Resilient Tunnel Plug

High-strength inflatable device that can be deployed rapidly to prevent fluid flow in a tunnel of any shape or size; originally developed for security applications to protect underground subway systems from flooding caused by damage to an underwater transit tunnel; can also be used for other applications, including the prevention of flooding from top-down water events, or to partition tunnels to prevent the movement of smoke, chemical/biological agents or people.

Relation to Adaptation and Resiliency

Helps achieve protection of underground track/tunnel in the event of floods, inundation, or natural disasters.

Benefits

Some of the benefits of applying this measure include halting flooding, minimizing damage to transit systems, and preventing loss of life. Saltwater inundation of subway stations, subway tunnels and a highway tunnel caused significant damage and the temporary closing of seven tunnels during Super Storm Sandy in New York City in 2012. Resilient tunnel plugs deployed prior to the flooding could have prevented much of the damage beyond the plug location. This measure should only be used in an emergency. The Chicago Tunnel flood of 1992 caused over $2 Billion damage to city property and $500 Million in lost business and productivity.

Limiting Factors (Constraints)

The inflatable tunnel plug should be suitable to be stored in a small storage space near the point of use. There should be clear instructions for any user that are available at the point of use.

Design & Preliminary Costs

It will be critical to follow the OME recommendations regarding use. It is recommended that a test program be implemented before selection of a tunnel plug product and prior to implementation so that the product and specific use can be reviewed and evaluated.

Pricing is dependent upon the specifics of the tunnel (e.g. diameter and cross-sectional shape of the tunnel, surface finish of the interior of the tunnel, depth of anticipated flood waters, expected deployment time, etc.). The costs of this measure include both capital and operational costs. Maintenance costs are expected to be minimal. (Source: ILC Dover). Maintenance costs are expected to be minimal.

Permits & Approvals

Authorities having jurisdiction, such as the fire marshal and tunnel owner/operator, may need to be consulted and special structure evacuation requirements may need to be implemented prior to deploying.

Implementation

Implementation requires annual testing of resilient tunnel plug by operations staff, and evacuation of subway tunnels, stations or highway tunnels in advance of deployment. Following evacuation and confirmation that evacuation is complete, deployment of the tunnel plug could be completed in less than an hour as it is intended to be rapidly installed. MTA New York City Transit tested an inflatable 30 ft. long, 14 ft. diameter tunnel plug in 2012 for a trial installation. In order to get a good seal, a section of the Third rail had to be removed and the tunnel floor, or invert, had to be raised.

Maintenance Requirements

The blower is an electro-mechanical system and requires routine maintenance. Overall, maintenance requirements should be minimal as robust materials and construction for high reliability is typical for tunnel plugs. It is a simple design with few moving reports and will therefore have low maintenance requirements. Resilient tunnel plugs should be tested at least once/year and replaced per manufacturer's guidelines or sooner if defects are found during testing. Annual training by operations staff is critical to the success of this measure.

Useful Life

A projected 20 to 25-year lifespan for the inflatable tunnel plug itself and a 35+year lifespan for the blower and associated hardware (i.e. the system that inflates the plug) (Source: ILC Dover).

References/Specifications

- Resilient Tunnel Project, Department of Homeland Security Science and Technology Directorate, https://www.dhs.gov/sites/default/files/publications/Resilient%20Tunnel%20Project-508_0.pdf
- MTA New York City Transit Tests Inflatable Tunnel Plug, https://www.youtube.com/watch?v=TmqoMp_gOvc
- ILC Dover Resilient Tunnel Plugs, https://www.ilcdover.com/catalog/residential-tunnel-plug/