Dynamic Response of Single-Layer Cylindrical Reticulated Shells under Impact Loading Based on the Finite Particle Method: Postprint

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Date: 2023-12-18T00:00:00+00:00

Abstract

To investigate the dynamic response of single-layer cylindrical reticulated shell structures under impact loading and verify the accuracy of the finite particle method in simulating the impact dynamic response of reticulated shell structures, finite particle method models for seven impact scenarios were established. The impact model adopted a double-sphere collision model based on symmetric penalty functions, the collision stiffness coefficient in the impact model was determined according to the law of energy conservation, the Cowper-Symonds constitutive model was introduced, structural dynamic responses were obtained, and the simulation results were compared with experimental results. The results indicate that: 1) the impact force time-history curves obtained by the finite particle method are similar to the experimental results; 2) due to the fact that structural damage factors were not considered, the nodal displacements obtained by the finite particle method are slightly smaller than the experimental values, but the structural instability momentum obtained is consistent with the experiments; 3) the strain energy generated by impact in the reticulated shell is more easily transmitted along the diagonal members of the shell, while members in the impact zone and members in regions with larger stiffness, such as those near the supports, are the main load-bearing components of the structure. The finite particle method can accurately determine the dynamic response of single-layer cylindrical reticulated shell structures under impact loading, and can provide a theoretical basis for improving the impact resistance performance of relevant structures.

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