

A fixed link across Fehmarnbelt

The link of the future between Scandinavia and the Continent

Femern
Sund ≈ Bælt



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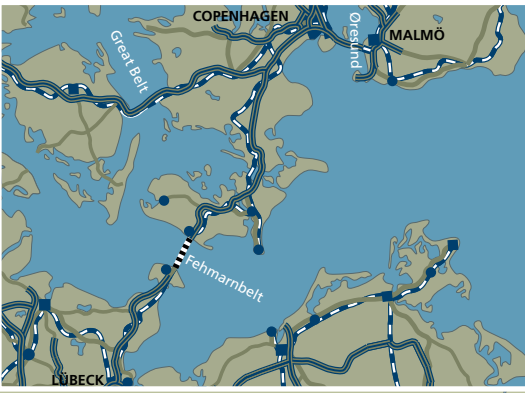
MALMÖ

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Fehmarnbelt



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Great Belt

Øresund

A European link becomes reality



DENMARK AND GERMANY HAVE SIGNED A TREATY FOR A FIXED LINK BETWEEN RØDBY AND PUTTGARDEN, LINKING SCANDINAVIA WITH CENTRAL EUROPE BY RAIL AND MOTORWAY

On September 3, 2008, the Danish and German Ministers of Transport signed a treaty for the establishment of the Fehmarnbelt link, which is now to be approved by the Danish Folketing and the German Bundestag.

An efficient transport corridor between Scandinavia and the continent across the Fehmarnbelt has been a vision for decades as the need to transport people

and freight has multiplied between cities such as Stockholm, Copenhagen/Malmö, Hamburg and Berlin.

A fixed link across Fehmarnbelt will offer very substantial benefits for Europe's economic development and for the regions that will be connected by this new infrastructure project.



Artistic impression of a cable-stayed bridge with a railway underneath and a roadway on top.

The Fehmarnbelt link will not only form a physical link, but will also build bridges between the commercial, educational and cultural communities on both sides of the water.

With its motorway and railway, the link will make transport between north and south faster, more efficient and offer greater flexibility. The project encompasses an upgrading of the railway and will improve the competitiveness of public transport in relation to passenger and freight transport. The link will, therefore, make a substantial contribution to improving the environment.

The link will offer the regions on both sides of the belt strong development opportunities. During the construction phase, these areas will see heightened activity and, once the project is completed, the regions will benefit from this new European transport corridor.

As a consequence, the EU has designated the rail link across the Fehmarnbelt as a priority project



within the Trans-European Transport Network (TEN-T).

Although the Fehmarnbelt link is a Danish-German project, Denmark has assumed sole responsibility for its implementation. The project will be financed through user payment and substantial subsidies from the EU. The necessary landworks in Denmark and Germany will be funded by each country. In Denmark, this is expected to be funded by revenue from the coast-coast link. The two countries' Ministers of Transport have agreed that a bridge link (cable-stayed bridge) is the preferred technical solution with an immersed tunnel as the preferred alternative.

No decision has yet been taken on the design of the structure, i.e. the alignment or whether the link will be constructed as a bridge or tunnel. This is expected to be determined within three years.

The link is expected to open in 2018.

THE AGREEMENT BETWEEN GERMANY AND DENMARK AND MANY OF THE REPORTS SO FAR PREPARED ON THE PROJECT ARE AVAILABLE AT WWW.FEHMARNLINK.COM

Regardless of the many obvious benefits offered by a fixed link, a project of this magnitude also carries risks for the environment both during the construction phase and the subsequent operating phase. Protecting nature and the environment has very high priority during the initial planning as well as during implementation, and a large number of investigations and analyses will be carried out in the area. The two countries' Transport Ministries have already carried out an environmental consultation process with the authorities and lobby organisations. Over the next two to three years, an Environmental Impact Assessment and evaluations of the effects of CO₂ will be carried out.

This brochure explains the current considerations concerning the project's design, its pre-requisites and funding as well as the procedures for the detailed planning and the environmental issues relating to the authorities' endorsement of the project.



Illustration of the high bridge as a cable-stayed bridge.

THE BRIDGE

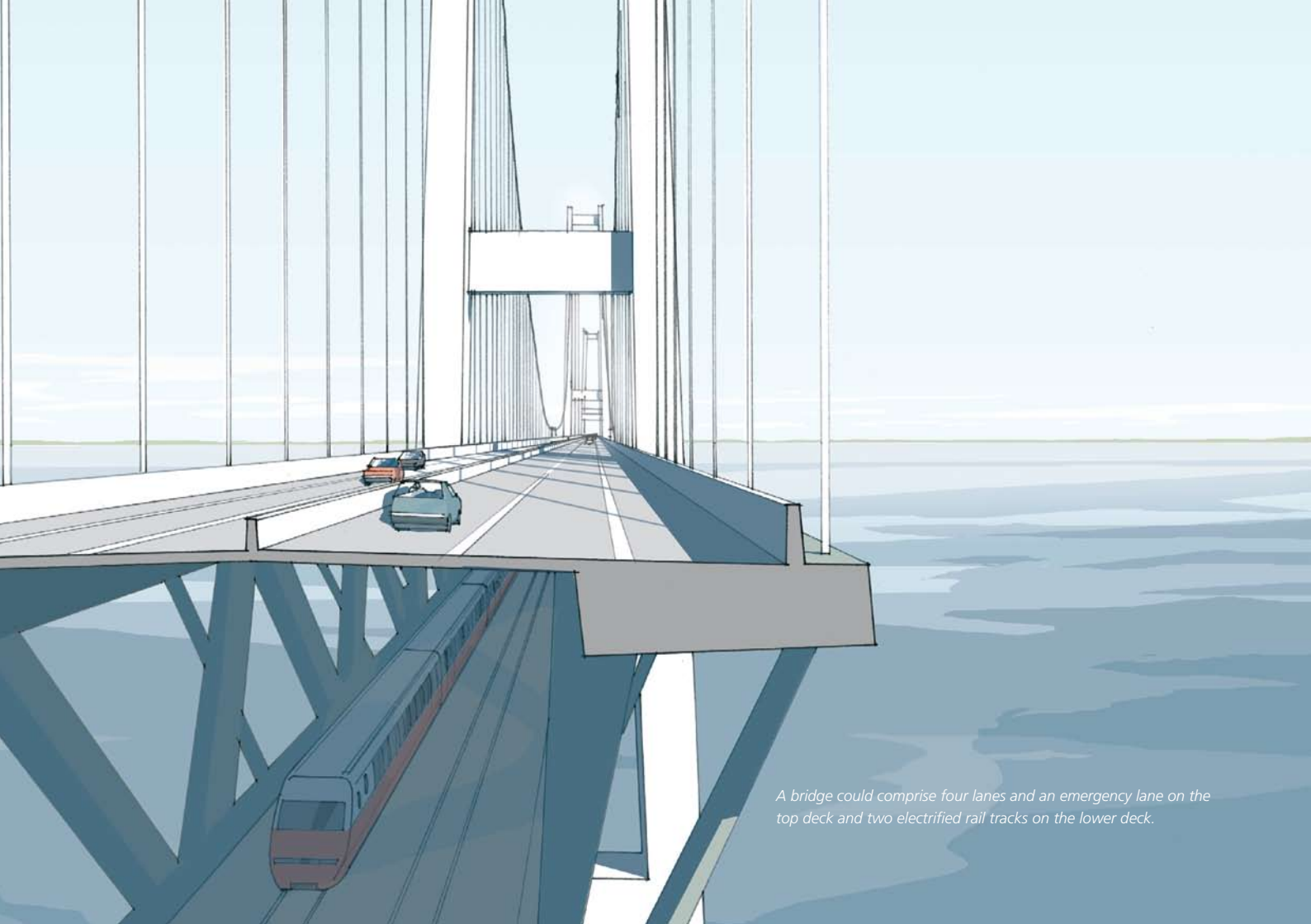
THE BRIDGE ACROSS FEHMARNBELT IS SET TO BECOME A WORLD CLASS ENGINEERING ACHIEVEMENT. WHEN COMPLETED, IT IS LIKELY TO BE THE LARGEST BRIDGE FOR ROAD AND RAIL TRAFFIC OF ITS TYPE IN THE WORLD. IT WILL CERTAINLY BE THE LARGEST BRIDGE PROJECT EVER UNDERTAKEN IN EUROPE

The bridge solution could be a cable-stayed bridge like the Øresund Bridge or a suspension bridge like the bridge across Storebælt. A cable-stayed design is the preferred solution.

In several ways, the dimensions will be even greater than other large-scale bridge projects, including the bridges across Storebælt and Øresund. The span and height of the bridge girders will, for instance, be close to 50 per cent larger than at the Øresund Bridge.

The dimensions will pose great demands on the construction and execution of the project. Whilst the engineers will plan the details of the new bridge, other specialists will develop new techniques for the construction itself. Currently, for instance, there are no floating cranes anywhere in the world with the capacity to lift the large bridge spans into place during the construction phase. Consequently a solution will have to be found for this task.





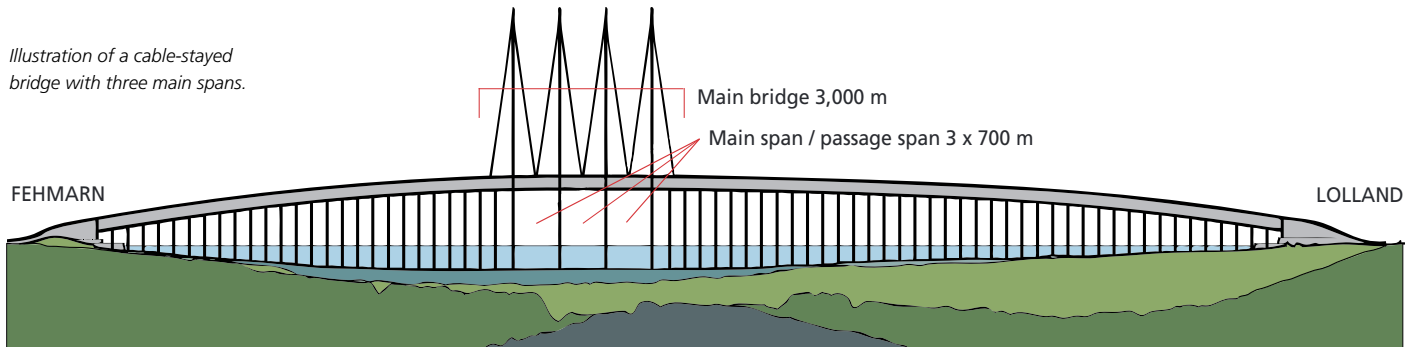
A bridge could comprise four lanes and an emergency lane on the top deck and two electrified rail tracks on the lower deck.

Steelwork and concrete casting also impose very substantial demands. At the same time, it is essential to ensure that the construction works have minimum impact on the local marine and land environments.

The bridge construction may consist of a main bridge with passage spans across the shipping route, two approach bridges and two approach sections connecting the fixed link to the landworks.

The design of the main bridge has not yet been finally determined, but initial studies include proposals for a cable-stayed bridge with three main spans of approximately 700 m each. With the corresponding side span, the main bridge would have a total length of approximately 3,000 m.

In addition, two approach bridges will be required in Germany and Denmark. The pylons, which carry the main bridge, will, under this proposal, be around 280 m high and be cast in situ in concrete.



The total length will be approx. 19 km.

The passage height will be at least 65 m corresponding to the clearance at the Storebælt bridge.

The bridge girders for the road and rail traffic would be constructed in concrete and steel, in all likelihood as finished elements and towed from the production facilities on land to the bridge alignment. The motorway will run on the upper deck with two lanes and an emergency lane in each direction with the double-track electrified railway running on the lower deck. A similar solution can be found at the Øresund Bridge.

The large pylons would be fixed in the seabed in large concrete caissons. These can be cast in dry dock on land, towed into place and lowered into previously dredged trenches to be firmly embedded deep under the seabed. It is crucial for the planning of the project that the engineers have detailed knowledge of the substratum.

READ MORE ABOUT THE GEOLOGICAL INVESTIGATIONS
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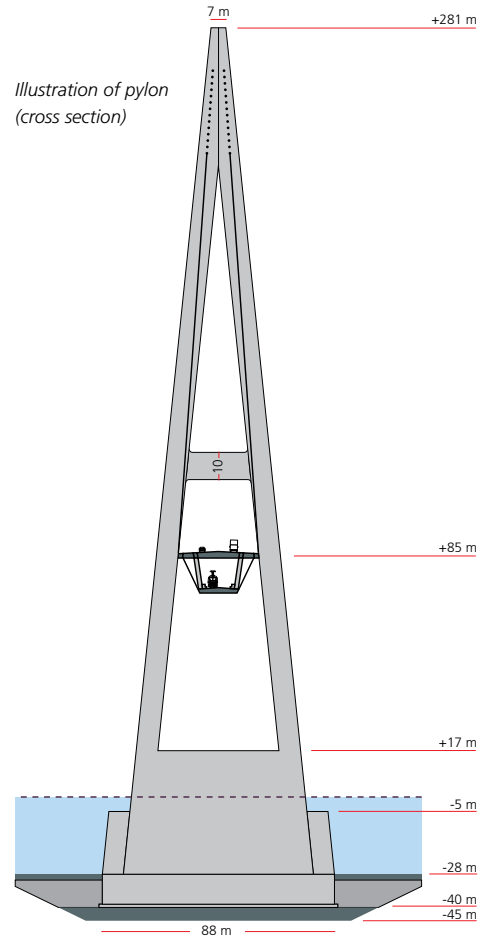




Illustration of an element factory for the foundations or the bridge piers east of Rødby.



The Fehmarnbelt substratum consists of clay and lime, materials that are familiar from previous major bridge building projects on Lillebælt, Storebælt and Øresund.

The bridge will connect with the land near the ferry ports at Rødby and Puttgarden, i.e. the shortest distance between Denmark and Germany (approx. 19 km). There are currently road and rail links to both ferry ports.

Although the infrastructure is partially in place, the development of the landworks will be a very

substantial task. This includes linking the fixed link's motorway and rail facilities to the existing facilities on land.

The challenge consists in creating an environmentally sound, aesthetic and architecturally attractive way of aligning car and rail traffic with the existing terrain. Cars and trains will run on separate levels across the bridge with motor traffic on the upper level and trains below. Traffic will connect with the existing road and rail facilities through structures such as viaducts or ramps on both sides.

THE WATER DEPTH ALLOWS SHIPPING TO NAVIGATE THROUGH THE FULL BREADTH OF FEHMARNBELT. AS A RESULT, THE HIGH BRIDGE AND THE BRIDGE ABUTMENTS WILL HAVE TO BE HIGH ABOVE THE SURFACE OF THE SEA

THE TOLL STATION

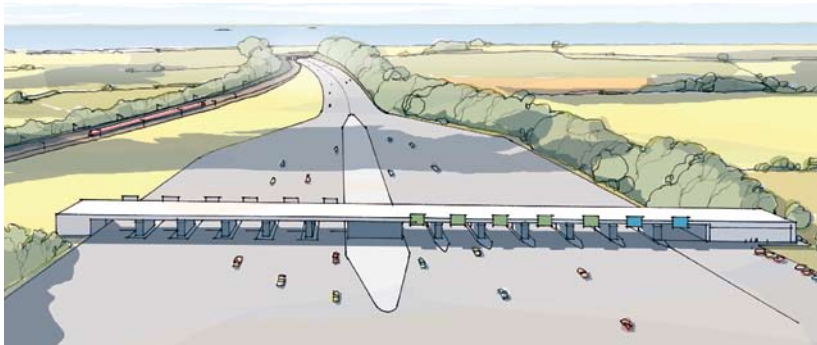
FUTURE USERS WILL PAY FOR THE FIXED LINK ACROSS THE FEHMARNBELT. CHARGES WILL ROUGHLY CORRESPOND TO THE CURRENT FERRY PRICES



It is estimated that 8-10,000 cars per day will cross the Fehmarnbelt fixed link. Based on experiences from other fixed links, expectations are for continued traffic growth between Denmark and Germany.

Since the fixed link will be paid for by its users, a toll station for cars, lorries and coaches will be established some kilometres inland on the Danish side.

The construction and operation of the fixed links across Storebælt and Øresund have provided substantial experience of the function and capacity of toll stations. This experience will be used in the design of the Fehmarnbelt toll station.



The toll station will be located on the Danish side of the link.

IMMERSED TUNNEL

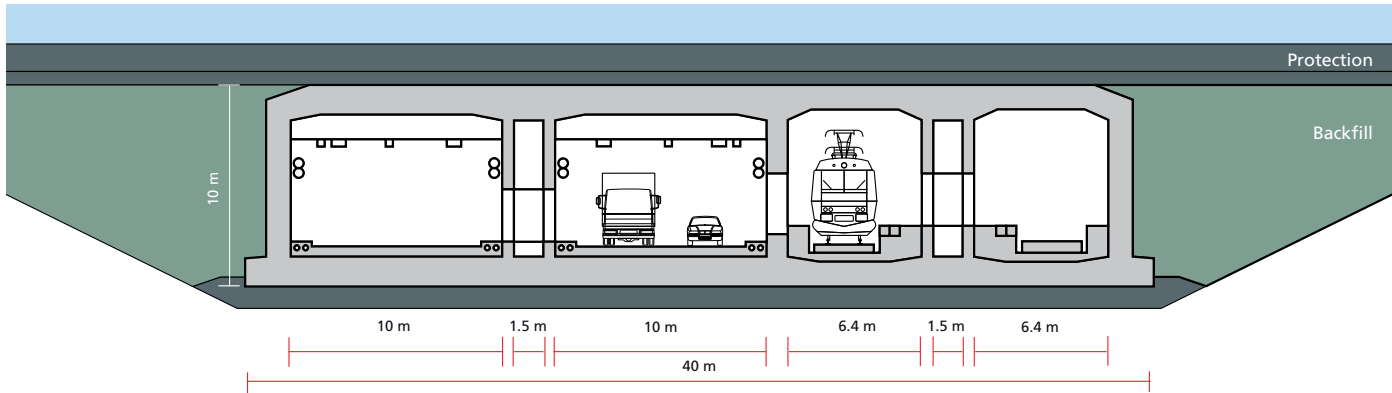
THE FIXED LINK COULD ALSO BE CONSTRUCTED AS A 20 KM LONG
IMMERSED TUNNEL

Although based on financial and technical considerations a cable-stayed bridge is the preferred solution, the Danish and German governments have decided that an alternative solution in the form of a tunnel between Lolland and Fehmarn will also be investigated during the planning stage.

A possible solution is an immersed tunnel which, like the bridge, would set a new record in terms of dimensions. At 20 km it would be the longest tunnel of its type ever built.

An immersed tunnel would consist of four tubes. The first two would comprise two lanes each while the two other tubes would comprise one rail track each. The tunnel's cross section would be rectangular, approximately 40 m wide and 10 m high. 1.5 m wide service galleries would be located on the outside containing the many technical installations required by tunnel structures.

A tunnel has certain benefits compared to a bridge. Some regard it as an advantage that a tunnel would have little impact on the existing landscape



because, with the exception of the approach facilities and ventilation islands, it would be invisible. The risk of shipping colliding with the traffic facility is remote.

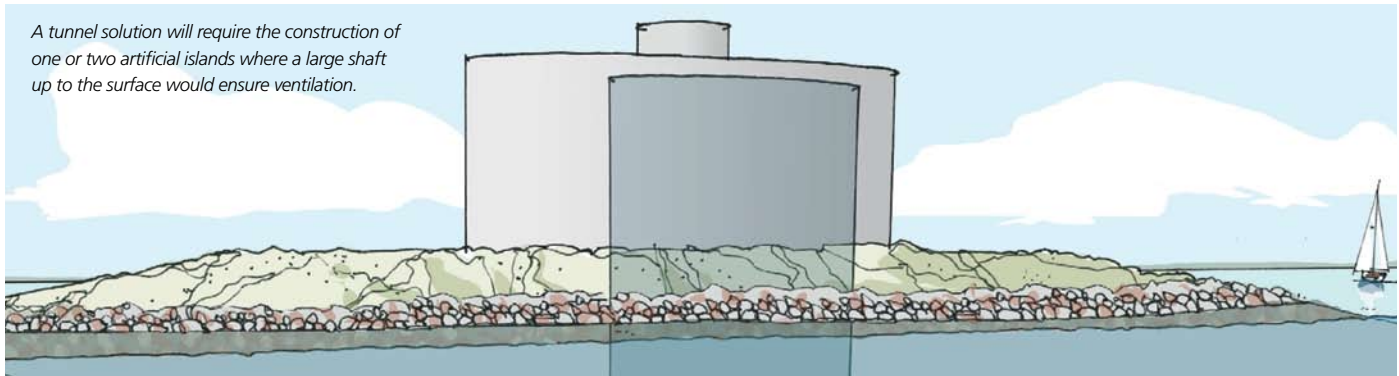
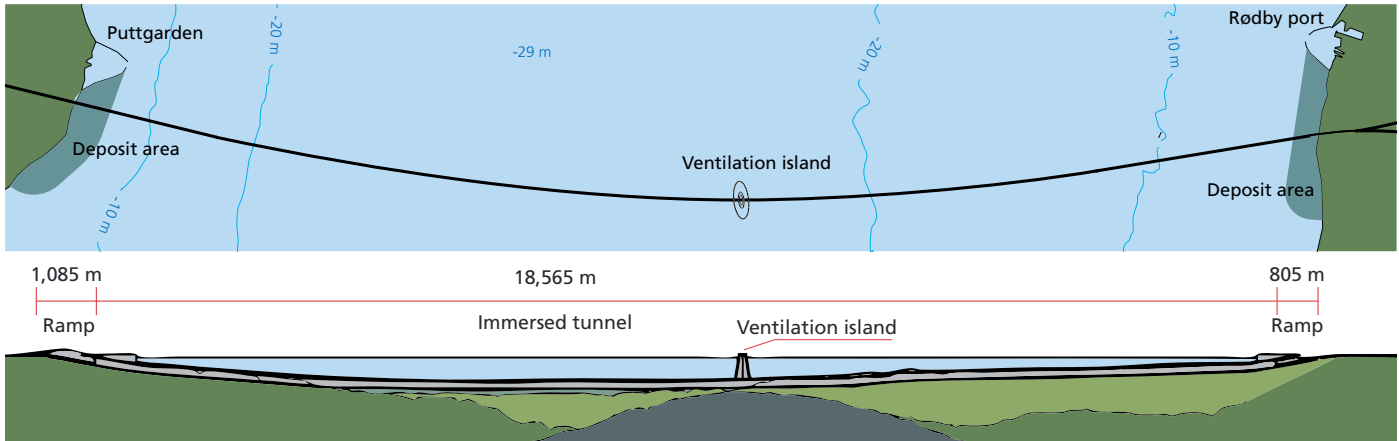
A tunnel, however, also has a number of disadvantages – financially, environmentally and in terms of safety.

A tunnel would also be a significantly more expensive solution compared to a bridge. While in itself this does not preclude a tunnel solution, it is, of course, a key factor in the project's profitability. Moreover,

during the construction phase, the construction of a tunnel would impact more on the local marine environment than a bridge solution.

An immersed tunnel would have to be excavated in the seabed which means that 18-20 million cubic metres of seabed would be removed. The corresponding figure for a bridge would be 3-5 million cubic metres. A tunnel solution would also pose a greater risk to Fehmarnbelt's maritime flora and fauna because of the amount of seabed material.

An immersed tunnel would be cast on land and placed piece by piece down into a trench dug into the seabed.



Safety and contingency issues are always a substantial challenge for large-scale tunnel projects of this type. Supplying tunnels of this length with fresh air and ensuring that smoke from fires can be controlled so that people can be evacuated from the tunnel safely is a highly complex task. The proposed solution, therefore, involves the construction of one or two artificial islands in Fehmarnbelt and dividing the tunnel into two or three sections. These islands would contain large ventilation shafts from the tunnel to the surface of the sea.

The shafts will supply the tunnel tubes with fresh air and, in the case of fire, extract smoke from the motorway or rail tunnel tubes.



The elements for an immersed tunnel would be cast on land, combined into sections and towed out to the tunnel trench where they would be positioned one by one. Photo of the production facility for the Øresund tunnel.



ENVIRONMENT



MAJOR CONSTRUCTION PROJECTS IMPACT ON THEIR SURROUNDINGS
DURING THE CONSTRUCTION PHASE AS WELL AS WHEN COMPLETED

Major infrastructure projects like the Fehmarnbelt link inevitably impact on the environment – both during the construction works and, subsequently, during daily operations. As the link is designed to have a lifetime of more than 100 years, environmental-friendly operations have high priority.

It is a basic principle that the choice of construction methods as well as the operational phase must aim at minimising the potential negative consequences for the environment. This is best secured by focusing on nature and the environment both during the preparation and actual planning stages. In all decisions made by the project company, assessments of environmental issues are included for the purpose of preventing or countering harmful effects on the environment and the natural world.

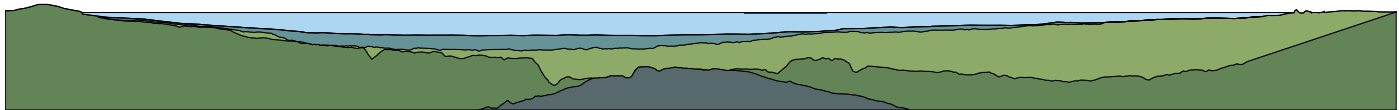
The substratum along the alignment consists of geological formations which are already familiar to Danish bridge builders from other large-scale construction projects.

Within this area, the experiences of Danish planners and bridge builders will prove valuable. Prior to the construction of the fixed links across Storebælt and Øresund, extensive analyses of the environmental consequences were undertaken. Corresponding preliminary investigations have already been carried out for the Fehmarnbelt project. Many more investigations and assessments will be conducted over the next few years.

Environmental impact can be divided into two parts: temporary effects during the construction phase and the permanent effects from the completed structure combined with the impact from ongoing operations.

FEHMARN

LOLLAND





The main impact on the local environment from the construction works will be caused by excavation and deposits of seabed material. Experience shows that the impact on fish and other marine animals and plants is relatively limited because the dredging will take place at depths of between 10 and 30 metres. At such depths, the marine environment is relatively robust and resistant to substantial variations in living conditions over the year and from year to year. However, in the shallower areas closer to the coast, environmental impact can be greater partly because the bottom vegetation is richer. As a result, construction works will be carried out so that the removal of seabed material and sediment waste is reduced as much as possible both in time and scope.

Parts of Fehmarnbelt are in the so-called Natura 2000 protection areas that require special attention.

A number of local low water areas at Lolland and Fehmarn are used by birds for feeding and reproduction. Some of these sites may be used as a deposit area in connection with the construction works. Consequently, during the current planning phase, there is already significant focus on protecting bird and animal life.

There are no specific breeding areas for birds close to the construction area.



Fehmarnbelt is a spawning and breeding area for a number of fish species, primarily cod, herring and sprat as well as flat fish. Cod spawning is not expected to be affected by the dredging works although herring and other species which spawn in low water areas may be disturbed during the spawning period and fish eggs can be destroyed or buried.

GO FOR A SWIM

Tourists will be able to enjoy the beaches in summer throughout the entire construction phase. Close to land, the water will be clear and clean because the dredging, which may make the water murky, will only take place near the coast outside the bathing season.

This will also be done to protect the flora and fauna on the seabed which are especially active in the summer months when there is abundant light.

However, as the main part of the dredging will take place outside the spawning and reproduction areas, construction works are not expected to cause major disturbance.

The seal sanctuary at Rødsand is home to up to 100 common seal who will be neighbours to the fixed link. It is, however, believed that the distance between the seal sanctuary and the construction works is sufficient to avoid disturbing the seals.

Regardless of whether a bridge or tunnel is selected, the solution will only have a modest impact on the water flow in Fehmarnbelt which, lying between the North Sea and the Baltic, is important for the flow of saline and oxygen-rich waters between the two seas. The issue will, however, be examined as part of the environmental investigations during the planning phase.

A number of hydraulic surveys have been carried out to determine the blocking effect of a fixed link on the water flow. The effect has been shown to be



Irrespective of whether a bridge or tunnel is selected, the solution will have little impact on the water flow in the Fehmarnbelt.



modest, about 0.3 per cent for a bridge and about 0.1 per cent for a tunnel. The low effect is owing to two factors: all underwater constructions are embedded in the seabed and streamlined and the number of bridge piers is kept to a minimum.

Should a bridge solution be chosen, structures and systems will have to be established to prevent shipping from colliding with the bridge piers. This

could, for instance, be in the form of a navigation monitoring and guidance system, a so-called VTS system. These issues will be investigated during the planning phase.

A major construction project such as the Fehmarn-belt link will employ thousands of people. As a result, of course, there will be considerable focus on the working environment. On the backdrop of the

THE CONSTRUCTION PROJECT SET TO BECOME A TOURIST ATTRACTION

There can be little doubt that the construction of Europe's largest fixed link will attract a large numbers of visitors. Femern Belt A/S expects that exhibitions about the project will be set up on both sides of the Belt.

The exhibitions will focus on nature, the geology, the construction and technology and the consequences of the fixed link between Scandinavia and the continent.

extensive experience from the construction of the Øresund link, the prevention and effective handling of industrial accidents would have high priority.

A fixed link across Fehmarnbelt will have a positive impact on CO₂ emissions largely because the energy-demanding ferries would cease operations. An analysis has shown that the emission of harmful substances and CO₂ from traffic would be less.

The reduction in the greenhouse gas, CO₂, has been estimated at 220,000 tonnes 25 years after the opening, corresponding to annual emissions from 20,000 people.

Nitrogen oxide, NO_x, will be reduced by 600 tonnes 25 years after the opening, corresponding to annual emissions from 40,000 people.



READ MORE ABOUT THE GEOTECHNICAL INVESTIGATIONS AND THE ENVIRONMENTAL SURVEYS AT WWW.FEHMARNLINK.COM

LANDWORKS

AN EFFICIENT FIXED LINK BETWEEN SCANDINAVIA AND
THE CONTINENT WILL REQUIRE AN UPGRADING OF THE
INFRASTRUCTURE ON LAND





The landworks will offer substantial opportunities for both freight traffic and public transport, which can be exploited by the regions on both sides of the Fehmarnbelt. The regions will gain an upgraded and modern infrastructure which will benefit local residents as well as commerce.

Between Copenhagen and Rødby on the Danish side, the motorway was completed in 2007. As a result, there will be no need for major extensions although certain environmental improvements as part of the construction of the fixed link may be appropriate.

The 119 km long rail line between Ringsted and Rødby will, however, be significantly improved through the electrification of the entire section and the extension to double track between Vordingborg and Rødby. The rail line across Storstrøms Bridge will remain single track.

On the German side, there will be extensive upgrades to both road and railway. An extension of the main highway from Heiligenhafen to Puttgarden will be upgraded to motorway standards.

No later than at the opening, the 89 km railway between Lübeck (Bad Schwartau) and Puttgarden will have been electrified. Seven years after the opening at the latest, the line will be extended to two tracks. The Femernsund bridge will, however, continue to have two lanes only.

Under the agreement between the Danish and German governments, the improvements to roads and railways on land will be built and paid for by the respective governments.

Revenue from the coast-coast link is expected to pay for the financing of the Danish landworks.

FINANCING

THE FIXED LINK WILL BE FINANCED BY LOANS GUARANTEED BY THE DANISH STATE AND EU SUBSIDIES. THE LOANS WILL BE REPAID BY USERS OF THE LINK. THE BRIDGE WILL BE BUILT TO LAST FOR AT LEAST 100 YEARS, BUT IS EXPECTED TO BE REPAID WITHIN 30 YEARS

Illustration of a bridge with two passage spans.



The fixed coast-coast section across the Fehmarnbelt will be owned by the Danish state.

The landworks on the Danish side will also be financed and owned by the Danish state while the landworks on the German side will be paid for and owned by Germany.

The construction of the bridge itself (cable-stayed bridge) will cost approx. 4.4 billion euro. In addition are the costs for the Danish landworks which are estimated at around 1.2 billion euro. These estimates (all prices are in 2008 prices) will be clarified during the planning stage. Financing will be provided through international loans raised by the project company responsible for the construction through Danish government guarantees. The costs of the German landworks will be funded by Germany.

The intention is for the bridge to be paid for by its users in the same way as, for instance, the Øresund and Storebælt links. A toll station for cars, coaches

and lorries will be built on the Danish side. Current calculations indicate that the fixed link, including the Danish landworks, will be repaid over a period of around 30 years.

Since a fixed Fehmarnbelt link will be a crucial Northern European traffic corridor, the project will qualify for subsidies from the EU's TEN programme (Trans European Network Programme).

EU TO PROVIDE A SUBSTANTIAL SUBSIDY

The EU has already granted substantial sums to the project, i.e. DKK 2.5 billion for the period 2007 to 2013 from the TEN programme. Moreover, the project is also expected to obtain subsidies during the subsequent TEN period which applies from 2014.

The "spiritual" bridge between Denmark and Germany will also receive funding from the EU. The border region has been given DKK 170 million in support for the period 2007 to 2013 in accordance with the so-called Interreg IV programme. The funds have been earmarked for projects between public organisations on both sides of the belt.

TIME SCHEDULE

THE SIGNING OF THE DANISH/GERMAN FEHMARNBELT TREATY IN SEPTEMBER 2008 BY THE TWO COUNTRIES MARKED A MILESTONE IN THE HISTORY OF THE PROJECT

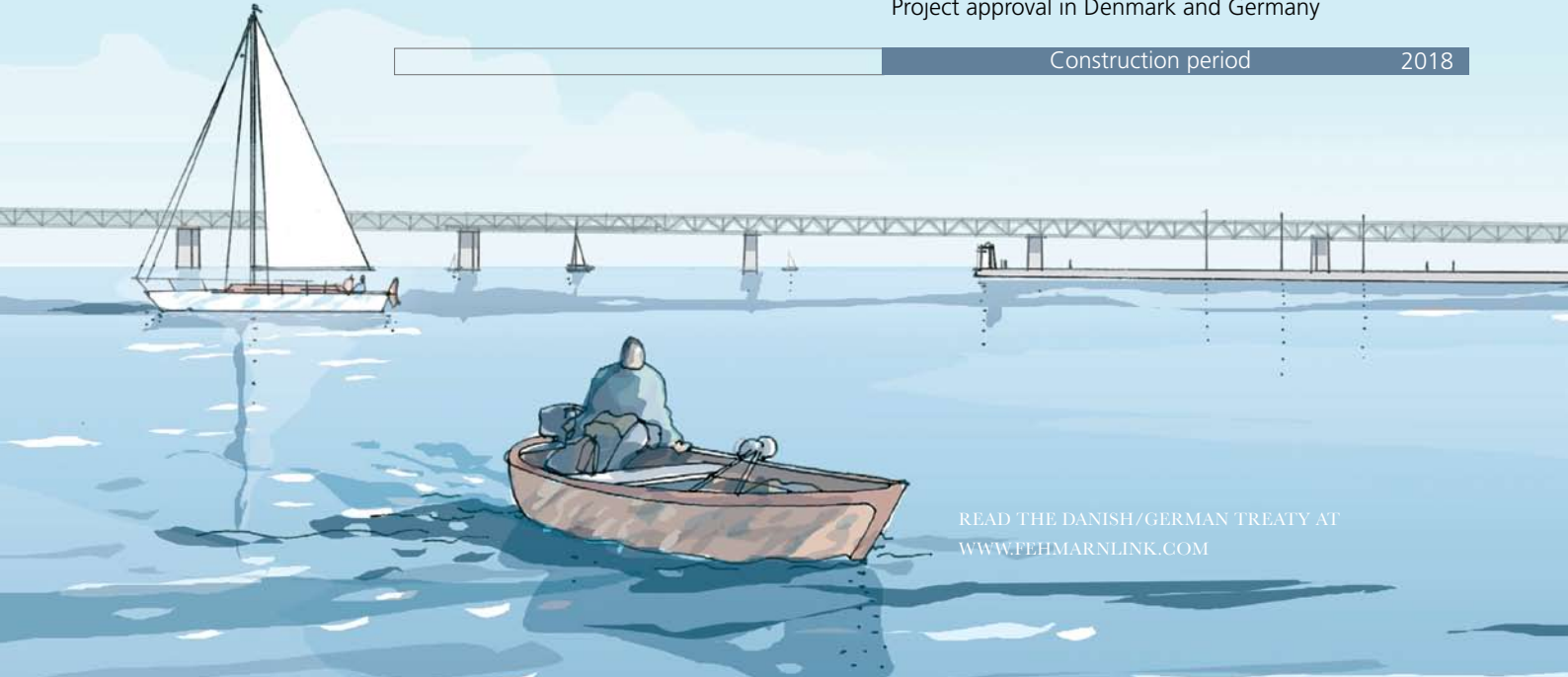
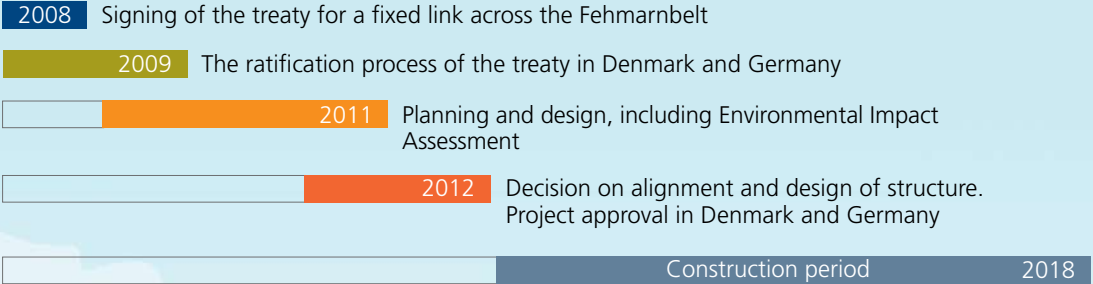
In Denmark, the treaty will be ratified by a Planning Act expected to be submitted to the Danish Parliament (Folketinget) in December 2008 and passed during 2009. In Germany, the Bundestag is expected to ratify the treaty during 2009.

The Planning Act authorises the Danish government – i.e. the Minister of Transport – to establish the organisation that will be responsible for the implementation of the project on behalf of the Danish government.

Over the next few years, detailed planning will be undertaken, including the highly important Environmental Impact Assessment. The decision concerning the fi-

nal alignment and the bridge's design will be made on the basis of the results from the Environmental Impact Assessment. The final project will be submitted to the authorities in Denmark and Germany for approval. In both countries, the views of the authorities, affected parties and local residents will be heard as part of the project approval procedure. In Denmark, final approval will be given through the passing of a Public Works Act by the Folketinget. In Germany, approval will be given by the competent planning authorities.

The actual construction of the Fehmarnbelt link will take around seven years. The aim is to open the fixed link to traffic in 2018.



READ THE DANISH/GERMAN TREATY AT
WWW.FEHMARNLINK.COM

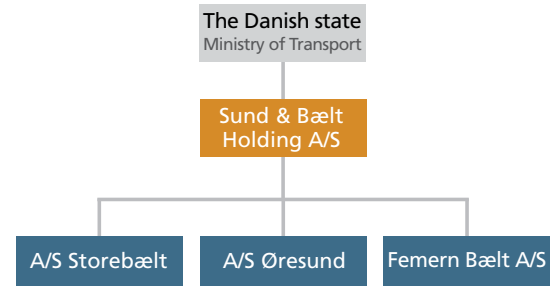
BRIDGE BUILDERS

In conjunction with the Danish Ministry of Transport, Femern Bælt A/S, which through Sund & Bælt Holding A/S is wholly owned by the Danish state, is responsible for the preparatory works and investigations concerning the coast-coast link up to the passing of the Planning Act.

On behalf of the Danish state, the fixed link across Fehmarnbelt will be owned and operated by a project company which is also responsible for the construction works.

As owner of the Fehmarnbelt project, the company will be responsible for the preparation, planning, design, construction, funding, ownership and operation and maintenance of the coast-coast link.

The company's corporate structure has yet to be finalised. This will be done in connection with the Danish Parliament's debate on the Planning Act.





Over the past ten years, Denmark has acquired very substantial experience with regard to the construction of large fixed link projects – as employer and through the many consulting engineering firms and large contractors. Femern Bælt A/S has accumulated considerable expertise from the large-scale projects at Storebælt and Øresund, i.e. within the environment, geotechnology, concrete, the working environment, planning and management as well as financing.

MORE INFORMATION

Femern Bælt A/S is responsible for the initial preparations for the coast-coast link. The planning and design of the German and Danish landworks is in the hands of the relevant public authorities.

For more information about the Fehmarnbelt fixed link, please visit Femern Bælt A/S' website at www.fehmarnlink.com.

Any questions regarding the coast-coast project should be addressed to:

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