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THE BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR RECONSTRUCTION
OF
THE MAIN BRIDGES ON ROAD NETWORK
IN
BOSNIA AND HERZEGOVINA

(DOBOJ AND MODRICA BRIDGES)

JULY 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
AND
CENTRAL CONSULTANT INC.

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PREFACE

In response to a request from the Government of Bosnia and Herzegovina, the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of the Main Bridges in Road Network in Bosnia and Herzegovina (Federation of Bosnia and Herzegovina) and entrusted the study to the Japan International Cooperation Agency (JICA).

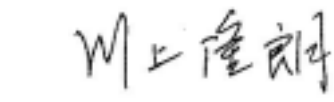
JICA sent to Bosnia and Herzegovina a study team from November 6 to December 10, 2002.

The team held discussions with the officials concerned of the Government of Bosnia and Herzegovina, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Bosnia and Herzegovina from February 27 to March 6, 2003 in order to discuss a draft basic design 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 to the Government of Bosnia and Herzegovina for their close cooperation extended to the teams.

July, 2003



Takao Kawakami
President
Japan International Cooperation Agency

July, 2003

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Reconstruction of the Main Bridges in Road Network in Bosnia and Herzegovina (Federation of Bosnia and Herzegovina).

This study was conducted by the joint venture between Nippon Koei Co., Ltd. and Central Consultant Inc. under a contract to JICA, during the period from October, 2002 to March, 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bosnia and Herzegovina 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 Reconstruction
of the Main Bridges in Road Network
in Bosnia and Herzegovina
Joint venture between
Nippon Koei Co., Ltd.,
and Central Consultant Inc.

The Project for Reconstruction of the Main Bridges on Road Network in Bosnia and Herzegovina

PERSPECTIVE VIEW OF THE PROPOSED DOBOJ BRIDGE

PERSPECTIVE VIEW OF THE PROPOSED MODRICA BRIDGE

LIST OF FIGURES AND TABLES

ABBREVIATIONS

A/P	Authorization to Pay
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
ADT	Average Daily Traffic
B/A	Banking Arrangement
BHN	Basic Human Needs
BiH	Bosnia and Herzegovina
BiHTMAP	Bosnia and Herzegovina Transport Master Plan
BR	Brcko Administrative District
BRIC	The Bosnia and Herzegovina Road Infrastructure Public Corporation
DIN	Deutsches Institute fur Normung
E/N	Exchange of Notes
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIA	Environment Impact Assessment
ETRP	Emergency Transport Reconstruction Program
EU	European Union
EUR	Euro
EPA	Emergency Program of Assistance
FBH	Federation of Bosnia and Herzegovina
FBHRD	Road Directorate, Federation of Bosnia and Herzegovina
GDP	Gross Domestic Product
GNP	Gross National Product
IMG	International Management Group
IPE	Institution of Protection and Ecology
JICA	Japan International Cooperation Agency
JUS	Jugoslovenski Standard
KM	Konvertibilna Marka
MAC	Mine Action Center
MOAFW	Ministry of Agriculture, Forestry and Water
MOCT	Ministry of Communications and Transport
MOD	Ministry of Defense
MOFA	Ministry of Foreign Affairs, Bosnia and Herzegovina
MOTC	Federal Ministry of Transport and Communications
former MOCA	Ministry of Civil Affairs and Communications, Bosnia and Herzegovina
MOTC	Republic of Srpska, Ministry of Transport and Communications
NATO	North Atlantic Treaty Organization
ODA	Official Development Assistance
OHR	Office of High Representative
PID	Project Implementation Department, MOCA
RPTF	Reconstruction and Return Task Force
RS	Republic of Srpska
RSRD	Road Directorate, Ministry of Transport and Communications, Republic of Srpska
SFOR	Peace Stabilization Force
USAID	United States Agency for International Development
UXO	Unexploded Ordnance
WB	World Bank

S u m m a r y

After the ceasefire of the internal war in 1995, Bosnia and Herzegovina (hereinafter referred to as “BiH”), with a territory of about 51,000 km^2 and a population of about 3.89 million, consists of two entities and one district: The Federation of Bosnia and Herzegovina (hereinafter referred to as “FBH”), the Republic of Srpska (hereinafter referred to as “RS”) and the Brcko District. The destruction and devastation of the country by the internal war from 1992 to 1995 was terribly severe. Above all, the fact that the road network, which had handled most of land transportation in the country, has been destroyed and cut to pieces poses a serious difficulty for the postwar restoration of the country.

Under financial assistance from multinational organizations such as the World Bank, the United States, EU, Japan, Italy, and Germany, an amount of about 333 million US dollars has been injected until now into the reconstruction of transport facilities according to the Emergency Transport Reconstruction Program (ETRP) established in 1996. As a result of these efforts, the Gross Domestic Product (GDP) per capita of BiH in 1999 increased to about 1,000 US dollars from 300 US dollars in 1994, before the cease- fire. However, in the actual domestic economic situation the country is still facing high unemployment and heavy foreign debt, making it difficult to undertake the restoration works by itself; therefore, more assistance by the international society is needed for this purpose. In the Transport Master Plan Study for BiH (BiHTMAP) carried out by the Japan International Cooperation Agency (JICA), it was estimated that an amount of 3.55 billion KM (equivalent to 23.00 billion Japanese Yen) is necessary for restoration and repair of the road network in BiH until 2020.

In 1999, the Government of BiH requested the Government of Japan to extend financial cooperation for the restoration of 17 bridges in BiH, which had not been funded within the framework of the ETRP. Again in 2002 the Government of BiH requested the Japanese Government for further cooperation for the restoration of the following 4 bridges which were selected based on the result of prioritization made by the Project Formulation Study Team dispatched by JICA to BiH in 2000:

- Osanica Bridge in FBH
- Ilovica-Bogatici Bridge in FBH (Bogatici Bridge)
- Doboj-Stanic Bridge in RS (Doboj Bridge)
- Modrica Bridge in RS

In response to the above request, the Japanese Government decided to execute the Basic Design Study for the Project to restore the objective four bridges, and JICA dispatched a Team

for the Study to BiH from 5 November to 12 December 2002.

With regard to the two bridges in RS, it was considered that the most appropriate way is to construct a new bridge at each location. As the RS side made a new proposal for the new bridge construction sites during the field investigation by the Basic Design Study Team, the Japanese Government decided to carry out an additional survey of the natural conditions at those proposed sites. As a result, the Basic Design Study Report was prepared dividing the project into two parts; one for the two bridges in FBH and the other for the two bridges in RS. The Draft Report for the bridges in FBH and in RS was submitted and explained to the BiH side separately in February and June 2003, respectively.

In the case the Project for the Doboj Bridge and the Modrica Bridge in RS is implemented with the Japanese Grant Aid, the time necessary for its completion was estimated to be five months for the detailed design and 27 months for the construction. The estimated cost for the Project would be about 1.30 billion Yen, consisting of a portion of 1.029 billion Yen to be financed by the Japanese Grant Aid and a portion of 273 million Yen equivalent to be financed by the local budget.

Moreover, it is also indispensable to ensure proper coordination between the construction works for the bridges with the Japanese Grant Aid and those for the bypasses with the local fund. The proposed time schedule of the works to be done by the RS side has been discussed and confirmed between the Road Directorate of RS and the Basic Design Study Team of JICA, and the results are described in the Minutes of Discussion signed by both sides. It is considered that the Road Directorate of RS could function well as a counterpart to the implementation group of the works to be executed under the Japanese Grant Aid, and has sufficient financial means for the execution of the Project.

The implementation of the Project, aiming not only at the restoration of the two damaged bridges but also at the reduction of traffic bottlenecks on the principal roads of the country, is feasible and very important for BiH and RS. The sites of the bridges are near to the boundary between the Entities, hence the benefit of the Project will extend to the whole territory of FBH. The Project is expected to benefit an estimated 432,000 people in the case of the Doboj Bridge and 262,000 people in the case of the Modrica Bridge, in both Entities. As indirect effects, the Project is expected to activate exchange of people and goods and to encourage reconstruction of the national economy and peace between the two Entities. Furthermore, the Project, which would be implemented under the cooperation between BiH and Japan, would promote deeper friendship between both countries.

THE BASIC DESIGN STUDY ON THE PROJECT FOR RECONSTRUCTION OF THE MAIN BRIDGES ON ROAD NETWORK IN BOSNIA AND HERZEGOVINA

CONTENTS

[Appendices]

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 BACKGROUND OF THE PROJECT

As a restoration program for Bosnia and Herzegovina (BiH) after cease internal war, the Government of BiH made a request to the Government of Japan for grant aid for the restoration of 17 bridges, of which 7 bridges in the Republic of Srpska (RS) were requested in February 1999 and 10 bridges in the Federation of Bosnia and Herzegovina (FBH) were requested in October 1999. Upon receiving the request from the Government of BiH, the Government of Japan sent a Project Formulation Study Team to BiH in December 2000. At the onset of the Project Formulation Study, BiH requested the addition of another 11 bridges including Lucki Bridge which gave a total of 28 bridges specified for the project formulation study (14 bridges in RS and 14 in FBH). As a result of the Project Formulation Study, the team selected four higher priority bridges from the 28. According to the result, BiH requested again to the Government of Japan for grant aid for restoration of those selected four bridges in September 2002.

The following two bridges of four are in FBH and should be repaired and reinforced or constructed newly:

- Osanica Bridge on the trunk road M20
- Bogatici Bridge on the Trans European Motorway E762

The Piece Stabilization Force (SFOR) considered that both M20 and E762 roads are important from the national security viewpoint, and hence they constructed temporary bridge (Bailey type) on the two bridges mentioned above, which had been destroyed by bombing during the internal war. However, SFOR is planning to withdraw from BiH in the near future and to remove the Bailey Bridges from the sites incidentally to their withdraw. Under such circumstances, the realization of the project, which aims to restore the bridges in order to guarantee transitability of the roads, would clearly be urgent.

Two bridges selected in the territory of RS are:

- Doboj Bridge on the trunk road M4-3
- Modrica Bridge on the Trans European Motorway E73

As the roads E73 and M4-3 run into the territory of FBH at about 5 km southward and eastward from Doboj City, respectively, the benefit of the restoration of these bridges extend not only to RS but also to FBH. At the same time, it is expected that the implementation of the restoration project for the bridges would promote the more peaceful relationship between two entities. The Bailey Bridge constructed on a parallel with the existing Doboj Bridge by SFOR for heavy traffic has happened a displacement at its pier foundation, and has been prohibited from passing of heavy vehicles since the beginning of 2003 like the existing Doboj Bridge. This urges to realize the restoration work urgently.

In 2002, the Japan International Cooperation Agency (JICA) decided to conduct a Basic Design Study (the Study) on the Project for Reconstruction of the Main Bridges on the Road Network in BiH (the Project) regarding the above four bridges and dispatched a study team (the Study Team) to BiH. The Study Team conducted field surveys on the four bridges from November 2002 to December 2002 in BiH. Additional surveys consisting of topographic surveys and geotechnical investigations were conducted for the Doboj Bridge and Modrica Bridge in May 2003.

The outcomes of the field surveys were analyzed in Japan. Hence, the Study Team prepared the layouts and design of facilities for the Osanica Bridge and Bogatici Bridge in FBH, the Doboj Bridge and Modrica Bridge in RS, then the Draft Study Report. In February 2003 for FBH, June 2003 for RS, JICA dispatched the Study Team respectively, in order to discuss the contents of the Draft Study Report regarding the bridges with the BiH side.

This Study Report has been prepared incorporating the results of the above-mentioned discussion and under the Japan's Grant Aid Scheme to record the character of the Basic Design Study and objectives and methods of the Study, and to confirm mutual understandings regarding basic items of the Project for building the four bridges.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

Since the cease internal war in 1995, it has been considered in RS that the restoration of the road network, above all bridges, which have been destroyed during the war. The Emergency Transport Reconstruction Program (ETRP) established for BiH has been implemented under the coordination of the International Managing Group (IMG) with the financial assistance from the multi-national organizations and bilateral cooperation, and is completed more or less in 2002. And the temporary bridges constructed as a running repair by SFOR with its own strategic viewpoint would be removed along with its withdraw from BiH.

Under such circumstances, restoration of the destroyed bridges for which the finance could not be assigned in ETRP and finding the substitutional measures for the bridges after removal of SFOR bridges are the present and most urgent issues in RS. The purpose of this Project is to restore permanently Doboj Bridge and Modrica Bridge, which are located on the most important trunk roads in RS, and then to promote socio-economic activity, better social life and peaceful relationship between the entities.

It is recommended in the Study for the Project to construct a new bypass near to existing Doboj Bridge and Modrica Bridge respectively, as the result of alternative study on a few ideas to restore the heavily damaged existing bridges to find the most appropriate method of restoration. Construction of the bypasses aim not only to make substitutional function of the existing bridges but to improve the road alignment in the vicinity and then to give the traffic more convenience. The Japanese Grant Aid would be for construction of a bridge on the bypass at both Doboj and Modrica sites.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Design Concept

The restoration plan for the facilities related to the Doboj Bridge and Modrica Bridge in RS is as follows:

A) Restoration of the existing Doboj Bridge: As the existing Doboj Bridge is so deteriorated that it cannot carry heavy vehicles, vehicles more than 20 tons should divert to the Bailey bridge temporarily built by SFOR about 600m on the downstream side of the existing bridge. Restoration by repairing [MT1] and reinforcing the existing bridge was judged not

advantageous from technical and economic view points as per Appendix 5-4. Accordingly, construction of a new bridge was considered in the subsequent study.

B) Location of a new Doboj Bridge: Two options were considered for the location study of a new bridge. Location 1 is to build a new bridge between the existing bridge and SFOR Bailey bridge. Location 2 is to build a new bridge on a new bypass route planned by the RS Government aiming to improve the road alignment together with the bridge construction, about 1km on the downstream side of the existing bridge.

C) As a result of comparative study on the two options, Location 2 was recommended from the view points of total project costs, highway geometry, traffic safety, impact on Doboj City Road Plan and so on as per Appendix 5-5. Accordingly, the basic design on the Doboj Bridge should be based on Location 2 (Bypass route).

D) Restoration of the existing Modrica Bridge: According to the structural soundness tests on the Modrica Bridge as per Appendix 5-4, restoration of the existing bridge was judged as a conceivable option by replacing the superstructure with a new one and repairing the substructures. However, the Road Directorate of the RS Government has intended to improve the road geometry on the basis of the design standards of Trans European Motorways E73 and proposed to build a new bridge on a new bypass route about 500m on the downstream side of the existing bridge.

E) Location of Modrica Bridge: Two options were considered for the bridge location study as discussed in C) above. Location 1 involves restoring the existing bridge by reconstructing a new superstructure and repairing the existing substructures. Location 2 involves building a new bridge on a new bypass route planned by the RS Government. As a result of comparative study on the two options for the Modrica Bridge, Location 2 was recommended from the view points of highway geometry, traffic safety, implication of the design standards for Trans European Motorways and so on as per Appendix 5-5. Accordingly, the basic design of the Modrica Bridge should be based on Location 2 (Bypass route).

F) Design standards: Design of the Doboj Bridge and Modrica Bridge should be in accordance with the current standards and requirements of road geometry and bridge design in BiH.

G) Undertakings by the RS side: In the case that the project is implemented by the Japan's Grant Aid, the RS side would have to secure the land for construction and complete the connection road in order not to hamper the construction schedule under the Japan's Grant Aid.

H) Ancillary Works: As a result of the hydrological and hydrographic studies, construction of both bridges should contain slope protection works around abutments.

I) As both bridges are located in the vicinity of urban areas and have a relatively longer length of 200m or more, road lighting facilities would have to be considered from the view point of

the traffic safety of these bridge sites.

2-2-1-2 Natural Characteristics

(1) Meteorological Condition and Suitable Construction Periods

Weather data from 1981 to 1990 in Doboj City and Modrica City are shown in Table 2-1 and Table 2-2. Considering the site temperature and snowfall, a suitable construction period for the Doboj and Modrica bridges seems to be 8 months from April to November.

Table 2-1 Meteorological Data at Doboj City (Observed from 1981 to 1990)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Avr.	Max	Total
Average temperature (°C)	-0.3	1.3	6.2	11.2	16.0	18.3	20.7	20.1	16.8	11.5	5.1	2.0	10.7		
Max. temperature (°C)	19.6	22.5	28.0	28.8	34.7	39.5	38.6	39.5	35.0	30.6	23.8	23.5		39.5	
Min. temperature (°C)	-22.4	-19.0	-14.6	-2.7	0.0	4.6	7.8	6.4	3.7	-3.4	-9.8	-15.2		-22.4	
Month precipitation (mm)	51	46	75	67	91	107	68	61	58	59	59	61			803
Days more than 10mm of precipitation	3	2	2	2	3	4	3	3	3	3	3	3			33
Days of snowfall	8	8	5	2							3	7			32
Maximum snowfall (cm)	29	72	37	10							20	26		72	

Source: Meteorological Survey Department, Sarajevo University

Table 2-2 Meteorological Data at Modrica City from 1981 to 1990

Month	1	2	3	4	5	6	7	8	9	10	11	12	Avr.	Max	Total
Average temperature (°C)	-0.5	0.9	6.1	11.3	16.4	19.7	20.7	20.5	17.0	11.5	9.5	2.0	11.3		
Max. temperature (°C)	18.3	23.0	28.0	28.0	33.5	37.0	40.0	37.5	36.5	30.0	22.6	19.5		40.0	
Min. temperature (°C)	-24.6	-21.0	-13.0	-1.4	1.1	6.1	6.5	5.5	4.0	-4.5	-10.0	-14.5		-24.6	
Month precipitation (mm)	53	37	66	70	65	95	61	59	54	55	57	47			717
Days more than 10mm of precipitation	2	2	2	2	3	3	3	2	2	2	3	2			28
Days of snowfall	5	4	2	1							2	4			17
Maximum snowfall (cm)	51	49	26	5							18	39		51	

Source: Meteorological Survey Department, Sarajevo University

(2) Earthquake Condition

Probable ground accelerations for the return period of 100 years are as follows, according to the seismographic study by the Earthquake Research Institute of Sarajevo University:

- Doboj Bridge : 0.065 (g)
- Modrica Bridge : 0.066 (g)

Anti-seismic performance for ground acceleration of 0.07 (g) was checked on both proposed bridges in this Study.

(3) Hydrological and Hydrographic Conditions

1) High water level and design velocity

The data on water levels of the Bosna River is available from 1890 to the present at the gage[MT2] stations near the sites of the Doboj and Modrica bridges. Maximum water levels and discharges at the bridge construction sites can be obtained based on that data.

a) Doboj Bridge

Location 1 (between the existing and SFOR bridges) and Location 2 (Bypass route) of the bridge location options are 1,750m and 1,150m upstream of the water gage station in Doboj City. Assuming the grade of river surface water is 0.888/1,000, water levels of Location 1 and 2 rise up 1.55m and 1.02m respectively from the water level of the water gage station. Table 2-3 summarizes the results of hydrographic analysis, which includes probability analysis methods and extraction from the past maximum records.

After discussions with the RS side, the design water levels for the Doboj Bridge were determined based on the past maximum records for more than 100 years with some modifications taking into consideration the topographic departures from the gage stations to the bridge locations. Accordingly, HWLs (high water levels) are at 144.34m and 143.81m for Location 1 and 2 with the design discharge of 3,400 m^3/sec and discharge/unit drainage area of 0.351 $m^3/sec/km^2$.

Table 2-3 Summary of Hydrographic Study on Doboj Bridge

Water Gage Station in Doboj City				Br. Location Option Location 1	Br. Location Option Location 2 (Bypass)
Probability	Discharge m^3/sec	Water Level (Gage Station, cm)	Water Level (Altitude, m)	Water Level (Altitude, m)	Water Level (Altitude, m)
1/100	3,746	590	142.91	144.46	143.93
Max. Record	3,400	578	142.79	144.34	**143.81 (Adopted)**
1/50	3,200	559	142.60	144.15	143.62
1/20	2,700	519	142.20	143.75	143.22
1/10	2,287	469	141.70	143.25	142.72

Source: Urbanisticko-Tehnicki Uslovi za Izgradnju Saobracajnice I Mosta na Putu M 4-3 u Doboj

b) Modrica Bridge

The water gage station in Modrica City is located on the existing bridge pier. Therefore, Location 1 of the bridge location options is just at the same point as the water gage station.

Location 2 (Bypass route) is 500m downstream of the water gage station. Assuming the grade of river surface water is 0.89/1,000, the water level of Location 2 is 0.44m lower than that of the water gage station (Location 1). Table 2-4 summarizes the results of hydrographic analysis which includes probability analysis methods and extraction from the past maximum records.

After discussions with the RS side, the design water levels at the bridge location options for the Modrica Bridge were determined based on the probable high water level for the 100 year return periods with some modifications taking into consideration the topographic departures from the gage stations to the bridge locations. Accordingly, HWLs (high water levels) were estimated at 104.49m and 104.05m for Location 1 and 2 with the design discharge of 3,600 m^3/sec and discharge/unit drainage area of 0.376 m^3/sec/km^2.

Table 2-4 Summary of Hydrographic Study on Modrica Bridge

Water Gage Station in Doboj City (Bridge Location Option: Location1(Existing Br.))				Br. Location Option Location 2 (Bypass)
Probability	Discharge m^3/sec	Water Level (Gage Station, cm)	Water Level (Altitude, m)	Water Level (Altitude, m)
1/100	3,922	552	104.49	**104.05 (Adopted)**
Max. Record	3,900	550	104.47	104.03
1/50	3,350	507	104.04	103.60
1/20	2,827	460	103.57	103.13
1/10	2,394	418	103.15	102.17

Source: Urbanisticko-Tehnicki Uslovi za Izgradnju Saobracajnice I Mosta na Putu 17-3 (E73) u Modrica, January 2003

2) Design Discharge and Flow Velocity

Based on the above hydrographic studies, the design discharges and flow velocities along with hydrographic factors are summarized in the following table for the selected bridge location options Location 2 (Bypass Route) of the Doboj and Modrica bridges.

Table 2-5 Design Discharges & Flow Velocities along with hydrographic factors for the Selected Bridge Location Options by Bridges

Bridge Site	HWL m	River Section m^2	Perimeter m	Riverbed Gradient	Roughness Coefficient	Flow Velocity m/sec	Discharge m^3/sec
Doboj	143.81	1830	3.21	0.888/1,000	0.035	1.85	3,400
Modrica	104.05	1,750	3.18	0.890/1,000	0.031	2.08	3,640

Source: Study Team

3) Bridge length

Floods of the Bosna River are likely to occur at both sites of the Doboj and Modrica bridges. The flood-prone areas of these sites occupy transversely up to 500m. As with the existing Doboj and Modrica bridges on a view point of economic construction costs, the bridge length will be narrowed by the embankment of approach and connection roads. When the width of a river at a bridge point is narrowed, then the flow is checked and the water level goes up in the upstream of the bridge. In this regard, the bridge lengths are determined taking into consideration the effects of water levels on the upstream sides and change of river channels.

Considering the influence of narrowed river width, of the bridge pier being slanting to river flow and installed piers, relationships between a rise of water level and the bridge length [MT3] at the Doboj and Modrica bridges were estimated by using the method of the U.S. Public Road Bureau.

The results of estimation are shown in Figure 2-1. In this calculation, the roughness coefficients at the Doboj and Modrica bridge sites were so adjusted that 3,400m^3/sec of discharge corresponds to 143.81m of HWL and 3,600m^3/sec of discharge corresponds to 104.05m of HWL, respectively.

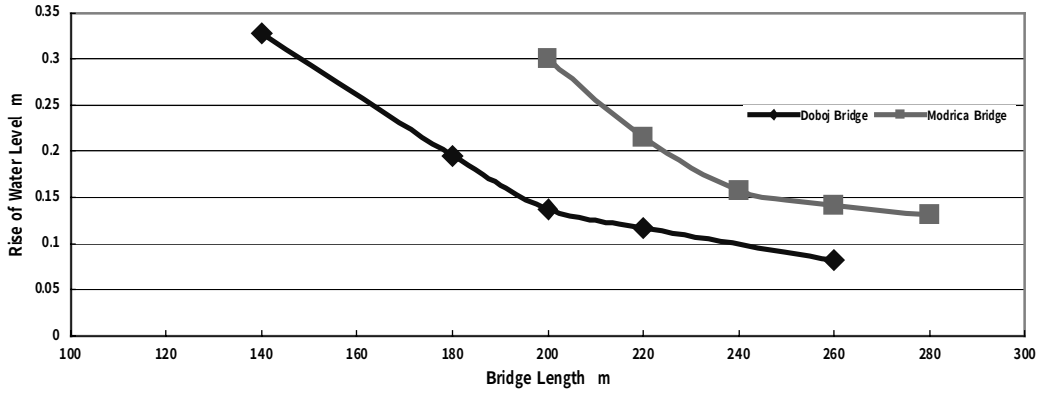
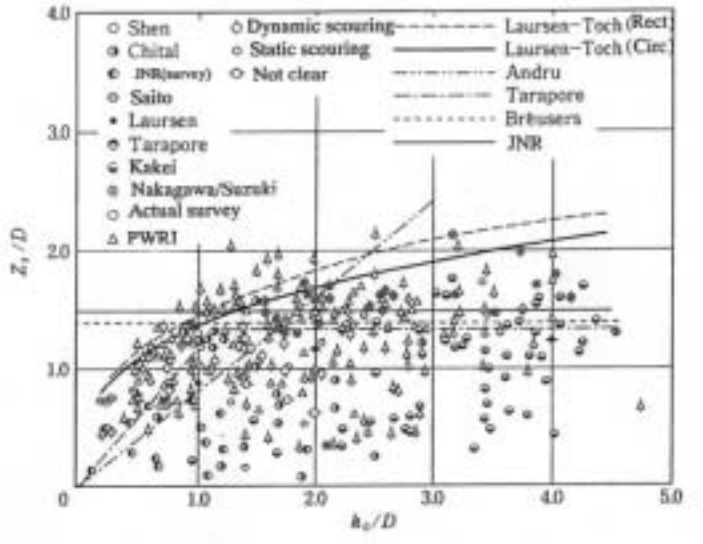


Figure 2-1 Relationships between river width and Increase of Water Levels

Figure 2-1 shows the sudden change of the increase of water level on the upstream side at the bridge length of 200m in the Doboj bridge, and near 240m in the Modrica bridge. Accordingly, the bridge length of the Doboj and Modrica bridges were determined at 200m and 240m respectively. In these cases, the increases of water level on the upstream side the piers are less than 20cm.

4) Local Scour Depth

There are possibilities of rapid water flow causing local scouring around the bridge piers and abutments. Scour depth was calculated on the basis of the various diagrams shown in the hydrological formula in 1999 by the Japan Society of Civil Engineering shown in the following Figure 2-2. The Figure shows, h_0/D at the Doboj Bridge is 5.0, Modrica Bridge is approximately 4.0 (where, Zs: Depth of local scouring, D: Pier column width against the direction of flow, h_0: Average depth of water). According to the graph[MT4], range of Zs /D=1.5, as the average value of the observed samples, so depth of it should be equal to 1.5 of "D" (pier column width against the current direction).



Source: Japan Society of Civil Engineering

Figure 2-2 Maximum depth of local scouring

Based on this analysis, it was confirmed that no special measures for local scour would be necessary in case that the depths of the footing of the piers in the river at the Doboj and the Modrica bridges would be – 2.0m from the river bed.

5) Vertical Clearance and Span Length

In accordance with the requirement of RS standards, the vertical channel clearance from HWL to girder soffit shall be 1.0m or more.

As the minimum span lengths calculated from the discharge at the Doboj and the Modrica bridges are 37m and 38m respectively, the span length of both bridges shall be 40m. In this case, the reduction of the drainage section [MT5]by constructing piers is 5% or less, and complies with the Japanese design codes.

2-2-1-3 Social Conditions

(1) Mines and Unexploded Ordnance

In response to the request of the Study Team through the Road Directrate of the RS, the areas around the Doboj and Modrica bridge sites had been searched for remnant mines and a certificate issued by the BiHMAC in December 2002. So the land will be used for the construction yard temporarily. However, in case that the temporary construction yard would be prepared outside of the certified area, prior to the construction under the Japan's grant aid, the RS side is to arrange a certificate by the BiHMAC for that.

(2) Site Possession

Land expropriation by the RS side is required for the new bridge construction by the Japan's grant aid including connection roads by the RS side on both the bypass routes of the Doboj and Modrica bridges. Such land expropriation should be as compulsory purchase for permanent use. In addition, planned grounds for construction yards for both bridges have to be requested from the RS side at the basic design stage with location maps. Each construction yard is temporarily used for offices, equipment and materials during a limited term on the basis of rented ground.

The RS side would have to complete the process to secure the land, followed by negotiation and procurement of land expropriated when the detailed design of the Doboj and Modrica bridges is completed.

(3) Certificate for Design of Bridges and Construction Permit

In the case of public works like road and bridge construction in RS, the detailed design would have to be carried out in parallel with discussions with the concerned authorities about the contents of designed facilities. EIA regarding the project would also be performed at the same time. After completing the detailed design and obtaining the approval from the concerned authorities, the Ministry of Transport and Communications should apply to obtain a construction permit from the Ministry of Urbanism, Housing, Public Utilities, Civil Engineering and Ecology.

2-2-1-4 Construction Conditions

(1) Employment Schedule

Regarding employment regulations, Labour Standard Law of RS specifies that the basic working hours should be within 40 hours a week from Monday to Friday, etc. This project should follow this regulation.

(2) Procurement for Construction Equipment and Materials

1) Concrete Plants and Asphalt Concrete Plants

There are a few plants of those kinds in Doboj City and in the vicinity. From those plants, ready mixed concrete can be procured. A concrete factory, about 17km away from Doboj City on M4-3, is operating to produce prestressed concrete precast beams.

There are asphalt concrete plants near the bridge sites; one is located at 7km from Doboj Bridge and the other 1km from Modrica Bridge. Moreover, most construction firms own such asphalt concrete plants in BiH, so no difficulties to procure asphalt pavement materials are anticipated.

In the case that quality tests by a third party are required for concrete and other materials, the Project can use the material laboratory of an institute (Institut za ispitivanje materijala I konstrukcija) at Banja Luka for obtaining its certification of quality.

2) Reinforcement

There are some companies that produce round bars, deformed bars (thickest diameter D32mm, BST500S DIN488, max. 12m long)and wire mesh. In particular, BH Steel in Zenica is the largest steel production company in BiH. However, the other steel materials are imported from many foreign countries, such as Germany, Italy, Czech, Slovakia and India.

3) Stone Materials

Plants in Doboj City and in its vicinity are using aggregates from the riverbed of the Bosna River. The plant of the concrete factory, about 17km away from Doboj City towards Tuzla, is using aggregates from the riverbed of the Sava River. Consumption of concrete in this factory is approximately 180 to 200m3/day and the hauling distance of aggregates from the Sava River to the factory is about 60km. In this regard, no difficulty is anticipated in supplying aggregates for the Project.

4) Construction Equipment

There is no leasing company to supply heavy construction equipment, large-sized vehicles and plant which are suitable for this project in RS. Major construction firms such as ZGP Doboj, Integral Inzenjering, Gradip hold some cranes, large-sized vehicles and construction equipment, and are carrying out integrated construction. During the basic design study in BiH, availability of 80 ton truck cranes was confirmed. Their locality was taken into account in the construction plan.

2-2-1-5 Applicability of Local Contractors

Organizations called Putevi, which were working on road maintenance in the former Yugoslavia, were split into 10 private firms and they are still working on maintenance job mainly.

There are many construction firms except them in BiH. Major construction firms have many examples of their work on the construction of bridges or restoration projects funded by EU, WB and USAID inside the country. Such firms holding construction equipment have technical capability and are adequate as a subcontractor. Especially concerning bridge construction, ZGP, Integral, Gradip and etc. have enough experience. The aforesaid manufacturing plant between Doboj and Tuzla has enough capability and facilities for fabricating precast bridge girders of the prestressed type for the Project.

2-2-1-6 Capability of Executing Agency for Maintenance and Operation

The Road Directorate of the Ministry of Transport and Communications of the Republic of Srpska Government is responsible to maintain 3,900km of trunk road, 680 bridges with a total length of 19km and 130 tunnels with a total length of 22km. The Road Directorate has 59 staff and sublets annually the whole works for maintaining and operating the roads, bridges and tunnels to the private firms like 10 Putevi by prefecture.

The Doboj and Modrica bridges to be built by the Project belong to the Doboj Branch of the Road Directorate. Therefore, the current O/M system of the Doboj Branch of the Road Directorate will govern the future O/M of the 2 bridges. However, as a number of engineers from the former Yugoslavia expatriated to other countries and RS has an insufficient number of engineers at present, some transfer knowledge programs from Japan seem to be indispensable for this purpose.

2-2-1-7 Policy of Standard of Facilities

(1) Existing Bridge Damaged Condition

The existing Doboj Bridge built in 1952 consists of two different structures, viz. RC 5 span continuous T-shaped girder bridge (Length=113m) over the Bosna River and RC 7 span continuous slab bridge (Length=100m) in the flood prone area on the right bank side. The existing structures are decayed and have deteriorated seriously. The structural soundness test by the JICA Study Team, as per Appendix 3, shows that the bridge could no longer carry heavy vehicles nor allow the re-use of the structural elements by reinforcement from the view points of economic construction cost and technical aspects.

The existing Modrica Bridge built in 1960, consists of RC 5 span continuous T-shaped girder bridge (Length=184m) over the Bosna River. During the war, the first span at the left bank side (Doboj

side) was destroyed by bombardment. In 1994, the destroyed span was reconstructed by RC 2 span continuous T-shaped girder with an additional RC pier at mid-span. The structural soundness test by the JICA Study Team shows that the re-use of the superstructure could be difficult while re-use of the substructures may be possible.

(2) Restoration Policy

A new bridge will be built for the Doboj Bridge restoration. A bridge location study was conducted by the RS side to compare the advantages of various aspects among the conceivable options of bridge location. The JICA Study Team conducted a comparative study between the bridge locations selected by the RS side and an alternative bridge location considered by the JICA Study Team. As a result, a bridge location on the new bypass route planned by the RS side, about 1km downstream side of the existing bridge, was selected for the subsequent basic design from the view points of economic construction cost, traffic safety, impact on the Doboj urban plan, etc. (See, Appendix-5-5)

As for the decision on the Modrica Bridge restoration, two options were studied:

- A plan to re-use the existing bridge by reinforcement of substructures and re-construction of the superstructure, and
- A plan for a new construction on the bypass route selected by the RS side.

Consequently, a plan for a new bridge to be built on the new bypass route planned by the RS side, about 500m downstream of the existing bridge, was selected from the view points of traffic safety, implication of a role in the European Motorway scenario, etc. (See, Appendix-5-5)

The locations for the comparative study are shown in Figure 2-3 and Figure 2-4.

(3) Bridges

The design concept of the new bridges to be planned is shown in the following:

- The new bridge shall cope with various natural conditions at the bridge site, and load carrying capacity of the new bridge shall be the same as the present bridge design criteria in RS including design for seismic conditions.
- The bridge length should meet the requirements from the hydraulic studies already discussed in 2-2-1-2 of this report.
- The Japan's grant covers building new bridges along with approach roads from bridge abutment to the end point of the connection road (50m and 100m from the abutment on left bank side and right bank side, respectively for both Doboj and Modrica bridges). The RS

side covers the connection road, intersections and other requirements like a railway underpass for Doboj.

- Geometric design of plan and profile for the new bridges and approach roads should follow the outcomes of the bypass routes planned by the RS side.

2-2-1-8 Design Policy for Construction Method and Construction Period

Considering the rainfall and snowfall season at the construction site, the construction except the preparatory and finishing work is well suited for 8 months from April to November, as described in 2-2-1-2(1). Hence a construction schedule will be planned for commencement of the main construction work from April and completion of it before the winter season.

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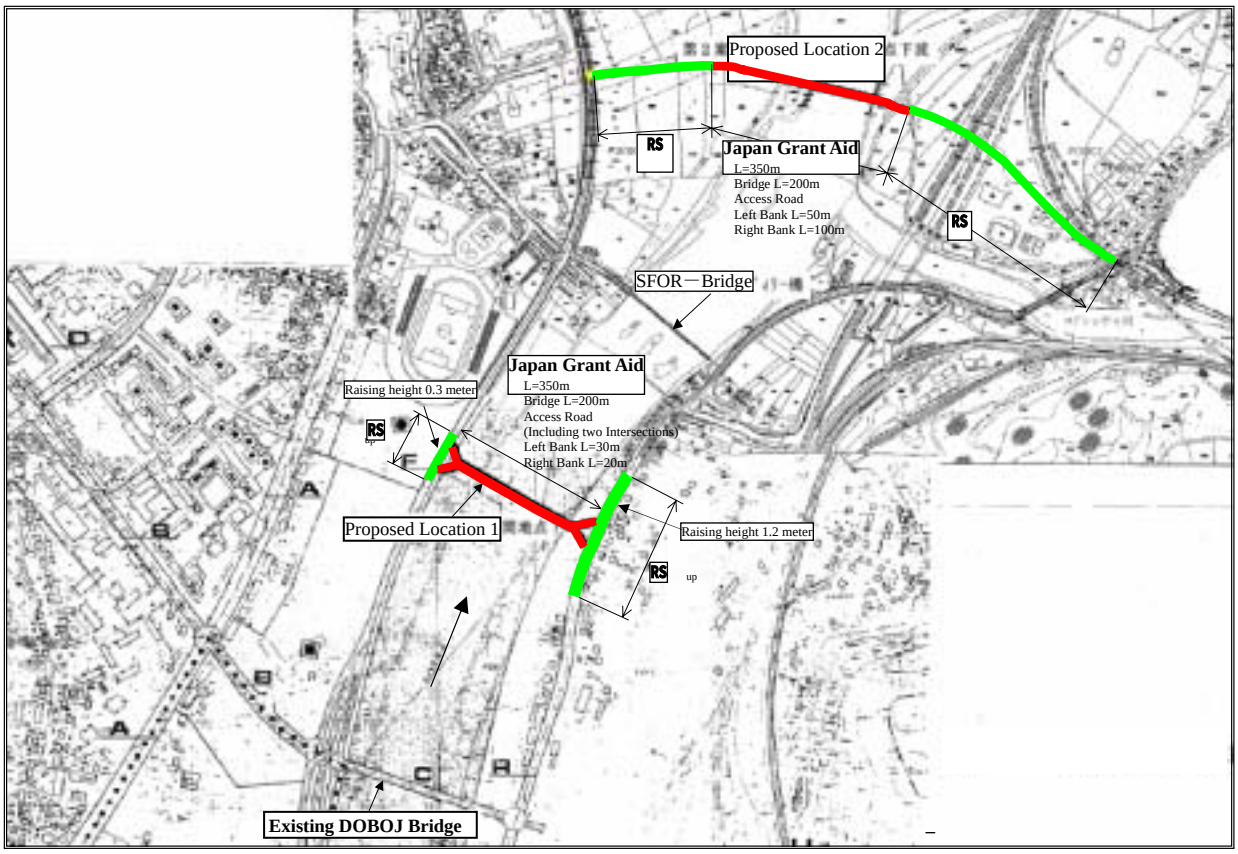


Figure 2-3 Bridge Location Options for Doboj Bridge

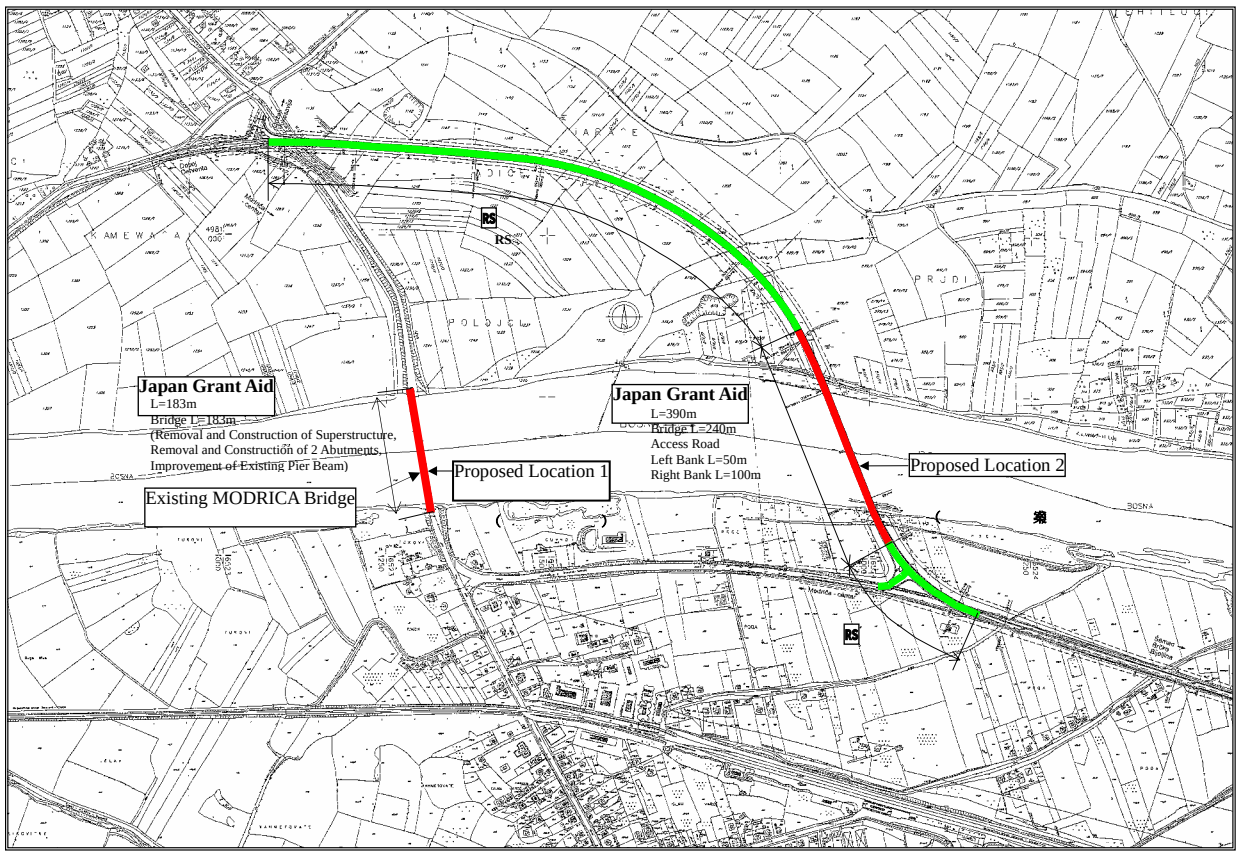


Figure 2-4 Bridge Location Options for Modrica Bridge

2-2-2 Basic Plan

2-2-2-1 Design Criteria

(1) General Description of Bridges

The following RS standards will be used, in principle, for the bridge project. The Geometric Design Standard will take into consideration the design standard and design policy of RSRD as shown in Table 2-6.

a) Bridge design criteria : Pravilniko technickim normativima za odredjivanje velicine opterecenja mostova (SFRJ, 1/1991): SFRJ = Social Federative Republic of Yugoslavia

b) Road design criteria : Pravilnik o osnovnim uslovima koje javni putevi izvan naselja i njihovi elementi moraju da ispunjavaju sa gledista bezbjednositi saobracaja (SFRJ: Social Federative Republic of Yugoslavia)

c) Earthquake proof design criteria: Pravilnik o technickim normativima za projektovanje I proracun inzenjerskih objekata u seizmickim podrucjima (SFRJ, 1988)

Table 2-6 Geometric Design Standard

Item	Standard		Remarks
Route name	Doboj Bridge：M4-3	Modrica Bridge：E73	
Present Traffic Volume (Future Traffic Volume)	6,000–7,000 veh./day (7,100 veh./day)	7,700 veh./day (15,100 veh./day)	See “Notes 1 and 2”.
Road specification	Road Class 2 (RC-2)		See “Note 3”
Design speed	80km/hr		On RC-2, hilly plain
Gradient	The maximum inclination 5%		On RC-2, hilly plain
Horizontal curve	Minimum radius 250m		On RC-2
Number of lanes	Two lanes		On RC-2
Traffic lane width	3.25m x 2		On RC-2, Design speed
Shoulder width	0.3m (Lateral Clearance) + 1.0m (marginal strip)		Carriage width, design speed
Footpath	Both sides		Nos of pedestrians
Footpath width	Minimum effective width 1.2m		RSRD criteria
Super-elevation	A single-sided inclination (2.0% is the minimum Super-elevation)		RSRD criteria
Footpath grade	1.0%		RSRD criteria

Notes 1: Present traffic volume of Modrica Bridge is according to the traffic volume counting survey in November, 2002. That of Doboj Bridge has been estimated for the new bridge from the results of surveying on the existing and SFOR bridges.

2: Future traffic volume is based on BiHTMAP.

3: Although the future traffic volume of the Modrica Bridge had required Road Class 1 (RC-1, V=100km/hr), Road Class 2 (RC-2, V=80km/hr) was adopted after the discussions with RSRD.

Cross section of both bridges is shown in Figure 2-5.

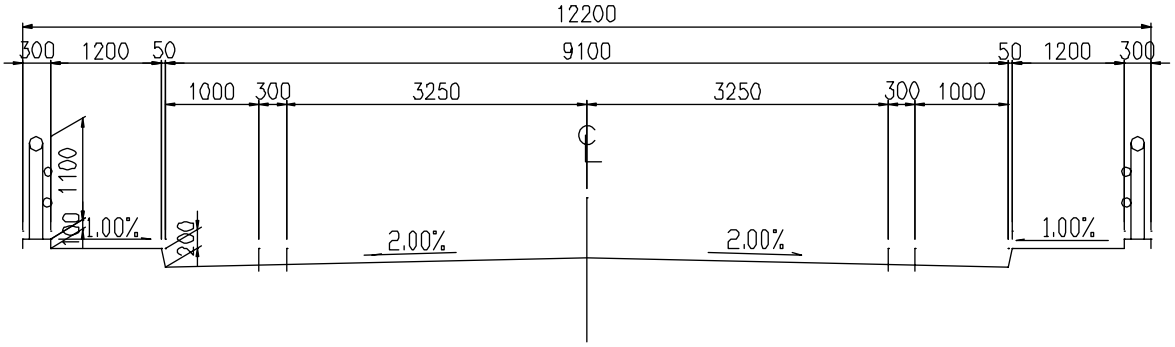


Figure 2-5 Cross Section of Doboj and Modrica Bridges

(2) Design Criteria

Design load based on the hydrological condition and the design standards for bridges, according to the standards used in RS, are shown in Table 2-7.

Table 2-7 Design Criteria of Bridges

Item		Design Criteria		Remarks
		Doboj	Modrica	
River condition	Design discharge	3,400m^3/sec	3,640m^3/sec	
	Design flow velocity	1.85m/sec	2.08m/sec	
	Design high water level	143.8m	104.1m	
	Vertical channel clearance	1.0m		
Design load	Live load	600kN + 300kN		
	Impact load	Kd=1.4-0.008L>1.00		
	Hydraulic pressure	P=0.515xkxV²		
	Thermal effect	-15℃ to +35℃		
	Snowfall load	1 kN/m^2		
	Ice gorge collision load	N.A.		There is no ice gorge in the river.
	Centrifugal-force load	N.A.		A plane alignment is close to a straight line.
	Seismic Load	K = 0.065g	K = 0.066g	Sarajevo university earthquake research institute data.

Item		Design Criteria		Remarks
		Doboj	Modrica	
Design load	Unit weight of Materials	Steel:77kN/m3 (7,850kgf/m³) Pre-stressed Concrete : 24.5kN/m³ (2,500kgf/m³) Reinforce Concrete: 24.5kN/m³ (2,500 kgf/m³) Pain Concrete: 23.5kN/m³ (2,400 kgf/m³) Asphalt Concrete: 23.5kN/m³(2,400kgf/m³)		A non-line and asphalt concrete are based on a Yugoslavian standard.
	Overlay load	5cm thickness of asphalt pavements is expected.		
Pavement on bridge		Waterproof layer 10mm + AS pavement (40mm + 30mm)		
Concrete design strength		MB25 (20N/mm² equivalent to cylinder) MB30 (24N/mm² equivalent to cylinder) MB50 (40N/mm² equivalent to cylinder)		MB is a compression strength value by the test cube
Utility		There is no utility for a design, 4 spaces of 11cm diameter are laid under the bottom of both footpaths.		Utilities are on the existing bridges.
Road lighting		Installed		

2-2-2-2 Facility Design

(1) Facility Scale

As a result of the hydraulic studies, bridge lengths of the Doboj and Modrica bridges were determined at 200m and 240m respectively.

Required minimum span lengths, which the design discharges dominate, were calculated at 37m for the Doboj Bridge and at 38m for the Modrica Bridge. In these cases, reduced sectional areas of the river channel are less than 5%.

Vertical channel clearance between HWL and girder soffit should be 1.0 m or more.

(2) Comparison of Superstructure Type Options

Three options for each bridge were examined for the bridge type selection taking into consideration the present condition of the existing bridges, bearing strata of subsoil, river characteristics, and available construction materials along with material prices.

1) Doboj Bridge

Bridge Type Option 1: 5 Span Continuous Steel Plate Girder (I Section)

Length of end spans is less than that of intermediate spans taking into consideration the most favorable span arrangements, 37m + 42m x 3 spans + 37m. Total number of girders is 5. Construction of this type of bridges was experienced in so many cases in BiH in the past.

Bridge Type Option 2: 5 Span PC I Girder

The I shaped girder is considered in order to facilitate the adjustment to the horizontal curve alignment near the abutments, while it is difficult to do so with a T shaped girder. Total number of girders for one span is 4. Span arrangement is 40m x 5 spans. One girder is made up with 5 segments pre-fabricated in a concrete factory.

Bridge Type Option 3: 2 Span Steel Truss Girder + 4 Span PC T Girder

This option is advantageous in minimizing the girder depth and resulted in a much more gentle longitudinal gradient of the approach roads, applying through truss structure in the river and short span concrete structure for the flood prone area. Span arrangement is 60m x 2 spans + 20m x 4 spans. PC T girder is based on the standard design in BiH and easily procured from a pre-stressed concrete factory. As the horizontal alignment is located in the steel truss girder, a special arrangement is required transversely by keeping more space than ordinal one between girders.

2) Modrica Bridge

Bridge Type Option 1: 5 Span Continuous Steel Box Girder

Span arrangement is 42m + 52m x 3 spans + 42m. Total number of girders is 2. Construction of this type of bridges was experienced in BiH in the past. This option is favorable for coping with a horizontally curved alignment.

Bridge Type Option 2: 6 Span Continuous Steel Plate Girder (I Section)

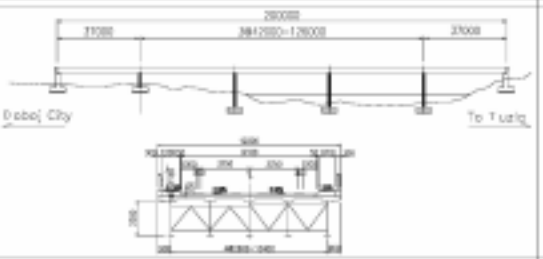
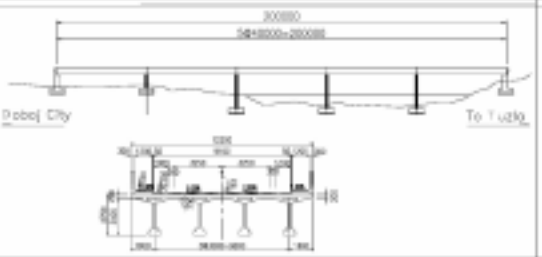
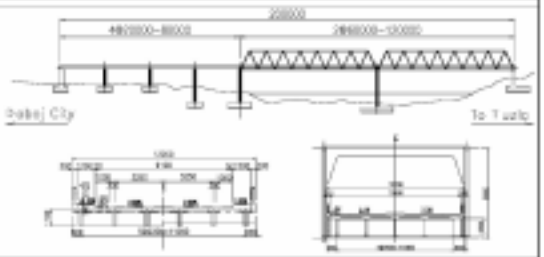
Span arrangement is 34m + 43m x 3 spans + 34m. Total number of girders is 4. Construction of this type of bridges was experienced in BiH in the past. This option is favorable for coping with a horizontally curved alignment.

Bridge Type Option 3: 6 Span PC I Girder

As with Option 2 of the Doboj Bridge, the total number of girders is 4. Span arrangement is 40m x 6 spans. One girder is made up with 5 segments pre-fabricated in a pre-stressed concrete factory. This option is favorable for coping with a horizontally curved alignment.

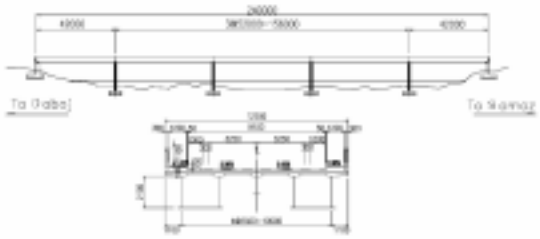
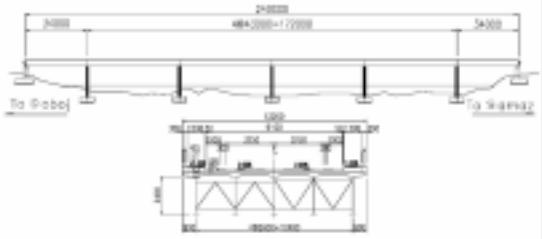
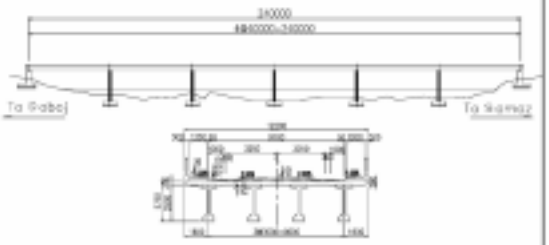
After examination of comparative studies on the above three bridge type options for each bridge, Option 2 (PC I girder) for the Doboj and Option 3 (PC I girder) for the Modrica bridges were selected. The summary of the comparative studies is shown in Table 2-8 and Table 2-9 for the Doboj and Modrica respectively.

Table 2-8 Comparison of Superstructure of Doboj Bridge

Item \ Type	Plan 1 Steel Continuous 5 span Plate Girder Bridge (RC Deck Slab)		Plan 2 Pre-stressed concrete 5 span I-girder Bridge with Post-tension		Plan 3 2 span Steel Truss Bridge (RC Deck Slab) + 4 span of Pre-tension T-girder Bridge	
General View						
Selection Outline	· The bypass road underpasses the railroad. Therefore the gradient of the access road to the bridge must be made as small as possible and a bridge type with a low beam height should be selected. · This plan adopts the bridge type that has been used successfully in Bosnia.		· The bypass road underpasses the railroad. The gradient of the access road to the bridge must be made as as possible in this case and a bridge type with a low beam height should be selected. · The PC post-tension beams that can be manufactured at a factory 17 km from Doboj towards Tuzula are used.		· The bypass crossed by this bridge underpasses the railroad parallel to main highway E-73. The gradient of the access road to the bridge must be made as small as possible and a bridge type having the lowest beam height is selected. · A steel truss bridge of the type of superstructure with the lowest beam height is used. The PC pre-tension T-beams manufactured by the factory are used for the flood area.	
Type of Bridge	Superstructure: Steel Continuous 5 span Plate Girder Structure (RC Deck Slab) Substructure : 4 wall type piers and 2 inverted T-type abutments (Direct Foundation)		Superstructure: 5 span PC I-shape girder structure (Post-tension) L = 40 m (precast segmental method) Substructure : 4 wall type piers and 2 inverted T-type abutments		Superstructure: 2 span Steel Truss Bridge (RC Deck Slab) & 4 span PC I-Shape girder structure (pre-tension) Substructure : 5 wall type piers and 2 inverted T-type abutments	
Structural Characteristics	· The bridge has a strong earthquake resistance by using a continuous structure, which reduces the number of expansion joints and supports required. Therefore this bridge has a suitable structure for traveling and maintenance. · The steel plate girder that have been installed successfully in Bosnia are used.	◎	· The bridge has a strong earthquake resistance by using a continuous structure, with reduced numbers of expansion joints and supports. Therefore this bridge has a suitable structure for traveling and maintenance. · The post-tension beams that have been adopted successfully in Bosnia are used. · The beams are of block type divided into five segments and manufactured by the factory.	◎	· The river and flood area are provided with continuous and connecting structures respectively and show a good resistance against earthquake. However, as an expansion joint is necessary to connect the truss bridge and the PC bridge, this plan is slightly less favorable than other plans for traveling and maintenance. · The PC pre-tension T-shape girder would be manufactured at a factory. · The truss bridge would also be manufactured at a factory.	○
Road geometric Alignment — Vertical Alignment	· As described above, it is necessary to make the longitudinal slope of the access road due to railroad underpassing. In this case, the longitudinal gradient is 4.18%. · The superstructure height is 2.70m, ca. 80cm higher than Plan 3.	○	· As described above, it is necessary to make the longitudinal slope of the access road in relation with railroad underpassing in this case, the longitudinal gradient is 4.25%. · The superstructure height is 2.89m, ca. 90cm higher than Plan 3.	○	· As described above, it is necessary to make the longitudinal gradient of the access road in relation with railroad underpassing. In this case, the longitudinal gradient is 3.60%. · The superstructure height is 1.99m, the lowest of the three plans.	◎
Road geometric Alignment — Horizontal Alignment	· There is no special problem.	◎	· There is no special problem.	◎	· The truss is hard to respond to a horizontal curve.	△
Construction	· Beams can be manufactured in Banja Luka City or Zenica City and transported on main highways. They are manufactured at a factory, ensuring their stable quality and workmanship. · The distance from the beam manufacturing site to the work site is approximately 81km for Zenica City, and approximately 100km for Banja Luka City. · The beam erection uses the push-out method for the river section and the crane method for the flood area. · The beams are manufactured at a factory, shortening the work period at the site.	○	· Post-tension beams can be manufactured at a factory located 17km from Doboj, so it is unnecessary to provide a beam-manufacturing yard near the site. They are manufactured at a factory, ensuring their stable quality and workmanship. · The distance from the beam manufacturing factory to the work site is approximately 17km , the shortest transport distance of the three Plans. · Beam erection uses erection beams for both the river section and the flood area. · The beams are manufactured at a factory, shortening the work period at the work site.	◎	· Truss beams can be manufactured in Banja Luka City or Zenica City and PC beams at a factory located 17km from Doboj, so it is unnecessary to provide a beam-manufacturing yard near the work site. The beams are manufactured at a factory, ensuring consistent stable quality. · The distance from the truss beam manufacturing factory to the work site is approximately 81km from Zenica City and the distance from the PC beam manufacturing factory to the work site is approximately 17km · Beam erection uses the push-out method for truss beams and the tandem lifting by two cranes for PC beams. · The beams are manufactured at factories, shortening the work period at the work site.	○
River Condition	· The maximum span is 42.0m, this will maintain a sufficient effective water flow section of the river.	○	· The span is 40.0m, which meets the standard span under the River Structure Act in Japan, and can maintain the sufficient river section.	○	· There is only one pier within the river section, which has a smaller effect on the river flow than Plan 1 or Plan 2. Therefore, it is more effective against river sediments.	◎
Construction Cost	· The cost is economically medium in three Plans. The Construction cost ratio: 1.06	○	· The cost is the lowest of the three Plans. Construction cost ratio: 1.00	◎	The cost is the highest of the three Plans. Construction cost ratio: 1.38	△
Technology Transfer	· The plate girder technology to be used prevails in Bosnia, so no special technology will be transferred. However, technologies such as de-stressing in welding are transferable.	○	· The post-tension beam using the segment method is used and the technology for the construction of long-span PC beam is transferable.	○	· Steel truss bridge and PC beams of about 20m long are widely used in Bosnia, so that the transferability of the technology for these is low.	○
Maintenance	· The steel bridge needs maintenance such as periodical painting (initially on a cycle of 10 years, thereafter about 5 years).	○	· The bridge is concrete type, which is basically maintenance-free.	◎	· The concrete parts of the bridge are basically maintenance-free, but the truss bridge needs maintenance such as periodical painting (initially on a cycle of 10 years, thereafter about 5 years).	○
Comprehensive Evaluation	· For this bridge, it is necessary to make the access road slope from the railway underpass small . Therefore bridge type shall be selected by paying special attention to the access road gradient and economy. Plan 3 allows the access road gradient to be the smallest. Plan 1 and Plan 2 make the access road gradient about 0.6% to 0.7% longer than Plan 3, which comply with the design codes and the differences are not a problem. For economy, Plan 2 has the lowest construction cost of the three Plans and Plan 3 is the most expensive. Therefore, Plan 2 will be selected as the most recommendable plan because of its economic superiority and ease of maintenance.					
			Adopted			

Remarks: The evaluation is based on the relative comparison of three Plans, but the "running performance" and "local procurement", and the "landscape" that depends upon personal subjective views are excluded from the evaluation because they are the same for all three Plans.

Table 2-9 Comparison of Superstructure of Modorica Bridge

Item \ Type	Plan 1 Steel Continuous 5 span Plate Box Girder Bridge(RC Deck Slab)		Plan 2 Steel Continuous 6 span Plate Girder Bridge (RC Deck Slab)		Plan 3 Pre-stressed concrete 5 span I-girder Bridge with Post-tension	
General View						
Selection Outline	– This type of bridge has been determined as economical superstructure type in the preliminary examination. – This bridge type has been used good results in Bosnia – This type can handle the skew angle (60 degrees)		– This type of bridge has been determined as economical superstructure type in the preliminary examination. – This bridge type has been used good results in Bosnia – This type can handle the skew angle (60 degrees)		– This type of bridge has been determined as economical superstructure type in the preliminary examination. – This type of bridge has been used with excellent results in Bosnia. In addition, this type can handle the skew angle (60 degrees) – The plan is to use PC post-tension beams (block beams) that can be manufactured by a factory located 17 km from Doboj towards Tuzula	
Type of bridge	Superstructure: Steel box Girder (2 main Girders are installed) RC floor slab Substructure : 4 wall-type piers (direct foundation) 2 abutments (inverted T-type, direct foundation)		Superstructure: Steel sheet plate girder (5 main girders are be installed) PC floor slab Substructure : 5 wall-type piers (direct foundation) 2 abutments (inverted T-type, direct foundation)		Superstructure: PC post-tension girder: L = 39.8 m (block beam) Substructure : 5 wall-type piers (direct foundation) 2 abutments (inverted T-type, direct foundation)	
Structural Characteristics	· The bridge has a streng earthquake resistance from using a continuous structure so the numbers of expansion devices and supports can be reduced. Therefore this bridge has a suitable structure for traveling and maintenance. · The Box beam, which has been installed successfully in Bosnia, and are used.	◎	· The bridge has a strong earthquake resistance from using a continuous structure so the numbers of expansion devices and supports can be reduced. Therefore this bridge has a suitable structure for traveling and maintenance. · The steel plate girder have previously been installed successfully in Bosnia.	◎	· The bridge has a strong earthquake resistance from using a continuous structure so the numbers of expansion devices and supports can be reduced. Therefore this bridge has a suitable structure for traveling and maintenance. · The post-tension beams that have been adopted successfully in Bosnia to be used. · The beams are of block type divided into five segments and manufactured at a factory.	◎
Vertical Alignment	– This bridge is built over a newly constructed road (bypass), which has no linear limitation. – The superstructure height is 2.99m, the lowest, and the embankment height of the access road is lower than that of the other plans.	○	– This bridge is built over a newly constructed road (bypass), which has no linear limitation. – The superstructure height is 2.88m, and the embankment height of the access road is a little higher than that of Plan 1.	△	– This bridge is built over a newly constructed road (bypass), which has no linear limitation. – The superstructure height is 2.88m, and the embankment height of the access road is a little higher than that in Plan 1.	◎
Construction	· Girders can be manufactured in Banja Luka City or Zenica City and transported on a main highway. They are manufactured at a factory, ensuring their stable quality and workmanship. · The distance of the beam manufacturing site to the work site is approximately 81km from Zenica City, or approximately 109km from Banja Luka City. · The beam erection uses the push-out method for the river section and the crane method .	○	· Girders can be manufactured in Banja Luka City or Zenica City and transported on a main highway. They are manufactured at a factory, ensuring their stable quality and workmanship. · The distance of the beam manufacturing site to the work site is approximately 81km from Zenica City, or approximately 109km from Banja Luka City. · The beam erection uses the push-out method for the river section and the crane method . – Beam erection, which is made in the river section, uses the push-out method or erection beam method. – Beam manufacturing at a factory will shorten the work period at the work site.	○	· Post-tension beams can be manufactured at a factory located 17km from Doboj, so that it is unnecessary to provide a beam-manufacturing yard near the site. They are manufactured at a factory, ensuring their stable quality and workmanship. · The distance from the beam manufacturing factory to the work site is approximately 68km , the shortest transport distance of the three Plans. · Beam erection uses the erection beam method. · The beams are manufactured at a factory, shortening the work period at the work site.	◎
River Condition	– The span is 52.0m, which meets the design standard span under the River Structure Act in Japan, and the effect on river flow capacity is no problem.	○	– The span is 40.0m, which meets the design standard span under the River Structure Act in Japan, and the effect on river flow capacity is no problem.	○	– The span is 40.5m, which meets the design standard span under the River Structure Act in Japan, and the effect on river flow capacity is no problem.	○
Construction Cost	This Plan is most expensive of the three Plans. Construction cost ratio: 1.16	△	This Plan is economically medium of the three Plans. Construction cost ratio: 1.09	○	This Plan has the lowest cost of the three Plans. Construction cost ratio: 1.00	◎
Technology Transfer	– The steel box girder technology is prevalent in Bosnia, so it is unnecessary to transfer any special technology, but the technologies such as destressing in welding are transferable.	○	– The steel box girder technology is prevalent in Bosnia, so it is unnecessary to transfer any special technology, but the technologies such as destressing in welding are transferable.	○	– The post-tension beam using the segment method is adopted, so the technology for long-span PC beams is transferable.	◎
Maintenance	· The steel bridge needs maintenance such as periodical painting (initially on a cycle of 10 years, thereafter about 5 years).	○	· The steel bridge needs maintenance such as periodical painting (initially on a cycle of 10 years, thereafter about 5 years).	○	– The bridge is concrete type, which is basically maintenance-free.	◎
Comprehensive Evaluation	– The type of bridge to be selected will be based on economy because the access road has no linear limitation. As clearly seen from the above comparison, the 6-span connecting post-tension concrete T-shape beam in Plan 3 would have the lowest cost. Therefore, the bridge of Plan 3 will be recommended and adopted, which is superior in economy and maintenance for the Doboj bridge.					
					Adopted	

Remarks: The evaluation is based on the relative comparison of three Plans, but the "running performance" and "local procurement", and the "landscape" that depends upon personal subjective views are excluded from the evaluation because they are the same in three Plans.

(3) Approach Road

Approach roads to be included in the Project under the Japan's grant should be within the construction areas for building the Doboj and Modrica bridges. The construction sequence for girder erection of both the Doboj and Modrica bridges is assumed to start from the right bank side toward the left bank. Considering the launching distance of girders progressing from the right bank side, lengths of the approach roads were determined at 100m and 50m on the right bank side and left bank side respectively both for the Doboj and Modrica bridges. Width composition of each approach road is considered to be the same as the bridge at this time. However, it shall be adjusted to the connection roads, which is to be implemented by the RS side, if necessary. [MT6]

(4) Slope Protection around Abutments

At both bridges, abutments are located at the bank of the water course. Considering the risk of erosion around the bank of abutments during a flood, slope protection should be applied with riprap. The area of it should be arranged up to the flood water level due to the abutments being located at exserted[MT7] embankment in the river course.

As the rooting depths of spread foundations are planned at more than scour depth, no riverbed protection is considered.

(5) Overall Scheme of the Facility

The overall scheme of the facility to be planned is shown in the Table 2-10.

Table 2-10 RS Bridges to be Constructed

		Doboj Bridge	Modrica Bridge
Bridge and Related Facilities	Reconstruction or New Construction	New Construction On Bypass Route	New Construction On Bypass Route
	Altitude of Bridge Site	Approx. 141 m	Approx. 104 m
	River Name	Bosna River	Bosna River
	Design Discharge	3,400 m^3/sec	3,640 m^3/sec
	Road Alignment	A=170~R=∞~A=170	A=200~R=∞~A=140
	Bridge Length	200 m	240 m
	Span Arrangement	5 x 40.0m	6 x 40.0m
	Whole Width	12.2 m	12.2 m
	Width Composition	0.3m+1.25m+2x4.55+1.25m+0.3m	0.3m+1.25m+2x4.55+1.25m+0.3m
	Superstructure	PC 5-span Continuous Composite I-Girder	PC 5-span Continuous Composite I-Girder
	Piers	RC Inverted T *	RC Inverted T*
	Abutment	RC Inverted T	RC Inverted T
	Foundation	Spread Foundation, Cast-in-place RC Pile**	Spread Foundation
	Approach Road Length	Left Bank Side: 50 m Right Bank Side: 100 m	Left Bank Side: 50 m Right Bank Side: 100 m
	Slope Protection	To be constructed	To be constructed.
	Riverbed Protection	None	None
	Road Lighting	To be installed.	To be installed.

* : Upstream side of piers in the river will be shaped with sharp angle.

**: The foundation of abutment on the right bank will be with piles

(Source: Study Team)

2-2-3 Basic Design Drawings

The basic design drawings consisting of Doboj Bridge and Modrica Bridge are attached on the following pages.

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The implementation policies are introduced, taking into account that the project would have to be implemented under the Japan's Grant Aid Scheme, as described below:

- To maximize the procurement of local labour, materials and equipment in BiH so as to increase employment opportunities, to facilitate technology transfer and to provide positive impact to the local economy.
- To establish good communication between the Government of BiH, the RS Government, the consultant and the contractor for the project implementation to be as smooth as possible.
- To prepare appropriate construction methods and construction plans taking the snowfall season into consideration..
- To prepare a practical construction plan taking into account the local rainfall pattern, period required for materials and equipment procurement and application of appropriate construction methods.

2-2-4-2 Implementation Condition

Special considerations for the project implementation are as follows:

(1) Labour Law

The contractor shall administer labour properly under adequate safety control and prevent conflict with local labour by observing the prevailing government laws in BiH and RS.

(2) Environmental Consideration

Environmental conditions with the construction permit by the Ministry of Urbanizm, Housing, Public Utilities, Civil Engineering and Ecology of RS should be cleared throughout the construction period.

In addition, the construction works of the Project should avoid any adverse impact such as disposal of excavated soil, dust and noise from embankment and pavement works or water pollution by piling works. Those construction works should follow the related RS’s laws

(3) Tight Security at Job Sites

Special security measures, if needed, will be provided by the RS side to secure safety of project personnel and property.

(4) Religious and Local Restriction

Besides national and public holidays, there are many religious or local traditional holidays in RS. These holidays have to be taken into account in the estimation of workable days.

(5) Customs Clearance of Import Items

Since BiH has no sea port, most of the imported items might arrive via Croatia and Srbija-Montenegro. The construction plan should be established taking into consideration sufficient time for unloading, custom clearance, inland transportation, etc.

(6) Public Traffic Diversion during Construction

As the Project is to build new bridges on the bypass route, the construction plan is prepared to minimize adverse effects on the existing roads. At the junction between the existing road and the temporary access road for the Project, traffic congestion might take place.

Under such conditions, public traffic control such as direction of vehicles and pedestrians and notices for the awareness of possible detours would have to be managed by the Road Directorate of RS.

(7) Transportation of PC Segment Members

If the works require special transportation like precast segment members for PC girders, the sizes and weights of precast members should be appropriate for existing road geometry and loading capacity.

2-2-4-3 Scope of Works

The scope of works to be undertaken by the Japanese Government as well as by the BiH Government respectively is as follows:

(1) Works and Facilities to be provided by the Japanese Government

1) Construction of Facilities

- Disposal of excavated soil to the disposal areas designated by the RS Government.
- Construction of facilities as per section “2-2-2 Basic Plan” of this report.
- Traffic safety facilities in connection with the above.
- Development of temporary construction yards (plant and material yards, site offices, etc.)

2) Procurement of Equipment and Materials

- Equipment and materials required for building the bridges and constructing approach roads and other associated facilities as per sub-section "2-2-4-6 Procurement Plan".

3) Safety Measure

- Safety control and safety measures required for the execution of construction works.

4) Consulting Services

- Detailed design, preparation of tender documents, assistance to the BiH and RS governments for tender proceedings, and construction supervision as per sub-section "2-2-4-4 Consultant Services"

(2) Works and Facilities to be provided by BiH Government

1) Obtaining Construction Permit

Before distributing the tender documents to the prospective tenderers, the Road Directorate of the Ministry of Transport & Communications would have to obtain a construction permit from the Ministry of Urbanism, Housing, Public Utilities, Civil Engineering and Ecology. EIA, which will be necessary to obtain the permit, must be carried out by the Road Directorate in advance.

2) Re-obtaining Mine-Free Certificate

The Road Directorate of RS would have to re-obtain a Mine-Free Certificate from BiH MAC (BiH Mine Action Center) when a contractor designates temporary construction yards outside the project sites where the Mine-Free Certificate from BiH MAC covers.

3) Land Acquisition and Compensation

Before deployment of a construction contractor, the Road Directorate of RS would have to secure the land and level any obstructive structures as per sub-section "2-2-4-4(3) Construction Plan".

4) Land Procurement on Rented Ground Basis

- Provide disposal areas for excavated soil designated by the RS Government.
- Secure the land for construction yards (plant and material yards, temporary offices, etc.) shown in the sub-section "2-2-4-4(3) Construction Plan".
- Provide quarry sites and borrow areas, if necessary.

5) Security Measure

- Safeguard the construction sites and construction yards.

6) Others

- Issue visas, certificates and other privileges to Japanese nationals and other personnel from any third country necessary for the execution of the Project.
- Exempt taxes and other levies for the consultant and contractor. Assign a full time managing counterpart and allocate budget for the Road Directorate's office, transport, and other expenses.

2-2-4-4 Consultant Supervision

(1) Schedule of Consulting Services

The project should commence with the signing of Exchange of Notes (E/N) between the two Governments (Japan and BiH) regarding the detailed design and preparation of tender documents of the Project. After E/N, JICA would issue a recommendation letter to the Road Directorate of RS, and then the contract for the said consulting service shall be concluded between the Road Directorate of RS and the Japanese consultant. After completion of the consulting services of the detailed design stage, E/N concerned with the construction shall be concluded and the contract for the services of the tender stage and construction supervision stage shall also be concluded between the R/D of RS and the consultant. The consultant will provide the following consulting services within the limits of the Japan's Grant Aid:

1) Detailed Design and Preparation of Tender Documentation Stage

Detailed design, which includes the following outputs, should be conducted for the facilities based on the Basic Design Study Report. Finally, tender documents will be prepared for the approval of the Road Directorate of RS.

- Design report
- Drawings
- Tender documents

2) Tender (Pre-construction) Stage

The Road Directorate of RS will select a successful tenderer and conclude the construction contract with him through a competitive tender method among Japanese construction firms. Representatives from BiH responsible for this procedure should consist of contractual officer and technical officer. The consultant should assist the Road Directorate of RS to conduct the following:

- Bid announcement

- Pre-qualification of contractors
- Tender and tender evaluation, and
- Contract negotiation

3) Construction Supervision Stage

After obtaining the verification of the construction contract from the Ministry of Foreign Affairs of the Government of Japan, the consultant will issue a Notice to Proceed to the contractor and then construction supervision shall begin.

The consultant within his capacity as the Engineer should directly report to the Road Directorate of RS and the Embassy of Japan in BiH about the filed activities, and should issue field memoranda or letters to the contractor, if necessary, regarding the various matters including progress, quality, safety and payment for the Project. In addition, the consultant should report to the Embassy of Japan in Austria and the JICA Austrian Office when required.

The defects liability period expires on the date one year after the completion of the Project. At the end of the defects liability period, defects liability inspection will be conducted as the final work of the consulting services.

(2) Staffing

The required staff and their responsibilities in the detailed design, tender (pre-construction) and construction stages are described below:

1) Detailed Design

The design of the following facilities will be conducted by the consultant team headed by the Project Manager.

- Bridge
- Approach Road
- Ancillary Works such as slope protection around abutments, road lighting, etc.

The services in this stage include the preparation of the tender documents described in 2-2-4-4(1).

2) Pre-construction Stage

- Project Manager

  Responsible for all the aspects of consulting services during the pre-construction stages.

- Tender Specialist

  Responsible for the review of the tender document, bid announcement, tender and tender evaluation.

- Tender Assistance

  Responsible for the review of the tender documents and drawings for assistance with the Tender Specialist.

3) Construction Stage

- Project Manager

  Responsible for all the aspects of consulting services during the construction stages.

- Resident Engineer

  Responsible for all the aspects of construction supervision at the sites.

- Bridge Engineer

  Responsible for bridge building works.

- Civil Engineer

  Responsible for quality assurance and for assistance with the Resident Engineer.

(3) Construction Plan

1) Temporary Works

Construction yards should be in a place where sufficient free-board is maintained, at least above the 5 year probability floods. Plant and material yards, offices, storages and other facilities would be located in the construction yards. The approximate area of each construction yard will be about 5,000m^2, which will be covered by the funds of the RS side. If the contractor requests more than the area of 5,000m^2, the excessive amount shall be covered by the contractor's expense. Conceptual layout plans of the respective construction yards are shown in Figure 2-6 and Figure 2-7.

2) Electricity and Potable Water for Temporary Use

Electricity and potable water in the construction yards and bridge sites will be obtained from suitable tapping points of the present public utilities.

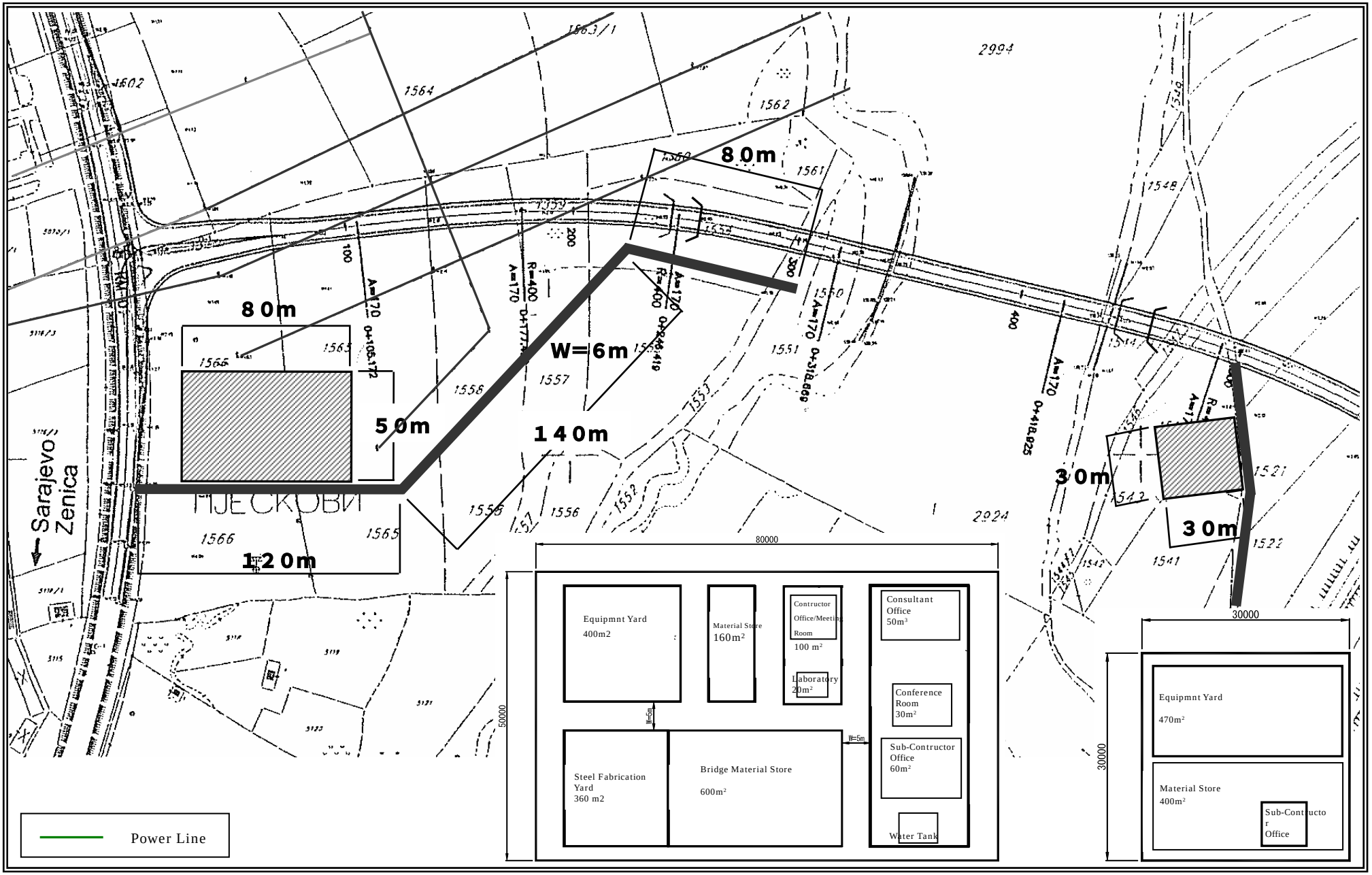


Figure 2-6 Doboj BridgeConstruction Yards

Figure 2-7 Modrica Bridge Construction Yards

3) Construction Works

a) Construction Order

As the specific bridge sites are on bypass routes, no adverse impact on the public traffic is anticipated other than during delivery of precast segment members from PC factory to the sites and ready mixed concrete from concrete mixing plant to the sites.

Construction order is shown in Figure 2-8.

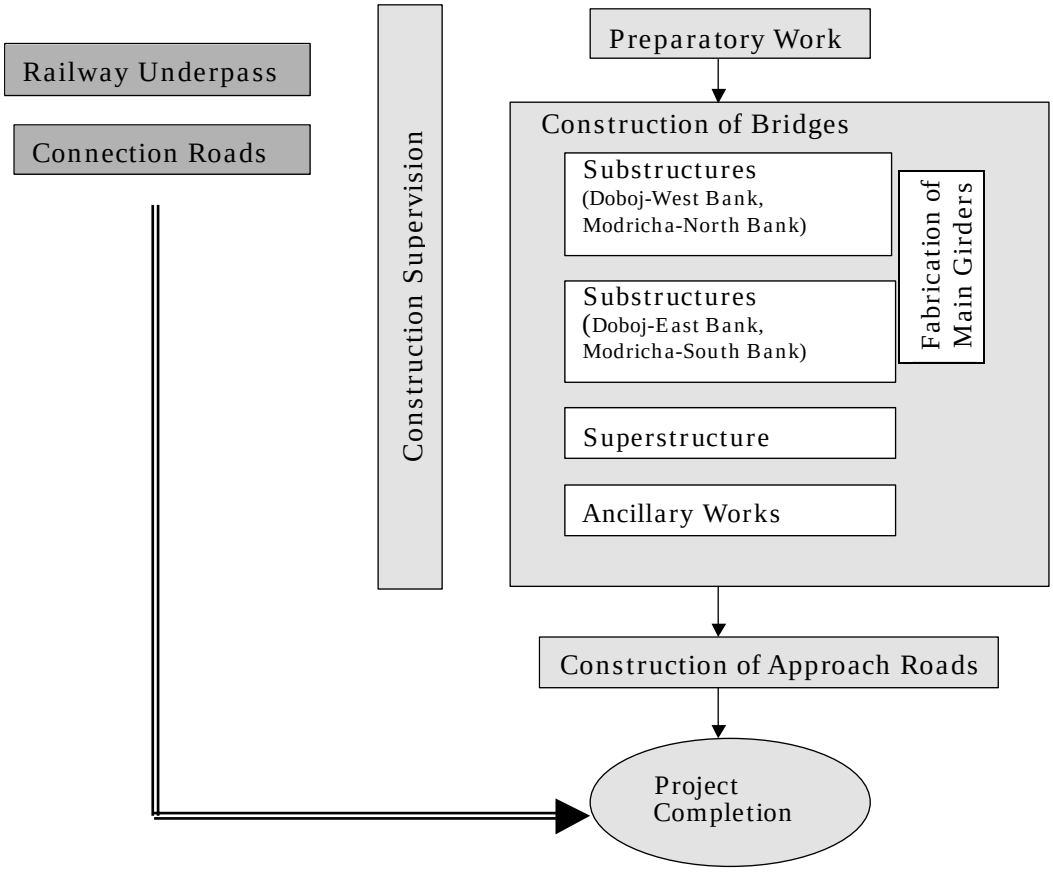


Figure 2-8 Construction Order

b) Supervision

Involvement of BiH firms in the Project would have to be considered as much as possible. In this regard the Japanese construction firm should be responsible for supervising the quality control and progress control of the works by them.

2-2-4-5 Quality Control Plan

The designing of the Project was done according to the Standards in RS. However there is no specific Quality Control Manual in BiH. For this reason, the quality control plan was formulated

on the basis of the design concept as shown in Table 2-11.

Table 2-11 Quality Control Tests Plan

Item			Test Method	Frequency
Crushed Rock Base	Mixed Material		Liquid Limit, Liner Shrinkage	Every mixing
			Sieve Gradation	
			TFVsoaked & TFV dry	
			Aggregate Density	
			Maximum Dry Density	
	Paving		Field Density (Compaction)	Daily
Prim Coat & Tack Coat	Material	Bitumen	Quality Certificate	
			Storage and Spraying Temperature	Every Truck
Asphaltic Concrete	Material	Bitumen	Quality Certificate & Chemical Analysis	Every material
		Aggregate	Sieve Gradation	Every mixing
			Water Absorption	Every material
			TFVsoaked & TFV dry	
	Mix Requirements		Marshall Stability	Every mixing
			Marshall Flows	
			Air Voids	
			Voids in Mineral Aggregate : VMA	
			Indirect Tensile Strength	
			Immersion (Strength) Index	
			Bitumen Content	
	Paving		Max. Temperature of Asphalt at Mixing	If any
			Temperature for Compaction	Every truck
			Coring and Laboratory Tests	Daily
Concrete	Material	Cement	Quality Guarantee, Chemical & Physical Analysis	Every material
		Water	Chemical Analysis	Every material
		Admixture	Quality Guarantee, Chemical Analysis	Every material
		Fine Aggregate	Bulk Specific Gravity Dry	Every material
			Sieve Gradation, Finesse Modulus	
			Clay and Friable Particles	
		Coarse Aggregates	Bulk Specific Gravity Dry	Every material
			Flakiness Index	
			Sieve Gradation	
			Sodium Sulfate Soundness	
	Mixing Test		Compressive Strength at 7 days & 28 days	Every mixing
	Casting		Slump (Concrete)	Daily
			Concrete Temperature before Casting	Daily
	Strength		Compressive Strength at 7 days & 28 days	Daily or >50m^3
Re-bar	Material		Quality Certificate	Each lot
Bearing	Material		Quality Certificate, Mechanical Tests	Each lot
Lighting Pole	Material		Quality Certificate, Mechanical Tests	Each lot

2-2-4-6 Procurement Plan

(1) Procurement of Construction Materials

Most of the construction materials to be used for the project are available in BiH, with the exception of special items such as structural steel, bearings, expansion joints, high tensile strength bolts, painting materials and so on which are mainly imported from EU countries.

Ready mixed concrete and asphalt mixtures can be procured in the outskirts of Doboj City for the construction of not only the Doboj Bridge but also the Modrica Bridge, about 45km away from the former bridge.

As for procurement of precast PC segments, they would be fabricated at a PC factory approximately 17km from Doboj City.

An indicative procurement schedule of major materials is shown in Table 2-12.

Table 2-12 Indicative Procurement Schedules of Materials

Item	BiH	Japan	Third Countries	Remarks
Paint for Concrete			O	
Pint for Lane Marking	O			
Railing	O			Zenica
Lighting Pole	O			Zenica
Lighting Bulb, others			O	
Bearing			O	
Drain Pile, etc.	O			Zenica
Scaffold	O			
Form	O			
Aggregate	O			Bosna R., Sava R.
Cement	O		O	
Gravel, Stone	O			
Admixture	O		O	
Cement Con. Mix.	O			Doboj
Pre-fabricated PC Beam	O			
Asphalt Con. Mix.	O			
Rebar	O			Zenica
Form	O			
Lubricant	O			
Fuel, Gasoline, others	O			

(2) Procurement of Construction Equipment

There are many construction firms in BiH, which own various construction equipments. It would be possible to subcontract with them and to rent their equipments. The list of major construction equipment available in BiH and their capacities are listed in Table 2-13.

Table 2-13 Indicative Procurement Schedule of Construction Equipment

Item	Capacity Spec.	BiH	Japan	Third Countries
Bulldozer	15t	O		
Power Shovel	1.4 m^3	O		
Dump Truck	8.0t	O		
Backhoe	0.6 m^3	O		
Crawler Crane	40 t	O		
Vibration Roller	3.0t~4.0t	O		
Load Roller	10.0t	O		
Motor Grader	3.1m	O		
Piling Machine	1.0~1.5m dia.	O		
Asphalt Spray	2,000 ltr	O		
Concrete Mixer	3.0m^3	O		
Lane Maker	2.0lit/min	O		
Asphalt Finisher	2.5~5.0m	O		

2-2-4-7 Implementation Schedule

The tentative implementation schedule for the project is prepared as per Figure 2-9 taking into account the procedure of the Japanese Grant Aid Scheme.

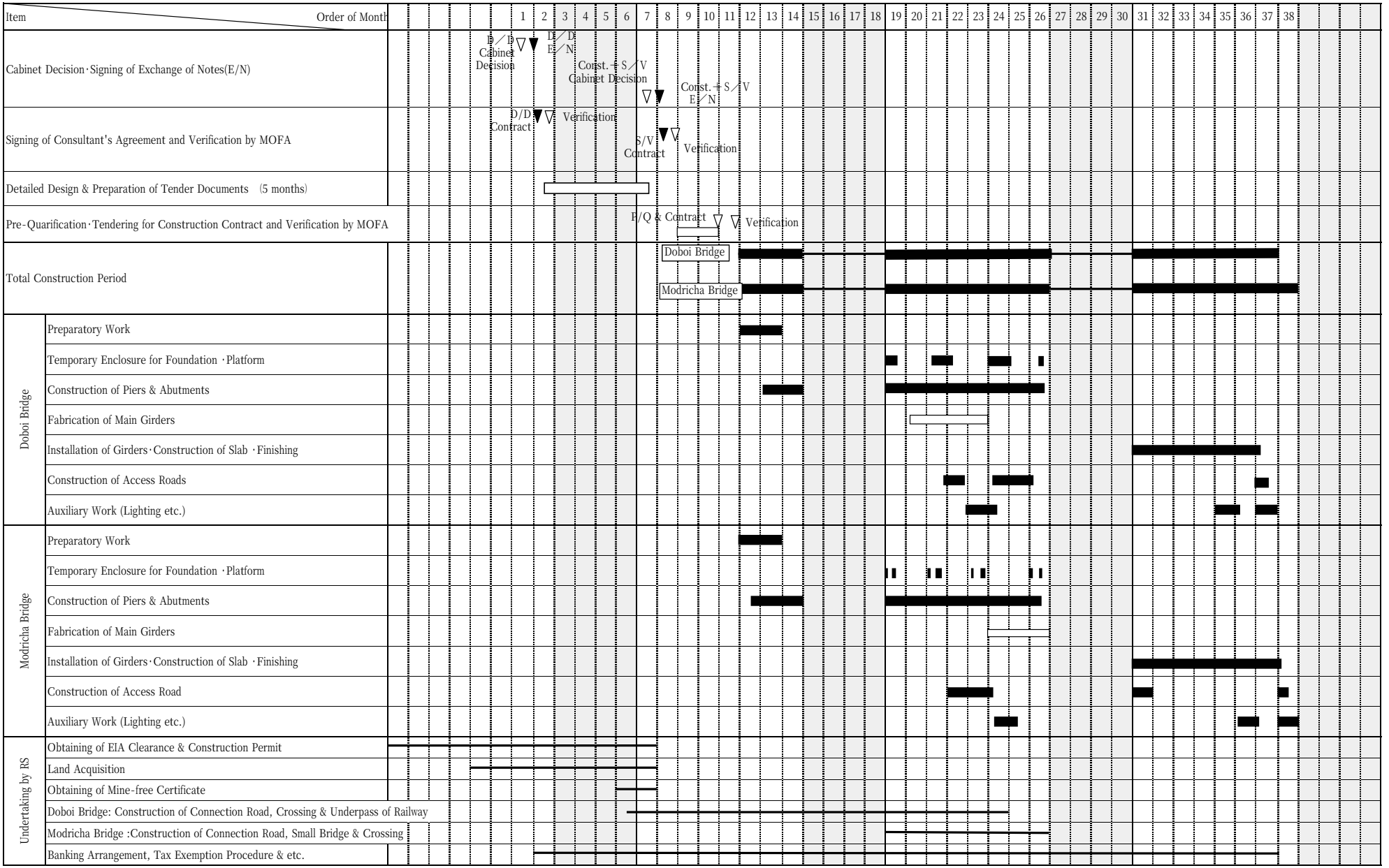


Figure 2-9 Implementation Schedule (Draft)

2-3 Obligations of Recipient Country

The following necessary measures should be undertaken by the BiH Government and the RS Government on condition that Grant Aid by the Government of Japan is extended to the Project.

2-3-1 Common Items of Japan's Grant Aid Scheme

Common items of undertakings by Bosnia and Herzegovina were already discussed as per Annex-4 of the Minutes of Discussions dated Sarajevo, November 18, 2002. Hence, general items in the same Annex-4 are reproduced in the following for reference purposes:

- To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction,
- To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,
- To secure buildings prior to the procurement in case the installation of the equipment,
- To ensure all the expense and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,
- To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts,
- To accord Japanese nationals, whose services may be required in connection with supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

2-3-2 Special Items of the Project

- The BiH side shall construct the connection roads by their own budget, and start the construction works of the connection roads of the bridges before March, 2004, and complete them before the completion of each bridge.

[Doboj Bridge]

- Improvement of the existing intersection on M4-3 on the east bank
- Connection road from the intersection on M4-3 to the end of approach road on the east bank
- Railway underpass on the connection road

- Connection road from the end of the approach road on the west bank to the new intersection on E73
- New intersection on E73 on the west bank

[Modrica Bridge]

- Improvement of the existing intersection on E73 on the north bank
- Connection road from the intersection on E73 to the end of approach road on the north bank
- Minor bridge over an irrigation channel on the connection road
- Connection road from the end of the approach road on the south bank to the new intersection on E73
- New intersection on E73 on the south bank

- The BiH side shall obtain the approval of the construction of two bridges in the RS, including Environment Impact Assessment (EIA) and secure the land for the Project by the end of May, 2004.
- The BiH side shall secure the areas for excavation disposal before the beginning of the construction works.
- The BiH side shall inform the results of the detailed design of the connection roads including public utilities installed on the bridges before the beginning of the detailed design of the bridges.
- The BiH side shall construct the electric power distribution facilities from transmission line to low voltage distributor including transformer for road lightening facilities four months before the completion of the bridges.
- The BiH side shall secure the necessary budget and personnel for the implementation of the Project and for maintenance of the facilities.
- The mine and UXO inspection and their clearance necessary for the construction of two bridges (including temporary usage for construction yards, etc.) in the RS has been completed. Hence, the land for the proposed bridges and approach roads are qualified as mine and UXO free by the BiH Mine Action Center (BiHMAC). During the detailed design stage and the construction stage, the BiH side shall obtain the certificates from the BiHMAC to confirm that the proposed sites are free from mines and UXOs, if necessary.

2-4 Project Operation Plan

The operation and maintenance works for the bridges after completion of the Project will be carried out by the RS side in accordance with the work schedule shown in Table 2-14.

Table 2-14 Operation and Maintenance Schedule

Item	Content of works
Drainage	Removal of deposit in cross drainage and side ditch.
Traffic safety	Repainting of lane mark.
	Repainting of traffic sign board.
Pavement	Overlay of asphalt concrete.
Expansion Joint	Check and Repair
Railing and Guardrails	Repainting of railings of 2 bridges, and guardrails of approach and connection roads.
Road Lighting	Maintenance of lighting bulbs, distribution panels.

2-5 Cost Estimation

2-5-1 Project Cost

2-5-1-1 Cost Estimate

The total cost of the Project by the Japanese Grant Aid is summarized in Table 2-15. This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

Approximate Project Costs Japanese Yen 1,029 million

Table 2-15 Approximate Project Costs

Doboj and Modrica Bridges (Total bridge length = 440m)

Items			Approximate Amount (Million Japanese Yen)	
Facilities	Doboj Bridge (Length; 200m)	Bridge	386	912
		Slope protection	18	
		Approach road	42	
	Modrica Bridge (Length; 240m)	Bridge	410	
		Slope protection	16	
		Approach road	40	
Detailed design and Construction supervision			117	

2-5-1-2 Condition of Cost Estimate

- Exchange rate: 1.0EUR＝ J. Yen 129.59
  (6 month average before May 21, 2003)
  1.0EUR＝1.9558 KM
- Construction period: 27 months
- Others: - On condition that the Project is implemented under the Japan's Grant Aid Scheme
  - The above-mentioned Exchange rate is to be reviewed by the Japanese Government.

2-5-2 Construction Costs to be borne by the BiH Side

Approximate costs required for the undertakings by the BiH side are shown in Table 2-16:

Table 2-16 Approximate Costs to be borne by the BiH Side

Work Items		Cost (KM)	Remarks
(1)	Doboj Bypass Construction Cost	(1,570,000)	
	a. Connection Road Construction	720,000	L=807m, 2 Intersections
	b. Railway Underpass Construction	300,000	L=43m
	c. Land Acquisition	550,000	
(2)	Modrica Bridge Construction Cost	(2,290,000)	
	a. Connection Road Construction	1,560,000	L=1,510m, 2 Intersections
	b. Minor Bridge Construction over Canal	80,000	
	c. Land Acquisition	650,000	
(3)	Detailed Design of Bypass	133,000	5% of Construction cost
(4)	Administration Cost + Supervision	133,000	5% of Construction cost
	TOTAL	**4,126,000**	
A.	Cost for Connection Roads	2,280,000	984 KM/m
B.	Cost for Structures (Railway Underpass, Minor Bridge)	380,000	
C.	Cost of Land Acquisition	1,200,000	
D.	Cost for Design, Administration, etc,	266,000	

Note: Figures of the above are indicative and subject to change. Source: Study Team

2-5-3 Maintenance Cost

Based on the maintenance work plan proposed in this section, the periodical maintenance schedule and costs are estimated as shown in Table 2-17.

Table 2-17 Approximate Estimated Maintenance Cost

Item	Works	Frequency	Approx. Costs (KM)
Drainage	cleaning, etc.	2 times per year	2 x 600 = 1,200
Lane mark.	repaint	Every year	6,700
Sign board	cleaning, repair	2 times per year	2 x 400 = 800
Expansion Joints	Check, repair	Every year	200
Annual cost for maintenance			**8,900**
Pavement	overlay	Every 6 years	120,000 (20,000)
Handrail, Guardrail	repaint	Every 7 years	40,000 (5,700)
Road Lighting	check, spare parts	Every 2 years	4,000 (2,000)
Average maintenance cost per year			**27,700**

The annual maintenance cost to be required by the Road Directorate of RS is estimated at about 36,600 KM. The annual budget of the Road Directorate of RS in 2002 is 70.0 million KM in total, and 29.5 million KM for maintenance of the roads and bridges. Hence, the above-estimated annual maintenance cost for the bridges constructed by the Project corresponds to 0.05 % of total budget and 0.12 % of the budget assigned for maintenance work.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

Chapter 3 PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effects

According to the results of the Study, the following effects can be expected from the Project:

3-1-1 Direct Effects

Present Situation and Issues	Countermeasures under the Project	Effect
The existing Doboj and Modrica Bridges were constructed more than 40 years ago, designed based on the old design standards. Therefore, they are not meeting the requirements related to the weight and size of the present vehicle types. In addition, these bridges were severely damaged by heavy vehicle passing and bombing during the war. Although these bridges are located on the main road in BiH, the risks of destruction and being not practicable still remain.	The new bridges will be designed according to the new structural design standards and will be constructed on the by-pass routes planned by the Road Directorate of RS.	The new bridges will be constructed in accordance with the up-to-date design standards. As such, the risk of damage will be minimized and their function as a link on the trunk road network will be enhanced.
The existing Doboj Bridge At Doboj city has a load limitation to 20tf for passing vehicles. Besides , the temporary bridge constructed by SFOR near the existing bridge as a makeshift measure also has similarly a limited load capacity due to the settlement of pier foundation. Hence, heavy vehicles are now obliged to make a detour to another bridge located 10km downstream.	The new bridges will be designed according to the new structural design standards.	Detour of heavy vehicles will be avoided. Thus, the traffic flow will be improved.
As the horizontal alignment of the roads to and from both the Doboj and Modrica Bridges is poor, passing vehicles are obliged to run at low speed of approximately 30 - 40km/h. Especially Modrica Bridge is located on Trans-European Highway, but it does not meet the required design speed of 80km/h for this highway. The temporary bridge constructed by SFOR in the Doboj city has only one-lane carriageway, therefore vehicle have to wait in long times for passing..	The new bridges will be constructed on the by-pass routes planned by the Road Directorate of RS to improve the road alignment at Doboj and Modrica.	The construction of the new Doboj and Modrica Bridges will solve the present problems in both structure and road alignment aspects. Consequently, the running speed of vehicles can be improved from 30 - 40 km/h at present to the design speed of 80 km/h. The vehicle's waiting time for passing due to the one-way traffic at the temporary bridge constructed by SFOR will be eliminated.

3-1-2 Indirect Effects

Expected Indirect Effects	Contents
1. Promoting better relationship and activation of movement of people and goods between two Entities	The Doboj Bridge is located in the territory of RS, but the roads M4-3 and E73 enter into the territory of FBH at about 5 km eastward and southward, respectively, from the bridge. Thus, owing to the bridge's location near to the boundary between the Entities, its restoration must be of great significance to the people of FBH too. The road E73, on which the Modrica Bridge is to be constructed, is a principal route for transport of goods imported from Croatia to Sarajevo, the most densely populated area of FBH. Taking this situation into account, it can be expected that the construction of the two new bridges will promote better relationship and activation of movement of people and goods between the two Entities as well as stimulate economy of both Entities.
2. Ensuring traffic safety and decreasing transportation cost	The restriction of vehicles' weight at the Doboj Bridge, the risk of destruction of the Modrica Bridge and the poor alignment of the road sections near the bridge are the major problems affecting the traffic safety. Completion of the bypasses and the new bridges will ensure traffic safety, better practicability, decrease of transportation cost and better performance of emergency cars such as ambulance and fire engine.
3. Representing a symbol of friendly relationship and peace in BiH	It would be possible to expect that the restoration of the two bridges to replace the damaged ones, erasing the remaining mark of the internal war, will have a favorable psychological effect on the people in both Entities, leading to enhanced friendship and peace among them.

3-1-3 Direct Beneficiaries of the Project

The numbers of inhabitants living in the vicinity of the Project sites, who will benefit directly from the Project, are estimated as follows:

Table 3-1 Beneficiaries of the Project

Region	Beneficiaries of Doboj Bridge	Beneficiaries of Modrica Bridge
RS: Doboj Area	82,000	41,000 (half of the region)
RS: Modrica Area	---	83,000
FBH: Srebrenik Area	113,000 (half of the region)	113,000 (half of the region)
FBH: Teslic Area	76,000 (half of the region)	---
FBH: Tuzla Area	161,000	---
FBH: Orasje Area	---	25,000 (half of the region)
Total	432,000	262,000

Source: Population is quoted from BiHTMAP(JICA)

3-2 Recommendations

The Project, which consists of the construction of bypasses and bridges and aims not only at restoring the function of the existing damaged bridges but also at resolving the present traffic problems, can be easily and clearly justified. In addition, the Project would contribute to enhancing friendship between the people of BiH and Japan owing to the fact that it will be implemented jointly under the BiH's Development Program and the Japanese Grant Aid Scheme.

In order to achieve a successful completion of the Project, it is recommended that those people who are concerned with the Project works on both BiH side and the Japanese side, cooperate closely with each other throughout the Project implementation, from the design stage to the construction stage.

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