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Abstract

The propagation of seismic waves introduces strains in buried pipelines. Considerable amount of work was performed in 1970's and early 1980's in this subject area. A good representative of such work is the model developed by Shinozuka and Koike in1979. The analytical models developed during this period are still the major tools in assessing the influence of seismic waves on buried pipelines. The foundations of these models are the assumptions and some simplified soil and pipe interaction models available at the time. In 1984 a spring model representing the interaction between soil and buried pipes was introduced by American Society of Civil Engineers (ASCE) in Guidelines for the Seismic Design of Oil and Gas Pipeline Systems. An improved version of the ASCE model was later published in Guidelines for the Design of Buried Steel Pipe by American Lifelines Alliance in 2001. Since then, the spring model has become one of the most widely used models by various industries and has been incorporated into commercial software, such as AutoPipe®. Most of the soil properties in fields are represented by the parameters of ASCE soil-spring model. However, it is inconvenient to assess the influence of seismic waves on pipeline with soil properties described by parameters of ASCE model. There are differences between the ASCE soil-spring model and the soil-pipe interactions in the seismic wave analysis model. In this paper the foundation of Shinozuka and Koike model is first reviewed. The model is thenrevised to accommodate the ASCE soil-spring model. Some unnecessary assumptions in the Shinozuka and Koike model are removed to make the model more generally applicable to various field conditions. Finally, the revised model is verified by finite element analysis under several typical pipeline field conditions, including straight pipe segment and segments with bends and tees.

Keywords

Seismic Wave, ASCE Soil-Spring Models, Buried Pipeline