

## BIM - Building Information Modeling

Structural engineering, minus the gaps and improvisations

## About the authors



### Frank Deinzer

Frank Deinzer is a member of SOFiSTiK's executive board and is responsible for sales and marketing. He received his civil engineering degree (Diplomingenieur) from the Technische Universität München. Frank has a strong background in information technology and software engineering. He served as head of GUI development and vice president of products and marketing before accepting the position of managing director in 2010. He assumed responsibility for sales and marketing in 2015. Frank strives to continually improve the usability of SOFiSTiK's applications while relentlessly pursuing innovations based on his deep understanding of the market.



### Armin Dariz

Armin Dariz is managing director of BiMOTiON, a member of the SOFiSTiK group. Armin held various positions as a structural engineer after he graduated from the Graz University of Technology. From the moment he learned of BIM and Revit back when it was still a new technology, he was fascinated and began exploring its potential for use in structural engineering. His next step was to found the startup cmotion in his hometown Brixen in the Italian Alps in 2009. Recognizing the enormous potential for innovation this technology represented, he teamed up with SOFiSTiK in 2010 to found BiMOTiON. His team oversees product management and training for SOFiSTiK's BIM portfolio.

# Structural engineering, minus the gaps improvisations

SOFiSTiK provides first 100-percent integrated BIM workflow for structural engineering

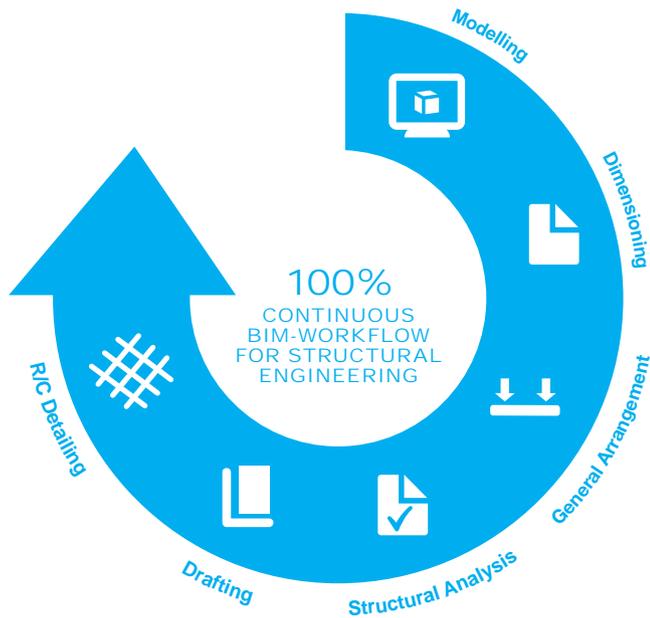


Figure 1. Structural engineering workflow

It's a breakthrough in construction planning: For the first time, all necessary steps from modeling through to generating reinforcement sheets for civil and structural engineering projects can be carried out within a single consistent data model. Using add-on modules for Autodesk Revit 2016 from SOFiSTiK AG, the last gaps in BIM-based structural engineering workflows (fig. 1) have now been closed. This integration into a single data model is not only extremely efficient, it also leads to a noticeable increase in planning qua-

lity. Changes are consistent across all aspects of the planning, and machine data can be generated for fabrication.

Here's the planning workflow:

## a) Modeling in Revit

The planning engineer either generates the geometric model directly in Revit or imports it through the IFC interface. This 3D model is object oriented and also contains all the necessary construction information. All data is stored by Revit in a centrally managed database.

## b) Optional: generating parametric models with Dynamo

Dynamo is a free, open-source plug-in for Autodesk Revit that gives users a visual programming editor for Revit. With this plug-in, users can for the first time parameterize structures in Revit and display case studies. In visual programming, existing or self-developed code blocks are linked to one another to generate mathematically describable elements and structures (fig. 2). Users don't need programming skills to be productive with Dynamo. Dynamo projects are created directly in Revit and can then be used normally.

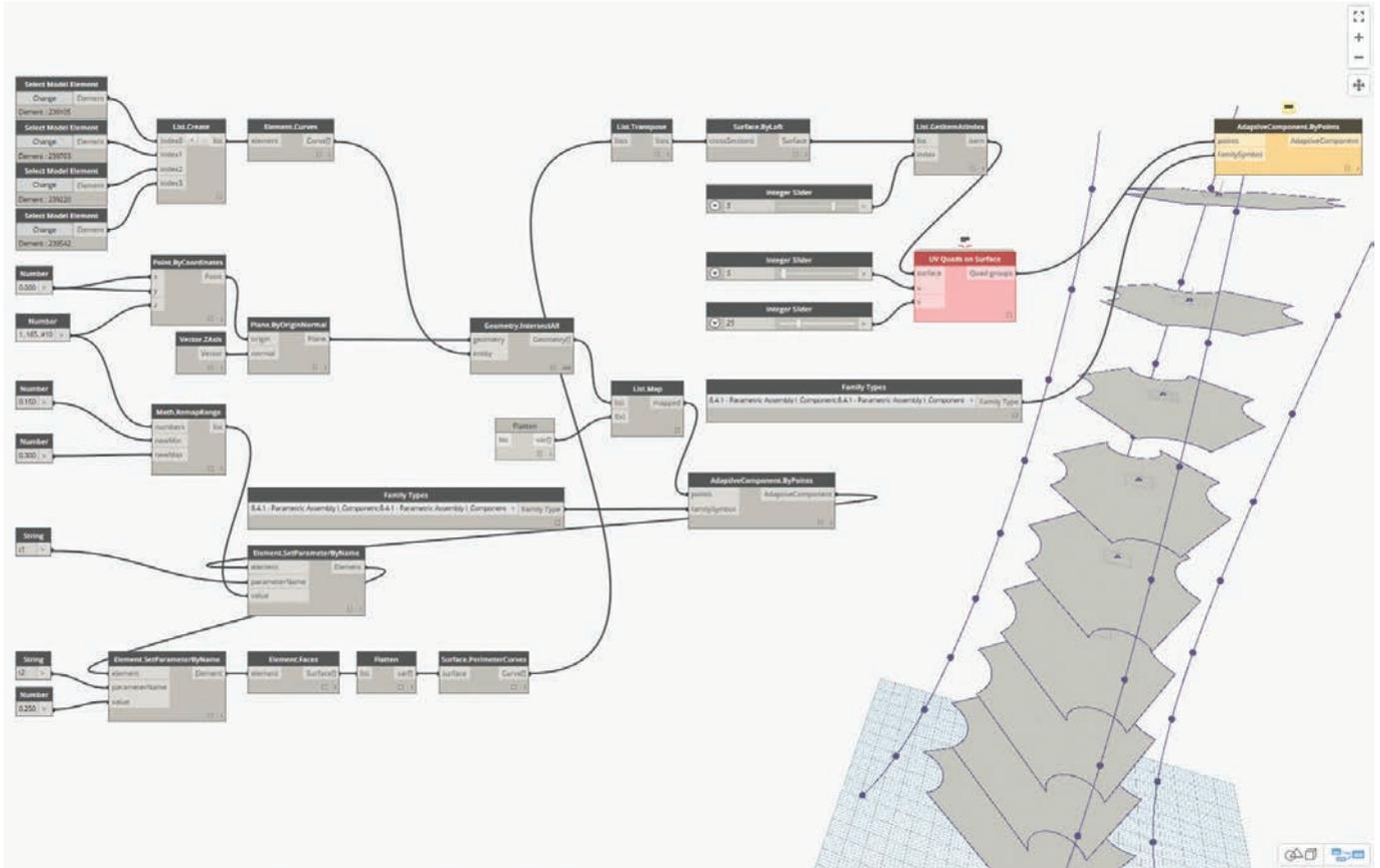


Figure 2. Visual Programming in Dynamo for Revit

### c) Generating general arrangements and formwork plans

General arrangement and formwork plans can be generated right from the Revit model. SOFiSTiK BIM-TOOLS also provides a number of additional tools such as automatic dimensioning. These tools increase the efficiency of creating plans in Revit by up to

50%. Plans that have already been generated are updated in real time when changes are made to the 3D model. BiMTOOLS is available free of charge in the Autodesk App Store.

## d) Modifying the analytical model

When generating a model in Revit (the geometrical model), an analytical model is automatically generated as well (fig. 3). This analytical model is an initial proposal for the structural engineer and can of course

be modified as necessary within definable tolerances. Modifications to the analytical model do not alter the geometrical model.

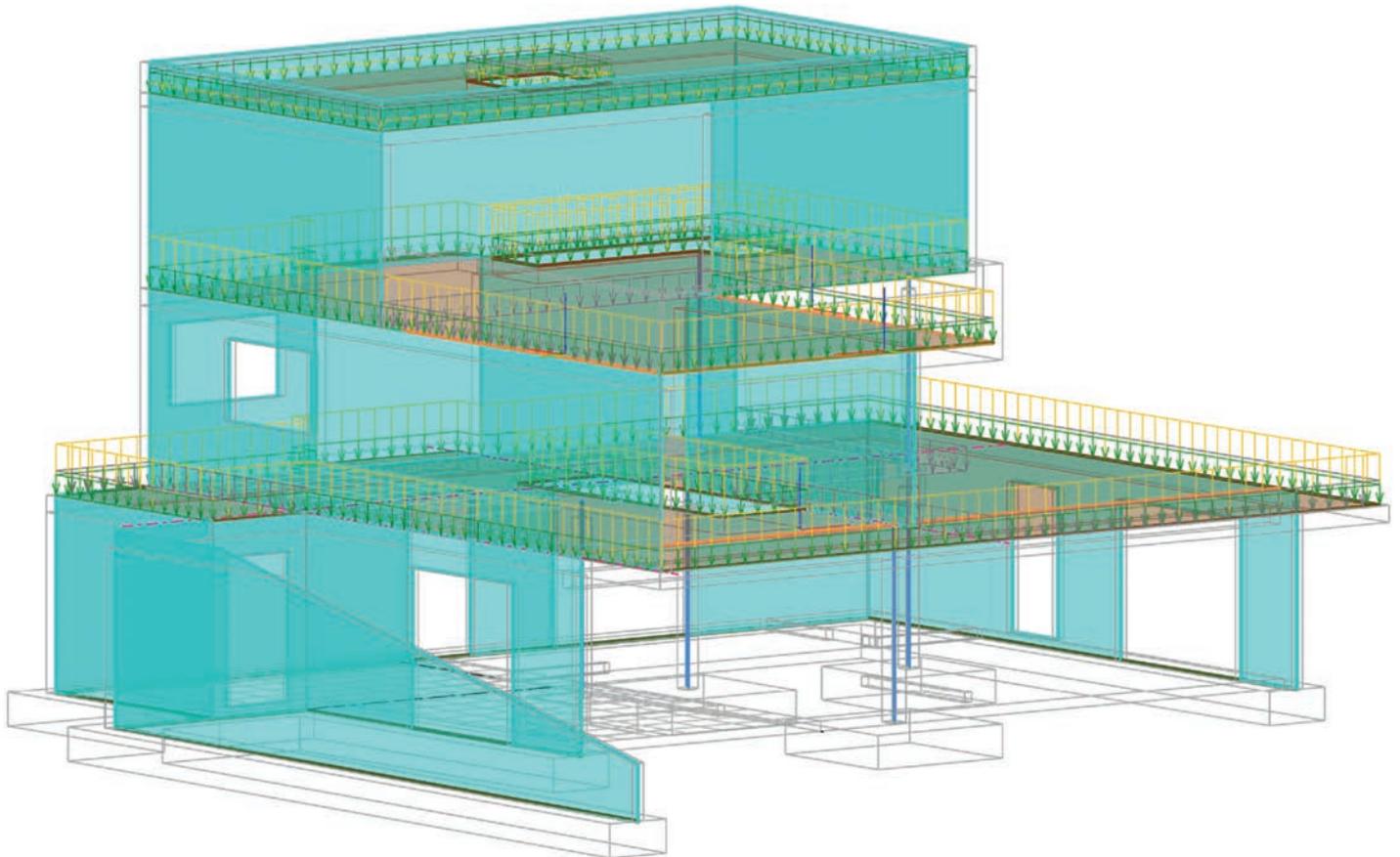


Figure 3. Analytical model in Revit

## e) Analysis, dimensioning

The SOFiSTiK FEA Extension generates a 3D FEA system or a 2D FEA subsystem straight from the Revit analytical model including all loads and boundary conditions (fig. 4). In SOFiSTiK Structural Desktop, analysis, enveloping, design and dimensioning for the FE systems are performed according to the standards that apply in the respective countries. In the 2016 version, characteristics that affect finite element analyses such as line hinges at slab edges or any type of analytic link conditions can be input into Revit — even if they're not a native characteristic in Revit. Supports are recognized as foundations and are dimensioned using the SOFiSTiK programs following Eurocode design rules. Similar foundations can be grouped together. They receive the same geometry and reinforcements in subsequent steps.

## f) Generating 3D reinforcements

Using SOFiSTiK Reinforcement Generation (RCG), a 3D reinforcement model is generated back in Revit from the SOFiSTiK design results. The automatically generated reinforcement proposal covers the structurally necessary reinforcement and can be modified or enhanced without limitation according to user requirements. Design requirements specified within standards and company design guidelines can be defined via user-specific rules in much the same way as they are in expert systems.

With visualizations of existing vs. required reinforcement (fig. 5), engineers are given a convenient way to ensure sufficient reinforcement is used. In the 2016 version, foundations designed in SOFiSTiK can now also be generated and reinforced on support points in Revit.

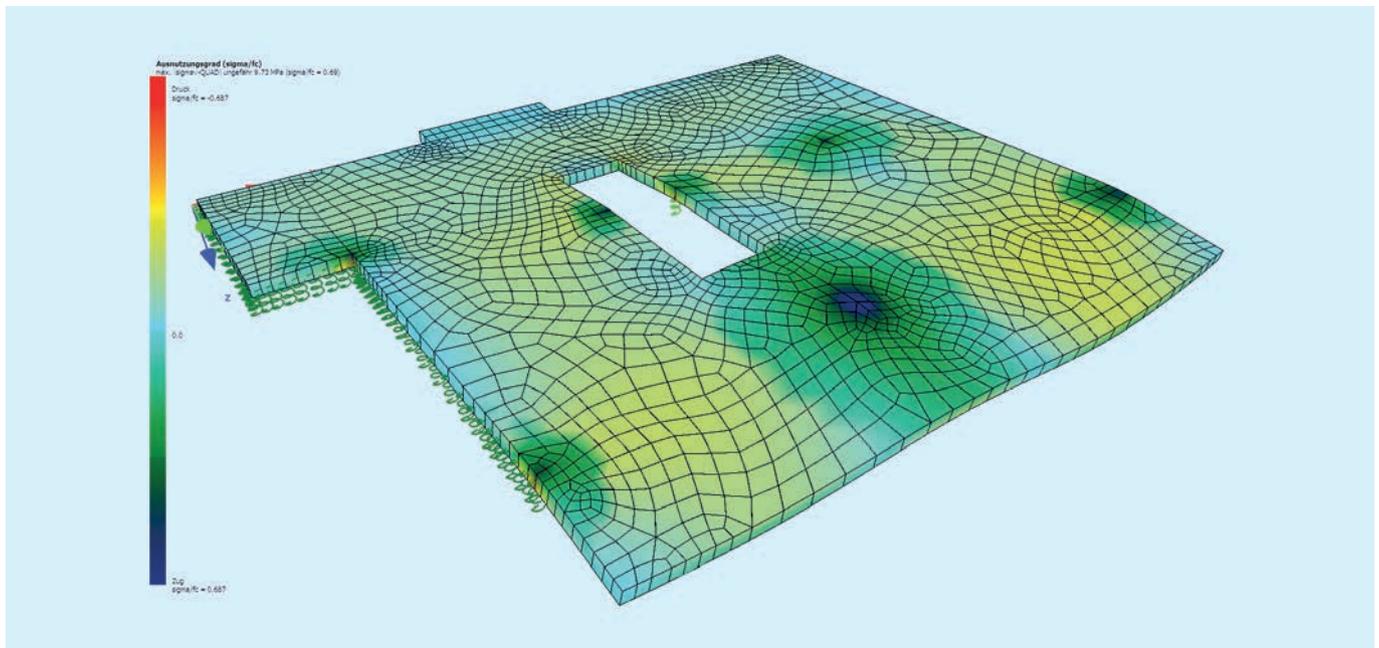


Figure 4. Deformations in a slab of a 2D subsystem in SOFiSTiK



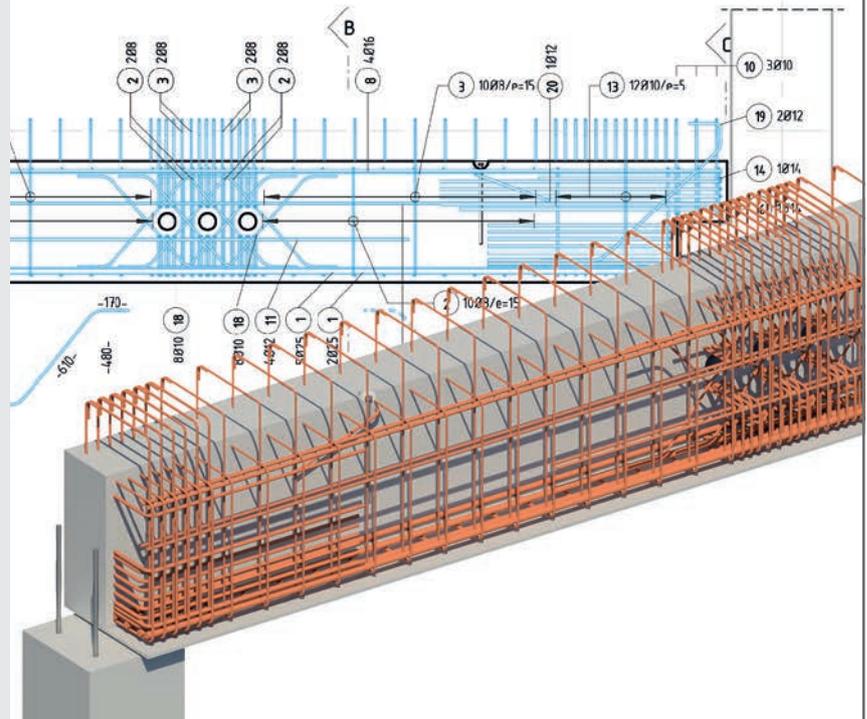


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