

Shell-like and member buckling of latticed shells made of H-shaped steel

Tetsuo YAMASHITA*, Kai KAGEYAMA^a

*Prof., School of architecture, Kogakuin University
 A2514, 1-24-2, Nishi-Shinjuku, Shinjuku-ku, Tokyo, Japan
 tetsuo_y@cc.kogakuin.ac.jp

^a Kanebako Structural Engineers, Completed master's program in Kogakuin University

Abstract

Latticed shell roofs are often constructed using H-shaped steel (Fig.1) [1]. An H-shaped section has strong and weak axes and in-plane member buckling about weak axis (Fig.2) often appears preceding out-of-plane shell-like buckling (Fig.3). This paper focuses member buckling and investigates the conditions to determine the buckling type in geometric nonlinear behavior.

Even when a linear buckling analysis shows in-plane member buckling as the 1st mode, geometric nonlinear effect sometimes leads the first cause of out-of-plane shell-like buckling that appears as a higher mode. It was found that, when the ratio of the shell-like linear buckling load to the 1st member buckling is under two, shell-like buckling precedes. That relates the ratio of the knockdown factors on the two buckling types.

The linear buckling load for both types of buckling can be estimated on the classical continuum analogy without FE computation. But the effective length ratio is required in the member buckling calculation. In this study, it was found under 0.7 theoretically and empirically.

By integrating the above studies, an index to determine the buckling type to occur is proposed. This is also useful to estimate the knockdown factor that distribute between 0.4 and 1.0 according to the buckling type (Fig.4).

References

- [1] H.C.Saw, K.K. Choong et al: Iconic Roof of Setia SPICE Convention Centre Penang Malaysia – Architectural and Engineering Aspect of Organic Form Single Layer Latticed Grids Steel Shell Roof, *Proceedings of the APCS2018*, Penang, Malaysia, 2018, pp.14-24

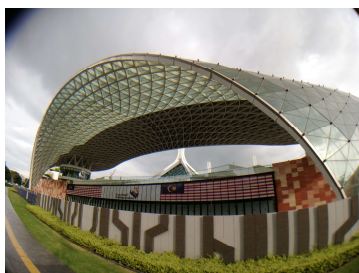


Fig.1 Latticed shell made of H-shaped steel

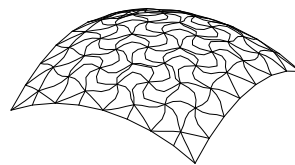


Fig.2 In-plane member buckling

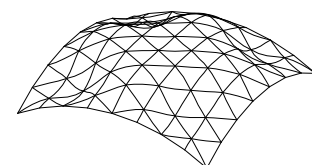


Fig.3 Out-of-plane shell-like buckling

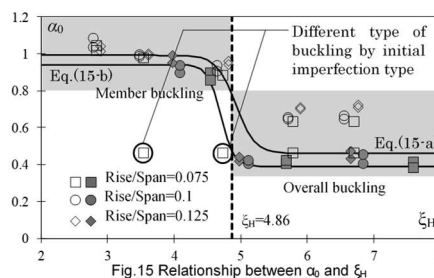


Fig.4 Shell-likeness index and knockdown factor