

## Milestone in the construction of the Fehmarnbelt Tunnel: PERI delivers 10,000 t of special formwork

Fehmarnbelt Tunnel, Rødbyhavn, Denmark

With a length of 18 km, the Fehmarnbelt Tunnel will be the longest immersed tunnel in the world and is considered one of the largest infrastructure construction sites in Europe. PERI developed a formwork concept for the central production of the standard tunnel elements. The PERI engineering solution stood out in terms of its performance and productivity as well as compliance with the highest safety standards. With the last of a total of twelve ships, the delivery of the customised special formwork from the central formwork supplier for this project was completed in spring 2023 with a volume of more than 10,000 t.

After its planned completion in 2029, the Fehmarnbelt Tunnel will connect Denmark and Germany for road and rail traffic. Thanks to a reduced travel time of only seven minutes by train and ten minutes by car, the construction project is making an important contribution to environmentally-friendly transport and providing a fast rail connection between Scandinavia and Central Europe.

The immersed tunnel with a total width of 45.00 m consists of a total of five tunnel tubes, two of which are two-lane tubes for motor vehicles, two are single-lane tubes for rail traffic and one is a service and escape tube. In total, PERI is supplying formwork material for 79 standard tunnel elements, each 217.00 m in length and 73,000 t in weight.

### Engineering expertise in a class of its own

To make the customer requirements a reality, the PERI engineers decided on an incremental launching method with nine roughly 24.00 m long concreting sections. The solution developed by PERI forms the foundation for monolithic concreting, which reduces the risk of water penetration during tunnel operation. In addition, a tunnel section is concreted without ties in the outer walls. At the same time, the approach means considerable savings in material and labour costs, thereby reducing the use of raw materials, among other things.

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## **More than 10,000 t of PERI formwork material delivered on time**

The special steel components of the PERI formwork solution were produced in Poland, Italy and at the PERI plant in Weißenhorn, Germany. Planning and execution of the delivery of the entire material with a total of twelve ships and over 250 trucks in accordance with requirements and deadlines were a key factor for on-time completion of the construction project and were made possible through close coordination between the client and PERI. At the end of February 2023, PERI already celebrated the delivery of the one millionth part to the construction site of the Fehmarnbelt Tunnel project in Denmark.

## **Assembly and immersion of a total of 79 standard tunnel elements**

Work is done both on land and at sea. The tunnel elements are produced in a large factory with the size of 140 football fields. The standard tunnel elements are produced on site in a total of five separate production lines, in production halls built especially for the project combined with a working port. Each of the total of 79 standard elements is composed of nine concreting sections with a width of 45.00 m and a height of 9.00 m. Around 3,000 m<sup>3</sup> of concrete are used per concreting section, resulting in a weight of more than 8,000 t each.

After the concreting process, the elements are fitted with bulkheads at both ends and sealed tightly. The basin containing the elements is then flooded with water. Thanks to the tight seal, the elements float and can be transported to the location in the Fehmarnbelt, where they are immersed in the tunnel trench and connected so they are watertight.

## **Highest safety standards and efficiency thanks to PERI solutions**

PERI not only supports the construction consortium with outstanding special solutions or the use of qualified PERI staff at the construction site, but it also makes an important contribution to the progress of the construction providing standard solutions. The factory built on what is currently one of Europe's largest infrastructure construction site involves a large number of different works that can be carried out in a safe and efficient manner.

For example, the use of MAXIMO formwork reduces the need for staff thanks to its fast and simple handling, PERI UP Scaffolding solutions ensure safe access to construction work at the construction site and PROKIT Mesh Barriers reliably protect staff from falls.

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## Consideration of ecological and social factors

In addition to the technical challenges of what is currently Europe's largest infrastructure project, compliance with environmental and social sustainability factors is key for the construction project. The 19 million m<sup>3</sup> of material excavated from the bottom of the Fehmarnbelt will be reused for land reclamation areas and for the construction of overpasses, ramps and embankments in the immediate vicinity of the ferry terminal.

## Training means investing in the future

PERI is giving its apprentices the chance to be part of this extraordinary construction project. Work specially designed for the apprentices gives them the chance to put their theoretical knowledge to practical use and gain experience in a safe production environment.

During a visit to the PERI plant in Weißenhorn in October 2022, representatives of the builder-owner and the construction consortium got a first-hand look at the apprentice programme at PERI. A tour of the factory and numerous discussions with the apprentices left a lasting impression of the professionalism of the apprentice programme on the guests.



**Image 1**

With a length of 18 km, the Fehmarnbelt Tunnel will be the longest immersed tunnel in the world and is considered one of the largest infrastructure construction sites in Europe. PERI has developed an engineering solution that stood out in terms of the required performance and productivity as well as compliance with the highest safety standards.

(Photo: PERI SE)

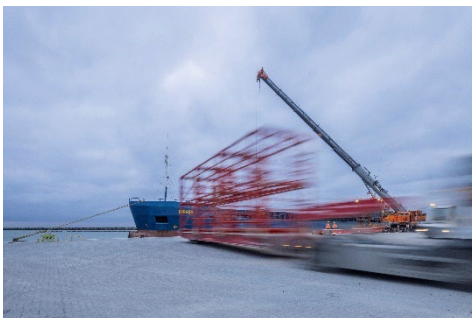


**Image 2**

The complete PERI formwork material was delivered to the working port with a total of twelve ships and over 250 trucks.

(Photo: PERI SE)

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**Image 3**

At the end of February 2023, PERI celebrated the delivery of the one millionth part to the construction site of the Fehmarnbelt Tunnel project in Denmark. In total, PERI has delivered more than 10,000 t of material to date, including the impressive figure of around 2,400 different parts.

(Photo: PERI SE)



**Image 4**

The tunnel elements are produced in a large factory with the size of 140 football fields. Each of the 79 standard elements is composed of nine segments with a width of 42.00 m and a height of 9.00 m and includes four traffic tubes and one rescue tube.

(Photo: PERI SE)

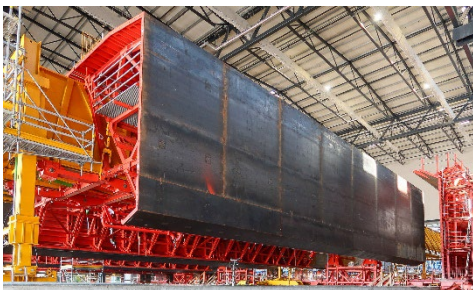


**Image 5**

The parts delivered to the site in Denmark are assembled to allow for efficient concreting processes.

(Photo: PERI SE)

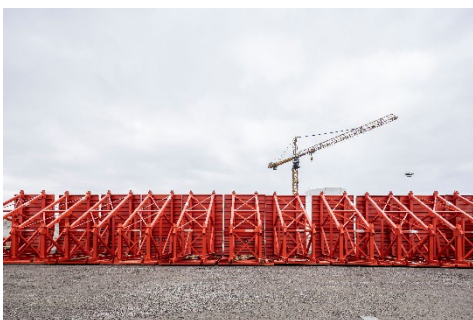


**Image 6**

In total, PERI is supplying formwork material for 79 standard tunnel elements, each 217.00 m long and 73,000 t in weight.

(Photo: PERI SE)

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**Image 7**

Visualisation of the immersion and connection of tunnel elements.

(Illustration: Femern A/S)



**Image 8**

Visualisation of the immersion and connection of tunnel elements.

(Illustration: Femern A/S)



**Image 9**

Visualisation of the casting hall in the tunnel element factory.

(Illustration: Femern A/S)



**Image 10**

Visualisation of the casting process of a standard tunnel element.

(Illustration: Femern A/S)

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## Contractor

Femern Link Contractors (FLC)

*Femern Link Contractors (FLC) consists of VINCI Constructions Grands Projets (France), Aarsleff (Denmark), Max Bögl Stiftung & CO KG (Germany), BAM Infra B.V (Holland), BAM International B.V (Holland), Wayss & Freytag Ingenieurbau AG (Germany), Solétanche-Bachy International S.A.S (France), CFE SA (Belgium), Dredging International NV (Belgium).*

## Field Service

PERI Group Project Support, Weißenhorn, Germany

PERI Denmark

## About PERI:

*With a turnover of € 1,846 million in 2022, PERI is one of the largest manufacturers and suppliers of formwork and scaffolding systems. With around 9,100 employees and well over 160 warehouse locations in more than 65 countries, the family-owned company with headquarters in Weissenhorn (Germany) serves its customers with innovative system equipment and comprehensive services relating to all aspects of formwork and scaffolding technology.*

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