Tanger Med Engineering

TANGER MED
ENGINEERING

YOUR PARTNER
FOR INNOVATIVE SOLUTIONS

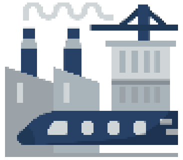
With strong regional expertise and international standards, TME delivers strategic, technical, and digital solutions that enhance connectivity, resilience, and competitiveness of port and industrial ecosystems.

Who We Are

Tanger Med Engineering (TME) is an independent engineering consultancy specialized in the planning, design, and supervision of port, maritime, logistics, and industrial infrastructures.
Our multidisciplinary team delivers integrated solutions that combine technical excellence, sustainability, and digital innovation to support complex infrastructure projects.

Business Areas

PORT & MARITIME



LOGISTICS & INDUSTRIAL

Key Figures

+40 Ports
+20 Industrial Zones
+80 Buildings & Facilities

+220 Engineers & Experts
+15 Years of experience
+20 countries of operation

TANGER MED ENGINEERING

Our Value

At TME, we are guided by four core values that define who we are and how we work. They represent a shared culture, clear principles, and a collective ambition.

EXCELLENCE

We pursue the highest standards of quality and efficiency, anticipating client needs and setting new benchmarks

INNOVATION

We embrace bold ideas and solutions that drive transformation and meet our clients' evolving challenges.

AGILITY

We adapt swiftly to change, staying focused on results and ensuring performance under pressure.

ENGAGEMENT

We act with integrity, teamwork, and dedication to deliver lasting value to our clients and partners.

Our Services

TME drives the development of smart, resilient, and sustainable ports and industrial infrastructures. From strategy to operations.

Our teams deliver end-to-end engineering, consulting, and digital solutions empowering clients to build the future of port infrastructure.

- Consulting
- Technical studies
- Works Supervision
- Equipment Engineering
- Energy
- Asset Management
- Digitalization
- Training

Consulting Services

TME provides strategic consulting to public and private stakeholders for the development and optimization of port, maritime, logistics, and industrial projects. Our role is to support decision-makers in defining investment strategies, identifying opportunities, and structuring bankable and sustainable projects.

Market & Feasibility Studies

We conduct market analyses for port, logistics, and industrial sectors, assessing competitiveness, connectivity, and demand potential.

Advisory & Financial Structuring

We structure PPP projects, conduct technical and commercial due diligence, and design governance and regulatory frameworks.

Project Preparation & Program Management

We provide PMO services for complex programs, ensuring coordination, risk management, and execution control

Main references

Port & Maritime Development: Tanger Med, Nador West Med, Casablanca Port, Monrovia, Kribi, Abidjan, Toamasina, Lagos

Industrial & Logistics Zones: Kribi, Niamey, Diass, Togo Agropark, Tangier Automotive City, Tanger Med Logistics Zone

Technical Studies

TME delivers comprehensive technical studies that transform project visions into robust, buildable, and resilient solutions, optimizing capacity, safety, cost, and schedule from concept to detailed design. Our multidisciplinary expertise covers geotechnical, structural, coastal, and hydraulic engineering, enabling clients to develop port and maritime infrastructures that meet the highest international standards.

Integrated Engineering & Master Planning

We translate market demand and operational requirements into optimized capacity and service-level targets, develop site layouts and terminal master plans, and designs for port and industrial infrastructures.

Simulation & Modeling

We conduct capacity modeling, navigational and mooring simulations, and advanced hydrodynamic wave, sediment transport, and maneuverability studies, to assess port performance, safety, and operability.

Cost & Schedule Reliability

We provide CAPEX/OPEX optimization, value engineering, and tender documentation to secure cost control, construction efficiency, and timely delivery of complex port and industrial projects.

Main References

Port & Maritime Projects Morocco: Tanger Med (containers, Ro-Ro, bulk, passenger terminals) · Nador West Med · Dakhla Atlantique · Safi · Agadir · Essaouira · Laayoune · Tarfaya · Casablanca (Container Terminals, Dry Port, Marina, Cruise Terminal, Shipyard)

International: Cotonou (Benin), Pointe-Noire (Congo), Kribi (Cameroon), Abidjan (Côte d'Ivoire), Conakry (Guinea), Lagos (Nigeria), Djibouti, Toamasina (Madagascar), Moroni (Comoros), Banjul (Gambia)

Industrial & Logistics Zones & Buildings;

Tangier Med Industrial & Logistics Zones, Jorf Lasfar Industrial Platform, Kenitra Atlantic Free Zone · Casablanca Industrial Areas · AMDL Logistics Zones (Casablanca, Kenitra, Fès, Agadir), Kribi Industrial Zone (Cameroon), Côte d'Ivoire Industrial Parks, Senegal · Togo, Niger

Work Supervision

TME manages and supervises complex port, maritime, logistics, and industrial projects from contract award to commissioning, ensuring compliance with scope, cost, schedule, quality, and safety. Our multidisciplinary team acts as Owner's Engineer or Project Management Consultant (PMC), coordinating all stakeholders and securing the successful delivery of large-scale infrastructures.

Project Management

We provide project governance, delivery strategies, and contract administration (FIDIC), including change control, claims management, risk registers, and cost tracking to ensure transparency and compliance
.

Quality & HSE

We deliver full site supervision for civil, structural, coastal, and MEP works, including inspection and test plans, material approvals, audits, and corrective actions to maintain quality and safety standards


NADOR WEST MED PORT ECT
Client: Marsa Maroc & MSC


NADOR WEST MED PORT ECT
Client: Marsa Maroc & CMA CGM


PORT OF COTONOU
Client: Bénin Terminal, subsidiary of AGL


PORT OF COTONOU
Client: Cotonou Port Authority


PORT TANGER MED 2


PORT OF DAKHLA ATLANTIQUE


LOGISTIC PLATFORM FOR EXPORTS AT TANGER MED PORT


TANGER AUTOMOTIVE CITY II INDUSTRIAL FREE ZONE

Equipment Engineering

TME provides integrated engineering solutions for port and terminal equipment, covering the entire lifecycle, from design and procurement to commissioning, maintenance, and performance optimization. Our expertise helps terminal operators and port developers improve operational reliability, efficiency, and asset longevity through tailored engineering, supervision, and digital management approaches.

Equipment Design & Procurement Support

We provide functional and technical design for new port equipment, develop technical specifications, and assist clients in procurement and factory acceptance testing (FAT/SAT).

Maintenance Engineering

We support operators in commissioning, preventive maintenance, spare parts management, and optimization of existing assets through structured maintenance strategies.

Digitalization & Performance Monitoring

We deploy digital tools (CMMS, IoT, predictive analytics) to monitor equipment performance and support decision-making across the equipment lifecycle.

Main References

TME has supported major operators in Africa through projects such as the acquisition and commissioning of STS and RTG cranes at Nador West Med and Casablanca Port, heavy mobile cranes for Jorf Lasfar and Safi, mobile cranes for the Multipurpose Terminal at Toamasina Port in Madagascar, and the deployment of digital supervision and IoT systems for Marsa Maroc.

Energy & Decarbonization

TME supports public authorities, port operators, and industrial developers in the design, integration, and optimization of sustainable energy infrastructures. Our approach combines technical excellence and environmental commitment to accelerate the energy transition through renewable production, electrification, and decarbonization programs.

Renewable Energy & Electrification

We offer design, and supervision of renewable energy projects, solar (rooftop, floating, and ground-mounted PV) and wind from resource assessment to detailed design and commissioning.
We also develop shore power systems (cold ironing) for vessel electrification and grid integration studies.

Power Systems & Energy Efficiency

Our expertise includes high and medium voltage substations (225/60/22 kV), transmission lines, and distribution networks.
We perform energy audits and ISO 50001 certification assistance, enabling ports and industrial platforms to reduce energy consumption and improve operational performance.

Hydrogen & Decarbonization Roadmaps

We design hydrogen production and storage infrastructures and define strategic decarbonization roadmaps aligned with international goals for clean mobility and green industry.

Main References

- Tanger Med Port Complex (Morocco): 13 MW floating PV plant, 1.4 MW rooftop PV installation, and 15–18 MW wind farm design.
- Casablanca Port: shore power feasibility study for container terminal electrification.
- ZOUA Zone (Tangier Tech): 100 MW PV plant feasibility study.
- TAC & Tangier Tech: 225/22 kV and 225/20 kV substations (design & supervision).
- Hydrogen pilot project – Tanger Med Port: infrastructure for H_2 refueling and clean mobility.
- Kankan (HFO plant, Guinea): 40 MW power generation project feasibility.

Training & Capacity Building

TME delivers operational training for port authorities and maritime professionals, combining technical expertise and high-fidelity simulation. Courses are conducted by experienced pilots and harbor masters using the Tangier Med Marine Simulator (TMMS), compliant with IMO and IALA standards.

Harbour Masters & VTS

Training in port operations, safety, security, and vessel traffic management (SOLAS, MARPOL, ISPS, IALA).Includes incident management and simulation-based exercises for real operational readiness.

Pilotage & Navigation

Advanced programs on ship handling, tug assistance, and bridge teamwork using the TMMS full-bridge simulator. Combine simulated scenarios with on-board practical sessions alongside senior pilots.

Port Operations

Complementary modules on cargo handling, infrastructure management, and port logistics, enhancing coordination and safety culture across all port services.

Digital & Data Intelligence

TME develops and integrates digital solutions that combine engineering expertise with advanced data analytics to optimize decision-making, operations, and maintenance.
Our approach connects data, models, and real-time monitoring systems to create a dynamic, intelligent environment across all project phases — from design to operation.

Digital Twin & Smart Asset Monitoring

Integration of 3D digital twin platforms, IoT sensors, and AI algorithms to visualize, monitor, and simulate port and industrial assets. These tools enable predictive maintenance, operational optimization, and data-driven asset management.

Data Intelligence & Predictive Analytics

Use of machine learning and data modeling to analyze technical, environmental, and operational data. Applications include predictive modeling, traffic forecasting, and energy efficiency, reducing risk and uncertainty.

Decision Support Dashboards

Development of interactive dashboards that centralize key indicators, alerts, and trends. They support strategic decisions, scenario analysis, and performance tracking for all stakeholders.

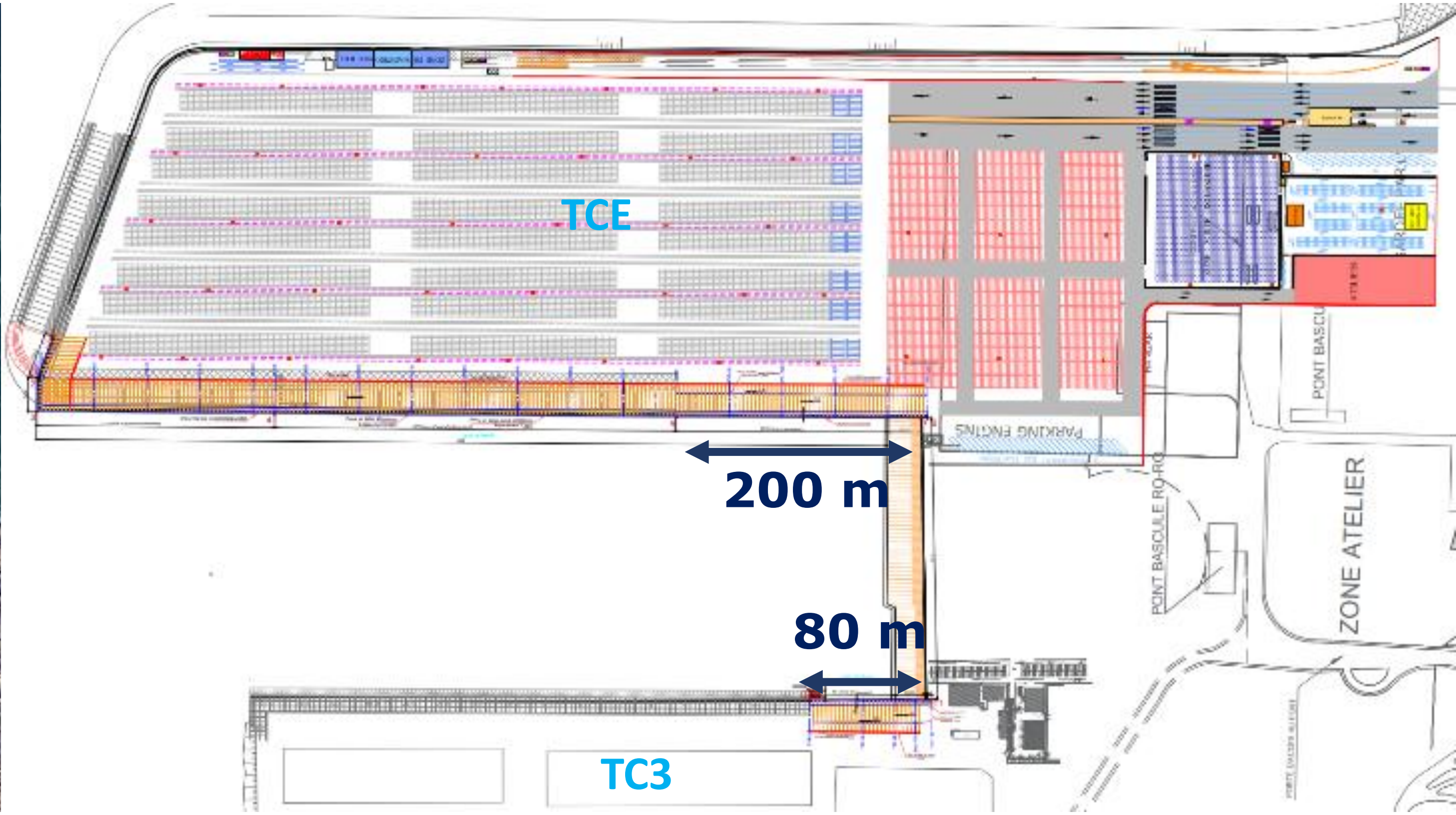
TANGER MED ENGINEERING

CASE STUDY :

CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING

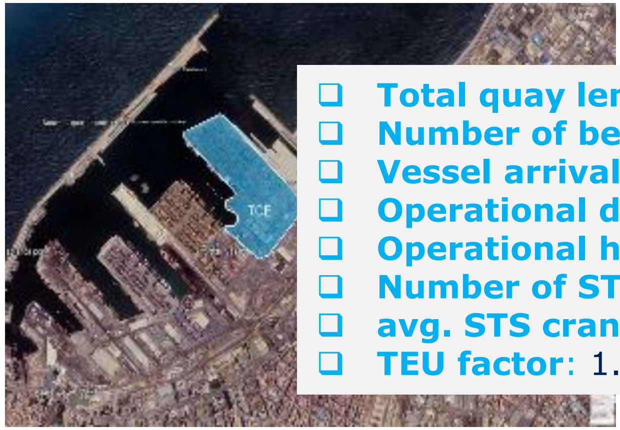
CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
OVERVIEW

- **Deepening Works:** Deepening of the existing **600 m** quay of the **East Container Terminal (TCE)** to a design depth of **-14.0 m CD**, with provisions for future deepening to **-16.0 m CD**.
- **Extension Works (TCE):** Extend the **TCE quay** by an additional **200 m**, bringing the total length to **800 m**.
- **Extension Works (TC3):** Extend the **TC3 quay** by **80 m** towards the **south**.



CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
CAPACITY ASSESSMENT

TCE



- Total quay length: 600 m
- Number of berths: 3
- Vessel arrivals: Unscheduled
- Operational days per year: 330 days
- Operational hours per day: 20 hours
- Number of STS cranes: 3
- avg. STS crane productivity: 29 moves/hour/crane
- TEU factor: 1.62

Existing Terminal capacity:

- **Berth Capacity** = 515,000 TEUs/Annum
- **Yard Capacity** = 405,100 TEUs/Annum

Forecasts:

- **2040** = 1,350,700 TEU/annum

Berth Capacity Shortfall:

- **2040** = 835,700 TEUs/Annum

Yard Capacity Shortfall:

- **2040** = 945,600 TEUs/Annum

TC3

- Length: 520m
- No of berths: 2
- Vessel arrivals: Unscheduled
- Operational days per year: 330 days
- Operational hours per day: 20 hours
- Number of STS cranes: 4
- avg. STS crane productivity: 29 moves/hour/crane
- TEU factor: 1.6

Existing Terminal capacity:

- **Berth Capacity =** 550,000TEUs/Annum
- **Yard Capacity =** 550,000 TEUs/Annum

Forecasts:

- **2040** = 650,500 TEUs/Annum

Berth Capacity Shortfall:

- **2040** = 100,500 TEUs/Annum

Yard Capacity Shortfall:

- **2040** = 100,500 TEU/Annum

CAPACITY ASSESSMENT

Short-term capacity upgrades (2025 – 2027) require short lead times and will largely focus on yard management and limited infrastructure investment.

Berth Capacity Immediate Upgrades (TCE & TC3):

Terminal	Option	Capacity Increase / Outcome
TC3	**Option 1: Mobile Harbour Crane**	Adding **one MHC** boosts quay capacity by 71,394 TEU/Annum, reaching 623,494 TEU/year (approx. 96% of 2027 forecast).
	Option 2: Permanent STS Crane	Procuring a **fifth STS** crane (operational by 2027) boosts total capacity to **690,128 TEU/Annum**.
TCE	**Option 1: Mobile Harbour Crane**	Adding **one MHC** boosts capacity to 603,126 TEU/year, sufficient until 2028.
	Option 2: Permanent STS Crane	Procuring a **fourth STS** crane (operational by 2027) boosts capacity to **685,908 TEUs/annum**, sufficient until 2030.

Yard Capacity Management (TCE & TC3):

- **Implement Modern Terminal Operating System (TOS):** Procure and utilize a modern yard management system (e.g., NAVIS 4 TOS is under consideration by Marsa Maroc) to determine the most efficient grounding of containers based on real-time data and algorithms.
- **Increase Stack Utilization:** Increase stack utilisation for laden and reefer containers to around **73% at TC3** and **70% at TCE** (to provide circa 663,500 TEUs/annum capacity until 2030).
- **Operational Efficiency:** Implement policies to control box location (avoiding fixed groundings), assign discharge location as late as possible based on real-time factors, and minimize housekeeping moves.
- **RTG Deployment:** TC3 requires a minimum total of **22 RTGs** to keep up with future crane productivity rates and external truck movements.

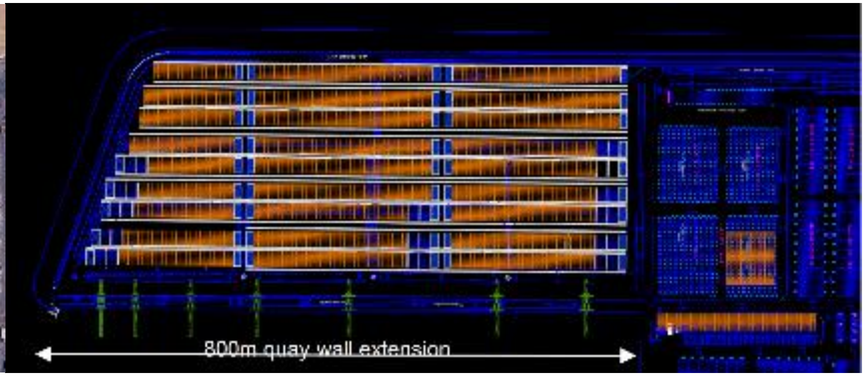
Long-Term Capacity Upgrades for Casablanca Container Terminal East (TCE) (Up to 2040):

❑ RTG Conversion

Implement a major terminal reconfiguration by converting the existing **straddle carrier (SC) operations to denser stacks served by Rubber Tyred Gantry Cranes (RTGs)**.

❑ Quay Extension and Cranes

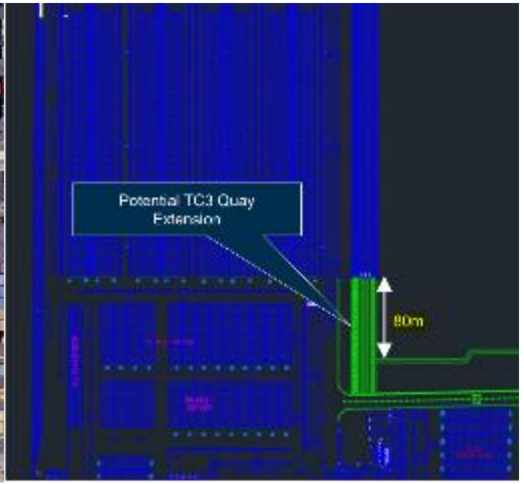
- **STS Crane Procurement:** Increase the total number of Ship-to-Shore (STS) cranes from 3 up to **8 cranes** to meet demand:
  - 5th STS crane required by the end of **2031**.
  - 6th STS crane required by **2034** (max capacity on current quay).
  - 7th STS crane required by **2037** (requires quay extension completion).
  - 8th STS crane required by the end of **2038** to achieve sufficient capacity for 2040.
- **Quay Extension Project:** Extend the TCE quay length from 600m to **800m** to accommodate the 7th and 8th STS cranes.
  - This extension requires extending the existing quay wall to the south and **closing the Ro-Ro terminal** situated between TCE and TC3.
  - Procurement and implementation of the 200m quay extension must commence by the start of **2035** for completion by 2037.



Long-Term Capacity Upgrades for Casablanca Container Terminal 3 (TC3) (Up to 2040):

❑ Quay Extension and Cranes

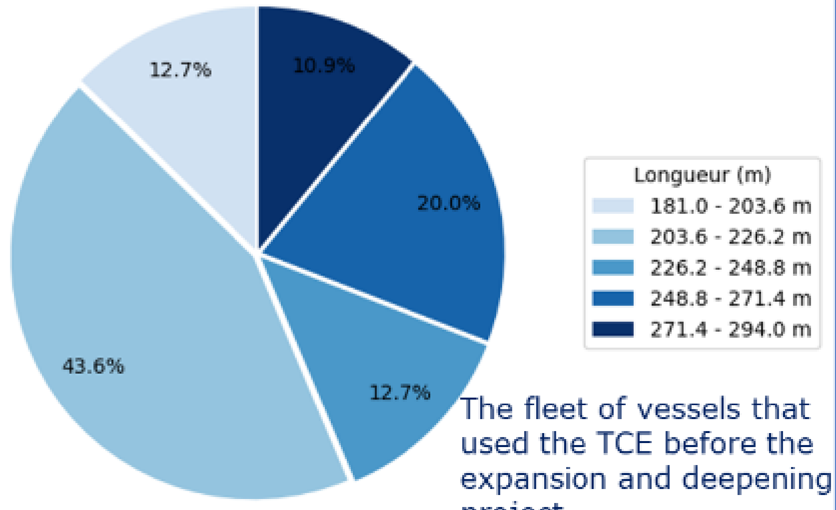
Extending the TC3 quay south by **80m** (total length 600m). This allows for the deployment of **6 STS cranes**, providing a theoretical quay capacity of **828,170 TEU/Annum**, which offers approximately 27% spare capacity over the 2040 forecast.



CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
DESIGN VESSELS

Before

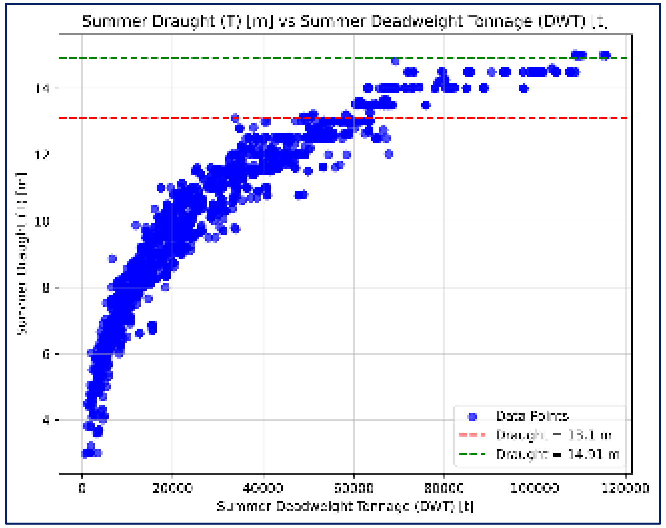
Prior to the expansion and deepening project, the quay accommodated vessels up to 294 meters in overall length, representing the maximum size handled under the previous operational conditions.

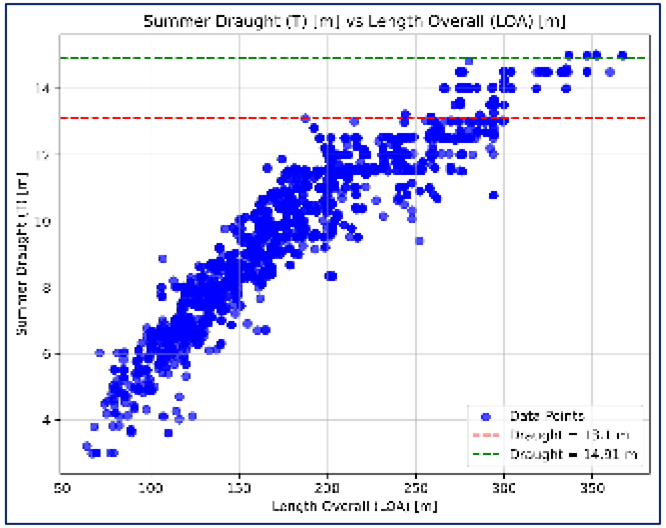


The fleet of vessels that used the TCE before the expansion and deepening project

After

Dredging Level	Tidal Condition	DESIGN VESSELS				
		Length (m)	Width (m)	Draft (m)	Deadweight (T)	TEU
-14 m (CD)	All tidal conditions	300	37.1	13.03	63 163	9K
-16 m (CD)	Rising tide above mean sea level	340	43.2	14.5	110 000	11K



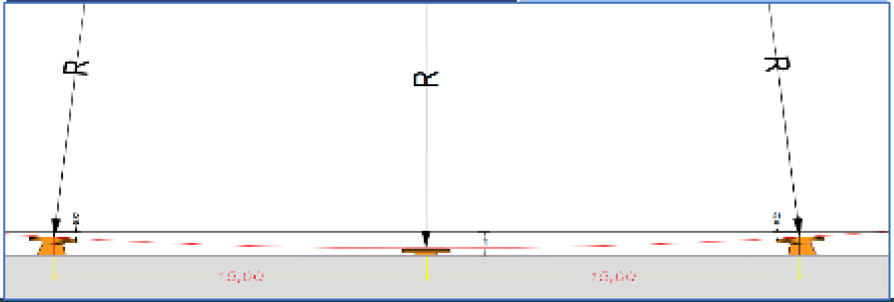


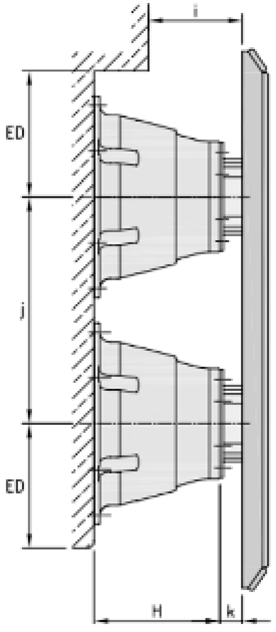
❑ Fenders

- **Objective**: To design a fender system for the project's new, larger vessel.
- **Methodology**: A comparative study of three standards (BS 2014, PIANC 2002, PIANC 2024) was conducted.
- The PIANC 2024 Fender Guidelines were chosen as the most modern and comprehensive standard.
- **Calculation**: Berthing energy was calculated for the largest design vessel (LOA=340m, draft=14,5m).
- **Result & Outcome:** A safe, optimized, and durable fender system was designed.

	Single Fender System Contact	Multiple Fender System Contact
Reference partial energy factor for 100 berthings per year $\gamma_{E,ref}$	1,45	1,25
Correction factor for alternative annual berthing frequencies γ_n	1,00	1,00
Correction factor for berthings without pilot assistance γ_p	1,00	1,00
Correction factor for correlations between design variables γ_c	1,00	1,00
Partial energy factor γ_E	1,45	1,25

Proposed fenders	SPC 1600 G2.4
Energy EA absorbed kN.m/cone	2 243
Absorbed RF reaction kN/cone	2 673





CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
MOORING ANALYSIS ASSESSMENT

❑ Mooring Analysis Assessment Goals:

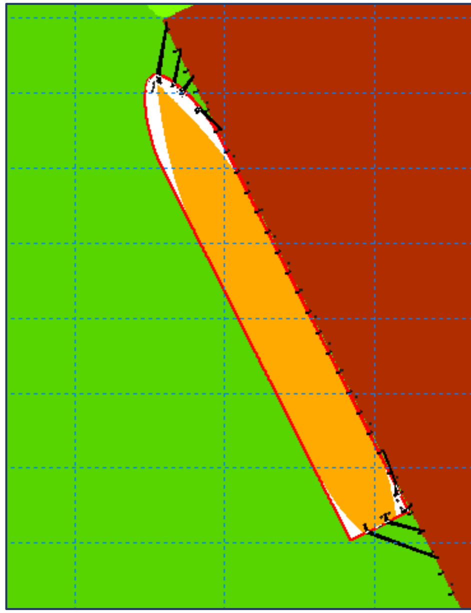
- **Determine Limit Conditions:** Define the maximum **environmental conditions (swell, wind, current)** that allow for safe mooring operations.
- **Evaluate Equipment Capacity:** Verify that the **new quay equipment (bollards and fenders)** are correctly designed and assess their capacity to withstand mooring efforts.
- **Optimize Configuration:** Validate and, if necessary, improve the **mooring configuration** adopted for the vessels tested.

❑ Methodology:

The study was conducted in two stages, focusing on the largest vessel (CS1, LOA=340m) and a representative smaller vessel (CS2, LOA=174m).

1.Data Acquisition and Analysis:

- Collected and analyzed environmental data (swell, wind, tide, current) covering 32 years (Jan 1992 to Dec 2023 for swell).
- Gathered specific site data (bollard/fender characteristics, bathymetry, quay geometry) and vessel characteristics (LOA, displacement, draft, etc.).
- Performed **RAO analysis (Response Amplitude Operator)** to identify vessel resonance periods.



❑ Methodology:

2.Numerical Modeling:

- Utilized the **Mike 21 MA (Mooring Analysis) mathematical model** to simulate vessel behavior under external forces (wind, swell) while moored. (Current was deemed negligible and not included in simulations).
- Tested predefined combinations of wind conditions (NW, NE, SW) and swell conditions (NNW and NW directions; Hs 0.1m to 0.8m; Tp 8s to 18s).
- Simulations involved **gradually increasing swell height (Hs)** until the maximum admissible height was reached, limited by criteria related to line tension (50% MBL) or vessel movement (six degrees of freedom).
- Mooring configurations adopted 16 lines for CS1 and 12 lines for CS2, aligned with standards (BS 6349 - 4: 2014 and ROM 92).

❑ Outcomes:

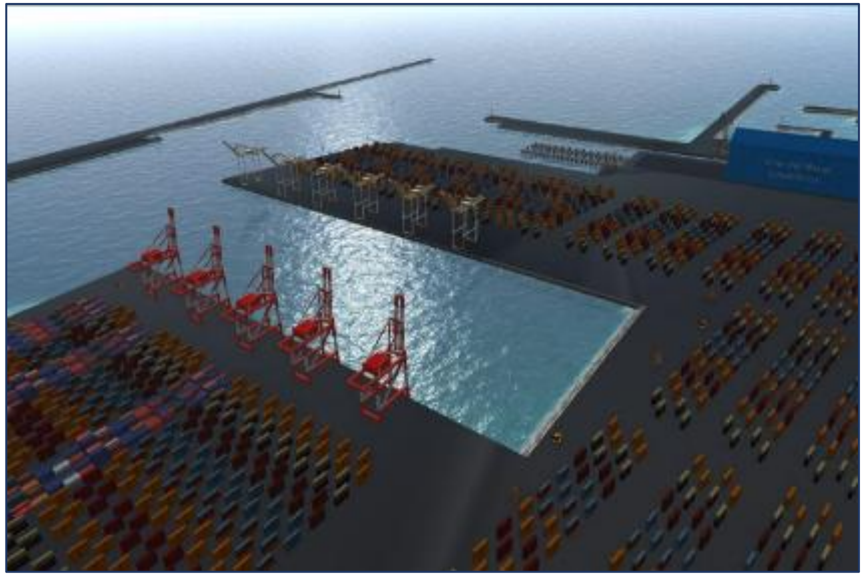
- **Equipment Validation:**
  - The existing bollards (150 T capacity, 30 m spacing) were insufficient to handle the efforts exerted by CS1, whereas the proposed bollards (200 T capacity, 20 m spacing) are sufficient to handle the efforts exerted by both vessels (CS1 & CS2).
  - The efforts on the fenders (SPC 1600 G2.4) are sufficient to handle the efforts exerted by both tested vessels.
- **Vessel Movement & Safety Margins:**
  - Vessel movements in the six degrees of freedom are well below the admissible values recommended by PIANC for safe working conditions.
  - Efforts transmitted to mooring lines and bollards do not present any danger under the resulting limit conditions.
- **Vessel Specific Findings (LOA=174m):** For the smaller vessel swell from the NNW direction imposes stricter mooring limits, leading to reduced safety margins.
- **Vessel Specific Findings (LOA=340m):** For the largest vessel (LOA=340m), the NNW swell direction does not constitute a limit to mooring.

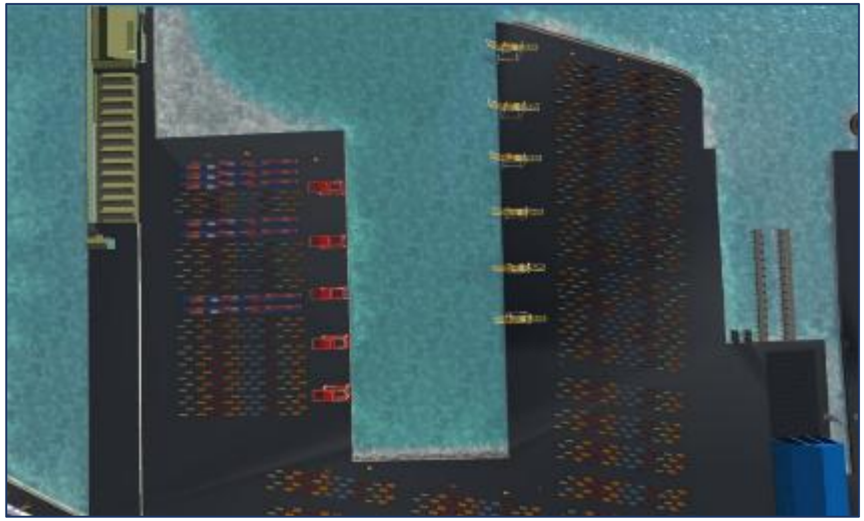
CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
MANOEUVRABILITY STUDY

A maneuverability study was conducted using the 3D simulator at the Tanger Med Marine Simulator (TMMS) to assess the safety and feasibility of operations.

This maneuverability study recommends several key actions to improve port safety and accommodate larger vessels:

- **Dredging**: The access channel and the basin between terminals TCE and TC3 must be dredged and deepened to allow entry for ships with a draft of 14m or greater.
- **Tug Assistance**: All vessels 300m or longer require mandatory assistance from three ASD tugs.
- **Operating Limits**: Maneuvers for large vessels should be restricted in adverse weather, specifically when swells exceed 2.5m or winds are over 20 knots. A minimum safety distance of 30m must also be maintained between the largest vessels (347m).
- **Navigational Safety**: The channel's markings (buoyage) must be enhanced, and a new directional light or ATON (Aids to Navigation) system should be installed to improve safety.





CASABLANCA CONTAINER TERMINALS (TCE & TC3) UPGRADING
Dynamic Under Keel Clearance Assessment

- **Comprehensive navigation simulations** were performed to evaluate the operability of a **Post-Panamax containership** transiting from the **offshore channel entrance** to the **container terminal**.
- The assessment utilized **12 months of metocean hindcast data**, with **vessel transits modeled at 30-minute intervals** to capture varying environmental conditions.
- **Hydrodynamic and wave models** were developed to simulate **tides, currents, and wave transformations**, accounting for the **influence of port structures**.
- The **NCOS ONLINE framework (DHI)** was employed to analyze **dynamic under keel clearance (UKC)**, integrating **vessel motion components** such as **squat, turning, wind heel, and wave response**.

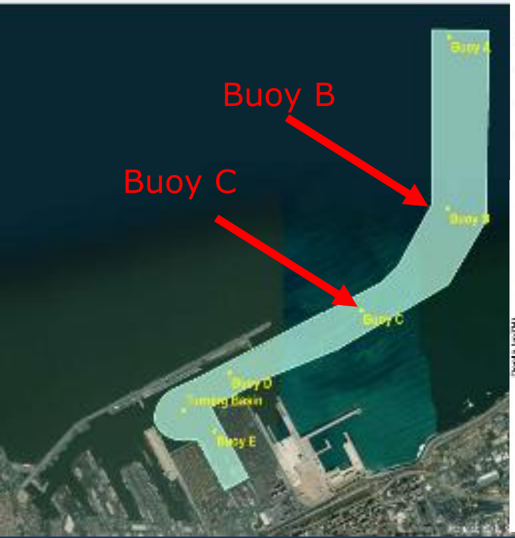
❑ Channel Operability Summary

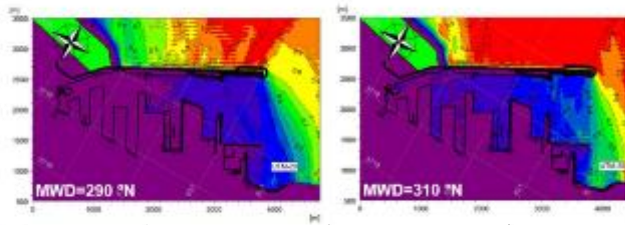
Annual Operability (2h tidal windows):
- Inbound vessels: 57.7%
- Outbound vessels: 54.6%

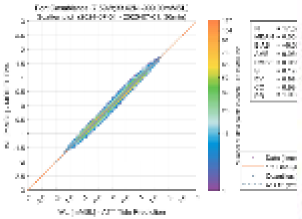
Seasonal Variation:
- Summer: Higher operability due to calmer wave conditions and minimal swell.
- Winter: Lower operability caused by high swells impacting the port.

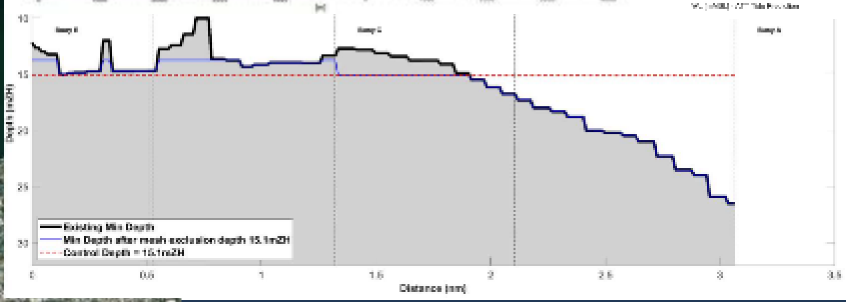
Critical Area:
- Buoy B to Buoy C: Identified as a chokepoint where swells are abeam to the vessel's travel direction, reducing operability.

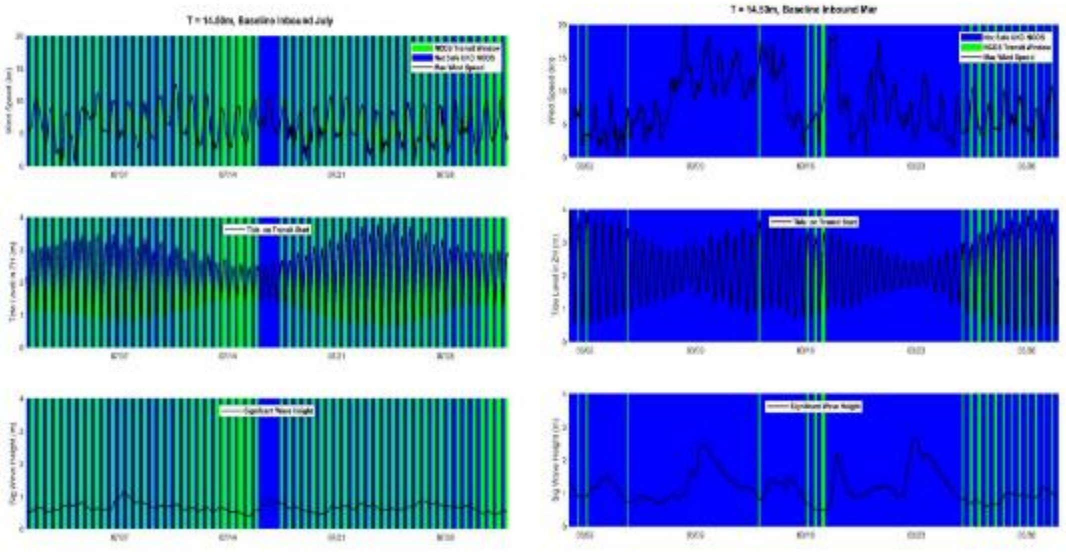
Recommendations:
- Confirm declared depth with the Harbour Master between Buoy B and C.
- Set seasonal dredging targets to improve operability, especially in winter.







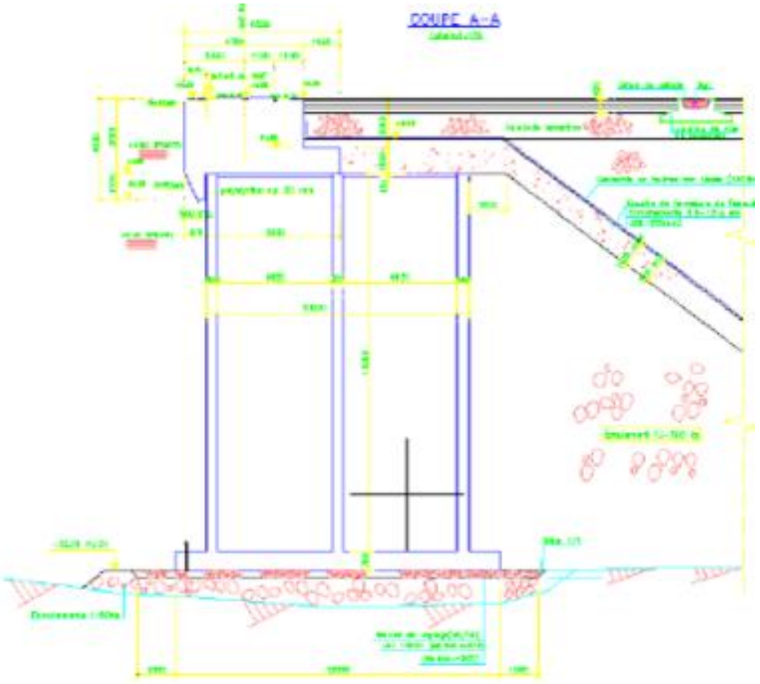




❑ Lithological Description:

Analysis of the soil cores has identified the following lithological succession from the existing ground level:

- **Formation 01:** A surface formation consisting of pavement structures and subgrade materials, overlying a hydraulic fill composed of sand, sandstone gravel, and sandstone blocks, with a varying thickness between 11.0 m and 14.5 m.
- **Formation 02:** A layer of sand, observed between 12.5 m and 16.0 m depth.
- **Formation 03:** The bedrock, formed of sandstone and shale, encountered down to the maximum investigation depth of the boreholes at 35.0 m.



❑ Existing Quay Configuration:

The existing TCE quay structure consists of hollow, two-compartment caissons with a design berth depth varying from -11.5 m to -12.0 m CD.

❑ Project Constraints:

- **Stability of the Existing Structure:** Deepening a caisson-type quay wall requires special attention to maintain the stability of the existing structures. This requirement limits the feasible construction solutions to vertical retaining systems.

- **Schedule Constraints:** The project is subject to a particularly tight execution schedule, requiring optimized construction methods and a rigorous phasing plan.

- **Maintaining Terminal Operations:** The works must be carried out without disrupting terminal operations, which is a major constraint in the selection of construction processes and methodologies.

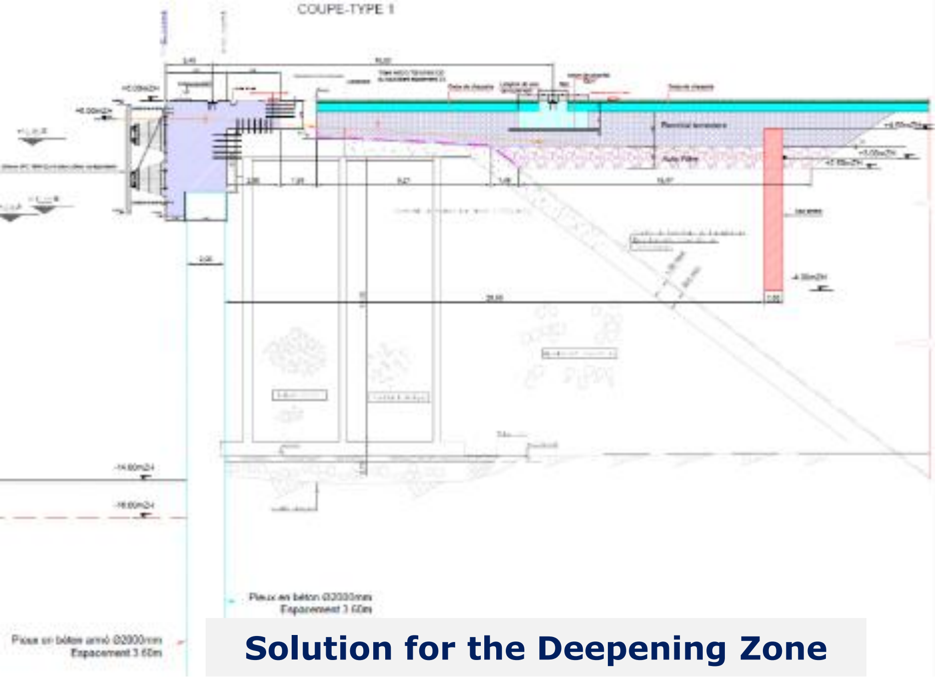
❑ Proposed Quay Solution:

The proposed solution that addresses these constraints is a secant pile quay wall, anchored by tie-rods to a rear diaphragm anchor wall.

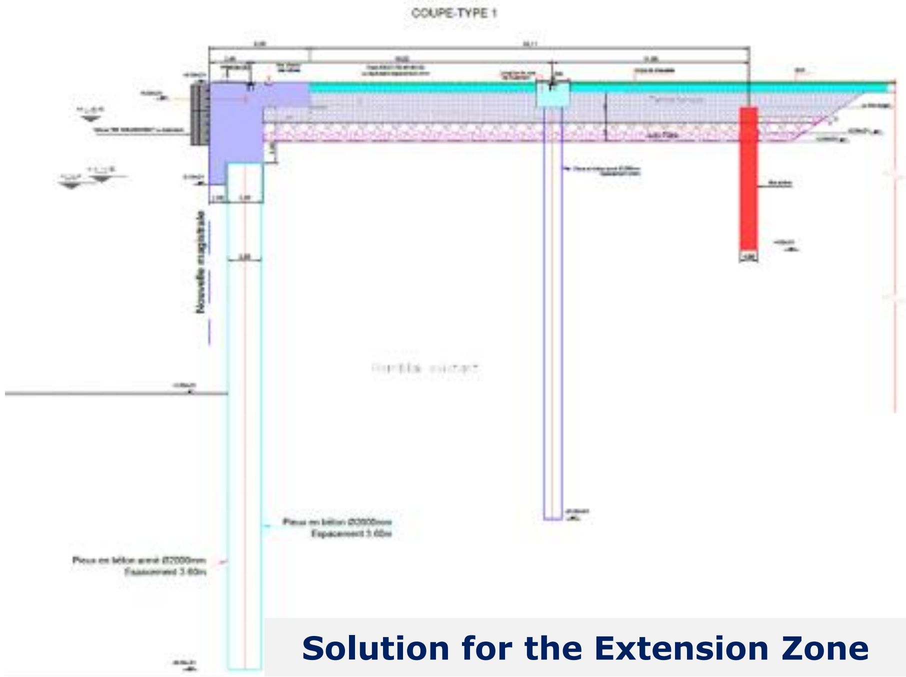
•**Quay Wall:** A 2.2 m thick reinforced concrete (RC) capping beam is planned, extending from elevation +0.0 m CD to +6.0 m CD. Below this, 2.0 m diameter piles will be installed at 1.8 m centers. The primary piles are reinforced concrete, and the secondary piles are unreinforced concrete.
All quay wall piles will extend down to an elevation of -27.0 m CD.

•**Anchorage System:** This consists of a single row of tie-rods connecting the front and rear walls at the following elevations: Zaa = +5.0 m CD (at the front wall) and Zab = +2.5 m CD (at the rear wall).

•**Rear Anchor Wall:** A 1.0 m thick reinforced concrete diaphragm wall. This wall extends from elevation +4.5 m CD down to -4.0 m CD.
The planned distance between the front quay wall and the rear anchor wall is approximately 30.0 m.



Solution for the Deepening Zone



Solution for the Extension Zone

CASE STUDY :

PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT

PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT
PROJECT OVERVIEW

With this project, Marsa Maroc is making a critical strategic investment in the future of the Port of Casablanca's Multipurpose Terminal. this work was a direct and necessary response to the irreversible global trend of increasing vessel sizes. This global trend directly impacts the terminal operational capacity, making this deepening project not just a strategic choice, but an operational necessity to maintain the port's long-term competitive positioning within the region's maritime trade network.

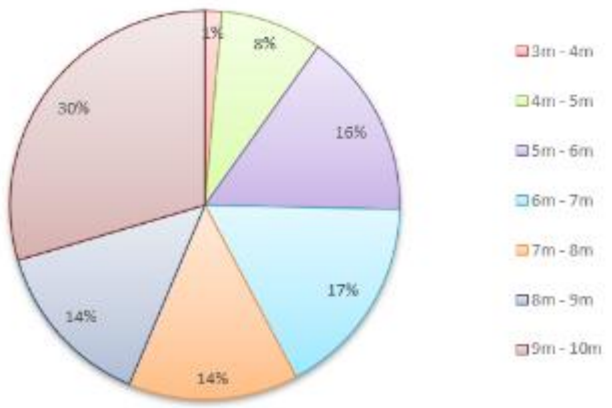
Strategic Goals	Key Project Metrics
❑ Increase terminal capacity to meet evolving client demands. ❑ Accommodate modern Post-Panamax vessels up to 70,000 DWT. ❑ Future-proof the terminal with a new structure designed for a 50-year service life.	❑ **Total Investment:** 475.5 Million MAD ❑ **Project Duration:** 42 months (Start: 01 Oct 2024) ❑ **Target Depth:** -12m (expandable to -14m) ❑ **Quay Length:** 530m for deepening + 40m of transition zones ❑ **Dredging Volume:** ~185,000 m³

Achieving these ambitious goals requires a sophisticated engineering solution designed to modernize our century-old quay infrastructure.

PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT
DESIGN VESSELS

BEFORE

The maximum draft of vessels calling at the multipurpose terminal does not exceed 10.0 m. docking at high tide.



AFTER

Calculation	Case 1: -12.5 mZH depth	Case 2: -14 mZH depth
Simplified calculation of the harbour master's office: **Docking at rising tide** **+0.6m (97% tide)** **-0.3m (Static UKC)**	TE max = 12.8m DWT=55000T	TE max=14.3m DWT=70000T
Conservative calculation: **Any tidal condition** **+0.4m (BMVEE)** **UKC = 10% x TE**	TE max= 11.72m DWT=40000T	TE max= 13.1m DWT=60000T

❑ Mooring Analysis Assessment Goals:

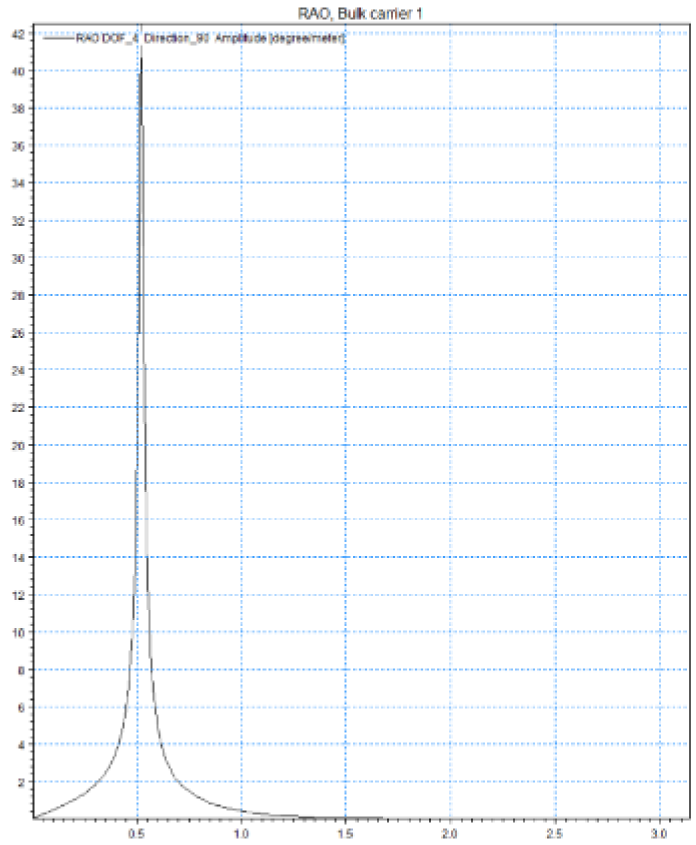
- Determine the limiting environmental conditions (swell/wave, wind, and current) necessary for secure mooring.
- Evaluate the capacity of the mooring equipment at the berth.
- The study aimed to evaluate the operating limits of the quay when project vessels are moored and subjected to climatic sea and wind conditions.
- Ultimately, the objective was to determine the limiting wave conditions beyond which the project vessels cannot be safely moored (i.e., risk of mooring rupture or damage to berth equipment).

❑ Methodology:

The study was conducted in two main stages and utilized a mathematical model:

Phase 1: Data Collection and Synthesis

- Gather environmental data (swell/wave, wind, tide, current) and site data (bollard and fender characteristics, bathymetry, quay geometry).
- Determine the characteristics of the project vessels (LOA, Width, Draft, etc.).



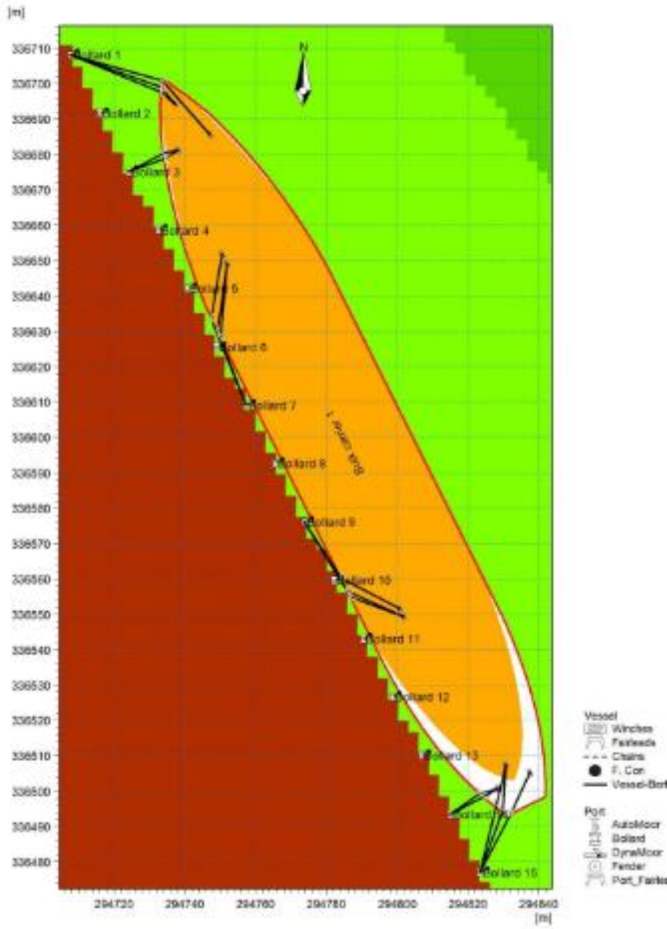
❑ Mooring Analysis Assessment Goals:

Phase 2: Numerical Mooring Study

- Model Used: The Mike 21 MA (Mooring Analysis) model was adopted to simulate the behavior of the vessel when subjected to external forces (wind, swell, and current) while moored.
- Vessels Tested: Two project bulk carriers were tested: one 230m LOA (74,000t displacement) and one 145.07m LOA (19,530t displacement).
- Environmental Tests: Simulations varied wave height (Hs) starting at 0.3m (or 0.2m for the smaller vessel) to find the admissible Hs while respecting movement criteria. Tested periods (Tp) ranged from 6 to 16 seconds. Wind conditions tested included NNE and SW directions, both at 20 knots.
- Mooring Criteria: Limiting parameters included ship movements in six degrees of freedom, the minimum breaking strength of mooring lines/bollards, and the capacity of the fenders. Movement limits were based on the "Cranes" criteria from the Port Designer's Handbook and PIANC.
- Configuration: The adopted mooring setups followed standard recommendations, such as British Standard 6349-4: 2014 and ROM 92.

❑ Outcomes:

- Ship movements in its six degrees of freedom are kept within the limits recommended by PIANC.
- The maximum forces exerted on the mooring lines and bollards do not present any danger.
- The capacity of the fenders to resist the mooring forces due to vessel movements is not exceeded.

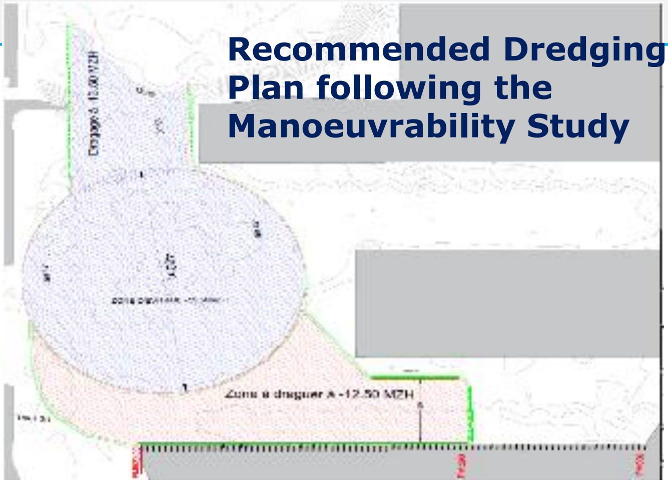


PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT
MANOEUVRABILITY STUDY

As part of the expansion project for the multipurpose terminal at the Port of Casablanca, a ship maneuverability study was conducted at the Tanger Med Maritime Simulation (TMMS) center. The study assessed berthing and unberthing maneuvers for various vessels (LOA = 230m, 182m, 200m) under two dredging scenarios (-12m CD and -14m CD). Simulations were run in both normal and adverse weather conditions, and also included emergency situations.

❑ **Key Findings:**

- **Tug Inadequacy**: The port's three conventional tugs are inadequate for handling 230m vessels in adverse conditions. The assistance of two 60-Tonne Bollard Pull ASD tugs is required to ensure safe operations.
- **Restricted Maneuvering area**: Maneuvering areas, particularly in strong wind conditions, become constrained. The implementation of priority rules for simultaneous vessel movements is necessary.
- **Berthing Approach**: Port-side berthing is the preferred and standard procedure. Starboard-side berthing should only be conducted in exceptional circumstances.
- **Deep-Draft Vessel Accommodation**: Handling vessels with a 14.3m draft at the -14m CD berth is contingent upon the completion of additional dredging and requires a dedicated Under-Keel Clearance (UKC) analysis.



Recommended Dredging Plan following the Manoeuvrability Study

PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT
GEOTECHNICAL AND STRUCTURAL DESIGN

❑ Existing structure:

- Solid block quay (1926) reinforced by a prefabricated wall (2002–2004).
- Length: 820 m.
- Footing level: -9.80 m CD (Chart Datum).

Solutions studied: creation of a new berthing face (offset by 4 m)

❑ Methodology:

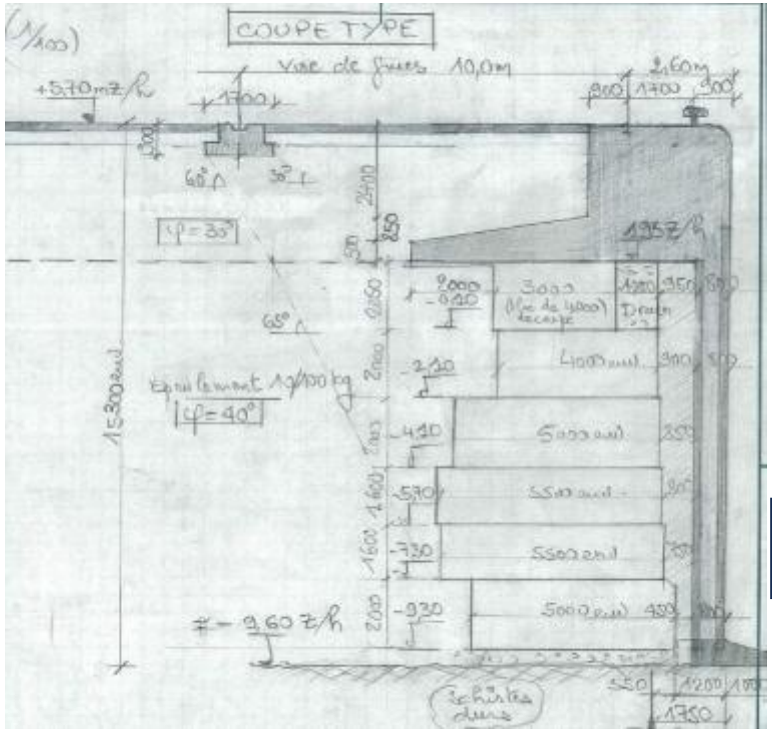
- Stabilization of the existing quay (micropiles).
- Anchorage and capping beam.
- Berthing / mooring equipment.
- Dredging and rock removal down to the target level.

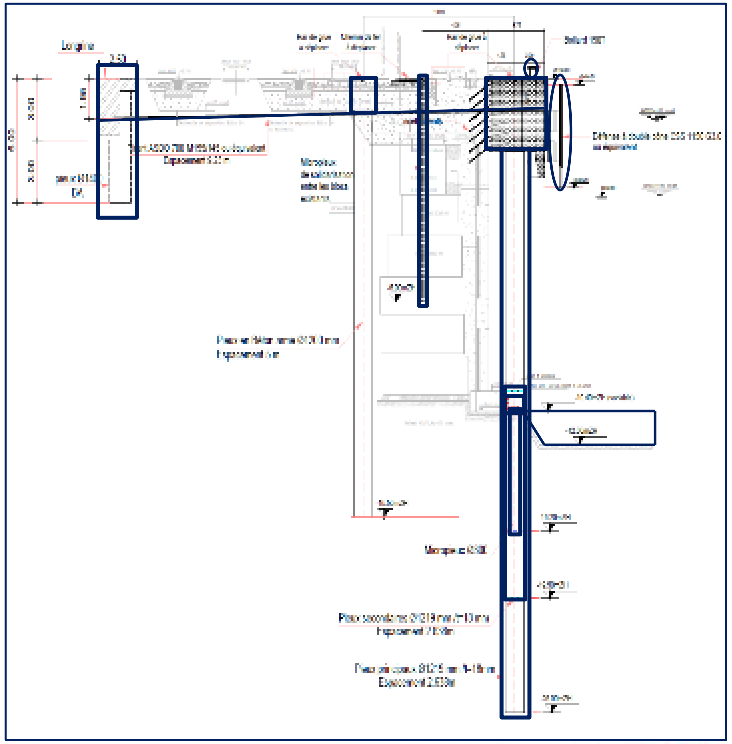
❑ Option 1: Concrete Secant Piles

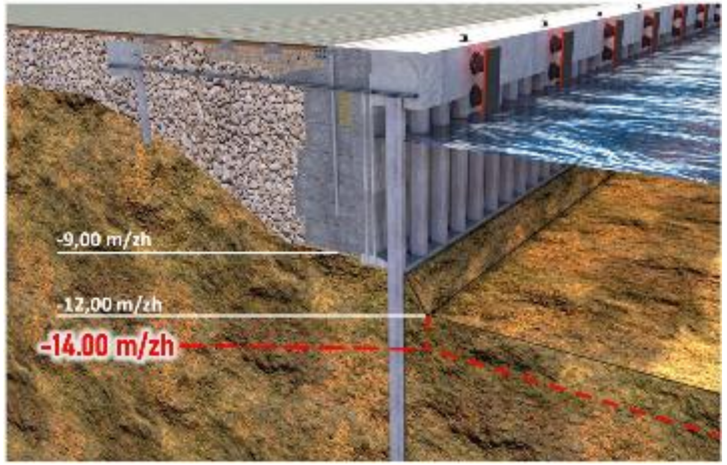
- Wall of reinforced / unreinforced piles.
- Reliable but more expensive solution.

❑ Option 2: Steel Piles (Selected)

- Anchored sheet pile wall.
- Cost optimization: -25%.
- Faster execution.
- Provision for future deepening to -14 m CD.

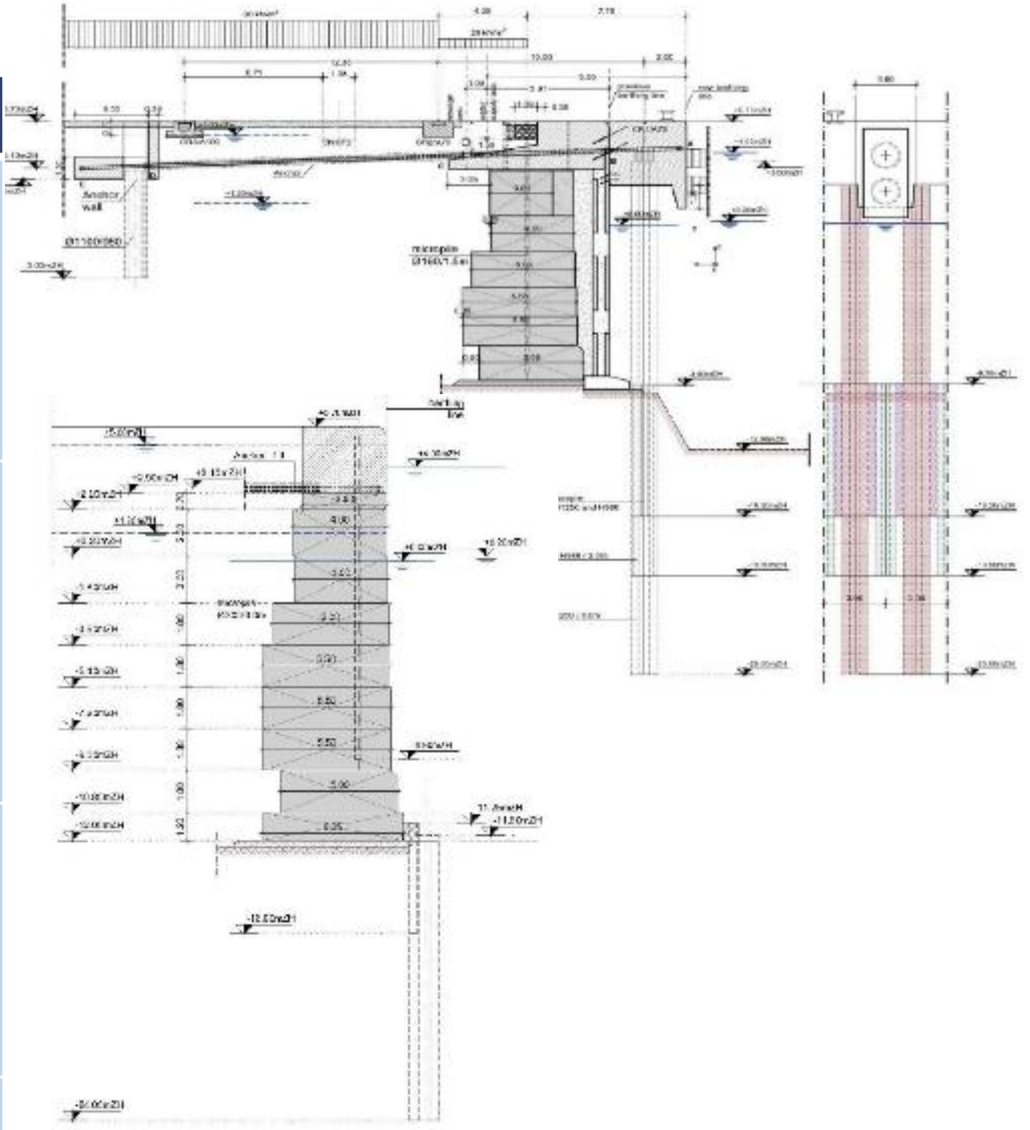






PORT OF CASABLANCA MULTIPURPOSE TERMINAL QUAY DEEPENING PROJECT
GEOTECHNICAL AND STRUCTURAL DESIGN

Section of Works	Baseline Design (Tender)	Proposed Alternative Solution	Advantages of the Variant Solution
Main Retaining Wall	Steel tubular piles (Ø1219mm, t=18mm)	Contiguous wall of precast reinforced concrete piles (H1250/H980) installed in boreholes	**Sustainability & Quality:** • Superior durability in marine environments. • Controlled quality (prefabrication on land). **Execution & Deadlines:** • Fast execution and elimination of complex inspections.
Anchoring System	One ASDO 700 tie-rod per anchor. Anchor block on cast-in-situ reinforced concrete piles.	Tie rods: 7 anchored steel bars Ø63.5 mmBlock: Capping beam on 4 prefabricated piles H980	**Technical & Safety:** • Improved distribution of anchoring forces. • Increased robustness and redundancy. **Execution & Deadlines:** • Fast construction thanks to the prefabricated piles of the block.
Existing Quay Wall Stabilizatio n	Ø160mm micropiles spaced at 2.5m intervals.	Ø160mm micropiles spaced at 1.5m intervals.	A denser stabilization grid for enhanced transfer and distribution of shear forces between the blocks of the existing wall.
Quay equipment	Bollard spacing of 18.46 m (30 bollards total).	Reduced bollard spacing of 15 m (37 bollards total).	**Operational:** • A 23% increase in the number of mooring points. • Improved berthing flexibility and accommodation capacity.



Phasing and Progress of the Works

❑ Work Phasing:

Phase 1 – Preparatory Works & Stabilization: Equipment removal, utility diversions, installation of Ø160 mm micropiles.
Phase 2 – Landside Anchorage System: Drilling and installation of H980 piles, construction of capping beams, installation of tie-rods.
Phase 3 – Retaining Wall: Drilling (using BG30 rig), installation and grouting of precast piles.
Phase 4 – Finishing Works & Dredging: Construction of anti-scour slab and micropiles, dredging to -12.00 m CD, installation of quay furniture.
Work Progress (Section 1 – Chainage 590 to 820):
Pile Prefabrication: Well advanced (D1100: 102/185 | D1400: 83/184)
Drilling & Installation: In progress (D1100: 64/77 | D1400: 65/77)
Anti-Scour Slab & Micropiles: Well advanced (Slab: 192 linear meters – 77% | Micropiles: 127 units – 76%)
Capping Beam: In progress (Sections 1 to 4 completed, work ongoing on Sections 5 & 6)

ABOUT TANGER MED ENGINEERING

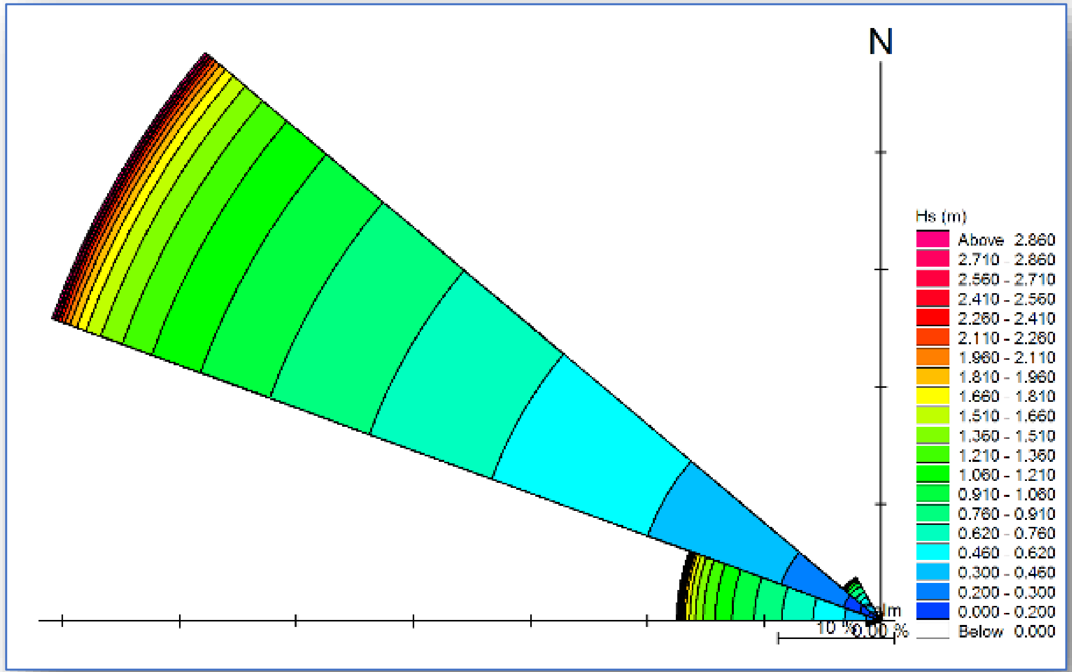
FORECAST OF WAVE AGITATION WITHIN A HARBOUR: THE EXAMPLE OF THE RAPIDLY DEVELOPING TANGER-MED PORT, MOROCCO

- Tangier-Med Port: strategic hub linking the Atlantic and Mediterranean.
- Rapid growth drives demand for safe and efficient berthing.
- Wave agitation inside the harbour directly affects mooring stability and operations.
- Forecasting inner-harbour conditions is critical for traffic reliability.
- The study aims to anticipate wave agitation to support port management and decision-making, through a forecasting tool that generates 3-day predictions and berth availability alerts.

- **Phase 1 – Offshore Wave Analysis**

Collection and statistical analysis of offshore wave data (height, period, direction).

Objective: define boundary conditions and characterize wave climate impacting Tangier-Med Port.



Example of a wave rose at the entrance of Tangier Med Port showing Hs/Direction

TANGER MED ENGINEERING

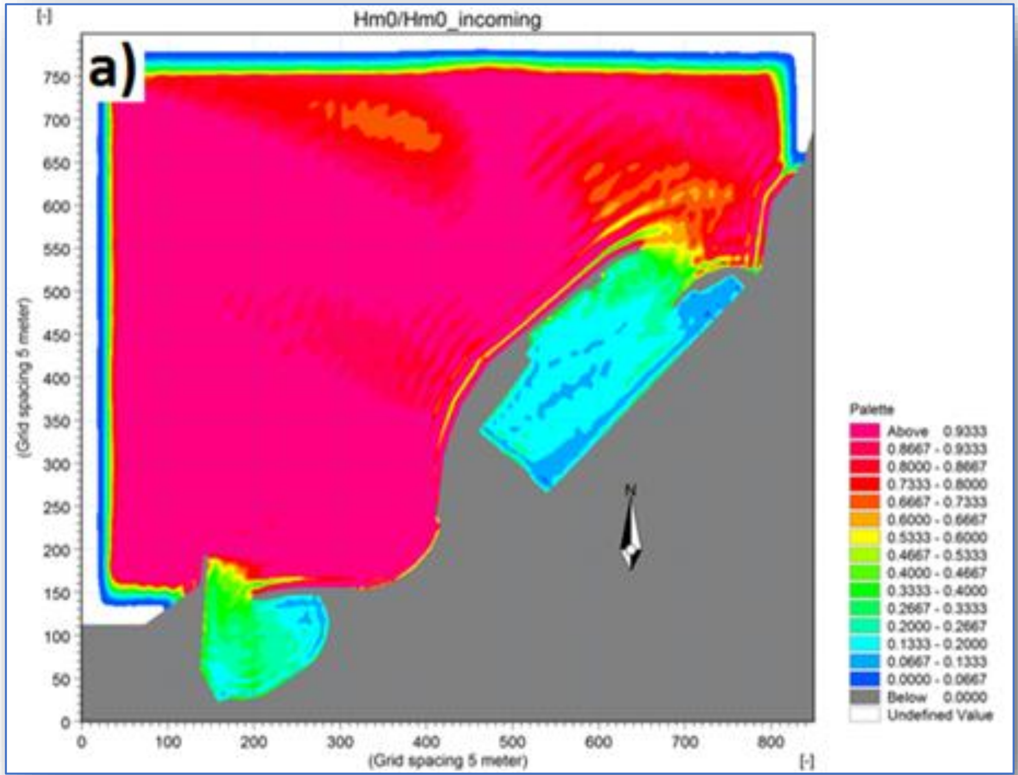
ABOUT TANGER MED ENGINEERING

FORECAST OF WAVE AGITATION WITHIN A HARBOUR: THE EXAMPLE OF THE RAPIDLY DEVELOPING TANGER-MED PORT, MOROCCO

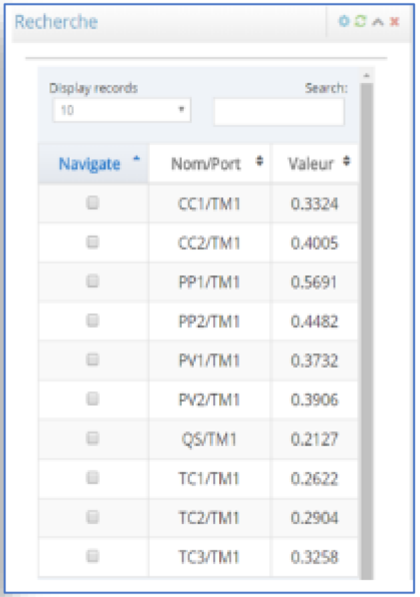
Phase 2 – Numerical Modelling with MIKE 21 BW

Simulation of wave propagation from offshore to the inner harbour using MIKE 21 BW (Boussinesq Wave Module).

Computation of Wave Disturbance and Agitation Coefficients at berth areas to assess harbour tranquillity.



Agitation coefficient of wave heights with waves from West



Navigate	Nom/Port	Valeur
	CC1/TM1	0.3324
	CC2/TM1	0.4005
	PP1/TM1	0.5691
	PP2/TM1	0.4482
	PV1/TM1	0.3732
	PV2/TM1	0.3906
	QS/TM1	0.2127
	TC1/TM1	0.2622
	TC2/TM1	0.2904
	TC3/TM1	0.3258

Example of agitation coefficient prediction for Tanger-Med Port

Phase 3 – Agitation Analysis and Forecasting System

Agitation results from MIKE 21 are compiled into a berth-wise database by direction and period, enabling:

- filtered wave data viewing ;
- berth mapping on satellite imagery ;
- agitation histograms vs. allowable limits ;
- colour-coded 3-day berth availability forecasts ;
- display of agitation maps and coefficients;
- automatic daily PDF reports with alerts.

ABOUT TANGER MED ENGINEERING

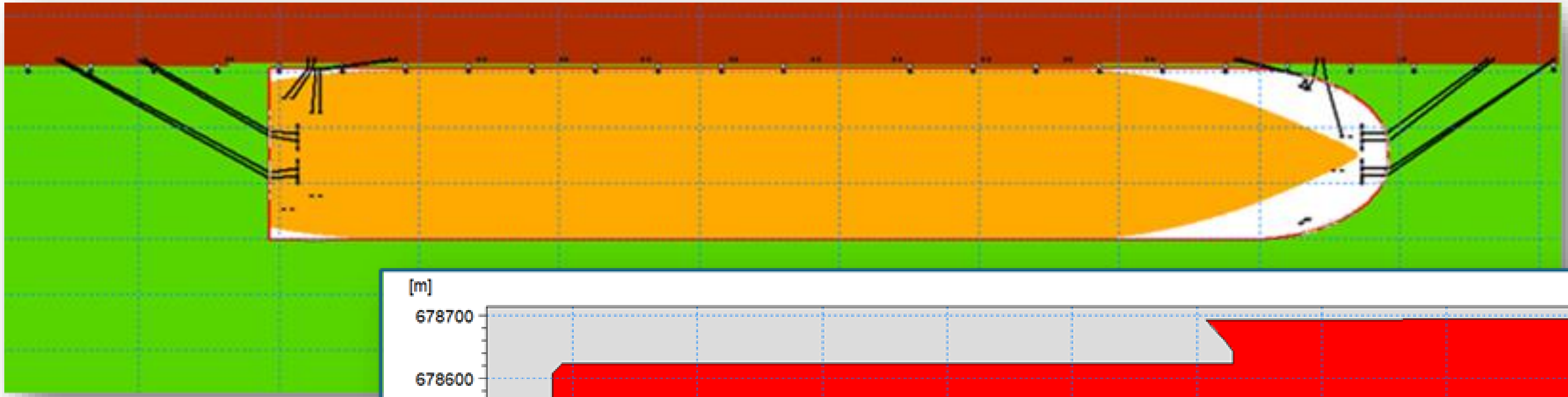
Mooring Analysis Study of a 24K TEU Vessel at the Container Terminal of the Autonomous Port of Lomé – Togo

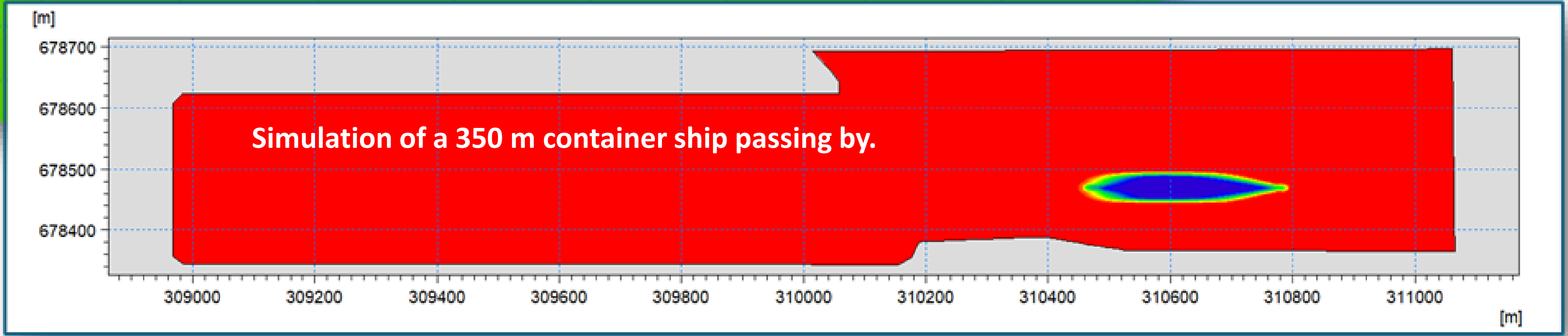
- A mooring analysis was conducted by TME for LCT to assess and optimize the terminal's capability to accommodate ULCVs safely and efficiently.
- Detailed assessment of wind, wave, and passing vessel effects.
- Objective: evaluate the feasibility and safety of mooring 400 m container ships at the terminal and confirm LCT's capability to safely accommodate 24,000 TEU vessels.
- A key milestone that strengthens Lomé's position as a leading maritime hub in the region.

- Phase 1: Collection and analysis of project site data — **waves, wind** along with information on **quay equipment.**
- Phase 2: Mooring analysis using **MIKE 21 MA** software: Numerical modeling of the vessel and quay equipment. Simulations under various wind and wave conditions for both loaded and ballast cases. Assessment of:
  - **Vessel motions under operational conditions.**
  - **Mooring line tensions.**
  - **Fender reactions.**
  - **Bollard loads.**

ABOUT TANGER MED ENGINEERING

Mooring Analysis Study of a 24K TEU Vessel at the Container Terminal of the Autonomous Port of Lomé – Togo





- Main findings :
- LCT demonstrates **excellent operability** for a 400 m / 24,000 TEU vessel.
- Prevailing S–W winds: no constraint up to 15 m/s → **high reliability**.
- N & NE winds: potential limits above 10 m/s, **but rarely occur at Lomé**.
- Passing vessel effect**: no major impact**.
- Bollards & fenders: **well-dimensioned, no overstress observed**.
- TME's study enables LCT to **safely receive ULCVs with 100% terminal availability**.

This study provides LCT with the technical assurance and commercial leverage to safely host 24K TEU vessels — positioning the Port of Lomé among the leading deep-sea hubs in West Africa.

TANGER MED
ENGINEERING

CONTACT US

Your partner for innovative solutions

Website:
www.tme.com

Email:
contact.tme@tme.ma