PROGETTO PER LA REALIZZAZIONE DI UN IMPIANTO AGRIVOLTAICO DENOMINATO "AGRO-SOLARE FISCAGLIA" DA UBICARSI IN AGRO DI FISCAGLIA (FE) E DELLE RELATIVE OPERE DI CONNESSIONE

Potenza nominale: 51,86 MWp - Potenza in immissione: 40,00 MW



ELABORATO

	CODIFICA	SCALA
RELAZIONE GEOLOGICA, IDROGEOLOGICA E GEOTECNICA	**AMB10R00**	**-**

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0	Maggio 2026	PRESENTAZIONE ISTANZA	Dott. F. Cianchi	Ing. F. Spinelli	Ing. M. De Donno

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1. IDENTIFICAZIONE DEL DOCUMENTO

Identificazione

Il presente lavoro viene identificato per mezzo del seguente codice AMB10R00

Direzione indagini e coordinamento lavoro

Dott. Geol. Francesco Cianchi

Collaboratori

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Redazione del documento

Il presente documento è stato redatto dal Geol. Francesco Cianchi in data 26/05/2026

Composizione del documento

Il presente documento è formato da n° 50 pagine e n° 376 fogli allegati

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2. NORMATIVA DI RIFERIMENTO

D.P.R. 380/2001
Testo Unico delle disposizioni legislative e regolamentari in materia edilizia;

D.M. 17/01/2018
Norme Tecniche per le Costruzioni;

Circolare 21/01/2019
Istruzioni per l'applicazione delle Nuove Norme Tecniche per le costruzioni di cui al D.M. del 17 gennaio 2018. Decreto Ministeriale

ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale
Linee Guida per la redazione degli studi di impatto ambientale relativi ad impianti agrivoltaici e fotovoltaici. Manuali e linee guida 57/2025.

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3. PREMESSA

La società Fiscaglia Agri-Solare S.r.l., intende realizzare un impianto agrivoltaico denominato "Agro-solare Fiscaglia" (di seguito l'"Impianto") situato nel comune di Fiscaglia (FE), concepito per integrare in modo sinergico la produzione di energia elettrica da fonte solare con la prosecuzione delle attività agricole già esercitate sul sito.

L'iniziativa si colloca negli indirizzi strategici nazionali ed europei in materia di decarbonizzazione e di promozione delle fonti rinnovabili, contribuendo alla transizione energetica e alla riduzione delle emissioni climalteranti.

L'Impianto è progettato adottando soluzioni tecniche che garantiscono la piena compatibilità tra l'infrastruttura energetica e l'esercizio delle attività agricole, assicurando la valorizzazione del territorio e un uso multifunzionale e sostenibile del suolo.

Ai sensi dell'art. 13 punto 2 comma d-ter) del D.Lgs. 190/2024, gli "*impianti fotovoltaici o agrivoltaici di potenza pari o superiore a 12 MW in zone classificate agricole che consentano l'effettiva compatibilità e integrazione con le attività agricole*" sono soggetti al giudizio di compatibilità ambientale di competenza regionale.

L'intervento, configurandosi come impianto per la produzione di energia da fonte rinnovabile finalizzato a integrare in modo sinergico la produzione di energia da fonte solare con l'attività agricola, è pertanto assoggettato alla procedura di Valutazione di Impatto Ambientale (VIA) nell'ambito del Provvedimento Autorizzatorio Unico Regionale (PAUR), ai sensi dell'art. 27-bis del D.Lgs. 152/2006, in coerenza con la L.R. n. 4/2018. Il PAUR costituisce il provvedimento autorizzatorio unico e comprende, oltre al provvedimento di VIA, tutti i titoli abilitativi necessari per la realizzazione e l'esercizio del progetto, acquisiti nell'ambito della conferenza dei servizi ai sensi degli artt. 15 e ss. della L.R. n. 4/2018.

In ragione della sua natura strategica, l'opera è altresì classificata come infrastruttura di pubblica utilità, indifferibile e urgente, ai sensi dell'art. 1 del medesimo decreto legislativo. Coerentemente con quanto disposto dall'art. 2, essa è dunque ubicabile anche in aree classificate come agricole dai vigenti strumenti urbanistico.

L'intervento prevede la realizzazione di un impianto agrivoltaico della potenza complessiva di 51.865,92 kWp; la superficie in disponibilità della Società Proponente in forza dei contratti preliminari di compravendita sottoscritti con i legittimi proprietari dei terreni interessati è pari a 81,10 ettari, la superficie totale del sistema agrivoltaico è pari invece a 57,21 ettari (di cui recintati 53,81 ed altri 3,40 di mitigazione) mentre la superficie agricola totale è di 55,78 ettari.

Dal punto di vista progettuale, l'Impianto si sviluppa in un'unica area e adotta soluzioni tecnologiche efficienti. Il progetto è realizzato con 75.168 moduli AIKO-STELLAR-690 bifacciali o equivalenti, con celle ABC monocristalline di tipo n, tecnologia che assicura elevati rendimenti di conversione, una ridotta perdita di efficienza all'aumentare della temperatura e una lunga vita utile. Il sistema è completato da 158 inverter multistringa HUAWEI da 330 kVA ciascuno o equivalenti.

L'Impianto è inoltre dotato delle infrastrutture ausiliarie necessarie alla piena operatività e alla sicurezza — monitoraggio in tempo reale, videosorveglianza, illuminazione perimetrale (attiva solo in caso di intrusione) e controllo accessi — alimentate da una rete interna in bassa tensione e gestite tramite sistema SCADA centralizzato. Le cabine di trasformazione, stoccaggio e ricezione, prefabbricate o in container preallestiti, garantiscono rapidità di installazione e smontaggio, contenendo l'impatto di cantiere e il consumo di risorse materiali.

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Il progetto è concepito con attenzione al contesto paesaggistico e idrogeologico: la viabilità interna sarà realizzata con materiali riciclati o naturali, i movimenti di terra ridotti al minimo e saranno previste opere di drenaggio e fasce di mitigazione a verde per un inserimento armonico dell'Impianto nel paesaggio.

Al fine di assicurare un layout d'impianto uniforme e compatto, la Società Proponente propone l'interramento della linea in media tensione esistente sull'area.

L' Impianto sarà connesso alla rete di trasmissione nazionale di proprietà di Terna S.p.A. secondo quanto indicato nel preventivo di connessione n. **202404133**, attraverso un cavidotto interrato a 36 kV che si estende lungo sedi stradali esistenti per circa 8 km, che verrà collegato su una nuova Stazione elettrica SE 380/132/36 kV denominata "Fiscaglia".

Si evidenzia, inoltre, che la SE Fiscaglia e i relativi raccordi alla RTN, **sono state già autorizzate** dal Ministero dell'Ambiente e della Sicurezza Energetica con **Decreto Direttoriale n. 55/65/2025 del 6 novembre 2025**.

Le Opere Utente hanno altresì ottenuto il **benestare tecnico al progetto** da parte di Terna S.p.A. con **nota prot. n.82637 del 15 giugno 2026**.

Considerato il rapido e continuo sviluppo delle tecnologie fotovoltaiche, è possibile che, tra la fase attuale di progettazione definitiva e quella di realizzazione, vengano introdotte variazioni nelle specifiche tecniche o nei modelli delle componenti principali. Tali eventuali aggiornamenti saranno adottati nel rispetto delle migliori soluzioni disponibili sul mercato al momento della realizzazione dell'Impianto, senza tuttavia modificare le caratteristiche sostanziali del progetto, che resteranno invariate in termini di potenza massima installata, configurazione generale, occupazione del suolo e volumetrie dei fabbricati.

La scelta del sito di installazione è avvenuta a seguito di un'attenta valutazione territoriale, finalizzata a individuare aree che presentassero una combinazione ottimale di fattori tecnici, agronomici e infrastrutturali, quali elevato livello di irraggiamento solare, condizioni orografiche favorevoli e un contesto territoriale compatibile con la pianificazione urbanistica e i vincoli normativi vigenti. Ulteriori elementi considerati nella localizzazione del progetto sono stati la prossimità a infrastrutture esistenti per la connessione alla rete elettrica e la presenza di un'adeguata viabilità d'accesso, necessaria sia in fase di costruzione che per la futura manutenzione dell'Impianto e il corretto svolgimento delle attività agricole.

Elemento centrale del progetto è la coesistenza funzionale tra generazione elettrica e attività agricola resa possibile dall'utilizzo di strutture sollevate da terra (tracker monoassiali) e di moduli fotovoltaici bifacciali ad alta efficienza montati su pali infissi, senza impiego di opere in calcestruzzo e con movimenti di terra minimi.

Ciò consente non solo la reversibilità completa dell'intervento, ma anche il mantenimento della fertilità e della morfologia naturale del suolo.

Le caratteristiche di layout assicurano un'occupazione del terreno coerente con i requisiti definiti dal Ministero dell'Ambiente e della Sicurezza Energetica (MASE): più del 97% della superficie totale è destinata all'uso agricolo attivo, in piena conformità al criterio A1, e la produttività per ettaro dell'attività agricola del progetto supera significativamente quella attuale come indicato nel documento "AMB13R_Relazione pedo-agronomica e progetto agricolo". Inoltre si evidenzia che la coesistenza e sinergia fra impianto fotovoltaico e attività agricola genera notevoli benefici per le colture previste, come:

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- Riduzione dello stress idrico: i pannelli possono creare ombra, riducendo l'evaporazione dell'acqua dal suolo e, di conseguenza, il fabbisogno irriguo delle colture sottostanti.
- Protezione dalle intemperie: i moduli possono proteggere le colture da eventi climatici estremi (grandine, eccessiva irradiazione solare, gelo tardivo).
- Aumento della resa o della qualità: per alcune colture che beneficiano di ombreggiamento, l'agrivoltaico può portare a rese migliori o a una qualità superiore del prodotto.

Nel suo complesso, il progetto "Agro-solare Fiscaglia" coniuga la produzione di energia rinnovabile con il presidio e la valorizzazione del territorio agricolo. La trattazione di dettaglio del piano colturale è riportata nel documento "AMB13R – Relazione pedo-agronomica e progetto agricolo", a cui si rinvia.

Le figure seguenti illustrano, a titolo esemplificativo, le sezioni e le planimetrie tipiche dell'Impianto.

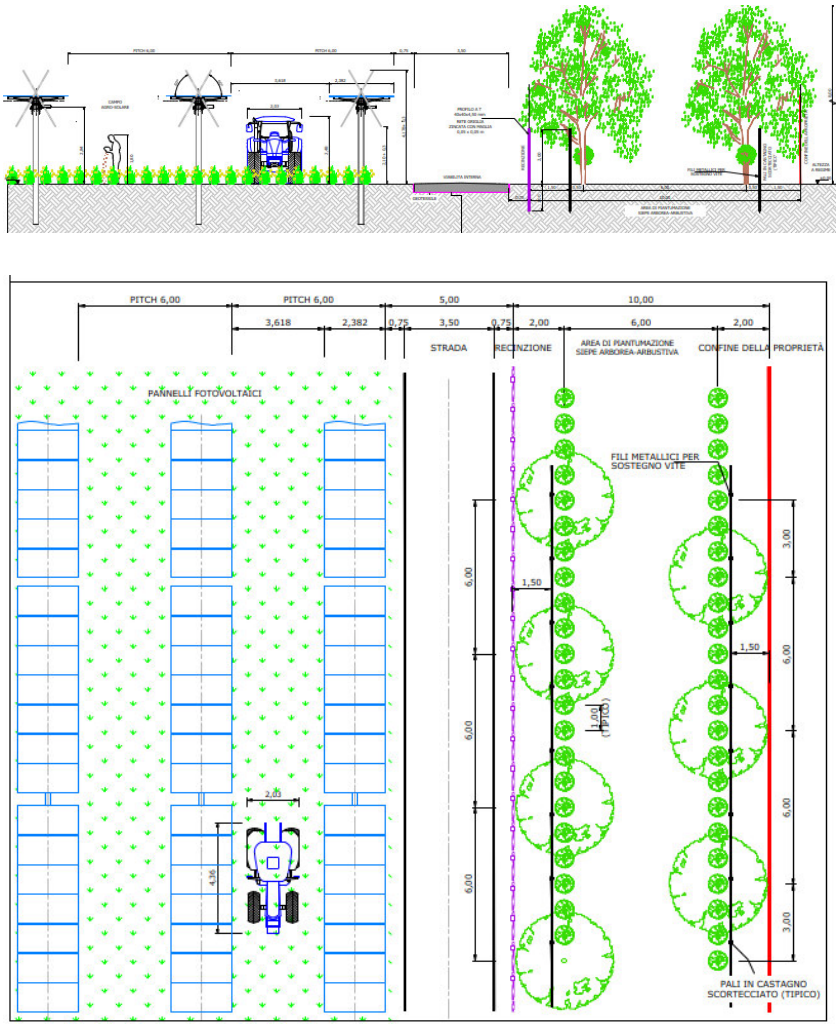


Figura 1. Sezione e planimetria tipiche di Impianto.

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Figura 2. Vista in pianta delle sezioni tipiche.

Nel presente documento (Relazione geologica, idrogeologica e geotecnica), redatto ai sensi della vigente normativa tecnica per le costruzioni (NTC 2018), viene descritto il modello geologico, idrogeologico e geotecnico dell'area in esame designata per l'impianto.

Si riportano di seguito glie estratti dei §§ 6.2.1 e 6.2.2 delle NTC 2018.

"Il modello geologico di riferimento è la ricostruzione concettuale della storia evolutiva dell'area di studio, attraverso la descrizione delle peculiarità genetiche dei diversi terreni presenti, delle dinamiche dei diversi termini litologici, dei rapporti di giustapposizione reciproca, delle vicende tettoniche subite e dell'azione dei diversi agenti morfogenetici. La caratterizzazione e la modellazione geologica del sito deve comprendere la ricostruzione dei caratteri litologici, stratigrafici, strutturali, idrogeologici, geomorfologici e, più in generale, di pericolosità geologica del territorio, descritti e sintetizzati dal modello geologico di riferimento.
In funzione del tipo di opera, di intervento e della complessità del contesto geologico nel quale si inserisce l'opera, specifiche indagini saranno finalizzate alla documentata ricostruzione del modello geologico.
Il modello geologico deve essere sviluppato in modo da costituire elemento di riferimento per il progettista per inquadrare i problemi geotecnici e per definire il programma delle indagini geotecniche."
"Le indagini geotecniche devono essere programmate in funzione del tipo di opera e/o di intervento, devono riguardare il volume significativo e, in presenza di azioni sismiche, devono essere conformi a quanto prescritto ai §§ 3.2.2 e 7.11.2 delle NTC 2018. Per volume significativo di terreno si intende la parte di sottosuolo influenzata, direttamente o indirettamente, dalla costruzione del manufatto e che influenza il manufatto stesso. Le indagini devono permettere la definizione dei modelli geotecnici di sottosuolo necessari alla progettazione. Della definizione del piano delle indagini, della caratterizzazione e della modellazione geotecnica è responsabile il progettista.
Ai fini dell'analisi quantitativa di uno specifico problema, per modello geotecnico di sottosuolo si intende uno schema rappresentativo del volume significativo di terreno, suddiviso in unità omogenee sotto il profilo fisico-meccanico, che devono essere caratterizzate con riferimento allo

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specifico problema geotecnico. Nel modello geotecnico di sottosuolo devono essere definiti il regime delle pressioni interstiziali e i valori caratteristici dei parametri geotecnici.
Per valore caratteristico di un parametro geotecnico deve intendersi una stima ragionata e cautelativa del valore del parametro per ogni stato limite considerato. I valori caratteristici delle proprietà fisiche e meccaniche da attribuire ai terreni devono essere dedotti dall'interpretazione dei risultati di specifiche prove di laboratorio su campioni rappresentativi di terreno e di prove e misure in sito."

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4. INQUADRAMENTO DELL'AREA

La scelta del sito di installazione è avvenuta a seguito di un'attenta valutazione territoriale, finalizzata a individuare aree che presentassero una combinazione ottimale di fattori tecnici, agronomici e infrastrutturali, quali elevato livello di irraggiamento solare, condizioni orografiche favorevoli e un contesto territoriale compatibile con la pianificazione urbanistica e i vincoli normativi vigenti. Ulteriori elementi considerati nella localizzazione del progetto sono stati la prossimità a infrastrutture esistenti per la connessione alla rete elettrica e la presenza di un'adeguata viabilità d'accesso, necessaria sia in fase di costruzione che per la futura manutenzione dell'Impianto e il corretto svolgimento delle attività agricole.

Il sito interessato dall'Impianto ricade nel territorio comunale di Fiscaglia (FE) e come riportato in Figura 3, dista dalla frazione Massa Fiscaglia circa 3,7 km, dal Comune di Codigoro 8 km e dal Comune di Lagosanto circa 8,3 km.

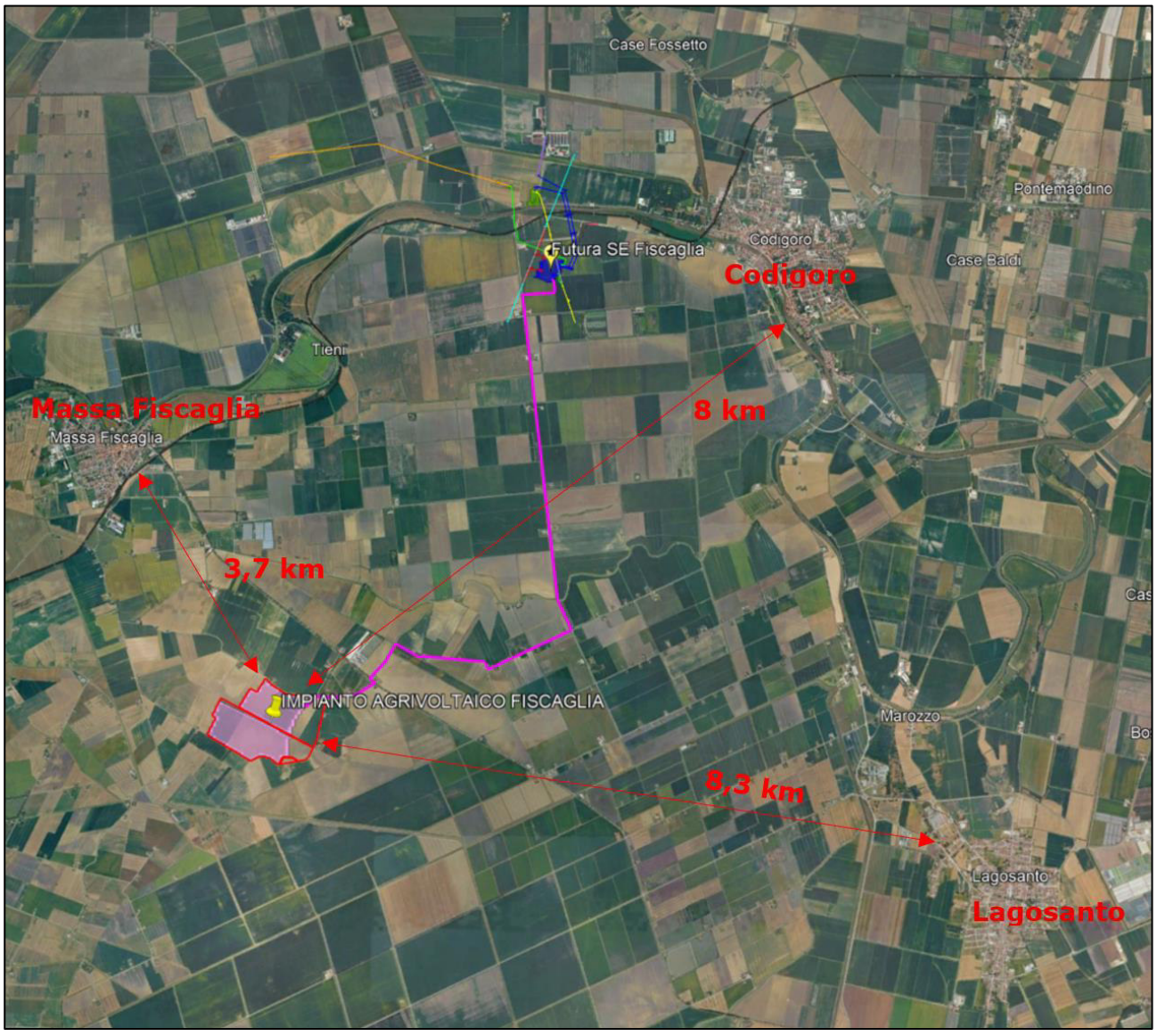
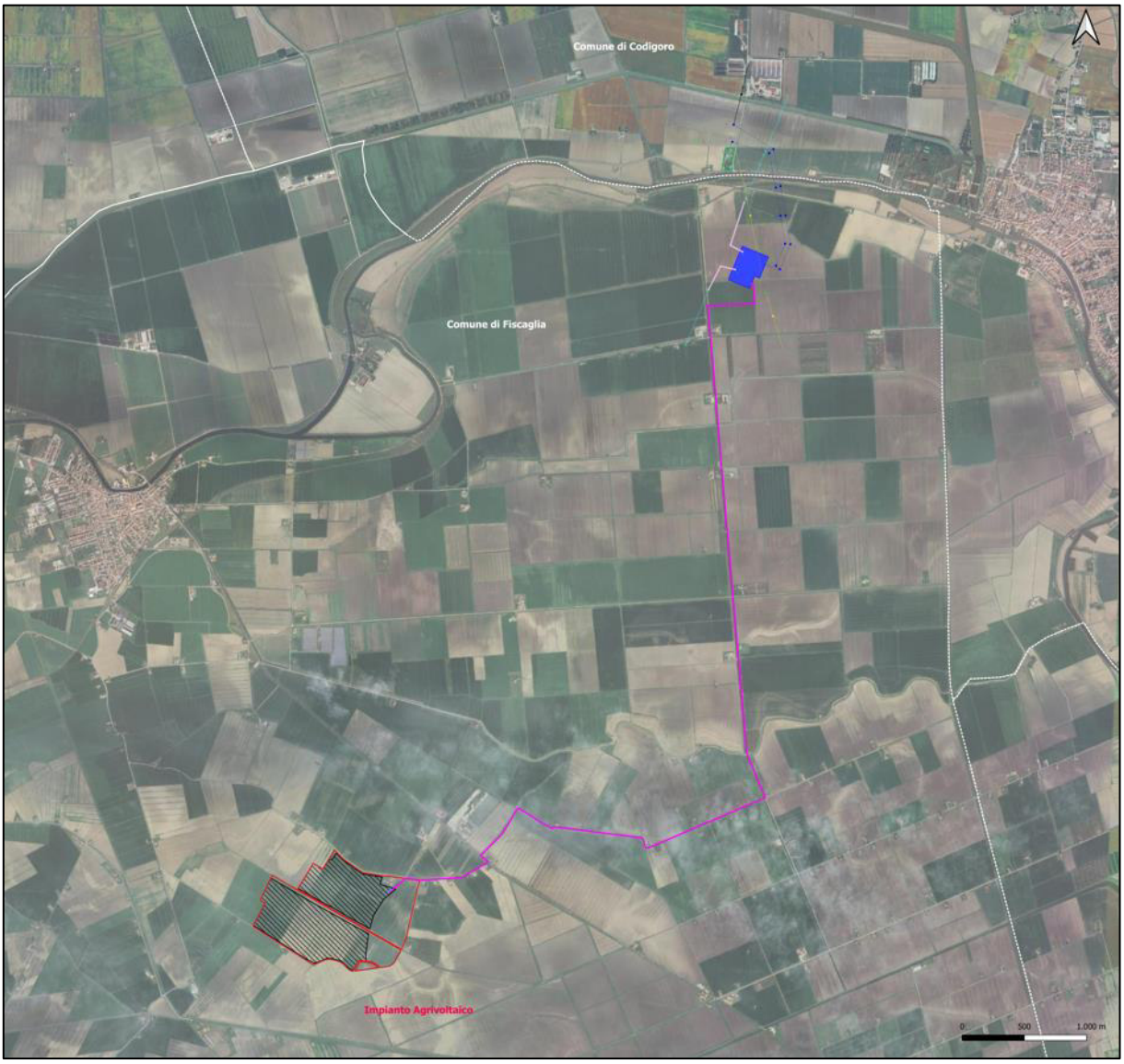


Figura 3. Individuazione dell'area di Impianto su foto satellitare.

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CONFINI COMUNALI
SUPERFICIE NELLA DISPONIBILÀ DEL PROPONENTE
IMPIANTO AGRIVOLTAICO
CABINA DI RICEZIONE, SEZIONAMENTO E CONTROLLO
LINEA IN CAVO INTERRATO 36 kV CABINA RICEZIONE - SE 380/132/36 kV "FISCAGLIA"

OPERE DI RETE*

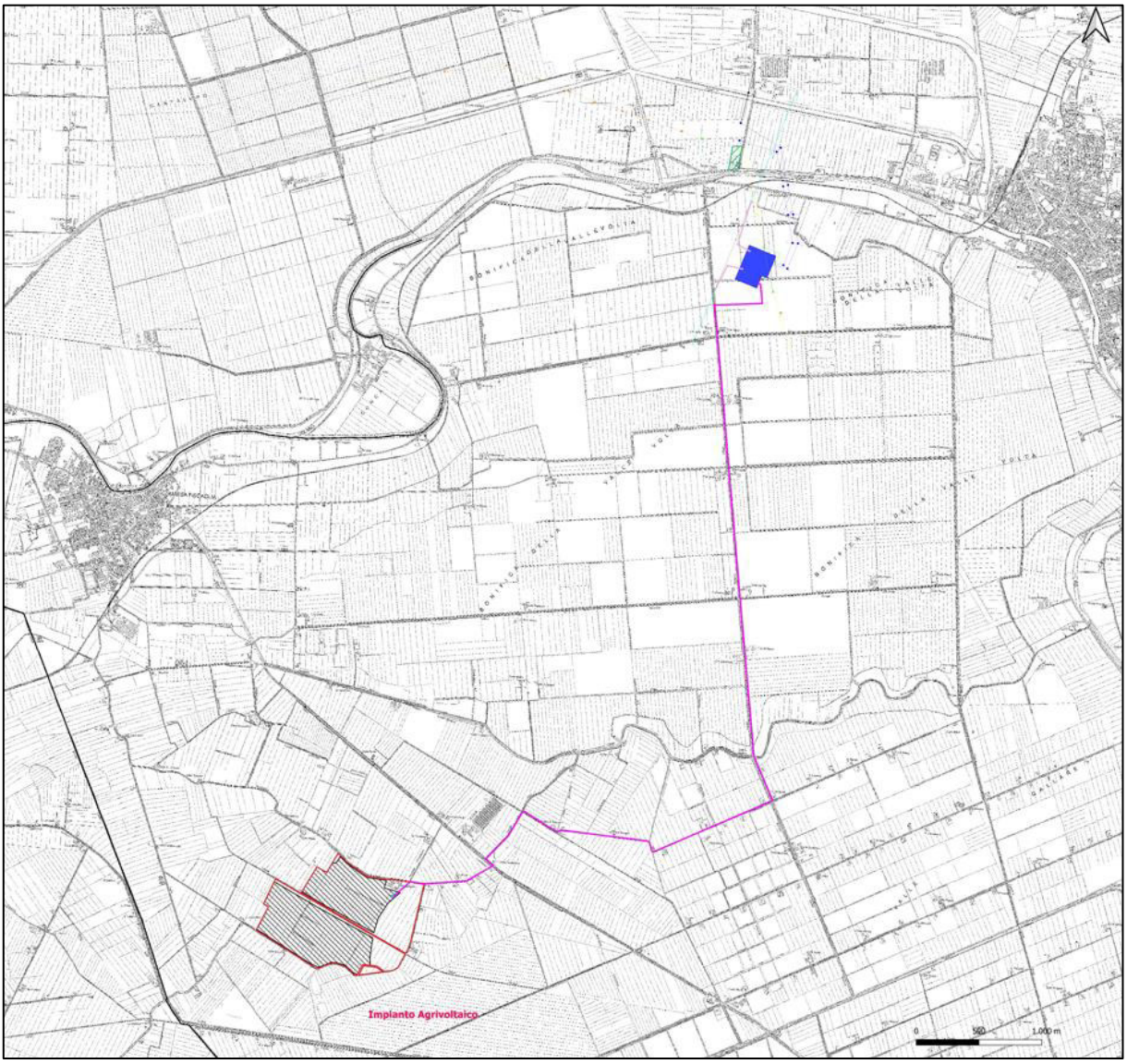
STAZIONE ELETTRICA (SE) 380/132/36 kV "FISCAGLIA"
CABINA PRIMARIA (CP) "CODIGORO"
STRADA DI ACCESSO ALLA SE 380/132/36 kV "FISCAGLIA"

RACCORDI AEREI 380 kV IN PROGETTO ALLA LINEA "PORTO TOLLE - RAVENNA CANALA"
RACCORDI AEREI 132 kV IN PROGETTO VERSO CP "ARIANO" E CP "CODIGORO"
LINEA AEREA AT 380 kV ESISTENTE "PORTO TOLLE - RAVENNA CANALA"
LINEA AEREA AT 132 kV ESISTENTE CP "CODIGORO" - CP "VOLANIA"
LINEA AEREA AT 132 kV ESISTENTE CP "ARIANO" - CP "CODIGORO"
LINEA AEREA AT 132 kV ESISTENTE CP "TRESIGALLO" - CP "CODIGORO"
LINEA AEREA ESISTENTE DA DEMOLIRE
RACCORDI IN CAVO INTERRATO 132 kV DA SE "FISCAGLIA" VERSO CP "VOLANIA" - CP "TRESIGALLO" - CP "CODIGORO"

ASSE NUOVI SOSTEGNI RACCORDI AEREI 380 kV ALLA LINEA "PORTO TOLLE - RAVENNA CANALA"
ASSE NUOVI SOSTEGNI RACCORDI AEREI 132 kV VERSO CP "ARIANO" E CP "CODIGORO"
ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 380 kV "PORTO TOLLE - RAVENNA CANALA"
ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "CODIGORO" - CP "VOLANIA"
ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "ARIANO" - CP "CODIGORO"
ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "TRESIGALLO" - CP "CODIGORO"
ASSE NUOVI SOSTEGNI TRANSIZIONE LINEE AEREE AT ESISTENTI - RACCORDI IN CAVO INTERRATO 132 kV
ASSE SOSTEGNI ESISTENTI DA DEMOLIRE

Figura 4. Individuazione delle opere su ortofoto - Estratto AMB03T00 - Inquadramento su Ortofoto.

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CONFINI COMUNALI

SUPERFICIE NELLA DISPONIBILÀ DEL PROPONENTE

IMPIANTO AGRIVOLTAICO

CABINA DI RICEZIONE, SEZIONAMENTO E CONTROLLO

LINEA IN CAVO INTERRATO 36 kV CABINA RICEZIONE - SE 380/132/36 kV "FISCAGLIA"

OPERE DI RETE*

STAZIONE ELETTRICA (SE) 380/132/36 kV "FISCAGLIA"

CABINA PRIMARIA (CP) "CODIGORO"

STRADA DI ACCESSO ALLA SE 380/132/36 kV "FISCAGLIA"

RACCORDI AEREI 380 kV IN PROGETTO ALLA LINEA "PORTO TOLLE - RAVENNA CANALA"

RACCORDI AEREI 132 kV IN PROGETTO VERSO CP "ARIANO" E CP "CODIGORO"

LINEA AEREA AT 380 kV ESISTENTE "PORTO TOLLE - RAVENNA CANALA"

LINEA AEREA AT 132 kV ESISTENTE CP "CODIGORO" - CP "VOLANIA"

LINEA AEREA AT 132 kV ESISTENTE CP "ARIANO" - CP "CODIGORO"

LINEA AEREA AT 132 kV ESISTENTE CP "TRESIGALLO" - CP "CODIGORO"

LINEA AEREA ESISTENTE DA DEMOLIRE

RACCORDI IN CAVO INTERRATO 132 kV DA SE "FISCAGLIA" VERSO CP "VOLANIA" - CP "TRESIGALLO" - CP "CODIGORO"

ASSE NUOVI SOSTEGNI RACCORDI AEREI 380 kV ALLA LINEA "PORTO TOLLE - RAVENNA CANALA"

ASSE NUOVI SOSTEGNI RACCORDI AEREI 132 kV VERSO CP "ARIANO" E CP "CODIGORO"

ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 380 kV "PORTO TOLLE - RAVENNA CANALA"

ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "CODIGORO" - CP "VOLANIA"

ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "ARIANO" - CP "CODIGORO"

ASSE SOSTEGNI ESISTENTI LINEA AEREA AT 132 kV CP "TRESIGALLO" - CP "CODIGORO"

ASSE NUOVI SOSTEGNI TRANSIZIONE LINEE AEREE AT ESISTENTI - RACCORDI IN CAVO INTERRATO 132 kV

ASSE SOSTEGNI ESISTENTI DA DEMOLIRE

Figura 5. Individuazione delle opere su CTR- Estratto AMB02T00 - Inquadramento su CTR.

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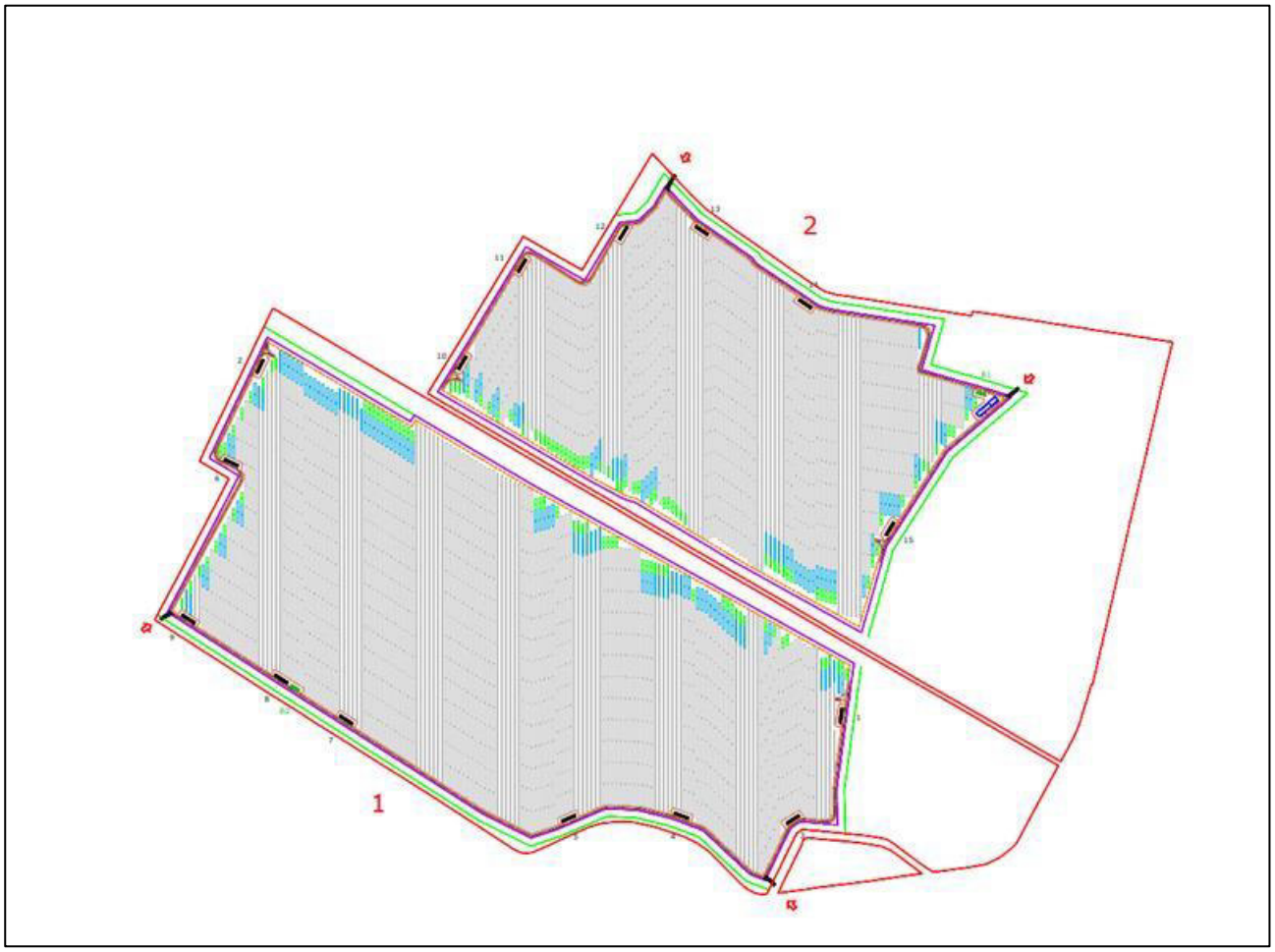


Figura 6. Layout d'Impianto.

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4.1. INQUADRAMENTO GEOLOGICO

Il sito in esame si colloca nel settore della Pianura Padana orientale. Dal punto di vista geostrutturale quest'area rappresenta la parte più esterna dell'arco delle pieghe Appenniniche ferraresi.

Infatti, l'area è stata segnata da una successione di fasi tettoniche protrattesi fino al Pleistocene. Questi eventi hanno generato ciclici piegamenti del substrato e una variazione costante dei lineamenti paleogeografici. Tale dinamica, regolata dall'interazione tra sollevamenti tettonici e processi di subsidenza, ha determinato l'alternanza temporale e spaziale di diversi ambienti deposizionali: da quelli marini e costieri a quelli propriamente deltizi e lagunari.

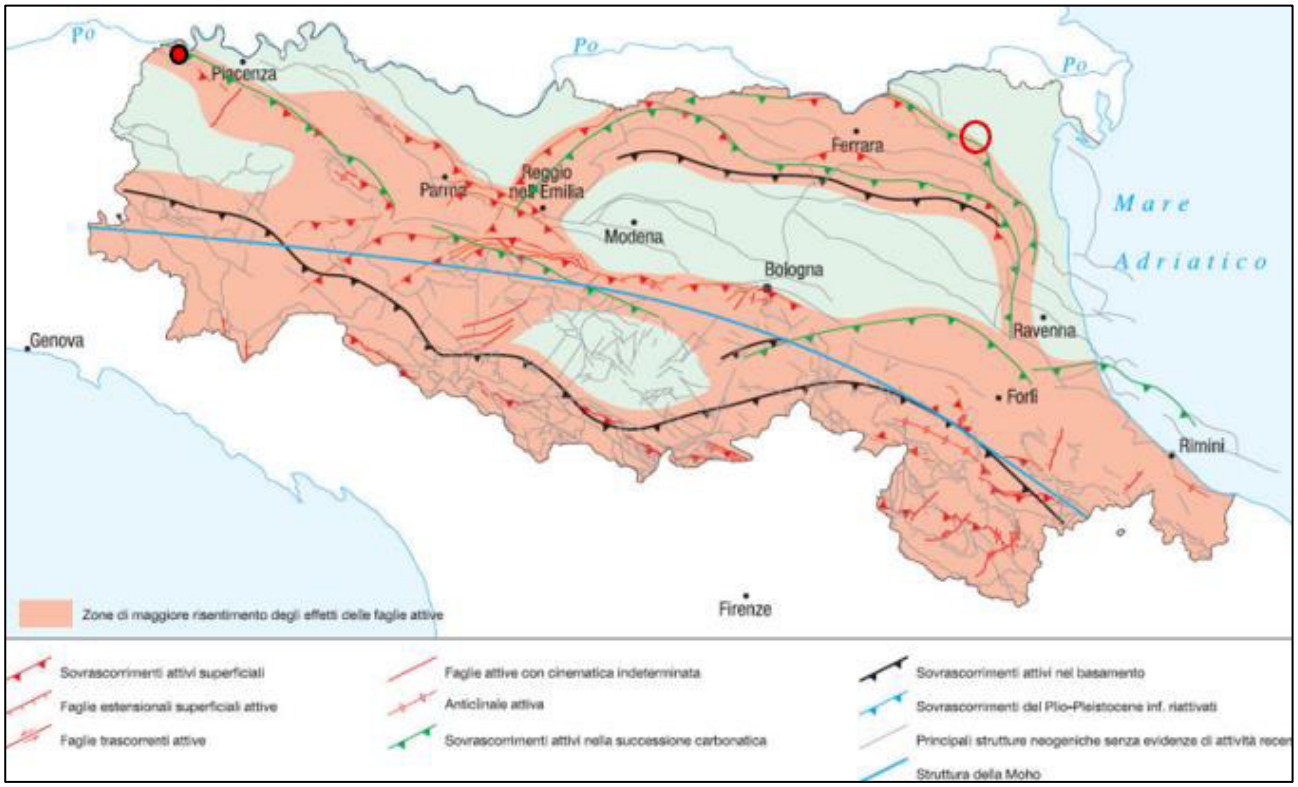


Figura 7. Localizzazione dell'area in studio ed inquadramento strutturale.

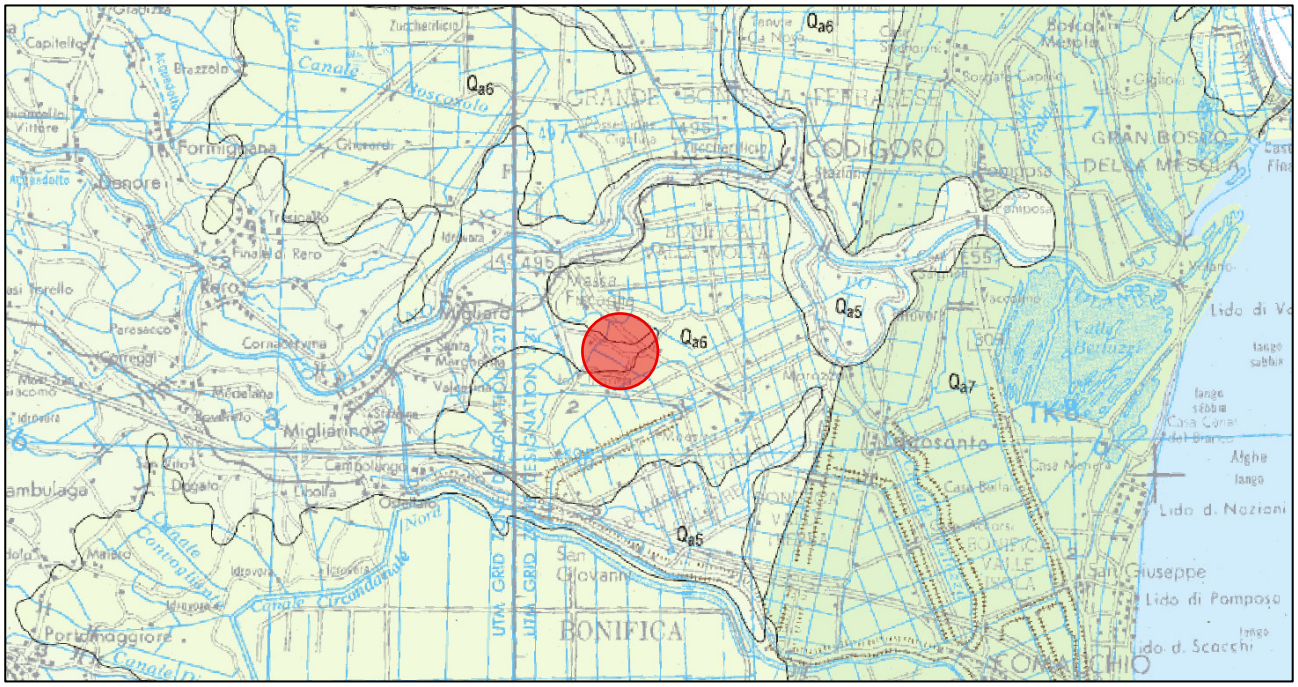
L'attuale assetto della pianura ferrarese è il prodotto di un prolungato processo di colmamento durante l'Olocene del bacino padano reso possibile anche dal fenomeno della subsidenza. Nel corso del Quaternario recente, la sedimentazione ha iniziato a prevalere sui processi di abbassamento: in coincidenza con le regressioni marine legate alle glaciazioni, i depositi continentali si sono sovrapposti ai sedimenti marini, definendo l'ossatura della pianura. Dopo un'ulteriore fase trasgressiva, che vide la linea di costa arretrare di oltre venti chilometri rispetto alla posizione odierna, l'ultima regressione ha guidato il progressivo avanzamento delle terre verso est, stabilizzando la conformazione del paesaggio attuale.
In questo arco temporale, i fiumi si sono spinti a valle delle conoidi pedemontane per dirigersi verso il collettore principale, evolvendo progressivamente verso una condizione di pensilità degli alvei. Tale fenomeno è causato dall'accumulo sistematico di sedimenti che la corrente non è più in grado di trasportare, elevando il letto del fiume rispetto alle aree circostanti. In un simile contesto, la morfologia del territorio viene costantemente rimodellata da episodi di rotta e tracimazione che operano una naturale selezione granulometrica dei materiali depositati: se nelle

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immediate vicinanze degli alvei si accumulano le frazioni più grossolane e sabbiose, allontanandosi verso le conche morfologiche il calo di energia idraulica favorisce la sedimentazione di limi, argille e, in presenza di ristagni prolungati, potenti banchi di torba.

L'evoluzione del settore di Fiscaglia, oggi caratterizzato prevalentemente da depositi affioranti di natura argillosa e limosa, si inserisce perfettamente in questa dinamica di accrezione tipica dei bacini subsidenti padani. La crescita della pianura avviene infatti lungo due direttrici: una orizzontale, determinata dalla migrazione e dal giustapporsi dei corpi d'alveo nel tempo, e una verticale, legata ai cicli di riempimento dei bacini di esondazione. Osservando il sottosuolo attraverso una sezione verticale, emerge dunque un'architettura complessa, costituita da un intreccio di lenti sabbiose, che rappresentano gli antichi argini naturali e i letti fluviali sepolti, immerse in una matrice di sedimenti a tessitura fine tipici degli ambienti interfluviali di esondazione.

In Figura 8 e in Figura 9 si riportano degli stralci cartografici di diverso dettaglio relativi alle unità geologiche affioranti desunte dalla Carta Geologica dell'Appennino Settentrionale alla scala 1:50.000 e dalla Carta Geologica alla scala 1:25 000.


Qa6
Qa6
Qa5
Qa6
Qa7
Qa5
CODIGORO
GRAN BOSCO
Formignana
Migliarino
Migliaro
Finale di Rero
Rero
Paviolo
Paviolo
Correggi
Cornacervina
Mezzolano
Cambolungo
Ospitale
Ambulaga
Portomaggiore
Canale Circondariale
Canale Contrabbasso
Canale Boscoforlo
Canale Migliarino
Canale Migliaro
Canale Naviglio
Canale Naviglio Nord
Canale Bianco
Canale Bianco Nord
Canale Bianco Sud
Canale Bianco Ovest
Canale Bianco Est
Canale Bianco Centrale
Canale Bianco Orientale
Canale Bianco Occidentale
Canale Bianco Meridionale
Canale Bianco Settentrionale
Canale Bianco Nuovo
Canale Bianco Vecchio
Canale Bianco Antico
Canale Bianco Moderno
Canale Bianco Storico
Canale Bianco Attuale
Canale Bianco Futuro
Canale Bianco Passato
Canale Bianco Presente
Canale Bianco Prossimo
Canale Bianco Remoto
Canale Bianco Vicino
Canale Bianco Lontano
Canale Bianco Interno
Canale Bianco Esterno
Canale Bianco Superiore
Canale Bianco Inferiore
Canale Bianco Destro
Canale Bianco Sinistro

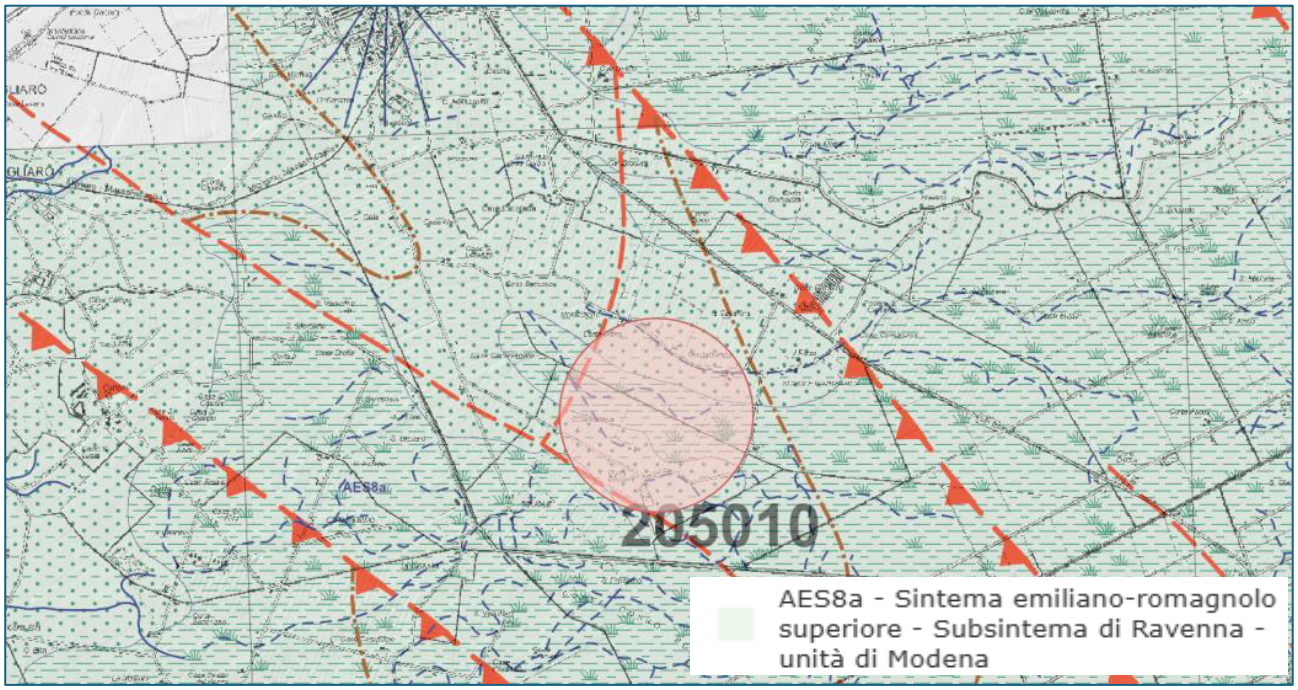


Figura 9. Stralcio cartografico delle unità geologiche affioranti nell'area in esame (Carta Geologica alla scala 1:25.000).

Le unità geologiche affioranti nel sito in esame sono costituite da depositi pleistocenici (Post romano – attuale) appartenenti all'Unità di Modena (AES8a) e, in particolare, sono attribuiti ai depositi quaternari di piana deltizia: depositi di baia interdistibutrice (Qa6).

Si riporta di seguito la descrizione dell'unità geologica affiorante come descritta nelle Note Illustrative della Carta Geologica d'Italia alla scala 1:25.000 del foglio 187 "Codigoro".

UNITÀ DI MODENA (AES8a)

Questa Unità appartiene al Sintema Emiliano Romagnolo Superiore e, in particolare, rappresenta il tetto del Subsistema di Ravenna (AES8).
Comprende sabbie, argille, limi e, subordinatamente, ghiaie di piana alluvionale. Inoltre, sono presenti terreni torbosi e ricchi di materiale organico. Limite inferiore inconforme, marcato da una superficie di erosione fluviale lateralmente a un suolo da decarbonato a parzialmente carbonato contenente resti archeologici di età dal Neolitico al Romano. Limite superiore coincidente col piano topografico e definito da un suolo calcareo di colore bruno olivastro e bruno grigiastro privo di reperti archeologici. Nell'area d'interesse la potenza dell'Unità raggiunge i 25 metri al massimo.

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4.2. INQUADRAMENTO GEOMORFOLOGICO

L'area in esame che ricade nella bassa pianura ferrarese, è parte integrante del vasto apparato deltizio del Po, un sistema che si estende per oltre 2000 km² nella provincia e che testimonia l'evoluzione millenaria dei depositi del grande fiume. Partendo da un gradiente altimetrico che a occidente raggiunge quote di 70-100 metri, la pianura degrada verso est fino a scendere sotto il livello del mare nei settori più depressi della piana deltizia. Il territorio studiato, ubicato a pochi km dalla costa (circa 15 km), presenta un'altitudine compresa tra -2.00÷0.00 m s.l.m.

L'architettura stratigrafica e geomorfologica del territorio, come detto in precedenza, è stata notevolmente influenzata dai fenomeni legati all'evoluzione dei corsi d'acqua. Tra le testimonianze più significative di tali processi, vi sono i paleoalvei.
Come si evince dallo stralcio della Carta Geomorfologica della Provincia di Ferrara (Figura 10), tutta l'area è segnata da queste strutture: tra i due paleoalvei di dimensioni importanti (il Po di Volano e il Canale Navigabile Ferrara – Porto Garibaldi) che sono situati rispettivamente a Nord dell'abitato di Fiscaglia e a Sud dell' abitato di Campolungo, si rilevano una serie di paleoalvei minori con prevalente orientazione O-E con riempimento passivo e attivo.

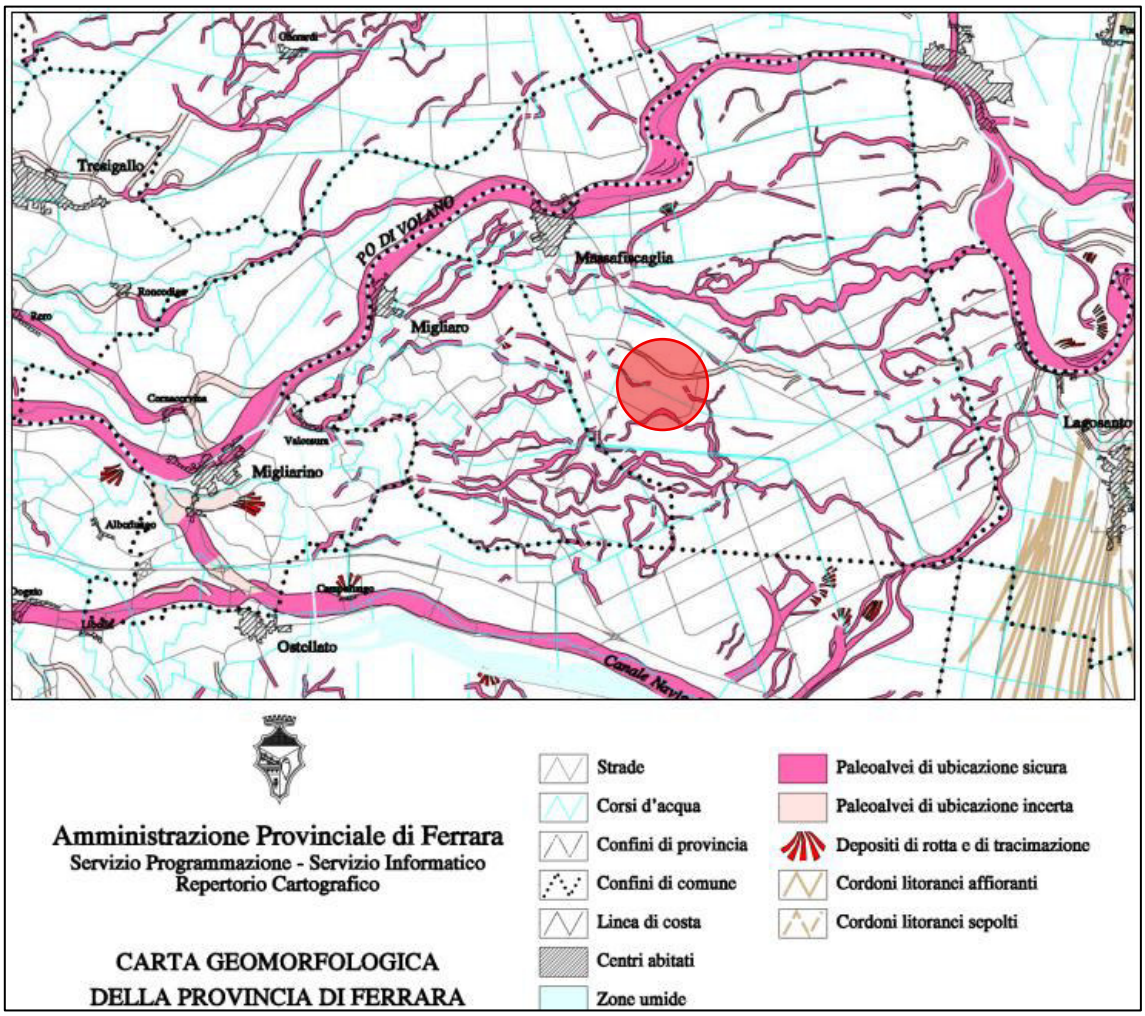


Figura 10. Stralcio della Carta geomorfologica della provincia di Ferrara.

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L'assetto contemporaneo è tuttavia il risultato di un radicale processo di antropizzazione: le imponenti opere di bonifica recenti (che hanno avuto inizio con l'introduzione in Italia dell'idrovora meccanica nel XIX secolo) hanno prosciugato quasi totalmente il territorio posizionando il piano campagna diversi metri sotto il livello del mare.

4.3. INQUADRAMENTO IDROLOGICO E IDROGEOLOGICO

La pianura ferrarese è solcata da numerosi corsi d'acqua che nascono dall'Appennino e scorrono verso E, confluendo nel bacino idrografico del Fiume Po (in cui ricade la zona interessata dal presente lavoro).
Nello specifico, il territorio d'interesse rientra nel sottobacino idrografico Po di Volano (Figura 11) che si sviluppa per una superficie totale di circa 85 km^2, quasi un terzo dell'estensione provinciale.

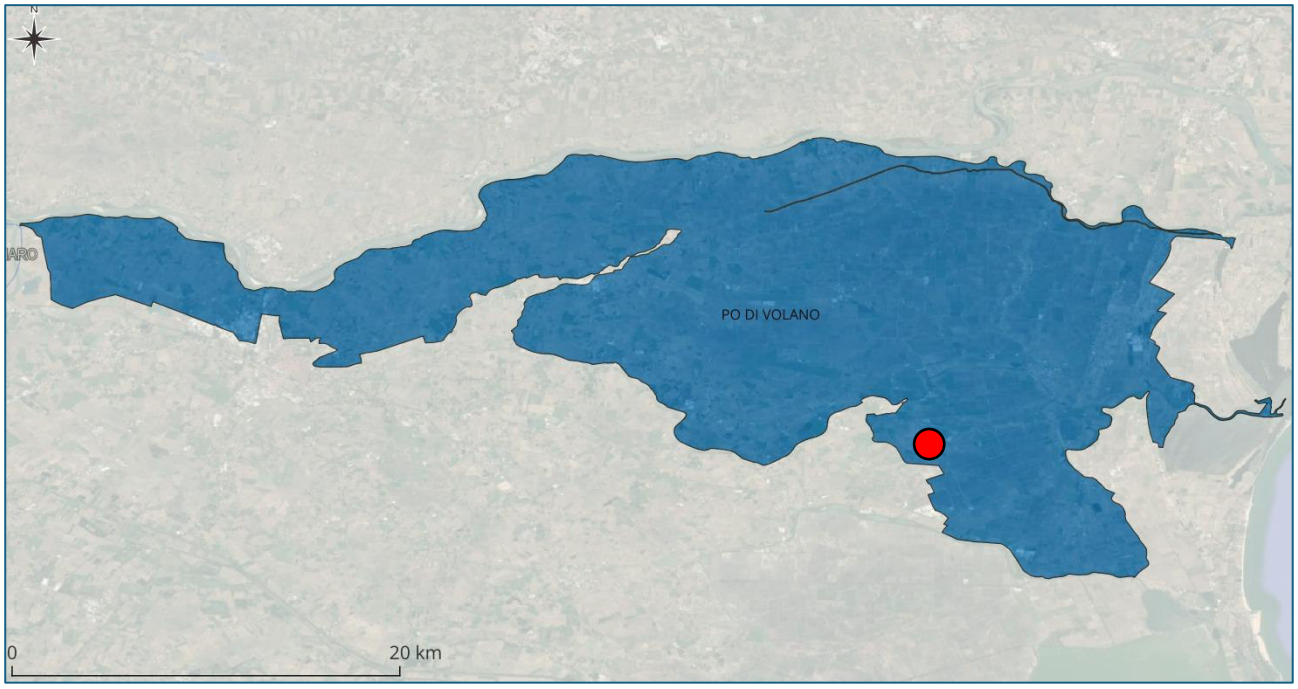


Figura 11. Limiti dei bacini idrografici principali. In azzurro il sottobacino Po di Volano (ADBPO).

All'interno del Bacino idrogeologico di riferimento, con la pubblicazione del volume "Risorse idriche Sotterranee della Regione Emilia Romagna" pubblicato da ENI – AGIP (Figura 12), sono state individuate tre distinte Unità Idrostratigrafiche.
Le caratteristiche delle tre unità sovrapposte riflettono l'evoluzione sedimentaria del bacino tra il Pliocene e l'Olocene. Al tetto della sequenza si colloca il Gruppo Acquifero A, un'unità intensamente sfruttata e costituita da depositi continentali di terrazzo e conoide alluvionale. La sua struttura interna è caratterizzata da una spiccata eterogeneità, con corpi lenticolari che variano in spessore da pochi decimetri a diversi metri. Dal punto di vista litologico, questi depositi presentano spesso una base erosiva formata da conglomerati poco cementati a matrice sabbiosa, che sfumano verso l'alto in sedimenti più fini, limoso-sabbiosi. La presenza di paleosuoli e la natura discordante del contatto con le unità sottostanti sottolineano la discontinuità di questa unità, la cui potenza affiorante non supera solitamente le poche decine di metri.
Procedendo verso il basso, si incontra l'Unità Idrogeologica B, risalente al Pleistocene medio. Questo gruppo, attualmente interessato solo da prelievi idrici locali, riflette un ambiente di pianura alluvionale dove predominano le argille limose. All'interno della matrice fine si

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rinvengono livelli discontinui di ghiaie e sabbie che, pur garantendo una certa permeabilità, risultano meno estesi rispetto al gruppo superiore. Anche in questo caso, lo spessore dell'unità si mantiene nell'ordine di alcune decine di metri e i contatti lungo il margine appenninico sono segnati da superfici di discordanza.
L'ossatura profonda del sistema è costituita dal Gruppo Acquifero C, un'unità che risale a un intervallo temporale compreso tra il Pliocene inferiore e il Pleistocene medio. A differenza delle precedenti, questa unità è raramente sfruttata poiché risulta isolata dalla superficie per gran parte della sua estensione. La sua genesi è legata ad ambienti di delta-conoide e marino-marginali, che hanno prodotto una prevalenza di sabbie e areniti ben selezionate, spesso caratterizzate da laminazioni incrociate o strutture massive ricche di bioclasti.
Con una potenza che può raggiungere i cento metri, questa unità poggia su un Aquitardo Basale impermeabile, il quale funge da limite invalicabile per la circolazione idrica sotterranea regionale.

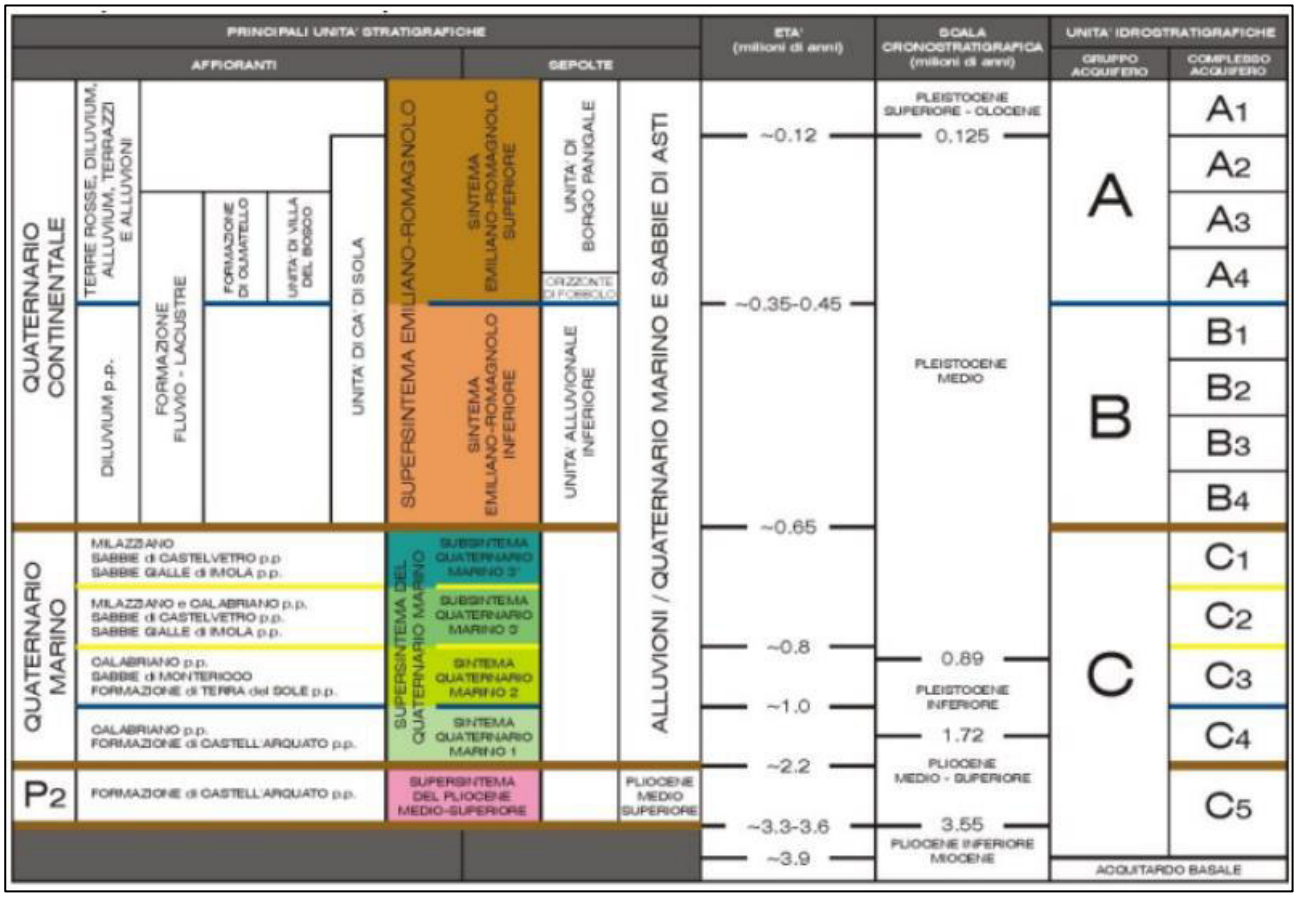


Figura 12. Unità idrostratigrafiche della bassa Pianura Padana (ENI – AGIP 1998).

Le caratteristiche degli acquiferi che ospitano i corpi idrici sotterranei sono strettamente correlate alla tipologia di depositi da cui sono costituiti.
Nello specifico, nella Pianura Padana, si rinvengono acquiferi monostrato a ridosso delle fasce pedecollinari in cui i depositi granulari si comportano come un unico corpo idrico restituendo a quest'area la funzione di zona di ricarica principale dell'intero sistema idrogeologico. Spostandosi verso la bassa pianura il sistema evolve in acquifero multistrato proprio a causa dell'eterogeneità dei depositi. Si originano in quest'ottica corpi idrici sovrapposti in cui sedimenti granulari vengono delimitati da strati a granulometria fine (poco permeabili) i quali modificano fortemente le dinamiche di flusso e pressione all'interno del bacino. Questo è il caso in cui ricade l'area di

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studio trattandosi di depositi di piana deltizia. Si tratta dunque di un acquifero confinato che presenta valori di soggiacenza media annua compresi tra il p.c. e i 10 m s.l.m. (Figura 13).

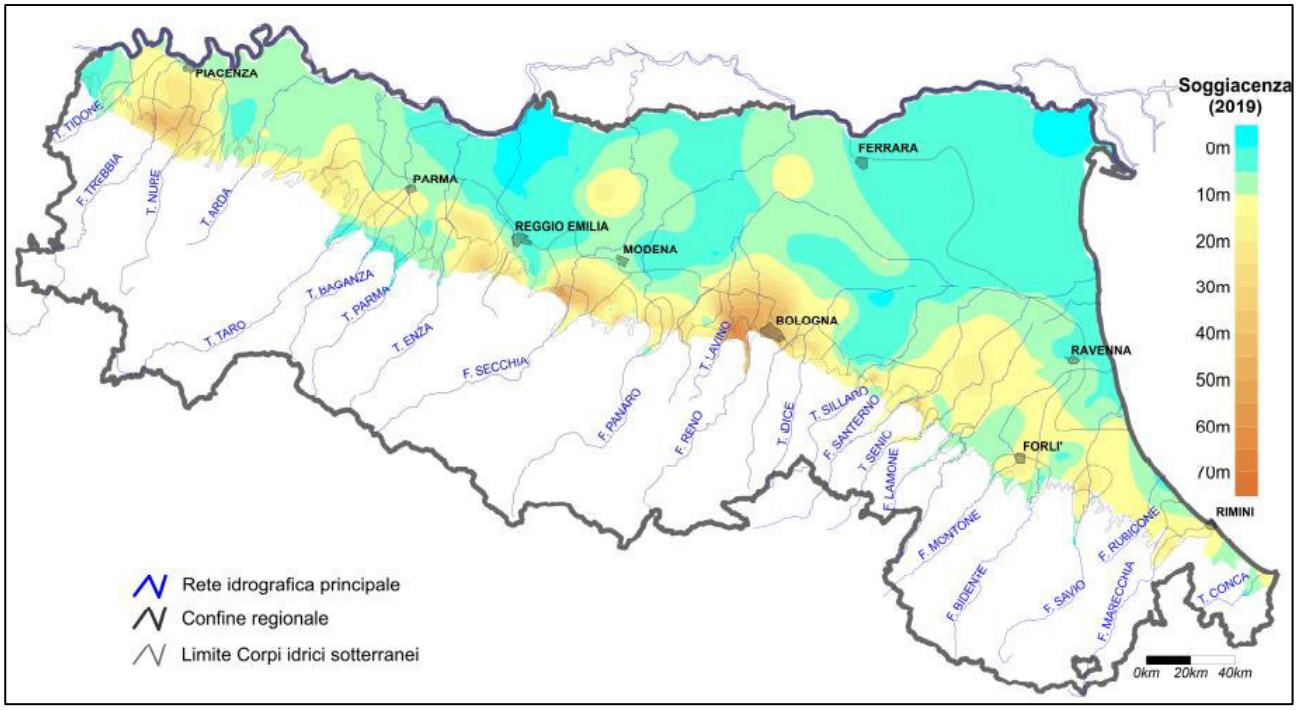


Figura 13. Soggiacenza media annua nei corpi idrici liberi e confinati (Arpae 2019).

4.4. INQUADRAMENTO SISMICO

4.4.1. Zona sismogenetica

ZS9 è un modello delle sorgenti sismogenetiche che viene utilizzato per la valutazione sismica a livello nazionale. Tale modello è diviso in 36 zone in cui sono previsti terremoti con Mw≥5. Presuppone inoltre che i terremoti con Mw fino a 5 possano verificarsi ovunque al di fuori delle zone sismogeniche, sebbene la probabilità associata sia piuttosto bassa. Ogni zona è caratterizzata anche dalla sua profondità sismogenica media (la profondità del volume crostale che presumibilmente rilascerà futuri terremoti) e meccanismo focale predominante (il loro meccanismo di rottura più probabile).

Come riportato in Figura 14 il territorio di Fiscaglia rientra in piccola parte nella ZS912, longitudinale rispetto all'asse della catena appenninica. Tale zona, insieme alla zona 917, rappresenta la porzione più esterna della fascia in compressione dell'arco appenninico settentrionale, chiusa poco a Sud di Porto S.Giorgio, laddove non si hanno più chiare evidenze di cinematica compressiva. In particolare, nella zona sismogenetica 912 ricadono un numero di terremoti decisamente superiori a quello degli eventi della zona 917, ove la sismicità sembra evidenziare l'andamento del fronte compressivo sepolto più avanzato (a ridosso del Po).

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Figura 14. Zonazione sismogenetica ZS9.

4.4.2. Database delle fonti sismogenetiche

Dal database delle singole sorgenti sismogenetiche (DISS 3.3.1), come riportato in Figura 15, il sito in oggetto è prossimo alla sorgente ITCS050 "Poggio Rusco - Migliarino", in cui le magnitudo massime attese sono pari a Mw = 6.8

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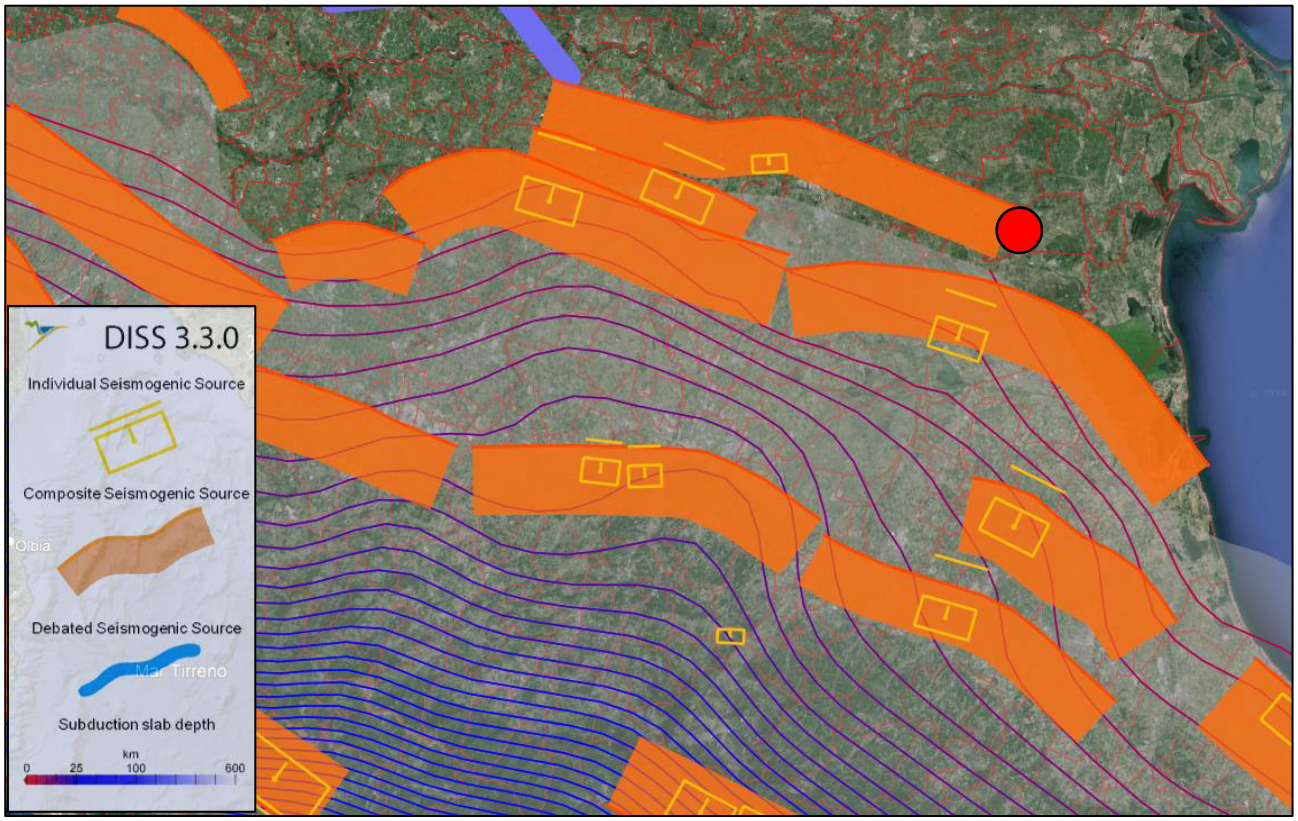


Figura 15. Distribuzione delle sorgenti sismogenetiche (DISS 3.3.1).

4.4.3. Storia sismica del territorio

Dai dati contenuti nel database macrosismico italiano CPTI15 – DBMI15 (disponibile online: https://emidius.mi.ingv.it/CPTI15-DBMI15) è possibile determinare i dati parametrici omogenei, sia macrosismici, sia strumentali, relativi ai terremoti con intensità massima ≥ 5 o magnitudo ≥ 4.0 d'interesse per l'Italia, nella finestra temporale 1000-2020. Il diagramma riportato in Figura 12 riporta in ascissa la collocazione temporale e in ordinata l'intensità al sito degli eventi sismici registrati in corrispondenza dell'area oggetto del presente studio, limitatamente a quelli con intensità epicentrale uguale o superiore a 3. In Figura 16 e in Tabella 1 si riportano gli eventi sismici registrati.

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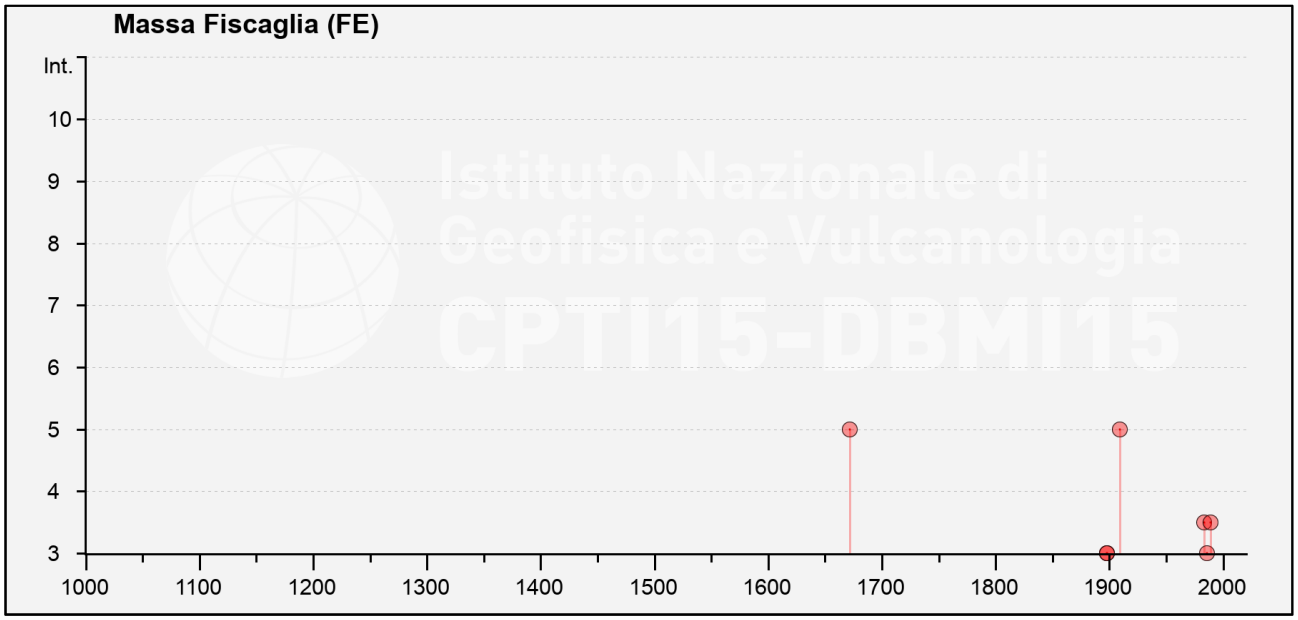


Figura 16. Intensità sismica (Is) degli eventi sismici con intensità epicentrale uguale o superiore a 3.

Effects	Reported earthquakes									
Int.	Year	Mo	Da	Ho	Mi	Se	Epicentral area	NMDP	Io	Mw
5	1672	04	14	15	45		Riminese	92	8	5.59
3	1898	01	16	13	10		Romagna settentrionale	110	6	4.59
3	1898	03	09	11	43		Romagna settentrionale	68	6	4.59
NF	1900	03	04	16	55		Asolano	98	6-7	5.05
5	1909	01	13	00	45		Emilia Romagna orientale	867	6-7	5.36
3-4	1983	11	09	16	29	5	Parmense	850	6-7	5.04
3	1986	12	06	17	07	1	Ferrarese	604	6	4.43
NF	1987	05	02	20	43	5	Reggiano	802	6	4.71
3-4	1989	09	13	21	54	0	Prealpi Vicentine	779	6-7	4.85
2-3	2002	11	02	10	57	4	Ferrarese	79	4	4.21
NF	2005	07	15	15	17	1	Forlivese	173	4-5	4.29

Tabella 1. Eventi sismici registrati.

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4.4.4. Classificazione sismica regionale

La classificazione simica dell'Emilia-Romagna è stata aggiornata con la DGR 146 del 6 febbraio 2023. La delibera classifica il comune di Fiscaglia in Zona 3.

ZONA SISMICA	DESCRIZIONE	ACCELERAZIONE CON PROBABILITÀ DI SUPERAMENTO PARI AL 10% IN 50 ANNI (ag)
1	È la zona più pericolosa. La probabilità che capiti un forte terremoto è alta	0.025g ≤ ag < 0.35g
2	In questa zona forti terremoti sono possibili	0.015g ≤ ag < 0.25g
3	In questa zona i forti terremoti sono meno probabili rispetto alla zona 1 e 2	0.05g ≤ ag < 0.15g
4	È la zona meno pericolosa: la probabilità che capiti un terremoto è molto bassa	≤ 0.05g

Tabella 2. Suddivisione delle zone sismiche in relazione all'accelerazione di picco su terreno rigido.

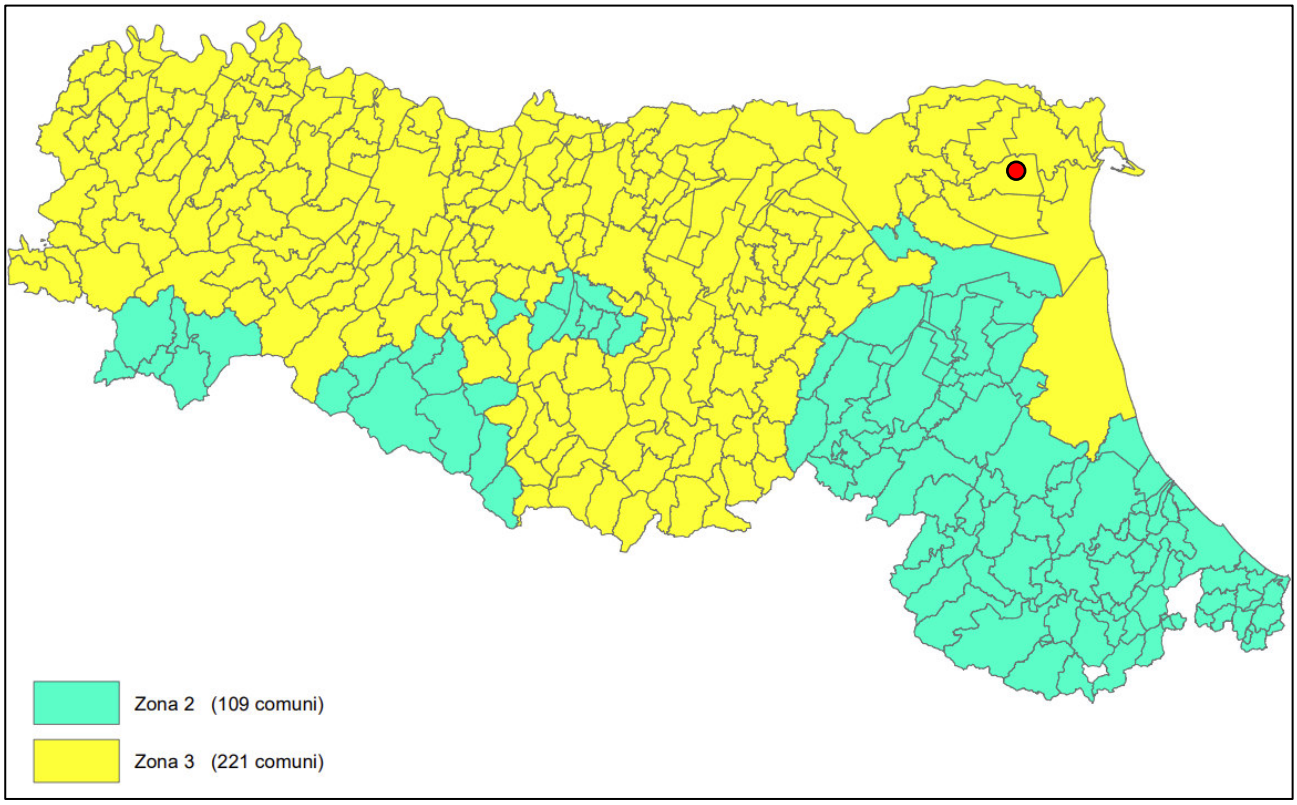


Figura 17. Classificazione sismica del territorio della Regione Emilia Romagna.

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5. INDAGINI GEOGNOSTICHE

Le caratteristiche sismiche, geologiche e geotecniche del sottosuolo in esame sono state desunte sia dalle conoscenze dirette dello scrivente, sia dalla consultazione di dati e testi della letteratura specializzata. È stata quindi eseguita una campagna di indagini geognostiche che hanno previsto l'esecuzione di:

- n° 17 prove penetrometriche statiche a punta elettrica e piezocono (CPTU)
- n° 2 prelievi di campioni di terreno da sottoporre a prove di laboratorio geotecnico
- n° 2 prove di taglio diretto in scatola di Casagrande
- n° 4 profilo sismico (MASW/REMI)
- n° 4 lettura sismica a stazione singola (HVSR)

Le indagini geotecniche sono state eseguite nella sola area di impianto.

In Figura 18 viene riportata l'ubicazione schematica delle indagini eseguite.



Figura 18. Ubicazione indagini.

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5.1. INDAGINI GEOFISICHE

Per la caratterizzazione sismica del sito sono state eseguite le seguenti indagini:

- n° 4 profili sismici (MASW/REMI)
- n° 4 letture sismiche a stazione singola (HVSR)

Tali indagini hanno permesso la ricostruzione del profilo delle onde di taglio relative al sito in esame.

Le indagini sismiche sono state eseguita utilizzando strumentazione della Moho S.r.l., in particolare Tromino per le letture sismiche a stazione singola e SoilSpy$_{Rosina}$ per i profili sismici. L'interpretazione delle prove è stata eseguita utilizzando il software Grilla distribuito da Moho S.r.l.

Si riportano di seguito i risultati ottenuti

<u>MASW/Re.Mi.1 – HVSR1</u>

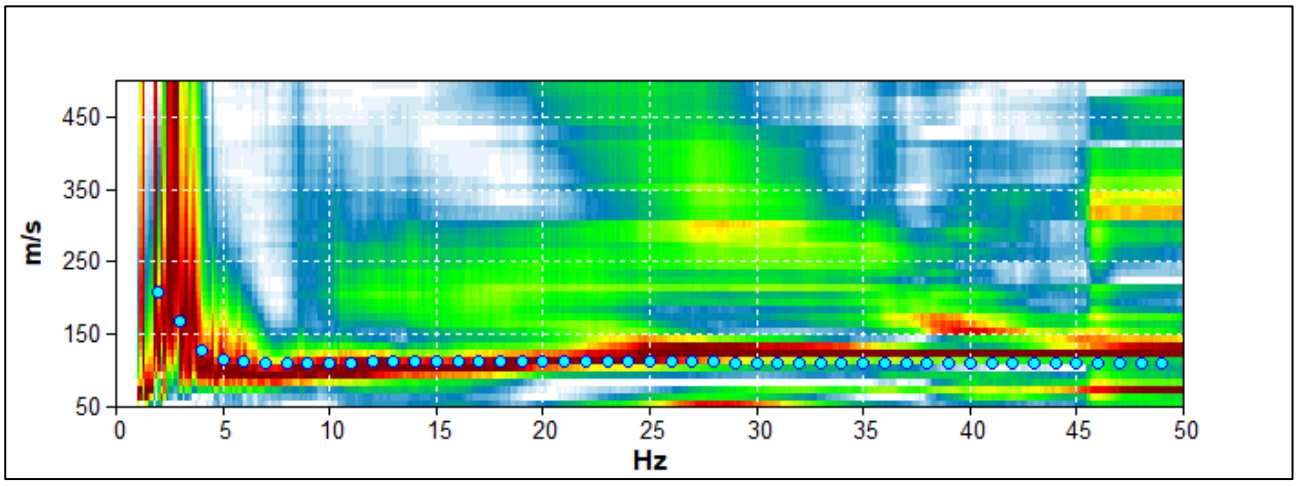


Figura 19. Spettro dell'indagine (MASW/Re.Mi.1).

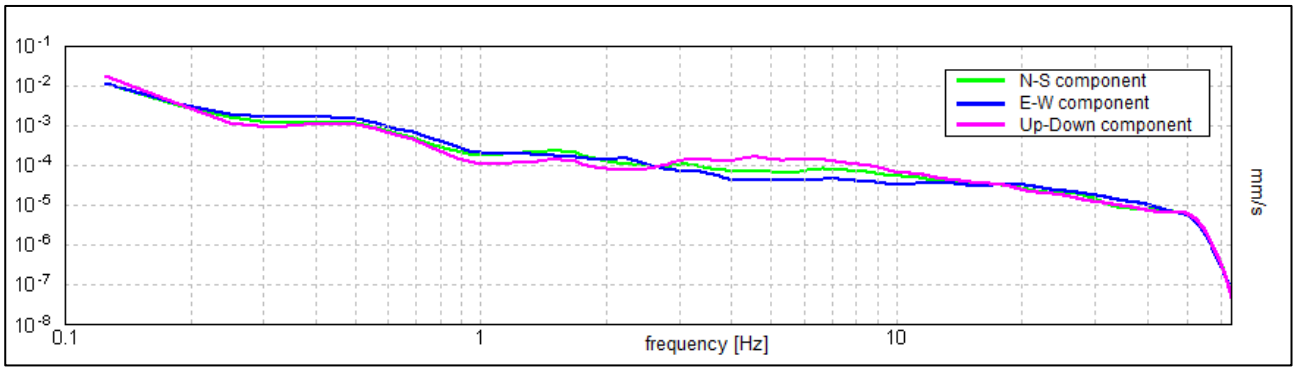


Figura 20. Spettri in frequenza delle singole componenti (HVSR1).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

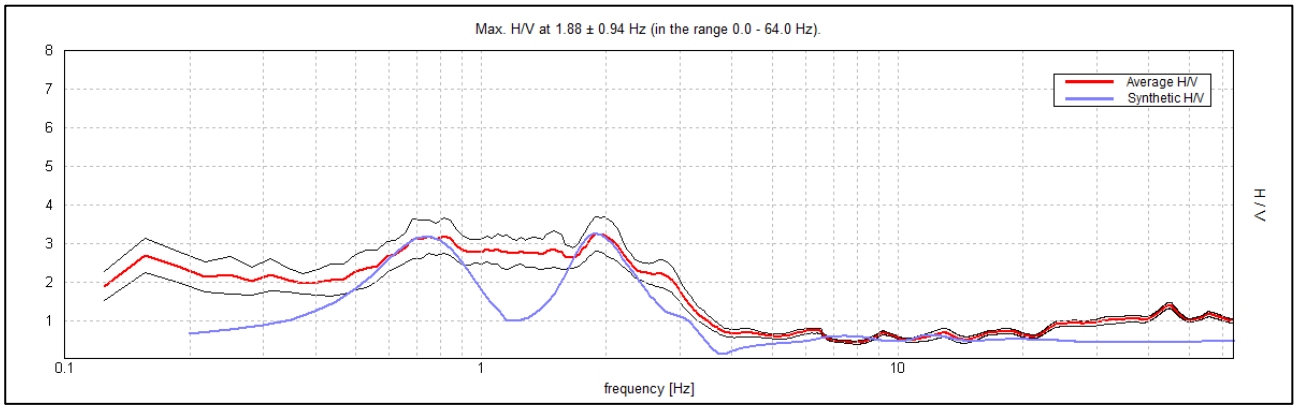


Figura 21. Modello sperimentale e modello sintetico dei rapporti spettrali (HVSR1).

L'elaborazione delle prove MASW/Re.Mi.1 e HVSR1 ha permesso di ricostruire il profilo sismico sintetizzato in Tabella 3.

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
1.00	1.00	130
2.00	1.00	170
14.00	12.00	110
39.00	25.00	200
59.00	20.00	240
159.00	100.00	260
259.00	100.00	280
inf.	inf.	430

Tabella 3. Modello del profilo verticale di velocità delle onde di taglio S (MASW/Re.Mi.1 – HVSR1).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

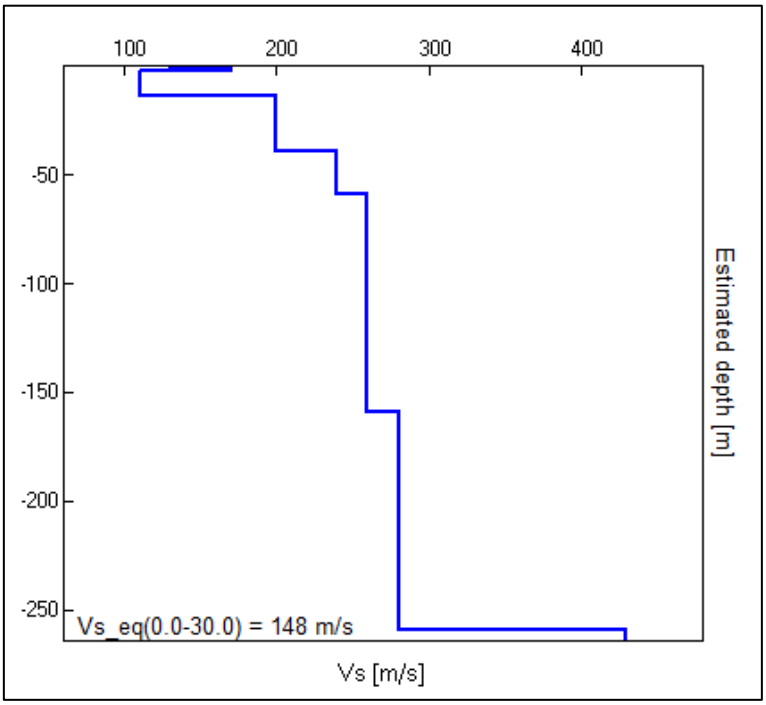


Figura 22. Profilo verticale delle velocità delle onde di taglio con la profondità (MASW/Re.MI.1 – HVSR1).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

MASW/Re.Mi.2 – HVSR2

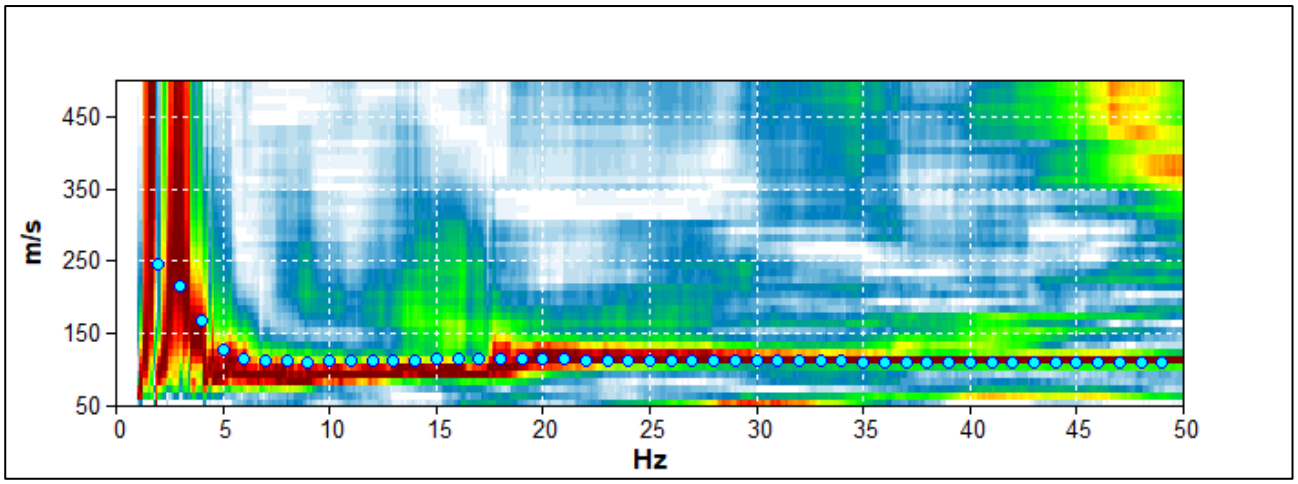


Figura 23. Spettro dell'indagine (MASW/Re.Mi.2).

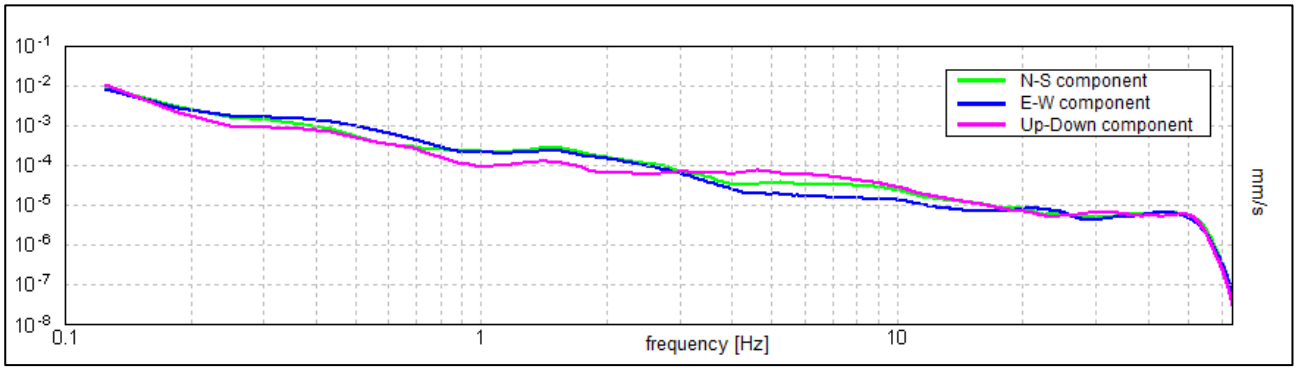


Figura 24. Spettri in frequenza delle singole componenti (HVSR2).

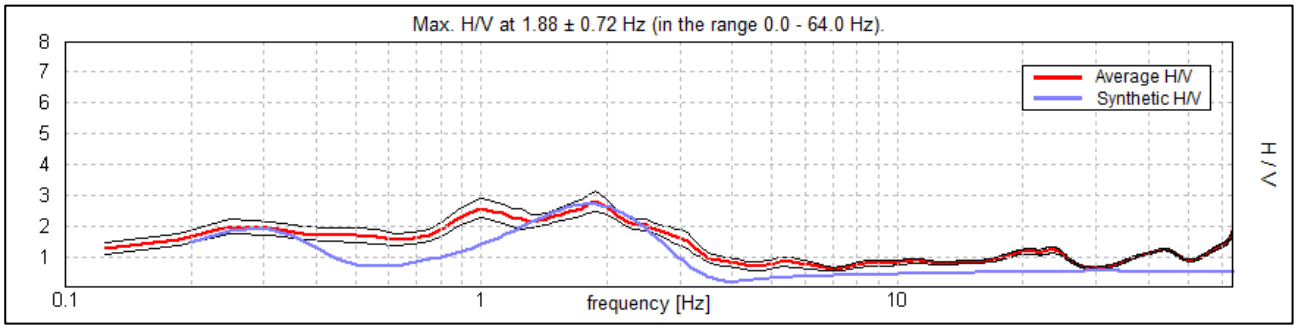


Figura 25. Modello sperimentale e modello sintetico dei rapporti spettrali (HVSR2).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

L'elaborazione delle prove MASW/Re.Mi.2 e HVSR2 ha permesso di ricostruire il profilo sismico sintetizzato in Tabella 4.

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
1.00	1.00	130
2.00	1.00	170
12.00	10.00	110
37.00	25.00	230
57.00	20.00	270
157.00	100.00	290
257.00	100.00	310
inf.	inf.	450

Tabella 4. Modello del profilo verticale di velocità delle onde di taglio S (MASW/Re.Mi.2 – HVSR2).

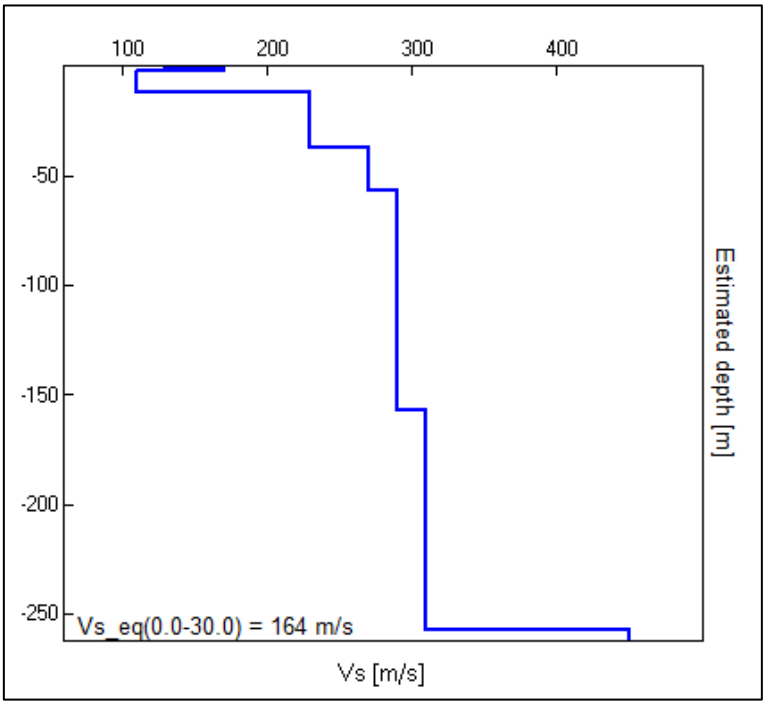


Figura 26. Profilo verticale delle velocità delle onde di taglio con la profondità (MASW/Re.MI.2 – HVSR2).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

MASW/Re.Mi.3 – HVSR3

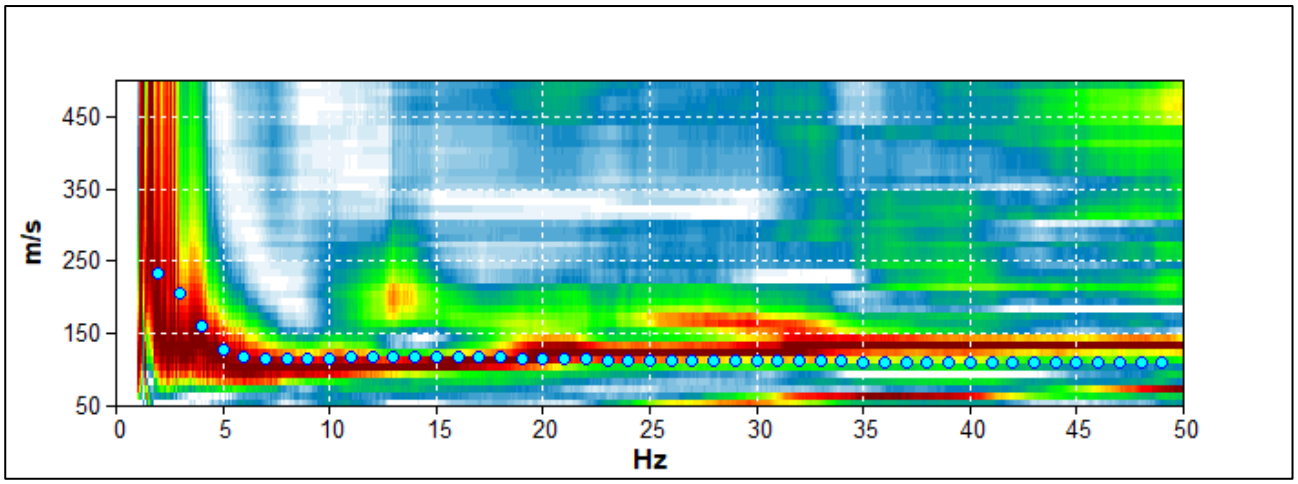


Figura 27. Spettro dell'indagine (MASW/Re.Mi.3).

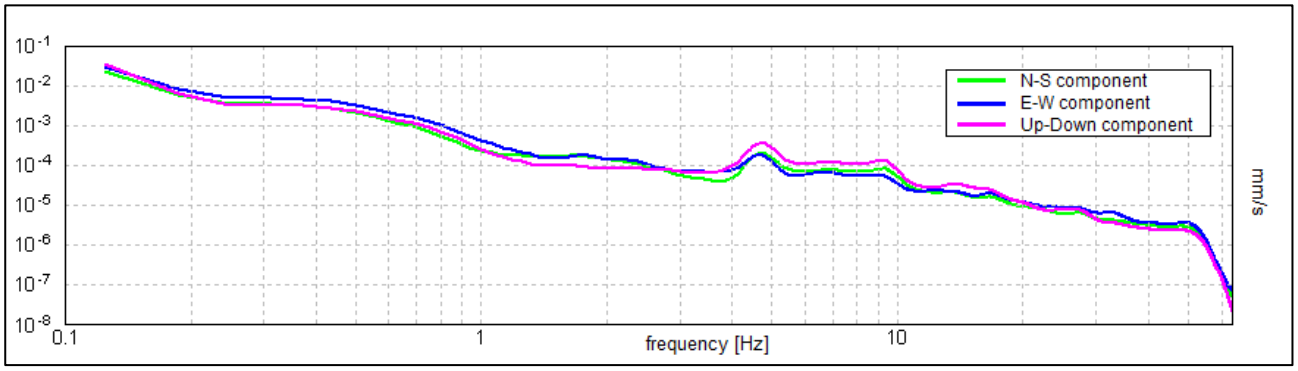


Figura 28. Spettri in frequenza delle singole componenti (HVSR3).

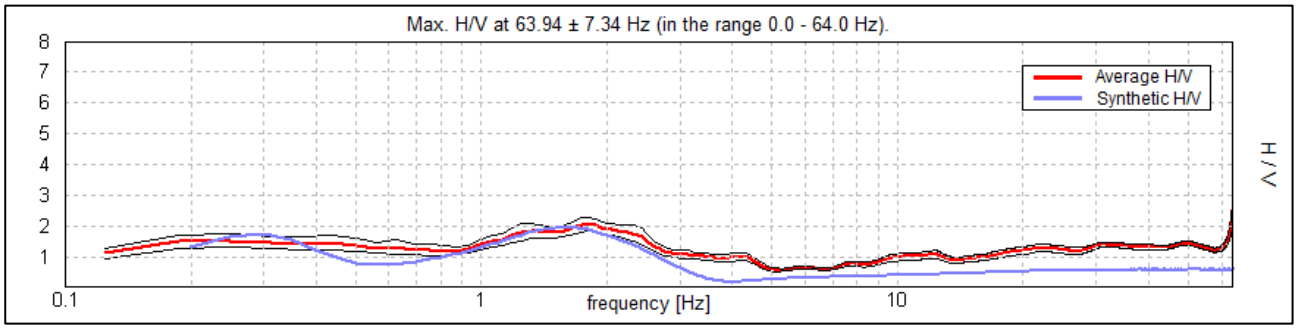


Figura 29. Modello sperimentale e modello sintetico dei rapporti spettrali (HVSR3).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

L'elaborazione delle prove MASW/Re.Mi.3 e HVSR3 ha permesso di ricostruire il profilo sismico sintetizzato in Tabella 5.

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
1.00	1.00	160
2.00	1.00	190
12.00	10.00	110
37.00	25.00	220
57.00	20.00	260
157.00	100.00	280
257.00	100.00	310
inf.	inf.	420

Tabella 5. Modello del profilo verticale di velocità delle onde di taglio S (MASW/Re.Mi.3 – HVSR3).

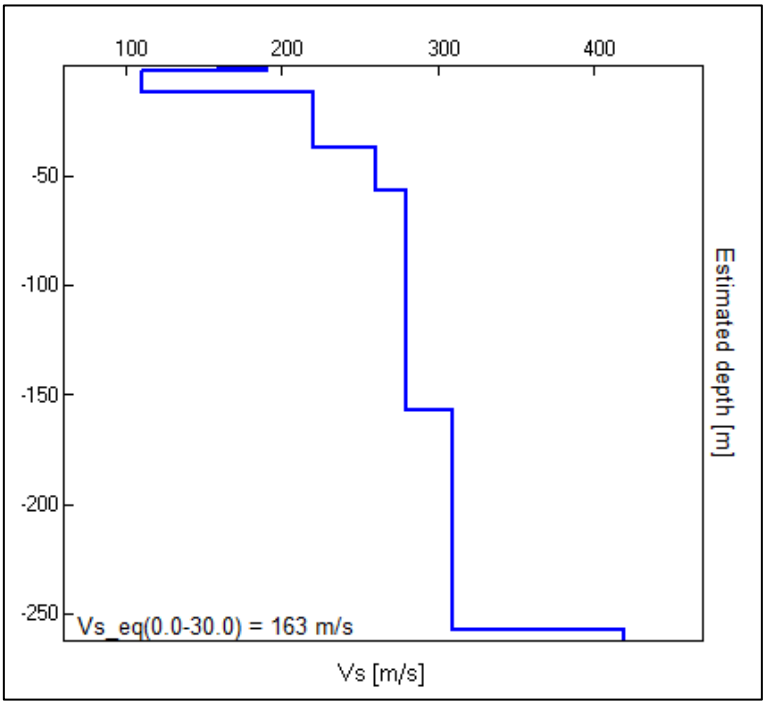


Figura 30. Profilo verticale delle velocità delle onde di taglio con la profondità (MASW/Re.MI.3 – HVSR3).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

MASW/Re.Mi.4 – HVSR4

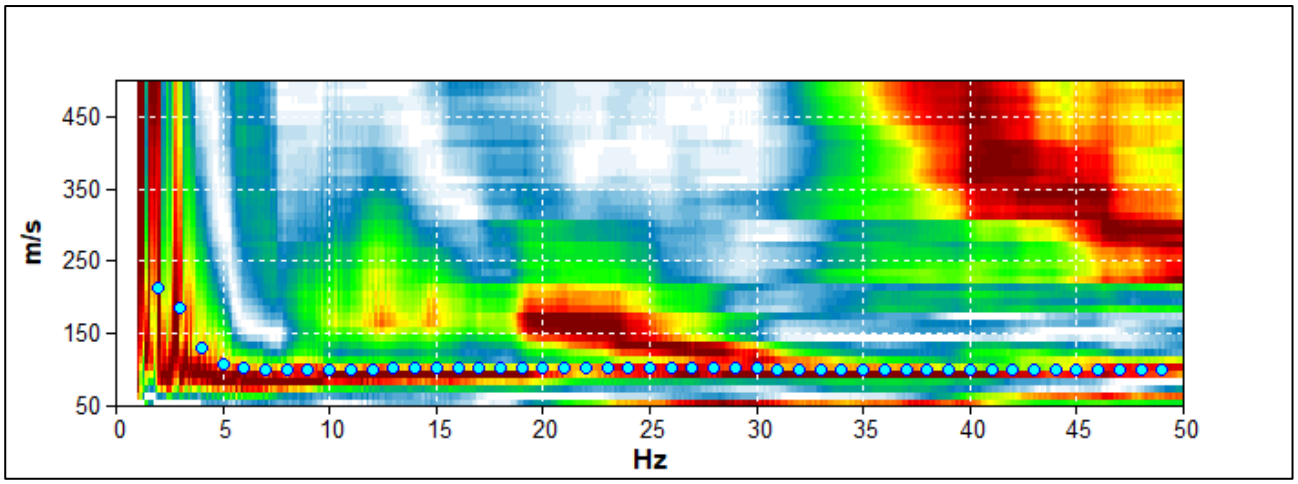


Figura 31. Spettro dell'indagine (MASW/Re.Mi.4).

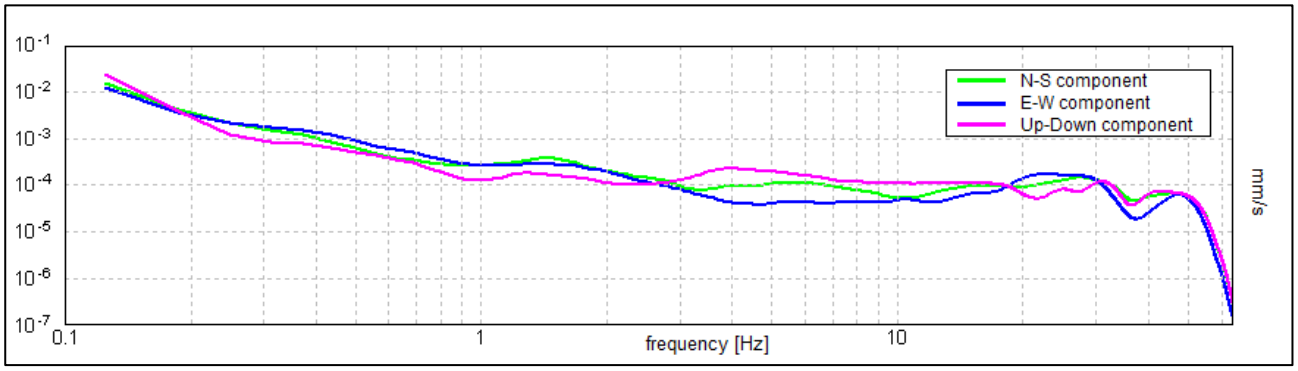


Figura 32. Spettri in frequenza delle singole componenti (HVSR4).

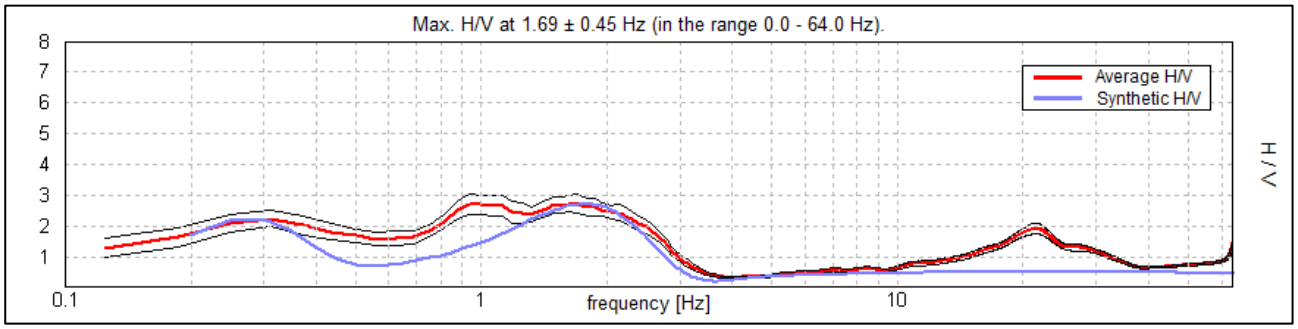


Figura 33. Modello sperimentale e modello sintetico dei rapporti spettrali (HVSR4).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

L'elaborazione delle prove MASW/Re.Mi.4 e HVSR4 ha permesso di ricostruire il profilo sismico sintetizzato in Tabella 6.

Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
1.00	1.00	110
2.00	1.00	150
12.00	10.00	100
37.00	25.00	210
57.00	20.00	240
157.00	100.00	260
257.00	100.00	300
inf.	inf.	420

Tabella 6. Modello del profilo verticale di velocità delle onde di taglio S (MASW/Re.Mi.4 – HVSR4).

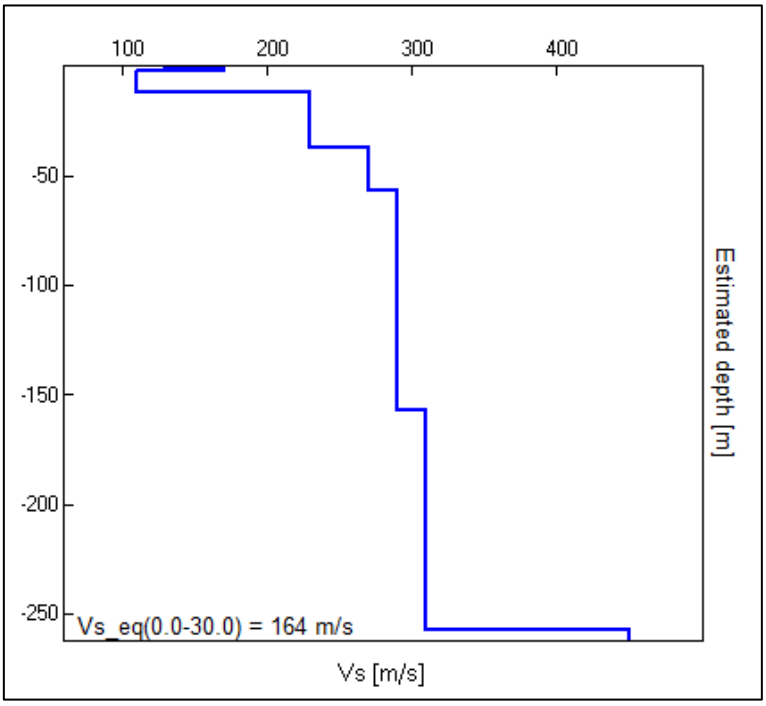


Figura 34. Profilo verticale delle velocità delle onde di taglio con la profondità (MASW/Re.MI.4 – HVSR4).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

5.1.1. Sintesi dei risultati

Le indagini sismiche masw in generale rilevano terreni caratterizzati da basse velocità delle onde di taglio. Più precisamente vengono riscontrati materiali caratterizzati da velocità delle onde Vs minori rispetto ai primi 2 metri di terreno dal piano campagna.
Le letture tromografiche evidenziano un picco in frequenza intorno a circa 1÷2 Hz, riconducibile al passaggio dai materiali sopra citati, a materiali maggiormente consolidati e con velocità delle onde di taglio maggiori e crescenti con la profondità.

In Tabella 7 si riporta la sintesi dei valori di velocità delle onde di taglio Vs_{eq}.

INDAGINI	VS_{eq}	CATEGORIA SISMICA
MASW/Re.Mi.1 - HVSR1	148	D
MASW/Re.Mi.2 – HVSR2	164	D
MASW/Re.Mi.3 – HVSR3	163	D
MASW/Re.Mi.4 – HVSR4	149	D

Tabella 7. Sintesi dei risultati delle prove geofisiche eseguite.

Secondo l'approccio semplificato delle NTC 2018, che si basa sulla classificazione del sottosuolo in funzione dei valori della velocità di propagazione delle onde di taglio VS, il sito in esame ricade nella classe sismica D (Depositi di terreni a grana grossa scarsamente addensati o di terreni a grana fina scarsamente consistenti, con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 100 m/s e 180 m/s).

Per un maggiore approfondimento dei risultati delle indagini sismiche e delle metodologie impiegate si rimanda all'"Allegato 1 – Indagini geofisiche".

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

5.2. INDAGINI PENETROMETRICHE STATICHE (CPTU)

Per la caratterizzazione geotecnica del sito sono state eseguite le seguenti indagini:

- n° 17 prove penetrometriche statiche a punta elettrica e piezocono (CPTU)

Tali indagini hanno permesso di caratterizzare il sottosuolo attraverso l'infissione di una punta nel terreno testandone la loro resistenza.

La prova penetrometrica è stata eseguita utilizzando un penetrometro statico da 20 t munito di punta elettrica e piezocono. L'interpretazione della prova è stata eseguita utilizzando il software CPT-eT distribuito dalla società Geologismiki.

<u>Parametri geotecnici ricavati dalle prove CPTU</u>

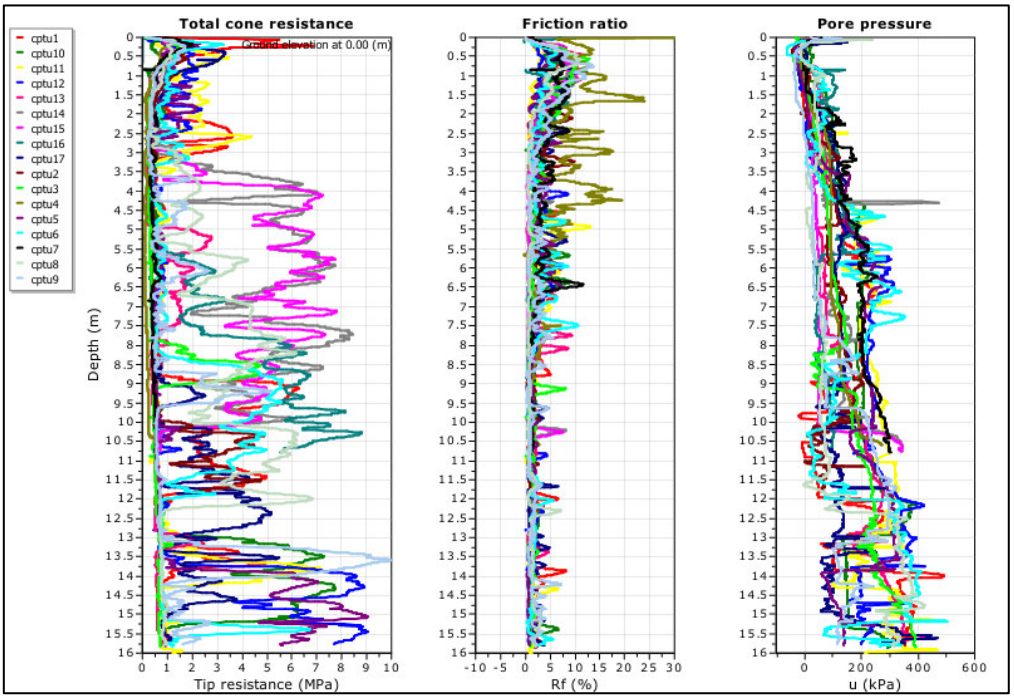


Figura 35. Parametri geotecnici: Total cone resistance; Friction ratio; Pore pressure; SBT index.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

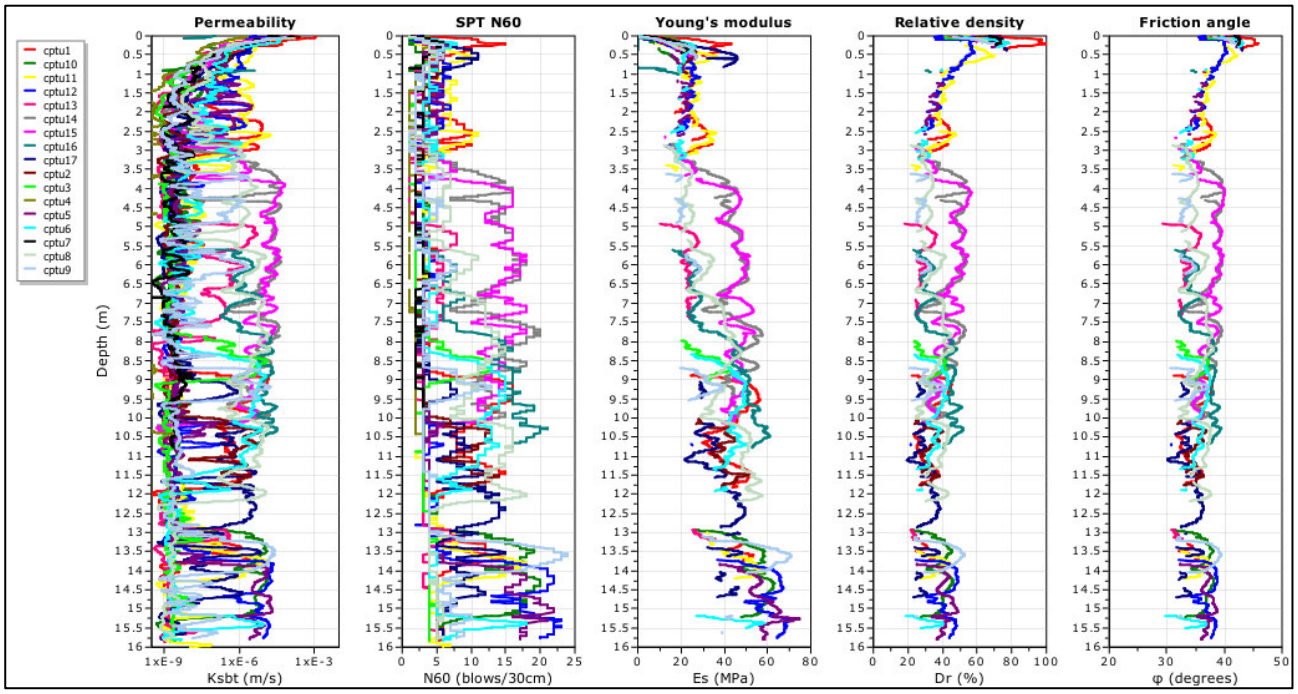


Figura 36. Parametri geotecnici: Permeability, SPT N60; Young's modulus; Relative density; Friction angle.

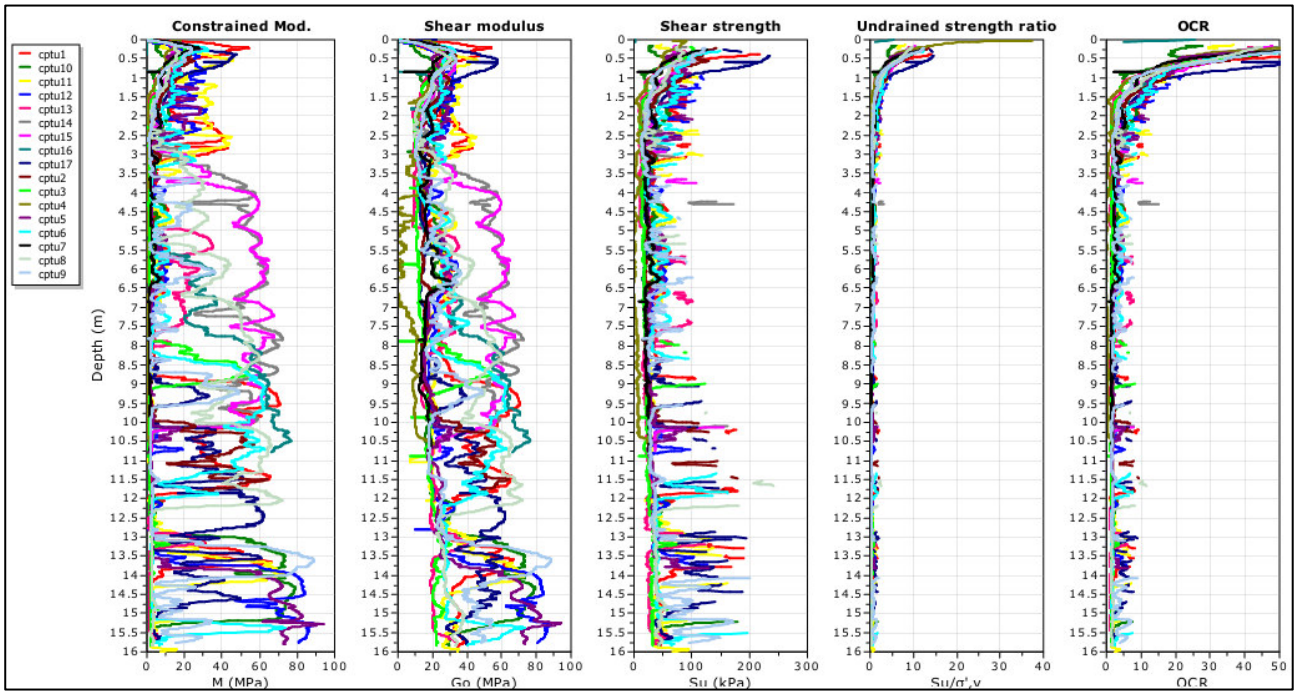


Figura 37. Parametri geotecnici: Constrained Modulus; Shear modulus; Shear strength, Undreined strength ratio; OCR.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

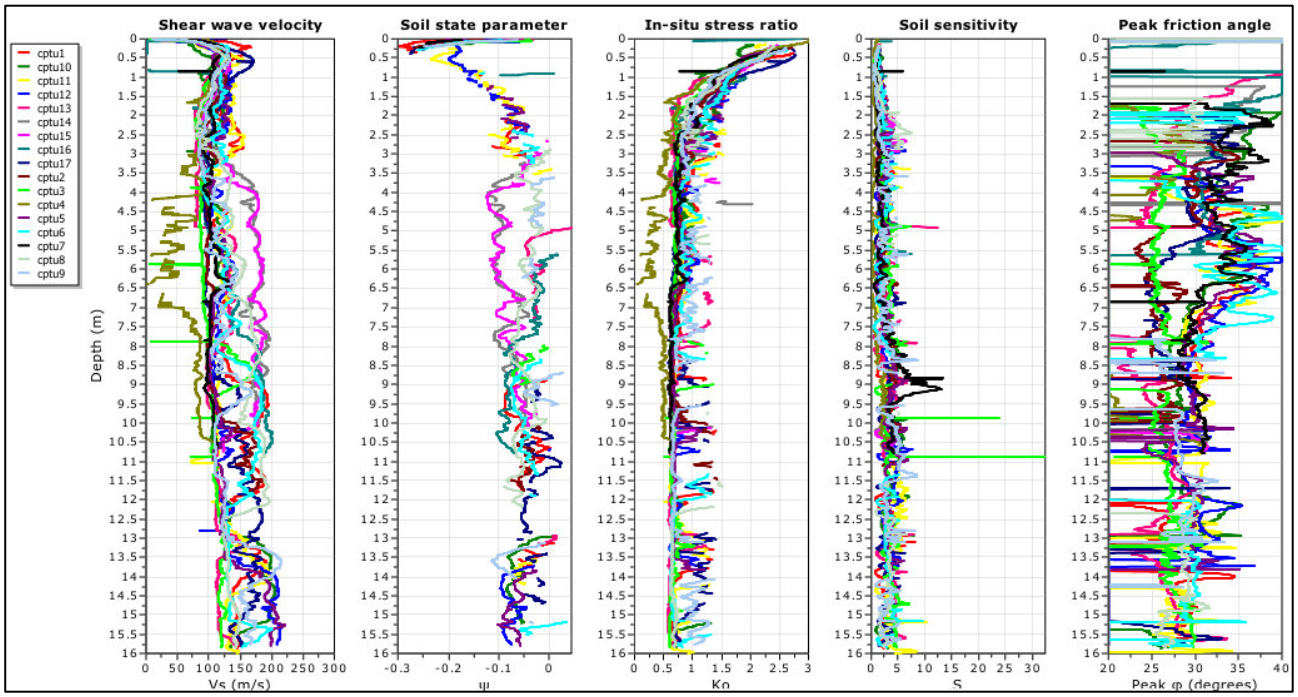


Figura 38. Parametri geotecnici: Shear wave velocity; Soil state parameter; In situ stress ratio; Soil sensitivity; Peak friction angle.

5.2.1. Sintesi dei risultati

Le prove penetrometriche rilevano materiali prevalentemente limoso-argillosi intervallati da spessori variabili di sabbie e/o limi sabbiosi individuati a diverse profondità.
Vengono riscontrati materiali leggermente sovraconsolidati nel primo metro di profondità dal piano campagna.

Per un maggiore approfondimento dei risultati delle indagini penetrometriche si rimanda all'"Allegato 2 – Indagini penetrometriche statiche CPTU".

5.3. PIEZOMETRIA

Al termine delle prove penetrometriche i fori di indagine sono stati indagati con un freatimetro. Si rileva presenza di acqua alla profondità di circa 1.60 metri dal piano campagna.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

5.4. PROVE GEOTECNICHE DI LABORATORIO

In prossimità della prova penetrometrica CPTU1 e CPTU5 sono stati prelevati rispettivamente i campioni di terreno S1C1 e S2C1, successivamente sottoposti a prove geotecniche di laboratorio. Di seguito la sintesi dei risultati delle prove di taglio in scatola di Casagrande.

CAMPIONE	Profondità [m da p.c.]	Prova di taglio	
		c' [kPa]	ϕ' [°]
S1C1	0.50÷1.00	28.69	23.35
S2C1	0.50÷1.00	30.50	24.76

Tabella 8. Risultati delle prove di taglio.

Per un maggiore approfondimento delle prove geotecniche di laboratorio si rimanda all'"Allegato 3 – Prove geotecniche di laboratorio".

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6. ANALISI DEI PRINCIPALI RISCHI GEOLOGICI

6.1. PERICOLOSITÀ SISMICA DI BASE

Con l'entrata in vigore del D.M. 14/01/2008 e modifiche del D.M. 20/02/2018, la stima della pericolosità sismica è definita mediante un approccio sito dipendente e non più mediante un criterio zona dipendente. Le azioni sismiche di progetto, in base alle quali valutare il rispetto dei diversi stati limite previsti nelle NTC, si definiscono a partire dalla "pericolosità sismica di base", chiamata d'ora in poi pericolosità sismica del sito. Essa è espressa in termini di accelerazione orizzontale massima ag su suolo rigido orizzontale di riferimento e costituisce l'elemento di conoscenza primario per la determinazione delle azioni sismiche. La pericolosità sismica del sito in esame viene definita a partire dalle sue coordinate geografiche e da quelle relative ai 4 nodi del reticolo di riferimento. Nella sottostante figura (tratta dalla pagina del sito di Geostru http://www.geostru.com/geoapp/parametri-sismici.aspx), si riportano i dati relativi alla determinazione della pericolosità sismica di base per il sito in oggetto.

I parametri sismici attesi al sito per:

- Coordinate WGS84: 44.780665°, 12.037509°;
- Tipo di costruzione 2 con vita nominale VN = 50 anni;
- Classe d'uso III (CU = 1.5);
- Periodo di riferimento VR = CU VN = 50 anni;
- Categoria topografica T1 (Superficie pianeggiante con inclinazione media i ≤ 15°);
- Categoria stratigrafica D.

Stati limite

Classe Edificio

III. Affollamento significativo...

Vita Nominale 50

Interpolazione Media ponderata

CU = 1.5

Stato Limite	Tr [anni]	a_g [g]	Fo	Tc^* [s]
Operatività (SLO)	45	0.039	2.554	0.271
Danno (SLD)	75	0.047	2.537	0.291
Salvaguardia vita (SLV)	712	0.116	2.585	0.299
Prevenzione collasso (SLC)	1462	0.149	2.589	0.304
Periodo di riferimento per l'azione sismica:	75			

Figura 39. Pericolosità sismica di base relativa al sito in esame.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6.1.1. DEFINIZIONE DELL'AZIONE SISMICA IN FORMA SEMPLIFICATA

Sulla base di quanto riportato in precedenza, la velocità media equivalente delle onde di taglio S (in questo caso si utilizza il parametro Vs30 m in quanto il bedrock è posto ad una profondità superiore a 30 m dal piano campagna), determinata dalle prove MASW/REMI e HVSR, risulta pari a 156 m/s. Pertanto, unicamente in riferimento ai valori riportati in tabella e al valore di Vs_{30} ottenuto dal profilo sismico, è possibile collocare il sottosuolo in classe D. Il coefficiente di amplificazione topografico (ST) è posto pari ad 1.0 in quanto la zona presenta un'inclinazione media i ≤ 15°.

A questo punto sulla base dei dati riportati nelle precedenti pagine è possibile definire l'azione sismica per il sito in esame con riferimento alla tipologia di opera che si intende realizzare (carattere strategico dell'opera), sulla base della pericolosità sismica di base (espressa in termini di accelerazione orizzontale massima ag per ciascun stato limite ultimo e di esercizio) e delle amplificazioni stratigrafiche e topografiche.

Coefficienti sismici

Tipo: Stabilità dei pendii e fondazioni

☐ Muri di sostegno che non sono in grado di subire spostamenti.

H (m): 1 — us (m): 0.1

Cat. Sottosuolo: D

Cat. Topografica: T1

	SLO	SLD	SLV	SLC
SS Amplificazione stratigrafica	1,80	1,80	1,80	1,80
CC Coeff. funz categoria	2,40	2,32	2,29	2,27
ST Amplificazione topografica	1,00	1,00	1,00	1,00

☐ Acc.ne massima attesa al sito [m/s²]: 0.6

Coefficienti	SLO	SLD	SLV	SLC
kh	0.014	0.017	0.050	0.064
kv	0.007	0.008	0.025	0.032
Amax [m/s²]	0.680	0.826	2.050	2.631
Beta	0.200	0.200	0.240	0.240

Figura 40. Coefficienti sismici (SS = coefficiente di amplificazione stratigrafica; Cc = coefficiente funzione della categoria di suolo; S = SS x ST; Amax = accelerazione massima attesa nel sito; Beta = coefficiente di riduzione; Kh = coefficiente sismico orizzontale; Kv = coefficiente sismico verticale).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6.2. VERIFICA DEL POTENZIALE DI LIQUEFAZIONE

Per il sito in esame sono presenti una serie di fattori predisponenti la probabilità di liquefazione:

- Presenza di strati limoso/sabbiosi
- presenza della falda
- accelerazioni massime superiori a 0.15 g

Si procede, in via preliminare, ad una verifica della liquefazione dei terreni calcolando l'indice Ic ed il potenziale di liquefazione IPL.
Per l'analisi in esame sono stati utilizzati i seguenti parametri:

- ag = 0.2
- magnitudo: 6.14
- falda: 1.60 m dal piano campagna durante l'evento sismico

In base al valore stimato dell'indice del potenziale di liquefazione IPL, come riportato in Tabella 9, si definiscono le classi di pericolosità (Sonmez, 2003).

Indice del potenziale di liquefazione, LPI	Pericolosità di liquefazione
LPI = 0	Nulla
0 < LPI 2	Bassa
2 < LPI 5	Moderata
5 < LPI 15	Alta
LPI > 15	Molto alta

Tabella 9. LPI-based hazard classes [SONMEZ 2003].

Le verifiche di calcolo sono state approntate con metodologie di tipo storico–empirico fra cui quelle basate su prove CPTe con particolare riferimento al metodo di "Robertson" (agg 2009-2010).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

Nella figura seguente si compendiano i risultati ottenuti.

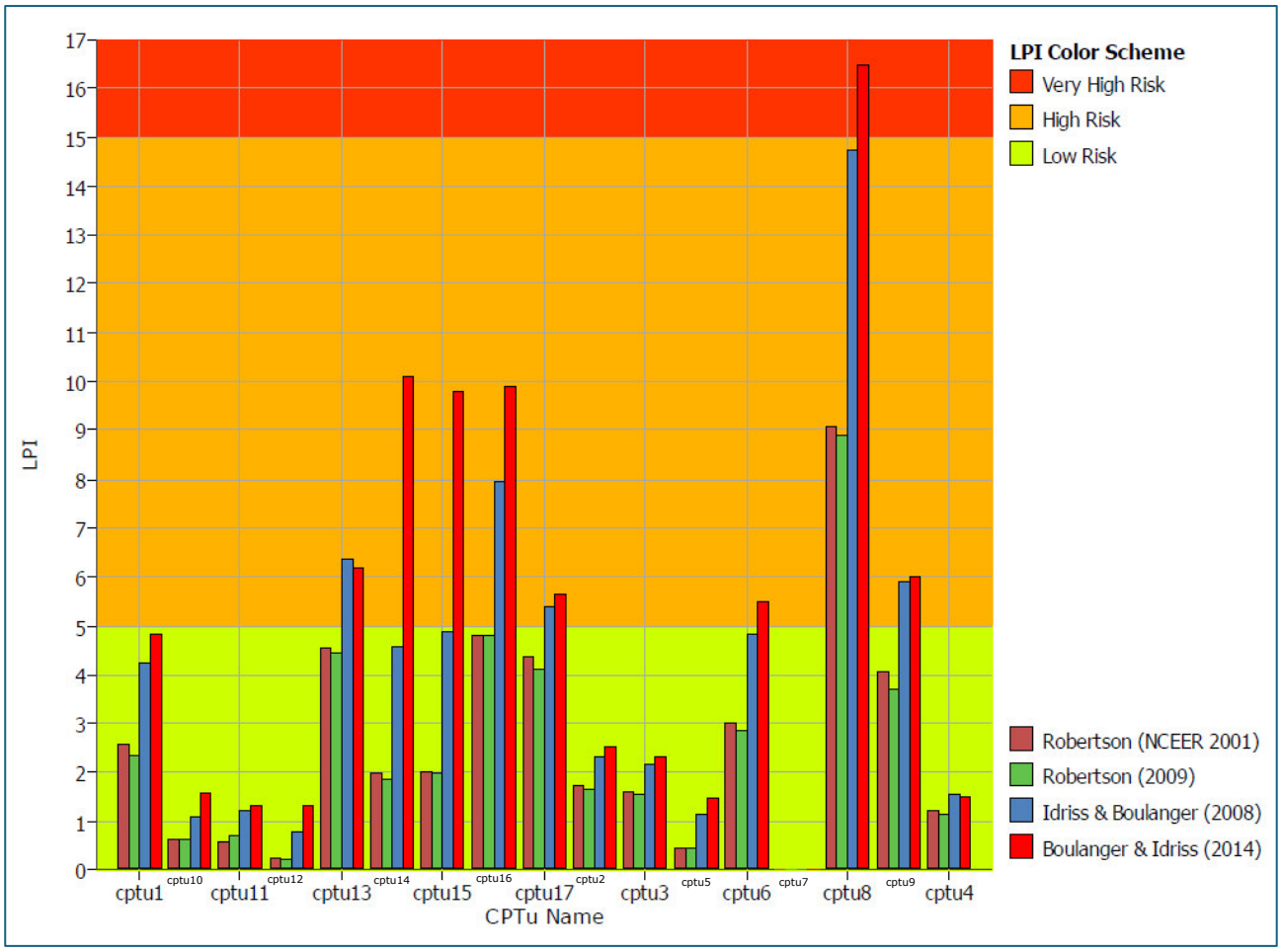


Figura 41. Confronto del potenziale di liquefazione con vari metodi di calcolo.

I terreni in esame presentano un potenziale di liquefazione (LPI) in alcuni casi superiore a 5, pertanto identificati come terreni ad elevato rischio di liquefazione secondo la rappresentazione di Robertson, classe moderata e alta secondo la classificazione di Sonmez.

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6.3. ALTRI RISCHI GEOLOGICI

Nell'ambito del presente studio è stata eseguita una verifica di compatibilità geologica preliminare per accertare preventivamente che l'intervento previsto garantisca la sicurezza del territorio.
La verifica è stata effettuata consultando la cartografia ufficiale di seguito riportata:

- Piano di assetto idrogeologico - Autorità di Bacino Distrettuale del Fiume Po (AdBPo)
- Piano Paesaggistico Territoriale Regionale (PPTR)
- Vincolo idrogeologico

nonché in base alle valutazioni e considerazioni relative agli aspetti geologici e geomorfologici eseguite dallo scrivente.

6.3.1. Pericolosità idrogeologica

Il Piano di Assetto Idrogeologico è un Piano territoriale di settore che rappresenta lo strumento conoscitivo, normativo e tecnico-operativo mediante il quale l'Autorità di Bacino, nell'ambito del territorio di propria competenza, pianifica e programma le azioni e le norme d'uso finalizzate alla tutela e alla difesa delle popolazioni, degli insediamenti, delle infrastrutture, del suolo e del sottosuolo.

L'area di progetto è compresa nel Bacino Distrettuale del Fiume Po.
L'individuazione e la perimetrazione delle aree soggette a pericolosità idraulica e geomorfologica (intese rispettivamente nel senso di aree inondabili e/o aree soggette ad allagamento ed aree interessate da movimenti di pendio) del territorio di competenza dell'Autorità di Bacino del Fiume Po è stato attuato sulla base delle informazioni storiche relative ad eventi calamitosi verificatisi nel passato.

6.3.2. Vincolo idrogeologico

Dalla Delibera di Giunta Regionale 11 luglio 2000, n. 1117, risulta che il comune di Fiscaglia non rientra nei comuni con presenza di vincolo idrogeologico esterni alle comunità montane.

Pertanto, le aree oggetto di intervento non rientrano nelle aree sottoposte a vincolo idrogeologico.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6.3.3. Pericolosità geomorfologica

Come riportato in Figura 42, l'area di impianto non ricade in aree a pericolosità geomorfologica.

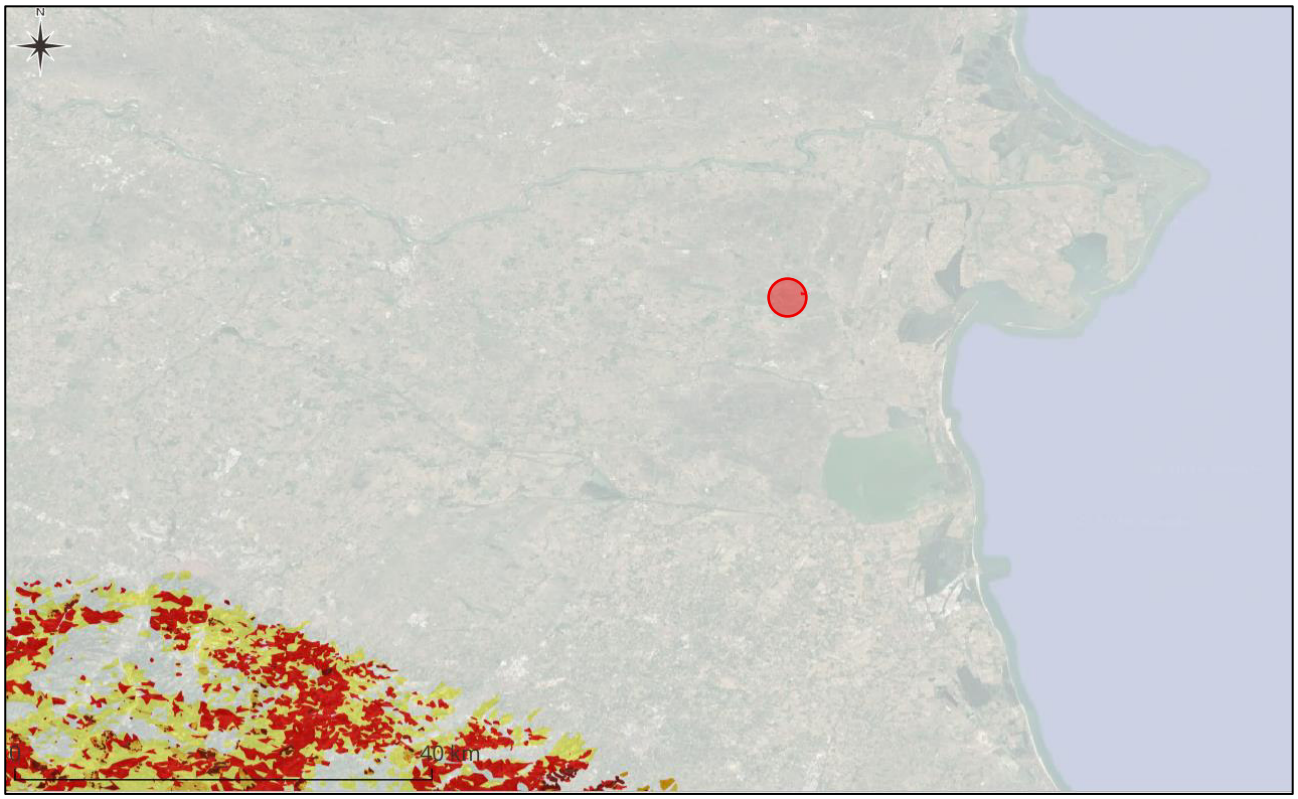


Figura 42. Aree instabili (PAI – Pericolosità geomorfologica).

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6.3.4. Pericolosità idraulica

Dalla piattaforma web delle frane e alluvioni italiane, come riportato Figura 43, l'area di impianto ricade in zone associate a pericolosità idraulica media, scenario P2 (Tr.100-200 anni).

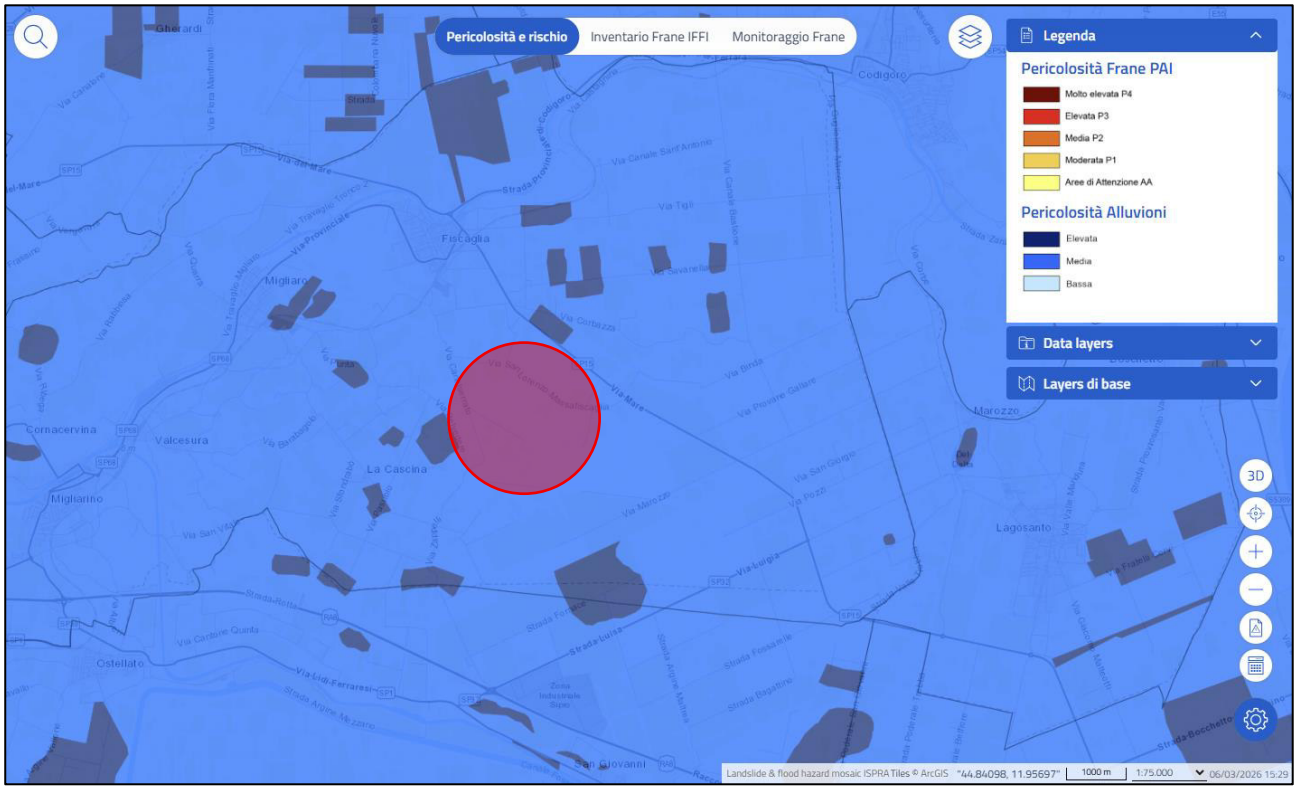


Figura 43. Aree inondabili (PAI – Assetto idraulico, Pericolosità idraulica). (IDROGEO: https://idrogeo.isprambiente.it/app/)

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

6.3.5. Fenomeni di subsidenza

Testi specializzati e studi eseguiti sulla piana ferrarese mostrano una non trascurabile presenza del fenomeno della subsidenza (Figura 44), ovvero un lento processo di abbassamento del suolo causato da fattori geologici.

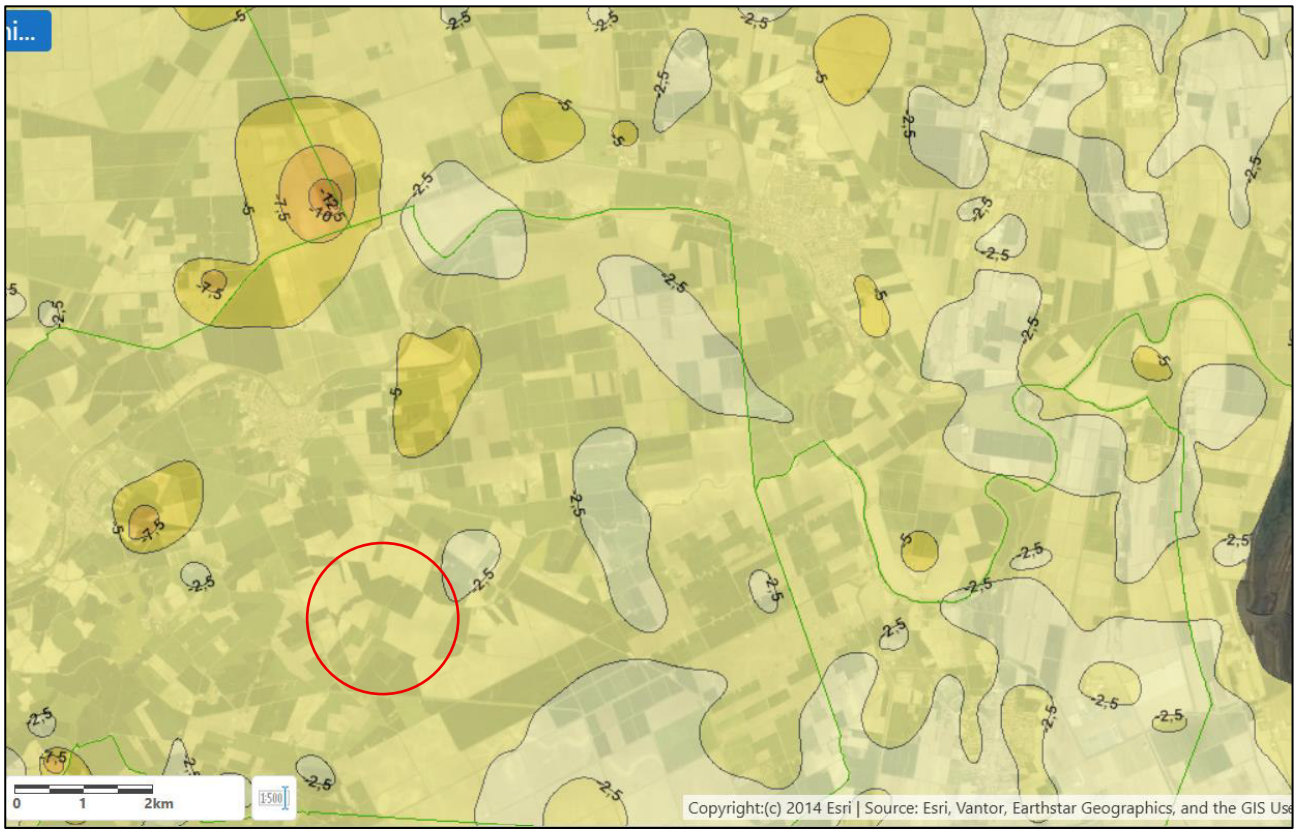


Figura 44 Tassi di subsidenza (mm/anno) riferiti al periodo 2016 – 2021 (Geoportale Arpae).

I tassi di subsidenza della zona in esame riscontrati in bibliografia si aggirano intorno ai 2.5 mm l'anno.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

7. MODELLO GEOLOGICO E GEOTECNICO

I risultati delle indagini geognostiche hanno permesso di ricostruire un modello geologico "allo scopo di costituire un elemento di riferimento per il progettista al fine di inquadrare i problemi geologici e per definire, eventualmente, il programma delle indagini geotecniche integrative" (§ 6.2.1, D.M. 17/01/2018).

Le indagini penetrometriche rilevano la presenza di depositi appartenenti all'Unità di Modena (AES8a) e, in particolare, sono attribuiti ai depositi quaternari di piana deltizia, ossia depositi di baia interdistibutrice (Qa6).

Le prove penetrometriche rilevano materiali prevalentemente argilloso limosi intervallati da spessori variabili di sabbie e/o limi sabbiosi individuati a diverse profondità.
Dalle prove eseguite non si riscontra un'elevata continuità degli strati sabbiosi e/o limoso-sabbiosi; pertanto la geometria di tali corpi è riconducibile a delle lenti.
Vengono riscontrati materiali leggermente sovraconsolidati nel primo metro di profondità dal piano campagna.

Le indagini sismiche con metodologia masw rilevano terreni con velocità delle onde di taglio Vs molto basse e decrescenti fino a circa 12.0÷14.0 metri dal piano campagna.
Dalle letture tromografiche si evidenzia un primo picco in frequenza intorno a circa 1÷2 Hz, riconducibile al passaggio dai materiali lenti a materiali maggiormente consolidati.

Quanto sopra esposto, si riporta in Tabella 10 una proposta di modello geologico e geotecnico monodimensionale del sito.

UNITA' LITOLOGICA	PROFONDITÀ		γ (kN/m3)	ϕ (°)	C' (kPa)	Cu (kPa)	Modulo edometrico (MPa)
	DA (m da p.c.)	A (m da p.c.)					
Limi argillosi e/o argille limose	0.00	10.00	18.0	23	28	25	3

Tabella 10. Modello geologico e geotecnico del sito in esame.

Date le elevate dimensioni del sito, data l'eterogeneità del terreno, per un maggior dettaglio delle caratteristiche geologiche e geotecniche, si faccia riferimento all'"Allegato 2 – Indagini penetrometriche statiche CPTU" in cui è stato schematizzato un modello geologico e geotecnico per ogni prova penetrometrica eseguita.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

8. CONCLUSIONI

La presente relazione geologica, idrogeologica e geotecnica è relativa alla realizzazione costruzione di un **impianto agrivoltaico** denominato "**Agro-solare Fiscaglia**" nel comune di Fiscaglia (FE).

Nell'ambito del presente studio è stata eseguita una verifica di compatibilità idrogeologica preliminare per accertare preventivamente che l'intervento previsto garantisca la sicurezza del territorio.
Dalla consultazione cartografica ufficiale (PAI, PTPR, Vincolo idrogeologico), l'area di impianto e il cavidotto ricadono negli scenari di pericolosità P1 per quanto riguarda le alluvioni.
Il sito di intervento non ricade in aree sottoposte a vincolo idrogeologico.

Per l'analisi degli aspetti geotecnici e sismici del sito ai fini della stabilità dell'area è stata eseguita la seguente campagna di indagini geognostiche che hanno previsto l'esecuzione di:

- n° 17 prove penetrometriche statiche a punta elettrica e piezocono (CPTU)
- n° 2 prelievi di campione di terreno da sottoporre a prove di laboratorio
- n° 2 prove di taglio diretto in scatola di Casagrande
- n° 4 profili sismici (MASW/REMI)
- n° 4 letture sismiche a stazione singola (HVSR)

Dal punto di vista stratigrafico l'area in esame è caratterizzata dalla presenza di depositi appartenenti all'Unità di Modena (AES8a) e, in particolare, sono attribuiti ai depositi quaternari di piana deltizia, ossia depositi di baia interdistibutrice (Qa6).

Tali depositi sono caratterizzati da materiali prevalentemente argilloso limosi intervallati da spessori variabili di sabbie e/o limi sabbiosi individuati a diverse profondità e con geometria lentiforme.

Le indagini eseguite hanno permesso di caratterizzare dal punto di vista geologico, geofisico e geotecnico i materiali presenti nell'area e la loro geometria.

I terreni in esame presentano un potenziale di liquefazione (LPI) in alcuni casi superiore a 5, pertanto identificati come terreni ad elevato rischio di liquefazione secondo la rappresentazione di Robertson, classe moderata e alta secondo la classificazione di Sonmez.
Tale aspetto va tenuto in considerazione per quanto riguarda le opere e le strutture da realizzare nel sito in esame.

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In considerazione di quanto esposto, si ritiene che l'intervento in progetto non determini interferenze che possono essere causa di instabilità in quanto non induce nessuna variazione del regime delle acque superficiali e sotterrane.

In base ai risultati delle indagini, si ritiene che non esistano vincoli per la realizzazione dell'opera prevista dal progetto, ritenendo questi interventi compatibili con le condizioni di stabilità dell'area.

Data

26/05/2026

Il tecnico

Dott. Geol. Francesco Cianchi

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9. ALLEGATI

Allegato 1 – Indagini geofisiche
Allegato 2 – Indagini penetrometriche statiche CPTU
Allegato 3 – Prove geotecniche di laboratorio
Allegato 4 – Documentazione fotografica

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PROFILO SISMICO IN ARRAY CON TECNICA MASW

Il metodo MASW è classificabile come tecnica di indagine sismica simile alla sismica a rifrazione e alla sismica a riflessione, perché il principio alla base della prova sperimentale in sito è analogo e consiste nel misurare le onde superficiali sul suolo. La Multichannel Analisys of Surface Waves (MASW) è un metodo d'indagine mediante il quale è possibile costruire un profilo di velocità delle onde di taglio (Vs) in relazione alla profondità, sulla base della misura delle onde superficiali. Il contributo predominante di quest'ultime è dato dalle onde di Rayleigh, che viaggiano ad una velocità correlata alla rigidezza del terreno interessato dalla propagazione. Nei terreni stratificati, le onde di Rayleigh sono dispersive e si propagano con diverse velocità di fase e di gruppo. La natura dispersiva è correlabile al fatto che onde ad alta frequenza (lunghezza d'onda corta) si propagano negli strati superficiali, mentre onde a bassa frequenza si propagano in strati profondi. La ricerca del profilo di velocità delle onde di taglio Vs con il metodo MASW consiste nel modificare il profilo di velocità Vs finché non sia raggiunto un buon accordo tra la curva di dispersione (o velocità di fase) apparente, misurata in sito, e la curva di dispersione (o velocità di fase) apparente simulata numericamente.

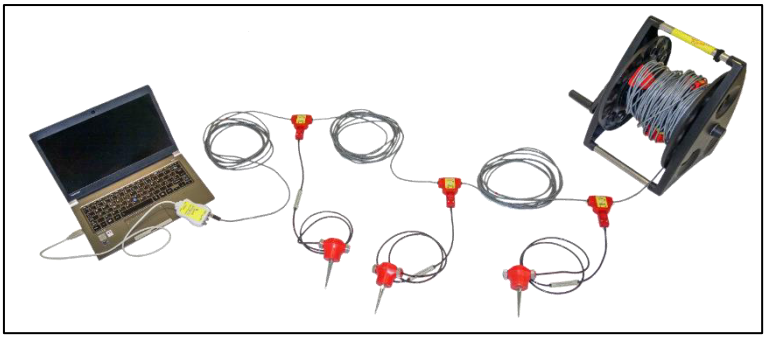


Figura 1 – Sismografo multicanale utilizzato per l'indagine geofisica MASW/Re.Mi.

Misura a stazione singola HVSR

Il metodo HVSR (Horizontal to Vertical Spectral Ratio) proposto da Nogoshi e Igarashi (1970) e successivamente modificato da Nakamura (1989), si basa sull'analisi del rapporto spettrale tra le componenti orizzontale (H) e verticale (V) del rumore sismico registrato in un sito. Il rumore sismico è presente ovunque ed è generato sia da fenomeni atmosferici (onde oceaniche, vento) che dall'attività antropica. Il rumore sismico è indicato spesso come microtremore poiché è caratterizzato da oscillazioni molto deboli (dell'ordine dei μm/s). I microtremori sono in parte costituiti da onde di volume, P o S, ma soprattutto da onde superficiali, la cui velocità è comunque prossima a quella delle onde S (Mulargia et al., 2007). La tecnica di misura del rumore sismico richiede tempi di registrazione pari a 15-20 minuti e necessita di sensori tridirezionali da sismologia con messa in bolla, digitalizzatore 24 bit con elevata dinamica, elevato guadagno ed elevata frequenza di campionamento nativo, con minimizzazione del rumore elettro/meccanico. L'acquisizione è stata eseguita utilizzando un tromografo digitale, "TROMINO" (Micromed S.p.A.) dotato di 3 canali velocimetrici (N-S, E-W, Up-Down) ad alto guadagno per l'acquisizione del microtremore sismico ambientale (fino a ~1.5 mm/s); il sistema opera nell'intervallo di frequenze 0.1–1024 Hz. E' stata acquisita una misura di rumore sismico per un tempo di registrazione in genere compreso tra 10 e 20 minuti. La misura è stata poi ripetuta per controllo. L'elaborazione dei dati di rumore sismico acquisiti è avvenuta mediante software Grilla (Micromed S.p.A.).

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Figura 2 – Tromino utilizzato per l'indagine geofisica HVSR

Risultati

Si riportano di seguito i risultati ottenuti.

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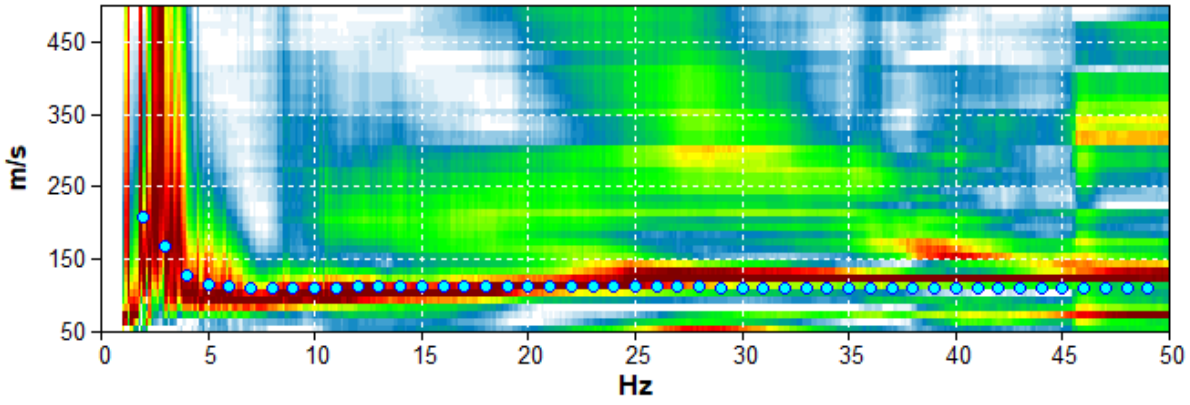
FISCAGLIA_MASW1

Start recording: 21/01/2026 12:18:53 End recording: 21/01/2026 12:30:53
Trace length: 0h12'00''. Analyzed 97% trace (manual window selection)
Sampling rate: 128 Hz

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

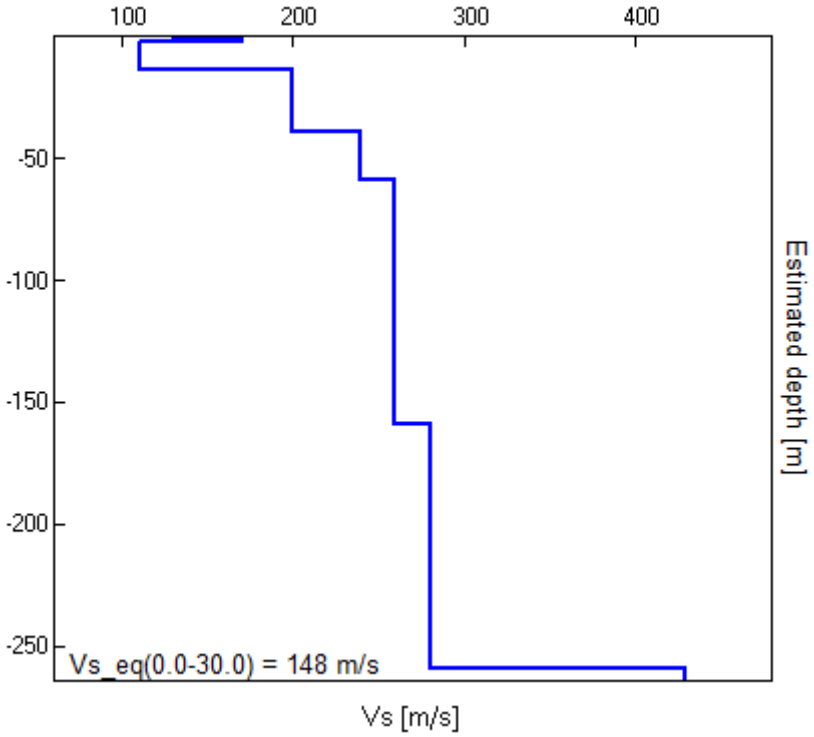
Array geometry (x): 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 m.

MODELLED RAYLEIGH WAVE PHASE VELOCITY DISPERSION CURVE



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	130	0.42
2.00	1.00	170	0.42
14.00	12.00	110	0.49
39.00	25.00	200	0.49
59.00	20.00	240	0.49
159.00	100.00	260	0.49
259.00	100.00	280	0.49
inf.	inf.	430	0.49

Vs_eq(0.0-30.0) = 148 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 148 m/s
Vs [m/s]
Estimated depth [m]

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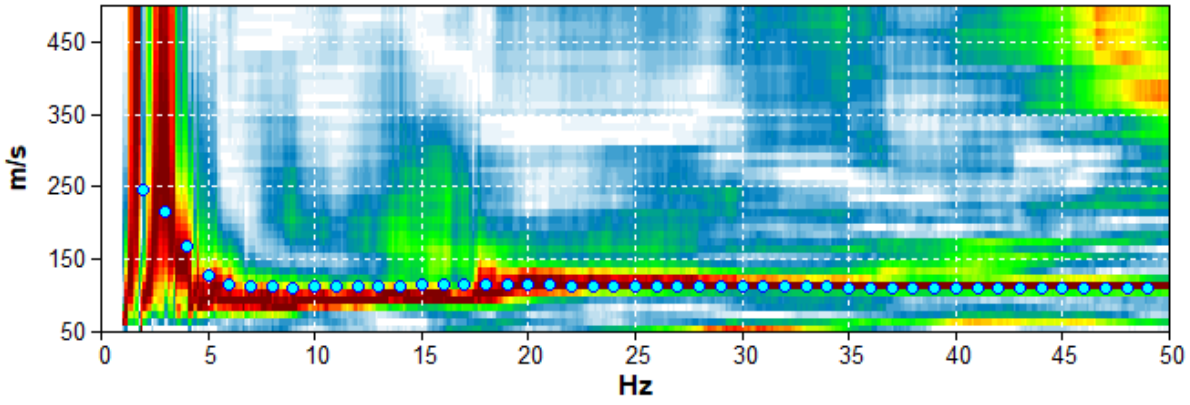
FISCAGLIA_SE_MASW1

Start recording: 22/01/2026 10:23:52 End recording: 22/01/2026 10:37:52
Trace length: 0h14'00''. Analyzed 94% trace (manual window selection)
Sampling rate: 128 Hz

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

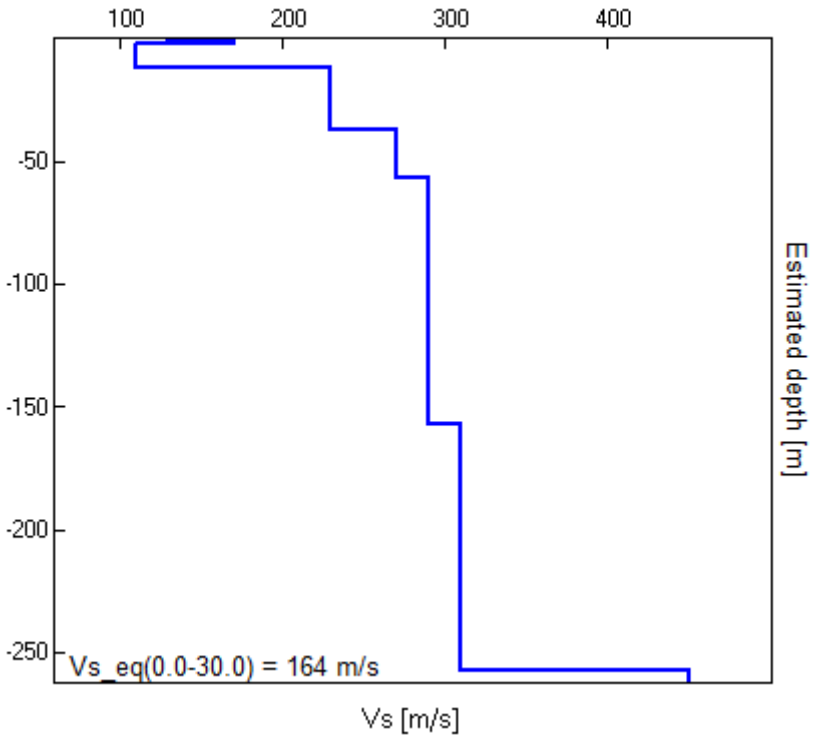
Array geometry (x): 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 m.

MODELLED RAYLEIGH WAVE PHASE VELOCITY DISPERSION CURVE



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	130	0.45
2.00	1.00	170	0.45
12.00	10.00	110	0.49
37.00	25.00	230	0.49
57.00	20.00	270	0.49
157.00	100.00	290	0.49
257.00	100.00	310	0.49
inf.	inf.	450	0.49

Vs_eq(0.0-30.0) = 164 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 164 m/s
Vs [m/s]
Estimated depth [m]

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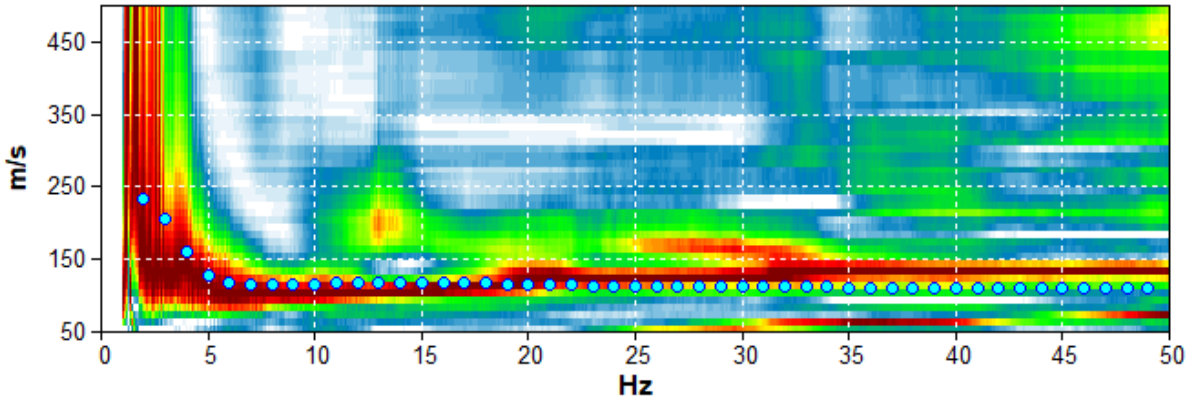
FISCAGLIA_SE_MASW3

Start recording: 20/01/2026 12:46:18 End recording: 20/01/2026 12:58:18
Trace length: 0h12'00''. Analyzed 99% trace (manual window selection)
Sampling rate: 128 Hz

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

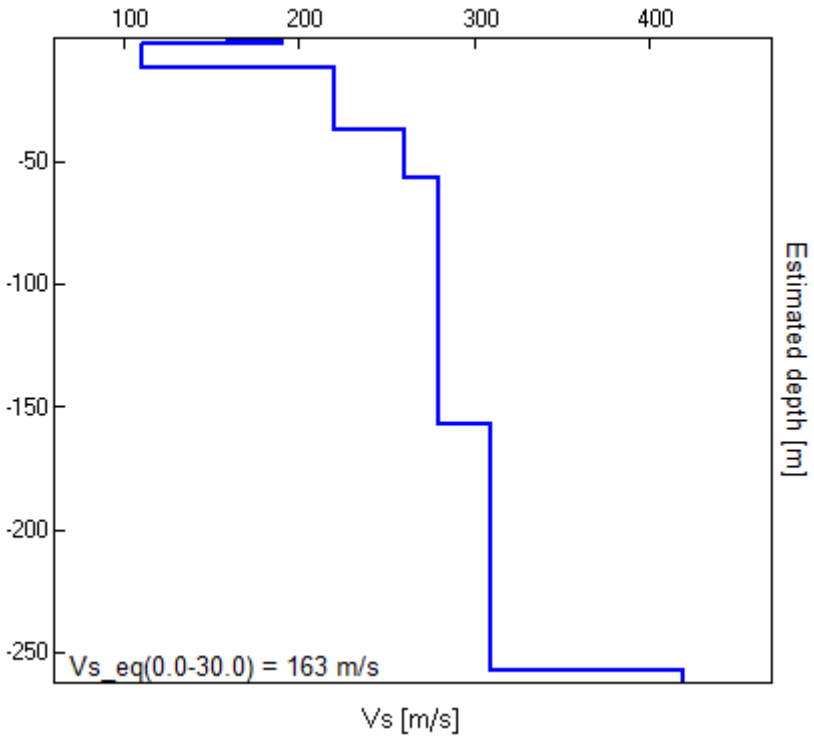
Array geometry (x): 0 3 6 9 12 15 18 21 m.

MODELLED RAYLEIGH WAVE PHASE VELOCITY DISPERSION CURVE



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	160	0.45
2.00	1.00	190	0.45
12.00	10.00	110	0.49
37.00	25.00	220	0.49
57.00	20.00	260	0.49
157.00	100.00	280	0.49
257.00	100.00	310	0.49
inf.	inf.	420	0.49

Vs_eq(0.0-30.0) = 163 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 163 m/s
Vs [m/s]
Estimated depth [m]

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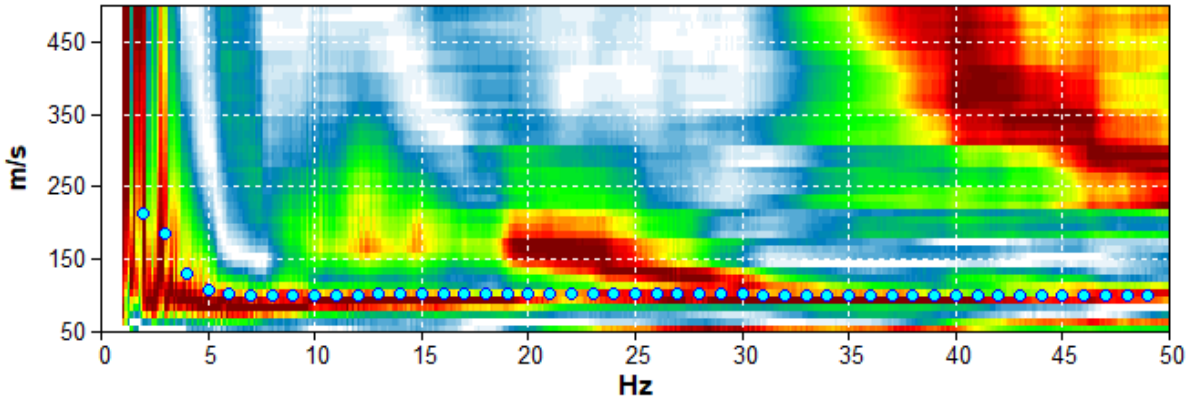
FISCAGLIA_SE_MASW4

Start recording: 22/01/2026 10:48:08 End recording: 22/01/2026 11:02:08
Trace length: 0h14'00''. Analyzed 96% trace (manual window selection)
Sampling rate: 128 Hz

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

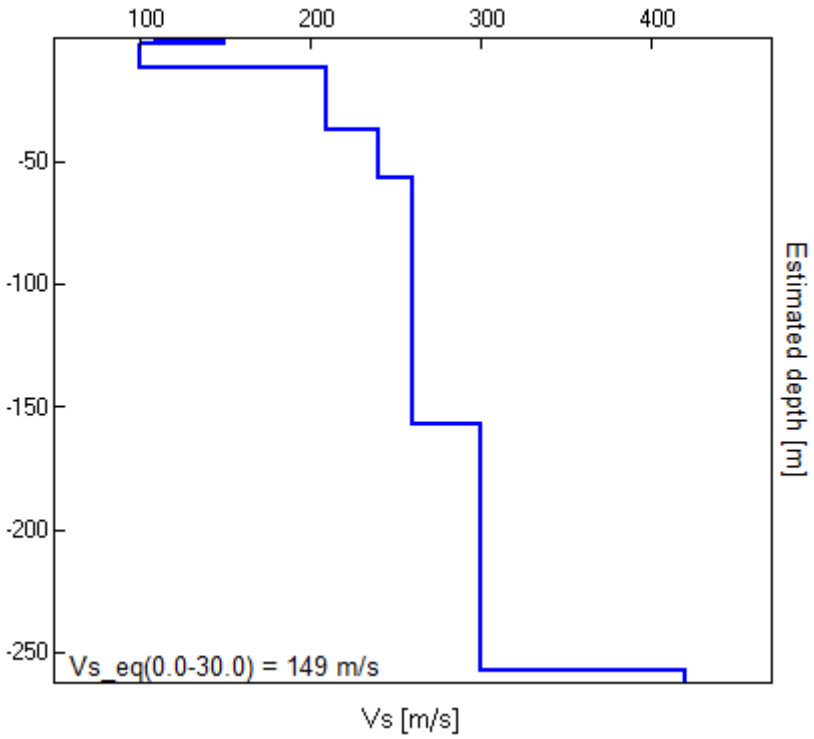
Array geometry (x): 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 m.

MODELLED RAYLEIGH WAVE PHASE VELOCITY DISPERSION CURVE



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	110	0.42
2.00	1.00	150	0.42
12.00	10.00	100	0.49
37.00	25.00	210	0.49
57.00	20.00	240	0.49
157.00	100.00	260	0.49
257.00	100.00	300	0.49
inf.	inf.	420	0.49

Vs_eq(0.0-30.0) = 149 m/s

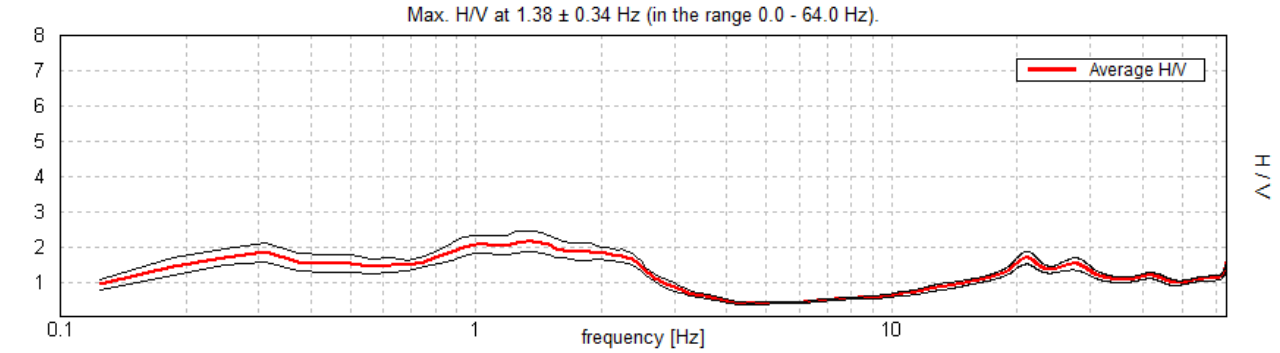

100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 149 m/s
Vs [m/s]
Estimated depth [m]

FISCAGLIA_SE_HVSR1

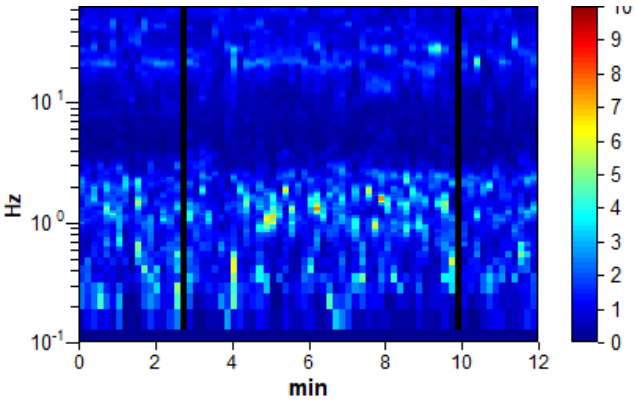
Instrument: TZ3-0008/01-13
Data format: 32 bit
Full scale [mV]: 51
Start recording: 21/01/2026 12:18:53 End recording: 21/01/2026 12:30:53
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

Trace length: 0h12'00''. Analyzed 97% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 10 s
Smoothing type: Triangular window
Smoothing: 10%

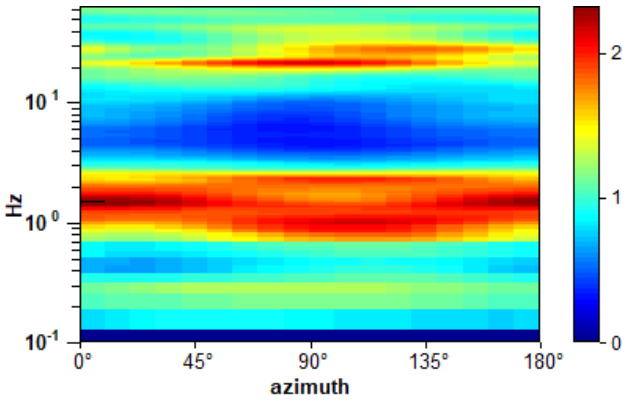
HORIZONTAL TO VERTICAL SPECTRAL RATIO



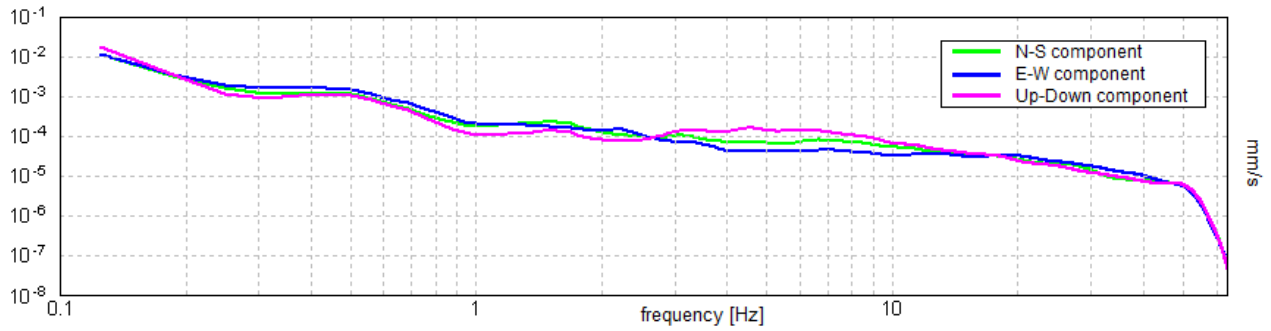
H/V TIME HISTORY



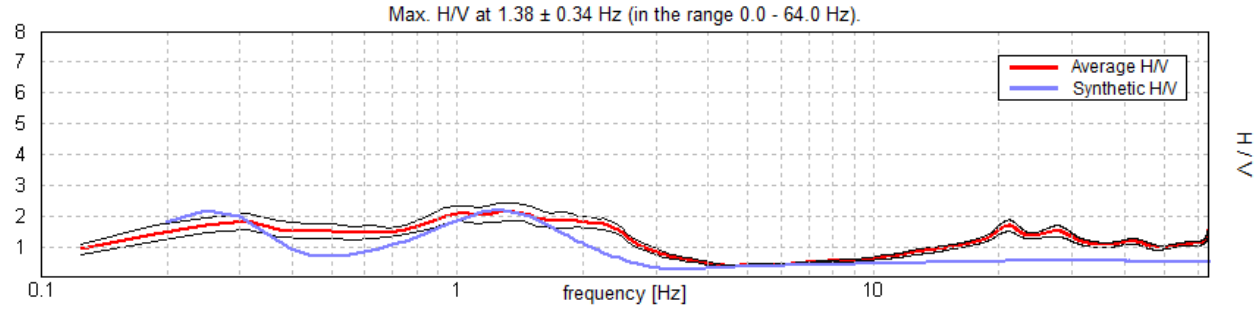
DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA

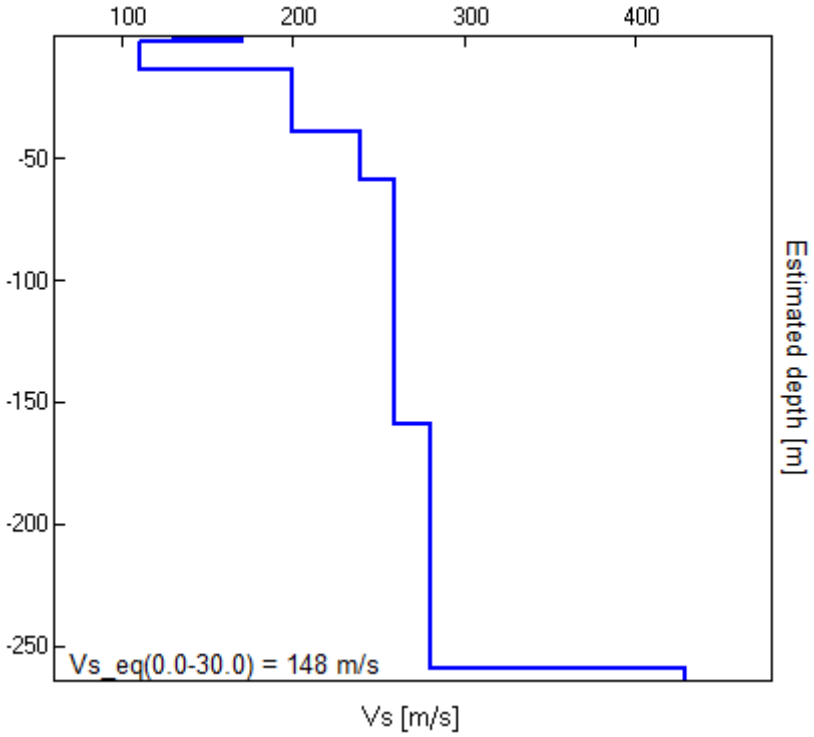


EXPERIMENTAL vs. SYNTHETIC H/V



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	130	0.42
2.00	1.00	170	0.42
14.00	12.00	110	0.49
39.00	25.00	200	0.49
59.00	20.00	240	0.49
159.00	100.00	260	0.42
259.00	100.00	280	0.49
inf.	inf.	430	0.49

Vs_eq(0.0-30.0) = 148 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 148 m/s
Vs [m/s]
Estimated depth [m]

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 1.38 ± 0.34 Hz (in the range 0.0 - 64.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	1.38 > 1.00	OK	
$n_c(f_0) > 200$	962.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 34 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	2.75 Hz	OK	
$A_0 > 2$	2.14 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.2492| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.34265 < 0.1375		NO
$\sigma_A(f_0) < \theta(f_0)$	0.2832 < 1.78	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

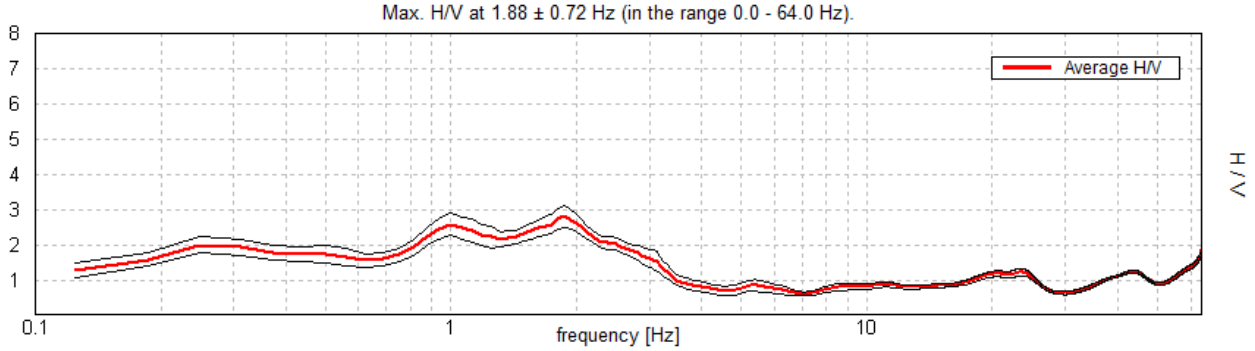
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FISCAGLIA_SE_HVSR2

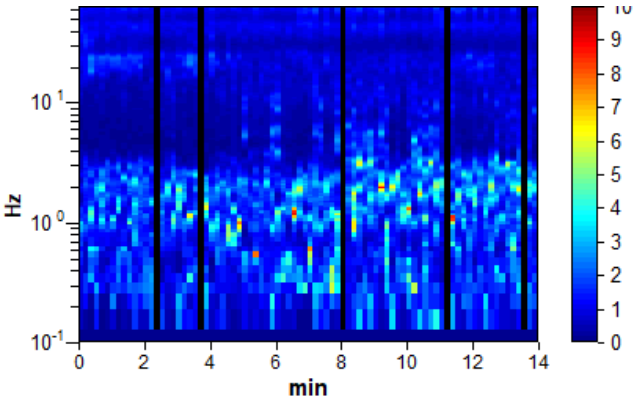
Instrument: TZ3-0008/01-13
Data format: 32 bit
Full scale [mV]: 51
Start recording: 22/01/2026 10:23:52 End recording: 22/01/2026 10:37:52
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

Trace length: 0h14'00''. Analyzed 94% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 10 s
Smoothing type: Triangular window
Smoothing: 10%

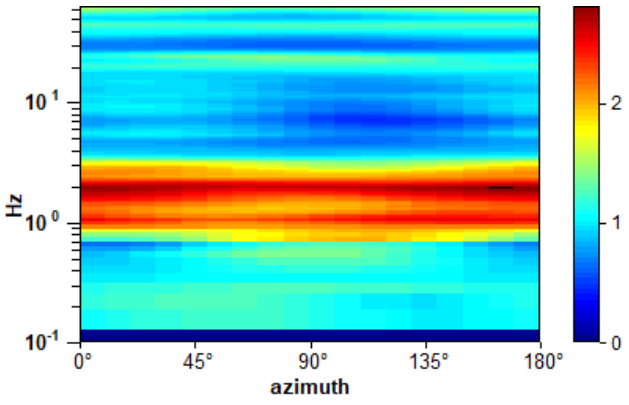
HORIZONTAL TO VERTICAL SPECTRAL RATIO



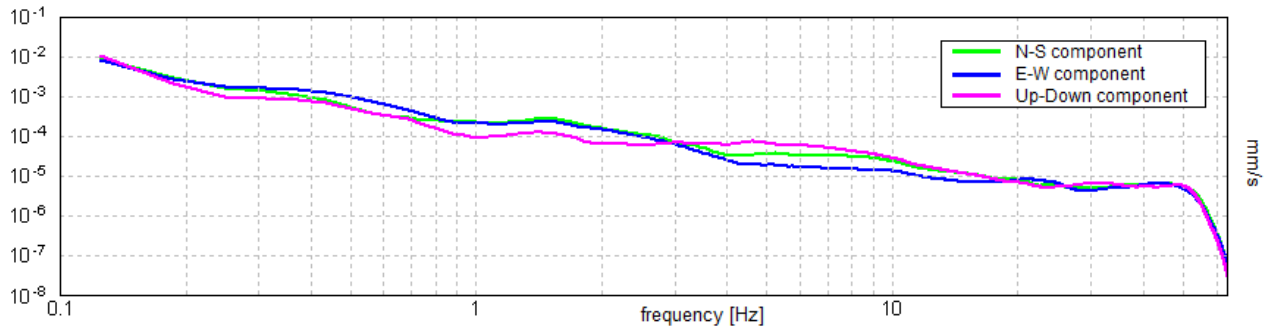
H/V TIME HISTORY



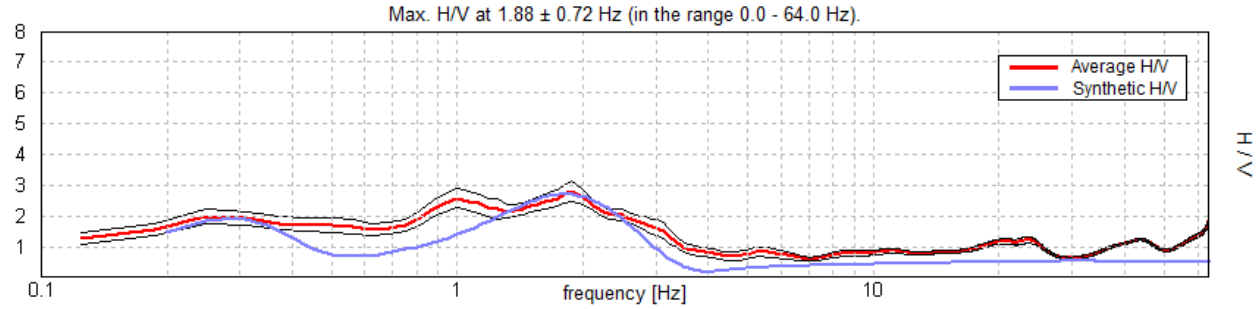
DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA

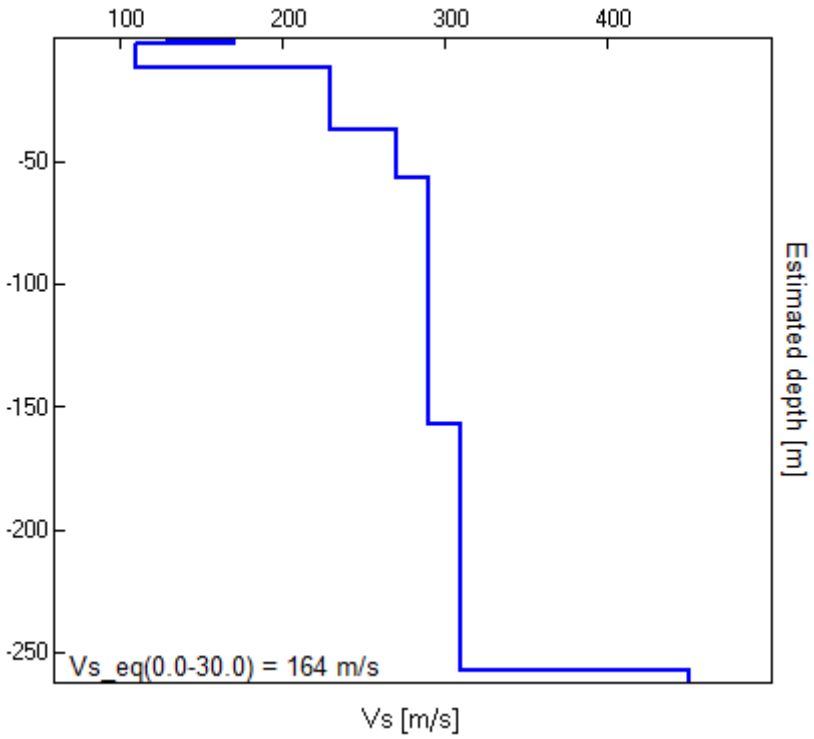


EXPERIMENTAL vs. SYNTHETIC H/V



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	130	0.45
2.00	1.00	170	0.45
12.00	10.00	110	0.49
37.00	25.00	230	0.49
57.00	20.00	270	0.49
157.00	100.00	290	0.49
257.00	100.00	310	0.49
inf.	inf.	450	0.49

Vs_eq(0.0-30.0) = 164 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 164 m/s
Vs [m/s]
Estimated depth [m]

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 1.88 ± 0.72 Hz (in the range 0.0 - 64.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	1.88 > 1.00	OK	
$n_c(f_0) > 200$	1481.3 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 46 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	3.25 Hz	OK	
$A_0 > 2$	2.80 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.38572| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.72322 < 0.1875		NO
$\sigma_A(f_0) < \theta(f_0)$	0.317 < 1.78	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

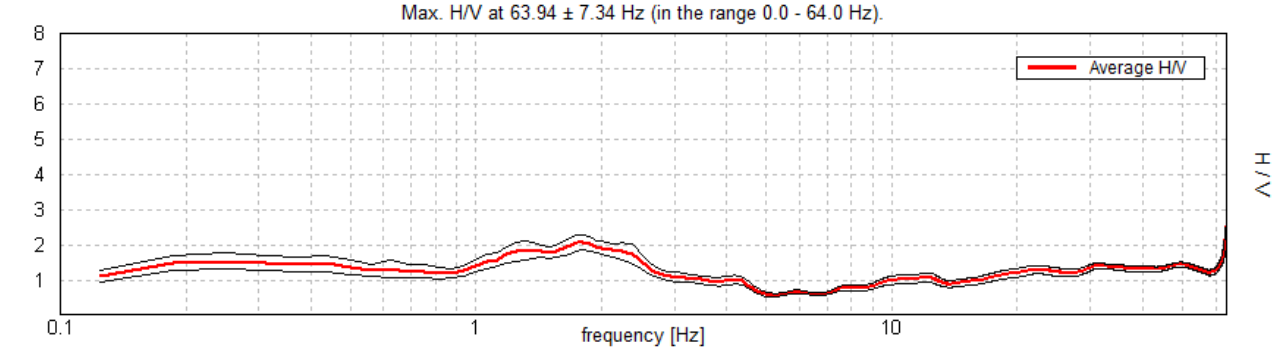
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FISCAGLIA_SE_HVSR3

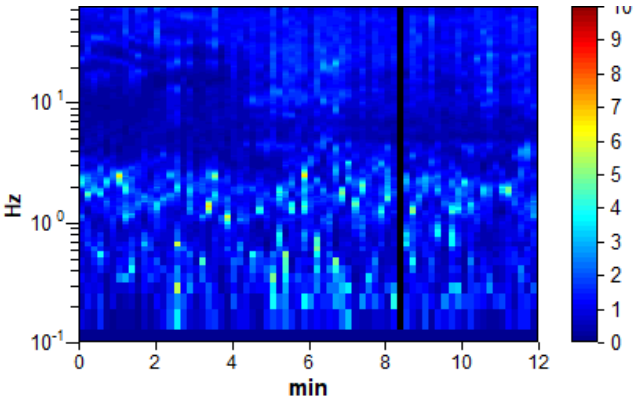
Instrument: TZ3-0008/01-13
Data format: 32 bit
Full scale [mV]: 51
Start recording: 20/01/2026 12:46:18 End recording: 20/01/2026 12:58:18
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

Trace length: 0h12'00''. Analyzed 99% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 10 s
Smoothing type: Triangular window
Smoothing: 10%

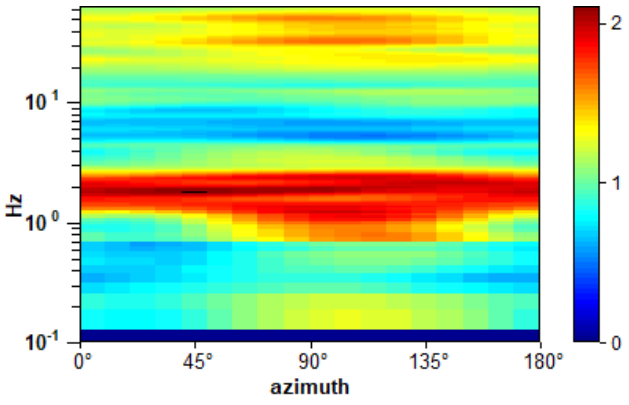
HORIZONTAL TO VERTICAL SPECTRAL RATIO



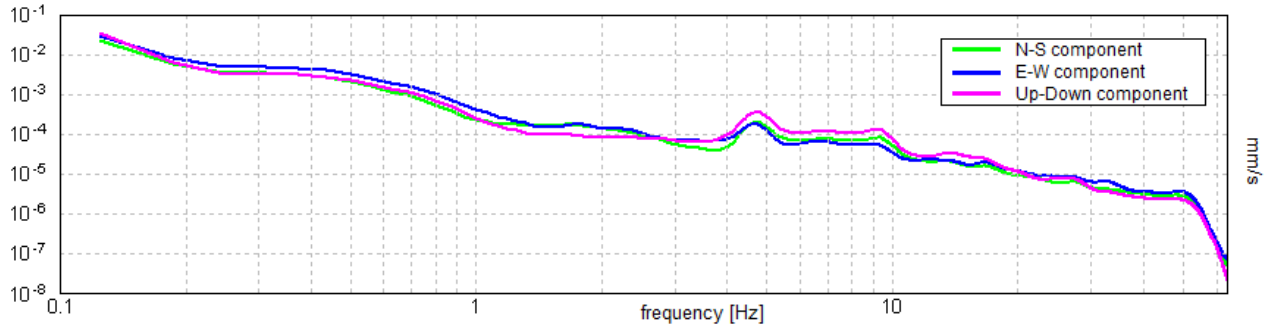
H/V TIME HISTORY



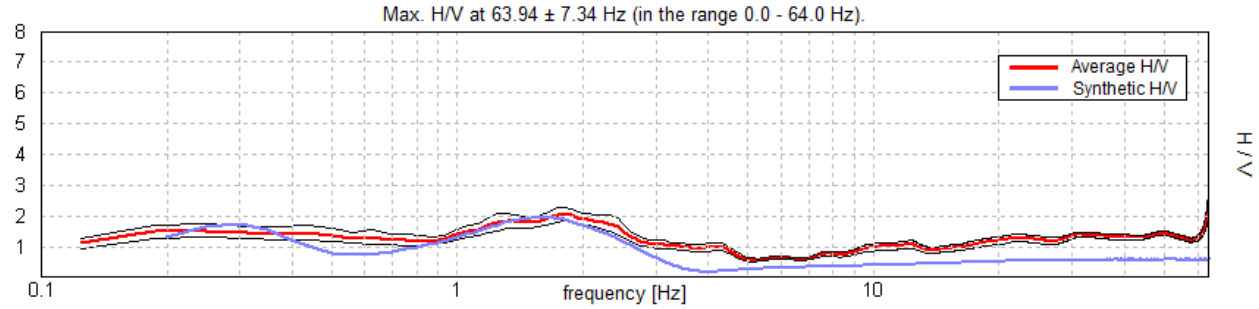
DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA

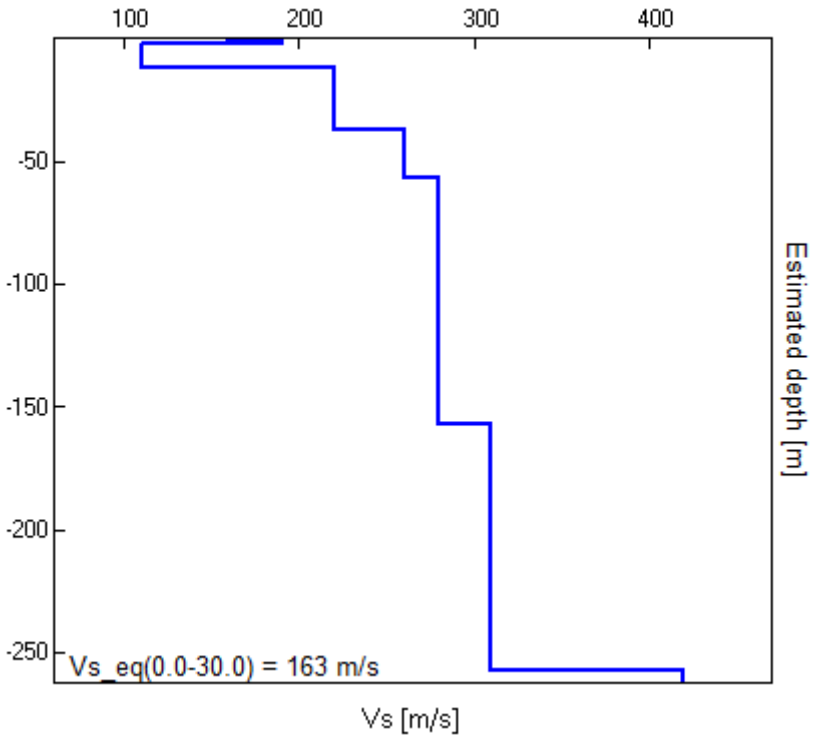


EXPERIMENTAL vs. SYNTHETIC H/V



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	160	0.45
2.00	1.00	190	0.45
12.00	10.00	110	0.49
37.00	25.00	220	0.49
57.00	20.00	260	0.49
157.00	100.00	280	0.49
257.00	100.00	310	0.49
inf.	inf.	420	0.49

Vs_eq(0.0-30.0) = 163 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 163 m/s
Vs [m/s]
Estimated depth [m]

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 63.94 ± 7.34 Hz (in the range 0.0 - 64.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	63.94 > 1.00	OK	
$n_c(f_0) > 200$	45395.6 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 513 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	59.75 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	2.52 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.11485| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	7.34321 < 3.19688		NO
$\sigma_A(f_0) < \theta(f_0)$	0.4168 < 1.58	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

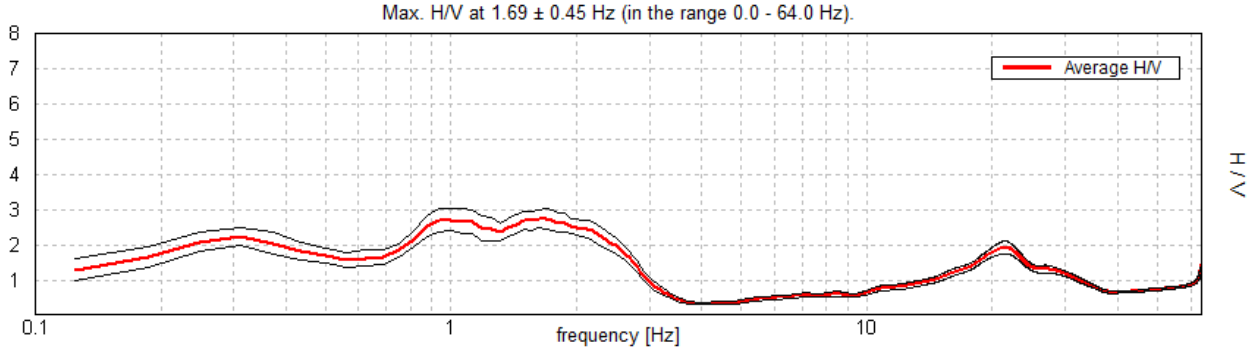
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FISCAGLIA_SE_HVSR4

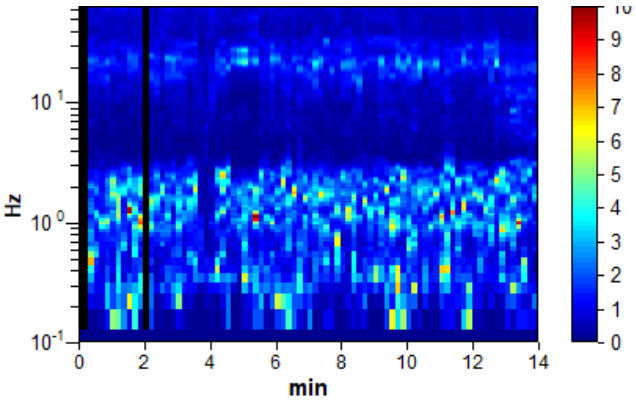
Instrument: TZ3-0008/01-13
Data format: 32 bit
Full scale [mV]: 51
Start recording: 22/01/2026 10:48:08 End recording: 22/01/2026 11:02:08
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

Trace length: 0h14'00''. Analyzed 96% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 10 s
Smoothing type: Triangular window
Smoothing: 10%

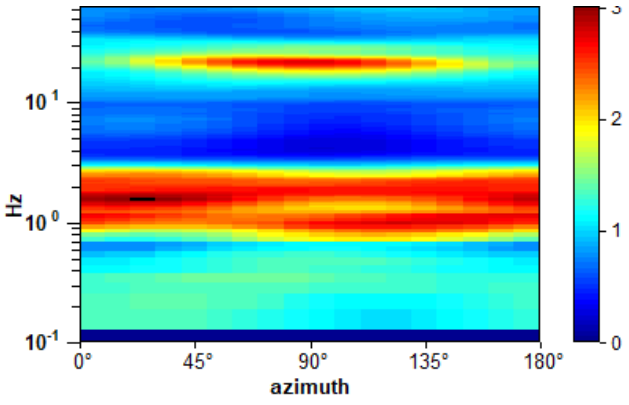
HORIZONTAL TO VERTICAL SPECTRAL RATIO



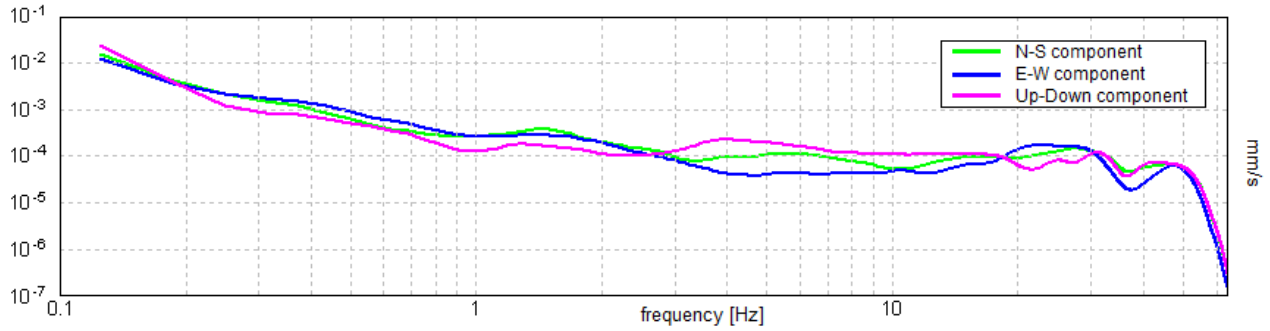
H/V TIME HISTORY



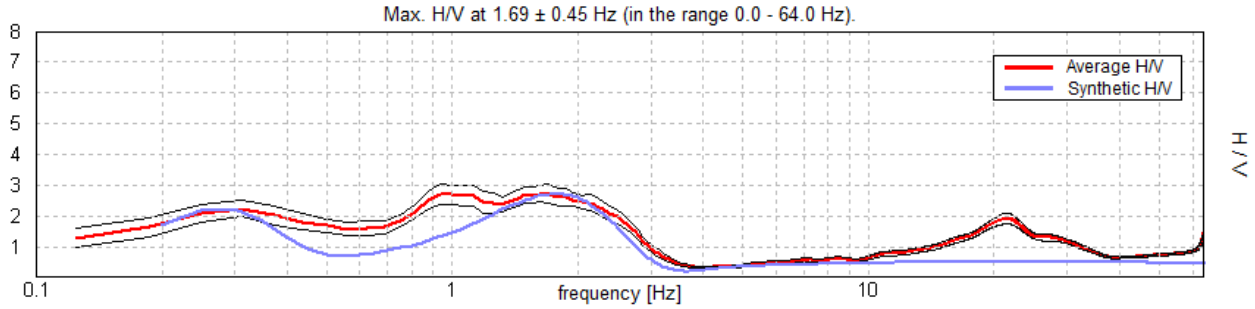
DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA

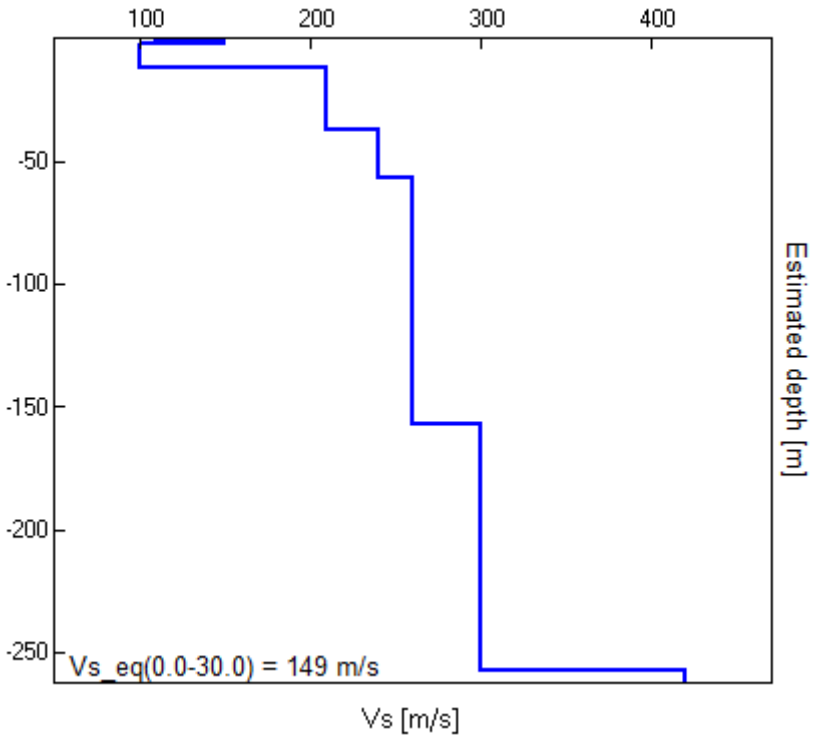


EXPERIMENTAL vs. SYNTHETIC H/V



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]	Poisson ratio
1.00	1.00	110	0.42
2.00	1.00	150	0.42
12.00	10.00	100	0.49
37.00	25.00	210	0.49
57.00	20.00	240	0.49
157.00	100.00	260	0.49
257.00	100.00	300	0.49
inf.	inf.	420	0.49

Vs_eq(0.0-30.0) = 149 m/s


100
200
300
400
-50
-100
-150
-200
-250
Vs_eq(0.0-30.0) = 149 m/s
Vs [m/s]
Estimated depth [m]

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 1.69 ± 0.45 Hz (in the range 0.0 - 64.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	1.69 > 1.00	OK	
$n_c(f_0) > 200$	1366.9 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 41 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	2.813 Hz	OK	
$A_0 > 2$	2.74 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.26692| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.45043 < 0.16875		NO
$\sigma_A(f_0) < \theta(f_0)$	0.2976 < 1.78	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Indagini penetrometriche statiche (CPTU)

Questa tipologia di prova è un'evoluzione della prova penetrometrica statica con punta meccanica (CPT). La prova consiste nell'infissione nel terreno di una batteria di aste precedute da una punta dotata di trasduttori e filtro poroso. Queste caratteristiche permettono alla prova di registrare in continuo valori di resistenza alla punta Qc, resistenza laterale Fs, pressione neutra u e angolo di inclinazione della batteria di aste. Un'indicazione della stratigrafia dei terreni indagati è fornita dal rapporto tra la resistenza all'infissione statica della punta (Qc) e la resistenza per attrito laterale locale (Fs) che il materiale sviluppa sul manicotto della punta meccanica. Nell'interpretazione quantitativa dei risultati, che consente di determinare le grandezze di alcuni parametri geotecnici dei terreni attraversati mediante formule empiriche, si è tenuto in considerazione che le prove sono assimilabili a prove rapide in condizioni di drenaggio impedito. Pertanto, in terreni coesivi, si ottiene una stima della coesione non drenata Cu. Nei terreni sabbiosi è possibile valutare il grado di addensamento e una stima del valore di angolo di attrito.

Le prove penetrometrica sono state eseguite utilizzando un penetrometro statico da 20 t munito di punta elettrica e piezocono. L'interpretazione delle prove è stata eseguita utilizzando il software CPT-eT distribuito dalla società Geologismiki.

NOTA: è vietata qualsiasi copia, riproduzione o divulgazione, totale o parziale, senza autorizzazione scritta. Tutti i diritti riservati.

Di seguito le formule utilizzate:

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

$I_c \leq 4.00$ and $I_c > 3.27$ 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, Es (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 (%) ::

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

:: State Parameter, ψ ::

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

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

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

(applicable only to SBT_n: 5, 6, 7 and 8)

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

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

:: Remolded undrained shear strength, Su(rem) (kPa) ::

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$

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

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_t}$$

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

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

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

(applicable for $0.10 < B_q < 1.00$)

Risultati

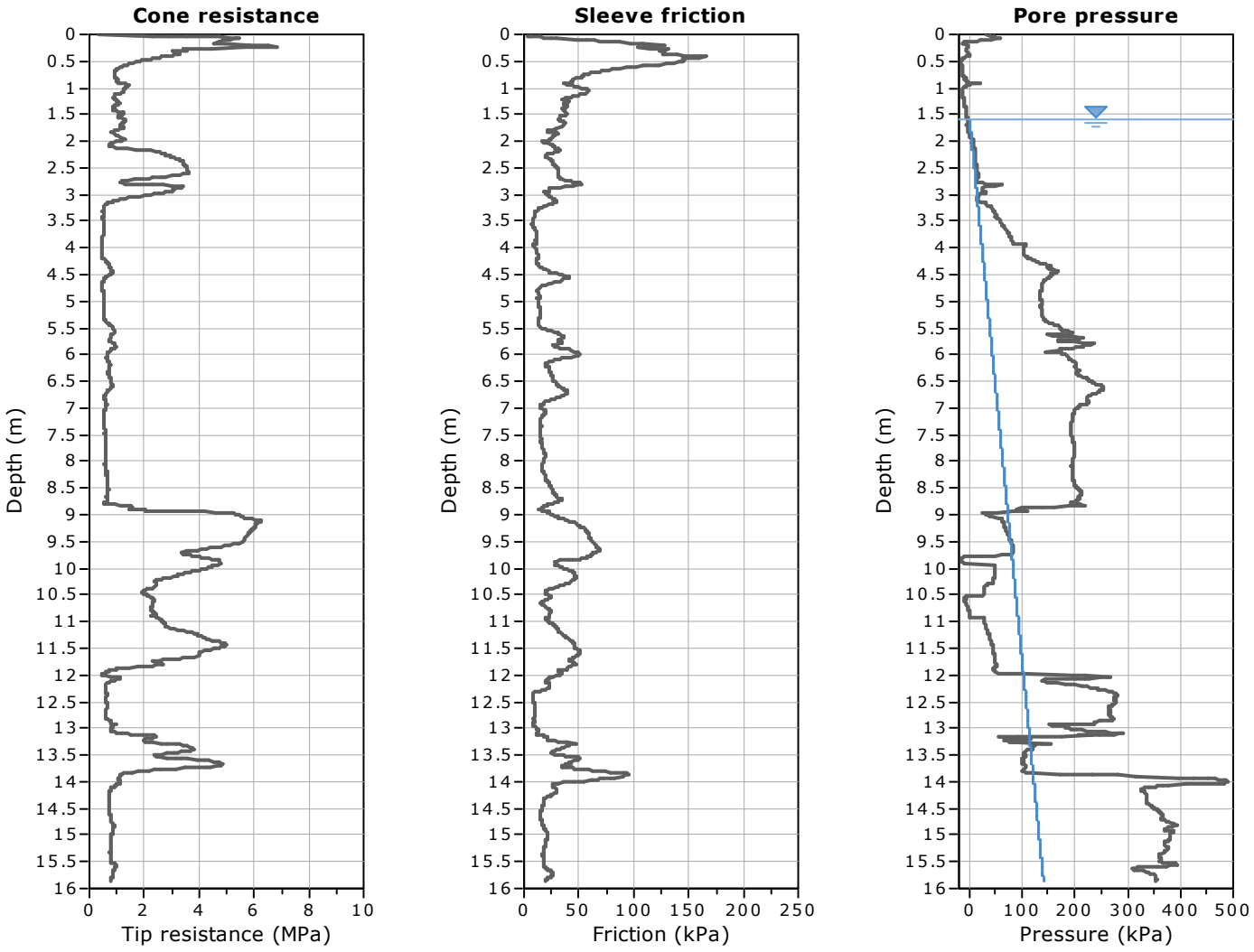
Si riportano di seguito i risultati ottenuti.

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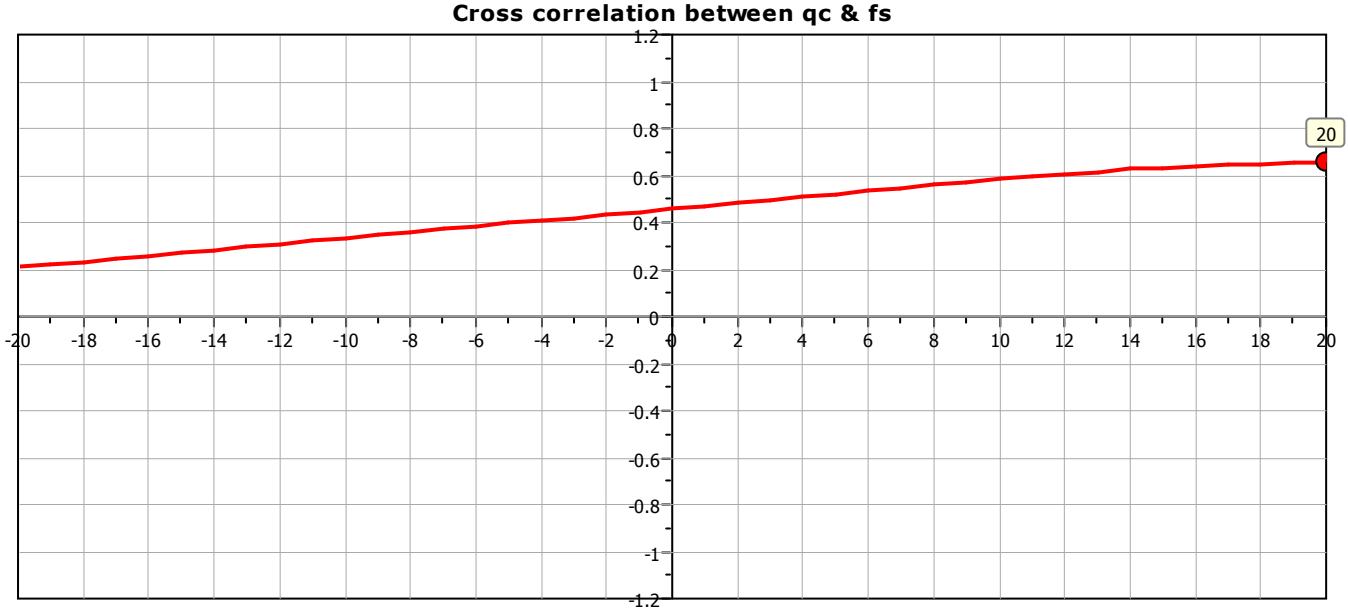
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

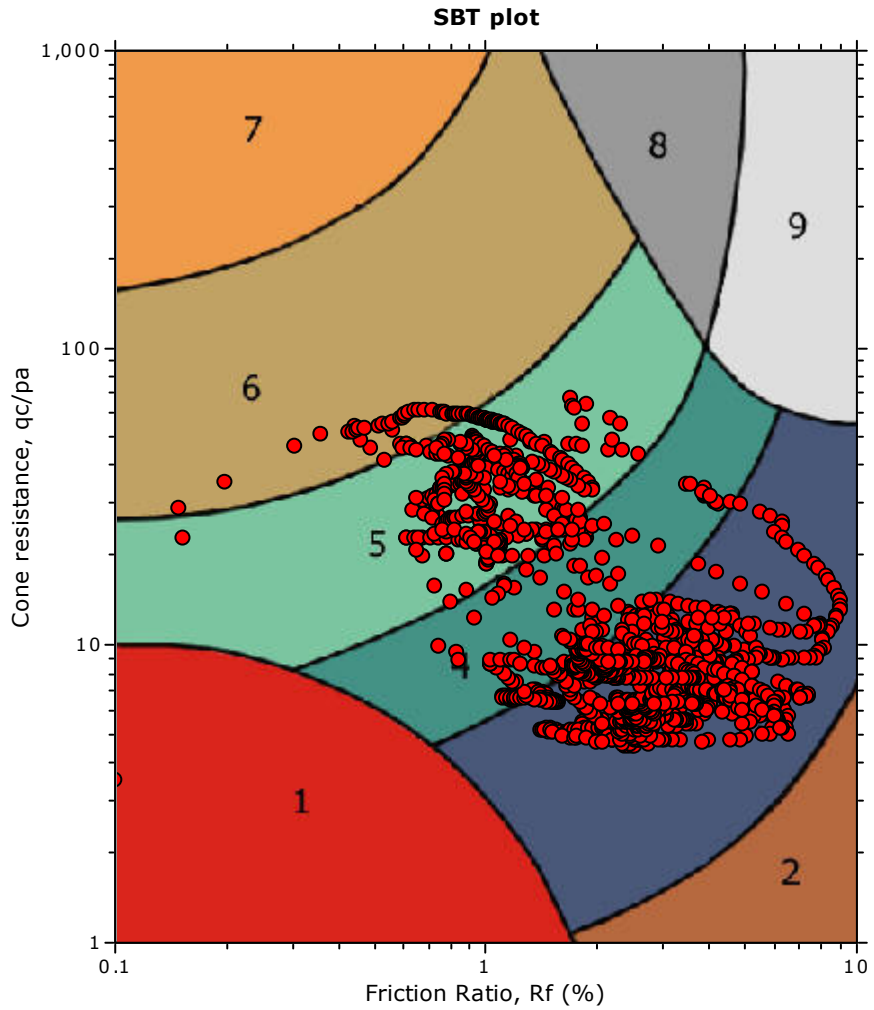


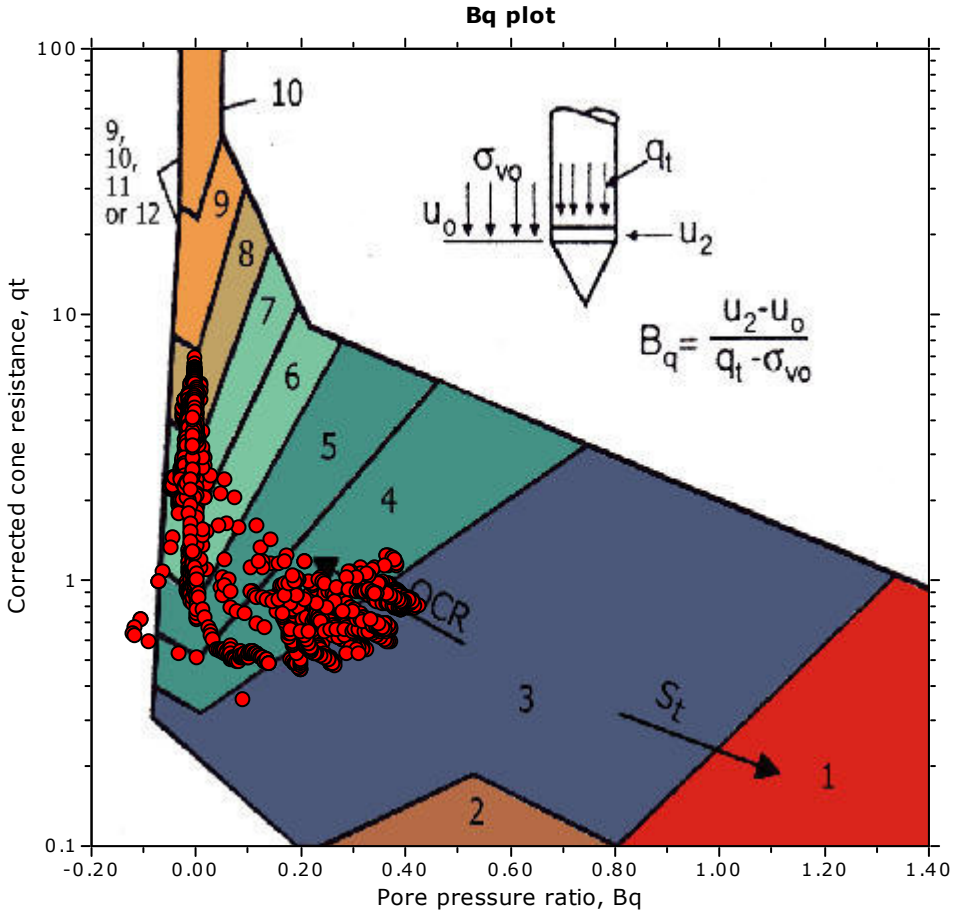
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

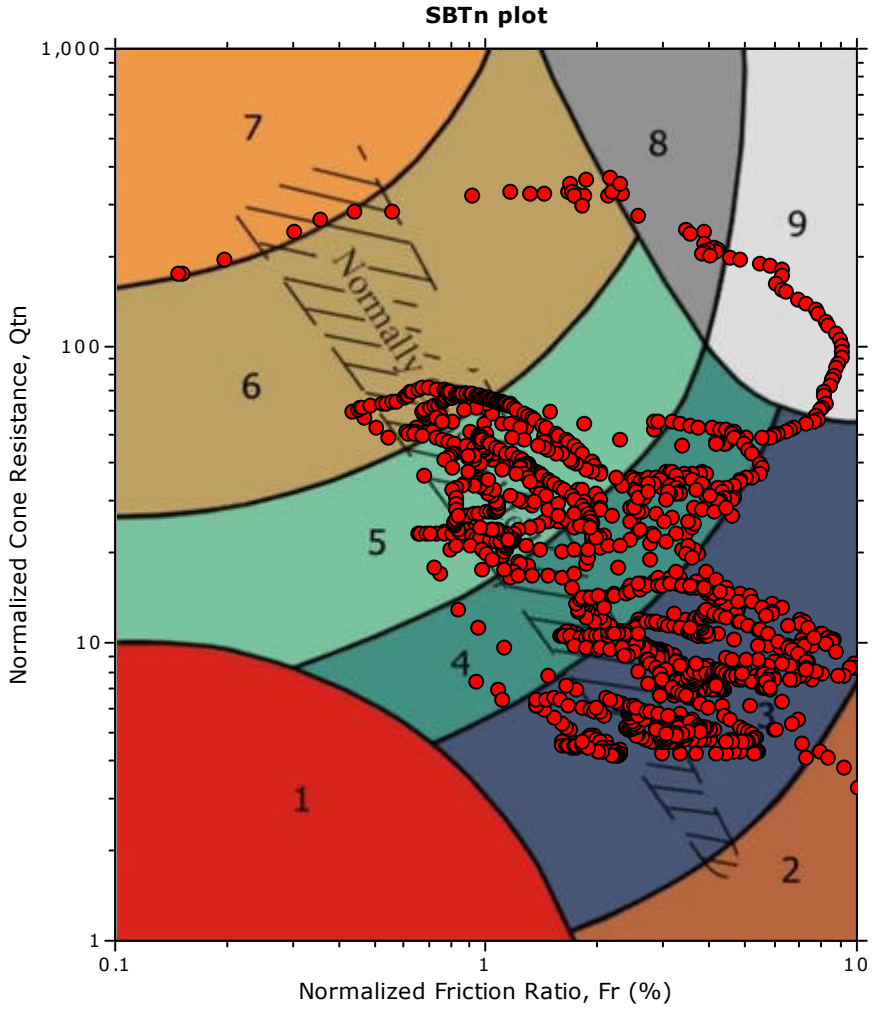
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

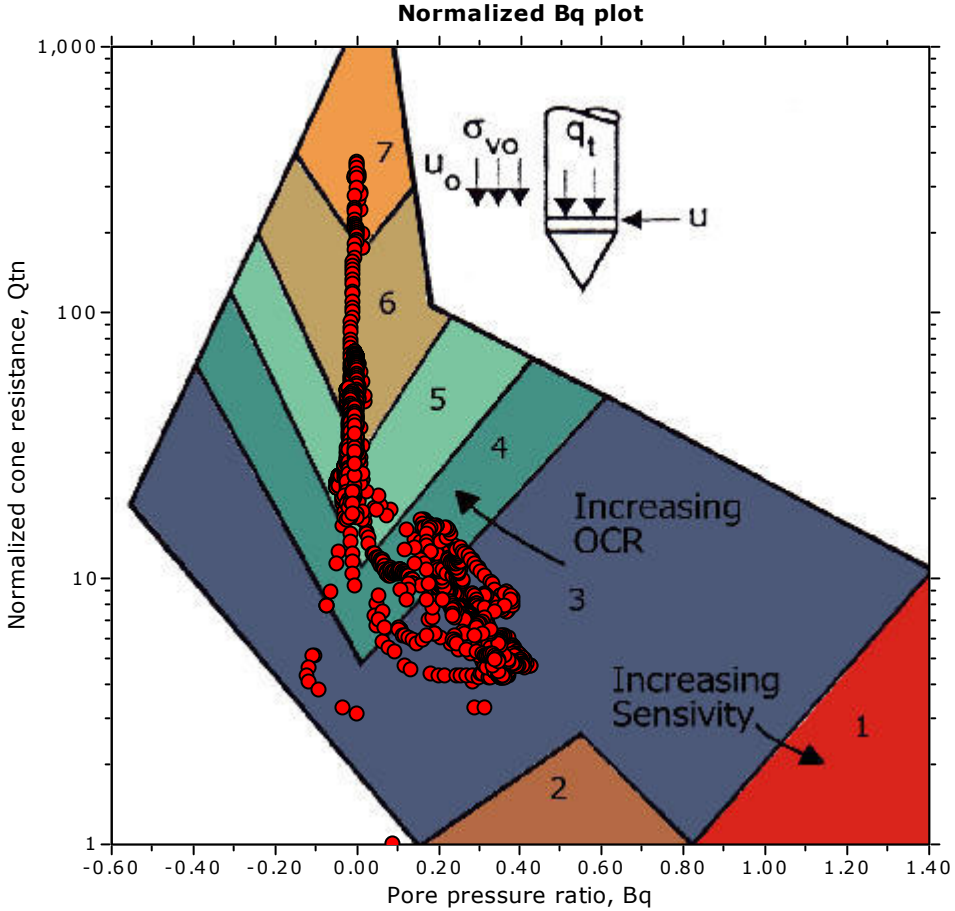
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

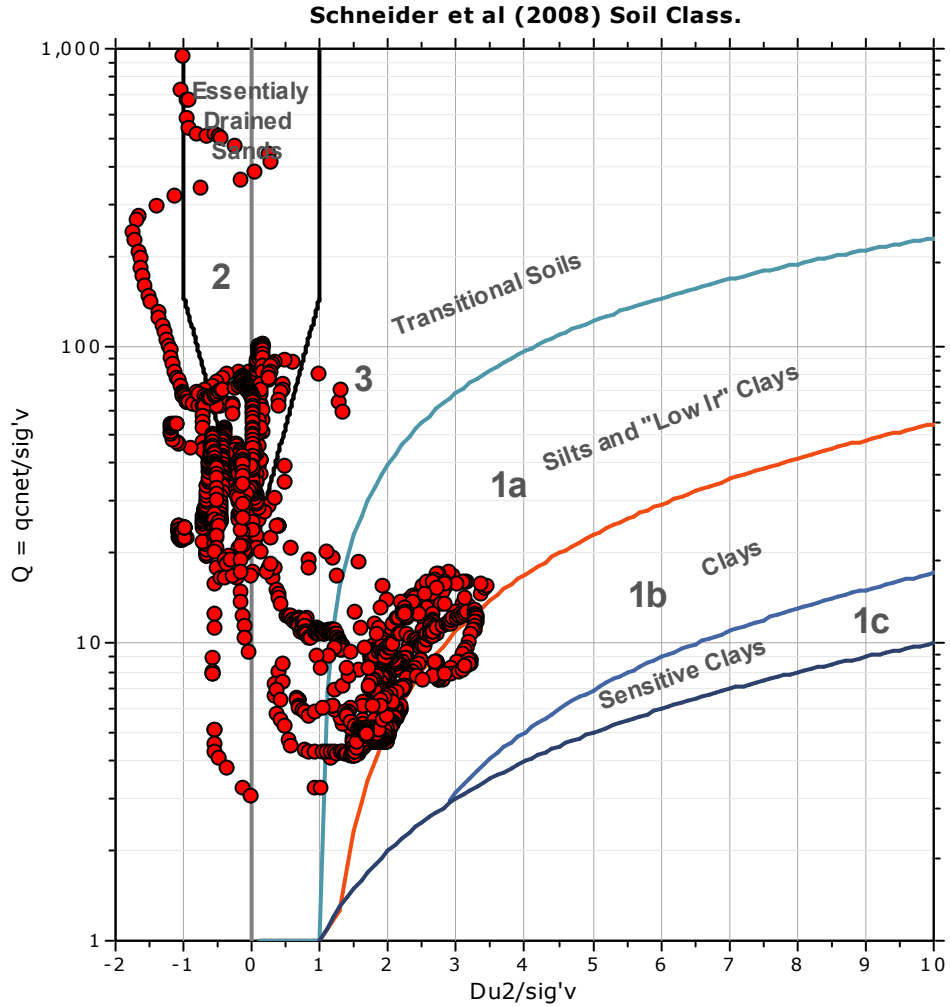
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

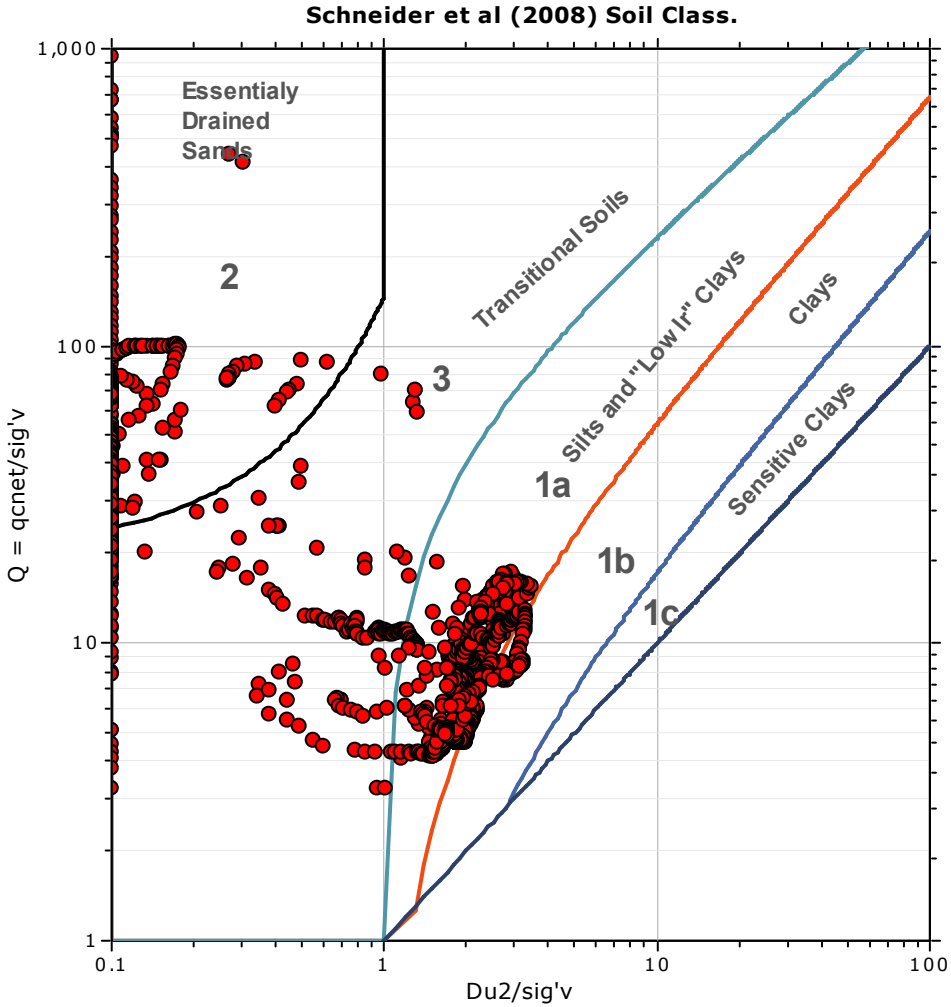
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

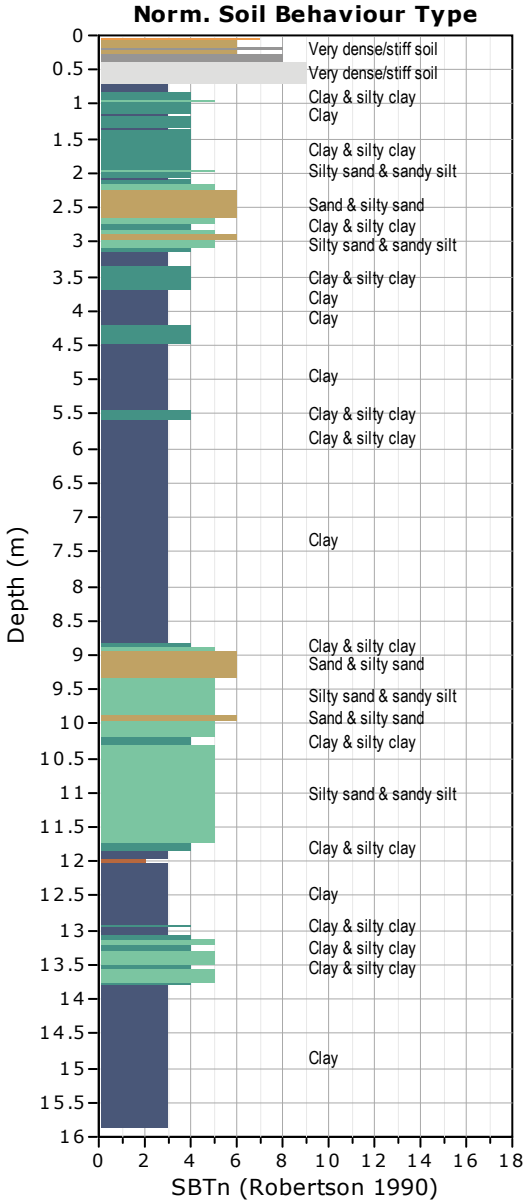


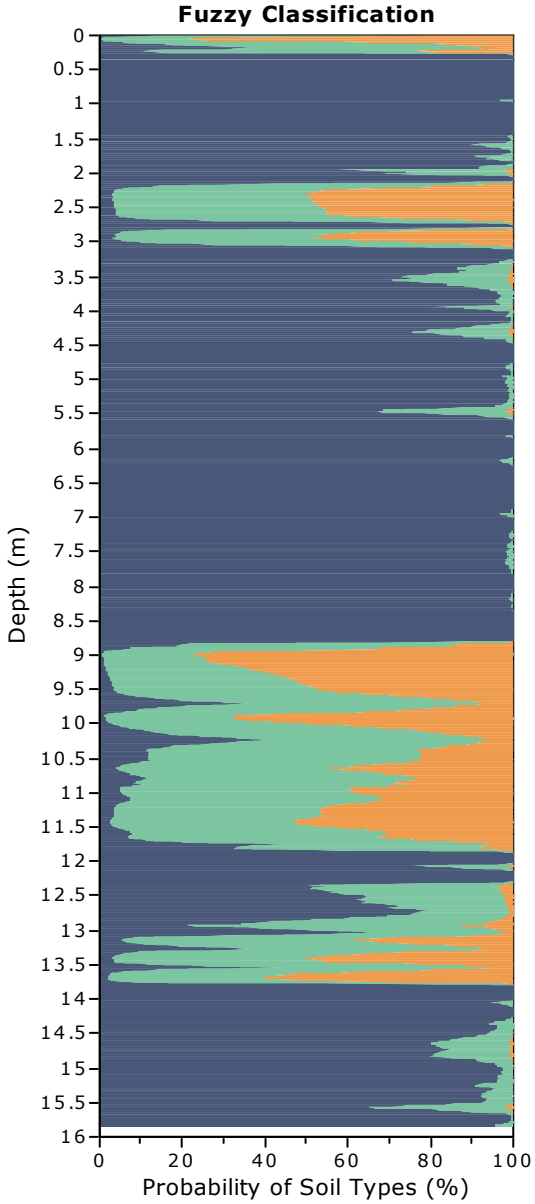


RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

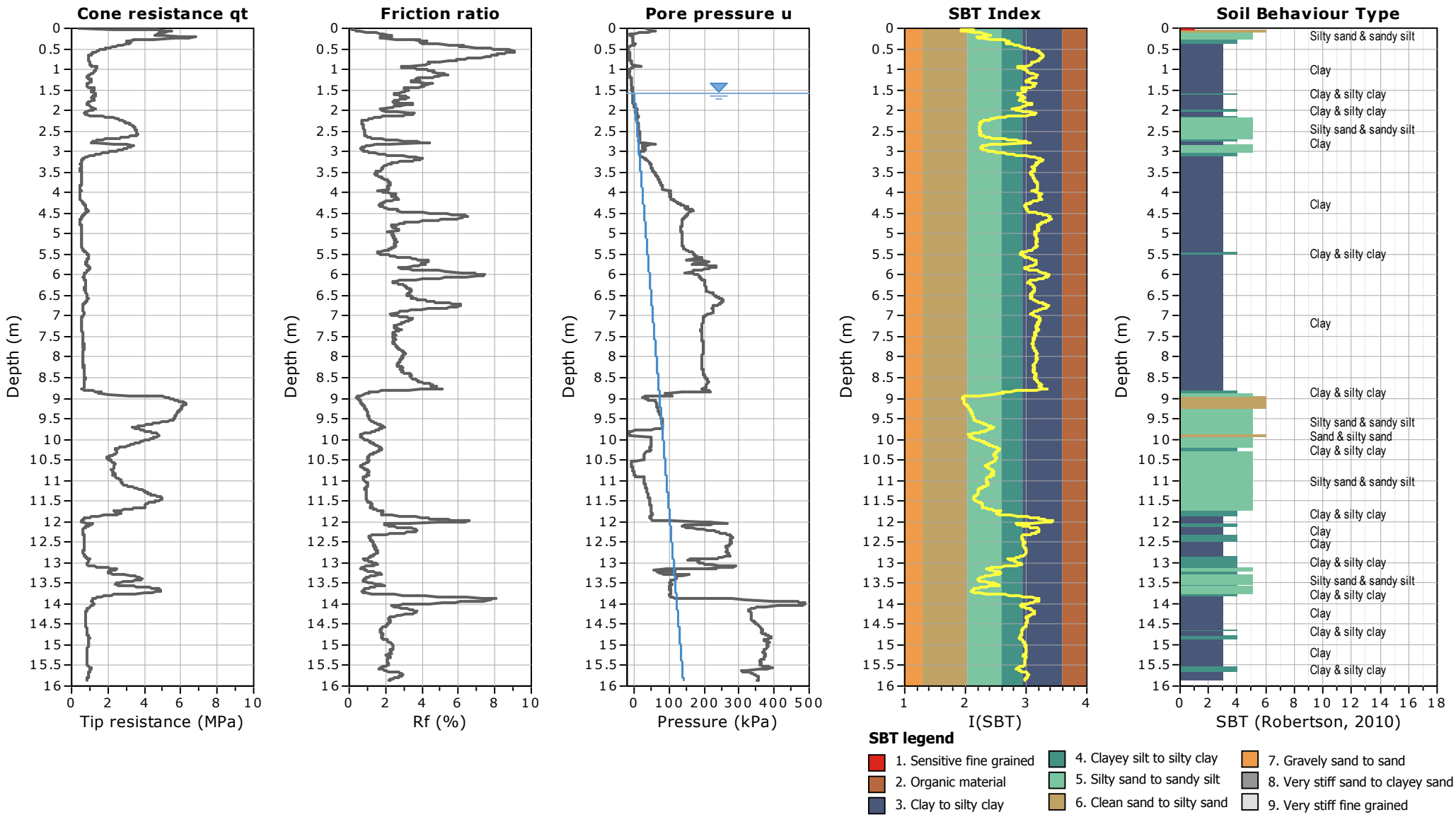




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CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

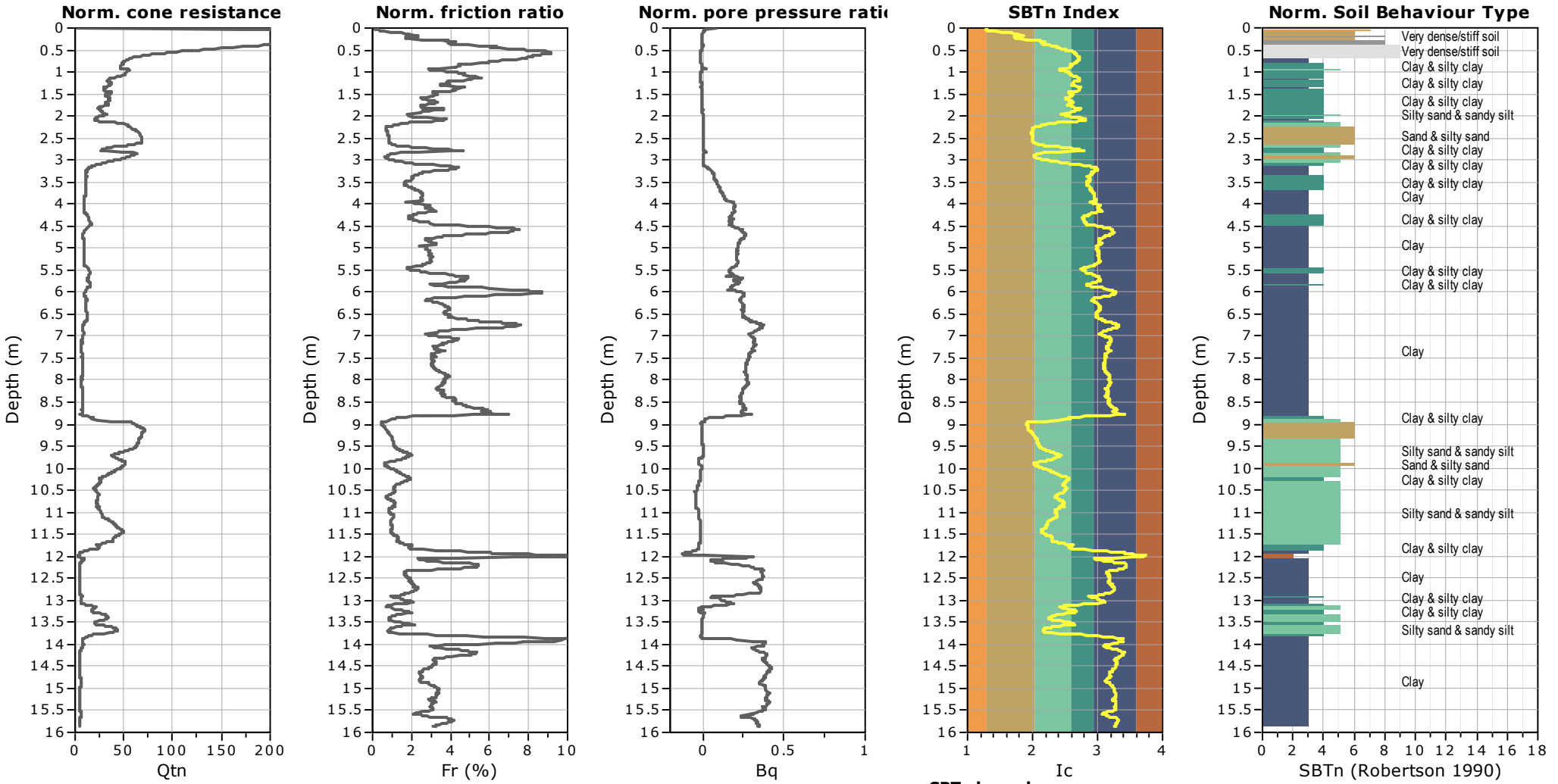
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



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rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

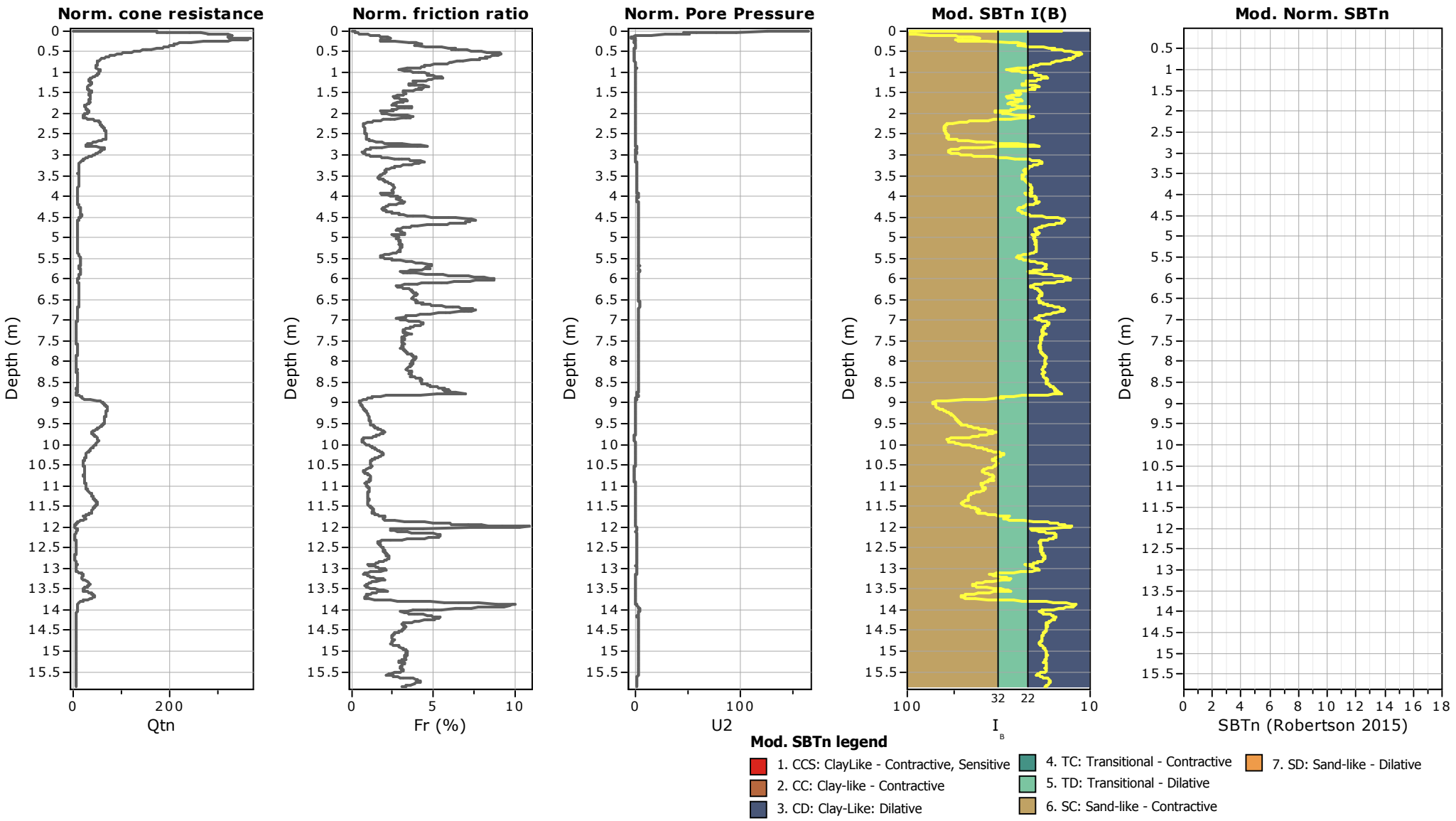
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

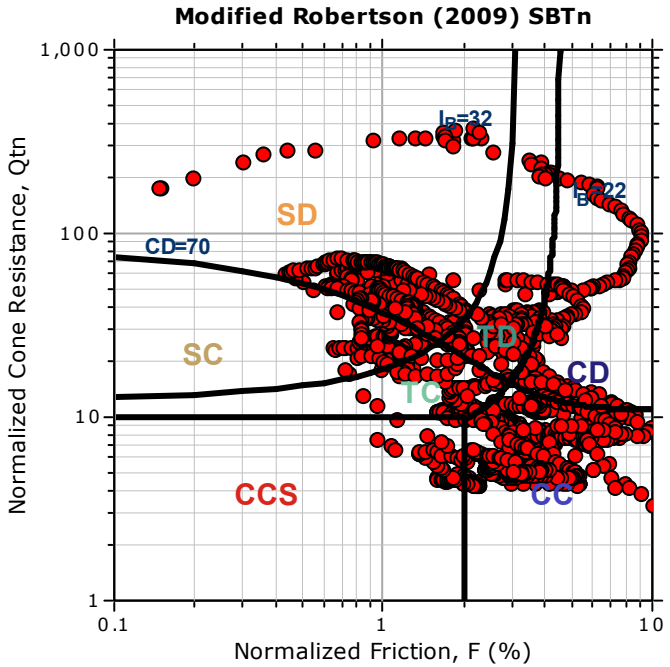


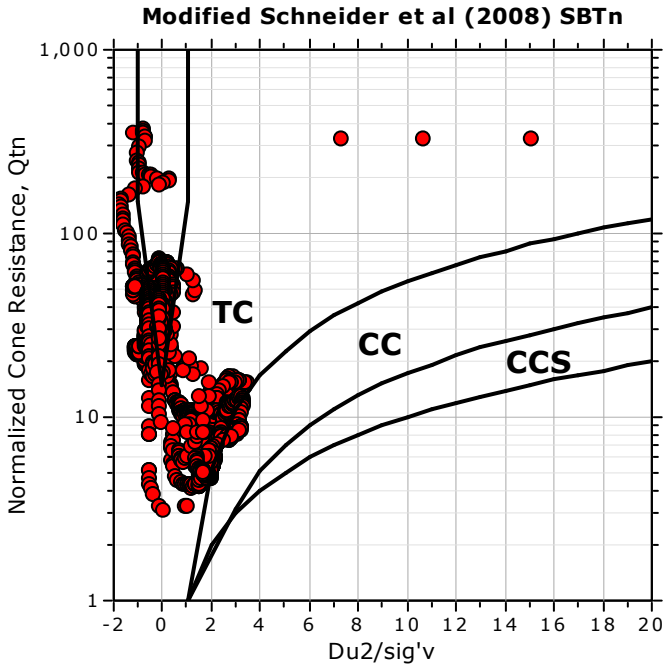
RDR SrL
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rocco.carbonella@fastwebnet.it

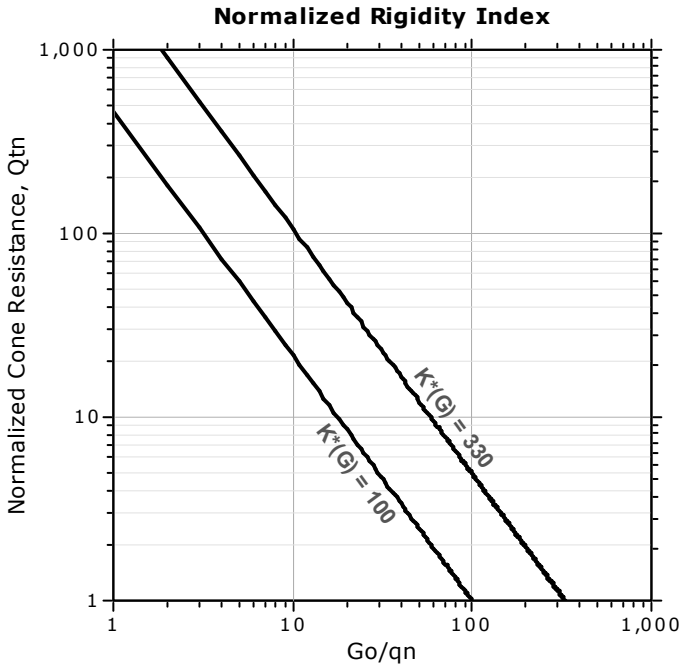
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







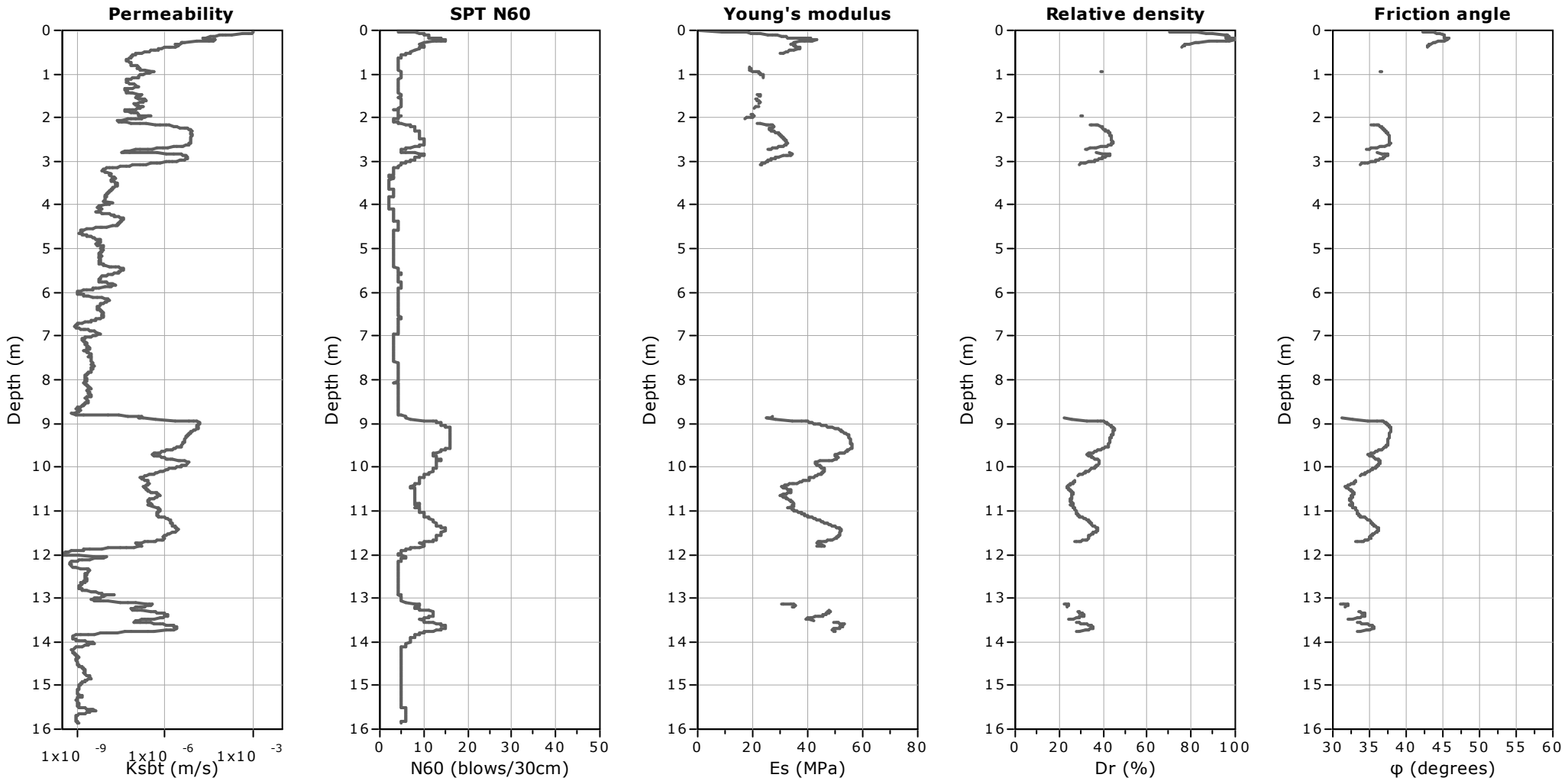
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
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CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



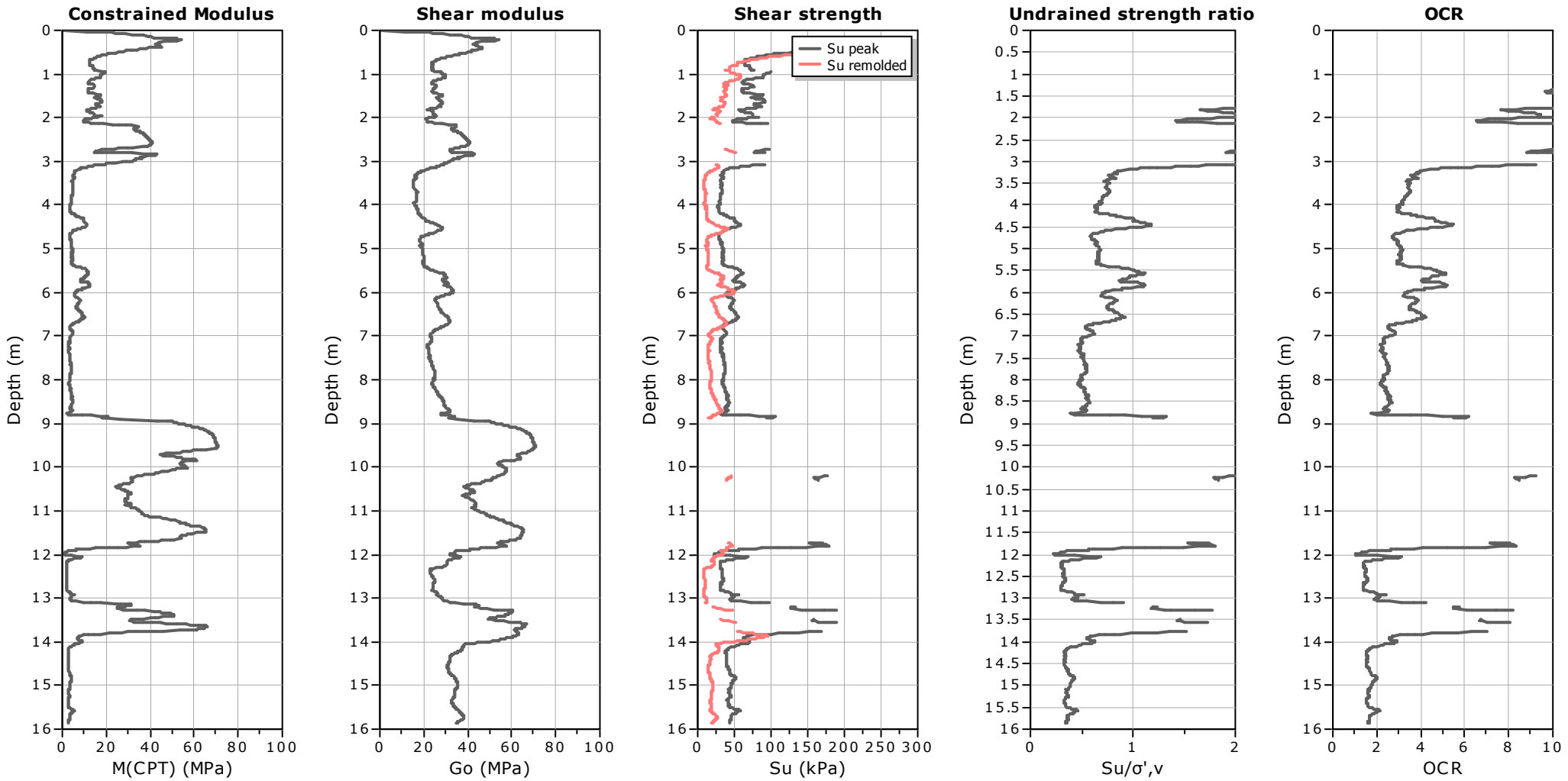
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

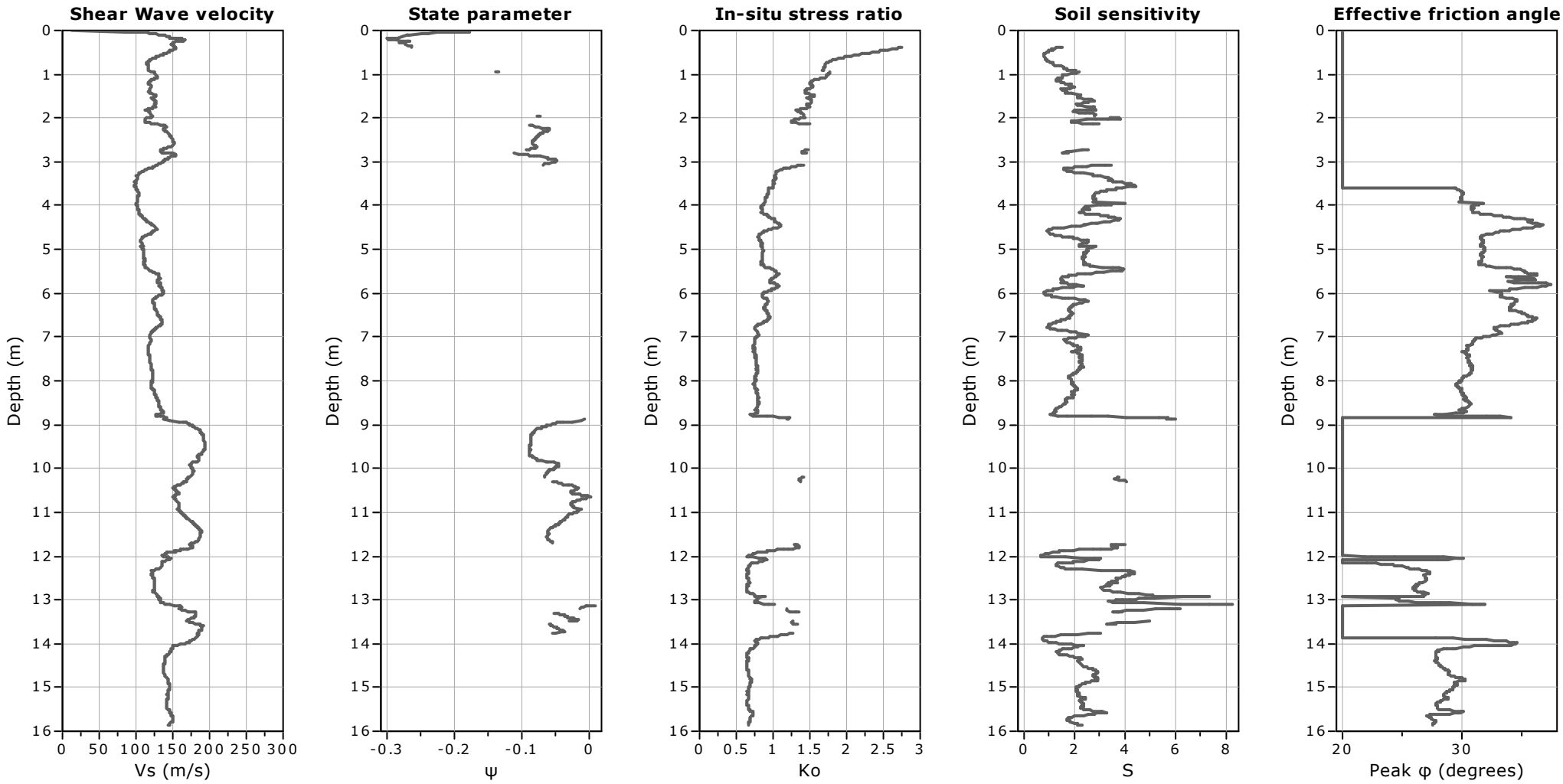
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



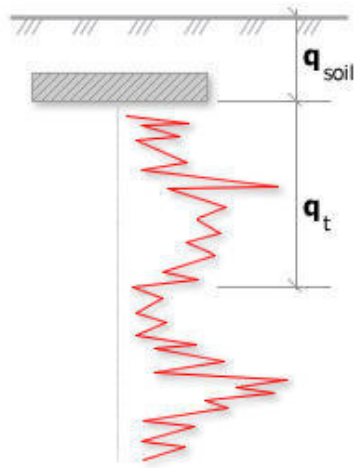
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

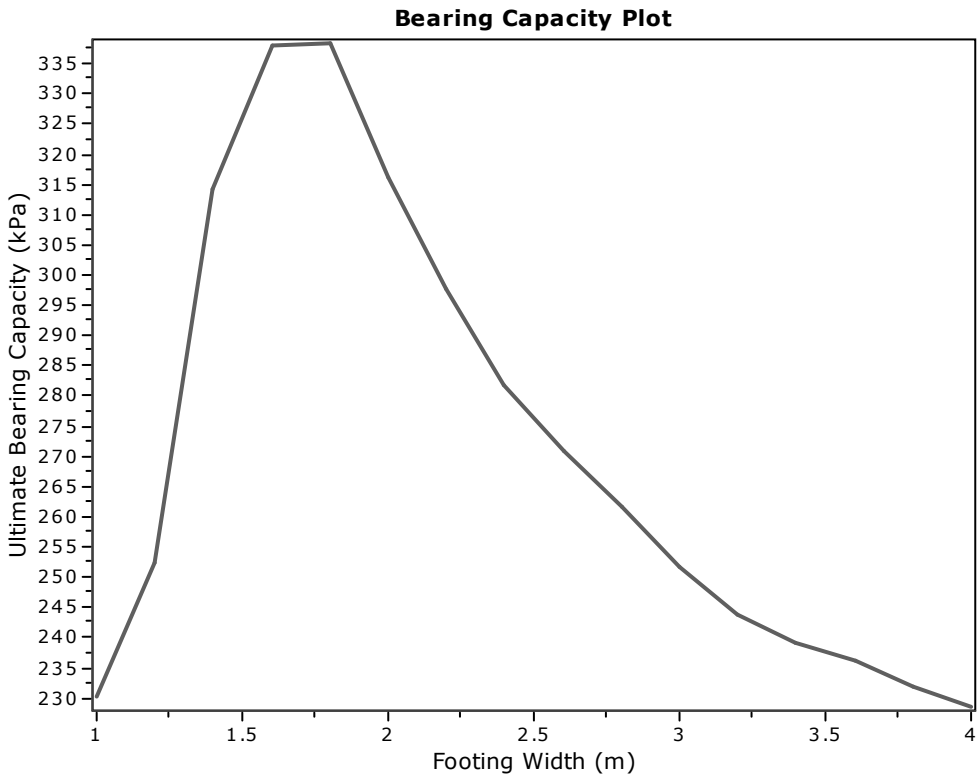
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



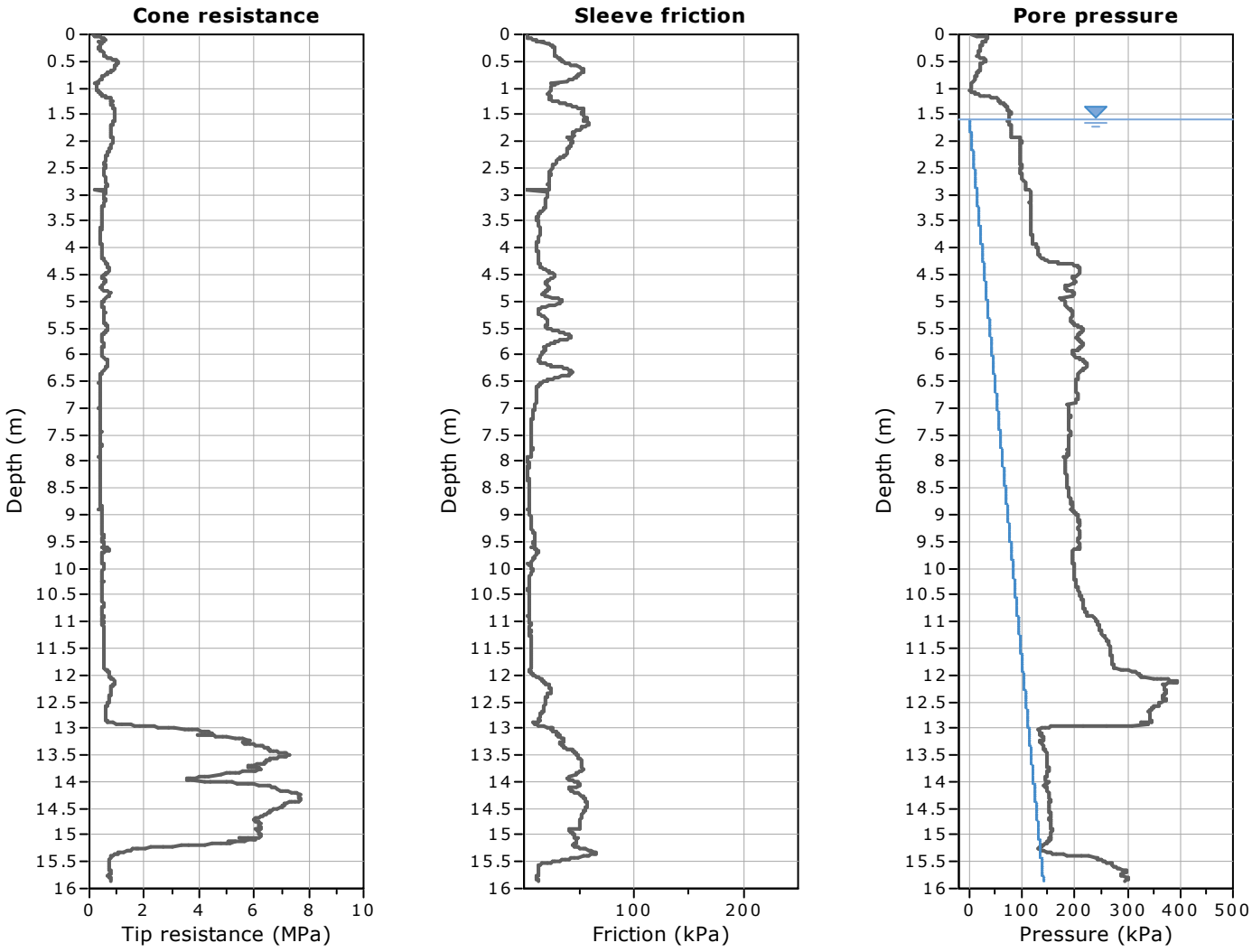
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.10	0.20	9.50	230.09
2	1.20	0.50	2.30	1.21	0.20	9.50	252.47
3	1.40	0.50	2.60	1.52	0.20	9.50	314.20
4	1.60	0.50	2.90	1.64	0.20	9.50	338.03
5	1.80	0.50	3.20	1.64	0.20	9.50	338.35
6	2.00	0.50	3.50	1.53	0.20	9.50	316.06
7	2.20	0.50	3.80	1.44	0.20	9.50	297.72
8	2.40	0.50	4.10	1.36	0.20	9.50	281.85
9	2.60	0.50	4.40	1.31	0.20	9.50	270.79
10	2.80	0.50	4.70	1.26	0.20	9.50	261.64
11	3.00	0.50	5.00	1.21	0.20	9.50	251.86
12	3.20	0.50	5.30	1.17	0.20	9.50	243.84
13	3.40	0.50	5.60	1.15	0.20	9.50	239.23
14	3.60	0.50	5.90	1.13	0.20	9.50	236.24
15	3.80	0.50	6.20	1.11	0.20	9.50	231.98
16	4.00	0.50	6.50	1.10	0.20	9.50	228.58

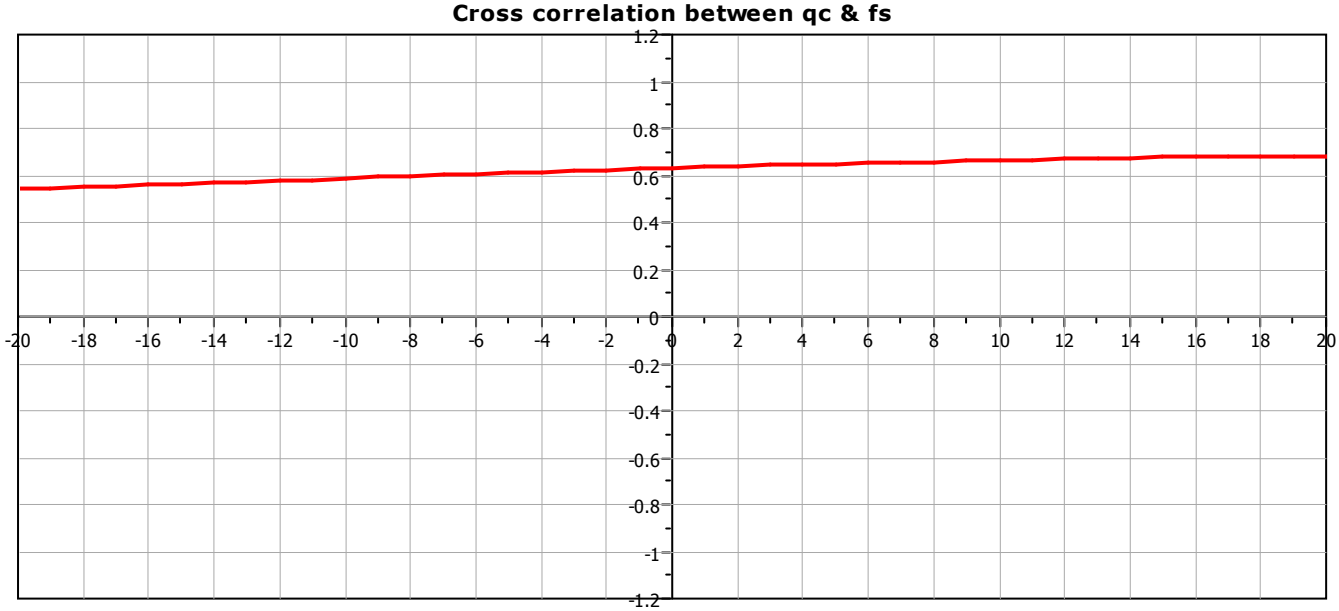
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

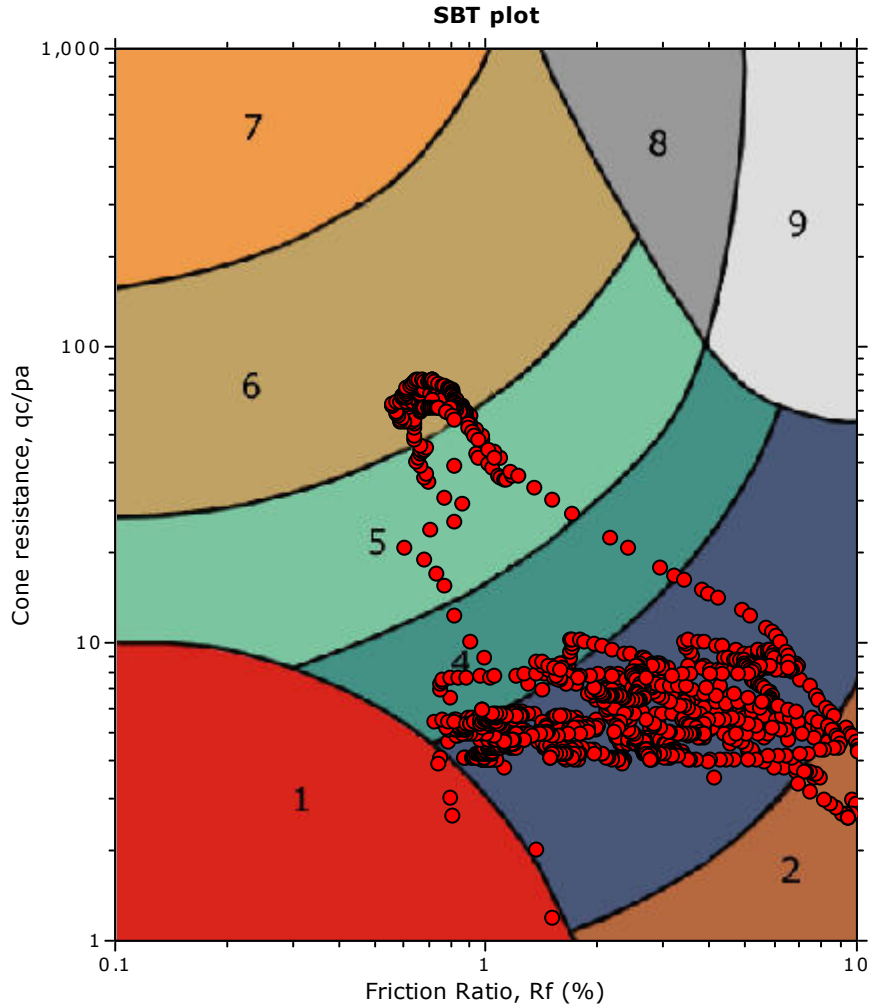


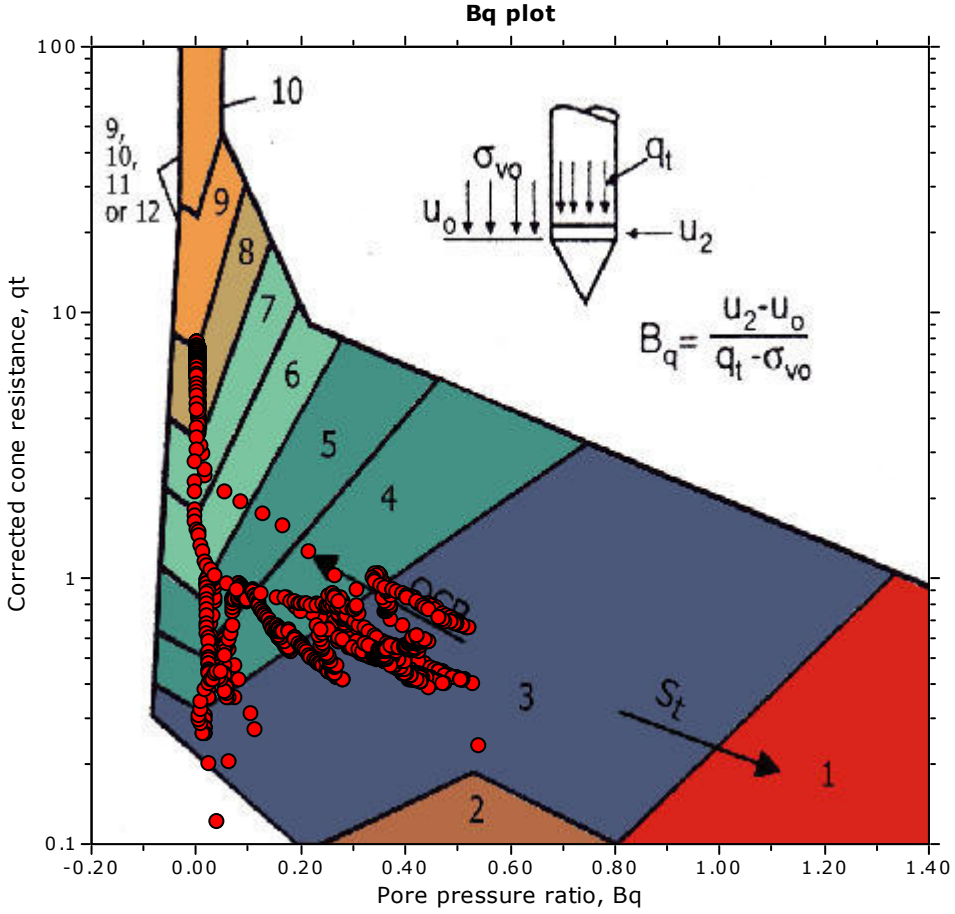
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

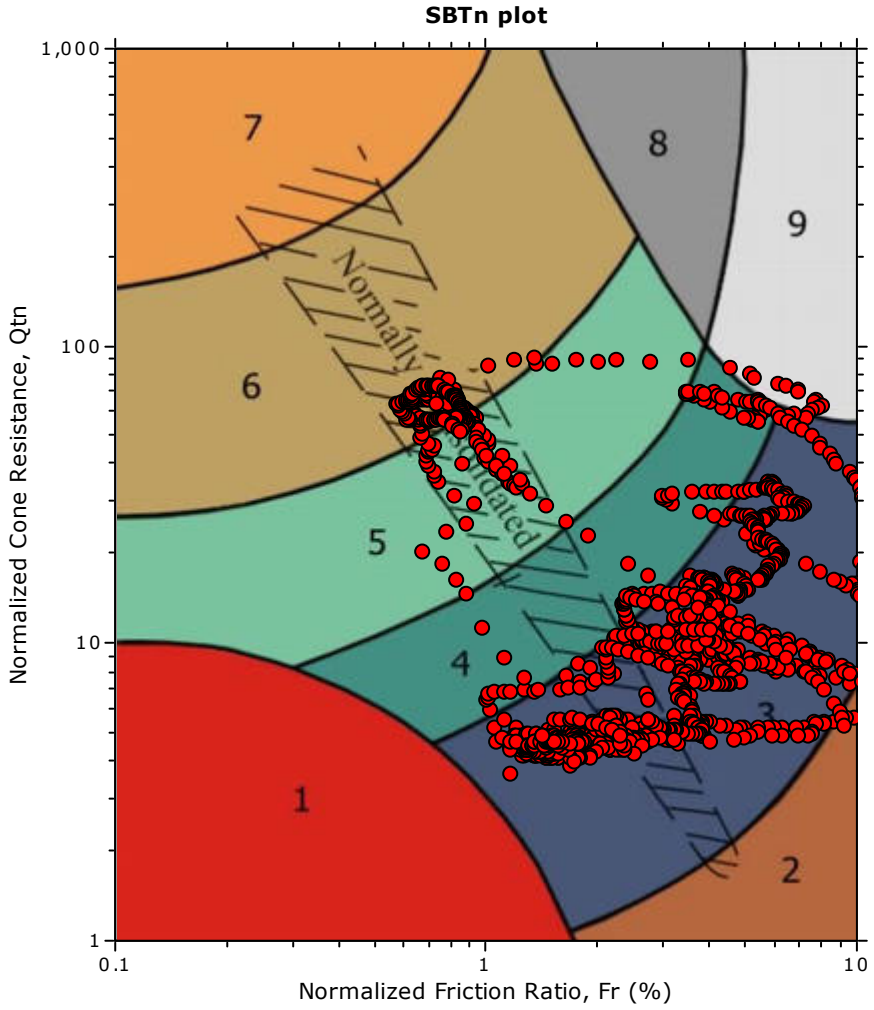
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

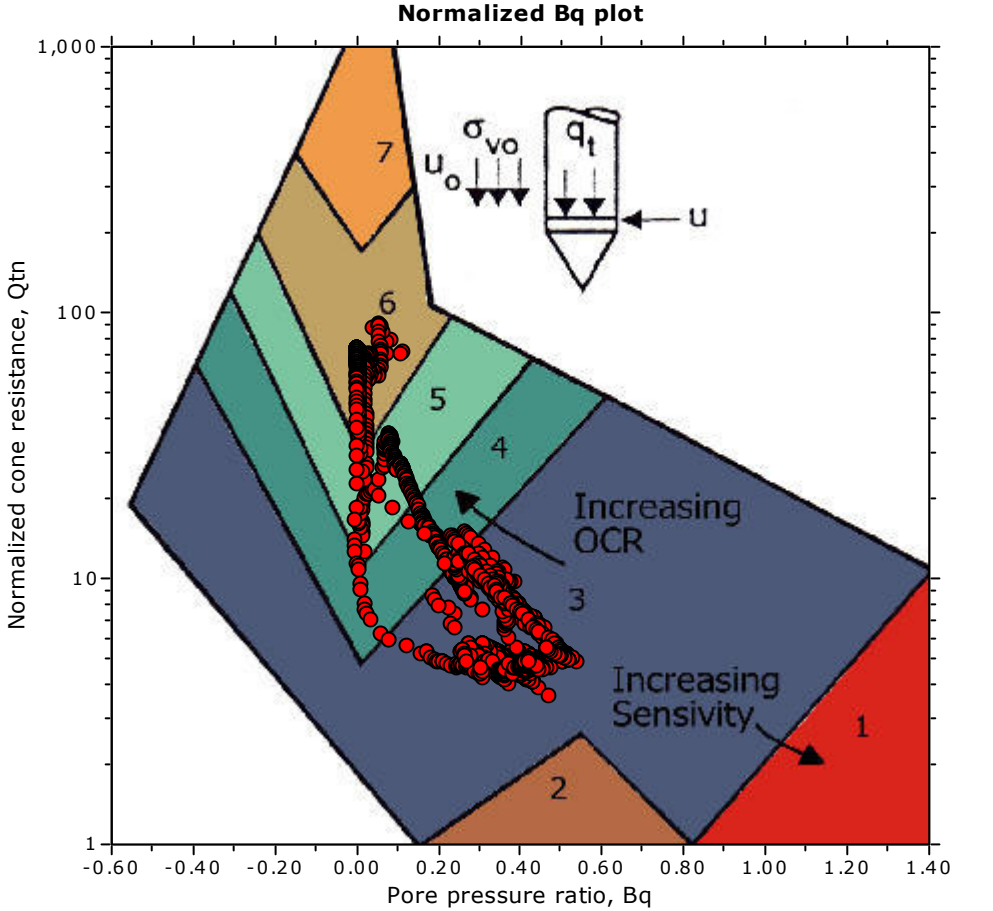
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

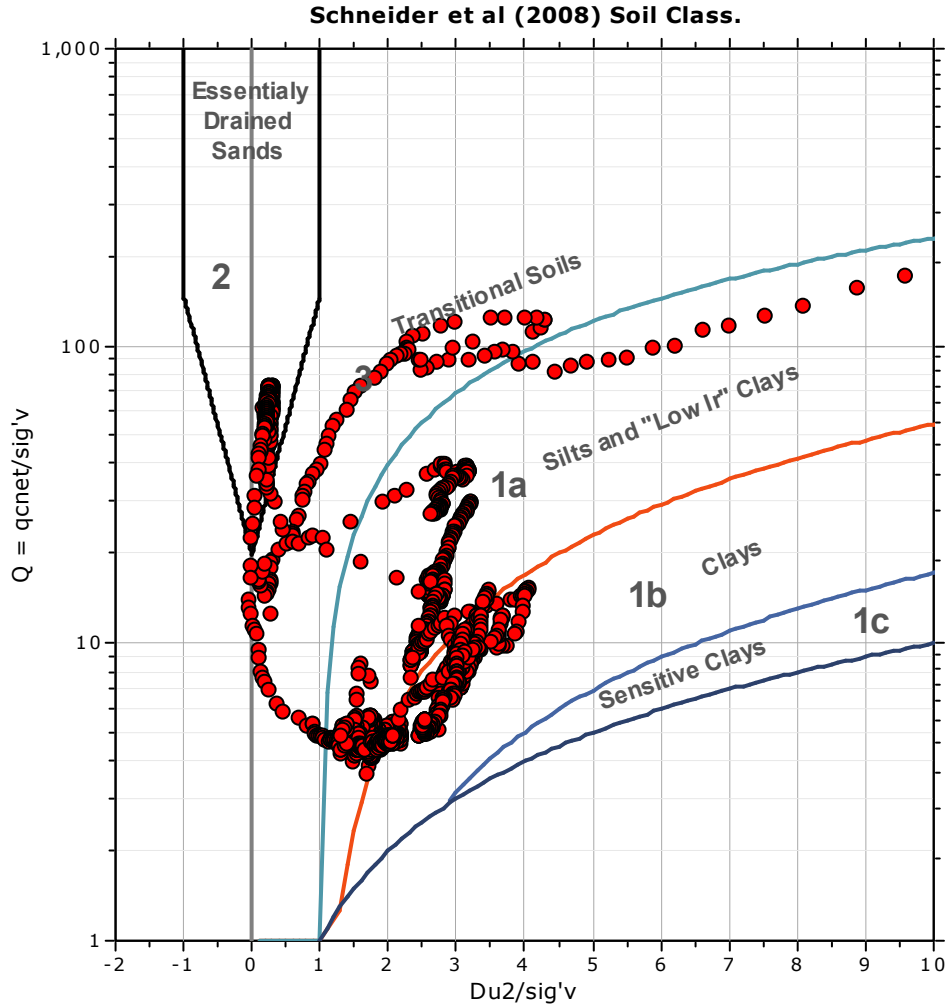
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

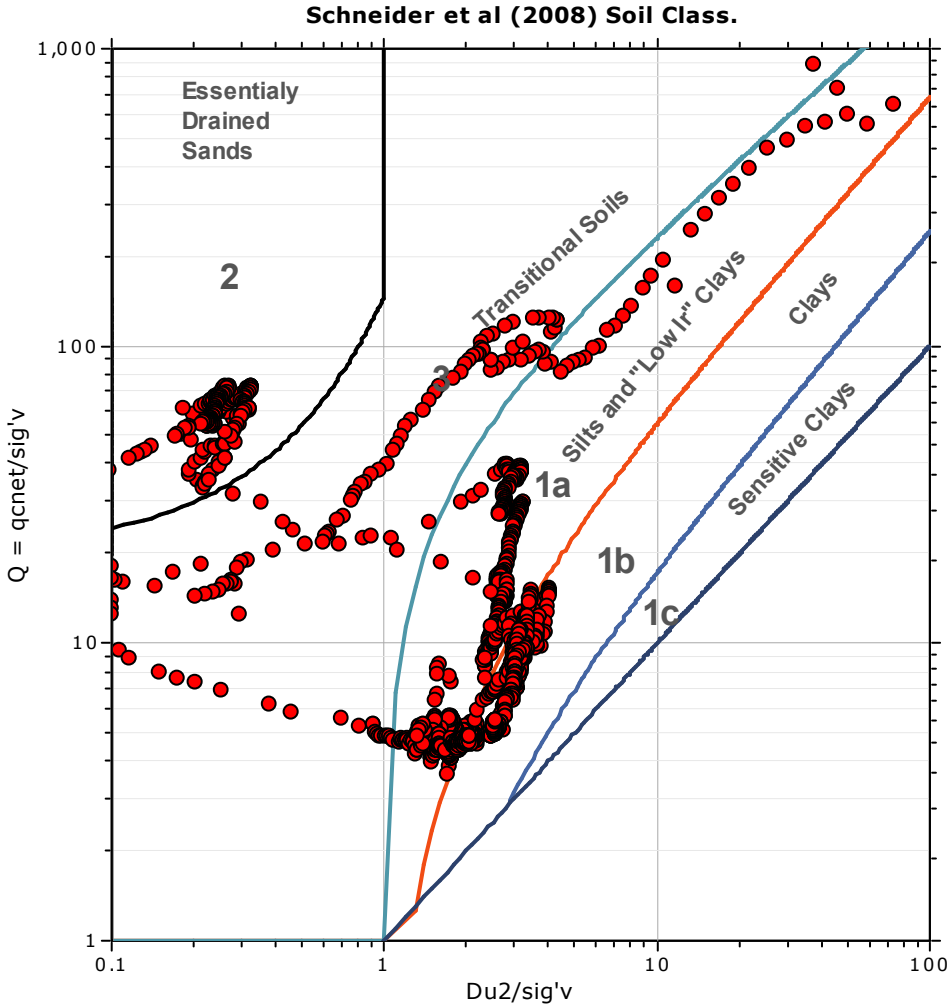
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

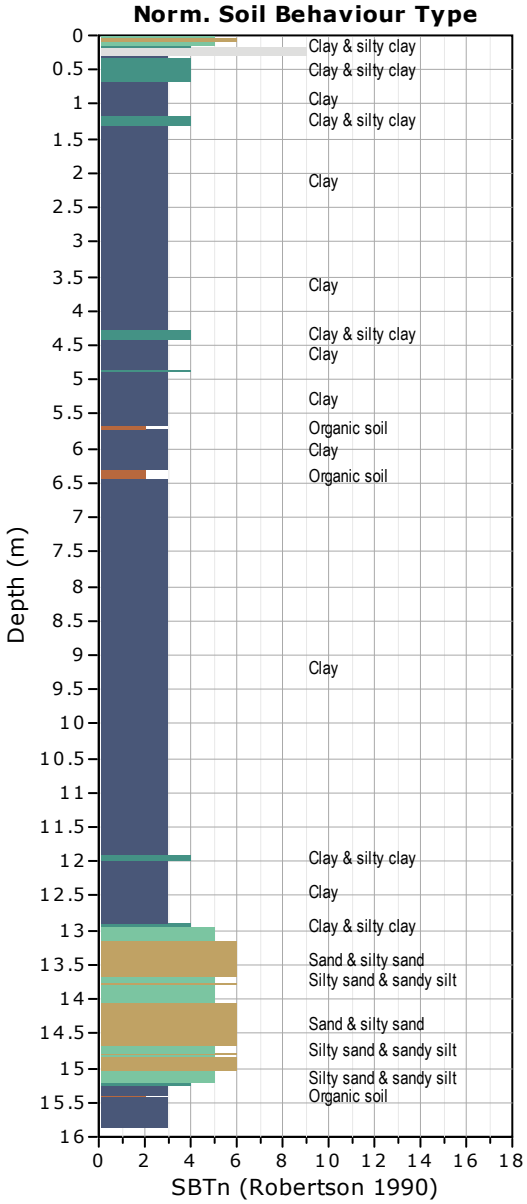


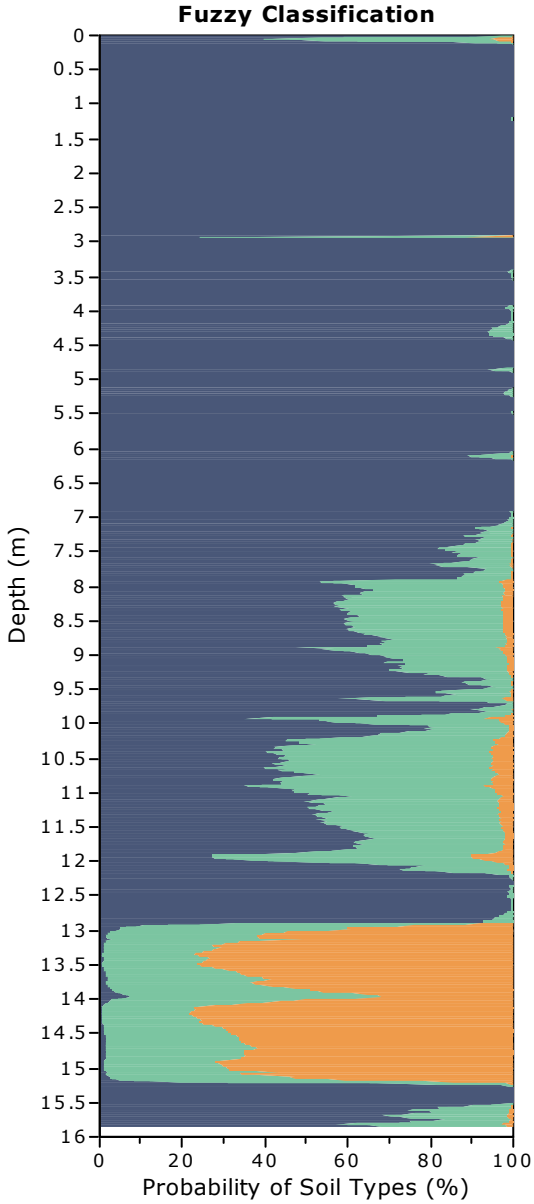


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

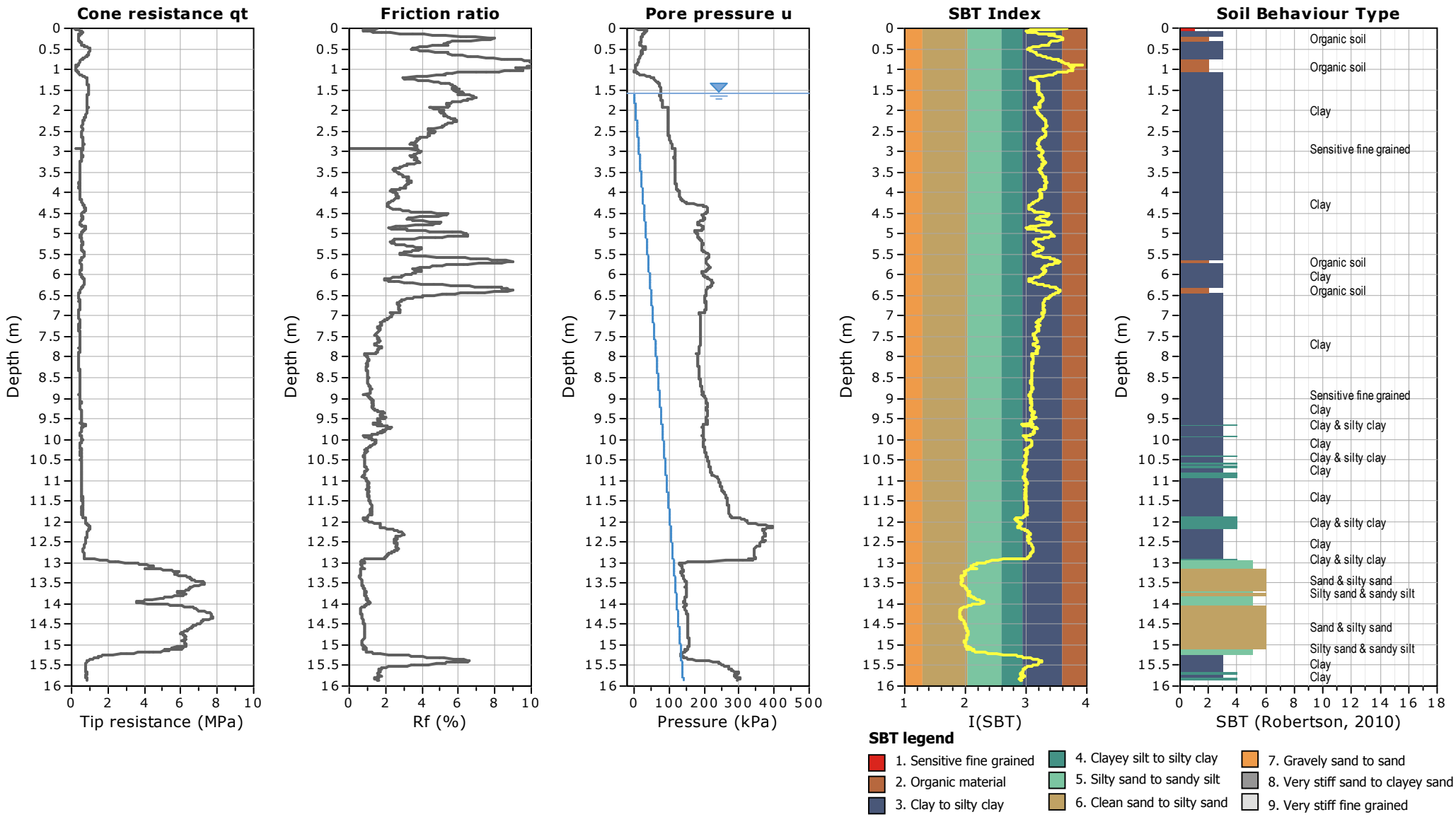




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

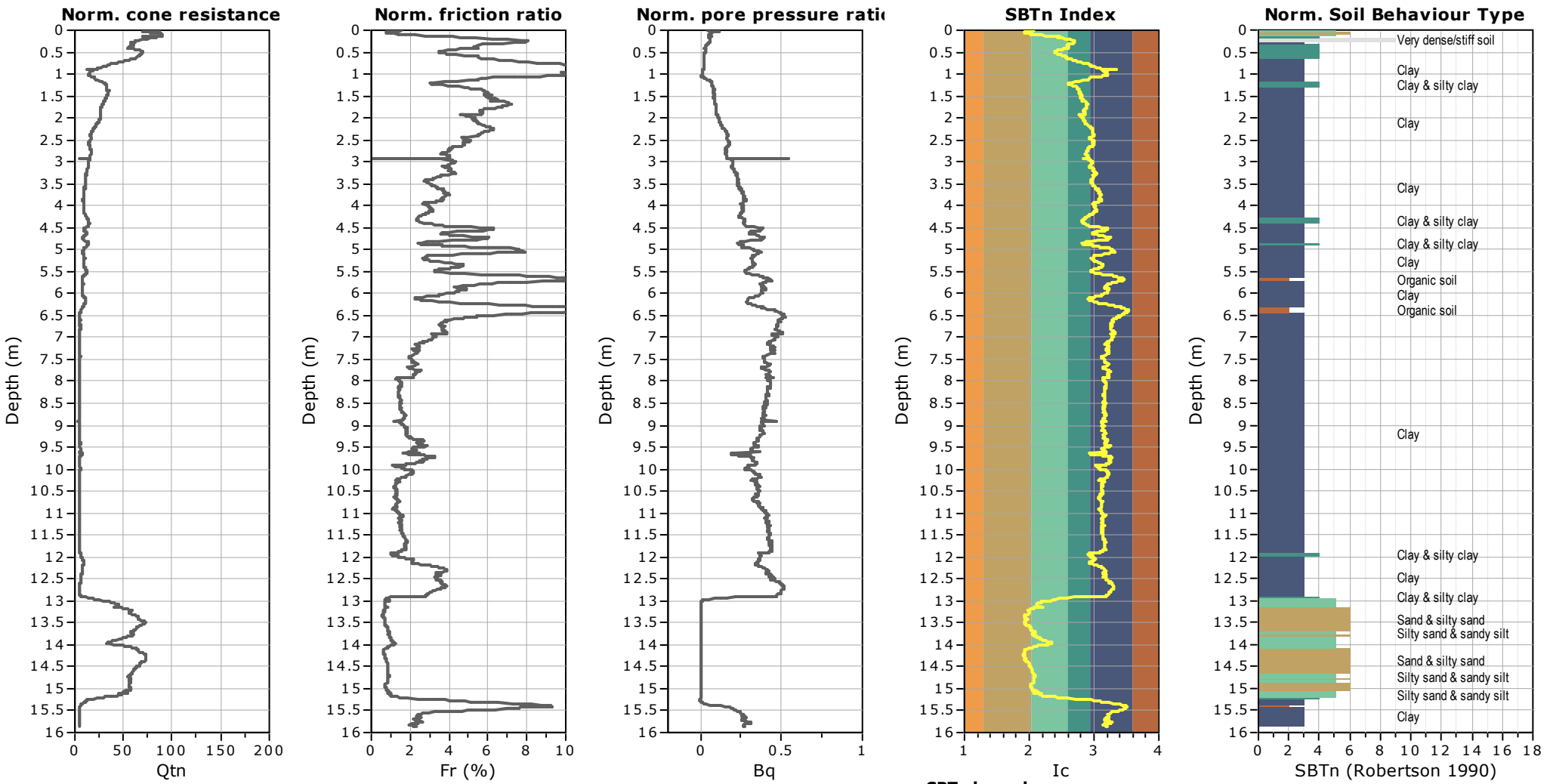
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

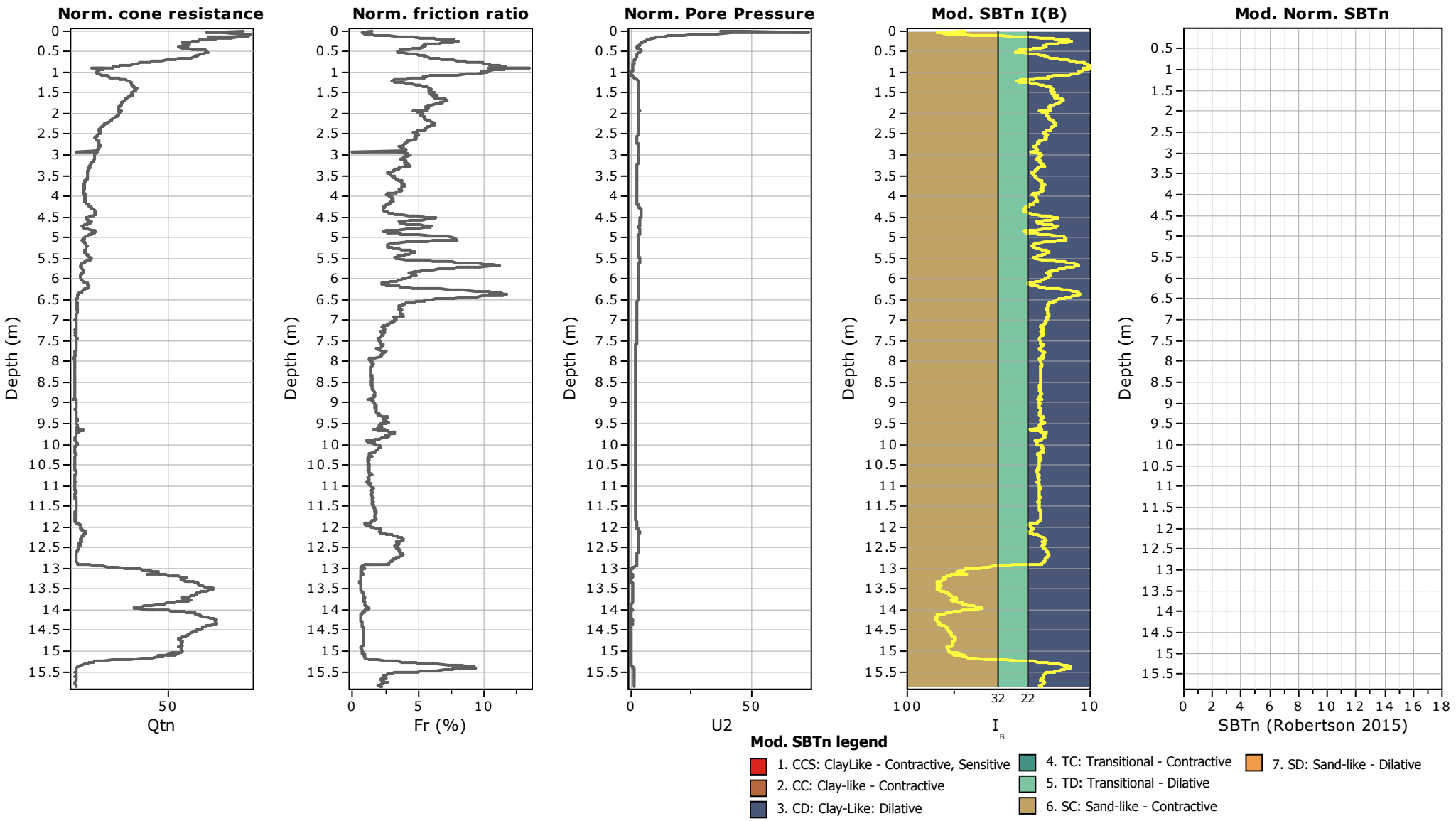
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

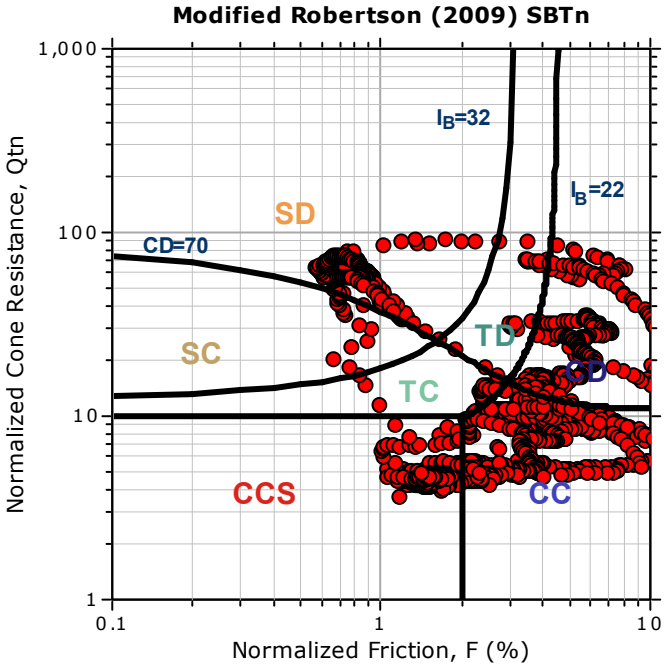


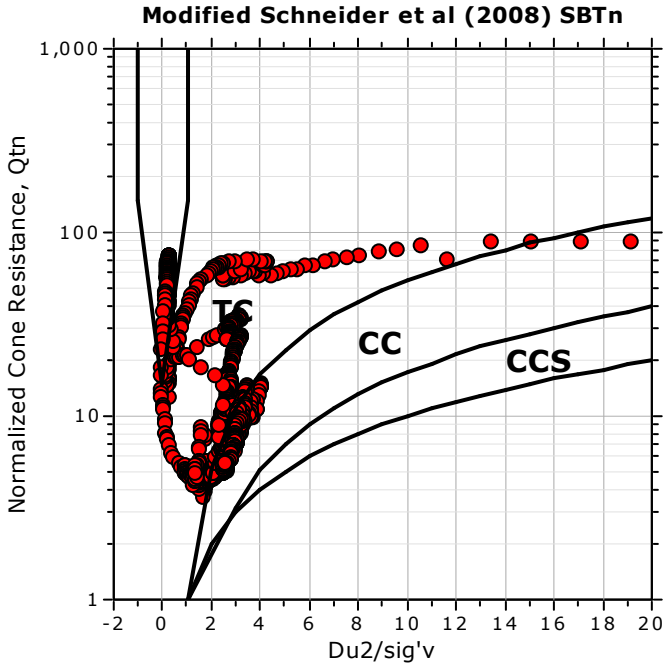
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

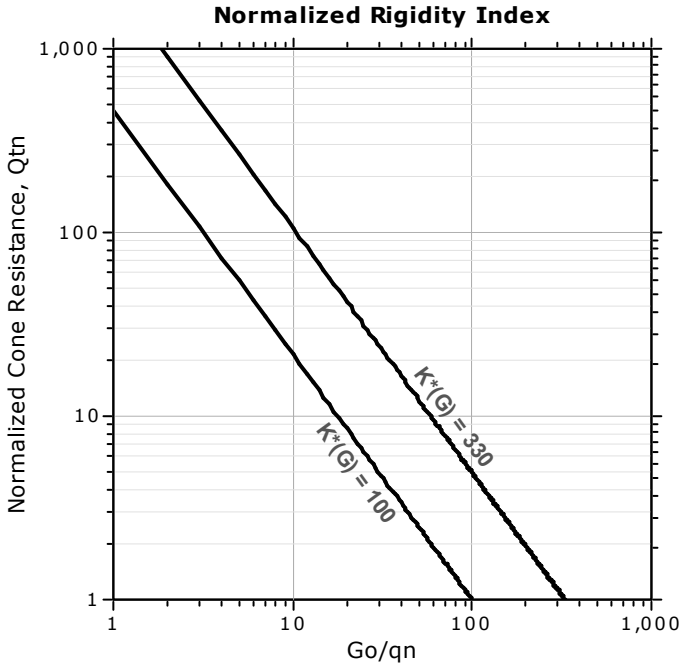
CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







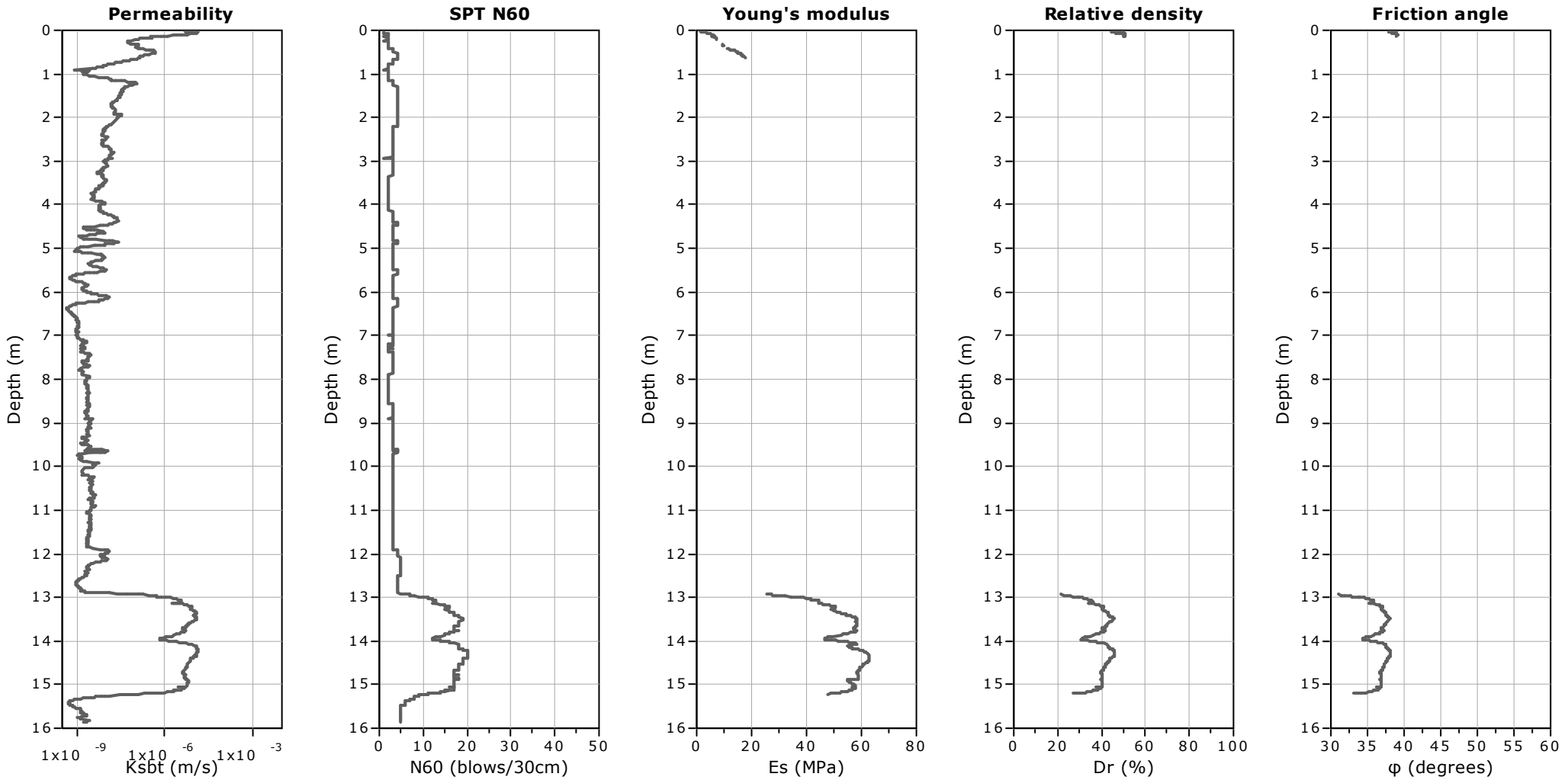
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



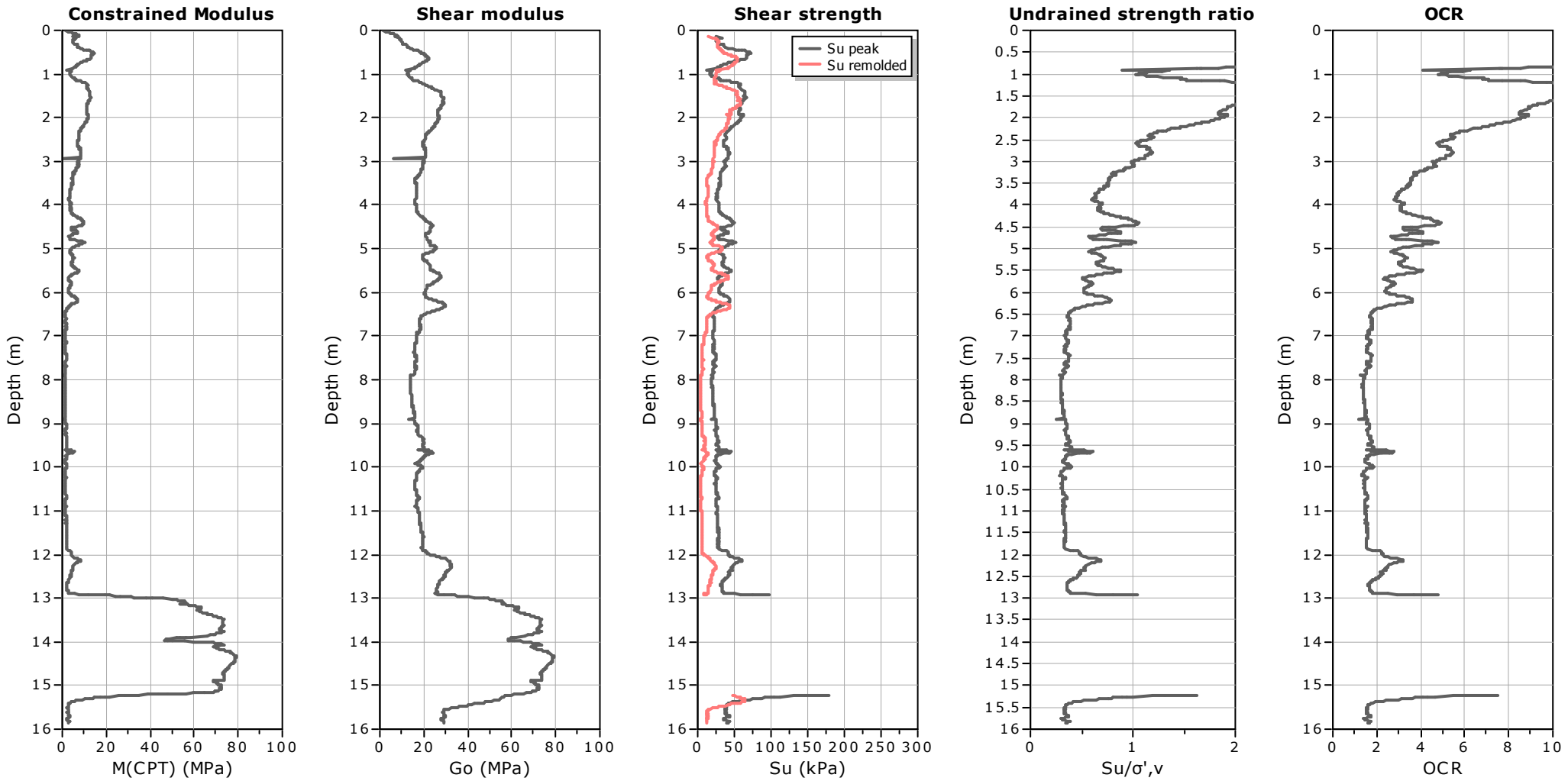
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



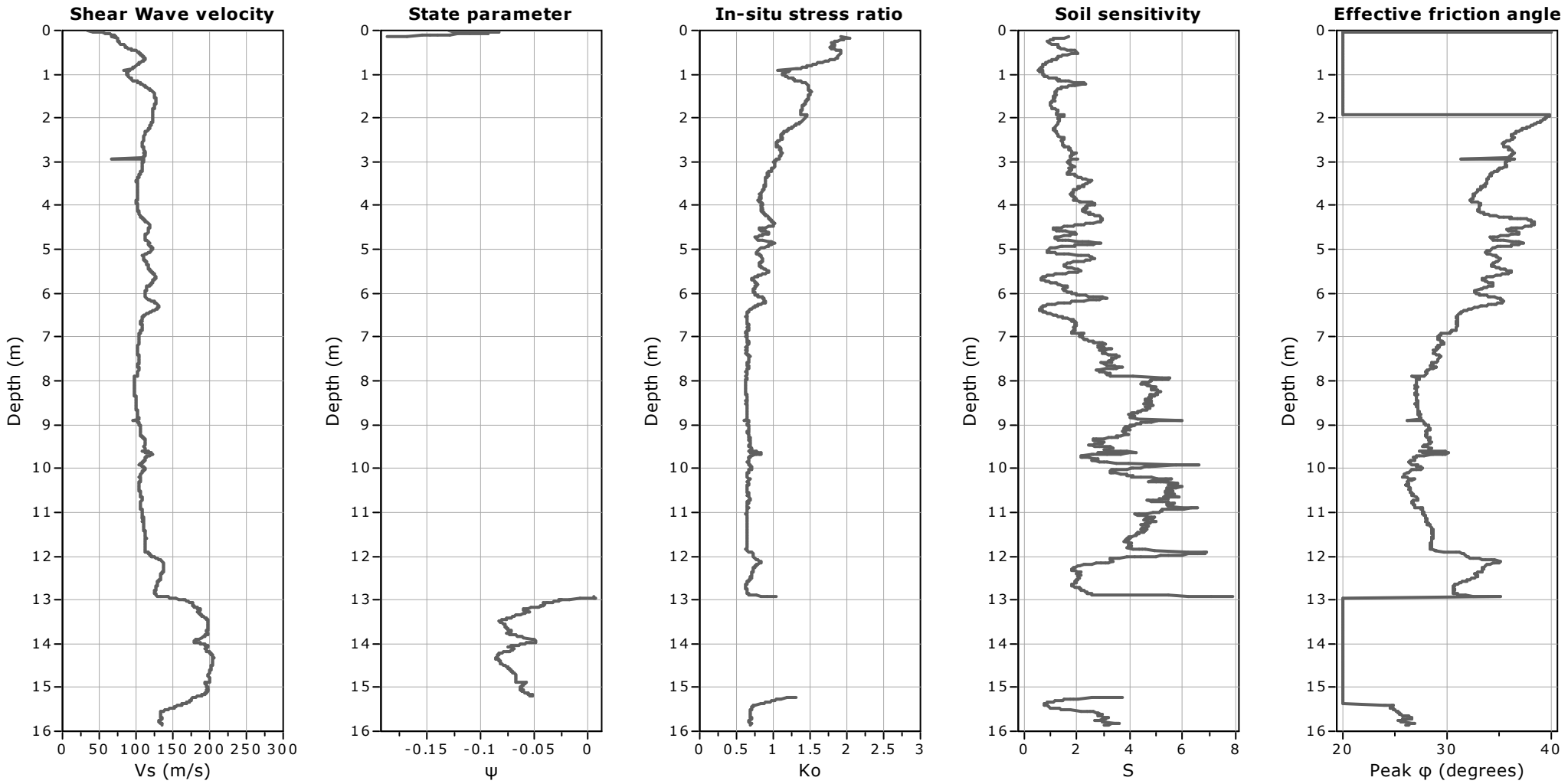
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



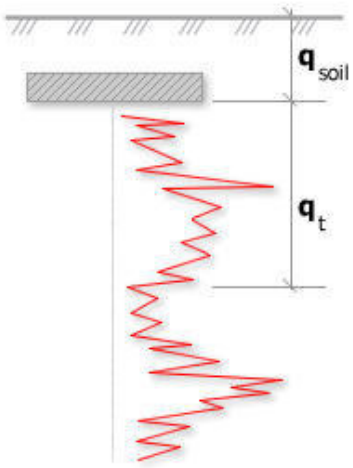
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

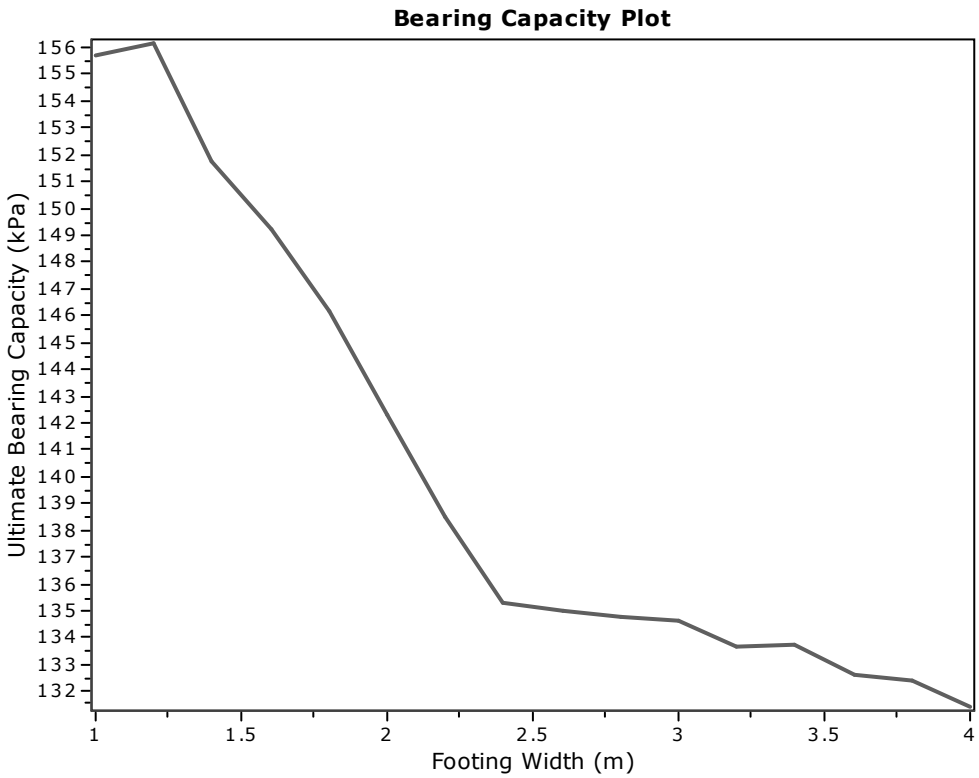
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



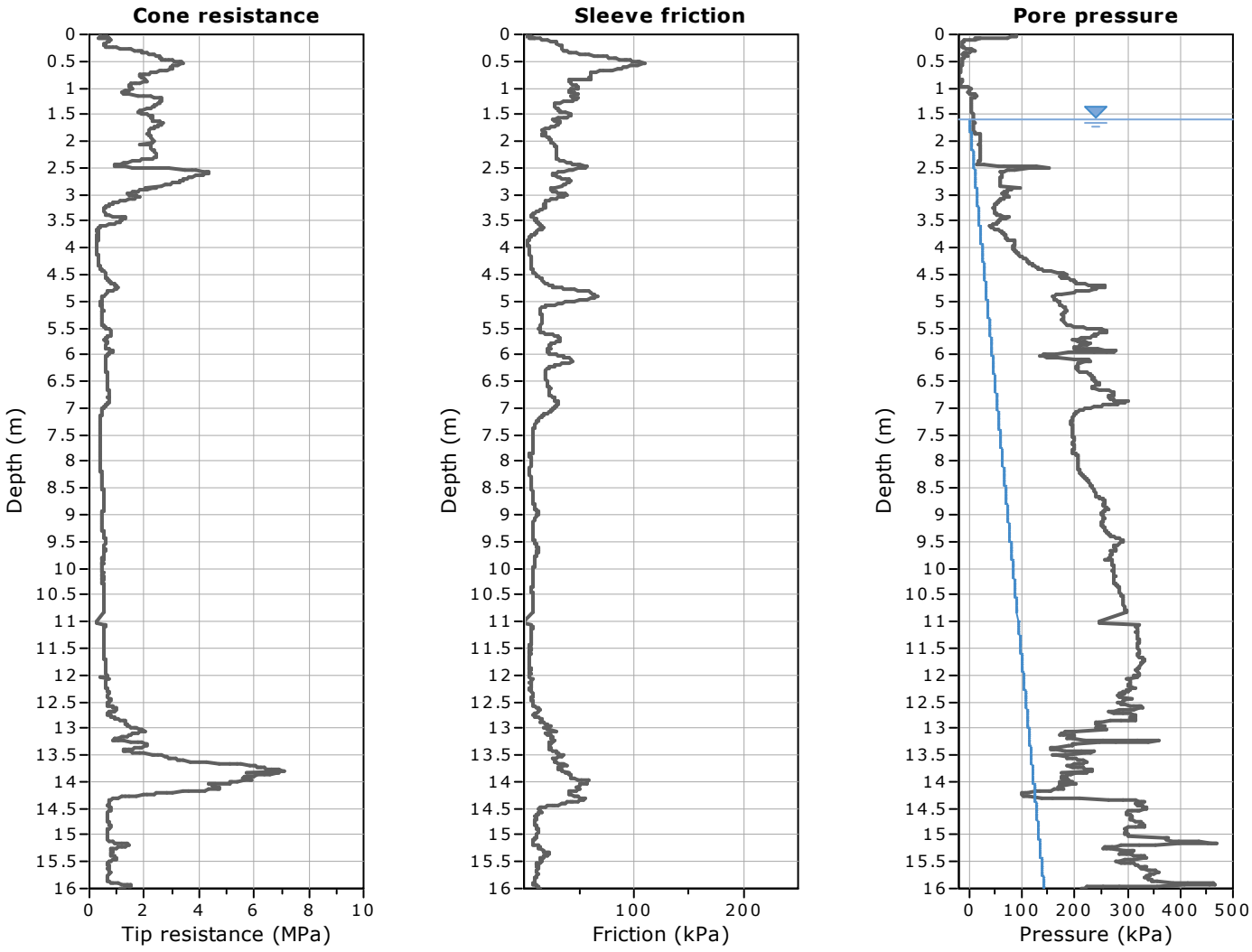
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.73	0.20	9.50	155.66
2	1.20	0.50	2.30	0.73	0.20	9.50	156.15
3	1.40	0.50	2.60	0.71	0.20	9.50	151.75
4	1.60	0.50	2.90	0.70	0.20	9.50	149.25
5	1.80	0.50	3.20	0.68	0.20	9.50	146.19
6	2.00	0.50	3.50	0.66	0.20	9.50	142.33
7	2.20	0.50	3.80	0.64	0.20	9.50	138.49
8	2.40	0.50	4.10	0.63	0.20	9.50	135.31
9	2.60	0.50	4.40	0.63	0.20	9.50	135.01
10	2.80	0.50	4.70	0.63	0.20	9.50	134.80
11	3.00	0.50	5.00	0.63	0.20	9.50	134.61
12	3.20	0.50	5.30	0.62	0.20	9.50	133.67
13	3.40	0.50	5.60	0.62	0.20	9.50	133.76
14	3.60	0.50	5.90	0.62	0.20	9.50	132.63
15	3.80	0.50	6.20	0.61	0.20	9.50	132.42
16	4.00	0.50	6.50	0.61	0.20	9.50	131.43

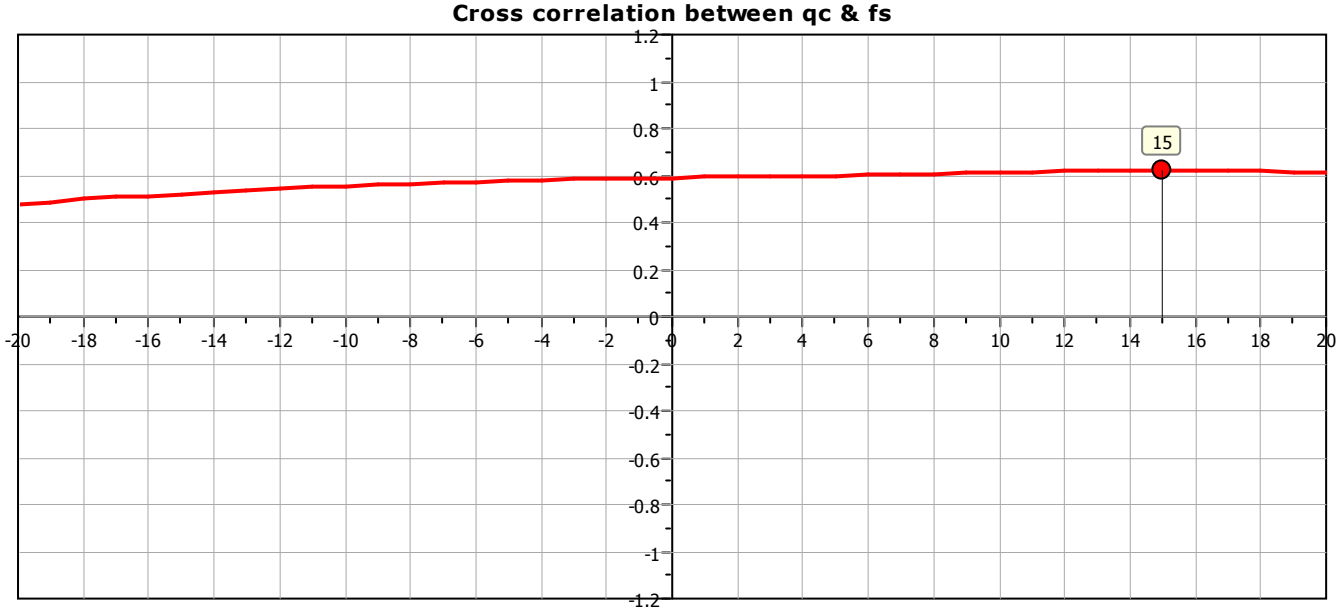
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

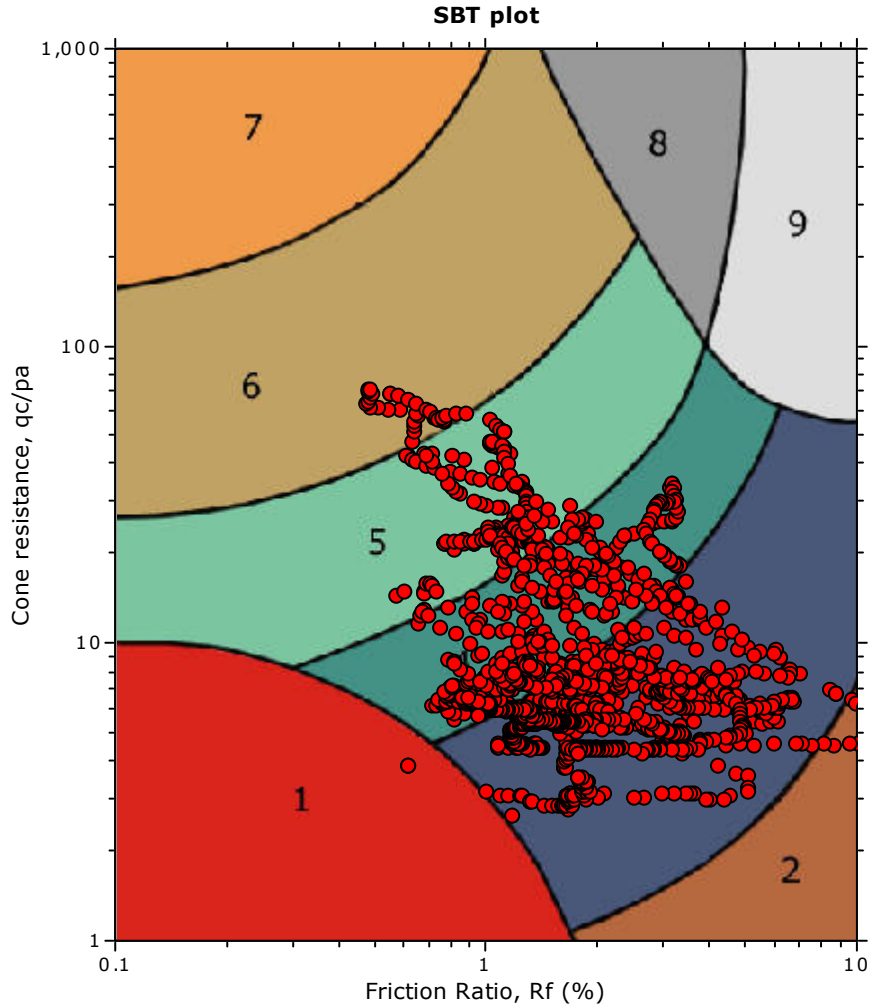


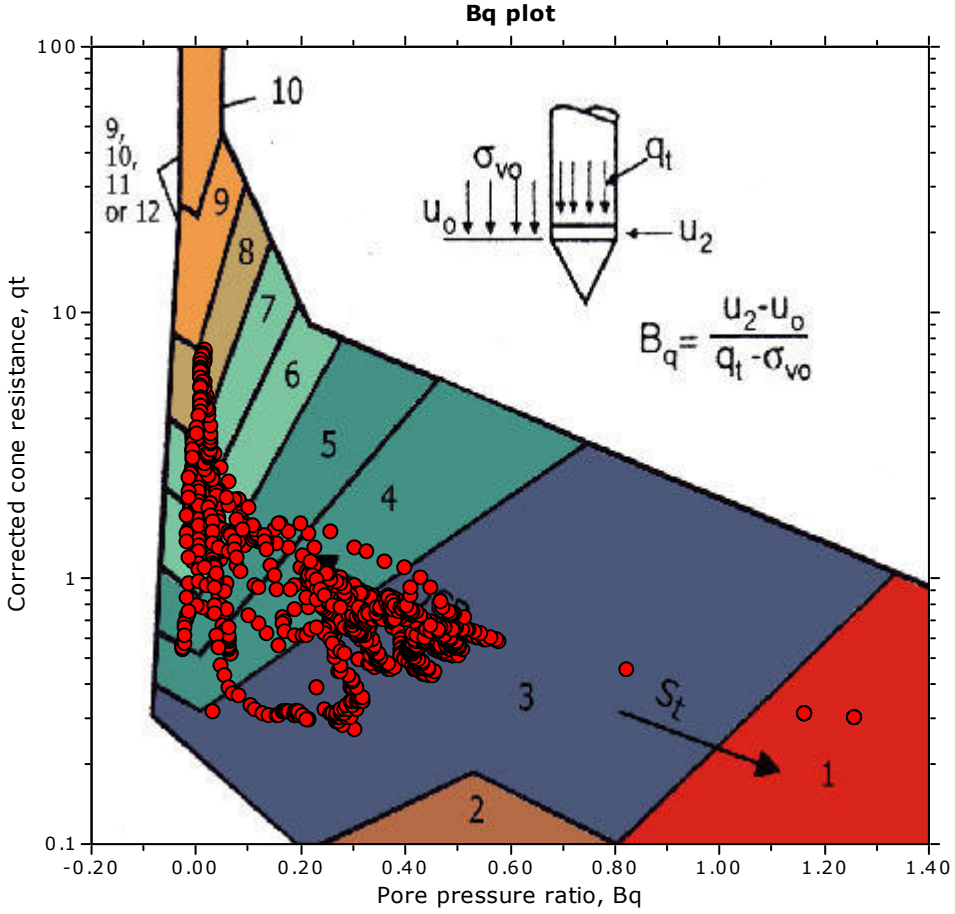
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

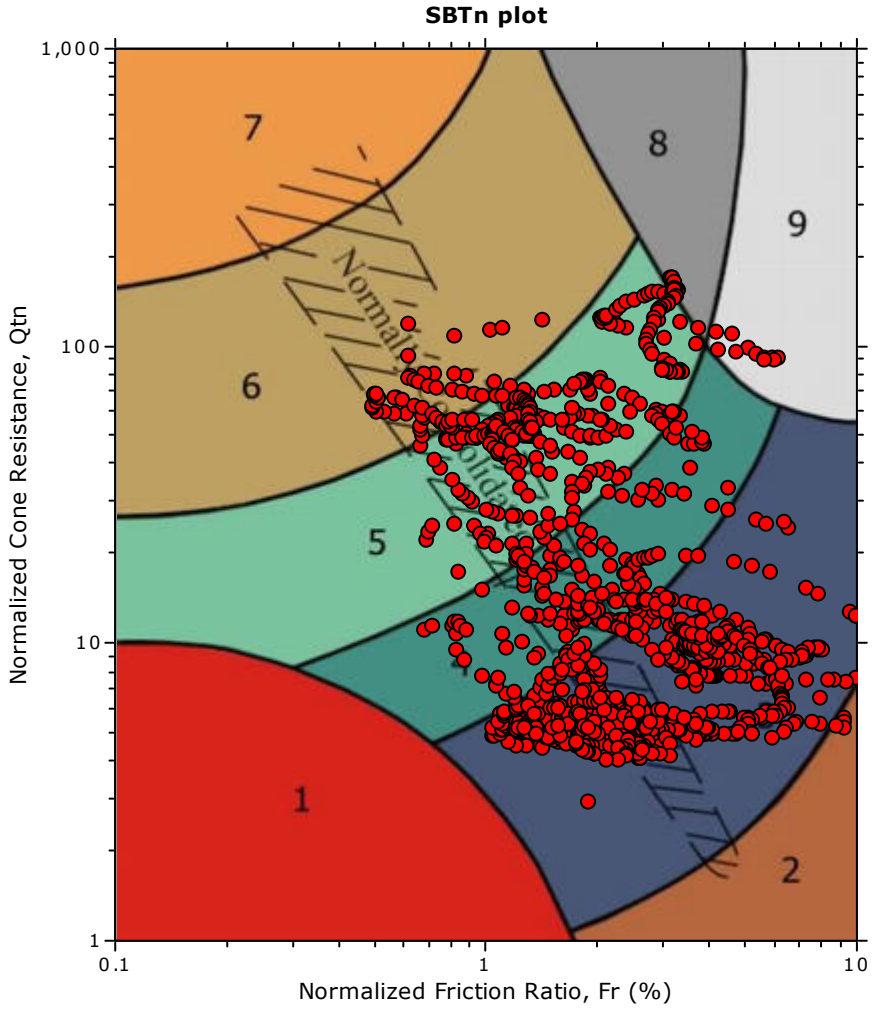
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

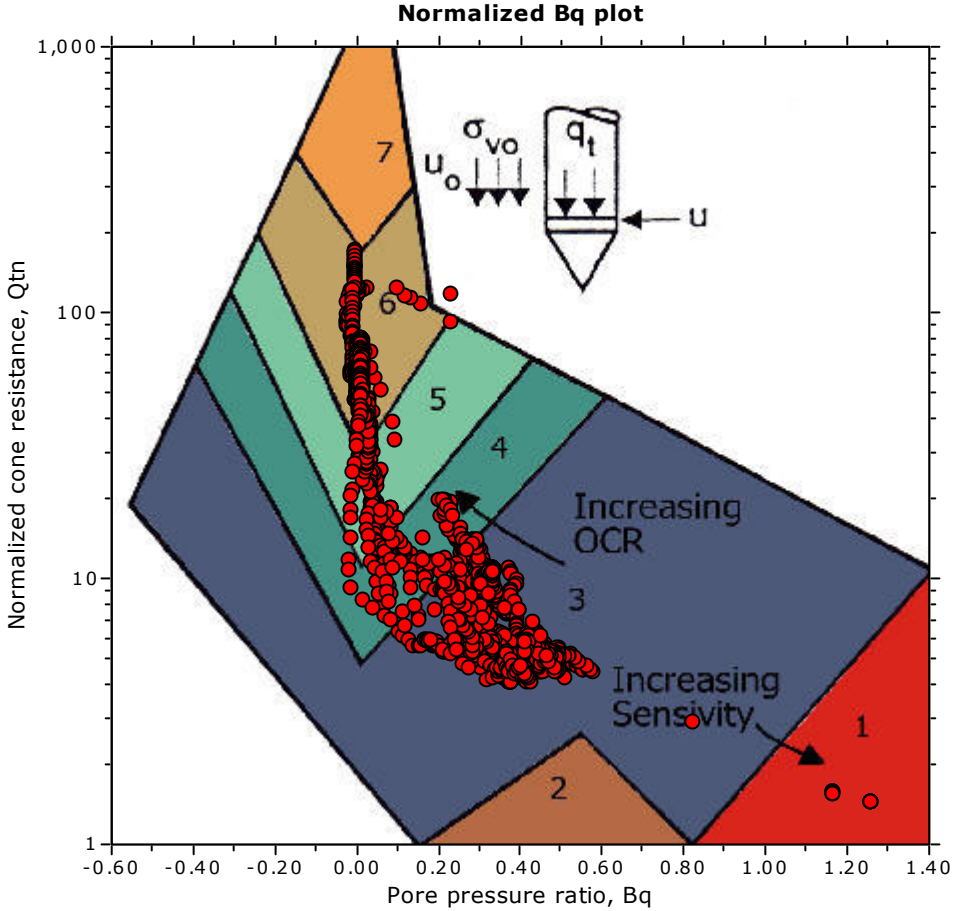
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

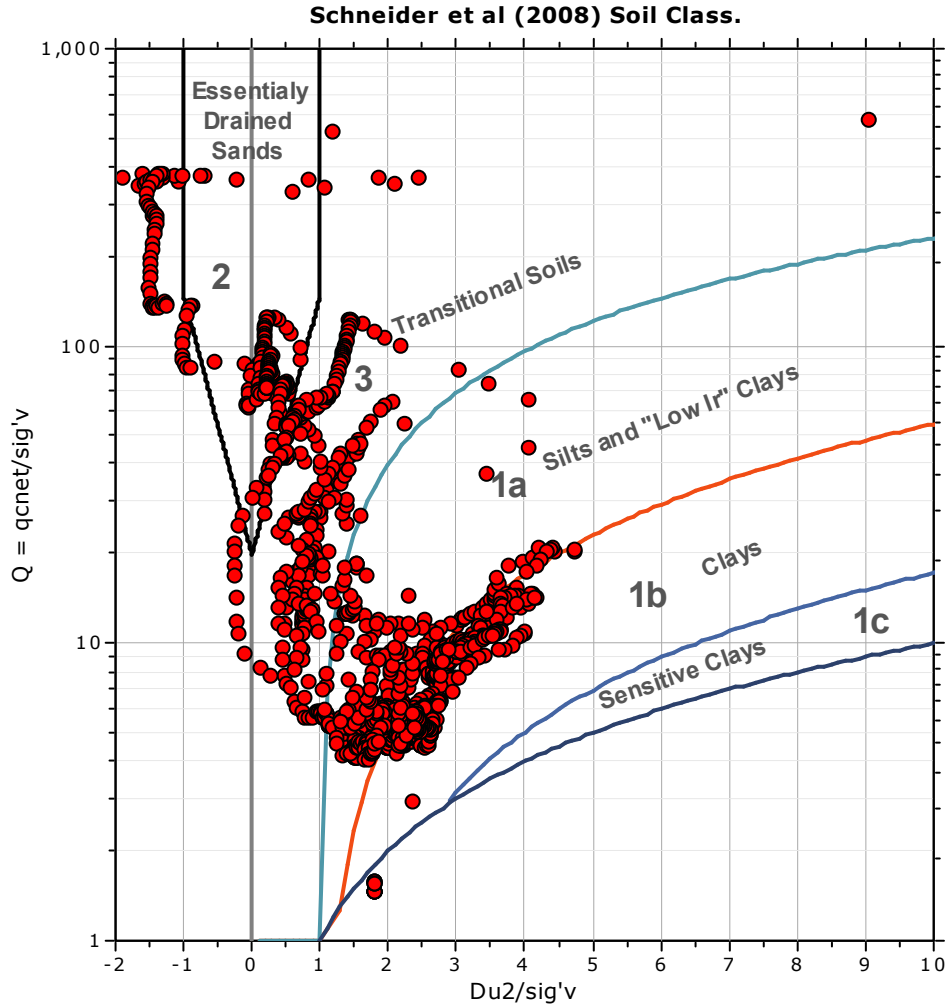
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

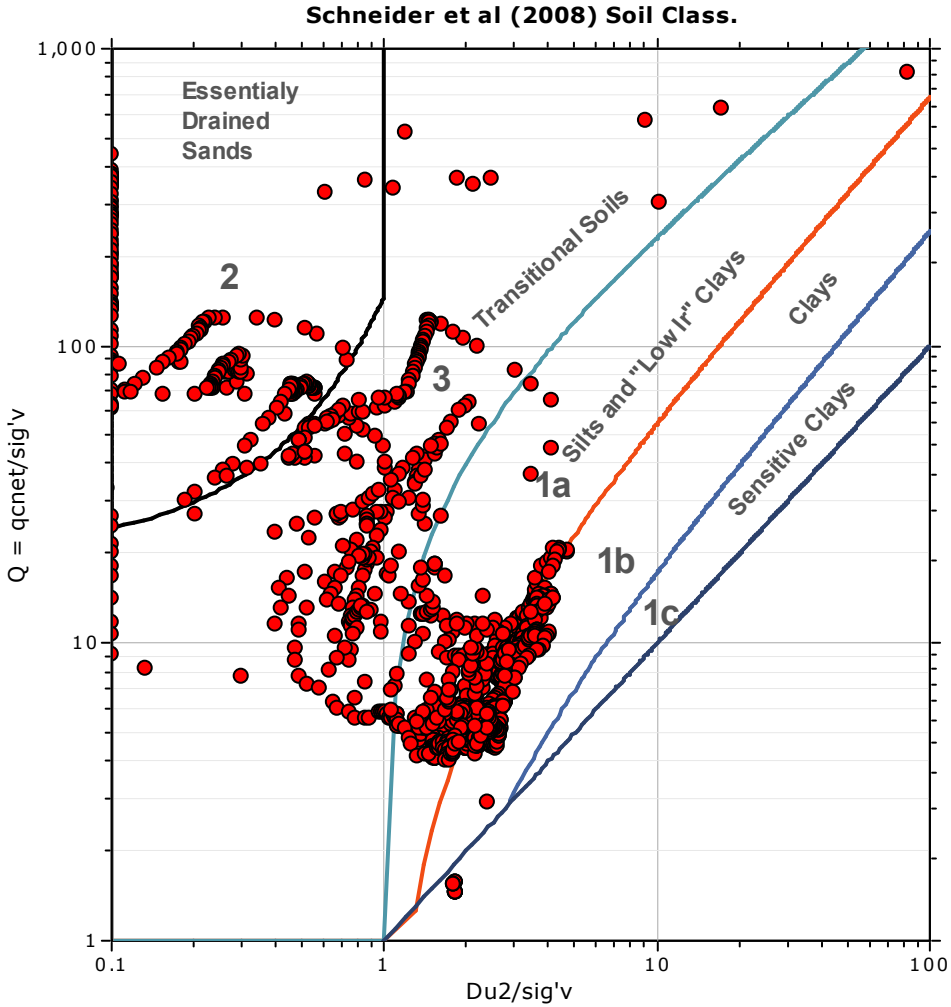
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

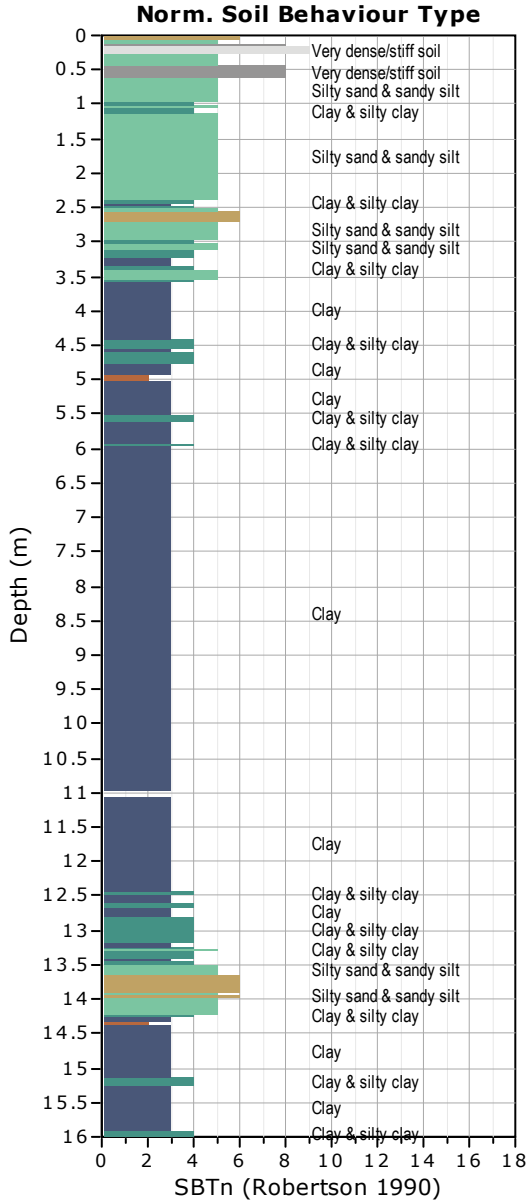


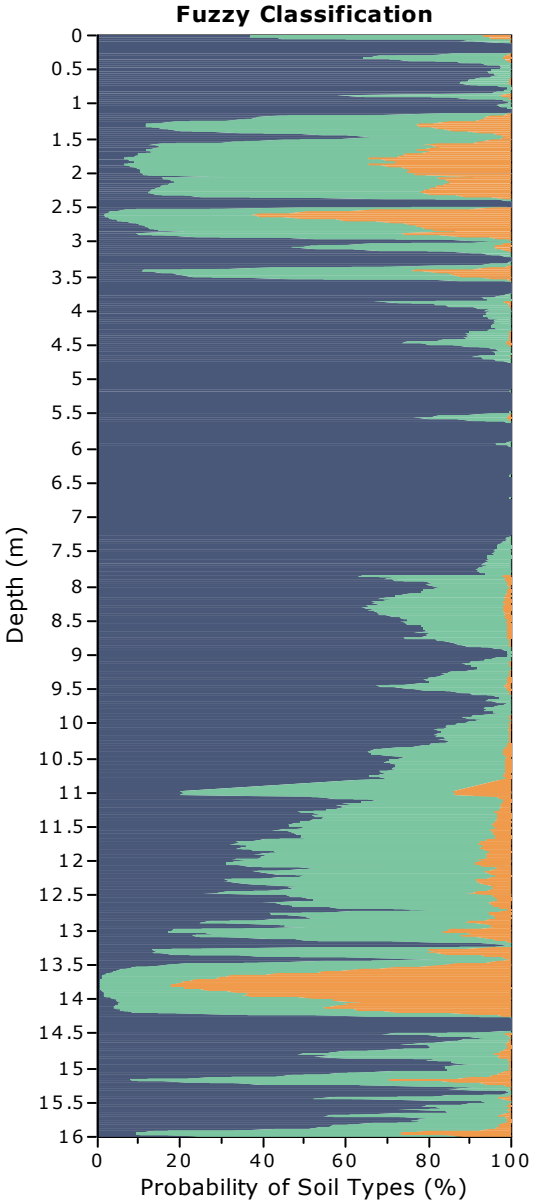


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

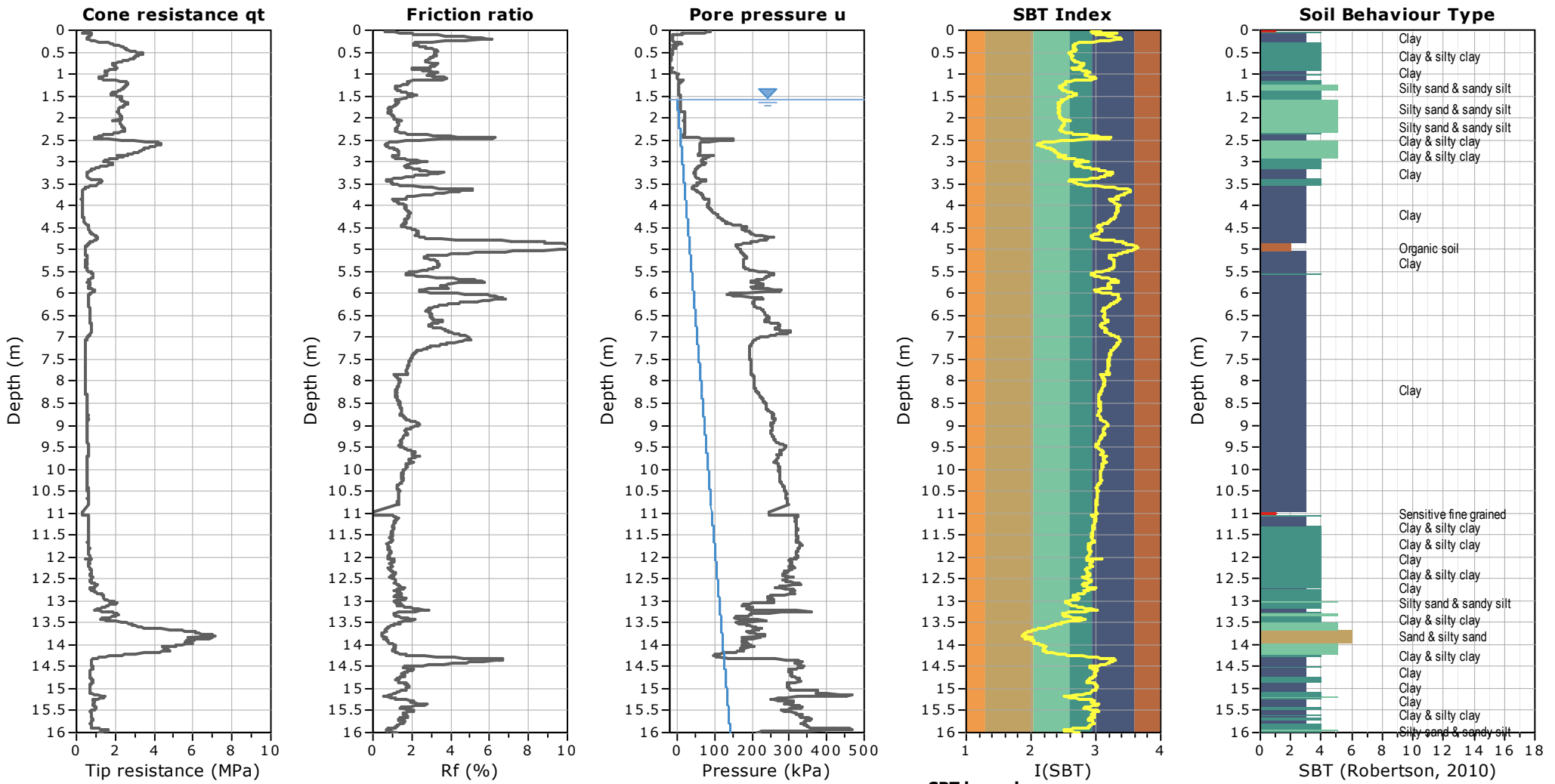




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

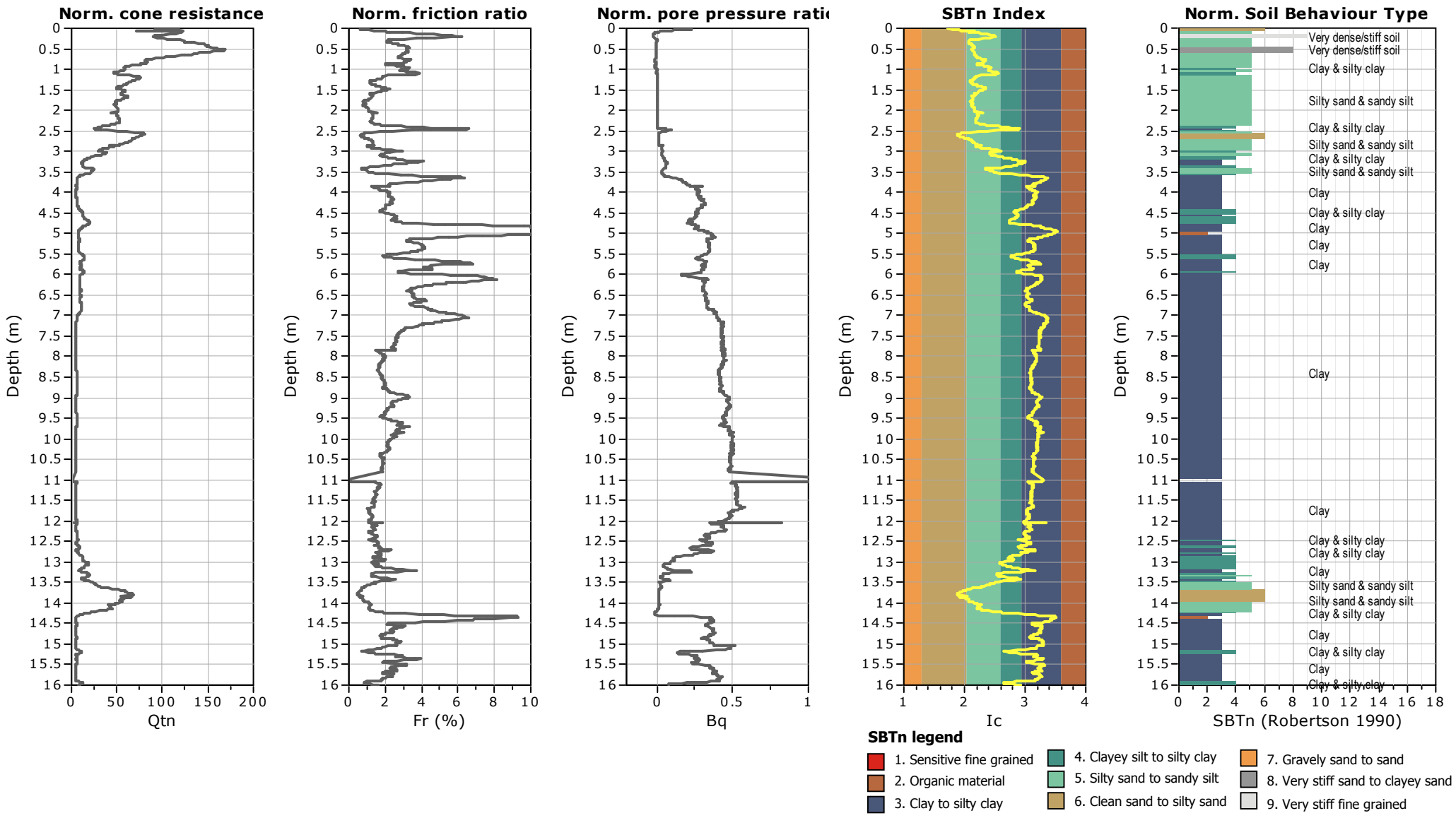
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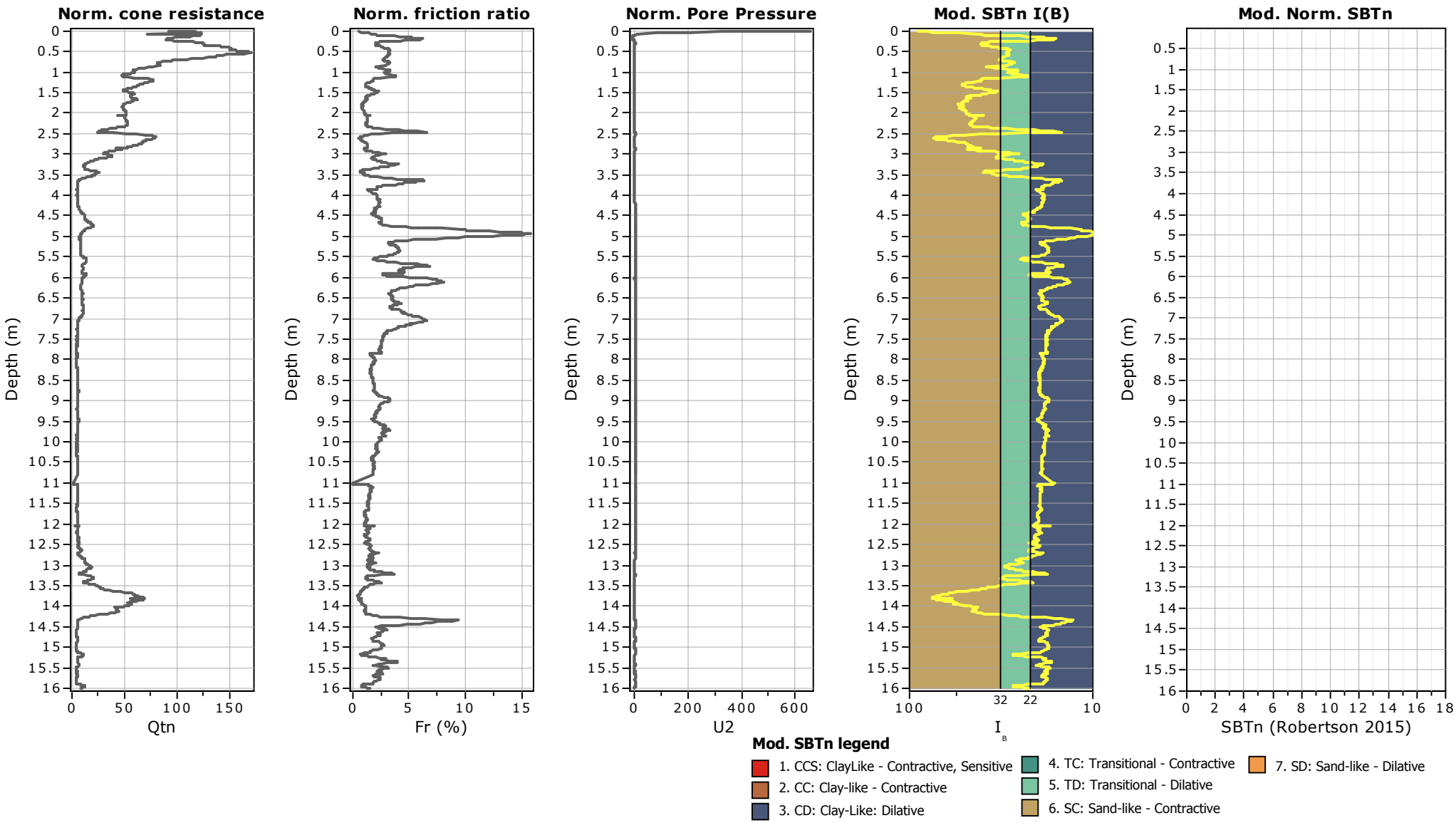
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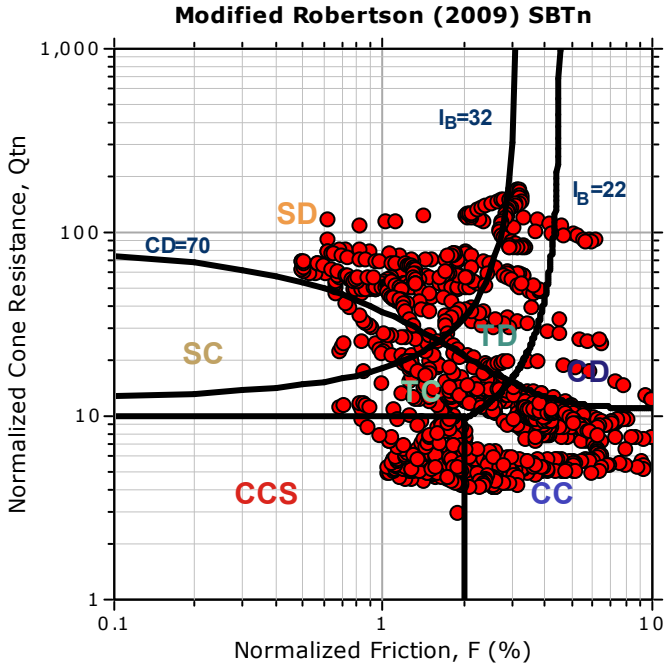


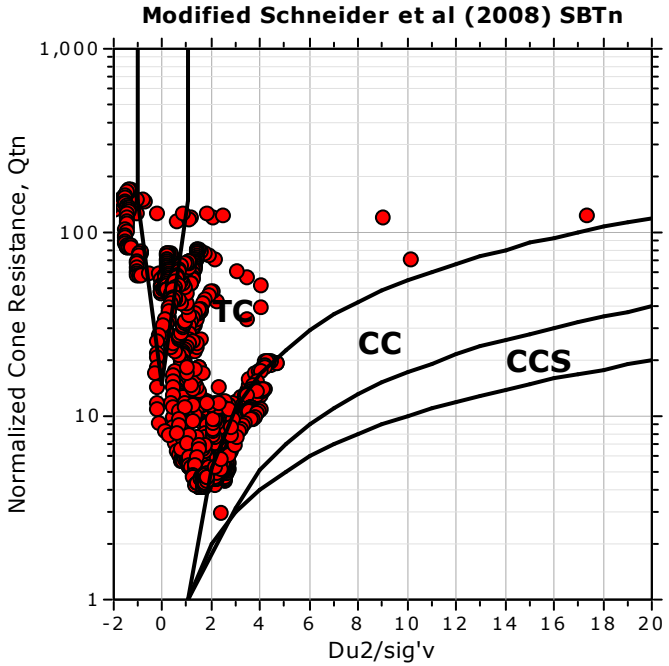
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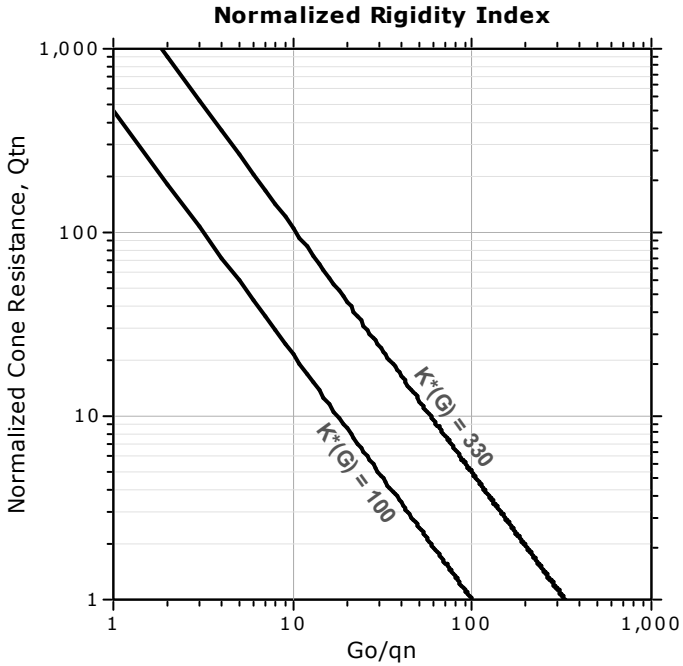
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







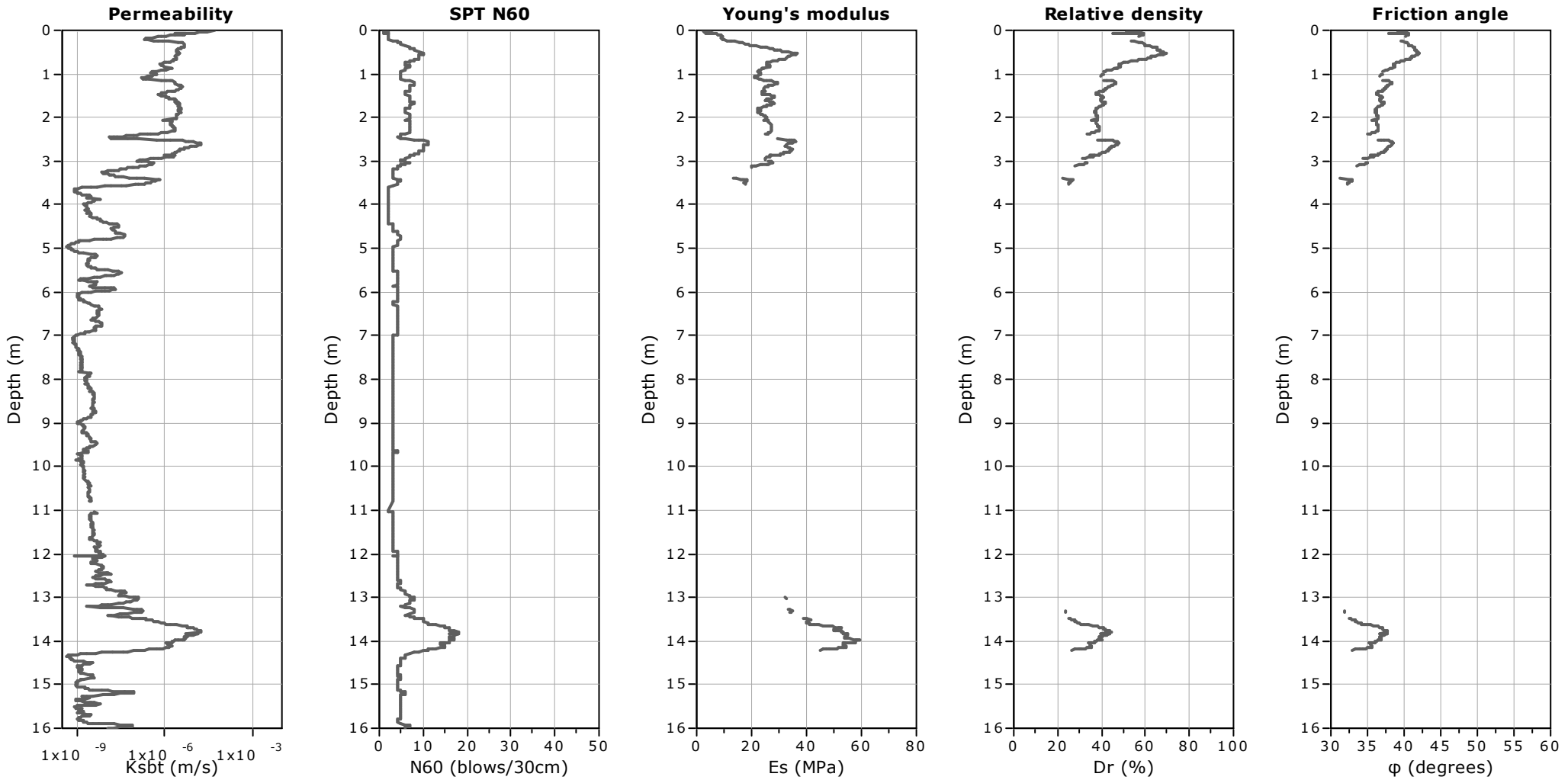
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
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SC: Sand-like - Contractive
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K(G) > 330: Soils with significant microstructure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

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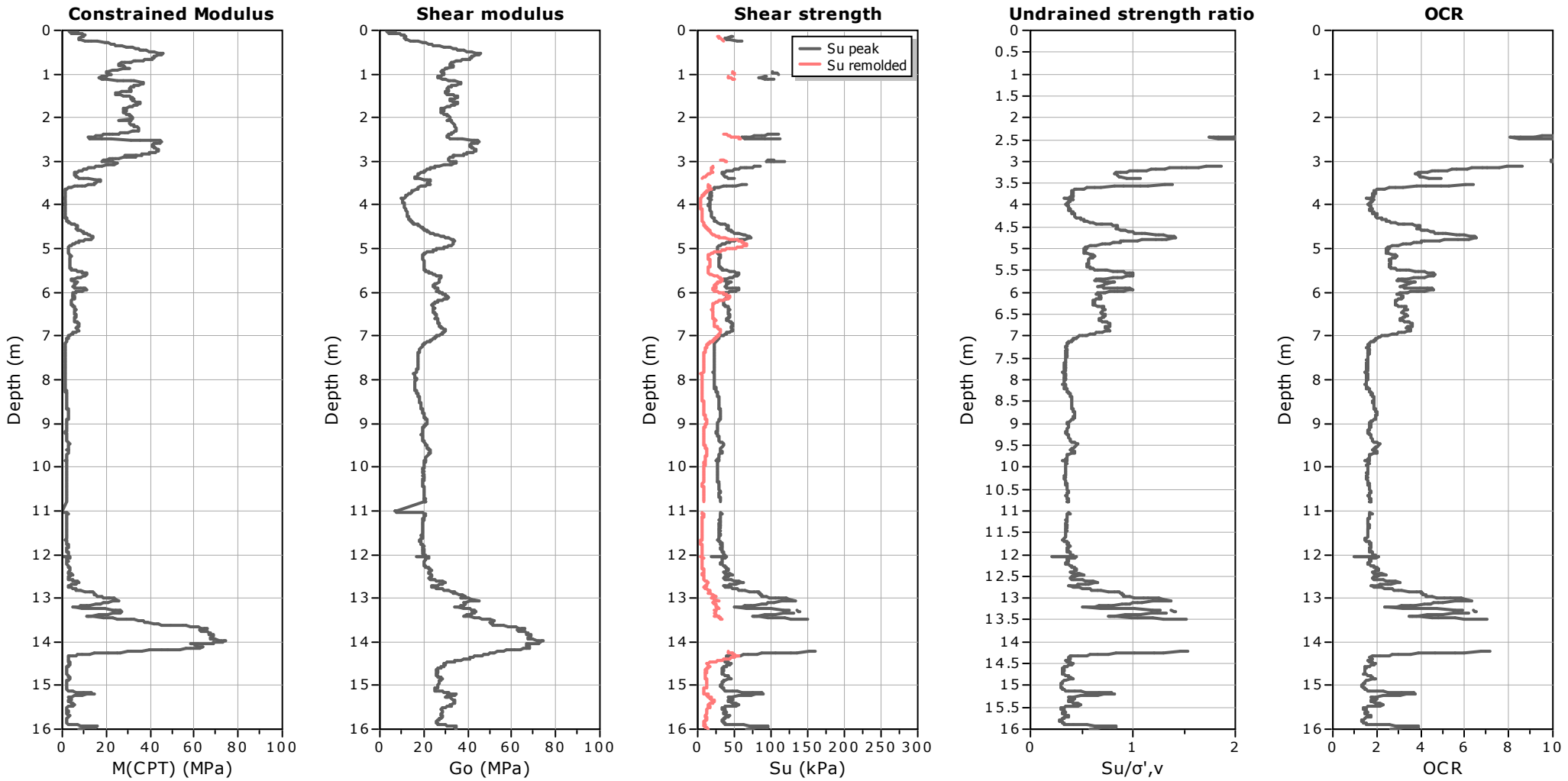
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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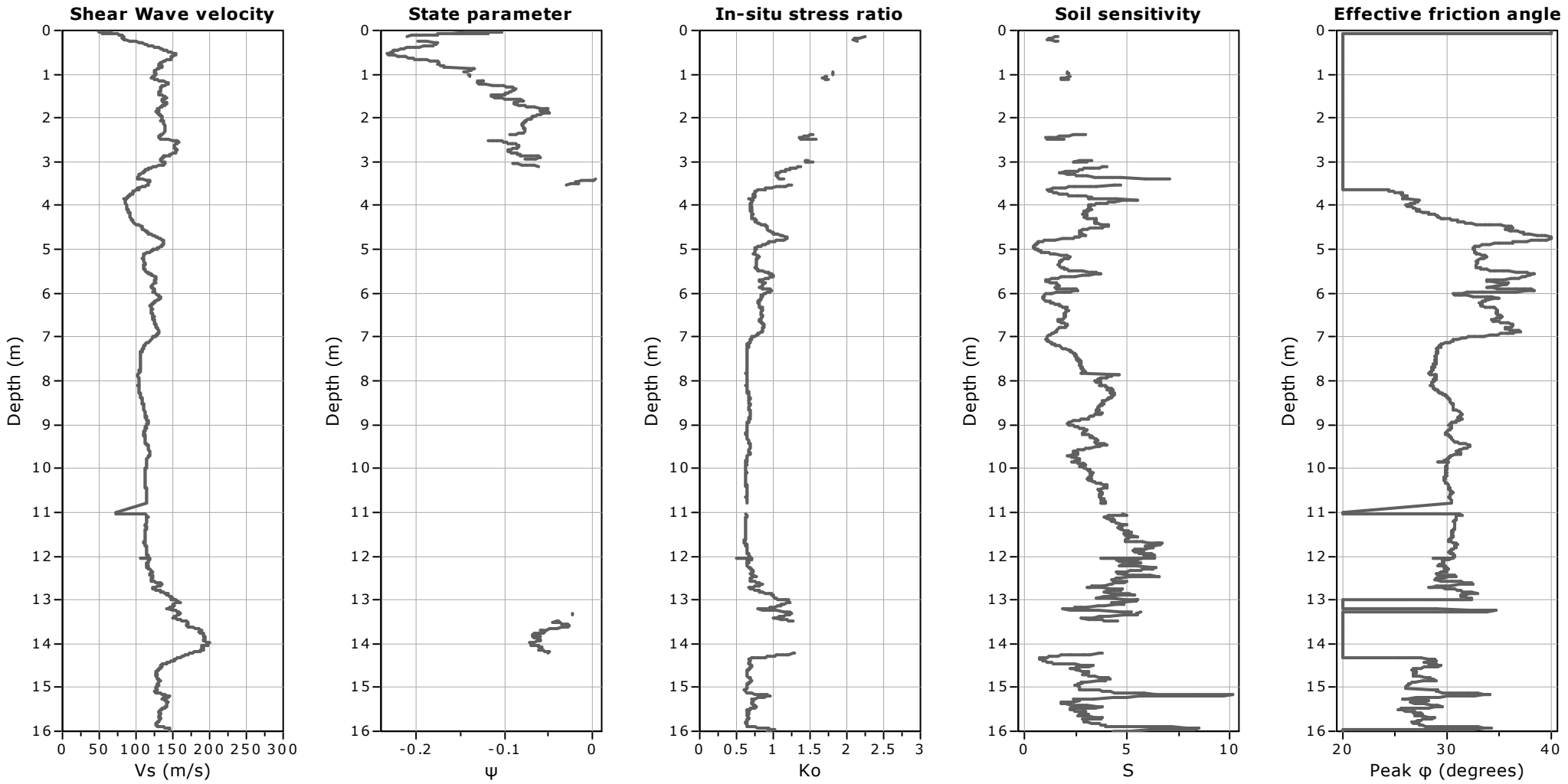
Calculation parameters

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

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Location: **Fiscaglia (FE)**



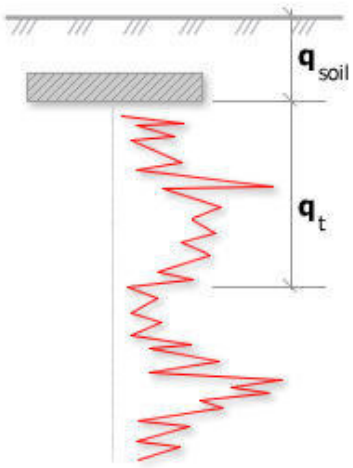
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

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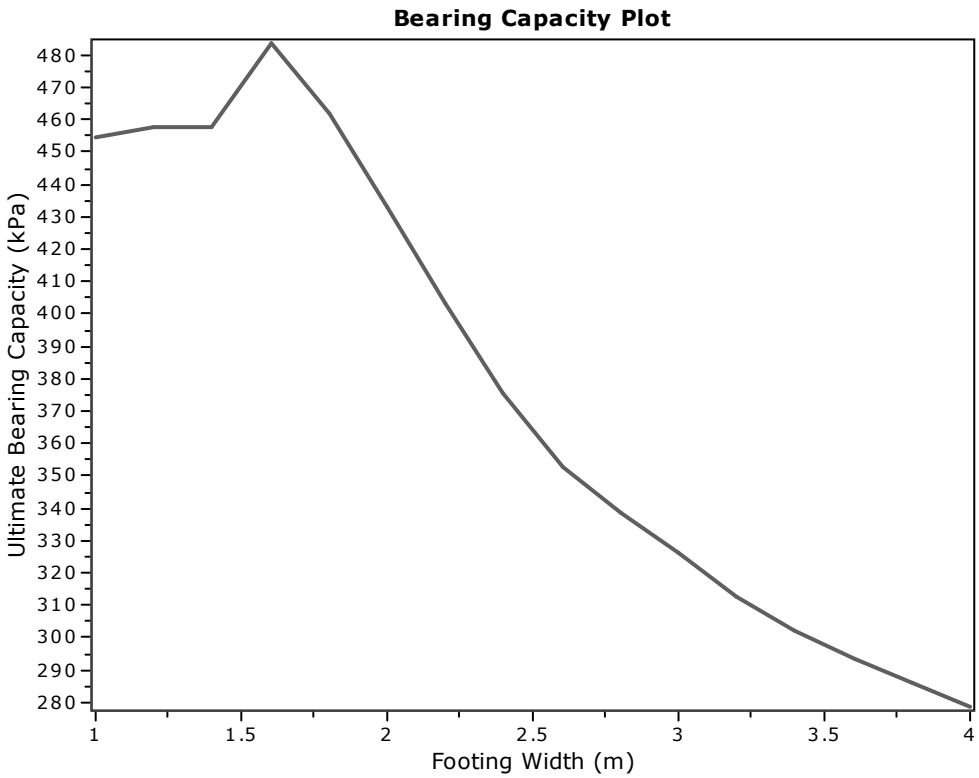
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Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



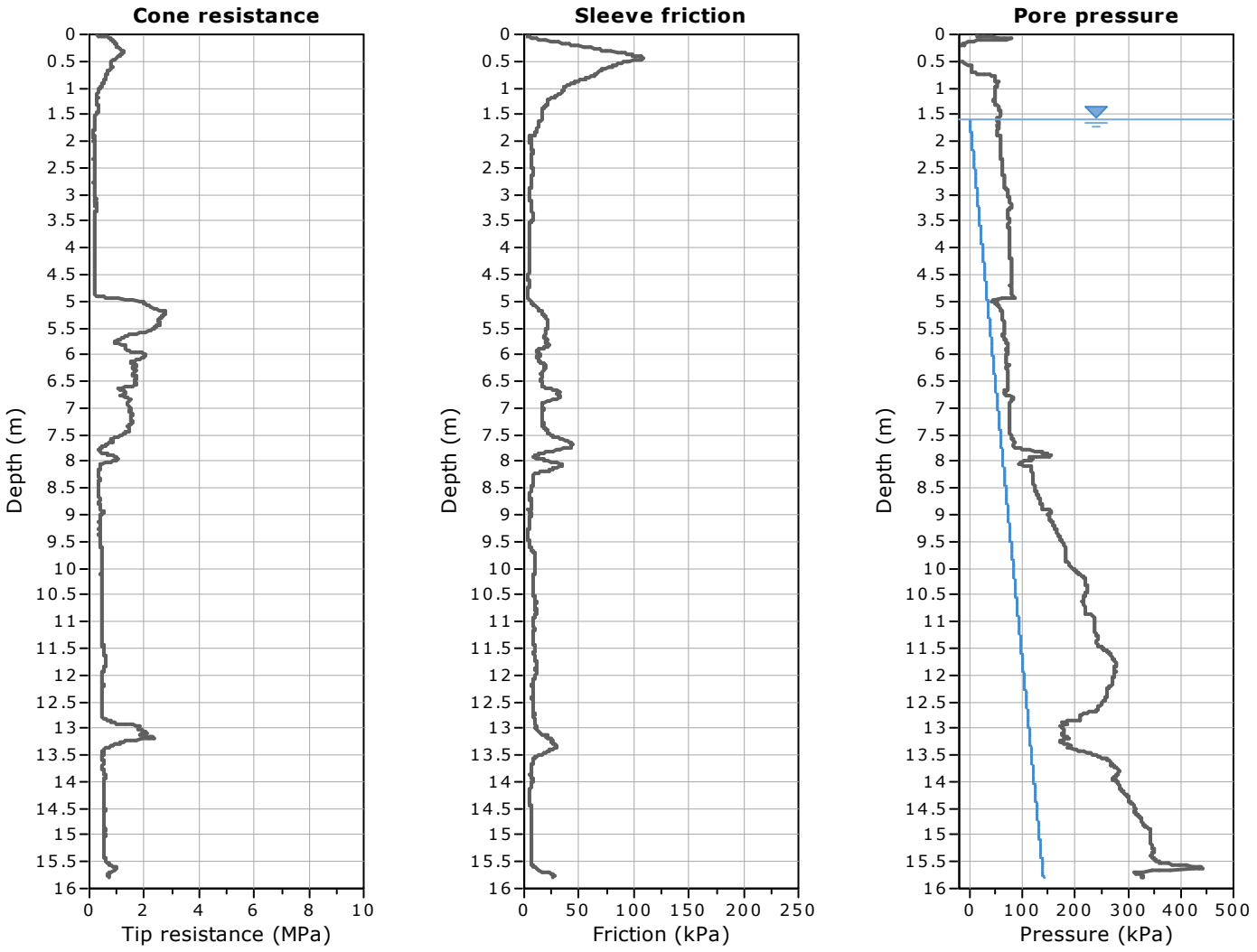
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.22	0.20	9.50	454.39
2	1.20	0.50	2.30	2.24	0.20	9.50	457.63
3	1.40	0.50	2.60	2.24	0.20	9.50	457.72
4	1.60	0.50	2.90	2.37	0.20	9.50	483.62
5	1.80	0.50	3.20	2.26	0.20	9.50	462.19
6	2.00	0.50	3.50	2.12	0.20	9.50	433.07
7	2.20	0.50	3.80	1.97	0.20	9.50	403.18
8	2.40	0.50	4.10	1.83	0.20	9.50	375.39
9	2.60	0.50	4.40	1.72	0.20	9.50	352.83
10	2.80	0.50	4.70	1.64	0.20	9.50	338.46
11	3.00	0.50	5.00	1.58	0.20	9.50	326.11
12	3.20	0.50	5.30	1.52	0.20	9.50	312.52
13	3.40	0.50	5.60	1.46	0.20	9.50	302.09
14	3.60	0.50	5.90	1.42	0.20	9.50	293.46
15	3.80	0.50	6.20	1.38	0.20	9.50	285.81
16	4.00	0.50	6.50	1.35	0.20	9.50	278.63

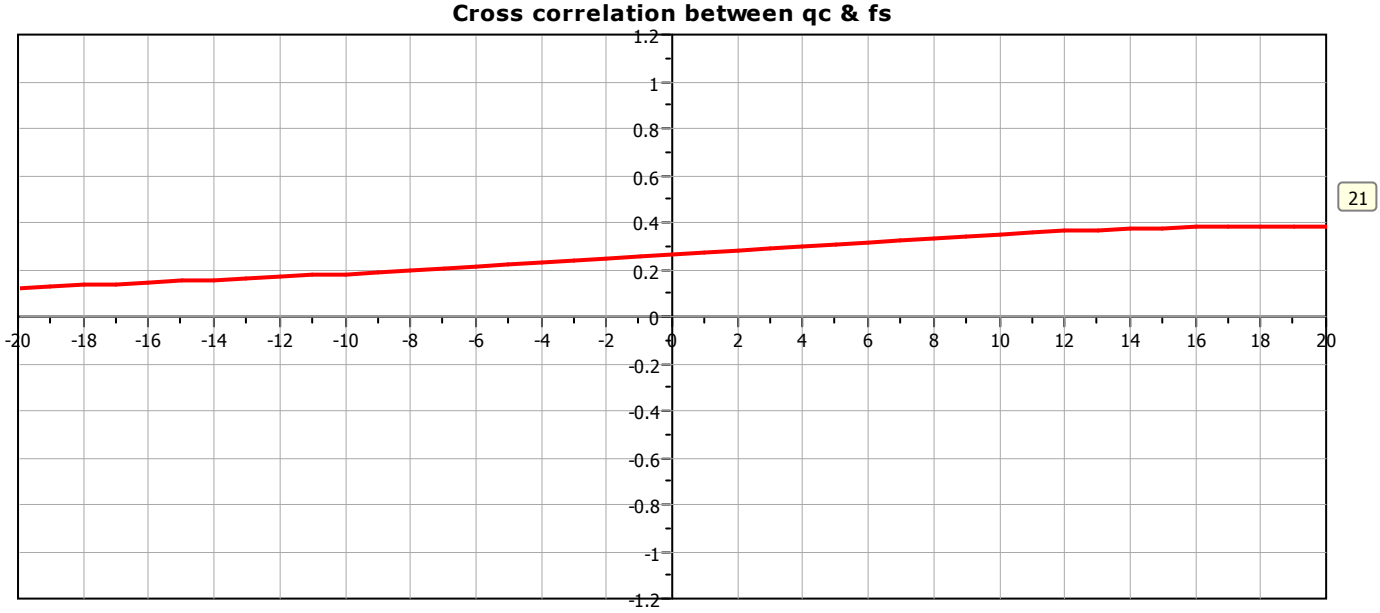
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

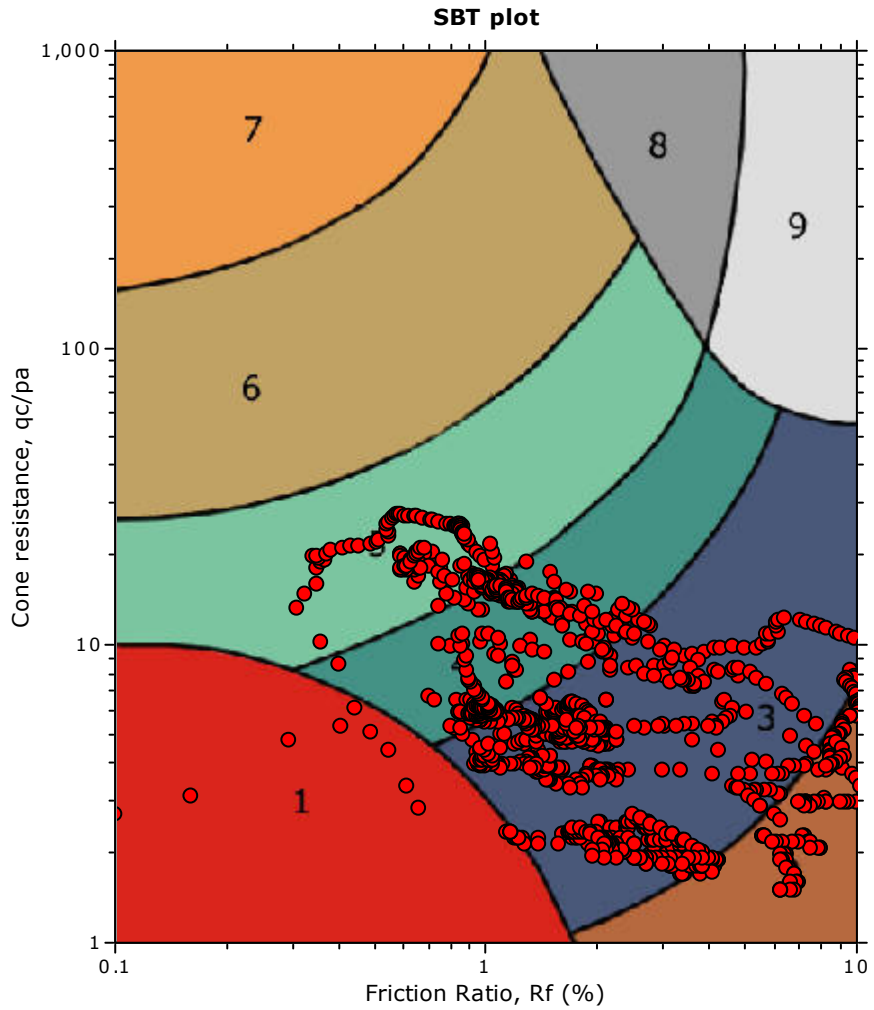


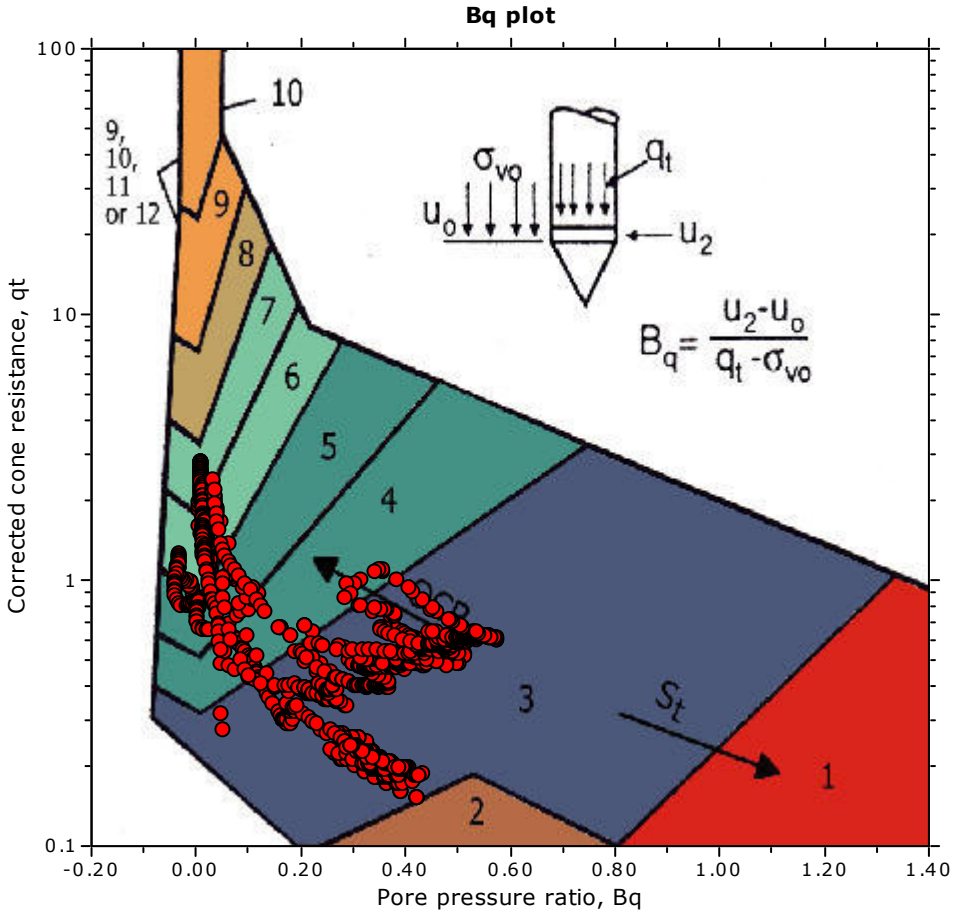
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

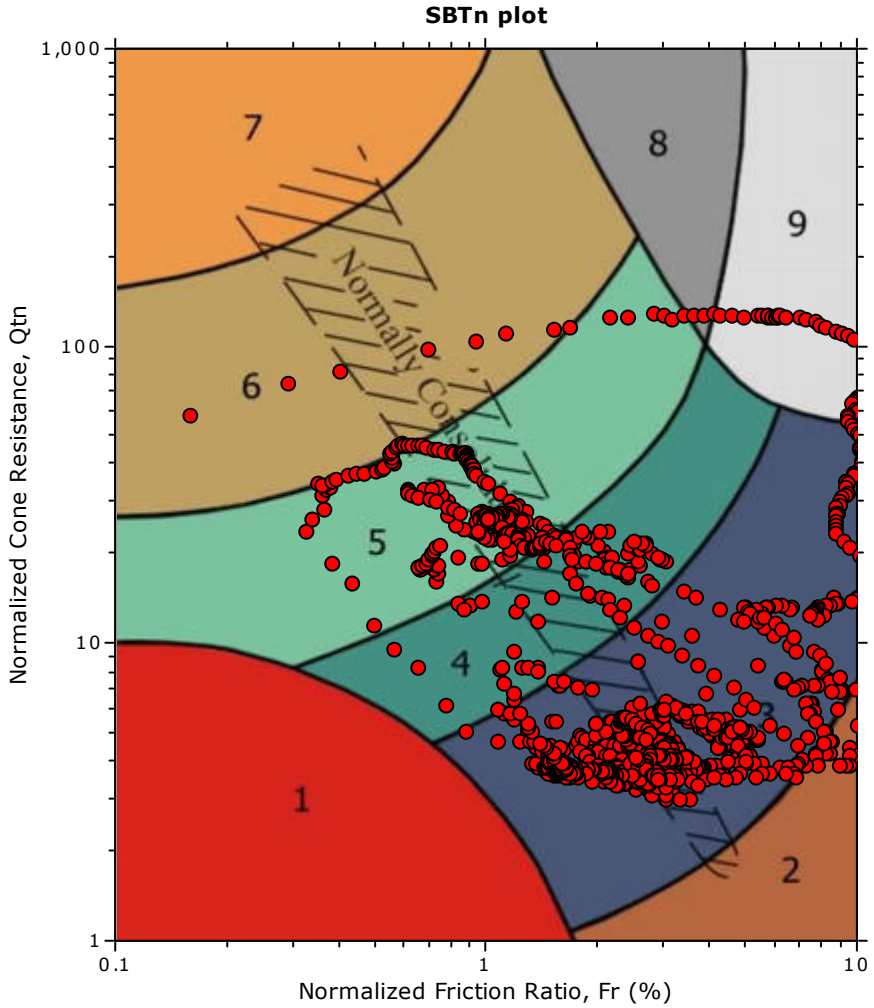
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

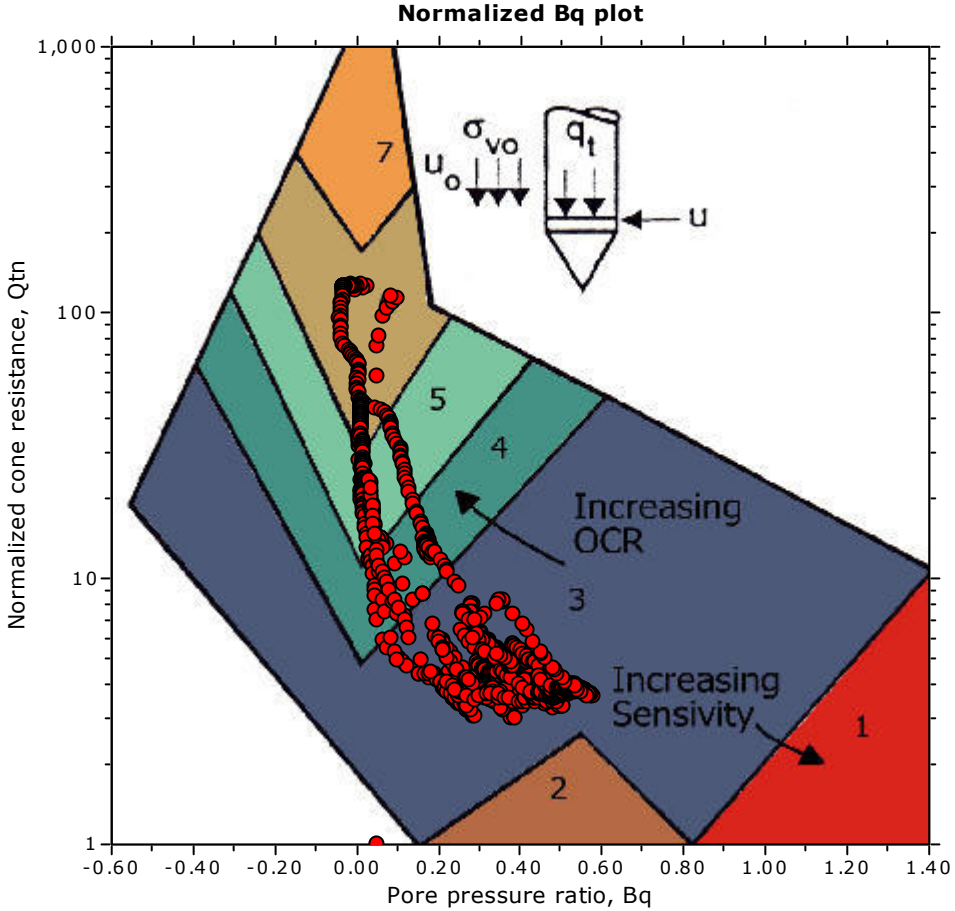
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rocco.carbonella@fastwebnet.it

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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

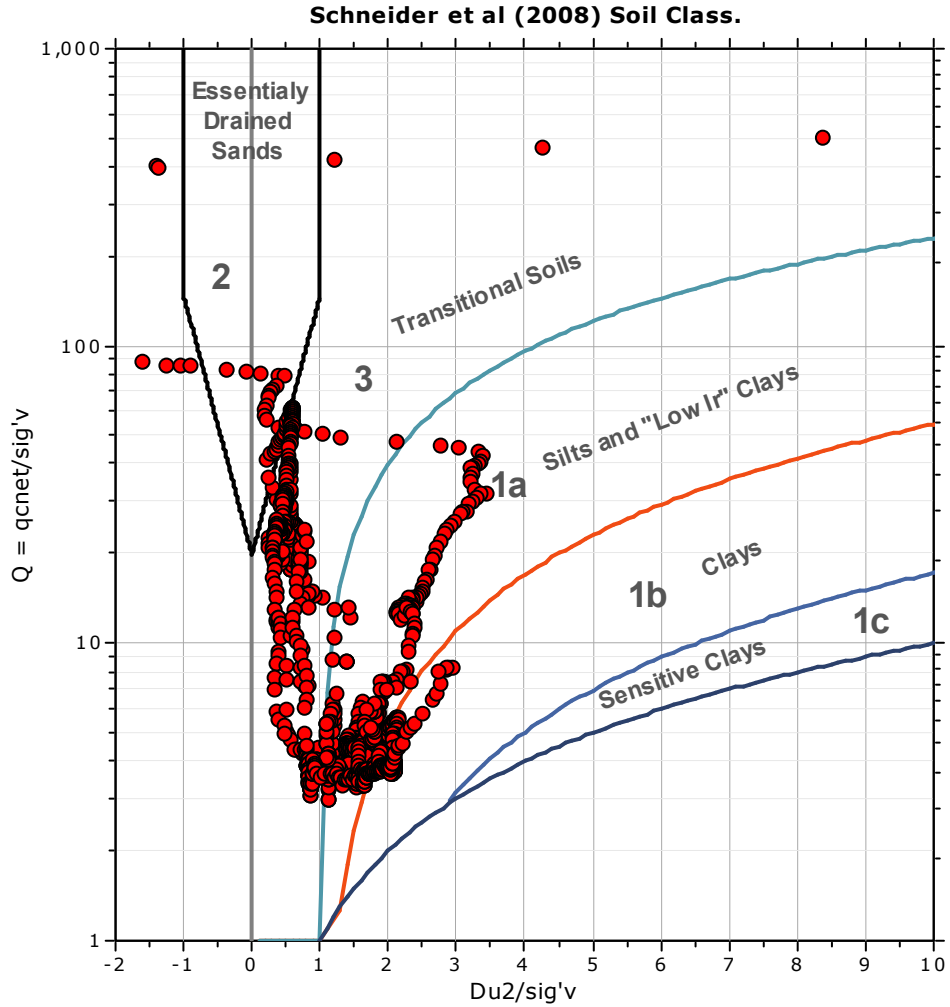
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
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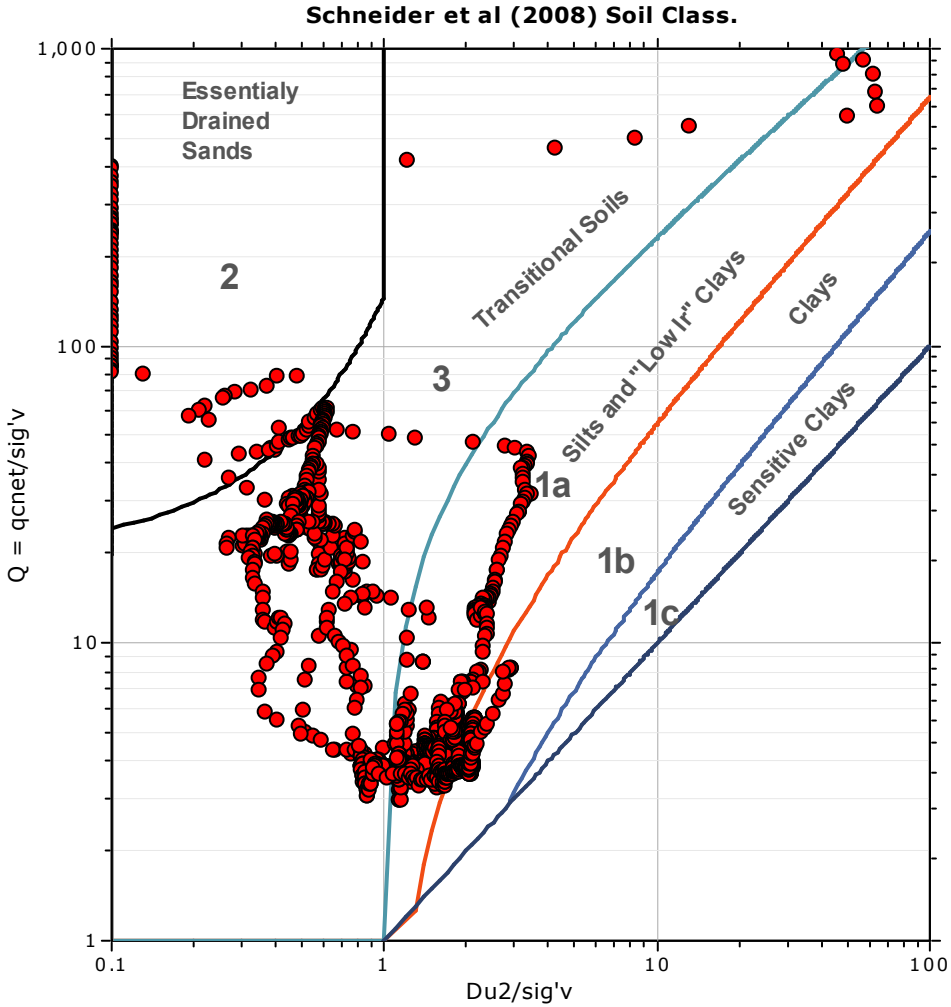
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Project: **Impianto fotovoltaico Fiscaglia**
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Bq plots (Schneider)

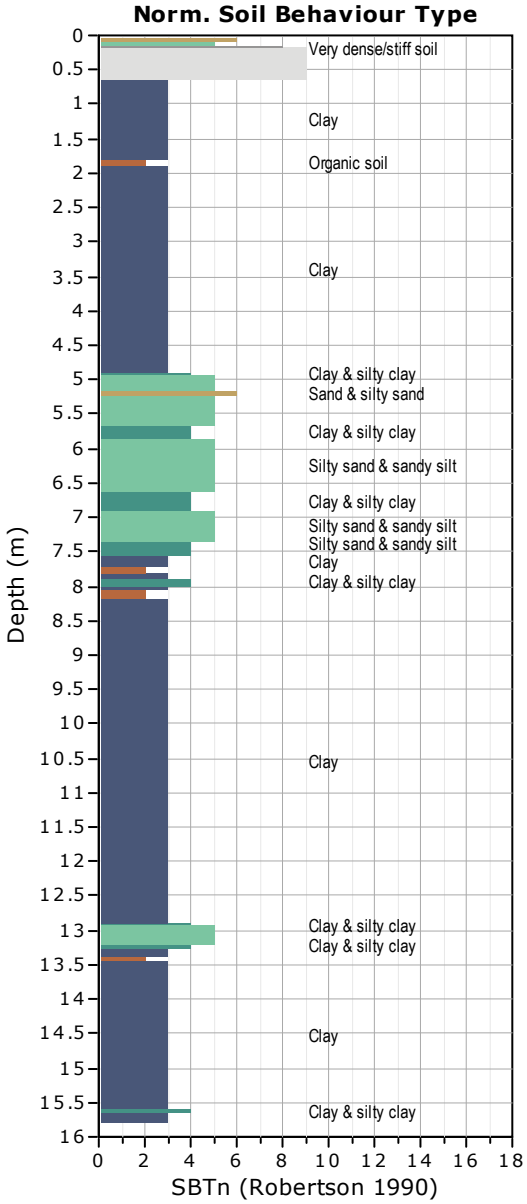


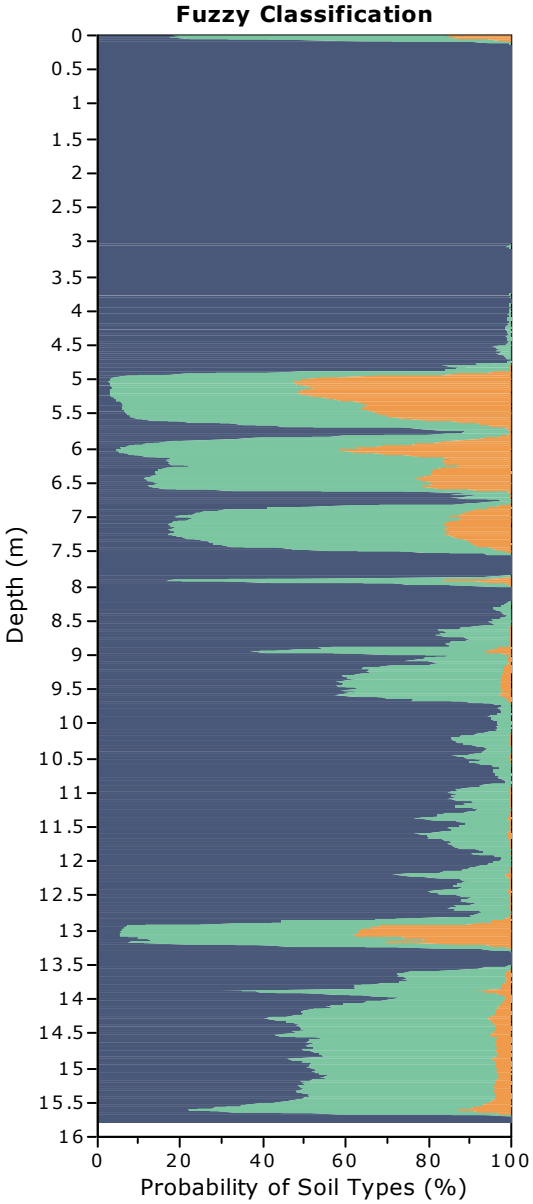


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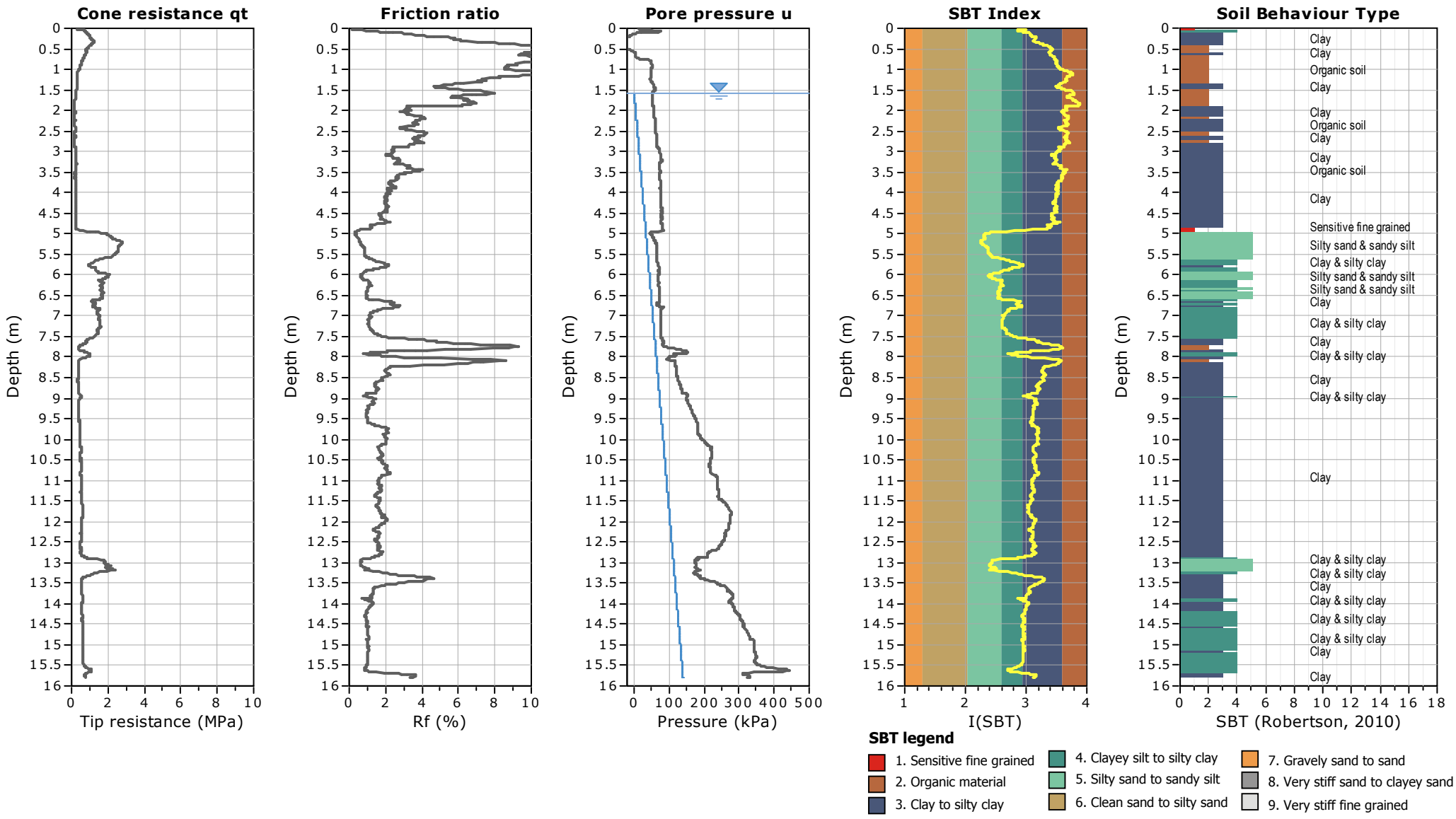




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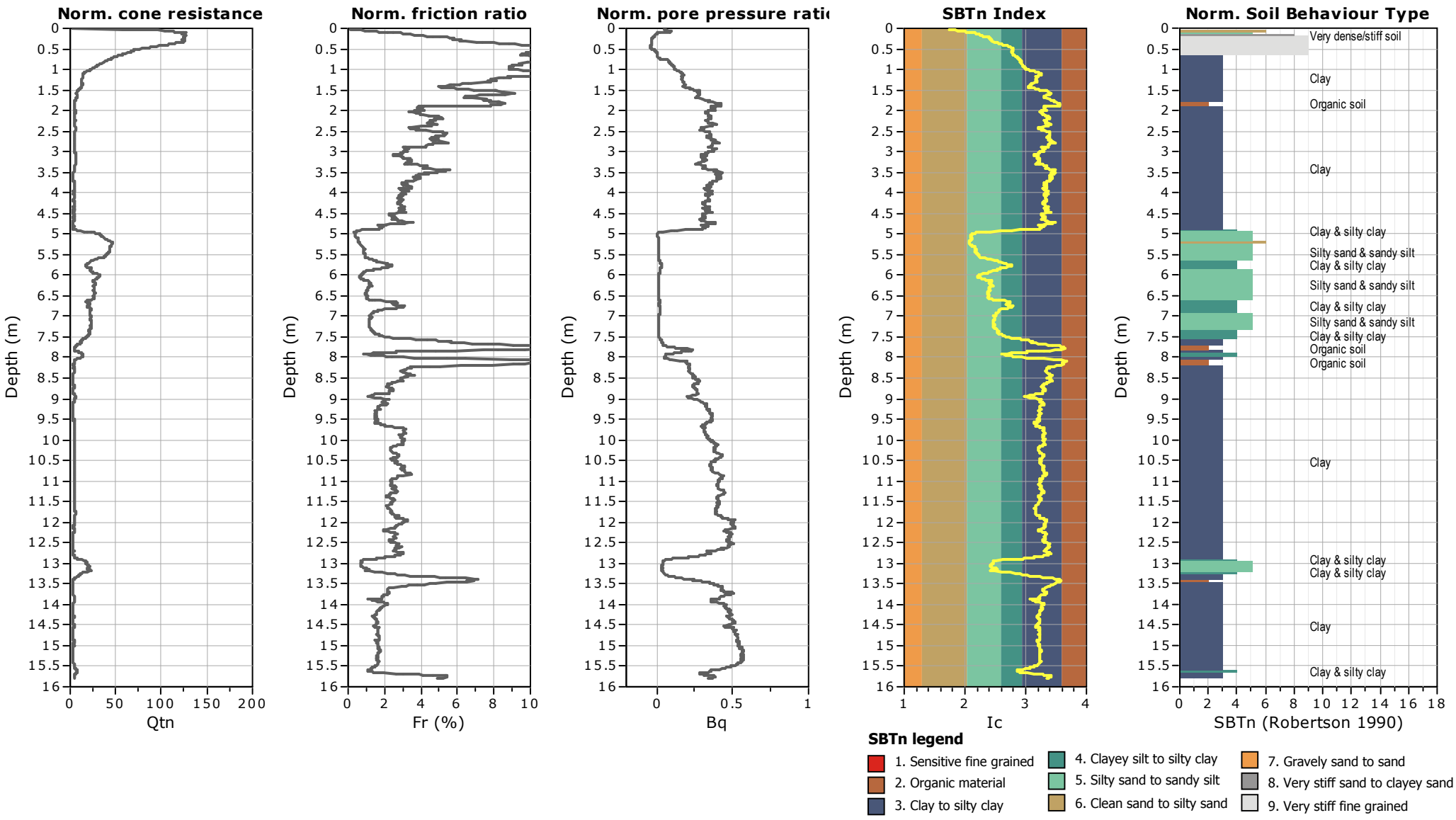
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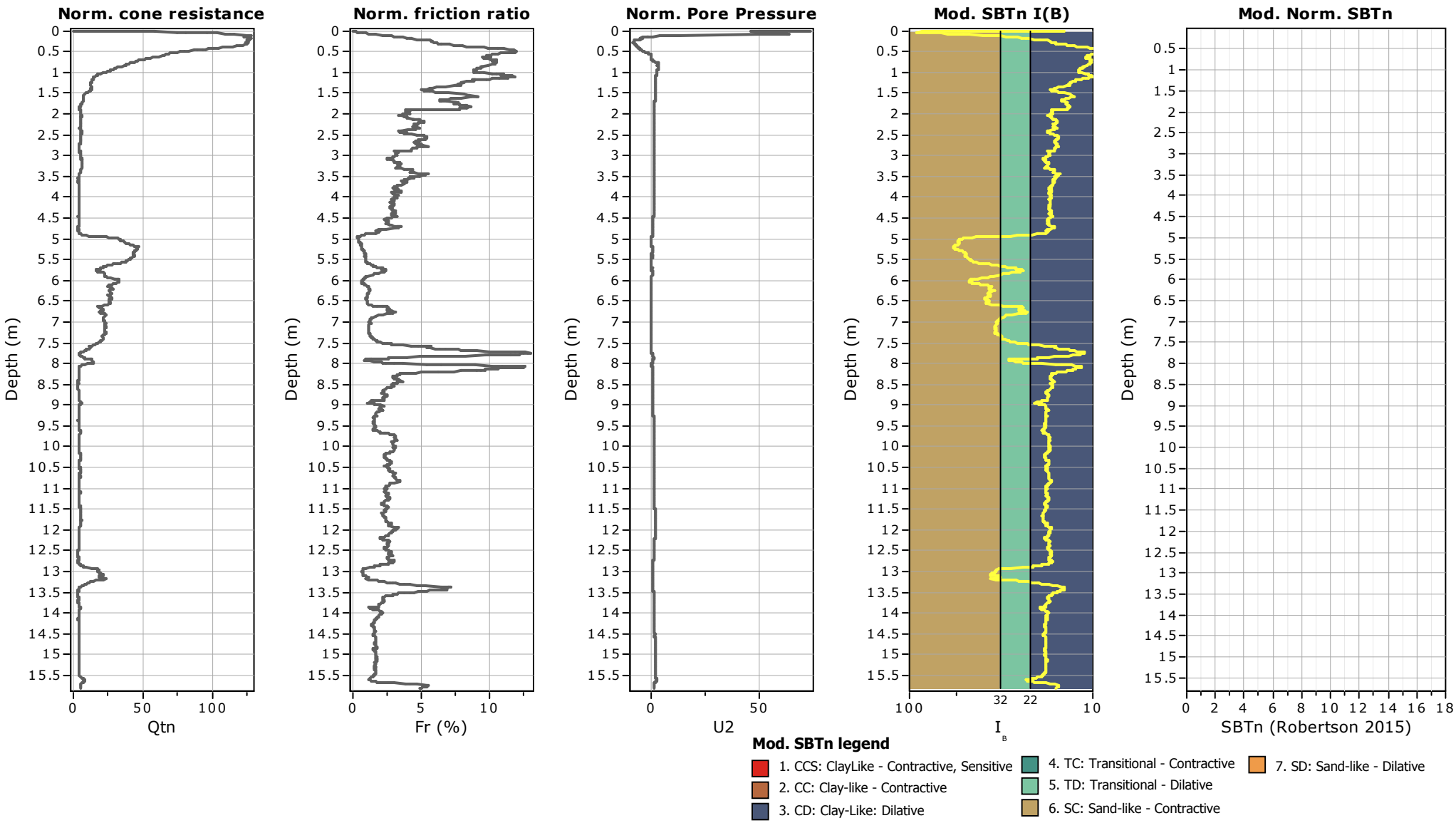
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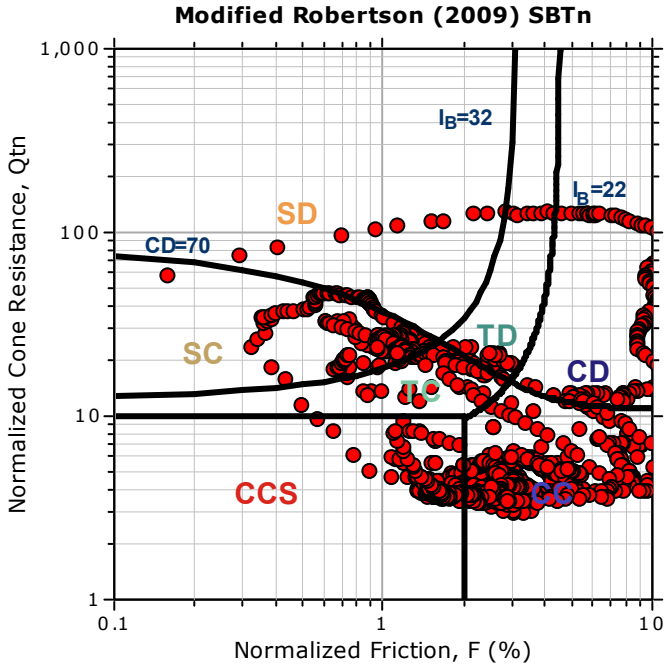


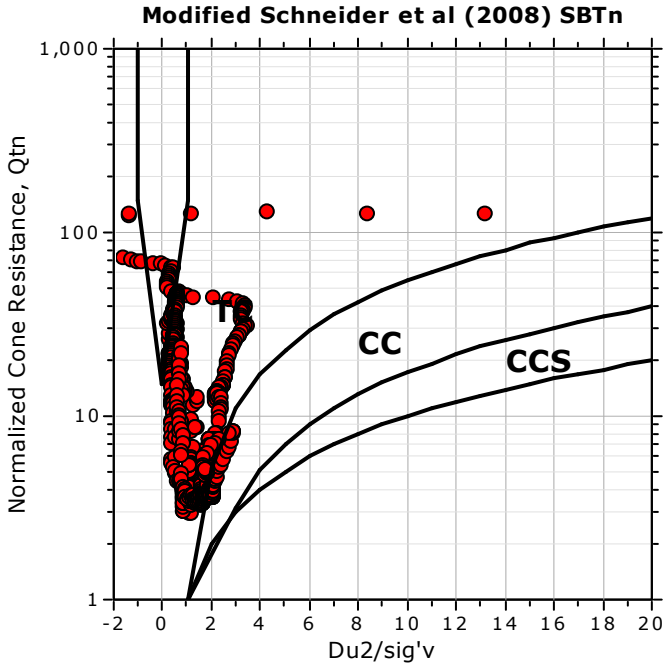
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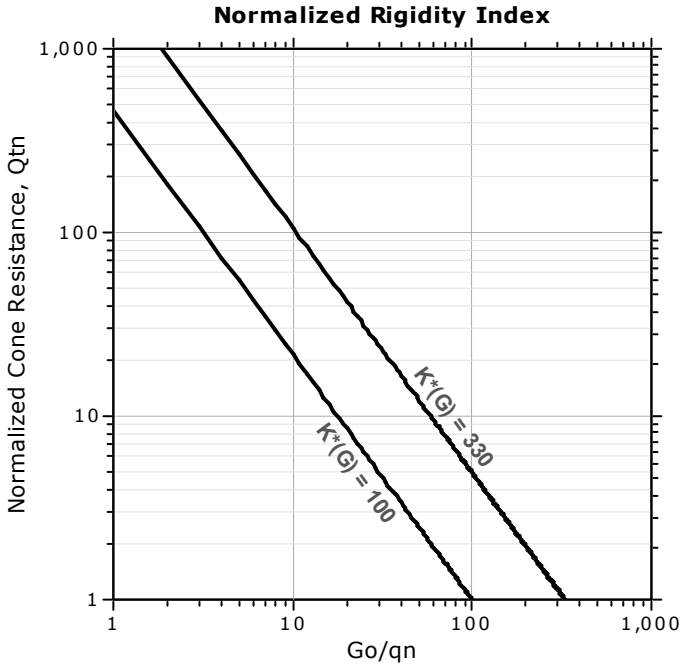
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Updated SBTn plots







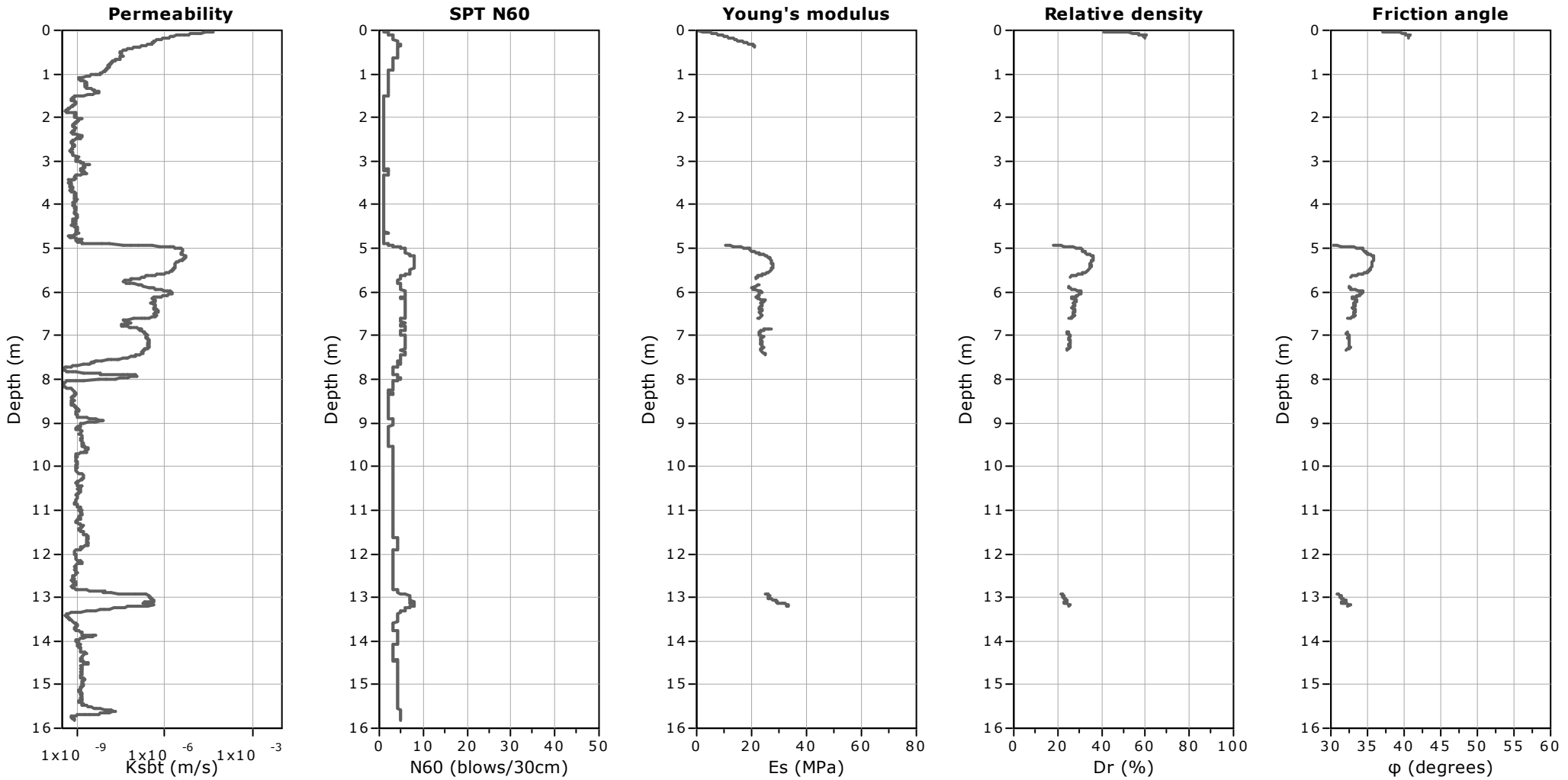
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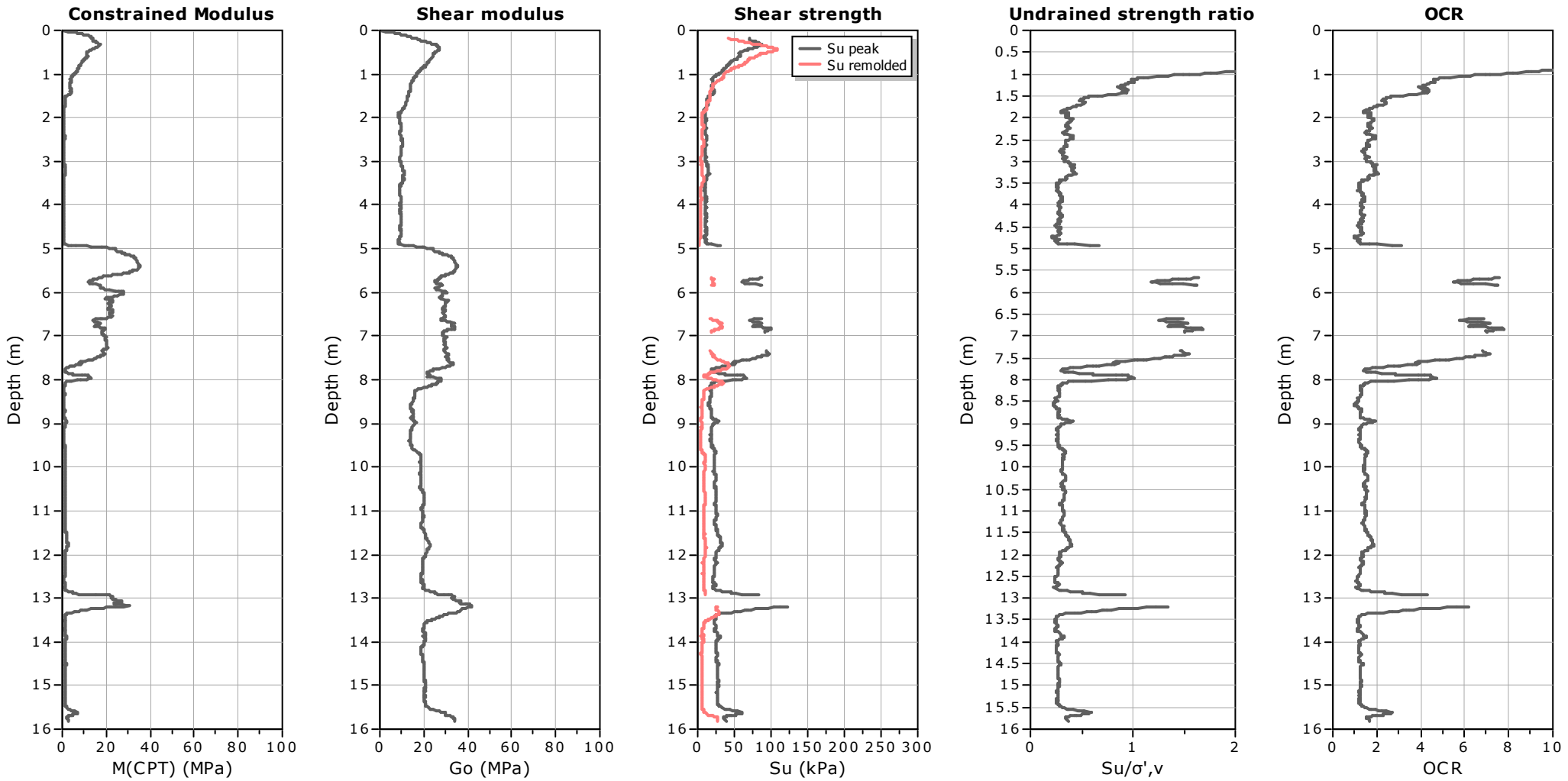
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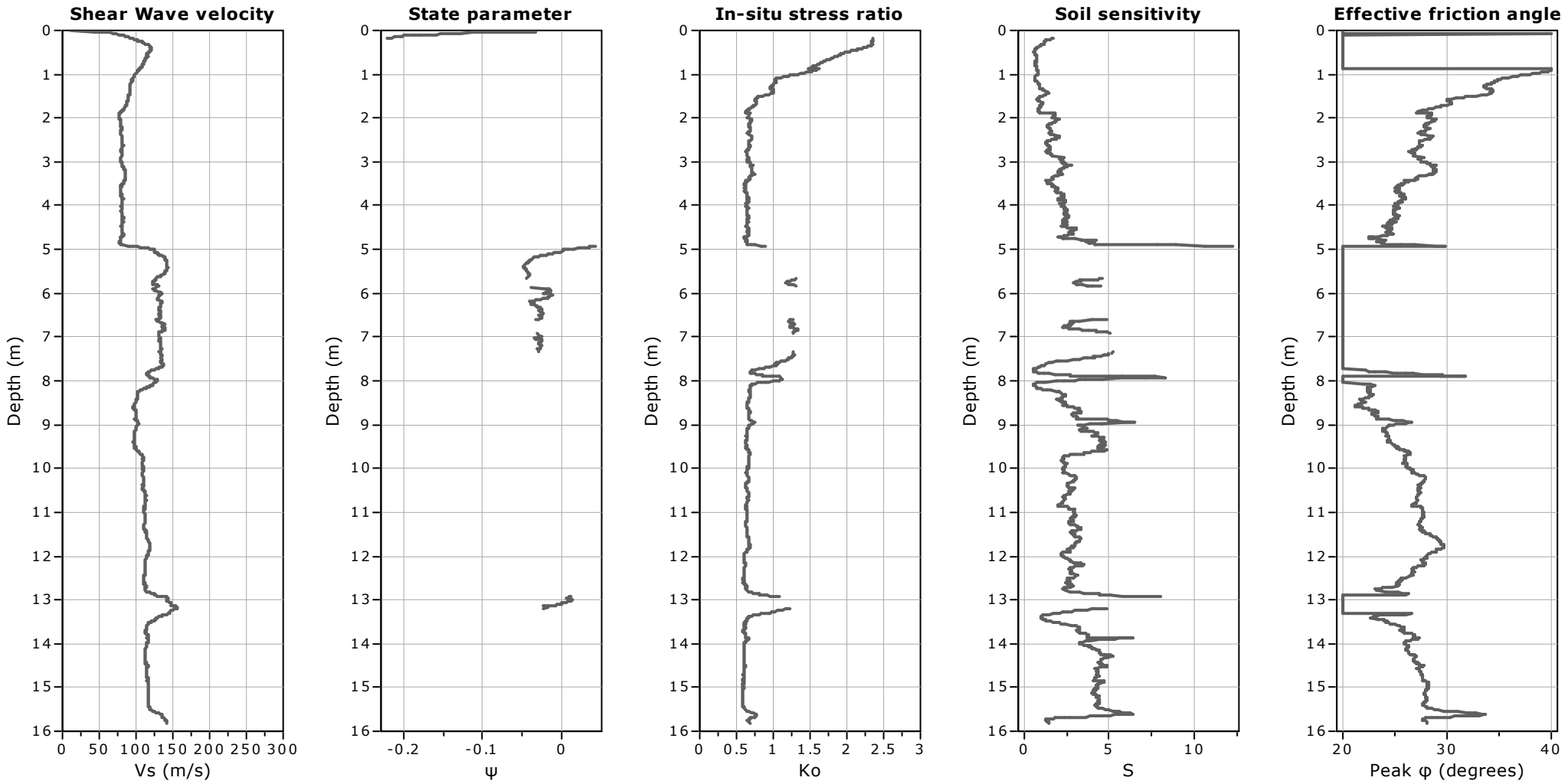
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RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu13
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



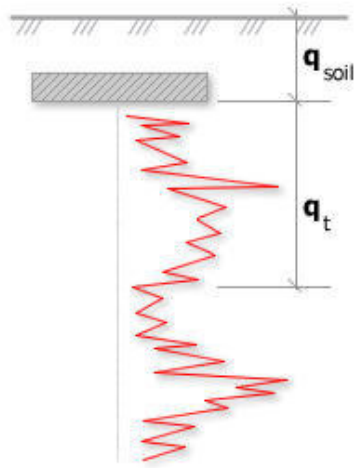
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu13
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

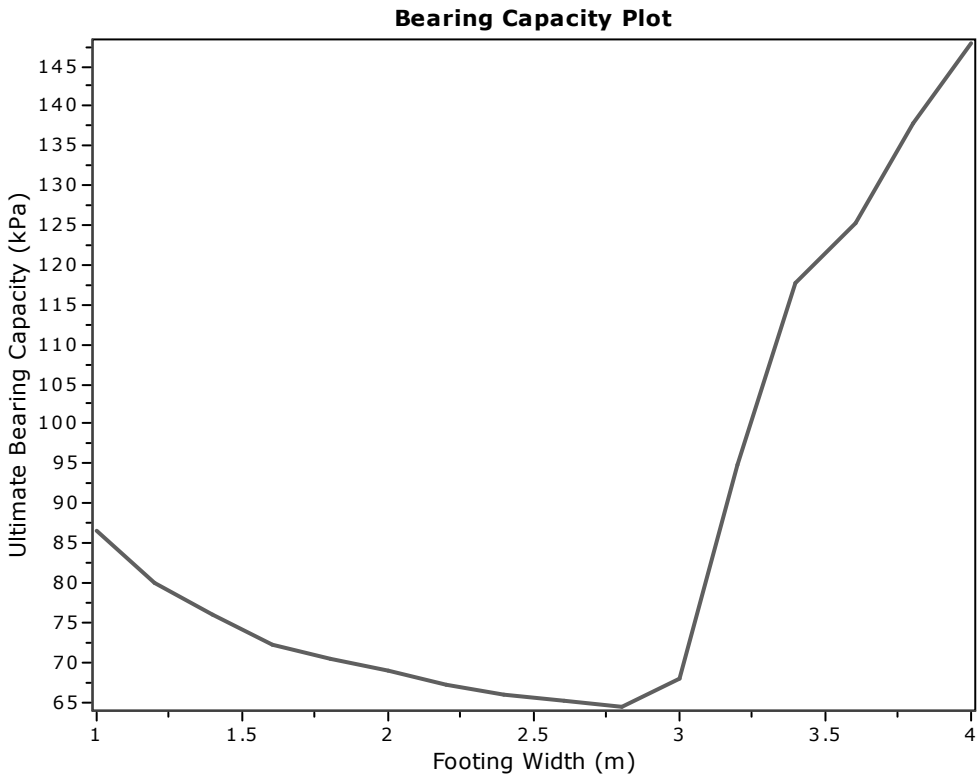
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



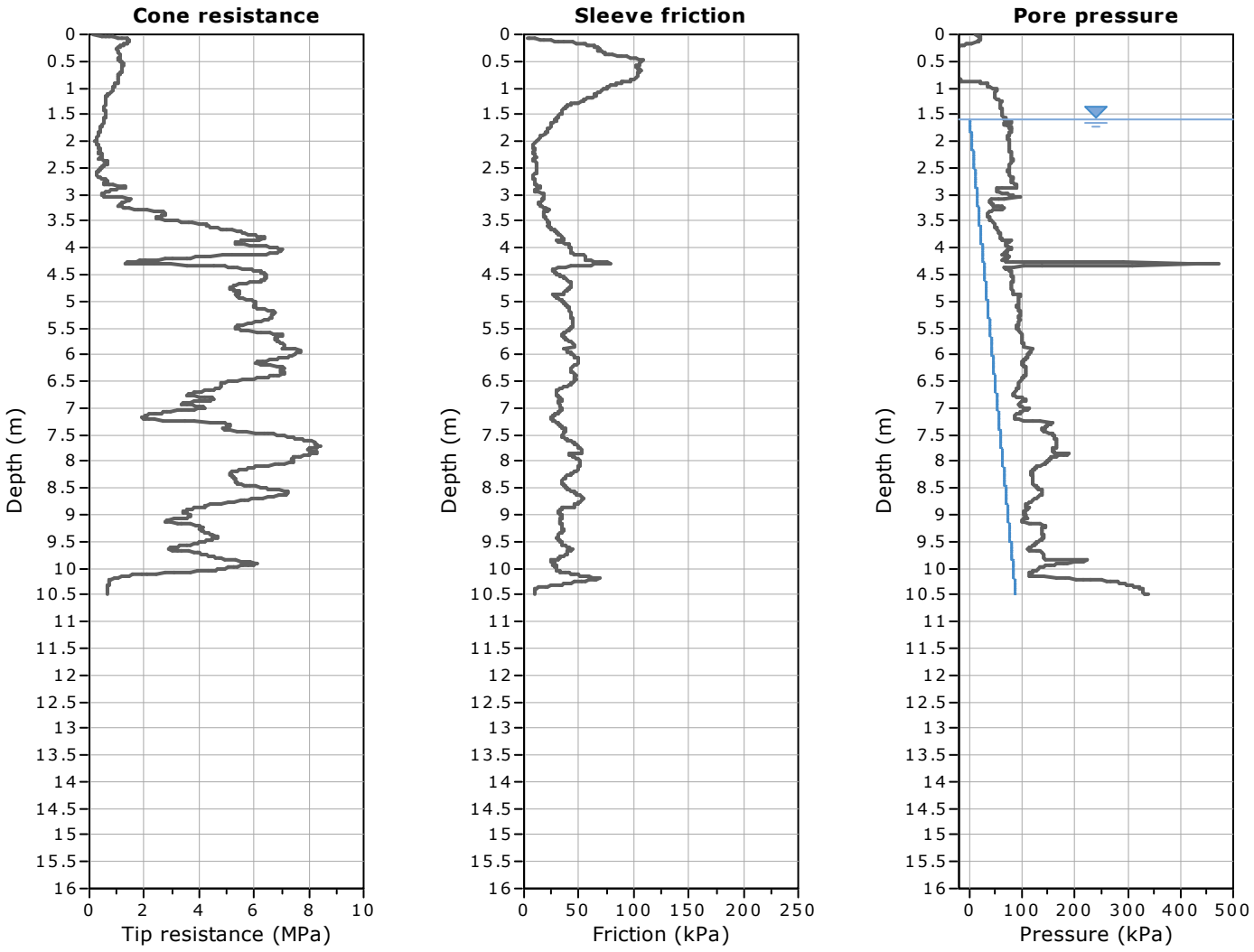
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.39	0.20	9.50	86.55
2	1.20	0.50	2.30	0.35	0.20	9.50	80.10
3	1.40	0.50	2.60	0.33	0.20	9.50	75.86
4	1.60	0.50	2.90	0.31	0.20	9.50	72.28
5	1.80	0.50	3.20	0.30	0.20	9.50	70.43
6	2.00	0.50	3.50	0.30	0.20	9.50	68.98
7	2.20	0.50	3.80	0.29	0.20	9.50	67.19
8	2.40	0.50	4.10	0.28	0.20	9.50	66.00
9	2.60	0.50	4.40	0.28	0.20	9.50	65.10
10	2.80	0.50	4.70	0.27	0.20	9.50	64.40
11	3.00	0.50	5.00	0.29	0.20	9.50	67.95
12	3.20	0.50	5.30	0.43	0.20	9.50	94.75
13	3.40	0.50	5.60	0.54	0.20	9.50	117.77
14	3.60	0.50	5.90	0.58	0.20	9.50	125.30
15	3.80	0.50	6.20	0.64	0.20	9.50	137.74
16	4.00	0.50	6.50	0.69	0.20	9.50	147.91

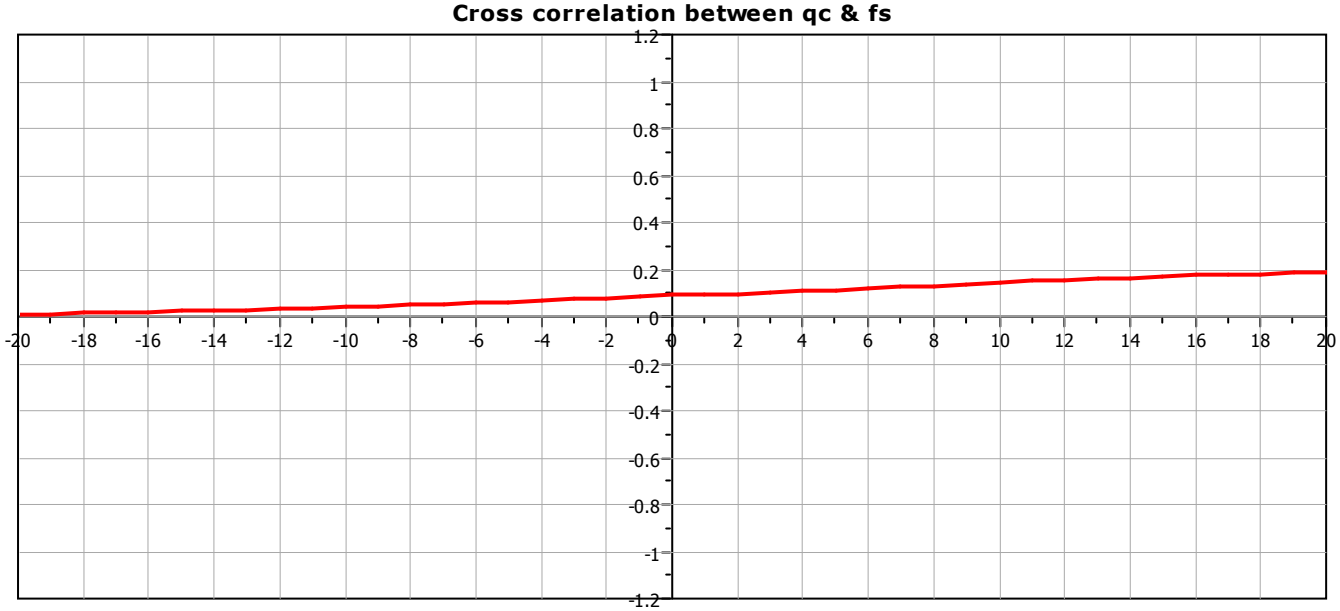
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CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

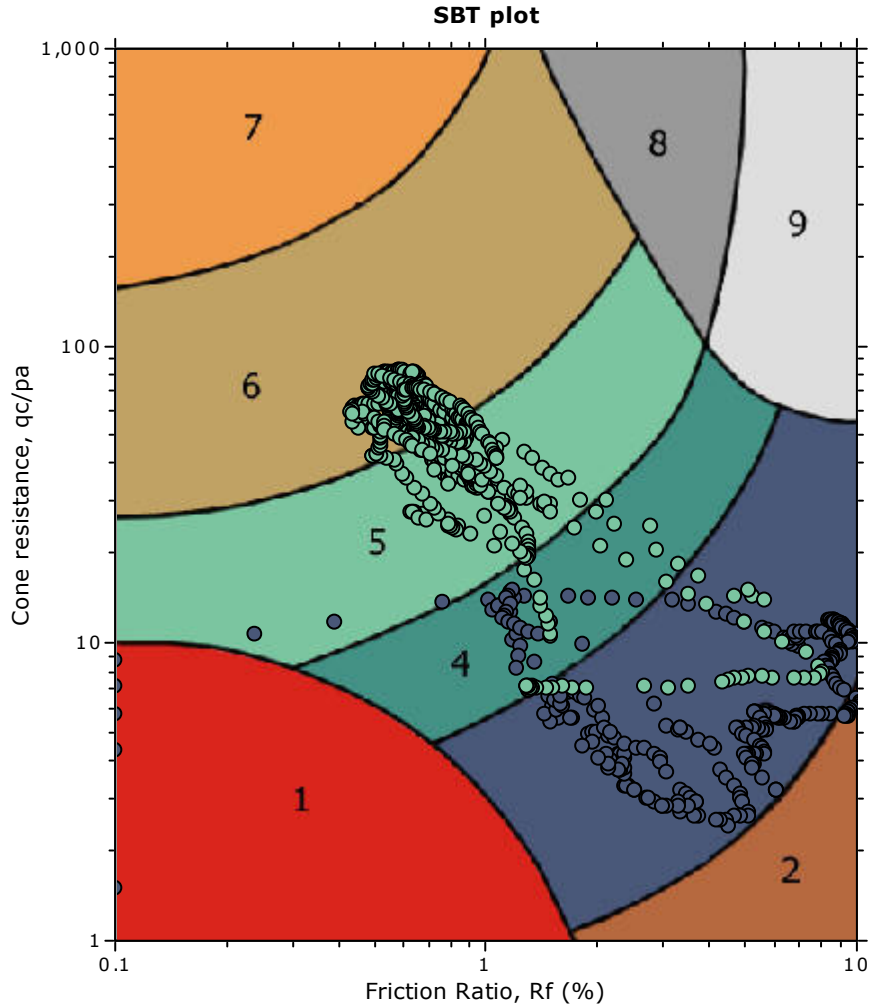


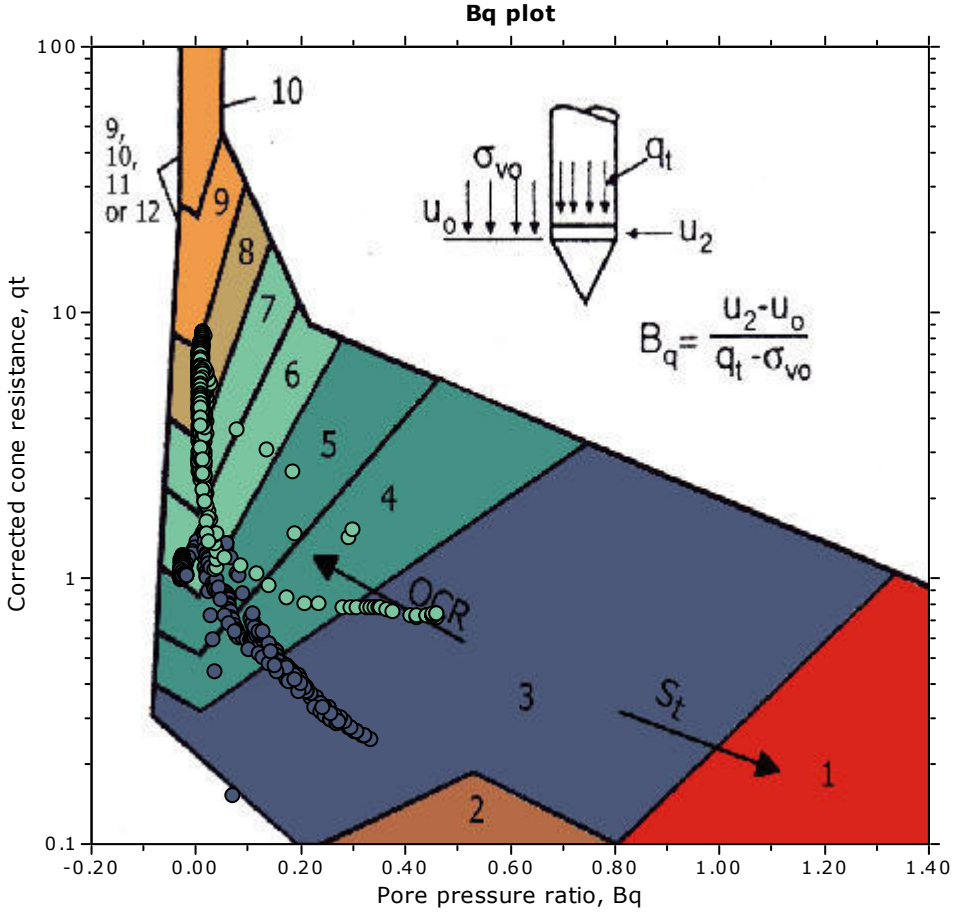
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CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

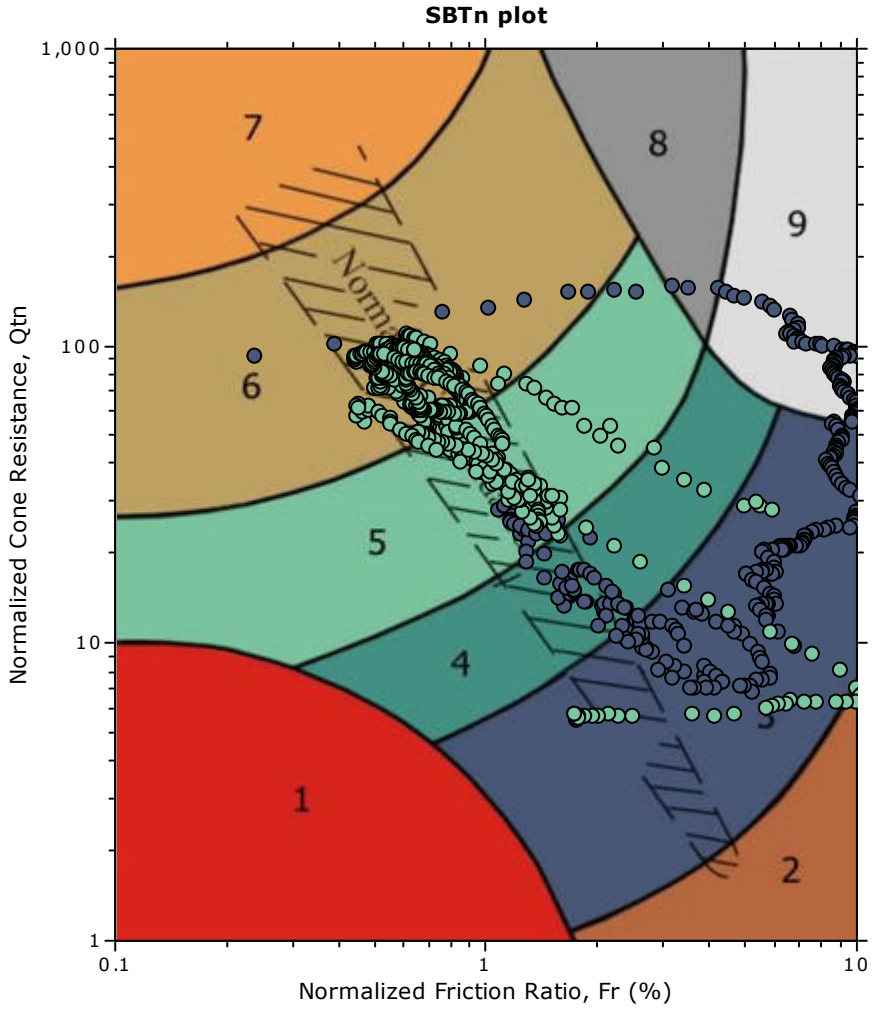
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

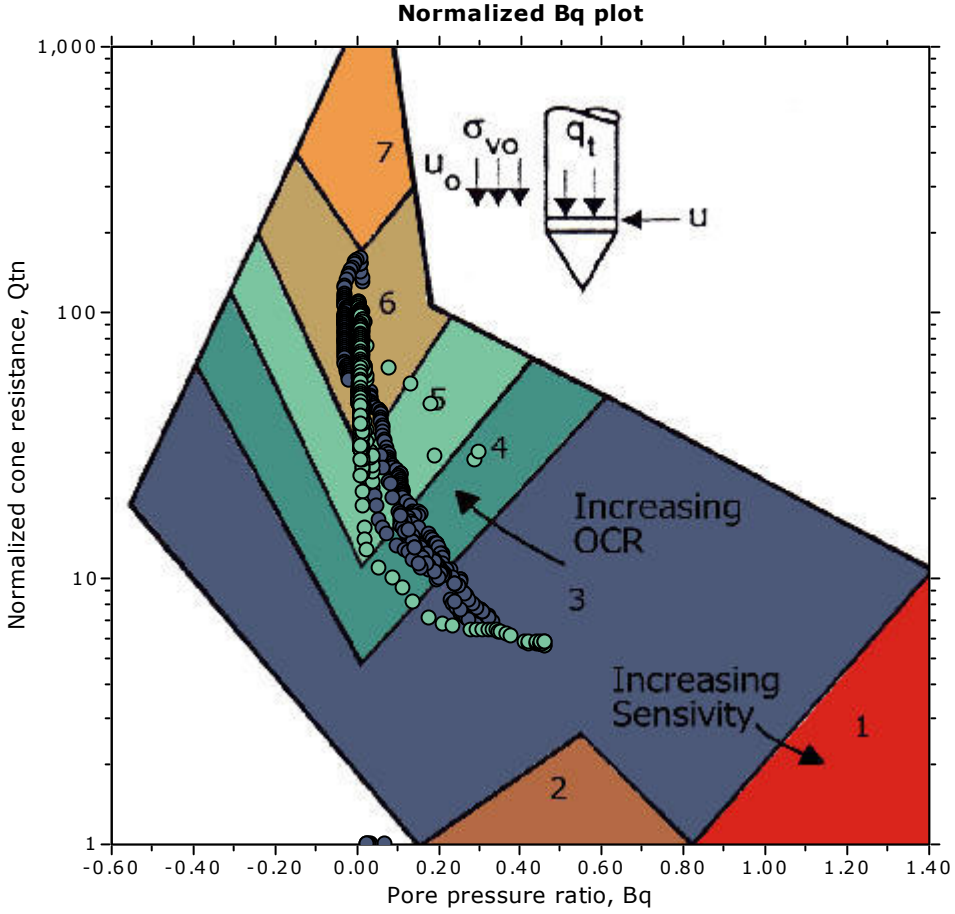
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

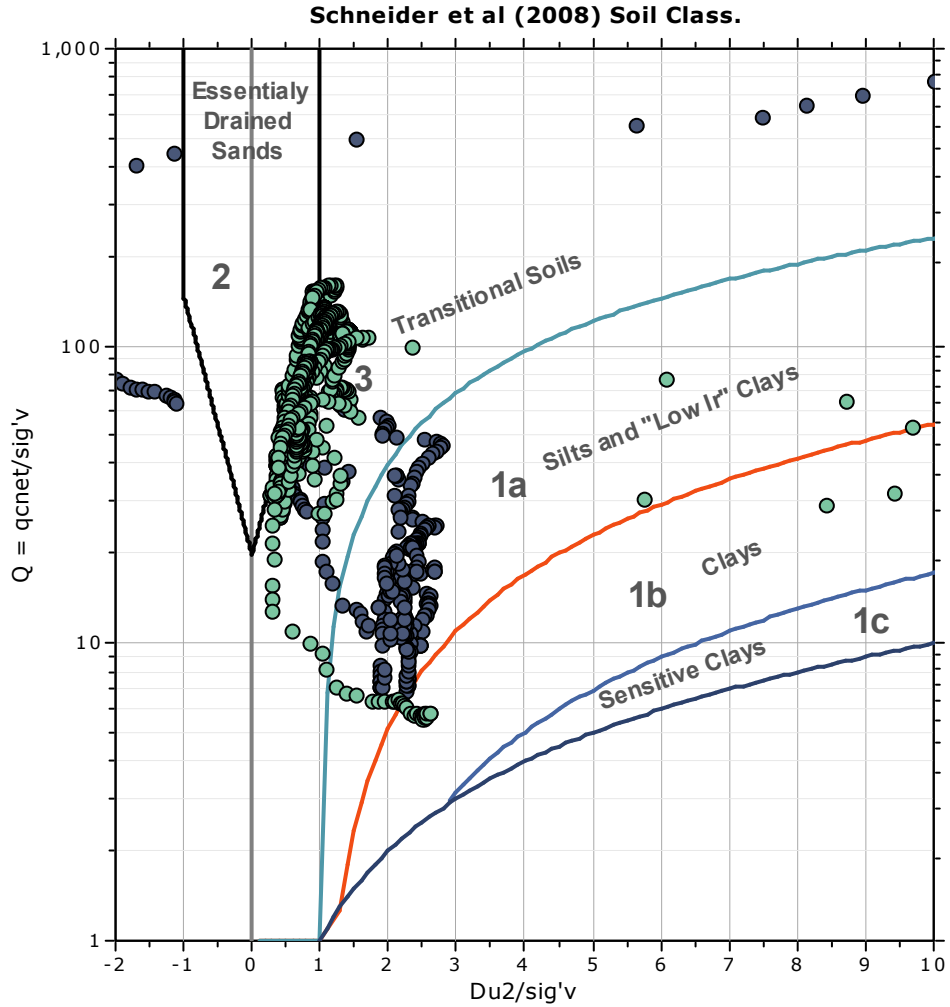
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

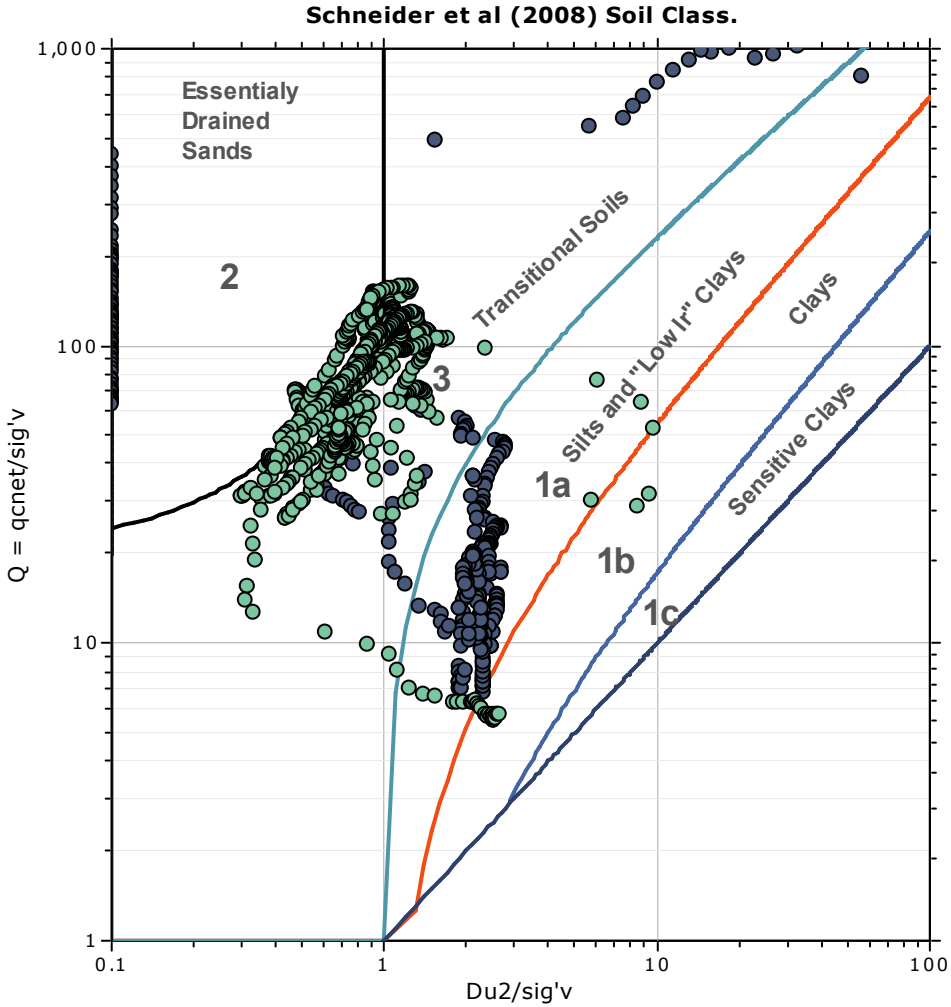
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

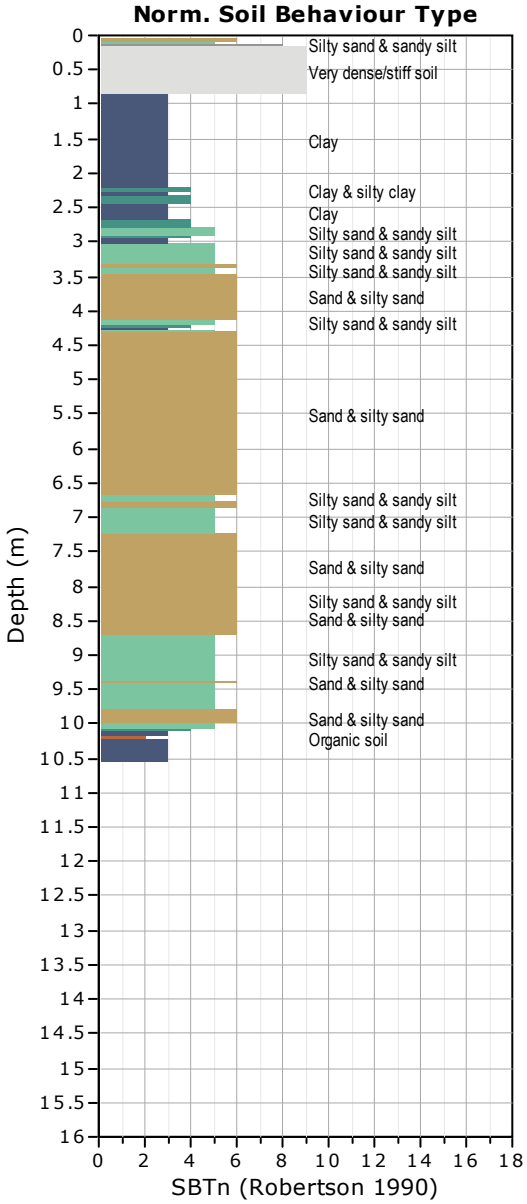


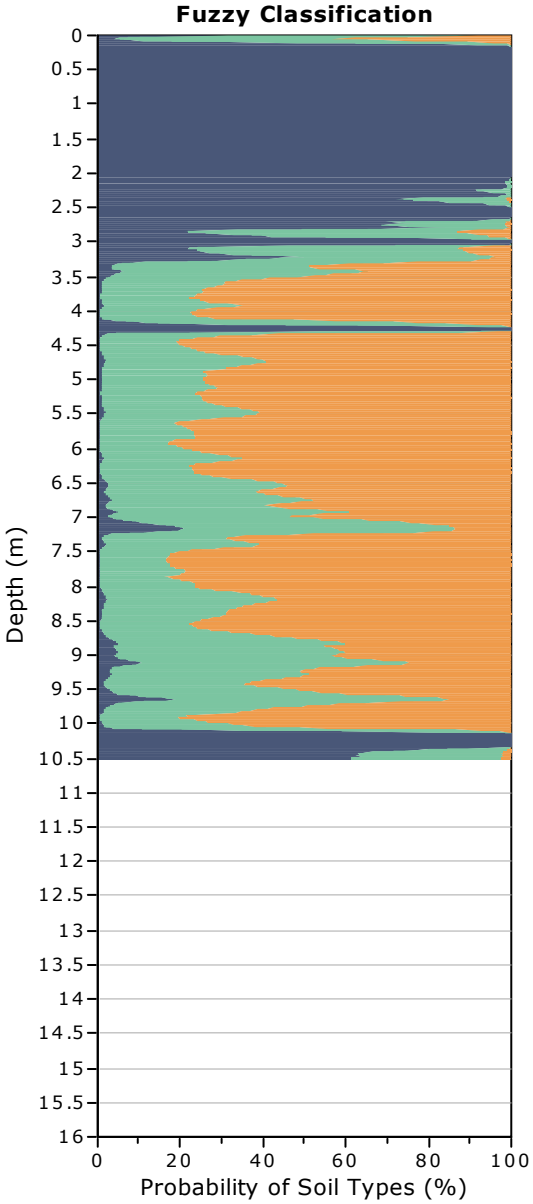


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Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

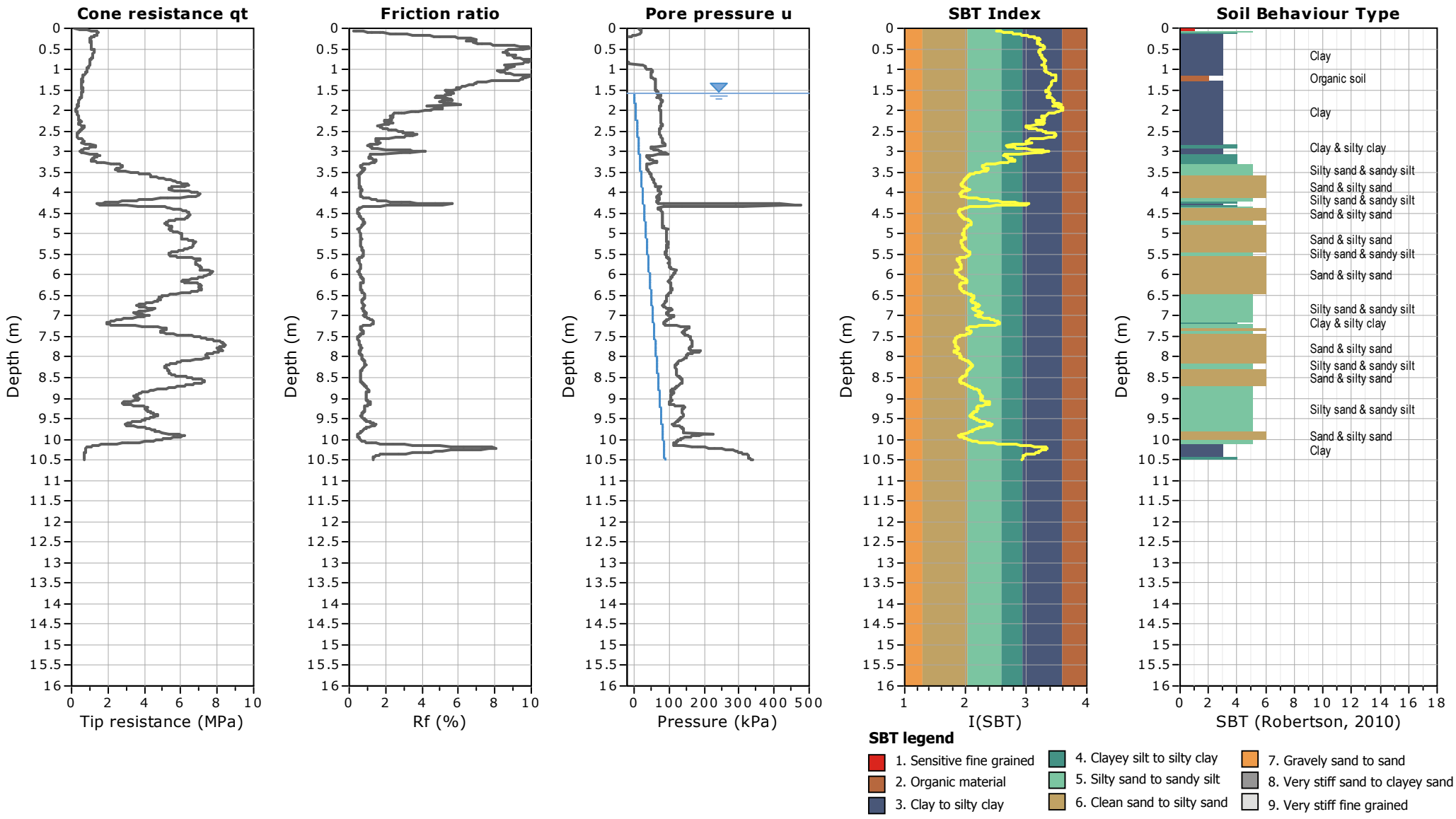




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CPT: cptu14
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

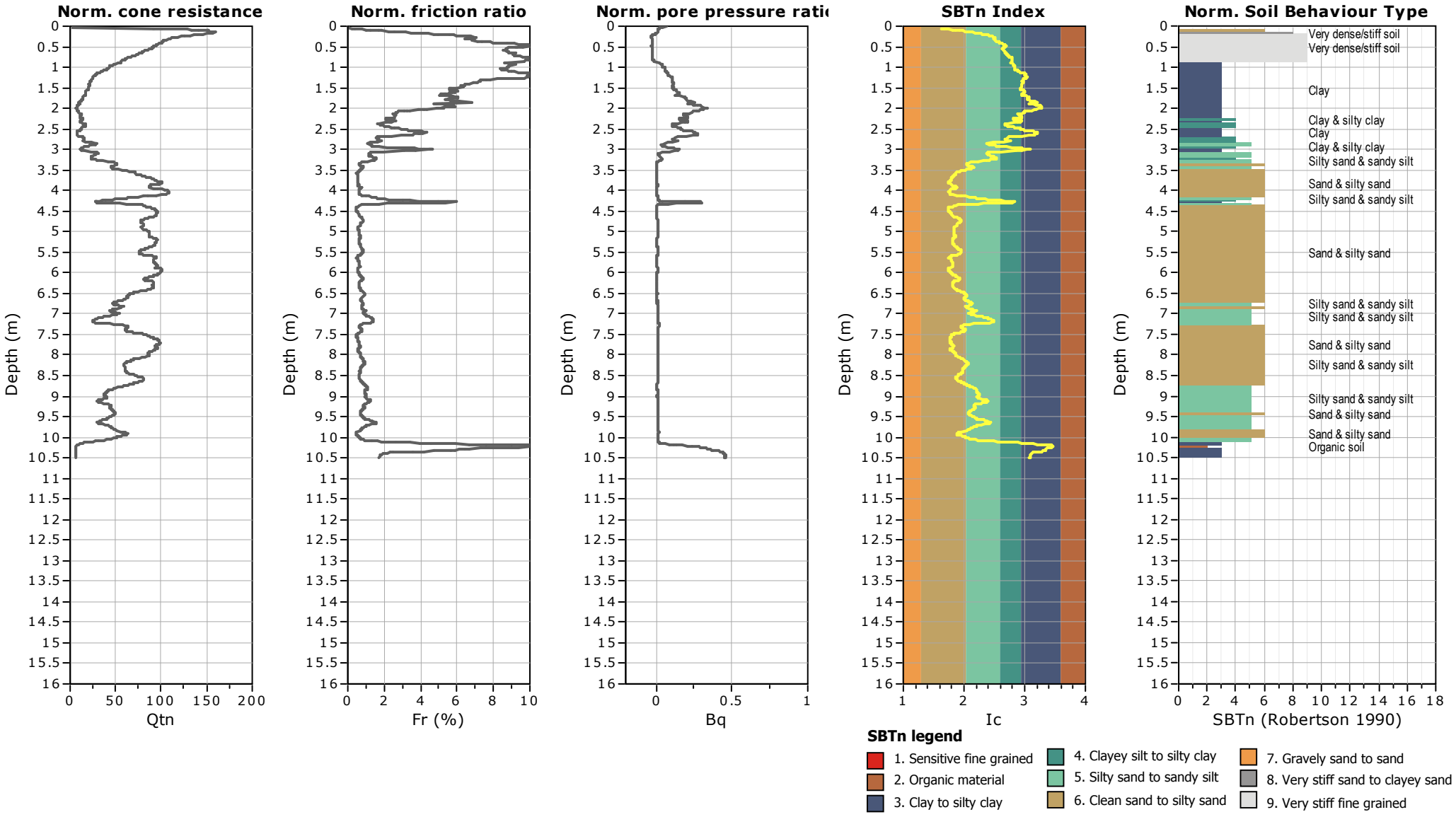
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



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rocco.carbonella@fastwebnet.it

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Cone Type: Uknown
Cone Operator: Uknown

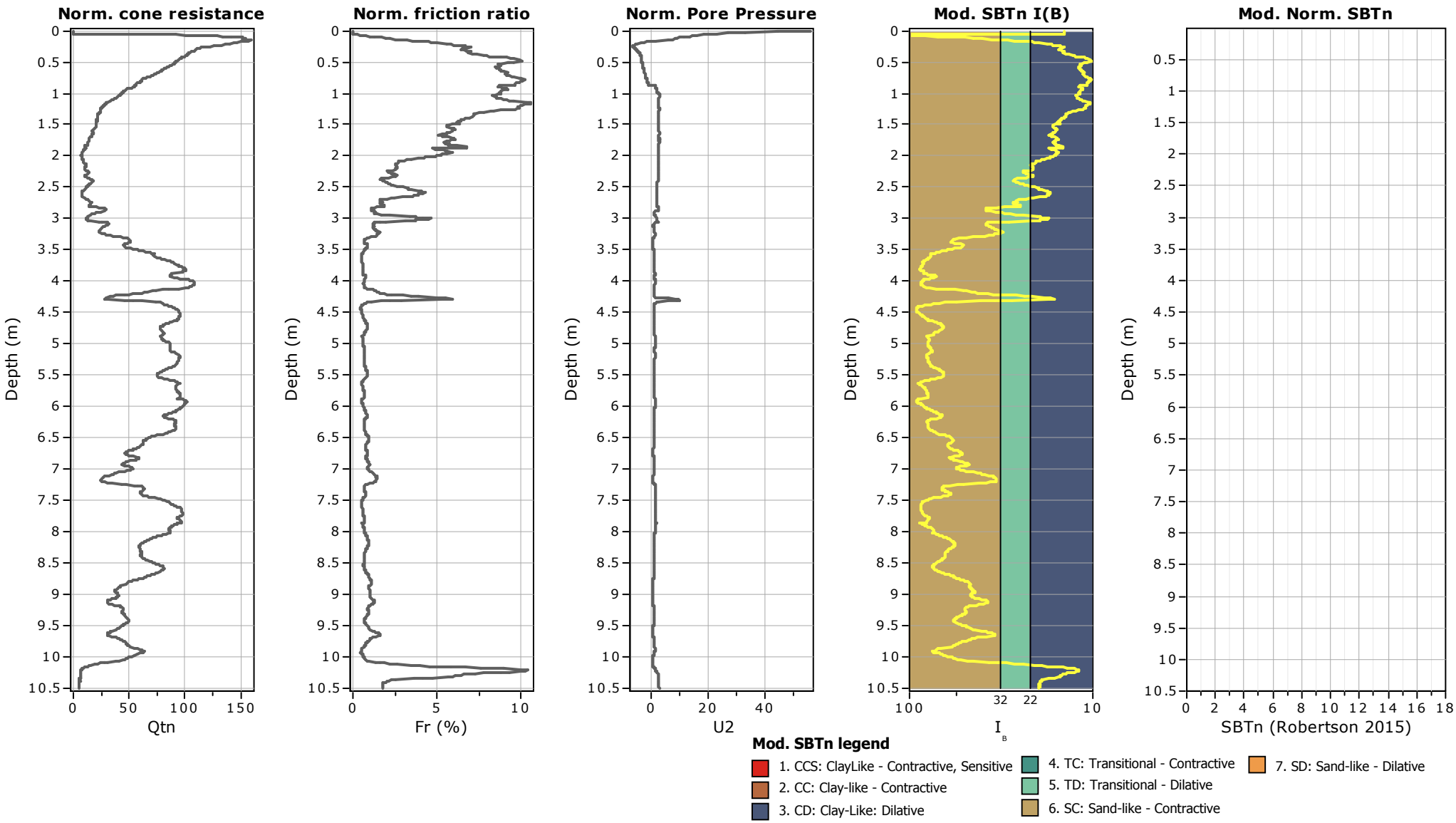
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



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Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

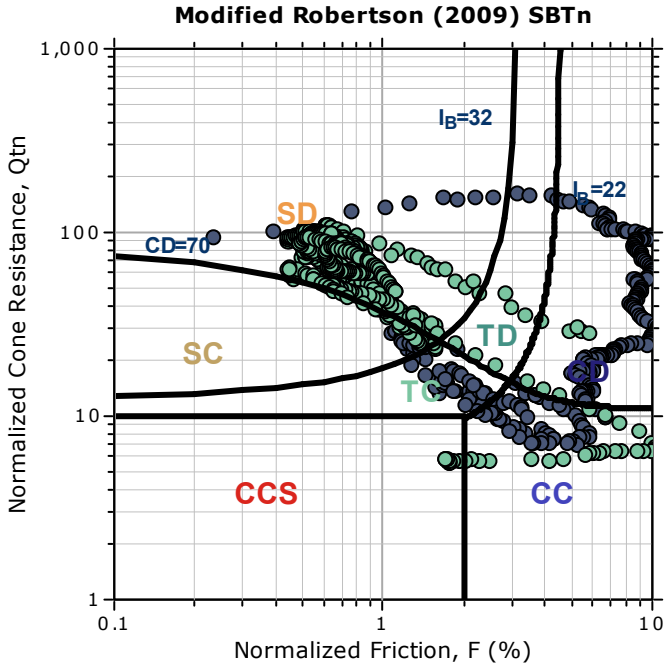


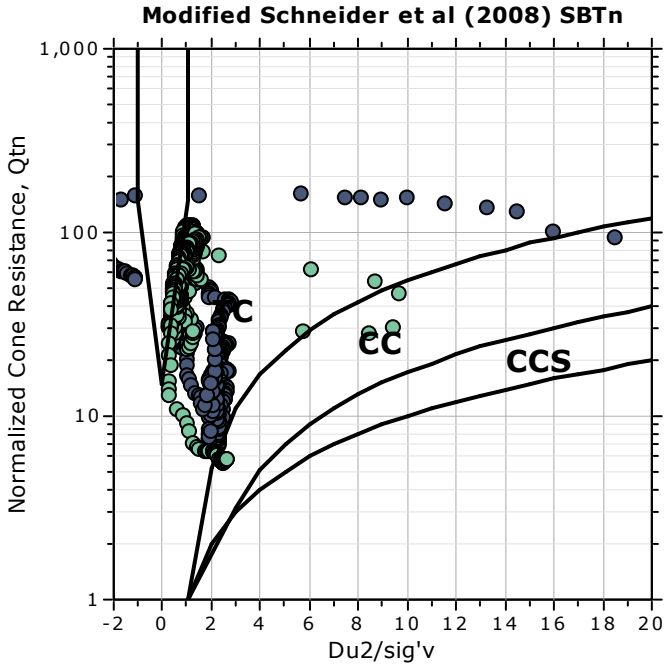
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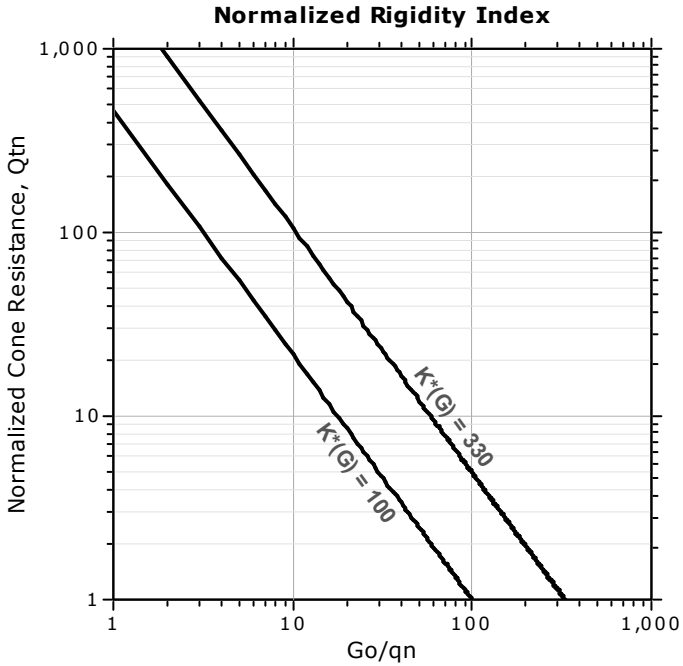
CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







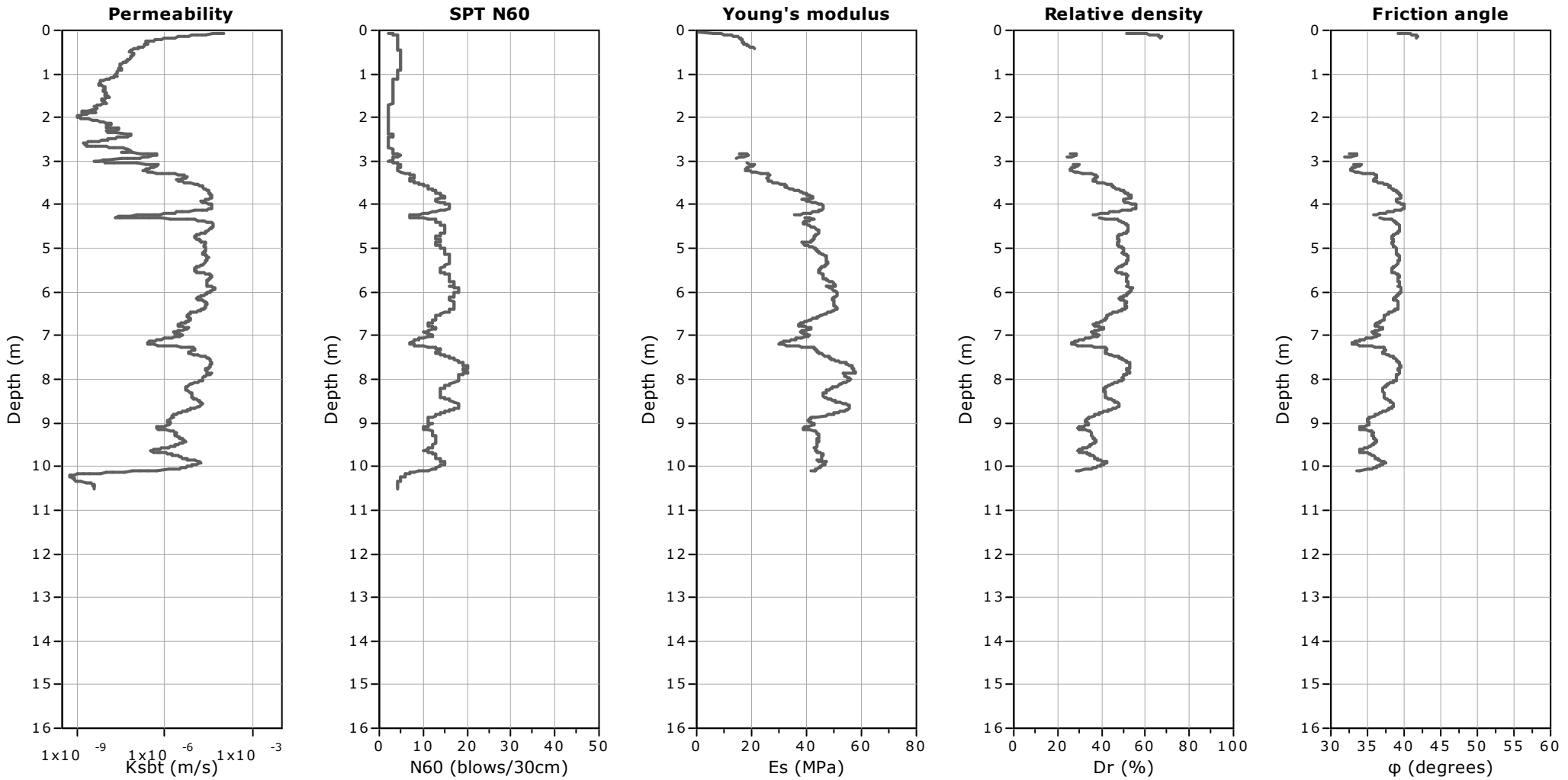
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



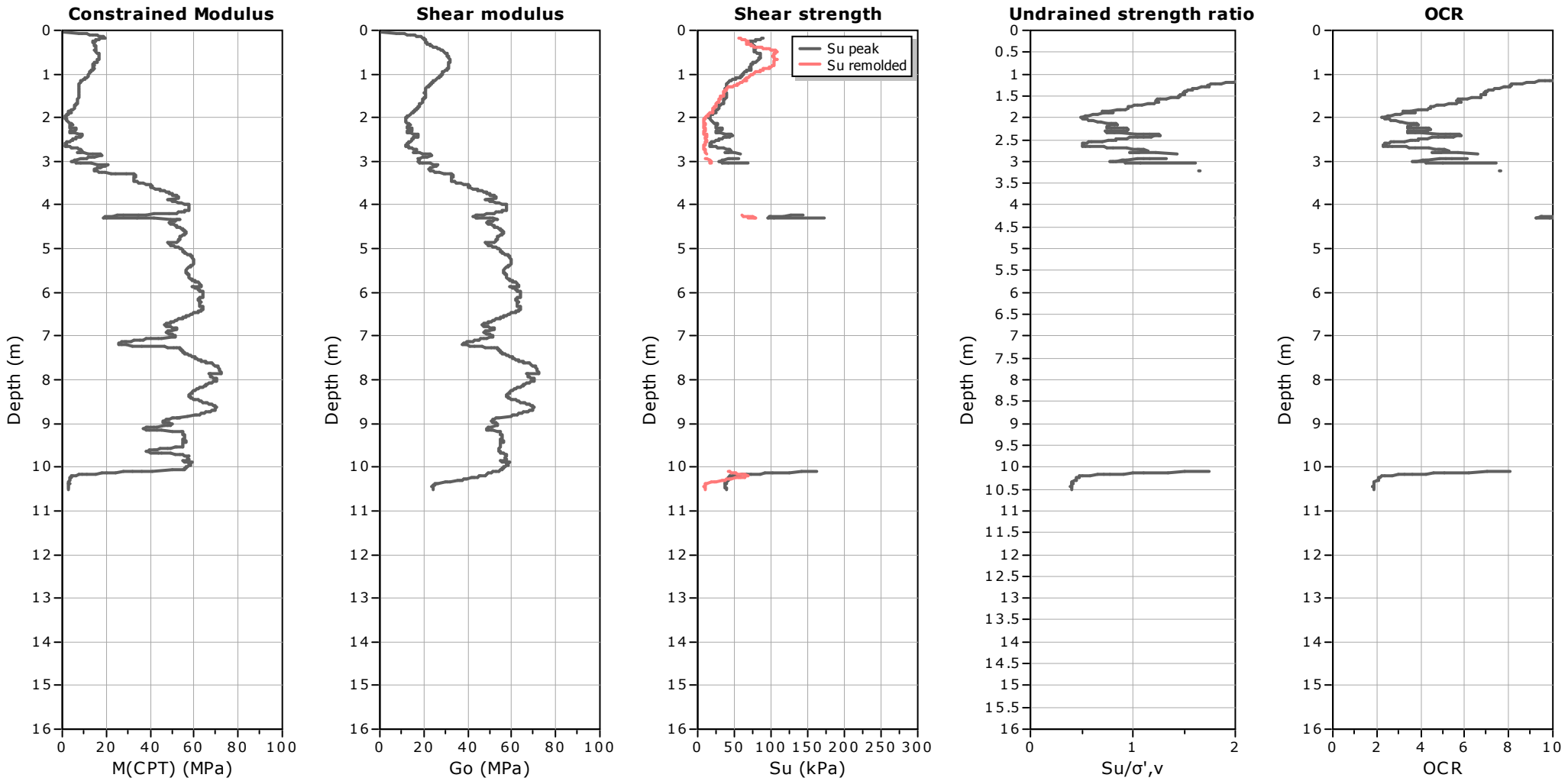
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



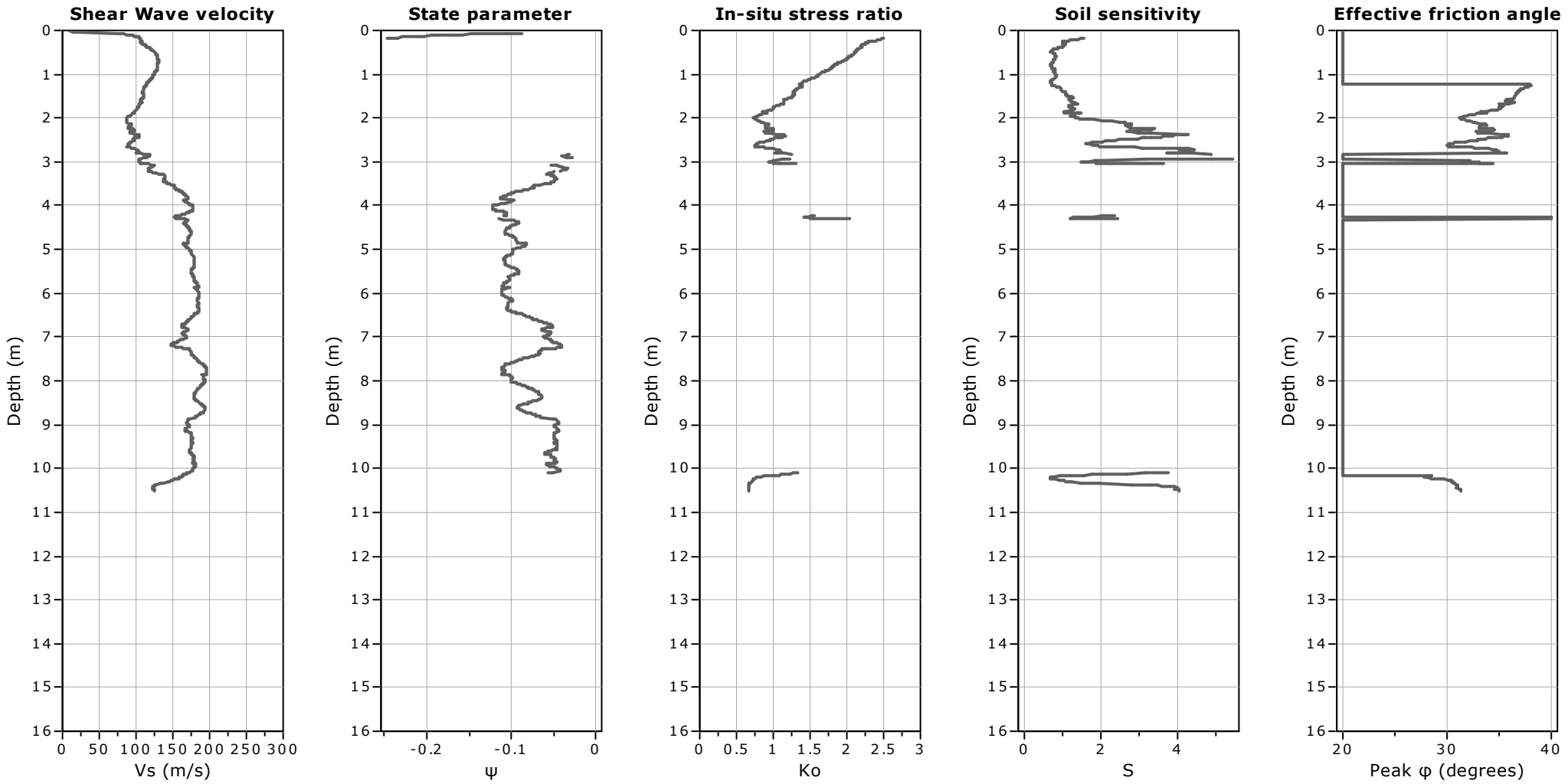
Calculation parameters

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

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Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



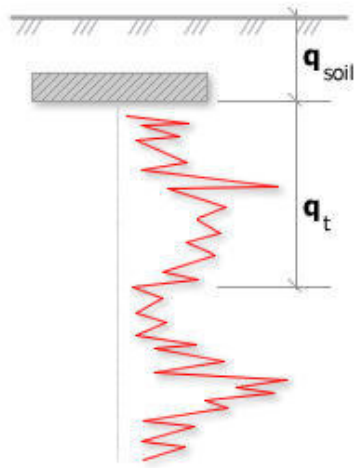
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

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CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

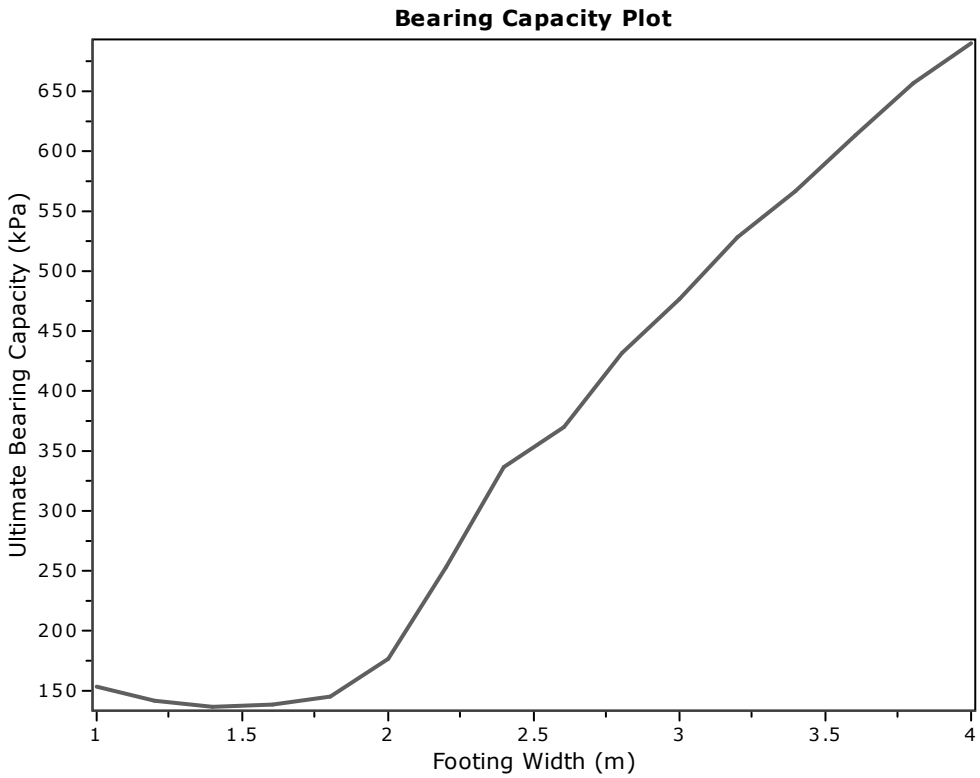
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



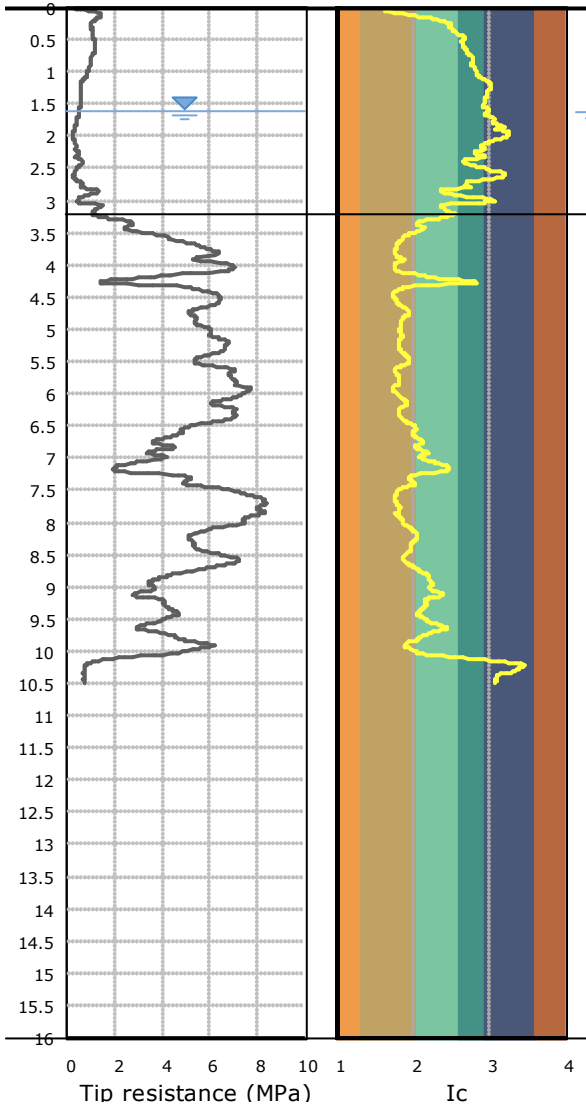
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.72	0.20	9.50	153.17
2	1.20	0.50	2.30	0.66	0.20	9.50	141.96
3	1.40	0.50	2.60	0.64	0.20	9.50	137.02
4	1.60	0.50	2.90	0.64	0.20	9.50	138.38
5	1.80	0.50	3.20	0.68	0.20	9.50	145.28
6	2.00	0.50	3.50	0.84	0.20	9.50	177.58
7	2.20	0.50	3.80	1.22	0.20	9.50	252.78
8	2.40	0.50	4.10	1.64	0.20	9.50	337.21
9	2.60	0.50	4.40	1.80	0.20	9.50	369.98
10	2.80	0.50	4.70	2.11	0.20	9.50	432.10
11	3.00	0.50	5.00	2.34	0.20	9.50	476.52
12	3.20	0.50	5.30	2.59	0.20	9.50	527.21
13	3.40	0.50	5.60	2.78	0.20	9.50	566.45
14	3.60	0.50	5.90	3.02	0.20	9.50	613.41
15	3.80	0.50	6.20	3.23	0.20	9.50	655.09
16	4.00	0.50	6.50	3.40	0.20	9.50	689.15

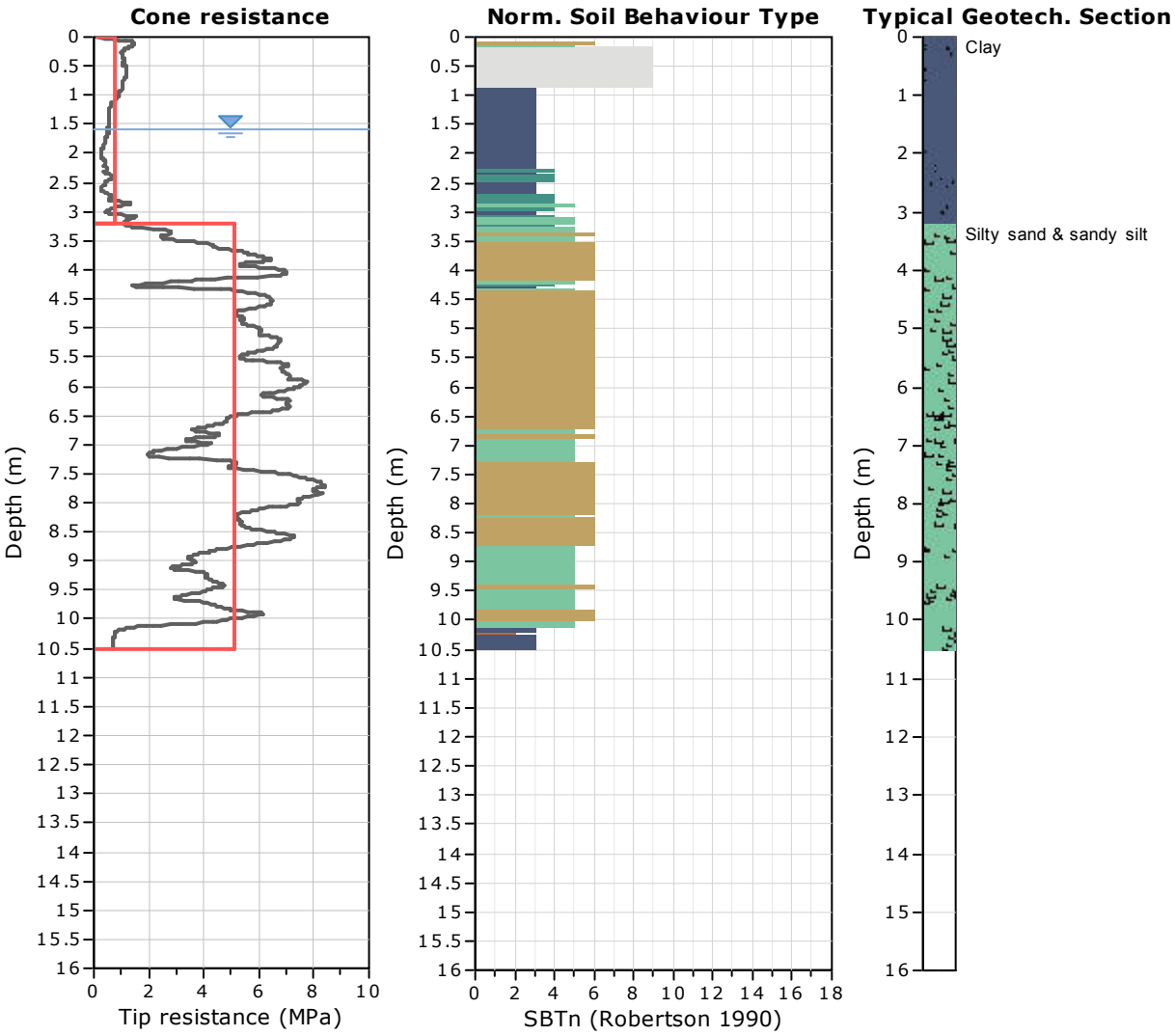
RDR SrL
Bologna Via Toscana 119
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CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.00	Clay	0.7	1.03E-6	3.3	14.9	-	-	9.4	20.3	46.4	2.6	12.1	16.7
3.20	Silty sand & sandy silt	5.1	1.43E-5	13.4	44.4	44.1	37.6	51.6	54.4	-	-	-	17.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 3.20 (m)

Description: Clay

Basic results

Total cone resistance: 0.74 ±0.34 MPa
Sleeve friction: 40.41 ±34.49 kPa
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 1.03E-06 ±7.77E-06 m/s
N60: 3.28 ±1.08 blows
Es: 14.90 ±6.51 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 16.69 ±1.20 kN/m³
Constrained Mod.: 9.42 ±5.22 MPa
Go: 20.30 ±6.69 MPa
Su: 46.36 ±22.07 kPa
Su ratio: 2.61 ±2.50
O.C.R.: 12.06 ±11.53

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.20 (m), **End depth:** 10.50 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 5.09 ±1.86 MPa	Permeability: 1.43E-05 ±1.30E-05 m/s	Constrained Mod.: 51.57 ±15.08 MPa
Sleeve friction: 37.99 ±10.18 kPa	N60: 13.36 ±3.57 blows	Go: 54.43 ±9.85 MPa
SBT_n: 5	Es: 44.44 ±6.83 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.13 ±7.36	Su ratio: 0.00 ±0.00
	φ (degrees): 37.63 ±1.70 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.71 ±0.49 kN/m³	

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rocco.carbonella@fastwebnet.it

CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

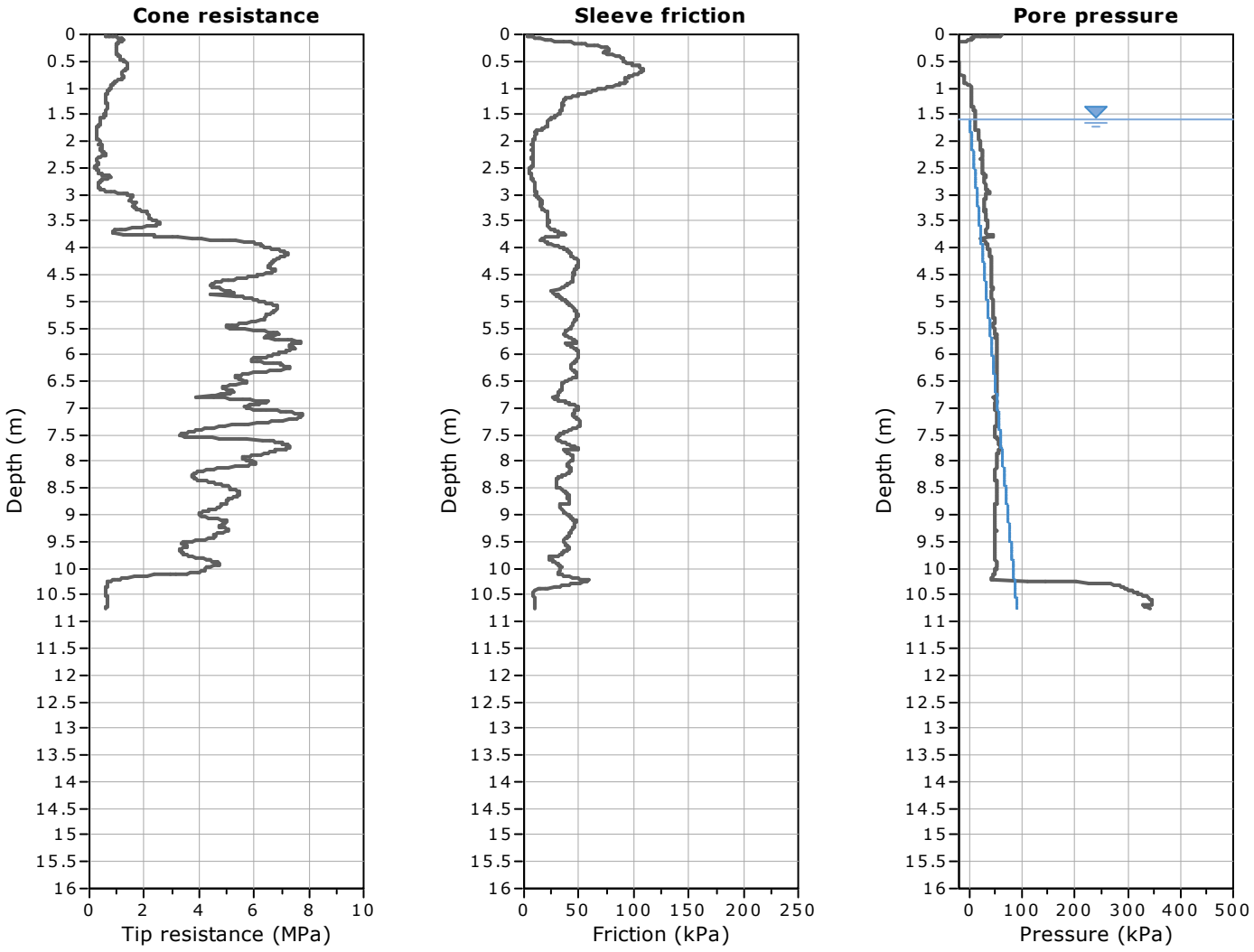
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	3.20	1.03E-06	3.3	14.9	0.0	0.0	9.4	20.3	46.4	2.6	12.1	16.7
3.20		(±7.77E-06)	(±1.1)	(±6.5)	(±0.0)	(±0.0)	(±5.2)	(±6.7)	(±22.1)	(±2.5)	(±11.5)	(±1.2)
3.20	7.30	1.43E-05	13.4	44.4	44.1	37.6	51.6	54.4	0.0	0.0	0.0	17.7
10.50		(±1.30E-05)	(±3.6)	(±6.8)	(±7.4)	(±1.7)	(±15.1)	(±9.9)	(±0.0)	(±0.0)	(±0.0)	(±0.5)

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

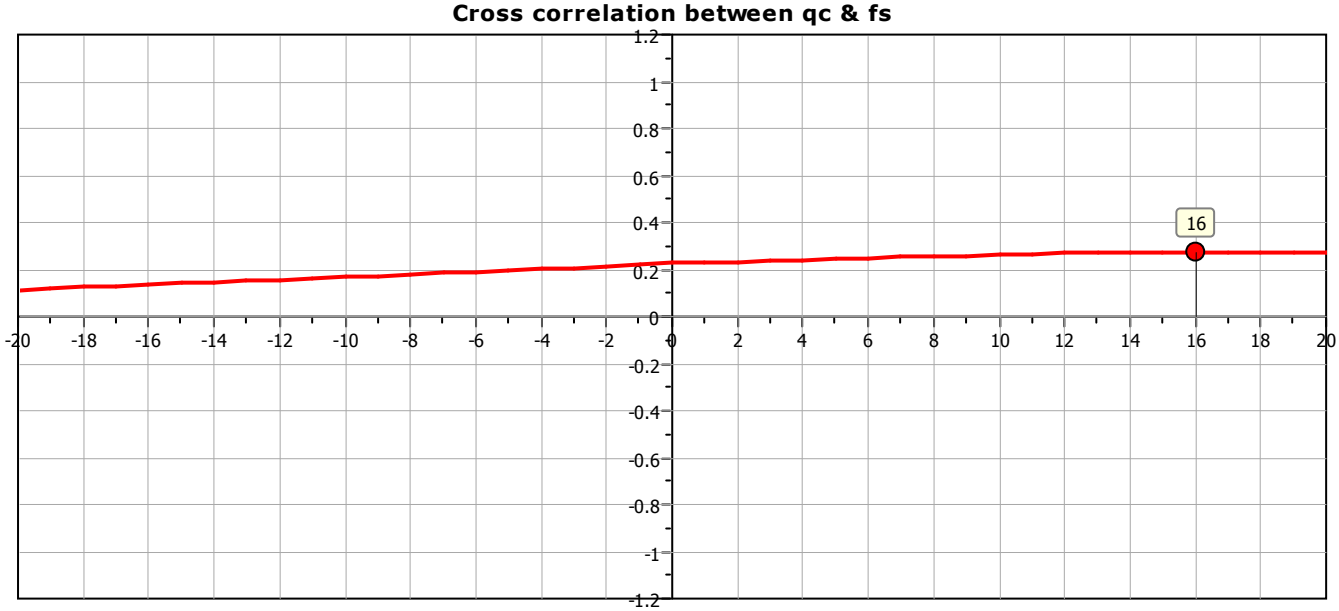
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

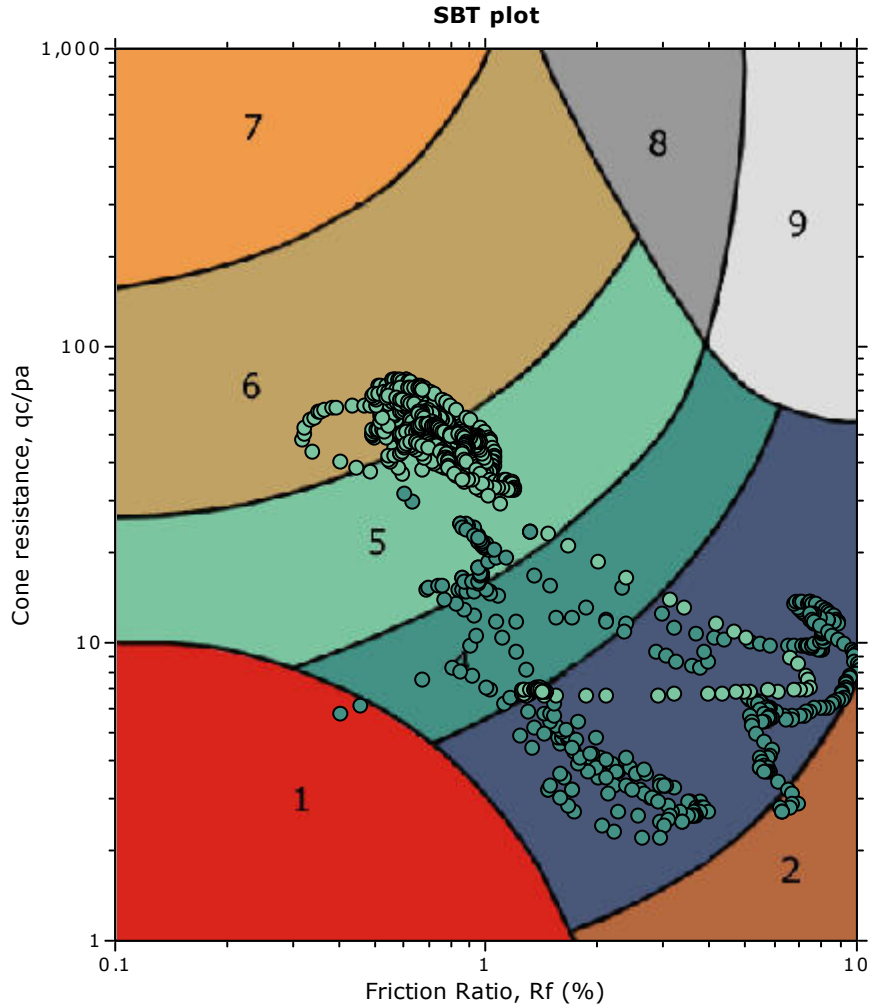


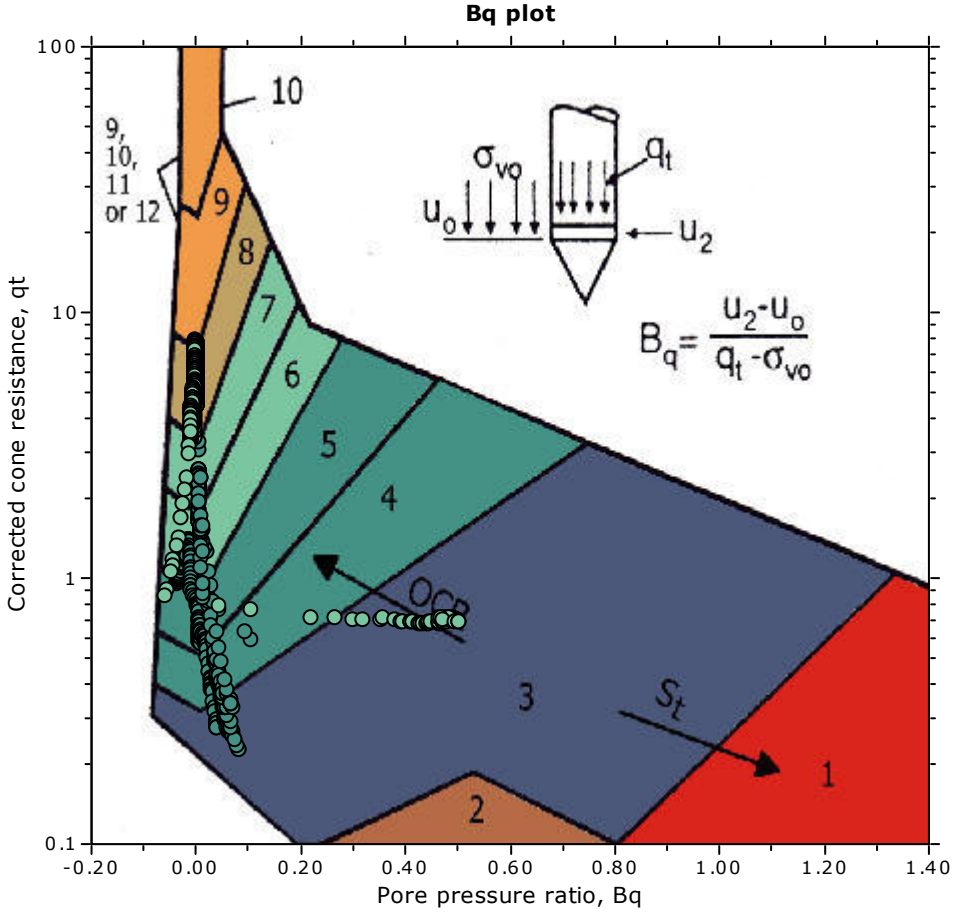
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

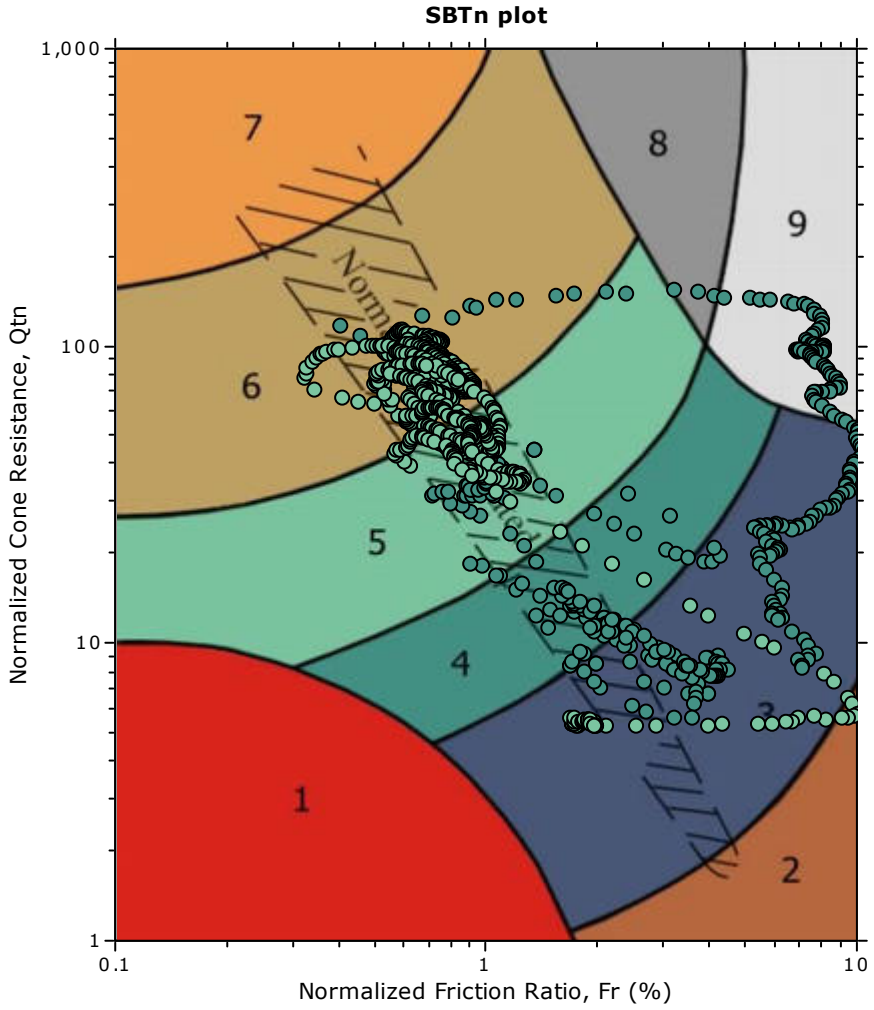
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

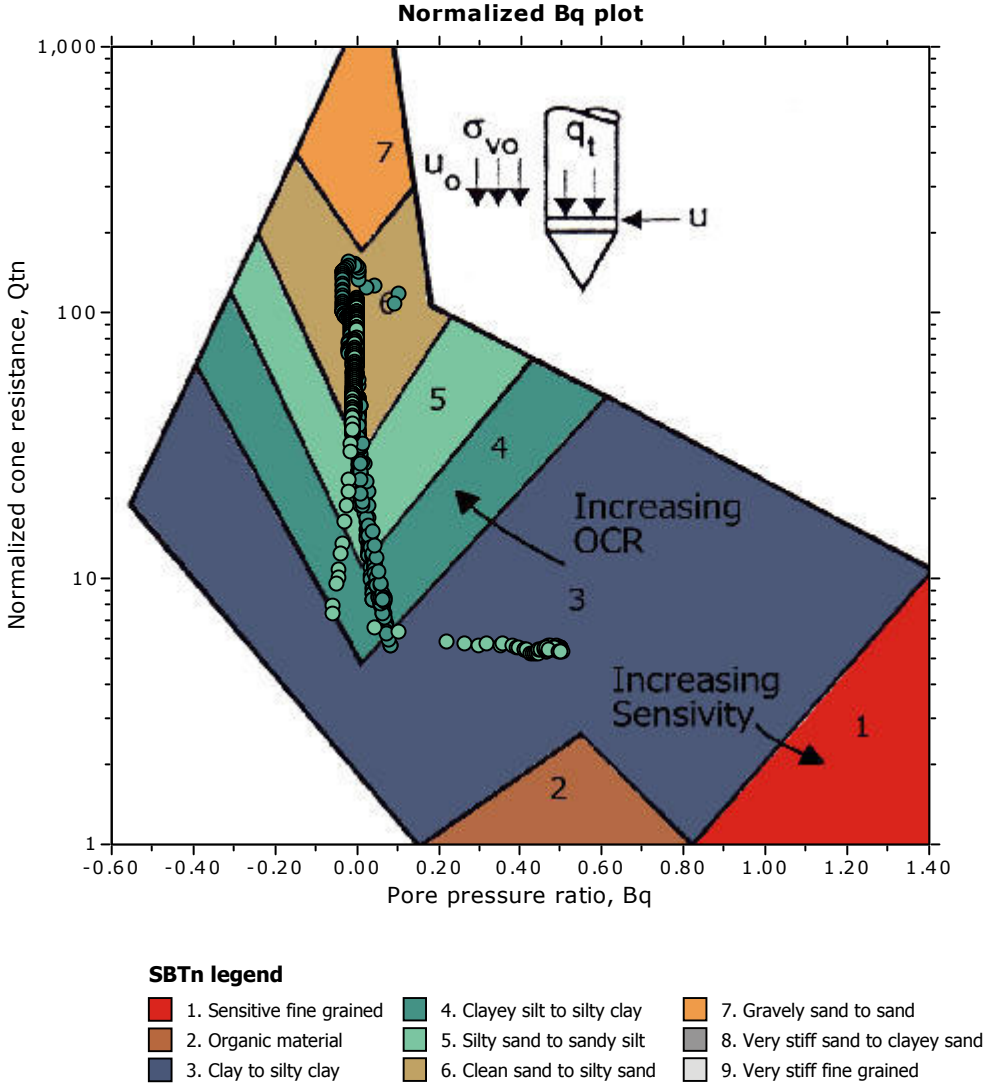
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

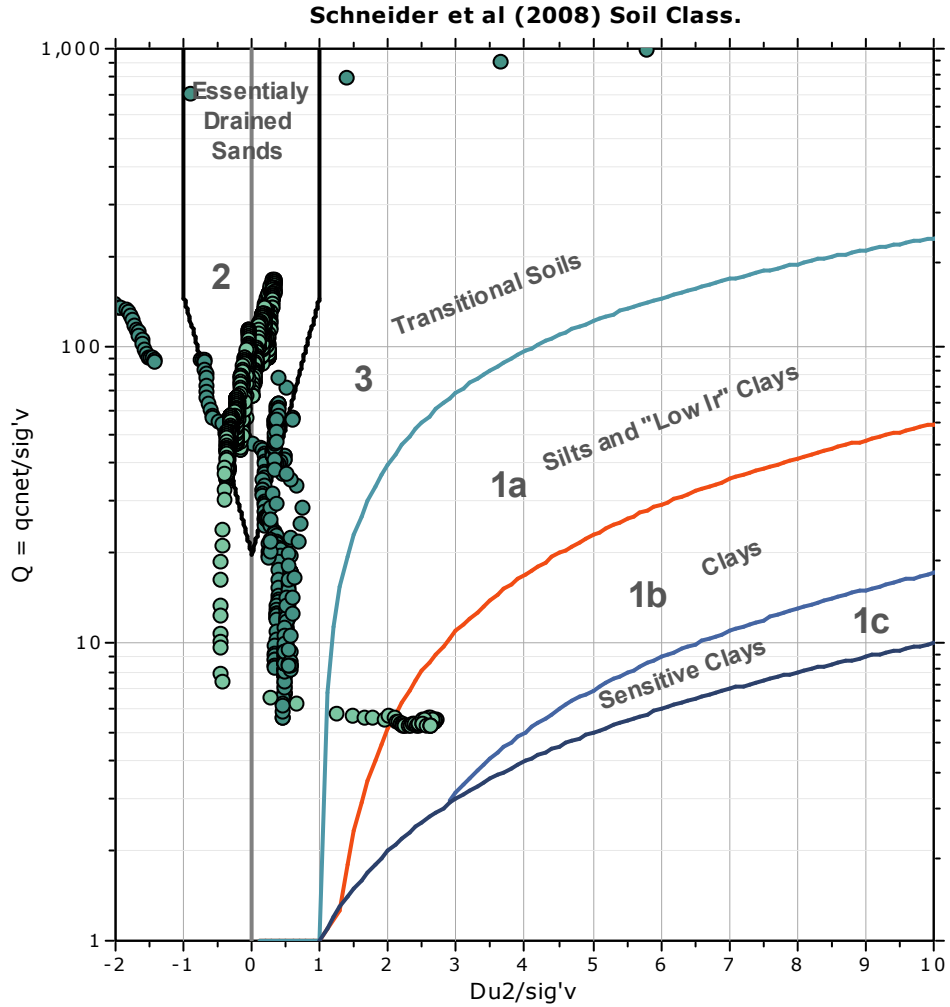
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

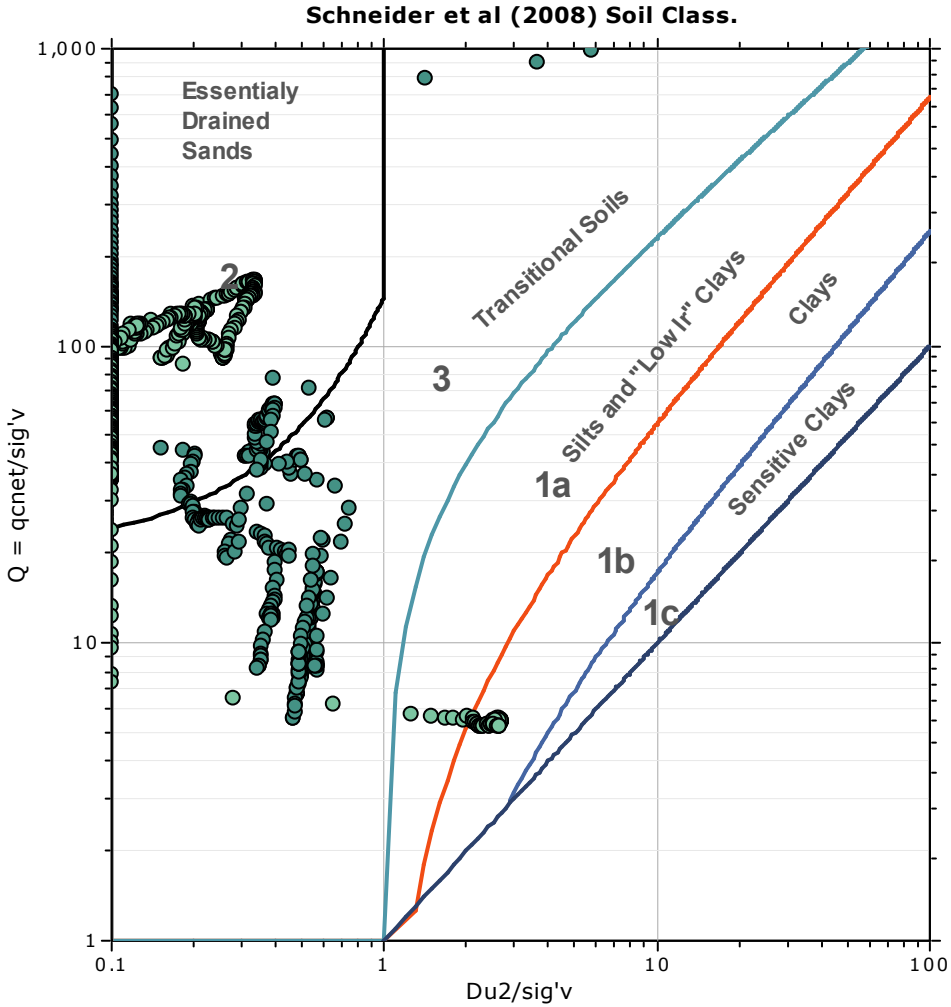
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

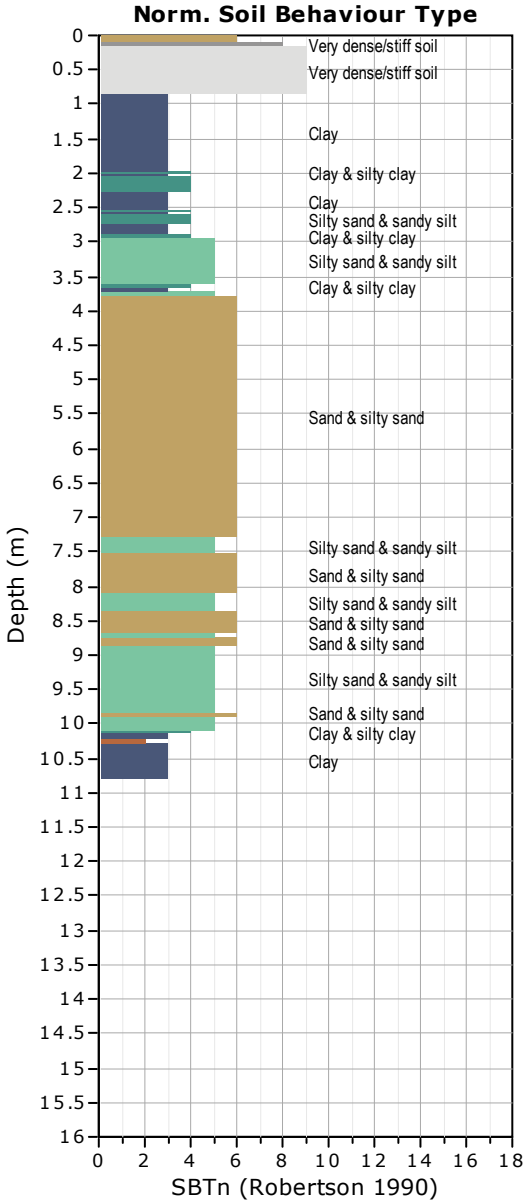


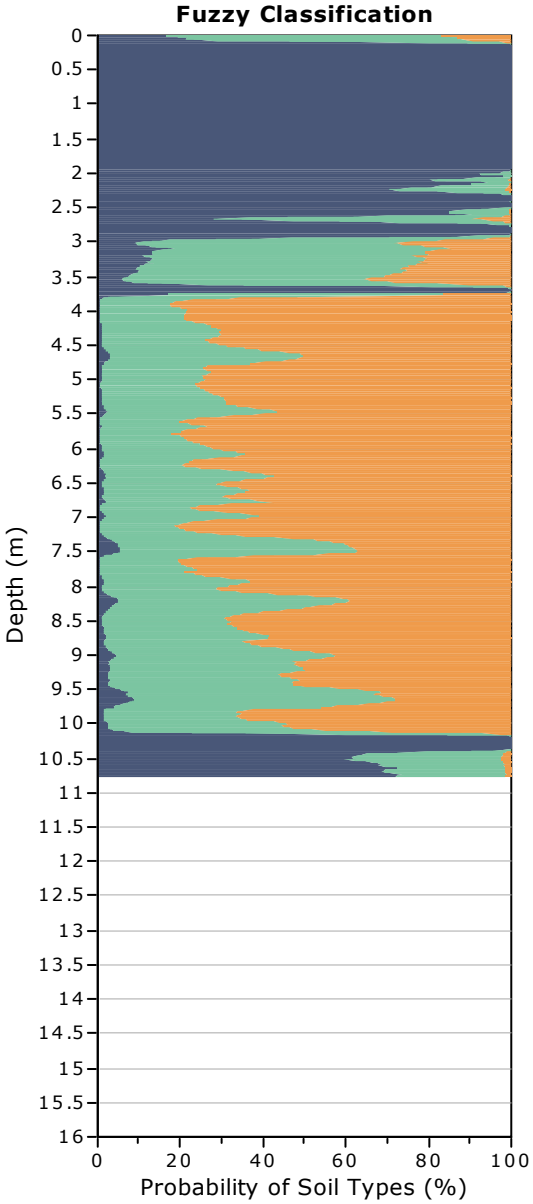


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

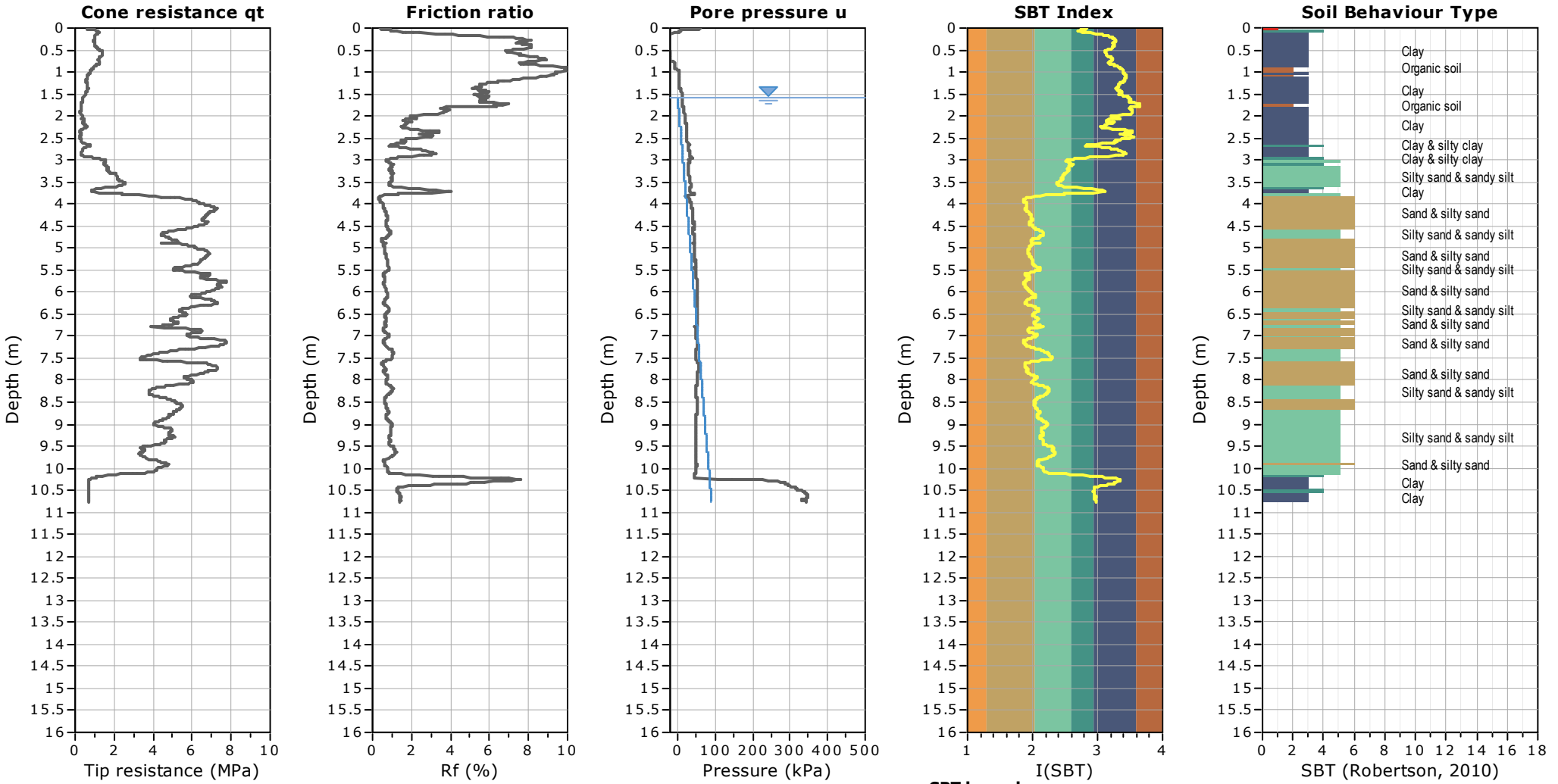




RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

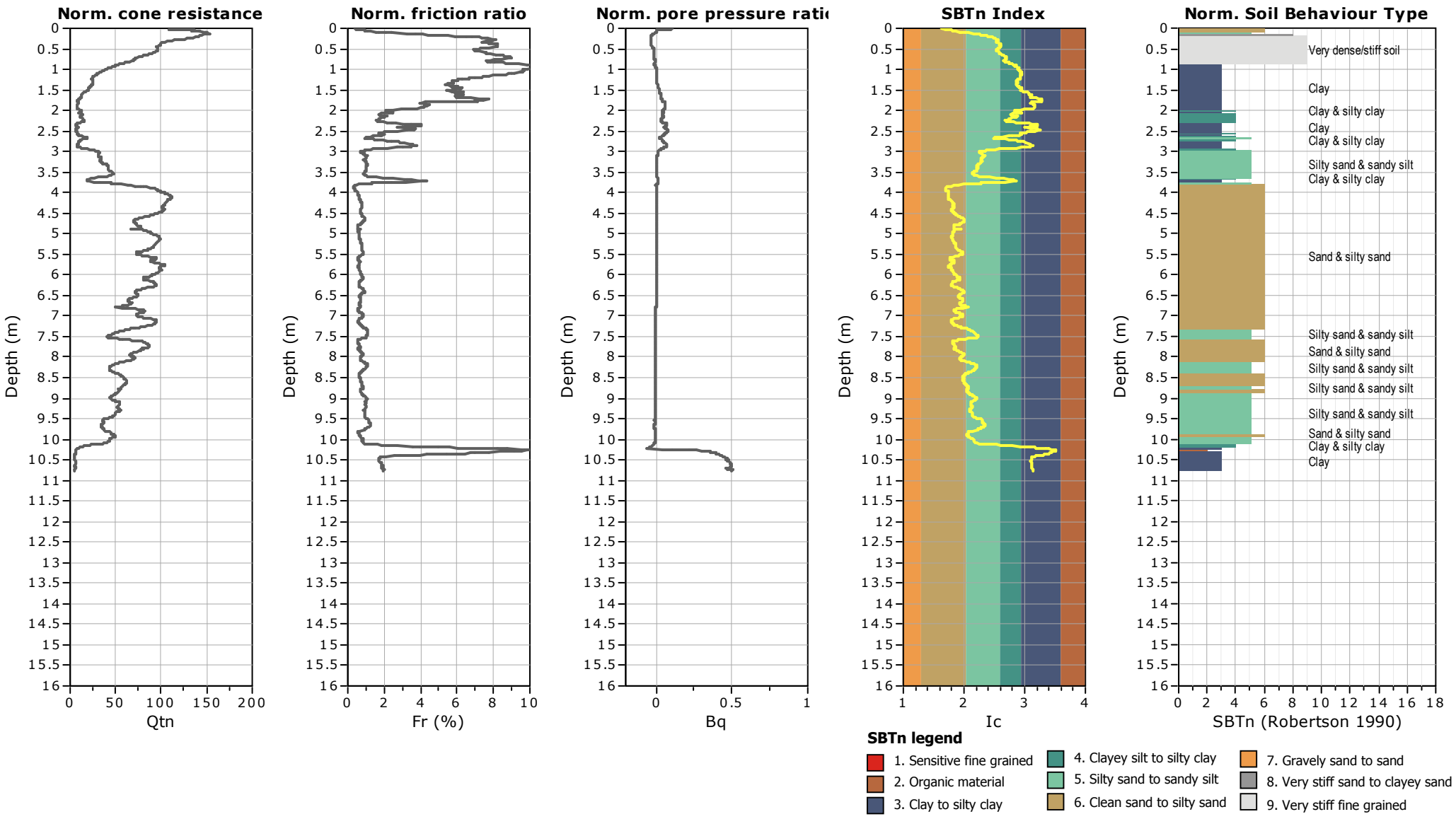
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

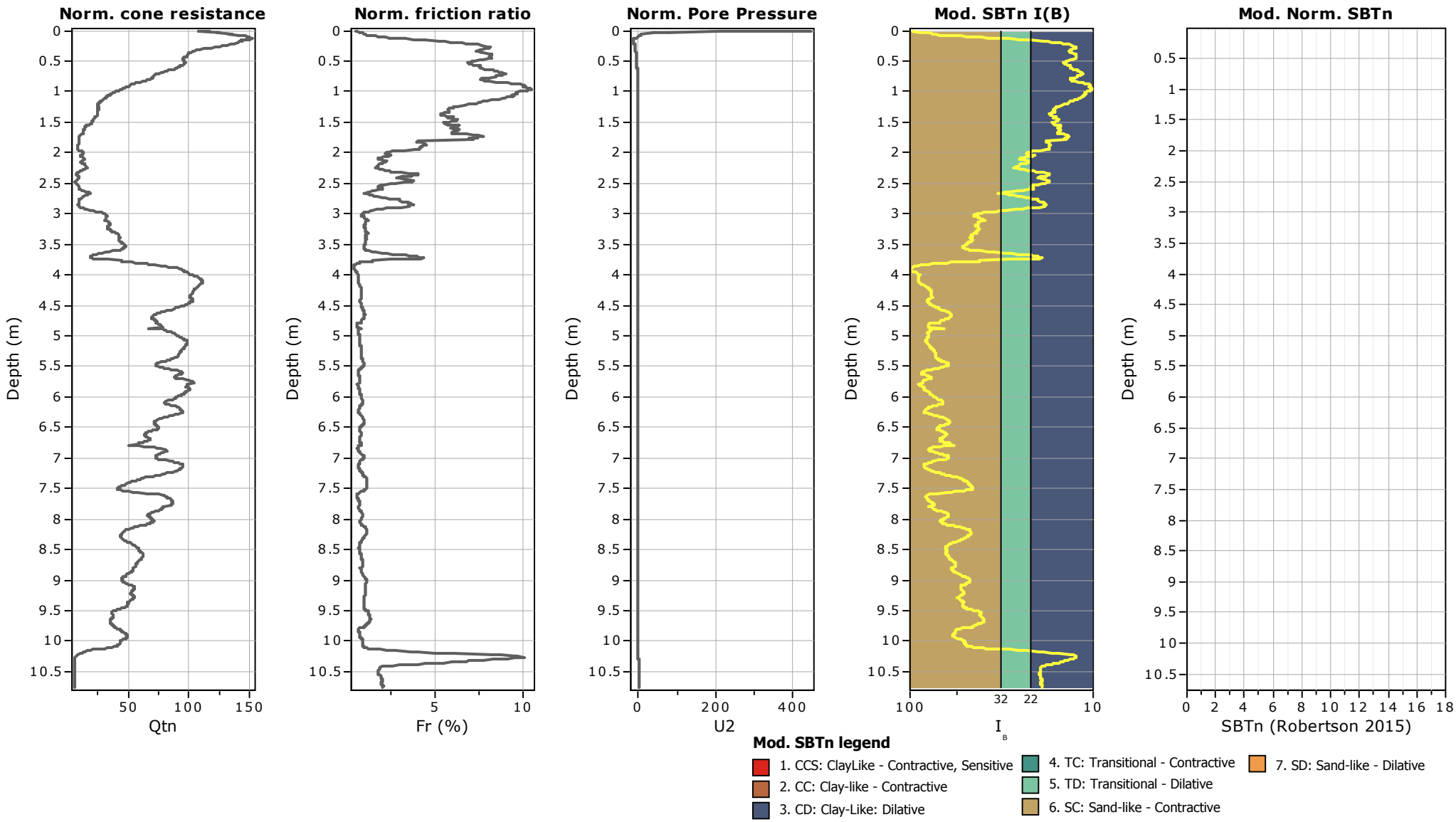
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

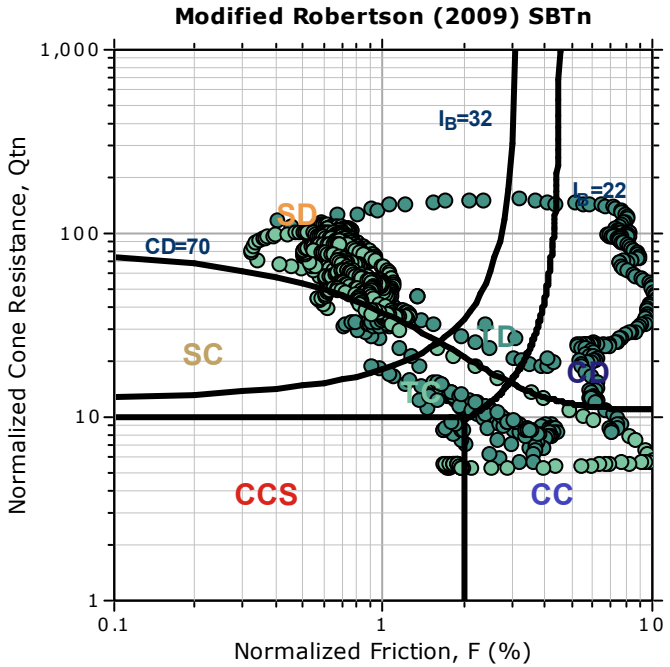


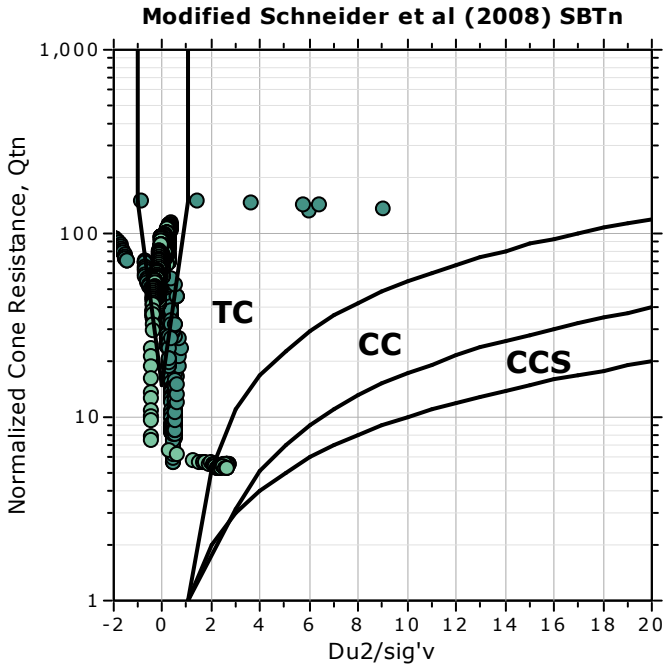
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

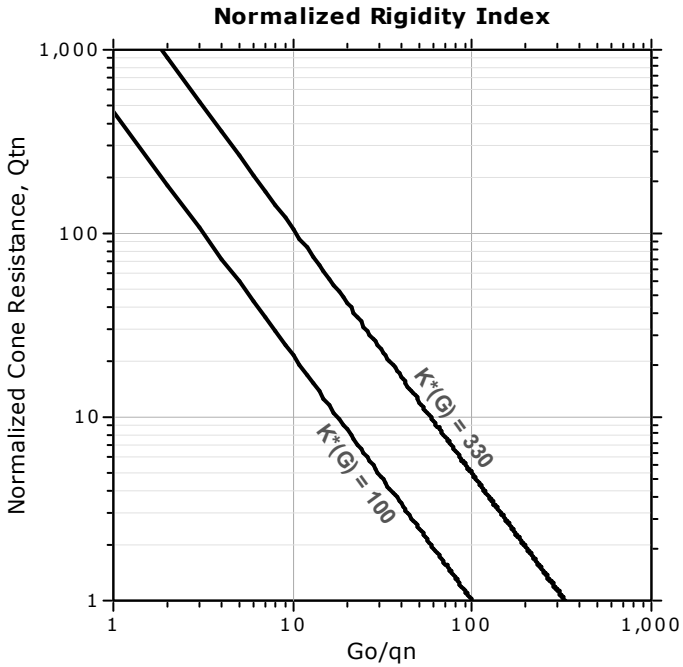
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







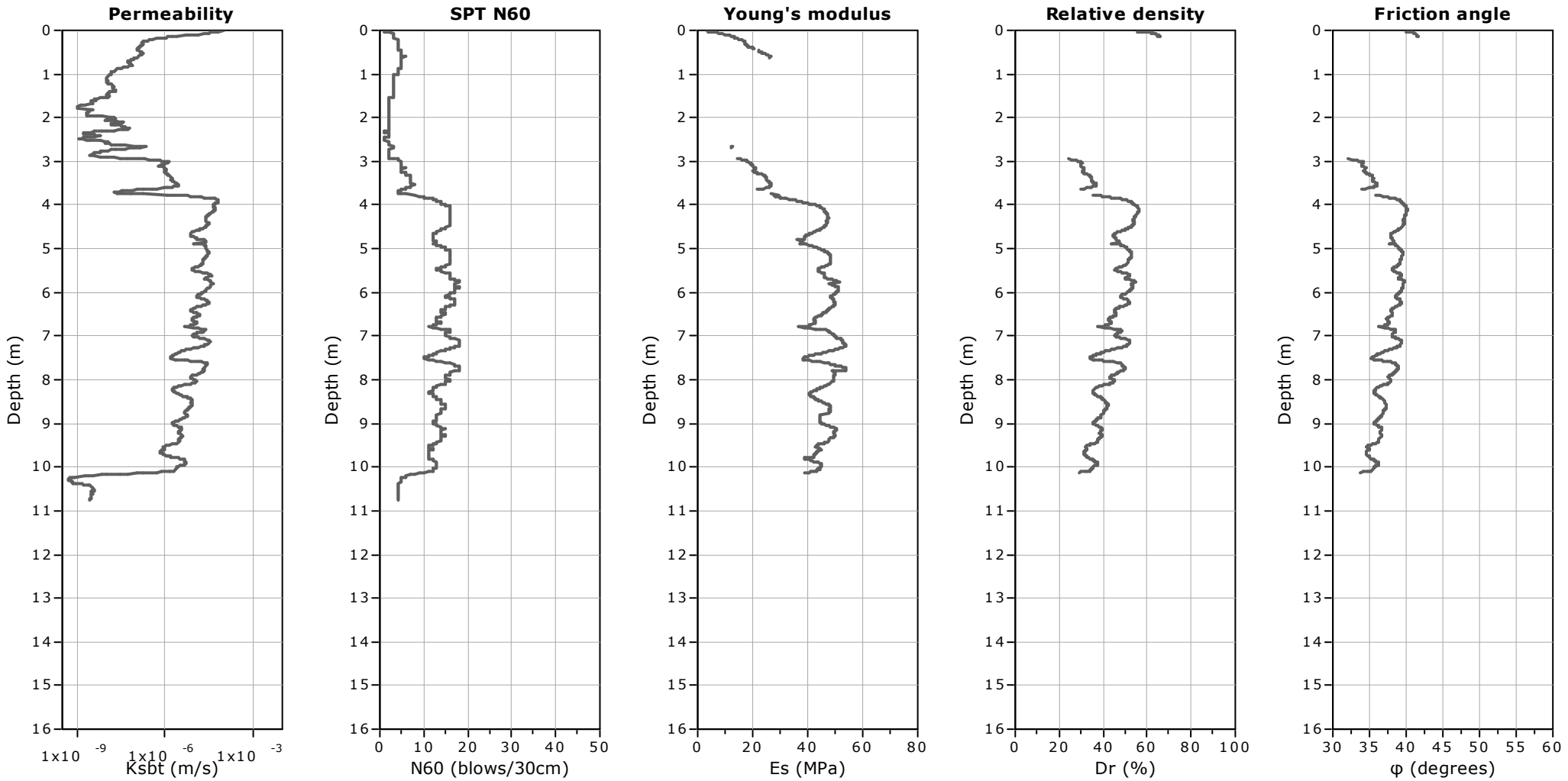
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



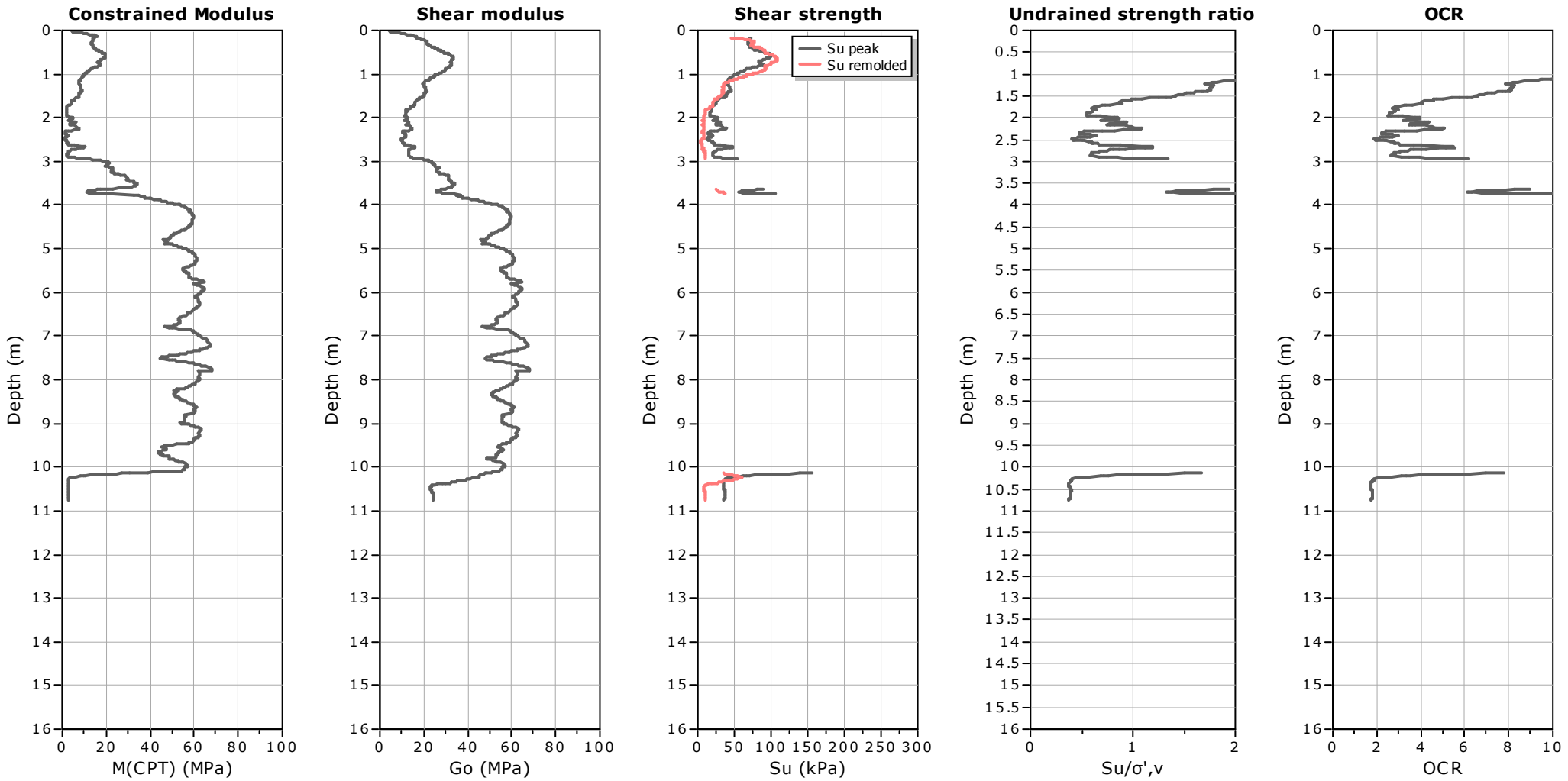
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



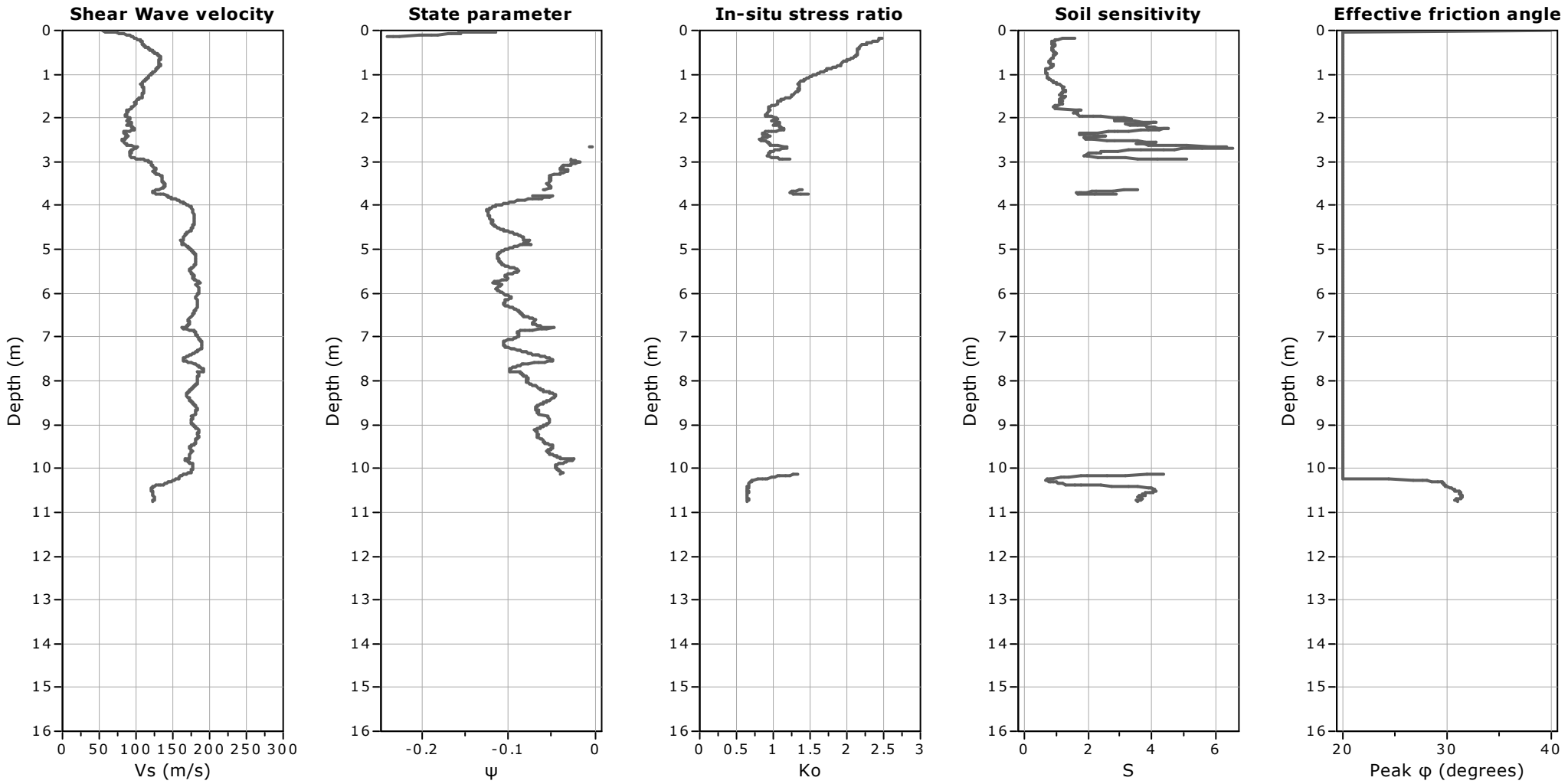
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



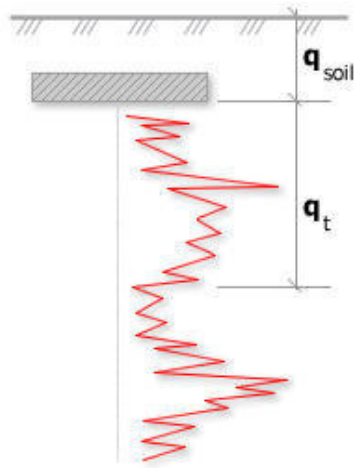
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

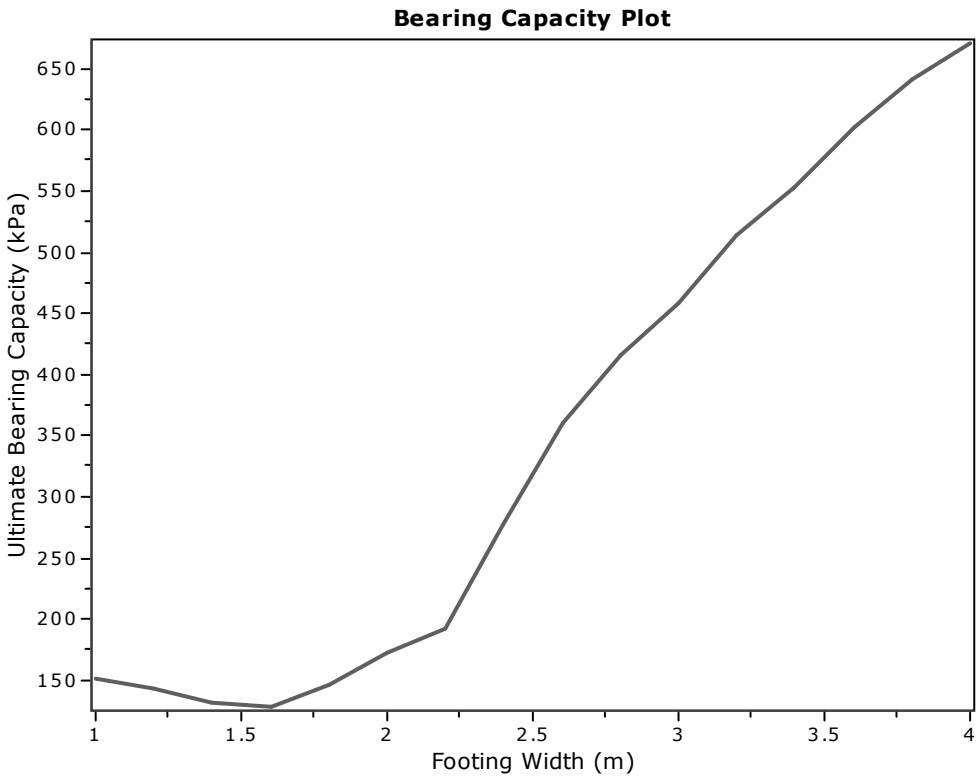
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



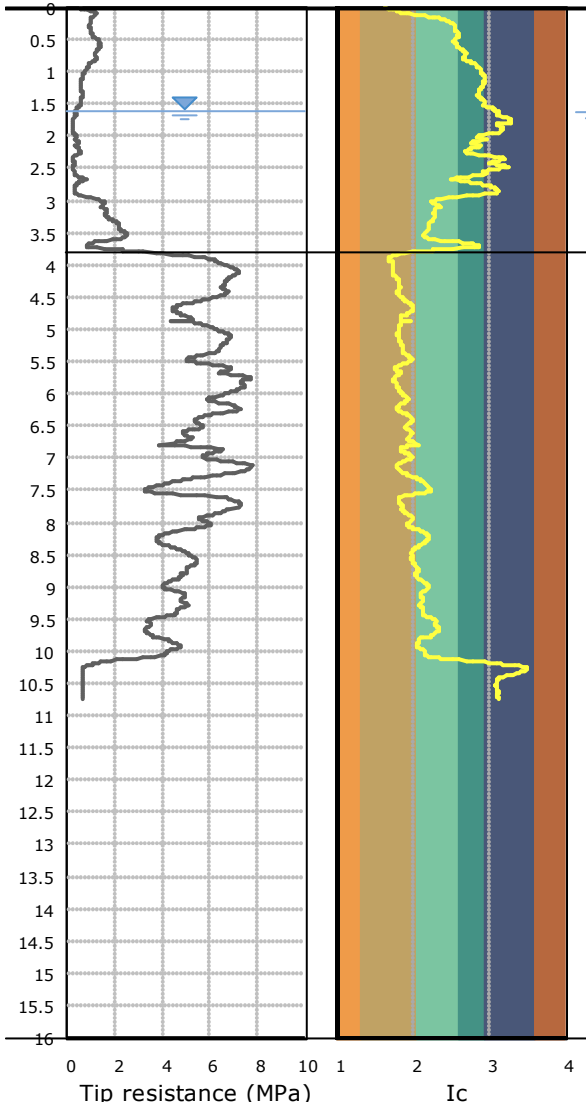
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.71	0.20	9.50	151.85
2	1.20	0.50	2.30	0.67	0.20	9.50	143.30
3	1.40	0.50	2.60	0.62	0.20	9.50	132.68
4	1.60	0.50	2.90	0.60	0.20	9.50	128.61
5	1.80	0.50	3.20	0.68	0.20	9.50	145.88
6	2.00	0.50	3.50	0.82	0.20	9.50	172.85
7	2.20	0.50	3.80	0.91	0.20	9.50	191.58
8	2.40	0.50	4.10	1.34	0.20	9.50	277.29
9	2.60	0.50	4.40	1.76	0.20	9.50	360.91
10	2.80	0.50	4.70	2.03	0.20	9.50	415.89
11	3.00	0.50	5.00	2.25	0.20	9.50	458.98
12	3.20	0.50	5.30	2.52	0.20	9.50	513.95
13	3.40	0.50	5.60	2.72	0.20	9.50	553.22
14	3.60	0.50	5.90	2.97	0.20	9.50	602.62
15	3.80	0.50	6.20	3.16	0.20	9.50	641.19
16	4.00	0.50	6.50	3.31	0.20	9.50	670.92

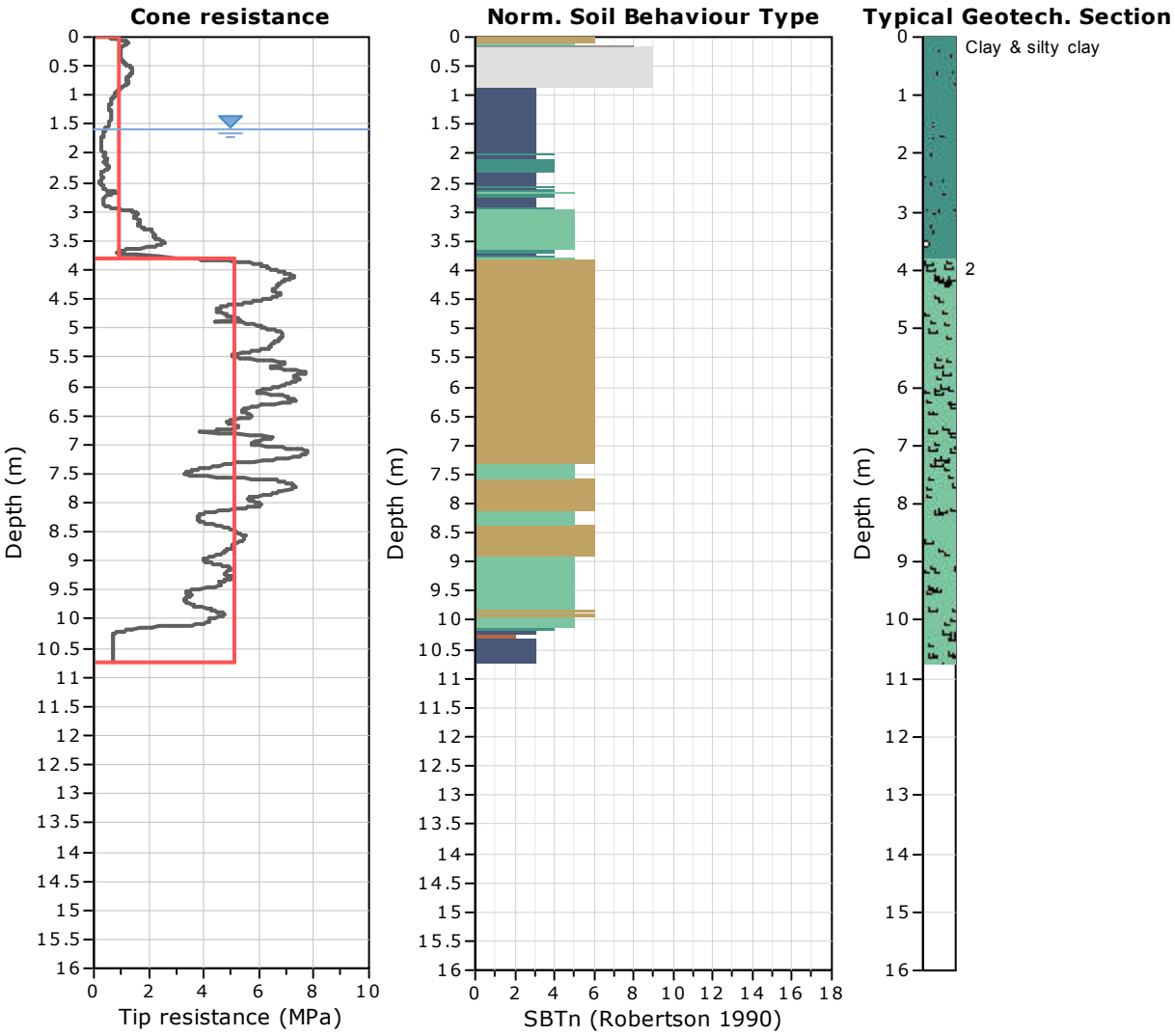
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay & silty clay	0.9	1.39E-6	3.6	19.8	-	-	11.9	21.0	45.5	2.6	12.1	16.5
2	5.1	1.39E-5	13.5	45.8	44.8	37.8	52.2	55.0	-	-	-	17.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 3.80 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 0.93 ±0.62 MPa	Permeability: 1.39E-06 ±7.51E-06 m/s	Constrained Mod.: 11.94 ±8.82 MPa
Sleeve friction: 34.83 ±31.84 kPa	N60: 3.60 ±1.72 blows	Go: 21.03 ±7.85 MPa
SBT_n: 4	Es: 19.78 ±4.22 MPa	Su: 45.48 ±25.51 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 2.61 ±2.64
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 12.06 ±12.22
	Unit weight: 16.47 ±1.22 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.80 (m), **End depth:** 10.76 (m)

Description: 2

Basic results	**Estimation results**	
Total cone resistance: 5.11 ±1.77 MPa	Permeability: 1.39E-05 ±1.34E-05 m/s	Constrained Mod.: 52.24 ±16.03 MPa
Sleeve friction: 38.26 ±9.93 kPa	N60: 13.49 ±3.37 blows	Go: 55.03 ±9.53 MPa
SBT_n: 5	Es: 45.83 ±4.17 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.80 ±6.82	Su ratio: 0.00 ±0.00
	φ (degrees): 37.80 ±1.51 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.70 ±0.61 kN/m³	

RDR SrL
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CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

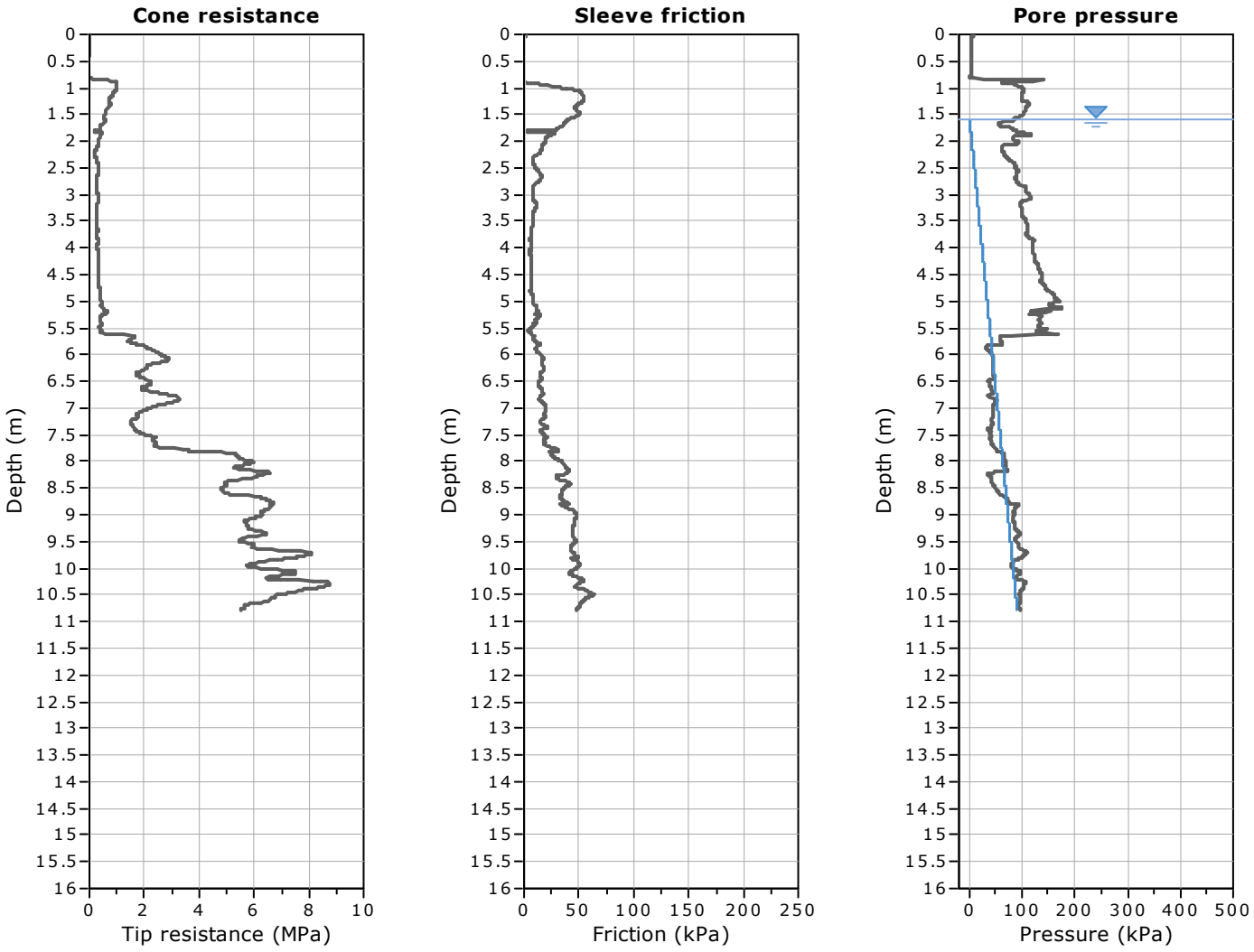
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	3.80	1.39E-06	3.6	19.8	0.0	0.0	11.9	21.0	45.5	2.6	12.1	16.5
3.80		(±7.51E-06)	(±1.7)	(±4.2)	(±0.0)	(±0.0)	(±8.8)	(±7.9)	(±25.5)	(±2.6)	(±12.2)	(±1.2)
3.80	6.96	1.39E-05	13.5	45.8	44.8	37.8	52.2	55.0	0.0	0.0	0.0	17.7
10.76		(±1.34E-05)	(±3.4)	(±4.2)	(±6.8)	(±1.5)	(±16.0)	(±9.5)	(±0.0)	(±0.0)	(±0.0)	(±0.6)

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

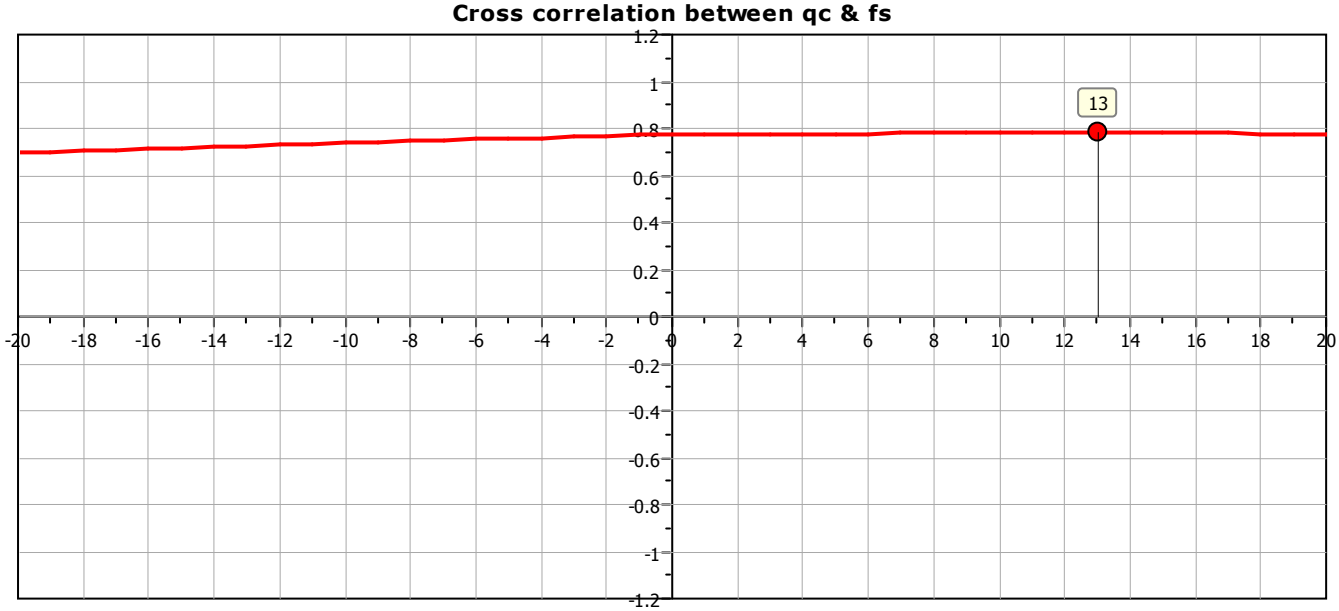
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

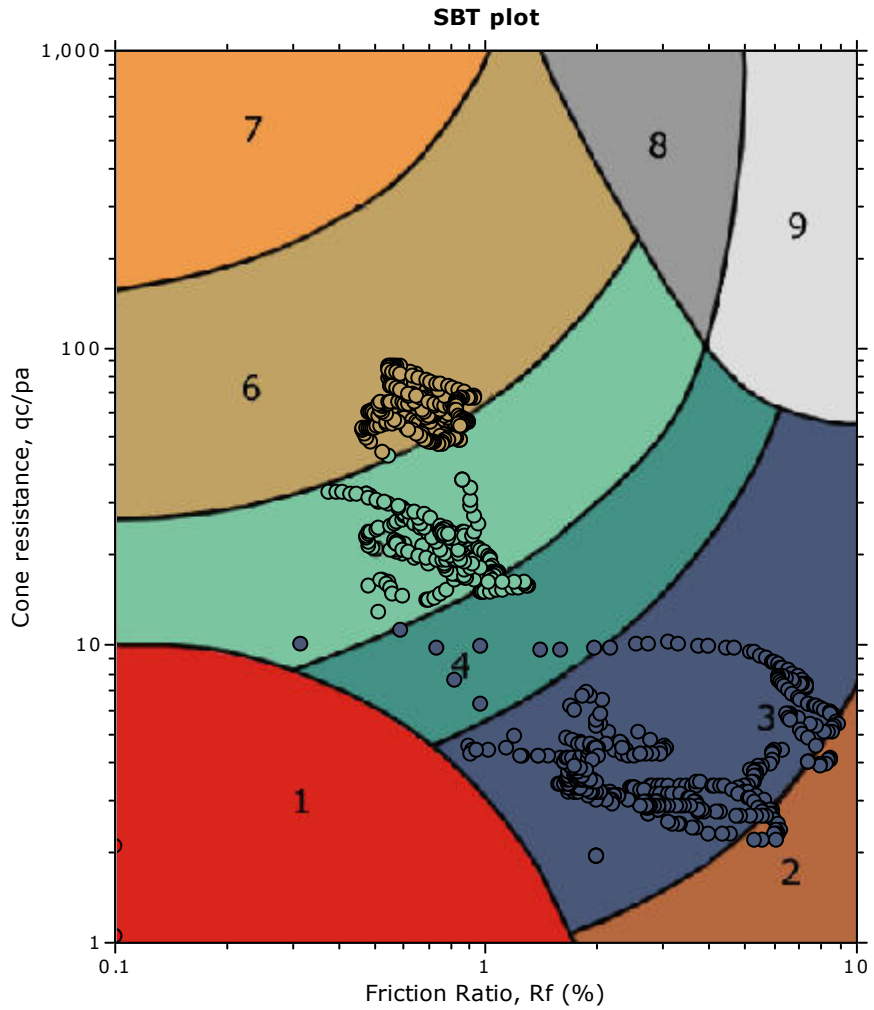


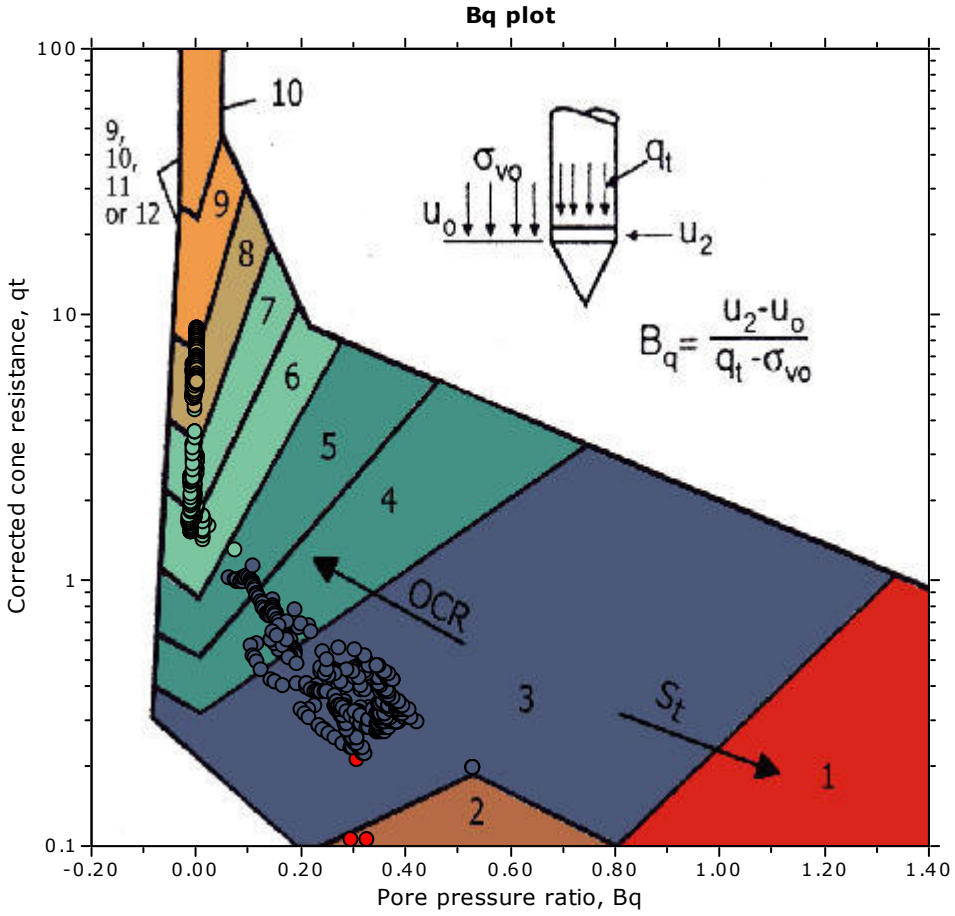
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

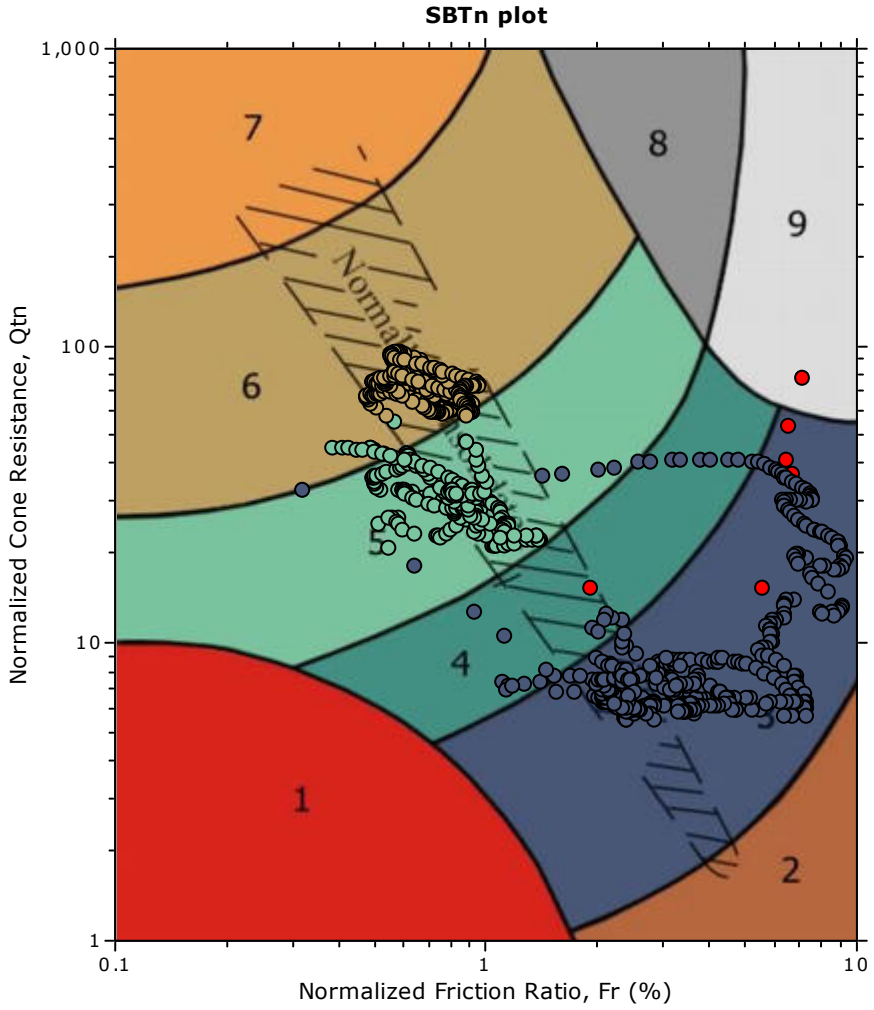
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

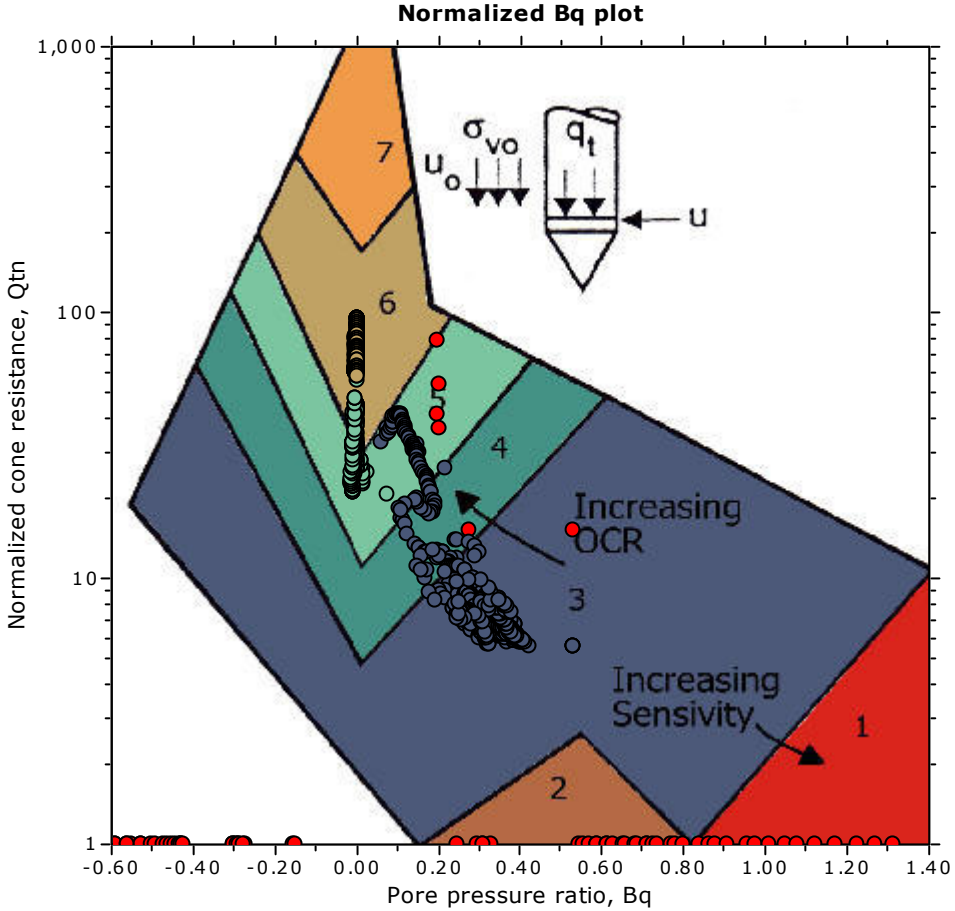
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

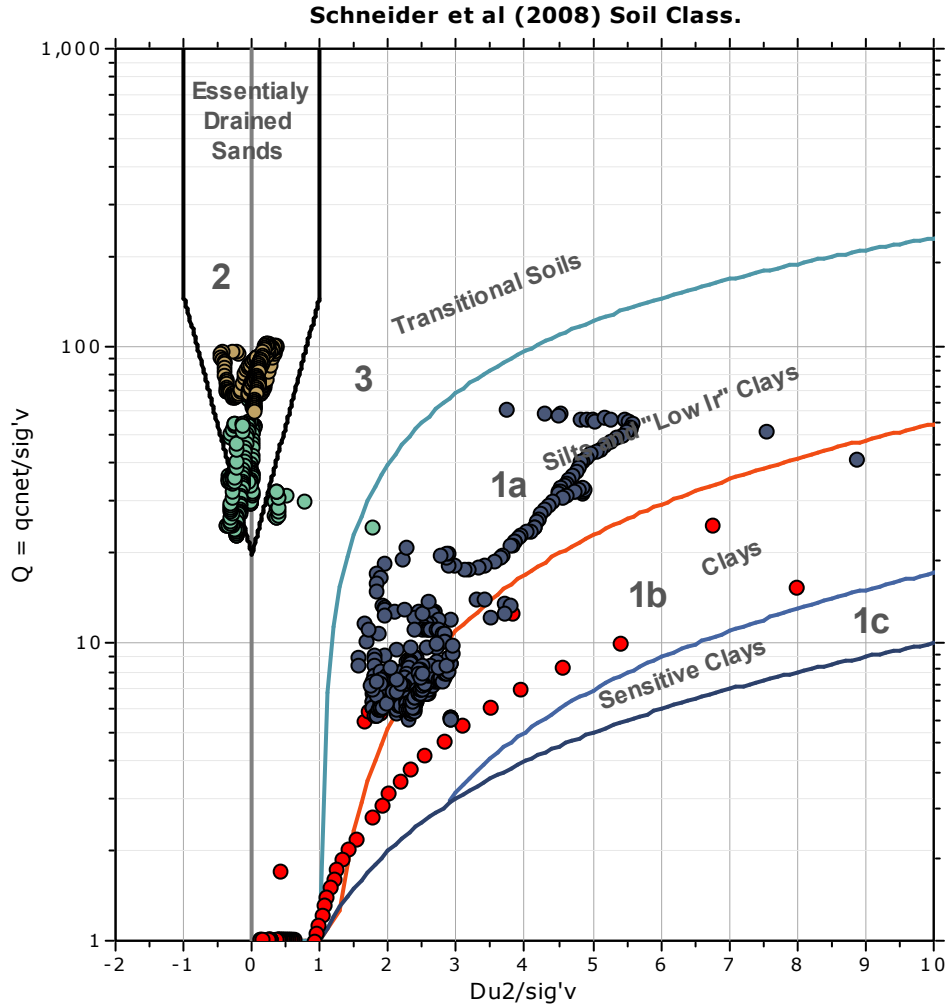
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

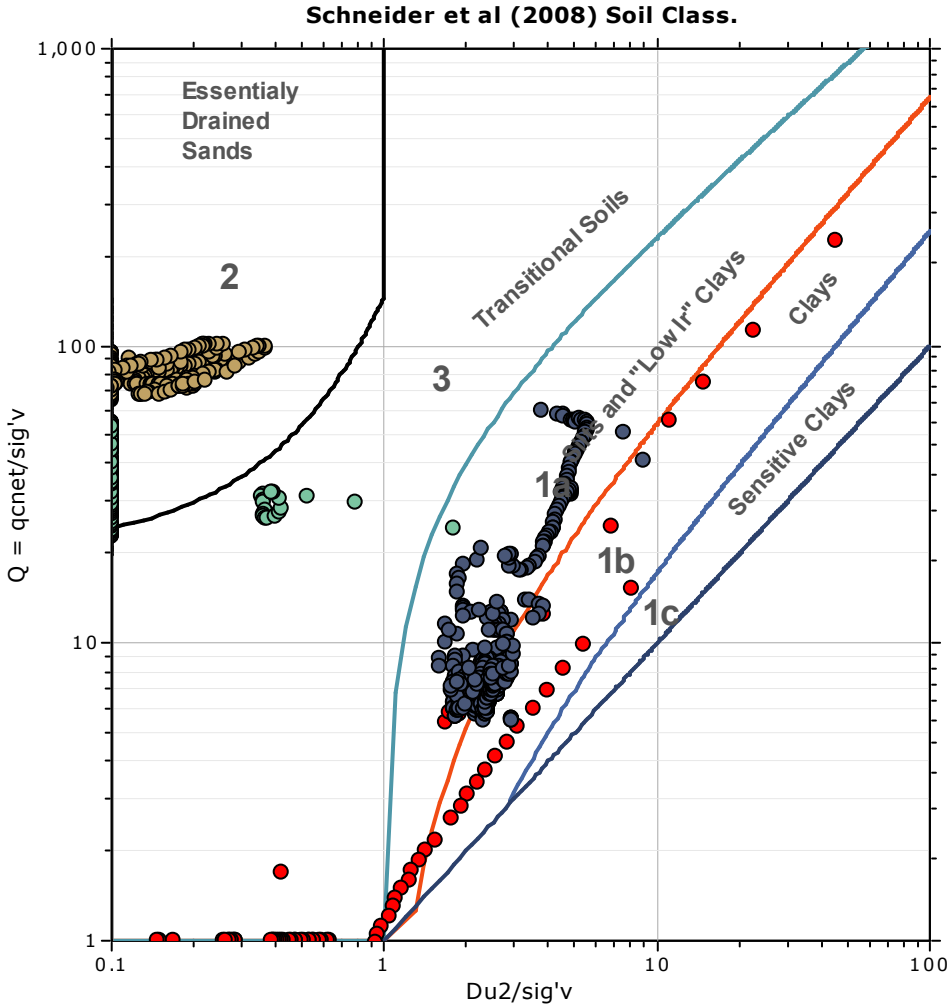
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

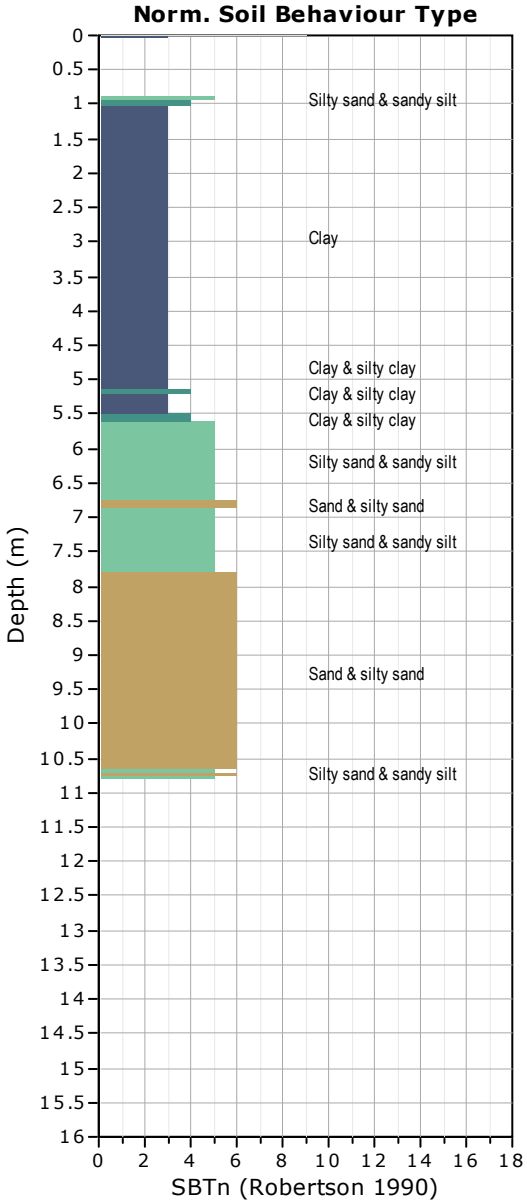


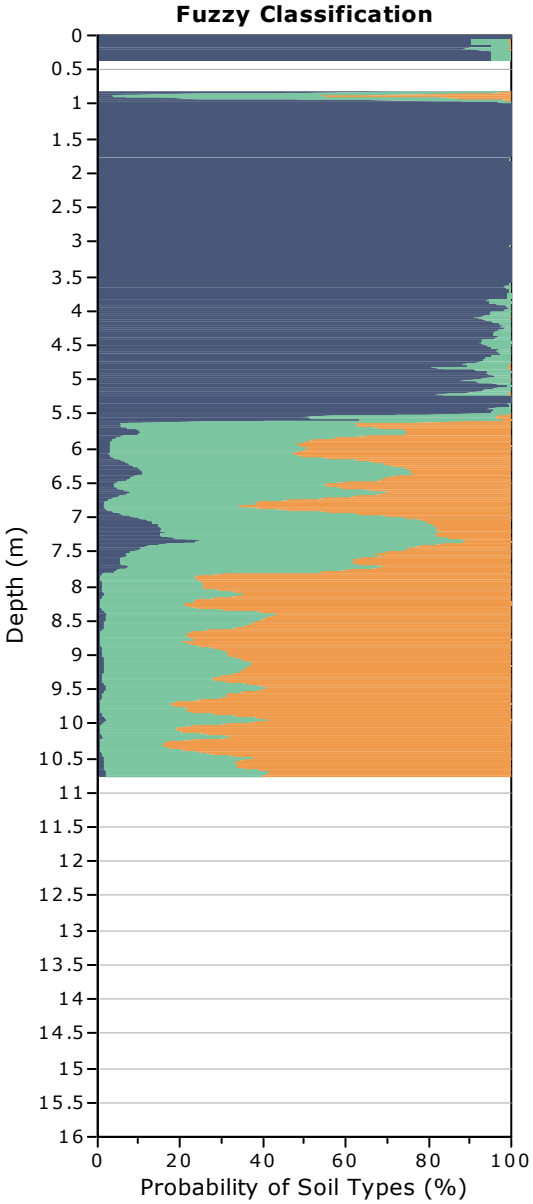


RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

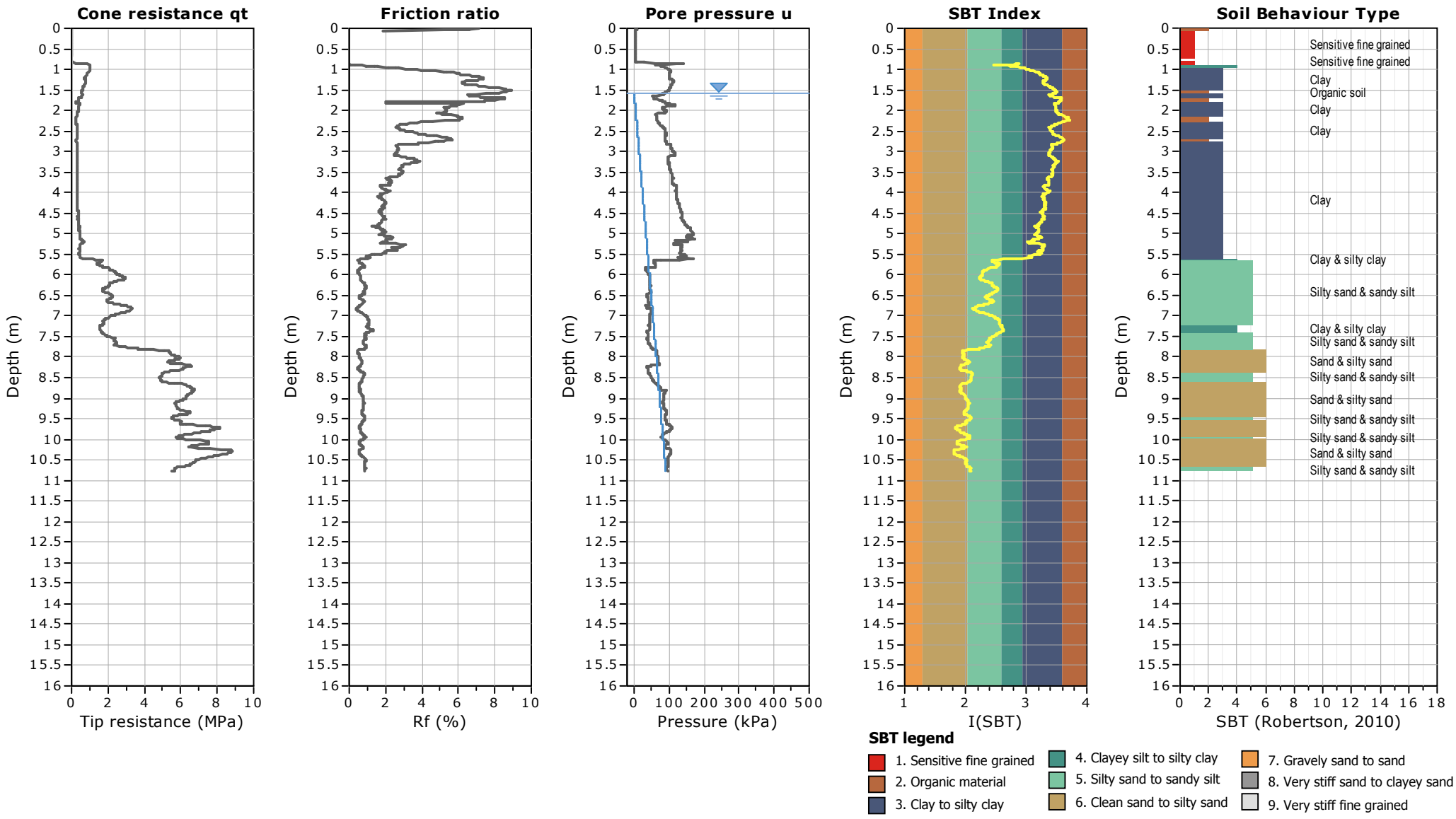




RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

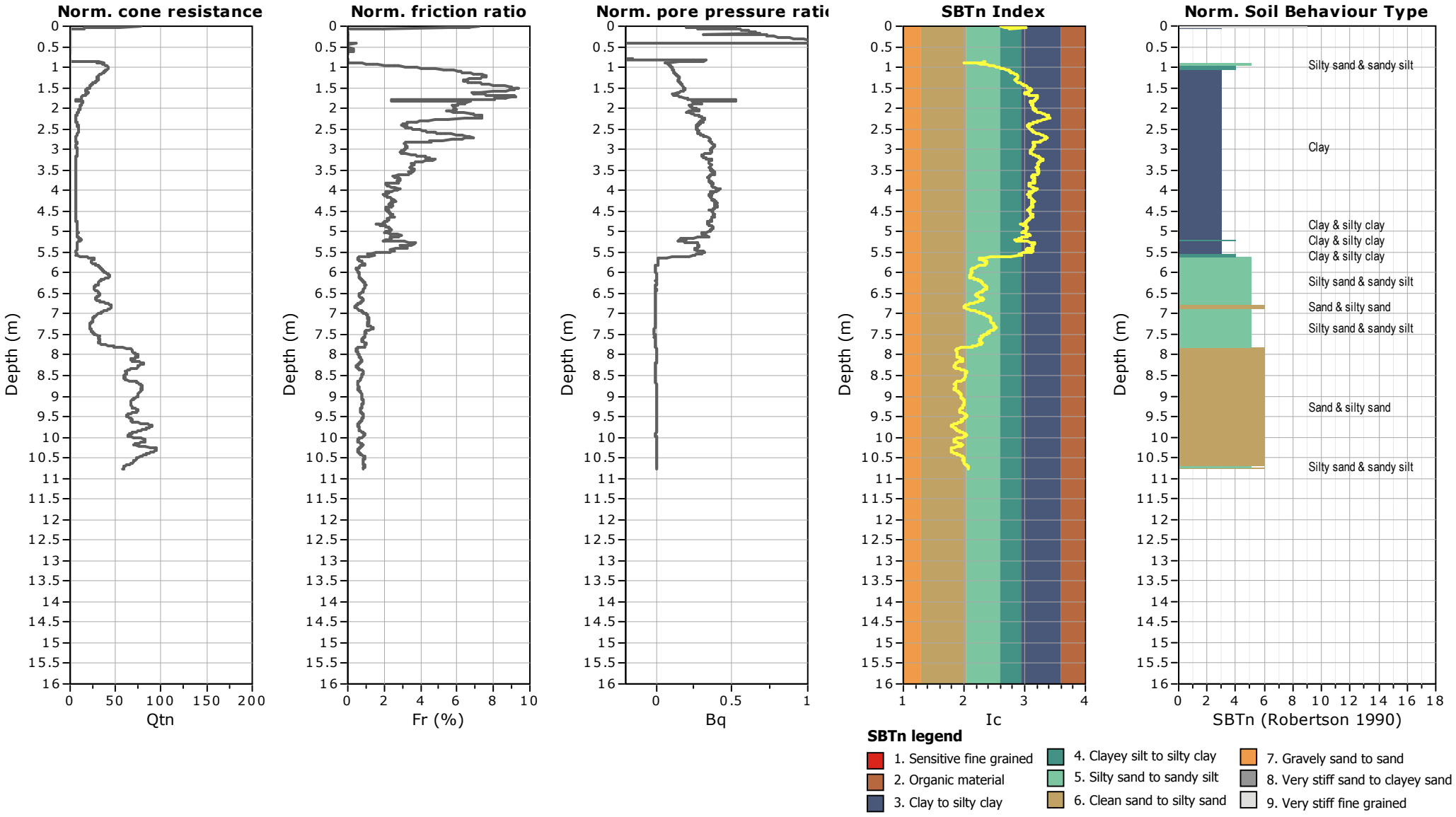
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

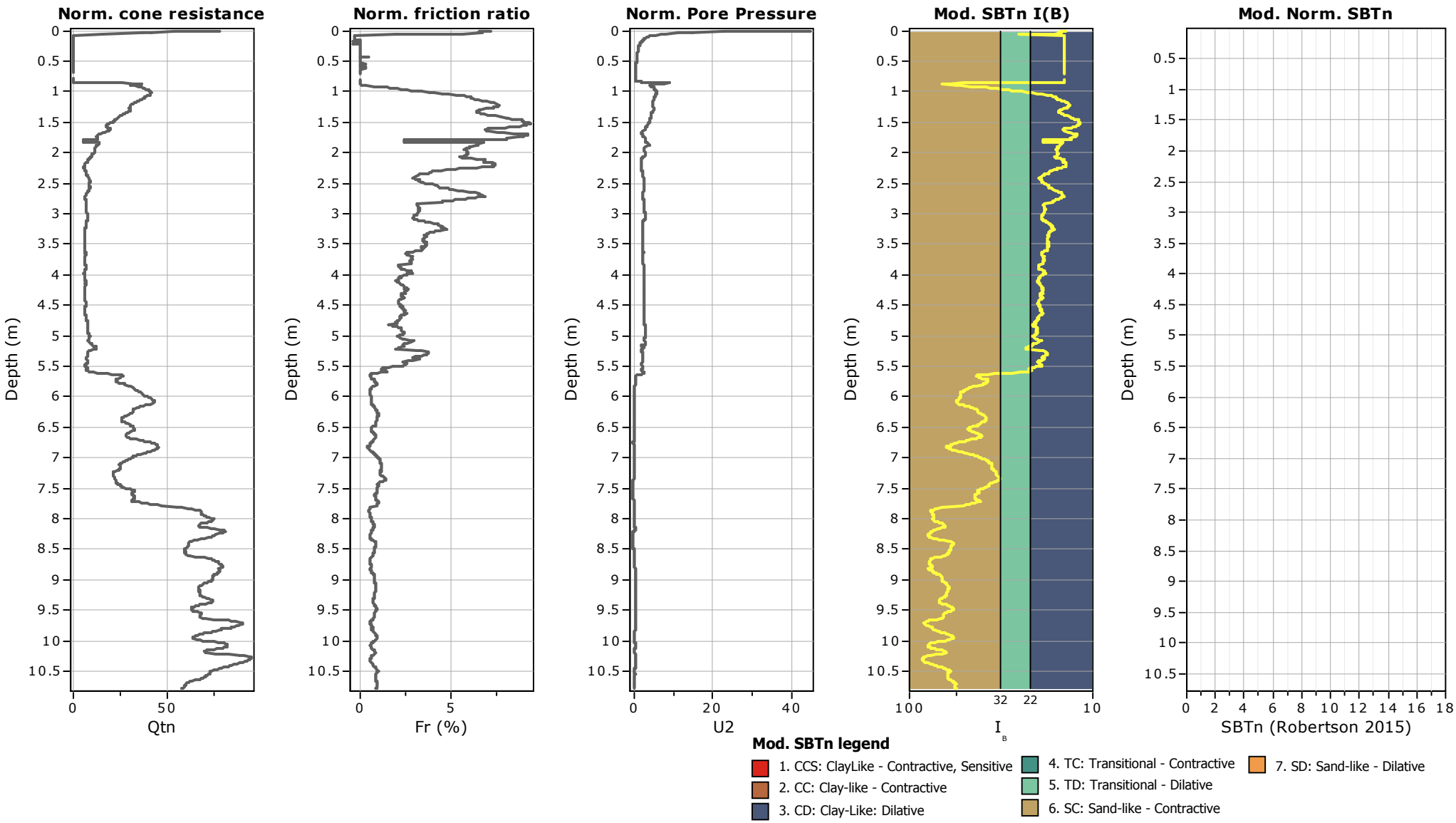
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

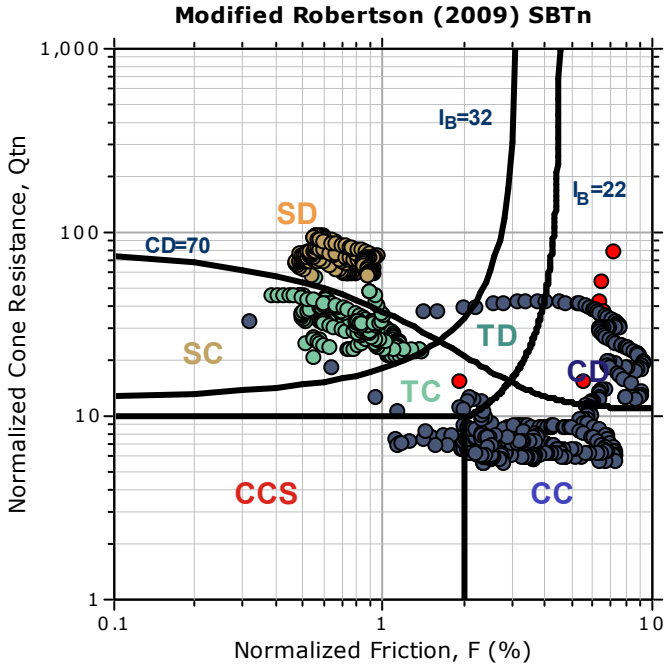


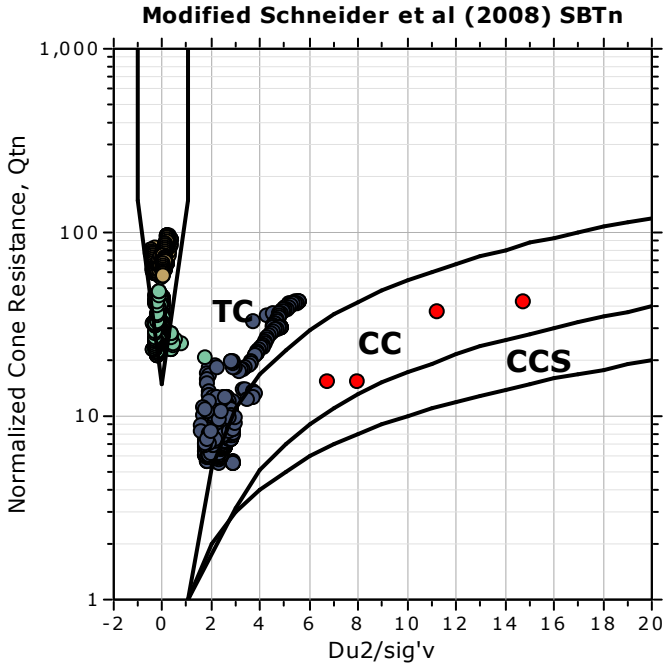
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

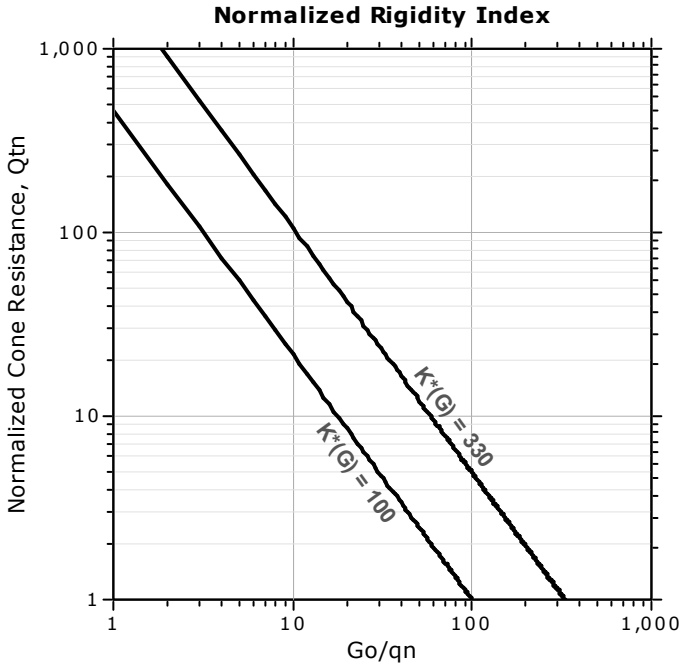
CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







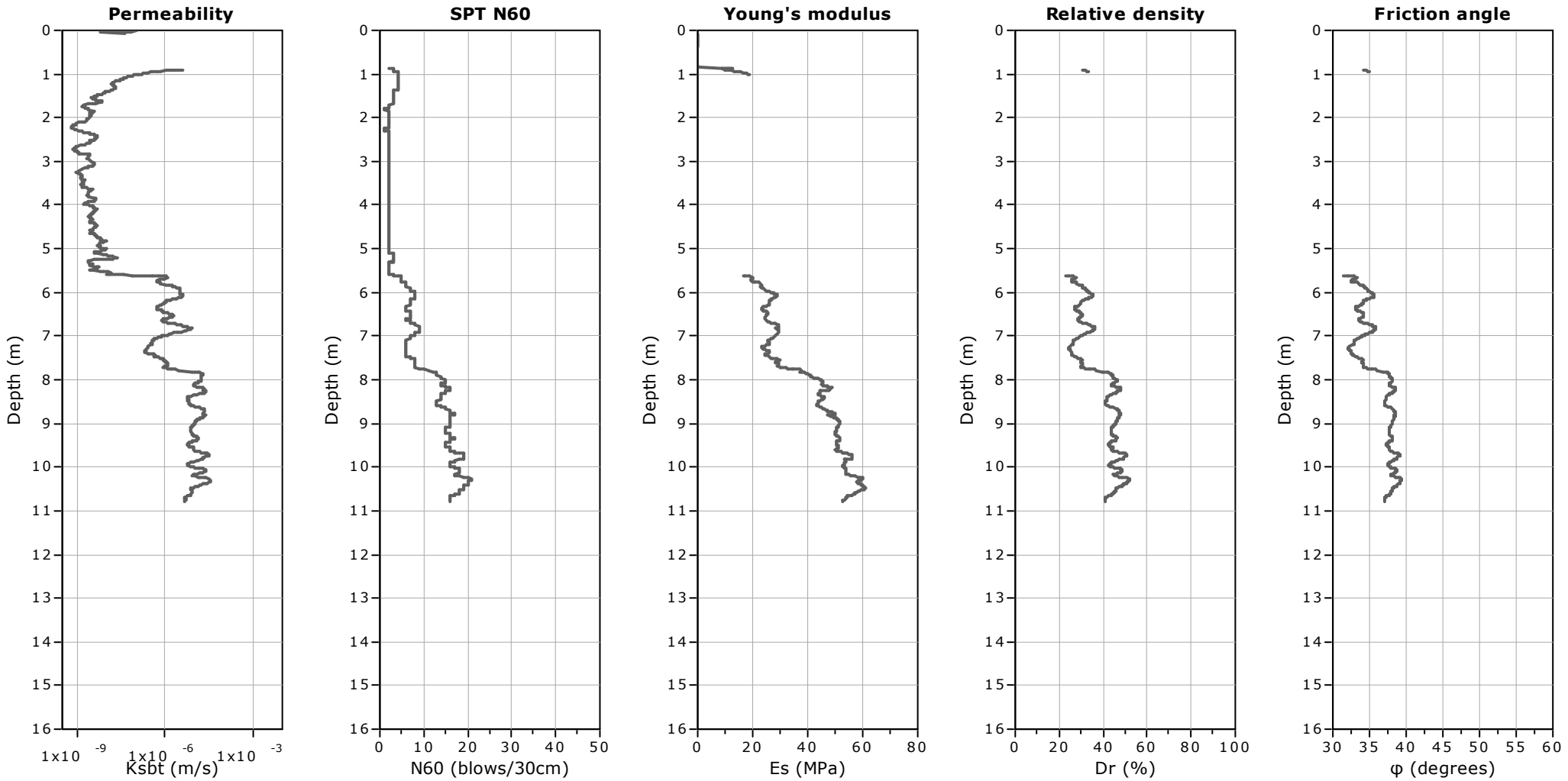
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
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CPT: cptu16
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



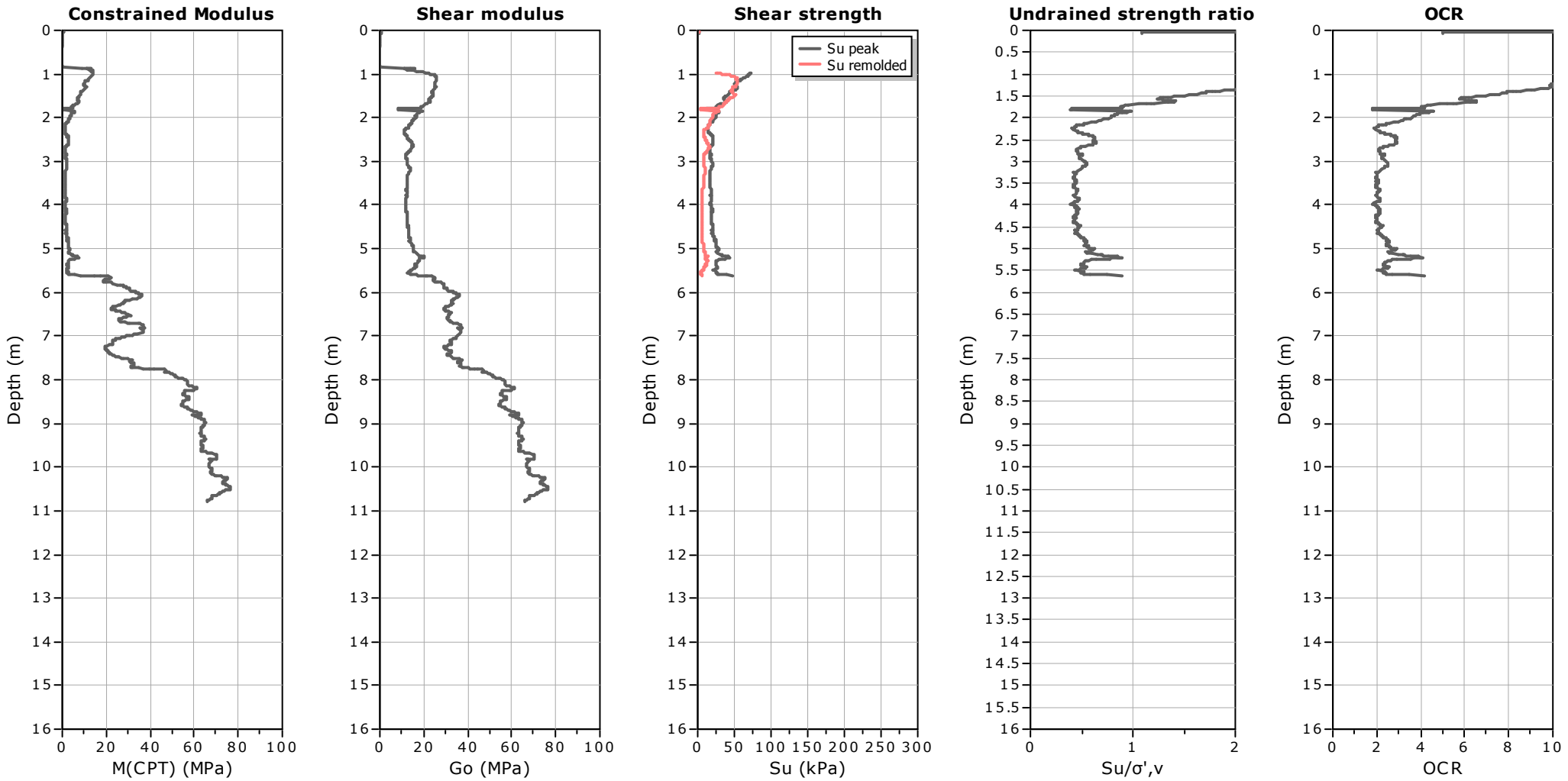
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



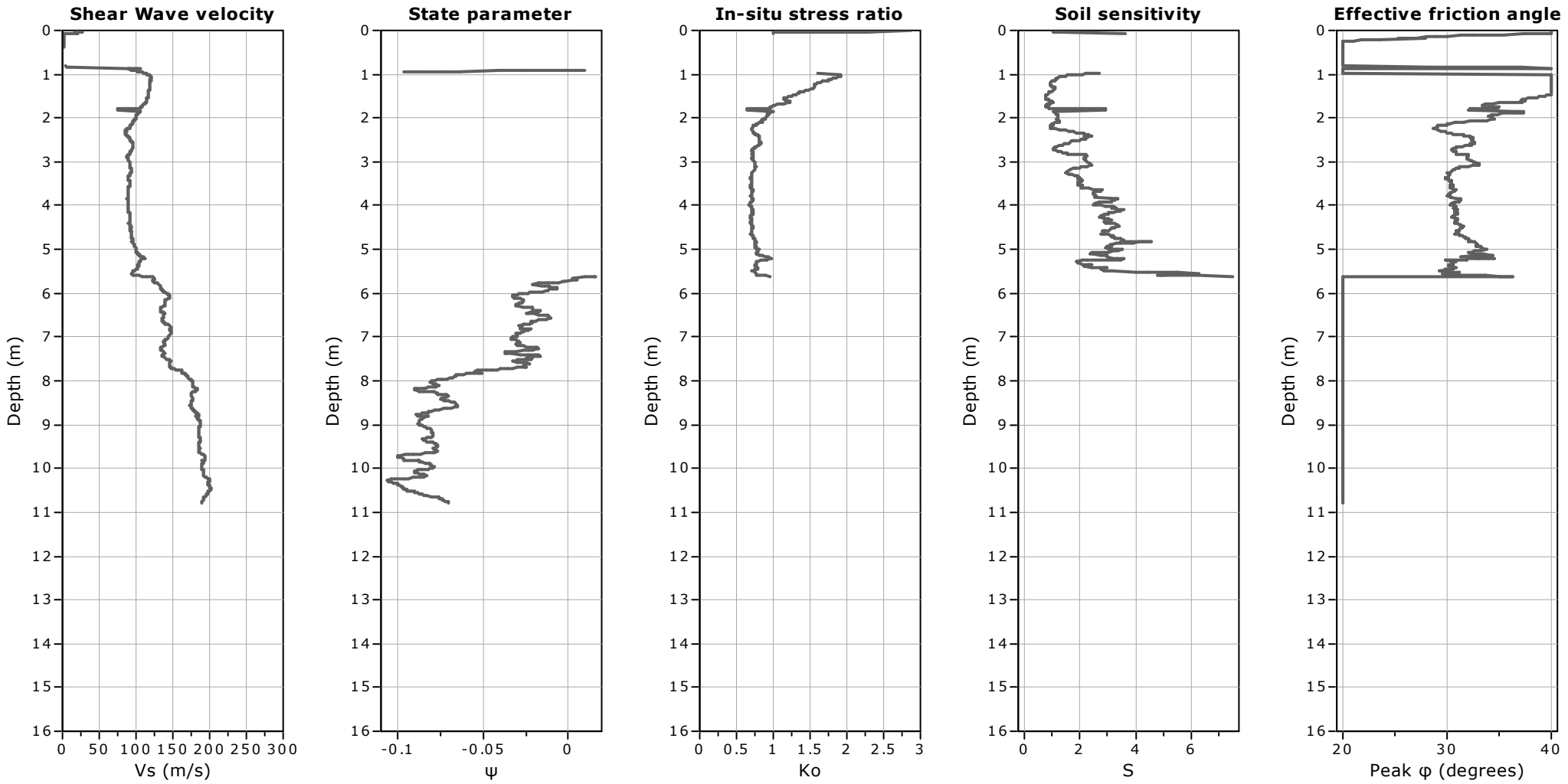
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



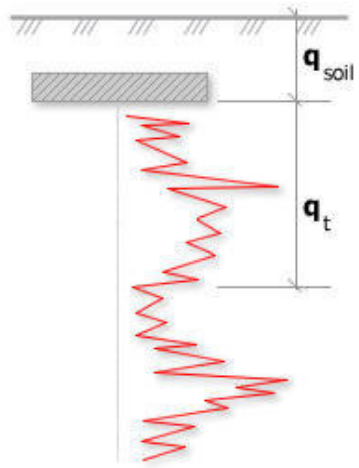
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

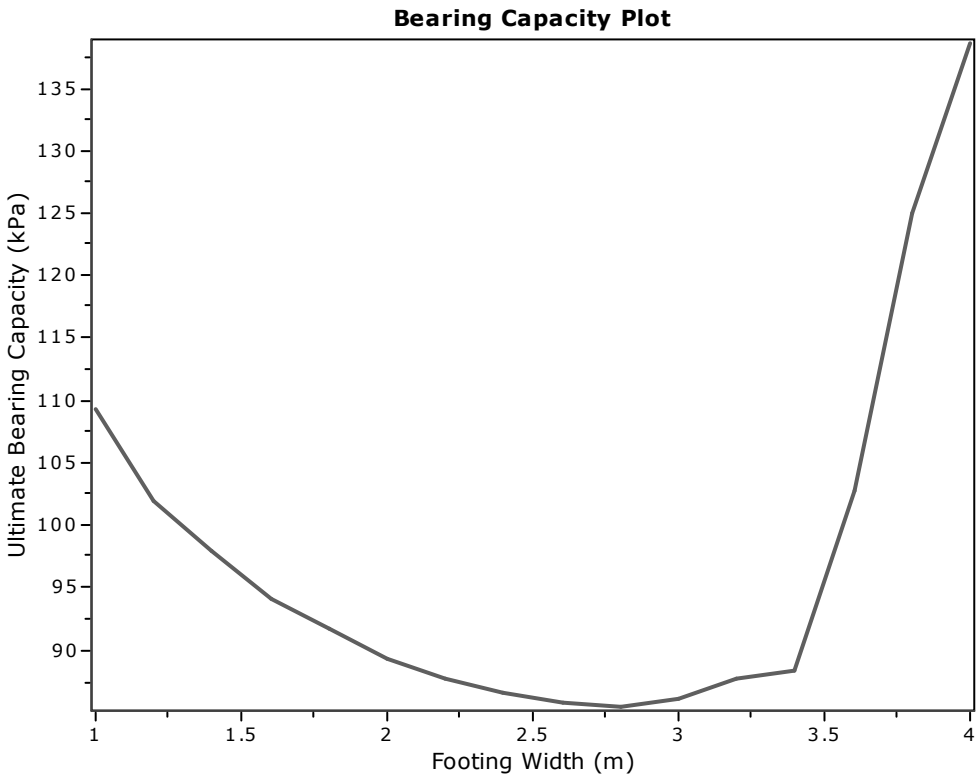
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



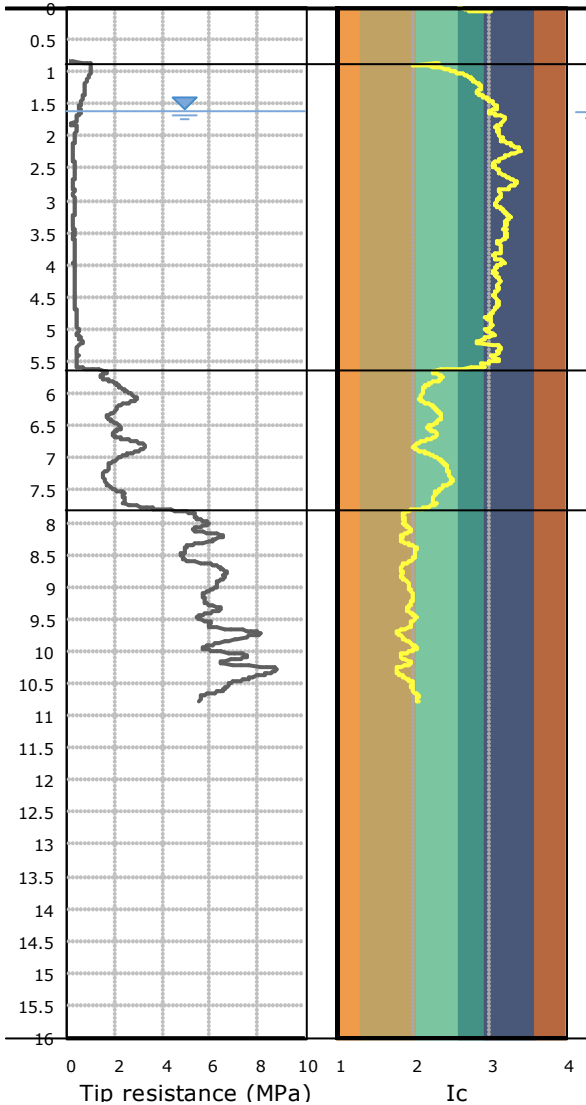
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.50	0.20	9.50	109.29
2	1.20	0.50	2.30	0.46	0.20	9.50	102.00
3	1.40	0.50	2.60	0.44	0.20	9.50	97.93
4	1.60	0.50	2.90	0.42	0.20	9.50	94.04
5	1.80	0.50	3.20	0.41	0.20	9.50	91.71
6	2.00	0.50	3.50	0.40	0.20	9.50	89.33
7	2.20	0.50	3.80	0.39	0.20	9.50	87.66
8	2.40	0.50	4.10	0.39	0.20	9.50	86.52
9	2.60	0.50	4.40	0.38	0.20	9.50	85.76
10	2.80	0.50	4.70	0.38	0.20	9.50	85.45
11	3.00	0.50	5.00	0.38	0.20	9.50	86.03
12	3.20	0.50	5.30	0.39	0.20	9.50	87.77
13	3.40	0.50	5.60	0.39	0.20	9.50	88.41
14	3.60	0.50	5.90	0.47	0.20	9.50	102.69
15	3.80	0.50	6.20	0.58	0.20	9.50	124.97
16	4.00	0.50	6.50	0.65	0.20	9.50	138.61

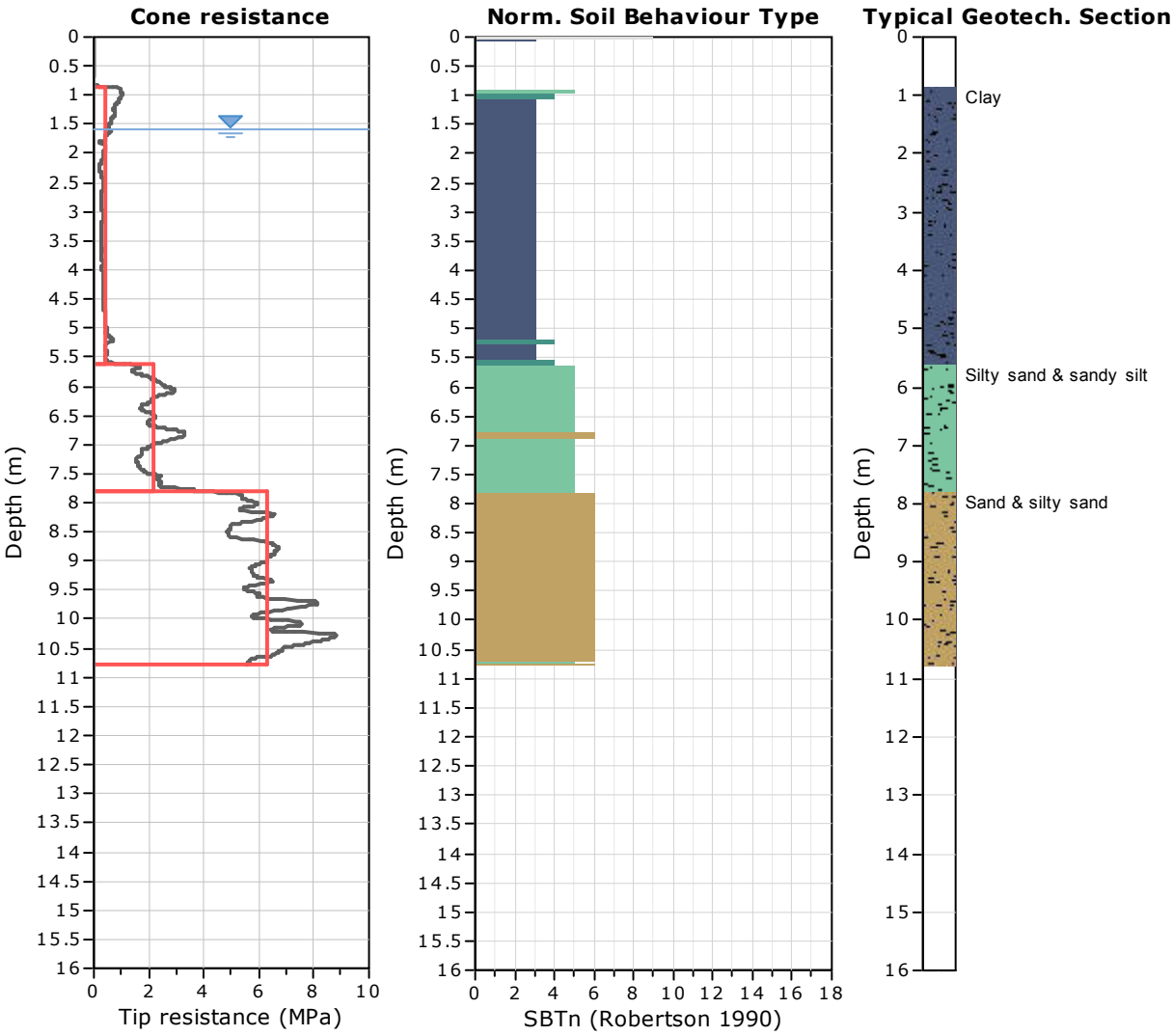
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.86	Clay	0.4	2.67E-8	2.3	14.4	-	-	3.7	15.4	25.5	0.8	3.5	15.4
5.62	Silty sand & sandy silt	2.2	1.59E-6	7.0	26.2	29.8	34.0	28.5	32.9	-	-	-	16.5
7.81	Sand & silty sand	6.3	1.34E-5	16.2	50.7	45.4	38.0	63.6	63.6	-	-	-	18.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.86 (m), **End depth:** 5.62 (m)

Description: Clay

Basic results

Total cone resistance: 0.43 ±0.19 MPa
Sleeve friction: 15.65 ±14.44 kPa
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 2.67E-08 ±2.10E-07 m/s
N60: 2.29 ±0.66 blows
Es: 14.44 ±4.04 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 15.45 ±0.92 kN/m³
Constrained Mod.: 3.69 ±3.39 MPa
Go: 15.36 ±4.24 MPa
Su: 25.54 ±12.52 kPa
Su ratio: 0.76 ±0.60
O.C.R.: 3.52 ±2.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 5.62 (m), **End depth:** 7.81 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 2.19 ±0.53 MPa	Permeability: 1.59E-06 ±1.57E-06 m/s	Constrained Mod.: 28.47 ±6.26 MPa
Sleeve friction: 16.55 ±3.99 kPa	N60: 7.03 ±1.27 blows	Go: 32.88 ±4.22 MPa
SBT_n: 5	Es: 26.24 ±3.36 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 29.80 ±3.30	Su ratio: 0.00 ±0.00
	φ (degrees): 33.96 ±1.05 °	O.C.R.: 0.00 ±0.00
	Unit weight: 16.47 ±0.33 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 7.81 (m), **End depth:** 10.78 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.28 ±0.92 MPa	Permeability: 1.34E-05 ±7.10E-06 m/s	Constrained Mod.: 63.60 ±6.60 MPa
Sleeve friction: 43.28 ±8.14 kPa	N60: 16.15 ±1.92 blows	Go: 63.60 ±6.60 MPa
SBT_n: 6	Es: 50.74 ±5.27 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 45.37 ±2.63	Su ratio: 0.00 ±0.00
	φ (degrees): 38.02 ±0.55 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.00 ±0.26 kN/m³	

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CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

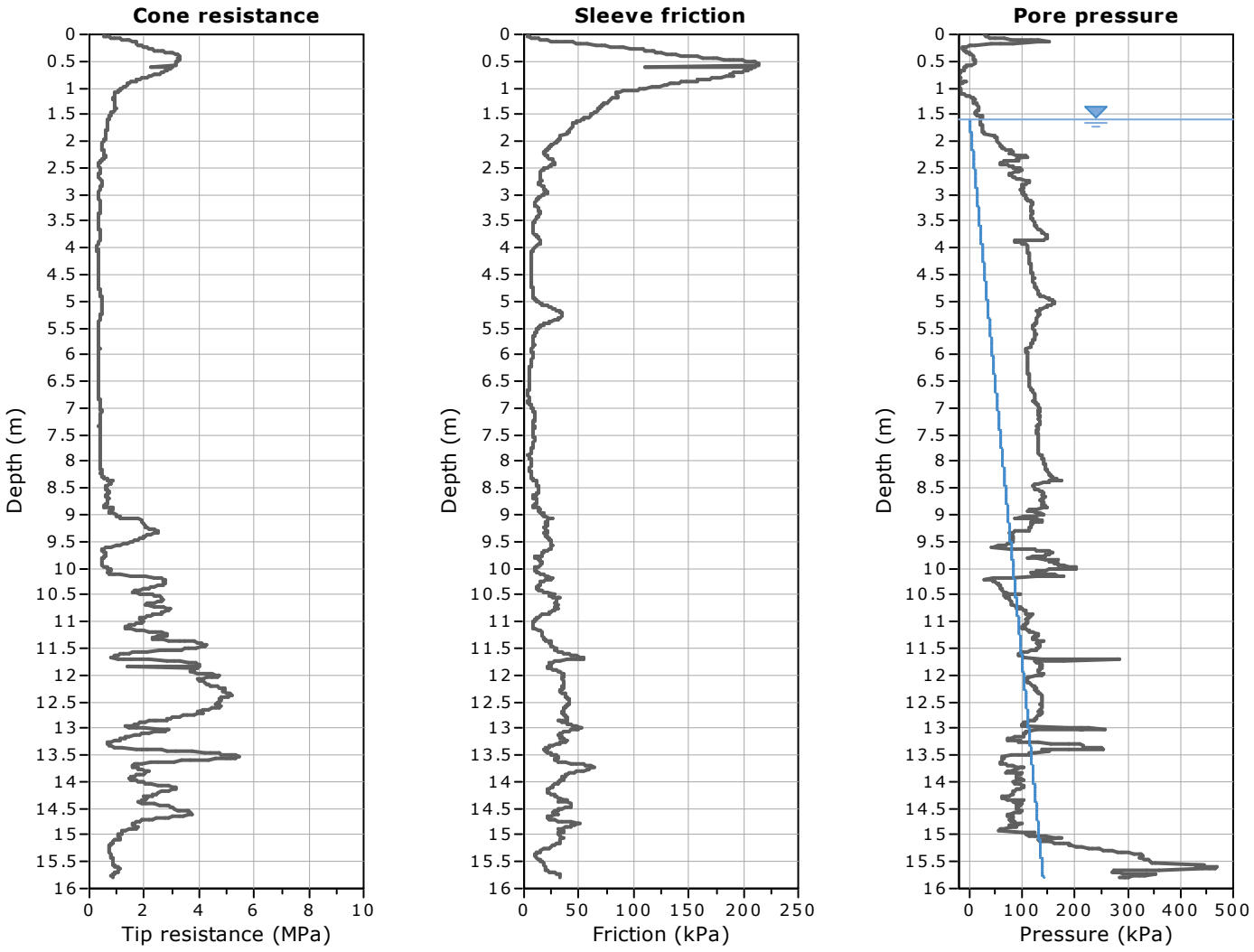
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.86	4.76	2.67E-08	2.3	14.4	0.0	0.0	3.7	15.4	25.5	0.8	3.5	15.4
5.62		(±2.10E-07)	(±0.7)	(±4.0)	(±0.0)	(±0.0)	(±3.4)	(±4.2)	(±12.5)	(±0.6)	(±2.8)	(±0.9)
5.62	2.19	1.59E-06	7.0	26.2	29.8	34.0	28.5	32.9	0.0	0.0	0.0	16.5
7.81		(±1.57E-06)	(±1.3)	(±3.4)	(±3.3)	(±1.0)	(±6.3)	(±4.2)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
7.81	2.97	1.34E-05	16.2	50.7	45.4	38.0	63.6	63.6	0.0	0.0	0.0	18.0
10.78		(±7.10E-06)	(±1.9)	(±5.3)	(±2.6)	(±0.5)	(±6.6)	(±6.6)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

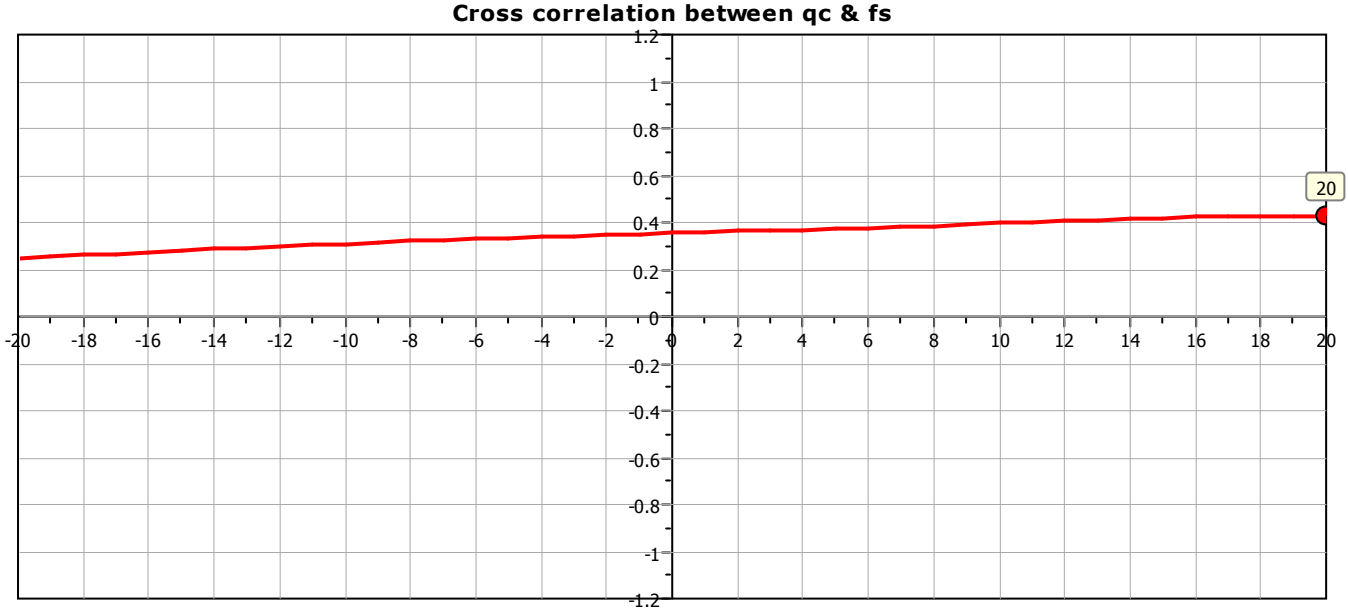
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

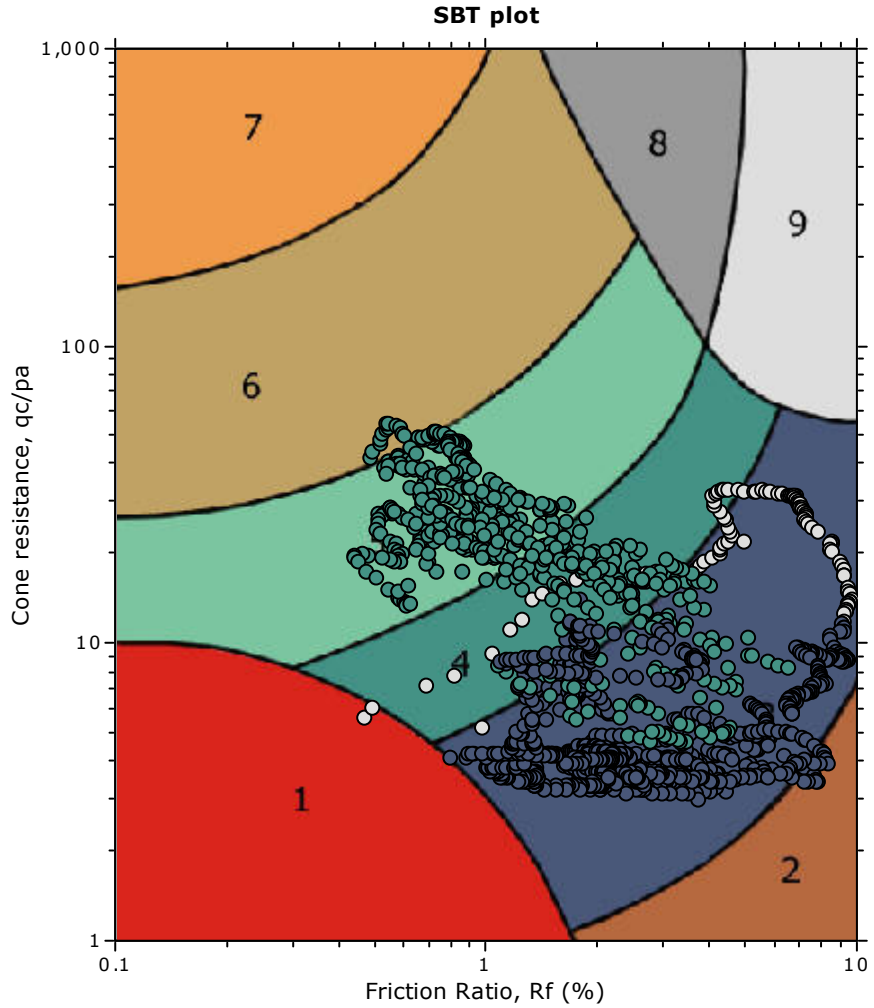


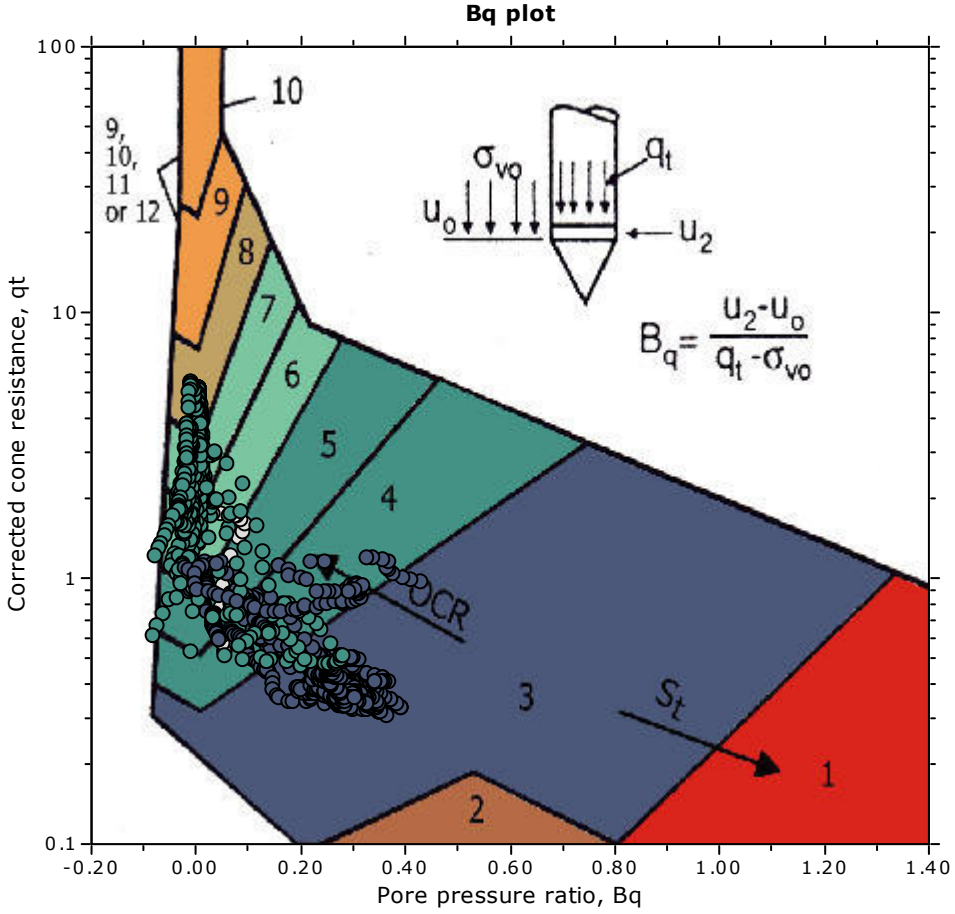
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

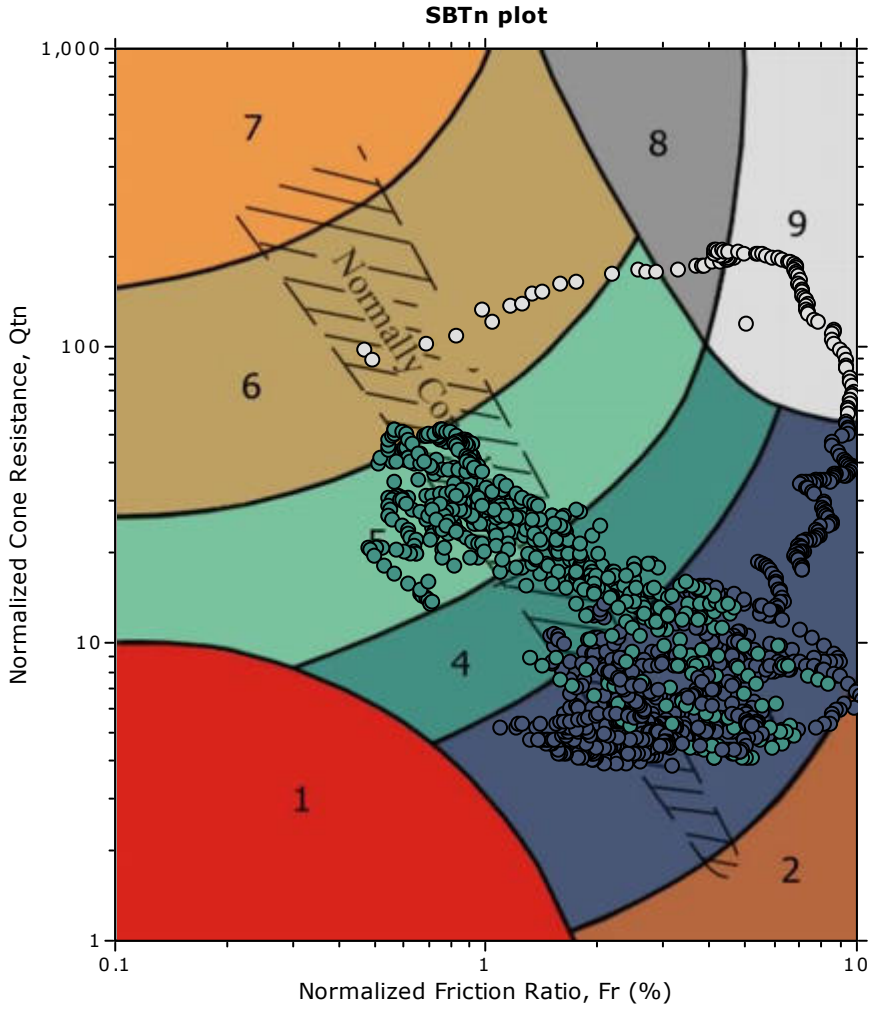
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

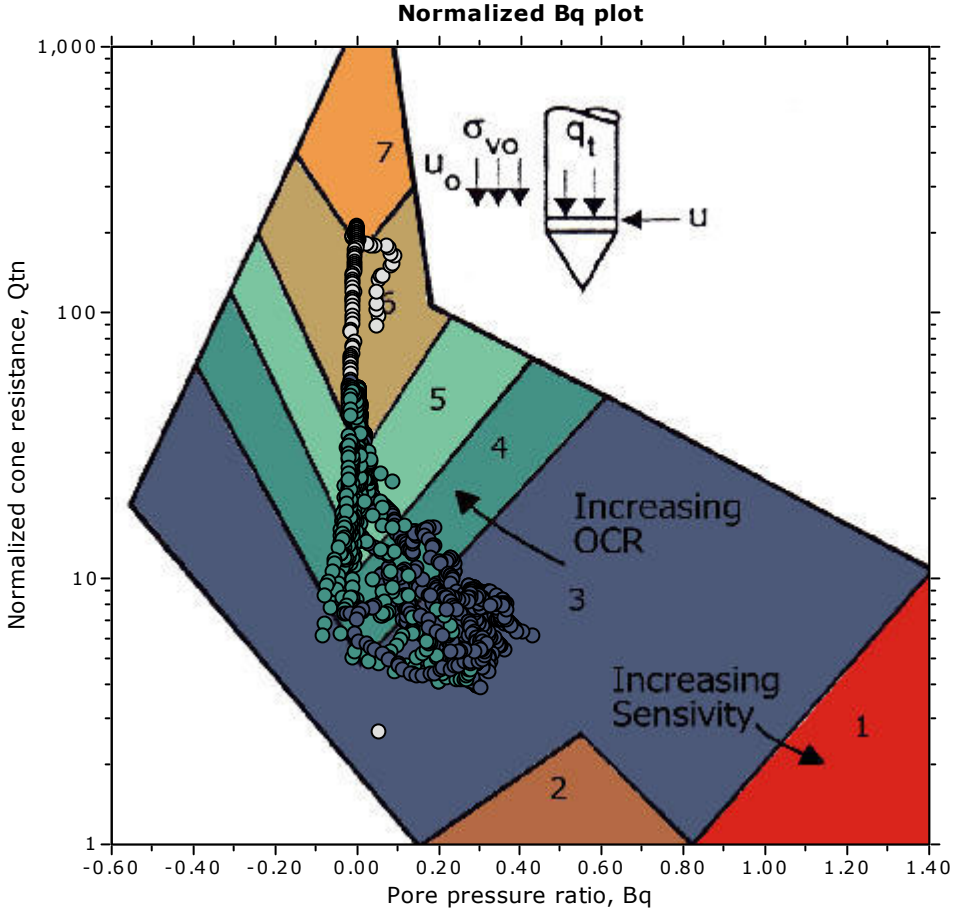
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

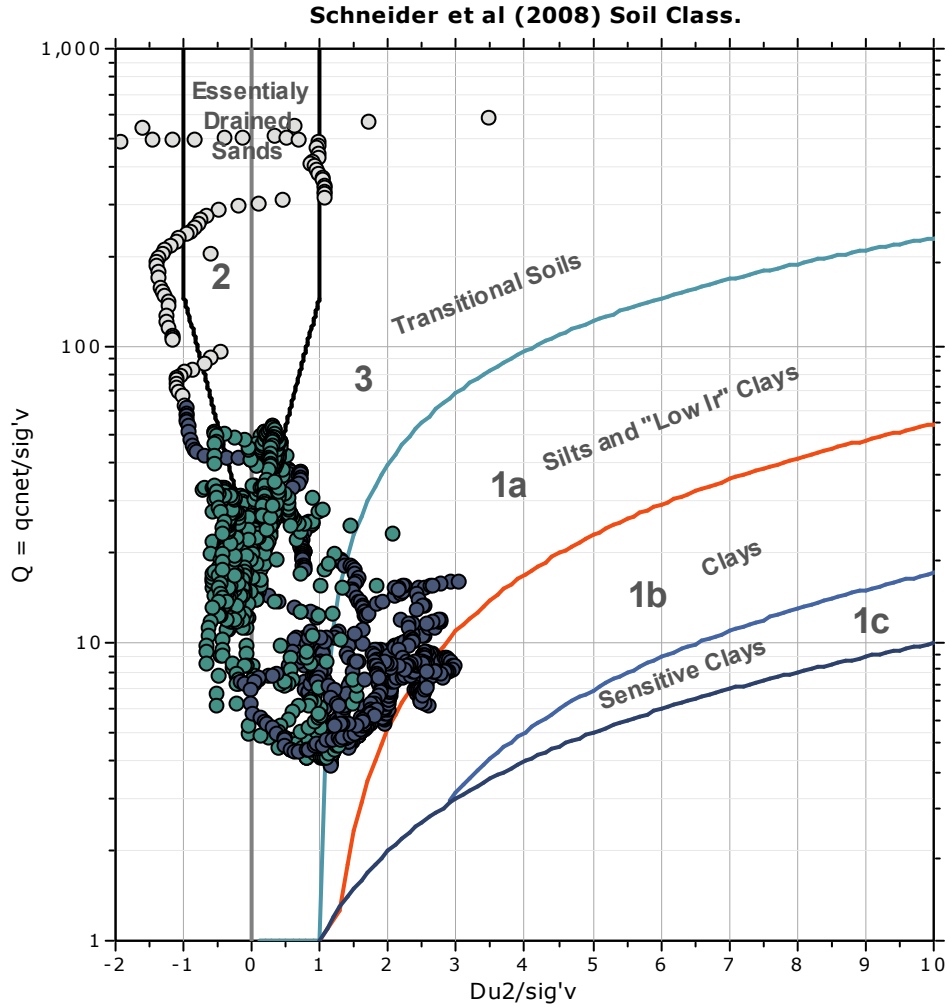
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

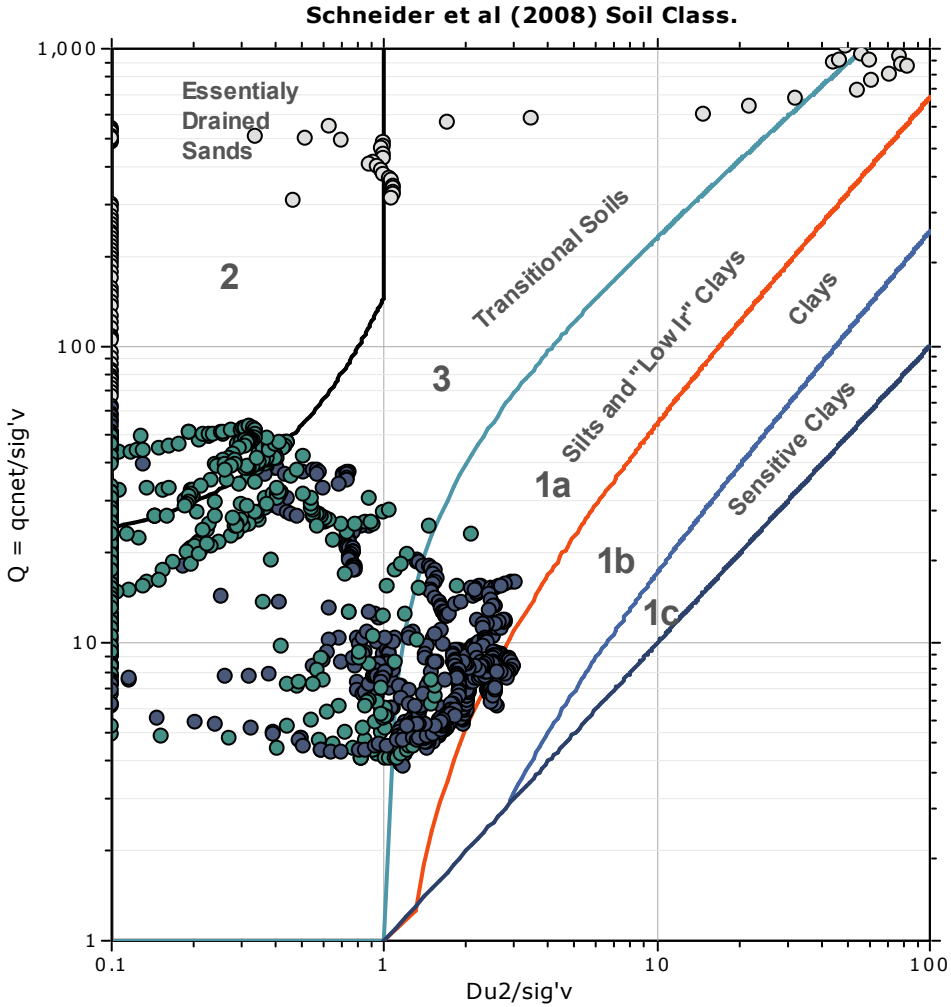
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

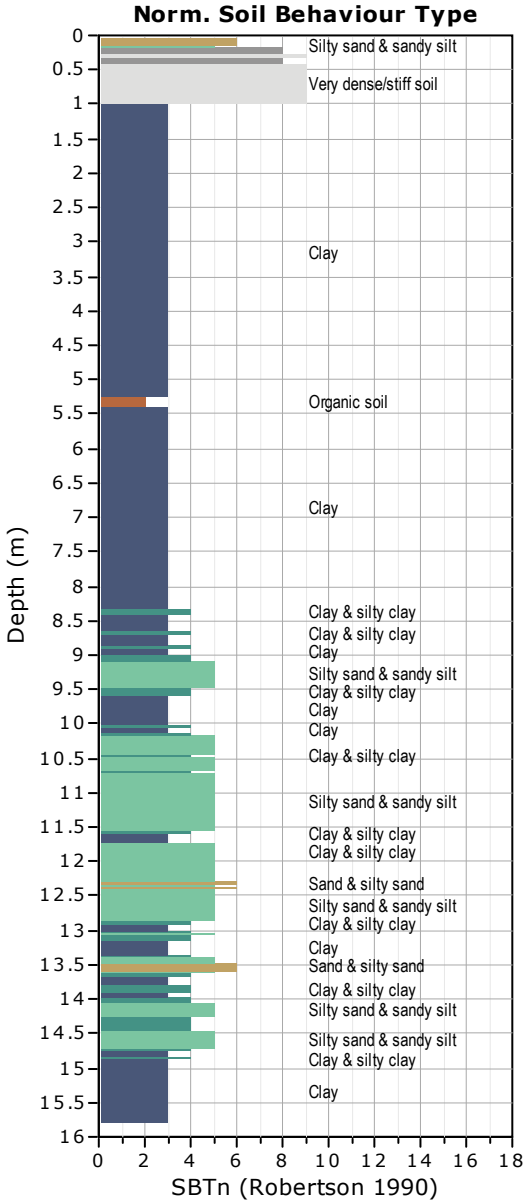


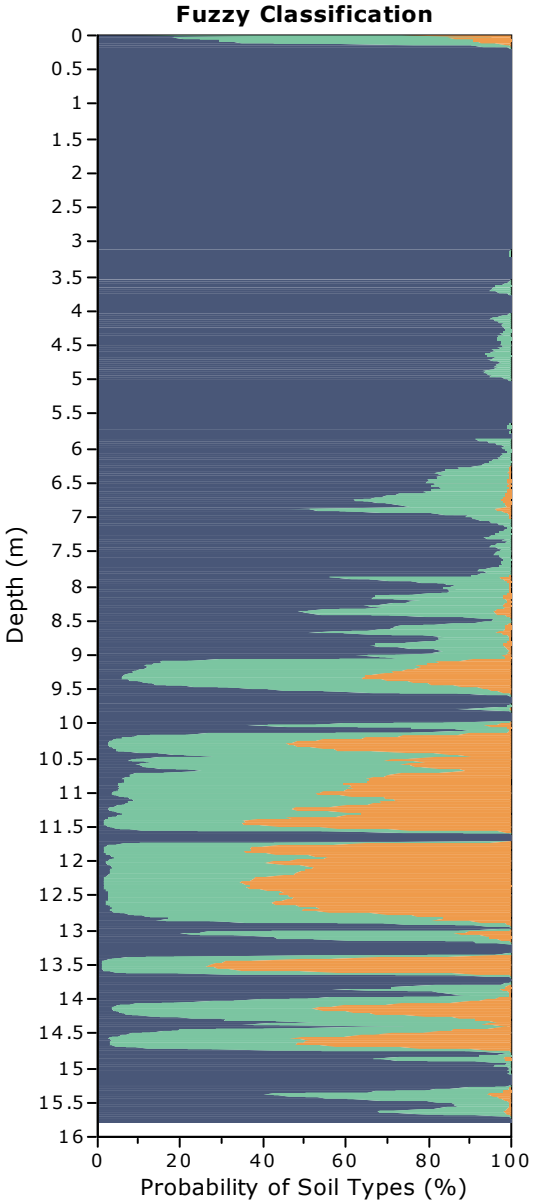


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

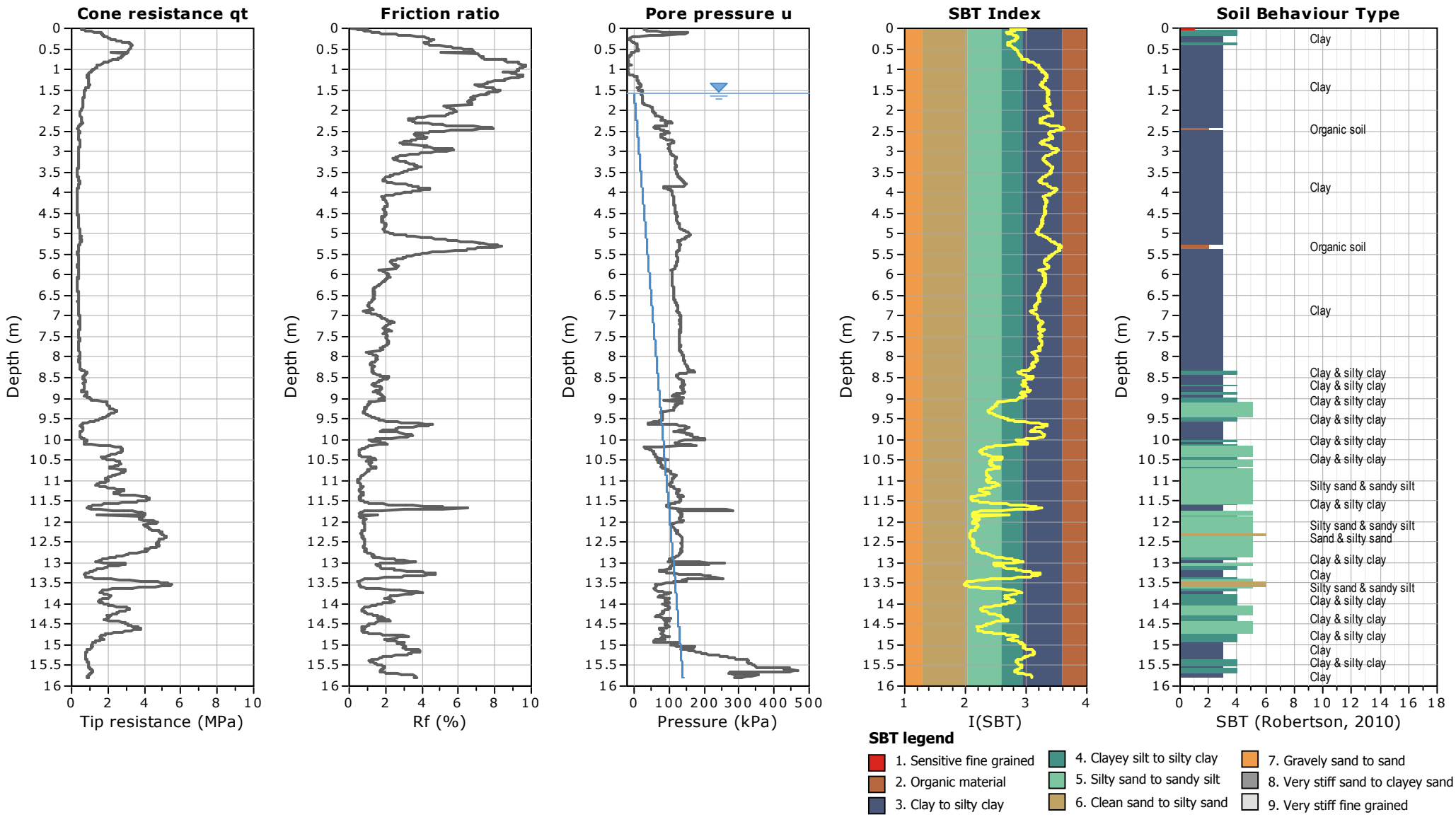




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

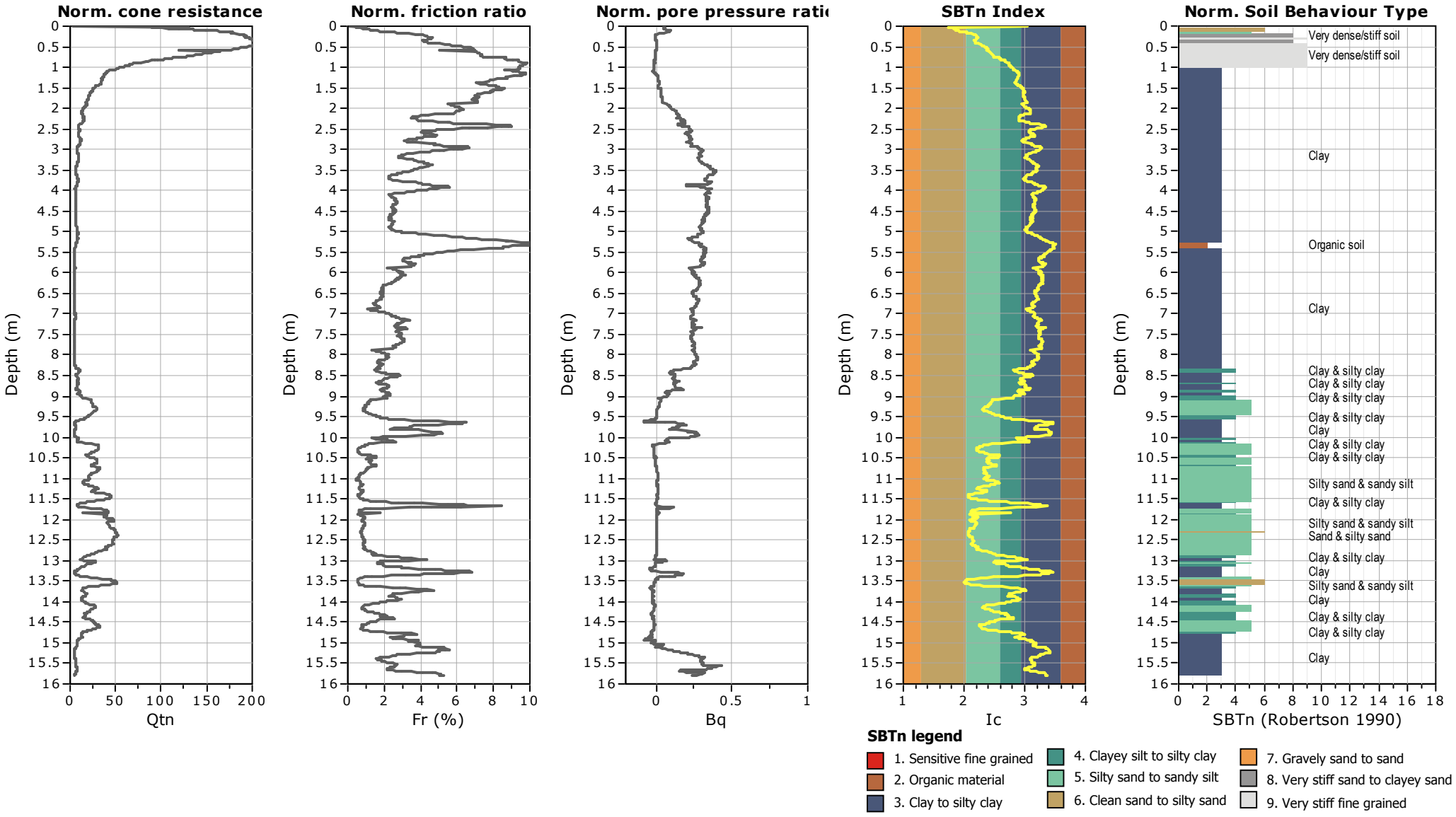
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

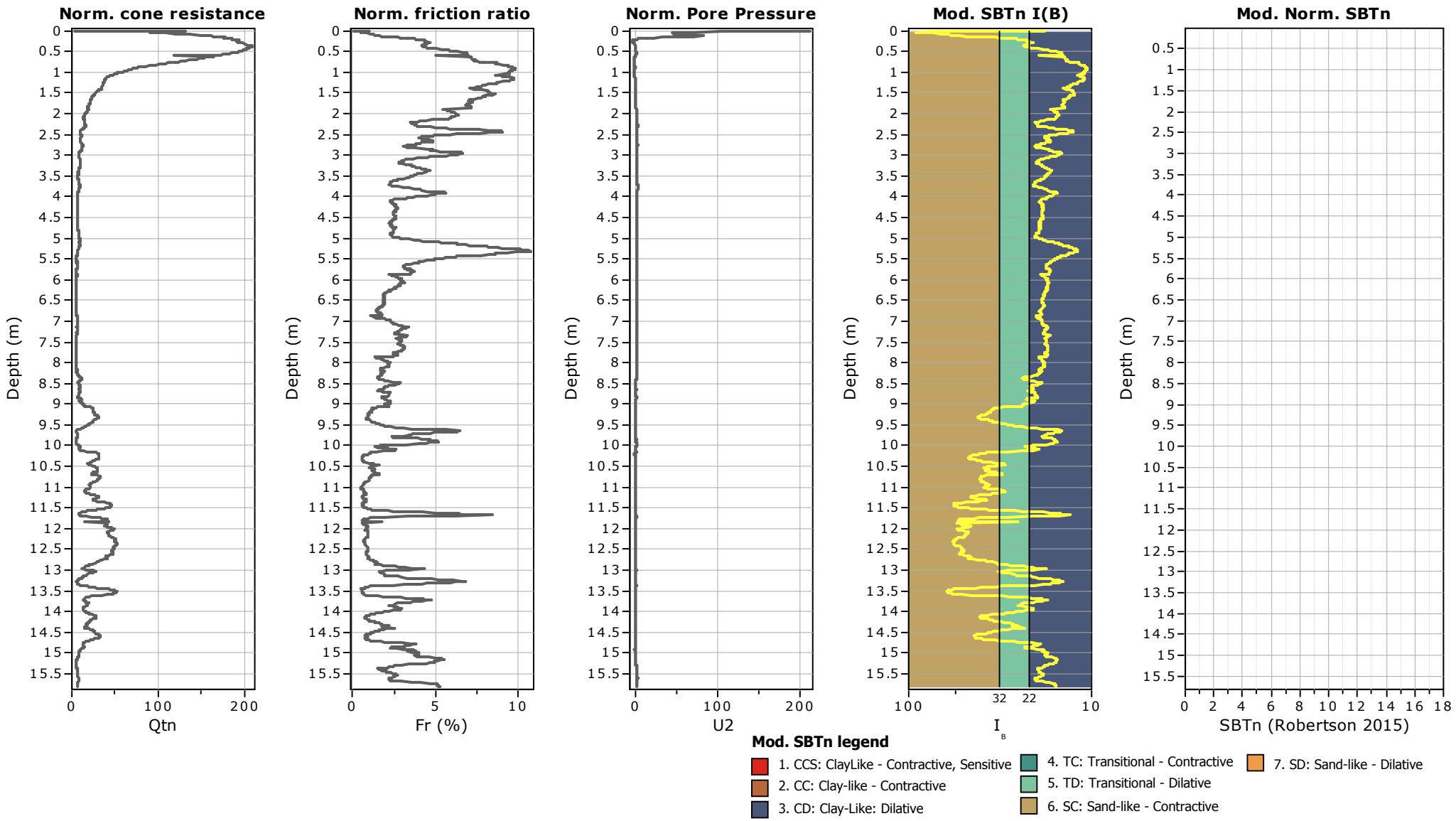
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

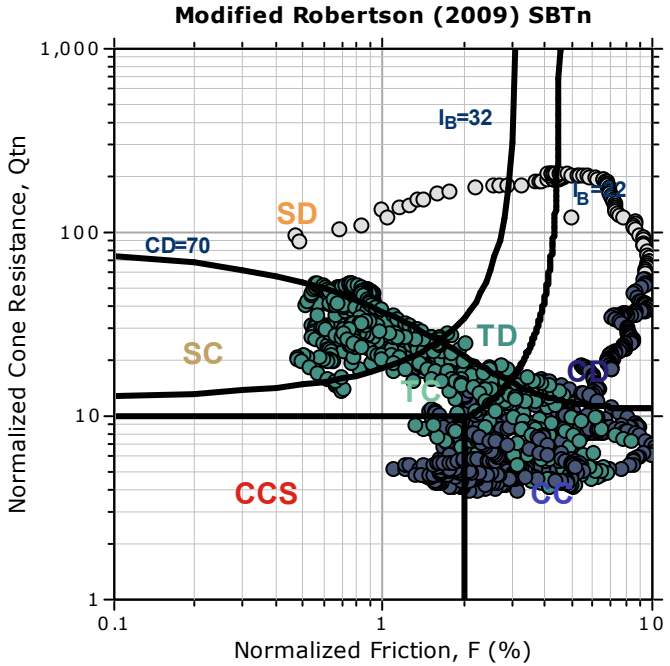


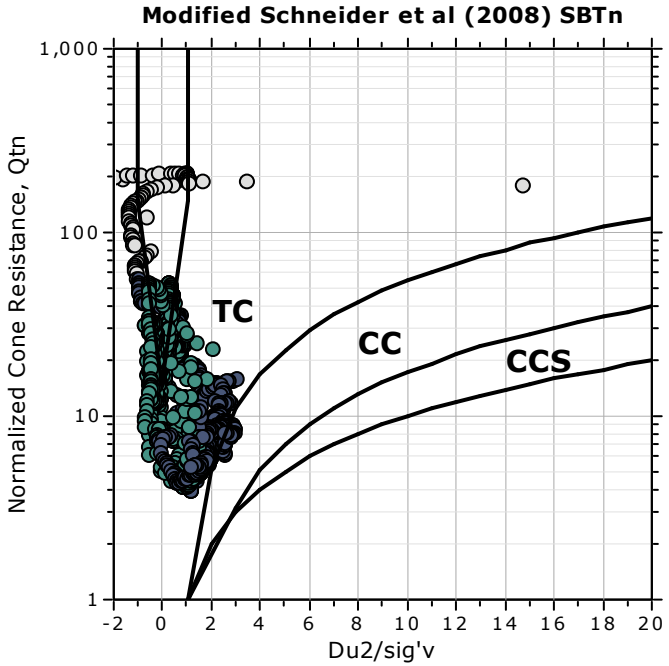
RDR SrL
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rocco.carbonella@fastwebnet.it

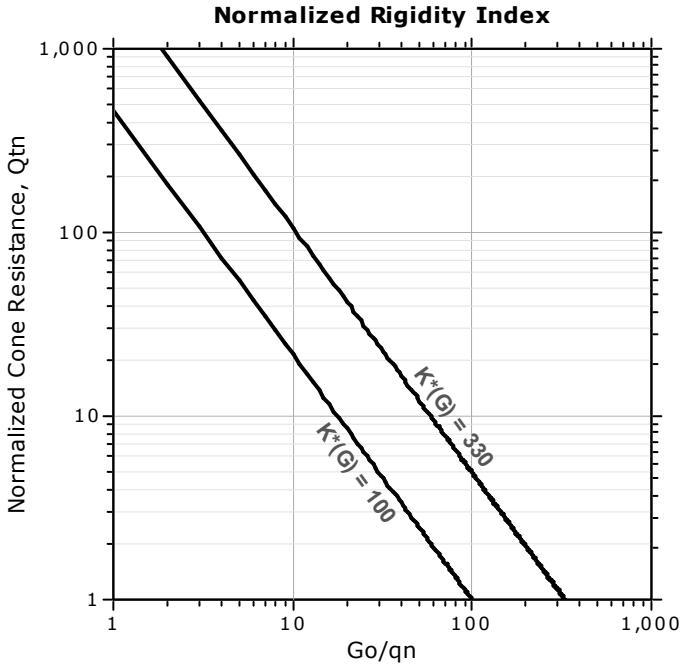
CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







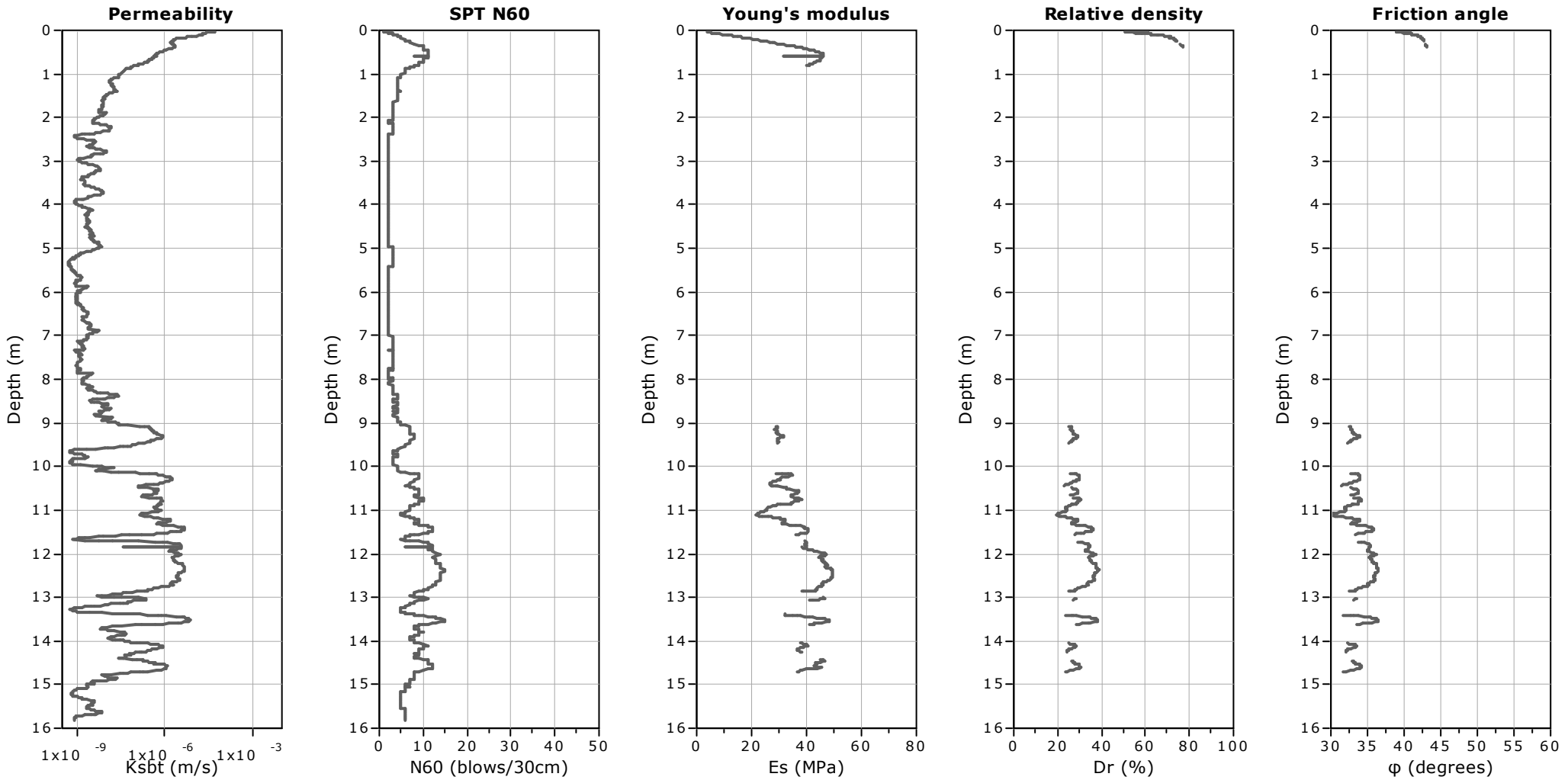
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



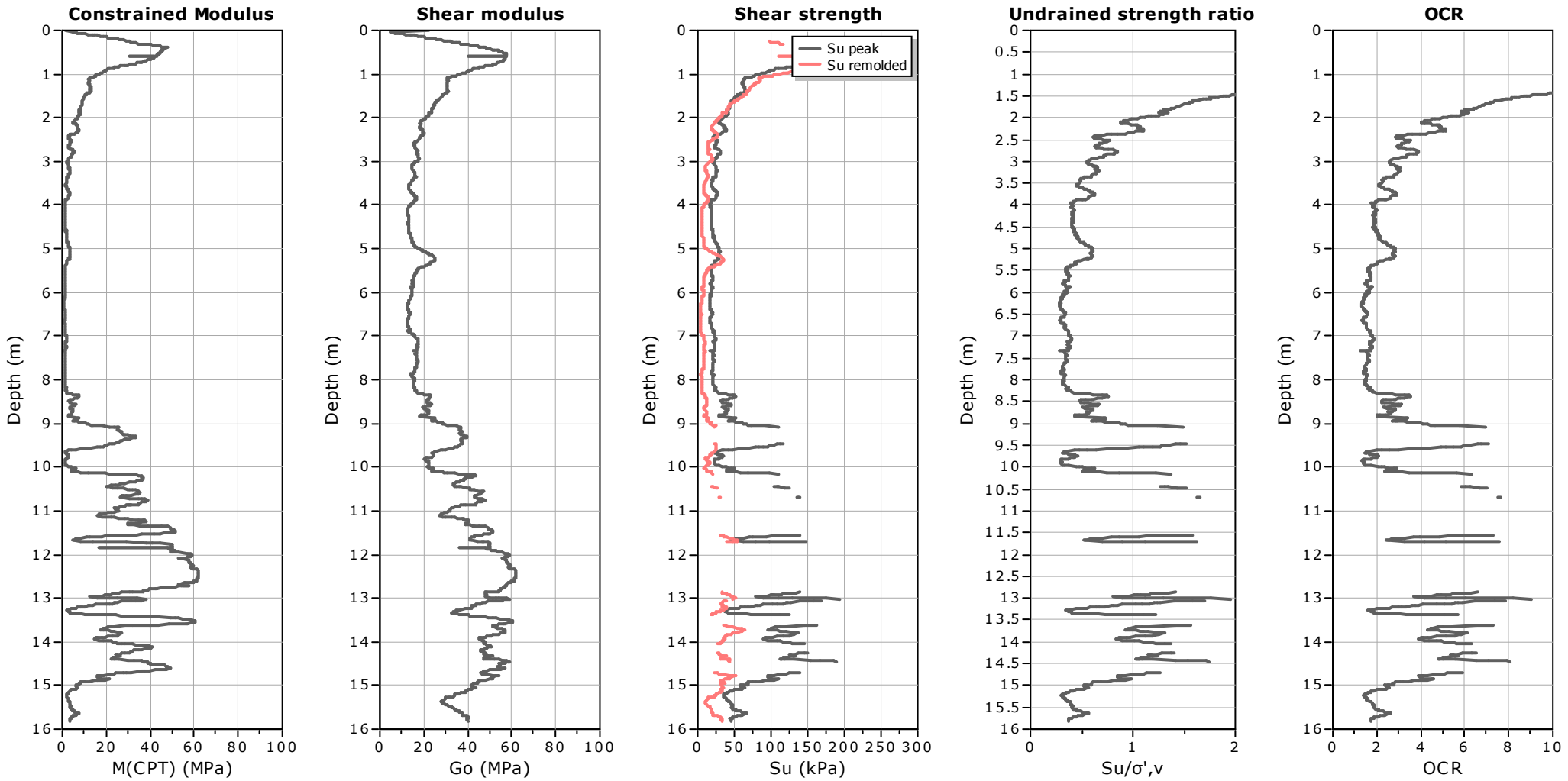
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
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CPT: cptu17
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

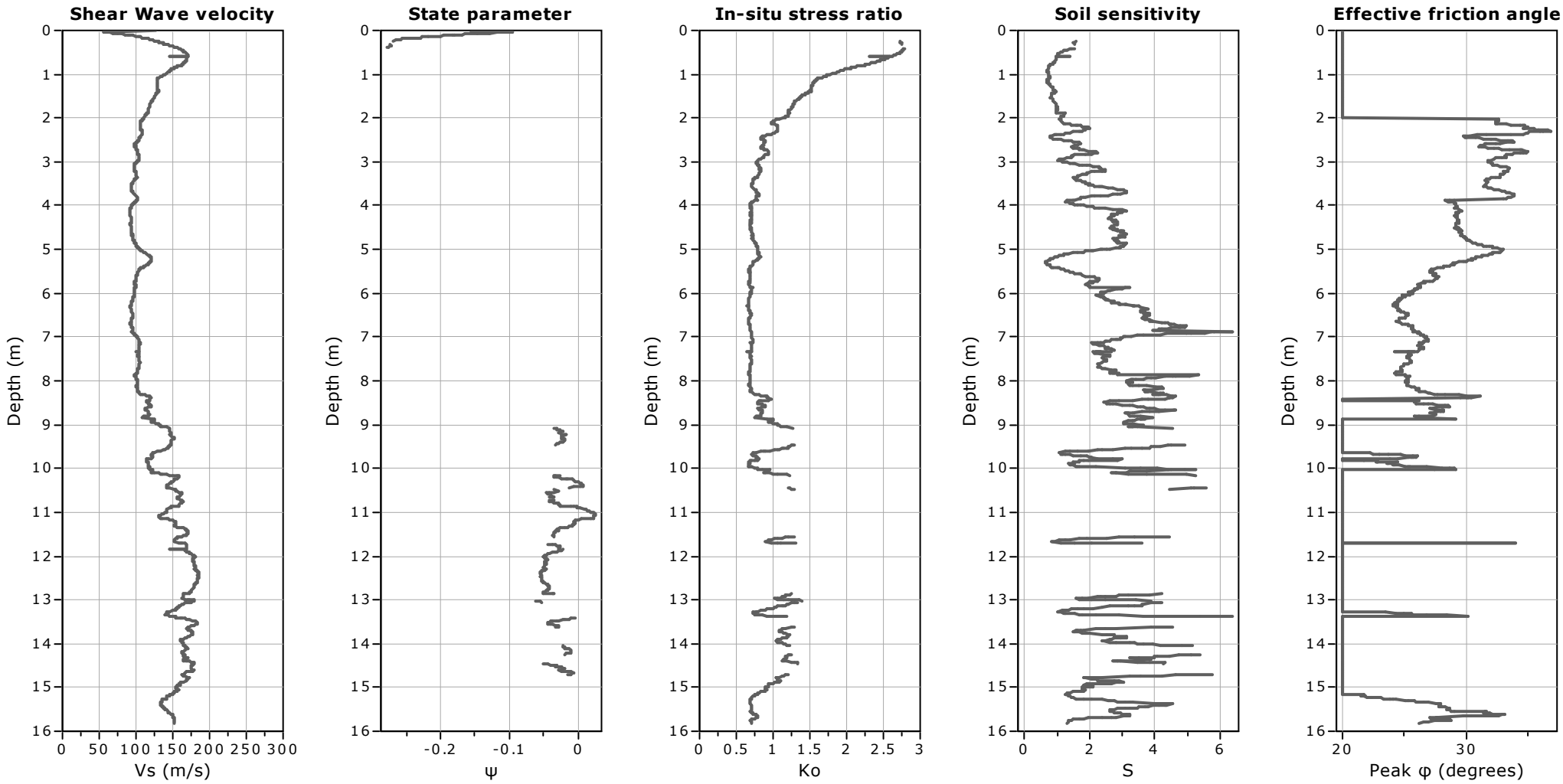
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



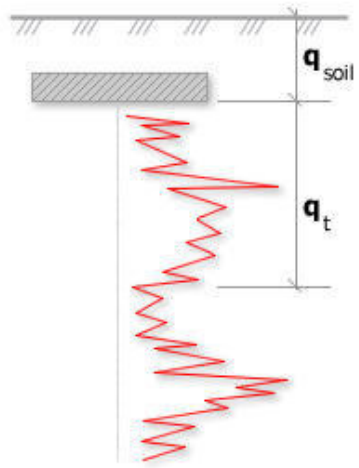
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

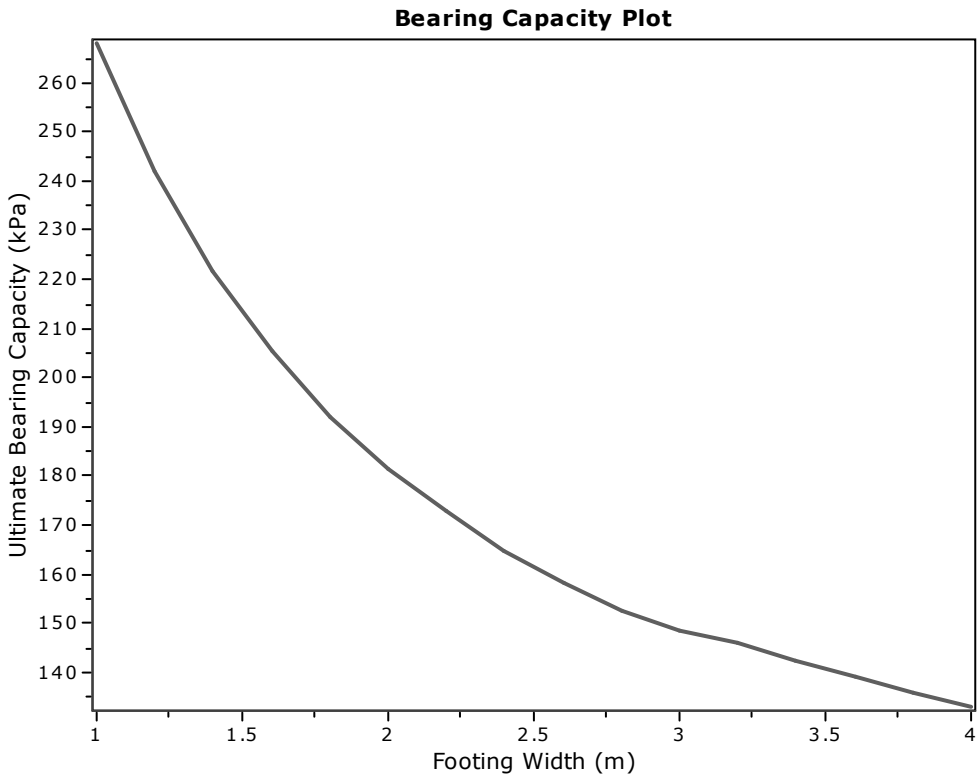
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



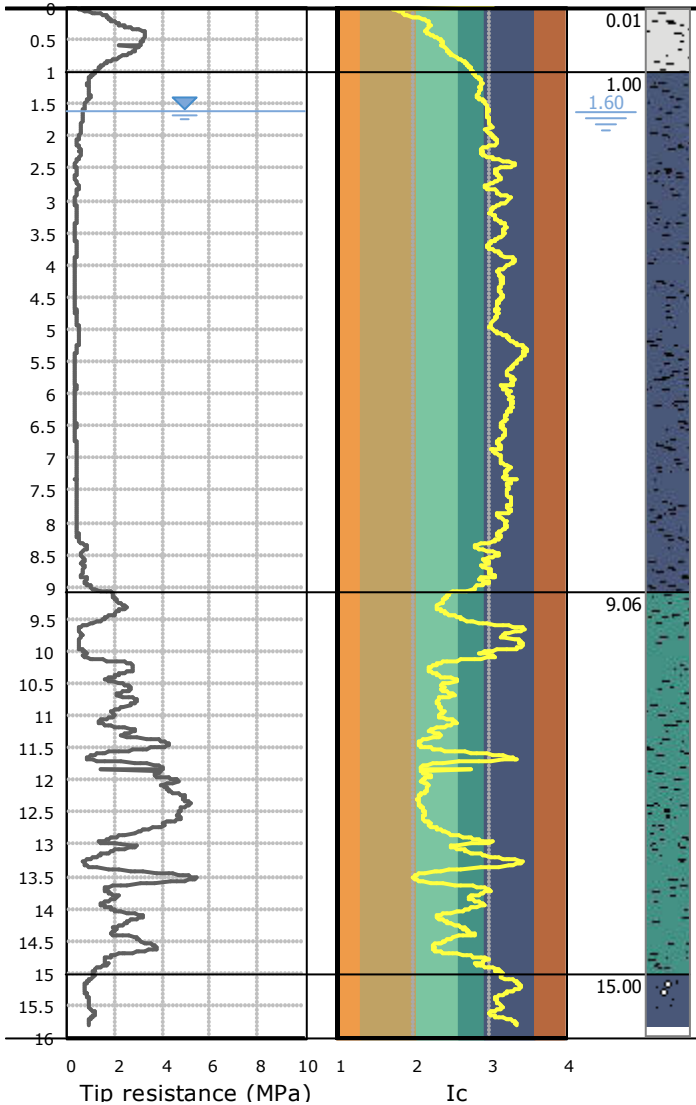
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.29	0.20	9.50	268.01
2	1.20	0.50	2.30	1.16	0.20	9.50	242.09
3	1.40	0.50	2.60	1.06	0.20	9.50	221.48
4	1.60	0.50	2.90	0.98	0.20	9.50	205.25
5	1.80	0.50	3.20	0.91	0.20	9.50	192.05
6	2.00	0.50	3.50	0.86	0.20	9.50	181.34
7	2.20	0.50	3.80	0.82	0.20	9.50	172.72
8	2.40	0.50	4.10	0.78	0.20	9.50	164.85
9	2.60	0.50	4.40	0.74	0.20	9.50	158.06
10	2.80	0.50	4.70	0.72	0.20	9.50	152.50
11	3.00	0.50	5.00	0.70	0.20	9.50	148.69
12	3.20	0.50	5.30	0.68	0.20	9.50	146.06
13	3.40	0.50	5.60	0.66	0.20	9.50	142.33
14	3.60	0.50	5.90	0.65	0.20	9.50	139.00
15	3.80	0.50	6.20	0.63	0.20	9.50	135.89
16	4.00	0.50	6.50	0.62	0.20	9.50	133.04

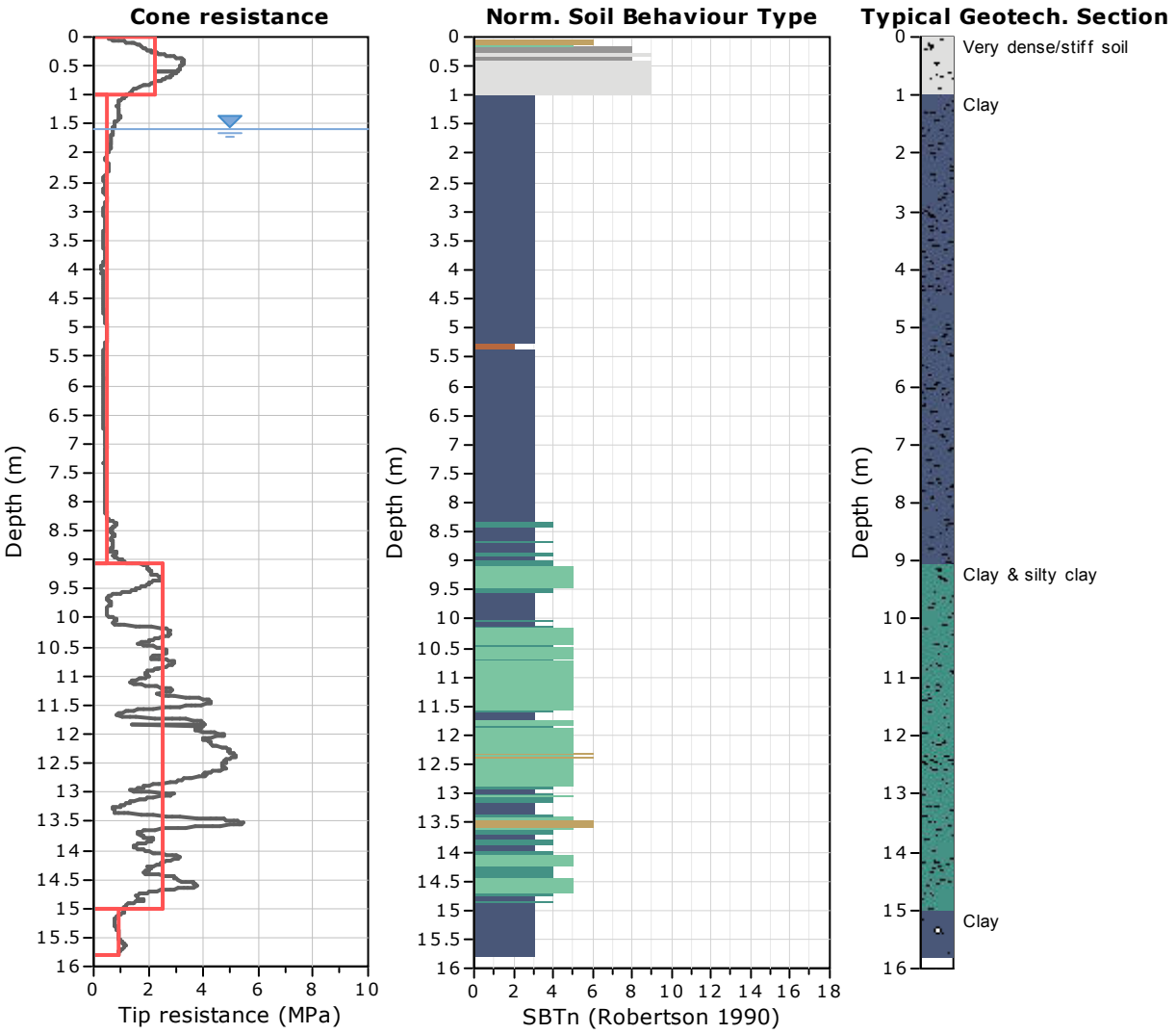
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.01	Very dense/stiff soil	2.2	3.78E-6	7.7	41.4	-	-	30.4	40.7	172.5	9.9	45.8	18.5
1.00	Clay	0.5	4.64E-9	2.6	-	-	-	3.6	17.9	28.5	0.7	3.2	15.6
9.06	Clay & silty clay	2.5	9.46E-7	8.8	36.2	-	-	30.7	44.9	86.7	0.9	4.1	17.0
15.00	Clay	0.9	2.20E-9	5.5	-	-	-	4.2	35.6	48.9	0.4	1.9	16.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.01 (m), **End depth:** 1.00 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 2.23 ±0.80 MPa
Sleeve friction: 133.52 ±65.55 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 3.78E-06 ±8.21E-06 m/s
N60: 7.65 ±2.78 blows
Es: 41.42 ±5.88 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 18.55 ±1.36 kN/m³
Constrained Mod.: 30.42 ±12.37 MPa
Go: 40.69 ±15.46 MPa
Su: 172.47 ±49.76 kPa
Su ratio: 9.90 ±3.63
O.C.R.: 45.75 ±16.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 9.06 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.48 ±0.18 MPa	Permeability: 4.64E-09 ±5.52E-09 m/s	Constrained Mod.: 3.61 ±3.34 MPa
Sleeve friction: 17.57 ±19.06 kPa	N60: 2.60 ±0.79 blows	Go: 17.95 ±5.09 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 28.46 ±13.46 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.69 ±0.61
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 3.20 ±2.81
	Unit weight: 15.57 ±0.97 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 9.06 (m), **End depth:** 15.00 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.49 ±1.27 MPa	Permeability: 9.46E-07 ±1.37E-06 m/s	Constrained Mod.: 30.72 ±17.41 MPa
Sleeve friction: 28.52 ±11.07 kPa	N60: 8.80 ±2.99 blows	Go: 44.88 ±10.73 MPa
SBT_n: 4	Es: 36.20 ±6.36 MPa	Su: 86.73 ±41.04 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.90 ±0.39
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 4.14 ±1.80
	Unit weight: 17.04 ±0.61 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 15.00 (m), **End depth:** 15.81 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.94 ±0.13 MPa	Permeability: 2.20E-09 ±1.51E-09 m/s	Constrained Mod.: 4.15 ±1.54 MPa
Sleeve friction: 22.75 ±8.21 kPa	N60: 5.52 ±0.53 blows	Go: 35.59 ±4.61 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 48.86 ±8.99 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.42 ±0.08
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.94 ±0.36
	Unit weight: 16.47 ±0.47 kN/m³	

RDR SrL
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CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

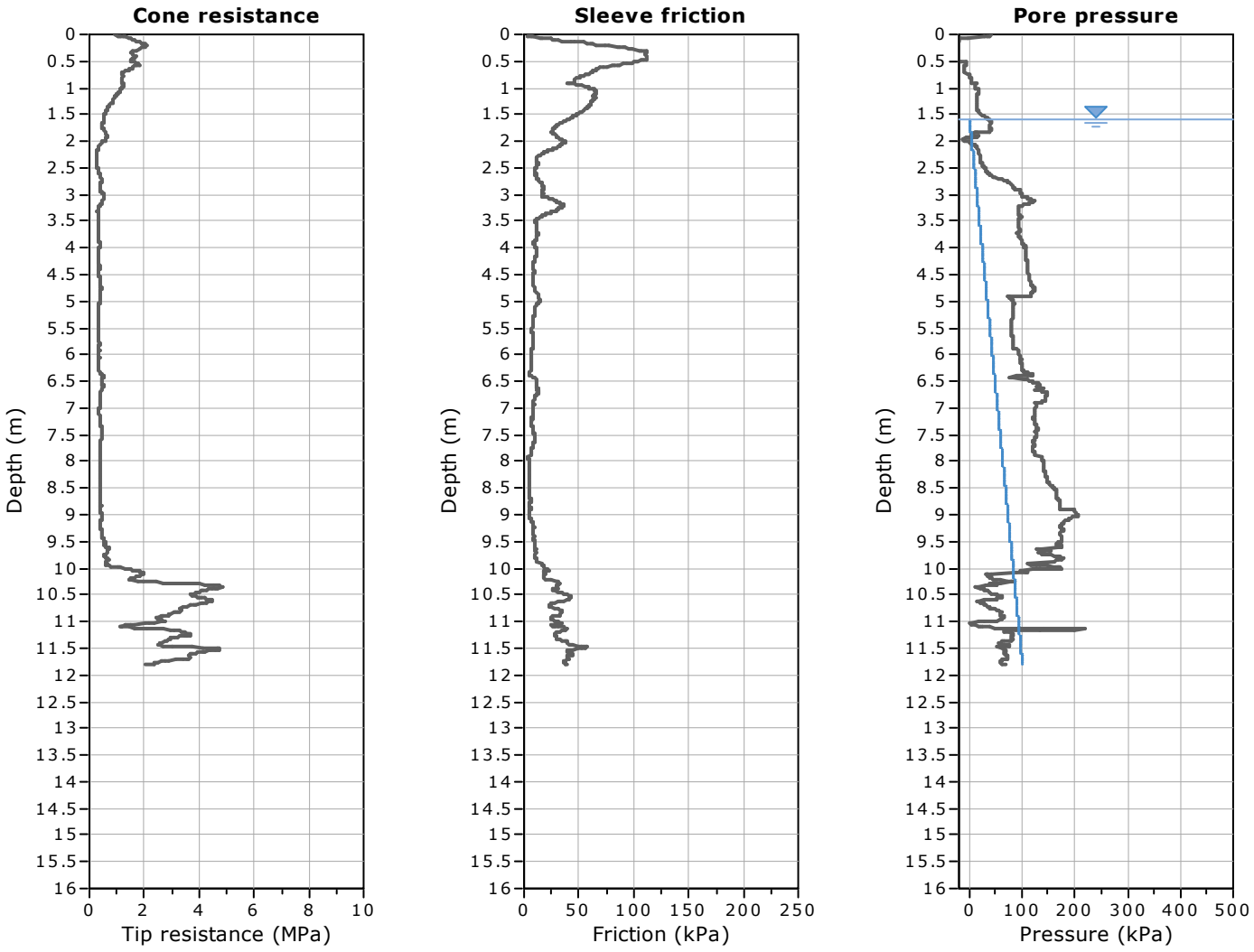
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.01	0.99	3.78E-06	7.7	41.4	0.0	0.0	30.4	40.7	172.5	9.9	45.8	18.5
1.00		(±8.21E-06)	(±2.8)	(±5.9)	(±0.0)	(±0.0)	(±12.4)	(±15.5)	(±49.8)	(±3.6)	(±16.8)	(±1.4)
1.00	8.06	4.64E-09	2.6	0.0	0.0	0.0	3.6	17.9	28.5	0.7	3.2	15.6
9.06		(±5.52E-09)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±3.3)	(±5.1)	(±13.5)	(±0.6)	(±2.8)	(±1.0)
9.06	5.94	9.46E-07	8.8	36.2	0.0	0.0	30.7	44.9	86.7	0.9	4.1	17.0
15.00		(±1.37E-06)	(±3.0)	(±6.4)	(±0.0)	(±0.0)	(±17.4)	(±10.7)	(±41.0)	(±0.4)	(±1.8)	(±0.6)
15.00	0.81	2.20E-09	5.5	0.0	0.0	0.0	4.2	35.6	48.9	0.4	1.9	16.5
15.81		(±1.51E-09)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±1.5)	(±4.6)	(±9.0)	(±0.1)	(±0.4)	(±0.5)

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

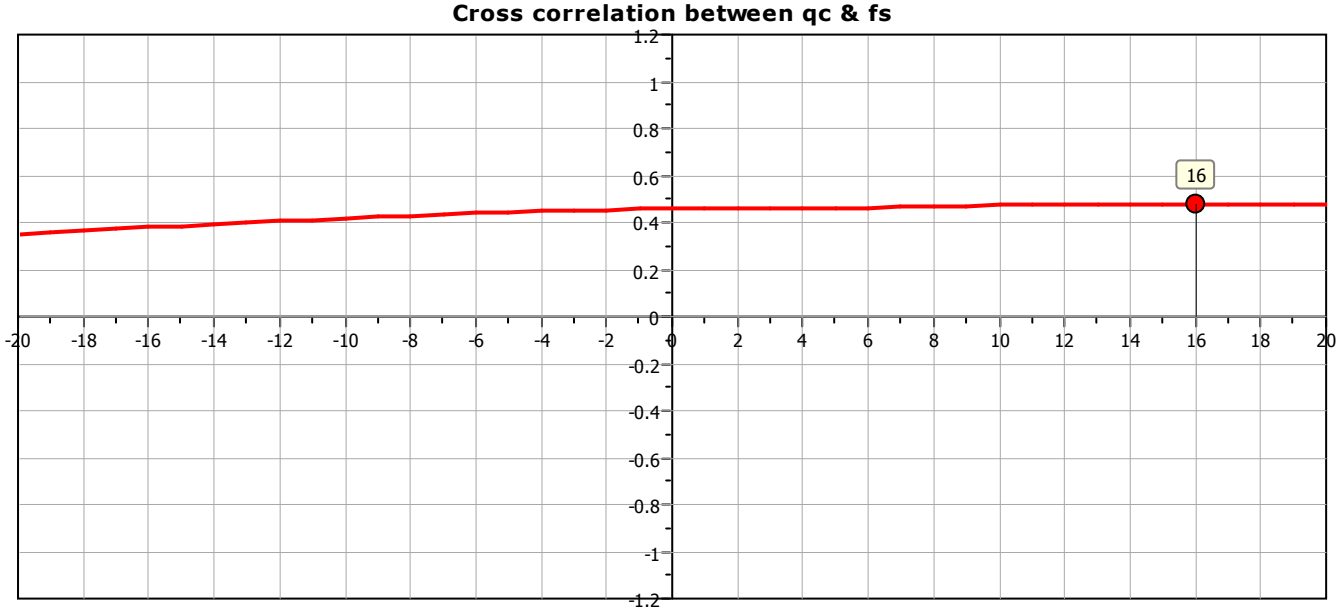
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

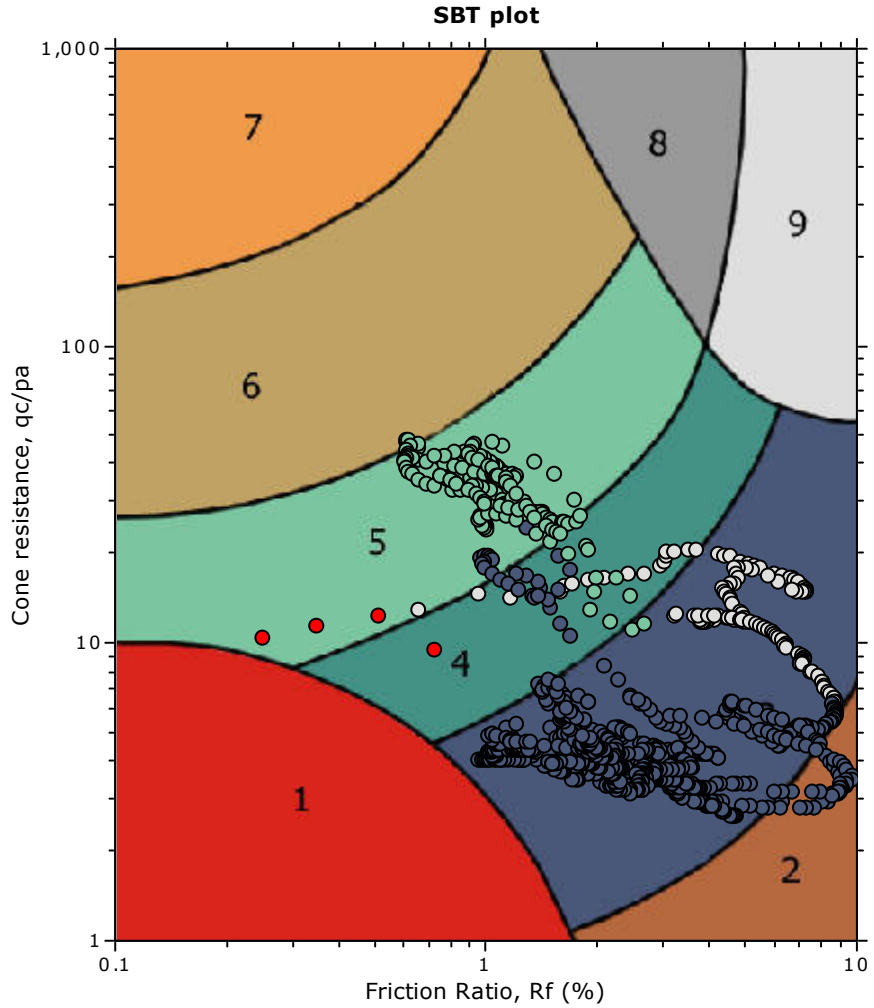


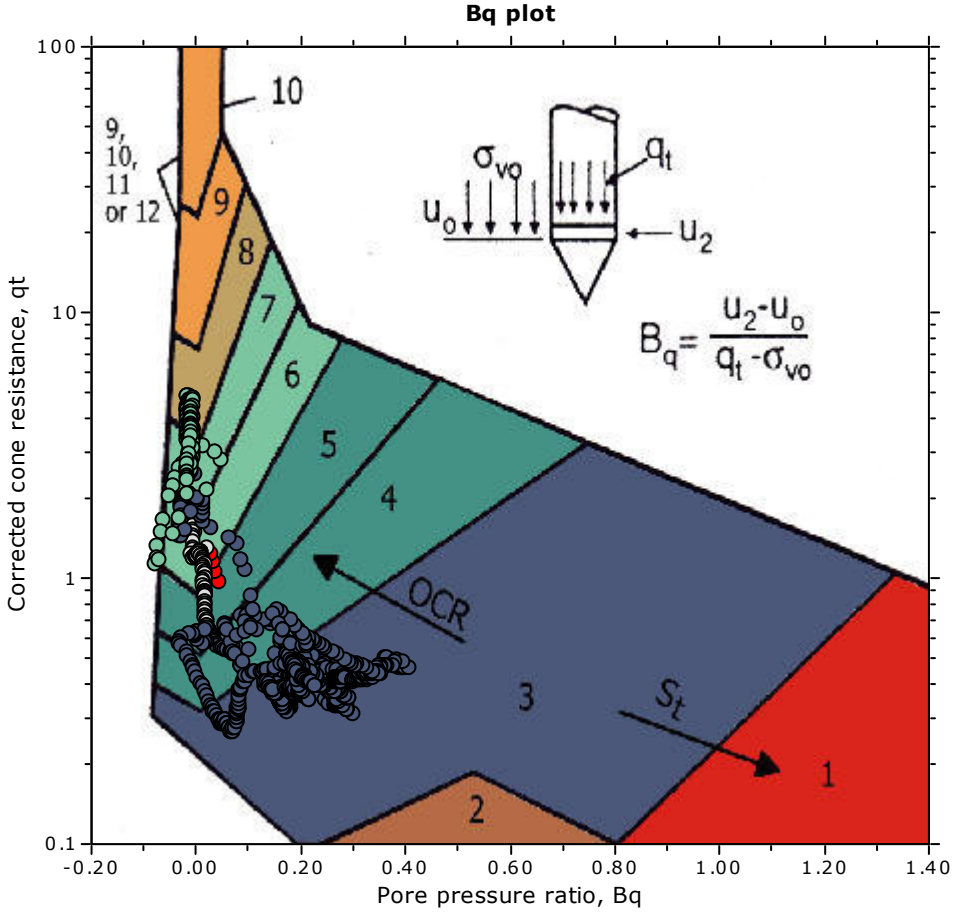
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

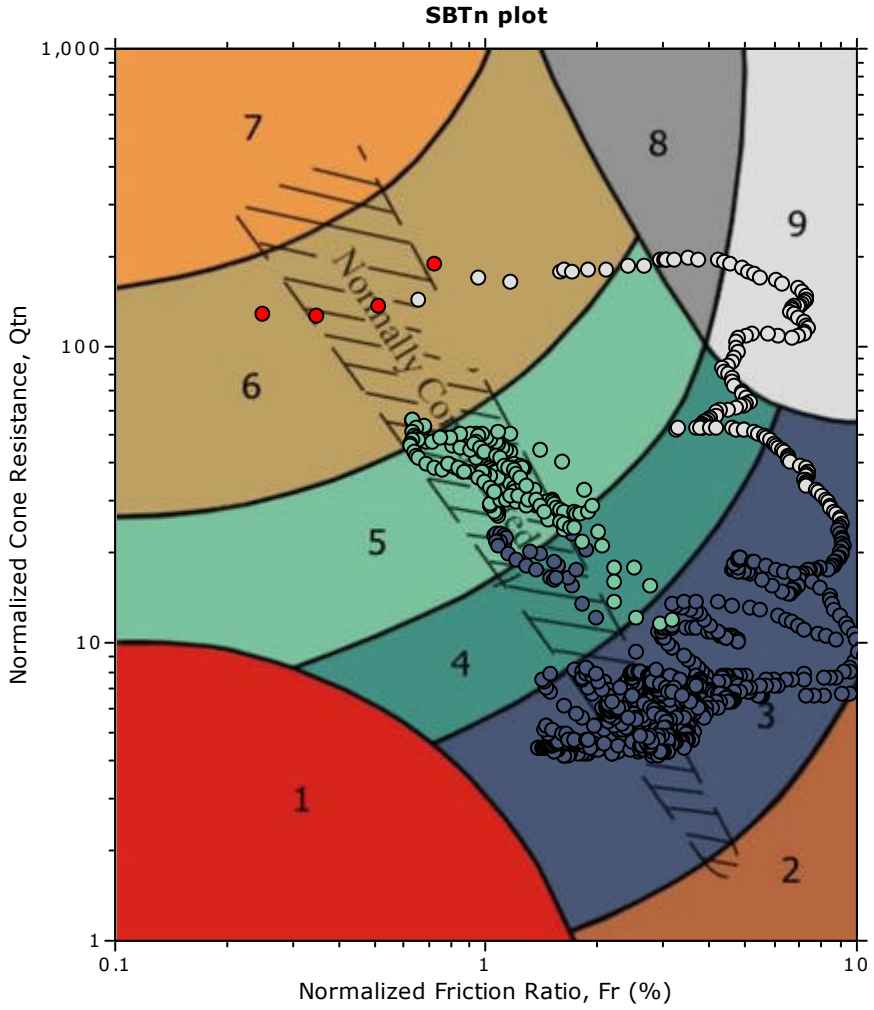
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

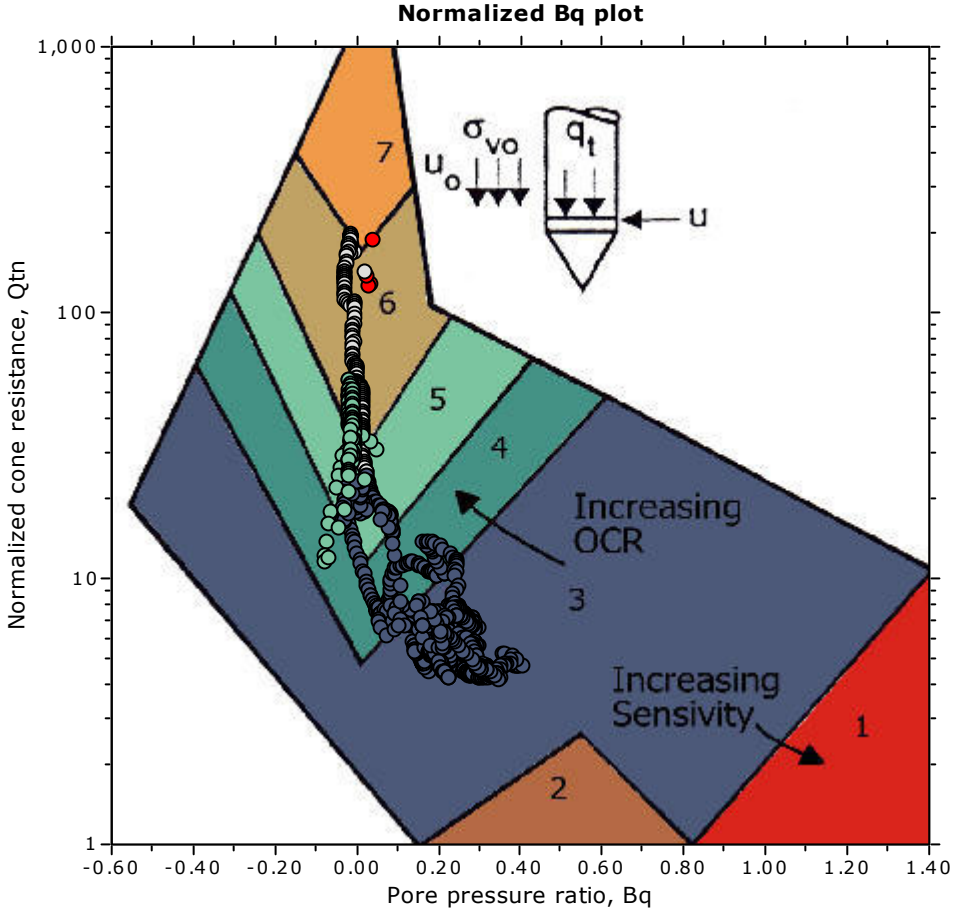
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

SBT - Bq plots (normalized)





SBTn legend

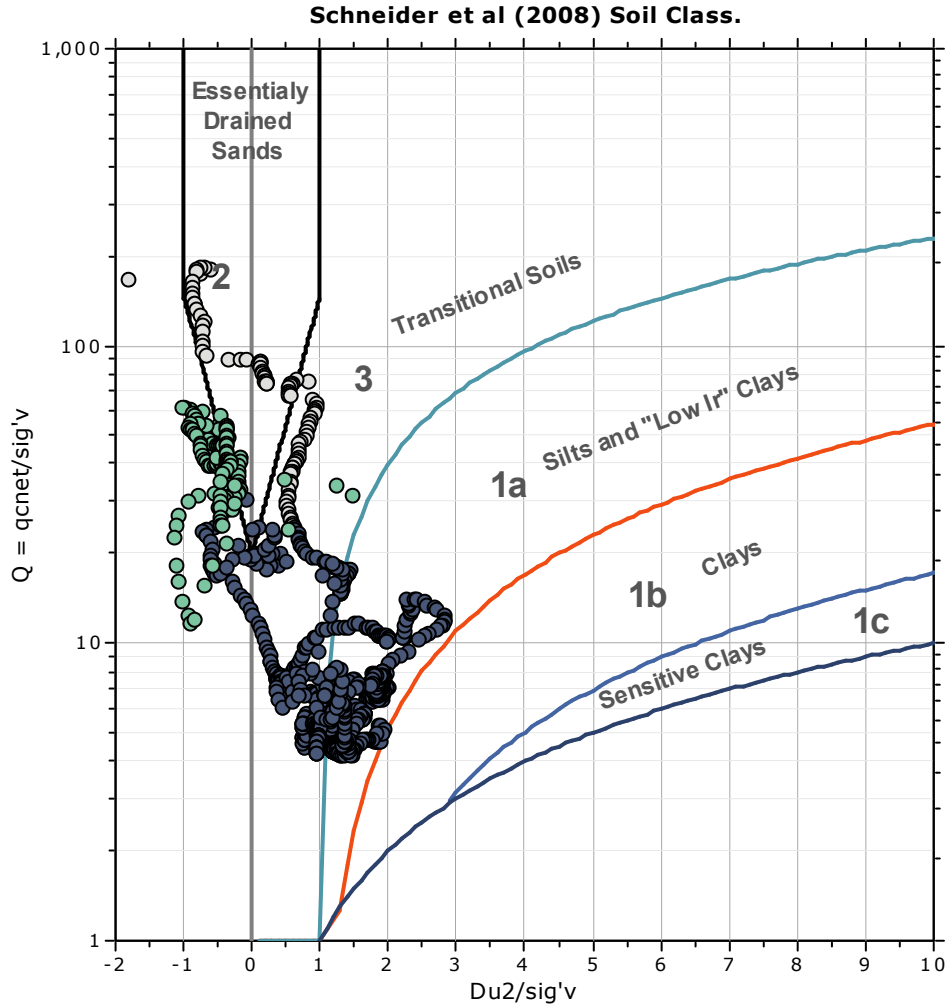
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

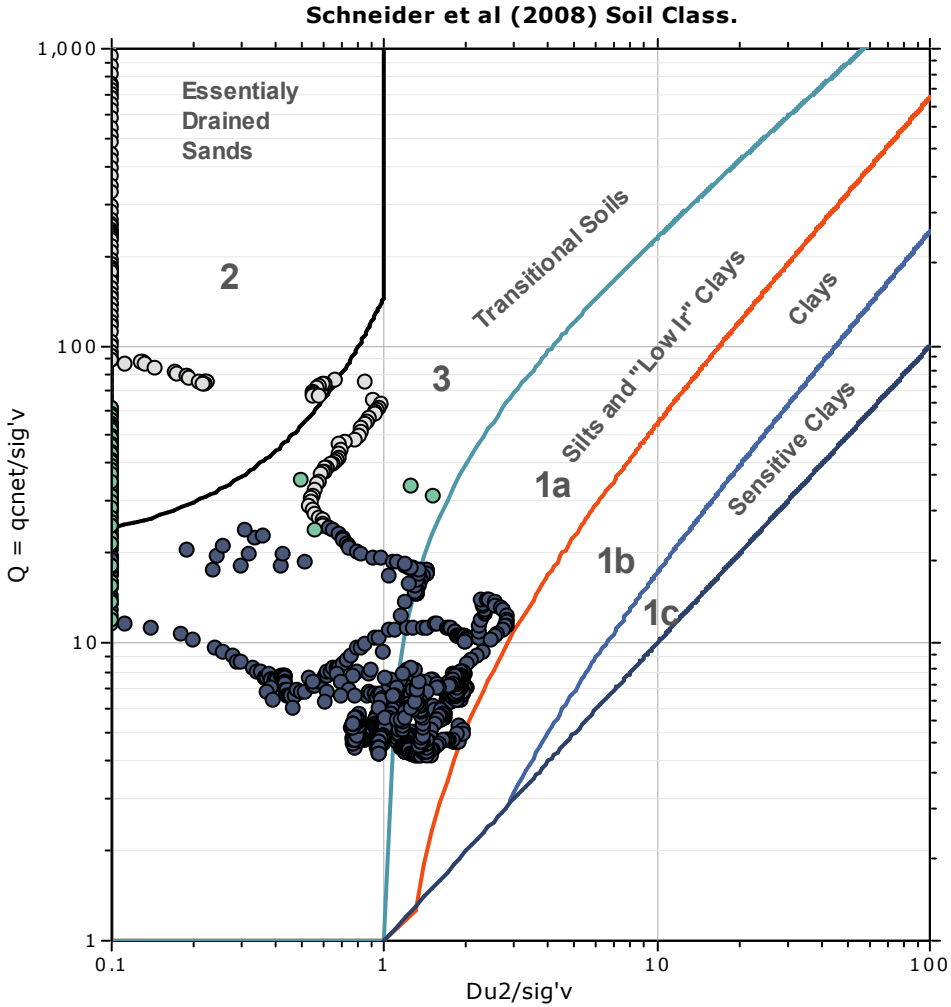
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

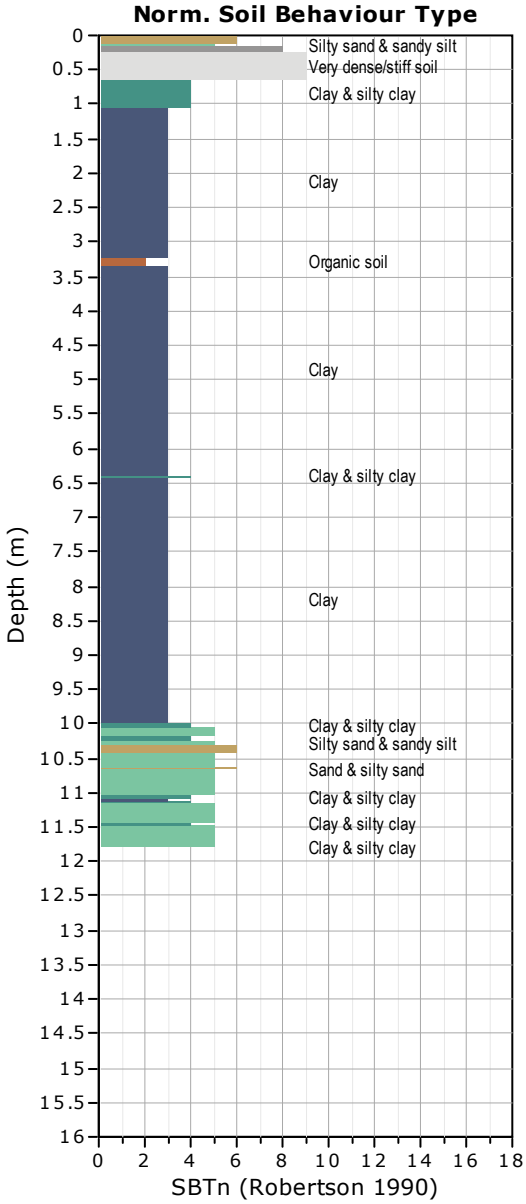


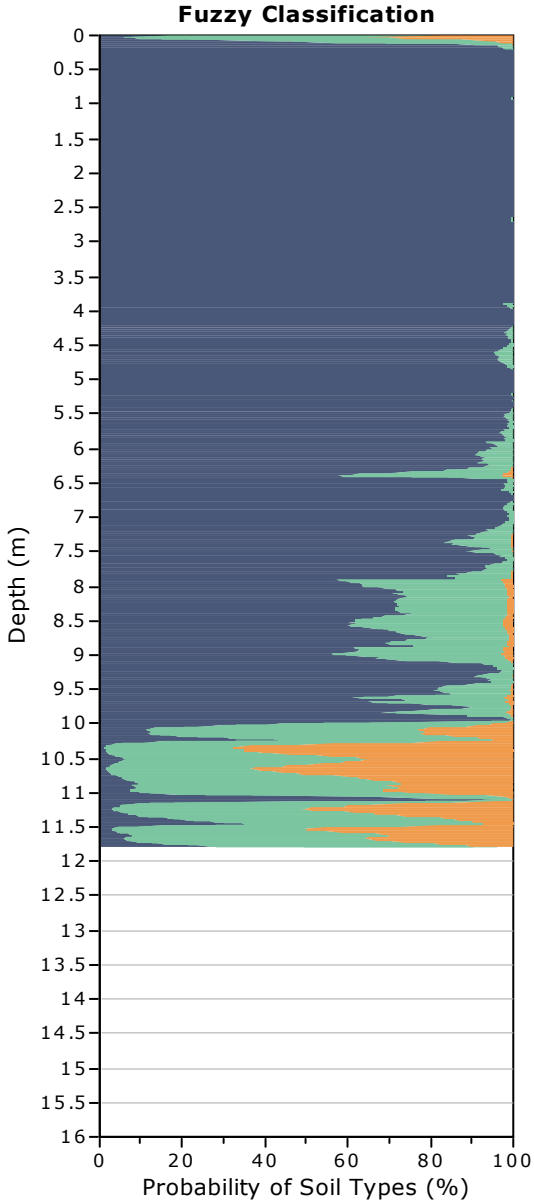


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

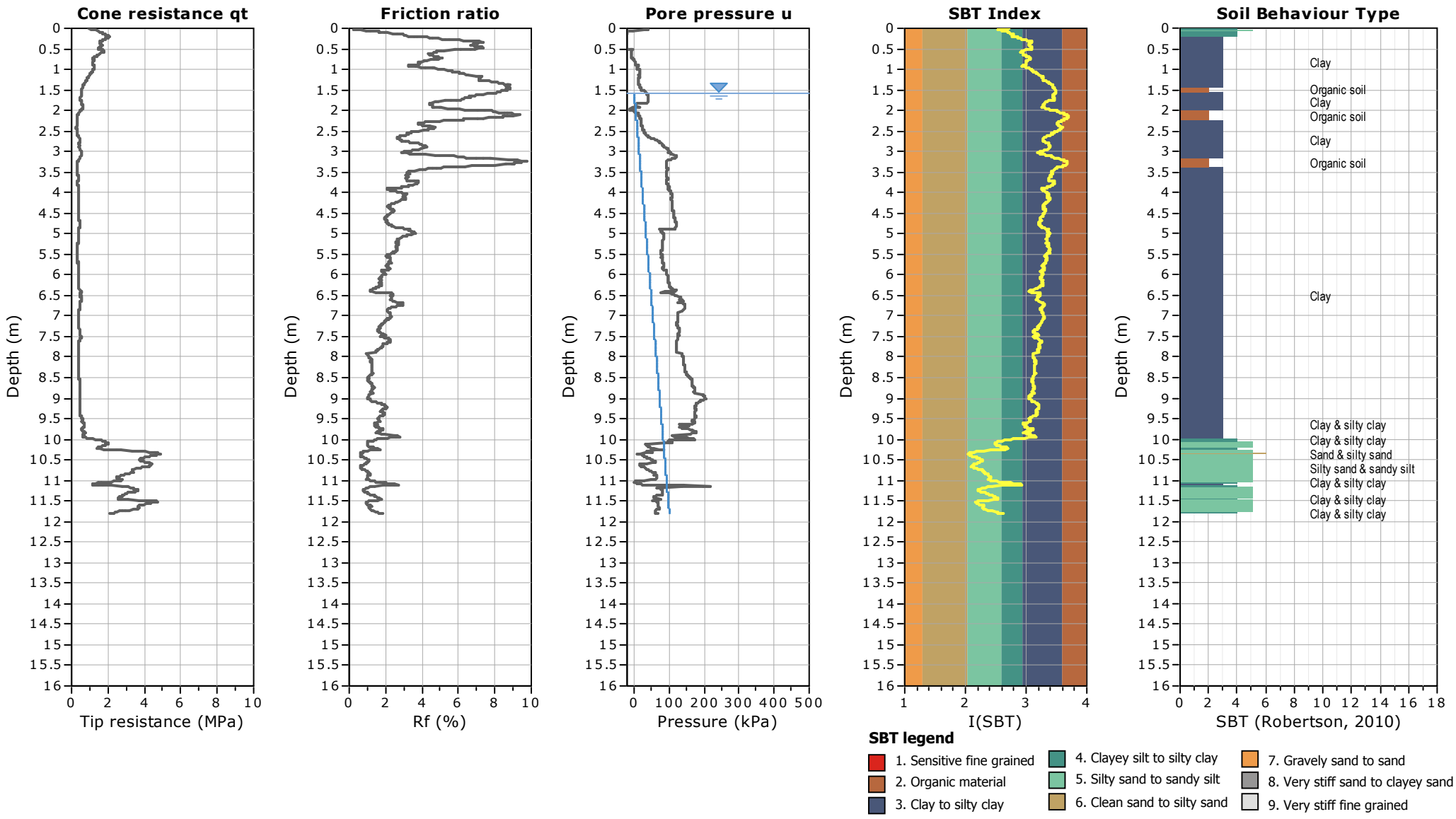




RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

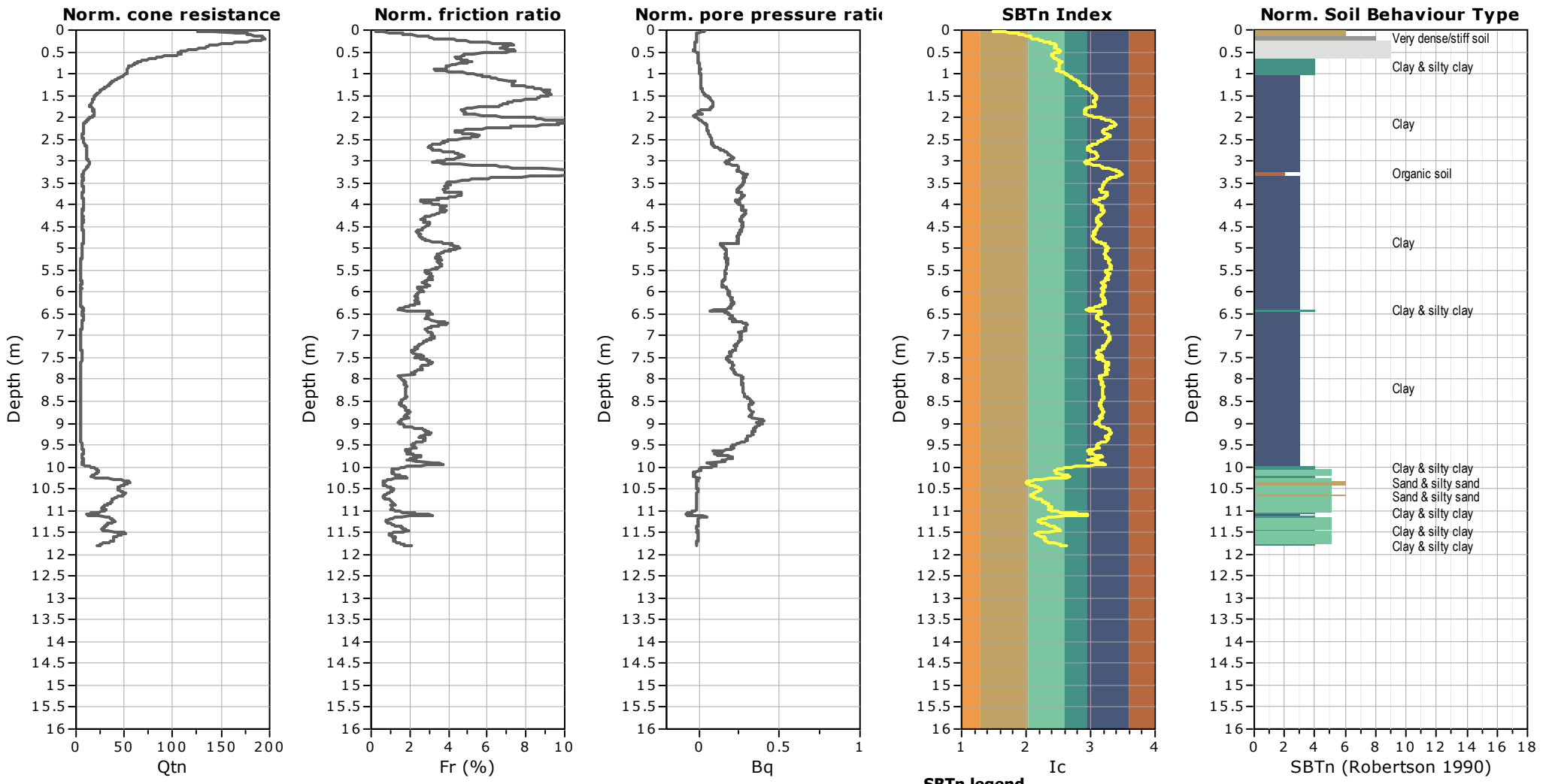
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

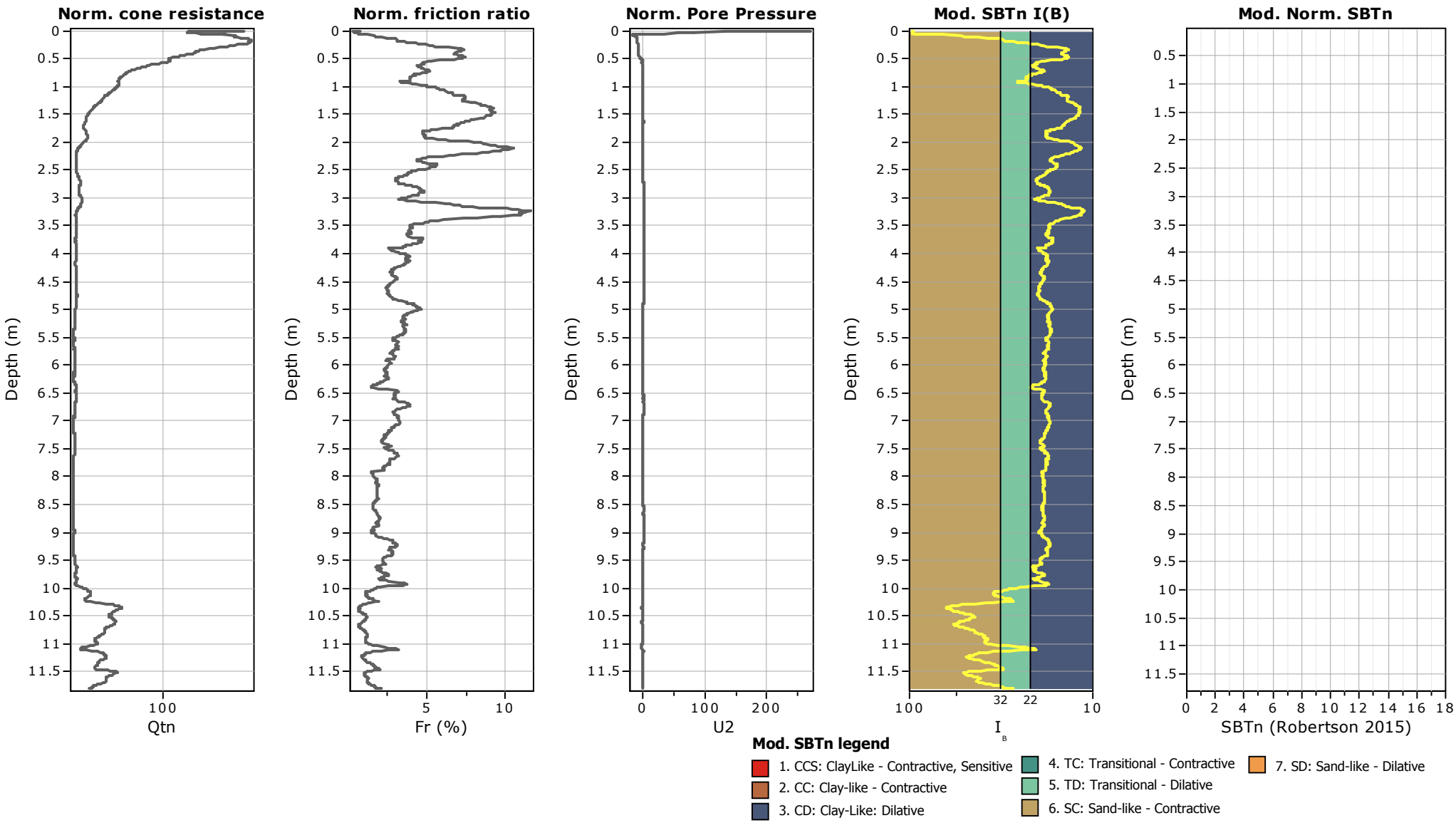
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

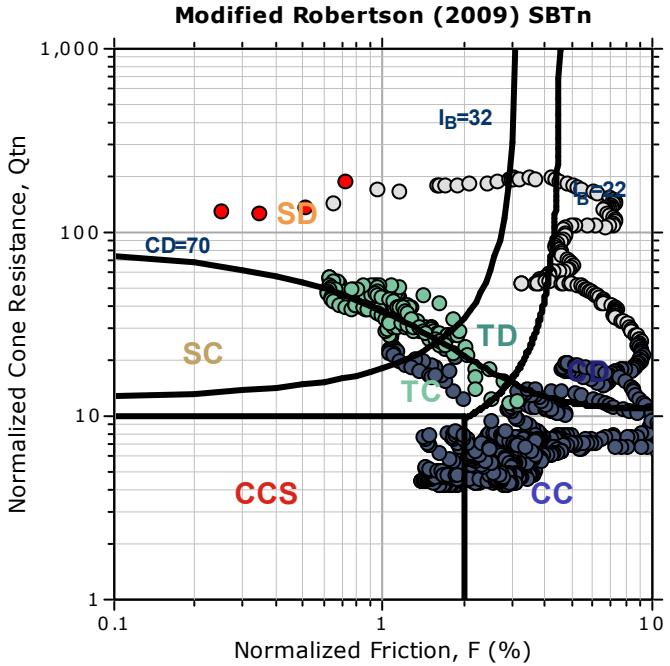


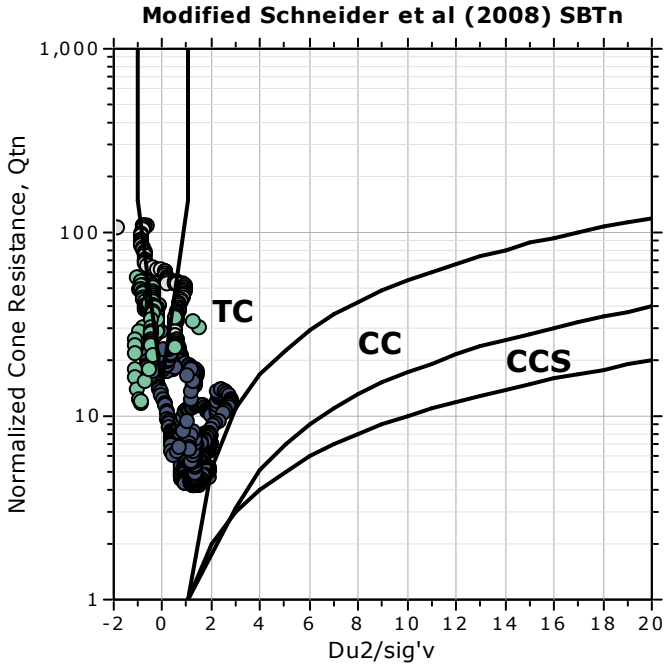
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

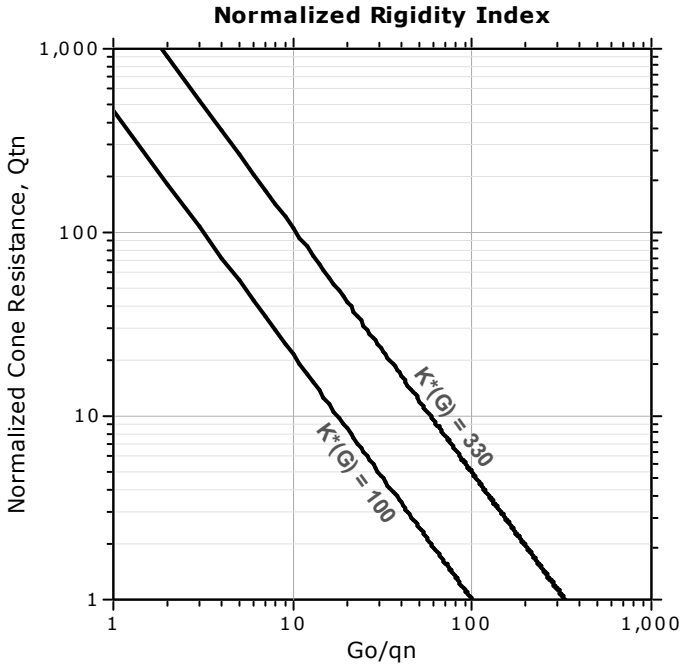
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







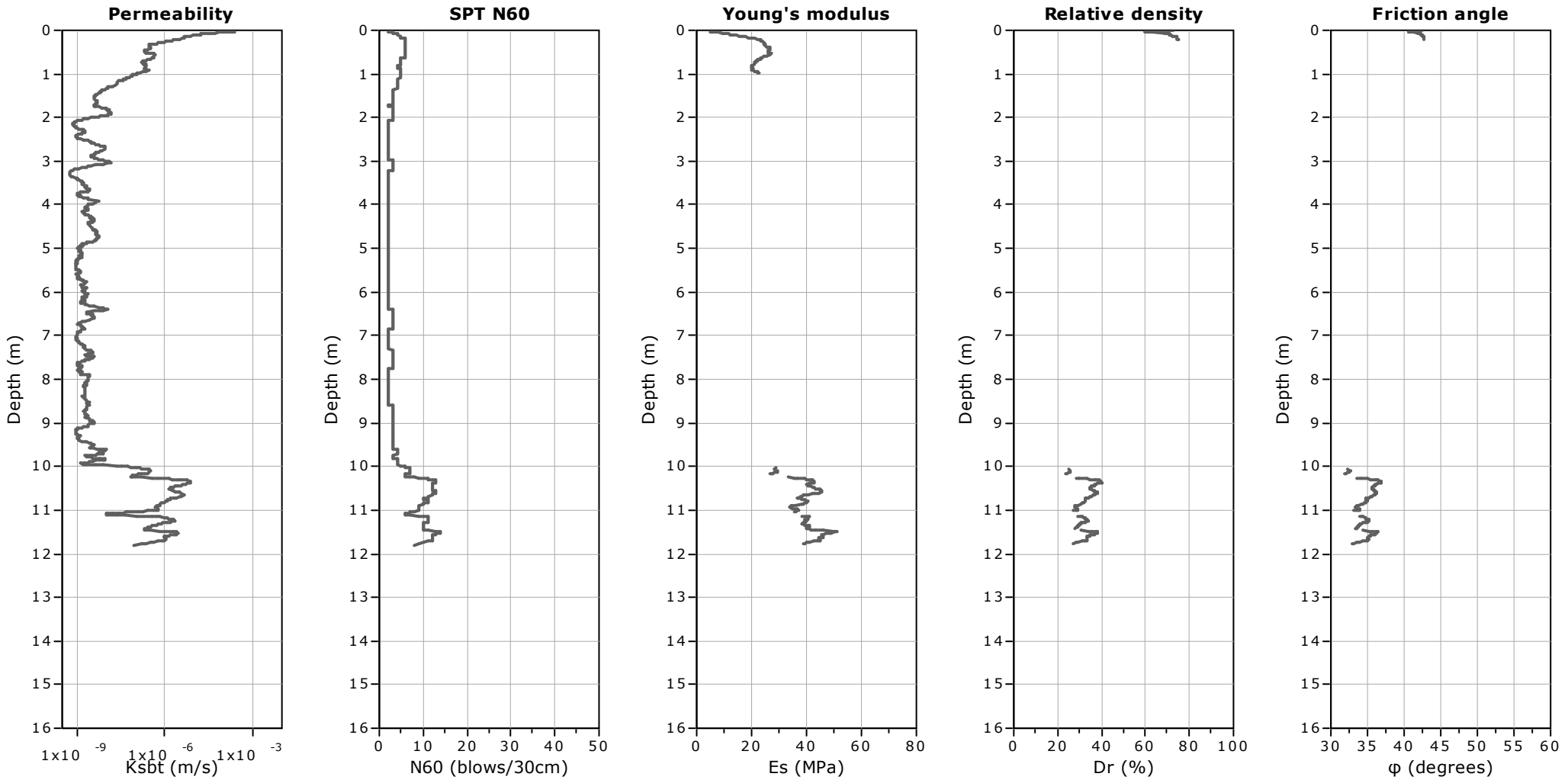
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



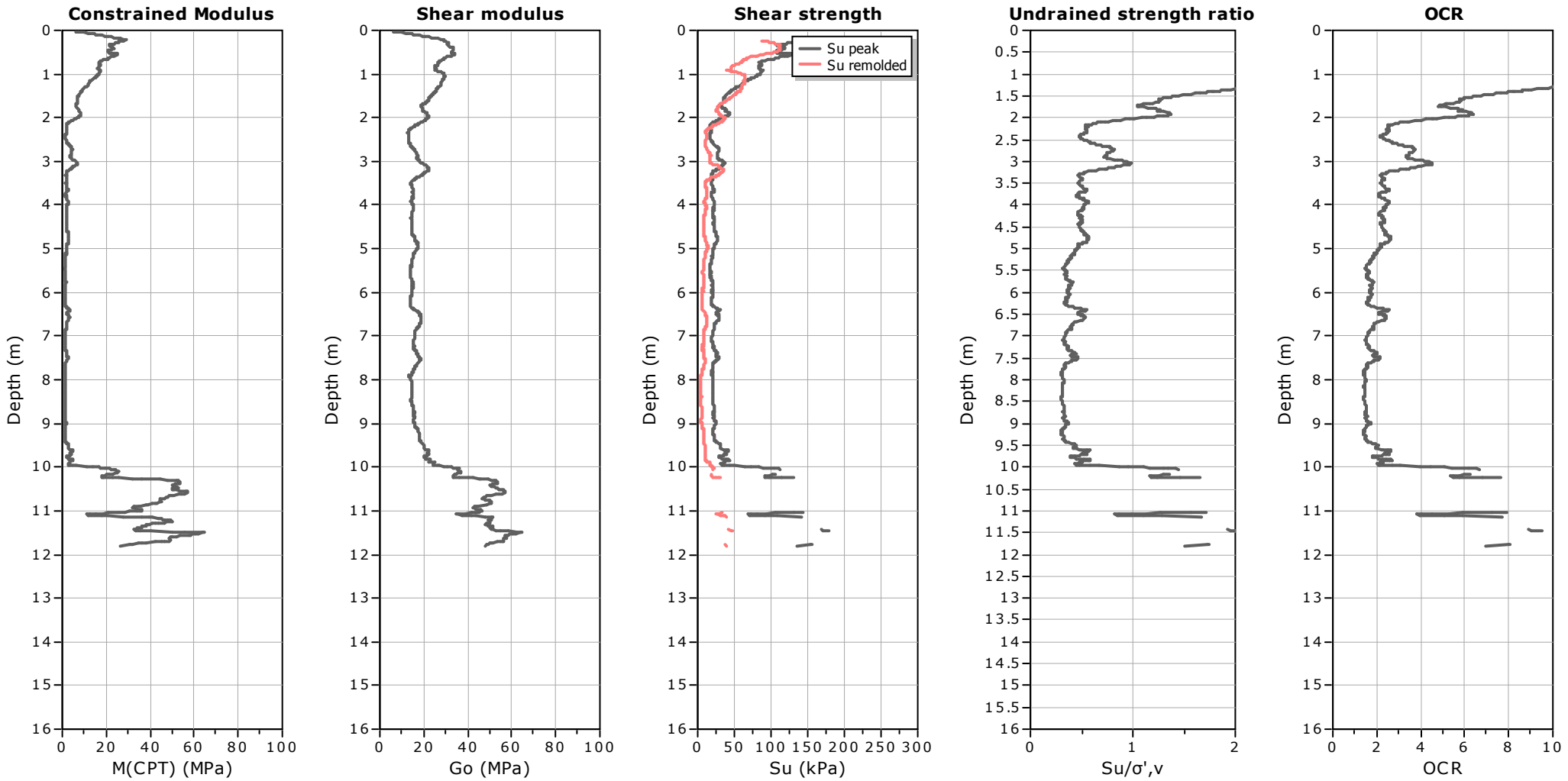
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



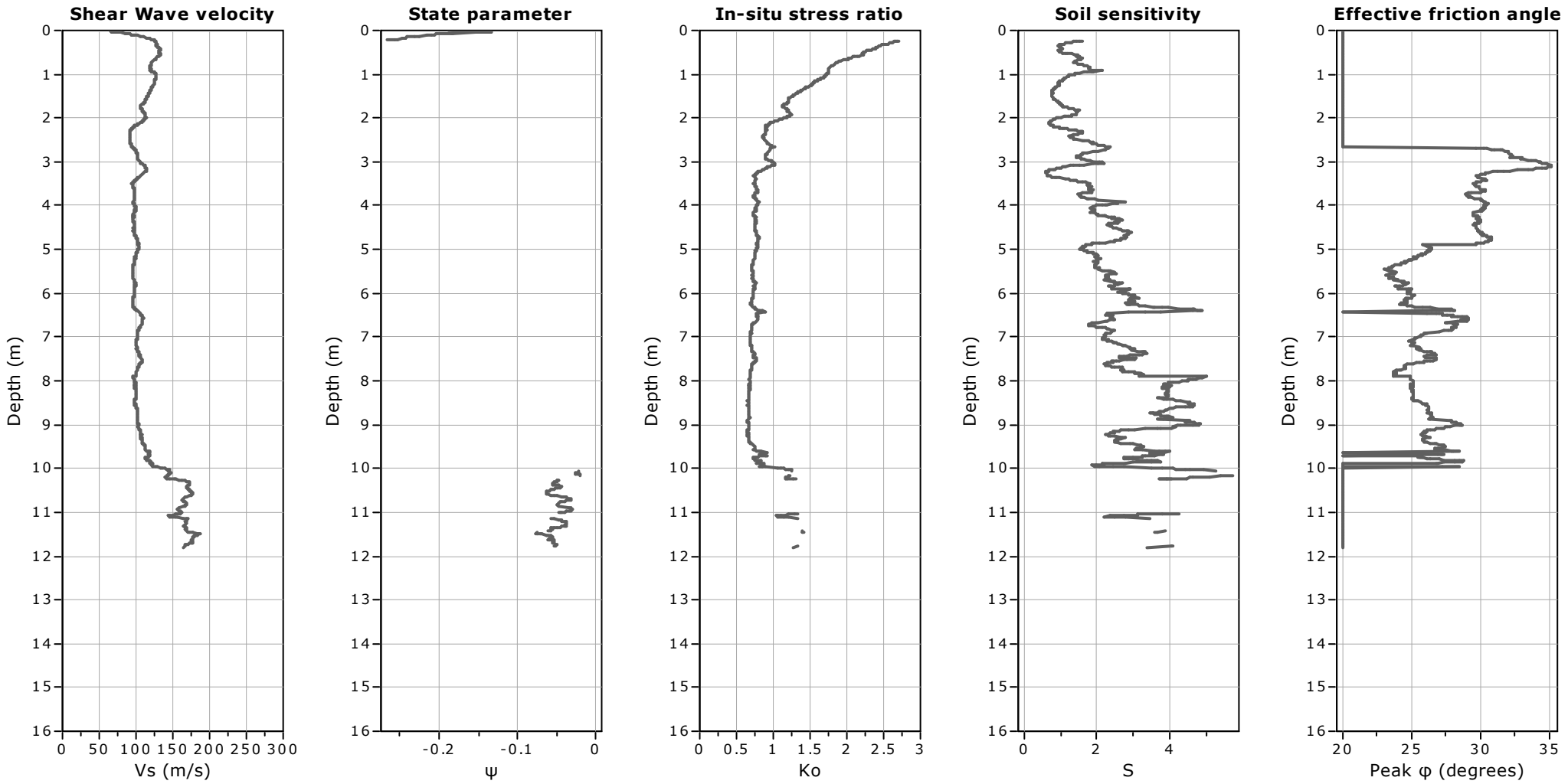
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



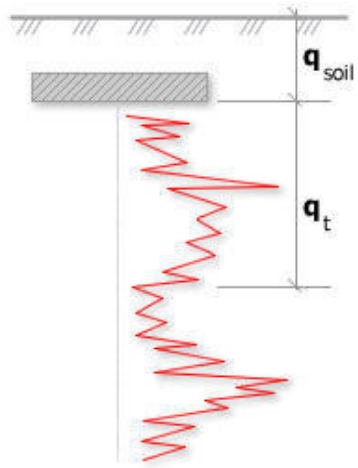
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

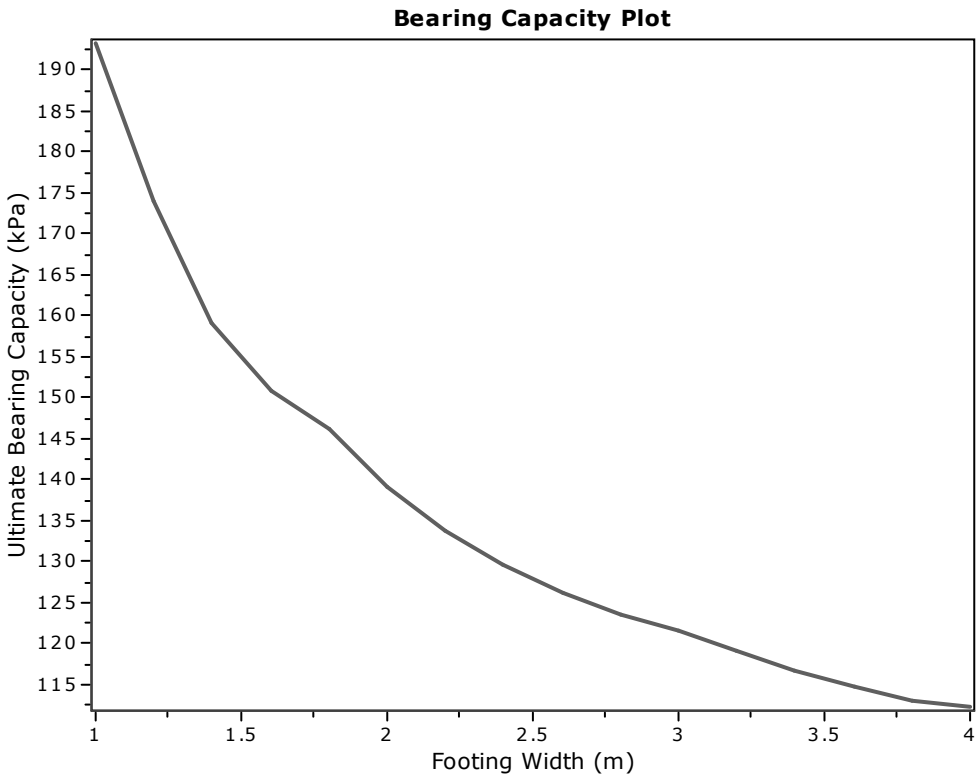
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



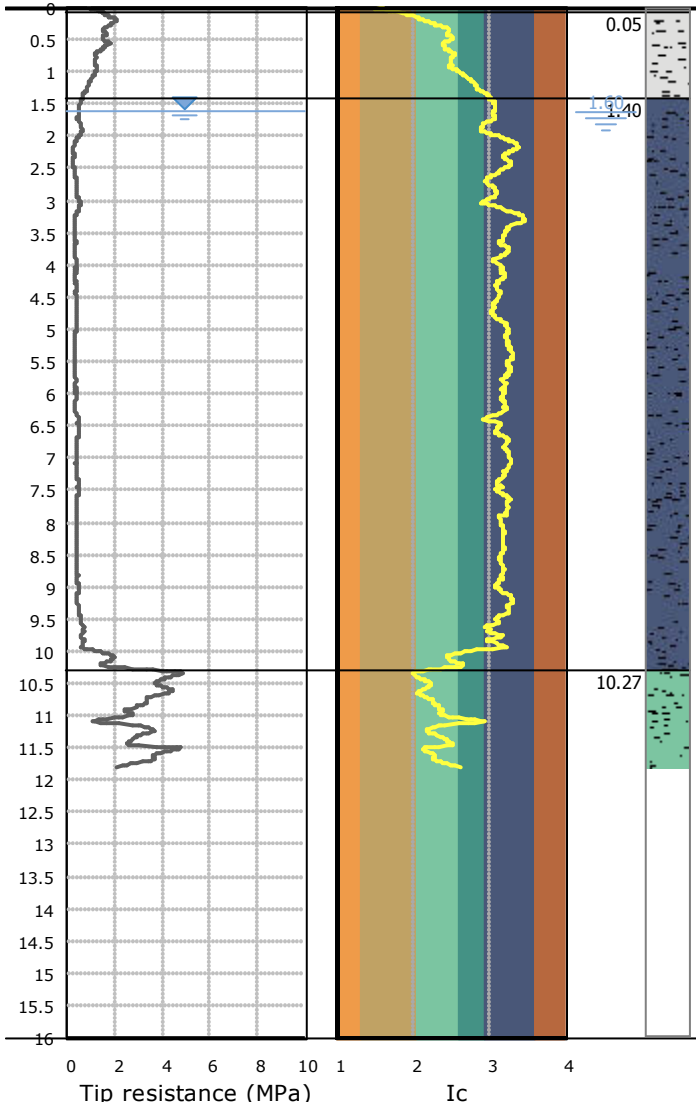
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.92	0.20	9.50	193.19
2	1.20	0.50	2.30	0.82	0.20	9.50	173.86
3	1.40	0.50	2.60	0.75	0.20	9.50	159.20
4	1.60	0.50	2.90	0.71	0.20	9.50	150.78
5	1.80	0.50	3.20	0.68	0.20	9.50	146.07
6	2.00	0.50	3.50	0.65	0.20	9.50	139.11
7	2.20	0.50	3.80	0.62	0.20	9.50	133.63
8	2.40	0.50	4.10	0.60	0.20	9.50	129.62
9	2.60	0.50	4.40	0.58	0.20	9.50	126.12
10	2.80	0.50	4.70	0.57	0.20	9.50	123.46
11	3.00	0.50	5.00	0.56	0.20	9.50	121.55
12	3.20	0.50	5.30	0.55	0.20	9.50	119.12
13	3.40	0.50	5.60	0.54	0.20	9.50	116.59
14	3.60	0.50	5.90	0.53	0.20	9.50	114.72
15	3.80	0.50	6.20	0.52	0.20	9.50	113.12
16	4.00	0.50	6.50	0.51	0.20	9.50	112.30

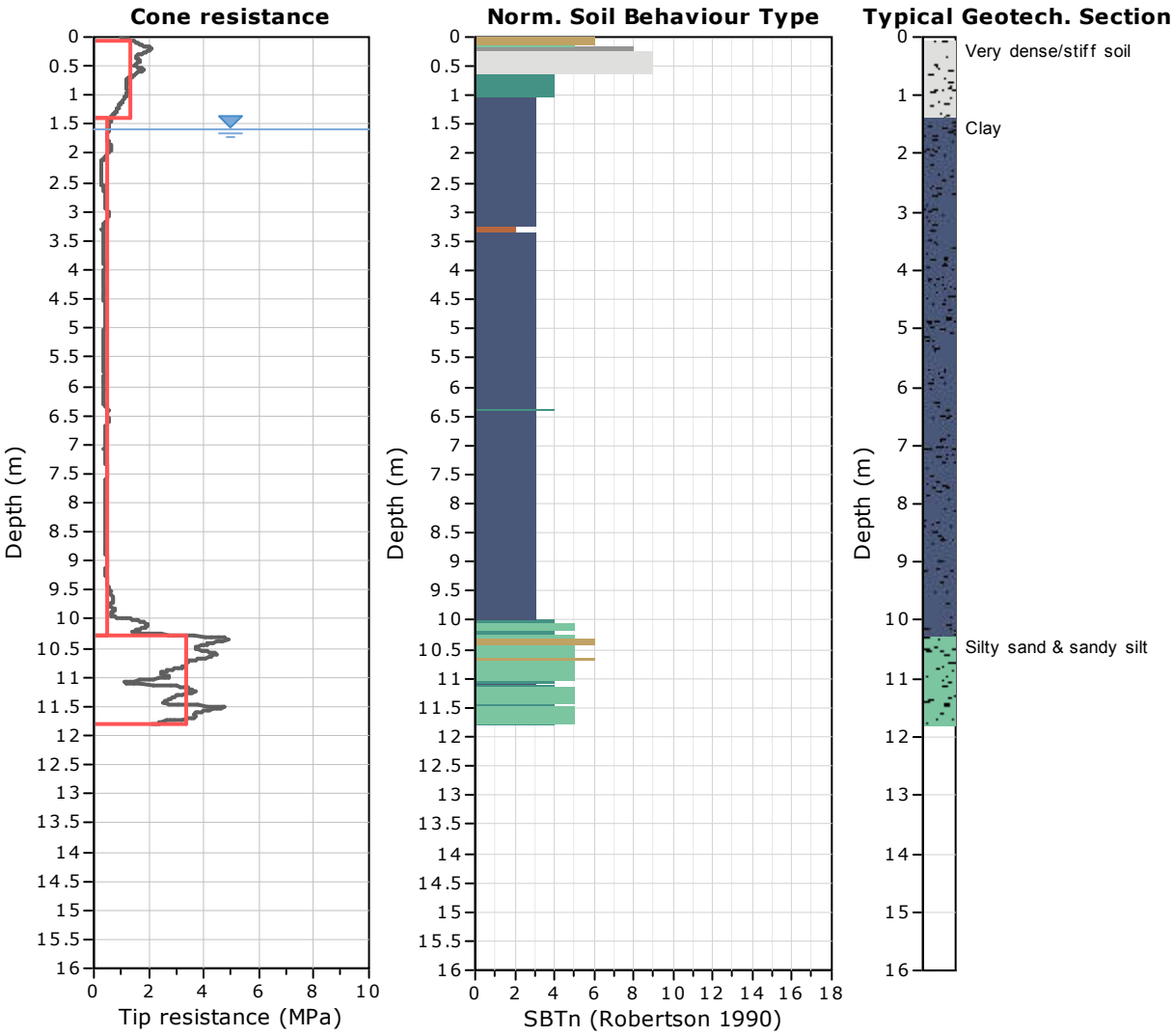
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.3	2.13E-6	4.9	23.5	-	-	18.0	27.7	90.0	5.4	25.2	17.9
Clay	0.5	8.87E-9	2.5	28.9	-	-	3.1	17.2	25.4	0.5	2.4	15.4
Silty sand & sandy silt	3.4	1.64E-6	10.8	41.2	33.2	35.0	43.5	50.9	-	-	-	17.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.05 (m), **End depth:** 1.40 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.34 ±0.37 MPa	Permeability: 2.13E-06 ±8.10E-06 m/s	Constrained Mod.: 17.97 ±5.07 MPa
Sleeve friction: 68.89 ±24.18 kPa	N60: 4.95 ±0.94 blows	Go: 27.75 ±4.41 MPa
SBT_n: 9	Es: 23.54 ±2.35 MPa	Su: 89.97 ±24.76 kPa
SBTn description: Very dense/stiff soil	Dr (%): 0.00 ±0.00	Su ratio: 5.45 ±3.13
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 25.16 ±14.45
	Unit weight: 17.87 ±0.51 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.40 (m), **End depth:** 10.27 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.47 ±0.26 MPa	Permeability: 8.87E-09 ±4.02E-08 m/s	Constrained Mod.: 3.14 ±4.00 MPa
Sleeve friction: 12.68 ±9.18 kPa	N60: 2.55 ±0.96 blows	Go: 17.16 ±4.43 MPa
SBT_n: 3	Es: 28.91 ±2.70 MPa	Su: 25.43 ±12.02 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.53 ±0.28
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.44 ±1.29
	Unit weight: 15.39 ±0.69 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 10.27 (m), **End depth:** 11.80 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.36 ±0.83 MPa	Permeability: 1.64E-06 ±1.63E-06 m/s	Constrained Mod.: 43.46 ±10.55 MPa
Sleeve friction: 34.48 ±6.88 kPa	N60: 10.83 ±1.70 blows	Go: 50.87 ±5.28 MPa
SBT_n: 5	Es: 41.23 ±3.61 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 33.22 ±3.42	Su ratio: 0.00 ±0.00
	φ (degrees): 35.00 ±0.99 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.49 ±0.27 kN/m³	

RDR SrL
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rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

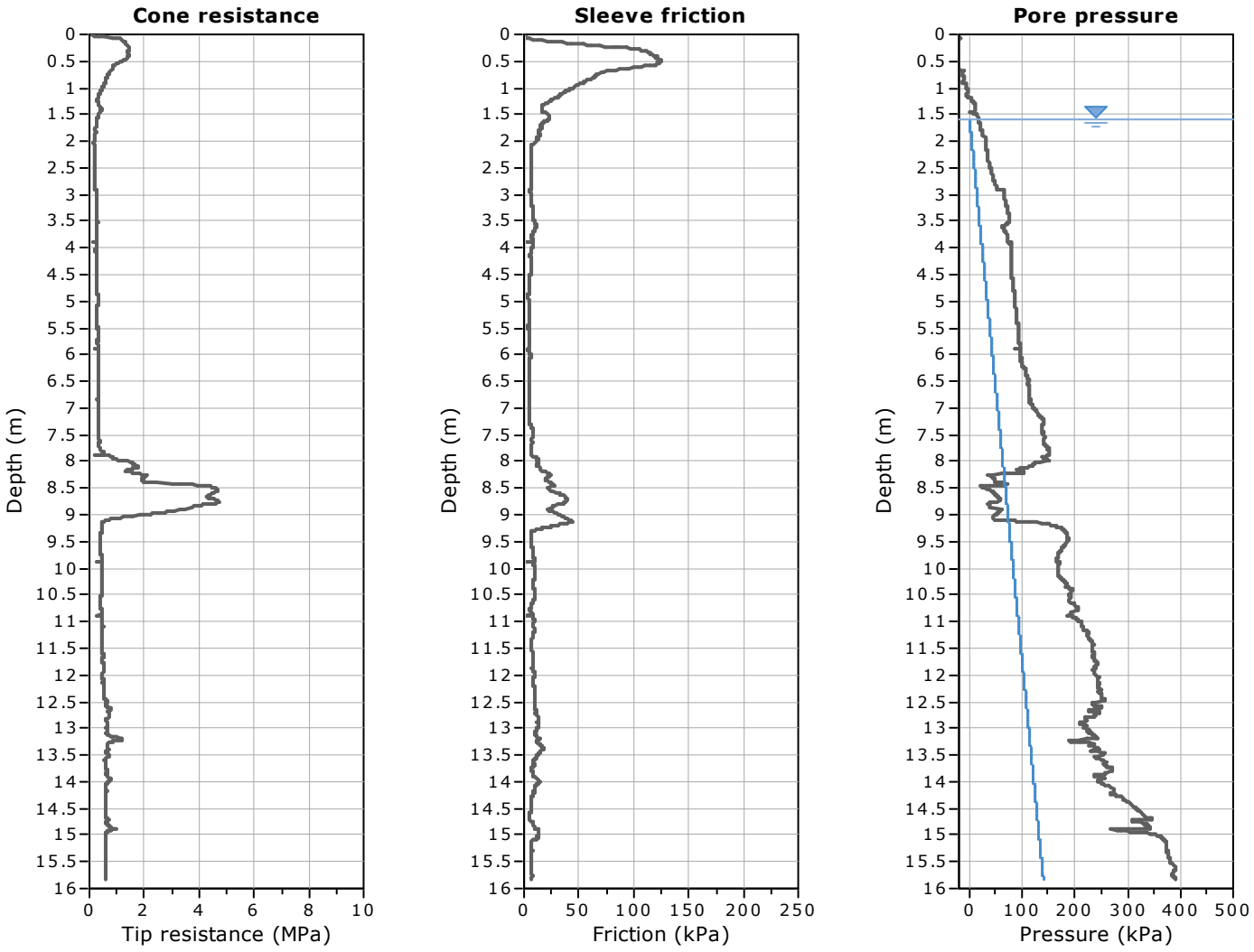
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.05	1.35	2.13E-06	4.9	23.5	0.0	0.0	18.0	27.7	90.0	5.4	25.2	17.9
1.40		(±8.10E-06)	(±0.9)	(±2.3)	(±0.0)	(±0.0)	(±5.1)	(±4.4)	(±24.8)	(±3.1)	(±14.4)	(±0.5)
1.40	8.87	8.87E-09	2.5	28.9	0.0	0.0	3.1	17.2	25.4	0.5	2.4	15.4
10.27		(±4.02E-08)	(±1.0)	(±2.7)	(±0.0)	(±0.0)	(±4.0)	(±4.4)	(±12.0)	(±0.3)	(±1.3)	(±0.7)
10.27	1.53	1.64E-06	10.8	41.2	33.2	35.0	43.5	50.9	0.0	0.0	0.0	17.5
11.80		(±1.63E-06)	(±1.7)	(±3.6)	(±3.4)	(±1.0)	(±10.6)	(±5.3)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

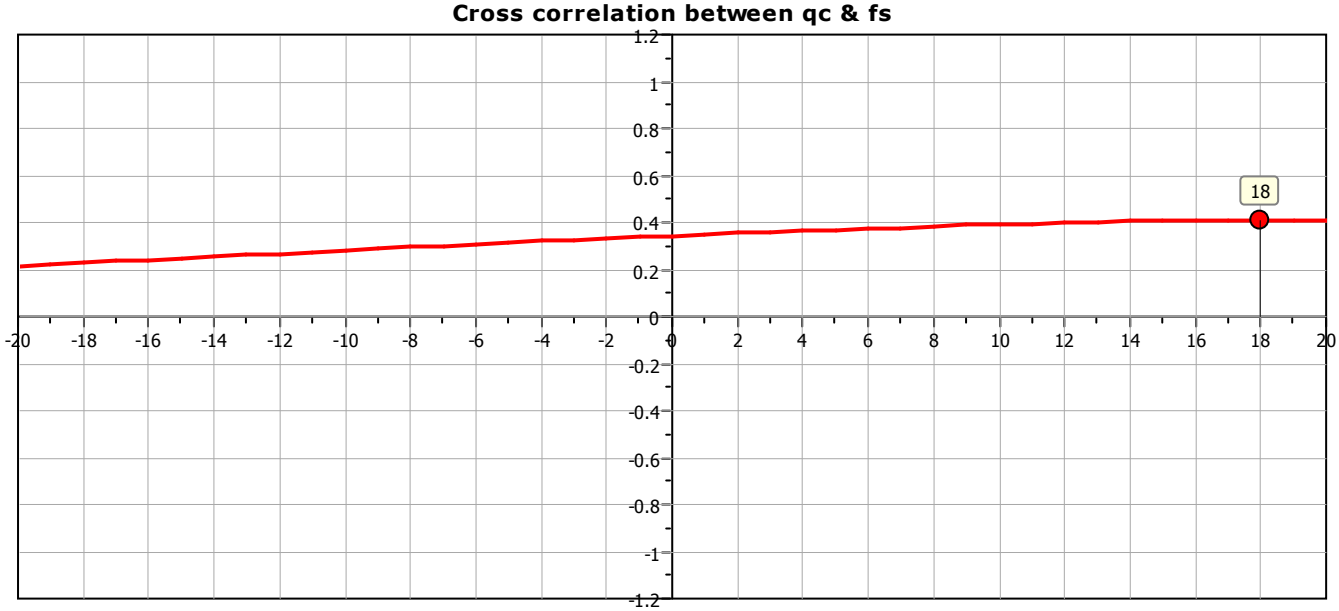
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

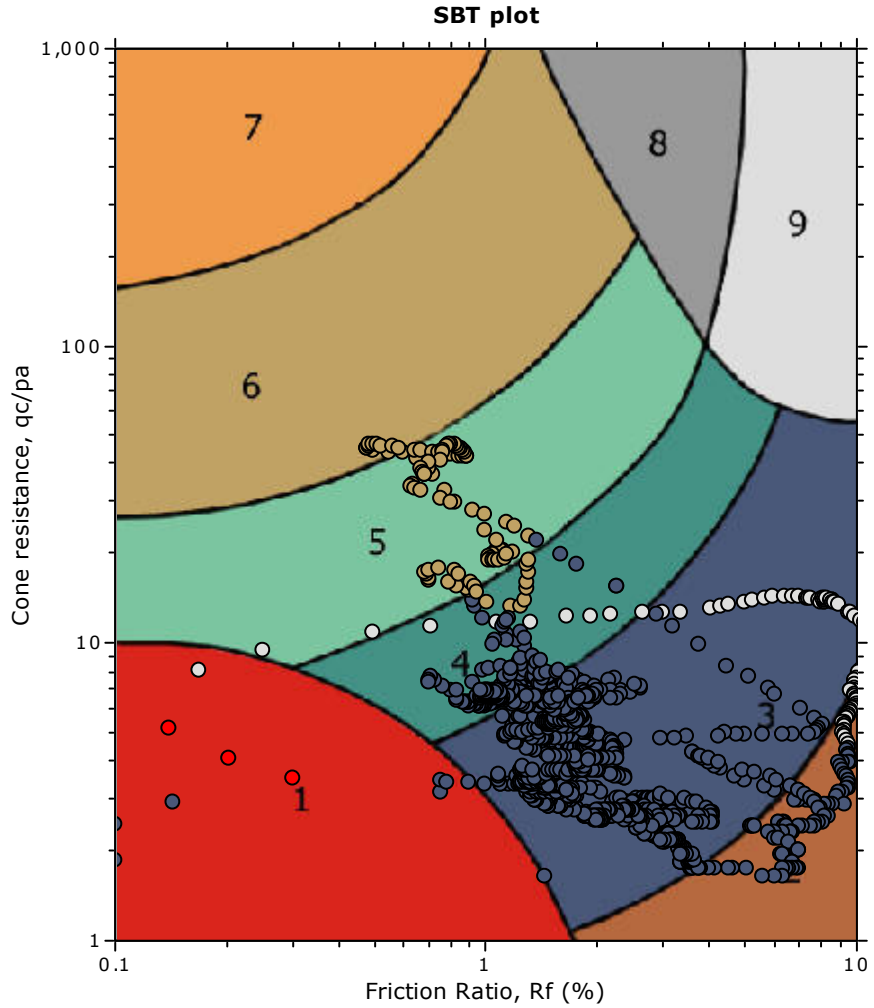


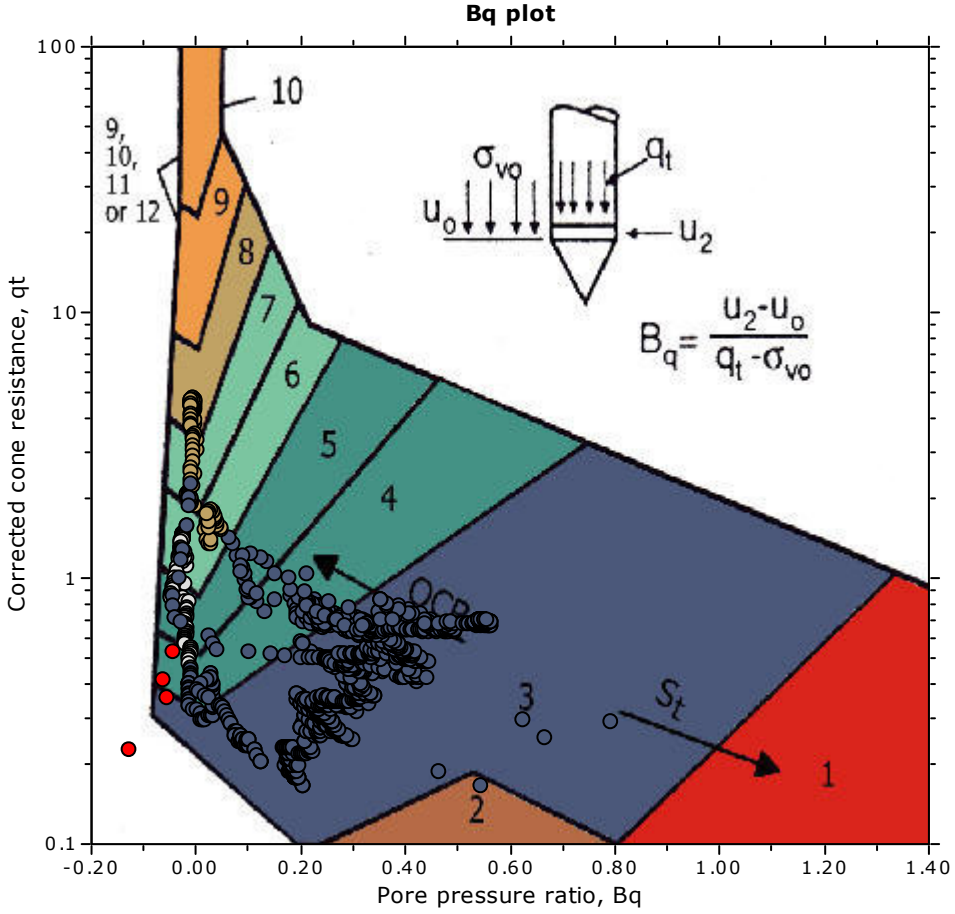
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

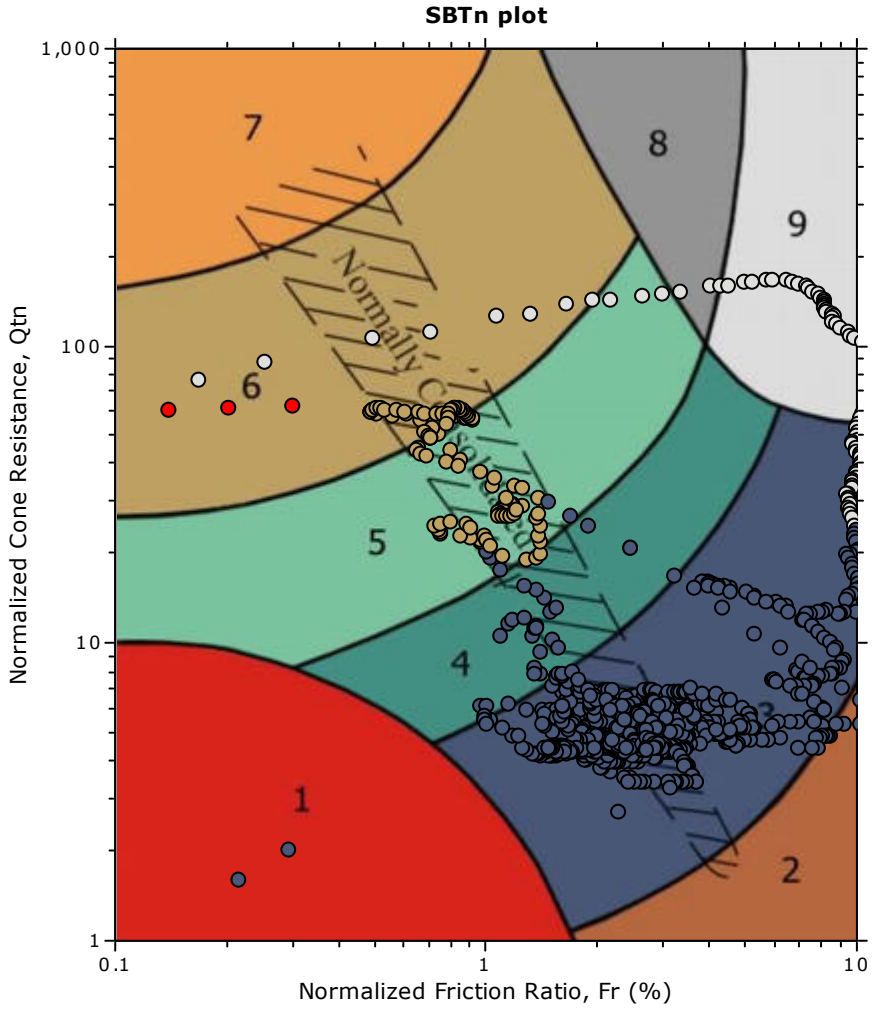
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

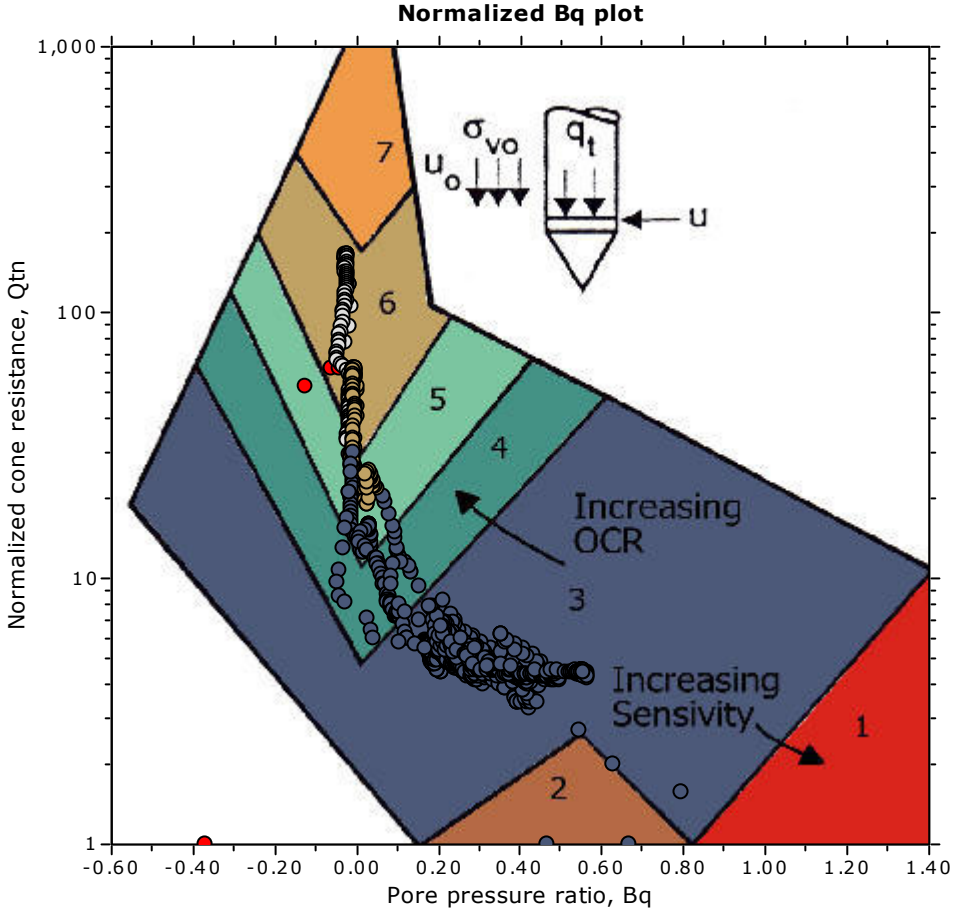
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

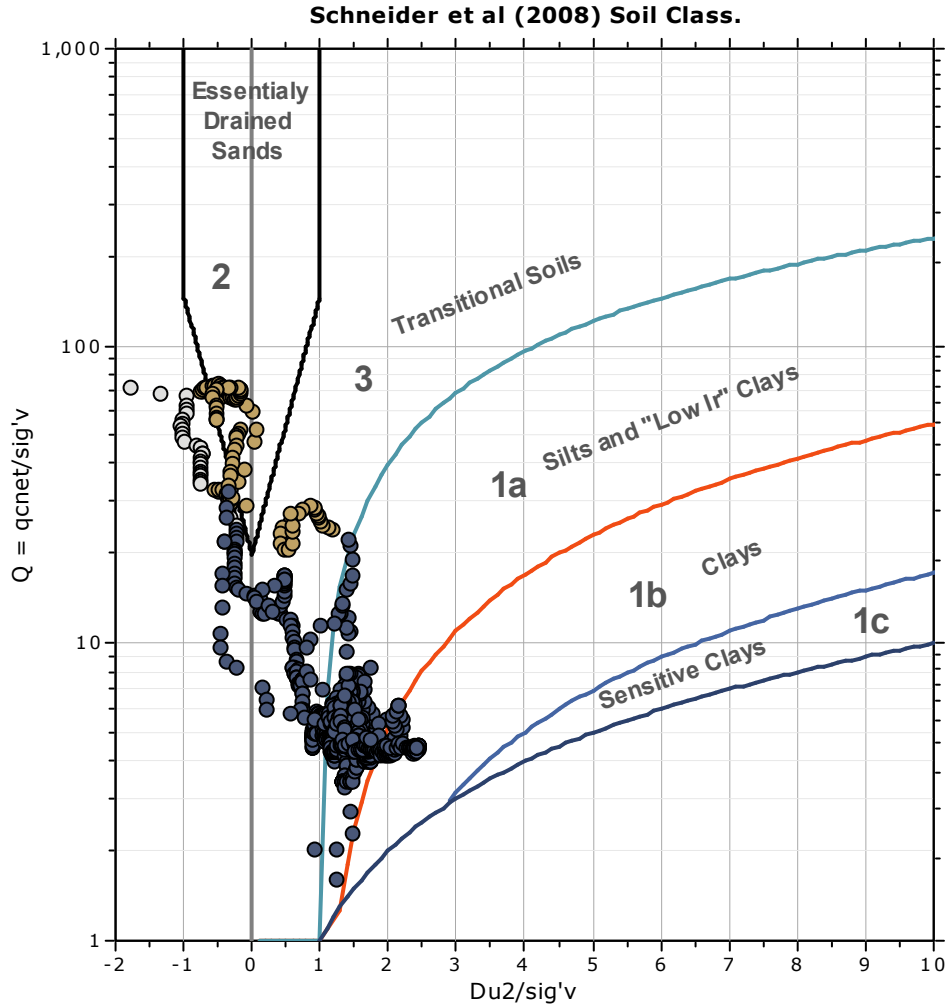
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

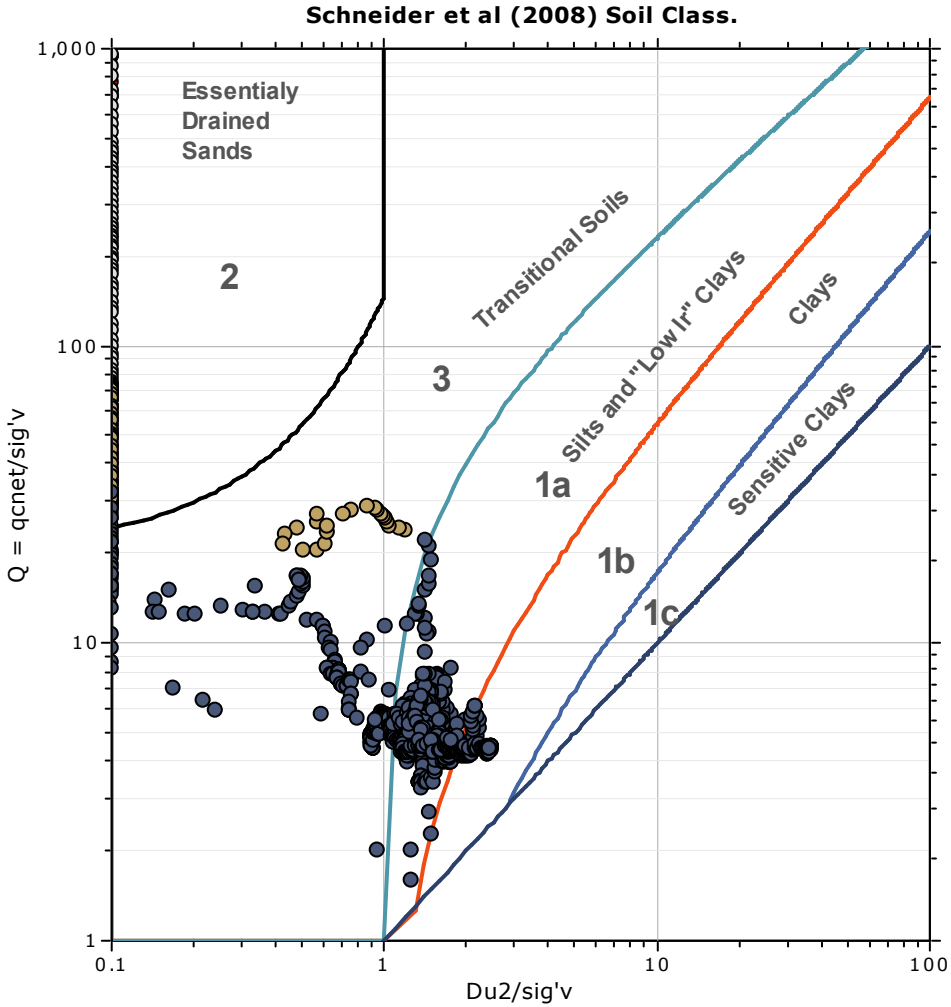
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

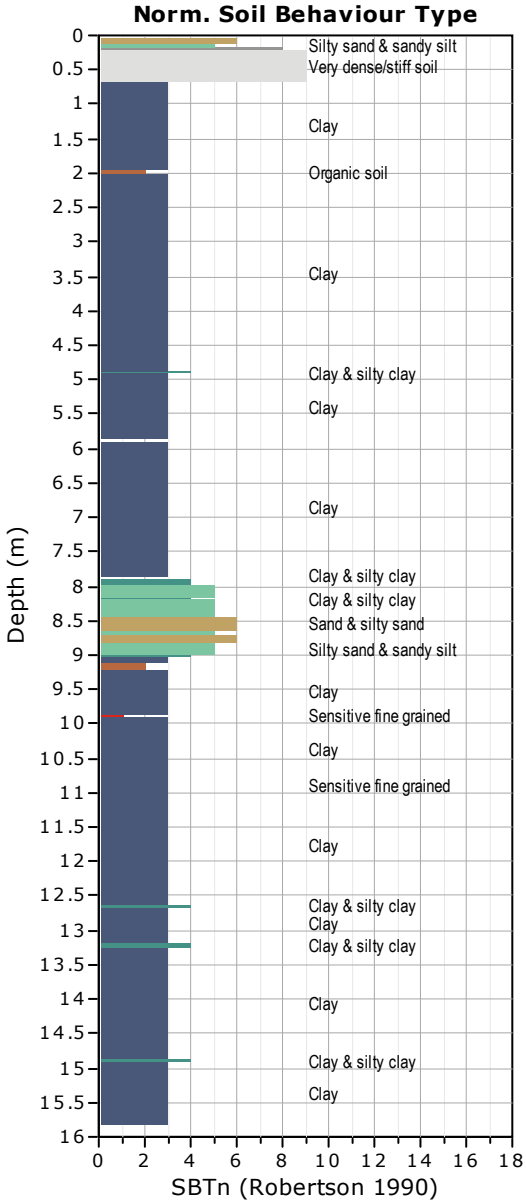


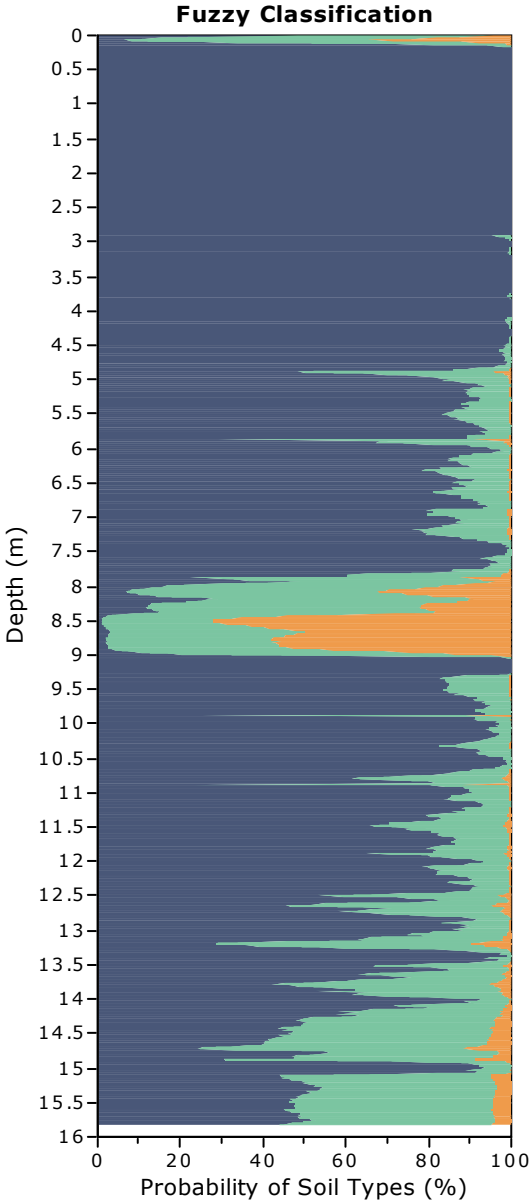


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

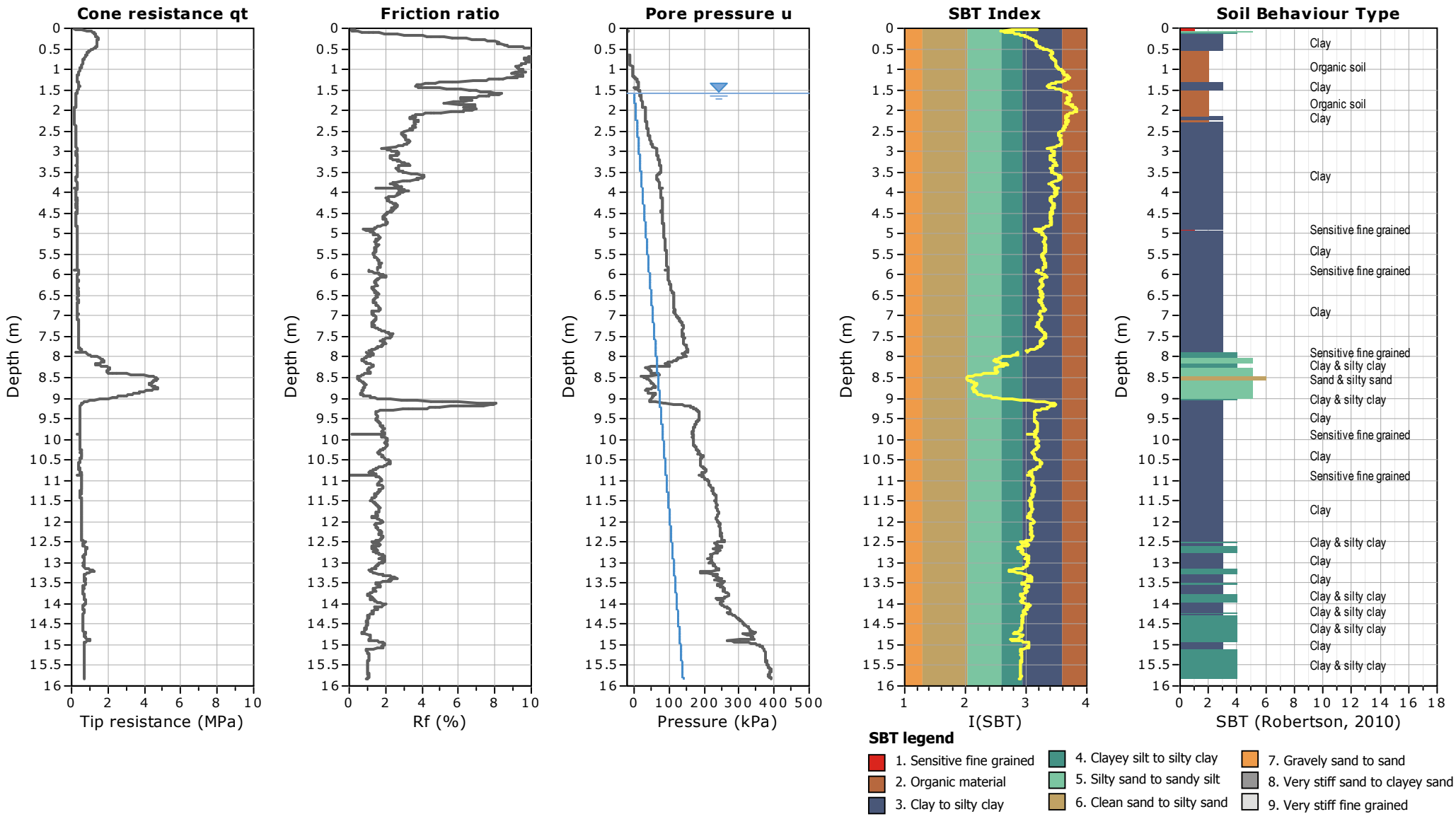




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

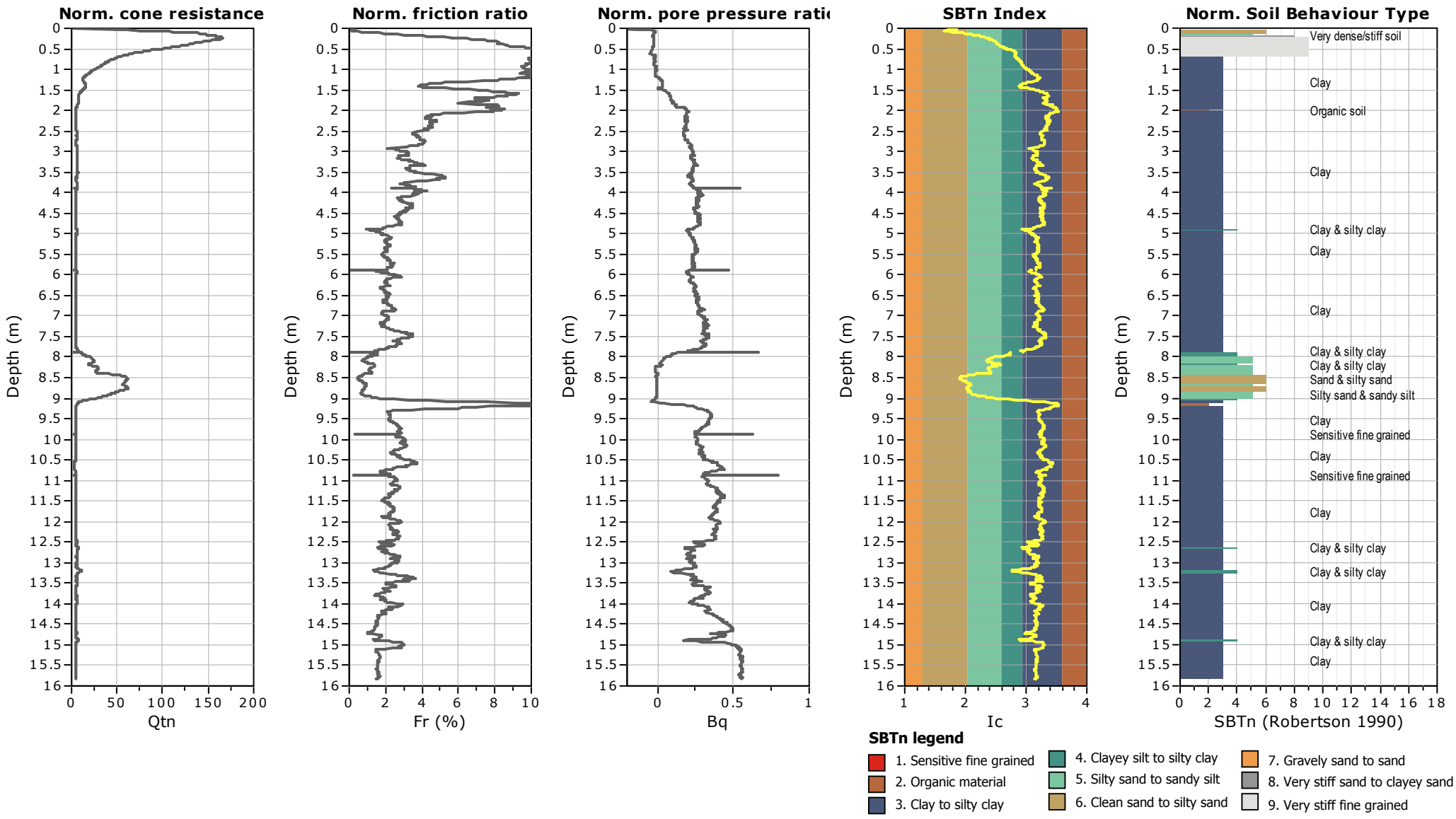
CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

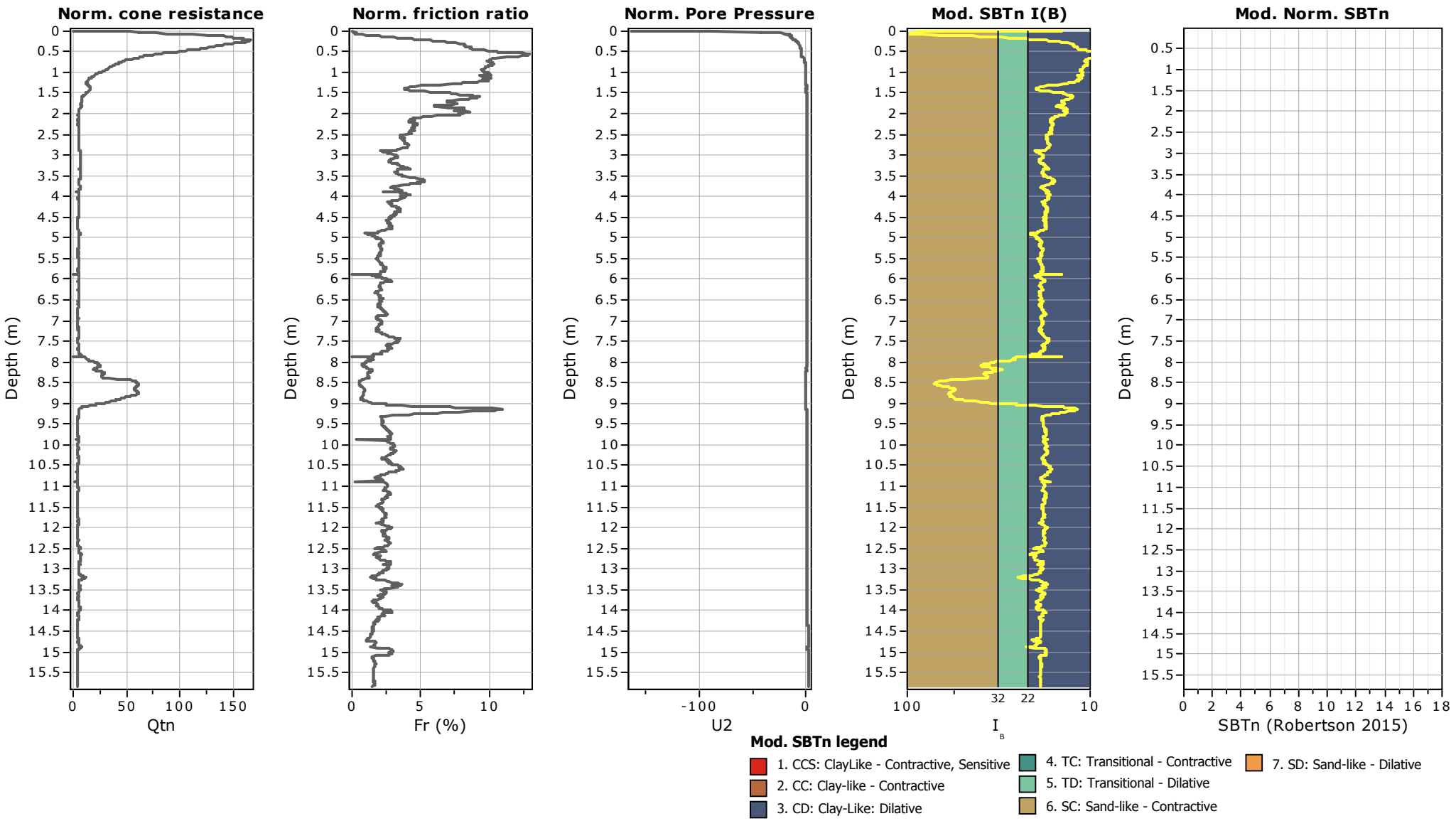
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

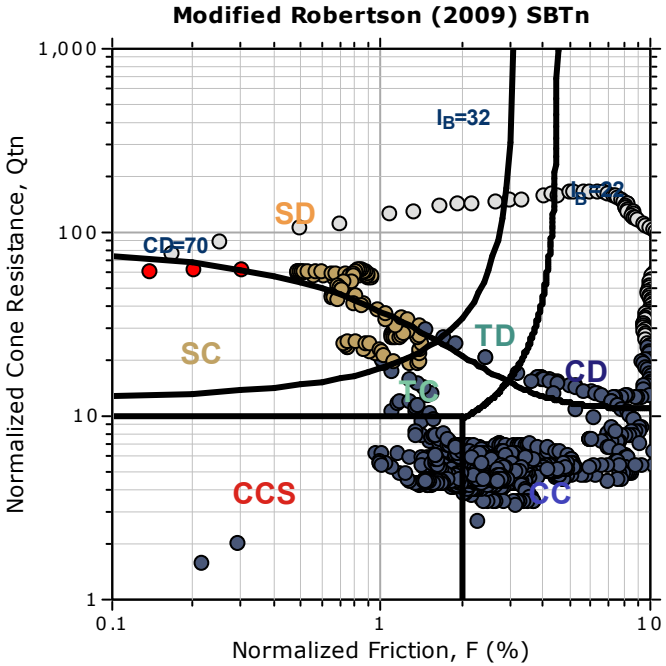


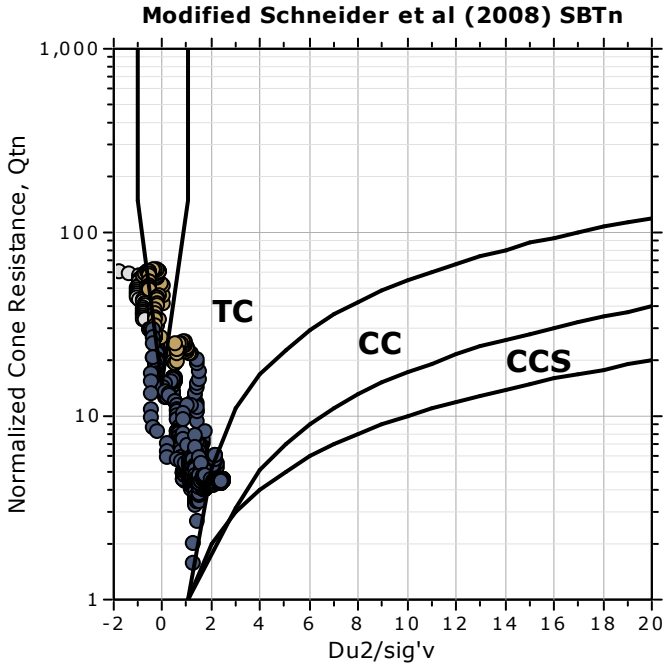
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

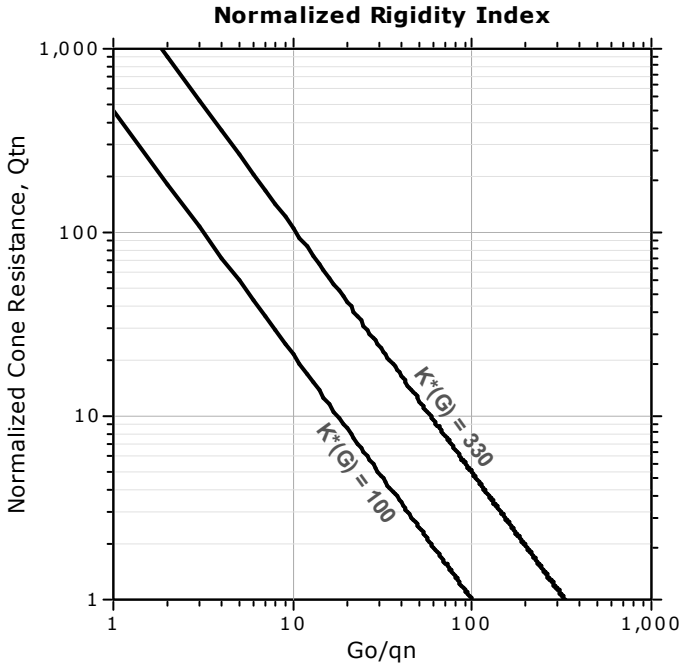
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







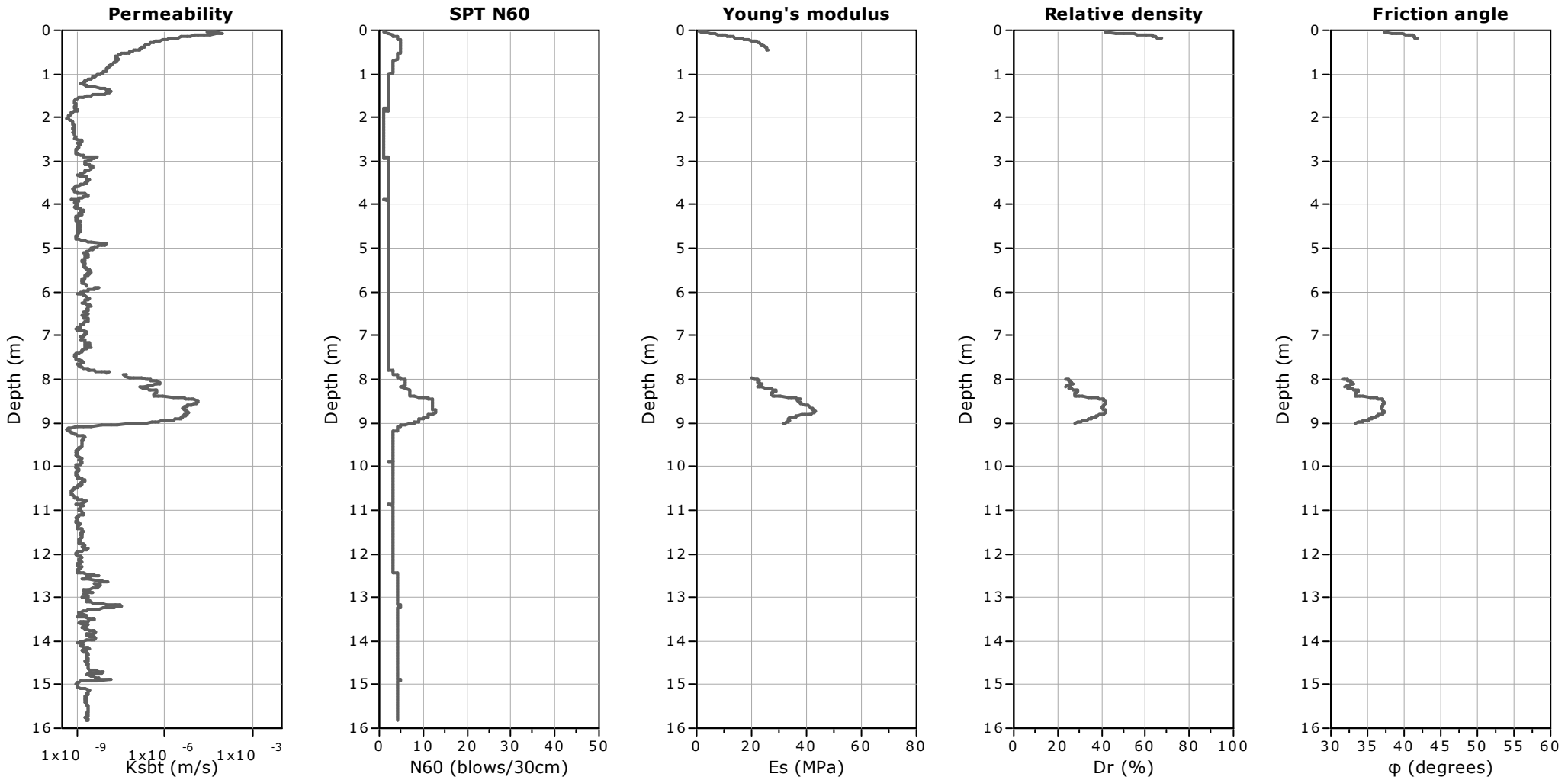
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



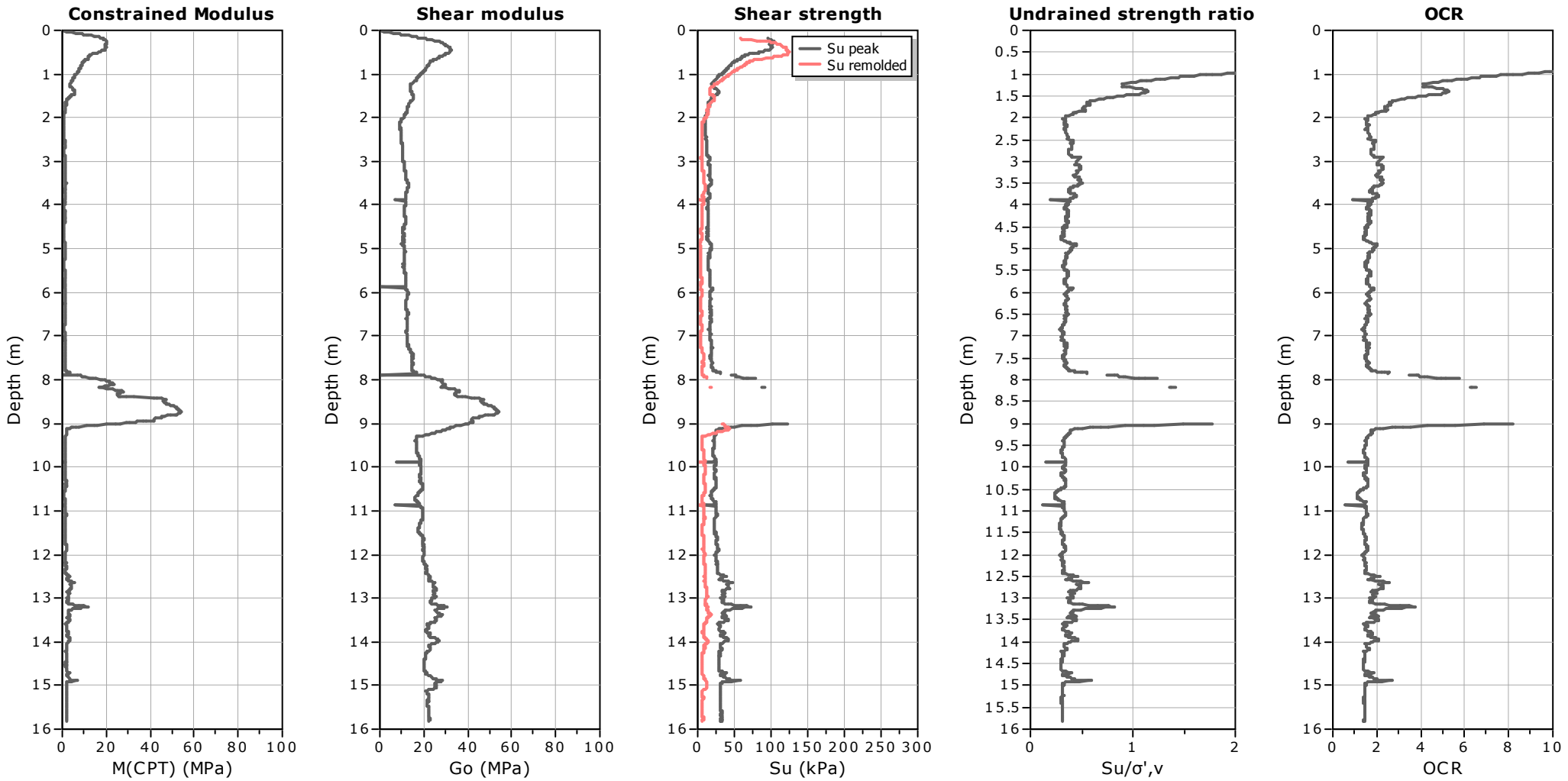
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

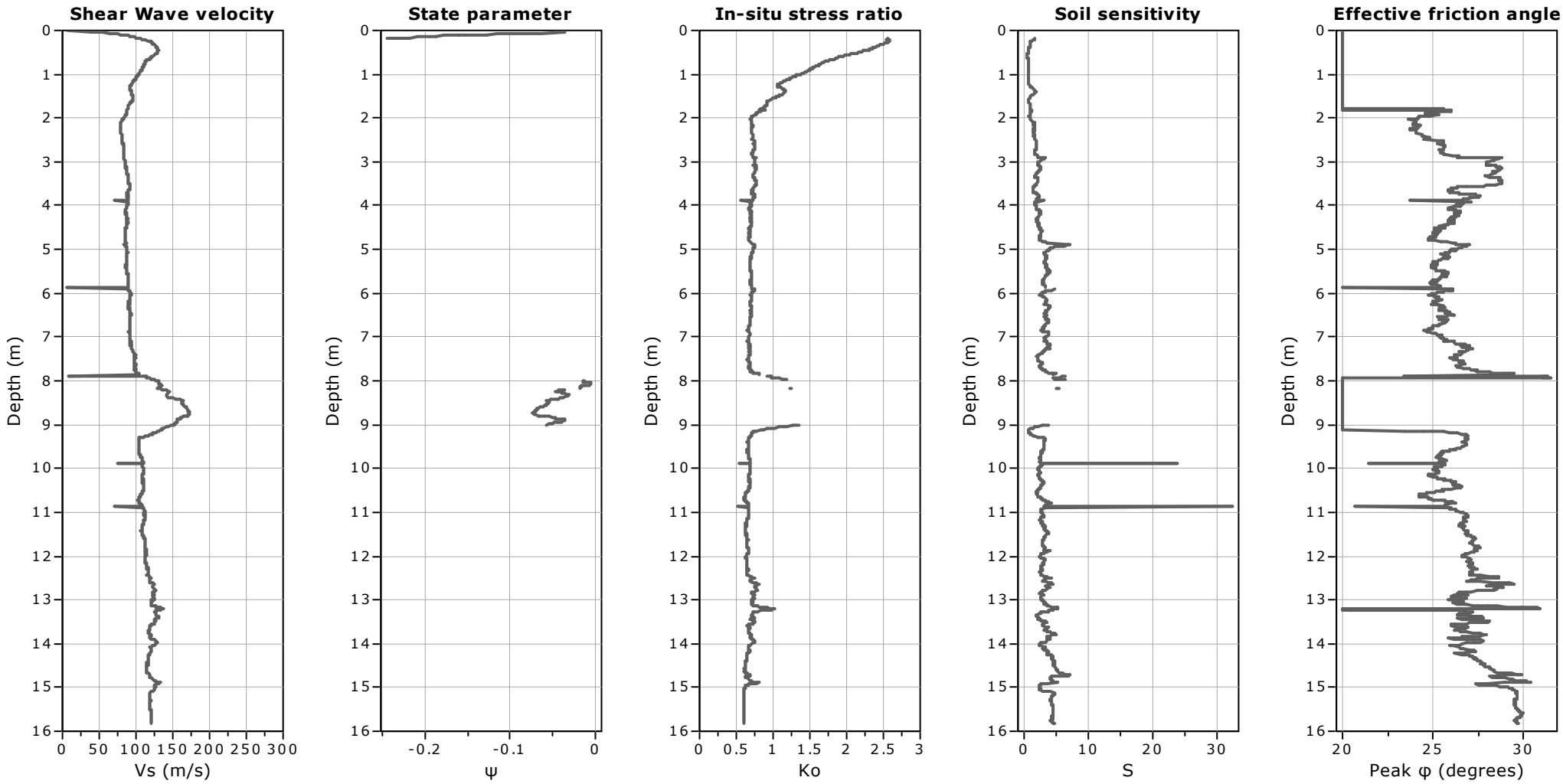
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



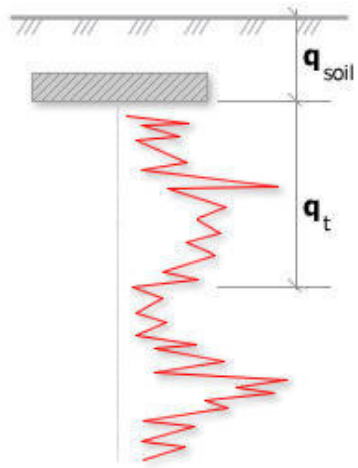
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

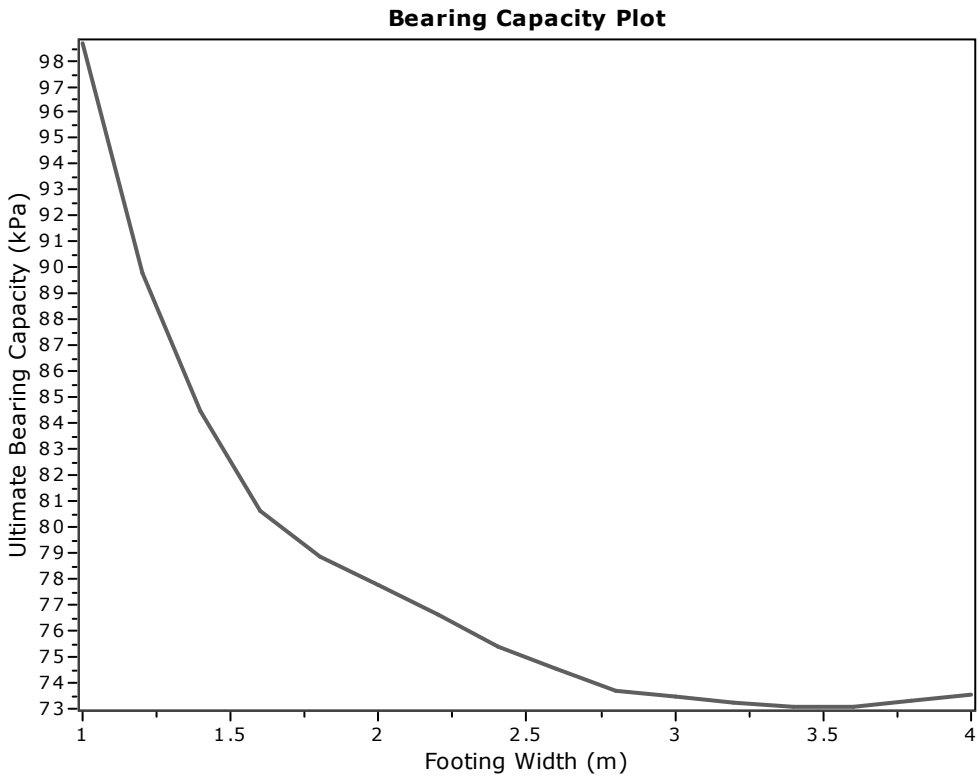
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



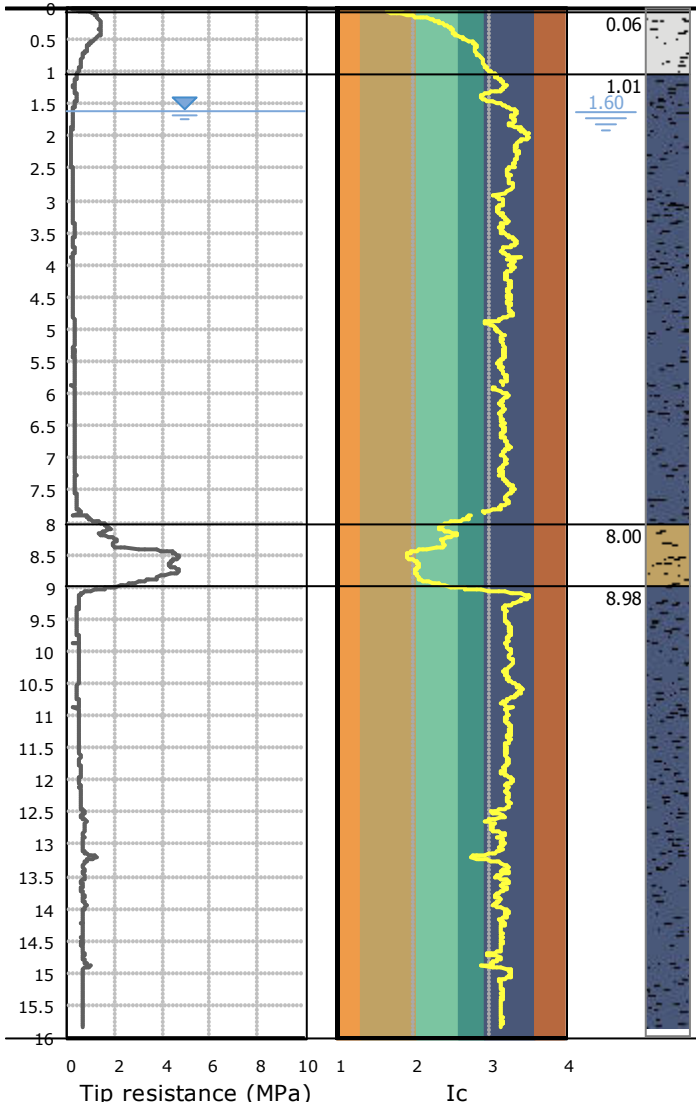
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.45	0.20	9.50	98.66
2	1.20	0.50	2.30	0.40	0.20	9.50	89.83
3	1.40	0.50	2.60	0.37	0.20	9.50	84.45
4	1.60	0.50	2.90	0.36	0.20	9.50	80.63
5	1.80	0.50	3.20	0.35	0.20	9.50	78.89
6	2.00	0.50	3.50	0.34	0.20	9.50	77.75
7	2.20	0.50	3.80	0.34	0.20	9.50	76.62
8	2.40	0.50	4.10	0.33	0.20	9.50	75.42
9	2.60	0.50	4.40	0.33	0.20	9.50	74.55
10	2.80	0.50	4.70	0.32	0.20	9.50	73.73
11	3.00	0.50	5.00	0.32	0.20	9.50	73.43
12	3.20	0.50	5.30	0.32	0.20	9.50	73.26
13	3.40	0.50	5.60	0.32	0.20	9.50	73.10
14	3.60	0.50	5.90	0.32	0.20	9.50	73.08
15	3.80	0.50	6.20	0.32	0.20	9.50	73.33
16	4.00	0.50	6.50	0.32	0.20	9.50	73.57

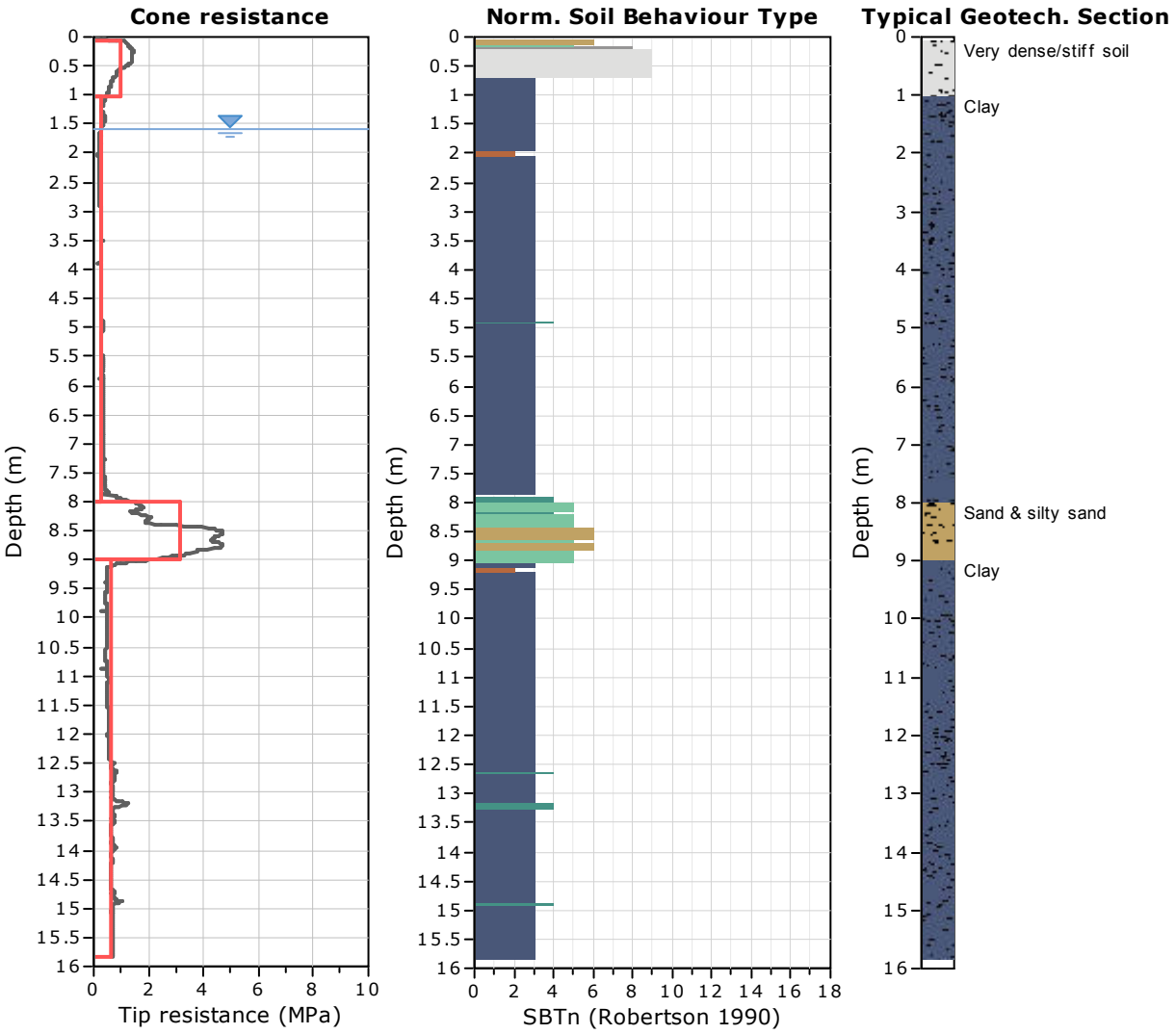
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.06	Very dense/stiff soil	1.0	3.61E-6	3.9	22.9	-	-	13.4	24.0	68.5	6.0	27.7	17.8
1.01	Clay	0.3	3.46E-9	1.9	6.8	-	-	1.6	12.3	17.1	0.4	2.1	14.8
8.00	Sand & silty sand	3.1	3.61E-6	9.3	33.2	34.2	35.1	37.3	41.2	-	-	-	17.0
8.98	Clay	0.6	4.09E-9	3.6	31.7	-	-	2.3	21.4	30.0	0.4	1.6	15.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.06 (m), **End depth:** 1.01 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.00 ±0.35 MPa	Permeability: 3.61E-06 ±1.43E-05 m/s	Constrained Mod.: 13.37 ±4.96 MPa
Sleeve friction: 78.46 ±34.90 kPa	N60: 3.86 ±0.96 blows	Go: 24.05 ±6.23 MPa
SBT_n: 9	Es: 22.87 ±2.73 MPa	Su: 68.54 ±25.93 kPa
SBTn description: Very dense/stiff soil	Dr (%): 0.00 ±0.00	Su ratio: 6.00 ±3.41
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 27.73 ±15.77
	Unit weight: 17.77 ±0.92 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.01 (m), **End depth:** 8.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.31 ±0.12 MPa	Permeability: 3.46E-09 ±1.47E-08 m/s	Constrained Mod.: 1.63 ±1.74 MPa
Sleeve friction: 8.31 ±6.26 kPa	N60: 1.89 ±0.49 blows	Go: 12.26 ±2.32 MPa
SBT_n: 3	Es: 6.78 ±11.60 MPa	Su: 17.13 ±6.34 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.44 ±0.23
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.05 ±1.05
	Unit weight: 14.80 ±0.62 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 8.00 (m), **End depth:** 8.98 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 3.13 ±1.26 MPa	Permeability: 3.61E-06 ±3.76E-06 m/s	Constrained Mod.: 37.26 ±12.81 MPa
Sleeve friction: 24.81 ±7.89 kPa	N60: 9.31 ±2.72 blows	Go: 41.25 ±8.80 MPa
SBT_n: 5	Es: 33.22 ±6.90 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 34.18 ±6.53	Su ratio: 0.00 ±0.00
	φ (degrees): 35.15 ±1.89 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.02 ±0.53 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 8.98 (m), **End depth:** 15.84 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.62 ±0.18 MPa	Permeability: 4.09E-09 ±2.40E-08 m/s	Constrained Mod.: 2.35 ±2.58 MPa
Sleeve friction: 10.01 ±5.68 kPa	N60: 3.58 ±0.67 blows	Go: 21.42 ±3.81 MPa
SBT_n: 3	Es: 31.74 ±31.74 MPa	Su: 30.02 ±9.53 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.12
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.64 ±0.55
	Unit weight: 15.35 ±0.46 kN/m³	

RDR SrL
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CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

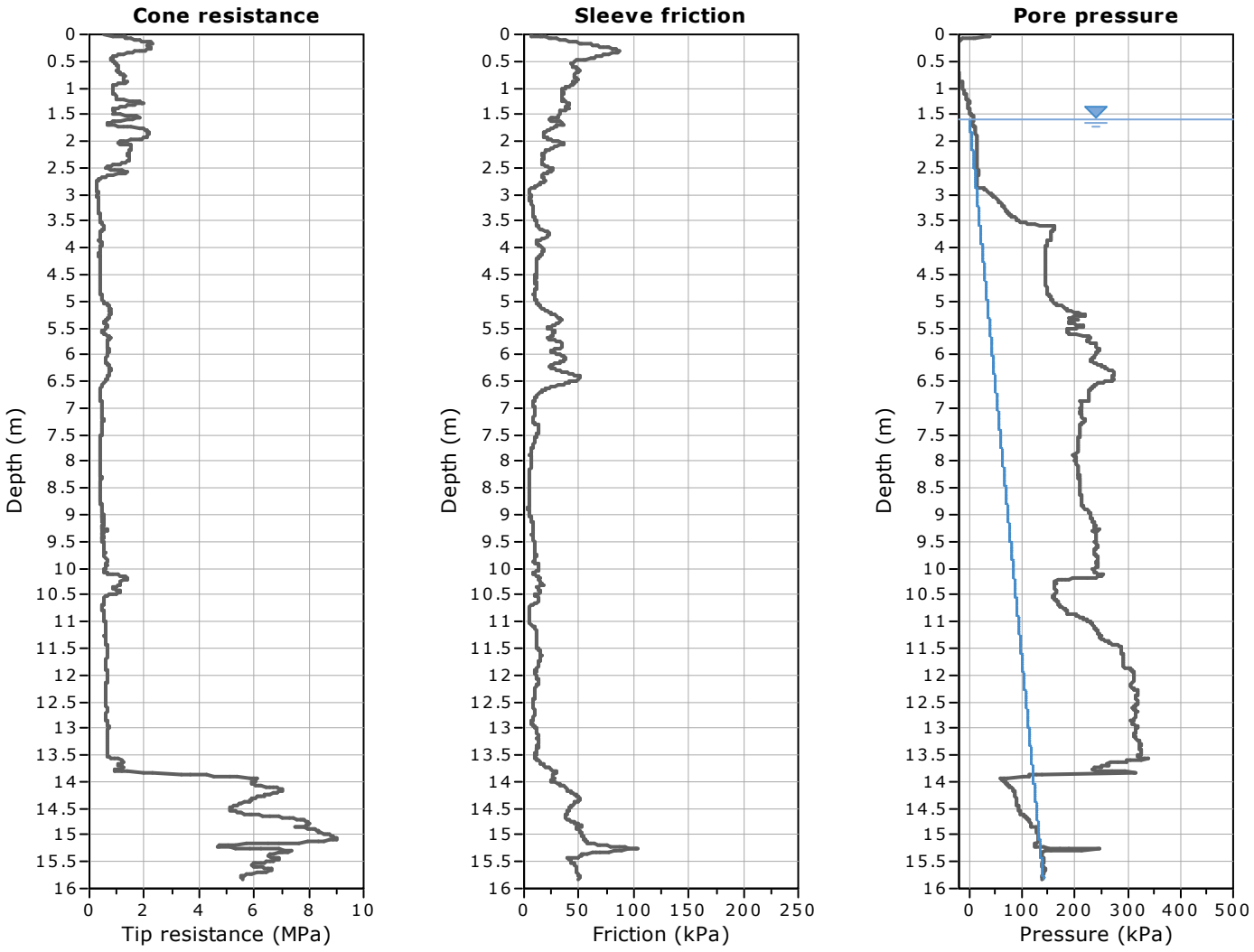
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.06	0.95	3.61E-06	3.9	22.9	0.0	0.0	13.4	24.0	68.5	6.0	27.7	17.8
1.01		(±1.43E-05)	(±1.0)	(±2.7)	(±0.0)	(±0.0)	(±5.0)	(±6.2)	(±25.9)	(±3.4)	(±15.8)	(±0.9)
1.01	6.99	3.46E-09	1.9	6.8	0.0	0.0	1.6	12.3	17.1	0.4	2.1	14.8
8.00		(±1.47E-08)	(±0.5)	(±11.6)	(±0.0)	(±0.0)	(±1.7)	(±2.3)	(±6.3)	(±0.2)	(±1.0)	(±0.6)
8.00	0.98	3.61E-06	9.3	33.2	34.2	35.1	37.3	41.2	0.0	0.0	0.0	17.0
8.98		(±3.76E-06)	(±2.7)	(±6.9)	(±6.5)	(±1.9)	(±12.8)	(±8.8)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
8.98	6.86	4.09E-09	3.6	31.7	0.0	0.0	2.3	21.4	30.0	0.4	1.6	15.3
15.84		(±2.40E-08)	(±0.7)	(±31.7)	(±0.0)	(±0.0)	(±2.6)	(±3.8)	(±9.5)	(±0.1)	(±0.6)	(±0.5)

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

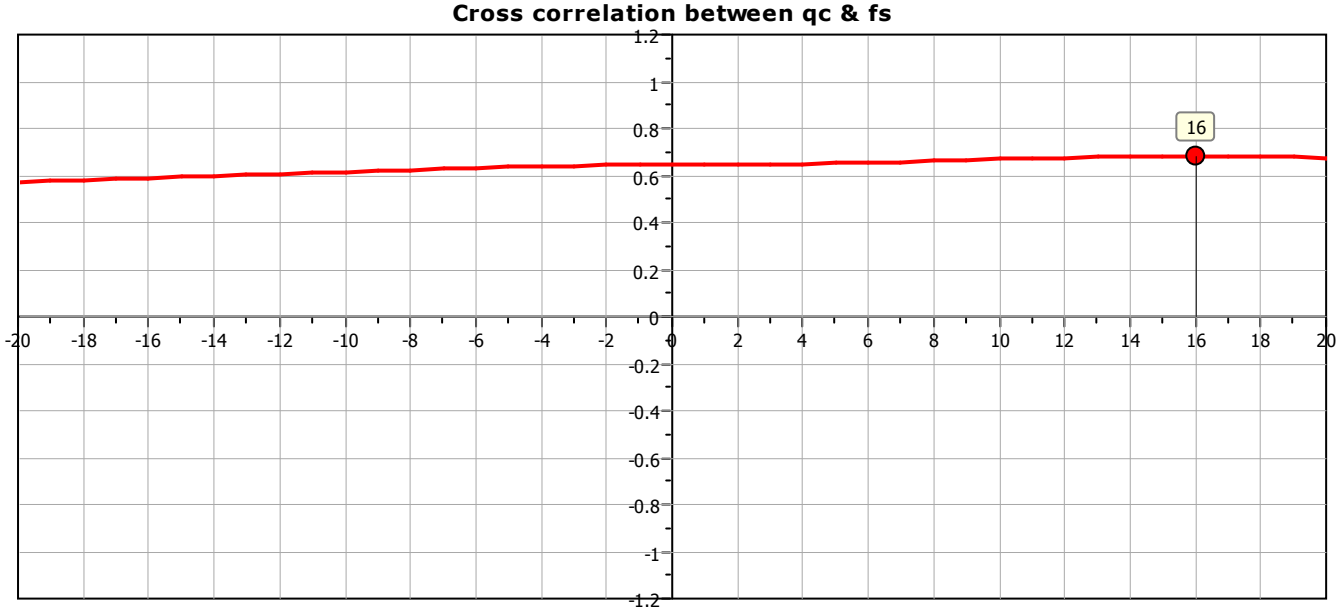
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

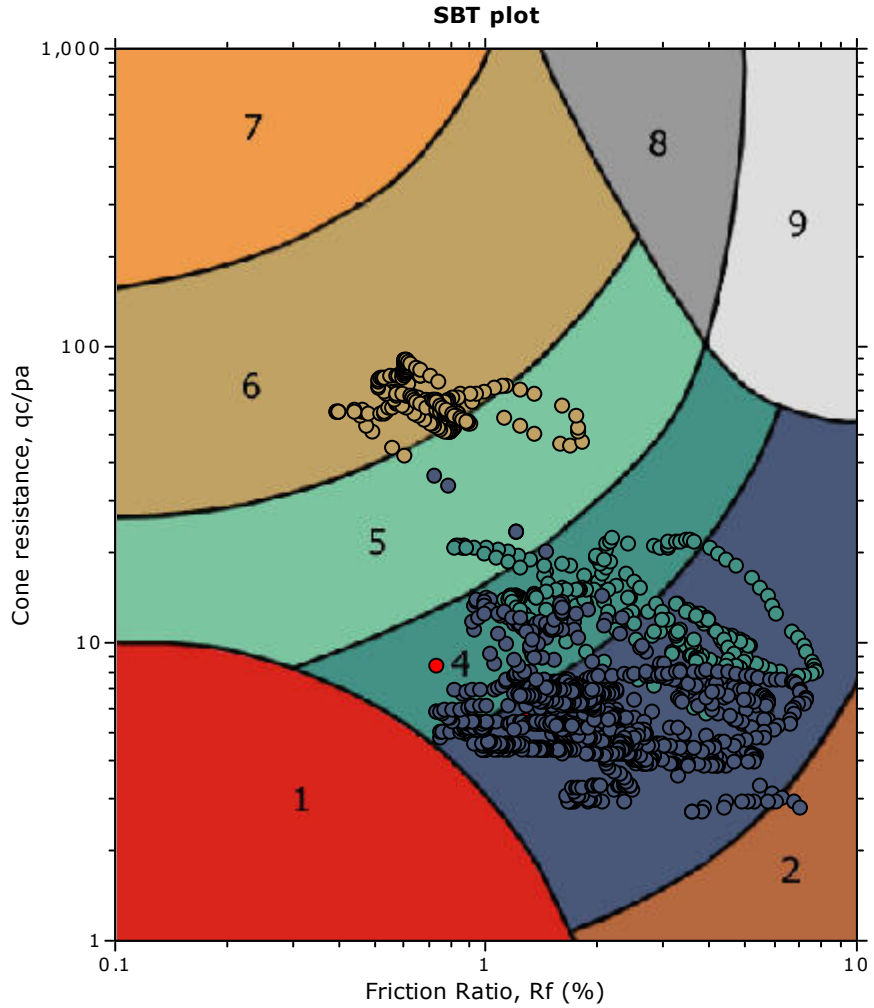


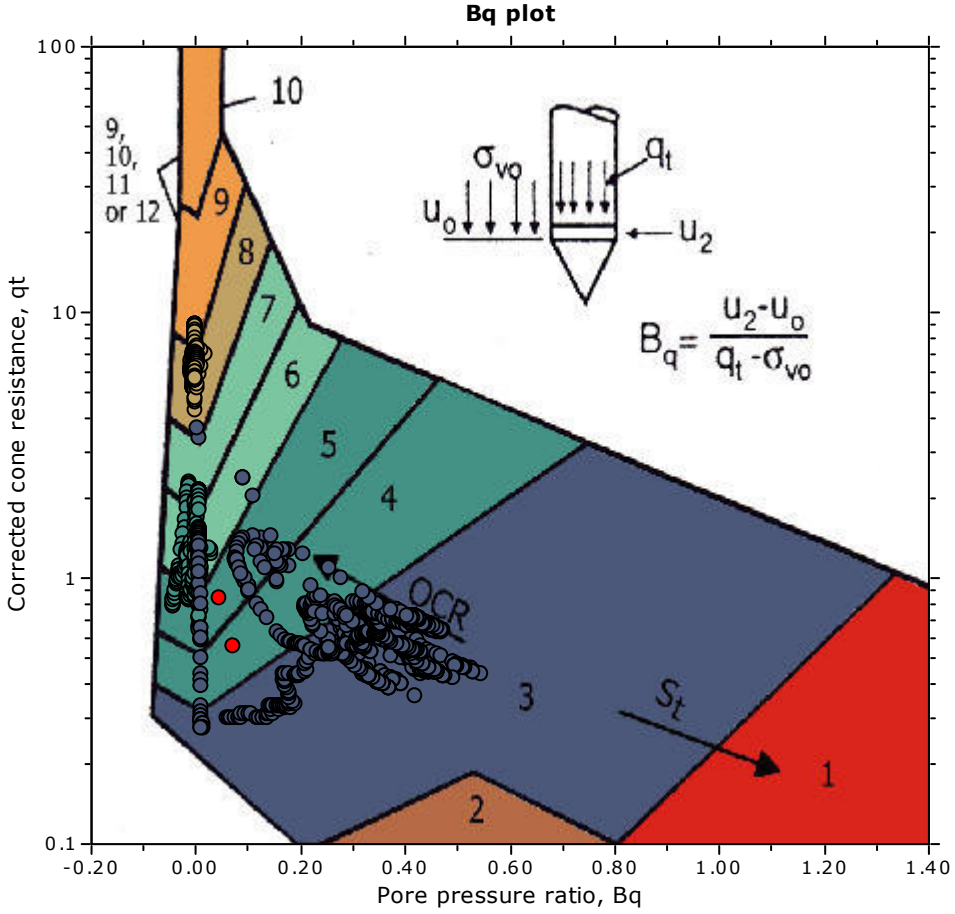
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

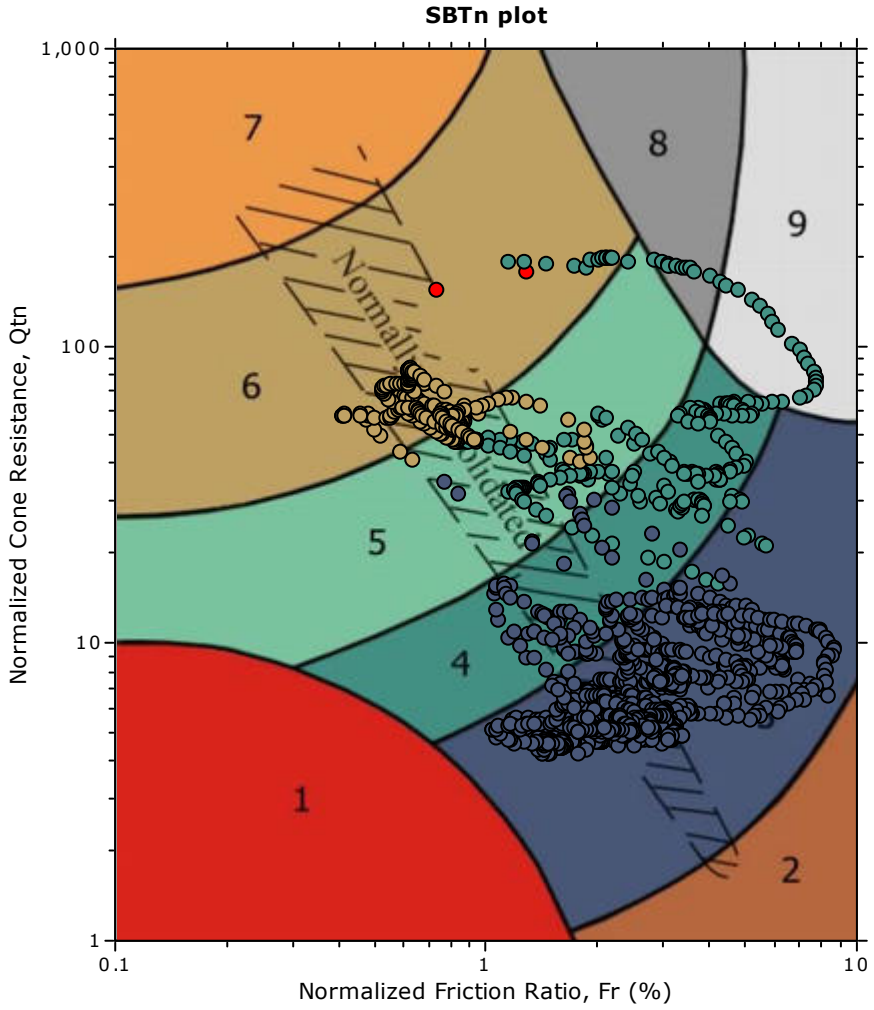
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

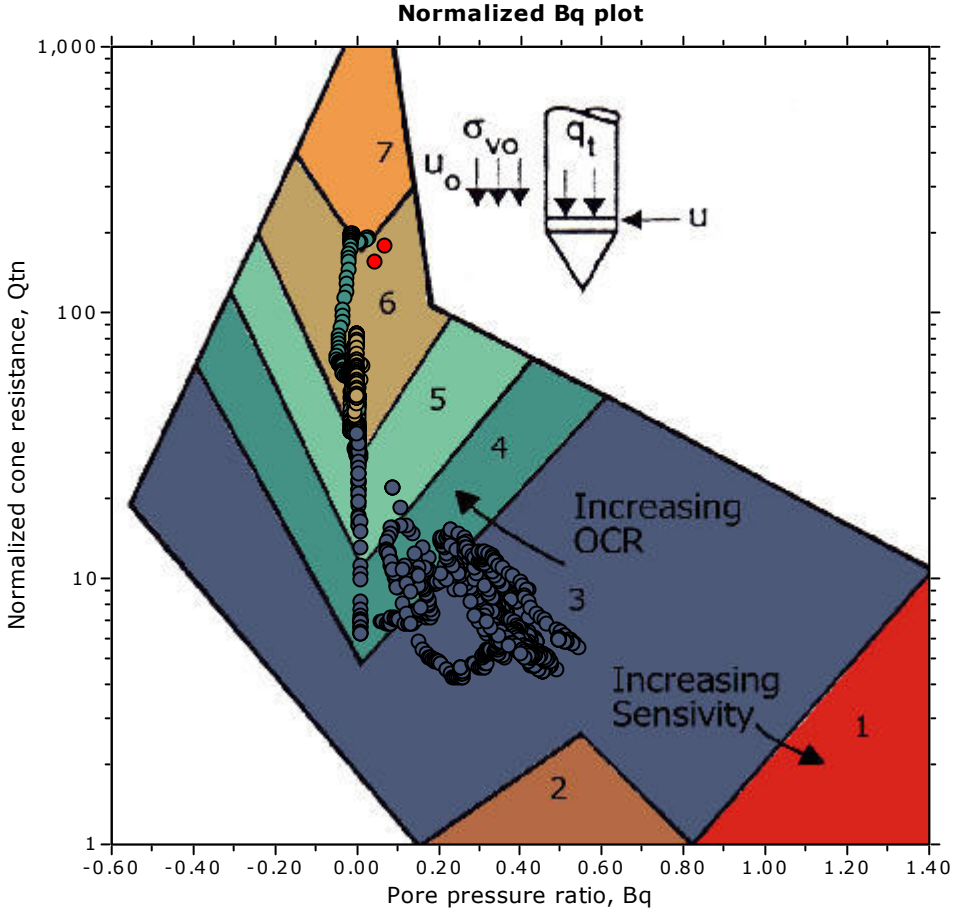
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

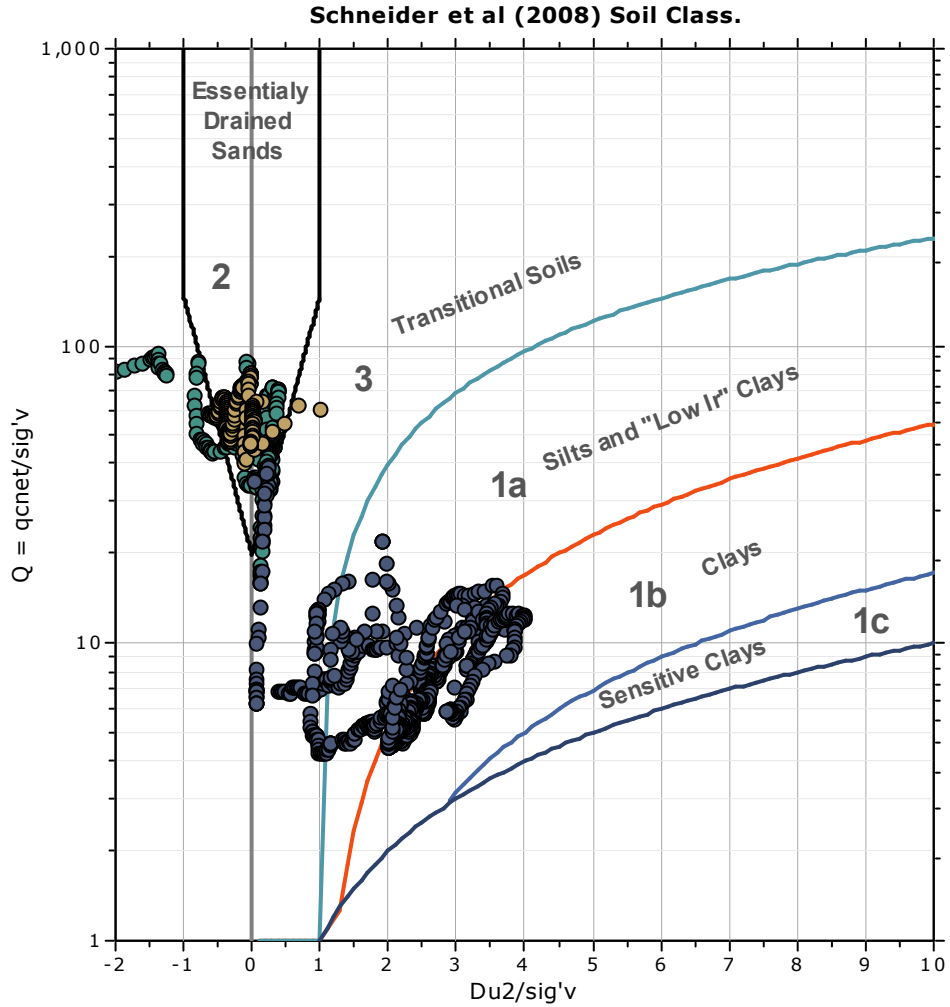
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

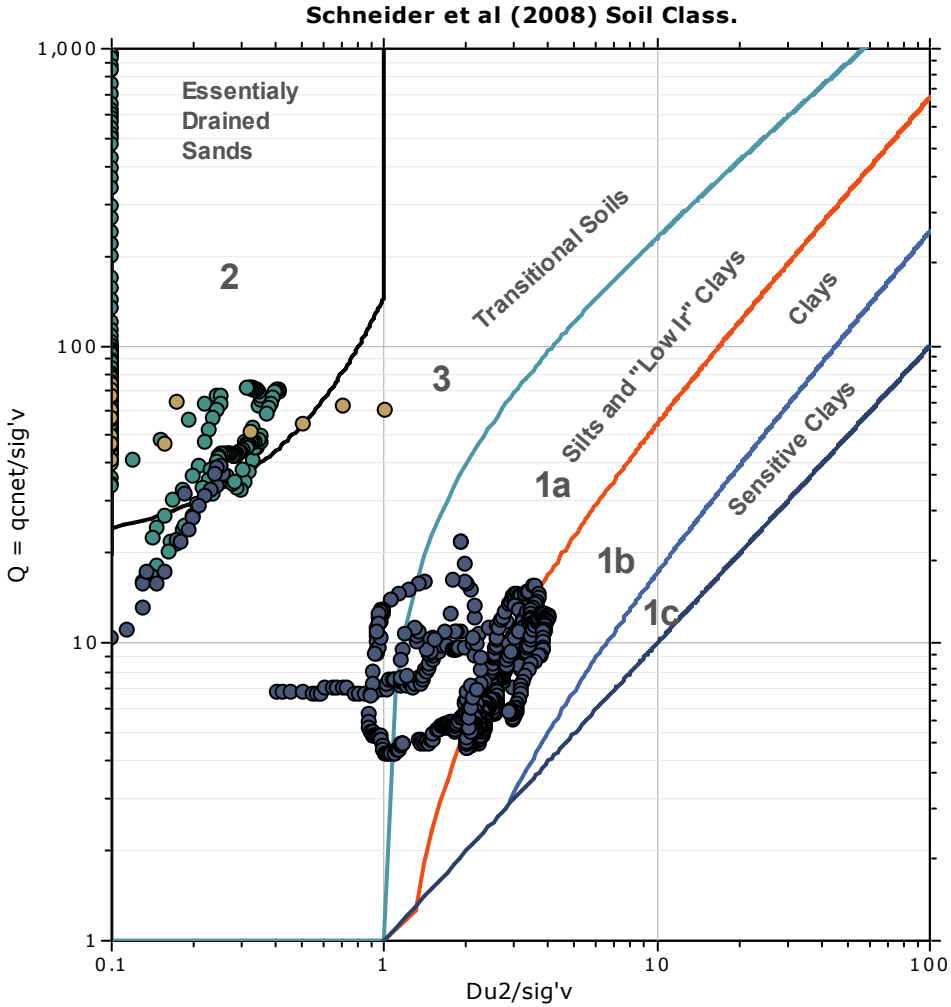
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

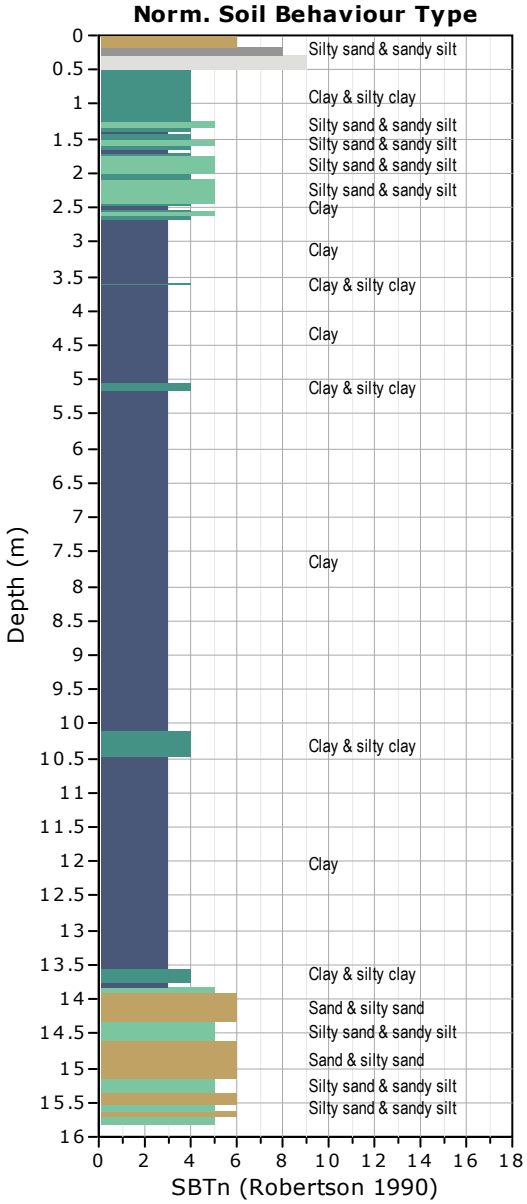


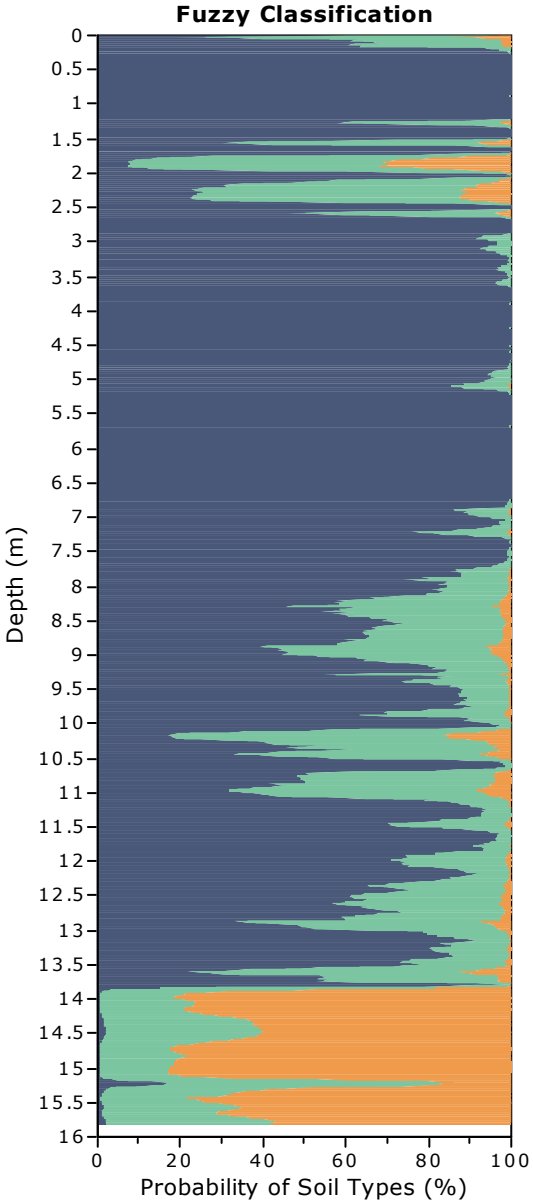


RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

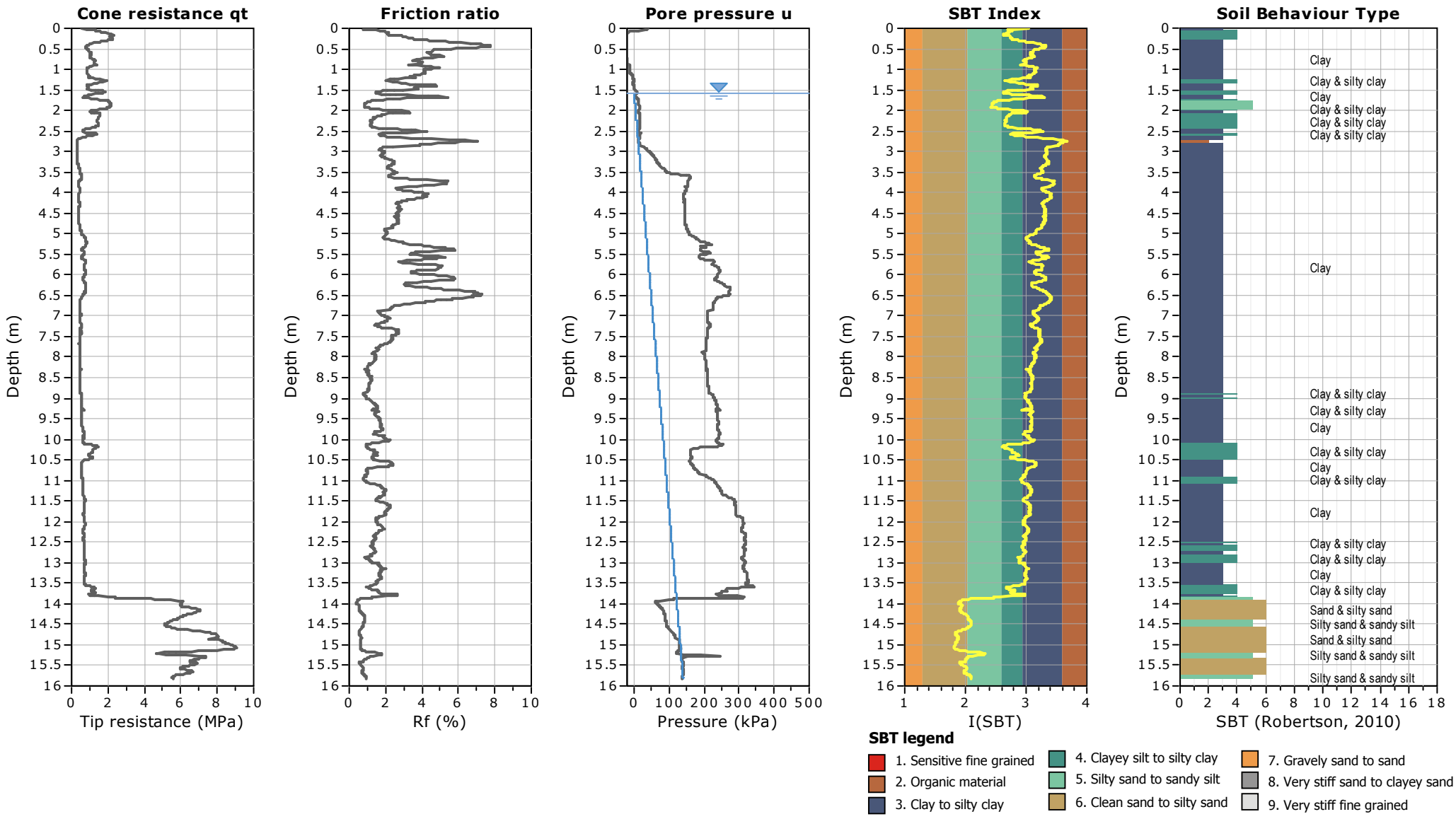




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rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

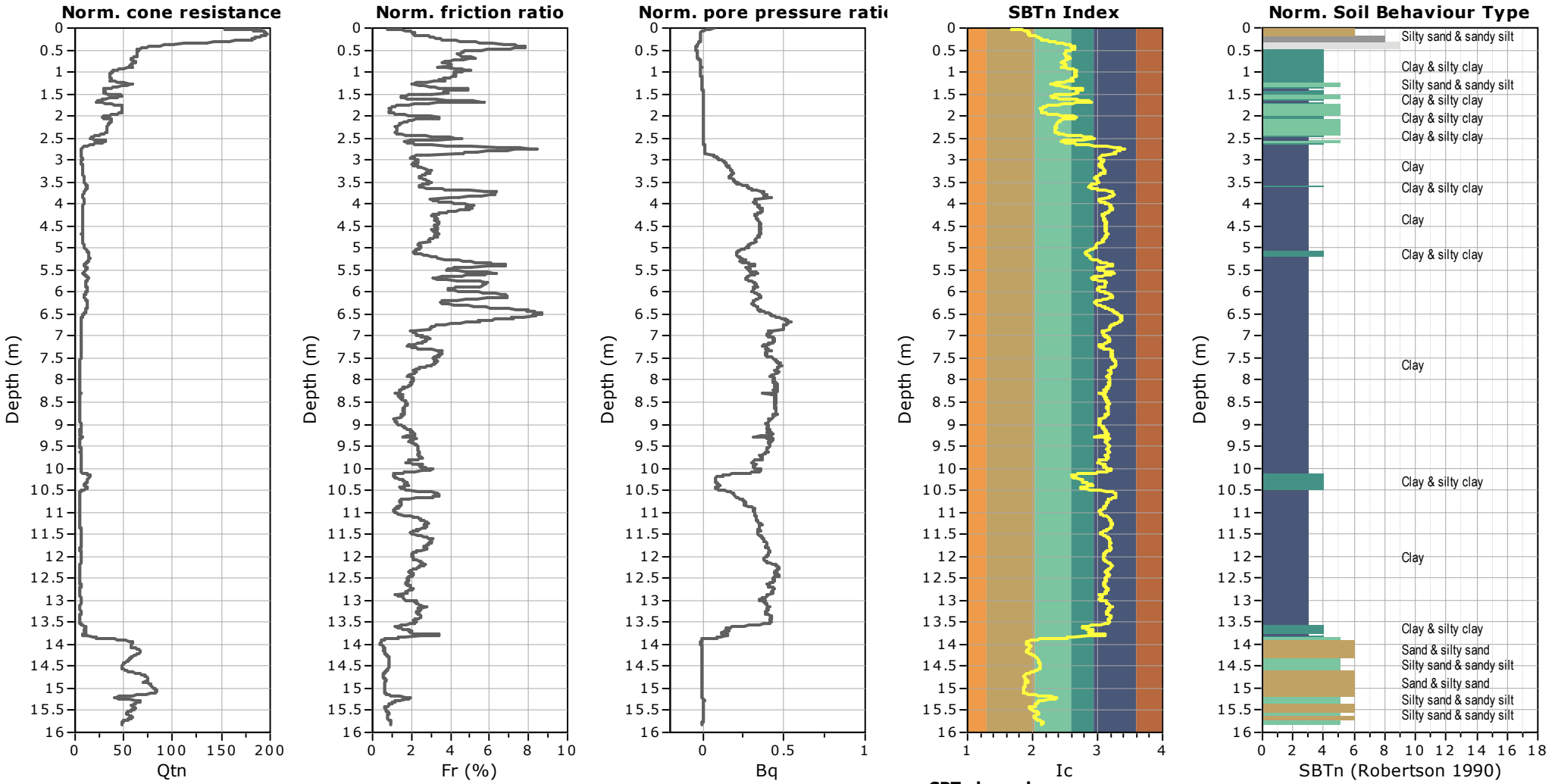
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

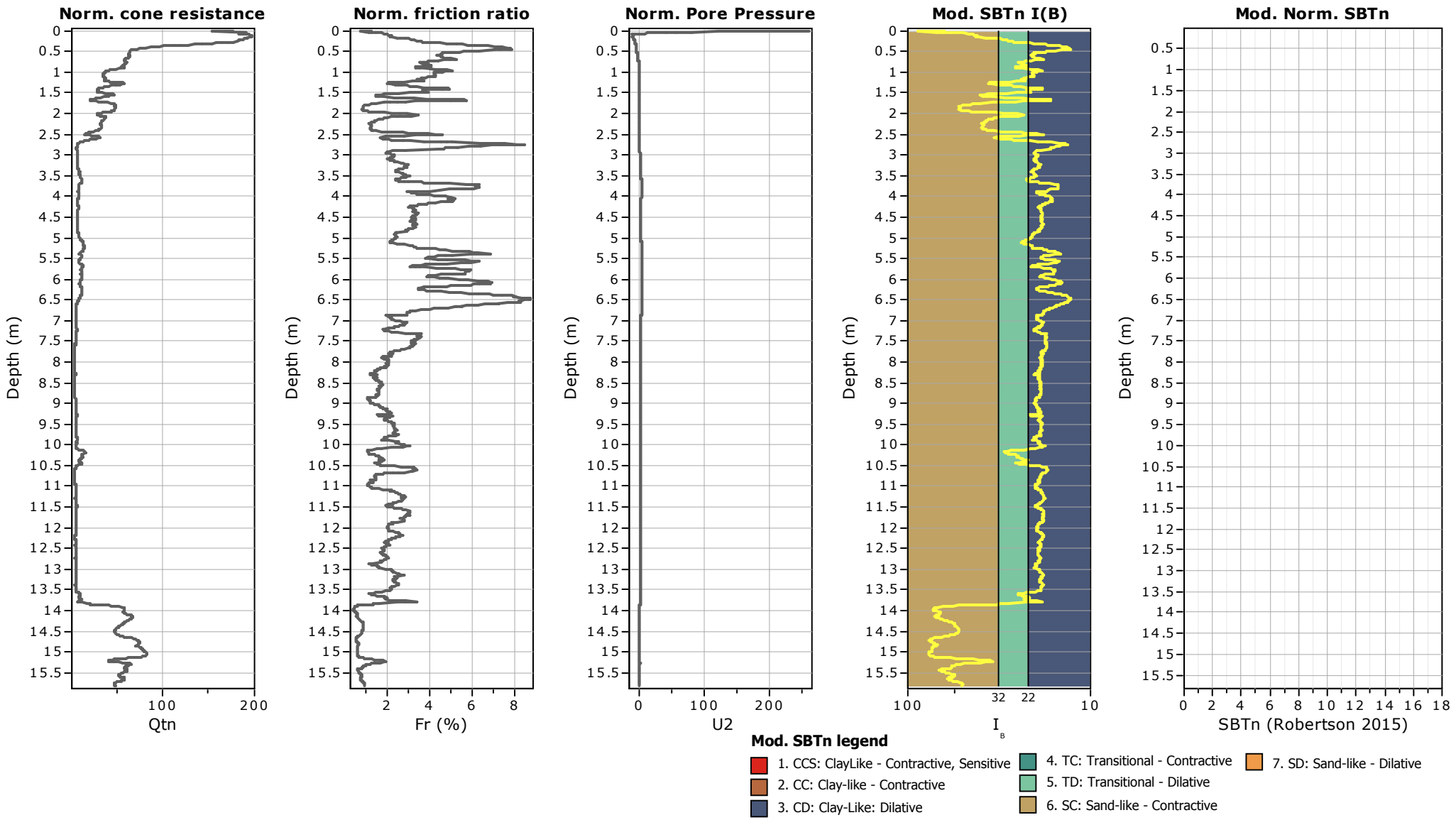
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

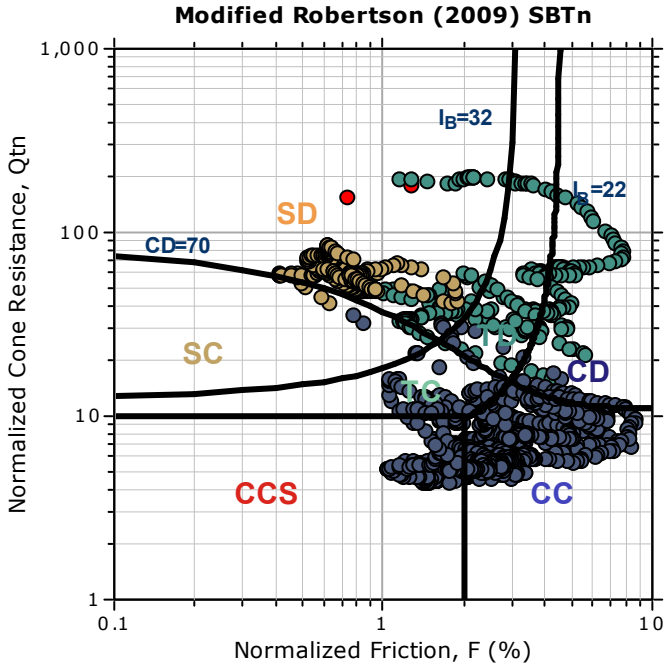


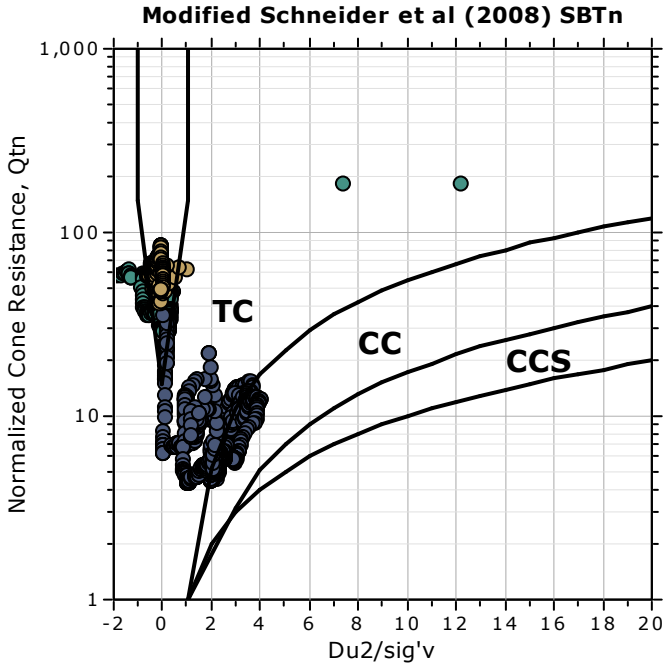
RDR SrL
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rocco.carbonella@fastwebnet.it

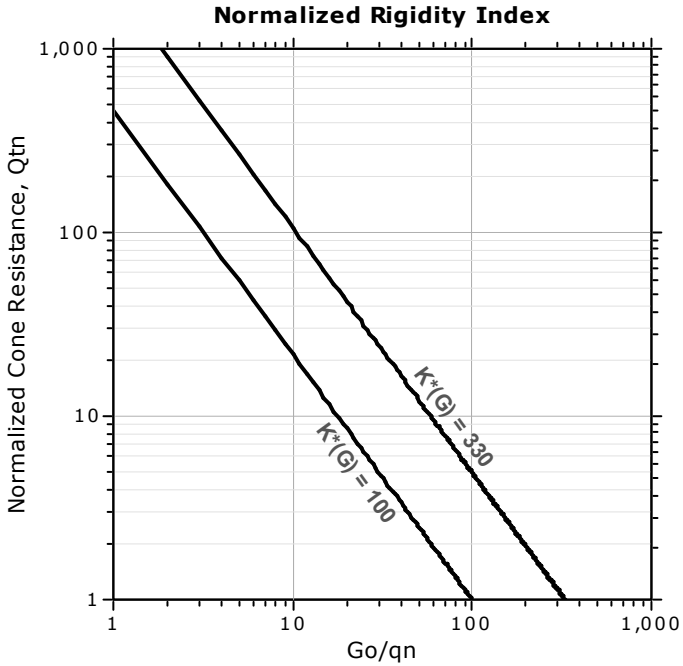
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







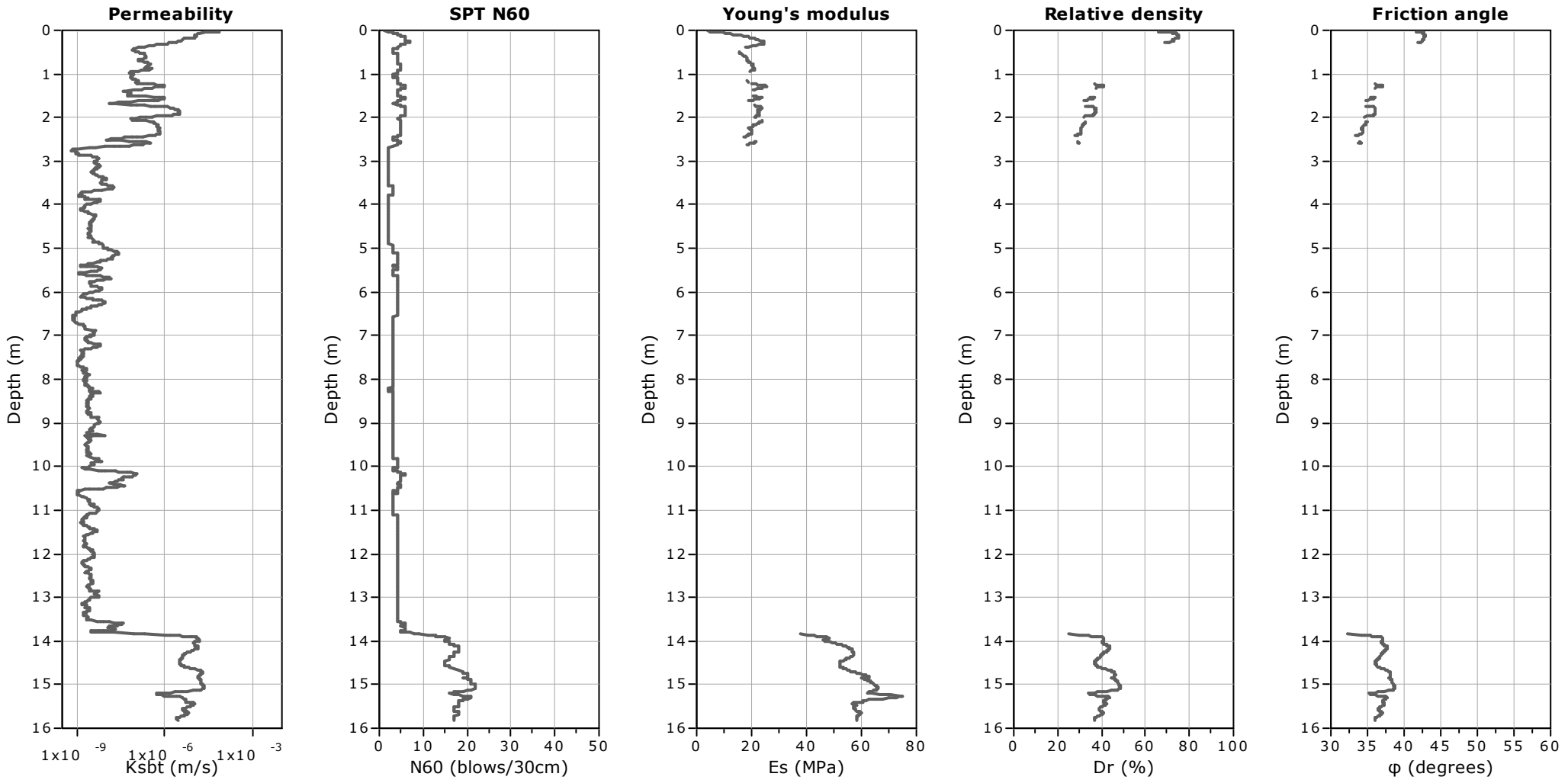
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



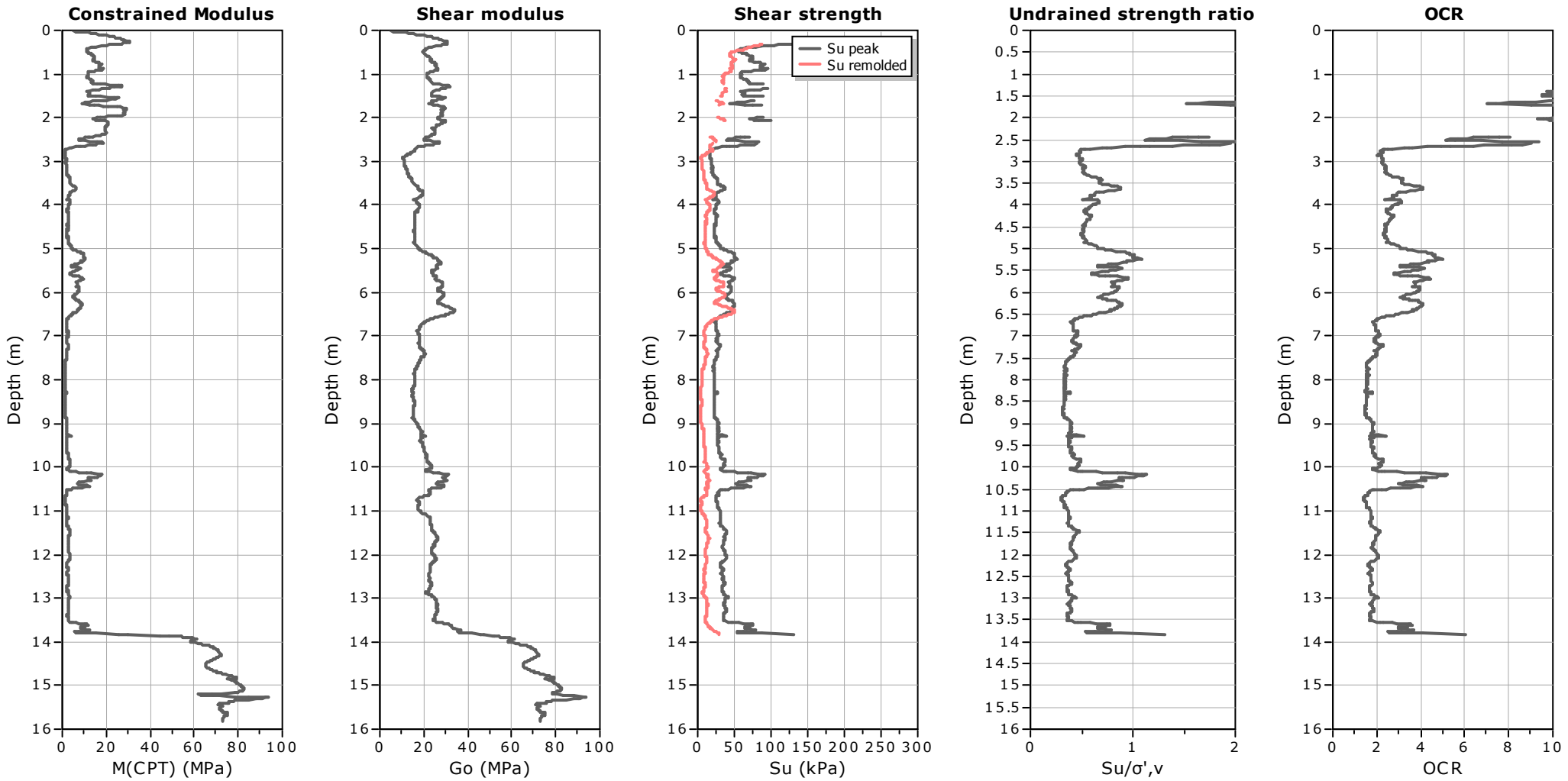
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

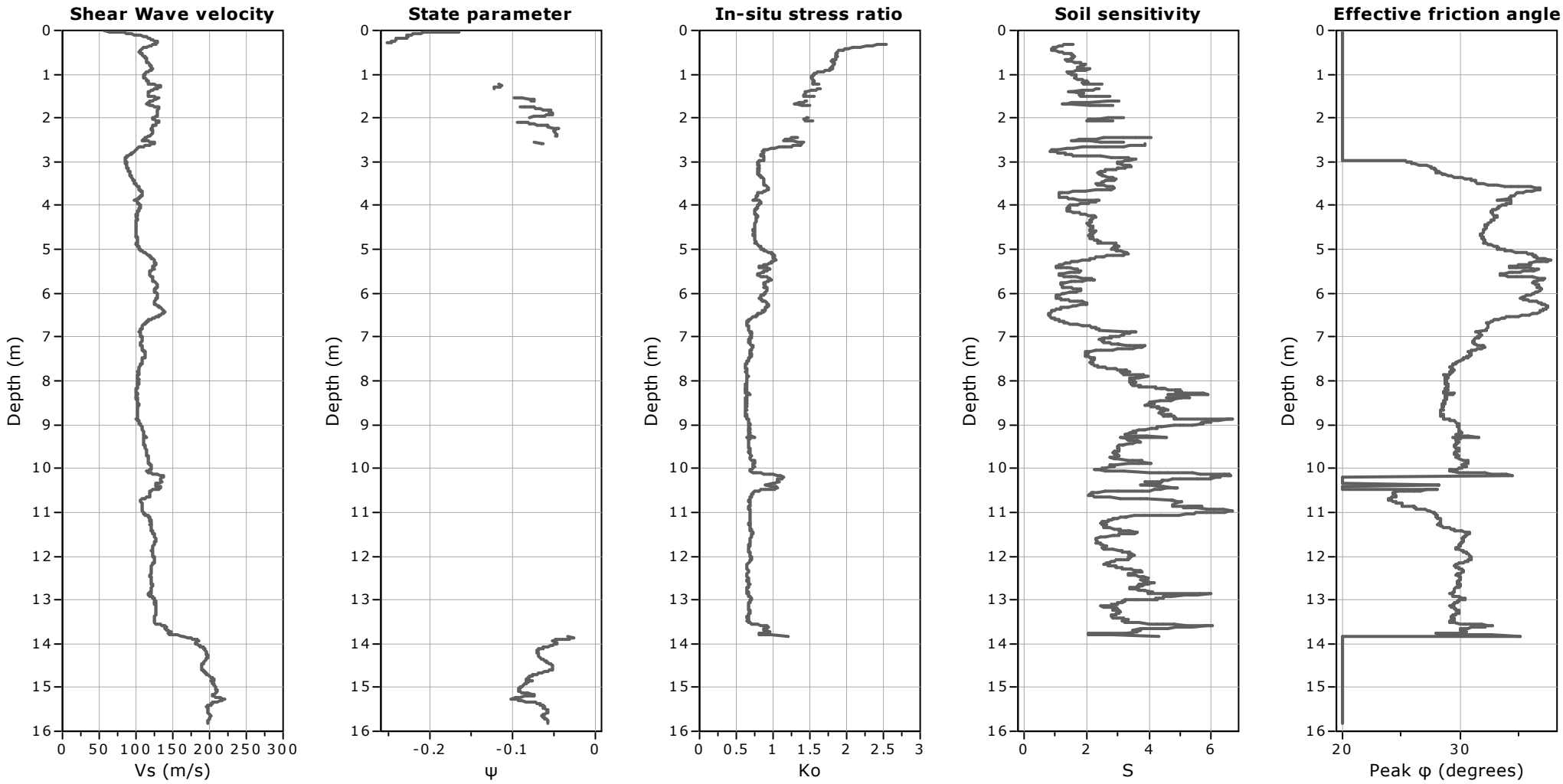
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



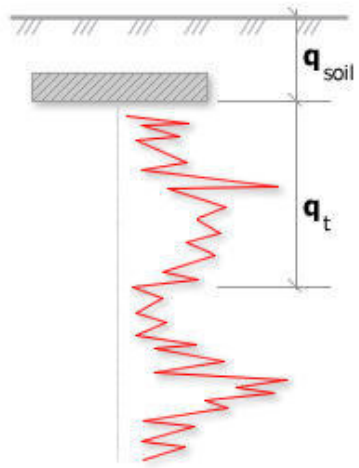
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

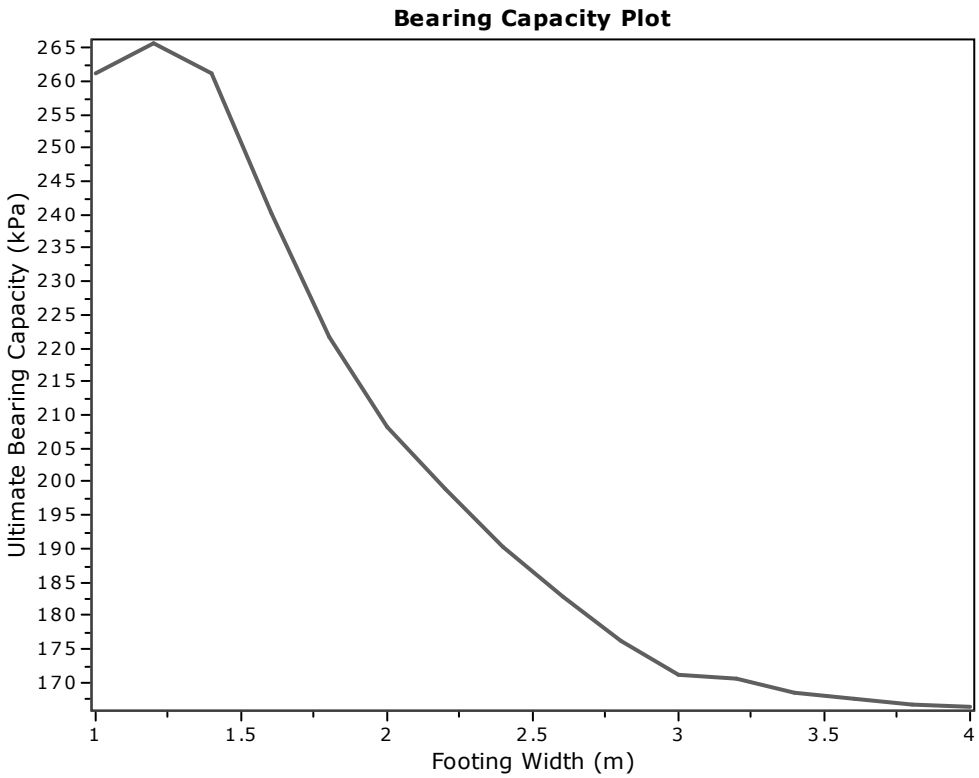
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



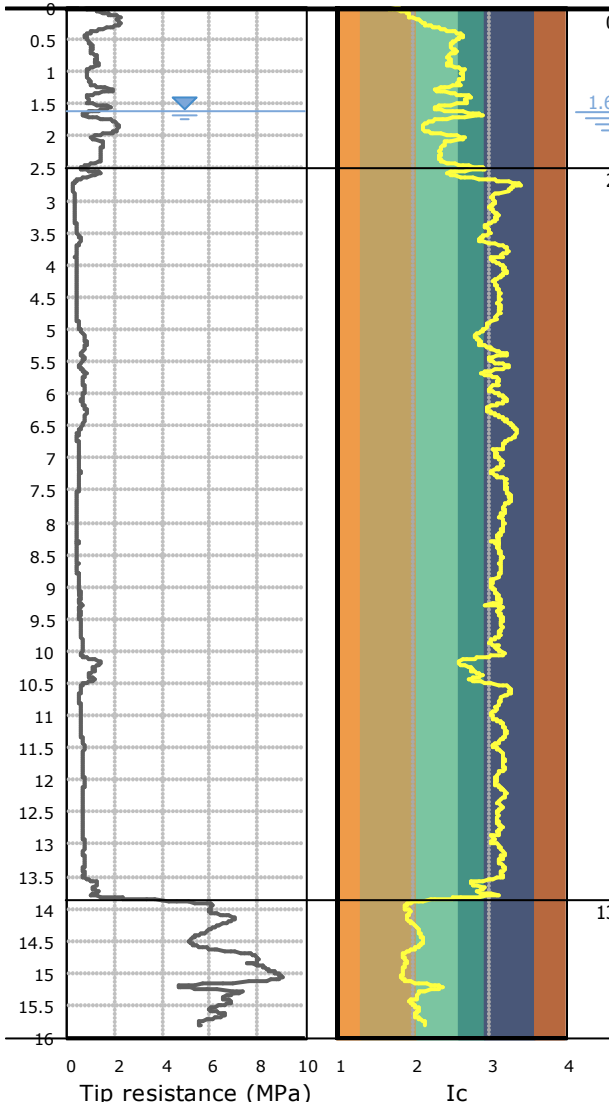
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.26	0.20	9.50	261.15
2	1.20	0.50	2.30	1.28	0.20	9.50	265.64
3	1.40	0.50	2.60	1.26	0.20	9.50	261.02
4	1.60	0.50	2.90	1.15	0.20	9.50	240.16
5	1.80	0.50	3.20	1.06	0.20	9.50	221.57
6	2.00	0.50	3.50	0.99	0.20	9.50	208.12
7	2.20	0.50	3.80	0.95	0.20	9.50	198.89
8	2.40	0.50	4.10	0.90	0.20	9.50	190.23
9	2.60	0.50	4.40	0.87	0.20	9.50	182.73
10	2.80	0.50	4.70	0.83	0.20	9.50	176.16
11	3.00	0.50	5.00	0.81	0.20	9.50	171.23
12	3.20	0.50	5.30	0.80	0.20	9.50	170.48
13	3.40	0.50	5.60	0.79	0.20	9.50	168.42
14	3.60	0.50	5.90	0.79	0.20	9.50	167.61
15	3.80	0.50	6.20	0.79	0.20	9.50	166.60
16	4.00	0.50	6.50	0.78	0.20	9.50	166.31

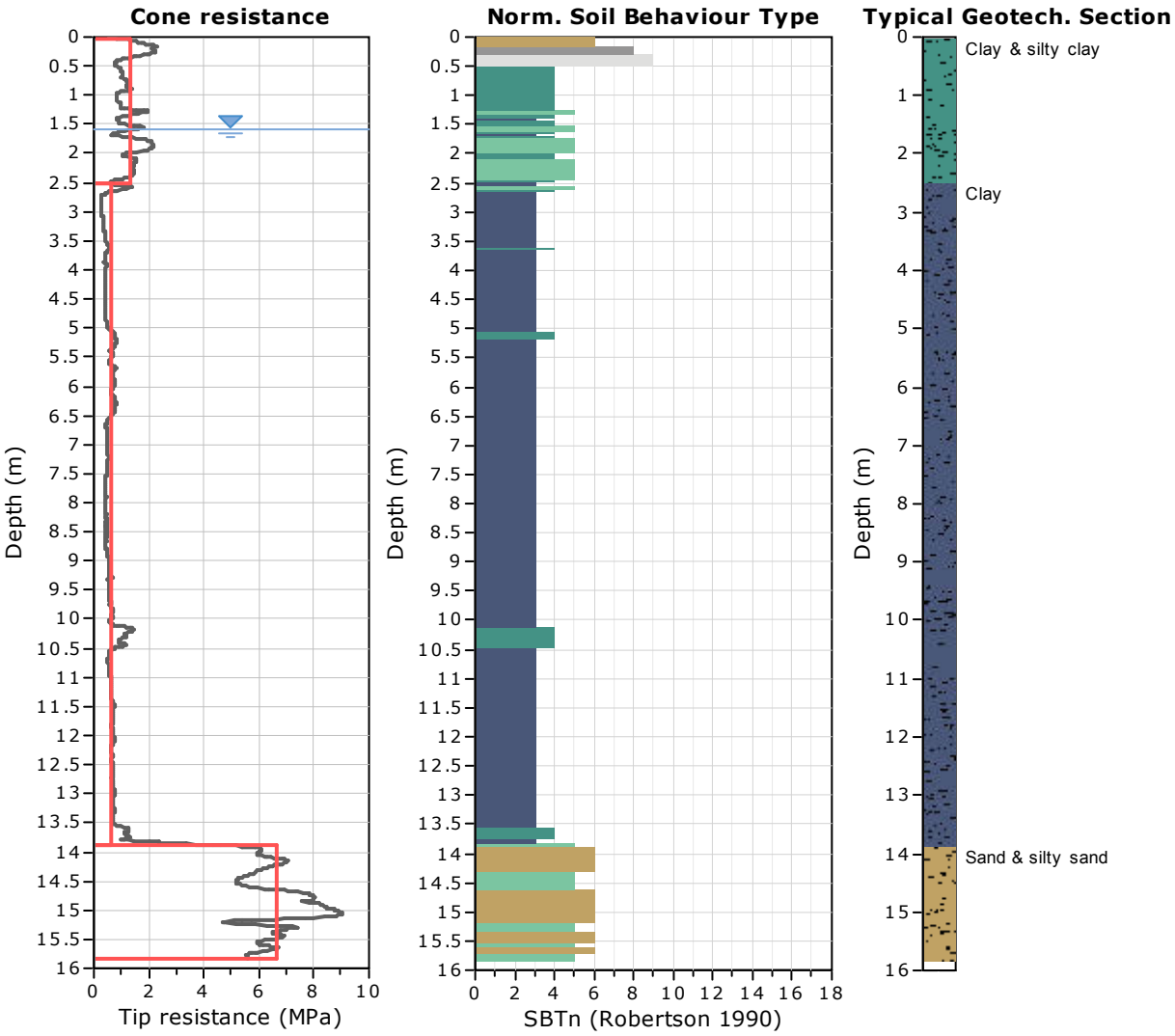
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.03	Clay & silty clay	1.3	1.55E-6	4.6	20.9	44.0	37.1	17.7	24.7	-	-	-	17.1
2.50	Clay	0.6	9.94E-9	3.3	20.5	-	-	3.9	21.0	33.3	0.5	2.4	15.6
13.87	Sand & silty sand	6.6	8.87E-6	17.9	58.0	41.5	37.1	72.1	72.8	-	-	-	18.1



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.03 (m), **End depth:** 2.50 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 1.33 ±0.44 MPa
Sleeve friction: 37.57 ±16.89 kPa
SBT_n: 5
SBTn description: Silty sand & sandy silt

Estimation results

Permeability: 1.55E-06 ±4.50E-06 m/s
N60: 4.62 ±0.99 blows
Es: 20.86 ±3.50 MPa
Dr (%): 43.97 ±17.42
φ (degrees): 37.11 ±3.32 °
Unit weight: 17.14 ±0.51 kN/m³
Constrained Mod.: 17.74 ±5.76 MPa
Go: 24.75 ±3.60 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:** 2.50 (m), **End depth:** 13.87 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.61 ±0.25 MPa	Permeability: 9.94E-09 ±6.04E-08 m/s	Constrained Mod.: 3.87 ±3.76 MPa
Sleeve friction: 13.38 ±8.49 kPa	N60: 3.35 ±1.00 blows	Go: 21.03 ±5.56 MPa
SBT_n: 3	Es: 20.51 ±2.26 MPa	Su: 33.30 ±12.66 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.52 ±0.22
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.42 ±1.00
	Unit weight: 15.58 ±0.68 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 13.87 (m), **End depth:** 15.82 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.62 ±1.12 MPa	Permeability: 8.87E-06 ±5.81E-06 m/s	Constrained Mod.: 72.07 ±7.38 MPa
Sleeve friction: 47.79 ±13.75 kPa	N60: 17.86 ±2.12 blows	Go: 72.75 ±7.71 MPa
SBT_n: 6	Es: 58.05 ±6.16 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 41.52 ±3.64	Su ratio: 0.00 ±0.00
	φ (degrees): 37.15 ±0.84 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.11 ±0.33 kN/m³	

RDR SrL
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

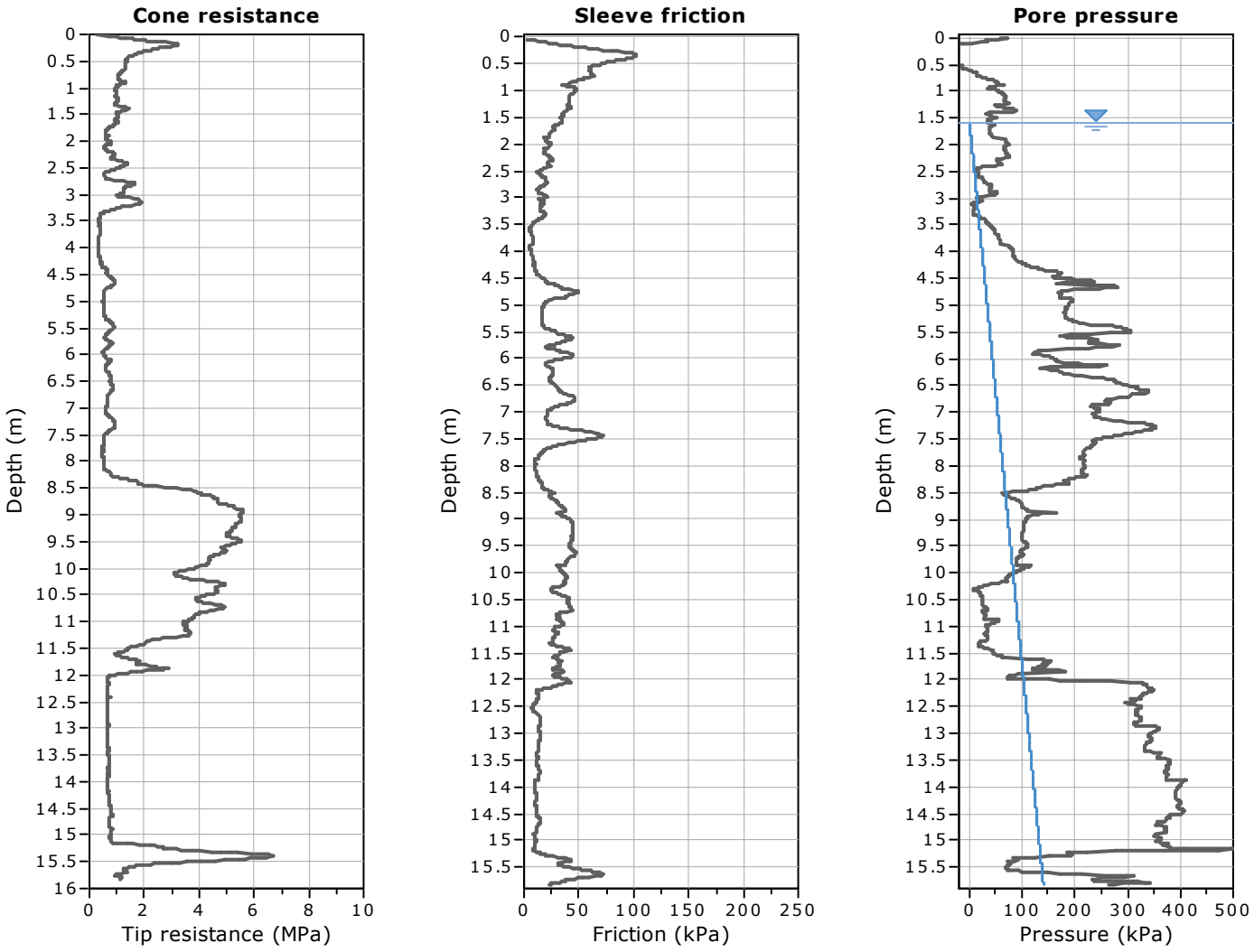
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.03	2.47	1.55E-06	4.6	20.9	44.0	37.1	17.7	24.7	0.0	0.0	0.0	17.1
2.50		(±4.50E-06)	(±1.0)	(±3.5)	(±17.4)	(±3.3)	(±5.8)	(±3.6)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
2.50	11.37	9.94E-09	3.3	20.5	0.0	0.0	3.9	21.0	33.3	0.5	2.4	15.6
13.87		(±6.04E-08)	(±1.0)	(±2.3)	(±0.0)	(±0.0)	(±3.8)	(±5.6)	(±12.7)	(±0.2)	(±1.0)	(±0.7)
13.87	1.95	8.87E-06	17.9	58.0	41.5	37.1	72.1	72.8	0.0	0.0	0.0	18.1
15.82		(±5.81E-06)	(±2.1)	(±6.2)	(±3.6)	(±0.8)	(±7.4)	(±7.7)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

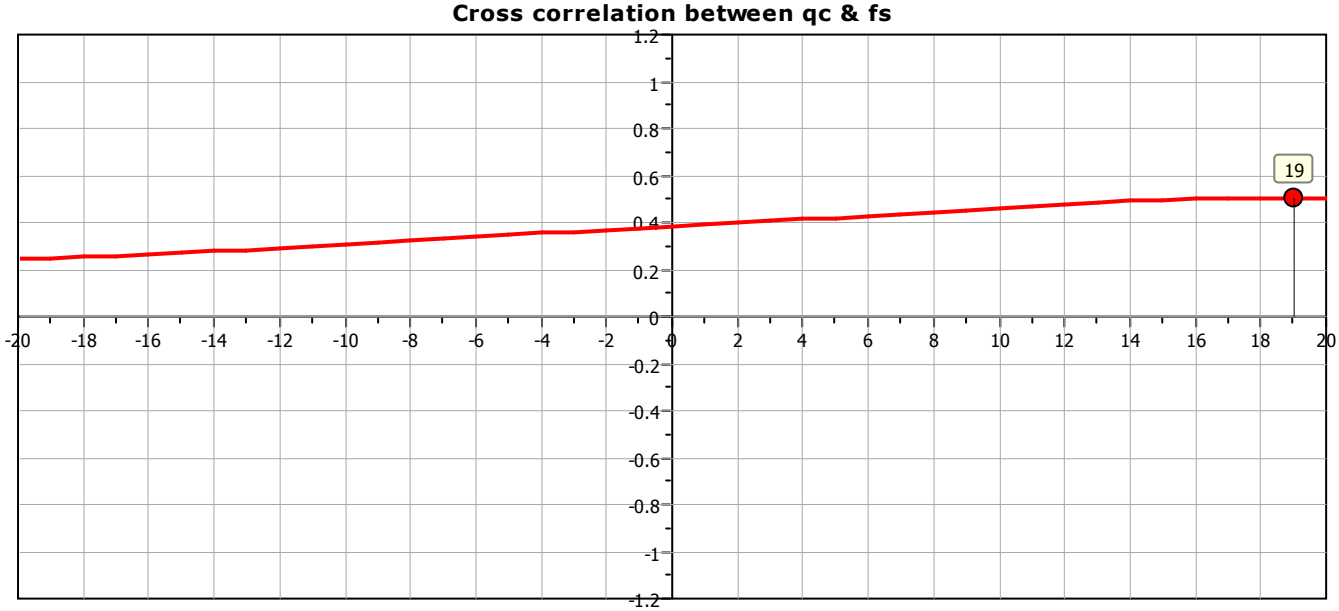
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

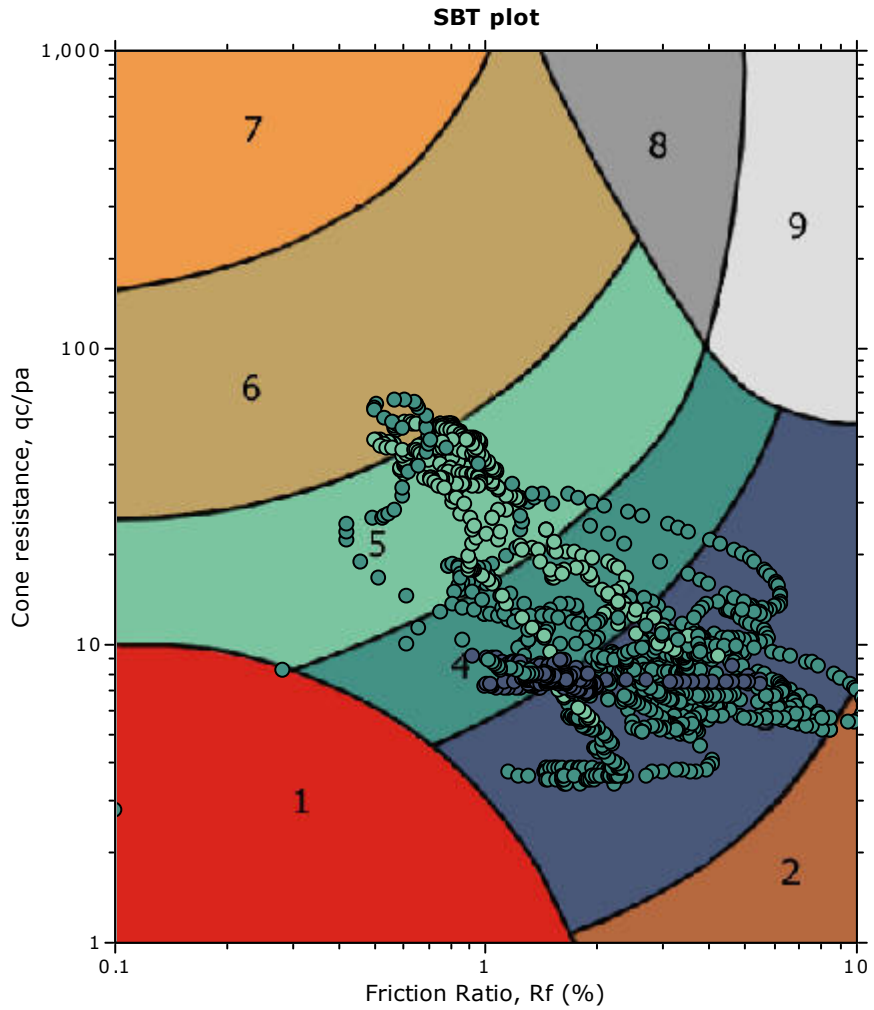


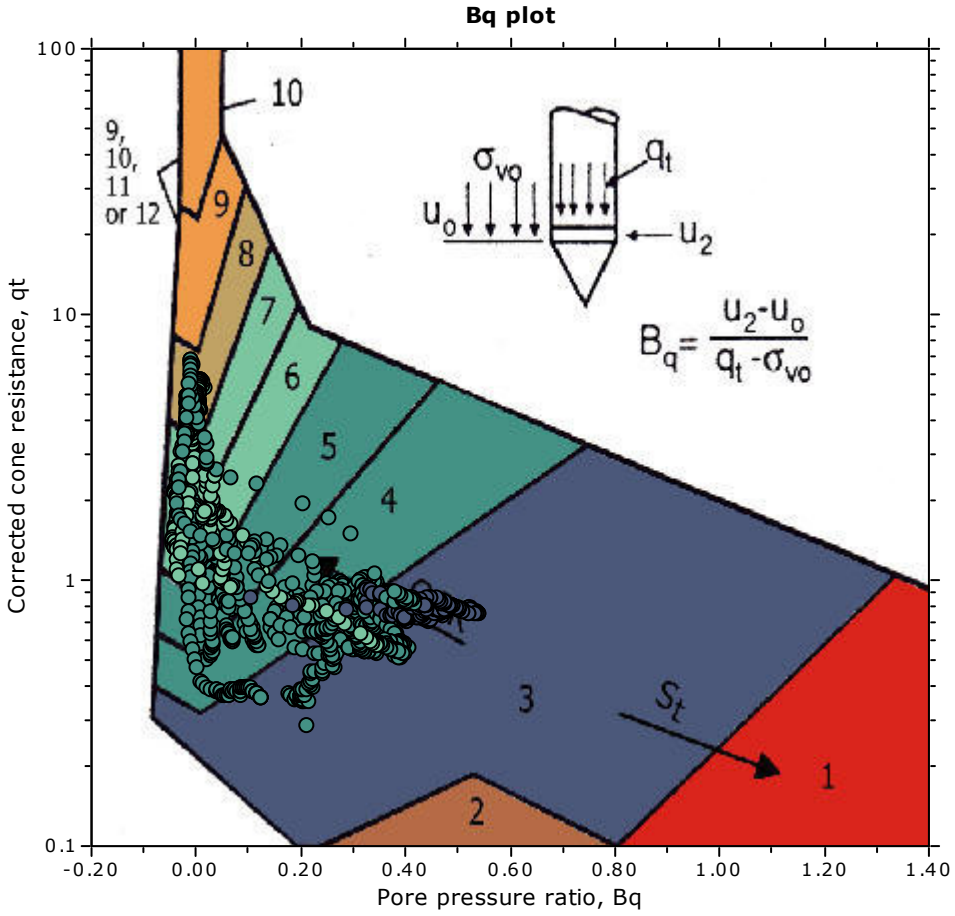
RDR SrL
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CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

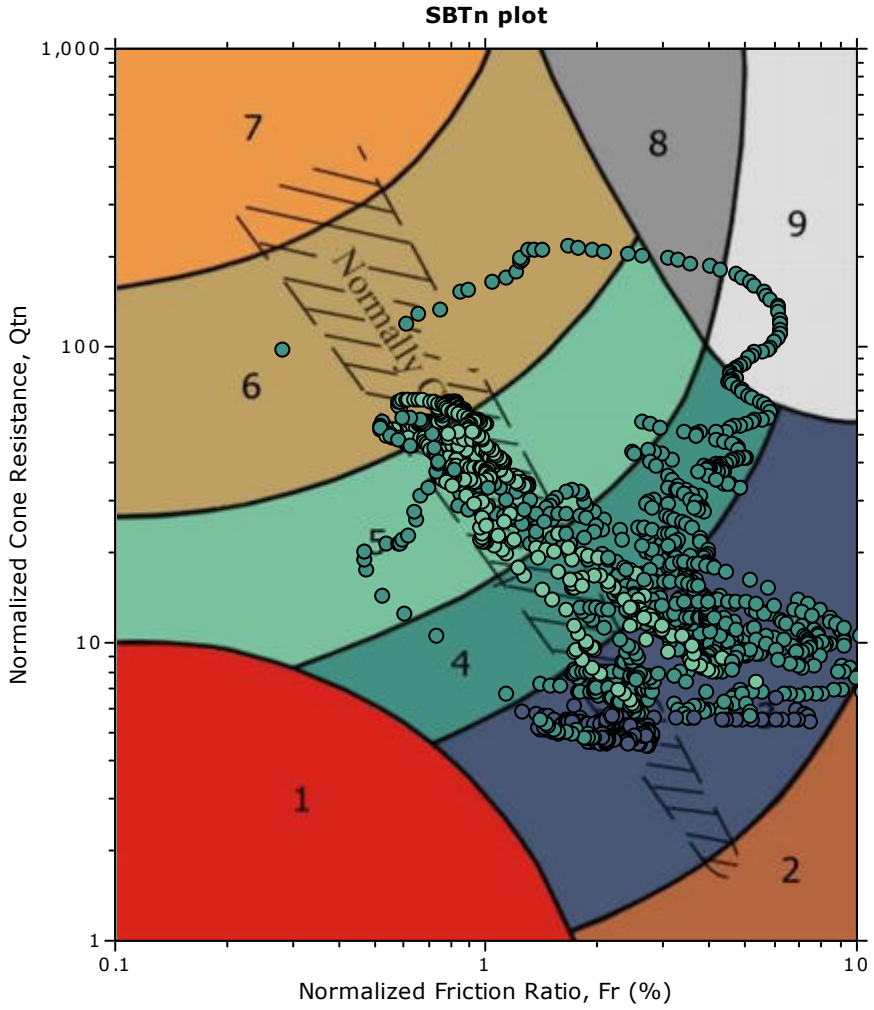
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

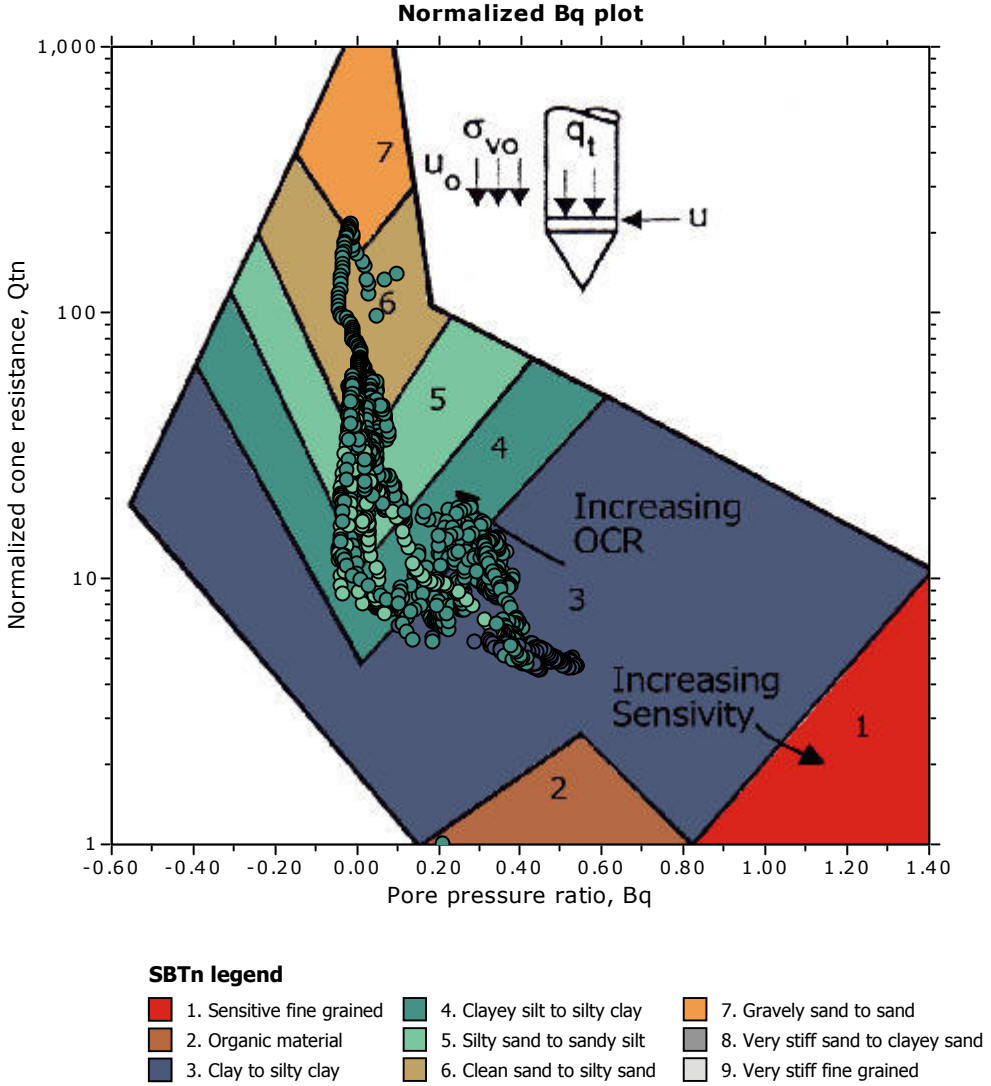
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

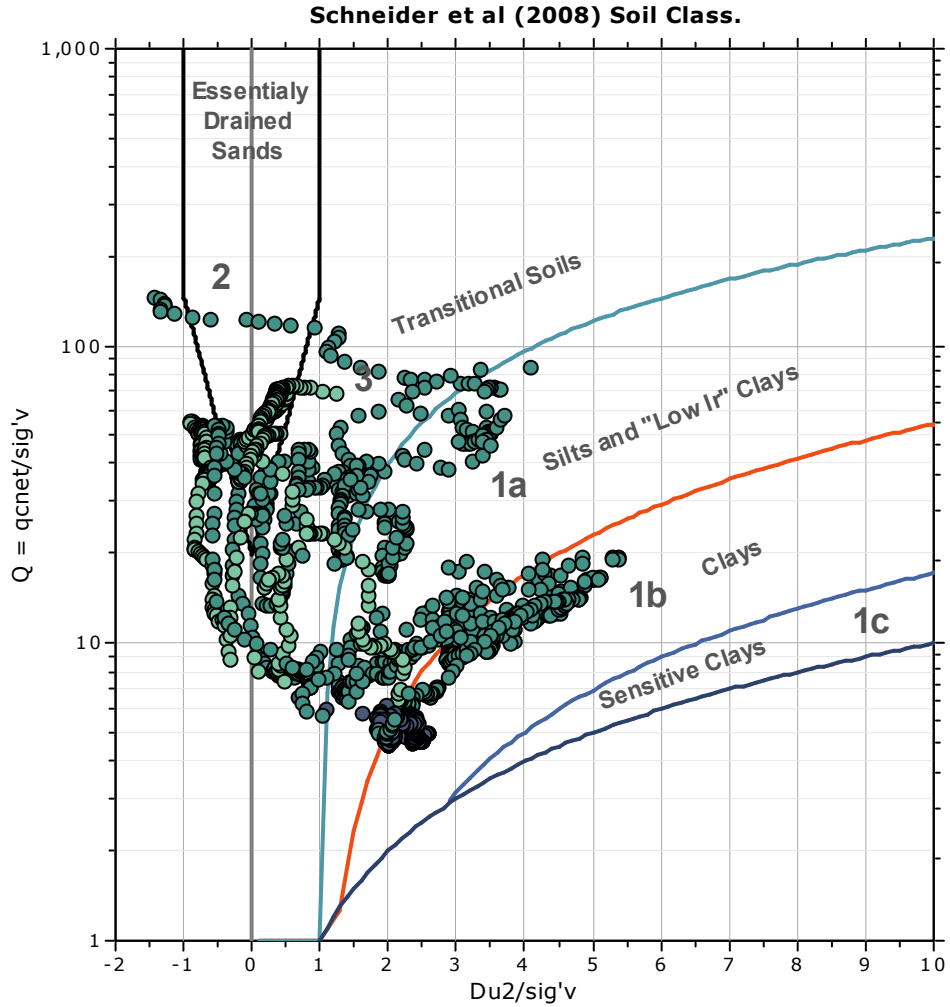
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

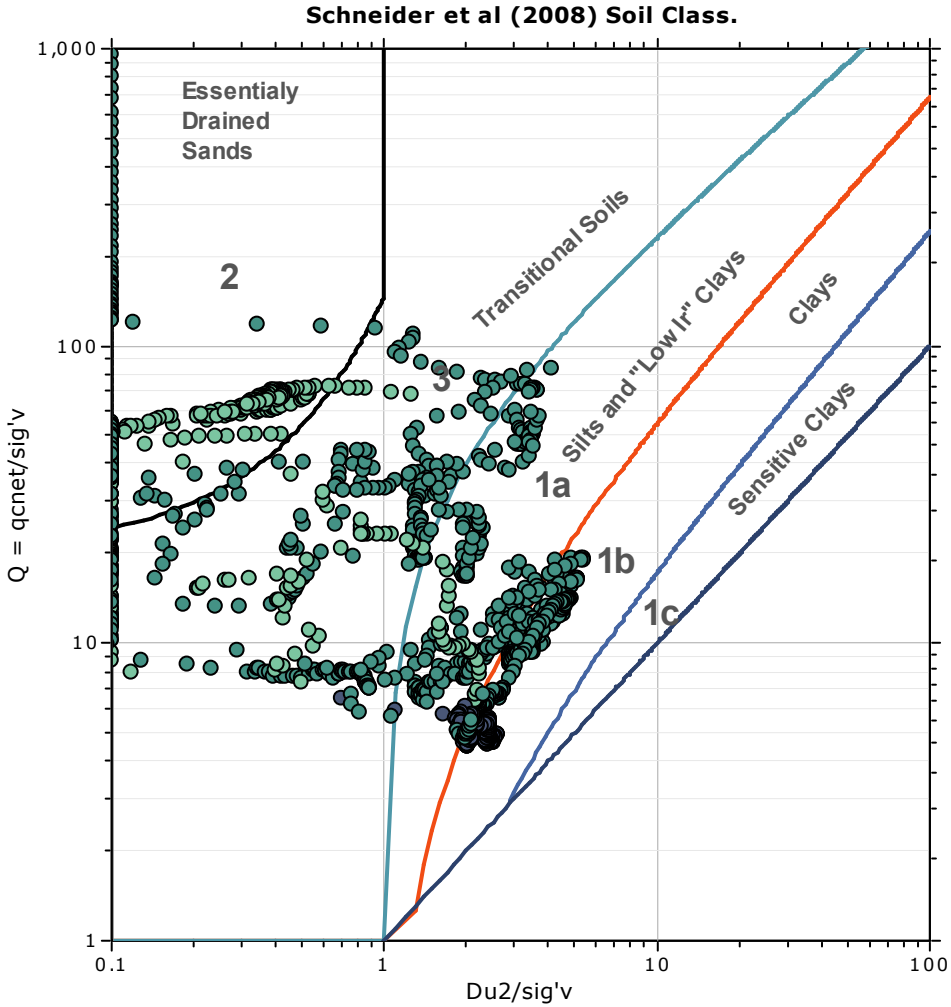
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

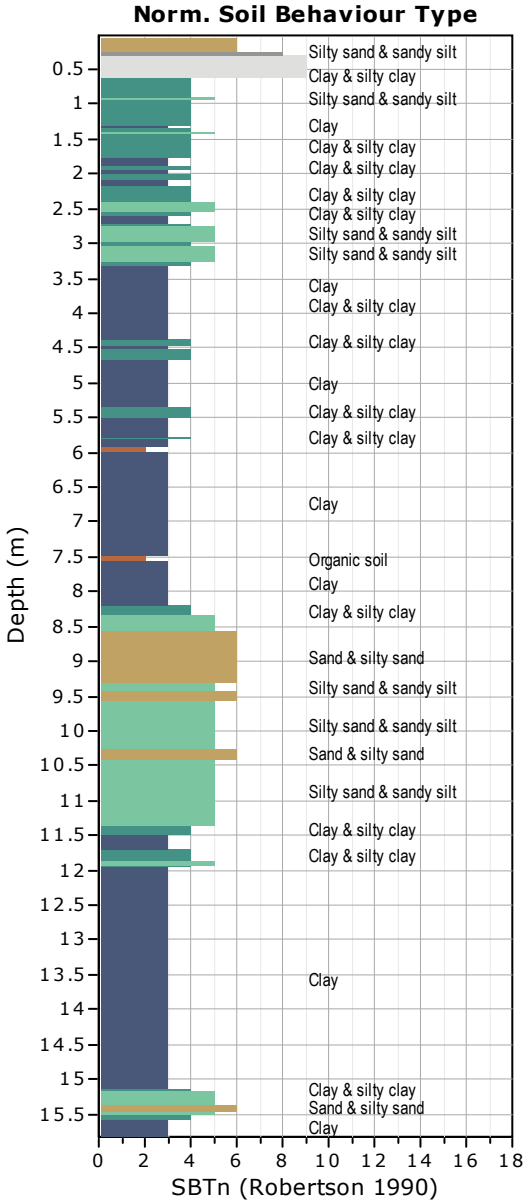


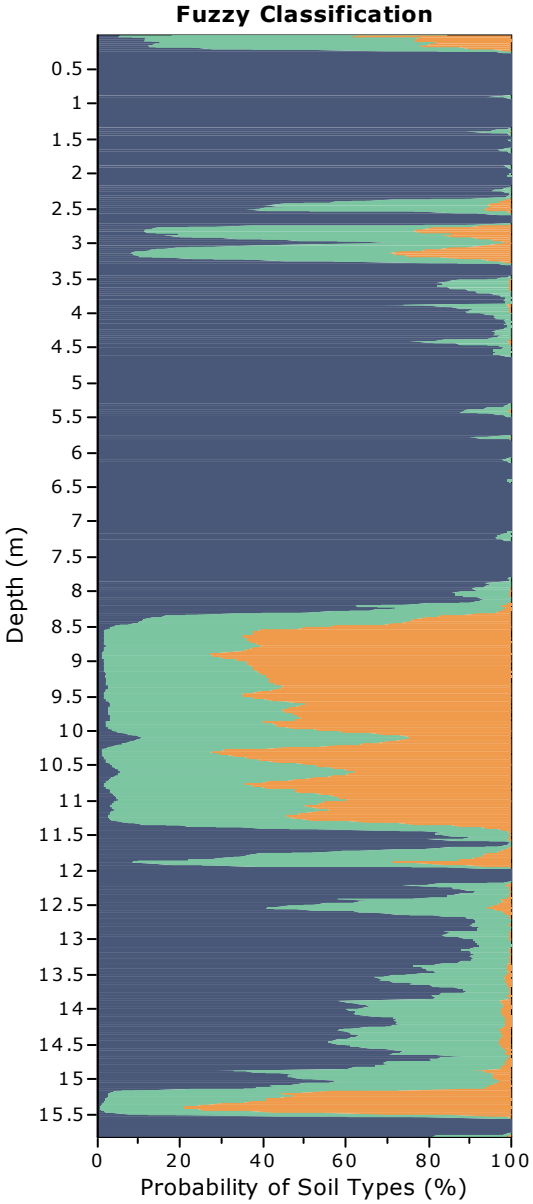


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rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

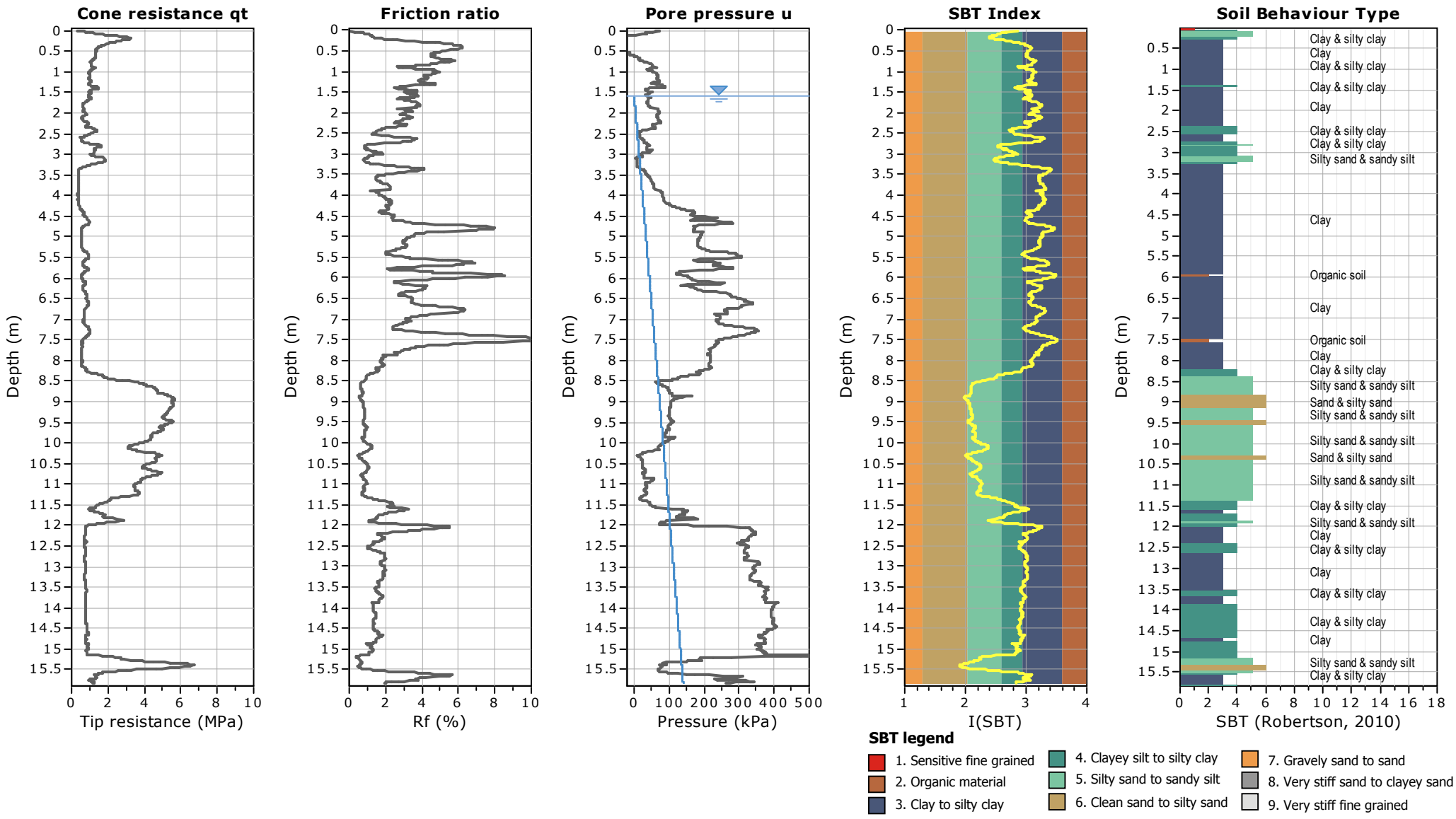




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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

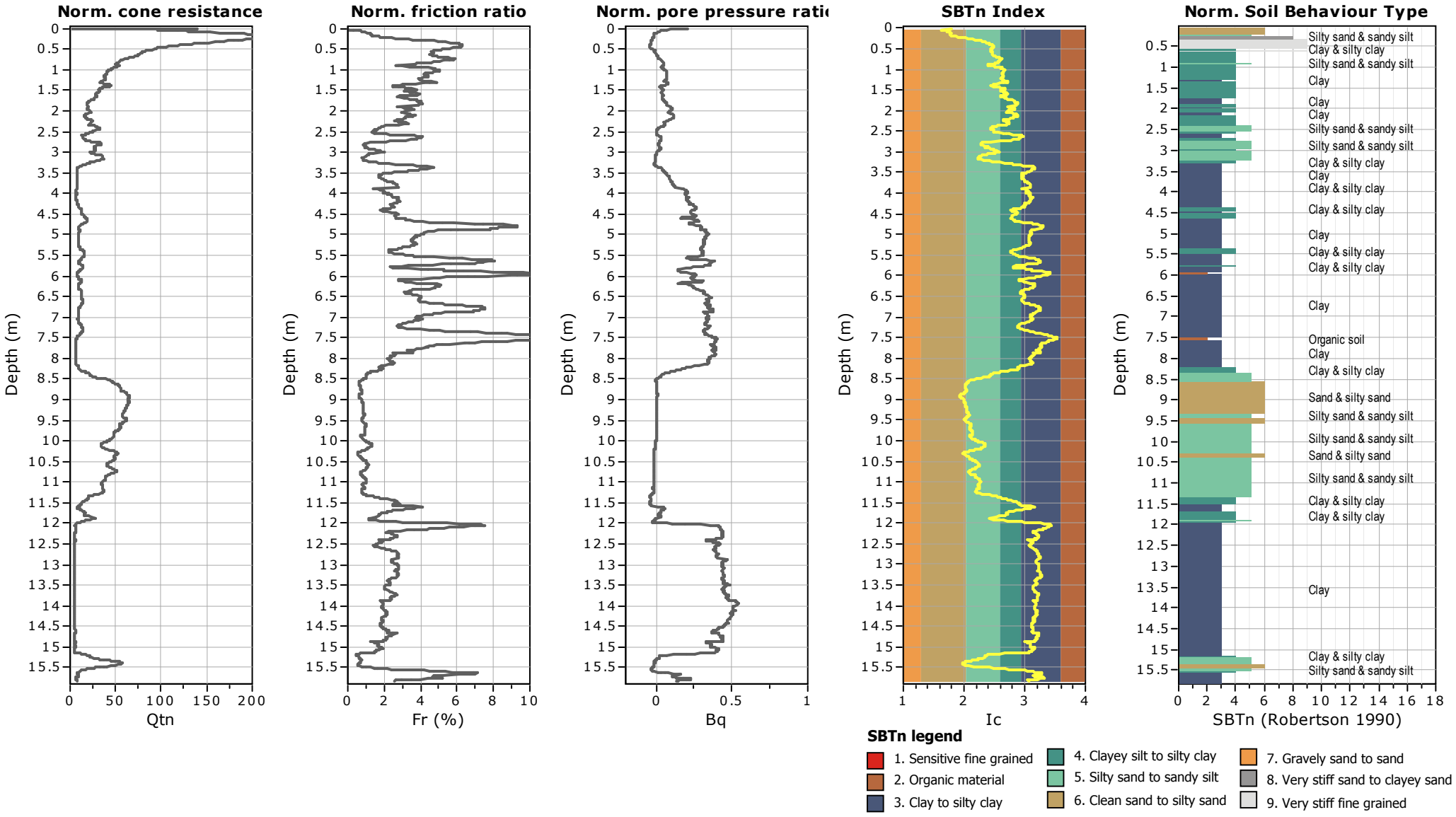
CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

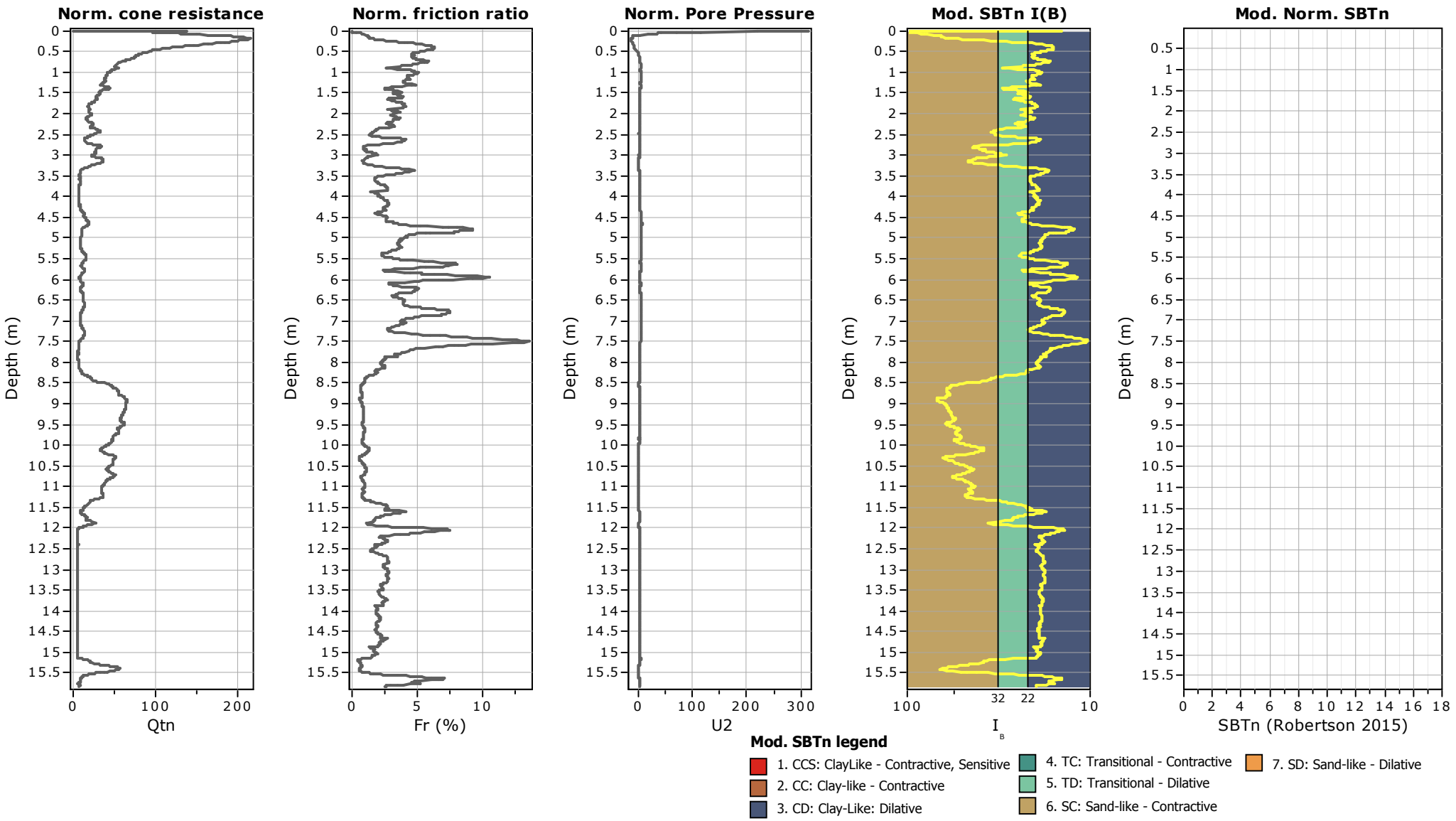
CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

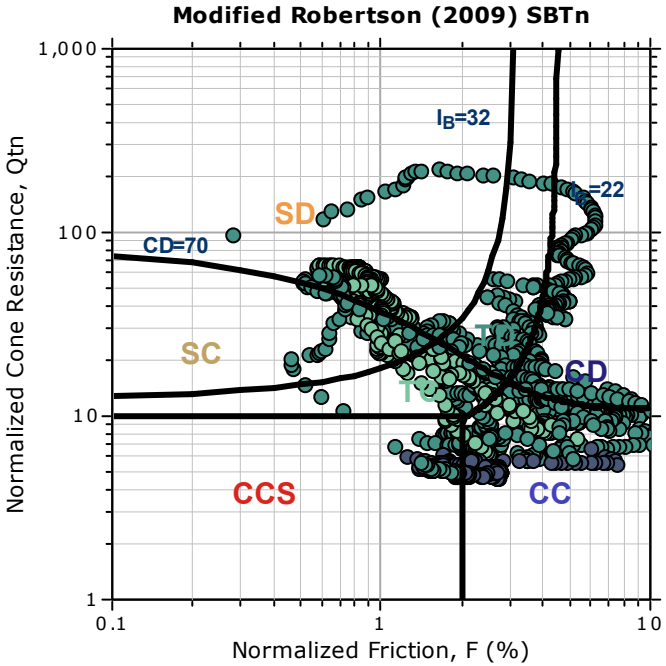


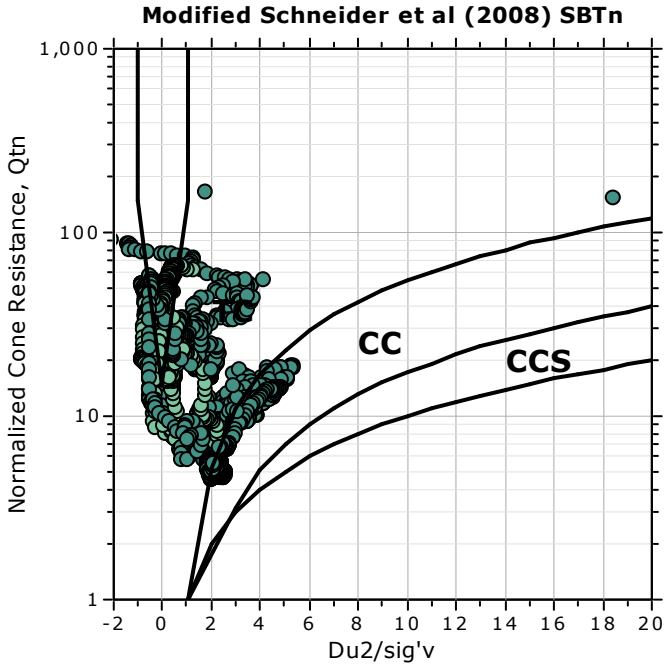
RDR SrL
Bologna Via Toscana 119
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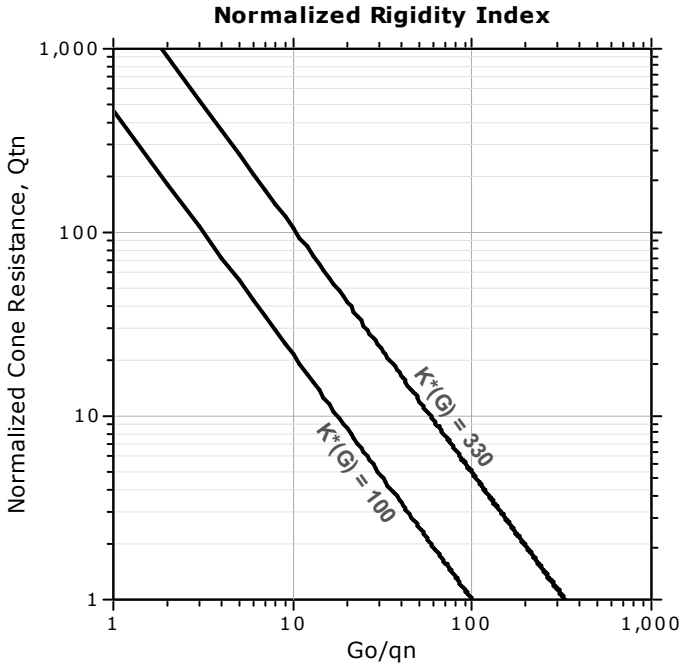
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







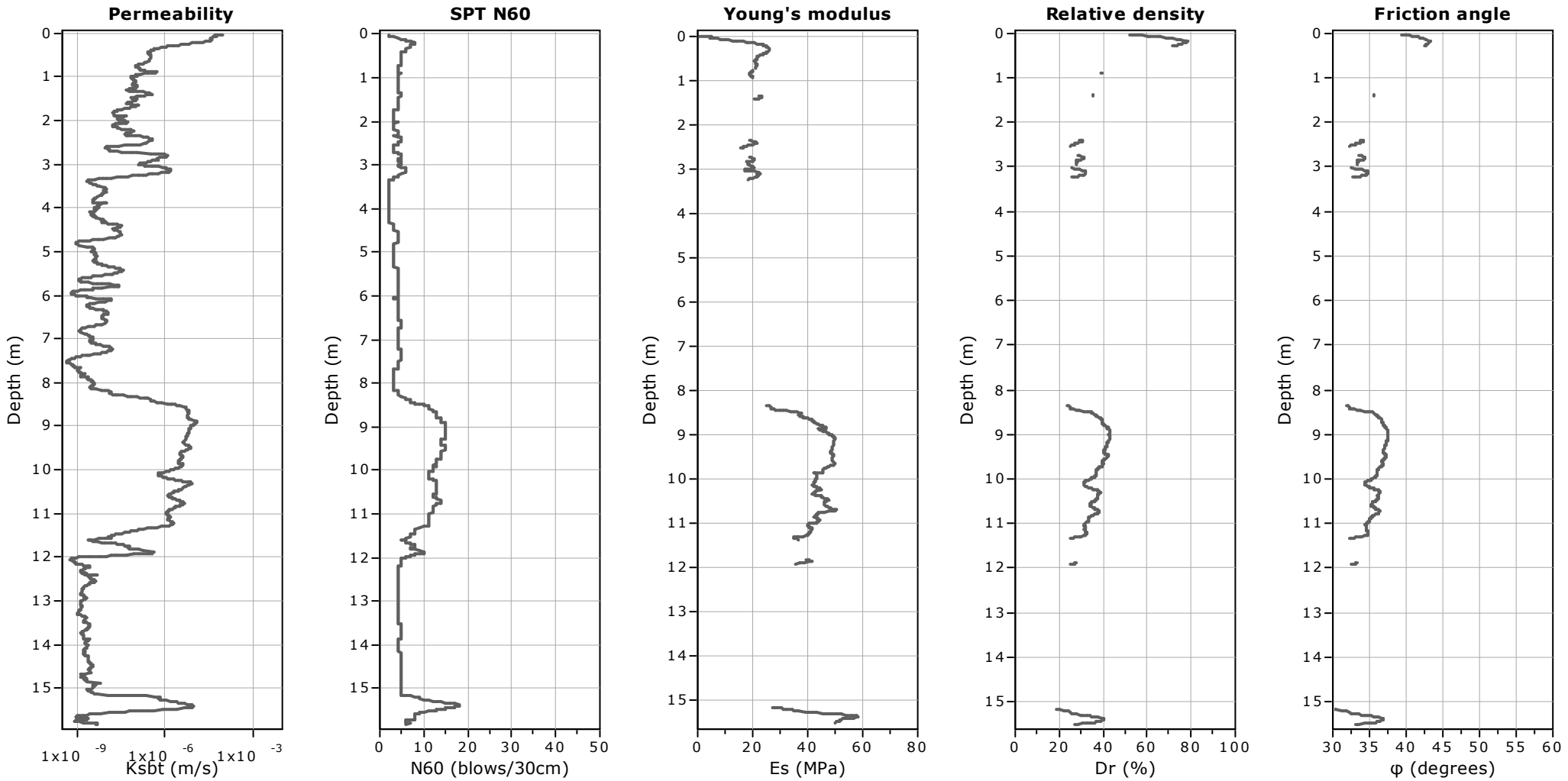
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



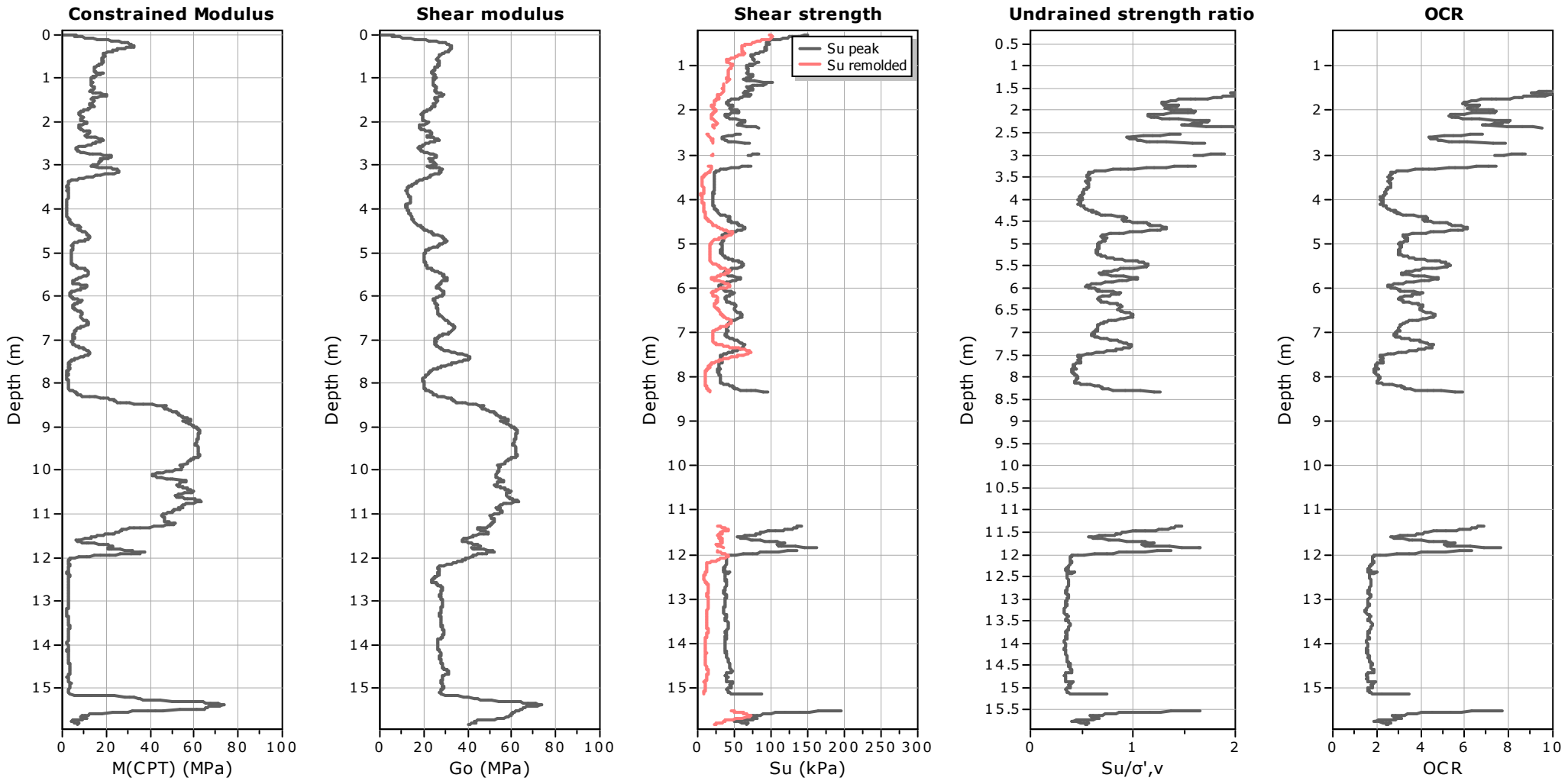
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



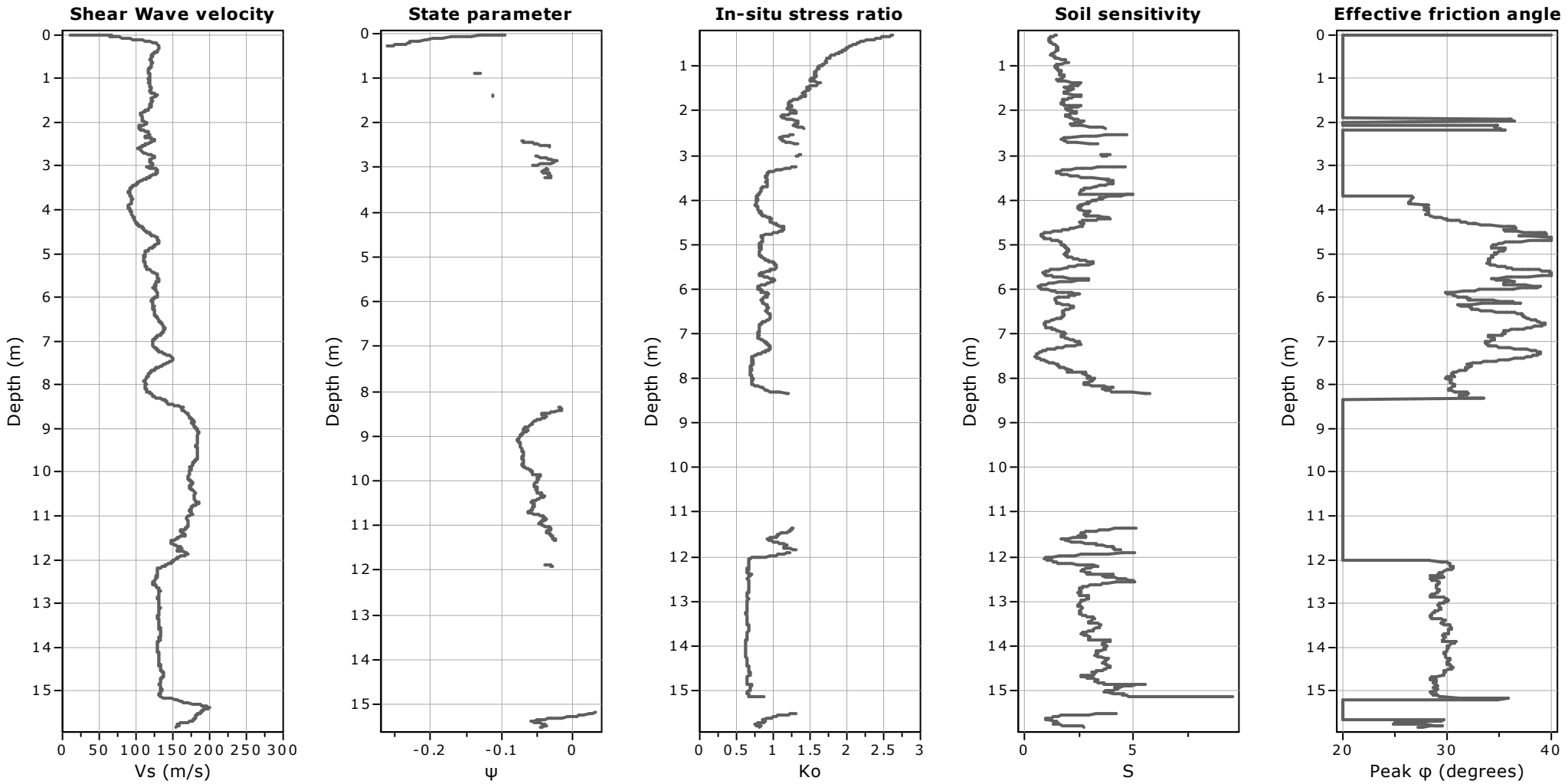
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



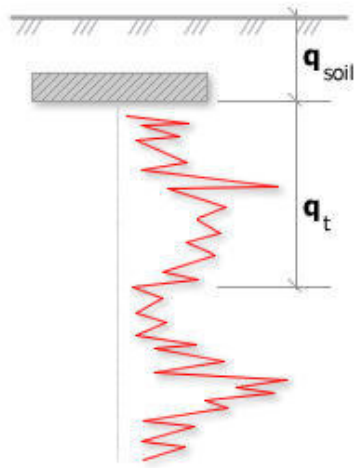
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

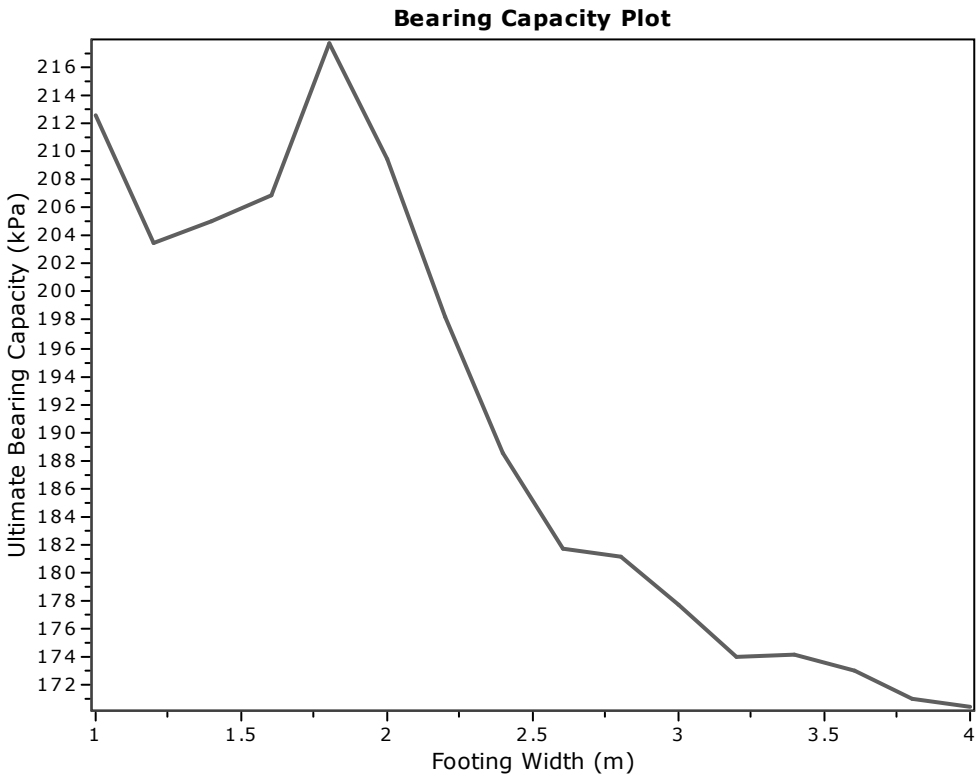
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



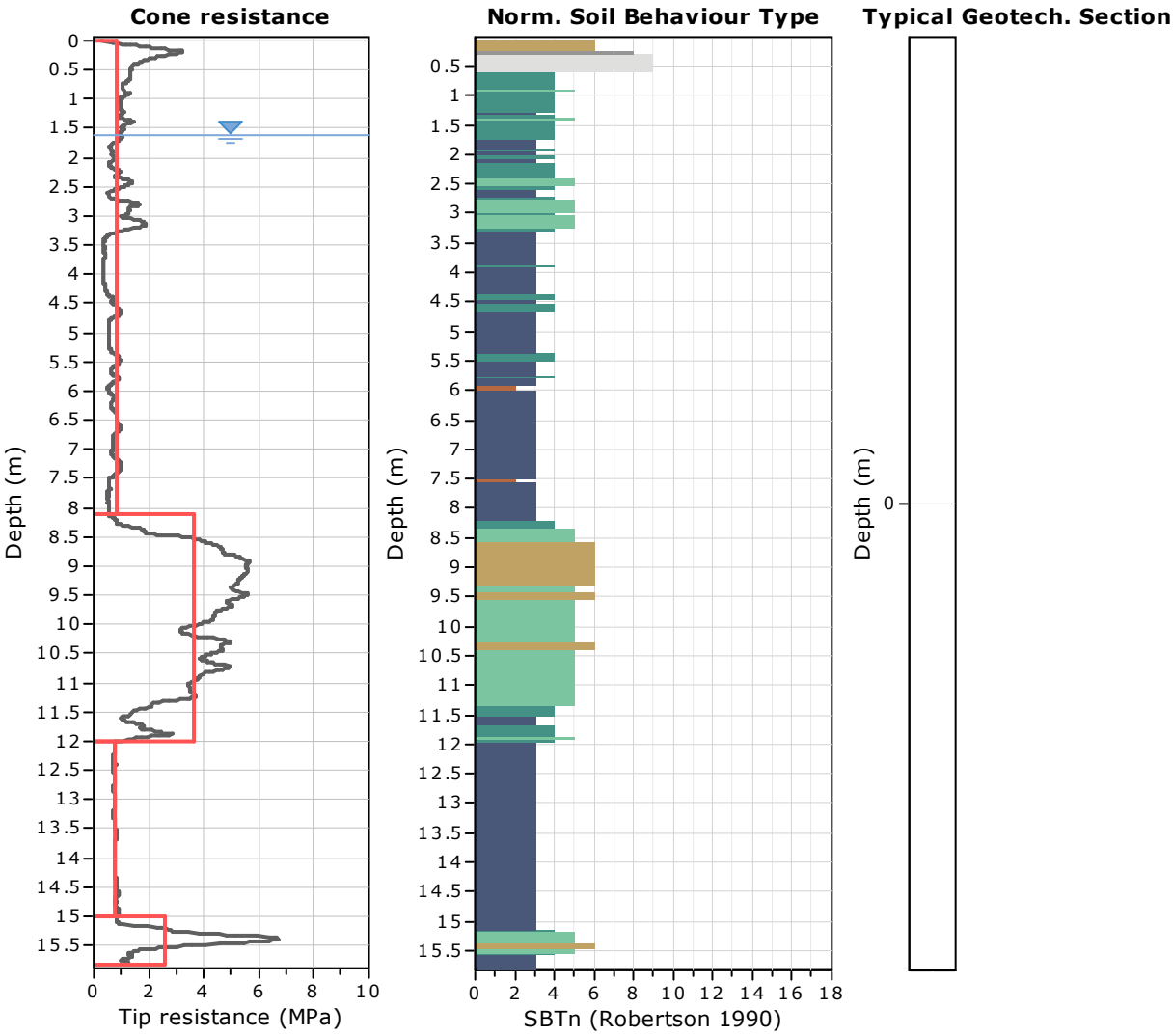
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.02	0.20	9.50	212.50
2	1.20	0.50	2.30	0.97	0.20	9.50	203.46
3	1.40	0.50	2.60	0.98	0.20	9.50	205.01
4	1.60	0.50	2.90	0.99	0.20	9.50	206.89
5	1.80	0.50	3.20	1.04	0.20	9.50	217.66
6	2.00	0.50	3.50	1.00	0.20	9.50	209.42
7	2.20	0.50	3.80	0.94	0.20	9.50	198.24
8	2.40	0.50	4.10	0.90	0.20	9.50	188.55
9	2.60	0.50	4.40	0.86	0.20	9.50	181.79
10	2.80	0.50	4.70	0.86	0.20	9.50	181.23
11	3.00	0.50	5.00	0.84	0.20	9.50	177.73
12	3.20	0.50	5.30	0.82	0.20	9.50	174.12
13	3.40	0.50	5.60	0.82	0.20	9.50	174.14
14	3.60	0.50	5.90	0.82	0.20	9.50	173.01
15	3.80	0.50	6.20	0.81	0.20	9.50	171.14
16	4.00	0.50	6.50	0.81	0.20	9.50	170.51

RDR SrL
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 8.10 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 0.85 ±0.44 MPa	Permeability: 1.04E-06 ±6.49E-06 m/s	Constrained Mod.: 9.60 ±6.43 MPa
Sleeve friction: 28.20 ±18.73 kPa	N60: 3.78 ±1.09 blows	Go: 23.80 ±5.98 MPa
SBT_n: 4	Es: 20.65 ±3.93 MPa	Su: 48.54 ±21.44 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 1.48 ±1.73
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 6.82 ±7.97
	Unit weight: 16.50 ±0.88 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 8.10 (m), **End depth:** 12.00 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.66 ±1.48 MPa	Permeability: 2.88E-06 ±2.73E-06 m/s	Constrained Mod.: 44.55 ±17.96 MPa
Sleeve friction: 33.27 ±8.73 kPa	N60: 11.18 ±3.21 blows	Go: 51.33 ±10.05 MPa
SBT_n: 5	Es: 43.96 ±5.01 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 36.46 ±4.66	Su ratio: 0.00 ±0.00
	φ (degrees): 35.86 ±1.29 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.42 ±0.55 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 12.00 (m), **End depth:** 15.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.78 ±0.05 MPa	Permeability: 1.99E-09 ±8.20E-10 m/s	Constrained Mod.: 2.81 ±0.38 MPa
Sleeve friction: 13.36 ±5.52 kPa	N60: 4.46 ±0.51 blows	Go: 28.16 ±2.47 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 39.36 ±2.89 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.02
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.68 ±0.11
	Unit weight: 15.81 ±0.32 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 15.00 (m), **End depth:** 15.83 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.60 ±1.91 MPa	Permeability: 1.32E-06 ±2.48E-06 m/s	Constrained Mod.: 27.74 ±25.00 MPa
Sleeve friction: 33.04 ±19.72 kPa	N60: 9.58 ±4.15 blows	Go: 50.18 ±14.63 MPa
SBT_n: 4	Es: 49.92 ±49.92 MPa	Su: 72.39 ±34.51 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.60 ±0.29
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.77 ±1.33
	Unit weight: 17.03 ±0.94 kN/m³	

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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

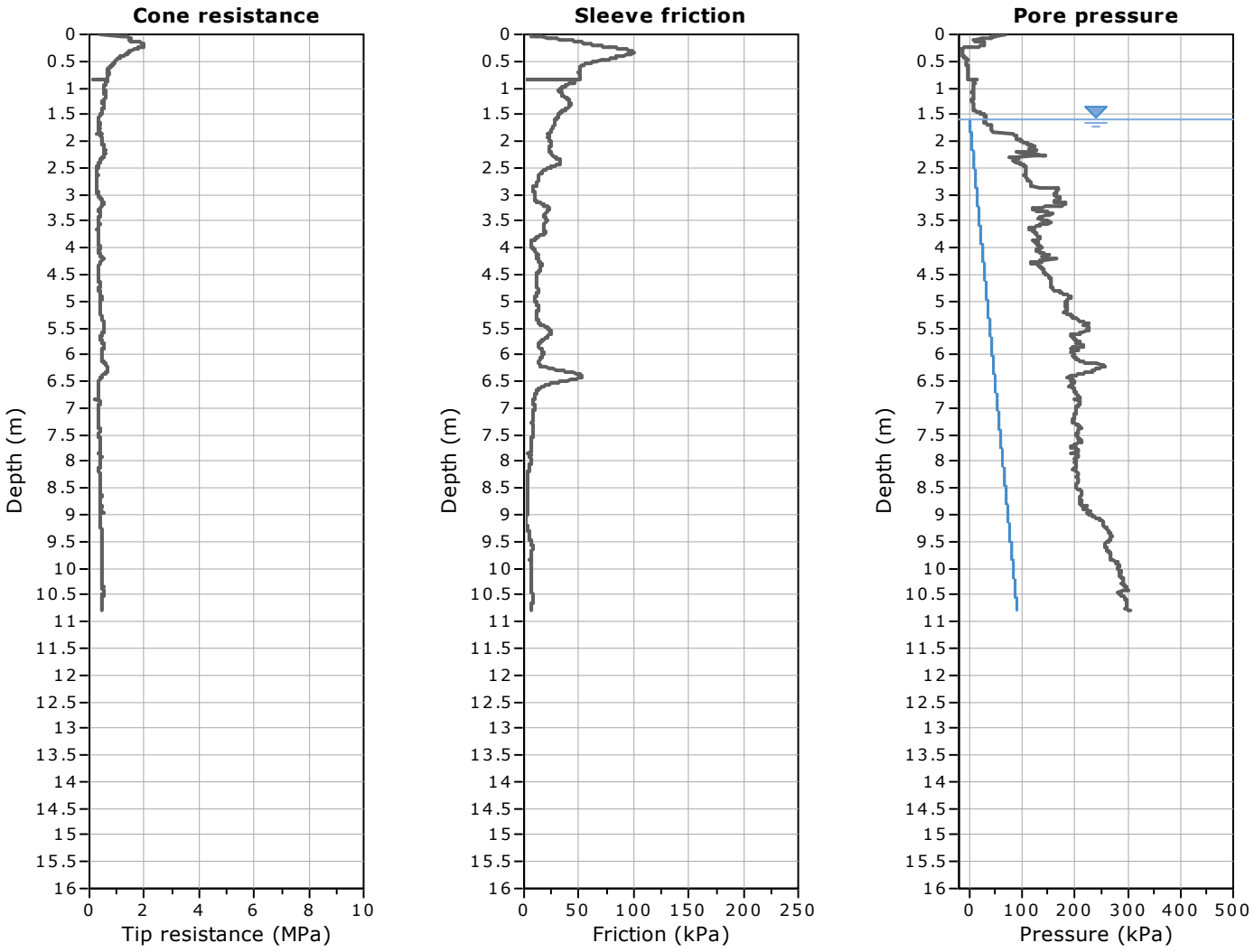
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	8.10	1.04E-06	3.8	20.7	0.0	0.0	9.6	23.8	48.5	1.5	6.8	16.5
8.10		(±6.49E-06)	(±1.1)	(±3.9)	(±0.0)	(±0.0)	(±6.4)	(±6.0)	(±21.4)	(±1.7)	(±8.0)	(±0.9)
8.10	3.90	2.88E-06	11.2	44.0	36.5	35.9	44.5	51.3	0.0	0.0	0.0	17.4
12.00		(±2.73E-06)	(±3.2)	(±5.0)	(±4.7)	(±1.3)	(±18.0)	(±10.1)	(±0.0)	(±0.0)	(±0.0)	(±0.6)
12.00	3.00	1.99E-09	4.5	0.0	0.0	0.0	2.8	28.2	39.4	0.4	1.7	15.8
15.00		(±8.20E-10)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±0.4)	(±2.5)	(±2.9)	(±0.0)	(±0.1)	(±0.3)
15.00	0.83	1.32E-06	9.6	49.9	0.0	0.0	27.7	50.2	72.4	0.6	2.8	17.0
15.83		(±2.48E-06)	(±4.2)	(±49.9)	(±0.0)	(±0.0)	(±25.0)	(±14.6)	(±34.5)	(±0.3)	(±1.3)	(±0.9)

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

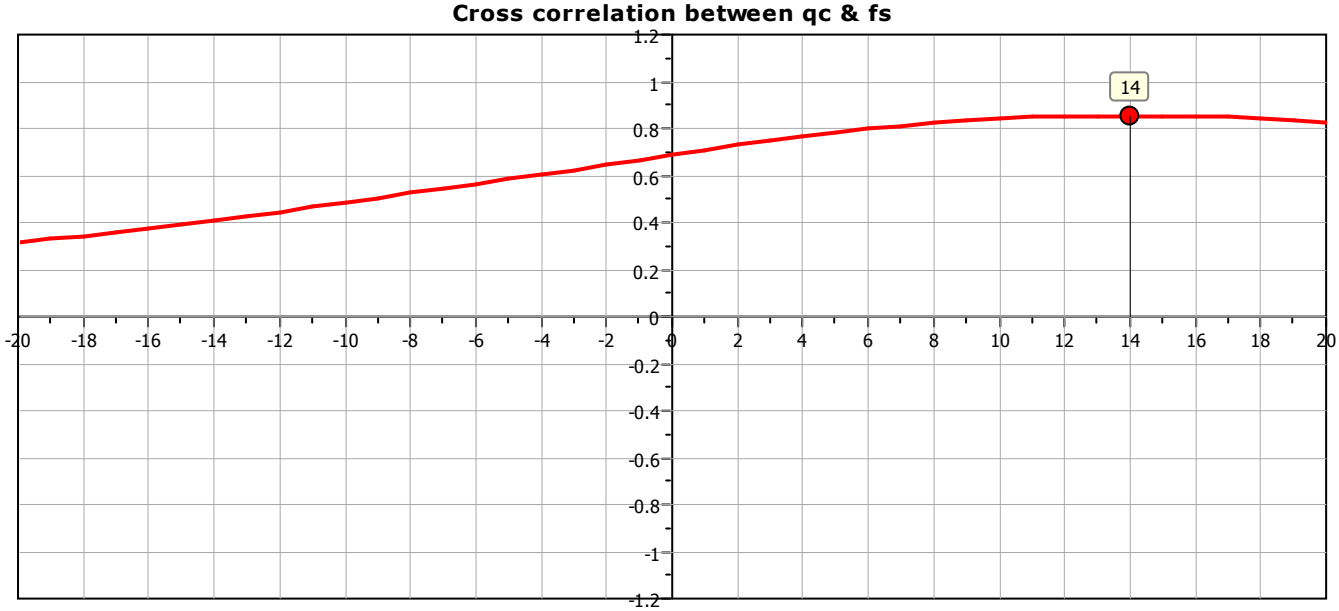
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).



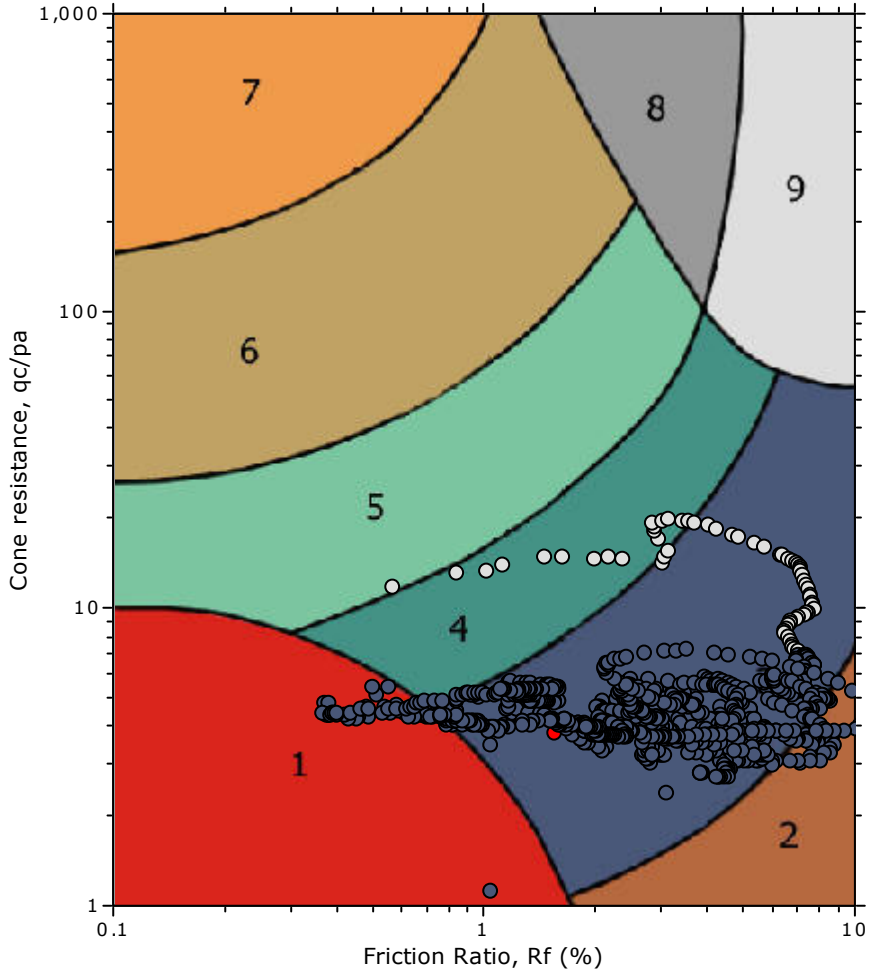
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

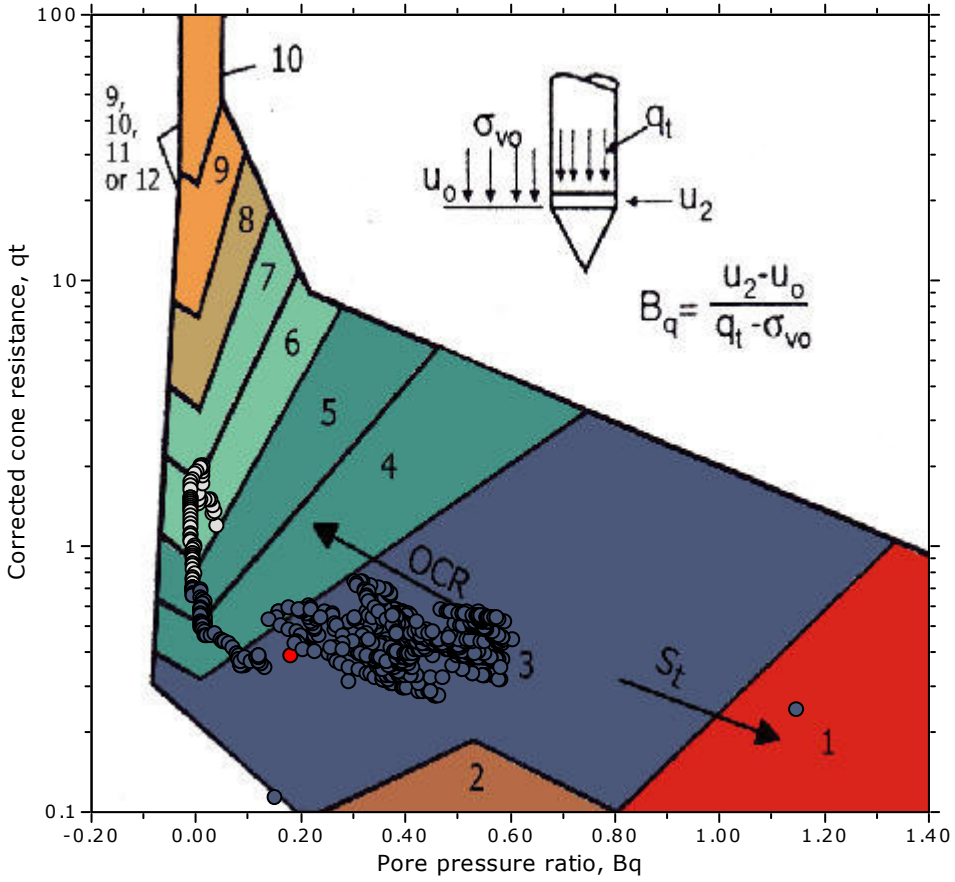
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots

SBT plot



Bq plot



SBT legend

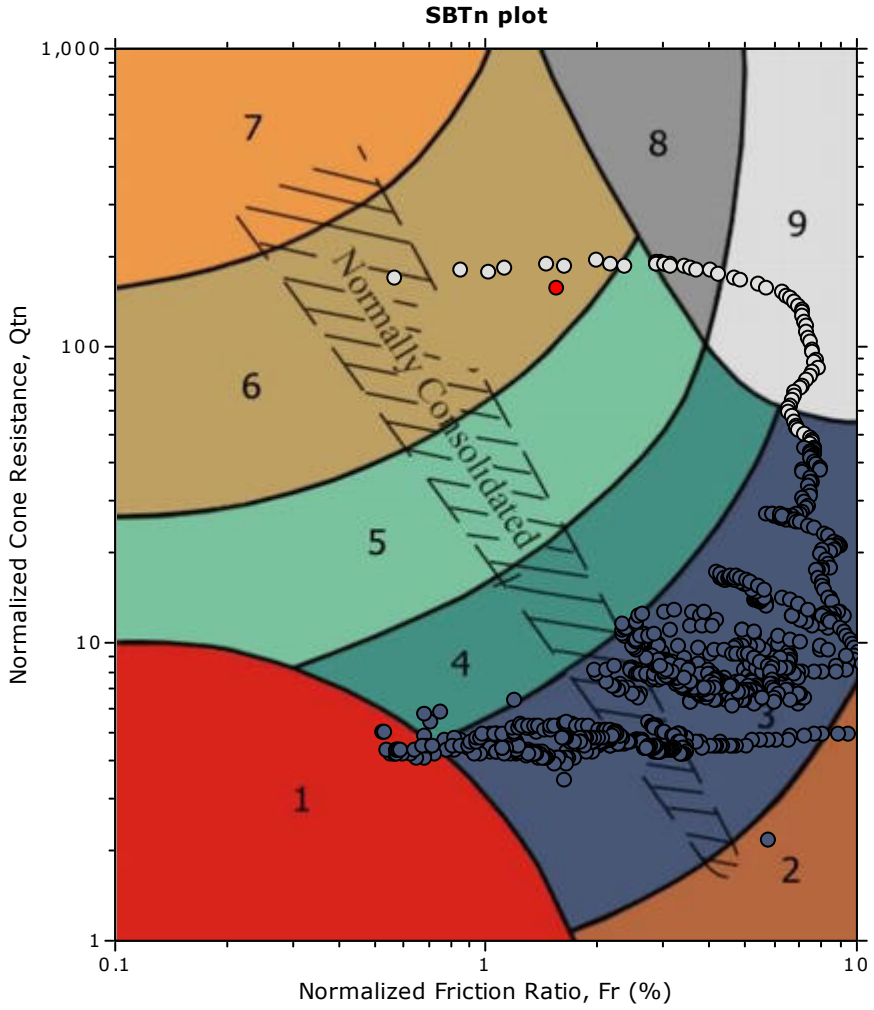
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

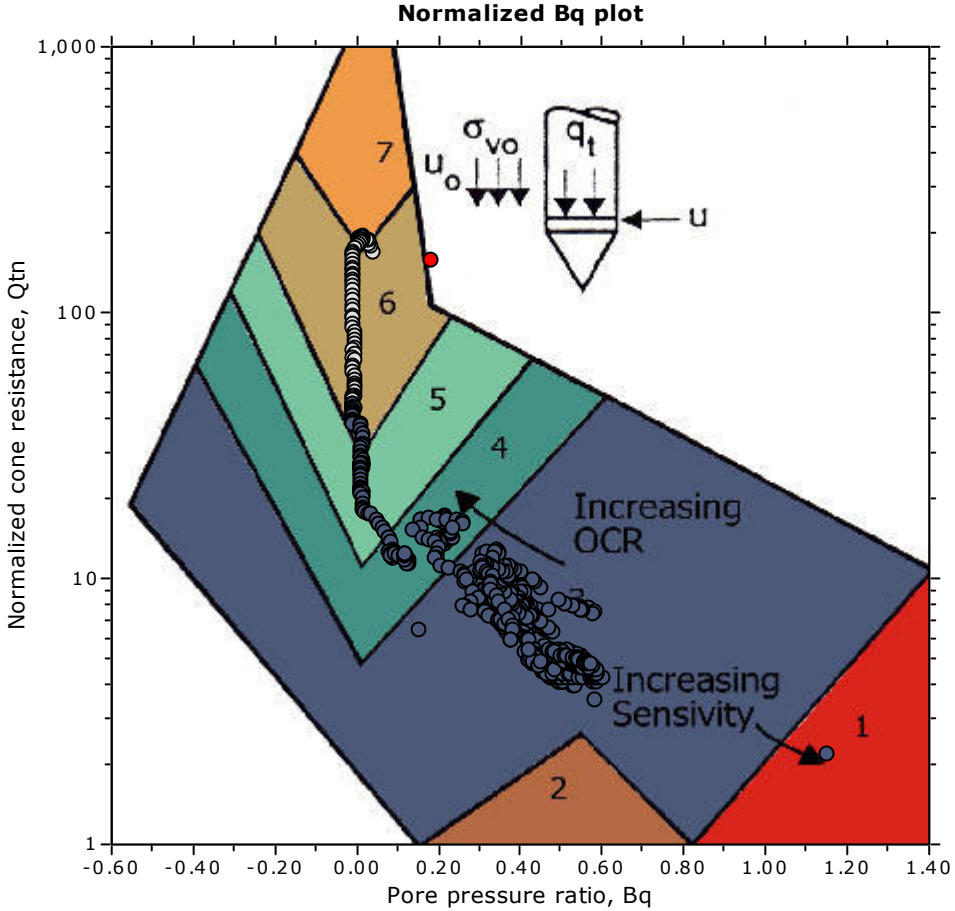
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

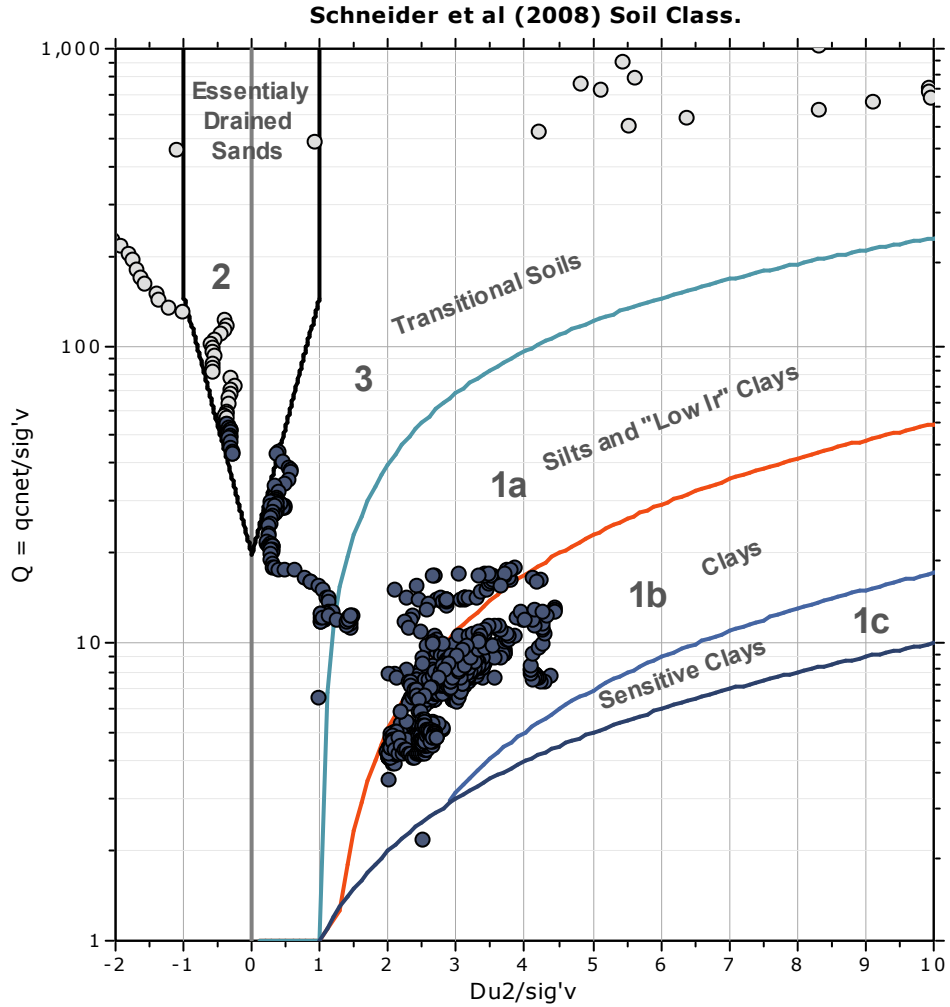
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

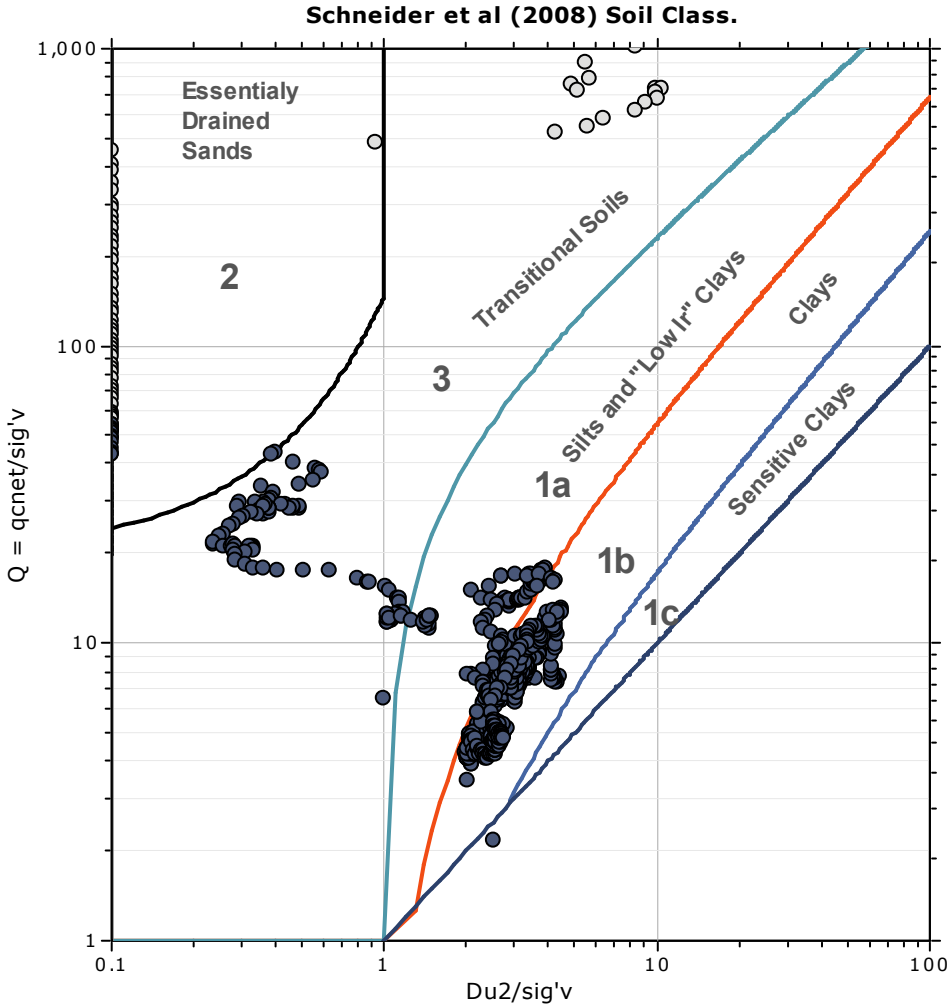
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Bq plots (Schneider)

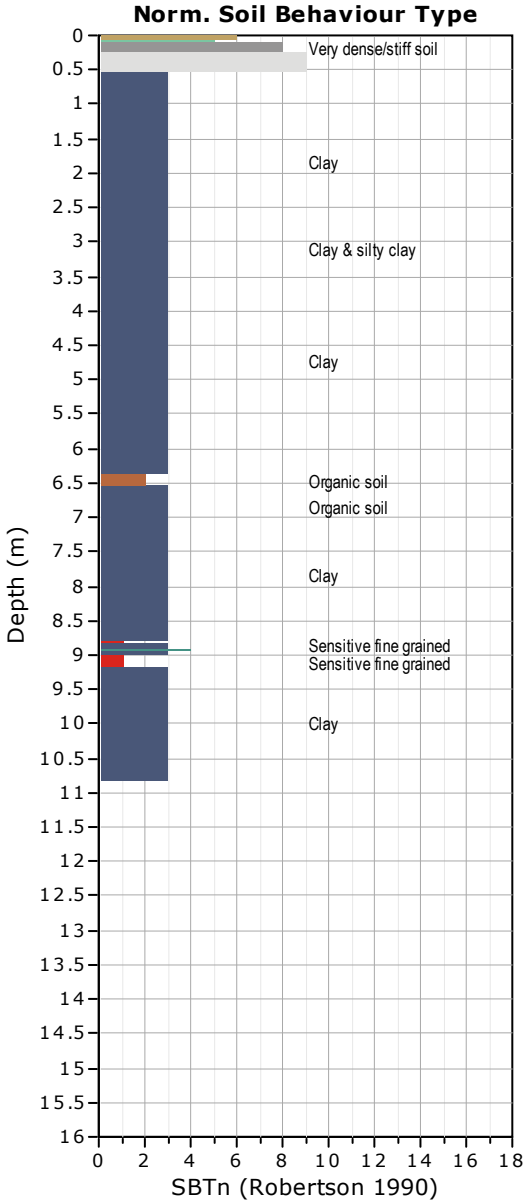


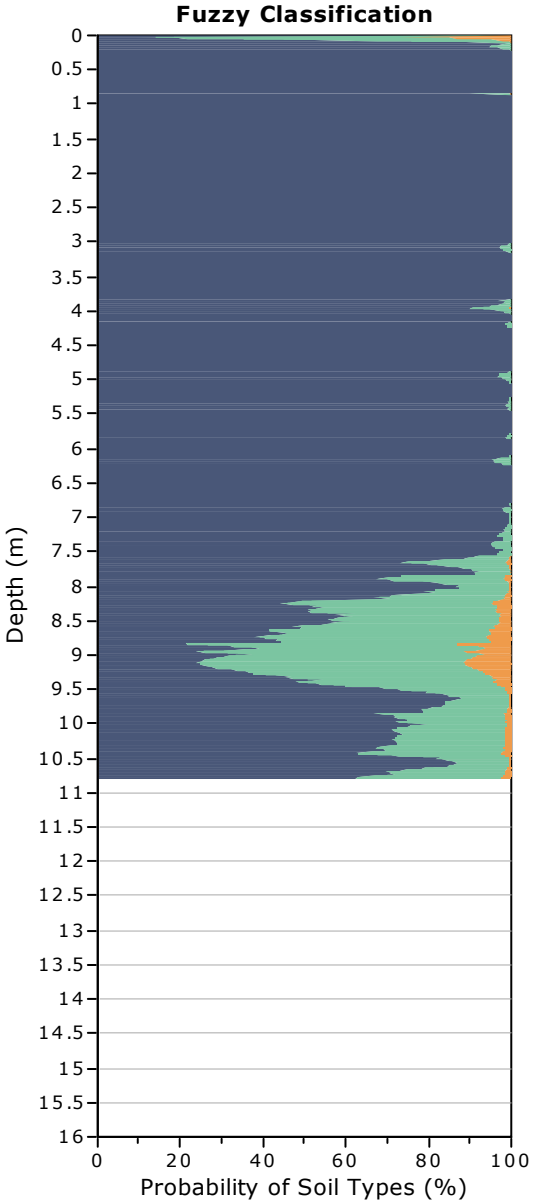


RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

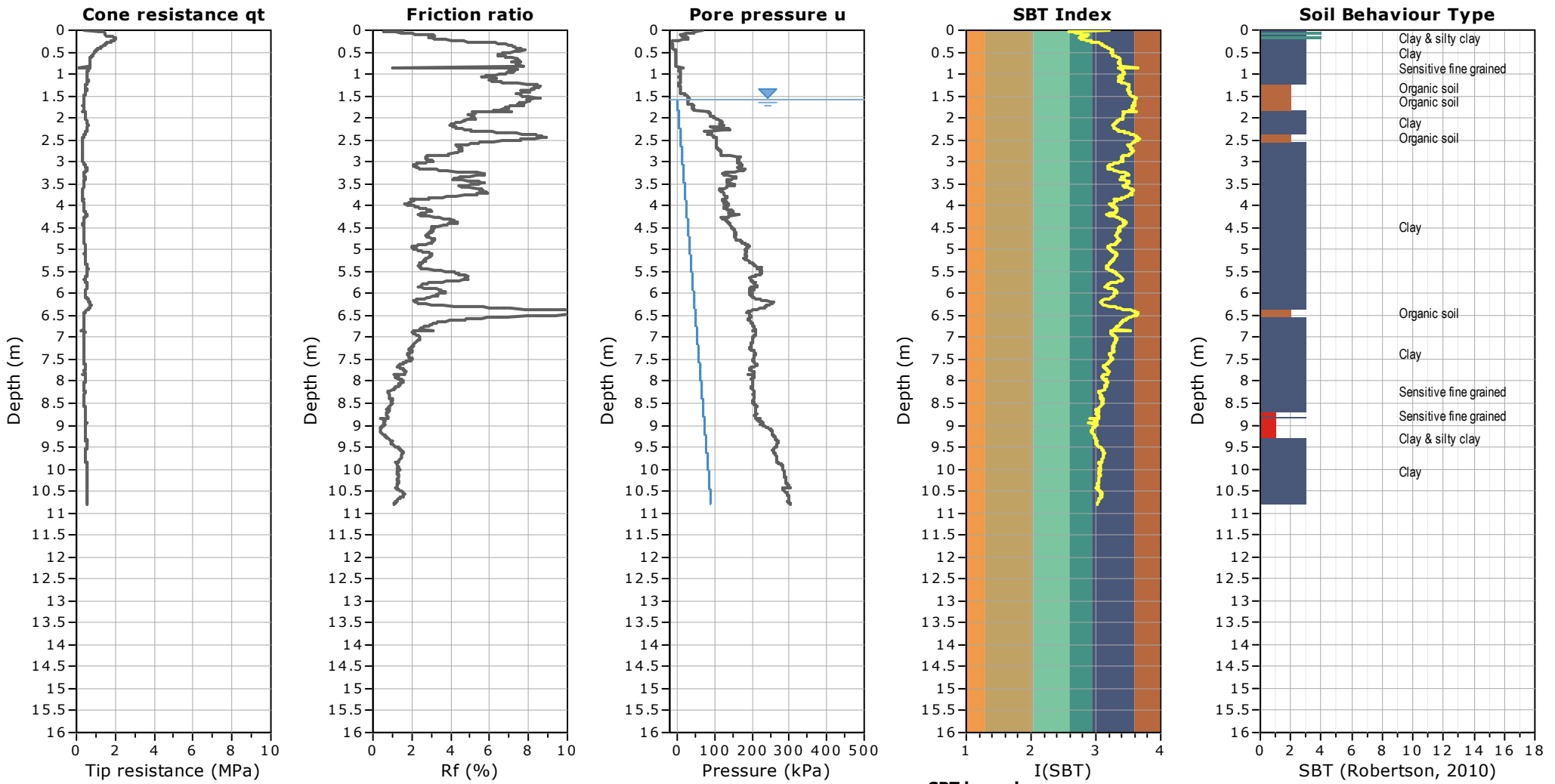




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rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

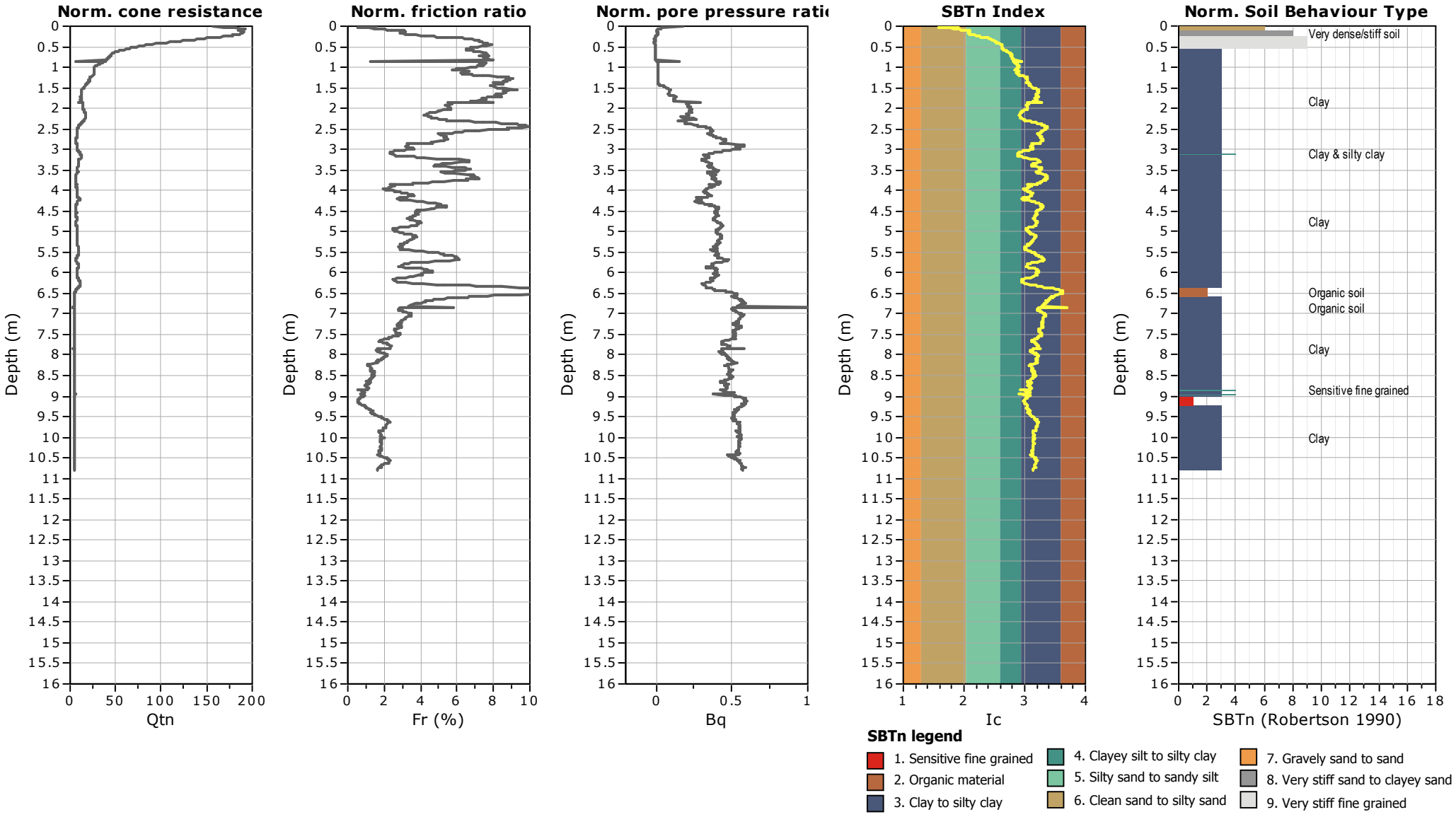
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



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rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

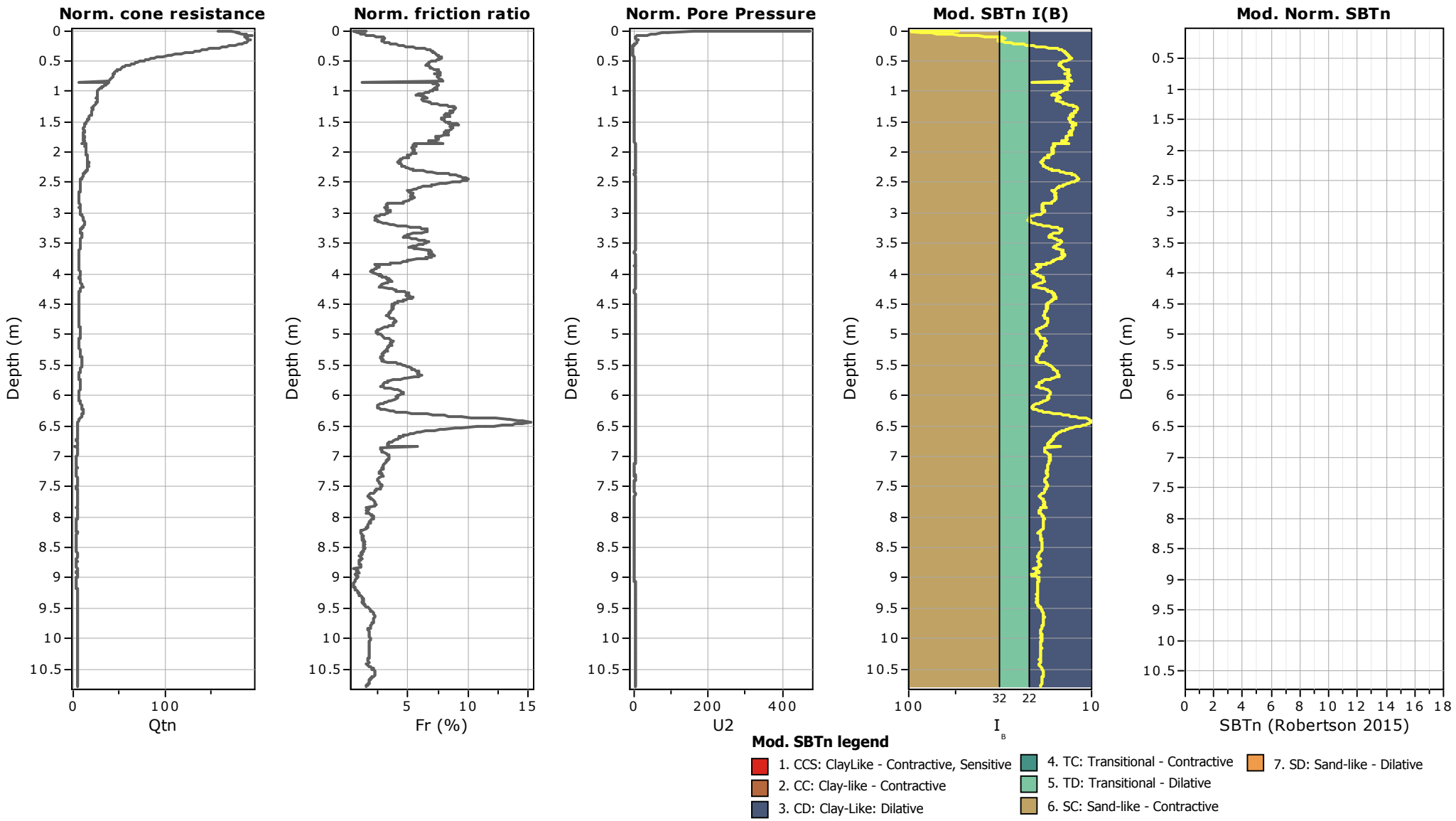
CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

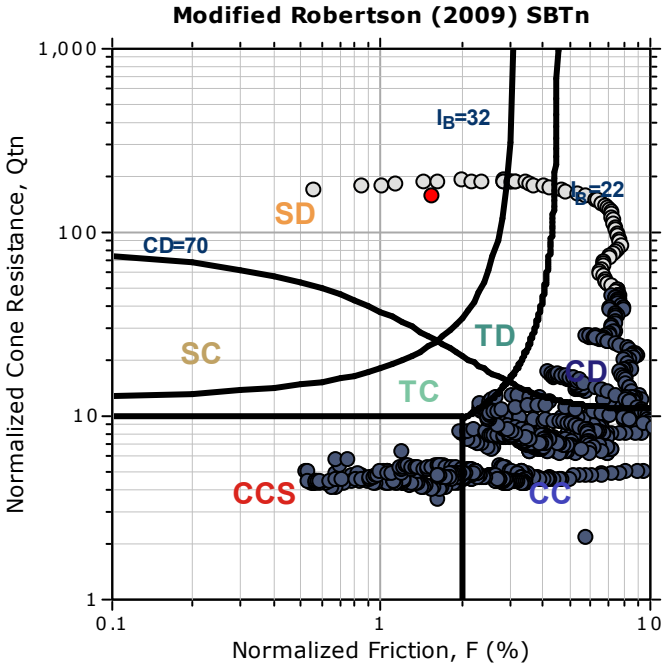


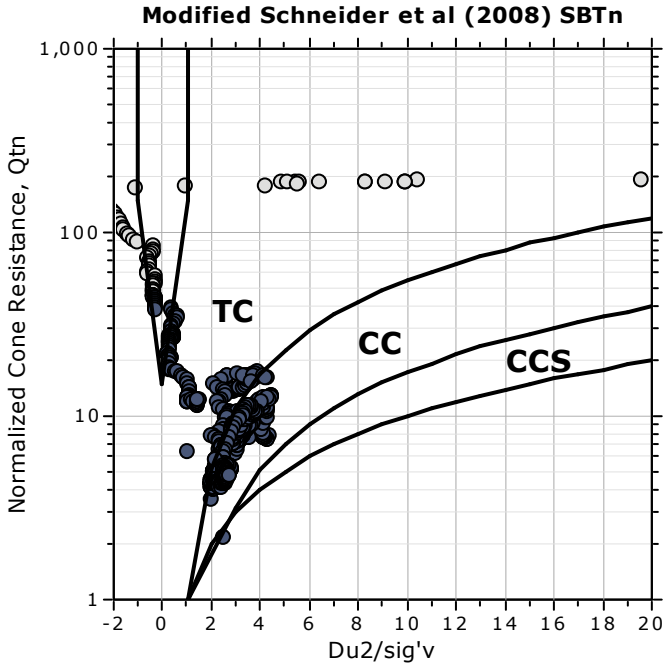
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

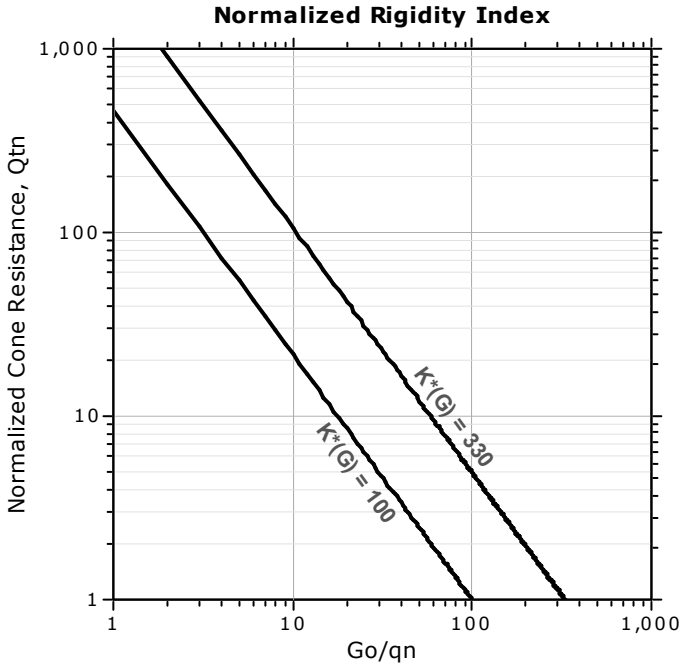
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







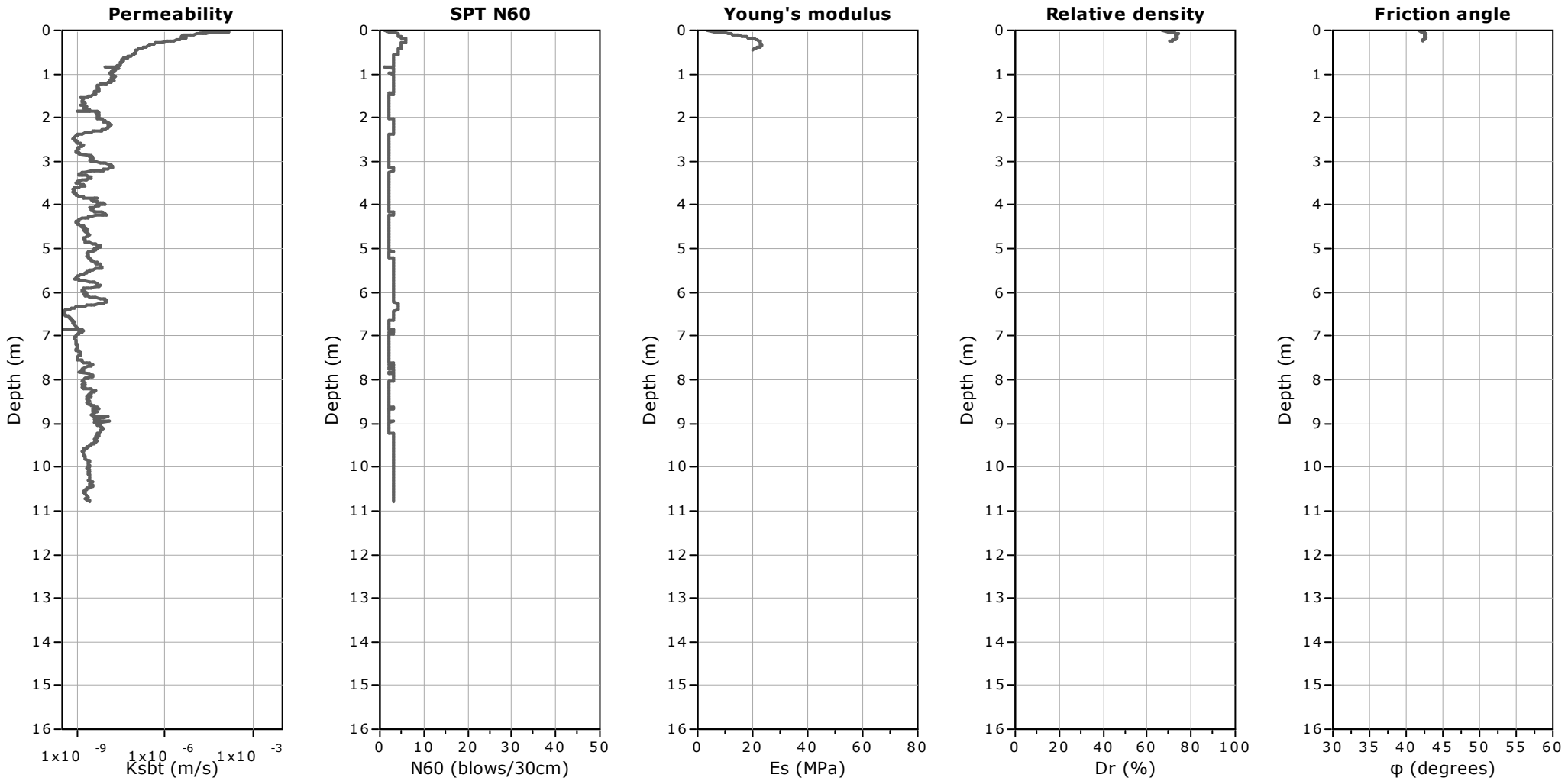
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



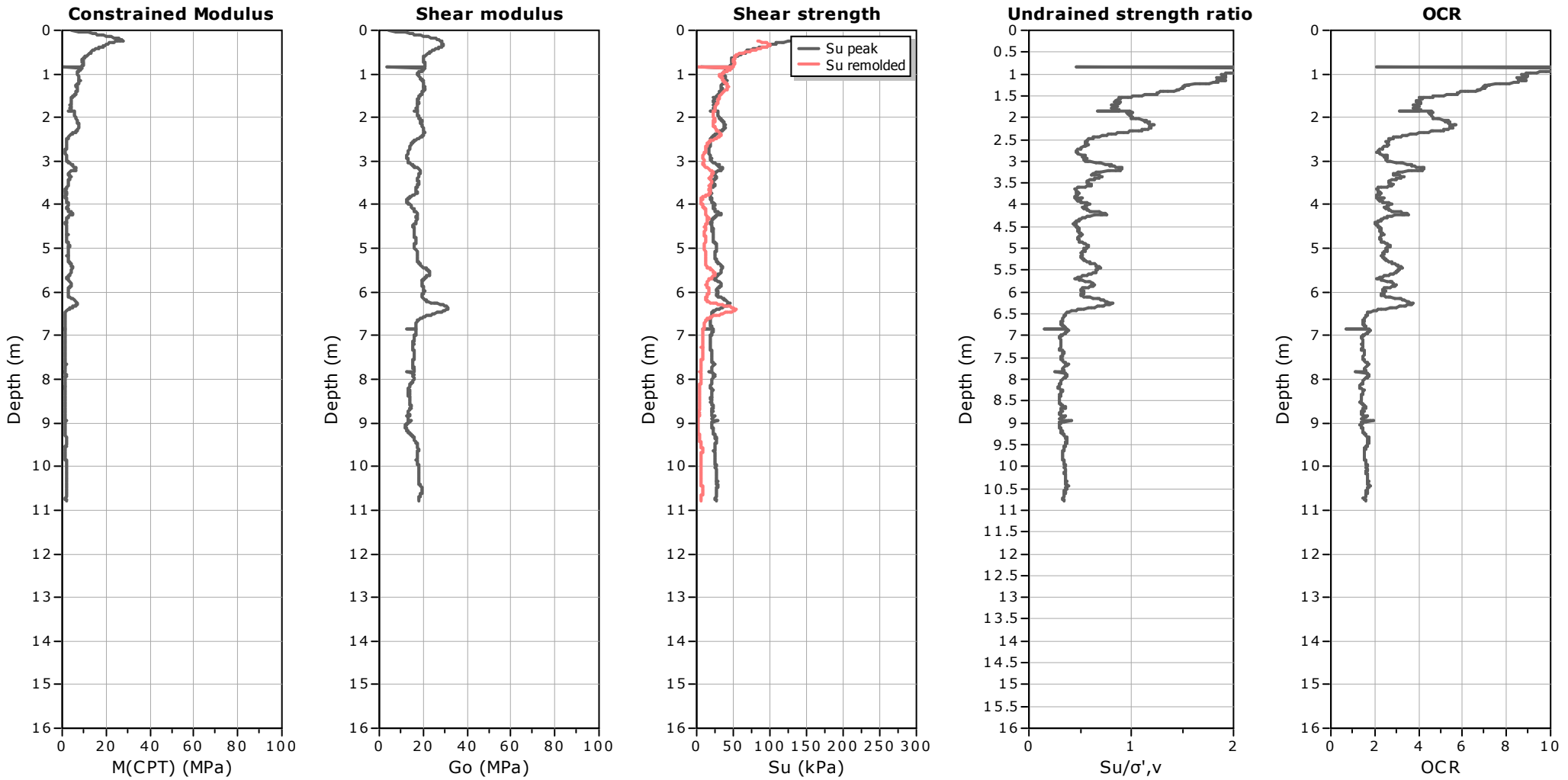
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



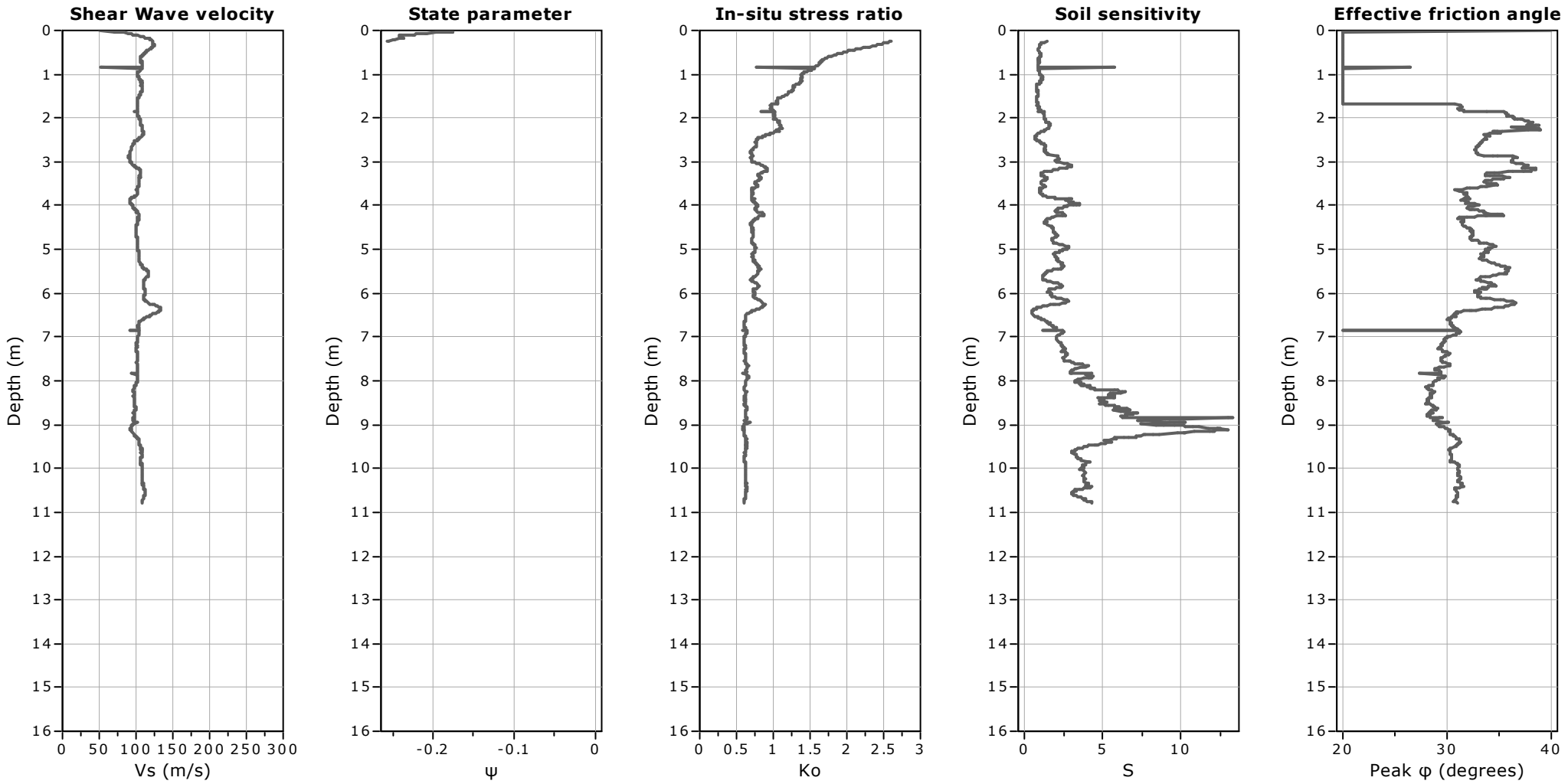
Calculation parameters

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



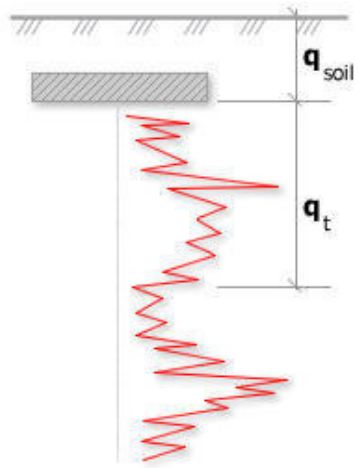
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

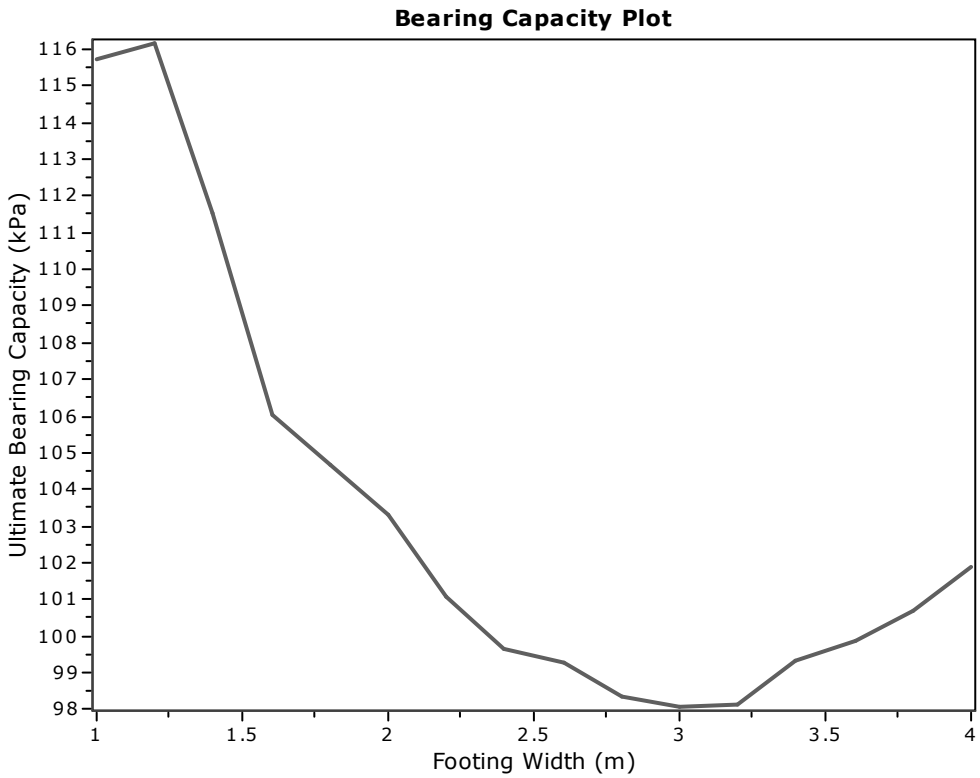
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



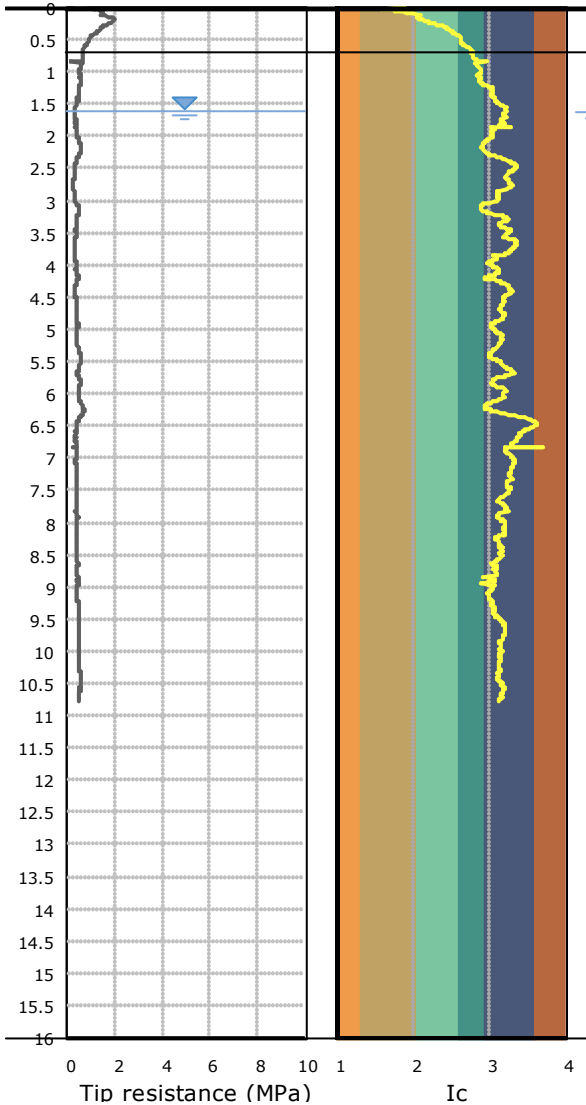
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.53	0.20	9.50	115.73
2	1.20	0.50	2.30	0.53	0.20	9.50	116.16
3	1.40	0.50	2.60	0.51	0.20	9.50	111.53
4	1.60	0.50	2.90	0.48	0.20	9.50	106.02
5	1.80	0.50	3.20	0.48	0.20	9.50	104.67
6	2.00	0.50	3.50	0.47	0.20	9.50	103.33
7	2.20	0.50	3.80	0.46	0.20	9.50	101.09
8	2.40	0.50	4.10	0.45	0.20	9.50	99.67
9	2.60	0.50	4.40	0.45	0.20	9.50	99.28
10	2.80	0.50	4.70	0.44	0.20	9.50	98.32
11	3.00	0.50	5.00	0.44	0.20	9.50	98.07
12	3.20	0.50	5.30	0.44	0.20	9.50	98.11
13	3.40	0.50	5.60	0.45	0.20	9.50	99.31
14	3.60	0.50	5.90	0.45	0.20	9.50	99.89
15	3.80	0.50	6.20	0.46	0.20	9.50	100.70
16	4.00	0.50	6.50	0.46	0.20	9.50	101.88

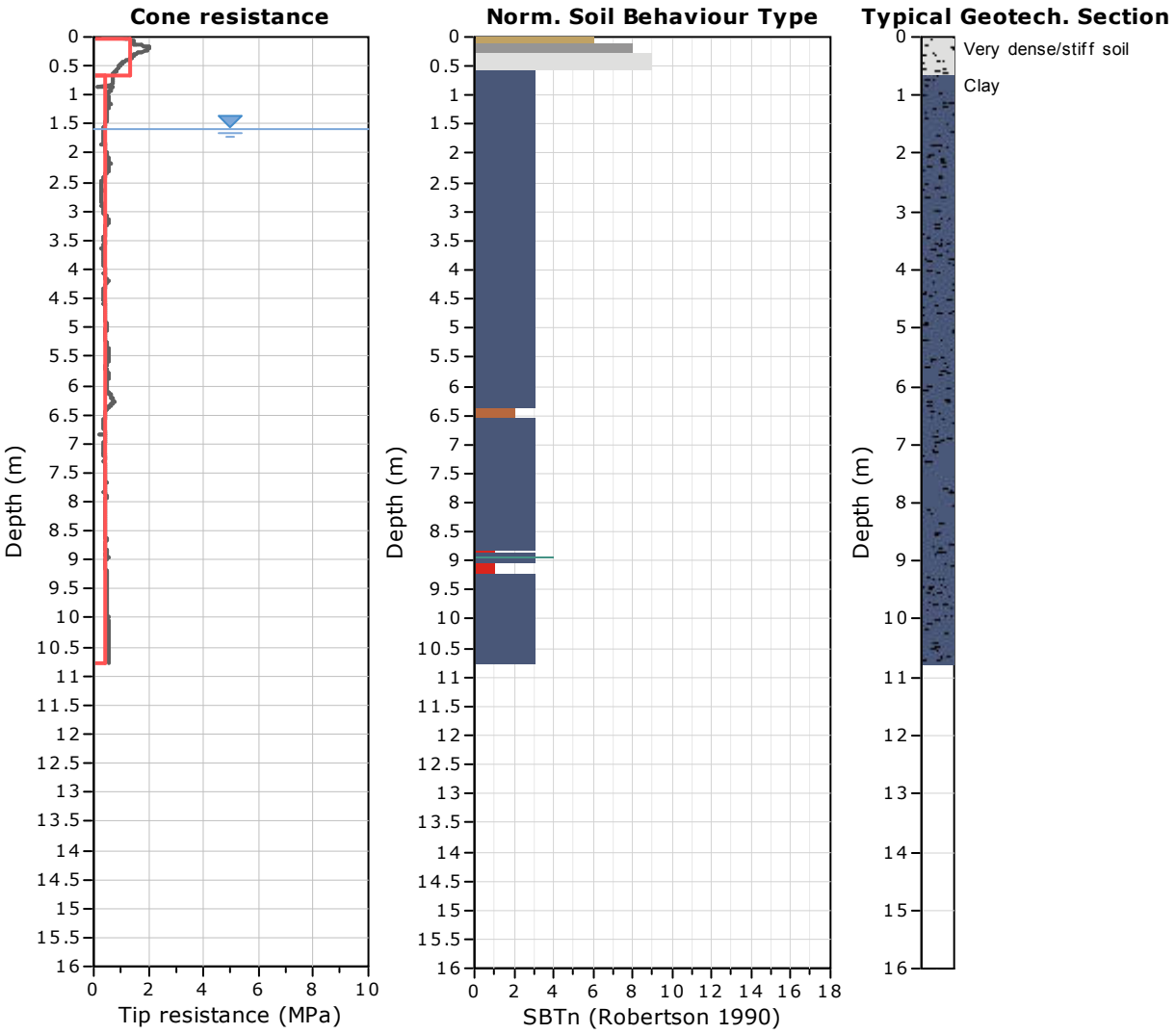
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.3	6.64E-6	4.3	22.3	-	-	16.8	22.9	78.1	6.7	31.0	17.7
Clay	0.5	3.97E-9	2.5	-	-	-	2.9	17.2	25.8	0.6	2.9	15.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.02 (m), **End depth:** 0.67 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.30 ±0.41 MPa	Permeability: 6.64E-06 ±2.09E-05 m/s	Constrained Mod.: 16.78 ±5.55 MPa
Sleeve friction: 64.43 ±24.38 kPa	N60: 4.35 ±1.07 blows	Go: 22.92 ±5.18 MPa
SBT_n: 9	Es: 22.30 ±0.95 MPa	Su: 78.06 ±23.37 kPa
SBTn description: Very dense/stiff soil	Dr (%): 0.00 ±0.00	Su ratio: 6.71 ±2.75
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 31.02 ±12.70
	Unit weight: 17.73 ±0.65 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.67 (m), **End depth:** 10.79 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.45 ±0.09 MPa	Permeability: 3.97E-09 ±4.92E-09 m/s	Constrained Mod.: 2.94 ±2.03 MPa
Sleeve friction: 15.06 ±11.64 kPa	N60: 2.49 ±0.54 blows	Go: 17.25 ±3.07 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 25.83 ±6.55 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.63 ±0.50
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.90 ±2.31
	Unit weight: 15.48 ±0.88 kN/m³	

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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

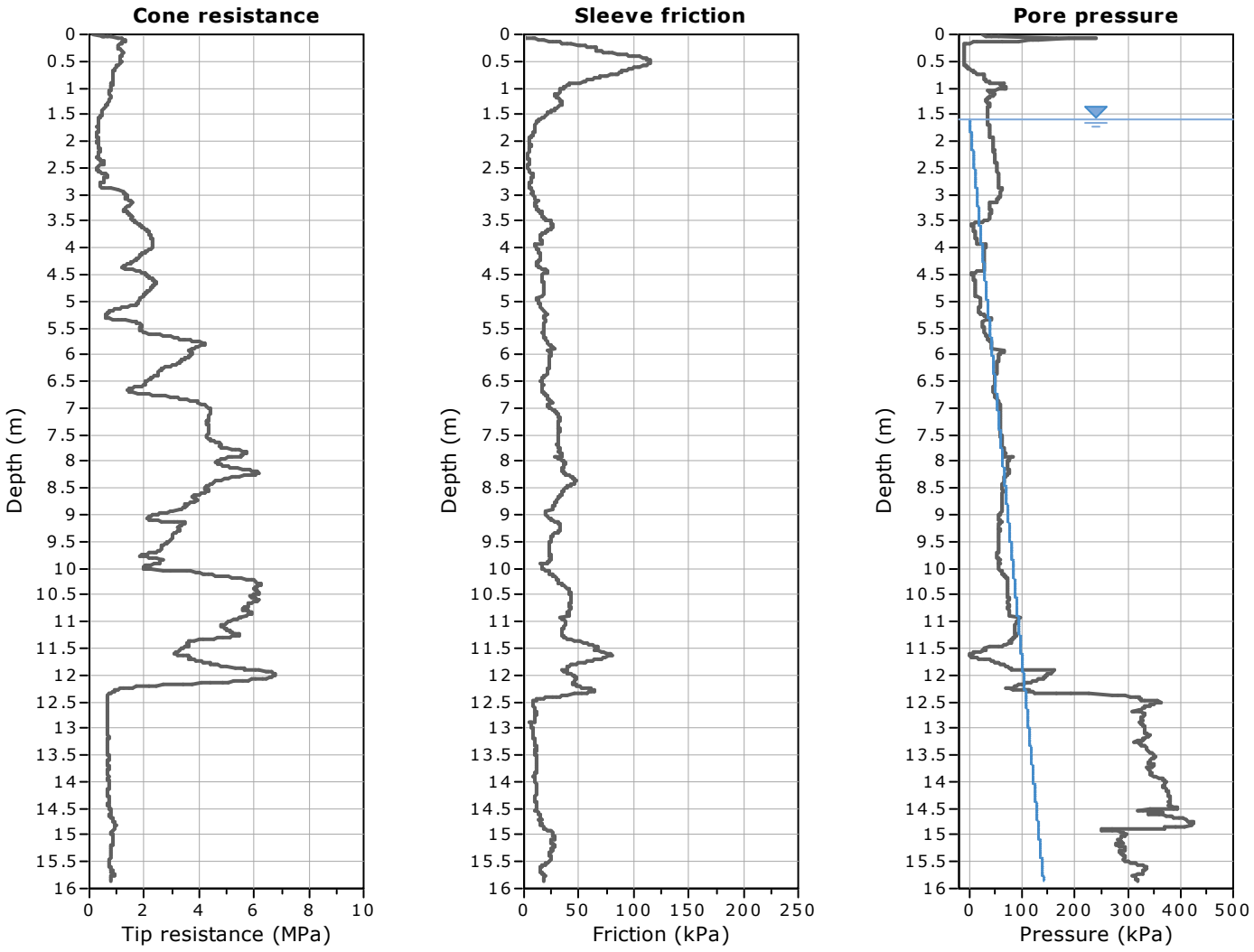
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.02	0.65	6.64E-06	4.3	22.3	0.0	0.0	16.8	22.9	78.1	6.7	31.0	17.7
0.67		(±2.09E-05)	(±1.1)	(±0.9)	(±0.0)	(±0.0)	(±5.6)	(±5.2)	(±23.4)	(±2.7)	(±12.7)	(±0.6)
0.67	10.12	3.97E-09	2.5	0.0	0.0	0.0	2.9	17.2	25.8	0.6	2.9	15.5
10.79		(±4.92E-09)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±2.0)	(±3.1)	(±6.5)	(±0.5)	(±2.3)	(±0.9)

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

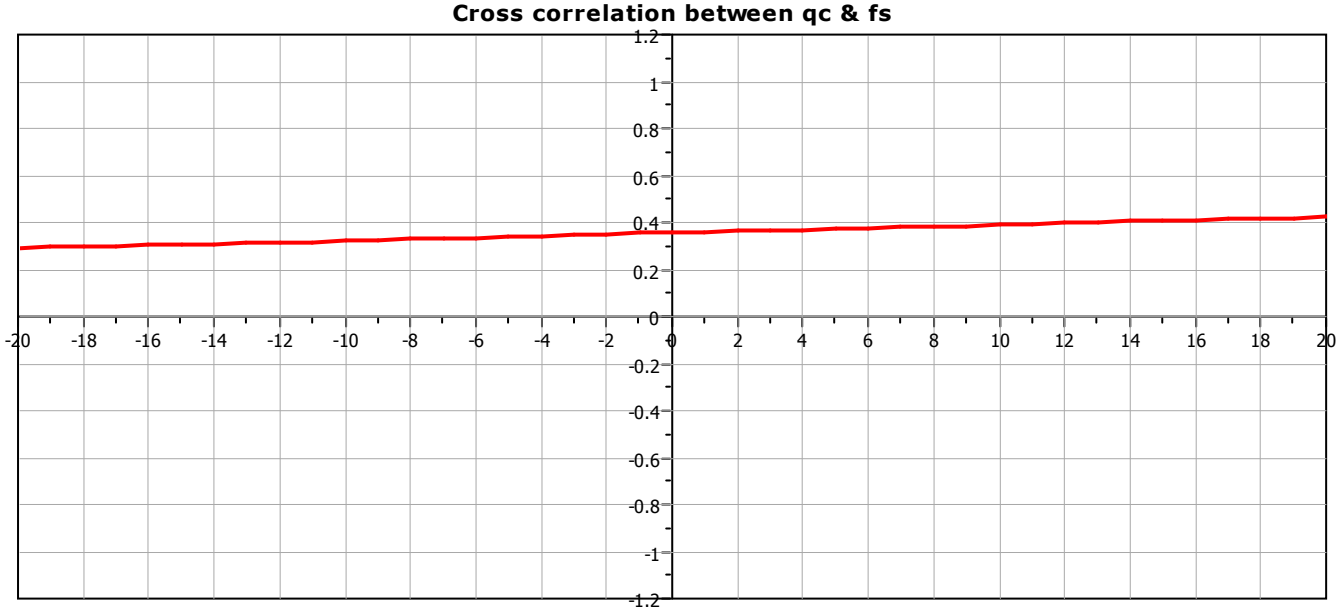
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

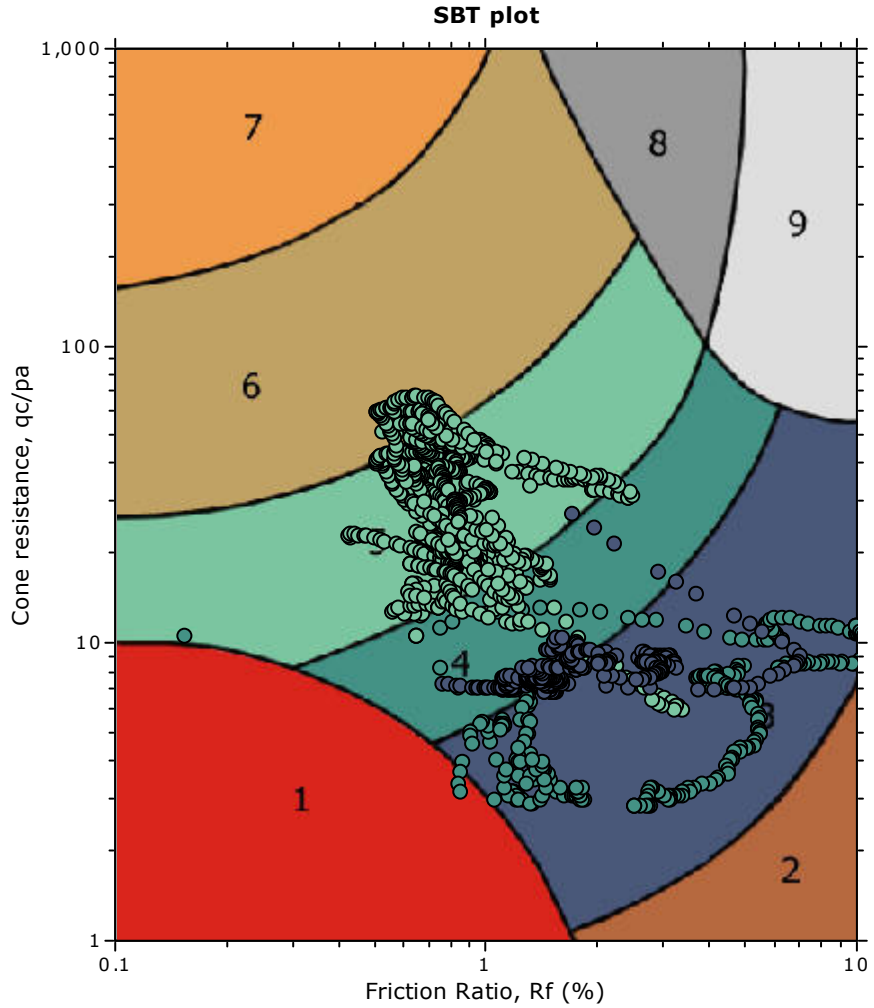


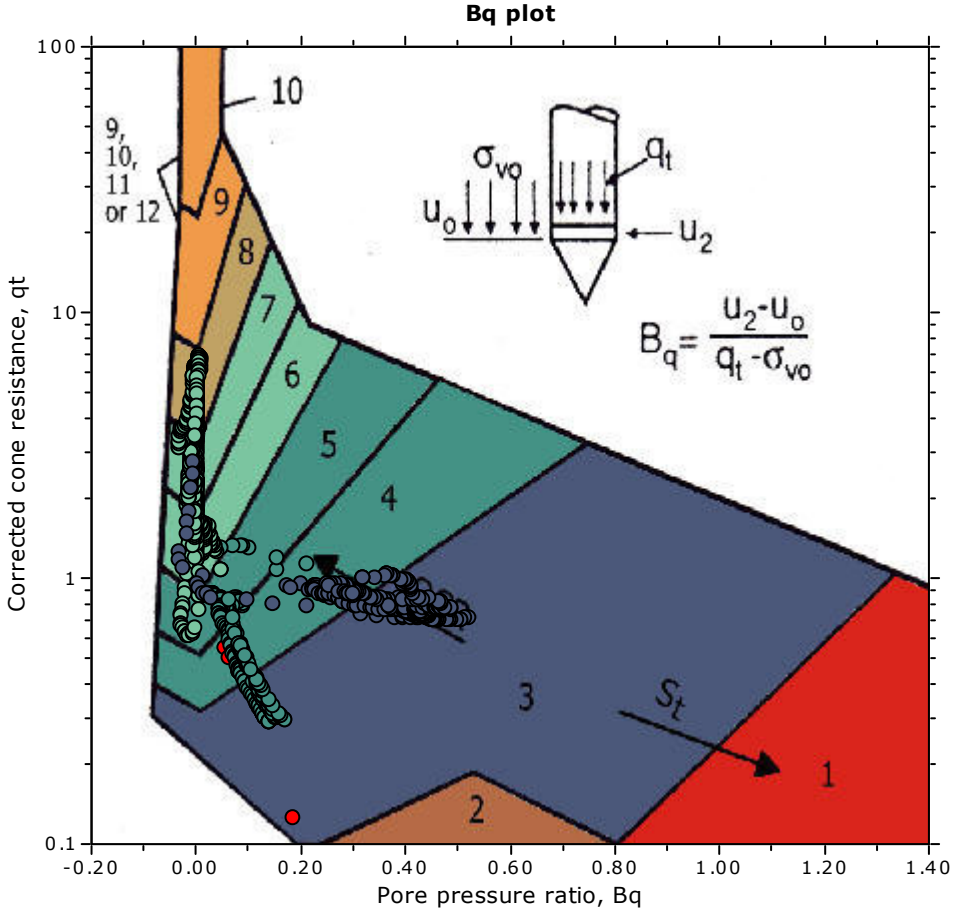
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

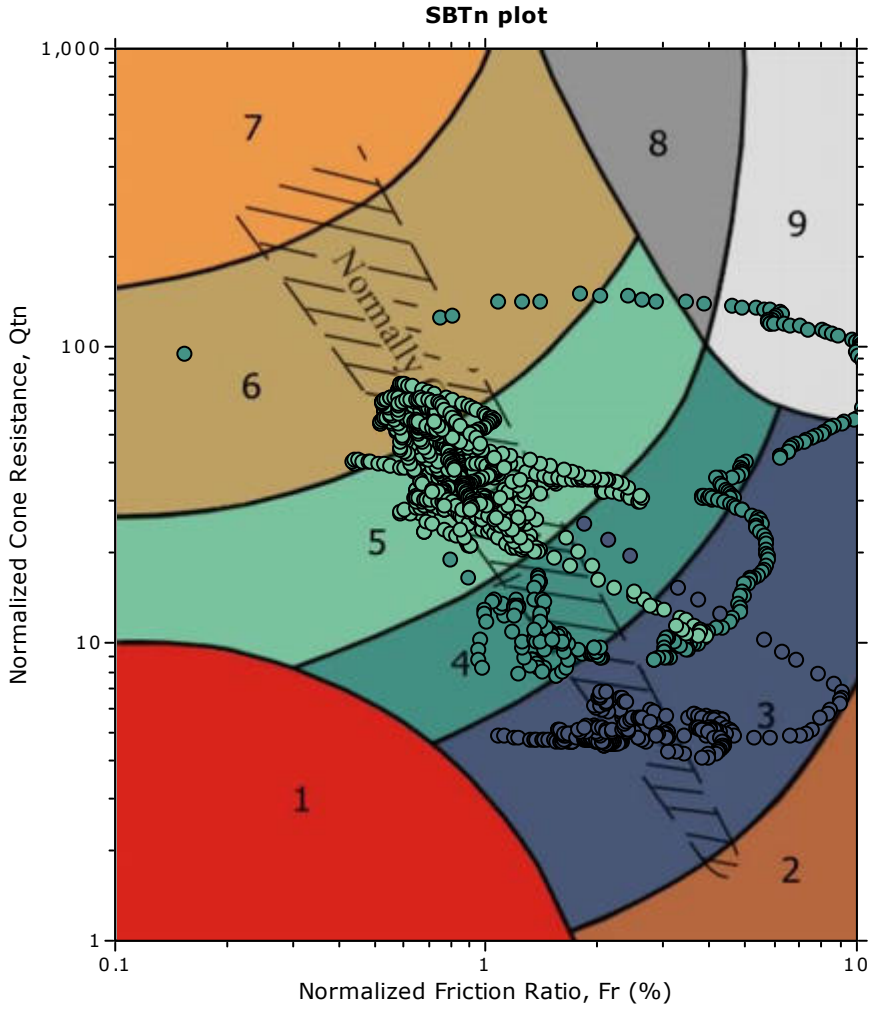
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

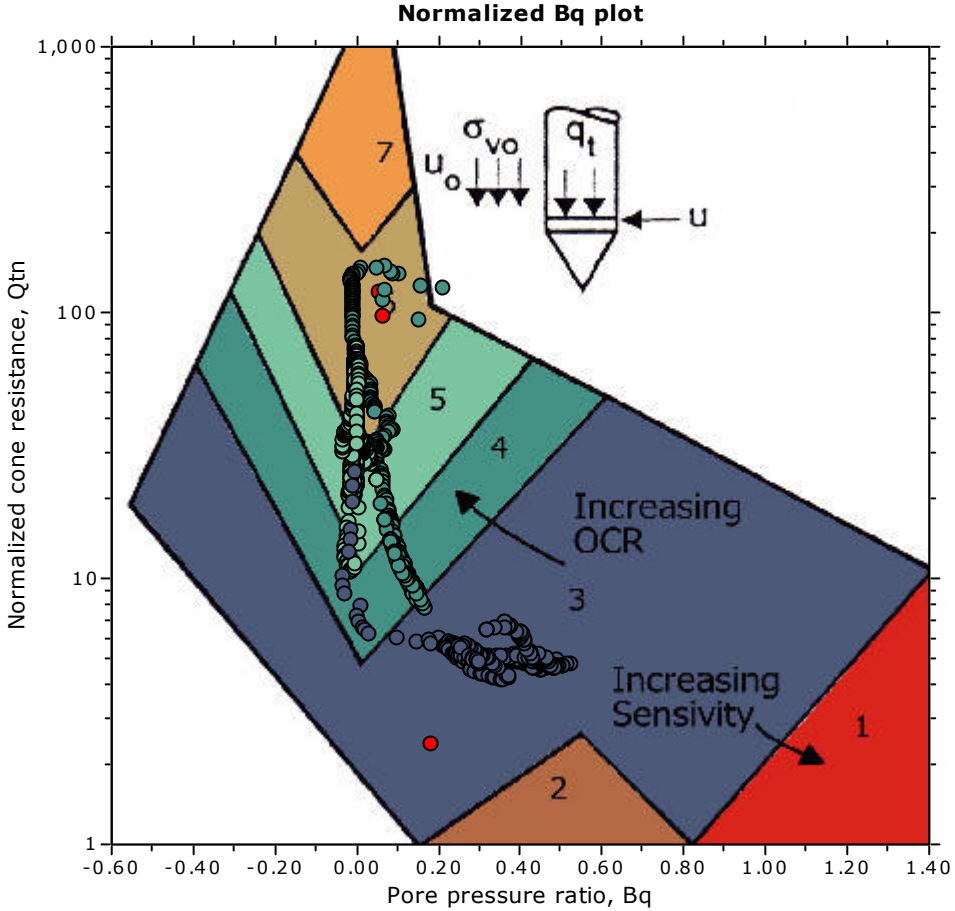
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

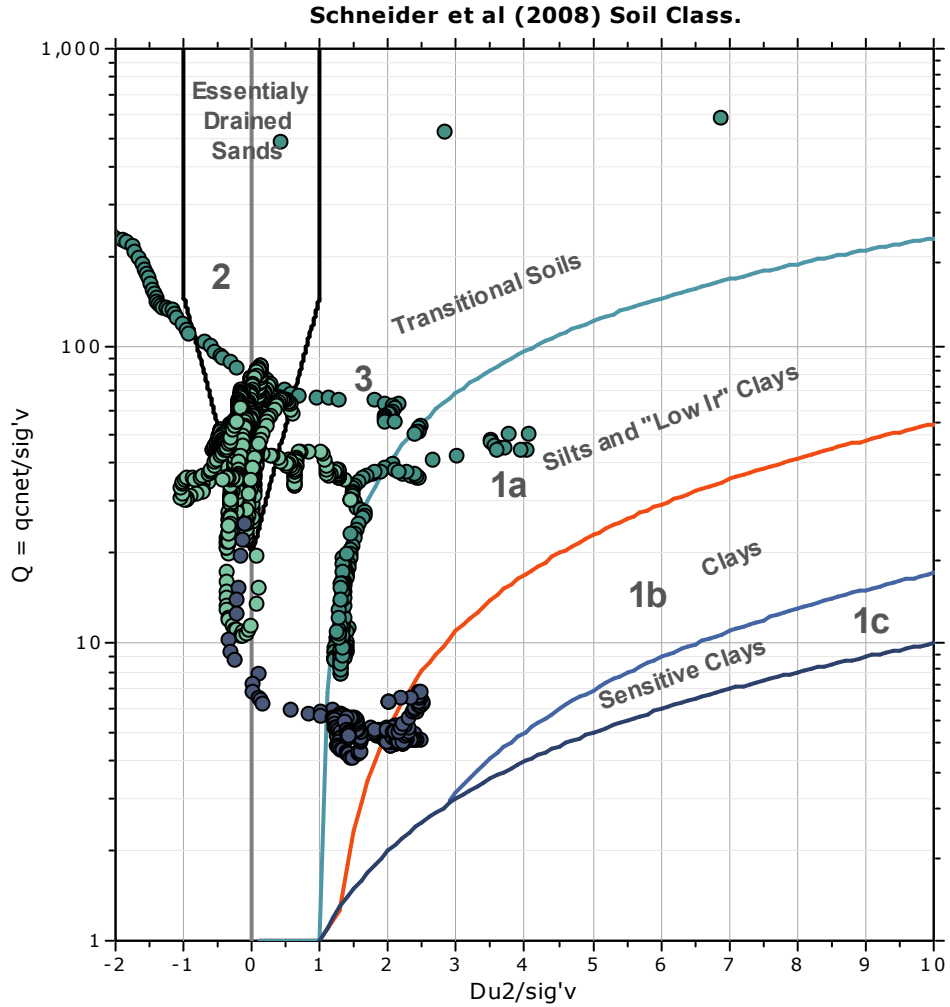
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

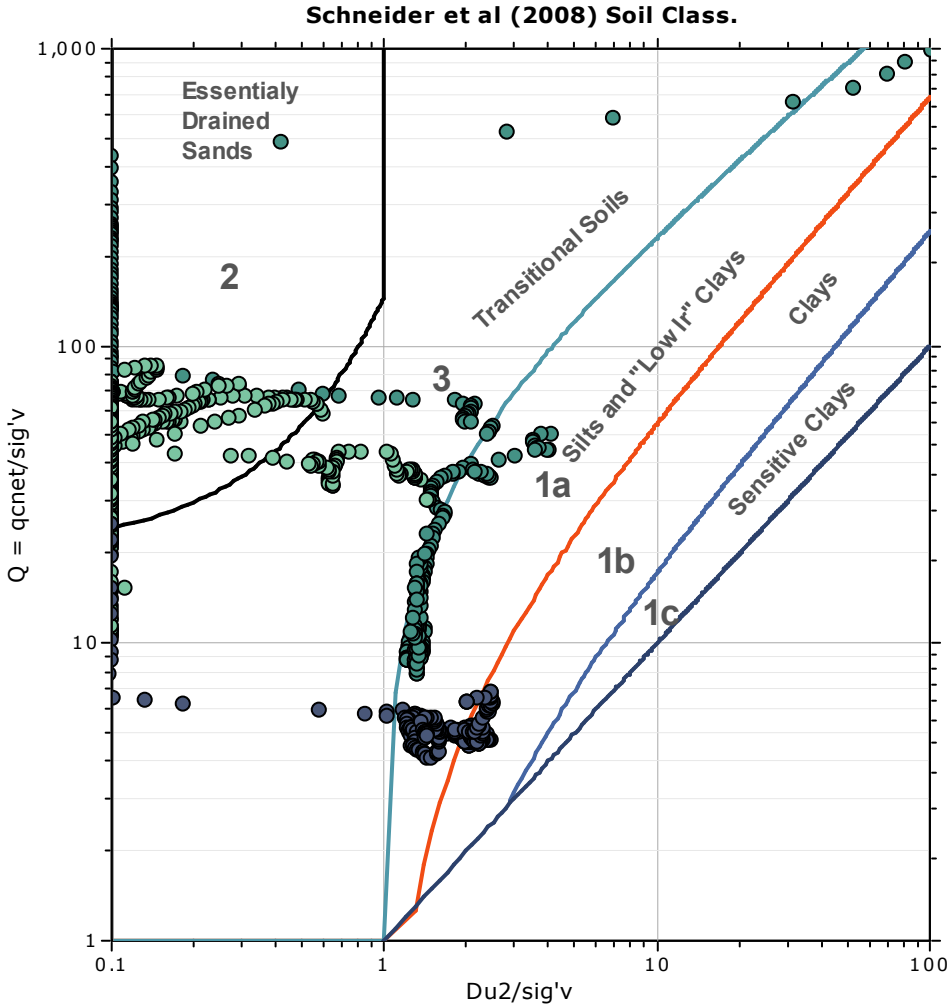
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

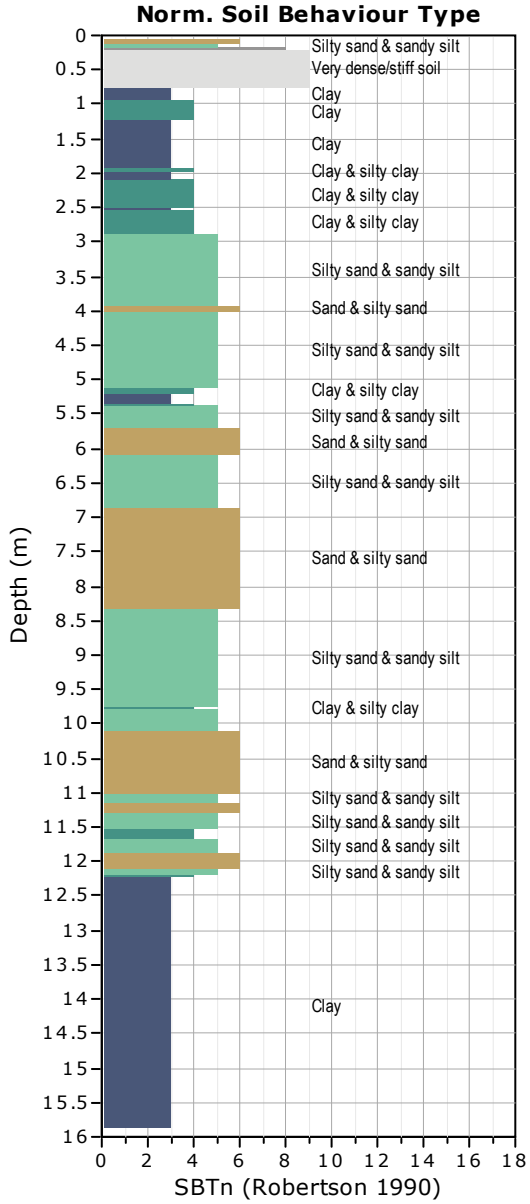


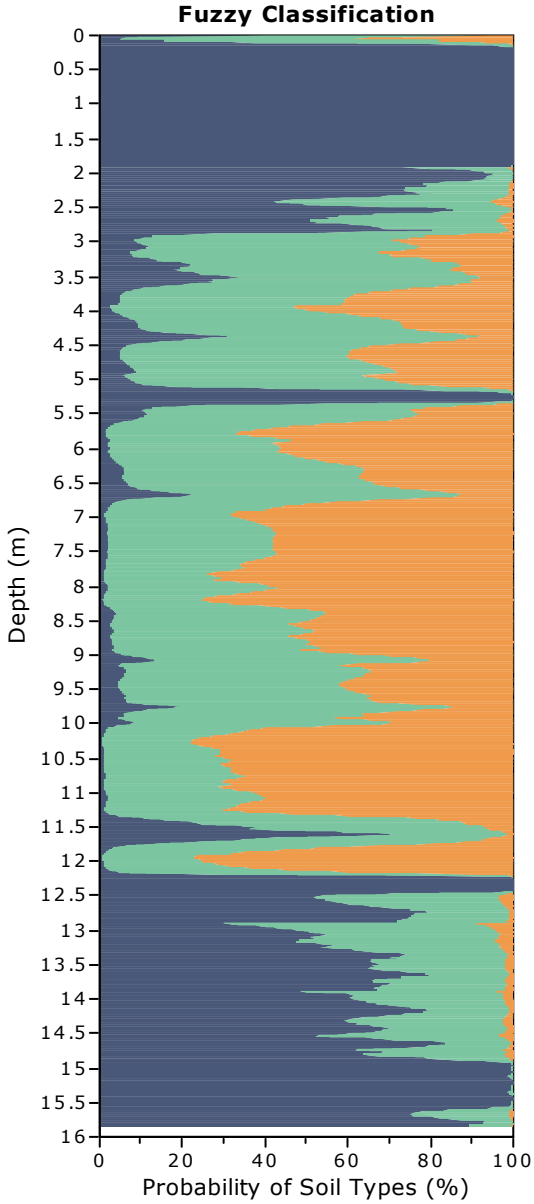


RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

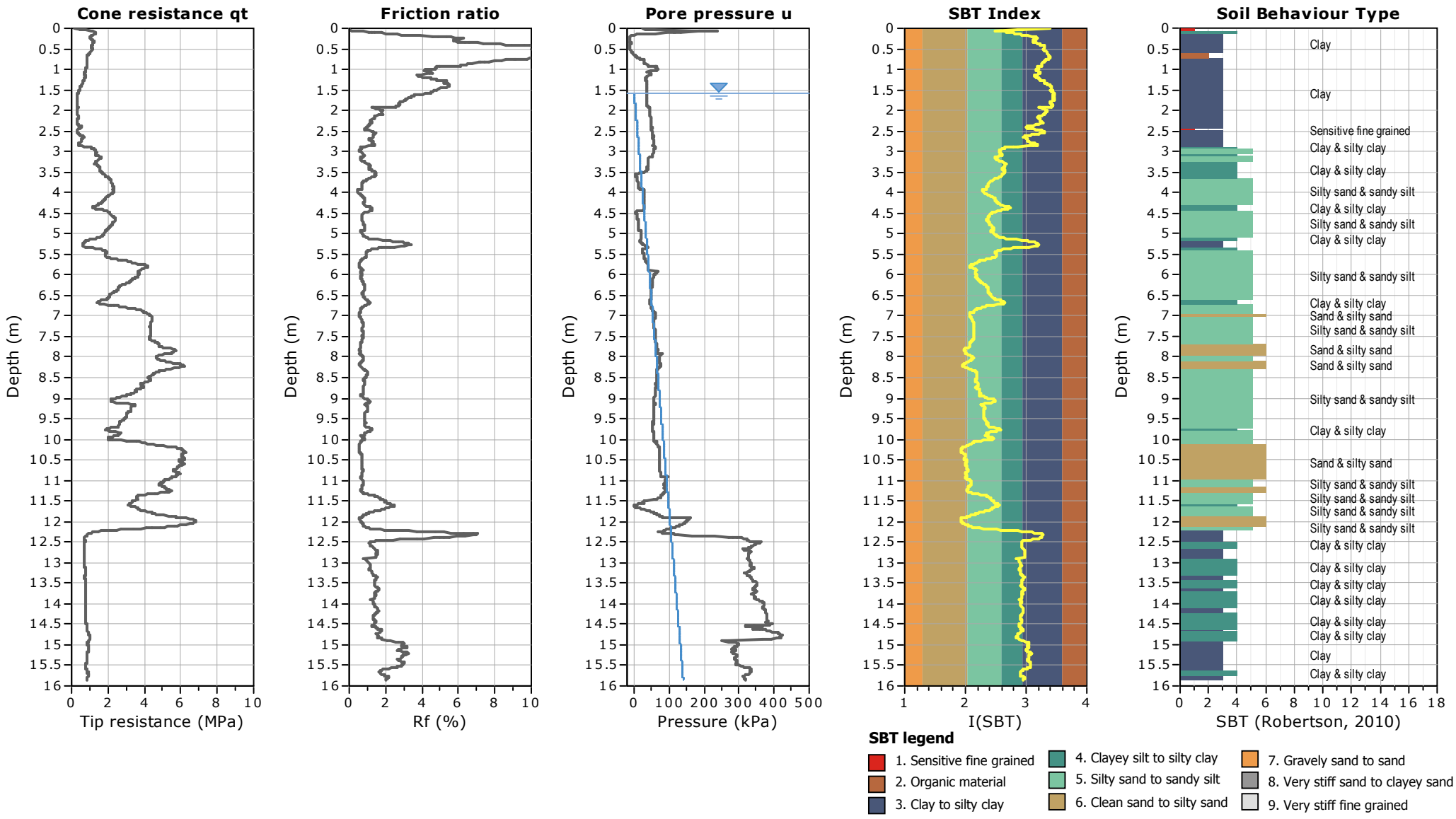




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

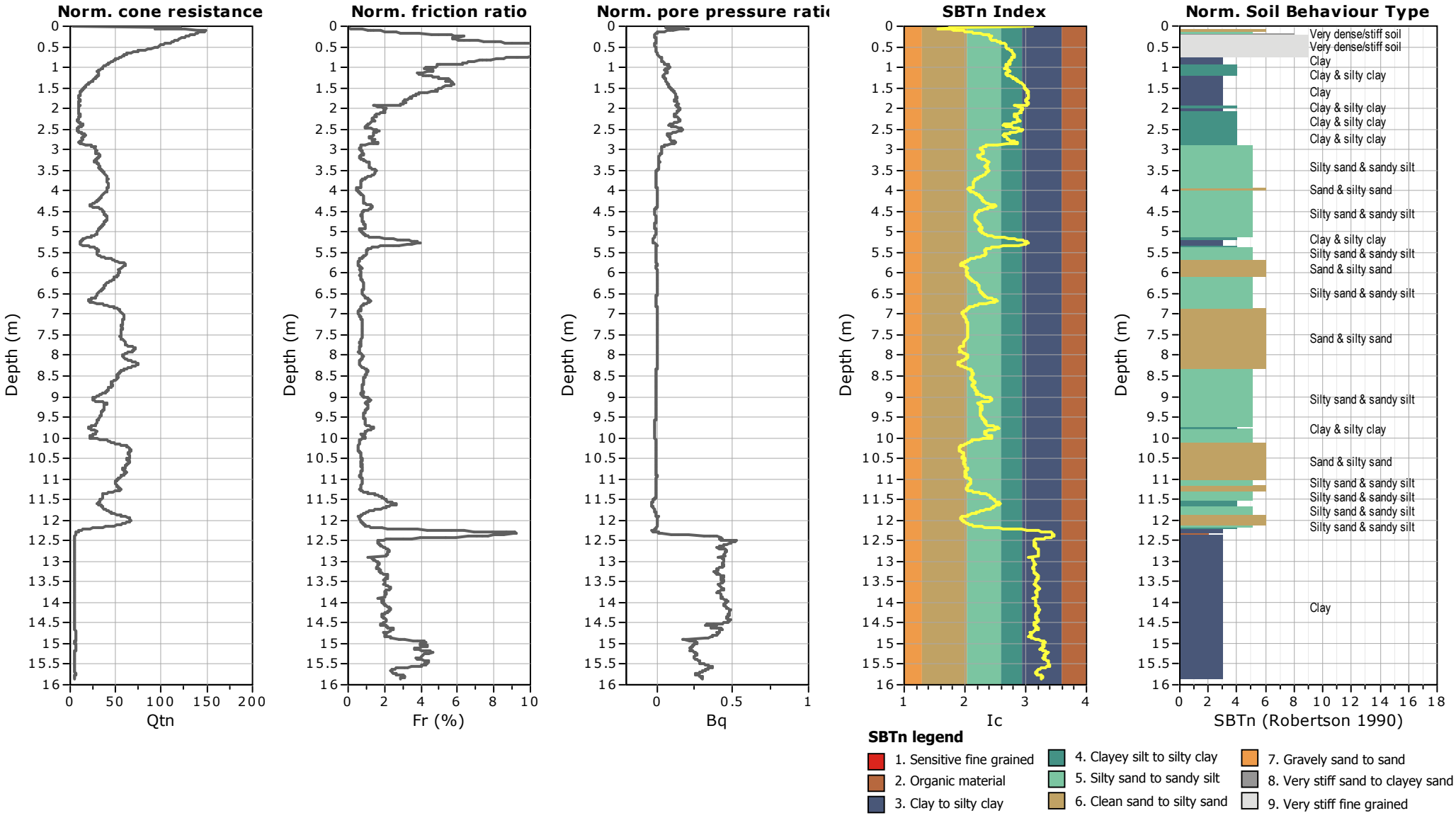
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

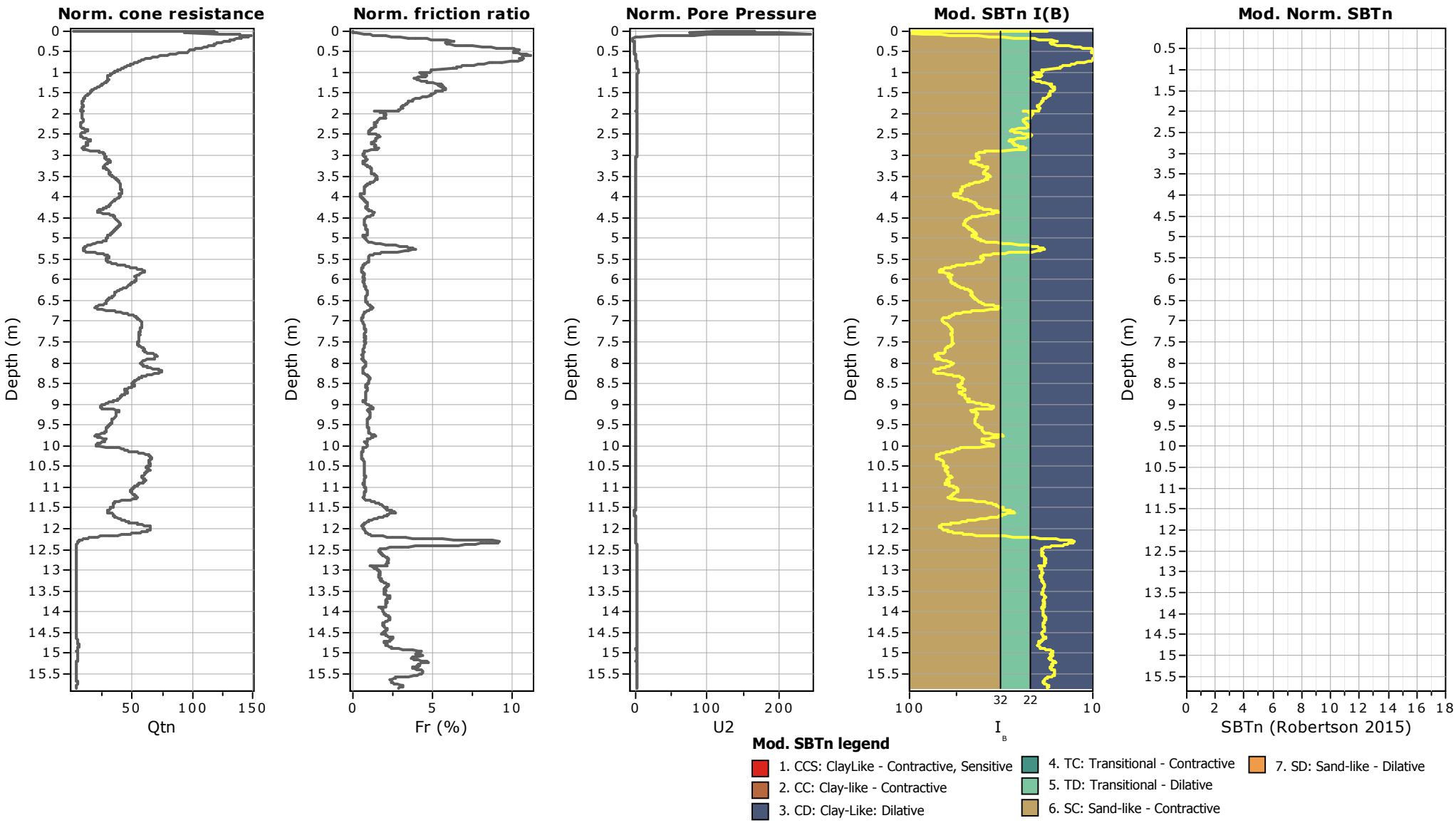
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

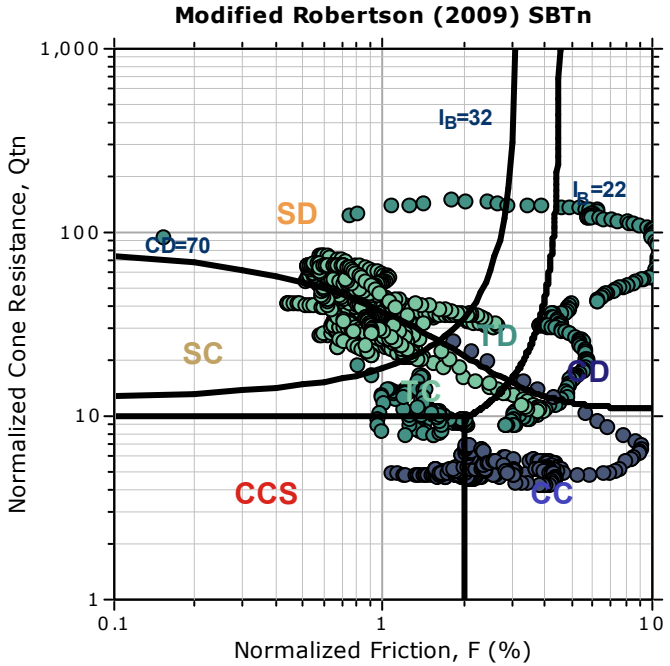


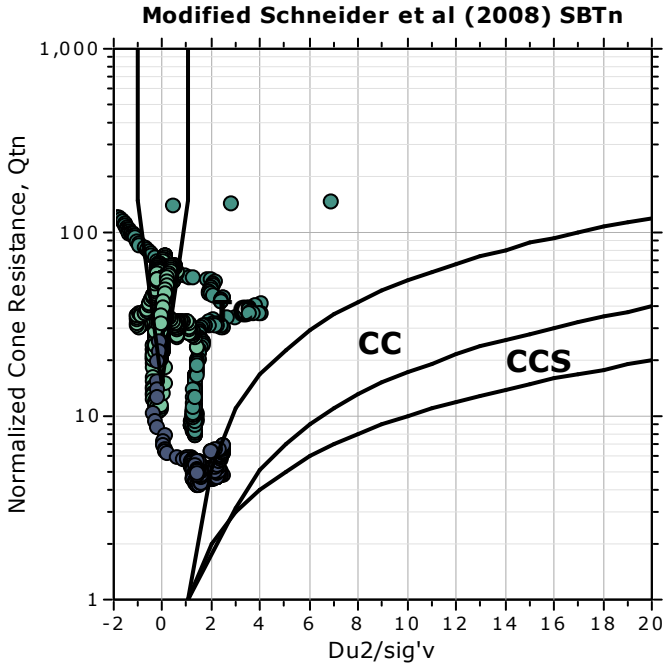
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

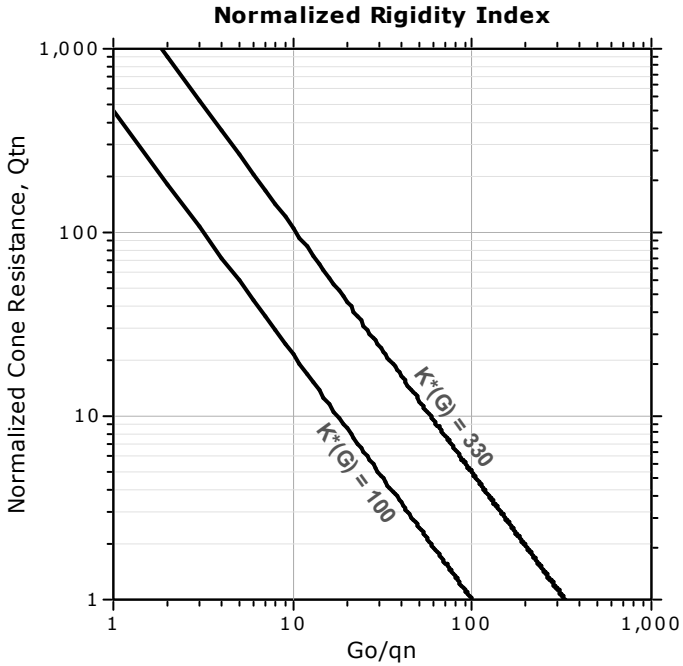
CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







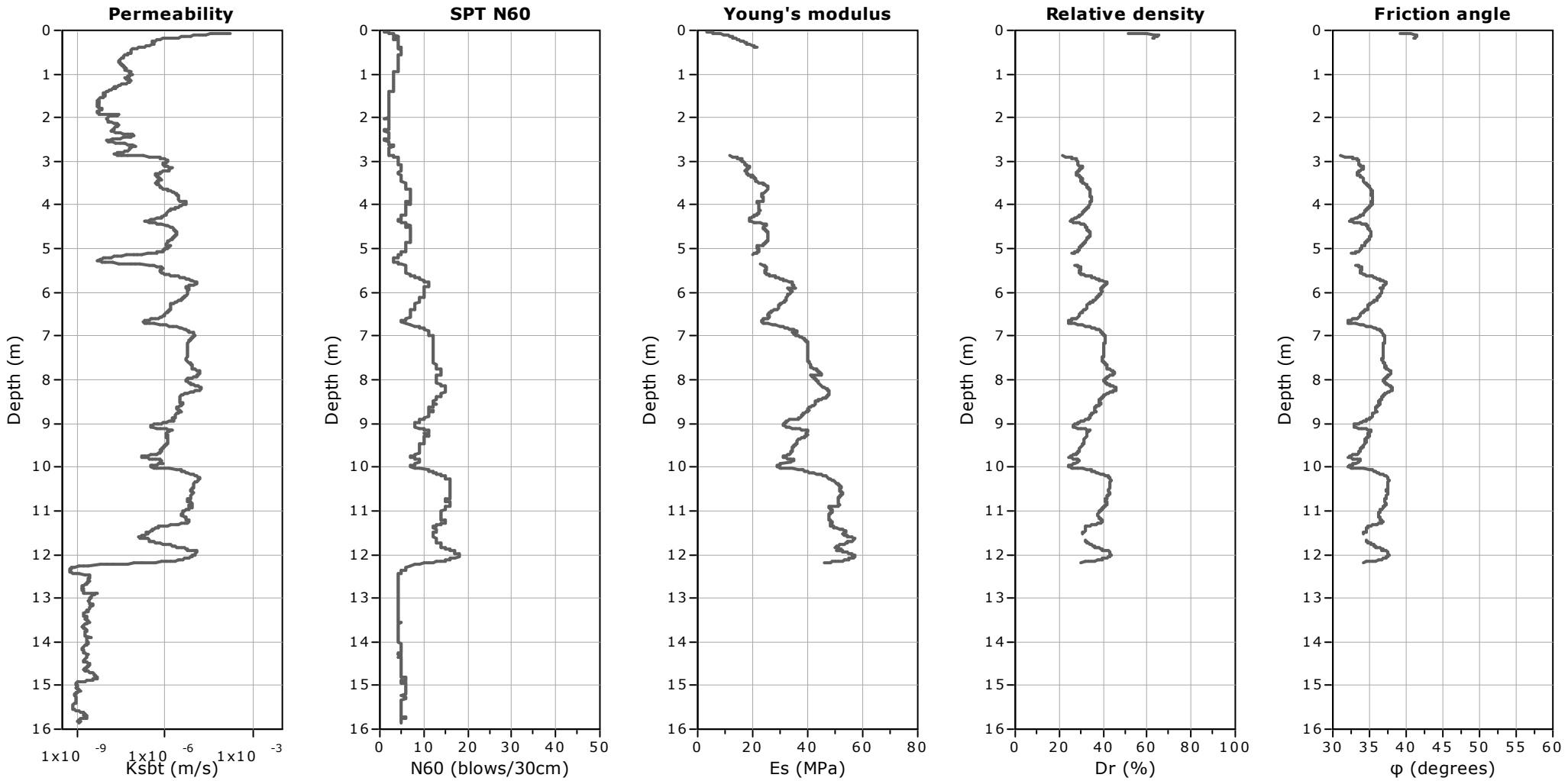
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



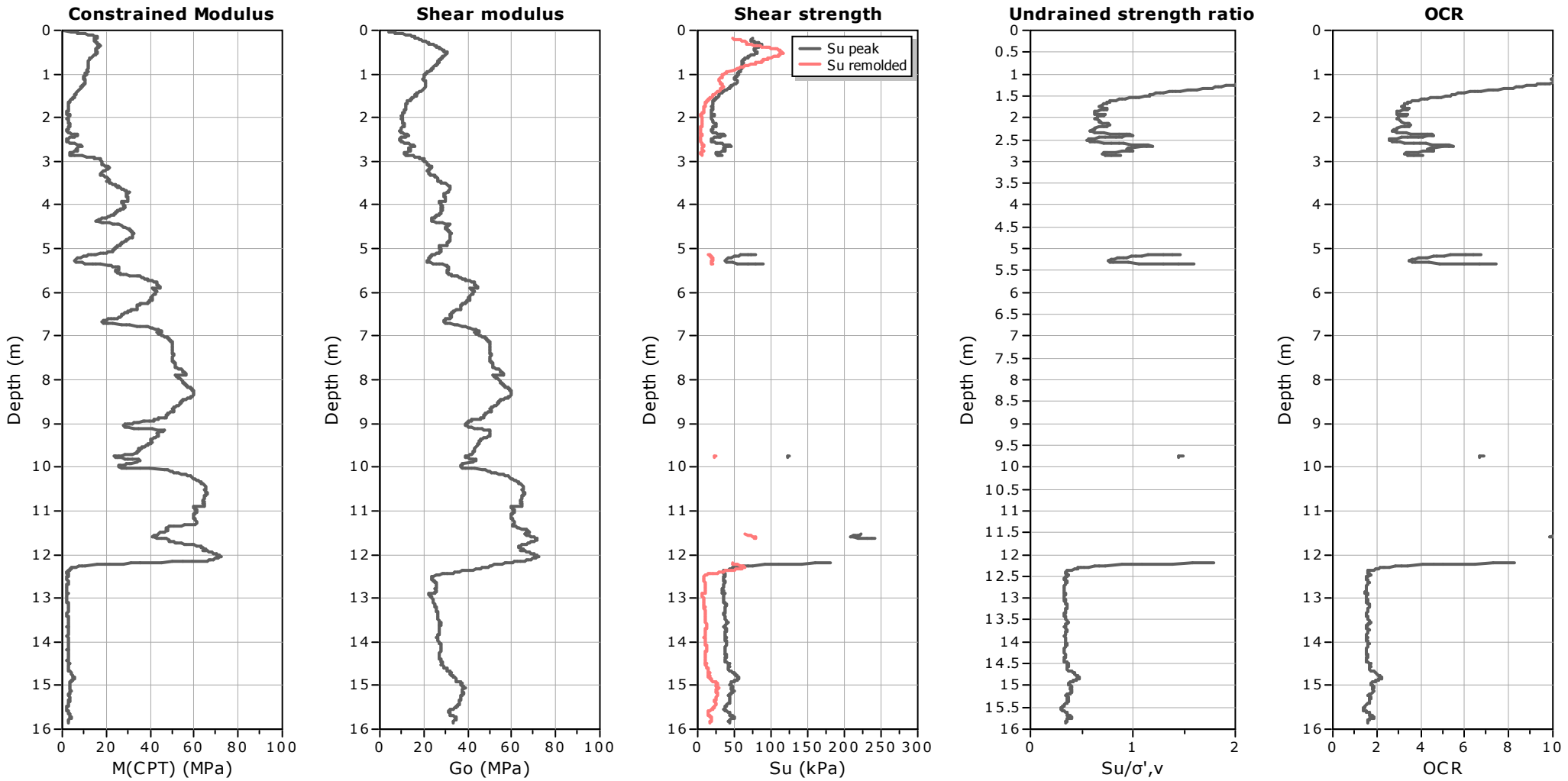
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

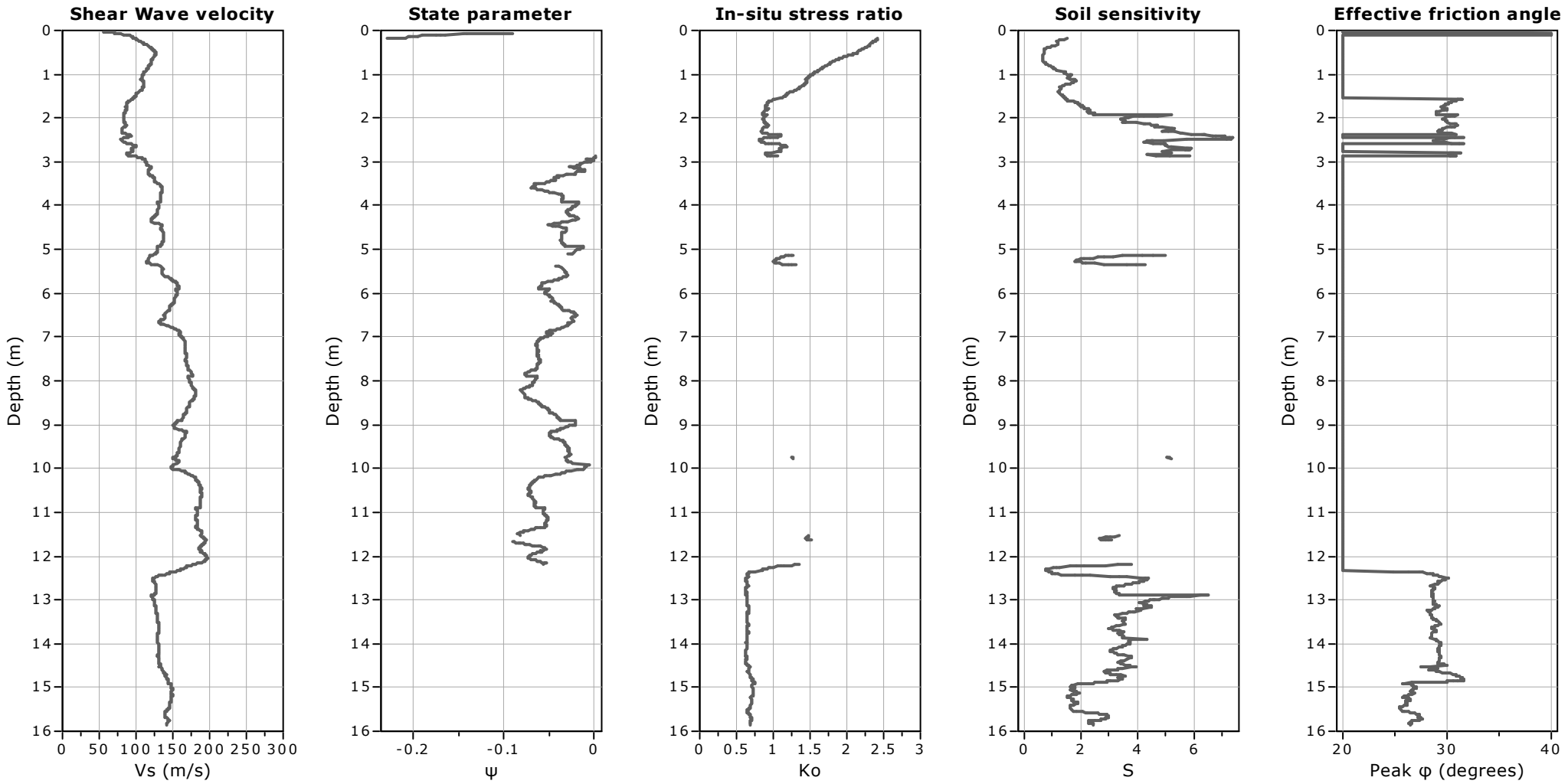
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



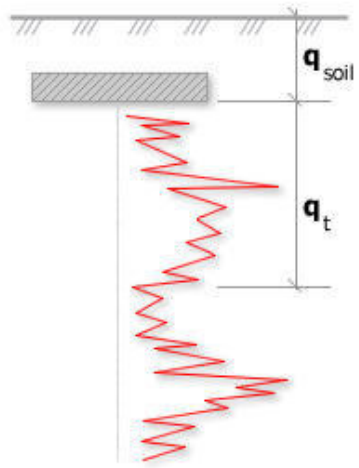
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

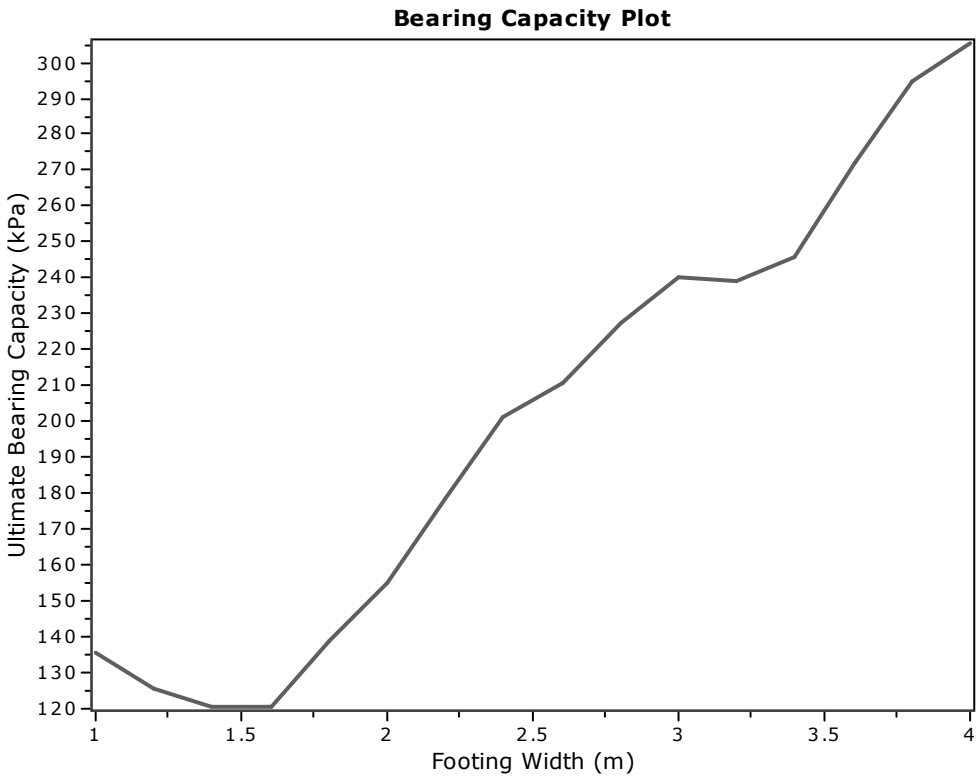
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



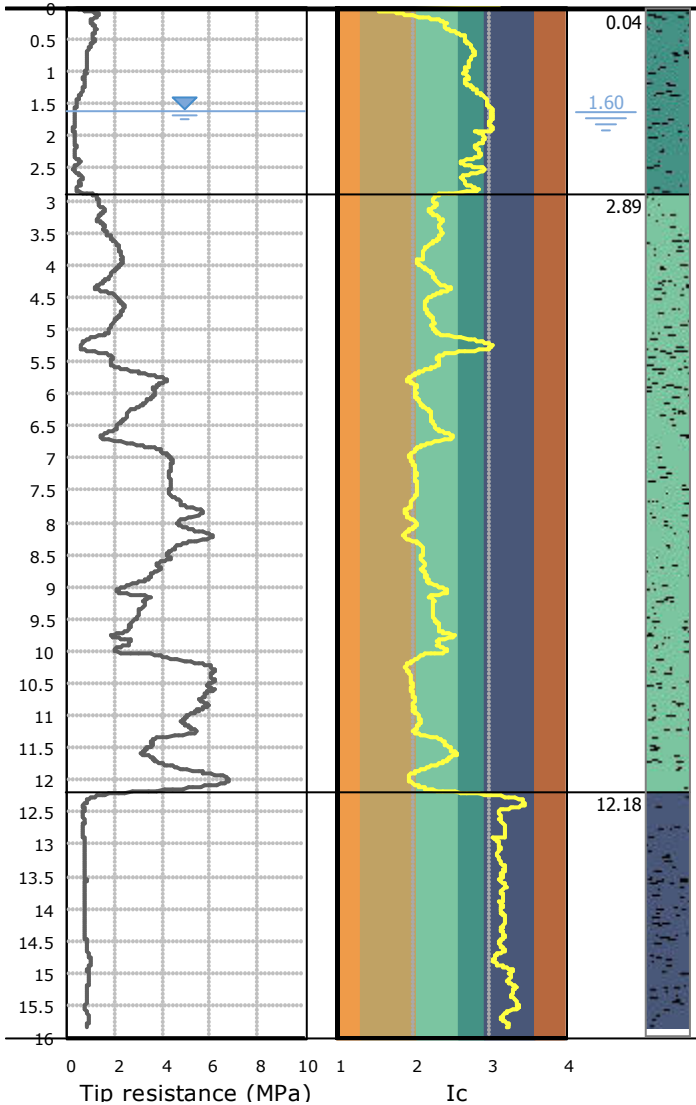
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.63	0.20	9.50	135.32
2	1.20	0.50	2.30	0.58	0.20	9.50	125.55
3	1.40	0.50	2.60	0.55	0.20	9.50	120.32
4	1.60	0.50	2.90	0.55	0.20	9.50	120.33
5	1.80	0.50	3.20	0.65	0.20	9.50	138.64
6	2.00	0.50	3.50	0.73	0.20	9.50	154.80
7	2.20	0.50	3.80	0.84	0.20	9.50	178.21
8	2.40	0.50	4.10	0.96	0.20	9.50	201.31
9	2.60	0.50	4.40	1.01	0.20	9.50	210.62
10	2.80	0.50	4.70	1.09	0.20	9.50	227.16
11	3.00	0.50	5.00	1.15	0.20	9.50	240.01
12	3.20	0.50	5.30	1.15	0.20	9.50	239.08
13	3.40	0.50	5.60	1.18	0.20	9.50	245.45
14	3.60	0.50	5.90	1.31	0.20	9.50	271.91
15	3.80	0.50	6.20	1.43	0.20	9.50	294.83
16	4.00	0.50	6.50	1.48	0.20	9.50	305.34

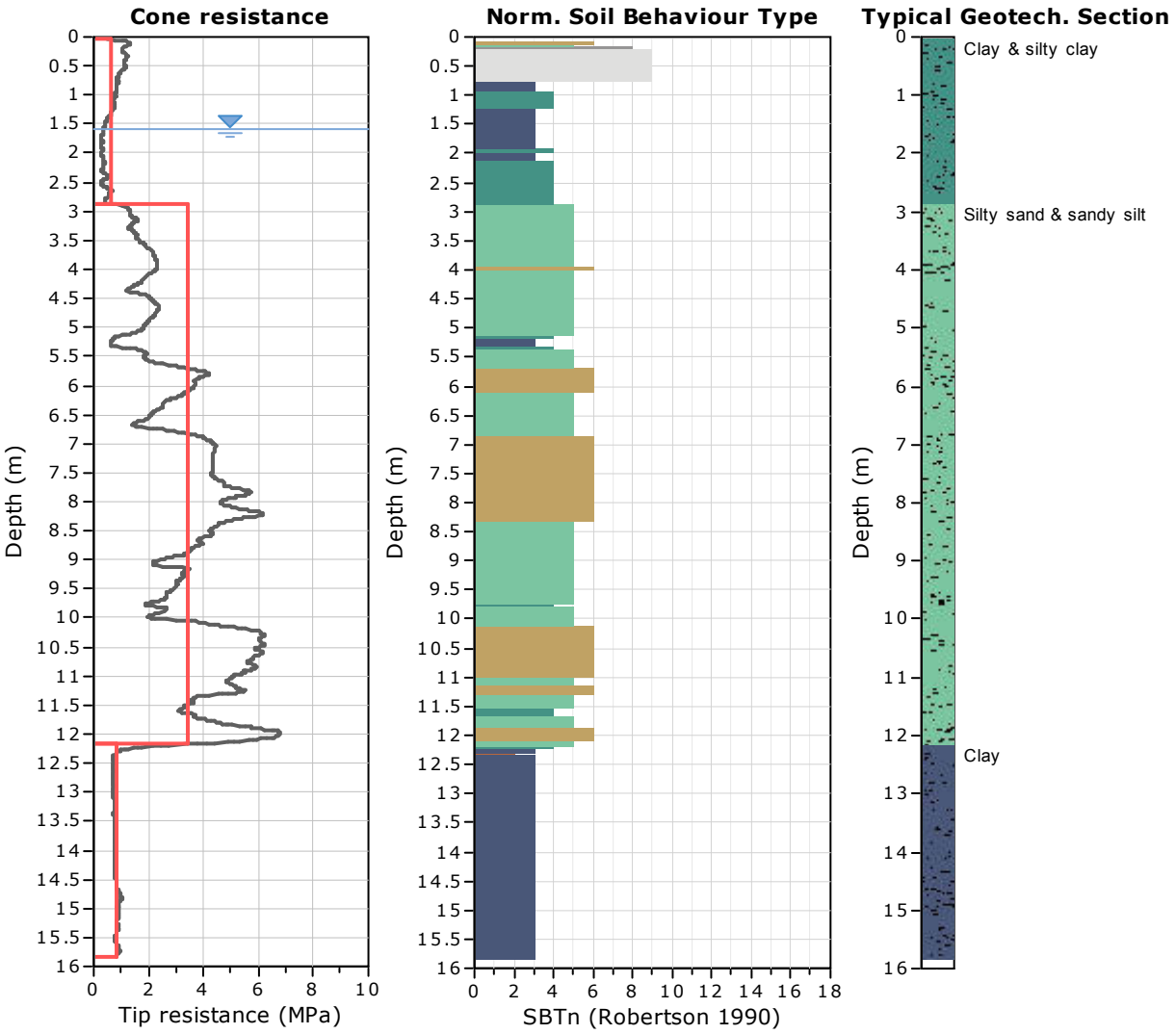
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay & silty clay	0.6	1.22E-6	2.8	16.8	-	-	8.0	17.0	42.2	2.5	11.5	16.1
Silty sand & sandy silt	3.4	3.72E-6	10.0	35.7	35.1	35.5	40.9	44.5	-	-	-	17.1
Clay	0.8	3.97E-9	4.8	46.1	-	-	3.4	30.6	42.2	0.4	1.7	16.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.04 (m), **End depth:** 2.89 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 0.64 ±0.31 MPa
Sleeve friction: 32.53 ±33.94 kPa
SBT_n: 4
SBTn description: Clay & silty clay

Estimation results

Permeability: 1.22E-06 ±1.06E-05 m/s
N60: 2.78 ±1.02 blows
Es: 16.84 ±4.28 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 16.08 ±1.49 kN/m³
Constrained Mod.: 7.99 ±4.75 MPa
Go: 17.01 ±6.48 MPa
Su: 42.15 ±21.42 kPa
Su ratio: 2.49 ±2.55
O.C.R.: 11.50 ±11.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.89 (m), **End depth:** 12.18 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.41 ±1.55 MPa	Permeability: 3.72E-06 ±3.67E-06 m/s	Constrained Mod.: 40.93 ±15.68 MPa
Sleeve friction: 27.73 ±12.92 kPa	N60: 10.03 ±3.76 blows	Go: 44.47 ±14.30 MPa
SBT_n: 5	Es: 35.70 ±11.08 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 35.10 ±5.49	Su ratio: 0.00 ±0.00
	φ (degrees): 35.46 ±1.52 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.12 ±0.69 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 12.18 (m), **End depth:** 15.85 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.83 ±0.23 MPa	Permeability: 3.97E-09 ±2.57E-08 m/s	Constrained Mod.: 3.41 ±3.79 MPa
Sleeve friction: 16.60 ±11.11 kPa	N60: 4.80 ±1.00 blows	Go: 30.56 ±6.47 MPa
SBT_n: 3	Es: 46.11 ±46.11 MPa	Su: 42.22 ±13.46 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.38 ±0.13
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.74 ±0.62
	Unit weight: 15.97 ±0.62 kN/m³	

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

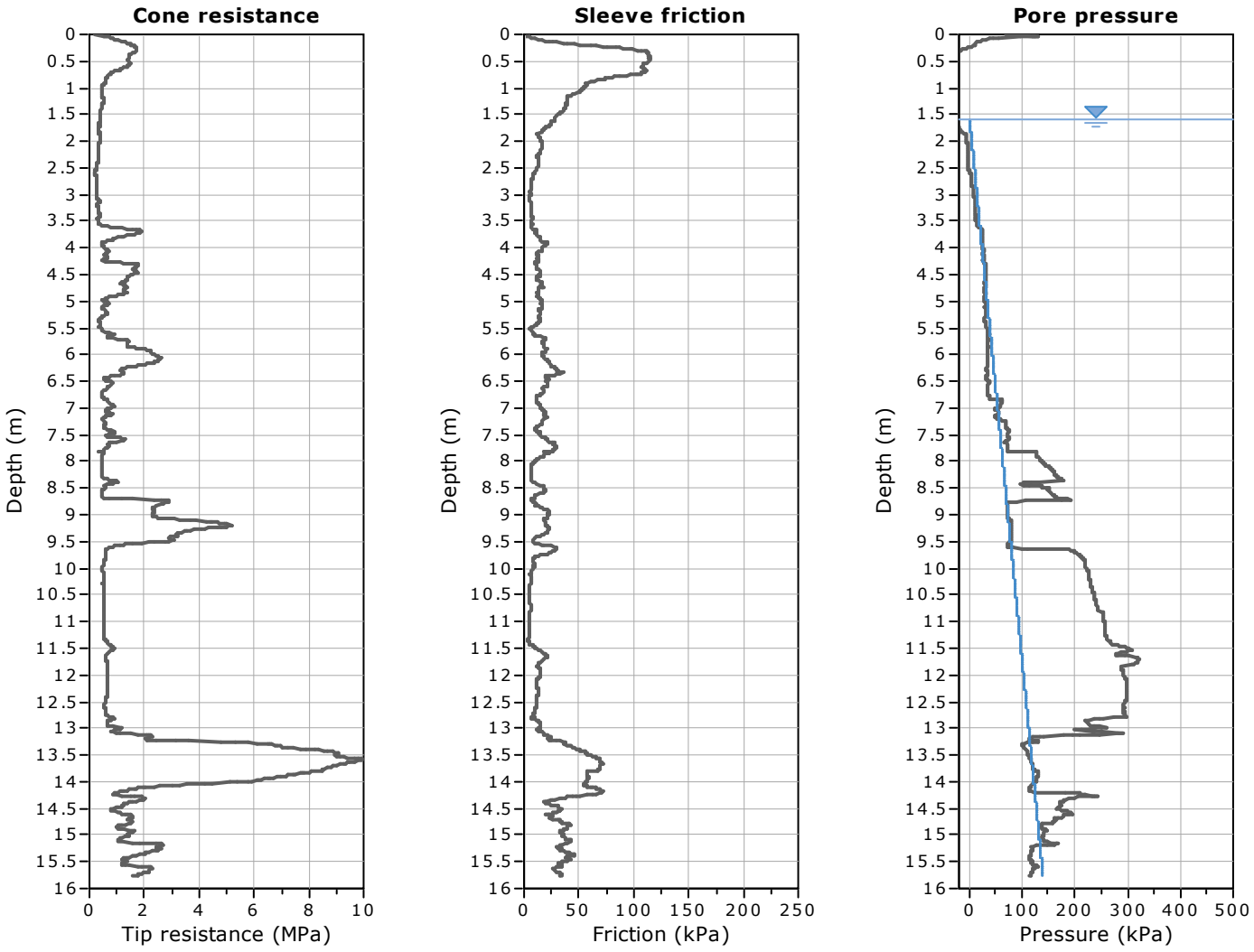
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.04 2.89	2.85	1.22E-06 (±1.06E-05)	2.8 (±1.0)	16.8 (±4.3)	0.0 (±0.0)	0.0 (±0.0)	8.0 (±4.8)	17.0 (±6.5)	42.2 (±21.4)	2.5 (±2.5)	11.5 (±11.8)	16.1 (±1.5)
2.89 12.18	9.29	3.72E-06 (±3.67E-06)	10.0 (±3.8)	35.7 (±11.1)	35.1 (±5.5)	35.5 (±1.5)	40.9 (±15.7)	44.5 (±14.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.1 (±0.7)
12.18 15.85	3.67	3.97E-09 (±2.57E-08)	4.8 (±1.0)	46.1 (±46.1)	0.0 (±0.0)	0.0 (±0.0)	3.4 (±3.8)	30.6 (±6.5)	42.2 (±13.5)	0.4 (±0.1)	1.7 (±0.6)	16.0 (±0.6)

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

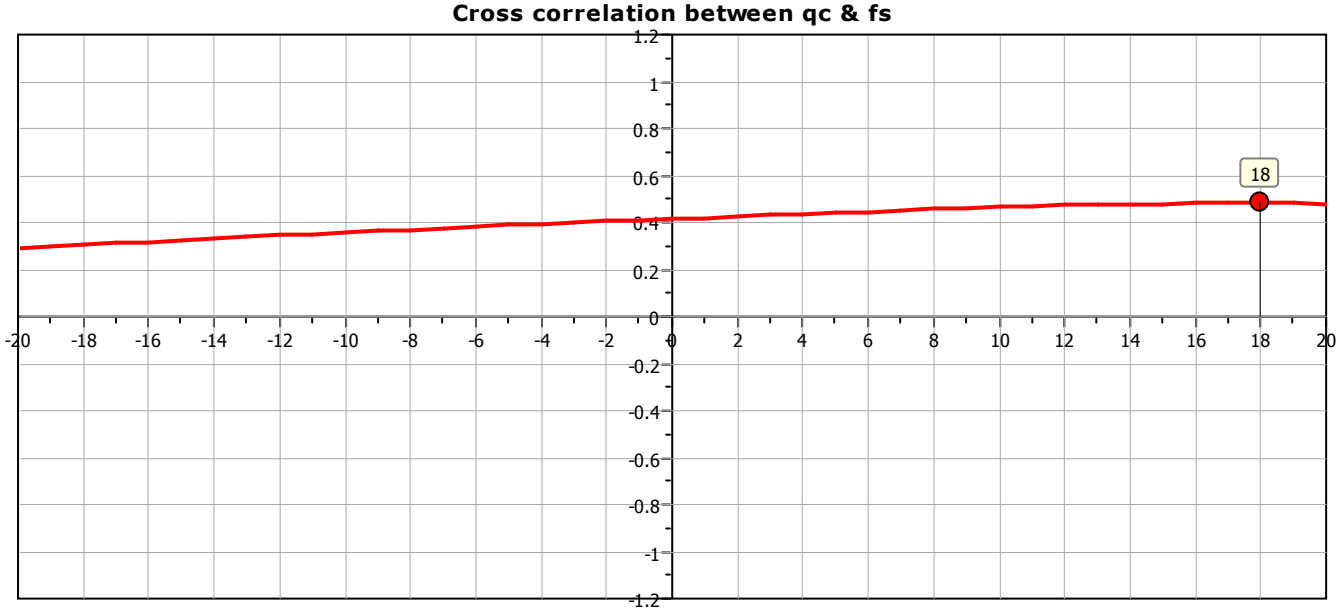
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

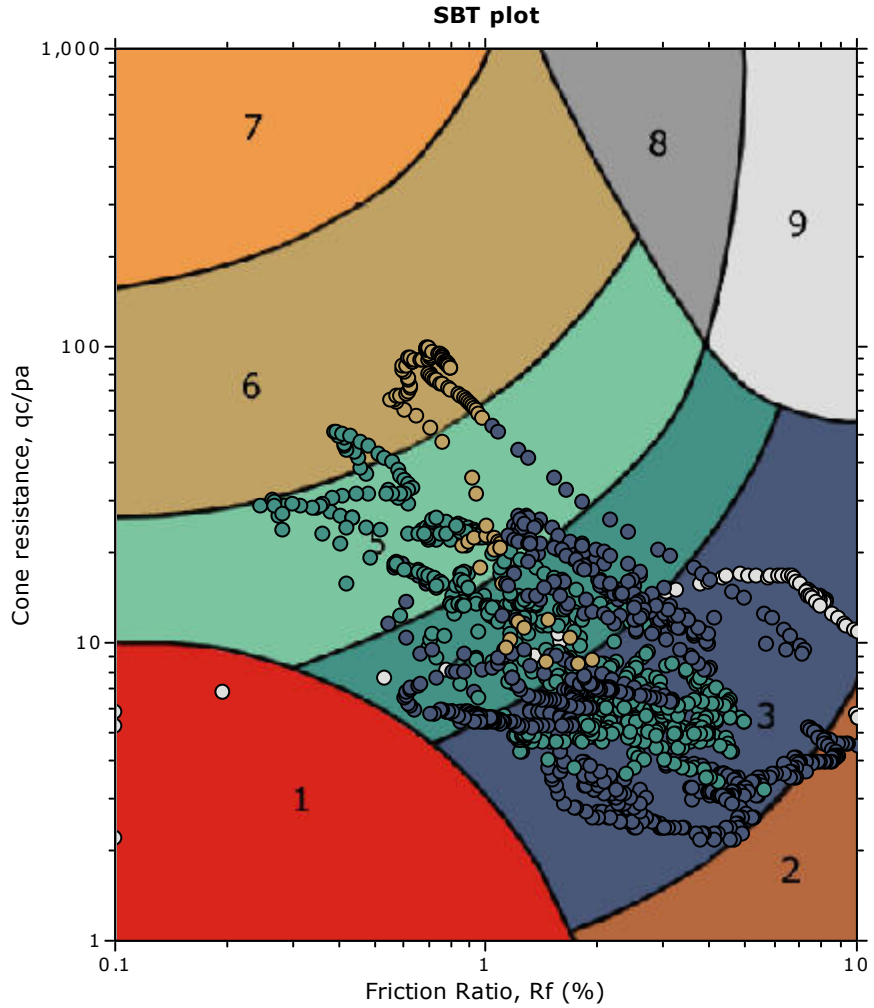


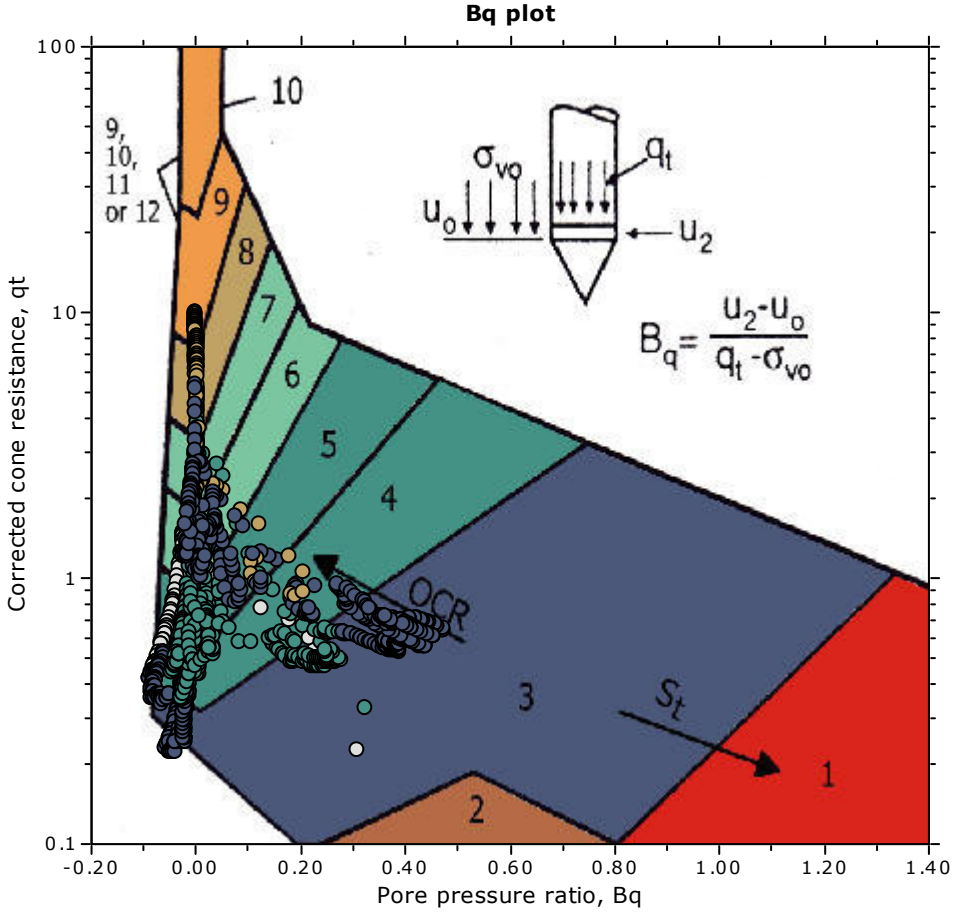
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

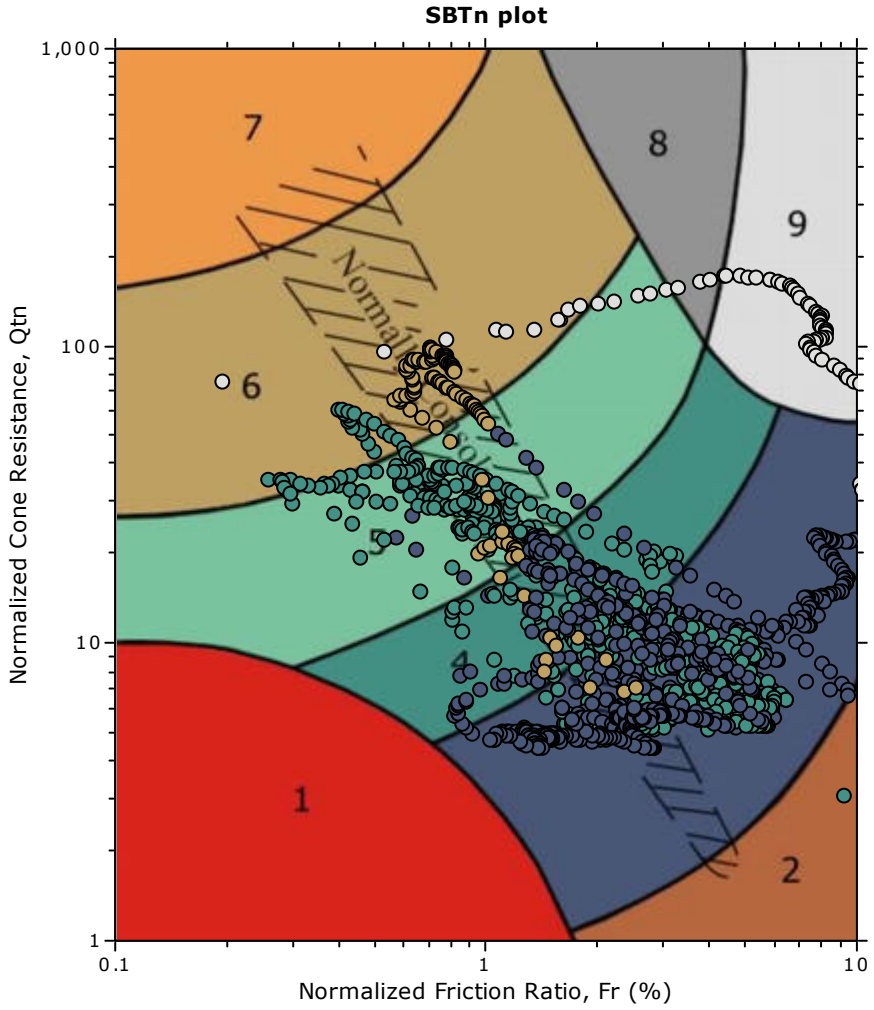
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

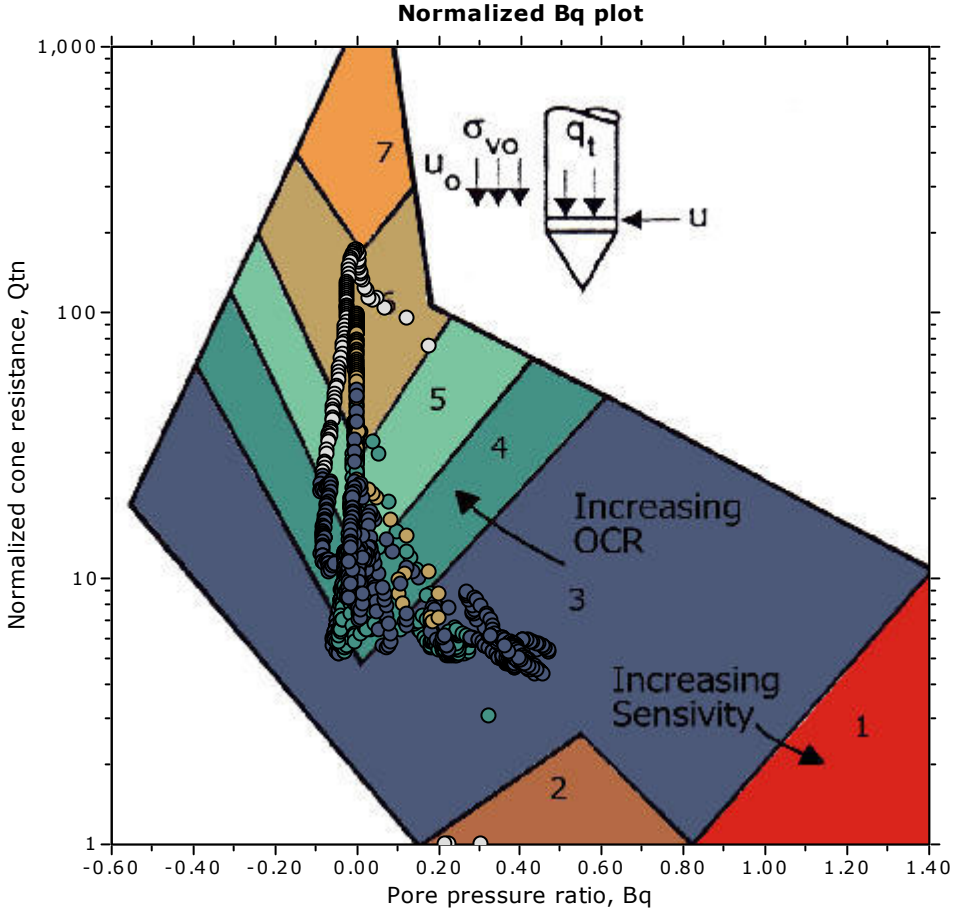
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

SBT - Bq plots (normalized)





SBTn legend

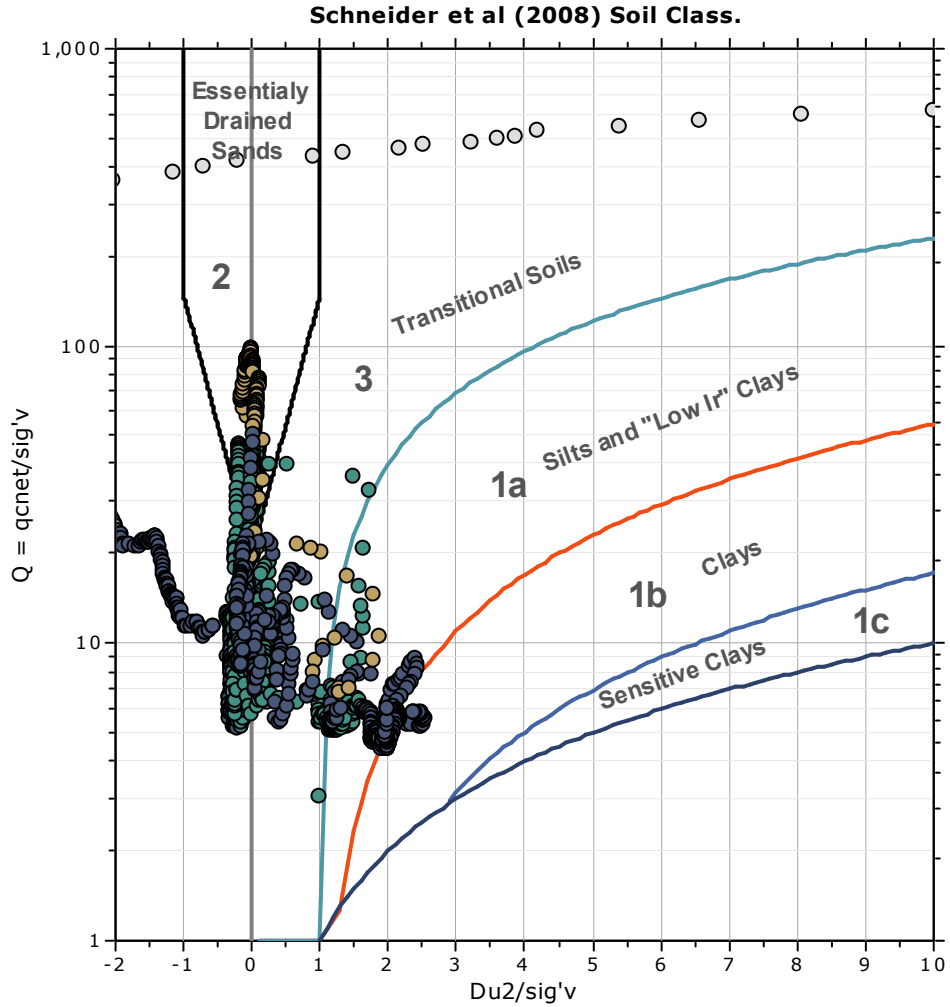
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

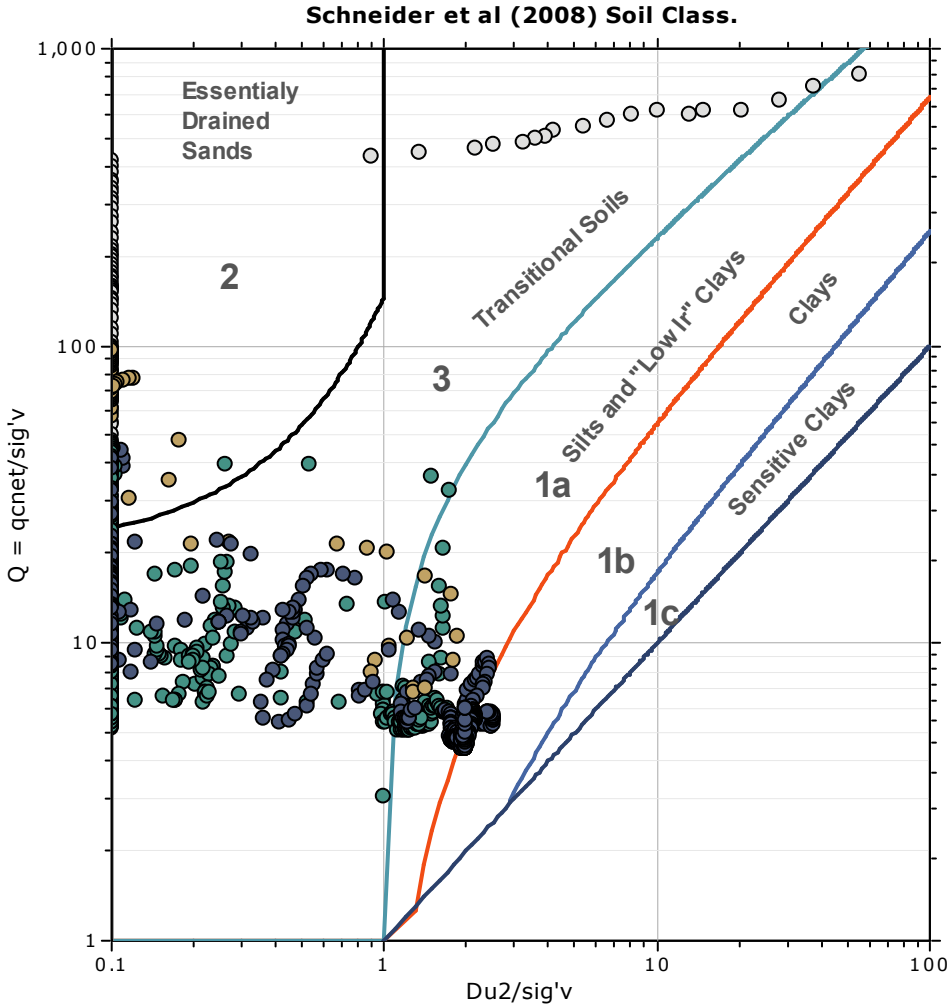
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Bq plots (Schneider)

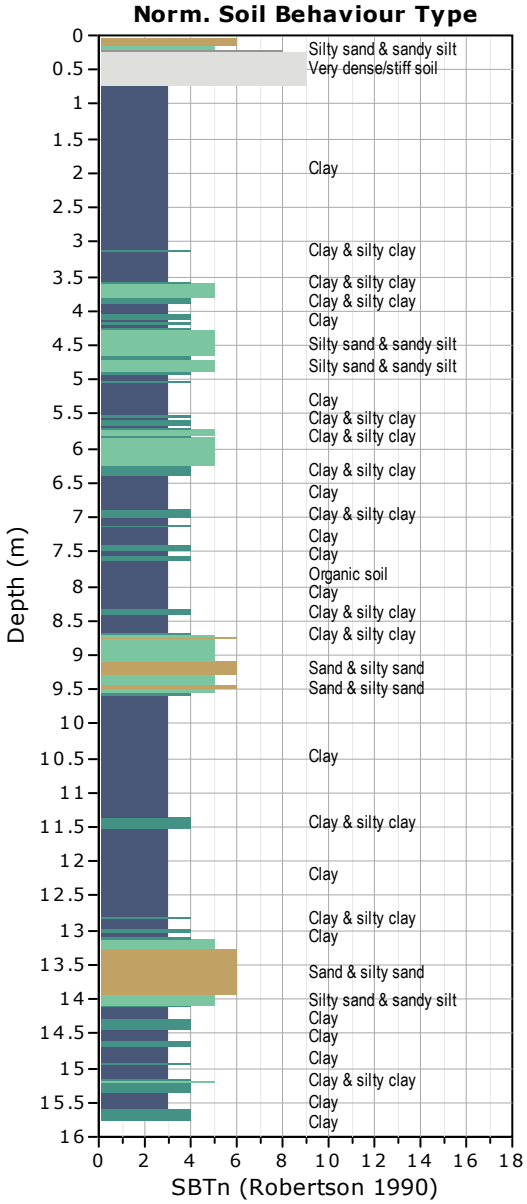


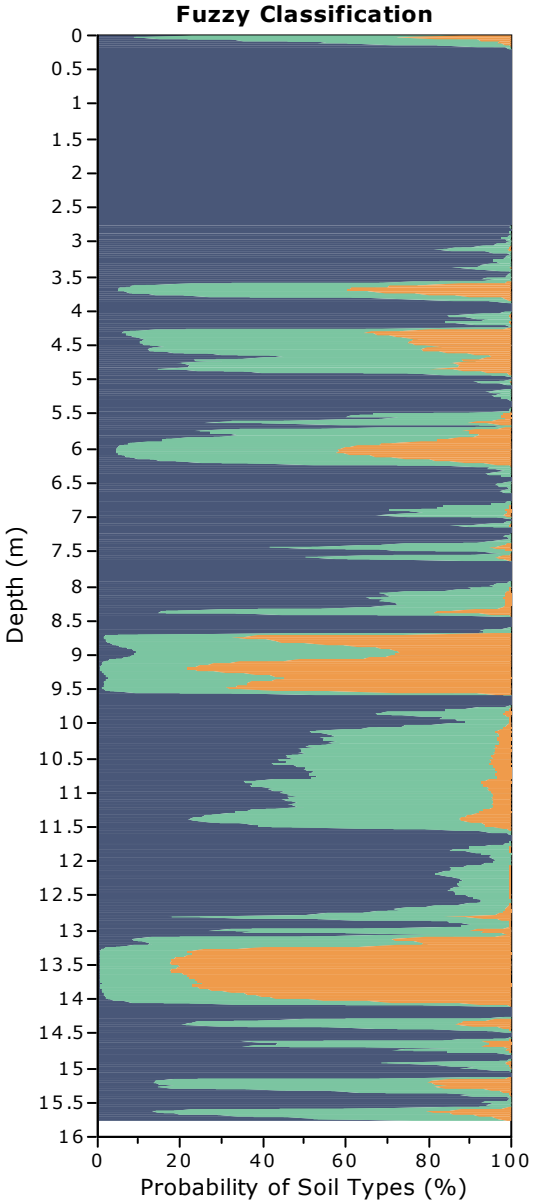


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rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

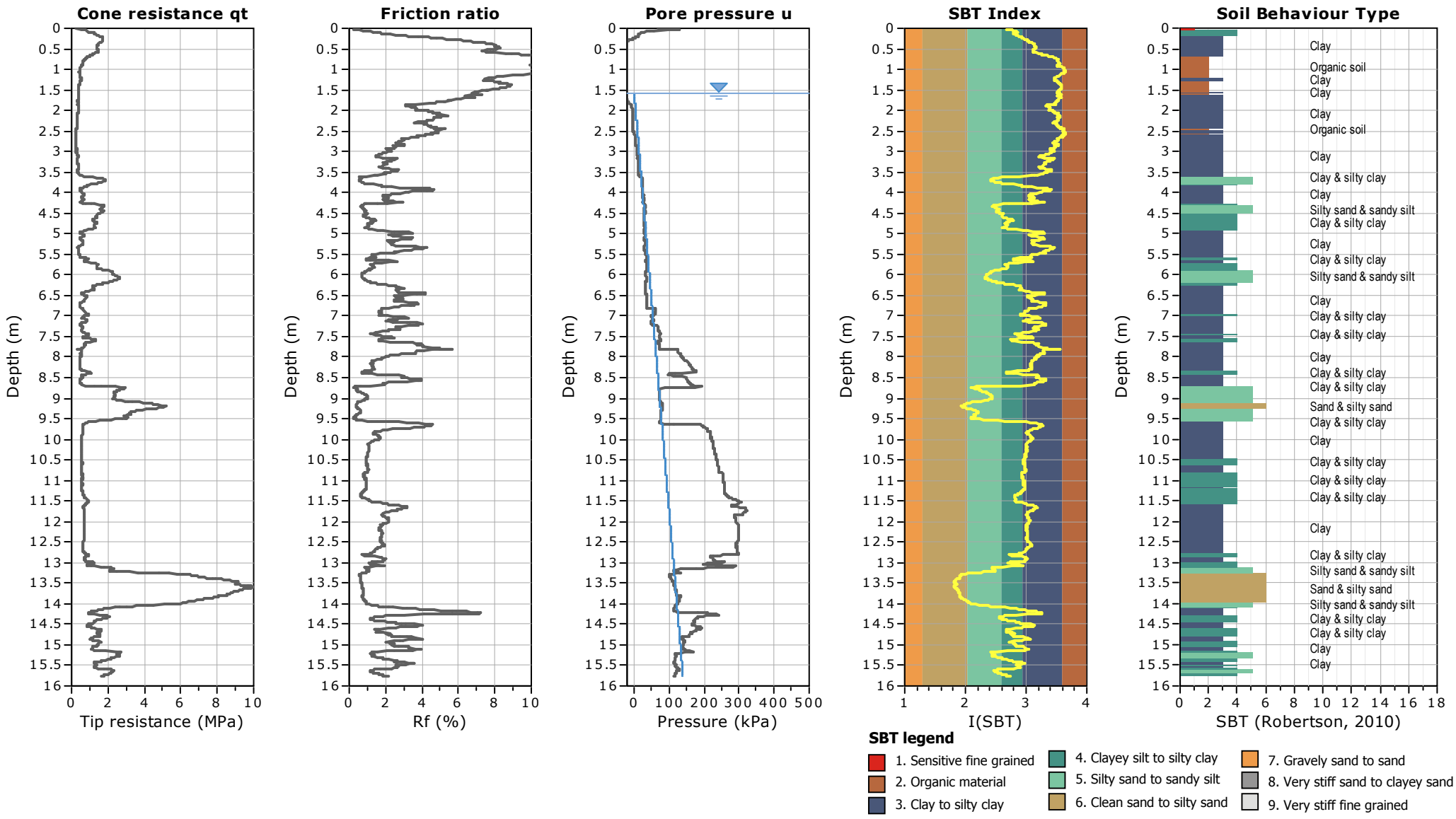




RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

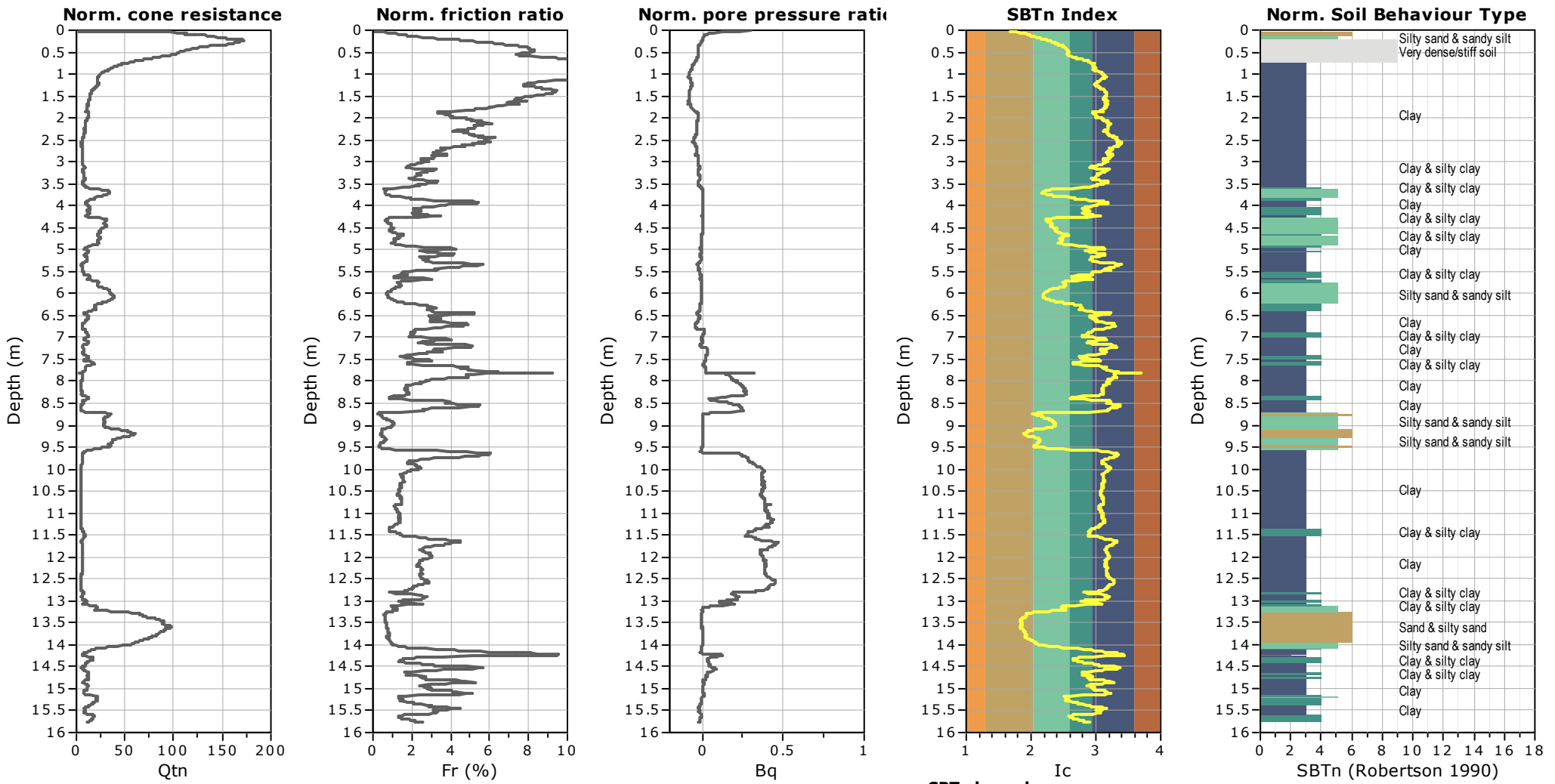
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

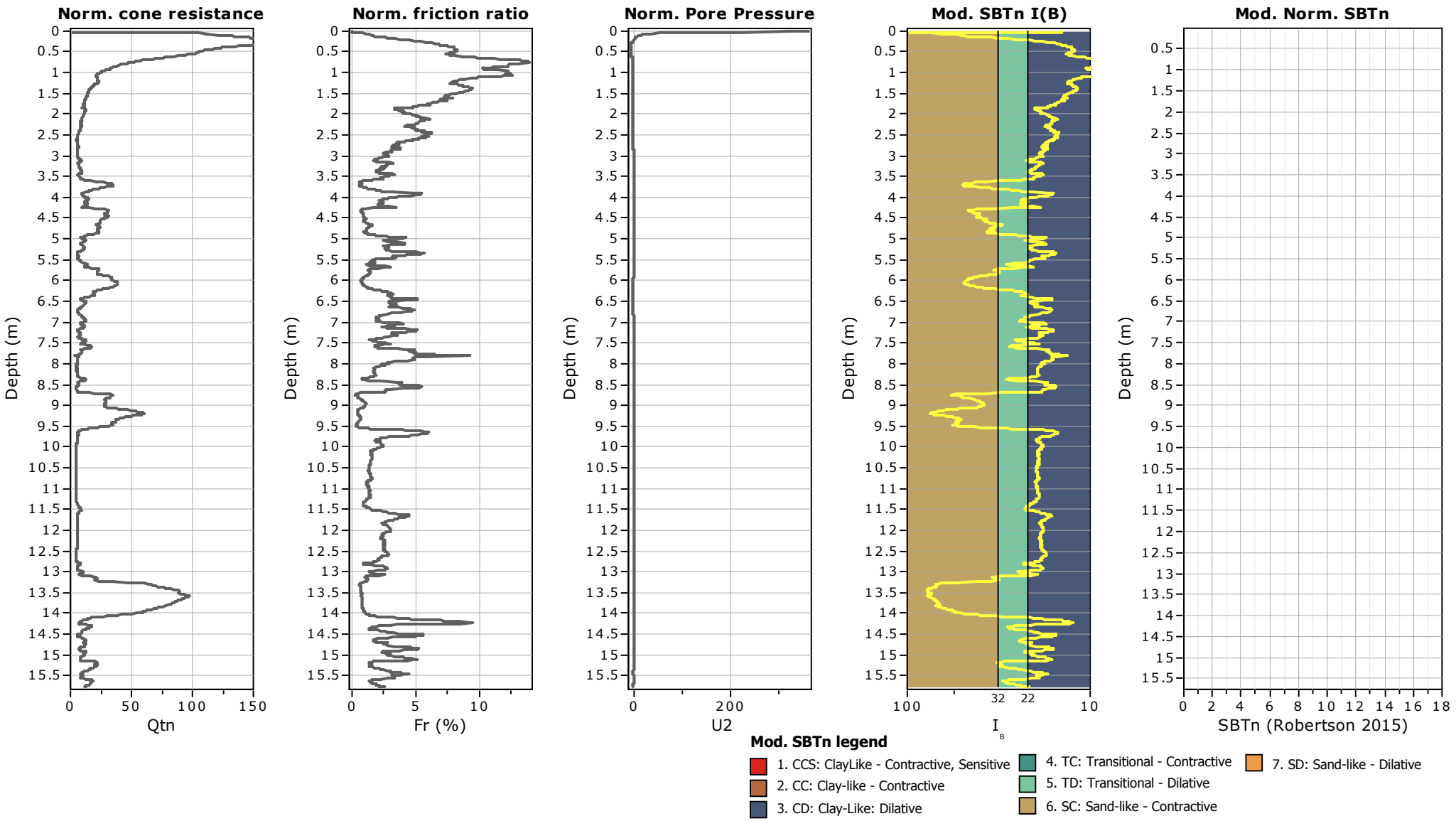
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
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rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

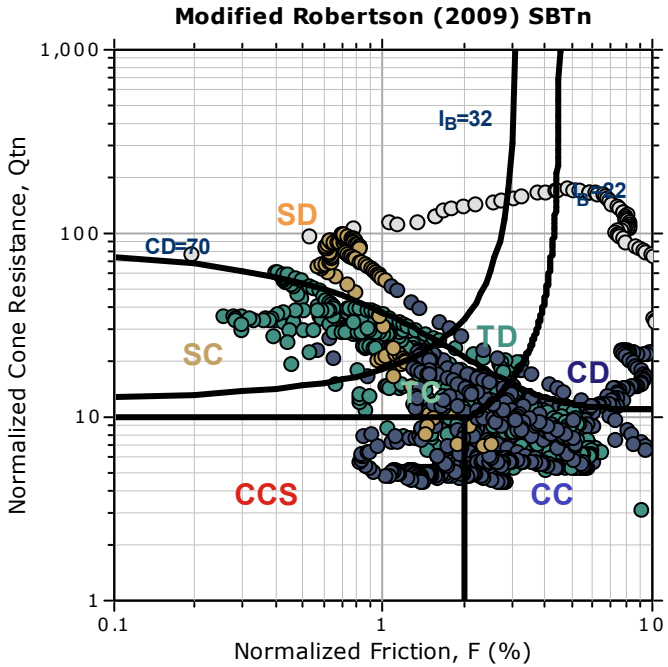


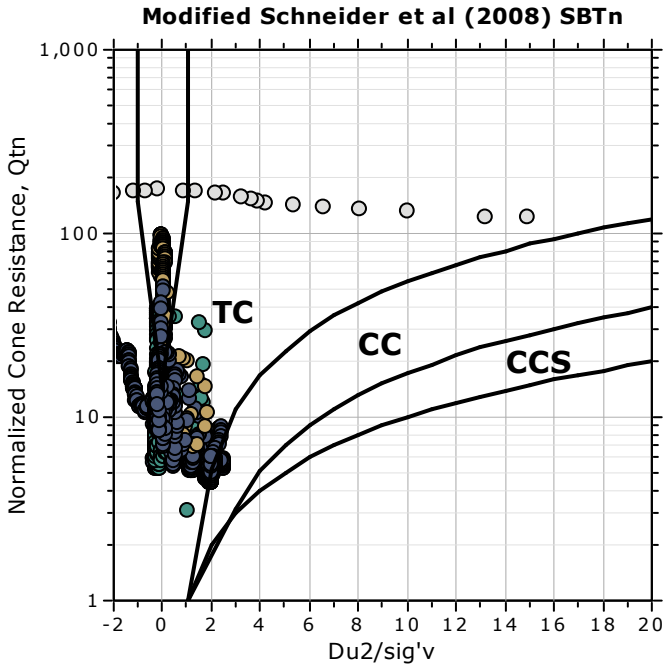
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

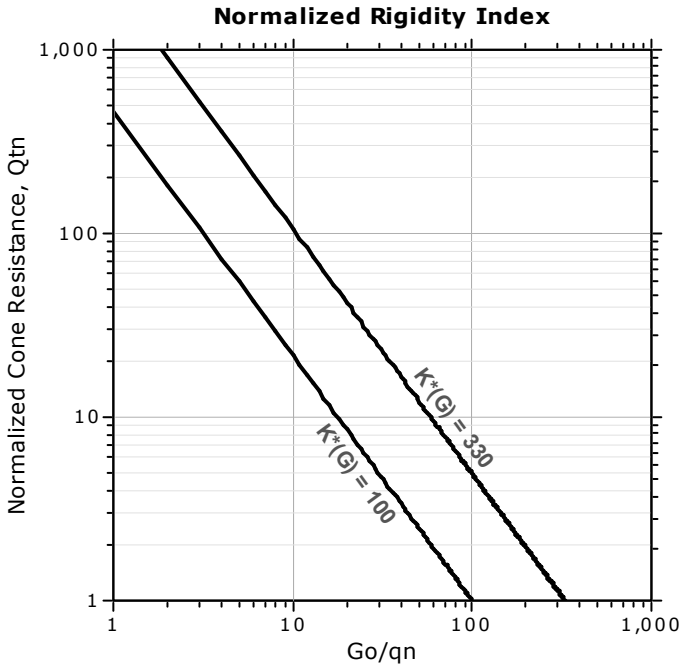
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Updated SBTn plots







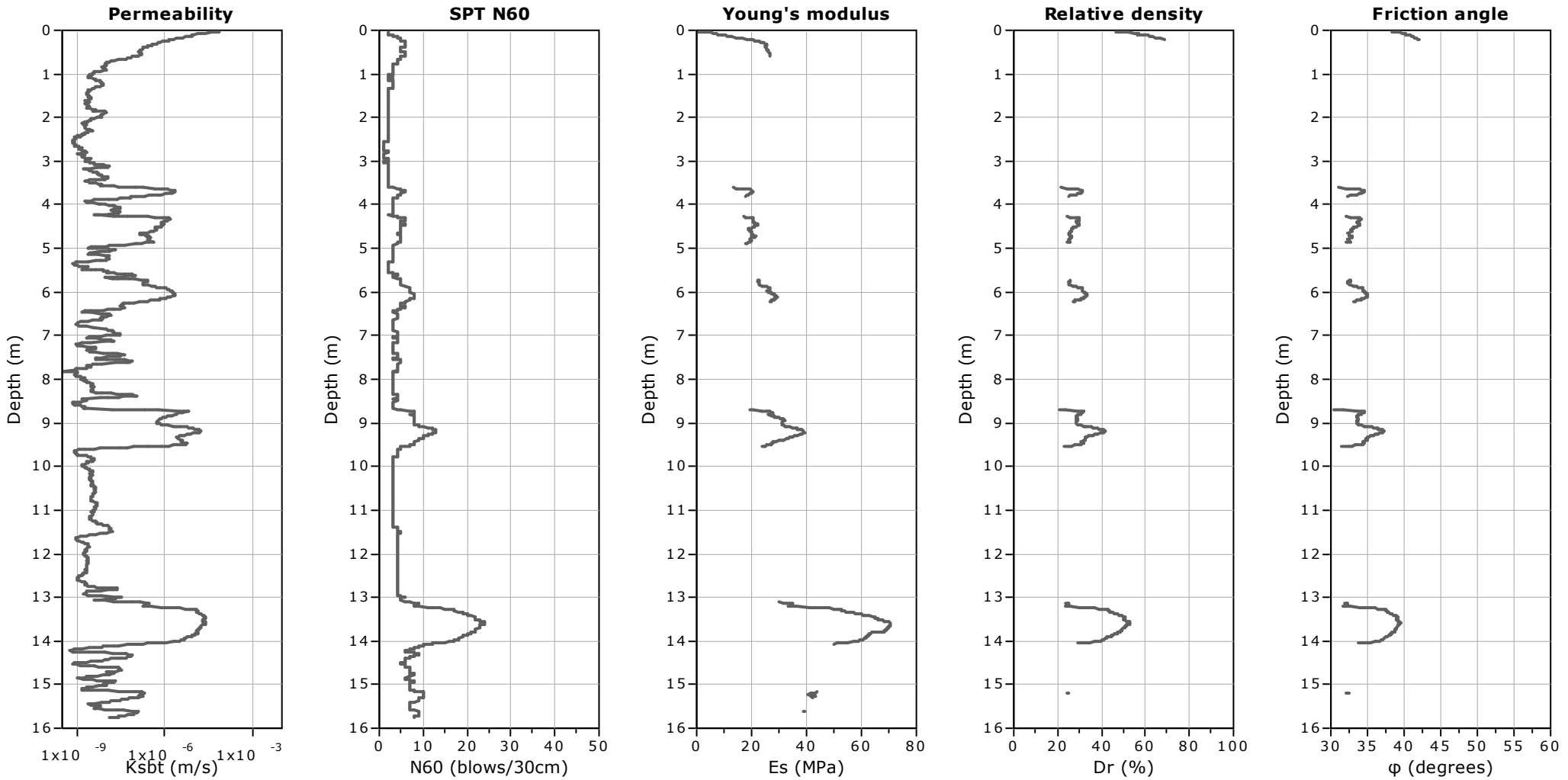
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

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CPT: cptu9
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



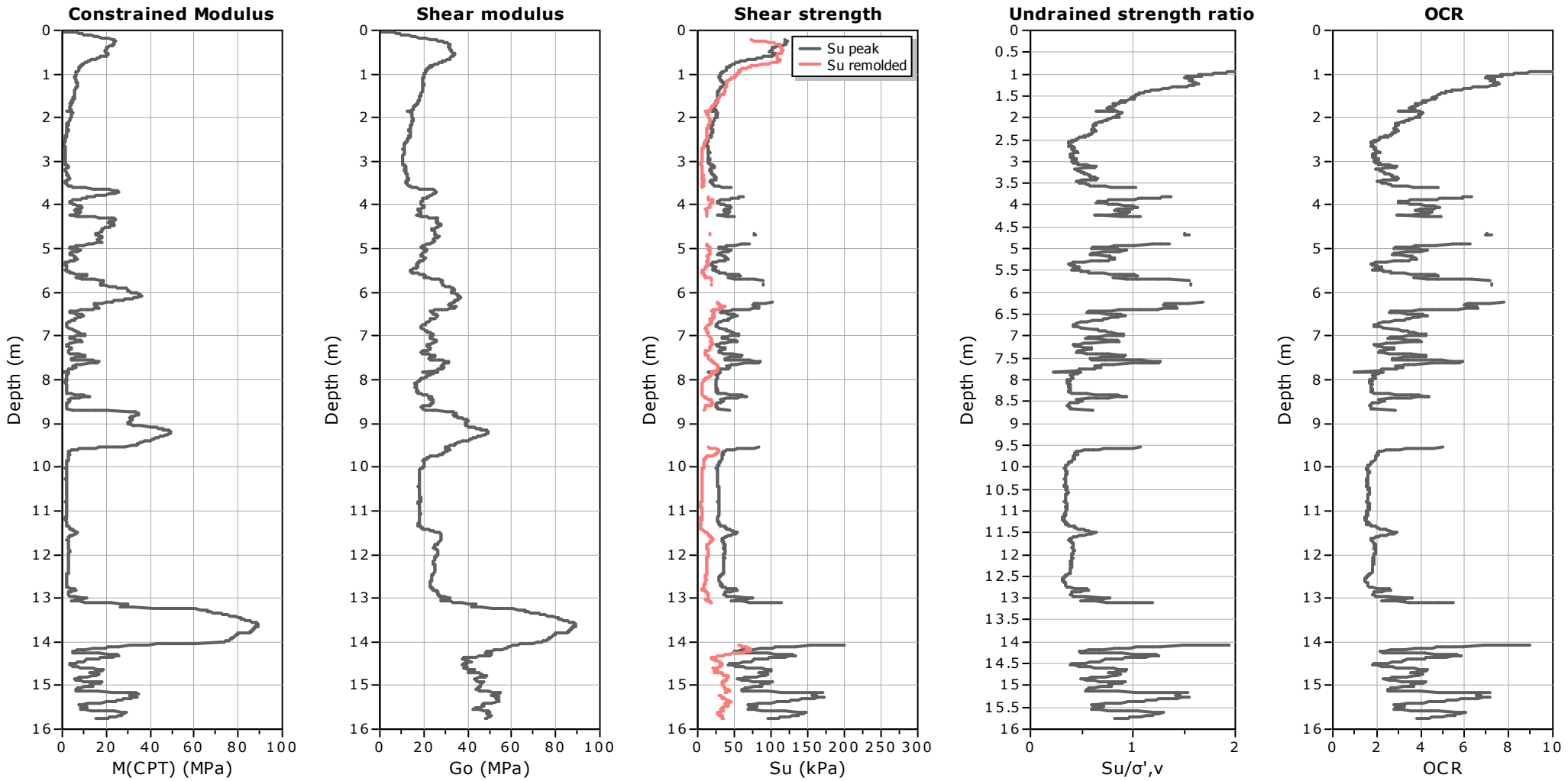
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
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CPT: cptu9
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

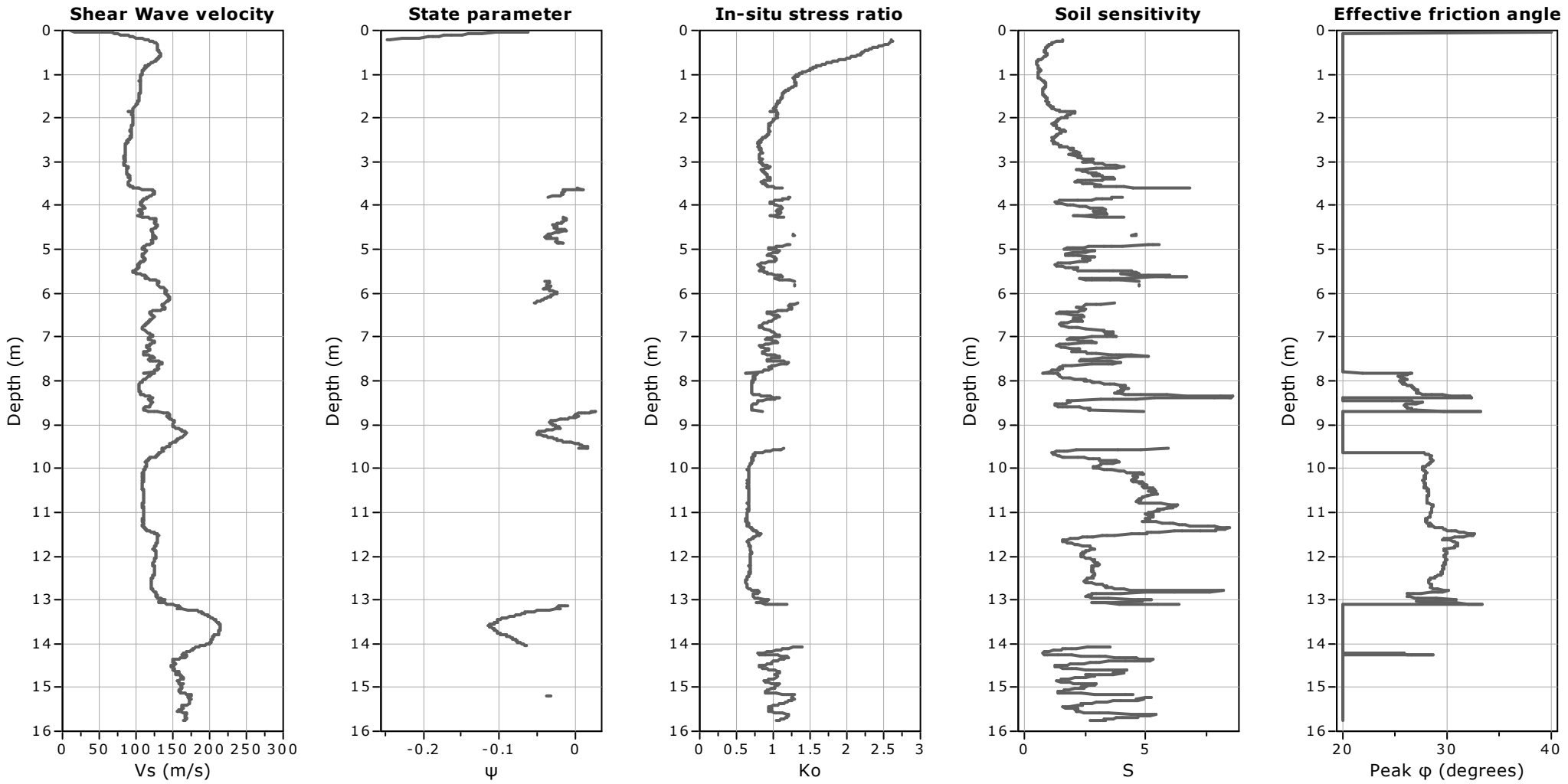
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
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Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



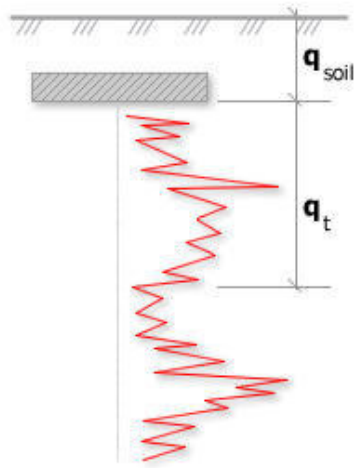
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

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Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

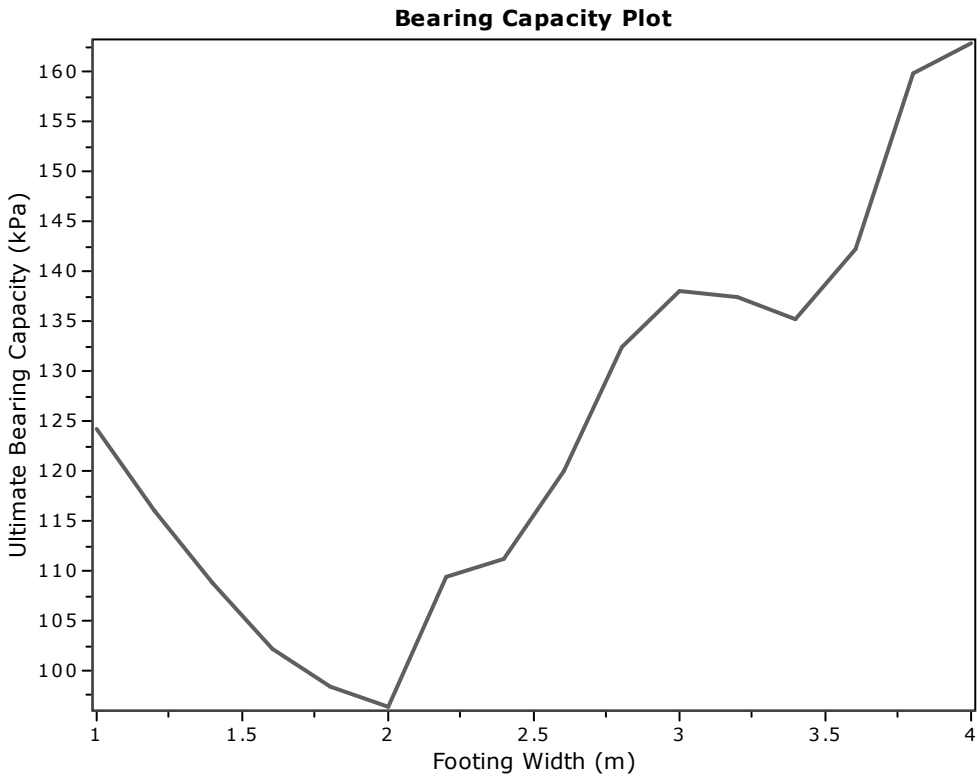
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



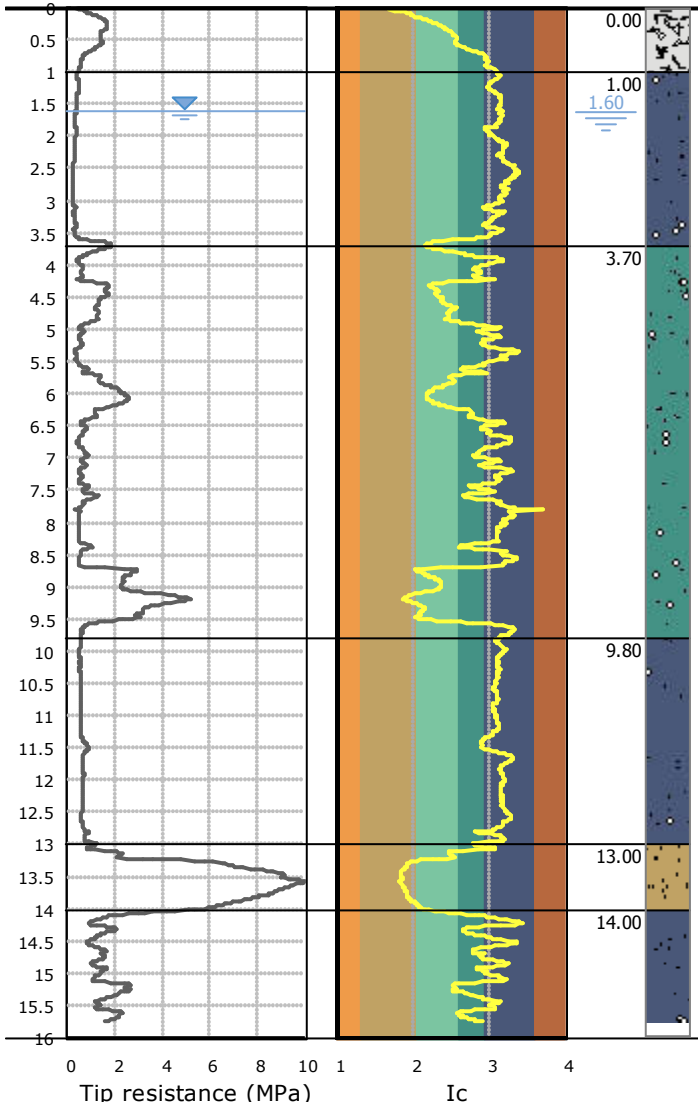
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.57	0.20	9.50	124.17
2	1.20	0.50	2.30	0.53	0.20	9.50	116.01
3	1.40	0.50	2.60	0.50	0.20	9.50	108.78
4	1.60	0.50	2.90	0.46	0.20	9.50	102.33
5	1.80	0.50	3.20	0.45	0.20	9.50	98.56
6	2.00	0.50	3.50	0.43	0.20	9.50	96.47
7	2.20	0.50	3.80	0.50	0.20	9.50	109.39
8	2.40	0.50	4.10	0.51	0.20	9.50	111.33
9	2.60	0.50	4.40	0.55	0.20	9.50	119.94
10	2.80	0.50	4.70	0.61	0.20	9.50	132.49
11	3.00	0.50	5.00	0.64	0.20	9.50	138.08
12	3.20	0.50	5.30	0.64	0.20	9.50	137.39
13	3.40	0.50	5.60	0.63	0.20	9.50	135.17
14	3.60	0.50	5.90	0.66	0.20	9.50	142.27
15	3.80	0.50	6.20	0.75	0.20	9.50	159.77
16	4.00	0.50	6.50	0.77	0.20	9.50	162.73

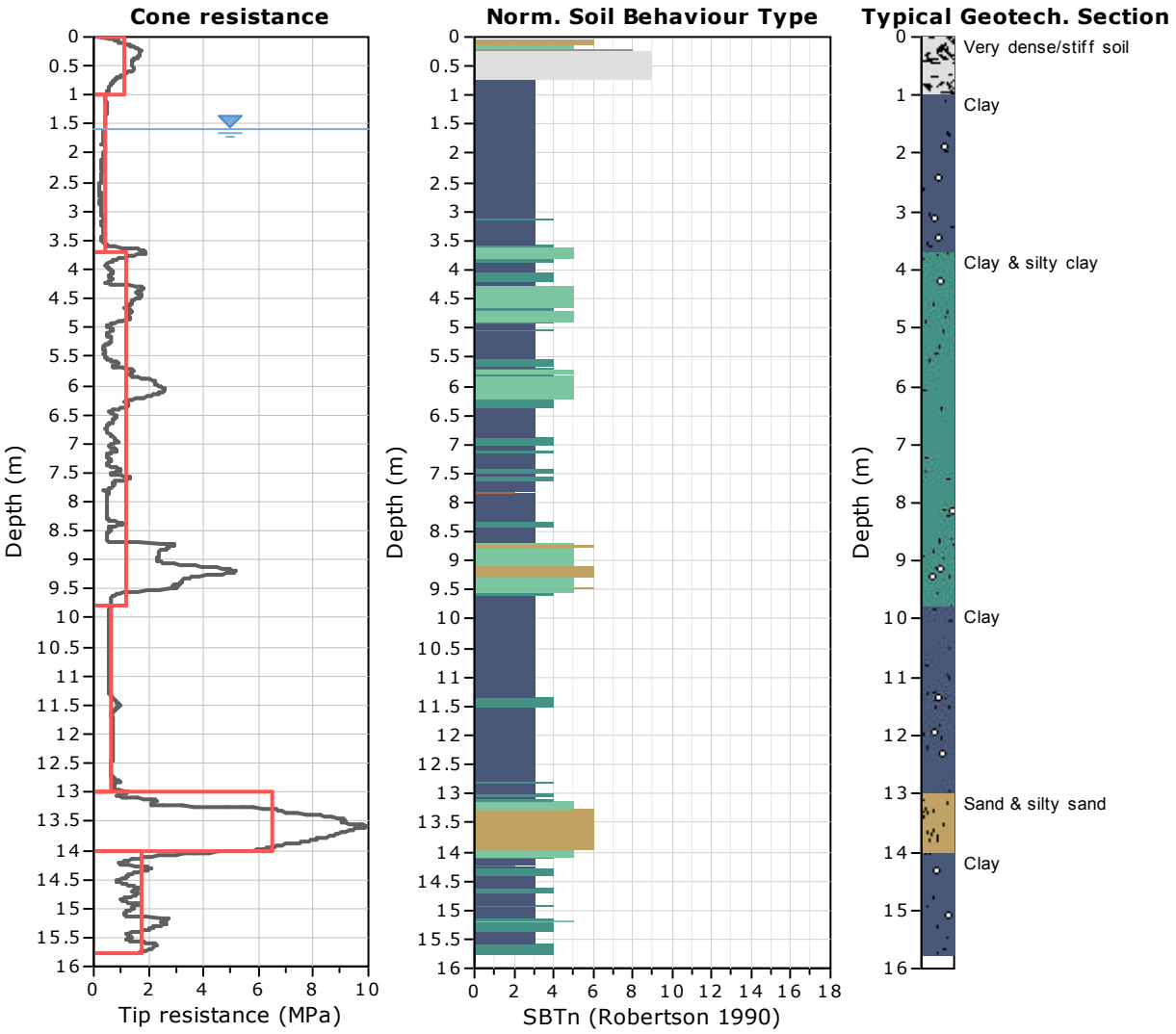
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.00	Very dense/stiff soil	1.1	2.58E-6	4.3	23.4	-	-	14.8	25.0	79.3	6.3	29.0	17.9
1.00	Clay	0.4	5.49E-8	2.1	-	-	-	3.8	14.7	22.1	0.8	3.5	15.6
3.70	Clay & silty clay	1.2	7.53E-7	4.6	21.3	-	-	13.3	25.7	40.1	0.7	3.2	16.1
9.80	Clay	0.6	3.72E-9	3.5	-	-	-	2.6	21.8	33.3	0.4	1.8	15.3
13.00	Sand & silty sand	6.5	1.11E-5	17.2	59.4	44.0	37.5	65.0	69.4	-	-	-	18.0
14.00	Clay	1.7	8.76E-8	7.9	42.2	-	-	18.1	48.0	95.0	0.9	4.0	17.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 1.00 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.11 ±0.43 MPa	Permeability: 2.58E-06 ±8.90E-06 m/s	Constrained Mod.: 14.81 ±6.58 MPa
Sleeve friction: 79.80 ±36.52 kPa	N60: 4.34 ±1.30 blows	Go: 24.98 ±8.45 MPa
SBT_n: 9	Es: 23.35 ±6.74 MPa	Su: 79.27 ±31.93 kPa
SBTn description: Very dense/stiff soil	Dr (%): 0.00 ±0.00	Su ratio: 6.28 ±3.37
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 28.99 ±15.58
	Unit weight: 17.90 ±0.96 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 3.70 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.39 ±0.24 MPa	Permeability: 5.49E-08 ±2.98E-07 m/s	Constrained Mod.: 3.84 ±3.85 MPa
Sleeve friction: 17.29 ±12.99 kPa	N60: 2.07 ±0.75 blows	Go: 14.70 ±3.50 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 22.06 ±6.18 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.77 ±0.37
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 3.54 ±1.72
	Unit weight: 15.59 ±0.85 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 3.70 (m), **End depth:** 9.80 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 1.20 ±0.96 MPa	Permeability: 7.53E-07 ±2.14E-06 m/s	Constrained Mod.: 13.33 ±12.59 MPa
Sleeve friction: 16.06 ±5.84 kPa	N60: 4.64 ±2.26 blows	Go: 25.67 ±7.52 MPa
SBT_n: 4	Es: 21.32 ±2.62 MPa	Su: 40.10 ±16.20 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.70 ±0.29
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 3.22 ±1.35
	Unit weight: 16.08 ±0.56 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 9.80 (m), **End depth:** 13.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.65 ±0.11 MPa	Permeability: 3.72E-09 ±3.83E-09 m/s	Constrained Mod.: 2.61 ±1.20 MPa
Sleeve friction: 9.33 ±4.17 kPa	N60: 3.53 ±0.56 blows	Go: 21.83 ±3.74 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 33.30 ±6.93 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.39 ±0.07
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.78 ±0.31
	Unit weight: 15.27 ±0.55 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 13.00 (m), **End depth:** 14.00 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.51 ±2.95 MPa	Permeability: 1.11E-05 ±8.40E-06 m/s	Constrained Mod.: 65.03 ±27.02 MPa
Sleeve friction: 48.72 ±19.15 kPa	N60: 17.23 ±6.26 blows	Go: 69.36 ±19.42 MPa
SBT_n: 6	Es: 59.42 ±11.41 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 43.95 ±8.64	Su ratio: 0.00 ±0.00
	φ (degrees): 37.50 ±2.27 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.98 ±0.88 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 14.00 (m), **End depth:** 15.76 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 1.72 ±0.78 MPa	Permeability: 8.76E-08 ±3.34E-07 m/s	Constrained Mod.: 18.09 ±12.53 MPa
Sleeve friction: 38.02 ±12.13 kPa	N60: 7.90 ±1.95 blows	Go: 48.04 ±6.92 MPa
SBT_n: 3	Es: 42.16 ±3.02 MPa	Su: 95.02 ±33.03 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.87 ±0.30
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 4.00 ±1.38
	Unit weight: 17.30 ±0.38 kN/m³	

RDR SrL
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CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

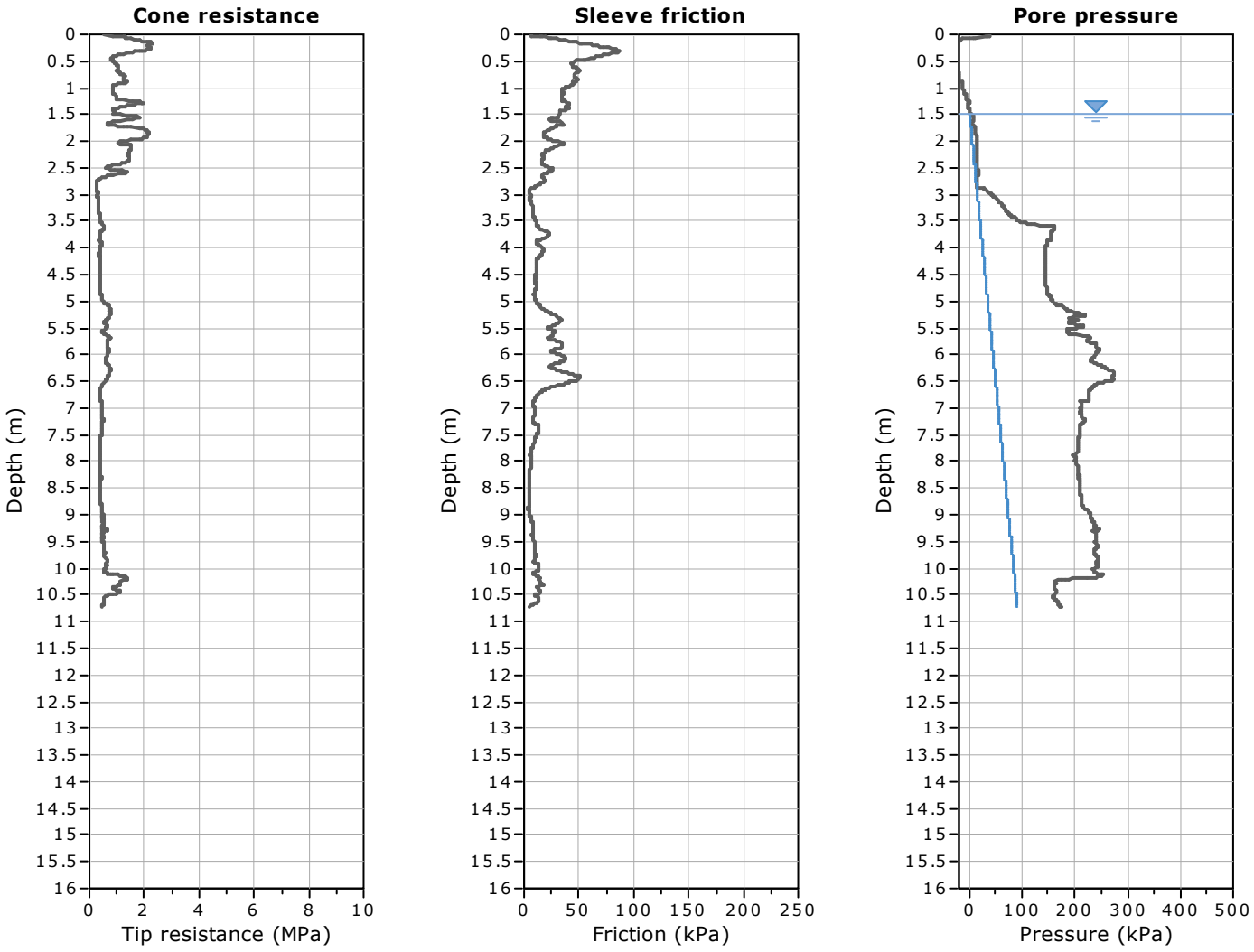
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	1.00	2.58E-06	4.3	23.4	0.0	0.0	14.8	25.0	79.3	6.3	29.0	17.9
1.00		(±8.90E-06)	(±1.3)	(±6.7)	(±0.0)	(±0.0)	(±6.6)	(±8.5)	(±31.9)	(±3.4)	(±15.6)	(±1.0)
1.00	2.70	5.49E-08	2.1	0.0	0.0	0.0	3.8	14.7	22.1	0.8	3.5	15.6
3.70		(±2.98E-07)	(±0.7)	(±0.0)	(±0.0)	(±0.0)	(±3.9)	(±3.5)	(±6.2)	(±0.4)	(±1.7)	(±0.9)
3.70	6.10	7.53E-07	4.6	21.3	0.0	0.0	13.3	25.7	40.1	0.7	3.2	16.1
9.80		(±2.14E-06)	(±2.3)	(±2.6)	(±0.0)	(±0.0)	(±12.6)	(±7.5)	(±16.2)	(±0.3)	(±1.4)	(±0.6)
9.80	3.20	3.72E-09	3.5	0.0	0.0	0.0	2.6	21.8	33.3	0.4	1.8	15.3
13.00		(±3.83E-09)	(±0.6)	(±0.0)	(±0.0)	(±0.0)	(±1.2)	(±3.7)	(±6.9)	(±0.1)	(±0.3)	(±0.6)
13.00	1.00	1.11E-05	17.2	59.4	44.0	37.5	65.0	69.4	0.0	0.0	0.0	18.0
14.00		(±8.40E-06)	(±6.3)	(±11.4)	(±8.6)	(±2.3)	(±27.0)	(±19.4)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
14.00	1.76	8.76E-08	7.9	42.2	0.0	0.0	18.1	48.0	95.0	0.9	4.0	17.3
15.76		(±3.34E-07)	(±1.9)	(±3.0)	(±0.0)	(±0.0)	(±12.5)	(±6.9)	(±33.0)	(±0.3)	(±1.4)	(±0.4)

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

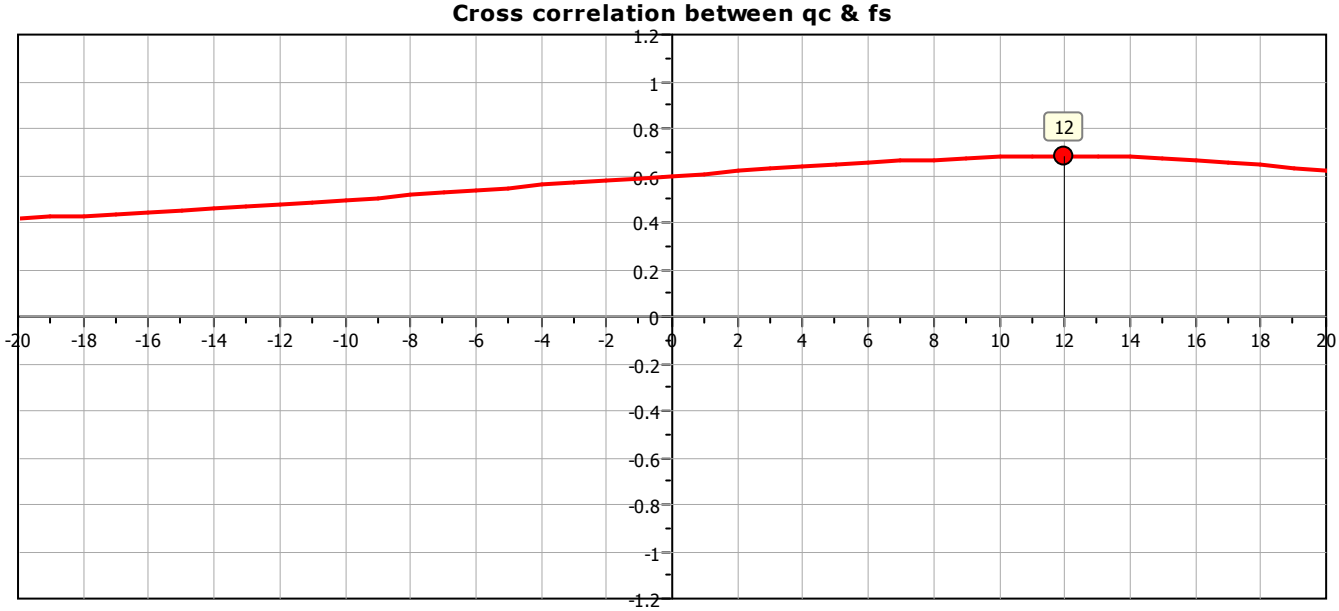
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

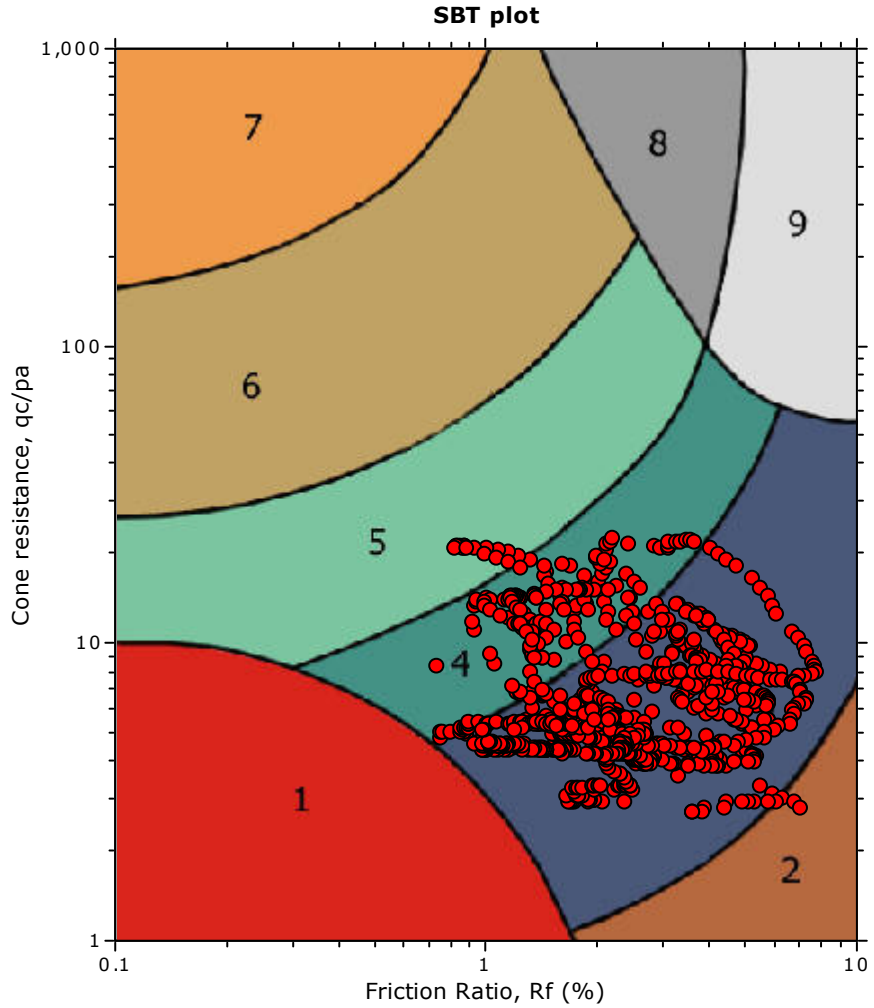


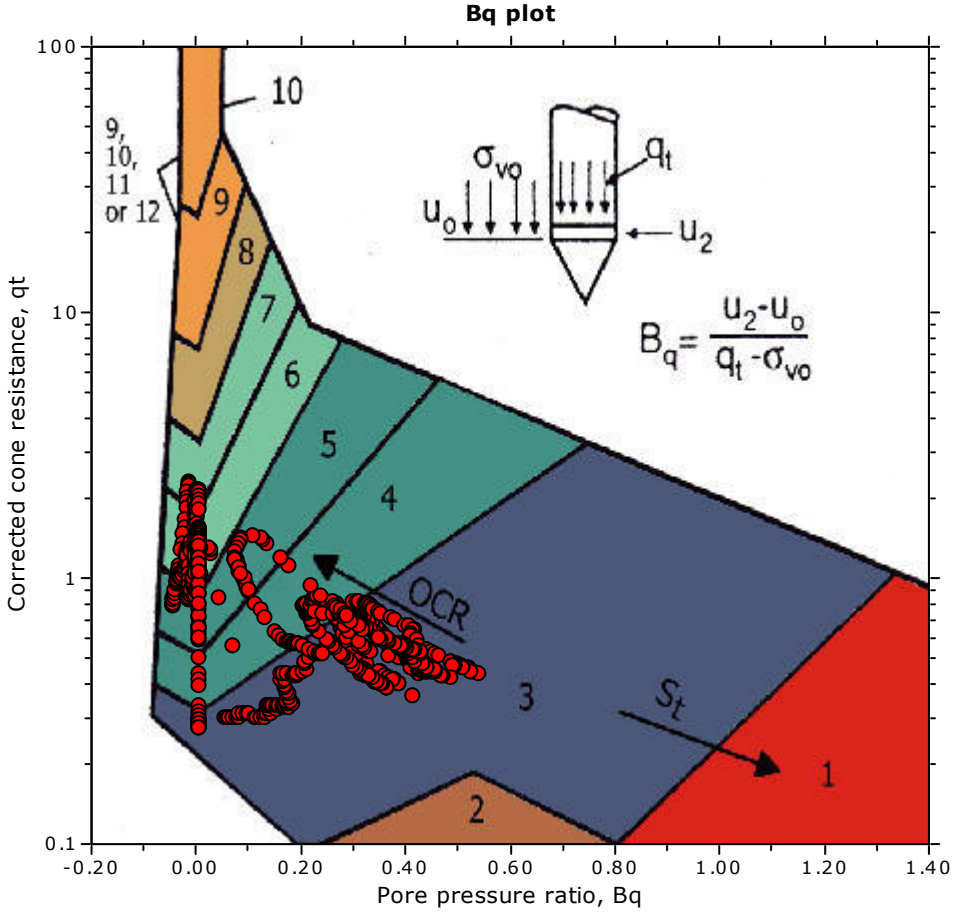
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

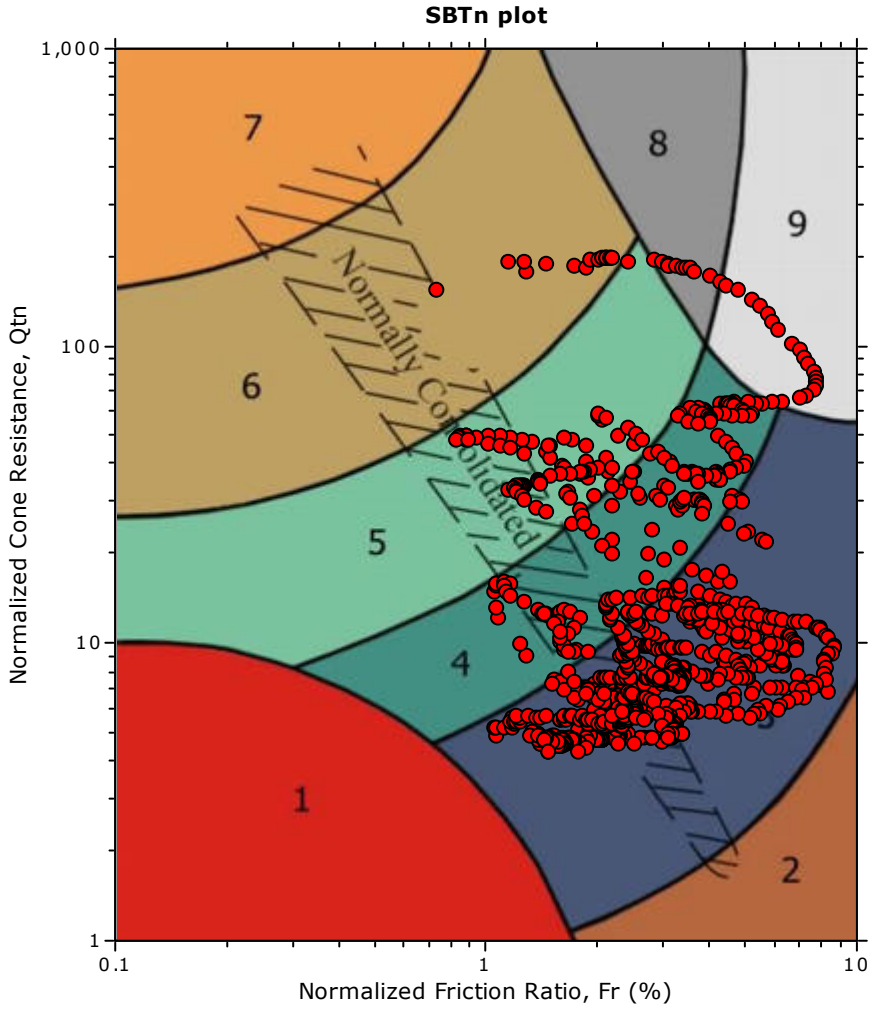
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

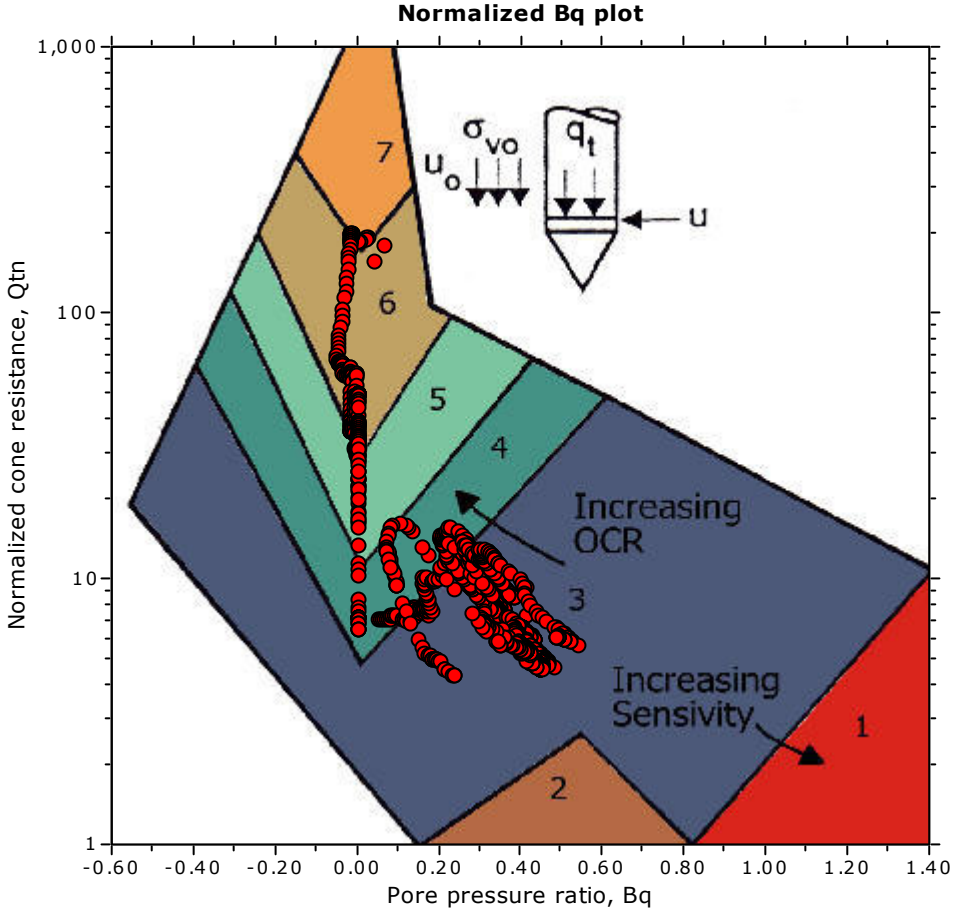
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

SBT - Bq plots (normalized)





SBTn legend

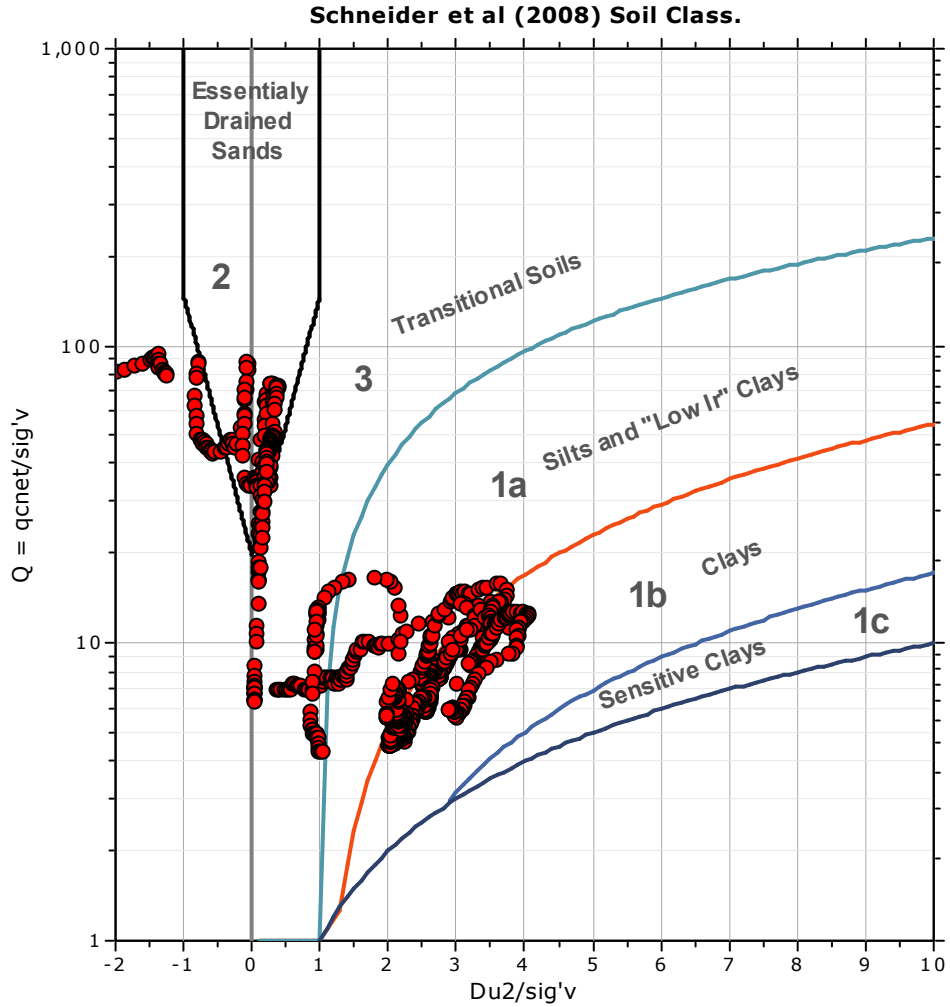
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

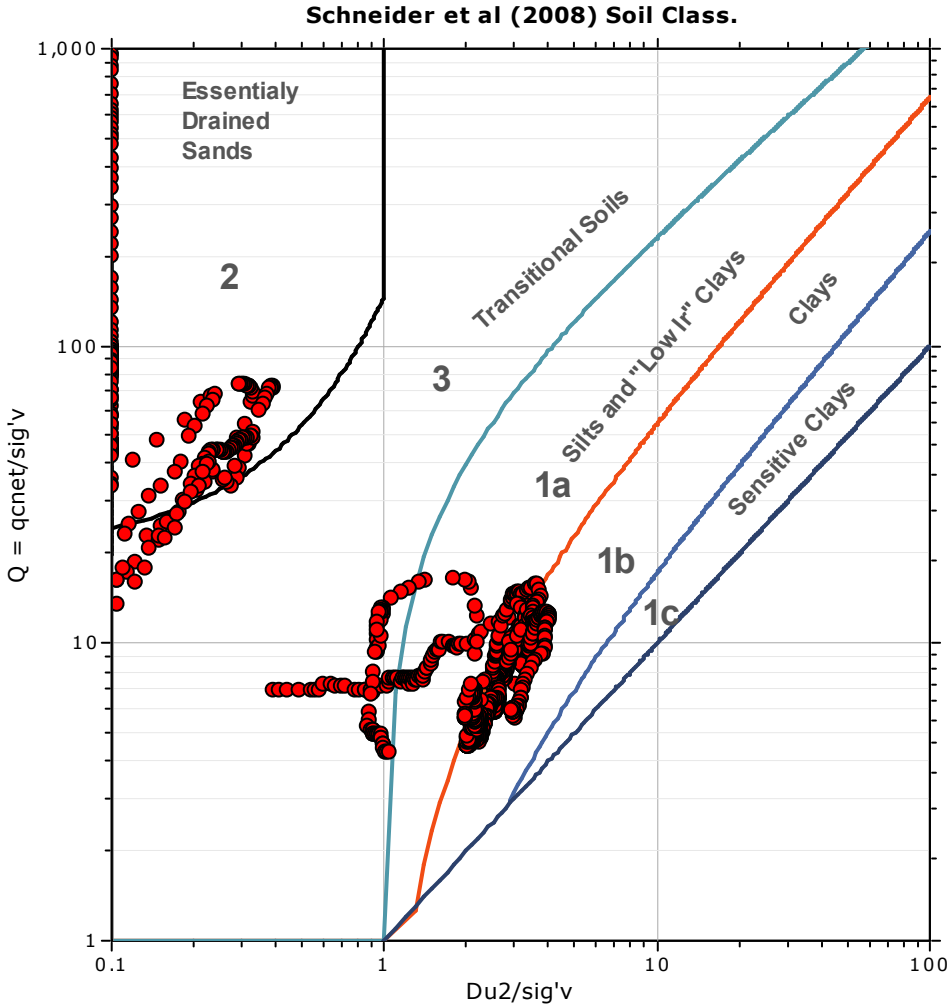
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Bq plots (Schneider)

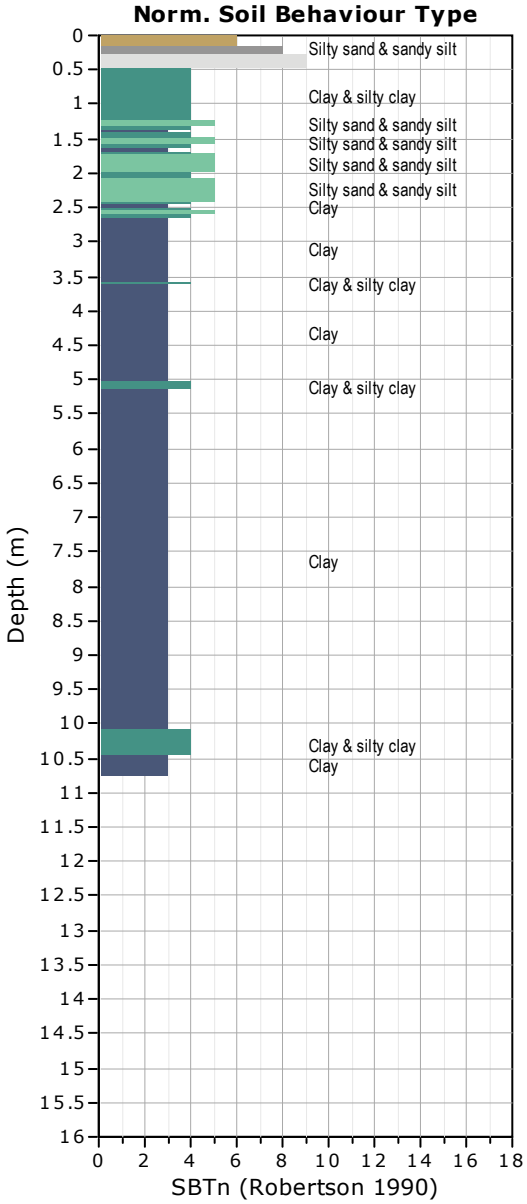


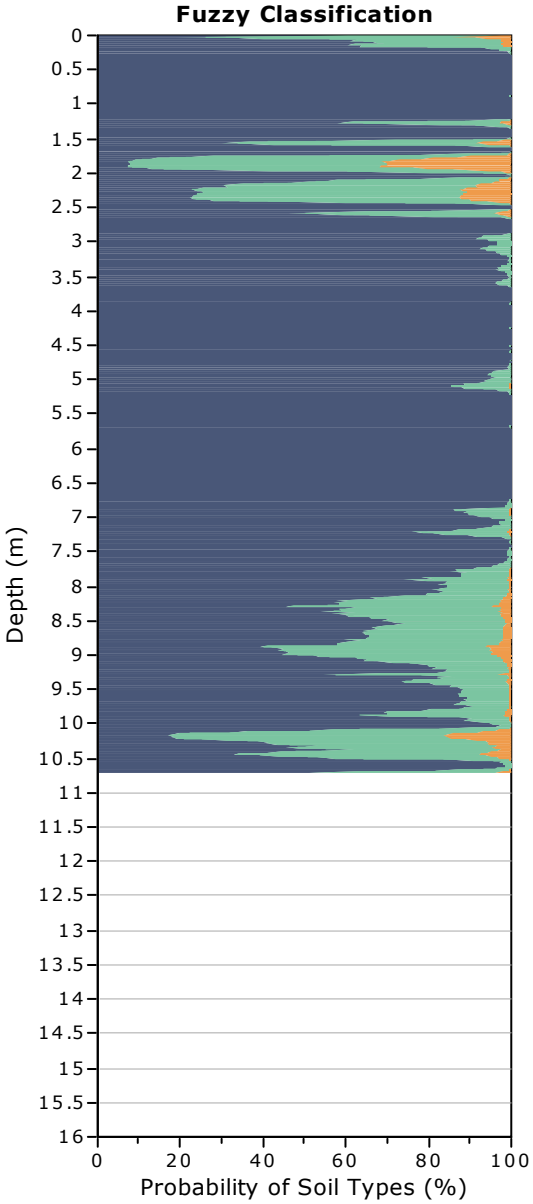


RDR SrL
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CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

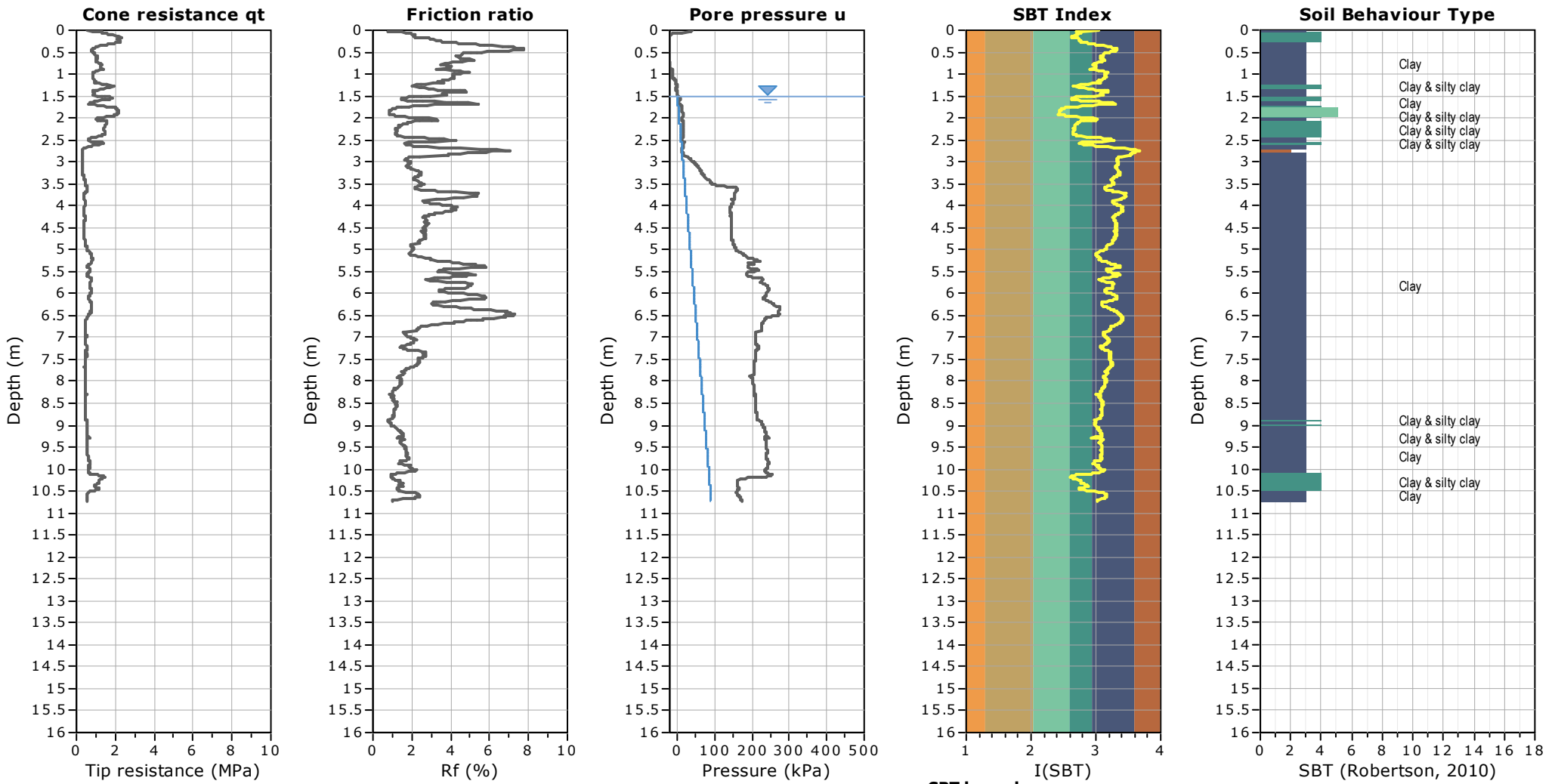




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CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

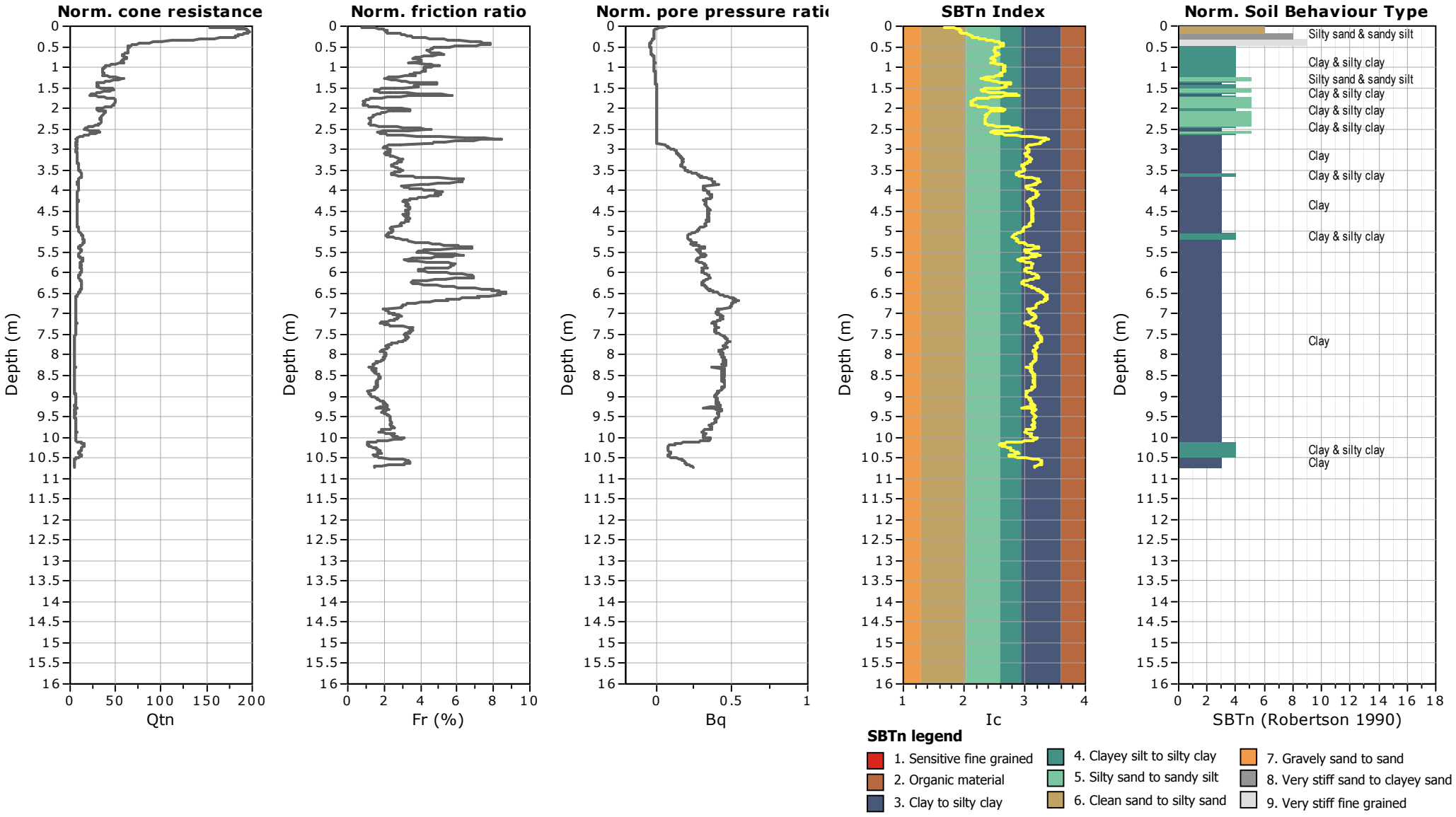
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

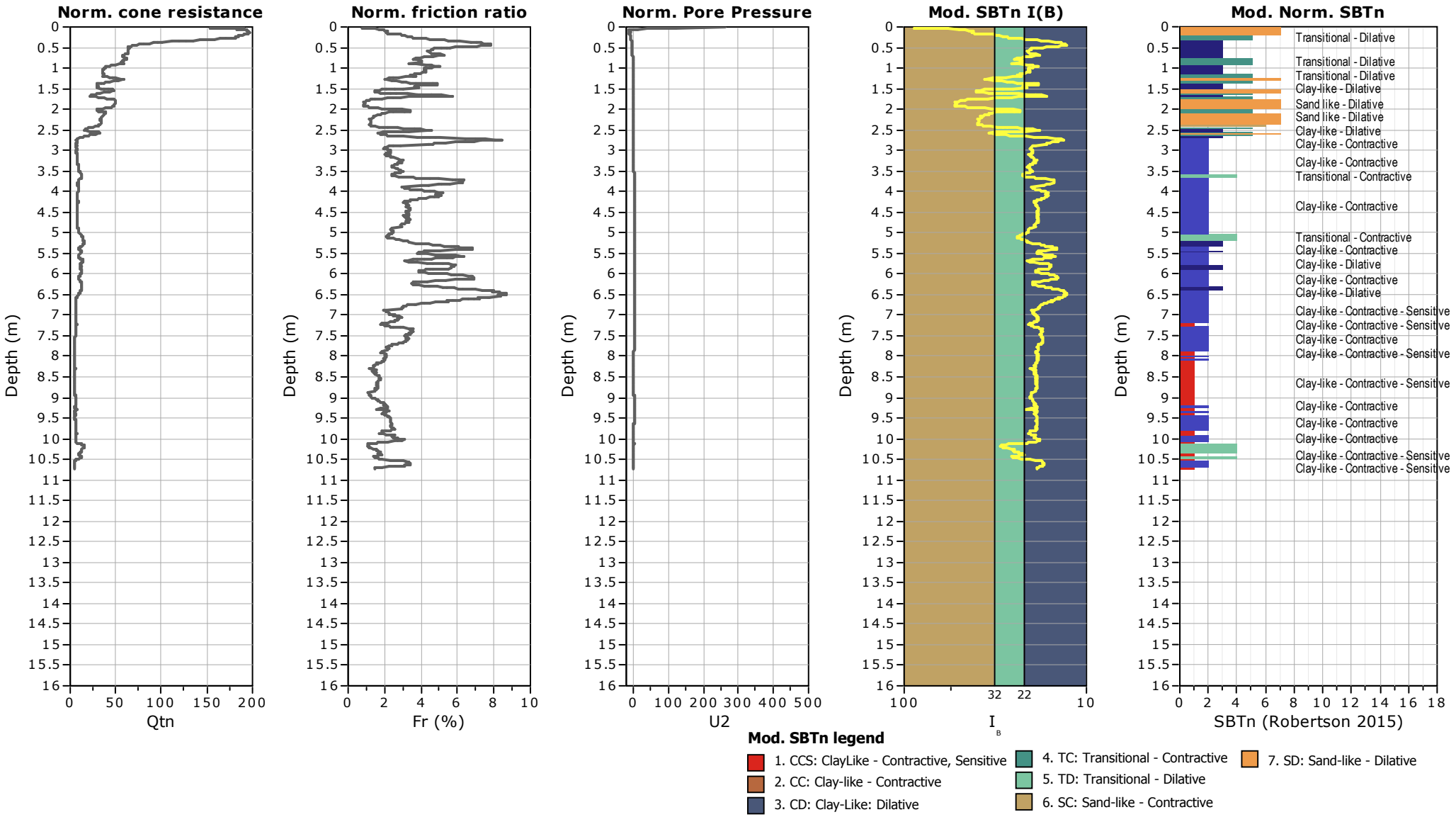
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

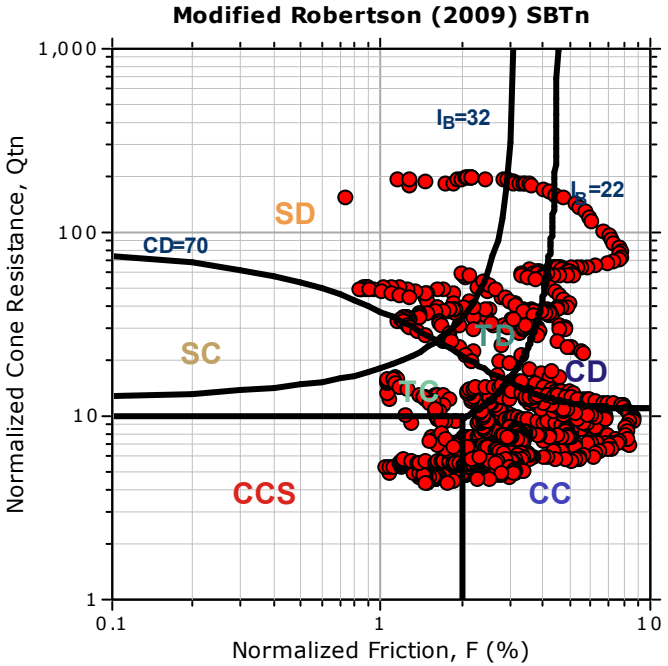


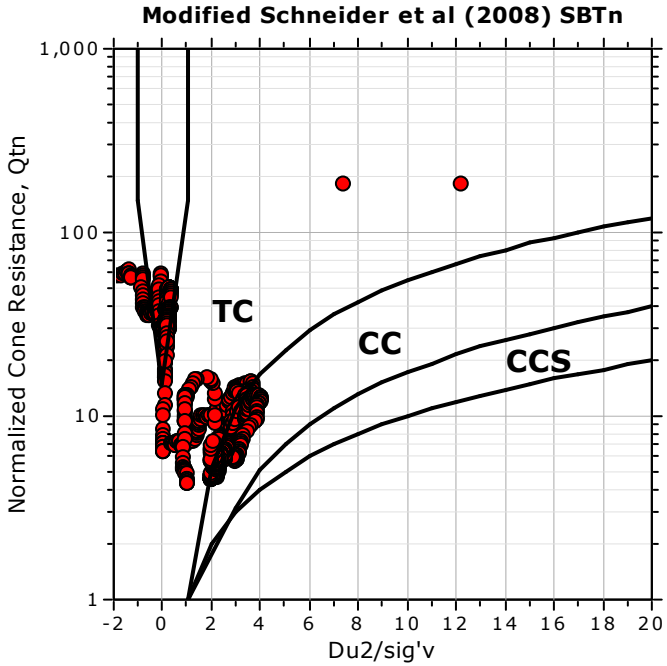
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

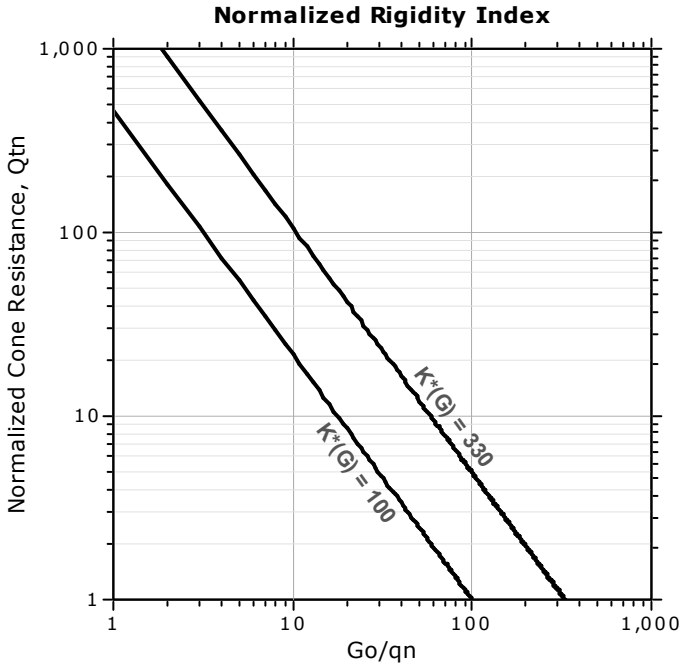
CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







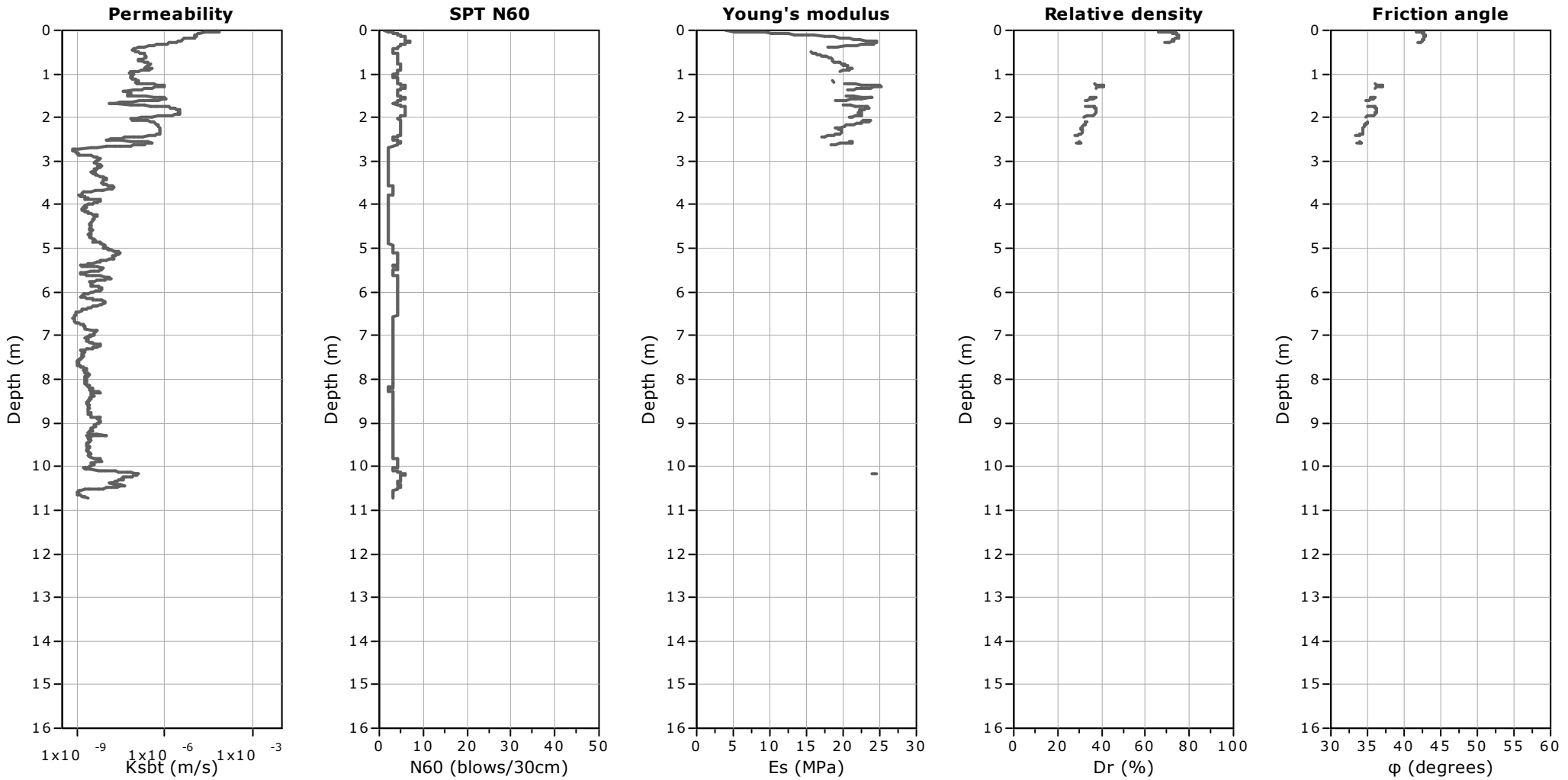
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



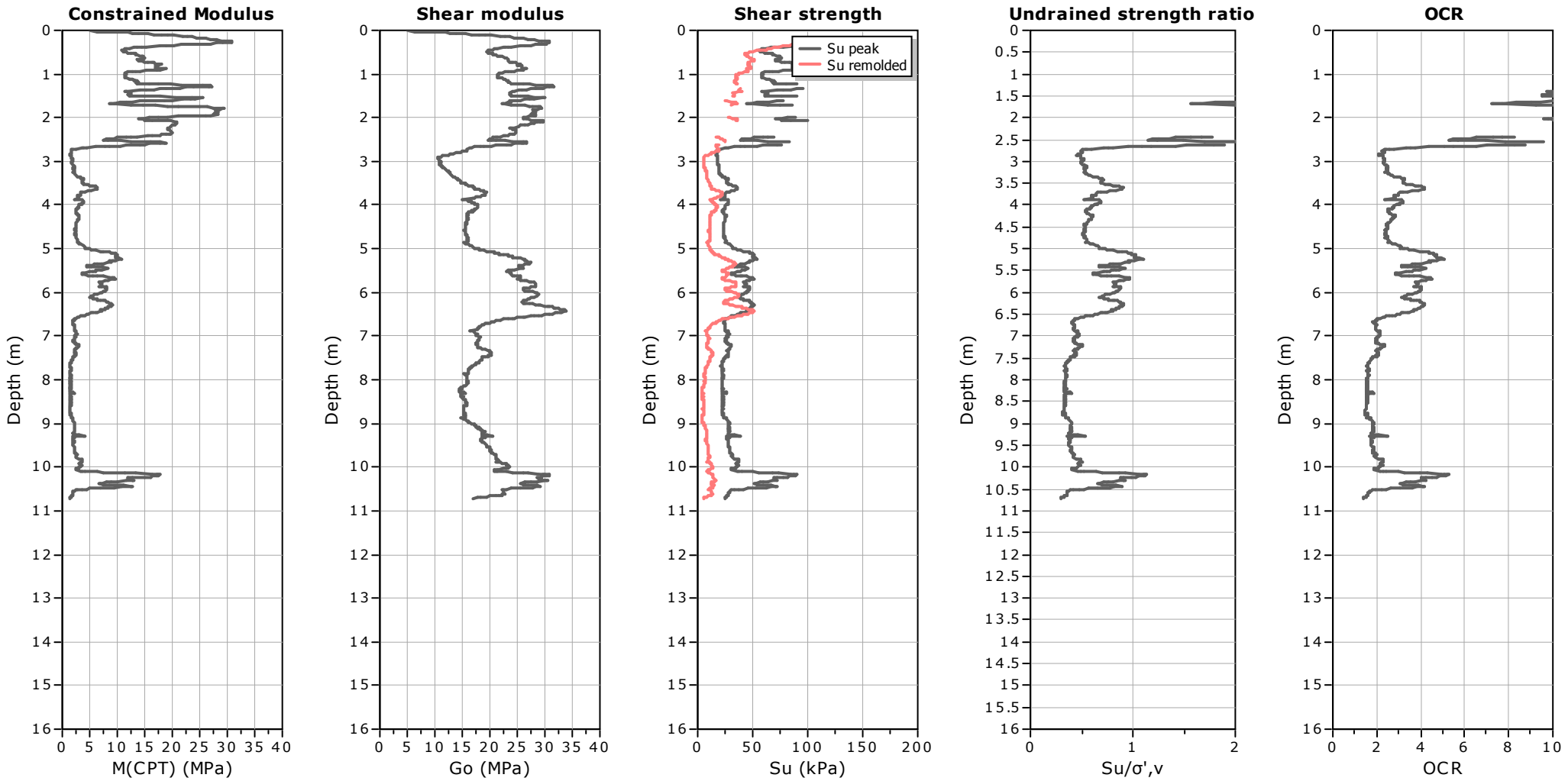
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

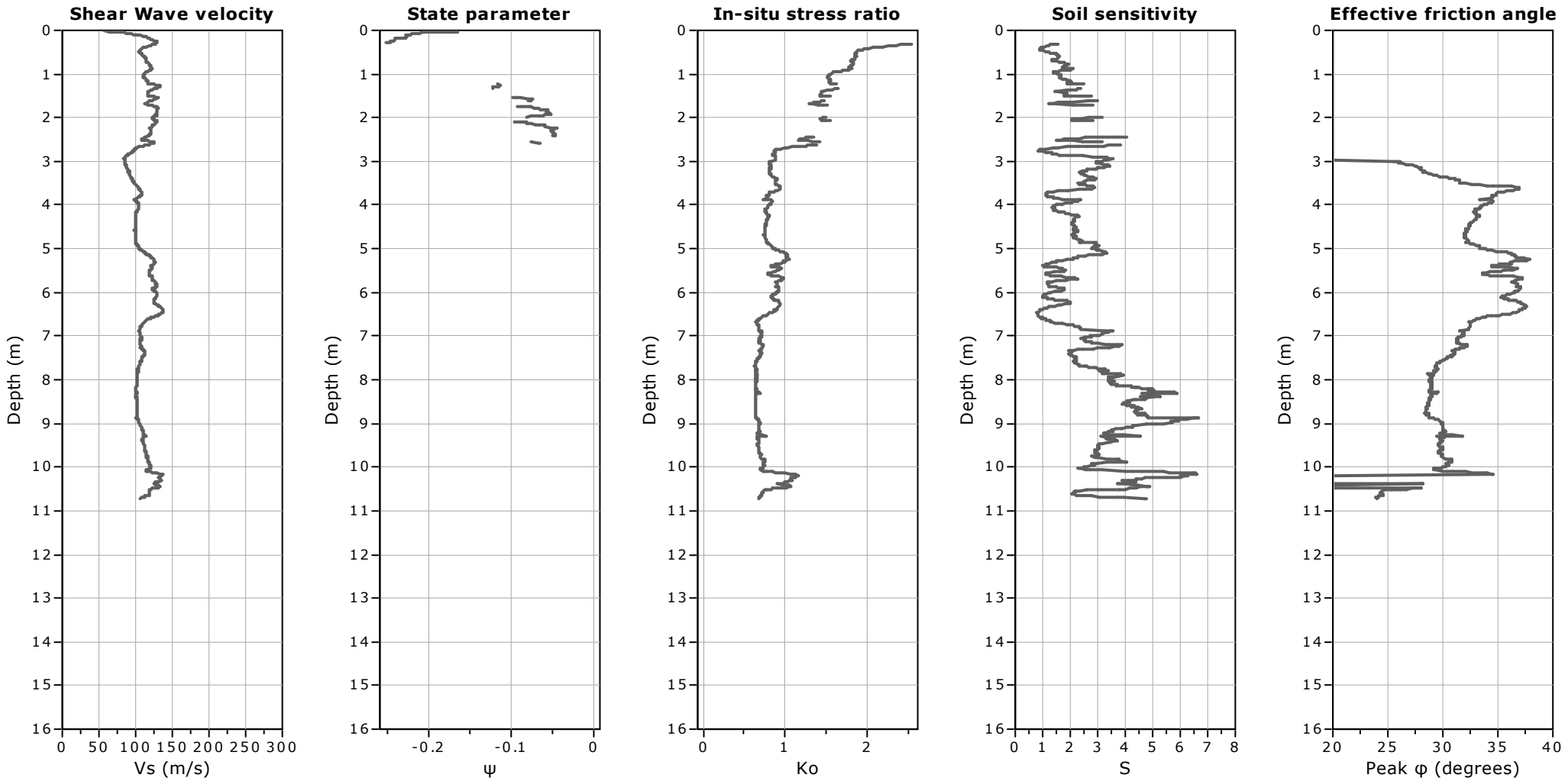
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



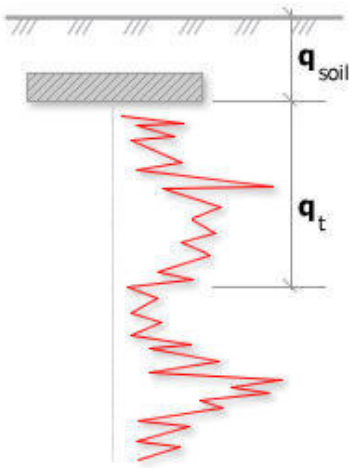
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

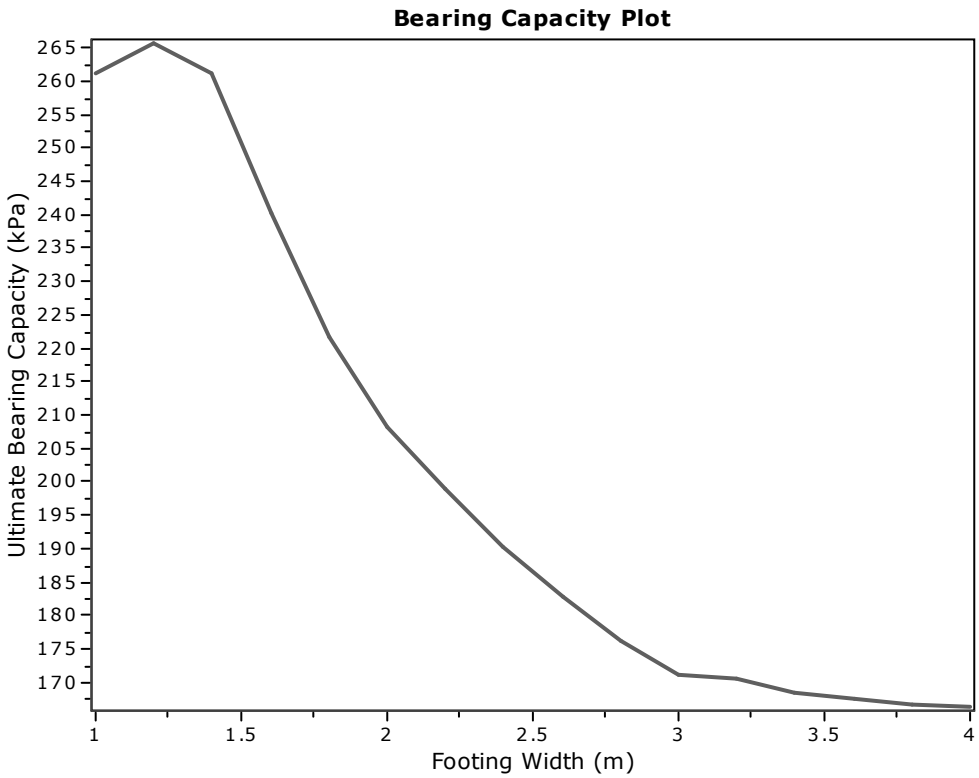
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



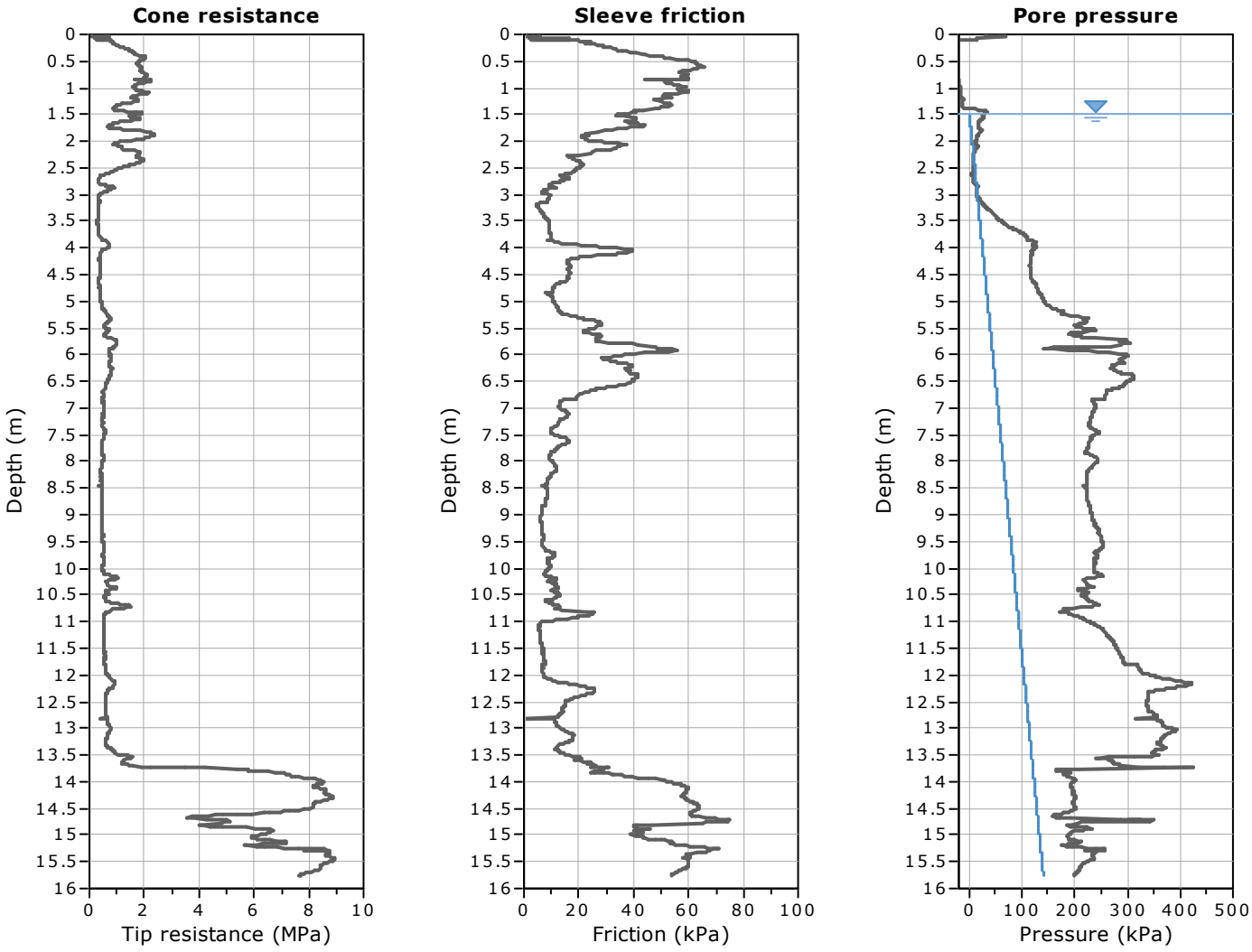
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.26	0.20	9.50	261.15
2	1.20	0.50	2.30	1.28	0.20	9.50	265.64
3	1.40	0.50	2.60	1.26	0.20	9.50	261.02
4	1.60	0.50	2.90	1.15	0.20	9.50	240.16
5	1.80	0.50	3.20	1.06	0.20	9.50	221.57
6	2.00	0.50	3.50	0.99	0.20	9.50	208.12
7	2.20	0.50	3.80	0.95	0.20	9.50	198.89
8	2.40	0.50	4.10	0.90	0.20	9.50	190.23
9	2.60	0.50	4.40	0.87	0.20	9.50	182.73
10	2.80	0.50	4.70	0.83	0.20	9.50	176.16
11	3.00	0.50	5.00	0.81	0.20	9.50	171.23
12	3.20	0.50	5.30	0.80	0.20	9.50	170.48
13	3.40	0.50	5.60	0.79	0.20	9.50	168.42
14	3.60	0.50	5.90	0.79	0.20	9.50	167.61
15	3.80	0.50	6.20	0.79	0.20	9.50	166.60
16	4.00	0.50	6.50	0.78	0.20	9.50	166.31

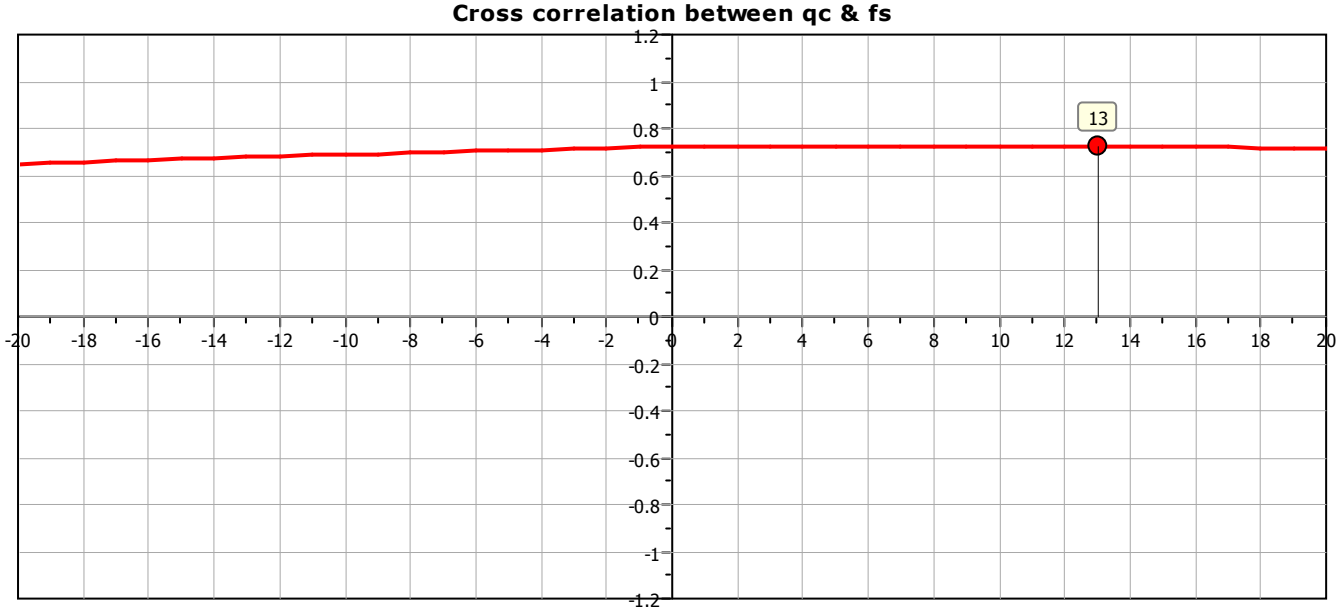
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



The plot below presents the cross correlation coeficient 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 sucessive CPT measurements).

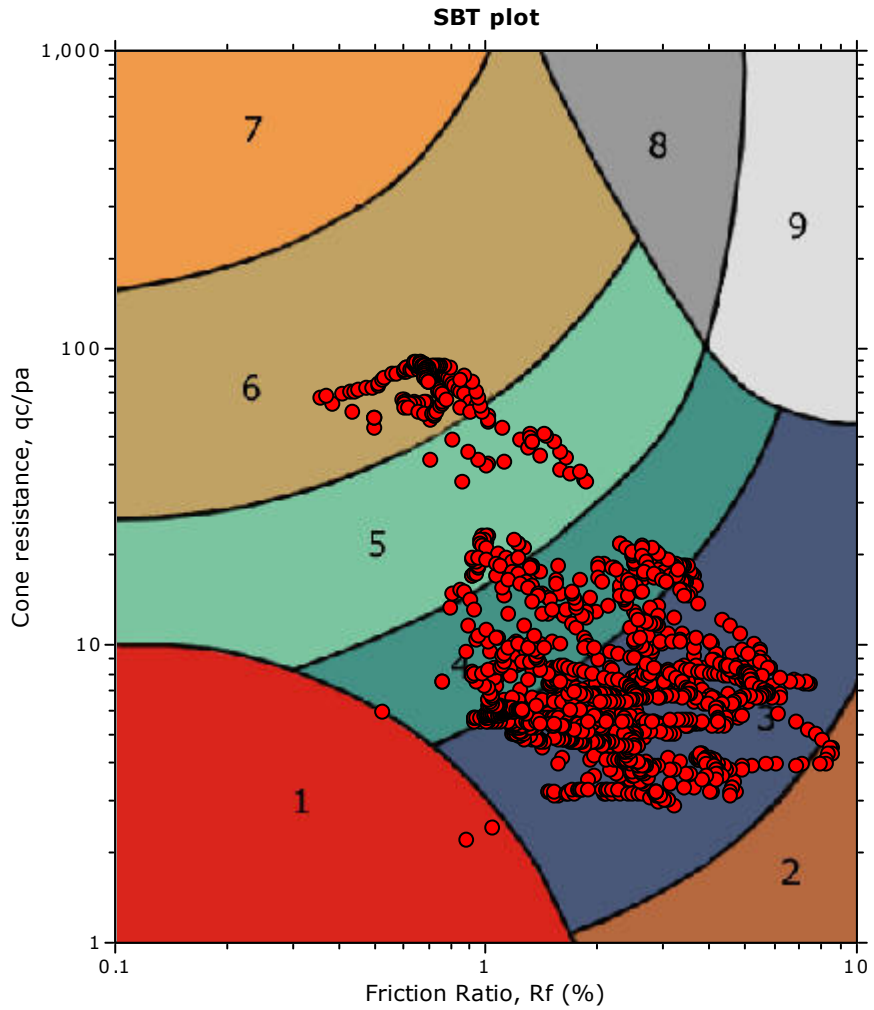


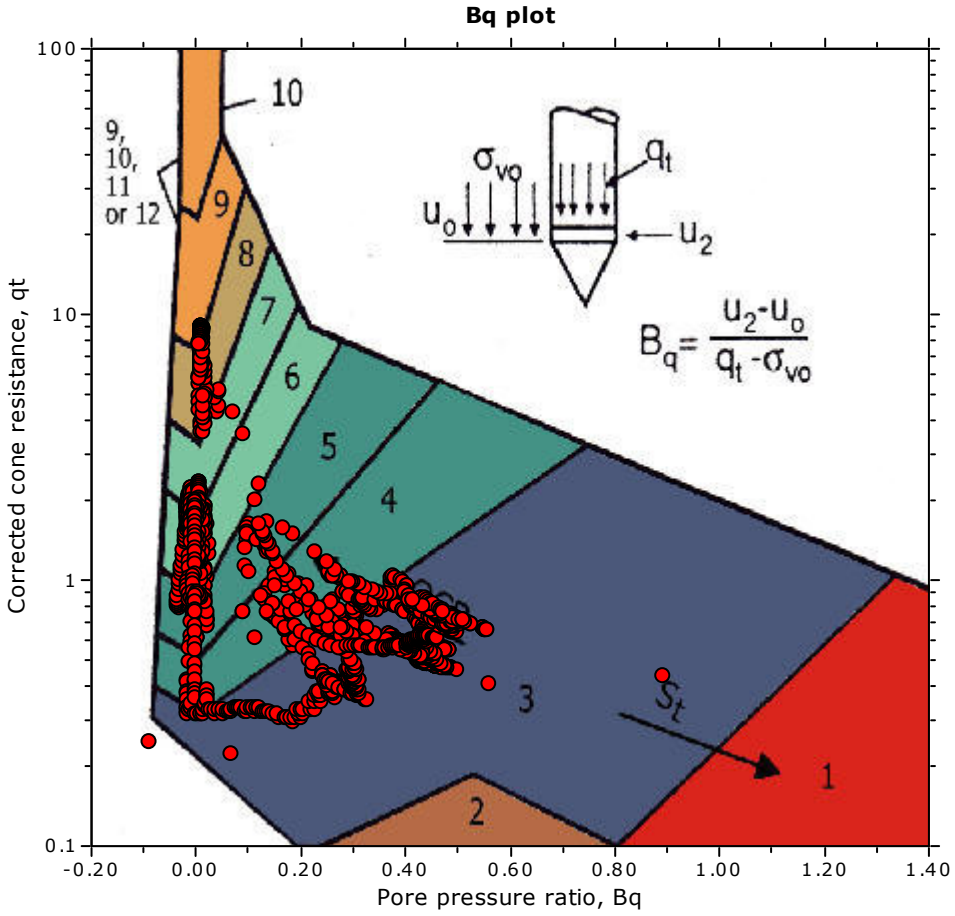
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots





SBT legend

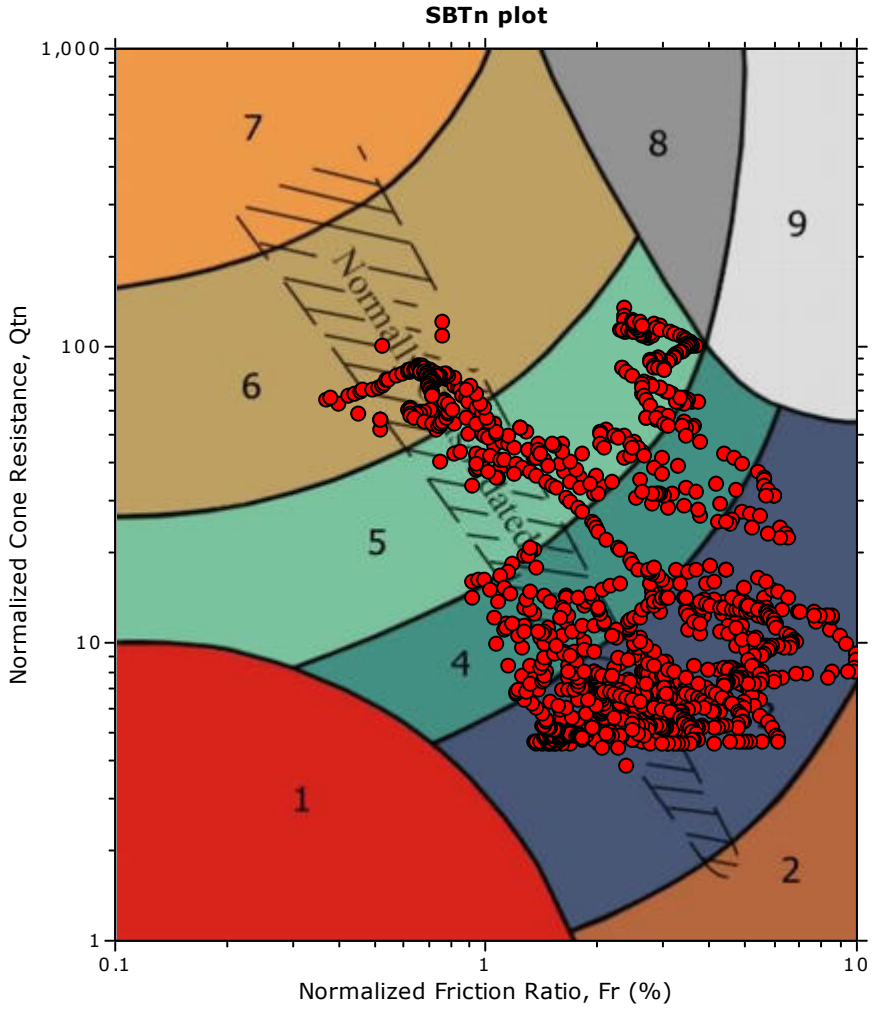
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

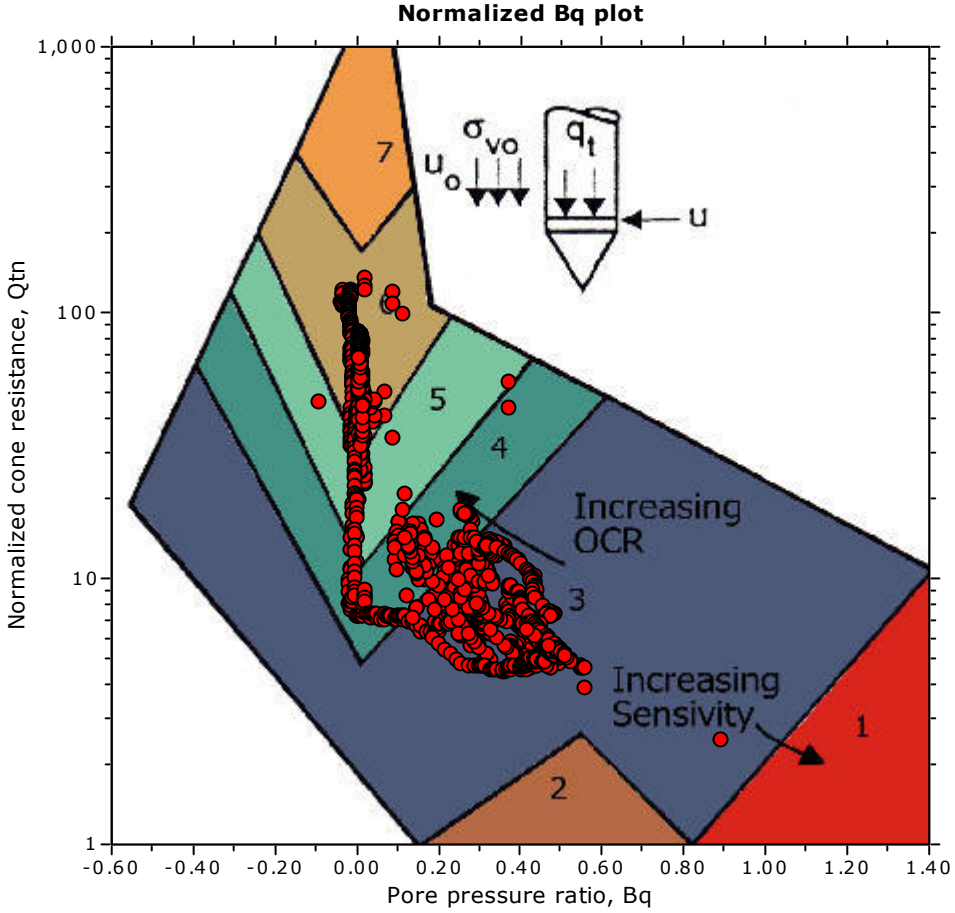
RDR SrL
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CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

SBT - Bq plots (normalized)





SBTn legend

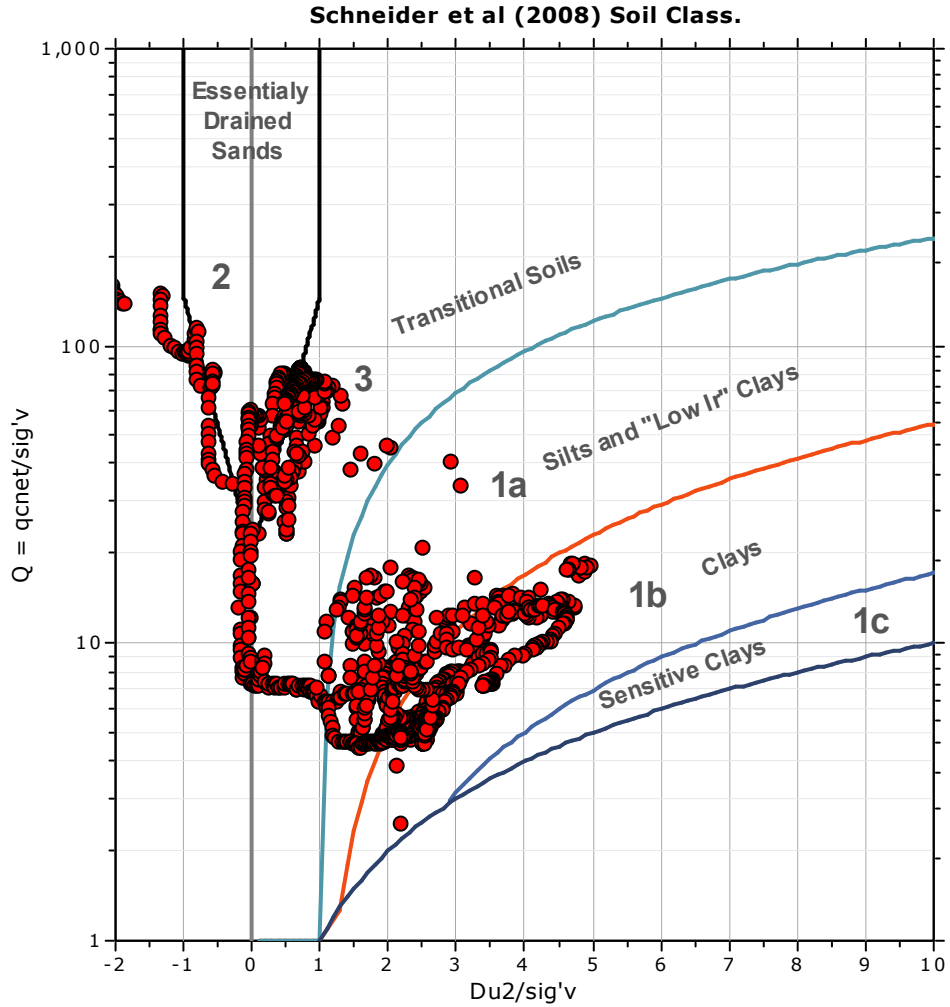
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

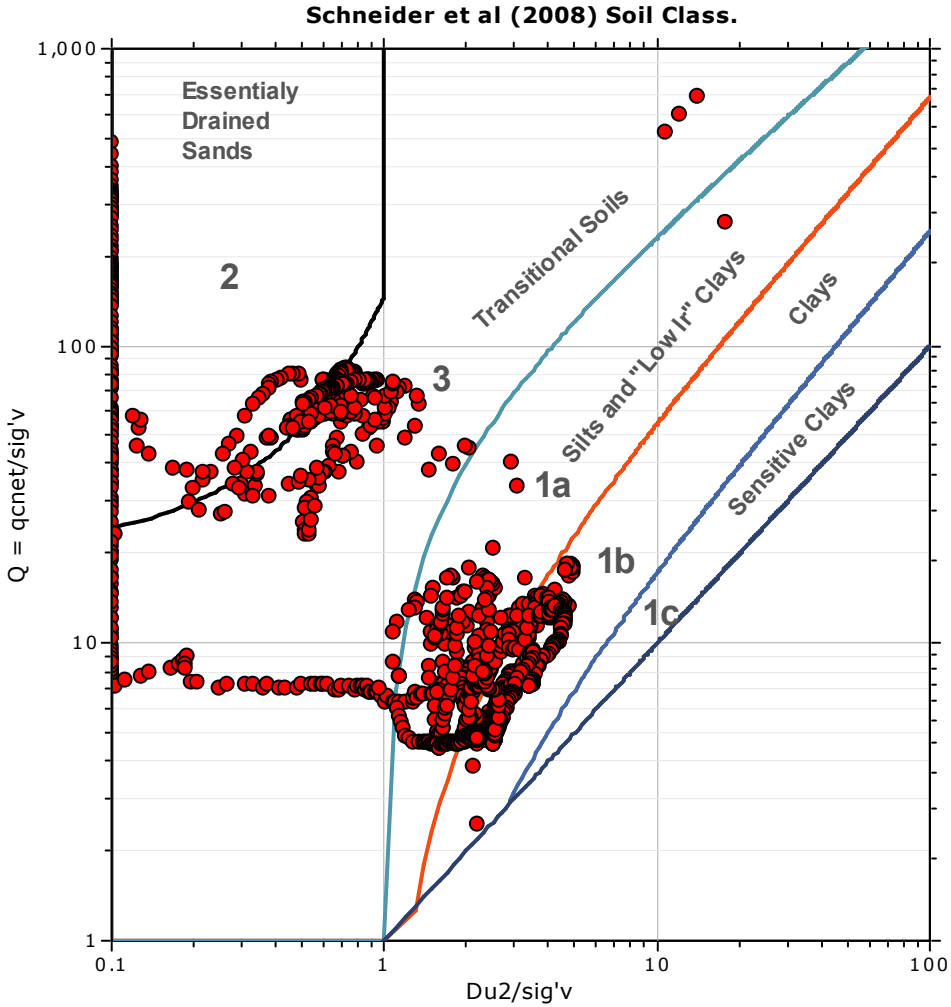
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Bq plots (Schneider)

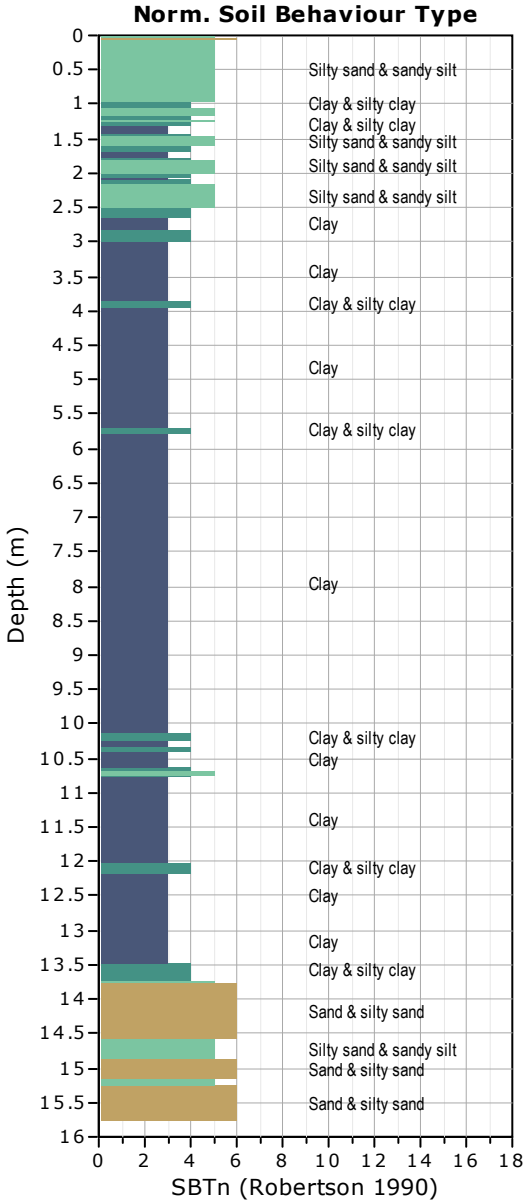


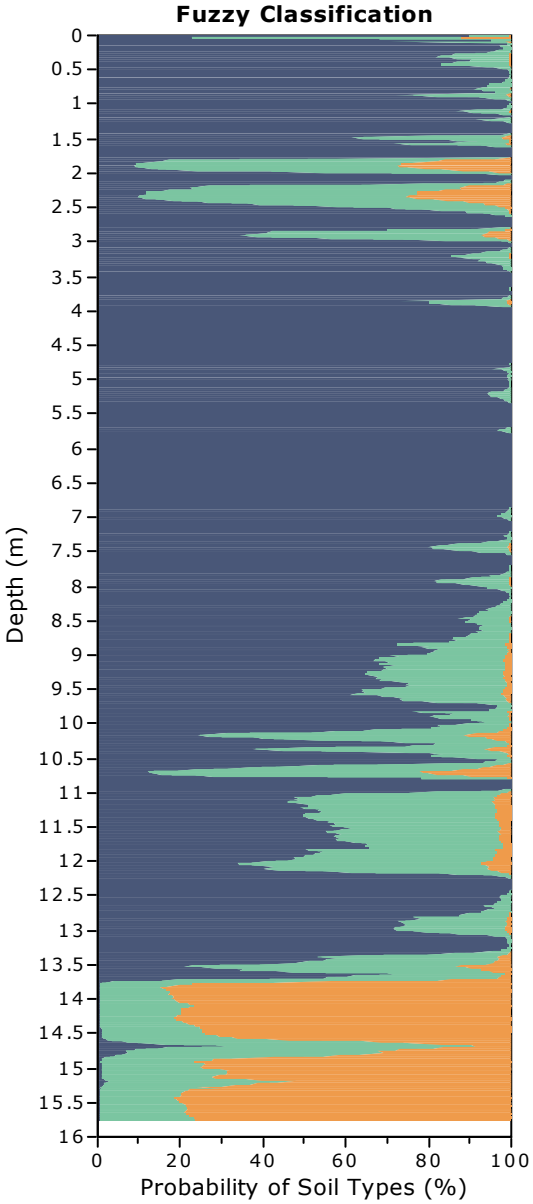


RDR SrL
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rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

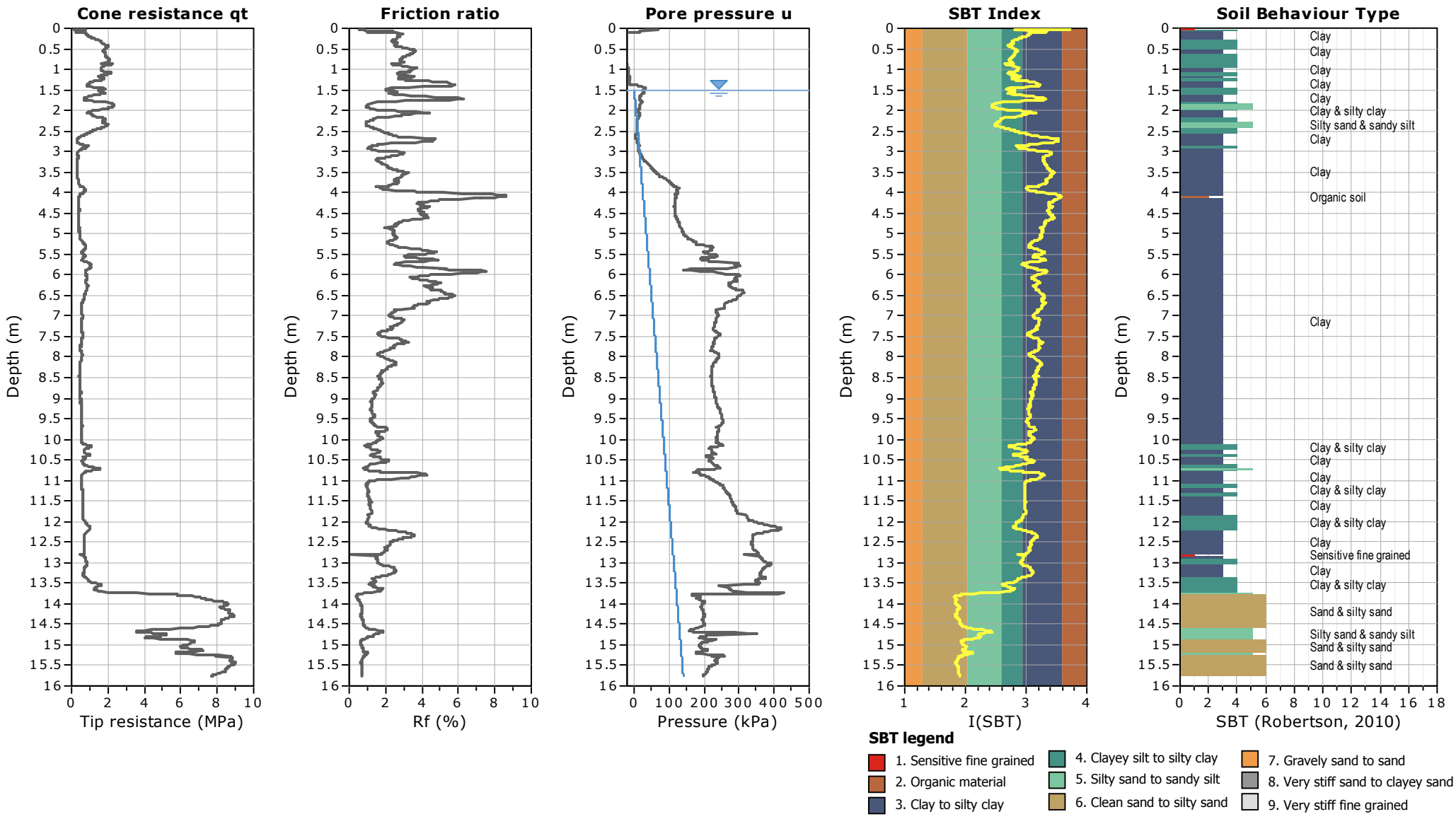




RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

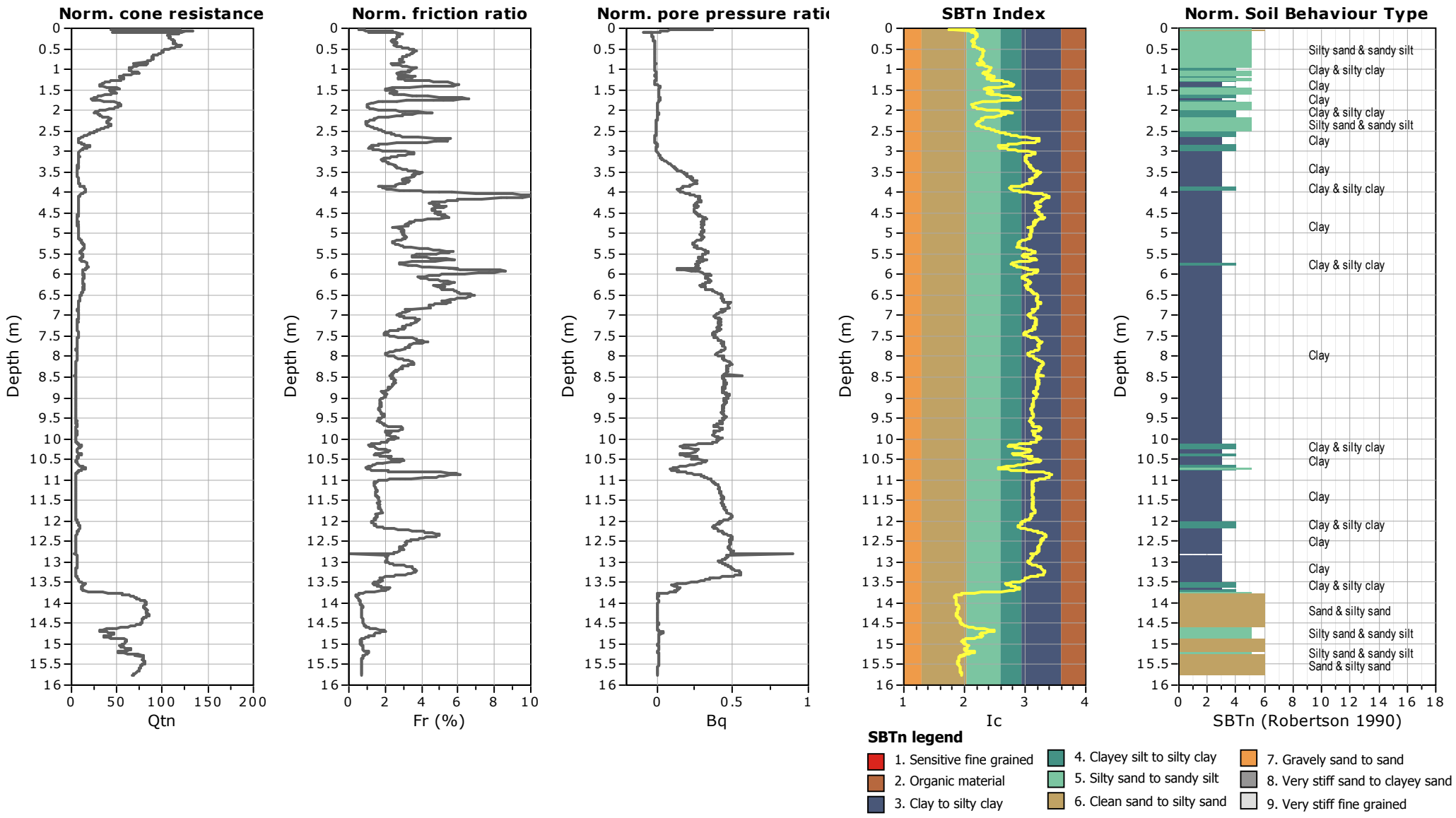
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

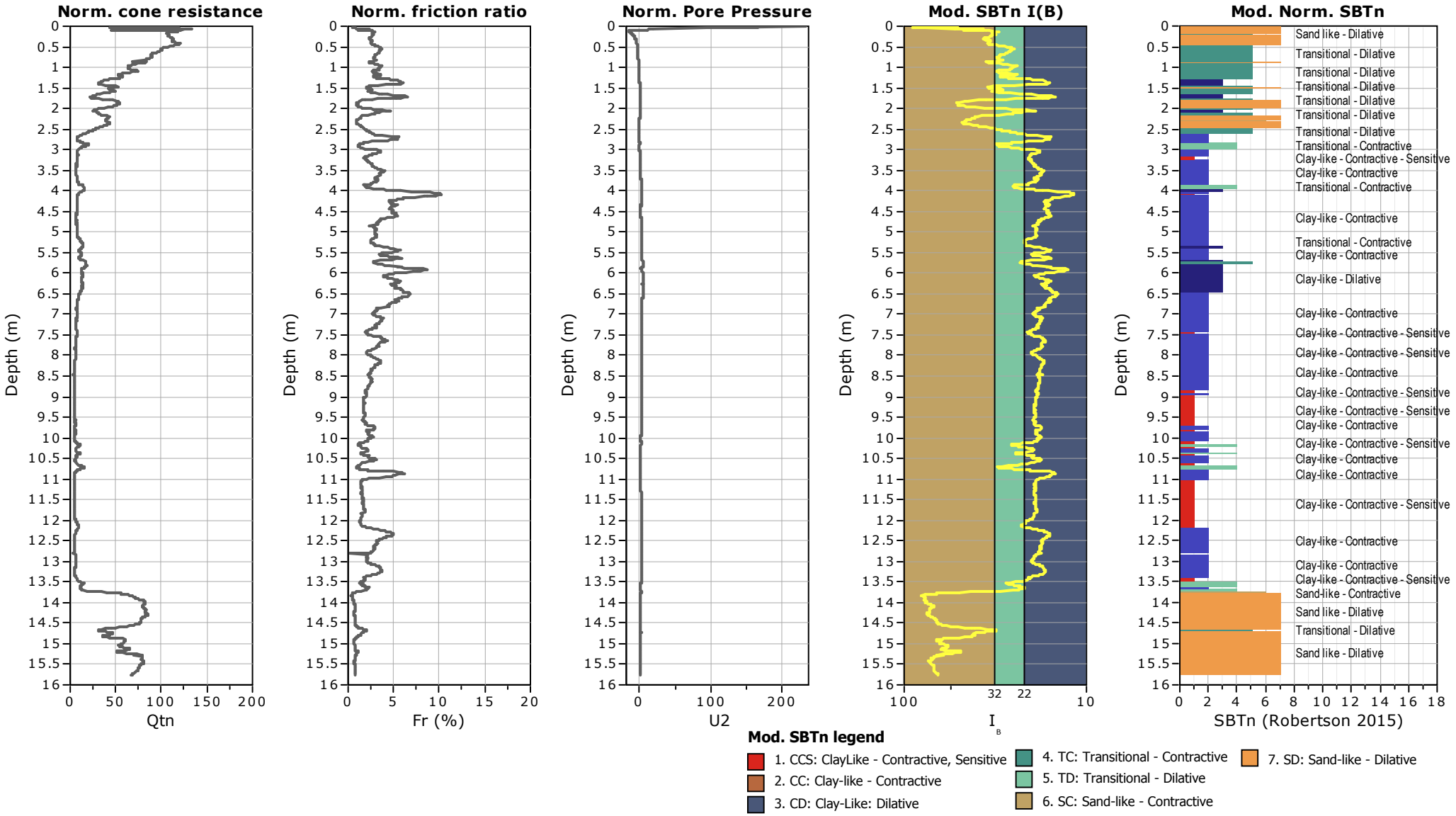
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



RDR SrL
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rocco.carbonella@fastwebnet.it

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

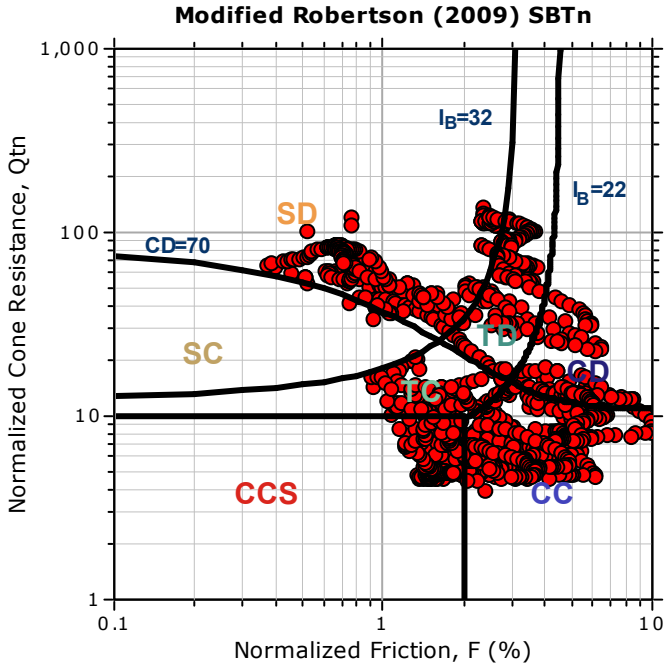


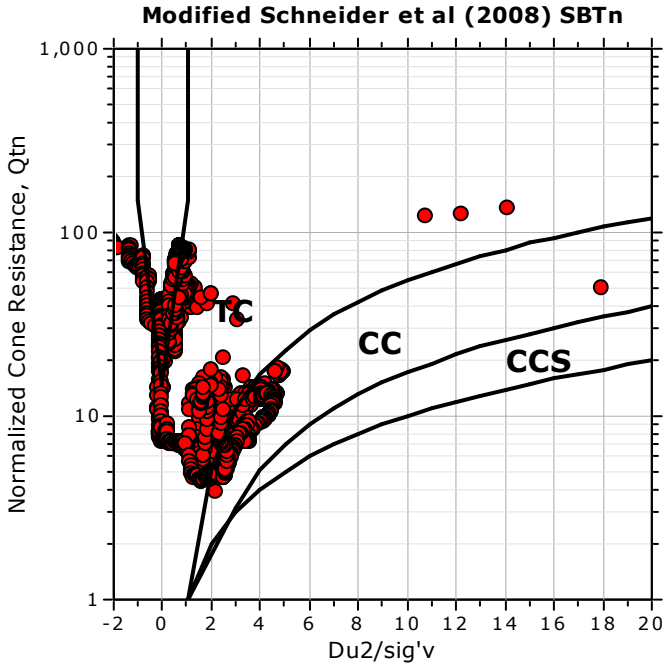
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

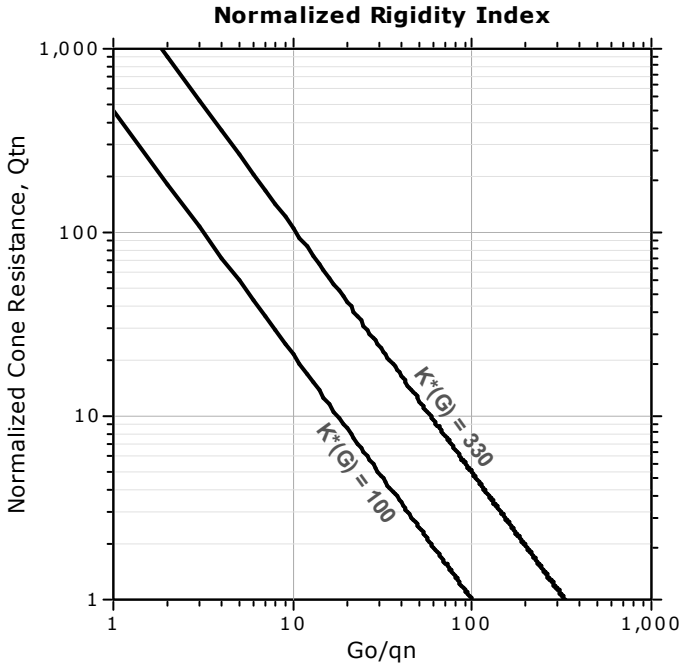
CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Updated SBTn plots







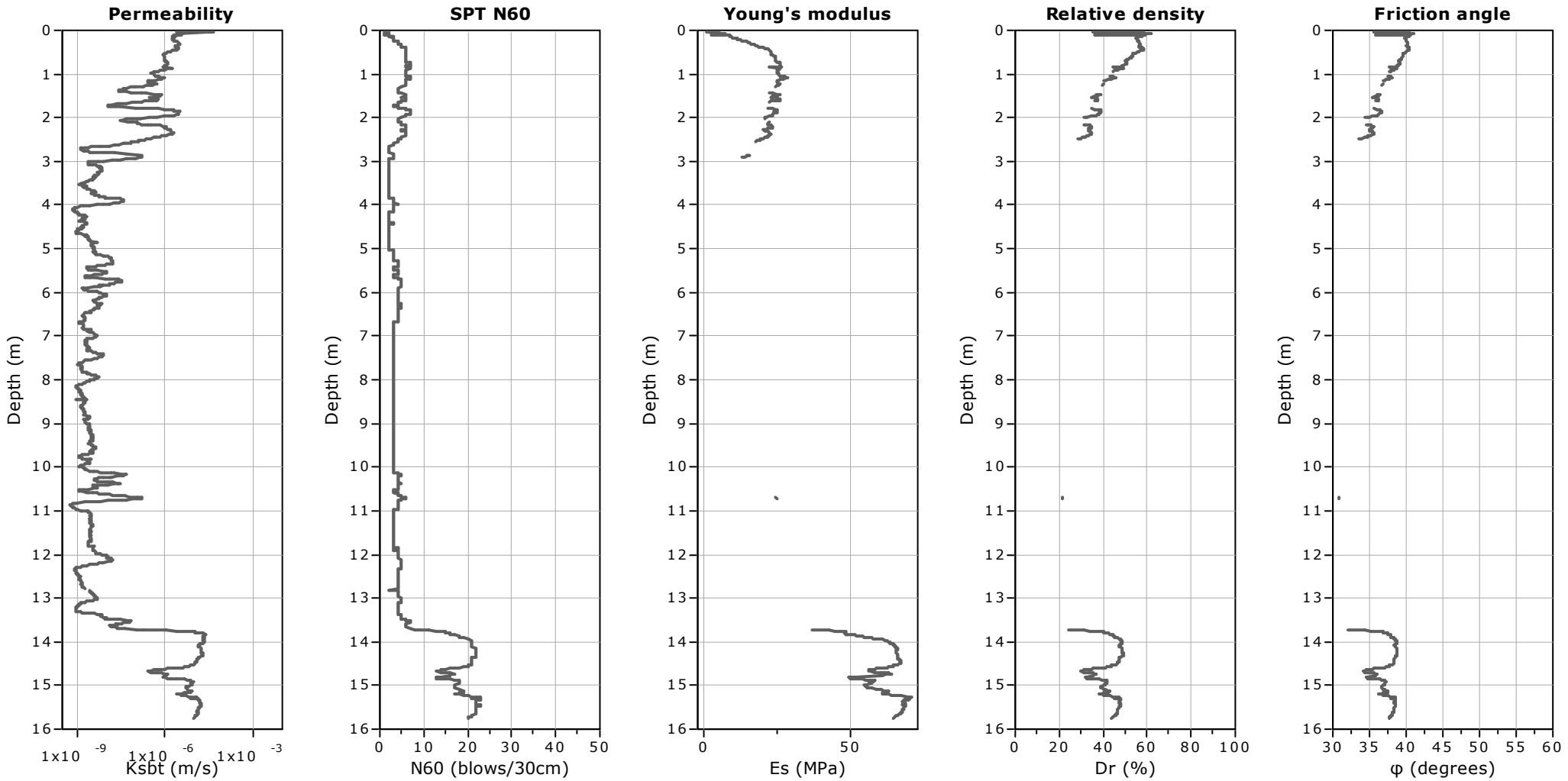
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

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

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



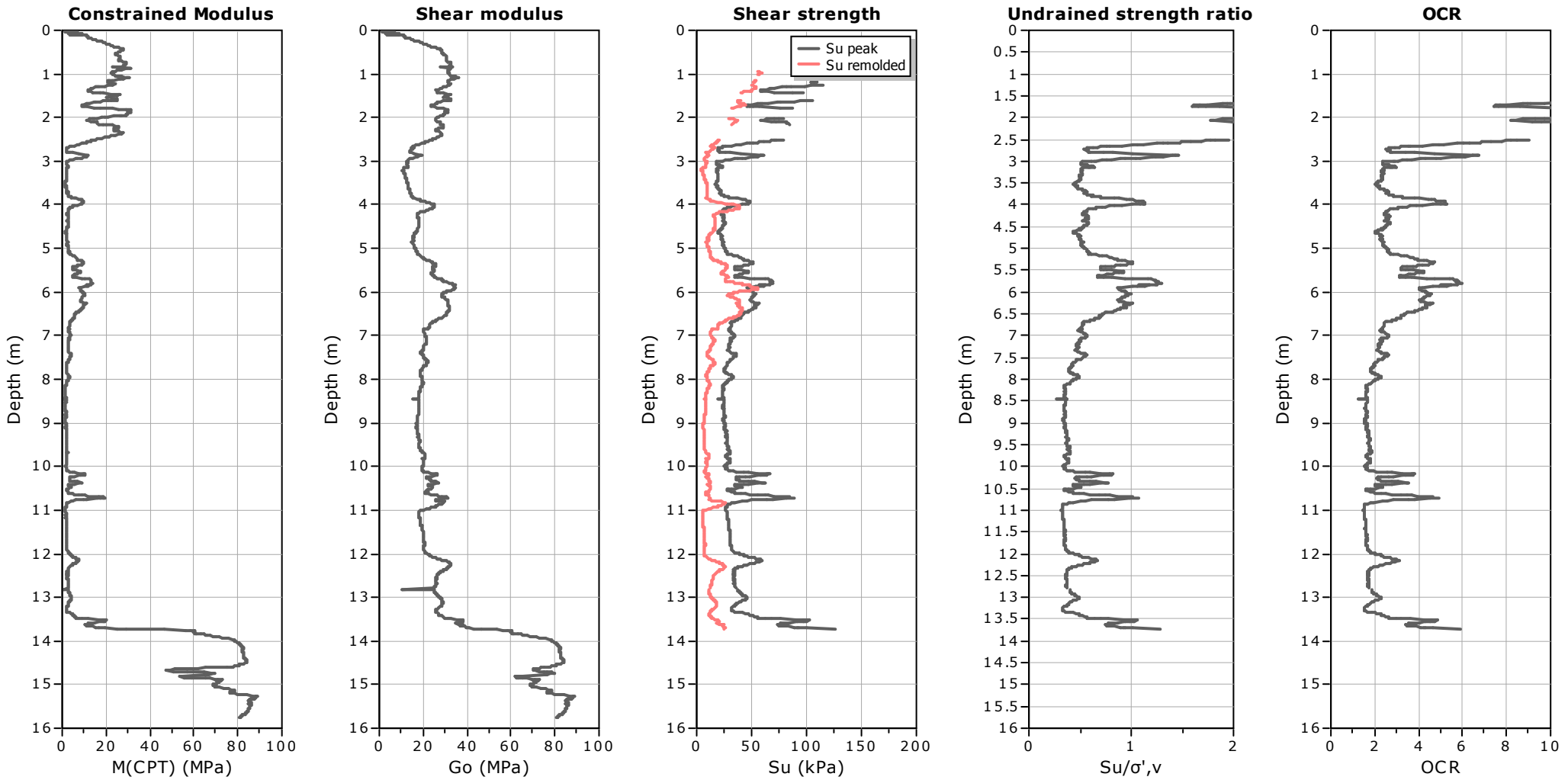
Calculation parameters

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 desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Calculation parameters

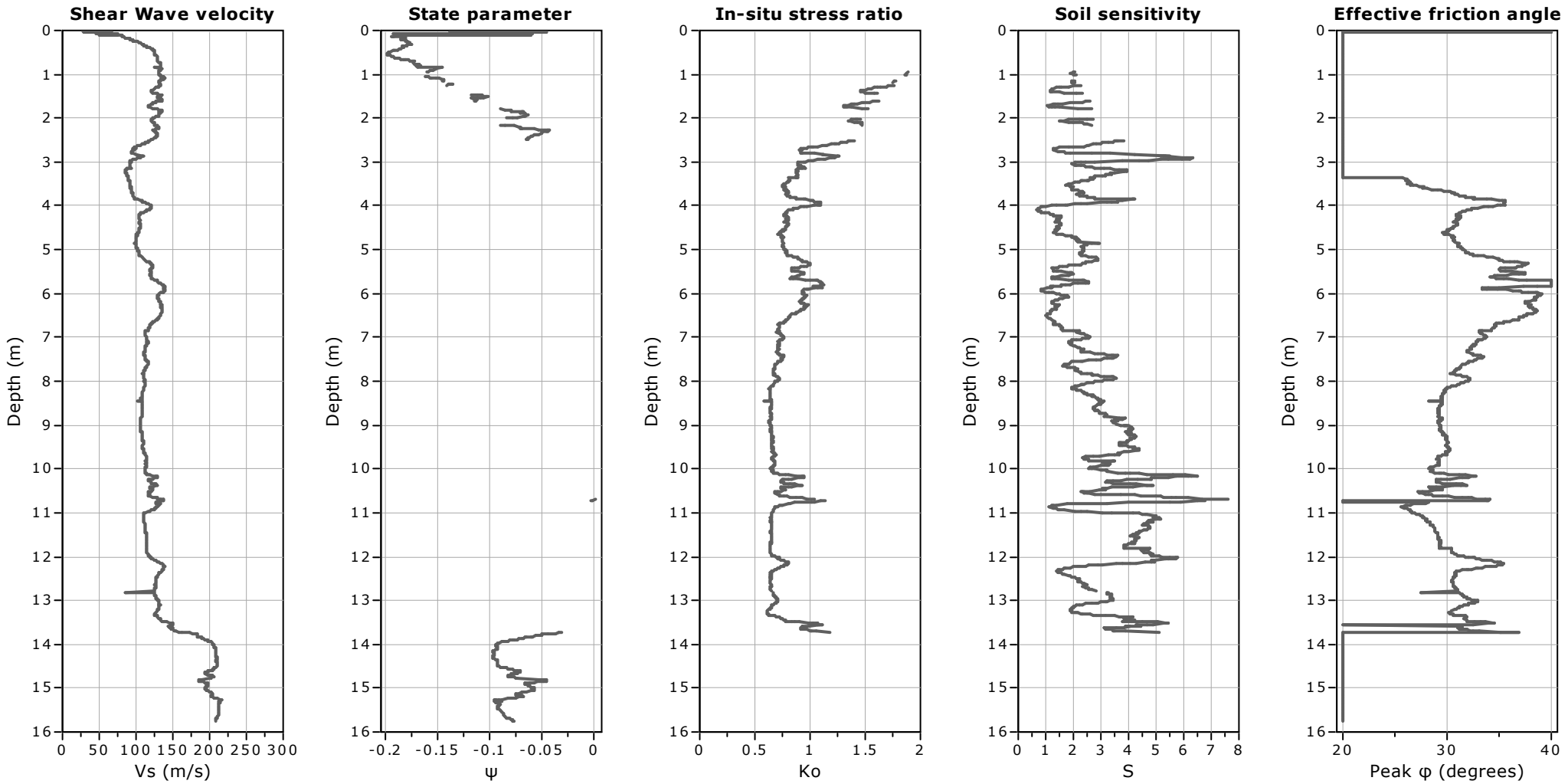
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



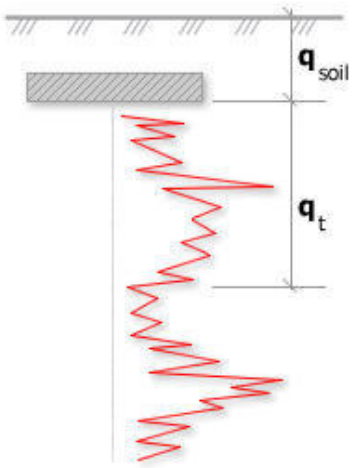
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

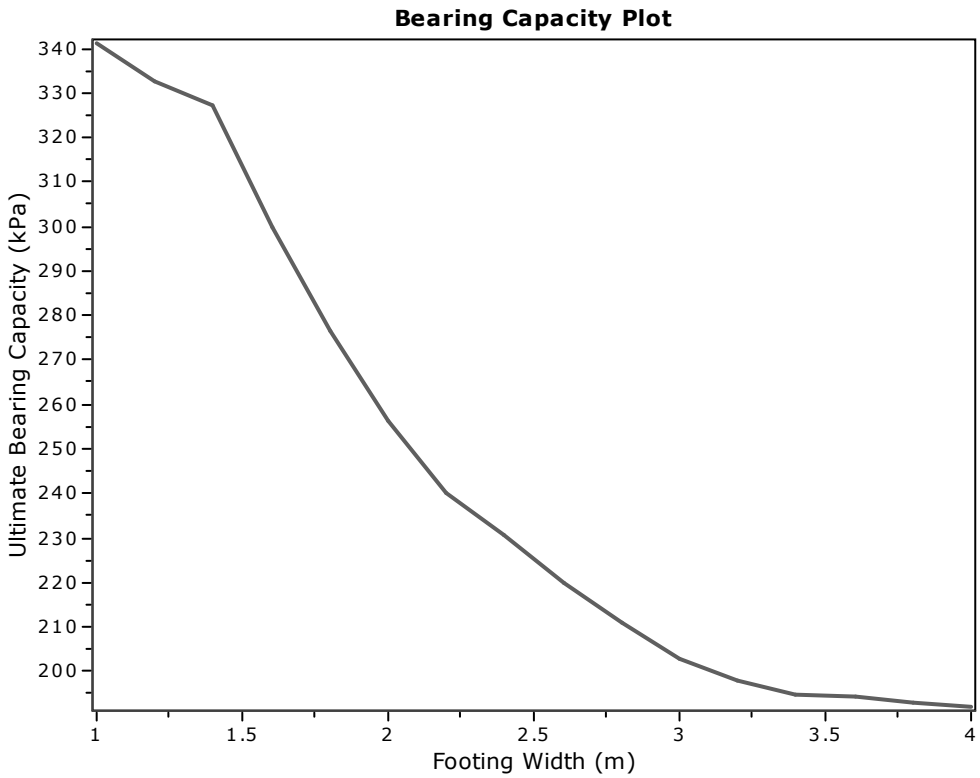
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.66	0.20	9.50	341.15
2	1.20	0.50	2.30	1.61	0.20	9.50	332.47
3	1.40	0.50	2.60	1.59	0.20	9.50	327.35
4	1.60	0.50	2.90	1.45	0.20	9.50	299.70
5	1.80	0.50	3.20	1.33	0.20	9.50	276.46
6	2.00	0.50	3.50	1.23	0.20	9.50	256.27
7	2.20	0.50	3.80	1.15	0.20	9.50	240.21
8	2.40	0.50	4.10	1.11	0.20	9.50	230.90
9	2.60	0.50	4.40	1.05	0.20	9.50	220.14
10	2.80	0.50	4.70	1.01	0.20	9.50	210.78
11	3.00	0.50	5.00	0.97	0.20	9.50	202.90
12	3.20	0.50	5.30	0.94	0.20	9.50	197.95
13	3.40	0.50	5.60	0.93	0.20	9.50	194.98
14	3.60	0.50	5.90	0.92	0.20	9.50	194.45
15	3.80	0.50	6.20	0.92	0.20	9.50	193.17
16	4.00	0.50	6.50	0.91	0.20	9.50	192.10

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

$I_c \leq 4.00$ and $I_c > 3.27$ 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, Es (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 (%) ::

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

:: State Parameter, ψ ::

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

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

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

(applicable only to SBT_n: 5, 6, 7 and 8)

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

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

:: Remolded undrained shear strength, Su(rem) (kPa) ::

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

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

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

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

(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., 5th Edition, November 2012

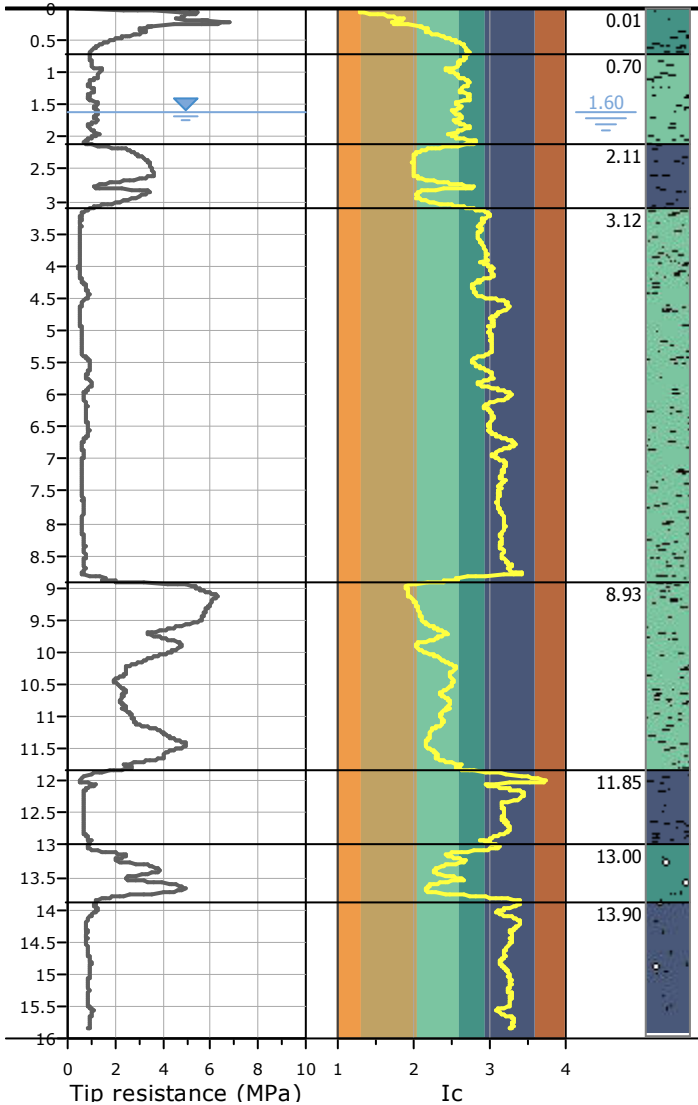
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Terms & Conditions

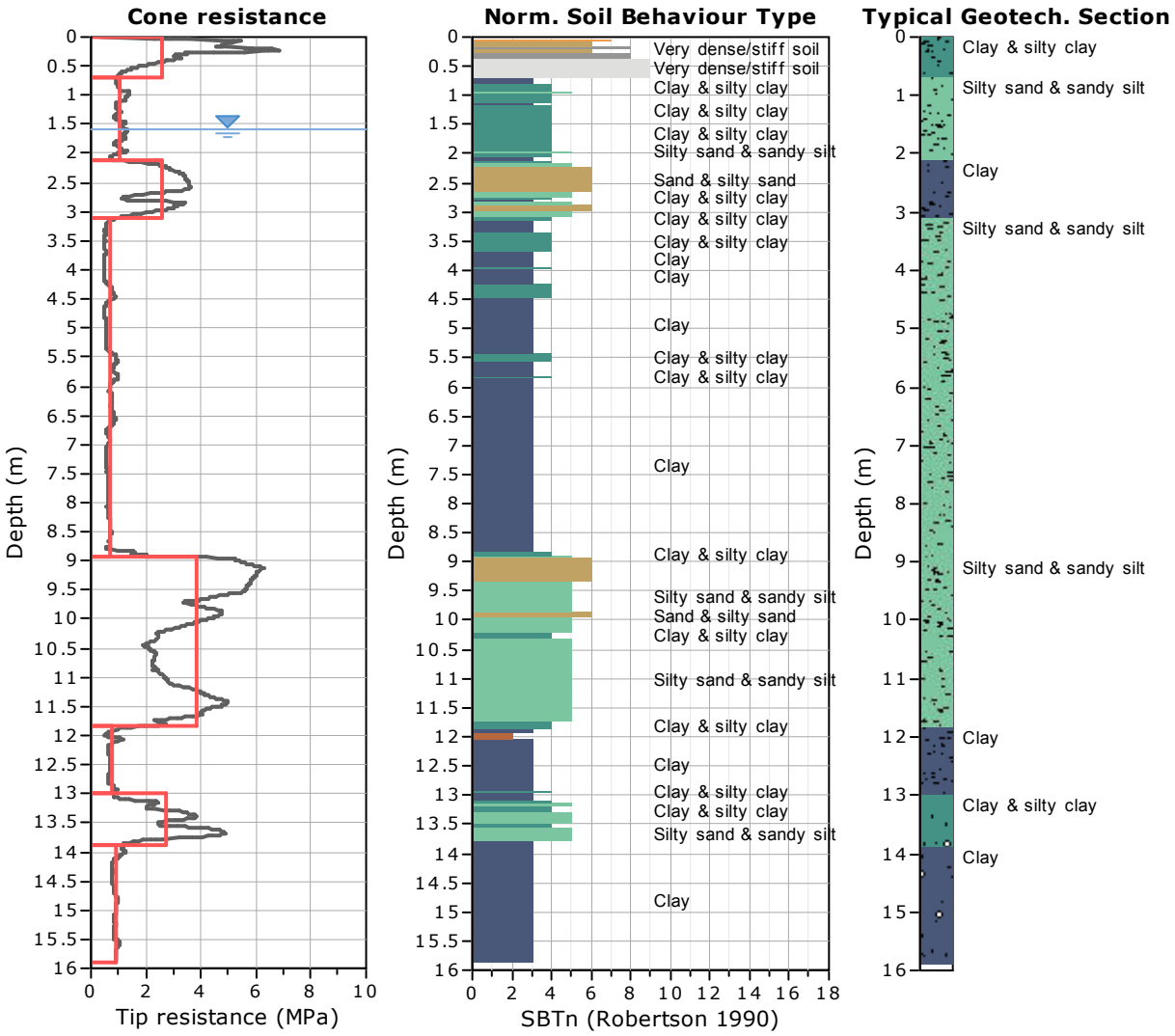
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.01	Clay & silty clay	2.6	2.56E-6	7.9	25.6	-	-	27.0	34.0	111.2	7.5	34.5	18.5
0.70	Silty sand & sandy silt	1.1	1.14E-7	4.3	21.3	-	-	14.4	25.4	72.8	2.6	12.0	17.1
2.11	Clay	2.6	4.00E-6	7.7	29.0	40.1	36.8	31.6	35.2	-	-	-	17.2
3.12	Silty sand & sandy silt	0.7	1.49E-8	3.5	26.3	-	-	5.9	23.8	39.9	0.7	3.3	16.2
8.93	Silty sand & sandy silt	3.8	2.49E-6	11.9	44.6	34.0	35.1	47.7	55.7	-	-	-	17.6
11.85	Clay	0.8	2.81E-9	4.4	-	-	-	3.2	28.3	39.0	0.4	1.8	15.9
13.00	Clay & silty clay	2.7	5.44E-7	10.1	41.5	-	-	34.1	53.4	106.6	1.0	4.5	17.4
13.90	Clay	0.9	1.37E-9	5.4	-	-	-	3.6	35.7	46.3	0.4	1.8	16.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.01 (m), **End depth:** 0.70 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 2.58 ±1.81 MPa
Sleeve friction: 0.00 ±112.51 kPa
SBT_n: 0
SBT description: N/A

Estimation results

Permeability: 2.56E-06 ±3.00E-04 m/s
N60: 7.92 ±3.14 blows
Es: 25.57 ±10.96 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 18.52 ±0.90 kN/m³
Constrained Mod.: 27.03 ±14.23 MPa
Go: 34.01 ±11.08 MPa
Su: 111.19 ±49.85 kPa
Su ratio: 7.46 ±3.35
O.C.R.: 34.49 ±15.48

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.70 (m), **End depth:** 2.11 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 1.06 ±0.17 MPa	Permeability: 1.14E-07 ±7.40E-08 m/s	Constrained Mod.: 14.45 ±2.43 MPa
Sleeve friction: 38.32 ±11.14 kPa	N60: 4.28 ±0.58 blows	Go: 25.43 ±2.20 MPa
SBT_n: 4	Es: 21.32 ±1.79 MPa	Su: 72.81 ±11.83 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 2.60 ±0.69
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 12.00 ±3.20
	Unit weight: 17.15 ±0.36 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.11 (m), **End depth:** 3.12 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 2.61 ±0.87 MPa	Permeability: 4.00E-06 ±3.07E-06 m/s	Constrained Mod.: 31.60 ±8.97 MPa
Sleeve friction: 29.24 ±7.59 kPa	N60: 7.71 ±1.81 blows	Go: 35.17 ±4.40 MPa
SBT_n: 5	Es: 29.04 ±2.85 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 40.09 ±3.87	Su ratio: 0.00 ±0.00
	ö (degrees): 36.80 ±0.98 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.18 ±0.28 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 3.12 (m), **End depth:** 8.93 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 0.67 ±0.21 MPa	Permeability: 1.49E-08 ±9.44E-08 m/s	Constrained Mod.: 5.86 ±3.60 MPa
Sleeve friction: 20.25 ±9.10 kPa	N60: 3.53 ±0.85 blows	Go: 23.82 ±5.11 MPa
SBT_n: 3	Es: 26.33 ±0.90 MPa	Su: 39.89 ±10.40 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.71 ±0.19
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 3.26 ±0.88
	Unit weight: 16.18 ±0.54 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 8.93 (m), **End depth:** 11.85 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.82 ±1.32 MPa	Permeability: 2.49E-06 ±3.45E-06 m/s	Constrained Mod.: 47.71 ±14.68 MPa
Sleeve friction: 39.76 ±14.66 kPa	N60: 11.89 ±2.84 blows	Go: 55.70 ±9.81 MPa
SBT_n: 5	Es: 44.61 ±8.11 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 33.95 ±6.60	Su ratio: 0.00 ±0.00
	ö (degrees): 35.08 ±1.88 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.63 ±0.55 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 11.85 (m), **End depth:** 13.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.76 ±0.19 MPa	Permeability: 2.81E-09 ±3.64E-09 m/s	Constrained Mod.: 3.22 ±2.83 MPa
Sleeve friction: 16.27 ±9.96 kPa	N60: 4.42 ±0.78 blows	Go: 28.32 ±5.54 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 38.99 ±13.32 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.38 ±0.13
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.75 ±0.62
	Unit weight: 15.89 ±0.65 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 13.00 (m), **End depth:** 13.90 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.74 ±1.21 MPa	Permeability: 5.44E-07 ±7.03E-07 m/s	Constrained Mod.: 34.11 ±18.54 MPa
Sleeve friction: 38.87 ±21.85 kPa	N60: 10.11 ±2.81 blows	Go: 53.42 ±11.59 MPa
SBT_n: 4	Es: 41.53 ±6.35 MPa	Su: 106.61 ±46.24 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.98 ±0.43
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 4.52 ±1.97
	Unit weight: 17.36 ±0.74 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 13.90 (m), **End depth:** 15.90 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.90 ±0.10 MPa	Permeability: 1.37E-09 ±6.99E-10 m/s	Constrained Mod.: 3.61 ±1.39 MPa
Sleeve friction: 23.13 ±12.82 kPa	N60: 5.35 ±0.64 blows	Go: 35.68 ±5.47 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 46.27 ±7.58 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.39 ±0.07
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.79 ±0.32
	Unit weight: 16.46 ±0.43 kN/m³	

RDR SrL
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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu1
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

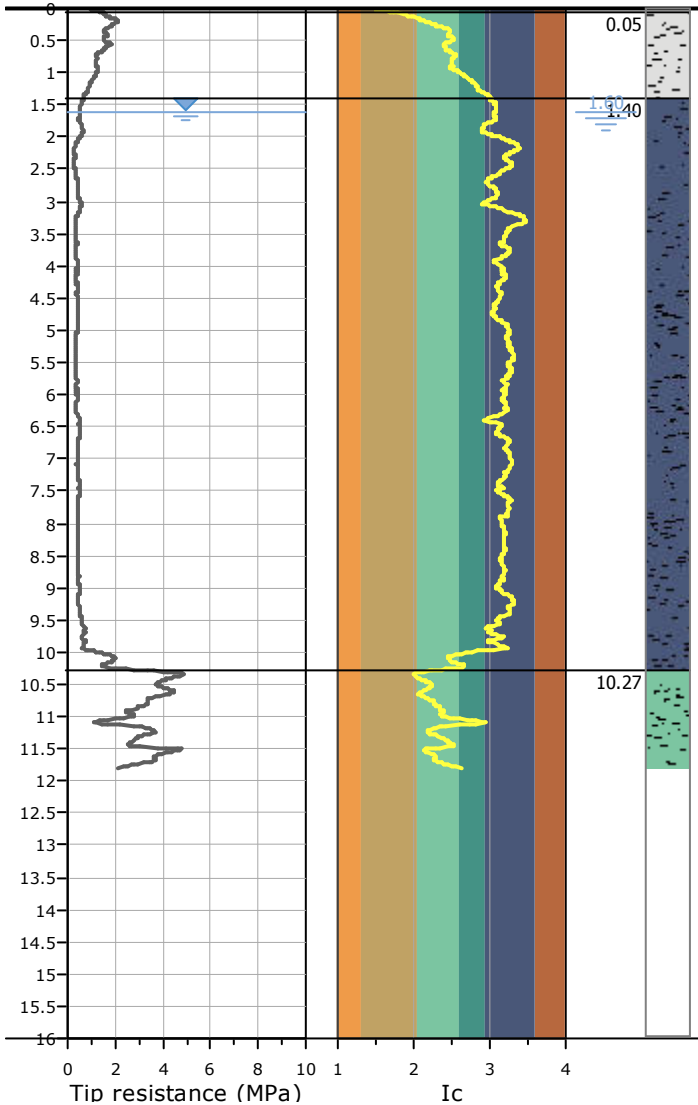
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.01 0.70	0.69	2.56E-06 (±3.00E-04)	7.9 (±3.1)	25.6 (±11.0)	0.0 (±0.0)	0.0 (±0.0)	27.0 (±14.2)	34.0 (±11.1)	111.2 (±49.8)	7.5 (±3.4)	34.5 (±15.5)	18.5 (±0.9)
0.70 2.11	1.41	1.14E-07 (±7.40E-08)	4.3 (±0.6)	21.3 (±1.8)	0.0 (±0.0)	0.0 (±0.0)	14.4 (±2.4)	25.4 (±2.2)	72.8 (±11.8)	2.6 (±0.7)	12.0 (±3.2)	17.1 (±0.4)
2.11 3.12	1.01	4.00E-06 (±3.07E-06)	7.7 (±1.8)	29.0 (±2.9)	40.1 (±3.9)	36.8 (±1.0)	31.6 (±9.0)	35.2 (±4.4)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.2 (±0.3)
3.12 8.93	5.81	1.49E-08 (±9.44E-08)	3.5 (±0.8)	26.3 (±0.9)	0.0 (±0.0)	0.0 (±0.0)	5.9 (±3.6)	23.8 (±5.1)	39.9 (±10.4)	0.7 (±0.2)	3.3 (±0.9)	16.2 (±0.5)
8.93 11.85	2.92	2.49E-06 (±3.45E-06)	11.9 (±2.8)	44.6 (±8.1)	34.0 (±6.6)	35.1 (±1.9)	47.7 (±14.7)	55.7 (±9.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.6 (±0.6)
11.85 13.00	1.15	2.81E-09 (±3.64E-09)	4.4 (±0.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	3.2 (±2.8)	28.3 (±5.5)	39.0 (±13.3)	0.4 (±0.1)	1.8 (±0.6)	15.9 (±0.7)
13.00 13.90	0.90	5.44E-07 (±7.03E-07)	10.1 (±2.8)	41.5 (±6.3)	0.0 (±0.0)	0.0 (±0.0)	34.1 (±18.5)	53.4 (±11.6)	106.6 (±46.2)	1.0 (±0.4)	4.5 (±2.0)	17.4 (±0.7)
13.90 15.90	2.00	1.37E-09 (±6.99E-10)	5.4 (±0.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	3.6 (±1.4)	35.7 (±5.5)	46.3 (±7.6)	0.4 (±0.1)	1.8 (±0.3)	16.5 (±0.4)

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

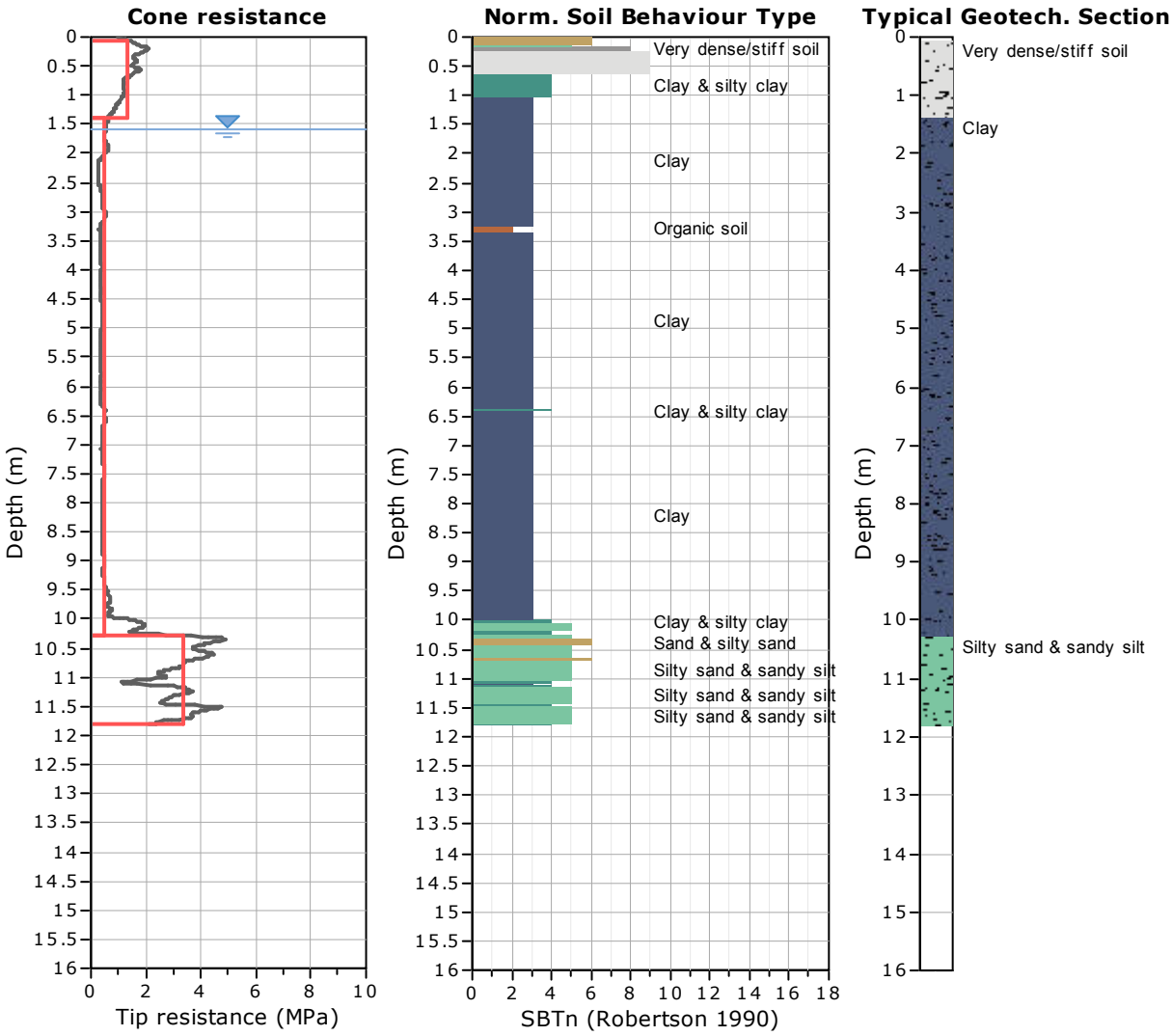
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CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.3	2.13E-6	4.9	23.5	-	-	18.0	27.7	90.0	5.4	25.2	17.9
Clay	0.5	8.87E-9	2.5	28.9	-	-	3.1	17.2	25.4	0.5	2.4	15.4
Silty sand & sandy silt	3.4	1.64E-6	10.8	41.2	33.2	35.0	43.5	50.9	-	-	-	17.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.05 (m), **End depth:** 1.40 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 1.34 ±0.37 MPa
Sleeve friction: 68.89 ±24.18 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 2.13E-06 ±8.10E-06 m/s
N60: 4.95 ±0.94 blows
Es: 23.54 ±2.35 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 17.87 ±0.51 kN/m³
Constrained Mod.: 17.97 ±5.07 MPa
Go: 27.75 ±4.41 MPa
Su: 89.97 ±24.76 kPa
Su ratio: 5.45 ±3.13
O.C.R.: 25.16 ±14.45

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.40 (m), **End depth:** 10.27 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.47 ±0.26 MPa	Permeability: 8.87E-09 ±4.02E-08 m/s	Constrained Mod.: 3.14 ±4.00 MPa
Sleeve friction: 12.68 ±9.18 kPa	N60: 2.55 ±0.96 blows	Go: 17.16 ±4.43 MPa
SBT_n: 3	Es: 28.91 ±2.70 MPa	Su: 25.43 ±12.02 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.53 ±0.28
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.44 ±1.29
	Unit weight: 15.39 ±0.69 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 10.27 (m), **End depth:** 11.80 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.36 ±0.83 MPa	Permeability: 1.64E-06 ±1.63E-06 m/s	Constrained Mod.: 43.46 ±10.55 MPa
Sleeve friction: 34.48 ±6.88 kPa	N60: 10.83 ±1.70 blows	Go: 50.87 ±5.28 MPa
SBT_n: 5	Es: 41.23 ±3.61 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 33.22 ±3.42	Su ratio: 0.00 ±0.00
	ö (degrees): 35.00 ±0.99 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.49 ±0.27 kN/m³	

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CPT: cptu2
Total depth: 11.80 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

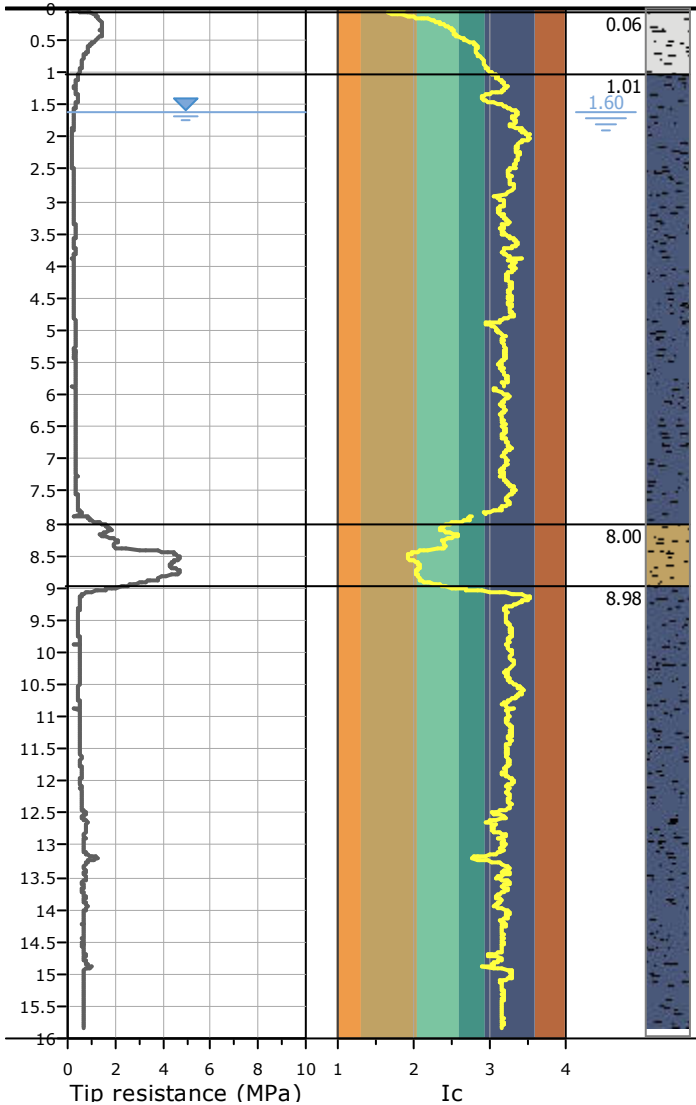
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.05	1.35	2.13E-06	4.9	23.5	0.0	0.0	18.0	27.7	90.0	5.4	25.2	17.9
1.40		(±8.10E-06)	(±0.9)	(±2.3)	(±0.0)	(±0.0)	(±5.1)	(±4.4)	(±24.8)	(±3.1)	(±14.4)	(±0.5)
1.40	8.87	8.87E-09	2.5	28.9	0.0	0.0	3.1	17.2	25.4	0.5	2.4	15.4
10.27		(±4.02E-08)	(±1.0)	(±2.7)	(±0.0)	(±0.0)	(±4.0)	(±4.4)	(±12.0)	(±0.3)	(±1.3)	(±0.7)
10.27	1.53	1.64E-06	10.8	41.2	33.2	35.0	43.5	50.9	0.0	0.0	0.0	17.5
11.80		(±1.63E-06)	(±1.7)	(±3.6)	(±3.4)	(±1.0)	(±10.6)	(±5.3)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

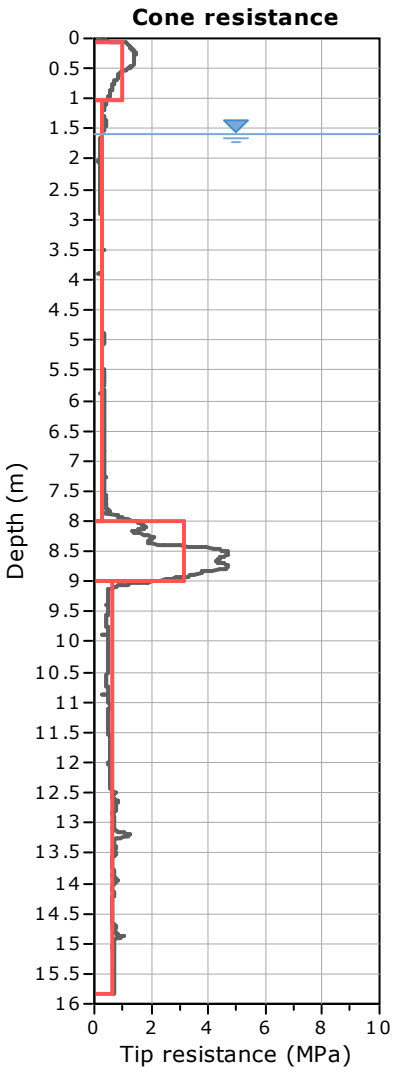
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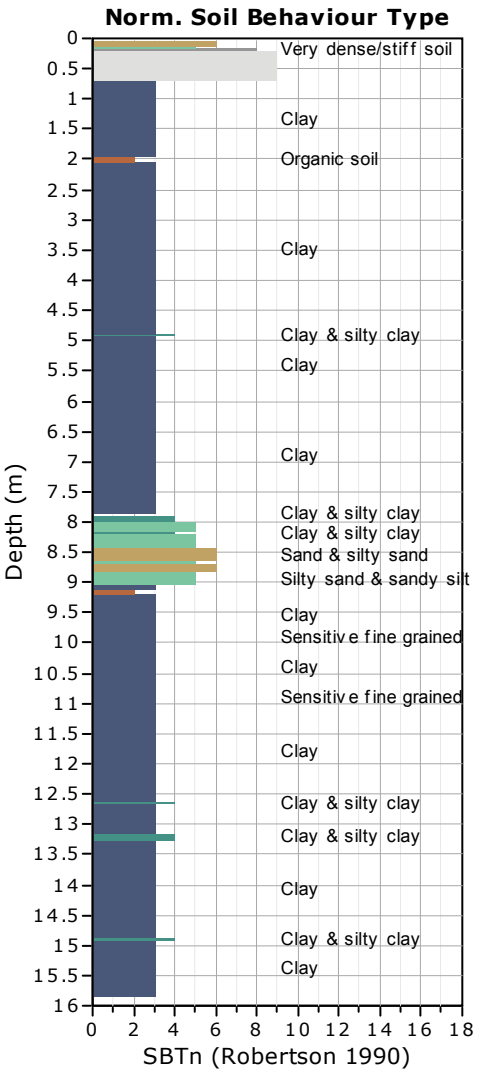
CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

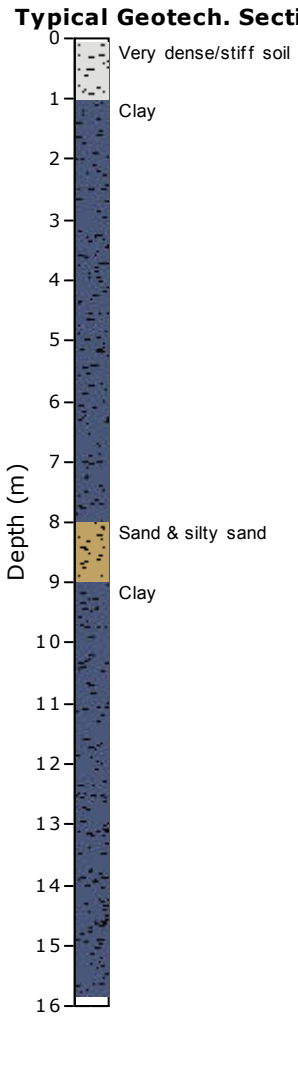
Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.0	3.61E-6	3.9	22.9	-	-	13.4	24.0	68.5	6.0	27.7	17.8
Clay	0.3	3.46E-9	1.9	6.8	-	-	1.6	12.3	17.1	0.4	2.1	14.8
Sand & silty sand	3.1	3.61E-6	9.3	33.2	34.2	35.1	37.3	41.2	-	-	-	17.0
Clay	0.6	4.09E-9	3.6	31.7	-	-	2.3	21.4	30.0	0.4	1.6	15.3







Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.06 (m), **End depth:** 1.01 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 1.00 ±0.35 MPa
Sleeve friction: 78.46 ±34.90 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 3.61E-06 ±1.43E-05 m/s
N60: 3.86 ±0.96 blows
Es: 22.87 ±2.73 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 17.77 ±0.92 kN/m³
Constrained Mod.: 13.37 ±4.96 MPa
Go: 24.05 ±6.23 MPa
Su: 68.54 ±25.93 kPa
Su ratio: 6.00 ±3.41
O.C.R.: 27.73 ±15.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.01 (m), **End depth:** 8.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.31 ±0.12 MPa	Permeability: 3.46E-09 ±1.47E-08 m/s	Constrained Mod.: 1.63 ±1.74 MPa
Sleeve friction: 8.31 ±6.26 kPa	N60: 1.89 ±0.49 blows	Go: 12.26 ±2.32 MPa
SBT_n: 3	Es: 6.78 ±11.60 MPa	Su: 17.13 ±6.34 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.44 ±0.23
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.05 ±1.05
	Unit weight: 14.80 ±0.62 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 8.00 (m), **End depth:** 8.98 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 3.13 ±1.26 MPa	Permeability: 3.61E-06 ±3.76E-06 m/s	Constrained Mod.: 37.26 ±12.81 MPa
Sleeve friction: 24.81 ±7.89 kPa	N60: 9.31 ±2.72 blows	Go: 41.25 ±8.80 MPa
SBT_n: 5	Es: 33.22 ±6.90 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 34.18 ±6.53	Su ratio: 0.00 ±0.00
	ö (degrees): 35.15 ±1.89 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.02 ±0.53 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 8.98 (m), **End depth:** 15.84 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.62 ±0.18 MPa	Permeability: 4.09E-09 ±2.40E-08 m/s	Constrained Mod.: 2.35 ±2.58 MPa
Sleeve friction: 10.01 ±5.68 kPa	N60: 3.58 ±0.67 blows	Go: 21.42 ±3.81 MPa
SBT_n: 3	Es: 31.74 ±31.74 MPa	Su: 30.03 ±9.53 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.12
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.64 ±0.55
	Unit weight: 15.35 ±0.46 kN/m³	

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CPT: cptu3
Total depth: 15.84 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

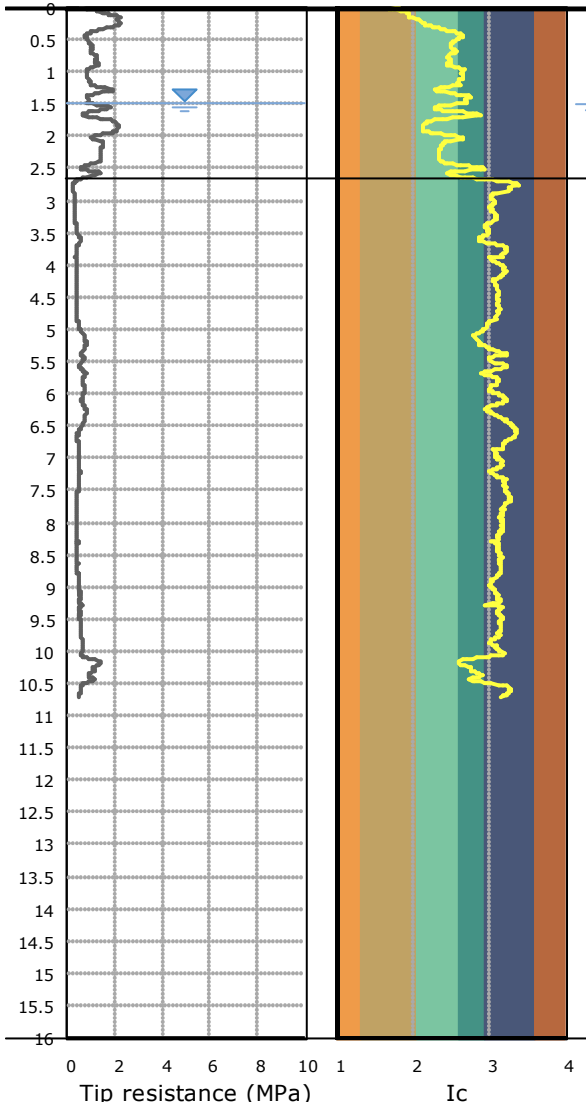
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.06	0.95	3.61E-06	3.9	22.9	0.0	0.0	13.4	24.0	68.5	6.0	27.7	17.8
1.01		(±1.43E-05)	(±1.0)	(±2.7)	(±0.0)	(±0.0)	(±5.0)	(±6.2)	(±25.9)	(±3.4)	(±15.8)	(±0.9)
1.01	6.99	3.46E-09	1.9	6.8	0.0	0.0	1.6	12.3	17.1	0.4	2.1	14.8
8.00		(±1.47E-08)	(±0.5)	(±11.6)	(±0.0)	(±0.0)	(±1.7)	(±2.3)	(±6.3)	(±0.2)	(±1.0)	(±0.6)
8.00	0.98	3.61E-06	9.3	33.2	34.2	35.1	37.3	41.2	0.0	0.0	0.0	17.0
8.98		(±3.76E-06)	(±2.7)	(±6.9)	(±6.5)	(±1.9)	(±12.8)	(±8.8)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
8.98	6.86	4.09E-09	3.6	31.7	0.0	0.0	2.3	21.4	30.0	0.4	1.6	15.3
15.84		(±2.40E-08)	(±0.7)	(±31.7)	(±0.0)	(±0.0)	(±2.6)	(±3.8)	(±9.5)	(±0.1)	(±0.6)	(±0.5)

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

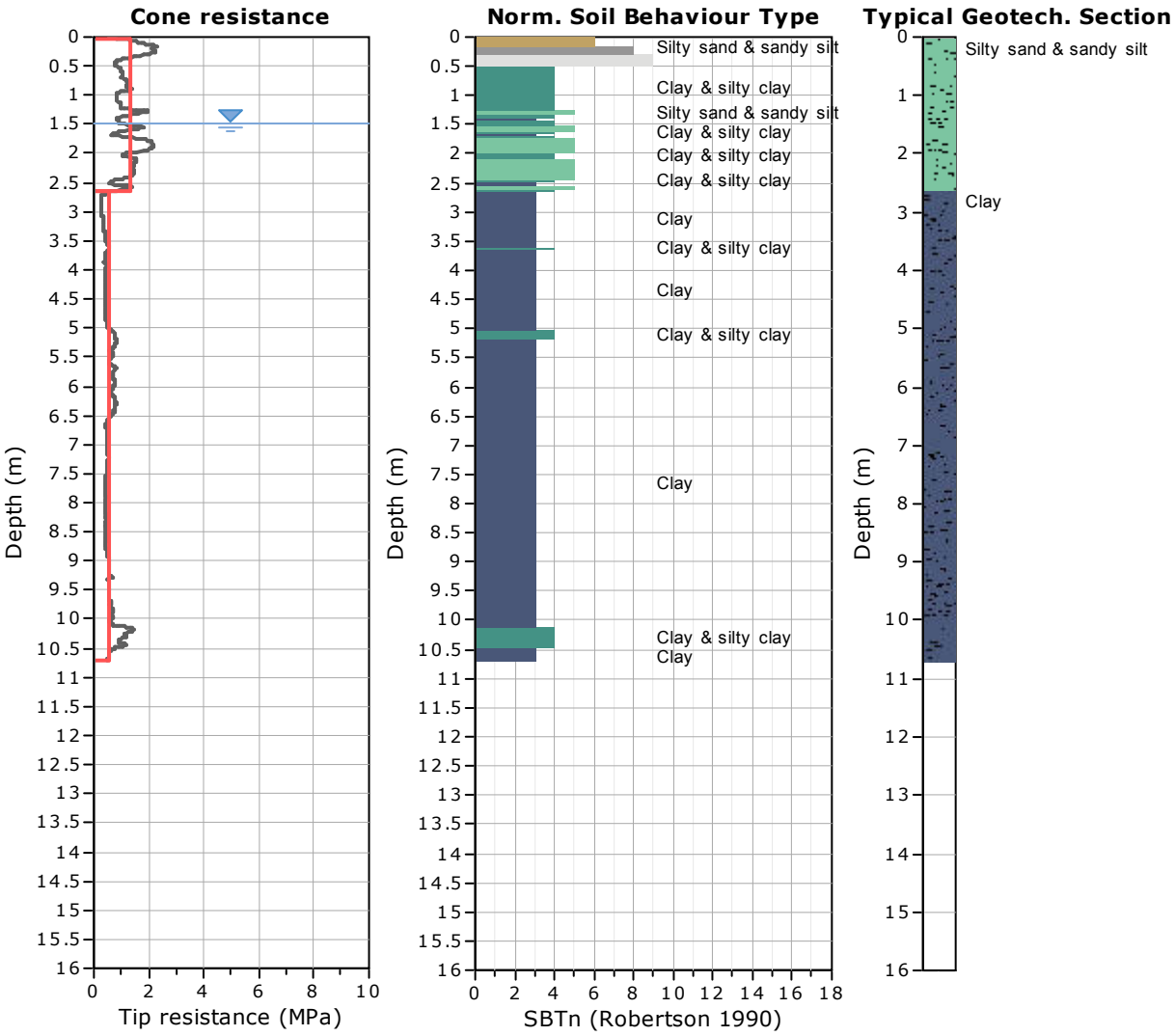
RDR SrL
Bologna Via Toscana 119
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CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.02	Silty sand & sandy silt	1.3	1.75E-6	4.6	20.6	43.7	37.1	17.5	24.5	-	-	-	17.1
2.64	Clay	0.5	6.15E-9	3.0	24.3	-	-	3.8	19.4	31.3	0.6	2.6	15.6



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.02 (m), **End depth:** 2.64 (m)

Description: Silty sand & sandy silt

Basic results

Total cone resistance: 1.31 ±0.44 MPa
Sleeve friction: 36.63 ±16.89 kPa
SBT_n: 5
SBTn description: Silty sand & sandy silt

Estimation results

Permeability: 1.75E-06 ±6.01E-06 m/s
N60: 4.59 ±1.00 blows
Es: 20.59 ±3.69 MPa
Dr (%): 43.73 ±17.22
φ (degrees): 37.06 ±3.29 °
Unit weight: 17.10 ±0.53 kN/m³
Constrained Mod.: 17.48 ±5.74 MPa
Go: 24.53 ±3.68 MPa
Su: 0.00 ±0.00 kPa
Su ratio: 0.00 ±0.00
O.C.R.: 0.00 ±0.00

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.64 (m), **End depth:** 10.72 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.55 ±0.18 MPa	Permeability: 6.15E-09 ±1.22E-08 m/s	Constrained Mod.: 3.79 ±2.93 MPa
Sleeve friction: 14.00 ±9.50 kPa	N60: 3.02 ±0.80 blows	Go: 19.44 ±5.09 MPa
SBT_n: 3	Es: 24.30 ±0.36 MPa	Su: 31.30 ±12.16 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.56 ±0.20
	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.60 ±0.95
	Unit weight: 15.56 ±0.74 kN/m³	

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CPT: cptu4
Total depth: 10.72 m, Date: 21/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

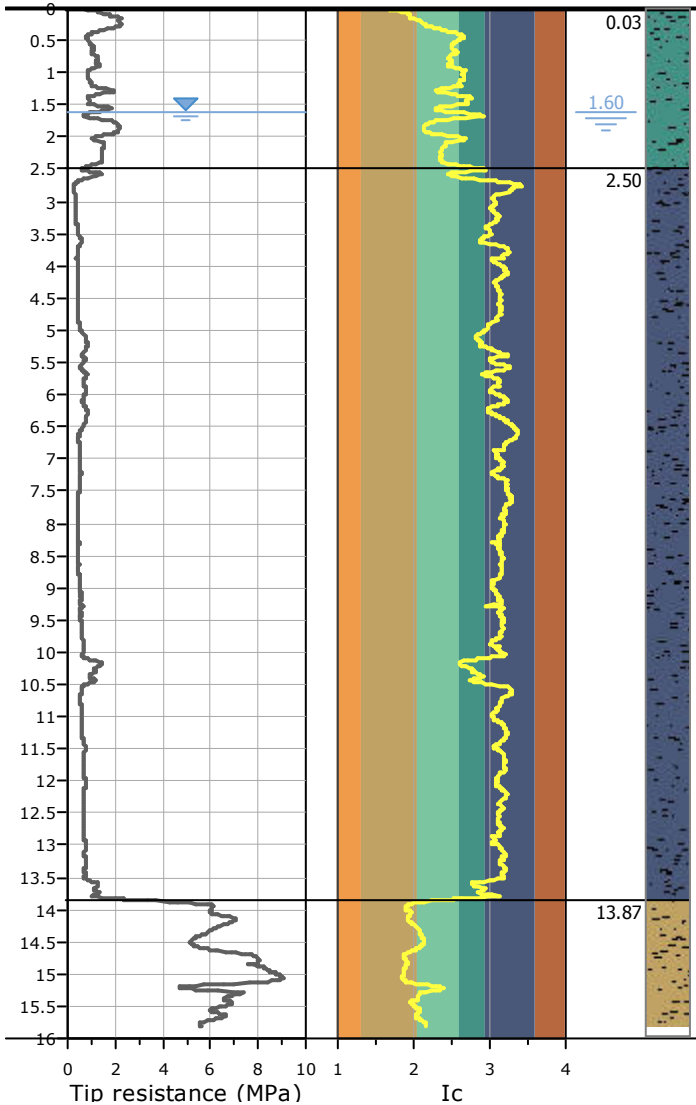
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.02	2.62	1.75E-06	4.6	20.6	43.7	37.1	17.5	24.5	0.0	0.0	0.0	17.1
2.64		(±6.01E-06)	(±1.0)	(±3.7)	(±17.2)	(±3.3)	(±5.7)	(±3.7)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
2.64	8.08	6.15E-09	3.0	24.3	0.0	0.0	3.8	19.4	31.3	0.6	2.6	15.6
10.72		(±1.22E-08)	(±0.8)	(±0.4)	(±0.0)	(±0.0)	(±2.9)	(±5.1)	(±12.2)	(±0.2)	(±0.9)	(±0.7)

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

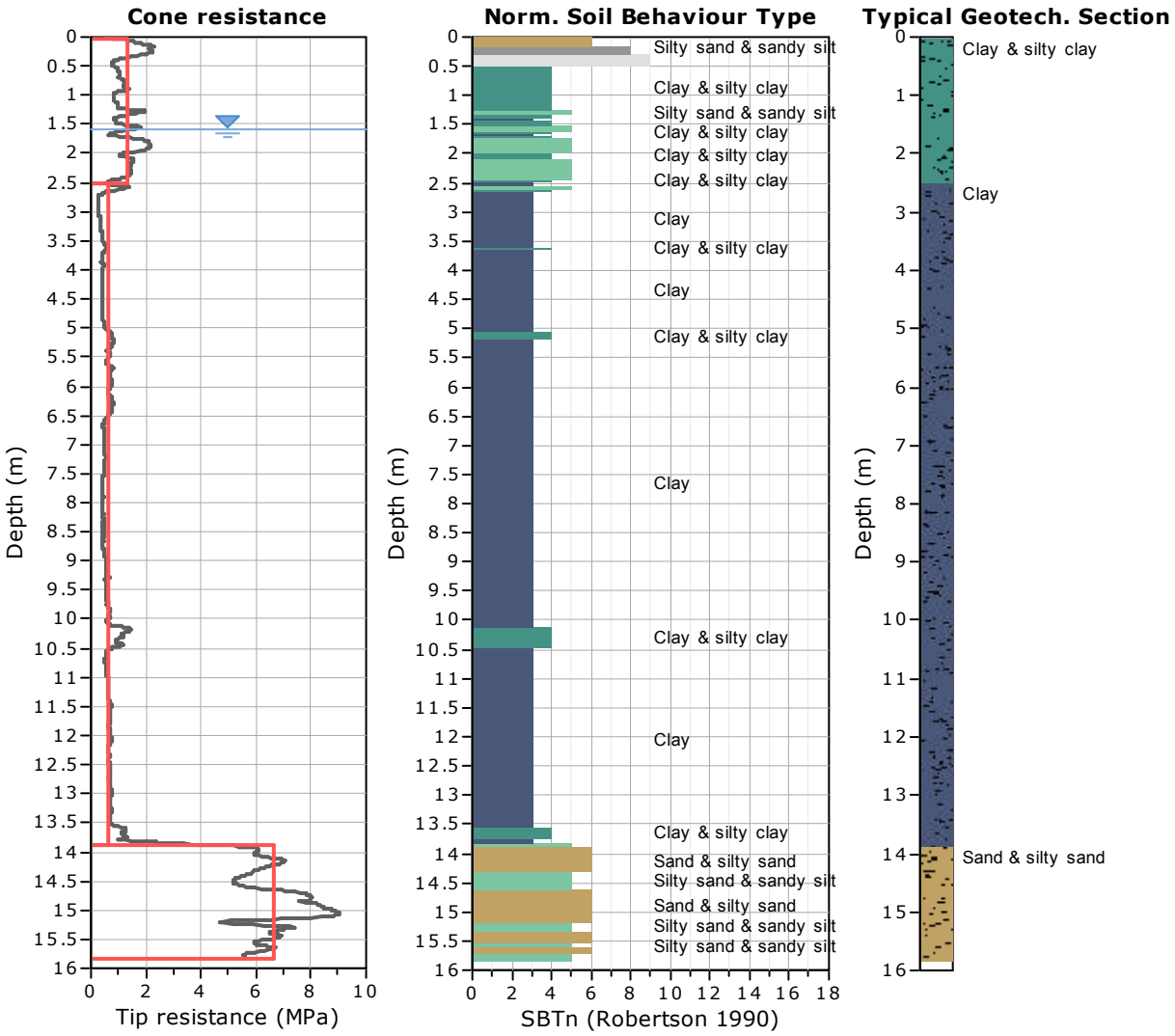
RDR SrL
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CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay & silty clay	1.3	1.55E-6	4.6	20.9	44.0	37.1	17.7	24.7	-	-	-	17.1
Clay	0.6	9.94E-9	3.3	20.5	-	-	3.9	21.0	33.3	0.5	2.4	15.6
Sand & silty sand	6.6	8.87E-6	17.9	58.0	41.5	37.1	72.1	72.8	-	-	-	18.1



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.03 (m), **End depth:** 2.50 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 1.33 ±0.44 MPa	Permeability: 1.55E-06 ±4.50E-06 m/s	Constrained Mod.: 17.74 ±5.76 MPa
Sleeve friction: 37.57 ±16.89 kPa	N60: 4.62 ±0.99 blows	Go: 24.75 ±3.60 MPa
SBT_n: 5	Es: 20.86 ±3.50 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 43.97 ±17.42	Su ratio: 0.00 ±0.00
	ö (degrees): 37.11 ±3.32 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.14 ±0.51 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.50 (m), **End depth:** 13.87 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.61 ±0.25 MPa	Permeability: 9.94E-09 ±6.04E-08 m/s	Constrained Mod.: 3.87 ±3.76 MPa
Sleeve friction: 13.38 ±8.49 kPa	N60: 3.35 ±1.00 blows	Go: 21.03 ±5.56 MPa
SBT_n: 3	Es: 20.51 ±2.26 MPa	Su: 33.30 ±12.66 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.52 ±0.22
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.42 ±1.00
	Unit weight: 15.58 ±0.68 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 13.87 (m), **End depth:** 15.82 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.62 ±1.12 MPa	Permeability: 8.87E-06 ±5.81E-06 m/s	Constrained Mod.: 72.07 ±7.38 MPa
Sleeve friction: 47.79 ±13.75 kPa	N60: 17.86 ±2.12 blows	Go: 72.75 ±7.71 MPa
SBT_n: 6	Es: 58.05 ±6.16 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 41.52 ±3.64	Su ratio: 0.00 ±0.00
	ö (degrees): 37.15 ±0.84 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.11 ±0.33 kN/m³	

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Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

CPT: cptu5
Total depth: 15.82 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Summary table of mean values

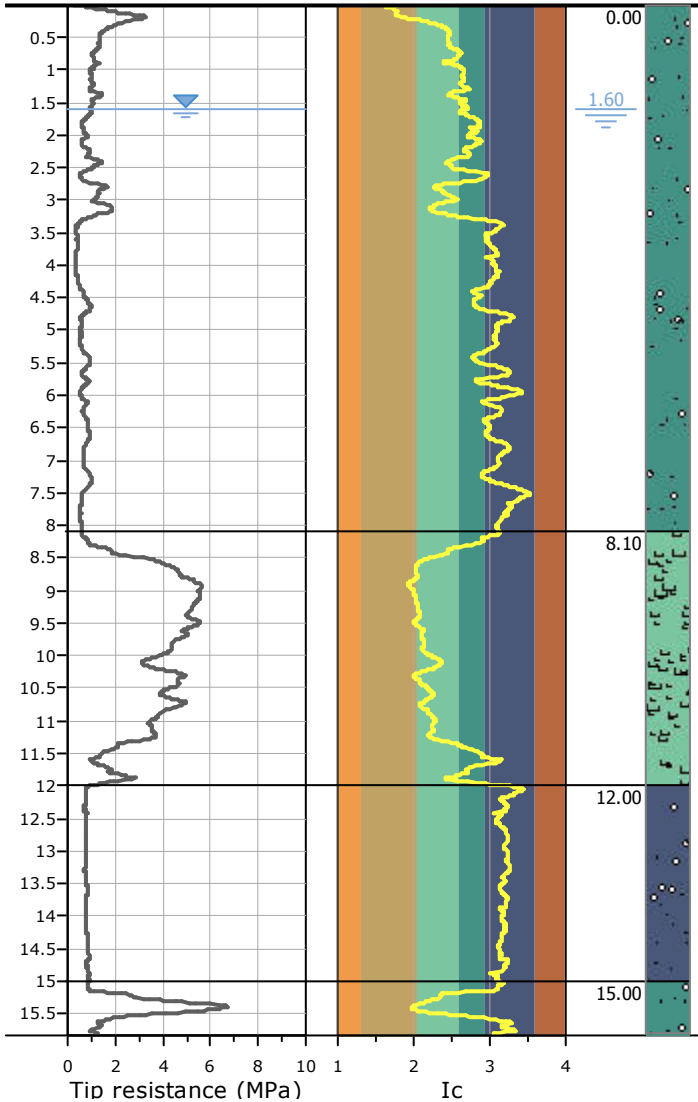
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.03	2.47	1.55E-06	4.6	20.9	44.0	37.1	17.7	24.7	0.0	0.0	0.0	17.1
2.50		(±4.50E-06)	(±1.0)	(±3.5)	(±17.4)	(±3.3)	(±5.8)	(±3.6)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
2.50	11.37	9.94E-09	3.3	20.5	0.0	0.0	3.9	21.0	33.3	0.5	2.4	15.6
13.87		(±6.04E-08)	(±1.0)	(±2.3)	(±0.0)	(±0.0)	(±3.8)	(±5.6)	(±12.7)	(±0.2)	(±1.0)	(±0.7)
13.87	1.95	8.87E-06	17.9	58.0	41.5	37.1	72.1	72.8	0.0	0.0	0.0	18.1
15.82		(±5.81E-06)	(±2.1)	(±6.2)	(±3.6)	(±0.8)	(±7.4)	(±7.7)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

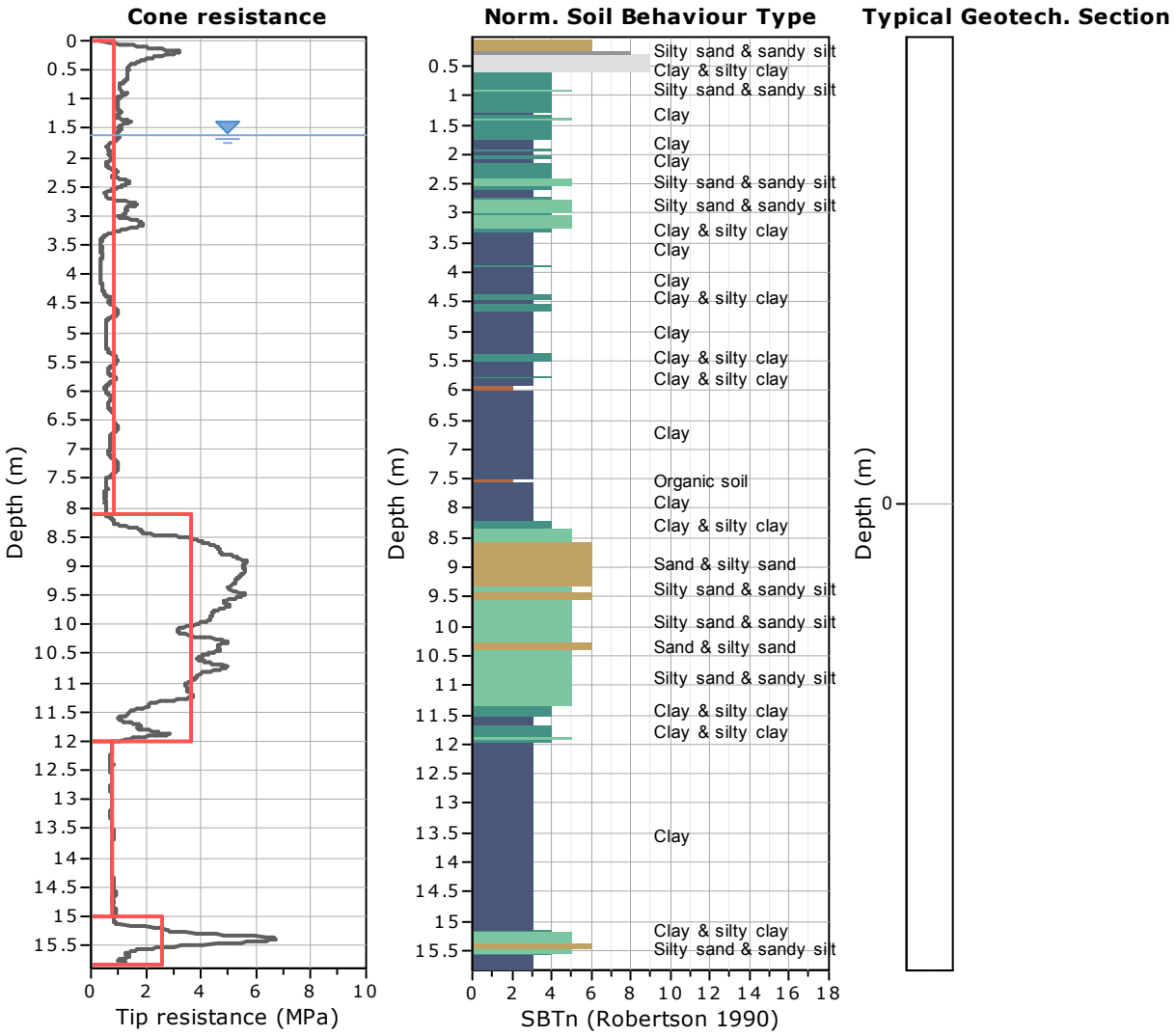
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Bologna Via Toscana 119
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CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.00	Clay & silty clay	0.9	1.04E-6	3.8	20.7	-	-	9.6	23.8	48.5	1.5	6.8	16.5
8.10	Silty sand & sandy silt	3.7	2.88E-6	11.2	44.0	36.5	35.9	44.5	51.3	-	-	-	17.4
12.00	Clay	0.8	1.99E-9	4.5	-	-	-	2.8	28.2	39.4	0.4	1.7	15.8
15.00	Clay & silty clay	2.6	1.32E-6	9.6	49.9	-	-	27.7	50.2	72.4	0.6	2.8	17.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 8.10 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 0.85 ±0.44 MPa
Sleeve friction: 28.20 ±18.73 kPa
SBT_n: 4
SBTn description: Clay & silty clay

Estimation results

Permeability: 1.04E-06 ±6.49E-06 m/s
N60: 3.78 ±1.09 blows
Es: 20.65 ±3.93 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 16.50 ±0.88 kN/m³
Constrained Mod.: 9.60 ±6.43 MPa
Go: 23.80 ±5.98 MPa
Su: 48.54 ±21.44 kPa
Su ratio: 1.48 ±1.73
O.C.R.: 6.82 ±7.97

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 8.10 (m), **End depth:** 12.00 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.66 ±1.48 MPa	Permeability: 2.88E-06 ±2.73E-06 m/s	Constrained Mod.: 44.55 ±17.96 MPa
Sleeve friction: 33.27 ±8.73 kPa	N60: 11.18 ±3.21 blows	Go: 51.33 ±10.05 MPa
SBT_n: 5	Es: 43.96 ±5.01 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 36.46 ±4.66	Su ratio: 0.00 ±0.00
	ö (degrees): 35.86 ±1.29 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.42 ±0.55 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 12.00 (m), **End depth:** 15.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.78 ±0.05 MPa	Permeability: 1.99E-09 ±8.20E-10 m/s	Constrained Mod.: 2.81 ±0.38 MPa
Sleeve friction: 13.36 ±5.52 kPa	N60: 4.46 ±0.51 blows	Go: 28.16 ±2.47 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 39.36 ±2.89 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.02
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.68 ±0.11
	Unit weight: 15.81 ±0.32 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 15.00 (m), **End depth:** 15.83 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.60 ±1.91 MPa	Permeability: 1.32E-06 ±2.48E-06 m/s	Constrained Mod.: 27.74 ±25.00 MPa
Sleeve friction: 33.04 ±19.72 kPa	N60: 9.58 ±4.15 blows	Go: 50.18 ±14.63 MPa
SBT_n: 4	Es: 49.92 ±49.92 MPa	Su: 72.39 ±34.51 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.60 ±0.29
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.77 ±1.33
	Unit weight: 17.03 ±0.94 kN/m³	

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CPT: cptu6
Total depth: 15.83 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

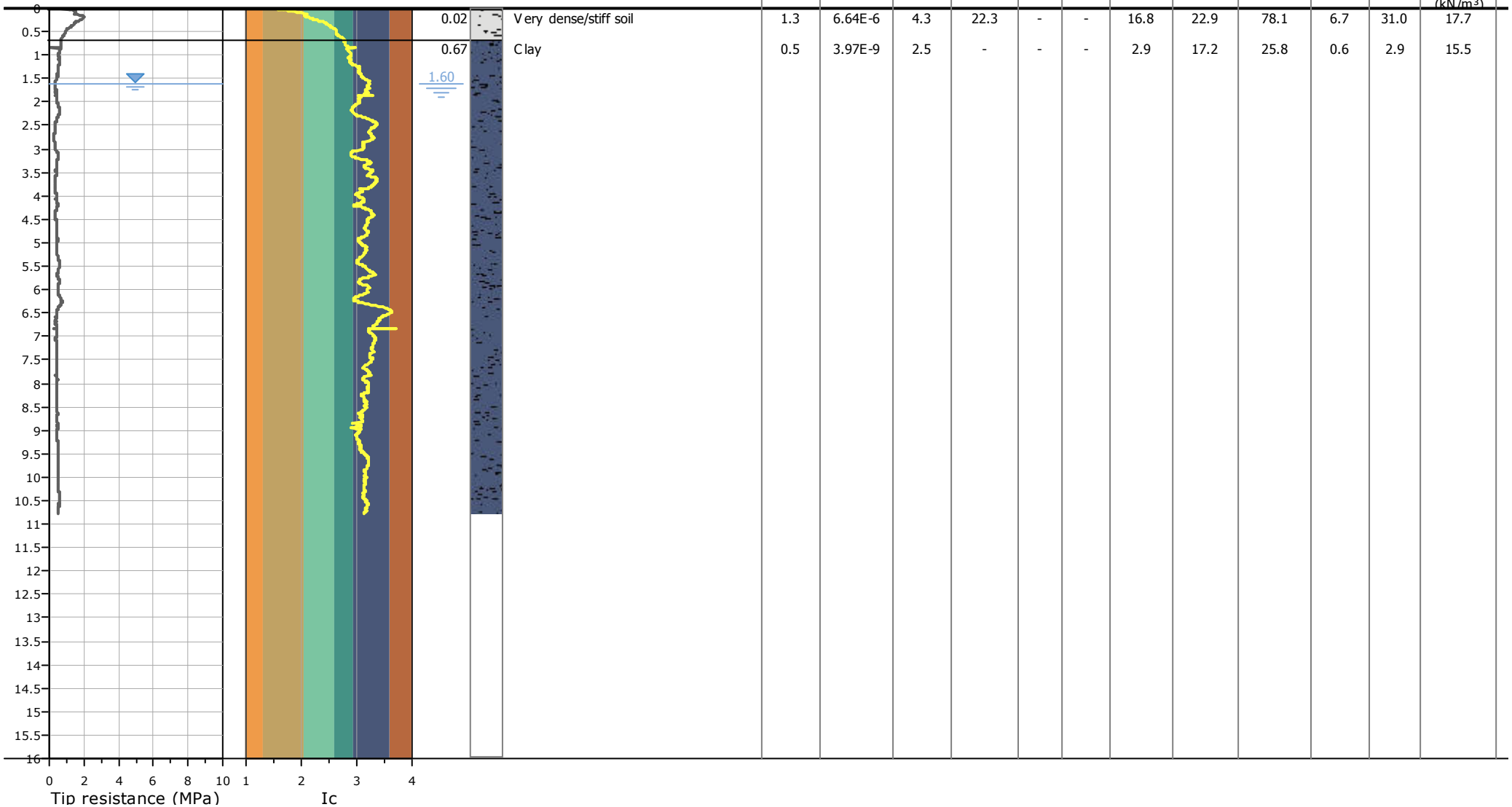
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	8.10	1.04E-06	3.8	20.7	0.0	0.0	9.6	23.8	48.5	1.5	6.8	16.5
8.10		(±6.49E-06)	(±1.1)	(±3.9)	(±0.0)	(±0.0)	(±6.4)	(±6.0)	(±21.4)	(±1.7)	(±8.0)	(±0.9)
8.10	3.90	2.88E-06	11.2	44.0	36.5	35.9	44.5	51.3	0.0	0.0	0.0	17.4
12.00		(±2.73E-06)	(±3.2)	(±5.0)	(±4.7)	(±1.3)	(±18.0)	(±10.1)	(±0.0)	(±0.0)	(±0.0)	(±0.6)
12.00	3.00	1.99E-09	4.5	0.0	0.0	0.0	2.8	28.2	39.4	0.4	1.7	15.8
15.00		(±8.20E-10)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±0.4)	(±2.5)	(±2.9)	(±0.0)	(±0.1)	(±0.3)
15.00	0.83	1.32E-06	9.6	49.9	0.0	0.0	27.7	50.2	72.4	0.6	2.8	17.0
15.83		(±2.48E-06)	(±4.2)	(±49.9)	(±0.0)	(±0.0)	(±25.0)	(±14.6)	(±34.5)	(±0.3)	(±1.3)	(±0.9)

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

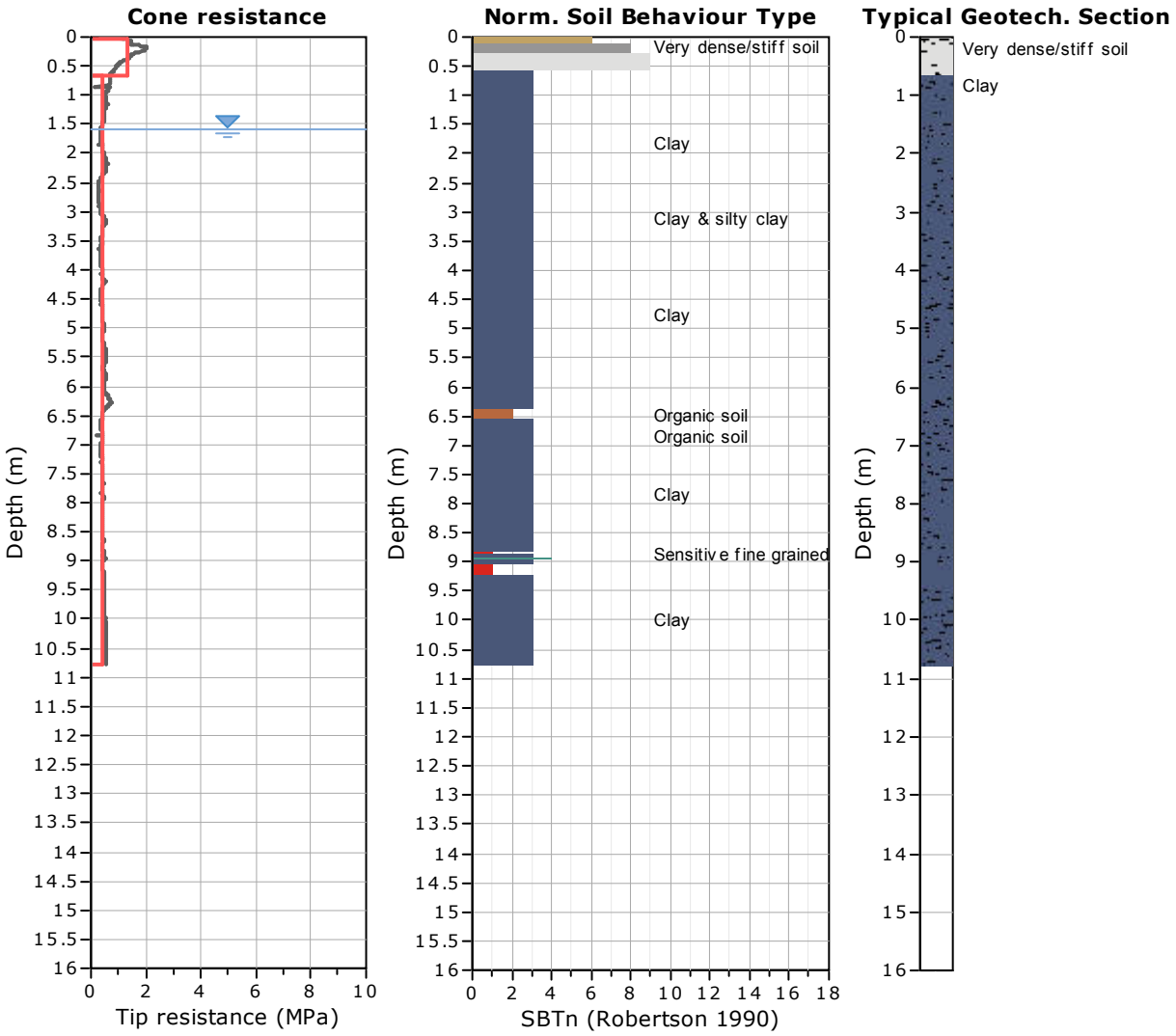
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CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.3	6.64E-6	4.3	22.3	-	-	16.8	22.9	78.1	6.7	31.0	17.7
Clay	0.5	3.97E-9	2.5	-	-	-	2.9	17.2	25.8	0.6	2.9	15.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.02 (m), **End depth:** 0.67 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 1.30 ±0.41 MPa
Sleeve friction: 64.43 ±24.38 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 6.64E-06 ±2.09E-05 m/s
N60: 4.35 ±1.07 blows
Es: 22.30 ±0.95 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 17.73 ±0.65 kN/m³
Constrained Mod.: 16.78 ±5.55 MPa
Go: 22.92 ±5.18 MPa
Su: 78.06 ±23.37 kPa
Su ratio: 6.71 ±2.75
O.C.R.: 31.02 ±12.69

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.67 (m), **End depth:** 10.79 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.45 ±0.09 MPa	Permeability: 3.97E-09 ±4.92E-09 m/s	Constrained Mod.: 2.94 ±2.03 MPa
Sleeve friction: 15.06 ±11.64 kPa	N60: 2.49 ±0.54 blows	Go: 17.25 ±3.07 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 25.83 ±6.55 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.63 ±0.50
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.90 ±2.31
	Unit weight: 15.48 ±0.88 kN/m³	

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CPT: cptu7
Total depth: 10.79 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

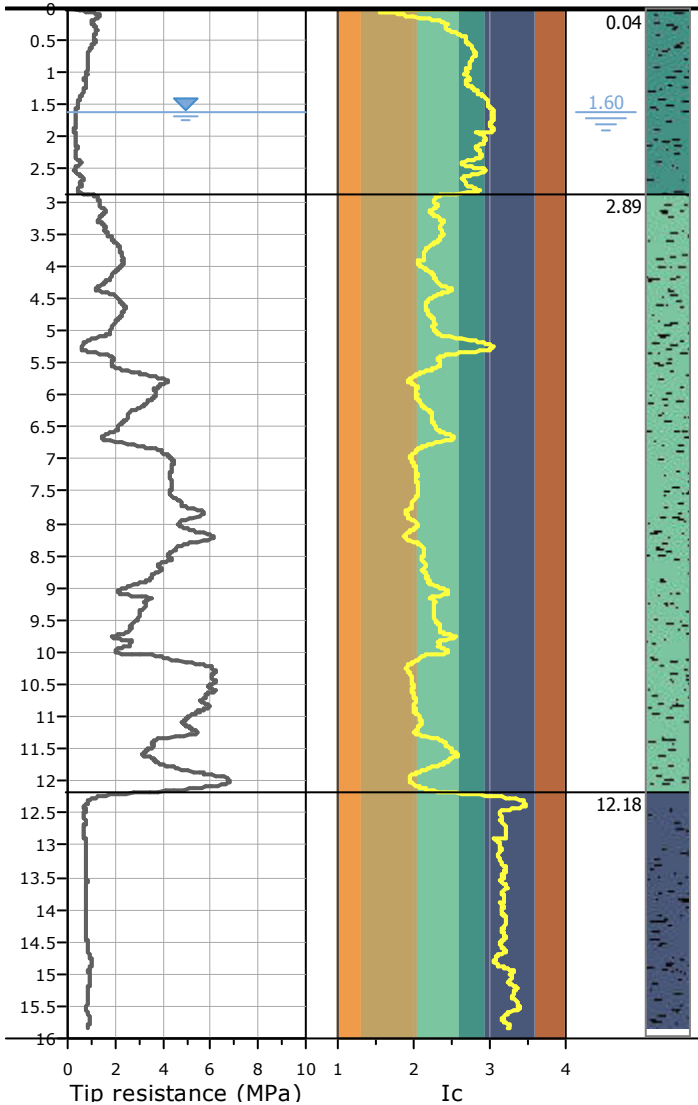
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.02	0.65	6.64E-06	4.3	22.3	0.0	0.0	16.8	22.9	78.1	6.7	31.0	17.7
0.67		(±2.09E-05)	(±1.1)	(±0.9)	(±0.0)	(±0.0)	(±5.6)	(±5.2)	(±23.4)	(±2.7)	(±12.7)	(±0.6)
0.67	10.12	3.97E-09	2.5	0.0	0.0	0.0	2.9	17.2	25.8	0.6	2.9	15.5
10.79		(±4.92E-09)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±2.0)	(±3.1)	(±6.5)	(±0.5)	(±2.3)	(±0.9)

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

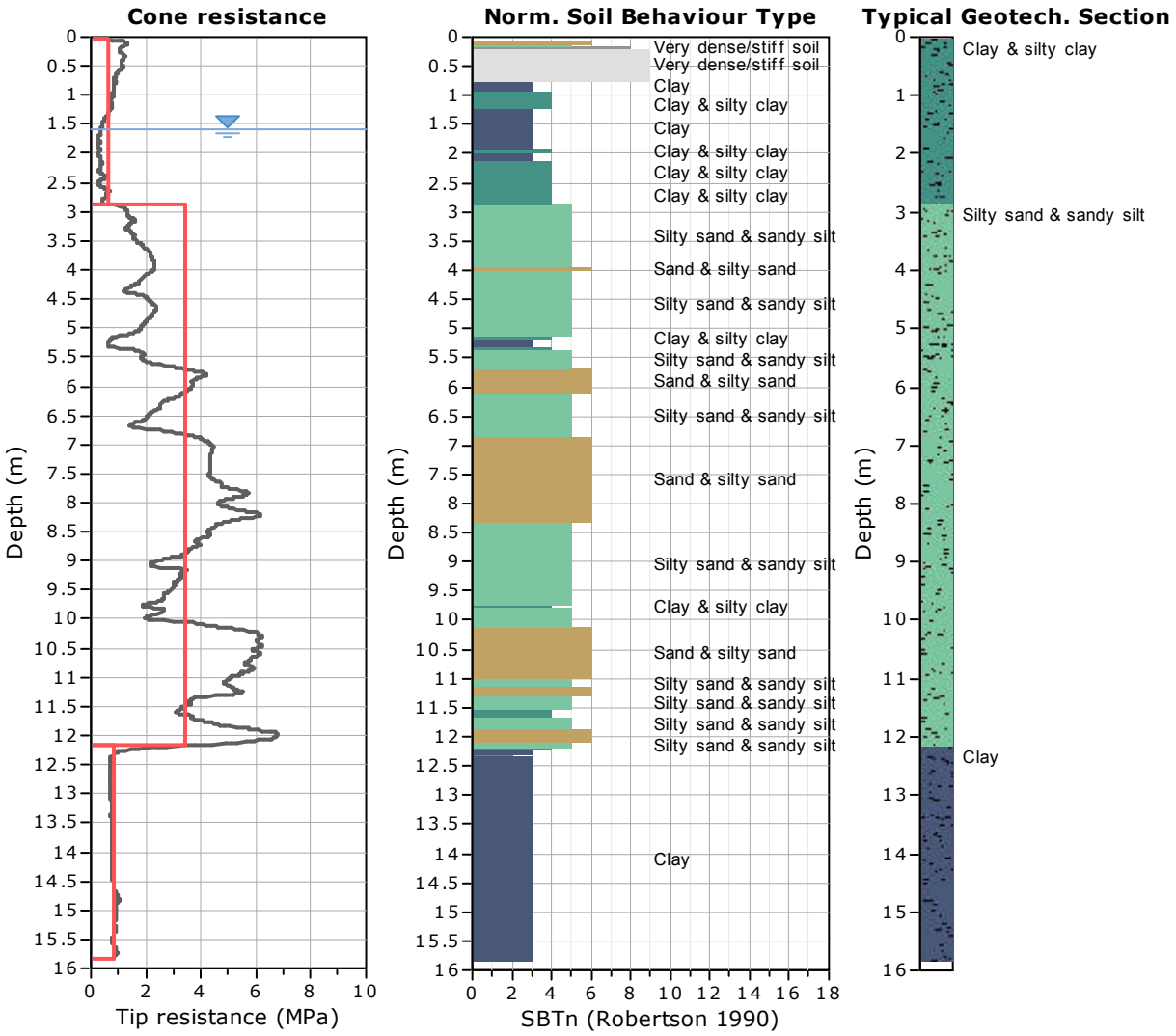
RDR SrL
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CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay & silty clay	0.6	1.22E-6	2.8	16.8	-	-	8.0	17.0	42.2	2.5	11.5	16.1
Silty sand & sandy silt	3.4	3.72E-6	10.0	35.7	35.1	35.5	40.9	44.5	-	-	-	17.1
Clay	0.8	3.97E-9	4.8	46.1	-	-	3.4	30.6	42.2	0.4	1.7	16.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.04 (m), **End depth:** 2.89 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 0.64 ±0.31 MPa
Sleeve friction: 32.53 ±33.94 kPa
SBT_n: 4
SBTn description: Clay & silty clay

Estimation results

Permeability: 1.22E-06 ±1.06E-05 m/s
N60: 2.78 ±1.02 blows
Es: 16.84 ±4.28 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 16.08 ±1.49 kN/m³

Constrained Mod.: 7.99 ±4.75 MPa
Go: 17.01 ±6.48 MPa
Su: 42.15 ±21.42 kPa
Su ratio: 2.49 ±2.55
O.C.R.: 11.50 ±11.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.89 (m), **End depth:** 12.18 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.41 ±1.55 MPa	Permeability: 3.72E-06 ±3.67E-06 m/s	Constrained Mod.: 40.93 ±15.68 MPa
Sleeve friction: 27.73 ±12.92 kPa	N60: 10.03 ±3.76 blows	Go: 44.47 ±14.30 MPa
SBT_n: 5	Es: 35.70 ±11.08 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 35.10 ±5.49	Su ratio: 0.00 ±0.00
	ö (degrees): 35.46 ±1.52 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.12 ±0.69 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 12.18 (m), **End depth:** 15.85 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.83 ±0.23 MPa	Permeability: 3.97E-09 ±2.57E-08 m/s	Constrained Mod.: 3.41 ±3.79 MPa
Sleeve friction: 16.60 ±11.11 kPa	N60: 4.80 ±1.00 blows	Go: 30.56 ±6.47 MPa
SBT_n: 3	Es: 46.11 ±46.11 MPa	Su: 42.22 ±13.46 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.38 ±0.13
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.74 ±0.62
	Unit weight: 15.97 ±0.62 kN/m³	

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu8
Total depth: 15.85 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

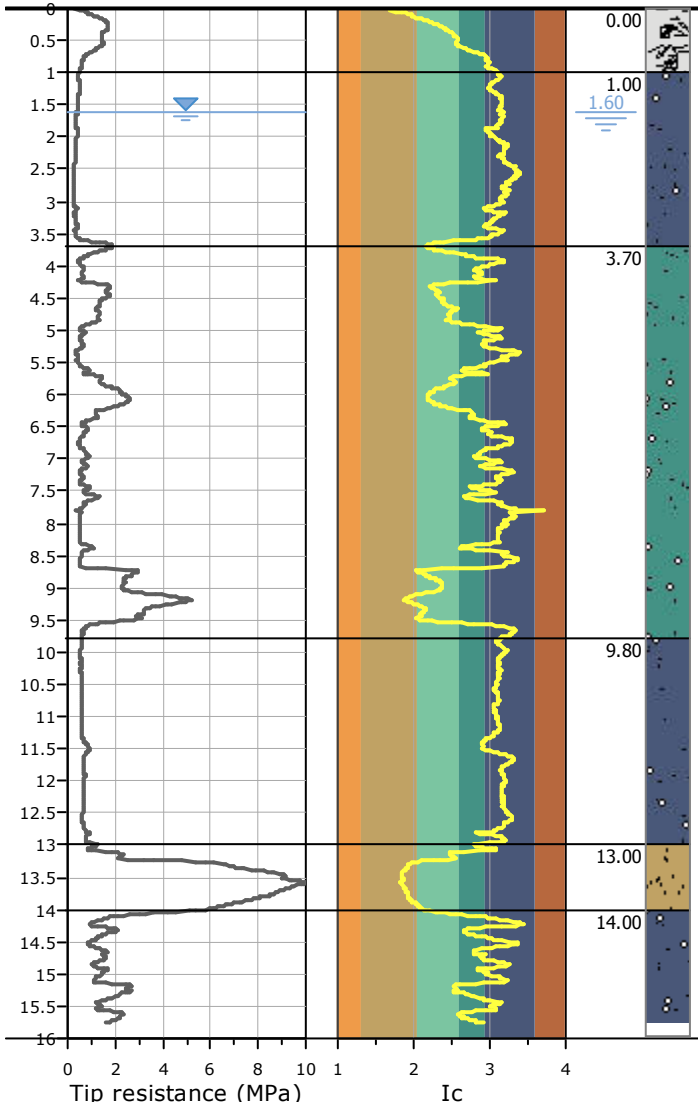
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.04	2.85	1.22E-06	2.8	16.8	0.0	0.0	8.0	17.0	42.2	2.5	11.5	16.1
2.89		(±1.06E-05)	(±1.0)	(±4.3)	(±0.0)	(±0.0)	(±4.8)	(±6.5)	(±21.4)	(±2.5)	(±11.8)	(±1.5)
2.89	9.29	3.72E-06	10.0	35.7	35.1	35.5	40.9	44.5	0.0	0.0	0.0	17.1
12.18		(±3.67E-06)	(±3.8)	(±11.1)	(±5.5)	(±1.5)	(±15.7)	(±14.3)	(±0.0)	(±0.0)	(±0.0)	(±0.7)
12.18	3.67	3.97E-09	4.8	46.1	0.0	0.0	3.4	30.6	42.2	0.4	1.7	16.0
15.85		(±2.57E-08)	(±1.0)	(±46.1)	(±0.0)	(±0.0)	(±3.8)	(±6.5)	(±13.5)	(±0.1)	(±0.6)	(±0.6)

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

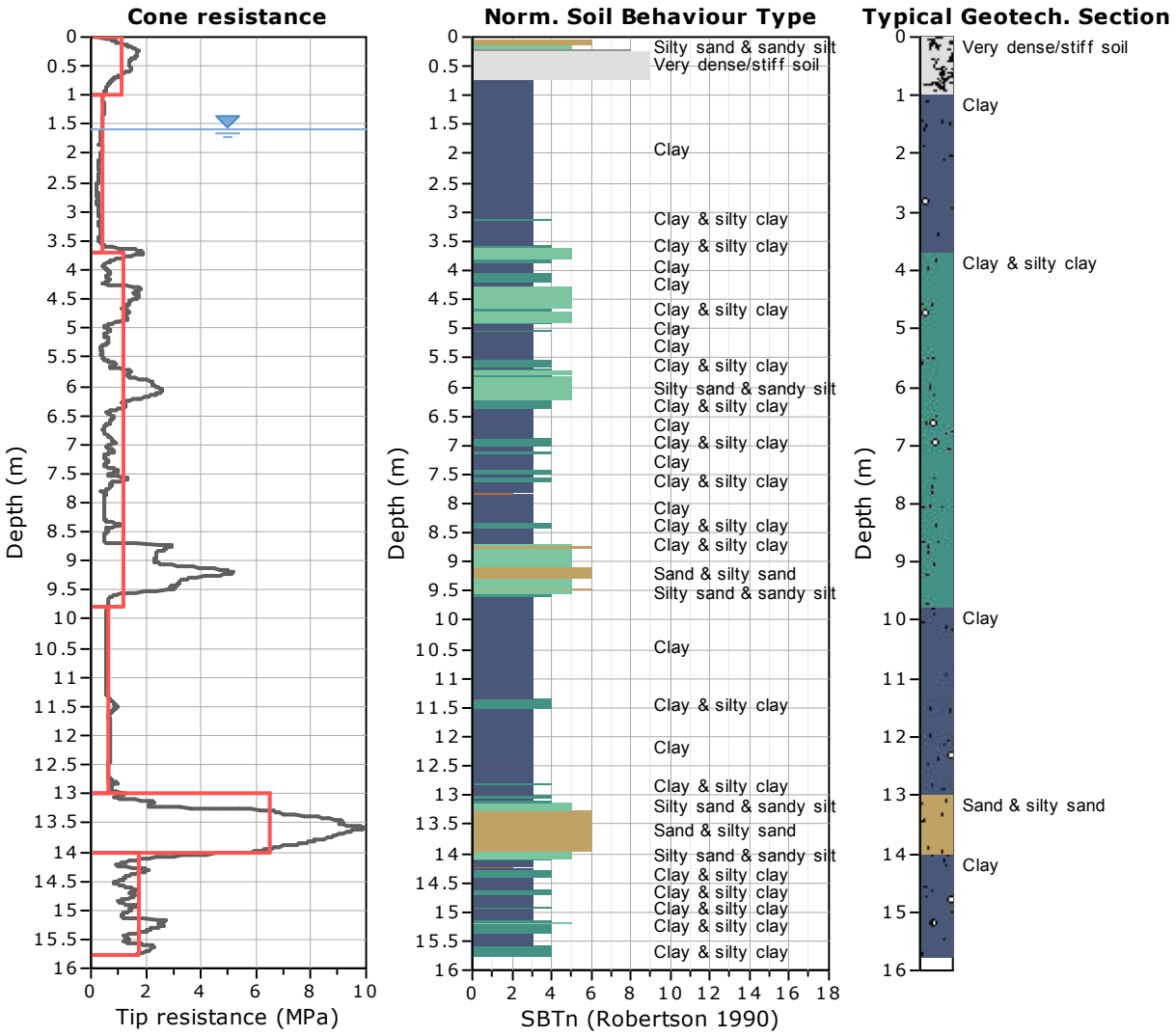
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	1.1	2.58E-6	4.3	23.4	-	-	14.8	25.0	79.3	6.3	29.0	17.9
Clay	0.4	5.49E-8	2.1	-	-	-	3.8	14.7	22.1	0.8	3.5	15.6
Clay & silty clay	1.2	7.53E-7	4.6	21.3	-	-	13.3	25.7	40.1	0.7	3.2	16.1
Clay	0.6	3.72E-9	3.5	-	-	-	2.6	21.8	33.3	0.4	1.8	15.3
Sand & silty sand	6.5	1.11E-5	17.2	59.4	44.0	37.5	65.0	69.4	-	-	-	18.0
Clay	1.7	8.76E-8	7.9	42.2	-	-	18.1	48.0	95.0	0.9	4.0	17.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 1.00 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.11 ±0.43 MPa	Permeability: 2.58E-06 ±8.90E-06 m/s	Constrained Mod.: 14.81 ±6.58 MPa
Sleeve friction: 79.80 ±36.52 kPa	N60: 4.34 ±1.30 blows	Go: 24.98 ±8.45 MPa
SBT_n: 9	Es: 23.35 ±6.74 MPa	Su: 79.27 ±31.93 kPa
SBTn description: Very dense/stiff soil	Dr (%): 0.00 ±0.00	Su ratio: 6.28 ±3.37
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 28.99 ±15.58
	Unit weight: 17.90 ±0.96 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 3.70 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.39 ±0.24 MPa	Permeability: 5.49E-08 ±2.98E-07 m/s	Constrained Mod.: 3.84 ±3.85 MPa
Sleeve friction: 17.29 ±12.99 kPa	N60: 2.07 ±0.75 blows	Go: 14.70 ±3.50 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 22.06 ±6.18 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.77 ±0.37
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 3.54 ±1.72
	Unit weight: 15.59 ±0.85 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 3.70 (m), **End depth:** 9.80 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 1.20 ±0.96 MPa	Permeability: 7.53E-07 ±2.14E-06 m/s	Constrained Mod.: 13.33 ±12.59 MPa
Sleeve friction: 16.06 ±5.84 kPa	N60: 4.64 ±2.26 blows	Go: 25.67 ±7.52 MPa
SBT_n: 4	Es: 21.32 ±2.62 MPa	Su: 40.10 ±16.20 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.70 ±0.29
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 3.22 ±1.35
	Unit weight: 16.08 ±0.56 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 9.80 (m), **End depth:** 13.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.65 ±0.11 MPa	Permeability: 3.72E-09 ±3.83E-09 m/s	Constrained Mod.: 2.61 ±1.20 MPa
Sleeve friction: 9.33 ±4.17 kPa	N60: 3.53 ±0.56 blows	Go: 21.83 ±3.74 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 33.30 ±6.93 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.39 ±0.07
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.78 ±0.31
	Unit weight: 15.27 ±0.55 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 13.00 (m), **End depth:** 14.00 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.51 ±2.95 MPa	Permeability: 1.11E-05 ±8.40E-06 m/s	Constrained Mod.: 65.03 ±27.02 MPa
Sleeve friction: 48.72 ±19.15 kPa	N60: 17.23 ±6.26 blows	Go: 69.36 ±19.42 MPa
SBT_n: 6	Es: 59.42 ±11.41 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 43.95 ±8.64	Su ratio: 0.00 ±0.00
	ö (degrees): 37.50 ±2.27 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.98 ±0.88 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 14.00 (m), **End depth:** 15.76 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 1.72 ±0.78 MPa	Permeability: 8.76E-08 ±3.34E-07 m/s	Constrained Mod.: 18.09 ±12.53 MPa
Sleeve friction: 38.02 ±12.13 kPa	N60: 7.90 ±1.95 blows	Go: 48.04 ±6.92 MPa
SBT_n: 3	Es: 42.16 ±3.02 MPa	Su: 95.02 ±33.03 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.87 ±0.30
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 4.00 ±1.38
	Unit weight: 17.30 ±0.38 kN/m³	

RDR SrL
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CPT: cptu9
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

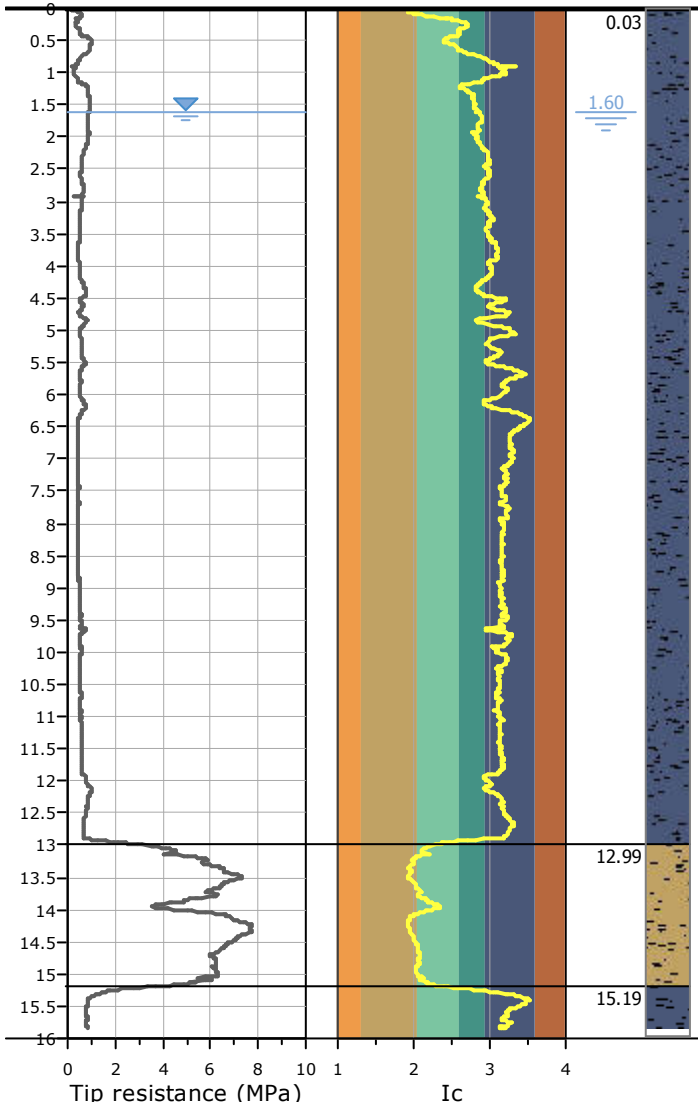
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	1.00	2.58E-06	4.3	23.4	0.0	0.0	14.8	25.0	79.3	6.3	29.0	17.9
1.00		(±8.90E-06)	(±1.3)	(±6.7)	(±0.0)	(±0.0)	(±6.6)	(±8.5)	(±31.9)	(±3.4)	(±15.6)	(±1.0)
1.00	2.70	5.49E-08	2.1	0.0	0.0	0.0	3.8	14.7	22.1	0.8	3.5	15.6
3.70		(±2.98E-07)	(±0.7)	(±0.0)	(±0.0)	(±0.0)	(±3.9)	(±3.5)	(±6.2)	(±0.4)	(±1.7)	(±0.9)
3.70	6.10	7.53E-07	4.6	21.3	0.0	0.0	13.3	25.7	40.1	0.7	3.2	16.1
9.80		(±2.14E-06)	(±2.3)	(±2.6)	(±0.0)	(±0.0)	(±12.6)	(±7.5)	(±16.2)	(±0.3)	(±1.4)	(±0.6)
9.80	3.20	3.72E-09	3.5	0.0	0.0	0.0	2.6	21.8	33.3	0.4	1.8	15.3
13.00		(±3.83E-09)	(±0.6)	(±0.0)	(±0.0)	(±0.0)	(±1.2)	(±3.7)	(±6.9)	(±0.1)	(±0.3)	(±0.6)
13.00	1.00	1.11E-05	17.2	59.4	44.0	37.5	65.0	69.4	0.0	0.0	0.0	18.0
14.00		(±8.40E-06)	(±6.3)	(±11.4)	(±8.6)	(±2.3)	(±27.0)	(±19.4)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
14.00	1.76	8.76E-08	7.9	42.2	0.0	0.0	18.1	48.0	95.0	0.9	4.0	17.3
15.76		(±3.34E-07)	(±1.9)	(±3.0)	(±0.0)	(±0.0)	(±12.5)	(±6.9)	(±33.0)	(±0.3)	(±1.4)	(±0.4)

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

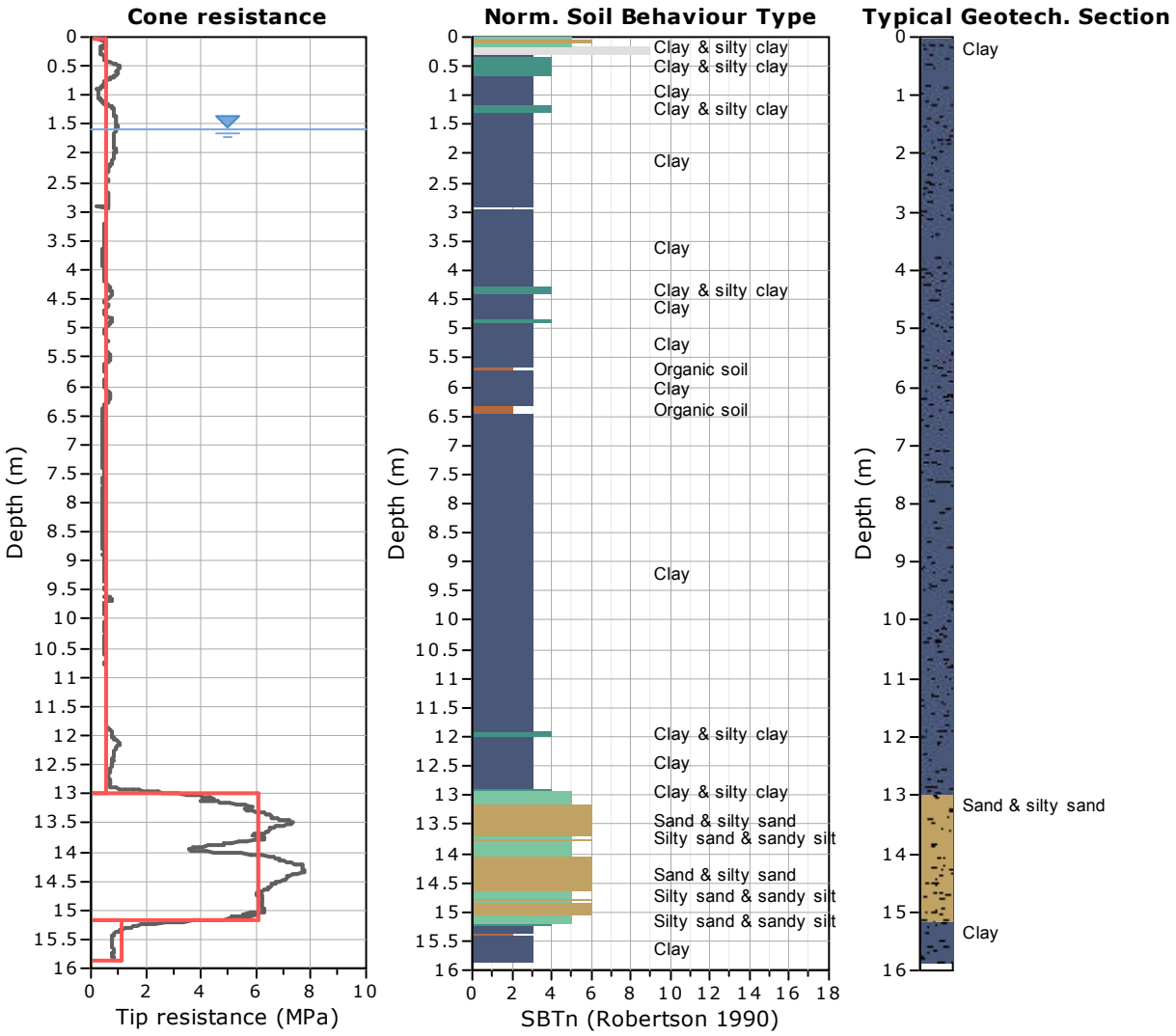
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay	0.6	7.28E-8	3.1	13.3	-	-	4.5	19.9	33.4	0.9	4.1	15.8
Sand & silty sand	6.1	6.29E-6	16.8	55.6	40.4	36.9	69.0	69.7	-	-	-	18.1
Clay	1.1	2.01E-8	6.2	47.7	-	-	7.4	39.2	52.8	0.5	2.2	16.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.03 (m), **End depth:** 12.99 (m)

Description: Clay

Basic results

Total cone resistance: 0.58 ±0.20 MPa
Sleeve friction: 17.90 ±13.63 kPa
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 7.28E-08 ±6.98E-07 m/s
N60: 3.07 ±0.80 blows
Es: 13.31 ±4.27 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 15.75 ±0.94 kN/m³
Constrained Mod.: 4.53 ±3.76 MPa
Go: 19.88 ±5.01 MPa
Su: 33.43 ±12.15 kPa
Su ratio: 0.88 ±0.96
O.C.R.: 4.07 ±4.43

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 12.99 (m), **End depth:** 15.19 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.07 ±1.07 MPa	Permeability: 6.29E-06 ±3.42E-06 m/s	Constrained Mod.: 68.96 ±8.29 MPa
Sleeve friction: 46.55 ±8.09 kPa	N60: 16.77 ±2.21 blows	Go: 69.69 ±6.92 MPa
SBT_n: 6	Es: 55.60 ±5.52 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 40.41 ±3.81	Su ratio: 0.00 ±0.00
	ö (degrees): 36.88 ±0.95 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.07 ±0.28 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_4 **Start depth:** 15.19 (m), **End depth:** 15.86 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 1.10 ±0.63 MPa	Permeability: 2.01E-08 ±7.80E-08 m/s	Constrained Mod.: 7.44 ±10.44 MPa
Sleeve friction: 31.62 ±20.32 kPa	N60: 6.19 ±1.92 blows	Go: 39.21 ±11.84 MPa
SBT_n: 3	Es: 47.72 ±47.72 MPa	Su: 52.81 ±28.81 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.47 ±0.26
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.16 ±1.22
	Unit weight: 16.70 ±0.88 kN/m³	

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu10
Total depth: 15.86 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

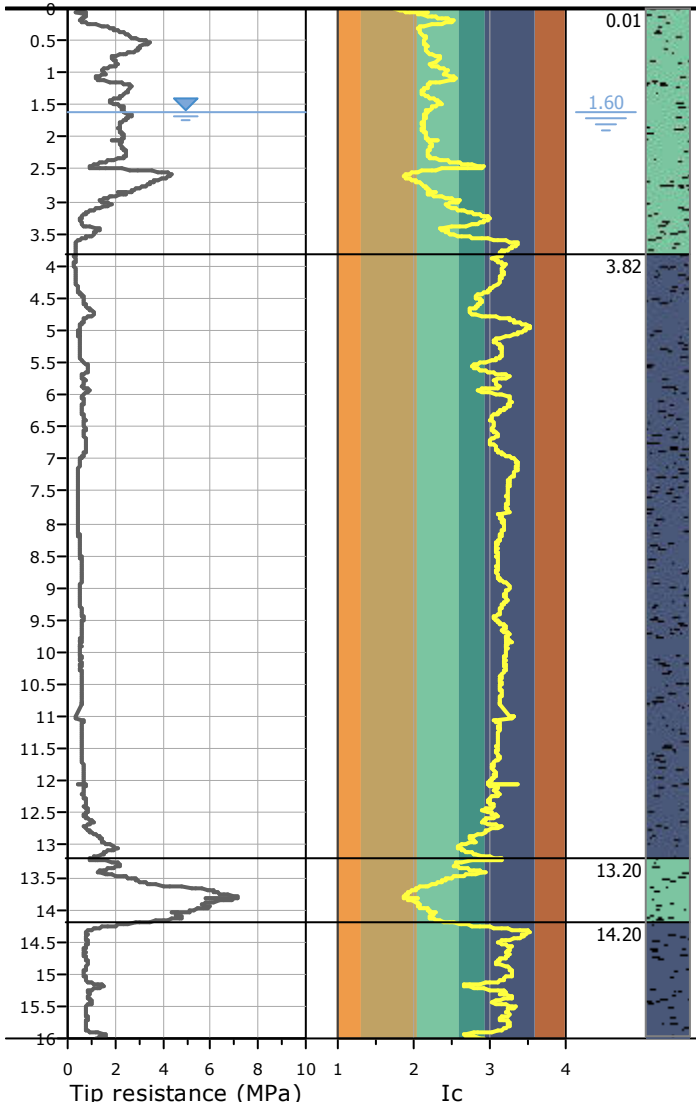
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.03	12.96	7.28E-08	3.1	13.3	0.0	0.0	4.5	19.9	33.4	0.9	4.1	15.8
12.99		(±6.98E-07)	(±0.8)	(±4.3)	(±0.0)	(±0.0)	(±3.8)	(±5.0)	(±12.1)	(±1.0)	(±4.4)	(±0.9)
12.99	2.20	6.29E-06	16.8	55.6	40.4	36.9	69.0	69.7	0.0	0.0	0.0	18.1
15.19		(±3.42E-06)	(±2.2)	(±5.5)	(±3.8)	(±1.0)	(±8.3)	(±6.9)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
15.19	0.67	2.01E-08	6.2	47.7	0.0	0.0	7.4	39.2	52.8	0.5	2.2	16.7
15.86		(±7.80E-08)	(±1.9)	(±47.7)	(±0.0)	(±0.0)	(±10.4)	(±11.8)	(±28.8)	(±0.3)	(±1.2)	(±0.9)

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

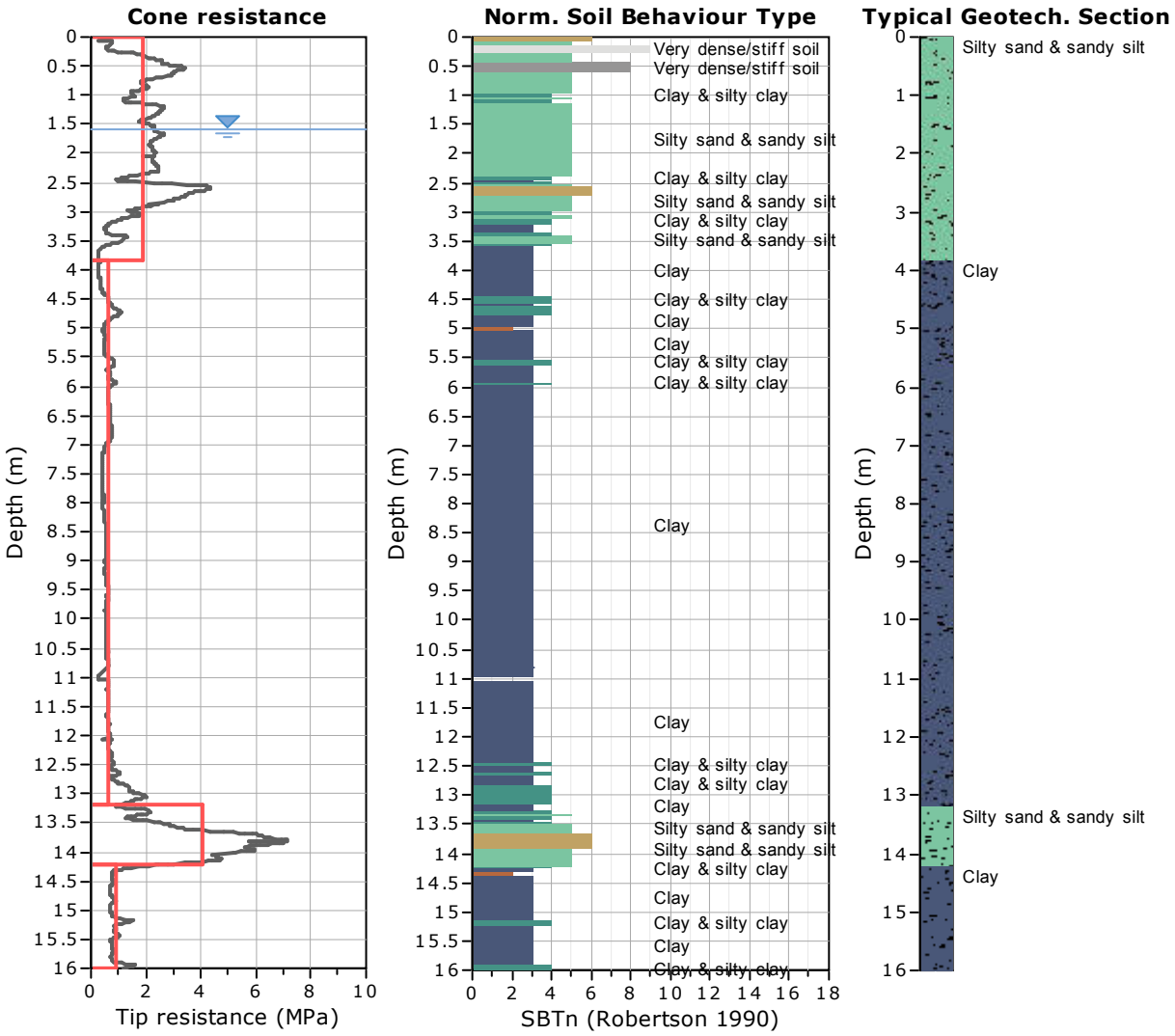
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Silty sand & sandy silt	1.9	2.25E-6	6.0	25.7	44.3	37.6	24.8	29.2	-	-	-	17.1
Clay	0.6	6.30E-9	3.4	32.8	-	-	3.8	21.4	34.8	0.5	2.3	15.5
Silty sand & sandy silt	4.0	3.44E-6	12.4	49.9	35.8	35.6	47.6	57.0	-	-	-	17.6
Clay	0.9	1.05E-8	5.1	-	-	-	4.9	31.2	47.1	0.4	2.0	16.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.01 (m), **End depth:** 3.82 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 1.89 ±0.94 MPa	Permeability: 2.25E-06 ±4.04E-06 m/s	Constrained Mod.: 24.82 ±12.21 MPa
Sleeve friction: 35.21 ±21.23 kPa	N60: 5.97 ±2.37 blows	Go: 29.20 ±9.19 MPa
SBT_n: 5	Es: 25.67 ±6.36 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.30 ±10.44	Su ratio: 0.00 ±0.00
	ö (degrees): 37.55 ±2.21 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.05 ±0.93 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.82 (m), **End depth:** 13.20 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.62 ±0.24 MPa	Permeability: 6.30E-09 ±1.33E-08 m/s	Constrained Mod.: 3.83 ±3.71 MPa
Sleeve friction: 13.63 ±10.96 kPa	N60: 3.37 ±0.93 blows	Go: 21.44 ±5.74 MPa
SBT_n: 3	Es: 32.82 ±0.39 MPa	Su: 34.82 ±15.77 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.51 ±0.22
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.34 ±1.03
	Unit weight: 15.53 ±0.80 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 13.20 (m), **End depth:** 14.20 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 4.04 ±1.90 MPa	Permeability: 3.44E-06 ±4.78E-06 m/s	Constrained Mod.: 47.61 ±20.95 MPa
Sleeve friction: 36.46 ±10.36 kPa	N60: 12.45 ±4.06 blows	Go: 57.03 ±11.86 MPa
SBT_n: 5	Es: 49.92 ±6.47 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 35.80 ±5.81	Su ratio: 0.00 ±0.00
	ö (degrees): 35.63 ±1.65 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.56 ±0.50 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 14.20 (m), **End depth:** 16.00 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.92 ±0.37 MPa	Permeability: 1.05E-08 ±3.11E-08 m/s	Constrained Mod.: 4.91 ±6.03 MPa
Sleeve friction: 17.19 ±11.56 kPa	N60: 5.07 ±1.23 blows	Go: 31.21 ±6.86 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 47.08 ±21.43 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.43 ±0.20
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.98 ±0.93
	Unit weight: 16.04 ±0.61 kN/m³	

RDR SrL
Bologna Via Toscana 119
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CPT: cptu11
Total depth: 16.00 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

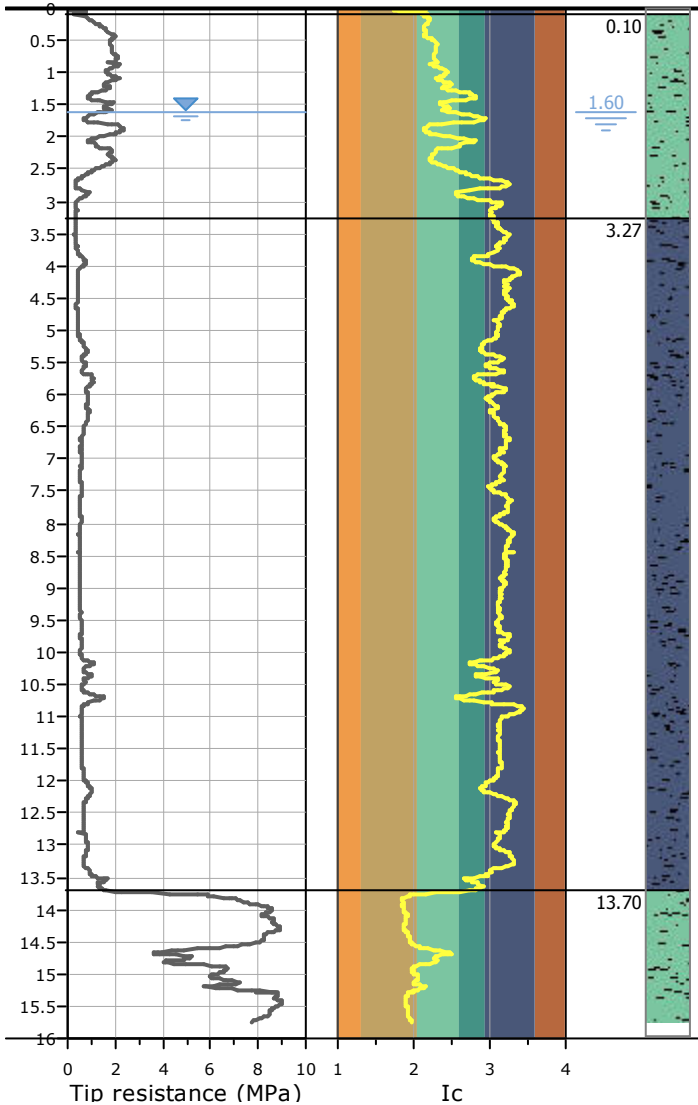
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.01	3.81	2.25E-06	6.0	25.7	44.3	37.6	24.8	29.2	0.0	0.0	0.0	17.1
3.82		(±4.04E-06)	(±2.4)	(±6.4)	(±10.4)	(±2.2)	(±12.2)	(±9.2)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
3.82	9.38	6.30E-09	3.4	32.8	0.0	0.0	3.8	21.4	34.8	0.5	2.3	15.5
13.20		(±1.33E-08)	(±0.9)	(±0.4)	(±0.0)	(±0.0)	(±3.7)	(±5.7)	(±15.8)	(±0.2)	(±1.0)	(±0.8)
13.20	1.00	3.44E-06	12.4	49.9	35.8	35.6	47.6	57.0	0.0	0.0	0.0	17.6
14.20		(±4.78E-06)	(±4.1)	(±6.5)	(±5.8)	(±1.6)	(±20.9)	(±11.9)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
14.20	1.80	1.05E-08	5.1	0.0	0.0	0.0	4.9	31.2	47.1	0.4	2.0	16.0
16.00		(±3.11E-08)	(±1.2)	(±0.0)	(±0.0)	(±0.0)	(±6.0)	(±6.9)	(±21.4)	(±0.2)	(±0.9)	(±0.6)

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

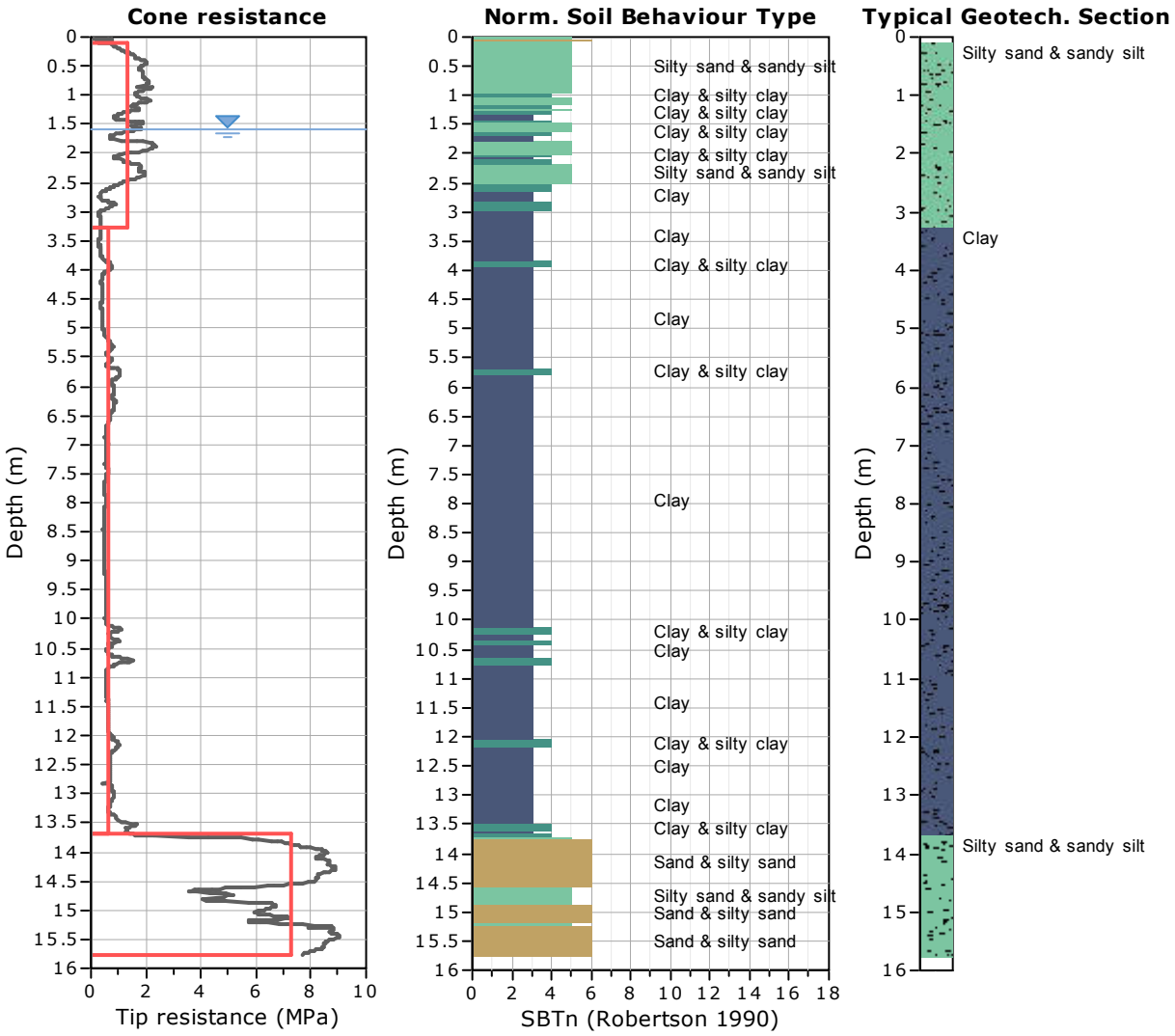
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Silty sand & sandy silt	1.3	7.60E-7	4.7	22.2	44.6	37.7	17.8	24.8	-	-	-	16.8
Clay	0.6	5.48E-9	3.4	25.2	-	-	3.9	22.3	34.8	0.5	2.4	15.7
Silty sand & sandy silt	7.2	1.07E-5	19.2	62.2	43.5	37.6	75.5	77.4	-	-	-	18.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.10 (m), **End depth:** 3.27 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 1.32 ±0.61 MPa	Permeability: 7.60E-07 ±8.56E-07 m/s	Constrained Mod.: 17.78 ±9.06 MPa
Sleeve friction: 33.51 ±18.31 kPa	N60: 4.67 ±1.68 blows	Go: 24.80 ±7.22 MPa
SBT_n: 5	Es: 22.23 ±4.67 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.60 ±9.37	Su ratio: 0.00 ±0.00
	ö (degrees): 37.65 ±2.05 °	O.C.R.: 0.00 ±0.00
	Unit weight: 16.84 ±1.02 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.27 (m), **End depth:** 13.70 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.63 ±0.21 MPa	Permeability: 5.48E-09 ±1.16E-08 m/s	Constrained Mod.: 3.92 ±3.21 MPa
Sleeve friction: 14.97 ±9.59 kPa	N60: 3.39 ±0.94 blows	Go: 22.26 ±5.48 MPa
SBT_n: 3	Es: 25.23 ±25.23 MPa	Su: 34.81 ±13.36 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.52 ±0.21
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 2.41 ±0.96
	Unit weight: 15.72 ±0.68 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 13.70 (m), **End depth:** 15.76 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 7.25 ±1.65 MPa	Permeability: 1.07E-05 ±6.27E-06 m/s	Constrained Mod.: 75.48 ±12.32 MPa
Sleeve friction: 54.16 ±11.53 kPa	N60: 19.24 ±3.16 blows	Go: 77.40 ±8.98 MPa
SBT_n: 6	Es: 62.17 ±6.32 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 43.48 ±5.13	Su ratio: 0.00 ±0.00
	ö (degrees): 37.55 ±1.23 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.29 ±0.35 kN/m³	

RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu12
Total depth: 15.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

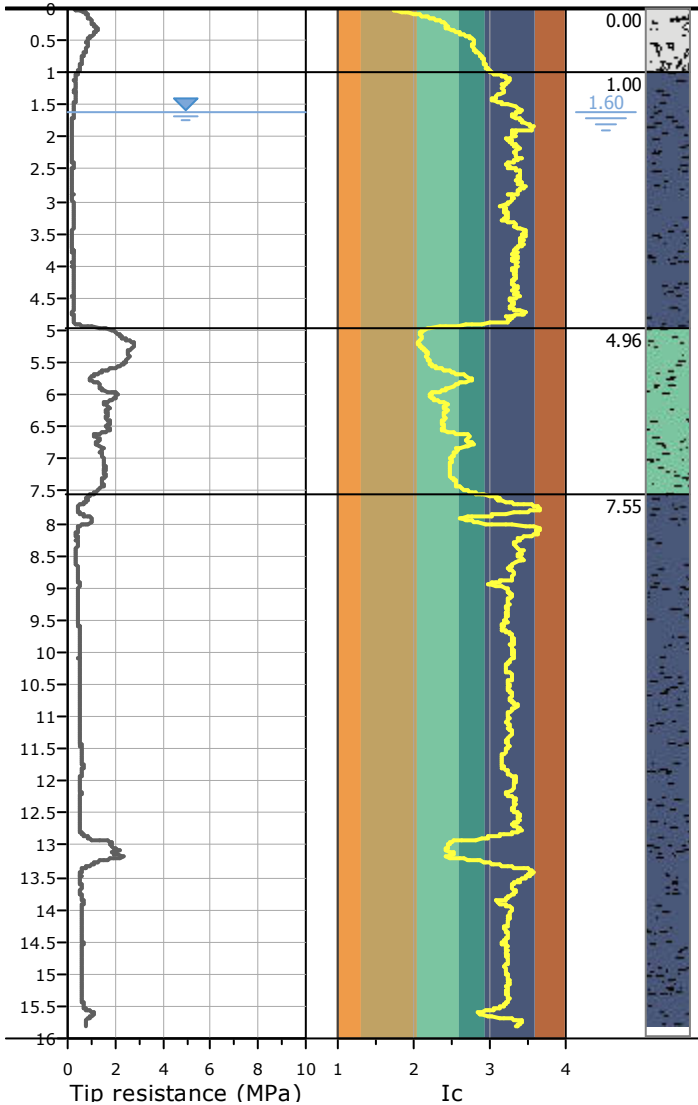
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.10	3.17	7.60E-07	4.7	22.2	44.6	37.7	17.8	24.8	0.0	0.0	0.0	16.8
3.27		(±8.56E-07)	(±1.7)	(±4.7)	(±9.4)	(±2.1)	(±9.1)	(±7.2)	(±0.0)	(±0.0)	(±0.0)	(±1.0)
3.27	10.43	5.48E-09	3.4	25.2	0.0	0.0	3.9	22.3	34.8	0.5	2.4	15.7
13.70		(±1.16E-08)	(±0.9)	(±25.2)	(±0.0)	(±0.0)	(±3.2)	(±5.5)	(±13.4)	(±0.2)	(±1.0)	(±0.7)
13.70	2.06	1.07E-05	19.2	62.2	43.5	37.6	75.5	77.4	0.0	0.0	0.0	18.3
15.76		(±6.27E-06)	(±3.2)	(±6.3)	(±5.1)	(±1.2)	(±12.3)	(±9.0)	(±0.0)	(±0.0)	(±0.0)	(±0.4)

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

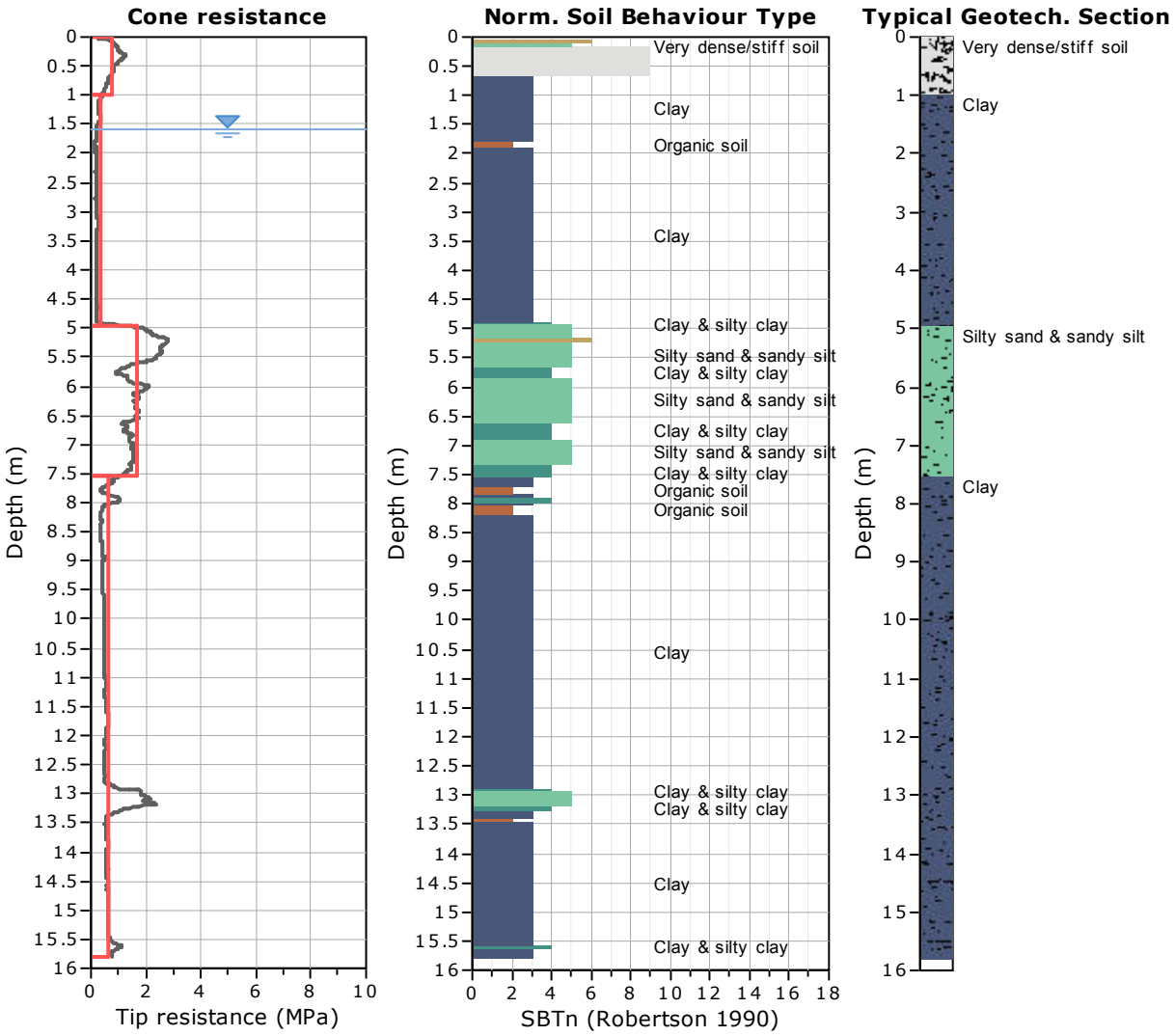
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu13
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Very dense/stiff soil	0.8	2.21E-6	3.2	16.7	-	-	10.7	20.0	56.7	5.1	23.7	17.4
Clay	0.3	2.03E-7	1.6	17.5	-	-	3.2	12.4	20.4	1.2	5.7	15.2
Silty sand & sandy silt	1.7	9.66E-7	5.9	23.7	29.1	33.7	22.1	29.8	-	-	-	16.5
Clay	0.6	1.26E-8	3.4	33.0	-	-	2.8	20.9	27.1	0.3	1.5	15.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 1.00 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 0.79 ±0.24 MPa
Sleeve friction: 61.03 ±28.57 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 2.21E-06 ±7.67E-06 m/s
N60: 3.22 ±0.86 blows
Es: 16.72 ±4.65 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 17.42 ±0.98 kN/m³
Constrained Mod.: 10.70 ±3.62 MPa
Go: 19.96 ±6.05 MPa
Su: 56.69 ±17.38 kPa
Su ratio: 5.13 ±2.60
O.C.R.: 23.70 ±11.99

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 4.96 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.35 ±0.26 MPa	Permeability: 2.03E-07 ±1.56E-06 m/s	Constrained Mod.: 3.19 ±4.37 MPa
Sleeve friction: 19.34 ±25.43 kPa	N60: 1.60 ±0.98 blows	Go: 12.44 ±4.91 MPa
SBT_n: 3	Es: 17.50 ±2.89 MPa	Su: 20.42 ±18.51 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 1.24 ±2.10
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 5.75 ±9.71
	Unit weight: 15.22 ±1.33 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 4.96 (m), **End depth:** 7.55 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 1.70 ±0.46 MPa	Permeability: 9.66E-07 ±1.28E-06 m/s	Constrained Mod.: 22.12 ±6.02 MPa
Sleeve friction: 18.26 ±5.25 kPa	N60: 5.95 ±0.97 blows	Go: 29.78 ±2.76 MPa
SBT_n: 5	Es: 23.71 ±2.25 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 29.09 ±3.76	Su ratio: 0.00 ±0.00
	ö (degrees): 33.71 ±1.20 °	O.C.R.: 0.00 ±0.00
	Unit weight: 16.47 ±0.35 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 7.55 (m), **End depth:** 15.81 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.61 ±0.30 MPa	Permeability: 1.26E-08 ±5.55E-08 m/s	Constrained Mod.: 2.78 ±4.71 MPa
Sleeve friction: 10.38 ±7.48 kPa	N60: 3.42 ±1.09 blows	Go: 20.86 ±5.32 MPa
SBT_n: 3	Es: 33.01 ±33.01 MPa	Su: 27.09 ±11.25 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.33 ±0.15
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.54 ±0.67
	Unit weight: 15.28 ±0.65 kN/m³	

RDR SrL
Bologna Via Toscana 119
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CPT: cptu13
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

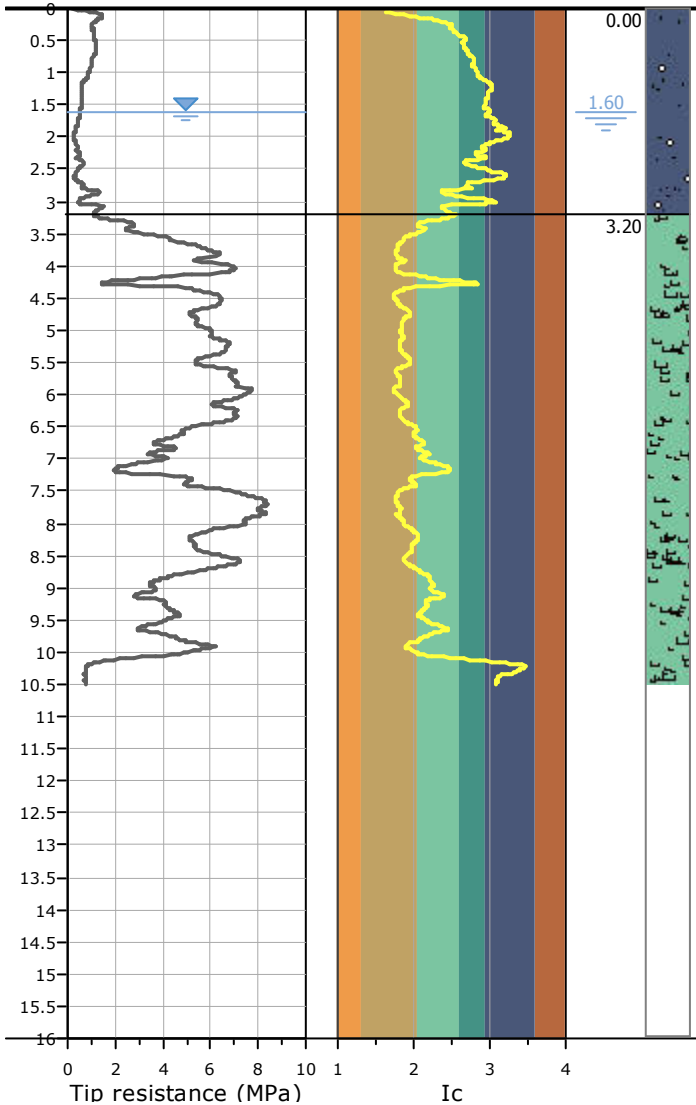
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	1.00	2.21E-06	3.2	16.7	0.0	0.0	10.7	20.0	56.7	5.1	23.7	17.4
1.00		(±7.67E-06)	(±0.9)	(±4.6)	(±0.0)	(±0.0)	(±3.6)	(±6.0)	(±17.4)	(±2.6)	(±12.0)	(±1.0)
1.00	3.96	2.03E-07	1.6	17.5	0.0	0.0	3.2	12.4	20.4	1.2	5.7	15.2
4.96		(±1.56E-06)	(±1.0)	(±2.9)	(±0.0)	(±0.0)	(±4.4)	(±4.9)	(±18.5)	(±2.1)	(±9.7)	(±1.3)
4.96	2.59	9.66E-07	5.9	23.7	29.1	33.7	22.1	29.8	0.0	0.0	0.0	16.5
7.55		(±1.28E-06)	(±1.0)	(±2.3)	(±3.8)	(±1.2)	(±6.0)	(±2.8)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
7.55	8.26	1.26E-08	3.4	33.0	0.0	0.0	2.8	20.9	27.1	0.3	1.5	15.3
15.81		(±5.55E-08)	(±1.1)	(±33.0)	(±0.0)	(±0.0)	(±4.7)	(±5.3)	(±11.2)	(±0.1)	(±0.7)	(±0.6)

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

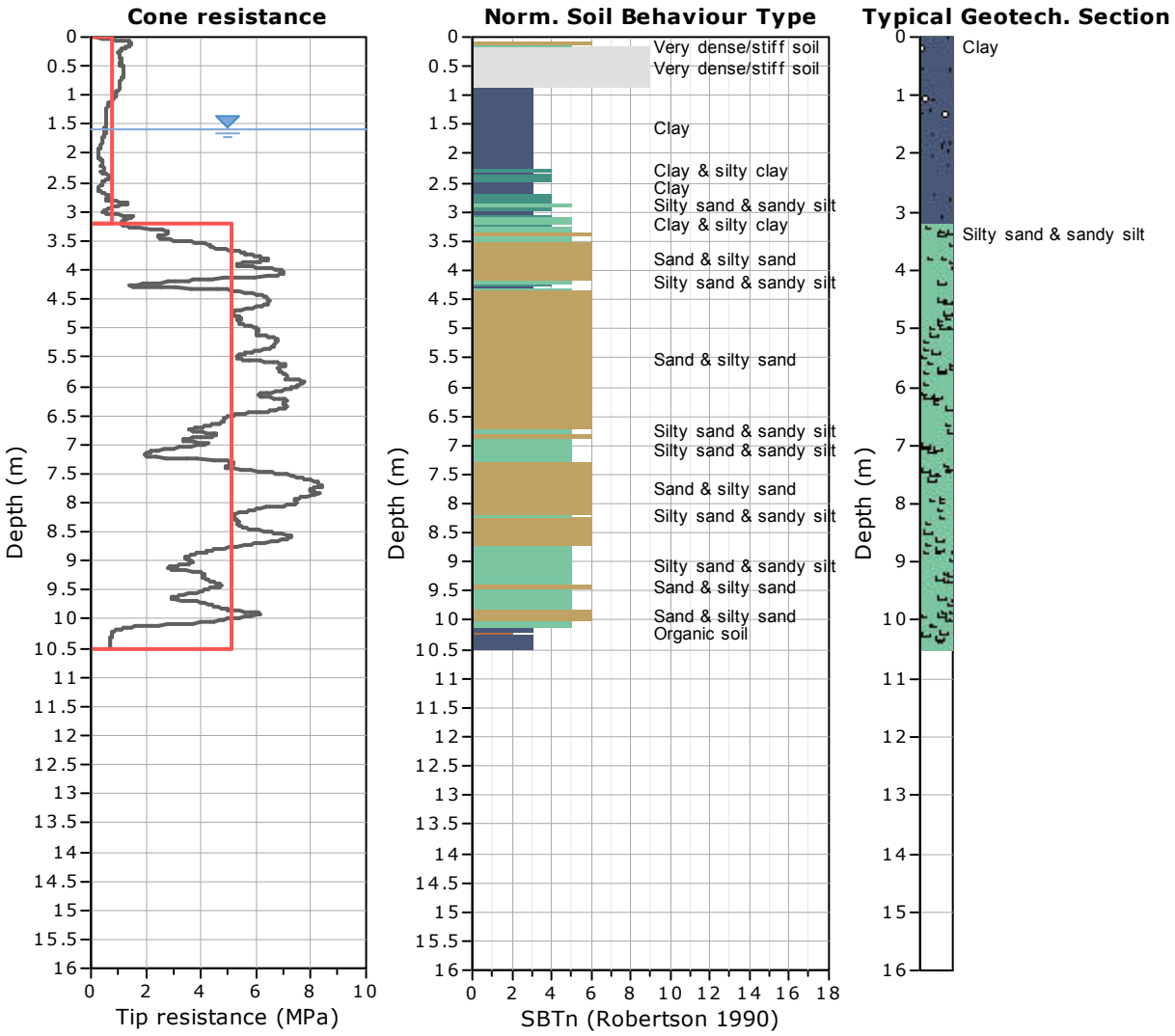
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay	0.7	1.03E-6	3.3	14.9	-	-	9.4	20.3	46.4	2.6	12.1	16.7
Silty sand & sandy silt	5.1	1.43E-5	13.4	44.4	44.1	37.6	51.6	54.4	-	-	-	17.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 3.20 (m)

Description: Clay

Basic results

Total cone resistance: 0.74 ±0.34 MPa
Sleeve friction: 40.41 ±34.50 kPa
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 1.03E-06 ±7.77E-06 m/s
N60: 3.28 ±1.08 blows
Es: 14.90 ±6.51 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 16.69 ±1.20 kN/m³
Constrained Mod.: 9.42 ±5.22 MPa
Go: 20.30 ±6.69 MPa
Su: 46.36 ±22.06 kPa
Su ratio: 2.61 ±2.50
O.C.R.: 12.06 ±11.53

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.20 (m), **End depth:** 10.50 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 5.09 ±1.86 MPa	Permeability: 1.43E-05 ±1.30E-05 m/s	Constrained Mod.: 51.57 ±15.08 MPa
Sleeve friction: 37.99 ±10.18 kPa	N60: 13.36 ±3.57 blows	Go: 54.43 ±9.85 MPa
SBT_n: 5	Es: 44.44 ±6.83 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.13 ±7.36	Su ratio: 0.00 ±0.00
	ö (degrees): 37.63 ±1.70 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.71 ±0.49 kN/m³	

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CPT: cptu14
Total depth: 10.50 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

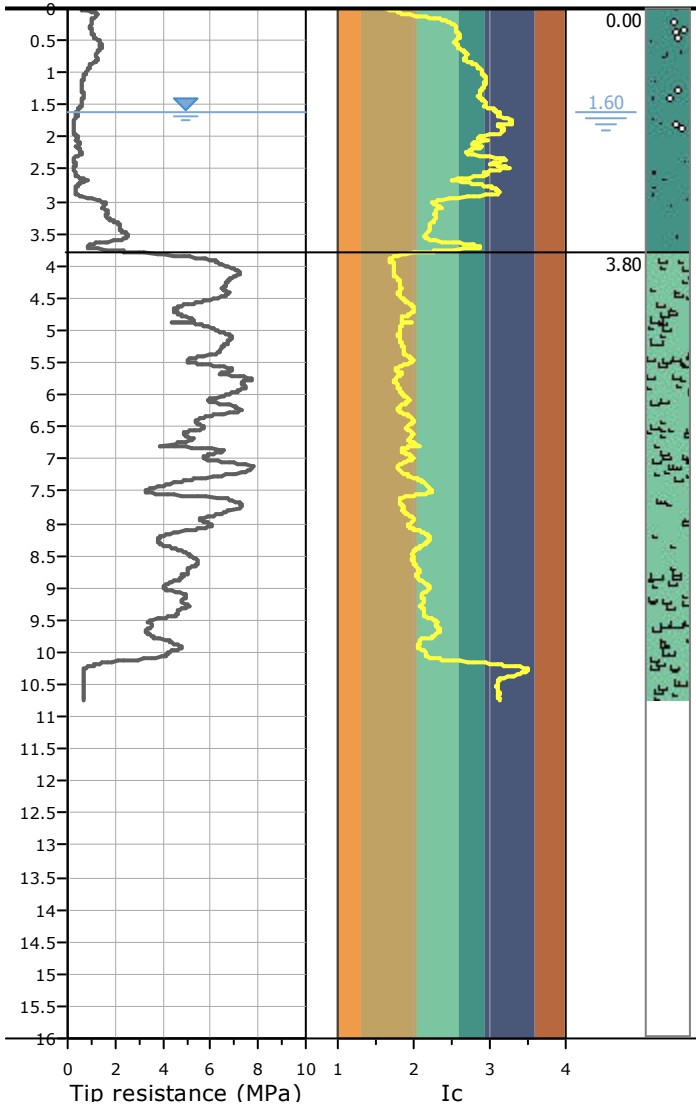
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	3.20	1.03E-06	3.3	14.9	0.0	0.0	9.4	20.3	46.4	2.6	12.1	16.7
3.20		(±7.77E-06)	(±1.1)	(±6.5)	(±0.0)	(±0.0)	(±5.2)	(±6.7)	(±22.1)	(±2.5)	(±11.5)	(±1.2)
3.20	7.30	1.43E-05	13.4	44.4	44.1	37.6	51.6	54.4	0.0	0.0	0.0	17.7
10.50		(±1.30E-05)	(±3.6)	(±6.8)	(±7.4)	(±1.7)	(±15.1)	(±9.9)	(±0.0)	(±0.0)	(±0.0)	(±0.5)

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

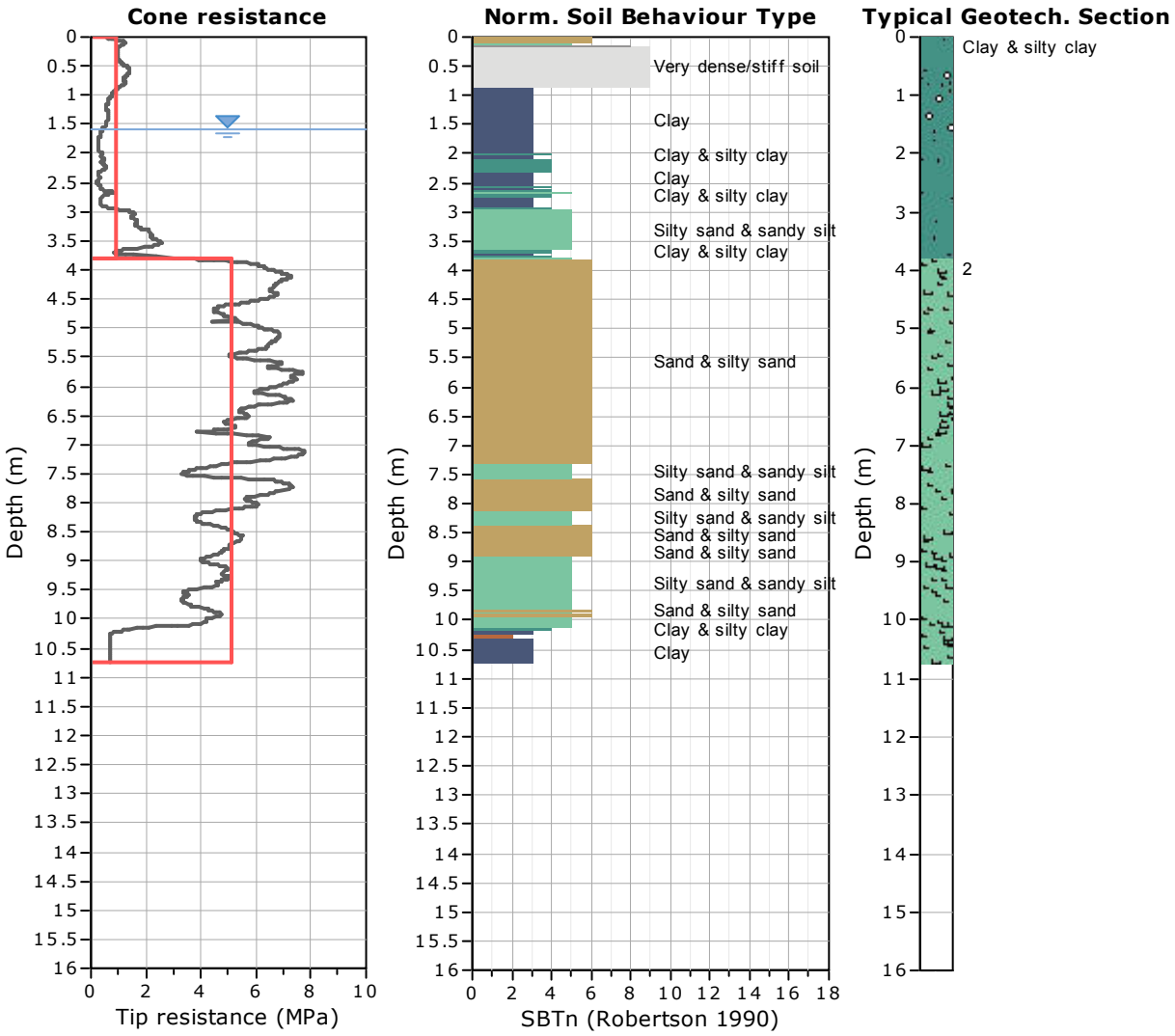
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.00	Clay & silty clay	0.9	1.39E-6	3.6	19.8	-	-	11.9	21.0	45.5	2.6	12.1	16.5
3.80	2	5.1	1.39E-5	13.5	45.8	44.8	37.8	52.2	55.0	-	-	-	17.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.00 (m), **End depth:** 3.80 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 0.93 ±0.62 MPa
Sleeve friction: 34.83 ±31.84 kPa
SBT_n: 4
SBTn description: Clay & silty clay

Estimation results

Permeability: 1.39E-06 ±7.51E-06 m/s
N60: 3.60 ±1.72 blows
Es: 19.78 ±4.22 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 16.47 ±1.22 kN/m³
Constrained Mod.: 11.94 ±8.82 MPa
Go: 21.03 ±7.85 MPa
Su: 45.48 ±25.51 kPa
Su ratio: 2.61 ±2.64
O.C.R.: 12.06 ±12.22

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 3.80 (m), **End depth:** 10.76 (m)

Description: 2

Basic results	**Estimation results**	
Total cone resistance: 5.11 ±1.77 MPa	Permeability: 1.39E-05 ±1.34E-05 m/s	Constrained Mod.: 52.24 ±16.03 MPa
Sleeve friction: 38.26 ±9.93 kPa	N60: 13.49 ±3.37 blows	Go: 55.03 ±9.53 MPa
SBT_n: 5	Es: 45.83 ±4.17 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 44.80 ±6.82	Su ratio: 0.00 ±0.00
	ö (degrees): 37.80 ±1.51 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.70 ±0.61 kN/m³	

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rocco.carbonella@fastwebnet.it

CPT: cptu15
Total depth: 10.76 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

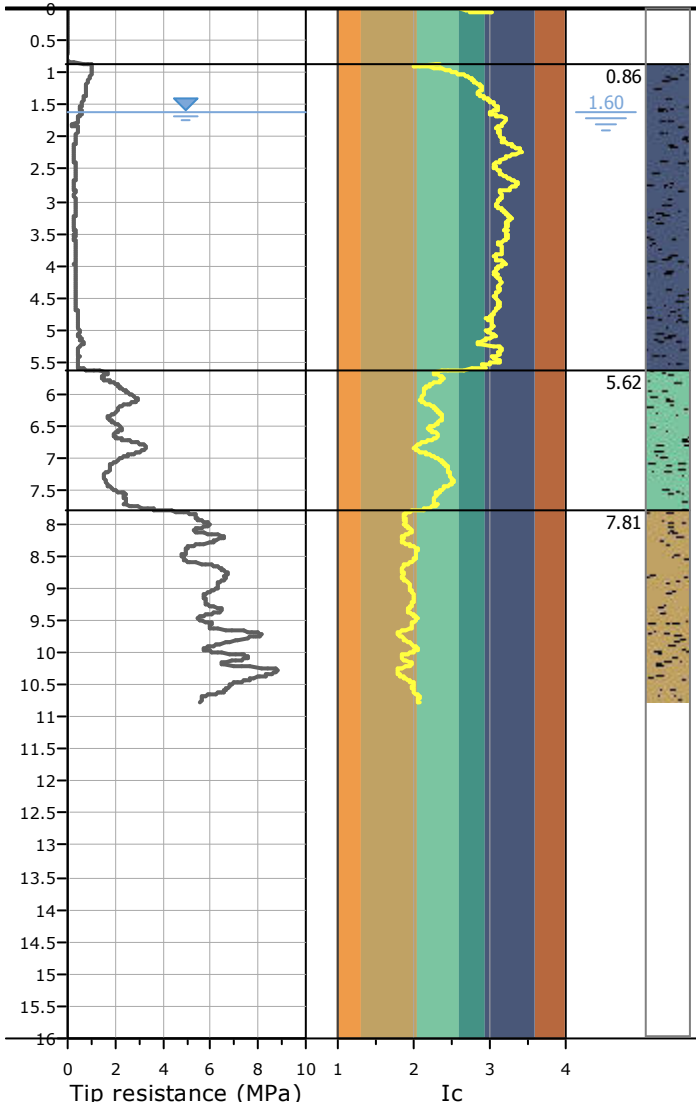
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.00	3.80	1.39E-06	3.6	19.8	0.0	0.0	11.9	21.0	45.5	2.6	12.1	16.5
3.80		(±7.51E-06)	(±1.7)	(±4.2)	(±0.0)	(±0.0)	(±8.8)	(±7.9)	(±25.5)	(±2.6)	(±12.2)	(±1.2)
3.80	6.96	1.39E-05	13.5	45.8	44.8	37.8	52.2	55.0	0.0	0.0	0.0	17.7
10.76		(±1.34E-05)	(±3.4)	(±4.2)	(±6.8)	(±1.5)	(±16.0)	(±9.5)	(±0.0)	(±0.0)	(±0.0)	(±0.6)

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

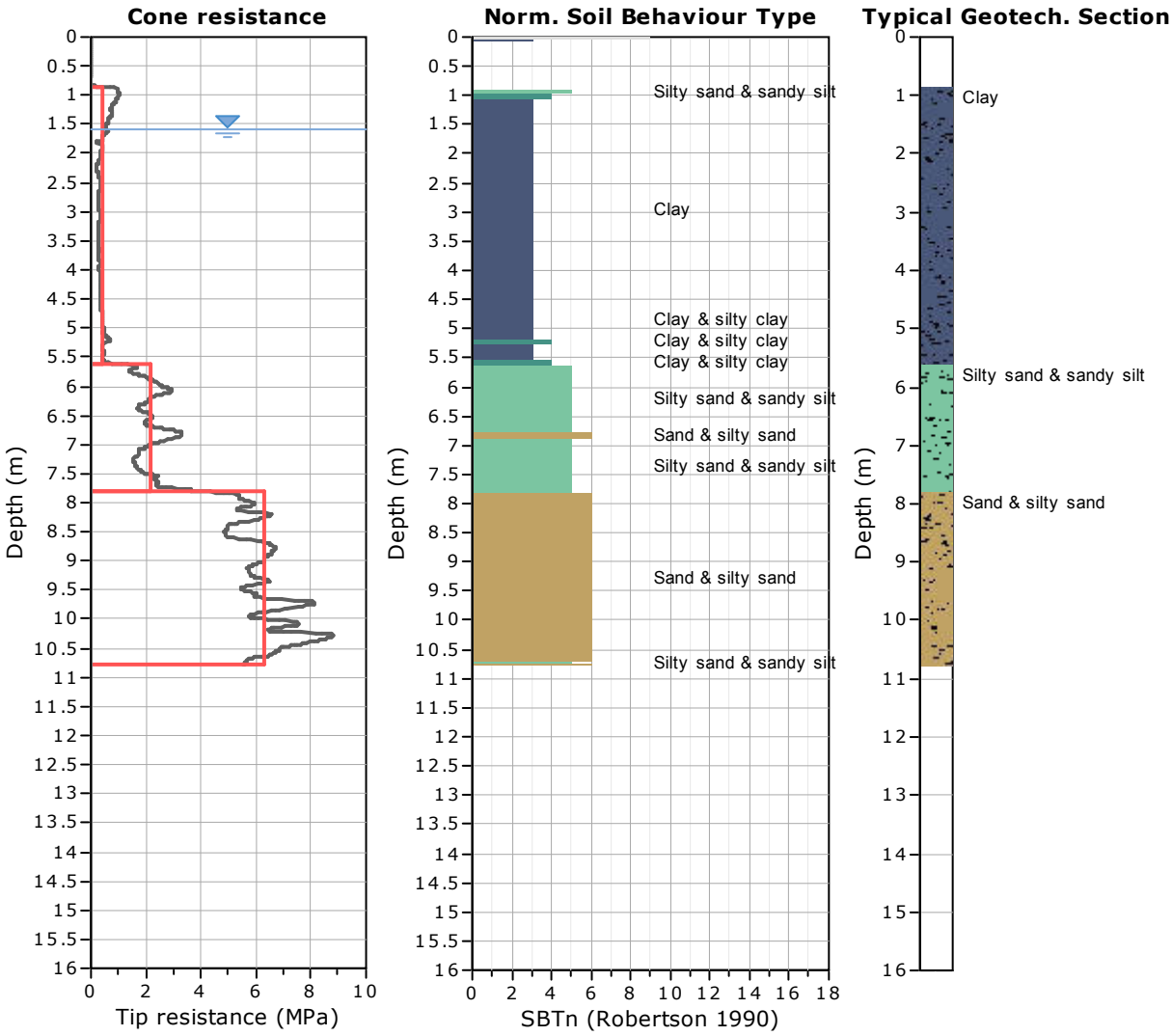
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay	0.4	2.67E-8	2.3	14.4	-	-	3.7	15.4	25.5	0.8	3.5	15.4
Silty sand & sandy silt	2.2	1.59E-6	7.0	26.2	29.8	34.0	28.5	32.9	-	-	-	16.5
Sand & silty sand	6.3	1.34E-5	16.2	50.7	45.4	38.0	63.6	63.6	-	-	-	18.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.86 (m), **End depth:** 5.62 (m)

Description: Clay

Basic results

Total cone resistance: 0.43 ±0.19 MPa
Sleeve friction: 15.65 ±14.44 kPa
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 2.67E-08 ±2.10E-07 m/s
N60: 2.29 ±0.66 blows
Es: 14.44 ±4.04 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 15.45 ±0.92 kN/m³
Constrained Mod.: 3.69 ±3.39 MPa
Go: 15.36 ±4.24 MPa
Su: 25.54 ±12.52 kPa
Su ratio: 0.76 ±0.60
O.C.R.: 3.52 ±2.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 5.62 (m), **End depth:** 7.81 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 2.19 ±0.53 MPa	Permeability: 1.59E-06 ±1.57E-06 m/s	Constrained Mod.: 28.47 ±6.26 MPa
Sleeve friction: 16.55 ±3.99 kPa	N60: 7.03 ±1.27 blows	Go: 32.88 ±4.22 MPa
SBT_n: 5	Es: 26.24 ±3.36 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Silty sand & sandy silt	Dr (%): 29.80 ±3.30	Su ratio: 0.00 ±0.00
	ö (degrees): 33.96 ±1.05 °	O.C.R.: 0.00 ±0.00
	Unit weight: 16.47 ±0.33 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 7.81 (m), **End depth:** 10.78 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 6.28 ±0.92 MPa	Permeability: 1.34E-05 ±7.10E-06 m/s	Constrained Mod.: 63.60 ±6.60 MPa
Sleeve friction: 43.28 ±8.14 kPa	N60: 16.15 ±1.92 blows	Go: 63.60 ±6.60 MPa
SBT_n: 6	Es: 50.74 ±5.27 MPa	Su: 0.00 ±0.00 kPa
SBTn description: Sand & silty sand	Dr (%): 45.37 ±2.63	Su ratio: 0.00 ±0.00
	ö (degrees): 38.02 ±0.55 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.00 ±0.26 kN/m³	

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Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu16
Total depth: 10.78 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

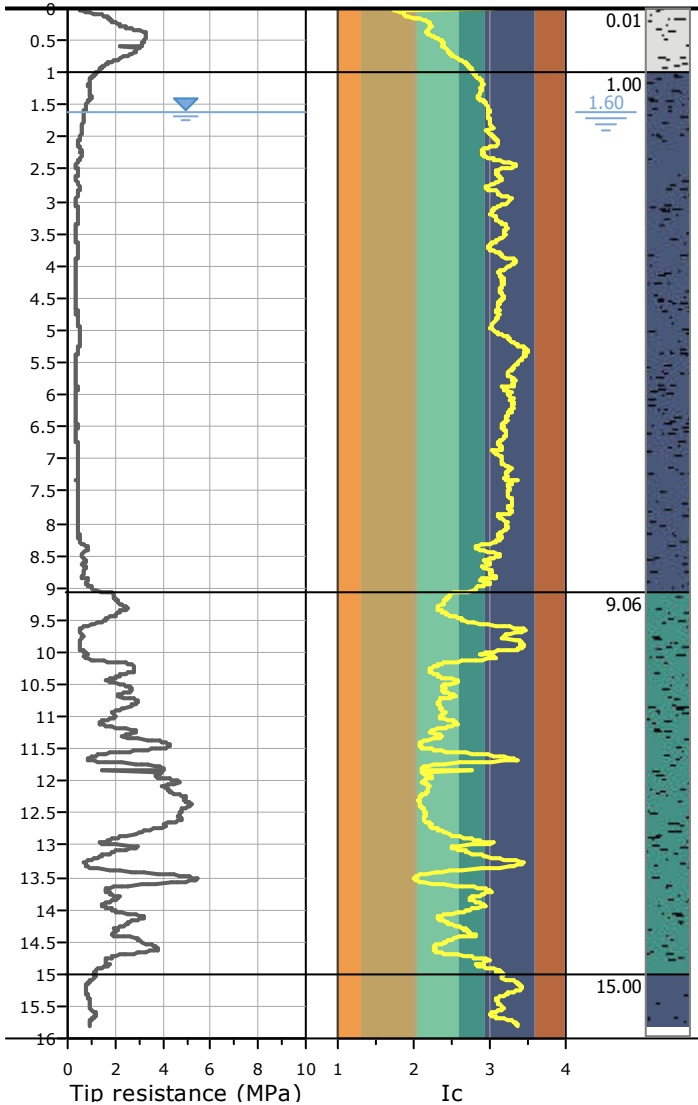
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.86	4.76	2.67E-08	2.3	14.4	0.0	0.0	3.7	15.4	25.5	0.8	3.5	15.4
5.62		(±2.10E-07)	(±0.7)	(±4.0)	(±0.0)	(±0.0)	(±3.4)	(±4.2)	(±12.5)	(±0.6)	(±2.8)	(±0.9)
5.62	2.19	1.59E-06	7.0	26.2	29.8	34.0	28.5	32.9	0.0	0.0	0.0	16.5
7.81		(±1.57E-06)	(±1.3)	(±3.4)	(±3.3)	(±1.0)	(±6.3)	(±4.2)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
7.81	2.97	1.34E-05	16.2	50.7	45.4	38.0	63.6	63.6	0.0	0.0	0.0	18.0
10.78		(±7.10E-06)	(±1.9)	(±5.3)	(±2.6)	(±0.5)	(±6.6)	(±6.6)	(±0.0)	(±0.0)	(±0.0)	(±0.3)

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

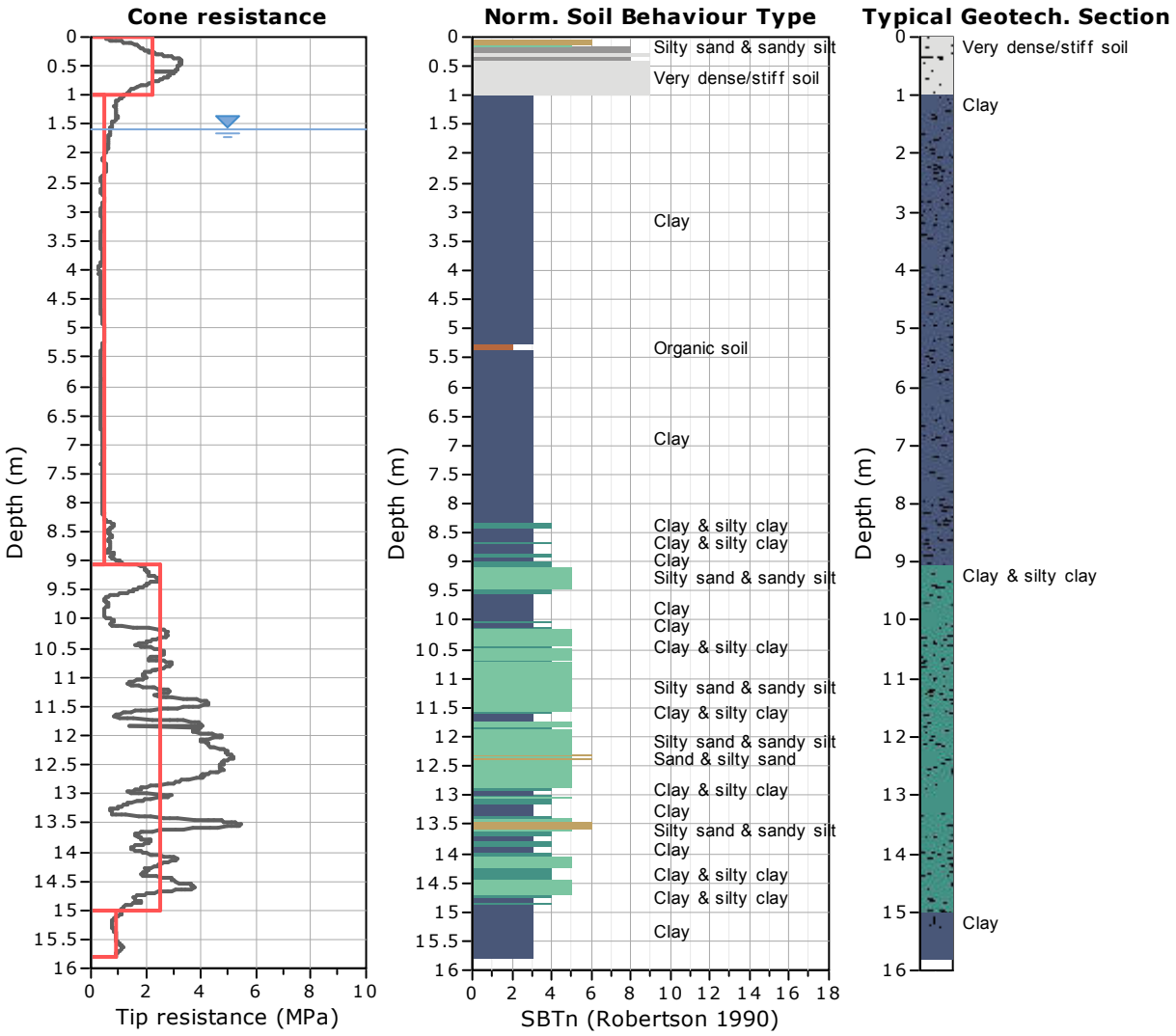
RDR SrL
Bologna Via Toscana 119
rocco.carbonella@fastwebnet.it

CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.01	Very dense/stiff soil	2.2	3.78E-6	7.7	41.4	-	-	30.4	40.7	172.5	9.9	45.8	18.5
1.00	Clay	0.5	4.64E-9	2.6	-	-	-	3.6	17.9	28.5	0.7	3.2	15.6
9.06	Clay & silty clay	2.5	9.46E-7	8.8	36.2	-	-	30.7	44.9	86.7	0.9	4.1	17.0
15.00	Clay	0.9	2.20E-9	5.5	-	-	-	4.2	35.6	48.9	0.4	1.9	16.5



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.01 (m), **End depth:** 1.00 (m)

Description: Very dense/stiff soil

Basic results

Total cone resistance: 2.23 ±0.80 MPa
Sleeve friction: 133.52 ±65.55 kPa
SBT_n: 9
SBTn description: Very dense/stiff soil

Estimation results

Permeability: 3.78E-06 ±8.21E-06 m/s
N60: 7.65 ±2.78 blows
Es: 41.42 ±5.88 MPa
Dr (%): 0.00 ±0.00
ö (degrees): 0.00 ±0.00 °
Unit weight: 18.55 ±1.36 kN/m³
Constrained Mod.: 30.42 ±12.37 MPa
Go: 40.69 ±15.46 MPa
Su: 172.47 ±49.76 kPa
Su ratio: 9.90 ±3.63
O.C.R.: 45.75 ±16.77

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 9.06 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.48 ±0.18 MPa	Permeability: 4.64E-09 ±5.52E-09 m/s	Constrained Mod.: 3.61 ±3.34 MPa
Sleeve friction: 17.57 ±19.06 kPa	N60: 2.60 ±0.79 blows	Go: 17.95 ±5.09 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 28.46 ±13.45 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.69 ±0.61
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 3.20 ±2.81
	Unit weight: 15.57 ±0.97 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 9.06 (m), **End depth:** 15.00 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.49 ±1.27 MPa	Permeability: 9.46E-07 ±1.37E-06 m/s	Constrained Mod.: 30.72 ±17.41 MPa
Sleeve friction: 28.52 ±11.07 kPa	N60: 8.80 ±2.99 blows	Go: 44.88 ±10.73 MPa
SBT_n: 4	Es: 36.20 ±6.36 MPa	Su: 86.73 ±41.04 kPa
SBTn description: Clay & silty clay	Dr (%): 0.00 ±0.00	Su ratio: 0.90 ±0.39
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 4.14 ±1.80
	Unit weight: 17.04 ±0.61 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 15.00 (m), **End depth:** 15.81 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.94 ±0.13 MPa	Permeability: 2.20E-09 ±1.51E-09 m/s	Constrained Mod.: 4.15 ±1.54 MPa
Sleeve friction: 22.75 ±8.21 kPa	N60: 5.52 ±0.53 blows	Go: 35.59 ±4.61 MPa
SBT_n: 3	Es: 0.00 ±0.00 MPa	Su: 48.86 ±8.99 kPa
SBTn description: Clay	Dr (%): 0.00 ±0.00	Su ratio: 0.42 ±0.08
	ö (degrees): 0.00 ±0.00 °	O.C.R.: 1.94 ±0.36
	Unit weight: 16.47 ±0.47 kN/m³	

RDR SrL
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CPT: cptu17
Total depth: 15.81 m, Date: 13/02/2026
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Impianto fotovoltaico Fiscaglia**
Location: **Fiscaglia (FE)**

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.01	0.99	3.78E-06	7.7	41.4	0.0	0.0	30.4	40.7	172.5	9.9	45.8	18.5
1.00		(±8.21E-06)	(±2.8)	(±5.9)	(±0.0)	(±0.0)	(±12.4)	(±15.5)	(±49.8)	(±3.6)	(±16.8)	(±1.4)
1.00	8.06	4.64E-09	2.6	0.0	0.0	0.0	3.6	17.9	28.5	0.7	3.2	15.6
9.06		(±5.52E-09)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±3.3)	(±5.1)	(±13.5)	(±0.6)	(±2.8)	(±1.0)
9.06	5.94	9.46E-07	8.8	36.2	0.0	0.0	30.7	44.9	86.7	0.9	4.1	17.0
15.00		(±1.37E-06)	(±3.0)	(±6.4)	(±0.0)	(±0.0)	(±17.4)	(±10.7)	(±41.0)	(±0.4)	(±1.8)	(±0.6)
15.00	0.81	2.20E-09	5.5	0.0	0.0	0.0	4.2	35.6	48.9	0.4	1.9	16.5
15.81		(±1.51E-09)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±1.5)	(±4.6)	(±9.0)	(±0.1)	(±0.4)	(±0.5)

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

TAGLIO DIRETTO IN SCATOLA CASAGRANDE

Obiettivo di questa prova è determinare le caratteristiche di resistenza a taglio di un terreno in condizioni drenate, mediante interpretazione della relazione t:s' nel piano di Mohr. Una prova completa viene eseguita su almeno tre provini consolidati a tensioni σ'v diverse. I provini adoperati sono in genere prismatici a sezione quadrata (ma talora anche cilindrici). Per l'impossibilità di prevenire o comunque di controllare il drenaggio questa prova è sempre consolidata – drenata. Le modalità di interpretazione risentono di alcune limitazioni intrinseche dell'apparecchiatura, e cioè:

- la superficie di rottura è predeterminata;
- le tensioni orizzontali al contorno non sono misurabili, pertanto sia i cerchi di Mohr che i percorsi tensionali sono ignoti fino alla rottura;
- le deformazioni tangenziali (concentrate intorno alla superficie di rottura) non sono deducibili dagli spostamenti orizzontali misurati.

Ne deriva che la prova di taglio diretto è interpretabile solo in termini di relazione τ:σ' in condizioni di rottura.

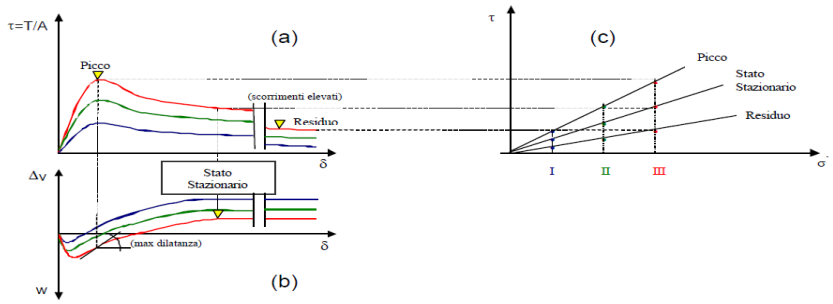


Figura 1 - Risultati di una prova di taglio in termini di relazioni tensione-scorrimento (a), cedimento-scorrimento (b) e tensioni limite nel piano di Mohr (c).

Malgrado la non uniforme distribuzione di tensioni tangenziali lungo la sezione trasversale del provino, nell'interpretazione il rapporto T/A viene indicato come "valore nominale di τ".

I risultati sono quindi rappresentabili attraverso curve τ:d e w:d associabili a ciascun valore della tensione di consolidazione σ'v applicata. Per ciascun provino, sono in linea di principio determinabili tre distinti valori della tensione tangenziale di rottura τf:

- la resistenza di picco τp (corrispondente al valore massimo τmax);
- la resistenza di stato stazionario τ_{ss} (corrispondente alle condizioni di stazionarietà di w, cioè 'a volume costante');
- la resistenza residua τ_r (corrispondente a scorrimenti d elevati).

Riportando le relative coppie di valori (σ',τ) sul piano di Mohr, sono di conseguenza determinabili (p. es. mediante regressione lineare) i parametri di resistenza a rottura.

Si riportano di seguito i risultati delle prove geotecniche di laboratorio eseguite.

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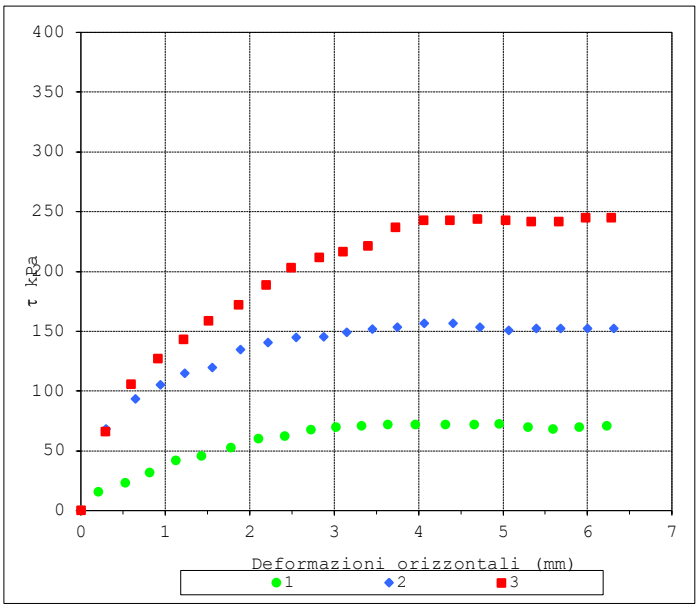
Dott. Rocco Carbonella
Via Toscana 119, 40141 Bologna
CLL 393 8376620
mail: rocco.carbonella@fastwebnet.it

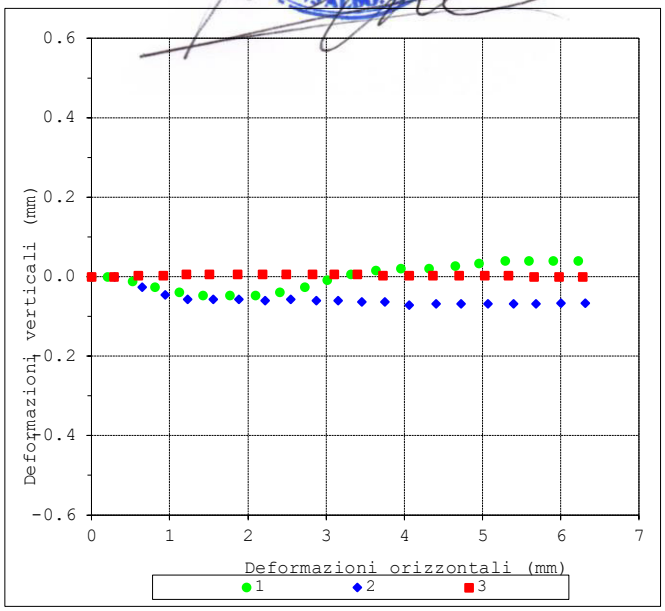
PROVA DI TAGLIO DIRETTO

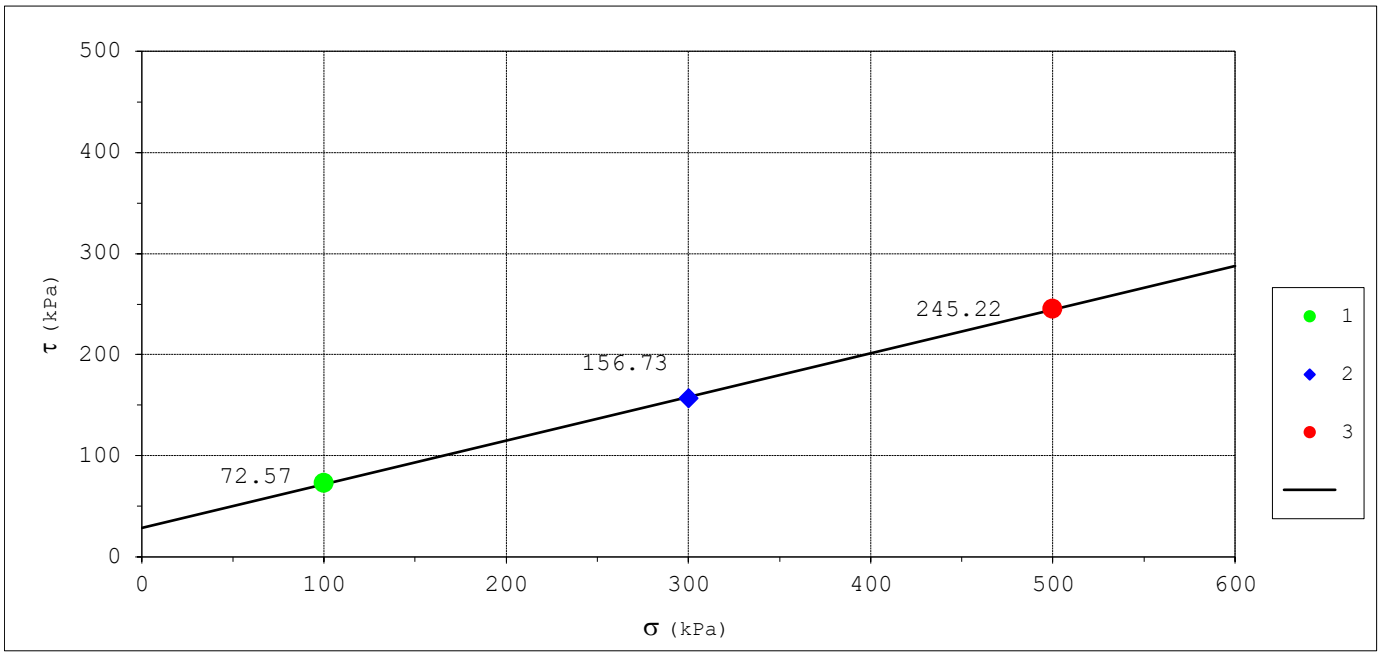
Norma di riferimento: UNI CEN ISO/TS 17892-10

Committente:	NRG Plus S.r.l.
Località:	Fiscaglia
Cantiere:	Fiscaglia SE
Sondaggio:	S1
Campione:	C1
Profondità:	0.50-1.00
Data:	Febbraio 2026

Sperimentatore:







Provino	n°	1	2	3
Deformazione a rottura	mm	4.96	4.41	6.28
Sforzo a rottura	kPa	72.57	156.73	245.22
Velocità di taglio:	mm/min	0.0100	0.0100	0.0100
c'	**KPa**	**28.69**		
ϕ'	**° sess**	**23.35**		

NOTE:

Certificato ai sensi del DPR 328/2001 art. 41 lettera L

Dott. Rocco Carbonella
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mail: rocco.carbonella@fastwebnet.it

PROVA DI TAGLIO DIRETTO

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.21	15.90
-0.01	0.53	23.50
-0.03	0.81	31.79
-0.04	1.13	42.16
-0.05	1.43	45.62
-0.05	1.77	52.53
-0.05	2.10	60.13
-0.04	2.41	62.21
-0.03	2.73	67.74
-0.01	3.02	69.81
0.01	3.32	71.19
0.01	3.63	71.88
0.02	3.96	71.88
0.02	4.32	71.88
0.03	4.66	71.88
0.03	4.96	72.57
0.04	5.29	69.81
0.04	5.59	68.43
0.04	5.90	69.81
0.04	6.23	71.19

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.30	68.52
-0.03	0.65	93.36
-0.04	0.95	105.35
-0.06	1.23	114.77
-0.06	1.55	119.91
-0.06	1.89	134.47
-0.06	2.22	140.46
-0.06	2.55	144.74
-0.06	2.87	145.60
-0.06	3.15	149.03
-0.06	3.45	151.60
-0.06	3.75	153.31
-0.07	4.07	156.73
-0.07	4.41	156.73
-0.07	4.73	153.31
-0.07	5.07	150.74
-0.07	5.39	152.45
-0.07	5.69	152.45
-0.07	6.00	152.45
-0.07	6.31	152.45

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.29	66.11
0.00	0.60	105.78
0.00	0.91	127.42
0.01	1.21	143.05
0.01	1.51	158.67
0.01	1.87	171.90
0.01	2.19	188.72
0.01	2.49	203.15
0.01	2.82	211.56
0.01	3.11	216.37
0.01	3.40	221.18
0.00	3.73	236.81
0.00	4.06	242.82
0.00	4.37	242.82
0.00	4.70	244.02
0.00	5.03	242.82
0.00	5.33	241.62
0.00	5.66	241.62
0.00	5.98	245.22
0.00	6.28	245.22

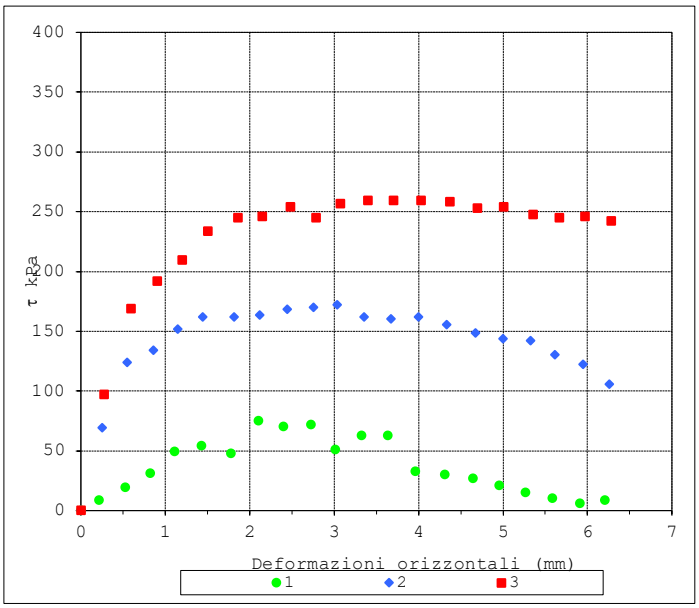
Dott. Rocco Carbonella
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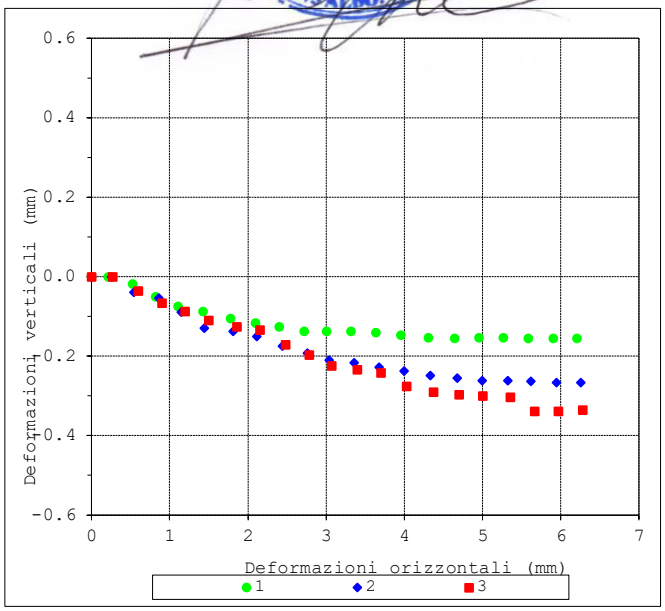
PROVA DI TAGLIO DIRETTO

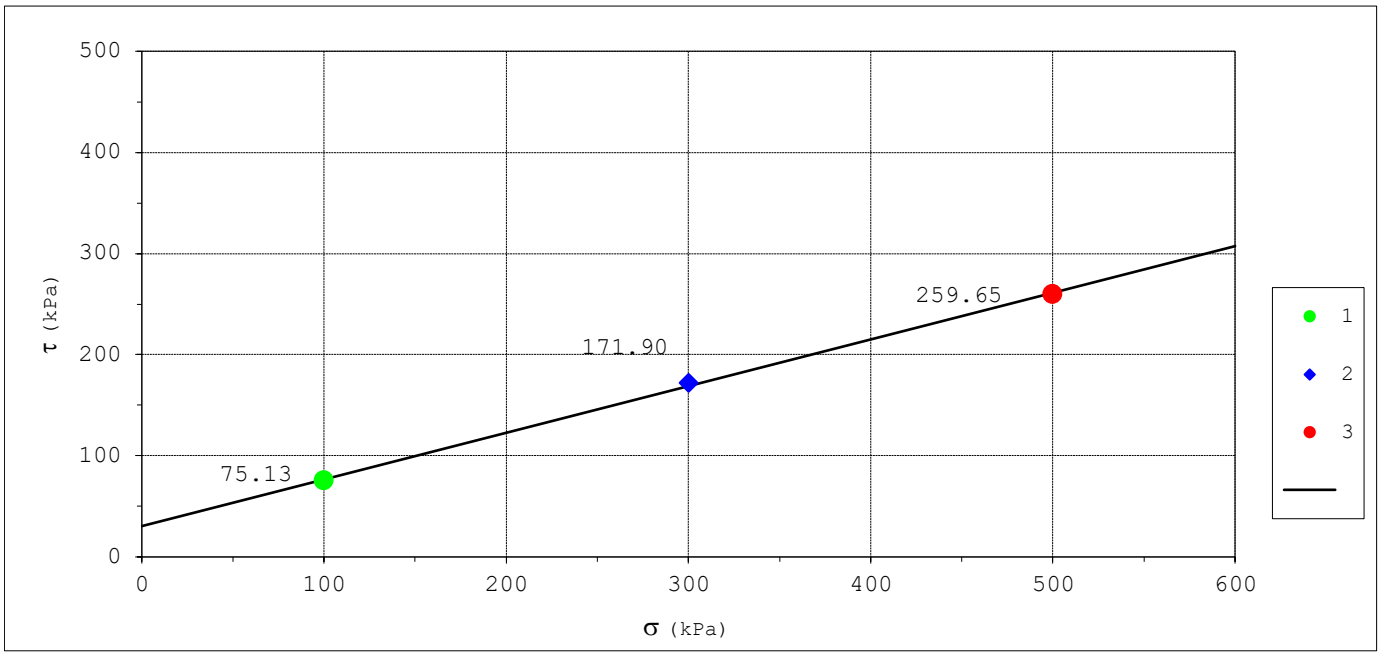
Norma di riferimento: UNI CEN ISO/TS 17892-10

Committente:	NRG Plus S.r.l.
Località:	Fiscaglia
Cantiere:	Fiscaglia SE
Sondaggio:	S2
Campione:	C1
Profondità:	0.50-1.00
Data:	Febbraio 2026

Sperimentatore:







Provino	n°	1	2	3
Deformazione a rottura	mm	2.10	3.04	4.03
Sforzo a rottura	kPa	75.13	171.90	259.65
Velocità di taglio:	mm/min	0.0100	0.0100	0.0100
c'	**KPa**	**30.50**		
ϕ'	**° sess**	**24.76**		

NOTE:

Dott. Rocco Carbonella
Via Toscana 119, 40141 Bologna
CLL 393 8376620
mail: rocco.carbonella@fastwebnet.it

PROVA DI TAGLIO DIRETTO

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.21	9.02
-0.02	0.52	19.53
-0.05	0.82	31.55
-0.07	1.11	49.59
-0.09	1.43	54.09
-0.11	1.78	48.08
-0.12	2.10	75.13
-0.13	2.40	70.62
-0.14	2.72	72.12
-0.14	3.01	51.09
-0.14	3.32	63.11
-0.14	3.63	63.11
-0.15	3.96	33.06
-0.15	4.31	30.05
-0.16	4.64	27.05
-0.15	4.96	21.04
-0.15	5.27	15.03
-0.16	5.58	10.52
-0.16	5.91	6.01
-0.16	6.20	9.02

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.25	69.42
-0.04	0.55	123.96
-0.05	0.86	133.88
-0.09	1.15	152.06
-0.13	1.45	161.98
-0.14	1.81	161.98
-0.15	2.12	163.63
-0.17	2.44	168.59
-0.19	2.76	170.24
-0.21	3.04	171.90
-0.22	3.36	161.98
-0.23	3.68	160.33
-0.24	4.00	161.98
-0.25	4.34	155.37
-0.26	4.67	148.76
-0.26	5.00	143.80
-0.26	5.33	142.14
-0.26	5.62	130.57
-0.27	5.95	122.31
-0.27	6.26	105.78

def. Vert,	def. Oriz.	Sf.
mm	mm	Kpa
0.00	0.00	0.00
0.00	0.28	97.37
-0.04	0.60	169.04
-0.07	0.91	192.03
-0.09	1.20	209.61
-0.11	1.50	233.95
-0.13	1.86	244.77
-0.14	2.15	246.12
-0.17	2.48	254.24
-0.20	2.79	244.77
-0.23	3.07	256.94
-0.23	3.40	259.65
-0.24	3.71	259.65
-0.28	4.03	259.65
-0.29	4.37	258.29
-0.30	4.70	252.88
-0.30	5.01	254.24
-0.30	5.36	247.48
-0.34	5.66	244.77
-0.34	5.97	246.12
-0.34	6.28	242.07



Figura 1 – Prova penetrometrica CPTU1



Figura 2 – Prova penetrometrica CPTU2



Figura 3 – Prova penetrometrica CPTU3



Figura 4 – Prova penetrometrica CPTU5



Figura 5 – Prova penetrometrica CPTU6

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Figura 6 – Prova penetrometrica CPTU7



Figura 7 – Prova penetrometrica CPTU8



Figura 8 – Prova penetrometrica CPTU9



Figura 9 – Prova penetrometrica CPTU10



Figura 10 – Prova penetrometrica CPTU11

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Figura 11 – Prova penetrometrica CPTU12



Figura 12 – Prova penetrometrica CPTU13



Figura 13 – Prova penetrometrica CPTU14



Figura 14 – Prova penetrometrica CPTU15



Figura 15 – Prova penetrometrica CPTU16

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Figura 16 – Prova penetrometrica CPTU17



Figura 17 – Prova sismica HVSR1



Figura 18 – Prova sismica HVSR2



Figura 19 – Prova sismica HVSR3

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Figura 20 – Prova sismica MASW/Re.Mi.1



Figura 21 – Prova sismica MASW/Re.Mi.2



Figura 22 – Prova sismica MASW/Re.Mi.4

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