CHAPTER 5

Highways Department

Maintenance of public roads

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MAINTENANCE OF PUBLIC ROADS

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PART 1: INTRODUCTION

1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

Background

1.2 The road network in Hong Kong is made up of about 2,070 kilometres (km) of public roads and over 3,800 highway structures (such as road tunnels, flyovers and footbridges). The **Highways Department (HyD)** is responsible for the maintenance of these public roads, including the highway structures and road furniture (Note 1). It aims to maintain the integrity of the road network with particular emphasis on safety and serviceability.

- 1.3 Road maintenance works can be broadly classified into three types:
 - (a) *Corrective repair.* This is carried out to rectify defects identified during regular inspections or reported to the HyD;
 - (b) *Preventive maintenance.* This is carried out on a regular basis to prevent defects from occurring. Examples include periodic clearing of road drainage and painting of steelwork; and
 - (c) **Rehabilitation maintenance.** This is to restore the serviceability and structural conditions of roads and highway structures. It is also of a preventive nature but usually of a larger scale than that of (b) above. Examples include road resurfacing and reconstruction works.

1.4 The HyD lets out term contracts (each lasting for four to eight years) through competitive tendering for undertaking road maintenance works. The two **Regional Offices** of the HyD (i.e. Urban and New Territories Offices) are responsible for administering the road maintenance contracts (Note 2) within their respective geographical areas. The HyD

- **Note 1:** *Examples include railings, street name plates and traffic signs (except traffic lights which are maintained by the Transport Department as part of the Area Traffic Control System).*
- **Note 2:** These contracts do not cover maintenance of: (a) the public lighting system, which falls within the scope of other HyD maintenance contracts; (b) escalators and lifts of footbridges, which is undertaken by the Electrical and Mechanical Services Department; and (c) some roads and highway structures (such as those included in the Tsing Ma Control Area and the Tsing Sha Control Area), which falls within the scope of the management-operation-maintenance contracts let out by the Transport Department.

has issued a Maintenance Administration Handbook, Inspection Manuals and various departmental instructions to provide specific guidelines on road maintenance. As at 1 July 2011, the two Regional Offices had a total strength of 905 staff. In 2011-12, the estimated expenditure on road maintenance and administration is \$1,157 million.

1.5 In 2004, the HyD started to include new contract provisions for the management and maintenance (M&M) of road network (see para. 2.2) in one of its road maintenance contracts with a view to achieving efficiency and cost savings. Up to April 2011, it had let out 14 contracts with such M&M provisions (i.e. Contracts A to N — see Appendix A).

Audit review

1.6 In 2005, the Audit Commission (Audit) completed a review of the HyD's management of road maintenance contracts without M&M provisions. The results were included as a subject in the Director of Audit's Report No. 45 of October 2005. Audit made a number of recommendations for improvement, which were accepted by the HyD.

1.7 Audit has recently conducted a review of the HyD's maintenance of public roads, focusing on the following areas:

- (a) implementation of M&M contract provisions (PART 2);
- (b) inspection of highway structures (PART 3);
- (c) rehabilitation maintenance for roads (PART 4); and
- (d) other management issues (PART 5).

Audit has found room for improvement in the above areas and has made a number of recommendations to address the issues.

Acknowledgement

1.8 Audit would like to acknowledge with gratitude the full cooperation of the staff of the HyD during the course of the audit review.

PART 2: IMPLEMENTATION OF M&M CONTRACT PROVISIONS

2.1 This PART examines the implementation of M&M provisions in the HyD's road maintenance contracts. The following issues are discussed:

- (a) measuring and monitoring contractors' performance (paras. 2.3 to 2.11);
- (b) control over road marking works (paras. 2.12 to 2.18);
- (c) Electronic Maintenance Management System (EMMS paras. 2.19 to 2.28); and
- (d) post-implementation review (paras. 2.29 to 2.34).

M&M contract provisions

2.2 In 2003, the HyD commissioned a consultant to study the feasibility of letting out road maintenance contracts in the form of Public-Private-Partnership (Note 3). In 2004, the HyD introduced M&M provisions in one of its road maintenance contracts. These provisions mainly covered road inspections and subsequent arrangement of contractors' minor repair works, which were previously undertaken by HyD staff. The objective was to achieve efficiency and staff cost savings through greater management input from contractors in road maintenance. Up to April 2011, the HyD had let out 14 road maintenance contracts with M&M provisions. The salient features of these provisions are summarised as follows:

(a) the contractors are required to manage and maintain the road network within the areas and up to the performance standards specified in the contracts. Examples of M&M works (Note 4) include corrective repair, preventive maintenance (see para. 1.3(a) and (b)) and the establishment and maintenance of an EMMS. The contractors are also required to put in place a quality assurance system for the day-to-day supervision of the M&M works;

Note 4: For larger scale maintenance works which are not covered by the M&M provisions (e.g. rehabilitation maintenance — see para. 1.3(c)), the HyD has to separately issue works orders and pay the contractors for such works.

Note 3: According to the consultant, there were five different forms of contract arrangements under Public-Private-Partnership, ranging from works and services contract (with the lowest extent of private sector participation) to full privatisation. M&M contracts ranked the second lowest in terms of private sector participation.

- (b) to ensure the quality of services and measure the contractors' performance, HyD staff conduct audits and inspections of their works, and of selected roads and highway structures maintained by them; and
- (c) the contractors are entitled to a monthly fee for each type of services provided under M&M provisions. Payment deductions will be made if the performance standards are not achieved.

Measuring and monitoring contractors' performance

2.3 Payment for M&M works is performance-linked. A contractor's performance is measured every three months to see if the laid-down standards are achieved. The HyD has adopted the following mechanism for measuring and monitoring the contractor's performance in carrying out M&M works:

- (a) *Engineer's audits.* HyD staff carry out Engineer's audits, on a sample basis, on the maintenance works completed by the contractor. The purpose of the audits is to measure the contractor's performance by ascertaining the number of defects (as defined in the contract) in the selected samples. The contractor normally receives not more than 24-hour prior notice of an audit but will not be advised of the nature and exact location of the works to be audited. In general, the contract payments would be progressively reduced if more defects (than those allowed in the contract) are found; and
- (b) *Engineer's inspections.* HyD staff also carry out Engineer's inspections, on a sample basis, during the execution of works by the contractor. They cover:
 - (i) works items not included in Engineer's audits; and
 - (ii) some aspects of the contractor's performance which cannot be ascertained from the audits. For example, an Engineer's inspection is carried out during the execution of roadworks to check the adequacy of lighting, signing and guarding which would be removed after completion of the works.

No prior notice of an inspection will be given to the contractor. For specified non-compliant items found, the HyD will issue a default notice to the contractor and a fixed sum will be deducted from the contract payments.

2.4 The HyD has laid down guidelines on the extent of Engineer's audits and inspections, the sample selection procedures and supervisory checks on the audit/inspection results. Audit examined three contracts (Contracts I, J and L) and found that there were areas for improvement in complying with the laid-down guidelines (see paras. 2.5 to 2.9).

Audit observations and recommendations

Sample selection for Engineer's audits and inspections

2.5 According to the HyD's guidelines, the selection of samples for both Engineer's audits and inspections should:

- (a) be random and conducted near the actual dates of audits/inspections; and
- (b) preferably involve more than one person who should not be the person carrying out the audits or inspections.

2.6 Audit found that the HyD had maintained adequate records of the sample selections (including the method, time and personnel involved) carried out for Engineer's audits. However, similar records for Engineer's inspections were not available to show that the stipulated sample selection procedures had been properly followed. In response to Audit enquiries, the HyD said that, given that Engineer's inspections had to be carried out during the progress of the contractors' works, it might not always be practicable to arrange such inspections on a random basis. The HyD would review the method of sample selection. In Audit's view, there is urgency to complete the review and put in place new sampling requirement for HyD staff to follow. For control purpose, the HyD also needs to maintain adequate records of sample selections carried out for Engineer's inspections.

Extent of Engineer's audits and inspections

2.7 For Engineer's audits, the HyD has stipulated in the contracts the required percentage or quantities of the contractors' works to be audited (e.g. 3% of the total area covered by the contractor's road inspections in one contract). While there are no similar contract provisions for Engineer's inspections, the HyD has laid down guidelines that not less than 5% of the works mentioned in paragraph 2.3(b) shall be selected for conducting Engineer's inspections.

2.8 Audit found that the HyD had regularly compiled statistics to monitor the compliance with the extent of Engineer's audits as stipulated in the contracts. However, the HyD had not done the same for Engineer's inspections and there was no assurance that the extent of inspections laid down in the guidelines had been carried out (see paras. 2.26 and 3.13). In response to Audit enquiries, in August 2011, the HyD said that:

- (a) it had been compiling statistics for Engineer's audits because there were contract provisions stipulating the minimum percentage of works to be audited;
- (b) as there were no similar contract provisions for Engineer's inspections, statistics were not compiled. However, supervisory checks on Engineer's inspections had been carried out (see para. 2.9); and
- (c) the present guidelines requiring Engineer's inspections of a fixed percentage of a wide range of contractors' works irrespective of their importance needed to be reviewed.

In Audit's view, there is urgency to complete the review and put in place new guidelines for HyD staff to follow. There is also a need to incorporate suitable procedures in the guidelines for monitoring compliance with the laid-down extent of Engineer's inspections.

Supervisory checks

2.9 To monitor the quality of Engineer's audits and inspections, the HyD has required its Inspector of Works (IOW) grade staff to check at least 25% of the audit and inspection results. Audit found that while there was evidence of supervisory checks conducted by the IOW grade staff, statistics were not compiled to monitor the extent of checks. Upon Audit's request, the HyD worked out the extent of supervisory checks conducted in March 2011 for two contracts. The results showed that the supervisory checks covered 79% of the Engineer's audits in one contract (Contract L) and 100% of the Engineer's inspections in another contract (Contract J). In both cases, the extents of checks were much higher than the stipulated 25%.

Audit recommendations

- 2.10 Audit has *recommended* that the Director of Highways should:
 - (a) take urgent action to complete the reviews and issue new guidelines on the sampling method and extent of check for conducting Engineer's inspections;
 - (b) maintain adequate records of the sample selections carried out for Engineer's inspections;
 - (c) monitor the compliance with the extent of Engineer's inspections as stipulated in the new guidelines; and
 - (d) regularly compile statistics to monitor the compliance with the requirement of 25% supervisory checks on results of Engineer's audits and inspections.

Response from the Administration

2.11 The **Director of Highways** agrees with the audit recommendations. He has said that the HyD will complete the reviews on sampling method and extent of check for Engineer's inspections within three months, and put in place new requirements in this regard by the end of 2011.

Control over road marking works

2.12 The purpose of maintaining road markings is to provide useful directions and warnings to road users. Such maintenance works have been entrusted to the contractors as part of the M&M works. The laid-down performance target is to maintain the road markings in such a state that there should be less than 20% loss of paint. In this connection, the contractors are required to carry out:

- (a) repainting of road markings as and when 20% or more loss of paint is found during road inspections; and
- (b) road marking renewal works for selected roads (as specified in the contracts) under which the markings should be roughened to reduce their thickness (Note 5) before repainting.

2.13 Audit sample checked the control over road marking works and found that there was room for improvement as reported in paragraphs 2.14 to 2.16.

Audit observations and recommendations

Omitted road marking renewal works

2.14 According to the terms of Contract I, the contractor shall carry out both repainting of road markings on a need basis and annual road marking renewal works for selected roads. The contract rate for the two types of road marking works was about \$2.5 million for each 12-month period. Since the commencement of Contract I in April 2007, the stipulated annual road marking renewal works had not been carried out but the contractor continued to receive payment of \$2.5 million for each 12-month period.

Note 5: There are contract requirements that road markings should be roughened to reduce the thickness of the existing marking materials by about 50%. For contracts commencing April 2010 onwards, there is a further requirement that the thickness of the markings after renewal should not exceed 6 millimetres.

- 2.15 In response to Audit enquiries, in June 2011, the HyD said that:
 - (a) after the award of Contract I in 2007, the contractor proposed that where the road markings were maintained to a satisfactory performance standard, the annual renewal of road markings stipulated under the contract would be unnecessary. This would obviate the need for traffic diversions thus causing less disruption and inconvenience to the public. The HyD reviewed the contract requirements and agreed to the contractor's proposal; and
 - (b) both the Engineer's audits and inspections showed that the road markings in the contract areas had been maintained to a satisfactory standard. No renewal works were considered necessary. The HyD would issue a variation order to omit the road marking renewal works and deduct an appropriate amount from the contract payments in accordance with the contract provisions.

2.16 Audit is concerned that in 2007, the HyD did not immediately issue a variation order for the omitted road marking renewal works and demand a corresponding deduction in the contract payments. Moreover, according to the Stores and Procurement Regulations, works omission is regarded as a contract variation requiring the approval of the appropriate authority (Note 6). Audit noted from the minutes of a meeting (held in August 2007 between the HyD and the contractor) that a Regional Highways Engineer of the HyD (a directorate officer at D2 level) was willing to alter the prescriptive requirements of Contract I, including road markings to suit specific requirements of the roads if necessary. There was no other record to show that specific approval had been sought for the omitted works.

Audit recommendations

- 2.17 Audit has *recommended* that the Director of Highways should:
 - (a) strengthen controls to ensure that a variation order is issued as early as practicable for reducing the scope of any M&M works items, setting out (among other things) the valuation basis for contract payment deduction purpose;
 - (b) remind the relevant HyD staff to seek specific approval for any omission of M&M works in accordance with the Stores and Procurement Regulations; and
- **Note 6:** For example, the approval of a directorate officer at D2 level should be sought for contract variations with individual value exceeding \$1.3 million up to \$4 million.

(c) expedite the recovery from the contractor concerned of the value of the omitted road marking renewal works under Contract I.

Response from the Administration

2.18 The **Director of Highways** agrees with the audit recommendations. He has said that in mid-August 2011, the HyD issued a variation order to omit the road marking renewal works under Contract I and payment would be deducted accordingly.

Electronic Maintenance Management System

2.19 As part of the M&M works, the contractors are required to establish and maintain an effective EMMS for planning, programming, data storage and retrieval of all aspects of inspections and maintenance works. The contractors shall allow the HyD unrestricted 24-hour access to the EMMS for audit purpose and pass all electronic records to the HyD upon expiry of the respective contract periods. The HyD shall then become the absolute and exclusive owner of all records and the related intellectual property rights.

2.20 The cost for the establishment and maintenance of the EMMS varied from one contract to another, ranging from \$1.8 million to \$4.3 million. Audit sample checked the establishment, operation and maintenance of the EMMSs in nine contracts, and found that there was room for improvement in the HyD's contract management in this regard (see paras. 2.21 to 2.26).

Audit observations and recommendations

Establishment of EMMS

2.21 In examining the contract provisions of one contract (Contract G), Audit noted that:

- (a) the EMMS (comprising seven sub-systems Note 7) should be established by 31 December 2005;
- (b) the related contract payments comprised a monthly payment for the works item "establish, maintain and hand over of the EMMS" and lump-sum payments for the establishment of the individual sub-systems; and

Note 7: An example is the complaint statistics sub-system for storing, categorising and analysing complaints.

(c) for every month of delay (or parts thereof) in establishing any individual sub-system, the relevant lump sum would be subject to a percentage deduction.

2.22 According to the completion certificate issued by the HyD, the EMMS of Contract G was physically completed on 21 December 2006 (one year after the due date of 31 December 2005). However, according to the payment records, monthly payments had been made to the contractor since 1 January 2006 (instead of 22 December 2006). Moreover, the lump-sum payments for four of the seven sub-systems were not deducted with due regard to the 12-month delay. For the remaining three sub-systems, deductions were only made for 6 months instead of 12 months. Upon Audit enquiries, the HyD explained that:

- (a) based on the user acceptance test results, the establishment of the EMMS of Contract G was satisfactorily completed on 31 December 2005 except for some outstanding works of three sub-systems. Such outstanding works were subsequently completed in June 2006 and hence deduction for a 6-month delay was made from the lump-sum payments of the three sub-systems; and
- (b) the physical completion date of 21 December 2006 in the completion certificate was inappropriately made with reference to the date of the contractor's application for completion certificate.

2.23 According to the HyD's Maintenance Administration Handbook, the physical completion date entered in a completion certificate is contractually binding. In Audit's view, the HyD needs to remind its staff to carefully check the accuracy of the completion date entered in a completion certificate.

Operation and maintenance of EMMS

2.24 The HyD has laid down in the contracts detailed requirements regarding the operation and maintenance of the EMMS, including the following:

- (a) the EMMS shall have facilities to:
 - (i) provide, hold and manage inventory data and maintenance history data;
 - (ii) record programmes and progress of works; and
 - (iii) produce lists of outstanding defects grouped by date, category or activity; and

(b) the contractor shall maintain timely data input into the EMMS and also arrange, as directed by the HyD, the transfer of the relevant data from and to the HyD's computer networks.

2.25 In examining the nine contracts (see para. 2.20), Audit found that there were cases of non-compliance with the above requirements as follows:

- (a) the EMMSs of three contracts (Contracts D, F and H) did not have the stipulated facilities to produce lists of outstanding defects (see para. 2.24(a)(iii)). All the concerned EMMSs had been operating without the stipulated facilities for three to four years;
- (b) for the six contracts with the stipulated reporting facilities in their EMMSs, Audit examined the outstanding defect lists of two contracts (Contracts J and M) in December 2010 and June 2011 respectively. The lists showed that over 900 defects in each contract had remained outstanding for over 6 months (up to 32 months in some cases). Upon Audit enquiries, the HyD clarified that rectification works for such defects had in fact been completed but the EMMS records were not maintained up-to-date (Note 8); and
- (c) although there were complaints from time to time, the complaint statistics sub-system (see Note 7 to para. 2.21(a)) of Contract F did not contain information for 3 months while those of Contracts K and I contained incomplete information for 8 and 41 months respectively.

2.26 The contractors' performance in operating and maintaining the EMMS is subject to the HyD Engineer's inspections. The fact that a number of the non-compliant cases mentioned in paragraph 2.25 had gone undetected for a long time warrants the HyD's attention. Audit considers that there is a need to tighten control in this area.

Audit recommendations

- 2.27 Audit has *recommended* that the Director of Highways should:
 - (a) strengthen the control over payment for the M&M works, particularly the checking of the accuracy of their physical completion date in the completion certificate;

Note 8: In September 2011, Audit found that the defect lists of Contracts J and M had been updated.

- (b) amend the physical completion date entered in the completion certificate for the establishment of EMMS under Contract G;
- (c) require the contractors concerned to promptly rectify the non-compliant problems highlighted in paragraph 2.25; and
- (d) tighten the control over the contractors' compliance with the contract requirements in operating and maintaining the EMMS.

Response from the Administration

2.28 The **Director of Highways** agrees with the audit recommendations. He has said that:

- (a) for the contracts mentioned in paragraph 2.25(a) and (b), the HyD had been using other means (inspection reports and defect completion reports) to monitor outstanding defects. For the contracts mentioned in paragraph 2.25(c), the HyD had been analysing complaint statistics through those compiled regularly by its Public Relations Unit;
- (b) the HyD will rectify the non-compliant problems highlighted in paragraph 2.25 and make effective use of the EMMS facilities provided under the contracts; and
- (c) the HyD will review the control over the contractors' compliance with the contract requirements in operating and maintaining the EMMS and consider appropriate measures to tighten the control by the end of October 2011.

Post-implementation review

Independent review of 2004

2.29 In June 2004, shortly after the launch of the first road maintenance contract (Contract A) with M&M provisions, the HyD commissioned a consultant to carry out an independent review. The purpose of the review was to provide early warning of potential problem areas and to draw lessons for future implementation of M&M provisions in other road maintenance contracts. The review covered the first nine-month operation of four contracts (Contracts A, B, C and G). The consultant recommended a number of measures to improve the measurement of the contractors' performance and the implementation of the EMMS, which had been taken on board by the HyD. The consultant also advised that the overall cost savings or otherwise in implementing the M&M provisions should be determined at the end of the respective contracts.

Audit observations and recommendations

Need for post-implementation review

2.30 Since 2004, the HyD has let out 14 road maintenance contracts with M&M provisions. As of April 2011, six of them had been completed. However, the HyD has not carried out a post-implementation review of the completed contracts to:

- (a) ascertain whether the M&M provisions in these contracts have achieved their intended objectives (such as improved efficiency and savings in the HyD's staff cost);
- (b) review the management of M&M provisions (such as the conduct of Engineer's audits and inspections); and
- (c) capture learning points for future improvements.

2.31 Audit noted that the HyD had, in accordance with established procedures, reviewed the contractual arrangements of each completed road maintenance contract with a view to improving the terms for subsequent contracts. However, given that these reviews focus on contractual issues, they have a narrower scope than that of a full scale post-implementation review. In Audit's view, a post-implementation review of the completed road maintenance contracts with M&M provisions is particularly important because:

- (a) according to the HyD, the values of M&M works in road maintenance contracts are significant (ranging from \$64 million to \$470 million);
- (b) as term contracts, they are ongoing in nature. The result of a post-implementation review is of high reference value; and
- (c) in the 2004 independent review, the consultant advised that the overall cost savings or otherwise should be determined at the end of the respective contracts (see para. 2.29).

Monitoring benefits achieved

2.32 As mentioned in paragraph 2.2, the objective of incorporating the M&M provisions in road maintenance contracts was to achieve efficiency and savings in the HyD's staff cost. To assess the extent of achievement of the objective, there is a need to monitor closely the benefits actually realised and check them against the projected benefits. However, Audit found that the HyD had not compiled at the project planning stage baseline information (such as the expected number and rank of staff that could be saved) for comparison.

Audit recommendations

- 2.33 Audit has *recommended* that the Director of Highways should:
 - (a) conduct a post-implementation review of the M&M contract arrangement to draw lessons for continuous improvement; and
 - (b) remind officers concerned to compile baseline information for monitoring the achievement of benefits expected from new contract arrangements in future.

Response from the Administration

2.34 The **Director of Highways** agrees with the audit recommendations.

PART 3: INSPECTION OF HIGHWAY STRUCTURES

3.1 As of April 2011, there were over 3,800 highway structures (such as road tunnels, flyovers and footbridges) under the HyD's maintenance responsibilities. Inspection is an integral part of maintenance of these highway structures. This PART examines the following issues relating to the inspection of highway structures:

- (a) general inspection (paras. 3.5 to 3.15);
- (b) special inspection (paras. 3.16 to 3.21);
- (c) principal inspection of road tunnels (paras. 3.22 to 3.32);
- (d) principal inspection of other highway structures (paras. 3.33 to 3.39); and
- (e) management information system (paras. 3.40 to 3.43).

Types of inspections

3.2 *Carriageway inspections*. Inspections of the carriageways on highway structures are carried out as part of the regular inspections of public roads. There are two types of public road inspections, namely safety inspections (Note 9) and detailed inspections (Note 10).

3.3 *Structural inspections.* The HyD has laid down specific inspection requirements on various structural parts of tunnels and other highway structures. In general, there are four types of structural inspections, namely:

(a) *Six-monthly inspection.* This is a very brief check for identifying obvious defects on a highway structure. The inspection covers visible and readily accessible parts of the highway structure. The six-monthly inspection of tunnels only covers carriageways;

Note 10: Detailed inspections are conducted for all road types once every six months to determine the road conditions and collect the relevant data for planning longer term repair works so that maintenance can be done in an organised manner for preventive purpose.

Note 9: Safety inspections aim to identify, as early as possible, defects that may pose dangers or cause inconvenience to the public. The frequencies of safety inspections depend on road types, i.e. daily for expressways, weekly for trunk roads and other primary distributor roads in urban areas, and once every one to three months for other roads.

- (b) General inspection. General inspection is carried out at two-year intervals. Besides examining visible and readily accessible parts of a highway structure, some specific structural parts (such as bridge bearings and movement joints) should be inspected within touching distance. Consideration should be given to the use of specialist access equipment such as an under-bridge inspection plant (UBIP — see Photographs 1 and 2 in paras. 3.9 and 3.10) or elevated platform, where necessary;
- (c) *Special inspection.* Ad hoc special inspection (which is similar in scope to a general inspection) should be carried out on a highway structure under specified circumstances (see para. 3.16(a)); and
- (d) Principal inspection. Principal inspection is an in-depth check on the structural integrity of a highway structure. The purpose is to provide an expert diagnosis of the health condition of the highway structure and recommend major improvement works. Principal inspection of a road tunnel is carried out 15 years after opening or at other intervals as recommended in the last inspection.

3.4 The HyD employs consultants to carry out principal inspections. As for the other three types of structural inspections and the carriageway inspections, they are undertaken by road maintenance contractors within the scope of the M&M provisions. For contracts commencing April 2008 onwards, the HyD has incorporated new provisions that the contractors shall employ Independent Inspection Consultants (instead of the contractors' staff) to inspect highway structures so as to improve the impartiality of the inspections.

General inspection

3.5 The HyD's Inspection Manual for Highway Structures has laid down detailed requirements for conducting general inspection. Over the years, the HyD has gradually tightened the inspection requirements of different parts of a highway structure, as follows:

- (a) *Before April 2006.* The HyD's Inspection Manual allowed the contractors to use binoculars for inspecting elevated parts of a highway structure;
- (b) For contracts commencing April 2006. The HyD specified more stringent inspection requirements such that some structural parts (e.g. movement joints) were to be examined within touching distance (i.e. Close Visual Inspection CVI). Main structure body might be inspected using binoculars but within a maximum distance of 20 metres (i.e. Visual Inspection VI). Other structural parts (such as bearings) were to be examined by a mix of CVIs and VIs (in the ratio of 20% to 80%); and

- (c) *For contracts commencing April 2009 onwards*. The HyD has further tightened the inspection requirements for bearings and similar structural parts such that the proportion of CVIs is increased from 20% to 50% (while the proportion of VIs is correspondingly reduced from 80% to 50%).
- 3.6 According to the HyD's Inspection Manual:
 - (a) consideration should be given to the use of specialist access equipment, such as a UBIP to gain quick and safe access to difficult locations (under-bridge structural parts such as bearings) for conducting CVIs; and
 - (b) the use of a UBIP is of paramount importance for very high bridges (such as the Shun Lee Tsuen Bridge in Kowloon East and the Liu To Bridge in Tsing Yi) and bridges over water (such as the Tsing Yi North and South Bridges, the Ap Lei Chau Bridge and the Island Eastern Corridor) where alternative access could only be gained by the use of scaffolding.

3.7 **Provision of UBIP.** In 1993, the HyD procured a UBIP which might be hired by its contractors for carrying out inspections and maintenance works of highway structures. In early 2006, the UBIP was put out of service as it was in a dilapidated condition beyond economic repair. With the introduction of the CVI requirement in April 2006 (see para. 3.5(b)), the HyD expected that there would be increasing demand for use of a UBIP. To meet the contractors' need, the HyD stipulated in Contract I (which commenced in April 2007) the procurement of a UBIP for carrying out inspections under the contract and for hiring to other contractors.

3.8 Utilisation of the UBIP. Audit examined the utilisation records of the UBIP (procured under Contract I) and found that it was used for a total of 446 days from 2008-09 to 2010-11. About 89% of the utilisation was accounted for by Contract J (mainly used for the inspection and maintenance works of the Shenzhen Western Corridor — Note 11). For high bridges and bridges over water, which the HyD considered the use of a UBIP was of paramount importance for obtaining access to the under-bridge structural parts (see para. 3.6), Audit found that six of them had no record of using the UBIP for their inspections. Upon Audit's requests, in June 2011, the HyD provided explanations for not using the UBIP in these cases (see Table 1).

Note 11: According to the HyD, the specifications of the UBIP procured under Contract I were drawn up mainly to suit the inspection requirements of the Shenzhen Western Corridor which consisted of extensive bridge structures over water. The UBIP can also be used in other bridges with access difficulties for conducting CVIs (such as the Island Eastern Corridor).

Table 1

Reasons for not using UBIP for general inspections of six bridges (June 2011)

| Bridge | Date of last general inspection | Reason |
|-----------------------------------|---|---|
| 1. Ap Lei Chau Bridge | 31.7.2009 and 12.9.2009 | The UBIP could not be used due to the wide footpath of the bridge (see paras. 3.9 and 3.10). Hydraulic platform and scaffoldings were used for CVIs of under-bridge structural parts. |
| 2. Liu To Bridge | 19.5.2009 (Note) | The UBIP could not be used due to the wide walkway and the fencing of the bridge. Scaffoldings were used for CVIs of under-bridge structural parts at two ends of the bridge. |
| 3. Shun Lee Tsuen Bridge | 13.12.2010 | Under-bridge structural parts requiring CVIs were located at two ends of the bridge, where hydraulic platform and scaffoldings could be used. |
| 4. Tsing Yi North Bridge | 22.10.2009 and 7.1.2010 | The UBIP could not be used due to the wide walkway and the fencing of the bridge. The under-bridge structural parts selected for CVIs were located at two ends of the bridge, where hydraulic platform could be used. |
| 5. Tsing Yi South Bridge — old | 22.10.2009, 26.11.2009 and 4.12.2009 | The under-bridge structural parts selected for CVIs were located inside the bridge cell where direct access was available. |
| 6. Tsing Yi South Bridge — new | 30.10.2009, 18.11.2009 and 4.12.2009 | The under-bridge structural parts selected for CVIs were located at two ends of the bridge, where hydraulic platform could be used. |

Source: HyD records

Note: In July 2011, another general inspection of the bridge was conducted during which UBIP was not used.

Audit observations and recommendations

Contract specifications for purchasing UBIP

3.9 According to the Inspection Manual for Highway Structures issued by the HyD in 2004, the UBIP purchased by the HyD in 1993 (see para. 3.7) was specifically modified for use in Hong Kong with particular reference to the Tsing Yi Bridges and the Ap Lei Chau Bridge. Photograph 1 shows the use of the modified UBIP by the HyD for inspecting the Ap Lei Chau Bridge in 2002. The extended arm length of the modified UBIP (measuring 2.5 metres) was long enough to span over the footpath.

Photograph 1



UBIP used by the HyD for inspecting the Ap Lei Chau Bridge

Source: HyD records

3.10 According to the specifications of Contract I, the UBIP required to be purchased under the contract shall have an extended arm length of not less than 1.7 metres. In the event, the contractor purchased a UBIP with an extended arm length of 2.25 metres (see Photograph 2) which was accepted by the HyD in May 2007 as having complied with the contract specifications. As shown in Table 1 in paragraph 3.8, the UBIP was found unfit for use in the Ap Lei Chau Bridge, the Liu To Bridge and the Tsing Yi North Bridge. In Audit's view, the special needs of these bridges should have been considered when arranging for the procurement of the UBIP under Contract I.

Photograph 2

UBIP purchased under Contract I



Source: HyD records

Requiring the use of UBIP

3.11 With the introduction of the CVI requirement in April 2006 (see para. 3.5(b)), the HyD expected that there would be increasing demand for use of a UBIP by the contractors. However, there was no contract provision requiring the use of a UBIP for conducting CVIs of under-bridge structures. In the absence of a contractual requirement, and given that the cost of using access equipment is borne by the contractors as part of their cost of M&M works, they could choose to use alternative access means (such as hydraulic platform or scaffoldings) instead of a UBIP depending on their costs. The HyD needs to consider specifying, in future contracts, those high bridges or bridges over water for which a UBIP should be used for conducting CVIs.

Control over the conduct of CVIs

3.12 *Approval of selected locations for conducting CVIs.* For structural parts to be examined by a mix of CVIs and VIs during general inspections (see para. 3.5(b) and (c)), there is a contract requirement that the contractor shall seek the HyD's approval of the selected locations for conducting CVIs. For the general inspections mentioned in Table 1 in paragraph 3.8, Audit found that there were cases of non-compliance with this approval requirement, as follows:

- (a) there was no record to show that the maintenance contractors of the Ap Lei Chau Bridge and the Shun Lee Tsuen Bridge had sought the HyD's approvals for conducting the inspections; and
- (b) the inspection of the Liu To Bridge was conducted on 19 May 2009 (see item 2 of Table 1 in para. 3.8). However, according to the contractor's e-mail of June 2009 to the HyD, the approval for the bridge inspection was given at a weekly meeting of 25 May 2009 (Note 12).

3.13 **CVIs at difficult locations.** At present, there is no contract provision requiring the contractors to inform the HyD of the specialist access equipment they would use for carrying out CVIs of highway structures at difficult locations (see para. 3.6). To ensure that these CVIs are properly conducted, the HyD needs to carry out Engineer's inspections (see para. 2.3(b)(ii)) when the CVIs are in progress. However, for CVIs of the high bridges and bridges over water mentioned in Table 1, the HyD had not carried out any Engineer's inspection to monitor the contractors' performance.

Audit recommendations

- 3.14 Audit has *recommended* that the Director of Highways should:
 - (a) check the specifications when procuring special equipment (including UBIP) intended to be let out for use in a number of contracts, to ensure that they adequately cater for different site conditions under which the equipment may be put to use;
 - (b) consider specifying, in future contracts, those high bridges or bridges over water for which a UBIP should be used for conducting CVIs;
- **Note 12:** While records of the meeting of 25 May 2009 did not show that approval had been given, the HyD informed Audit in August 2011 that the selected locations for conducting CVIs were agreed at that meeting.

- (c) closely monitor the contractors' compliance with the contract requirement of seeking approvals of selected locations for conducting CVIs;
- (d) consider requiring contractors (in future contracts) to provide information on the specialist access equipment to be used for conducting CVIs of highway structures at difficult locations; and
- (e) remind HyD staff to conduct adequate Engineer's inspections to monitor contractors' performance in conducting CVIs of highway structures at difficult locations.

Response from the Administration

3.15 The **Director of Highways** agrees with the audit recommendations. Regarding the audit observations in paragraph 3.11, he has said that depending on the situation, the cost of using alternative access means could be higher or lower than that of using a UBIP. With contract provisions specifying the use of a UBIP in future (see para. 3.14(b)), tenderers would be made aware of such a requirement in advance and be able to price accordingly.

Special inspection

3.16 Since April 2006, the HyD has stipulated in the road maintenance contracts the following requirements on special inspections:

- (a) the scope of special inspections is similar to that of general inspections. The contractor shall carry out VIs and CVIs as appropriate to a highway structure under the following circumstances:
 - (i) passage of vehicles with an abnormally heavy load likely to result in a factor of safety lower than normally acceptable;
 - (ii) heavy flooding or water main burst in the area of the structure;
 - (iii) major accident impact or fire on or near the structure;
 - (iv) other construction activities close to the structure such as piling, excavation, tunneling or dredging; and
 - (v) settlement occurring suddenly or greater than allowed for in the design;

- (b) upon the occurrence of the events triggering the special inspection as stated in
 (a) above, the contractor shall report to the HyD within 24 hours the details together with the inspection arrangements;
- (c) the special inspection shall be carried out within seven days or such other period as agreed with the HyD; and
- (d) the contractor shall submit the inspection report to the HyD within seven days after the inspection.

3.17 *Audit examination.* Of the nine contracts operating in March 2011, eight had incorporated the above special inspection provisions (Note 13). Audit examination of the inspection records of these eight contracts showed that special inspections had not been conducted for two of them (Contracts F and I) since their commencement in April 2007 (i.e. for four years). For the other six contracts (Contracts D, H, J, K, L and M) with special inspections conducted, Audit noted that none of them was triggered by water main burst (see para. 3.16(a)(ii)). According to the Water Supplies Department (WSD)'s statistics, there were 988 and 609 water main burst incidents in 2009-10 and 2010-11 respectively. Audit selected two water main burst incidents occurring near highway structures to examine how the incidents were handled by the HyD and the contractors concerned (see Cases 1 and 2).

Note 13: The remaining contract (Contract G) without the special inspection provision was awarded before April 2006.

Case 1

Water main burst near a footbridge in Gloucester Road, Wan Chai (31.8.2009)

1. Around 7:10 a.m. on 31 August 2009, a salt water main (45 centimetres in diameter) burst occurred outside Immigration Tower at 7 Gloucester Road, Wan Chai, causing part of the eastbound carriageway to collapse. Above that section of the Gloucester Road is a footbridge connecting O'Brien Road and Immigration Tower. The burst main lies between two supporting piers of the footbridge — one on the footpath outside Immigration Tower and the other on the central divider of Gloucester Road (see Figure 1).

- 2. Audit examination of the HyD's records revealed that:
 - (a) around 9:50 a.m., the HyD's computer system received (via the Efficiency Unit's Integrated Call Centre hotline) an application from the WSD for an emergency excavation permit to carry out repair works for the burst main. There was no record to show that after the issue of the permit, the maintenance contractor of the footbridge was alerted to the water main burst incident for taking necessary follow-up action;
 - (b) there was no record to show that the contractor had informed the HyD of the detailed arrangements for any special inspection of the footbridge within 24 hours in accordance with the contract requirements (see para. 3.16(b)); and
 - (c) HyD staff inspected the water main burst scene and found that the water main burst spot was about 10 metres from the nearest footbridge pier (see Photograph 3). As no apparent damage or settlement at the piers of the footbridge was found, HyD staff did not take further action to request the contractor to carry out special inspection of the footbridge structure.

Source: HyD and WSD records

Figure 1

Locations of the water main burst in Gloucester Road and the nearby footbridge



Legend: • Water main burst spot • Supporting piers to footbridge

Source: HyD records

Photograph 3

Water main burst in Gloucester Road, Wan Chai



Source: HyD records

Case 2

Water main burst alongside the Tai Chung Kiu Road flyover, Shatin (14.1.2011)

1. Around 10:10 p.m. on 14 January 2011, a fresh water main (60 centimetres in diameter) burst occurred in On King Street, Shatin. The burst main lies alongside the up ramp of the Tai Chung Kiu Road flyover near the Shek Mun Interchange (see Figure 2 and Photograph 4).

- 2. Audit examination of the HyD's records revealed that:
 - (a) around 11:00 p.m., the HyD's computer system received (via the Integrated Call Centre hotline) an application from the WSD for an emergency excavation permit to carry out repair works for the burst main. There was no record to show that after the issue of the permit, the maintenance contractor of the flyover and HyD subject staff were alerted to the water main burst incident for taking necessary follow-up action;
 - (b) there was no record to show that the contractor had informed the HyD of the detailed arrangements for any special inspection of the flyover within 24 hours in accordance with the contract requirements;
 - (c) there was no documented justification for not conducting a special inspection of the flyover; and
 - (d) on 28 February 2011, in response to a public complaint about some structural defects of the flyovers of the Shek Mun Interchange, the HyD instructed the contractor to conduct a special inspection. The flyovers were found to be in serviceable condition. Some defects identified during the inspection (including voids found at the foot of some flyover abutments) were subsequently rectified in March 2011.

Source: HyD and WSD records

Figure 2

Locations of the water main burst and the Tai Chung Kiu Road flyover, Shatin



Source: HyD records

Photograph 4

Water main burst in On King Street, Shatin



Source: WSD records

Audit observations and recommendations

Need to closely monitor triggering events of special inspection

3.18 According to the WSD's statistics, there were 988 and 609 water main burst incidents in 2009-10 and 2010-11 (see para. 3.17). As a triggering event of special inspection (see para. 3.16(a)(ii)), the HyD needs to monitor these incidents to see if they occur in the area of any highway structures. Given that the WSD has to apply for an excavation permit from the HyD to carry out repair works as soon as possible, the HyD receives timely information about water main burst incidents (including their locations). However, as seen in Cases 1 and 2 in paragraph 3.17, the HyD has not put such information into effective use, such as alerting the relevant maintenance contractors to the need for conducting a special inspection or informing HyD subject staff to monitor the contractors' follow-up actions. Audit considers that there is a need to establish a mechanism for disseminating information in this regard.

Need to specify clearly triggering events

3.19 For a number of triggering events of special inspection specified in the maintenance contracts (such as water main burst, fire, and construction activities), the locations of these events are described as "in the area of", "near" or "close to" the affected structures (see para. 3.16(a)). Without specifying the distance between a triggering event and the affected highway structure, the requirement of a special inspection could be open to interpretation. For example, the water main burst of Case 2 occurred alongside the up ramp of the Tai Chung Kiu Road flyover near the Shek Mun Interchange (see Photograph 4). However, in response to Audit enquiries on the reason for not conducting special inspection of the flyover in January 2011, HyD staff said that the water main burst occurred away from the Shek Mun Interchange. In Audit's view, there is a need to review and revise the contract provisions concerning special inspections with a view to clearly specifying the circumstances under which such inspections should be conducted.

Audit recommendations

- 3.20 Audit has *recommended* that the Director of Highways should:
 - (a) closely monitor triggering events of special inspections (particularly the water main burst incidents) to ensure that the relevant maintenance contractors carry out the inspections in accordance with the contract requirements;
 - (b) introduce a mechanism for disseminating water main burst information received (from the WSD) to alert the relevant HyD staff to the need for monitoring the contractors' follow-up actions on conducting special inspections; and
 - (c) review and revise the contract provisions concerning special inspections with a view to clearly specifying the circumstances under which such inspections should be conducted.

Response from the Administration

3.21 The **Director of Highways** agrees with the audit recommendations.

Principal inspection of road tunnels

3.22 As of April 2011, there were 15 major road tunnels in Hong Kong. Of these, eleven were government-managed tunnels and four were franchised tunnels. Franchised tunnels were constructed and operated under Build-Operate-Transfer contract arrangements. The operations of these franchised tunnels are governed by their respective Ordinances and Project Agreements signed between the franchisees and the Government (represented by the Transport and Housing Bureau).

3.23 Principal inspections of government tunnels were first conducted to check the structural integrity of the Aberdeen Tunnel and the Lion Rock Tunnel during 2000 and 2001. After a review in 2002, the HyD decided that principal inspections should be conducted for all government tunnels when they reached 15 years after opening. The detailed requirements were laid down in a Guideline on Inspection of Road Tunnels issued in June 2003 (the 2003 Inspection Guideline).

Audit observations and recommendations

Principal inspection of government tunnels

3.24 Since the promulgation of the 2003 Inspection Guideline, the HyD has completed principal inspections of three tunnels (see Table 2).

Table 2

| | | Principal inspection | | |
|-------------------------|-----------------|----------------------|----------------------|--------------------|
| Tunnel | Date of opening | Due date | Commencement date | Completion date |
| Kai Tak Tunnel | June 1982 | (Note) | August 2004 | August 2005 |
| Shing Mun Tunnels | April 1990 | April 2005 | January 2006 | July 2007 |
| Tseung Kwan O Tunnel | November 1990 | November 2005 | January 2006 | July 2007 |

Principal inspections of three government tunnels

Source: HyD records

Note: The Kai Tak Tunnel was 21 years old when the Inspection Guideline was issued in June 2003.

3.25 As can be seen from Table 2, the principal inspections of the three tunnels commenced some 2 to 14 months after they were due (or after the issue of the 2003 Inspection Guideline for the Kai Tak Tunnel). The inspections also took some 12 to 18 months to complete. In Audit's view, there is room for improving the timeliness of principal inspections of government tunnels. Improvement measures may include reminding the relevant staff to start preparing for the inspections at an early date taking into account the inspection lead time, and requiring the completion of the inspections within a reasonable time after they are due.

Principal inspection of franchised tunnels

3.26 The Ordinances and Project Agreements governing the operation of the four franchised tunnels were drawn up before the issue of the 2003 Inspection Guideline. The maintenance obligations of the franchisees as stated in the respective Ordinances and Project Agreements are very general. In essence, the franchisees are required to maintain the respective tunnels and keep them in a state of repair to the satisfaction of the Director of Highways.

3.27 In 2002 when the HyD decided to conduct principal inspections for government tunnels after they reached 15 years old, the application of the same inspection requirements to franchised tunnels was also discussed. The HyD then considered that the enforcement of the inspection requirements would be subject to the limitations of the respective Ordinances and Project Agreements. The franchisees would be advised to adopt the 2003 Inspection Guideline.

3.28 Since the issue of the 2003 Inspection Guideline, two of the four franchised tunnels (Tunnels A and B) reached 15 years old in 2004 and 2006 respectively. The franchisee of Tunnel B conducted a principal inspection at his own cost during 2006 and 2007 in accordance with the Guideline. As regards Tunnel A, Audit found that:

- (a) the franchisee of Tunnel A did not carry out a principal inspection in 2004; and
- (b) at two meetings held in July 2005 and January 2007, HyD staff suggested that the franchisee should conduct principal inspection as Tunnel A was over 15 years old. At the first meeting, the franchisee representatives replied that they had met the obligation under the Ordinance and had no plan to carry out a principal inspection. At the second meeting, the franchisee representatives replied that they would recommend to their top management to conduct a principal inspection.

3.29 In response to Audit enquiries on the development regarding the principal inspection of Tunnel A, in May and August 2011, the HyD said that:

- (a) the franchise of Tunnel A had two parts, i.e. one covering a railway tunnel (the railway tunnel franchise) and the other covering a road tunnel (the road tunnel franchise). The railway tunnel franchise had expired by February 2008. Before taking over the maintenance responsibilities of the railway tunnel, the HyD had employed a consultant to carry out a condition survey in 2008 to ascertain that there were no outstanding maintenance works that should be carried out by the franchisee. The survey included checks on the structural health and integrity of both the railway and road tunnels, which were similar to those of a principal inspection; and
- (b) in December 2010, the franchisee of Tunnel A informed the HyD that an inspection similar to a principal inspection (though the format might not be identical) was adopted.

3.30 Audit notes that the remaining two franchised tunnels (other than Tunnels A and B) will reach 15 years old in 2012 and 2013 respectively. For public safety, there is a need to take effective measures to ensure that principal inspections are properly conducted for these two tunnels. As shown in paragraph 3.28, there could be difficulties to implement principal inspections through the franchisees on an advisory basis. The HyD needs to engage the management of the franchised tunnels in the discussion process well before the inspections are due to resolve issues that may arise.

Audit recommendations

- 3.31 Audit has *recommended* that the Director of Highways should:
 - (a) take measures to improve the timeliness of principal inspections of government tunnels, such as:
 - (i) reminding the relevant HyD staff to start the preparatory work for the inspections at an early date taking into account the inspection lead time; and
 - (ii) stipulating that the inspections should be completed within a reasonable time after they are due; and
 - (b) remind the management of the two remaining franchised tunnels to carry out sufficient inspections equivalent to principal inspections and engage them in discussion well before the inspections are due to resolve issues that may arise.

Response from the Administration

3.32 The **Director of Highways** agrees with the audit recommendations. He has said that:

- (a) there were special circumstances leading to the delay of 14 months in commencing the principal inspection for the Kai Tak Tunnel as mentioned in paragraph 3.25. As it was the first tunnel requiring such an inspection, HyD staff took some time to investigate and finalise the scope of work, and to select consultants to carry out the inspection; and
- (b) in implementing the audit recommendation of paragraph 3.31(a)(ii), the HyD will carefully consider the complexity of the principal inspection in each case and require each to be completed within a reasonable time after it is due.

Principal inspection of other highway structures

3.33 In 2000, the HyD introduced a ten-yearly principal inspection for highway structures (other than tunnels) of age over 25 years. The aim of the principal inspection was to monitor the condition of an aged highway structure which might decline over time and to discover problems in time.

3.34 *Audit examination.* Audit examination of HyD records showed that in April 2002, the HyD employed a consultant to carry out principal inspections for two flyovers, each over 25 years of age (i.e. the Canal Road Flyover and the Gascoigne Road Flyover). As of April 2011, there were 3,860 highway structures maintained by the HyD. Of these structures, 1,013 (or 26%) were over 25 years old but for which no principal inspection had been conducted.

- 3.35 In response to Audit enquiries, in April 2011, the HyD said that:
 - (a) the ten-yearly principal inspection requirement for highway structures (other than tunnels) of age over 25 was reviewed in 2004. It was concluded that such a requirement was over-conservative and resource-intensive. The findings of the principal inspections conducted in 2002 and subsequent experience also revealed that the actual condition of a highway structure did not bear a direct relationship with the age of the structure and there were other factors such as usage, actual loading and environmental conditions that had to be taken into account; and
 - (b) hence, the ten-yearly principal inspection requirement for aged highway structures was withdrawn in 2004. Nevertheless, for some high-consequence structures in the Tsing Ma Control Area and the Tsing Sha Control Area, principal inspections were conducted before the end of the relevant management-operation-maintenance contracts (see Note 2 to para. 1.4).

Audit observations and recommendations

Need to document decisions on inspection requirements

3.36 Audit noted the HyD's explanation that principal inspections had not been conducted on the highway structures of age over 25 due to a change in the inspection requirement in 2004. However, Audit is concerned that there was no documentation on the justifications for the change in the inspection requirement. In Audit's view, the HyD needs to maintain adequate documentation to support its decisions on inspection requirements so as to enhance transparency and public accountability.

Need to develop new inspection requirements

3.37 According to the HyD's 2004 review, the ten-yearly principal inspection requirement for highway structures of age over 25 was over-conservative and resource-intensive. There were other factors such as usage, actual loading and environmental conditions that had to be taken into account in conducting principal inspections. However, it was not until March 2011 that a working group was formed to conduct a review with a view to recommending a long-term strategy for principal inspections. There is a need to expedite action in this regard.

Audit recommendations

- 3.38 Audit has *recommended* that the Director of Highways should:
 - (a) maintain adequate documentation to support the HyD's decisions on inspection requirements; and
 - (b) expedite action on formulating a long-term strategy for conducting principal inspections of aged highway structures.

Response from the Administration

3.39 The **Director of Highways** agrees with the audit recommendations. Regarding the audit observations in paragraph 3.37, he has said that:

- (a) after the 2004 review, the HyD concentrated its efforts of principal inspection on major bridges in the Tsing Ma Control Area and the Tsing Sha Control Area. At around the same time, the HyD had enhanced the effectiveness of structural inspections by specifying more stringent inspection requirements, such that critical structural parts were to be examined within closer distances and at higher frequencies (see para. 3.5); and
- (b) in March 2011, the HyD further expanded its effort by forming a working group to conduct a review with a view to recommending a long-term strategy for principal inspections for the remaining highway structures.

Management information system

3.40 *Integrated Structure Information System (ISIS)*. In June 2002, the HyD developed an ISIS for the management of highway structure information (such as layout plans, design information and the latest maintenance records). The purpose was to improve the efficiency of storage and retrieval of highway structure records for maintenance planning.

Audit observations and recommendations

3.41 Audit examination has revealed that there is room for improvement in the ISIS as follows:

- (a) *Maintenance records.* At present, the ISIS only captures the results of six-monthly inspections and general inspections of highway structures but not those of special inspections. As mentioned in paragraph 3.16(a), a special inspection is similar in scope to a general inspection and it is triggered by events which could have an impact on a highway structure. The results of special inspections form an integral part of the maintenance history of a highway structure and their storage in the ISIS would facilitate maintenance planning; and
- (b) **Data updating.** In March 2011, Audit cross-checked the inspection records of ten highway structures (maintained under three contracts) against the ISIS. Audit found that inspection data of these structures in the ISIS had not been kept up-to-date for periods ranging from 7 to 27 months. Audit noted that the data to be input into the ISIS were extracted from the inspection reports submitted by the contractors. The updating process involved manual efforts and was prone to transcription error. As mentioned in paragraph 2.24, there are contract provisions that a contractor shall store maintenance history data in the EMMS and that the HyD may transfer the relevant data to its computer networks. There is a need to explore the feasibility of electronic transfer of inspection data to improve operational efficiency.

Audit recommendations

- 3.42 Audit has *recommended* that the Director of Highways should:
 - (a) capture special inspection results in the ISIS as part of the maintenance history of highway structures to facilitate their retrieval for maintenance planning;
 - (b) take measures to ensure the timely inputting of inspection results into the ISIS to keep the system information up-to-date; and
 - (c) explore the feasibility of electronic transfer of inspection data from the EMMS to the HyD's computer system to improve operational efficiency in data updating.

Response from the Administration

3.43 The **Director of Highways** agrees with the audit recommendations.

PART 4: REHABILITATION MAINTENANCE FOR ROADS

4.1 This PART examines the HyD's rehabilitation maintenance for roads and suggests areas for improvement.

Road condition survey

4.2 The two Regional Offices of the HyD are responsible for identifying the roads that need rehabilitation maintenance works (see para. 1.3(c)). They prepare an annual maintenance works plan by assessing information collected from various sources, including regular inspections (see para. 3.2) and ad hoc road condition surveys.

4.3 Road condition surveys are conducted to assess the structural conditions of selected roads. From 2002 to 2006, the HyD commissioned four road condition surveys covering 5,295 km (in lane length — Note 14) of roads throughout Hong Kong Island, Kowloon and the New Territories. The surveys found that 463 km (or 9%) of them required the HyD's attention.

4.4 The HyD further inspected the 463 km lane length of roads and confirmed that 363 km of them (in 17,738 road sections) required rehabilitation maintenance works. Since 2007, the Regional Offices have been required to report to a working group (Note 15) the progress of the maintenance works. The working group meets every two months to consider, among other things, the progress reports submitted by the Regional Offices. Table 3 shows the reported position of April 2011.

Note 14: *Lane length refers to the length of a traffic lane of a road.*

Note 15: The working group is chaired by an Assistant Director of the HyD Headquarters and has representatives of the Regional Offices as members. It is set up to monitor, discuss and review various aspects of highway maintenance works.

Table 3

Progress of rehabilitation maintenance works (April 2011)

| | Lane length of roads requiring maintenance works (km) | | | | | |
|---|---|------------------------|----------|--------------------|-------|--|
| | Survey A | Survey B | Survey C | Survey D | Total | |
| Commissioning date | May 2002 | Jan 2004 | Mar 2004 | May 2004 | _ | |
| Completion date | Oct 2003 | Mar 2006 | Mar 2006 | Dec 2006 | _ | |
| Region | Hong Kong Island | Hong Kong Island | Kowloon | New Territories | _ | |
| (a) Works completed | 92 | 34 | 98 | 108 | 332 | |
| (b) Works not yet carried out due to site constraints | 1 | 1 | 6 | 3 | 11 | |
| (c) Works in progress/ under planning | 16 | 2 | 1 | 1 | 20 | |
| Total | 109 | 37 | 105 | 112 | 363 | |

Source: HyD records

Audit observations and recommendations

Outstanding rehabilitation maintenance works

4.5 As of April 2011, the HyD had not completed actions on 31 km (8.5% of the total) lane length of roads requiring rehabilitation maintenance works (see items (b) and (c) of Table 3). About 55% of the outstanding maintenance works (in 17 out of the 31 km of roads) were identified in 2003 by Survey A. However, there was no target date set for completing these works. In Audit's view, the HyD needs to expedite action on the works and set a target completion date to monitor the progress.

Reporting errors

4.6 In an examination of the progress reports, Audit noted that the number of road sections with site constraints had substantially reduced from 875 in February 2011 by 517 to 358 in April 2011.

4.7 Audit selected a sample of 30 road sections and examined the HyD's records to ascertain the reasons for the removal of their site constraints within a short period of two months. The audit findings are summarised below:

(a) *Reporting errors before April 2011.* 13 road sections had been wrongly reported as having site constraints in the past (see details in Table 4). However, the reporting errors were only detected and rectified by the HyD in the progress report of April 2011; and

Table 4

Road sections with reporting errors (April 2011)

| Number of road sections wrongly reported as having site constraints | Actual position | | |
|---|---|--|--|
| 6 | Maintenance works had been completed for 8 to 44 months | | |
| 6 | Maintenance works had been found to be unnecessary for 13 to 34 months | | |
| 1 | Site constraint had been removed for 19 months | | |

Source: Audit analysis of HyD records

(b) *Reporting errors made in April 2011.* Audit found four reporting errors in the progress report of April 2011. These included three road sections reported as not requiring maintenance works and one road section as having maintenance works completed. In fact, all four road sections required maintenance works pending removal of site constraints.

Audit recommendations

- 4.8 Audit has *recommended* that the Director of Highways should:
 - (a) expedite action on the outstanding rehabilitation maintenance works mentioned in paragraph 4.5;
 - (b) set a target completion date for monitoring the progress of these works; and
 - (c) remind staff concerned to carry out validation checks on the accuracy of information contained in road maintenance management reports before they are submitted.

Response from the Administration

4.9 The **Director of Highways** agrees with the audit recommendations. He has said that:

- (a) for the road sections with outstanding rehabilitation maintenance works (see para. 4.5), they had been closely monitored through regular safety and detailed inspections. Corrective repairs had been carried out in a timely manner to ensure that the roads were kept in acceptable conditions. The priority of the outstanding rehabilitation maintenance works has to be weighed against other maintenance works identified every year from various sources; and
- (b) the HyD has completed works for the majority of roads requiring rehabilitation maintenance. For the remaining roads, detailed planning for their rehabilitation maintenance works is in progress to overcome difficult traffic constraints. The HyD would strive to expedite the completion of the outstanding works.

PART 5: OTHER MANAGEMENT ISSUES

- 5.1 This PART examines the following road maintenance management issues:
 - (a) management of works orders (paras. 5.2 to 5.10); and
 - (b) performance reporting (paras. 5.11 to 5.22).

Management of works orders

5.2 In the past, the HyD had to issue a large number of works orders to a contractor for carrying out road maintenance works. With the M&M contract provisions covering a wide range of maintenance works, the HyD only issues individual works orders for maintenance works which go beyond the extent of these provisions (see Note 4 to para. 2.2(a)). According to the HyD, implementation of the M&M provisions had reduced the number of works orders issued in a year from about 90,000 to 17,000.

5.3 Before the issue of a works order, the HyD prepares a cost estimate of the order. During the progress of works, the contractor can apply for interim payments for the completion of part of a works order. The aggregate interim payments for any works order shall not exceed 90% of its cost estimate. Within 90 days of completion of the works under a works order, the contractor is required to submit a dimension book (Note 16) to the HyD. The HyD shall check the accuracy of the measurements in the dimension books before making a final payment and finalising the works order.

5.4 In 2008, the HyD's senior management expressed concern over the slow progress in finalising works orders (i.e. their related payments) for some contracts long after the expiry of their respective contract periods (completed contracts). As of early March 2008, 925 works orders (under nine completed contracts) had not been finalised. After a review, the HyD found that the common causes of delays included unsettled claims and disputes, and late submission of dimension books. In late March 2008, the HyD decided to adopt a number of improvement measures, including the formation of a working group (comprising staff of the HyD and the contractor) for each contract to monitor the progress in finalising works orders and to resolve outstanding problems in a timely manner.

Note 16: A dimension book contains records of the works done for a works order and their respective quantities and measurements, which are subject to verification and agreement by the HyD.

Audit observations and recommendations

Finalisation of works orders

5.5 In March 2011, Audit reviewed the HyD's progress in finalising works orders of completed contracts. There were a total of 909 works orders under five completed contracts not yet finalised (of which 158 were related to two contracts that had been completed for three years or more). The HyD needs to explore more effective measures to expedite the finalisation of these works orders.

Submission of dimension books

5.6 According to the HyD's 2008 review, late submission of dimension books was one of the reasons for delays in finalising works orders. Besides, it would be difficult to verify a contractor's claimed quantities of works if the dimension books are submitted a long time after works completion. This could adversely affect the HyD's valuation of the completed works. As of March 2011, there were 1,297 works orders (of ongoing contracts) with overdue dimension books. Ageing analysis of these 1,297 cases showed that 32% of them had been overdue for one year or more (see Table 5). The HyD needs to take measures to ensure timely submission of dimension books by contractors.

Table 5

Analysis of overdue dimension books (March 2011)

| Overdue period | Number of dimension books | |
|--------------------------------------|------------------------------|-----------|
| Less than 1 year | 878 | |
| Between 1 year and less than 2 years | 302 | |
| 2 years or more | 117 (Note) | 419 (32%) |
| Total | 1,297 | r |

Source: Audit analysis of HyD records

Note: In four cases, the overdue dimension books had remained outstanding for more than 4 years.

5.7 According to the 2008 review (see para. 5.4), an effective measure to put pressure on a contractor to submit dimension books on time is to invoke the following contract provision:

- (a) a contractor shall repay the interim payments previously made to him if he fails to submit the dimension books on time; and
- (b) the recovered amount will be repaid to the contractor when the dimension books are subsequently submitted.

According to the HyD's Maintenance Administration Handbook, a contractor may apply to the HyD for withholding recovery action if the late submission of dimension books is not due to his fault.

5.8 Audit sample checked the HyD's approval of contractors' applications for withholding recovery action and found that there was room for improvement in the HyD's documentation of the approval reasons.

Audit recommendations

- 5.9 Audit has *recommended* that the Director of Highways should:
 - (a) explore more effective measures to expedite the finalisation of works orders;
 - (b) take measures to ensure the timely submission of dimension books by contractors; and
 - (c) remind officers concerned to fully document the reasons for approving contractors' applications for withholding recovery of interim payments.

Response from the Administration

5.10 The **Director of Highways** agrees with the audit recommendations. He has said that the HyD has been holding regular meetings with contractors to finalise works orders of completed contracts. Recently, the HyD has finalised the works orders of a contract in two years and three months after the end of the contract period.

Performance reporting

5.11 The Controlling Officer's Report (COR), as part of the Estimates, forms the basis for the Finance Committee of the Legislative Council to approve the Government's estimates of expenditure for the following financial year and for stakeholders to evaluate the bureaux/departments' performance for the past and current years. Every year, the Financial Services and the Treasury Bureau (FSTB) issues guidelines to bureaux and departments on preparation of the CORs. The guidelines require amongst other things that the controlling officers should:

- (a) ensure that all information set out in the CORs is substantiated and accurate;
- (b) satisfy themselves that proper performance records are maintained and as far as practicable can be validated;
- (c) when developing performance measures for individual programmes, focus on targets measured preferably in terms of intended outcome; and
- (d) review performance against these targets throughout the financial year and be ready to account for deviations, indicating, where relevant, the levels of services that have been achieved, such as turnaround times and backlogs of work. Performance pledge commitments in particular should be reflected.

5.12 In the 2011-12 COR, the HyD included 18 performance targets and 14 indicators for the programme area of district administration and road maintenance. Audit examined these performance targets and indicators, and found that there was room for improvement as reported in paragraphs 5.13 to 5.19.

Audit observations and recommendations

Performance indicator on road maintenance complaints

5.13 The HyD receives complaints from a number of sources, including the Integrated Call Centre hotline, the media and other government departments. The HyD has maintained a database to analyse the complaints by nature and compile statistics on a quarterly basis for review by its senior management. The numbers of valid complaints (Note 17) on the road network handled by the two Regional Offices for 2008, 2009 and 2010 were 19,909, 17,933 and 17,817 respectively. A breakdown of these complaints by nature is shown in Table 6.

Note 17: Valid complaints excluded duplicated cases and those outside the jurisdiction of the two Regional Offices.

Table 6

| Complaint nature | 2008 (Number) | 2009 (Number) | 2010 (Number) |
|-------------------------|------------------|------------------|------------------|
| Carriageway maintenance | 3,708 | 3,462 | 3,284 |
| Dumping | 2,184 | 2,024 | 2,232 |
| Footpath maintenance | 4,606 | 5,058 | 5,261 |
| Roadworks | 1,900 | 1,648 | 1,420 |
| Road blockage | 336 | 222 | 158 |
| Road drainage | 550 | 582 | 893 |
| Slope matters | 740 | 547 | 308 |
| Structures | 446 | 547 | 371 |
| Traffic aids | 2,433 | 2,398 | 2,347 |
| Vegetation management | 1,672 | 897 | 876 |
| Miscellaneous (Note) | 1,334 | 548 | 667 |
| Total | 19,909 | 17,933 | 17,817 |

Analysis of complaints handled by the HyD's Regional Offices (2008 to 2010)

Source: HyD records

Note: These include complaints relating to the HyD staff and services.

5.14 The HyD has reported the number of complaints relating to road maintenance as one of its performance indicators in the COR. The numbers of complaints reported in the CORs for 2008, 2009 and 2010 were 6,446, 5,678 and 5,750 respectively. Audit noted that these reported figures were only about one-third of total complaints handled (see Table 6). In response to Audit enquiries, in May and August 2011, the HyD said that:

(a) it had been reporting the road maintenance complaint figures in the annual COR for a long time on a consistent basis by counting only the complaints against engineering maintenance aspects of roads, such as potholes, defective paving blocks and rusted pedestrian railings;

- (b) in late 2001, the HyD started to engage the Integrated Call Centre hotline to handle, log and report all public complaints lodged with the HyD, covering aspects of diverse types and nature in addition to the engineering maintenance of roads. These additional complaints included those against street management issues, dumping, roadworks, slope matters and vegetation management; and
- (c) hence, the HyD needed to extract the relevant complaints (see (a) above) from the data set of the Integrated Call Centre hotline for reporting, in accordance with the long established practices.

5.15 In Audit's view, complaints on road maintenance serve as an important source of public feedback on the effectiveness of the HyD's work in this area. As a performance indicator to be reported in the COR, the complaint statistics need to be complete and reflect all aspects of the HyD's maintenance work. Therefore, the HyD needs to review its way of reporting complaint statistics in the COR. Moreover, Audit examination of the HyD's arrangements for compiling complaint statistics for the COR revealed that there were no laid-down criteria for differentiating complaints relating to engineering maintenance of roads from others.

Performance targets on road cleanliness

5.16 Under the section "Matters requiring special attention" of the CORs for the past 11 years, the HyD stated that it would continue to contribute to improving road cleanliness. In this connection, the HyD included two targets for measuring its performance in cleaning road furniture such as traffic signs, i.e. one for expressways and the other for streets with high traffic flow (or black spots for the years before 2011). Audit notes that as a department directly serving the public, the HyD has also published performance pledges informing the public about the levels of services that are available. Regarding road cleanliness, the HyD has set seven targets in its performance pledges. Two of these seven performance pledge targets (relating to cleaning of street furniture) were included in the COR, but not the remaining five targets which were related to cleaning of footbridge/subway structures and clearance of dumping on expressways.

5.17 In Audit's view, the HyD needs to include these five performance pledge targets in the COR to provide a complete picture of its performance in improving road cleanliness. Inclusion of these performance pledge commitments in the COR is also necessary to comply with the FSTB's guideline requirement (see para. 5.11(d)).

Performance reporting on principal inspections

5.18 *Highway structures (other than tunnels).* In the 2000-01 COR, the HyD included as part of the performance target on inspection of highway structures a new service of ten-yearly principal inspections on structures of age over 25 years. According to the HyD, the ten-yearly principal inspection requirement was withdrawn in 2004 (see para. 3.35(b)). However, in the CORs for 2004-05 to 2011-12, the HyD continued to report the extent of achievement of the targeted inspections (including principal inspections) as 100%. Upon Audit enquiries, the HyD said that principal inspections continued to be conducted for high-consequence structures (such as those in the Tsing Ma Control Area) before the end of their respective maintenance contract terms (a duration of five to six years). In Audit's view, there is a need to provide explanatory notes in the CORs for changes in the reporting basis of performance measures (such as the changed scope and frequency of principal inspections) to enable report users to have a proper understanding of the reported figures.

5.19 **Tunnels.** In 2003, the HyD laid down the requirement that principal inspections should be conducted for all government road tunnels when they reached 15 years after opening (see para. 3.23). However, the HyD did not report its extent of achievement of this target in the CORs for 2004-05 to 2011-12. To enhance public accountability and to tie in with the current reporting practice for other highway structures, the HyD needs to consider reporting in the COR its performance in conducting principal inspections of tunnels.

Audit recommendations

- 5.20 Audit has *recommended* that the Director of Highways should:
 - (a) review the way of reporting complaint statistics in the COR with a view to reflecting all aspects of the HyD's maintenance work;
 - (b) issue clear guidelines on compiling complaint statistics for the COR, including the criteria for differentiating complaints relating to maintenance of roads from others (see para. 5.15);
 - (c) include in the COR the five performance pledge targets concerning road cleanliness (as mentioned in paras. 5.16 and 5.17) and report the extent of their achievement;
 - (d) provide explanatory notes in the COR for changes in the reporting basis of performance measures in future; and
 - (e) consider reporting in the COR, the HyD's performance in conducting principal inspections of tunnels.

Response from the Administration

5.21 The **Director of Highways** agrees with the audit recommendations.

5.22 The Secretary for Financial Services and the Treasury has said that:

- (a) as the controlling officer, the Director of Highways would be responsible for revising the related performance targets and indicators in the COR in the light of the audit recommendations; and
- (b) the FSTB shall keep in view the HyD's follow-up with the recommendations as appropriate in preparing the Estimates (see para. 5.11) in future.

| Completed contract | Contract period | Actual expenditure (\$ million) |
|--------------------|----------------------|---------------------------------------|
| 1. Contract A | 1.4.2004 - 31.3.2008 | 467 |
| | (4 years) | |
| 2. Contract B | 1.4.2005 - 31.3.2009 | 459 |
| | (4 years) | |
| 3. Contract C | 1.4.2005 - 31.3.2009 | 708 |
| | (4 years) | |
| 4. Contract D | 1.4.2006 - 31.3.2011 | 354 |
| | (5 years) | |
| 5. Contract E | 1.4.2006 - 31.3.2010 | 424 |
| | (4 years) | |
| 6. Contract F | 1.4.2007 - 31.3.2011 | 435 |
| | (4 years) | |
| Ongoing contract | Contract period | Estimated expenditure (\$ million) |
| 7. Contract G | 1.4.2005 - 31.3.2013 | 410 |
| | (8 years) | |
| 8. Contract H | 1.4.2006 - 31.3.2012 | 430 |
| | (6 years) | |
| 9. Contract I | 1.4.2007 - 31.3.2012 | 310 |
| | (5 years) | |
| 10. Contract J | 1.4.2008 - 31.3.2016 | 720 |
| | (8 years) | |
| 11. Contract K | 1.4.2009 - 31.3.2014 | 450 |
| | (5 years) | |
| 12. Contract L | 1.4.2009 - 31.3.2015 | 580 |
| | (6 years) | |
| 13. Contract M | 1.4.2010 - 31.3.2014 | 270 |
| | (4 years) | |
| 14. Contract N | 1.4.2011 - 31.3.2017 | 840 |
| | (6 years) | |

Road maintenance contracts with M&M provisions (April 2011)

Source: HyD records

Appendix B

Acronyms and abbreviations

| Audit | Audit Commission |
|-------|--|
| COR | Controlling Officer's Report |
| CVI | Close Visual Inspection |
| EMMS | Electronic Maintenance Management System |
| FSTB | Financial Services and the Treasury Bureau |
| HyD | Highways Department |
| IOW | Inspector of Works |
| ISIS | Integrated Structure Information System |
| km | Kilometres |
| M&M | Management and maintenance |
| UBIP | Under-bridge inspection plant |
| VI | Visual Inspection |
| WSD | Water Supplies Department |