The SOFiSTiK Bridge + Infrastructure Modeler – an important part of the BIM infrastructure process

Parametric modelling of axis-based infrastructures in Autodesk® Revit® 2020, 2021 and 2022

Since the product launch in autumn 2018, the SOFiSTiK Bridge + Infrastructure Modeler has found its place with planners, construction companies and customers. Many national and international projects have been carried out using the tool and there is no end in sight. Thanks to the intensive exchange between the development team and our customers, many great functions were added in the past three years. They improve and reduce the modelling steps, as well as significantly easing the BIM process in infrastructure construction.

Infrastructure projects consist usually of lengthy structures, following an axis. Along these axes, additional engineering structures such as bridges, underpasses, tunnels, retaining walls, etc. are necessary. Routes and engineering structures are often worked on by different planning offices. Basis for the civil engineering planning is axis and as-built data, e.g. from the terrain. It is then used for planning engineering structures. In a BIM process it is imperative that essential model information is "fed back" to a centralized coordination model. During construction, a continuous stream of new information and updating model data is critical. For operating the infrastructure, a as-built model can be created, a so called "digital twin". This model can then be linked to monitoring systems (e.g. SmartBridge Hamburg https://www.homeport.hamburg/portfolio/smartbridge) or be enriched with further data.

The SOFiSTiK Bridge + Infrastructure Modeler is the perfect fit for this workflow

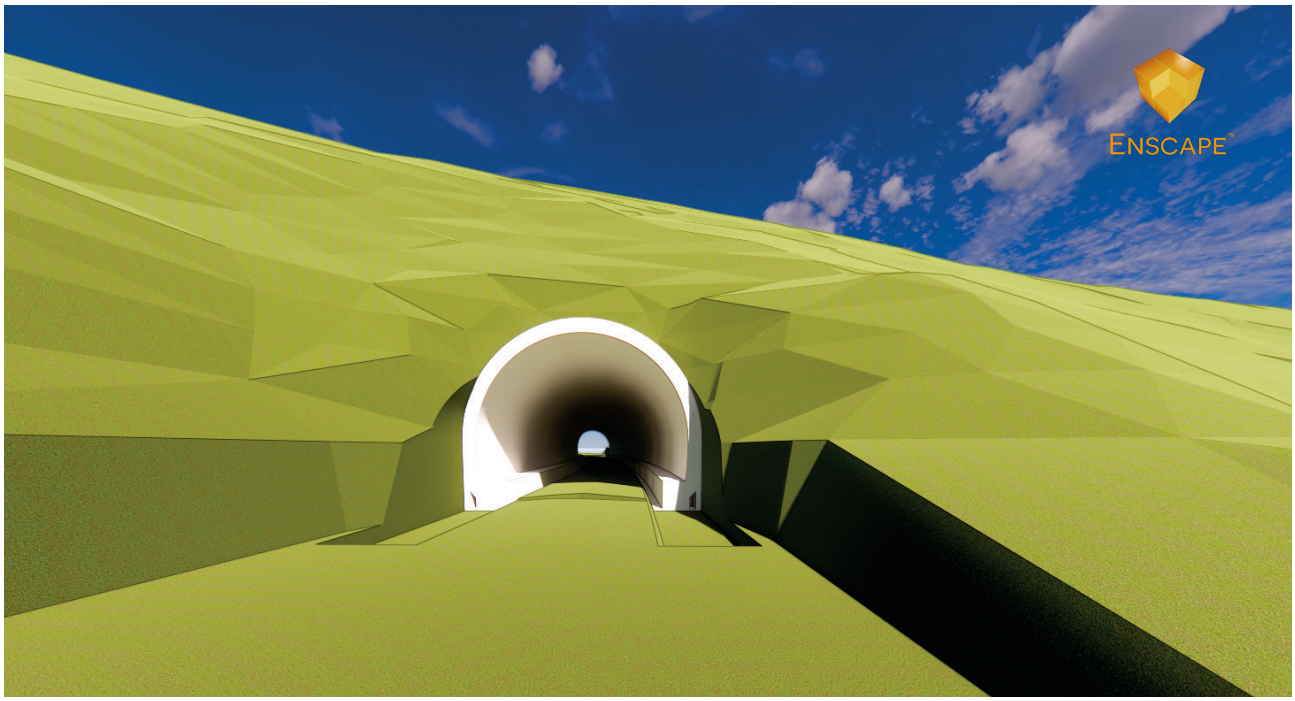
Image: BIM infrastructure process with SBIM

New Features
Many new features have been added to SBIM in the past two years to optimize your modelling process. New functions:

- Functional extension for modelling of precast bridges, tunnels, trough structures and railway bridges
- New modelling functions: duplicate, transfer parameters, graphical placement creation
- Enhanced axis functions: import, link, export
- Enhanced cross beam functions: e.g. modelling of tunnel segments
- Enhanced terrain functions: import and intersection
- Improved plan derivation with extended labelling and update functions
- Interface to SOFiSTiK FEA
- Improved quantity determination

The following part shows some of these new features in detail.

Tunnel
There are several approaches to modelling tunnels, all of which are supported by SBIM. The simplest approach is to model the tunnel like a bridge superstructure. A cross section extruded along an axis to form a volume. Alternatively, the tunnel can be modelled in blocks. Individual blocks can easily be exchanged, if required. Depending on the modelling approach quantities of individual construction stages, per block, can be evaluated. The "Terrain" function turns a terrain surface into a volume model. The tunnel can then "dig" through the terrain model. Unfolded section representations are easily created using the "Longitudinal" function. It creates a clear and easy to understand cut, following the complex geometry of an axis.



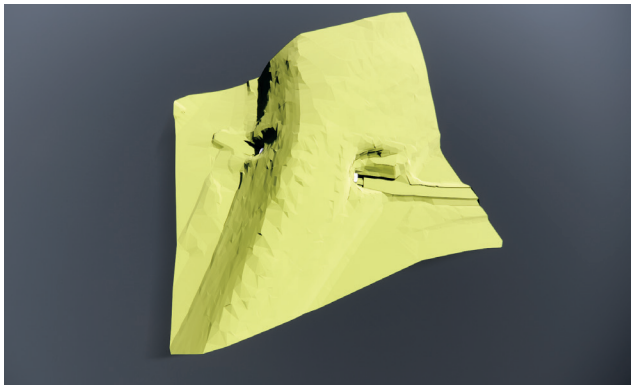


Image: Tunnel project Treuchtlingen Ingolstadt railway line

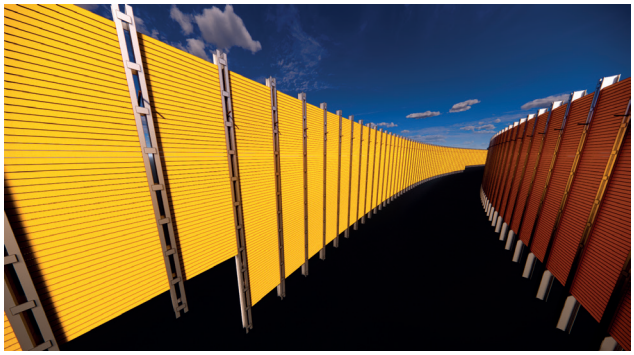


Image: Vertical excavation pit with anchors

Trough Structures / Excavation Pits
Similarly to tunnels, trough structures and excavation shoring/sheet pile walls are modelled and built polygonal along an axis. The lengths of the individual elements are predefined along the chords of the axis. With new options for the new layout rules, even the most demanding modelling requirements can be easily implemented.

If tolerances and spacing are properly considered for modelling anchors, collisions are found easily and quickly. They can then be avoided by changing, e.g. the anchor direction.

Railway Bridges
A special case is modelling short to medium span railway bridges. The bridge structure is usually straight and the crossing angle between the railway and the crossing element is known. For modelling truss bridges SBIM offers a special function that models the trusses easily and quickly. Simultaneously, it generates an analytical model for a subsequent calculation.

Analysis Link
Structural engineers and design engineers have completely different model requirements. Nevertheless, axis information, cross-section outlines and other variables are needed to create an idealized structural model of the construction. Exactly this structural data is transferred with the "Analysis Link" to the SOFiSTiK FEA environment. There, the required calculations and verifications can be performed. Adjustments, e.g. of the cross-section are simply transferred back to Revit by exchanging parameters.

Terrain Import
Every infrastructure is positioned according to the terrain. This should also be considered in the planning process. In addition to modelling the final state, e.g. of a new bridge, it can be important to model necessary excavations and terrain adjustments. The "Import Terrain as Volume" function fulfils the prerequisite for carrying out further terrain modifications. We complemented corresponding intersection functions.

Quantity Determination
Once the construction model is completed, the data should be prepared and ready to be used for further 4D and 5D planning. Especially for a 5D evaluation, it is imperative to be able to derive quantities from the model. The "Quantification" function from SBIM allows you to derive quantities even from the most complex components. These can then be used, e.g. for a bill of quantities. Such quantity evaluations are also important for the planning and organization of the construction site.

Reference Project
This road underpass was designed by ibbs ZT-GmbH in Vienna. In addition to the final state, the excavation shoring and the temporary bridge were modelled. It is a complex structure but one that often occurs in these situations.

Outlook
The constructive cooperation with our users and positive feedback strengthens our conviction to create an even better product for the BIM infrastructure process. Progress and innovation are both a motivation and a requirement for our future developments.

As already mentioned at the beginning, the requirements for a BIM model are different throughout the life cycle of an infrastructure. For example, there are different requirements for the model in preliminary and design planning compared to execution planning. In terms of 4D and 5D, additional requirements are added once again. The "as built"

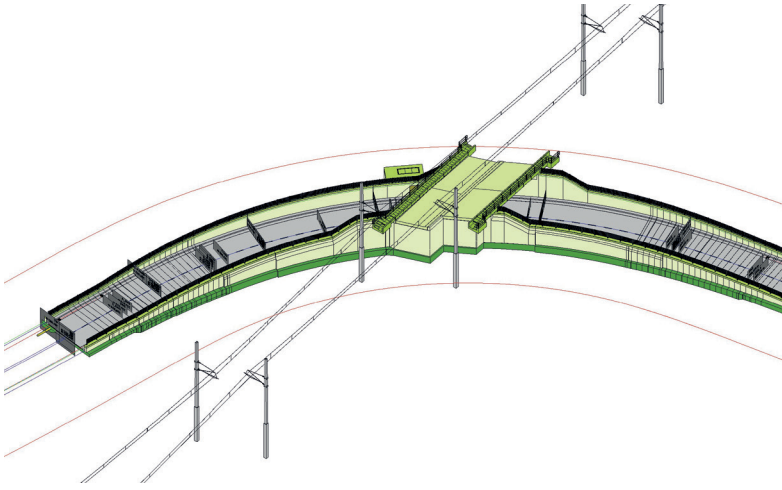


Image: WIB bridge for ÖBB / Screenshot Revit

Image: WIB bridge for ÖBB

information is then important for the operator. The question of whether these requirements can or must all be covered by a single BIM model is neither complete nor clearly answered. It remains exciting to see how the processes and experiences develop. We offer you a software solution integrated in the BIM process that can generate models for many requirements easily and quickly.

Summary

After the launch of SOFiSTiK Bridge + Infrastructure Modeler in 2018, it was immediately used by bridge designers to create successful projects. The simple four-step workflow for axis-based parametric modelling of engineering structures within Autodesk Revit has proven itself. This universal concept can be used for all axis-based infrastructure projects in structural engineering.

The user-friendly handling and seamless integration in Revit enables users to implement daily engineering tasks in a BIM workflow easily and efficiently with little training effort.

We would like to thank all users for their constructive feedback. It helps us to further develop and improve the tool. We especially thank Clemens Schweighofer from ibbs ZT-GmbH, who provided us with the reference project.

For more information about SOFiSTiK Bridge + Infrastructure Modeler, please visit:
www.sofistik.com/bridge.

Dr.-Ing. Martin Siffling
SOFiSTiK AG Nuremberg

Clemens Schweighofer from ibbs ZT-GmbH in Vienna about his work with SBIM:

“SBIM supports us in overall planning of complex engineering structures such as bridges or trough and tunnel structures. Not only definitive structures can be easily modelled using parameterizable cross-sections, but also excavation pits and earth excavations. In line with the BIM concept, 3D models are created as an integral part of our planning process. We obtain not only the necessary 2D planning documents, but also masses for tender documents. The centralized model is used for planning meetings, coordination and visualisations. We benefit greatly from teamwork on the digital building model. Additionally, working with SBIM is great fun for everyone involved.”

SOFiSTiK

SOFiSTiK AG · Flataustr. 14 · 90411 Nuremberg · Germany
info@sofistik.com · www.sofistik.com