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Elastoplastic Collapse Analysis of Pipe Bends Using Finite Element Analysis

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Abstract : When an external load is applied to one of its ends, a pipe's bends cross section tends to deform significantly both in and out of its end plane. This shell type behaviour characteristic of pipe bends and mainly due to their curves geometry accounts for their greater flexibility. This added flexibility is also accompanied by stressed and strains that are much higher than those present in a straight pipe. The primary goal of this research is to study the elastic-plastic behaviour of pipe bends under out of plane moment loading. It is also required to study the effects of changing the value of the pipe bend factor and the value of the internal pressure on that behaviour and to determine the value of the limit moments in each case. The results of these analyses are presented in the form of load deflection plots for each load case belonging to each model. From the load deflection curves, the limit moments of each case are obtained. The limit loads are then compared to those computed using some of the analytical and empirical equation available in the literature. The effects of modelling parameters are also studied. The results obtained from small displacement and large displacement analyses are compared and the effects of using a strain hardened material model are also investigated. To better understand the behaviour of pipe elbows under out of plane bending and internal pressure, it was deemed important to know how the cross section deforms and to study the distribution of stresses that cause it to deform in a particular manner. An elbow with pipe bend factor h=0.1 to h=1 is considered and the results of the detailed analysis are thereof examined.

Keywords : elasto-plastic, finite element analysis, pipe bends, simulation
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