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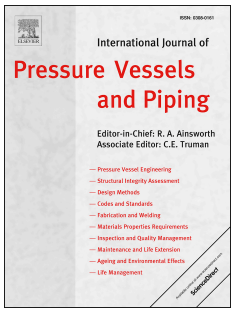

Post-buckling behavior of fluid-storage steel horizontal tanks

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Post-buckling behavior of fluid-storage steel horizontal tanks

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ABSTRACT: This paper focuses on the buckling and post-buckling of horizontal steel tanks with conical end-caps, supported on discrete saddles, under pressure caused by internal vacuum and liquid pressure. Linear bifurcation, as well as geometrically nonlinear analyses with imperfections, was performed on a single geometric configuration in order to highlight modeling differences, imperfection sensitivity, and post-buckling behavior. Results are presented for (a) increasing uniform external pressure; (b) increasing pressure under fixed fluid level; (c) coupled increasing pressure and decreasing fluid. For perfect shells, the lowest maximum loads are reached at the conical end-caps; however, imperfection-sensitivity is more stringent for the cylindrical shell than for the conical caps, with the consequence that the buckling mode has displacements in the cylinder and in the conical caps. The influence of radius to thickness ratio and fluid level are investigated by means of parametric studies.

Keywords: horizontal tanks; buckling; finite element analysis; shells; vacuum; fluid.

1 Introduction

In a recent review on the structural behavior of liquid storage tanks, Zingoni [1] showed that considerable effort has been given to explore the buckling behavior of vertical tanks but only a few papers on horizontal tanks are found in the technical literature. Explanations for this lack of urgency in research may be that horizontal tanks (with a volume capacity usually limited to 200m^3) have a much smaller storage capacity than vertical ones; their cost of fabrication are much lower; and the consequences to be expected from a structural failure are less dramatic than in a vertical tank. But safe designs are expected in all cases and research involving non-linear behavior is needed to fill the voids