Study on the failure mechanism and parameter influence of single-layer reticulated shells under severe earthquake

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Abstract

Because of its beautiful appearance and reasonable structure stress, the reticulated shell structure has been widely used in important buildings such as stadiums, theatres and terminals. However, the failure mechanism of reticulated shell under strong earthquake action is not fully studied. In this paper, OpenSees software is used to create the numerical models and carry out the analyses and a fiber-based method is selected due to its ability to distribute plasticity within a section. The material and geometric nonlinearities are considered in the analyses. The plastic developing process and the seismic failure mode are studied by carrying out the incremental dynamic analysis (IDA). Based on the analysis of the change of fiber stress over time, the plastic development of the bars and the location distribution of the failure elements, as well as the collapse mechanism of the single-layer spherical reticulated shell structure are revealed. Moreover, the effects of span, rise-span ratio and roof load on ultimate bearing capacity of single-layer reticulated shells under earthquake are analyzed. The results show that, under the action of earthquake, the ultimate bearing capacity of single-layer spherical reticulated shell increases with the increase of span in a certain range, and decreases with the increase of the ratio of rise to span. With the increase of roof load, the ultimate bearing capacity decreased obviously.

References

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