



BIM in Civil Projects

Bjørvika Tunnel

Oslo, Norway

Skanska's Dutch partners on this project (BAM and VSCE) have experience on more than 25 immersed tunnel projects, and they brought this invaluable expertise to the Bjørvika Tunnel project as well.

Bjørvika Tunnel	
Length	675 meters (2,000ft)
Number of elements	6 x 112.5 meters (369ft) length
Width	28–43 meters (92–141ft)
Height	Up to 9.8 meters (32ft)
Element weight	30,000 tons

The models usage on this project was focused on correct and accurate geometry. The project demonstrates the innovative use of technology to ensure that the elements would fit together and achieve the levels of precision required to execute the project. Scanning technology and 3-D design were used in the production phase for trench excavation and backfilling design. It was important to gain full control of material quantities and monitor excavation progress from the outset. In particular, the contaminated mud from the sea floor required special techniques for dredging to avoid spreading material. To achieve this, a boat was equipped with a multi-beam scanner to scan the harbor. This helped to create and maintain a highly accurate terrain model of the sea floor, as well as to provide complete terrain models for machine guidance on all dredging vessels.

The tunnel was built using large concrete elements placed on the harbor floor and connected together.

These elements were prefabricated at a dry dock in Hanøytangen near Bergen, Norway. After completion, each element was laser scanned to create a precise, as-built point-cloud model of each element. Once the scan was completed the elements were sealed and prepared for floating and towing from Hanøytangen to Oslo.

The two tunnel mouths that the sunken tunnel was to join were also laser-scanned. These three sets of scanned point-cloud models were put together to enable a virtual quality control of the complete tunnel using the as-built elements and the multi-beam scans of the harbor floor. This quality check confirmed that the tunnel elements fit together correctly with both the harbor floor and adjoining tunnel mouth. The quality check was made possible by setting up the measuring system used in laser scanning at the dry dock at Hanøytangen so that the reference points on the elements could be forced into the correct coor-

ordinate system for the elements final location on the harbor floor. This simulation of as-built geometric data from the elements allowed the project team to set out the elements as if they were in their final positions in the Bjørvika basin. This same as-built data was used for volume calculation for weight control, ballast calculations for the transport leg and geometric checks.

Parallel to the prefabrication of the elements in Hanøytangen, the harbor floor in Oslo was being prepared for placing the elements. During the project 680,000 m³ (24,000,000cf) of material was dredged up from the harbor. The dredged trench was then filled with gravel on which the tunnel would finally rest. The dredging and subsequent backfilling processes were monitored continually using the machine guidance software while the multi-beam scan data was updated on a weekly basis. Once the elements were in place and joined, the seals were removed and Skanska began building the roads inside the immersed tunnels.