BIM Track for Underground Infrastructure: Subway line expansion by Amberg Engineering

The project

Stockholm's Tunnelbana metro system is both modern and extensive. A new expansion project, starting in late 2018, will build a new four-kilometer subway line from Odenplan to Arenastaden, with 3 new subway substations.

The job

Amberg Engineering, as one of the underground engineering consulting companies of the Tunnelbana Odenplan to Arenastaden project, was tasked with finding engineering solutions for challenging areas in the subway tunnels & modeling and coordinating the tunnels through the use of BIM.

Figure 1. Expansion plan of Stockholm's Tunnelbana metro system from Odenplan to Arenastaden, "Yellow Line" (Image courtesy of Stockholms läns landsting)

The challenge

Amberg faced several physical challenges in the "Yellow Line" expansion. They had to figure out how to cross a current subway city line and connect the new tunnels to the existing subway network—all while factoring in hard granite and gneiss formations with numerous weakness zones, as well as low rock cover situations with only approximately 4 meters of rock.

What's more, the project had very tight deadlines. A new way for a large, multidisciplinary infrastructure team to collaborate than the conventional coordination and review processes was needed. On previous projects, information about model issues was exchanged in presentations and via lists and pictures sent by email. This team needed to work together simultaneously on complex 3D geometries and modelling that require advanced methods, such as 3D parametric modelling along horizontal and vertical alignments with varying tunnel cross sections, divisions and cross passages, to cope with major changing boundary conditions such as changing alignments for the new subway stations and lines.

The solution

From the onset of the project, the engineering team of record, WSP Sweden, and Amberg, had the goal of using the federated model for calculation, design, communication and coordination. To reach this lofty goal, the team knew that they needed to develop a well-oiled BIM coordination workflow. By fully understanding the interactions and needs of each team, the teams worked together to first clearly define everyone's roles and the communication processes.

After defining these human resources workflows, the team implemented the intuitive, web-based collaboration platform, BIM Track. Thanks to the tight integration between Navisworks and BIM Track, the Amberg team established a coordinated BIM workflow that gave the interdisciplinary team real-time access to critical information, as well as the ability to communicate around this information.

The engineering challenges were tackled using both the geometrical information on the project, as well as calculation models (2D and 3D numerical simulations, based on the information contained in the 3D model for rock excavation, rock and ground surface, geological information, surface loads, etc.) for certain areas.

Making geometrical information available in the coordination model to all technical stakeholders was the top priority as the design was not yet fully detailed. Since all issues related to geometry (ex: connections to stations, space for installations, etc.) were synchronized across software platforms using BIM Track, the data was reliable, and all issues could be resolved more accurately. The 3D geometry was also used as the source of information for setting up the calculation models.

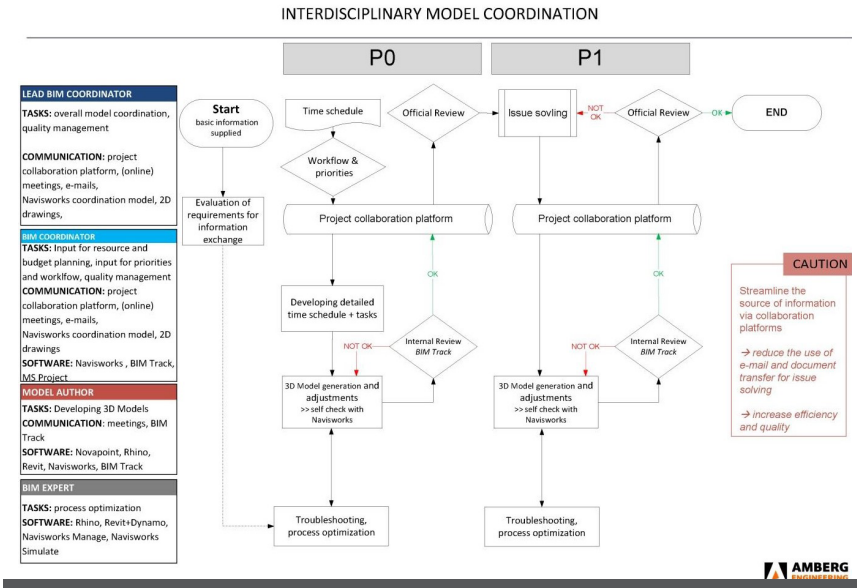

Figure 2. Interdisciplinary model coordination workflow. Image courtesy of Amberg Engineering.

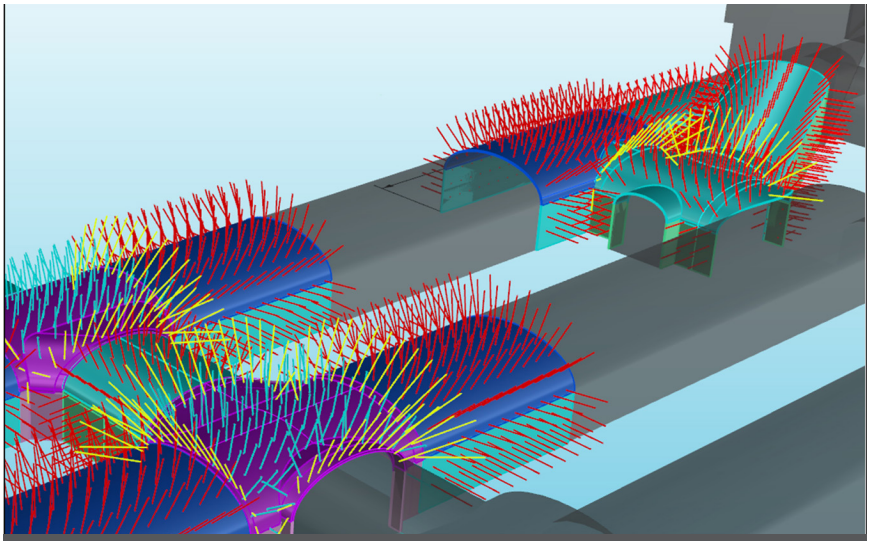

Figure 3. 3D Rock Excavation Model of Hagastaden Station. Image courtesy of Amberg Engineering.

Results

-60% Almost 60% less email between the model coordinator and modelling team.

-30% 30% less issues thanks to quicker detection of clashes and discrepancies.

Improvement

^ quality in delivered models

^ traceability during review processes and to ensure compliance

Accelerated issue management time and productivity

We have learnt that conventional coordination and review processes are no longer working with this new level of speed. BIM allows the different engineers to work simultaneously at the same project, that means communication has to be quicker and clearer. The BIM Track platform allowed us to detected errors or clashes very quickly and automatically send a message to the responsible person. This made us feel confident about the high quality of our work. On the whole, the new processes and possibilities coming with BIM Track created a much more relaxed atmosphere in the planning team.

MAGDALENA STELZER Tunnel engineers at Amberg Engineering.

ABOUT MAGDALENA STELZER

- Studied Civil Engineering with a specialization in geotechnics and tunneling at the University of Technology in Graz, Austria.
- Project Engineer at Amberg Engineering since 2016 in the tunneling department where she works on tunneling projects in Switzerland and throughout Europe.
- BIM coordinator and member of the Amberg BIM department.

ABOUT AMBERG ENGINEERING

Amberg Engineering, as part of the Amberg Group, is a Swiss-based engineering firm that specializes in underground structures, including railway, road and metro tunnels, as well as infrastructure galleries. Founded over 40 years ago, they provide solutions from planning, design, site supervision and commissioning through to renewal and refurbishment of structures. Their expertise also includes project management and consulting, as well as inspections and state assessments.

ABOUT BIM TRACK

BIM Track® is a collaboration platform to enhance your BIM coordination workflow. Users can create, transfer and review issues from different platforms, including Revit, NavisWorks, Tekla Structures and the cloud-based web application, making issues transparent to the whole project team. Communication occurs in real time and issues are viewable at the click of a button.

See how BIM Track can improve your next project