Proceedings of the
International Association for Shell and Spatial Structures (IASS) Symposium 2019, Barcelona
7 - 10 October 2019, Barcelona, Spain

Design of a free-form single-layer lattice shell connecting ten building

Jian ZHOU[1*],YanPeng LI[1], YaoKang ZhANG, Hongjun WANG, Bengwei JIAG,XiaoTian YANG,Jiahun CHUI

[1*]East China Architectural Design & Research Institute
151 Hankou Road, Shanghai , China
Jian_zhou@ecadi.com

Abstract

This paper is to introduce the structure design of a sky-net (600-meter-long and 130-meter-width) which is supported by ten high-rise buildings. The sky-net applies free-form single-layer lattice shell with combined material of steel and aluminium. This paper includes form-finding, mesh generation, wind load and temperature load determination, and global analysis of the structure.

A method based on the minimum strain energy theory is adopted in form-finding. The cloud-shaped curvature is finally approached, meeting both requirements on load-transferring efficiency and architectural requirement. The curvature is peaked at the top of each building and dropped between buildings, who has specific tension-dominated region, compression-dominated region and moment-controlled transition region.

Mesh generation is based on the principle of force flow direction under gravity and is determined among several possible regular layout modes. The grid in right triangle with single-way diagonal is eventually selected, whose size is determined with the consideration of both ventilation rate and member slenderness ratio.

Wind load is one of control loads in the structure design. As there is a technical difficulty on wind tunnel test, which is owing to the undersized member section at uncovered area, the wind load in the project is approached by numerical simulation.

The 600-meter continuous length within shell results in temperature effect imposing huge impact on structure. The temperature variation range of this project is achieved by field test and its adverse influence of temperature effect is minimized by controlling closure temperature, special joint treatment and other methods.

This paper also presents the analysis of overall structure under gravity, wind, temperature, earthquake and other actions.