WESTPRO PORTUS

Use of RD Piles for Marine Construction

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Picture: https://www.westpro.fi/portus//taloyhtio

TODAY'S AGENDA

- About the Westpro Portus Project
- Geotechnical conditions
- Sheet pile retaining wall
- Design of foundation using SSAB RD piles
- Anchoring for the SSAB RD piles
- Challenges during the design phase
- Conclusion
- Q & A session

WESTPRO PORTUS

- Located at Verkkosaari, Helsinki
- 400 metres from Kalasatama metro station
- The tallest building is 14 storeys high and rises over 57.5 metres above the sea level
- Basement floor level is 600 mm above the sea level.
- 13928 m2 of living space
- 540,5 m2 of retail space
- 233 apartments
- 135 parking plots for vehicle
- 520 parking plots for bicycles

Fig (1): Project site.

GEOTECHNICAL CONDITIONS

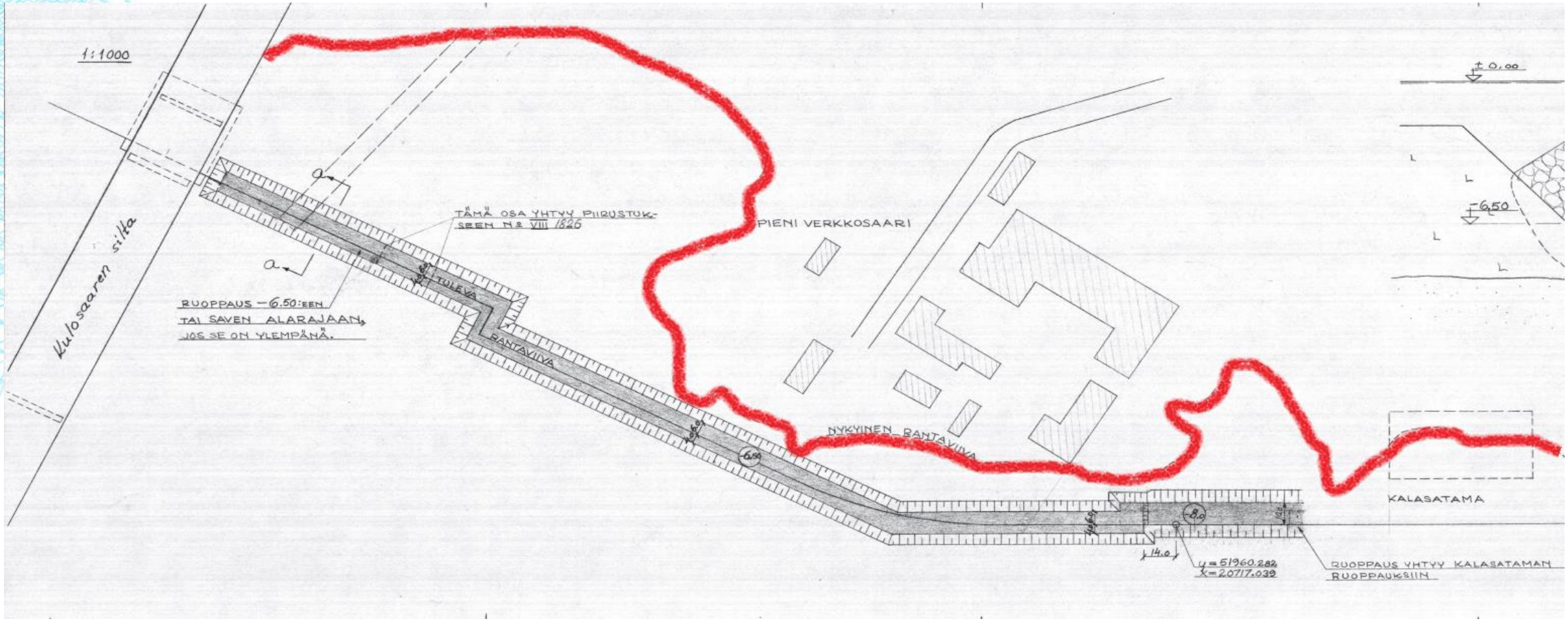


Fig (2): Previous extensions of the shoreline, year 1964.

- The shoreline have been extended previously by filling and reinforcing the shores with blasted rock.

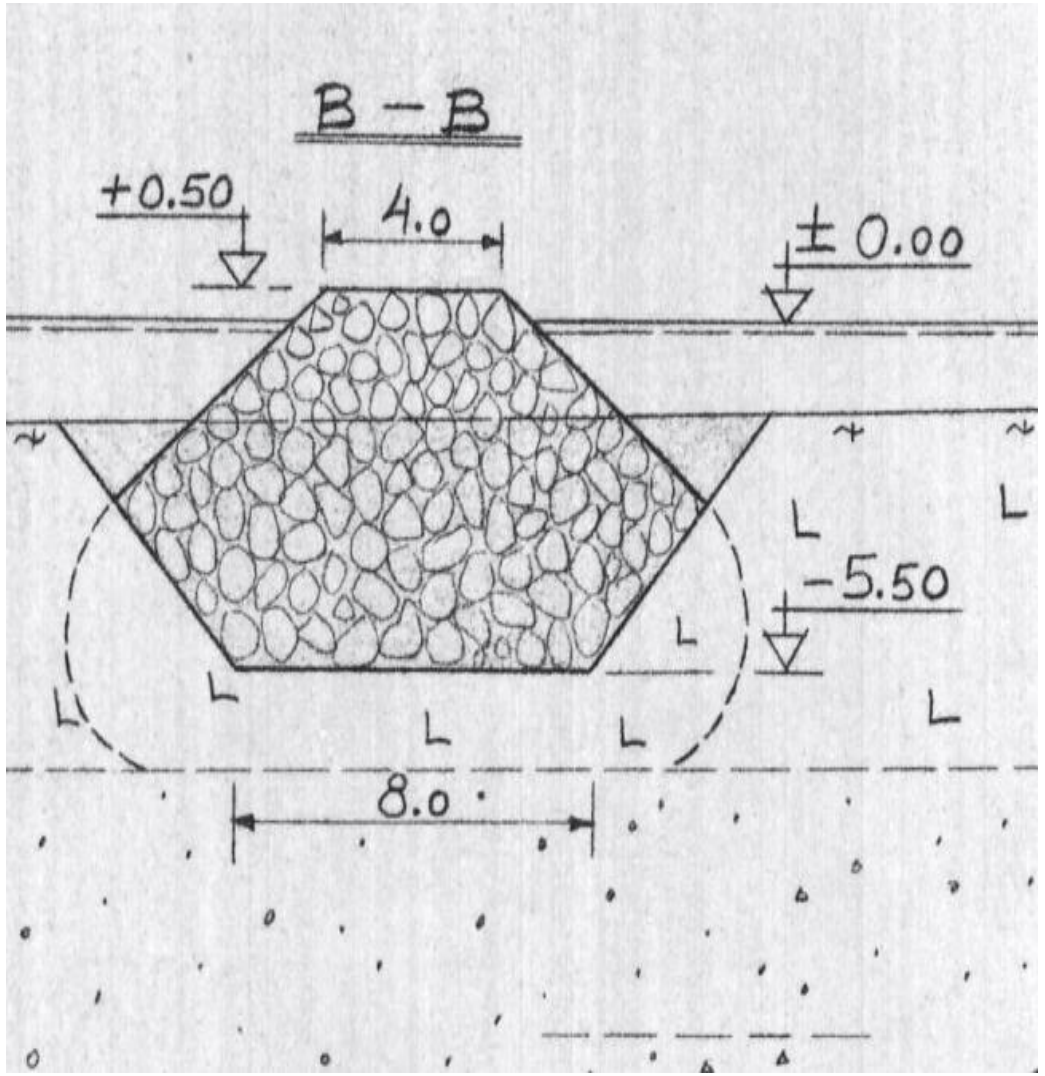


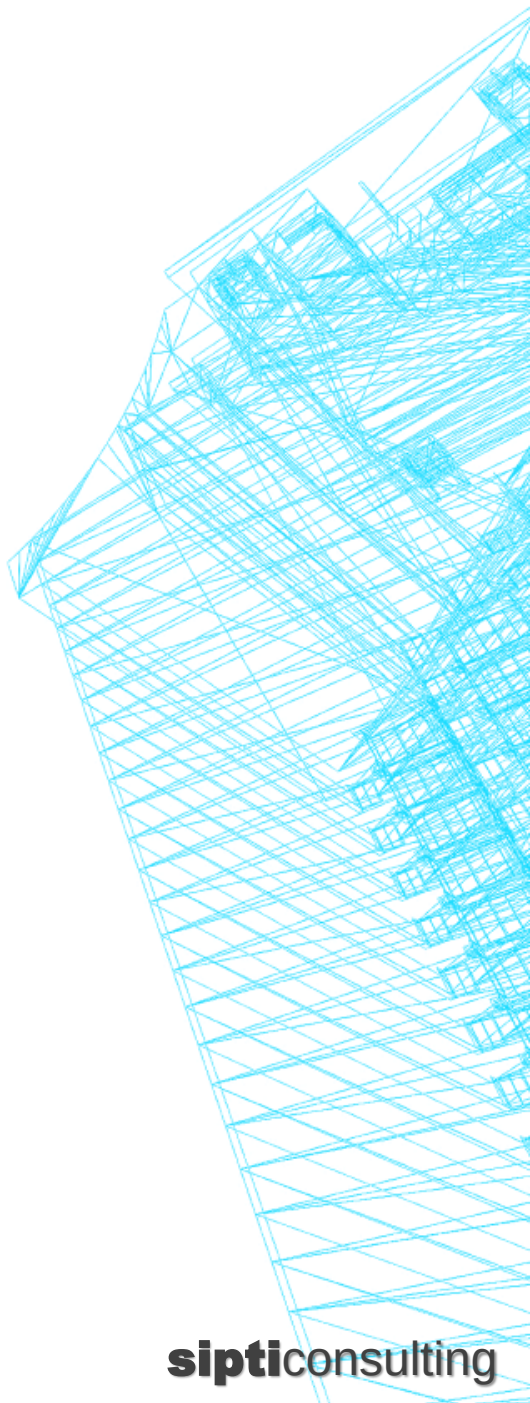
Fig (3): Cross section of the old embankment profile.

- The present construction plan extends the current shoreline further to the sea by over 10 meters.

- The building itself extends about 40 meters to the sea compared to current shoreline.

- The sounding results and pile plan shows that the maximum bedrock surface depth for the piling is 24 meters.

- Corrosion margin of 4mm/100 years to the steel pile have been considered during the design phase.



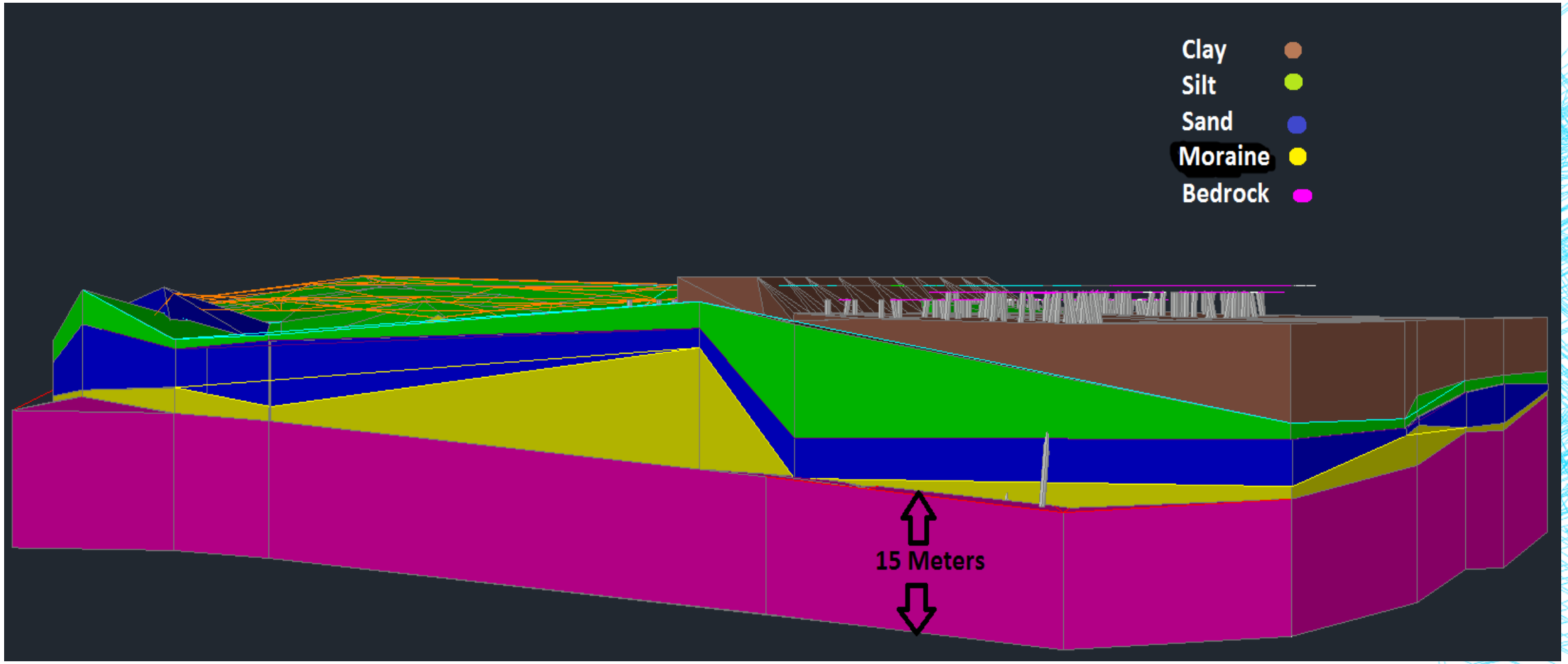


Fig (4): 3D view of the soil layers underneath site.

- The clay layer is 0.8 to 10.5 meters thick.
- Below soft clays, there is silt layer of about 0 to 12 meters.
- Below silt layer, there is sand layer of about 0 to 7 meters.
- Below sand layer, there is moraine layer of about 0 to 13 meters.
- The bedrock surface level ranges from -5 metres to -24 metres.
- The sea bed is about 3 to 5 meters below the water level.

SHEET PILE RETAINING WALL

- Larssen sheet pile type L605 for external wall and type L603 for internal wall.
- The sheet pile length ranges between 8 meters and 30 meters.
- Approximately, 19 Km of sheet piles will be used.
- Double layered section of section of the sheet pile will be reinforced with HE300B beams and GEWI 32 mm tie bars.

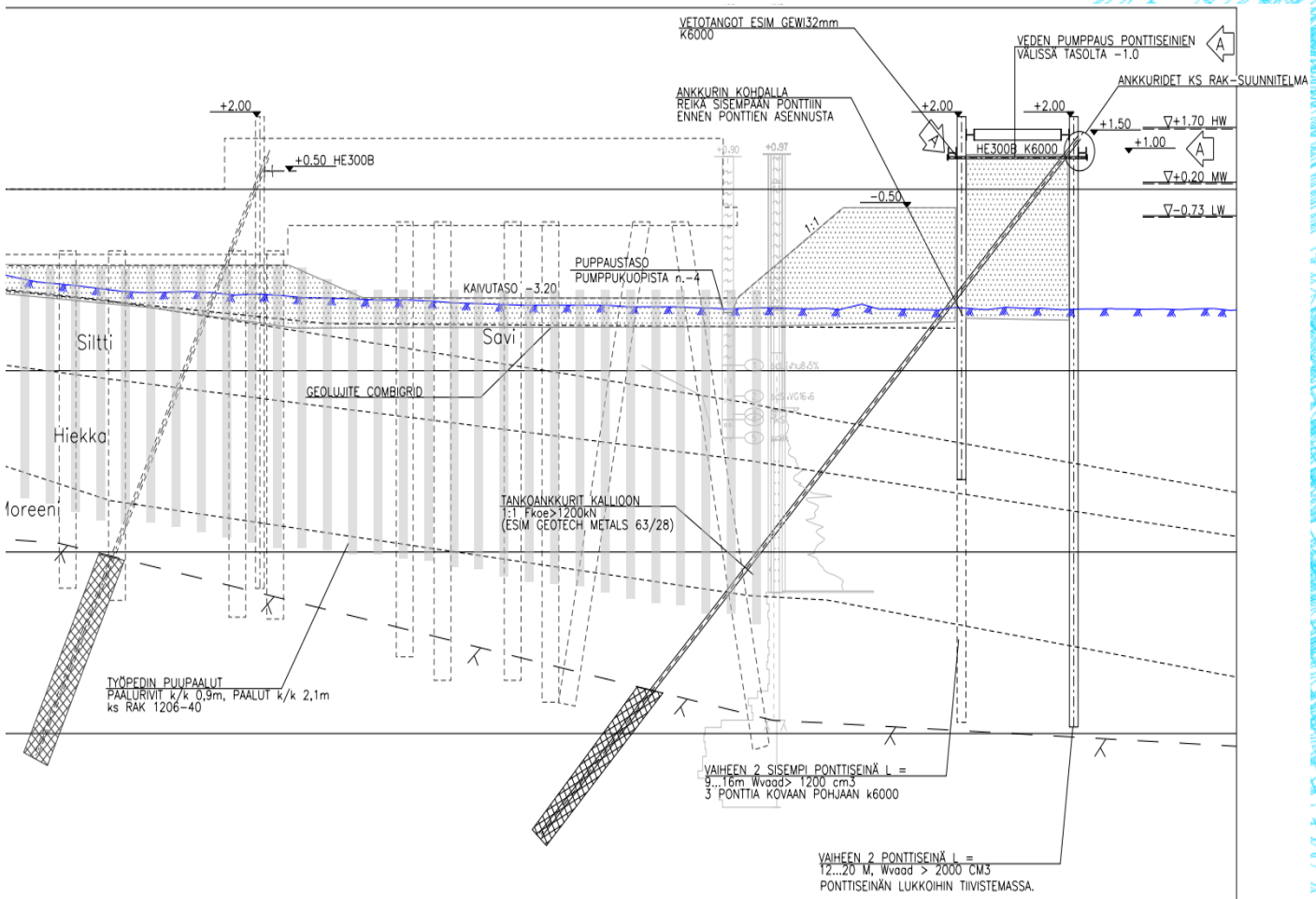
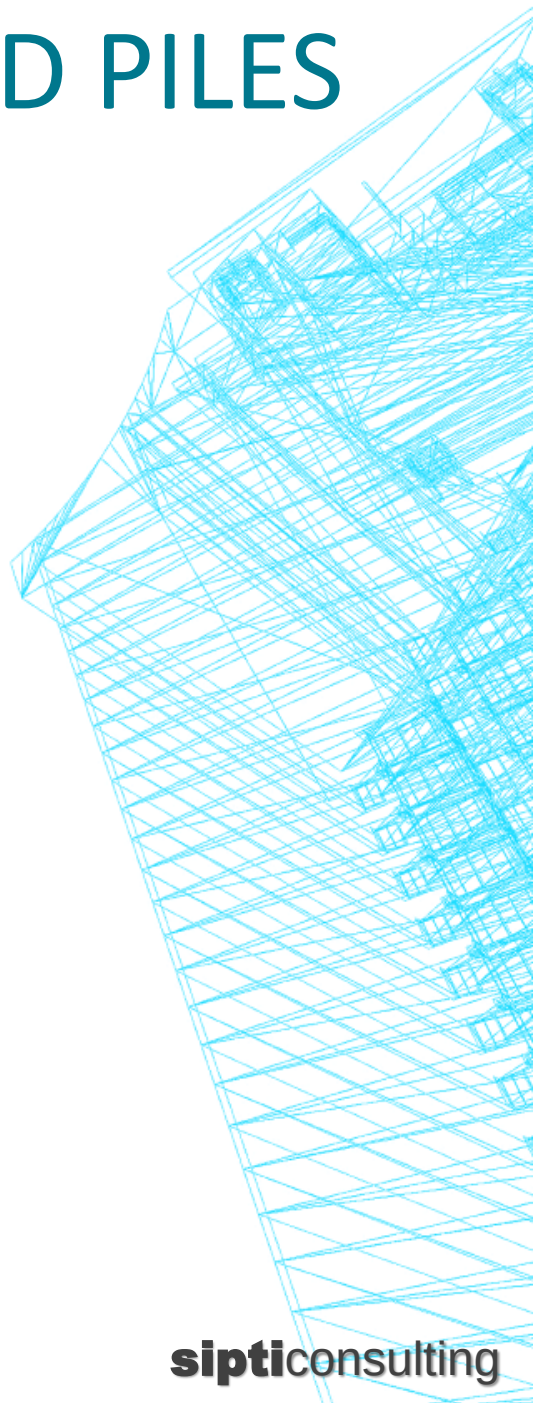


Fig (5): Anchoring of the sheet pile wall.

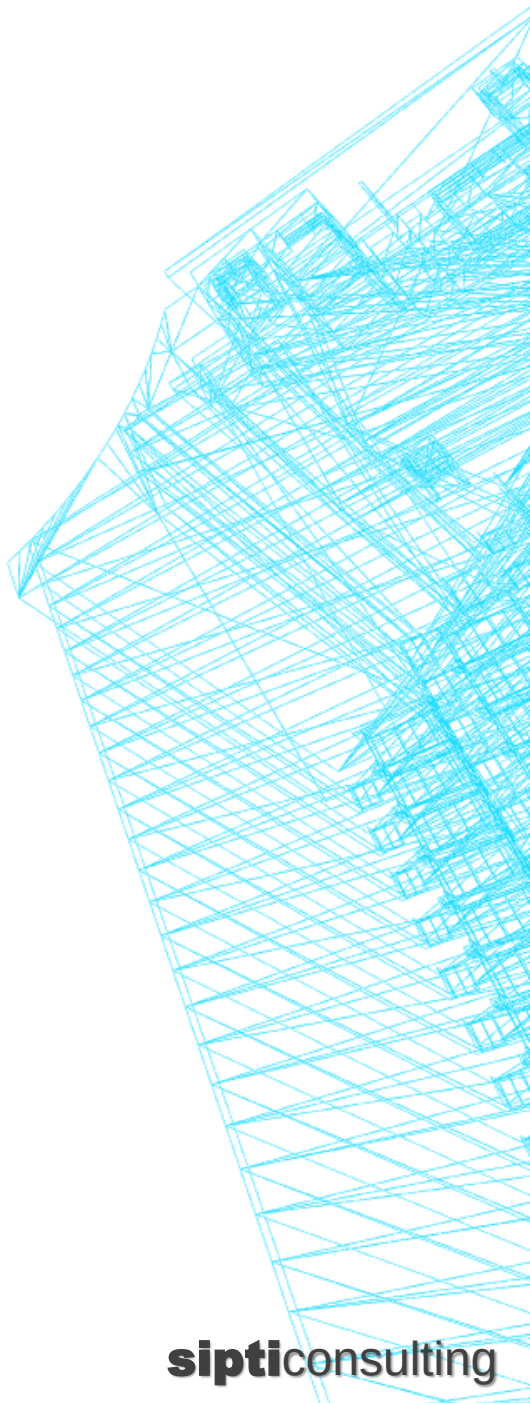
- Anchoring of the sheet pile is done by using GEWI 63.5 bars.
- The anchor bars are grouted 7 meters in the bedrock.
- The inclination of the anchors are 1:1 and 2:1 and the horizontal design resistance are 1000 kN and 627kN respectively.

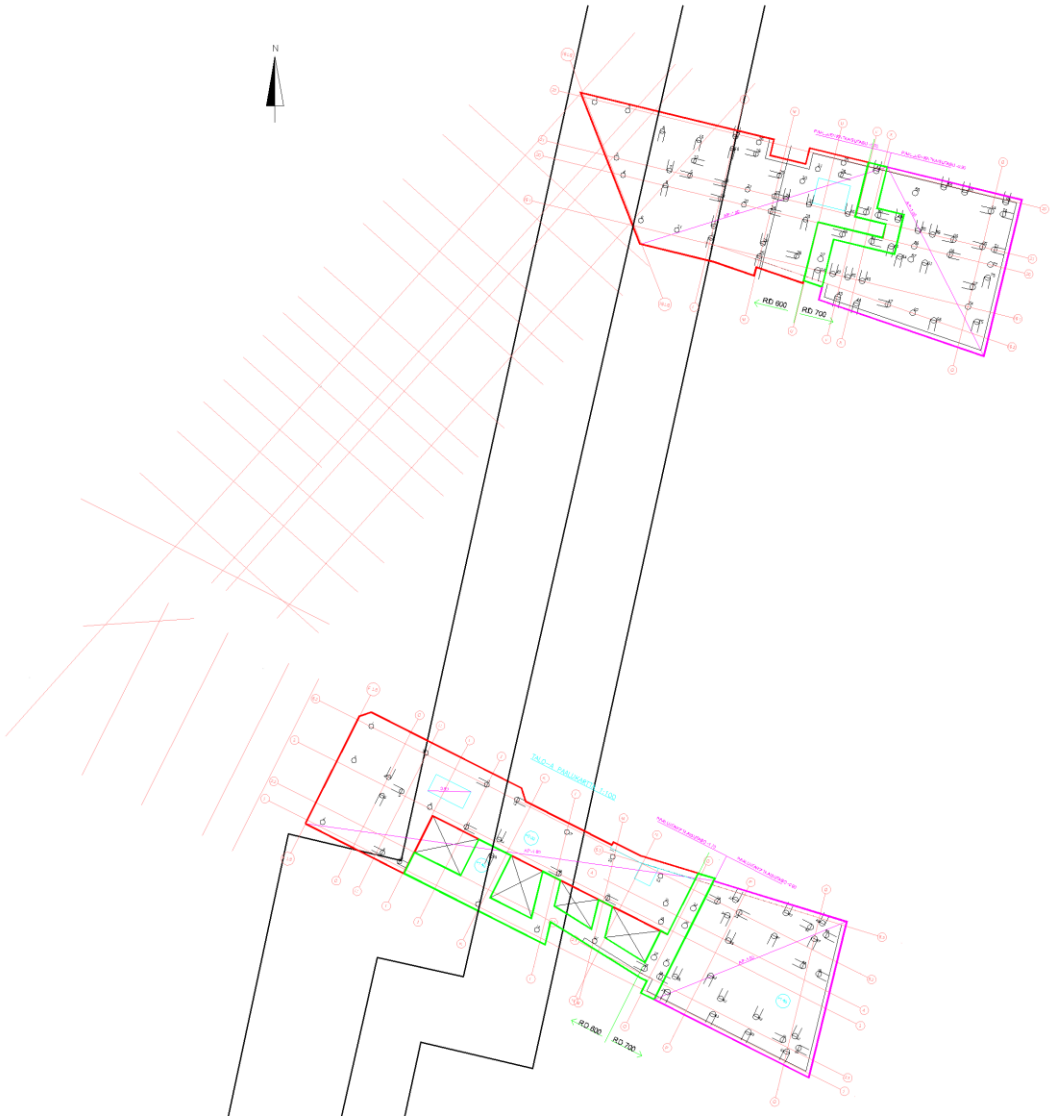
DESIGN OF FOUNDATION USING SSAB RD PILES

- Total number of RD piles used is 129 out of which,
- 61 are RD600/18, total length 699.4 meters.
- 68 are RD700/18, total length 1054.9 meters.
- Steel grade of the piles is S440J2H.
- RD600 piles extend further 2 meter below bedrock surface and RD700 piles extends further 2.5 meters.



- The piles are filled with concrete and reinforcement.
- The foundation slab thickness ranges from 1800 mm to 3200 mm.
- Concrete grade used for the foundation slab is C35/45.





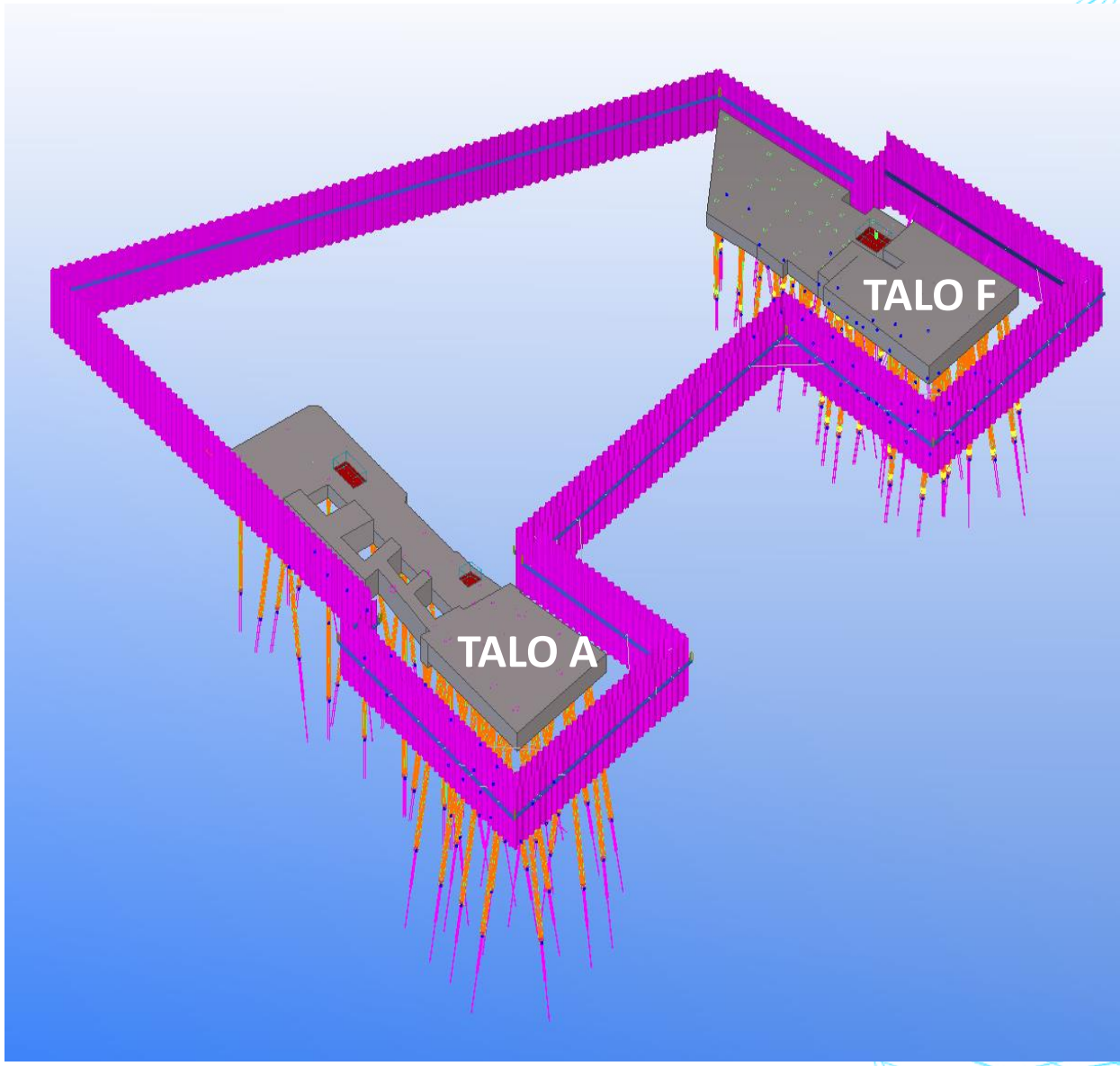
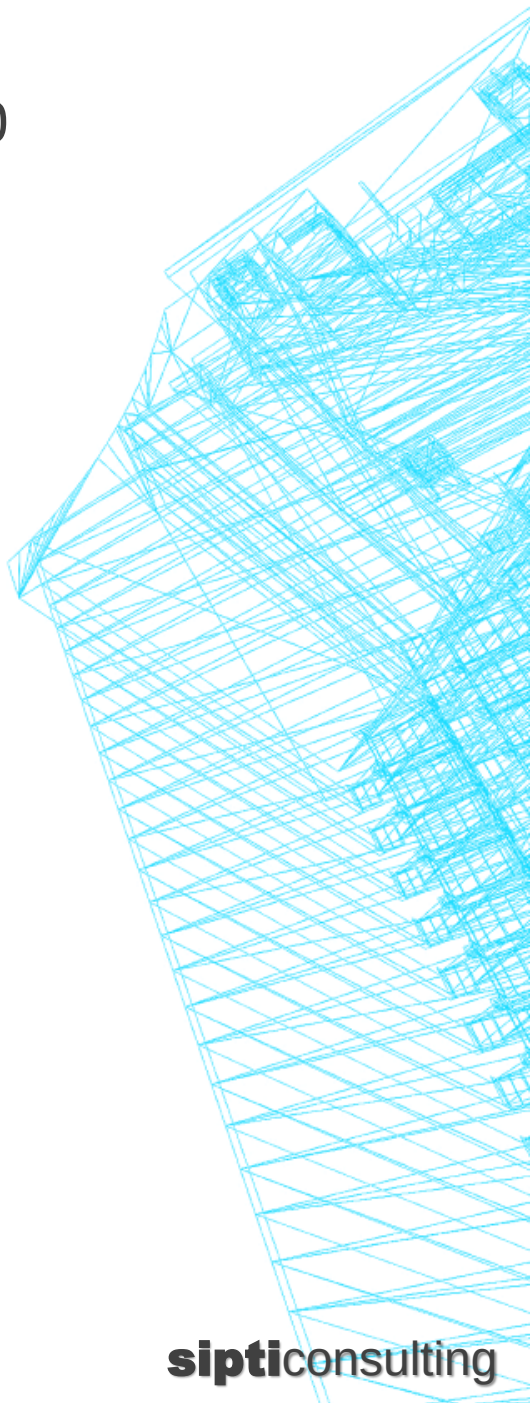


Fig (6): On the left, foundation plan where Red, Magenta and Green coloured parts represents the slab with thickness of 1800 mm, 2400 mm and 3200 mm respectively. On the right, Tekla model of the foundation with Sheet pile retaining wall.

- The design value for the compression resistance of RD600 and RD700 piles were limited to 8697 KN and 10360 KN respectively. Bending moment caused due to soil compaction is taken into account.

- Total vertical design load including the self weight of the foundation was 285.4 MN and 241.9 MN for Talo F and Talo A respectively.

- Maximum compressive force experienced by any pile was 8650 KN and maximum tension force experienced by any pile was 2071 KN.



ANCHORING FOR THE SSAB RD PILES

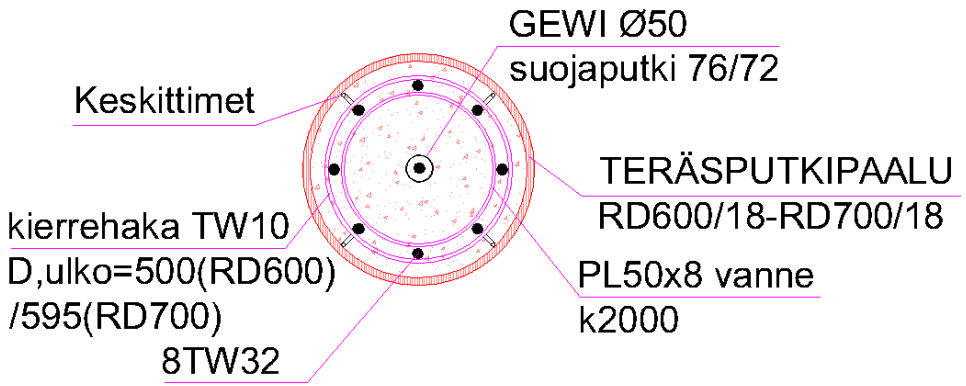


Fig (7): Anchor details for pile experiencing less than 600 KN of tension force.

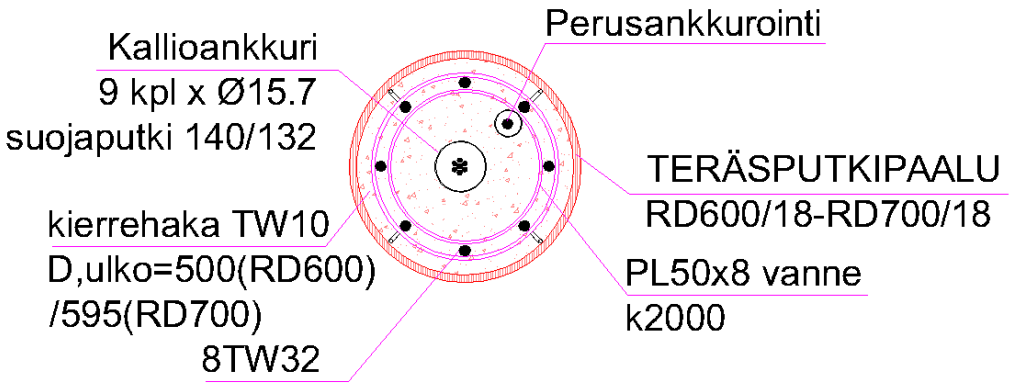
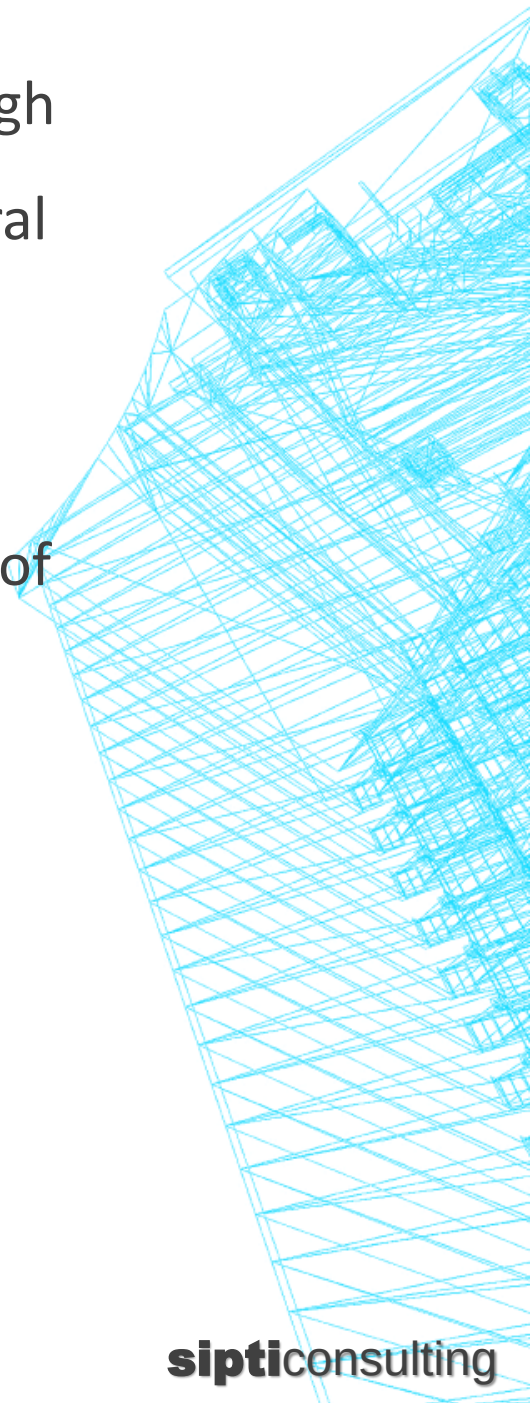


Fig (8): Anchor details for pile experiencing more than 600 KN of tension force.

- Apart from traditional lateral loading, the structure experiences high lateral loading due to ice. This results in high tension force in several piles at times.

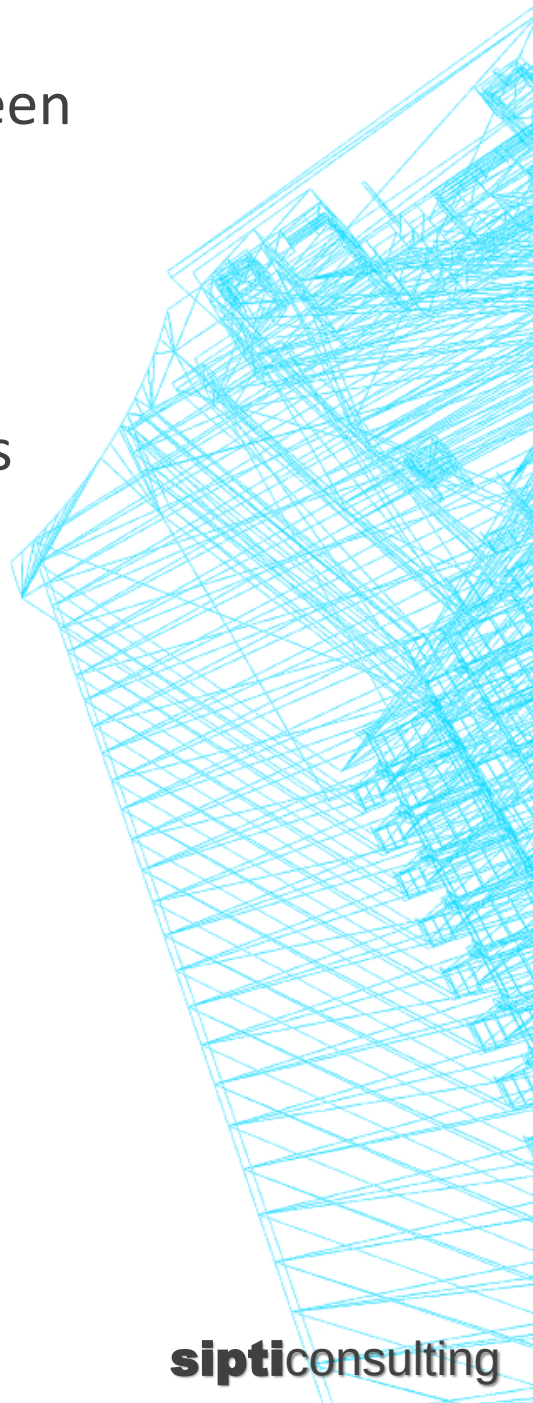
- There will be two types of pile anchoring based on the magnitude of the tension experienced by the piles.

- The basic anchoring will be limited for the piles experiencing less than 600 KN of tension force.



- Additional anchoring will be done for the piles experiencing between 600 KN and 2400 KN of tension force.

- Out of 129 piles, 97 piles will have the basic anchoring and 32 piles will have additional anchoring.



CHALLENGES DURING THE DESIGN PHASE

- Design of tension piles and anchors due to high lateral loading caused by ice forces.

- Constantly changing design required frequent updates

- Precise modelling of the whole structure including the sheet piles, sheet pile anchor, RD piles and RD pile anchors in order to avoid collision between any of those entity.

CONCLUSION

- Attention to details while modeling the structure in terms of position, inclination angle and required minimum tolerances was critical.

- Use of 3D modeling tools made it possible to mitigate the conflict between structure underneath.

- Implementation of the design on site according to the plan is most important.

QUESTIONS