



Headed Reinforcement Corporation Europe

PROJECT INFORMATION – Bjørvika Immersed Tunnel Project

Information about the project:

- 1100m long road tunnel across Oslo harbour as part of the E18 highway reconstruction project
- The project includes a 675m long immersed tunnel and approach ramps
- 6 tunnel elements, prefabricated in a dry dock near Bergen and towed about 700 km to the installation site
- The finished tunnel is part of the busiest road system in Norway

Client: Statens vegvesen (Norwegian Road Authority)
Contractor immersed tunnel: Skanska Norge AS, BAM Civiil BV, Volker Stevin Construction Europe BV
Contractor approach ramps: NCC Construction AS, AF Gruppen Norge
Consultant tunnel: Dr. Ing. Aas-Jakobsen AS
Consultant approach ramps: Dr. Ing. Aas-Jakobsen AS, Reinertsen Engineering AS
Construction time: 2005-20012



Construction of tunnel elements in dry dock
(Picture: Byggindustrien)



Tow of an element to Oslo (Picture: Statens vegvesen)



Approach ramp west under construction



Building site on the east approach of the tunnel

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HRC-Europe has delivered the following products to the project:

HRC 100 series T-headed reinforcement

HRC 400 series reinforcement couplers

HRC 100 T-head



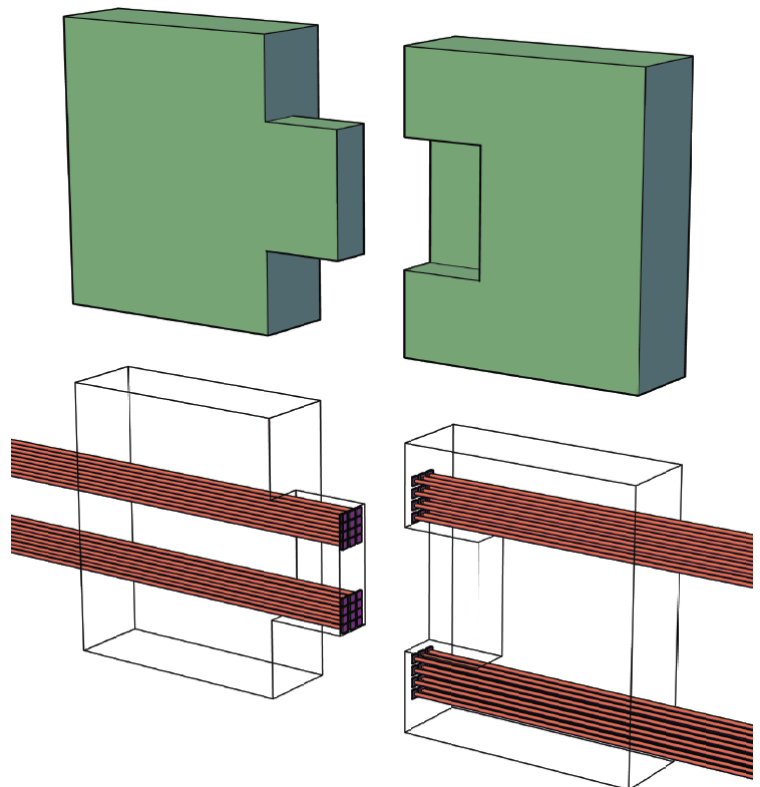
Some examples for the use of HRC-products:

Shear keys in expansions joint between tunnel segments:

Discrete shear keys were used to transfer shear loads in the expansion joints of the tunnel elements. Due to the high shear forces the required reinforcement was quite large. The use of T-headed bars simplified construction and improved casting conditions for this important detail.



HRC 150 used for reinforcement of shear keys

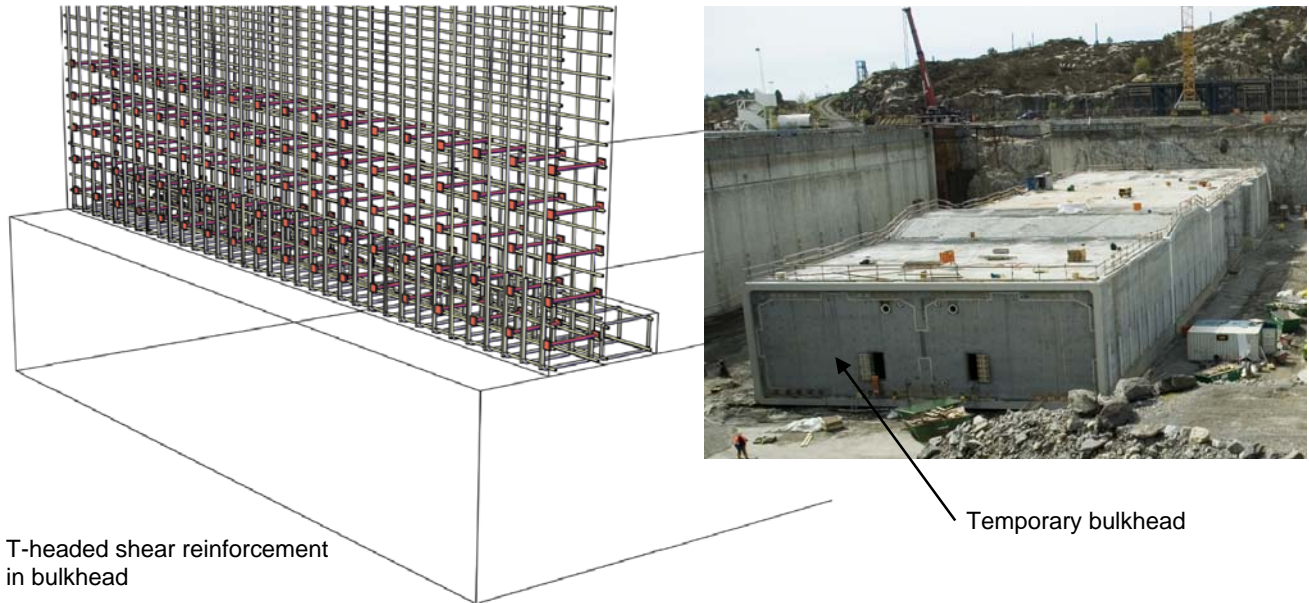


Principle of discrete shear key and application of T-headed reinforcement

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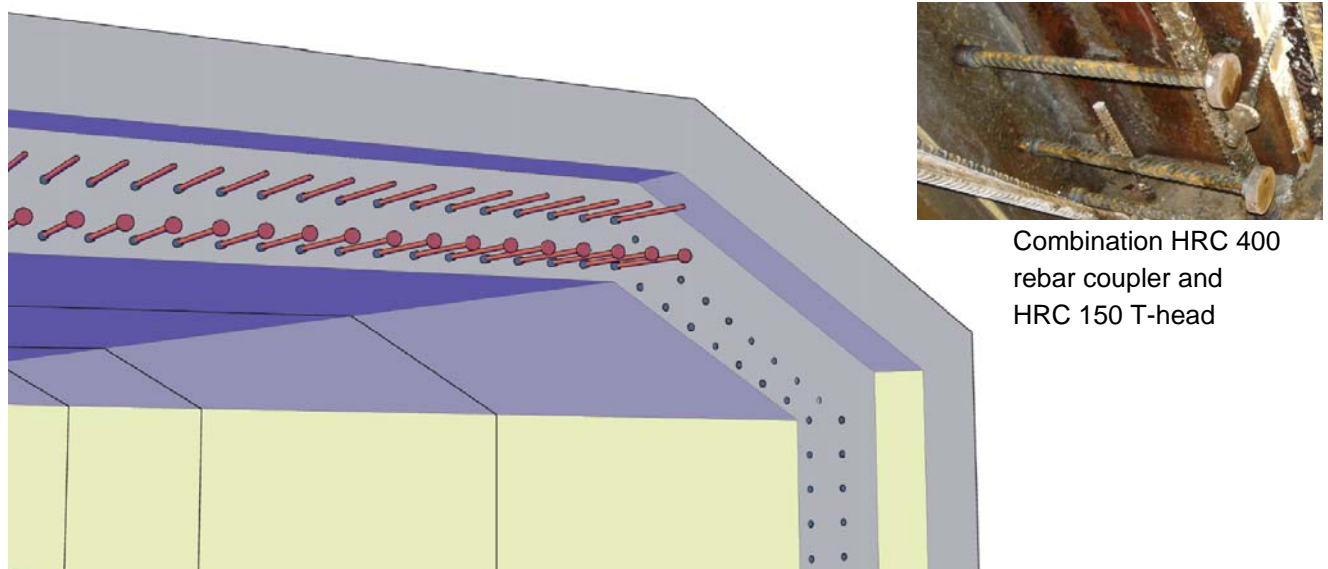
T-headed shear reinforcement for temporary bulkhead:

The temporary bulkheads safeguard the elements during transport and immersion phase. Even if temporary in nature, their function is vital for the project.



Reinforcement of the in-situ concrete between tunnel elements:

HRC 400 rebar couplers were extensively used for the reinforcement of the infill concrete between the tunnel elements. Some of the HRC 400 female coupler components were submerged in seawater for app. 2 years before installation of the male part of the coupler. The coarse tapered threads facilitated the assembly under such demanding circumstances. HRC 400's easy visual quality control made the result reliable.



Principle of connecting reinforcement using HRC 400 rebar couplers and HRC 150 circular T-heads

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T-headed shear reinforcement in slabs and beams:



T-headed shear reinforcement $\varnothing 32\text{mm}$ in large beam



T-headed shear reinforcement in base slab of an approach ramp