

COMPANY

Waagner-Biro Stahlbau AG

LOCATION

Vienna, Austria

SOFTWARE

Autodesk Advance Steel

Floating canopy of light for Abu Dhabi Louvre

Waagner-Biro is designing a huge dome roof for the museum island of the Arab Emirates with the help of Autodesk Advance Steel

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Director of Engineering
at Waagner-Biro



Dome under construction (Image courtesy of Waagner-Biro)

In the capital of the largest Arab desert emirate, an oriental architectural gem is being created directly by the sea, building a cultural bridge between East and West with a collection of primarily European art. The prestigious building will be a milestone in the portfolio of the international steel and glass engineering organisation Waagner-Biro, which has been active for 160 years and has its headquarters in Vienna.

More than 1,000 employees in 15 locations in Europe, the Middle East and South-East Asia implement complex structures of steel and glass. The Austrian company is considered a specialist in this area and is renowned for its high-level of expertise with geometrically sophisticated architecture. Waagner-Biro’s references include the dome of the Reichstag in Berlin, the envelope of the Yas Marina Hotel in Abu Dhabi (Formula 1 circuit), the glass roof on the British Museum in London, the Red Bull Hangar 7 in Salzburg and the roofing of the Sony Center in Berlin. The engineers have worked together with many world-renowned architects and designers such as Foster and Partners, Asymptote Architecture, Jerde

Partnership or Murphy Jahn. In Abu Dhabi, the Viennese steel company is now realizing the extraordinary design of the famed French architect Jean Nouvel, which will be completed by December 2015, with the help of the Autodesk Advance Steel software.

Play of lights like an oriental bazaar

Next to tourist facilities, a number of leading cultural institutions such as the Louvre Abu Dhabi will be built on Saadiyat Island, an offshore island in front of the center of Abu Dhabi. This project is the first part of the future museum island in the desert city. The steel and glass division of Waagner-Biro is currently modelling, designing, manufacturing and assembling a 184 meters wide and 4,850-ton heavy dome structure. With the size of about five soccer fields this structure is suspended by only four bearings and thus appears to be floating. The dome, bolted indoors and welded on the edge area as desired by the architect, is made up of square steel hollow sections and nodes, whose lower and upper dome skin is each covered with ornamental stars from different aluminum sections. Inspired by light

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rays that flood the reed mat covered alleyways in an oriental bazaar, each four-layer, star-shaped ornaments should create a graceful interplay of direct and indirect light.

The challenges of the project mainly arose from the tight time frame - Waagner-Biro was awarded the contract for the project in May 2013, with the completion of the steel structure within one and a half years – as well as the sophisticated geometry of the dome. Since this is only suspended by four bearings, the different peaks had to be considered as an important parameter in the design. Making matters worse was that none of the 7,384 star-shaped ornaments were alike. Each layer was twisted in contrast to the other by a certain number of degrees, so that there was no right angle and each star had to be made individually.

Software facilitates the project implementation

In order to realize the complex and challenging project within the budget and schedule, Waagner-Biro used the 3D software solution Autodesk Advance Steel for the planning of the steel package, which the company has been working with for over 15 years. A big advantage for this was the unified data base. The dwg. format of AutoCAD®, as a globally recognized CAD standard, enables an uncomplicated and full data exchange between the various trades, companies and participants. From the very beginning, the facade engineering department and steel works, responsible for the construction of the ornaments, worked closely together, so that the respective geometries and connectors match and changes in the adjacent area could easily be taken over. "We have never had the problem that some data was not correct with Advance Steel. The failure probability is close to zero percent," says Gert Weimann, Director of Engineering at Waagner-Biro.

Thanks to the software support, Waagner-Biro could easily implement special requests from the architect. "Nowadays, you actually weld together the entire structure to a large construction. But Jean Nouvel wanted to see 'real screws'," Weimann elaborates. "That is why, from the beginning of the design process, we created a 3D model in elevated state and then presented all the nodes in order to coordinate with him. Due to the powerful

support for 3D planning in Advance Steel we were able to model the surfaces, rods, nodes and connections without any problems." The software processes all data of the 3D model, creates all required documents in an automated and time-saving way and checks the model in accordance with the drawings. In Advance Steel, the complete workshop documents such as drawings, list of components, NC data and assembly overviews are automatically derived from the 3D model by using the company's own programming. When a component is ready and approved, the software creates a drawing for each part using appropriate pre-settings as well as the project-specific sheet format. "With regard to geometry, construction, production and assembly, the Louvre project was a highly challenging task. Due to the 3D functionality and possibilities of a comprehensive programming, Advance Steel became a great help in our planning," says Weimann.

Advance Steel increases productivity by 25 percent

By using extensive programming, Waagner-Biro kept the total cost of construction as low as possible. It helped that the dome is a double-symmetrical structure. Thus, each node occurs a total of four times. For that reason, the team was able to determine certain types and thereby reduce the number of nodes to



Star-shaped ornaments
(Image courtesy of Waagner-Biro)

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be constructed. However, since the entire dome design only rests on four supports and assembly sequences have to be taken into account respectively, it has a wide range of case combinations. "In our analysis model, we have incorporated all load cases and then calculated the overlays," Weimann explains. "The profiles of the single rods and nodes were then determined and the optimized geometry imported into the Advance Steel model via one of our programmed pre-processors. So with little manual effort we integrated the previously determined square rods and nodes into the system." Waagner-Biro managed to keep the cost of the entire project significantly lower through the use of Autodesk Advance Steel. "Thanks to the programming we could record an increase of productivity by 25 percent," Weimann states. "Of course, we regularly check the market, but so far we haven't found anything in the high-end area that is comparable to our constructions with Autodesk Advance Steel. Although there are solutions and systems that are equivalent in normal indoor and steel building construction, when it concerns the programming, reading of data or importing of structural data into the model, the software is so far the best." These advantages were also evident in the construction of the dome roof of the Abu Dhabi Louvre. Through the combination of lightness, illusion and highly sophisticated design, the cupola sets new standards and arouses curiosity about the next projects of the Viennese steel and glass engineering organisation.