Flexible PVC Pipe-Backfill Interaction Study

Mohan K Neelam and **C. Vipulanandan**

Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4791
Phone: (713)-743-4291; email: mneelam@hotmail.com

ABSTRACT

Behavior of flexible PVC pipes with sand and Controlled Low Strength Material (CLSM) as backfill materials was investigated in the soil box. A series of tests were conducted with pipes, under SDR of 55, to determine load-deflection relationship under incremental backfill loads. A special deflection-measuring sensor and pressure sensor were fabricated and used in the soil box tests. Pipe deflections will be compared against the modified Iowa formula and appropriate modification will be recommended for CLSM.

1. INTRODUCTION

The use of flexible plastic pipes as horizontal buried conduits has gained much popularity over the recent years. Flexible plastic pipes, made of Polyvinyl Chloride (PVC) or High Density Polyethylene (HDPE), are replacing the more conventional concrete and clay pipes in water supply, sanitation and environmental applications. Controlled Low Strength Materials (CLSM) are also being increasingly used as backfill material due to their ease of placement and economy. This study presents results from experimental investigations on the backfill behavior of flexible PVC pipes with sand and CLSM.

2. BACKFILL MATERIALS

The backfills used in this study are sand and CLSM. The unit weight of sand was 1.77 g/cc. The basic components of CLSM are Portland cement, fine aggregate, fly ash and water. The proportions used for CLSM are Type I Portland cement (0.3 parts), sand (25 parts), Class F fly ash (4.7 parts) and water (3.7 parts). The compressive strength of CLSM achieved in 28 days was 45 psi.

3. TESTING PROGRAM

PVC pipes 8" (203mm) in diameter and 24"(609 mm) in length with SDR (standard dimension ratio, defined as pipe diameter/thickness) of 55 was used. Pipes of SDR 35 were machined on the out side to achieve a SDR of 55. Two soil boxes were fabricated to simulate wide and narrow trenches. A special loading arrangement was designed for applying the addition load.

The inner dimensions of the narrow box are 18" x 24"x 35" (W x L x H). The wider box was 48" x 18" x 35" in size. The sand was rained from a height into the soil box. CLSM was mixed in batches in a portable mixer in a controlled environment and poured into the soil box. The load was applied by tightening bolts fixed at the corners of the box facilitating loads up to 60 kips. Sixteen strain gages were attached at the mid section of the PVC pipe with eight inside and eight outer surface of the pipe. Specially-developed deflectometers and total pressure transducers were used to measure the vertical and horizontal deflection and the pressure acting at the invert, spring line and the crown. For each test, the pipe-backfill system was instrumented to read the following data:

1. Circumferential and longitudinal strains in the pipe wall at the inside and outside fibers at eight equally spaced locations at the mid-length circumference
2. Vertical deflection and horizontal elongation of the pipe section

3. Soil pressure at the crown, spring line and invert. 4. Construction and dead load applied on the top of the soil box

4. RESULTS

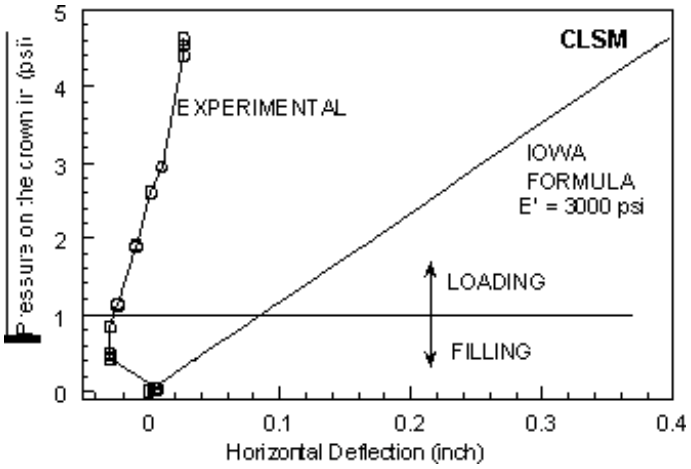

Figure 1 Typical Pressure Deflection Curves for Sand as a Backfill

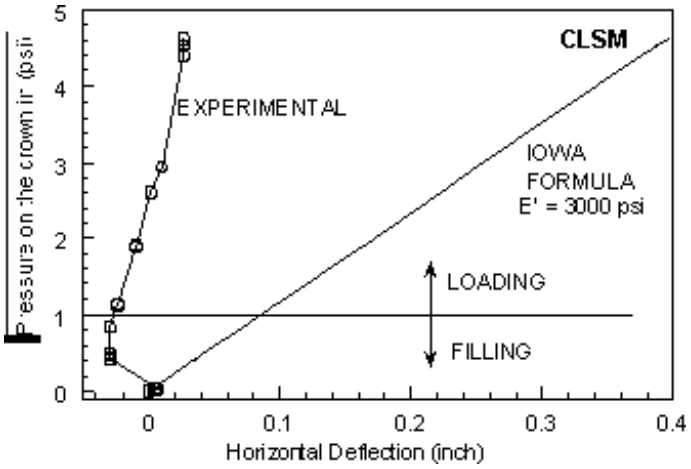

Figure 2 Typical Pressure Deflection Curve for CLSM as a Backfill

5. SUMMARY

Soil box was used to study the behavior of flexible PVC pipes with backfill sand and CLSM materials. The results are being analyzed and compared to the modified Iowa formula.

6. ACKNOWLEDGEMENTS

This work was supported by the Center for Innovative Grouting Materials and Technology under grants from the City of Houston and National Science Foundation.

7. REFERENCES

1. ASTM Committee F-17, ASTM D-2412-87, "Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading", 1987.
2. Howard, A. K., "Modulus of Soil Reaction Values for Buried Flexible Pipe", Journal of Geotechnical Engineering, ASCE, Vol. 103, GTL, 1977 pp. 33-43.
3. Fernando, N.S.M. and Carter, J.P., "Elastic Analysis of Buried Pipes Under Surface Patch Loadings", Journal of Geotechnical Engineering, ASCE, Vol.124, No.8, 1998. pp. 720-728.

If you have any questions, please contact Dr. C.Vipulanandan