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Evaluation of Deformable Boundary Condition Using Finite Element Method and Impact Test for Steel Tubes

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Abstract : Stainless steel pipelines are crucial components to transportation and storage in the oil and gas industry. However, the rise of random attacks and vandalism on these pipes for their valuable transport has led to more security and protection for incoming surface impacts. These surface impacts can lead to large global deformations of the pipe and place the pipe under strain, causing the eventual failure of the pipeline. Therefore, understanding how these surface impact loads affect the pipes is vital to improving the pipes’ security and protection. In this study, experimental test and finite element analysis (FEA) have been carried out on EN3B stainless steel specimens to study the impact behaviour. Low velocity impact tests at 9 m/s with 16 kg dome impactor was used to simulate for high momentum impact for localised failure. FEA models of clamped and deformable boundaries were modelled to study the effect of the boundaries on the pipes impact behaviour on its impact resistance, using experimental and FEA approach. Comparison of experimental and FE simulation shows good correlation to the deformable boundaries in order to validate the robustness of the FE model to be implemented in pipe models with complex anisotropic structure.

Keywords : dynamic impact, deformable boundary conditions, finite element modelling, LS-DYNA, stainless steel pipe
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