Application of parametric design tools for the roof of the C^3 tech demonstration house – CUBE

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Abstract

The C^3 Project (Carbon Concrete Composite) is the largest research project in the German construction industry. It is currently underway researching carbon reinforced concrete construction with an interdisciplinary consortium of more than 160 partners. The "CUBE" building, represented in Figure 1, exemplifies the results of this project, and it is assumed to be the world's first building, constructed entirely of carbon reinforced concrete, which will be completed in 2021. The main purpose of the building that has a gross floor area of about 200 m^2 is to show that the C^3 construction method has progressed so far that the entire process chain can be integrated, including the design, planning, tendering, construction and operation. Additionally, the building provides a testing facility site where innovative components of multiple future research projects can be implemented and tested under realistic conditions.

To develop the lightweight roof shell of the CUBE, that is designed as symmetric twisted ruled surface, a software solutions Rhinoceros 3D + Grasshopper 3D was used as the main algorithmic environment. The current paper presents methods and specially developed tools that were used to model and compare multiple structural solutions of the load-bearing shell. The paper additionally describes an overview over the important aspects that are of particular interest within the CUBE project, such as design workflows and manufacturing strategies of the appropriate shape of the formwork, insulation and biaxially loaded carbon grid reinforcing mats, which is one of the key focus of C^3 Project.

Figure 1: Visualization of the CUBE building. Front View.