LCQ12: Repair and maintenance of public roads

Following is a question by the Hon Chan Siu-hung and a written reply by the Secretary for Transport and Logistics, Ms Mable Chan, in the Legislative Council today (June 18):

Question:

It is learnt that the Highways Department (HyD) adopts innovative technologies and promotes management digitalisation to enhance the efficiency in road repair and maintenance services. In this connection, will the Government inform this Council:

(1) of the total length of public roads in Hong Kong, the total length of public roads repaired and the total project cost for repair of public roads in each of the past three years; the respective details of the contracts awarded for repair and maintenance of such roads (including but not limited to the names of contractors, districts involved, contract periods, length of the roads involved and contract values);

(2) as the Government indicated in its reply to a question from a Member of this Council on March 27 last year that the HyD aimed to digitalise most inspection and supervision procedures in all road maintenance contracts in 2024, of the progress of the relevant work; whether it has assessed how the adoption of innovative technologies help enhance the efficiency and cost-effectiveness of road inspection, including the savings in manpower expenditure and project cost; if so, of the details; if not, the reasons for that;

(3) given that, according to the information from the HyD, the HyD is using the Road Defect Detection System (RDDS) and the Road Condition Assessment System (RCAS) for inspection of road conditions, of the respective application scenarios, stages of application (e.g. at trial stage or being converted to regular use), efficiency of inspection and cost-effectiveness of the two systems;

(4) given that, according to the estimation of HyD, the introduction of RCAS will be able to free up about one-fourth of the manpower of the contractors' road inspection teams, and the HyD is now evaluating the effectiveness of RCAS and will consider in due course the full scale application of the technology and its incorporation into the standard operating procedures for future road inspections, of the latest progress of the relevant work, and whether it has studied if future deployment will be implemented by adopting both systems, namely RDDS and RCAS, or either one of them; and

(5) given that HyD is one of the selected applicants for the first batch of low-altitude economy Regulatory Sandbox pilot projects, of the details of HyD's pilot projects involving road repair and maintenance as well as road

inspection (including but not limited to the contents of the projects, application scenarios, flight paths, route plans and flight distances)?

Reply:

President,

Having consulted the Highways Department (HyD), my reply to the various parts of the question raised by Hon Chan Siu-hung is as follows:

(1) In the past three years (i.e. from 2022 to 2024), the total length of roads maintained by the HyD each year was 2 223, 2 239 and 2 241 kilometres respectively. The annual expenditure on maintenance of roads and associated road facilities was about $1.70 billion, $1.73 billion, and $1.66 billion respectively.

The HyD ensures the safety and reliability of the public road network by engaging road maintenance contractors under term contracts to carry out regular inspection and maintenance work. When damage to road surfaces is identified during inspections or damages to roads and ancillary road facilities are reported by the public, the HyD would arrange contractors to carry out repair works as soon as possible to defects that may pose hazard to road users. As such repairs are part of the routine road maintenance work, the HyD does not separately keep statistics on the area of such type of road surface maintained.

Moreover, for defects that do not pose immediate danger to road safety, the HyD would formulate appropriate maintenance plan and schedule for such defects after taking into account various factors, such as arranging road resurfacing at a timely juncture. In each of the past three years (i.e. from 2022 to 2024), the areas of roads resurfaced and reconstructed by HyD are about 1.55, 1.77 and 1.65 million square metre respectively.

Currently, the HyD has a total of 9 road maintenance contracts for the maintenance of all public roads in Hong Kong, details of which are at Annex.

(2) At present, the Road Maintenance Monitoring System (RMMS), which is a system that fully digitalises the monitoring and administrative work of road maintenance, has been used in all road maintenance contracts. In the past, whenever the HyD's staff identified defects in road facilities during inspection, they were required to fill in and send the relevant physical form to the contractors upon completion of the inspections. With the RMMS, staff can now log on to the system during outdoor inspections and electronically notify the contractors of the information on damage to facilities captured on site, so that contractors can receive the relevant data promptly and arrange for repair works accordingly. After completion of repair works, contractors can also use RMMS to report the work done and submit maintenance records. The adoption of RMMS can cut down on complicated paperwork and transmission time to enhance work efficiency, facilitating HyD's staff to monitor the progress of maintenance. It resulted in better maintenance record keeping as well as reduction in the use of paper. In addition, the HyD is now developing the second phase of RMMS, which will incorporate more monitoring and management

functions, such as automatic alerts or warnings to contractors with unsatisfactory maintenance progress, as well as digitalised checking procedures, etc.

In terms of cost-effectiveness, with the full implementation of the first phase of the RMMS, the average time taken by the HyD's staff to handle a case of damaged road facility (from the discovery of damage to road facility to the completion of the repair works) is about 20 per cent faster than before. Subsequently, upon completion and full adoption of the second phase of the RMMS, the HyD will then consider adjusting the manpower requirements of contractors for new road maintenance works. At that time, the HyD would re-assess the savings in manpower expenditure and works cost arising from the use of RMMS, as well as the cost-effectiveness of the system.

(3) The Road Defect Detection System (RDDS) utilises high-definition cameras installed on inspection patrol vehicles to capture images of road conditions, and employs global satellite positioning technology to record the locations of such images. It then uses artificial intelligence (AI) technology to automatically identify road surface cracks and discoloured road markings, instead of relying on the visual inspection by road inspectors as in the past to ensure that the detection results are objective and accurate (above 90 per cent accuracy). Contractors use inspection patrol vehicles equipped with RDDS to carry out comprehensive inspection of all roads in Hong Kong once every three months. The detection results of road defects will be displayed on a web-based maintenance platform equipped with geographic information system maps, to facilitate maintenance personnel to locate the defects and carry out repair works. Moreover, the RDDS can consolidate relevant information into defect reports for maintenance personnel to record and audit the maintenance status. With enhanced inspection accuracy and maintenance records, the required maintenance works can be completed more swiftly and efficiently. At present, the RDDS has been incorporated as a standard operating procedure for road inspection on a regular basis. With the full adoption of RDDS, the average time taken by the contractors from completion of road inspection work to submission of the relevant inspection report has been substantially reduced from 48 hours to within 24 hours. To further enhance the efficiency of road maintenance, the HyD would expand the analytical capability of the AI system of the RDDS to identify more different types of road defects, such as overgrown vegetation, as well as discoloured/obstructed/bent traffic signs on the road surface.

The Road Condition Assessment System (RCAS), which scans three-dimensional images of road surfaces, uses patrol vehicles equipped with laser scanning equipment and global satellite positioning technology to drive on a carriageway at normal speed, and can automatically identify and accurately record various types of defects on the road surface such as potholes, rutting etc. It calculates a Pavement Condition Index (PCI) for every 100 metres of the road for the reference of engineering personnel responsible for maintenance to determine whether the section of road should be prioritised for reconstruction or resurfacing works. Compared to the past when road inspectors had to conduct visual inspection and measurement on the road

surface after making road closure arrangements, which only covered a few hundred meters of carriageways per day at most, RCAS enables the maintenance team to have a more comprehensive grasp of the latest conditions of all road surfaces without the need for road closures. This allows for more effective use of resources when planning road maintenance works, and also helps avoid disruption to traffic.

The HyD expects that after using RCAS to inspect all major road sections in Hong Kong, it will be able to make more effective use of resources by prioritising sections with poorer conditions for road maintenance. RCAS is still in the trial stage and is capable of inspecting about 200 km of carriageways per day. It is expected that during the one year trial period, all major road sections in Hong Kong can be inspected and the data collected will be used for establishing a web-based maintenance platform for use by engineering staff.

As RCAS is still at the trial stage, the cost-effectiveness of the technology is still being assessed. However, according to preliminary estimation, the introduction of RCAS can free up about one-fourth of the manpower of the contractors' road inspection teams to cope with the increasing road maintenance work.

(4) Since 2024, the HyD has engaged various service contractors through road maintenance contracts to participate in the development of RCAS which is used to accurately record the undulations of road surfaces and identify road defects such as potholes, to facilitate the planning of road maintenance work. The aforesaid development project is broadly divided into three stages: in the first stage, the service contractors are required to procure vehicles and install laser scanning equipment and positioning devices on the vehicles; in the second stage, the service contractors are required to develop an AI and geometric analysis algorithm system to automatically detect road defects, assess road conditions, and establish a Geographic Information System (GIS) web-based platform to disseminate the relevant information; and in the third stage, the service contractors are required to utilise this system to scan all road surfaces in Hong Kong and automatically assess road conditions, as well as upload the assessment results to the GIS web-based platform at the same time. The first and second stages have been completed, while work on the third stage has commenced and is anticipated to be completed within this year. The HyD is evaluating the effectiveness of the entire smart road conditions analysis system and would consider incorporating this technology into the standard operating procedures for future road inspections in due course.

Currently, the RDDS is used for rapid identification of cracks on road surface and discoloured road markings which facilitates maintenance staff to locate road defects and expedite the completion of the required maintenance works, thereby enhancing maintenance efficiency. Meanwhile, RCAS focuses on accurately identifying and recording various types of defects on road surfaces and their degree of deterioration. It calculates the PCI for every 100m of carriageway which will help maintenance staff to determine whether a road section should be prioritised for resurfacing works. In view of the distinctive functions of RDDS and RCAS, as well as their differences in speed

and accuracy in detecting road conditions, the positioning of their applications is thus different. These two systems will be implemented in parallel at this stage. However, the HyD will continue to develop the functions of RDDS and RCAS and will not rule out the possibility of merging them in the future when their functions, speed, and accuracy become comparable.

(5) According to the requirements of the existing Small Unmanned Aircraft (SUA) Order, the "pilot" controlling a SUA is required to maintain visual-line-of-sight with SUA under standard operation. The HyD's Regulatory Sandbox project utilises beyond visual-line-of-sight (BVLOS) technology, coupled with 4G/5G command and control links, to enable SUA to operate beyond the pilot's line-of-sight in a safer and more stable manner, up to a distance of several kilometres. This enables flexible deployment for surveying and inspecting road infrastructures and major trunk roads during emergencies, such as landslides, as well as routine operation.

In emergency situations, with the adoption of BVLOS technology, SUA can swiftly reach a remote landslide site and calculate a three-dimensional model of the slope through aerial photographs taken, which facilitates engineers to accurately measure the area and volume of landslide debris in support of slope restoration work. In addition, under extreme weather condition, SUA can be operated to fly along designated pre-set routes to quickly see whether there are any flooding, fallen trees, or other obstructions on major highways. For routine surveys and inspections, BVLOS technology can assist in the inspections in places such as cross-sea bridges, confined spaces and elevated structures that are difficult for engineering personnel to access or visually inspect. Such technology can be regularly applied to routine operations, such as surface defect inspection of bridge structures and slope restoration works.

The test flights of the Regulatory Sandbox project are conducted in stages under different scenarios, at locations including Tai Po Waterfront Pier to Sam Mun Tsai, Tseung Kwan O Tunnel Road, Tseung Kwan O Cross Bay Link, Tate's Cairn Highway, and Ap Lei Chau Bridge. These simulated flights carry out BVLOS inspections of slopes along the roads at the above locations and the related major trunk roads, with flying distances ranging from 200m to 2 000m. Among them, the HyD has already completed the trial flights at the first two test sites, with the remaining three expected to be completed in phases by the end of September 2025.