DHS Science and Technology Directorate

Resilient Tunnel Project

Tunnel floods cause billions of dollars of damage

Normally, mass transit officials are focused on keeping things moving, but when it comes to tunnel flooding, stopping the flow of water is the number one issue. When a tunnel floods, the damage is swift and the dangers are deadly. In 1992, Chicago experienced a tunnel flood that led to nearly $2 billion in damage to city property. Approximately 50,000 office workers were impacted by the flooding, and the Chicago Chamber of Commerce estimated that the flooding caused $500 million in lost business and productivity. New York City's extensive subway system has experienced a number of floods in recent years, including massive flooding that closed seven tunnels during Hurricane Sandy in 2012.

The tunnel plug conforms to the shape of a subway tunnel, as seen in this photo. When deflated, the plug can be stored on the sides of the tunnel without interfering with tunnel operations.

DHS explores ways to stop floods

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) is researching technologies that can prevent or limit flooding in transportation tunnels. Initially, S&T focused on solutions that can be deployed in subway tunnels. Additional engineering will be needed to address the needs of major highway tunnels, as well as other key nodes of transit systems.

Through the Resilient Tunnel project, S&T partnered with the Pacific Northwest National Laboratory (Richland, WA), West Virginia University (Morgantown, WV), and ILC Dover (Frederica, DE), a textile company that manufactures spacesuit fabrics. Together, the team developed an inflatable tunnel plug that uses state-of-the-art textile technology and manufacturing techniques to isolate and seal tunnel sections, limiting the spread of damage.

The tunnel plug can withstand the high-pressures of flood waters

S&T designed a plug made of high-strength Vectran® fabric, which ILC Dover had used for the landing pods of the Mars Rover. During testing of an early plug prototype, scientists found that a single layer of Vectran fabric was insufficient, so S&T developed a tri-layer version with a webbed fabric outer layer. In 2012, S&T successfully tested the modified version in the project's full-scale test tunnel, which can simulate actual tunnel conditions. The current plug has been tested by initially inflating it with air, then filling it with water to achieve full internal pressures. Future tests will attempt to pressurize the plug with air, offering tunnel owners more inflation options to fulfill specific transit system needs.

Pre-installed and ready for quick deployment

S&T designed the tunnel plug to be pre-installed, in a custom-designed, compact container at strategic locations in underground transportation tunnels. When needed, the tunnel plug can be inflated quickly to halt flooding, minimize loss of life, and limit damage to infrastructure.

A major U.S. transit system plans to begin installing tunnel plugs in 2016. The project team is working closely with transit agencies and the Transportation Security Administration to ensure the technology can be efficiently installed in subway tunnels.

The plug uses special high-strength textiles to withstand the pressures of a flooded tunnel.

Homeland Security
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To learn more about the Resilient Tunnel Project, contact sandt.rsd@hq.dhs.gov.

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