

MAJOR UNDER WATER CROSSINGS



COWI



CROSSING WIDE WATERS

Urbanisation and the demands of modern society are posing significant challenges for infrastructure in cities across the globe. While much of this development is being built upwards, many features are being driven underground. COWI is a world leader in connecting underground spaces and in driving innovation in congested underground environments.

Working closely with clients, we employ knowledge and expertise gained from years of hands-on experience in design and construction to develop optimal tunnel and underground solutions for even the most complex projects.

Whether you need a total engineering solution or professional advice on a specific problem, we offer a comprehensive set of competencies to tunnel owners and contractors at every phase of a tunnel's lifecycle from early concepts to operations, through to rehabilitation or decommissioning.

COWI. Your experienced partner in tunnels.



A SUSTAINABLE SOLUTION

Road and rail crossings connect regions, countries and cities. Crossings bring people together and improves local and regional economy. Crossing projects always consider among others health & safety, biodiversity, innovation, social and environmental impact of the crossing.

Crossings are made in the sea, across bays/fjords, between mainland and island, across wide rivers or along a waterfront of a major city forming part of an orbital road etc. The configuration of the route alignment of a crossing are many.

When considering an underwater crossing, it is often considered as an alternative to a bridge. Perhaps the route alignment is next to an urban development, where noise and pollution would make a road above difficult to accept socially or politically or passing through a protected habitat for threatened species. An underwater tunnel could also be selected to maintain the amenity of a place and or a place of natural beauty

e.g. by minimizing the disturbance of the landscape. It could also be the underwater crossing is located close to an airport, thereby the risk of plane collisions would prevent construction of a long span bridge.

Many considerations around route alignment and types of crossing (bridge, immersed tunnel, bored tunnel or conventional tunnel) are almost without exception linked to a project's objective on sustainability.

The United Nations Sustainable Development Goals are very useful to identify the selection criteria for a route alignment associated method of construction (bridge or tunnel). It is for each crossing owner to decide what sustainability objective to consider.

The Design Life for Crossings are 100-150 years, and it is therefore important to include durability and provisions for future technology, whatever that may bring. Future proofing is thinking about sustainable designs.

BUSAN GEOJE FIXED LINK: ONE OF THE WORLD'S DEEPEST AND LONGEST IMMERSED TUNNELS

The Busan-Geoje Fixed Link connects the island of Geoje with the large city of Busan in the southern part of South Korea, improving access from the city to the industrial and recreational areas on the Island. Two of the world's largest shipyards are located on Geoje Island. The link is an important connection for motorists, reducing travel time from three hours to under one hour.

The link comprises three major elements: one of the world's deepest and longest immersed tunnels and two long-span cable-stayed bridges.

The total length of the immersed tunnel is around 3,5 kilometres, with two 170 metre long cut and cover sections at both ends. Designed to withstand typhoons with wave heights of 15 metres, not only was it the first major immersed tunnel in Korea.

FACTS

LOCATION: Korea
PERIOD: 2003–2011
CLIENT: Daewoo Engineering & Construction Co. Ltd.

COWI SERVICES: IMMERSED TUNNEL

- › Basic design
- › Detailed Design of permanent structures and foundations
- › Detailed Design of scour protection and marine works
- › Detailed Design of mechanical and electrical works
- › Detailed Design of temporary works
- › Technical follow-up during construction.

CABLE STAY BRIDGES

- › Basic Design
- › Detailed Design
- › Technical follow-up during construction.

CONNECTING THE PEARL RIVER DELTA

HONG KONG ZHUHAI MACAO

The Pearl River Delta is one of the most densely populated areas in China. Its rapid growth has created a need for better infrastructure between the delta cities: Hong Kong, Shenzhen, Guangzhou, Zhongshan, Zhuhai and Macao. This new infrastructure will create a megacity with more than 50 million people.

The 50 kilometre Hong Kong–Zhuhai–Macao Fixed Link consists of several bridges, two artificial islands and six kilometres of immersed tunnel.

The tunnel section is the world's longest immersed tunnel for road traffic, comprising two bores with three lanes of traffic in each direction. 33 tunnel elements were built and installed – each one measuring up to 180 m x 38 m x 11 m and weighing 72,000 tons. The tunnel elements were designed with the concrete structure providing water-tightness, similar to other long immersed tunnels such as the Øresund tunnel connecting Denmark and Sweden and the Busan Geoje tunnel in South Korea.

FACTS

LOCATION: Hong Kong
PERIOD: 2010–2018
CLIENT: Joint Venture lead by
CCCC (China Communication
Construction Company)

COWI SERVICES:

- › Conceptual design
- › Preliminary design
- › Technical assistance before tender
- › Tender design
- › Inspection of soil investigation

EASING CONGESTION ON THE DARTFORD CROSSING

LOWER THAMES CROSSING, UNITED KINGDOM

The Lower Thames Crossing (LTC) will be a bored tunnel under the River Thames east of Gravesend and Tilbury. The new crossing will ease congestion on the Dartford Crossing which handles around 55 million journeys every year - six million more than it was designed for – and suffers frequent closures.

The crossing will also provide more than 70% additional road capacity across the river, unlocking major investments and the creation of new jobs.

LTC consists of 23 kilometres of 3 lane roads connected to the strategic road network north and south of the river, junctions, construction or replacement of 50 bridges and structures and a 4 kilometre twin-bored tunnel. The crossing is a bored tunnel due to the proximity of an environmentally sensitive area and to protect the existing landscape around the river.

FACTS

Location: London, UK
Year: 2016 – Ongoing
Client: Highways England
ARCHITECT: Fereday-Pollard

COWI'S SERVICES:

- › Technical partner providing preferred route design and assessment
- › Preliminary design for approval
- › Reference design for procurement
- › Fire & Life Safety
- › Bored tunnel requirements
- › Tunnel Operation and Construction advice
- › Technical management

THE LONGEST AND DEEPEST SUBSEA ROAD TUNNEL EVER PLANNED

ROGFAST

Rogfast will be the world's longest and deepest sub-sea road-tunnel. It will also be the deepest sub-sea road-tunnel in the world. When Rogfast is completed, the journey time between Stavanger and Bergen will be reduced by approximately 40 minutes. At the same time, it will facilitate an expansion in the housing and labor markets in the region, which will strengthen important business clusters.

The Rogfast tunnel in Norway will consist of two dual-lane tunnels under the Boknafjord, north of Stavanger, the hub of the country's oil industry. The project will shave 40 minutes off the journey on one of Norway's busiest roads.

FACTS

LOCATION: Stavanger, Norway
PERIOD: 2016–2024
(construction period)
CLIENT: The Norwegian Public
Roads Administration

COWI SERVICES:

- › Preparation of conceptual design as basis for municipal plans
- › Overall responsibility for tunnel
- › Tunnel design and construction including geological assessment
- › Tunnel installations, operational safety in tunnels
- › Roads in tunnels and visualisation and video presentation

TYING A NATION TOGETHER

GREAT BELT TUNNEL

In June 1997, the first passenger train rolled through the tunnel under the Great Belt, and the bridge for car traffic opened the following year, in 1998.

The Great Belt connection is one of the world's largest bridge and tunnel constructions, and the connection has had a tremendous impact on the millions of Danes who use it.

The railway tunnel is one out of the three major components in the USD 3.5 billion Great Belt Link. The project includes two 7,410 m long main tunnel bores with cross passages each 250 m, cut and cover tunnel sections at each end terminated by portals, and permanently drained ramps.

The internal diameter of the main tube and the cross passages are 7.7 m and 4.5 m, respectively. At the deepest point, the rails are 75 m below sea level.

FACTS

LOCATION: Denmark

PERIOD: 1987–1997

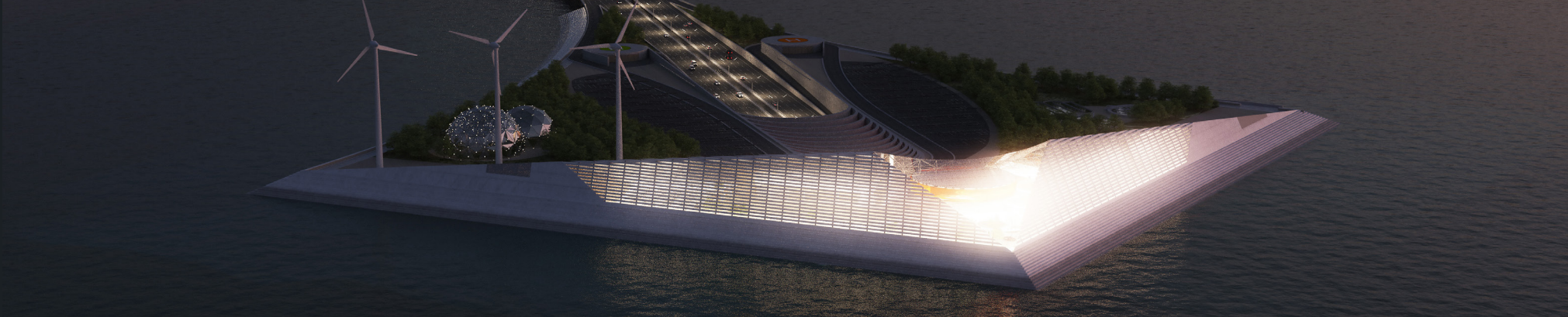
CLIENT: A/S Storebæltsforbindelsen
(Great Belt A.S.)

COWI SERVICES:

TENDER DESIGN

- › Tender evaluation
- › Detailed design, site supervision, and design of mechanical installations as leading partner in joint venture with Mott MacDonald Ltd.

COWI PROJECTS – UNDER WATER CROSSINGS PROJECTS



LIMERICK IMMERSED TUNNEL

LOCATION: Ireland

PERIOD: 1999–2010

CLIENT: Limerick County Council, Limerick Corporation, Clare Council and National Roads Authorit

SERVICES

- › Feasibility study
- › Risk assessments analyses
- › Geotechnical investigations
- › Preliminary design
- › Tender documents including requirements for design, construction and O&M
- › Tender evaluation
- › Review of the preliminary design, detailed design and method statements
- › Monitoring and advice regarding the project in general
- › Study concerning restrictions to routing af hazardous goods through the tunnel, applying the OECD/PIARC risk model.

FEHMARNBELT TUNNEL

LOCATION: Denmark/Germany

PERIOD: 2013–ongoing

CLIENT: Femern Link Contractors (FLC), Joint Venture of Vinci Construction Grands Projets, Aarsleff, Wayss & Freytag, Max Bögl, CFE, Solétance-Bachy/BAM Infra

SERVICES

- › Tender design
- › Detailed design.

MARIEHOLM IMMERSED TUNNEL

LOCATION: Sweden

PERIOD: 2009–2016

CLIENT: The Swedish Road Administration

SERVICES

- › Conceptual design and designer’s production planning
- › Preliminary design
- › Tender documents
- › Risk assessments
- › Tender evaluation
- › Construction follow-up.

BOSPORUS TUBE CROSSING

LOCATION: Turkey

PERIOD: 2003

CLIENT: HPYG JV: Hazama (J), Penta-Ocean (J) Yüksel (TÜR) and Güris (TÜR).

SERVICES

- › Tender design programme management
- › Managing, coordinating and editing the tender design
- › Expert review of tender design.

ØRESUND TUNNEL

LOCATION: Denmark/Sweden

PERIOD: 1994–1996

CLIENT: Sund Link Contractors

SERVICES

- › Planning and technical studies
- › Foundation and structural engineering
- › Mechanical and electrical design
- › Assessment and construction methods.

SÖDERSTRÖM IMMERSED TUNNEL

LOCATION: Sweden

PERIOD: 2006–2014

CLIENT: JVS Söderströmstunneln HB

SERVICES

- › Tender design
- › Basic design
- › Detailed design
- › Construction follow up.

SHENZHONG FIXED LINK

LOCATION: China

PERIOD: 2016–2017

CLIENT: The Administration Center of the Shenzhong Link Project

SERVICES

- › Concept Design for the International Design Competition
- › Development of the winning concept into Preliminary Design
- › Technical consultancy during development of Overall Design, Preliminary Design, Technical Design and Detailed Design.

MARACAIBO 2ND FIXED LINK PROJECT

LOCATION: Venezuela

PERIOD: 2006–2010

CLIENT: HPYG JV: Hazama (J), Penta-Ocean (J) Yüksel (TÜR) and Güris (TÜR).

SERVICES

- › Conceptual design studies
- › Design basis, safety concept and risk analyses
- › Concrete durability and mix design investigations
- › Basic design of permanent tunnel, bridge and island structures
- › Basic design of mechanical and electrical installations
- › Basic design of tunnel element casting basin and temporary installations
- › Supervision of ground investigations and interpretation of results
- › Environmental impact assessment (EIA).

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POWERING YOUR 360° SOLUTIONS

COWI is a leading consulting group that creates value for customers, people and society through our 360° approach. We tackle challenges from many vantage points to create coherent solutions for our customers.