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The Fehmarnbelt Fixed Link:

Bridge or Tunnel?

Work on a fixed link over the Fehmarnbelt is progressing as planned. Femern A/S has defined two principle tasks: Project 2012, under which all approvals from the authorities are to be in place by that date, and Project 2018, where the political objective is for the construction work to be finished and the fixed link to open by that date.

Around 2012, a Construction Act is expected to be put before the *Folketing*, the Danish Parliament, which will take the final decision on the form of the construction and the route option across the Fehmarnbelt between Rødbyhavn and Puttgarden. The Construction Act will depend on a project that can be approved by the authorities in both Germany and Denmark.

Femern A/S's main task over the next couple of years, therefore, is to produce a project for approval by the authorities – *Planfeststellung* as this process is called in our neighbouring country Germany, to which we will soon be connected by a fixed link.

Over the last year, the consultants Cowi-Obermeyer and Rambøll-Arup-TEC have been working on what is known as a *conceptual design* for a bridge and for a tunnel across the Fehmarnbelt. These are outline proposals that Femern A/S continuously develops and optimises, whilst at the same time carrying out extensive surveys of the environment, geotechnical details and navigational conditions.

The birth of a new region

The fixed link over the Fehmarnbelt will, in itself, be a key part of the European transport network as it will link the whole of Scandinavia with continental Europe. The quantity of goods transported is expected to double by 2030, so it is important that freight transport on the railways, too, be bolstered. The link will also have another, equally important result: it will create the possibility for a dynamic Fehmarnbelt Region stretching from Scania in Sweden, across Zealand in Denmark to Hamburg in Germany. The success of the Øresund region represents a clear model here.

The Fehmarnbelt Region has strengths in areas such as research, logistics and tourism that should be exploited, and these are areas where the construction of new and strong collaborative relationships is already underway.

The region consists of 10 million people and covers the areas of Scania in Sweden, the Capital Region and the Zealand Region in Denmark and the Federal States of Schleswig-Holstein, Mecklenburg-Vorpommern and Hamburg in Germany. 63% of the population live in Germany, 25% in Denmark and 12% in the Swedish part of the region.

Femern A/S is tasked with designing and planning of a fixed link between Denmark and Germany across the Fehmarnbelt. Femern A/S is a subsidiary of the Danish, state-owned Sund & Bælt Holding A/S, which has experience from the construction of the fixed links across the Great Belt and the Øresund.

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It is a prosperous area that is now being linked up. Local residents are considerably better off than the EU average: the gross regional product per capita was EUR 34,100 in 2009, as opposed to just EUR 24,800 for the EU average.

Careful study of the environment

There is still a lot of work to do before a fixed link can be opened in 2018, however. Both the bridge and the tunnel projects will be included in the extensive environmental impact assessments (EIAs) that will be carried out over the next few years.

By the end of 2010, Femern A/S will complete its collection of the quantities of environmental data that will be used in the public hearings that form part of the EIA process. Once all the data has been reported and evaluated, it is expected that the Danish Ministry of Transport will be able to submit the EIA report to public hearing during the autumn of 2011.

Femern A/S has been responsible for collecting an extensive range of environmental data from the Fehmarnbelt since autumn 2008, both on land, at sea and in the air.

As part of the preparations for the Fehmarnbelt construction project, the air pollution that the fixed link will produce is among the elements that will be assessed. Dust and CO_2, for example, may be generated. The assessment is focused on local and regional air quality and on what the project might mean for the global climate.

New infrastructure will affect society, now and in the future, for which reason businesses, open air activities, tourism and housing will all be evaluated. The assessments will also take a look at whether there is an impact on cultural heritage.

A fixed link between Denmark and Germany may mean major changes for the local population, with both advantages and disadvantages. Many groups in society will also be affected. This will be the case both while the bridge or tunnel is being built and when it opens to traffic. The EIAs therefore cover the conditions for people and society.

Simulations to ensure safety

The safety of shipping traffic is one of the major challenges when planning to build a bridge link between Rødbyhavn and Puttgarden. Every year, around 40,000 ships pass through the Fehmarnbelt – around twice as many as pass through the Great Belt.

Femern A/S aims for it to be at least as safe to sail through the Fehmarnbelt with a bridge between Rødbyhavn and Puttgarden as it is today.

In order to achieve the best possible safety level for shipping traffic, Femern A/S is carrying out tests in a sailing simulator that is able to recreate different widths of the main span for a bridge, which is to say the part of the bridge that ships would sail under.

Similar simulations were carried out before construction got underway on bridges across both the Great Belt and the Øresund (also known as The Sound).

100 holes 100 metres deep

The geotechnical surveys in the Fehmarnbelt include a series of test drillings across a four-kilometre wide corridor, where the final route is going to be found. Over the course of 2009 and 2010, Femern A/S will be carrying out 100 drillings to 100 metres in depth. Strength measurements will be taken in the drillings, along with a series of geophysical measurements, and samples will be taken on an ongoing basis for laboratory tests. All this is designed to obtain a precise knowledge of the characteristics of the land.

The majority of the seabed beneath the Fehmarnbelt is of a character and composition that geotechnical engineers already have a detailed knowledge of from other similar projects, but an area a few kilometres out from the German coast has a seabed with a 50-metre thick clay layer that geotechnical engineers do not have as much experience of.

For that reason, a large-scale test is going to be carried out about a kilometre from the German coast in order to verify the results of the test drillings. From the summer of 2010 for about three years, various tests with take place in an area about 40 x 70 metres with piles being sunk and load tests performed in order to evaluate how much the earth subsides and how it behaves in general during the construction work.