2d-Flow Model For Lateral Pipe Joint

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Abstract

A small-scaled two-dimensional lateral joint model was built to study the flow patterns during infiltration and grouting (exfiltration). Infiltration leak rates were measured at different water pressures applied. The variation of the infiltration flow due to changes on the effective stress of the soil was investigated.

1. Introduction

Infiltration & inflow (I/I) can cause great capacity reductions of sewer systems and further may cause collapse of the pipe. Leaking lateral joints are among the main cause of infiltration into the system, and many trenchless methods are available to rehabilitate these joints. Sealing leaking joints using chemical grouts is one of the most widely used applications and has been in use for more than forty-five years. This method has been advanced later with the usage of small cameras and lateral packers that provides accessibility into lateral pipes from the mainline. Even though this application is well established, and the results can be monitored inside pipes with help of cameras, the percolation behavior of the grout around the lateral pipe is unknown. A two dimensional model that allows for investigation of the flow patterns around the laterals was built in the CIGMAT laboratory.

2. Objectives

- **a.** To build a tabletop model to represent a leaking lateral joint that allows for visual observations of flow patterns around the joint.
- **b.** To investigate the relationship of infiltration, in-situ stress, soil permeability and water pressure which represents the groundwater table level.
- **c.** To investigate the grout flow pattern during grouting (exfiltration).

3. Materials and Testing Method

Tap water was used with Deweyville #2 sand for the initial study. Deweyville #2 sand has hydraulic conductivity of 1.2×10^{-1} cm/sec. The infiltration rates were measured (Fig. 1) with water pressures ranging from 1 to 5 psi. The same procedure was repeated by changing the vertical effective stress of soil from 0.5 to 7 psi (Fig. 2).

4. Conclusions

a. Infiltration increased with increasing water pressure. These values ranged from 185 to 451 gpd/in.diameter at 1 psi and 5 psi water pressures respectively (Fig. 3).

b. Infiltration rates decreased with the increase of effective soil stress of the sand.

c. Visual observations during exfiltration study showed that the water infiltration into the unsaturated soil was ellipsoid shaped with a ratio of semi-major to semi-minor axis (h/r) range from 2.1 to 2.25 (Fig. 4).

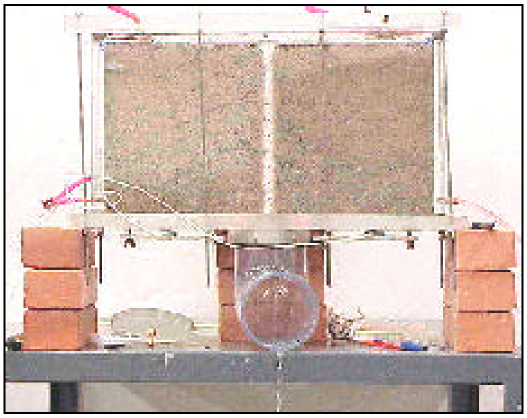

Figure 1. Infiltration Rate Tests

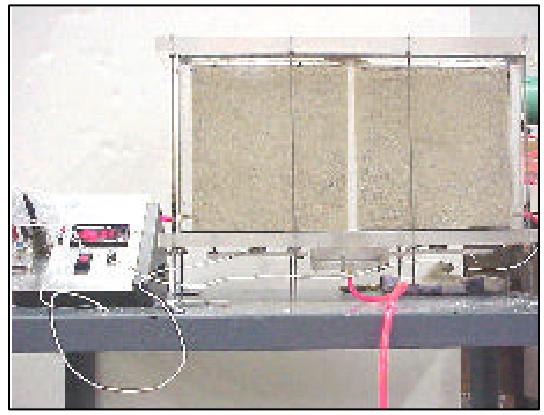

Figure 2. Effective Vertical Stress Tests

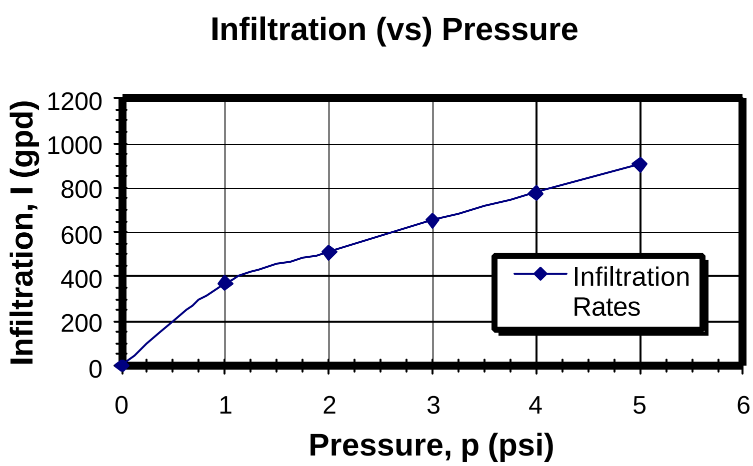

Figure 3. Infiltration Leak Rates

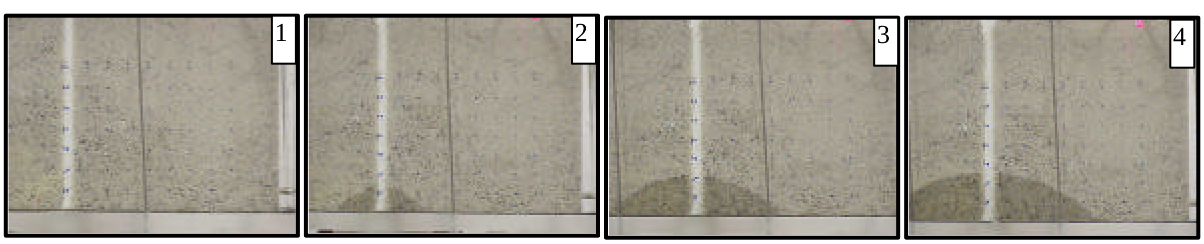

Figure 4. Exfiltration Study

5. Acknowledgements

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6. References

Environmental Technology Verification Program For Grouts Used For Leak Control In Wastewater Collection And Treatment Systems And Concrete Repair – CIGMAT, October 2000.