NEMETSCHEK Allplan

Pumping station Katwijk, Netherlands

Consulting Engineers Tauw, Netherlands

Man the pumps!

Dykes, polders, windmills and sluices – the fight against too much water is ever-present in the Netherlands. The rising level caused by climate change, higher rainfall rates and larger sealed areas mean new volumes of water are constantly expected. It is a threat countered by the extension of pumping stations like the one on the North Sea coast in Katwijk. What makes it special is that engineering office Tauw planned the entire project in 3D with the help of Allplan.

Built in 1954, the pumping station in Katwijk can currently transport 54 cubic meters of water per second, which corresponds to a volume of a room of around 4 by 5 meters. Even though the plant already offers impressive output, it no longer meets future requirements. In an expansion measure, the output of the pumping station will be increased to 94 m3/s and thus almost doubled – on the one hand by upgrading the three existing pumps from diesel to electric motors, but primarily through the construction of an additional, fourth pump unit.

The long-standing company Tauw is responsible for this construction work on the order of the Water and Soil Association Rijnland. The engineering office with 1,200 employees at 6 locations in the Netherlands and 11 in Germany specializes in environmental projects and has more than 80 years' experience in the planning and restoration of pumping stations. The company has really become a talking point with the pumping station in Katwijk, because with Allplan from Nemetschek, it has been able to process this highly complex project extremely efficiently using the principle of Building Information Modeling (BIM).

Particularly complex elements

The building, the details of which were designed by Tauw based on the basic draft by architects Aletta van Aalst & Partners, has a whole series of unusual building elements. For example, in addition to the trapezoidal exterior walls of the new pump housing, there is a cylinder-shaped trough, in which the rotors of the pump move, a pump gear and round flow openings out of which the water flows. The building also has elliptical platforms on which the cleaning cranes the for the dirt collection grate will later be mounted.

These are all complex forms that are difficult to cope with in 2D. Integrated 3D planning on a virtual building model as propagated by the BIM principle was exactly the right solution for a project of this complexity. "3D is simply better because it significantly facilitates understanding, particularly in complicated building projects. Conflicts are apparent on the screen and can be resolved in good time. As a result, the number of errors on the construction side is reduced," says Ivo Oomen, responsible for CAD in the project at Tauw. "For me, Allplan is the best tool when it comes to 3D planning."

Simple designing in 3D

In a first step, a complete 3D model of the new building and adjacent parts of the existing pumping station was created. The basis for this was two-dimensional plan data from the architects, which was imported to Allplan in DWG format, and scanned plans of the existing pumping station. Using this basic data, the planners generated primarily 3D solid bodies – since there were practically no standard building elements such as walls, ceilings, windows or stairs. Despite the complexity of the individual elements, modeling progressed rapidly: "Allplan offers numerous tools and methods that make 3D designing easy. And thanks to the option of switching between different views during input and looking at the model as a whole, you always know where you are," says Ivo Oomen.

In order to further increase the understanding of such a complex structure, visualizations were frequently calculated. As a result, problem areas could be identified more easily and corrected immediately on the screen. The sophisticated project structure, in which the building was divided up by the various components such as foundation and superstructure, ensured ease of orientation. This division also made it possible for several employees to work simultaneously on the project without the assignment of additional rights. The consistency of all entries was nevertheless guaranteed because all designers ultimately had access to the same project model. As a result, all the data was perfectly harmonized

Accuracy of plans guaranteed

However, the huge advantage of a consistently three-dimensional project with Allplan is not just consistent planning. From the 3D model, all project data such as floor plans, views and sections, as well as quantities and costs, can be automatically evaluated, because all this information already exists in the virtual building. The applies both for the architectural designs and the general arrangement and reinforcement designs: Allplan enables a structure model to be generated from the 3D model and this serves as the basis for general arrangement and reinforcement planning.

The engineers at Tauw made use of this option and automatically generated all general arrangement designs with ground plans, views and sections using the structure model. “For input in 3D, you perhaps need a little more time than for 2D, but this additional effort certainly pays off in the end, because all plans can be derived from the model,” says Ivo Oomen. “And their accuracy is then guaranteed.”

This is an advantage that also paid off in the modification phase. While there were no major changes during planning of the pumping station, there were still smaller modifications, for example for the recesses for the electrical systems. Thanks to 3D, these could be handled far more easily because – in contrast to conventional planning – they did not have to be subsequently included in ground plans, views and sections individually, they merely needed to be entered in a central model and were then automatically included in all drawing documents. “Changes can be integrated in 3D much more easily than in conventional 2D planning,” states Ivo Oomen. “In addition, in 3D I have a better overview of the modifications, and I can always define additional steps for checking purposes, to make sure that everything is consistent. With Allplan, it’s really easy.”

3D reinforcement is more efficient

In Allplan, reinforcement planning can also be done in 3D. The shell edges of the construction form the reference point for the spatial arrangement of bars and meshes. The designers at Tauw

also made use of this option in the Katwijk project – in the first step for reinforcement planning for the more simple, right-angled structure for the sluice gates. “It worked so well that we quickly moved on to the more difficult elements,” states Ivo Oomen. Here, too, 3D reinforcement planning was not a problem. On the contrary – the round forms, in particular, were reinforced more easily in 3D. The engineers were then able to automatically derive the corresponding plans from the 3D reinforcement model. “As a result, 3D reinforcement planning is certainly more efficient than the manual placing of bars and meshes in the ground plan, views and sections,” says Ivo Oomen.

The engineers would also have been able to automatically determine mesh schedules and bending schedules lists and from the structure model. However, the designers did not use this option because in the Netherlands, the commissioned construction company, rather than the design engineers, is responsible for creating these documents. Nevertheless, Tauw still intends to do this in the future – simply because the data is already available and the engineering office can therefore control the reinforcement even more accurately. Round-Trip Engineering is also planned, in which the 3D model created with Allplan is used as the basis for assessing load capacity and fitness for use. Tauw is already using the right solution for structural calculations, namely Scia Engineer, but in this project, the structure model was created separately on the basis of 2D drawings.

Laying the reinforcement for the pumping station on the Dutch North Sea coast.

Quantities and costs from the model

The three-dimensional project data from Allplan was however used for a continuous control of costs. Quantities and costs had already been determined for the tender. Over the course of the project, the current quantities of concrete were then regularly generated from the 3D model and compared with the initial values, in order to accurately calculate minimum and maximum costs. This control measure did not involve much additional effort: as a result of 3D planning, the spatial model already contained the quantities, so they could be automatically calculated.

As a result, Allplan proved an efficient tool continually supporting planning in all areas. Ivo Oomen agrees: “Thanks to Allplan, our planning contained far fewer errors and we were able to deliver far higher quality than would have been possible with a conventional working method. I am convinced that this is also the reason the project went so well.” Right on schedule, the new pump will soon go into operation, and ensure that the residents in the region will continue to keep dry in the future.

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