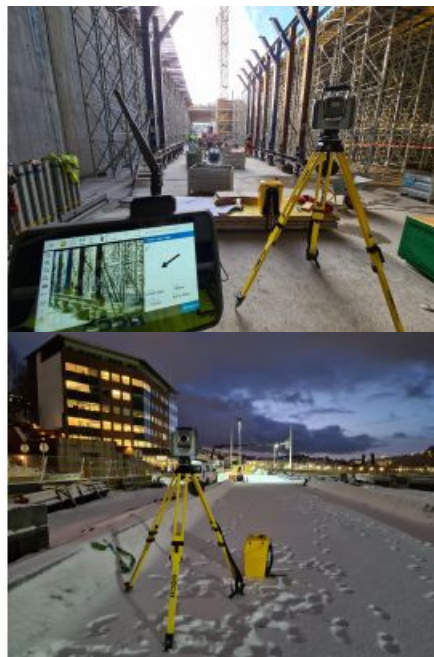
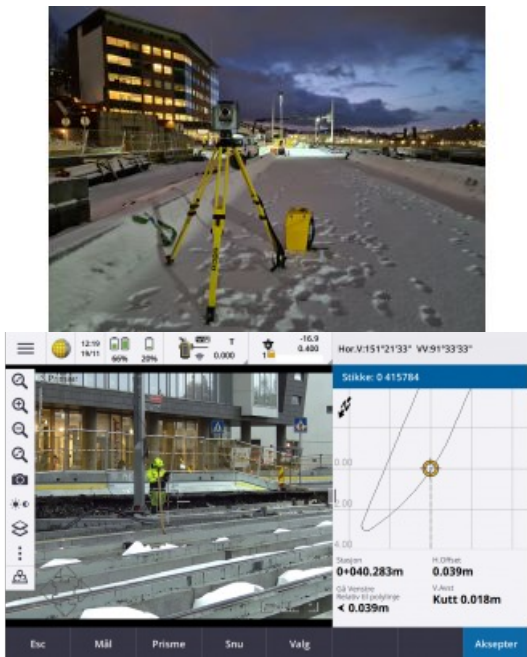


Norwegian Light Rail Project Goes Paperless with Digital 3D Models



When Bybanen Utbygging was hired for the complex Bergen Light Rail Project in Norway, it decided to go paperless and provide all building information for Phase 4 via 3D BIM models. Vestland County Municipality and parties in the Urban Growth Agreement for Bergen had asked Bybanen Utbygging to manage the light rail design, construction and operations with an emphasis on environmentally friendly solutions. This fits in with a broader trend of growing concerns about the environment, driving organizations to explore new tactics to make engineering, planning and construction 'greener'. Not only does

Bybanen Utbygging's innovative approach conserve resources, it also improves the flow of information when sharing updates with construction contractor NCC.

All Digital Design and Construction

In 2019, Bybanen Utbygging, an agency within Vestland County Municipality, selected [NCC](#) as the builder for two sections of the Bergen Light Rail Project. NCC completed the D16 Fyllingsdalen section in mid-2021 and is currently working on [D14 Mindemyren](#). This is NCC's eleventh project on the light rail line since 2008.

The D14 project consists of demolishing existing infrastructure, establishing a project-design line for 1.6km of light rail double track, building new underground infrastructure and a new road alongside the track, and realigning the watercourse. NCC's responsibilities include removing approximately 800 storm water, wastewater and drinking water manholes, purchasing new pre-fabricated manholes from suppliers, staking out the locations and installing the manholes and related pipework. The firm is also building a multitude of concrete constructions, such as a highway bridge and supporting walls.

To the south, NCC's contract ends where the Løvstakken tunnel starts (D15) but includes the concrete portal for the tunnel. The twin tunnel will have a bicycle/pedestrian tunnel on one side and the light rail in the other. When finished it will be Europe's longest bicycle tunnel at 2,900m long.

The construction process starts with the measurement of existing structures, then the majority of soil and existing infrastructure is removed, and new soil and infrastructure are put in its place to upgrade the entire area. To efficiently receive their client's IFC-formatted 3D models and to expedite data capture and new construction, NCC utilizes a Trimble SX12 scanning total station and a TSC7 controller running Trimble Access software. Access to models in the field helps workers visualize the desired results and implement the design accurately and efficiently to reduce disruption in this active industrial and commercial area.

"We completed the D16 portion of the project using equipment other than the [Trimble SX12](#)," says Richard A. Olsen, chief survey engineer with NCC. "The addition of the SX12 on the D14 stretch allows a more streamlined and direct process from design to construction/stake-out which we found to be missing before." The system combines the capabilities of a high-accuracy robotic

total station and a high-speed 3D laser scanner in one piece of equipment, providing flexibility and efficiency for a variety of activities. Several performance upgrades included in the SX12 made it an attractive solution for the Bergen Light Rail Project.

□ During portal construction on the tunnel leading to Fyllingsdalen, the Trimble SX12 is used to set the beams and supports at exactly the right height from the floor so no further adjustment is needed as construction progresses. (Courtesy: NCC)

The green focusable laser pointer yields the smallest spot size in the industry, just 6mm at 100m. Also, integrated cameras in the telescope produce sharper images with richer colors and less noise. The narrowest field of view can be used to create extremely detailed metric panoramas with a pixel size of less than a millimeter at 50m.

“We chose the SX12 because of the combination of technologies: the three integrated and calibrated cameras in the telescope, combined with the green laser pointer, allow a single operator to perform concrete stakeouts straight from IFC files provided by the client,” says Richard A. Olsen, Chief Survey Engineer with NCC. “The cameras are very useful in situations with lots of traffic, fences and other obstacles that can interrupt line of sight, enabling the operator to see where the obstacle is and take necessary action to rectify it.”

The integrated software also streamlines the post-processing workflow and the distribution of revised models. Trimble Business Center is used to export laser scan data and perform network corrections and traverse calculations. The IFC files are loaded into [Trimble Connect](#) (a cloud-based common data environment (CDE) and collaboration platform), and [Trimble Sync Manager](#) synchronizes jobs and data between the [TSC7 controller](#), Trimble Connect and Trimble Business Center. With other data controller software, the IFC lines have to be processed into a format the software can handle, creating time-consuming work when there are constant revisions. With this combination of tools in the field, workers easily extract the most current measurements, contour heights and other details on demand, which makes the workflow from model to stakeout a shorter process.

“Trimble Access is the only data collector software we have found that is able to handle the IFC-formatted models being used on our project,” says Olsen. “It’s easier to stay current with changes since we load the fully revised model on the TSC7 controller. Our ability to collaborate and plan on a digital platform is key to meeting the client’s and other third parties’ expectations.”

□ Screenshot from the Trimble TSC7 while a surveyor stakes out/checks curb stone

Green Process Improves Efficiency

The innovative BIM model approach results in a streamlined design and construction process that supports the goal of conserving resources and encouraging sustainability. The extensive use of 3D models creates an effective platform for the exchange of information between designers, engineers, contractors, owners, and other interested parties. Everyone involved is able to visualize the project in its entirety and access the details relevant to the day’s work, which improves collaboration and reduces errors and rework.

Trimble software and hardware is unique in its ability to load and work with the IFC-formatted models being used in this paperless workflow. In addition, Trimble’s advanced scanning total station expedites surveying with a high-precision laser pointer and integrated cameras and quickly documents situations in the field that would normally require a site visit to inspect. The combined savings of materials and time are a step in the right direction for greener construction.

The D14 Mindemyren project is scheduled to be completed by early 2023. As part of “Grønnere Bybaneutvikling” (greener light rail development), NCC has applied for a [CEEQUAL certification](#) of the project and is aiming for a “very good” rating. The CEEQUAL is a sustainability assessment tool applied to civil engineering, infrastructure, landscaping and public realm projects that validates performance against an internationally recognized benchmark.

□ Work on the Bergen Light Rail Project is not delayed by winter weather. The Trimble SX12 operates in the cold without issues. (Courtesy: NCC)

<https://www.gim-international.com/content/news/norwegian-light-rail-project-goes-paperless-with-digital-3d-models>
