Flood Safety for Basement Spaces

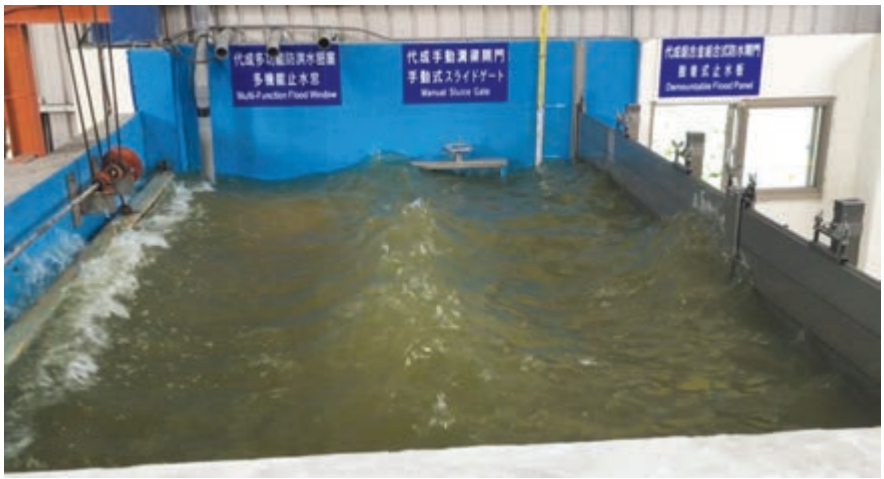
Ir. Loo Chee Kin

The basement of a building can house important articles. In commercial buildings, this may be used for mechanical and electrical utilities as well as a carpark. In a hospital, heavy imaging equipment, such as X-ray and MRI scanners, will be placed here. In residential houses, it may be the place to keep old furniture and cars or turned into a wine cellar or gaming/entertainment room with high-tech audio-visual equipment. In major cities, MRT lines will have underground sections, so there will be tunnel openings and underground stations.

Water flooding into the basement causes not only damage to equipment but also economic loss and short/long-term damage to reputation. For example, if the basement of a mall is flooded, the chiller plant and electrical rooms will be wet when submerged. Not only will the equipment be damaged, but without chilled water and electricity, the mall simply cannot operate. Furthermore, news of customer vehicles affected by the flood waters and shoppers trapped in the dark, stuffy mall will spread quickly on social media.

The primary step in preventing flood in basement spaces is to keep the water out with watertight construction. But basements need openings for people and vehicular access. Usually, these are kept open but yet, they should be able to be closed quickly in the event of a flood as water will flow through any gap or opening. As water follows the fluid mechanics law, it will fill the basement over time.

Entrances need to be blocked before flood water can enter. The use of sandbags is not effective and is time consuming as it will, ergonomically, be a challenge to move hundreds of sandbags, each weighing tens of kilogrammes. The placement and stacking of sandbags can also be a technical challenge, as the sandbag wall must be stable, with minimal water seepage through it. Then, after the water recedes, much time is needed to remove and store those sandbags.



Wave testing in progress. On the right side is a demountable flood panel being the flood gate

Self-engineered gates may do the job, but there is no guarantee of performance and long-term durability. Certified flood gates will have to undergo several engineering tests and evaluations. These may be full-scale water flow simulation tests as well as individual component tests. These include hydrostatic strength, leakage, cyclical, vibration, impact and wear resistant, salt spray corrosion, tensile and elongation, accelerate aging, compression, environment corrosion resistant, extreme conditions, abrasion resistant, tear and puncture. A deployable gate has to meet deployment time, wave-induced hydrodynamic load, overtopping, debris impact and current.

The hydrostatic strength of the gate should be tested in a workshop, as field testing will not be able to generate the required pressure on the retaining parts such as seals and bladder. The acceptable leakage test by the American National Standards is 3 litres per minute per metre length as higher leakage may overwhelm the pumps in the protected area. As the gates will be in contact with water, a salt spray corrosion testing will ensure metal parts will not deteriorate prematurely.

Conversely, compression and accelerate ageing tests are crucial for plastic and rubber parts. The environment corrosion resistant extreme condition simulates storage

Flap gate for drain outlet

Flood barrier for rail tracks

Residential building protection

conditions, where the gate parts are subjected to moist carbon dioxide/ sulfur dioxide mixture for several days and at elevated temperatures.

Deployment time varies with gate designs and the manufacturer must state the time, manpower, tools and resources to get the barrier installed. Since flood water is not still, the barrier has to withstand waves without significant deflection and additional leaks as well as water current flow at 2 m/s. An overtopping condition happens when a barrier floats, overturns or a catastrophic failure occurs when water flow over it. Debris impact is a rigorous test too as the barrier has to withstand impact by a simulated log measuring 43cm in diameter, weighing 358kg and moving at 8km per hour.

As water seepage is expected around the gates and infiltration through the basement structure, this water must be removed. Flood abatement pumps are used to pump water into appropriate drains. Backwater valves will be needed on any discharge line from the building. This may be rain water, floor drains, sewers or sanitary lines. Otherwise back flow or water head in sewer lines will let water into the basement. Floor or perimeter drains may require sluice gates as well.

The flood plan should be documented as an emergency response plan. This plan should detail in order the first steps to be taken as well as subsequent steps and resources needed. Otherwise, time may be spent on unnecessary measures or less important steps. Having a checklist will ensure that all flood barriers are erected or in place, pumps and backwater valves are checked and sluice gates closed. The plan should be triggered if there is flood warning from the authorities, local flood detection system or long periods of heavy rainfall. ■

Author's Biodata

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