CHAPTER 3

Civil Engineering and Development Department
Home Affairs Department

Maintenance of public marine facilities

Audit Commission
Hong Kong
31 March 2006

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.

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MAINTENANCE OF PUBLIC MARINE FACILITIES

Contents

PART 1: INTRODUCTION

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

Public marine facilities

1.2 Under the Government's port development programme, the Civil Engineering and Development Department (CEDD – Note 1) is responsible for planning, designing, and constructing public marine facilities. The CEDD is also responsible for maintaining these public marine facilities (see Table 1).

Table 1

Public marine facilities maintained by the CEDD
(1 July 2005)

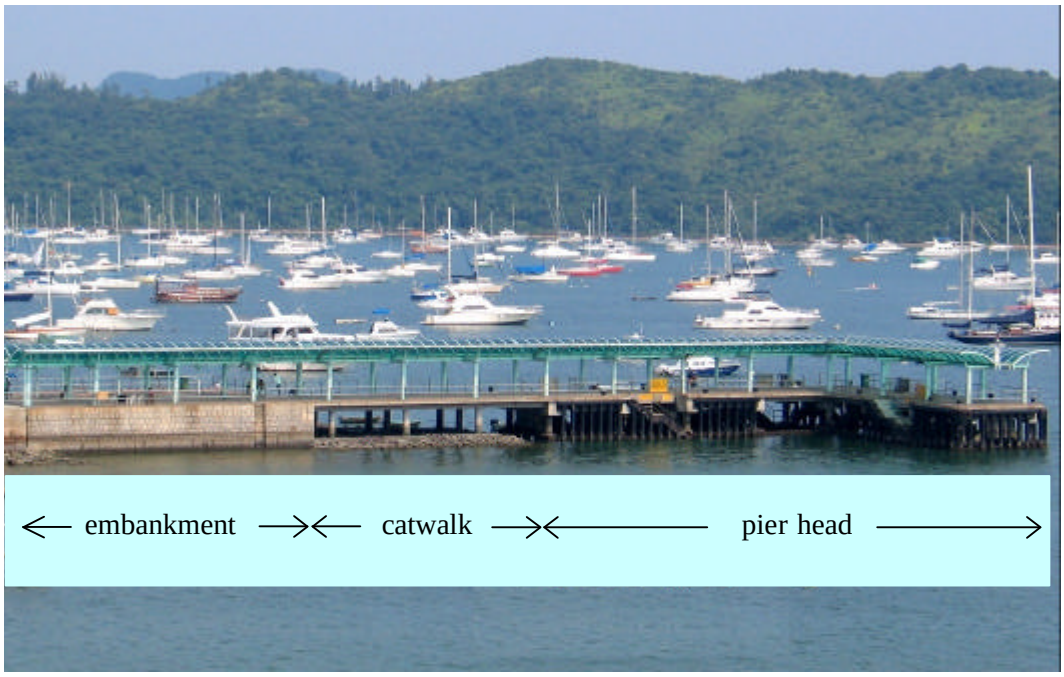
Facility	Quantity
Pier (see Photograph 1)	**144 numbers**
Landing (see Photograph 2)	**189 numbers**
Dolphin (see Photograph 3)	99 numbers
Seawall	120 kilometres
Breakwater	13 kilometres
Quay at public cargo working area	8 kilometres
Typhoon shelter	506 hectares
Major fairway	14,100 hectares

Source: CEDD records

Note 1: *The CEDD was formed on 1 July 2004 by merging the former Civil Engineering Department and the Territory Development Department.*

Photograph 1

A pier with a catwalk and an embankment
(Sai Kung – Pak Sha Wan Public Pier)



Source: Photograph taken by Audit

Photograph 2

A landing
(Peng Chau)

Source: Photograph taken by Audit

Photograph 3

A dolphin
(Cheung Chau Typhoon Shelter)

Source: *Photograph taken by Audit*

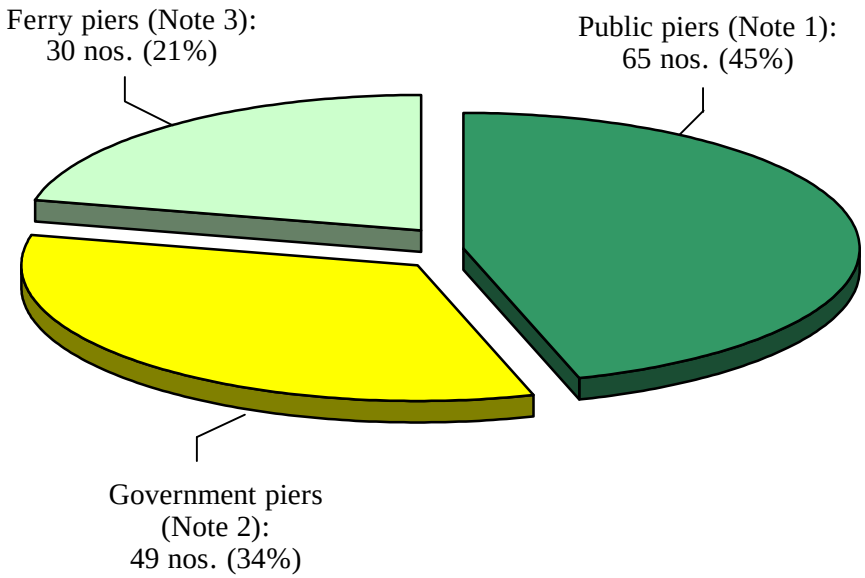
Marine landing facilities

1.3 Marine landing facilities include piers and landings (see Table 1). A pier is a structure protruding from the shore with one or more berths on the sides of the pier head. The pier head may be further extended by a catwalk and an embankment. A landing (also called a landing step) is a landing facility embedded in a seawall. The CEDD assigns a marine structure number to each landing facility constructed by the Government (see Photograph 10 in para. 5.5).

1.4 As at 1 July 2005, the CEDD was responsible for maintaining 144 piers (see Figure 1):

Figure 1

Piers maintained by the CEDD
(1 July 2005)



Source: *CEDD records*

Note 1: *Public piers are open for public use for boarding and alighting of passengers, and loading and unloading of goods, e.g. Queen's Pier in Central.*

Note 2: *Government piers are for the exclusive use by government departments, e.g. piers at the Government Dockyard at Stonecutters Island.*

Note 3: *Ferry piers are for the exclusive use by operators of franchised and licensed ferry services, e.g. the Tsim Sha Tsui Ferry Pier.*

Deterioration of reinforced concrete piers

1.5 As laid down in the CEDD's Port Works Design Manual, the design life of a pier is 50 years (Note 2). Most of the piers maintained by the CEDD (hereinafter referred to as CEDD piers) are built in the form of a reinforced concrete structure (see Appendix A), in which the embedded steel reinforcement is vulnerable to corrosion due to the humid climate and the penetration of chloride from seawater. The rust from corrosion, which has a volume of two to four times that of the original steel, causes cracking and deterioration of the concrete structure.

1.6 In 1996, the CEDD commenced a **reconstruction** programme for replacing 12 structurally deteriorated piers at a total estimated cost of $359 million. Many of the works projects were completed by December 2005. The deterioration of reinforced concrete piers has significant implications on the **maintenance** of public marine facilities. In 2000, the CEDD commenced the development of a new maintenance strategy. In 2003, the maintenance strategy was promulgated in the CEDD's Maintenance Manual for Marine Facilities.

Maintenance of marine facilities

1.7 Maintenance of public marine facilities comprises:

(a) routine repairs and maintenance of a recurrent nature; and

(b) improvement works of a non-recurrent nature.

Term contracts for maintenance

1.8 The CEDD employs term contractors for carrying out maintenance works on public marine facilities. During the period of a term contract, the CEDD issues works orders to the contractors for executing maintenance works as and when required. A contractor is remunerated for the works completed based on a Schedule of Rates in the term contract.

Note 2: *The design life of a pier is its intended useful life. The actual service life may exceed 50 years if proper maintenance is carried out to upkeep its structural condition.*

Contracts for improvement works

1.9 For improvement works of a non-recurrent nature, the CEDD may award works contracts by separate tenders. These works contracts usually have a defined scope of works.

Involvement of other government departments in pier maintenance

1.10 Besides the CEDD, the following three government departments are also involved in pier maintenance:

(a) ***The Home Affairs Department (HAD).*** The HAD is responsible for the overall maintenance of small public piers in the New Territories (including outlying islands);

(b) ***The Architectural Services Department (ArchSD).*** The ArchSD is responsible for the maintenance of structures above the deck level of CEDD piers; and

(c) ***The Electrical and Mechanical Services Department (EMSD).*** The EMSD maintains the electrical and mechanical installations of CEDD piers as a service provider under a trading fund arrangement (Note 3).

Director of Audit's Report on the reprovisioning of public piers

1.11 In Chapter 5 of the Director of Audit's Report No. 44 of March 2005, the Audit Commission (Audit) reported its observations on the reconstruction of a number of deteriorated piers in the CEDD's pier reconstruction programme. Audit made a number of recommendations for improvement. The CEDD accepted all the audit recommendations and subsequently implemented them.

Note 3: *The Electrical and Mechanical Services Trading Fund was established in August 1996 to account for the operation of the commercial services of the EMSD. The Trading Fund charges fees on government departments for services provided. For the maintenance of the electrical and mechanical installations of piers, the Trading Fund mainly provides services to the Transport Department (for ferry piers) and the Marine Department (for the China Ferry Terminal and the Macau Ferry Terminals).*

Audit review

1.12 Audit has recently conducted a review to examine the maintenance of public marine facilities by the CEDD and other government departments. The audit review focused on the following areas:

(a) monitoring of maintenance cost (see PART 2);

(b) monitoring of pier maintenance (see PART 3);

(c) implementation of improvement works projects (see PART 4); and

(d) maintenance responsibilities of other government departments (see PART 5).

Audit has found that there are areas where improvements can be made by the relevant government departments in maintaining public marine facilities.

General response from the Administration

1.13 The **Director of Civil Engineering and Development** and the **Director of Home Affairs** welcome the recommendations in this audit report.

Acknowledgement

1.14 Audit would like to acknowledge with gratitude the full cooperation of the staff of the CEDD, the HAD, the ArchSD, the EMSD and the Transport Department during the course of the review.

PART 2: MONITORING OF MAINTENANCE COST

2.1 This PART examines the CEDD's monitoring of the maintenance cost of public marine facilities.

Maintenance cost of public marine facilities

2.2 In 2005-06, the CEDD's estimated expenditure on the maintenance of public marine facilities amounts to $101 million, comprising:

(a) ***$50 million for routine repairs and maintenance of a recurrent nature.*** The works include inspections, regular cleansing of landings, minor structural repairs and pier furniture repairs. This expenditure is funded under the General Revenue Account; and

(b) ***$51 million for improvement works of a non-recurrent nature.*** The works include major structural repairs, measures for corrosion protection and upgrading of fenders. This expenditure is funded under the Capital Works Reserve Fund.

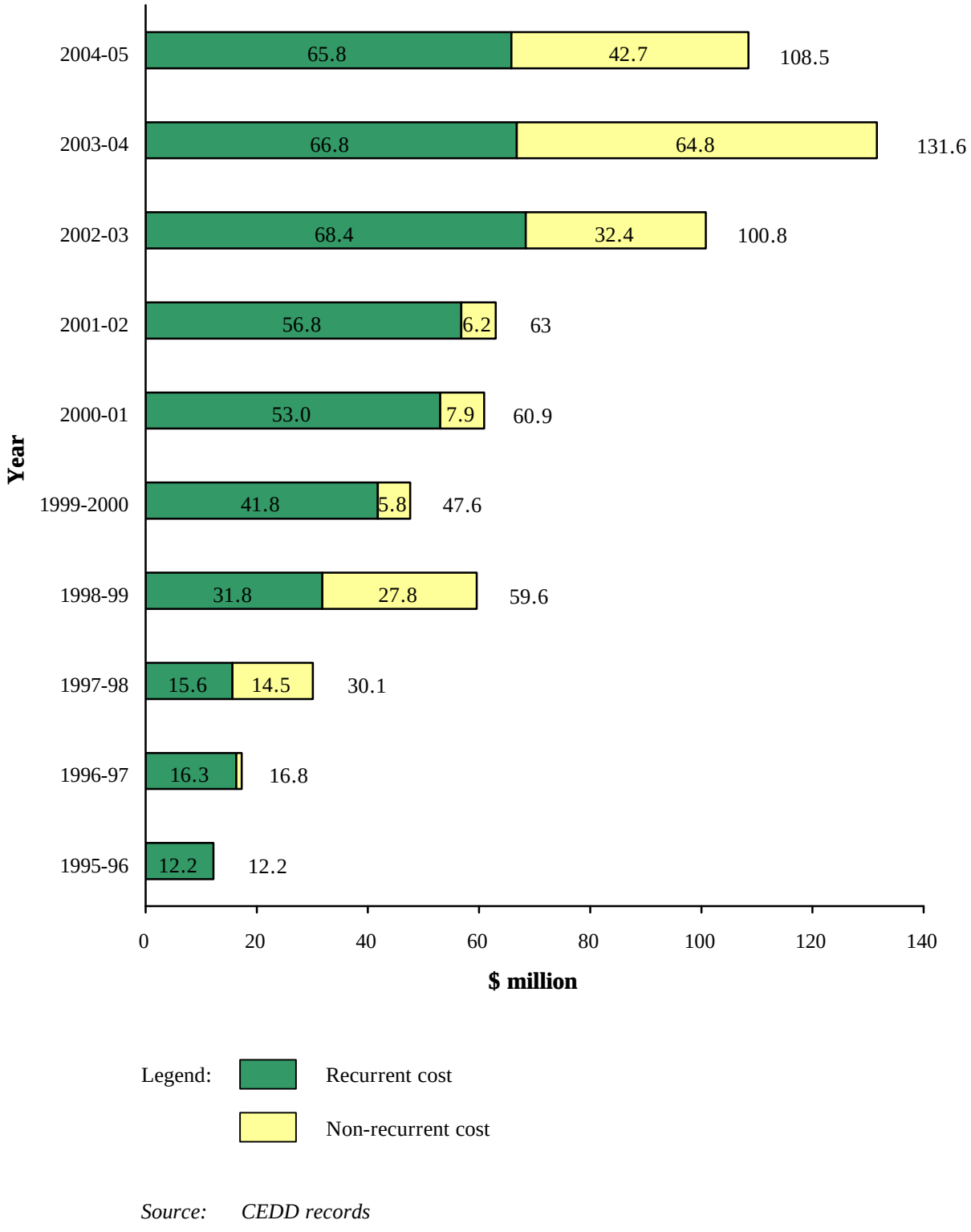
Audit observations

Need to compile management reports for monitoring the maintenance cost

2.3 Audit noted that the total annual maintenance cost of public marine facilities increased from $12.2 million in 1995-96 to $131.6 million in 2003-04, and then decreased to $108.5 million in 2004-05 (see Figure 2).

Figure 2

Maintenance cost of public marine facilities
(1995-96 to 2004-05)

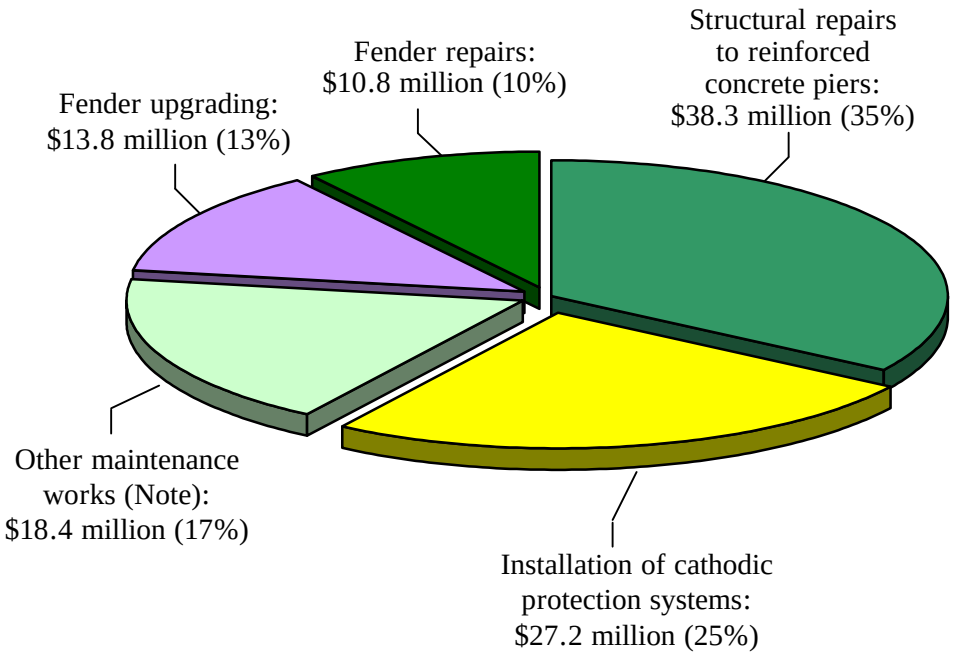


Source: *CEDD records*

2.4 In terms of works types, Audit's analysis revealed that the major portions of the total maintenance cost of $108.5 million in 2004-05 were spent on structural repairs to reinforced concrete piers and on installation of cathodic protection systems (see Figure 3).

Figure 3

Maintenance cost by works types
(2004-05)



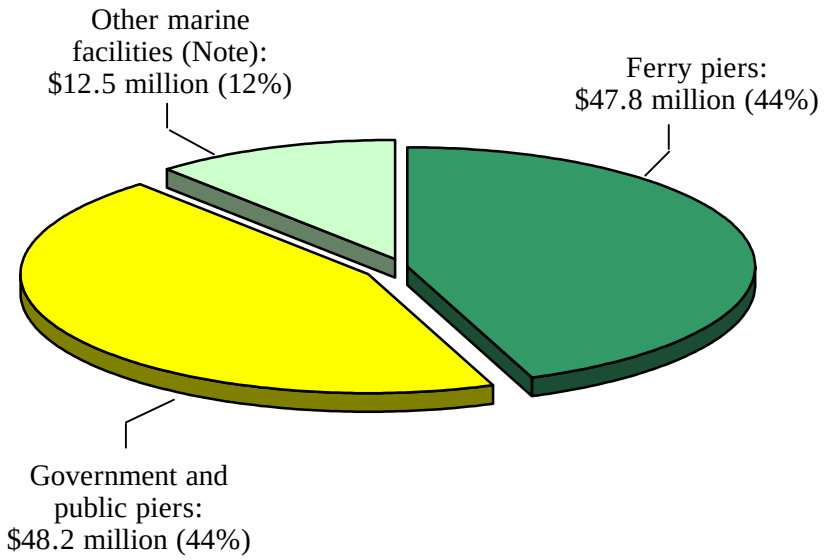
Source: *CEDD records and audit analysis*

Note: *Other maintenance works included cleansing of landings, seawall repairs and the application of protective coating to reinforced concrete piers.*

2.5 In terms of types of public marine facilities, Audit's analysis showed that almost 90% of the maintenance cost of $108.5 million in 2004-05 was incurred on piers (see Figure 4).

Figure 4

Maintenance cost by types of facility (2004-05)



Source: CEDD records and audit analysis

Note: Other marine facilities included landings, seawalls and dolphins.

2.6 Figure 2 shows that the CEDD's maintenance cost of public marine facilities increased substantially from 1995-96 to 2004-05. In November 2005, in response to Audit's enquiry, the CEDD said that the reasons for the increase over the ten-year period included:

(a) ***Increase in the number of marine facilities.*** The number of landing facilities increased from 223 to 333 (49% increase), and the total length of seawalls increased from 84 kilometres to 120 kilometres (43% increase);

(b) ***Ageing of public marine facilities.*** Many of the public marine facilities, in particular piers, were built many years ago. The majority of the piers were constructed over 20 years ago and required regular maintenance;

(c) ***Upgrading of fenders.*** Since 2003, the CEDD had commenced a programme for replacing traditional timber fenders with fenders made of recycled materials (see paras. 4.26 to 4.30);

(d) ***Taking over the maintenance of ferry piers.*** Since 1998, the CEDD had taken over the maintenance of ferry piers (Note 4); and

(e) ***Deterioration of reinforced concrete piers.*** A consultancy study commissioned by the CEDD in 1995 found that there was extensive deterioration in many reinforced concrete piers. The piers had to be repaired on a regular basis or improved to prolong their service lives (Note 5).

2.7 Audit's examination revealed that there was room for improvement in the CEDD's compilation of management information for monitoring the maintenance cost of public marine facilities. **In view of the large expenditure of over $100 million a year, Audit considers that the CEDD needs to compile comprehensive management reports for cost monitoring.** The reports should include the information included in Figures 2 to 4 (the information in these figures was compiled at the request of Audit in mid-2005). The

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Note 4: *According to the Ferry Services Ordinance (Cap. 104), operators of ferry services are required to repair and maintain the piers they lease from the Government. In 1998, with a view to reducing the financial burden on ferry operators, the Government took over the maintenance of the structures of franchised and licensed ferry piers.*

Note 5: *In the early 1990s, the CEDD found that there was extensive deterioration in many piers due mainly to the corrosion of the steel reinforcement. In April 1995, the CEDD commissioned a consultancy study to find ways to enhance the operational safety and the durability of the piers. The scope of the consultancy study included a detailed study of 93 reinforced concrete piers and a review of the concrete mix design for the marine environment.*

CEDD needs to compile periodic reports to analyse the maintenance cost of, and repair works done to, each pier. Such information would help the CEDD compare the maintenance costs of similar piers. This would help monitor the maintenance costs and improve the maintenance programme.

Need to monitor implementation of new information system

2.8 Audit's examination revealed that the CEDD basically maintained the information related to the maintenance of marine facilities in manual form. Such information included:

(a) an inventory of marine facilities, including the as-built drawings, take-over records, furniture details and inspection records; and

(b) works orders issued to the term contractors, including payment details and works records.

2.9 The CEDD had developed some simple computer systems to facilitate the management and sharing of maintenance information. However, these computer systems only provided limited functions and data coverage. Audit noted that the CEDD did not maintain a central record of all marine facilities and works orders. As a result, it was difficult to trace the maintenance history and costs of individual marine facilities. **Audit considers that the issues mentioned above have affected the CEDD's management of maintenance works, budgetary control, cost monitoring, and prompt response to enquiries for such information.**

2.10 In 2001, the CEDD commissioned a feasibility study for implementing a Port Maintenance Information System (PMIS). In September 2002, the Financial Services and the Treasury Bureau approved $8 million for implementing the PMIS (including hardware, software and implementation services). The system was targeted for completion in March 2004. The CEDD informed Audit that, due to a change in the arrangements for procuring information technology services in 2003, it could only invite tenders for the PMIS in June 2004. The PMIS was launched in February 2006. As at the end of February 2006, data input and conversion were in progress. **Audit considers that the CEDD needs to closely monitor the implementation of this system.**

Room for improvement in the inventory of landing facilities

2.11 The CEDD assigns a marine structure number to each government-owned landing facility and maintains an inventory of these facilities. Audit examined the CEDD's inventory and noted the following areas for improvement:

(a) ***Updating of inventory.*** A comparison of the inventory compiled in August 2004 and that in July 2005 revealed that the number of landing facilities had increased, as follows:

	Inventory compiled in		
	August 2004	**July 2005**	**Increase**
Piers	137	144	7
Landings	165	189	24
Total	**302**	**333**	**31**

Audit noted that the increase was mainly due to the omission of piers and landings in the August 2004 inventory. In December 2005, Audit found that the information about the number of public marine facilities posted on the CEDD's website was still based on the August 2004 inventory (the last review date was stated as 13 April 2005);

(b) ***New landings in Peng Chau.*** In 2002 and 2003, seven new landings were completed in Peng Chau but they were not recorded in the August 2004 inventory. The July 2005 inventory only included four of the seven new landings;

(c) ***Classification of Tai Lam Chung Pier.*** This pier was reconstructed in early 2003 as a police marine base with two piers comprising six berths. However, the CEDD classified this pier as six landings in its inventory, though the CEDD still referred to this pier as "Tai Lam Chung Pier" in its works orders; and

(d) ***Piers maintained by HAD.*** The CEDD's inventory also included piers maintained by the HAD. The HAD is responsible for the overall maintenance of 46 small public piers (hereinafter referred to as HAD piers) in the New Territories (see para. 5.2). The CEDD only assigned marine structure numbers to 24 (52%) of the 46 HAD piers and included them in the CEDD's inventory. The other 22 HAD piers with no marine structure numbers assigned were not included.

2.12 **Audit considers that there is a need for the CEDD to improve the accuracy of the inventory of landing facilities, and ensure that it is complete and up-to-date.**

Need to disclose information on public landing facilities

2.13 Public piers and landings are built for public use. Members of the public need to have information about the locations and facilities of such piers and landings. During the review, Audit searched the websites of the CEDD, the Transport Department and the Marine Department but could not find such information. Audit considers that there is scope for improvement in this area.

Audit recommendations

2.14 **Audit has *recommended* that the Director of Civil Engineering and Development should:**

(a) **compile comprehensive management reports to facilitate the monitoring of the maintenance cost of public marine facilities (see para. 2.7);**

(b) **closely monitor the implementation of the PMIS with a view to ensuring that it will provide the necessary support for compiling useful management information for the maintenance of public marine facilities (see para. 2.10);**

(c) **take action to ensure that the inventory of public marine facilities is complete and up-to-date (see para. 2.12); and**

(d) **include an updated list of public piers and landings (with locations) in the CEDD's website for public information, and provide the list to the Marine Department and the Transport Department for inclusion in their websites (see para. 2.13).**

Response from the Administration

2.15 The **Director of Civil Engineering and Development** agrees with the audit recommendations in paragraph 2.14. He has said that:

(a) the PMIS has been launched and the data conversion is in progress; and

(b) the PMIS will provide additional support to the management of assets and compilation of reports for expenditure monitoring.

PART 3: MONITORING OF PIER MAINTENANCE

3.1 This PART examines the CEDD's planning and monitoring of maintenance of piers.

Maintenance of piers

3.2 There are two types of maintenance, namely corrective maintenance and preventive maintenance. Corrective maintenance mainly involves rectifying defects identified during inspections. Preventive maintenance aims at prolonging the service life of structures and reducing maintenance costs in the long term. A well-planned preventive maintenance strategy helps reduce the overall maintenance cost and minimise the risk of disruption to services.

Corrective maintenance strategy

3.3 As part of its corrective maintenance strategy, the CEDD has developed a maintenance inspection system for carrying out regular inspections of pier structures and pier furniture (such as fenders and railings) for identifying defects. The CEDD's maintenance inspections include:

(a) ***Routine inspections.*** The frequency of routine inspections of a pier is determined based on its utilisation, vulnerability to damage and the consequence of disruption to its service. Each pier is inspected once or twice a year; and

(b) ***Special inspections after typhoons.*** Piers are susceptible to damage during typhoons, particularly their fenders. The CEDD carries out visual inspections of piers after severe typhoons to ascertain if repairs are needed.

3.4 Maintenance inspections are conducted by the CEDD's inspectors, works supervisors and maintenance engineers. They record the inspection findings on standard inspection forms, indicating the defects (with photographs) and the repairs required. The CEDD issues works orders to the maintenance term contractors for the repair works. The CEDD's maintenance inspections do not include a systematic assessment of the structural condition of the piers for formulating preventive maintenance measures.

Preventive maintenance strategy

3.5 In 1995, the CEDD engaged a consultant to conduct a study of the structural condition of 93 selected reinforced concrete piers (see para. 2.6(e)). The consultant considered that the CEDD's maintenance arrangements were ineffective as they had not restricted the spread of reinforcement corrosion in the pier structures. In 2000, the CEDD began to develop a new maintenance strategy based on the findings of the consultancy study. In February 2003, the CEDD promulgated a new maintenance strategy in its Maintenance Manual for Marine Facilities. The new maintenance strategy included a system to survey the condition of piers.

Condition survey system

3.6 The CEDD's condition survey system is designed to supplement the maintenance inspection system. The system assesses the structural condition of piers for determining the appropriate repair strategy and methodology. It has two stages of inspection, namely visual inspection and detailed investigation.

3.7 ***Visual inspection.*** The visual inspection aims to obtain a quick overall assessment of the structural deterioration of a pier by identifying and recording the extent and severity of visible defects. The frequency of visual inspections is as follows:

Age of pier	Frequency
Less than 5 years	Once every 5 years
Between 5 and 10 years	Once every 4 years
Between 11 and 25 years	Once every 3 years
More than 25 years	Once every 2 years

Visual inspections are normally conducted at low tide during which photographic and video records are taken. Each defect identified is codified for ease of recording and assessment (Note 6). A Visual Inspection Report is compiled to record in detail the different categories and types of defects (such as rust stains and cracks). A **deterioration index** is calculated to indicate the degree of deterioration of the pier examined.

Note 6: *The defects are classified into two categories. Category 1 defects are those that adversely affect the serviceability or integrity of the pier. Category 2 defects are those that indicate symptoms of deterioration, which need to be recorded and monitored.*

3.8 Based on the deterioration indices of the piers, the CEDD determines the priority of repair works. The CEDD draws up a **priority list** for selecting piers for detailed investigation (see para. 3.9) and repair works. As a general rule, a pier with a higher deterioration index score is given a higher priority, taking also into account its functional importance and future use. According to the CEDD's Maintenance Manual for Marine Facilities, the priority list should be updated after a visual inspection.

3.9 ***Detailed investigation.*** The objective of a detailed investigation is to verify and supplement the results of visual inspections. For piers with high deterioration index scores, the CEDD carries out a detailed investigation to collect data for ascertaining the cause of the problem, as well as the extent of deterioration. The findings form the basis for planning future repairs. The site work of a detailed investigation usually involves a combination of the following processes:

(i) detailed visual inspections;

(ii) non-destructive tests using measuring instruments; and

(iii) destructive testing, including drilling holes and making inspection windows on the concrete structure.

Repair options

3.10 The CEDD has the following repair options for piers:

(a) short-term treatment, including:

  (i) spraying concrete on pier structures; and

  (ii) recasting works;

(b) medium-term treatment, including:

  (i) patch repair works, recasting works, spraying concrete on pier structures;

  (ii) applying protective coating to pier structures; and

  (iii) chloride extraction process; and

(c) long-term treatment, including:

(i) patch repair works, recasting works, spraying concrete and applying coating on pier structures;

(ii) applying protective coating to pier structures;

(iii) chloride extraction process; and

(iv) installation of cathodic protection system.

3.11 The selection of a repair option is mainly determined by the remaining service life of the pier (Note 7).

Audit observations

Need to promptly update the priority list

3.12 The CEDD's Maintenance Manual for Marine Facilities requires that the priority list should be updated after each visual inspection. Audit's examination revealed that the priority list was not promptly updated in some cases (see Table 2).

Note 7: *The remaining service life of a pier is determined on the basis of age, nature, extent and severity of the deterioration and the functional importance of the pier.*

Table 2

Audit observations on CEDD's priority list for pier maintenance

Audit observation	Particulars
Priority list not promptly updated after visual inspections.	During the audit inspection in August 2005, Audit noted that the priority list only included the results of visual inspections conducted up to December 2004. The CEDD updated the list subsequent to Audit's inspection. **As the CEDD makes use of the priority list to determine the maintenance priority of piers, Audit considers that it should have taken prompt action to update the priority list.**
Piers abandoned or transferred to other departments but still on the list.	Audit noted that the priority list of September 2005 contained the deterioration indices of 13 piers that had either been decommissioned (10 piers) or transferred to other departments for maintenance (3 piers). **Audit considers that these piers should have been deleted from the priority list.**
Priority list not updated after structural repair works.	After the completion of structural repairs to a pier, its original deterioration index becomes outdated. Audit noted that the CEDD had not updated the deterioration indices of some piers after the completion of structural repair works. **Audit considers that there is scope for improvement in this area.**

Source: CEDD records and Audit analysis

Need for a separate maintenance strategy for solid piers

3.13 In response to Audit's enquiries, in November 2005, the CEDD said that:

(a) the deterioration indices were primarily intended for reinforced concrete piers; and

(b) for solid piers (see Appendix A) built by mass concrete blocks, the risk of corrosion was low because there was no steel reinforcement.

3.14 Audit's examination revealed that the CEDD:

(a) did not maintain a separate category for solid piers in the priority list for pier maintenance;

(b) had carried out visual inspections of most of the 31 solid piers it maintained; and

(c) had computed deterioration indices for four solid piers for priority ranking together with the other reinforced concrete piers.

3.15 **In view of the fact that the risk of corrosion of solid piers is low as compared to reinforced concrete piers, Audit considers that there are merits for the CEDD to consider adopting a different maintenance strategy for solid piers.**

3.16 Audit's examination also revealed that some of the piers classified as solid piers actually contained reinforced concrete elements in the form of suspended beams between sections of the solid structure. Examples include:

(a) Sham Tseng Pier; and

(b) Pier at Angler's Beach.

The CEDD's records indicated that the Sham Tseng Pier was in poor structural condition with severe corrosion. **To ensure that an appropriate maintenance strategy is adopted for these piers, Audit considers that the CEDD needs to conduct a review to determine whether solid piers with suspended beams should also be classified as reinforced concrete piers.**

Need for a separate maintenance strategy for prestressed concrete piers

3.17 Audit's examination revealed that five public piers in Sha Tau Kok, Wong Shek, Ko Lau Wan, Sham Chung and Lai Chi Chong were constructed using the prestressing technique (Note 8) to make beams or slabs of a longer span. In response to Audit's enquiry, the CEDD said that:

(a) the steel reinforcement of these prestressed concrete piers was highly susceptible to corrosion;

(b) unlike other reinforced concrete piers, the signs of corrosion of prestressed concrete piers could not be easily detected by visual inspections; and

(c) there was a risk of a sudden failure of prestressed concrete piers.

These piers had low rankings in the CEDD's priority list. However, recent CEDD investigations revealed that these five piers had deteriorated beyond economic repair and required reconstruction. **There is a need for the CEDD to consider adopting a different maintenance strategy for prestressed concrete piers, as the deterioration indices may not fully reflect their conditions.**

Areas for improvement in conducting detailed investigations

3.18 In mid-2003, the CEDD began conducting the detailed investigations of the piers. Up to December 2005, the CEDD had conducted 24 detailed investigations. Audit's examination of the investigation records revealed that:

(a) the CEDD did not conduct detailed investigations according to the ranking of the piers in the priority list, and did not document the selection criteria;

(b) the CEDD did not use standardised forms for recording the tests conducted and the findings. Audit considers that the use of standardised forms will help facilitate the management of the testing results; and

(c) the CEDD did not update the deterioration index of a pier after the completion of a detailed investigation. Audit considers that updating is necessary for ensuring that the deterioration index is useful.

Note 8: *The prestressing technique involves the application of forces to a reinforced concrete structure to deform it in such a way that it will withstand its working loads more effectively*.

Need to integrate information on structural condition into PMIS

3.19 In the paper of April 2002 seeking funding for implementing the PMIS (see para. 2.10), it was stated that:

(a) with the efficient information support of the PMIS, the CEDD would formulate a pro-active preventive maintenance strategy for government and public marine facilities; and

(b) under this preventive maintenance strategy:

(i) the maintenance and repairs of reinforced concrete piers could be carried out at an early stage before the occurrence of extensive corrosion;

(ii) maintenance cost would be reduced in the long run; and

(iii) the service life of marine facilities could be prolonged, leading to cost savings.

3.20 Audit considers that there is a need for the CEDD to:

(a) integrate information on the structural condition of a pier (obtained from visual inspections and detailed investigations) into the PMIS; and

(b) ensure that the PMIS is capable of capturing and generating the necessary management information for formulating comprehensive and effective preventive maintenance strategies for different types of piers.

Need to determine the repair option for individual pier

3.21 In the 1995 consultancy study (see para. 2.6(e)), the consultant, in conjunction with the CEDD, assessed the remaining service life of 86 piers for determining the appropriate repair options (see para. 3.10).

3.22 Audit noted that, of the 144 piers maintained by the CEDD, 30 (21%) were over 40 years old (see Table 3 and Appendix B).

Table 3

Age analysis of the 144 piers
(1 July 2005)

Age	Number	
0 – 10	48	
11 – 20	31	
21 – 30	15	
31 – 40	18	
41 – 50	20	30 (21%)
Over 50	10	
Not traceable	2	
Total	**144**	

Source: CEDD records

3.23 **Audit considers that the CEDD needs to, in consultation with the managing department concerned (e.g. the Transport Department for public and ferry piers), determine an appropriate repair option for each pier over 40 years old, before carrying out major maintenance or improvement works.**

Need to take into account utilisation and future use

3.24 In view of the development of land transport, the demand for waterborne transport is diminishing, especially in the harbour area. Moreover, plans for reclamation and land development also affect the future use of some piers. Audit noted that the utilisation of some piers would be affected by planned future developments (see for example items 4, 5 and 6 in Appendix C). **Audit considers that the CEDD needs to consult the managing department concerned before carrying out major maintenance works of a pier, particularly if there are indications that its utilisation is low or its future use is in doubt.**

Audit recommendations

3.25 **Audit has *recommended* that the Director of Civil Engineering and Development should:**

(a) **promptly update the priority list:**

(i) **after each visual inspection (see para. 3.12);**

(ii) **when a pier is no longer maintained by the CEDD (see para. 3.12); and**

(iii) **after structural repair works have been performed (see para. 3.12);**

(b) **adopt different maintenance strategies for reinforced concrete piers, solid piers and prestressed concrete piers (see paras. 3.13, 3.15 and 3.17);**

(c) **conduct a review to determine whether, for the purpose of the maintenance programme, solid piers with suspended beams should also be classified as reinforced concrete piers (see para. 3.16);**

(d) **improve the arrangements for conducting detailed investigations by:**

(i) **making reference to the deterioration indices as far as possible (see para. 3.18(a));**

(ii) **using standardised forms for documenting the results of detailed investigations (see para. 3.18(b)); and**

(iii) **updating promptly the deterioration index after the completion of a detailed investigation (see para. 3.18(c));**

(e) **take action to ensure that the PMIS is capable of capturing the results of visual inspections and detailed investigations, and generating management information for formulating comprehensive and effective preventive maintenance strategies for different types of piers (see para. 3.20);**

(f) **in consultation with the managing department concerned, determine an appropriate repair option for each pier over 40 years old (see para. 3.23); and**

(g) **consult the managing department concerned before carrying out major maintenance works of a pier, particularly if there are indications that its utilisation is low or its future use is in doubt (see para. 3.24).**

Response from the Administration

3.26 The **Director of Civil Engineering and Development** agrees with the audit recommendations in paragraph 3.25. He has said that:

(a) the CEDD will review the condition survey system used for assessing the structural conditions of piers with a view to simplifying the inspection workflow and procedures for different types of piers. The PMIS will be suitably upgraded to integrate any revised inspection workflow and procedures; and

(b) the visual inspections and the use of the deterioration index for determining the maintenance priority is not suitable for prestressed concrete piers. The CEDD will state clearly this limitation in the Maintenance Manual for Marine Facilities. It will remove prestressed concrete piers from the deterioration-index database and the priority list and give them a separate classification for maintenance purpose.

3.27 The **Commissioner for Transport** supports the audit recommendations in paragraphs 3.25(f) and 3.25(g). He has said that:

(a) in determining appropriate repair options for public piers over 40 years old or before carrying out major maintenance works of these piers, the Transport Department will assist the CEDD by providing comments from the utilisation point of view; and

(b) for piers which are used exclusively for ferry services, the Transport Department will assist the CEDD by consulting the ferry operators on the CEDD's proposed repair option.

PART 4: IMPLEMENTATION OF IMPROVEMENT WORKS PROJECTS

4.1 This PART examines the CEDD's implementation of improvement works projects for public marine facilities, with particular reference to the fender upgrading programme.

Improvement works projects

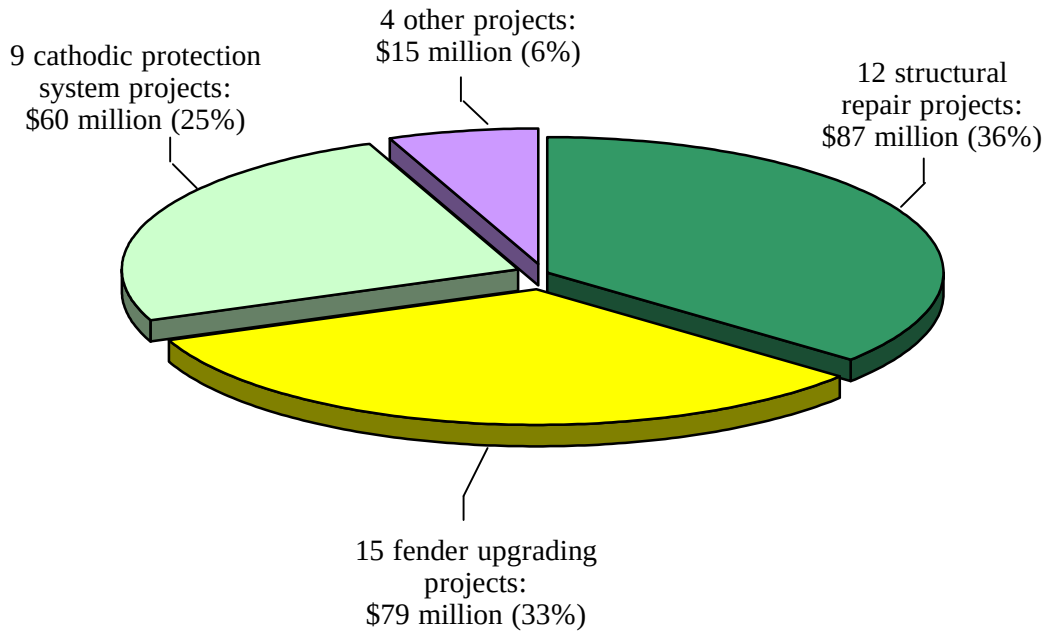
4.2 The CEDD's routine maintenance and repairs of public marine facilities are usually funded by a recurrent vote and carried out by its maintenance term contractors. Large-scale improvement works projects of a non-recurrent nature usually have a well-defined scope and a specific design. For improvement works projects costing not more than $15 million each, they are funded by a non-recurrent vote under the Capital Works Reserve Fund (Note 9). For projects costing over $15 million each, the funding approval of the Finance Committee of the Legislative Council is required.

4.3 In the ten-year period from 1995-96 to 2004-05, the CEDD implemented 40 improvement works projects for public marine facilities at a total approved project estimate of $241 million (see Figure 5).

Note 9: *The non-recurrent vote is 5101CX "Civil engineering works, studies and investigations for items in Category D of the Public Works Programme".*

Figure 5

Approved project estimates of improvement works projects (1995-96 to 2004-05)



Source: CEDD records

Maintenance term contracts

4.4 The CEDD awards term contracts for carrying out maintenance works and minor works. Under a term contract, the appointed term contractor undertakes works for a fixed term. The quantity of works to be carried out is not specified in the contract. During the contract period, the CEDD issues works orders to the contractor for executing works as and when required. He is remunerated for the works completed based on a **Schedule of Rates.** For works items not included in the Schedule of Rates or specified as **net-invoice-price items,** he is remunerated for the actual cost of executing the works, or the net invoice price of the procurement items, plus 15% for overheads and profits. The CEDD usually manages three term contracts for the maintenance of public marine facilities. These term contracts are re-tendered upon expiry (see Table 4).

Table 4

Term contracts for the maintenance of public marine facilities

Scope of maintenance and repairs	Expired contracts			Current contracts		
	Contract	**Commencement**	**Duration (months)**	**Contract**	**Commencement**	**Duration (months)**
Seawalls and other port works	**A**	January 2002	33	**D**	October 2004	36
Government and public piers	**B**	April 2002	33	**E**	January 2005	36
Licensed and franchised ferry piers	**C**	May 2002	36	**F**	June 2005	36

Source: CEDD records

Audit observations

Need to invite separate tenders for improvement works projects

4.5 As laid down in the CEDD's Project Administration Handbook for Civil Engineering Works (hereinafter referred to as the Project Administration Handbook), new works projects funded by non-recurrent votes are normally subject to separate tender procedures. The Project Administration Handbook states that maintenance term contractors may be used for such projects if **both** of the following conditions are met:

(a) either:

(i) the works required are urgent. It would cause unacceptable delay if the normal tender procedures are followed; or

(ii) there are other compelling reasons for not using the normal tender procedures, e.g. shortage of staff to prepare tender documents; or

(iii) it is reasonably certain that the use of a term contractor is the more economical option, taking into consideration the maintenance rates and savings of departmental expenditure, e.g. savings in overheads due to earlier completion of the works; and

(b) the scheduled rates (see para. 4.4) are reasonable in relation to the related works and the scheduled completion time.

4.6 The Financial Services and the Treasury Bureau has laid down guidelines on the carrying out of capital works chargeable to a non-recurrent vote under term contracts. In February 1995, the then Secretary for the Treasury issued a memorandum setting out the financial limits and authority for approval and reminding the departments concerned that:

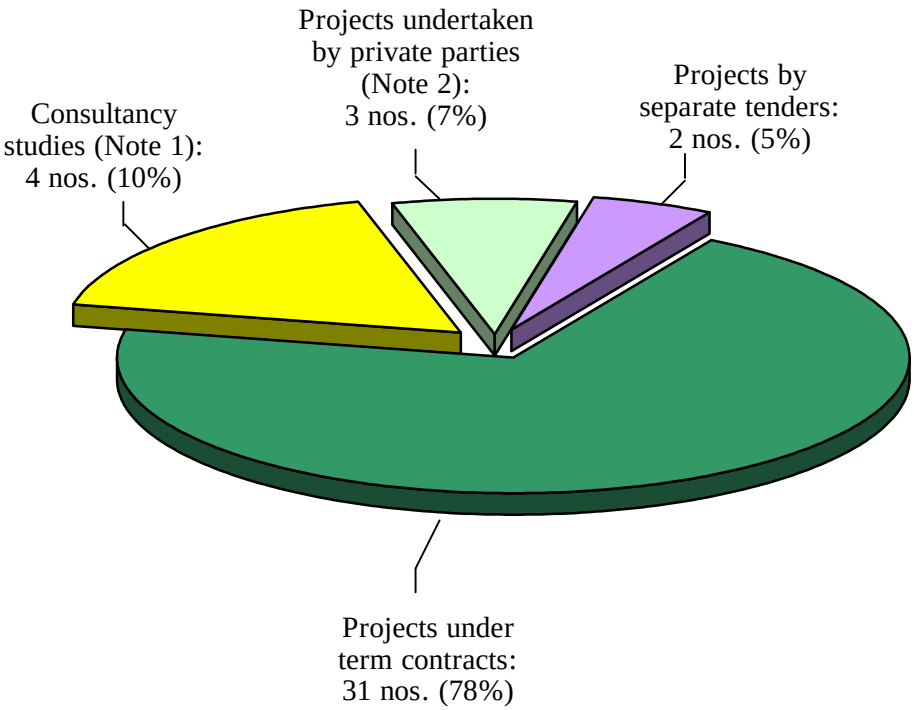
(a) the authority delegated to departments amounted to a waiver of the normal tender procedures to enable the new works to be awarded to a single tenderer; and

(b) in exercising the delegated authority, the officers responsible should satisfy themselves that the conditions (see para. 4.5) set out in the Project Administration Handbook were met.

4.7 Audit's examination revealed that, of the 40 improvement works projects (including 4 consultancy studies) on public marine facilities carried out by the CEDD in the past ten years (see Figure 5 in para. 4.3), 31 (78%) were carried out under the term contracts instead of by separate tenders (see Figure 6).

Figure 6

Contract arrangements for improvement works projects (1995-96 to 2004-05)



Source: *CEDD records*

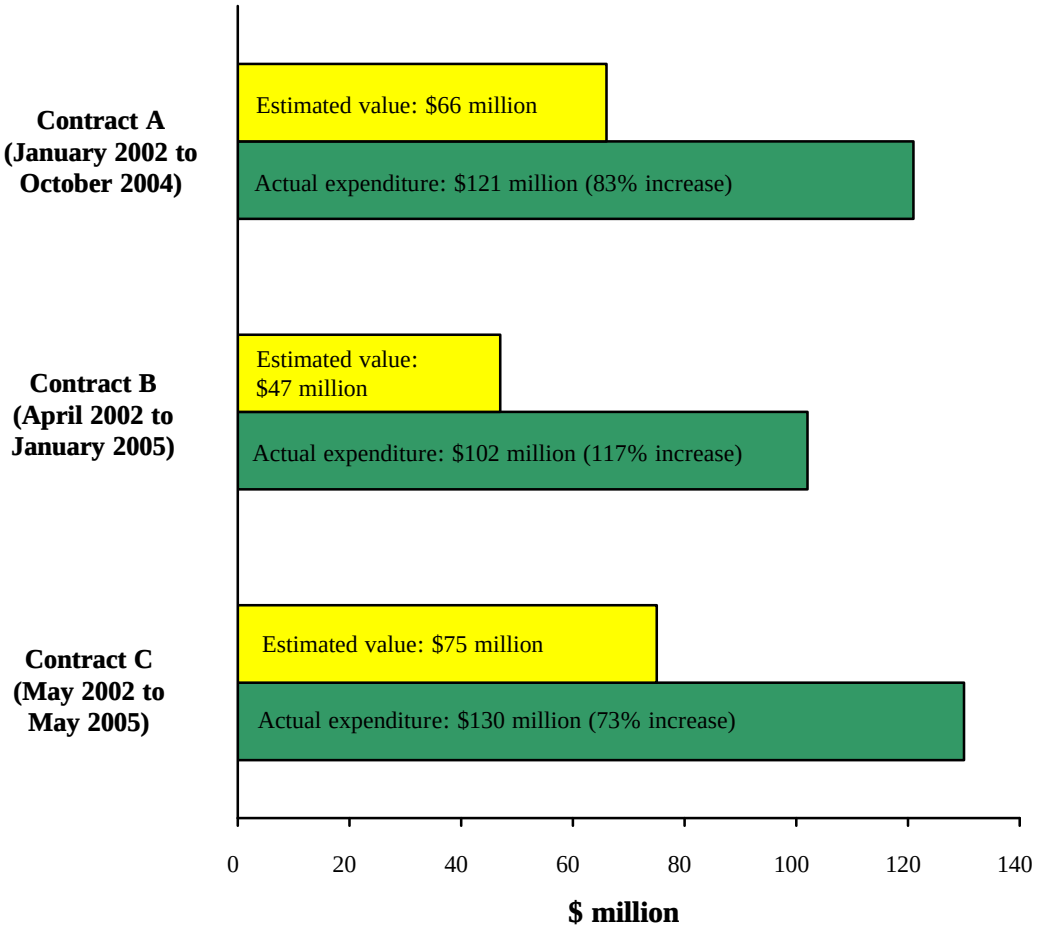
Note 1: *These studies related to consultancy studies on investigation, design and supervision of works.*

Note 2: *These projects were undertaken by ferry operators in 1998 for the maintenance of ferry piers, with costs reimbursed by the CEDD.*

4.8 To indicate the quantity of works to be carried out by the successful term contractor, the CEDD included in the tender documents the estimated value of works for the duration of the term contract. Audit noted that the CEDD's actual expenditures incurred under the three term contracts (see Table 4 in para. 4.4) exceeded the estimated values by 73% to 117% (see Figure 7).

Figure 7

Expenditure under three term contracts



Source: CEDD records

4.9 The increase in the actual expenditure over the estimated value indicated that the improvement works might not have been fully anticipated at the time of estimating the value of works for the term contracts. The carrying out of improvement works under the term contracts deprived other contractors an opportunity to tender for the works.

4.10 **Audit considers that the CEDD should have invited separate tenders for the improvement works projects.** This is because a term contract based on a Schedule of Rates is intended mainly for maintenance works (i.e. the scope of works is dependent on maintenance needs). In contrast, the scope of works under an improvement works project is usually well defined according to a specific design. Separate tenders may yield competitive bids.

4.11 In December 2005, the CEDD informed Audit that:

(a) the CEDD had carried out two structural repair projects in 1996 and 1999 by separate tenders, but there were contract management problems. As a result, the CEDD would prefer to use term contractors for improvement works projects of a maintenance nature;

(b) the use of term contractors helped resolve some contract management issues, e.g. changes in schedule, variations of works, and dealing with ferry operators' requirements;

(c) there were instances where it was necessary to fast-track the implementation of the improvement works projects by using the term contractors;

(d) the inclusion of improvement works under the term contracts was based on economical consideration. The CEDD considered that this arrangement could lead to savings in terms of less expenditure on overheads, temporary accommodation, safety provisions, insurance and marine transport; and

(e) approvals at the appropriate levels had been sought in all cases involving the use of term contractors for improvement works projects chargeable to the non-recurrent vote.

4.12 **Audit considers that, as it is government policy to promote open and fair competition in the procurement of public works, there is a concern over the CEDD's reliance on term contractors to carry out improvement works projects. Having regard to the guidelines in paragraphs 4.5 and 4.6, the CEDD needs to consider putting some improvement projects to tender to see if it is a cost-effective option. To minimise contract management efforts, low-value projects could be bundled up in one works contract for tendering.**

4.13 Regarding the CEDD's need to fast-track the implementation of some improvement works projects, Audit noted that, in October 2001, the Government introduced simplified tendering arrangements for capital works under Financial Circular No. 10/2001. Under the new arrangements, controlling officers are authorised to approve the award of works contracts under $15 million each without recourse to the Public Works Tender Board/Central Tender Board. As a result, the lead time between tender invitation and the award of a works contract under $15 million is reduced from 9-11 weeks to 4-6 weeks.

4.14 Based upon the findings of this audit review, Audit considers that the CEDD needs to consider inviting separate tenders for implementing improvement works projects, particularly the following:

(a) projects involving large-scale construction works with a well-defined scope and a detailed design, e.g. a pier reconstruction project (see para. 4.15);

(b) projects with works items of significant value that do not have scheduled rates in the term contracts (see para. 4.16); and

(c) projects of a specialised nature, e.g. installation of cathodic protection systems (see para. 4.18).

Improvement works projects particularly in need of separate tenders

4.15 ***Projects with a well-defined scope and a detailed design.*** The CEDD recently commenced the reconstruction of the Tung Ping Chau Public Pier under Contract E (see Table 4 in para. 4.4 – Note 10). In the Schedule of Rates of Contract E, the CEDD included a separate section with the heading of "Works in Tung Ping Chau Public Pier". The approved estimate for this project was $8.9 million. The scope of works included:

(a) demolition of the reinforced concrete catwalk;

(b) construction of a 33 metre-long and 5.5 metre-wide catwalk;

(c) widening (from 3 metres to 5.5 metres) of the existing embankment;

(d) construction of a roof cover at the existing pier head; and

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Note 10: *Upon the expiry of Contract B in January 2005, a new term contract (Contract E) commenced in January 2005 for a duration of 36 months.*

(e) installation of floor finishings, handrails, benches and a notice board.

In view of the well-defined scope and detailed design of the Tung Ping Chau Public Pier project, Audit considers that the CEDD should have assessed the merits of inviting tenders for this project.

4.16 ***Projects with works items that do not have scheduled rates.*** Of the total cost of $73.6 million incurred for the 15 fender upgrading projects carried out under the term contracts, $24.9 million (34%) were for the supply of plastic fenders. Under these term contracts, the supply of plastic fenders was set out as a net-invoice-price item because the fender specifications and rate could not be determined before the letting of the contracts. Under the term contracts, the contractors were reimbursed the actual cost for the supply of plastic fenders plus 15% for overheads and profits. **Audit considers that it may have been more cost effective for the CEDD to invite separate tenders for the fender upgrading projects, instead of carrying out the works under term contracts (see paras. 4.21 to 4.22).**

4.17 ***Projects of a specialised nature.*** Since 2000, the CEDD has commenced installing cathodic protection systems (Note 11) at reinforced concrete piers. The CEDD did not have previous experience of installing these systems. Up to December 2005, the CEDD had carried out projects for installing the cathodic protection systems at seven piers, with individual approved project estimates ranging from $4.3 million to $11.6 million. **Despite the specialised nature and high value of the works, the CEDD used the term contractors to carry out the works.**

4.18 As the installation works were of a specialised nature, the CEDD required the term contractors to provide a cathodic protection engineer and a specialist with the requisite qualifications and experience to undertake the works. The term contractors sub-contracted the works to specialist contractors. **In view of these facts, Audit considers that the CEDD should have invited separate tenders for such projects.**

Need for contractors to provide required number of quotations

4.19 As laid down in the CEDD's term contracts, for the supply of materials based on the net invoice prices, the contractors had to submit quotations of at least five suppliers to the CEDD for assessment. Audit's examination of the 23 works orders for the supply of plastic fenders between January 2002 and September 2004 under the three term contracts

Note 11: *A cathodic protection system prevents corrosion of steel reinforcement embedded in concrete by applying an external electric current to the steel to counteract the corrosion current.*

revealed that, in all 23 cases, although the contractors had invited five or more suppliers to submit quotations, they received less than five quotations for submission to the CEDD. In 19 cases, the contractors were only able to obtain quotations from two suppliers. In response to Audit's enquiry, the CEDD said that as the number of manufacturers was limited, the contractors were unable to obtain five quotations as required.

Need to vigilantly examine unit cost of plastic fenders

4.20 Audit's examination of the 23 works orders for the supply of plastic fenders revealed that there were wide variations in the unit costs, ranging from $19,483 per cubic metre to $34,382 per cubic metre. Audit noted that the CEDD assessed the quotations based on the total invoice costs. The CEDD did not assess the reasonableness of the unit costs. The CEDD also did not compare such unit costs with those under previous works orders or under other contracts. Audit considers that there is scope for improvement in this area.

4.21 Audit noted that the average unit costs of plastic fenders of the three contracts varied significantly. Contract A had the highest average unit cost ($29,526 per cubic metre) whereas Contract C had the lowest ($22,447 per cubic metre). **Audit considers that the CEDD could achieve savings by inviting separate tenders for the fender upgrading projects, and for the supply of plastic fenders.**

4.22 In response to Audit's enquiry, the CEDD said that:

(a) the unit costs of plastic fenders varied, depending on their size and their availability in the market at the prevailing time; and

(b) the specifications and scheduled rate (at $21,500 per cubic metre) for the supply of plastic fenders had been incorporated in the subsequent term contracts, i.e. Contract D, Contract E and Contract F (see Table 4 in para. 4.4).

Audit recommendations

4.23 **Audit has *recommended* that the Director of Civil Engineering and Development should:**

(a) **consider inviting separate tenders (instead of using term contractors) for improvement works projects funded by the non-recurrent vote, in particular:**

(i) **projects involving large-scale construction works with a well-defined scope and a detailed design (see paras. 4.14(a) and 4.15);**

(ii) **projects with works items of significant value that do not have scheduled rates in the term contracts (see paras. 4.14(b) and 4.16); and**

(iii) **projects of a specialised nature (see paras. 4.14(c) and 4.18);**

(b) **take action to ensure that the required number of quotations is submitted by term contractors for procuring net-invoice-price items (see para. 4.19);**

(c) **when assessing the quotations submitted by a term contractor for procuring a net-invoice-price item, calculate its unit cost so that a cost comparison with similar items supplied under other works orders or other contracts can be made (see para. 4.20); and**

(d) **review the arrangements for the procurement of plastic fender in future fender upgrading projects with a view to achieving better cost-effectiveness (see para. 4.21).**

Response from the Administration

4.24 The **Director of Civil Engineering and Development** agrees with the audit recommendations in paragraph 4.23. He has said that:

(a) the cathodic protection system is a specialised technique and is new to the maintenance of marine facilities in Hong Kong. When first adopting this system, the CEDD had to enlist the support of the term contractors in order to bring in the new expertise. With the gradual development of the local market, the CEDD will consider inviting separate tenders for the installation of cathodic protection systems on a trial basis;

(b) the CEDD adopted a quotation system for the supply of plastic fenders in the previous three term contracts because there was insufficient information for establishing the relevant rates in the contracts. At that time, plastic fenders were new to the CEDD and their supply in the market was very limited. With the assistance of the term contractors, the CEDD could identify competitive manufacturers for providing the fender materials; and

(c) the CEDD has included a scheduled rate for the supply of plastic fenders in the three current term contracts. The CEDD will further review the procurement of plastic fenders upon the expiry of the contracts and consider all appropriate options with a view to achieving further improvement in cost effectiveness.

4.25 The **Secretary for the Environment, Transport and Works** agrees that the CEDD can consider inviting separate tenders for implementing certain improvement works funded by the non-recurrent vote having regard to the merits of individual cases. She has said that:

(a) the CEDD is permitted under the established procedures to carry out improvement works projects using maintenance term contractors subject to the conditions in the Project Administration Handbook; and

(b) the provisions in the Handbook enable the works departments to strike a balance between the potential benefit and the additional time and cost arising from inviting separate tenders for improvement works projects. The existing practice ensures adequate check and balance on the proper use of term contracts in carrying out such works.

Fender upgrading programme

4.26 Fenders are installed at landing facilities to protect the structures and the vessels. Traditionally, hardwood timber has been used. Hardwood timber is not a sustainable natural resource and using it as fender material is considered not environmentally friendly.

4.27 In order to minimise the use of hardwood timber, the CEDD studied the use of plastic and rubber fenders. In 2000, the CEDD commenced trial installations of non-timber fenders at selected piers and landings. The overall performance was satisfactory. In 2003, the CEDD commenced an upgrading programme to replace timber fenders with plastic fenders (mainly for reinforced concrete piers) and rubber ones (mainly for seawall landings).

4.28 The fender upgrading programme was implemented under improvement works projects funded under the Capital Works Reserve Fund. Up to March 2005, the CEDD had carried out 15 fender upgrading projects with a total approved project estimate of $79.4 million.

Cost effectiveness of new fenders

4.29 In April 2005, the CEDD conducted a review of the use of plastic or rubber fenders. The review indicated that plastic or rubber fenders were more cost-effective than timber fenders due to their longer service life (see Table 5).

Table 5

Installation cost of fenders

Fender type	Installation cost (Note)	Estimated service life	Average installation cost per year
	($ per cubic metre)	(years)	($ per cubic metre)
	(a)	(b)	(c) = (a) ÷ (b)
Timber	12,395	5	2,479
Plastic	**27,045**	15	1,803
Rubber	**31,280**	20	1,564

Source: *CEDD records*

Note: *Installation cost includes both material cost and labour cost.*

The CEDD concluded that:

(a) with the use of plastic and rubber fenders, the frequency of fender repairs would be reduced (due to their enhanced durability), resulting in lower maintenance costs; and

(b) the disruption to ferry services and disturbance to the public due to maintenance works would also be reduced.

Berthing practice under the new fenders

4.30 The CEDD's review also identified the physical characteristics of different types of fenders (see Appendix D). The CEDD found that:

(a) the energy absorption capacities of different fenders were different;

(b) in the course of berthing, loads would be generated between the vessel and the landing facility. The magnitude of the loads would depend not only on the size and velocity of the vessel, but also on the nature of the structure, including any fenders, and the degree of resilience of the structure; and

(c) in terms of the berthing comfort of vessels, plastic and timber fenders were similar because they had similar engineering properties. Rubber fenders could provide better berthing comfort because of their higher energy absorption capacity.

Audit observations

Need for a cost-effective fender upgrading programme

4.31 **In view of the high initial cost of plastic and rubber fenders, Audit considers that the CEDD needs to adopt a cost-effective approach to formulating the fender upgrading programme.** In particular, the CEDD should take into account the utilisation and future use of the landing facilities (by consulting the managing departments) in formulating the fender upgrading programme. For landing facilities with low utilisation, or if the future use of the landing facilities is dependent on future development, they should be given a low priority.

4.32 **In upgrading the fenders of large ferry piers, Audit considers that the CEDD needs to give different priorities to berthing zones and non-berthing zones.** At the non-berthing zone of a ferry pier, the timber fenders usually stay in a better condition as there is less wear and tear. These timber fenders could be replaced at a later stage.

4.33 In response to Audit's enquiry, the CEDD said that:

(a) the carrying out of fender upgrading works at a pier depended on the conditions of the fenders;

(b) the CEDD would inspect the fenders in detail before carrying out upgrading works; and

(c) the CEDD would only replace the fenders at a particular zone of a pier if they had deteriorated.

Need to review the performance and durability of new fenders

4.34 The use of plastic and rubber fenders is new in Hong Kong. At present, there is not much data about their performance and durability in the Hong Kong environment. The CEDD has gathered performance data since 2002 upon the completion of the fender upgrading works at several large piers. The service life estimates of plastic and rubber fenders were based on the warranty information provided by the manufacturers, experience in the United States, and the experience in Hong Kong since 2002. **Audit considers that the CEDD needs to closely monitor the long-term performance and durability of these new fenders.**

4.35 ***Audit field inspections.*** In October and November 2005, Audit conducted several site visits to observe the fenders installed. Audit noted the following:

(a) there were damages to rubber fenders at two piers, namely:

  (i) Tung Lung Chau (North) Pier (see Photograph 4); and

  (ii) Mo Tat Wan (North) Pier;

(b) there were scratch marks on the plastic fenders installed at North Point (West) Ferry Pier (see Photograph 5);

(c) rubber tyres were installed at four ferry piers in Central District, covering the plastic or rubber fenders recently installed, namely:

  (i) Central Pier No. 2;

  (ii) Central Pier No. 3;

  (iii) Central Pier No. 4 (see Photograph 6); and

  (iv) Central Pier No. 6; and

(d) two piers in Central District with timber fenders did not have rubber tyres installed, namely:

  (i) Central Pier No. 5 (see Photograph 7); and

  (ii) Edinburgh Place Pier (Star Ferry).

Audit considers that the CEDD needs to investigate the reasons for the fender damages.

Photograph 4

A damaged rubber fender at Tung Lung Chau (North) Pier

Source: Photograph taken by Audit in November 2005

Photograph 5

Plastic fenders at North Point (West) Ferry Pier with scratch marks

Source: Photograph taken by Audit in November 2005

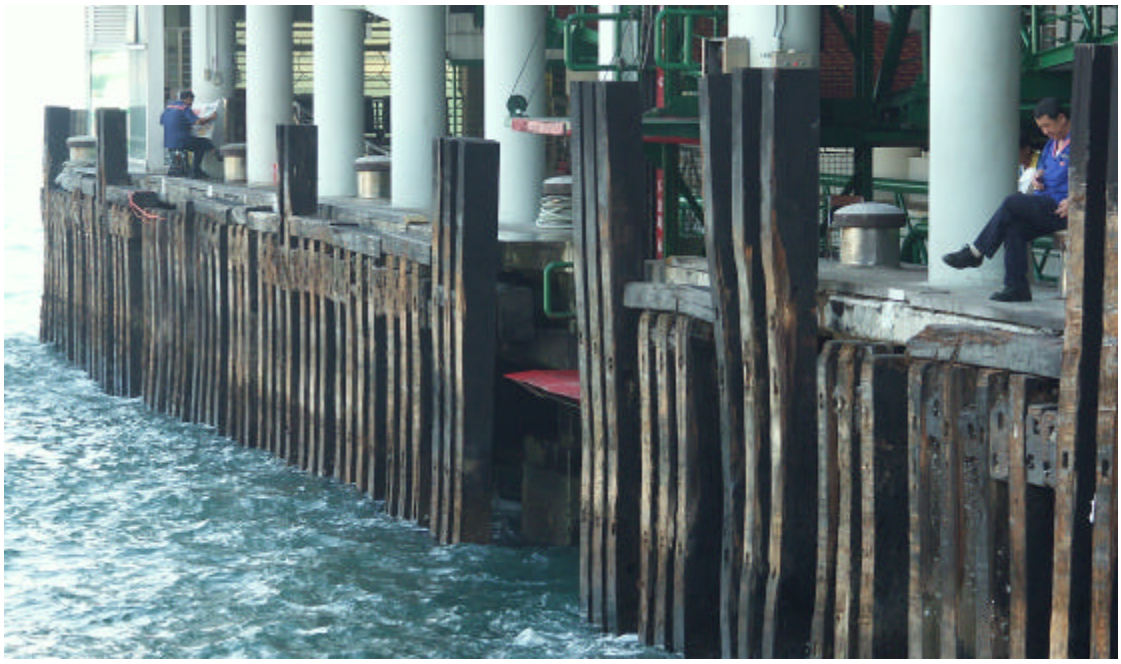
Photograph 6

Plastic fenders at Central Pier No. 4 covered with rubber tyres

Source: Photograph taken by Audit in October 2005

Photograph 7

Timber fenders at Central Pier No. 5 without rubber tyres



Source: Photograph taken by Audit in October 2005

4.36 **Audit considers that the CEDD needs to closely liaise with ferry operators and take into account their views in assessing the performance and durability of the new fenders. The berthing practice of ferry operators may also affect the durability of fenders. It is important that the CEDD should liaise with the ferry operators to ascertain if they have adopted an appropriate berthing practice, having regard to the physical properties of the new fenders.**

Audit recommendations

4.37 **Audit has *recommended* that the Director of Civil Engineering and Development should:**

(a) **adopt a cost-effective approach to formulating the fender upgrading programme by taking into account the future use of the landing facilities (see para. 4.31); and**

(b) **in consultation with the Commissioner for Transport:**

(i) **closely monitor the long-term performance and durability of the new fenders installed at ferry piers, taking into account the views of the ferry operators (see paras. 4.34 and 4.36); and**

(ii) **liaise with the ferry operators to ascertain if they have adopted an appropriate berthing practice, having regard to the physical properties of the new fenders (see para. 4.36).**

Response from the Administration

4.38 The **Director of Civil Engineering and Development** agrees with the audit recommendations in paragraph 4.37. He has said that the CEDD will consult the ferry operators, as users of ferry piers, about the performance and durability of plastic fenders recently installed, and make enquiries about the reasons as to why some plastic fenders are covered with rubber tyres.

4.39 The **Commissioner for Transport** supports the audit recommendations in paragraph 4.37(b). He has said that the Transport Department will assist the CEDD in liaison with the relevant ferry operators on the issues.

PART 5: MAINTENANCE RESPONSIBILITIES OF OTHER GOVERNMENT DEPARTMENTS

5.1 This PART examines the responsibilities of government departments other than the CEDD for pier maintenance.

Other government departments' involvement in pier maintenance

5.2 Apart from the CEDD (which is the major department responsible for maintaining public marine facilities), some other departments are also involved in pier maintenance (see Table 6).

Table 6

Other government departments' involved in pier maintenance

Government department	Maintenance works	Maintenance cost in 2004-05 ($ million)
EMSD	Electrical and mechanical installations of CEDD piers, including lighting and lift-and-ramp systems of ferry piers.	61.9 (Note)
ArchSD	Superstructure items above the deck of CEDD piers, including roof covers and building structures (see paras. 5.8 to 5.11).	16.5
HAD	Overall maintenance of 46 small public piers in the New Territories (see paras. 5.3 to 5.7).	Nil

Source: *Records of the EMSD, ArchSD and HAD*

Note: *The maintenance cost of $61.9 million was the service fees the Electrical and Mechanical Services Trading Fund received from departments for the maintenance of piers, including the Marine Department and the Transport Department (see Note 3 in para. 1.10).*

5.3 In the past, the HAD constructed a number of public piers in the New Territories, including:

(a) ***Piers built under the Rural Planning and Improvement Strategy Minor Works Programme (hereinafter referred to as Minor Works Programme).*** These piers, each costing not more than $15 million, were built to the standards and specifications of the Port Works Design Manual issued by the CEDD. The CEDD took over the maintenance of these piers after their completion; and

(b) ***Piers built under minor works projects.*** These piers, each usually costing below $3 million, were not built to the standards and specifications of the Port Works Design Manual. The HAD was responsible for maintaining these piers after their completion.

Table 7 and Table 8 show the HAD expenditure on pier maintenance and the number of piers by district respectively.

Table 7

The HAD's expenditure on repair and maintenance of piers (2001-02 to 2005-06)

District	2001-02 ($'000)	2002-03 ($'000)	2003-04 ($'000)	2004-05 ($'000)	2005-06 (Estimate) ($'000)	Total ($'000)
Islands	–	–	937	–	1,144	2,081
Sai Kung	–	627	–	–	–	627
North	423	–	–	–	–	423
Tsuen Wan	17	–	–	–	–	17
Tai Po	–	–	–	–	–	–
Total	**440**	**627**	**937**	**–**	**1,144**	**3,148**

Source: HAD records

Table 8

Piers maintained by the HAD
(September 2005)

District	Number of piers		
	Piers with reinforced concrete elements (see Photograph 8)	Solid piers without reinforced concrete elements (see Photograph 9)	Total
Islands	9	7	16
Sai Kung	7	1	8
North	–	6	6
Tsuen Wan	3	2	5
Tai Po	11	–	11
Total	**30**	**16**	**46**

Source: HAD records

Photograph 8

An HAD pier with reinforced concrete elements
(Sai Kung – Kiu Tsui)

Source: Photograph taken by Audit

Photograph 9

An HAD solid pier without reinforced concrete elements (Lantau Island – Nim Shue Wan)

Source: Photograph taken by Audit

5.4 As stated in paragraph 5.3, the CEDD took over the maintenance responsibility for piers constructed by the HAD under the Minor Works Programme, because these piers were built to the standards and specifications of the CEDD. The smaller piers built under the HAD's minor works projects were not taken over.

Audit observations

Room for improvement in HAD's maintenance of piers

5.5 Audit's examination in 2005 revealed that there was room for improvement in the HAD's maintenance of the 46 piers. Audit noted that the HAD:

(a) normally carried out pier inspections during the inspections of nearby HAD projects, or upon receipt of requests from village representatives or referrals from other government departments. The HAD did not have a maintenance programme for conducting regular pier inspections. On the other hand, the CEDD conducted regular inspections based on a programme (see para. 3.3);

(b) had no records of the last inspections of 22 piers;

(c) did not take prompt action to rectify the defects of three piers identified in July and August 2004 (Note 12); and

(d) did not install information plates to show a pier's marine structure number, the government department responsible for maintenance, and the telephone number for enquiries and reporting defects. Unlike the HAD, the CEDD installed such information plates at the piers under its maintenance (see Photograph 10). Such information plates would provide useful information to pier users.

Photograph 10

Information plates installed at a CEDD pier
(Cheung Sha Wan – Water Boat Dock Pier)

Source: Photograph provided by the CEDD

Note 12: *The three piers were as follows:*

(a) pier at Tai Long Wan – there was serious rusting on a galvanised channel beam;

(b) pier at Ha Keng – there was settlement of steps; and

(c) pier at Siu A Chau – there was a broken concrete slab.

5.6 In September 2005, in response to Audit's enquiry, the HAD said that, in view of the age of some piers, it was reviewing the need for periodic checks of the piers which required maintenance to a high standard to ensure public safety. Audit welcomes the HAD's initiative in strengthening its maintenance efforts. **Audit considers that, before the CEDD takes over the maintenance responsibilities for piers from the HAD (see para. 5.7), the HAD needs to strengthen the arrangements for pier maintenance. As the CEDD possesses technical expertise and experience on pier maintenance, the HAD needs to seek technical support and expert advice from the CEDD.**

Benefits of CEDD taking over HAD's maintenance responsibility

5.7 **Audit considers that there are merits for the CEDD to take over the maintenance responsibilities for the 46 HAD piers (with and without reinforced concrete elements) for the following reasons:**

(a) **the 30 HAD piers with reinforced concrete elements (see Table 8 in para. 5.3) are subject to corrosion. These piers require professional monitoring of their structural conditions. The CEDD is the maintenance authority of public marine facilities and possesses the technical expertise and experience in the maintenance of reinforced concrete piers; and**

(b) **pooling of the maintenance responsibilities under the CEDD would have the benefits of economies of scale. As the CEDD uses term contractors for pier maintenance, it would be cost effective to the Government if the HAD piers are included in the CEDD's maintenance programme.**

Consideration for CEDD taking over more maintenance responsibility from ArchSD

5.8 For piers maintained by the CEDD, the CEDD is responsible for the civil engineering marine works. Two other works departments, namely the ArchSD and the EMSD (see Table 6 in para. 5.2), are also involved.

5.9 The three works departments (CEDD, ArchSD and EMSD) employ their own maintenance term contractors, conduct inspections and carry out maintenance works based on their own programmes. They liaise with other government departments responsible for managing the piers (Note 13).

Note 13: *(a) Transport Department – for ferry piers and public piers;*
(b) Marine Department – for the Macau Ferry Terminals and the China Ferry Terminal; and
(c) the respective user departments – for government piers.

5.10 In December 2004, the Environment, Transport and Works Bureau proposed that the CEDD should consider taking over the above-deck maintenance works from the ArchSD in respect of government and public piers. The Bureau considered that there would be advantages of streamlining all the structural maintenance works in one works department. With effect from 1 July 2005, the CEDD has assumed the maintenance responsibilities for the above-deck structures of 23 government and public piers (which had no substantial building works). Under the new arrangements:

(a) the ArchSD would provide technical support on the architectural and structural aspects to deal with emergency situation;

(b) the funding and working arrangements for electrical and mechanical works at the piers carried out by the EMSD remain unchanged; and

(c) the ArchSD retains the maintenance responsibilities for the above-deck structures of 63 piers with substantial building works.

5.11 The CEDD and the ArchSD considered that it would not be cost effective to further transfer the maintenance responsibilities for the remaining piers to the CEDD, given the different expertise of the two departments in building works and civil works. Audit concurs with the Bureau's proposal mentioned in paragraph 5.10. Nevertheless, the CEDD and the ArchSD may wish to keep in view the opportunity and benefits of further pooling the maintenance responsibilities for the piers in future.

Audit recommendations

5.12 **Audit has *recommended* that the Director of Civil Engineering and Development should, in collaboration with the Director of Home Affairs, explore whether there are merits of the CEDD taking over the HAD's maintenance responsibilities for small public piers (see para. 5.7).**

5.13 **Audit has *recommended* that the Director of Home Affairs should, before the transfer of the pier maintenance responsibilities to the CEDD, take action to:**

(a) **strengthen the HAD's maintenance efforts by:**

(i) **compiling a maintenance programme for conducting regular inspections of the piers (see para. 5.5(a))**;

(ii) **maintaining proper records of pier inspections (see para. 5.5(b));**

(iii) **taking prompt action to rectify defects identified (see para. 5.5(c)); and**

(iv) **installing information plates at the piers (see para. 5.5(d)); and**

(b) **seek technical support and expert advice from the CEDD on pier maintenance where necessary (see para. 5.6)**.

Response from the Administration

Audit recommendation in paragraph 5.12

5.14 The **Director of Home Affairs** welcomes and supports the audit recommendation. She has said that:

(a) there are merits for the CEDD to take over the maintenance responsibilities for the 46 HAD piers. The CEDD is the maintenance authority of public marine facilities and possesses the technical expertise and experience in the maintenance of reinforced concrete piers. In addition, the pooling of maintenance responsibilities under the CEDD would help achieve economies of scale and benefit the Government as a whole; and

(b) the HAD has requested the CEDD to consider taking over the maintenance responsibilities for the HAD piers. It will continue to discuss this matter further with the CEDD. The HAD will also facilitate the CEDD's taking over of the pier maintenance responsibilities as far as possible.

5.15 The **Director of Civil Engineering and Development** has said that the CEDD will consider taking over the HAD's maintenance responsibilities for small public piers after the HAD has upgraded these piers to the required standards and has decided how its related resources would be allocated to the CEDD.

5.16 The **Secretary for the Environment, Transport and Works** has said that she has no objection for the CEDD to explore the merits of taking over the HAD's maintenance responsibilities for small public piers. She has also said that:

(a) since these piers were not constructed up to the CEDD's standards, there is a need for the HAD to upgrade these piers to the required standards; and

(b) there is a need for the two departments to agree on the allocation of the related resources before consideration could be given to the transfer of the maintenance responsibilities.

5.17 The **Secretary for Financial Services and the Treasury** has said that the proposal of the CEDD taking over the HAD's maintenance responsibilities for small public piers should be based on the understanding that the transfer of the related HAD resources to the CEDD is cost-neutral.

Audit recommendations in paragraph 5.13

5.18 The **Director of Home Affairs** welcomes and agrees with the audit recommendations. She has said that:

(a) the HAD will compile a maintenance programme and conduct regular inspections of the piers with its available staff resources;

(b) the HAD has issued guidelines to its staff reminding them to maintain proper records of pier inspections;

(c) regarding the three piers mentioned in paragraph 5.5(c), repair works to the pier at Tai Long Wan are scheduled for completion in 2005-06. The HAD aims to rectify the defects of the other two piers in 2006-07;

(d) the HAD will install information plates at the piers in 2006-07; and

(e) the HAD has sought the CEDD's technical advice on complicated cases on the construction and maintenance of piers. It will continue this practice and seek the CEDD's technical support and expert advice where necessary.

Appendix A
(paras. 1.5 and 3.13 refer)

Reinforced concrete pier and solid pier

A reinforced concrete pier is built in the form of an open structure with steel reinforcement embedded in the concrete, and usually includes a suspended deck supported on piles (see Photograph 1). A solid pier is built in the form of a solid structure by mass concrete blocks with no steel reinforcement (see Photograph 2).

Photograph 1

A reinforced concrete pier
(Lai Chi Chong Public Pier)

Source: Photograph taken by Audit

Photograph 2

A solid pier
(Chek Keng Public Pier)

Source: Photograph taken by Audit

Appendix B
(para. 3.22 refers)

Piers over 40 years of age

Item	Name of pier	Age in 2005 (years)	Maintenance cost 2002-03 to 2004-05 ($'000)
1	Tai Tam Bay Pier	60	16
2	Tai Po Railway Pier	60	124
3	Sha Tau Kok Public Pier	60	3,213
4	Green Island Police Pier	60	93
5	Green Island CSD Pier	60	183
6	St. Stephen's Beach (South) Pier	60	18
7	Kennedy Town Poultry Pier	57	314
8	Tai O Public Pier	53	373
9	Tung Ping Chau Public Pier	51	102
10	Queen's Pier	51	398
11	Kowloon City Ferry Pier	50	62
12	Tap Mun Pier	47	184
13	Chi Ma Wan Pier	47	701
14	Tsim Sha Tsui Ferry Pier	47	3,921
15	Edinburgh Place Ferry Pier	47	623
16	Sok Kwu Wan Public Pier	46	488
17	Kei Ling Ha Hoi Pier	46	1,169
18	Ma Wan Public Pier	45	377
19	Cheung Chau Ferry Pier	45	1,412
20	Tung Chung Public Pier	44	1,341

Appendix B
(Cont'd)
(para. 3.22 refers)

Item	Name of pier	Age in 2005 (years)	Maintenance cost 2002-03 to 2004-05 ($'000)
21	Kwun Tong Public Pier	44	158
22	Sham Chung Pier	43	541
23	Lai Chi Chong Pier	43	771
24	Sham Tseng Public Pier	43	248
25	Shek Kwu Chau Pier	43	693
26	Kai Tak Pier	43	–
27	Yung Shue Wan Public Pier	42	2,008
28	Mui Wo Vehicular Ferry Pier	42	68
29	North Point (East) Ferry Pier	42	641
30	Tsim Bei Tsui Pier	41	543

Source: CEDD records

Appendix C
(para. 3.24 refers)

Maintenance of piers of low utilisation

Item	Name of pier	Age in 2005 (years)	Maintenance cost 2002-03 to 2004-05 ($'000)	Remarks
1	Kennedy Town Old Cattle Pier	31	495	The Kennedy Town Abattoir was closed in 1999. As a result, the need for these three piers diminished. In 2002, these piers were found to be illegally occupied. Clearance action was taken in early 2005. Since then, these piers had been fenced off and ceased operation.
2	Kennedy Town Incinerator Pier	39	–	
3	Kennedy Town Poultry Pier	57	314	
4	Sham Tseng Public Pier	43	248	This pier was severely deteriorated beyond economic repair. A new pier at Angler's Beach, which is near this pier, commenced operation in 2004.
5	Tung Chung Public Pier	44	1,341	The need for this pier is questionable due to the availability of land transport in the area. The licensed kaito service using this pier ceased operation in 2004.
6	Ma Wan Public Pier	45	377	The licensed ferry service using this pier ceased operation in 2005.
7	Tung Chung Development Pier	12	1,247	This is a temporary pier with a design life of 15 years for the Airport Core Project. This pier is approaching the end of its design life.
8	Tai Lei Island Pier	19	269	Tai Lei Island is connected by a bridge to Peng Chau where landing facilities are available. The need for this pier is questionable.

Source: CEDD records

Appendix D
(para. 4.30 refers)

Characteristics of different types of fenders

	Timber fenders	Plastic fenders	Rubber fenders
Strength	• low strength • moderate abrasive resistance	• strength similar to timber • higher abrasive resistance	• strength designed to requirements • higher abrasive resistance
Durability	• subject to rotting, marine borer attack • cracks will develop in insufficiently seasoned timber	• resistant to most biological and chemical attack, ultraviolet exposure and corrosion • **longer service life than timber fenders**	• resistant to most biological and chemical attack, ultraviolet exposure and corrosion • **longer service life than timber fenders**
Energy absorption capacity	• **lower energy absorption capacity**	• **moderate energy absorption capacity**	• **moderate to high energy absorption capacity**
Environmental consideration	• consumption of tropical hardwood, less environmentally friendly	• use of recycled material, more environmentally friendly	• use of natural or synthetic rubber, more environmentally friendly
Supply	• specific hardwood to meet the strength requirements	• plastic fenders with or without fibre glass reinforcement available	• a wide range of products available
Cost	• **lower initial cost but higher maintenance cost**	• **higher initial cost but lower maintenance cost relative to timber fenders**	• **higher initial cost but lower maintenance cost relative to timber fenders**

Source: CEDD records

Appendix E

Acronyms and abbreviations

ArchSD	Architectural Services Department
Audit	Audit Commission
CEDD	Civil Engineering and Development Department
EMSD	Electrical and Mechanical Services Department
HAD	Home Affairs Department
PMIS	Port Maintenance Information System