The Opal - The Danish Society of Engineers, IDA

Rasmus Holst

Søren Jensen Consulting Engineers, Copenhagen, Denmark

Contact: rkh@sj.dk

Abstract

The Opal will be the new landmark building for the Danish Society of Engineers (IDA) in Copenhagen. The light and hovering appearance of the addition is the result of a structural principle developed in collaboration with Dorte Mandrup Architects and Søren Jensen Consulting Engineers.

Keywords: Computational design, interdisciplinary collaboration, digital workflow.

1 Introduction

The building will contain a conference hall, restaurant and a partially outdoors structure hanging below the main structure.

Placed between the existing IDA buildings near the harbour front at Kalvebodbrygge in Copenhagen, the Opal is a timber and steel hybrid diagrid shell structure in the shape of an ovoid.

The volume is carried by four V-columns placed on a single axis, moved backward from centre of the geometry allowing the building to cantilever out over the waterfront. Equilibrium is provided by tension elements in the back.

Computational design has been used as the main tool throughout the whole project to generate and systemize geometry and data necessary for the project team.

2 Geometry

The geometry is created by first smoothening the original architectural ovoid shape through mesh optimisation and then cutting through the shape vertically and radially creating a simpler mesh resembling the facetted surface of an Opal.

This mesh and edges make up all of the reference geometry and is sorted and shared among the project team in an online database.

3 Structure

The basic principle of cantilevering the gridshell structure is similar to that of a cable stayed bridge, with certain grid diagonals acting as tension cables around the doubly curved surface, four enlarged vertical grid elements at support columns leaning against each other acting as pylons and finally the floors and shell acting as the deck of a bridge.

3.1 Shell

The outer steel diagrid structure acts as the skin wrapping around the vertical glulam elements representing the bones of the shell.

The steel tension and compression elements in the cantilevered shell creates the resemblance of a three-dimensional version of the theoretical topology optimisation minimal structure similar to a Michell Truss.

3.2 Analysis

A detailed structural FEM model, set up through a parametric Grasshopper script allows for analysis and optimisation of geometry, connections, material distribution etc. The entire setup – including setting up load cases, materials, releases etc. - of the FEM model is done in Grasshopper so

https://doi.org/10.2749/222137817821232568
Distributed by structurae