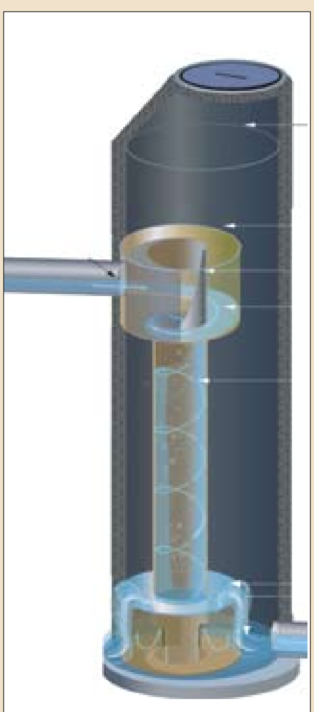
Trenchless Technology Center Newsletter

DECEMBER 2010

Research Project Highlight:

eVortex: Energy Harvesting from Waste and Storm Water Conveyance Systems

Gravity driven sewer and storm water pipes transport tens of billions of gallons of water each day and continuously flow year-round. There is an interest within the engineering community to use the mechanical energy available in the sewer flows to generate electricity. Though sewers are ubiquitous in urban environments, not all sewers are suitable for energy harvesting. Most of the gravity driven sewer pipes are constructed with the minimal slope needed to maintain minimum flow velocity (approx. 2 ft/sec). Thus, the introduction of turbines to extract kinetic energy slows down the flow rate, hampering the sewer's operational efficiency. Moreover, the presence of debris and turbidity of the flowing wastewater present additional challenges in terms of frequent turbine blockage, making the process of power generation less reliable and cost-effective.



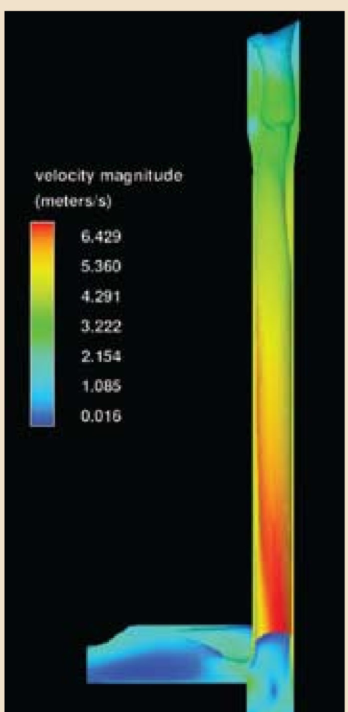


Fig 1. Rendering of a vortex insert drop structure

Fig 2. Velocity profile within a vortex drop structure

Conversely, drop structures present ideal locations for the installation of hydro turbines. These underground 'urban waterfalls' are constructed for the purpose of directing flow from shallow surface sewers to deeper collection tunnels via a vertical shaft. More specifically, vortex drop structures consist of an inlet, outlet, spiral section at the entrance to create a vortex flow, and a vertical pipe section (see Figure 1). The water entering the structure is accelerated by the spiral section such that a spiral motion takes place along the wall of the vertical pipe. The height of these structures range from 5 ft to as high as 300 ft and have sufficient head to generate many kilowatts of power. However, the unique characteristics of the flow within the drop structure and the presence of sediments and debris in the flow render traditional turbine architectures are not suitable.

The Trenchless Technology Center is currently undertaking a research work aimed at the design, analysis, fabrication and testing of an innovative, low-cost turbine for harvesting the kinetic energy generated by the flow of fluids through vertical drop structures. The outcome of this work is the eVortex, a novel, patent-pending turbine design capable of handling the challenges associated with energy harvesting from storm and wastewater collection systems, including debris, highly corrosive environments and variable flow rates. Following the initial concept design, a detailed 3D numerical model of the drop structure has been developed and the results validated against both analytical solutions and experimental data. A screen capture from a finite element model of the velocity profile within a vortex structure is given in Figure 2, while a cross-sectional view of the water flow within the eVortex is shown in Figure 3. The research team is now working on harnessing the power of a supercomputer to develop detailed computational fluid mechanic model of a 30 ft tall vortex drop structure, capable of housing a single or multiple eVortex turbine modules.

Based on the numerical results, a full scale prototype was fabricated and installed in the hydraulic laboratory at Louisiana Tech University. Figure 4 presents an image of the experimental setup. The research team expects to have a field ready prototype by summer 2011 and hopes

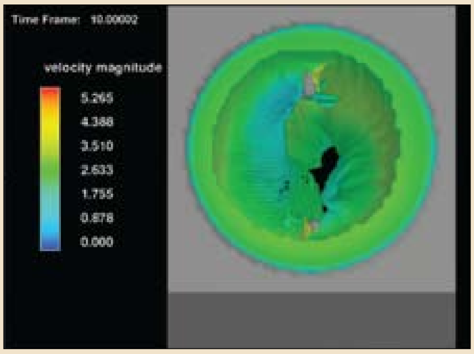


Fig 3. Cross-sectional view of the flow within an eVortex module (flow rate = 10 liters/s)

Fig 4. An experimental setup of an eVortex structure

to complete the installation of the first eVortex unit in a municipal collection system by the end of 2011.

The eVortex technology will add electricity generation functionality to drop structures in addition to odor control, without hindering the primary function of these structures. Benefits to municipalities include a long-term revenue source, as well as a source of green credits for balancing their ‘carbon emission’ balance sheet.

The TTC is committed to the development and promotion of innovative ‘green technologies,’ assisting the trenchless industry in providing municipalities with cost-effective and sustainability-oriented solutions to their waste, storm and potable water conveyance systems.

October 2010 TTC IAB Meeting in Ruston

The 2010 Industry Advisory Board fall meeting was held Oct. 21-22. The IAB fall meetings are held each year at Louisiana Tech in Ruston, where industry members, faculty and students get together for two days of presentations and discussions wrapped around several enjoyable social events. A social highlight of the meeting was now already a traditional BBQ, held on the evening before the board meeting commenced, and hosted by Rob and Linda McKim.

The meeting itself had 13 different presentations on TTC research projects and the graduate students normally presented their own research activities to the board. Demonstrations using some of the TTC novel testing facilities further enhanced the event, displaying engineering phenomena tested on full-scale specimens under highly controlled conditions. Inquiries about participation in TTC activities as an Industry Advisory Board member or Sponsor are welcomed. The IAB is a key part of the TTC success, providing critical financial and intellectual support.

Industry Advisory Board

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Trenchless Technology Center

Louisiana Tech University

Adminstrative Director: Dr. Rob McKim

Research Director:
Dr. Erez Allouche

Research Engineer:
Jadranka Simicevic

Laboratory Technician:
Nathan Pettit

Secretarial Staff:
Sandi Perry *(administrative secretary)*

Mailing address:
P.O. Box 10348
Ruston, LA 71272-0046 USA

Phone: (318) 257-4072
Toll Free: (800) 626-8659
Fax: (318) 257-2777

E-mail: ttc@Latech.edu
Web site for TTC:
www.ttc.latech.edu

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