Deep Ground Improvement by Controlled Modulus Columns (CMC) and Prefabricated Vertical Drains (PVD) Future Fuel Terminal Tuxpan, Veracruz, México

TC211 Workshop

Cancún 2019

(52) 55 5241 1108 / menard@menard.com.mx

www.menard.com.mx / www.menard-group.com

Contents

01

Project

Deep Ground Improvement by CMC and PVD

SIMSG ISSMGE TC 211

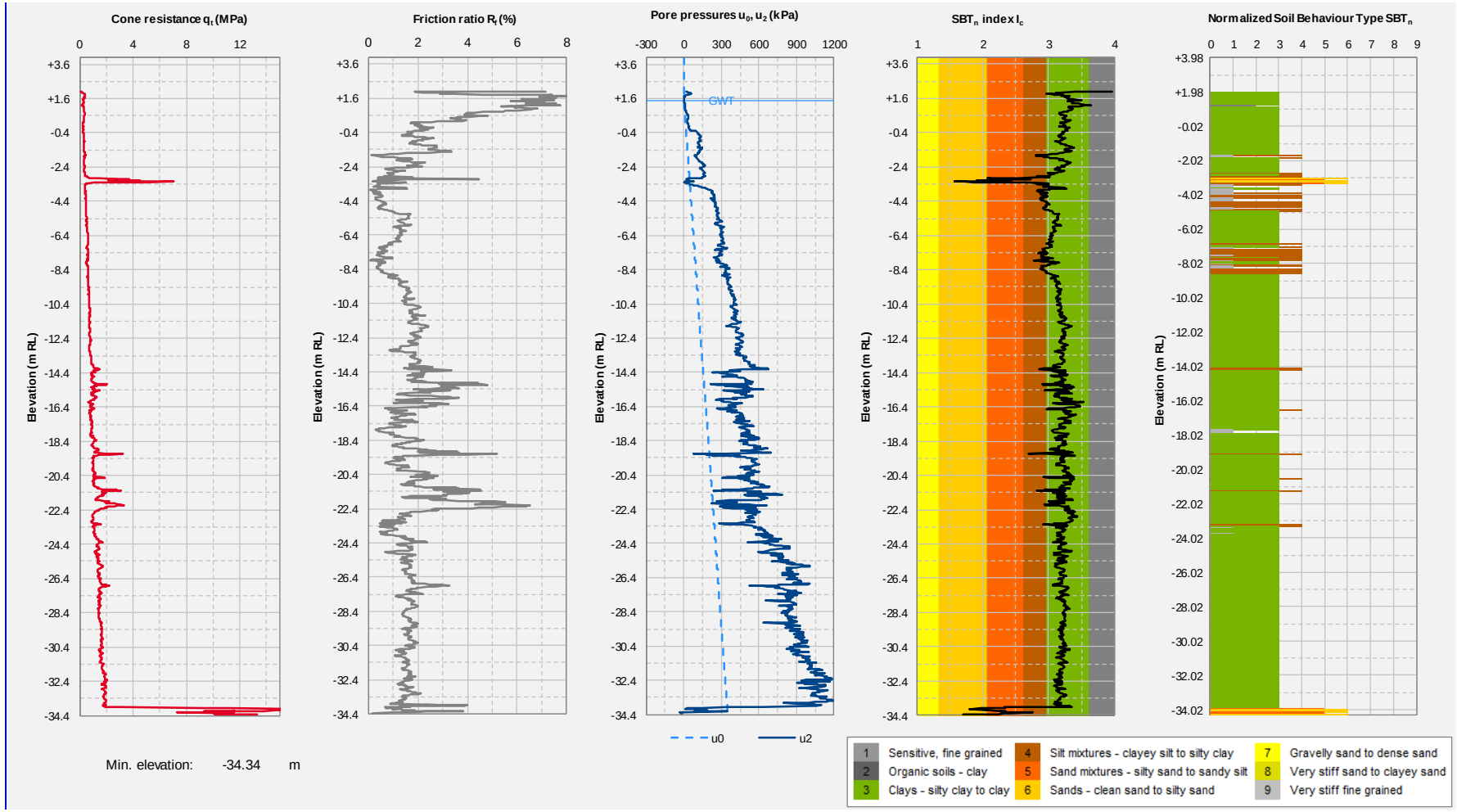
menard

Deep Ground Improvement by CMC and PVD

Scope:

- Landfill of 3m thick (113,000m2), distributed load 50 kPa
- Foundation of 11 tanks, diameter 43m, applying 202 kPa on the ground

Deep Ground Improvement by CMC and PVD



www.menard.com.mx / www.menard-group.com

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD

Scope of work / geotechnical challenges / ground improvement solution:

- Landfill of 3m thick (113,000m2), distributed load 50 kPa
  - ✓ Settlements (medium and long term)
    - ➢ Prefabricated Vertical Drains and Preload

- Foundation of 11 tanks, diameter 43m, applying 202 kPa on the ground
  - ✓ Total and differential settlements
  - ✓ Bearing capacity
    - ➢ Controlled Modulus Columns (CMC)

02

Design

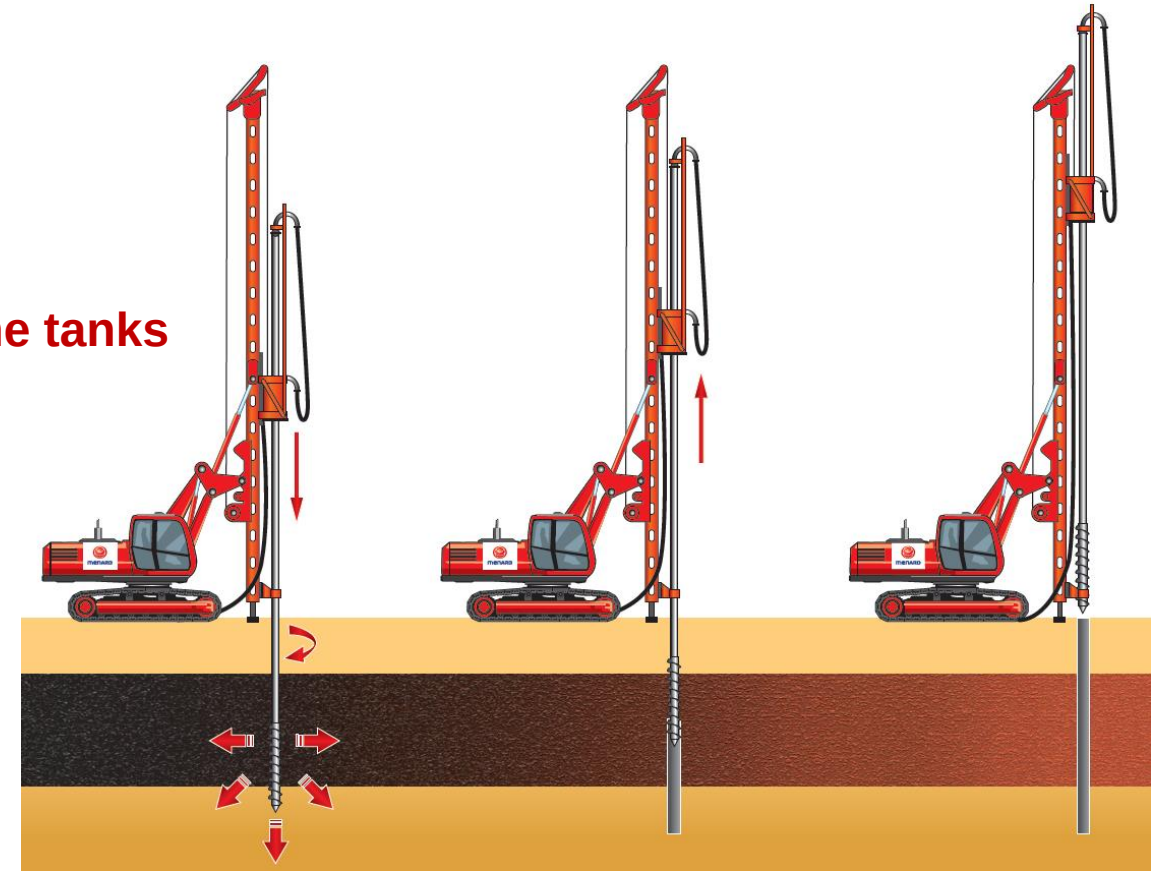
Deep Ground Improvement by CMC and PVD

Design basis:

- Controlled Modulus Columns (CMC)
  - Diameter 400 mm
  - Distance 2.0 to 2.5 m
  - Depth from 35 to 38 m

- Prefabricated Vertical Drains (PVD)
  - Prefabricated Material
  - Distance about 2.0 m
  - Depth from 33 to 35 m

Below the tanks



SIMSG ISSMGE TC 211

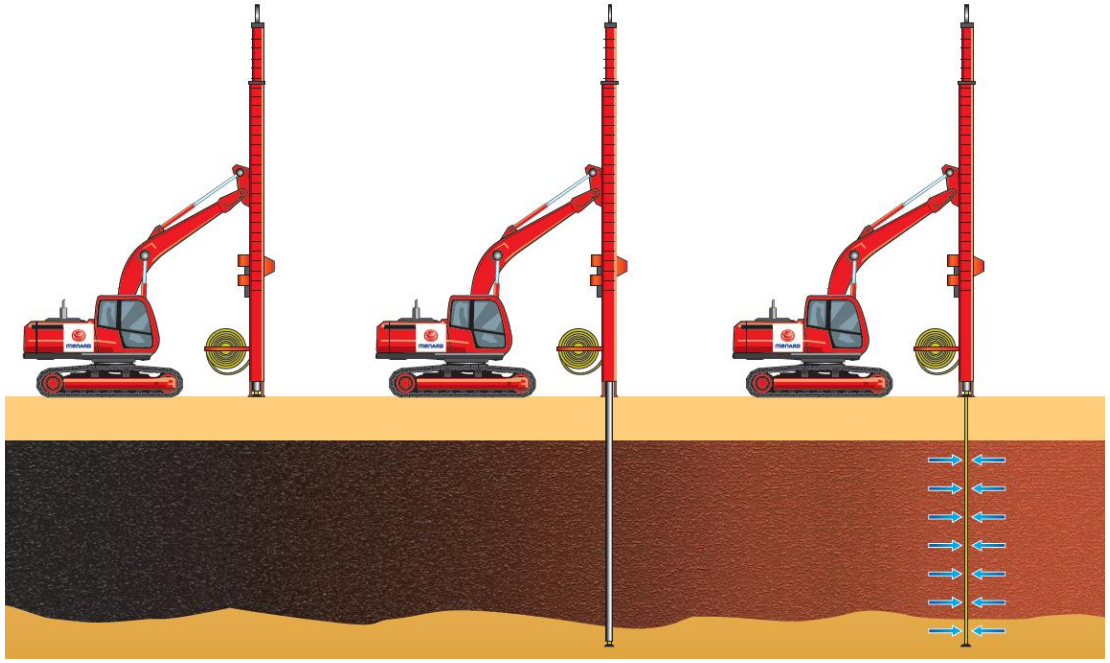
menard

Deep Ground Improvement by CMC and PVD

Design basis:

- Controlled Modulus Columns (CMC)
  - Diameter 400 mm
  - Distance 2.0 to 2.5 m
  - Depth from 35 to 38 m

- Prefabricated Vertical Drains (PVD)
  - Prefabricated Material
  - Distance about 2.0 m
  - Depth from 33 to 35 m

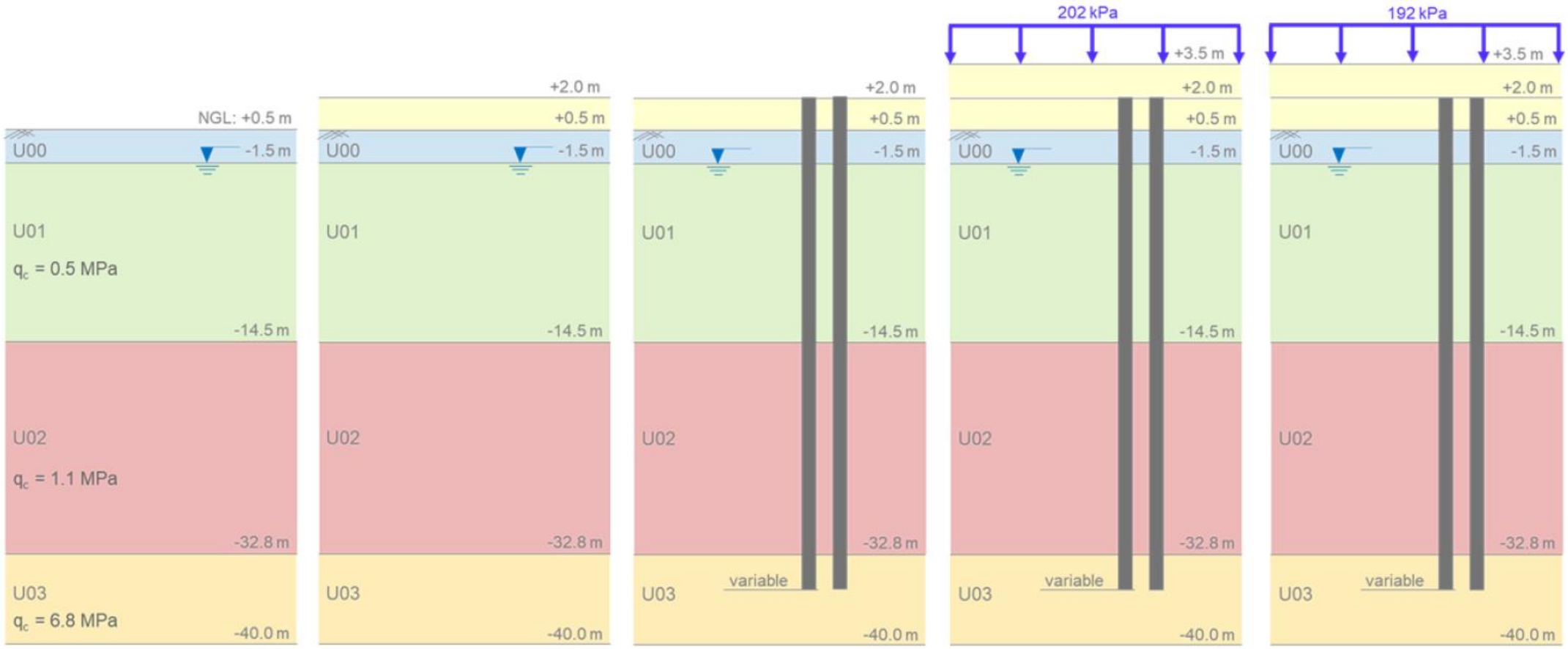


Below the tanks + preloaded areas

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD

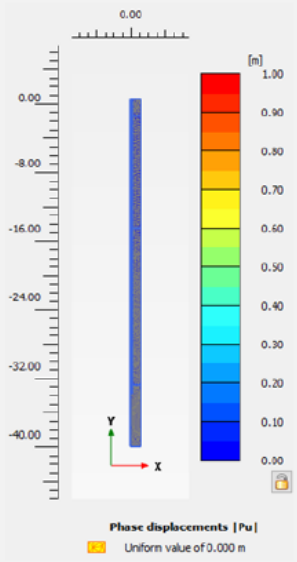
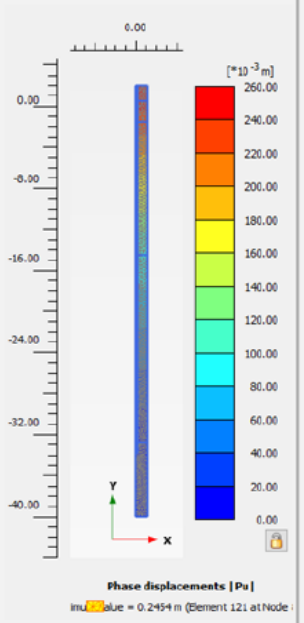
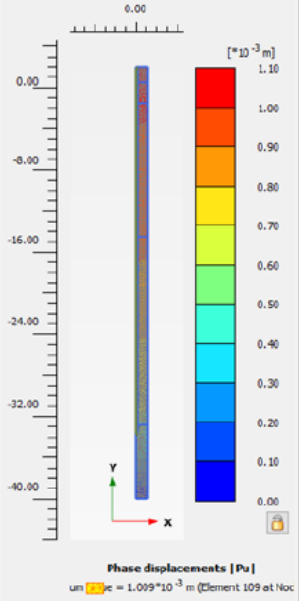
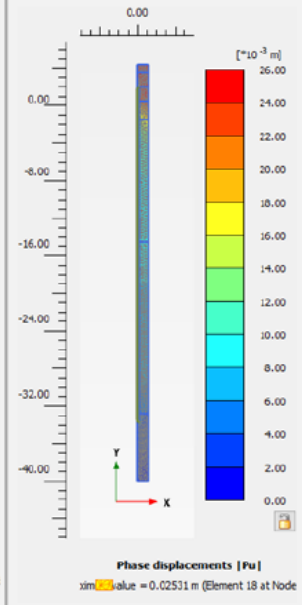
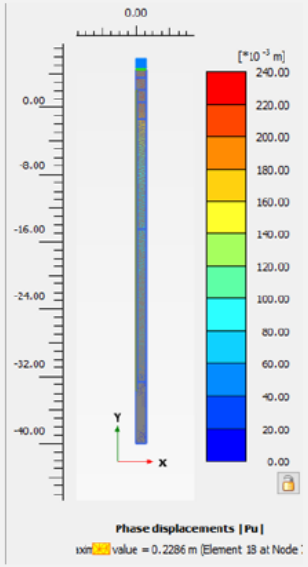
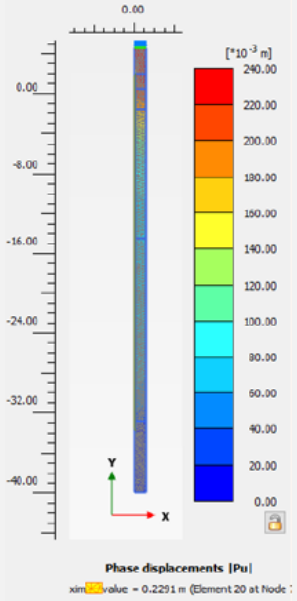


 www.menard.com.mx / www.menard-group.com

SIMSG ISSMGE TC 211

menard

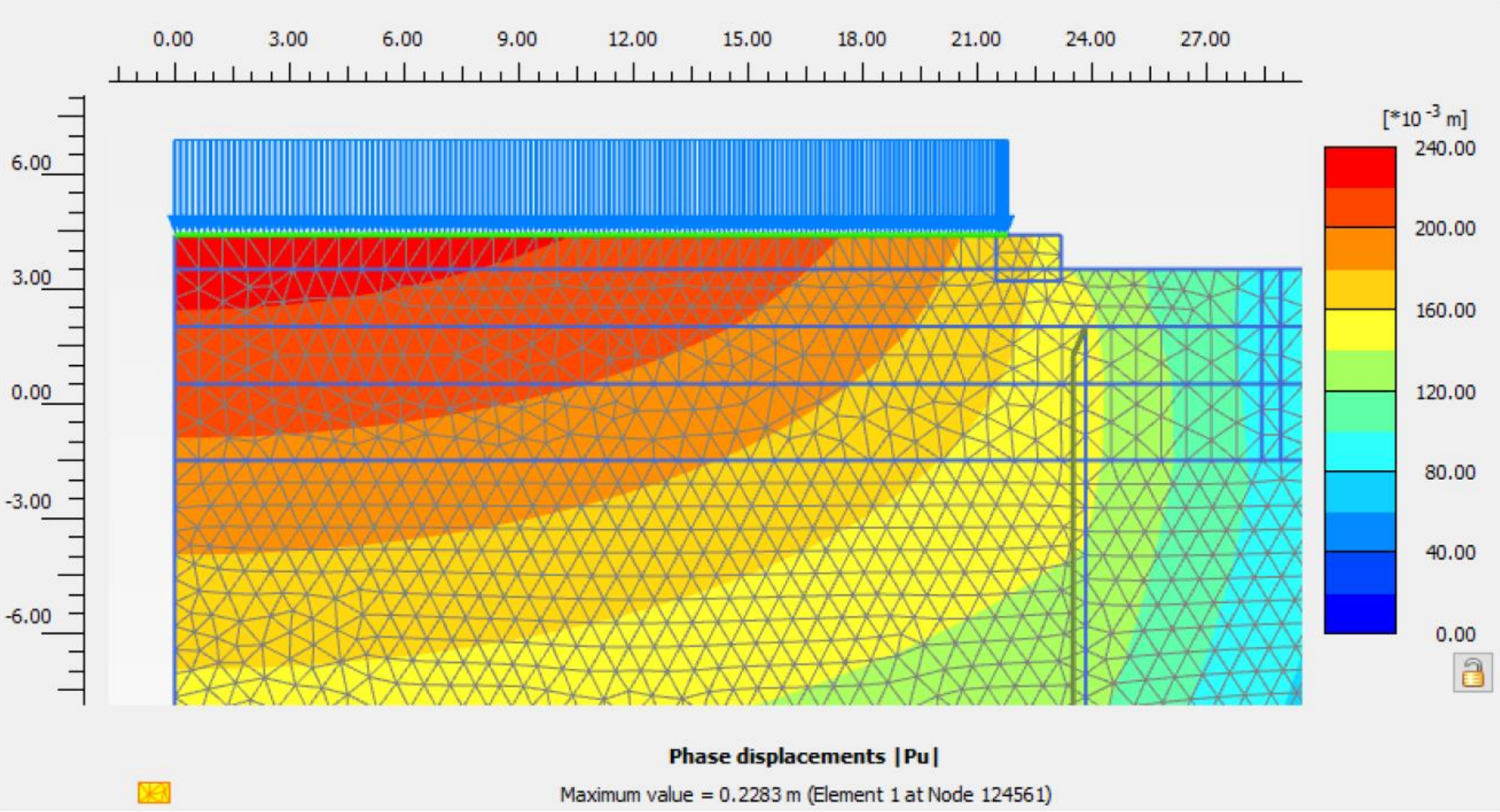
Deep Ground Improvement by CMC and PVD

Phase 0. Stress initialization at level +0.5	Phase 1: Working platform (EL. +2.00).	Phase 2: CMC installation	Phase 3: Load transfer platform (LTP) installation (EL. +4.40 m) + ring wall + tank installation	Phase 4: Hydrotest loading (22 days)	Phase 5: Operation loading (202 kPa)
					
Max. Settlement = 0.00 cm	*Max. Settlement = 24.54 cm*	*Max. Settlement = 0.00 cm*	*Max. Settlement = 2.531cm*	*Max. Settlement = 18.97 cm U(%)=83%*	*Residual = 3.89 cm*

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD



SIMSG ISSMGE TC 211

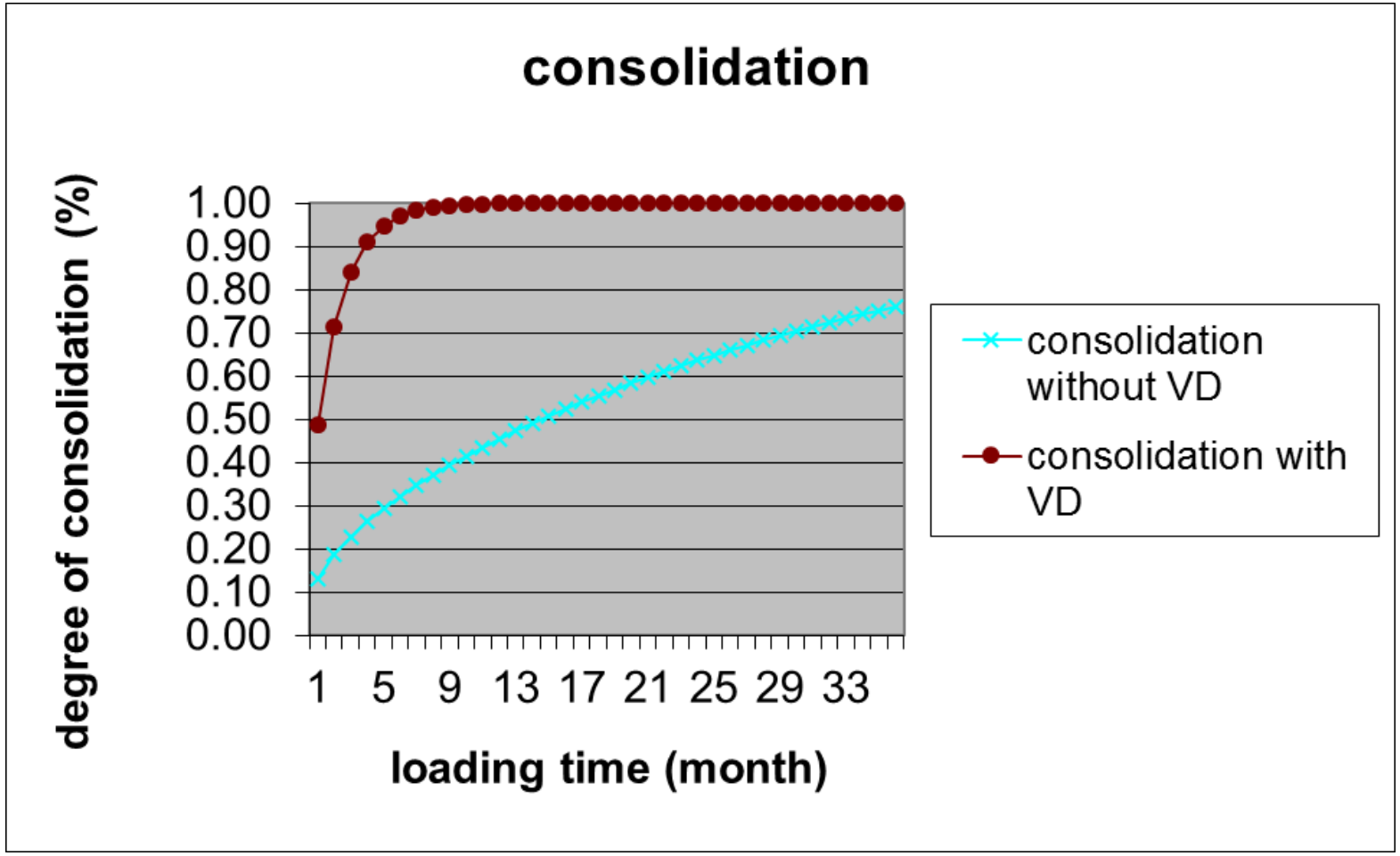
menard

Deep Ground Improvement by CMC and PVD

Soil parameters		Value	Unit
Vertical consolidation coefficient	Cv	1.3E-07	m²/s
Radial consolidation coefficient	Cr	3.9E-07	m²/s
Drained sides (1 ou 2)		2	
Drained thickness	h		m

Vertical Drains parameters		Value	Unit
Mesh	L	2.0	m
Triangular (1,05); Squared (1,13)		1.13	
Drains diameter	d	0.05	m

Determination of loading time		Value	Unit
Loading time	**t**	**4.00**	**month**
undrained consolidation	Uv	26.25	%
drained consolidation	U	90.95	%



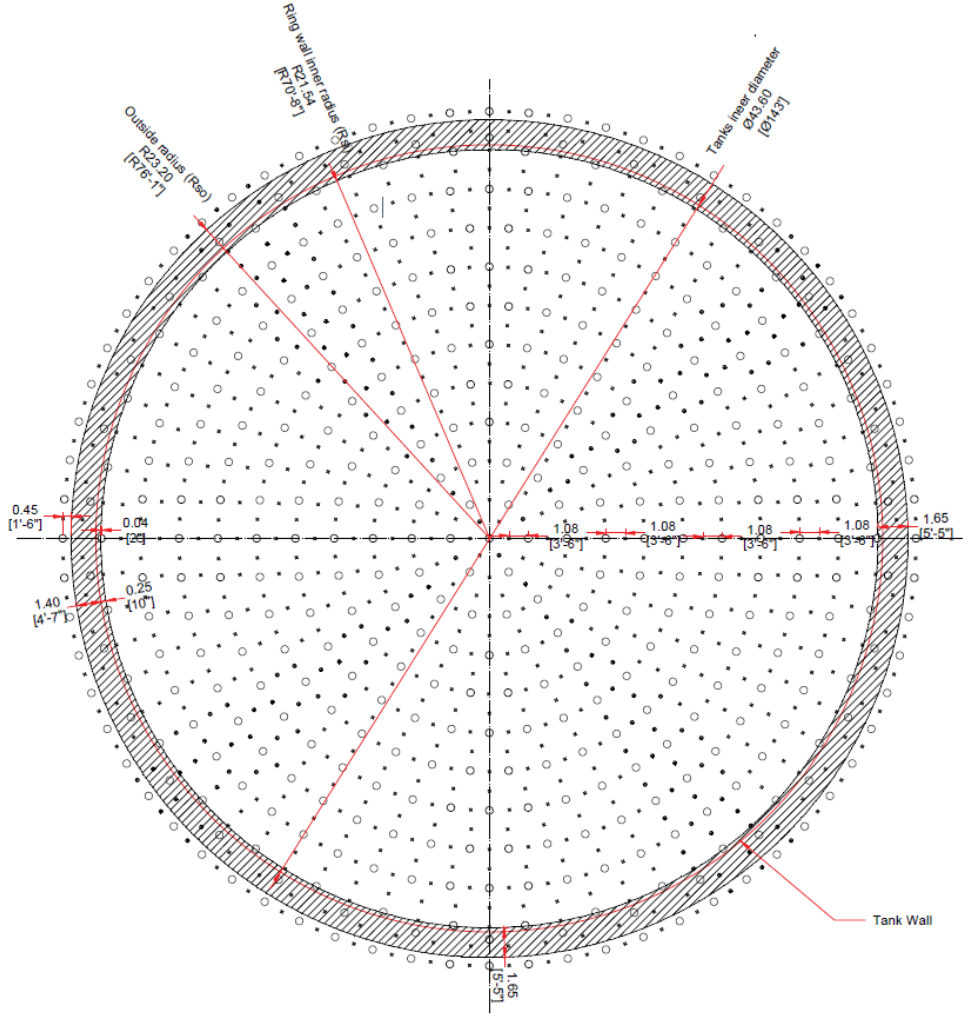
SIMSG ISSMGE TC 211

menard

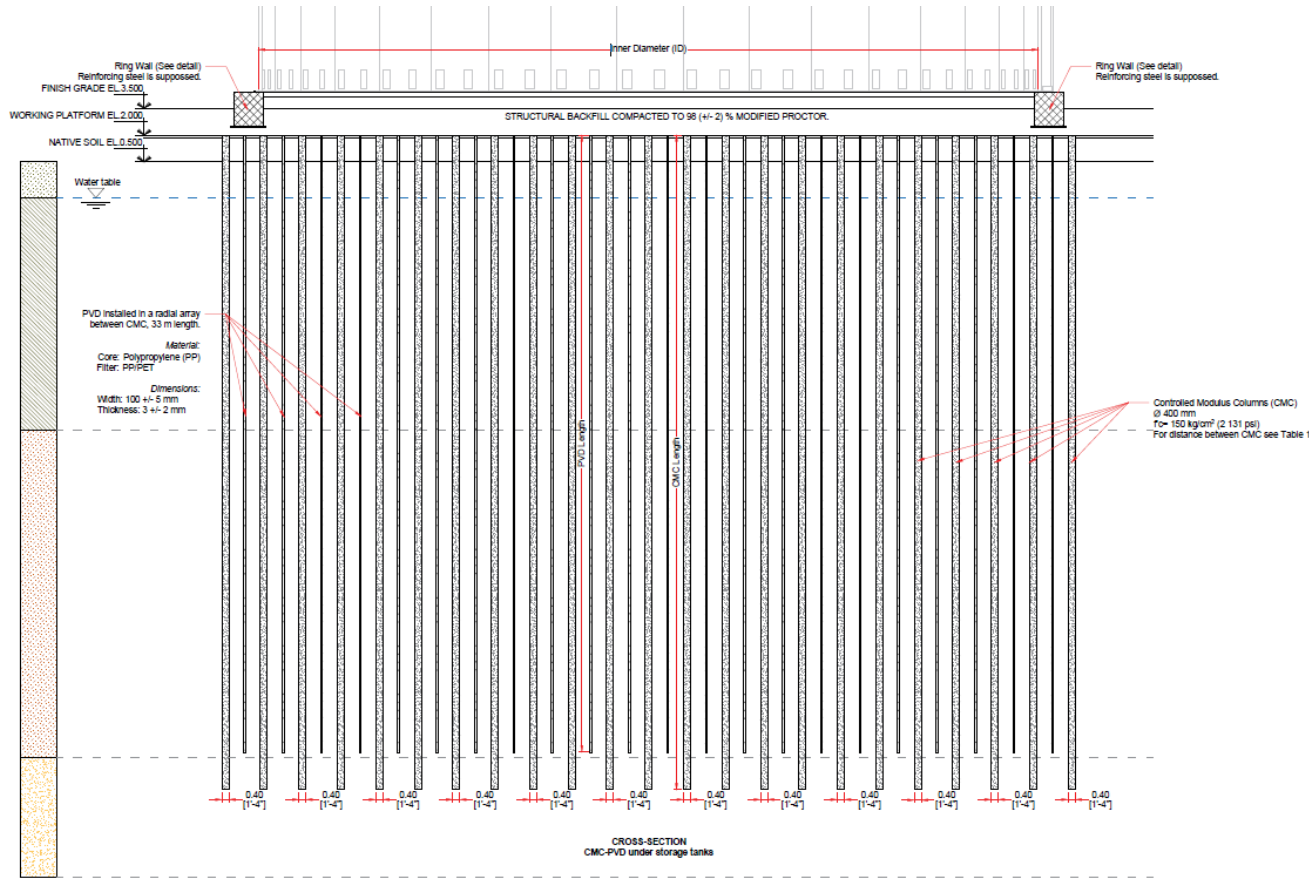
03

Execution

Deep Ground Improvement by CMC and PVD



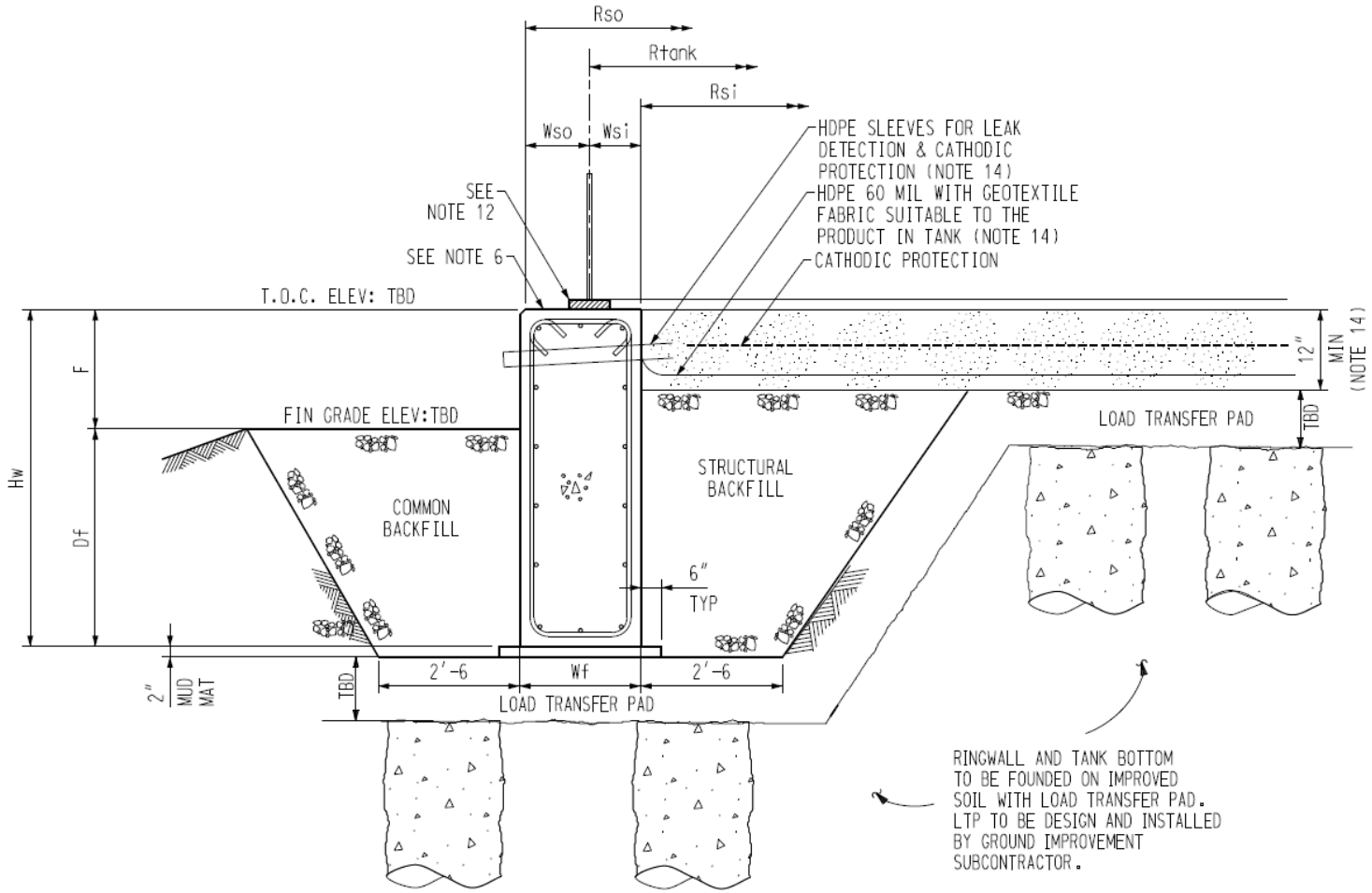
CMC + PVD combined solution



SIMSG ISSMGE
TC 211

menard

Deep Ground Improvement by CMC and PVD



Constructive details for treatment below the ringwall

SIMSG ISSMGE TC 211

menard

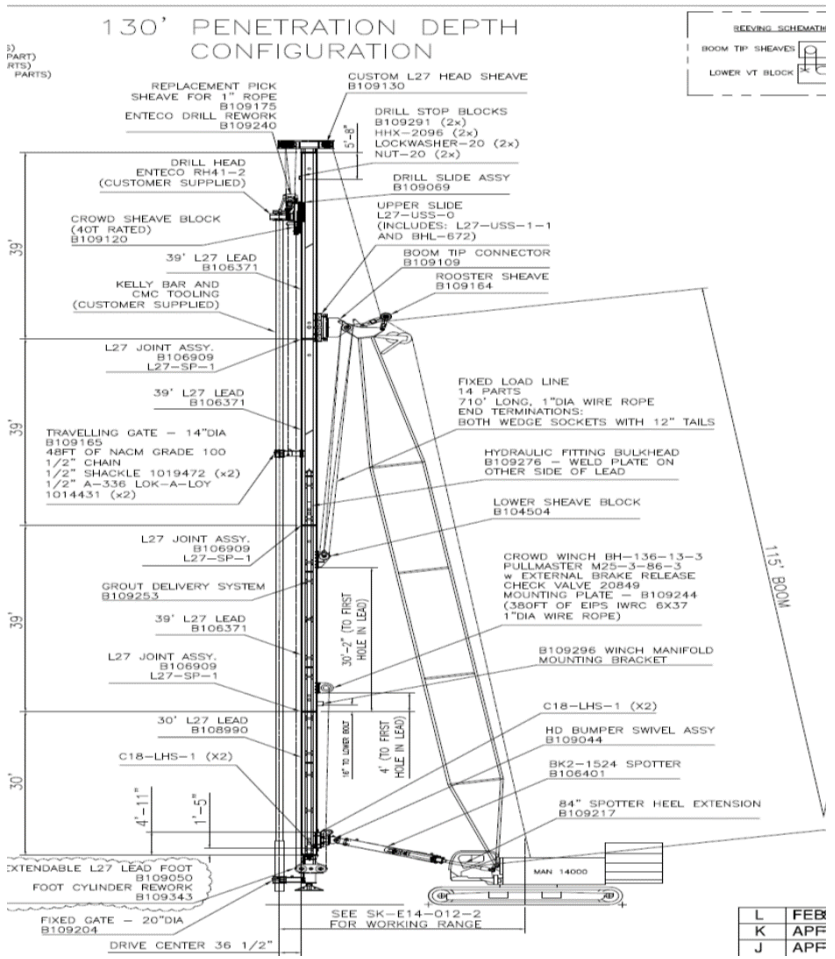
Deep Ground Improvement by CMC and PVD

CMC equipments

SIMSG ISSMGE TC 211

menard

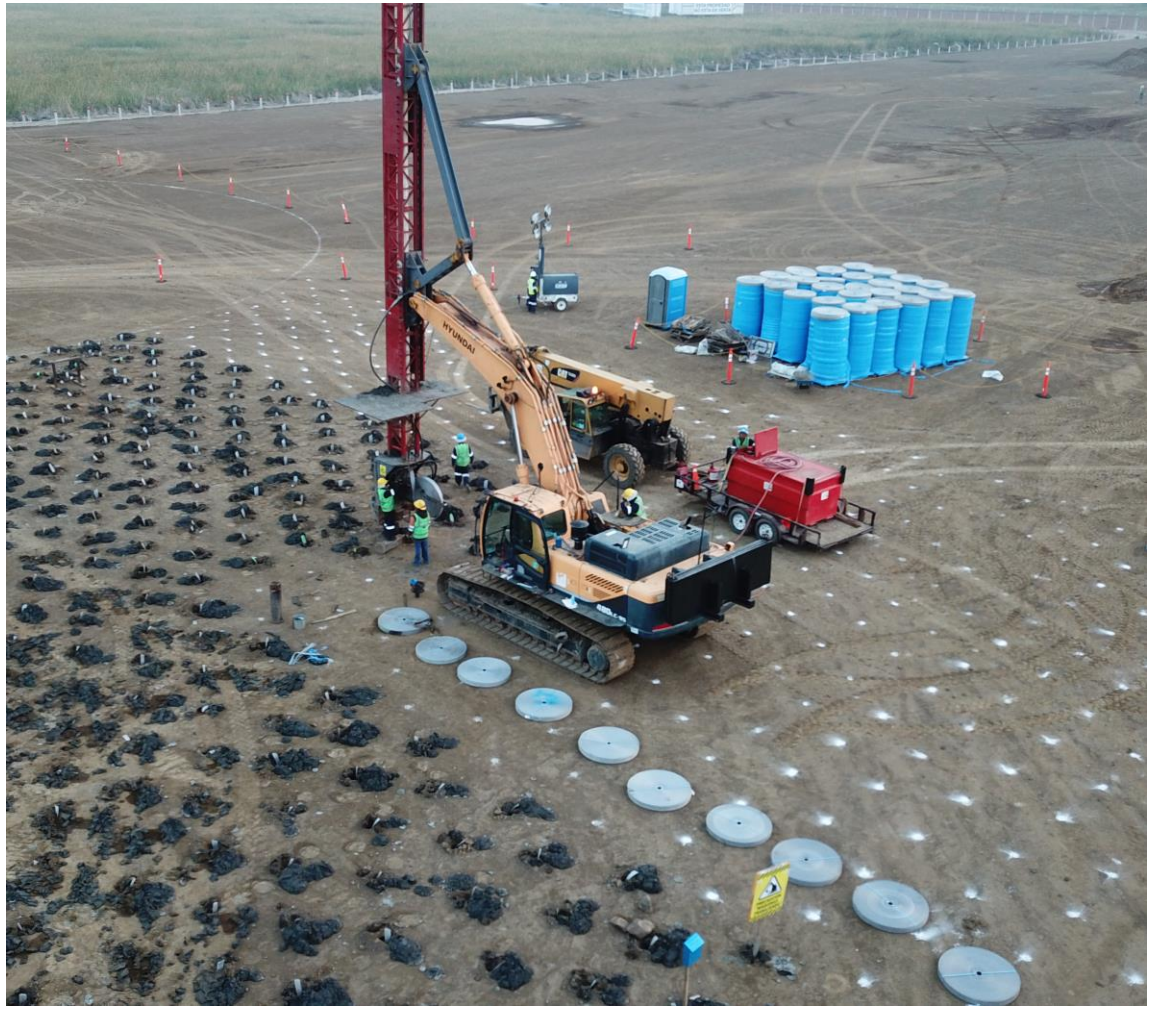
Deep Ground Improvement by CMC and PVD



SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD



PVD equipment

SIMSG ISSMGE TC 211

menard

04

QA / QC

Deep Ground Improvement by CMC and PVD

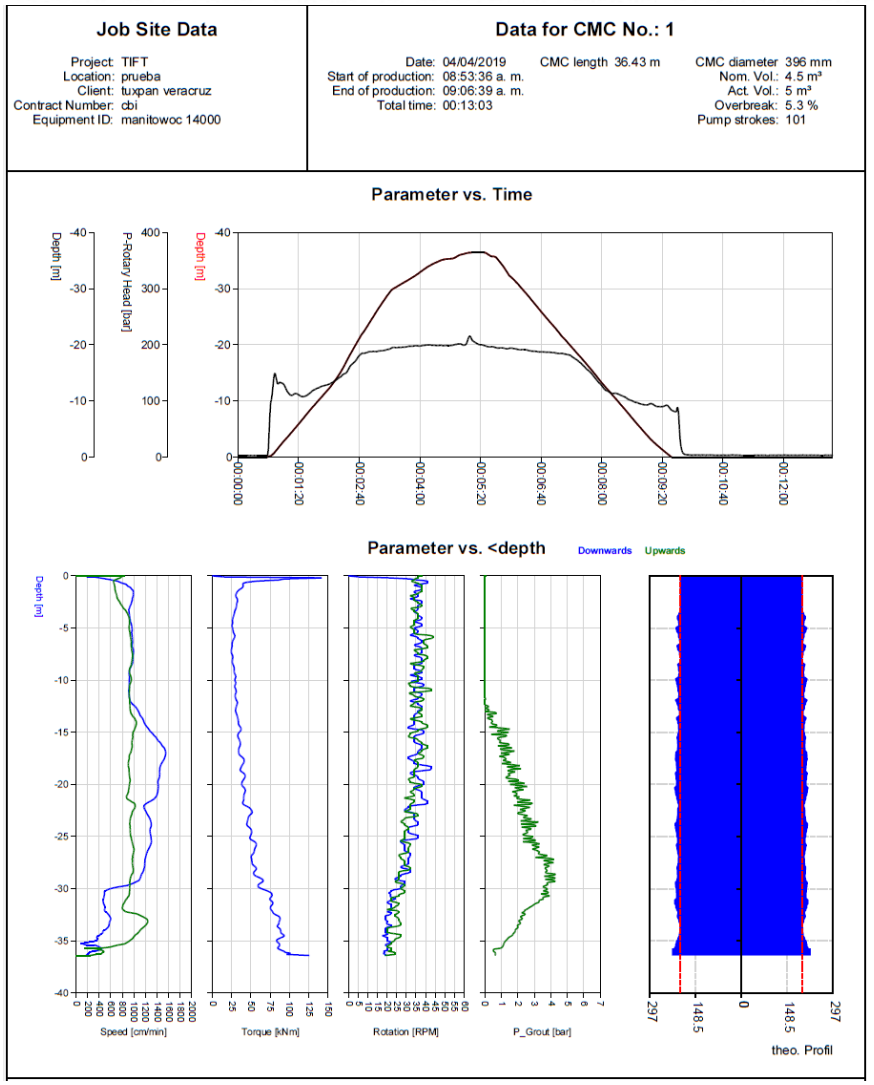
Real time monitoring system

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD

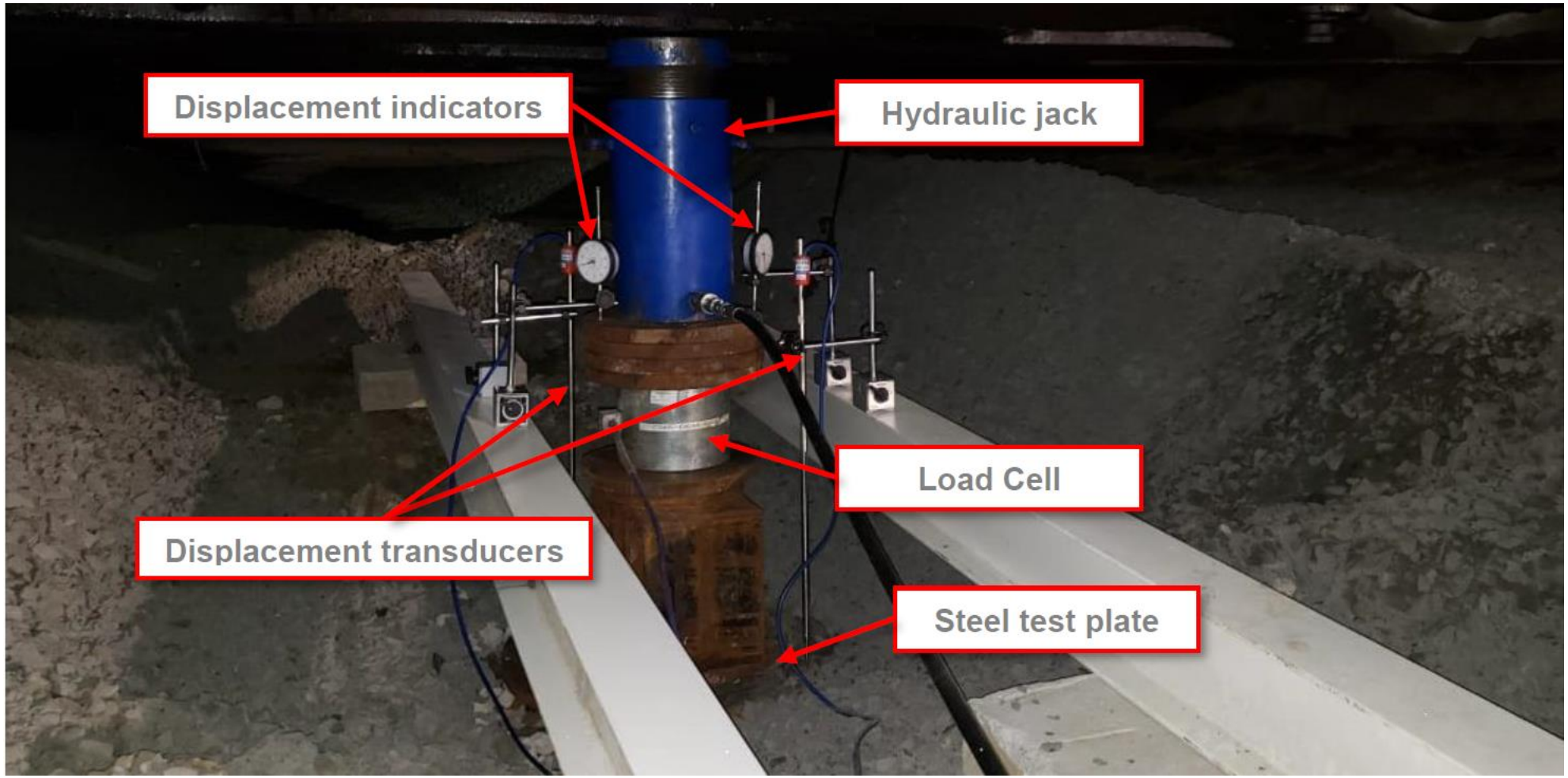
- Hydraulic pressure
- Concrete pressure
- Pull-down
- Torque
- Penetration speed
- Extraction speed
- CMC's profile



SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD

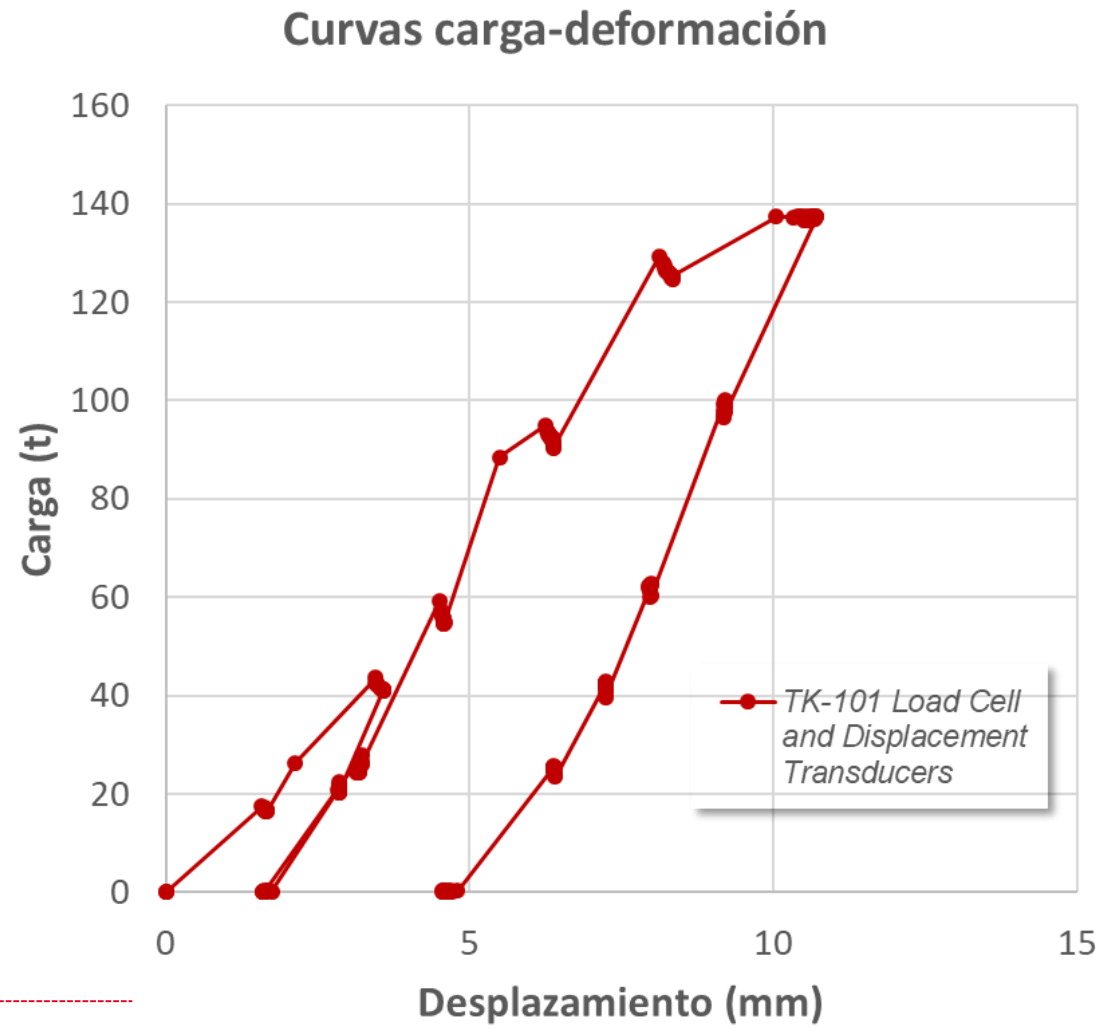


Load-bearing control test

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD



Load-bearing control test

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD

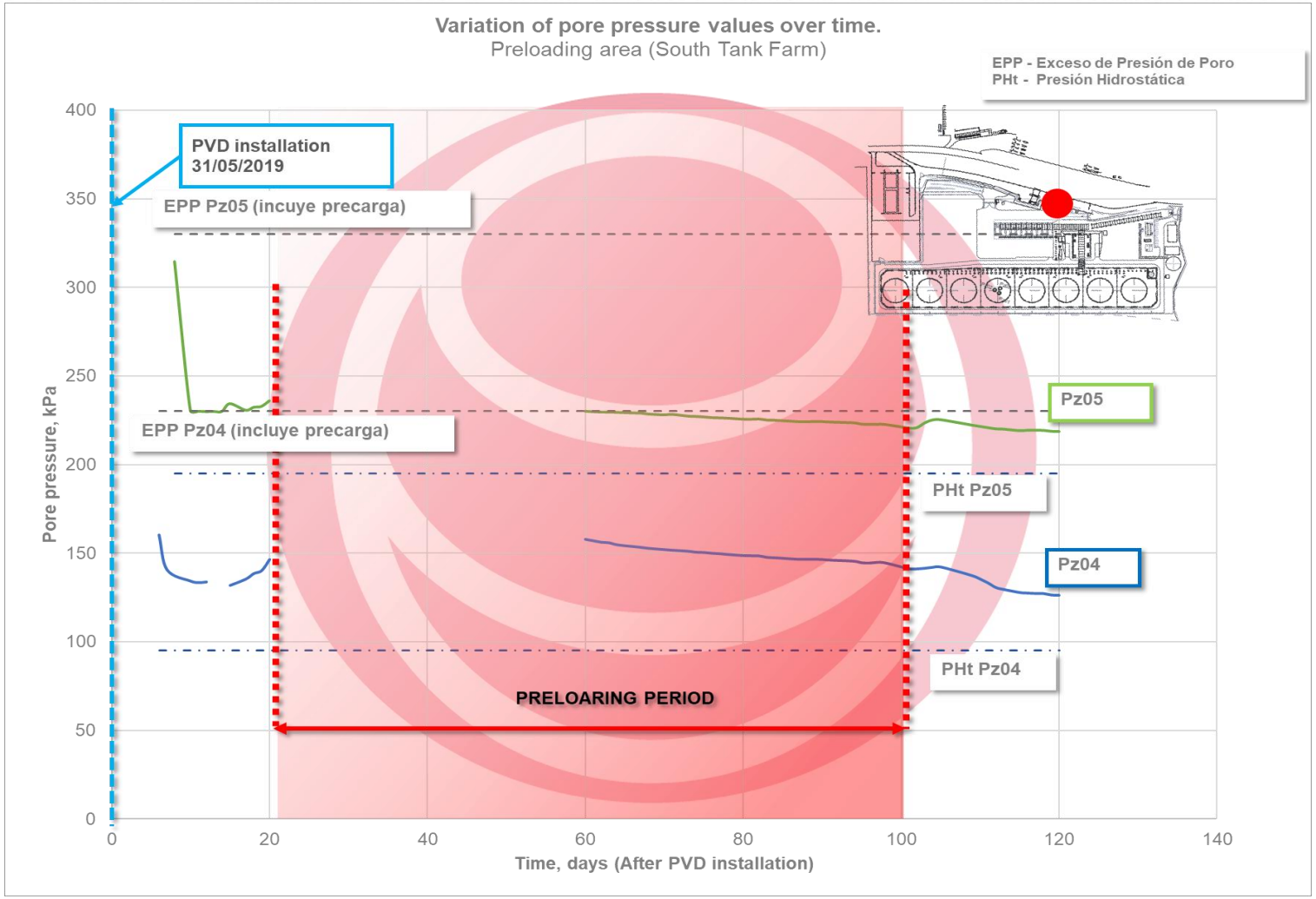
Concrete slump test

Compressive strength tests

SIMSG ISSMGE TC 211

menard

Deep Ground Improvement by CMC and PVD



Piezometers

SIMSG ISSMGE TC 211

menard

¡GRACIAS!

menard

(52) 55 5241 1108 / menard@menard.com.mx

www.menard.com.mx / www.menard-group.com