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THE OBSERVATION POINT "WOLKENHAIN" – BRIDGE AS WELL AS TOWER: A NEW LANDMARK IN BERLIN

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Summary

The following paper describes the innovative steel observation point „Wolkenhain" from the point of view of the checking engineener. Many aspects of designing, manufacturing and erecting such unusual structures, like specific characteristics of the construction, load assumptions, modelling, structural behavior are discussed. It is shown that structural calculation of structures with difficult geometries and loading conditions have to be supported by additional experimental tests and wind appraisals.

Keywords: steel structure; spatial truss; welded spherical joint; welding tests; wind appraisal

From April to October 2017 the International Garden Show (IGA) takes place in Berlin. For this event the Kienberg area, located in the Marzahn-Hellersdord district in Berlin, was developed as a part of the IGA park. Inside the 60 hectares of the park one can find footbridges, a ropeway and also the observation point called "Wolkenhain". The observation point „Wolkenhain" was designed by Kolb Ripke Architects, responsible for the architecure and VIC GmbH, responsible for the structural design. It is the winner design of a design competition, which was carried out especially for the Kienbergpark as a part of the IGA area. The execution planning and the execution itself were checked by the engineering company Klähne Ingenieure.

The "Wolkenhain" with its height of 30 m is placed on the top of the 110 m high Kienberg. From there the visitors can have a fantastic view over Berlin and its surroundings. This platform serves the visitors as a walkable "Cloud" which virtually hovers above the Kienberg. At the foot of the "Wolkenhain" a building for visitor´s service and catering is located. The main plattform of the „Wolkenhain" is a steel structure based on 25 m high slender steel columns. It evolves a polygonal structure with different heights and layouts, covering an area of about 30x40 m. This space structure consists of many irregular placed pipe profiles which meet each other in about 160 nodes consisting of solid steel balls. The structure is accesible by stairs and elevator. The external sides of the structure is covered with a translucent membrane, which gives it an appearance of a cloud.

The structure was designed as a footbridge in accordance with DIN EN 1991-2. The structure was calculated for following loads: dead-load, pedestrian load (5 kN/m^2), wind loads and temperature. For the purpose of the check calculations a three-dimensional framework model was created using the computer program Sofistik. The heavy solid steel balls (160 connections) had to be considered as additional dead-load. The other parts of the structure could be modeled with their exact geometry. Because of the complicated shape of the structure the rules of DIN EN 1991-1- 4 could not be used for calculating the wind load. A survey of the local wind velocities and wind forces defined not only the influence of the Topography of the construction site but also the wind load at the bottom side of the structure as well as the pressure inside the structure.

The structure was manufactured by the steel construction company Vollack GmbH. The very irregular geometry of the structure required an extensive workshop planning which was made with the computer program Tekla Structures. The pipe profiles of the spatial truss were connected with the solid steel balls. About 160 such connections were needed to build the structure. Due to the vital importance of the balls for the structural safety the quality of the material and the welded connections were tested by GSI SLV Halle. The tests showed that the material properties and the welding parameters had to be optimized. For this purpose, GSI SLV prepared new welding specifications (WPS) with improved welding parameters. For manufacturing and assembly reasons the structure was divided into 14 sections. The sections of the structure were delivered to the construction site and finally assembled. In a first step the steel columns and the elevator tower were mounted. In a second step, particular sections were joined together in so called assembly groups and then built-in. Because every group was assembled separately it was necessary to check numerous different static systems of the structure. In every case it was proved that the structure has sufficient capacity and stability.

The checking calculations showed that during the execution planning process of constructions like the “Wolkenhain”, many additional aspects have to be considered. Thanks to the cooperation between structural and checking engineers as well as wind and welding experts it was possible to create and to build this amazing structure.

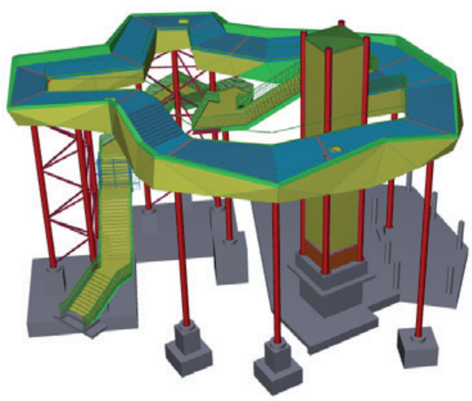

Fig.1 The structure of “Wolkenhain”

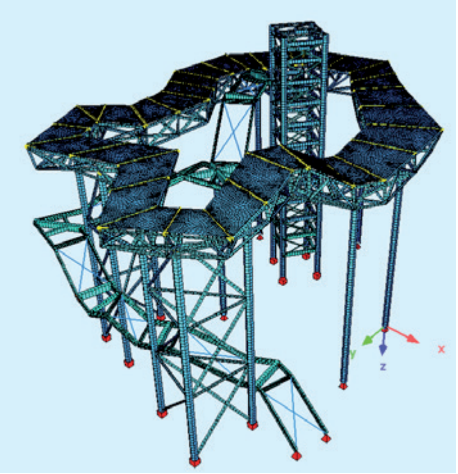

Fig.2 FEM model for check calculations

Fig.3 Welded spherical joint

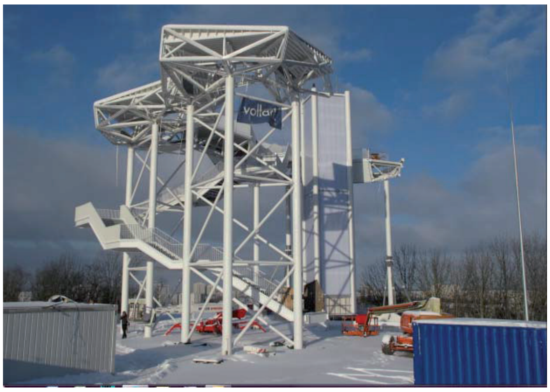

Fig.4 One of the several assembly static system