

Comparison of Static Stability and Seismic Behavior between Steel and Aluminum Alloy Single-Layer Spherical Reticulated Shells

Jinzhi WU*, Guojun SUN, Zikui SONG, Zitai MIAO, Shiro KATO^a, Zhiqiang LI^b, Yigang ZHANG

*Spatial Structures Research Center, Beijing University of Technology
100 Pingleyuan, Chaoyang district, Beijing, 100124, China
kongjian@bjut.edu.cn

^a Department of Architecture and Civil Engineering, Toyohashi University of Technology

^b Shanghai Tongzheng Aluminum Engineering Co., Ltd.

Abstract

Because of its light weight, high corrosion resistance and relatively high strength, there have been more and more aluminum alloy(AA) single-layer spherical reticulated shells built in China in the past few years. Because the Young's modulus of AA is only one third of that of steel, there are significant difference of the static and dynamic behaviours between the steel and AA reticulated shells. In this paper, the comparison of the static stability and seismic behaviour has been done between the steel and AA single-layer spherical shells based on numerical analysis.

Firstly, the static stability of single-layer shells of the two materials has been analyzed, in which the global geometry imperfections, connection rigidity, member profile, member buckling and load distribution are considered. The results indicate that AA shells are more sensitive to imperfections, and have lower buckling strength than the steel shells, and that the safety factor for the design of AA shells should be higher than that of steel shells.

Secondly, seismic response of AA and steel shells of different size are analyzed under different earthquake records. The results indicate that the seismic capacity of AA shells is quite lower than steel shells, and the failure modes are different.

Based on the analysis above, some suggestions for the design of AA reticulated shells are given.

Keywords: Aluminum Alloy, Reticulated shell, Stability, Buckling strength, Seismic performance

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