Project: OMNITURM, Frankfurt am Main
Rendering:
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Allplan in practice

A NEWCOMER TO THE FRANKFURT SKYLINE

With the OMNITURM, Frankfurt am Main is getting an iconic mixed-use structure that is unique throughout Germany.

The skyline of Frankfurt am Main is distinctive in Europe. Nine of the approximately 30 buildings—each over 100 meters in height—are among the ten tallest buildings in Germany. By 2019, this collection is to be enhanced with another skyscraper. At that point, the OMNITURM will be the fifth-tallest building in Frankfurt at about 190 meters, and at the same time, the first truly mixed-use high-rise in Germany, which will offer public spaces in addition to office and living space. The client, Tischman Speyer, has already created three icons in the Frankfurt cityscape, with the MesseTurm, OpernTurm and TaunusTurm. In the architectural competition for the OMNITURM, the entry of BIG (Bjarke Ingels Group) in cooperation with Bollinger + Grohmann Engineers was successful: initially a classical, linear-looking high-rise design, which has a sensational unique feature of cleverly offset levels. At the same time as the competition, Bollinger + Grohmann Engineers prepared a feasibility study. After they won the public tendering, the engineers were responsible for large parts of the supporting structure and exterior design (LP 1-3 as well as LP 6), a preliminary load calculation with a certifiable stiffening calculation, as well as the approval and design planning for the foundation piles and the partial covers (excavation pit).

Between the reinforcement layers
Photo: © Lupp

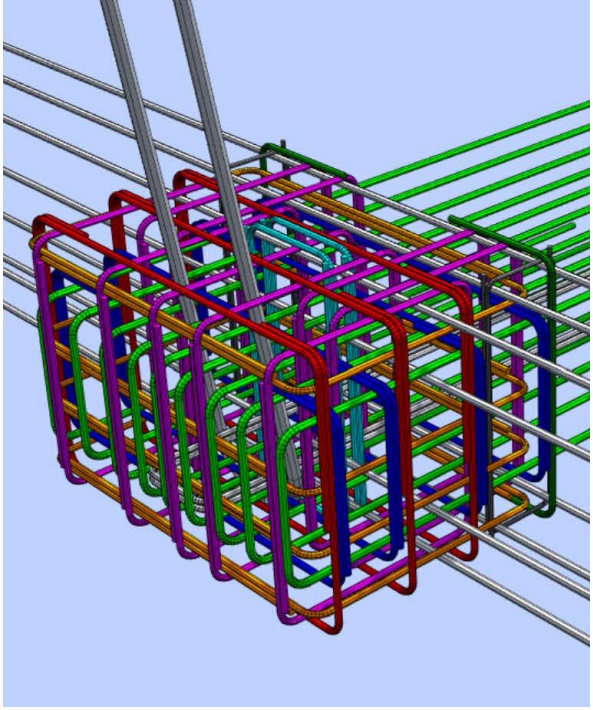
THE CHALLENGE

The ambitious construction project involved a number of challenges for Bollinger + Grohmann Engineers. For example, the OMNITURM foregoes the usual corner supports to offer its users unrestricted views from the popular corner rooms. Accordingly, in cooperation with BIG and B & V Braun Canton Architects, a support system had to be developed which manages without these structural members. The unique feature of the tower also had to be taken into account: the base levels—designed as public space—as well as the residential floors in the middle of the building are offset along the vertical axis, which means that the geometry of the support sections had to be optimized on these stories in order to minimize the gradients or deflections of the supports.

The foundation of the tower was also challenging, which required a combined pile-raft foundation (CPRF), including coordination of the pile rigidities with the geotechnical engineer. It also required an excavation pit using a partial cover design. This was to be designed in two partial covers (a slab over the second and fourth basement floor) and, since this was a separate order, with primary supports independent of the unfinished structure. Due to the slenderness of the partial covers, stability was threatened, resulting in a risk of the building frame distorting. So, in collaboration with the client—the joint venture Tiefbau TESSUTO—"floating" partial covers had to be developed, with suspension on the bored pile wall and adjustable suspension on the primary supports. The partial covers also required highly concentrated areas of reinforcement at various points, such as in the punching reinforcement areas, connection points of the high-rise supports, and load transfer sites at the edge of the lids, needing correspondingly complex designs.

THE SOLUTION

The development of the special support system without corner columns—including optimized geometry with respect to the support position and distortion in the section and plan views— was initially done with the help of parametric models in the software Rhino. After the basic geometry was defined, the data was easily transferred into Allplan Engineering for further editing, and finally, for the creation of the design documents and drawings. Since a high-strength steel reinforcement (SAS 670 from the steel mill Annahütte (SAH)) was specified for the supports to reduce the reinforcement area, the engineers benefited from the integrated SAH



Left: Construction progress of the building
Right: Suspension point of the partial cover
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SAS 670/800 for bar couplers catalog within Allplan Engineering.

The geometry or the general arrangement drawing of the "floating" partial cover was designed traditionally in 2D with Allplan Engineering due to a change order, making this scope or works separate from the unfinished structure. The calculation of the basic reinforcement was also done in 2D. Allplan Engineering was especially useful when designing the highly concentrated areas of reinforcement. All high-stress intersection points were designed using 3D models. During the process, the highly complex reinforcement placement was precisely and clearly designed and matched to the building site using mockups. Similarly, the engineers benefited from Allplan Engineering when creating the plans for the CPRF foundation piles, as these were reinforced with D40 (sometimes double-row), and included the development of the reinforcement joints.

- **The basic geometry created in Rhino was easily imported into Allplan Engineering for further editing.**
- **The SAH 670/800 for bar couplers catalog that is integrated in Allplan Engineering allowed for a thorough design using the high-strength reinforcing steel SAS 670.**
- **Allplan Engineering can be used to accurately and clearly design the highly complex reinforcement placement of the high-stress intersection points in 3D.**

"For us, planning using the BIM method means not being tied to one software package. We use different programs and are therefore reliant on them to communicate with each other without losing information. Allplan is a tool here in all design phases that focuses on the design planning (framework and reinforcement design). Allplan is especially ideal for complex 3D reinforcement placements."

Simon Ruppert, Partner/Managing Director, Bollinger+ Grohmann Engineers

THE CUSTOMER

Since its founding in 1983 by Klaus Bollinger and Manfred Grohmann, Bollinger + Grohmann Engineers has been passionate about good architecture and innovative construction. As responsible engineers, they focus on optimizing and developing their unique designs.

Bollinger + Grohmann Engineers see themselves as partners within a multidisciplinary design team, and they develop tailor-made solutions together with architects, clients, construction companies, and industry, as well as any specialist designers. They are always an integral component of the overall concept and are never an end in themselves.

In addition to technical innovation, Bollinger + Grohmann Engineers stand for partnership dialog, open-mindedness, and treating all parties involved with respect. They are convinced that sustainable solutions can only be created in harmony with technical and social progress.

ABOUT ALLPLAN

ALLPLAN is a global provider of BIM design software for the AEC industry. True to our "Design to Build" claim, we cover the entire process from the first concept to final detailed design for the construction site and for prefabrication. Allplan users create deliverables of the highest quality and level of detail thanks to lean workflows. ALLPLAN offers powerful integrated cloud technology to support interdisciplinary collaboration on building and civil engineering projects. Around the world over 500 dedicated employees continue to write the ALLPLAN success story. Headquartered in Munich, Germany, ALLPLAN is part of the Nemetschek Group which is a pioneer for digital transformation in the construction sector.

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