



PIANC French Section



PIANC Mediterranean Days and Conference «Port of the future» by Cerema 25 to 27 october 2023 in Sete France

Performance-based design of berthing/mooring
dolphin structure considering geotechnical and
structural constraints under offshore load
conditions

Chambre de Commerce
et d'Industrie
de Corse

Author: Vasileios Afentoulis, SUEZ Consulting



Introduction



Motivation Behind the Study:

Highlighting the significance of berthing and mooring operations in the dynamic realm of maritime activities.

Illuminating the challenges encountered by current berthing facilities when dealing with the demands of accommodating large and imposing vessels.

Unveiling the pivotal role played by dolphins as instrumental structures in expanding terminals and elevating berthing capacity.



Project's aims :

- 1) Secure the berthing of large vessels by increasing the supporting surface;
- 2) To enhance the mooring capabilities by adding additional mooring points;
- 3) Reinforce the safety of passenger embarkation and disembarkation, ensuring a continuous flow between the Terminal and the water structures

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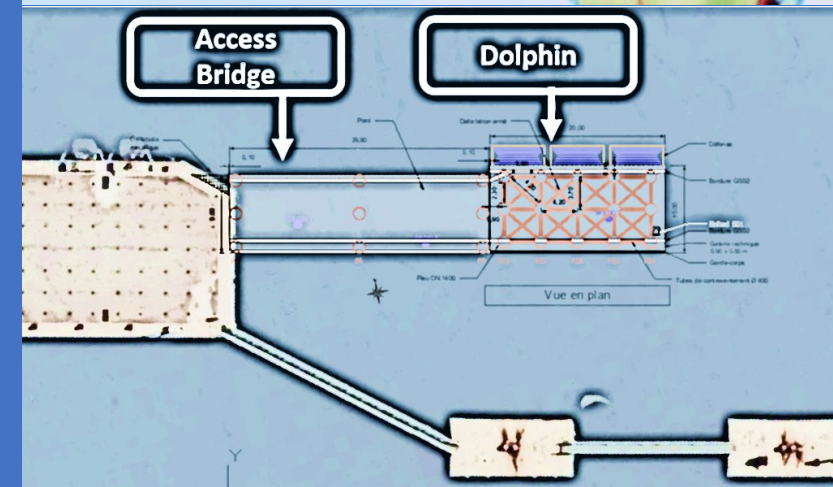
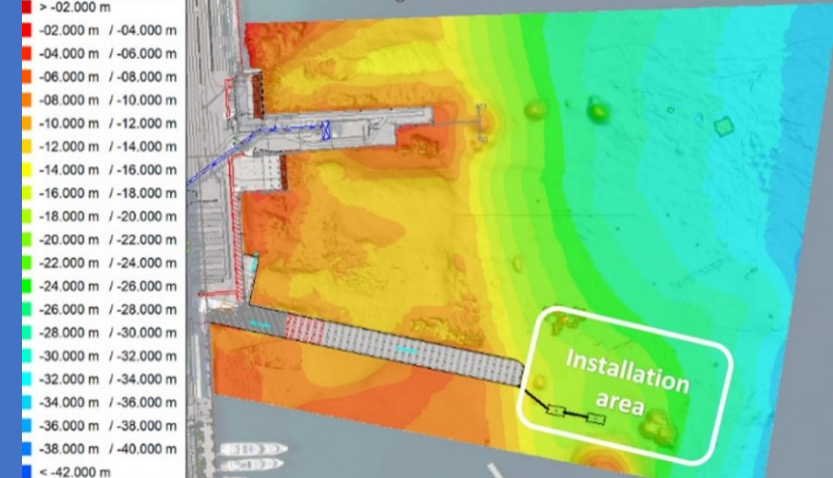
Intro/Study Case

Location: "Mole Croisière" in Ajaccio Port, France, is a key maritime hub.

Structure: The berth integrates two mooring dolphins, supported by piles and walkways. A mooring buoy, linked to a seabed sinker, complements the mooring infrastructure.

Constraints/Objectives:

- Navigating environmental factors,
- construction feasibility,
- structural design requirements.



Environmental Conditions

Prevailing Winds and Wave Conditions:

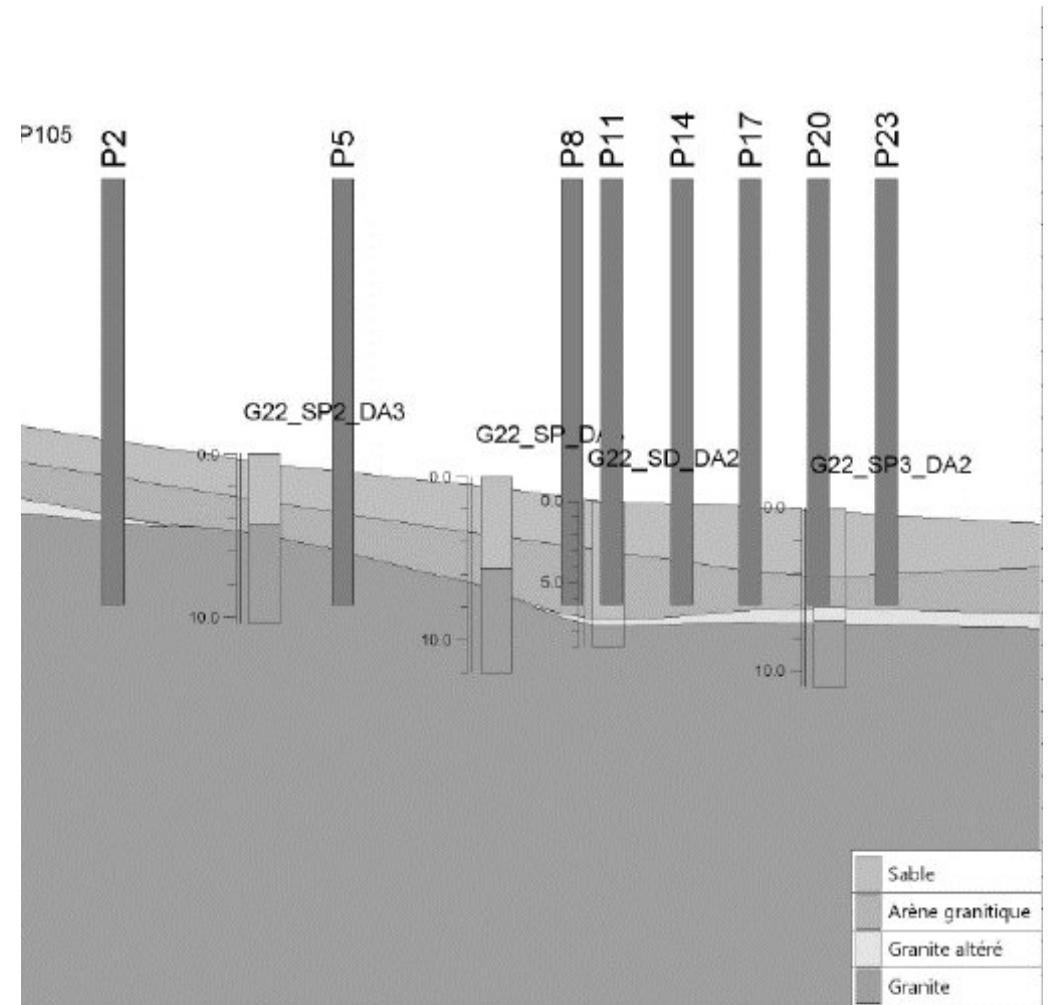
- West Corsica's wind patterns.
- Seasonal wave variations.

Design Site Water Levels:

- Adjusted for sea level rise.
- Critical parameters: Highest Astronomical Tide, Mean High Water, Lowest Astronomical Tide.

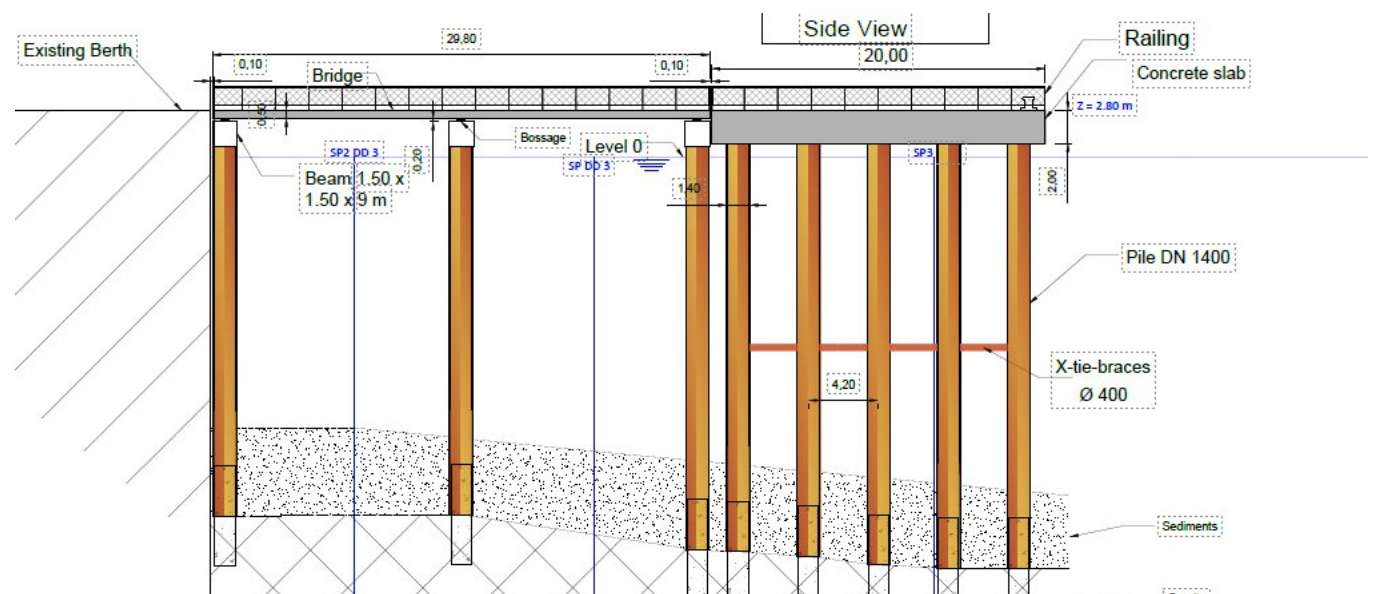
Soil Characteristics:

- Pressuremeter tests: sandy silts, granitic arenas, granite bedrock.



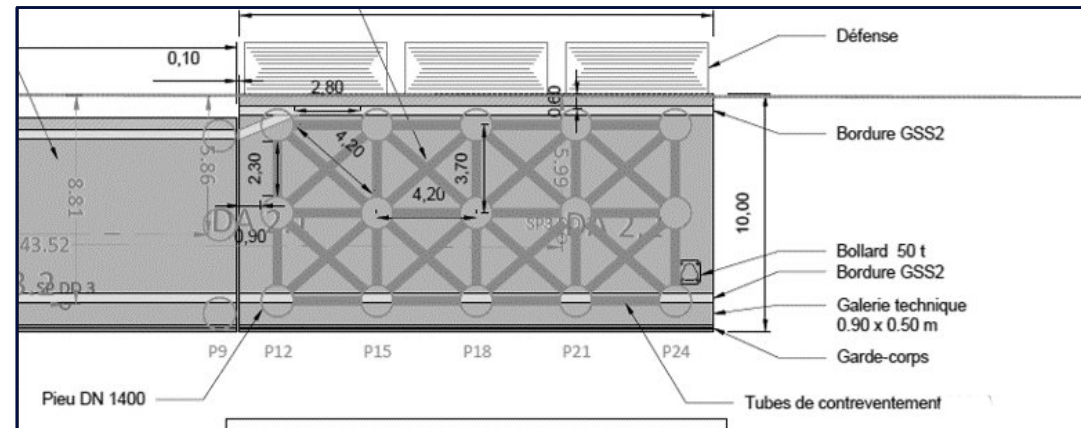
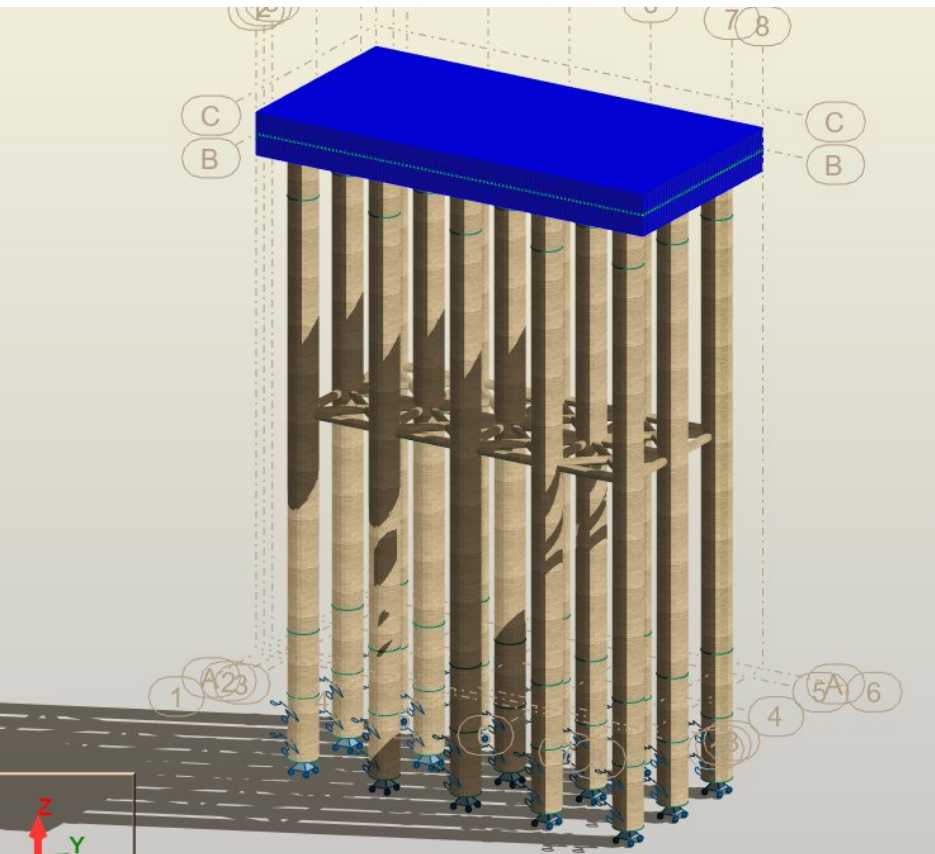


Conceptual Design



Proposed Dolphin Structure:

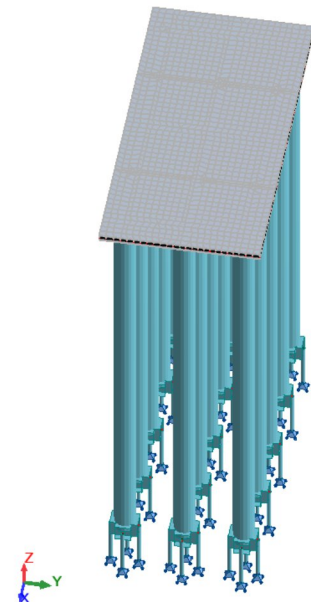
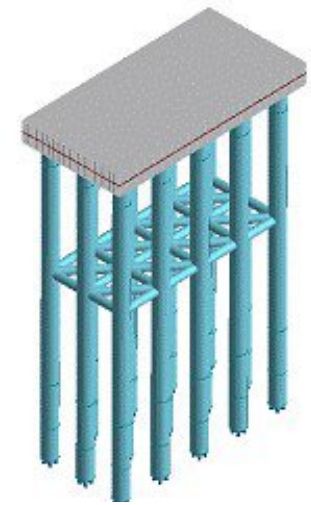
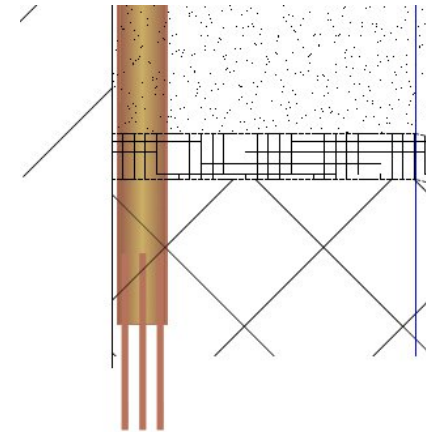
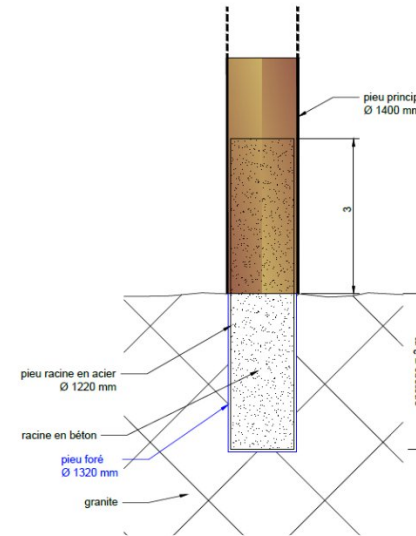
- 20m x 10m platform, 15 piles;
- Tubular steel piles (1400mm diameter);
- Located 30m seaward from the existing berth, connected to the existing structure via a bridge



Conceptual Design

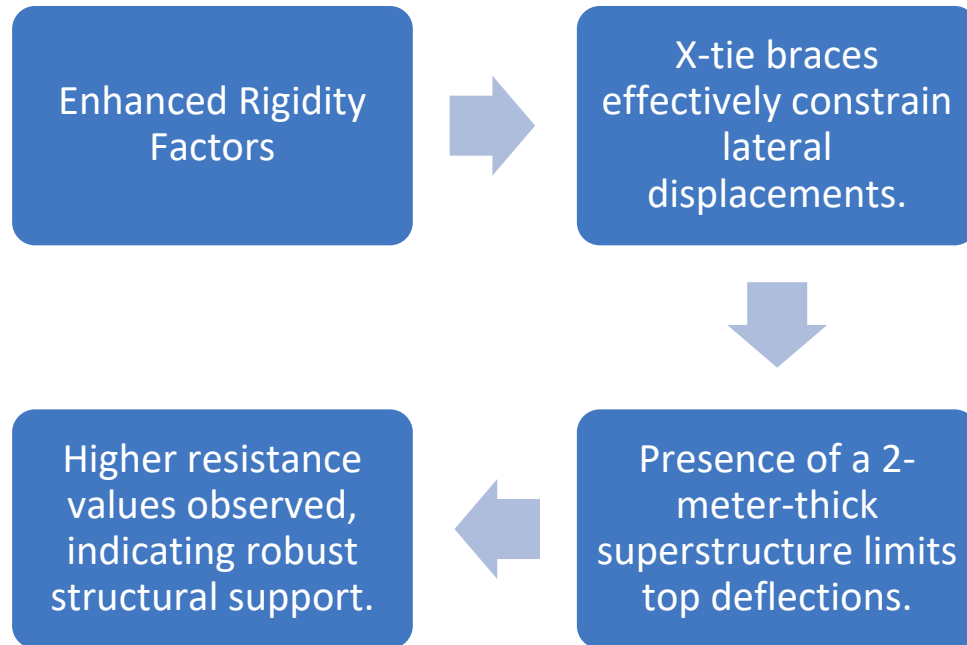
Two design schemes were evaluated for the project:

- 1. Rigid Structure:** This design involves rock-socketed foundation piles with X-tie-braces and a 2m width superstructure.
- 2. Flexible Structure:** The more flexible approach incorporates micro-piles for foundation reinforcement. It consists of a 300mm concrete slab supported by beams.

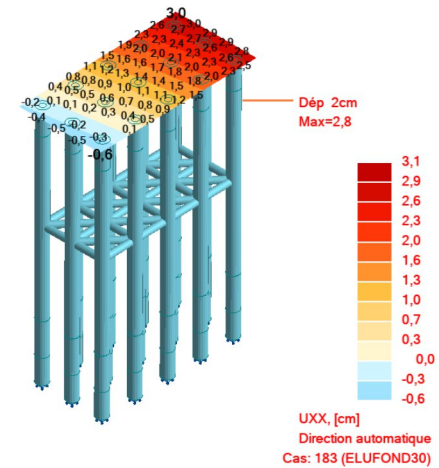
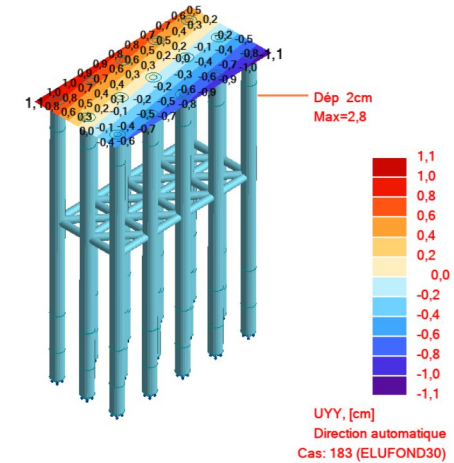


Calculations and numerical simulations

Scheme 1

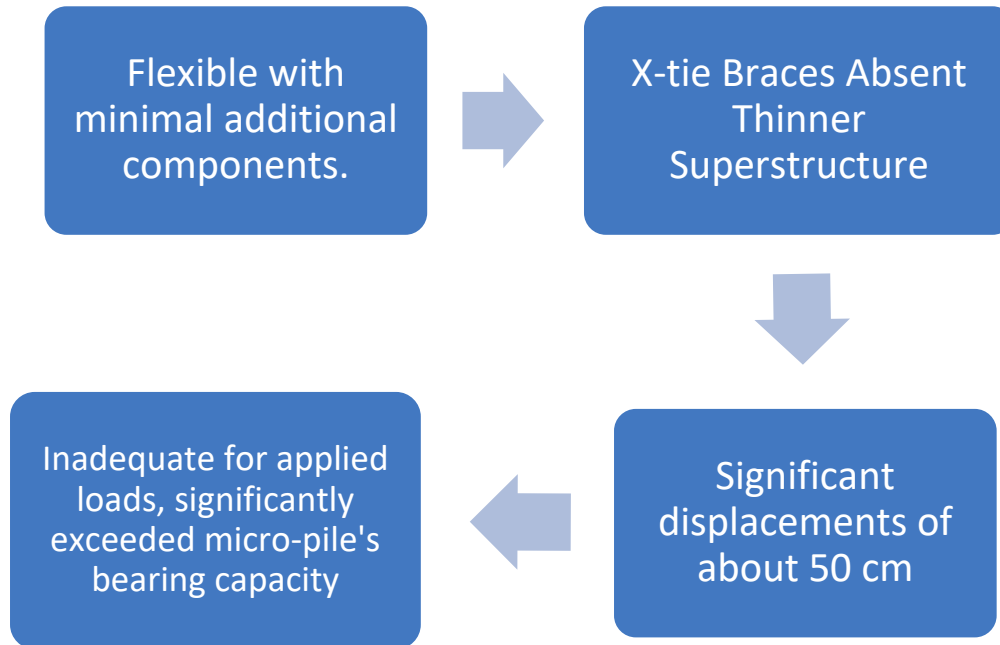


Maximum deflections

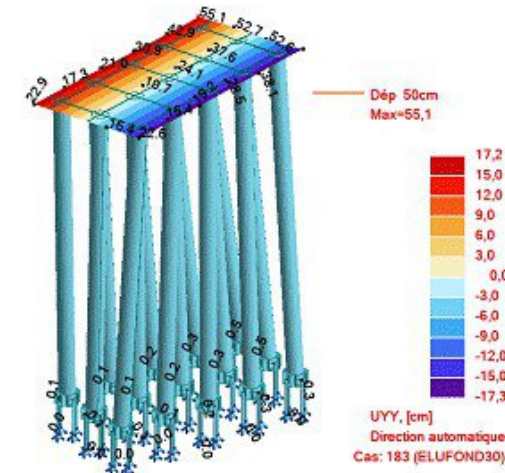
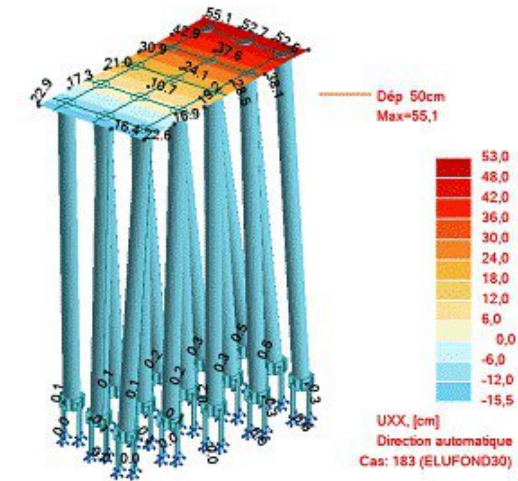


Calculations and numerical simulations

Scheme 2



Maximum deflections



Key Construction Constraints

Mobilization of Maritime Equipment:

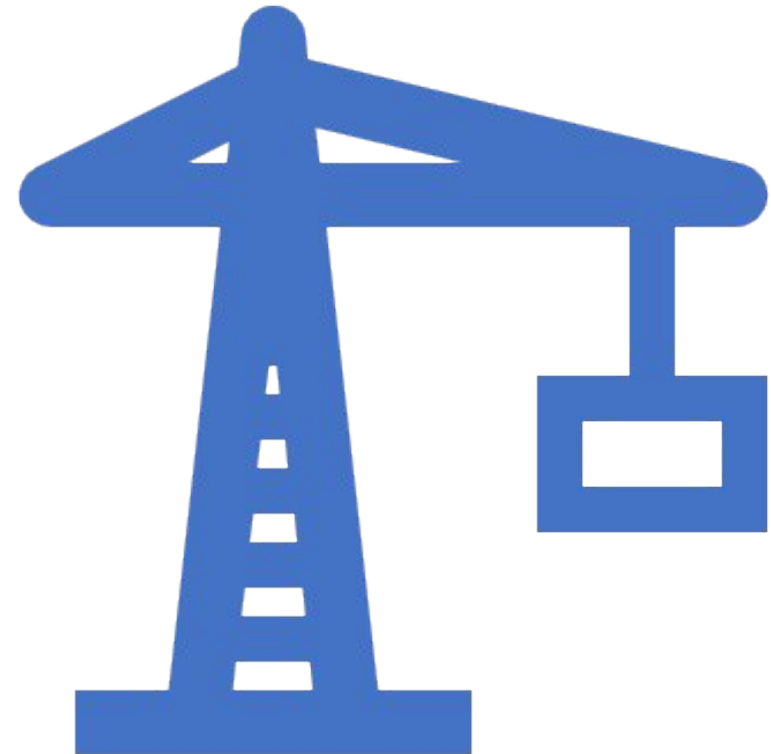
- ✓ Deployment of substantial maritime equipment for the drilling of piles into the offshore bedrock.

Environmental Constraints in Posidonia and Fauna Zones:

- ✓ Adherence to environmental regulations in zones inhabited by Posidonia seagrass and marine fauna, necessitating protective measures such as containment barriers.

Financial Considerations:

- ✓ Evaluation and management of financial aspects associated with the project.



Key Takeaways

Key objectives of Dolphin Design:

Meets future berthing and mooring needs.

Enhances berthing for large vessels and adds mooring points for improved capabilities.

Reinforces safety for passenger flow.

Comprehensive Analyses:

Enhances performance while minimizing environmental impact.

Design Scheme Comparison:

3D simulations favor the optimal solution of Scheme 1 for superior stability.

Future Research Directions:

Recommends exploring additional schemes for continual improvement.

An aerial photograph of three large cruise ships docked at a pier. The ships are white with blue and yellow accents. The ship on the right is the most prominent, showing its multiple decks and a swimming pool on the upper deck. The other two ships are docked behind it. The water is dark blue, and a city skyline is visible in the background under a clear sky. A small orange rectangle is located in the top left corner of the image.

Thank You for
Your Attention!