No. 1

MINISTRY OF PUBLIC WORKS & HOUSING
THE HASHEMITE KINGDOM OF JORDAN

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR CONSTRUCTION OF KING HUSSEIN BRIDGE AND SHEIKH HUSSEIN BRIDGE IN THE HASHEMITE KINGDOM OF JORDAN

MARCH, 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
NIPPON KOEI CO., LTD.

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PREFACE

In response to a request from the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct a basic design study on the Project for Construction of King Hussein Bridge and Sheikh Hussein Bridge in the Hashemite Kingdom of Jordan and entrusted the study to the Japan International Cooperation Agency (JICA).

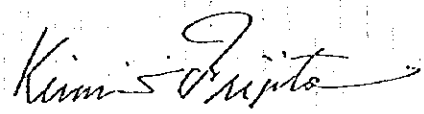
JICA sent to Jordan a study team from January 5 to February 18, 1996.

The team held discussions with the officials concerned of the Government of Jordan, and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Hashemite Kingdom of Jordan for their close cooperation extended to the team.

March, 1996



Kimio Fujita
President
Japan International Cooperation Agency

March, 1996

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of King Hussein Bridge and Sheikh Hussein Bridge in the Hashemite Kingdom of Jordan.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from December 26, 1995 to March 29, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Jordan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

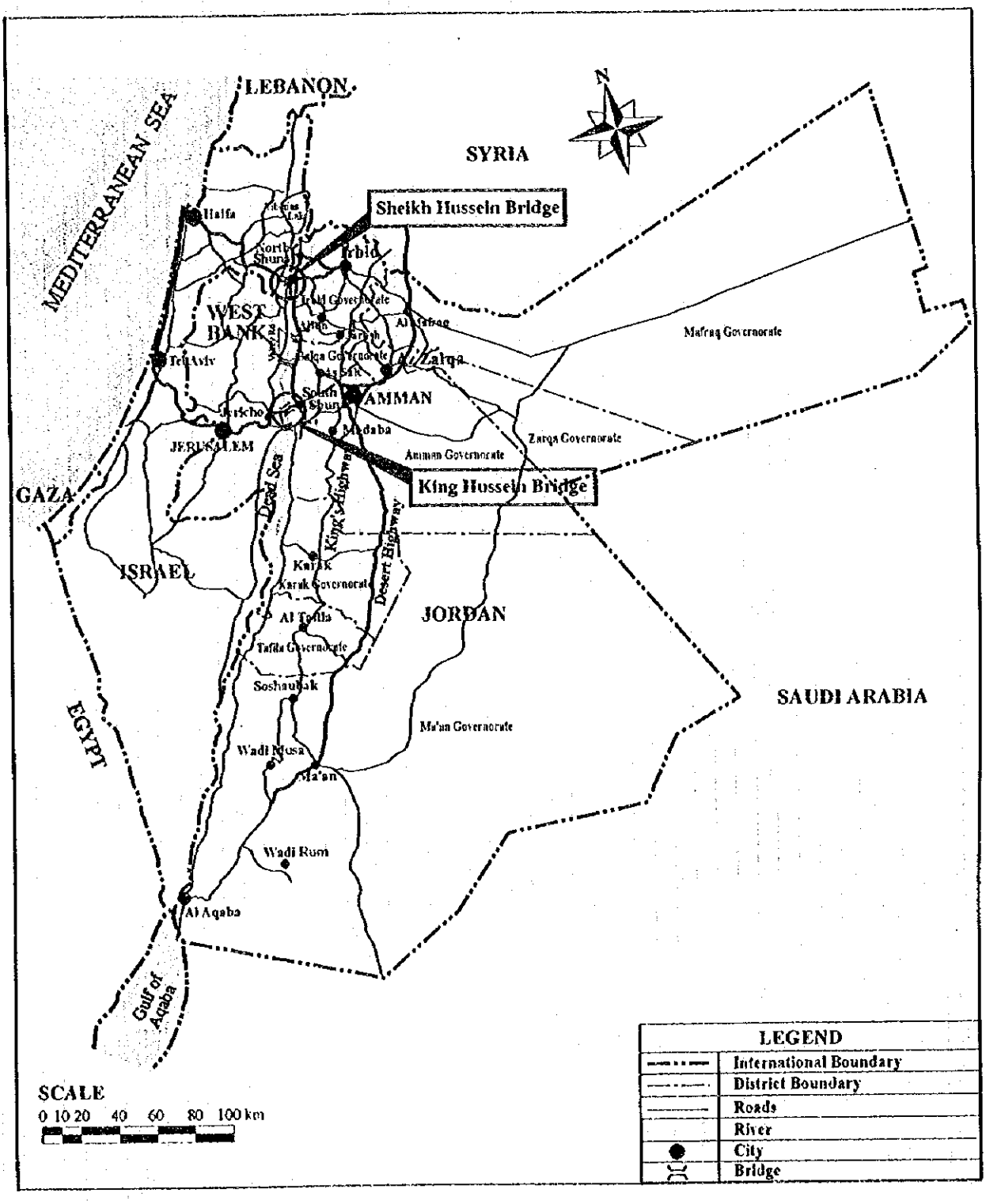
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

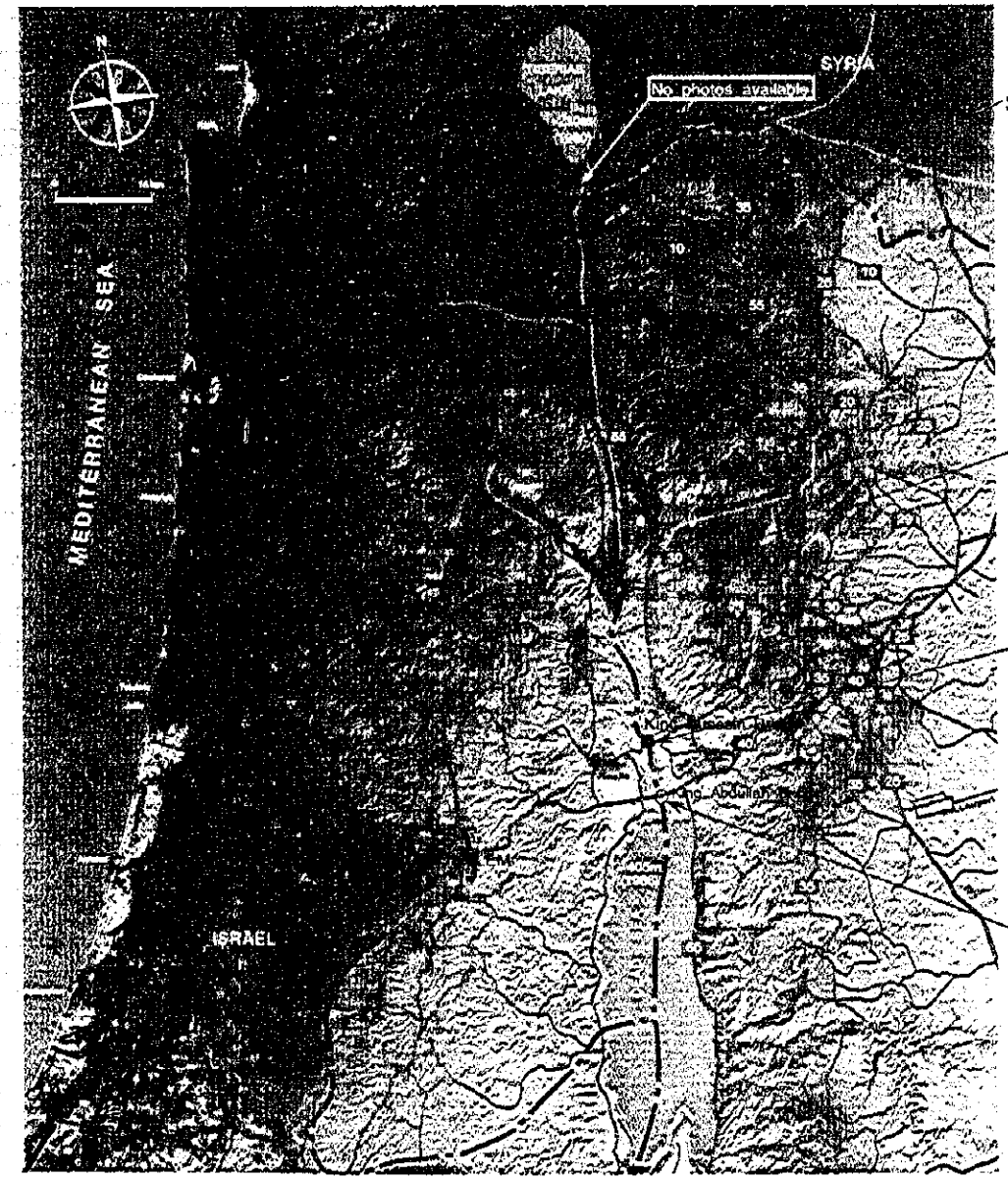
Katsufumi Matsuzawa
Project Manager,

Basic Design Study Team on
The Project for Construction of
King Hussein Bridge and Sheikh
Hussein Bridge in the Hashemite
Kingdom of Jordan

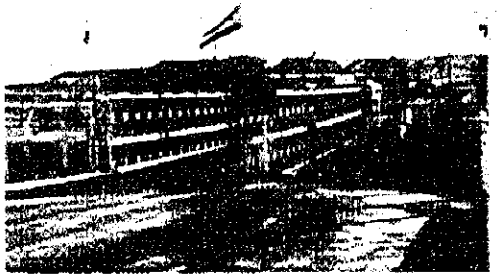
Nippon Koei Co., Ltd.



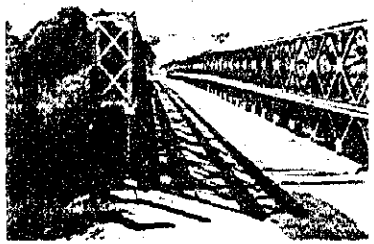
LOCATION MAP (NO. 1)



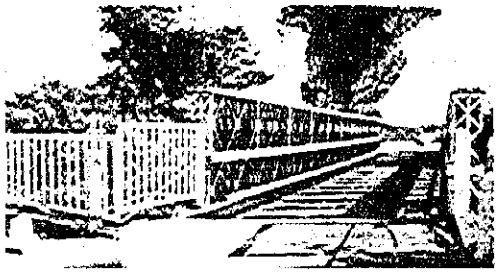
SHEIKH HUSSEIN BRIDGE
(Specific Bridge in this Study)



PRINCE MOHAMMAD BRIDGE

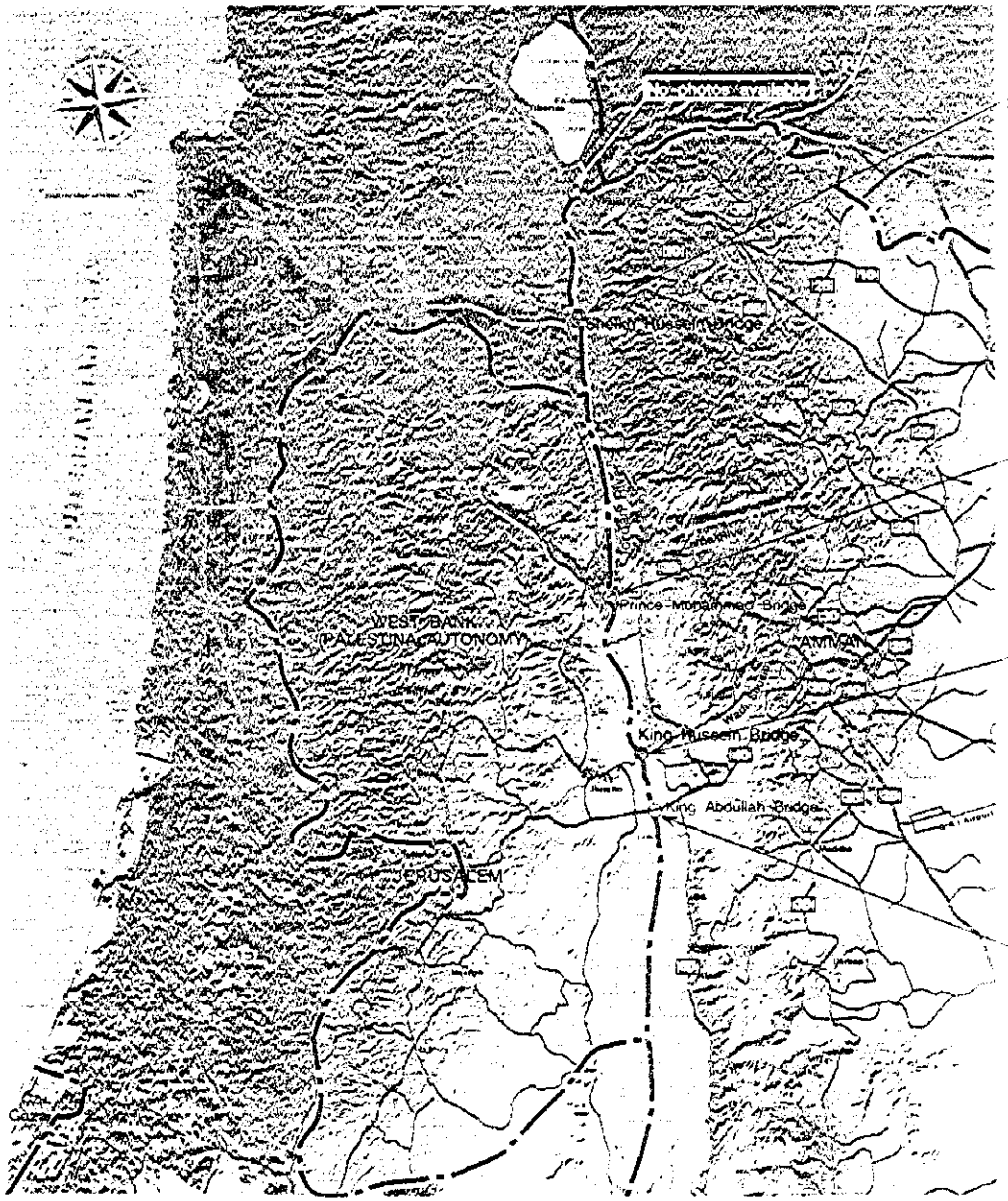


KING HUSSEIN BRIDGE
(Specific Bridge in this Study)

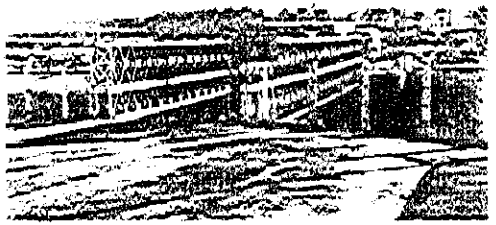


KING ABDULLAH BRIDGE

LOCATION MAP (NO.2)



SHEIKH HUSSEIN BRIDGE
(Opening Bridge in this Study)



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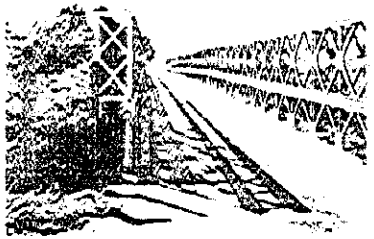

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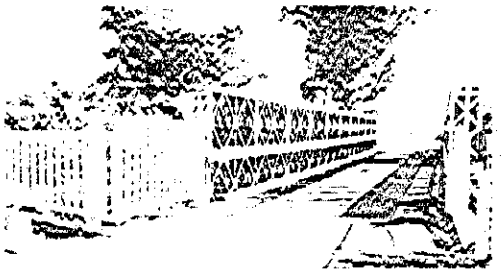
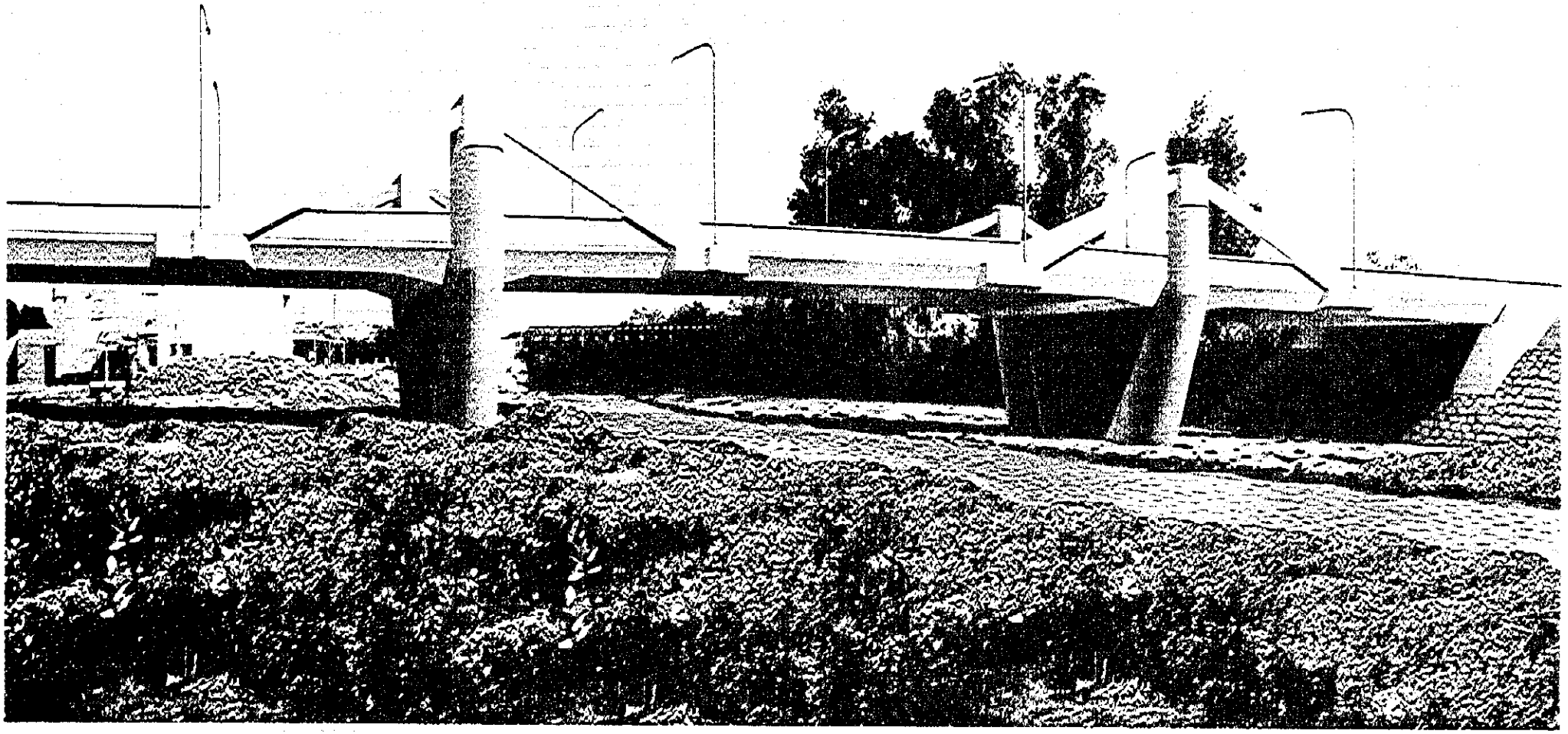
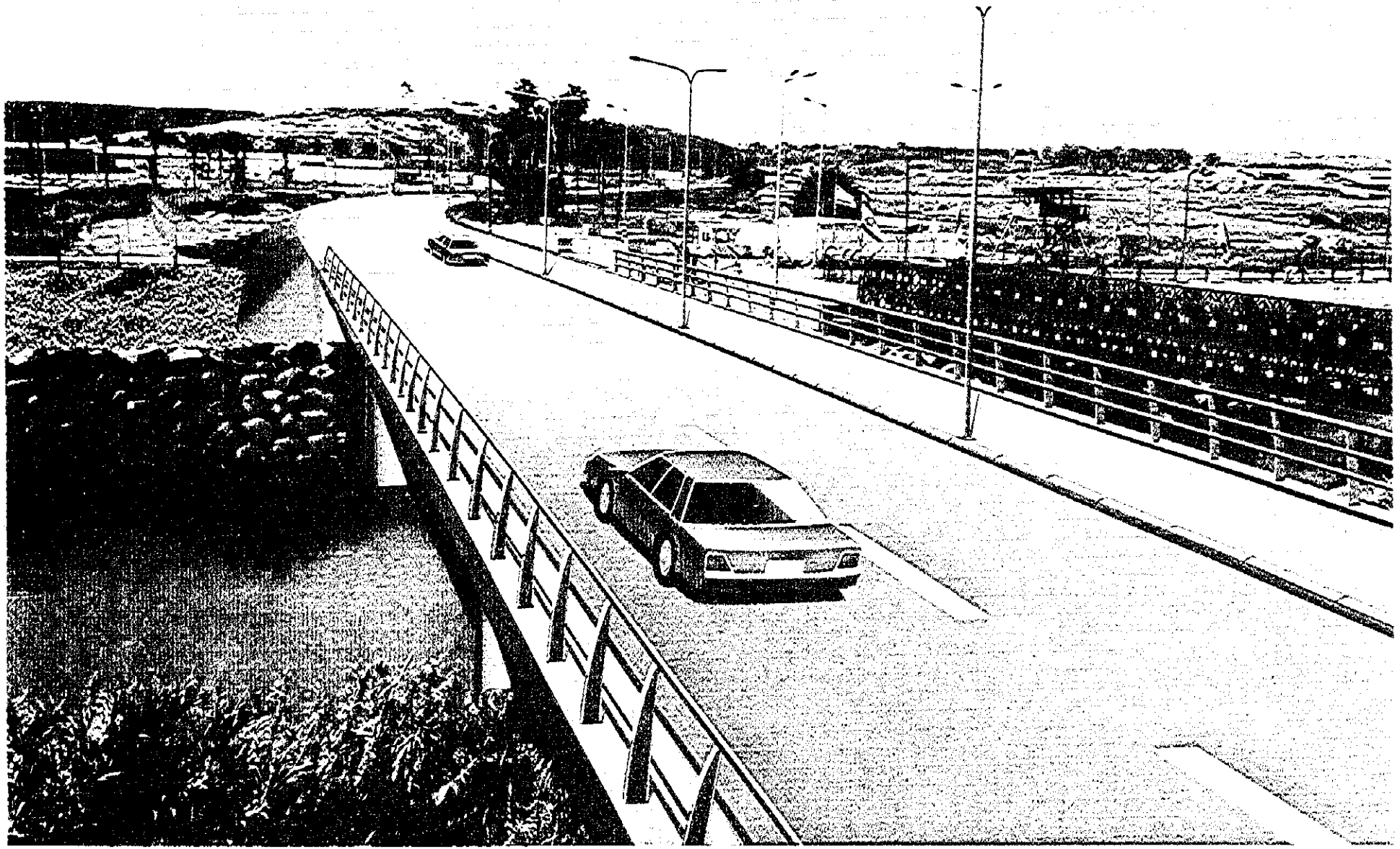


KING ABDULLAH BRIDGE

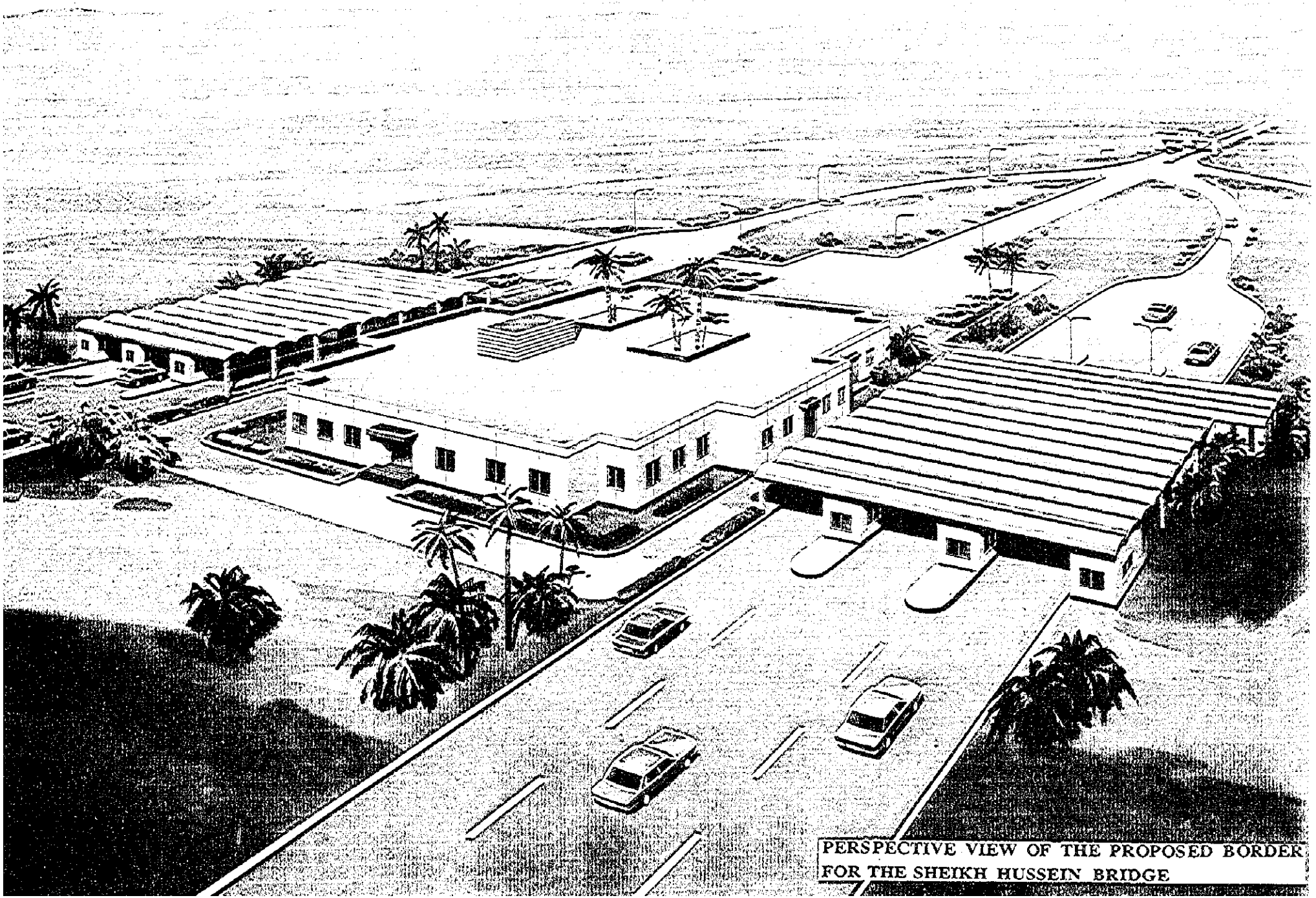
LOCATION MAP (NO.2)



PERSPECTIVE VIEW OF THE PROPOSED KING HUSSEIN BRIDGE



PERSPECTIVE VIEW OF THE PROPOSED SHEIKH HUSSEIN BRIDGE



PERSPECTIVE VIEW OF THE PROPOSED BORDER FOR THE SHEIKH HUSSEIN BRIDGE

ABBREVIATION

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transport Officials
ASTM	American Standards for Testing and Materials
CIDA	Canadian International Development Agency
E/N	Exchange of Notes
GDP	Gross Domestic Products
GNP	Gross National Products
HSD	Highway Studies Directorate
IMF	International Monetary Fund
JD	Jordan Dinar
JICA	Japan International Cooperation Agency
OD	Origin Destination
ODA	Official Development Assistance
OPEC	Organization of Petroleum Exporting Countries
PC	Prestressed Concrete
PLO	Palestine Liberation Organization
RC	Reinforced Concrete
UNDP	United Nations Development Programme
USAID	US Agency for International Development

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CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 Background Information of the Study

Jordan, the Hashemite Kingdom of Jordan, is bordered with Syria to the north, Israel and Palestina West Bank to the west, and Saudi Arabia to the east and south. The country is located in lat. 29° ~ 33°N and long. 35° ~ 39°E, and its total land area is 89,210 square kilometers mostly covered by dusty desert. The climate of the country is mild as categorized in the Mediterranean climate. Jordan Valley occupies the west of the country, where the Jordan River, the border between Jordan and Israel, originates in the Tiberias (Galilee) Lake at an altitude of -210 m and flows southwards into the Dead Sea at an altitude of -407 m.

In the past, 5 bridges were built over the Jordan River to connect both banks: the northmost Majame, Sheikh Hussein, Prince Mohammad, King Hussein and southmost King Abdullah bridges.

All the bridges have been destroyed by the Third Middle East War in 1967: firstly two bridges, the Majame Bridge and the Sheikh Hussein Bridge, were destroyed in 1948 and then the rest three bridges were destroyed in 1967.

Afterwards, 3 Bailey bridges were constructed temporarily: The King Hussein Bridge and Prince Mohammad Bridge in 1968 for connecting Jordan and West Bank just soon after the ceasefire, and the Sheikh Hussein Bridge in November 1994 for connecting Jordan and Israel as part of framework after the peace treaty between Jordan and Israel. These existing bridges are temporary ones which have insufficient carriageway widths for the present and future traffics. Further, traffics were closed in some bridges, which had been inundated by floods.

In this regard, the Government of the Hashemite Kingdom of Jordan made a request for grant aid regarding the Project for Construction of King Hussein Bridge and Sheikh Hussein Bridge (the Project) to the Government of Japan.

The Government of Japan, having made the decision to examine the viability of the Project on the request, entrusted the basic design study (the Study) to the Japan International Cooperation Agency.

1.2 Major Components of the Jordan's Request

The gist of the Project requested by the Jordanian Government to the Japanese Government as of May 1995 is in the following:

1) Reconstruction of the King Hussein Bridge includes:

   - Construction of a 4 lane concrete bridge over the Jordan River, adjacent to the existing temporary one,
   - Construction of a 10 km access road with 4 lanes, connecting the new bridge with the Main Valley Highway (South Shuna - North Shuna Highway), and
   - Construction of the regular border facilities.

2) Reconstruction of the Sheikh Hussein Bridge includes:

   - Construction of a 4 lane concrete bridge over the Jordan River, about 100 m south of the existing temporary one,
   - Construction of a 3 km access road with 4 lanes, connecting the new bridge and the Main Valley Highway, and
   - Construction of the regular border facilities as well as a trade facilitation which consists of the parking areas for trucks from one side to the other, parking areas, and handling area for goods exchanged at the crossing, and handling equipment for containers and general cargoes.

However, the actual status departs from the components in the original request by the Jordanian Government because of the following:

- Ministry of Public Works and Housing (MPWH) of the Jordanian Government has already completed the border facilities for the King Hussein Bridge, about 2 km to the proposed bridge site.
- Ministry of Construction and Housing of the Israeli Government has decided to construct a 2-lane Sheikh Hussein Bridge by October or November 1996. Therefore, the Jordanian Government's request to the Japanese Government is changed to build the Sheikh Hussein Bridge which has the carriageway width of required lane number for future traffic demands minus 2 lanes.

- As for the border facilities for the Sheikh Hussein Bridge, the Jordanian Government has decided to request the Japanese Government the urgently required basic facilities.

The summary table to compare the components in the original request and actual one is shown in Table 1.2.1.

Table 1.2.1 Components of the Request

		Original Request	Actual Request
King Hussein Bridge	Bridge	4 lane concrete bridge	4 lane concrete bridge
	Access Road	4 lanes, 10 km	2 lanes, 7.7 km
	Approach Road*	Nil	350 m on the Jordan side 250 m on the West Bank side
	Border Facilities	Passenger terminal building	Not required
Sheikh Hussein Bridge	Bridge	4 lane concrete bridge	2 lane concrete bridge
	Access Road	4 lanes, 3 km	2 lanes, 2.4 km
	Approach Road	Nil	100 m on the Israel side
	Border Facilities	Passenger terminal building, vehicle inspection sheds, gates, cargo exchange facility, truck terminal, parking lot	Passenger terminal building, vehicle inspection sheds, gates

*) Approach Road: The road from abutment to the existing road in the flood prone area

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objective of the Project

The Project aims at building 2 bridges over the Jordan river along with their border facilities and associated roads, i.e., King Hussein Bridge and Sheikh Hussin Bridge which are of temporary Bailey bridges. It is expected that those construction works would contribute to the regional development of the surrounding areas including Jordan, West Bank and Israel as well as the promotion of friendly international relation between Arab countries and Israel.

2.2 Basic Concept of Project

The basic concept of the Project is:

1) To build a 110 m long King Hussein Bridge along with the approach roads on both the Jordan side and West Bank side and the access road on the Jordan side, and

2) To build a 90 m long Sheikh Hussein Bridge along with the access road on the Jordan side and approach road on the Israel side as well as to build a passenger terminal building and other basic facilities of the Jordanian Border Facilities.

The scale of the above facilities has been determined taking into consideration the following:

a. To implement the project in conformity with the Japan's Grant Aid Scheme and its procedures

b. To construct the bridges which have symbolic meaning of the peace treaty in the Middle East, linking the nations which have been isolated from each other due to prolonged political conflicts

c. To provide the long-term traffic capacity for the bridges which would have longer durability than other facilities

d. To provide the short-term traffic capacity for the access roads which would have relatively shorter durability

e. To provide the basic border facilities

The Project is the first attempt under the Japan's Grant Aid Scheme to build bridges over the international river. It should be noted that the required proceedings related to diplomatic and legal matters be cleared through the collaboration with the nations concerned.

2.3 Basic Design

2.3.1 Design Concept

(1) Design Principles

The principles to prepare the basic design of the proposed bridges as well as their associated roads and border facilities are as follows:

1) Natural Characteristics

The Jordan Valley has rainy season for 5 months from November to next March, and little rainfall for 4 months from June to September. During the drought season, the temperature rises sometimes over 40°C and therefore special emphasis should be placed on the quality control of placing and curing the concrete. On the other hand, floods are likely to occur during rainy season, and therefore the foundation work of the bridge is very difficult.

The subsoil exploration has revealed that the bearing strata of both bridges are relatively deep and therefore the conceivable foundation type of the bridges would be piles.

As earthquakes took place in the past, consideration of seismic force toward the bridge design is crucial in Jordan: statically equivalent horizontal force of 0.2 would have to be considered.

2) Social Conditions

Islam is the dominant religion in Jordan and Palestinian West Bank while Judaism is that in Israel. In this regard, due consideration should be taken into account for the preparation of construction schedule, i.e., Ramadan Holiday, etc.

Exchange rate of Jordan Dinar for US Dollars is relatively stable at present. Such exchange rate will be largely affected by the process of Palestina

autonomy to sovereign in future. As far as construction period of the Project is concerned, the exchange rate seems to be stable.

As the sites of the Project are located in the prolonged disputed area between Jordan, West Bank and Israel, construction planning should be prepared taking into consideration the unexploded mines and ordnance in the area. It is very crucial to remove such unexploded mines and ordnance by the governments of Jordan and Israel prior to the commencement of works.

3) Circumstances of Construction Conditions

Mechanized construction methods are generally used in Jordan, and the levels of construction practice are relatively high. As for bridge works, an extra-dosed bridge, one of the most advanced structural type, was built recently by Jordanian contractor(s).

A number of foreign workers like Egyptian are engaged as labors in construction work, so that labor costs are relatively high in Jordan comparing to Asian countries other than the Middle East countries.

Water in the Jordan River contains salt and is not favorable for the use of concrete work. Water for construction use would have to be obtained from the King Abdullah Canal.

Borrow pits for embankment materials can be obtained in the vicinity of the project sites. In addition, many kinds of construction materials and equipment are available in the country.

Materials being procured in the country include all the taxes imposed by the Government of Jordan, which should be exempted or reimbursed to the foreign contractors in case of execution under grant aid schemes of foreign countries.

4) Local Contractor

Contractors having capability to construct bridges, highways and buildings are available in the country. Such qualified contractors might be able to participate in the project as subcontractors of Japanese construction firm.

5) Capacity of Road and Bridge Maintenance

Most of existing roads and bridges are well maintained by the Ministry of Public Works and Housing. In this regard, no serious issues of future maintenance is anticipated towards the Project facilities.

6) Bridge Design Principles

a. The required number of lanes, which dominates the bridge width, should be determined taking into consideration not only the present traffic volume but also future demands.

b. The Project includes the construction of the King Hussein Bridge that covers all the required number of lanes. On the other hand, the government of Israel is going to build a 2 lane Sheikh Hussein Bridge to deal with the present traffic volume, so that the Project covers the rest of the required lane number.

c. As the government of Israel has already decided the structural type of the Sheikh Hussein Bridge, the Sheikh Hussein Bridge of the Project should follow the similar appearance of the Israeli design as much as possible to well blend each other.

7) Road Basic Design

a. The required lane number of access roads should be determined so as to satisfy the short-term (10 years after completion) traffic demands.

b. As the King Hussein Bridge site is located in about 1 km wide flood-prone area, the height of the approach road embankment should satisfy an appropriate free-board to avoid the inferior effect by inundation. The future expansion of the approach road width seems to be difficult in such an area. In this regard, the approach road of the King Hussein Bridge meets the required lane number as with the bridge taking into consideration not only the present traffic volume but also future traffic demands.

8) Border Facility Basic Design

a. The Project covers only the basic facilities consisting of the passenger terminal building and its associated facilities such as vehicle inspection sheds and border gates.

b. Other facilities such as truck terminal building, parking lots, cargo exchange facility, etc., would have to be developed by the Jordanian government.

(2) Traffic Demand Forecast

(A) Purpose of the Study

For the purpose of obtaining basic data for the basic design study of the King Hussein and Sheikh Hussein bridges and their associated facilities, traffic demand analyses were conducted by the JICA study team. Methodology and the result of the analysis are explained below.

(B) Methodology

1) Introduction

The analysis was carried out regarding following two aspects of traffic movement, which were deemed to be major traffic flow on the bridges.

a) Induced traffic

It is expected that the opening of the bridges over the Jordan river in the peaceful international relation would induce a great amount of traffic volume which is suppressed until this day. Those traffic which would be realized with the opening of the bridges in the peaceful environment of international relation was defined as induced traffic and analysis about this sort of traffic was carried out in this study.

b) Diverted traffic from port of Aqaba to that of Hayfa in Israel

The inter-regional travel distance brought about by the opening of the new bridges is expected to change the pattern of inter-regional transport activities. Especially, some portions of the international cargoes which are now being shipped at Aqaba port will be transferred to Hayfa port due to better accessibility of the latter to be realized with the opening of the bridges. Analysis about this diverted traffic was carried out in this study as well.

2) Methodology

a) Estimation of induced traffic

The estimation of the induced traffic was done applying Gravity Model where the magnitude of the national economies and international travel distance are two of the explanatory variables as explained below:

$$T(i, j) = E(i) \times [(a \times E(j)^b) \div D(i, j)^c]$$

where,

T(i, j)	:	Traffic volume between nation (i) and nation (j)
E(i)	:	Magnitude of economic activity of nation (i), measured in terms of GDP
E(j)	:	Magnitude of economic activity of nation (j), measured in terms of GDP
D(i, j)	:	Travel time between nation (i) and nation (j), measured in terms of hour
a, b, c	:	Parameters

Parameters for the above model were estimated by Least Square Method using International Origin-Destination matrices available at Ar Ramtha Customs office and macro-economic data of related nations and international travel time matrices especially established for this purpose. As a result, structure of the model was determined as shown below:

(Passenger vehicle and bus)

$$T(i, j) = E(i) \times [(7.093 \times E(j)^{0.423}) \div D(i, j)^{-2.708}] \quad R = 0.790$$

(Truck)

$$T(i, j) = E(i) \times [(5.218 \times E(j)^{0.678}) \div D(i, j)^{-2.122}] \quad R = 0.940$$

Future international traffic volume was obtained by inputting future magnitude of economic activities of corresponding nations and their travel distances realized with the introduction of the new bridges.

b) Diverted Traffic from port of Aqaba to that of Hayfa

This traffic was estimated in accordance with the following procedure:

- Classification of diverted cargoes

Such cargoes as fertilizer, phosphate and potash, which are bulky are classified as non-convertible cargoes because of economic disadvantage and of the fact that the port of Aqaba has sufficient handling capability for these cargoes. In addition, international cargoes having origin or

destination in Europe or America are defined as potential diverted cargoes to the port of Hayfa.

- Forecast of amount of potential cargoes to be diverted from the port of Aqaba. (Under Without Project scenario)

  Amount of diverted cargo to be transported in With No Bridge Scenario was forecasted based on historical cargo transportation data at the port of Aqaba.

- Forecast of probable cargoes to be diverted to the port of Hayfa.

  Amongst the potential diverted cargoes obtained in the previous procedure, cargoes to and from northern part of Jordan and Iraq are defined as highly diverted cargoes to the port of Hayfa and 50% of probability of route changing from conventional route to the port of Aqaba to that of Hayfa for these cargoes was applied.

- Estimation of diverted traffic to Hayfa

  Diverted cargoes obtained in the above process and expressed in tonnage was converted into actual vehicle number applying formation available at Ar Ramtha Customs office.

(C) Study Result

Traffic volume on the project bridges was forecasted as shown in Tables 2.3.1 and 2.3.2. According to the Tables traffic volume on Sheikh Hussein and King Hussein bridges in 1998, which is a proposed opening year of the bridges, is estimated at about 7,770 AADT and 5,900 AADT respectively. The reason why the former has more number of traffic than the latter is that the former contains about 2,500 AADT of diverted traffic from the port of Aqaba.

The data used for the analysis and details of the result are shown in Appendices.

Table 2.3.1 Future Traffic Volume at King Hussein Bridge

(Unit: AADT)

		1998	2000	2007	2017	2027
Induced Traffic	Passenger Car	4,630	5,626	9,146	18,313	36,667
	Truck	1,278	1,629	2,890	6,552	14,858
	Total	5,908	7,255	12,036	24,865	51,525
Diverted Traffic to Hayfa	Passenger Car	0	0	0	0	0
	Truck	0	0	0	0	0
	Total	0	0	0	0	0
Total	Passenger Car	4,630	5,626	9,146	18,313	36,667
	Truck	1,278	1,629	2,890	6,552	14,858
	Total	5,908	7,255	12,037	24,865	51,525
Required Lanes		2	2	2	4	4

Table 2.3.2 Future Traffic Volume at Sheikh Hussein Bridge

(Unit: AADT)

		1998	2000	2007	2017	2027
Induced Traffic	Passenger Car	2384	2780	4520	9050	18120
	Truck	2895	3451	6121	13880	31474
	Total	5279	6231	10641	22930	49594
Diverted Traffic to Hayfa	Passenger Car	0	0	0	0	0
	Truck	2491	2733	3786	6034	9624
	Total	2491	2733	3786	6034	9624
Total	Passenger Car	2384	2780	4520	9050	18120
	Truck	5386	6184	9907	19914	41098
	Total	7770	8964	14427	28964	59218
Required Lanes		2	2	2	4	4

2.3.2 Design Criteria and Standards to be Applied

(1) Bridge Design

a. According to the Jordanian standards, the bridges should be designed to carry the live load of 1.5 times of HS-20 as specified by AASHTO.

Basic seismic coefficient of 0.2, statically equivalent horizontal force, should be considered.

b. Design calculation should be based on the bridge design specifications adopted by Japan Road Association 1995. As for the determination of bridge length, the required openings specified in the "Determination Method of Causeway Length in Flood-Prone Area" by the Ministry of Construction of Japan 1959.

Figure 2.3.1 LANDSAT TM-data Map (January 23, 1995)

Figure 2.3.1 LANDSAT TM-data Map (January 23, 1995)

c. Bridges should be designed to maintain the following vertical clearance:

- King Hussein Bridge

  Since the site is located in the prolonged disputed area and no significant hydrographic data is available, vertical clearance of 2.0 m should be kept above the last-year-flood level: -377.7 m which was estimated based on the LANDSAT TM-data dated January 23, 1995 and the topographic survey data in February 1996 by the Study Team. The map obtained from the LANDSAT TM-data is shown in Figure 2.3.1. In addition, preliminary study was conducted to estimate the probable water level for the 50 year return period. As a result, the probable water level was estimated at -376.647 m (discharge = 1,740 t/sec) as shown in Appendices.

- Sheikh Hussein Bridge

  Vertical clearance of 0.6 m should be maintained above the high water level of -275.0 m (discharge = 1,300 t/sec) for the 50 year return period. It is noted that the high water level was given to the Study Team by the Ministry of Construction and Housing of the Israeli Government.

(2) Road Design

a. Road design should be according to the Jordanian standards.

b. In case of approach road design for the King Hussein Bridge where embankment would be constructed in the flood-prone area, box culverts should be allocated in an appropriate interval. Embankment materials of this approach road should be in conformity with the stipulation of Jordanian Specifications.

c. Some parts of the access road of the King Hussein Bridge would pass in parallel with the Wadi Shueib. The new alignment of the access road should be planned apart from the wadi as much as possible to eliminate the risk of erosion.

d. The access road of the Sheikh Hussein Bridge will cross the King Abdullah Canal near the conjunction with Valley Road (NH-65). Disruption of this canal should be avoided even during the construction of the access road by constructing a minor bridge or box culvert.

(3) Border Facilities

a. The passenger terminal building should meet the basically required area for the short-term demands.

b. The vehicle inspection sheds should have the required number of traffic lanes and inspection counters for the short-term traffic demands.

c. The border gate should be designed as with the similar projects in Jordan.

2.3.3 Basic Design of the King Hussein Bridge and Associated Facilities

(1) Bridge Location

The road will cross the Jordan River at 8.1 km counted from the starting point at South Shuna intersection. The location of the proposed King Hussein Bridge will be 30 m upstream of the existing Bailey bridge as shown in Figure 2.3.2.

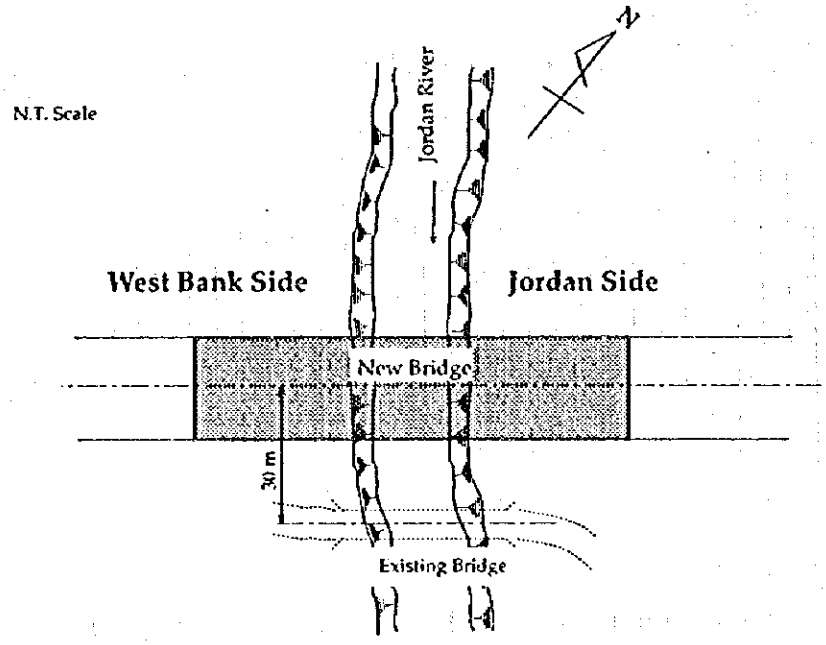


Figure 2.3.2 Location of King Hussein Bridge

The bridge location was decided among the participants from the concerned governments and Study Team. Main reason for the new bridge location is to avoid the risks for the remainder of unexploded mines that were placed in the forest downstream.

(2) Location of Approach Roads and Access Road

The following definition was made in the Study:

- Approach Road: Road section being constructed in the flood prone area from the abutment of the bridge to the conjunction of existing road.
- Access Road: Road improvement section from the starting point at South Shuna intersection to the conjunction of the approach road.

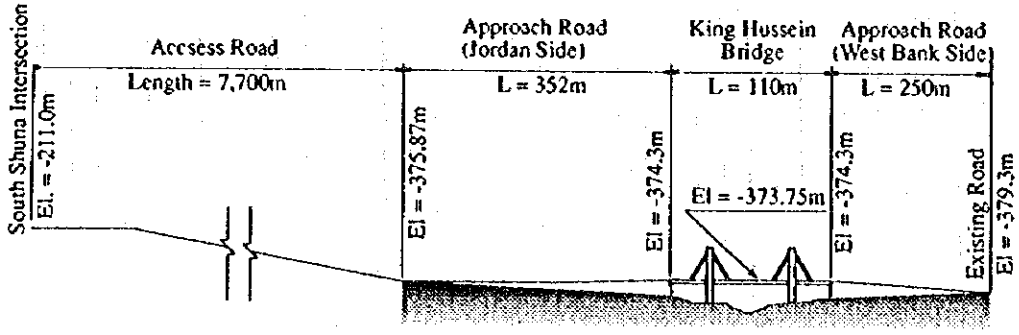
The configuration of the location of approach road and access road is shown in Figure 2.3.3, and the gist of these roads is summarized below.

i) Roads on the Jordan Side

- Approach Road : 352 m long 4 lane road (new construction)
- Access Road : about 7.7 km long 2 lane road (improvement)

ii) Road on the West Bank Side

- Approach Road : 250 m long 4 lane road (new construction)
- Access Road : Nil



N.T. Scale

Figure 2.3.3 Relationship of Approach & Access Roads

(3) Sizes of the Proposed Bridge

i) Bridge Length = 110 m

The bridge length of the existing bridge is 30.5 m. This bridge was inundated when flood had taken place. According to the stipulation in the "Determination Method of Causeway Length in Flood-Prone Area" by the Ministry of

Construction, Japan 1959, the required bridge length was calculated at 110 m. The details are discussed in Appendices.

ii) Maximum Span Length = 50 m (Center Span)

The 50 m long span, which eliminates the construction of piers in the river, was determined for the center span since the removal of un-exploded mines and ordnance in water seemed to be very difficult from the technical view point.

iii) Bridge Width = 18.9 m

The bridge should have 4 lanes on the basis of the following traffic demands.

Table 2.3.3 Summary of future Traffic Volume

(unit: AADT)

	1998 (Opening)	2007 (After 10 years)	2017 (After 20 years)	2027 (After 30 years)
Future Traffic Volume	5,908	12,036	24,865	51,525

The bridge should have a 3.0 m wide median strip according to the usual practice in Jordan. Nevertheless, it is possible to reduce the bridge width by using New-Jersey type block instead of the median strip in accordance with the Jordan Standards.

The bridge should have 1.5 m wide sidewalks on both sides.

Subsequently, the total width was determined at 18.9 m as shown in Figure 2.3.4.

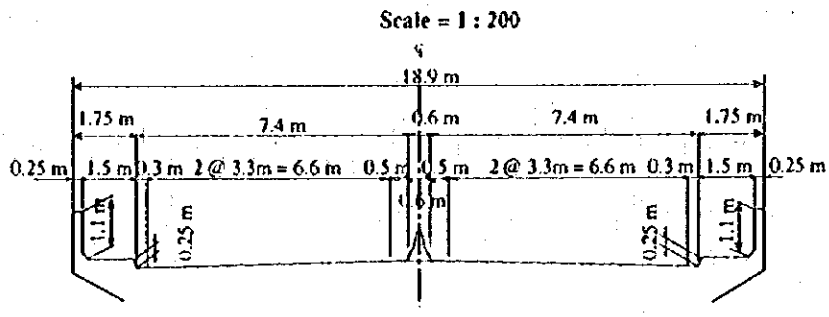


Figure 2.3.4 Cross Section of King Hussein Bridge

iv) Crossfall and Longitudinal Grade

- Crossfall = ±2.0%

- Longitudinal Grade = ±1.0% (0.5% parabolic curve)

v) Skew Angle = 90° (Right Angle)

vi) Foundation = Below 30 m from the ground surface

(4) Bridge Type Selection

i) Superstructure

Conceivable options of the structural types are in the following:

Option - 1 : Prestressed Concrete (PC) Box Girder with Rigid Frame
Option - 2 : PC Connection I-Girder
Option - 3 : PC Extra-dosed Girder

As a result of the overall assessment including the structural characteristics, construction methods, future maintenance, aesthetics and economic aspects, the PC extra-dosed girder (option-3) was recommended as the proposed bridge type for the King Hussein Bridge. The comparison among 3 options is summarized in Figure 2.3.5.

ii) Foundation

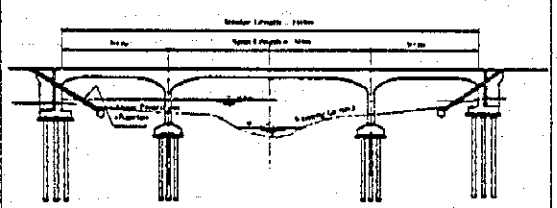
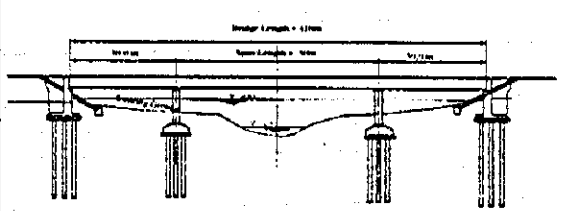
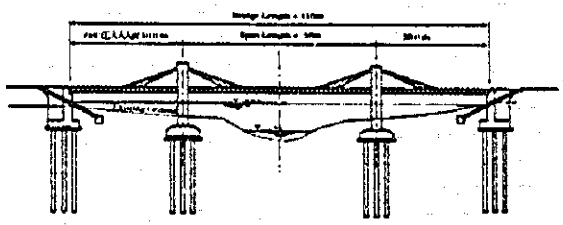
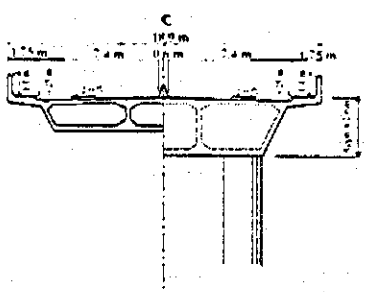
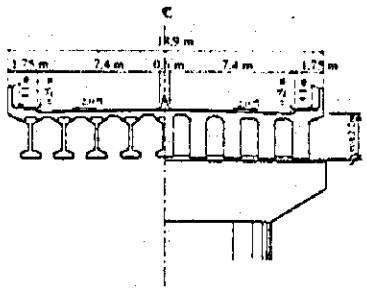
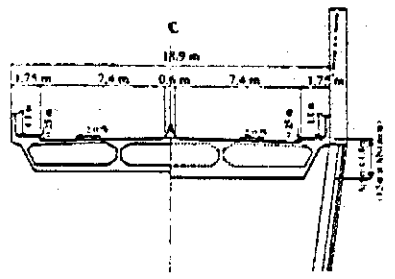
The bearing strata, which contains intermediate layers of silty clay and clay intercalated each other, exist about 30 m below the ground surface.

In such strata, cast-in-place RC piles were selected from the view points of economy and construction speed. As for the diameter of the piles, 1.2 m dia was determined taking into consideration the effective layout of the piles.

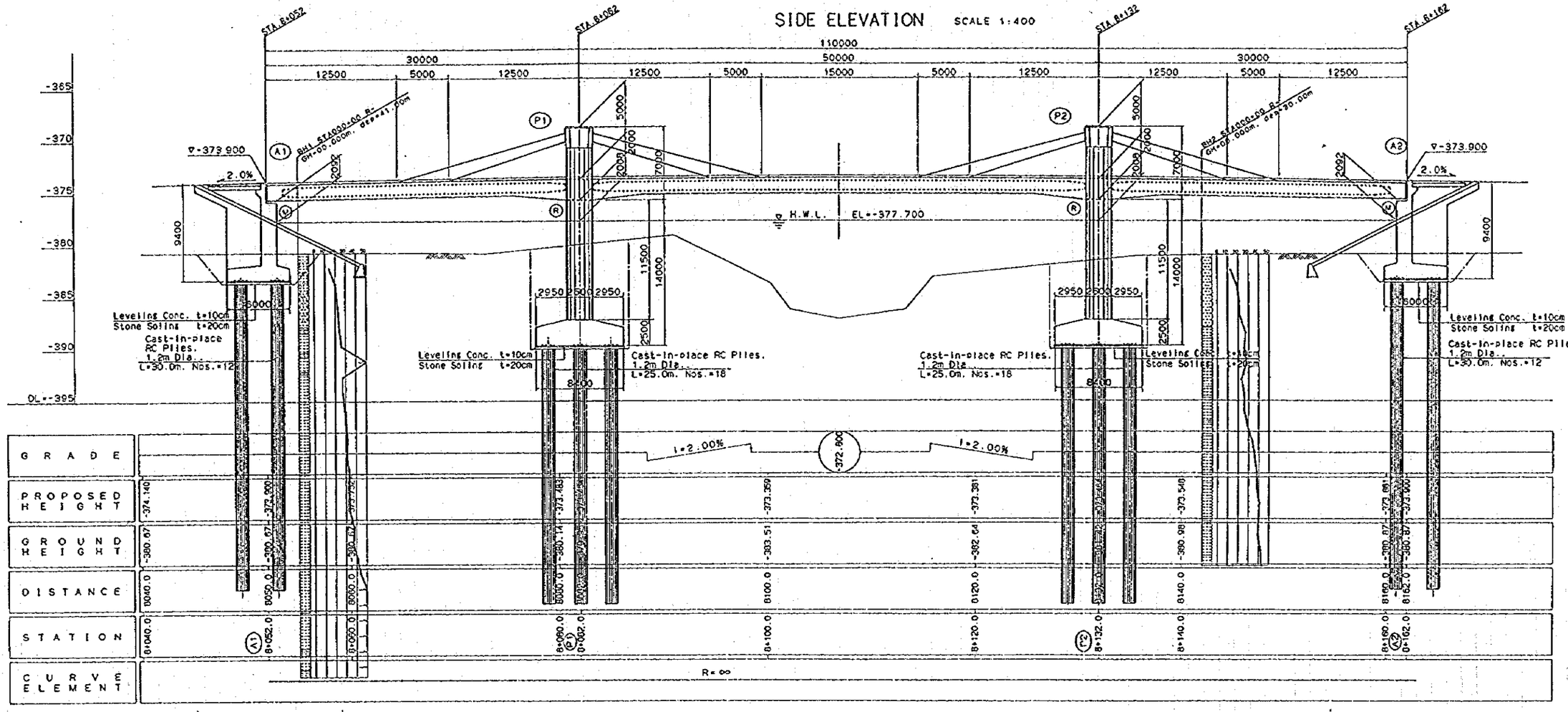
(5) General Layout Plan

The general view of the proposed bridge is shown in Figure. 2.3.6.

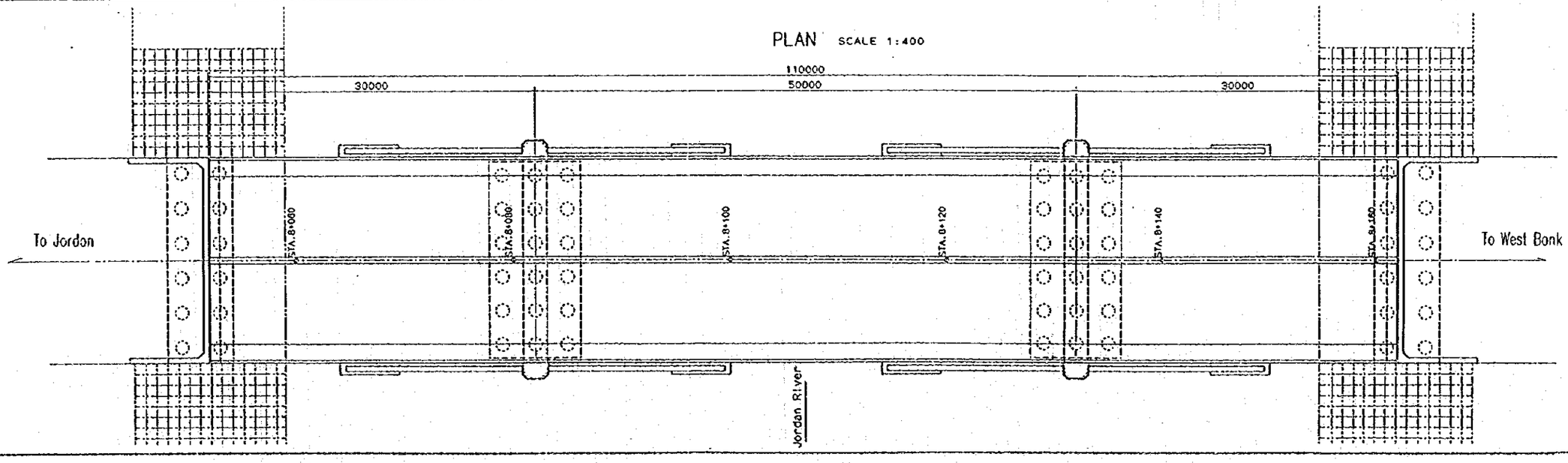
Figure 2.3.5 COMPARISON OF BRIDGE TYPE OPTIONS

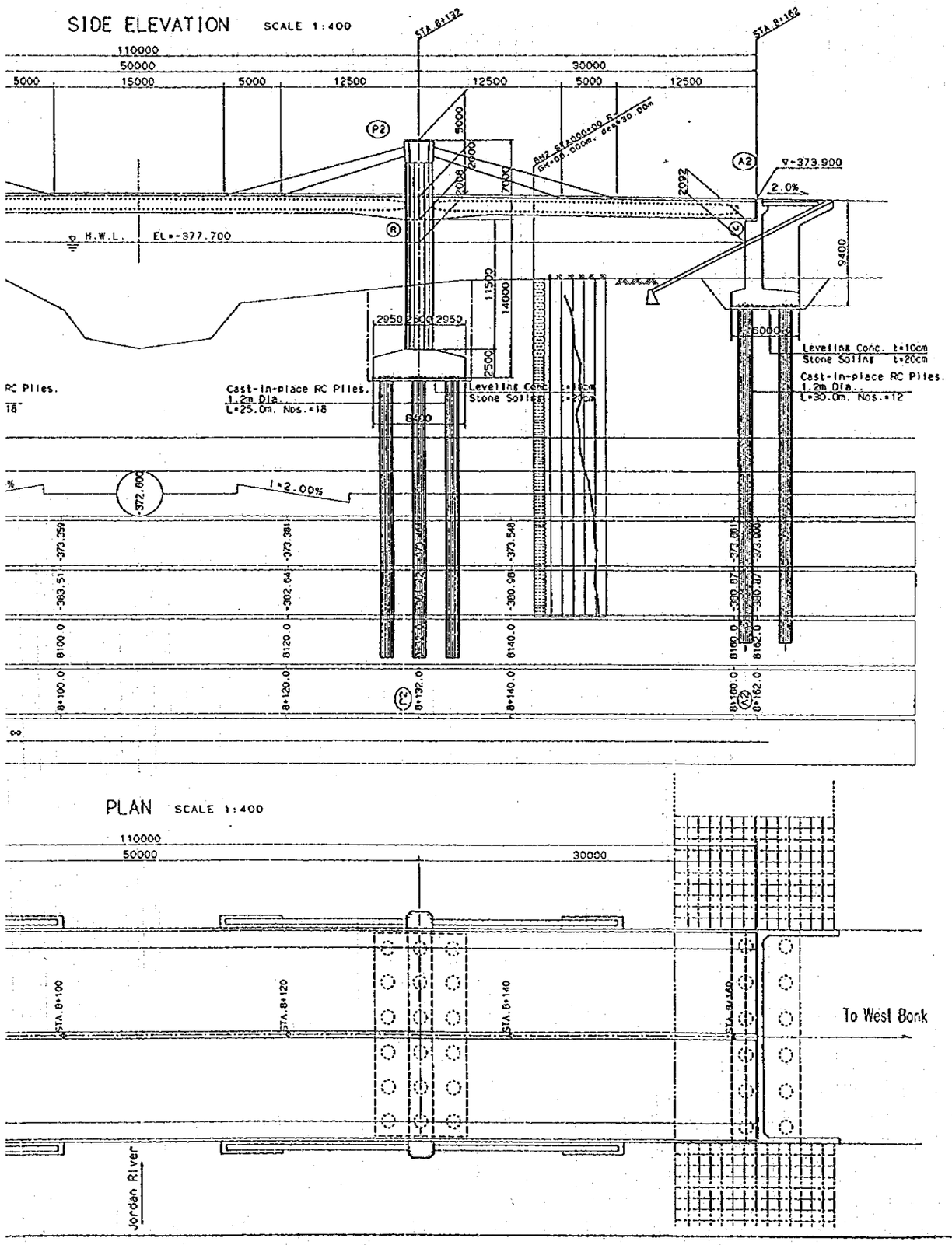
		OPTION - 1 (PC Box Girder with Rigid Frame)	OPTION - 2 (PC Connection I - Girder)	OPTION - 3 (PC Extra-dosed Girder)
General View	Side View			
	Cross-Section			
Structural Characteristics		- Prestressed concrete box girder (post-tensioning) having rigid frame system with substructures which can eliminate the expansion joints as well as bearings. - Largest girder depth among 3 options.	- Connection beam system that consists of prefabricated prestressed concrete I-girders and cast-in-place concrete of the connection part and deck slabs - Simple girders during erection period, which become continuous girders after the cast-in-place concrete work.	- Difference of conventional PC box girders is to arrange diagonal cables outside main girders. - As prestressing forces of the diagonal cables work effectively to reduce the required section of main girders, the depth of girder is the minimum among 3 options. Accordingly, the height of approach embankment decreases.
Construction Method		- Full scaffolding method can be applied since the clear height of the girder is relatively less. - As the structural system is of rigid frame, special emphasis should be placed upon the concrete curing work to avoid shirinkage cracks.	- This system requires the most simple erection method. - As the weight of the pre-fabricated girders are heavy, crane erection will not be favorable and erection girder will be required.	- Full scaffolding method can be applied since the clear height of the girder is relatively less. - As the structural system is very advanced one, high construction technology is required. It should be noted that the Jordanian construction firms have similar experience in the construction of the Wadi-Mudi Bridge. In this regard, any serious difficulties are not anticipated for the workmanship by Jordanian labors.
Future Maintenance		- No expansion joints and no bearings will eliminate the maintenance cost in the future.	- As all abutments and piers have bearings and expansion joints are installed on the abutments, minor maintenance work will be required.	- As the abutments have bearings and expansion joints, minor maintenance work will be required.
Aesthetics		- Good	- Fair	- Very good with strong impact of visual quality
Economic View Point		Superstructure 255 Million Yen Substructure/Foundation 123 Million Yen Approach Road 111 Million Yen Total 489 Million Yen	Superstructure 254 Million Yen Substructure/Foundation 132 Million Yen Approach Road 102 Million Yen Total 488 Million Yen	Superstructure 244 Million Yen Substructure/Foundation 131 Million Yen Approach Road 90 Million Yen Total 465 Million Yen
Overall Evaluation		Advantageous for future maintenance, but costly than OPTION - 3.	Too conventional and inferior in technology impact	○

SIDE ELEVATION SCALE 1:400

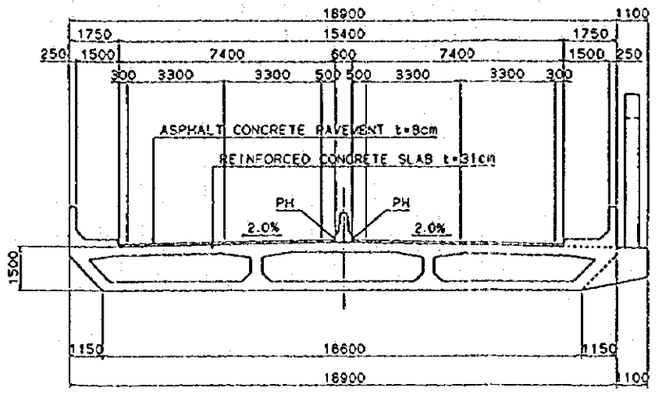


PLAN SCALE 1:400



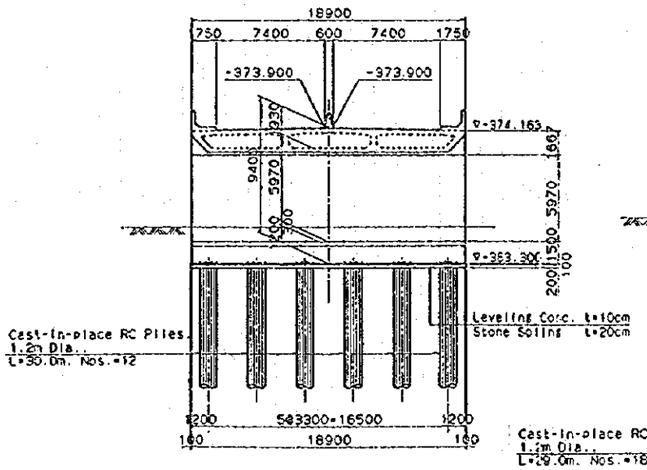


CROSS SECTION SCALE 1:200



ABUTMENT SCALE 1:400

(A1) . (A2)



PIER SCALE 1:400

(P1) . (P2)

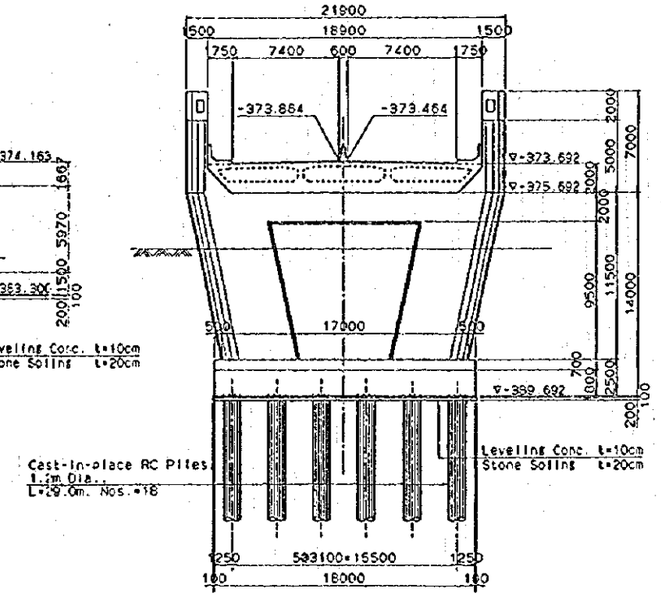
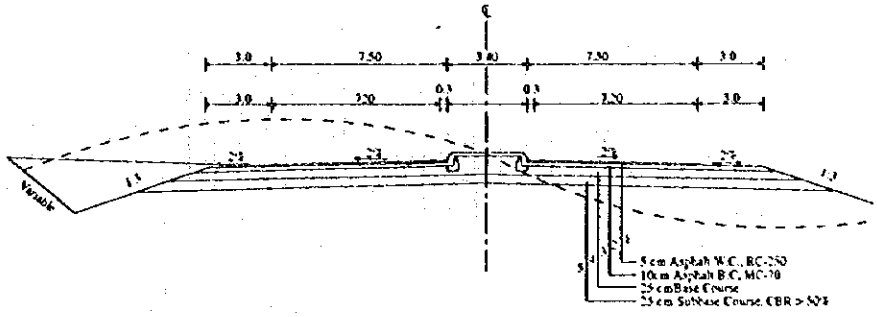


Figure 2.3.6 General Layout Plan of King Hussein Bridge

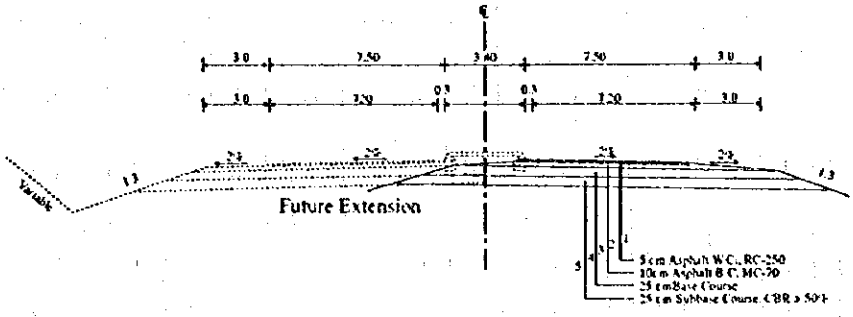
(6) Approach Roads and Access Road

The access roads was designed to have 2 lanes while the approach roads, of which future expansion might be very difficult, was to have 4 lanes. Typical cross sections based on the Jordan standards are shown in Figure 2.3.7 and Figure 2.3.8 respectively.



TYPICAL CROSS SECTION OF APPROACH ROAD
Scale H = 1/400
V = 1/40

Figure 2.3.7



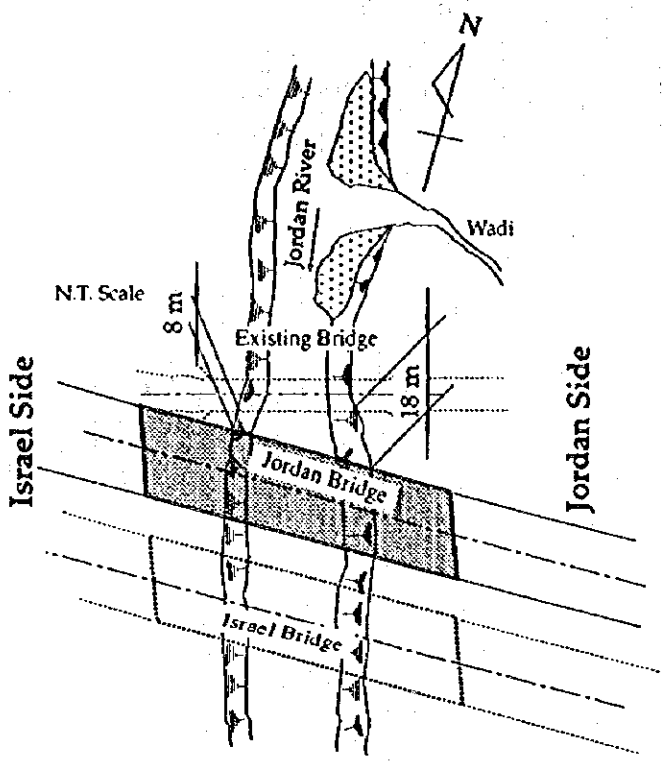
TYPICAL CROSS SECTION OF ACCESS ROAD
Scale H = 1/400
V = 1/40

Figure 2.3.8

2.3.4 Basic Design of the Sheikh Hussein Bridge and Associated Facilities

(1) Bridge Location

The proposed bridge will be approximately at 2.4 km from the starting point on the Main Valley Road. The location of the bridge will be approximately 18 m downstream of the existing Bailey bridge on the Jordan side and 8 m downstream of the same on the Israel side, as shown in Figure 2.3.9.



Note: Jordan Bridge = specific bridge in the Study

Figure 2.3.9 Location of Sheikh Hussein Bridge

The bridge location and alignment were determined through discussions with officers from Ministry of Construction of the Israeli Government, MOPH and Ministry of Planning (MOP) of the Jordanian Government and Study Team taking into consideration the accessibility and location of the border facilities on the Israel side. It should be noted that the traffics towards Israel be carried by the Jordanian Bridge vice versa towards Jordan by the Israel Bridge.

(2) Location of Approach Road, Access Road and Border Facilities

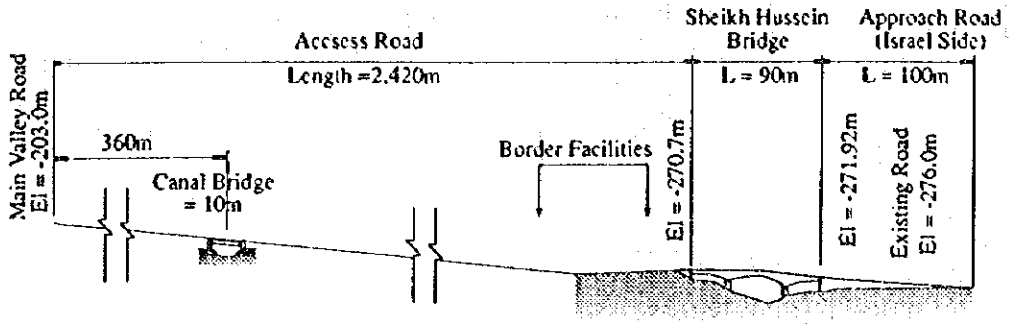
The definition of the approach road and access road follows that of the King Hussein Bridge (refer to page 2 - 11)

i) Road on the Jordan Side

- Access Road: about 2.5 km long 2 lane road (new construction)

ii) Road on the Israel Side

- Approach Road: 100 m long 2 lane road (new construction)



N.T. Scale

Figure 2.3.10 Locations of Approach Roads, Access Road and Border Facilities

(3) Sizes of the Proposed Bridge

As discussed previously, the Ministry of Construction and Housing of the Israeli Government is going to construct a 2-lane bridge for the traffic between Jordan and Israel. After the completion of the proposed bridge in this study, the Israeli bridge will be used for the traffic from Israel towards Jordan. In this regard, the sizes and types of the proposed bridge will follow the Israeli design.

i) Bridge Length = 90 m

ii) Maximum Span Length = 43 m (center span)

iii) Bridge Width = 12.1 m (2 lane + one sidewalk)

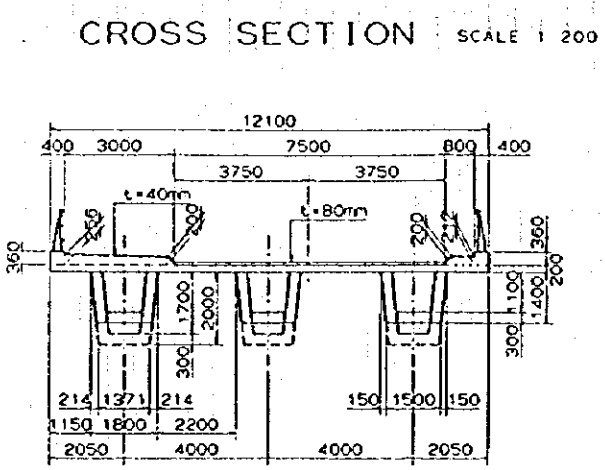


Figure 2.3.11 Cross-Section of Sheikh Hussein Bridge

iv) Crossfall and Longitudinal Grade

- Crossfall = ±2.0%
- Longitudinal Grade = -2.5%

v) Skew Angle = 72°

vi) Foundation = Below 16 m from the ground surface

(4) Bridge Type

As with the Israel Bridge, the bridge will have the following structural types

i) Superstructure

PC Continuous Box Girder

ii) Foundation

1.2 m dia. Cast-in-Place RC piles

(5) General Layout Plan

The general view of the proposed bridge is shown in Figure 2.3.12.

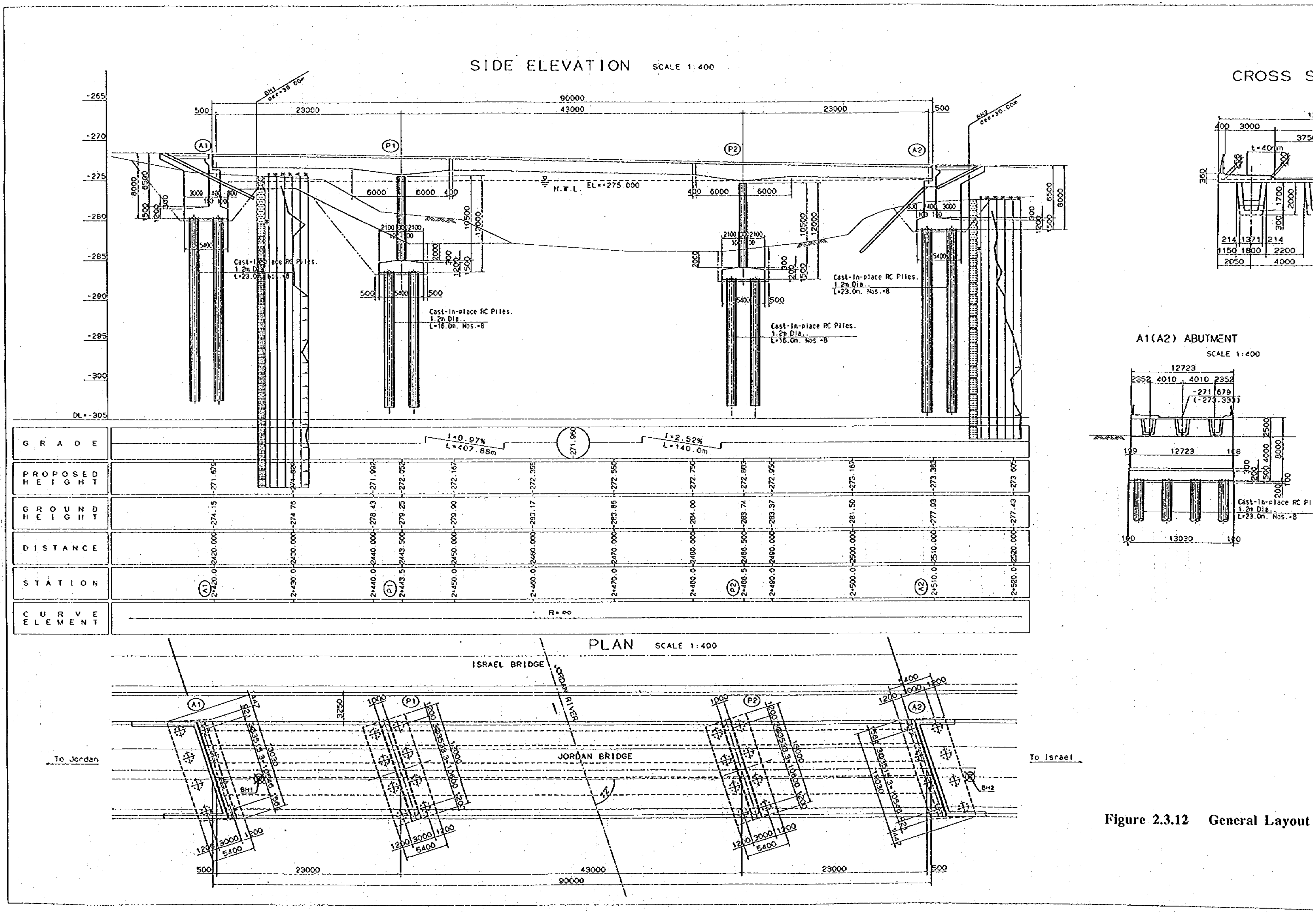
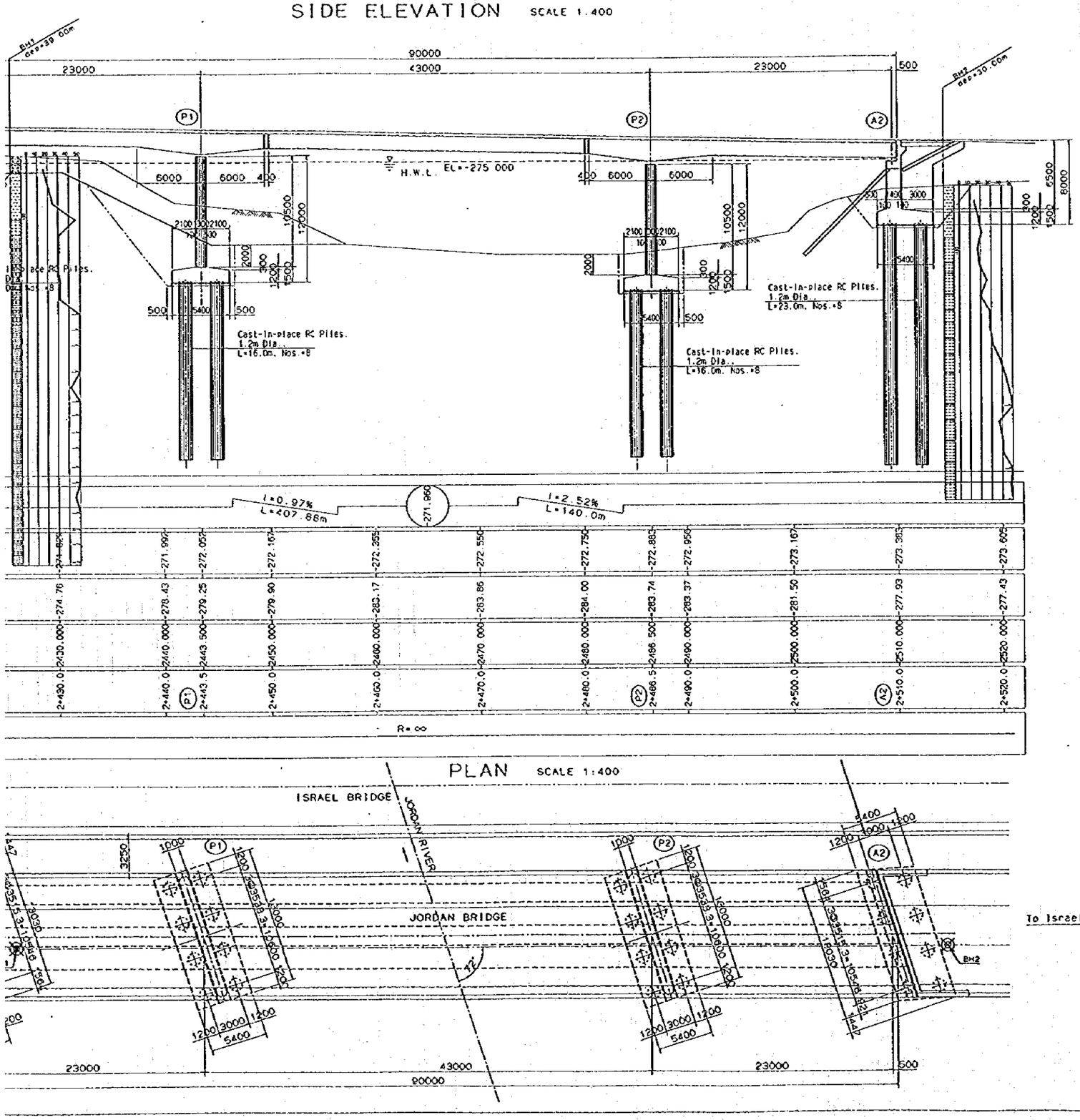
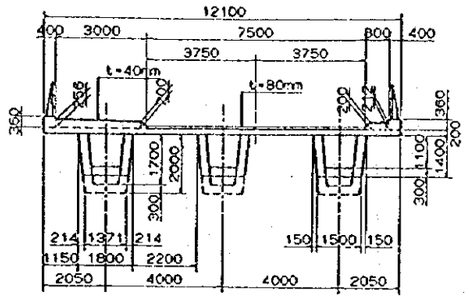


Figure 2.3.12 General Layout

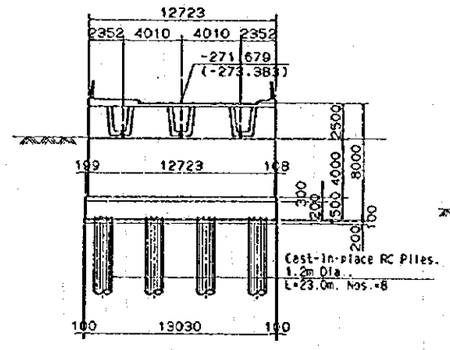
SIDE ELEVATION SCALE 1:400



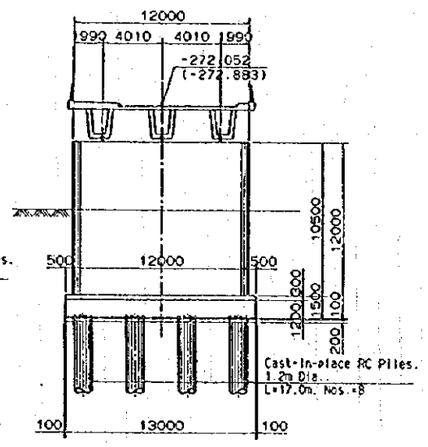
CROSS SECTION SCALE 1:200



A1(A2) ABUTMENT SCALE 1:400



P1(P2) PIER SCALE 1:400

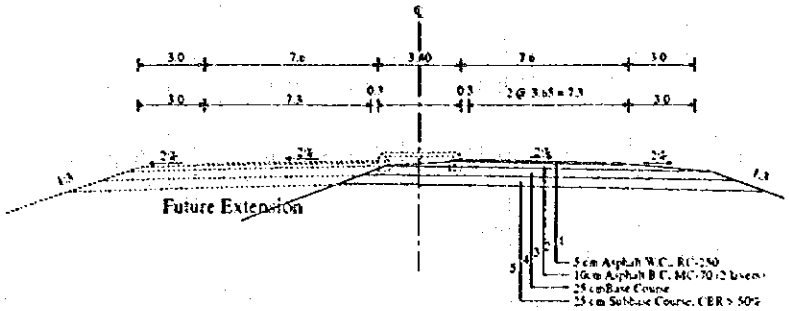


PLAN SCALE 1:400

Figure 2.3.12 General Layout Plan of Sheikh Hussein Bridge

(6) Approach Road and Access Road

The access road and approach road of the Sheikh Hussein Bridge have the same width composition as shown in Figure 2.3.13 in accordance with the Jordanian standards.



TYPICAL CROSS SECTION OFAPPROACH & ACCESS ROAD
Scale H = 1/400
V = 1/40

Figure 2.3.13 Typical Cross Section

(7) Border Facilities

1) Floor Area of Passenger Terminal Building

The required floor area of the passenger terminal building is broadly divided into the following purposes:

a) Passengers' hall for customs clearance and vehicle registration

b) Passengers' hall for passport and security control

c) Meeting room for distinguished guests

d) Office space for the concerned authorities

The required areas for a) and b) of the above can be calculated on the basis of the future traffic/passenger demands while those for d) of the above can be based on the number of employees. The area for c) of the above will be determined taking the similar projects into consideration.

As a result, the required areas for the respective use are summarized in the third column in Table 2.3.4 and the actually designed areas in the fourth column of the same table. The layout plan of the terminal building is shown in Figure 2.3.15.

Table 2.3.4 Floor Area Summary

Name of Facilities		Nos. of Persons	Required Floor Area	Designed Floor Area	Remarks
A-1	Customs & Vehicle Registration Hall for Departing Passengers	1,180 person/hour	115 m2	128 m2	Nos. of vehicles in peak hour = 271
A-2	Customs & Vehicle Registration Hall for Arriving Passengers	1,180 person/hour	115 m2	128 m2	Nos. of vehicles in peak hour = 271
B-1	Security & Passport Control Hall for Departing Passengers	1,180 person/hour	256 m2	276 m2	Nos. of vehicles in peak hour = 271
B-2	Security & Passport Control Hall for Arriving Passengers	1,180 person/hour	256 m2	276 m2	Nos. of vehicles in peak hour = 271
C	Meeting Room for Distinguished Guests			112 m2	
D	Offices for Custom Department	80 person/3-shifts	440 m2	464 m2	17.4 m2/person
E	Offices for Police Department	125 person/3-shifts	500 m2	540 m2	13.0 m2/person
F	Offices for Defense Department	12 person/3-shifts	48 m2	56 m2	14.0 m2/person
G	Offices for Intelligence Department	40 person/3-shifts	192 m2	192 m2	14.4 m2/person
H	Common: Toilet, Corridor, Entrance Hall, Vacant Room(28m2), etc.			348 m2	
	Total			2,532 m2	

Note: Persons being working for the Vehicle Inspection Shed are excluded.

The details of the required area (column 3) are discussed below.

A. Required Area for Customs & Vehicle Registration Hall

a) Required Area for Customs Clearance

$S = P \times T/60 \times A = 79$ m2

where,

P: Nos. of passenger = 1,180 persons/hour ... year 2007
T: Dwell time/passenger = 2 min /person
A: Sandard area/person = 2 m2/person

b) Required Area for Vehicle Registration

$S' = P' \times T'/60 \times A = 36$ m3

where,

P':	Nos. of drivers =	271 persons/hour ... year 2007
T':	Dwell time/drivers =	4 min /person
A:	Standard area/person =	2 m2/person

Total Area for Customs & Vehicle Registration Hall

Total Area = S + S' = 115 m2

Note: Each hall for arrival/departure has the above area.

B. Required Area for Public Security & Passport Control

S = P x T/60 x A + X = 217 m2

where,

P:	Nos. of passenger =	1,180 persons/hour
T:	Dwell time/passenger =	5 min /person
A:	Standard area/person =	2 m2/person
X:	Area for X-ray check =	20 m2

Note: Each hall for arrival/departure has the above area.

C. Meeting Facility for Distinguished Guests

Lounge will be provided in the passenger terminal building for the use of meeting by the distinguished guests from Israel and Jordan. Such facility is very common and essential in the region: similar facility is existing at the King Hussein Border and Jabir Border.

D. Required Office Area

a) Customs Department

S = (n/3) x A + A' = 440 m2

where,

n:	Total nos. of staff =	80 persons (3 shifts)
A:	Unit area per person =	15 m2
A'	Meeting room =	40 m2

b) Border Police Department

$S = (n/3) \times A = 500$ m2

where,

n:	Total nos. of staff =	125 persons (3 shifts)
A:	Unit area per person =	12 m2

c) Defense Force

$S = (n/3) \times A = 48$ m2

where,

n:	Total nos. of staff =	12 persons (3 shifts)
A:	Unit area per person =	12 m2

d) Intelligence Department

$S = (n/3) \times A + A' = 192$ m2

where,

n:	Total nos. of staff =	40 persons (3 shifts)
A:	Unit area per person =	12 m2
A'	Meeting room =	32 m2

2) Required Sizes of Vehicle Inspection Sheds

The following were determined taking into consideration the traffic demands at present as well as for the short term projection (after 10 years). The figures of the following are for departing and arriving sheds respectively.

Shed Area =	1,360 m2
Shed Length =	40 m
Shed Width =	34 m
Nos. of Inspection Counters =	19
Inspection Offices =	9 m2 x 12 place = 108 m2

The above figures have been obtained as follows:

A. Required Nos. of Inspection Counters

Each vehicle should be inspected during the arriving and departing time. In this case, the vehicle should be inspected in the shedded facility which has the sufficient counter number to deal with the traffic volumes.

The number of 19 was calculated for the traffic volume of 271 vehicles/peak hour for the year 2007.

N = P x (T/60) = 18.1, say 19

where,

P:	Traffic volume =	271 vehicles/peak hour ... year 2007
T:	Dwell time =	4 minutes

B. Required Lane Number

The preferable length of the vehicle inspection shed should be same as the length of custom clearance hall plus security control hall. In this regard, the required number of counters is obtained at 4, of which concept is illustrated below.

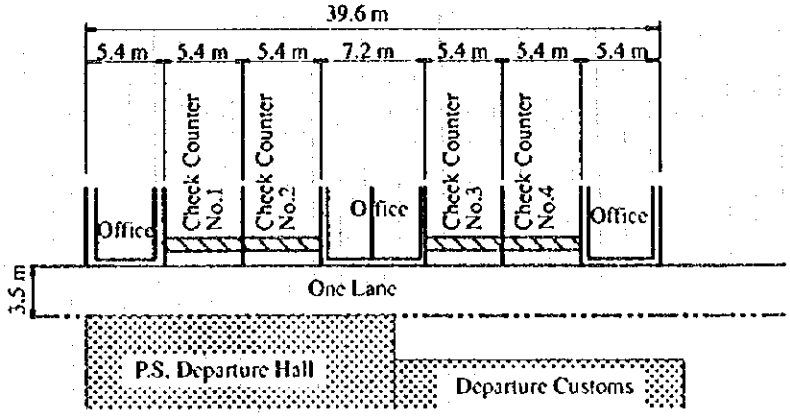


Figure 2.3.14 Layout of Vehicle Inspection Shed for One Traffic Lane

C. Shed Area and Office Area of Inspection Shed

Shed Length =	40 m as shown in Figure 2.3.14
Shed Width =	34 m (5 lanes + 3 rows of counter)
Nos. staff =	12 (4 each row)
Office area =	3 m x 3 m x 12 nos. = 108 m2

3) Border Gate

Two border gates, one for arrival and the other for departure, will be designed as with the Jabir Border, which is similar one to the Project.

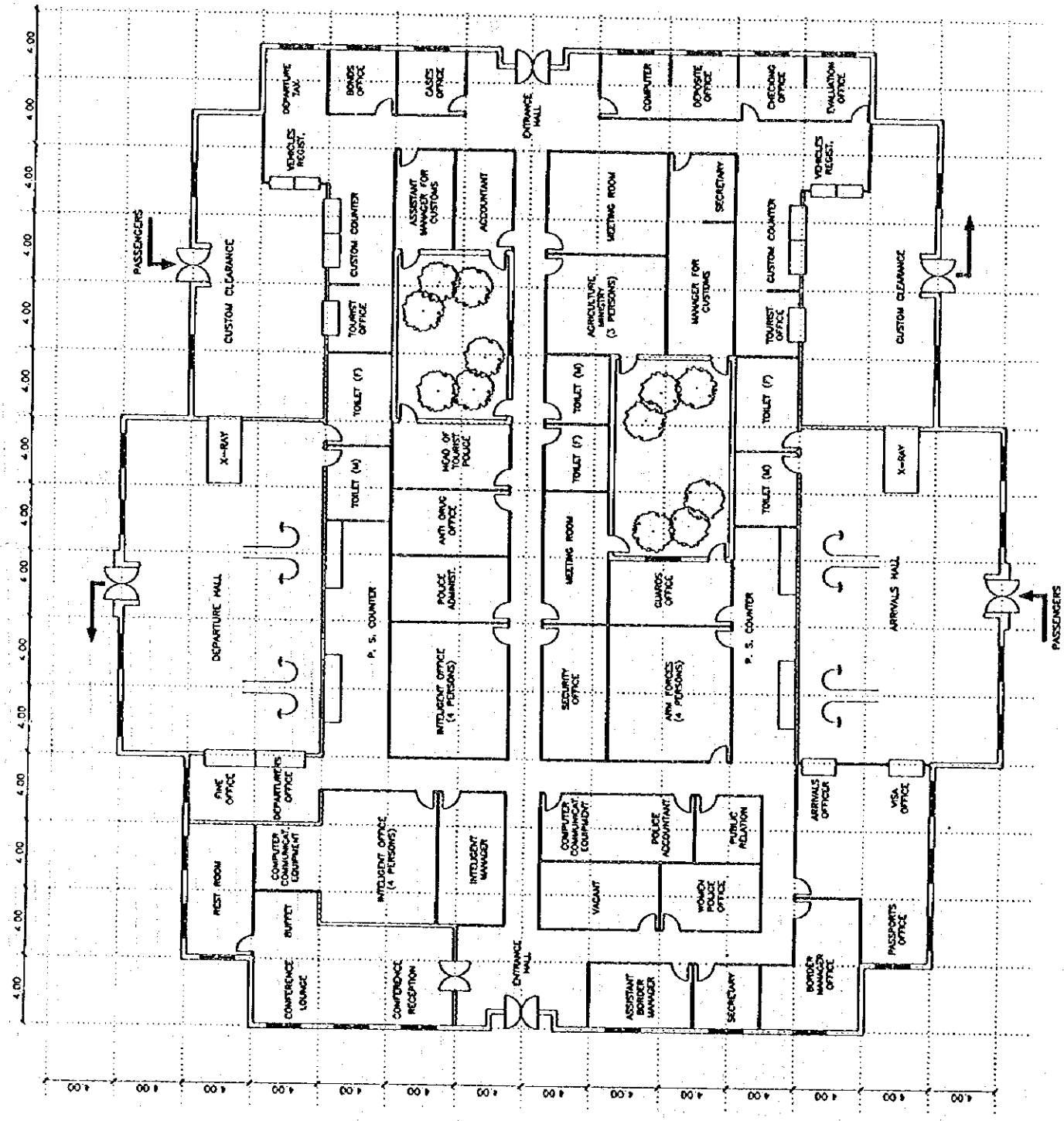


Figure 2.3.15 Plan of Passenger Terminal Building

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

(1) Implementation Method

An implementation plan has been studied assuming that the project will be executed under the grant aid from the Japanese Government and has been made taking the following conditions into consideration:

(i) The construction of the Sheikh Hussein bridge has to be started earlier than that of the King Hussein Bridge since the Israeli Bridge is scheduled to be completed by November 1996,

(ii) As Jordan holds relatively high level of engineering standard in their civil engineering undertakings, a Jordanian contractor might be employed during the implementation of the project as a sub-contractor,

(iii) In principle, materials and equipment for the construction will be procured in Jordan. However, those materials and equipment that are scarce in Jordan will be mobilized from Japan and/or Europe,

(iv) Execution of the work will be proceeded throughout the year,

(v) Execution of the work will be proceeded so as not to disrupt present activities at immigration and customs offices which are located nearby the existing bridges,

(vi) The execution of the project will be proceeded paying attention to the environment and ecology nearby the site,

(vii) For the Project cost estimate purpose, plants and machinery for the construction will not be mobilized separately for each of the bridges but be simultaneously used for the construction of the two bridges under well-organized mobilization plan.

(2) Implementation Plan

Major work items for the Project are described in Table 3.1.1.

Table 3.1.1 Item of Construction Works

King Hussein Bridge		Sheikh Hussein Bridge	
Items of Facility	Major Work Items	Items of Facility	Major Work Items
Bridge Construction	- Cast-in-place RC Pile	Bridge Construction	- Cast-in-place RC Pile
	- Substructure and Foundation		- Substructure and Foundation
	- Superstructure		- Superstructure
	- Stressing of PC Cable		- Stressing of PC Cable
Access Road	- Embankment	Access Road	- Embankment
	- Asphalt Pavement		- Asphalt Pavement
		Construction of Border Facility	- RC Concrete
			- Building
			- Pavement

3.1.2 Implementation Condition

To implement the Project, the following factors which concern coordination of the work areas, construction methods, procurement of material, and so on must be considered:

(a) As the projects sites are located in the international boundary, close communication between the concerned governments is prerequisite for the smooth and prompt implementation of the Project. Especially, in the issuance of entrance permission and labour management, organized coordination system and schedule are inevitable to be established,

(b) Location of the temporally yards has to be decided through the examination of flood level of the Jordan river,

(c) As the Project is urgent to be completed the progress during the rainy season (November - March) is critical. The mobilization of the work during the period has to be well planned,

(d) Bridge engineers who are responsible for foundation work and superstructure work will be dispatched from Japan while the construction materials and machinery which are not available in Jordan will be transported from Japan and/or Europe. Procurement and mobilization of these materials and machinery on schedule are very important for the smooth implementation of the Project,

(e) Public utilities such as power cable and telephone cable have to be replaced partially. These replacement work has to be proceeded so as not to disturb the construction work of the Project,

(f) Quality control of aggregates for concrete use is important since these aggregates contain salt. Procedure of desalination through washing with pure water is inevitable before the usage, and

(g) As access roads for both the King Hussein bridge and Sheikh Hussein bridge have to be constructed across the King Abdullah Canal, construction management so as not to disrupt the function of the channel has to be considered.

3.1.3 Scope of Work

Scope of the work for the project implementation is described below.

(1) Consulting Service

- To carry out detailed design
- To prepare tender documents
- To carry out construction supervision

(2) Construction

a) King Hussein Bridge

- To construct a 4-lane bridge
- To construct an approach road (4-lane, West Bank side: 250 m, Jordan side: 352 m)
- To construct a access road (2-lane, Jordan side : 7.7 km)

b) Sheikh Hussein Bridge

- To construct a 2-lane bridge
- To construct an approach road (2-lane, Israel side: 100 m)
- To construct an access road (2-lane, Jordan side: 2.5 km)

- To construct a passenger terminal, sheds and gates as part of border facilities

3.1.4 Consulting Services

Immediately after signing the Exchange of Notes (E/N), the contract for engineering consulting service should be signed. The services will cover the detailed design, cost estimation, preparation of tender/contract documents, tendering and construction supervision.

The required Japanese staff and their responsibilities are described below:

(i) Team Leader

Responsible for all the activities of consulting services during the detail design and construction supervision.

(ii) Bridge Engineer

Responsible for the design of superstructure, substructure and foundation of the bridge.

(iii) Construction Planner/Cost Estimator

Responsible for the preparation of detailed implementation plan including the review of project costs made in the detail design stage.

(iv) Facility Expert

Responsible for consulting the local consultants in designing of building, utility and lighting of the border facility and supervising the construction during the construction stage.

(v) Soil/Material Engineer

Responsible for checking and advising to the contractor in the quality control of the materials for the bridge structure, approach and access roads, and border facilities.

3.1.5 Procurement Plan

The construction materials to be used for the Project are mostly available in Jordan. However, some of the materials are recommended to be procured in Japan as shown in Table 3.1.2.

As for construction machinery, the procurement schedule is shown in Table 3.1.3.

Table 3.1.2 Procurement of Construction Materials

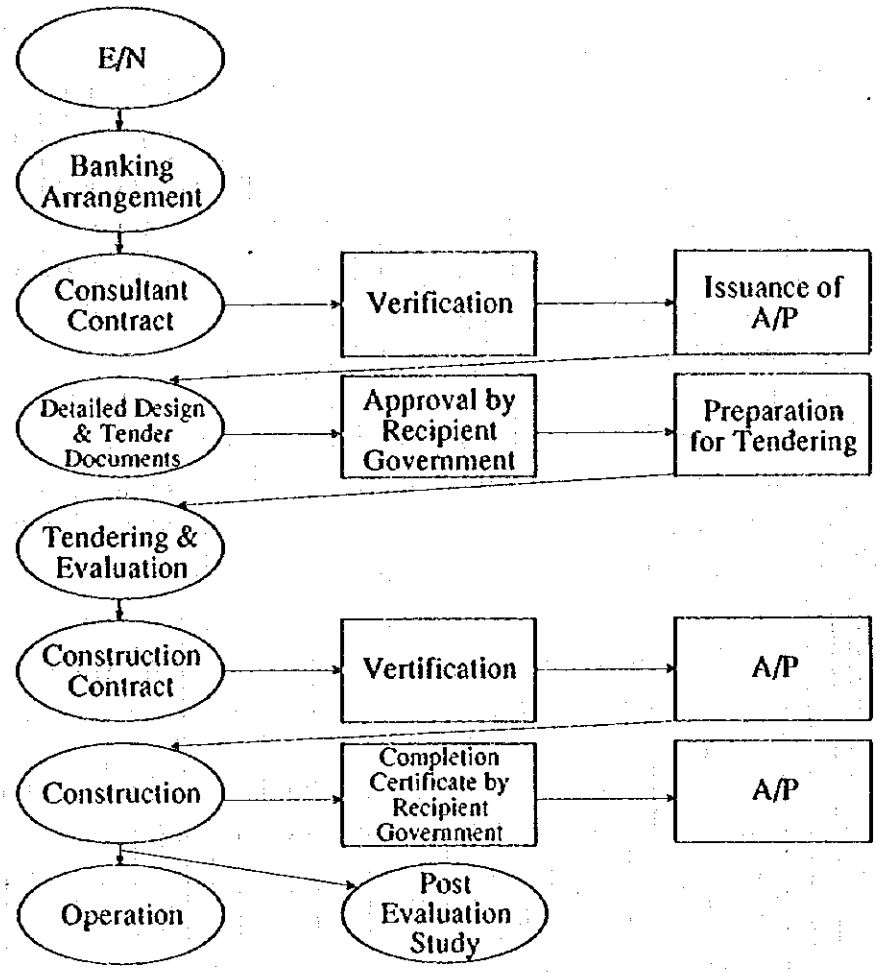
Description	Procured in Jordan	Procured in Japan	Procured in Other Countries
Cement	O		
Reinforcing bar	O		
Crushed stone, Sand	O		
Asphalt, Asphalt Emulsion	O		
Shaped Steel, Steel Sheet Pile	O		
PC Cable, Tendon		O	
PC Sheath		O	
PC Anchor		O	
Asphalt Mixture	O		
Concrete Admixture	O		
Expansion Joints		O	
Bearings		O	
Steel Form	O		
Timber	O		
Materials for scaffolding	O		
Gasoline, Fuel	O		

Table 3.1.3 Procurement of Construction Machinery

	Specification	Procured in Jordan	Procured in Japan or Europe
Dump Truck	11 ton	O	
Bulldozer	15 ton, 21 ton	O	
Backhoe	0.6 m^3	O	
Vibrating Roller	0.8 - 1.1 ton	O	
Truck Crane	20 - 22, 15 - 16 ton	O	
Crawler Crane	40 ton	O	
Bibro Hammer	40 kW	O	
Water Jet	150 kg/cm^2		O
Tamper	60 - 100 kg	O	
Asphalt Finisher	2.4 - 5.0 m	O	
Concrete Pump	60 m^3/h	O	
Welding Set	250 A	O	
Center Hole Jack	50 ton, 200 ton		O
Road Sprinkler	5.5 - 6.5 kl	O	
Tractor Shovel	14 m^3	O	
Boring Machine	55 kW	O	
Tire Roller	8 - 20 ton	O	
Tamper	60 kg	O	
Concrete Bucket	0.6 m^3	O	
Breaker	600 - 800 kg	O	
Road Roller	10 - 12 t	O	
Generator (1)	125 kVA	O	
Generator (2)	50 kVA	O	
Water Pump	50*20 mm	O	
Concrete Vibrator		O	
Grouting Pump	200 lit.	O	
Grouting Mixer	2.2 kW	O	
Cram Shell Grapping Crane	0.8 m3	O	
Oil Hydraulic Pump	1.5 kW		O
Reverse Circulation Drill	60 - 100 kg	O	
Concrete Mixing Plant	45 m^3/h		O
Agitator Car	0.3 m^3		O

3.1.6 Implementation Schedule

The implementation schedule for the detailed design and construction was prepared taking into consideration the procedure of the Japanese Grant Aid System as shown in Fig 3.1.1:



Note (1) E/N : Exchange of Note
(2) A/P : Authorization to Pay

Fig 3.1.1 Procedure of Japanese Grant Aid Program

Each phase is broadly divided into three stages as shown below:

Stage 1: Contract with the consultant and the detailed design

After signing the contract with the selected Japanese consulting firm, the detailed design will be carried out by the consultant including the preparation of the tender/contract documents, drawings and cost estimate. The direct contract system will be applied to procure the consultant.

Stage 2: Pre-qualification, Tendering and Contracting with the Contractor

After discussion with and approval by JICA pertaining to evaluation of the items for the pre-qualification (P/Q) of tenderers for the construction work, the P/Q activities will be carried out in Japan by the consultant on behalf of the Government of Jordan to select the qualified tenderers.

In the tendering operation, the principle of general competitive bidding will be applied to select a Japanese contractor for the construction work. Evaluation of the tenders and selection of the contractor will be performed in Japan by representatives of the Government of Jordan and the consultant in the presence of JICA officials. Negotiation with the selected contractor and signing of the contract will be also done in Japan. The contract system currently in use will be applied to obtain the Contractor.

Parallel to the signing of the contract, the Government of Jordan will conclude a banking arrangement with an authorized foreign exchange bank in Japan to open accounts for the purpose of receiving the funds granted by the Government of Japan, and making payment to the Japanese consultant and contractor. This banking arrangement will serve as the basis for the Government of Jordan to issue the Authorization to Pay (A/P) that is indispensable for use by the Japanese consultant as well as for use by the Japanese contractor who will have to obtain export licenses for equipment and materials.

Such banking arrangement will also be used to receive payments as stipulated in the contract terms and should be concluded within one month after the signing of the E/N. It is noted that the Japanese consultant and contractor will be able to carry out their responsibilities only after receiving the verified contract and A/P.

The next step is a verification to be conducted by the Government of Japan. Verification means examination whether the contents of contracts conform to the provisions of the E/N, which is requisite for the contract to be effective.

Stage 3 Construction Work

The construction period will be 9.5 months for each bridge, including such works as preparatory work, construction of temporary yard, bridge substructure, bridge superstructure, access road, construction of border facility and demobilization. Implementation schedule for construction is shown in Table 3.1.4.

Table 3.1.4 Implementation Schedule for Construction

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
King Hussein Bridge						PW				Civil Work					AW
Sheikh Hussein Bridge	PW		Civil/Building Work							AW					

(Subject to change)

PW: Preparatory Work
AW: Ancillary Work

3.1.7 Obligations of the Recipient Country

For the implementation of the project, the government of Jordan will undertake the following:

(1) Undertakings required for construction work

- Land acquisition,
- Land lease for temporary facilities,
- Clearing/grubbing of the site,
- Construction of border facilities which are not covered by Japanese Grant Aid, such as truck terminal building, parking area of trucks, pavement of streets inside the border facilities and buildings for employees,
- Connection of utility cables to the project site, and
- Dismantlement of the existing Bailey bridges.

(2) Administration work

- To furnish data necessary for the detailed design and construction supervision,
- To bear commission for the banking services based on the Banking Arrangement,
- To ensure prompt unloading and customs clearance at the port of disembarkation in Jordan for the equipment, materials and machinery required for the Project,
- To ensure tax exemption for the consultant and the contractor engaged in the Project,

- To issue visa, traffic certificate and other certificates necessary for the execution of the Project to the consultant and the contractor,
- To ensure contractual payments to the consultant and the contractor,
- To bear expenses required for the proper and effective maintenance after completion of the Project, and
- To bear all the expenses necessary for the execution of the Project other than those to be borne by the Grant Aid.

(3) Expenditure to be borne by Jordan Government

In connection with the implementation of the Project the following expenditures were estimated:

Table 3.1.5 Expenditure by Jordan Government

	Expenditure of Jordan Gov.		Remarks
	Jordan Dinar (JD'000)	Yen equiv. (¥'000,000)	
Land Acquisition & Compensation	600	87.0	Estimated by MPWH
Relocation and New Installation of Electric & Telephone Cables	305	44.2	Electricity = 8,500 m Telephone = 6,000 m
Removal & Unexploded Mines & Ordnance	21	3.0	
Total	926	134.2	

Note: 1) The table excludes the tax exemption both for import items and for local purchase items.

2) Exchange Rate

US$1.0 = ¥103 = JD0.71

Figure 3.1.2 (a) Implementation Schedule of the Sheikh Hussein Bridge

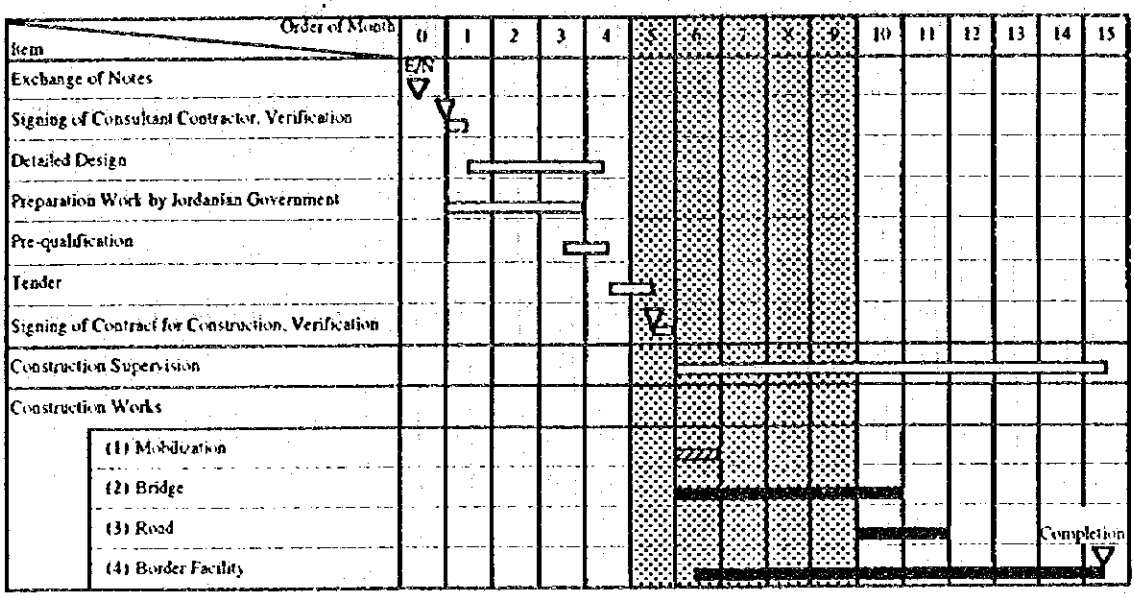
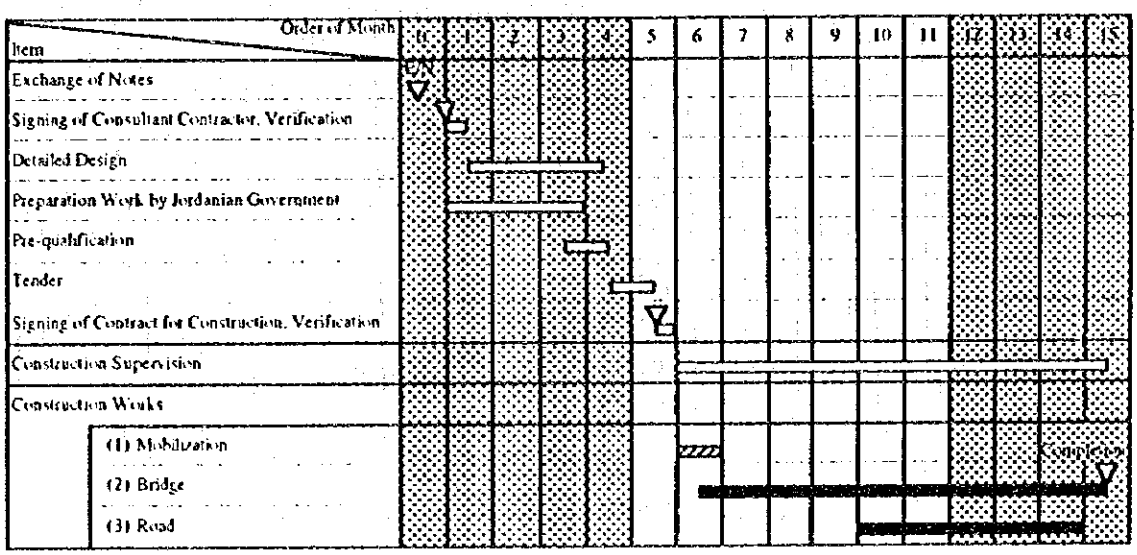


Figure 3.1.2 (b) Implementation Schedule of the King Hussein Bridge



Remarks: ⁘⁘⁘⁘⁘ Rainy Season

3.2 Operation and Maintenance Plan

3.2.1 Organization for Operation and Maintenance

The Ministry of Public Works and Housing (MPWH) will be the governmental body responsible for the maintenance of the bridges, border facilities and roads consisting of approach road and access roads on the Jordan side. The border facilities will be operated by the border police, the Police Department of the government of Jordan.

On the other hand, the approach roads on the Israel side and West Bank side will be maintained by the concerned governments.

The periodic inspection and maintenance work will be carried out by the governmental officers and rehabilitation work will be undertaken by specific contractors when required.

3.2.2 Inspection Items and Expected Maintenance Work

Table 3.2.1 Inspection & Maintenance

	Inspection Items	Expected Maintenance Work
Bridges (inspection per year)	Expansion joint Railing Lighting Bearing	Repairs of lightings and railings will be required in adhoc occasions. In case of railings, minor repairs will be taken place due to a piece of mischief.
Roads (inspection per year)	Pavement Slope Protection Drainage Lighting	Ordinarily, the replacement of lighting bulbs will be required. Overlay of pavement will be required every 10 years.
Passenger Terminal Building at Border Facilities (inspection by occasion)	Sewage Tank Water Tank Water Pump	Ordinary building maintenance will be required.

3.2.3 Cost for Operation and Maintenance

As the costs of maintenance for new bridges and roads will surely be less than those for existing bridges, the expense by MPWH will be reduced by implementing the Project.

On the other hand, the following expense would have to be borne by the Border Police Department for maintaining the passenger terminal building, vehicle inspection sheds and border gates in the Sheikh Hussein Border Facilities.

i)	Labor Cost	JD23,000/year
ii)	Electricity	JD9,000/year
iii)	Water	JD5,500/year
iv)	Cleaning, etc.	JD1,500/year
v)	Others	JD3,900/year
	Total	JD42,900/year
		(¥6.2 million)

Now, the Jordanian Government collect a charge JD4.0 per person at the temporary Sheikh Hussein Border. The collected charge is kept in the national treasury, and about JD24.3 million per year (JD66,800/day) is expected to be collected at the Sheikh Hussein Border after the completion of the Project in 1998. In this regard, such expense for operation and maintenance of passenger terminal building in the above would be easily allocated from the national treasury budget in Jordan.

3.3 Special Consideration for Construction of Bridges over International Rivers

The Project, which would be granted to the Jordanian Government under the Japan's Grant Aid Scheme, is to construct 2 bridges connecting Jordan with Israel and West Bank. In this regard, coordination work among Jordan, Israel, West Bank and Japan is crucial till the completion of the Project. The coordination work will cover many subjects for the study, design and construction stages.

3.3.1 Arrangements Already Conducted in the Study

The following items were coordinated by the Ministry of Public Works and Housing of the Jordanian Government, Ministry of Construction and Housing of the Israeli Government and the Study Team, in collaboration with Jordanian and Israeli Defense Forces during the Basic Design Study.

(1) Confirmation of the proposed locations of the King Hussein Bridge and Sheikh Hussein Bridge.

(2) Technical discussions regarding the design of the Sheikh Hussein Bridge, of which 2-lane bridge design is underway by the Israeli Government. In this case, the Study Team and the Ministry of Public Works & Housing of the Jordanian Government have collaborated with the Ministry of Construction & Housing of the Israeli Government to adjust the bridge length, width, span

arrangement, skew angle, girder depth, high water level and vertical clearance, bridge type and its appearance, and alignment as much as possible.

(3) Permission of the Israel Government for the entry into the sites of the bridges on the Israel side and West Bank side.

(4) Removal of un-exploded mines by defense forces at the site of the proposed King Hussein Bridge.

3.3.2 Anticipated Items Required before Signing of E/N

In addition to the normal arrangements before signing the Exchange of Notes (E/N) as the ordinarily bi-lateral cooperation between Japanese and Jordanian Governments, involvement of the concerned government(s) would have to be crucial in connection with the approach roads on the Israel side and West Bank side.

A number of items would have to be considered before signing the E/N, and are summarized in Table 3.3.1.

Table 3.3.1 Required Items to be considered before E/N

	Japan	Jordan	Israel
Confirmation/Agreement between Japan and Jordan	O		
Included in E/N (Detailed Design, Construction)			
- Common items included in ordinary E/N	O	O	
- Arrangements for construction yards, work areas, project offices on the Jordan side		O	
- Obligation of maintenance for bridges		O	
- Obligation of approach road maintenance on the Jordan side		O	
- Obligation of access road maintenance on the Jordan side		O	
- Obligation of border facility maintenance on the Jordan side		O	
- Request to Israel for collaboration and coordination	O	O	
Confirmation/Agreement between Japan and Israel			
- Explanation of E/N between Japan and Jordan	O		
- Facilitation of the provision of land for approach roads other than the Jordan side			O
- Arrangements for work areas other than the Jordan side			O
- Obligation of approach road maintenance other than the Jordan side			O
Confirmation/Agreement between Jordan and Israel			
- Facilitation of the provision of land for approach roads		O	O
- Removal of un-exploded mines		O	O
- Undertakings to be provided for work areas		O	O
- Obligation of maintenance for project facilities		O	O
- Obligation of coordination		O	O

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

It is expected that the Project produces a great socio-economic effects in the surrounding areas. These effects are incentive role of regional development including promotion of tourism and export industries owing to improved inter-regional accessibility among the regions. In addition, it is expected that the Project would produce many other intangible benefits such as enhancement of communication and dissemination of information. These would result in promotion of peaceful environment in the areas.

(1) Direct Benefit

i) Traffic

The completion of the 2 bridges would remarkably contribute to the economic and social activities among Jordan, Palestinian West Bank and Israel under such political circumstances as to realize the peace process in the Middle East. In tangible terms, the future traffic volume is expected as follows:

a. The King Hussein Bridge would mainly carry the vehicles between Jordan and Palestinian West Bank (including vehicles from Gaza): approximately 5,900 AADT is expected for the opening year 1998, afterwards 12,000 AADT for 2007, 24,900 AADT for 2017 and 51,500 AADT for 2027.

b. The Sheikh Hussein Bridge would mainly carry the vehicles between Jordan and Israel: approximately 7,800 AADT is expected for the opening year 1998, of which 30% (2,500 AADT) are the cargo vehicles to and from the Haifa Port owing to the improved access. The future traffic for the years 2007, 2017 and 2027 would be approximately 14,400 AADT, 29,000 AADT and 59,200 AADT respectively.

ii) Beneficial Population

Total beneficial population as of now is approximately 14.3 millions, of which breakdown is as follows:

a. King Hussein Bridge

Inhabitants in Northern Jordan	:	3.7 million
Inhabitants in Palestinian West Bank	:	1.0 million
Inhabitants in Gaza	:	0.7 million
Total		5.4 million

b. Sheikh Hussein Bridge

Inhabitants in Northern Jordan	:	3.7 million
Inhabitants in Israel	:	5.2 million
Total		8.9 million

iii) Reduction of Vehicle Breakdown Occurrence and Reduction of Temporary Bridge Maintenance Cost

The Project is to replace the existing temporary bridges (Bailey bridges) by prestressed concrete permanent bridges. As such, occurrence of vehicle breakdown will reduce in future since the existing bridges have wooden decks where vehicles are now compelled to pass. Maintenance costs for replacing of the wooden decks, painting of steel members and reinstallation of metal fittings will not be required in future.

iv) Relief from Bridge Closure due to Natural Calamities like Floods and Earthquakes

The existing King Hussein Bridge was temporarily built and therefore it was sometimes closed for the public traffic due to the inundation when floods took place. Such a bridge closure will be relieved by constructing a new permanent bridge. In addition, the new bridge, of which design should be made based on seismic proof design, will be able to withstand earthquakes in the future.

(2) Indirect Benefit

i) Enhancement of Economic and Social Activities in the Region

The completion of the Project would contribute to the regional development, strengthening of export industry and enhancement of tourism industry in the surrounding areas including Jordan Northern Region, Israel and Palestinian West Bank.

ii) Structuring of International Friendship in the Region

International friendship in the region would be structured through the interchange of social and economic activities between Jordan and Israel as well as between Jordan and Palestinian West Bank.

4.2 Recommendation

The project aims at connecting nations and regions surrounding the Jordan river which had long been separated for political reason. It is expected that the project would produce a great amount of effects on the areas, of which the impact between Jordan, West Bank and Israel is the greatest. For this reason, the project implementation under the Japanese Grant Aid Scheme is greatly justified. However, from the nature that the bridges are located in the controversial territories, it requisites numbers of coordination works among the parties. These include coordination in the formulation of implementation plan, coordination during construction, and coordination in the operation and maintenance of the bridges after the inauguration of the bridges. In addition, the project has many legal and legislative issues to be solved beforehand.

The bridges will be the first full fledged bridges across the Jordan river. In this context, the concept and methodology applied in this Project will be emulated by succeeding bridge construction projects across the river.

Implementation of the project with all the efforts by concerned parties is a prerequisite for the success of the Project.

APPENDICES

1. Member List of the Survey Team

Leader	SASAKI Takahiro	Japan International Cooperation Agency
Grant Aid Program	ENDO Kazuya	Economic Cooperation Bureau, Ministry of Foreign Affairs
Coordinator	ABE Toshiya	Japan International Cooperation Agency
Consultant Chief / Bridge Designer	MATSUZAWA Katsufumi	Nippon Koei
Transport Planner	MATSUDA Katsuyoshi	Nippon Koei
Engineering Surveyor	KAWAKAMI Toru	Nippon Koei
Construction Planner/ Cost Estimator	YAMAZAKI Kiyohito	Nippon Koei

2. Survey Schedule

Description	1995	1996				
	Dec.	Jan.	Feb.	Mar.	Apr.	May
Preparatory Work in Japan			Inception Report			
Field Survey in Jordan			Inception Report			
Study & Analysis in Japan			Field Survey Report		Study Report	
Explanation of Study Report in Jordan						Study Report
Preparation of Executive Summary Report				Executive Summary		

3. List of Party Concerned in the Recipient Country

Ministry of Planning

Dr. Nabil Ammari	Secretary General
Mr. Salem Ghawi	Assistant Secretary General for International Cooperation Affairs (tel. 644466)
Mr. Yousef Batshon	Director of Infrastructure Department
Dr. Mustafa Saleh	Director of Bilateral Cooperation Department
Dr. Nael Al Hajaj	Head, Bilateral Cooperation Section
Ms. Wafa Dabbas	Civil Engineer
Ms. Tharwat Al Awamleh	Researcher, Bilateral Cooperation Department
Mr. Hasan Al Rafei	Transport Engineer Infrastructure Department

Ministry of Public Works and Housing

Dr. Abdel Razzaq Ennsor	Minister
Mr. Bashir Jaghbeer	Secretary General
Mr. Abdel Majeed Kabariti	Highway Studies Director (tel. 685560)
Ms. Sanaa Nazer	Building Department
Mr. Sami Halaseh	Geometric Section
Mr. Mahammad Radwan	Architecture Engineer
Ms. Muna Jahmany	Structure Section
Mr. Mahmood Ayyash	Structure Section

Ministry of Transport

Mr. Abdullah Jbour	Director of Land Transport (tel. 607111)

Sheikh Hussein Bridge

Israeli Side

Mr. Avi Zohar	Deputy Manager

Jordanian Side

Mr. Sami Al Azam	Liaison Officer

Japanese Side in Jordan

H.E. Mr. Kimura Takayuki	Ambassador , Japanese Embassy
Mr.Mori Yasuyuki	Resident Representative, JICA
Mr.Kuno Kichiro	Deputy Director, JICA

Israel Side

Ilan Baruch	M.F.A
Ruth Kahanoff	Director, North East Asia Division, M.F.A
David Tans	M.F.A
Tjipola Rimon	Economic Department, M.F.A
Ilana Mittelman	Jordanian Div. M.F.A.
Samlik Bass	North East Asia Div., M.F.A
Reuven Azar	M.F.A.
Herim Eilam	Public Works Department, M.C.H
M. Kenigsberg	Public Works Deptartment, M.C.H
Baruch Spregel	General, I.D.F.
Shiklosh Gideon	Manager, Airport Terminal
O. Rafawel	I.D.F (Ministry of Defence)
Efrain Hanok	I.D.F
Co Moti	Aloma LHC
Avi Borger	Colonel, District Brigade Commander, I.D.F

Safade Amer	Coordinator Officer of Allenby Bridge, I.D.F
Zvi Eckenling	Israel Airport Authority

Japanese Embassy In Israel

Mr.Saito Mitsugiu	Counsellor , Japanese Embassy
Mr. Matahiro Yamaguchi	First Secretary, Japanese Embassy
Mr.Shoji Katsuo	First Secretary, Japanese Embassy
Mr.Tsurusaki Tsuneo	Project Formulation Advisor, Japanese Embassy

Basic Design Study Team

Mr.Sasaki Takahiro	Team Leader, JICA
Mr.Endo Kazuya	Grant Aid Program, MOFA
Mr.Abe Toshiya	Coordinator, JICA
Mr.Matsuzawa Katsufumi	Consultant Chief / Bridge Designer,
Mr.Matsuda Katsuyoshi	Transport Planner
Mr.Kawakami Toru	Engineering Surveyor
Mr.Yamazaki Kiyohito	Construction Planner / Cost Estimator