Study of dynamic behavior of buried steel pipes at bend point under propagating waves

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Pipelines are used to transmit gas, oil, water, etc. The vulnerability of pipelines under propagating waves especially at bend area, emphasizes the need of studying in this context. In the conducted studies in this field the beam and beam-shell hybrid models were usually used, but in this study a new model named continuum is examined. For this purpose, pipe is modeled by shell elements and equivalent boundary conditions are considered to simulate infinite length of the pipe away from the bend. The soil around the pipe is modeled by 3D elements with Mohr-Coulomb behavioral model. Also, equivalent boundary conditions are used to simulate soil infinite area. The models have been investigated under San Fernando, Northridge, Kobe, ChiChi, Tottori, Darfield earthquakes. The curves related to axial strain, the effects of incidence angle of seismic waves, bend angle, pipe diameter, pipe thickness, and physical properties of soil are presented. In most of the investigated states, axial strain has the highest value when the bend angle is 90 degrees. Using the mentioned analyses as well as regression analysis, an equation is presented for estimating seismic behavior of buried pipes at bend area. This semi-analytic equation estimates the response accurately.

Keywords: Buried pipe, Bend, Wave propagation, Continuum model, Numerical analysis, Semi-analytical equation.