Delta Marine Consultants

Solutions for marine, coastal and infrastructure projects

Ramspol flood barrier, the Netherlands

Delta Marine Consultants is operating in a rapidly changing world. Clients today continually present us with new challenges and invite us to develop unique solutions to a wide range of requirements. The development of those solutions often leads to innovations: sometimes by creating completely new concepts, in other cases by combining existing technologies and materials in a creative way to produce a better solution.

Experience and knowledge for tailor made solutions

We provide our services as an independent consultant and have extensive experience in all project phases: from developing a concept, preparing the tender process, providing tender support to bidders and producing a detailed design to consultancy services during the maintenance phase.
Supported by our strong relationship with the construction companies of our parent company, the Royal BAM Group, we are able to offer practical design solutions and combine innovation and feasibility to yield an optimal result.

Constructability, reliability and economics are the key concepts on which Delta Marine Consultants bases its activities. This is not just the message for the outside world - it's also the basic principle underlying our internal management policy.


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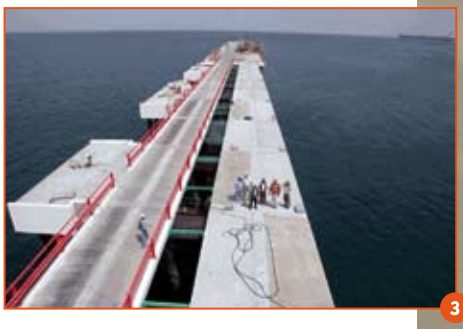
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Finding the economic optimum

Port projects are generally associated with substantial economic and public interest. In order to find the optimum solutions, the relative merits of different concepts need to be weighted carefully. For Delta Marine Consultants, it is a key priority to provide our clients with creative input and produce good, economic and constructible designs.

In port projects, local factors such as wave climate, wind and current conditions and the nature of the soil have a significant effect on the choice of concept and the design process. We have in-house experts with the knowledge and experience to study the effect of these local conditions, not just on the design of port and marine structures, but also on navigation and port operations.

Apart from designing the optimal layout of a port and the access channels, we focus on providing advice, concept development and detailed design of harbour structures, including container terminals, transfer jetties, quay walls, mooring facilities for ferries, breakwaters and cooling water systems.

1. Oiltanking Jetty, Jurong Island, Singapore
2. Universal Terminal jetties, Jurong Island, Singapore
3. QAFCO III and IV Urea Export Jetties, Qatar
4. Cruise and Ferry Berths, Kingstown, St Vincent
5. Hazira LNG Terminal, India

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Ports and harbours

Euromax container terminal, the Netherlands

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1 Locks 10 to 13, Zuid Willemsvaart, the Netherlands

2 Upgrading N31 Motorway, the Netherlands

3 A59 Motorway, the Netherlands

4 Sentosa Sea Wall, Singapore

5 Storm Surge Barrier, Rotterdam, the Netherlands

Infrastructure

High speed Line tunnel, Rotterdam

The development of new infrastructure worldwide

Delta Marine Consultants is working on the development of new infrastructure worldwide. We have many years of experience in the design of civil structures for road and rail transport and structures for navigation and flood protection.

We are fully geared-up for the changing situation in the infrastructure projects market. We take an integrated conceptual approach and we therefore understand the vital importance of communication with other parties, such as the end-user, other engineering disciplines and construction companies. This kind of interaction is essential to the success of new trends like systems engineering and risk management, and has a direct impact on the adopted concept. We have a long track record of successful design and construct projects.

Our capacity for innovation is conclusively demonstrated by our engineering achievements at storm surge barriers in the Netherlands like those in the Eastern Scheldt estuary and the New Waterway (the main entrance to the port of Rotterdam), and our design for the inflatable dam barrier at Ramspol.


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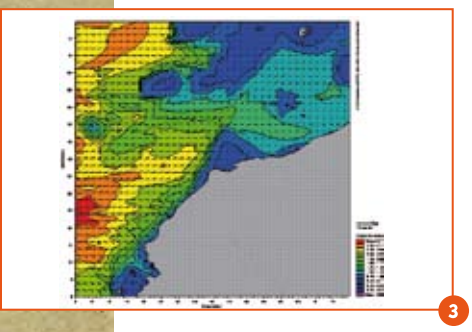
1. Breakwater Fregate Island, Seychelles
2. Xbloc® breakwater, Caladh Mohr, Ireland
3. Offshore nearshore transformation of waves, MIKE21
4. Modeltest Xbloc®
5. Breakwater, Port Oriel, Ireland

Coastal engineering

Where land meets water



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Coastal areas and river banks are home to the majority of humanity and have always been important to trade and transport and as such are vital links in the economic chain. We provide designs and advice for breakwaters, beaches, dikes, shore protection and also conduct hydraulic and morphological studies

Delta Marine Consultants works for a variety of clients worldwide and is involved in port development and land reclamation projects, urban waterfront and marina developments, shore protection and restoration projects. We search for new solutions to stop the detrimental effects of global warming. Our activities include model testing and numerical studies.

For breakwaters we developed the Xbloc®, a simple, robust and reliable concrete breakwater armour unit. It has good structural integrity as an individual element and has great hydraulic stability in the armour layer which makes it an economic alternative to other solutions. The Xbloc® can also be used for shore protection, river groynes and artificial reefs for recreational divers. For more information about the Xbloc®: www.xbloc.com.

Constructability of our designs


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Delta Marine Consultants has been involved in tunnel projects for many years. Our reference list includes cut and cover tunnels as well as immersed and bored tunnels, from concept design to detailed design, for both permanent and temporary structures.

Our knowledge of immersed tunnels has been passed down through generations of engineers in our company, with each generation bringing in innovations and new experiences. We are one of the few companies to have hands-on experience with 'concrete' as well as 'steel' tunnel elements and can provide detailed engineering services for immersion works. We have involvement in several bored tunnel projects in the Netherlands and have developed a widely used, low strength mortar sealing plug for exit shafts.

We also have comprehensive experience with the design of cut and cover tunnels, in many cases located below groundwater level. The cut and cover technique is also used for underground car parks. These structures usually form part of projects in congested inner city areas. The associated technical and logistical problems during construction call for creative design solutions.

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1 Immersed tunnel High Speed Link, Oude Maas, the Netherlands

2 Bored tunnel, The Hague, the Netherlands

3 High Speed Link tunnel, Rotterdam, the Netherlands

4 Second Heinenoord tunnel, Barendrecht, the Netherlands

5 Cut & Cover tunnel Zevenaar, the Netherlands

Tunnels

Characterised by their variety

Heavy civil structures for industry projects are characterised by their variety. Delta Marine Consultants has the expert knowledge to offer a wide variety of services, ranging from the inspection of concrete structures to the detailed design of machine foundations, factory floors, pipe racks, cooling water systems, settling tanks, pump houses, hydro-electric power stations, storage tanks for oil and gas and offshore platforms.

As with our projects in other sectors, close cooperation between design disciplines and construction is essential in industrial projects as all design processes of the different discipline areas run in parallel, and many times as part of a fully integrated design and construct planning. We know that interface management by experienced personnel is crucial for the success of these projects.

A number of our recent projects have been carried out for the renewable energy sector, such as design of foundation structures for wind and wave energy units and the development of tidal and wave energy facilities.

1. Compressor station, Noord-Holland, the Netherlands
2. Seawater Intake, Oman
3. F3 Gravity Based Structure, North Sea
4. Hydro Power Station, Maurik, the Netherlands
5. COVRA Nuclear Waste Storage, Vlissingen, the Netherlands

Industry and energy

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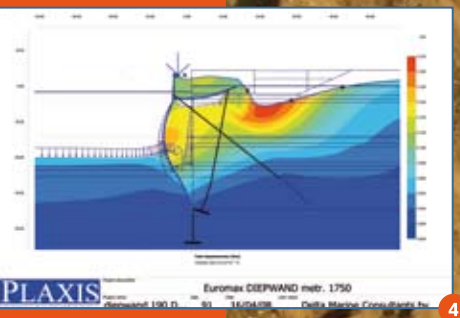

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1 Virtual Construction

2 MPU Slipform, concrete technology

3 3-dimensional drafting (3D CAD)

4 PLAXIS FE analysis software, quay wall design

5 Pile Testing (PDA and static), Fujairah, UAE

6 DMC wave flume

Specialists

Solid engineering is based on in-depth knowledge of materials and mechanics

Geotechnical and foundation engineering
Most civil and coastal structures cannot be designed without detailed knowledge of foundation engineering and soil-structure interaction. Soil and rock are highly complex and variable materials and expert knowledge of soil and rock mechanics is essential to sound and reliable designs. Delta Marine Consultants employs a team of specialists who prepare specifications for soil investigation, perform soil characterisation, define design parameters, perform the required analyses and supervise and interpret various static and dynamic testing methods.

Material technology
Our staff includes a group of specialists who provide comprehensive advice on all aspects of concrete technology, including selection of materials and design of concrete mixes for different criteria and durability requirements. Non-linear, time-dependent finite element tools (FEC3S) have been developed in-house for analysis of concrete hydration temperature and stress distributions. The software has been calibrated on a large number of different projects.

Virtual design
We have full 3-dimensional drafting capabilities and can make use of virtual construction model technology. A range of different 3D CAD tools is available for production of construction drawings, interface control and clash detection, integration of construction schedule, detailed material take-off lists, electronic survey data, visualisation, etc. 3D tools are used extensively to prepare roadway design, dredging and excavation works and complicated steel and concrete structures, and provide a framework for Building Information Models (BIM).

2D Wave Flume
As a general rule theoretical or empirical calculation methods as found in the relevant standards and guidelines only allow for approximate determination of the hydraulic stability and functional performance of coastal structures. To verify and optimize the design physical model tests are still the preferred method, in particular for non-standard structures. In order to investigate innovative designs, detail the knowledge on Xbloc® performance in limit ranges and to optimize protection schemes in respect of wave overtopping, DMC has established a new up-to-date wave flume facility integrated in our Utrecht laboratory. The 25m long flume started commercial operations in September 2008.

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