Rifacimento metanodotto Livorno - Piombino

DN 750 (30"), DP 75 bar

ed opere connesse

CARATTERIZZAZIONE DELLA SISMICITÀ

E

VERIFICA ALLO SCUOTIMENTO SISMICO

ALLEGATO 5

Pieramelio Baldelli

Signed
24/03/2022

ORDINE DEI GEOLOGI DELLE MARCHE
Pieramelio BALDELLI
Geologo Specialista
N. 206
ALBO SEZIONE A

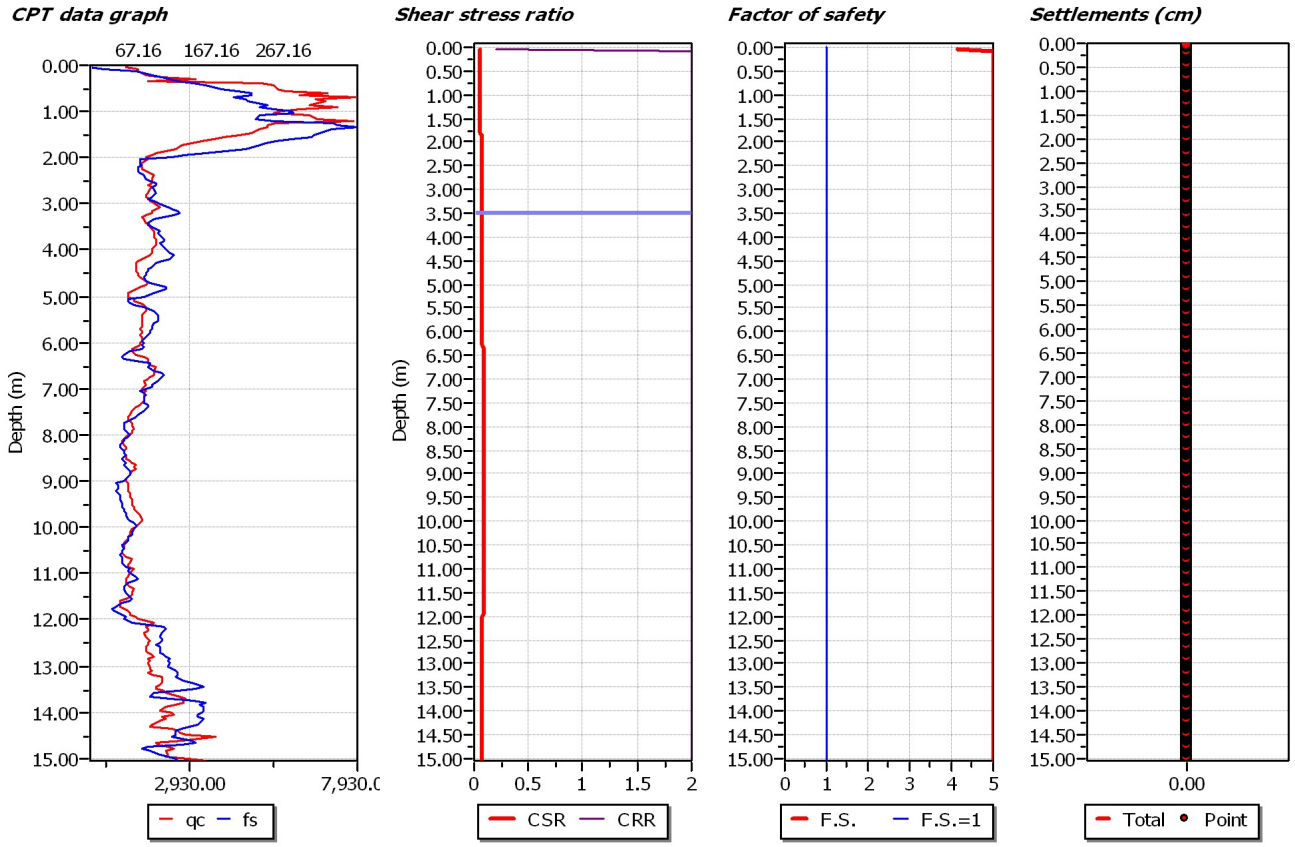
LIQUEFACTION ANALYSIS REPORT

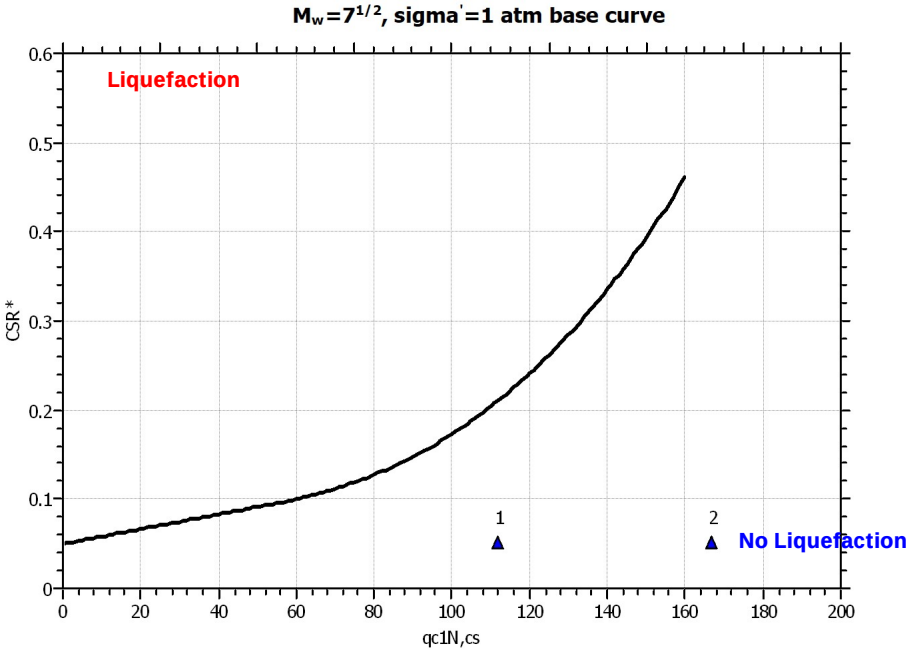
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C02

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	3.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.75
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





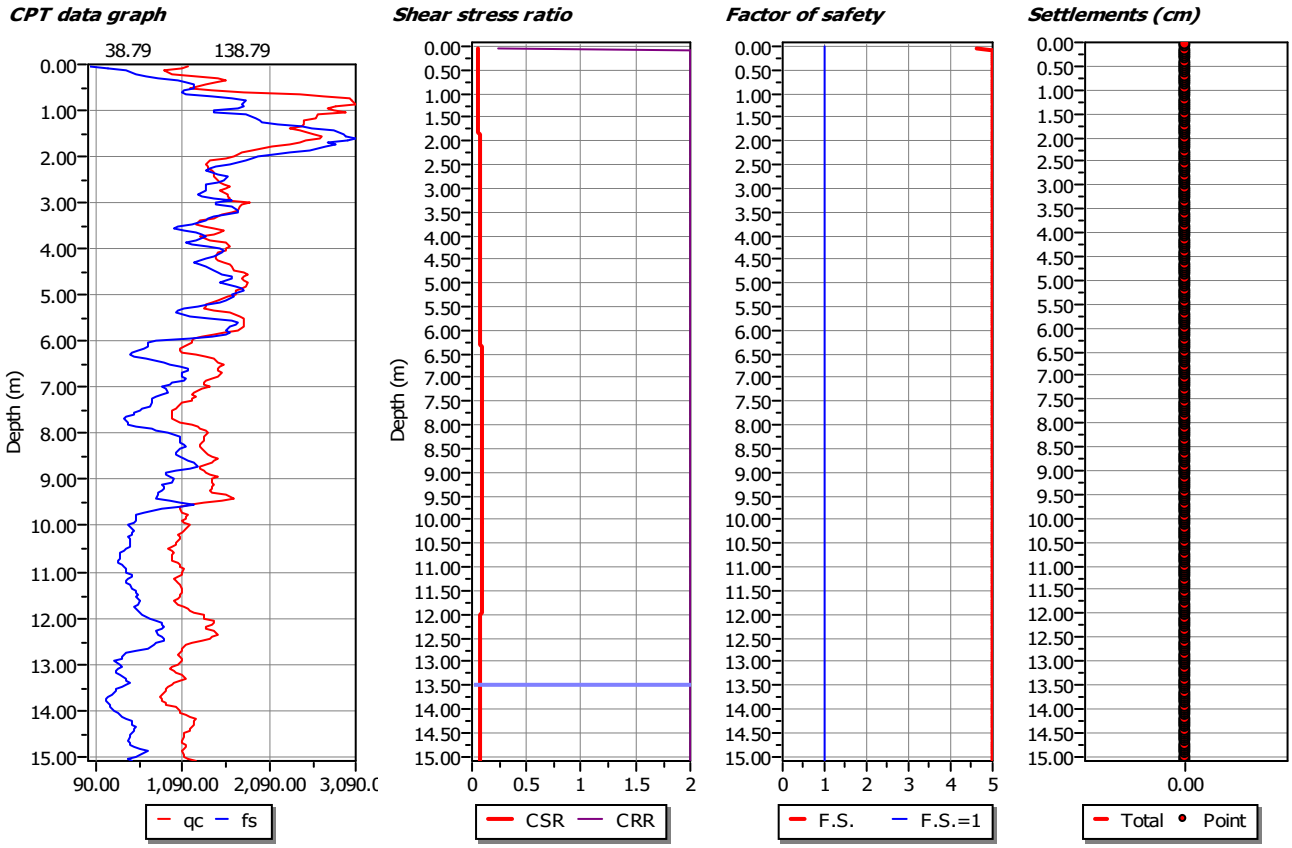
LIQUEFACTION ANALYSIS REPORT

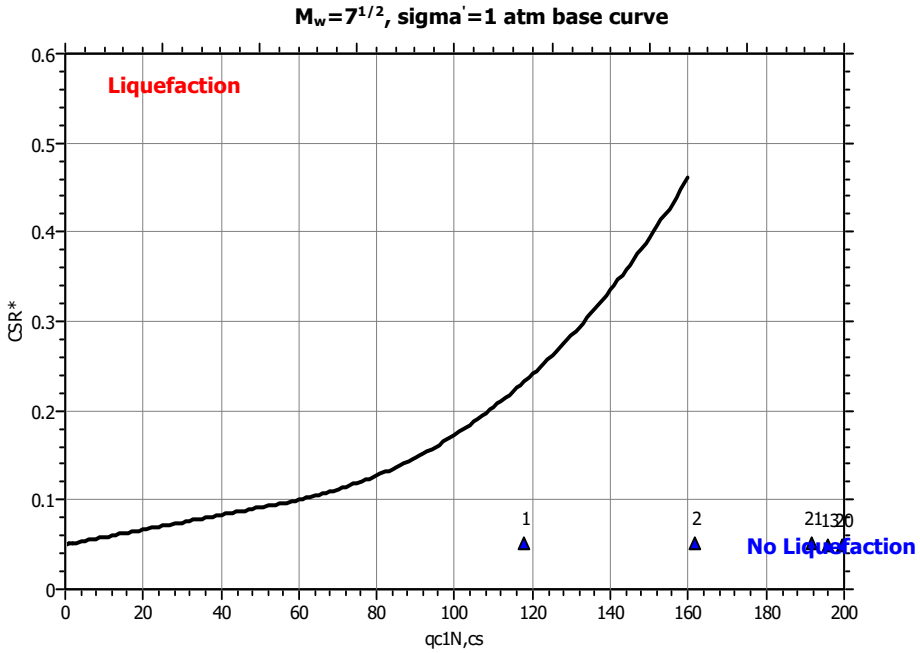
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C03

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	13.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.75
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





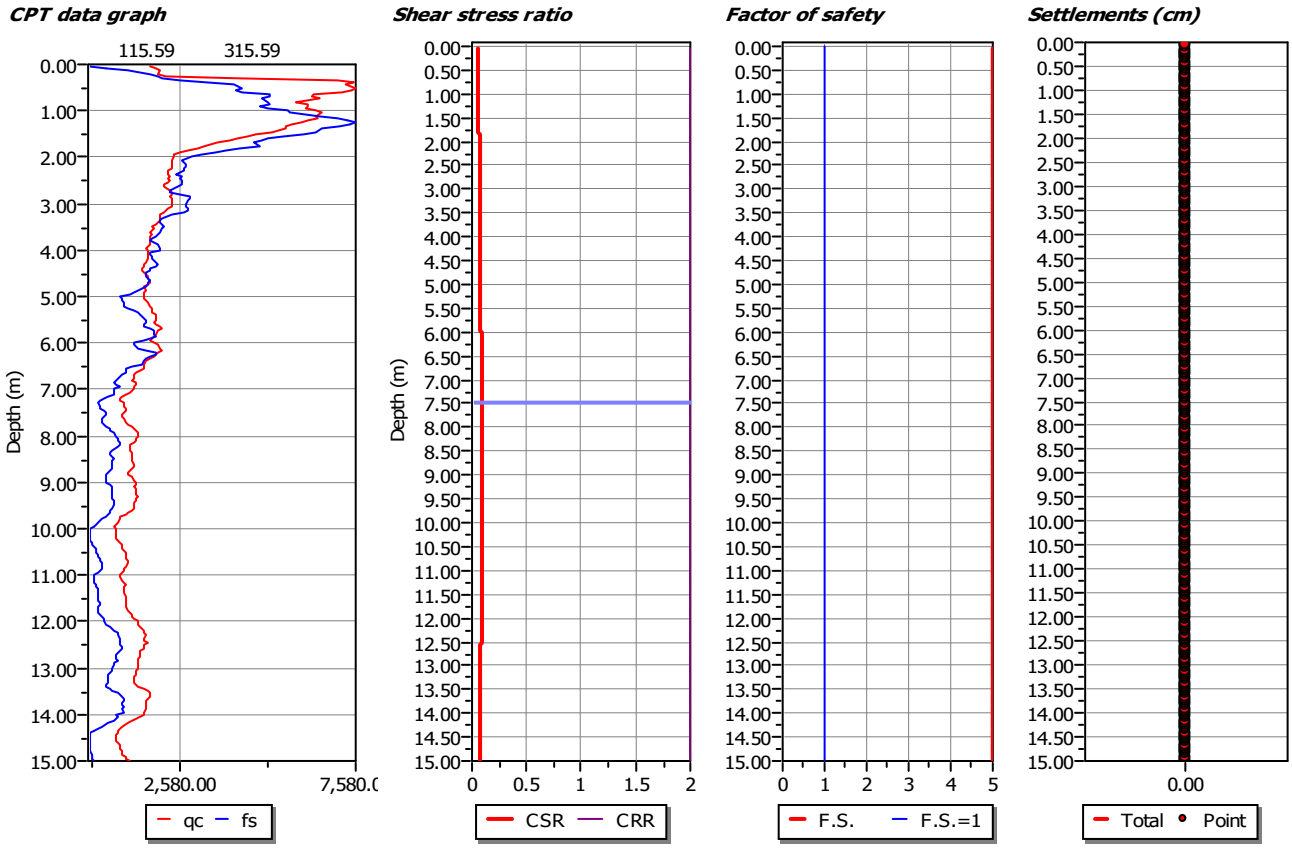
LIQUEFACTION ANALYSIS REPORT

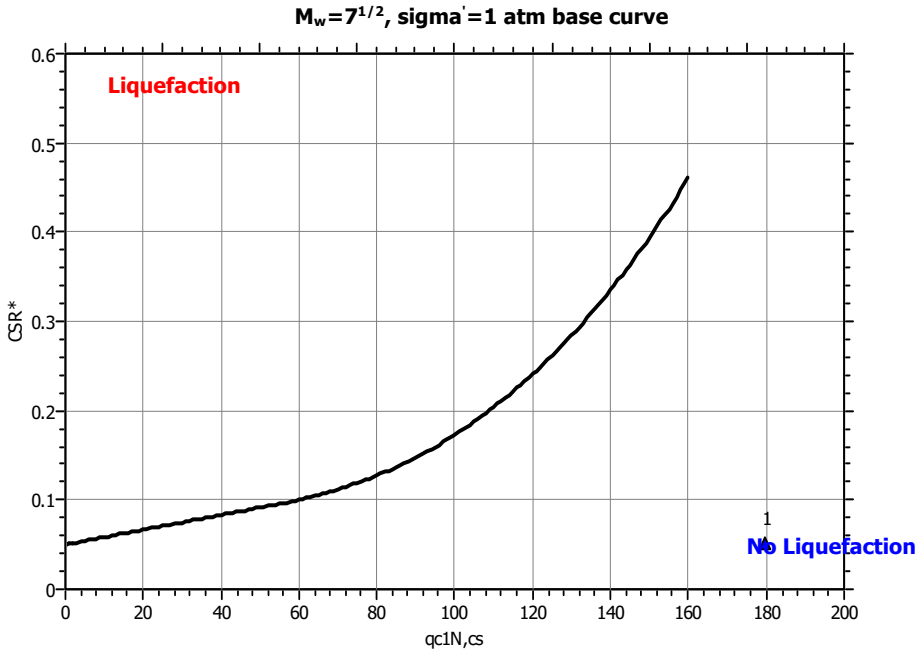
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C04

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	7.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





LIQUEFACTION ANALYSIS REPORT

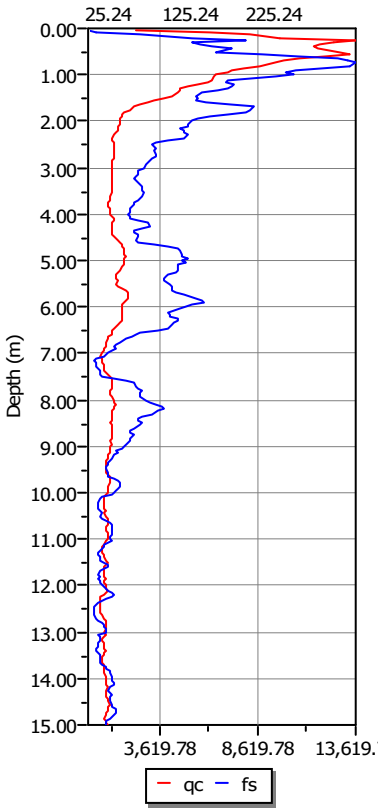
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C06

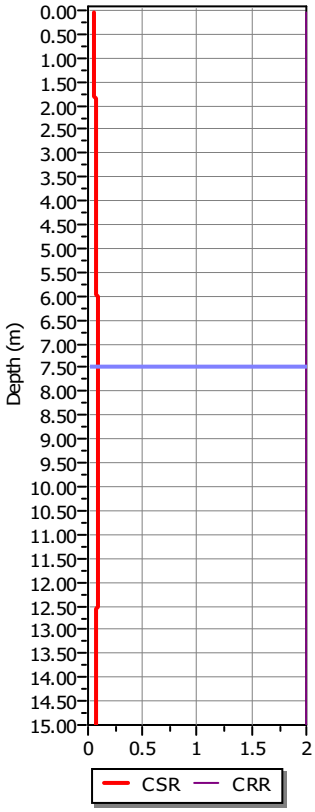
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	7.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

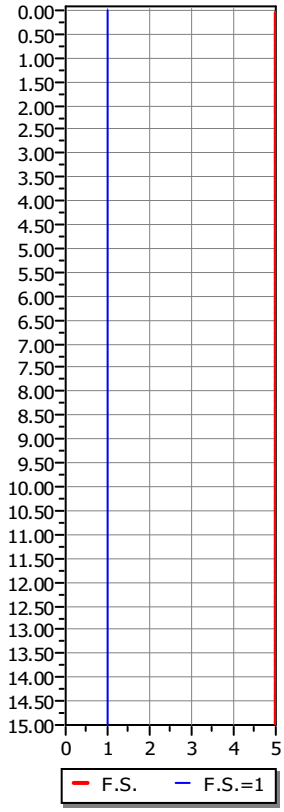
CPT data graph



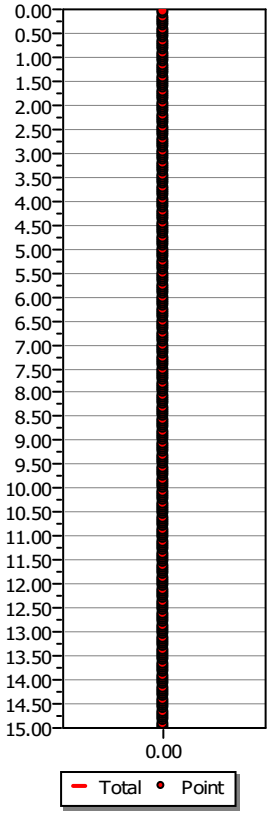
Shear stress ratio



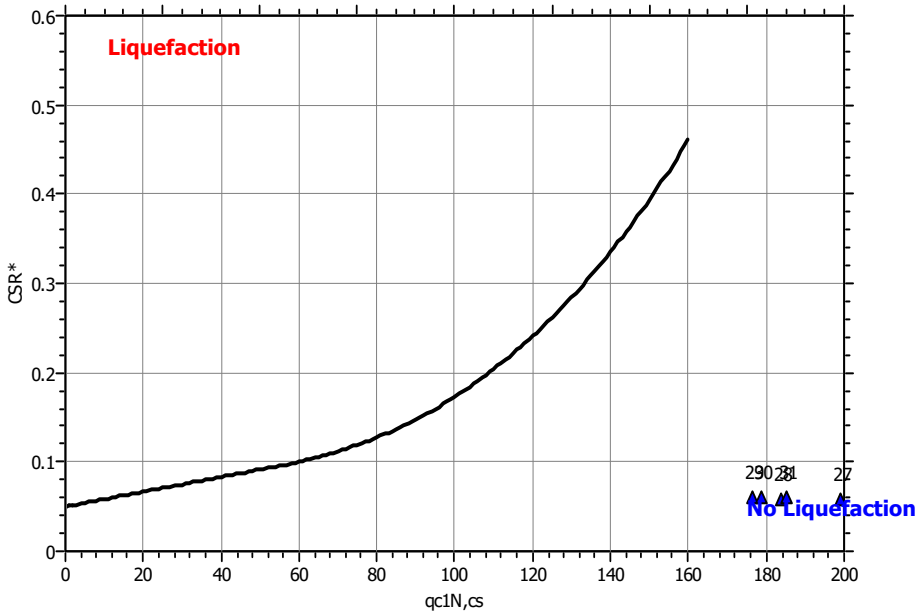
Factor of safety



Settlements (cm)



$M_w=7^{1/2}$, sigma'=1 atm base curve



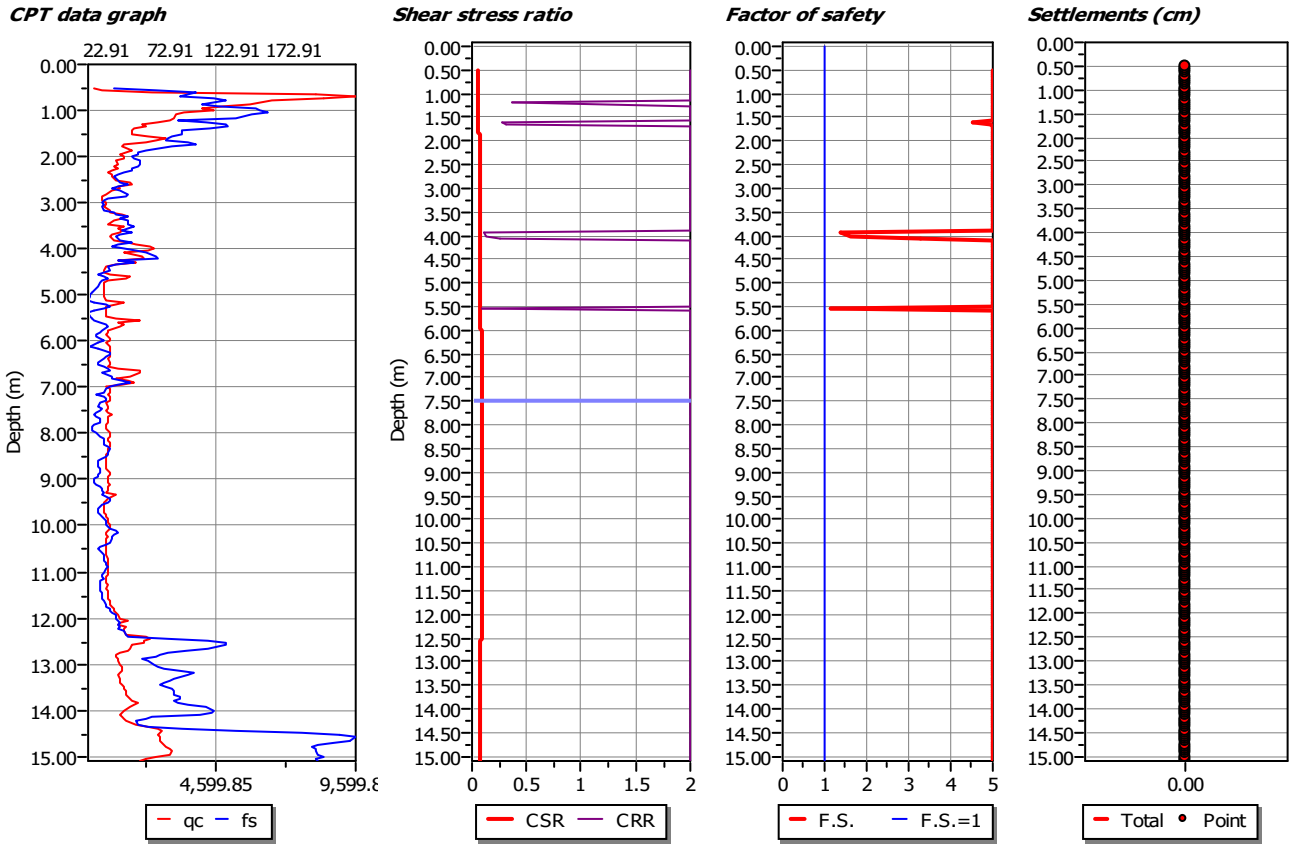
LIQUEFACTION ANALYSIS REPORT

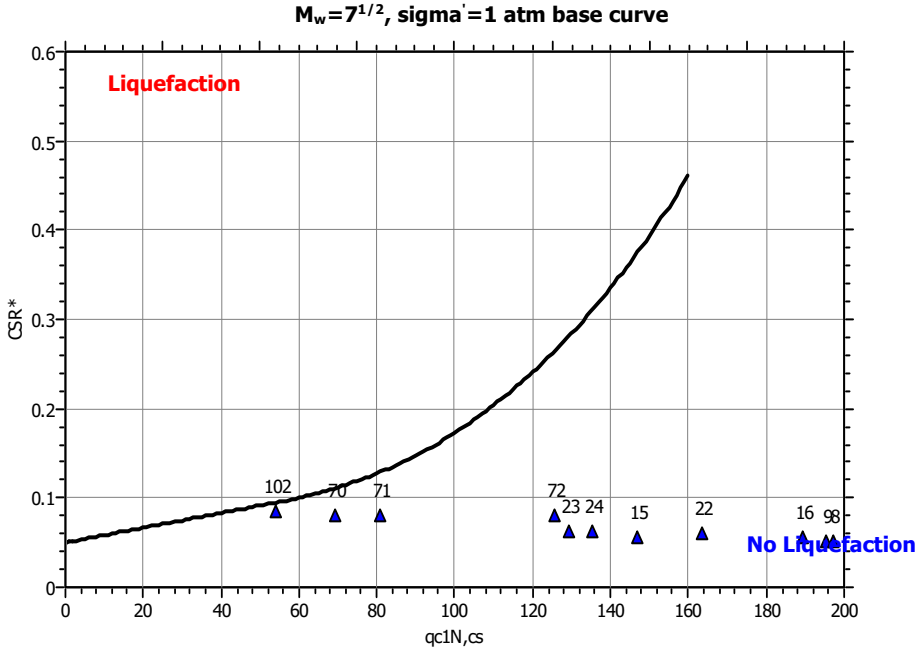
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C07

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	7.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





SAIPEM S.p.A.

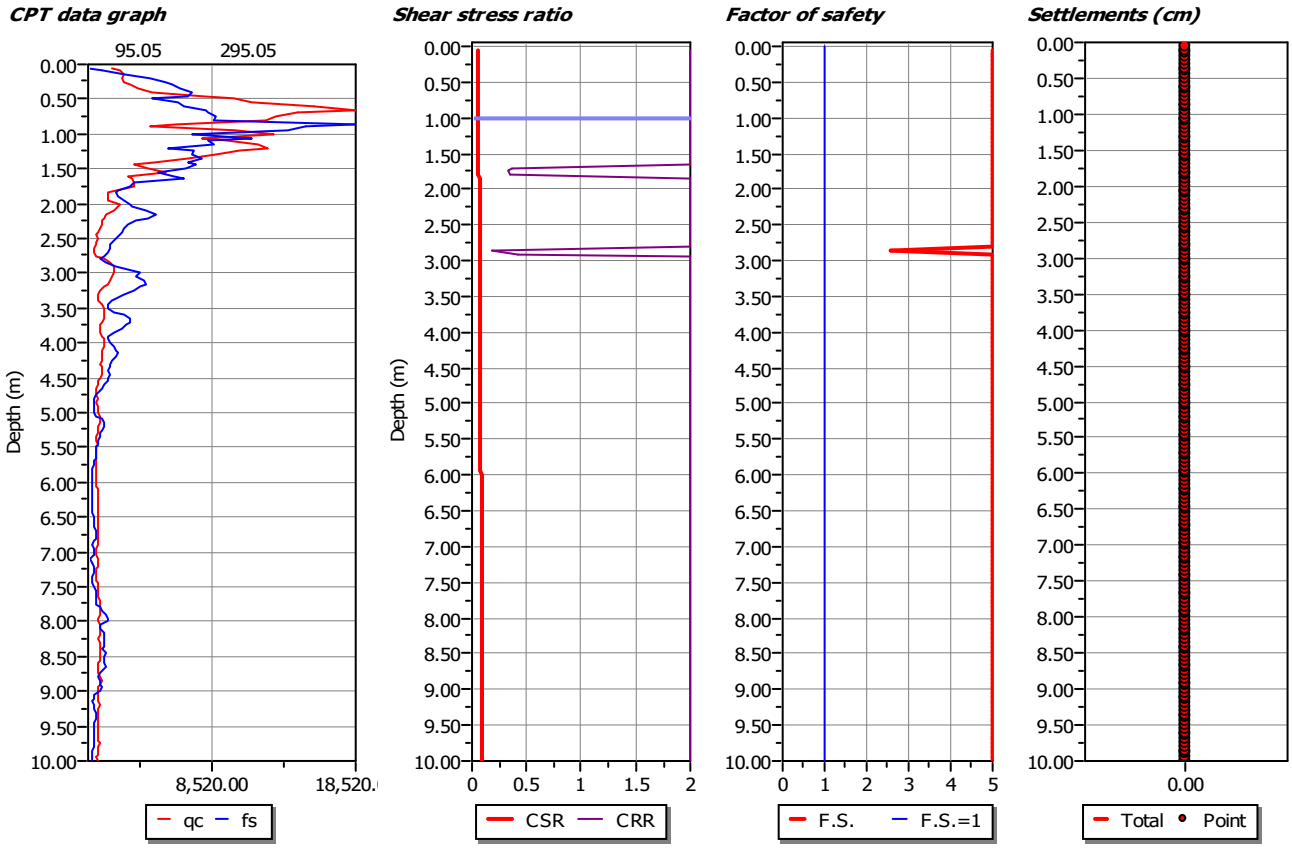
LIQUEFACTION ANALYSIS REPORT

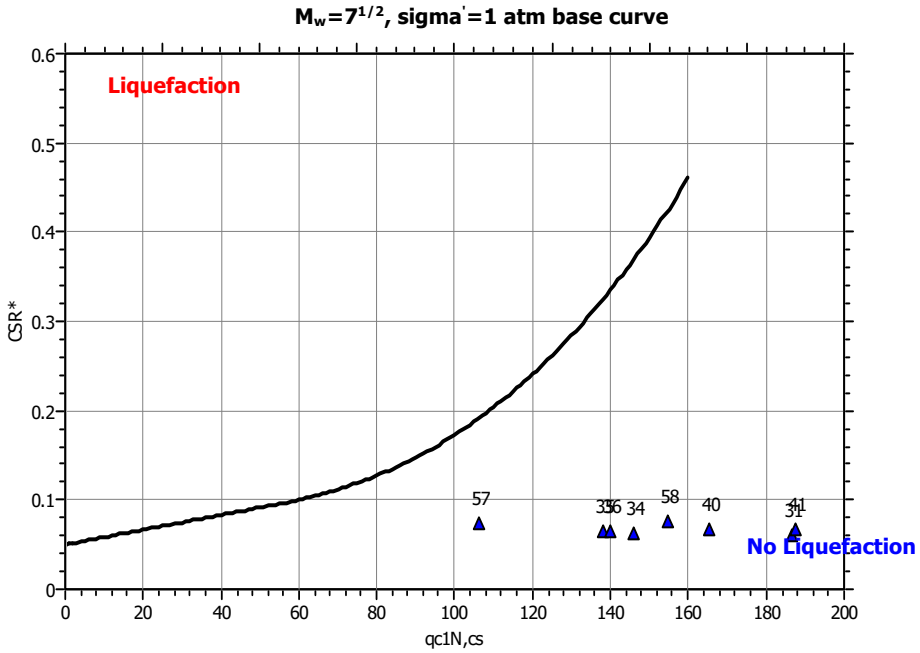
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C08

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





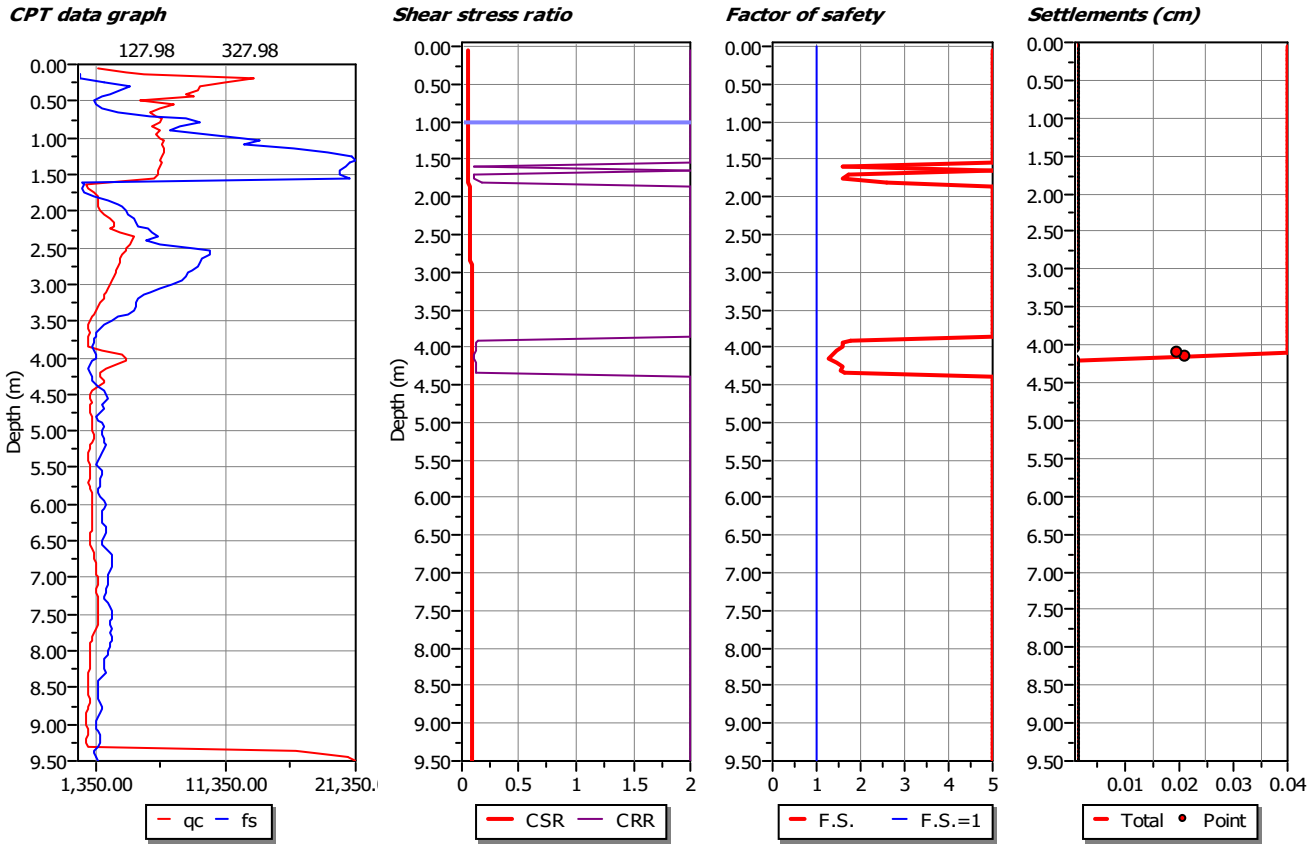
LIQUEFACTION ANALYSIS REPORT

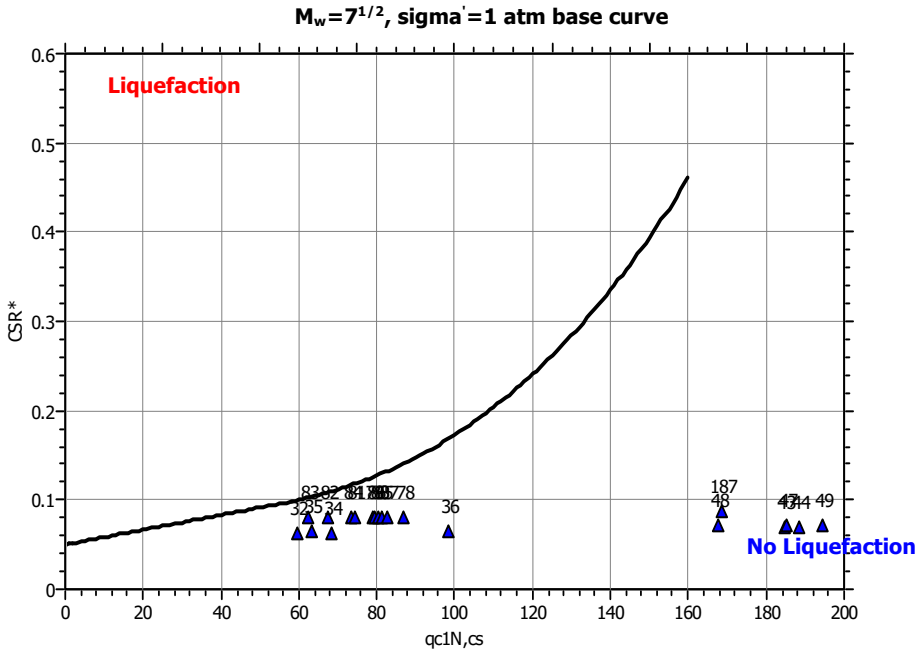
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C09

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





SAIPEM S.p.A.

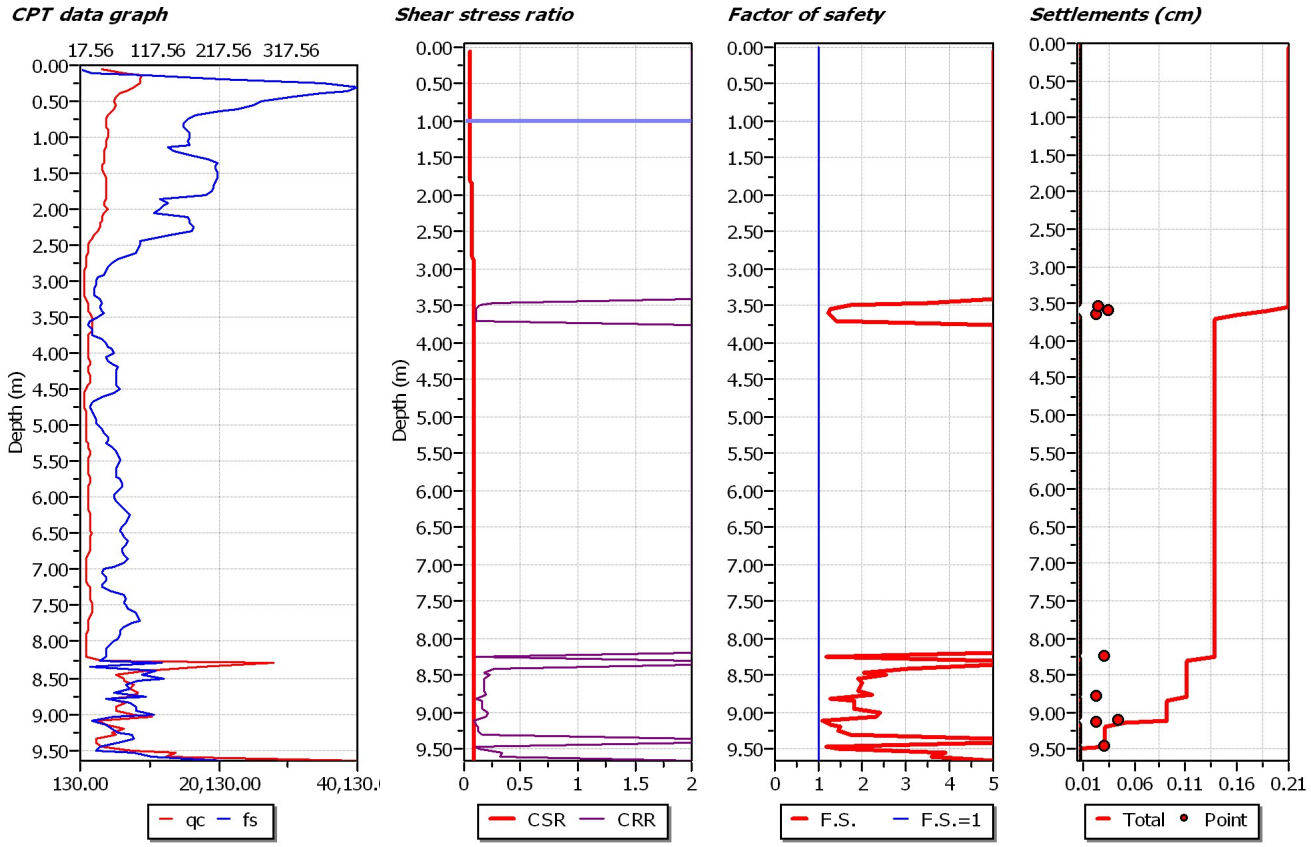
LIQUEFACTION ANALYSIS REPORT

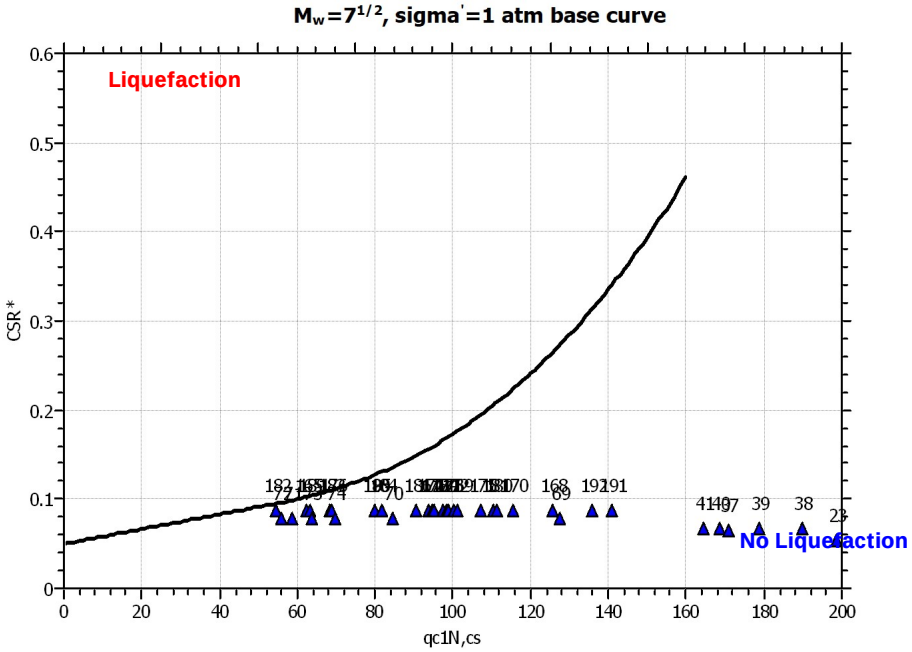
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C10

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





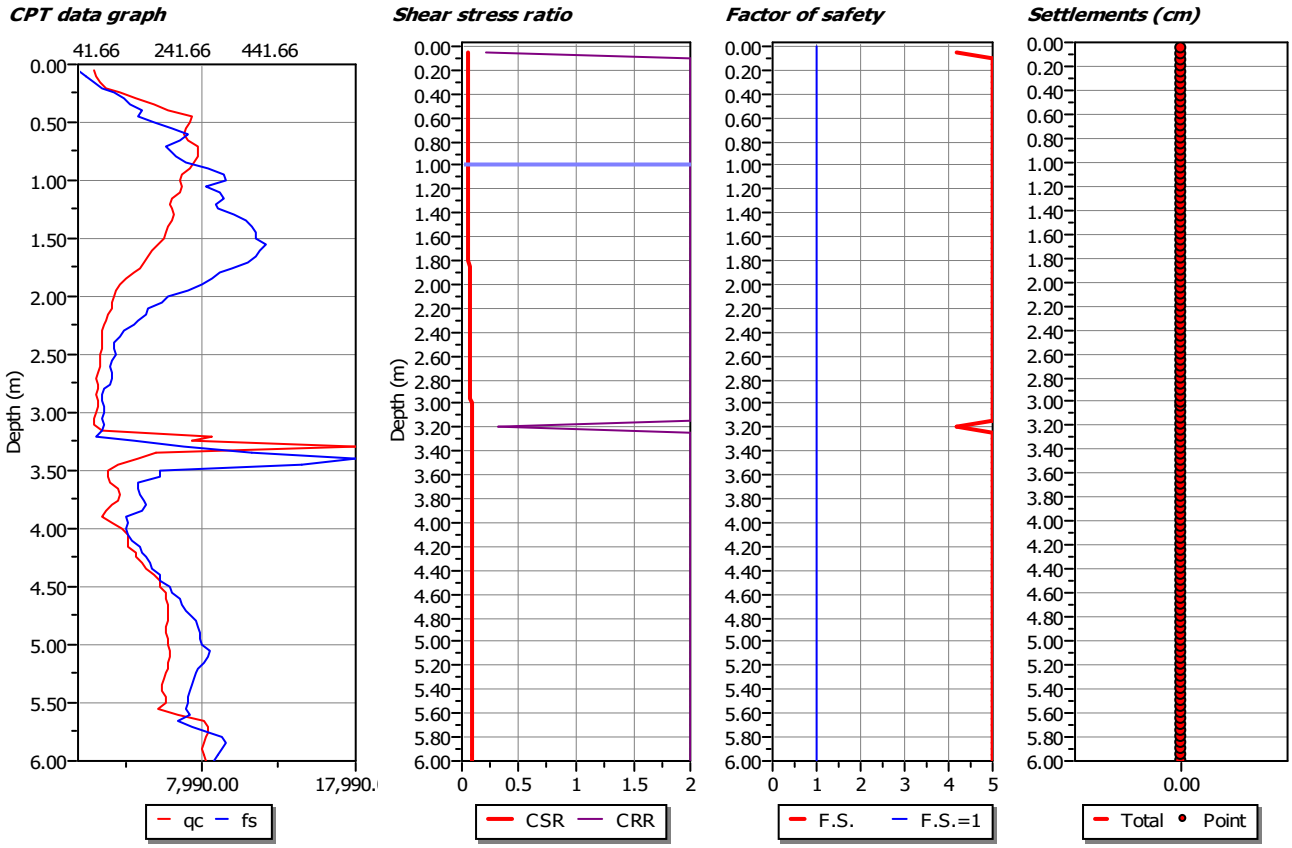
LIQUEFACTION ANALYSIS REPORT

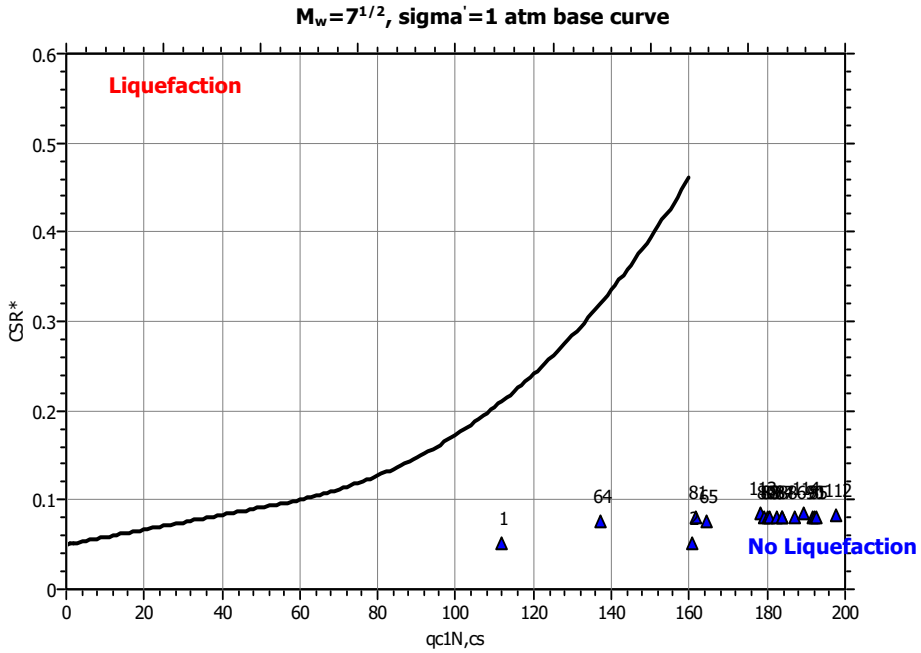
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C11

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.75
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





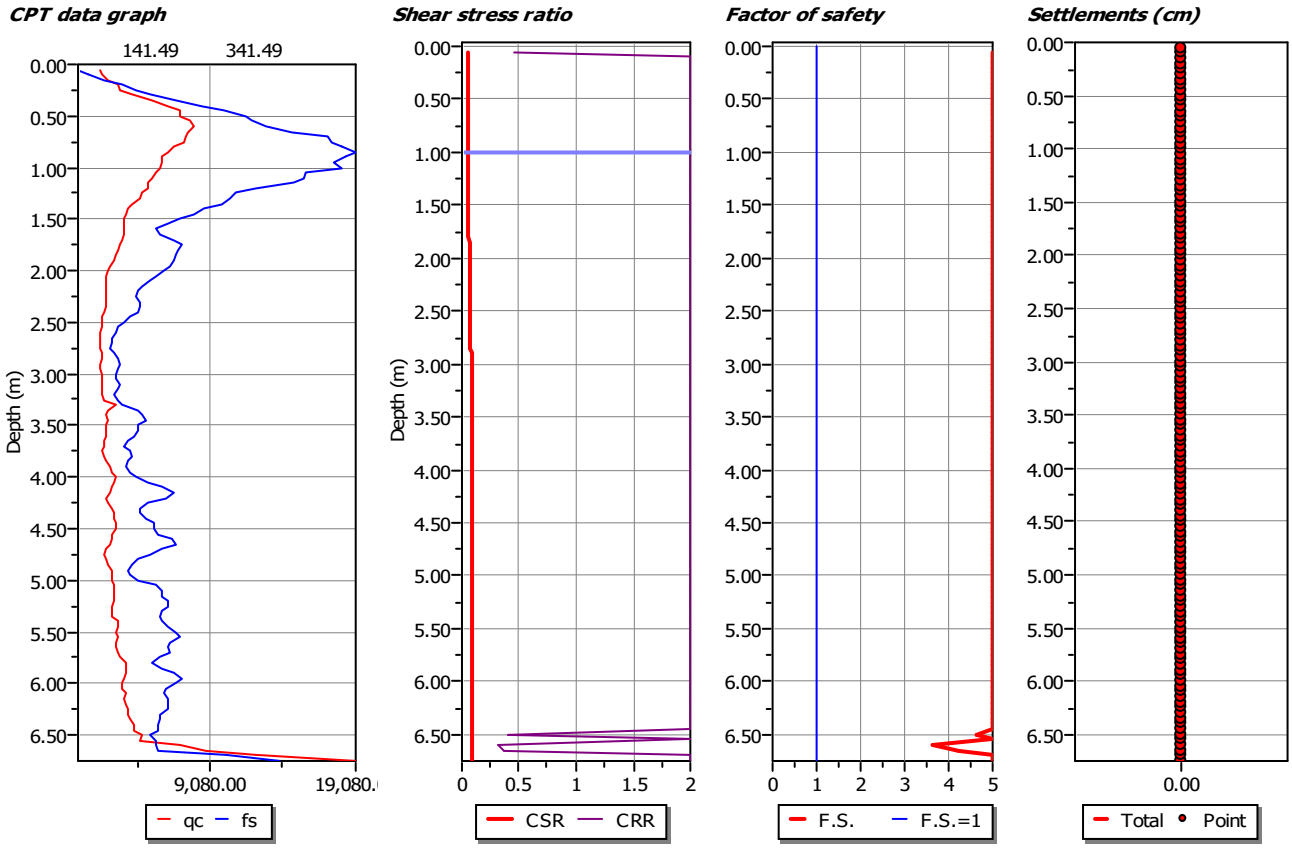
LIQUEFACTION ANALYSIS REPORT

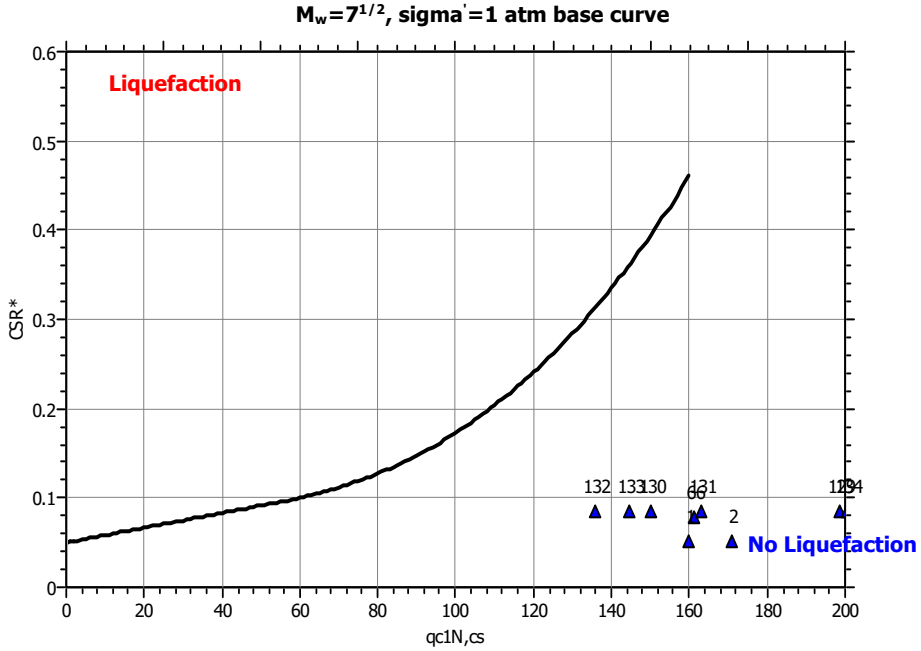
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C12

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





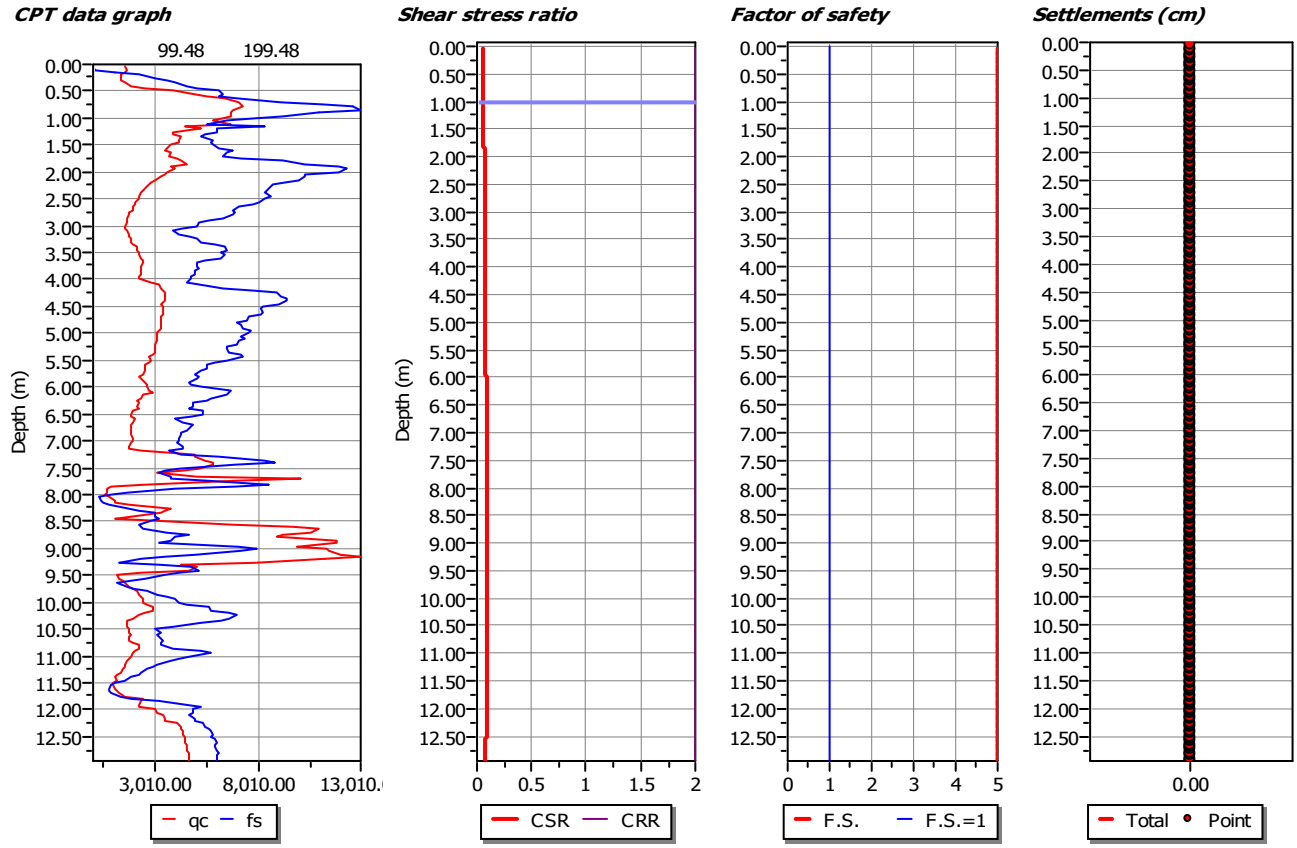
LIQUEFACTION ANALYSIS REPORT

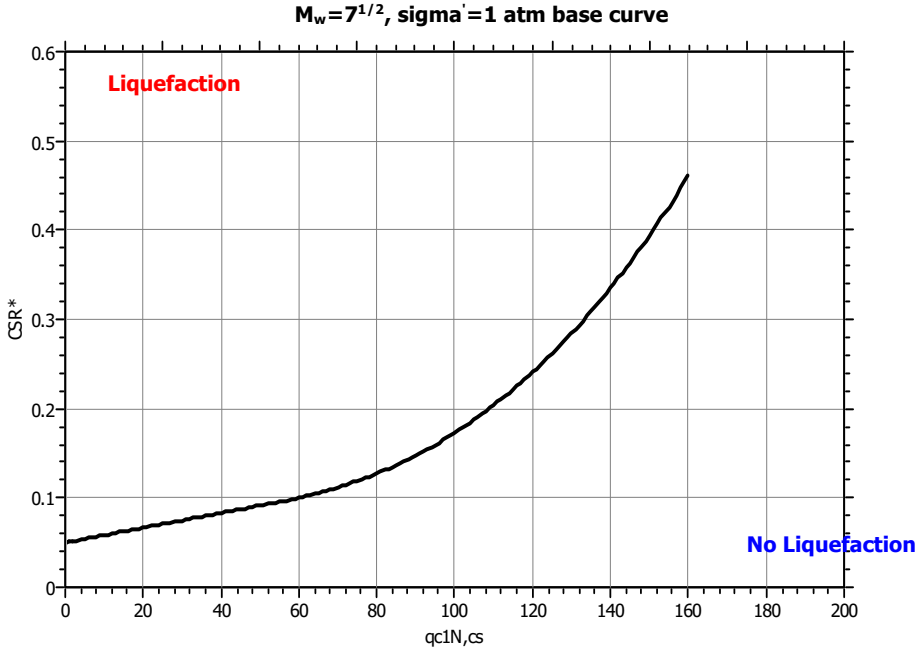
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C13

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





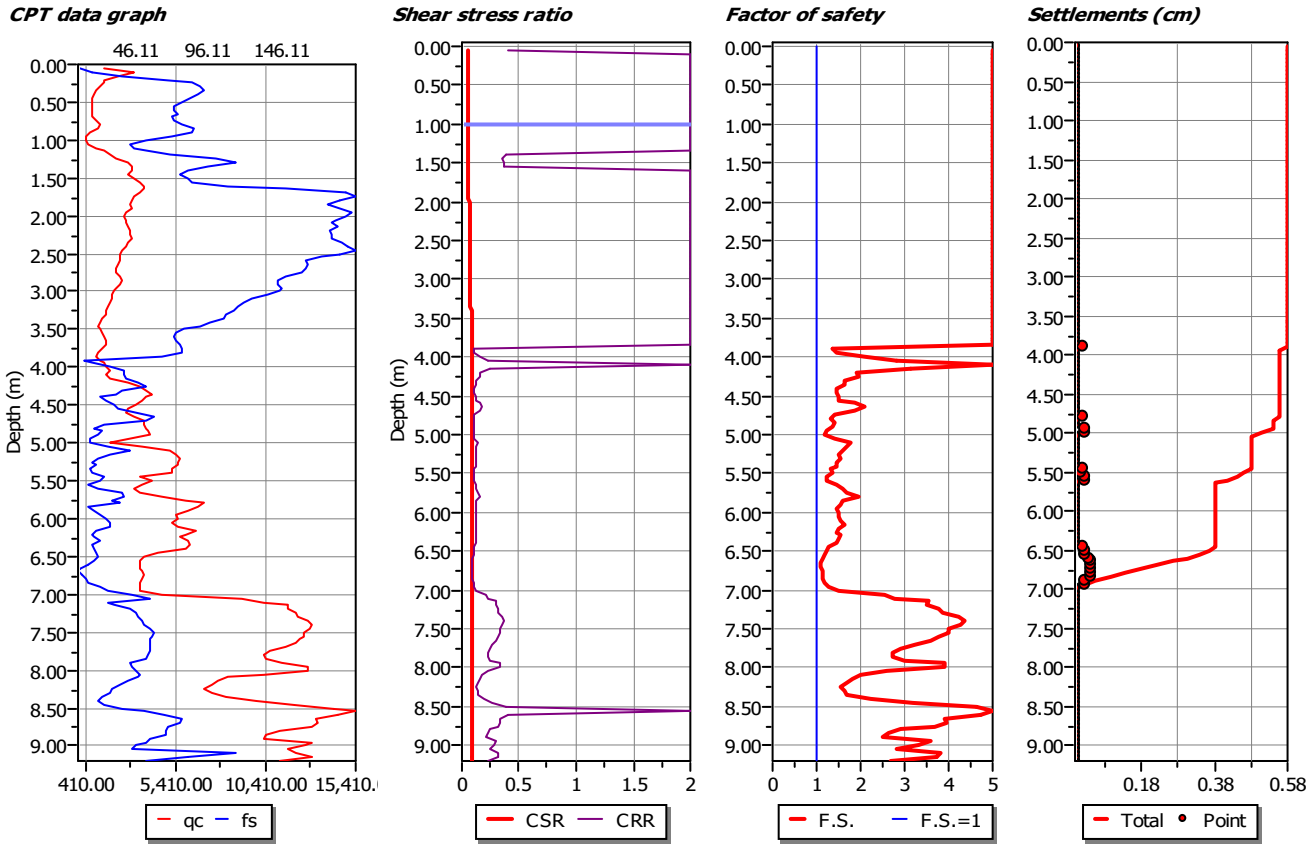
LIQUEFACTION ANALYSIS REPORT

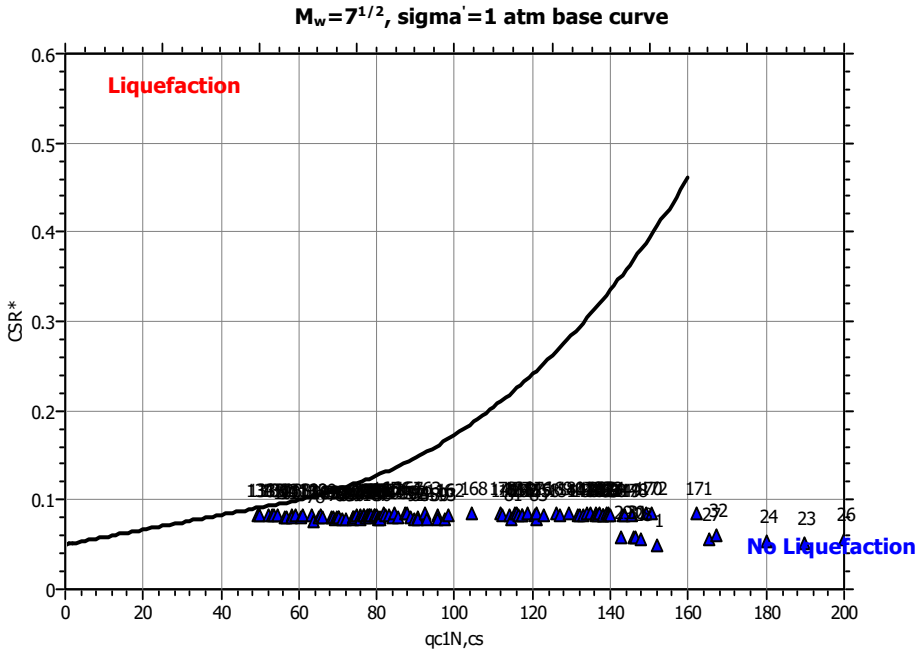
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C14

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.77
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.24 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





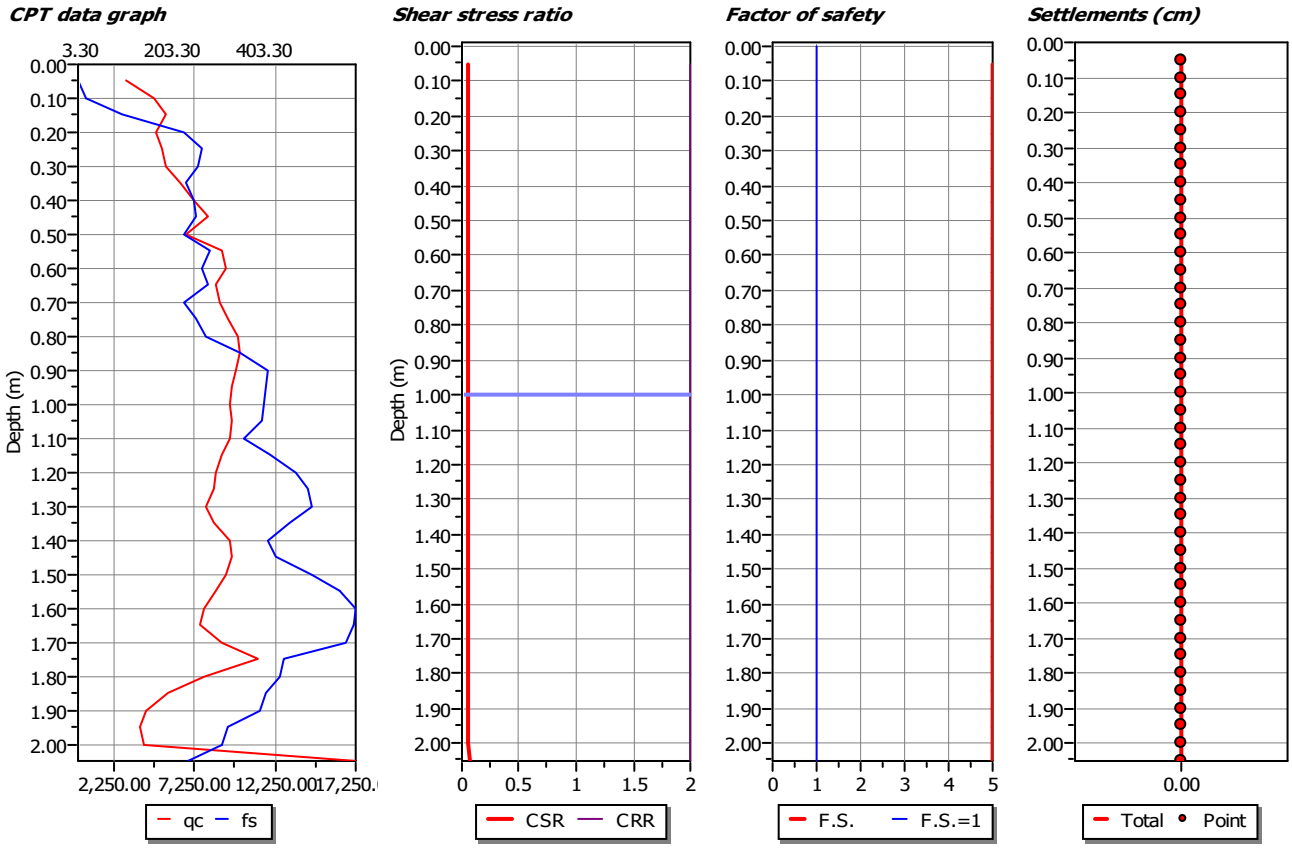
LIQUEFACTION ANALYSIS REPORT

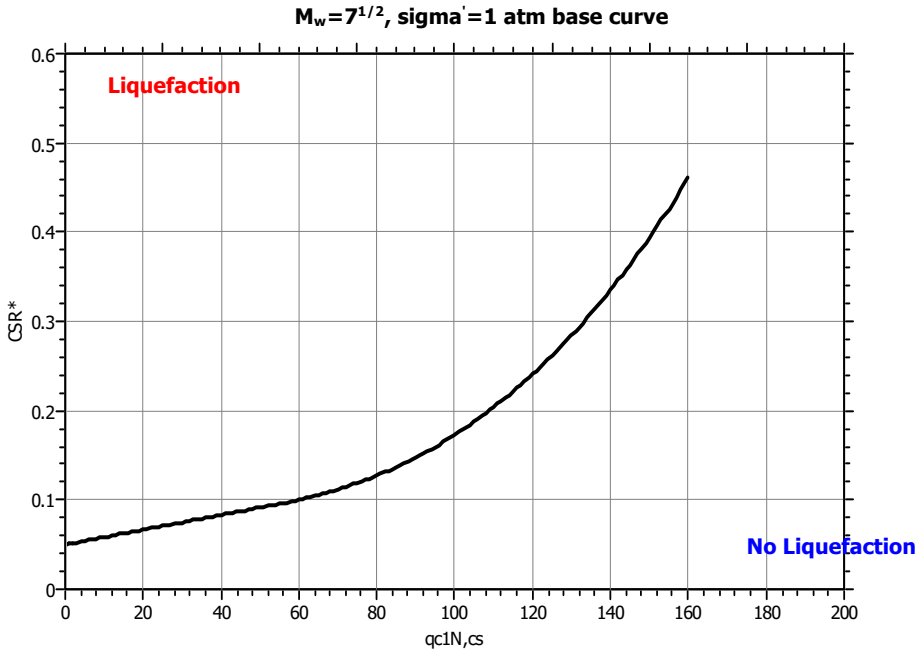
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C15

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.24 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





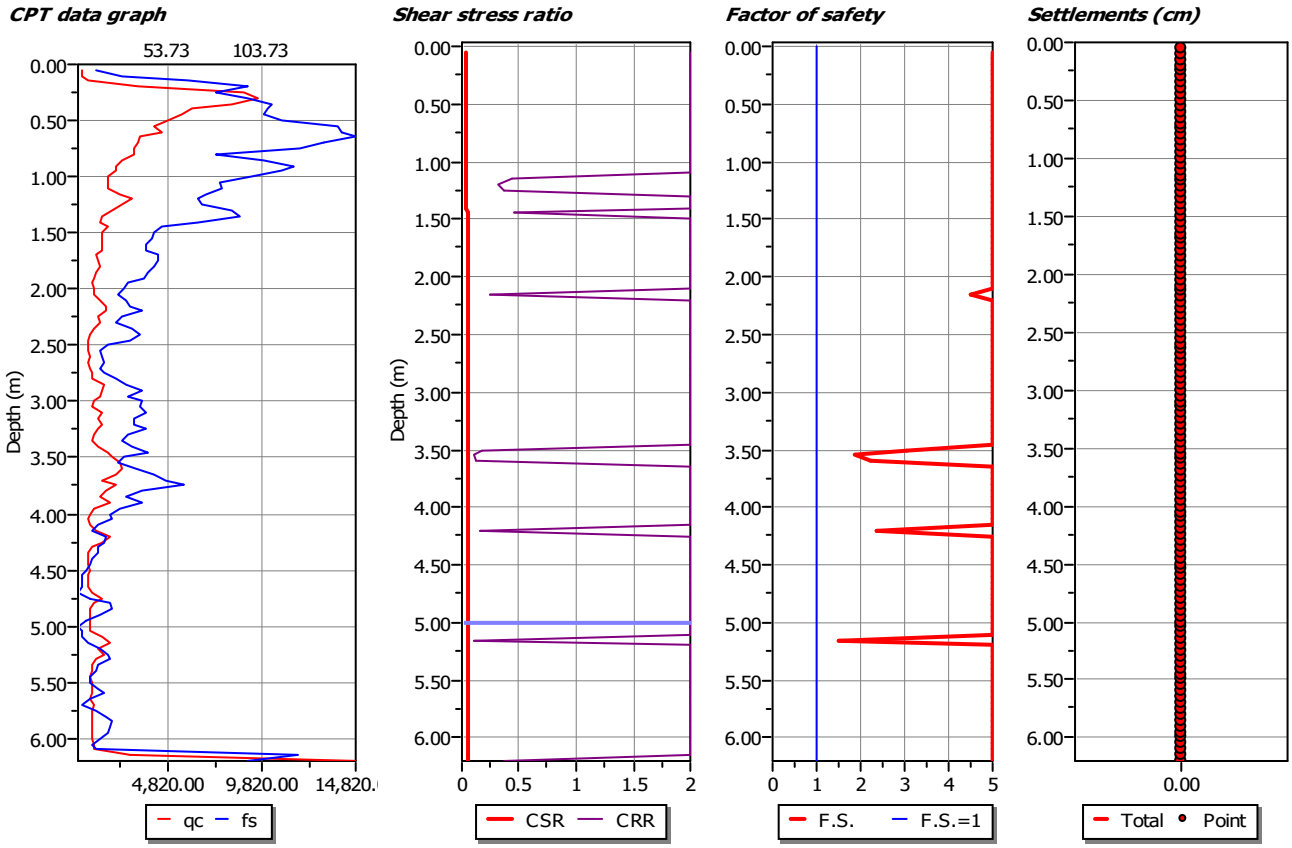
LIQUEFACTION ANALYSIS REPORT

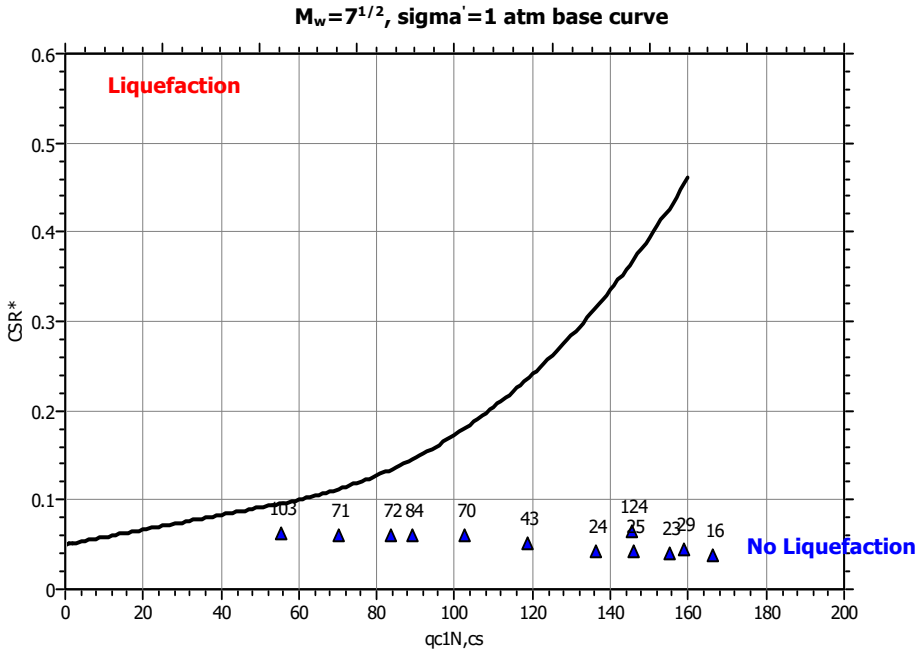
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C16

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	5.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.19 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





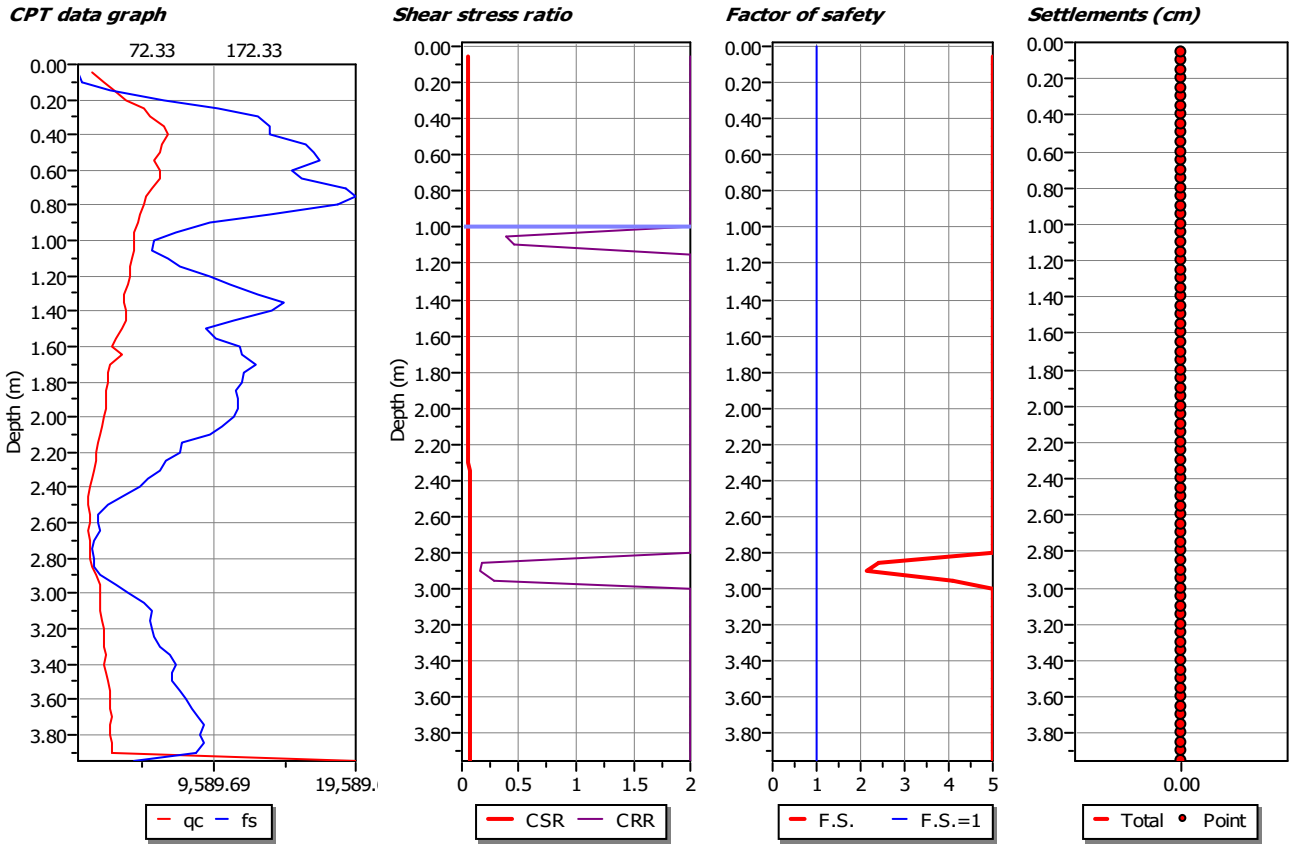
LIQUEFACTION ANALYSIS REPORT

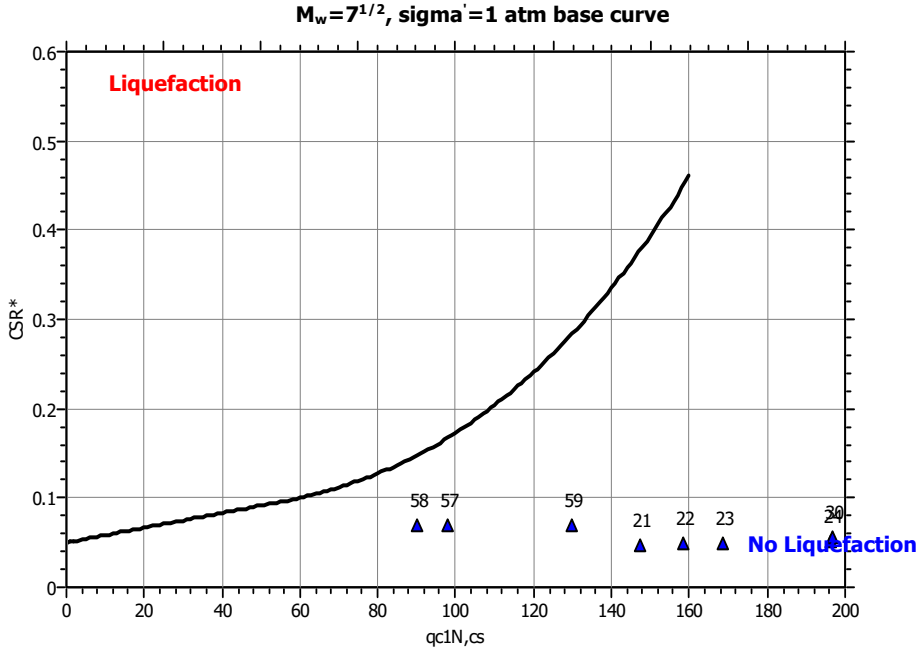
Project title : Met. Livorno Piombino

Project subtitle : LP-A-C17

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.23 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





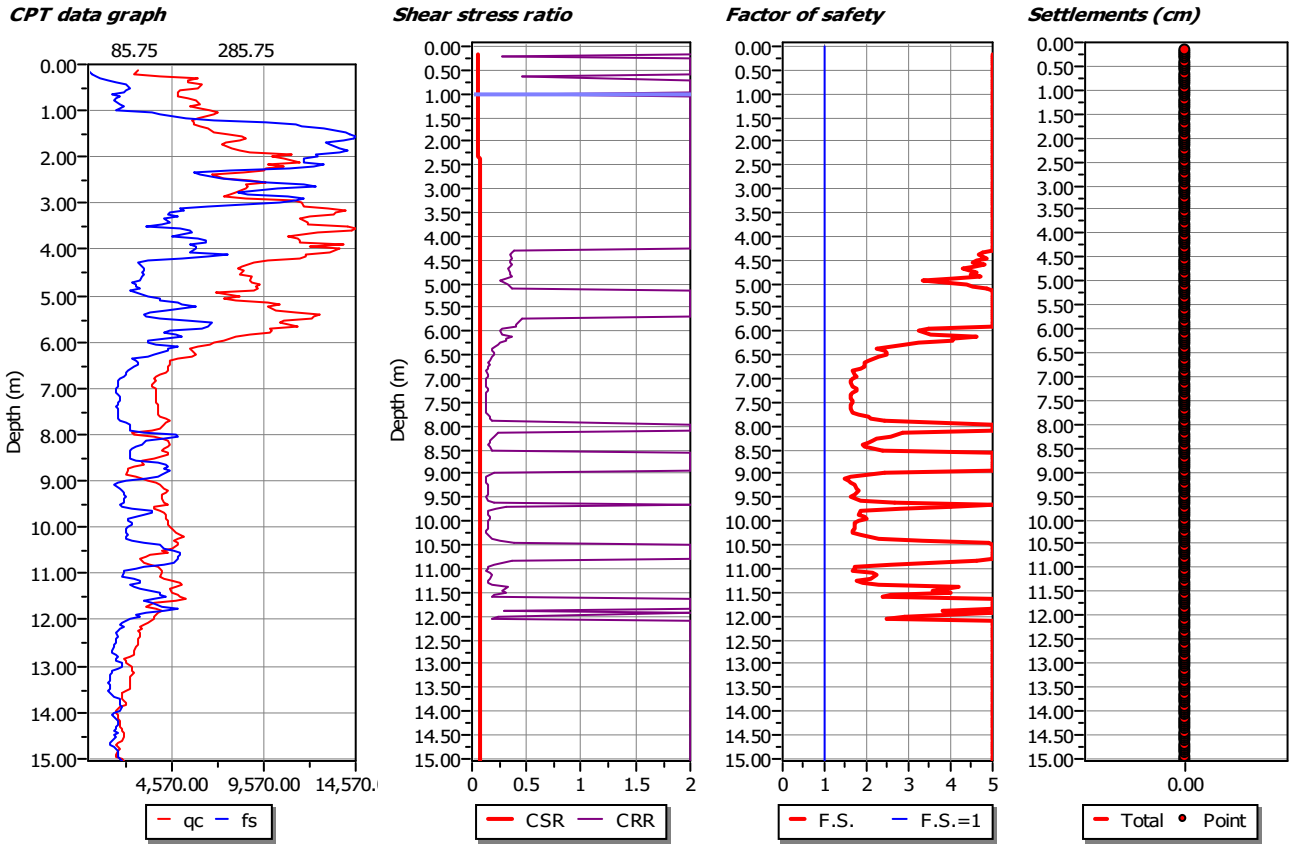
LIQUEFACTION ANALYSIS REPORT

Project title : Met. Livorno-Piombino

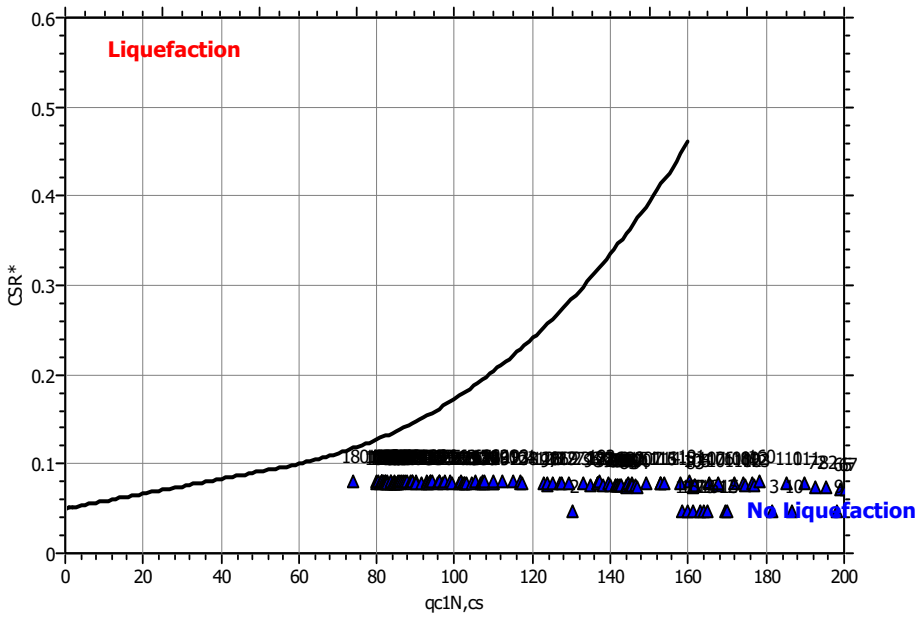
Project subtitle : LP-A-C17a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.23 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00



$M_w=7^{1/2}$, sigma'=1 atm base curve



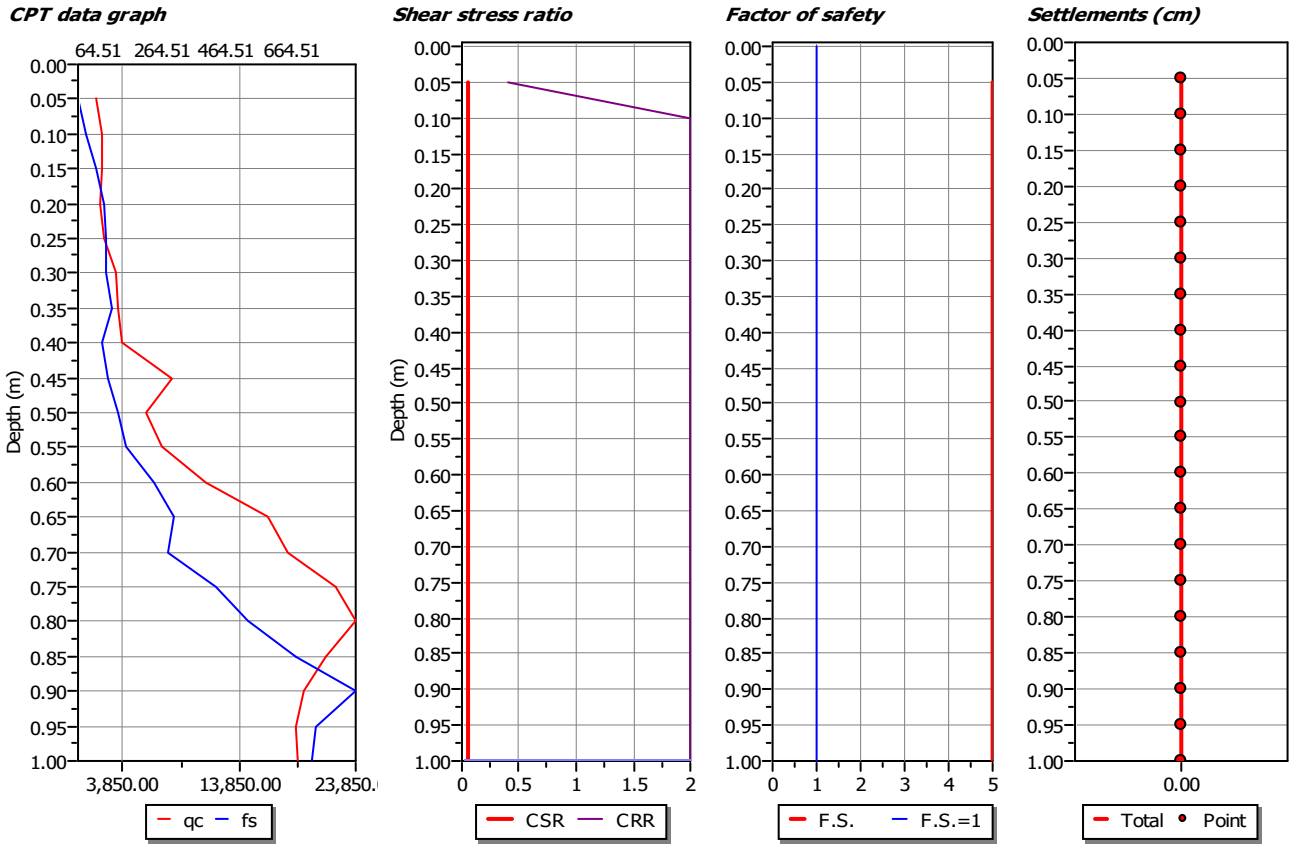
LIQUEFACTION ANALYSIS REPORT

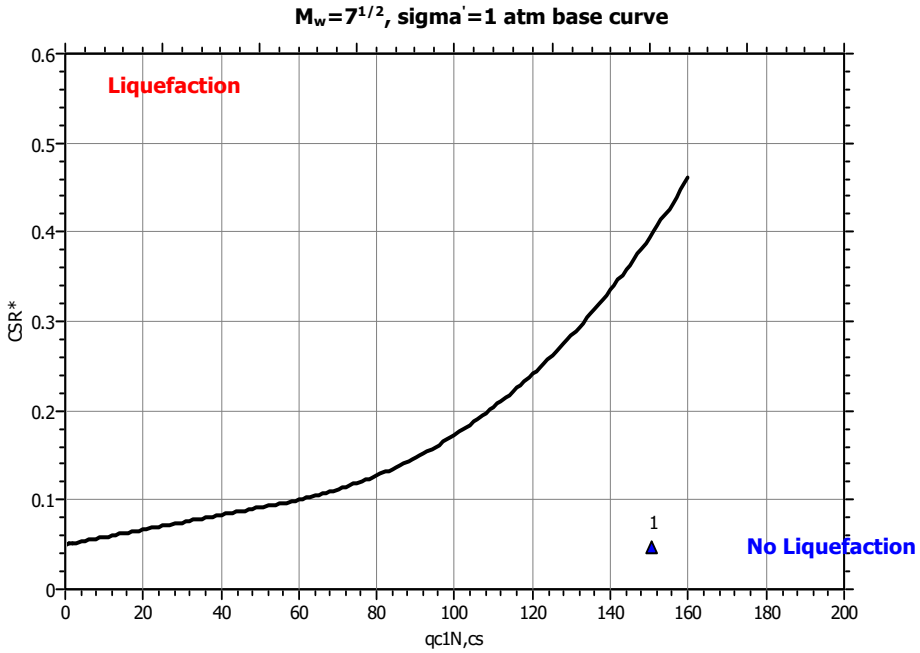
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C17b

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.23 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





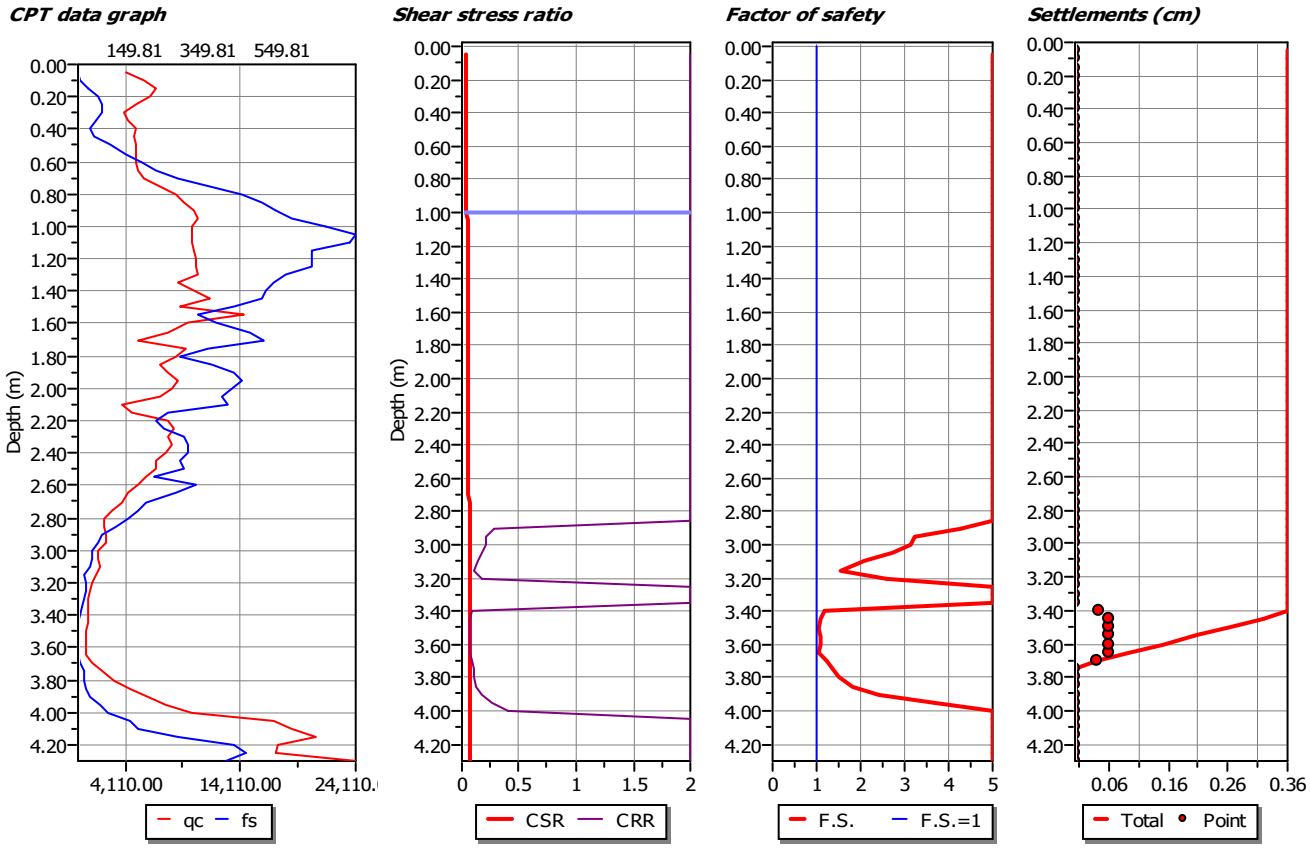
LIQUEFACTION ANALYSIS REPORT

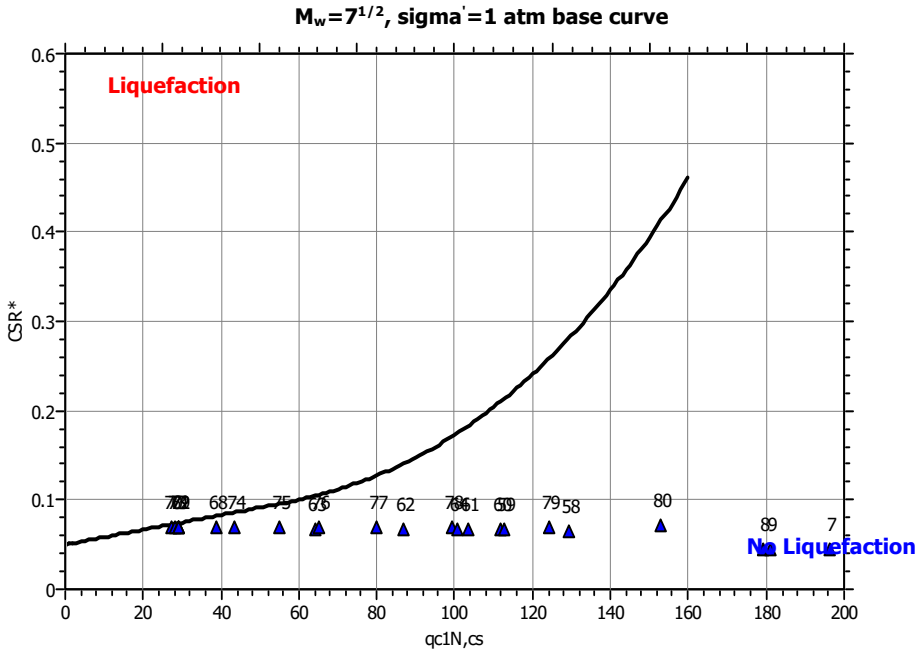
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C18

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.22 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





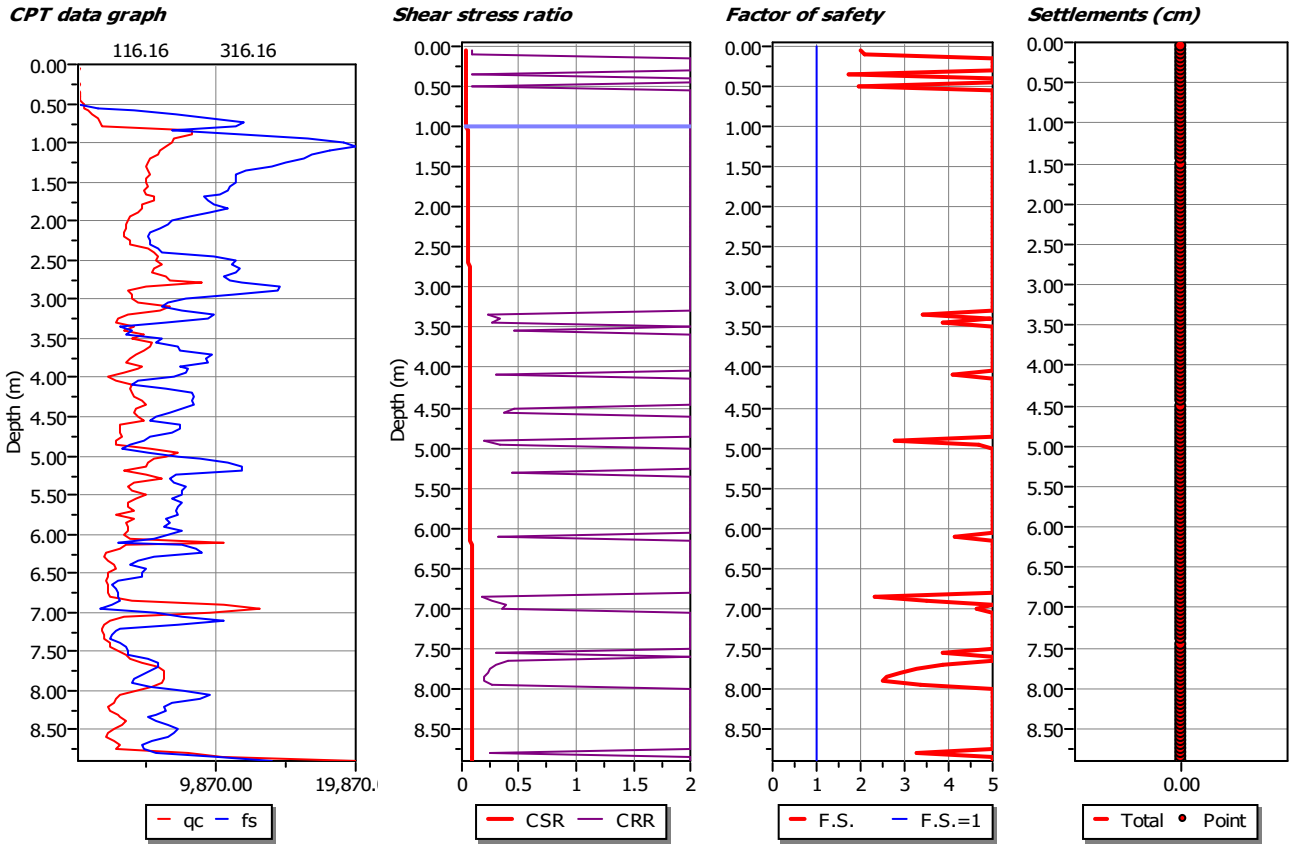
LIQUEFACTION ANALYSIS REPORT

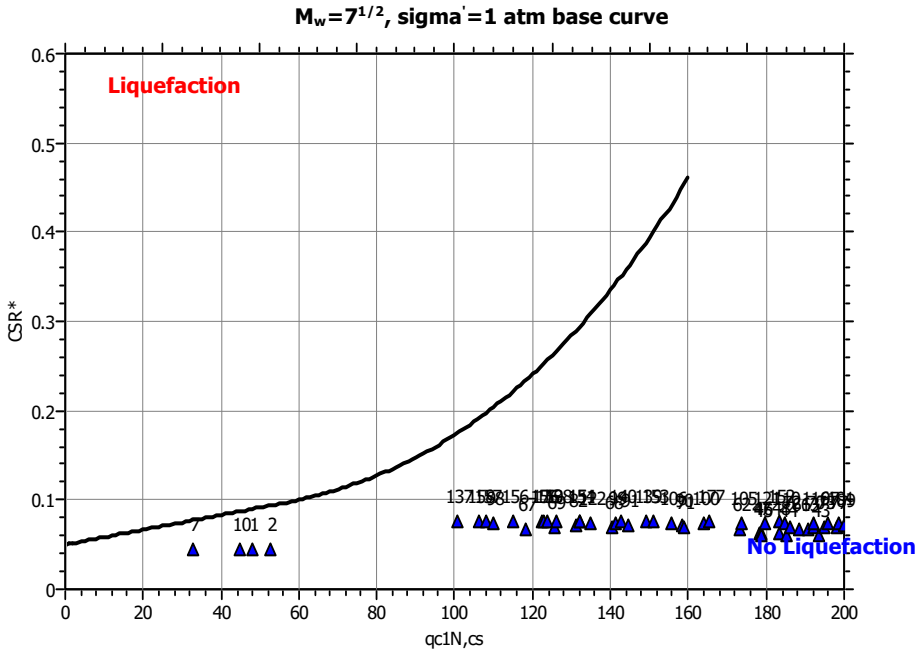
Project title : Met. Livorno-Piombino

Project subtitle : LP-A-C19

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.76
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.22 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





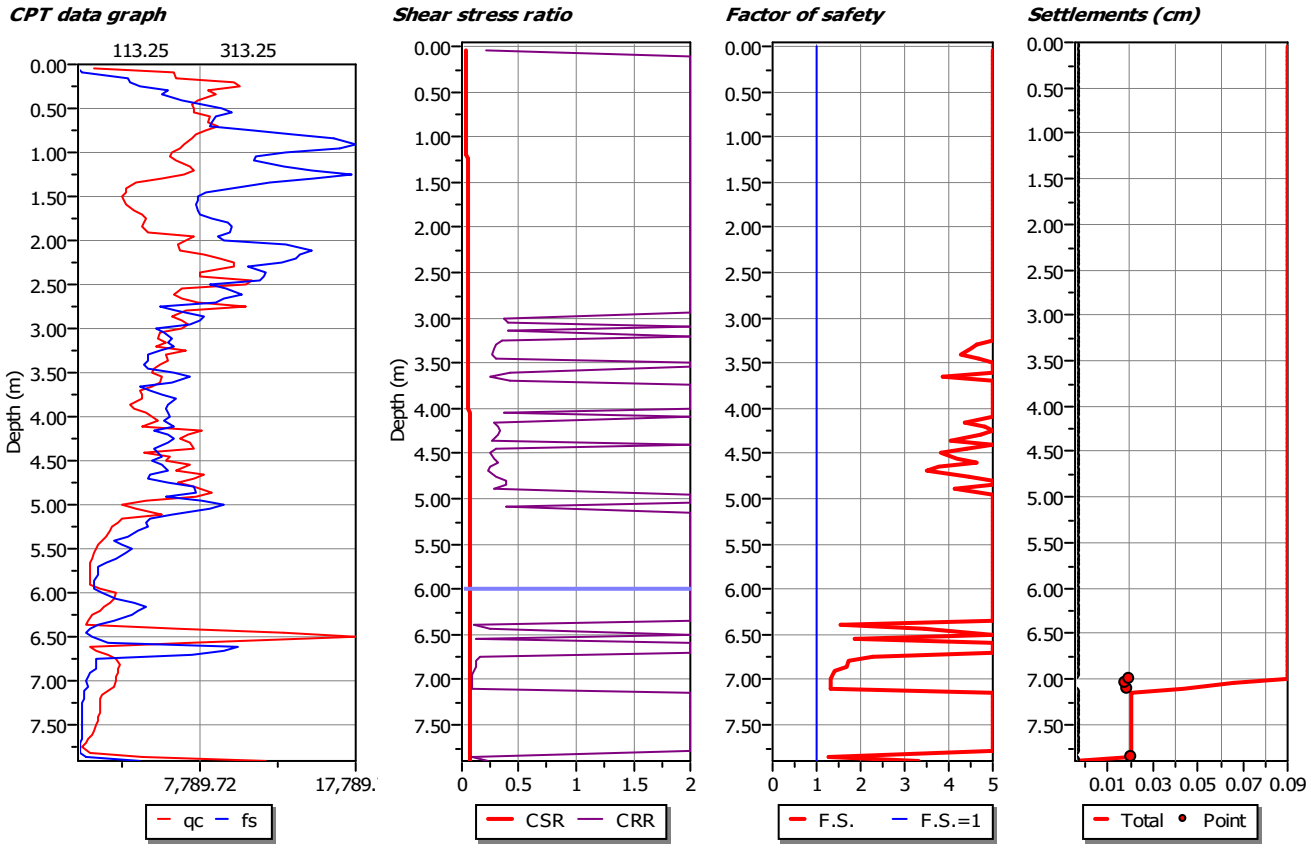
LIQUEFACTION ANALYSIS REPORT

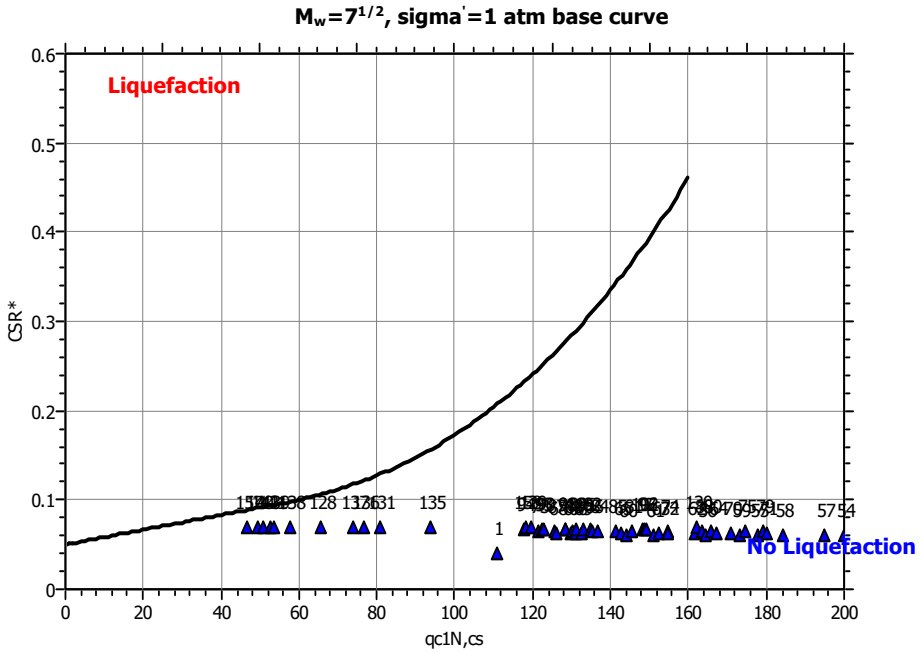
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C19a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	6.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.78
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.20 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





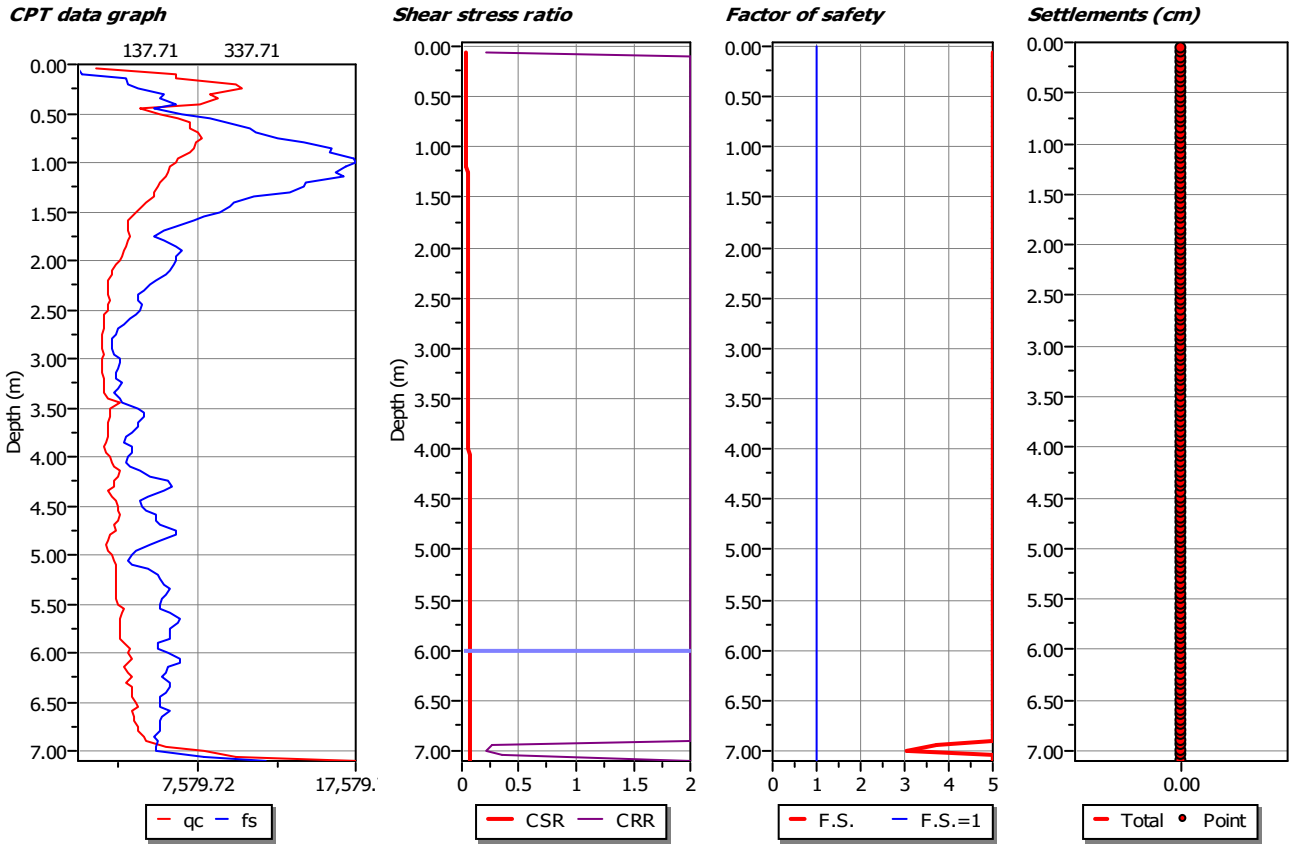
LIQUEFACTION ANALYSIS REPORT

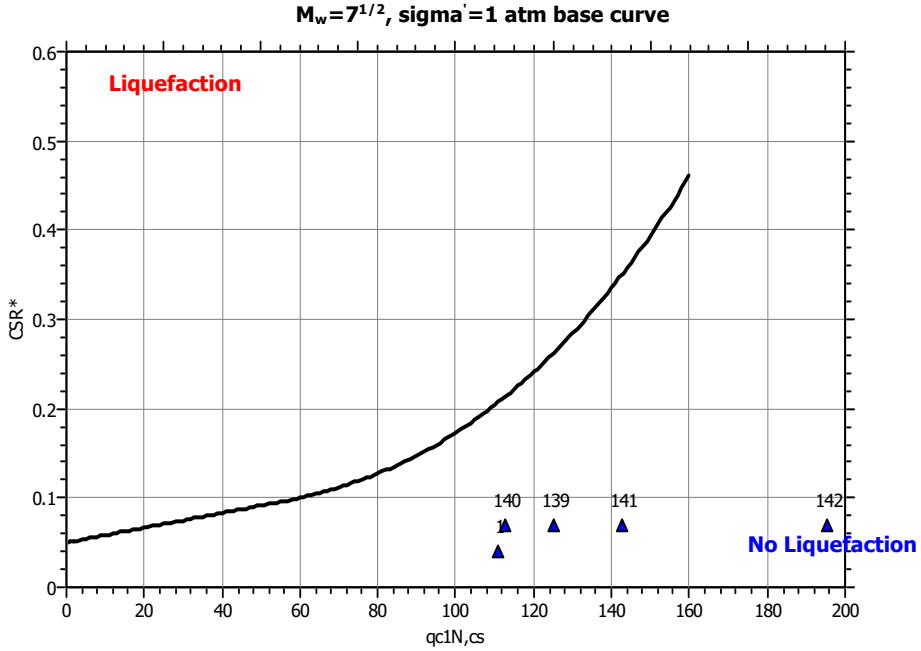
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C19b

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	6.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.78
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.20 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





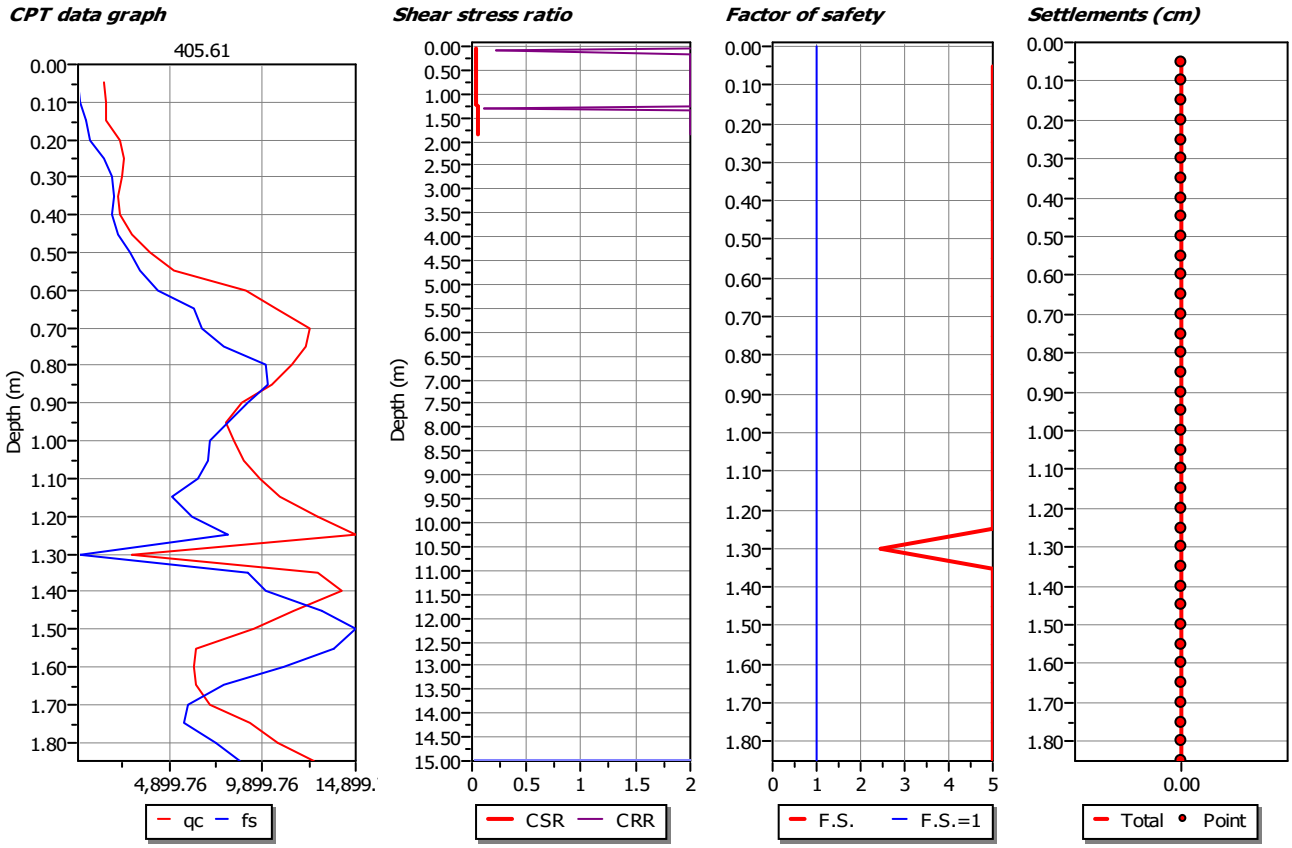
LIQUEFACTION ANALYSIS REPORT

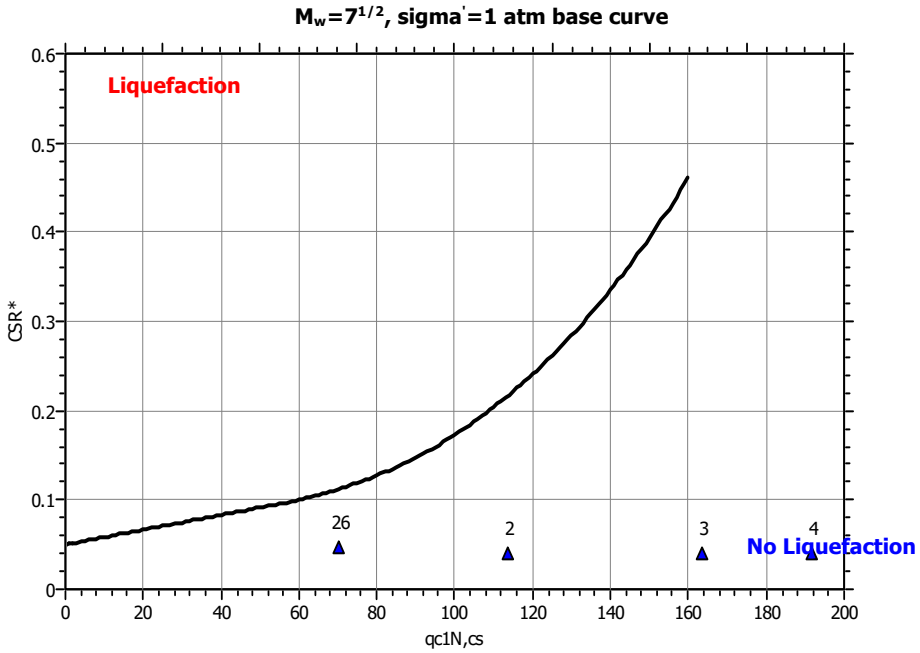
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C20

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.78
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.20 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





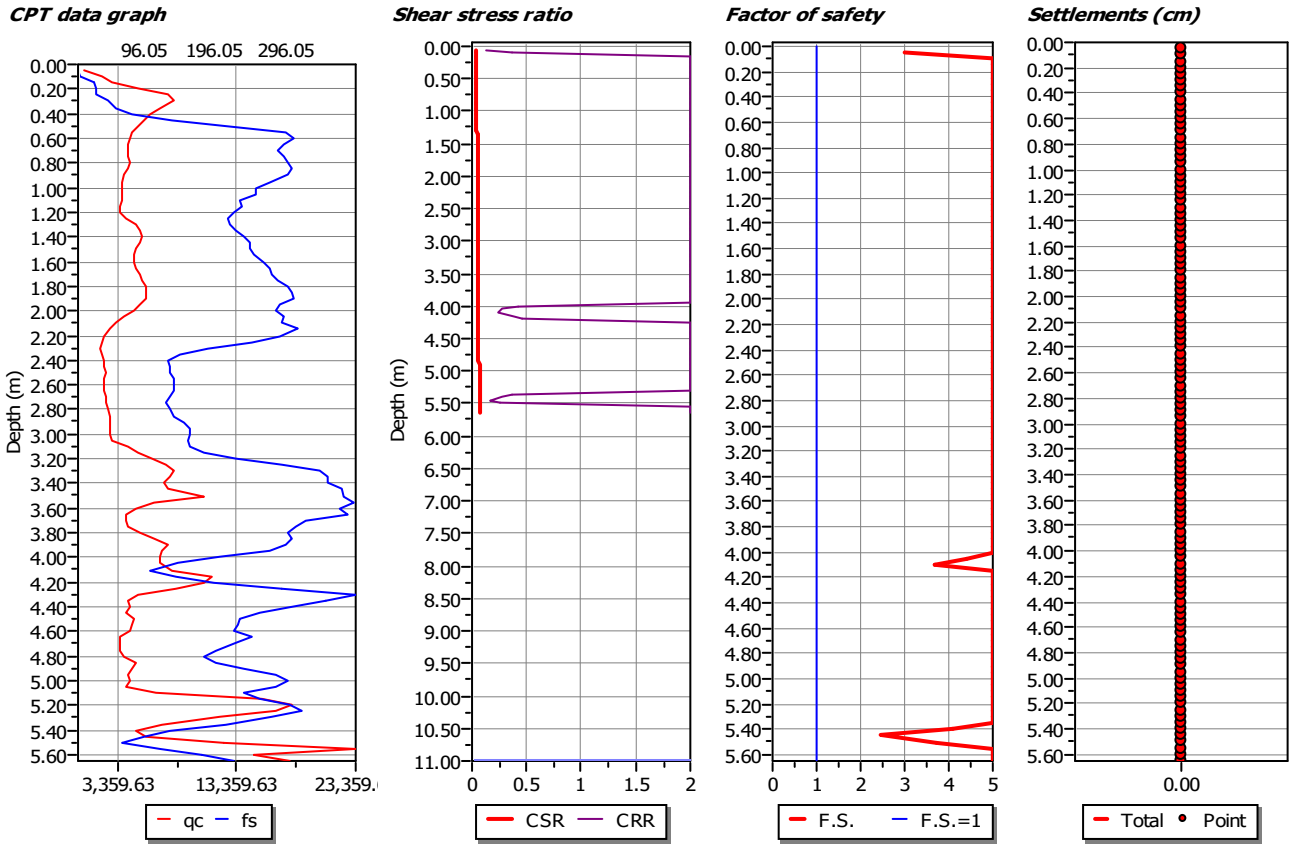
LIQUEFACTION ANALYSIS REPORT

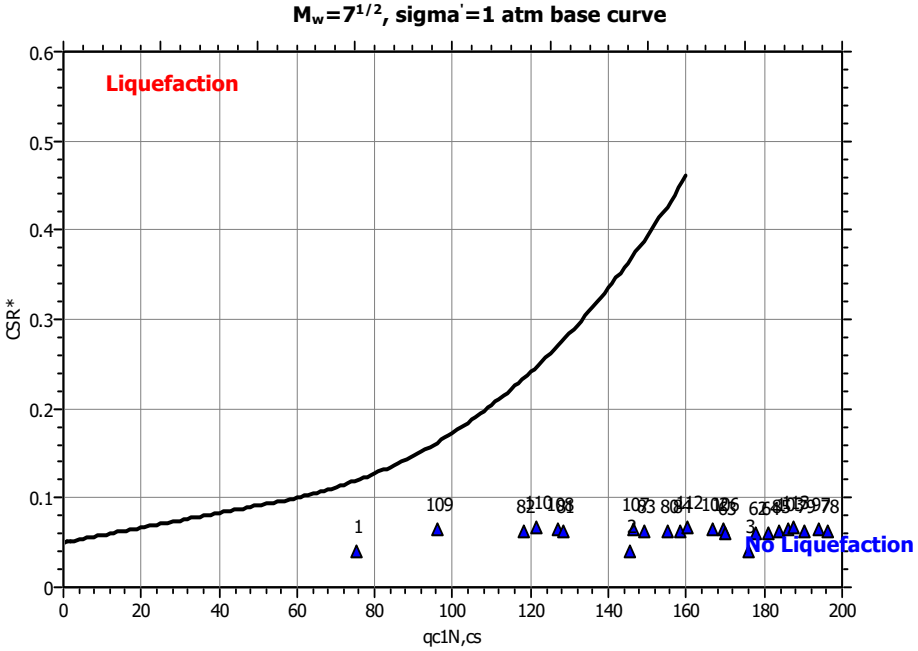
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C20a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	11.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.82
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.19 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





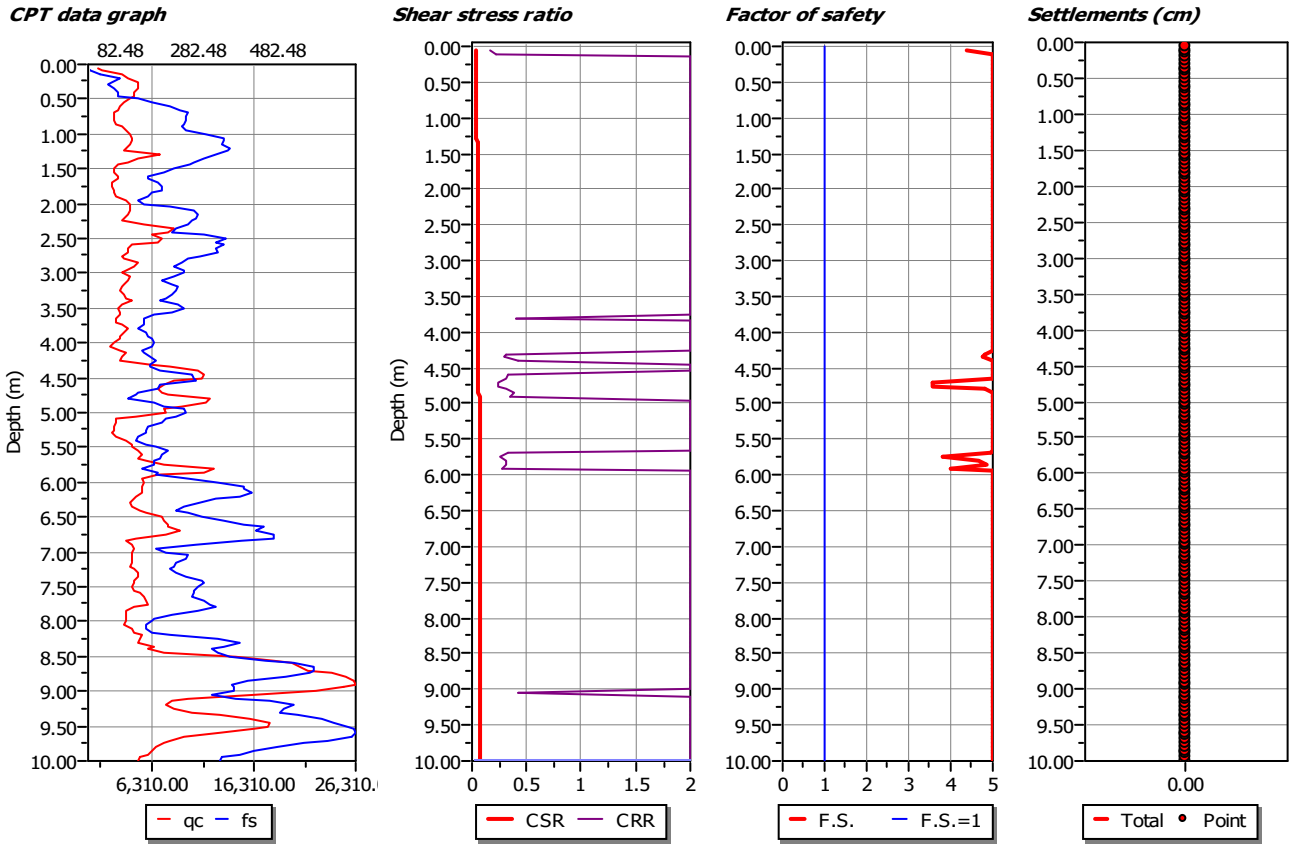
LIQUEFACTION ANALYSIS REPORT

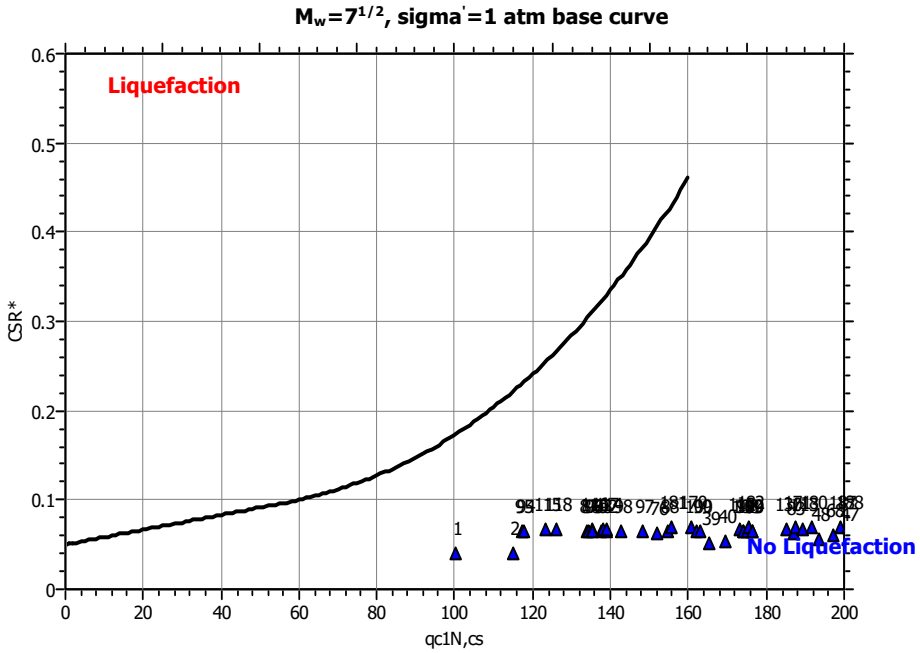
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C21

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.82
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.19 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





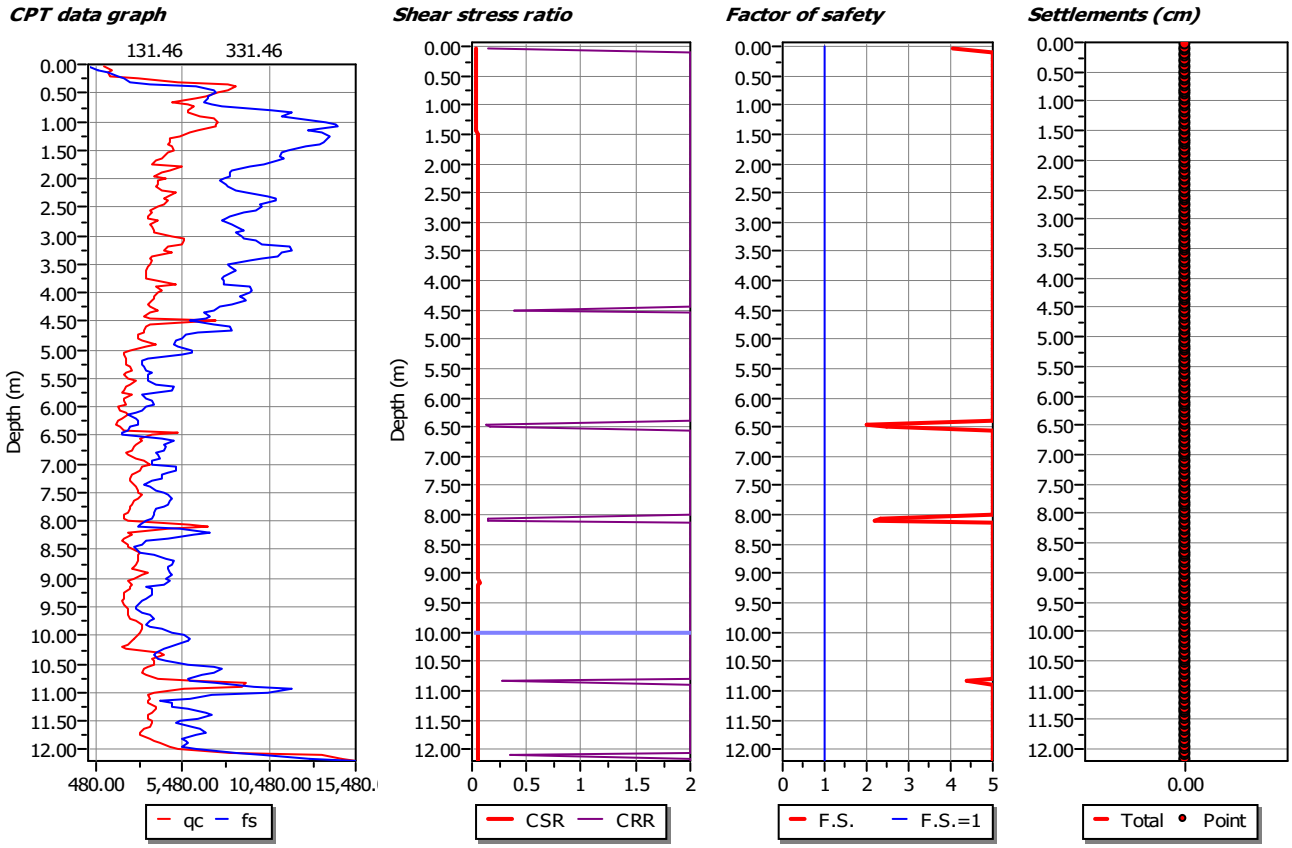
LIQUEFACTION ANALYSIS REPORT

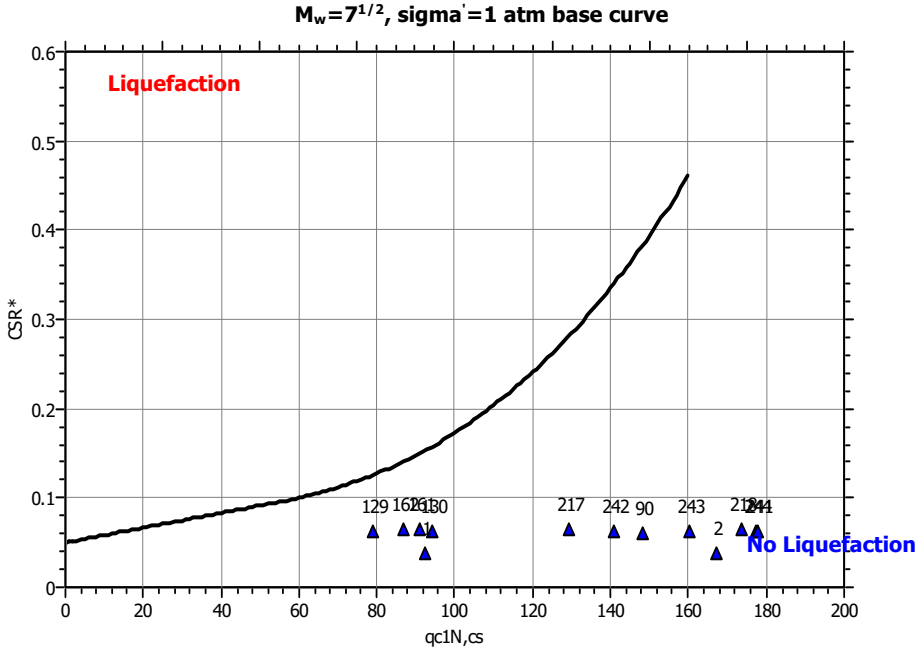
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-21a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.82
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.18 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





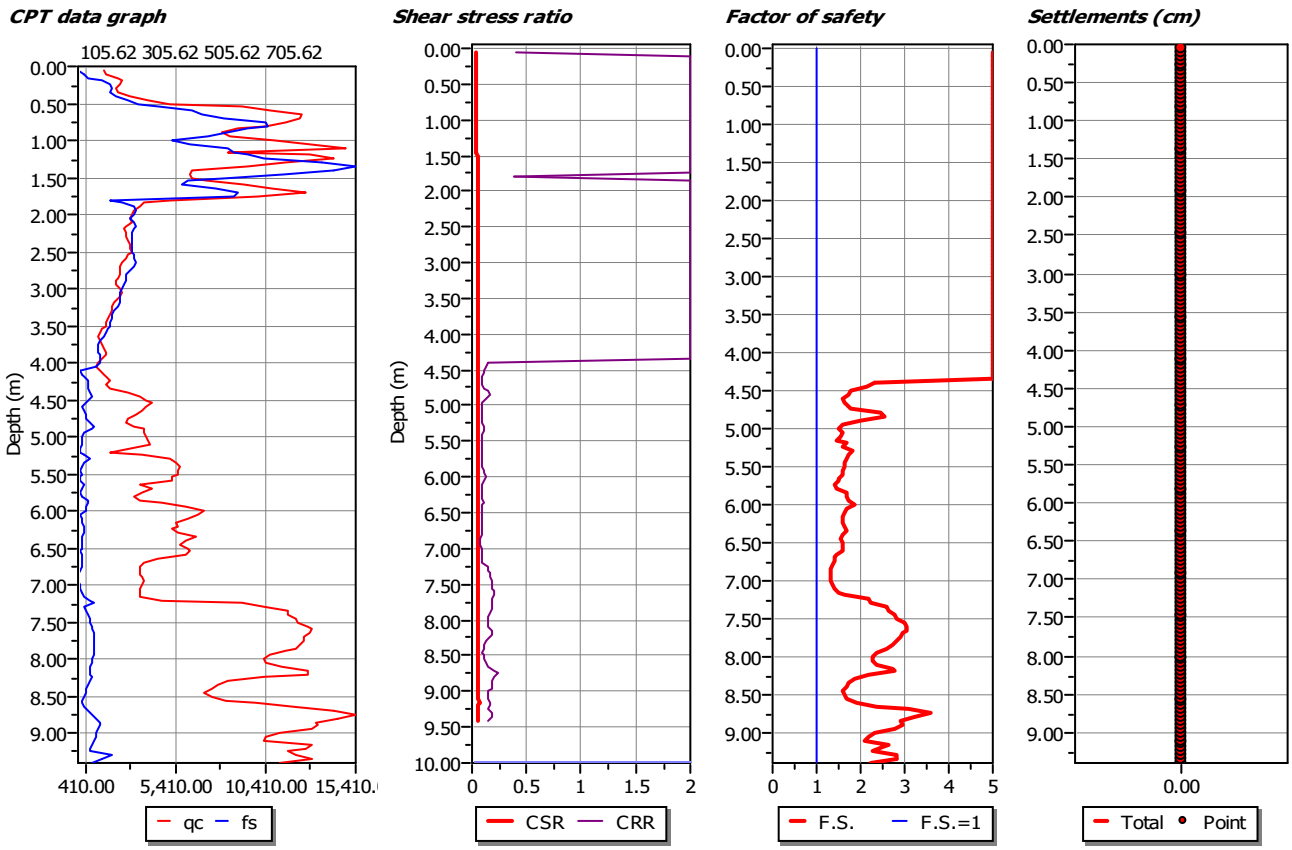
LIQUEFACTION ANALYSIS REPORT

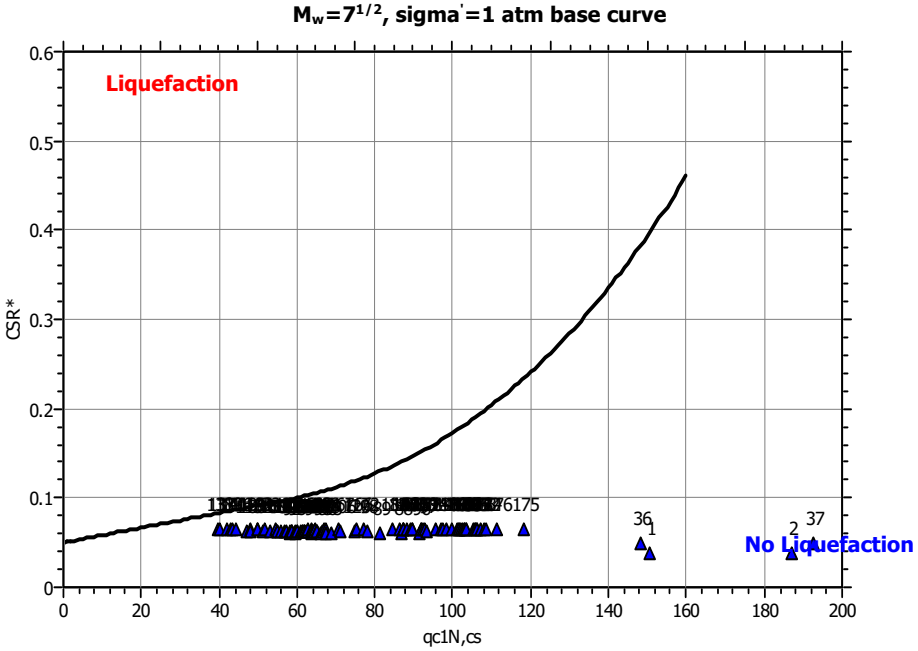
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C21b

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.82
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.18 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





LIQUEFACTION ANALYSIS REPORT

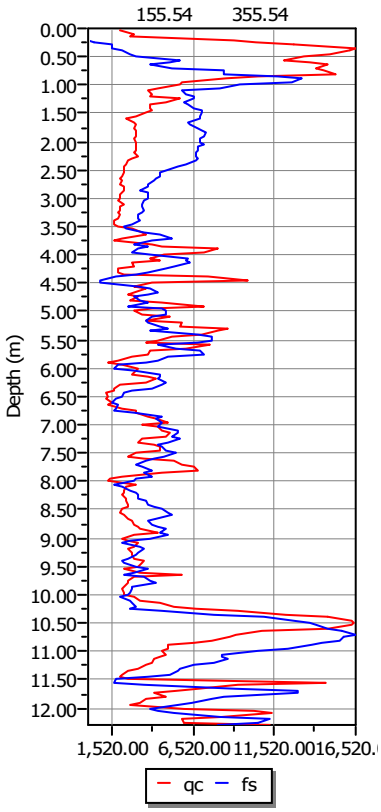
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C22

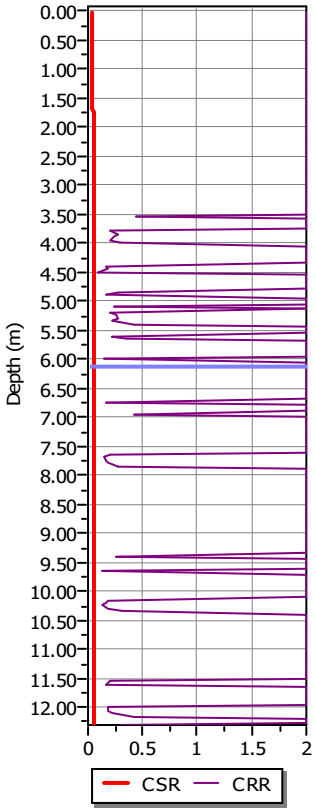
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	6.15 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.82
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.17 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

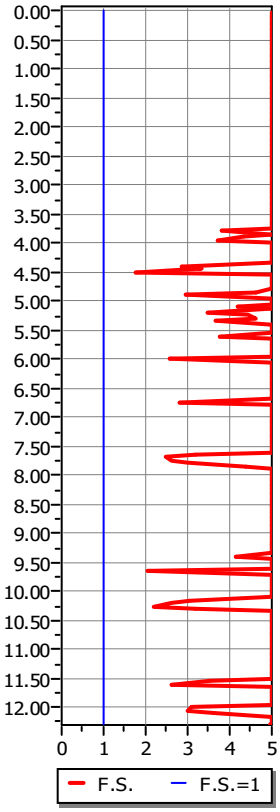
CPT data graph



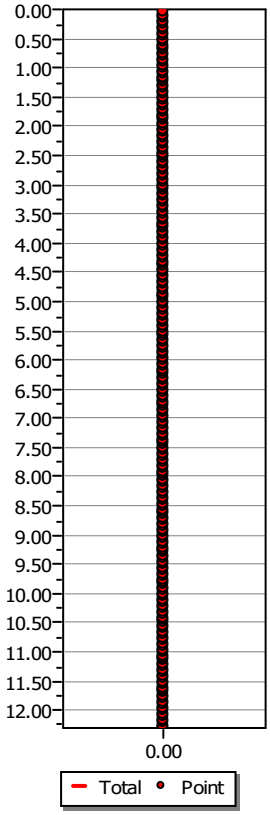
Shear stress ratio



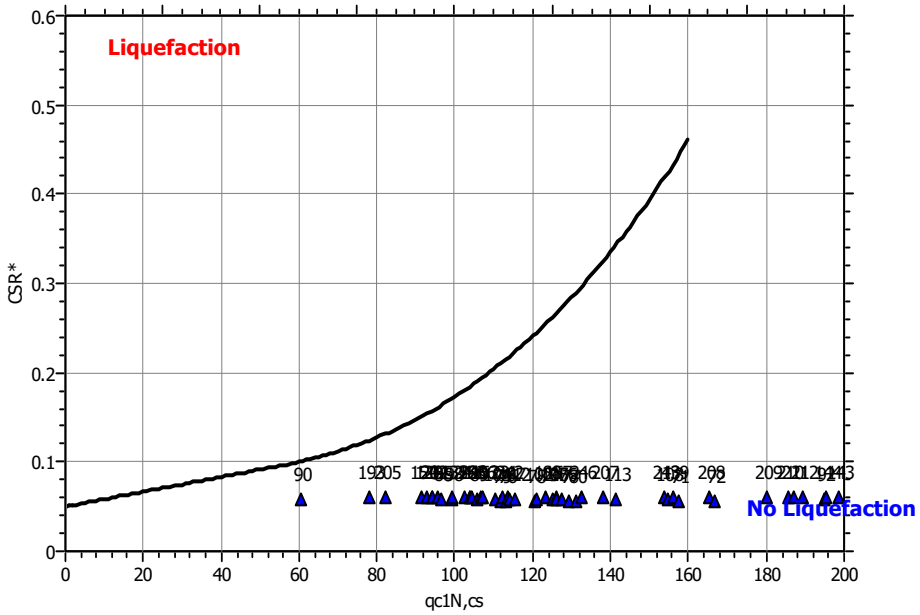
Factor of safety



Settlements (cm)



$M_w=7^{1/2}$, sigma'=1 atm base curve



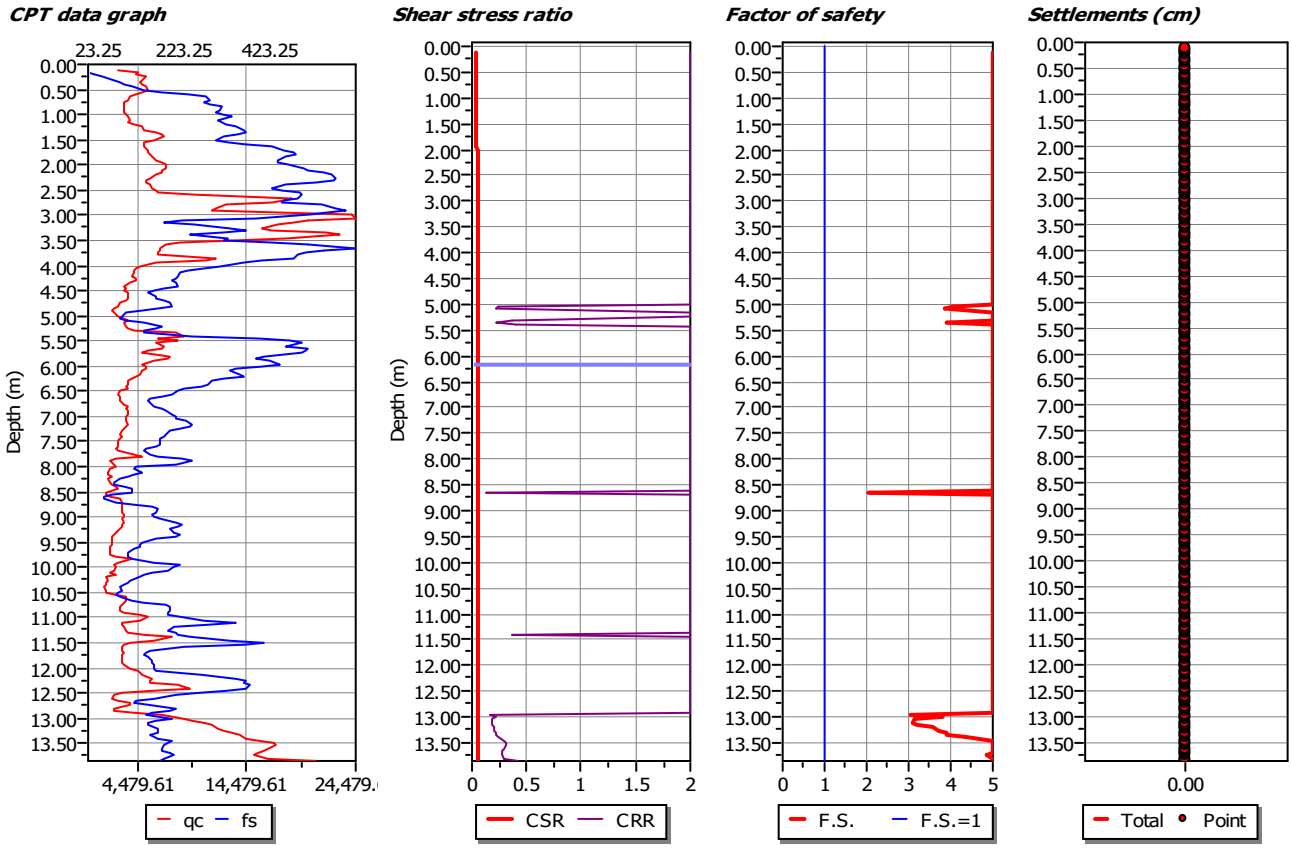
LIQUEFACTION ANALYSIS REPORT

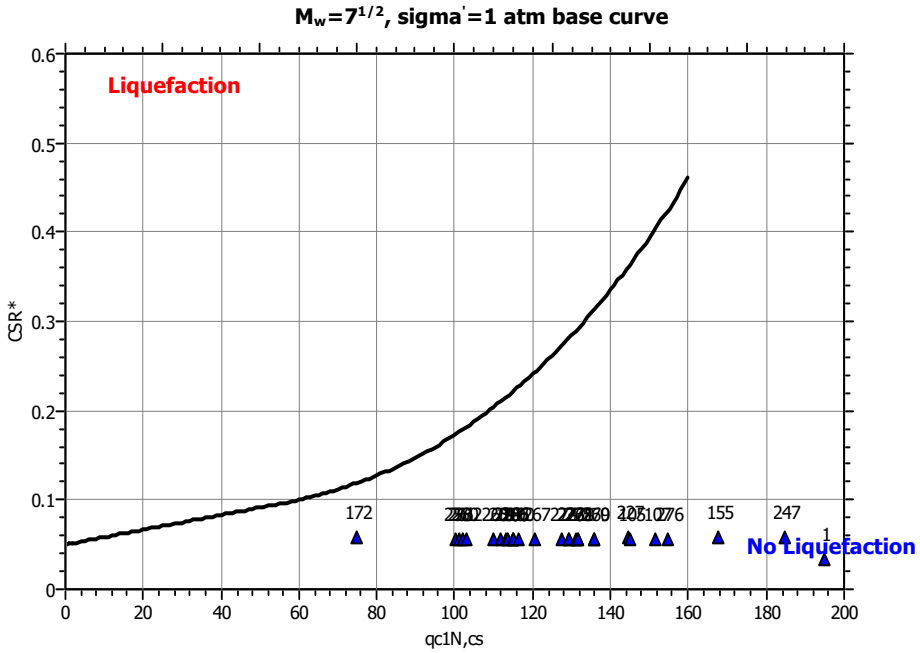
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C22a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	6.15 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.16 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





SAIPEM S.p.A.

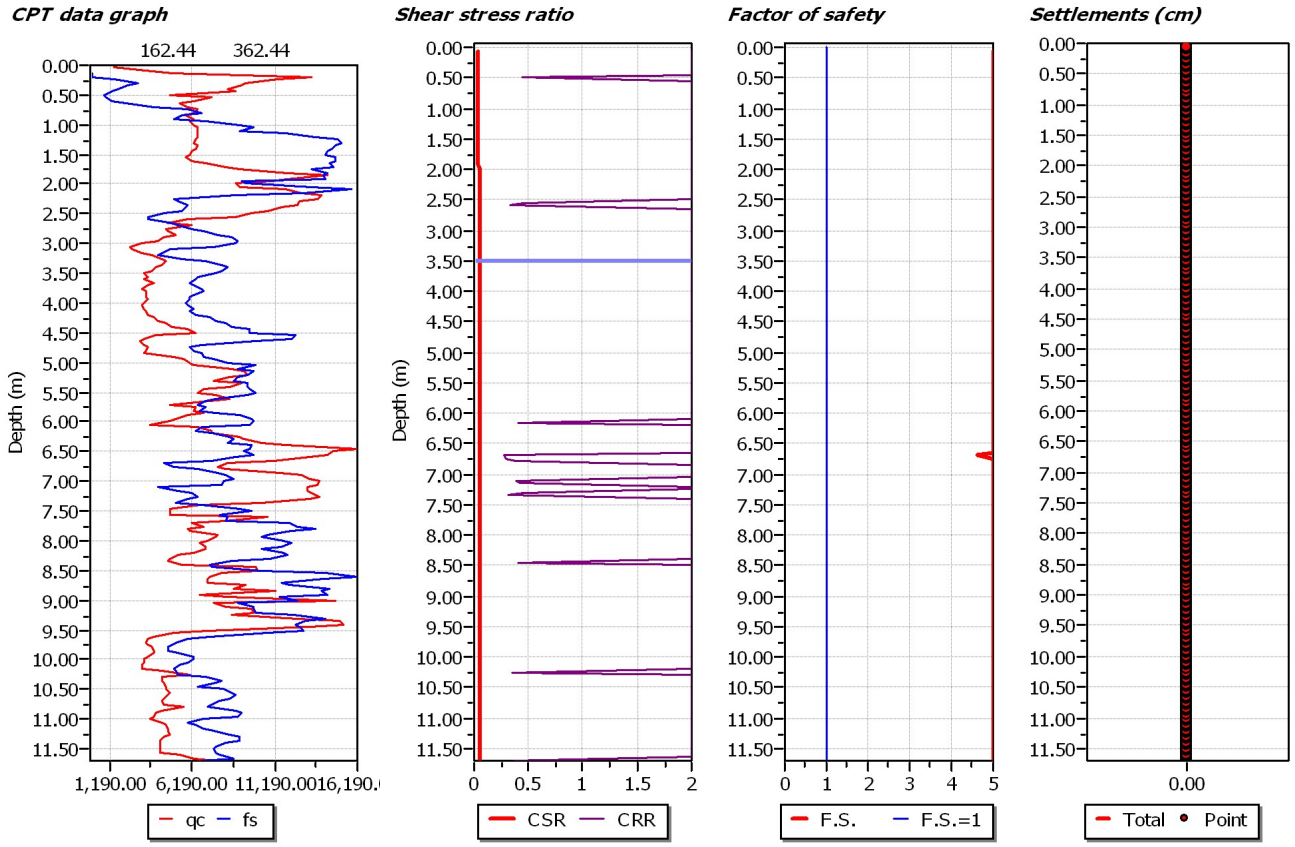
LIQUEFACTION ANALYSIS REPORT

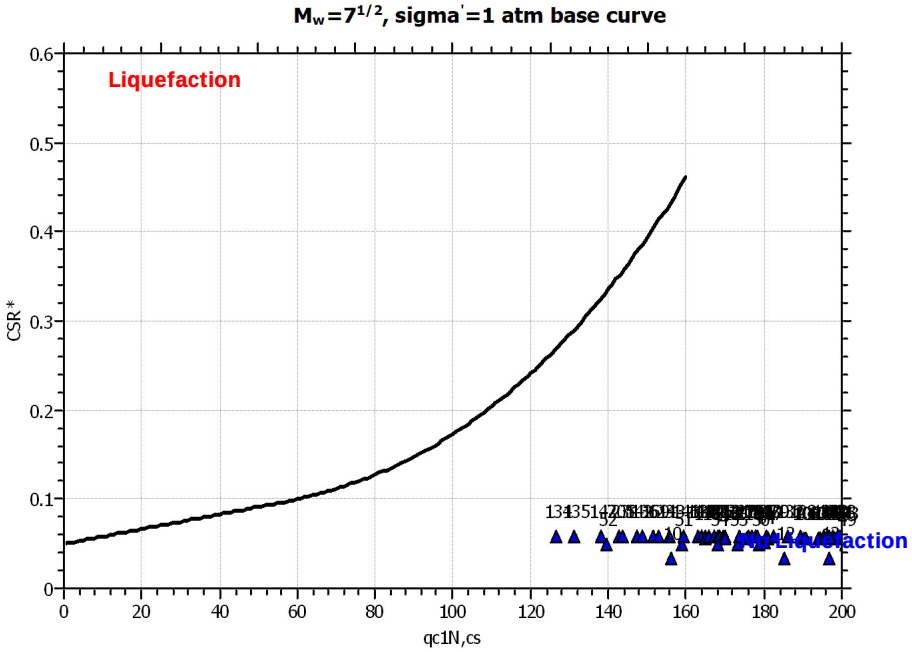
Project title : Met. Livorno Piombino

Project subtitle : CPTU LP-B-C22b

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	3.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.16 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





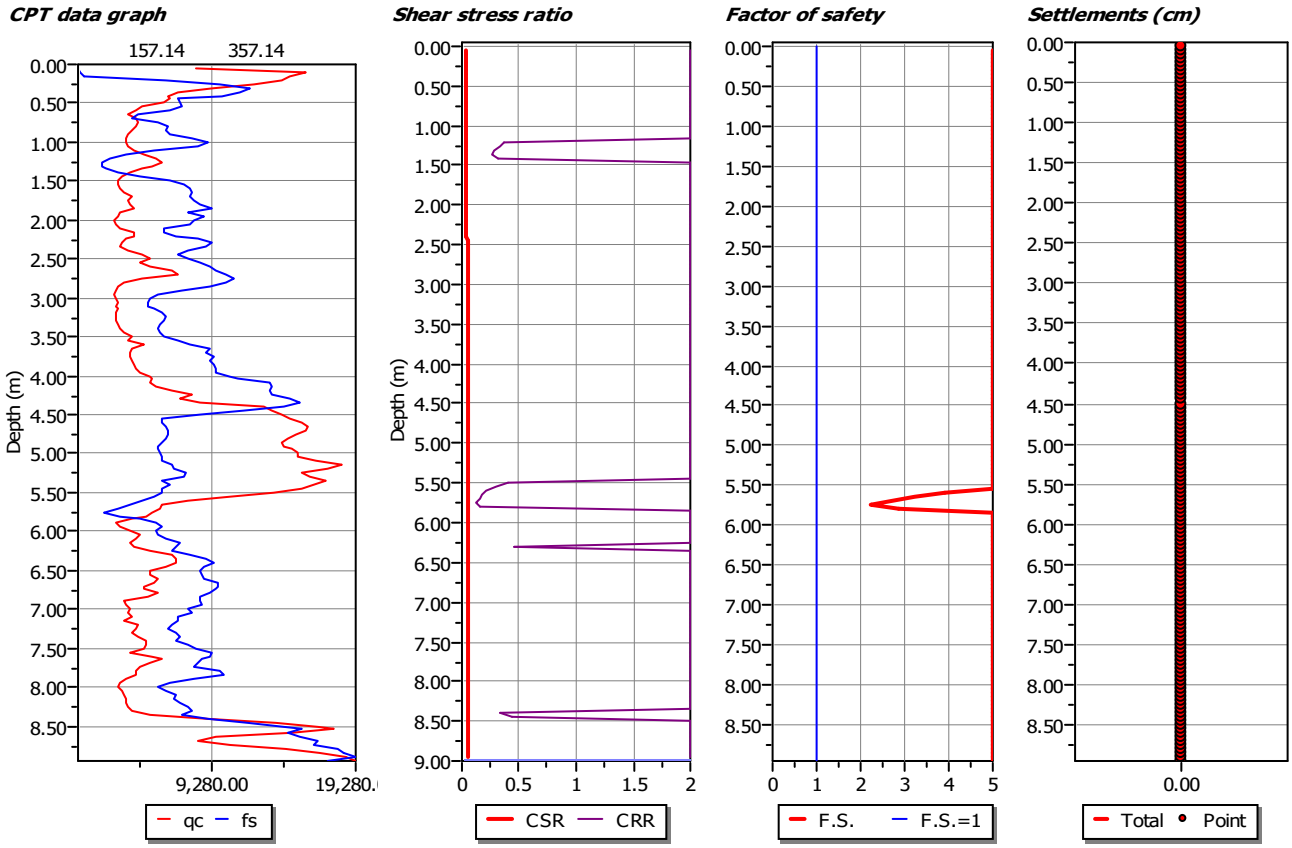
LIQUEFACTION ANALYSIS REPORT

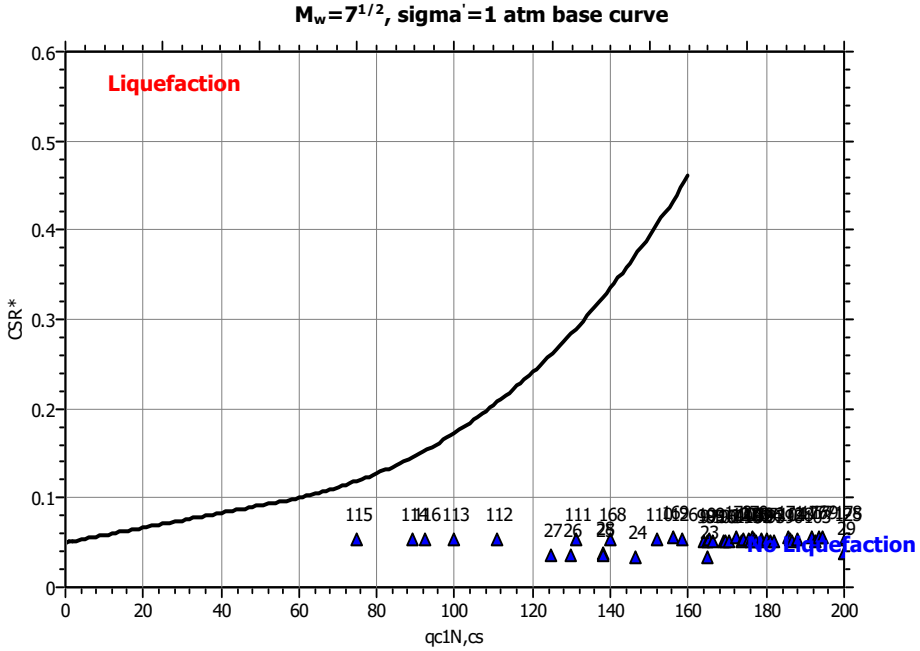
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C22c

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	9.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.15 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





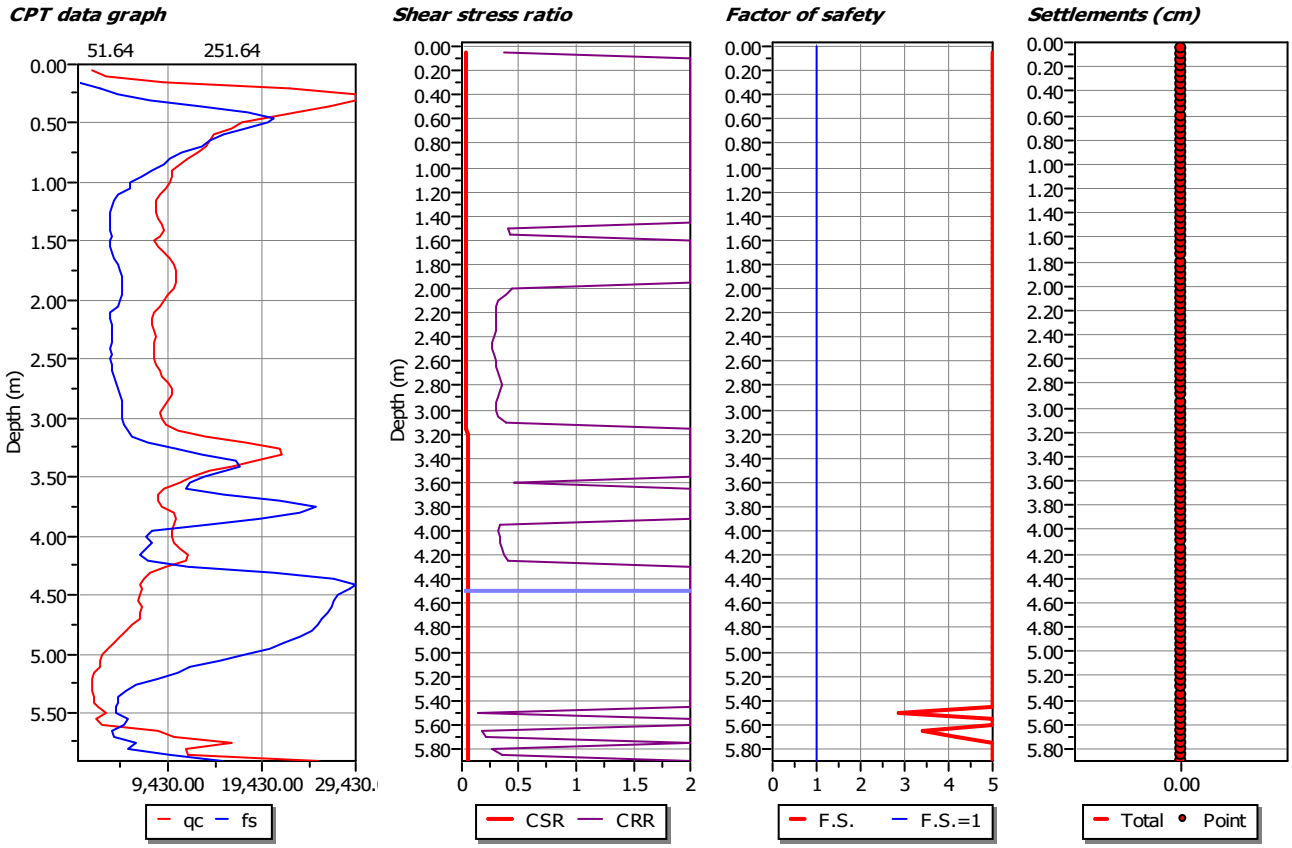
LIQUEFACTION ANALYSIS REPORT

Project title : Met. Livorno Piombino

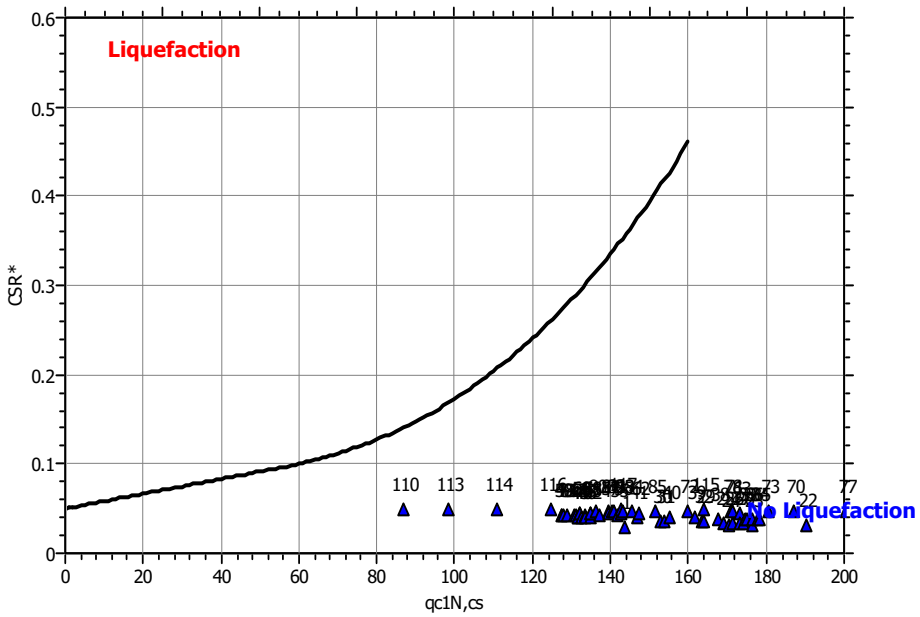
Project subtitle : LP-B-C23

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	4.50 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.14 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00



$M_w=7^{1/2}$, sigma'=1 atm base curve



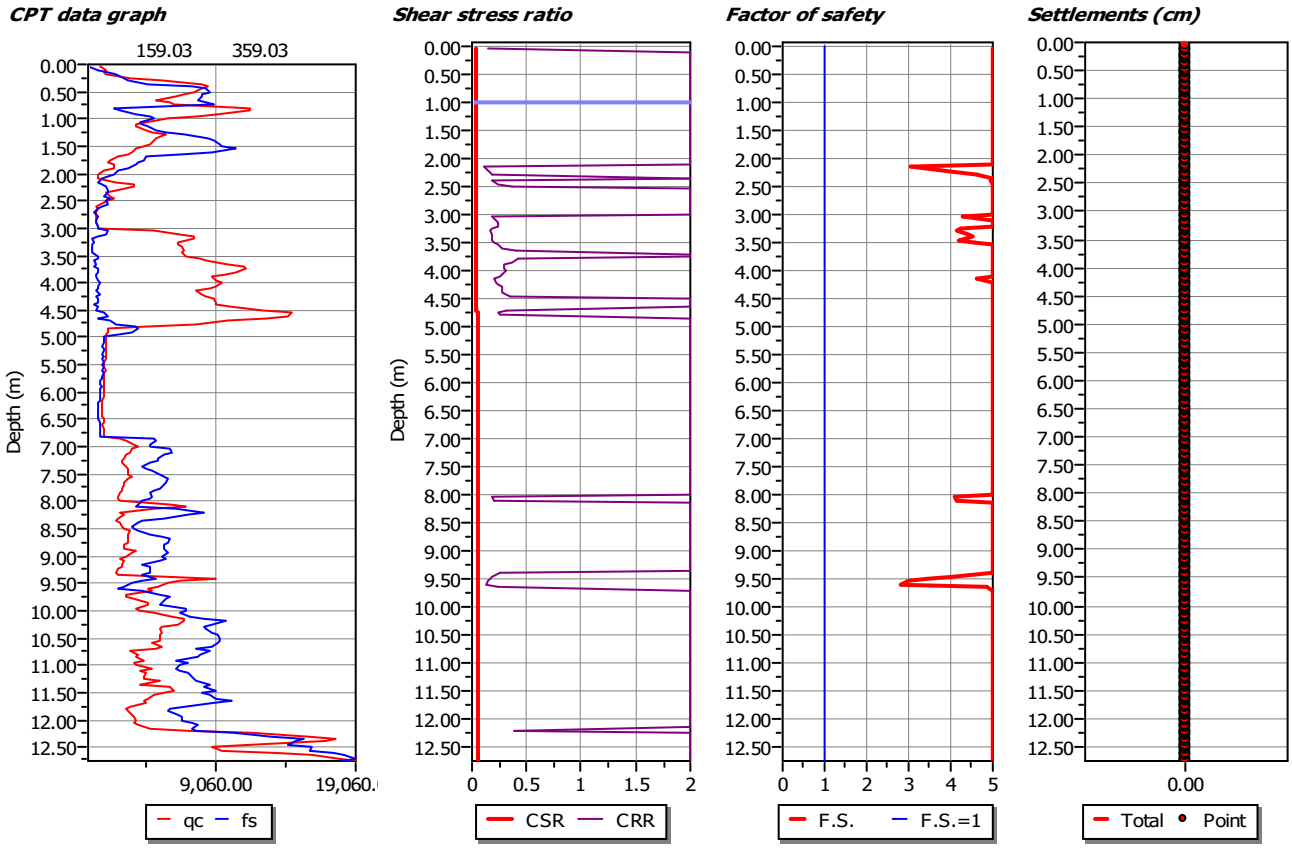
LIQUEFACTION ANALYSIS REPORT

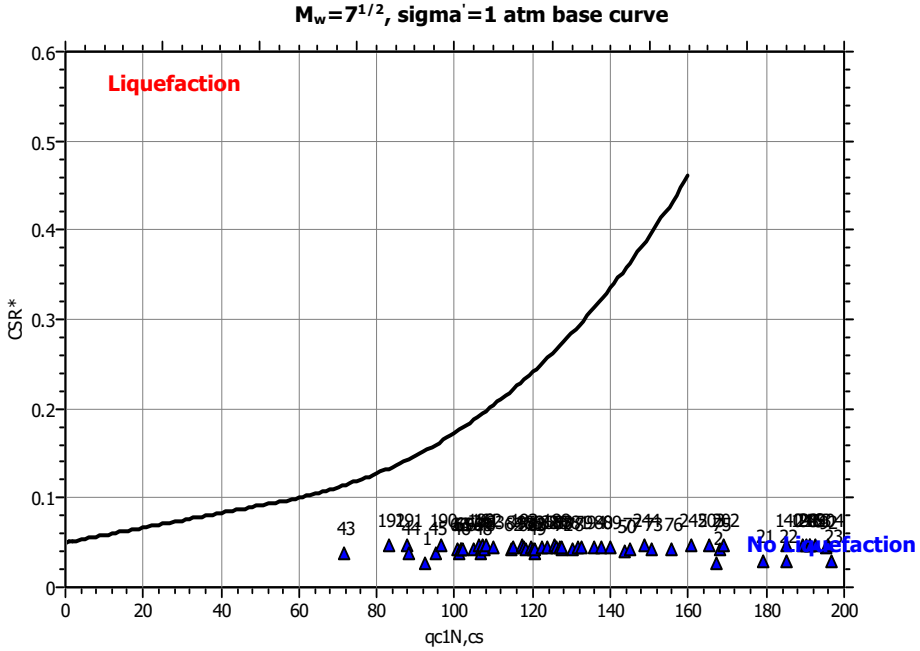
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C24

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.13 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





LIQUEFACTION ANALYSIS REPORT

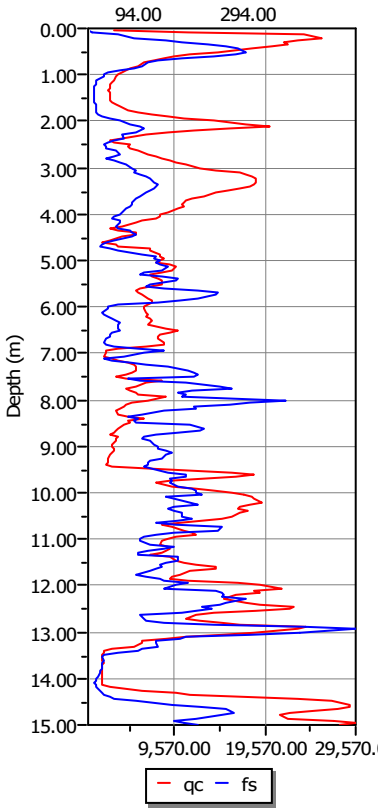
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C25

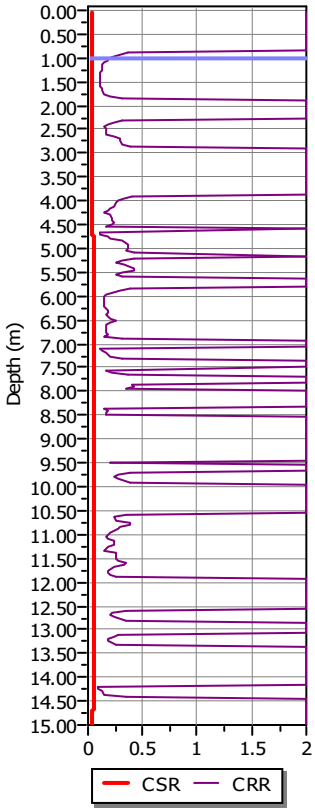
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.13 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

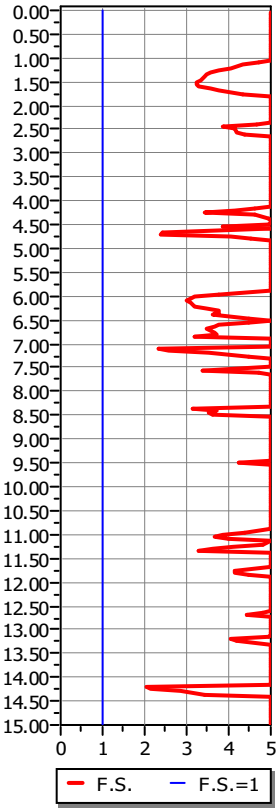
CPT data graph



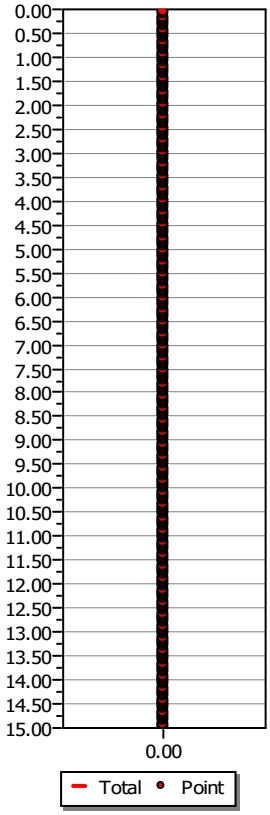
Shear stress ratio



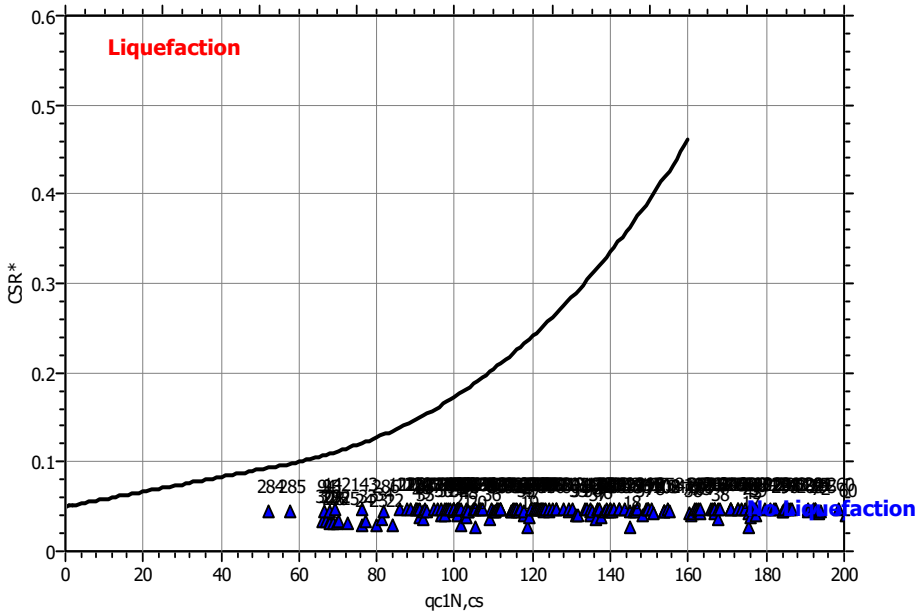
Factor of safety



Settlements (cm)



$M_w=7^{1/2}$, sigma'=1 atm base curve



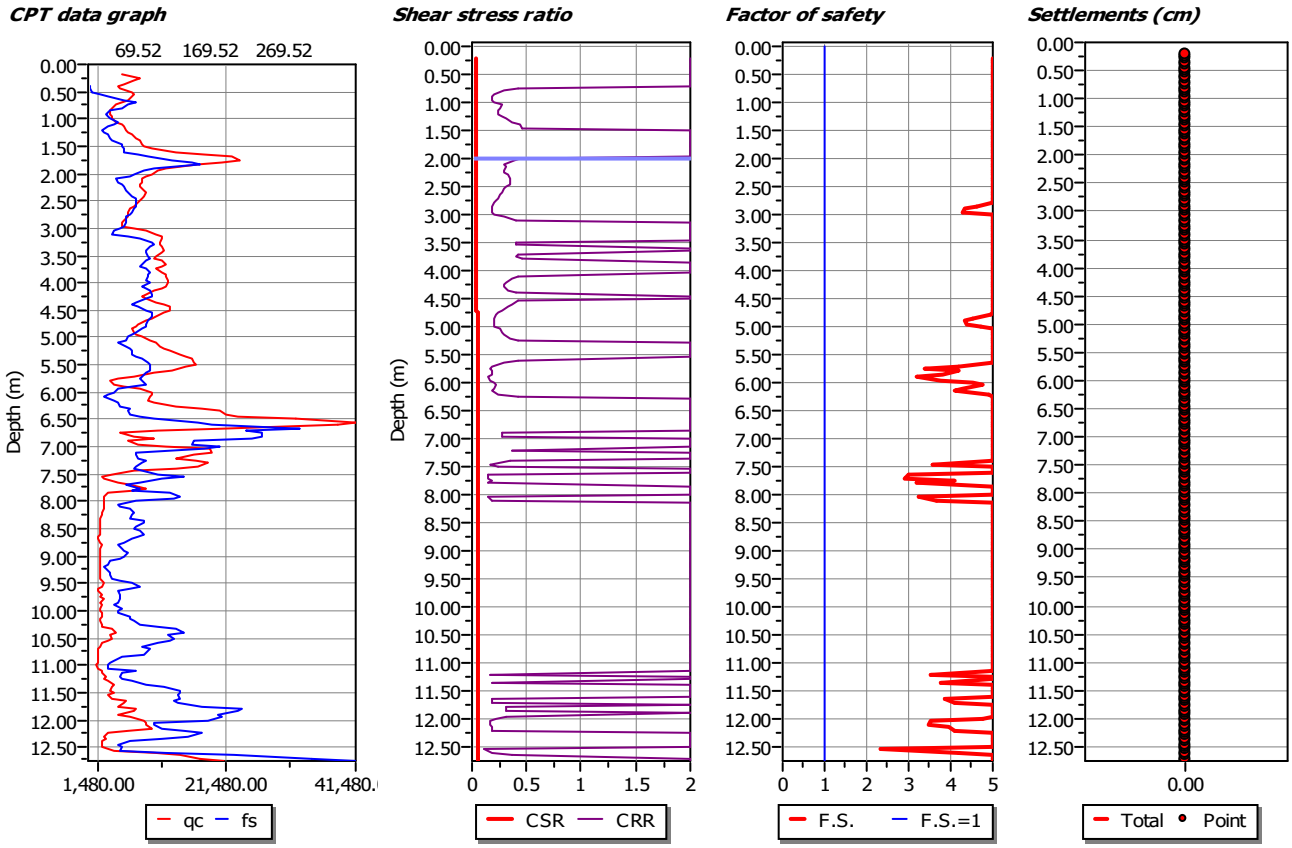
LIQUEFACTION ANALYSIS REPORT

Project title : Met. Livorno-Piombino

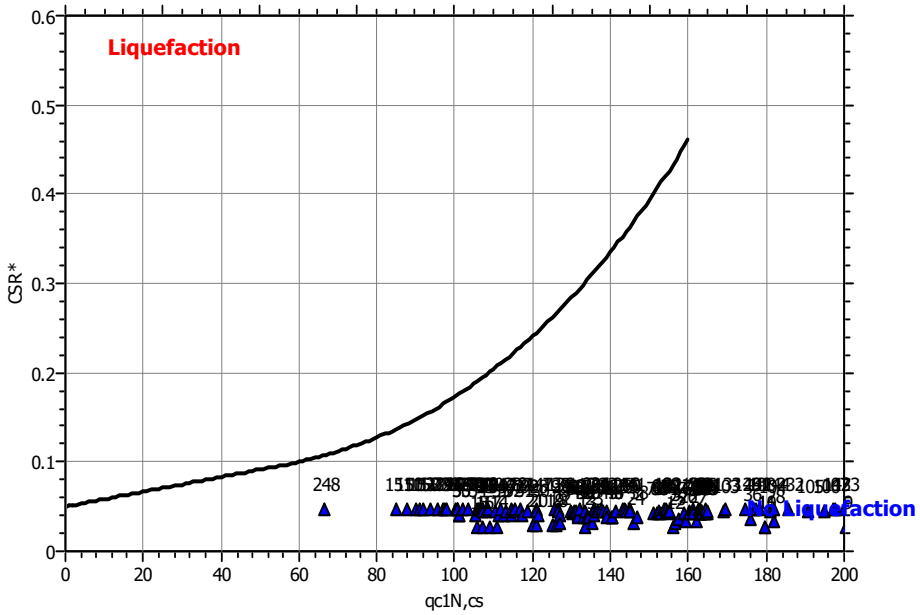
Project subtitle : LP-B-C26

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	2.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.13 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00



$M_w=7^{1/2}$, sigma'=1 atm base curve



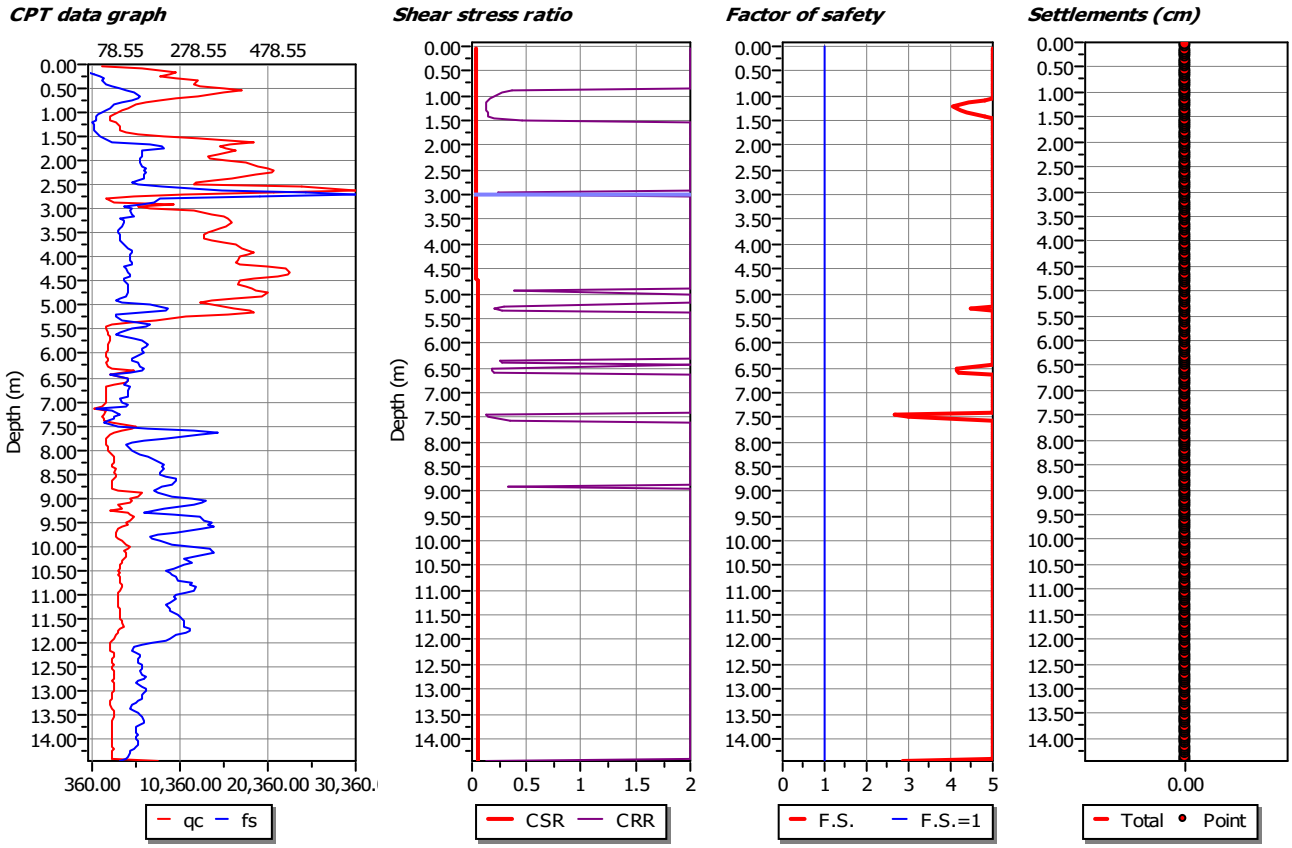
LIQUEFACTION ANALYSIS REPORT

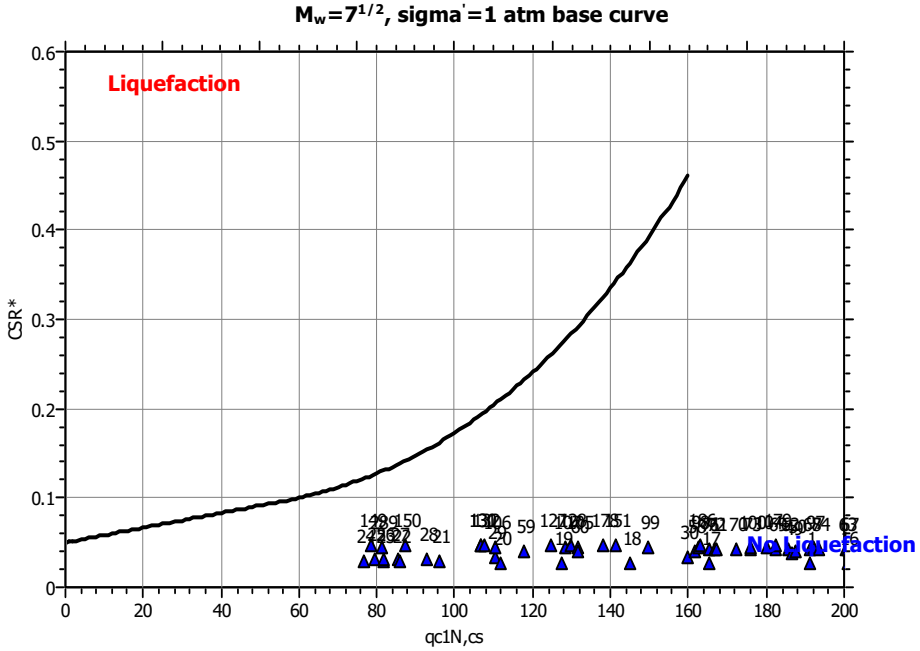
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C27

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	3.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.13 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





SAIPEM S.p.A.

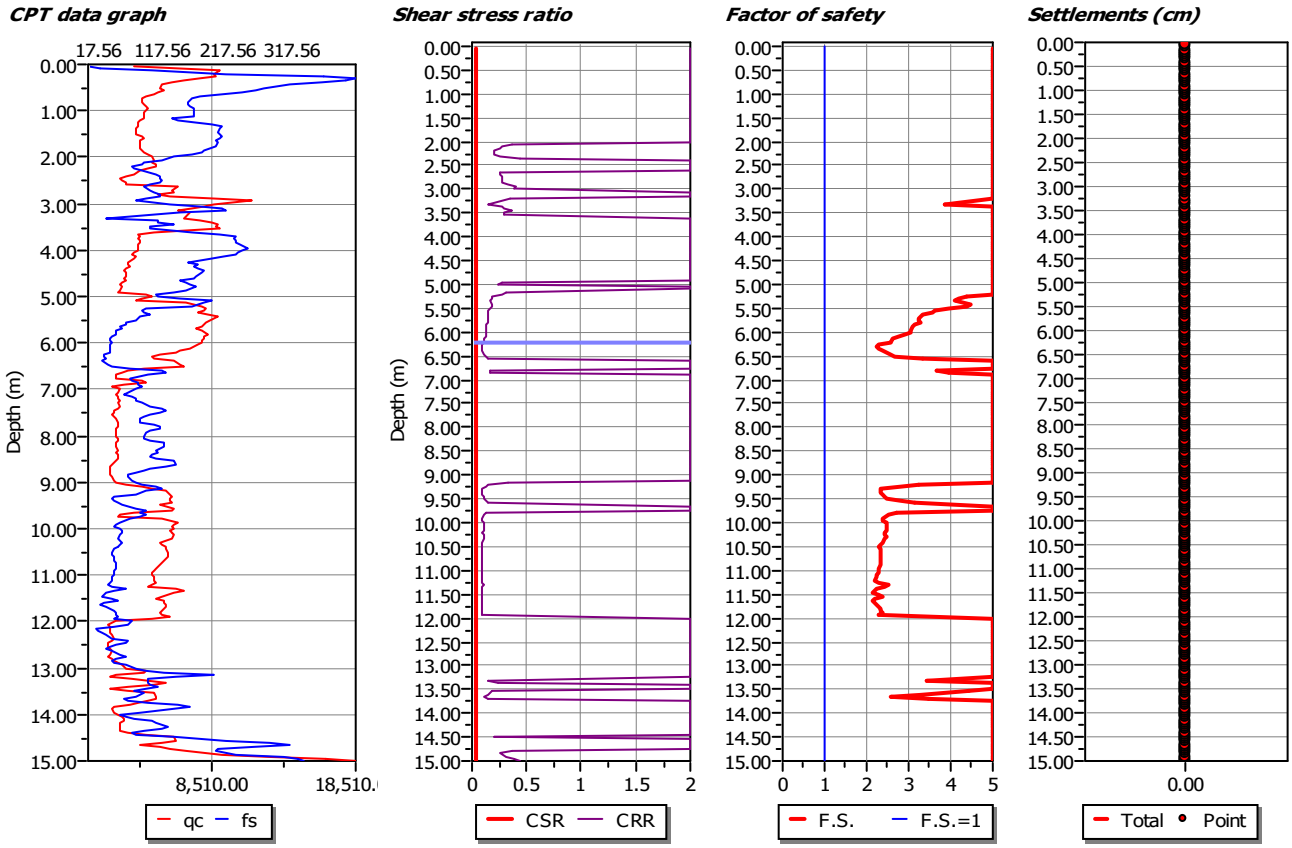
LIQUEFACTION ANALYSIS REPORT

Project title : Met. Livorno-Piombino

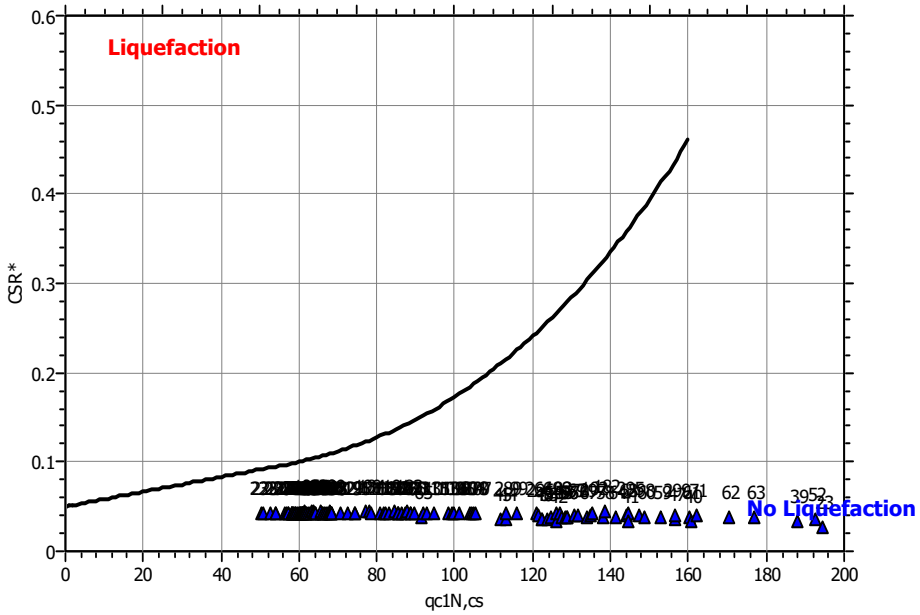
Project subtitle : LP-B-C28

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	6.20 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.12 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00



$M_w=7^{1/2}$, sigma'=1 atm base curve



SAIPEM S.p.A.

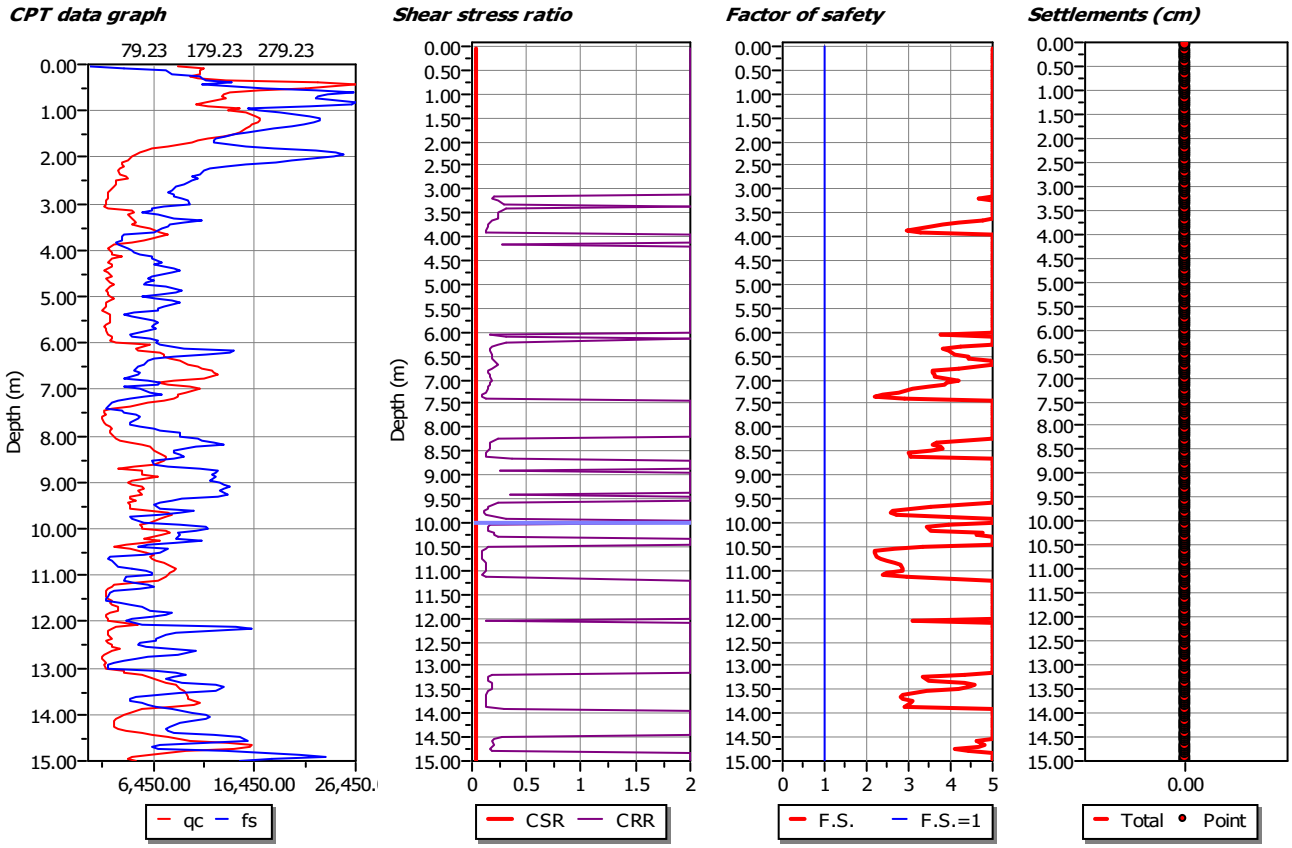
LIQUEFACTION ANALYSIS REPORT

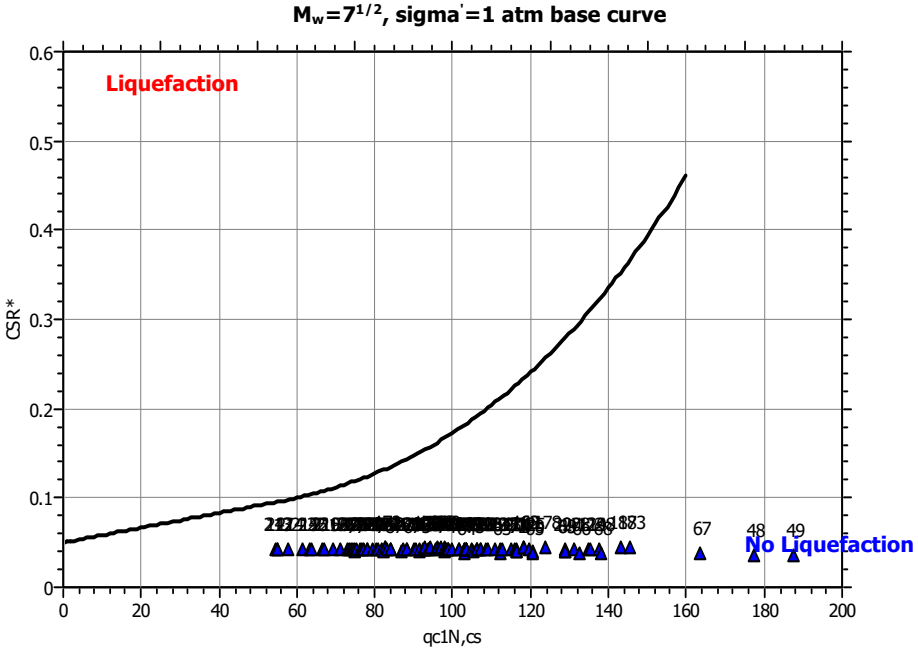
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C29

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.12 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





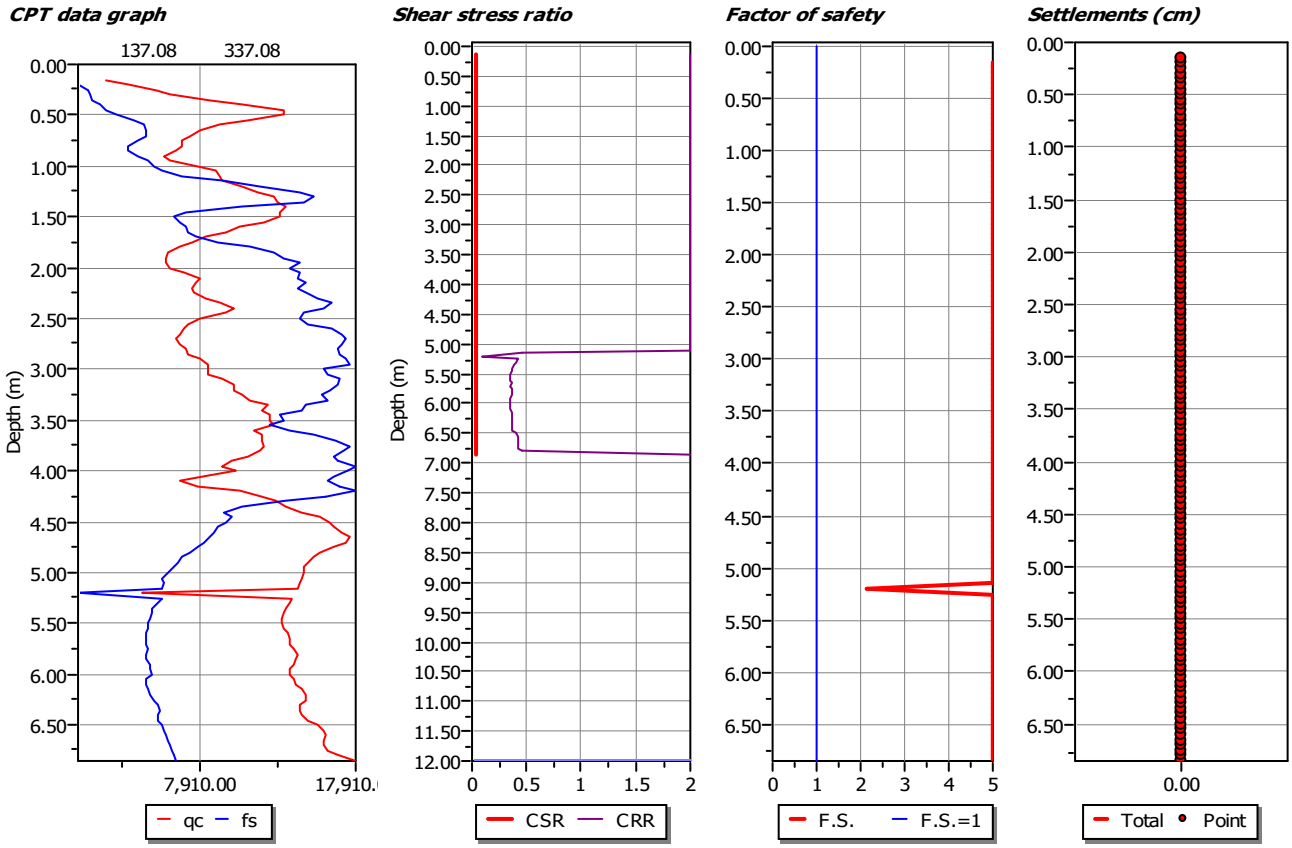
LIQUEFACTION ANALYSIS REPORT

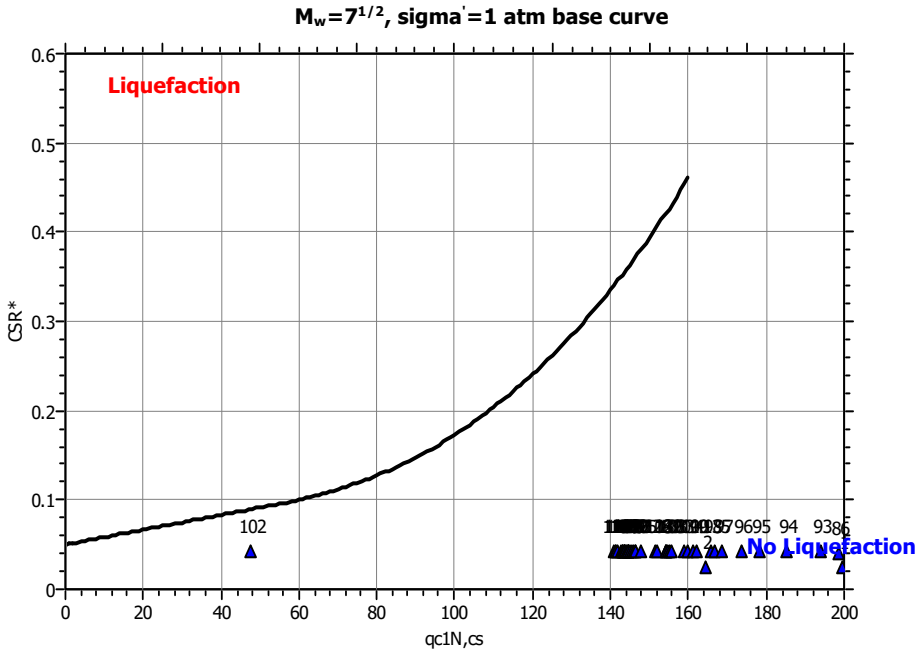
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C30

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	12.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.12 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





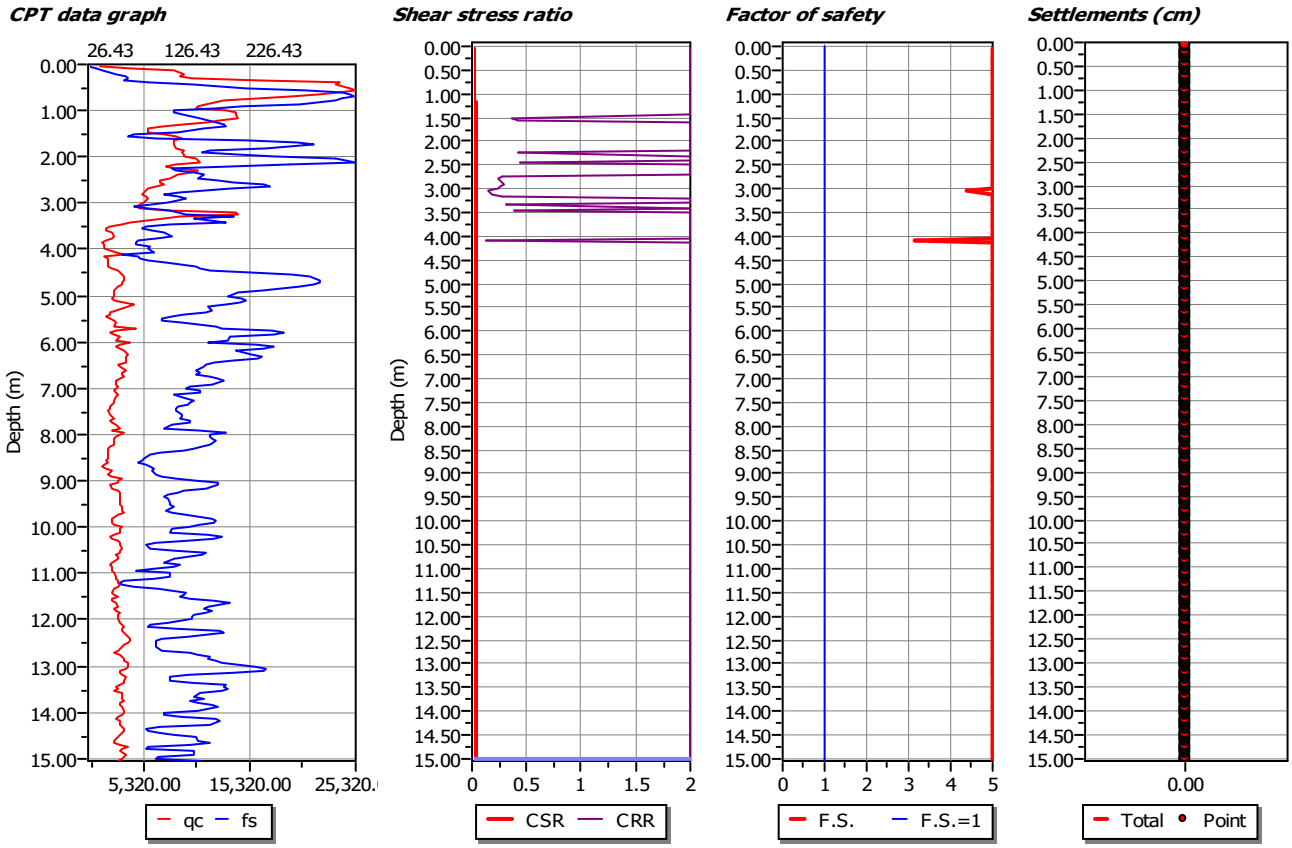
LIQUEFACTION ANALYSIS REPORT

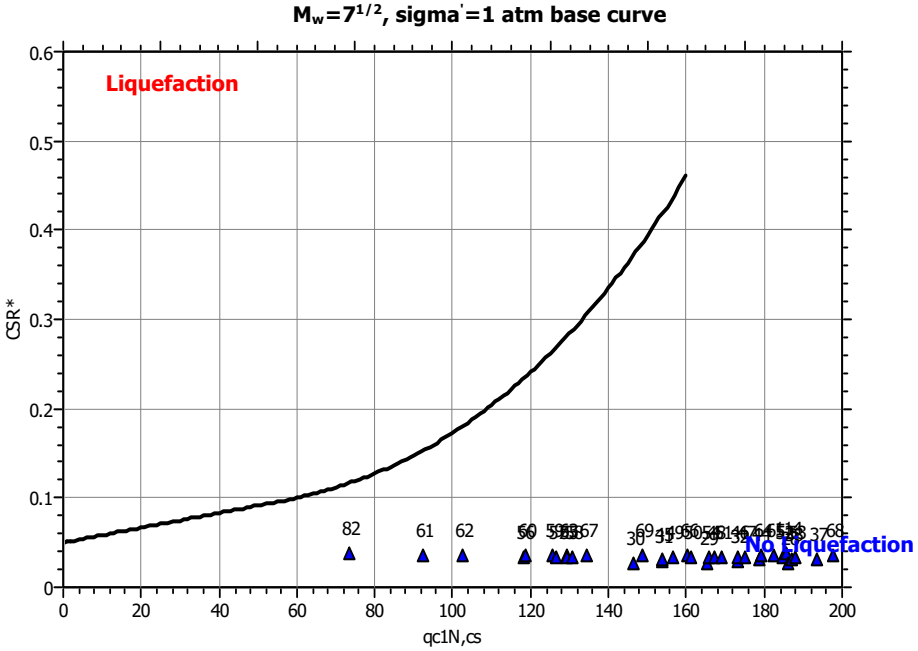
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C31

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





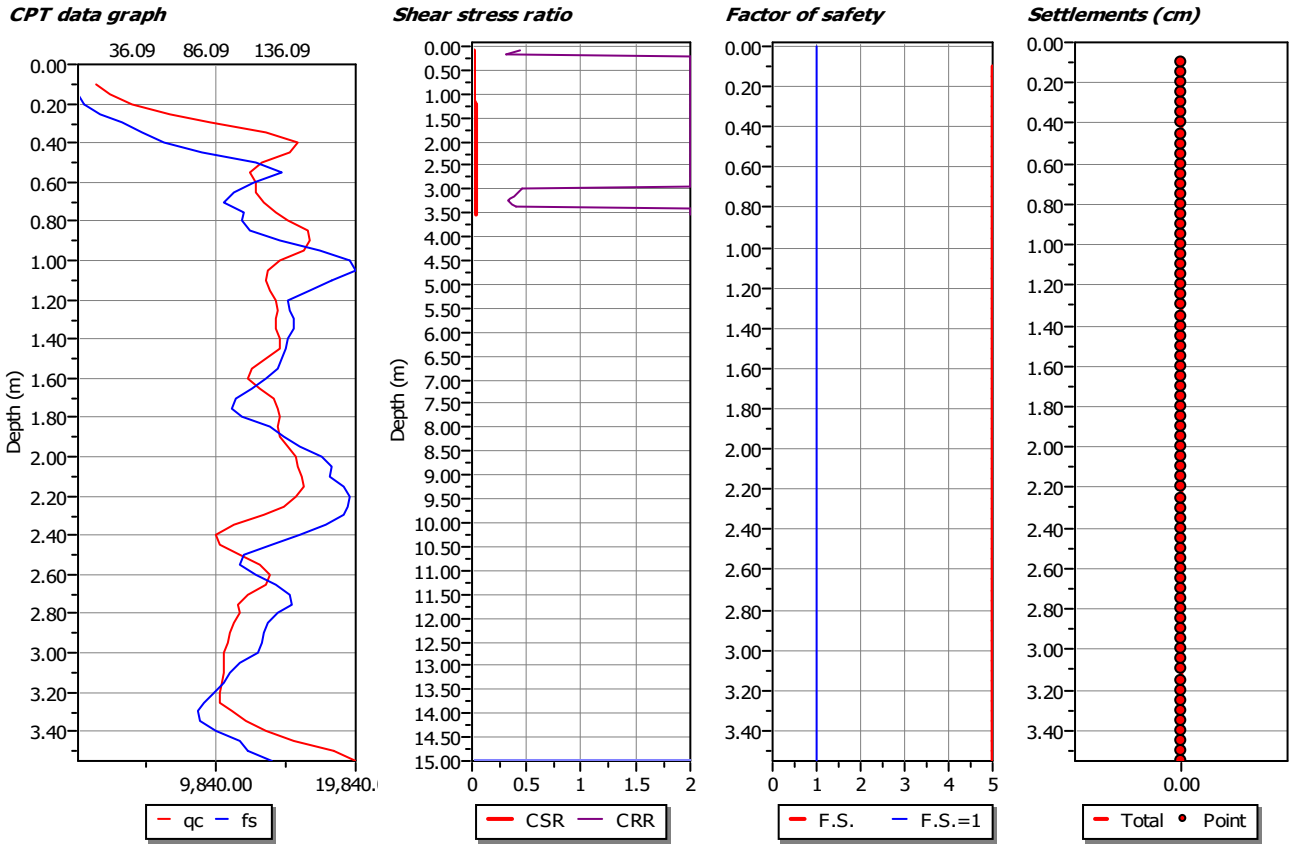
LIQUEFACTION ANALYSIS REPORT

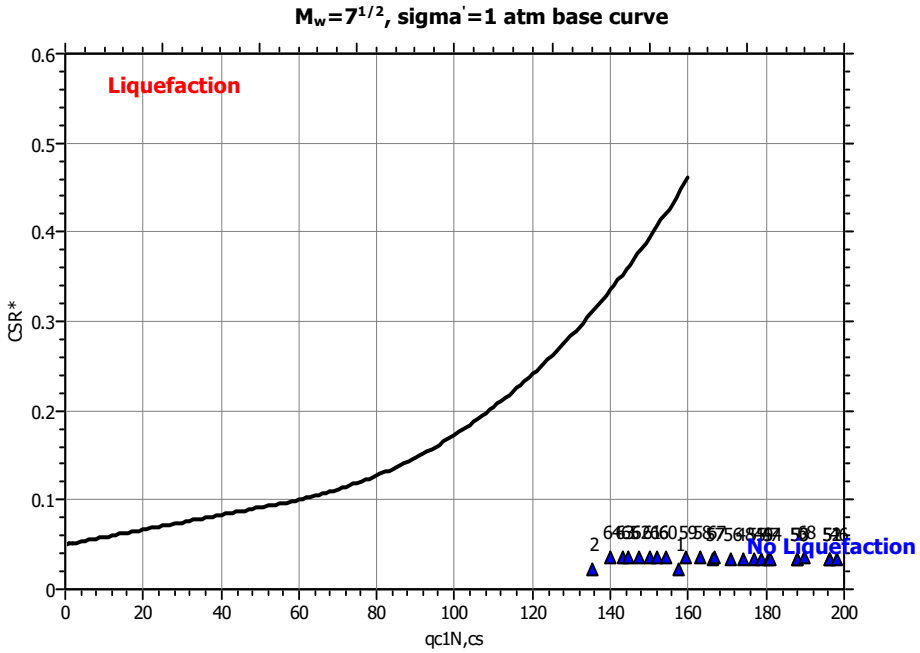
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C31a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





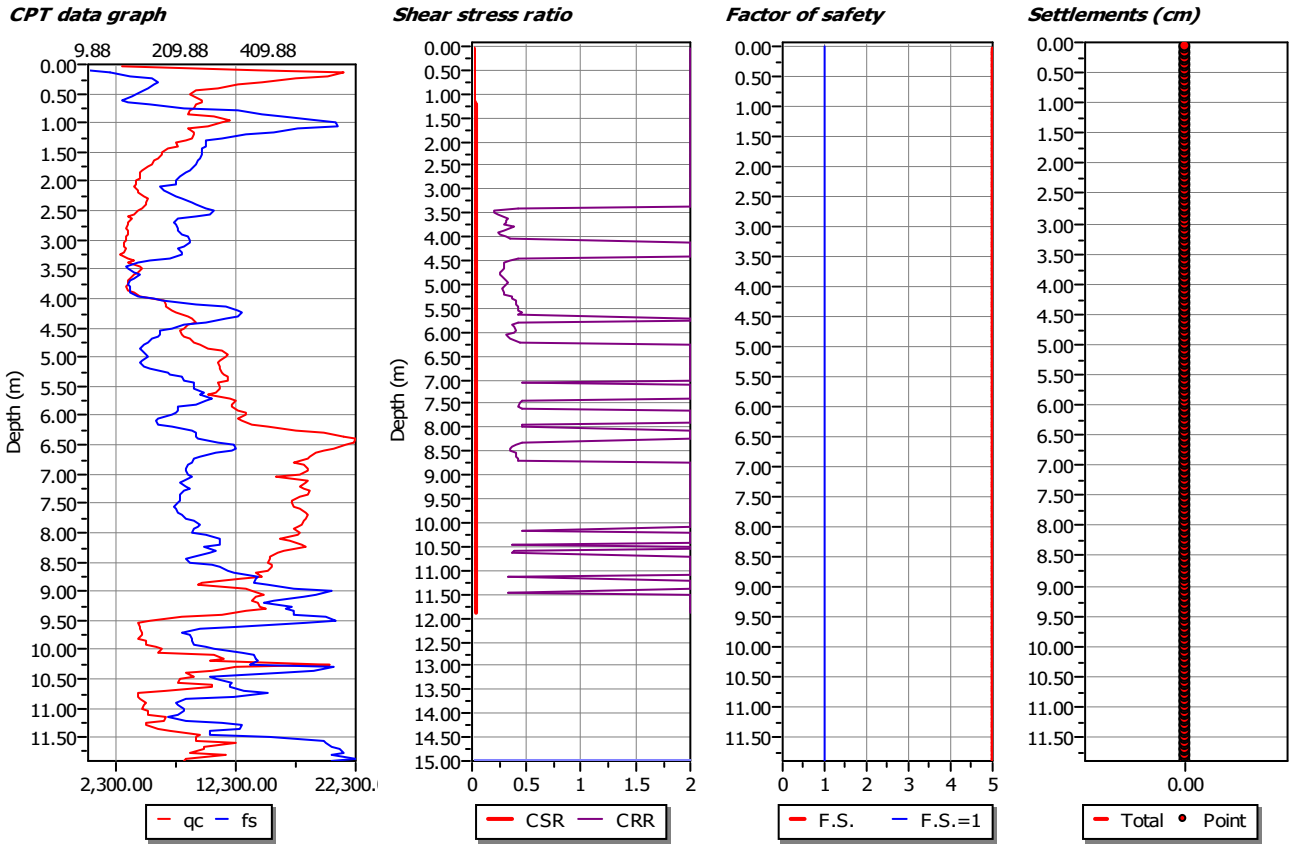
LIQUEFACTION ANALYSIS REPORT

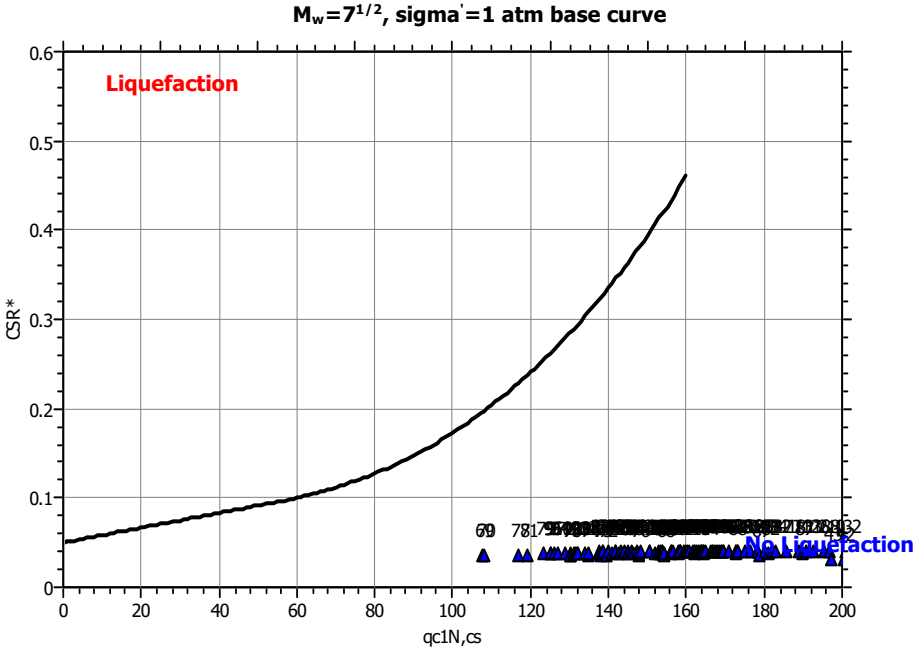
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C32

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





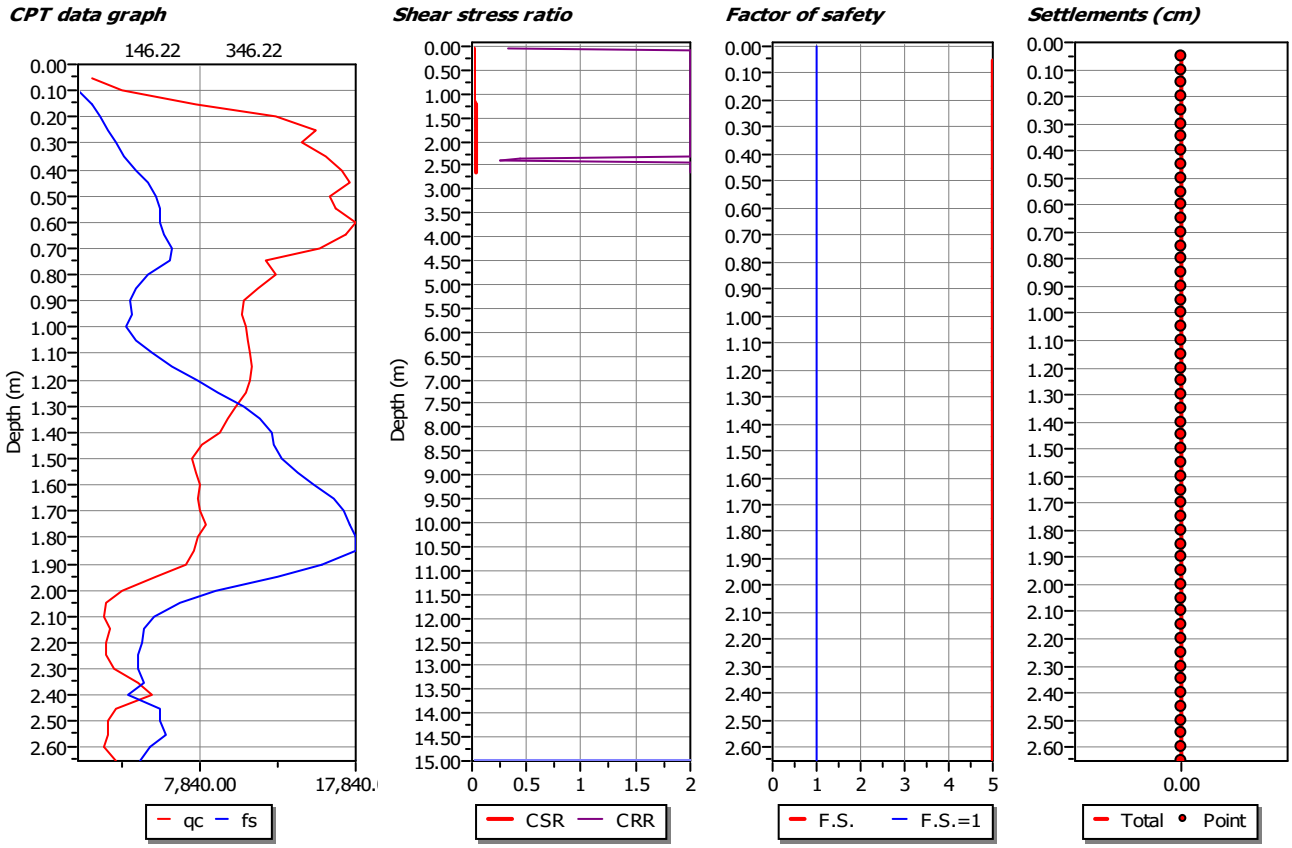
LIQUEFACTION ANALYSIS REPORT

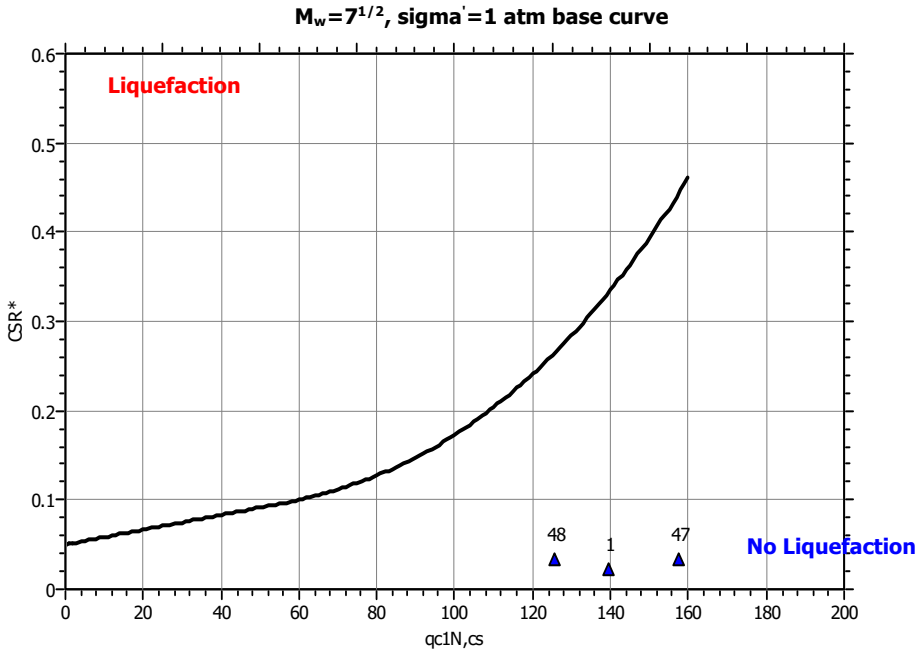
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C32a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





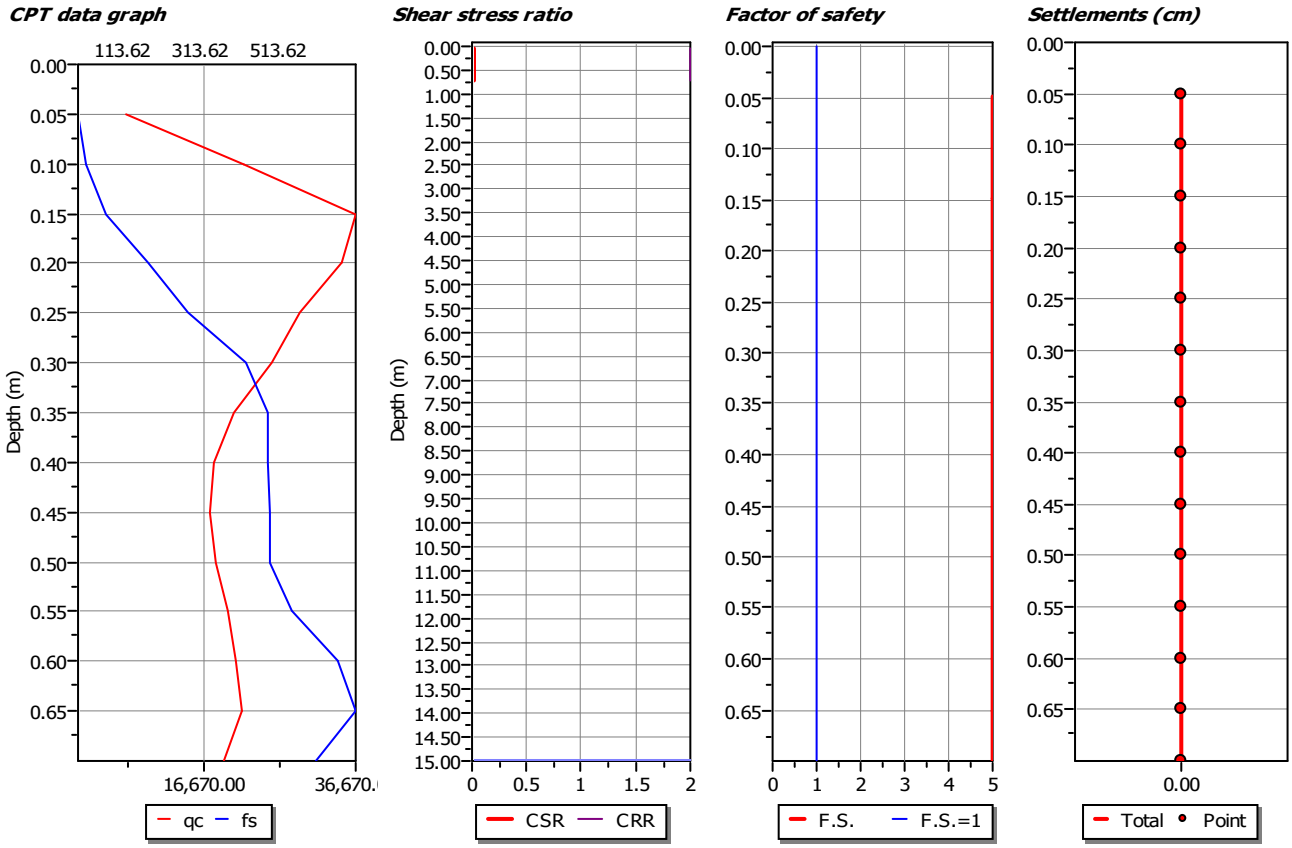
LIQUEFACTION ANALYSIS REPORT

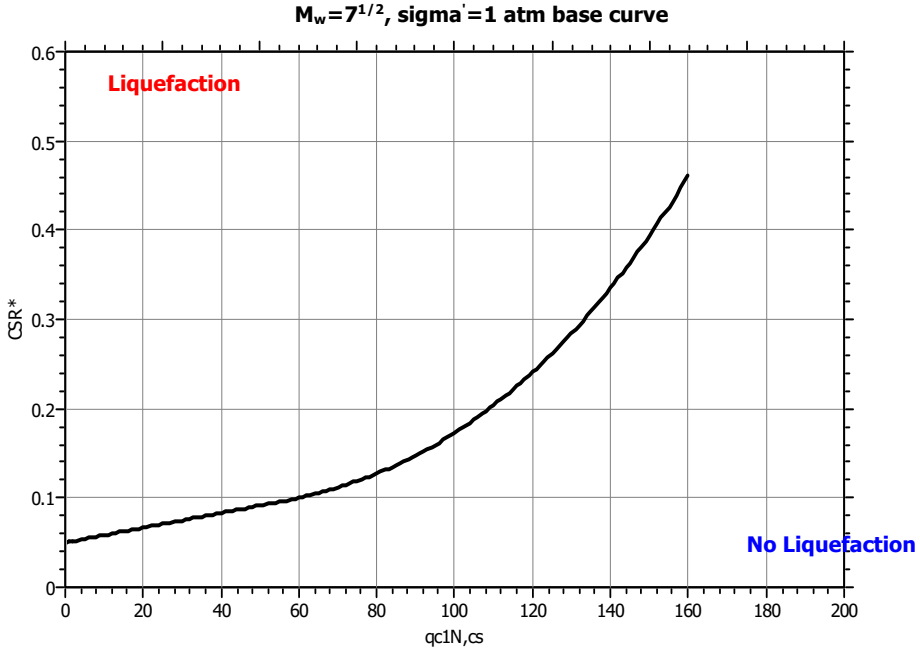
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C32b

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





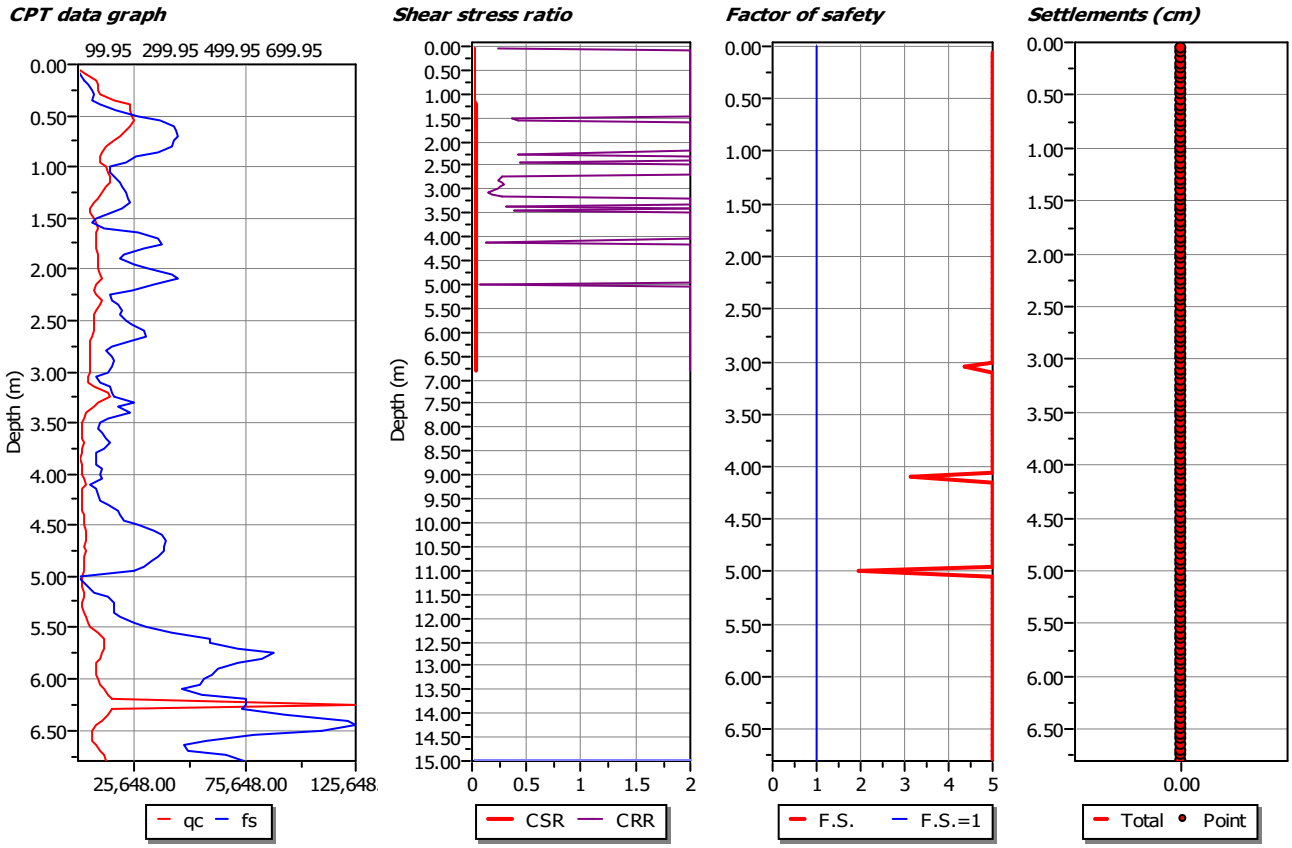
LIQUEFACTION ANALYSIS REPORT

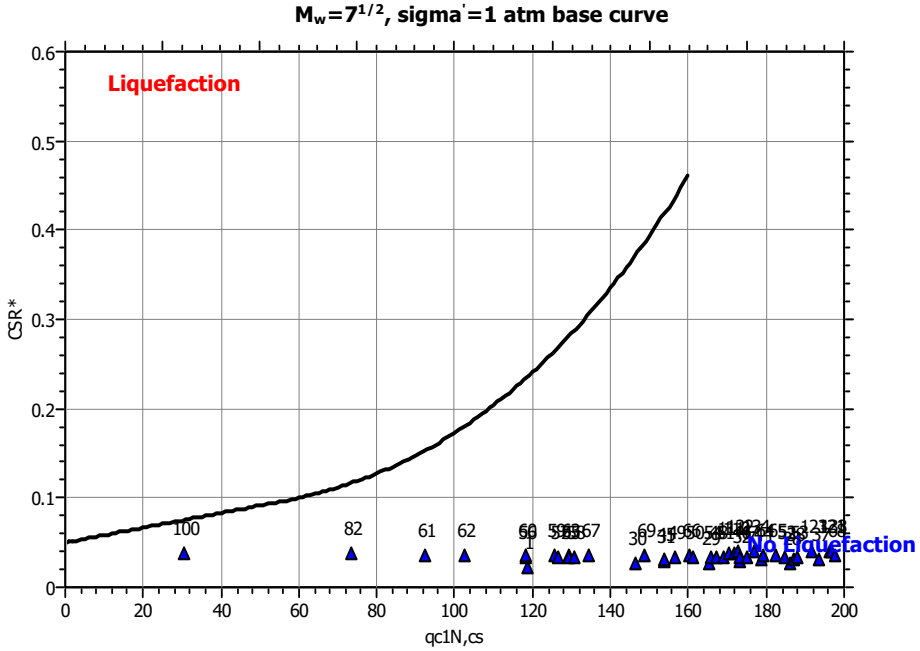
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C32c

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





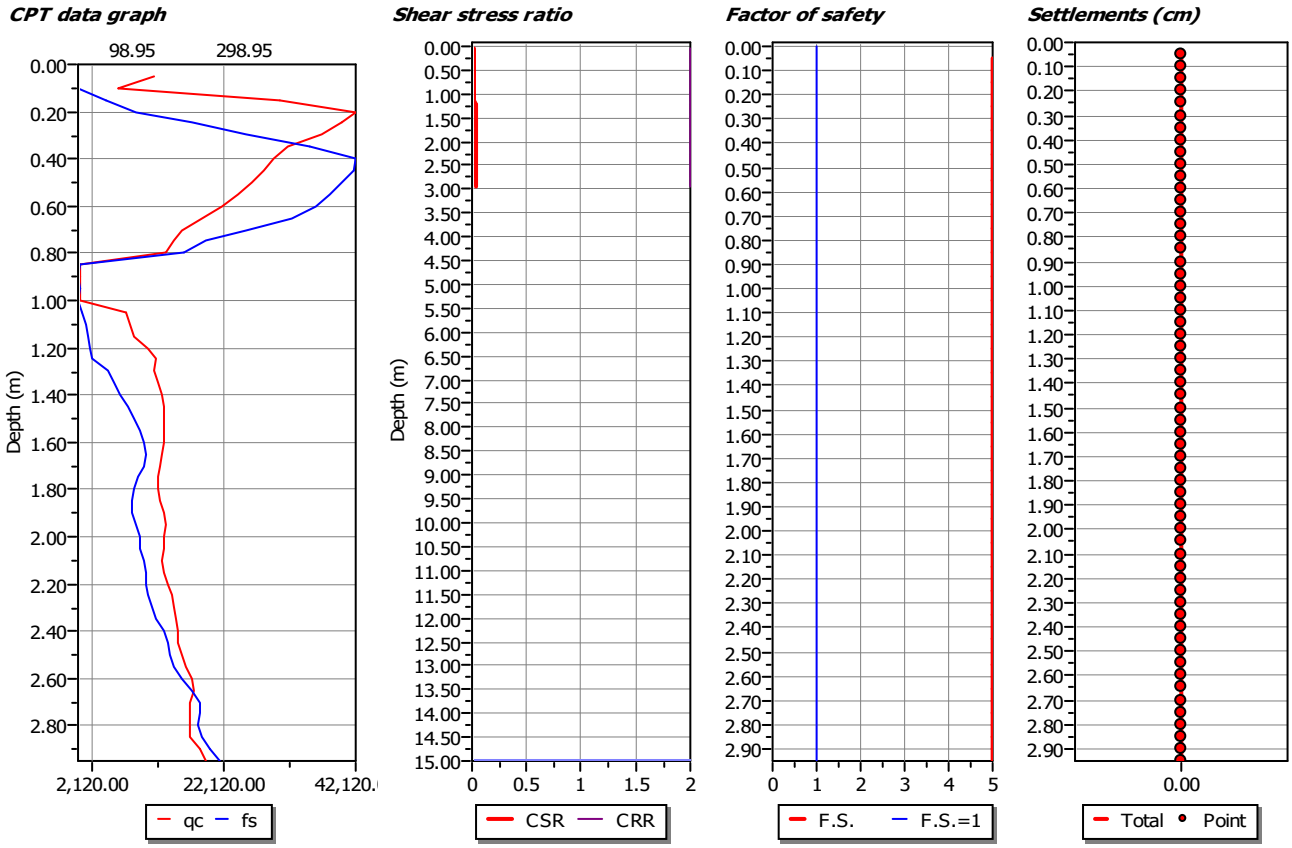
LIQUEFACTION ANALYSIS REPORT

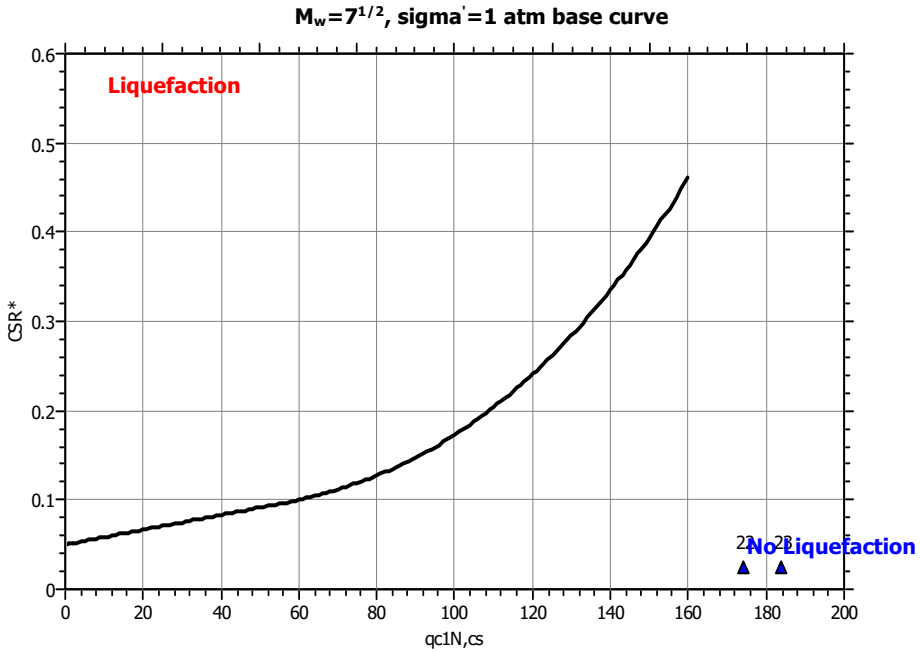
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C33

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.85
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.11 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





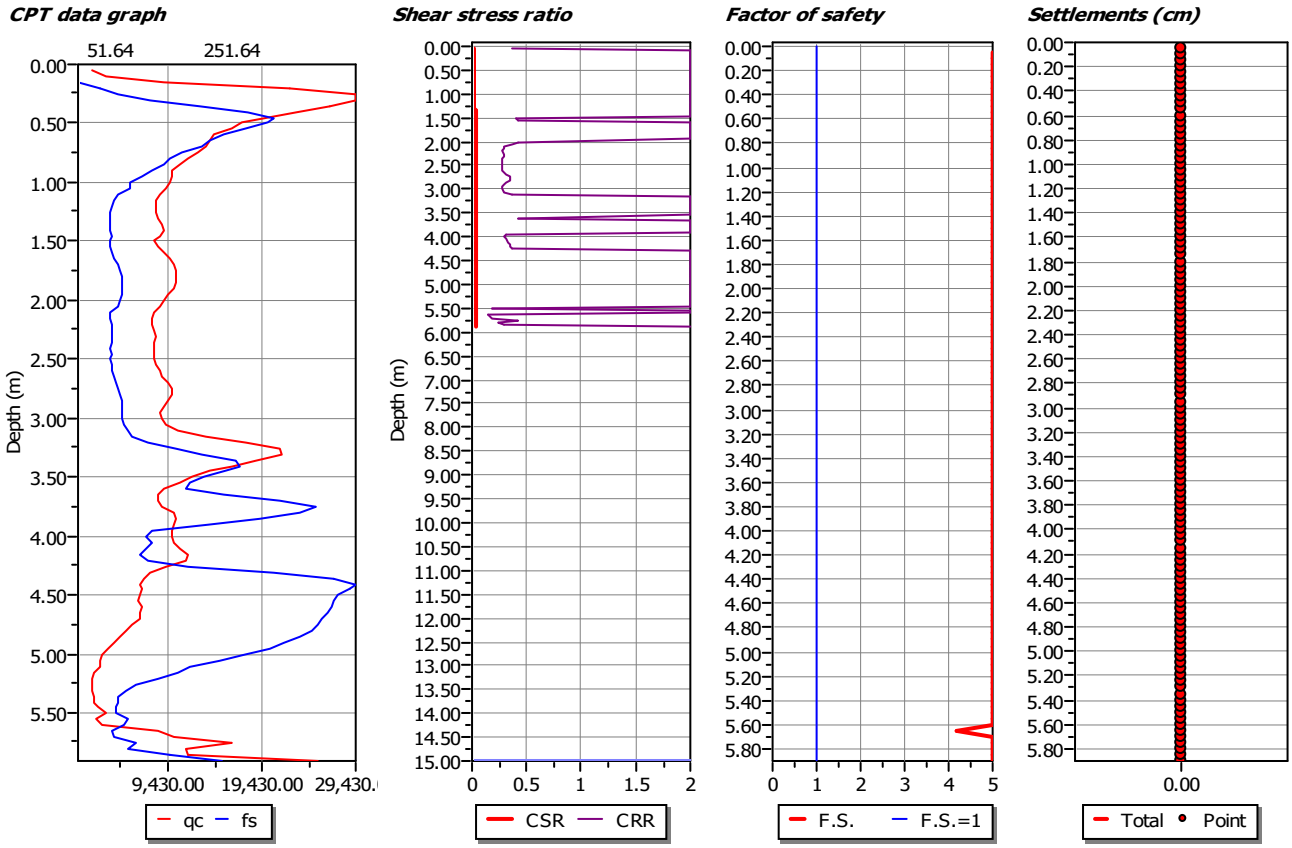
LIQUEFACTION ANALYSIS REPORT

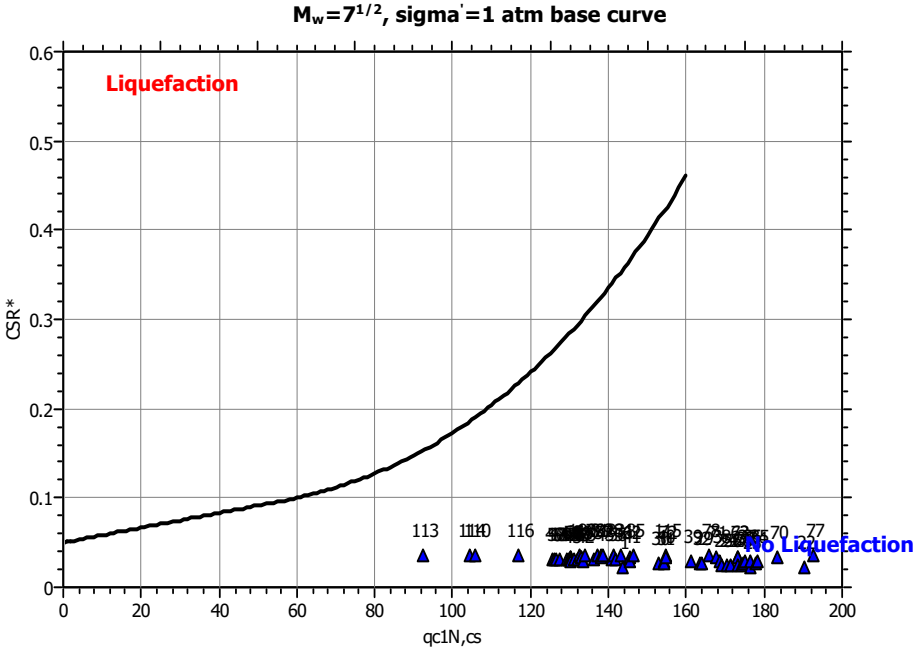
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C36

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.92
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.10 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





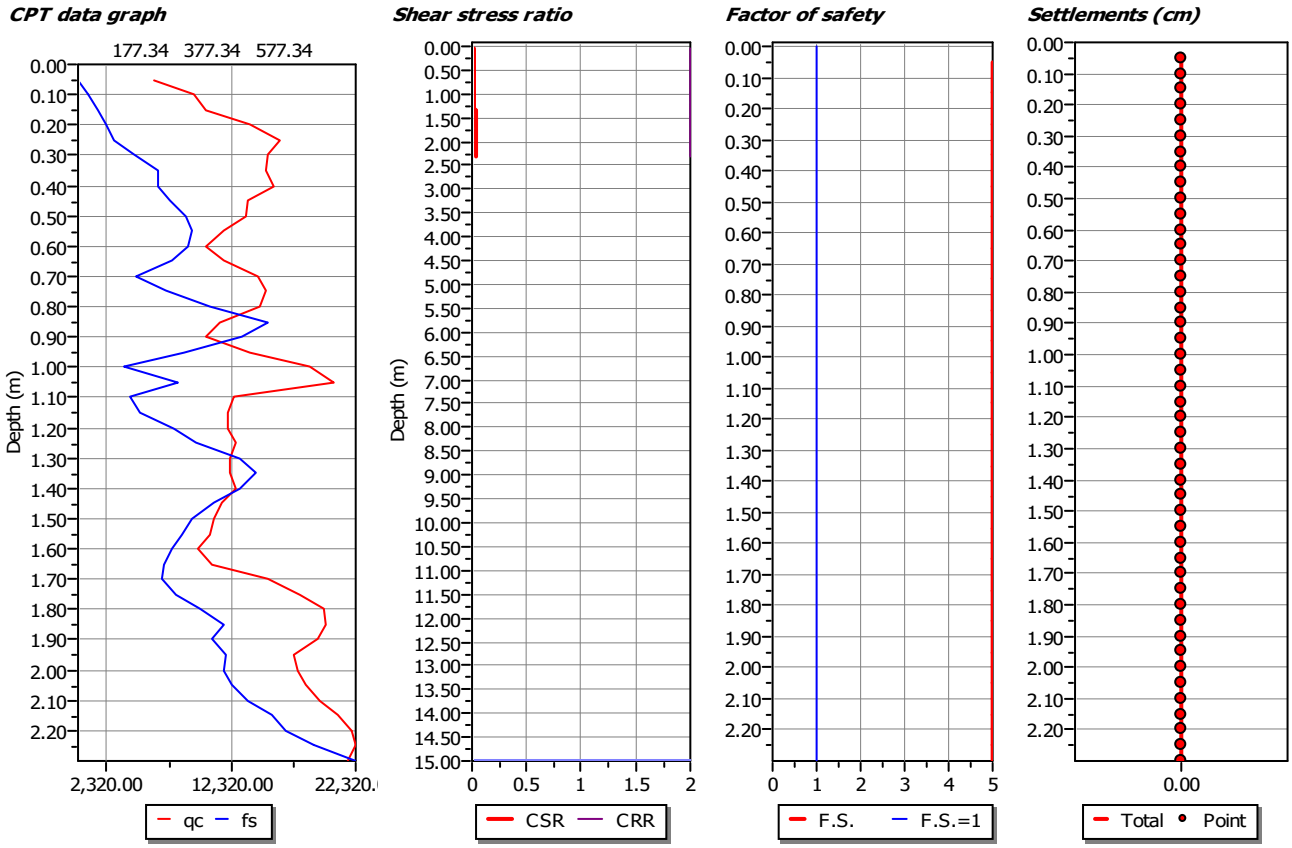
LIQUEFACTION ANALYSIS REPORT

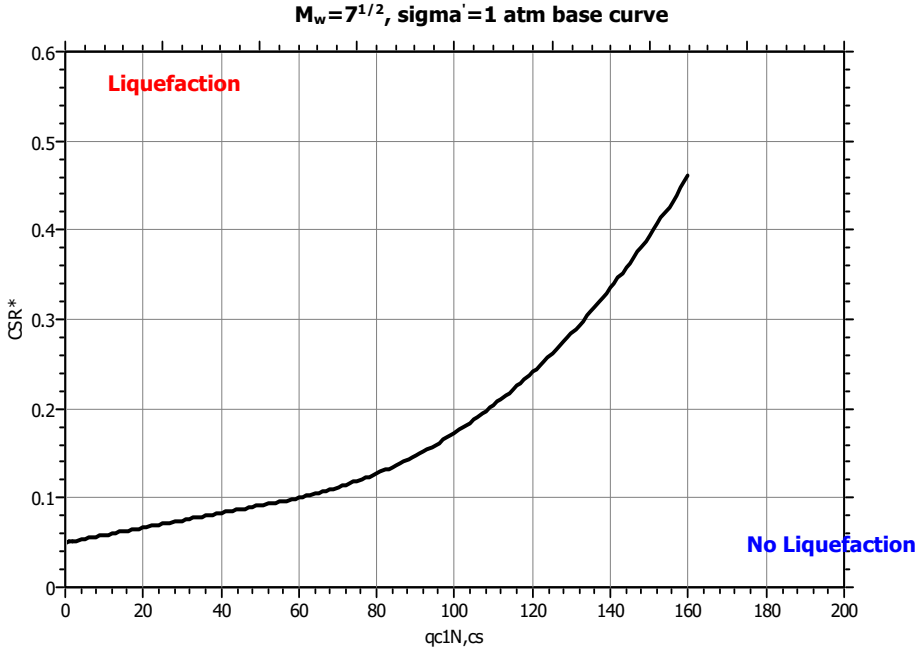
Project title : Met. Livorno-Piombino

Project subtitle : LP-B-C36a

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	15.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.92
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.10 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





LIQUEFACTION ANALYSIS REPORT

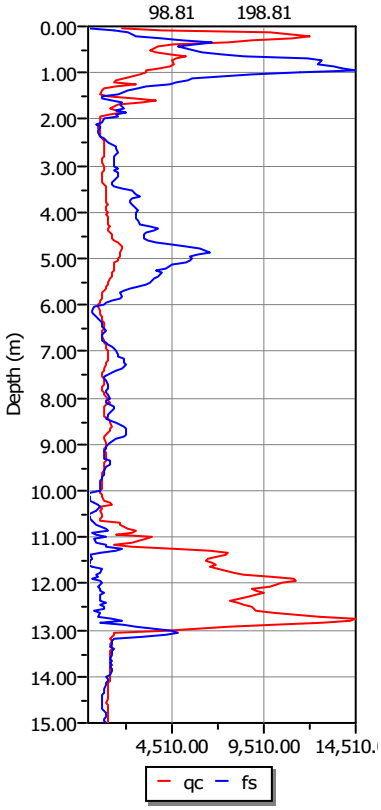
Project title : Met. Derivazione Rosen Rosignano

Project subtitle : LP-A-C45

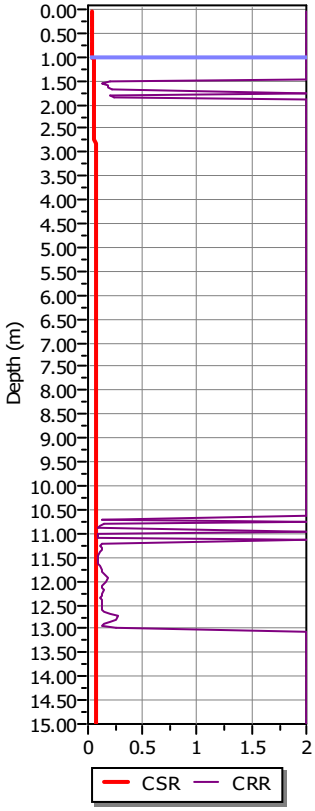
Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.75
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.22 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00

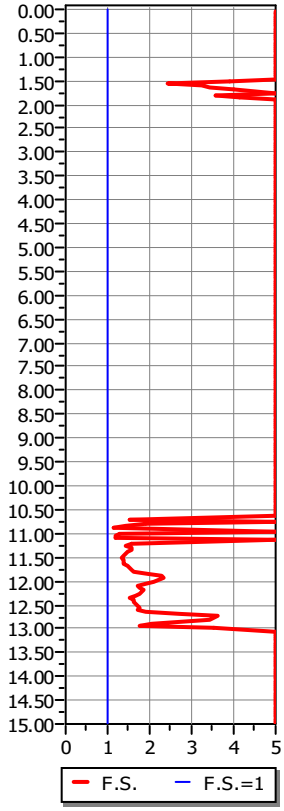
CPT data graph



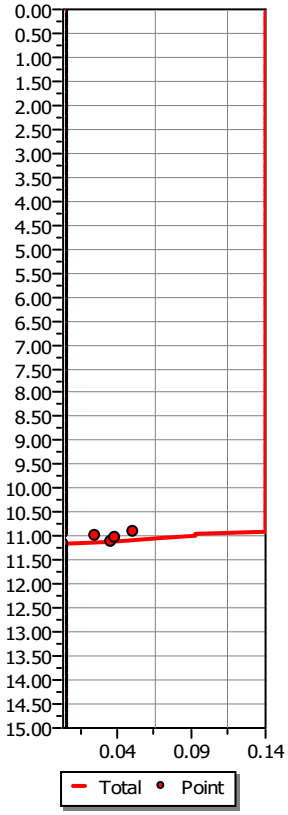
Shear stress ratio



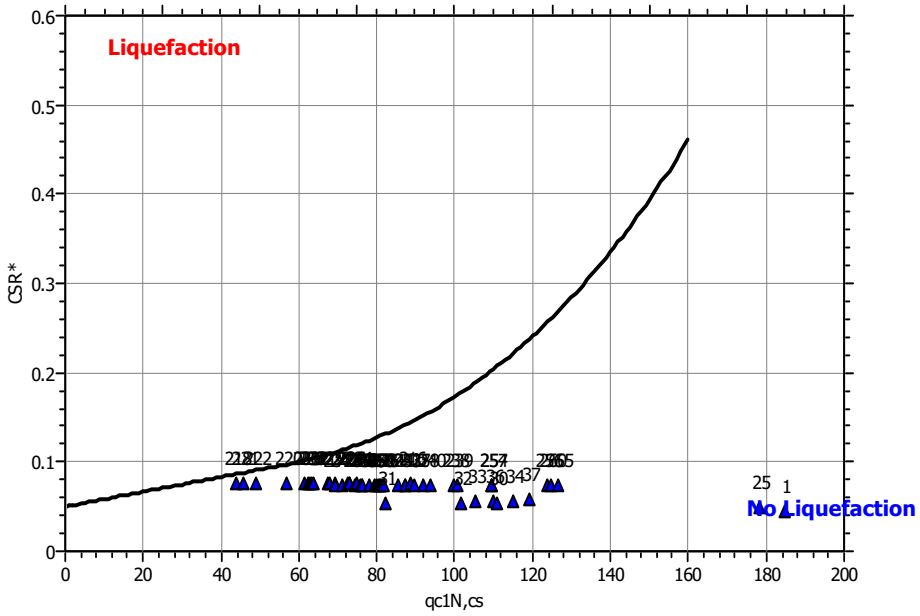
Factor of safety



Settlements (cm)



$M_w=7^{1/2}$, sigma'=1 atm base curve



SAIPEM S.p.A.

LIQUEFACTION ANALYSIS REPORT

Project title : Met. Derivazione Rosen Rosignano

Project subtitle : LP-A-C46

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 m
Analysis type:	Deterministic	Earthquake magnitude M_w:	4.75
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.22 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00