Helgolandkai will undergo extensive renovation by mid-2020.
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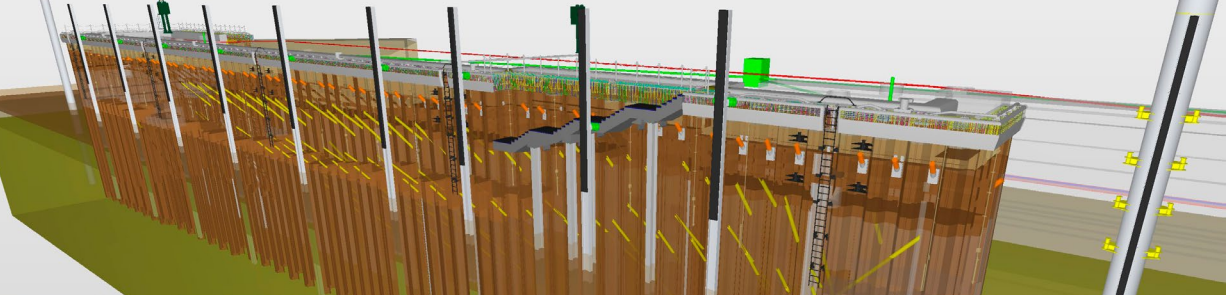
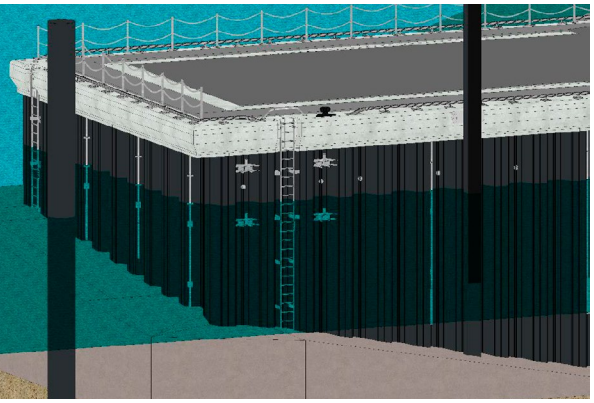
Allplan in practice

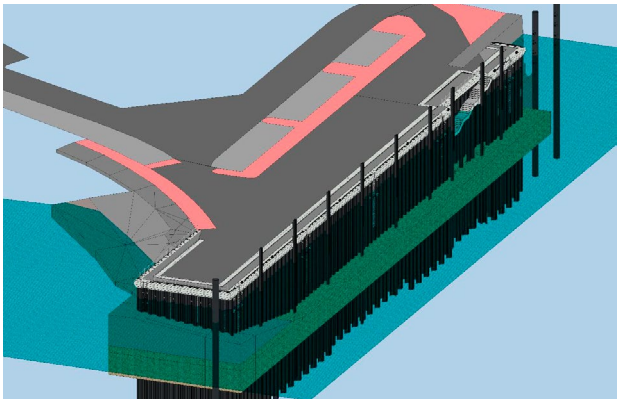
HELGOLANDKAI: BIM PILOT PROJECT IN PORT CONSTRUCTION

In Wilhelmshaven, a 130-year-old quay is once again writing engineering history as a BIM pilot project.

Built between 1877 and 1886, Helgolandkai served for a long time as the „first entry" for Wilhelmshaven's shipping traffic. Since then, the artificial bank, with a usable length of about 100 metres, has seen many a construction project, including the installation of a back-anchored sheet pile wall (1953 to 1957), the installation of a corrosion protection system (1985), a drainage system (drains and pump shafts) and a reinforced concrete beam (2004). Of course, regular maintenance measures were also carried out. The last of these took place between 2007 and 2008. The structure was also continuously inspected, with the main inspections most recently showing that the quay facilities can now only be used to a limited extent. This is now changing. Since the beginning of 2019, a comprehensive rehabilitation of the over 130-year-old structure – awarded to Tiefbau GmbH Unterweser, a company of the LUDWIG FREYTAG Group – has been underway and will be completed by mid-2020. Unlike the previous rehabilitation work, however, this time it is a milestone in the history of German port construction: The owner and operator, Niedersachsen Ports (nPorts), has







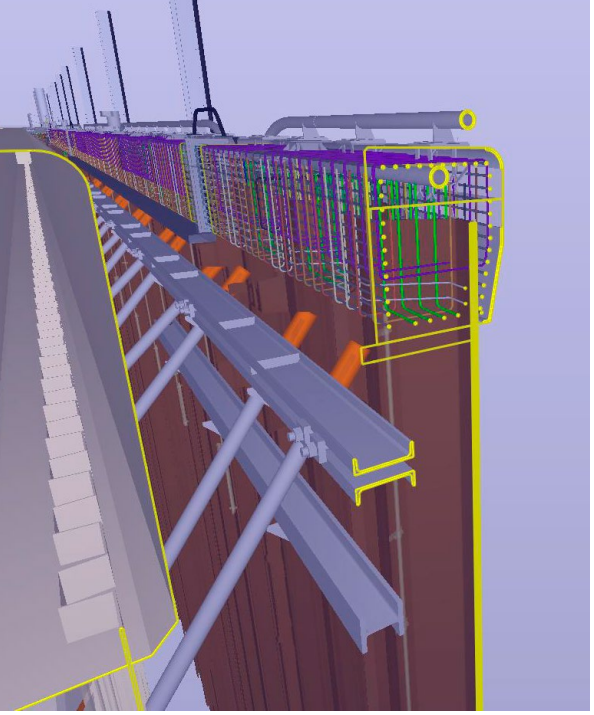
top: View of the partial models loaded together (detailed design), © LUDWIG FREYTAG. below: View of partial models (design planning), © WKC

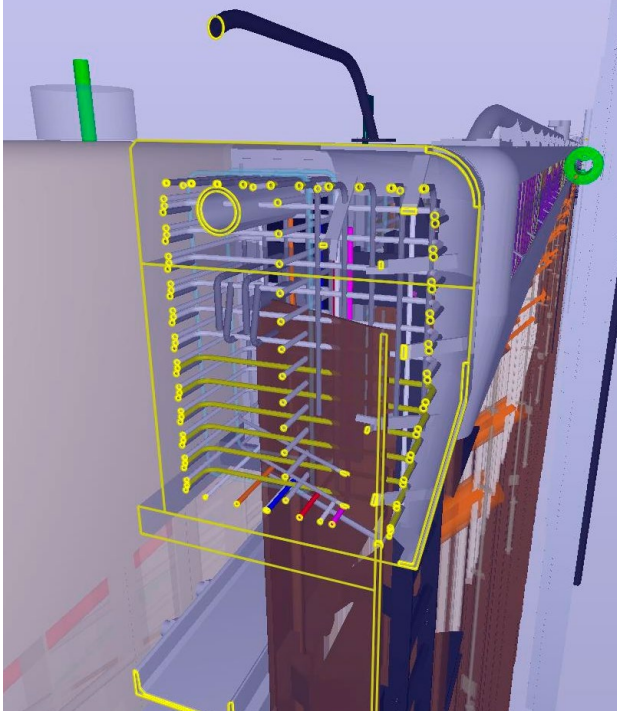
chosen the construction project as its first pilot project for Building Information Modeling (BIM). WK Consult (WKC) was commissioned for the project planning and structural design. Engineers from the BIM department of LUDWIG FREYTAG, in cooperation with the civil engineering team of Eriksen und Partner GmbH, from Oldenburg, were responsible for the implementation planning and technical processing. The project planning was supported by the BIM management of albert.ing.

ONE STEP BACK, TWO STEPS FORWARD: SUBSEQUENT BIM PROCESSES

The rehabilitation of the quay comprises a technically demanding package of measures: a new wave sheet pile wall is placed in front of the existing sheet pile wall, anchored, and then backfilled. The head of the quay has to be erected and a staircase of the sheet pile wall has to be presented. In addition, fixed ladders, crosses, head bollards as well as mooring and mooring dolphins have to be installed. WKC was commissioned by nPorts in July 2015 to plan the project. In March 2017, the port company decided in consultation with the engineers to implement the construction measures as a BIM project. For them, this was seen as an ideal project to test the BIM method on complex existing infrastructure. Furthermore, the decision was made in favor of open BIM. This was intended to keep the circle of bidders open and to ensure the most barrier-free data exchange possible between all project participants using software solutions from different manufacturers. As the conventional planning was almost completed at this point in time, the BIM processes were subsequently simulated. All in all, this resulted in a number of new tasks for object planning.

Together with nPorts, WKC developed the contractor information requirements on the basis of which the contractor's overall BIM coordinator prepared a BIM processing plan. The existing structure and planned design were created as an attributed 3D model in Allplan Engineering, from which all 2D designs could be derived. The object-oriented 3D model also served as a pilot for model-based communication with nPorts via a common open BIM platform (Common Data Environment). Performance items and quantity calculations were attributed in the model and additionally linked to tendering software. Furthermore, WKC supplied the contractor information requirements for the construction tender and the integration into the conventional performance specification. Based on the design model, the BIM model authors at LUDWIG FREYTAG created an execution model (including 2D plan derivation) with a significantly higher level of detail (LOD 400 instead of LOD 200), also with the help of Allplan Engineering, which is maintained and enhanced up to the transfer model (LOD 600).





Loaded design models of sheet piling, anchoring, waling and concrete beam, including reinforcement and equipment components, © LUDWIG FREYTAG

ONE QUAY; 14 SPECIALIST MODELS

ALLPLAN software proved to be a powerful and reliable tool for the designers. The basic components in particular could be modelled quickly and easily. For the sheet piling profiles, for example, the DWGs from the manufacturer could be easily imported and processed, ladders could be modelled in detail according to the information from sample sheets or the concrete beam could be generated as a 2D profile according to the design specifications and then extruded along the building axis. WKC created a total of 14 specialist models – five for existing buildings, six for new buildings and three specifically for demolition work. The six new construction models included: sheet pile wall/deep foundation work, anchors, waling/steelwork, earthwork, concrete work and equipment. However, the division into the various specialist models was not done in the native CAD software, but only in the IFC export from Allplan. The reason for splitting into individual specialist models was that this made both visual and rule-based model checking easier and, if changes were made to the model, only the relevant specialist model had to be re-exported and replaced. The handling of the IFC models proved to be much more intuitive as a result. This also applied to various testing software such as the Solibri Model Checker or the open BIM platform (CDE) implemented in the project, on which the individual specialist models were combined into coordination models by the contractor and transferred to the BIM management team on the client side. Unfortunately, exporting to the tendering program proved to be problematic when calculating quantities, so it was decided to perform the calculations exclusively directly in Allplan, which – like the derivation of 2D plans – worked perfectly.

PRAGMATIC IMPLEMENTATION PLANNING

In the course of the implementation planning, LUDWIG FREYTAG reversed the separation of the sub-models – at least partially – and restructured them: in order to better assign the demolition components to the existing components, the existing and demolition models were combined. A core drilling through a gravity wall illustrates why: At first the drilling is modelled as a cylindrical auxiliary body, which corresponds to its later hole with regard to position in space, diameter etc. Then the section body is created from this auxiliary body with the gravity wall and subtracted from the latter. Thus, the hole in the wall is made and the drill core is present as a quantity. If the core drilling is changed, the model can thus be well adapted by changing the auxiliary body and both components can be attributed. However, this procedure is only

With the BIM pilot project, the 130-year-old quay is making civil engineering history once again.
© LUDWIG FREYTAG

easy to understand if demolition and stock are represented in one model. The components can be filtered and assigned using the status as attribute.

In addition, the engineers took advantage of a function in Allplan that is not normally used in hydro-engineering: they simply used the program's flexible floor assignment to divide the overall model into sub models. This enabled them to work in a well-structured manner and to achieve a high-performance IFC export, as all drawing files of a sub model are automatically assigned to the sub model via the floor.

SUCCESSFUL EXPERIMENT

Overall, the BIM pilot project Helgolandkai can already be considered a success. According to the designers, several specific problem areas could be identified and solved in the 3D model, which would not necessarily have been noticed in a pure 2D design for a linear structure of this type. In particular, collisions of components – especially the anchors, both among themselves and to the existing structure – could be successfully avoided. The quantity take-off was clearly more error-free and easier than in a conventional, manual way.

THE CLIENTS

Niedersachsen Ports:
With 15 port locations, Niedersachsen Ports is the largest operator of public seaports in Germany. Along Lower Saxony's North Sea coast, nPorts shapes the port landscape for the future with its experts, partners and customers. As a service provider for its port customers, the company creates the conditions for the further development of Lower Saxony's seaports.

''Thanks to Allplan, several problem areas in the model could be identified and solved that would not necessarily have been noticed in a pure 2D design for a linear structure of this type.''

Christian Tiedemann, BIM designer WK Consult © WKC

''With Allplan, hydraulic engineering can be modeled easily and quickly, even with architectural components!''

Svea Ohmstede, BIM designer LUDWIG FREYTAG © LUDWIG FREYTAG

WK Consult:
Starting as a small engineering office, WK Consult has continuously developed over the last 75 years. In terms of space, expertise and personnel. Today, the engineers offer their clients the entire spectrum of civil engineering: from the planning engineer to the test engineer, from the structural engineer to the programmer to the engineer diver.

LUDWIG FREYTAG:
Since 1891, experience, quality awareness and solidity have characterized the work of LUDWIG FREYTAG. Today, the group of companies is active in several highly specialized business fields and at the same time realizes complete solutions from planning to turnkey execution to the supervision and maintenance of construction projects of various types and sizes.

albert.ing:
albert.ing is the BIM partner for planners, implementers, builders and operators of buildings and infrastructure. They are consultants and doers when it comes to digital construction. The dedicated team at albert.ing combines experience in project business and software development with operational excellence in the implementation of innovation and change processes.

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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