



HIGHWAYS DEPARTMENT

PRACTICE NOTES

Flooding Warning System in Subways/Underpasses

Bridges & Structures Division

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1. Introduction

Flooding has been one of major maintenance problems in subways and underpasses. Despite enormous amount of effort paid to maintain subways and underpasses, flooding still occurs quite frequently especially during rainy seasons. The causes of flooding are normally due to unexpected heavy rainfall, trapped rubbish, incoming power failure, tripping of electrical protective device or pump system failure. Flooding could cause serious threat to public safety and there is a need to incorporate a flooding warning system in subways/underpasses that could give the maintenance authority a warning on any flooding incident.

The objective of this Practice Notes is to provide guidelines on the requirements of design and installation of flooding warning system for all new subways/underpasses.

This Practice Notes supersedes BSTR/PN/002D with immediate effect.

2. General Requirements of Flooding Warning System

Where a flooding warning system and its associated measures are proposed to be handed over to Highways Department (HyD) and the Electrical & Mechanical Services Department (EMSD) for maintenance, prior explicit written agreement from HyD in consultation with EMSD to undertake future maintenance shall be obtained before the systems are installed. The project team shall not proceed with the installation of these systems without such explicit written agreement. HyD in consultation with EMSD will consider each proposal on a case-by-case basis. The project office shall also reserve adequate recurrent funding for the operation, maintenance, and replacement of these systems throughout their required service life.

The flooding warning system shall comprise a Remote Monitoring Unit. The Remote Monitoring Unit should be able to detect flooding incident and send a telephone message to the maintenance authority and other relevant departments (e.g., Drainage Services Department) through mobile networks. It should also send response messages to the authority when being prompted over telephone.

The flooding warning system shall be compatible with and capable of integration into the existing flooding warning system of the maintenance authority. The system shall also be equipped with an Application Programming Interface (API) or equivalent functionality to enable data exchange with the maintenance authority's systems.

Technically, the designer shall seek advice from EMSD and maintenance authority for the detailed requirements, specifications, etc. to suit the specific operational need for individual sites.

3 General System Requirements of Remote Monitoring Unit (RMU)

- (a) The RMU shall include sensor devices, transmitters and receivers.
- (b) The RMU shall be capable to carry out the following functions, possibly through sensors, control unit and telephone transmitter: -
 - (i) to detect any incoming power failure in pillar box;
 - (ii) to detect pump power failure in pump house;
 - (iii) to detect high water level in pump pit inside pump room;
 - (iv) to detect high water level in main barrel of subway/underpass;
 - (v) to resume to normal condition for all fault signals; and
 - (vi) to report automatically to the HyD's message receiver on the detected faults. At present, the message receiver is located at the Customer Service Centre of EMSD Headquarters.
- (c) The RMU including the sensor devices, transmitter, receivers and the type of mobile networks shall be reliable and durable to stand for the site environment with 99% overall reliability.
- (d) The design of the RMU shall allow for future expansion such as addition of warning signals detected by the sensor device and addition of locations. Details shall be agreed with the respective maintenance offices during the design stage.
- (e) The RMU shall contain system watch-dog circuit (i.e., self-diagnosis function) and built-in backup battery to sustain 6-hour continuous operation once power supply is failed.

3.1 Sensor Devices Requirements

- (a) The sensors shall be designed to differentiate false alarms resulting from transient incidence such as accidental water splash. Each sensor devices shall be provided with time delay function. The interval for the time delay function shall be adjusted in the range of 4 to 6 minutes.
- (b) The sensors devices for the main barrel of subway or underpass shall cater for the transient high water level by the accidental wetting of routine barrel cleaning works.
- (c) The exact positions of the sensor devices shall be agreed with the respective maintenance offices of HyD in consultation with EMSD.

3.2 Transmitter Requirements

- (a) The transmitter shall be of the weatherproof type normally housed in an above ground pillar-box.
- (b) The transmitter shall be designed to suit any type of mobile networks with Short Message Service (SMS) in Hong Kong.
- (c) The transmitter shall be designed with the watchdog or self-monitoring function in case of malfunction.
- (d) The transmitter shall have status display unit or indicator showing the status of the sensors and the communication status with the message receiver to facilitate on-site maintenance works or diagnosis works. The status display unit shall be agreed with the respective maintenance offices of HyD in consultation with EMSD.
- (e) A fault report attendance switch shall be provided in the transmitter for record of maintenance attendance. The signal of fault attendance shall be relayed to the RMU.

3.3 Receiver Requirements

- (a) The receiver shall be capable of monitoring the status of the drainage system and the condition of the RMU automatically.
- (b) The receiver shall be capable of checking the performance of the RMU circuitry and the receiving and transmitting of all alarm signals.
- (c) The receiver shall include all the hardware and software to perform the intended functions of the RMU and shall be positioned in the venue designed by the respective maintenance offices.

4. Advanced Measures to be implemented together with Flooding Warning System

During the detailed design stage, the designer shall review the necessity of installing a closed-circuit television (CCTV) system for new subways/underpasses to be installed with a flooding warning system. The CCTV system should enable officers to monitor real-time conditions inside the subways/underpasses and implement appropriate follow-up measures in a timely manner during extreme weather conditions. The CCTV system shall be compatible with and capable of integration into the existing CCTV system of the maintenance authority. The system shall also be equipped with an Application Programming Interface (API) or equivalent functionality to enable data exchange with the maintenance authority's systems.

For new subways to be installed with a flooding warning system, in addition to the CCTV system, the designer shall consider the provision of electronic warning signs to alert pedestrians before entry and to keep them away from flood risks. While the designer should seek advice from the maintenance offices of HyD and EMSD regarding specific arrangements, the electronic warning signs shall meet the following minimum requirements –

- (a) the electronic warning sign shall be equipped with weatherproof features;
- (b) the electronic warning sign shall be installed at prominent locations of the subway to ensure pedestrians observe the warning before entry;
- (c) the electronic warning sign shall be equipped with flashing lights to enhance pedestrian awareness during flooding conditions; and
- (d) the display screen shall have a diagonal dimension not less than 65 inches to ensure that the warning messages are clearly visible from a distance. The exact dimensions and pixel pitch may vary depending on the actual site conditions, subject to agreement with the maintenance offices of HyD in consultation with EMSD.

Apart from electronic warning signs, the designer shall also consider the installation of an alarm system for new subways to be installed with a flooding warning system. For example, a sounder may be triggered once its sensors detect people approaching a flooded subway. The designer should take into account the surrounding environment and adjust the design of the alarm system as necessary in consultation with the maintenance offices of HyD and EMSD. For instance, the sounder may be disabled during certain hours if the subway is located in close proximity to residential areas.

The designer shall liaise with the respective maintenance offices of HyD and EMSD to ascertain whether these systems are required and, where necessary, coordinate with them to determine the exact equipment locations and system arrangements.

5. Implementation

The flooding warning system shall be incorporated for all new subways/underpasses if any of the following conditions apply–

- (a) the subway/underpass is located within 30m of the nearest shoreline;
- (b) the subway/underpass is located in an area identified by the Drainage Services Department (DSD) as Flood-Prone Areas; or
- (c) the subway/underpass does not fall within conditions (a) or (b) above but is considered vulnerable to flooding.

For cases where risk of flooding of the new subways/underpasses is considered minimal, prior agreement from the respective maintenance offices of HyD, in consultation with EMSD, and DSD shall be sought if a flooding warning system is not to be incorporated.