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Investigation into cyclic behavior of steel pipes under different boundary conditions

Mahdi Haghdoust *, S. Mohammad Reza Oujaghi, Hossein. Showkati.

Graduate Student of Structural engineering , Urmia University, st_m.haghdoust@urmia.ac.ir
M.Sc. Structural engineering , Urmia University, Rezaojaghi72@gmail.com

3. - Professor at department of Civil Engineering, Urmia University, h.showkati@urmia.ac.ir

Abstract

Today, sea-going pipelines are mostly non-buried on the sea bed. By changing the flow field around the tube, the sediments under the tube begin to move, and the scouring phenomenon of the bed happens, the presence of roughness in the seabed, leads to the phenomenon of free spans in the pipelines. The simultaneous combination of this phenomenon under cyclic loading is considered as one of the causes of failure of sea pipelines and there is a potential for all kinds of collapses such as yielding and buckling. In this research, numerical and experimental evaluation of two steel tube specimens, one with two-ends fixed boundary condition and 177 cm length, with a constant thickness of 0.2 cm, and a cantilever one with 100 cm length with a constant thickness of 0.2 cm, was carried out under cyclic loading according to SAC loading protocol. The results obtained from the test showed that the compressive and tensile strength decreased with increasing loading cycles after local buckling in the specimens and boundary conditions were effective on the cyclic behavior of the specimens, With the exception of the two-end boundary conditions in the sample, with increasing loading cycles, the gradual decrease in the thickness of the samples at the load location, a gap was created and low cycle fatigue problem was observed on the sample. But in the specimen with cantilever boundary condition, loading continued until the last cycle, without creating any gap in the sample.

Key words: free spanning, cyclic loading, steel pipes, hysteresis, buckling

1. Introduction

One of the important issues in the study of free spans is the study of bending behavior of pipelines. the type of loading used for determining hysteresis behavior is cyclic loading. This type of loading is due to earthquake or earth movements . One of the most important consequences of cyclic loading is the reduction of structural strength with increasing of deformations. Integrating free spans with cyclic loading is an important phenomenon in reducing the structural life. It is important to accurately predict the response of these conditions for pipe members to prevent catastrophic failures.