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# Shape optimisation of assembled single-layer grid structure with semi-rigid joints

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## ABSTRACT

It is generally known that the mechanical properties of connecting joints in assembled structures, such as strength and bending stiffness, have a great influence on the mechanical behaviour of the structure. Observations from earlier studies by Fathelbab (1987) confirmed that joint stiffness has a considerable effect on the load-displacement behaviour of a structure. Then, various types of joints have been experimented for their respective mechanical performances by Kato et al. (1998) and Ma et al. (2013), which have demonstrated different effects on reticulated shells. Furthermore, some new semi-rigid joints were developed by Feng et al. (2017), such as the ring-sleeve joint and the double-ring joint. It is worth to note that there are few studies of shape optimisation of assembled single-layer grid structure considering the effects of semi-rigid joints.

This paper takes the effect of the semi-rigid joints into account to optimise an assembled single-layer grid structure. Based on experimental results of the semi-rigid joints, finite element models of a single-layer grid structure with semi-rigid joints are established, and spring elements, as shown as Fig.1, are used to simulate the joint stiffness. The optimisation process is completed with the collaboration of ANSYS and MATLAB data. The research goal is to minmise the total strain engergy. Genetic algorithm is used for the optimisation, and nodal z-coordinates are chosen as variabies. The effect of the semi-rigid joints on the shape optimisation is studied by changing the joint stiffness. With this method, the optimal shapes of the assembled grid structure with different joint stiffness and improved buckling load are obtained.

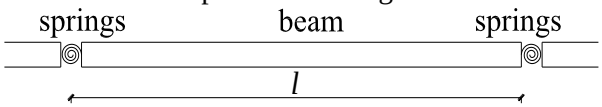


Fig. 1 Space beam and virtual spring model

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