LABORATORY STUDY OF STATIC PIPE BURSTING

Three-Dimensional Ground Displacements and Pull Force during Installation, and Subsequent Response of HDPE Replacement Pipes under Surcharge Loading

by

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ABSTRACT

Results from six static pipe burst experiments conducted with sand backfill are reported. Pipe bursting is a trenchless construction technique where a hydraulically undersized or structurally deteriorated host pipe buried in the ground is "burst" (or broken) and pushed radially outward into the surrounding soil and a new pipe is then pulled into place. Both replacement (host pipe is the same size as the new pipe) and upsize (the new pipe is larger than the host pipe) experiments were conducted at burial depths of 685 mm and 885 mm. Displacements at the ground surface were monitored using a total station and reflective prisms. Ground displacements were shown to occur five burst head diameters in advance of, and laterally (perpendicular) outward from the burst head. Permanent ground displacements were observed behind the burst head. On average, the ground displacements were 30% larger for upsize tests compared to replacement tests. Similarly, the ground displacements were found to be approximately 30% larger for pipe burst tested at shallow burial depths compared to deep burial depths. Pull forces were also measured for each experiment and were also found to be dependent on burial depth. The three components contributing to the overall pull force (related to expansion of the soil cavity, breaking of the host pipe and friction generated between the sand and HDPE pipe) were quantified. For the specific conditions tested (2 meter pull length) the cavity expansion force, breaking force and friction force were approximately 79%, 20%, and 1% of the total force, respectively. Finally the response of the replacement pipe when subject to additional vertical pressures was measured. It was found that a pipe replaced using

pipe bursting can experience deflections up to 1.5 times those of a similar pipe installed using cut and cover construction techniques. The presence and orientation of the broken host pipe were found to affect the overburden response of the replaced pipe compared to that of a pipe installed using traditional cut and cover construction.