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A CASE STUDY OF SEISMIC ASSESSMENT OF BURIED PIPELINES

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Pipeline systems can be performed as different lifeline structures including water and wastewater pipeline, fuel transition line, power and communication lines. Most pipelines are built as buried structures so their it has been illustrated repeatedly that these buried pipelines are vulnerable during the earthquake (Toprak & Taskin, 2007). Damages and disruptions of the buried pipeline systems in the earthquake could threaten seriously social life and property, and prolong economic recovery during post-earthquake construction and rehabilitation. So earthquake performance and safety of the buried pipeline systems are very important. Most specifically in the crisis of earthquake occurrence. Due to complexity, lots of components and facilities of the systems, buried pipelines is one of the most vulnerable categories in earthquake engineering. Nowadays, construction of vast transmission networks for water pipelines in cities and villages a routine manner. Although, these water transmission lines are constructed by engineering methods but, the lack of seismic design to improve their performance and reliability for after earthquake occurrence is seen. Field observations and various studies indicate that major seismic hazards to the buried pipeline systems are: (1) excessive axial and bending stresses and deformations in the pipelines created mainly by the phase difference and change of wave shape between different points along the pipeline; (2) large displacements due to the ground deformation during an earthquake if the pipeline crosses a major fault; (3) landslides and damage caused by soil liquefaction. Earthquake induced permanent ground deformations are one of the main reasons why the buried pipelines destroy, and most of them caused by fault movements. Thus, it is necessary to determine the behavior of this system based on great historical earthquakes. Thus, the results of these investigations can be proposed as revisions on existing codes, to provide more resistant system against earthquakes. Evaluation of lifeline structures in earthquake engineering has implemented since 70s in the United States and Japan. Various models are proposed to investigate the occurrence of earthquake on buried pipeline transmission system. During recent century, the effect of various parameters on existing models were investigated to achieve more realistic results. (Newmark, 1968) investigated on the effect of fault rupture on buried transmission pipelines and proposed a simple method for the response of the pipeline regarding wave propagation. (Kennedy, 1977) developed Newmark method by concerning lateral applied soil forces, curvature and bending strain. Based on research achievements, a 3-D model is developed for the seismic response analysis of the buried pipeline system due to the fault generated large ground deformation. Several Abaqus built-in features enable a wide range of simulating such problems. For complex problems Abaqus can be extended via user subroutine Hügel et al. (2008). In this paper the buried pipeline is considered as a space shell structure, and the soil around the pipeline also taken out for analysis in the model. Therefore, the interactions between the pipeline and the soil deal with by solving the contact problem, and the responses of both the pipeline and the soil around can be computed. The model of Zahedan's water pipeline was simulated in ABAQUS Software. Then, parametric study on soils' primary parameters and pipe with their variations was investigated to achieve the applied stress.

In order to validate the model using a static pushover analysis, by increasing the internal pressure of the pipe from a low to high value, which respectively represents the linear and nonlinear behavior of the pipe, the constitutive model of

steel is used in the pipeline. Thus, with increasing internal pressure of the pipe, the stresses and strain values of the shell were changed and the results were compared with the software input constitutive model which was collected using laboratory results.
It should be noted that the verification of the accuracy of pushover techniques, has so far been restrained to the cases of reinforced concrete buildings and continuous-span bridges, with steel construction having been essentially overlooked. For pipe line structure, no limitation has been reported.

According to the Figure 1, the results of the numerical analysis are in good agreement with the results of experimental analysis. Therefore, the results of the numerical model can be desirable.

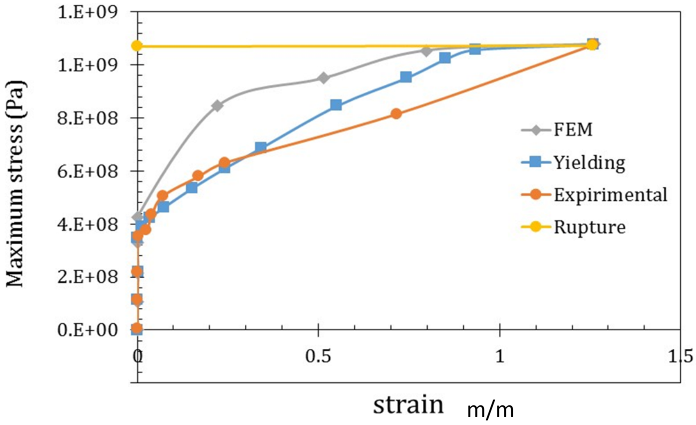

Figure 1. Static pushover results compared with nonlinear behavior Sts370 steel.

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