CHAPTER 10

CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

Provision of a bypass in Tuen Mun West

Audit Commission
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This audit review was carried out under a set of guidelines tabled in the Provisional Legislative Council by the Chairman of the Public Accounts Committee on 11 February 1998. The guidelines were agreed between the Public Accounts Committee and the Director of Audit and accepted by the Government of the Hong Kong Special Administrative Region.

Report No. 53 of the Director of Audit contains 11 Chapters which are available on our website at http://www.aud.gov.hk.

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PROVISION OF A BYPASS IN TUEN MUN WEST

Contents

PART 1: INTRODUCTION

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

Background

1.2 In the Port and Airport Development Strategy issued in 1989 (1989 Strategy), Tuen Mun Area 38 in Tuen Mun West (hereinafter referred to as TMA 38) was identified as a suitable site for a River Trade Terminal (RTT) and a special industries area (SIA — Note 1). In October 1990, the Civil Engineering and Development Department (CEDD — Note 2) completed a study of TMA 38 (1990 Study — Note 3). The 1990 Study supported the 1989 Strategy findings on the development of an RTT and an SIA in Tuen Mun West. The 1990 Study also reviewed the planning, engineering and environmental issues relating to the RTT and SIA developments.

1.3 In order to meet the traffic demand generated by the RTT and SIA developments in TMA 38, the 1990 Study recommended the construction of a new bypass connecting TMA 38 with Tuen Mun New Town, and the implementation of some road improvement works in Tuen Mun (Note 4).

Note 1: *The SIA would provide land for special industries which are capital intensive and land extensive, and may require additional attention to environmental effects, heavy consumption of water or direct access to port facilities.*

Note 2: *In July 2004, the CEDD was formed by merging the former Civil Engineering Department and the Territory Development Department. For simplicity, both the Civil Engineering Department and the Territory Development Department are referred to as the CEDD in this report.*

Note 3: *The 1990 Study (namely the Expanded Development Study of TMA 38) reviewed the need to improve the highway infrastructure to cope with the increased traffic on Lung Mun Road and Wong Chu Road subsequent to the RTT and SIA developments.*

Note 4: *The works included:*

(a) realigning and widening of the section of Lung Mun Road in TMA 38 from a two-lane single carriageway to a two-lane dual carriageway; and

(b) improvements of the Wong Chu Road/Lung Mun Road and Wong Chu Road/Tuen Mun Road interchanges.

1.4 In February 1998, the Finance Committee (FC) of the Legislative Council (LegCo) approved funding of $2,062 million for constructing a road (known as Lung Fu Road after completion — see Figure 1) along the foothills of Tsing Shan between TMA 38 and Wong Chu Road, and associated road improvement and noise mitigation works along Wong Chu Road. The Lung Fu Road project (hereinafter referred to as the LFR Project) comprised two contracts (Contracts A and B — see Table 1).

Figure 1

Road sections of two works contracts

Source: CEDD records

Table 1

Two works contracts

Contract	Works	Original contract sum ($ million)	Contract commencement	Substantial completion
A	Construction of northern section of Lung Fu Road from the junction of Wong Chu Road and Lung Mun Road to an area near Tuen Mun Golf Club, and improvement works of Wong Chu Road	598	9/1998	8/2002
B	Construction of southern section of Lung Fu Road connecting the northern section to an area near Butterfly Beach, and associated slope stabilisation works	457	1/1999	2/2002

Source: CEDD records

1.5 The project was carried out by the CEDD. The CEDD appointed an engineering consultant (the Consultant) as the project consultant and the Engineer for Contracts A and B. On 8 March 2002, after road works completion, Lung Fu Road was open to traffic.

Audit review

1.6 The Audit Commission (Audit) has recently conducted a review to examine the CEDD's management of the LFR Project. The review focused on the following areas:

(a) traffic planning and road utilisation (PART 2);

(b) project planning and control of approved project estimate (PART 3);

(c) provision of a roundabout at Junction A (PART 4);

(d) provision of noise enclosures (PART 5); and

(e) construction of Viaduct A (PART 6).

Audit has found areas where improvements can be made by the CEDD in administering road projects. Audit has made a number of recommendations to address the issues.

Acknowledgement

1.7 Audit would like to acknowledge with gratitude the full cooperation of the staff of the CEDD and the Transport Department (TD) during the course of the audit review.

PART 2: TRAFFIC PLANNING AND ROAD UTILISATION

2.1 This PART examines the traffic planning and utilisation of Lung Fu Road.

Design flow of Lung Fu Road

2.2 As mentioned in the funding paper submitted to the Public Works Subcommittee (PWSC) of the FC in February 1998:

(a) Lung Fu Road would accommodate 2,800 vehicles per hour in each direction; and

(b) the new road would divert traffic from Lung Mun Road, in particular that generated by heavy goods and container vehicles.

Utilisation of Lung Fu Road

2.3 In 1996, the CEDD employed a consultant to prepare a traffic-flow forecast for Lung Fu Road. According to the CEDD, the forecast assumed that heavy vehicles would account for 38% of the traffic volume of Lung Fu Road (Note 5). Table 2 shows the traffic-flow forecasts made by the CEDD and the actual traffic flows from 2004 to 2008.

Note 5: *According to the Report of Final Environmental Impact Assessment of January 1997, 38% of the road traffic was heavy vehicles.*

Table 2

Traffic flows of Lung Fu Road

Particulars	Number of vehicles per hour during peak period (Note 1)	
	Northbound	**Southbound**
Forecast traffic flow for 2006	1,390	1,790
Forecast traffic flow for 2011	1,470	1,810
Actual traffic flow (Note 2) for:		
2004	830	832
2005	834	832
2006	840	854
2007	860	862
2008	875	867

Source: *TD and CEDD records*

Note 1: *The proportions of heavy vehicles of the forecast and actual traffic flows were different (see para. 2.11(c)).*

Note 2: *Lung Fu Road was open to traffic in March 2002. The figures for 2002 and 2003 were not available.*

2.4 As stated in the Transport Planning and Design Manual (TPDM — Note 6) of the TD, the operating condition of a road is normally assessed by comparing its peak hourly traffic flow with the design hourly traffic flow. This is expressed as a volume-to-capacity (v/c) ratio (Note 7).

Note 6: *The TPDM provides guidance and information on the planning and design of transport infrastructure.*

Note 7: *A v/c ratio below 1.0 indicates that the road is operating within the design capacity. A v/c ratio above 1.0 indicates a mild to serious degree of congestion. When a v/c ratio reaches 1.2, traffic congestion will become obvious.*

2.5 In June 2009, the TD informed Audit that the design traffic capacity of Lung Fu Road as stated in the funding paper (i.e. 2,800 vehicles per hour in each direction — see para. 2.2(a)) could not be used directly to determine the v/c ratio. This was because about 78% and 83% of vehicles travelling in the morning and evening peak hours respectively comprised heavy goods vehicles, while the design traffic capacity of 2,800 vehicles per hour assumed that only 15% of traffic was heavy goods vehicles.

2.6 According to the TD, based on the actual percentages of 78% and 83% of heavy vehicles, the design traffic capacity of 2,800 vehicles per hour **should be reduced by 50% to 1,400 vehicles per hour for 2009 (see Appendix A),** and the actual v/c ratios in 2006 should be 0.6 and 0.61 for the northbound and southbound traffic respectively. The ratios indicated that Lung Fu Road was operating under an "easy flow" condition.

2.7 In September 2009, the CEDD informed Audit that:

(a) if the design of Lung Fu Road was revised from a dual two-lane road to a single two-lane road, given the high percentages of heavy vehicles, the design traffic capacity would be reduced to only about 600 vehicles per hour in each direction. This would be less than the current peak traffic flow of about 870 vehicles per hour; and

(b) although the v/c ratios indicated that Lung Fu Road was operating under an "easy flow" condition, the existing traffic condition fully justified the need for the dual two-lane road.

Traffic assessment for Tuen Mun Area 38 development

2.8 Since 1996, there had been changes to the TMA 38 development. In 1997, the Government planned to take forward the SIA development in the form of a Fourth Industrial Estate (see para. 3.2(d)). However, at the time of the funding submission to the FC for the LFR Project in February 1998, the development of the Fourth Industrial Estate had not yet been finalised. As it transpired, in 2001, it was decided not to develop the Fourth Industrial Estate in TMA 38 (see para. 3.3).

2.9 According to an information note submitted to the LegCo Panel on Transport in September 1996 on the traffic impact and improvements related to the TMA 38 development, the SIA and the RTT would respectively generate 5,000 and 3,000 goods vehicle trips each direction per day. The forecast traffic flow of Lung Fu Road was based on the forecast prepared in 1996 (see para. 2.3). In the event that the SIA development could not be implemented, the forecast traffic flow (including the proportion of heavy vehicles) might be different, dependent on the eventual land use.

Audit observations and recommendations

Traffic forecast of Lung Fu Road

2.10 As shown in Table 2 in paragraph 2.3, in 2006, the actual peak flows of 840 vehicles per hour (northbound) and 854 vehicles per hour (southbound) only accounted for 60% and 48% of the forecast traffic flows (expressed in number of vehicles) respectively. Audit notes that the variance may be attributable to changes in parameters on traffic projection (see para. 2.11).

2.11 In June and September 2009, in response to Audit's enquiry on the variances between forecast and actual traffic flows of Lung Fu Road, the CEDD and the TD informed Audit that:

CEDD

(a) the funding submission for the LFR Project was prepared on the basis that the first lot of the Fourth Industrial Estate (for SIA development) would be developed at TMA 38 in 2001 as set out in the Policy Addresses of 1997 and 1998;

(b) at the time of planning Lung Fu Road, the development of the Fourth Industrial Estate was quite certain. It was not envisaged that the planned SIA development might not be eventually implemented;

(c) the proportion of heavy vehicles actually using Lung Fu Road (about 80%) was higher than the original forecast of 38% (see para. 2.3). The forecast traffic flow during peak hours for 2006 assumed that about 38% of traffic was heavy vehicles. However, for the actual traffic flow during peak hours in 2006, about 80% of traffic was heavy vehicles due to a change in land use in TMA 38;

(d) it would be more appropriate to compare the forecast and actual traffic flows in 2006 in terms of passenger car units (PCU — Note 8). If expressed in PCU, the actual traffic flows would account for 89% (northbound) and 70% (southbound) of the forecast traffic flows (see Appendix B);

TD

(e) there had been changes in the planning assumptions and scenarios for the developments in TMA 38. The traffic projections for these developments were subject to uncertain parameters, including the scale, timing, intensity and type of the developments, which could not be defined with full confidence at the project planning stage;

(f) the traffic forecasts made in the early 1990s, and subsequently updated in 1996, were based on the information available at that time on population, employment, forecasts of Gross Domestic Product growth, vehicle growth, and port cargo forecasts. The information might be subject to change over time. As traffic was sensitive to changes in development, economy and circumstantial factors, variance between forecast and actual flows was common and normal; and

(g) the types of vehicles generated by a development depended mainly on its land use. The current land use of TMA 38 was different from that of the original assumption when the traffic forecast was prepared in 1996. The difference in the proportion of heavy vehicles between the forecast and actual traffic (see sub-para. (c) above) was likely due to the change in land use.

2.12 **Audit considers that in planning road projects in future, the CEDD needs to consider different possible design scenarios to cater for the likely changes to planned development, which may lead to different forecasts on the proportion of heavy vehicles using the road.**

Note 8: *"PCU" is a unit of measuring traffic flow in an equivalent number of private cars. Other vehicles are converted to the same unit by a factor that depends on the types of vehicles and the road conditions. For example, a heavy vehicle has a PCU of 3 at hilly terrain taking into account the fact that it would occupy more road space and travel at a lower speed than a private car.*

Need to take into account proportion of heavy vehicles in determining design traffic capacity

2.13 According to the TPDM, the design traffic capacity of a road should be reduced if the proportion of heavy vehicles exceeds 15%. In this connection, Audit notes that the design traffic capacity (expressed in number of vehicles) would decrease if there is an increase in the proportion of heavy vehicles using the road. Assuming that 38% of the traffic volume of Lung Fu Road was heavy vehicles, its design traffic capacity should be reduced to 2,045 vehicles per hour (see Appendix A). However, the CEDD had not adjusted the design traffic capacity in the PWSC paper of February 1998 (see para. 2.2(a)) in accordance with the TPDM. **Audit considers that, in future road projects, the CEDD needs to take due account of the usage by heavy vehicles in reporting to LegCo on the estimation of design traffic capacity of a road.**

Need to express road traffic capacity in PCU

2.14 The design traffic capacity of Lung Fu Road is 2,800 vehicles per hour in each direction, on the assumption that not exceeding 15% of traffic is heavy vehicles. According to the TD, assuming that all traffic using Lung Fu Road is **private cars**, its design traffic capacity would be **3,600 vehicles per hour** (or 3,600 PCU per hour). However, if all road traffic is heavy vehicles, its design traffic capacity would be reduced to **1,200 vehicles per hour.** As shown in Appendix A, the design traffic capacity of a road would, if expressed in vehicle units, vary with the proportion of heavy vehicle usage. For roads with a high percentage of forecast heavy vehicle volume (such as Lung Fu Road), the TPDM suggests using the PCU for estimating traffic flow. **In Audit's view, for roads with a high percentage of heavy vehicles, the CEDD needs to consider expressing the road traffic capacity in terms of PCU (in addition to vehicle units) in funding submissions to LegCo.**

Audit recommendations

2.15 **Audit has *recommended* that, in planning road projects in future, the Director of Civil Engineering and Development should, in collaboration with the Commissioner for Transport:**

(a) **consider different possible design scenarios for planned development to cater for likely changes, which may lead to different forecasts on the proportion of heavy vehicles using the road (see para. 2.12);**

(b) **take due account of usage by heavy vehicles in reporting to LegCo on the estimation of design traffic capacity of a road (see para. 2.13); and**

(c) **for roads with a high percentage of usage by heavy vehicles, consider expressing the traffic capacity in terms of PCU, in addition to vehicle units, in funding submissions to LegCo (see para. 2.14).**

Response from the Administration

2.16 The **Director of Civil Engineering and Development** agrees with the audit recommendations. He has said that if there are likely changes to planned developments, different possible design scenarios should be considered, and each case has to be considered on its own merits.

2.17 The **Commissioner for Transport** has said that the TD will continue to liaise closely with the works departments and their consultants to improve traffic forecasting and analysis in road project planning.

PART 3: PROJECT PLANNING AND CONTROL OF APPROVED PROJECT ESTIMATE

3.1 This PART examines the funding application for the LFR Project and control of the approved project estimate with a view to identifying room for improvement.

Funding for Lung Fu Road Project

3.2 On 17 February 1998, in a paper submitted to the PWSC of the FC to seek funding for the LFR Project, the Administration said that:

(a) **the existing Lung Mun Road connecting Tuen Mun Town Centre and Tuen Mun West did not have adequate capacity to cope with the anticipated increase in traffic generated from the proposed developments of the RTT and the SIA in TMA 38;**

(b) the interchanges at Lung Mun Road/Wong Chu Road and Wong Chu Road/Tuen Mun Road, which were the main road access to and from TMA 38, were either operating at full capacity at that time or would reach their full capacity in 2001;

(c) **if the road network in Tuen Mun area was not improved, the additional traffic generated from TMA 38, when the RTT and the SIA started to operate in 2000 and 2001 respectively, would seriously overload Lung Mun Road and Wong Chu Road.** The traffic noise along these roads would also reach unacceptable levels; and

(d) the developer of the RTT (involving about 56 hectares of land) planned to complete the terminal in phases between 1998 and 2000. The then Hong Kong Industrial Estates Corporation (HKIEC — Note 9) planned to dispose of the first lot of the Fourth Industrial Estate (Note 10) for special industries development (involving about 55 hectares of land) by end 2001 or early 2002.

Note 9: *In 2001, the Hong Kong Science and Technology Parks Corporation was formed by merging the HKIEC with the Hong Kong Science Park and the Hong Kong Industrial Technology Centre Corporation.*

Note 10: *The first three industrial estates are known as Tai Po, Yuen Long and Tseung Kwan O Industrial Estates.*

3.3 In February 1998, the FC approved funding of $2,062 million for the LFR Project. In late 1999, the RTT commenced operation. In 2001, the Hong Kong Science and Technology Parks Corporation (see Note 9) and the Government agreed not to proceed with the development of the Fourth Industrial Estate in TMA 38. Thereafter, the area earmarked for special industries development was allocated for the development of:

(a) a permanent aviation fuel facility;

(b) an EcoPark; and

(c) a temporary public fill bank (Note 11).

Photograph 1 shows the developments in TMA 38 as at January 2008.

Photograph 1

Development in TMA 38
(January 2008)

Source: Environmental Protection Department records

Note 11: *A public fill bank is used to store fill materials from construction, excavation, renovation, demolition and road works for reuse in subsequent reclamation and site formation projects.*

Audit observations and recommendations

Need to provide full and relevant information in funding applications to FC

3.4 Audit examination of the funding submission to the PWSC of the FC in February 1998 for the LFR Project (see para. 3.2) revealed that the following information was not provided:

(a) the progress of development of TMA 38 (see paras. 3.5 to 3.7);

(b) the traffic-flow forecast of Lung Fu Road (see para. 3.8); and

(c) the benefits of slope stabilisation works (see paras. 3.9 and 3.10).

3.5 ***SIA of TMA 38.*** The development of the SIA in TMA 38 involved land reclamation of 61 hectares by two stages. In June 1995, the FC approved the funding for the Stage 1 reclamation (which commenced in September 1995 and was completed in January 2000). In January 1997, the Administration submitted a funding application to the PWSC for the Stage 2 reclamation. At the PWSC meeting, there were questions about the demand for special industries, and a request for an updated assessment on the demand for the SIA was made. **The Administration withdrew the funding application in order to carry out a review of the demand for special industries (Note 12).**

3.6 Audit noted that the funding submission for the LFR Project did not mention the withdrawal of funding application for the Stage 2 reclamation in connection with the development of SIA. In July and September 2009, in response to Audit's enquiry, the CEDD said that:

(a) the withdrawal of the funding application for the Stage 2 reclamation was overtaken by event in the light of the planned development of the Fourth Industrial Estate. The 1997 and 1998 Policy Addresses confirmed the plan and programme of the Fourth Industrial Estate (Note 13);

Note 12: *In June 2000, the FC approved the Stage 2 reclamation to provide a public filling area for the disposal of public fill. The reclamation works commenced in November 2000 and were completed in October 2004.*

Note 13: *In 2001, the Hong Kong Science and Technology Parks Corporation decided not to proceed with the development of the Fourth Industrial Estate.*

(b) at the time of the funding application for the LFR Project in February 1998, the development of the Fourth Industrial Estate was quite certain. The CEDD had planned the road based on the latest information;

(c) the LFR Project did not solely depend on the SIA development. Provision of Lung Fu Road would also meet the growing traffic demand resulting from the future development in Tuen Mun West;

(d) in view of the potential development in Tuen Mun West, the additional traffic would add further load to the already congested Lung Mun Road. The subsequent changes in the development in TMA 38 would not change the scope of the LFR Project because a dual two-lane road would be required to meet development in Tuen Mun West, other than TMA 38; and

(e) the capacity of the existing Lung Mun Road between Butterfly Beach and Wong Chu Road was constrained by the signalised road junctions. The at-grade road junctions along Lung Mun Road and the slip roads at Tuen Mun Road and Wong Chu Road would be overloaded by the additional traffic generated from the TMA 38 development by 2001. Any further development in Tuen Mun West would aggravate the traffic congestion problems unless the improvement schemes were implemented.

3.7 **In Audit's view, it is important to provide information in the LFR Project funding submission on the progress of the SIA development, and on an assessment of its impact on the LFR Project.** This is because one of the main justifications for constructing Lung Fu Road, as set out in the PWSC paper (see para. 3.2(a) and (c)), was to meet the additional traffic generated by the SIA development.

3.8 ***Traffic-flow forecast of Lung Fu Road.*** Audit noted that the traffic-flow forecast information prepared by the consultant in 1996 (see para. 2.3) was not included in the funding application to the FC. **Audit considers that the provision of this information to the FC would be useful as this would form one of the bases for evaluating the effectiveness of the road after its opening.**

3.9 ***Benefits of slope stabilisation works.*** On 10 February 1998, in a briefing paper submitted to the then LegCo Panel on Planning, Lands and Works, the then Planning, Environment and Lands Bureau (Note 14) informed the Panel about the LFR Project. The Bureau said that:

(a) ancillary to the construction of Lung Fu Road, opportunity was taken to stabilise a large existing cut slope in Area 19 (see Figure 1 in para. 1.4) which had a long history of instability for over 20 years; and

(b) the stabilisation of the slope would not only ensure the safety of Lung Fu Road, but would also allow the land nearby to be re-planned for permanent uses.

3.10 **As the slope stabilisation works would help improve the safety of Lung Fu Road and planning of the nearby areas, Audit considers that there were merits to include the benefits of the slope stabilisation works in the funding submission.**

3.11 In August 2008, the Financial Services and the Treasury Bureau (FSTB) issued Financial Circular No. 3/2008 which promulgated guidelines for preparing PWSC/FC papers. **The circular states that PWSC papers should provide all relevant information pertinent to the subject at hand. Audit considers that the Development Bureau should remind works departments to provide full and relevant information in future submissions to the PWSC/FC, in accordance with the guidelines set out in the circular.**

Functions of Lung Fu Road

3.12 ***Current land use of TMA 38.*** In TMA 38, 61 hectares of land were reclaimed for special industries purposes (the original size was 55 hectares — see para. 3.2(d)). Audit noted that, as at June 2009, of the 61 hectares of reclaimed land, 27 hectares (44%) were allocated for developing the EcoPark and the permanent aviation fuel facility. The remaining 34 hectares (56%) were allocated to the CEDD for use as a temporary public fill bank.

3.13 At present, Lung Fu Road is operating well within the design capacity. However, Audit notes that there were substantial changes in the development of TMA 38 since the commissioning of Lung Fu Road (see para. 3.12). The future development in

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Note 14: *In 1998, the Planning, Environment and Lands Bureau was responsible for the policy on land development matters. After several re-organisations of the Government Secretariat over the years, in July 2007, the Development Bureau was formed to take up, among others, the policy on land development matters.*

Tuen Mun West, including the development of the EcoPark, might generate additional traffic for Lung Fu Road. In June and July 2009, the TD and the CEDD informed Audit that:

TD

(a) Lung Fu Road had served the functions as planned. It helped segregate traffic (especially heavy goods vehicles) from Lung Mun Road to Lung Fu Road. The pertinent section of Lung Mun Road served the residential development while Lung Fu Road provided a through traffic route for the RTT in TMA 38 and Tuen Mun West;

(b) the road improved the current performance of critical junctions of Lung Mun Road. The reserve capacity of the critical junctions had increased with the commissioning of Lung Fu Road. It also helped divert heavy vehicles away from Lung Mun Road and reduce the traffic noise level, thereby mitigating the nuisance caused to the residential developments near Lung Mun Road (see para. 3.2(c)); and

CEDD

(c) the CEDD would monitor and review the development programme of Tuen Mun West and the TD would monitor the use of completed roads. If there were changes to the development of Tuen Mun West, the CEDD would work closely with the TD to examine if improvement measures to the road system would be put forward.

3.14 **Audit considers that the CEDD, in collaboration with the TD, needs to keep in view the development of Tuen Mun West and continue to monitor the traffic conditions of Lung Fu Road.**

Audit recommendations

3.15 **Audit has *recommended* that the Secretary for Development should remind works departments to provide the PWSC/FC with full and relevant information in funding applications for road projects in future (e.g. progress of development in related areas, traffic-flow forecasts and benefits of slope stabilisation works — see paras. 3.7, 3.8 and 3.10), in accordance with the guidelines set out in Financial Circular No. 3/2008 (see para. 3.11).**

3.16 **Audit has *recommended* that the Director of Civil Engineering and Development should, in collaboration with the Commissioner for Transport, keep in view the development of Tuen Mun West and continue to monitor the traffic conditions of Lung Fu Road (see para. 3.14).**

Response from the Administration

3.17 The **Secretary for Development** agrees with the audit recommendation in paragraph 3.15. She has said that the Development Bureau will write to works departments to remind them to provide the PWSC/FC with full and relevant information in funding applications for road projects in future.

3.18 The **Director of Civil Engineering and Development** agrees with the audit recommendation in paragraph 3.16. He has said that the CEDD, in collaboration with the TD, will continue to keep in view the development of Tuen Mun West and monitor the traffic conditions of Lung Fu Road.

3.19 The **Commissioner for Transport** has said that the TD will continue to monitor the development of Tuen Mun West and the traffic conditions of Lung Fu Road.

Approved project estimate

3.20 For a works project, upon the approval of funding by the FC, the responsible department could commence the works and incur expenditure up to the approved project estimate (APE). The APE would usually comprise estimates of:

(a) the contract price;

(b) consultancy fees; and

(c) a reserve for contingencies.

Expenditure exceeding the APE by more than $15 million would require the approval of the FC (Note 15).

Note 15: *Expenditure exceeding the APE by not more than $15 million may be approved by the Secretary for Financial Services and the Treasury under delegated authority from the FC.*

3.21 In August 1990, the Administration issued Financial Circular No. 8/1990 on the Public Works Programme. The Circular set out procedures on the amendment of the APE, as follows:

(a) where the APE of a project in Category A (i.e. a project which is ready in all respects for tenders to be invited and for construction works to proceed, and has been granted an APE by the FC) required amendment (without a change in scope), a submission should be made in the form of a PWSC paper by the works department to the Secretary, PWSC, copied to the then Works Bureau (Note 16); and

(b) a detailed analysis of the change required, a cost comparison, and an indication of any exceptional urgency (such as outstanding tenders) must be given in the PWSC paper.

3.22 In February 1993, the FSTB (the then Finance Bureau) issued a memorandum setting out the simplified procedures whereby relevant departments could make a request for reduction in the APE by memorandum to the Secretary for Financial Services and the Treasury (the then Secretary for the Treasury) if there was no change in the scope of a project.

3.23 In March 1996, in an information paper submitted to the FC, the Administration said that:

> *"where the tender sum is below the estimate approved by the Finance Committee, we will consider reducing the approved estimate to reflect the lower forecast outturn price".*

3.24 In January 2000, the then Secretary for Works expressed concern about the persistent over-estimation of the APEs in works projects against the contracts awarded and the magnitude of the over-estimation. The then Works Bureau requested the works departments:

Note 16: *In July 2002, the responsibility of the then Works Bureau was taken up by the then Environment, Transport and Works Bureau. After re-organisation of the Government Secretariat in July 2007, the Development Bureau was formed to take up, among others, the works policy portfolio of the Environment, Transport and Works Bureau.*

(a) **to take measures to improve the accuracy of project estimates before preparing the PWSC papers for funding approval; and**

(b) **to suitably adjust the APE and the cashflow projections of a project, if necessary, when the tender price was much lower than the approved estimate.**

3.25 In 2002, the FSTB promulgated the administrative procedures for imposing a project expenditure ceiling. For a works project the contract prices of which were substantially lower than the estimates, in order not to withhold resources unnecessarily, the FSTB would impose expenditure ceilings lower than the APE. The works department could not incur project expenditure exceeding the ceilings without the FSTB's approval.

3.26 In Chapter 3 of the Director of Audit's Report No. 42 of March 2004, Audit reported on the need to improve the accuracy of the APE for works projects of the Drainage Services Department. **After considering the Director of Audit's Report No. 42, the Public Accounts Committee (PAC) of LegCo, in its Report No. 42 of June 2004, commented that the heads of works departments were given too much discretionary power to decide whether or not to adjust the APE even when the accepted tender price was much lower than the estimated contract sum in the APE, especially when the APE might be used to cover huge sums of highly uncertain dispute settlements and contract variations. The PAC recommended that, in order to ensure LegCo's effective monitoring of the use of funding for works projects, works departments should inform LegCo, with full justifications provided, under the following circumstances:**

(a) **when the difference between the accepted tender price and the estimated contract sum in the APE was $15 million or more; and**

(b) **when the expenditure relating to a dispute settlement under a works contract amounted to $15 million or more.**

3.27 Subsequent to the PAC's recommendations, in December 2004 and August 2006, two guidelines were issued on controlling the APE, namely Financial Circular No. 11/2004 "Capital Works Programme" (superseding Financial Circular No. 8/1990 — see para. 3.21) and Environment, Transport and Works Bureau Technical Circular (Works) No. 4/2006 "Delivery of Capital Works Projects". As stated in the two circulars, works departments are required to:

(a) ascertain, after contract award, the reasons for any substantial deviations between the accepted tender price and estimated provision allowed for in the APE;

(b) submit returns to the Development Bureau on the reasons for substantial deviations (equal to or exceeding $15 million or 10% of the estimated provision in the APE, whichever is the greater) for reporting to LegCo for information; and

(c) **apply to the FSTB to reduce the APE when the tender price is significantly lower than the estimated contract sum allowed for in the APE, or document the reasons for not applying for a reduction in the APE.**

Audit observations and recommendations

Need to improve the accuracy of project estimates in funding submission

3.28 The contract prices of Contracts A and B were substantially lower than the estimates included in the APE. Table 3 shows the over-estimation of the contract sum in the APE.

Table 3

Prices of Contracts A and B

	Estimated contract price in APE	**Awarded contract price**	**Over-estimation of contract sum in APE**	
	(a)	**(b)**	**(c) = (a)–(b)**	**(d) = $\frac{(c)}{(a)} \times 100\%$**
	($ million)	**($ million)**	**($ million)**	**(%)**
Contract A	900	598	**302**	**34%**
Contract B	630	457	**173**	**27%**
Overall	1,530	1,055	**475**	**31%**

Source: Audit analysis of CEDD records

3.29 Table 3 shows that the over-estimation of the contract sums amounted to a total of $475 million or 31% of the estimated contract prices. This was a substantial amount in relation to the contract values of the two contracts ($598 million for Contract A and $457 million for Contract B). It is also relevant to note that, at the PAC meeting held in May 2004, the Administration said that:

(a) in 2003, the differences between the estimated contract sums and the accepted tender prices were in the range of 10% to 15% on average; and

(b) as it was not always possible to have very accurate project estimates and in view of inherent uncertainties in works projects, the 10% to 15% difference was considered to be reasonable in serving as a buffer for works departments to cope with unforeseen circumstances.

Audit considers that the CEDD needs to improve the accuracy of the estimated contract sums included in the APE.

Need to consider reducing the APE

3.30 During the period from 1999 to 2007, the CEDD submitted annual returns on the forecast expenditure of the LFR Project to the FSTB. Between 2002 and 2007, in view of the low forecast expenditure vis-à-vis the APE, the FSTB imposed expenditure ceilings on the project. Details are shown in Table 4.

Table 4

Expenditure of LFR Project

	1999 ($ M)	2000 ($ M)	2001 ($ M)	2002 ($ M)	2003 ($ M)	2004 ($ M)	2005 ($ M)	2006 ($ M)	2007 ($ M)
APE	2,062	2,062	2,062	2,062	2,062	2,062	2,062	2,062	2,062
Forecast project expenditure	1,438	1,455	1,144	1,147	1,150	1,150	1,134	1,091	1,089
Expenditure ceiling imposed by FSTB	— (Note)	— (Note)	— (Note)	1,147	1,147	1,147	1,147	1,139	1,091

Source: CEDD records

Note: The administrative procedures for imposing a project expenditure ceiling have been adopted by the FSTB since 2002 (see para. 3.25).

3.31 In February 2009, in the annual report submitted to the FC on the expenditure of capital works projects completed in the previous financial year (Note 17), the Administration said that the final expenditure of the LFR Project was $1,088 million (Note 18), representing 53% of the APE (Note 19). The expenditure was much lower than the APE, which was mainly due to the fact that the awarded contract prices of Contracts A and B were substantially lower than the estimated ones (see Table 3 in para. 3.28). However, no action had been taken to reduce the APE to reflect the lower prices of awarded contracts (see paras. 3.21 to 3.24). **Audit considers that the CEDD needs to comply with the requirements of reducing the APE of works projects in future.**

Note 17: *Since 1998-99, the Administration has undertaken to provide the FC with annual reports on the actual expenditure vis-à-vis the APE of projects with accounts finalised in the previous year. The report included a ratio of expenditure to the original/revised APE for individual project as a performance indicator.*

Note 18: *The expenditure of $1,088 million comprised Contract A cost of $600 million, Contract B cost of $357 million, and consultants' fees and miscellaneous costs of $131 million.*

Note 19: *The ratio of expenditure to the original or revised APE for the LFR Project was lower than the average of 80% for the 118 capital projects completed in 2007-08.*

3.32 In September 2009, the CEDD informed Audit that:

(a) the contract prices were not substantially lower than the estimates (Note 20). There should be an allowance for possible expenditure arising from contractual claims, particularly for under-priced tenders (Note 21);

(b) in order to make provision for the possible expenditure arising from contractual claims which might be substantial, it was not unreasonable to decide not to reduce the APE;

(c) the fact that the final expenditure was lower than the APE was partly because of the saving accruing from contract price fluctuations due to the unexpected downturn of the economy in the late 1990s and the early 2000s; and

(d) the two guidelines mentioned in paragraph 3.27 were issued in 2004 and 2006 after the award of Contracts A and B in 1998 and 1999 respectively.

3.33 **In Audit's view, in deciding whether or not to apply for a reduction of the APE for works projects in future, reference should be made to the comments made by the PAC in its Report No. 42 of June 2004 (see para. 3.26).**

Audit recommendations

3.34 **Audit has *recommended* that, in works projects in future, the Director of Civil Engineering and Development should:**

(a) **improve the accuracy of the project estimates provided in the funding submission to the FC (see para. 3.29); and**

(b) **take action in accordance with Financial Circular No. 11/2004 and Environment, Transport and Works Bureau Technical Circular (Works) No. 4/2006 if the awarded contract prices are significantly lower than the estimated ones included in the APE (see para. 3.31).**

Note 20: *In the light of the comments made by the Administration at the PAC meeting held in May 2004 (see para. 3.29), Audit considers that the over-estimation of contract sum in the APE by 31% or $475 million was substantial.*

Note 21: *The original contract sum of the two contracts was $1,055 million in total whereas the final contract sum was $957 million in total.*

Response from the Administration

3.35 The **Director of Civil Engineering and Development** agrees with the audit recommendations. He has said that:

(a) the CEDD will continue to improve the accuracy of the project estimates; and

(b) it is not always possible to have very accurate project estimates, particularly at the time of unstable market conditions in the late 1990s when estimates were prepared for Contracts A and B.

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

(a) while Financial Circular No. 8/1990 and the memorandum issued in 1993 (see paras. 3.21 and 3.22) did not specifically require the works departments to apply for a reduction in the APE when the awarded contract sum of a contract under a works project was lower than expected, as a general financial management and control principle, works departments should review the project estimates in the light of actual progress and put forward realistic estimates so as to avoid locking up valuable resources. Under this principle, works departments are expected to decide when the APE of a project should be reduced taking into account all relevant considerations, including the outturn tender price; and

(b) the FSTB presumes that the non-application for a reduction in the APE after the award of Contracts A and B in 1998 and 1999 was an informed decision by the CEDD that a reduction was considered not suitable, after taking into account the requirements and procedures in Financial Circular No. 8/1990 and the 1993 memorandum.

PART 4: PROVISION OF A ROUNDABOUT AT JUNCTION A

4.1 This PART examines the CEDD's provision of a roundabout at the junction of Lung Fu Road and Lung Mun Road (Junction A — see Figure 1 in para. 1.4) and the subsequent conversion of the roundabout into a signalised junction.

Construction of a roundabout at Junction A

4.2 After the opening of Lung Fu Road, the vehicular traffic from Lung Fu Road and Lung Mun Road would meet at Junction A. There are two main types of road junctions, namely a roundabout junction and a signalised junction. According to the TPDM (see Note 6 to para. 2.4), in choosing an appropriate type of road junction, the departments concerned need to consider the following factors:

(a) a roundabout junction would cause little traffic delays whereas a signalised junction would lead to unnecessary traffic delays;

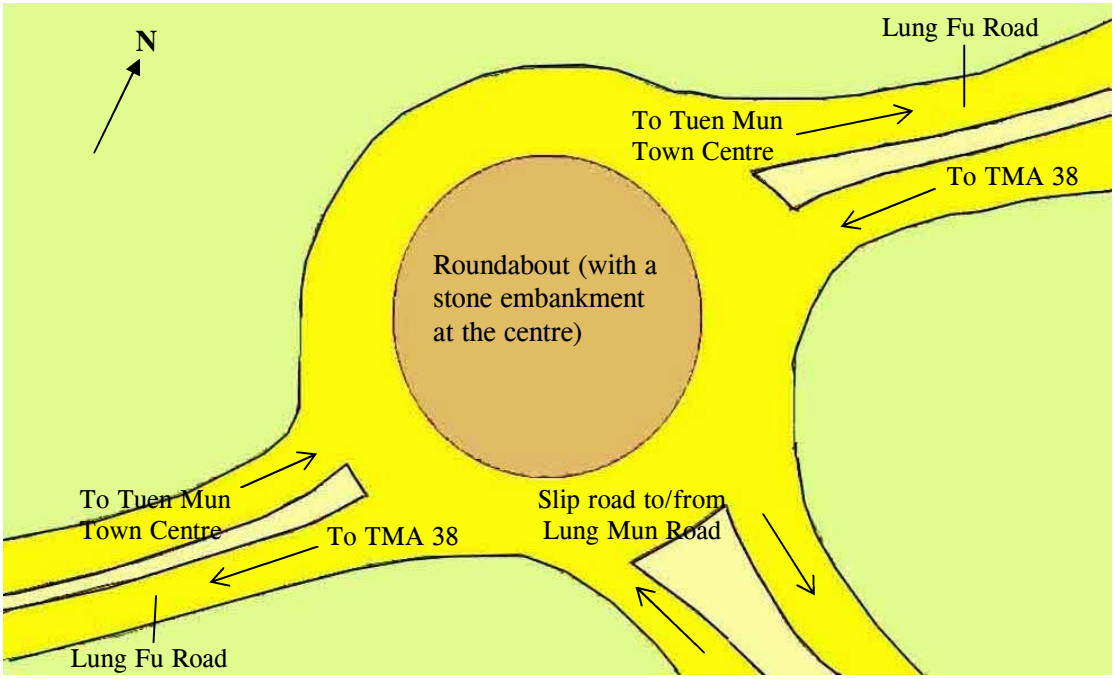
(b) generally a roundabout junction is the safest form of an at-grade junction over a range of traffic flows and speeds; and

(c) a roundabout junction requires more land.

4.3 In October and November 1996, the CEDD consulted the Highways Department (HyD — see Note 25 to para. 5.6), the TD, the Planning Department, the Lands Department, the Hong Kong Police Force (HKPF) and the Tuen Mun District Office of the Home Affairs Department on the design of Junction A. **During the consultation, the CEDD agreed with the departments concerned that a roundabout with a diameter of 40 metres should be provided at Junction A.** Subsequently, the roundabout, with a stone embankment at the centre, was constructed under Contract B (see Figure 2 and Photograph 2).

Figure 2

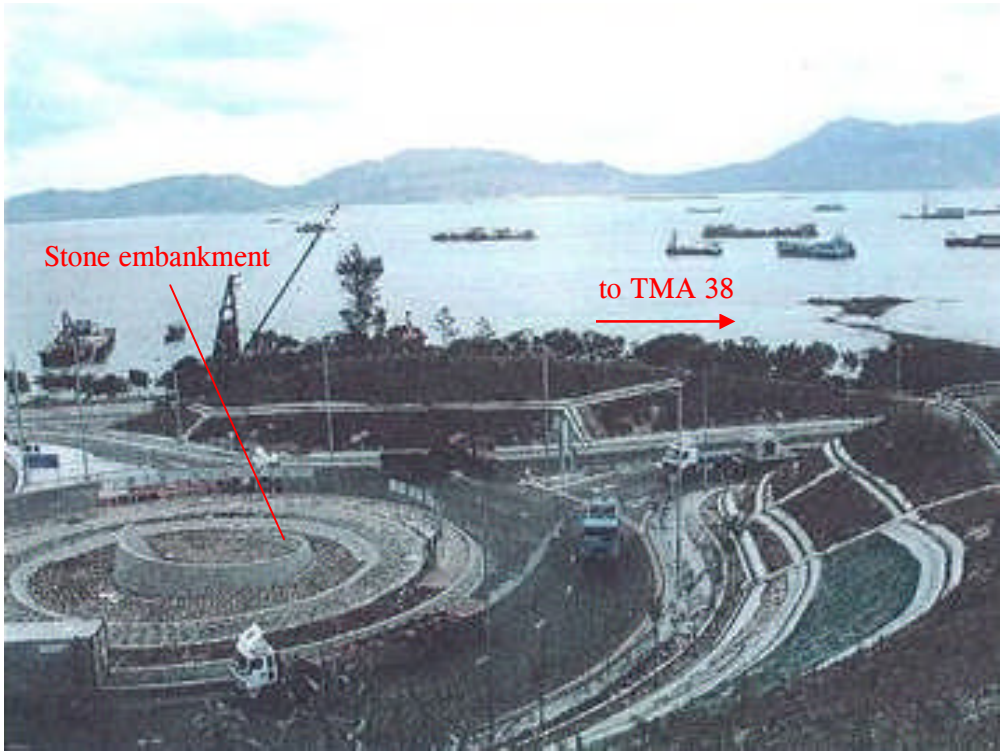
Roundabout at Junction A



Source: CEDD records

Photograph 2

Roundabout at Junction A
(April 2002)



Source: CEDD records

Public complaint

4.4 Lung Fu Road was open to traffic on 8 March 2002. On 13 March 2002, a member of the public lodged a complaint with the TD, saying that:

(a) drivers might drive at a speed exceeding the speed limit (Note 22) as Lung Fu Road was wide and straight; and

(b) for vehicles going towards the TMA 38 direction, the drivers might not see the roundabout at Junction A unless adequate notices were provided.

Note 22: *The speed limit of most parts of Lung Fu Road is 70 kilometres per hour (km/hr). For parts of the road approaching the roundabout, the speed limit was 50 km/hr.*

Improvement measures after road opening

4.5 On 7 April 2002, a serious traffic accident involving a private car causing the death of three persons occurred at Junction A. According to the traffic accident investigation reports of the HKPF and the TD, the car crashed into the stone embankment of the roundabout, flipping over and bursting into flames. The TD's investigation found that the design of the roundabout at Junction A generally complied with the guidelines of the TPDM. In order to further enhance road safety at the roundabout, the TD recommended implementation of the following traffic improvement measures:

(a) erecting additional chevron signs at the central island of the roundabout facing the approach roads;

(b) painting "Give Way" markings on the roads approaching the roundabout;

(c) relocating the warning signs "Roundabout Ahead/Reduce Speed Now" to maintain a distance between the warning signs and the advance directional sign on the roads; and

(d) relocating the advance directional sign on northbound Lung Fu Road to enhance its visibility.

4.6 On 23 April 2002, the CEDD informed the TD that:

(a) the design of the traffic aids for the roundabout at Junction A was in compliance with the guidelines of the TPDM;

(b) there was no evidence that the design needed to be changed to enhance road safety at the roundabout; and

(c) since the roundabout had just been open to traffic, the CEDD would observe the performance of the roundabout and review the need for any design modification at a later date.

4.7 On 28 April 2002, another serious traffic accident causing the death of a person occurred at Junction A. Similar to the accident on 7 April 2002 (see para. 4.5), a car ran into the stone embankment of the roundabout at Junction A.

4.8 In May 2002, the TD requested the HyD to carry out (through its term contractor) the following improvement works (which were completed at a cost of $0.6 million) at Junction A:

(a) erecting permanent roundabout warning signs with distance indicators at advance locations of the approaching roads to alert drivers of the presence of a roundabout ahead;

(b) extending the turn left/chevron signs at the central island of the roundabout;

(c) extending the 50-km/hr speed-limit zone of the roads approaching the roundabout from 70 metres to 140 metres (the speed limits of most parts of Lung Mun Road and Lung Fu Road were 70 km/hr);

(d) relocating the roundabout warning signs and directional signs along the roads at a further distance from the roundabout;

(e) painting additional yellow transverse-bar markings on the roads; and

(f) widening the width of chevron signs on the roads to 800 millimetres.

4.9 In the same month, the departments concerned had the following views on the roundabout:

(a) the CEDD recommended the replacement of the hard landscape (i.e. the stone embankment) at the centre of the roundabout with a soft landscaping arrester bed (Note 23) to slow down vehicles running into the centre of the roundabout;

(b) the TD proposed the provision of an arrester bed at the centre of the roundabout to further enhance road safety at Junction A; and

(c) **the HKPF said that there might be a visibility problem. Drivers had to rely on warning signs as Junction A was at the brow of a hill and the roundabout was invisible to drivers until their vehicles were at a close distance from it.**

Note 23: *An arrester bed is an area adjacent to a road filled with special materials to slow down and stop errant vehicles.*

4.10 In July 2002, the CEDD and the HyD noted that the site condition restricted the provision of an arrester bed with a sufficient size to effectively stop vehicles running into the centre of the roundabout. In August 2002, with a view to reducing the impact on vehicles during traffic accidents at the roundabout, at the request of the TD, the HyD (through its term contractor) carried out works to remove the stone embankment at the centre.

4.11 In August 2002, the representatives of the TD, the HyD, the HKPF and the CEDD agreed at a meeting that:

(a) the site condition restricted the provision of an arrester bed with a sufficient size to effectively stop vehicles travelling faster than 50 km/hr;

(b) in order to provide an arrester bed with a sufficient size, the estimated cost of construction and site alterations amounted to $10 million, which was not cost-effective; and

(c) **the roundabout at Junction A should be replaced by a signalised junction to enhance road safety.**

4.12 In September 2002, the Road Safety and Standards Division (Note 24) of the TD conducted an accident investigation and commented on the roundabout design, as follows:

(a) **due to site restrictions, the roundabout at Junction A was apparently invisible and hardly recognisable to drivers until they were at a close distance; and**

(b) **as a result, there was a potential hazard to drivers who were travelling at high speed.**

4.13 In November 2002, the TD consulted the Traffic and Transport Committee of the Tuen Mun District Council on the proposal of providing a signalised junction at Junction A. In January 2003, the Committee expressed support for the proposal. In April 2006, the HyD (through its term contractor) completed the conversion works at a cost of $3.2 million. A photograph of the signalised junction is shown at Photograph 3.

Note 24: *The Division promotes road safety through formulation of road safety strategies, accident investigations, and education and publicity campaigns.*

Photograph 3

Signalised junction at Junction A
(May 2009)

Source: Photograph taken by Audit on 8 May 2009

Traffic accident statistics

4.14 Table 5 shows the number of traffic accidents and the casualties involved at Junction A from 2002 to 2009 (the junction was open to traffic on 8 March 2002).

Table 5

Traffic accidents at Junction A
(2002 to 2009)

Year	2002	2003	2004	2005	2006	2007	2008	2009 (Note)
Number of accidents	4	0	2	0	0	0	0	2
Number of persons died	4	0	0	0	0	0	0	0
Number of persons injured	7	0	2	0	0	0	0	5

Source: TD records

Note: The data for 2009 were up to September 2009.

Audit observations and recommendations

Need to determine the appropriate type of road junction at design stage

4.15 At the design stage, the CEDD chose the roundabout as the preferred junction type (see para. 4.3). In August 2002, it was agreed that the design of Junction A would be revised from a roundabout to a signalised junction to enhance road safety (see para. 4.11(c)). In September 2002, the Road Safety and Standards Division of the TD commented that, from the road safety perspective, the site restrictions at Junction A would pose a potential hazard to drivers travelling at high speed (see para. 4.12(b)). In April 2006, the roundabout junction was converted into a signalised junction (see para. 4.13). **To improve road safety and obviate the need to amend the design of a junction after road commissioning, Audit considers that the CEDD, in collaboration with the TD, needs to determine the appropriate type of junction at the design stage for road projects in future, taking into account the topographic conditions, drivers' behaviour and possible speeding of vehicles.**

Need to conduct safety assessment before road commissioning

4.16 Audit noted that after the opening of Lung Fu Road to traffic in March 2002, road improvement works were implemented. These included the removal of the stone embankment, the relocation of traffic signs and the provision of additional traffic signs (see paras. 4.8 and 4.10).

4.17 In September 2009, the TD informed Audit that:

(a) the design including the visibility requirement of the roundabout, which was based on the design speed adopted by the Consultant, complied with the TPDM; and

(b) the accidents were caused by speeding of vehicles far in excess of the speed limit imposed (see paras. 4.12(b) and 4.15).

4.18 **In Audit's view, before the commissioning of new roads in future, the CEDD, in collaboration with the TD, needs to conduct safety assessments from the perspective of road users, with a view to identifying potential safety hazards and implementing measures to enhance road safety.**

Audit recommendations

4.19 **Audit has *recommended* that, in implementing road projects in future, the Director of Civil Engineering and Development should, in collaboration with the Commissioner for Transport:**

(a) **determine the appropriate type of a junction at the design stage, taking into account factors including:**

(i) **the topographic conditions of the junction;**

(ii) **drivers' behaviour; and**

(iii) **possible speeding of vehicles (see para. 4.15); and**

(b) **before the commissioning of a new road, conduct safety assessments on the road design (including landscaping) with a view to:**

(i) **detecting potential safety hazards; and**

(ii) **implementing measures to enhance road safety where appropriate (see para. 4.18).**

Response from the Administration

4.20 The **Director of Civil Engineering and Development** agrees with the audit recommendations. He has said that:

(a) the CEDD will continue to liaise closely with the TD in selecting the type of road junctions and design, having regard to the need to comply with road safety standards;

(b) the determination of an appropriate type of a road junction is a professional judgement and many relevant factors, in addition to those mentioned in paragraph 4.19(a), need to be considered; and

(c) the guidelines on the design of road junctions are contained in the relevant chapters of the TPDM.

4.21 The **Commissioner for Transport** has said that:

(a) the TD will continue to liaise closely with the works departments and their consultants in the selection of the type of road junctions and the design, having regard to the need to comply with road safety standards;

(b) before commissioning of a new road, the TD will continue to liaise with the works departments and their consultants to carry out road safety checks and works inspections; and

(c) if any potential safety hazards are identified, the TD will liaise with the works departments to implement measures to enhance road safety.

PART 5: PROVISION OF NOISE ENCLOSURES

5.1 This PART examines the CEDD's administration of noise enclosure works under Contract A.

Contract A works

5.2 Contract A mainly comprised the following construction works:

(a) two sections of noise enclosures along Wong Chu Road (see Photographs 4 and 5), each of 230 metres in length, for reducing impact of traffic noise on the surrounding buildings; and

(b) a 900-metre long dual two-lane carriageway (mainly on bridge structures — hereinafter referred to as Viaduct A) from Tuen Mun Area 19 to the interchange at Lung Mun Road/Wong Chu Road.

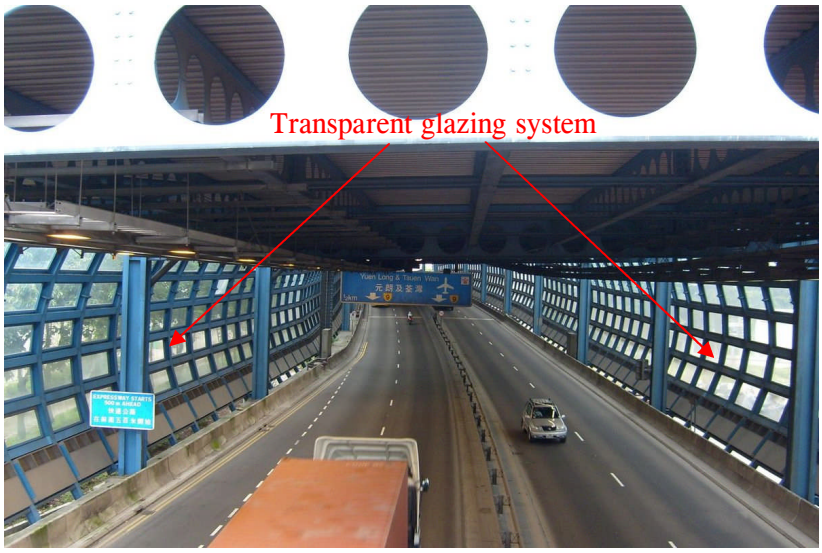
Photograph 4

A section of Wong Chu Road

Source: CEDD records

Photograph 5

Noise enclosures on Wong Chu Road



Source: CEDD records

5.3 Contract A was originally scheduled for completion in May 2001. After granting 143 days of extension of time for inclement weather, the scheduled completion date was revised to September 2001. In the event, the contract was completed in August 2002, 11 months later than the revised scheduled completion date.

5.4 The CEDD and Contractor A had disputes over some contractual issues including those relating to the noise enclosures (see paras. 5.5 to 5.9) and viaduct works (see PART 6). In May 2006, after mediation, the FSTB approved the settlement of all outstanding claims under Contract A by executing a deed of settlement. In June 2006, the CEDD paid a lump sum to Contractor A under the deed.

Construction of noise enclosures

Contract specifications for noise enclosures

5.5 Under Contract A, the cost of the noise enclosures was $185 million, representing 31% of the final contract sum. The provision of noise enclosures along Wong Chu Road was to reduce the traffic noise level upon the commissioning of Lung Fu Road. In early 1997, with a view to minimising the fire risks of the noise enclosures, the draft contract specifications included a requirement which stipulated that the materials forming the glazing system should be incombustible.

5.6 In November 1997, before the tendering of Contract A, the HyD (Note 25) expressed concerns about the fire resistance of the noise enclosures. The HyD said that the noise enclosures, in particular the structural frames, should be designed for an appropriate fire resistance period to ensure that they would not collapse during a fire, and that detailed consultation with the Fire Services Department (FSD) should be made. In early 1998, the draft contract specifications were revised to include the following provisions:

(a) acoustic materials for the noise enclosures should be fire-retardant and incombustible with a fire rating (Note 26) of one hour;

(b) testing certificates for the acoustic materials should be submitted to confirm their fire resistance capability; and

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Note 25: *The HyD is the maintenance department of Lung Fu Road and Wong Chu Road. Since September 2004, it has promulgated design guidance/practice notes on noise barriers/enclosures with transparent panels.*

Note 26: *Fire rating refers to the ability of the materials to withstand exposure to a certain temperature within a specific time without loss of their fire separating function.*

(c) the structural steel components and the connections of the noise enclosures should be painted with protective coatings to provide a one-hour fire resistance.

5.7 In September 1998, the CEDD awarded Contract A to Contractor A. After the award of contract, there were difficulties in identifying noise enclosure materials in the market meeting the contract specifications. In October 1999, the Consultant submitted the revised contract specifications (see para. 5.6) to the FSD for comments. In the same month, the FSD informed the CEDD that:

(a) there were no statutory fire-services requirements for fire resistance of noise barriers on highway structures;

(b) the structural components of the noise enclosures should be strong enough to resist effects of a fire during the early stage of the fire;

(c) the materials used should meet the following criteria:

(i) they would not melt and form burning droplets under a fire situation;

(ii) they would not form sharp and harmful pieces when shattered;

(iii) they would not emit toxic vapour or gases in a fire; and

(iv) the lining within the noise enclosures should comply with the British standard on the spread of flame, or be brought up to that standard by the use of an approved fire-retardant product; and

(d) the revised contract specifications for the noise enclosures addressed the concerns of the FSD.

Contractual disputes over noise enclosures

5.8 During construction, the CEDD and Contractor A had disputes over the construction of noise enclosures. These included disputes relating to ambiguities about the use of fire-retardant materials, as follows:

(a) **whether the glass panels of the transparent glazing system (see Photograph 5 in para. 5.2) should be classified as an "acoustic" material and hence were required to meet the one-hour fire-rating specification.** The contract specifications required that all acoustic materials should be fire-retardant and incombustible with a fire rating of one hour;

(b) **whether the materials used for the glass panels were consistent with the overall fire-rating requirement of the transparent glazing system.** The contract specifications required that the reflective glazing panels should be laminated, comprising a sheet of tempered glass and a sheet of heat strengthened glass bonded together with a resin interlayer in the centre. However, the interlayer and heat strengthened glass could not be fire-retardant or incombustible; and

(c) **whether steel or aluminium should be used as the material for the glass mounting frames.** The contract specifications required that steel should be used while the contract drawings specified aluminium instead. Aluminium and other relevant materials required for use in the transparent glazing system were not fire-retardant in accordance with the contract requirements.

These disputes were resolved by mediation in June 2006 (see para. 5.4).

5.9 In July 2009, in response to Audit's enquiry, the CEDD said that:

(a) during the design stage, the HyD pointed out that the fire resistance of noise enclosures should be at least half an hour. Based on this criterion and taking into account possible traffic congestion which might occur during a traffic accident, the Consultant considered that the one-hour fire resistance period was appropriate;

(b) at the time of preparing contract specifications for noise enclosures, the HyD's guidelines on fire resistance were not available. As the HyD would be responsible for maintaining the noise enclosures, the Consultant consulted the HyD and then incorporated the one-hour fire-rating requirement into the contract specifications;

(c) during the construction stage, the fire-rating requirement was further discussed in October 1999. The HyD considered that the one-hour fire-rating requirement originally specified by the Consultant should be maintained provided that suitable materials could be procured;

(d) the CEDD could not find records on whether the Consultant or the CEDD had further consulted the FSD on the subject before incorporating the one-hour fire-rating requirement into the contract specifications; and

(e) to avoid occurrence of similar incidents in future, the CEDD conducted an experience-sharing session in October 2006 to remind its project offices of the need to check for ambiguities and discrepancies in contract specifications.

Audit observations and recommendations

Need to ascertain fire-services requirements of noise enclosures

5.10 As mentioned in paragraph 5.8(a), there were disputes over the use of acoustic materials for noise enclosures which should be fire-retardant and incombustible with a one-hour fire rating. The disputes, together with other disputes, resulted in a payment to Contractor A for settlement of claims. In this connection, Audit notes that the noise enclosure system of Wong Chu Road was the first of its kind constructed in Hong Kong. In early 1997, at the time of preparing the contract specifications for tendering:

(a) sample specifications for the pertinent noise enclosure systems were not available; and

(b) the Structures Design Manual for the Highways and Railways promulgated by the HyD did not provide specific requirements/guidance on fire resistance of noise enclosure systems.

5.11 Audit noted that the Consultant was responsible for preparing the tender documents and contract specifications. However, for both in-house and outsourced (i.e. consultant-managed) projects, the procuring department (i.e. the CEDD) had an ultimate responsibility for ensuring that the tender documents/contract specifications were properly drawn up. **Audit considers that, in administering contracts adopting innovative designs or new construction materials in future, the CEDD needs to vigilantly check the tender documents and contract specifications to minimise ambiguities. The CEDD also needs to critically assess the fire-services requirements of construction materials and consult the government departments concerned (including the FSD) before the award of a contract.**

Need to ensure market availability of proprietary products

5.12 In early 1997, during the drafting of the contract specifications for the noise enclosures, enquiries were made with the local suppliers on the different materials required for the noise enclosures, including those for the transparent reflective glass panels. At that time, the one-hour fire-rating requirement for the transparent panels had not yet been incorporated into the specifications.

5.13 In early 1998, the draft specifications were revised to include the one-hour fire-rating requirement. As far as Audit could ascertain, there was no documentary evidence (Note 27) on enquiries made with the suppliers on the supply of the materials in the light of the change in requirements, or market research to confirm the supply of the materials at a reasonable price. **Audit considers that the CEDD needs to ascertain the supply of the required products, particularly new construction materials, before incorporating them into the tender documents.**

Audit recommendations

5.14 **Audit has *recommended* that, in administering a road project in future, the Director of Civil Engineering and Development should:**

(a) **vigilantly check the tender documents and contract specifications adopting innovative designs or new construction materials with a view to avoiding ambiguities and inconsistencies (see para. 5.11);**

(b) **critically assess the fire-services requirements of construction materials (see para. 5.11);**

(c) **consult the relevant departments (such as the FSD) on the fire-services requirements of construction materials before incorporating them into the tender documents (see para. 5.11); and**

(d) **conduct market research to ascertain the supply of new construction materials, before incorporating them into the tender documents (see para. 5.13).**

Response from the Administration

5.15 The **Director of Civil Engineering and Development** agrees with the audit recommendations. He has said that the CEDD's consultant had consulted the HyD on the specification of the noise enclosures and included the HyD's requirement in the contract documents.

Note 27: *In response to Audit's enquiry, in September 2009, the CEDD said that the Consultant made a number of enquiries with the suppliers about the performance and price of the glazing panels available in the market at the time of revising the specifications. The information was collected through the suppliers' presentations, quotations and the Consultant's inspection of the suppliers' material catalogues. However, there was no written record of the Consultant's communication with the suppliers.*

PART 6: CONSTRUCTION OF VIADUCT A

6.1 This PART examines the CEDD's administration of viaduct works under Contract A.

Design of viaduct structure

6.2 The original design of Viaduct A (i.e. the conforming design) comprised a bridge deck mainly formed by precast beams supported by bored piles.

6.3 In May 1998, during the tendering of Contract A, the CEDD received an uninvited alternative design proposal for constructing the viaduct from a tenderer (who was later awarded the contract, namely Contractor A). The alternative design adopted a cast-in-situ approach (Note 28) in constructing a bridge deck of lesser weight using fewer piles. The alternative design would achieve a saving of $57 million compared with the conforming design. During the tender assessment, in response to the Consultant's enquiries, the tenderer said that, if he was awarded the contract, he would carry out the detailed design (including the checking and certification by an independent checking engineer) after the award of the contract.

Tender report to Central Tender Board

6.4 In August 1998, the CEDD proposed to the Central Tender Board to accept the alternative design submitted by the tenderer in the sum of $598 million. According to the tender report submitted to the Central Tender Board:

(a) the conforming design had the following merits:

(i) the use of precast beams was common in Hong Kong and this type of construction was well known to contractors. It would require less labour input;

(ii) it would enable fast-track construction to meet the tight programme; and

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Note 28: *A cast-in-situ approach is a construction method whereby concrete or plaster is poured in place on the site for various parts of a construction structure.*

(iii) it would require less temporary support works during construction and would cause the least disruption to traffic; and

(b) the alternative design had the following merits:

(i) the cost saving would mainly result from the use of a light-weight bridge deck;

(ii) the total number of bored piles used for the foundation could be reduced; and

(iii) the cast-in-situ approach would rely on more labour input for erecting temporary works for constructing the deck. It appeared that the tenderer would be able to take advantage of the then recession in the construction industry, whereby labour would be more easily available and less expensive.

In September 1998, with the Central Tender Board's approval, the CEDD adopted the alternative design and awarded Contract A to Contractor A.

Design work

6.5 In November 1998, Contractor A submitted the design of Viaduct A to the Consultant for approval. In December 1998, the Consultant forwarded the design to the HyD, which would be responsible for maintaining the viaduct, for comments. After taking into account the HyD's and the Consultant's comments in March 1999, Contractor A submitted a revised design to the Consultant and commenced the foundation works.

Piling works

6.6 In May 1999, the Consultant approved the revised design. During construction of the viaduct foundation, anomalies in some of the core samples (Note 29) were noted. As a result, additional samples were taken and load testings on the bored piles were carried out. In January 2000, Contractor A submitted certified reports on the bored piles after carrying out additional testings. In April 2000, the Consultant accepted that the bored piles complied with the contract specifications.

Note 29: *Core samples were required to be taken from bored piles for carrying out various testings to confirm the integrity of the piles.*

Contract claim

6.7 In June 2001, Contractor A submitted a claim for 193 days of extension of time for completing the viaduct works. There were disputes between the CEDD and Contractor A over the following issues:

(a) whether there were delays in accepting the alternative design of viaduct structure;

(b) whether additional time was required for additional load testings for the bored piles; and

(c) whether proper testing instructions for the bored piles had been given.

6.8 The claim for extension of time, together with other claims under Contract A, was resolved by mediation in June 2006.

Requirements after the award of Contract A

6.9 ***Alternative design.*** In August 2004, Environment, Transport and Works Bureau Technical Circular (Works) No. 25/2004 was issued. Under the circular, the works departments:

(a) shall not consider any uninvited alternative design proposal;

(b) subject to the approval of an officer of D2 Level or above, may invite tenderers to submit an alternative design proposal for part of the works which is not covered by the Engineer's design; and

(c) shall include an assessment of the risk of a contractor's failure to perform in evaluating the alternative design proposal.

6.10 ***Systematic Risk Management.*** In June 2005, a circular on the implementation of "Systematic Risk Management" in public works projects (Environment, Transport and Works Bureau Technical Circular (Works) No. 6/2005) was issued. In September 2009, the CEDD informed Audit that the "Systematic Risk Management" of public works projects would:

(a) help project managers identify, assess and rank risks, develop contingency plans for unavoidable risks, and limit potential damage should a risk materialise; and

(b) improve the chance of completing a project on time, within budget and to the required quality.

Audit observations and recommendations

Need to critically assess risks of project slippage

6.11 The cost of the alternative design (adopting the cast-in-situ approach) was $57 million lower than that of the conforming design (adopting the precast beams approach). As stated in the tender report submitted to the Central Tender Board in August 1998, the conforming design would enable fast-track construction to meet the tight programme (see para. 6.4(a)(ii)), require less temporary support works and cause the least disruption to traffic (see para. 6.4(a)(iii)).

6.12 In Audit's view, there was a risk of project slippage in adopting the alternative design because it might require a longer time for completing the viaduct works vis-à-vis the conforming design for the following reasons:

(a) the detailed design of the alternative design works was carried out after the award of Contract A, and the design required the Consultant's approval. In the event, the detailed design was approved in May 1999 (see para. 6.6), eight months after the award of Contract A in September 1998; and

(b) extensive temporary support works and additional measures to mitigate disruption to traffic were required (see para. 6.4(a)(iii)).

6.13 In this connection, Audit noted that Lung Fu Road was required to be completed on time in order to match the development programme of the RTT and the SIA in TMA 38 (see para. 3.2(a) and (c)). As it transpired, the Viaduct A works were completed in February 2002, 207 days after the scheduled completion date.

6.14 In July and September 2009, in response to Audit's enquiry, the CEDD said that:

(a) the Consultant had carried out a technical assessment of the alternative design during the tender assessment. Based on the information provided by Contractor A, the Consultant did not envisage any problem for Contractor A to meet the project programme;

(b) the Consultant's assessment and the CEDD's recommendation were contained in the tender report submitted to the Central Tender Board. All relevant factors and information available at that time, including the proposed construction method, any impact on construction programme and the cost saving, were taken into consideration in formulating the recommendation. Such consideration was essentially an assessment of the risk associated with the alternative design; and

(c) part of the longer time required for completing the viaduct works was attributable to the design work and temporary support works.

6.15 **Audit considers that, in considering an alternative design for a time-critical project in future, the CEDD needs to critically assess the risks of project slippage, in accordance with the guidelines set out in Environment, Transport and Works Bureau Technical Circular (Works) No. 6/2005. The CEDD also needs to include the risk assessment in the tender report submitted to the Central Tender Board.**

Audit recommendations

6.16 **Audit has *recommended* that, in considering an alternative design for a time-critical project in future, the Director of Civil Engineering and Development should:**

(a) **critically assess the risks of project slippage as a result of using the alternative design (see para. 6.15); and**

(b) **include the risk assessment of project slippage in the tender report submitted to the Central Tender Board (see para. 6.15).**

Response from the Administration

6.17 The **Director of Civil Engineering and Development** agrees with the audit recommendations. He has said that:

(a) in assessing the tenders of Contract A, all relevant factors, including the risk of project slippage as a result of using the alternative design, were taken into consideration in formulating the tender recommendation, even though the risk of project slippage was not explicitly explained in the tender report; and

(b) the requirements on assessment of contractors' alternative designs, including the risk of a contractor's failure to perform, are already laid down in Environment, Transport and Works Bureau Technical Circular (Works) No. 25/2004 (see para. 6.9(c)).

Appendix A
(paras. 2.6, 2.13 and 2.14 refer)

Proportion of heavy vehicles and traffic capacity of Lung Fu Road

Proportion of heavy vehicles	Number of vehicles per hour per direction
Not exceeding 15%	2,800
15.1% to 20%	2,604
20.1% to 25%	2,520
38%	2,045
80%	1,400
100%	1,200

Source: Audit analysis of TD records

Appendix B
(para. 2.11(d) refers)

Traffic flow of Lung Fu Road in 2006

Particulars	**PCU per hour during peak period**	
	Northbound	**Southbound**
(a) Forecast	2,446	3,150
(b) Actual	2,184	2,220
(c) $\frac{\text{Actual}}{\text{Forecast}}$ ($\frac{\text{(b)}}{\text{(a)}} \times 100\%$)	89%	70%

Source: CEDD records

Appendix C

Acronyms and abbreviations

APE	Approved project estimate
Audit	Audit Commission
CEDD	Civil Engineering and Development Department
FC	Finance Committee
FSD	Fire Services Department
FSTB	Financial Services and the Treasury Bureau
HKIEC	Hong Kong Industrial Estates Corporation
HKPF	Hong Kong Police Force
HyD	Highways Department
km/hr	Kilometres per hour
LegCo	Legislative Council
LFR Project	Lung Fu Road Project
PAC	Public Accounts Committee
PCU	Passenger car units
PWSC	Public Works Subcommittee
RTT	River Trade Terminal
SIA	Special industries area
TD	Transport Department
TMA 38	Tuen Mun Area 38
TPDM	Transport Planning and Design Manual
v/c ratio	Volume-to-capacity ratio