

STRUCTURAL DESIGN OF SPORTS FACILITIES BY PROVIDING MODERN SOFTWARES

Giorgi Goksadze

Georgian Technical University

ABSTRACT

In the modern construction industry, among the outstanding buildings, we will meet many sports buildings, it can be said that every new construction challenge was reflected in sports buildings from the very beginning of the history of mankind and became a reality. According to the stages of evolution, at each step of the development of humanity, sports facilities were the limit of the maximum possibilities a person reached in construction. This movement is now proceeding at maximum speed, and I think it is necessary for us to set foot on it as much as possible, evaluate, discuss and investigate, in this case from a constructive and structural point of view. The growing pace is accelerating every day, in construction and especially in the construction of sports facilities, that's why I chose for the article issue, the vast, extremely important, and first of all structurally interesting "Structural design of sports facilities by providing modern softwares". In this article we will overview the best softwares for structural engineers, all of the softwares are popular in worldwide and can be found in the internet easily in case of interest.

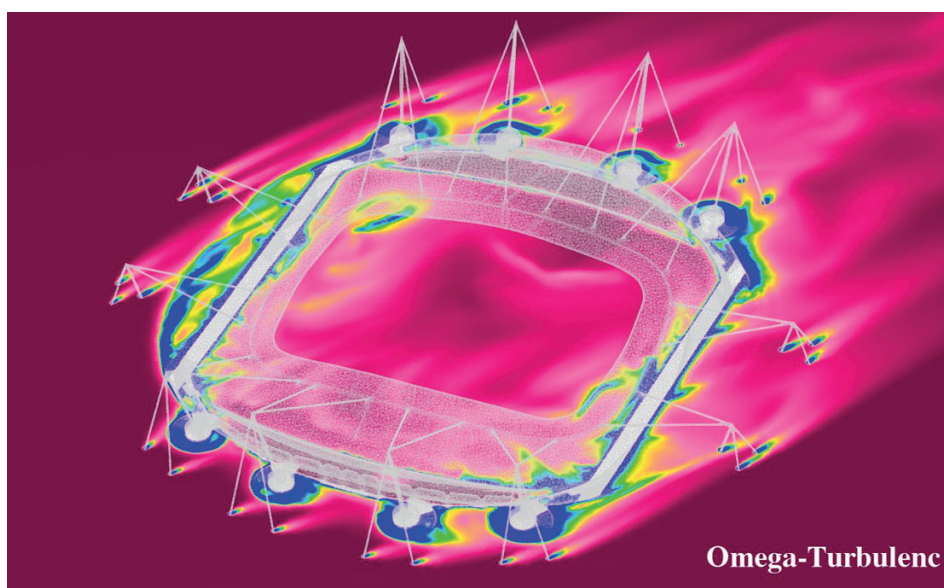
Key words: #Stadium; #Construction; #StructuralEngineering; #Modern; #Sports; #Software; #Dlubal; #Scia; #Etabs; #Allplans; #TopEngineer; #Grandstand; #Calculations; #3dmodel; #steel; #Revit; #Tekla; #Advancesteel.

MAIN TEXT

The general definition of sports facilities is as follows: specialized buildings, where it is possible to hold massive physical-rehabilitation, training-training and various sports events. Sports facilities are divided into:

main, auxiliary and spectator. Now let's move on to a review of specific projects that clearly present the significance of sports facilities in the modern construction industry.

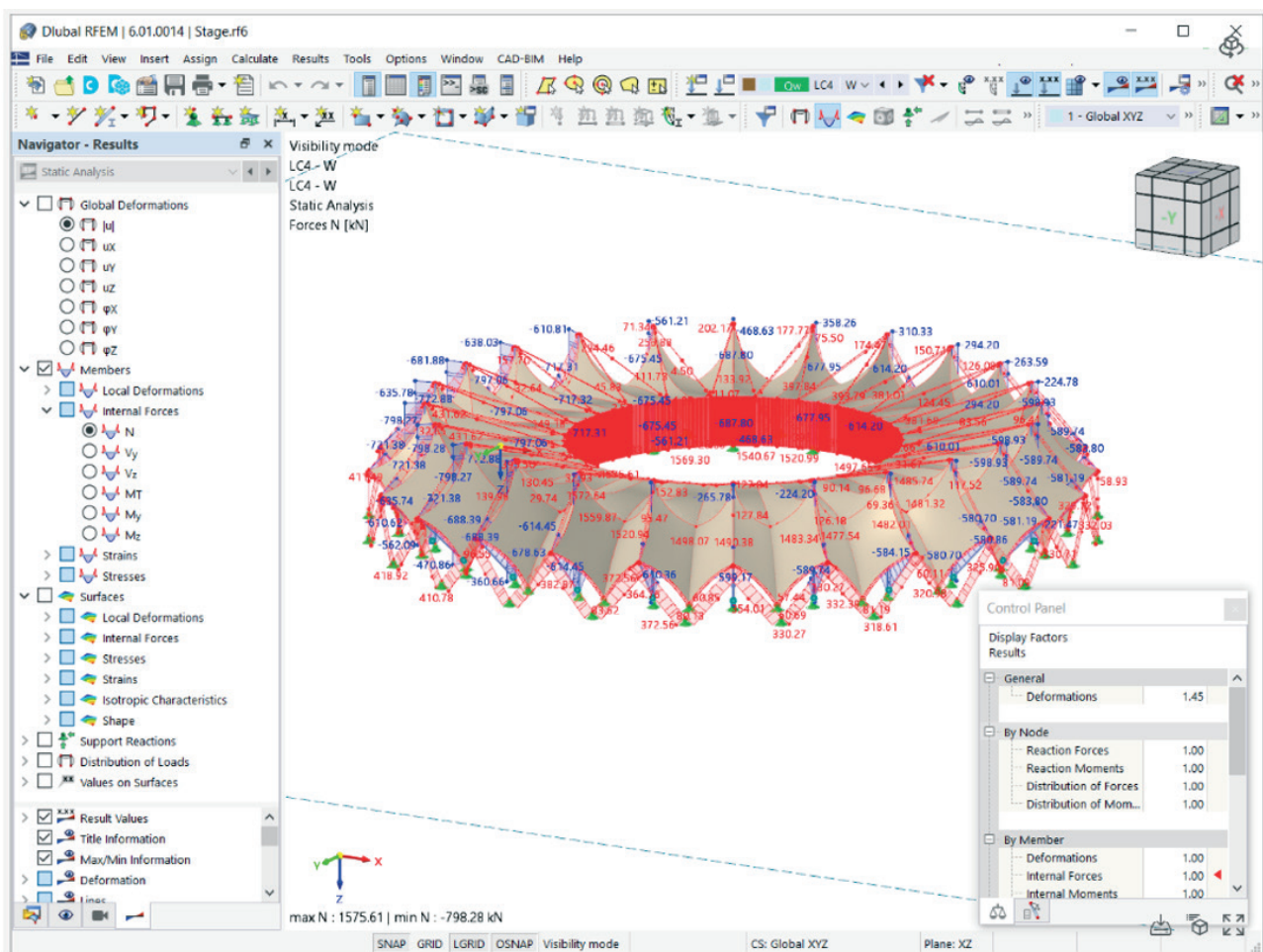
Etihad Stadium, Home of Manchester City F.C. Architect: Arup, KSS Design Group, Populous Structural engineer: Arup. The existing roof structure, which consisted of a cable net structure with a tension ring from which steel roof rafters were suspended, was technically challenging to design. In order for the present tension ring to maintain its structural integrity, it must run around the whole circle of the roof; as a result, any modification to the roof, even in regions where roof rafters were removed, would not have any effect on it. It was critical to protect the current cable because there was no maintenance mechanism in place, and damage would result in the need for replacement and, potentially, the closure of the stadium for two years if the cable was not protected. Significant design optimization work was done, particularly for the steel roof and stability cores. A comprehensive set of geometric studies analyzed the impacts of various stay and mast angles, culminating in a design that met both the minimum material requirements and the lowest possible cost. The stability cores were constructed of steel vertical brace planes with the addition of outrigger bracing to increase efficiency, and despite the fact that this is not a solution often used on tall structures, it proved to be beneficial for this project. A case study in RWIND 2 by Dlubal Software. With Dlubal we can also mention SCIA and Etabs as the biggest players in the structural calculation and modeling softwares.



Now, review RWIND 2 closer, which is a program for generating wind loads based on CFD (Computational Fluid Dynamics). The wind flow numerical simulation is generated around any building including irregular or unique geometry types to determine the wind loads on surfaces and members. RWIND 2 can be integrated with RFEM/RSTAB for the structural analysis and design or as a stand-alone application.

Both RFEM and RSTAB have an interface for exporting models to RWIND where the wind (in terms of speed and turbulence) can be defined in tabular form or, even more practically, on the basis of a wind standard specification. When running the RWIND program manually, no interface in RFEM or RSTAB is required and you can define the height-dependent wind load and other fluid-mechanical data directly in RWIND. In addition, you can directly model the structures and the terrain environment by importing VTP, STL, OBJ, and IFC files.

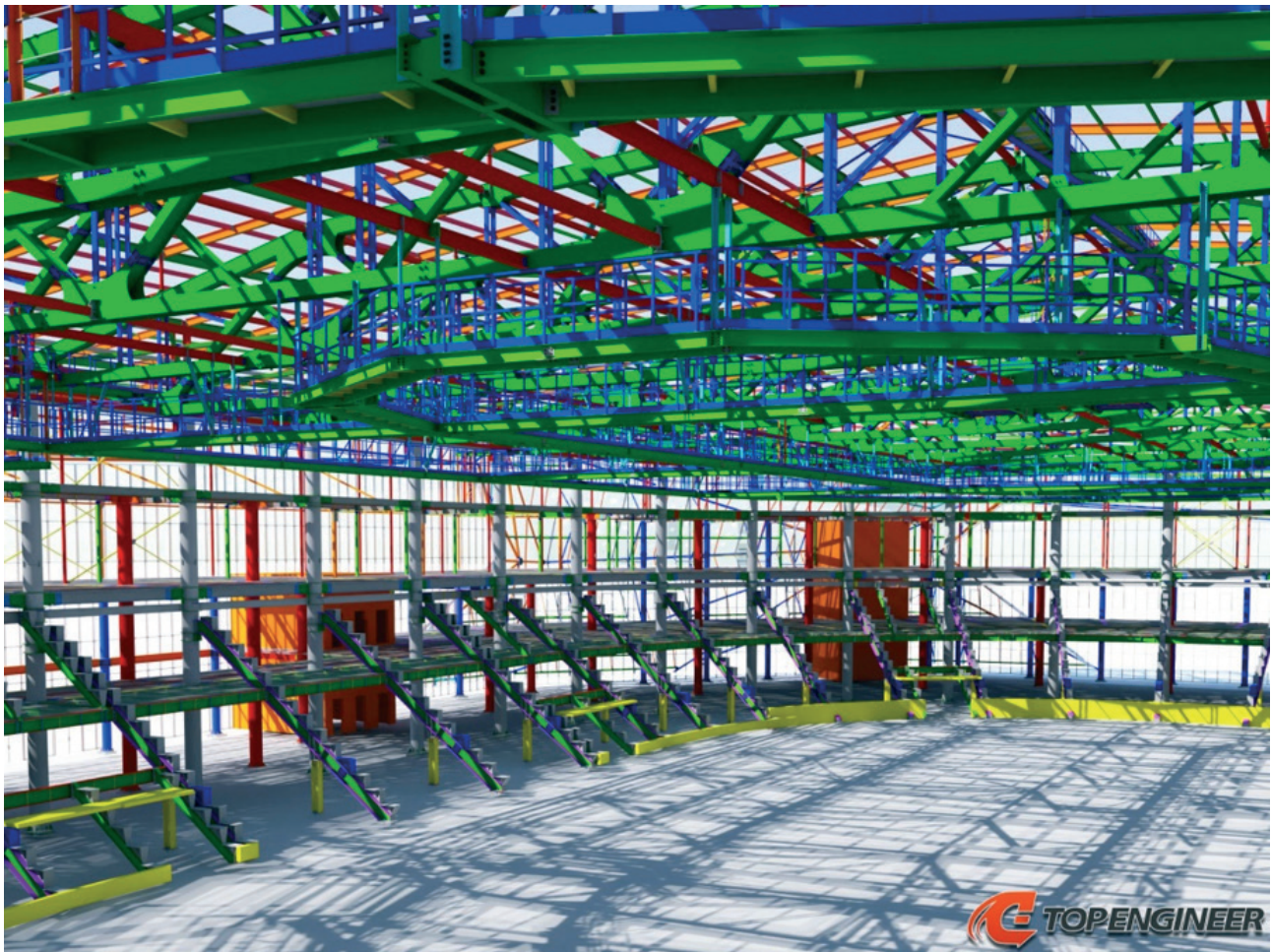
recognize in 2D.” Nevertheless, the Wildparkstadion presented new challenges for ASSMANN. It is the first time that the engineers have used the BIM method for such a large project. The modeling in Allplan has therefore been changed so that IFC models can be exchanged with the other project members. In addition, structural and architectural properties were assigned to the 3D components, which greatly facilitated both internal and external processes. For example, the data could be used to create formwork and reinforcement plans or mass calculations, while other designers could build on the information exchanged and use it in their work. Allplan is also one of the best software to work with when it comes to structural engineering. “The easy-to-use 3D modeler from Allplan was a very big help here, as in the rest of the stadium,” Manfred Klawonn says. Thanks to Allplan, the engineers were able to see that the originally planned geometry of the Y-columns caused the



With calculations also very important is to design the structure properly. There is much software to help that process, we will talk about them. The structural designers have been working on stadiums in 3D for six years. Even from the early design stages, modeling was already taking place. “Because a stadium is very demanding geometrically, the 3D model helps enormously here,” says Manfred Klawonn. “In the grandstand area, many details are resolved, which would be difficult to

upper support points in the interior view to deviate considerably from each other in the Z-direction. “In the Allplan model, we were finally able to develop solutions for the architects that were feasible in terms of design.” Says the lead structural engineer of the stadium. With All Plans we have to mention Tekla Structure; Advance Steel and Autodesk Revit, as one of the best software for designing complex sports and overall structures.

And at the end one of the impressive works of the



engineering team and software work, personally for me is the multifunctional stadium shown below. The realization of a Stadium, was an interesting design, the construction of a steel spatial structure. For this design, you need to be very careful in the production and de-

tails of the steel structure; for this project, the team of TopEngineer carried out the meticulous calculation of the welds and the spatial structure, the development of assembly plans, detail, and installation scheme for the truss of great light.

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