Soil Box Tests on Flexible Plastic Pipes

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Abstract

Plastic pipes are increasingly being used in water supply, water waste systems and other underground applications. However, limited information is available on the performance of these buried pipes under construction and long-term loads. This study is focused on using soil boxes to investigate the parameters affecting the deflection and wall loading of buried plastic pipes and to evalute pipe behavior under various backfills. Pipe wall strain recorded indicates that placing and excavation of the backfill have noticeable effects on the deformations of the pipe as compared to the deflection during sustained crown loading.

1. Introduction

Plastic pipes offer the advantages of light weight, durability, ease of handling, economy and consistent performance in aggressive environments. The design of these plastic pipes is governed by the following factors: deflection under both static and dynamic backfill loads, ring bending moment, ring compression force and buckling.

In this study, soil boxes are used to evalute the performance of plastic pipes during placing and excavation and under sustained loads.

2. Testing Program

8-in (203 mm) diameter plastic pipes of 24 in (609 mm) length with SDR of 35 and 55 were selected for this study. Eighteen strain gauges were glued to each pipe: eight on the inside mid section, eight on the outside mid section along the circumfrential direction. Two strain gages were placed along the longitudinal direction. The strain gages were glued using the M Bond-200 adhesive after surface preparation. External loading was applied by tightening a set of four rods on the side of the chamber. Slots were made on the side of the soil box so that the pipe projected, reduce side effects and to access the pipes for deflection measurements from outside.

Load cells were placed beneath the cross beam connecting the loading rods. Two strain gauges were mounted on each rod to estimate the load magnitude. The rods were calibrated on the Tinius Olsen Universal Testing Machine. Two earth pressure cells were placed 1 inch above the crown and along the springline.

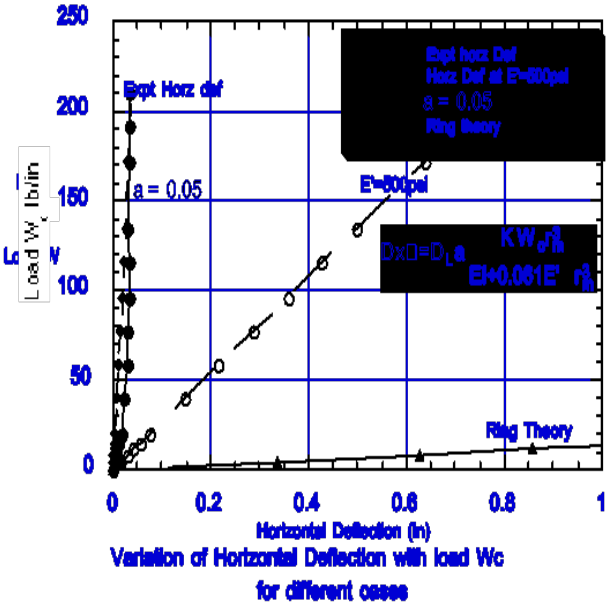
Deflections were monitored within the mid section by a special device fabricated for this purpose. This device consisted of two spring steel elements in the form of a semi-circular arch. Two strain gauges were attached to each arch, one in the compression side and the other in the tension side.

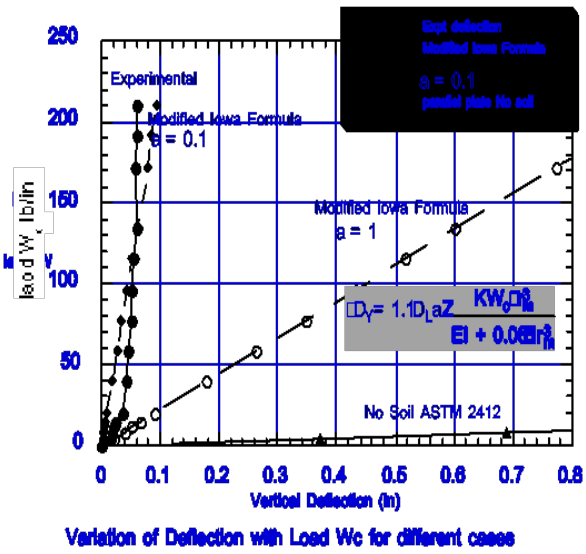
The four strain gauges were then connected to a full bridge. Deflections in the pipes were measured both in the vertical and horizontal directions.

2.1. Backfill Materials

ASTM C33 sand was used as the backfill material in the soil box for the initial study. The unit weight of the backfill was 1.77 g / cc. Future tests are planned on cemented sand, soil slurry and CLSM (control low strength material) as backfill material.

3. Results





4. Conclusions

1. The horizontal deflection ?x and Vertical deflection ?y are less compared to the modified Iowa formula.

2. A factor a was introduced in the modified Iowa formula to better represent the test data, for E' = 500 psi, Vertical deflection a = 0.1 and for Horizontal deflection a = 0.05 corresponds to the measured experimental results.

5. Acknowledgements

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6. References

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