Dynamic buckling criteria for shells under impulsive loads

Mariano P. Ameijeiras*, Luis A. Godoy†

*FCEFyN, Universidad Nacional de Córdoba, Argentina
mameijeiras@efn.uncor.edu

†Institute for Advanced Studies in Engineering and Technology, UNC-CONICET, FCEFyN, Universidad Nacional de Córdoba, Córdoba, Argentina
lgodoy@efn.uncor.edu

ABSTRACT

The buckling of shells under dynamic loads is a complex problem which is still under discussion. The stability analysis of shells under step loading has been studied in a number of publications and is currently based on a criterion due to Budiansky, in which the non-linear dynamic response is investigated for several load levels until a large displacement response is obtained for a small load increment. However, there are problems in the identification of dynamic buckling in which pressures alternate their values, such as under seismic loads, or for pressures with very short duration, such as in cases of explosions. Cases of impulsive loads of short duration (in the order of tens or hundreds of milliseconds), such as those occurring during an explosion, have only recently attracted the attention of researchers, and the current experience is limited. This work is motivated by the investigation of the non-linear dynamic response of oil storage tanks under lateral pressures due to an adjacent explosion. Spatial distribution of pressure is taken from test performed on small scale empty tank. Computations of non-linear dynamic response have been carried out using a general purpose finite element code. Numerical studies are presented for a case study under impulses of different durations. Several dynamic buckling criteria are applied, including those reported by Budiansky, Simitses, Virella et al. Following the impact of the pressures exerted by an explosion, the shell restores the elastic energy and does not advance into non-elastic states, thus causing difficulties in the identification of dynamic buckling.

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