CHAPTER 7

SUMMARY OF PROJECT COST ESTIMATE

CHAPTER 7 SUMMARY OF PROJECT COST ESTIMATE

7.1 Cost Estimate Method

7.1.1 General Conditions

(1) Major Materials Available

In the domestic construction materials, the following major materials are available for this project.

i) Coarse and fine aggregates for cement concrete
ii) Coarse and fine aggregates for asphalt concrete
iii) Portland cement
iv) Reinforcing bar (up to 40 mm)
v) Light structural steel
vi) Gasoline and diesel oil
vii) Asphalt and
viii) Embankment materials

Other construction materials listed below are to be imported:

i) Prestressing tendons
ii) Stay cables
iii) Structural steel and
iv) Plywood

(2) Labor conditions

i) Working Hours and National Holidays

Working hours :7 hours a day and 6 days a week
National Holidays : 12 days in 1996

Normal working hours are flexible in a reasonable range depending upon the company. During Ramadan period, which was scheduled from 22 January to 21 February in 1996, normal working hours were reduced. It is common among local companies to start at 6 a.m. and close at 1 p.m. during this period.

ii) Availability of Labor

Unskilled labor is very variable in availability. Skilled labor like riggers, are not readily available, but there are large number of reasonably experienced welders available.

(3) Equipment

The general equipment used in bridge and road construction is available in Egypt. However such equipment as indicated below is considered necessary to be imported due to their lack of availability due to their popularity with local contractors:

i) tower crane class 200 tm (H>175 m)
ii) mobile crane 450 tm
iii) mobile crane 150 tm
iv) welder and generator
v) winch
vi) hydraulic jack
vii) concrete plant 1 m3
viii) cooling plant and
ix) agitator truck 4 m3

7.1.2 Japanese Grant Aid Portion

(1) General

The cost estimation has been carried out based on the standard procedures and guidelines employed in normal construction projects in Japan and recommended by the Ministry of Construction.

(2) Construction Cost Elements

The construction cost is composed of the following items:

i) direct construction cost
ii) common temporary facilities cost
iii) Japanese skilled labor overseas costs
iv) package and shipment cost and
v) administration cost

1) Direct Construction Cost

In this item construction cost of the main bridge and approach bridge structures (560 m approach bridges on both sides of the Canal) including pavement, temporary ferry and wharf and miscellaneous works, such as guard rail, guard net, road lighting, navigation lights, airway hazard signals, median and maintenance side walks are included. It also includes the costs for the revision of the radar system of Suez Canal VTMS system and microwave system influenced by the bridge construction.

2) Common Temporary Facilities Cost

In this item the following cost of temporary facilities are included:

i) camp yard preparation
ii) contractor site offices, residences, labor camps, etc.
iii) consultants and client site offices
iv) re-bar shop and formwork shop
v) laboratory and first aid room
vi) warehouse and fuel/oil supply area
vii) concrete plant and
viii) water reserve tanks

3) Japanese Skilled Labor Overseas

To ensure maintenance of quality of workmanship and technical transfer of bridge construction works, a few Japanese skilled laborers in several trades such as rigger, re-bar setter, carpenter, welder, PS tendon setter and foremen are included in the cost estimation.

i) skilled labor cost
ii) living allowance and
iii) international travel cost

4) Package and Shipment Cost

The transportation cost for imported materials and equipment as well as those for locally produced materials and equipment are taken into account.

i) imported goods : packing cost
sea transportation cost
custom clearance charge
inland transportation cost and
insurance cost

ii) local goods : inland transportation cost and
insurance cost

5) Site Management Cost

In this item the following costs necessary to run the contractors site office and other facilities are involved:

i) contractor's site office
ii) local staff cost
iii) living allowance for Japanese and local staff
iv) international travel cost
v) cost for office facilities and supplies
vi) cost for first aid room facilities and supplies
vii) transportation and communication cost and
viii) construction insurance charge

6) Administration Cost

This construction supervision is to be carried out for both , Japanese Grant Aid Portion and Egyptian Portion. Therefore supervising teams for both portions are required and the cost for construction supervision is estimated based this.

The cost includes the following:

i) Japanese staff cost
ii) local staff cost
iii) living allowance for Japanese and local staff
iv) international travel cost
v) cost for office facilities and supplies
vi) transportation and communication cost and
vii) insurance cost

7.1.3 Egyptian Portion

(1) General

Egyptian portion is composed of two separate construction contracts, i.e. East Bank and West Bank, each of which involves approach bridge and approach road construction.

(2) Cost Basis

The construction cost is composed of direct construction cost, contingency and indirect cost.

1) Direct Construction Cost

This item includes the costs for the bridge structures, approach embankment, minor bridges crossing over irrigation canals, box culverts, interchange improvement, road lighting, road marking and traffic safety facilities, such as guard rails and traffic signs, plus maintenance road construction, etc.

2) Contingency

Following contingencies have been prepared for the case of construction quantity increase and price escalation of construction materials during the construction period.

Physical contingency	: 5 % of direct construction cost
price contingency	: 3 % per annum

3) Indirect Cost

Following components have been included for the indirect cost:

i) camp yard preparation
ii) construction of site office, warehouse, shops and residences
iii) site management cost and
iv) administration

20 % of the sum of direct cost and contingency has been allowed as indirect cost.

7.2 Cost Estimate

7.2.1 Japanese Grant Aid Portion

Table 7.2.1 Construction Cost of Japanese Grant Aid Portion (Million Yen)

Item	1st year	2nd year	3rd year	4th year	Total
Direct Cost					
Main Bridge					
Approach Bridge (W)					
Approach Bridge (E)					
Pavement					
Miscellaneous Works					
Temporary Wharves/Ferry					
Radar/Microwave Relocate.					
Common Temp. Facilities C.					
Package & Shipment Cost					
Skilled Labor overseas Cost					
Site Management Cost					
Administration Cost					
Total					

7.2.2 Egyptian Portion

(1) West Bank

Table 7.2.2 Construction Cost of Egyptian Portion (West Bank) (Million US$)

Item	1st year	2nd year	3rd year	4th year	Total
Direct Cost					
Approach Bridge					
Approach Road					
Pavement					
Miscellaneous Works					
Contingency					
Physical Contingency					
Price Contingency					
Indirect Cost					
Total					

(2) East Bank

Table 7.2.3 Construction Cost of Egyptian (East Bank) (Million US$)

Item	1st year	2nd year	3rd year	4th year	Total
Direct Cost					
Approach Bridge					
Approach Road					
Pavement					
Miscellaneous Works					
Contingency					
Physical Contingency					
Price Contingency					
Indirect Cost					
Total					

CHAPTER 8

PROJECT IMPLEMENTATION PROGRAM

CHAPTER 8 PROJECT IMPLEMENTATION PROGRAM

8.1 Project Implementation Program

8.1.1 Work Allotment

The Project is divided into 2, the portion of works to be constructed under the Japanese Grant Aid Program (main bridge + approach viaduct; h ≥ FL 49.5), and the portion constructed by the Government of Egypt funding (approach bridges, h ≤ FL 49.5 + approach roads), as shown in Fig. 8.1.

(1) The Work Portion to be borne by the Japanese side

- Construction of the bridge under the Japanese Grant Aid.

  Main Bridge: L=730 m

  Approach Bridge: East Bank L = 560 m

  West Bank L = 560 m

- The maintenance or site access roads required in connection with the construction works (bridge, piers), the construction of temporary facilities and their removal.

- Procurement of materials and equipment required in connection with the above construction works and their transportation, and the dispatch of laborers.

- Contractor's field supervision of the above construction works.

- The consulting services including coordination and management required for the construction operations (whole Project including Egyptian portion).

(2) The Work Portion to be borne by the Egyptian side

- The construction of works to be implemented by the Egyptian side

  Approach Bridge: East Bank L = 880 m

  West Bank L = 1,162.9 m

  Approach Road: East Bank L = 3,745 m

  West Bank L = 1,562.1 m

- The maintenance or site access roads required in connection with the construction works (bridge, piers), the construction of temporary facilities and their removal.

- Procurement of materials and equipment required in connection with the above construction works and their transportation, and the provision of labor.

- Contractor's field supervision of the above construction works.

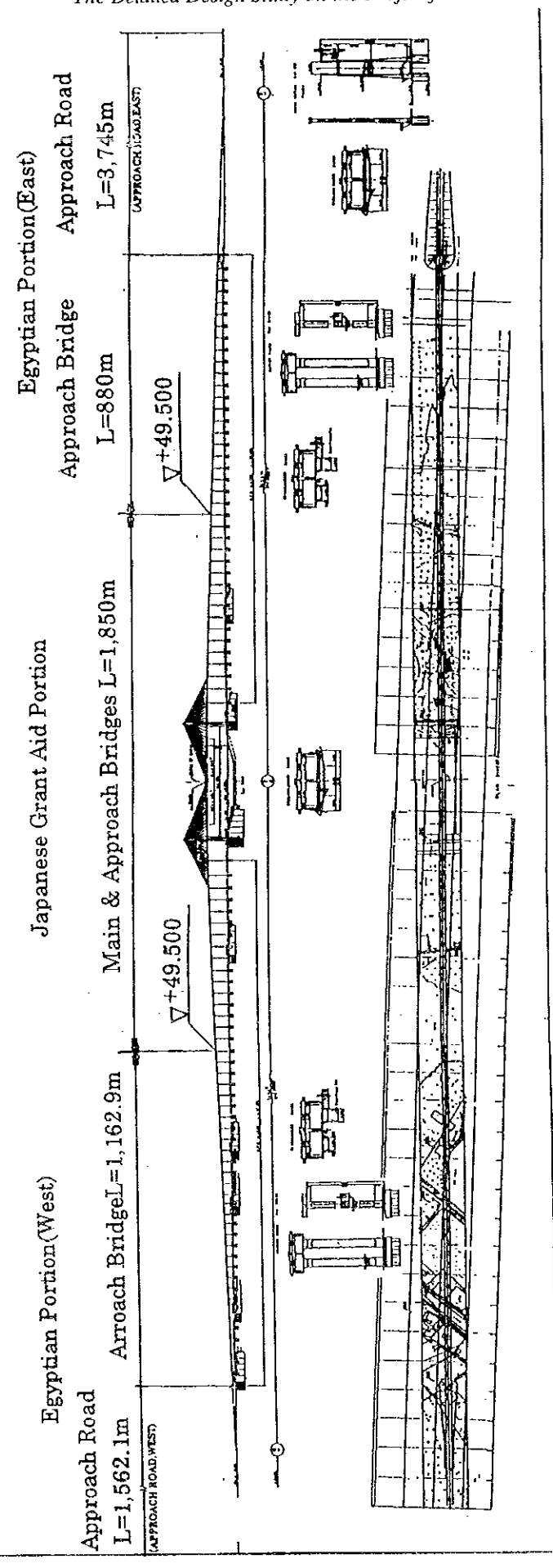

Fig. 8.1 Work Allotment

8.1.2 Construction Time Schedule

In Chapter 6, the Construction Plan, construction time schedule has been studied, examined and finalized.

The summary of the construction time schedule for the whole project is shown in Fig. 8.2.

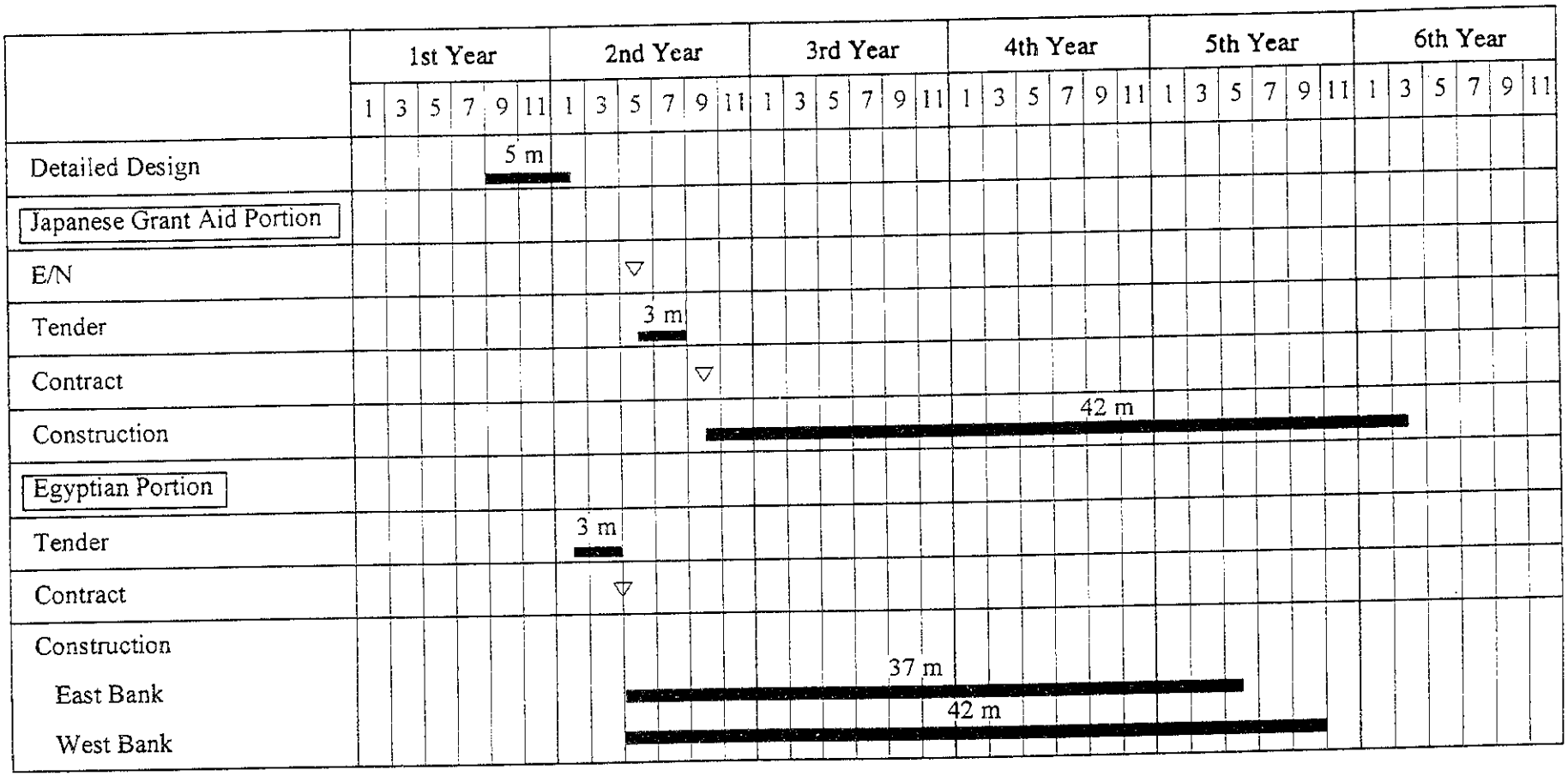

Fig. 8.2 Construction Schedule

8.1.3 Construction Supervision

(1) Basic Policy for Detailed Design and Construction Supervision

Detailed design for all of the works, including Japanese grant aid portion and Egyptian portion will be executed under the Japanese Technical Assistance.

It has also been decided that construction supervision will be undertaken for all of the works under the Japanese grant aid scheme by the Japanese consultant.

The basic policy for the detailed design will be as follows:

1) The field studies for the detailed design will collect data necessary for the detailed design and will be based on the field work, operations, cost estimates obtained through the confirmation of requirements of the Egyptian side for the field investigations, additional surveys, and detailed design.

2) Detailed design covers both the Japanese grant aid portion and Egyptian portions. Construction will be implemented, for the Japanese portion by grant aid, and for Egyptian portion by Egyptian Funds. Therefore two different sets of tender documents will be prepared.

3) After the detailed design is completed, the contents of the detailed design will be explained to the Egyptian side and discussions will be held.

The basic policy of the construction supervision works will be as follows:

1) As the main bridge and part of approach bridges constructed under the Japanese grant aid program, and the Egyptian approach bridges and roads will be constructed in parallel at the same time, the construction supervision will be conducted simultaneously by both the Japanese and Egyptian engineers. The transfer of technology will be performed to the Egyptian engineers at this time through the day to day activities.

2) Construction supervision services cannot be commenced before the Exchange of Notes, since these services will be made under the Japanese Grant Aid scheme. It means that the Japanese consultant cannot perform the works for tender assistance and construction supervision, if tender and construction of the Egyptian portion commences earlier than for the Japanese Grant Aid portion.

3) The construction supervisory engineers will perform the operations described in the following Section (2).

(2) Construction Supervision Works

For the Japanese Grant Aid portion the following works will be performed by the Japanese consultant teams.

1) Review of Detailed Design

Detailed design will be reviewed in advance before tender commences. When required, the documents will be amended.

2) Approval of Project Plans and Construction Drawings

The project plans, schedules, construction drawings furnished by the contractor will be checked to see whether or not they conform to the contract agreement, contract drawings and specifications. When satisfactory, approval of the documents will be made.

3) Construction Schedule

After a briefing from the contractor on the project status, give the necessary recommendations to enable completion of the project by the planned completion date.

4) Quality Assurance

Check the quality of the construction materials and the quality and workmanship of the construction performance to see whether they conform to the contract drawings and specification requirements, and give approval when they meet with the requirements.

5) Check of Work Performed

The profiles and dimensions of the finished work will be checked for their conformance to the control standards, and at the same time checks on the quantities installed will be made.

6) Issue of Certificates

Issue the necessary certificates for payments to the contractor, Completion of Works, and Defects Liability Certificate.

7) Submission of Reports

Review the contractors monthly reports, as-built drawings, and project photographs prepared for submittal to the Japan International Cooperation Agency and the Egyptian Government. Also after completion of the project prepare an overall report in accordance with the "Guideline for the Preparation of the Final Report of Project under the Japanese Grant Aid Program" for submittal to the Japan International Cooperation Agency.

For the Egyptian portion the following works will be performed by the Japanese consultant teams.

1) Review of Detailed Design

Detailed design and tender documents will be reviewed in advance before tender commences. When required, the documents will be amended and submitted.

2) Approval of Project Plans and Construction Drawings

The project plans, schedules, construction drawings furnished by the contractor will be checked to see if they conform to the contract agreement, contract drawings and specifications. When satisfactory, approval of the documents will be made.

3) Construction Schedule

After a briefing from the contractor on the project status, give the necessary recommendations for the completion of the project by the planned completion date.

4) Quality Assurance

Check the quality of the construction materials and the quality and workmanship of the construction performance to see whether they conform to the contract drawings and specification requirements, and give approval when they meet with the requirements.

5) Check of Work Performed

The profiles and dimensions of the finished work will be checked for their conformance to the control standards.

6) Estimate of Work Performed

Estimate work performed each month.

7) Issue of Certificate

Issue the certificate of periodical payment in accordance with the results of periodical works performed.

8) Issue of Work Completion Certificate

When construction has been completed, inspect all the construction works and issue completion certificate together with necessary lists of remedial works to final completion.

9) Submission of Reports

Inspect the periodical reports, as-built drawings, project photographs prepared by the contractor for submittal to the Egyptian and Japanese governments.

(3) Organization Chart for Construction Supervision

The team of the Japanese engineers and the Egyptian engineers engaged in the construction supervision will be organized into the arrangement by the type of construction operations and time schedule shown in Fig. 8.3.

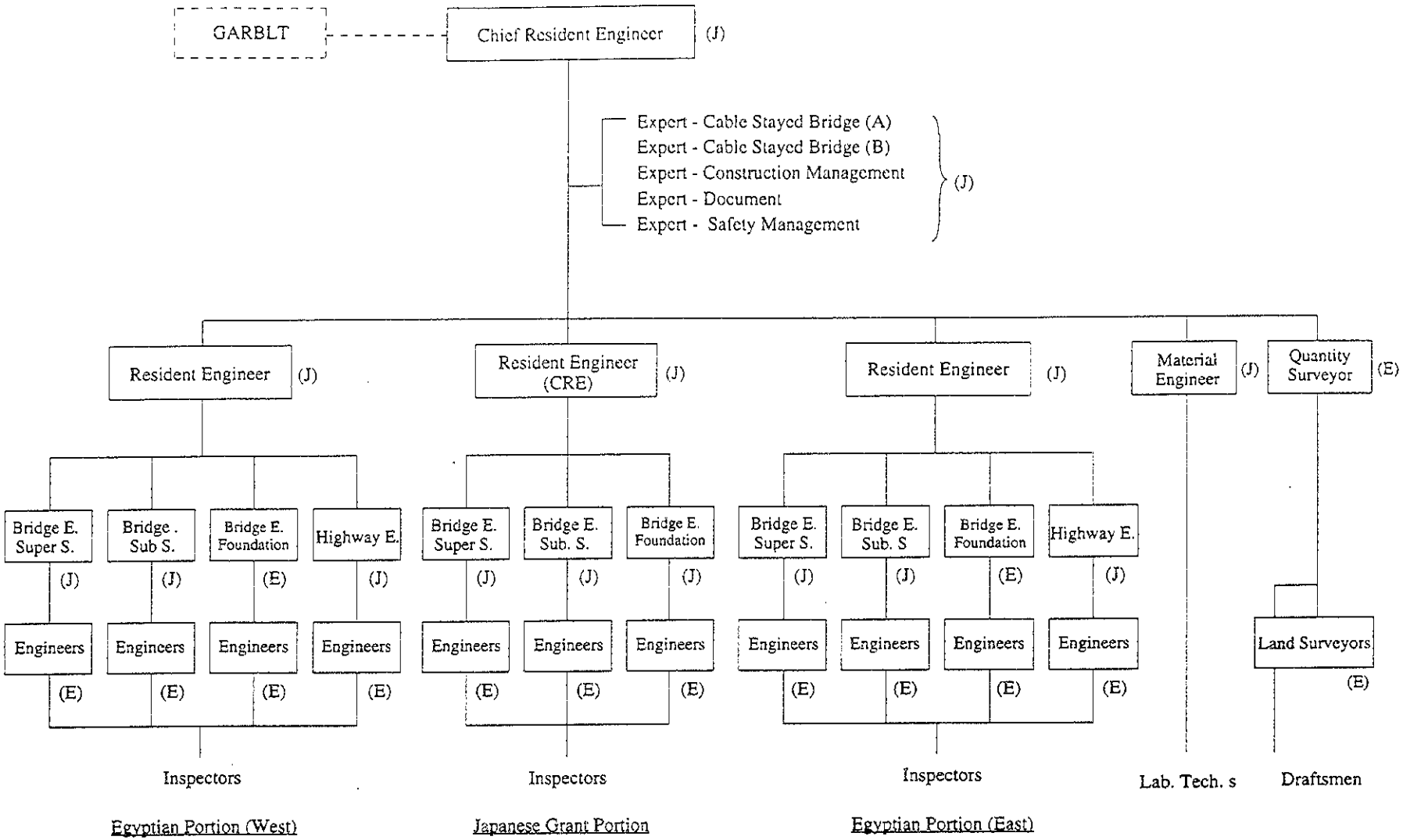

Fig. 8.3 Organization of Construction Supervision Team

8.1.4 Project Implementation Schedule

(1) The flow of activities of the Project under the Japanese Grant Aid can be divided as follows:

1) Detailed Design

Detailed design for both the Japanese Grant Aid portion and the Egyptian portion will be executed under Japanese Technical Assistance.

2) Pre-Qualifications

After review of evaluation criteria of contractor's qualifications with JICA, obtain their approval beforehand, and then review the contractor's qualifications. This process will be conducted by the Japanese consultant as the executing agency for the Egyptian Government.

3) Tendering, Contract Award

a) Tendering, Contract Award

The selection of the contractor will be witnessed in the presence of JICA and attended by the consultant, representatives of the Egyptian Government, and the tenderers. The tender award will be made at the tender opening. The contract will be a direct agreement between the Government of Egypt and the Japanese contractor (consultant and construction contractor). The contract process, will be conducted under open tender system rules with Japanese contractors.

b) Bank Arrangement

In parallel with the award of the contract, the government of Egypt will make arrangement with Japanese foreign exchange bank to open an account for receiving the Japanese assistant fund and paying the Japanese contractors. This bank arrangement will be the basis for the Authorization to Pay (A/P) issued by the Government of Egypt which is necessary, for the application to obtain the export approval from the Ministry of International Trade and Industry of Japan and to receive the Advance Payment under the clause of contract payment.

c) Verification of Contract

"Verification of Contract" means the Japanese Government confirms that the contract above mentioned is eligible as the object of this grant aid project, which is the pre-condition for effecting this contract.

d) Execution of Contract

The Japanese contractor will execute the terms of the contract upon receipt of the Contract Authentication and A/P documents.

4) Construction

The construction consists mainly of mobilization and preparation, the construction of the bridges and approach roads, and demobilization. The mobilization and preparation will comprise procurement of the necessary materials and equipment immediately after the contract signing together with the setting up of the transportation, temporary facilities at the site (assembly yard for the steel girders, establishing the concrete plant, PSC yard, reinforcing steel yard, concrete formwork fabrication yard, and the site office). The demobilization will comprise the removal of the materials and equipment upon completion of the woks, removal of the temporary facilities, and overall clean up.

(2) The flow of the activities of the Project under the Egyptian portion can be divided as follows:

Pre-Qualification
↓
Tender and Contract Award
↓
Construction

When the implementation of the Egyptian portion is carried out simultaneously with the implementation of the Japanese Grant Aid portion, the Japanese consultant will assist the Egyptian Government with the Pre-Qualification, Tender and Contract Award. However, if the implementation of the Egyptian portion is commenced prior to the Exchange of Notes (E/N), the Egyptian Government will have carry out Pre-Qualification, Tender and Contract Award.

CHAPTER 9

SUMMARY OF TENDER AND CONTRACT DOCUMENTS

CHAPTER 9 TENDER AND CONTRACT DOCUMENTS

9.1 General

In preparing the Tender Documents for the Construction of the Suez Canal Bridge, the difference of the prevailing tendering practice for civil works in the Arab Republic of Egypt and the system for Japanese Grant Aid Projects has been taken into consideration. In general, the Tender Documents shown in Table 9-1 have been prepared. The contents required for the preparation of the documents for this Project were decided during the discussions with the General Authority for Roads, Bridges and Land Transport (GARBLT).

Table 9.1 Documents for Tender and Contract

Documents	for Egyptian Section	for Japanese Grant Aid Section
Pre Qualification	0	0
Instruction to Tenderers	0	0
Forms of Tender	0	0
1) Form of Tender & Appendix	0	0
2) Form of Contract Agreement + Appe.	0	0
3) Form of Tender Bond	0	-
4) Form of Performance Bond	0	0
General Conditions of Contract	0	-
Particular Conditions of Contract	0	0
Bills of Quantities	0	-
General Specification	0	0
Special Specification	0	0
Drawings	0	0

9.2 Pre Qualification

First, a short liste of contractors approved by GARBLT will be invited to pre qualify for the Egyptian Portions. Concurrent with this, an invitation to pre qualify for the Japanese Grant Aid Portion will be made in the Japanese press. All the contractors which are deemed to have the capability to undertake the Project are requested to respond to these invitations. It is advantageous for the Employer to include only capable contractors for the forth coming tender and also for the contractors who are not capable

of undertaking such work to be aware of the scale of the Project and hence not waste their efforts in Tendering.

The Prequalification Documents consist of the following chapters:

(1) Background to the Project
(2) Scope of Works
(3) Conditions of Prequalification
(4) Required Documents for Prequalification
(5) Notification to Applicants
(6) Further Schedule
(7) Attachment Forms

9.3 Instruction and Form of Tender

Instructions and Form of Tender have been prepared separately for the Egyptian Portions and Japanese Grant Aid Portion. The Instructions to Tenderers have been prepared for the two cases describing the Sites and Scope of Work. The contents of these two types of Instructions to Tenderers are:

(1) Invitation to Tender
This comprises a letter to the prequalified firms, inviting them to tender for the project. The letter specifies the manner in which to prepare the tender submission and the date of submission, etc.

(2) Instructions to Tenderers
This describes the Scope of Tender , Sources of Funding , Eligible Tenderers, Requirement of Tenderers, etc..

(3) Contents of Tender Documents

(a) Instructions to Tenderers
(b) Conditions of Contract
(The standard JICA form of contract includes the Conditions.)
(c) Particular Conditions (Egyptian Portion)
or Supplement to Contract (Japanese Grant Aid Portion)
(d) General Specification and Special Specification
(e) Form of Tender plus Appendix
(f) Bill of Quantities

(g) Form of Agreement and Bank Guarantees
(h) Contract Drawings

(4) Measurement of Work
This is the Bill of Quantities containing estimated quantities only.

(5) Equipment
This is to be completed by the Tenderers to indicate the major items of equipment to be used in the Project.

(6) Key Personnel
To indicate the Key Personnel who are proposed to be employed on the Project in Egypt, with the Expatriates listed separately.

(7) Sub Contractors
Requests information on proposed Sub Contractors experiences.

(8) Form of Tender
A Standard Form specified by the Executing Agency, to be filled in by the tenderer, which contains the quoted price for the proposed Works. It becomes the binding document for the contractor for the proposed Works at the quoted price for a specified time period stipulated in the form, prior to the completion of the evaluation and selection of the best qualified tender by the Employer.

(9) Appendix to the Form of Tender
This stipulates the amount of bonds, third party insurance and interest, together with the date of commencement, maintenance period and other relevant information.

(10) Form of Agreement
This is a standard form prescribed by the Executing Body, which will be duly signed by the successful contractor and the representatives of the Government of the Arab Republic of Egypt, and will constitute a legal and binding document for the duration of the Project.

(11) Appendix "A" to Form of Agreement
This prescribes the constitution of the company.

(12) Appendix "B" to Form of Agreement

The tender form is accompanied by a summary of the Tender Price, in a format specified by the Employer. The summary is a breakdown of the total Tender Price into various packages, and by the type of work, such as Preliminaries, Permanent works, Sub-contracted works, Day works, etc.

(13) Form of Tender Bond

This is also a standard form prescribed by the Executing body to be completed by a bank following the deposit of a certain percent of the Tender Price by the Contractor, as a Guarantee Bond against any withdrawal of his tender within the stipulated Tender Period.

(14) Form of Performance Bond

This is a standard form designated by the Executing Agency for the successful tenderer to secure a bond equivalent to a specified percentage value of the Contract Price, from an authorized bank, against any failure in the completion of the Contract.

(15) Note to Contractor

Note to Contractor about the effect of the Performance Bond.

(16) Form of Advance Payment Bond

Another standard form for the successful tenderer to secure a bond against the Advance Payment made to the Contractor by the Employer.

(17) Schedule of Drawings

A list of the Contract Drawings that will be included.

9.4 Conditions of Contract

1) General Conditions (Part I)

The Conditions (Part I) contained in the document shown below are in accordance with "Conditions of Contract for Works of Civil Engineering Construction" Fourth Edition (1992) by "Federation International Des Ingenieurs-Conseils "(FIDIC).

(1) Definitions and Interpretation

(2) Engineer and Engineer's Representative

(3) Assignment and Sub-Letting
(4) Contract Documents
(5) General Obligations
(6) Labor
(7) Materials and Workmanship
(8 Suspension
(9) Commencement Time, Procedures and Delays
(10) Defects Liability
(11) Additions, Alterations and Omissions
(12 Procedure for Claims
(13) Contractors' Equipment, Temporary Works and Materials
(14) Measurement
(15) Provisional Sums
(16) Nominated Sub Contractors
(17) Certificates and Payment
(18) Remedies
(19) Special Risks
(20) Release from Performance
(21) Settlement of Disputes
(22) Notices
(23) Default of Employer
(24) Changes in Cost and Legislation
(25) Currency and Rates of Exchange

Plus Conditions of particular Application (Part II)

2) Conditions of Particular Application (Part II)

In general these contain amendments to Part I Clauses, applicable to this particular Contract together with additional clauses included to clarify and suit the requirement of this Project. These have been taken from various sources including, Benha Bridge Project, Cairo Wastewater Project, PCI and FIDIC.

9.5 Bills of Quantity

The Bills of Quantity (BOQ) will be prepared for the tenderers to enter their prices in. The BOQ to be included in the Tender Document for the Estimate of this Project costs will basically follow the BOQ prepared and discussed for the Project.

9.6 Specifications

1) General Specifications for the Works

The Detailed Design of the proposed bridge and roads has been based chiefly on the specifications contained in the General Specifications. These are the General Specifications in the Tender Document for this project, which contain the following:

(1) Description of Works
(2) General Specification
(3) Earthworks
(4) Slope Protection
(5) Concrete and Concrete Structures
(6) Piling
(7) Diaphragm Wall
(8) Drainage and Service Ducts
(9) Steel Structures
(10) Bridge Bearings, Expansion Joints, Joint Seals and Fillers
(11) Painting
(12) Road Works
(13) Landscaping and Irrigation
(14) Safety Equipment
(15) Electrical Works

2) Special Specifications for the Works

Specifications on design materials and other requirements proposed for this Project, which are not covered in the General Specifications for the Works are specified in the Special Specifications for the Works and include the following:.

(1) The Site and Weather Conditions, etc.
(2) Restrictions on Working due to Suez Canal, Military, Ordnance, Railways, etc.
(3) Assistance to the Engineers Staff, Records, Opening Ceremony
(4) Offices and all Materials for the Engineer, Vehicles, Communications, etc.
(5) Concrete, Mixes, Testing, QC, etc.

9.7 Drawings

These Drawings based on the Detailed Design of the Project are a part of the Tender Documents. Tenderers are requested to prepare their quotation based on the designs shown on the Drawings.

CHAPTER 10

MAINTENANCE AND MANAGEMENT

CHAPTER 10 MAINTENANCE AND MANAGEMENT

10.1 Maintenance and Management Organization

Road construction and rehabilitation is generally carried out under contract with the GARBLT Head Quarters by the public construction companies and private contractors. Routine maintenance is executed by the direct labor organizations of the GARBLT Headquarters in nine district offices. The amount allocated to routine maintenance was LE (5) million for bridges in 1995/96. The construction costs of bridges were LE220 million in the same year. Therefore, the ratio of maintenance to construction is about 1 to 44. The maintenance plan is shown below.

10.2 Maintenance and Management Plan

Since bridges are designed to last for 50 to 100 years, it is vital to continue inspections and repair on a regular basis for the long term. Therefore, a maintenance manual based on this requirement should be prepared and, even when maintenance managers are replaced, the maintenance should be continued in the same manner according to the manual. Outside Japan, the AASHTO Manual (1978) and the DIN Manual 1976 (1983) are recognized as manuals/standards of bridge maintenance and inspections. In Japan manuals to repair road bridges are available.

In preparing a maintenance plan for Cable-Stayed bridges, which should be in accordance with those manuals/standards, characteristics of the cables need to be understood. From examples of past damage to Cable-Stayed bridges, cable damage is often found to be similar to that of the Kohlbrand Bridge in Germany, the Wye Bridge in the United Kingdom and the Maracaibo Bridge in Venezuela. The damage is mainly caused by corrosion, fatigue and vibration. To maintain main girders, and the same rules apply for the girders of suspension bridges, inspection plan should focus on the inspection of defects of the painting, corrosion of steel materials, deformations, distortion and cracks in members, loosening and damage of bolts, and wetting and ponding of rain water etc. Functioning of bridge bearing and expansion joints should also be checked. The facilities required to maintain Cable-Stayed bridges are mostly the same as those for ordinary bridges except for the cables. Basically the facilities should be designed to approach a specific area of the bridge structure, and for this purpose inspection vehicles, elevators, gondolas, inspection paths, ladders, manholes, metal anchors and lighting are set up will be required.

To maintain the outer surface of main girders, inspection vehicles and/or scaffolding are generally used, and to maintain the inner one, inspection paths are used. On the other hand, to maintain the outer surface of pylons portable gondolas are utilized, whenever necessary, connected by metal anchors to the top of the pylons. Generally cable painting or its protective cover is visually inspected by binoculars from the bridge, and when closer inspection is necessary mobile hoists are used. However, it is recommended that inspection vehicles especially designed for cable inspections be made use of, as the mobile hoists cannot be very tall nor very safe.

(1) Inspection

Maintenance of any bridge follows the process of inspection. In the case of the Suez Canal Bridge, it is recommended that an inspection be conducted routinely and whenever damage or a defect is discovered, a thorough examination should be made and a report, prepared detailing the actual problems. A thorough investigation should be conducted whenever necessary, and recommendations for repairs should follow. Repairs should be made in a timely fashion as it is important to maintain the full functions of the bridge. The maintenance plan for the Suez Canal Bridge should be based on the following three inspections:

i) Daily Inspection
ii) Routine Inspection
iii) Provisional Inspection

i) Daily Inspection

The daily inspection should consist of ocular observation from patrol cars and should be carried out on a daily basis. Items to be inspected are as follows:

- Roadway Surface Condition (frequency: once daily)
  road marking, pavement status, expansion/contraction joints, objects of litter, etc.
- Roadway Accessories (frequency: once daily)
  railings, curbs, road signals, lighting, toll gate facilities, etc.
- Sub-surface Condition (frequency: once weekly)
  structures, embankments etc.

ii) Routine Inspection

Approach bridges, excluding the main bridge over the canal, shall be inspected from below once a year, by observing with binoculars and/or taking pictures

while walking so as to record any distortion or damage and/or progressive damage of structures.

The Cable-Stayed bridge over the canal should be inspected by using a movable inspection gondola.

iii) Provisional Inspections

If any emergency repairs become necessary due to occurrence of traffic accidents, earthquakes, and/or any unexpected accidents happen and cause damage to the bridge, an inspection should be undertaken immediately.

Any records of inspections are to be kept on files as data base.

(2) Maintenance Works

According to the maintenance plan, the following works are deemed to be necessary.

i) Routine Maintenance

It is proposed that every year two engineers, two assistant engineers and several assistants be available to execute routine maintenance. The maintenance work by patrol cars for road inspection is indispensable. With seven hundred and forty street lamps, since 50 percent of their bulbs may need to be replaced every year and the lighting consumes a considerable amount of electric power, sufficient funds should be allocated.

In addition, maintenance cost of emergency telephones should be allowed for.

ii) Repavement

As the roadway surface condition becomes damaged, the surface should be planed off and repaved once every seven to ten years.

iii) Repainting

Repainting of steel railings, as well as repainting of main girders by using an inspection gondola will be required once every ten years.

iv) Other Partial Restoration

In addition to those mentioned above, repairs including partial restoration due to damages and partial replacement could be needed once every ten years.

10.3 Maintenance and Management Costs

Annual maintenance and management costs for the whole project (Japanese Grant Aid portion and Egyptian) have been estimated as follows in accordance with the maintenance plan.

Routine maintenance	892,000 LE
Pavement renewal	1,467,000 LE
Repainting	345,000 LE
Total	2,704,000 LE

Breakdown is shown below.

Routine Maintenance

Labor costs	70,000 LE
Patrol cars	60,000 LE
Lighting power and bulbs	307,000 LE
Telephone	9,000 LE
Indirect costs	446,000 LE
Sub-total	892,000 LE

Repavement (Once per 7 years)

Removal of pavement	18.6 m x 9,200 m x 20 LE x 1/7 = 489,000 LE
Repavement	18.6 m x 9,200 m x 40 LE x 1/7 = 978,000 LE
Sub-total	1,467,000 LE

Repainting (Once per 10 year)

Steel girder	26 m x 730 m x 150 LE x 1/10 = 285,000 LE
Steel railings	1.5 m x 2 x 4,000 m x 50 LE x 1/10 = 60,000 LE
Sub-total	345,000 LE

ANNEX

ANNEX

(1) Egyptian Members of the Steering Committee

1) Ministry of Foreign Affairs

Mr.Ahmed Shahin	3rd Secretary, Japan and two Koreas Department

2) Ministry of Economy and International Cooperation

Mr.Ahmed Ragaie	First Under Secretary
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Eng. Emad EID in Nabil	Technical Office

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Eng. Ali M.Abdel Fattah	Manager of Works, Engineering Department

5) Ministry of Planning

Dr. Rashad El Mitiny	Transport Planner, UN. Project

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1) Mr. K. Iwaguchi	Japan International Cooperation Agency (JICA)
2) Mr.Y. Kishimoto	Honshu-Shikoku Bridge Authority
3) Mr. M. Suzuki	Ministry of Transport
4) Mr. Y. Ishikawa	Land Authority

(3) Members of Embassy of Japan, JICA Egypt Office and JICA Study Team

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1) Mr. K. Katakura	Ambassador
2) Mr. M. Sakaba	Minister
3) Mr. N. Ito	Embassy of Japan (Egypt)
4) Mr. A. Yahiro	Embassy of Japan (Egypt)
5) Mr. M. Danno	Embassy of Japan (Egypt)

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Mr. Y. Yamamoto	Aesthetic Design Engineer
Mr. Y. Furukawa	Approach Bridge Planner
Mr. S. Kaneko	Approach bridge Design Engineer I
Mr. S. Yoshihara	Approach Bridge Design Engineer II
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Mr. M. Gouma	Approach Bridge Design Engineer
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Mr. Y. Kudo	Cost Estimate Engineer
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Mr. W. Namiki	Facility Design Engineer
Mr. T. Kato	Facility Design Engineer
Mr. T. Nakajima	Facility Design Engineer
Mr. K. Urano	Facility Design Engineer
Mr. T. Takeuchi	Facility Design Engineer
Mr. T. Tsuzukuishi	Facility Design Engineer

ANNEX - 2

THE DETAILED DESIGN STUDY
ON
THE PROJECT
FOR
CONSTRUCTION OF THE SUEZ CANAL BRIDGE

MINUTES OF MEETING

SUBJECT : Submission and discussion of the Inception Report
DATE: October 9 - 12, 1996
PLACE: Conference Room at General Authority for Roads, Bridges and Land Transport
PARTICIPANTS : Refer to ANNEX II

1. INTRODUCTION

1.1 The Study Team commissioned by the Japan International Cooperation Agency (JICA), headed by Mr. H. Endo, held the meetings with the Steering Committee of the Arab Republic of Egypt from October 9 to 12, 1996 at the premises of General Authority for Roads, Bridges and Land Transport.

1.2 The meeting was chaired by Eng. Fouad Abdel Aziz Khalil, Chairman, General Authority for Roads, Bridges and Land Transport, Ministry of Transport and Communications.

1.3 The purpose of the meeting was to discuss on the contents of the Inception Report (hereafter referred to as IC/R) for "The Detailed Design Study on the Project for Construction of the Suez Canal Bridge" (hereafter referred to as "the Study").

2. SUBMISSION AND DISCUSSION OF THE INCEPTION REPORT

The Study Team submitted 30 copies of the IC/R prior to the meetings and explained the contents of the report.

3. MAIN POINTS OF DISCUSSIONS

(1) Draft Final Report

The Japanese side proposed that explanation and hand over of the Draft Final Report to the Egyptian side to be conducted in Japan during the period from the end of November to the 1st week of December 1996, since the key personnels of GARBLT would be under counterpart training held in Japan for the same period.

Both sides agreed in principle on the above mentioned proposal while the Egyptian side stated that this would be raised to the concerned authorities for ratification, and set the following schedule;

- **From the end of November to the 1st week of December 1996;**
  Counterpart training and hand over of the Draft Final Report to the Egyptian side in Japan.
- **2nd week of December 1996;**
  Presentation of the Draft Final Report by GARBLT to the Steering Committee in Egypt.
- **4th week of December 1996;**
  Submission of comments on the Draft Final Report to JICA.
- **3rd week of January 1997;**
  Submission of the Final Report to GARBLT in Egypt.

(2) Dispatch of Japanese Expert

Both sides confirmed the necessity of dispatch of a Japanese expert on "construction of cable stayed bridge" during construction period of the Project.

(3) Observation Facility

The Egyptian side explained the necessity for building an observation facility at the bridge site to demonstrate the aesthetic and technical aspects of the huge project of the Suez Canal bridge at Qantara and the grant aid given by the Japanese People. This building consists of two floors, the first as restaurant and the second terraces for observation. Memorial paints to show different stages of construction and list of team members that participated in the Project to be put at the entrance of the building. A complete model of the bridge to be put in a distinguished place.

The Japanese side stated that to take new project component such as obsevation facility into the Project at this stage is very difficult due to the limited study period and budget under the Japanese Grant Aid Scheme, although the point would be conveyed to the concerned authorities in Japan.

(4) Technical Discussion

The results of technical discussions are attached in ANNEX I.

4. ACKNOWLEDGMENT OF THE INCEPTION REPORT

The Egyptian side acknowledged the IC/R submitted by the Japanese side. The Japanese side will take the comments offered by the Egyptian side during the technical discussions into consideration in preparing the Draft Fianl Report.

Cairo, 12 October, 1996

Eng. Fouad Abdel Aziz Khalil
Chairman of Board
GARBLT

Mr. Hiroyuki Endo
Team Leader
JICA Study Team

In witness

Mr. Hassan Gaafar
Japan Department
MOEIC

Mr. Nobuhiko Hanazato
JICA

ANNEX I

Discussion Items:

1) Design Loads and Design Method
2) Collision Load by Vessel
3) Alternative Plans of Radar System
4) Alignment of Approach Road on the West Bank
   - Horizontal alignment
   - Method of connection into the existing road
5) Structure Type of Approach Bridges
   - Continuous Rigid Frame and Continuous Girder
   - Support Conditions
6) Span Arrangement of Approach Bridges
   - Bridges over the irrigation canal and existing road

1. Design Loads and Design Method

Refer to the Design Criteria for Suez Canal Bridge Construction in Appendix 1.

2. Collision Load by Vessel

Collision loads in the following cases are adopted for the design of pylons;

1) Collision load of 560,000 t tanker in ballast
   - Weigh = 250,000 t
   - Length = 380 m, Width = 60 m, Draft = 10 m
   - Collision speed = 14 Km/hr
   - Collision angle = 15 degrees

   Distribution force from the collision point is adopted.

2) Collision load of 10,000 t ship in full load
   - Weigh = 10,000 t
   - Length = 100 m, Width = 20 m, Draft = 5m.
   - Collision speed = 14 Km/hr
   - Collision angle = 30 degrees

   Collision load acts directly on pylon

3) Collision load of 100,000 t ship in ballast

   - Weigh in ballast = 44,500 t in ballast
   - Length =270m, Width=41m, Draft(front)= 4m, Draft(end)=8m
   - Collision speed = 14 Km/hr
   - Collision angle = 15 degrees (to be discussed with SCA)

   Study possibilities of ship sliding on side slopes of Suez canal

Study and consider to provide a Jetty or other protective system to prevent Ships from hitting Pylon.

3. Alternative Plans of Radar System

To be discussed with SCA on 13 October.

4. Alignment Design of Approach Road on the West Bank

The alignment of the Canal road crossing needs further study. Conclusion should be made within 3rd week of October.

5. Structure Types of Approach Bridges

1) Rigid Frame and Continuous Girder
   -East Side,for elevation more than 20 m: Continuous rigid frames
   -West Side,for elevation more than 32.959 m:Continuous rigid frames
   -West Side,for elevation less than 32.959 m: Continuous girders

2) Support Condition

   For Approaches:
   - Rubber shoes(elastomeric - neoprene bearings) are not accepted.
   - Pot(or Disc) Bearings, could be used for continuous girders less than 32.959m on West side.

   For Main Bridge: Special High Quality Rubber lead bearings or similar could be used at pylon.

6. Span Arrangement

1) Span Arrangement of Approach Bridge

   The span arrangement of the Approach Viaducts submitted by JICA study team is adopted.

2) Bridges over Irrigation Canal and Existing Road
   - The span arrangement of the approach bridges in the section crossing Abassah Canal and Ismailiya - Port Said Road proposed by JICA study team is adopted.
   - The center line of bearings crosses the bridge axis at right angle.

Appendix 1

Design Criteria for Suez Canal Bridge Construction

1. **Road Class :** Desert Highway
2. **Design Speed:** 80 km/hr
3. **Bridge Width:** 4 lanes (2x8.15 m), median (1.0 m) side maintenance walk (2x0.75m)

4. Loading:

4.1 Vehicle load:

For main structural system: Egyptian Standard Load.
For floor system: Egyptian Standard Load.
For Cable Stays: Egyptian Standard Load- (60ton & 30 ton) Trucks placed to produce maximum force in cable stays

Egyptian Standard Load (Clause 5-2 of Egyptian Code for Loads in Structures and Buildings). Load applied to adverse areas only, and in locations to produce maximum effects in all members.

4.2 Impact load:

by Egyptian Standard I = 0.4 - 0.008*L
L = length of adverse areas only

4.3 Maintenance walk load, and Median: 500 kg/m^2

4.4 Temperature change:

For hole structure: Steel structure 20 ± 30°C
Concrete structure 20 ± 20°C

Between members and linear gradient between member top and bottom
Steel structure ± 15°C
Concrete structure ± 5°C

Between cables and (steel deck & concrete tower): ± 20°C

4.5 Wind load: 20 m/s (to be confirmed) at 10 m above the ground,
height adjustment factor (Z/10)1/7
p = 1/2.ro.V2.C.G
p: wind load,ro: air density, V: design velocity
C: resistance factor (=2.1 - 0.1 B/D)
B: girder width, D: girder depth
G: gust response factor (=1.9)
Z: height from the ground

wind pressure not less than,
200 kg/m2 at 10m above ground
250 kg/m2 at 100m above ground
350 kg/m2 at 200m above ground

4.5 Wind with live load
Half minimum values given above, application as given in clause 5-2-7 of Egyptian standard.

4.6 Seismic load:

-Ground level acceleration: 125 gal

-Minimum values of Kh
Kh>= 0.156 elevation < 40m

Kh>= 0.125 elevation > 40m
Kh>= 0.100 for Cable-Stayed Bridges

-Same Kh for all bridge parts,
Kh to be applied in Longitudinal, transverse, directions.
Kh to be applied in Vertical direction during check and review.

4.7 Creep and shrinkage of the concrete:
average humidity: 50%
based upon the specification of JRA, taking into consideration the member dimension and humidity of the site.

4.8 Erection error:
For main pylon: pylon top displacement of 0.15 m, equivalent to 1/1000 or pylon height

4.9 Differential settlement:
between two main pylons in longitudinal direction: 2.5 cm
between two legs of each pylon in transverse direction: 1.5 cm
between piers : 1.5 cm

note:if only one pile cap only is used for both sides of approach viaduct, then design pile cap for the case of one side is completed and the other side not yet completed

Points 4.10 to 4.13 according to Egyptian Standards, apply to viaducts, and main Cable-Stayed Bridge over Suez Canal

4.10 Braking Force in Longitudinal Direction
Egyptian code for loads, clause 5-6

4.11 Friction of Sliding Bearings
Egyptian code for loads, clause 6-10

4.12 Replacement of Bearings
Egyptian code for loads, clause 5-3

4.13 Cable Stay Breakage:
One cable broken: Design Deck for all dead loads + Full live loads
Two Cables Broken: Deck for all dead loads + ten percent of live loads

4.14 Load on railings, parapet

4.15 Collision load of Vehicles with bridge piers and columns
In direction of traffic=100tons, Normal to direction of traffic=50 tons.
The load is assumed to act at 1.20m from the surface of roadway.

4.16 Collision Load of Ship
As defined previuosly

4.17 Loss of Supportsin Side Spans of Cable-Stayed Bridge:
To be confirmed after further study.

5. Load Combination

5.1 Abbreviation:

D: dead load	PS: prestressing
CR: creep of concrete	SH: shrinkage of concrete
AA: D + PS + CR +SH	EO: erection error
L: vehicle load	I: impact load
EQ: seismic load	SD: differential settlement

W : wind load WL : wind with Live load
T: temperature change
BR: braking force
FR: friction of bearings RR:replacement of Bearings
CO: Collison Load
C1: One cable broken C2: two cables broken
r: increase ratio of allowable stress

5.2 Load combination:

1)	D + PS + CR + SH = AA,	r = 1.00
2)	AA + EO + SD	r = 1.00
3)	AA + L + I + EO + SD	r = 1.00
4)	AA + L + I + EO + SD + T	r = 1.15
5)	AA + L + I + EO + SD + BR	r = 1.15
6)	AA + EO + SD + W	r = 1.25
	(for foundation stability, r = 1.50)	
7)	AA + L + I + EO + SD + W/2	r = 1.25
8)	AA + EO + SD + T + W	r = 1.35
9)	AA + L + I +EO + SD + T + W/2	r = 1.35
10)	AA + EO + SD + EQ	r = 1.50
11)	AA + + L + I + EO + SD + CO	r = 1.50
12)	EO (for superstructure only)	r = 1.25
13)	W (for superstructure only)	r = 1.20
14)	AA + (L + I) + EO + SD + C1	r = 1.15
15)	AA + 0.1*(L+I) + EO + SD + C2	r = 1.50
16)	AA + L + I + EO + SD + RR	r = 1.00
17)	AA + L + I + EO + SD + FR	r = 1.15

6. Materials

6.1 Concrete: (cylinder specimen)
cast-in-situ concrete pile, and pile cap: 240 kg/cm^2
caisson or diaphragm wall :240 kg/cm^2
pier and abutment :240 kg/cm^2
pylon shaft :300 kg/cm^2
anchorage zone of pylon :350 kg/cm^2
concrete box girder :350 kg/cm^2

6.2 Reinforcing bar: ST37 /ST52 (BS standard) or equivalent

6.3 Structural steel: SS400/SM490/SM490Y/SM520 or equivalent

6.4 Prestressing tendon: Freyssinet strand, 12T15.2

6.5 Stay cable: Freyssinet strand, H15.

6.6 Concrete Subject to Salt Water: For concrete of substructures and foundations subject to Salt water, take precautions to prevent corrosion deterioration of steel.

7. Allowable Stress

Allowable stresses as defined in Japanese Codes, and as modified below for local conditions. Examples of some values of allowable stresses are given below for reference.

7.1 Concrete:
Based on Japanese Code, and
No Tensile stresses allowed in Prestressed Concrete for Case of
D + PS + CR + SH + L + I + SD + EO

7.2 Reinforcing bar:

ST37:	1200	kg/cm^2
ST52:	1800	kg/cm^2
	1600	kg/cm^2 (under ground water)

7.3 Structural steel: tension stress by bending

SS400:	1400	kg/cm^2
SM490:	1900	kg/cm^2
SM490Y/520	2100	kg/cm^2

7.4 Bearing capacity of ground under pile: 280 $tons/m^2$
Only end bearing, and no Frcition

7.5 Bearing capacity of ground under caisson: 80 $tons/m^2$
for Diaphragm walls, to be discussed

8. Design methodology

8.1 Structural Design

Allowable stress design method according to JRA, and modified for local conditions in Egypt as summarised below. This applies to all design requirements including:

- Loads
- Load combinations
- Allowable stresses
- Detailing
- Any other code requirements

8.1b Structural Check of Design

BS 5400 Limit state design method by BS is adopted to check
-structural safety factor at ultimate limit state
-structural serviceability limit state.
-Fatigue check
-Buckling of long columns of Approach viaduct
-Use loads specified in BS5400, BD 37/88

In application of BS5400 to the Suez Canal Bridge, reference shall be made to the Aswan Bridge Design Specifications, which are based on BS5400 and modified to be suitable for local conditions in Egypt.

Select sections to be checked in Cable-Stayed bridge and approach viaduct.

8.2 Seismic Design

8.2.1 Main Bridge

(a) Design using Modified acceleration response method is adopted.
Kh minimum =0.1

(b) Check using Response Spectrum, and Time History Seismic Analysis. Prepare an artificial wave record specific for site conditions at Qantara.

8.2.2 Approach Bridge

- Design using
For elevation less than 40 m: kh = 0.156
For elevation more than 40 m: kh = 0.125
Note:
East Side,for elevation more than 20 m: Continuous rigid frames
West Side,for elevation more than 32.959 m:Continuous rigid frames
West Side,for elevation less than 32.959 m: Continuous girders

- Check using response spectrum method.

where Kh = horizontal seismic coefficient for design,
while Ko =standard hor. seismic coefficent for design

8.2.3 For cable-Stayed Bridge and Approach viaducts, study Seismic effects in Transverse, Longitudinal directions. Study seismic loads in Vertical direction during review stage.

8.3 Fatigue

Check Cables, cable anchorages, connections in steel deck

8.4 Analyses to Check Design of CABLE-STAYED BRIDGE according to ASCE Guidlines

After design of Cable-Stayed Bridge, the design has to be checked for following:

-- Increase of stresses in steel deck due to P-Delta effects
-- Compute Buckling load of Cable-Stayed Bridge
-- Check above also for Elasto-Plastic Behavior
-- Check bearings of Cable-Stayed Bridge for Vertical uplift at all supports, including pylon

8.5 Deflection

- Maximum deflection = L/500 (under live loads given in Egyptian standards)
- Maximum slope change for truck loading: 2% (1.15 degrees)

8.6 Stay Cables important cosiderations:

-- Consideration of Cable-Nonlinearities during regular design (Ernst Formula, or similar)

Describe and Design for the following:

-- Corrosion protection
-- Prevention Vibration of cables, need to put dampers
-- Replacement of stay cables
-- Replacement of pipes for stay cables
-- measuring forces in Stay cables after finish construction

8.7 Some Points for Approaches:

- Pounding between two approach viaducts during Earthquakes.
- Buckling of Columns and Second Order moments in Columns

8.8 Minimum Dimensions:

- Minimum thickness of any Concrete Members 20cm

- Approach Viaduct Columns
  Minimum Dimension of Voided Column (height/18)
  (height > 27m): Minimum Thickness of each Wall of Voided Column 75cm, but to be confirmed after further study.
  Minimum longitudinal Reinforceemnt in columns 1%
  2 layers of reiforcement in members

Foundations:
min. distance between C.L. piles: 2.5 diameter
min. distance between C.L. caissons: 2.0 diameter

9. Structural Detail

9.1 Concrete cover (net)

Pile, pile cap	:10 cm
substructure :	7 cm (columns all sides)
superstructure:	3.5 cm for floor slab
	3.5 cm for web
	3.5 cm for bottom slab
	3. cm for others

9.2 Shoe

main pylon :	Special quality lead-rubber type or similar
auxiliary pier:	steel pendel type
appr. viaduct :	Only Pot bearings or Disc bearings allowed. Rubber/elastomeric/neoprene bearings not allowed

9.3 Hand rail

1) Main bridge: steel rail
2) Appr. Viaduct: concrete wall + steel rail

9.4 Drainage: Iron type

9.5 Road lighting: at two sides.

9.6 Expansion joint

steel type or steel-rubber type

9.7 Pavement

main bridge : asphalt concrete, t = 8 cm
appr. viaduct: asphalt concrete, t = 7 cm
Comment: Asphalt mix for CSB has to be designed very carefully, and tested early during construction stage in conditions similar to actual field conditions, in order to avoid problems such as happened in CSB in Thailand.

9.8 Protective net

Protective net on the Cable-Stayed portion shall be provided

9.9 Others

Emergency telephone, emergency stairs, monitoring camera, police station, navigation guide, aero-navigation sign, lighting, road marking, road guide/sign etc. are to be discussed.

Waiting areas for a Police car, and waiting area for a Towing truck are to be provided on the Up ramps on both East and West sides.
For example: West Side Elevations 23., El. 49.
East Side Elevations 23., El. 49.

U-Turns, provided at the same locations as Waiting areas.
The need for more waiting areas, and more U-turns should be studied if needed.

9.10 Maintenance considerations during design

Access to inside bridge, Design for Instrumentation(such as strong motion accelerograms, wind speed,vibrations, temperature, etc..) have to be taken intoconsideration during design stage.

9.11 Load Testing

Design procedure for vehicle load test to be carried at bridge opening including dynamic testing. Dynamic testing can be repeated during operation of bridge, to help in maintenance process, Equipment to Measure cable forces.

ANNEX II

LIST OF PARTICIPANTS

A - Egyptian side

1. Ministry of Foreign Affairs

1) Mr. Ahmed Shahin	3rd secretary, Japan and Two Koreas Department

2. Ministry of Economy and International Cooperation

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7) Eng. Alaa Moustafa	Technical office
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4.JICA Study Team

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2) Mr. Y. Kajimura	Main Bridge Planner
3) Mr. Y. Yamamoto	Aesthetic Design Engineer
4) Mr. Y. Furukawa	Approach Bridge Planner
5) Mr. S. Yoshihara	Approach Bridge Design Engineer
6) Mr. H. Mukaichi	Road Planner
7) Mr. K. Tachibana	Road Design Engineer
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