

For discussion
16 February 2024

Legislative Council Panel on Transport

**Highways Department's emergency recovery works in response to
road-related incidents under extreme weather**

Purpose

This paper briefs Members on the Highways Department (HyD)'s contingency measures and recovery works in road emergencies under extreme weather conditions.

Background

2. Located in the subtropical region, Hong Kong is susceptible to threats such as tropical cyclones, heavy rainfall and storm surges. With the intensification of climate change, the threat of extreme weather is expected to become more frequent and serious. The Government is committed to taking precautionary measures to enhance the resilience of our infrastructure against extreme weather, such as landslide preventive measures and drainage improvement works, in order to protect the lives and properties of the citizens.

3. On transport infrastructure, HyD is responsible for the maintenance of about 2 200 kilometres of public roads, about 13 000 roadside man-made slopes and about 600 000 roadside trees in Hong Kong, as well as emergency recovery works to road facilities damaged during extreme weather conditions. Common damages to public roads and associated facilities caused by extreme weather include (i) blockage of roads due to collapse of roadside trees; (ii) blockage of downhill roads due to landslides caused by heavy rainfall; (iii) subsidence or landslides caused by rainwater damage to road base; and (iv) road flooding due to rainfall exceeding the capacity of the road drainage system or blockage of culverts by debris. To cope with the impact of extreme weather on public roads, HyD carries out a series of preventive measures and formulates emergency response measures. As soon as the threat of extreme weather has subsided, HyD will carry out recovery works for damaged road facilities with a view to

minimising the impact on the public and protecting the safety of road users. Details are set out below.

Preventive Measures

4. Every year, before the onset of the tropical cyclone and rainy season, HyD will instruct its contractors to inspect in advance the roads¹ with higher risk, drainage facilities of structures and the pumping facilities in road tunnels/pedestrian subways, etc. under its purview. It will also step up the inspection and clearance works of the outfalls and drains of public roads with the relevant government departments to ensure that they are free from blockage. During the rainy season, HyD will step up the regular clearance of road drainage facilities, and arrange clearance for roads with higher flooding risks on a monthly basis instead of at three-month intervals. In addition, HyD's public works project teams will inspect the works sites and the surroundings (including slopes) of its projects before and after rainstorms to clear any flooding or blockage of drains that may be caused by heavy rainstorms, with a view to minimising the inconvenience caused to the residents in the vicinity and ensuring safety.

5. HyD also takes appropriate preventive measures for its roadside slopes on a regular basis, including annual maintenance inspections of all slopes to assess the condition of slopes or retaining walls and their maintenance condition. HyD conducts regular inspections of its roadside slopes and expressways and carries out vegetation maintenance operation such as pruning of tree crowns and firming up tree stakes.

6. Concurrent storm surges during typhoons may raise the sea or river level and increase the flooding risks on nearby roads. In light of the information from the Hong Kong Observatory (HKO) and the Drainage Services Department (DSD), HyD will make timely advance closure of pedestrian subways with a higher risk of flooding. In addition, the long span bridges in Hong Kong (including Tsing Ma Bridge, Kap Shui Mun Bridge, Stonecutters Bridge, Ting Kau Bridge, Shenzhen Bay Bridge, Hong Kong-Zhuhai-Macao Bridge and Tseung Kwan O Cross Bay Link) are equipped with bridge health monitoring

¹ Higher risk roads include roads in low-lying areas, adjacent to rivers or streams, which are generally more susceptible to drainage problems or flooding, and more heavily utilised roads (including trunk roads, expressways, major bus routes, only access road connecting the areas, etc.) which require special attention in the maintenance of their drainage systems.

systems, which can provide real-time information on environmental parameters such as wind speed, wind direction, temperature, etc., as well as dynamic data of the bridges. HyD's engineering staff will also monitor and assess the condition of the bridges round the clock, and will close the roads concerned or implement diversion measures where necessary. In addition, HyD had engaged the University of Hong Kong to conduct a study on the impact of the increased wind force brought by climate change on long span bridge. It is confirmed that the bridges concerned are able to withstand the increased wind force.

7. To ensure that there are sufficient manpower and resources to cope with the onslaught of inclement weather, HyD will instruct the road maintenance contractors to make preparation and arrange for adequate manpower, machinery and materials, etc., so that prompt contingency actions can be taken when necessary. In addition, HyD will co-ordinate with other public works contractors in advance to provide backup resources in case of inclement weather, so as to make use of the resources of these contractors to expedite the progress of road clearance works.

8. Before the onset of the tropical cyclone and rainy season, HyD's staff will also conduct drills with the contractors to simulate the handling of road emergencies and inspect major roads in the territory. It would enable HyD's staff and contractors to understand their respective duties and familiarise themselves with the procedures of handling road emergencies and the points to note in carrying out emergency recovery works of road facilities.

Handling of Emergency Incidents

9. HyD has set up four Emergency Control Centres (ECCs)² that will operate throughout the periods of inclement weather³ to centralise the receipt of information on incidents on public roads and to co-ordinate the deployment of resources for handling road emergencies. The ECCs will be activated two hours before the hoisting of Typhoon Signal No. 8 or when the Red or Black Rainstorm

² They are Urban, New Territories, Cross Boundary, and Tsing Ma and Tsing Sha Control Areas.

³ The ECCs shall be activated whenever -

- a Tropical Cyclone Warning Signal No. 8 or higher;
- a Red or Black Rainstorm Warning;
- a Landslip Warning; or
- Earthquake of Intensity VI or above comes into effect.

Warning Signal is in force. They serve to monitor the latest conditions of major public roads in real time and handle road emergencies (including taking prompt action to clear obstructions on the roads) when necessary to maintain smooth traffic flow and safeguard the safety of road users. The ECCs will closely liaise with other government departments (including HKO, DSD, the Hong Kong Police Force (HKPF), the Fire Services Department (FSD), the Transport Department (TD) and the Geotechnical Engineering Office (GEO), etc.). The ECCs will disseminate information on the latest situation of road blockage and emergency follow-up actions, etc. to the departments concerned, including the Emergency Monitoring and Support Centre of the Security Bureau and the 24-hour Emergency Transport Co-ordination Centre of TD, so as to provide support to the Government in handling emergency incidents in a comprehensive manner.

10. During the operation of the ECCs, apart from having HyD's staff on duty, road maintenance contractors also provide frontline support. The contractors will arrange the necessary staff and mechanical equipment, including grab-mounted lorry, chain saws and water pumps, to be deployed at some 50 road maintenance depots at different locations throughout the territory to stand by for handling road emergencies and carrying out emergency repair works under safe conditions. The works include the clearance of blocked road outfalls and drains in case of flooding, clearance of fallen trees or other debris blocking the roads using tools such as chain saws, reinforcing collapsed slopes with emergency shotcrete, and stockpiling rockfill materials for the repairs of road subsidence, with a view to opening up the roads as soon as possible.

11. The ECCs will receive emergency incident reports from other departments (including HKPF and TD) and the Government's 1823 Call Centre during its operation. Upon the receipt of an incident report, HyD's staff will ascertain the nature, location, scope and traffic impact of the incident, and prioritise the incident according to the usage of the obstructed road. This will enable them to arrange resources to carry out emergency works, and inform the relevant contractor(s) to standby or mobilise the necessary machinery/materials as appropriate to cope with the emergency. In case of major emergency incidents, HyD's staff will also attend to the incident sites as soon as possible and liaise closely with the contractor's frontline engineering staff to determine and arrange for the contractor to carry out the necessary emergency works. HyD's staff will also assist the police officers, other relevant works departments, TD or utility undertakers to carry out other necessary actions (e.g. implementing

temporary traffic diversion and diversion of public transport services) with a view to re-opening the road and resuming the traffic as soon as possible.

12. To keep abreast of the latest road conditions as early as possible, HyD will, before Typhoon Signal No. 8 is replaced by Signal No. 3 and under safe conditions, arrange for the contractors to deploy about 50 patrol teams to inspect major roads in the territory and to help understand the situation of road blockages, and clear roads blocked by fallen trees or other debris during typhoons. To keep track of the patrol progress and situation, the ECCs have put in place a Patrol Team Monitoring System, which uses the Global Positioning System to obtain real-time information on the locations of the patrol teams. The latest photos of road conditions would be uploaded using cloud-based operation to facilitate real-time monitoring of the road conditions. In addition, to ensure road safety of bus routes, HyD liaises closely with TD and conducts road inspections jointly with the staff of bus companies. If fallen trees or protruding tree branches are found obstructing the traffic lanes at the road sections under inspection, HyD will prioritise the arrangement of clearance and pruning.

13. When the Amber and Red Rainstorm Warning Signals are in force or when the Black Rainstorm Warning Signal is lowered, the ECCs will immediately mobilise about 40 drainage cleansing teams to inspect the major public road networks. If road flooding is detected, the obstructed road outfalls and/or drains will be cleared immediately to alleviate the flooding situation.

Incident Recovery

14. After the threat of inclement weather has subsided, HyD and the contractors will devote every efforts in carrying out the recovery works, with a view to resuming the major public roads and traffic as soon as possible. HyD will open up the obstructed roads early in accordance with their utilisation and priority so as to minimise the impact on the travel of the public. Generally speaking, HyD will open up trunk roads and roads more heavily used by the public as soon as possible. HyD will also pay special attention to the road conditions of major bus routes and entrance/exits of bus depots, and carry out road clearance and reinstatement works promptly so as to minimise the impact on the subsequent resumption of bus services. In addition, if there is no alternative route for the blocked road, which will seriously affect the travel of the public, HyD will clear the road surface and carry out emergency repair works as soon as possible, with a view to opening up at least one lane as soon as possible to

minimise the inconvenience caused to the public and ensuring the safety of road users.

15. HyD will use small unmanned aircraft to conduct site inspections and surveys in slope failures caused by extreme weather conditions, so as to provide real-time information at the scene to assist the engineering staff in grasping the scope of the incident and making assessment, planning for repairs and subsequent follow-up work. For example, in 2019, 2021 and 2023, HyD used small unmanned aircraft for emergency surveys in the slope failures at Peel Rise, Peak Road and Yiu Hing Road on Hong Kong Island respectively. HyD made use of aerial photos taken at vertical and oblique angles to produce point cloud and 3D mesh models of the slope failures, so as to quickly and accurately ascertain the extent of the landslides to facilitate the carrying out of repair works.

16. In the aftermath of typhoons or rainstorms, HyD also inspects the condition of trees on its slopes and clears fallen trees to ensure public safety. Most of the slope areas are inaccessible, and any trees or larger branches collapsed on the slopes will make site visits more difficult. HyD will use small unmanned aircraft to take photos of the inaccessible slopes to assess the condition of the collapsed/damaged trees, so as to quickly grasp the scope of the tree-collapse incident and the situation at the scene, and to assist in arranging follow-up actions.

Recovery Works of Shek O Road and Yiu Hing Road

17. During the onslaught of Super Typhoon Saola and the Black Rainstorm in September last year, HyD's ECCs received more than 1 400 and 700 reports of road-related incidents respectively, which were several times more than the number of reports received during normal typhoons or rainstorms in the past. The extent of impact was also more serious than that in the past. The cases received this time were mainly obstruction of roads caused by fallen trees or landslides. In the wake of the inclement weather, HyD's contractors have in the first instance cleared the fallen trees, landslides and debris causing road blockage under safe condition, and opened up major roads and resumed road traffic within one to two days, as well as opened up at least one traffic lane on most of the blocked road sections. Apart from mobilising contractors to repair road facilities under its management, HyD also worked closely and coordinated with other relevant government departments (including HKPF, FSD, Civil Engineering and

Development Department (CEDD), DSD, TD and Home Affairs Department, etc.), and to work together to carry out emergency repair works at full steam.

18. On 8 September 2023, road collapse occurred on Shek O Road due to a landslide during the severe rainstorm and the full section was closed. As the incident had seriously affected the travel and daily lives of the residents, HyD, in collaboration with GEO, immediately carry out emergency reinstatement works, including debris removal and shotcreting to stabilise the location of the landslide, as well as stockpiling of rockfill materials to support the collapsed section. HyD also immediately mobilised the heavy vehicles and equipment from other contractors within the department to enable the works to continue round the clock. With the active coordination among departments and the contractor's efforts, a lane was re-opened in about two days.

19. With respect to rehabilitation, HyD and GEO have drawn up a scheme for the full resumption of two-lane traffic on Shek O Road, which includes the installation of additional 31 mini-piles at the roadside to stabilise the slope and to reduce the inclination of the temporary slope to enhance safety. The mini-pile installation works have been substantially completed and it is expected that the two-lane traffic can be resumed in late February 2024. In addition, HyD has arranged for the contractor to clear the road drainage system at the concerned section of Shek O Road, and will arrange for the improvement works of the associated sump pits after the re-opening of the two traffic lanes. Photographs of the works are at **Annex 1**.

20. As for Yiu Hing Road, the natural hillside, which is about 60 to 100 meters above ground level of the road, collapsed and a large number of debris, many of which are of large size, have fallen down. As there are boulders and a large amount of debris on the surface of the natural hillside at a high altitude that need to be stabilised or removed, and there is no road access for transporting machinery to the debris location, the works are very difficult and dangerous. In view of this, HyD has been liaising and coordinating closely with GEO and has been carrying out the recovery works in three stages based on the scheme formulated by GEO.

21. The first stage of works, which was completed in December 2023, included clearing of the debris from the carriageway, followed by placing containers at suitable locations on the road as barriers to prevent loose debris from falling to nearby facilities and causing accidents. HyD is now carrying out

the second stage of the works, which involves the use of large crane to remove as much debris as possible from the slope surface; stabilising the remaining debris on the slope with shotcrete, then covering the shotcrete surface on the middle portion of the slope with a metal protection net; and at the same time stabilising the large boulders at the top of the slope with concrete buttress or other techniques. The remaining Stage 3 will be handed over to GEO to carry out other long-term landslide preventive and mitigation works. As the first two stages are very difficult and hazardous and take time to complete, HyD is now working closely with GEO with a view to opening a temporary lane on Yiu Hing Road in March 2024 upon completion of part of the Stage 2 works and after GEO assesses that it is safe to do so. Upon completion of the Stage 2 works, GEO will review and re-assess the slope condition of the natural hillside surface with a view to re-opening all lanes of Yiu Hing Road in the second quarter of 2024. At that time, GEO will commence Stage 3 works to further stabilise the slope in the long term. Photographs of the works are at [Annex 2](#).

Strengthening Measures against Extreme Weather

22. To strengthen its response to the impact of extreme weather on public roads, HyD is implementing a series of measures to enhance its capability in handling emergency incidents.

Consultancy Study on Critical Road Infrastructure

23. The Government attaches great importance to the resilience of public infrastructure against climate change and extreme weather, and established the Climate Change Working Group on Infrastructure (CCWGI) in 2016 led by CEDD to coordinate the work of the works departments in adapting to climate change. CEDD has completed a consultancy study in 2020 to examine from a macro perspective the scope of enhancement works under various works departments necessary for strengthening the resilience of existing critical infrastructure under the impact of climate change and extreme weather. In particular, based on the recommendations of the study, HyD has completed a review of the resilience of 75 critical road infrastructures under its purview (including major public roads, road tunnels, etc.) against the threat of flooding. It is now conducting a technical assessment and drawing up an implementation plan for the relevant countermeasures, which is expected to be completed in the

second quarter of 2024, with the implementation works expected to commence from 2025 onwards in phases.

Flood Warning System for Pedestrian Subways

24. HyD will install flood warning systems for some pedestrian subways along Shing Mun River in Sha Tin, Lam Tsuen River in Tai Po and Tai Po River in phases from 2024 to 2025. When the water level inside a pedestrian subway exceeds the pre-set level of the flooding triggering sensor, a warning message will be displayed on the light box at the subway to advise pedestrians not to enter. In addition, HyD is exploring with the Electrical and Mechanical Services Department to install closed-circuit television systems at pedestrian subways in low-lying areas with higher flooding risk to provide real-time information on the situation inside the subways to the ECCs, so as to further enhance the flooding monitoring of pedestrian subways.

Advice Sought

25. We welcome Members' views on the above measures.

**Transport and Logistics Bureau
Highways Department
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Photos of the recovery works at Shek O Road

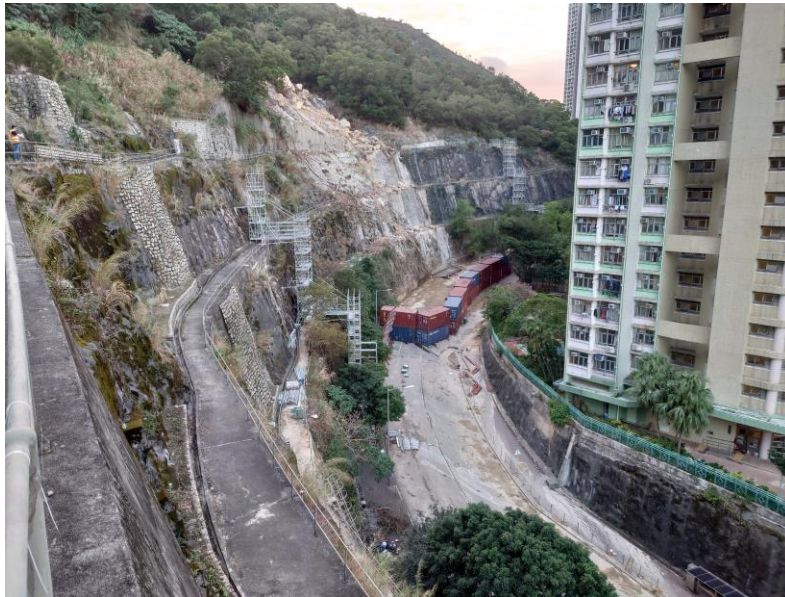


Shotcreting to stabilise the location of the landslide



Installation of mini-piles to stabilise the slope

Photos of the recovery works at Yiu Hing Road



Placing containers as barriers to prevent loose debris from falling to nearby facilities



Using large crane to remove debris from the slope surface