THE EFFECT OF JOINTS ON THE STABILITY OF SHALLOW SINGLE LAYER LATTICE DOMES

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Abstract

Considerable improvements in the technology of space frame joints have been achieved in recent years. The conventional procedure for the analysis and study of space structure stability assumes that the joints of these structures behave as either pure pins or are fully rigid despite the fact that the joints of most space structures are semi-rigid. The actual behaviour of joints has been shown to have a significant effect on the behaviour of space structures, especially for shallow single layer lattice domes.

In this thesis the development of a general space frame member tangent stiffness matrix is reported. This matrix incorporates, in addition to the effects of axial force and bowing, the effects of joint characteristics. An algorithm for following the pre and post buckling behaviour of shallow single layer lattice domes has also been developed. The tangent stiffness matrix and the new algorithm have been implemented in a computer program for the geometrically nonlinear analysis of space frames. Results obtained using the modified computer program, have been tested against the available published results.

The computer program developed is then used to analyse and study the stability of a number of experimental shallow single layer lattice dome models. In these tests, various combinations of member size, joint type, and load pattern were tested. The results of all these tests along with the corresponding computer predictions are presented in this thesis. The ability of the program to model accurately the observed experimental behaviour is clearly demonstrated as is clearly demonstrated as is the significant influence that joint bending stiffness has on behaviour of shallow single layer lattice domes. In particular, realistic levels of joint bending stiffness are shown to produce a considerable improvement in load carrying capacity as compared with predictions based on pin jointed behaviour.