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# Revit: The Hub for Structural Engineering in a Collaborative Environment

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## Learning Objectives

- Learn how Revit can be used as a platform for a complete, always up-to-date and connected structural design-to-detailing workflow
- Understand how multiple analysis variants can be organized within Revit using Views and Design Options
- See how the design of members like columns, beams, or slabs is carried out and managed within Revit
- See how all this structural information can be shared with others through Collaboration for Revit and BIM 360

## Description

This class will demonstrate a workflow where the 3D intelligent model in Revit software serves as a central hub for setting up the analysis and design of buildings in construction engineering. The analytical model in Revit is enhanced with additional properties beyond the already existing analytical properties; the analysis and the design of members is controlled and organized directly within Revit. We are also going to demonstrate how different analysis variants can be set up within different views, like setting up a 3D model for dynamic analysis, separated 2D slab models for calculating the vertical load transfer, or local models for detailed analysis. As all this information is stored within the Revit database, consistency is ensured, structural information can be combined with other data in the intelligent model, and all information can be shared with others via Collaboration for Revit and BIM 360 software.

## Speaker(s)

Andreas Niggel  
Structural Engineer and Software Development Lead, SOFiSTiK AG

After receiving his PhD in Structural Engineering at the Technical University of Munich, Andreas is working in software development for SOFiSTiK AG, a leading European supplier of software for analysis, design and detailing. Andreas is registered consulting engineer in the Bavarian Chamber of Building Engineers. Currently, he is leading a team which tries to bring structural

analysis into Revit, allowing the user to keep within this platform for all structural tasks from analysis to detailing.

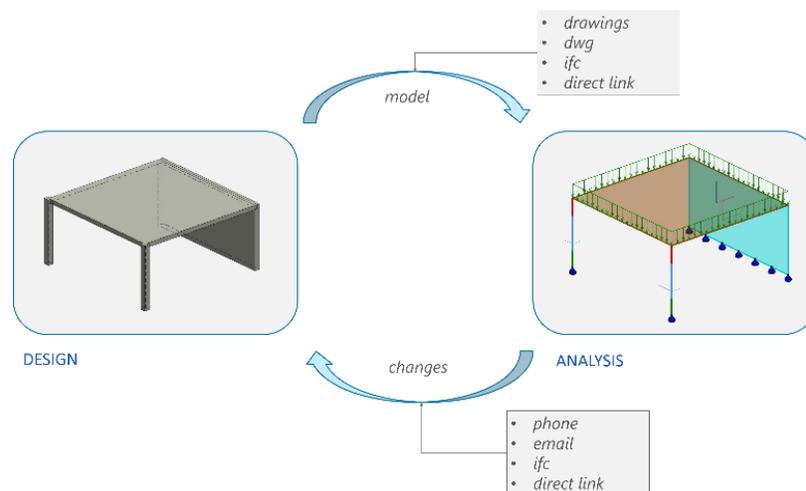
Thomas Fink  
CEO, SOFiSTiK AG

After receiving his diploma in structural engineering at Technical University Munich, Thomas has worked in structural engineering and software development for over 30 years. He is co-founder and CEO of SOFiSTiK AG, a leading German supplier of software for analysis, design, and detailing. He was on the board of the German section of buildingSMART for more than 10 years and chaired the working group “innovations” of the Bavarian Chamber of Building Engineers.

## Workflow in structural analysis

Structural analysis plays an important role in the planning phase of a building project. Analysis and member design checks ensure the feasibility of the designed structural concept. This is not only valid for the final phase where the design is already set but also – more and more important - in early project phases when different variants need to be explored and changes are less costly.

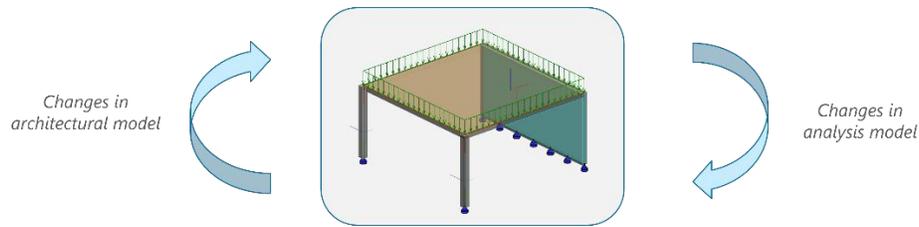
While the adoption of Building Information Modeling is increasingly commonplace in architectural design and formwork layout, the structural analysis is often de-coupled from a general BIM-workflow. Structural analysis and member design is usually performed in separate, dedicated applications. There, the structural model is entered separately often based on printed drawings or file-formats like pdf or dwg used as underlay. Results are propagated back to the initial model through different means ranging from simple e-mail to automatic model updates. However, especially in case of changes in the initial model, these changes need to be passed manually, which not only leads to additional re-work but may also poses the risk of inconsistencies. Following picture displays schematically this classical workflow.



Classical, de-coupled workflow in structural analysis.

This workflow in structural analysis contradicts the general concept of BIM of having a central model being the ‘single source of truth’. Even if Revit is used as authoring tool for the structural model, the analytical model in Revit is usually being ‘exported’ to third party applications where it will be enriched with additional data (loads, analysis control data) and often further modified. Though this workflow is automatized to a certain extends, the central problem of having a separate possibly inconsistent database for the analytical information remains. The structural analysis is decoupled and no longer part of the central model.

In contrast, it would be much better to integrate the structural analysis into the central BIM mode – which is indeed what Revit provides. Following picture shows this:



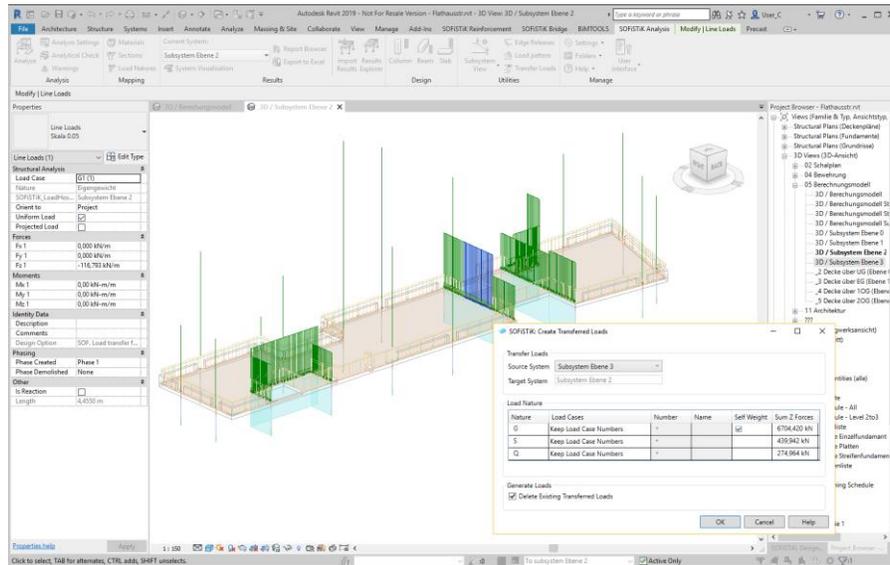
Ideal workflow in structural analysis.

SOFiSTiK as a provider of software for analysis and design in structural engineering tries to solve this integration issue by providing a solution where the analysis and the design of buildings is entirely based within Revit. This class will present the application “SOFiSTiK Analysis + Design for Revit” which is an extension to Revit and available soon within the Autodesk App-Store. The application provides functionality allowing to extend the analytical model in Revit with additional properties like slab/wall hinges or meshing properties and to perform analysis of the model and the design of members directly within Revit. As all additional information is consistently stored within the Revit database, this information can be shared with others using the standard collaboration features.

The aim of this class is to emphasize the benefits of this approach, when analysis is no longer decoupled but integrated within Revit. The benefits will be shown by three different workflows:

### Organization of multiple analysis models derived from central building model

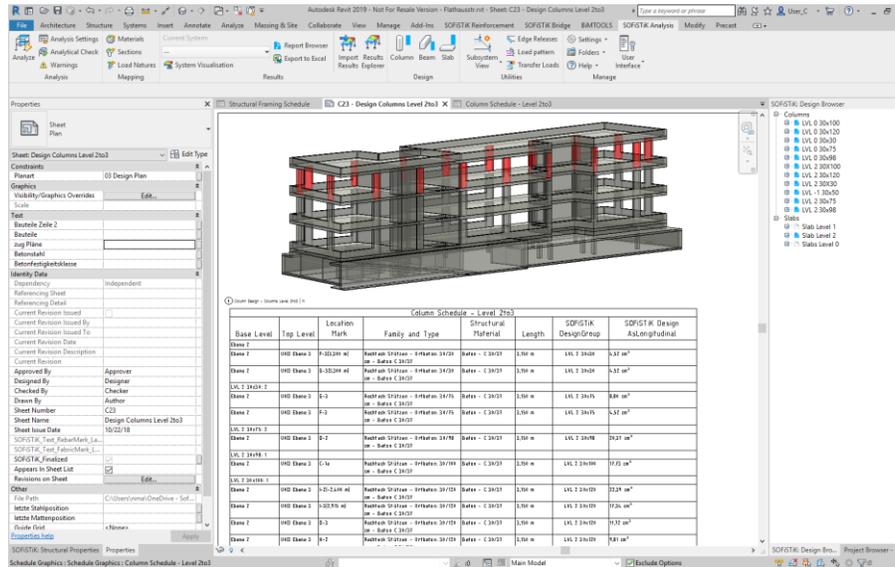
The analysis of a structure usually involves multiple analysis models of different fidelity. A global (often simplified) model of the 3D-structure is being used for global load take down or dynamic analysis. Local models are used for detailed analysis or member design. For example, the design of a column is carried out on a separated model by usually taking geometric and material nonlinear effects into regard. Similarly, the reinforcement design of slab members is often performed by separating the slabs from the global model. This class will show a workflow, where analysis variants can be set up within different views from which they can be analyzed by the SOFiSTiK Extension. It will also be shown, how local modifications being subject to only one single model can be set up using Design Options within Revit. This will be demonstrated by loads being transferred from one sub-model to another.



Extracted slab sub-system with loads transferred from upper sub-system.

## Organization of member design within Revit

When designing members, especially columns, elements of similar properties and loading are often collected into groups to reduce the number of different items to be designed and printed in the reports and also the number of variations which need to be built on site. A sensible grouping requires information from the BIM-model (shape, location) as well as information from the analysis (loading, required reinforcement). The class will show, how column members will be organized into groups within a standard column schedule by physical as well as analytical properties. Member check as well as reporting will be carried out within Revit.



Design Check of selected column members, results displayed in column schedule.

## Collaboration through BIM 360

As the SOFiSTiK Extension “SOFiSTiK Analysis + Design” stores all analysis information within the Revit database, this information can directly be shared with others like any other property within the \*.rvt. In this class we want to present, how the reinforcement design of a column being set up by one party will be uploaded to a central model within BIM 360 and from there re-used by another party to set up automatically a reinforcement layout based on the results of the design calculation. Once the reinforcement layout is set up, drawings and 2D-reinforcement sheets can be derived using SOFiSTiK functionality.