Water scarcity has been identified as a global issue. Both water harvesting and an efficient water piping system are some of the important factors to meet the water demand. In this study, high-density polyethylene (HDPE) pipes used as an underground storage was evaluated and a Microsoft EXCEL based model was developed, called PIPEâ€“R Model. To study the structural integrity of the pipes, laboratory and field testing were conducted. For the water harvesting, UCF Stormwater Management Academy designed an EXCEL based model to simulate the systemâ€™s performance to store and redistribute water for an average year.

The purpose of PIPEâ€“R Model was to provide average yearly values such as groundwater recharge, hydrologic efficiency and make up water needed in order to guide the user in the design process. The PIPEâ€“R Model consisted of evaluating specific pipe systems based on properties selected by the user. Input variables such as system dimensions, soil type and reuseâ€“water demand provided flexibility to the user while evaluating the system. Results of the study showed that the PIPEâ€“R Model might be an effective tool while designing these pipe systems. A detailed example was shown to help visualize the process required to use the model. The PIPEâ€“R model allowed the user a wide range of possibilities and resulted in important performance data that will hopefully optimize the cost for its construction.

For the evaluation of the structural integrity of the pipe system, laboratory testing was conducted in accordance with ASTM D2412 â€“ 11 â€œDetermination of External Loading Characteristics of Plastic Pipe by Parallelâ€“Plate Loadingâ€œ. This method helps evaluate the structural performance based on the pipe stiffness (PS) against the standard values stated by AASHTO M252. The test procedure consisted of establishing loadâ€“deflection relationship of a single pipe under parallel plate loading. However, this research project involved the analysis of bundled pipes of different sizes and levels. Thus, modifications were added to the formula in order to evaluate multiple pipes by accounting the number of pipes in contact with the loading plate. Laboratory results demonstrated that the pipes exceeded the minimum requirements stated by AASHTO M252 and that strength is decreased as the number of levels increases.

In addition, field testing was conducted to study the behavior of bundle systems under the effects of dead and live loads. Three different cover configurations were studied ranging from 18 inches to 43 inches of depth. Drawâ€“wire sensors, a type of displacement sensors, were placed inside buried housing structures to monitor deformation values experienced by the pipe bundles during the test. Average deformations for the cover depths of 43 in, 30 in and 18 in were found to be 0.07 in, 0.32 in and 0.64 in, respectively. Based on these results, it was recommended that a minimum of 30 inches of cover is appropriate if live loads are anticipated.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2013, University of Central Florida

Committee in Charge:
Manoj Chopra, Chair, Civil Engineering
BooHyun Nam, Assistant Professor
Dingbao Wang, Assistant Professor
Ikiensinma Gogoâ€“Abite, Research Associate

Approved for distribution by Manoj Chopra, Committee Chair, on March 23, 2015.

The public is welcome to attend.