

Femern:

In February 2011 the Danish Minister of Transport announced that the preferred solution for the Fehmarnbelt Fixed Link would be an immersed tunnel. The immersed tunnel design team comprises a joint venture between Ramboll, Arup and TEC.

The total length of the tunnel is 18.1 km from tunnel entrance to tunnel exit. The tunnel will be cast in watertight concrete with road and rail tubes located adjacent to each other with two motorway tubes on the west side and two rail tubes on the east side. A central corridor for installations and an escape passage is provided between the two road tunnel tubes.

The immersed tunnel comprises approximately 89 elements, each up to 220 m in length. The elements will be sited in a trench excavated beneath the seabed and covered by a stone layer, approximately 1.2 m thick. The trench bottom will be located at a maximum 40 m below sea level.

The tunnel elements are divided into standard elements and special elements. The standard elements are standardized and interchangeable whereas the special elements are two-storey elements – each of them unique.

Cross section of standard element

The special elements are constructed to fit to specific positions along the tunnel length as it is within the special elements that all changes in alignment are accommodated. In the lower storey of the special elements all technical installations and the pump sumps can be accommodated.

Access to the installations is provided on the western side where the element is widened by 3.0 m with a lay-by for the maintenance staff and emergency use.

The safety of all those who use, or are affected by the link, is paramount in the design, construction and operation. The safety strategy adopts an integrated, holistic, risk based approach which links design, maintenance and operations

Tunnel interior

The Tender design is on-going in the Ramboll-Arup-TEC organisation at the moment in parallel with the preparation of the Plan Approval documentation. The Design & Build Tender is planned for late 2012.

Metro Cityringen

The progress on the Cityringen project continues. The project consist of a completely new Metro with 15 km metro circle line all underground (30 km tunnels) and 17 underground stations and will have its own maintenance and service centre.

There will be 5 interchange stations to existing railway and metro lines.

In January 2011 the project went into the execution phase by the signing of the contracts for the Civil Works Construction and for the delivery of the Transportation Systems. For the Civil Works the contract was signed with the Copenhagen Metro Team a joint venture of the companies Salini, Trevi and Seli from Italy. The Transportation System contract was signed with Ansaldo, Italy. The contracts are design and build and delivery contracts.

The civil works contract includes construction of 30 km of tunnels, construction of 17 stations and 3 underground chambers for cross-overs and bifurcations of the Metro line.

The tunnels will be constructed using four earth pressure balance TBMs in geology varying from competent lime stone to glacial deposits of clay till and sand layers. More than 500 boreholes and 17 km of seismic investigations have been performed in order to investigate the ground conditions and to provide a firm basis for the contract. The ground coverage to the tunnels varies between 5 to 30 m with generally 15 m at stations and 25 m at low points between stations.

The stations will be constructed using cut & cover method with retaining walls of either secant piles or diaphragm walls depending on the ground conditions and the depth of the walls. There are 14 so called standard stations and 3 special stations of which one has to be constructed partly in a water canal. The station boxes are generally 22 m side and 70 m long with platform depth of generally 19 m below ground. The civil works contract includes also the mechanical and electrical equipment such as power supply, tunnel and station ventilations and SCADA systems.

The project value is 3 billion Euros and the Metro Circle Line is scheduled to open in 2018

By the end of 2011 the Municipality of Copenhagen decided a new Metro line to the Northern hharbour area shall be constructed and link up to the Cityringen project. This line will include two underground stations and 2,3 km tunnel as well as and elevated section with several stations

Northern Harbour Tunnel:

The main contract for the Northern Harbour Tunnel (Nordhavnsvej) was signed in August 2011 with the contractor JV Pihl-Züblin and the road will be opened in 2015. Nordhavnsvej will be approximately 1.65 km with a 620 m Cut & Cover tunnel. The cross section of the tunnel consists of 2 lanes in each direction.

In the future, a new urban area will be developed in the Northern Harbour. The Northern Harbour is one of Copenhagen's largest urban development areas. The establishing of Nordhavnsvej is to secure a better infrastructure to Northern

Harbour by connecting the Elsingor motorway and the Northern Harbour area. Also, it will relieve traffic from existing local streets on Østerbro and the inner city of Copenhagen.

Northern Harbour Tunnel will pass through densely populated city areas and will also have to pass under three busy railway lines and several roads.

Marselis Tunnel in Aarhus:

The first phase of the Marselis Boulevard Tunnel in Aarhus - connecting the Motorway system and Ring Road network with the Port of Aarhus - is planned to finish at the beginning of next year. The financial agreement of the second phase with a 2 km cut & cover tunnel is expected to fall in place by September 2012 and hence preparation of tender documents will continue. Now, final EIA studies for the tunnel are carried out.

The new railway line Copenhagen-Ringsted:

A new railway line between Copenhagen and Ringsted is being built. It is the largest railway construction project in Denmark in more than a hundred years.

The new electrified line will double capacity between Copenhagen and Ringsted and it will be the first railway in Denmark with potential for high speed trains. The project is a vital link of the European TEN-T rail corridor between the European continent and northern Scandinavia. It will be in service two years prior to the opening of the fixed Femern Belt connection between Denmark and Germany. The budget is 10.4 billion Danish kroner (1.4 billion euro) and it is the first railway in Denmark being built to support a maximum speed of 250 km/h. The project is being developed by Danish Rail Net.

The new 60 km line will commence at Ny Ellebjerg S-train Station in the southwestern part of Copenhagen where new platforms will be built. At this station passengers can transfer between the new line, the S-train network and to trains to other parts of Zealand and to Sweden. Most of the new line will be placed in cut and cover-tunnels or open cuts for the first 2,5 kilometers in order to minimize the new line's negative impact on residential and recreational areas. Two tunnels are planned for this section. 600 meters of cut and cover tunnel under the recreation area Vigerslev Parken and 600 meters of cut and cover tunnel on the north side of Motorway M21. Design is on-going and the railway line will open in 2018.

3rd Limfjord Fixed Crossing

Presently there are 2 road crossings of the waters of the Limfjord at Aalborg in the northern part of the country - a bridge from 1933 and an immersed tunnel from 1969. There is a lack of capacity and the Danish Road Directorate has carried out studies and an EIA for various new fiord crossing options. All the investigated options include tunnels. The EIA has been in a public hearing and the Road

Directorate has prepared a recommendation to the Minister of Transport. The preferred option is a 20 km motorway bypass west of the city, including a 1 km long immersed tunnel.

Roskilde Fjord, New fiord crossing at Frederikssund

After a public hearing of the EIA for various bridge and tunnel solutions, the Danish Road Directorate recommended a bridge solution.

The Storstrøm fixed link

The road and railway bridge, the Storstrøm bridge crossing the waters of Storstrøm, was temporarily closed down for traffic in autumn 2011, after cracks were found in the steel structures. The bridge built in 1937 is generally not prepared for the increase in railway traffic, when the Femern Tunnel to Germany opens in 2021. Therefore Banedanmark (the owner of the Danish railway network) is carrying out studies of new Storstrøm crossing options. The studies includes both tunnel and bridge solutions.

The Eastern Ring Road, Copenhagen:

The eastern ring road is to access one or two new harbour connections with the motorway to the north, the M3 and the Elsinore motorway with the motorways to the south, west and the southern motorway. Further, the circular road is to provide the opportunity for urban development in Copenhagen. Initial screenings is going on for different solutions. A preferred solution is expected to be selected in 2012.