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Vibration Mitigation in Partially Liquid-Filled Vessel Using Passive Energy Absorbers

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Abstract : The following study deals with fluid vibration of a liquid in a partially filled vessel under periodic ground excitation. This external excitation might lead to hidraulic impact applied on the vessel inner walls. In order to model these sloshing dynamic regimes, several equivalent mechanical models were suggested in the literature, such as series of pendula or mass-spring systems that are able to impact the inner tank walls. In the following study, we use the latter methodology, use parameter values documented in literature corresponding to cylindrical tanks and consider structural elasticity of the tank. The hydraulic impulses are modeled by the high-exponent potential function. Additional system parameters are found with the help of Finite-Element (FE) analysis. Model-driven stress assessment method is developed. Finally, vibration mitigation performances of both tuned mass damper (TMD) and nonlinear energy sink (NES) are examined.

Keywords : nonlinear energy sink (NES), reduced-order modelling, liquid sloshing, vibration mitigation, vibro-impact dynamics
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