We continue to focus our research on environmentally friendly technology, such as improving the design of pavement material, reviewing the pavement maintenance practice and applying Mobile Mapping System technology for highly efficient road inventories survey.

Research & Technology

Long-Life Pavement Strategy

General Description of the Strategy and Long Life Roadbase

Road reconstruction unavoidably causes nuisance to nearby residents and disturbance to road users. To effectively eliminate the large scale full depth reconstruction of bituminous carriageway, the development of a long-life bituminous pavement strategy for Hong Kong thus comes into place. The strategy makes reference to the latest international understanding that a pavement designed to an adequate roadbase thickness would not manifest structural failure. With timely maintenance and appropriate rehabilitation works, the service life of a well-designed and properly constructed pavement structure can be prolonged sustainably and the need for major reconstruction is remote.

Bituminous roadbase under construction

The strategy comprises an integrated approach covering proper design and construction, regular monitoring of road defects, timely implementation of stop-gap repairs and rehabilitation works to restore the pavement serviceability and integrity and to avoid distress proliferation to such a manner that full depth construction is required. The relevant design guidelines have been promulgated in 2013 for implementation. In the long run, the overall life cycle cost for our road asset and environmental impacts induced by their reconstruction can considerably be reduced.

Robust Surfacing - Polymer Modified Stone Mastic Asphalt

As part of the long-life pavement strategy, Stone Mastic Asphalt (SMA) had been promoted to be used as the surfacing layer on heavily utilized and stressed bituminous carriageways since 2001. Due to the instability under high local temperature, the occurrence of rutting and shoving on SMA was noted and sometimes these defects emerged shortly after construction. In view of the cause of the failure, the Highways Department (HyD)

launched a laboratory study to evaluate the performance of the conventional SMA and the SMA with polymer modified bitumen (PMSMA). The laboratory tests showed that PMSMA could positively address the stability problem of the conventional SMA. With the promising outcome, the PMSMA was put forth for further site trials to evaluate its performance under live traffic. The trials also showed that PMSMA has much higher stability against heavy traffic loading, even under high temperature in the summer. Use of PMSMA has then been started to be included in HyD's maintenance contract commenced in 2012 and extended to be included in HyD's maintenance contracts commenced in 2013. With the use of this robust surfacing, the frequency of resurfacing and its associated environmental impact can be reduced.

PMSMA surfacing at Pok Oi Interchange, Yuen Long

Resurfacing of Polymer Modified Friction Course Without Relaying Wearing Course

Polymer modified friction course (PMFC) is a standard bituminous surfacing material for high speed roads (HSR) in Hong Kong to provide better surface drainage and higher skid resistance, particularly on rainy days. Under the current practice, defective HSR surface is made good by milling off and re-laying both the PMFC and its underlying wearing course (WC).

Some overseas experience and local pilot study indicate that deteriorated PMFC can be milled off and resurfaced while maintaining its underlying WC untouched without affecting its intended performance. A progressive trial program in tandem with theoretical verification is being conducted to thoroughly assess the performance of PMFC layer without WC re-laid under various HSR traffic and road geometry conditions. In the foreseeable future, the single-layer PMFC resurfacing practice will likely be adopted in many circumstances, bringing a more cost-effective and environmentally friendly maintenance method to society.

Re-laying PMFC over existing WC

Road Inventory Survey by Mobile Mapping System

Comprehensive collecion of road inventory data requires input of significant resources and thus carries environmental implications. Nowadays, Mobile Mapping System (MMS) technology is increasingly significant in a wide range of applications from automation of the survey data collection, digital mapping to autonomous navigation. A service contract was awarded in 2013 for the acquisition of a complete set of 3D geo-referenced images by using the MMS technology for updating road surface inventories of the streets, roads and tunnels maintained by the Highways Department.

MMS Computer System on board

Through the use of this advanced and cost-effective technology, 3D geo-referenced photographic images of streets and roads can be obtained by a set of cameras with GPS and inertia sensor devices mounted on a vehicle traveling at normal speed. With the use of the MMS associated tools for visualization, mapping and measurement functions, a large number of road surface drains, roadside trees and footpaths can be extracted for asset management and other application purposes, e.g. establishment of road inventory data, planning and design of road maintenance works, etc. It can be seen that the use of the MMS technology can facilitate the updating of our road asset in a more efficient and environmentally friendly manner, as well as can enhance the efficiency and cost-effectiveness at work.

Mitigation of Vehicle Usage

MMS changes the mode of traditional field survey operation. MMS primarily employs only one vehicle for the acquisition of road inventory data, whilst the traditional survey methods always involve more field survey teams and field trips to complete the task. In comparison with the traditional survey methods, MMS is an effective means to reduce the number of vehicles deployed for large scale inventory survey. This in turn helps reduce fuel consumption, vehicle emissions and air pollutants, inclusive of Carbon Monoxide, Oxides of Nitrogen, particles and hydrocarbons, etc., and mitigate roadside air pollution accordingly.

Only one MMS vehicle deployed for the road inventory survey

Reduction of Paper Wastage

MMS also changes the mode of data capture and data dissemination. In traditional surveys, small portable field books are used for recording both survey data and relevant notes taken at sites. Record plans of the surveys showing the captured road inventory features are also produced. To complete the road inventory survey covering all roads maintained by the department would involve a bulk consumption of paper field books and ink/toner cartridges for the plans production. On the contrary, the MMS survey deliverables involve only a complete and reliable set of 3D Geo-referenced Images associated with the attribute data of road inventories. The digital images and inventory data can facilitate respective users for other applications with less printing and plotting, e.g. digitization and taking measurement of any viewable features and visualization of proposed works in the MMS virtual reality environment. It thus helps saving the consumption of field books, drawing papers, drawing films, ink/toner and print cartridges, etc.

A stack of record plans

Field books

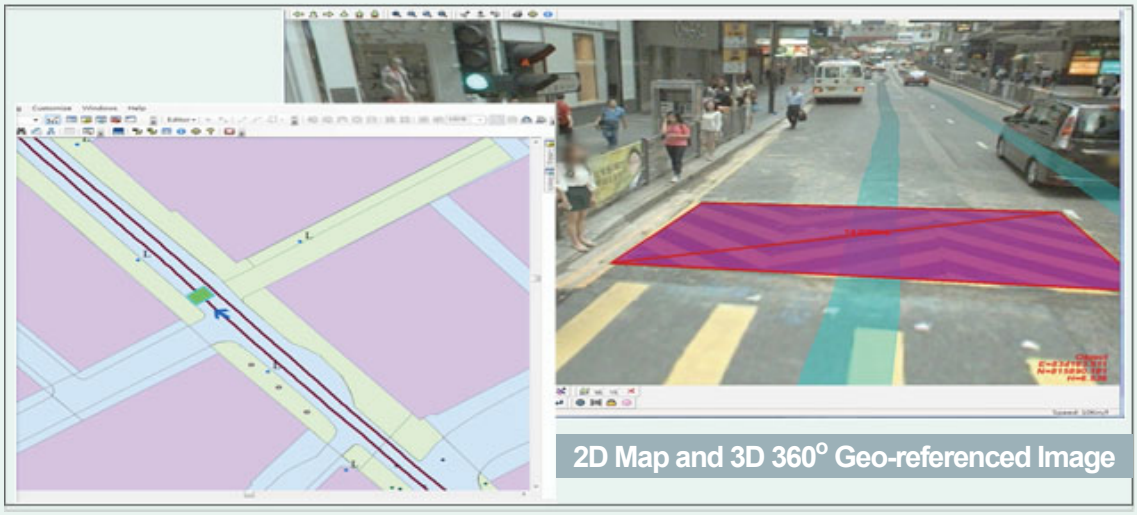
Detailed Configuration of MMS

The system consists of a vehicle mounted

with two sets of 360-degree digital cameras for image acquisition, Global Navigation Satellite System (GNSS), an Inertial Measurement Unit (IMU), a distance measurement indicator (DMI) devices for position fixing and an inclinometer for image rectification (see Diagram 1). In addition, a MMS computer system is installed inside the vehicle for capturing of time synchronized image and positional data that shot by cameras as well. Through the formation of 3D Geo-referenced Images and extraction of road inventory GIS data, the data can be readily identified and visualized from the images. Besides, initial planning and design of road work could be performed using the images.

Diagram 1 - Mobile Platform of MMS

Equipment Setup :	
Image capturing Device System	1) LadyBug 360° camera (2 sets) with an Inclinometer
Position Fixing Device System	2) GNSS Antenna with calibrated GNSS receiver (2 sets)
	3) IMU
	4) DMI



2D Map and 3D 360° Geo-referenced Image

Planning and Design of road works using the 3D Geo-referenced Image