

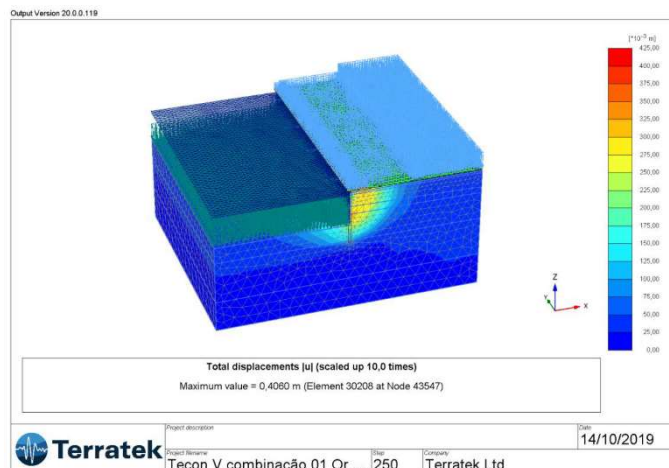
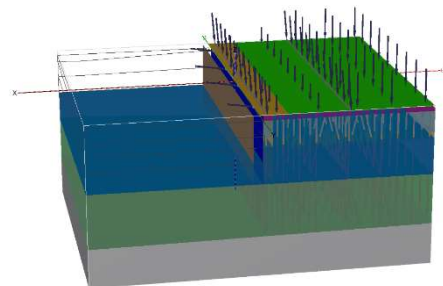
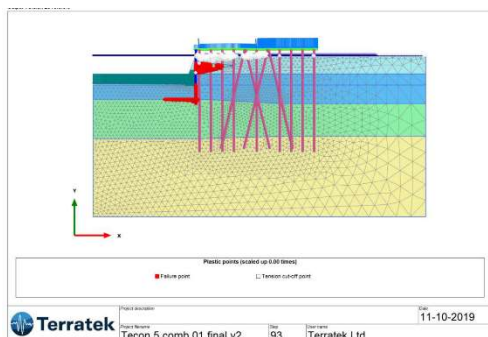
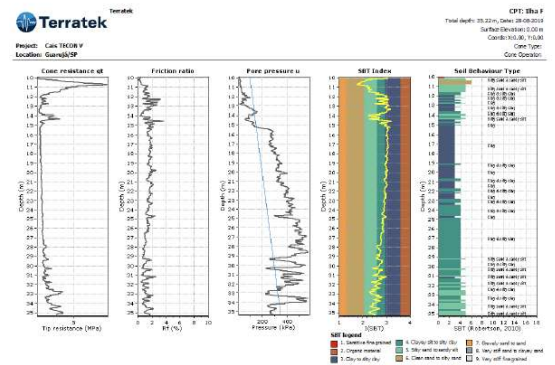
# Project datasheet Harbour and Offshore

## Container Terminal Tecon 5 Quay Wall

Location: Santos Harbour, SP, Brazil

Client: Axxo Contractors

**Description:** Terratek analysed the behaviour of quay wall consisting of a piled slab and with a front steel sheet piling under the effect of loading and dredging down to the elevation -10 m. The first step was to analyse site investigation data which included in situ CPTU and VST, as well as laboratory test data. Terratek, then, assembled a Plaxis 2D and 3D stress and deformation numerical model of the structure. The Plaxis 3D results led to less bending moments on the sheet piling than the 2D analyses. The analyses gave pile loading and bending moments which enabled the design of the structural elements and led to an optimised design.



# Project datasheet Harbour and Offshore

## CAD Contained Aquatic Disposal of dredged sediments

Location: Piaçaquera Canal, Cubatão, SP

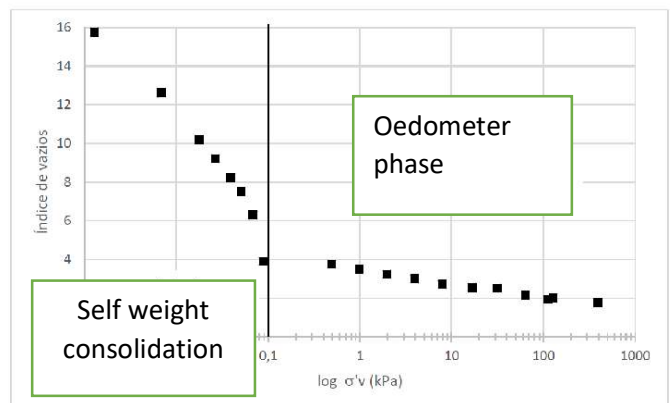


**Description:** The design needs the volume of the dredged sediments to be contained in the CAD and this was the scope of Terratek's work.

### Services provided by Terratek

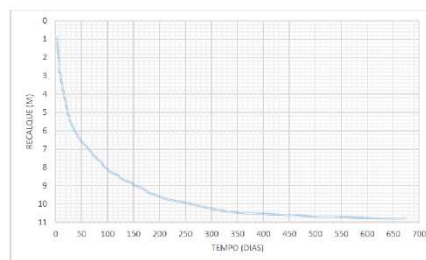
- Geotechnical consultancy;
- Sedimentation analysis of a 25 m high soil column using Lee & Sills (1981) theory
- Consolidation analysis using soft Soil Model and Plaxis 2D

Lab testing with sedimentation and oedometer consolidation phases



Time versus settlement curve

Tempo decorrido (dias)	CF adotado (m <sup>2</sup> /dia)	Grau de Adensamento (%)	Recalque estimado (m)
90	7.38E-03	72	7.78
120	7.38E-03	78	8.42
150	7.38E-03	83	8.96
180	7.38E-03	87	9.40



# Project datasheet Harbour and Offshore

## Feasibility study of steel sheet piling quay wall

**Location:** Marina City, Biguaçu, SC, Brazil

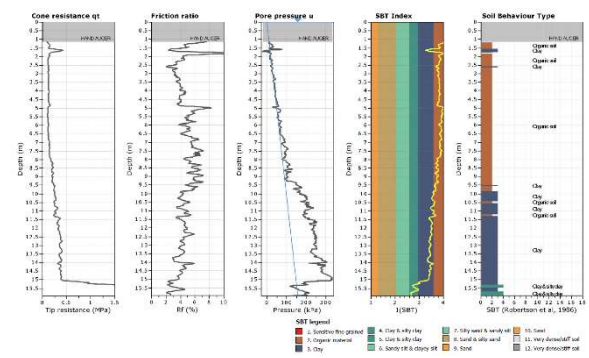
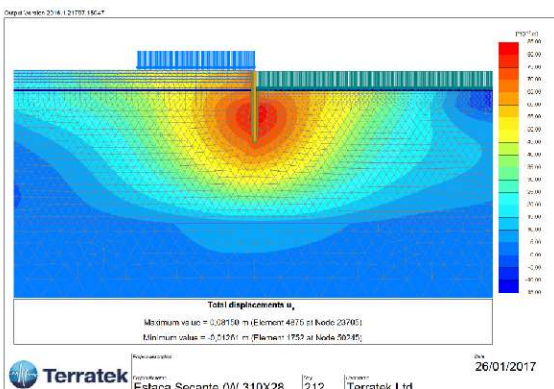


**Client:** Flamarpar, Achilles Partners

**Description:** The work consisted of a preliminary design of a 7 m depth sheet pile wall with 22 m long sheet piles

### Services provided by Terratek

- Geotechnical consultancy and preliminary design;
- Site investigation analysis results;
- Plaxis 2D analysis of an embankment construction on soft soils, consolidation and dredging in front of the wall
- Consolidation analysis using soft Soil Model and Plaxis 2D



## Project datasheet Harbour and Offshore

### Instrumentation and monitoring of iron ore stockpile lifting

Location: Sepetiba, RJ, Brazil

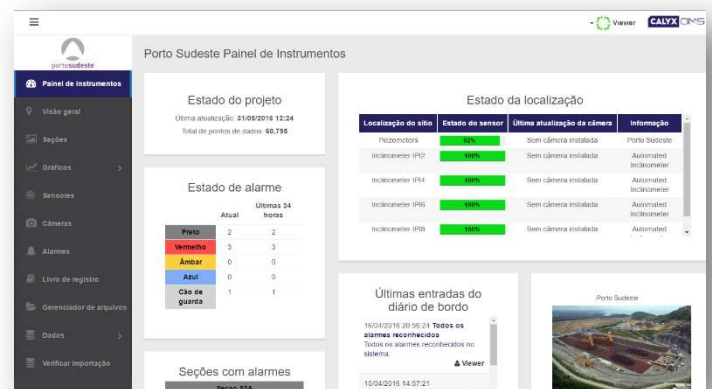
Client: Sudeste Harbour Co

**Description:** The work consisted of instrumentation design, supplying, installation and automated monitoring of the first lifting of 18 m high, 60 m wide iron ore stockpiles built on stone column improved soft soils.



### Services provided by Terratek

- Instrumentation design;
- Supplying of instruments and dataloggers from Soil Instruments Ltd, UK, (In-place inclinometers, VW piezometers, settlement gauges;
- Drilling and instrument installation;
- Calyx monitoring system configuring;
- Data analyses.



# Project datasheet Harbour and Offshore

## Numerical analysis of sheet piling wall

Location: Açu Harbour, Brazil

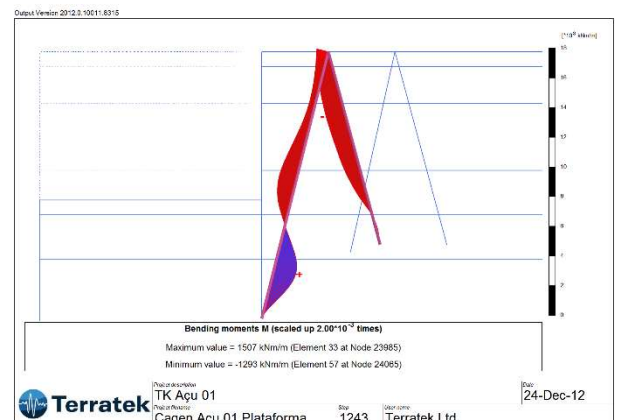
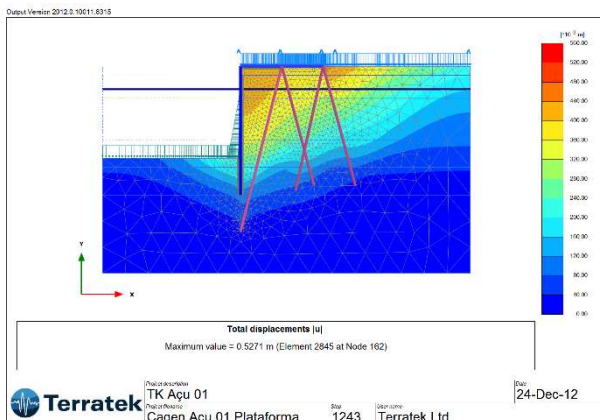
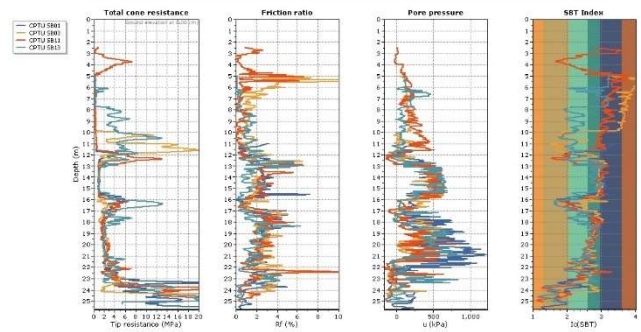
Client: Carioca Contractors

**Description:** Terratek provided in 2012 the analysis and sign-off review of a piled harbour structure designed by Carioca Contractors. Ground conditions included a 10 m thick dense sand layer overlying soft clays. The structure included a 30 m long steel sheet pile and a piled slab. Berth dredging was designed to take place afterwards and would lead to large horizontal displacements and high moments to the piles. The results showed that the design was unsafe leading to failure.



### Services provided by Terratek

- Analyses of site investigation data;
- Numerical analyses with Plaxis 2D;
- Reporting



# Project datasheet Harbour and Offshore

## Tiplam Terminal & Harbour Geotechnical Design

Location: Santos, SP,  
Brazil

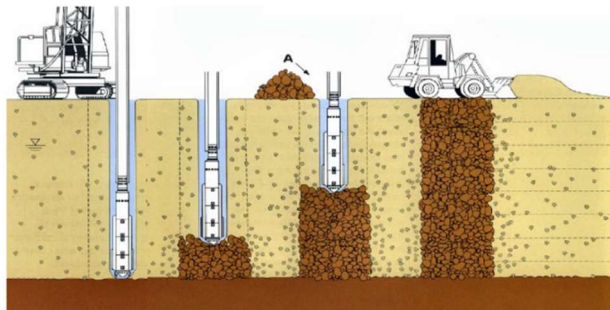
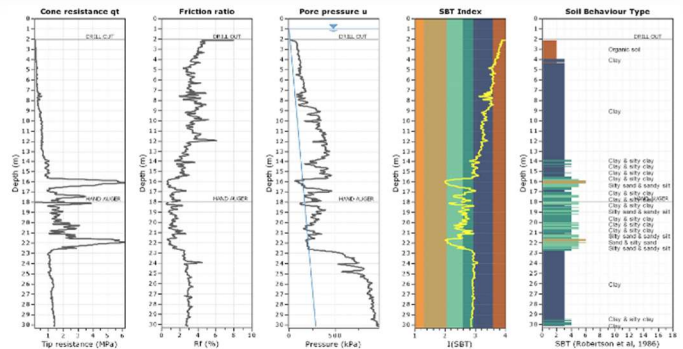
Client: Progen / VLI

**Description:** Tiplam is a large harbour terminal facility acquired by VLI and in 2012 a large renovation design took place.



### Services provided by Terratek

- Site investigation data analyses;
- Reinforced embankment design on soft soils
- Ground improvement design alternatives using wickdrains, stone columns and DSM (deep soil mixing)
- Warehouses foundation design with H section steel piles and also precast centrifuged concrete piles;



# Project datasheet Harbour and Offshore

## Pecem Harbour Geotechnical Design

Location: Ceará, Brazil

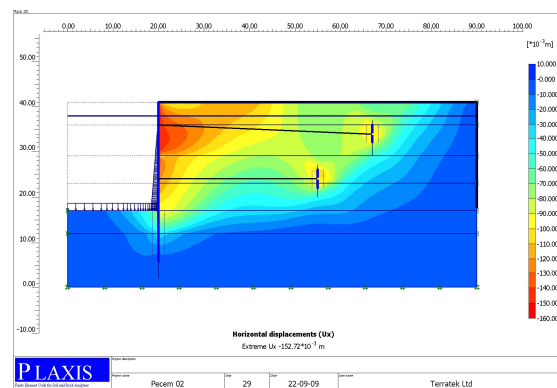
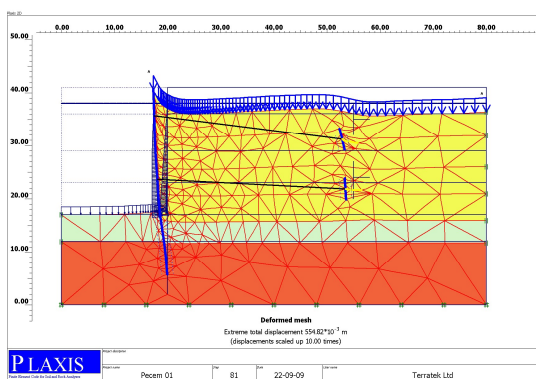


**Description:** In 2009 Terratek carried out studies to analyse the behaviour of the harbour structures.

It consisted of a sheet pile wall backfilled with dredged sand. The wall is tied back by two levels of soil anchors with dead-mans. The analyses led to an improved location of the dead-mans to avoid interference with displacements at the front of the wall.

### Services provided by Terratek

- Plaxis 2D numerical modelling;
- Reporting



# Project datasheet Harbour and Offshore

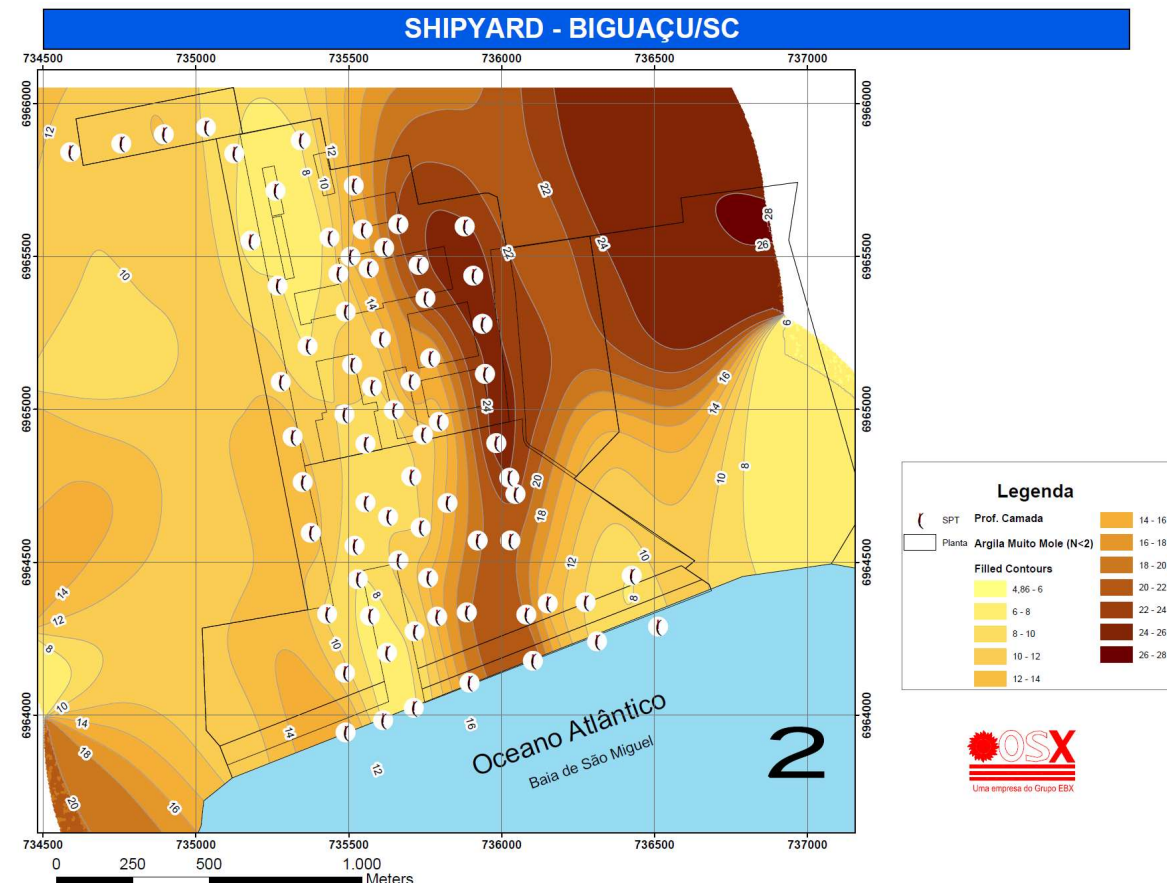
## OSX Shipyard feasibility geotechnical studies

Location: Biguaçu, SC, Brazil

**Description:** In 2010 Terratek carried out preliminary studies to analyse the feasibility of a 3 to 4 m high embankment to be built on very soft soils of varying depths from 5 to 30 m. Terratek analysed alternatives for soft soil improvement which took into account: wickdrains and temporary surcharge and stone columns.

### Services provided by Terratek

- Site investigation data analysis;
- Mapping the soft soil depth
- Reporting





# Project datasheet Harbour and Offshore

## Load-out studies for offshore platform modules

Location: Rio de Janeiro, Brazil

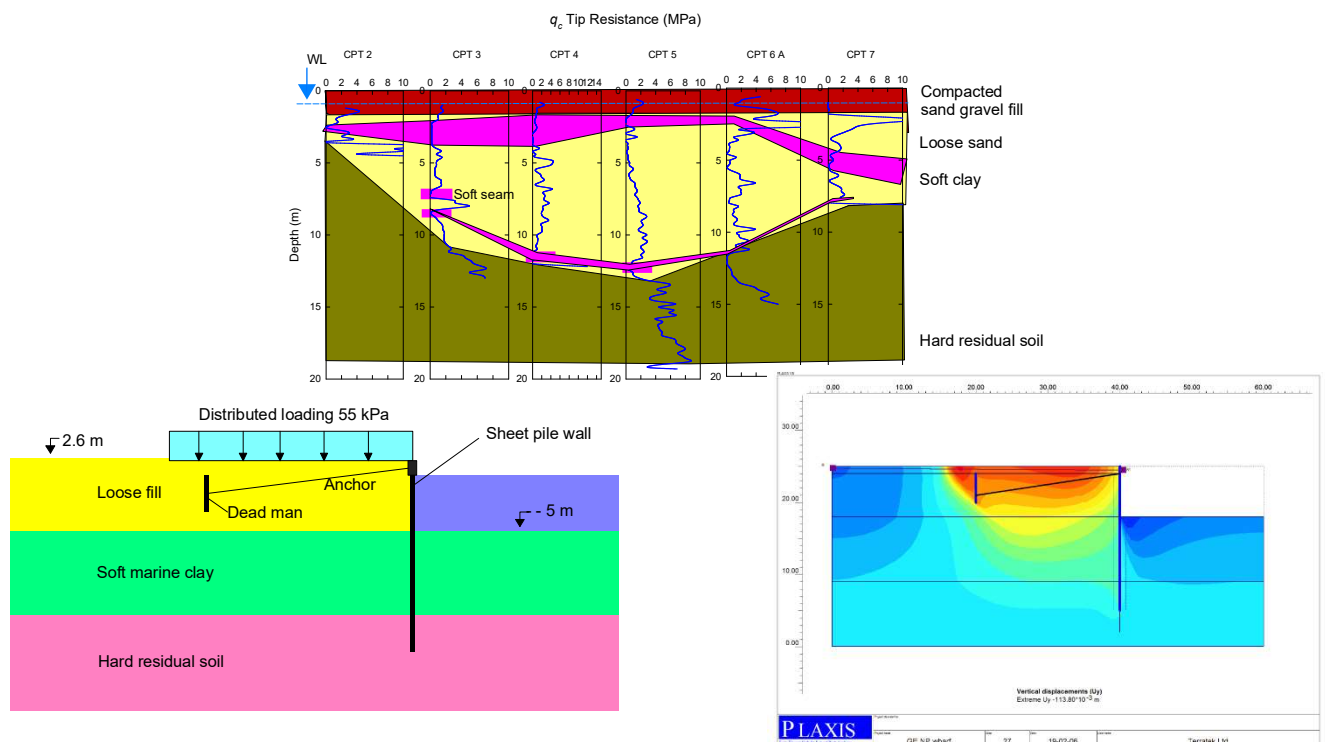
Client: GE Nuovo Pignone

**Description:** In 2009 Terratek carried out studies to analyse the behaviour of very high loads to be applied on the ground during load-out operation of offshore modules. These modules, which applied a distributed surcharge of 55 kPa on the ground level, were built onshore and had to be moved and loaded on a barge. The operation required loadings to be applied to an old quay wall, which was analysed.



## Services provided by Terratek

- Site investigation SPT and CPT;
- Data analysis;
- Plaxis 2D numerical modelling of the quay wall structure



## Project datasheet Harbour and Offshore

### Dynamic monitoring of harbour structures

Location: Tubarão Harbour, Vitória, ES, Brazil

Client: Vale Mining

**Description:** Terratek carried out in 2003 dynamic monitoring of a few harbour structures located at Pier 2, Tubarão Harbour, aiming at analysing structural integrity of 30-year-old reinforced concrete structures. The work included: five dolphins, two swivel tables, two supporting curved beams and two conveyor belts.



### Services provided by Terratek

1. Measurements of vibration with precise accelerometers;
2. Signals spectral analyses;
3. Numerical modelling of all structures;
4. Validation of the numerical models in the frequency domain;
5. Analysis of the results.



# Project datasheet Harbour and Offshore

## Berth dredging geotechnical design

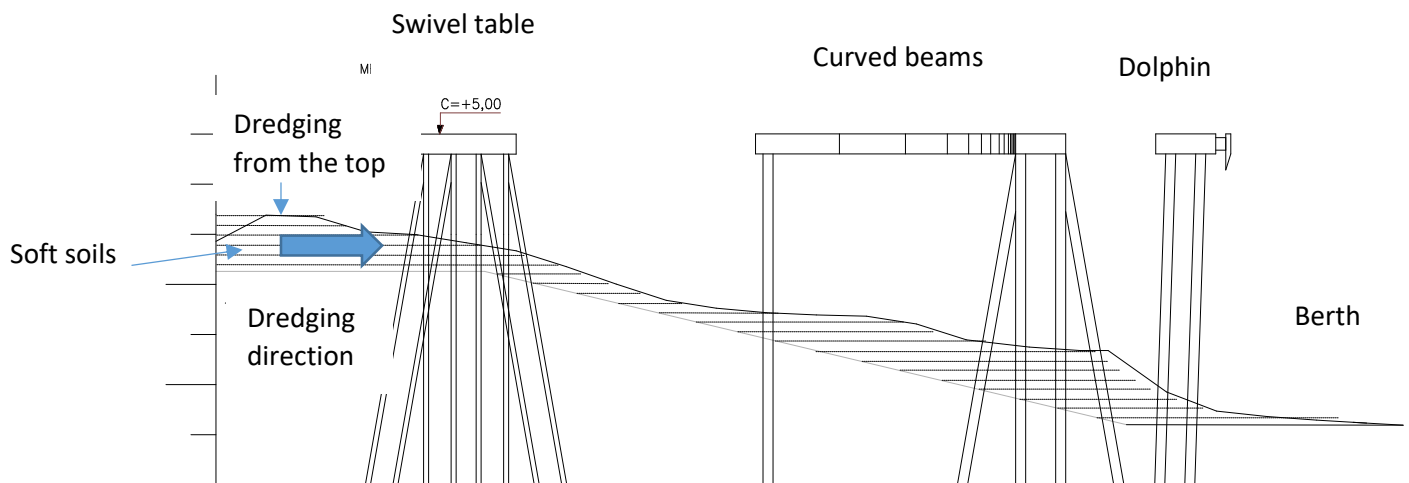
Location: Tubarão Harbour, Vitória, ES, Brazil

Client: Vale Mining

**Description:** Terratek carried out in 2001 the geotechnical design for dredging of Pier 2 berth. The whole area was covered with an 8 m thick soft sediment. The initial studies had shown that if the berth was dredged without removing the soft sediment, a horizontal slide would occur, leading to horizontal displacements around the piles and a major failure. The analyses showed the need for the removal of this soft layer, starting from the top and then progressing towards the berth by using a drag-line excavator.

## Services provided by Terratek

- Geotechnical consultancy and design;
- CPTU testing;
- Analyses of the pile behaviour under horizontal loading;
- Instrumentation and monitoring during dredging with inclinometers.



## Project datasheet Harbour and Offshore

### Iron ore stockpile lifting instrumentation and monitoring

Location: Sepetiba Harbour

Client: Ferteco (now Vale)

**Description:** In 2005 Terratek instrumented 18 m high, 60 m wide iron ore stockpiles, with inclinometers, VW piezometers and a settlement profiler to monitor the behaviour during first lifting.

### Services provided by Terratek

- Geotechnical consultancy and design;
- Instrumentation installation (inclinometer, VW piezometers, settlement profiler)
- Analysis of the behaviour



## Project datasheet Harbour and Offshore

### Offshore structure dynamic monitoring

Location: offshore Talara, Peru

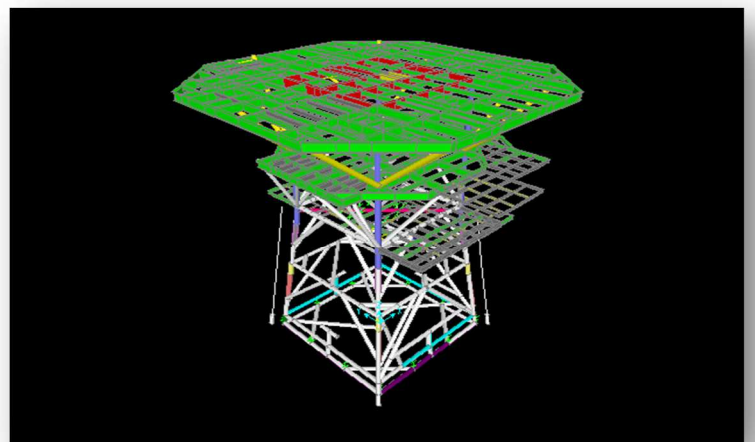
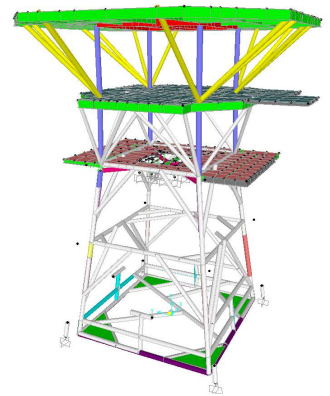
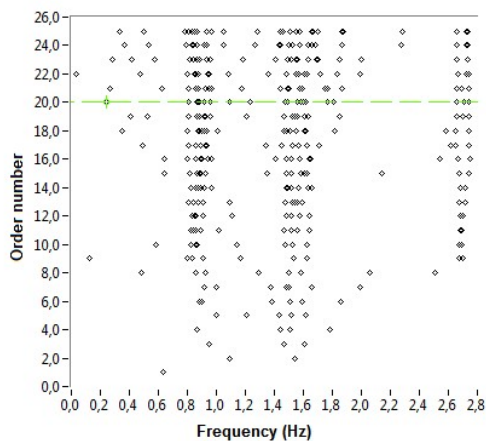
Client: Savia Petroleum, Peru

**Description:** Terratek in 2010 carried out a structural integrity assessment through dynamic methods.



### Services provided by Terratek

1. Measurements of vibration at many points on the structure with precise accelerometers;
2. Signal spectral analyses through SSI Stochastic Subspace Identification method;
3. Numerical modelling of the structure;
4. Validation of the numerical model in the frequency domain;
5. Analysis of the results.



# Project datasheet Harbour and Offshore

## Quay wall design for the supply boat harbour

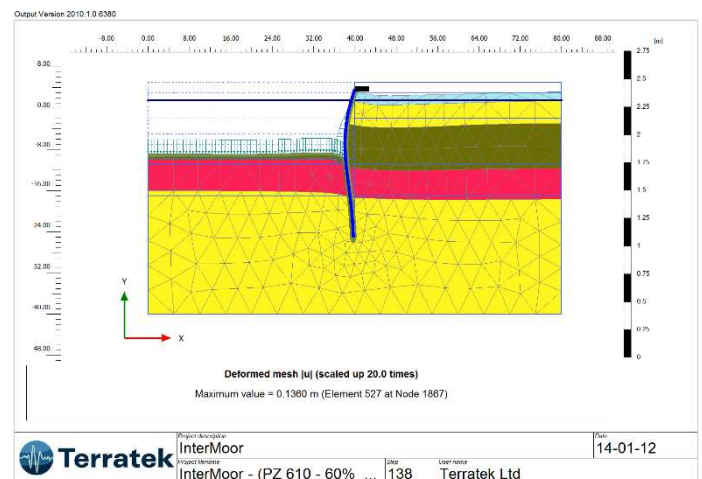
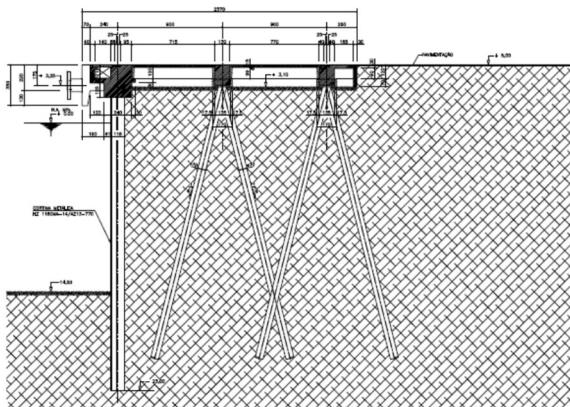
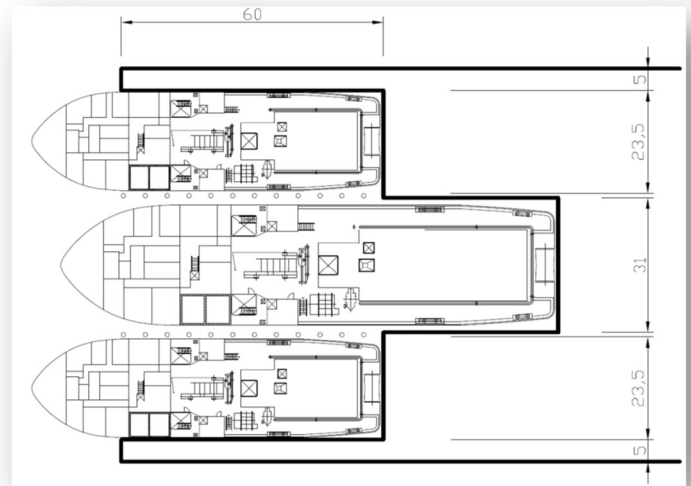
Location: Açú Harbour, RJ, Brazil

Client: Intermoor, Inc.

**Description:** Terratek designed in 2012 a steel sheet pile quay wall for berthing three supply boats at the client's harbour facility in Açú Harbour.

### Services provided by Terratek

1. Site investigation analysis
2. Geotechnical design based on Plaxis 2D model of the sheet pile wall
3. Structural design



# Project datasheet Harbour and Offshore

## CPTU testing and geotechnical analyses

Location: Rio de Janeiro Harbour

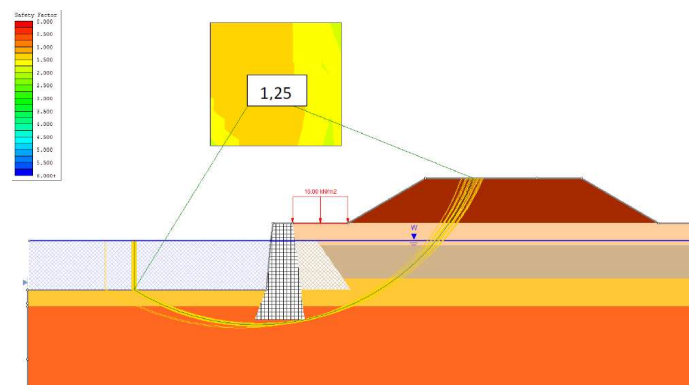
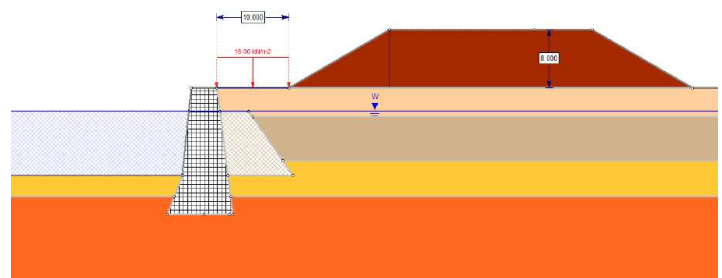
Client: Triunfo Logistics

**Description:** Triunfo Logistics in 2016 awarded Terratek a contract to carry out CPTU testing and geotechnical analyses of very high loading of a pig iron stockpile to place close to a 100-year old quay wall.



## Services provided by Terratek

1. CPTU Testing
2. Stability and settlement analyses of the quay wall



## Project datasheet Harbour and Offshore

### PIT & PDA Dynamic pile testing

Location: Rio de Janeiro, Brazil

Client: Transcarioca Contractors JV

**Description:** From 2012 to 2015, Terratek carried out dynamic pile testing for  $\phi$  800 to 1200 mm steel bored pipe piles socketed into the hard rock for a stayed bridge from Fundão to Governor's Island in Rio de Janeiro.

### Services provided by Terratek

1. PIT and PDA testing
2. Capwap numerical analyses
3. Reporting

