SBT<sub>n</sub>: 6  
 SBT<sub>n</sub> description: Sand & silty sand

**Estimation results**

Permeability: 2.12E-05 ±1.69E-05 m/s  
 N<sub>60</sub>: 19.05 ±2.07 blows  
 Es: 56.63 ±4.01 MPa  
 Dr (%): 46.45 ±4.27  
 φ (degrees): 35.86 ±0.74 °  
 Unit weight: 18.02 ±0.20 kN/m<sup>3</sup>

Constrained Mod.: 112.13 ±11.26 MPa  
 Go: 70.98 ±5.02 MPa  
 Su: 0.00 ±0.00 kPa  
 Su ratio: 0.00 ±0.00  
 O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 14.08 (m), **End depth:** 14.92 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.64 ±0.84 MPa  
 Sleeve friction: 35.63 ±3.56 kPa  
 Ic: 1.96 ±0.09  
 SBT<sub>n</sub>: 6  
 SBT<sub>n</sub> description: Sand & silty sand

**Estimation results**

Permeability: 9.58E-06 ±3.40E-06 m/s  
 N<sub>60</sub>: 17.39 ±1.67 blows  
 Es: 55.08 ±3.48 MPa  
 Dr (%): 40.58 ±3.14  
 φ (degrees): 34.64 ±0.43 °  
 Unit weight: 17.82 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 106.67 ±15.00 MPa  
 Go: 69.04 ±4.36 MPa  
 Su: 0.00 ±0.00 kPa  
 Su ratio: 0.00 ±0.00  
 O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 14.92 (m), **End depth:** 17.12 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.30 ±1.63 MPa  
 Sleeve friction: 22.41 ±16.29 kPa  
 Ic: 3.00 ±0.46  
 SBT<sub>n</sub>: 3  
 SBT<sub>n</sub> description: Clay

**Estimation results**

Permeability: 6.15E-09 ±3.20E-06 m/s  
 N<sub>60</sub>: 6.85 ±3.37 blows  
 Es: 0.00 ±0.00 MPa  
 Dr (%): 0.00 ±0.00  
 φ (degrees): 0.00 ±0.00 °  
 Unit weight: 16.67 ±0.70 kN/m<sup>3</sup>

Constrained Mod.: 6.58 ±31.30 MPa  
 Go: 40.86 ±11.19 MPa  
 Su: 51.65 ±23.31 kPa  
 Su ratio: 0.41 ±0.19  
 O.C.R.: 1.87 ±0.88

**Project:**

**Location:**

**CPT: CPTU 4 (Km 25.3)**

Total depth: 17.12 m, Date: 19/06/2019

Coords: lat 44.678086° lon 12.226064°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.42                          | 1.46             | 4.54E-05              | 7.1                                | 20.7                    | 50.8                  | 36.6              | 40.6                               | 25.4                                      | 0.0  | 0.0                            | 0.0    | 16.4                                |
| 1.88                          |                  | (±4.15E-05)           | (±1.7)                             | (±3.6)                  | (±5.2)                | (±1.0)            | (±8.2)                             | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 1.88                          | 2.67             | 2.72E-05              | 10.4                               | 30.6                    | 49.8                  | 36.6              | 61.3                               | 38.4                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 4.55                          |                  | (±2.62E-05)           | (±1.4)                             | (±2.5)                  | (±4.9)                | (±0.9)            | (±5.0)                             | (±3.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.55                          | 0.77             | 2.16E-08              | 3.5                                | 0.0                     | 0.0                   | 0.0               | 7.8                                | 21.4                                      | 37.3   | 0.9                            | 4.1    | 16.2                                |
| 5.32                          |                  | (±1.83E-06)           | (±2.2)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±14.5)                            | (±9.2)                                    | (±19.0)  | (±0.4)                         | (±1.8) | (±1.0)                              |
| 5.32                          | 1.48             | 1.53E-06              | 8.3                                | 34.7                    | 44.9                  | 35.6              | 32.9                               | 37.8                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 6.80                          |                  | (±3.73E-05)           | (±4.2)                             | (±3.7)                  | (±5.8)                | (±0.8)            | (±33.4)                            | (±8.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 6.80                          | 1.60             | 1.30E-04              | 21.1                               | 54.2                    | 60.4                  | 38.6              | 108.4                              | 68.0                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 8.40                          |                  | (±9.26E-05)           | (±2.9)                             | (±5.5)                  | (±5.5)                | (±1.1)            | (±11.0)                            | (±6.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 8.40                          | 2.54             | 1.89E-06              | 11.7                               | 45.4                    | 41.5                  | 35.2              | 53.1                               | 52.4                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 10.94                         |                  | (±1.44E-05)           | (±4.3)                             | (±6.6)                  | (±5.6)                | (±1.1)            | (±40.0)                            | (±11.1)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 10.94                         | 3.14             | 2.12E-05              | 19.0                               | 56.6                    | 46.4                  | 35.9              | 112.1                              | 71.0                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 14.08                         |                  | (±1.69E-05)           | (±2.1)                             | (±4.0)                  | (±4.3)                | (±0.7)            | (±11.3)                            | (±5.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 14.08                         | 0.84             | 9.58E-06              | 17.4                               | 55.1                    | 40.6                  | 34.6              | 106.7                              | 69.0                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 14.92                         |                  | (±3.40E-06)           | (±1.7)                             | (±3.5)                  | (±3.1)                | (±0.4)            | (±15.0)                            | (±4.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 14.92                         | 2.20             | 6.15E-09              | 6.8                                | 0.0                     | 0.0                   | 0.0               | 6.6                                | 40.9                                      | 51.7   | 0.4                            | 1.9    | 16.7                                |
| 17.12                         |                  | (±3.20E-06)           | (±3.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±31.3)                            | (±11.2)                                   | (±23.3)  | (±0.2)                         | (±0.9) | (±0.7)                              |

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

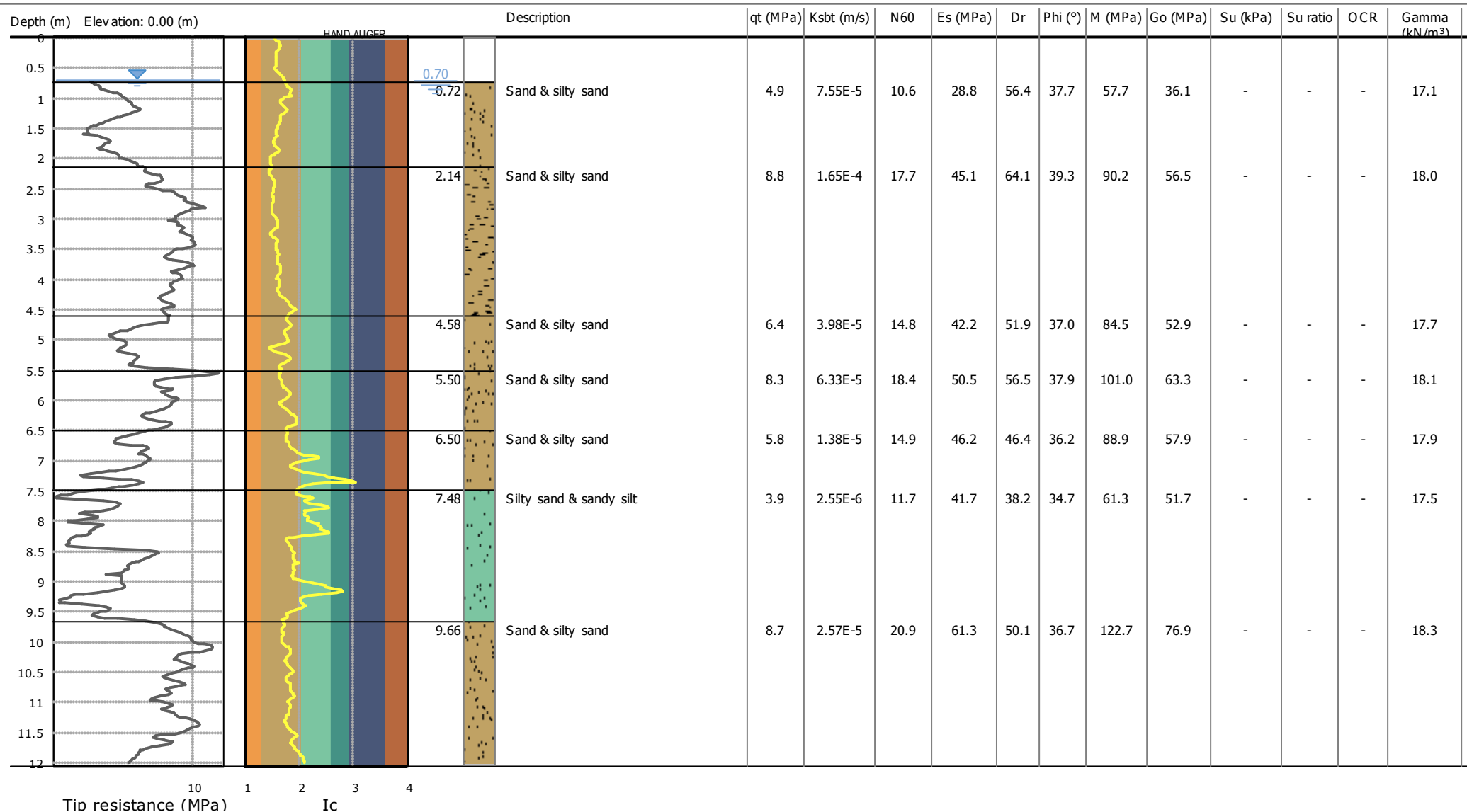
**CPT: CPTU 9 (Km 31.0)**

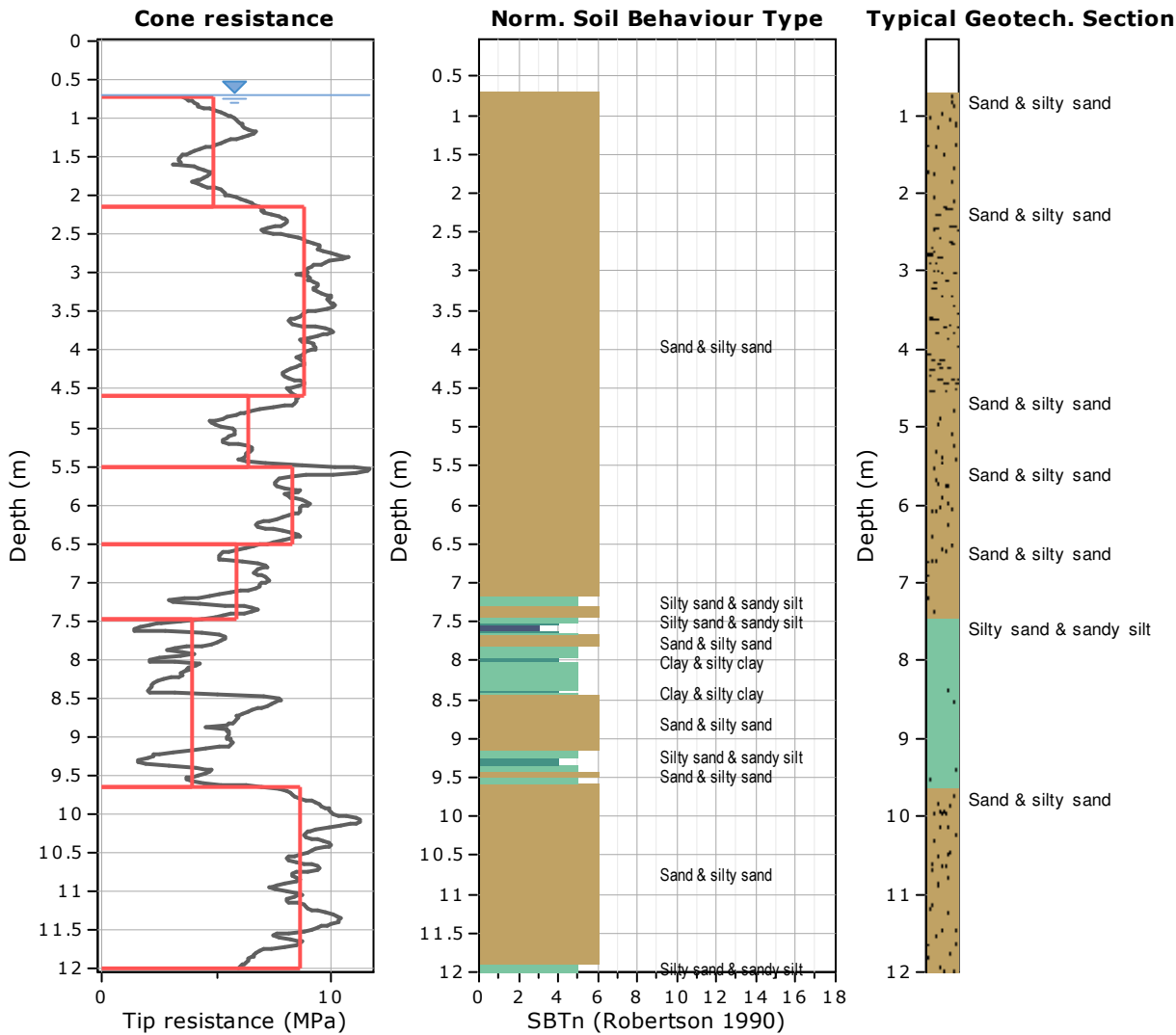
Total depth: 12.00 m

Coords: lat 44.724103° lon 12.212225°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.72 (m), **End depth:** 2.14 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance: 4.88 ±1.04 MPa

Sleeve friction: 21.49 ±5.82 kPa

Ic: 1.67 ±0.09

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability: 7.55E-05 ±4.50E-05 m/s

N<sub>60</sub>: 10.60 ±1.90 blows

Es: 28.84 ±4.08 MPa

Dr (%): 56.45 ±4.99

φ (degrees): 37.75 ±1.01 °

Unit weight: 17.12 ±0.44 kN/m<sup>3</sup>

Constrained Mod.: 57.68 ±8.16 MPa

Go: 36.15 ±5.11 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 2.14 (m), **End depth:** 4.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.79 ±0.86 MPa

Sleeve friction: 36.30 ±3.27 kPa

Ic: 1.56 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.65E-04 ±6.96E-05 m/s

N<sub>60</sub>: 17.72 ±1.37 blows

Es: 45.09 ±3.01 MPa

Dr (%): 64.08 ±2.97

φ (degrees): 39.29 ±0.63 °

Unit weight: 17.95 ±0.13 kN/m<sup>3</sup>

Constrained Mod.: 90.18 ±6.02 MPa

Go: 56.52 ±3.77 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 4.58 (m), **End depth:** 5.50 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.42 ±1.31 MPa

Sleeve friction: 32.42 ±3.14 kPa

Ic: 1.76 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.98E-05 ±4.27E-05 m/s

N<sub>60</sub>: 14.84 ±2.07 blows

Es: 42.24 ±3.16 MPa

Dr (%): 51.95 ±4.60

φ (degrees): 36.96 ±0.82 °

Unit weight: 17.70 ±0.16 kN/m<sup>3</sup>

Constrained Mod.: 84.47 ±6.32 MPa

Go: 52.94 ±3.96 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 5.50 (m), **End depth:** 6.50 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.34 ±1.13 MPa

Sleeve friction: 41.06 ±7.41 kPa

Ic: 1.69 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.33E-05 ±7.03E-05 m/s

N<sub>60</sub>: 18.44 ±1.35 blows

Es: 50.51 ±2.00 MPa

Dr (%): 56.48 ±3.53

φ (degrees): 37.85 ±0.66 °

Unit weight: 18.07 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 101.02 ±4.00 MPa

Go: 63.31 ±2.50 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 6.50 (m), **End depth:** 7.48 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.85 ±1.14 MPa

Sleeve friction: 38.96 ±6.85 kPa

Ic: 1.91 ±0.15

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.38E-05 ±1.41E-05 m/s

N<sub>60</sub>: 14.94 ±1.84 blows

Es: 46.21 ±2.88 MPa

Dr (%): 46.36 ±4.49

φ (degrees): 36.24 ±0.51 °

Unit weight: 17.88 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 88.88 ±13.15 MPa

Go: 57.91 ±3.61 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_7    **Start depth:** 7.48 (m), **End depth:** 9.66 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.93 ±1.71 MPa

Sleeve friction: 32.55 ±14.33 kPa

Ic: 2.13 ±0.29

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.55E-06 ±1.03E-05 m/s

N<sub>60</sub>: 11.71 ±3.06 blows

Es: 41.70 ±5.69 MPa

Dr (%): 38.18 ±6.16

φ (degrees): 34.73 ±0.95 °

Unit weight: 17.52 ±0.38 kN/m<sup>3</sup>

Constrained Mod.: 61.26 ±28.82 MPa

Go: 51.70 ±7.05 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_8    **Start depth:** 9.66 (m), **End depth:** 12.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.69 ±1.19 MPa

Sleeve friction: 50.46 ±7.45 kPa

Ic: 1.82 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.57E-05 ±1.86E-05 m/s

N<sub>60</sub>: 20.93 ±1.87 blows

Es: 61.34 ±3.93 MPa

Dr (%): 50.05 ±4.02

φ (degrees): 36.73 ±0.69 °

Unit weight: 18.33 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 122.68 ±7.87 MPa

Go: 76.88 ±4.93 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU 9 (Km 31.0)**

Total depth: 12.00 m, Date: 19/06/2019

Coords: lat 44.724103° lon 12.212225°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.72                          | 1.42             | 7.55E-05              | 10.6                               | 28.8                    | 56.4                  | 37.7              | 57.7                               | 36.1                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 2.14                          |                  | (±4.50E-05)           | (±1.9)                             | (±4.1)                  | (±5.0)                | (±1.0)            | (±8.2)                             | (±5.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 2.14                          | 2.44             | 1.65E-04              | 17.7                               | 45.1                    | 64.1                  | 39.3              | 90.2                               | 56.5                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 4.58                          |                  | (±6.96E-05)           | (±1.4)                             | (±3.0)                  | (±3.0)                | (±0.6)            | (±6.0)                             | (±3.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 4.58                          | 0.92             | 3.98E-05              | 14.8                               | 42.2                    | 51.9                  | 37.0              | 84.5                               | 52.9                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 5.50                          |                  | (±4.27E-05)           | (±2.1)                             | (±3.2)                  | (±4.6)                | (±0.8)            | (±6.3)                             | (±4.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.50                          | 1.00             | 6.33E-05              | 18.4                               | 50.5                    | 56.5                  | 37.9              | 101.0                              | 63.3                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 6.50                          |                  | (±7.03E-05)           | (±1.3)                             | (±2.0)                  | (±3.5)                | (±0.7)            | (±4.0)                             | (±2.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.50                          | 0.98             | 1.38E-05              | 14.9                               | 46.2                    | 46.4                  | 36.2              | 88.9                               | 57.9                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 7.48                          |                  | (±1.41E-05)           | (±1.8)                             | (±2.9)                  | (±4.5)                | (±0.5)            | (±13.2)                            | (±3.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.48                          | 2.18             | 2.55E-06              | 11.7                               | 41.7                    | 38.2                  | 34.7              | 61.3                               | 51.7                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 9.66                          |                  | (±1.03E-05)           | (±3.1)                             | (±5.7)                  | (±6.2)                | (±0.9)            | (±28.8)                            | (±7.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 9.66                          | 2.34             | 2.57E-05              | 20.9                               | 61.3                    | 50.1                  | 36.7              | 122.7                              | 76.9                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 12.00                         |                  | (±1.86E-05)           | (±1.9)                             | (±3.9)                  | (±4.0)                | (±0.7)            | (±7.9)                             | (±4.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

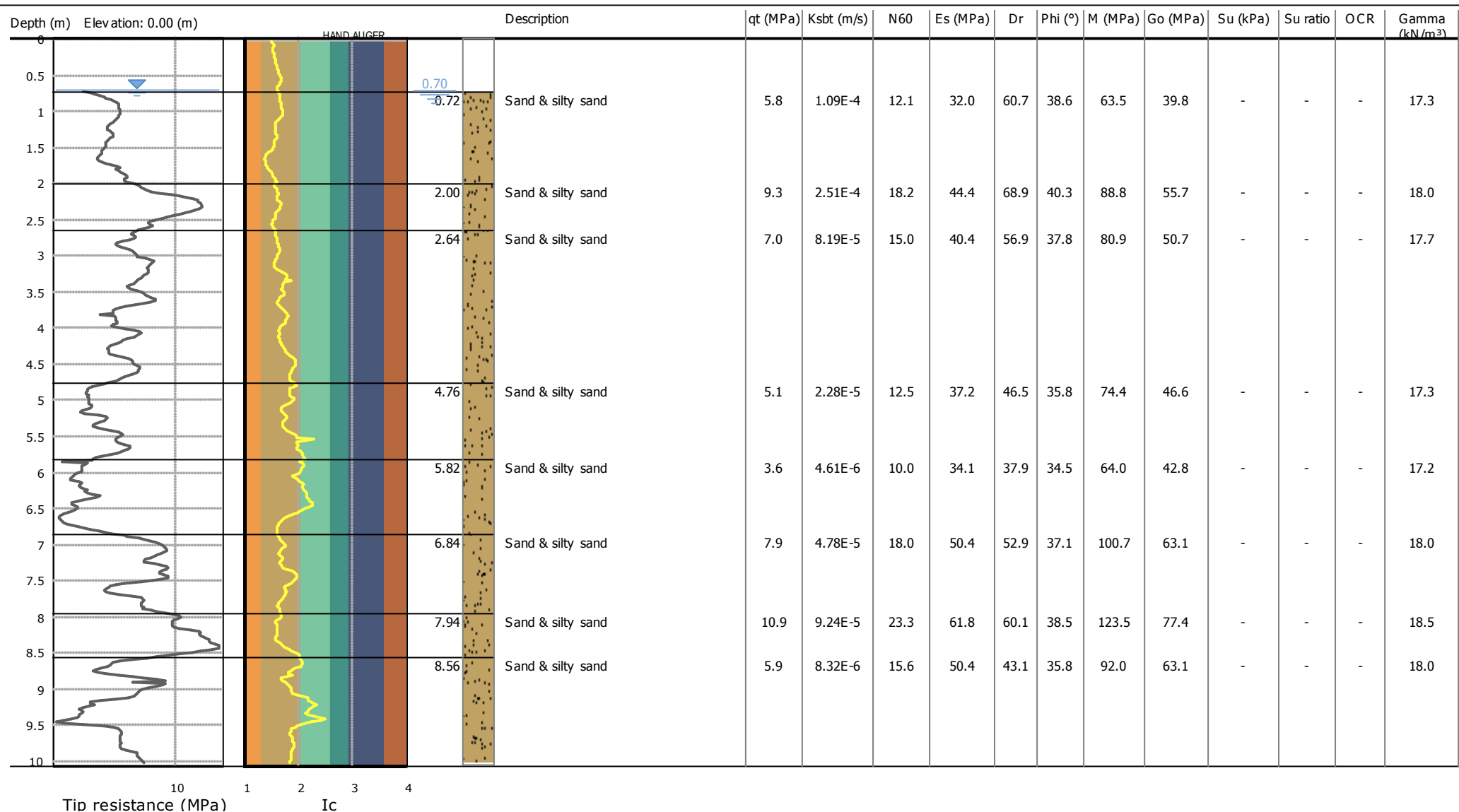
**CPT: CPTU 10 (Km 31.0)**

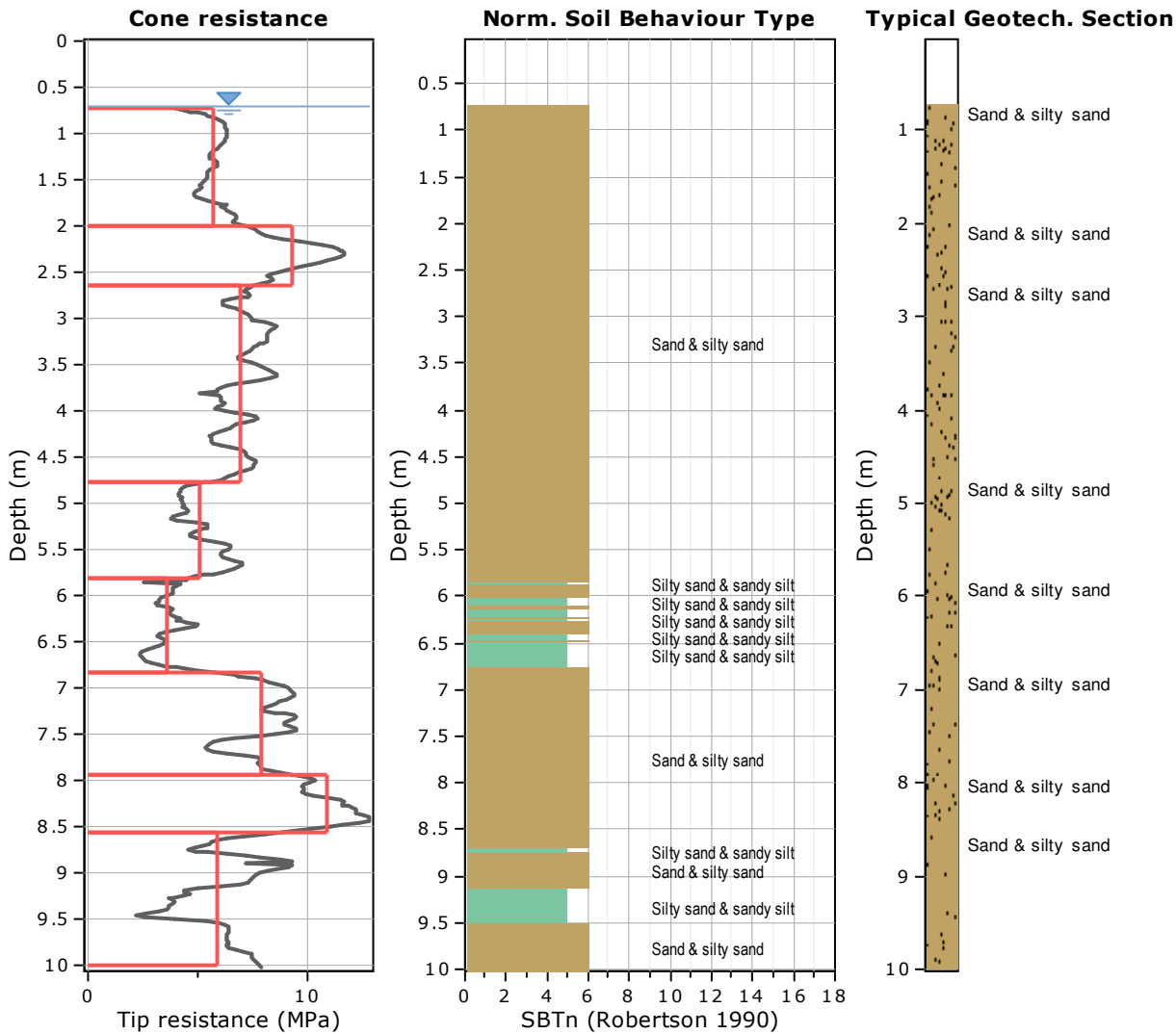
Total depth: 10.02 m

Coords: lat 44.724294° lon 12.212892°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.72 (m), **End depth:** 2.00 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $5.75 \pm 0.63$  MPa

Sleeve friction:  $24.75 \pm 6.19$  kPa

Ic:  $1.61 \pm 0.05$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $1.09\text{E-}04 \pm 4.38\text{E-}05$  m/s

N<sub>60</sub>:  $12.10 \pm 1.26$  blows

Es:  $32.02 \pm 2.82$  MPa

Dr (%):  $60.69 \pm 2.87$

φ (degrees):  $38.59 \pm 0.60$  °

Unit weight:  $17.35 \pm 0.48$  kN/m<sup>3</sup>

Constrained Mod.:  $63.53 \pm 6.49$  MPa

Go:  $39.81 \pm 4.07$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 2.00 (m), **End depth:** 2.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.33 ±1.52 MPa

Sleeve friction: 37.38 ±5.37 kPa

Ic: 1.50 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.51E-04 ±1.58E-04 m/s

N<sub>60</sub>: 18.15 ±2.11 blows

Es: 44.42 ±3.77 MPa

Dr (%): 68.92 ±4.35

φ (degrees): 40.29 ±0.87 °

Unit weight: 18.01 ±0.20 kN/m<sup>3</sup>

Constrained Mod.: 88.84 ±7.54 MPa

Go: 55.67 ±4.73 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 2.64 (m), **End depth:** 4.76 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.97 ±0.87 MPa

Sleeve friction: 30.23 ±3.15 kPa

Ic: 1.66 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.19E-05 ±4.93E-05 m/s

N<sub>60</sub>: 15.03 ±1.23 blows

Es: 40.44 ±2.07 MPa

Dr (%): 56.92 ±3.84

φ (degrees): 37.83 ±0.74 °

Unit weight: 17.65 ±0.13 kN/m<sup>3</sup>

Constrained Mod.: 80.88 ±4.14 MPa

Go: 50.69 ±2.59 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 4.76 (m), **End depth:** 5.82 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.14 ±0.95 MPa

Sleeve friction: 25.41 ±4.63 kPa

Ic: 1.84 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.28E-05 ±1.72E-05 m/s

N<sub>60</sub>: 12.49 ±1.63 blows

Es: 37.21 ±3.61 MPa

Dr (%): 46.51 ±3.39

φ (degrees): 35.79 ±0.67 °

Unit weight: 17.34 ±0.26 kN/m<sup>3</sup>

Constrained Mod.: 74.43 ±7.23 MPa

Go: 46.64 ±4.53 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 5.82 (m), **End depth:** 6.84 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 3.58 ±0.75 MPa

Sleeve friction: 24.51 ±5.59 kPa

Ic: 2.07 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.61E-06 ±4.14E-06 m/s

N<sub>60</sub>: 10.02 ±1.64 blows

Es: 34.11 ±3.77 MPa

Dr (%): 37.90 ±3.80

φ (degrees): 34.45 ±0.77 °

Unit weight: 17.16 ±0.33 kN/m<sup>3</sup>

Constrained Mod.: 63.96 ±13.35 MPa

Go: 42.75 ±4.73 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 6.84 (m), **End depth:** 7.94 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.93 ±1.27 MPa

Sleeve friction: 37.75 ±4.99 kPa

Ic: 1.73 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.78E-05 ±3.37E-05 m/s

N<sub>60</sub>: 18.04 ±1.87 blows

Es: 50.37 ±3.27 MPa

Dr (%): 52.92 ±4.21

φ (degrees): 37.09 ±0.69 °

Unit weight: 17.96 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 100.74 ±6.54 MPa

Go: 63.13 ±4.10 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 7.94 (m), **End depth:** 8.56 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.93 ±1.21 MPa

Sleeve friction: 52.06 ±9.08 kPa

Ic: 1.64 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.24E-05 ±3.23E-05 m/s

N<sub>60</sub>: 23.29 ±2.05 blows

Es: 61.77 ±4.54 MPa

Dr (%): 60.14 ±3.04

φ (degrees): 38.51 ±0.59 °

Unit weight: 18.45 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 123.55 ±9.08 MPa

Go: 77.42 ±5.69 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 8.56 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.86 ±1.74 MPa

Sleeve friction: 42.01 ±10.13 kPa

Ic: 1.98 ±0.18

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.32E-06 ±1.52E-05 m/s

N<sub>60</sub>: 15.57 ±3.07 blows

Es: 50.38 ±6.12 MPa

Dr (%): 43.11 ±6.51

φ (degrees): 35.76 ±0.95 °

Unit weight: 17.97 ±0.33 kN/m<sup>3</sup>

Constrained Mod.: 92.04 ±23.02 MPa

Go: 63.14 ±7.67 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**Project:**

**Location:**

**CPT: CPTU 10 (Km 31.0)**

Total depth: 10.02 m, Date: 19/06/2019

Coords: lat 44.724294° lon 12.212892°

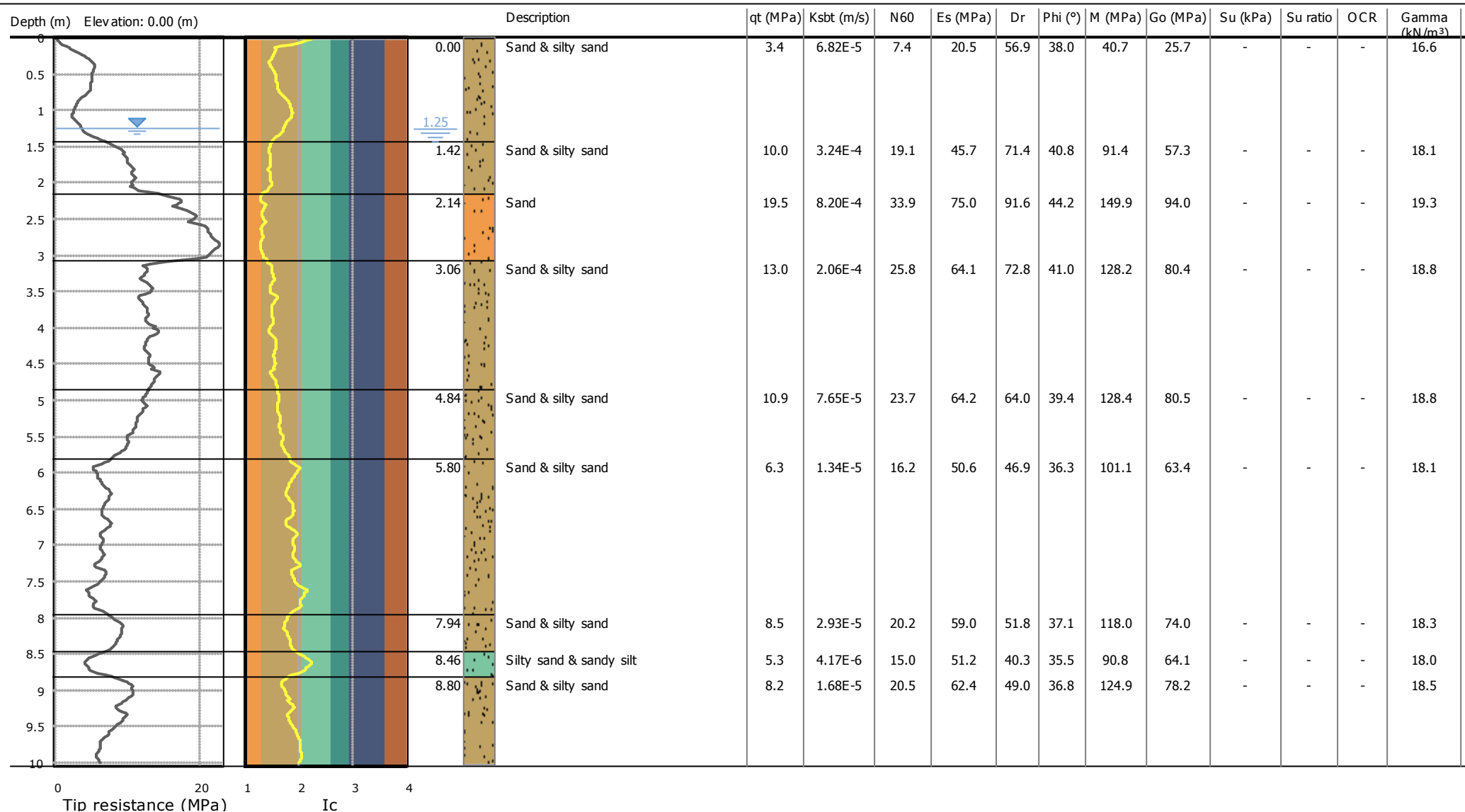
**Summary table of mean values**

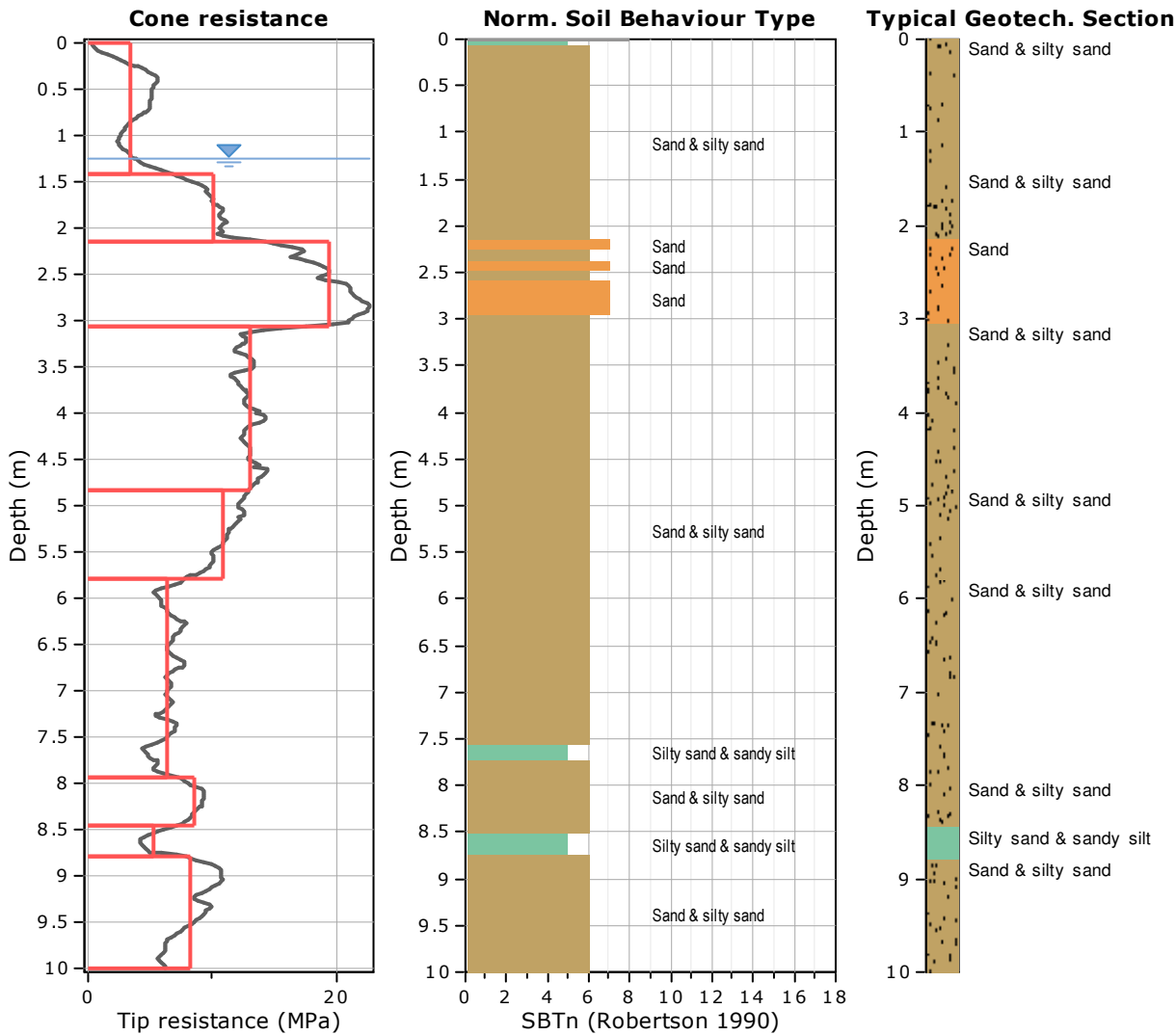
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.72                          | 1.28             | 1.09E-04              | 12.1                               | 32.0                    | 60.7                  | 38.6              | 63.5                               | 39.8                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 2.00                          |                  | (±4.38E-05)           | (±1.3)                             | (±2.8)                  | (±2.9)                | (±0.6)            | (±6.5)                             | (±4.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 2.00                          | 0.64             | 2.51E-04              | 18.2                               | 44.4                    | 68.9                  | 40.3              | 88.8                               | 55.7                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 2.64                          |                  | (±1.58E-04)           | (±2.1)                             | (±3.8)                  | (±4.4)                | (±0.9)            | (±7.5)                             | (±4.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.64                          | 2.12             | 8.19E-05              | 15.0                               | 40.4                    | 56.9                  | 37.8              | 80.9                               | 50.7                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 4.76                          |                  | (±4.93E-05)           | (±1.2)                             | (±2.1)                  | (±3.8)                | (±0.7)            | (±4.1)                             | (±2.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 4.76                          | 1.06             | 2.28E-05              | 12.5                               | 37.2                    | 46.5                  | 35.8              | 74.4                               | 46.6                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 5.82                          |                  | (±1.72E-05)           | (±1.6)                             | (±3.6)                  | (±3.4)                | (±0.7)            | (±7.2)                             | (±4.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 5.82                          | 1.02             | 4.61E-06              | 10.0                               | 34.1                    | 37.9                  | 34.5              | 64.0                               | 42.8                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 6.84                          |                  | (±4.14E-06)           | (±1.6)                             | (±3.8)                  | (±3.8)                | (±0.8)            | (±13.4)                            | (±4.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.84                          | 1.10             | 4.78E-05              | 18.0                               | 50.4                    | 52.9                  | 37.1              | 100.7                              | 63.1                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 7.94                          |                  | (±3.37E-05)           | (±1.9)                             | (±3.3)                  | (±4.2)                | (±0.7)            | (±6.5)                             | (±4.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.94                          | 0.62             | 9.24E-05              | 23.3                               | 61.8                    | 60.1                  | 38.5              | 123.5                              | 77.4                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 8.56                          |                  | (±3.23E-05)           | (±2.0)                             | (±4.5)                  | (±3.0)                | (±0.6)            | (±9.1)                             | (±5.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.56                          | 1.44             | 8.32E-06              | 15.6                               | 50.4                    | 43.1                  | 35.8              | 92.0                               | 63.1                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 10.00                         |                  | (±1.52E-05)           | (±3.1)                             | (±6.1)                  | (±6.5)                | (±0.9)            | (±23.0)                            | (±7.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 1.42 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $3.40 \pm 1.52$  MPa

Sleeve friction:  $16.00 \pm 5.51$  kPa

Ic:  $1.68 \pm 0.17$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $6.82E-05 \pm 1.02E-04$  m/s

N<sub>60</sub>:  $7.44 \pm 2.80$  blows

Es:  $20.52 \pm 6.55$  MPa

Dr (%):  $56.87 \pm 8.62$

φ (degrees):  $38.03 \pm 1.95$  °

Unit weight:  $16.65 \pm 0.58$  kN/m<sup>3</sup>

Constrained Mod.:  $40.71 \pm 13.29$  MPa

Go:  $25.71 \pm 8.21$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 1.42 (m), **End depth:** 2.14 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.04 ±1.42 MPa

Sleeve friction: 38.26 ±8.73 kPa

Ic: 1.46 ±0.03

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.24E-04 ±1.10E-04 m/s

N<sub>60</sub>: 19.08 ±2.46 blows

Es: 45.71 ±5.28 MPa

Dr (%): 71.37 ±3.78

φ (degrees): 40.77 ±0.75 °

Unit weight: 18.06 ±0.35 kN/m<sup>3</sup>

Constrained Mod.: 91.41 ±10.56 MPa

Go: 57.29 ±6.62 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.14 (m), **End depth:** 3.06 (m)**Description:** Sand**Basic results**

Total cone resistance: 19.46 ±2.29 MPa

Sleeve friction: 86.60 ±18.22 kPa

Ic: 1.33 ±0.03

SBT<sub>n</sub>: 7SBT<sub>n</sub> description: Sand**Estimation results**

Permeability: 8.20E-04 ±1.80E-04 m/s

N<sub>60</sub>: 33.93 ±3.77 blows

Es: 74.96 ±8.31 MPa

Dr (%): 91.62 ±4.26

φ (degrees): 44.21 ±0.65 °

Unit weight: 19.26 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 149.92 ±16.62 MPa

Go: 93.95 ±10.42 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 3.06 (m), **End depth:** 4.84 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 13.01 ±0.88 MPa

Sleeve friction: 67.66 ±8.74 kPa

Ic: 1.52 ±0.05

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.06E-04 ±7.06E-05 m/s

N<sub>60</sub>: 25.80 ±1.54 blows

Es: 64.11 ±3.90 MPa

Dr (%): 72.77 ±2.26

φ (degrees): 41.04 ±0.41 °

Unit weight: 18.82 ±0.15 kN/m<sup>3</sup>

Constrained Mod.: 128.23 ±7.80 MPa

Go: 80.36 ±4.89 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 4.84 (m), **End depth:** 5.80 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.93 ±1.38 MPa

Sleeve friction: 69.39 ±8.06 kPa

Ic: 1.67 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 7.65E-05 ±2.86E-05 m/s

N<sub>60</sub>: 23.73 ±2.20 blows

Es: 64.22 ±3.93 MPa

Dr (%): 64.03 ±4.46

φ (degrees): 39.43 ±0.77 °

Unit weight: 18.78 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 128.44 ±7.86 MPa

Go: 80.49 ±4.93 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 5.80 (m), **End depth:** 7.94 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.35 ±0.82 MPa

Sleeve friction: 44.87 ±4.55 kPa

Ic: 1.91 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.34E-05 ±9.71E-06 m/s

N<sub>60</sub>: 16.23 ±1.29 blows

Es: 50.57 ±2.15 MPa

Dr (%): 46.90 ±3.46

φ (degrees): 36.33 ±0.53 °

Unit weight: 18.07 ±0.12 kN/m<sup>3</sup>

Constrained Mod.: 101.14 ±4.29 MPa

Go: 63.38 ±2.69 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 7.94 (m), **End depth:** 8.46 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.52 ±0.69 MPa

Sleeve friction: 51.02 ±7.03 kPa

Ic: 1.80 ±0.05

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.93E-05 ±1.17E-05 m/s

N<sub>60</sub>: 20.18 ±1.28 blows

Es: 59.02 ±3.14 MPa

Dr (%): 51.79 ±2.11

φ (degrees): 37.09 ±0.39 °

Unit weight: 18.33 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 118.03 ±6.28 MPa

Go: 73.97 ±3.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 8.46 (m), **End depth:** 8.80 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.26 ±1.18 MPa

Sleeve friction: 46.56 ±3.74 kPa

Ic: 2.08 ±0.13

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 4.17E-06 ±7.57E-06 m/s

N<sub>60</sub>: 15.00 ±1.97 blows

Es: 51.17 ±2.94 MPa

Dr (%): 40.30 ±4.27

φ (degrees): 35.47 ±0.47 °

Unit weight: 18.04 ±0.12 kN/m<sup>3</sup>

Constrained Mod.: 90.76 ±21.16 MPa

Go: 64.13 ±3.69 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 8.80 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.18 ±1.71 MPa

Sleeve friction: 57.43 ±10.30 kPa

Ic: 1.88 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.68E-05 ±1.86E-05 m/s

N<sub>60</sub>: 20.48 ±2.90 blows

Es: 62.43 ±5.65 MPa

Dr (%): 49.01 ±5.61

φ (degrees): 36.77 ±0.98 °

Unit weight: 18.45 ±0.26 kN/m<sup>3</sup>

Constrained Mod.: 124.86 ±11.31 MPa

Go: 78.25 ±7.09 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km35+500**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.761497° lon 12.192237°

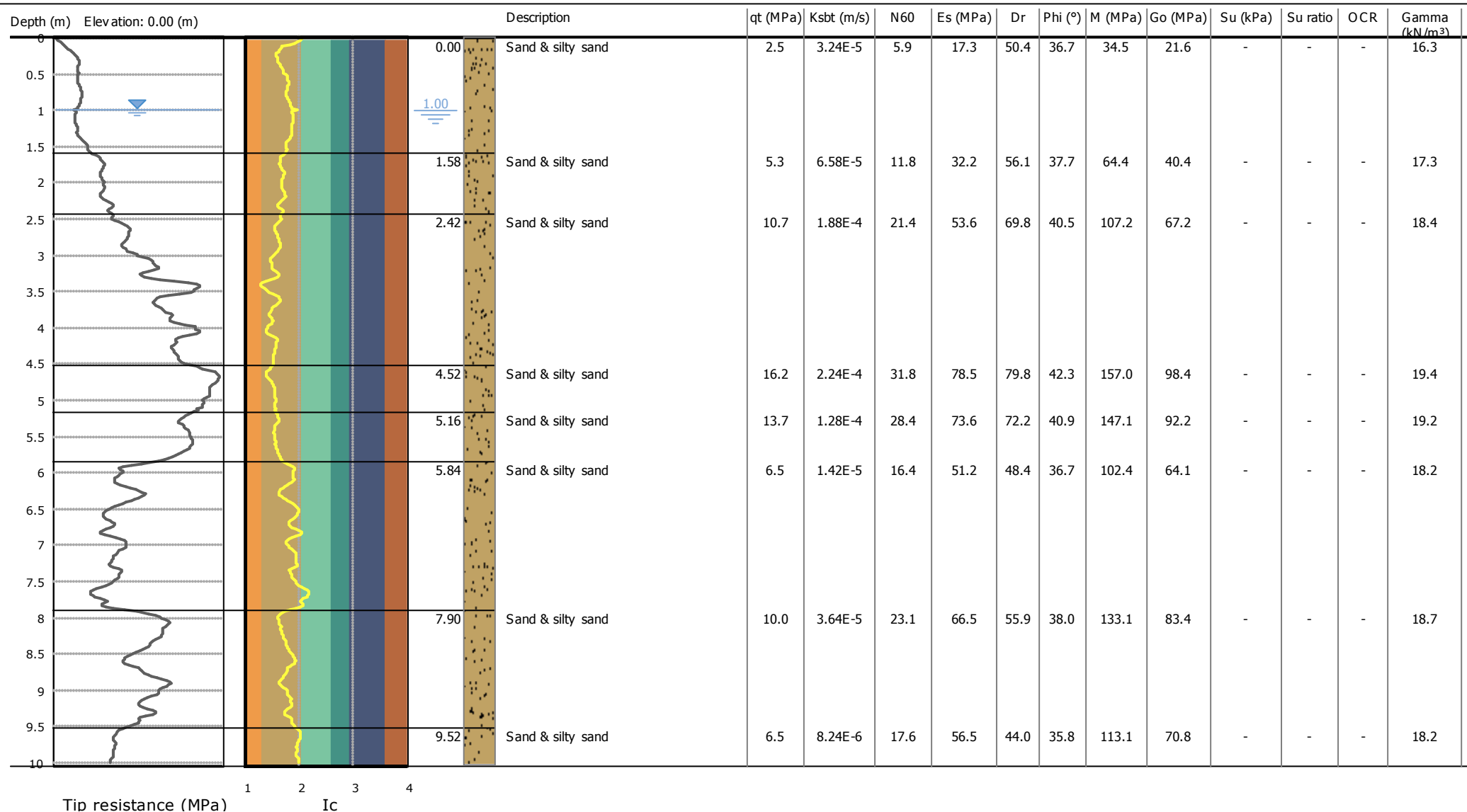
### Summary table of mean values

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.42             | 6.82E-05              | 7.4                                | 20.5                    | 56.9                  | 38.0              | 40.7                               | 25.7                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 1.42                          |                  | (±1.02E-04)           | (±2.8)                             | (±6.6)                  | (±8.6)                | (±2.0)            | (±13.3)                            | (±8.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 1.42                          | 0.72             | 3.24E-04              | 19.1                               | 45.7                    | 71.4                  | 40.8              | 91.4                               | 57.3                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 2.14                          |                  | (±1.10E-04)           | (±2.5)                             | (±5.3)                  | (±3.8)                | (±0.7)            | (±10.6)                            | (±6.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 2.14                          | 0.92             | 8.20E-04              | 33.9                               | 75.0                    | 91.6                  | 44.2              | 149.9                              | 94.0                                      | 0.0  | 0.0                            | 0.0    | 19.3                                |
| 3.06                          |                  | (±1.80E-04)           | (±3.8)                             | (±8.3)                  | (±4.3)                | (±0.7)            | (±16.6)                            | (±10.4)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 3.06                          | 1.78             | 2.06E-04              | 25.8                               | 64.1                    | 72.8                  | 41.0              | 128.2                              | 80.4                                      | 0.0  | 0.0                            | 0.0    | 18.8                                |
| 4.84                          |                  | (±7.06E-05)           | (±1.5)                             | (±3.9)                  | (±2.3)                | (±0.4)            | (±7.8)                             | (±4.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.84                          | 0.96             | 7.65E-05              | 23.7                               | 64.2                    | 64.0                  | 39.4              | 128.4                              | 80.5                                      | 0.0  | 0.0                            | 0.0    | 18.8                                |
| 5.80                          |                  | (±2.86E-05)           | (±2.2)                             | (±3.9)                  | (±4.5)                | (±0.8)            | (±7.9)                             | (±4.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.80                          | 2.14             | 1.34E-05              | 16.2                               | 50.6                    | 46.9                  | 36.3              | 101.1                              | 63.4                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 7.94                          |                  | (±9.71E-06)           | (±1.3)                             | (±2.1)                  | (±3.5)                | (±0.5)            | (±4.3)                             | (±2.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 7.94                          | 0.52             | 2.93E-05              | 20.2                               | 59.0                    | 51.8                  | 37.1              | 118.0                              | 74.0                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 8.46                          |                  | (±1.17E-05)           | (±1.3)                             | (±3.1)                  | (±2.1)                | (±0.4)            | (±6.3)                             | (±3.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.46                          | 0.34             | 4.17E-06              | 15.0                               | 51.2                    | 40.3                  | 35.5              | 90.8                               | 64.1                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 8.80                          |                  | (±7.57E-06)           | (±2.0)                             | (±2.9)                  | (±4.3)                | (±0.5)            | (±21.2)                            | (±3.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 8.80                          | 1.20             | 1.68E-05              | 20.5                               | 62.4                    | 49.0                  | 36.8              | 124.9                              | 78.2                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 10.00                         |                  | (±1.86E-05)           | (±2.9)                             | (±5.7)                  | (±5.6)                | (±1.0)            | (±11.3)                            | (±7.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |

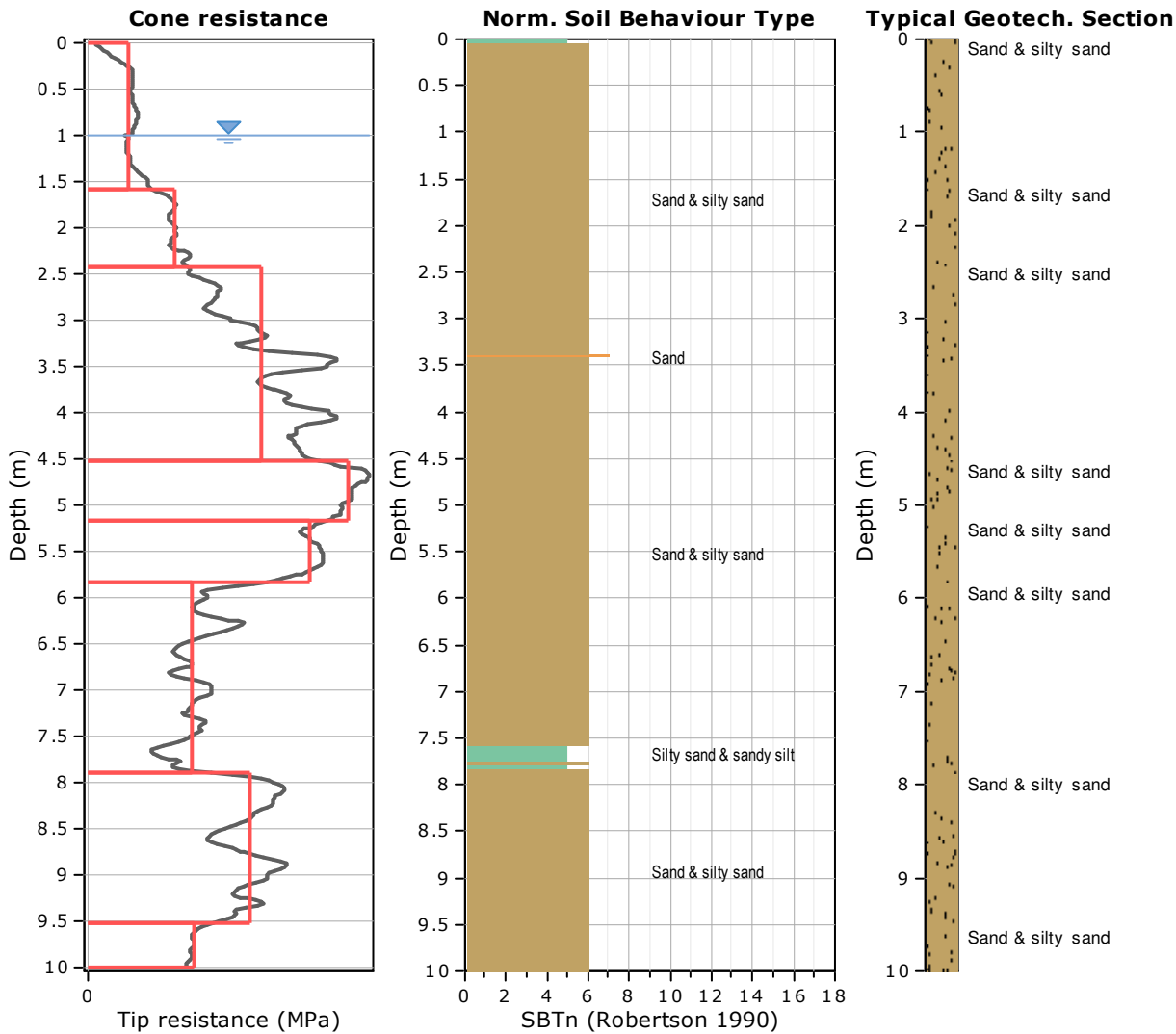
Depth values presented in this table are measured from free ground surface

**Project:**

**Location:**







### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.00 (m), **End depth:** 1.58 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $2.50 \pm 0.68$  MPa

Sleeve friction:  $12.80 \pm 3.62$  kPa

Ic:  $1.79 \pm 0.10$

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability:  $3.24E-05 \pm 3.52E-05$  m/s

N<sub>60</sub>:  $5.86 \pm 1.60$  blows

Es:  $17.26 \pm 4.77$  MPa

Dr (%):  $50.43 \pm 5.39$

φ (degrees):  $36.67 \pm 1.38$  °

Unit weight:  $16.27 \pm 0.45$  kN/m<sup>3</sup>

Constrained Mod.:  $34.53 \pm 9.53$  MPa

Go:  $21.64 \pm 5.97$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 1.58 (m), **End depth:** 2.42 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.32 ±0.50 MPa

Sleeve friction: 25.37 ±3.14 kPa

Ic: 1.69 ±0.04

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.58E-05 ±1.86E-05 m/s

N<sub>60</sub>: 11.75 ±0.92 blows

Es: 32.21 ±2.27 MPa

Dr (%): 56.12 ±1.49

φ (degrees): 37.68 ±0.28 °

Unit weight: 17.35 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 64.42 ±4.54 MPa

Go: 40.37 ±2.85 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.42 (m), **End depth:** 4.52 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.69 ±2.71 MPa

Sleeve friction: 52.16 ±18.22 kPa

Ic: 1.54 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.88E-04 ±1.88E-04 m/s

N<sub>60</sub>: 21.42 ±4.57 blows

Es: 53.61 ±10.20 MPa

Dr (%): 69.85 ±6.08

φ (degrees): 40.47 ±1.20 °

Unit weight: 18.45 ±0.46 kN/m<sup>3</sup>

Constrained Mod.: 107.23 ±20.39 MPa

Go: 67.20 ±12.78 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 4.52 (m), **End depth:** 5.16 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 16.16 ±0.83 MPa

Sleeve friction: 100.28 ±15.45 kPa

Ic: 1.51 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.24E-04 ±1.20E-04 m/s

N<sub>60</sub>: 31.82 ±1.30 blows

Es: 78.50 ±4.47 MPa

Dr (%): 79.80 ±1.93

φ (degrees): 42.31 ±0.33 °

Unit weight: 19.36 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 157.01 ±8.95 MPa

Go: 98.39 ±5.61 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 5.16 (m), **End depth:** 5.84 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 13.71 ±0.88 MPa

Sleeve friction: 89.65 ±6.43 kPa

Ic: 1.59 ±0.04

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.28E-04 ±3.25E-05 m/s

N<sub>60</sub>: 28.40 ±1.34 blows

Es: 73.57 ±2.35 MPa

Dr (%): 72.20 ±2.43

φ (degrees): 40.95 ±0.44 °

Unit weight: 19.16 ±0.09 kN/m<sup>3</sup>

Constrained Mod.: 147.14 ±4.70 MPa

Go: 92.21 ±2.95 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 5.84 (m), **End depth:** 7.90 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.49 ±1.36 MPa

Sleeve friction: 48.19 ±10.31 kPa

Ic: 1.90 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.42E-05 ±2.08E-05 m/s

N<sub>60</sub>: 16.43 ±2.23 blows

Es: 51.18 ±4.46 MPa

Dr (%): 48.35 ±5.33

φ (degrees): 36.73 ±0.88 °

Unit weight: 18.16 ±0.27 kN/m<sup>3</sup>

Constrained Mod.: 102.36 ±8.92 MPa

Go: 64.14 ±5.59 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 7.90 (m), **End depth:** 9.52 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.97 ±1.41 MPa

Sleeve friction: 65.91 ±9.07 kPa

Ic: 1.77 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.64E-05 ±2.99E-05 m/s

N<sub>60</sub>: 23.14 ±2.16 blows

Es: 66.53 ±4.24 MPa

Dr (%): 55.95 ±4.15

φ (degrees): 38.02 ±0.65 °

Unit weight: 18.69 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 133.06 ±8.49 MPa

Go: 83.38 ±5.32 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 9.52 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.55 ±0.37 MPa

Sleeve friction: 50.40 ±8.76 kPa

Ic: 1.99 ±0.03

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.24E-06 ±1.66E-06 m/s

N<sub>60</sub>: 17.56 ±0.88 blows

Es: 56.53 ±3.34 MPa

Dr (%): 43.97 ±1.42

φ (degrees): 35.82 ±0.44 °

Unit weight: 18.22 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 113.05 ±6.68 MPa

Go: 70.85 ±4.18 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km36+000**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.765533° lon 12.19032°

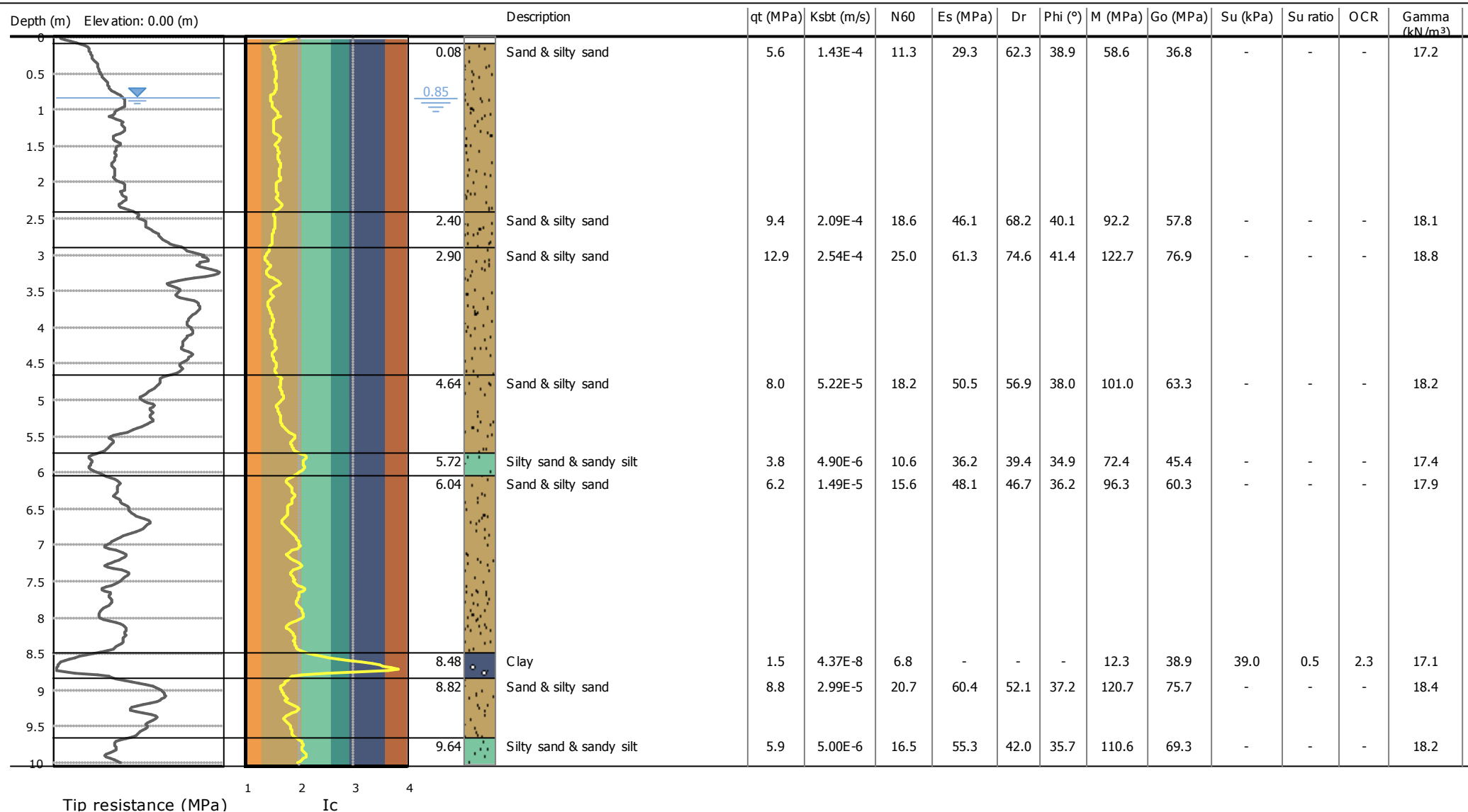
**Summary table of mean values**

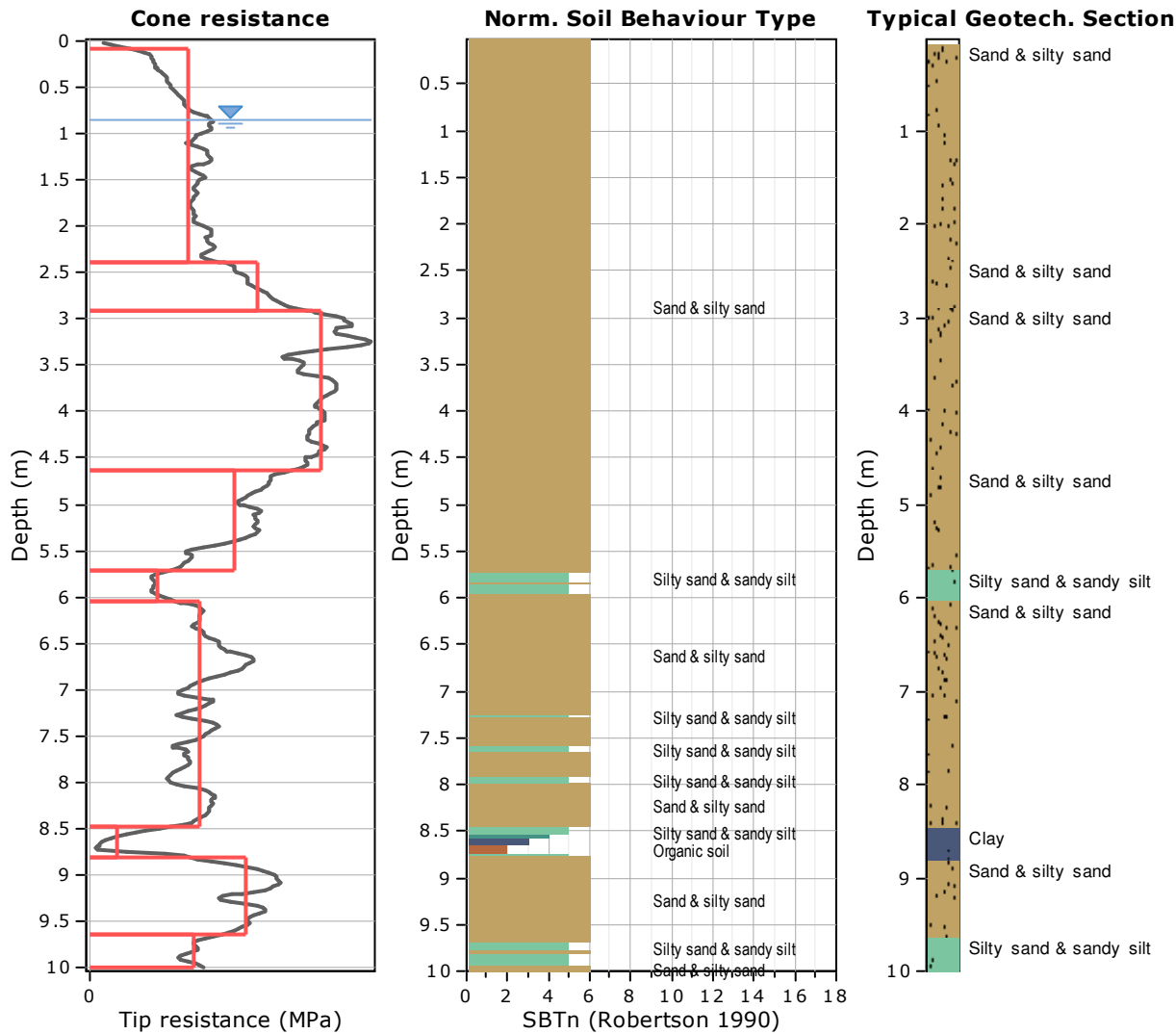
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.58             | 3.24E-05              | 5.9                                | 17.3                    | 50.4                  | 36.7              | 34.5                               | 21.6                                      | 0.0  | 0.0                            | 0.0    | 16.3                                |
| 1.58                          |                  | (±3.52E-05)           | (±1.6)                             | (±4.8)                  | (±5.4)                | (±1.4)            | (±9.5)                             | (±6.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 1.58                          | 0.84             | 6.58E-05              | 11.8                               | 32.2                    | 56.1                  | 37.7              | 64.4                               | 40.4                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 2.42                          |                  | (±1.86E-05)           | (±0.9)                             | (±2.3)                  | (±1.5)                | (±0.3)            | (±4.5)                             | (±2.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.42                          | 2.10             | 1.88E-04              | 21.4                               | 53.6                    | 69.8                  | 40.5              | 107.2                              | 67.2                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 4.52                          |                  | (±1.88E-04)           | (±4.6)                             | (±10.2)                 | (±6.1)                | (±1.2)            | (±20.4)                            | (±12.8)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 4.52                          | 0.64             | 2.24E-04              | 31.8                               | 78.5                    | 79.8                  | 42.3              | 157.0                              | 98.4                                      | 0.0  | 0.0                            | 0.0    | 19.4                                |
| 5.16                          |                  | (±1.20E-04)           | (±1.3)                             | (±4.5)                  | (±1.9)                | (±0.3)            | (±8.9)                             | (±5.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.16                          | 0.68             | 1.28E-04              | 28.4                               | 73.6                    | 72.2                  | 40.9              | 147.1                              | 92.2                                      | 0.0  | 0.0                            | 0.0    | 19.2                                |
| 5.84                          |                  | (±3.25E-05)           | (±1.3)                             | (±2.4)                  | (±2.4)                | (±0.4)            | (±4.7)                             | (±2.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 5.84                          | 2.06             | 1.42E-05              | 16.4                               | 51.2                    | 48.4                  | 36.7              | 102.4                              | 64.1                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 7.90                          |                  | (±2.08E-05)           | (±2.2)                             | (±4.5)                  | (±5.3)                | (±0.9)            | (±8.9)                             | (±5.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.90                          | 1.62             | 3.64E-05              | 23.1                               | 66.5                    | 55.9                  | 38.0              | 133.1                              | 83.4                                      | 0.0  | 0.0                            | 0.0    | 18.7                                |
| 9.52                          |                  | (±2.99E-05)           | (±2.2)                             | (±4.2)                  | (±4.2)                | (±0.6)            | (±8.5)                             | (±5.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 9.52                          | 0.48             | 8.24E-06              | 17.6                               | 56.5                    | 44.0                  | 35.8              | 113.1                              | 70.8                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 10.00                         |                  | (±1.66E-06)           | (±0.9)                             | (±3.3)                  | (±1.4)                | (±0.4)            | (±6.7)                             | (±4.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.08 (m), **End depth:** 2.40 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $5.55 \pm 1.11$  MPa

Sleeve friction:  $22.95 \pm 4.96$  kPa

Ic:  $1.58 \pm 0.05$

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability:  $1.43E-04 \pm 5.51E-05$  m/s

N<sub>60</sub>:  $11.34 \pm 2.31$  blows

Es:  $29.32 \pm 6.18$  MPa

Dr (%):  $62.32 \pm 2.66$

φ (degrees):  $38.92 \pm 0.57$  °

Unit weight:  $17.25 \pm 0.35$  kN/m<sup>3</sup>

Constrained Mod.:  $58.64 \pm 12.36$  MPa

Go:  $36.75 \pm 7.75$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 2.40 (m), **End depth:** 2.90 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.36 ±1.22 MPa

Sleeve friction: 40.48 ±6.75 kPa

Ic: 1.52 ±0.03

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.09E-04 ±4.75E-05 m/s

N<sub>60</sub>: 18.58 ±2.10 blows

Es: 46.08 ±4.40 MPa

Dr (%): 68.18 ±3.28

φ (degrees): 40.14 ±0.66 °

Unit weight: 18.10 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 92.16 ±8.80 MPa

Go: 57.75 ±5.52 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 2.90 (m), **End depth:** 4.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 12.92 ±1.05 MPa

Sleeve friction: 64.15 ±8.40 kPa

Ic: 1.49 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.54E-04 ±1.32E-04 m/s

N<sub>60</sub>: 25.05 ±1.29 blows

Es: 61.34 ±2.80 MPa

Dr (%): 74.65 ±3.41

φ (degrees): 41.39 ±0.62 °

Unit weight: 18.76 ±0.15 kN/m<sup>3</sup>

Constrained Mod.: 122.68 ±5.59 MPa

Go: 76.88 ±3.51 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 4.64 (m), **End depth:** 5.72 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.04 ±1.85 MPa

Sleeve friction: 45.55 ±10.48 kPa

Ic: 1.72 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.22E-05 ±3.92E-05 m/s

N<sub>60</sub>: 18.16 ±3.08 blows

Es: 50.49 ±6.04 MPa

Dr (%): 56.92 ±6.83

φ (degrees): 38.04 ±1.26 °

Unit weight: 18.18 ±0.34 kN/m<sup>3</sup>

Constrained Mod.: 100.99 ±12.09 MPa

Go: 63.28 ±7.58 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 5.72 (m), **End depth:** 6.04 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.82 ±0.43 MPa

Sleeve friction: 28.75 ±2.27 kPa

Ic: 2.06 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.90E-06 ±2.80E-06 m/s

N<sub>60</sub>: 10.62 ±0.79 blows

Es: 36.22 ±1.37 MPa

Dr (%): 39.37 ±1.89

φ (degrees): 34.87 ±0.27 °

Unit weight: 17.37 ±0.10 kN/m<sup>3</sup>

Constrained Mod.: 72.45 ±2.74 MPa

Go: 45.40 ±1.72 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 6.04 (m), **End depth:** 8.48 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.17 ±1.12 MPa

Sleeve friction: 40.33 ±7.71 kPa

Ic: 1.90 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.49E-05 ±1.46E-05 m/s

N<sub>60</sub>: 15.59 ±1.90 blows

Es: 48.13 ±4.19 MPa

Dr (%): 46.75 ±4.43

φ (degrees): 36.20 ±0.81 °

Unit weight: 17.94 ±0.26 kN/m<sup>3</sup>

Constrained Mod.: 96.27 ±8.37 MPa

Go: 60.33 ±5.25 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 8.48 (m), **End depth:** 8.82 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.51 ±1.95 MPa

Sleeve friction: 30.37 ±5.51 kPa

Ic: 2.71 ±0.69

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 4.37E-08 ±7.37E-06 m/s

N<sub>60</sub>: 6.79 ±3.95 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.07 ±0.36 kN/m<sup>3</sup>

Constrained Mod.: 12.30 ±40.21 MPa

Go: 38.88 ±10.29 MPa

Su: 38.98 ±42.05 kPa

Su ratio: 0.49 ±0.52

O.C.R.: 2.28 ±2.42

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 8.82 (m), **End depth:** 9.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.76 ±1.26 MPa

Sleeve friction: 52.07 ±14.91 kPa

Ic: 1.80 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.99E-05 ±2.07E-05 m/s

N<sub>60</sub>: 20.71 ±2.36 blows

Es: 60.36 ±6.72 MPa

Dr (%): 52.11 ±3.82

φ (degrees): 37.17 ±0.83 °

Unit weight: 18.37 ±0.43 kN/m<sup>3</sup>

Constrained Mod.: 120.72 ±13.44 MPa

Go: 75.65 ±8.42 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 9.64 (m), **End depth:** 10.00 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.87 ±0.62 MPa

Sleeve friction: 52.85 ±3.28 kPa

Ic: 2.06 ±0.05

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.00E-06 ±2.41E-06 m/s

N<sub>60</sub>: 16.52 ±1.04 blows

Es: 55.30 ±2.23 MPa

Dr (%): 42.01 ±2.30

φ (degrees): 35.73 ±0.35 °

Unit weight: 18.23 ±0.10 kN/m<sup>3</sup>

Constrained Mod.: 110.59 ±4.46 MPa

Go: 69.30 ±2.80 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km36+500**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.769812° lon 12.18858°

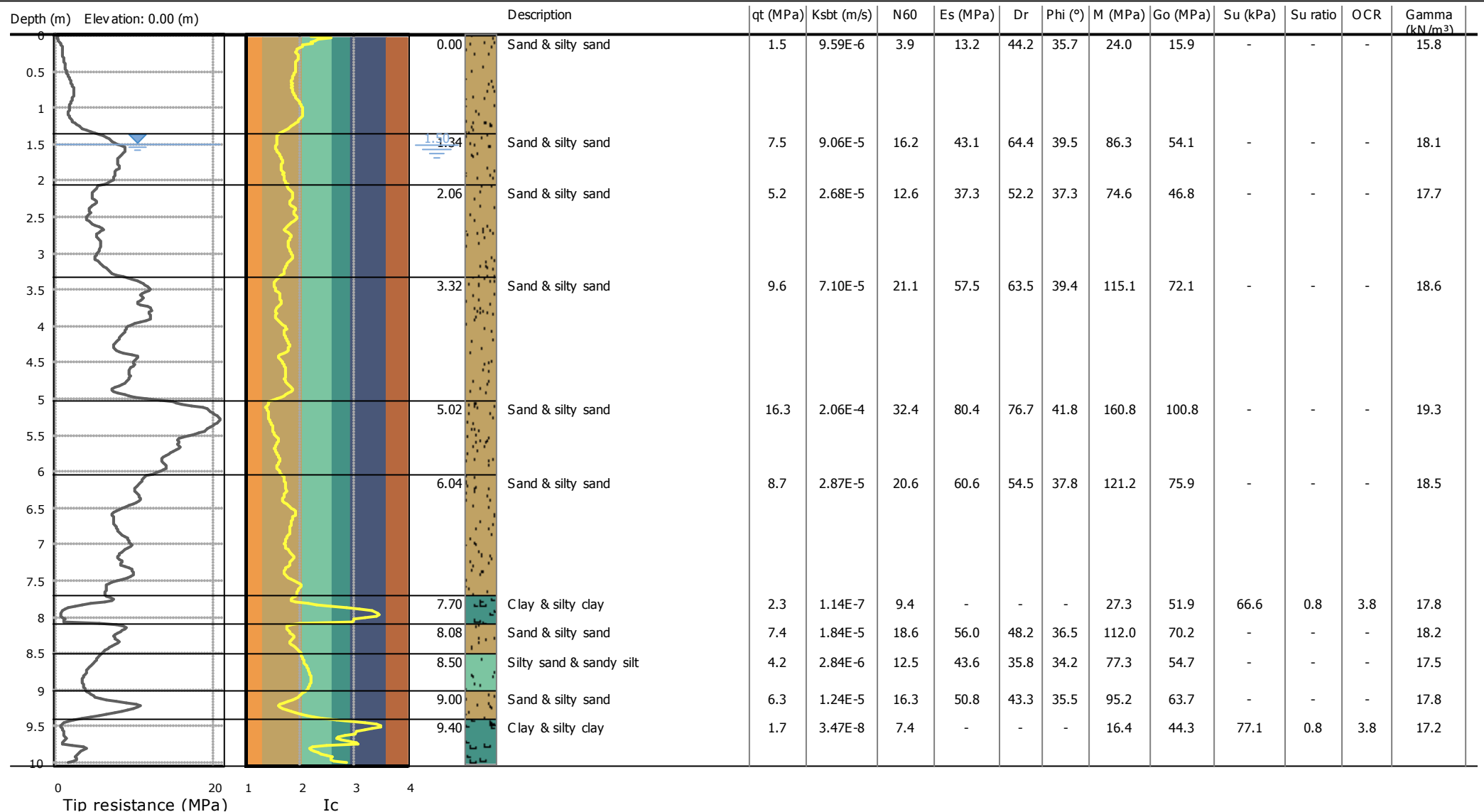
**Summary table of mean values**

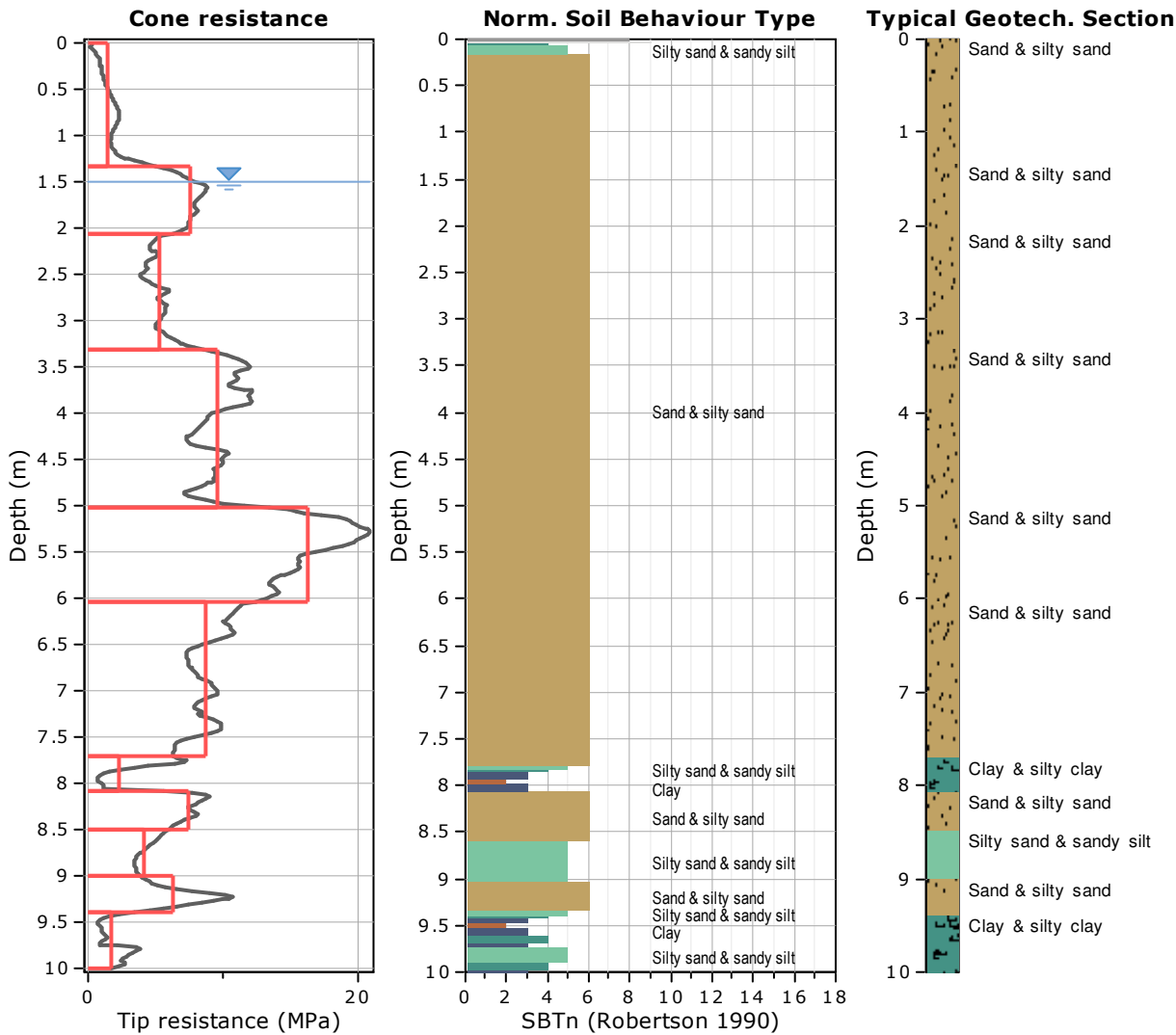
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.08                          | 2.32             | 1.43E-04              | 11.3                               | 29.3                    | 62.3                  | 38.9              | 58.6                               | 36.8                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 2.40                          |                  | (±5.51E-05)           | (±2.3)                             | (±6.2)                  | (±2.7)                | (±0.6)            | (±12.4)                            | (±7.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 2.40                          | 0.50             | 2.09E-04              | 18.6                               | 46.1                    | 68.2                  | 40.1              | 92.2                               | 57.8                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 2.90                          |                  | (±4.75E-05)           | (±2.1)                             | (±4.4)                  | (±3.3)                | (±0.7)            | (±8.8)                             | (±5.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.90                          | 1.74             | 2.54E-04              | 25.0                               | 61.3                    | 74.6                  | 41.4              | 122.7                              | 76.9                                      | 0.0  | 0.0                            | 0.0    | 18.8                                |
| 4.64                          |                  | (±1.32E-04)           | (±1.3)                             | (±2.8)                  | (±3.4)                | (±0.6)            | (±5.6)                             | (±3.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 4.64                          | 1.08             | 5.22E-05              | 18.2                               | 50.5                    | 56.9                  | 38.0              | 101.0                              | 63.3                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 5.72                          |                  | (±3.92E-05)           | (±3.1)                             | (±6.0)                  | (±6.8)                | (±1.3)            | (±12.1)                            | (±7.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 5.72                          | 0.32             | 4.90E-06              | 10.6                               | 36.2                    | 39.4                  | 34.9              | 72.4                               | 45.4                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 6.04                          |                  | (±2.80E-06)           | (±0.8)                             | (±1.4)                  | (±1.9)                | (±0.3)            | (±2.7)                             | (±1.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 6.04                          | 2.44             | 1.49E-05              | 15.6                               | 48.1                    | 46.7                  | 36.2              | 96.3                               | 60.3                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 8.48                          |                  | (±1.46E-05)           | (±1.9)                             | (±4.2)                  | (±4.4)                | (±0.8)            | (±8.4)                             | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 8.48                          | 0.34             | 4.37E-08              | 6.8                                | 0.0                     | 0.0                   | 0.0               | 12.3                               | 38.9                                      | 39.0   | 0.5                            | 2.3    | 17.1                                |
| 8.82                          |                  | (±7.37E-06)           | (±3.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±40.2)                            | (±10.3)                                   | (±42.0)  | (±0.5)                         | (±2.4) | (±0.4)                              |
| 8.82                          | 0.82             | 2.99E-05              | 20.7                               | 60.4                    | 52.1                  | 37.2              | 120.7                              | 75.7                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 9.64                          |                  | (±2.07E-05)           | (±2.4)                             | (±6.7)                  | (±3.8)                | (±0.8)            | (±13.4)                            | (±8.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 9.64                          | 0.36             | 5.00E-06              | 16.5                               | 55.3                    | 42.0                  | 35.7              | 110.6                              | 69.3                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 10.00                         |                  | (±2.41E-06)           | (±1.0)                             | (±2.2)                  | (±2.3)                | (±0.3)            | (±4.5)                             | (±2.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 1.34 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $1.48 \pm 0.94$  MPa

Sleeve friction:  $10.46 \pm 3.69$  kPa

Ic:  $1.96 \pm 0.14$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $9.59E-06 \pm 1.47E-05$  m/s

N<sub>60</sub>:  $3.91 \pm 2.15$  blows

Es:  $13.21 \pm 5.54$  MPa

Dr (%):  $44.22 \pm 4.84$

φ (degrees):  $35.71 \pm 1.66$  °

Unit weight:  $15.84 \pm 0.55$  kN/m<sup>3</sup>

Constrained Mod.:  $23.96 \pm 12.55$  MPa

Go:  $15.91 \pm 7.28$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 1.34 (m), **End depth:** 2.06 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.53 ±0.88 MPa

Sleeve friction: 44.16 ±11.83 kPa

Ic: 1.64 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.06E-05 ±4.05E-05 m/s

N<sub>60</sub>: 16.16 ±1.79 blows

Es: 43.15 ±5.14 MPa

Dr (%): 64.43 ±3.34

φ (degrees): 39.48 ±0.70 °

Unit weight: 18.12 ±0.40 kN/m<sup>3</sup>

Constrained Mod.: 86.29 ±10.28 MPa

Go: 54.08 ±6.44 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.06 (m), **End depth:** 3.32 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.25 ±0.91 MPa

Sleeve friction: 34.23 ±3.67 kPa

Ic: 1.82 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.68E-05 ±1.68E-05 m/s

N<sub>60</sub>: 12.61 ±1.62 blows

Es: 37.32 ±3.26 MPa

Dr (%): 52.17 ±2.98

φ (degrees): 37.25 ±0.50 °

Unit weight: 17.69 ±0.16 kN/m<sup>3</sup>

Constrained Mod.: 74.63 ±6.53 MPa

Go: 46.77 ±4.09 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 3.32 (m), **End depth:** 5.02 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.65 ±1.54 MPa

Sleeve friction: 62.42 ±8.41 kPa

Ic: 1.68 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 7.10E-05 ±5.72E-05 m/s

N<sub>60</sub>: 21.11 ±2.31 blows

Es: 57.54 ±4.00 MPa

Dr (%): 63.50 ±5.17

φ (degrees): 39.42 ±0.87 °

Unit weight: 18.61 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 115.08 ±7.99 MPa

Go: 72.12 ±5.01 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 5.02 (m), **End depth:** 6.04 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 16.32 ±2.70 MPa

Sleeve friction: 96.10 ±20.09 kPa

Ic: 1.52 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.06E-04 ±1.48E-04 m/s

N<sub>60</sub>: 32.43 ±4.04 blows

Es: 80.40 ±8.11 MPa

Dr (%): 76.68 ±6.38

φ (degrees): 41.75 ±1.13 °

Unit weight: 19.31 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 160.81 ±16.21 MPa

Go: 100.77 ±10.16 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 6.04 (m), **End depth:** 7.70 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.69 ±1.47 MPa

Sleeve friction: 60.89 ±9.76 kPa

Ic: 1.80 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.87E-05 ±1.88E-05 m/s

N<sub>60</sub>: 20.65 ±2.44 blows

Es: 60.59 ±4.49 MPa

Dr (%): 54.46 ±5.00

φ (degrees): 37.81 ±0.87 °

Unit weight: 18.54 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 121.19 ±8.97 MPa

Go: 75.95 ±5.62 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 7.70 (m), **End depth:** 8.08 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.32 ±2.85 MPa

Sleeve friction: 49.94 ±12.81 kPa

Ic: 2.54 ±0.63

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.14E-07 ±9.71E-06 m/s

N<sub>60</sub>: 9.42 ±5.25 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.81 ±0.30 kN/m<sup>3</sup>

Constrained Mod.: 27.28 ±50.93 MPa

Go: 51.90 ±10.82 MPa

Su: 66.63 ±36.57 kPa

Su ratio: 0.83 ±0.45

O.C.R.: 3.84 ±2.06

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 8.08 (m), **End depth:** 8.50 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.45 ±0.93 MPa

Sleeve friction: 47.42 ±2.42 kPa

Ic: 1.87 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.84E-05 ±1.09E-05 m/s

N<sub>60</sub>: 18.58 ±1.47 blows

Es: 55.98 ±1.97 MPa

Dr (%): 48.23 ±3.09

φ (degrees): 36.45 ±0.47 °

Unit weight: 18.20 ±0.08 kN/m<sup>3</sup>

Constrained Mod.: 111.96 ±3.93 MPa

Go: 70.16 ±2.46 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 8.50 (m), **End depth:** 9.00 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.21 ±0.82 MPa

Sleeve friction: 32.26 ±8.08 kPa

Ic: 2.14 ±0.07

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.84E-06 ±1.56E-06 m/s

N<sub>60</sub>: 12.47 ±1.75 blows

Es: 43.61 ±5.00 MPa

Dr (%): 35.76 ±3.60

φ (degrees): 34.21 ±0.79 °

Unit weight: 17.54 ±0.34 kN/m<sup>3</sup>

Constrained Mod.: 77.28 ±20.81 MPa

Go: 54.66 ±6.26 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 9.00 (m), **End depth:** 9.40 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.34 ±2.48 MPa

Sleeve friction: 35.74 ±14.45 kPa

Ic: 1.92 ±0.22

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.24E-05 ±3.91E-05 m/s

N<sub>60</sub>: 16.35 ±4.04 blows

Es: 50.83 ±8.11 MPa

Dr (%): 43.30 ±8.10

φ (degrees): 35.50 ±1.46 °

Unit weight: 17.81 ±0.49 kN/m<sup>3</sup>

Constrained Mod.: 95.22 ±22.08 MPa

Go: 63.70 ±10.16 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 11 ::****Code:** Layer\_11    **Start depth:** 9.40 (m), **End depth:** 10.00 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.66 ±1.07 MPa

Sleeve friction: 33.02 ±20.00 kPa

Ic: 2.75 ±0.40

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 3.47E-08 ±6.19E-07 m/s

N<sub>60</sub>: 7.39 ±2.60 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.20 ±0.69 kN/m<sup>3</sup>

Constrained Mod.: 16.44 ±20.53 MPa

Go: 44.27 ±10.28 MPa

Su: 77.12 ±49.52 kPa

Su ratio: 0.82 ±0.51

O.C.R.: 3.81 ±2.36



**Project:**

**Location:**

**CPT: CPTU km39+600**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.797144° lon 12.17936°

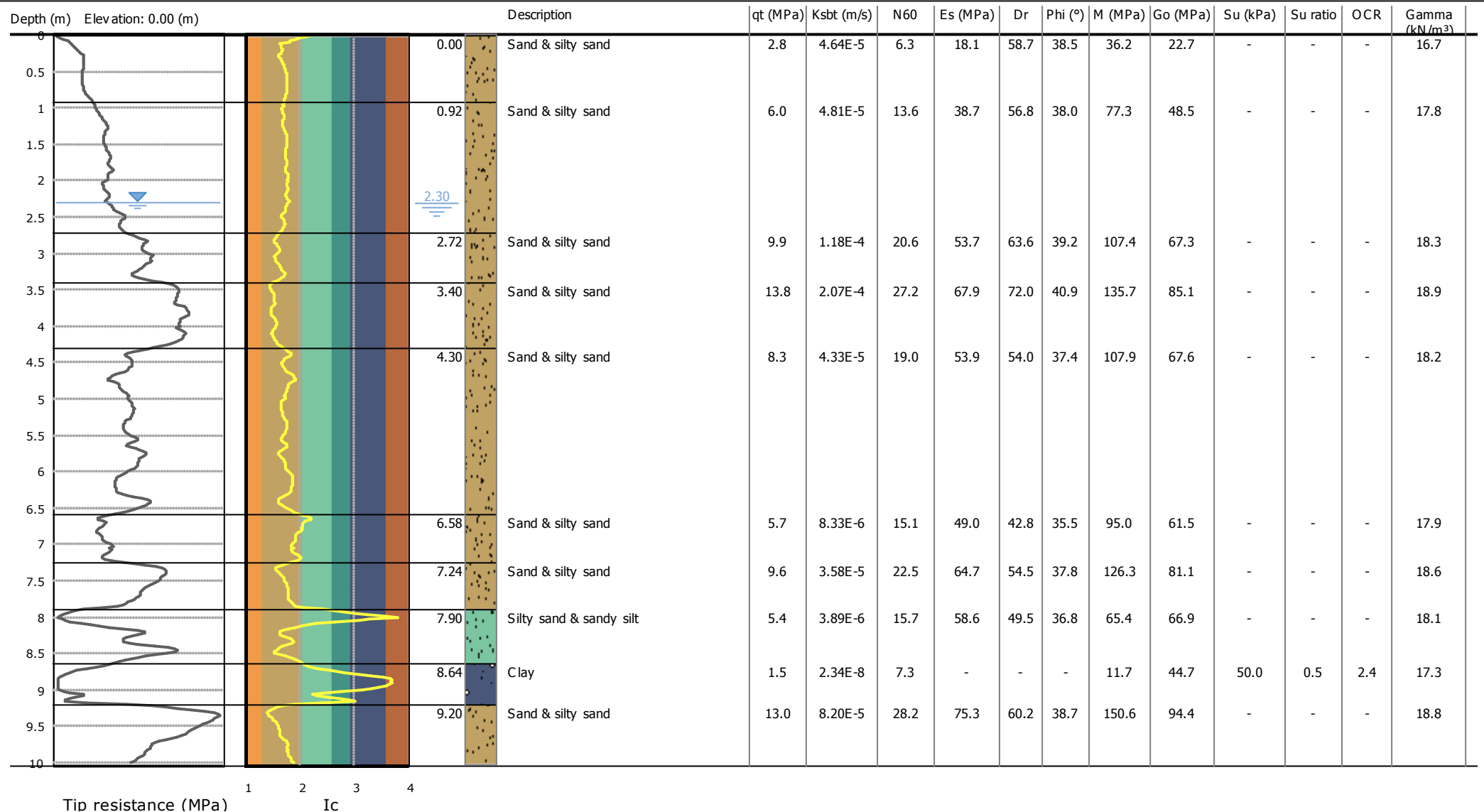
**Summary table of mean values**

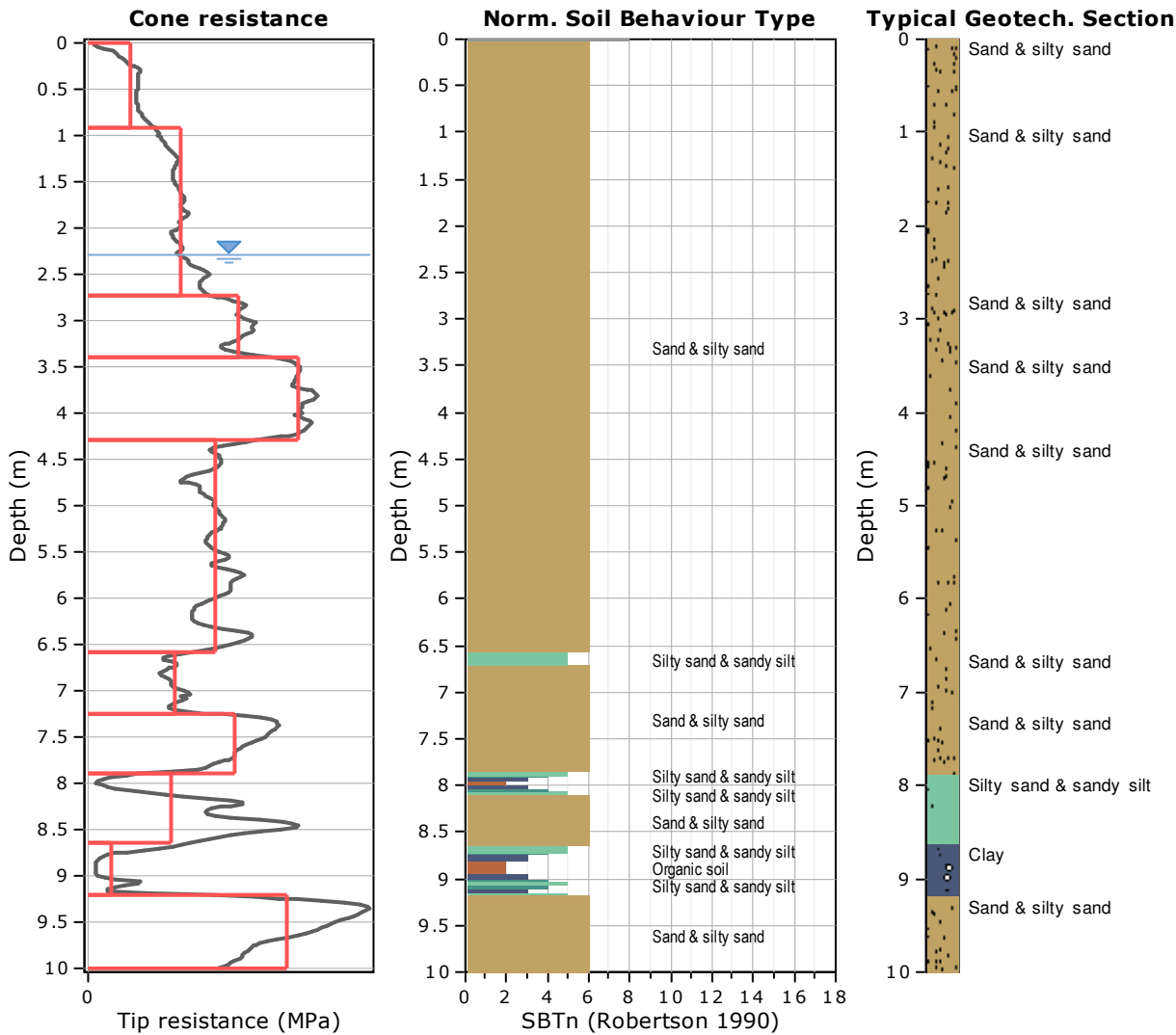
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.34             | 9.59E-06              | 3.9                                | 13.2                    | 44.2                  | 35.7              | 24.0                               | 15.9                                      | 0.0  | 0.0                            | 0.0    | 15.8                                |
| 1.34                          |                  | (±1.47E-05)           | (±2.1)                             | (±5.5)                  | (±4.8)                | (±1.7)            | (±12.5)                            | (±7.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 1.34                          | 0.72             | 9.06E-05              | 16.2                               | 43.1                    | 64.4                  | 39.5              | 86.3                               | 54.1                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 2.06                          |                  | (±4.05E-05)           | (±1.8)                             | (±5.1)                  | (±3.3)                | (±0.7)            | (±10.3)                            | (±6.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 2.06                          | 1.26             | 2.68E-05              | 12.6                               | 37.3                    | 52.2                  | 37.3              | 74.6                               | 46.8                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 3.32                          |                  | (±1.68E-05)           | (±1.6)                             | (±3.3)                  | (±3.0)                | (±0.5)            | (±6.5)                             | (±4.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.32                          | 1.70             | 7.10E-05              | 21.1                               | 57.5                    | 63.5                  | 39.4              | 115.1                              | 72.1                                      | 0.0  | 0.0                            | 0.0    | 18.6                                |
| 5.02                          |                  | (±5.72E-05)           | (±2.3)                             | (±4.0)                  | (±5.2)                | (±0.9)            | (±8.0)                             | (±5.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.02                          | 1.02             | 2.06E-04              | 32.4                               | 80.4                    | 76.7                  | 41.8              | 160.8                              | 100.8                                     | 0.0  | 0.0                            | 0.0    | 19.3                                |
| 6.04                          |                  | (±1.48E-04)           | (±4.0)                             | (±8.1)                  | (±6.4)                | (±1.1)            | (±16.2)                            | (±10.2)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.04                          | 1.66             | 2.87E-05              | 20.6                               | 60.6                    | 54.5                  | 37.8              | 121.2                              | 75.9                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 7.70                          |                  | (±1.88E-05)           | (±2.4)                             | (±4.5)                  | (±5.0)                | (±0.9)            | (±9.0)                             | (±5.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.70                          | 0.38             | 1.14E-07              | 9.4                                | 0.0                     | 0.0                   | 0.0               | 27.3                               | 51.9                                      | 66.6   | 0.8                            | 3.8    | 17.8                                |
| 8.08                          |                  | (±9.71E-06)           | (±5.3)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±50.9)                            | (±10.8)                                   | (±36.6)  | (±0.4)                         | (±2.1) | (±0.3)                              |
| 8.08                          | 0.42             | 1.84E-05              | 18.6                               | 56.0                    | 48.2                  | 36.5              | 112.0                              | 70.2                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 8.50                          |                  | (±1.09E-05)           | (±1.5)                             | (±2.0)                  | (±3.1)                | (±0.5)            | (±3.9)                             | (±2.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 8.50                          | 0.50             | 2.84E-06              | 12.5                               | 43.6                    | 35.8                  | 34.2              | 77.3                               | 54.7                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 9.00                          |                  | (±1.56E-06)           | (±1.8)                             | (±5.0)                  | (±3.6)                | (±0.8)            | (±20.8)                            | (±6.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 9.00                          | 0.40             | 1.24E-05              | 16.3                               | 50.8                    | 43.3                  | 35.5              | 95.2                               | 63.7                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 9.40                          |                  | (±3.91E-05)           | (±4.0)                             | (±8.1)                  | (±8.1)                | (±1.5)            | (±22.1)                            | (±10.2)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 9.40                          | 0.60             | 3.47E-08              | 7.4                                | 0.0                     | 0.0                   | 0.0               | 16.4                               | 44.3                                      | 77.1   | 0.8                            | 3.8    | 17.2                                |
| 10.00                         |                  | (±6.19E-07)           | (±2.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±20.5)                            | (±10.3)                                   | (±49.5)  | (±0.5)                         | (±2.4) | (±0.7)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.92 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $2.79 \pm 0.87$  MPa

Sleeve friction:  $18.19 \pm 3.04$  kPa

Ic:  $1.74 \pm 0.09$

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability:  $4.64E-05 \pm 2.57E-05$  m/s

N<sub>60</sub>:  $6.28 \pm 1.88$  blows

E<sub>s</sub>:  $18.08 \pm 5.28$  MPa

Dr (%):  $58.70 \pm 4.59$

φ (degrees):  $38.52 \pm 1.29$  °

Unit weight:  $16.72 \pm 0.35$  kN/m<sup>3</sup>

Constrained Mod.:  $36.17 \pm 10.57$  MPa

G<sub>o</sub>:  $22.66 \pm 6.62$  MPa

S<sub>u</sub>:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.92 (m), **End depth:** 2.72 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.03 ±0.83 MPa

Sleeve friction: 35.88 ±5.56 kPa

Ic: 1.73 ±0.04

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.81E-05 ±1.33E-05 m/s

N<sub>60</sub>: 13.65 ±1.80 blows

Es: 38.67 ±4.96 MPa

Dr (%): 56.81 ±2.26

φ (degrees): 38.04 ±0.48 °

Unit weight: 17.80 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 77.34 ±9.92 MPa

Go: 48.47 ±6.21 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.72 (m), **End depth:** 3.40 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.86 ±0.85 MPa

Sleeve friction: 48.21 ±8.05 kPa

Ic: 1.60 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.18E-04 ±5.01E-05 m/s

N<sub>60</sub>: 20.56 ±1.36 blows

Es: 53.72 ±3.33 MPa

Dr (%): 63.57 ±2.26

φ (degrees): 39.23 ±0.44 °

Unit weight: 18.32 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 107.43 ±6.66 MPa

Go: 67.32 ±4.17 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 3.40 (m), **End depth:** 4.30 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 13.77 ±0.80 MPa

Sleeve friction: 69.54 ±9.67 kPa

Ic: 1.52 ±0.05

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.07E-04 ±6.80E-05 m/s

N<sub>60</sub>: 27.23 ±1.32 blows

Es: 67.86 ±3.64 MPa

Dr (%): 72.03 ±2.00

φ (degrees): 40.91 ±0.37 °

Unit weight: 18.87 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 135.73 ±7.27 MPa

Go: 85.06 ±4.56 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 4.30 (m), **End depth:** 6.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.30 ±1.09 MPa

Sleeve friction: 44.84 ±9.45 kPa

Ic: 1.75 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.33E-05 ±2.68E-05 m/s

N<sub>60</sub>: 19.00 ±1.70 blows

Es: 53.95 ±3.98 MPa

Dr (%): 53.98 ±3.36

φ (degrees): 37.41 ±0.61 °

Unit weight: 18.17 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 107.90 ±7.95 MPa

Go: 67.62 ±4.98 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6 **Start depth:** 6.58 (m), **End depth:** 7.24 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.66 ±0.65 MPa

Sleeve friction: 39.63 ±16.58 kPa

Ic: 1.98 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.33E-06 ±6.57E-06 m/s

N<sub>60</sub>: 15.09 ±1.37 blows

Es: 49.04 ±5.48 MPa

Dr (%): 42.83 ±2.26

φ (degrees): 35.52 ±0.77 °

Unit weight: 17.89 ±0.42 kN/m<sup>3</sup>

Constrained Mod.: 95.04 ±12.43 MPa

Go: 61.47 ±6.87 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7 **Start depth:** 7.24 (m), **End depth:** 7.90 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.65 ±2.13 MPa

Sleeve friction: 59.74 ±11.08 kPa

Ic: 1.77 ±0.16

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.58E-05 ±4.46E-05 m/s

N<sub>60</sub>: 22.45 ±3.39 blows

Es: 64.68 ±6.09 MPa

Dr (%): 54.48 ±6.57

φ (degrees): 37.78 ±0.94 °

Unit weight: 18.56 ±0.25 kN/m<sup>3</sup>

Constrained Mod.: 126.28 ±18.55 MPa

Go: 81.06 ±7.63 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8 **Start depth:** 7.90 (m), **End depth:** 8.64 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.43 ±4.44 MPa

Sleeve friction: 48.27 ±15.15 kPa

Ic: 2.03 ±0.62

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.89E-06 ±6.65E-05 m/s

N<sub>60</sub>: 15.66 ±7.37 blows

Es: 58.63 ±8.63 MPa

Dr (%): 49.47 ±8.67

φ (degrees): 36.77 ±1.37 °

Unit weight: 18.10 ±0.44 kN/m<sup>3</sup>

Constrained Mod.: 65.40 ±55.87 MPa

Go: 66.87 ±15.05 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 9 :::****Code:** Layer\_9 **Start depth:** 8.64 (m), **End depth:** 9.20 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.54 ±2.28 MPa

Sleeve friction: 36.10 ±19.44 kPa

Ic: 2.82 ±0.61

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 2.34E-08 ±3.19E-06 m/s

N<sub>60</sub>: 7.26 ±5.18 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.28 ±0.88 kN/m<sup>3</sup>

Constrained Mod.: 11.73 ±45.69 MPa

Go: 44.68 ±16.75 MPa

Su: 49.99 ±49.15 kPa

Su ratio: 0.52 ±0.51

O.C.R.: 2.41 ±2.36

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 9.20 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 13.04 ±3.23 MPa

Sleeve friction: 66.68 ±14.41 kPa

Ic: 1.65 ±0.14

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.20E-05 ±1.40E-04 m/s

N<sub>60</sub>: 28.18 ±4.64 blows

Es: 75.31 ±7.81 MPa

Dr (%): 60.21 ±7.69

φ (degrees): 38.71 ±1.43 °

Unit weight: 18.80 ±0.30 kN/m<sup>3</sup>

Constrained Mod.: 150.61 ±15.61 MPa

Go: 94.38 ±9.78 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km40+300**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.803166° lon 12.178438°

**Summary table of mean values**

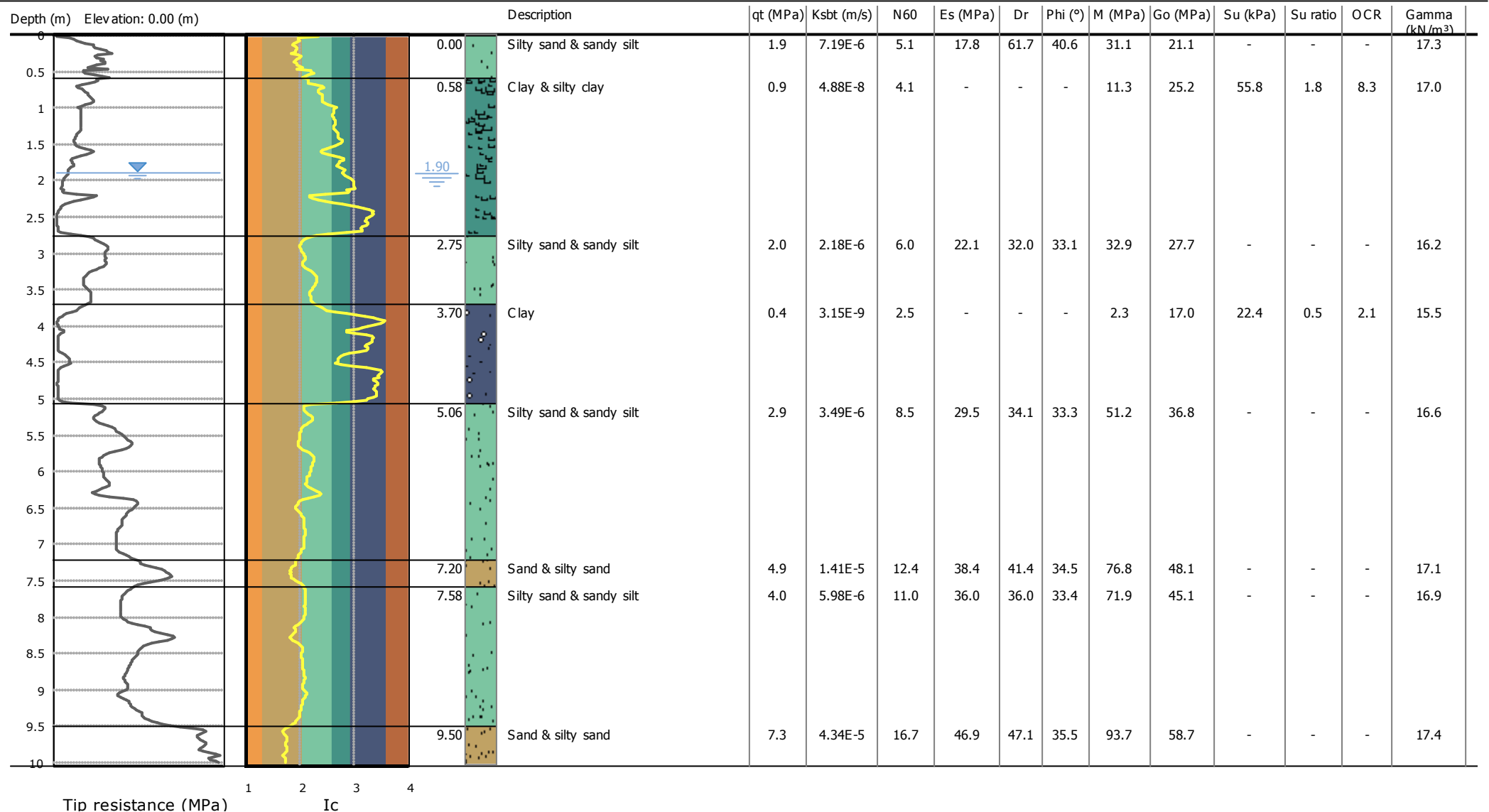
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.92             | 4.64E-05              | 6.3                                | 18.1                    | 58.7                  | 38.5              | 36.2                               | 22.7                                      | 0.0  | 0.0                            | 0.0    | 16.7                                |
| 0.92                          |                  | (±2.57E-05)           | (±1.9)                             | (±5.3)                  | (±4.6)                | (±1.3)            | (±10.6)                            | (±6.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 0.92                          | 1.80             | 4.81E-05              | 13.6                               | 38.7                    | 56.8                  | 38.0              | 77.3                               | 48.5                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 2.72                          |                  | (±1.33E-05)           | (±1.8)                             | (±5.0)                  | (±2.3)                | (±0.5)            | (±9.9)                             | (±6.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.72                          | 0.68             | 1.18E-04              | 20.6                               | 53.7                    | 63.6                  | 39.2              | 107.4                              | 67.3                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 3.40                          |                  | (±5.01E-05)           | (±1.4)                             | (±3.3)                  | (±2.3)                | (±0.4)            | (±6.7)                             | (±4.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.40                          | 0.90             | 2.07E-04              | 27.2                               | 67.9                    | 72.0                  | 40.9              | 135.7                              | 85.1                                      | 0.0  | 0.0                            | 0.0    | 18.9                                |
| 4.30                          |                  | (±6.80E-05)           | (±1.3)                             | (±3.6)                  | (±2.0)                | (±0.4)            | (±7.3)                             | (±4.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.30                          | 2.28             | 4.33E-05              | 19.0                               | 53.9                    | 54.0                  | 37.4              | 107.9                              | 67.6                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 6.58                          |                  | (±2.68E-05)           | (±1.7)                             | (±4.0)                  | (±3.4)                | (±0.6)            | (±8.0)                             | (±5.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.58                          | 0.66             | 8.33E-06              | 15.1                               | 49.0                    | 42.8                  | 35.5              | 95.0                               | 61.5                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 7.24                          |                  | (±6.57E-06)           | (±1.4)                             | (±5.5)                  | (±2.3)                | (±0.8)            | (±12.4)                            | (±6.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 7.24                          | 0.66             | 3.58E-05              | 22.5                               | 64.7                    | 54.5                  | 37.8              | 126.3                              | 81.1                                      | 0.0  | 0.0                            | 0.0    | 18.6                                |
| 7.90                          |                  | (±4.46E-05)           | (±3.4)                             | (±6.1)                  | (±6.6)                | (±0.9)            | (±18.6)                            | (±7.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.90                          | 0.74             | 3.89E-06              | 15.7                               | 58.6                    | 49.5                  | 36.8              | 65.4                               | 66.9                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 8.64                          |                  | (±6.65E-05)           | (±7.4)                             | (±8.6)                  | (±8.7)                | (±1.4)            | (±55.9)                            | (±15.1)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 8.64                          | 0.56             | 2.34E-08              | 7.3                                | 0.0                     | 0.0                   | 0.0               | 11.7                               | 44.7                                      | 50.0   | 0.5                            | 2.4    | 17.3                                |
| 9.20                          |                  | (±3.19E-06)           | (±5.2)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±45.7)                            | (±16.8)                                   | (±49.1)  | (±0.5)                         | (±2.4) | (±0.9)                              |
| 9.20                          | 0.80             | 8.20E-05              | 28.2                               | 75.3                    | 60.2                  | 38.7              | 150.6                              | 94.4                                      | 0.0  | 0.0                            | 0.0    | 18.8                                |
| 10.00                         |                  | (±1.40E-04)           | (±4.6)                             | (±7.8)                  | (±7.7)                | (±1.4)            | (±15.6)                            | (±9.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |

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



**Project:**

**Location:**





O.C.R.: 0.00 ±0.00

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.58 (m), **End depth:** 2.75 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 0.94 ±0.61 MPa

Sleeve friction: 34.70 ±29.46 kPa

Ic: 2.70 ±0.31

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 4.88E-08 ±7.69E-07 m/s

N<sub>60</sub>: 4.09 ±1.78 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.04 ±1.14 kN/m<sup>3</sup>

Constrained Mod.: 11.29 ±12.31 MPa

Go: 25.21 ±8.51 MPa

Su: 55.82 ±39.56 kPa

Su ratio: 1.80 ±1.82

O.C.R.: 8.34 ±8.43

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.75 (m), **End depth:** 3.70 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.01 ±0.46 MPa

Sleeve friction: 12.68 ±2.25 kPa

Ic: 2.17 ±0.12

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.18E-06 ±2.15E-06 m/s

N<sub>60</sub>: 6.04 ±0.95 blows

Es: 22.09 ±2.28 MPa

Dr (%): 32.04 ±3.39

φ (degrees): 33.12 ±0.48 °

Unit weight: 16.18 ±0.25 kN/m<sup>3</sup>

Constrained Mod.: 32.90 ±13.16 MPa

Go: 27.69 ±2.86 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 3.70 (m), **End depth:** 5.06 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.43 ±0.35 MPa

Sleeve friction: 11.43 ±4.85 kPa

Ic: 3.13 ±0.34

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 3.15E-09 ±1.99E-07 m/s

N<sub>60</sub>: 2.48 ±1.00 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 15.47 ±0.50 kN/m<sup>3</sup>

Constrained Mod.: 2.34 ±5.99 MPa

Go: 16.95 ±3.87 MPa

Su: 22.44 ±14.74 kPa

Su ratio: 0.45 ±0.28

O.C.R.: 2.10 ±1.30

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 5.06 (m), **End depth:** 7.20 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.94 ±0.64 MPa

Sleeve friction: 16.31 ±4.08 kPa

Ic: 2.11 ±0.12

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.49E-06 ±3.10E-06 m/s

N<sub>60</sub>: 8.52 ±1.35 blows

Es: 29.53 ±3.21 MPa

Dr (%): 34.09 ±2.97

φ (degrees): 33.29 ±0.58 °

Unit weight: 16.61 ±0.31 kN/m<sup>3</sup>

Constrained Mod.: 51.21 ±14.46 MPa

Go: 36.84 ±4.27 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6    **Start depth:** 7.20 (m), **End depth:** 7.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.89 ±0.64 MPa

Sleeve friction: 21.73 ±5.18 kPa

Ic: 1.91 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.41E-05 ±7.43E-06 m/s

N<sub>60</sub>: 12.39 ±1.24 blows

Es: 38.41 ±2.99 MPa

Dr (%): 41.35 ±2.55

φ (degrees): 34.55 ±0.56 °

Unit weight: 17.14 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 76.83 ±5.98 MPa

Go: 48.15 ±3.75 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7    **Start depth:** 7.58 (m), **End depth:** 9.50 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.97 ±0.69 MPa

Sleeve friction: 19.00 ±3.32 kPa

Ic: 2.03 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.98E-06 ±5.10E-06 m/s

N<sub>60</sub>: 10.95 ±1.27 blows

Es: 35.97 ±2.86 MPa

Dr (%): 36.05 ±2.89

φ (degrees): 33.45 ±0.62 °

Unit weight: 16.90 ±0.23 kN/m<sup>3</sup>

Constrained Mod.: 71.94 ±5.73 MPa

Go: 45.08 ±3.59 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8    **Start depth:** 9.50 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.30 ±0.52 MPa

Sleeve friction: 23.96 ±2.81 kPa

Ic: 1.75 ±0.03

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.34E-05 ±9.22E-06 m/s

N<sub>60</sub>: 16.69 ±0.98 blows

Es: 46.86 ±2.22 MPa

Dr (%): 47.08 ±1.58

φ (degrees): 35.52 ±0.36 °

Unit weight: 17.40 ±0.16 kN/m<sup>3</sup>

Constrained Mod.: 93.72 ±4.45 MPa

Go: 58.73 ±2.79 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km42+400**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.82308° lon 12.178416°

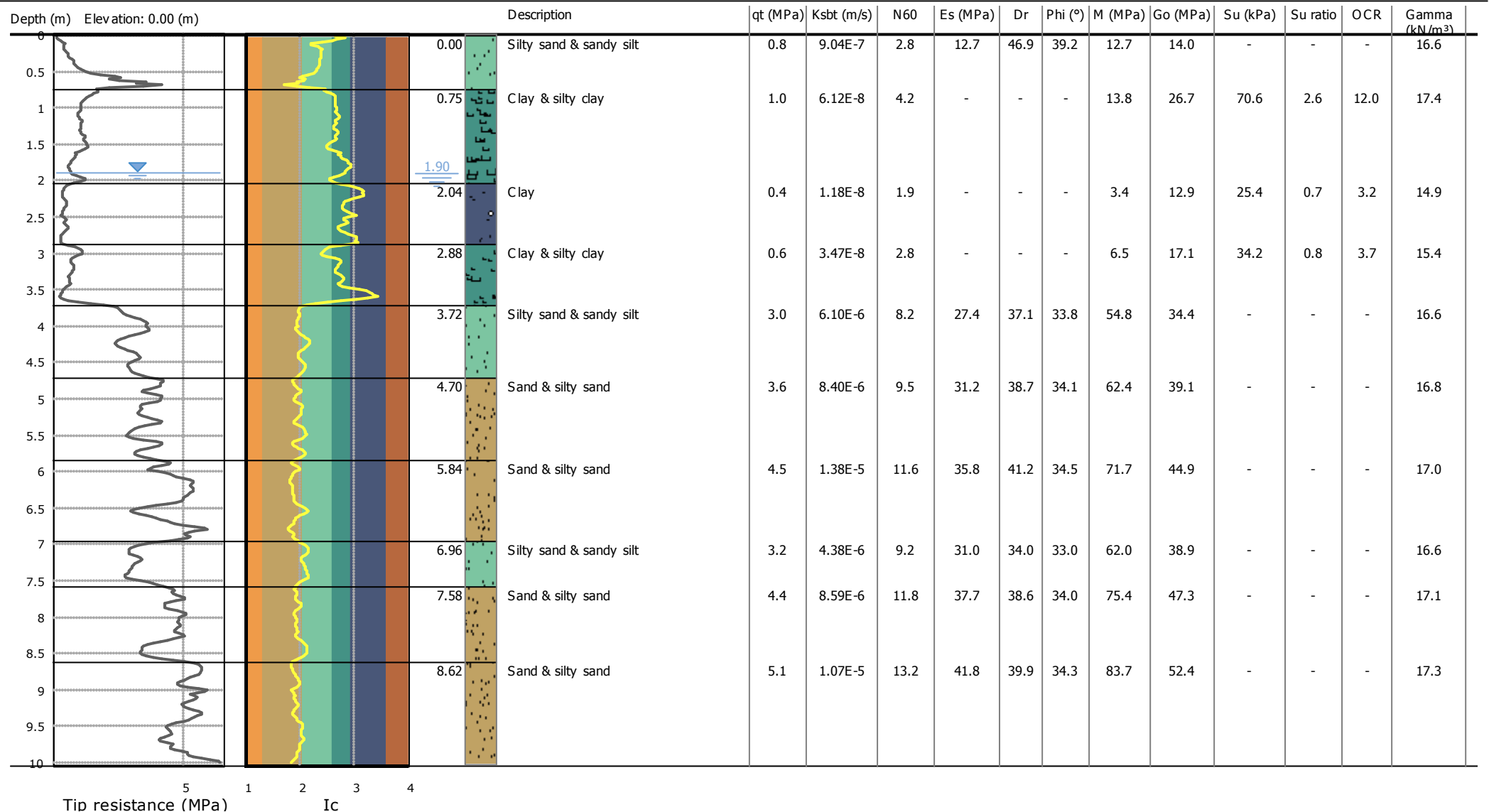
**Summary table of mean values**

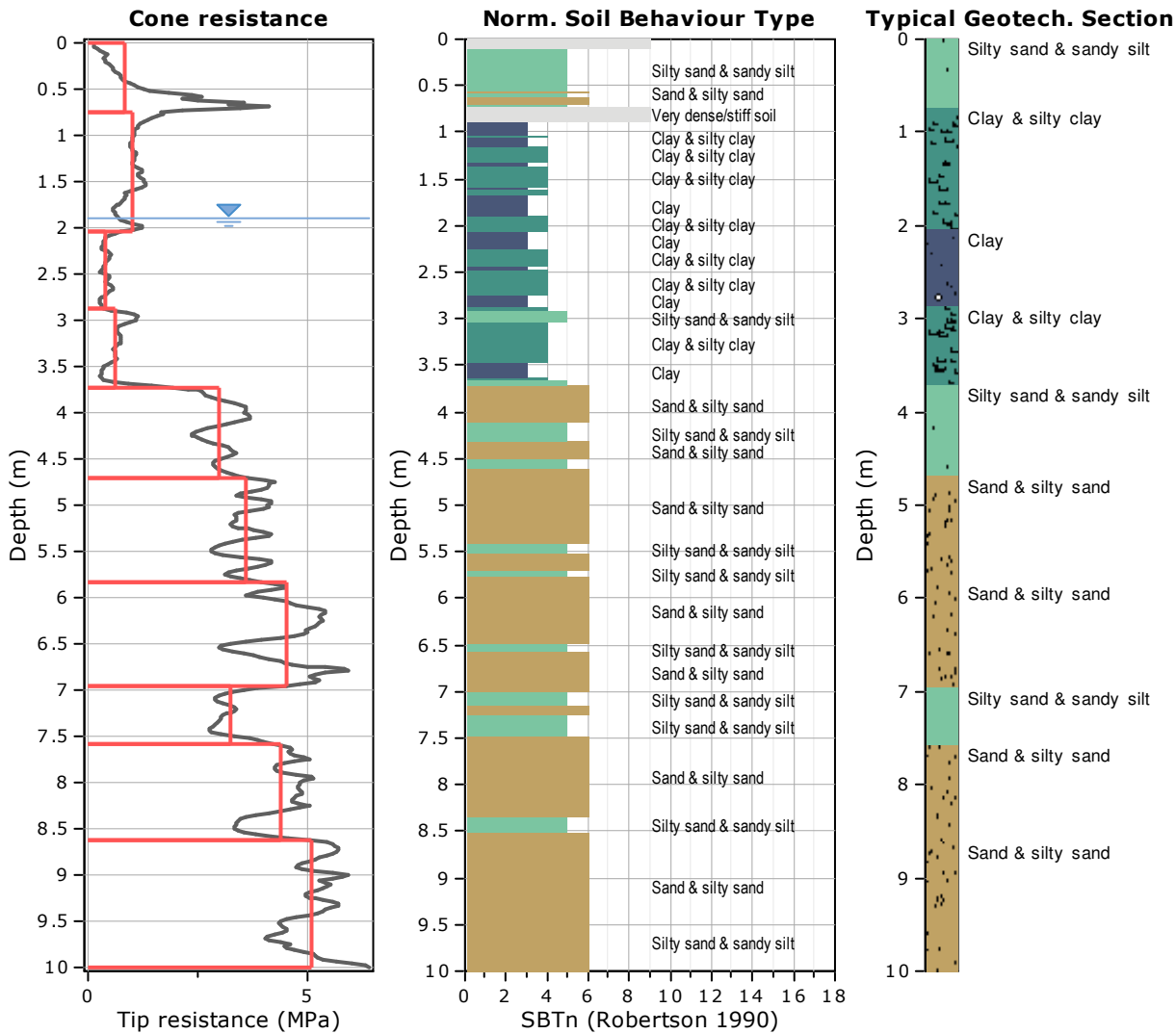
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.58             | 7.19E-06              | 5.1                                | 17.8                    | 61.7                  | 40.6              | 31.1                               | 21.1                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 0.58                          |                  | (±5.76E-06)           | (±1.7)                             | (±4.6)                  | (±7.4)                | (±1.2)            | (±12.1)                            | (±6.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 0.58                          | 2.17             | 4.88E-08              | 4.1                                | 0.0                     | 0.0                   | 0.0               | 11.3                               | 25.2                                      | 55.8   | 1.8                            | 8.3    | 17.0                                |
| 2.75                          |                  | (±7.69E-07)           | (±1.8)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±12.3)                            | (±8.5)                                    | (±39.6)  | (±1.8)                         | (±8.4) | (±1.1)                              |
| 2.75                          | 0.95             | 2.18E-06              | 6.0                                | 22.1                    | 32.0                  | 33.1              | 32.9                               | 27.7                                      | 0.0  | 0.0                            | 0.0    | 16.2                                |
| 3.70                          |                  | (±2.15E-06)           | (±1.0)                             | (±2.3)                  | (±3.4)                | (±0.5)            | (±13.2)                            | (±2.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 3.70                          | 1.36             | 3.15E-09              | 2.5                                | 0.0                     | 0.0                   | 0.0               | 2.3                                | 17.0                                      | 22.4   | 0.5                            | 2.1    | 15.5                                |
| 5.06                          |                  | (±1.99E-07)           | (±1.0)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±6.0)                             | (±3.9)                                    | (±14.7)  | (±0.3)                         | (±1.3) | (±0.5)                              |
| 5.06                          | 2.14             | 3.49E-06              | 8.5                                | 29.5                    | 34.1                  | 33.3              | 51.2                               | 36.8                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 7.20                          |                  | (±3.10E-06)           | (±1.3)                             | (±3.2)                  | (±3.0)                | (±0.6)            | (±14.5)                            | (±4.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.20                          | 0.38             | 1.41E-05              | 12.4                               | 38.4                    | 41.4                  | 34.5              | 76.8                               | 48.1                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 7.58                          |                  | (±7.43E-06)           | (±1.2)                             | (±3.0)                  | (±2.6)                | (±0.6)            | (±6.0)                             | (±3.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.58                          | 1.92             | 5.98E-06              | 11.0                               | 36.0                    | 36.0                  | 33.4              | 71.9                               | 45.1                                      | 0.0  | 0.0                            | 0.0    | 16.9                                |
| 9.50                          |                  | (±5.10E-06)           | (±1.3)                             | (±2.9)                  | (±2.9)                | (±0.6)            | (±5.7)                             | (±3.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 9.50                          | 0.50             | 4.34E-05              | 16.7                               | 46.9                    | 47.1                  | 35.5              | 93.7                               | 58.7                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 10.00                         |                  | (±9.22E-06)           | (±1.0)                             | (±2.2)                  | (±1.6)                | (±0.4)            | (±4.4)                             | (±2.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.75 (m)

**Description:** Silty sand & sandy silt

#### Basic results

Total cone resistance:  $0.85 \pm 1.16$  MPa

Sleeve friction:  $24.44 \pm 16.80$  kPa

Ic:  $2.29 \pm 0.23$

SBT<sub>n</sub>: 5

SBT<sub>n</sub> description: Silty sand & sandy silt

#### Estimation results

Permeability:  $9.04E-07 \pm 1.04E-05$  m/s

N<sub>60</sub>:  $2.77 \pm 2.82$  blows

Es:  $12.70 \pm 8.32$  MPa

Dr (%):  $46.93 \pm 6.98$

φ (degrees):  $39.15 \pm 0.72$  °

Unit weight:  $16.60 \pm 0.95$  kN/m<sup>3</sup>

Constrained Mod.:  $12.67 \pm 20.74$  MPa

Go:  $13.95 \pm 11.14$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$



**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.75 (m), **End depth:** 2.04 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.01 ±0.26 MPa

Sleeve friction: 44.93 ±23.70 kPa

Ic: 2.68 ±0.12

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 6.12E-08 ±7.05E-08 m/s

N<sub>60</sub>: 4.21 ±0.88 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.37 ±0.59 kN/m<sup>3</sup>

Constrained Mod.: 13.84 ±3.77 MPa

Go: 26.69 ±4.06 MPa

Su: 70.61 ±19.22 kPa

Su ratio: 2.60 ±1.32

O.C.R.: 11.99 ±6.09

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 2.04 (m), **End depth:** 2.88 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.40 ±0.11 MPa

Sleeve friction: 7.10 ±4.83 kPa

Ic: 2.92 ±0.15

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.18E-08 ±1.77E-08 m/s

N<sub>60</sub>: 1.91 ±0.38 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 14.89 ±0.67 kN/m<sup>3</sup>

Constrained Mod.: 3.39 ±2.07 MPa

Go: 12.94 ±2.51 MPa

Su: 25.42 ±7.83 kPa

Su ratio: 0.69 ±0.20

O.C.R.: 3.17 ±0.92

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 2.88 (m), **End depth:** 3.72 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 0.63 ±0.33 MPa

Sleeve friction: 9.62 ±2.42 kPa

Ic: 2.76 ±0.29

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 3.47E-08 ±4.89E-07 m/s

N<sub>60</sub>: 2.85 ±0.85 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 15.41 ±0.31 kN/m<sup>3</sup>

Constrained Mod.: 6.52 ±6.88 MPa

Go: 17.06 ±2.73 MPa

Su: 34.17 ±12.67 kPa

Su ratio: 0.80 ±0.28

O.C.R.: 3.70 ±1.30

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 3.72 (m), **End depth:** 4.70 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.99 ±0.44 MPa

Sleeve friction: 15.95 ±3.44 kPa

Ic: 2.03 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.10E-06 ±3.13E-06 m/s

N<sub>60</sub>: 8.20 ±0.97 blows

Es: 27.41 ±2.50 MPa

Dr (%): 37.12 ±2.42

φ (degrees): 33.83 ±0.58 °

Unit weight: 16.59 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 54.83 ±5.01 MPa

Go: 34.36 ±3.14 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6 **Start depth:** 4.70 (m), **End depth:** 5.84 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 3.61 ±0.42 MPa

Sleeve friction: 18.01 ±1.92 kPa

Ic: 1.98 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.40E-06 ±4.80E-06 m/s

N<sub>60</sub>: 9.52 ±0.73 blows

Es: 31.18 ±1.13 MPa

Dr (%): 38.66 ±2.27

φ (degrees): 34.07 ±0.37 °

Unit weight: 16.81 ±0.12 kN/m<sup>3</sup>

Constrained Mod.: 62.36 ±2.25 MPa

Go: 39.08 ±1.41 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7 **Start depth:** 5.84 (m), **End depth:** 6.96 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.54 ±0.75 MPa

Sleeve friction: 20.34 ±3.96 kPa

Ic: 1.91 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.38E-05 ±7.34E-06 m/s

N<sub>60</sub>: 11.56 ±1.44 blows

Es: 35.85 ±3.22 MPa

Dr (%): 41.25 ±3.24

φ (degrees): 34.53 ±0.65 °

Unit weight: 17.03 ±0.26 kN/m<sup>3</sup>

Constrained Mod.: 71.69 ±6.44 MPa

Go: 44.93 ±4.04 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8 **Start depth:** 6.96 (m), **End depth:** 7.58 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.24 ±0.44 MPa

Sleeve friction: 15.46 ±2.51 kPa

Ic: 2.07 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.38E-06 ±2.63E-06 m/s

N<sub>60</sub>: 9.18 ±0.87 blows

Es: 31.01 ±1.88 MPa

Dr (%): 34.03 ±2.15

φ (degrees): 33.00 ±0.43 °

Unit weight: 16.59 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 62.02 ±3.75 MPa

Go: 38.87 ±2.35 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 9 :::****Code:** Layer\_9 **Start depth:** 7.58 (m), **End depth:** 8.62 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.42 ±0.55 MPa

Sleeve friction: 21.29 ±2.55 kPa

Ic: 1.98 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.59E-06 ±4.25E-06 m/s

N<sub>60</sub>: 11.81 ±1.01 blows

Es: 37.70 ±1.91 MPa

Dr (%): 38.55 ±2.58

φ (degrees): 34.01 ±0.46 °

Unit weight: 17.08 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 75.40 ±3.82 MPa

Go: 47.25 ±2.40 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 8.62 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.10 ±0.52 MPa

Sleeve friction: 24.05 ±2.39 kPa

Ic: 1.95 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.07E-05 ±5.27E-06 m/s

N<sub>60</sub>: 13.23 ±0.92 blows

Es: 41.83 ±1.64 MPa

Dr (%): 39.90 ±2.24

φ (degrees): 34.28 ±0.41 °

Unit weight: 17.27 ±0.13 kN/m<sup>3</sup>

Constrained Mod.: 83.67 ±3.28 MPa

Go: 52.43 ±2.05 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km42+600**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.82313° lon 12.177701°

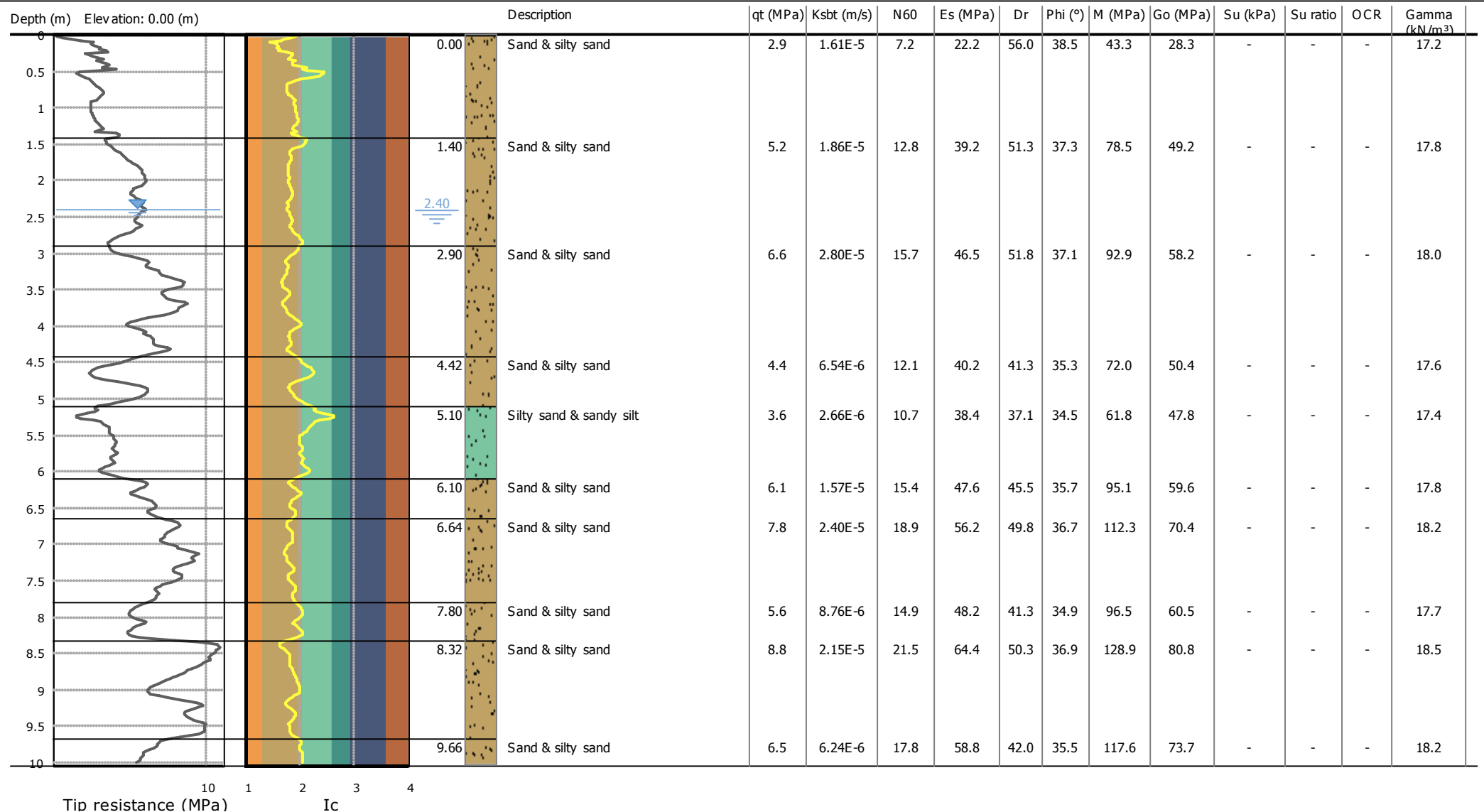
**Summary table of mean values**

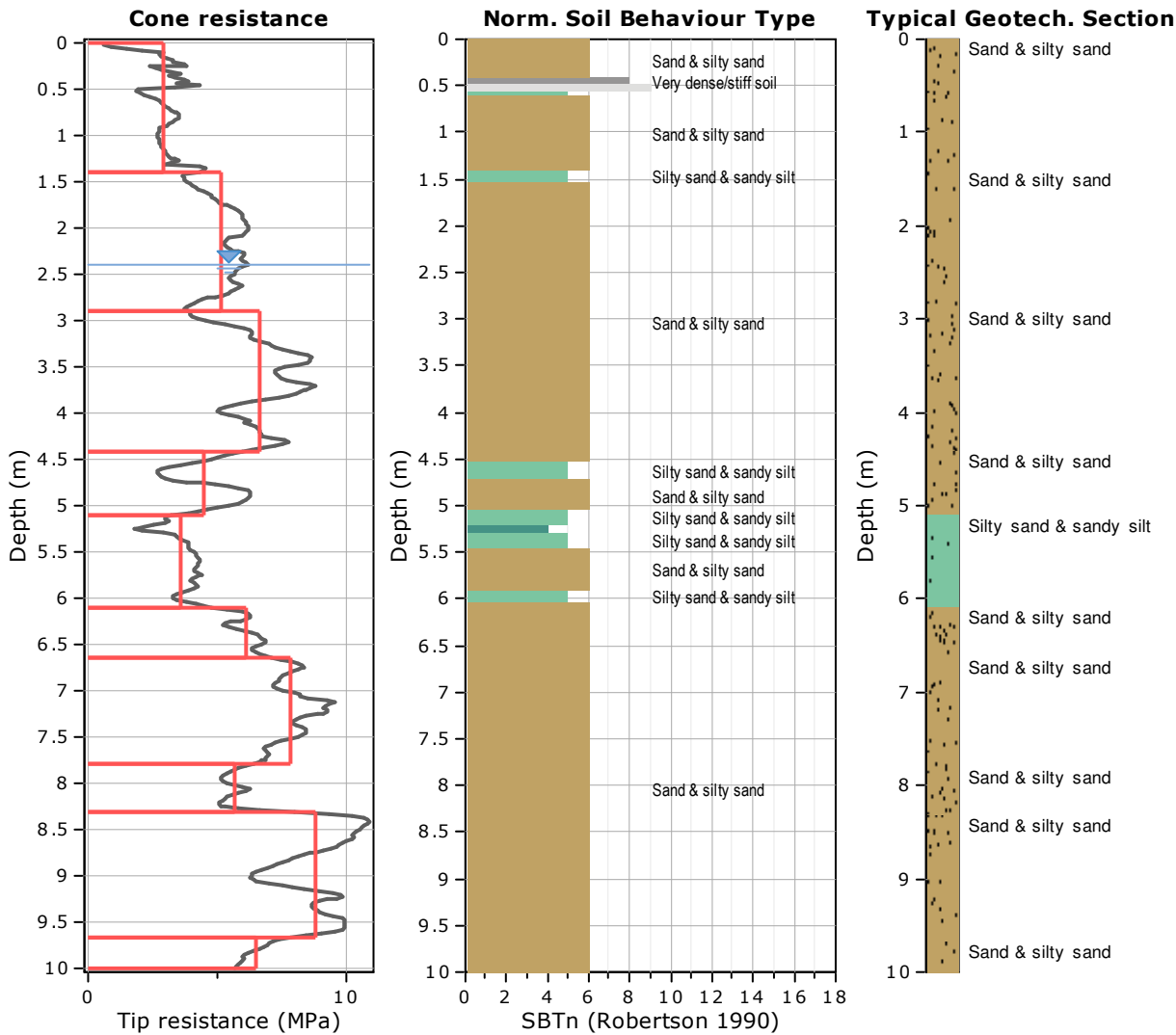
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.75             | 9.04E-07              | 2.8                                | 12.7                    | 46.9                  | 39.2              | 12.7                               | 14.0                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 0.75                          |                  | (±1.04E-05)           | (±2.8)                             | (±8.3)                  | (±7.0)                | (±0.7)            | (±20.7)                            | (±11.1)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.9)                              |
| 0.75                          | 1.29             | 6.12E-08              | 4.2                                | 0.0                     | 0.0                   | 0.0               | 13.8                               | 26.7                                      | 70.6   | 2.6                            | 12.0   | 17.4                                |
| 2.04                          |                  | (±7.05E-08)           | (±0.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±3.8)                             | (±4.1)                                    | (±19.2)  | (±1.3)                         | (±6.1) | (±0.6)                              |
| 2.04                          | 0.84             | 1.18E-08              | 1.9                                | 0.0                     | 0.0                   | 0.0               | 3.4                                | 12.9                                      | 25.4   | 0.7                            | 3.2    | 14.9                                |
| 2.88                          |                  | (±1.77E-08)           | (±0.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±2.1)                             | (±2.5)                                    | (±7.8)   | (±0.2)                         | (±0.9) | (±0.7)                              |
| 2.88                          | 0.84             | 3.47E-08              | 2.8                                | 0.0                     | 0.0                   | 0.0               | 6.5                                | 17.1                                      | 34.2   | 0.8                            | 3.7    | 15.4                                |
| 3.72                          |                  | (±4.89E-07)           | (±0.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±6.9)                             | (±2.7)                                    | (±12.7)  | (±0.3)                         | (±1.3) | (±0.3)                              |
| 3.72                          | 0.98             | 6.10E-06              | 8.2                                | 27.4                    | 37.1                  | 33.8              | 54.8                               | 34.4                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 4.70                          |                  | (±3.13E-06)           | (±1.0)                             | (±2.5)                  | (±2.4)                | (±0.6)            | (±5.0)                             | (±3.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 4.70                          | 1.14             | 8.40E-06              | 9.5                                | 31.2                    | 38.7                  | 34.1              | 62.4                               | 39.1                                      | 0.0  | 0.0                            | 0.0    | 16.8                                |
| 5.84                          |                  | (±4.80E-06)           | (±0.7)                             | (±1.1)                  | (±2.3)                | (±0.4)            | (±2.3)                             | (±1.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 5.84                          | 1.12             | 1.38E-05              | 11.6                               | 35.8                    | 41.2                  | 34.5              | 71.7                               | 44.9                                      | 0.0  | 0.0                            | 0.0    | 17.0                                |
| 6.96                          |                  | (±7.34E-06)           | (±1.4)                             | (±3.2)                  | (±3.2)                | (±0.6)            | (±6.4)                             | (±4.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.96                          | 0.62             | 4.38E-06              | 9.2                                | 31.0                    | 34.0                  | 33.0              | 62.0                               | 38.9                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 7.58                          |                  | (±2.63E-06)           | (±0.9)                             | (±1.9)                  | (±2.1)                | (±0.4)            | (±3.8)                             | (±2.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.58                          | 1.04             | 8.59E-06              | 11.8                               | 37.7                    | 38.6                  | 34.0              | 75.4                               | 47.3                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 8.62                          |                  | (±4.25E-06)           | (±1.0)                             | (±1.9)                  | (±2.6)                | (±0.5)            | (±3.8)                             | (±2.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.62                          | 1.38             | 1.07E-05              | 13.2                               | 41.8                    | 39.9                  | 34.3              | 83.7                               | 52.4                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 10.00                         |                  | (±5.27E-06)           | (±0.9)                             | (±1.6)                  | (±2.2)                | (±0.4)            | (±3.3)                             | (±2.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1     **Start depth:** 0.00 (m), **End depth:** 1.40 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $2.89 \pm 0.72$  MPa

Sleeve friction:  $28.37 \pm 31.79$  kPa

Ic:  $1.88 \pm 0.19$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $1.61E-05 \pm 5.23E-05$  m/s

N<sub>60</sub>:  $7.19 \pm 1.89$  blows

Es:  $22.22 \pm 6.82$  MPa

Dr (%):  $55.98 \pm 9.64$

φ (degrees):  $38.45 \pm 2.23$  °

Unit weight:  $17.24 \pm 0.78$  kN/m<sup>3</sup>

Constrained Mod.:  $43.25 \pm 14.02$  MPa

Go:  $28.34 \pm 8.54$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 1.40 (m), **End depth:** 2.90 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.16 ±0.81 MPa

Sleeve friction: 39.15 ±9.06 kPa

Ic: 1.87 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.86E-05 ±1.07E-05 m/s

N<sub>60</sub>: 12.80 ±1.40 blows

Es: 39.23 ±2.85 MPa

Dr (%): 51.31 ±3.40

φ (degrees): 37.31 ±0.78 °

Unit weight: 17.84 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 78.45 ±5.70 MPa

Go: 49.16 ±3.57 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 2.90 (m), **End depth:** 4.42 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.60 ±1.27 MPa

Sleeve friction: 40.87 ±8.84 kPa

Ic: 1.81 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.80E-05 ±1.95E-05 m/s

N<sub>60</sub>: 15.73 ±2.36 blows

Es: 46.45 ±5.35 MPa

Dr (%): 51.81 ±4.49

φ (degrees): 37.14 ±0.84 °

Unit weight: 17.98 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 92.91 ±10.70 MPa

Go: 58.22 ±6.71 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 4.42 (m), **End depth:** 5.10 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.43 ±1.27 MPa

Sleeve friction: 32.39 ±9.23 kPa

Ic: 2.01 ±0.15

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.54E-06 ±9.84E-06 m/s

N<sub>60</sub>: 12.10 ±2.40 blows

Es: 40.20 ±5.65 MPa

Dr (%): 41.27 ±5.46

φ (degrees): 35.33 ±0.92 °

Unit weight: 17.56 ±0.39 kN/m<sup>3</sup>

Constrained Mod.: 72.03 ±20.83 MPa

Go: 50.38 ±7.08 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 5.10 (m), **End depth:** 6.10 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.60 ±0.70 MPa

Sleeve friction: 30.08 ±7.87 kPa

Ic: 2.14 ±0.17

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.66E-06 ±3.16E-06 m/s

N<sub>60</sub>: 10.69 ±1.23 blows

Es: 38.38 ±1.69 MPa

Dr (%): 37.08 ±2.08

φ (degrees): 34.53 ±0.49 °

Unit weight: 17.39 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 61.83 ±18.44 MPa

Go: 47.79 ±2.30 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**::: Layer No: 6 :::****Code:** Layer\_6    **Start depth:** 6.10 (m), **End depth:** 6.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.14 ±0.58 MPa

Sleeve friction: 35.61 ±7.59 kPa

Ic: 1.89 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.57E-05 ±6.84E-06 m/s

N<sub>60</sub>: 15.37 ±1.29 blows

Es: 47.56 ±3.63 MPa

Dr (%): 45.46 ±1.95

φ (degrees): 35.75 ±0.46 °

Unit weight: 17.79 ±0.27 kN/m<sup>3</sup>

Constrained Mod.: 95.11 ±7.26 MPa

Go: 59.60 ±4.55 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7    **Start depth:** 6.64 (m), **End depth:** 7.80 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.81 ±0.80 MPa

Sleeve friction: 46.93 ±6.23 kPa

Ic: 1.83 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.40E-05 ±1.17E-05 m/s

N<sub>60</sub>: 18.85 ±1.32 blows

Es: 56.17 ±2.99 MPa

Dr (%): 49.79 ±2.66

φ (degrees): 36.68 ±0.51 °

Unit weight: 18.20 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 112.34 ±5.99 MPa

Go: 70.40 ±3.75 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8    **Start depth:** 7.80 (m), **End depth:** 8.32 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.64 ±0.63 MPa

Sleeve friction: 34.49 ±4.04 kPa

Ic: 1.98 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.76E-06 ±6.88E-06 m/s

N<sub>60</sub>: 14.92 ±1.16 blows

Es: 48.24 ±1.78 MPa

Dr (%): 41.30 ±2.17

φ (degrees): 34.93 ±0.36 °

Unit weight: 17.72 ±0.13 kN/m<sup>3</sup>

Constrained Mod.: 96.48 ±3.57 MPa

Go: 60.46 ±2.23 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 9 :::****Code:** Layer\_9    **Start depth:** 8.32 (m), **End depth:** 9.66 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.80 ±1.31 MPa

Sleeve friction: 57.61 ±12.49 kPa

Ic: 1.85 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.15E-05 ±2.11E-05 m/s

N<sub>60</sub>: 21.51 ±2.35 blows

Es: 64.44 ±5.72 MPa

Dr (%): 50.28 ±3.99

φ (degrees): 36.91 ±0.74 °

Unit weight: 18.48 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 128.87 ±11.43 MPa

Go: 80.76 ±7.16 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 9.66 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.48 ±0.63 MPa

Sleeve friction: 51.33 ±9.11 kPa

Ic: 2.03 ±0.02

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.24E-06 ±1.13E-06 m/s

N<sub>60</sub>: 17.82 ±1.54 blows

Es: 58.81 ±4.32 MPa

Dr (%): 42.00 ±2.19

φ (degrees): 35.47 ±0.56 °

Unit weight: 18.23 ±0.23 kN/m<sup>3</sup>

Constrained Mod.: 117.62 ±8.64 MPa

Go: 73.71 ±5.42 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km45+900**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.852193° lon 12.177099°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.40             | 1.61E-05              | 7.2                                | 22.2                    | 56.0                  | 38.5              | 43.3                               | 28.3                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 1.40                          |                  | (±5.23E-05)           | (±1.9)                             | (±6.8)                  | (±9.6)                | (±2.2)            | (±14.0)                            | (±8.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.8)                              |
| 1.40                          | 1.50             | 1.86E-05              | 12.8                               | 39.2                    | 51.3                  | 37.3              | 78.5                               | 49.2                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 2.90                          |                  | (±1.07E-05)           | (±1.4)                             | (±2.9)                  | (±3.4)                | (±0.8)            | (±5.7)                             | (±3.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.90                          | 1.52             | 2.80E-05              | 15.7                               | 46.5                    | 51.8                  | 37.1              | 92.9                               | 58.2                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 4.42                          |                  | (±1.95E-05)           | (±2.4)                             | (±5.4)                  | (±4.5)                | (±0.8)            | (±10.7)                            | (±6.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 4.42                          | 0.68             | 6.54E-06              | 12.1                               | 40.2                    | 41.3                  | 35.3              | 72.0                               | 50.4                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 5.10                          |                  | (±9.84E-06)           | (±2.4)                             | (±5.6)                  | (±5.5)                | (±0.9)            | (±20.8)                            | (±7.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 5.10                          | 1.00             | 2.66E-06              | 10.7                               | 38.4                    | 37.1                  | 34.5              | 61.8                               | 47.8                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 6.10                          |                  | (±3.16E-06)           | (±1.2)                             | (±1.7)                  | (±2.1)                | (±0.5)            | (±18.4)                            | (±2.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.10                          | 0.54             | 1.57E-05              | 15.4                               | 47.6                    | 45.5                  | 35.7              | 95.1                               | 59.6                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 6.64                          |                  | (±6.84E-06)           | (±1.3)                             | (±3.6)                  | (±1.9)                | (±0.5)            | (±7.3)                             | (±4.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.64                          | 1.16             | 2.40E-05              | 18.9                               | 56.2                    | 49.8                  | 36.7              | 112.3                              | 70.4                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 7.80                          |                  | (±1.17E-05)           | (±1.3)                             | (±3.0)                  | (±2.7)                | (±0.5)            | (±6.0)                             | (±3.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.80                          | 0.52             | 8.76E-06              | 14.9                               | 48.2                    | 41.3                  | 34.9              | 96.5                               | 60.5                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 8.32                          |                  | (±6.88E-06)           | (±1.2)                             | (±1.8)                  | (±2.2)                | (±0.4)            | (±3.6)                             | (±2.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 8.32                          | 1.34             | 2.15E-05              | 21.5                               | 64.4                    | 50.3                  | 36.9              | 128.9                              | 80.8                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 9.66                          |                  | (±2.11E-05)           | (±2.4)                             | (±5.7)                  | (±4.0)                | (±0.7)            | (±11.4)                            | (±7.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 9.66                          | 0.34             | 6.24E-06              | 17.8                               | 58.8                    | 42.0                  | 35.5              | 117.6                              | 73.7                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 10.00                         |                  | (±1.13E-06)           | (±1.5)                             | (±4.3)                  | (±2.2)                | (±0.6)            | (±8.6)                             | (±5.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

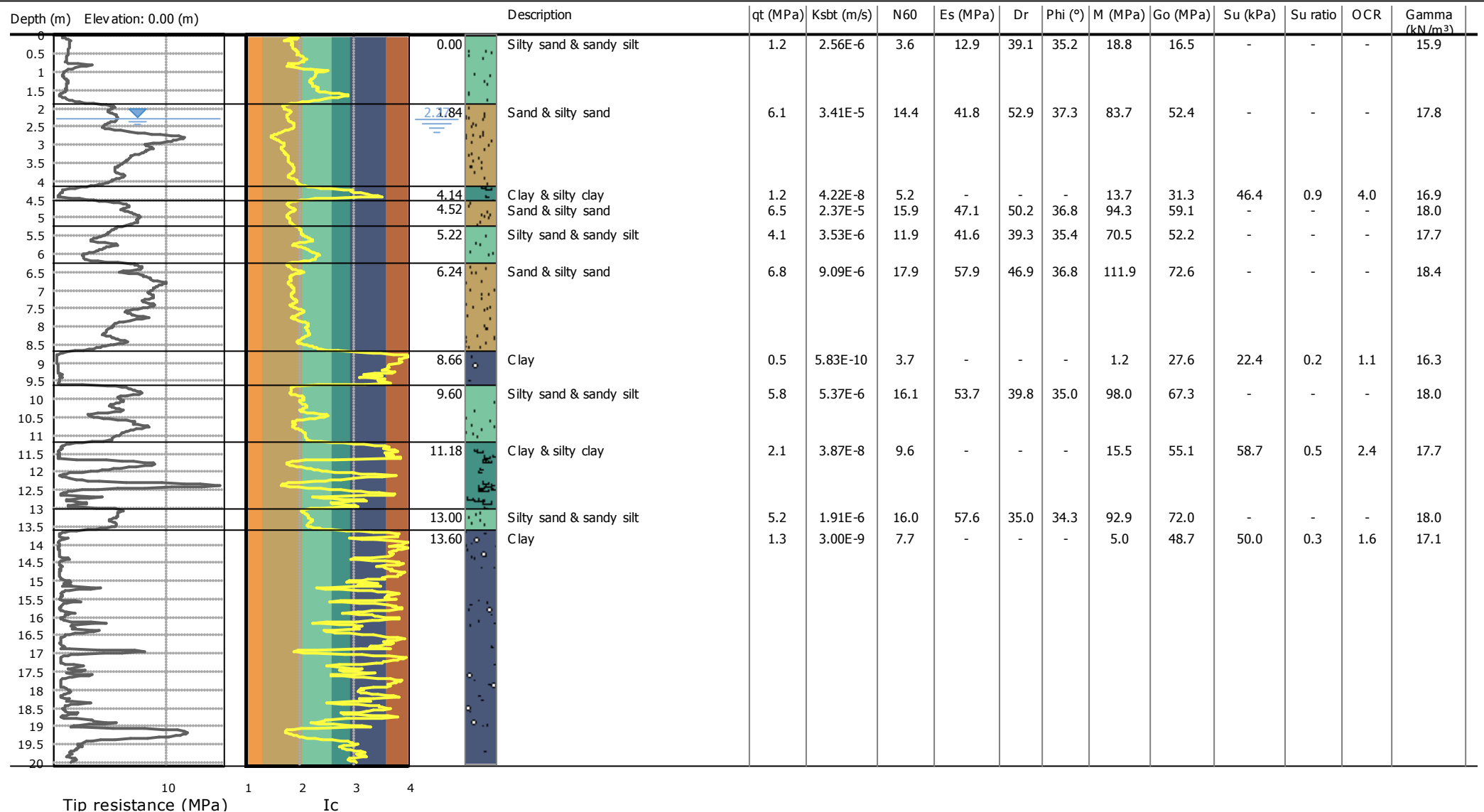
**CPT: CPTU km50+500**

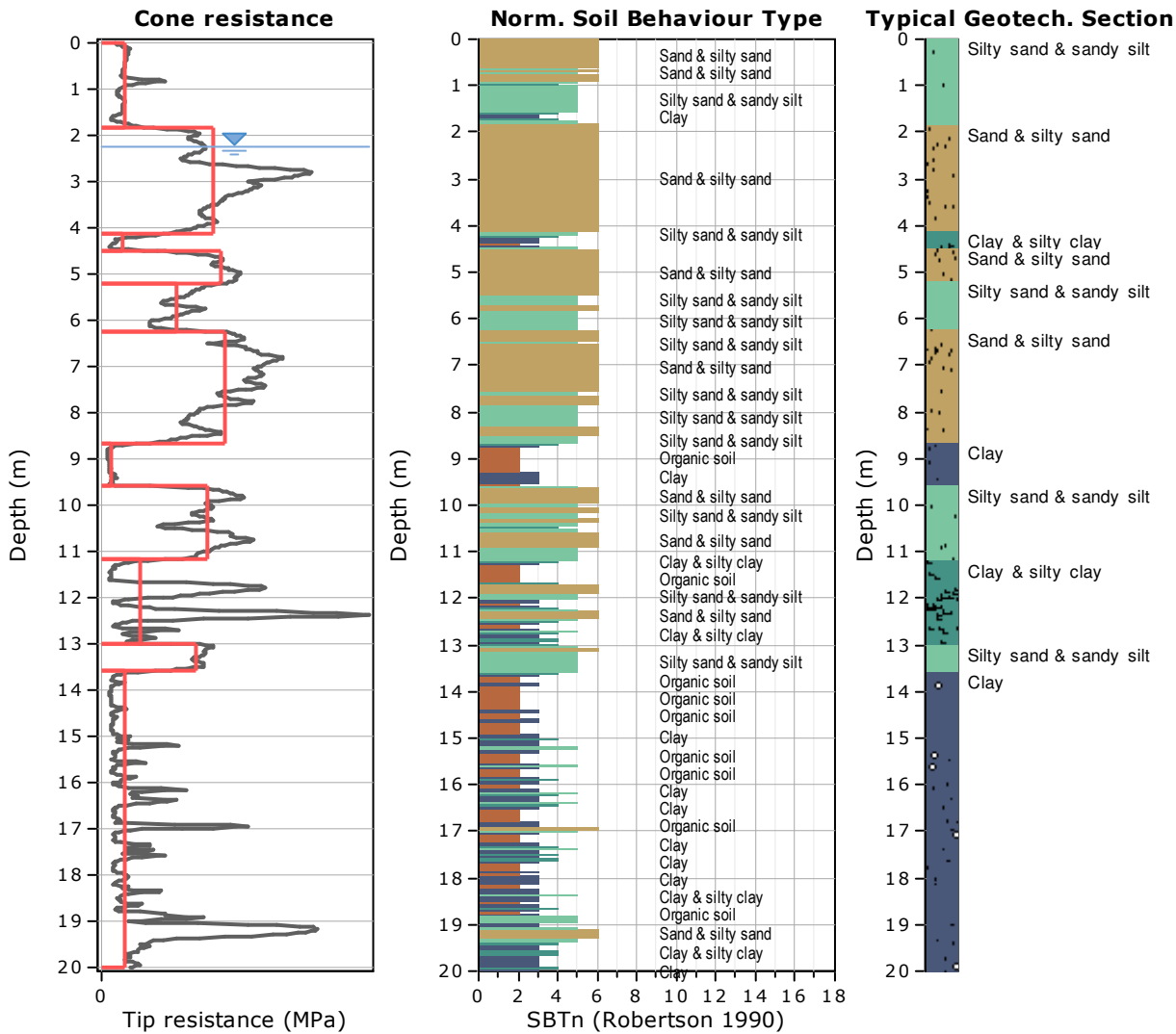
Total depth: 20.00 m

Coords: lat 44.887163° lon 12.210513°

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.00 (m), **End depth:** 1.84 (m)

**Description:** Silty sand & sandy silt

#### Basic results

Total cone resistance: 1.22 ±0.52 MPa

Sleeve friction: 11.57 ±7.46 kPa

Ic: 2.14 ±0.27

SBT<sub>n</sub>: 5

SBT<sub>n</sub> description: Silty sand & sandy silt

#### Estimation results

Permeability: 2.56E-06 ±1.17E-05 m/s

N<sub>60</sub>: 3.59 ±1.16 blows

Es: 12.85 ±3.81 MPa

Dr (%): 39.14 ±10.26

φ (degrees): 35.20 ±2.02 °

Unit weight: 15.88 ±0.53 kN/m<sup>3</sup>

Constrained Mod.: 18.77 ±8.99 MPa

Go: 16.50 ±4.73 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 1.84 (m), **End depth:** 4.14 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.14 ±1.96 MPa

Sleeve friction: 36.01 ±10.61 kPa

Ic: 1.78 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.41E-05 ±5.76E-05 m/s

N<sub>60</sub>: 14.41 ±3.39 blows

Es: 41.83 ±7.34 MPa

Dr (%): 52.85 ±6.76

φ (degrees): 37.32 ±1.27 °

Unit weight: 17.81 ±0.43 kN/m<sup>3</sup>

Constrained Mod.: 83.66 ±14.67 MPa

Go: 52.43 ±9.20 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 4.14 (m), **End depth:** 4.52 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.16 ±1.13 MPa

Sleeve friction: 28.54 ±3.91 kPa

Ic: 2.71 ±0.49

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 4.22E-08 ±1.89E-06 m/s

N<sub>60</sub>: 5.15 ±2.57 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.90 ±0.16 kN/m<sup>3</sup>

Constrained Mod.: 13.71 ±25.13 MPa

Go: 31.34 ±5.91 MPa

Su: 46.39 ±24.98 kPa

Su ratio: 0.86 ±0.42

O.C.R.: 3.96 ±1.93

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 4.52 (m), **End depth:** 5.22 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.52 ±0.97 MPa

Sleeve friction: 40.28 ±10.40 kPa

Ic: 1.83 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.37E-05 ±8.49E-06 m/s

N<sub>60</sub>: 15.88 ±2.07 blows

Es: 47.14 ±5.71 MPa

Dr (%): 50.20 ±3.56

φ (degrees): 36.80 ±0.86 °

Unit weight: 17.96 ±0.40 kN/m<sup>3</sup>

Constrained Mod.: 94.28 ±11.43 MPa

Go: 59.09 ±7.16 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 5.22 (m), **End depth:** 6.24 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.13 ±1.05 MPa

Sleeve friction: 37.62 ±7.85 kPa

Ic: 2.10 ±0.14

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.53E-06 ±5.00E-06 m/s

N<sub>60</sub>: 11.89 ±2.01 blows

Es: 41.62 ±4.50 MPa

Dr (%): 39.33 ±5.04

φ (degrees): 35.35 ±0.73 °

Unit weight: 17.70 ±0.30 kN/m<sup>3</sup>

Constrained Mod.: 70.52 ±22.69 MPa

Go: 52.17 ±5.64 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 6.24 (m), **End depth:** 8.66 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.78 ±1.71 MPa

Sleeve friction: 59.28 ±13.40 kPa

Ic: 1.97 ±0.15

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.09E-06 ±1.12E-05 m/s

N<sub>60</sub>: 17.94 ±3.10 blows

Es: 57.89 ±6.63 MPa

Dr (%): 46.85 ±6.73

φ (degrees): 36.75 ±1.07 °

Unit weight: 18.42 ±0.34 kN/m<sup>3</sup>

Constrained Mod.: 111.91 ±19.61 MPa

Go: 72.56 ±8.31 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 8.66 (m), **End depth:** 9.60 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.52 ±0.51 MPa

Sleeve friction: 23.09 ±9.44 kPa

Ic: 3.53 ±0.37

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 5.83E-10 ±1.09E-07 m/s

N<sub>60</sub>: 3.73 ±1.53 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.35 ±0.47 kN/m<sup>3</sup>

Constrained Mod.: 1.25 ±7.91 MPa

Go: 27.60 ±7.15 MPa

Su: 22.38 ±19.72 kPa

Su ratio: 0.24 ±0.22

O.C.R.: 1.12 ±1.01

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 9.60 (m), **End depth:** 11.18 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.79 ±1.29 MPa

Sleeve friction: 41.67 ±9.33 kPa

Ic: 2.04 ±0.16

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.37E-06 ±8.18E-06 m/s

N<sub>60</sub>: 16.14 ±2.28 blows

Es: 53.71 ±4.93 MPa

Dr (%): 39.84 ±4.61

φ (degrees): 35.03 ±0.62 °

Unit weight: 17.95 ±0.30 kN/m<sup>3</sup>

Constrained Mod.: 98.02 ±22.42 MPa

Go: 67.29 ±6.15 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 11.18 (m), **End depth:** 13.00 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.09 ±3.80 MPa

Sleeve friction: 45.10 ±21.65 kPa

Ic: 2.73 ±0.70

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 3.87E-08 ±1.66E-05 m/s

N<sub>60</sub>: 9.59 ±7.42 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.65 ±0.72 kN/m<sup>3</sup>

Constrained Mod.: 15.48 ±60.76 MPa

Go: 55.08 ±20.67 MPa

Su: 58.68 ±60.59 kPa

Su ratio: 0.51 ±0.52

O.C.R.: 2.36 ±2.39



**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 13.00 (m), **End depth:** 13.60 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 5.20 ±0.71 MPa

Sleeve friction: 45.59 ±4.32 kPa

Ic: 2.19 ±0.12

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.91E-06 ±1.46E-06 m/s

N<sub>60</sub>: 16.01 ±1.26 blows

Es: 57.58 ±1.51 MPa

Dr (%): 34.96 ±2.30

φ (degrees): 34.35 ±0.16 °

Unit weight: 18.01 ±0.10 kN/m<sup>3</sup>

Constrained Mod.: 92.89 ±28.13 MPa

Go: 71.96 ±2.17 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 11 ::****Code:** Layer\_11    **Start depth:** 13.60 (m), **End depth:** 20.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.28 ±2.24 MPa

Sleeve friction: 33.87 ±17.46 kPa

Ic: 3.18 ±0.54

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 3.00E-09 ±5.70E-06 m/s

N<sub>60</sub>: 7.67 ±4.93 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.14 ±0.68 kN/m<sup>3</sup>

Constrained Mod.: 5.00 ±37.76 MPa

Go: 48.74 ±17.78 MPa

Su: 49.97 ±49.59 kPa

Su ratio: 0.34 ±0.31

O.C.R.: 1.56 ±1.45

**Project:**

**Location:**

**CPT: CPTU km50+500**

Total depth: 20.00 m, Date: 19/06/2019

Coords: lat 44.887163° lon 12.210513°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.84             | 2.56E-06              | 3.6                                | 12.9                    | 39.1                  | 35.2              | 18.8                               | 16.5                                      | 0.0  | 0.0                            | 0.0    | 15.9                                |
| 1.84                          |                  | (±1.17E-05)           | (±1.2)                             | (±3.8)                  | (±10.3)               | (±2.0)            | (±9.0)                             | (±4.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 1.84                          | 2.30             | 3.41E-05              | 14.4                               | 41.8                    | 52.9                  | 37.3              | 83.7                               | 52.4                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 4.14                          |                  | (±5.76E-05)           | (±3.4)                             | (±7.3)                  | (±6.8)                | (±1.3)            | (±14.7)                            | (±9.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 4.14                          | 0.38             | 4.22E-08              | 5.2                                | 0.0                     | 0.0                   | 0.0               | 13.7                               | 31.3                                      | 46.4   | 0.9                            | 4.0    | 16.9                                |
| 4.52                          |                  | (±1.89E-06)           | (±2.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±25.1)                            | (±5.9)                                    | (±25.0)  | (±0.4)                         | (±1.9) | (±0.2)                              |
| 4.52                          | 0.70             | 2.37E-05              | 15.9                               | 47.1                    | 50.2                  | 36.8              | 94.3                               | 59.1                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 5.22                          |                  | (±8.49E-06)           | (±2.1)                             | (±5.7)                  | (±3.6)                | (±0.9)            | (±11.4)                            | (±7.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 5.22                          | 1.02             | 3.53E-06              | 11.9                               | 41.6                    | 39.3                  | 35.4              | 70.5                               | 52.2                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 6.24                          |                  | (±5.00E-06)           | (±2.0)                             | (±4.5)                  | (±5.0)                | (±0.7)            | (±22.7)                            | (±5.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 6.24                          | 2.42             | 9.09E-06              | 17.9                               | 57.9                    | 46.9                  | 36.8              | 111.9                              | 72.6                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 8.66                          |                  | (±1.12E-05)           | (±3.1)                             | (±6.6)                  | (±6.7)                | (±1.1)            | (±19.6)                            | (±8.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 8.66                          | 0.94             | 5.83E-10              | 3.7                                | 0.0                     | 0.0                   | 0.0               | 1.2                                | 27.6                                      | 22.4   | 0.2                            | 1.1    | 16.3                                |
| 9.60                          |                  | (±1.09E-07)           | (±1.5)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±7.9)                             | (±7.2)                                    | (±19.7)  | (±0.2)                         | (±1.0) | (±0.5)                              |
| 9.60                          | 1.58             | 5.37E-06              | 16.1                               | 53.7                    | 39.8                  | 35.0              | 98.0                               | 67.3                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 11.18                         |                  | (±8.18E-06)           | (±2.3)                             | (±4.9)                  | (±4.6)                | (±0.6)            | (±22.4)                            | (±6.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 11.18                         | 1.82             | 3.87E-08              | 9.6                                | 0.0                     | 0.0                   | 0.0               | 15.5                               | 55.1                                      | 58.7   | 0.5                            | 2.4    | 17.7                                |
| 13.00                         |                  | (±1.66E-05)           | (±7.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±60.8)                            | (±20.7)                                   | (±60.6)  | (±0.5)                         | (±2.4) | (±0.7)                              |
| 13.00                         | 0.60             | 1.91E-06              | 16.0                               | 57.6                    | 35.0                  | 34.3              | 92.9                               | 72.0                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 13.60                         |                  | (±1.46E-06)           | (±1.3)                             | (±1.5)                  | (±2.3)                | (±0.2)            | (±28.1)                            | (±2.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 13.60                         | 6.40             | 3.00E-09              | 7.7                                | 0.0                     | 0.0                   | 0.0               | 5.0                                | 48.7                                      | 50.0   | 0.3                            | 1.6    | 17.1                                |
| 20.00                         |                  | (±5.70E-06)           | (±4.9)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±37.8)                            | (±17.8)                                   | (±49.6)  | (±0.3)                         | (±1.5) | (±0.7)                              |

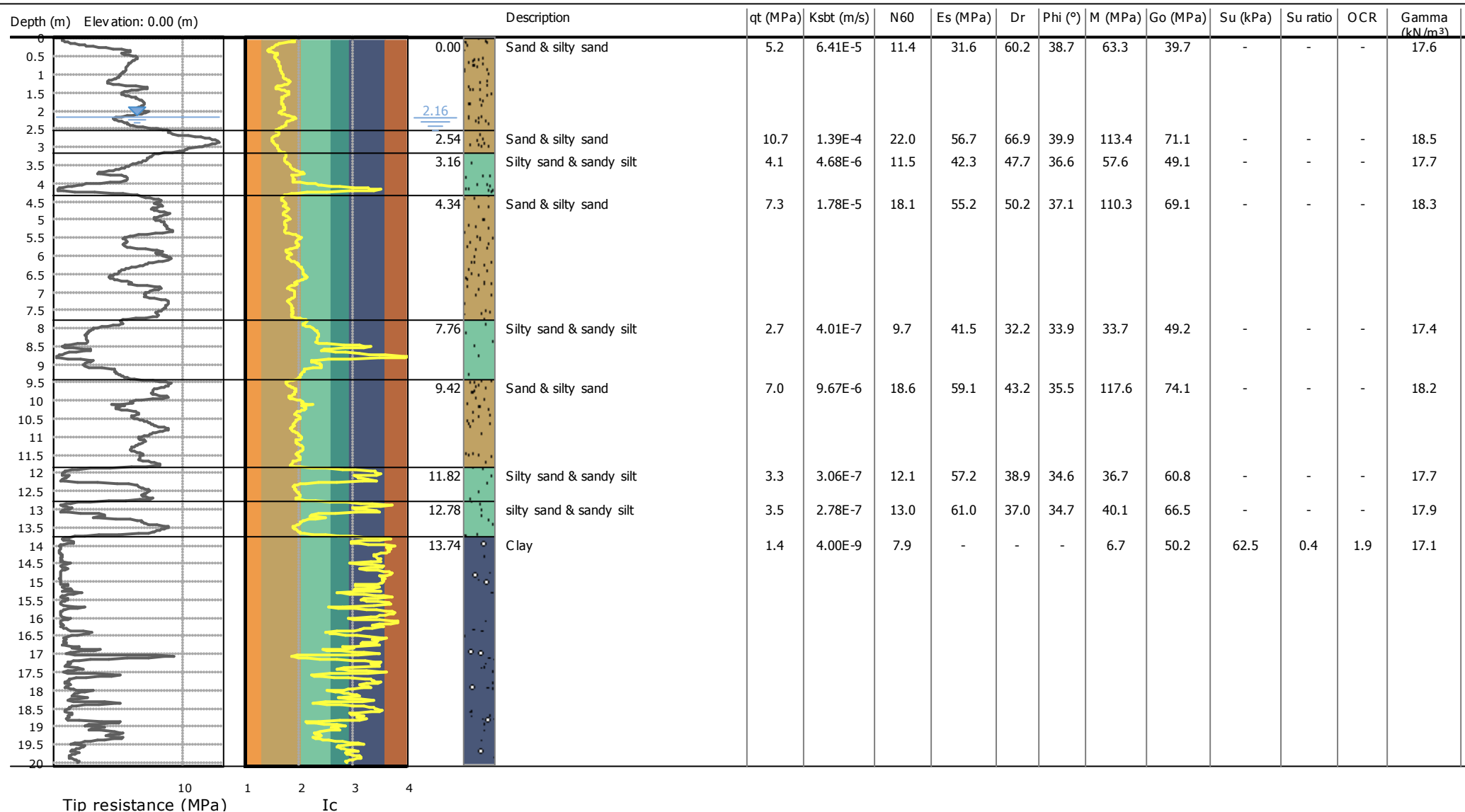
Depth values presented in this table are measured from free ground surface

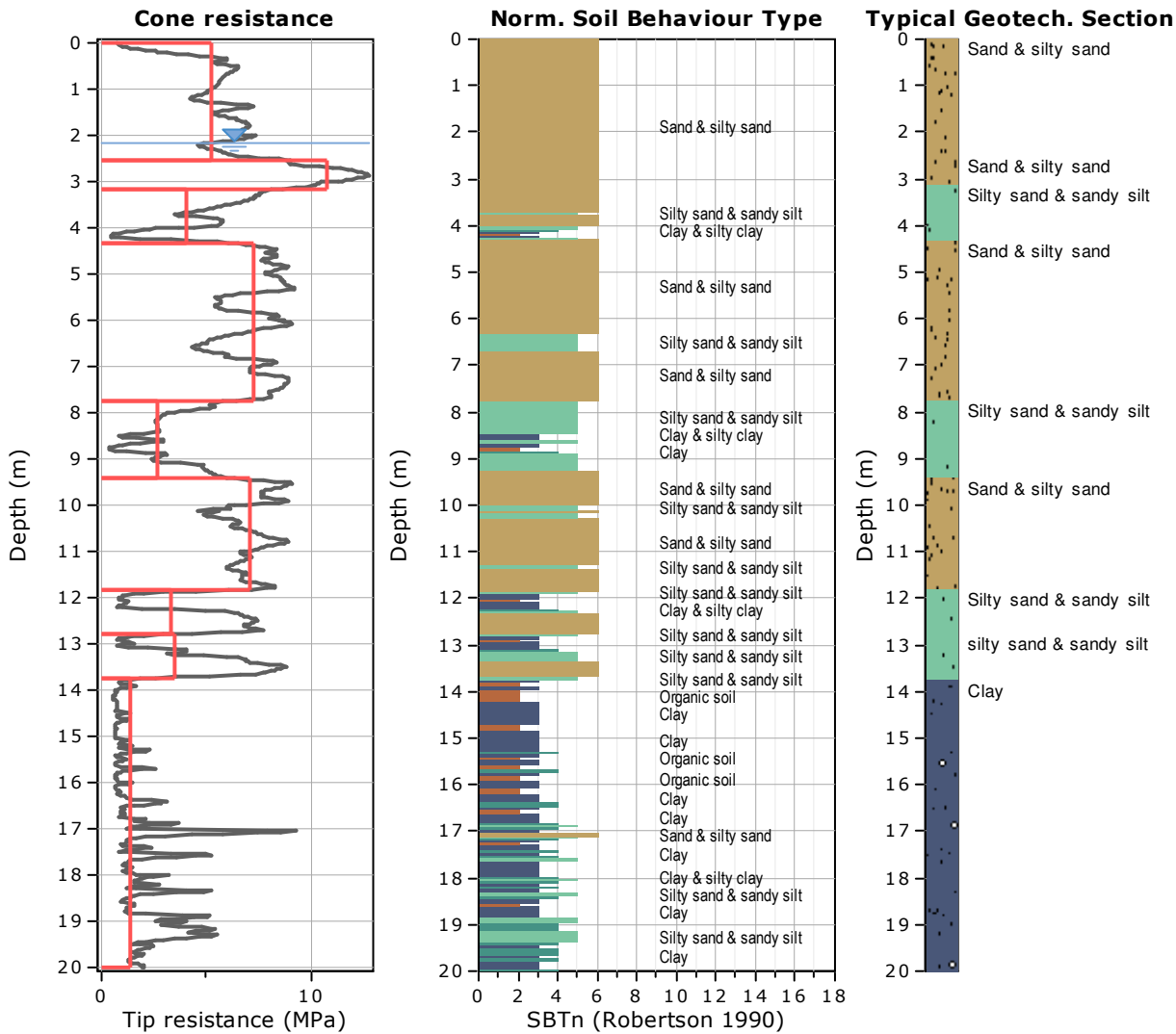
**Project:**

Total depth: 20.00 m

**Location:**

Coords: lat 44.887298° lon 12.211225°





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1     **Start depth:** 0.00 (m), **End depth:** 2.54 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance: 5.19 ±1.56 MPa

Sleeve friction: 30.55 ±9.46 kPa

Ic: 1.69 ±0.11

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability: 6.41E-05 ±8.05E-05 m/s

N<sub>60</sub>: 11.41 ±3.35 blows

Es: 31.64 ±9.35 MPa

Dr (%): 60.17 ±6.75

φ (degrees): 38.74 ±1.31 °

Unit weight: 17.55 ±0.64 kN/m<sup>3</sup>

Constrained Mod.: 63.28 ±18.70 MPa

Go: 39.66 ±11.72 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 2.54 (m), **End depth:** 3.16 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 10.70 ±1.40 MPa

Sleeve friction: 55.32 ±9.61 kPa

Ic: 1.58 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.39E-04 ±5.88E-05 m/s

N<sub>60</sub>: 22.01 ±2.24 blows

Es: 56.69 ±4.91 MPa

Dr (%): 66.93 ±3.85

φ (degrees): 39.90 ±0.77 °

Unit weight: 18.51 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 113.39 ±9.82 MPa

Go: 71.06 ±6.15 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 3.16 (m), **End depth:** 4.34 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.07 ±2.39 MPa

Sleeve friction: 37.75 ±7.54 kPa

Ic: 2.03 ±0.46

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 4.68E-06 ±2.23E-05 m/s

N<sub>60</sub>: 11.45 ±4.38 blows

Es: 42.33 ±5.44 MPa

Dr (%): 47.70 ±6.87

φ (degrees): 36.58 ±1.04 °

Unit weight: 17.70 ±0.37 kN/m<sup>3</sup>

Constrained Mod.: 57.62 ±33.74 MPa

Go: 49.10 ±10.15 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 4.34 (m), **End depth:** 7.76 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.26 ±1.33 MPa

Sleeve friction: 52.93 ±10.47 kPa

Ic: 1.87 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.78E-05 ±1.78E-05 m/s

N<sub>60</sub>: 18.08 ±2.39 blows

Es: 55.16 ±5.65 MPa

Dr (%): 50.16 ±5.01

φ (degrees): 37.06 ±0.82 °

Unit weight: 18.31 ±0.27 kN/m<sup>3</sup>

Constrained Mod.: 110.32 ±11.31 MPa

Go: 69.13 ±7.09 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 7.76 (m), **End depth:** 9.42 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.67 ±1.65 MPa

Sleeve friction: 32.22 ±11.49 kPa

Ic: 2.41 ±0.47

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 4.01E-07 ±2.60E-06 m/s

N<sub>60</sub>: 9.73 ±3.47 blows

Es: 41.54 ±7.22 MPa

Dr (%): 32.19 ±5.48

φ (degrees): 33.90 ±0.97 °

Unit weight: 17.36 ±0.44 kN/m<sup>3</sup>

Constrained Mod.: 33.69 ±39.23 MPa

Go: 49.20 ±9.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 9.42 (m), **End depth:** 11.82 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.05 ±1.04 MPa

Sleeve friction: 46.65 ±7.07 kPa

Ic: 1.96 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.67E-06 ±8.05E-06 m/s

N<sub>60</sub>: 18.55 ±1.78 blows

Es: 59.10 ±3.70 MPa

Dr (%): 43.17 ±3.55

φ (degrees): 35.48 ±0.62 °

Unit weight: 18.16 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 117.62 ±9.02 MPa

Go: 74.07 ±4.64 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 11.82 (m), **End depth:** 12.78 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.30 ±3.02 MPa

Sleeve friction: 39.77 ±12.25 kPa

Ic: 2.40 ±0.61

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.06E-07 ±6.98E-06 m/s

N<sub>60</sub>: 12.08 ±5.84 blows

Es: 57.22 ±5.14 MPa

Dr (%): 38.88 ±4.27

φ (degrees): 34.60 ±0.53 °

Unit weight: 17.68 ±0.49 kN/m<sup>3</sup>

Constrained Mod.: 36.74 ±63.39 MPa

Go: 60.85 ±14.28 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 12.78 (m), **End depth:** 13.74 (m)**Description:** silty sand & sandy silt**Basic results**

Total cone resistance: 3.52 ±3.10 MPa

Sleeve friction: 46.95 ±14.38 kPa

Ic: 2.43 ±0.57

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.78E-07 ±5.96E-06 m/s

N<sub>60</sub>: 12.95 ±6.12 blows

Es: 60.96 ±8.22 MPa

Dr (%): 37.01 ±6.51

φ (degrees): 34.71 ±0.98 °

Unit weight: 17.90 ±0.54 kN/m<sup>3</sup>

Constrained Mod.: 40.14 ±64.56 MPa

Go: 66.53 ±15.67 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 13.74 (m), **End depth:** 20.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.40 ±1.42 MPa

Sleeve friction: 31.61 ±15.92 kPa

Ic: 3.10 ±0.43

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 4.00E-09 ±1.59E-06 m/s

N<sub>60</sub>: 7.92 ±3.51 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.09 ±0.60 kN/m<sup>3</sup>

Constrained Mod.: 6.65 ±25.35 MPa

Go: 50.18 ±14.24 MPa

Su: 62.54 ±48.95 kPa

Su ratio: 0.41 ±0.30

O.C.R.: 1.89 ±1.37

**Project:**

**Location:**

**CPT: CPTU km50+700**

Total depth: 20.00 m, Date: 19/06/2019

Coords: lat 44.887298° lon 12.211225°

**Summary table of mean values**

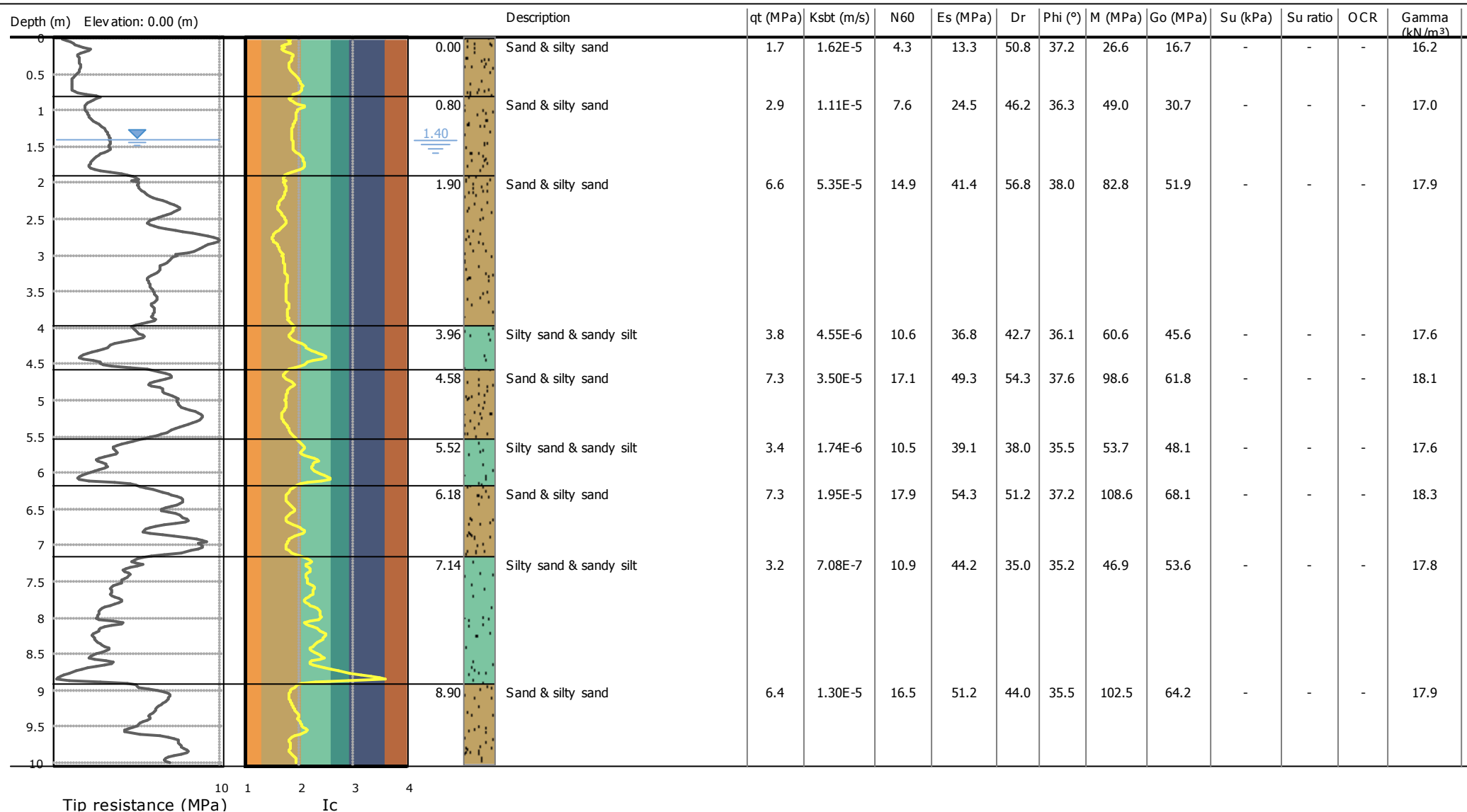
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 2.54             | 6.41E-05              | 11.4                               | 31.6                    | 60.2                  | 38.7              | 63.3                               | 39.7                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 2.54                          |                  | (±8.05E-05)           | (±3.4)                             | (±9.4)                  | (±6.8)                | (±1.3)            | (±18.7)                            | (±11.7)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 2.54                          | 0.62             | 1.39E-04              | 22.0                               | 56.7                    | 66.9                  | 39.9              | 113.4                              | 71.1                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 3.16                          |                  | (±5.88E-05)           | (±2.2)                             | (±4.9)                  | (±3.9)                | (±0.8)            | (±9.8)                             | (±6.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.16                          | 1.18             | 4.68E-06              | 11.5                               | 42.3                    | 47.7                  | 36.6              | 57.6                               | 49.1                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 4.34                          |                  | (±2.23E-05)           | (±4.4)                             | (±5.4)                  | (±6.9)                | (±1.0)            | (±33.7)                            | (±10.1)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 4.34                          | 3.42             | 1.78E-05              | 18.1                               | 55.2                    | 50.2                  | 37.1              | 110.3                              | 69.1                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 7.76                          |                  | (±1.78E-05)           | (±2.4)                             | (±5.7)                  | (±5.0)                | (±0.8)            | (±11.3)                            | (±7.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.76                          | 1.66             | 4.01E-07              | 9.7                                | 41.5                    | 32.2                  | 33.9              | 33.7                               | 49.2                                      | 0.0  | 0.0                            | 0.0    | 17.4                                |
| 9.42                          |                  | (±2.60E-06)           | (±3.5)                             | (±7.2)                  | (±5.5)                | (±1.0)            | (±39.2)                            | (±9.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 9.42                          | 2.40             | 9.67E-06              | 18.6                               | 59.1                    | 43.2                  | 35.5              | 117.6                              | 74.1                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 11.82                         |                  | (±8.05E-06)           | (±1.8)                             | (±3.7)                  | (±3.5)                | (±0.6)            | (±9.0)                             | (±4.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 11.82                         | 0.96             | 3.06E-07              | 12.1                               | 57.2                    | 38.9                  | 34.6              | 36.7                               | 60.8                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 12.78                         |                  | (±6.98E-06)           | (±5.8)                             | (±5.1)                  | (±4.3)                | (±0.5)            | (±63.4)                            | (±14.3)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 12.78                         | 0.96             | 2.78E-07              | 13.0                               | 61.0                    | 37.0                  | 34.7              | 40.1                               | 66.5                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 13.74                         |                  | (±5.96E-06)           | (±6.1)                             | (±8.2)                  | (±6.5)                | (±1.0)            | (±64.6)                            | (±15.7)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 13.74                         | 6.26             | 4.00E-09              | 7.9                                | 0.0                     | 0.0                   | 0.0               | 6.7                                | 50.2                                      | 62.5   | 0.4                            | 1.9    | 17.1                                |
| 20.00                         |                  | (±1.59E-06)           | (±3.5)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±25.3)                            | (±14.2)                                   | (±49.0)  | (±0.3)                         | (±1.4) | (±0.6)                              |

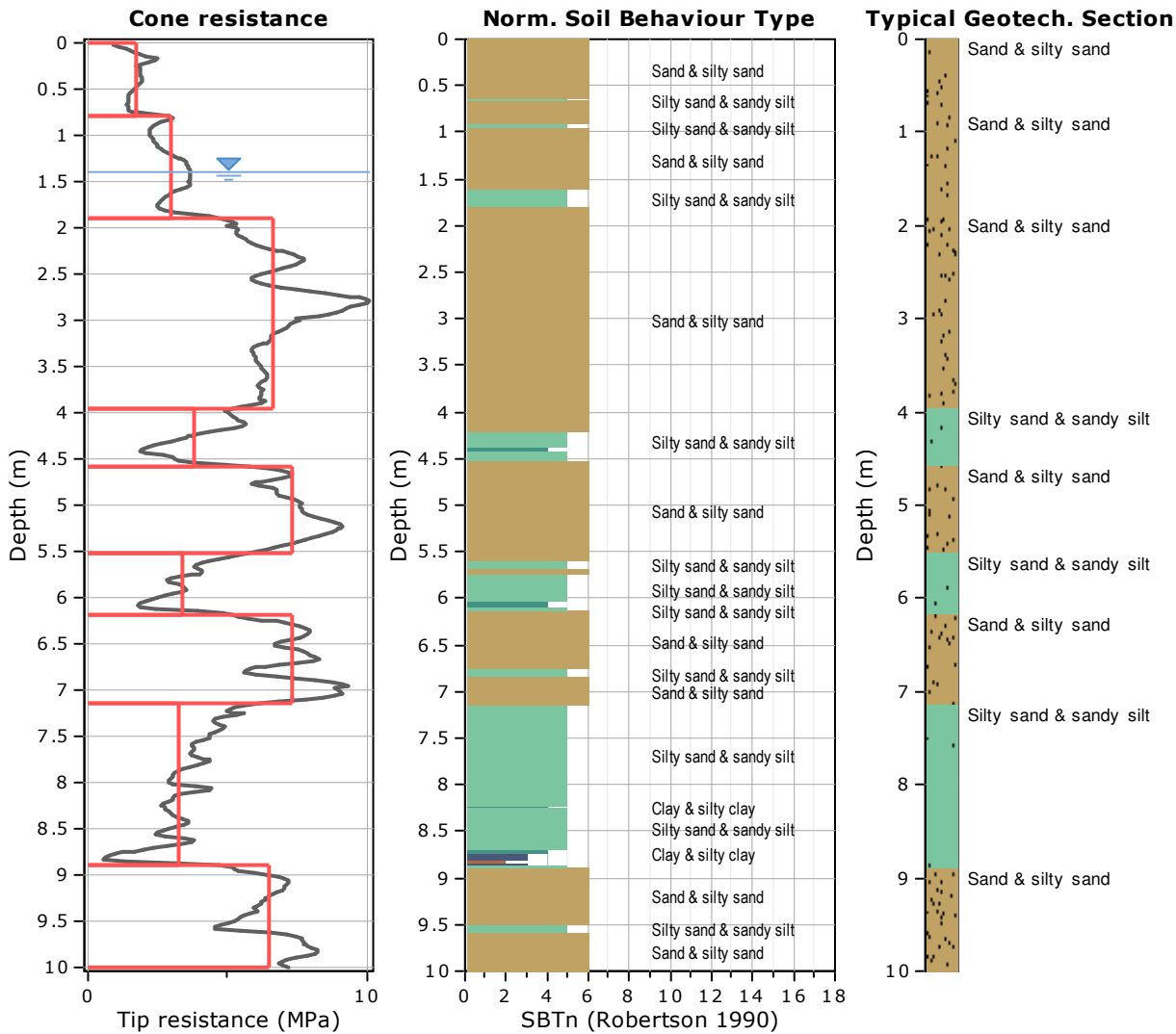
Depth values presented in this table are measured from free ground surface



**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.80 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $1.70 \pm 0.38$  MPa

Sleeve friction:  $13.38 \pm 3.56$  kPa

Ic:  $1.89 \pm 0.11$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $1.62\text{E-}05 \pm 1.76\text{E-}05$  m/s

N<sub>60</sub>:  $4.32 \pm 0.85$  blows

Es:  $13.30 \pm 2.47$  MPa

Dr (%):  $50.79 \pm 10.00$

φ (degrees):  $37.24 \pm 2.07$  °

Unit weight:  $16.18 \pm 0.31$  kN/m<sup>3</sup>

Constrained Mod.:  $26.60 \pm 4.94$  MPa

Go:  $16.67 \pm 3.10$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 0.80 (m), **End depth:** 1.90 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 2.94 ±0.59 MPa

Sleeve friction: 22.44 ±4.88 kPa

Ic: 1.94 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.11E-05 ±8.01E-06 m/s

N<sub>60</sub>: 7.61 ±1.26 blows

Es: 24.52 ±3.36 MPa

Dr (%): 46.25 ±2.78

φ (degrees): 36.30 ±0.50 °

Unit weight: 16.98 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 49.04 ±6.73 MPa

Go: 30.73 ±4.22 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 1.90 (m), **End depth:** 3.96 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.60 ±1.22 MPa

Sleeve friction: 36.82 ±6.04 kPa

Ic: 1.72 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.35E-05 ±4.81E-05 m/s

N<sub>60</sub>: 14.88 ±2.00 blows

Es: 41.40 ±4.21 MPa

Dr (%): 56.78 ±4.49

φ (degrees): 38.01 ±0.82 °

Unit weight: 17.86 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 82.81 ±8.43 MPa

Go: 51.89 ±5.28 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 3.96 (m), **End depth:** 4.58 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.76 ±1.28 MPa

Sleeve friction: 35.60 ±4.29 kPa

Ic: 2.06 ±0.21

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 4.55E-06 ±1.03E-05 m/s

N<sub>60</sub>: 10.60 ±2.27 blows

Es: 36.81 ±3.17 MPa

Dr (%): 42.73 ±5.76

φ (degrees): 36.09 ±0.53 °

Unit weight: 17.61 ±0.15 kN/m<sup>3</sup>

Constrained Mod.: 60.61 ±20.66 MPa

Go: 45.61 ±4.30 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 4.58 (m), **End depth:** 5.52 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.31 ±0.96 MPa

Sleeve friction: 45.49 ±6.01 kPa

Ic: 1.78 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.50E-05 ±1.67E-05 m/s

N<sub>60</sub>: 17.10 ±1.71 blows

Es: 49.30 ±3.57 MPa

Dr (%): 54.26 ±2.95

φ (degrees): 37.62 ±0.49 °

Unit weight: 18.14 ±0.19 kN/m<sup>3</sup>

Constrained Mod.: 98.60 ±7.14 MPa

Go: 61.79 ±4.47 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6    **Start depth:** 5.52 (m), **End depth:** 6.18 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.37 ±1.04 MPa

Sleeve friction: 38.31 ±6.47 kPa

Ic: 2.20 ±0.18

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.74E-06 ±3.43E-06 m/s

N<sub>60</sub>: 10.48 ±2.02 blows

Es: 39.09 ±3.73 MPa

Dr (%): 37.99 ±4.62

φ (degrees): 35.51 ±0.54 °

Unit weight: 17.65 ±0.24 kN/m<sup>3</sup>

Constrained Mod.: 53.74 ±24.49 MPa

Go: 48.11 ±5.21 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7    **Start depth:** 6.18 (m), **End depth:** 7.14 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.27 ±1.10 MPa

Sleeve friction: 53.11 ±11.89 kPa

Ic: 1.86 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.95E-05 ±1.29E-05 m/s

N<sub>60</sub>: 17.87 ±1.97 blows

Es: 54.31 ±4.89 MPa

Dr (%): 51.17 ±3.41

φ (degrees): 37.25 ±0.56 °

Unit weight: 18.32 ±0.27 kN/m<sup>3</sup>

Constrained Mod.: 108.61 ±9.77 MPa

Go: 68.06 ±6.13 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8    **Start depth:** 7.14 (m), **End depth:** 8.90 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.25 ±1.14 MPa

Sleeve friction: 43.50 ±13.52 kPa

Ic: 2.33 ±0.28

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 7.08E-07 ±1.40E-06 m/s

N<sub>60</sub>: 10.92 ±2.69 blows

Es: 44.16 ±5.64 MPa

Dr (%): 35.05 ±4.53

φ (degrees): 35.21 ±0.91 °

Unit weight: 17.78 ±0.40 kN/m<sup>3</sup>

Constrained Mod.: 46.86 ±29.74 MPa

Go: 53.60 ±8.34 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9    **Start depth:** 8.90 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.43 ±1.02 MPa

Sleeve friction: 37.71 ±6.46 kPa

Ic: 1.92 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.30E-05 ±8.31E-06 m/s

N<sub>60</sub>: 16.52 ±1.85 blows

Es: 51.23 ±4.17 MPa

Dr (%): 43.99 ±3.35

φ (degrees): 35.48 ±0.58 °

Unit weight: 17.88 ±0.23 kN/m<sup>3</sup>

Constrained Mod.: 102.47 ±8.33 MPa

Go: 64.21 ±5.22 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km52+600**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.899758° lon 12.226448°

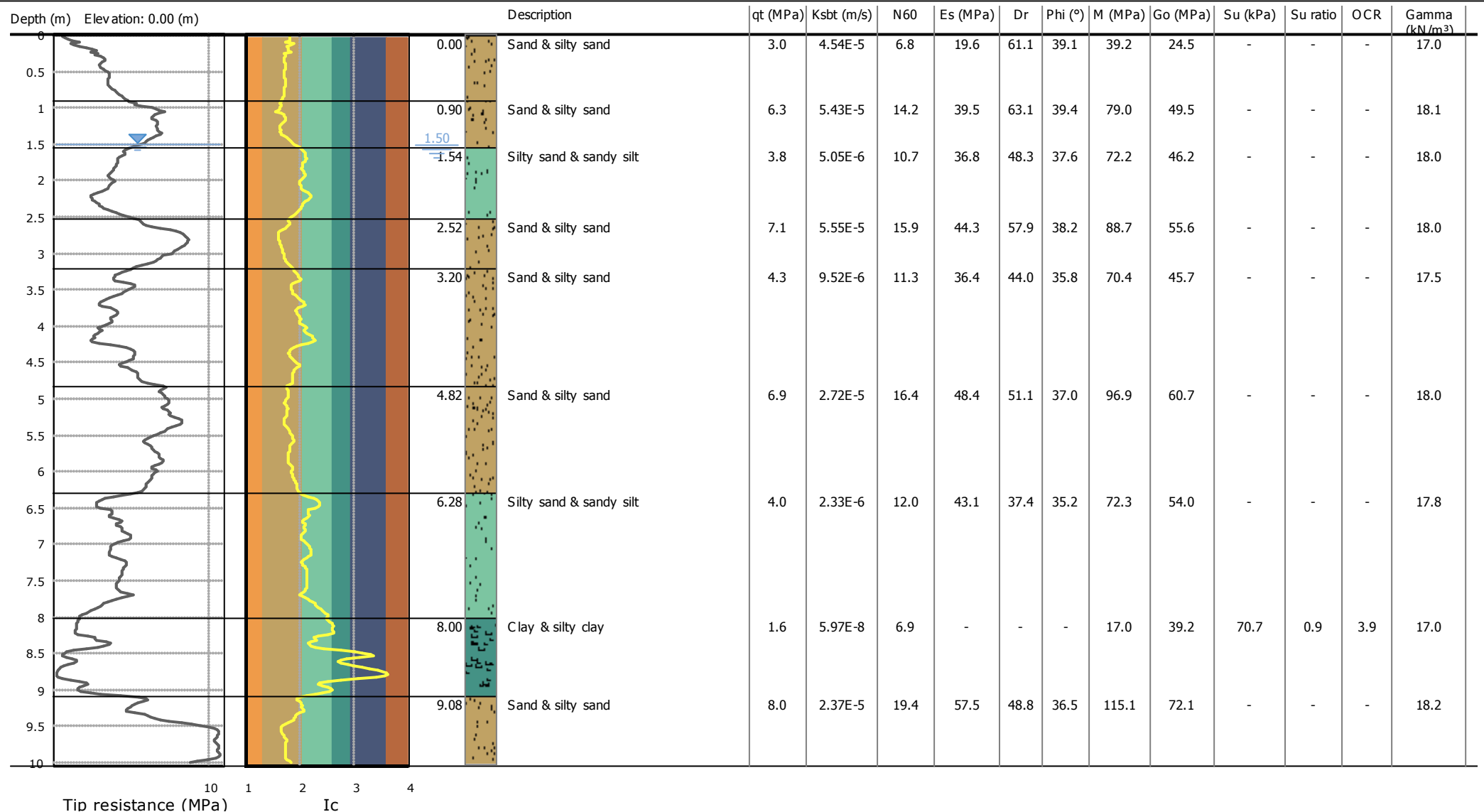
**Summary table of mean values**

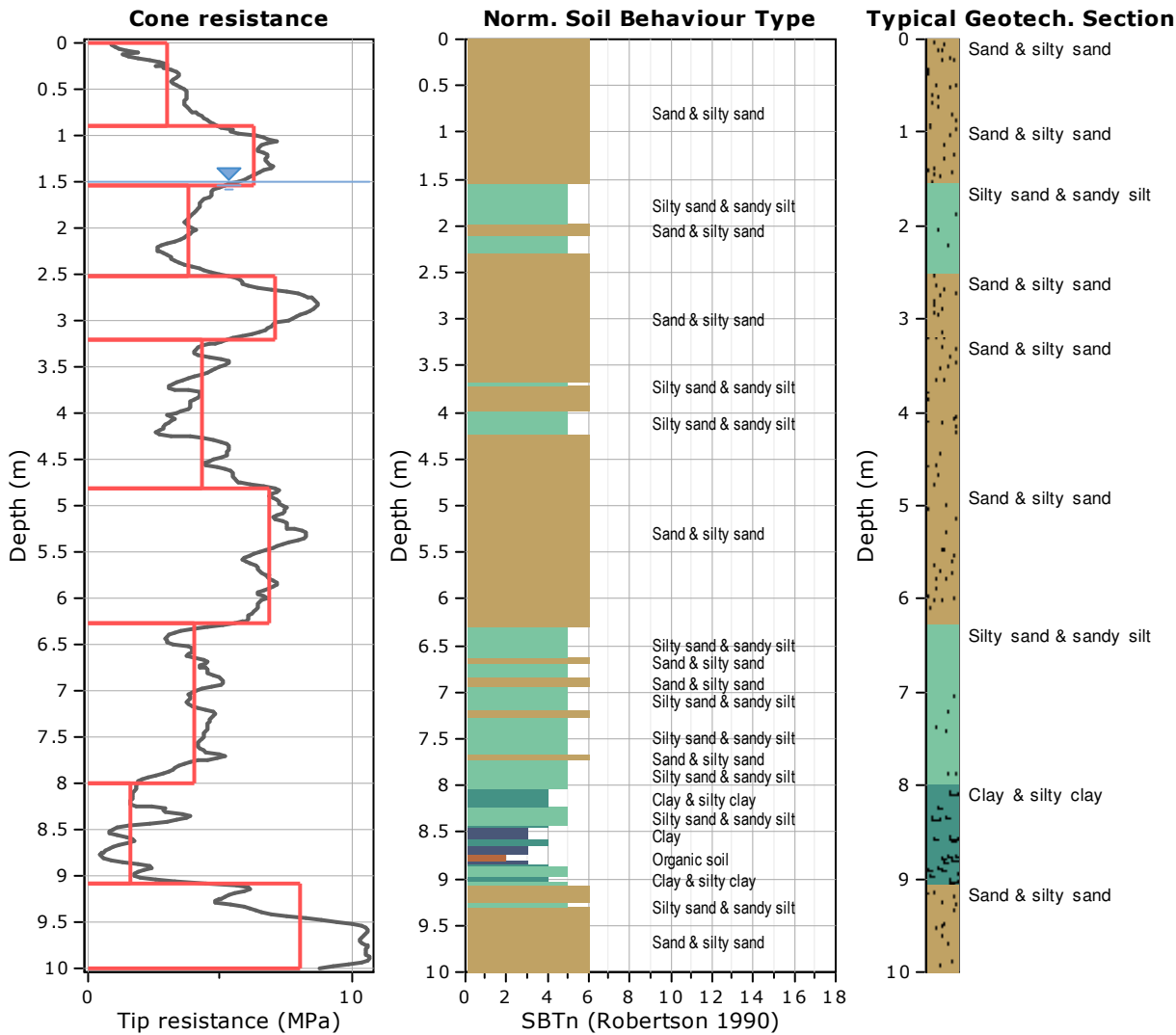
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.80             | 1.62E-05              | 4.3                                | 13.3                    | 50.8                  | 37.2              | 26.6                               | 16.7                                      | 0.0  | 0.0                            | 0.0    | 16.2                                |
| 0.80                          |                  | (±1.76E-05)           | (±0.8)                             | (±2.5)                  | (±10.0)               | (±2.1)            | (±4.9)                             | (±3.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 0.80                          | 1.10             | 1.11E-05              | 7.6                                | 24.5                    | 46.2                  | 36.3              | 49.0                               | 30.7                                      | 0.0  | 0.0                            | 0.0    | 17.0                                |
| 1.90                          |                  | (±8.01E-06)           | (±1.3)                             | (±3.4)                  | (±2.8)                | (±0.5)            | (±6.7)                             | (±4.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 1.90                          | 2.06             | 5.35E-05              | 14.9                               | 41.4                    | 56.8                  | 38.0              | 82.8                               | 51.9                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 3.96                          |                  | (±4.81E-05)           | (±2.0)                             | (±4.2)                  | (±4.5)                | (±0.8)            | (±8.4)                             | (±5.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.96                          | 0.62             | 4.55E-06              | 10.6                               | 36.8                    | 42.7                  | 36.1              | 60.6                               | 45.6                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 4.58                          |                  | (±1.03E-05)           | (±2.3)                             | (±3.2)                  | (±5.8)                | (±0.5)            | (±20.7)                            | (±4.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.58                          | 0.94             | 3.50E-05              | 17.1                               | 49.3                    | 54.3                  | 37.6              | 98.6                               | 61.8                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 5.52                          |                  | (±1.67E-05)           | (±1.7)                             | (±3.6)                  | (±3.0)                | (±0.5)            | (±7.1)                             | (±4.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.52                          | 0.66             | 1.74E-06              | 10.5                               | 39.1                    | 38.0                  | 35.5              | 53.7                               | 48.1                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 6.18                          |                  | (±3.43E-06)           | (±2.0)                             | (±3.7)                  | (±4.6)                | (±0.5)            | (±24.5)                            | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.18                          | 0.96             | 1.95E-05              | 17.9                               | 54.3                    | 51.2                  | 37.2              | 108.6                              | 68.1                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 7.14                          |                  | (±1.29E-05)           | (±2.0)                             | (±4.9)                  | (±3.4)                | (±0.6)            | (±9.8)                             | (±6.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 7.14                          | 1.76             | 7.08E-07              | 10.9                               | 44.2                    | 35.0                  | 35.2              | 46.9                               | 53.6                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 8.90                          |                  | (±1.40E-06)           | (±2.7)                             | (±5.6)                  | (±4.5)                | (±0.9)            | (±29.7)                            | (±8.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 8.90                          | 1.10             | 1.30E-05              | 16.5                               | 51.2                    | 44.0                  | 35.5              | 102.5                              | 64.2                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 10.00                         |                  | (±8.31E-06)           | (±1.9)                             | (±4.2)                  | (±3.3)                | (±0.6)            | (±8.3)                             | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.90 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance: 3.01 ±1.05 MPa

Sleeve friction: 22.16 ±4.75 kPa

Ic: 1.74 ±0.05

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability: 4.54E-05 ±1.38E-05 m/s

N<sub>60</sub>: 6.84 ±2.21 blows

Es: 19.58 ±5.93 MPa

Dr (%): 61.09 ±4.35

φ (degrees): 39.06 ±1.08 °

Unit weight: 16.97 ±0.39 kN/m<sup>3</sup>

Constrained Mod.: 39.16 ±11.87 MPa

Go: 24.54 ±7.44 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.90 (m), **End depth:** 1.54 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.29 ±0.63 MPa

Sleeve friction: 45.91 ±15.10 kPa

Ic: 1.71 ±0.10

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.43E-05 ±3.79E-05 m/s

N<sub>60</sub>: 14.16 ±1.22 blows

Es: 39.52 ±4.74 MPa

Dr (%): 63.10 ±2.52

φ (degrees): 39.44 ±0.47 °

Unit weight: 18.09 ±0.37 kN/m<sup>3</sup>

Constrained Mod.: 79.05 ±9.47 MPa

Go: 49.54 ±5.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 1.54 (m), **End depth:** 2.52 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.84 ±0.70 MPa

Sleeve friction: 49.30 ±21.91 kPa

Ic: 2.05 ±0.08

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 5.05E-06 ±4.71E-06 m/s

N<sub>60</sub>: 10.67 ±1.78 blows

Es: 36.84 ±5.73 MPa

Dr (%): 48.28 ±4.93

φ (degrees): 37.64 ±1.33 °

Unit weight: 17.99 ±0.49 kN/m<sup>3</sup>

Constrained Mod.: 72.16 ±13.55 MPa

Go: 46.17 ±7.18 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 2.52 (m), **End depth:** 3.20 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.11 ±1.16 MPa

Sleeve friction: 41.09 ±3.58 kPa

Ic: 1.71 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.55E-05 ±3.54E-05 m/s

N<sub>60</sub>: 15.87 ±1.78 blows

Es: 44.34 ±3.07 MPa

Dr (%): 57.87 ±3.95

φ (degrees): 38.23 ±0.63 °

Unit weight: 18.01 ±0.14 kN/m<sup>3</sup>

Constrained Mod.: 88.68 ±6.13 MPa

Go: 55.57 ±3.84 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 3.20 (m), **End depth:** 4.82 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.29 ±0.99 MPa

Sleeve friction: 30.73 ±4.77 kPa

Ic: 1.96 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.52E-06 ±8.72E-06 m/s

N<sub>60</sub>: 11.32 ±1.86 blows

Es: 36.43 ±3.82 MPa

Dr (%): 44.02 ±4.18

φ (degrees): 35.80 ±0.61 °

Unit weight: 17.49 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 70.36 ±11.55 MPa

Go: 45.66 ±4.79 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 4.82 (m), **End depth:** 6.28 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.87 ±0.64 MPa

Sleeve friction: 41.55 ±4.22 kPa

Ic: 1.81 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.72E-05 ±1.36E-05 m/s

N<sub>60</sub>: 16.41 ±0.89 blows

Es: 48.43 ±1.68 MPa

Dr (%): 51.10 ±2.71

φ (degrees): 36.96 ±0.43 °

Unit weight: 18.01 ±0.11 kN/m<sup>3</sup>

Constrained Mod.: 96.85 ±3.35 MPa

Go: 60.69 ±2.10 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 6.28 (m), **End depth:** 8.00 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.00 ±0.77 MPa

Sleeve friction: 39.83 ±4.90 kPa

Ic: 2.16 ±0.12

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.33E-06 ±1.96E-06 m/s

N<sub>60</sub>: 11.97 ±1.55 blows

Es: 43.11 ±3.18 MPa

Dr (%): 37.40 ±3.86

φ (degrees): 35.16 ±0.44 °

Unit weight: 17.76 ±0.20 kN/m<sup>3</sup>

Constrained Mod.: 72.32 ±22.11 MPa

Go: 54.03 ±3.99 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 8.00 (m), **End depth:** 9.08 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.60 ±0.96 MPa

Sleeve friction: 27.37 ±9.05 kPa

Ic: 2.68 ±0.40

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 5.97E-08 ±7.21E-07 m/s

N<sub>60</sub>: 6.87 ±2.13 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.98 ±0.35 kN/m<sup>3</sup>

Constrained Mod.: 17.00 ±20.56 MPa

Go: 39.24 ±6.47 MPa

Su: 70.69 ±35.61 kPa

Su ratio: 0.85 ±0.43

O.C.R.: 3.93 ±1.98

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 9.08 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.02 ±2.37 MPa

Sleeve friction: 45.41 ±10.19 kPa

Ic: 1.83 ±0.14

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.37E-05 ±2.72E-05 m/s

N<sub>60</sub>: 19.44 ±4.16 blows

Es: 57.54 ±8.12 MPa

Dr (%): 48.83 ±6.99

φ (degrees): 36.48 ±1.27 °

Unit weight: 18.18 ±0.35 kN/m<sup>3</sup>

Constrained Mod.: 115.07 ±16.24 MPa

Go: 72.11 ±10.18 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km52+800**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.900677° lon 12.227736°

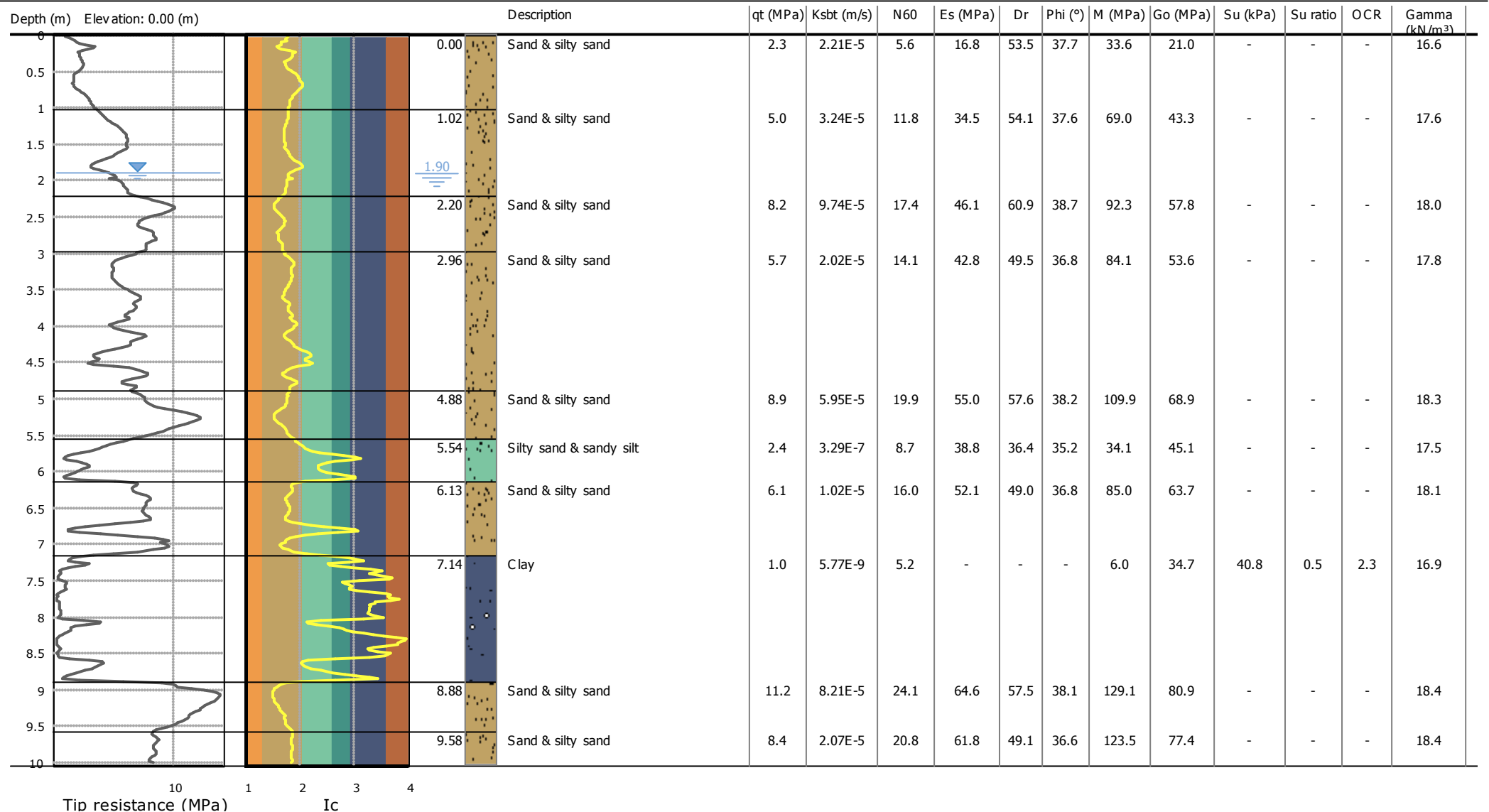
**Summary table of mean values**

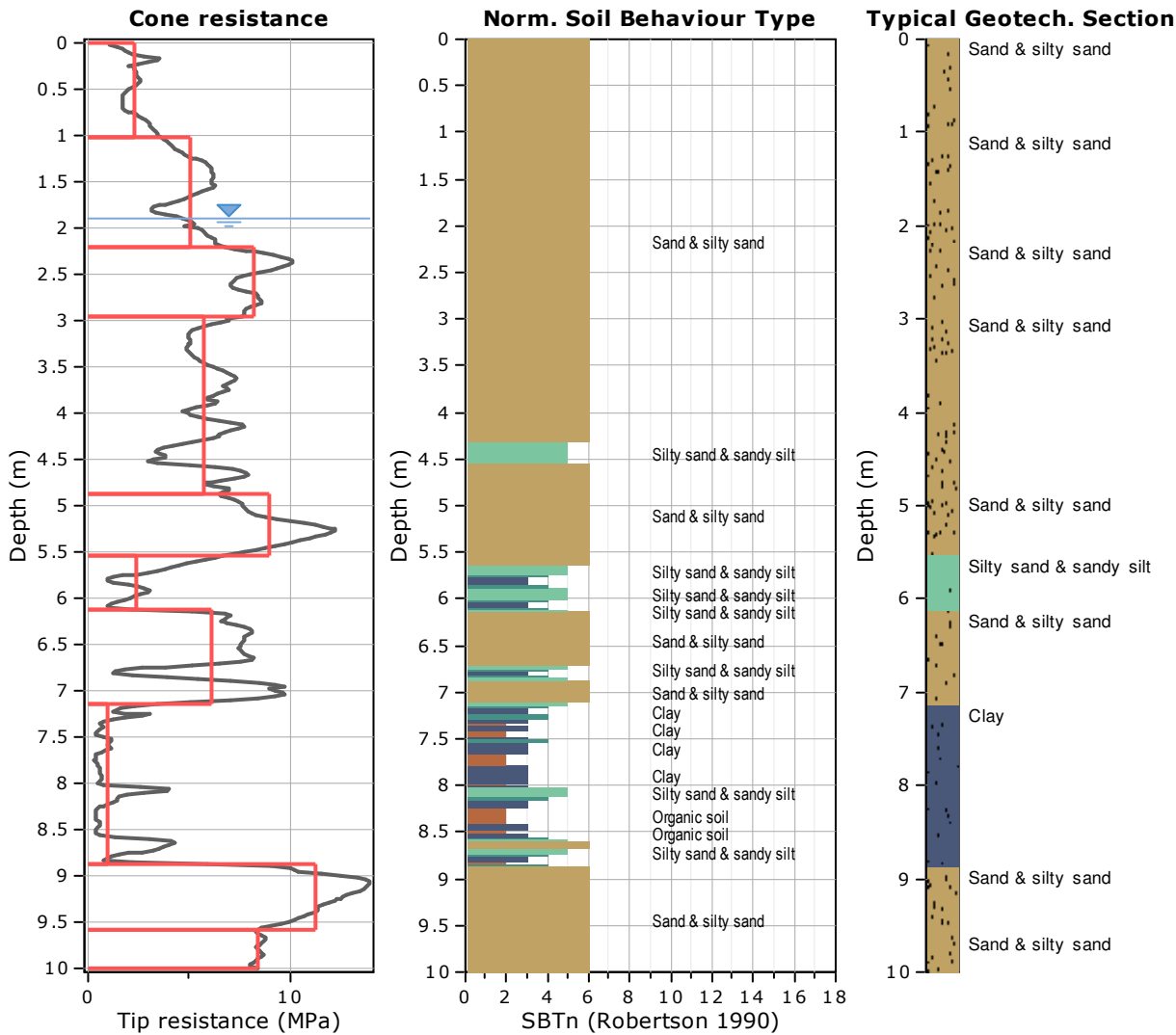
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.90             | 4.54E-05              | 6.8                                | 19.6                    | 61.1                  | 39.1              | 39.2                               | 24.5                                      | 0.0  | 0.0                            | 0.0    | 17.0                                |
| 0.90                          |                  | (±1.38E-05)           | (±2.2)                             | (±5.9)                  | (±4.4)                | (±1.1)            | (±11.9)                            | (±7.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 0.90                          | 0.64             | 5.43E-05              | 14.2                               | 39.5                    | 63.1                  | 39.4              | 79.0                               | 49.5                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 1.54                          |                  | (±3.79E-05)           | (±1.2)                             | (±4.7)                  | (±2.5)                | (±0.5)            | (±9.5)                             | (±5.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 1.54                          | 0.98             | 5.05E-06              | 10.7                               | 36.8                    | 48.3                  | 37.6              | 72.2                               | 46.2                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 2.52                          |                  | (±4.71E-06)           | (±1.8)                             | (±5.7)                  | (±4.9)                | (±1.3)            | (±13.6)                            | (±7.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 2.52                          | 0.68             | 5.55E-05              | 15.9                               | 44.3                    | 57.9                  | 38.2              | 88.7                               | 55.6                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 3.20                          |                  | (±3.54E-05)           | (±1.8)                             | (±3.1)                  | (±3.9)                | (±0.6)            | (±6.1)                             | (±3.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 3.20                          | 1.62             | 9.52E-06              | 11.3                               | 36.4                    | 44.0                  | 35.8              | 70.4                               | 45.7                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 4.82                          |                  | (±8.72E-06)           | (±1.9)                             | (±3.8)                  | (±4.2)                | (±0.6)            | (±11.5)                            | (±4.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.82                          | 1.46             | 2.72E-05              | 16.4                               | 48.4                    | 51.1                  | 37.0              | 96.9                               | 60.7                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 6.28                          |                  | (±1.36E-05)           | (±0.9)                             | (±1.7)                  | (±2.7)                | (±0.4)            | (±3.4)                             | (±2.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 6.28                          | 1.72             | 2.33E-06              | 12.0                               | 43.1                    | 37.4                  | 35.2              | 72.3                               | 54.0                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 8.00                          |                  | (±1.96E-06)           | (±1.6)                             | (±3.2)                  | (±3.9)                | (±0.4)            | (±22.1)                            | (±4.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.00                          | 1.08             | 5.97E-08              | 6.9                                | 0.0                     | 0.0                   | 0.0               | 17.0                               | 39.2                                      | 70.7   | 0.9                            | 3.9    | 17.0                                |
| 9.08                          |                  | (±7.21E-07)           | (±2.1)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±20.6)                            | (±6.5)                                    | (±35.6)  | (±0.4)                         | (±2.0) | (±0.3)                              |
| 9.08                          | 0.92             | 2.37E-05              | 19.4                               | 57.5                    | 48.8                  | 36.5              | 115.1                              | 72.1                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 10.00                         |                  | (±2.72E-05)           | (±4.2)                             | (±8.1)                  | (±7.0)                | (±1.3)            | (±16.2)                            | (±10.2)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 1.02 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $2.27 \pm 0.62$  MPa

Sleeve friction:  $17.40 \pm 3.91$  kPa

Ic:  $1.84 \pm 0.12$

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability:  $2.21E-05 \pm 2.91E-05$  m/s

N<sub>60</sub>:  $5.62 \pm 1.30$  blows

Es:  $16.79 \pm 3.73$  MPa

Dr (%):  $53.51 \pm 9.46$

φ (degrees):  $37.74 \pm 1.85$  °

Unit weight:  $16.59 \pm 0.30$  kN/m<sup>3</sup>

Constrained Mod.:  $33.59 \pm 7.46$  MPa

Go:  $21.05 \pm 4.67$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 1.02 (m), **End depth:** 2.20 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.01 ±1.01 MPa

Sleeve friction: 32.55 ±4.98 kPa

Ic: 1.79 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.24E-05 ±1.74E-05 m/s

N<sub>60</sub>: 11.81 ±1.87 blows

Es: 34.51 ±4.16 MPa

Dr (%): 54.09 ±4.72

φ (degrees): 37.64 ±0.81 °

Unit weight: 17.61 ±0.25 kN/m<sup>3</sup>

Constrained Mod.: 69.02 ±8.33 MPa

Go: 43.25 ±5.22 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 2.20 (m), **End depth:** 2.96 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.17 ±0.91 MPa

Sleeve friction: 39.60 ±4.97 kPa

Ic: 1.63 ±0.06

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.74E-05 ±5.11E-05 m/s

N<sub>60</sub>: 17.42 ±1.30 blows

Es: 46.14 ±2.35 MPa

Dr (%): 60.93 ±3.01

φ (degrees): 38.70 ±0.59 °

Unit weight: 18.03 ±0.15 kN/m<sup>3</sup>

Constrained Mod.: 92.27 ±4.70 MPa

Go: 57.82 ±2.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 2.96 (m), **End depth:** 4.88 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.74 ±1.18 MPa

Sleeve friction: 37.48 ±7.53 kPa

Ic: 1.85 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.02E-05 ±1.89E-05 m/s

N<sub>60</sub>: 14.08 ±2.06 blows

Es: 42.75 ±4.32 MPa

Dr (%): 49.50 ±4.68

φ (degrees): 36.80 ±0.65 °

Unit weight: 17.83 ±0.25 kN/m<sup>3</sup>

Constrained Mod.: 84.09 ±11.19 MPa

Go: 53.59 ±5.42 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 4.88 (m), **End depth:** 5.54 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.95 ±1.88 MPa

Sleeve friction: 48.83 ±7.90 kPa

Ic: 1.70 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.95E-05 ±6.60E-05 m/s

N<sub>60</sub>: 19.93 ±2.80 blows

Es: 54.97 ±5.03 MPa

Dr (%): 57.60 ±5.21

φ (degrees): 38.19 ±0.94 °

Unit weight: 18.30 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 109.94 ±10.06 MPa

Go: 68.90 ±6.30 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6    **Start depth:** 5.54 (m), **End depth:** 6.13 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 2.39 ±1.71 MPa

Sleeve friction: 38.99 ±10.51 kPa

Ic: 2.42 ±0.38

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.29E-07 ±5.19E-06 m/s

N<sub>60</sub>: 8.66 ±3.38 blows

Es: 38.80 ±6.49 MPa

Dr (%): 36.37 ±7.19

φ (degrees): 35.18 ±0.95 °

Unit weight: 17.54 ±0.36 kN/m<sup>3</sup>

Constrained Mod.: 34.10 ±32.18 MPa

Go: 45.14 ±8.31 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7    **Start depth:** 6.13 (m), **End depth:** 7.14 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.10 ±2.31 MPa

Sleeve friction: 46.54 ±11.33 kPa

Ic: 1.93 ±0.34

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.02E-05 ±2.89E-05 m/s

N<sub>60</sub>: 15.97 ±3.63 blows

Es: 52.08 ±3.66 MPa

Dr (%): 48.97 ±5.65

φ (degrees): 36.79 ±0.53 °

Unit weight: 18.10 ±0.18 kN/m<sup>3</sup>

Constrained Mod.: 85.02 ±29.78 MPa

Go: 63.73 ±6.22 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8    **Start depth:** 7.14 (m), **End depth:** 8.88 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.96 ±1.25 MPa

Sleeve friction: 29.87 ±20.89 kPa

Ic: 3.04 ±0.53

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 5.77E-09 ±1.40E-06 m/s

N<sub>60</sub>: 5.18 ±3.05 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.88 ±0.74 kN/m<sup>3</sup>

Constrained Mod.: 5.96 ±26.55 MPa

Go: 34.66 ±11.93 MPa

Su: 40.79 ±43.41 kPa

Su ratio: 0.50 ±0.54

O.C.R.: 2.33 ±2.51

**::: Layer No: 9 :::****Code:** Layer\_9    **Start depth:** 8.88 (m), **End depth:** 9.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 11.19 ±1.89 MPa

Sleeve friction: 49.41 ±10.33 kPa

Ic: 1.65 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 8.21E-05 ±8.30E-05 m/s

N<sub>60</sub>: 24.13 ±2.61 blows

Es: 64.56 ±4.74 MPa

Dr (%): 57.48 ±5.04

φ (degrees): 38.06 ±0.90 °

Unit weight: 18.40 ±0.26 kN/m<sup>3</sup>

Constrained Mod.: 129.11 ±9.47 MPa

Go: 80.91 ±5.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00



**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 9.58 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.39 ±0.21 MPa

Sleeve friction: 52.64 ±2.88 kPa

Ic: 1.85 ±0.01

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.07E-05 ±1.94E-06 m/s

N<sub>60</sub>: 20.76 ±0.44 blows

Es: 61.75 ±1.13 MPa

Dr (%): 49.10 ±0.72

φ (degrees): 36.58 ±0.17 °

Unit weight: 18.36 ±0.07 kN/m<sup>3</sup>

Constrained Mod.: 123.51 ±2.25 MPa

Go: 77.40 ±1.41 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km54+000**

Total depth: 10.00 m, Date: 27/06/2019

Coords: lat 44.912587° lon 12.232972°

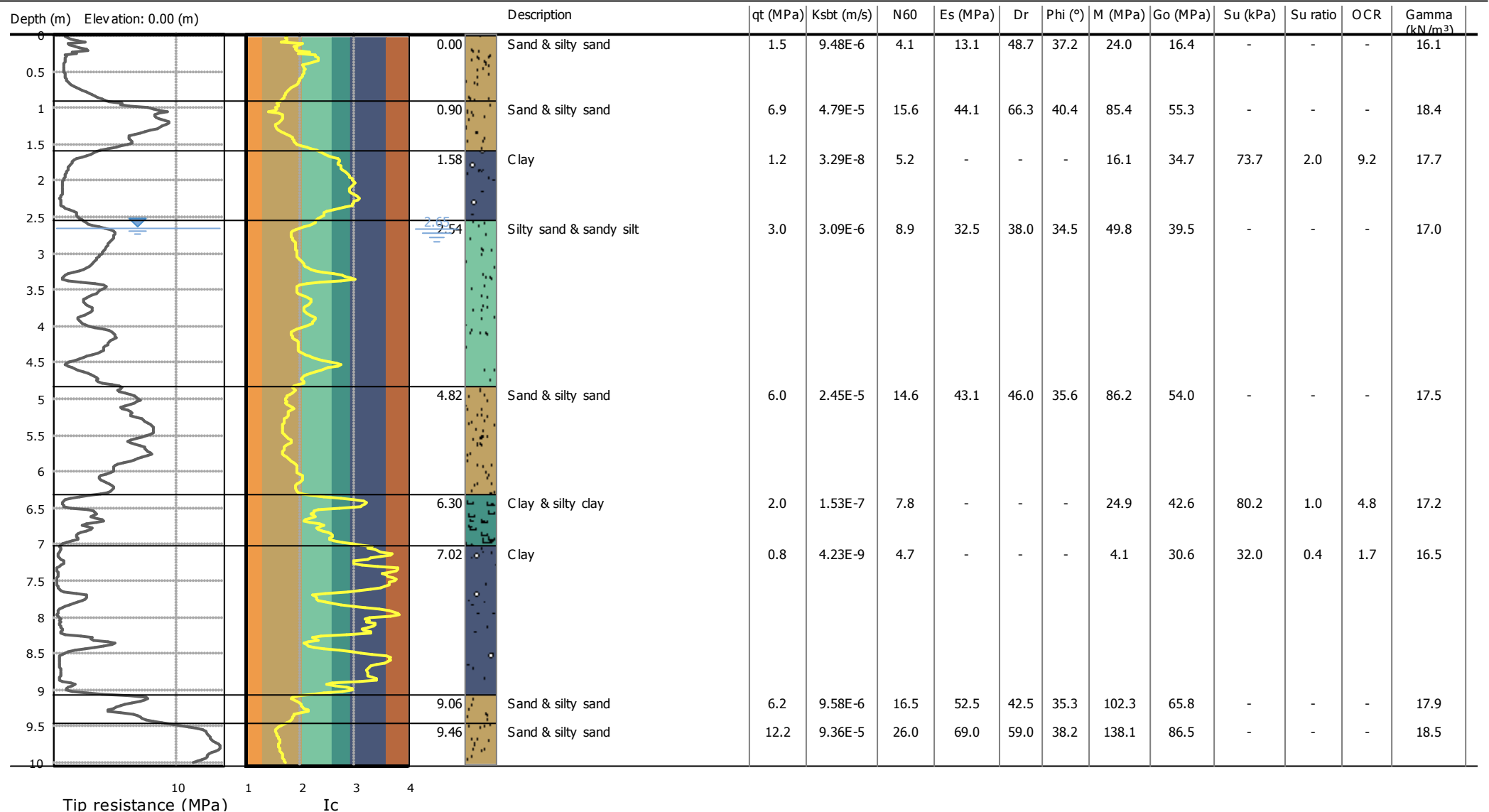
**Summary table of mean values**

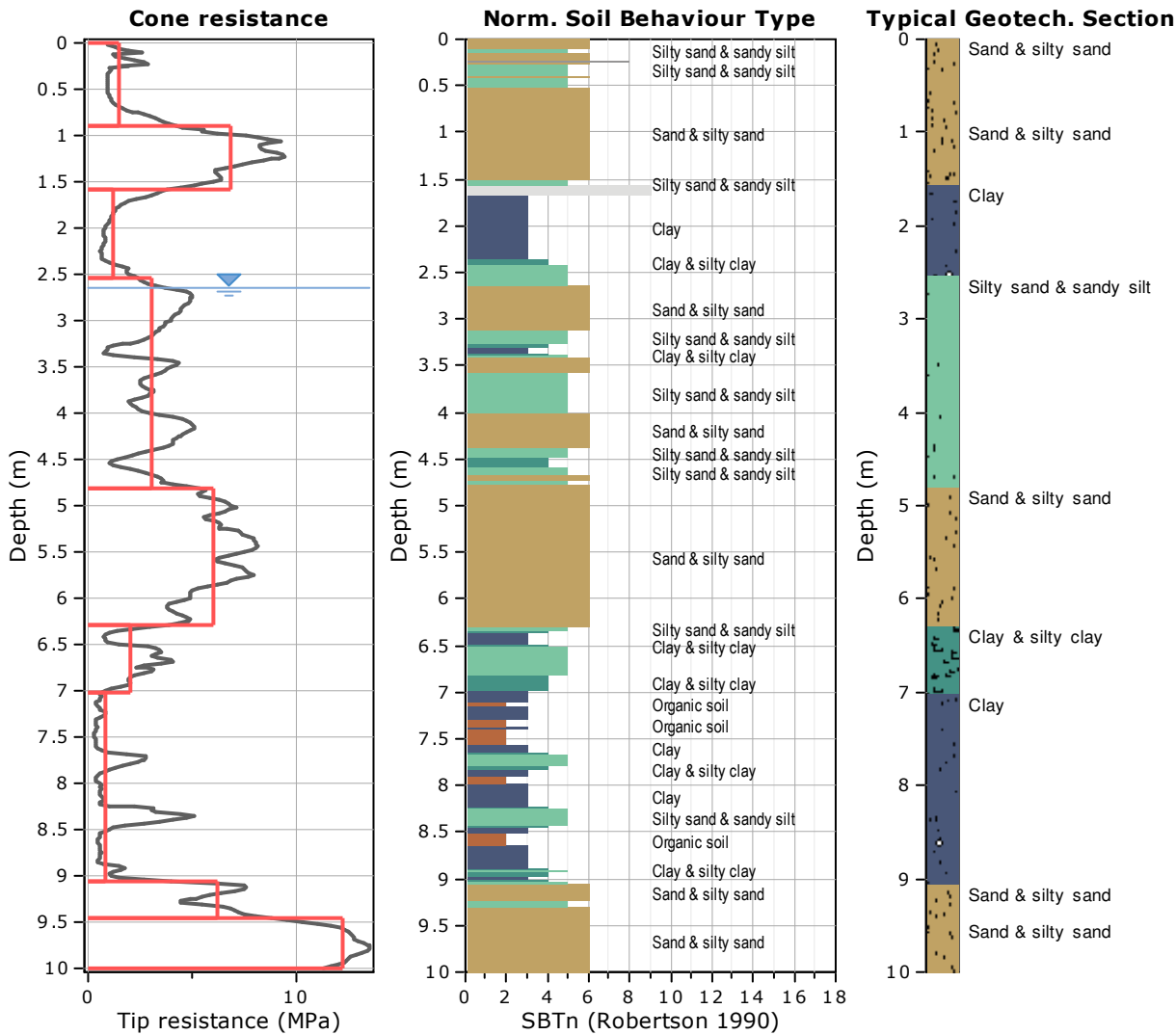
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.02             | 2.21E-05              | 5.6                                | 16.8                    | 53.5                  | 37.7              | 33.6                               | 21.0                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 1.02                          |                  | (±2.91E-05)           | (±1.3)                             | (±3.7)                  | (±9.5)                | (±1.8)            | (±7.5)                             | (±4.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 1.02                          | 1.18             | 3.24E-05              | 11.8                               | 34.5                    | 54.1                  | 37.6              | 69.0                               | 43.3                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 2.20                          |                  | (±1.74E-05)           | (±1.9)                             | (±4.2)                  | (±4.7)                | (±0.8)            | (±8.3)                             | (±5.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.20                          | 0.76             | 9.74E-05              | 17.4                               | 46.1                    | 60.9                  | 38.7              | 92.3                               | 57.8                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 2.96                          |                  | (±5.11E-05)           | (±1.3)                             | (±2.3)                  | (±3.0)                | (±0.6)            | (±4.7)                             | (±2.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 2.96                          | 1.92             | 2.02E-05              | 14.1                               | 42.8                    | 49.5                  | 36.8              | 84.1                               | 53.6                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 4.88                          |                  | (±1.89E-05)           | (±2.1)                             | (±4.3)                  | (±4.7)                | (±0.7)            | (±11.2)                            | (±5.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 4.88                          | 0.66             | 5.95E-05              | 19.9                               | 55.0                    | 57.6                  | 38.2              | 109.9                              | 68.9                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 5.54                          |                  | (±6.60E-05)           | (±2.8)                             | (±5.0)                  | (±5.2)                | (±0.9)            | (±10.1)                            | (±6.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 5.54                          | 0.59             | 3.29E-07              | 8.7                                | 38.8                    | 36.4                  | 35.2              | 34.1                               | 45.1                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 6.13                          |                  | (±5.19E-06)           | (±3.4)                             | (±6.5)                  | (±7.2)                | (±0.9)            | (±32.2)                            | (±8.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 6.13                          | 1.01             | 1.02E-05              | 16.0                               | 52.1                    | 49.0                  | 36.8              | 85.0                               | 63.7                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 7.14                          |                  | (±2.89E-05)           | (±3.6)                             | (±3.7)                  | (±5.7)                | (±0.5)            | (±29.8)                            | (±6.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 7.14                          | 1.74             | 5.77E-09              | 5.2                                | 0.0                     | 0.0                   | 0.0               | 6.0                                | 34.7                                      | 40.8   | 0.5                            | 2.3    | 16.9                                |
| 8.88                          |                  | (±1.40E-06)           | (±3.0)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±26.5)                            | (±11.9)                                   | (±43.4)  | (±0.5)                         | (±2.5) | (±0.7)                              |
| 8.88                          | 0.70             | 8.21E-05              | 24.1                               | 64.6                    | 57.5                  | 38.1              | 129.1                              | 80.9                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 9.58                          |                  | (±8.30E-05)           | (±2.6)                             | (±4.7)                  | (±5.0)                | (±0.9)            | (±9.5)                             | (±5.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 9.58                          | 0.42             | 2.07E-05              | 20.8                               | 61.8                    | 49.1                  | 36.6              | 123.5                              | 77.4                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 10.00                         |                  | (±1.94E-06)           | (±0.4)                             | (±1.1)                  | (±0.7)                | (±0.2)            | (±2.3)                             | (±1.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.90 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $1.52 \pm 0.96$  MPa

Sleeve friction:  $13.04 \pm 15.27$  kPa

Ic:  $1.96 \pm 0.20$

SBT<sub>n</sub>: 6

SBTn description: Sand & silty sand

#### Estimation results

Permeability:  $9.48E-06 \pm 2.54E-05$  m/s

N<sub>60</sub>:  $4.09 \pm 1.92$  blows

Es:  $13.09 \pm 4.96$  MPa

Dr (%):  $48.71 \pm 13.44$

φ (degrees):  $37.21 \pm 3.41$  °

Unit weight:  $16.10 \pm 0.98$  kN/m<sup>3</sup>

Constrained Mod.:  $24.03 \pm 11.10$  MPa

Go:  $16.41 \pm 6.21$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.90 (m), **End depth:** 1.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.86 ±1.65 MPa

Sleeve friction: 58.72 ±32.19 kPa

Ic: 1.72 ±0.20

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.79E-05 ±9.23E-05 m/s

N<sub>60</sub>: 15.60 ±2.75 blows

Es: 44.12 ±7.96 MPa

Dr (%): 66.34 ±6.58

φ (degrees): 40.41 ±1.10 °

Unit weight: 18.41 ±0.64 kN/m<sup>3</sup>

Constrained Mod.: 85.35 ±17.28 MPa

Go: 55.30 ±9.98 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 1.58 (m), **End depth:** 2.54 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.19 ±0.85 MPa

Sleeve friction: 57.16 ±41.07 kPa

Ic: 2.76 ±0.24

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 3.29E-08 ±2.37E-07 m/s

N<sub>60</sub>: 5.24 ±2.62 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.71 ±0.77 kN/m<sup>3</sup>

Constrained Mod.: 16.07 ±11.97 MPa

Go: 34.69 ±11.74 MPa

Su: 73.70 ±55.22 kPa

Su ratio: 1.99 ±1.56

O.C.R.: 9.21 ±7.23

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 2.54 (m), **End depth:** 4.82 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.05 ±1.18 MPa

Sleeve friction: 23.04 ±5.80 kPa

Ic: 2.11 ±0.25

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.09E-06 ±7.54E-06 m/s

N<sub>60</sub>: 8.94 ±2.29 blows

Es: 32.53 ±3.81 MPa

Dr (%): 37.99 ±5.00

φ (degrees): 34.51 ±0.84 °

Unit weight: 17.02 ±0.31 kN/m<sup>3</sup>

Constrained Mod.: 49.75 ±21.28 MPa

Go: 39.54 ±5.70 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 4.82 (m), **End depth:** 6.30 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.01 ±1.29 MPa

Sleeve friction: 27.38 ±3.72 kPa

Ic: 1.83 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.45E-05 ±2.27E-05 m/s

N<sub>60</sub>: 14.58 ±2.13 blows

Es: 43.09 ±3.63 MPa

Dr (%): 45.98 ±5.01

φ (degrees): 35.60 ±0.97 °

Unit weight: 17.48 ±0.23 kN/m<sup>3</sup>

Constrained Mod.: 86.18 ±7.25 MPa

Go: 54.01 ±4.54 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 6.30 (m), **End depth:** 7.02 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 2.00 ±1.09 MPa

Sleeve friction: 31.77 ±8.01 kPa

Ic: 2.53 ±0.36

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 1.53E-07 ±1.35E-06 m/s

N<sub>60</sub>: 7.82 ±2.45 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.23 ±0.39 kN/m<sup>3</sup>

Constrained Mod.: 24.91 ±22.19 MPa

Go: 42.55 ±6.96 MPa

Su: 80.23 ±40.06 kPa

Su ratio: 1.04 ±0.48

O.C.R.: 4.80 ±2.22

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 7.02 (m), **End depth:** 9.06 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.82 ±1.13 MPa

Sleeve friction: 21.99 ±10.02 kPa

Ic: 3.09 ±0.50

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 4.23E-09 ±7.31E-07 m/s

N<sub>60</sub>: 4.66 ±2.78 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.46 ±0.61 kN/m<sup>3</sup>

Constrained Mod.: 4.13 ±22.51 MPa

Go: 30.62 ±10.13 MPa

Su: 32.02 ±23.69 kPa

Su ratio: 0.38 ±0.26

O.C.R.: 1.75 ±1.22

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 9.06 (m), **End depth:** 9.46 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.24 ±1.33 MPa

Sleeve friction: 39.65 ±4.51 kPa

Ic: 1.96 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.58E-06 ±1.04E-05 m/s

N<sub>60</sub>: 16.53 ±2.13 blows

Es: 52.51 ±3.70 MPa

Dr (%): 42.51 ±4.54

φ (degrees): 35.32 ±0.66 °

Unit weight: 17.92 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 102.26 ±13.41 MPa

Go: 65.81 ±4.64 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 9.46 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 12.24 ±1.19 MPa

Sleeve friction: 54.21 ±12.41 kPa

Ic: 1.64 ±0.05

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.36E-05 ±3.28E-05 m/s

N<sub>60</sub>: 26.04 ±2.32 blows

Es: 69.03 ±6.11 MPa

Dr (%): 58.97 ±2.89

φ (degrees): 38.23 ±0.61 °

Unit weight: 18.54 ±0.31 kN/m<sup>3</sup>

Constrained Mod.: 138.06 ±12.22 MPa

Go: 86.52 ±7.66 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km54+500**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.915326° lon 12.234709°

**Summary table of mean values**

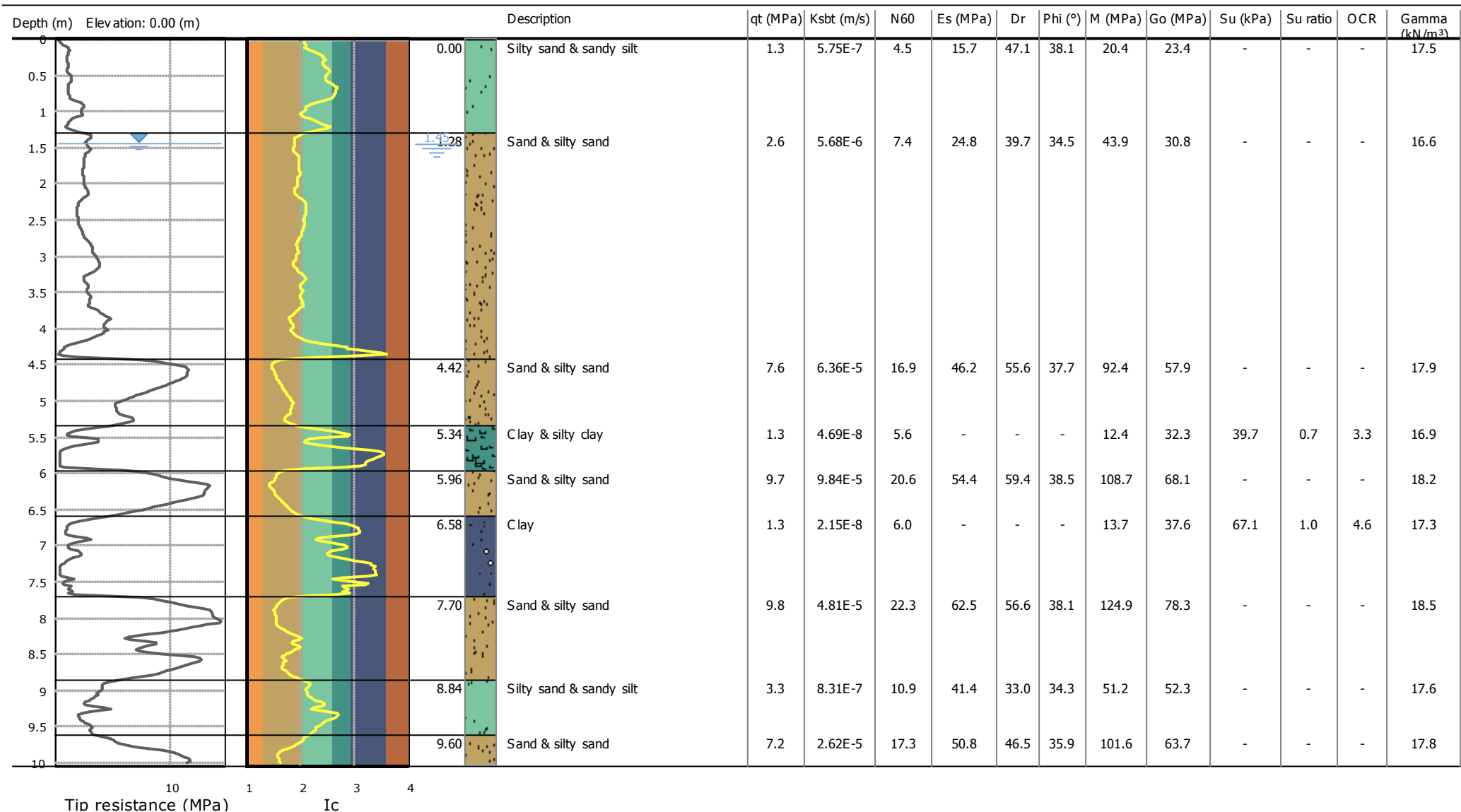
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.90             | 9.48E-06              | 4.1                                | 13.1                    | 48.7                  | 37.2              | 24.0                               | 16.4                                      | 0.0  | 0.0                            | 0.0    | 16.1                                |
| 0.90                          |                  | (±2.54E-05)           | (±1.9)                             | (±5.0)                  | (±13.4)               | (±3.4)            | (±11.1)                            | (±6.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±1.0)                              |
| 0.90                          | 0.68             | 4.79E-05              | 15.6                               | 44.1                    | 66.3                  | 40.4              | 85.4                               | 55.3                                      | 0.0  | 0.0                            | 0.0    | 18.4                                |
| 1.58                          |                  | (±9.23E-05)           | (±2.7)                             | (±8.0)                  | (±6.6)                | (±1.1)            | (±17.3)                            | (±10.0)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 1.58                          | 0.96             | 3.29E-08              | 5.2                                | 0.0                     | 0.0                   | 0.0               | 16.1                               | 34.7                                      | 73.7   | 2.0                            | 9.2    | 17.7                                |
| 2.54                          |                  | (±2.37E-07)           | (±2.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±12.0)                            | (±11.7)                                   | (±55.2)  | (±1.6)                         | (±7.2) | (±0.8)                              |
| 2.54                          | 2.28             | 3.09E-06              | 8.9                                | 32.5                    | 38.0                  | 34.5              | 49.8                               | 39.5                                      | 0.0  | 0.0                            | 0.0    | 17.0                                |
| 4.82                          |                  | (±7.54E-06)           | (±2.3)                             | (±3.8)                  | (±5.0)                | (±0.8)            | (±21.3)                            | (±5.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 4.82                          | 1.48             | 2.45E-05              | 14.6                               | 43.1                    | 46.0                  | 35.6              | 86.2                               | 54.0                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 6.30                          |                  | (±2.27E-05)           | (±2.1)                             | (±3.6)                  | (±5.0)                | (±1.0)            | (±7.3)                             | (±4.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.30                          | 0.72             | 1.53E-07              | 7.8                                | 0.0                     | 0.0                   | 0.0               | 24.9                               | 42.6                                      | 80.2   | 1.0                            | 4.8    | 17.2                                |
| 7.02                          |                  | (±1.35E-06)           | (±2.4)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±22.2)                            | (±7.0)                                    | (±40.1)  | (±0.5)                         | (±2.2) | (±0.4)                              |
| 7.02                          | 2.04             | 4.23E-09              | 4.7                                | 0.0                     | 0.0                   | 0.0               | 4.1                                | 30.6                                      | 32.0   | 0.4                            | 1.7    | 16.5                                |
| 9.06                          |                  | (±7.31E-07)           | (±2.8)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±22.5)                            | (±10.1)                                   | (±23.7)  | (±0.3)                         | (±1.2) | (±0.6)                              |
| 9.06                          | 0.40             | 9.58E-06              | 16.5                               | 52.5                    | 42.5                  | 35.3              | 102.3                              | 65.8                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 9.46                          |                  | (±1.04E-05)           | (±2.1)                             | (±3.7)                  | (±4.5)                | (±0.7)            | (±13.4)                            | (±4.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 9.46                          | 0.54             | 9.36E-05              | 26.0                               | 69.0                    | 59.0                  | 38.2              | 138.1                              | 86.5                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 10.00                         |                  | (±3.28E-05)           | (±2.3)                             | (±6.1)                  | (±2.9)                | (±0.6)            | (±12.2)                            | (±7.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |

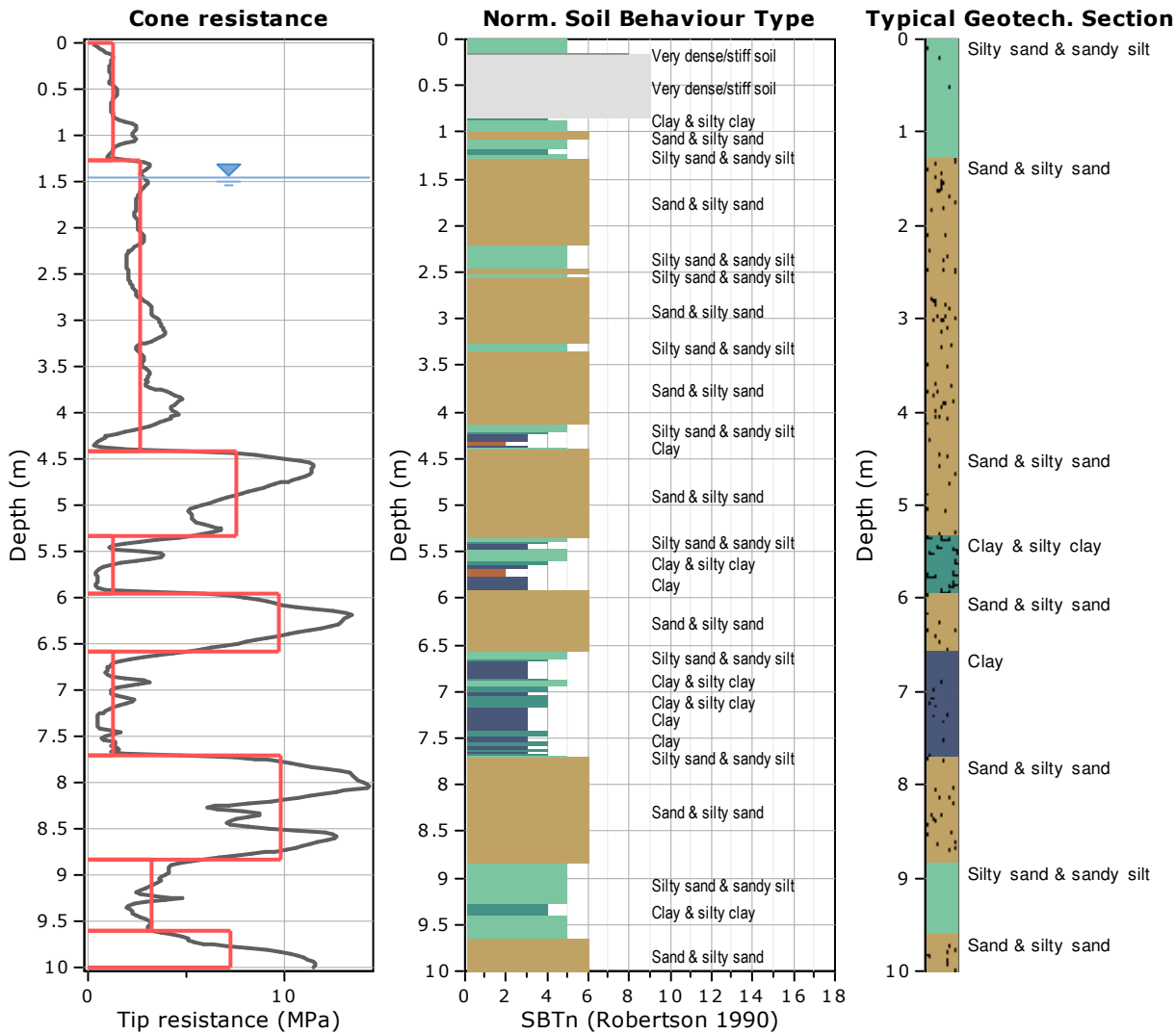
Depth values presented in this table are measured from free ground surface



**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.00 (m), **End depth:** 1.28 (m)

**Description:** Silty sand & sandy silt

#### Basic results

Total cone resistance:  $1.31 \pm 0.52$  MPa

Sleeve friction:  $45.08 \pm 29.54$  kPa

Ic:  $2.36 \pm 0.21$

SBT<sub>n</sub>: 5

SBT<sub>n</sub> description: Silty sand & sandy silt

#### Estimation results

Permeability:  $5.75E-07 \pm 2.09E-06$  m/s

N<sub>60</sub>:  $4.46 \pm 1.41$  blows

Es:  $15.74 \pm 7.71$  MPa

Dr (%):  $47.09 \pm 10.93$

$\phi$  (degrees):  $38.10 \pm 2.69$  °

Unit weight:  $17.47 \pm 0.82$  kN/m<sup>3</sup>

Constrained Mod.:  $20.35 \pm 11.64$  MPa

Go:  $23.41 \pm 7.29$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 1.28 (m), **End depth:** 4.42 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 2.64 ±0.88 MPa

Sleeve friction: 16.38 ±6.36 kPa

Ic: 2.03 ±0.28

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.68E-06 ±7.57E-06 m/s

N<sub>60</sub>: 7.36 ±1.77 blows

Es: 24.78 ±4.06 MPa

Dr (%): 39.71 ±3.59

φ (degrees): 34.47 ±0.73 °

Unit weight: 16.58 ±0.36 kN/m<sup>3</sup>

Constrained Mod.: 43.93 ±13.18 MPa

Go: 30.79 ±5.10 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 4.42 (m), **End depth:** 5.34 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.63 ±2.34 MPa

Sleeve friction: 35.63 ±11.00 kPa

Ic: 1.69 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.36E-05 ±9.55E-05 m/s

N<sub>60</sub>: 16.92 ±3.71 blows

Es: 46.22 ±7.09 MPa

Dr (%): 55.62 ±7.85

φ (degrees): 37.71 ±1.57 °

Unit weight: 17.88 ±0.42 kN/m<sup>3</sup>

Constrained Mod.: 92.45 ±14.18 MPa

Go: 57.93 ±8.88 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 5.34 (m), **End depth:** 5.96 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.26 ±1.75 MPa

Sleeve friction: 28.55 ±13.01 kPa

Ic: 2.69 ±0.58

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 4.69E-08 ±9.51E-06 m/s

N<sub>60</sub>: 5.57 ±3.64 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.93 ±0.74 kN/m<sup>3</sup>

Constrained Mod.: 12.44 ±34.75 MPa

Go: 32.33 ±11.17 MPa

Su: 39.67 ±33.28 kPa

Su ratio: 0.70 ±0.57

O.C.R.: 3.25 ±2.63

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 5.96 (m), **End depth:** 6.58 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.71 ±2.59 MPa

Sleeve friction: 42.14 ±14.49 kPa

Ic: 1.62 ±0.15

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.84E-05 ±1.26E-04 m/s

N<sub>60</sub>: 20.62 ±3.95 blows

Es: 54.37 ±7.85 MPa

Dr (%): 59.36 ±7.49

φ (degrees): 38.48 ±1.45 °

Unit weight: 18.16 ±0.47 kN/m<sup>3</sup>

Constrained Mod.: 108.73 ±15.71 MPa

Go: 68.14 ±9.84 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6 **Start depth:** 6.58 (m), **End depth:** 7.70 (m)**Description:** Clay**Basic results**

Total cone resistance: 1.29 ±1.07 MPa

Sleeve friction: 37.49 ±10.90 kPa

Ic: 2.82 ±0.37

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 2.15E-08 ±1.38E-06 m/s

N<sub>60</sub>: 5.96 ±2.49 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.25 ±0.47 kN/m<sup>3</sup>

Constrained Mod.: 13.74 ±21.79 MPa

Go: 37.63 ±8.08 MPa

Su: 67.07 ±36.14 kPa

Su ratio: 0.99 ±0.51

O.C.R.: 4.56 ±2.35

**::: Layer No: 7 :::****Code:** Layer\_7 **Start depth:** 7.70 (m), **End depth:** 8.84 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 9.83 ±2.60 MPa

Sleeve friction: 57.14 ±14.41 kPa

Ic: 1.73 ±0.16

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.81E-05 ±7.38E-05 m/s

N<sub>60</sub>: 22.32 ±3.96 blows

Es: 62.46 ±7.19 MPa

Dr (%): 56.61 ±7.30

φ (degrees): 38.13 ±1.25 °

Unit weight: 18.52 ±0.31 kN/m<sup>3</sup>

Constrained Mod.: 124.93 ±14.38 MPa

Go: 78.29 ±9.01 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8 **Start depth:** 8.84 (m), **End depth:** 9.60 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.27 ±0.90 MPa

Sleeve friction: 36.04 ±14.71 kPa

Ic: 2.31 ±0.19

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 8.31E-07 ±1.63E-06 m/s

N<sub>60</sub>: 10.88 ±1.92 blows

Es: 41.45 ±5.88 MPa

Dr (%): 32.96 ±4.01

φ (degrees): 34.30 ±0.94 °

Unit weight: 17.57 ±0.43 kN/m<sup>3</sup>

Constrained Mod.: 51.24 ±25.19 MPa

Go: 52.30 ±7.06 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 9 :::****Code:** Layer\_9 **Start depth:** 9.60 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.24 ±3.06 MPa

Sleeve friction: 32.53 ±6.80 kPa

Ic: 1.81 ±0.21

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.62E-05 ±6.42E-05 m/s

N<sub>60</sub>: 17.35 ±4.88 blows

Es: 50.80 ±8.21 MPa

Dr (%): 46.52 ±9.46

φ (degrees): 35.87 ±1.75 °

Unit weight: 17.75 ±0.39 kN/m<sup>3</sup>

Constrained Mod.: 101.60 ±16.43 MPa

Go: 63.67 ±10.29 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km54+600**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.915892° lon 12.23453°

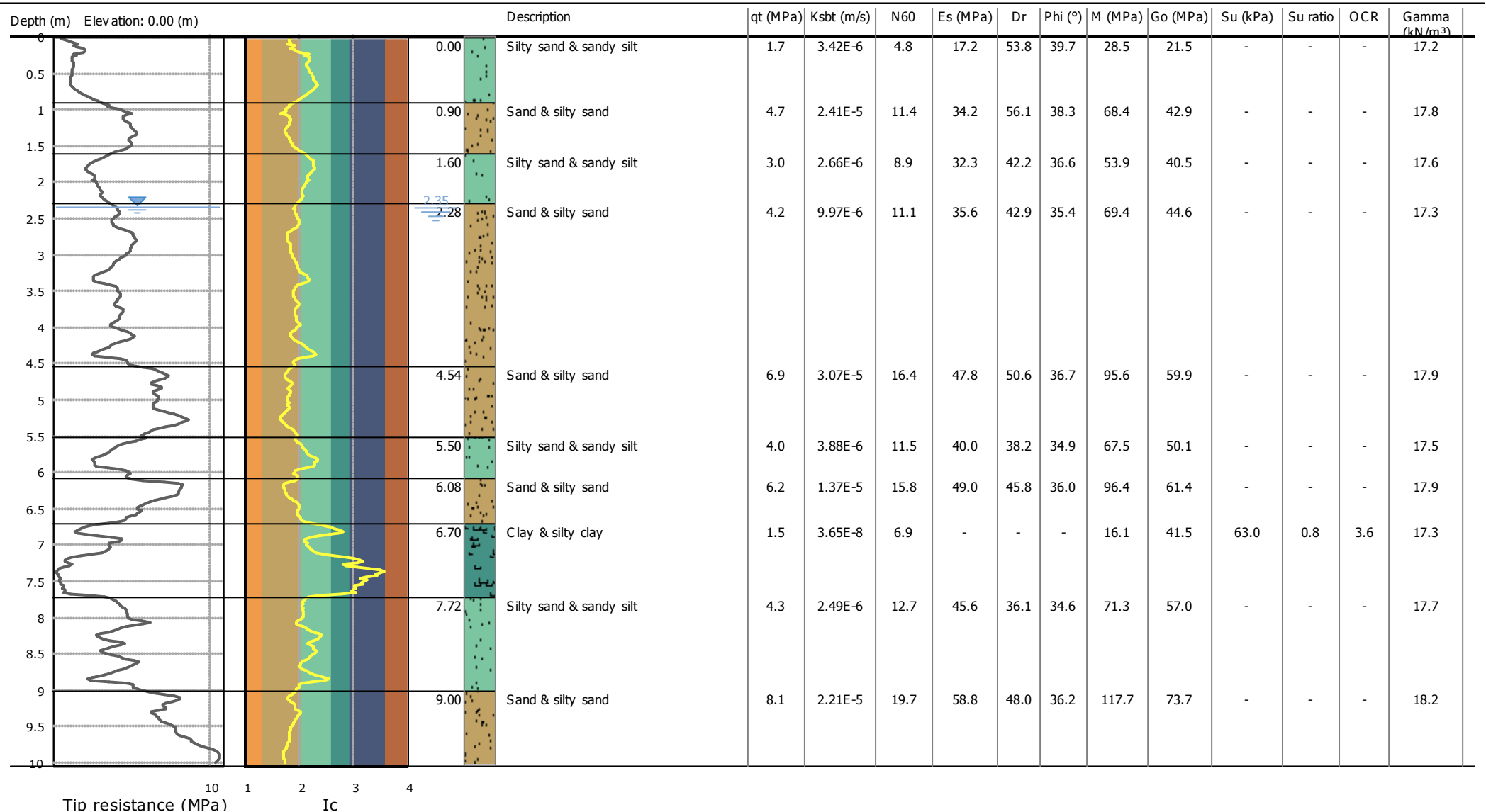
**Summary table of mean values**

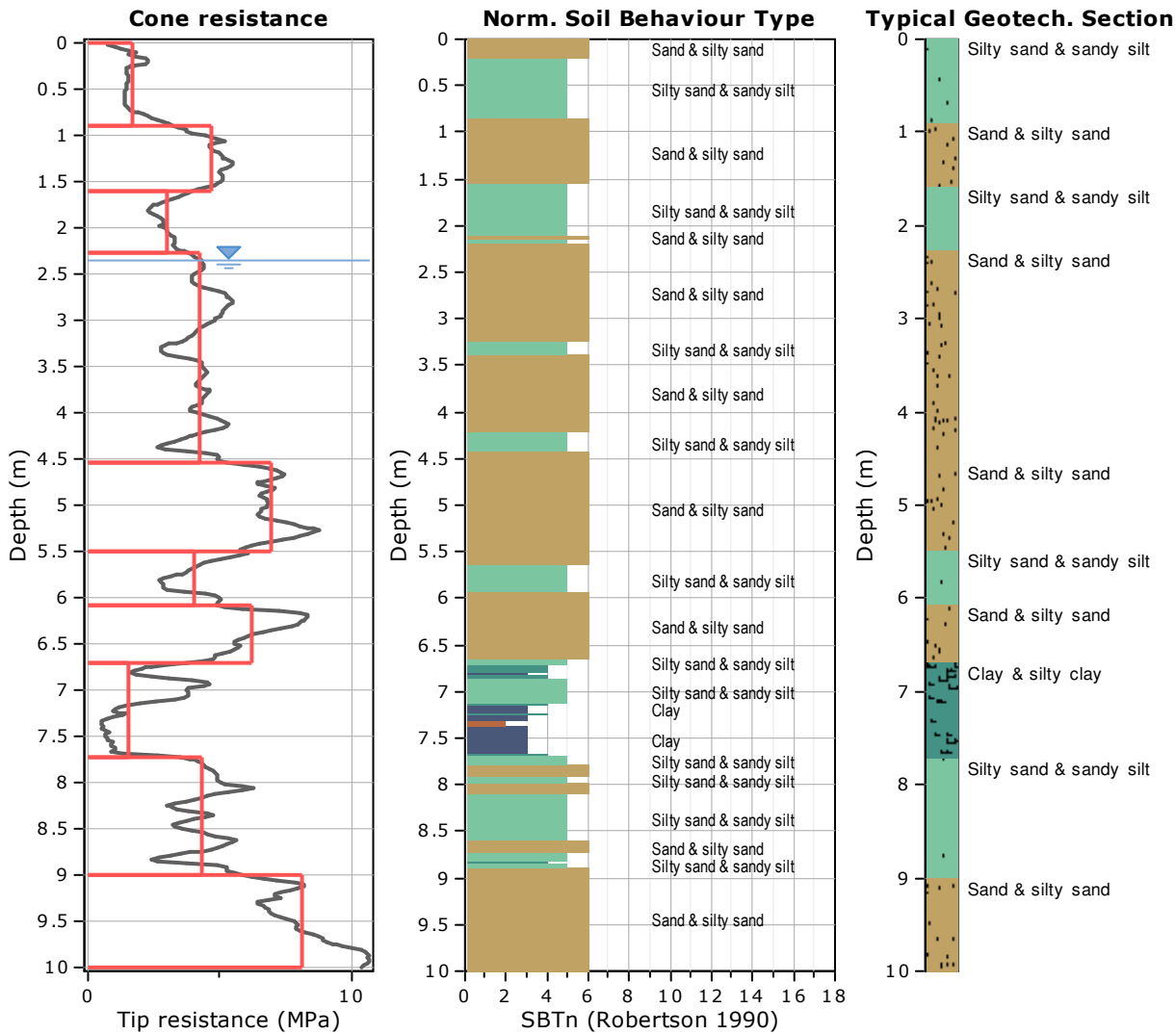
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 1.28             | 5.75E-07              | 4.5                                | 15.7                    | 47.1                  | 38.1              | 20.4                               | 23.4                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 1.28                          |                  | (±2.09E-06)           | (±1.4)                             | (±7.7)                  | (±10.9)               | (±2.7)            | (±11.6)                            | (±7.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.8)                              |
| 1.28                          | 3.14             | 5.68E-06              | 7.4                                | 24.8                    | 39.7                  | 34.5              | 43.9                               | 30.8                                      | 0.0  | 0.0                            | 0.0    | 16.6                                |
| 4.42                          |                  | (±7.57E-06)           | (±1.8)                             | (±4.1)                  | (±3.6)                | (±0.7)            | (±13.2)                            | (±5.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 4.42                          | 0.92             | 6.36E-05              | 16.9                               | 46.2                    | 55.6                  | 37.7              | 92.4                               | 57.9                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 5.34                          |                  | (±9.55E-05)           | (±3.7)                             | (±7.1)                  | (±7.8)                | (±1.6)            | (±14.2)                            | (±8.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 5.34                          | 0.62             | 4.69E-08              | 5.6                                | 0.0                     | 0.0                   | 0.0               | 12.4                               | 32.3                                      | 39.7   | 0.7                            | 3.3    | 16.9                                |
| 5.96                          |                  | (±9.51E-06)           | (±3.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±34.7)                            | (±11.2)                                   | (±33.3)  | (±0.6)                         | (±2.6) | (±0.7)                              |
| 5.96                          | 0.62             | 9.84E-05              | 20.6                               | 54.4                    | 59.4                  | 38.5              | 108.7                              | 68.1                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 6.58                          |                  | (±1.26E-04)           | (±4.0)                             | (±7.9)                  | (±7.5)                | (±1.5)            | (±15.7)                            | (±9.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 6.58                          | 1.12             | 2.15E-08              | 6.0                                | 0.0                     | 0.0                   | 0.0               | 13.7                               | 37.6                                      | 67.1   | 1.0                            | 4.6    | 17.3                                |
| 7.70                          |                  | (±1.38E-06)           | (±2.5)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±21.8)                            | (±8.1)                                    | (±36.1)  | (±0.5)                         | (±2.3) | (±0.5)                              |
| 7.70                          | 1.14             | 4.81E-05              | 22.3                               | 62.5                    | 56.6                  | 38.1              | 124.9                              | 78.3                                      | 0.0  | 0.0                            | 0.0    | 18.5                                |
| 8.84                          |                  | (±7.38E-05)           | (±4.0)                             | (±7.2)                  | (±7.3)                | (±1.2)            | (±14.4)                            | (±9.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 8.84                          | 0.76             | 8.31E-07              | 10.9                               | 41.4                    | 33.0                  | 34.3              | 51.2                               | 52.3                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 9.60                          |                  | (±1.63E-06)           | (±1.9)                             | (±5.9)                  | (±4.0)                | (±0.9)            | (±25.2)                            | (±7.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 9.60                          | 0.40             | 2.62E-05              | 17.3                               | 50.8                    | 46.5                  | 35.9              | 101.6                              | 63.7                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 10.00                         |                  | (±6.42E-05)           | (±4.9)                             | (±8.2)                  | (±9.5)                | (±1.8)            | (±16.4)                            | (±10.3)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1    **Start depth:** 0.00 (m), **End depth:** 0.90 (m)

**Description:** Silty sand & sandy silt

#### Basic results

Total cone resistance:  $1.66 \pm 0.52$  MPa

Sleeve friction:  $32.71 \pm 8.36$  kPa

Ic:  $2.10 \pm 0.16$

SBT<sub>n</sub>: 5

SBTn description: Silty sand & sandy silt

#### Estimation results

Permeability:  $3.42E-06 \pm 9.04E-06$  m/s

N<sub>60</sub>:  $4.81 \pm 1.36$  blows

Es:  $17.18 \pm 4.51$  MPa

Dr (%):  $53.76 \pm 9.11$

φ (degrees):  $39.73 \pm 1.28$  °

Unit weight:  $17.19 \pm 0.42$  kN/m<sup>3</sup>

Constrained Mod.:  $28.47 \pm 11.45$  MPa

Go:  $21.53 \pm 5.65$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$



**::: Layer No: 2 :::****Code:** Layer\_2    **Start depth:** 0.90 (m), **End depth:** 1.60 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.70 ±0.58 MPa

Sleeve friction: 39.43 ±11.08 kPa

Ic: 1.83 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.41E-05 ±1.50E-05 m/s

N<sub>60</sub>: 11.35 ±1.39 blows

Es: 34.21 ±4.35 MPa

Dr (%): 56.09 ±2.09

φ (degrees): 38.35 ±0.34 °

Unit weight: 17.81 ±0.32 kN/m<sup>3</sup>

Constrained Mod.: 68.42 ±8.71 MPa

Go: 42.88 ±5.46 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 3 :::****Code:** Layer\_3    **Start depth:** 1.60 (m), **End depth:** 2.28 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 3.00 ±0.45 MPa

Sleeve friction: 38.78 ±13.91 kPa

Ic: 2.15 ±0.09

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.66E-06 ±2.07E-06 m/s

N<sub>60</sub>: 8.89 ±1.03 blows

Es: 32.33 ±3.11 MPa

Dr (%): 42.17 ±3.04

φ (degrees): 36.58 ±1.10 °

Unit weight: 17.62 ±0.35 kN/m<sup>3</sup>

Constrained Mod.: 53.93 ±15.31 MPa

Go: 40.52 ±3.90 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 4 :::****Code:** Layer\_4    **Start depth:** 2.28 (m), **End depth:** 4.54 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.21 ±0.68 MPa

Sleeve friction: 27.11 ±3.93 kPa

Ic: 1.96 ±0.11

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 9.97E-06 ±8.09E-06 m/s

N<sub>60</sub>: 11.05 ±1.15 blows

Es: 35.61 ±2.23 MPa

Dr (%): 42.88 ±3.41

φ (degrees): 35.38 ±0.48 °

Unit weight: 17.34 ±0.16 kN/m<sup>3</sup>

Constrained Mod.: 69.40 ±7.90 MPa

Go: 44.64 ±2.79 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 5 :::****Code:** Layer\_5    **Start depth:** 4.54 (m), **End depth:** 5.50 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.92 ±0.76 MPa

Sleeve friction: 37.67 ±4.74 kPa

Ic: 1.80 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 3.07E-05 ±1.88E-05 m/s

N<sub>60</sub>: 16.37 ±1.15 blows

Es: 47.82 ±2.03 MPa

Dr (%): 50.57 ±2.37

φ (degrees): 36.74 ±0.35 °

Unit weight: 17.90 ±0.13 kN/m<sup>3</sup>

Constrained Mod.: 95.64 ±4.07 MPa

Go: 59.93 ±2.55 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 6 :::****Code:** Layer\_6    **Start depth:** 5.50 (m), **End depth:** 6.08 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.03 ±1.03 MPa

Sleeve friction: 31.78 ±5.03 kPa

Ic: 2.09 ±0.15

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 3.88E-06 ±5.11E-06 m/s

N<sub>60</sub>: 11.51 ±1.98 blows

Es: 39.95 ±3.52 MPa

Dr (%): 38.19 ±4.61

φ (degrees): 34.86 ±0.54 °

Unit weight: 17.50 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 67.52 ±20.81 MPa

Go: 50.08 ±4.41 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 7 :::****Code:** Layer\_7    **Start depth:** 6.08 (m), **End depth:** 6.70 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 6.17 ±1.37 MPa

Sleeve friction: 40.06 ±4.66 kPa

Ic: 1.91 ±0.13

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 1.37E-05 ±1.87E-05 m/s

N<sub>60</sub>: 15.78 ±2.26 blows

Es: 48.99 ±3.46 MPa

Dr (%): 45.80 ±4.94

φ (degrees): 36.02 ±0.77 °

Unit weight: 17.93 ±0.17 kN/m<sup>3</sup>

Constrained Mod.: 96.40 ±10.68 MPa

Go: 61.39 ±4.34 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**::: Layer No: 8 :::****Code:** Layer\_8    **Start depth:** 6.70 (m), **End depth:** 7.72 (m)**Description:** Clay & silty clay**Basic results**

Total cone resistance: 1.55 ±1.37 MPa

Sleeve friction: 35.50 ±11.28 kPa

Ic: 2.73 ±0.45

SBT<sub>n</sub>: 4SBT<sub>n</sub> description: Clay & silty clay**Estimation results**

Permeability: 3.65E-08 ±1.22E-06 m/s

N<sub>60</sub>: 6.91 ±3.14 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.26 ±0.52 kN/m<sup>3</sup>

Constrained Mod.: 16.07 ±30.83 MPa

Go: 41.54 ±9.89 MPa

Su: 63.05 ±41.36 kPa

Su ratio: 0.79 ±0.53

O.C.R.: 3.64 ±2.46

**::: Layer No: 9 :::****Code:** Layer\_9    **Start depth:** 7.72 (m), **End depth:** 9.00 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.28 ±0.89 MPa

Sleeve friction: 36.20 ±7.03 kPa

Ic: 2.15 ±0.15

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 2.49E-06 ±3.22E-06 m/s

N<sub>60</sub>: 12.75 ±1.58 blows

Es: 45.58 ±3.32 MPa

Dr (%): 36.14 ±3.66

φ (degrees): 34.58 ±0.46 °

Unit weight: 17.67 ±0.22 kN/m<sup>3</sup>

Constrained Mod.: 71.32 ±23.82 MPa

Go: 57.03 ±4.19 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 9.00 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.09 ±1.43 MPa

Sleeve friction: 45.30 ±6.49 kPa

Ic: 1.84 ±0.09

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 2.21E-05 ±1.59E-05 m/s

N<sub>60</sub>: 19.74 ±2.40 blows

Es: 58.84 ±4.59 MPa

Dr (%): 47.97 ±3.86

φ (degrees): 36.25 ±0.69 °

Unit weight: 18.18 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 117.69 ±9.18 MPa

Go: 73.75 ±5.75 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km54+600\_BIS**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.915897° lon 12.234774°

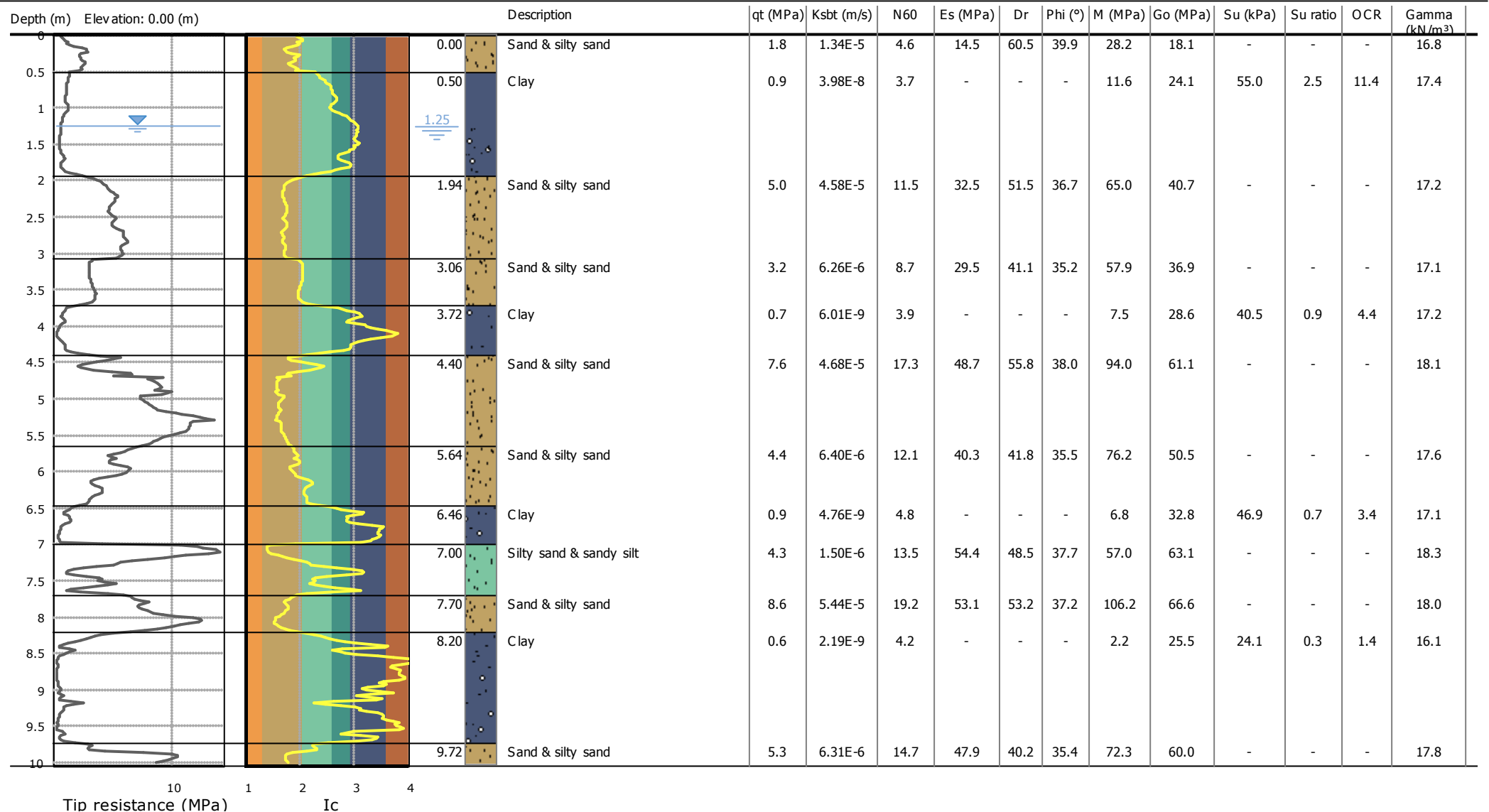
**Summary table of mean values**

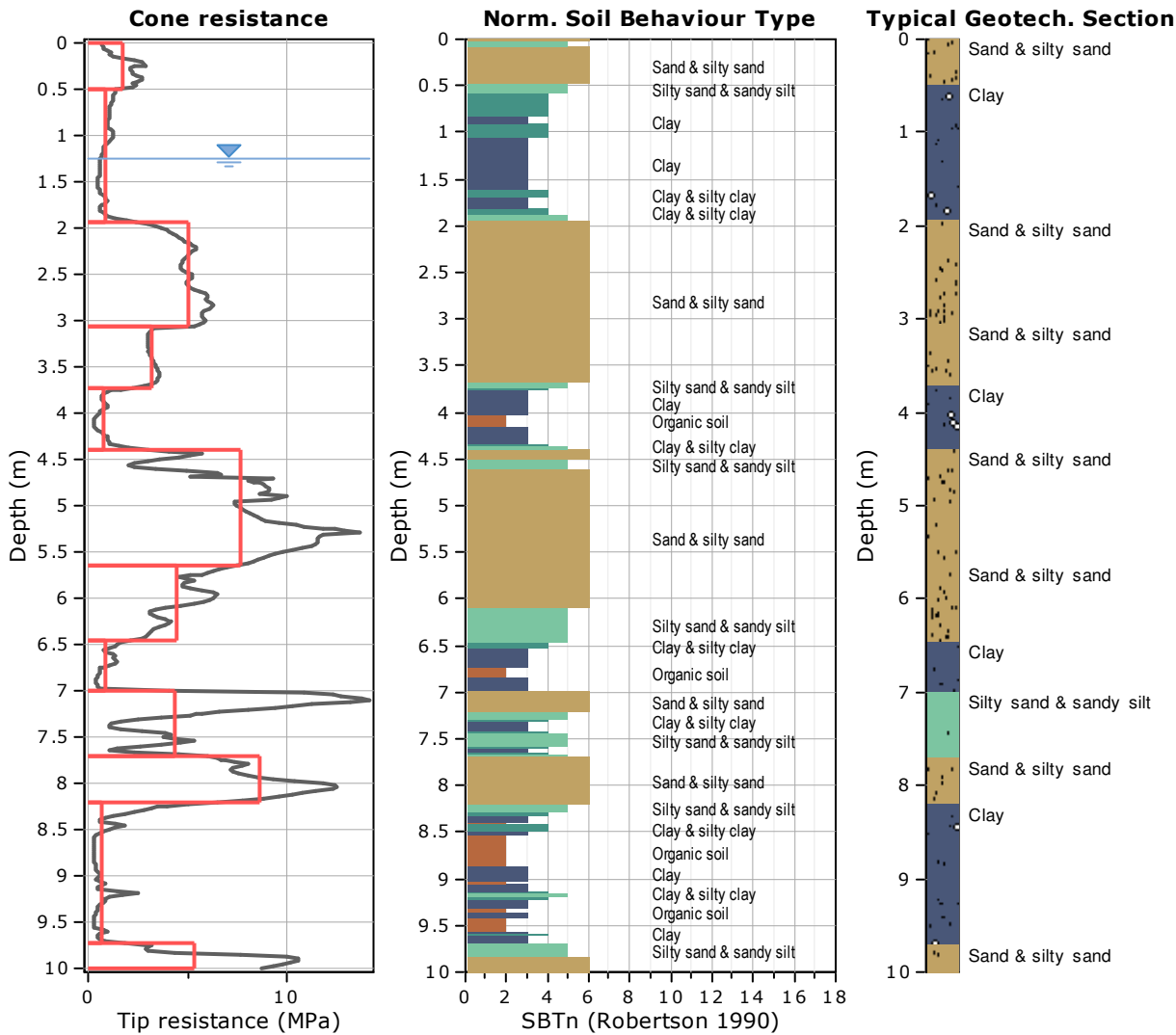
| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.90             | 3.42E-06              | 4.8                                | 17.2                    | 53.8                  | 39.7              | 28.5                               | 21.5                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 0.90                          |                  | (±9.04E-06)           | (±1.4)                             | (±4.5)                  | (±9.1)                | (±1.3)            | (±11.5)                            | (±5.7)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 0.90                          | 0.70             | 2.41E-05              | 11.4                               | 34.2                    | 56.1                  | 38.3              | 68.4                               | 42.9                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 1.60                          |                  | (±1.50E-05)           | (±1.4)                             | (±4.4)                  | (±2.1)                | (±0.3)            | (±8.7)                             | (±5.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.3)                              |
| 1.60                          | 0.68             | 2.66E-06              | 8.9                                | 32.3                    | 42.2                  | 36.6              | 53.9                               | 40.5                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 2.28                          |                  | (±2.07E-06)           | (±1.0)                             | (±3.1)                  | (±3.0)                | (±1.1)            | (±15.3)                            | (±3.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 2.28                          | 2.26             | 9.97E-06              | 11.1                               | 35.6                    | 42.9                  | 35.4              | 69.4                               | 44.6                                      | 0.0  | 0.0                            | 0.0    | 17.3                                |
| 4.54                          |                  | (±8.09E-06)           | (±1.2)                             | (±2.2)                  | (±3.4)                | (±0.5)            | (±7.9)                             | (±2.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 4.54                          | 0.96             | 3.07E-05              | 16.4                               | 47.8                    | 50.6                  | 36.7              | 95.6                               | 59.9                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 5.50                          |                  | (±1.88E-05)           | (±1.2)                             | (±2.0)                  | (±2.4)                | (±0.3)            | (±4.1)                             | (±2.5)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 5.50                          | 0.58             | 3.88E-06              | 11.5                               | 40.0                    | 38.2                  | 34.9              | 67.5                               | 50.1                                      | 0.0  | 0.0                            | 0.0    | 17.5                                |
| 6.08                          |                  | (±5.11E-06)           | (±2.0)                             | (±3.5)                  | (±4.6)                | (±0.5)            | (±20.8)                            | (±4.4)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.08                          | 0.62             | 1.37E-05              | 15.8                               | 49.0                    | 45.8                  | 36.0              | 96.4                               | 61.4                                      | 0.0  | 0.0                            | 0.0    | 17.9                                |
| 6.70                          |                  | (±1.87E-05)           | (±2.3)                             | (±3.5)                  | (±4.9)                | (±0.8)            | (±10.7)                            | (±4.3)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 6.70                          | 1.02             | 3.65E-08              | 6.9                                | 0.0                     | 0.0                   | 0.0               | 16.1                               | 41.5                                      | 63.0   | 0.8                            | 3.6    | 17.3                                |
| 7.72                          |                  | (±1.22E-06)           | (±3.1)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±30.8)                            | (±9.9)                                    | (±41.4)  | (±0.5)                         | (±2.5) | (±0.5)                              |
| 7.72                          | 1.28             | 2.49E-06              | 12.7                               | 45.6                    | 36.1                  | 34.6              | 71.3                               | 57.0                                      | 0.0  | 0.0                            | 0.0    | 17.7                                |
| 9.00                          |                  | (±3.22E-06)           | (±1.6)                             | (±3.3)                  | (±3.7)                | (±0.5)            | (±23.8)                            | (±4.2)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 9.00                          | 1.00             | 2.21E-05              | 19.7                               | 58.8                    | 48.0                  | 36.2              | 117.7                              | 73.7                                      | 0.0  | 0.0                            | 0.0    | 18.2                                |
| 10.00                         |                  | (±1.59E-05)           | (±2.4)                             | (±4.6)                  | (±3.9)                | (±0.7)            | (±9.2)                             | (±5.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |

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

**Project:**

**Location:**





### Tabular results

#### ::: Layer No: 1 :::

**Code:** Layer\_1      **Start depth:** 0.00 (m), **End depth:** 0.50 (m)

**Description:** Sand & silty sand

#### Basic results

Total cone resistance:  $1.78 \pm 0.74$  MPa

Sleeve friction:  $23.53 \pm 7.00$  kPa

Ic:  $1.91 \pm 0.12$

SBT<sub>n</sub>: 6

SBT<sub>n</sub> description: Sand & silty sand

#### Estimation results

Permeability:  $1.34E-05 \pm 1.53E-05$  m/s

N<sub>60</sub>:  $4.58 \pm 1.69$  blows

Es:  $14.47 \pm 4.85$  MPa

Dr (%):  $60.51 \pm 5.67$

φ (degrees):  $39.86 \pm 1.20$  °

Unit weight:  $16.84 \pm 0.45$  kN/m<sup>3</sup>

Constrained Mod.:  $28.21 \pm 10.00$  MPa

Go:  $18.13 \pm 6.08$  MPa

Su:  $0.00 \pm 0.00$  kPa

Su ratio:  $0.00 \pm 0.00$

O.C.R.:  $0.00 \pm 0.00$

**:: Layer No: 2 ::****Code:** Layer\_2    **Start depth:** 0.50 (m), **End depth:** 1.94 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.85 ±0.35 MPa

Sleeve friction: 47.43 ±13.76 kPa

Ic: 2.74 ±0.25

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 3.98E-08 ±4.18E-07 m/s

N<sub>60</sub>: 3.69 ±0.79 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.37 ±0.37 kN/m<sup>3</sup>

Constrained Mod.: 11.65 ±6.25 MPa

Go: 24.14 ±2.71 MPa

Su: 55.01 ±18.33 kPa

Su ratio: 2.48 ±1.19

O.C.R.: 11.44 ±5.50

**:: Layer No: 3 ::****Code:** Layer\_3    **Start depth:** 1.94 (m), **End depth:** 3.06 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.04 ±0.79 MPa

Sleeve friction: 22.66 ±3.76 kPa

Ic: 1.74 ±0.08

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.58E-05 ±1.67E-05 m/s

N<sub>60</sub>: 11.55 ±1.50 blows

Es: 32.50 ±3.20 MPa

Dr (%): 51.51 ±2.80

φ (degrees): 36.74 ±0.45 °

Unit weight: 17.20 ±0.23 kN/m<sup>3</sup>

Constrained Mod.: 64.99 ±6.40 MPa

Go: 40.73 ±4.01 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 4 ::****Code:** Layer\_4    **Start depth:** 3.06 (m), **End depth:** 3.72 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 3.22 ±0.46 MPa

Sleeve friction: 23.99 ±0.86 kPa

Ic: 2.02 ±0.07

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.26E-06 ±6.57E-06 m/s

N<sub>60</sub>: 8.70 ±0.79 blows

Es: 29.45 ±1.28 MPa

Dr (%): 41.05 ±2.28

φ (degrees): 35.19 ±0.28 °

Unit weight: 17.09 ±0.05 kN/m<sup>3</sup>

Constrained Mod.: 57.90 ±5.51 MPa

Go: 36.91 ±1.61 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 5 ::****Code:** Layer\_5    **Start depth:** 3.72 (m), **End depth:** 4.40 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.74 ±0.61 MPa

Sleeve friction: 42.00 ±8.67 kPa

Ic: 3.03 ±0.41

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 6.01E-09 ±5.33E-07 m/s

N<sub>60</sub>: 3.90 ±1.59 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.17 ±0.29 kN/m<sup>3</sup>

Constrained Mod.: 7.52 ±12.20 MPa

Go: 28.57 ±4.84 MPa

Su: 40.51 ±22.21 kPa

Su ratio: 0.95 ±0.48

O.C.R.: 4.38 ±2.21



**:: Layer No: 6 ::****Code:** Layer\_6 **Start depth:** 4.40 (m), **End depth:** 5.64 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 7.61 ±2.86 MPa

Sleeve friction: 42.80 ±18.89 kPa

Ic: 1.73 ±0.21

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 4.68E-05 ±5.89E-05 m/s

N<sub>60</sub>: 17.26 ±5.12 blows

Es: 48.72 ±11.15 MPa

Dr (%): 55.80 ±9.41

φ (degrees): 38.03 ±1.49 °

Unit weight: 18.09 ±0.56 kN/m<sup>3</sup>

Constrained Mod.: 94.02 ±26.07 MPa

Go: 61.06 ±13.97 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 7 ::****Code:** Layer\_7 **Start depth:** 5.64 (m), **End depth:** 6.46 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 4.45 ±1.38 MPa

Sleeve friction: 34.24 ±9.55 kPa

Ic: 2.02 ±0.14

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.40E-06 ±7.84E-06 m/s

N<sub>60</sub>: 12.15 ±2.76 blows

Es: 40.29 ±6.21 MPa

Dr (%): 41.81 ±6.35

φ (degrees): 35.51 ±1.16 °

Unit weight: 17.62 ±0.42 kN/m<sup>3</sup>

Constrained Mod.: 76.18 ±17.63 MPa

Go: 50.49 ±7.78 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 8 ::****Code:** Layer\_8 **Start depth:** 6.46 (m), **End depth:** 7.00 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.87 ±0.77 MPa

Sleeve friction: 36.09 ±19.63 kPa

Ic: 3.06 ±0.40

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 4.76E-09 ±2.29E-06 m/s

N<sub>60</sub>: 4.79 ±1.79 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 17.06 ±0.72 kN/m<sup>3</sup>

Constrained Mod.: 6.85 ±14.06 MPa

Go: 32.83 ±8.25 MPa

Su: 46.92 ±31.19 kPa

Su ratio: 0.73 ±0.49

O.C.R.: 3.39 ±2.25

**:: Layer No: 9 ::****Code:** Layer\_9 **Start depth:** 7.00 (m), **End depth:** 7.70 (m)**Description:** Silty sand & sandy silt**Basic results**

Total cone resistance: 4.35 ±4.30 MPa

Sleeve friction: 60.12 ±26.36 kPa

Ic: 2.16 ±0.56

SBT<sub>n</sub>: 5SBT<sub>n</sub> description: Silty sand & sandy silt**Estimation results**

Permeability: 1.50E-06 ±1.92E-04 m/s

N<sub>60</sub>: 13.47 ±6.20 blows

Es: 54.37 ±6.97 MPa

Dr (%): 48.45 ±11.51

φ (degrees): 37.70 ±1.54 °

Unit weight: 18.26 ±0.49 kN/m<sup>3</sup>

Constrained Mod.: 57.01 ±43.81 MPa

Go: 63.10 ±10.75 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 10 ::****Code:** Layer\_10    **Start depth:** 7.70 (m), **End depth:** 8.20 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 8.56 ±2.07 MPa

Sleeve friction: 38.18 ±5.43 kPa

Ic: 1.71 ±0.12

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 5.44E-05 ±6.66E-05 m/s

N<sub>60</sub>: 19.23 ±3.10 blows

Es: 53.12 ±4.74 MPa

Dr (%): 53.19 ±5.75

φ (degrees): 37.16 ±1.08 °

Unit weight: 18.00 ±0.21 kN/m<sup>3</sup>

Constrained Mod.: 106.24 ±9.48 MPa

Go: 66.58 ±5.94 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**:: Layer No: 11 ::****Code:** Layer\_11    **Start depth:** 8.20 (m), **End depth:** 9.72 (m)**Description:** Clay**Basic results**

Total cone resistance: 0.64 ±1.16 MPa

Sleeve friction: 18.04 ±19.03 kPa

Ic: 3.27 ±0.53

SBT<sub>n</sub>: 3SBT<sub>n</sub> description: Clay**Estimation results**

Permeability: 2.19E-09 ±1.40E-06 m/s

N<sub>60</sub>: 4.16 ±3.01 blows

Es: 0.00 ±0.00 MPa

Dr (%): 0.00 ±0.00

φ (degrees): 0.00 ±0.00 °

Unit weight: 16.14 ±0.99 kN/m<sup>3</sup>

Constrained Mod.: 2.15 ±20.80 MPa

Go: 25.52 ±13.74 MPa

Su: 24.11 ±36.92 kPa

Su ratio: 0.30 ±0.47

O.C.R.: 1.38 ±2.16

**:: Layer No: 12 ::****Code:** Layer\_12    **Start depth:** 9.72 (m), **End depth:** 10.00 (m)**Description:** Sand & silty sand**Basic results**

Total cone resistance: 5.35 ±3.71 MPa

Sleeve friction: 36.35 ±16.52 kPa

Ic: 2.00 ±0.29

SBT<sub>n</sub>: 6SBT<sub>n</sub> description: Sand & silty sand**Estimation results**

Permeability: 6.31E-06 ±2.82E-05 m/s

N<sub>60</sub>: 14.70 ±6.82 blows

Es: 47.91 ±14.37 MPa

Dr (%): 40.23 ±12.99

φ (degrees): 35.35 ±2.19 °

Unit weight: 17.76 ±0.75 kN/m<sup>3</sup>

Constrained Mod.: 72.33 ±46.81 MPa

Go: 60.05 ±18.01 MPa

Su: 0.00 ±0.00 kPa

Su ratio: 0.00 ±0.00

O.C.R.: 0.00 ±0.00

**Project:**

**Location:**

**CPT: CPTU km55+100**

Total depth: 10.00 m, Date: 19/06/2019

Coords: lat 44.9209° lon 12.236488°

**Summary table of mean values**

| From depth<br>To depth<br>(m) | Thickness<br>(m) | Permeability<br>(m/s) | SPT <sub>N60</sub><br>(blows/30cm) | E <sub>s</sub><br>(MPa) | D <sub>r</sub><br>(%) | Friction<br>angle | Constrained<br>modulus, M<br>(MPa) | Shear<br>modulus, G <sub>0</sub><br>(MPa) | Undrained<br>strength, S <sub>u</sub><br>(kPa) | Undrained<br>strength<br>ratio | OCR    | Unit weight<br>(kN/m <sup>3</sup> ) |
|-------------------------------|------------------|-----------------------|------------------------------------|-------------------------|-----------------------|-------------------|------------------------------------|---|--|--------------------------------|--------|-------------------------------------|
| 0.00                          | 0.50             | 1.34E-05              | 4.6                                | 14.5                    | 60.5                  | 39.9              | 28.2                               | 18.1                                      | 0.0  | 0.0                            | 0.0    | 16.8                                |
| 0.50                          |                  | (±1.53E-05)           | (±1.7)                             | (±4.9)                  | (±5.7)                | (±1.2)            | (±10.0)                            | (±6.1)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 0.50                          | 1.44             | 3.98E-08              | 3.7                                | 0.0                     | 0.0                   | 0.0               | 11.6                               | 24.1                                      | 55.0   | 2.5                            | 11.4   | 17.4                                |
| 1.94                          |                  | (±4.18E-07)           | (±0.8)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±6.2)                             | (±2.7)                                    | (±18.3)  | (±1.2)                         | (±5.5) | (±0.4)                              |
| 1.94                          | 1.12             | 4.58E-05              | 11.5                               | 32.5                    | 51.5                  | 36.7              | 65.0                               | 40.7                                      | 0.0  | 0.0                            | 0.0    | 17.2                                |
| 3.06                          |                  | (±1.67E-05)           | (±1.5)                             | (±3.2)                  | (±2.8)                | (±0.4)            | (±6.4)                             | (±4.0)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 3.06                          | 0.66             | 6.26E-06              | 8.7                                | 29.5                    | 41.1                  | 35.2              | 57.9                               | 36.9                                      | 0.0  | 0.0                            | 0.0    | 17.1                                |
| 3.72                          |                  | (±6.57E-06)           | (±0.8)                             | (±1.3)                  | (±2.3)                | (±0.3)            | (±5.5)                             | (±1.6)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.1)                              |
| 3.72                          | 0.68             | 6.01E-09              | 3.9                                | 0.0                     | 0.0                   | 0.0               | 7.5                                | 28.6                                      | 40.5   | 0.9                            | 4.4    | 17.2                                |
| 4.40                          |                  | (±5.33E-07)           | (±1.6)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±12.2)                            | (±4.8)                                    | (±22.2)  | (±0.5)                         | (±2.2) | (±0.3)                              |
| 4.40                          | 1.24             | 4.68E-05              | 17.3                               | 48.7                    | 55.8                  | 38.0              | 94.0                               | 61.1                                      | 0.0  | 0.0                            | 0.0    | 18.1                                |
| 5.64                          |                  | (±5.89E-05)           | (±5.1)                             | (±11.1)                 | (±9.4)                | (±1.5)            | (±26.1)                            | (±14.0)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.6)                              |
| 5.64                          | 0.82             | 6.40E-06              | 12.1                               | 40.3                    | 41.8                  | 35.5              | 76.2                               | 50.5                                      | 0.0  | 0.0                            | 0.0    | 17.6                                |
| 6.46                          |                  | (±7.84E-06)           | (±2.8)                             | (±6.2)                  | (±6.4)                | (±1.2)            | (±17.6)                            | (±7.8)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.4)                              |
| 6.46                          | 0.54             | 4.76E-09              | 4.8                                | 0.0                     | 0.0                   | 0.0               | 6.8                                | 32.8                                      | 46.9   | 0.7                            | 3.4    | 17.1                                |
| 7.00                          |                  | (±2.29E-06)           | (±1.8)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±14.1)                            | (±8.2)                                    | (±31.2)  | (±0.5)                         | (±2.3) | (±0.7)                              |
| 7.00                          | 0.70             | 1.50E-06              | 13.5                               | 54.4                    | 48.5                  | 37.7              | 57.0                               | 63.1                                      | 0.0  | 0.0                            | 0.0    | 18.3                                |
| 7.70                          |                  | (±1.92E-04)           | (±6.2)                             | (±7.0)                  | (±11.5)               | (±1.5)            | (±43.8)                            | (±10.7)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.5)                              |
| 7.70                          | 0.50             | 5.44E-05              | 19.2                               | 53.1                    | 53.2                  | 37.2              | 106.2                              | 66.6                                      | 0.0  | 0.0                            | 0.0    | 18.0                                |
| 8.20                          |                  | (±6.66E-05)           | (±3.1)                             | (±4.7)                  | (±5.7)                | (±1.1)            | (±9.5)                             | (±5.9)                                    | (±0.0)   | (±0.0)                         | (±0.0) | (±0.2)                              |
| 8.20                          | 1.52             | 2.19E-09              | 4.2                                | 0.0                     | 0.0                   | 0.0               | 2.2                                | 25.5                                      | 24.1   | 0.3                            | 1.4    | 16.1                                |
| 9.72                          |                  | (±1.40E-06)           | (±3.0)                             | (±0.0)                  | (±0.0)                | (±0.0)            | (±20.8)                            | (±13.7)                                   | (±36.9)  | (±0.5)                         | (±2.2) | (±1.0)                              |
| 9.72                          | 0.28             | 6.31E-06              | 14.7                               | 47.9                    | 40.2                  | 35.4              | 72.3                               | 60.0                                      | 0.0  | 0.0                            | 0.0    | 17.8                                |
| 10.00                         |                  | (±2.82E-05)           | (±6.8)                             | (±14.4)                 | (±13.0)               | (±2.2)            | (±46.8)                            | (±18.0)                                   | (±0.0)   | (±0.0)                         | (±0.0) | (±0.8)                              |

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