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New Dolphin Structure

Project Description

A new dolphin structure is required to aid in the berthing and loading of a new, larger design ship, the Villa de Teror

Project Location:

Cap-aux-Meules, QC

Project Scope:

- Calculation of vessel mooring and berthing loads
- Design of bollard and fender
- Design of dolphin structure and location
- Design of an access walkway
- Production of reports, drawings, cost estimates and construction schedule

Design Process

Berthing and Mooring Loads

- Berthing & mooring forces calculated using Fender Team Manual & Guidelines for Safe Mooring respectively
- Fender & bollard selected to support 450kN and 1225kN respectively

Design and Layout of Two Dolphin Options

Steel Pile

- Pile layout designed to resist lateral loads via batter piles and to ensure adequate load distribution
- Soil bearing capacity was calculated to determine required pile embedment length, P-Y curves were utilized to confirm calculations

SSP Cell

- Cell layout & embedment depth was estimated and checked with USSSP design manual, once design passed all safety checks, pile dimensions & material was selected. Then, the final layout based on pile dimensions was checked

Design of Concrete Reinforcement

- Deck was reinforced against bending, shear, and cracking

Design of Access Walkway

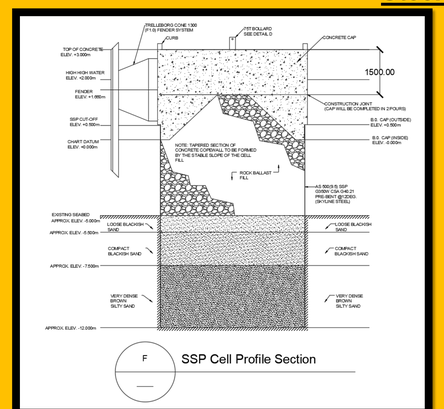
- Designed as simple truss, checked according to NBCC

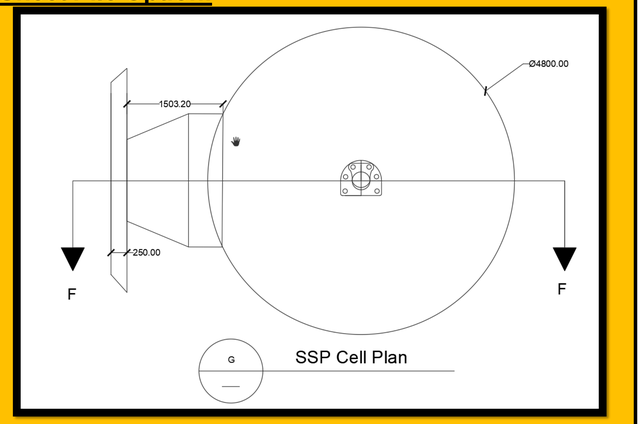
Cost Estimation of Each Option

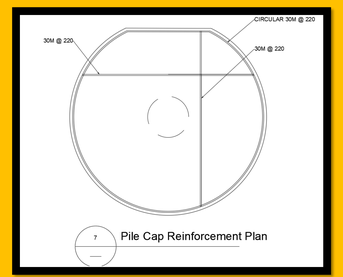
- Cost estimates used to decide the recommended design

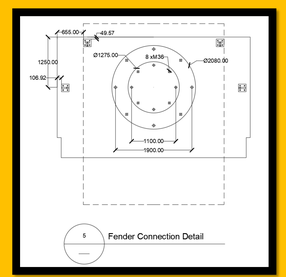
Details of Design

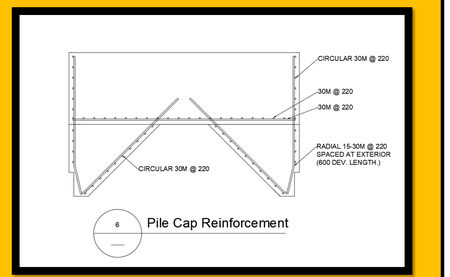
Steel Sheet Pile Option:



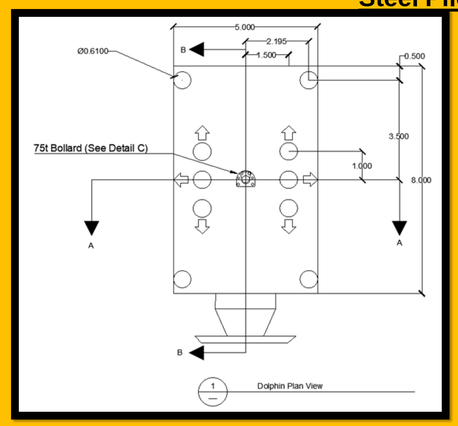


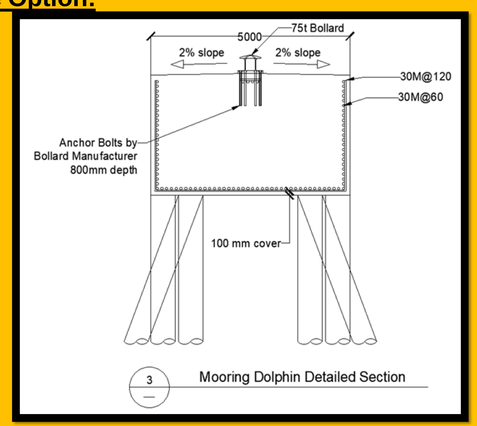


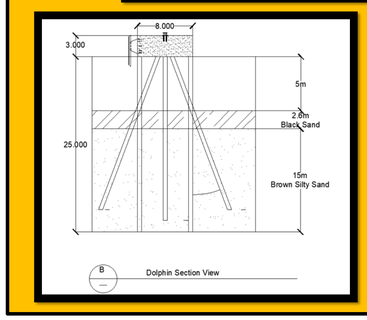


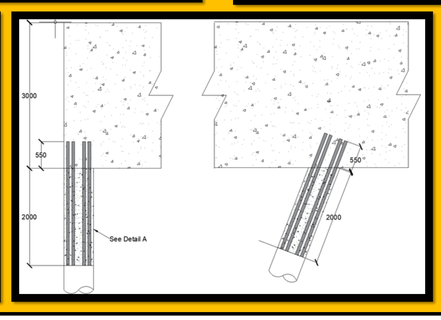


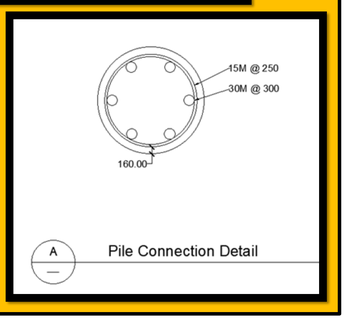
Steel Pile Option:











Conclusion and Recommendations

	Steel Pile Option	Sheet Pile Option
Cost ($)	623,300	288,200

- There are two main factors attributing to our design recommendation. The most important being construction cost, with the sheet pile option costing less than half of the steel pile option. And secondly factors relating to the construction of the dolphin

Construction cost

- The main difference in cost between the two designs is directly related to the cost of reinforced concrete & pile costs
- The steel sheet pile cell design only uses a third of the volume of reinforced concrete required for the steel pile design, this attributes to a $170,000 difference in cost
- The total pile material and installation cost for the steel sheet pile cell is $45,000 lower than the steel pile design

Construction & Staging

- When working offshore, space efficient and simple construction is essential. The steel sheet pile option uses a flat, easily transportable and stored material
- Steel sheet piles are piled straight down in a circular pattern, while the steel pile option requires a complex layout using raking piles which must be piled diagonally into the soil

- Due to the effective cost and construction benefits of the steel sheet pile cell option, we recommend this design as the new dolphin structure for Cap-aux-Meules

References

- FenderTeam Design Manual
- US Steel 1984 Steel Sheet Piling design manual
- Guidelines and Recommendation for the Safe mooring of Large Ships at Piers and Sea Islands
- Unified Facilities Criteria Design: Moorings
- Nucor Skyline As Hit Rolled Steel Sheet Pile
- Trelleborg Marine and Infrastructure Fender System product Brochure