IMDC

International Marine and Dredging Consultants (IMDC) is an engineering and consultancy company specialized in a vast range of water related projects. Our highly qualified staff offers advice based on recent research results of leading universities and research institutes and hands-on experience acquired throughout the years. One of IMDC's activities is the design and engineering of hydraulic structures.

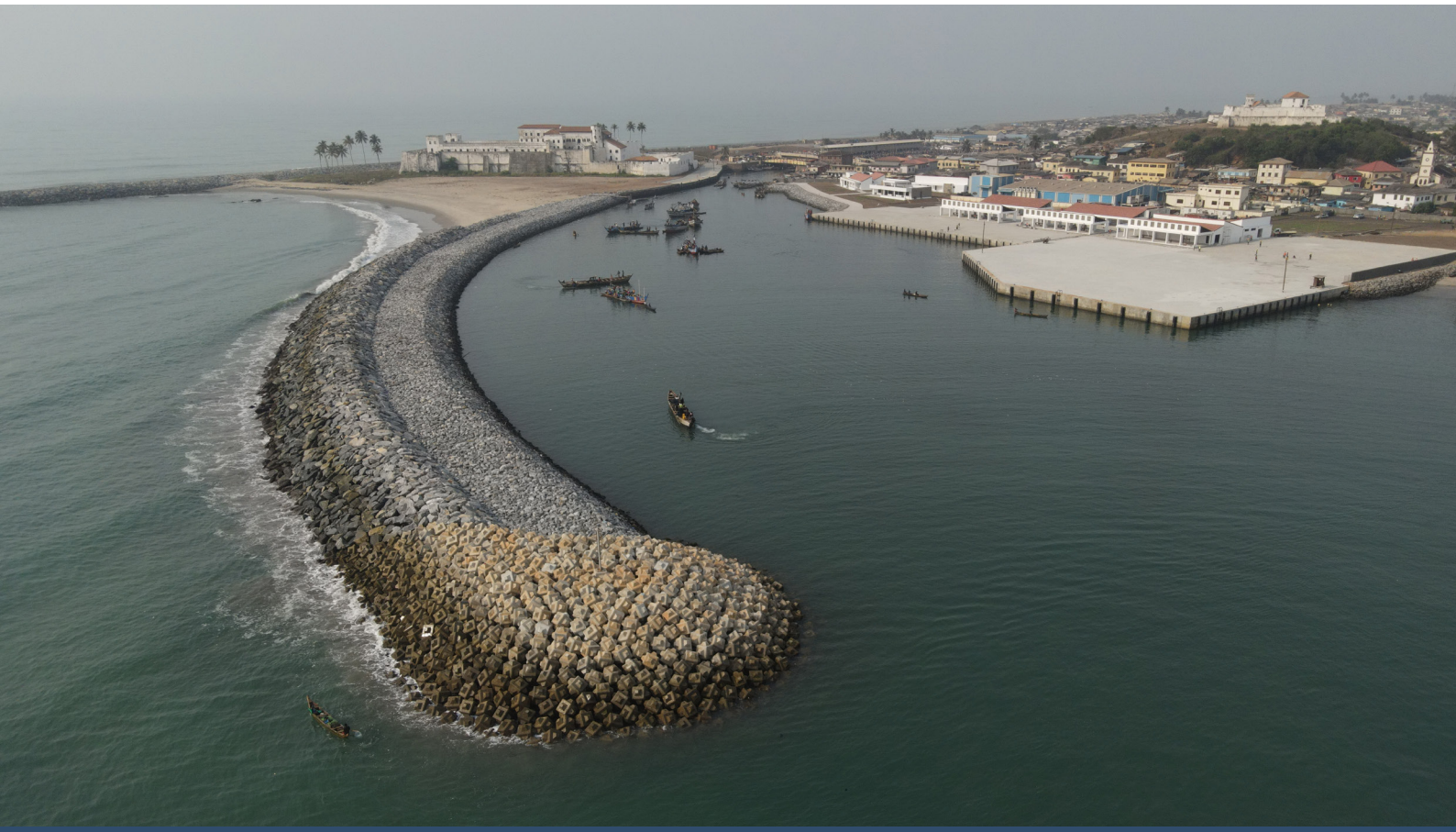
More information can be found on our website www.imdc.be

Hydraulic structures

IMDC provides specialized expertise in the engineering and design of marine and hydraulic structures in offshore, coastal, and port environments, covering the entire project lifecycle from concept development to detailed design and construction support. We apply a rigorous, multidisciplinary methodology that integrates comprehensive data acquisition and measurement campaigns with advanced numerical and physical modelling. These technical foundations are complemented by state-of-the-art design methodologies and internationally recognized engineering standards, ensuring the delivery of reliable, efficient, and environmentally responsible infrastructure.

IMDC's strength lies in the integration of innovative design tools with a deep understanding of hydraulic and coastal processes. This capability enables the development of optimized, resilient, and cost-effective solutions that minimize technical and financial risks while ensuring long-term structural performance under changing environmental conditions. Through this evidence-based and performance-driven approach, IMDC consistently contributes to safer, more resilient, and sustainable coastal and port infrastructure systems.

Elmina breakwater



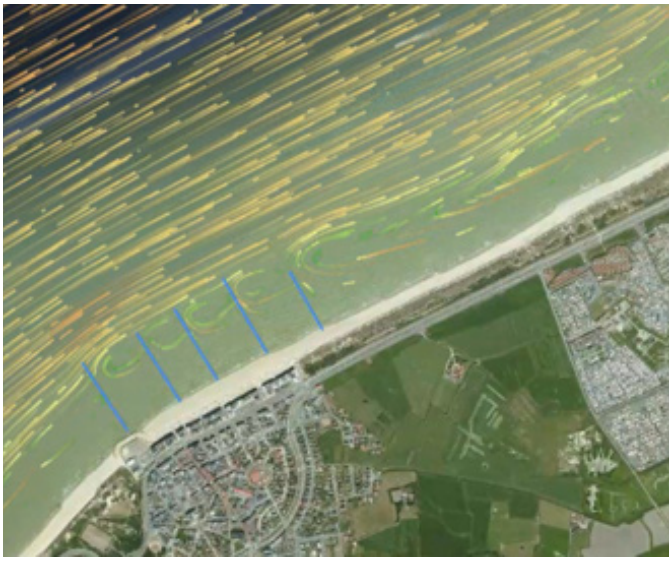
Services

Site Characterization

A successful design starts with a clear understanding of the site conditions. IMDC collects, processes, and analyses hydraulic, morphological, and geotechnical data to characterize the environment in which structures will operate. Field campaigns can be conducted by IMDC's in-house measurement team, combined with remote sensing and existing datasets, capture key parameters such as waves, tides, currents, bathymetry, topography, sediment properties, and extreme water levels.

This information forms the basis for defining boundary conditions and ensures that designs are robust under current conditions and resilient to future changes, including climate change and sea-level rise.

IMDC field team conducting a measurements surveys and data collection



Numerical Modelling and Hydraulic Assessment

IMDC applies advanced numerical models to simulate the interaction of waves, currents, and sediment dynamics in the vicinity of coastal and marine structures. These simulations support the evaluation of alternative layout configurations, the optimization of design solutions, and the identification of potential erosion and sedimentation zones, while also enabling a thorough assessment of hydraulic performance under various forcing conditions.

The modelling work focuses on wave transformation from offshore to nearshore, including reflection, transmission, and agitation; tidal and extreme water levels; current fields; sediment transport and scour risks; and the influence of future climate scenarios on hydraulic boundary conditions. This approach ensures that designs are safe, efficient, and resilient, reducing uncertainties prior to construction.

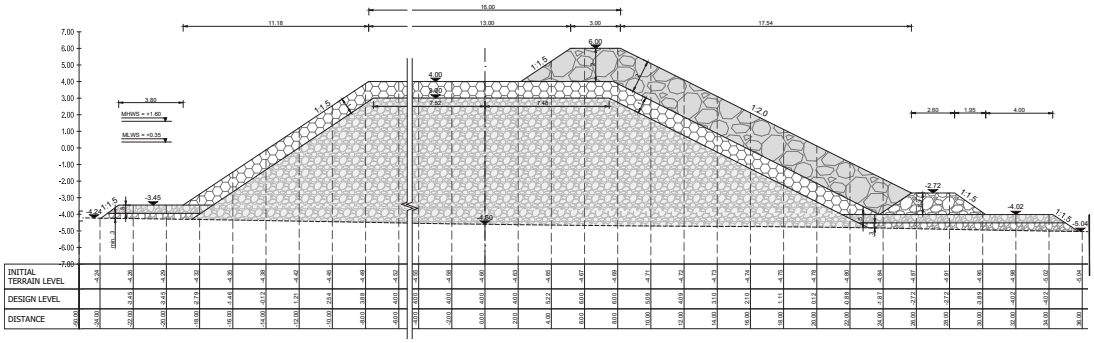
Design of Hydraulic Structures

Coastal and marine structures are fundamental to creating sheltered port and marina environments, protecting critical land-based infrastructure, and mitigating flooding and erosion risks. IMDC has extensive expertise in the design of a wide range of structures, including:

- Breakwaters and groynes for coastal protection and harbour shelter
- Revetments and seawalls for shoreline stabilisation
- Scour protections for offshore foundations, quay walls, and pipelines/cables
- Dams, weirs, and quay walls for inland and port infrastructure

The design process involves defining the layout and geometry, determining structural dimensions and slopes, selecting appropriate materials, and calculating armour unit or concrete block sizes. All relevant hydraulic and structural mechanisms such as wave run-up and overtopping (front and rear), structural stability under wave loading, scour protection requirements, and drainage performance are explicitly accounted for to ensure robust and durable designs under site-specific environmental conditions.

IMDC applies advanced design tools and methodologies, complemented by extensive engineering experience, to deliver technically sound, cost-efficient, and constructible solutions. In addition, comprehensive site supervision and design verification services are provided to support the construction phase.

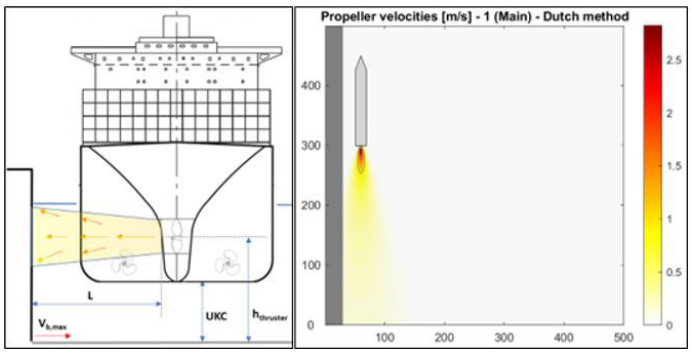


Typical cross-section of a rock (filter and core) and concrete (armour) combined breakwater showing layers, slope, and armour units

Design of scour protection and scour assessment

The phenomenon of local scouring around coastal, marine, and port structures is a critical consideration in coastal and hydraulic engineering, as it directly affects the stability, safety, and service life of infrastructure. IMDC has carried out extensive research and engineering studies on the design and optimisation of bed protection systems, as well as the assessment of both global and local scour processes. This includes scouring induced by wave and current interaction around marine structures, offshore wind turbine foundations, and subsea cable protection systems.

IMDC also has substantial experience in the design of bank and bottom protection measures for inland waterways, as well as in developing solutions to protect berthing and quay structures from scour generated by ship propeller-induced flow. This expertise ensures that structures remain stable under complex hydraulic loading conditions throughout their operational lifetime.



Flow field due to the action of the propeller jets

Physical Model Testing and Validation

Physical modeling investigations are indispensable for studying wave-structure interaction, serving as a pivotal design tool for coastal engineers. Drawing upon our extensive experience and expertise in physical modeling,

IMDC offers comprehensive support to clients throughout every stage of a laboratory test campaign. From initial test setup to execution, analysis, and interpretation of data collected, we provide invaluable assistance tailored to your project needs.

Physical model of a coastal structure tested in a laboratory wave flume

Construction Support and Site Supervision

IMDC provides comprehensive technical support during the construction phase to ensure that design intent is accurately translated into the built structure. This includes advising on material selection, verifying construction quality, and providing engineering input to address site-specific conditions or unforeseen circumstances.

IMDC's supervision activities focus on maintaining alignment between design specifications and execution, ensuring structural integrity, durability, and compliance with applicable standards. This approach supports the successful delivery of works and enhances the long-term performance of coastal and hydraulic infrastructure.

IMDC engineer supervising construction of coastal protection works.

Key references

Elmina fishing port and waterfront development

Ghana, 2020 - 2023
Client: DEME & Ministry of Transport, Government of Ghana

IMDC undertook the detailed design for the Elmina Fishing Port in Ghana, involving two new breakwaters, dredging and reclamation works, and new quay structures. The design focused on innovation, sustainability, and the reuse of materials from the existing breakwaters to reduce environmental impact and costs. The breakwaters were engineered to ensure effective wave attenuation and harbour tranquillity, based on detailed hydrodynamic, wave, and morphological modelling, supported by physical model testing. Their structural design defined the core, filter, and armour layers, selected suitable armour units, and verified overall stability under design conditions. Comprehensive scour protection and revetment systems were incorporated to safeguard the new and existing structures. These included toe and bed armouring and transitional details at quay interfaces to prevent erosion and ensure long-term durability. IMDC's services covered site investigations, modelling, port layout optimisation, and the concept and detailed design of marine structures, including breakwaters, quays, moorings, scour protection, and fender systems. Construction drawings, specifications, value engineering, design verification, and supervision during execution were also provided to ensure full alignment with design intent and quality standards.

Sustainable Development Goals

Princess Elizabeth island (MOG2 island)

Belgium, 2019 - 2022
Client: Elia Asset NV/SA

The Princess Elisabeth Island, also known as the Modular Offshore Grid 2 (MOG 2) artificial island, is planned to be the world's first artificial energy island. As part of this project, Elia aims to develop and construct new grid infrastructure in the Belgian North Sea. The island's infrastructure is designed to collect and connect wind farm export cables from the Princess Elisabeth Zone, while also serving as a strategic hub for future interconnectors with the UK (Nautilus) and/or Denmark (TritonLink). The energy island will have a maximum capacity of 3.5 GW. Constructing this artificial island demands innovative marine and hydraulic engineering solutions. The island will cover approximately five hectares above the waterline and will be located about 45 km offshore. Its foundation will consist of concrete caissons, which will be floated to the site, installed, and backfilled with sand to form the island's structure — a process requiring detailed hydraulic design of caisson stability, scour protection, and sediment management. IMDC, supported by its partners, prepared the tender reference design and tender documentation for the Energy Island. As Island Consultant, IMDC's key responsibilities included the coordination and development of the EPCI tender documents, the hydraulic design and quality control of both numerical and physical modelling, geotechnical and hydraulic stability verifications of the caisson structures, design of cable landings and subsea cable routings, preparation of a constructability report based on weather downtime analyses, and CAPEX/OPEX estimations for project optimization

Sustainable Development Goals

Grand Port Maritime de Dunkerque - Passerelle RoRo 6

Country: France
Year: 2021 - 2022
Client: Tractebel Engineering N.V

As part of the port expansion at Grand Port Maritime de Dunkerque, Tractebel Engineering France engaged IMDC to provide technical expertise for the detailed design and site supervision of the scour protection at the new Ro-Ro berth (RoRo6). IMDC began by analysing bottom velocities induced by propeller wash during vessel manoeuvres and, based on these results, proposed and evaluated several scour protection concepts to ensure resilience under frequent berthing conditions. After selecting the optimal solution in collaboration with the Client and Contractors, IMDC prepared the detailed design, including specifications and execution drawings, and subsequently supervised on-site installation to verify full compliance with the design requirements.

Sustainable Development Goal

Engineering support for FSRU Wilhelmshaven development

Country: Germany
Year: 2022 - Ongoing
Client: ENGIE

FSRU GmbH, a joint venture between ENGIE and TES-H2, commissioned the construction of an LNG terminal in Wilhelmshaven, Germany. IMDC, acting as Owner's Engineer, supported all project stages from design and procurement to construction and follow-up. With safety and environmental performance as priorities, IMDC prepared permitting documentation, conducted metocean measurements, and managed dredging campaigns including UXO clearance, turning basin design, hydrographic surveys, and sediment plume studies. A key element was the design, coordination, and monitoring of the scour protection system, ensuring long-term stability of the monopile and jetty structures. The design defined the layout, rock gradation, and filter layers based on site-specific hydrodynamic and geotechnical conditions, with IMDC supervising installation to meet design and environmental requirements. Additional tasks included the design and management of monopile and jetty installations, Dynamic Mooring Analysis studies, procurement support, site inspections, and supervision during SIMOPS operations.

Sustainable Development Goals

Al Numan Island marine consultancy

Kingdom of Saudi Arabia, 2024 - 2026
Client: Red Sea Global

IMDC is delivering comprehensive marine engineering services for Al Numan Island, covering marine planning, design, and early works to support the creation of a destination centered on wellness, culture, sustainability, and refined coastal living. As part of this high-profile project, IMDC has developed multiple design solutions, including beach layouts, breakwaters, several jetties, quay walls, and marina structures, as well as scour protection systems. Both the conceptual and detailed design phases are being executed, ensuring that all structures are optimized for safety, functionality, and environmental performance. This project highlights IMDC's expertise in delivering visionary waterfront environments with international appeal.

Sustainable Development Goals

Blankenberge-Wenduine

Belgium, 2017-2022
Client: THV SBE - Technum

IMDC conducted a feasibility study for the Flemish Government to address sedimentation at the harbour entrance of Blankenberge and beach erosion at Wenduine. Through advanced numerical modelling, IMDC evaluated the technical effectiveness, safety, cost-efficiency, and environmental impact of various coastal protection measures, providing a data-driven basis for sustainable coastal management and reinforcing IMDC's role as a trusted partner for complex coastal solutions. In the subsequent phases, the selected breakwater alternatives were further developed through detailed engineering design, focusing on structural stability, hydraulic performance, and constructability. The design included the definition of cross-sections, material gradations, and toe and crest configurations to ensure long-term functionality under North Sea conditions. IMDC also carried out Environmental Impact Assessment (EIA) studies and provided technical assistance during construction to ensure the works were executed in full alignment with the detailed design and environmental objectives.

Sustainable Development Goals

Ada coastal protection works phase 2

Ghana, 2012 - 2016
Client: Government of Ghana, Ministery of Water Resources, Works and Housing

In order to stop the ongoing erosion of the coastal stretch between Ada Foah and Totope, the Ghanaian government charged IMDC with the continuation of the coastal protection project around Ada Foah to the west over a distance of approximately 10 km up until Totope. IMDC collected the required data through desk studies and field measurements to define the design conditions. A coastal protection system was designed including groynes, beach suppletion and dune heightening. Numerical and physical models were used to refine and optimise the design. IMDC also drafted technical specifications towards the Contractor and organised supervision during construction.

Sustainable Development Goals