BRIDGES

COWI

BRIDGE, TUNNEL AND MARINE STRUCTURES

INDUSTRY AND ENERGY

360

POWERING YOUR SOLUTIONS

GEOGRAPHICAL INFORMATION AND IT

RAILWAYS, ROADS AND AIRPORTS

ECONOMICS, MANAGEMENT AND PLANNING

BUILDINGS

WATER AND ENVIRONMENT

GREAT BELT LINK, EAST BRIDGE, DENMARK

The East Bridge spans the international navigation route between the Baltic and the North Sea. It is one of the longest suspension bridges in the world and a component in the Great Belt Link that links Eastern and Western Denmark.

FACTS

Main span	1,624 m
Total length	6,790 m
Project period	1986-1998
Client	A/S Storebæltsforbindelsen

SERVICES

- Conceptual design
- Tender design
- Detailed design
- General supervision
- Operation and maintenance

Photo: Claus Koruth

STONECUTTERS BRIDGE, HONG KONG

Stonecutters Bridge spans the entrance to one of the world's busiest ports, the Kwai Chung Container Terminal. It is one of the longest cable-stayed bridges in the world, linking Hong Kong International Airport and the Kowloon peninsula.

FACTS

Main span	1,018 m
Total length	1,596 m
Project period	1999-2010
Client	Highways Department, Hong Kong

SERVICES

Feasibility study of cable-stayed bridge
Detailed design of main cable-stayed span and towers

MESSINA STRAIT BRIDGE, ITALY

As the world's longest suspension bridge, the Messina Strait Bridge is the realization of an idea that dates back to Roman times. It connects Sicily and Calabria, creating favourable conditions for economic regeneration of the region.

FACTS

Main span	3,300 m
Total length	3,666 m
Project period	2003-2011
Client	Eurolink, Italy

SERVICES

Bid design
Final design

By courtesy of ATI Impregilo S.p.A.

AT ANY GIVEN TIME, WE ARE INVOLVED IN MORE THAN 200 BRIDGE PROJECTS WORLDWIDE

WORLDWIDE REACH

In COWI, we take pride in our achievements. For more than 80 years, we have been at the forefront of bridge engineering, setting the standard for tomorrow's best practices. Together with our clients, we have been involved in more than 3,000 bridges all over the world – from South America to the far corners of Russia.

WEST GATE BRIDGE, AUSTRALIA

The West Gate Bridge is an iconic and notorious cable-stayed bridge in Melbourne that spans the Yarra River. Increased traffic has pushed the landmark structure to its limits and in need of upgrading to five lanes in each direction.

FACTS

Main span	336 m
Total length	2,582 m
Project period	2008-2011
Client	VicRoads

SERVICES

- Structural assessment
- Design of strengthening works
- Supervision of works

Photo: Christian Pearson, Melvaig

BUSAN-GEOJE FIXED LINK, KOREA

The Busan-Geoje Fixed Link is a major achievement that brought state-of-the-art bridge engineering to the Korean market. The two cable stayed bridges and immersed tunnel reduce travel time between Busan and the island of Geoje with two hours.

FACTS

Main spans	475 m and 2 x 230 m
Total length	8,200 m
Project period	2003-2010
Client	Daewoo E&C

SERVICES

- Basic design
- Detailed design
- Technical follow-up

LIONS' GATE BRIDGE, BRITISH COLUMBIA, CANADA

The Lions' Gate Bridge marks the entrance to Vancouver's harbour, spanning the First Narrows of Burrard Inlet. As one of two crossings between Vancouver and the communities to the north, it is of vital importance to the local economy.

FACTS

Main span	472 m
Total length	1,517 m
Project period	1972-2002
Client	BC Ministry of Transportation

SERVICES

Owners engineer
Detailed design of replacement of suspended deck
Design of ship impact protection

OUR SERVICES

With our services, we cover the entire project life cycle of a bridge from early ideas to the operation 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.

Photo: ©Arup

DIFFERENT PHASES
DIFFERENT SERVICES

Agility and expertise is the key to efficient bridge 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.

PROJECT IMPLEMENTATION
We provide policy planning, advice and management consulting in relation to project decision and project implementation.

FEASIBILITY STUDIES
We have all the competencies to carry out feasibility studies – also for fixed links. And we take into account technical, environmental, social and economic aspects to establish the basis for the right decisions.

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

INDEPENDENT DESIGN CHECK AND VALUE ENGINEERING
We provide assistance to clients of complex bridge 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 bridge. We handle erection schemes, logistics, temporary structures as well as the erection engineering itself.

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

SITE SUPERVISION
We handle all disciplines relating to preconstruction and construction, project completion and subsequent defects liabily phase. And we deliver full documentation of the quality of the project.

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 rehabilitations at existing structure for increased capacity and for replacement of key structural elements.

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.

IZMIT BAY BRIDGE, TURKEY

The Izmit Bay Bridge is located in one of most seismically active areas in the world. It is located 50 km south of Istanbul, and crosses the Sea of Marmara with one of the longest spanning suspension bridges in the world.

FACTS

Main span	1,550 m
Total length	2,682 m
Project period	2010-2015
Client	IHI, Japan

SERVICES

- Bid design
- Detailed design
- Technical follow-up

ÅRSTA BRIDGE, SWEDEN

Stockholm's Årsta Bridge sweeps across Årstaviken Bay, complementing the existing 1929 bridge. At the same time, it significantly increases rail capacity with minimal impact on the surrounding landscape.

FACTS

Total length	815 m
Project period	1994-2004
Client	Banverket, Stockholm

SERVICES

- Structural evaluations
- Tender design
- Detailed design
- Technical follow-up
- Operation and maintenance

OUR TEAMS

Since we designed our first bridge in 1938, COWI has actively participated in the research and development of new techniques, the use of new materials and new technologies in the field of bridge engineering.

Today, our teams deliver cutting-edge know how within all aspects of bridge 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 a team with the right competencies to match your project.

> IBDAS > HYDRAULIC MODELLING > SOIL STRUCTURE INTERACTION > CFD ANALYSES
> AERODYNAMICS > MAPPING > STAY CABLE VIBRATIONS > SERVICE LIFE DESIGN
> MATERIAL TECHNOLOGY > SEISMIC ANALYSES > FATIGUE ASSESSMENTS
> NON-LINEAR TIME-HISTORY ANALYSIS > LIFE CYCLE COSTS > SUSTAINABLE ENGINEERING
> CABLE TECHNOLOGY > TUNED MASS DAMPERS > OPERATIONAL RISK MANAGEMENT
> CONSTRUCTION RISK MANAGEMENT > DEHUMIDIFICATION SYSTEMS > CONSTRUCTION STAGE ANALYSIS > STRUCTURAL DYNAMICS > SHIP COLLISION RISK > STRUCTURAL MONITORING
> RELIABILITY CENTRED MAINTENANCE > COMFORT ANALYSES > MODEL TEST VERIFICATIONS
> SHIP IMPACT PROTECTION > CATHODIC PROTECTION > LANDSCAPING

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

THE RISK EXPERT
Our risk expert is responsible for all risk aspects – including hazard analysis and operational risk analysis.

THE GEOTECHNICAL EXPERT
Our geotechnical expert will specify the geotechnical site investigations, analyse the results and establish a geotechnical design basis for the project.

THE WIND SPECIALIST
Our wind expert liaise with the wind tunnel facility and is responsible for analysing the aerodynamic stability and mitigating vibration of the bridge.

THE PROJECT MANAGER
Our project manager is responsible for managing the contract towards the client and to deliver the project on agread time and budget.

THE SENIOR BRIDGE ENGINEERS
Our senior bridge engineers are responsible for all basic engineering aspects of the project – drawings and verification and to secure practical buildable structures.

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

THE DURABILITY EXPERT
Our durability expert is responsible for the requirements to the concrete that secures the durability of the structure.

HÅLOGALAND BRIDGE, NORWAY

The slender Hålogaland Bridge crosses the Rombaks Fjord in the harsh environment of Northern Norway. As part of the European route E6, the bridge shortens the north-south highway in the country and opens up new development land.

FACTS

Main span	1,120 m
Total length	1,534 m
Project period	2007-
Client	Norwegian Public Roads Administration

SERVICES

- Basic design
- Detailed design
- Tender documents
- Technical follow-up

DISSING+WEITLING

CONSTANTINE VIADUCT, ALGERIA

The Constantine Viaduct is the first cable-stayed bridge in the 'City of Bridges', as the Algerian city is known. The bridge spans the deep gorge above the river Rhummel to connect the ONU area and the Mansourah plateau.

FACTS

Main span	259 m
Total length	750 m
Project period	2008-2013
Client	Andrade Gutierrez S.A.

SERVICES

- Bid design
- Detailed design
- Construction engineering
- Technical follow-up

Photo: Nicky Bonne

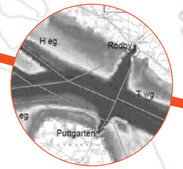
OUR EXPERTISES

Every bridge project is unique. To meet the challenge, we have 600 world-class engineers and experts working together to create a seamless integration of all aspects of bridge engineering – from the bridge itself to traffic planning, geo mapping and environmental impact assessment.

And for every project from a small bridge to a major fixed link, we set 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. Take a fixed link, for example. It is a major undertaking that spans the best of our range of expertise.



SITE INVESTIGATIONS
- Design basis development
- Traffic studies
- Geological, wind and hydraulic investigations
- Operational risk and safety concepts

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

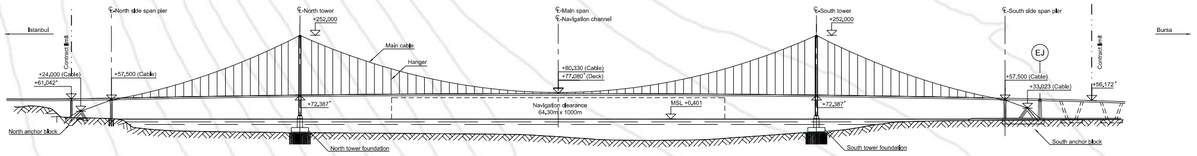
CONCEPT DEVELOPMENT
- Alignment
- Bridge components
- Tunnel components
- Embankments
- Marine structures
- Renderings and animations

DESIGN
- Marine foundation design
- Main navigation bridge design
- Approach bridge / viaduct bridge design
- Traffic management systems
- Toll collection stations
- Electrical and mechanical design

PROCUREMENT
- Procurement strategies
- Tender documents
- Scheduling
- Contracting

LIFE CYCLE CONSIDERATIONS
- Operation and emergency planning
- Inspection and maintenance systems
- Lice cycle cost optimization
- Sustainability

IMPLEMENTATION
- Construction management
- Site supervision



ØRESUND BRIDGE, SWEDEN – DENMARK

The Øresund Bridge is one of the world's longest cable-stayed bridge for combined motorway and railway traffic. It spans the international navigation route between Sweden and Denmark, a critical component for the high-growth Øresund Region.

FACTS

Main span	490 m
Total length	7,844 m
Project period	1994-2000
Client	Sundlink HB

SERVICES

- Bid design
- Basic design
- Detailed design
- Endorsement of construction works
- Operation and maintenance

Photo: Claus Knuth

MADE BY COWI

XIHOUMEN BRIDGE, PR CHINA

Total length: 2,228 m
Main span: 1,650 m
Completed: 2009
Client: Zhoushan Mainland Link

SERVICES: Specialist assistance including aerodynamic analysis.

JOHN JAMES AUDUBON BRIDGE, LOUISIANA, USA

Total length: 975 m
Main span: 482 m
Completed: 2011
Client: Parsons Transportation Group

SERVICES: Bid design and detailed design of the cable-stayed portion of the bridge with the exception of its foundations (Buckland & Taylor).

SURAMADU BRIDGE, INDONESIA

Total length: 5,000 m
Main span: 434 m
Completed: 2009
Client: P.T. Virama Karya

SERVICES: Independent design check and consultancy for cable-stayed bridge and approach bridges. Construction supervision service.

2ND INCHEON SHIP IMPACT PROTECTION, KOREA

Total length: 12,343 m
Main span: 800 m
Completed: 2009
Client: Samsung Corporation

SERVICES: Preliminary design for developer (Buckland & Taylor). Basic and detailed design of ship Impact protection structures (COWI).

LUSAIL MARINE BRIDGES, QATAR

Total length: 204 m
Main span: 129 m
Completed: 2014
Client: Qatari Diar Real Estate Investment Company

SERVICES: Basic and detailed design of marine bridges and geotechnical investigations. Supervision of marine works.

SUNGAI JOHOR, MALAYSIA

Total length: 1,708 m
Main span: 500 m
Completed: 2011
Client: Ranhill Bersekutu Sdn. Bhd.

SERVICES: Concept design, basic and detailed design of superstructure incl. pylons and bearings, construction engineering and construction follow-up.

AQUITAINE BRIDGE, FRANCE

Total length: 1,767 m
Main span: 400 m
Completed: 2003
Client: Direction Départementale de l'Equipment (DDE) de la Gironde, Bordeaux

SERVICES: Tender design for replacement of main cables, tender evaluation and technical supervision during the construction.

PONT DE NORMANDIE, FRANCE

The construction of the Normandy Bridge marked a gigantic step forward in terms of span length for cable stayed bridges. With a main span of 856 m it surpassed the world record by more than 60%.

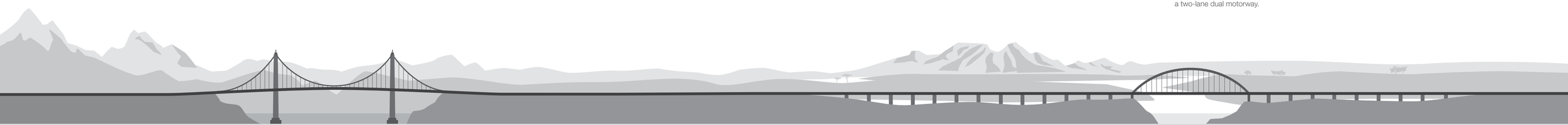
The Normandy Bridge held the world record cable stayed span for 4 years.

Situated about 15 km east of Le Havre, the bridge crosses the river Seine and when inaugurated in 1995 allowed for a needed relief of the Tancarville suspension bridge from 1959.

With an effective width of 19.7 m the bridge carries a two-lane dual motorway.

Total length: 2,000 m
Main span: 856 m
Completed: 1995
Client: Monberg & Thorsen A/S

SERVICES: Review of tender design, general studies and detailed design of main span, girder and cables.



MADE BY COWI

HARILAOS TRIKOUPIS (RION ANTIRION) BRIDGE, GREECE

Total length: 2,860 m
Main span: 3 x 560 m
Completed: 2004
Client: Gefyra S.A.

SERVICES: Independent design check (Buckland & Taylor).

GOLDEN EARS BRIDGE, CANADA

Total length: 968 m
Main span: 242 m
Completed: 2009
Client: Golden Crossing Group

SERVICES: Conceptual, priliminary and detailed design of the extra closed main bridge and approaches and provided erection engineering for the construction of this design/build/finance/operate/maintain bridge (Buckland & Taylor).

SHEIKH ZAYED BRIDGE, ABU DHABI, UNITED ARAB EMIRATES

Total length: 842 m
Main span: 234 m
Completed: 2005
Client: Works Department, Emirate of Abu Dhabi

SERVICES: Independent design check (COWI). Erection engineering for Archirodon (Buckland & Taylor).

DANUBE CLEARANCE PROJECT, YUGOSLAVIA

COWI's assignment involved removing the remains of 3 large cable-supported bridges across the Danube river, which were destroyed when NATO bombed Yugoslavia in 1999.

Completed: 2005
Client: EU commission

SERVICES: Planning, project engineering, preparation of tender document, tendering, contract management, supervision and preparation of final documentation after completion of the project.

ANGUS L. MACDONALD BRIDGE, CANADA

Total length: 762 m
Main span: 441 m
Completed: 1955, 1996-2010
Client: Halifax Harbour Bridges

SERVICES: Review of the bridge, design of the replacement of the entire suspended structure (deck and hangers) during night-time closures (Buckland & Taylor).

SECOND BRIDGE ACROSS THE PANAMA CANAL

Total length: 1,050 m
Main span: 420 m
Vertical clearance: 80 m
Completed: 2004
Client: Ministry of Public works (MOP), Panama

SERVICES: Independent design check. Project management and site supervision.

WILLIAM R. BENNETT BRIDGE, CANADA

Total length: 1,060 m
Floating bridge section: 690 m
Completed: 2000
Client: Okanagan Lake Consession Partnership

SERVICES: Structural design for the entire crossing including the floating bridge and the associated engineering services during construction including field reviews (Buckland & Taylor).

CHACAO BRIDGE, CHILE

Total length: 2,634 m
Main span: 1,055 m + 1,100 m
Project Period: 1999-2001
Client: Ministerio de Obras Públicas
Designer: COWI – ICUATRO Joint Venture

SERVICES: Feasibility study and scheme design, preparation of design basis, preparation of tender documents for double span suspension bridge. From 2005 to 2007 COWI developed the design for the concessionaire (CPC).

SUTONG BRIDGE, JIANGSU PROVINCE, PR CHINA

The SuTong Bridge is a major crossing of the Yangtze River in Jiangsu Province north of Shanghai. It carries a six lane highway with emergency lanes. The main bridge is a cable stayed bridge with a world record breaking main span of 1,088 m.

The cable stayed bridge has more than 300 m high inverted Y-shaped concrete towers, while the superstructure is formed as a closed steel box girder. Foundations for the towers and the side span piers are cast in-situ bored piles.

Total length: 6,000 m
Main span: 1,088 m
Project period: 2003-2007
Client: Jiangsu Province Sutong Bridge Construction Commanding Department

SERVICES: Design assistance and design review of cable-stayed bridge and special fairway bridge, design of scour protection, aerodynamic investigations, consultancy during construction.

MADE BY COWI

TSING MA BRIDGE, HONG KONG

Total length: 2,088 km
Main span: 1,377 m
Completed: 1981, 1990, 1992-2997
Client: Highways Department Hong Kong

SERVICES: Independent design check, construction engineering, development of WASHMS and specialist advice (Flint & Neill).

NAINI BRIDGE, INDIA

Total length: 1,600 m
Main span: 260 m
Completed: 2004
Client: The Ministry of Surface Transport (MOST), India and National Highways Authority of India (NHAI)

SERVICES: Feasibility study, detailed design, tender documents and construction supervision.

NELSON MANDELA BRIDGE, SOUTH AFRICA

Total length: 284 m
Main span: 176 m
Completed: 2003
Client: SANRAL (South African National Roads Agency Limited, department of transport)

SERVICES: Conceptual design, tender design, tender assistance, detailed design, technical assistance during construction.

ZÁRATE-BRAZO LARGO BRIDGES, ARGENTINA

Total length: 15,000 m
Main span: 330 m
Completed: 1977
Client: Dirección Nacional de Vialidad, Argentina

SERVICES: Inspection, testing and rehabilitation design.

QATAR – BAHRAIN CAUSEWAY

Total length: 42,000 m
Main spans: 250 m
Client: Ministry of Municipal Affairs and Agriculture, Qatar

SERVICES: Preliminary environmental and engineering investigations, incl. site investigations. Subsequent development of basic design for contractor for the 42 km long fixed link for road and railway.

GIBRALTAR STRAIT CROSSING, SPAIN – MOROCCO

Total length: 14 - 27 km
Main spans: 2 x 5,000 m or 3 x 3,500 m
Client: SECEGSA, Madrid, Spain and Société Nationale d'Etudes du Détroit, Rabat, Morocco

SERVICES: Pier concepts, ship protection systems, superstructure designs and preliminary design.

FEHMARN BELT, DENMARK – GERMANY

Total length: 20 km
Main span: 724 m
Client: Danish and German Traffic Ministries

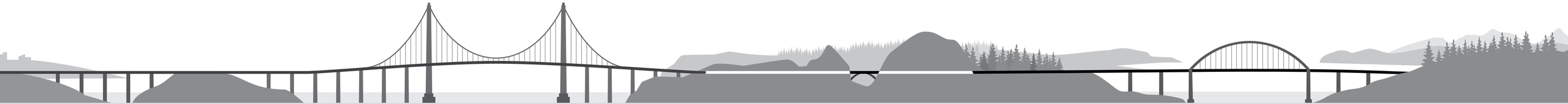
SERVICES: Feasibility study, concept design for the bridge solution. The services included comprehensive risk studies, cost estimation, input to plan approval documents and scheduling.

HÖGA KUSTEN BRIDGE (HIGH COAST BRIDGE), SWEDEN

The Höga Kusten Bridge carries European Interstate Highway E4 and crosses the river Ångermanälven about 500 km north of Stockholm. With a main span of 1,210 m it is one of the largest suspension bridges in Europe. The overall length is 1,800 m. The bridge is designed to carry a dual-lane highway, although the width will make it possible for it to carry four lanes in the future.

Total length: 1,800 m
Main span: 1,210 m
Project period: 1991-1997
Client: The Swedish National Road Administration through Kjessler & Mannerstråle

SERVICES: Tender design, detailed design, technical follow-up during construction, dehumidification of main cables and operation and maintenance services.



MADE BY COWI

PUENTE NIGALE, VENEZUELA

Total length: 11 km
Main span: 460 m
Project period: 2010 - ongoing
Client: Odebrecht

SERVICES: Basic and detailed design of 11 km long fixed link for road and railway.

GREAT BELT LINK, WEST BRIDGE, DENMARK

Total length: 6,600 m
Main spans: 110 m
Completed: 1994
Client: A/S Storebæltsforbindelsen

SERVICES: Conceptual and tender design, prequalification, tender evaluation assistance, design management, design check and technical services in connection with detailed design and construction.

LUANGWA BRIDGE, ZAMBIA

Total length: 350 m
Main span: 222 m
Client: Danish Ministry of Foreign Affairs / Danida and Ministry of Works and Supply, Zambia

SERVICES: Inspection, testing, condition assessment, feasibility study, strengthening and rehabilitation design, tender documents, tender evaluation and construction supervision.

NEW LITTLE BELT BRIDGE, DENMARK

Total length: 1,700 m
Main span: 600 m
Completed: 1970
Client: Ministry of Public Works, the Road Directorate, Denmark

SERVICES: Conceptual design, site investigations, tender documents, Detailed design and construction supervision. General inspection and maintenance works.

HIGH-SPEED RAIL PROJECT, TAIWAN

Project period: 2000-2006
Client, Lot C240: Hyundai - Chung Lin JV
Client, Lot C250: Hochtief AG - Ballast Nedam - Pan Asia JV

SERVICES: Checking design of permanent works, checking design and construction of major temporary works, checking changes in design of permanent works, verification of geotechnical conditions on site during construction, analytical check including independent calculations.

SHEIKH JABER AL AHMED AL SABAH CAUSEWAY, KUWAIT

Total length: 36 km
Main span: 150 m
Project period: 2002 - ongoing
Client: Ministry of Public Works, Roads Administration, Kuwait

SERVICES: Feasibility studies and surveys, concept and tender design. Preparation tender documents, tendering and tender evaluation.

CHONGMING BRIDGE, PR CHINA

Total length: 9,600 m
Main span: 730 m
Completed: 2008
Client: Shanghai Yangtze River Tunnel and Bridge Construction Development Co. Ltd.

SERVICES: Independent design check and consultancy during construction for cable-stayed bridge and approach bridge.

RUSSKY ISLAND BRIDGE, RUSSIA

Total length: 1,886 m
Main span: 1,104 m
Project period: 2012
Client: Mostovik

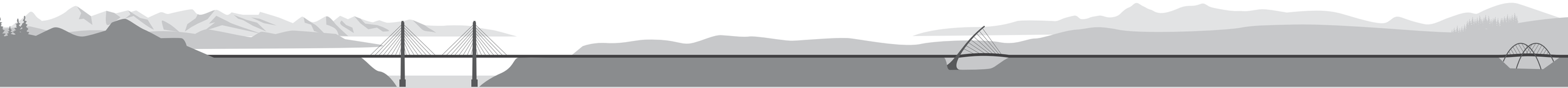
SERVICES: Wind tunnel tests, design review and specialist consulting during construction.

YEMEN-DJIBOUTI FIXED LINK, MIDDLE EAST – AFRICA

The project comprises a fixed link between Yemen and Djibouti across the Bab El-Mandeb Strait which connects the Red Sea to the Indean Ocean via the Gulf of Aden. The island of Perim divides the strait into an Eastern channel approx. 3.5 km wide (water depth approx. 20 m) and a Western channel approx. 21.5 km wide (water depth up to 300 m). The link is expected to include a highway and a railway. Given the water depth and the requirements to navigational clearance it is expected that a large part of crossing of the Western channel will consist of a very long multi-span suspension bridge with main spans of up to 3,000 m.

Total length: 28 km
Main span: 2,700 m
Completed: 2008
Client:Middle East Development LLC

SERVICES: Sketch design.



MEET US AT: WWW.COWI.COM

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.

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Photo: Daewoo Engineering and Construction