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The GeoEngineering Centre

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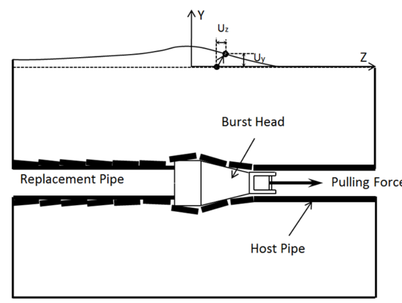
KAZI RAHMAN, PHD (2013)

RESEARCH SUMMARY

- **ABAQUS ANALYSIS TO MODEL THE PIPE BURSTING PROCESS**
- **ESTIMATES OF GROUND SURFACE MOVEMENTS COMPARED TO TEST MEASUREMENTS**
- **VERTICAL, AXIAL, AND LATERAL SOIL MOVEMENTS STUDIED**
- **EXAMINATION OF HOW BURSTING AFFECTS CAST IRON AND PVC PRESSURE PIPES NEARBY**
- **ESTIMATES OF PULLING FORCES ALSO COMPARED TO MEASURED VALUES**
- **DESIGN CHARTS DEVELOPED FOR ESTIMATING SIZE AND IMPACT OF THE SOIL MOVEMENTS**

THREE DIMENSIONAL NUMERICAL ANALYSIS OF STATIC PIPE BURSTING

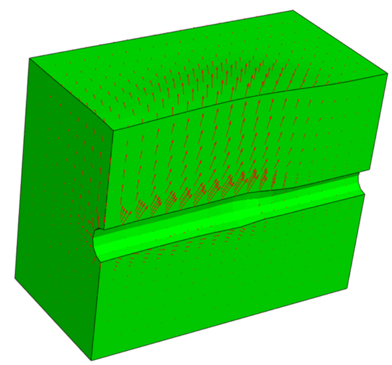
Static pipe bursting is a trenchless technology that permits installation of buried thermoplastic pipes. A cone shaped expander is used to fracture an existing pipe, displace the resulting fragments out into the surrounding ground, and pull a new HDPE or other pipe into place through the resulting cavity. The soil movements that result in the surrounding ground can damage overlying pavements, and can also fracture pipe structures running parallel or transverse to the pipe being replaced.



Schematic of the pipe bursting process and the surface movements

Kazi Rahman used nonlinear finite element program ABAQUS to analyze pipe bursting experiments conducted in dense sand and gravel by former graduate students Brian Lapos and John Cholewa, and used comparisons of the calculated response to test measurements to evaluate the performance of the computer models. He then undertook parametric studies using his ABAQUS models to examine the influence of key geometrical and material properties, such as the depth and diameter of the old sewer being replaced, the upsize (how much the diameter of the burst head is larger than the old pipe), the strength of the surrounding soil and its initial and final density after bursting (the extent to which the dense soil increases in volume as it is sheared). Modeling captured the nonlinear response at the interface between the burst head and the old pipe, shear failure and nonlinear dilation of the dense soil, and the large changes in geometry.

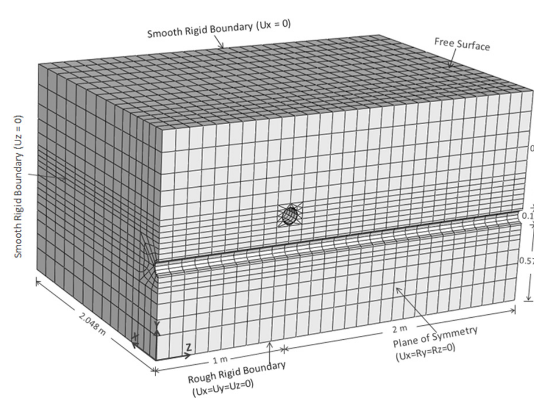
Calculated values of ground motion caused by the burst head



RESPONSE OF ADJACENT PIPE DURING BURSTING

Kazi examined the response of both cast iron and PVC water pipes adjacent over or beside the sewer being replaced, and demonstrated the size of strains that arise in those pressure pipes during static pipe bursting. A number of cases have occurred where gas and water pipes fractured during or after pipe bursting.

Analysis mesh showing transverse pipe overhead



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Sponsors: NSERC

HIGHLIGHTS

- **awarded the Michael E. Sargent Scholarship of the North American Society of Trenchless Technology at the NoDig conference in Washington**
- **won the 35th Annual Michael Bozozuk Student Forum, a competition for graduate students at Carleton, Ottawa, Queen`s and RMC**