

Construction process analysis of Lianyungang gymnasium suspen dome

Yingying ZHANG

Ph.D student
Tongji University
Shanghai, China
zhangyingying85@163.com

Yingying Zhang, born 1985, received his civil engineering degree from Xi'an University of architecture and technology

Qilin ZHANG

Director
Tongji University
Shanghai, China
zhangqilin@tongji.edu.cn

Qilin Zhang, born 1962, received his civil engineering degree from Tongji University

Lu CHEN

Civil Engineer
Shanghai Tongji Construction
Quality Inspection Station
Shanghai, China
Bark719@163.com

Lu Chen, born 1978, received his civil engineering degree from Tongji University

Summary

Suspen dome is a new prestressed structure, consisting of an upper single-layer lattice shell and cable-struts. It needs control of the design state namely the final service-state and the safety in the construction. Lianyungang gymnasium suspen dome is taken as the research subject. Forward analysis based on birth and death element method was adopted to simulate the construction. The measured data in construction is compared with the theoretical calculation to gain the curves of displacement and cable force. Results show the birth and death element method can simulate the construction of suspen dome effectively. The measured data are in good agreement with the simulation calculation. The construction is affected by environment significantly.

Keywords: prestress, suspen dome, numerical simulation, monitoring

1. Introduction

In recent years, space structures have been developing rapidly. Plane lattices, lattice domes, and tensegrity structures are widely used all over the world. The suspen dome, which was developed by Kawaguchi et al., is one of the most popular space structures because of its excellent properties [1].

The suspen dome is the stiffening of a single-layer dome with a tensegrity system. The topmost single-layer dome provides rigid support and decreases the flexibility of the bottom tensegrity system. Simultaneously, the bottom tensegrity system reduces the stress in the members of the topmost single-layer dome. Thus the pretension in the cables of suspen dome is less than that of the cable dome. As a result, the buckling capacity of the overall system is enhanced. The suspen dome has been widely used, with the Hikarigaoka Dome, Fureai Dome in Japan and the Kiewitt suspen dome in Tianjin in China as examples [2-4].

For suspen dome, the design and construction are two inseparable stages. The design should consider the feasibility of the construction. Different construction sequence and tension methods will affect the internal forces and the final form. Even the internal forces of some members in the construction are larger than that after tension.

This paper takes Lianyungang gymnasium suspen dome as the research subject. Forward analysis based on birth and death element method was adopted to simulate the construction process. The EM sensors are conducted to track the construction process and ensure the construction safety.