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Stability Analysis and Experiment of the Spherical Shell

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Summary

The spherical shell is a typical form of revolution shells, which is widely used in pressure vessel and piping industry, nuclear power industry and ocean engineering for its specific structural shape to obtain kinds of performance. However compared to the cylindrical or conical shell, the spherical shell is mainly used as main structure or pressure hull in underwater engineering because of the superiority of theoretical solution and its manufacture. For the significance of the spherical shell, many researchers in the region of engineering and mechanics have spent great efforts to solve it and do lots of experiments in order to obtain its accurate theoretical analysis and design method as the engineering rule.

To show the characteristics of a spherical shell with some initial imperfections, both material nonlinear and geometric nonlinear Finite Element Analysis (FEA) has been presented in this paper. In this presented Finite Element Method (FEM), the elastic-plasticity stress-strain relations have been adopted, and the initial deflection of spherical shell created by manufacture was also taken into account. It is shown that the nonlinear structural characteristics of the spherical shell vary from its different dimension parameters for initial imperfection through by nonlinear FEM. Compared with the different rule's methods, nonlinear FEM could exactly show sphere's stability varying by initial imperfections. Then two experiments of spherical model, made by some high strength steel and with same sizes but different initial deflection, have been presented in presentation. The experiment results eventually indicate that the stability of a spherical shell varies by its initial imperfection and such sphere stability could not be accounted by currently rules except nonlinear FEM. It is essential to obtain the design method for spherical shell made by high strength steel used in deep sea vehicle and ocean engineering.