Analysis of Buried Plastic Pipes in Dune Sand

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Abstract

Dune sands create major problems in Oman for construction of buried pipes. It is not a suitable backfill soil for buried pipe because of its low bearing capacity, easy to collapse upon wetting, high permeability and low shear strength. This thesis studied the performance of buried plastic pipes in dune sands by simulating the pipe–soil model using a two dimensional plane strain element in ABAQUS. Because of symmetry, only one-half of the soil-pipe system was modeled. The nonlinear behavior of soil was modeled with hypo elastic model.

The study considered different factors that affect the performance of plastic pipe such as non linear properties of backfill and bedding soil, relative soil density (dense, medium and loose), bedding angle (00 , 450 ,900), installation methods (trench and embankment), pipe material (HDPE and PVC), pipe diameter (1076 mm and 610 mm) and internal pressure in the pipe. The pipe soil response includes normalized change in vertical diameter, hoop strain, bending strain and pressure in the pipe. It was found that soil relative density is one of the most important factor that affect the performance of plastic pipe.

The percentage change in vertical diameter increases while the hoop and bending strains decrease as the relative density increases. The normalized change in vertical diameter, hoop strain, bending strain and pressure in the pipe decrease with increase in bedding angle. The hoop and bending strain increase with an increase in the modulus of elasticity for the pipe. The main conclusion of this study is that dense dune sands can be used as a backfill material for plastic pipe with bedding angle of 450.