DYNAMIC BUCKLING OF CYLINDRICAL SHELLS SUBJECTED TO EXTERNAL PRESSURE PULSE

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ABSTRACT

When a launcher takes off, its engine and more particularly the nozzle extension, is subjected to numerous dynamic forces. In particular, the ignition of the booster engine on the launch pad upon takeoff generates a blast wave represented by a temporal dynamic pressure field applied to the structures. This experimental and numerical research was carried out with the aim of better understanding the phenomenon of dynamic buckling under external pressure pulse. Dynamic buckling tests of thin cylindrical shells under lateral pulse loading are scarce [1], then an important campaign with several tests is here carried out. The applied load is a shock wave which corresponds to an explosion or external pressure pulse generated by a specific device initially intended for the artificial triggering of avalanches [2]. The steel cylindrical shells tested are 0.1 mm thick, 110mm high and have a diameter of 110mm (then R/t = 550 and H/R = 2). The strain gauges glued to the shells in the radial and circumferential direction allow us to measure the shell response and to conducts modal analysis. The deformations of the shells are captured by a high-speed camera with 3000 images/second. The objective of the experimental campaign was to have reproducible test results allowing us to qualify the dynamic buckling behavior more particularly to quantify the critical pressures. Dynamic buckling is observed in the elastic phase and the associated pic loading characterized, for higher pulse loading yielding occurred in post-critical phase. Several numerical simulations are conducted with Abaqus code in its explicit version. The effects of the representation of the dynamic pulse loading, as well as boundary conditions and geometrical imperfections, are investigated trough several parametric studies. The test results are then interpreted with regard to the different conducted simulations.

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