The Osterberg Lecture

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Those Days the Earth Doesn't Stand Still: *Pipeline Response to Imposed Ground Motion*

Abstract: Various circumstances arise where pipelines are subjected to ground motion, and successful pipeline performance is contingent on understanding and accounting for the resulting pipe-soil interaction. This presentation presents the results of experimental and computational studies examining the details of two kinds of ground motions.

Firstly, problems involving movement laterally past pipelines buried within are studied, like those resulting from downslope soil movements or as soil displaces ahead and below an iceberg keel. Measurements of pipe deformations & bending are compared with 3D finite element analyses. Experimental observations of soil displacement fields, strain fields, and zones of localized shear failure around pipelines are then presented, and compared with nonlinear finite element analyses.

Secondly, pipeline response to differential ground movement is studied where the pipeline straddles across a normal ground fault. Centrifuge studies are used to investigate the impact of pipeline flexibility on behaviour, as well as the performance of conventional 'beam on elastic spring' buried pipeline models. Prototype scale experiments using a new test box are then discussed, for both continuous PVC and jointed clay sewer pipes. Tests on clay pipe focus on the kinematics of jointed rigid pipes, and how the shear forces generated across the joints under even modest ground movements can lead to joint leakage.

The research findings are providing guidance on changes to pressure pipeline design practice, rational design procedures for pipe joints considering resistance to expected demands (replacing empirical design practice), and physical evidence to support development of 2D and 3D computer models for complex ground-movement problems.

Biography: Trained in Australia, Dr. Moore has been Canada Research Chair in Infrastructure Engineering at Queen's University since 2001. An expert on the behavior and design of buried pipes, Dr. Moore has contributed to North American and other codes, design and construction practices for culverts, sewers, manholes, liners, storm-water detention chambers and pressure pipe systems. Other activities include editorship of the Canadian Geotechnical Journal and the Canadian Foundation Engineering Manual, and keynote lectures in North America, Asia, Europe, Africa and Australia. Dr. Moore's work has been recognized by various honors, including the John B. Stirling Medal of the Engineering Institute of Canada, the John R. Booker award of the International Association for Computer Methods and Analysis in Geomechanics, and best paper awards from the American Society of Civil Engineers, the Canadian Geotechnical Society, the Canadian Society for Civil Engineering, and the North American Society for Trenchless Technology. Dr. Moore is an elected fellow of the Canadian Academy of Engineering and other learned societies. Since 2002 he has been Executive Director of the GeoEngineering Centre at Queen's – RMC, North America's largest GeoEngineering research team and one of the leading such groups internationally.

Presented by the Civil and Environmental Engineering Department