CHAPTER 10

THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

CAPITAL WORKS RESERVE FUND

GOVERNMENT SECRETARIAT

Works Bureau

GOVERNMENT DEPARTMENT

Highways Department

Construction of two bridges

Audit Commission
Hong Kong
12 October 2000

CONSTRUCTION OF TWO BRIDGES

Contents

CONSTRUCTION OF TWO BRIDGES

Summary and key findings

A. **Introduction.** Two bridges, Bridge A and Bridge B, were constructed to connect the urban areas of Hong Kong Island and Kowloon to the Western New Territories. Both bridges were completed within budget. These bridges have become landmarks of Hong Kong. The Highways Department (HyD) awarded two lump sum fixed-price contracts (Contract A and Contract B) for the construction of the two bridges. During the construction of the bridges, disputes arose between the HyD and the contractors. In the event, the HyD had to make additional payments to the contractors (paras. 1.1 to 1.4).

B. **Audit review.** Audit has recently carried out a review to ascertain why payments had been made to settle contractors' claims, whether there are lessons to be learnt, and whether there is room for improvement in project planning and contract administration. **In view of the contractual duty to maintain confidentiality of information relating to the contracts concerned, the Director of Highways raised his concerns over the potential disclosure of confidential contract information. After seeking advice from the Department of Justice, Audit has excluded the relevant information (i.e. detailed information relating to the contractors, the dispute resolution processes and the settlement sums) from the Report.** The audit findings are summarised in paragraphs C to E below (paras. 1.5 to 1.7).

C. **Construction of Bridge A.** During the construction of Bridge A, there was a change in the design of the lifts of the bridge towers in order to provide direct access to the lower deck. In the event, the HyD had to make an additional payment to the contractor of Contract A. Audit noted that the Employer's Requirements did not indicate that the lifts should have direct access to both decks of the bridge towers. Audit considers that the functional requirement of the lifts should have been defined clearly in the contract documents so as to obviate the need to make subsequent changes after the commencement of the design work (paras. 2.8 to 2.10).

D. **Construction of Bridge B.** In the design of long span bridges, there were a number of applicable codes of practice and standards available for determining the total wind load. However, Contract B and the "Structures Design Manual for Highways and Railways" (SDM) of the HyD did not specifically mention which wind load factor was to be used for determining the aerodynamic effects of wind. In the event, the HyD had to make an additional payment to the contractor of Contract B to settle the contractor's claim for additional costs. In Audit's view, it is important that in future contracts, the parameters to be used in design work should be clearly specified. The HyD should consider amending the SDM of the HyD to specify clearly the wind load factor to be used for determining the aerodynamic effects of wind in Hong Kong (paras. 3.11 and 3.12).

E. Contract B, which was a design-and-build contract and had to be completed within a relatively short period, did not specify any particular period of time for the review of design submissions. In the event, the HyD had to make an additional payment to the contractor of Contract B to settle the contractor's claims for additional costs. Audit considers that it is essential that, in future contracts, the criteria for determining the period allowed for the design review are clearly stipulated and sufficient milestones are set to control the design submission and design review process (paras. 3.19 and 3.20).

F. **Audit recommendations.** Audit has made the following main recommendations:

(a) the Director of Highways should:

(i) specify clearly the essential requirements in works contracts, particularly design-and-build contracts, so as to avoid having to make subsequent changes after the commencement of design work and to reduce the risk of abortive work (para. 2.11(a));

(ii) if there are different acceptable design parameters applicable under different codes of practice, specify clearly in contracts the design parameters to be used so as to avoid disputes arising from ambiguities and different interpretations of contract requirements (para. 3.13(a));

(iii) in his current review of the SDM of the HyD, consider amending the SDM to specify clearly the wind load factor to be used for determining the aerodynamic effects of wind in the design of bridges (para. 3.13(b)); and

(iv) if a project is to be designed by contractors or consultants, stipulate clearly the criteria for determining the period allowed for design review and set sufficient milestones to control the design submission and design review process (para. 3.22(a)); and

(b) the Secretary for Works should consider notifying in writing all works departments of the audit recommendations in order to minimise the occurrence of similar cases in future (para. 4.1).

G. **Response from the Administration.** The Director of Highways and the Secretary for Works have generally agreed with the audit recommendations.

PART 1: INTRODUCTION

Background

1.1 Two bridges, Bridge A and Bridge B, were constructed to connect the urban areas of Hong Kong Island and Kowloon to the Western New Territories. Both bridges were completed within budget. These bridges have become landmarks of Hong Kong.

Funding Approval

1.2 ***Bridge A.*** In the early 1990s, the Finance Committee (FC) of the Legislative Council approved the upgrading of a project to Category A (Note 1) of the Public Works Programme. The works included:

(a) the design and construction of Bridge A and a viaduct with the most economic form of construction to be proposed by the contractor; and

(b) the associated electrical and mechanical works and other miscellaneous works.

1.3 ***Bridge B.*** In the early 1990s, the FC approved the upgrading of another project to Category A of the Public Works Programme. The works included:

(a) a long span Bridge B to carry a dual three-lane carriageway;

(b) an approach viaduct and other roadworks; and

(c) the associated electrical and mechanical works and other miscellaneous works.

Note 1: *Public works projects are classified into several categories under the Public Works Programme. Category A projects are projects which are ready in all aspects for tenders to be invited and for construction works to proceed, and which have approved project estimates.*

Award of contracts

1.4 The Highways Department (HyD) awarded a total of two lump sum fixed-price contracts for the construction of Bridge A and Bridge B as follows:

	Bridge A	**Bridge B**
Contractor	Contractor A	Contractor B
Engineer or Supervising Officer for the Contract	Engineer (see paragraph 2.3 below)	Supervising Officer (see paragraph 3.2 below)
Contract type	Design-and-build	Design-and-build

During the construction of the bridges, disputes arose between the HyD and the contractors. In the event, the HyD had to make additional payments to the contractors.

Audit review

1.5 Audit has recently carried out a review to ascertain:

(a) why payments had been made to settle contractors' claims;

(b) whether there are lessons to be learnt; and

(c) whether there is room for improvement in project planning and contract administration.

1.6 In the course of this audit, in view of the contractual duty on the part of the Government and the contractors concerned to maintain confidentiality of information relating to the contracts in question, the Director of Highways raised his concerns over the potential disclosure of information provided by the contractors and information relating to dispute resolution processes in the Director of Audit's Report to be submitted to the President of the Legislative Council.

1.7 At Audit's request, in September 2000, the Director of Highways wrote to Contractor A and Contractor B to seek their consent to the disclosure of contract information in the Director of Audit's Report. However, both contractors declined to give their consent to the disclosure of contract information for the purpose of this audit review. **After seeking advice from the Department of Justice, Audit has excluded the relevant information (i.e. detailed information relating to the contractors, the dispute resolution processes and the settlement sums) from the Report. Therefore, Audit is only able to disclose in this Report the general information about the contract administration of the construction of Bridge A and Bridge B.**

PART 2: CONSTRUCTION OF BRIDGE A

2.1 This part examines the change in the design of the lift installed in each of the bridge towers of Bridge A. The audit has revealed that there is room for improvement in project planning and contract administration.

Design-and-build contract

2.2 As mentioned in paragraph 1.4 above, Contract A was a design-and-build contract. Design-and-build contracts differ from the conventional works contracts in which contractors are only required to carry out works that normally have been fully designed either by a works department or by its consultants. At the tender stage of a design-and-build contract, the tenderer is required to carry out design of the works to an extent sufficient for a tender to be prepared, and in compliance with the Government's requirements, known as the "Employer's Requirements". The Employer's Requirements normally include:

(a) all relevant information related to a project; and

(b) all the elements and requirements that the end user wants to be included, such as the requirements for design checking and the requirements for construction.

Based on the Employer's Requirements, the tenderer has to submit, in his tender, a technical proposal for carrying out, among other things, the design, the construction, and the coordination of the works, etc. The successful tenderer will commence the detailed design after the award of the contract.

2.3 The HyD appointed a consulting engineer as the Engineer for Contract A. The Engineer was required to undertake design checking duties in addition to site supervision duties.

Design change of the lift openings

2.4 According to the Employer's Requirements of Contract A, the scope of works, among other things, included the design and construction of a structure with two decks and the installation of electrical and mechanical equipment. Based on the Employer's Requirements, Contractor A prepared a technical proposal.

2.5 During construction of Bridge A, the Engineer issued a variation order to instruct Contractor A to design and to construct the lift openings to the lower deck in order to provide direct access to the lower deck. Before issuing the variation order, the HyD requested Contractor A to provide an estimate of the design cost. Subsequently, the HyD received a cost estimate. Later, in view of an anticipated delay, the Engineer instructed Contractor A to take acceleration measures and said that the delay would be assessed against the actual progress.

2.6 The HyD did not grant any extension of time to Contractor A because the HyD considered that only the abortive design work arising from the variation order would be considered. No extension of time would be granted for the design programme which had been overcome by the acceleration measures taken. The HyD considered that there was also no delay to the completion of the works as some of the construction works were not on the critical path.

2.7 A mediation (Note 2) and an adjudication (Note 3) were held. Subsequently, the HyD received a proposal for a commercial settlement of all claims and variations. Based on the initial assessment of the outstanding claims and variations by the Engineer, the HyD informed the Secretary for the Treasury that negotiating a commercial settlement would be beneficial to the Government. A commercial settlement could obviate the need to resolve all other claims and variations item by item through the lengthy process of mediation or arbitration (Note 4), and would save time and cost to the Government.

2.8 After conducting negotiation with Contractor A, the HyD obtained the Secretary for the Treasury's approval to accept the settlement proposal. As a result, an additional payment had to be made to Contractor A.

Note 2: *A mediation is a dispute resolution process provided in a works contract for resolving disputes between the employer and the contractor. There is no restriction on the kind of disputes that can be referred to mediation. The recommendation of the mediator is not binding and has no effect until it is accepted by the employer and the contractor, and embodied in an agreement in writing.*

Note 3: *An adjudication is a dispute resolution process provided in a works contract if a mediation fails to resolve the dispute. It deals with disputes concerning the contractor's entitlement to extension of time and payments. The decision of the adjudicator is binding on the parties to the contract until an award of arbitration.*

Note 4: *An arbitration is a dispute resolution process provided in a works contract when the dispute is not referable to adjudication after mediation, or the dispute is subsequent to the adjudicator's decision. An arbitration cannot proceed until after the substantial completion of the works. There is no restriction on the kind of disputes for arbitration. The decision of the arbitrator is binding on the parties to the contract.*

Audit observations on the design change of lifts of Bridge A towers

2.9 Bridge A consists of two decks. However, the Employer's Requirements did not indicate that the lifts should have direct access to both decks of the bridge towers. Audit enquired why the requirement of having direct access to both decks, which gave rise to the need to extend the travel length of the lifts to the lower deck, had not been included in the contract documents. In response, the HyD said that:

(a) in preparing tender documents for design-and-build contracts, there was always a danger in over-specifying the requirements;

(b) an over-specified requirement might become a constraint in the design, invalidate innovative ideas and even result in an unnecessarily expensive product; and

(c) the constraints might take away flexibility which was important for design-and-build contracts.

Audit considers that the functional requirement of the lifts should have been defined clearly in the contract documents so as to obviate the need to make subsequent changes after the commencement of the design work.

2.10 As far as could be ascertained by Audit, before the issue of the variation order (see paragraph 2.5 above), the HyD had not agreed with Contractor A the additional cost and time involved for both the design and construction works. In the event, in the commercial settlement with Contractor A, an additional payment was made (see paragraph 2.8 above).

Audit recommendations on the design change of lifts of Bridge A towers

2.11 **Audit has *recommended* that the Director of Highways should:**

(a) **specify clearly the essential requirements in works contracts, particularly design-and-build contracts, so as to avoid having to make subsequent changes after the commencement of design work and to reduce the risk of abortive work; and**

(b) **in a design-and-build contract, if changes are considered necessary after the commencement of the design, critically assess the possible effects of the changes on time and cost, and agree in advance with the contractor the extra time and cost involved before the issue of the variation order.**

Response from the Administration

2.12 The **Director of Highways** has generally agreed with the audit recommendations.

PART 3: CONSTRUCTION OF BRIDGE B

3.1 This part examines the design issue involving wind load factor and the design review process of Bridge B. The audit has revealed that there are lessons to be learnt from the construction of Bridge B and there is room for improvement in project planning and contract administration.

Provision for design standards and design review

3.2 For Contract B, the person responsible for site supervision of the construction works was called the Supervising Officer for Contract B. The HyD appointed one of its own engineers as the Supervising Officer whose general site supervisory duties were to carry out monitoring, to verify the contractor's quality assurance system and to ensure that timely tests were being carried out in accordance with relevant standards. The Supervising Officer was also required to carry out a check (Note 5) of Contractor B's design.

Proven up-to-date good practices and highest standards

3.3 Contract B made reference to a number of standards and codes of practice, mainly those adopted by Hong Kong and the United Kingdom for civil engineering and highways construction works. In general, Contract B required the works of Bridge B to be designed and constructed by Contractor B using proven up-to-date good practices and to the highest standards available.

Design issue involving wind load factor

3.4 In the design of bridges with a span longer than 100 metres, the design engineer is required to take into consideration:

(a) ***The static wind load.*** This is the force exerted on the bridge structures due to continuous and uniform wind pressure; and

---

Note 5: *The HyD appointed an independent checking engineer to review Contractor B's design packages for the construction of Bridge B on behalf of the Supervising Officer.*

(b) ***The aerodynamic effects***. These are effects of the wind-excited oscillations of the bridge, e.g. fluttering of the bridge due to gusty wind and structural response in resonance with the wind.

In order to provide an additional safety margin for any unexpected failure in materials or any deviation in design calculation, both the static wind load and the aerodynamic effects of wind had to be multiplied by a factor (known as the "wind load factor") so as to give a total factored loading of the bridge due to the static wind load and the aerodynamic effects of wind.

3.5 In connection with the wind load design, Contract B referred to the codes of practice in the following documents:

(a) "Structures Design Manual for Highways and Railways" (hereinafter referred to as the SDM) of the HyD, which in particular made reference to the Draft British Design Rules for the aerodynamic effects;

(b) "British Standard 5400 on Steel, Concrete and Composite Bridge" (hereinafter referred to as BS 5400); and

(c) "Departmental Standard 49/93 of the Design Manual for Roads and Bridges of the Department of Transport, United Kingdom" (hereinafter referred to as BD 49/93). In addition, Annex C of BD 49/93, which was also mentioned in Contract B, referred specifically to methods and procedures for wind tunnel testing.

Table 1 below shows the wind load factors to be applied to the wind effects, the static wind load and the aerodynamic effects in the design of bridges under different codes of practice.

Table 1

Wind load factors to be used in the design of bridges under different codes of practice

Code of practice of the HyD	**Wind load factor to be used**	
	Wind effects	
SDM	1.9 (see paragraph 3.6 below)	
British code of practice	**Wind load factor to be used**	
	Static wind load	**Aerodynamic effects**
BS 5400	1.4	No wind load factor specified
Draft British Design Rules (Note 1)	Not applicable	No values assigned to wind load factor
BD 49/93 (Note 2)	Not applicable	1.2

Source: HyD's records

Note 1: In the Draft British Design Rules, no values were assigned to wind load factor for the aerodynamic effects. The Draft British Design Rules were replaced by BD 49/93 in January 1993 (see Note 2 below).

Note 2: BD 49/93 was mainly concerned with the design rules for the aerodynamic effects on bridges. Annex C of BD 49/93 referred specifically to methods and procedures for wind tunnel testing.

3.6 The wind load factor of 1.9 in the SDM of the HyD was modified from the wind load factor of 1.4 (static wind load) as specified in BS 5400 to suit the environment in Hong Kong. The SDM of the HyD specified that this wind load factor of 1.9 should be applied to the wind effects, and a distinction was not made between the static wind load and the aerodynamic effects in the design of bridges. For the aerodynamic effects, the SDM of the HyD required that consideration should be given to wind-excited oscillations of bridges and that the guidance provided in the Draft British Design Rules should be followed. In Contract B, there was no definitive document that specified which wind load factor should be applied to the aerodynamic effects of wind in the design of Bridge B.

Design review process

3.7 One of the roles of the Supervising Officer was to check Contractor B's design. Contract B required Contractor B to prepare a programme for design submissions, which should set out Contractor B's anticipated schedule of design submissions to the Supervising Officer for checking and approval. The programme for design submissions should allow for periods of review by the Supervising Officer. The construction works relating to a particular design package could not proceed until the Supervising Officer's approval had been obtained. After reviewing the design, the Supervising Officer had to return to Contractor B the design together with a Notice of No Objection, or a Statement of Objections. If a Statement of Objections was issued, the Supervising Officer had to identify those aspects of the design which did not comply with Contract B. Alternatively, the Supervising Officer could issue a Notice of No Objection to Contractor B (accompanied by a Schedule of Comments about minor revisions, if any). Contractor B was obliged to comply with the Supervising Officer's suggested revisions.

Wind load factor to be used in the design

3.8 After the commencement of the works of Contract B, the HyD received a design proposal for the analysis of the overall stability of Bridge B using wind tunnel tests (Note 6). The Supervising Officer had no comments on the design proposal. Subsequently, the wind tunnel tests were completed for the full model of Bridge B. The HyD considered that the design had not included an allowance for the dynamic response of the bridge structures to allow for the dispersion of typhoon wind in Hong Kong. After discussions, the Supervising Officer required Contractor B to take full account of the forces measured during the wind tunnel tests. Contractor B was required to use a wind load factor of 1.9 for the aerodynamic effects of wind. Despite reservations, measures were taken to strengthen the bridge structures. Subsequently, the HyD and Contractor B had a dispute over the issue, and Contractor B submitted a claim.

3.9 After due consideration, the Supervising Officer did not grant any additional costs and extension of time to Contractor B.

3.10 A mediation was held. Later, the HyD received a proposal to settle the dispute. The HyD considered that the proposal was reasonable and there were benefits to the Government in accepting the proposal because:

(a) several civil engineering consultants, including those appointed during the mediation process to provide an expert opinion, had different interpretations of the wind load provisions of Contract B;

Note 6: *The wind tunnel test involves the use of a conical or cylindrical structure through which air is blown at measured speeds to test the effect of wind on cable-stayed bridges or suspension bridges.*

(b) there was no definitive document that clearly specified the wind load factor for typhoon conditions in Hong Kong, particularly how a designer should deal with the resonant effects of long span bridges;

(c) the works of Bridge B had suffered delay. A settlement of the dispute would keep the momentum of the progress of the works;

(d) the SDM of the HyD needed to be amended for the clarification of the wind load factor to be used for determining the aerodynamic effects. The amendment of the SDM should be done without delay as there would be two imminent large bridge projects, which could be adversely affected if the SDM was not amended. However, the Government's position in any subsequent arbitration of the claim could be prejudiced if the HyD now decided to amend the SDM; and

(e) the settlement would save legal expenses and resources by obviating the need for arbitration.

3.11 After obtaining the Secretary for the Treasury's approval, the HyD accepted the proposal for settlement. The HyD made an additional payment and granted an extension of time to Contractor B.

Audit observations on the design issue involving wind load factor

3.12 Contract B required the works to be designed and constructed using proven up-to-date good practices and to the highest standards available (see paragraph 3.3 above). In the design of long span bridges, Audit noted that there were a number of applicable codes of practice and standards available for determining the wind load. Contract B and the SDM of the HyD did not specifically mention which wind load factor was to be used for determining the aerodynamic effects of wind (see paragraph 3.6 above). Audit noted that there was no definitive document that clearly specified the wind load factor for typhoon conditions in Hong Kong (see paragraph 3.10(b) above). In order to minimise the risk of disputes between the Government and contractors over the use of wind load factors applicable under different codes of practice, it is important that in future contracts, the wind load factors to be used in design work should be clearly specified. Audit also noted that under the HyD's new quality assurance system, all manuals, circulars and instructions were reviewed annually. In early 2000, the HyD employed a consultant to review the SDM of the HyD. In particular, the part of the SDM concerning wind loads was being reviewed. **Audit considers that, for the avoidance of doubt, the HyD should consider amending the SDM of the HyD to specify clearly the wind load factor to be used for determining the aerodynamic effects of wind in Hong Kong.**

Audit recommendations on the design issue involving wind load factor

3.13 **Audit has *recommended* that the Director of Highways should:**

(a) **if there are different acceptable design parameters applicable under different codes of practice, specify clearly in contracts the design parameters to be used (such as the wind load factor to be used for determining the aerodynamic effects of wind), so as to avoid disputes arising from ambiguities and different interpretations of contract requirements; and**

(b) **in his current review of the SDM of the HyD, consider amending the SDM to specify clearly the wind load factor to be used for determining the aerodynamic effects of wind in the design of bridges.**

Response from the Administration

3.14 The **Director of Highways** has generally agreed with the audit recommendations. He has said that:

(a) in preparing the tender documents, the HyD employed a world renowned engineering consultant to conduct a thorough review of the tender documents including the tender design specifications on wind loading requirements. Contractor B was required to expand the design specifications by developing or adding to the proven up-to-date good practices and the highest standards available, or else by adopting other equivalent design standards;

(b) Contractor B was obliged to submit the design specifications together with any proposed amendments and/or expansion to these specifications to form the contract design specifications;

(c) the Supervising Officer had no comments on Contractor B's initial design proposal because the proposal included a wind load factor of 1.9 for the combination of the aerodynamic wind effects, dead load and superimposed dead load;

(d) after the wind tunnel tests, it was found that there was a high dynamic response on the structure in resonance with the wind. This aerodynamic phenomenon was very rare and was not expected to happen in Bridge B before carrying out the wind tunnel tests. Therefore, additional strengthening measures were required; and

(e) he had taken urgent and proactive action in respect of the aerodynamic issue.

The design review process for the construction of Bridge B

3.15 As mentioned in paragraph 3.7 above, as part of the design review process, Contract B required Contractor B to prepare a programme for design submissions. After commencement of Contract B, the HyD received five versions of the programme for approval. However, none of the programmes for design submissions were approved because the programmes contained a number of inconsistencies, and there was disagreement between Contractor B and the Supervising Officer on the period that should be allowed for design review. In the absence of an approved programme for design submissions, Contractor B submitted his design to the HyD for review in accordance with the progress of the design.

3.16 About 28 months after the commencement of the design review process, the Supervising Officer received a claim for extension of time and additional costs for the delays caused by the design review process. The Supervising Officer requested substantiations, which were submitted about 18 months later. At about the same time, the Supervising Officer received a consolidated claim on a number of alleged variations relating to the design review process.

3.17 According to the contract provisions, a claim for additional costs, and a claim for extension of time, should be lodged within 21 days and 14 days respectively after the occurrence of the event giving rise to the claim. The Supervising Officer considered that Contractor B had failed to comply with the contract provisions regarding the lodgement of claims. The HyD accepted the Supervising Officer's decision to reject Contractor B's claim.

3.18 A mediation was held. Subsequently, the HyD received a settlement proposal for the claim together with some other minor claims. The HyD recommended to the Secretary for the Treasury that Contractor B's proposal should be accepted because:

(a) the British codes did not cover all aspects for the design work of Bridge B. In some design work of Contract B, other codes for bridge design were used. They differed somewhat from the British codes used for design checking. A longer design review time was inevitable;

(b) in the works contract for the design and the construction of Bridge A, the same design review and checking procedures had been adopted. The structure of Bridge A was simpler than Bridge B. The contract period for Bridge A was longer than that of Bridge B; and

(c) the claim relating to the design review was a complex claim involving a number of allegations over the whole contract period. It might take years to settle a claim of this scale by arbitration and the uncertainties were enormous. It would tie up considerable resources of the Government, including a large amount of legal cost. The acceptance of Contractor B's offer would relieve government resources for other purposes.

3.19 After obtaining the approval from the Secretary for the Treasury, the claim in connection with the design review process and eight minor claims were settled such that the HyD had to make an additional payment and grant extensions of time to Contractor B.

Audit observations on the design review process

3.20 Contract B, which was a design-and-build contract and had to be completed within a relatively short period, did not specify any particular period of time for the review of design submissions. As mentioned in paragraph 3.15 above, none of the programmes for design submissions were approved. Audit noted that in the absence of an approved programme for design submissions, Contractor B had to submit the design to the HyD for review according to the progress of Contractor B's design. This gave rise to the dispute between the HyD and Contractor B over the design review process. **To minimise possible disputes with the contractors, it is essential that in future contracts, the criteria for determining the period allowed for the design review are clearly stipulated and sufficient milestones are set to control the design submission and design review process.**

3.21 The design of Bridge B involved different design codes of practice (see paragraph 3.18(a) above). In discharging his design review duties, the Supervising Officer had to exercise due care in reviewing and checking Contractor B's design submissions in order to ensure that the design conformed with all relevant requirements and that the required quality was achieved. However, for a design-and-build contract, there is a trade-off between the contractor's freedom to design and the employer's control over the design. This could give rise to disputes with the contractors. **Under such circumstances, it is important that in future design-and-build contracts, more proactive action should be taken to ensure that detailed design modifications required are provided to the contractors in good time. This would facilitate the contractors to complete the design modification works in an efficient and effective manner.**

Audit recommendations on the design review process

3.22 **Audit has *recommended* that the Director of Highways should:**

(a) **if a project is to be designed by contractors (e.g. in design-and-build contracts) or by consultants, stipulate clearly the criteria for determining the period allowed for**

design review and set sufficient milestones to control the design submission and design review process;

(b) **if design submissions by contractors or consultants require modifications, take proactive action to specify clearly the detailed modifications required, in particular for time-critical projects, so that the design can be revised in an efficient and effective manner; and**

(c) **allow adequate time for the completion of the works, in particular if the works are complex.**

Response from the Administration

3.23 The **Director of Highways** has generally agreed with the audit recommendations. He has said that:

(a) Contractor B submitted a tender programme together with his tender. This programme covering also the design process, after amplification and development, was accepted by the HyD prior to the award of the tender. Contractor B was required to submit, within seven days of notification of acceptance of Contractor B's tender, this accepted programme as his initial programme. Contract B required Contractor B to expand the initial programme to a more detailed programme for design submissions. Therefore, an attempt had been made to introduce control over the design submission and review process and to achieve a pre-contract agreement on the initial programme. Subsequent events were to lead to inconsistencies in the submitted programmes and the non-approval of the design submission programmes;

(b) he notes that the "Administrative Procedures for Design-and-Build Contracts" promulgated by the Works Bureau in late 1999 (see paragraph 4.1 below) require, among other things, that the design review period has to be stated in a contract;

(c) taking proactive action in respect of design matters for which ultimately a contractor is to be held liable may under certain circumstances transfer design responsibility to the Government. However, he accepts that proactive action may be necessary under certain circumstances; and

(d) specifically, in the case of Contract B, prior to inviting tenders, the HyD recognised the relative complexity of Contract B and the short period allowed for completion, and required tenderers to complete the design work for the programme-critical section of the foundation works for design review at the tender stage.

PART 4: AUDIT RECOMMENDATIONS FOR OTHER WORKS DEPARTMENTS

4.1 Audit notes that the Works Bureau, based on the experience gained from design-and-build contracts, has revised and updated in late 1999, the "Administrative Procedures for Design-and-Build Contracts" through which some of the audit recommendations have been promulgated. Nevertheless, the lessons learnt from the construction of the two bridges may also benefit other works departments in improving their contract planning and administration of major capital works projects. **Audit, therefore, has *recommended* that the Secretary for Works should consider notifying in writing all works departments of the audit recommendations in respect of the specification of design parameters in contracts and the adequacy of contract completion time (as mentioned in paragraphs 3.13(a) and 3.22(c) above) in order to minimise the occurrence of similar cases in future.**

Response from the Administration

4.2 The **Secretary for Works** has generally agreed with the audit recommendations. He has said that, since the promulgation of the first "Administrative Procedures for Design-and-Build Contracts" in 1992, the Works Bureau has been monitoring the results of many design-and-build contracts. The latest review of the procedures carried out in 1999 has taken into account the overall experience and feedback from the industry.

Appendix A

Acronyms and abbreviations

BD 49/93	Departmental Standard 49/93 of the Design Manual for Roads and Bridges of the Department of Transport, United Kingdom
BS 5400	British Standard 5400 on Steel, Concrete and Composite Bridge
FC	Finance Committee
HyD	Highways Department
SDM	Structures Design Manual for Highways and Railways issued by the Highways Department