

Project Summary

Organization:
AECOM

Solution:
Megaprojects

Location:
Stockholm, Sweden

Project Objective:

- An energy-efficient transport system that provides efficient services in metro areas, and a robust and reliable infrastructure.
- A bypass around Stockholm for the European Highway, comprised of a 21-kilometer motorway incorporating 18 kilometers of twin-tunnels and six interchanges.
- Full compliance with environmental requirements, including construction of a majority of the route underground to mitigate impacts on six natural and cultural reserves.

Products used:

Bentley Navigator, InRoads®, MicroStation®, MXROAD, ProjectWise®

Fast Facts

- Using Bentley's 3D modeling and collaboration applications, the joint venture designed the world's second longest road tunnels, mitigating environmental impacts during construction.
- By 2035, Swedish Transport Administration Trafikverket estimates that the Stockholm Bypass will be used by approximately 140,000 vehicles per day.
- The successful application of BIM processes led Trafikverket to develop a national strategy for BIM implementation on future projects.

ROI

- Using ProjectWise with Bentley's BIM solutions facilitated information modeling, management, and mobility on this SEK 27.6 billion megaproject, increasing efficiency and enhancing data integrity.
- The streamlined, collaborative process for BIM review and checking produced correct, well-thought-out solutions, resulting in significant time and cost savings.
- ProjectWise implementation will carry forward through construction and into operations, enabling better asset management and lower operating costs.

Bentley Technology Drives Joint Venture's Collaboration on E4 Stockholm Bypass

AECOM and ÅF Consult Leverage Power of BIM Methodologies for Integrated Project Delivery

Megaproject Sets BIM Standard

This SEK 27.6 billion multi-discipline project required the AECOM and ÅF joint venture (JV) to design 18 kilometers of twin tunnels for the Stockholm Bypass, a 21-kilometer motorway linking southern and northern Stockholm, Sweden. Intended to reduce the impacts on sensitive natural and cultural resources, the underground link will be the world's second longest road tunnels, with their mainline reaching a maximum depth of 100 meters. Given the magnitude of subsurface work involved, the project required 19 million tons of rock to be excavated during construction.

The JV used an integrated project delivery (IPD) method, fielding a team of 560 designers in 19 disciplines across nine countries. Powered by Bentley technology, building information modeling (BIM) methodologies streamlined the collaborative design process and supported the resolution of technical, construction planning, information management, and environmental challenges. The successful demonstration of IPD incorporating BIM processes led the Swedish Transport Administration (Trafikverket) to spearhead a national strategy for BIM implementation.

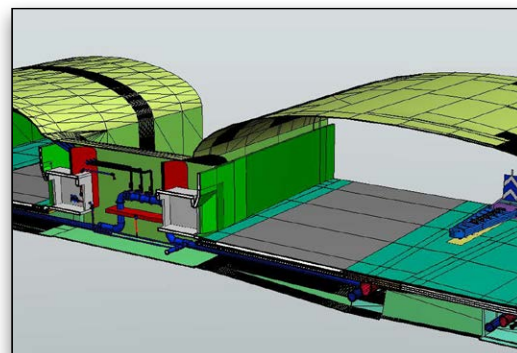
Massive Civil Engineering Challenge

Trafikverket investigated various alternatives for the European Highway (E4) to link southern and northern Stockholm while bypassing the city itself. The chosen alignment will support growth and development in the region, unify the labor and housing markets, and relieve traffic congestion on the Essingeleden motorway, which today operates at twice its design capacity. AECOM and ÅF Consult, a Swedish engineering and consulting company, formed a joint venture to undertake the Stockholm Bypass project's biggest design contract—FSK02 Rock Tunnels—one of the largest civil engineering undertakings in Sweden.

The twin tunnels each comprise three lanes with hard shoulders, as well as safe evacuation passages and tunnel operation facilities. In addition, three major underground interchanges required connecting tunnels for exit and entrance ramps. During construction, separate access tunnels and crushing chambers were needed to efficiently transport

the 19 million tons of rock excavated from the site. Temporary jetties had to be installed to transport 50 percent of the rock by conveyor to sea transport. A foremost consideration during construction was minimizing adverse effects on local residents and the environment, which included sensitive areas such as a UNESCO World Heritage site.

This massive undertaking presented countless engineering hurdles, as well as design process, workflow complications, and project information management challenges. With hundreds of designers working in multiple countries, the various design teams generated more than 50,000 documents during the design phase for the FSK02 Rock Tunnels contract alone. Effective communication and collaboration were paramount to successfully delivering the design.



Bentley's BIM solutions facilitated 3D modeling, collaboration, and integration among the diverse project teams, with ProjectWise® as the common data environment.

Interoperability and Information Mobility

Trafikverket used BIM to standardize information flow in design and construction, paving the way for its use on all future projects procured in the Swedish construction industry. AECOM - ÅF joint venture proposed a strategy that emphasized interoperability and information mobility as the way to ensure accessibility of the right information to the right people at the right time across the entire project lifecycle. The JV also advocated for IPD, emphasizing a collaborative, cooperative way of working to produce technically comprehensive designs.

“Bentley’s software allowed the AECOM - ÅF joint venture team, which consisted of more than 560 people working across nine countries, to successfully deliver the design of the Stockholm Bypass, one of the largest infrastructure projects in Sweden. It is difficult to contemplate how a project of this magnitude and complexity could have been delivered without the use of building information.”

— Kenneth O’Hara,
Project Director, AECOM

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The JV selected Bentley’s BIM methodology to facilitate 3D modeling, collaboration, and integration among the diverse project teams, and ProjectWise to establish a common data environment for all stakeholders. ProjectWise enabled the use of custom workflows (a derivative of BS 1192), and location of textual documents and CAD models in a geospatial context. By building an integrated information model, AECOM assessed the impact and operations of the tunnel facilities in a virtual environment to determine technical solutions, reduce construction risks, and meet environmental standards. Bentley software ensured accurate integration of numerous multi-discipline models, enhancing data integrity.

During detailed design, a dedicated information management team provided support and training for the design teams, as well as developed automation tools with functionality such as asset code checks, document metadata checks, and document list creation.

Intelligent Modeling Reduces Errors

Using MicroStation®, MXROAD®, and InRoads®, AECOM modeled evacuation routes and tunnel facilities. ProjectWise allowed the incorporation of metadata in all 3D designs to facilitate asset management throughout the project lifecycle. Bentley’s i-model technology enabled open infrastructure information exchange, with ProjectWise ensuring information mobility. The common data environment in conjunction with BIM standard libraries, codes, and processes allowed the design teams to collaboratively produce models that adhered to project principles.

Bentley Navigator provided the collaborative 3D design environment necessary to detect clashes and design issues among models created by the 19 different disciplines. The 3D model reviews also presented an opportunity to identify coordination and phasing issues that could result in safety concerns, which in turn ensured the integration of relevant

infrastructure assets. The intelligent model became the basis for scheduling, quantity and cost estimates, and construction-ready design documentation. The common data environment provided by ProjectWise facilitated the delivery of information to contractors during construction. Contractors accessed models for applications such as automatic machine guidance to assure quality and safety of onsite operations.

National Strategy

Using ProjectWise to provide a common data environment permitted rigorous optioneering during design development. The streamlined, collaborative process for review and checking design detailing produced correct, well-thought-out solutions during the early stages of the project. As a result, significant time and cost savings will be realized in the operations phase. The use of ProjectWise will carry forward through construction (expected to be completed in 2025) and into operations, enabling better asset management and lower operating costs.

Bentley’s interoperable modeling and collaboration software enabled effective asset management throughout the entire project lifecycle. The software’s information mobility and BIM review processes ensured effective collaboration, enhanced data integrity, eliminated potential discrepancies and conflicts, and reduced overall risk. This significantly diminished the number of cost events during construction.

The AECOM – ÅF joint venture introduced a new way of working in Sweden. The power and flexibility of Bentley technology enabled the JV team to successfully collaborate, design, and coordinate the multi-discipline models. Productivity increased, and information was used more efficiently. The successful application of BIM processes during the design phase of this megaproject led Trafikverket to develop a national strategy for BIM implementation on future infrastructure projects.