THE EFFECT OF FAULT PLANE ANGLE ON THE STRUCTURAL RESPONSE OF BURIED STEEL PIPELINE SUBJECTED TO FAULT MOVEMENT

Abdollah Rohani Hajiagha
M.Sc, Hormozgan University, Bandar Abbas, Iran
sasanrohani@gmail.com

Abolfazl Riahi Nouri
Ph. D. Candidate, International Institute of Earthquake Engineering and Seismology, Tehran, Iran
a.riyahi@iiees.ac.ir

Mohammad Ghasem Vetr
Assistant Professor, International Institute of Earthquake Engineering and Seismology, Tehran, Iran
vetr@iiees.ac.ir

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ABSTRACT

Analysis and design of buried pipelines are complicated problems. The reason lies in the fact that it incorporates interaction between soil and pipeline as well as nonlinear behaviour of surrounding soil. In the present study, the effect of soil elastic and plastic characteristics on mechanical behaviour of pipeline is investigated numerically. Strike-slip fault displacement is imposed in various angles to longitudinal pipeline axis. Soil is considered as an elastic-perfectly plastic material conforming Mohr-Coulomb criterion. The results obtained numerically were compared to well-known analytical methods. Although, analytical methods and numerical softwares prepares loads of possibilities to take into consideration pipe and soil interaction more realistically, the present study shows that a comprehensive experimental study should be done in each of the cases to calibrate and determine realistic values for soil and pipe interaction needed for various methods.

INTRODUCTION

Buried pipelines are often referred to lifeline because play a vital role in the transporting of crude and refined petroleum, fuels such as oil, natural gas and biofuels. Earthquake is a major area of interest within the field of pipelines safety that consists of permanent movements of ground (i.e., PGD) or by transient seismic wave propagation.

Over the past decades, most research in the analysis of steel pipelines subjected to PGD has emphasized the use of analytical or numerical methods. Newmark and Hall (1975) analysed the fault-crossing pipe. However, they did not consider the bending stiffness of the pipe and lateral interactions between pipe and soil. Kennedy et al. (1977) developed the Newmark and Hall's approach by considering effect of lateral interaction and pipe's bending stiffness especially at large axial strains. Using a beam on elastic foundation Wang and Yeh (1985) introduced a new approach to study the behaviour of pipe. They neglect the effect of pipe axial stress on pipe bending stiffness. Karamitros et al. (2007) by adopting some ideas of Wang and Yeh (1985) developed the Kennedy's model. On the other hand, a number of authors have used of finite element methods to study the fault-pipeline problem. Vazouras et al. (2012) studied a