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The Geo Engineering Centre

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JOHN CHOLEWA, PHD (2009)

RESEARCH SUMMARY

RESPONSE OF SOIL AND ADJACENT WATER PIPE DURING SEWER REPLACEMENT BY PIPE BURSTING

LARGE SCALE TEST FACILITY USED TO STUDY MECHANICS OF PIPE BURSTING

CONCRETE SEWER REPLACED WITH HDPE PIPE

MEASUREMENTS OF PULLING FORCE AND GROUND DISPLACEMENTS

FRACTURES DEVELOPED IN THE WELL GRADED GRAVEL (ROAD BASE)

BENDING IN ADJACENT PVC WATER PIPE MONITORED—STRAINS SAFELY BELOW PVC LIMITS

MEASUREMENTS USED BY RAHMAN TO DEVELOP FINITE ELEMENT ANALYSIS

Various trenchless technologies permit installation of buried thermoplastic pipes by pulling them into place through the ground. Pipe bursting uses a cone shaped expander to fracture an existing pipe, displace the resulting fragments out into the surrounding ground, and pull a new HDPE or other pipe into place through the resulting cavity. The expansion of the soil leads to vertical and lateral ground movements that can damage overlying pavements, and can also fracture pipe structures running parallel or transverse to the pipe being replaced.

John Cholewa designed and conducted a large scale pipe bursting experiment to replace a concrete sewer with a new HDPE pipe. Bending strains were measured in a PVC water pipe running transverse to the concrete sewer (see below). Post-test analysis provided the displacement profile of the PVC water pipe, and a new design method was proposed to permit consultants to estimate bending strains in PVC and other pressure pipes in the vicinity of pipe bursting operations.

The large scale buried infrastructure test facility at Queen's permits experimental studies under known geotechnical and construction conditions. John employed digital photographs and analysis using Particle Image Velocimetry, and the lab's servo-controlled total station, to determine patterns of surface movement throughout the tests. These results are being used by PhD student Kazi Rahman to develop 3D finite element models of bursting using ABAQUS.

John conducting his large scale laboratory test in 2007.

HIGHLIGHTS

- **Long term axial stress in pulled in place pipe not critical provided length recovery permitted for 24 hours**
- **HDPE creep functions provide estimates of installation strains**
- **New methodology for estimating bending in adjacent water pipe**
- **Working for Golder Associates, Ottawa since January 2009.**

RESPONSE OF HDPE PIPE DURING AND AFTER INSTALLATION BY HDD

John developed a unique fixture to simulate cyclic loading of HDPE pipe during directional drilling, length recovery after installation, and axial tension development after pipe attachment to appurtenances. Viscoelastic and viscoplastic analysis established that simple creep functions provide reasonable estimates of installation strains.

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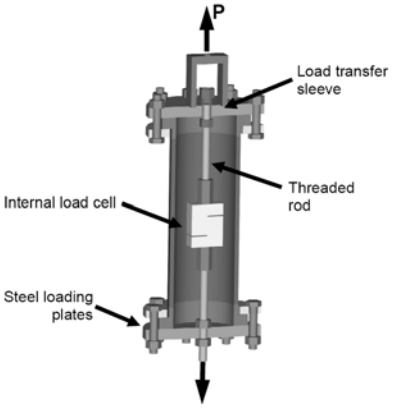

Fixture designed to provide axial restraint and force measurement.