COWI’s history in civil engineering dates back to 1930 when the company was founded. Since then, COWI has pushed the boundaries of marine design through our involvement in more than 3,000 marine projects worldwide. These projects range from large and technically challenging LNG terminals, container ports and waterfront developments to cooling water systems, offshore wind farms, flood protection, locks and dams.

Today, we are a world leader in marine and coastal engineering. It is a position we have achieved by diligently pushing the development of new technologies to stretch the limits of what is possible.

We are driven by innovation and by our ambition to work closely with our clients to deliver world-class marine structures. Our services cover the entire life cycle of a marine structure, from the initial ideas to the operation phase, decommissioning or rehabilitation.

With a full set of world-class competencies within marine and coastal engineering combined with local presence and experience, we are ready to take on the most complex projects anywhere in the world – no matter how large or small.

Together, we will take you there.
WORLD-CLASS MARINE AND COASTAL ENGINEERING

We create value for our customers through our world-class knowledge and multi-disciplinary approach.

Our references show the breadth and depth of our global experience.
GORGON LNG PLANT, AUSTRALIA

The Chevron-operated Gorgon liquefied natural gas project on Barrow Island will bring on stream a three-train 15 m t/y, exploiting off-shore gas fields off Australia’s north west coast.

It is the largest of more than a dozen planned LNG projects in Australia.

Venture partners with Chevron are Exxon Mobil Corp, Royal Dutch Shell Plc, Osaka Gas, Tokyo Gas and Chubu Electric Power. The Saipem-Leighton Consortium (SLC) was awarded the Gorgon LNG jetty and marine structure contract in November 2009 based on a design concept with caissons to be prefabricated off-site, towed in and placed onto gravel beds. A connecting trestle is made of steel trusses spanning 70-80 m between caissons. The jetty is located approximately 2 km off shore.

SLC engaged COWI to carry out independent design verification for the marine facility design which included checking more than 2000 documents and performing independent design calculations.

FACTS
Project period: 2012-2013
Client: Saipem Leighton Consortium

SERVICES
- Independent design verification (IDV)
- Independent calculations for validation of the structural integrity.

AIN SUKHNA PRODUCT HUB, EGYPT

Arab Petroleum Pipeline Co. has established a fully equipped product hub at their Ain Sukhna complex on the Red Sea Coast in Egypt. The hub includes both onshore and offshore facilities. The offshore facility comprises 61 product storage tanks with a total capacity of 2.125 million m³, and two 50 km long underground pipelines to the city of Suez. The diameter of the individual product storage tanks varies from 21 to 59 m.

The offshore facility comprises a jetty and berth (300-160,000 DWT) including a mooring pipeline and other auxiliaries. The hub includes an offshore single point mooring (SPM) for very large crude carriers (VLCC), connected via a sea pipeline. The offshore facility is intended to accommodate future expansions to handle up to 24 million tonnes per annum of various products.

The entire project development is planned to be completed in five main development phases with a specific phase for LPG tanks and berth.

FACTS
Project period: 2012-2013
Client: Arab Petroleum Pipeline Co. (SUMED)

SERVICES
- Topographic survey at fuel tank site and land pipeline corridor
- Concept design of marine terminal, tank farm, single lay mooring and land pipeline
- Plant layout and 3D modeling
- Front end engineering design (FEED)
- Preparation of tender documents.
The Norvikudden project is a modern green-field port development of a 44 hectare site located about 65 km south of Stockholm. The fully developed port will comprise about 1.4 km of quays accommodating four berths for container carriers with four to five ship-to-shore container cranes and two berths with movable end ramps for ro-ro vessels. The planned water depth at the quays ranges from 10 to 18.5 m and the port capacity will enable the annual handling of 300,000 TEU and 200,000 ro-ro vehicles.

COWI was selected as the contractor’s consultant for the design of all quay structures, revetment, quay equipment, dredging work, scour protection, soil improvement, pavement works, drainage, utilities, mechanical and electrical works and access roads and bridges to the terminal.

FACTS
- Project period: 2011-2012
- Client: NCC-Aarsleff
- Norvikudden Consortium

SERVICES
- Numerical modelling of waves, currents and water levels
- Programming of the geotechnical investigations
- Design basis for all marine works based on the functional requirements for the container terminal and ro-ro terminal
- Concept design of all marine works
- Estimation of main quantities
NEW FERRY AND CRUISE TERMINAL IN
THE PORT OF STOCKHOLM, SWEDEN

The new port facility will consist of three new ferry berths and two upgraded ferry terminals with associated movable steel end ramps and berth equipment.

The design water depth at the new ferry berths will be 11 m. The structural system consists of a prefabricated concrete deck supported by approximately 1,050 tubular steel piles (diameter 1,000 mm and average length 45 m).

The piled deck consists typically of 11 m by 9 m prefabricated concrete deck elements cast together on site. Along the inner edge of the piled deck a double anchored steel sheet pile wall is used to retain the new fill above the existing sea bed.

To support the fill in the existing harbour structure a large prefabricated reinforced concrete L-wall is used.

Cement-limestone piles and jet grouting are used to improve soil conditions in order to support the new loads behind the retaining walls. Rock armour will protect the existing slopes and the new retaining walls from propeller scour.

COWI is the design consultant for all construction works.

FACTS
Project period 2013-2015
Client Per Aarsleff A/S

SERVICES
› Tender and detailed design
› Geotechnical design
› Marine structural design
› Design of pavement, drainage and utilities.

PORT OF SALALAH INSPECTION,
SULTANATE OF OMAN

As part of a feasibility study for dredging an additional 2.5 m, COWI carried out an underwater investigation for berths 21-24.

The objective of the investigation was to assess the existing condition of the structure to determine the improvements required to accommodate the additional dredged depth.

COWI mobilized a full surface supplied dive station, an engineer-diver, and a dive supervisor.

Berths 21-24 are constructed as a precast concrete caisson bulkhead that supports a cast-in-place concrete cap. It measures approximately 720 m and is currently dredged to approximately 12 m depth.

FACTS
Project period 2011
Client Port of Salalah

SERVICES
› Underwater and above water inspection
› Feasibility study.
AT ANY GIVEN TIME, WE ARE INVOLVED IN MORE THAN 200 MARINE PROJECTS WORLDWIDE

WORLDWIDE REACH

In COWI, we take pride in our achievements. Since our inception, we have been at the forefront of marine engineering, setting the standard for tomorrow’s best practices. Together with our clients, we have been involved in more than 3,000 marine projects all over the world – from Argentina to the far corners of Russia.

We can take your marine project further than you imagine. COWI’s key marine and coastal engineering offices are shown here. With offices around the globe, we are never far away. And regardless of the scope of your marine construction or problem, we deliver worldwide.

All other COWI offices are listed on www.cowi.com
KRONBORG CASTLE AND ELSINORE HARBOR, DENMARK

Cultural Harbour Kronborg is a comprehensive renewal of the area between the town of Elsinore and Kronborg Castle, which is on the UNESCO world heritage list. The area has been developed into a recreational area with a new harbour front with new quay walls, wooden promenades along the quay walls, approximately 12,000 m² of granite paving, lighting, and 1,1 km of benches.

The fortifications around Kronborg have been recreated or restored including the recreation of von Scholten's ravelin, a contemporary architectural interpretation of the original ravelin. Most of the soil was reused in the project to create the new King's Quay and the Ravelin. The project also comprises new access roads and parking for buses and cars.

The multidisciplinary project was developed in close collaboration with the Client and the landscape architect Jeppe Aagaard Andersen. Risk assessment was integrated in the planning phase and the successive cost calculation.

FACTS

Project period: 2007-2014
Client: Ministry of the Interior, Elsinore Municipality

SERVICES

› Overall planning
› Preparation of tender documents
› Project management consultant for the implementation of the entire project
› Environmental and geotechnical investigations
› Cost estimations and supervision of works.
LUSAIL DEVELOPMENT
QATAR

The waterfront development is located along the shoreline north of Doha. It covers an area of about 21 km² which is approximately the same size as the entire Midtown and Lower Manhattan in New York.

The project has transformed the present shoreline through dredging and reclamation, creating new islands, access channels and beaches. The new development includes low and high rise residential buildings, hotels, retail areas, conferences and entertainment district.

COWI completed the planning and design activities of the marine and earthworks for the Lusail Development and subsequently designed marinas and beaches. Finally, COWI supervised construction of all marine works.

FACTS

Project period: 2004-2014
Client: Qatari Diar / Bechtel Overseas Corporation

SERVICES

- Master planning
- Bathymetric and topographic surveys
- Geotechnical investigations
- Environmental impact assessment
- Conceptual and detailed design
- Preparation of tender documents
- Assistance in tendering and contracting phase
- Construction supervision.

LONDON ARRAY OFFSHORE WIND FARM, UK

With 175 monopiles, designed to carry the Siemens 2.6 MW turbines, the London Array offshore wind farm is the world’s largest, with a peak rated power of 630 MW in 2013. Monopiles of 4.7 m and 5.7 m diameter have been installed at water depths between 0 m and 25 m. With length up to 85 m, these foundations are amongst the largest ever built.

Its turbines are capable of generating enough energy to power nearly half a million UK homes and reduce harmful CO₂ emissions by over 900,000 tonnes a year.

A consortium of DONG, E.ON and Masdar commissioned Aarsleff | Bilfinger Berger Joint Venture (ABJV) as contractor to undertake fabrication and installation of the steel foundations. To carry out the detailed design of the monopiles, ABJV engaged COWI as lead in a joint venture with IMS Ingenieurgesellschaft mbH (COWI-IMS JV).

The project is one of the first offshore wind projects to use the conical grouted connection. Significant advances were introduced in the geotechnical methodology for calculations of soil-structure interaction.

FACTS

Project period: 2009-2013
Client: Aarsleff / Bilfinger Berger Joint Venture

SERVICES

- Hydraulic load calculations
- Structural design
- Geotechnical design
- Driveability analyses
- Cathodic protection analysis and design
- Scour assessment
- Risk management.
The joint venture of COWI and IMS Ingenieurgesellschaft mbH, led by COWI, has been entrusted with the detailed design of the foundations and the basic design of the substation.

COWI was Iberdrola’s representative in the preliminary geophysical and geotechnical investigations for the 1st German regulatory system’s (BSH) release, and is finishing the detailed geotechnical investigations for the 2nd BSH release.

Before this, COWI carried out the feasibility study of the turbine foundation types, investigating concepts for monopiles, gravity-based foundations and jacket foundations for depth variations up to 42 m. Based on our preliminary foundation design, we were awarded the basic design of the jacket foundations equipped with AREVA 5 MW turbines, for the application for the 2nd BSH release. The offshore wind farm is expected to deliver up to 400 MW.

For the offshore substation, COWI’s scope of work includes the mechanical and electrical design services in addition to the topside and jackets structure design.

**FACTS**

**Project period**: 2010-2014

**Client**: Iberdrola Renovables

**SERVICES**

- Structural design of topside and jackets
- Hydraulic design
- Geotechnical design
- Electrical and mechanical design
- Low voltage design
OUR SERVICES

With our services, we cover the entire project life cycle of a marine project from early ideas to the operational phase and rehabilitation – or decommissioning when the time comes.

We can handle the entire project, or we can step in at any given moment to provide your project with that extra expertise you need. The choice is yours.
Agility and expertise are the key to efficient marine and coastal engineering. We bring both to the table to make sure we provide you with the exact service and expertise your project needs – regardless of where you are in the process.

**INDEPENDENT DESIGN CHECK AND VALUE ENGINEERING**
We provide assistance to clients of complex marine projects assessing if the project is reliable, safe, durable, constructable and optimal.

**CONSTRUCTION ENGINEERING**
The right selection and combination of construction methods is of crucial importance to any marine project. We handle erection schemes, logistics, temporary structures as well as the erection engineering itself.

**OPERATION AND MANAGEMENT**
Our asset management is based on worldwide practical experience with planning, budgeting and handling of short and long-term operation, maintenance and rehabilitation works, as well as implementation of management concepts.

**RE-EVALUATION AND REHABILITATION**
We cover all phases and every step of the inspections to ensure that technical evaluations are coherent – from visual inspections to special studies of load capacity and safety of structures. We design rehabilitation works for existing structures for increased capacity and for replacement of key structural elements.

**SITE SUPERVISION**
We handle all disciplines relating to preconstruction and construction, project completion and subsequent defects liability period and we deliver full project quality documentation.

**DESIGN**
We handle everything from development of design basis to construction aspects as well as the lifecycle design. We have state-of-the-art analysis tools that enable us to deliver competitive designs to tight schedules. With our vast experience we can secure delivery of your project to quality, on time and budget.

**CONSTRUCTION MANAGEMENT**
We handle the contract, monitoring the progress of the project in all details as well as control and take care of risk management. We also handle stakeholders and authorities and perform technical follow-up.

**OPERATION AND MANAGEMENT**
Our asset management is based on worldwide practical experience with planning, budgeting and handling of short and long-term operation, maintenance and rehabilitation works, as well as implementation of management concepts.

**DECOMMISSIONING**
To facilitate the choice between removal options, we carry out quantitative, comparative risk assessments of the various options and we take damaged structures, personnel and environmental risks into account.
YANBU 2 POWER AND WATER PROJECT, SAUDI ARABIA

The power and water utility company Marafiq is developing a new 850 MW (net to the grid) power and water plant for Yanbu 2 Industrial City to meet the increasing demand for power, process and portable water and seawater cooling.

The plant is located on the Red Sea coast of the Kingdom of Saudi Arabia, approximately 280 km north of Jeddah.

Saudi Archirodon Ltd. has been selected as contractor for the marine facilities with COWI as consultant for the detailed design.

The marine facilities consist of a seawater intake facility and associated pumping station and a seawater outfall. Hydraulic modelling was used to develop near shore design conditions for marine structures (extreme waves, currents, water levels).

FACTS

Project period: 2011-2014

Client: Saudi Archirodon Ltd.

SERVICES

- Seawater intake/outfall channel design
- Hydraulic and coastal engineering
- Design of dredging and reclamation
- Design of breakwaters and revetments
- Pumping station design
- Architectural and structural design of buildings
- Infrastructure design (roads and storm water drainage)
RABIGH POWER PLANT NO 2, SAUDI ARABIA

The project is located in Rabigh, on the Red Sea coast, north of Jeddah in the Kingdom of Saudi Arabia. As part of the expansion programme for Rabigh Power Station, an additional four (or six) power generation units of 700 MW capacity each were installed.

Doosan Heavy Industries & Construction (Doosan) was awarded the engineering procurement contract (EPC) by Saudi Electricity Company (SEC) to deliver the Rabigh Power Plant No. 2. Huta Marine Works Ltd. was sub-contractor to Doosan for the marine works. The marine subcontract entails a seawater cooling system for the power plant and covers seawater intake pipes, intake basin surrounded by revetments, pumping station, outlet channel, outlet structure and breakwaters, and shore protection.

COWI provided numerical modelling and design services for the marine subcontract.

FACTS
Project period 2010-2013
Client Huta Marine Works Ltd.

SERVICES
› Hydraulic engineering and numerical modelling
› Management of physical modelling of pumping station, carried out in hydraulic lab, breakwater revetment, and outlet structure
› Geotechnical engineering
› Piping engineering for intake glass reinforced pipes
› Electrical engineering for the cathodic protection of marine works.

OLMSTED LOCKS AND DAM, IL, USA

The Olmsted Dam on the Ohio River is currently under construction 16 miles upstream from the confluence with the Mississippi River. It will consist of an 800-foot-long barrier gate section, a 1,400-foot navigable pass, two fixed abutment sections, a fixed weir section, and upstream and downstream scour protection.

COWI provided the detailed design for the new navigation dam and also construction design support of the precast yard including the mate- rings sluice for load-out of the pre-cast shell segments.

The construction design encompassed concrete and steel retaining walls, gantry crane bays, and bridge rail including beam and foundation sys- tems both above and below water, precast shell crane, shell frames, and templates, Birg- making details for the precast shell, mooring structures, and slipways.

COWI also completed the shell design for the navigable pass precast segments, paving blocks and the lifting frame for the navigable pass segments and supported the design of the barrier gates.

FACTS
Project period 2005-2020
Client U.S. Army Corps of Engineers, Louisville District

SERVICES
› Casting yards/launch system
› Dredging
› Heavy lift systems
› Detailed design of all precast and in situ cast concrete elements
› Foundation design
› Monitoring and briefing
› Seismic analysis and cost estimation.
NEW ORLEANS FLOOD PROTECTION

COWI was responsible for the detailed design of the flood barrier and the monolith foundations and guide walls, for the main sector gate structures, and a concrete swing barge gate, all of which will be used to regulate navigation, tidal flows, and storm surge into the inner harbour navigational canal (IHNC) in New Orleans.

This $1.3 billion project is the largest civil works design-build project ever awarded by the United States Army Corps of Engineers. It won the American Society of Civil Engineers’ highest design honor in 2014 and is an excellent example of innovative design and of fast-track construction.

The federally funded contract was for construction of a storm surge barrier to keep surges from entering New Orleans’ inner harbour navigational canal. Failures of floodwalls overwhelmed by storm surge during Hurricane Katrina in 2005 along the IHNC contributed greatly to the flooding of the city.

The IHNC barrier was completed by mid-2012 near the confluence of the Gulf Intracoastal Waterway and the Mississippi River Gulf outlet, a natural funnel identified as an area of critical vulnerability.

FACTS

- Project period: 2008-2012
- Client: The U.S. Army Corps of Engineers

SERVICES

- Numerical modelling
- Concept and detailed design of the main sector gate monolith, batter pile floodwall, reinforced concrete by-pass barge gate, MRGO berm structure, GIWW approach walls, and scour protection.
Since we designed our first marine project, we have actively participated in the research and development of new techniques, the use of new materials and new technologies in the field of marine structures.

Today, our teams deliver cutting-edge know-how in all aspects of marine and coastal engineering. And we continue to push the boundaries to maximise value for our clients.
DIFFERENT ASSIGNMENTS
DIFFERENT COMPETENCIES

Our extensive pool of engineers and experts enable the project manager to set up a team with the right competencies to match your project.

> STRUCTURAL DESIGN    > DREDGING DESIGN    > COST ESTIMATION    > REHABILITATION ENGINEERING    > WAVE MODELLING    > HYDRAULIC MODELLING    > SOIL STRUCTURE INTERACTION    > HYDRODYNAMIC FLOW MODELLING
> CURRENT MODELLING    > METOCEAN STUDIES    > SERVICE LIFE DESIGN    > LABORATORY TESTING    > SEISMIC ANALYSES    > FATIGUE ASSESSMENTS    > FINE ELEMENT ANALYSES    > LIFE CYCLE COSTS    > SUSTAINABLE ENGINEERING    > MECHANICAL AND ELECTRICAL INSTALLATION DESIGN    > OPERATIONAL RISK MANAGEMENT
> CONSTRUCTION RISK MANAGEMENT    > NAVIGATION SIMULATION    > MASTER PLANNING    > STRUCTURAL DYNAMICS
> SHIP COLLISION RISK    > UTILITIES    > BUILDING DESIGN    > MODEL TEST VERIFICATIONS    > SHIP IMPACT PROTECTION
> MOORING ANALYSES    > HAZID/HAZOP

THE CONSTRUCTION SPECIALIST
Our construction specialist works to secure the balance between design and construction.

THE GEOTECHNICAL EXPERT
Our geotechnical expert specifies the geotechnical site investigations, analyses the results and establishes a geotechnical design basis for the project.

THE PROJECT MANAGER
Our project manager is responsible for managing the contract with the client and for delivering the project on agreed times and budget.

THE STRUCTURAL ENGINEER
Our senior structural engineers are responsible for all basic engineering aspects of the project – drawings and verification, to secure practical buildable structures.

THE SEISMIC EXPERT
Based on information from the site, our seismic expert establishes spectra and time series to be used in the design process.

THE HYDRAULIC AND COASTAL EXPERT
Our hydraulic expert is responsible for determining how the hydrodynamic processes influence the design and functionality of any structure.
GSPC LNG TERMINAL AT MUNDRA, INDIA

The Gujarat State Petroleum Corporation (GSPC) is developing a 5 MTPA (expandable to 20 MTPA) LNG receiving, storage and regasification terminal in Mundra Port in the State of Gujarat, India.

The terminal consists of LNG carrier berthing and unloading, storage tanks, boil-off gas handling, pressurization and vaporization, and connection to the natural gas grid.

COWI provides the preconstruction and construction services including site supervision.

FACTS
Project period: 2012-2017
Client: Whessoe Projects Ltd.

SERVICES
- Front end engineering design (FEED) review
- Cost estimation
- Request for proposals
- Owner’s engineering services
- Site supervision.

AL RUWAIS PORT DEVELOPMENT, QATAR

Al Ruwais Port is located approximately 120 km north of Doha. The project comprises the development of the existing fishing port with new facilities to accommodate dhows, coastal trading vessels and passenger ferry traffic importing general cargo including fruit and vegetables, livestock and building materials.

The marine construction work includes dredging, reclamation, concrete block quay walls, fenders, navigation aids, rock revetments, utilities and port furniture, lighting, berthing and navigation aids, sea water intake and outfall.

COWI provides post-contract professional general and site supervision and quantity surveying consultancy services for construction.

FACTS
Project period: 2010-2014
Client: Public Works Authority (PWA), Ashghal

SERVICES
- Project management
- Redesign of marine works
- Quality assurance program
- As-built drawing review
- Record documentation
- Post-contract quantity surveying
- Site supervision.

OSPC LNG TERMINAL AT MUNDRA, INDIA

The Gujarat State Petroleum Corporation (GSPC) is developing a 5 MTPA (expandable to 20 MTPA) LNG receiving, storage and regasification terminal in Mundra Port in the State of Gujarat, India.

The terminal consists of LNG carrier berthing and unloading, storage tanks, boil-off gas handling, pressurization and vaporization, and connection to the natural gas grid.

The terminal is designed for handling LNG carriers of up to 285,000 m³ capacity.

COWI provides the preconstruction and construction services including site supervision.

FACTS
Project period: 2010-2017
Client: Whessoe Projects Ltd.

SERVICES
- Front end engineering design (FEED) review
- Cost estimation
- Request for proposals
- Owner’s engineering services
- Site supervision.

MARINE AND COASTAL ENGINEERING

MARINE AND COASTAL ENGINEERING
OUR EXPERTISE

Every marine project is unique. To meet this challenge, we have world-class engineers and experts working together to seamlessly integrate all aspects of marine engineering – from the marine construction itself to traffic planning, geo mapping and environmental impact assessment.

For every project, from a small coastal protection project to a major LNG terminal, we establish a specific team to ensure that we deliver the perfect solution for you.
DIFFERENT CHALLENGES
DIFFERENT EXPERTISE

We combine our expertise and competencies to deliver the optimal solution to your challenge.

CONCEPT DEVELOPMENT
- Marine structures
- Renderings and animations

IMPACT ASSESSMENT
- Environmental impact
- Hydraulic modelling
- Social impact
- Planning impact
- Cost impact

SITE INVESTIGATIONS
- Design basic development
- Geotechnical, soil and hydraulic investigations
- Operational risk and safety concepts
- Metocean conditions

DESIGN
- Marine foundations design
- Offshore wind turbine foundations
- Marine terminals
- Ports
- Offshore pipelines
- Waterfront developments
- Offshore islands
- Breakwaters
- Electrical and mechanical design of installations

PROCUREMENT
- Procurement strategies
- Tender documents
- Scheduling
- Contracting

LIFE CYCLE CONSIDERATIONS
- Operation and emergency planning
- Inspection and maintenance systems
- Life cycle cost optimisation
- Sustainability

CONSTRUCTION
- Construction management
- Site supervision

MARINE AND COASTAL ENGINEERING
THE PEARL-QATAR
The Pearl-Qatar project involved detailed design of the reclamation works for the 400 hectares new island requiring approximately 13.5 million m³ of fill and the associated sea defence structures for the 40 km of new shoreline.

The development included private beaches along most of the perimeter, which adds to the aesthetics and exclusiveness of the development. Various concepts were developed to create a variety of beach environments that are optimised to suit the local conditions and requirements.

Numerical hydrodynamic model studies were carried out to determine the metocean design basis.

COWI has, in addition to the island design, rendered technical assistance during construction and the design of the marinas.

FACTS
Project period 2003-2008
Client United Development Company (UDC)

SERVICES
- Bathymetric survey
- Design of marinas
- Design of culverts
- Design basis
- Conceptual design
- Detailed design
- Preparation of tender and contract documents.
MARINE TERMINALS

KIMC NORTH AND SOUTH FIER SURREY, KUWAIT

Ashore facilities to be developed include new containerised berths, modernised facilities, regeneration of current berth, construction of a new deep water berth, and new terminal reclaim and access channel. The terminal will be equipped with a quadrant ship loader to increase the capacity of the port.

PORT OF REDWOOD CITY, CALIFORNIA, USA

Lead a modernization project for Wharves 1 and 2. The Wharves, built in the 1930’s and 1940’s, are used to handle Panamax vessels. COWI was retained to assess the design/build team lead a modernization project for Wharves 1 and 2.

SHIP HANDLING PROCEDURES FOR SEMARANG, INDONESIA

Establishment of a safe corridor for vessels navigating into the west coast of the Java Sea. Services included: detailed design of marine facilities (blockworks, revetments) and supervision of works.

SCHOTTELAND LNG TERMINAL, CALIFORNIA

An offshore facility to be built off the coast of the United States, design includes: construction of a new access channel, new terminal reclaim, and construction of a new deep water berth. The terminal will be equipped with a quadrant ship loader to increase the capacity of the port.

MASTER PLAN FOR KAKINDA SEZ PORT, INDIA

Upgrading and adding current and future vessel operations at a port existing on the east coast of the State of Andhra Pradesh. The plan includes new berths, a new quay, and new terminal reclaim and access channel. The terminal will be equipped with a quadrant ship loader to increase the capacity of the port.

PORT OF FREDERIKSHAVN, DENMARK

The port expansion comprises 4.5 km of new outer breakwaters and dredging of more than 6 million cubic meters from the new outer breakwaters. A new 1,000 m long outer breakwater is designed for design/bid-build on a turnkey basis, includes: detailed design and tendering of the marine works contract, including: design, procurement, construction, supervision of works.

SONARTEC REFINERY MARINE TERMINAL, ANGOLA

A new terminal for a new refinery. Services included: detailed design of marine facilities (blockworks, revetments), supervision of works, and supervision of works.

BROOKLYN NAVY YARD, NY, USA

Survey of existing conditions to develop recommendations, including: detailed design of rehabilitation alternatives.

PORTS AND HARBOURS

RUNNING SULPHUR EXPANSION, UNITED ARAB EMIRATES

Marine terminal for export of granulated sulphur to be built off the coast of the United Arab Emirates with a capacity of 1,800 t/h to a total of 3,600 t/h.

MARINE AND COASTAL ENGINEERING

47
## AL AIN BREAKWATER, UNITED ARAB EMIRATES

New port development with 8 km rubble mound breakwater.

<table>
<thead>
<tr>
<th>SERVICES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Detailed design of breakwater and staging pier.</td>
<td>- Foundation design including stability, soil improvement, and settlement analysis and need for soil improvement.</td>
</tr>
<tr>
<td>- Met-ocean and morphological studies.</td>
<td>- Studies for alternative foundation solutions, including piles, monopiles, and gravity based structures.</td>
</tr>
<tr>
<td>- Data collection and review.</td>
<td>- Detailed design of foundations.</td>
</tr>
</tbody>
</table>

## THE PEARL MARIAS, QATAR

Three large marinas with floating pontoons systems and 60 metres in length.

<table>
<thead>
<tr>
<th>SERVICES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Technical specifications.</td>
<td>- Geotechnical and meteorological services.</td>
</tr>
<tr>
<td>- M&amp;E design including fuel berths.</td>
<td>- Geotechnical and structural investigations.</td>
</tr>
<tr>
<td>- Marine transport feasibility study.</td>
<td>- Detailed design of the foundations.</td>
</tr>
<tr>
<td>- Basic design of three marinas including a super yacht area.</td>
<td>- Detailed design of Nysted and Rødsand 1 and 2 offshore wind farms located in the Baltic Sea just south of Denmark. 90, 2.3 MW, and 200 MW platforms in operations respectively.</td>
</tr>
</tbody>
</table>

## STORM DAMAGE ASSESSMENT AND REPAIR, DENMARK

The storm black in December 2013 caused vast and very high water levels, Consent waters and caused much material damage. It gave rise to many different adaptive activities.

<table>
<thead>
<tr>
<th>SERVICES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Preliminary and detailed design of coastal structures following damage by the storm black.</td>
<td>- Design of coastal structures.</td>
</tr>
<tr>
<td>- Geotechnical assessment report.</td>
<td>- Structural and geotechnical design for foundations.</td>
</tr>
<tr>
<td>- Field surveys.</td>
<td>- Hydraulic calculations.</td>
</tr>
</tbody>
</table>

## PRE-INVESTIGATIONS AT SIX NEARSHORE WIND FARM SITES, DENMARK

Pre-investigations are part of the process towards the tendering of the operation and maintenance of the owned offshore wind farm.

<table>
<thead>
<tr>
<th>SERVICES</th>
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</tr>
</thead>
<tbody>
<tr>
<td>- Met-ocean study report for the OWF App.</td>
<td>- Environmental permits for the OWF App.</td>
</tr>
<tr>
<td>- Background reports to the EIA concession bidding process.</td>
<td>- Structural design of foundations.</td>
</tr>
<tr>
<td>- Geotechnical and oceanographic studies.</td>
<td>- Geotechnical and structural investigations.</td>
</tr>
</tbody>
</table>

## THORNTON BANK OFFSHORE WIND FARM - PHASE 1, BELGIUM

An offshore wind farm in East Asia on the western coast of Taiwan, consisting of 72 turbines in total.

<table>
<thead>
<tr>
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<tr>
<td>- Detailed design of the foundations.</td>
<td>- Foundation design for eight 2 MW MHI turbine platforms.</td>
</tr>
<tr>
<td></td>
<td>- Detailed design of Nysted and Rødsand 1 and 2 offshore wind farms located in the Baltic Sea just south of Denmark. 90, 2.3 MW, and 200 MW platforms in operations respectively.</td>
</tr>
</tbody>
</table>

## DANYSK OFFSHORE WIND FARM, GERMANY

The Offshore Wind Farm in East Asia on the western coast of Taiwan, consisting of 72 turbines in total.

<table>
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</table>

## FORMOSA 1 OFFSHORE WIND FARM/CONRAKLINDT, CHINA

An offshore wind farm in East Asia on the western coast of Taiwan, consisting of 72 turbines in total.

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## RØDSAND 1 AND 2 GRAVITY BASED FOUNDATIONS, DENMARK

Detailed design of Nysted and Rødsand 1 and 2 offshore wind farms located in the Baltic Sea just south of Denmark. 90, 2.3 MW, and 200 MW platforms in operations respectively.

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## DENMARK MARINE AND COASTAL ENGINEERING AND WATERFRONT DEVELOPMENTS

- Design of breakwater and staging pier.
- Foundation design including stability, soil improvement, and settlement analysis and need for soil improvement.
- Met-ocean and morphological studies.
- Data collection and review.
- Design and permitting of coastal protection.
- Inspection.

## QATAR DEVELOPMENTS

- Preparation of tender documents.
- Technical specifications.
- M&E design including fuel berths.
- Marine transport feasibility study.
- Basic design of three marinas including a super yacht area.

## UNITED ARAB EMIRATES DEVELOPMENTS

- Preparation of tender documents.
- Reclamation works design.
- Preliminary and detailed design of coastal structures.
- Geotechnical assessment report.
- Structural and geotechnical design for foundations.
- Hydraulic calculations.

## UNITED DEVELOPMENT COMPANY (UDC) DEVELOPMENTS

- Preparation of tender documents.
- Technical specifications.
- M&E design including fuel berths.
- Marine transport feasibility study.
- Basic design of three marinas including a super yacht area.
COOLING WATER SYSTEMS

SERVICES:
- Designed the structures for cooling water.
- Located 100 km south of the Port of Dammam.
- COWI combined cycle power plant located 100 km south of the Port of Dammam.

QURAYYAH COMBINED CYCLE POWER PLANT, SAUDI ARABIA

- POWER PLANT, SAUDI ARABIA

- Project period: 2010-2012

- Client: Huta Marine Works Ltd.

- Structural design of roads.
- Geotechnical design
- Design of shore protection
- Design of outfall channel and end weir
- Design of intake pipes and intake basin
- Hydraulic design and hydraulic modelling
- Wave modelling
- Smart plant design (3D modelling).
- Piping design
- Mechanical design
- Hydraulic studies and design
- Geotechnical design
- Structural design
- Marine and coastal design
- Detailed design
- Precast concrete construction
- Construction sequencing and scheduling
- Construction engineering.

FOLGON DAM SILLWY
CA, USA

- Design of new spillway and new intake structures to avoid head losses.
- Taking advantage of the river's capacity.
- Design of new river wall and appurtenant works.

CHARRFORD LOCKS AND DAM - LOCK 14, PA, USA

- Design of a lock and dam.
- Lock and dam
- Construction engineering.

BRACORD LOCK DAM 2, MISSION RIVER, BRADENT, PA, USA

- RDW was retained by the USACE to design the lock and dam.
- Design included navigation structures.
- Construction engineering.

MARINE AND COASTAL ENGINEERING
Together with our customers, we create coherence in tomorrow’s sustainable societies through our unique 360° approach.

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