NO

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

(OSANICA AND BOGATICI BRIDGES)

JULY 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

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

GR3
JR
03-172

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

(OSANICA AND BOGATICI BRIDGES)

JULY 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

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

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 OSANICA BRIDGE

PERSPECTIVE VIEW OF THE PROPOSED BOGATICI BRIDGE

LIST OF FIGURES AND TABLES

Figure 2-1 Relationships between the rainfall intensity and the rainfall duration of 100 year return period 2-5
Figure 2-2 Relationships between river width and H.W.L at Bogatici Bridge 2-6
Figure 2-3 Maximum depth of local scouring 2-7
Figure 2-4 Cross Section of Osanica Bridge 2-12
Figure 2-5 Cross Section of Bogatici Bridge 2-13
Figure 2-6 Osanica Bridge Construction Yard 2-32
Figure 2-7 Bogatici Bridge Construction Yard 2-33
Figure 2-8 Scaffolding and False-work for Osanica Bridge 2-34
Figure 2-9 Construction Order 2-34
Figure 2-10 Tentative Implementation Schedule 2-38

Table 2-1 FBH Bridges to be Constructed 2-1
Table 2-2 Meteorological Data at Gorazde City (Observed from 1981 to 1990) 2-3
Table 2-3 Meteorological Data at Trnovo city from 1961 to 1990 2-3
Table 2-4 Earthquake Scale for 100 year return period 2-4
Table 2-5 Calculated H.W.L and Flow Velocity 2-5
Table 2-6 H.W.L. At of the Bogatici Bridge estimated from Observatory data 2-6
Table 2-7 Geometric Design Standard 2-12
Table 2-8 Design Criteria of Bridges 2-13
Table 2-9 Comparison of Superstructure of Osanica Bridge 2-16
Table 2-10 Comparison of Superstructure of Bogatici Bridge 2-17
Table 2-11 Comparison of the Pile Diameter 2-19
Table 2-12 Quality Control Tests Plan 2-35
Table 2-13 Indicative Procurement Schedule of Materials 2-37
Table 2-14 Indicative Procurement Schedule of Construction Equipment 2-38
Table 2-15 Operation and Maintenance Schedule 2-40
Table 2-16 Approximate Project Costs 2-41
Table 2-17 Approximate Costs to be borne by the BiH Side 2-42
Table 2-18 Estimated Maintenance Costs 2-42
Table 3-1 Direct Beneficiaries of the Project 3-2

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 km2 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 that the Project for Osanica Bridge and Bogatici Bridge in FBH is implemented with the Japanese Grant Aid, the time necessary for its completion was estimated to be five months for the detailed design and 9 months for the construction. The estimated cost for the Project would be about 513 million Yen, consisting of a portion of 489 million Yen financed by the Japanese Grant Aid and a portion of 24 million Yen equivalent to be financed by the local budget.

The FBH Road Directorate, as the Project executing agency, will be responsible for the construction and management of the detour roads and temporary bridges. For smooth and successful completion of the Project as a whole, close and proper coordination between BiH and Japan is a prerequisite. It is recommended that young staff of the Road Directorates of BiH be provided with a counterpart training course in Japan on relevant administrative and technical aspects to ensure smooth operation and management of the Project under the Japanese Grand Aid and for improvement of bridge maintenance techniques.

The implementation of the Project, aiming not only at the restoration of the damaged two bridges but also at the reduction of traffic bottleneck on the principal roads of the country, is feasible and very important for BiH and FBH. The sites of the bridges are located on the Trans-European Motorway and the main roads linking the two Entities, hence the benefit of the Project extends to the territory of RS. The Project is expected to benefit an estimated 134 thousands people and 97 thousands people in both Entities in case of the Osanica Bridge and the Bogatici Bridge, respectively. As indirect effects, the Project is expected to activate exchange of people and goods and to encourage reconstruction of national economy and peace between the two Entities. Furthermore, the Project, which would be implemented with cooperation of 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

Preface

Letter of Transmittal

Location Map/Perspective

List of Figures and Tables

Abbreviations

Summary

Contents

Chapter 1 BACKGROUND OF THE PROJECT 1-1

Chapter 2 CONTENTS OF THE PROJECT 2-1

2-1 The Basic Concept of the Project 2-1

2-2 Basic Design of the Requested Japanese Assistance 2-2

2-2-1 Design Policy 2-2

2-2-1-1 Design Concept 2-2

2-2-1-2 Natural Characteristics 2-3

2-2-1-3 Social Conditions 2-7

2-2-1-4 Construction Conditions 2-8

2-2-1-5 Applicability of Local Contractors 2-9

2-2-1-6 Capability of Executing Agency for Maintenance and Operation 2-10

2-2-1-7 Policy of Standard of Facilities 2-10

2-2-1-8 Design Policy for Construction Method and Construction Period 2-11

2-2-2 Basic Plan 2-11

2-2-2-1 Design Criteria 2-11

2-2-2-2 Facility Design 2-14

2-2-3 Basic Design Drawings 2-20

2-2-4 Implementation Plan 2-26

2-2-4-1 Implementation Policy 2-26

2-2-4-2 Implementation Conditions 2-26

2-2-4-3 Scope of Works 2-27

2-2-4-4 Consultant Supervision 2-29

2-2-4-5 Quality Control Plan 2-35

2-2-4-6 Procurement Plan 2-36

2-2-4-7 Implementation Schedule 2-38

2-3 Obligation of Recipient Country 2-39
2-3-1 Common Items of Japan's Grant Aid Scheme 2-39
2-3-2 Special Items of the Project 2-39
2-4 Project Operation Plan 2-40
2-4-1 Operation and Maintenance Schedule 2-40
2-5 Cost Estimation 2-41
2-5-1 Project Cost 2-41
2-5-1-1 Cost Estimate 2-41
2-5-1-2 Condition of Cost Estimate 2-41
2-5-2 Reconstruction Costs to be borne by the BiH side 2-42
2-5-3 Maintenance Cost 2-42
Chapter 3 PROJECT EVALUATION AND RECOMMENDATIONS 3-1
3-1 Project Effects 3-1
3-1-1 Direct Effects 3-1
3-1-2 Indirect Effects 3-2
3-1-3 Direct Beneficiaries of the Project 3-2
3-2 Recommendations 3-2

[Appendices]

1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Other Relevant Data
   - 5-1 Topographical Survey
   - 5-2 Geotechnical Investigation
   - 5-3 Traffic Volume Survey
   - 5-4 Structural Soundness of Existing Bridges

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. A 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 The Basic Concept of the Project

The facilities to be incorporated in the scope of the Project under the Japan's Grant Aid for building the Osanica Bridge and Bogatici Bridge in FBH are as shown in Table 2-1.

Table 2-1 FBH Bridges to be Constructed

		Osanica Bridge	Bogatici Bridge
General	Road Name	M20	E762 (M18)
	Present Traffic Volume	1,575 vehicles/day	1,971 vehicles/day
	Altitude of Bridge Site	Approx. 375 m	Approx. 780 m
	River Name	Osanica River	Zeljeznica River
	Design Discharge	280 m^3/sec	500 m^3/sec
Bridge and Related Facilities	Reconstruction or New Construction	Reconstruction (New girder and 1 new pier; and re-use of 3 piers and 2 abutments by improvement)	New Construction
	Bridge Length	130.0 m	62.1 m
	Span Arrangement	22.9m+3x28.0m+22.9m	4 x15.5m
	Whole Width	10.7 m	10.5 m
	Width Composition	0.3m+1.05m+2x(0.5m+3.5m)+1.05m +0.3m	0.3m+0.95m+2x(0.5m+3.5m)+0.95m+ 0.3m
	Type of Bridge Superstructure Piers Abutment Foundation	 Steel Plate I-Girder RC Inverted T RC Gravity Shallow RC Caisson	 PC T-Beam RC Inverted T RC Inverted T Cast-in-place RC Pile
	Approach Road Length	Foca side: 50 m Gorazde side: 50 m	Sarajevo side: 80 m Foca side: 80 m
	Slope Protection	None	To be constructed.
	Riverbed Protection	None	None
	Road Lighting	To be installed.	To be installed.

Source: Study Team

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Design Concept

The improvement plan for the facilities related to the Osanica Bridge and Bogatici Bridge in FBH is as follows:

A) As a result of the structural soundness tests for the existing Osanica Bridge, it was decided to re-use the existing 3 piers and 2 abutments after some reinforcing works. This bridge building work would mainly consist of erection of new steel girders along with Concrete deck works, construction of a new pier, reinforcement of 3 existing piers, and reinforcement of 2 existing abutments.

B) On the other hand, no existing structural element of the Bogatici Bridge was suitable for future re-use because of severe damage and dilapidation. In addition, the existing bridge could not meet the hydrographical requirements: Bridge length is insufficient for design discharge and there is inadequate vertical clearance between design flood level and girder soffit.

C) Design on the Osanica Bridge and Bogatici Bridge should be in accordance with the current standards and requirements of road geometry and bridge design.

D) Local scour around the piers of the Osanica Bridge would not likely occur since hard rock occupies the riverbed of the site. Risk of erosion of the abutment is not anticipated because the design water level would not rise to the abutment levels. Accordingly, no provision of river revetment and riverbed protection is considered.

E) As the Zeljeznica River meanders on the upstream side of the Bogatici Bridge site, the river course is likely to be unstable where sand and gravel cover the riverbed. Local scour would take place around piers in flooding time. In this regard, pile caps should be embedded below the local scour level.

F) An intersection and school exist in the vicinity of the Osanica Bridge. There are a restaurant and a coffee shop near the Bogatici Bridge. Road lighting facilities would have to be considered from the view point of traffic safety of these bridge sites.

G) As all facilities of both bridges are to be contained within the right-of-way of FBH Road Directorate, no land acquisition is considered.

2-2-1-2 Natural Characteristics

(1) Meteorological Condition

Weather data from 1981 to 1990 in Gorazde City, the nearest observation point to the Osanica Bridge, are shown in Table 2-2.

Considering the site temperature and snowfall, suitable construction period for the Osanica Bridge seems to be 8 months from April to November.

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

Month	1	2	3	4	5	6	7	8	9	10	11	12	Ave.	Mac.	Total
Average temperature(°C)	-1.4	1.1	5.9	10.2	14.8	17.1	19.5	19.1	15.8	10.8	3.9	0.5	9.8		
Max. temperature(°C)	16.4	19.8	19.8	28.0	32.4	35.8	38.0	37.8	34.8	27.6	26.0	20.6		38.0	
Min. temperature(°C)	-23.0	-20.0	-14.0	-4.0	1.0	2.0	5.0	4.0	1.0	-4.0	-13.0	-15.0		-23.0	
Days below 0 °C	25	22	14	3						1	14	21			100
Month precipitation(mm)	47	51	55	55	55	78	45	78	59	56	75	55			
Days more than 10mm of precipitation	2	2	2	2	2	3	2	2	2	2	2	2			25
Days of snowfall	7	6	3	1							3	6			25
Maximum snowfall(cm)	28	45	21	2						4	29	33		45	

Source: Meteorological Survey Department, Sarajevo University

Meteorological data from 1961 to 1990 in Trnovo City, about 4km south of Bogatici Bridge, are shown in Table 2-3.

A suitable period for construction of the new Bogatici Bridge appears to be 7 months from April to October, considering site temperature and snowfall. As the Bogatici Bridge is at a higher altitude than Gorazde City near the Osanica Bridge, the site of the former has a lower temperature and high precipitation and much snowfall.

Table 2-3 Meteorological Data at Trnovo city from 1961 to 1990

Month	1	2	3	4	5	6	7	8	9	10	11	12	Ave.	Mac.	Total
Average temperature(°C)	-2.3	-0.4	3.0	7.1	11.7	14.4	16.0	15.7	12.5	8.0	3.6	-1.0	7.4		
Max. temperature(°C)	17.0	17.3	22.5	26.2	31.0	32.0	34.8	33.0	31.1	29.0	21.8	18.5		34.8	
Min. temperature(°C)	-29.0	-27.0	-23.2	-12.5	-12.1	0.0	0.0	0.0	-5.2	-9.4	-22.4	-25.0		-29.0	
Month precipitation(mm)	97	91	105	100	95	100	81	83	93	113	150	141			1250
Days more than 10mm of precipitation	4	3	4	4	3	4	3	3	3	4	5	5			
Days of snowfall	29	22	17	4	1					4	12	17			106
Maximum snowfall(cm)	107	72	59	31	2					27	51	64		107	

Source: Meteorological Survey Department, Sarajevo University

(2) Earthquake Condition

Since the Dinaru Alps are formed of crust movement from the southwest, earthquakes are likely to occur in BiH. Analysis of past earthquake records indicates that medium scale earthquakes take place in the southwest of the country, resulting in smaller earthquakes towards the northeast.

Probable earthquakes (ground acceleration, displacement and MCS scale) for the return period of 100 years are in Table 2-4, according to the seismographic study by the Earthquake Research Institute of Sarajevo University.

Table 2-4 Earthquake Scale for 100 year return period

Bridge	Observation Point	Acceleration (g)	Velocity (cm/s)	Displacement (cm)	MCS scale
Osanica	Gorazde	0.080	5.00	1.70	VII
Bogatici	Trnovo	0.200	18.00	6.10	VIII

Source: Meteorological Survey Department, Sarajevo University

(3) Hydrological and Hydrographic Conditions

1) Rainfall

The Osanica Bridge crosses over the confluence of the Osanica River and Drina River. The Osanica river basin spreads on the western side of the Drina River. There are two observation points, Sarajevo and Visegrad, for which data has been collected for long periods and significant for probability analyses. The rainfall intensity and duration for a 100 year return period from these two observation point are summarized in Figure 2-1.

For the Bogatici Bridge, the rainfall intensity and duration for a 100 year return period are obtained from the data of two observation points, Ledici and Delljas, as summarized in Figure 2-1.

The rainfall intensity of 40 mm/hr corresponds to the rainfall duration of 140 minutes at the Osanica Bridge site. On the other hand, the rainfall intensity of 50 mm/hr corresponds to rainfall duration of 180 minutes at the Bogatici Bridge site.

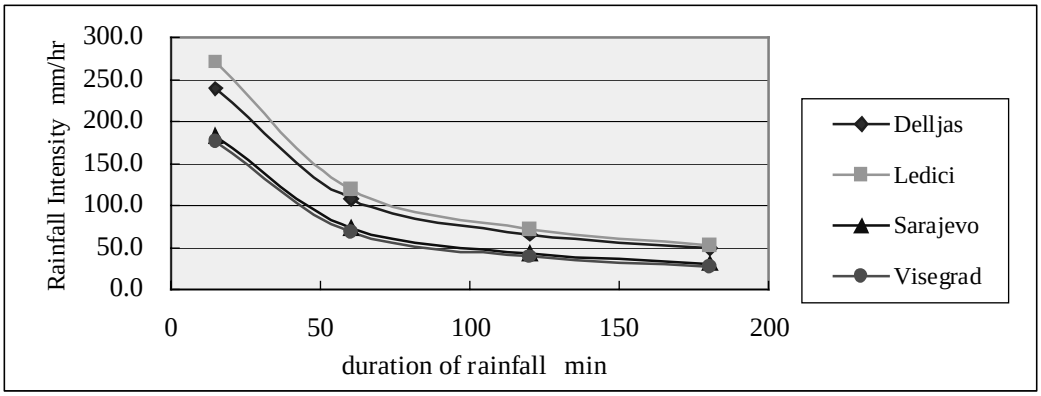


Figure 2-1 Relationships between the rainfall intensity and the rainfall duration of 100 year return period

2) High water level and design velocity

High water level (H.W.L) and flow velocity for the design flood discharge by the respective bridge sites were calculated based on Manning's formula.

Since the river section at the Bogatici Bridge site is partially narrow, high water level was calculated by using the average river section and hydraulic mean depth of the downstream side so as to eliminate the influences of the existing bridge.

The calculation results are shown in Table 2-5.

Table 2-5 Calculated H.W.L and Flow Velocity

River	H.W.L. (m)	Section (m^2)	Hydraulic mean depth (m)	Grade	Coefficient of Roughness	Velocity (m/s)	Flood Peak Level (m^3/s)
Osanica	361.8	111.5	0.81	1/48	0.05	2.51	280
Zeljeznica	778.5	145.1	2.38	1/167	0.04	3.45	500

Regarding the water level of the Drina River where the Osanica River flows in, the water level data during 1982 to 1992 is available at Vitkovici gage station, 11km downstream of the confluence. According to the data for the past 11 years from 1984 to 1992, maximum water level is 347.9m. The present road elevation on the opposite bank to the confluence is 362.25m, and this elevation was considered as H.W.L. as a result of the topographic survey. As H.W.L. of the Drina River is higher than the calculated H.W.L. of the Osanica River in Table 2-4, the design H.W.L of the Osanica Bridge is determined at 362.25m.

A water gage station exists at Ilovica Luke, about 430m downstream of Bogatici Bridge, where design water levels of the Zeljeznica River for various return periods are available.

Based on such water levels and an assumption of 1/167 riverbed grade, the water levels for the return periods of 20 and 100 years are obtained in Table 2-6. As a result, the design H.W.L of the Bogatici Bridge is set at 778.5m.

Table 2-6 H.W.L. At of the Bogatici Bridge estimated from Observatory data

Return Period	H.W.L at Ilovica Luke	H.W.L at Bogatici
1/20	775.69m	778.3m
1/100	775.97m	778.5m

3) Bridge length

When the width of a river at a bridge point is narrowed from its natural state, then flow is checked and the water level rises upstream.

Considering the influence of narrowed river width, of the bridge pier being slanting to river flow and of installed piers, relationships between H.W.L and river width at Bogatici Bridge were estimated by using the method of the U.S. Public Road Bureau.

The river section area at a point 50m down-stream of Bogatici Bridge was used for calculation. This section area is nearly equal to the average river section area around Bogatici Bridge except 60m length area before and behind from the bridge point.

The H.W.L of a 100 year return period on the upstream side of the bridge corresponding to river width from 40 m to 70 m are shown in Figure 2-2. In this calculation, 500m³/sec of flood peak level, and 1/167 of the riverbed grade was used. In the case where the river width is narrower than 60m with H.W.L. 778.5m, water level goes up rapidly. In accordance with the consideration mentioned above, a river width of more than 60m will be adopted at the Bogatici Bridge site.

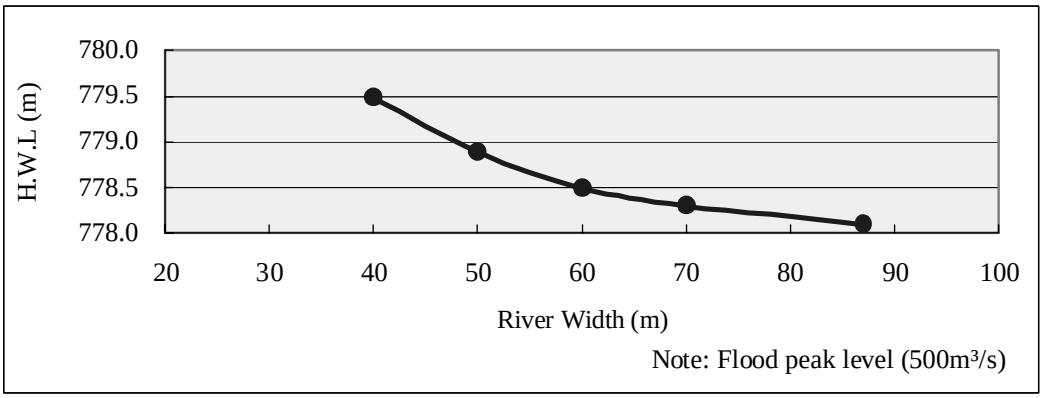
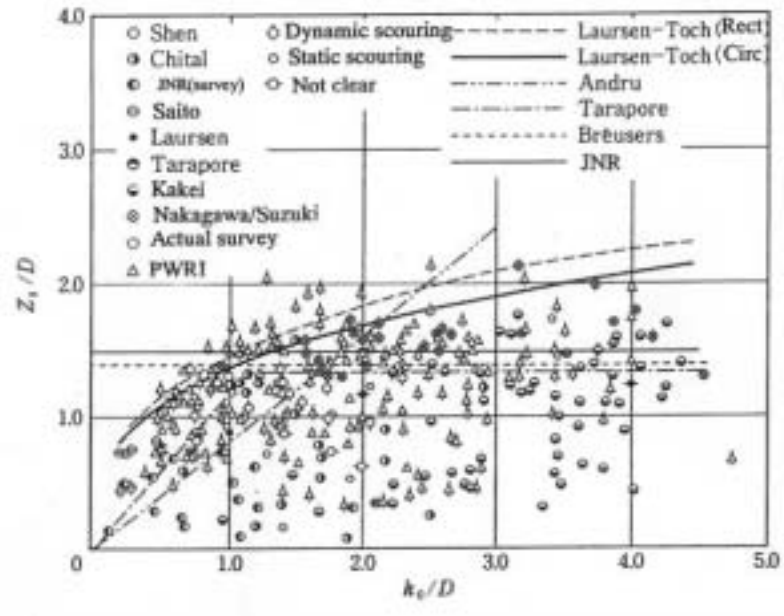


Figure 2-2 Relationships between river width and H.W.L at Bogatici Bridge

4) Local Scour Depth

It is possible that rapid water flow will cause local scouring around the bridge piers and abutments. Scour depth was calculated on the basis of the various diagrams used in the hydrological formula of the Japan Society of Civil Engineering (1999), as shown in Figure 2-3. The figure shows that h_0/D at the Osanica Bridge is 1.0 and at the Bogatici Bridge it is approximately 2.0 (where, Zs: Depth of local scouring, D: Pier column width at direction of flow, h_0: Average depth of water). From the graph, the range of Zs /D=1.5, as Laursen and the formula of the Japan National Railway indicate, so its depth should be equal to or more than 1.5 of "D" (pier column width against the current direction).



Source: Japan Society of Civil Engineering

Figure 2-3 Maximum depth of local scouring

5) Span length

At the existing old bridge downstream of Bogatici Bridge, the small span length of 7m results in debris and driftwood restricting the flow of water and causing permanent flooding. On the other hand, the lengths of existing spans on the Bogatici Bridge are 13m and 16.2m, and while some small debris is caught on the pier columns temporarily, they do not block the river. Accordingly the span length is adequate to retain.

2-2-1-3 Social Conditions

(1) Mines and unexploded bomb

The area around the Osanica Bridge site had been searched for remaining mines and any found had

been dismantled. Hence a certificate was issued for the area by the BiHMAC in 2000. Accordingly, the land will be used for the construction yard temporarily. However, to cover the case of mines being cast ashore by flood water from the Drina River in the year 2003, it will be necessary to ask the FBH to undertake mine detection at the construction area before use.

At Bogatici Bridge, there is information about one piece of UXO remaining under the ground of the old bridge piers. Accordingly, access roads have to be planned for the upstream side of the existing bridge for construction work.

(2) Site Possession

In FBH, expropriation and procurement of land is established by law, and there are two types of land use: rented ground for temporary use during a limited term and compulsory purchase for permanent use. Whenever a new bridge is planned at the same place as an existing one, it is not necessary to request land purchase and but rented ground is needed. Planned ground for a construction yard for both bridges has to be requested from FBH at the basic design stage with location maps.

Normally, the terms under which the land is taken depend on whether the land is under government or private ownership. When the owner is government it will take approximately 75 days, and 105 days for private ownership, after the request is made.

(3) Certificate for Design of Bridges and Re-use of an Existing Concrete Bridge

In BiH, if existing concrete bridge structures are to be re-used for reconstruction of a bridge, the certificate to verify the strength of concrete should be come from a public research laboratory, such as the Institute of Sarajevo University, Zenica University, etc.

In the detailed design stage of the bridges, the Road Directorate of FBH (FBHRD) should obtain a construction permit as the implementation agency by using the design calculations and drawings in Bosnian language.

2-2-1-4 Construction Conditions

(1) Employment Schedule

Regarding employment regulations, Standard Labour Law of FBH specifies that employment hours should be within 40 hours in a week, etc. This project should follow this regulation.

(2) Procurement for Construction Equipment and Materials

1) Concrete Plants and Asphalt Concrete Plants

There are some kinds of plant in the vicinity of the main cities in BiH. For construction of the new Osanica Bridge, ready mixed concrete plant and asphalt plant in the vicinity of Gorazde city are available to use, and for Bogatici Bridge plants that are in the nearest area from the northern part of the airport in Sarajevo city are available. Ready mixed concrete and asphalt concrete that secure a predetermined quality can be procured for this project.

In BiH, concerning quality control of ready mixed concrete, it is obligatory to send concrete samples from the plant or construction site to the laboratory of the institute at the University of Sarajevo or Zenica and to conduct compressive strength tests and obtain recognition from those universities. Raw material also should obtain recognition 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. Specifically, BH Steel in Zenica is the largest steel production company in BiH. However, other steel materials are imported from many foreign countries, such as Germany, Italy, Czechoslovakia and India

3) Stone Materials

In Bosnia, as a lot of salt is sprinkled on the road surface as a measure against snowfall coverage in winter, it is standard that natural stone with excellent durability is used as the curb stone on the boundary of the carriageway and footway on bridges. For that reason granite stone produced and processed at a factory in Jablanica city 80km south of Sarajevo is widely used in FBH.

4) Construction Equipment

There is no leasing company to provide heavy construction equipment, large-sized vehicles and plant which are suitable for this project in BiH. Major construction firms such as ZGP SARAJEVO, GIK HIDARGRADJIA, GP PUT hold some cranes, large-sized vehicles and construction equipment and are carrying out integrated construction. Two companies hold equipment for cast-in place piles suitable for bridge foundations, although their cranes are rated for 40t weight at the maximum. The construction plan should be drawn up in consideration of these present conditions.

2-2-1-5 Applicability of Local Contractors

There are many construction firms and consultants in BiH. Major construction firms have a lot of

actual performance experience in construction of bridges or restoration projects founded by EU, WB and USAID inside the country. Such firms holding construction equipment have technical capability and are adequate as subcontractors. Especially concerning bridge construction, ZGP SARAJEVO has enough experience. In spite of the fact that steel plates have to be imported from another country, a steel fabricating factory inside the country has sufficient skill for the project, and welding labourers, though there are few of them, have enough experience. In the vicinity of Sarajevo and Doboj, there are manufacturing plants for precast bridge girders of the pre-tension prestressed type.

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

Although ten prefectural governments (called canton), which constitute FBH, were in charge of maintenance and management of roads and bridges, the result of their activity is not apparent at either of the bridges. From the year 2002 organization revision has been carried out in FBHRD, and FBHRD has started to maintain 2,200km of trunk road. In 2003, repair works for that road and bridges are to be commissioned to Putivi or private firms by contracts. However, as of December 2002, the indications are that the personnel affairs staff in FBHRD have not yet made the necessary decisions. It is desirable that FBHRD recognize the necessity for periodical maintenance and allow the technology transfer to be performed through the implementation of this project for local engineer's experience and improvement of management ability.

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

(1) Bridges

The design concept for 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 the load carrying capacity of the new bridge shall be the same as the present bridge design criteria in FBH including design for seismic conditions.
- With the exception of the dismantling of the damaged bridge structures of the Osanica Bridge, BiH are to construct the connection road, temporary road, temporary bridges for both bridges, and undertake the management of them throughout the construction term.
- The plan is to evaluate the condition of the existing bridge elements and use reasonable and minimum cost methods for reconstruction.

(2) Damaged Condition of Existing Bridge

The existing Osanica Bridge was constructed in 1964 and is RC 5 span continuous T-shaped girder bridge (Bridge length=129.66m, Carriageway width=7.0m). In 1995 the first pier on the Foca side was destroyed by bombardment and 2 spans on that pier fell. The concrete deck slab of the 4th span

was also damaged by bombardment. Furthermore, without effective remedy work or maintenance for the damaged area, the bridge has totally deteriorated since the war.

The Bogatici Bridge, constructed in 1958, consisted of RC 3 span slab bridge with ridged frame slab and pier (Bridge length=43.25m, Carriageway width=6.0m) and was destroyed by 2 bombardments on the slab of both side spans and totally deteriorated through the absence of remedy work and maintenance after that. The shape of foundations under the ground could not be confirmed because of the loss of the original drawings. Additionally, the bottom of the foundation at both of the abutments could be seen due to local scouring and not enough embedment depth.

(3) Restoration Policy

At the Osanica Bridge the girder was completely destroyed but the remaining portion of the bridge, including both abutments and the 3 piers on the Gorazde city side are judged totally safe and useful from an engineering point of view and will be repaired and reinforced. As well, the existing girder was made from RC concrete and was a light weight structure based on the former concept of design for live load and less seismic load. So, the new bridge girder should be made of steel as a featherweight structure to avoid increasing the superstructure weight in order to retain stability of existing piers and abutments.

The Bogatici Bridge has been totally damaged. In addition to that, the bridge opening is not wide enough for discharge at the 100-year return period rate and the substantially single lane road with 6m width of carriageway should be replaced completely with a new bridge. The new bridge shall be located at the same place as the existing one as the existing alignment is suitable in view of its location as existing houses are close to the connecting road on the Sarajevo side of the bridge.

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

Considering the rainfall and snowfall season at the construction site, the construction is well suited for the 7 months from April to October. Hence the construction schedule will be planned with commencement of the main construction work from April and completion of it before the winter season.

2-2-2 Basic Plan

2-2-2-1 Design Criteria

(1) General Description of Bridges

The following FBH standards will be used in principle for the bridge project. The Geometric Design Standard, taking into consideration the design standard and design policy of FBHRD, is

shown in the following Table 2-7.

- Design criteria : Jugoslovenskih Pravilnika i Standarda za Gradevinske Konstrukcije, Knjiga 1 Dejstva na Konstrukcije (Beograd 1995)
- 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)

Table 2-7 Geometric Design Standard

Item	Standard	Remarks
Route name	Osanica Bridge : M20 Bogatici Bridge : E762 (M18)	
Road specification	Road Class-3 (RC-3)	
Design speed	80km/hr	On RC-3, hilly area
Gradient	The maximum inclination 5%	On RC-3, hilly area
Horizontal curve	Minimum radius 250m	On RC-3
Number of lanes	Two lanes	On RC-3
Traffic lane width	3.50m	On RC-3, Design speed
Shoulder width	0.50m	FBHRD criteria
Footpath	Both sides	Same as current state
Footpath width	Minimum effective width 1.00m	FBHRD criteria
Superelevation	A single-sided inclination (2.5% is the minimum Superelevation)	FBHRD criteria
Footpath grade	1.5%	FBHRD criteria

The cross section of each of the bridges is shown in Figure 2-4 and Figure 2-5.

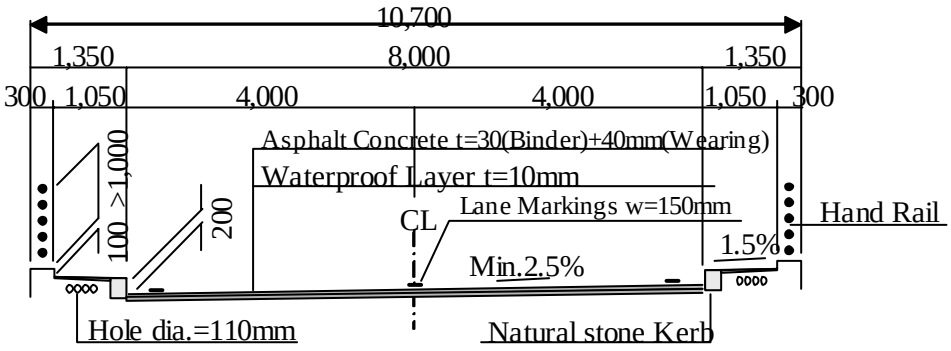


Figure 2-4 Cross Section of Osanica Bridge

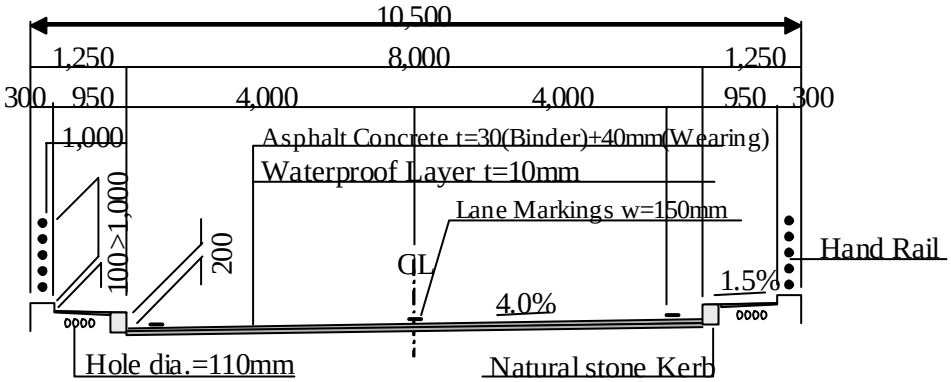


Figure 2-5 Cross Section of Bogatici Bridge

(2) Design Criteria

The design loads based on the hydrological condition and the design standard for bridges, according to the Yugoslavian standard used in FBH, are shown in Table 2-8.

Table 2-8 Design Criteria of Bridges

Item		Design Criteria	Remarks
Flood water Level		100-year probability flood water level	It computes from metrological and hydrological data.
Free board quantity		1.0m	FBHRD criteria
Design load	Live load	600kN + 300kN	
	Impact load	Kd=1.4-0.008L>1.00	
	Hydraulic pressure	$P=0.515xkxV^2$	
	Thermal effect	Temperature follows a Yugoslavian standard.	
	Snowfall load	Osanica Bridge：2.0kN/m² Bogatici Bridge：2.5kN/m² (Not used together with live load)	It is decided from the altitude of a bridge construction point.
	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	Osanica Bridge：k=0.08g Bogatici Bridge：k=0.20g	It is based on the Sarajevo university earthquake research institute data.

Item		Design Criteria	Remarks
	Unit weight of Materials	Steel:77kN/m3 (7,850kg/m³) Prestressed Concrete : 24.5kN/m³ (2,500kg/m³) Reinforce Concrete: 24.5kN/m³ (2,500kg/m³) Pain Concrete: 23.5kN/m³ (2,400kg/m³) Asphalt Concrete: 23.5kN/m³(2,400kg/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) MB30 (24N/mm² equivalent) MB50 (40N/mm² equivalent)	MB is a compression strength value measured 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.	As of now, no utility

2-2-2-2 Facility Design

(1) Facility Scale

The overall scheme of the facility to be planned is shown in Table 2-1.

(2) Bridge Length, Span and Clearance

Referring to hydrology and hydraulics analysis, the bridge length and span arrangement are determined as follows:

1) Osanica Bridge

The existing bridge length is 129.66m（span arrangement 22.4+3@28m+22.4m）. The existing substructure, except where there is serious damage, shall be re-used. Therefore, the bridge location, bridge length, span arrangement and geometric design will adopt the existing condition. Against the flood water level of Drina River at an altitude of 262.25m, the existing girder soffit is 374.7m. Hence, clearance under the new girder （more than 12m height） will be retained as it is adequate.

2) Bogatici Bridge

Length of the existing bridge is 43.25m (span arrangement = 13m+16.25m+13m). The new bridge should be 62m long, according to the required 60m width of the river and should avoid the location of existing bridge foundations under the riverbed. Consequently, the new bridge length of 62.1m is favorable. Vertical clearance of 1.0m above the 100-year probable flood water level of EL 778.5m was decided for the bridge design. New piers and abutments are planned at an angle of 70 degrees against the road center, as a skewed bridge.

(3) Comparison of Superstructure Type Options

1) Osanica Bridge

The superstructure of the existing bridge consists of 2 reinforced concrete girders with a 6m long interval between the girders and is light weight. Moreover, the new bridge should be designed with increased live load and adopt seismic load for design. Subsequently, the girder material is to be a steel structure in order to minimize the weight of superstructure. However, the more effective method of steel deck plate with steel girders to reduce weight was not applicable at the request of FBHRD due to its tendency to freeze the asphalt concrete pavement surface on it in the snowfall season.

For selection of the optimum bridge made of steel, I-shaped girder, Box girder, etc. were considered and the various aspects are shown in Table 2-9. Finally, based upon the evaluation of these alternatives, steel I-shaped plate girder construction with RC deck slab was determined to be the most suitable structure.

2) Bogatici Bridge

Based upon the proposal that a new bridge be erected with the same alignment as the existing one, a 4 span or 2 span arrangement would be required to avoid foundations which remain below the riverbed. It is necessary to minimize the height of structures against surrounding terrain and houses adjacent to the connection road so the roadway height is to be designed to the existing ground level, and precast girders economically procured from a source near the site. Precast girders are to be made to the BiH design standard in a factory located at Sarajevo.

Comparative-study result is shown in Table 2-10.

Table 2-9 Comparison of Alternative Superstructure Types for Osanica Bridge

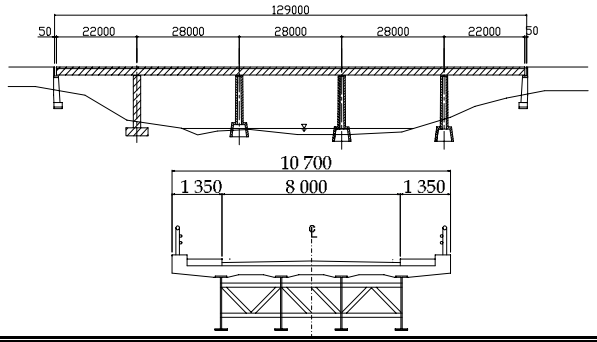
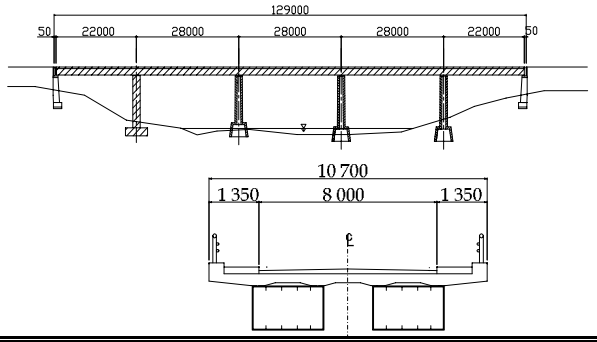
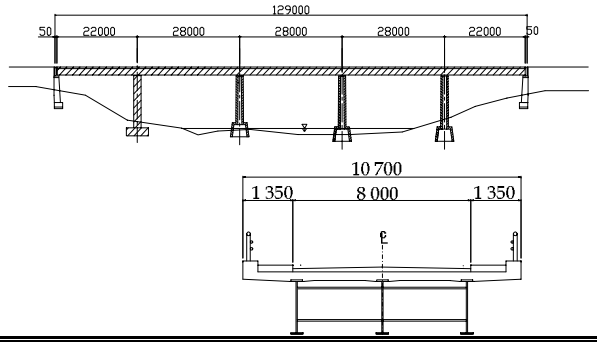
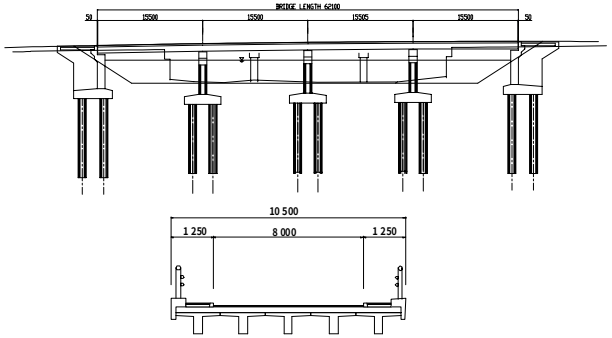
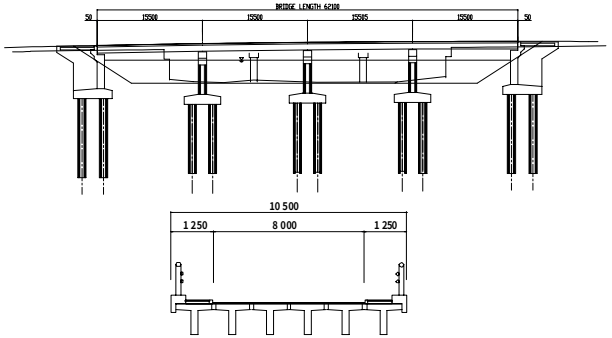
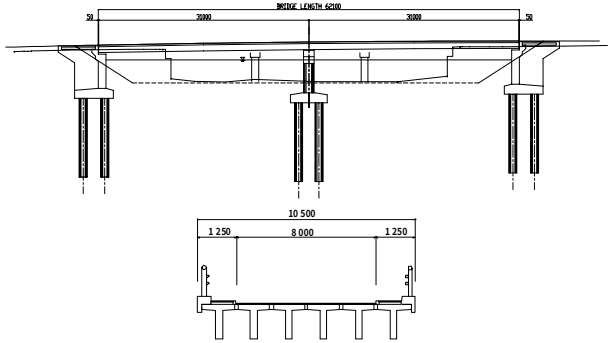
Item \ Type	Alternative 1 Steel Continuous Plate Girder I-beam (RC Deck Slab)		Alternative 2 Steel Continuous Plate Girder Box (RC Deck Slab)		Alternative 3 Steel Continuous Plate Girder I beam (PC Deck Slab)	
General View						
Structural Characteristics	· Continuous Girder with few expansion joints and bearings can minimize the size of the T-beam. · This bridge has almost the same dead load as the existing bridge (1.4t/m^2).	○	· This system has high rigidity and stability but is heavy.	◎	· In order to prevent cracks and to raise durability, precast PC Slab is adopted.	◎
Procurement	· Assembly can be done inside the country, although raw material of steel wood need to be imported.	◎	· Assembly can be done inside the country, although raw material of steel wood need to be imported.	◎	· Assembly can be done inside the country, although raw material of steel wood need to be imported. · PC Steel bar, mechanical fittings and engineers for pre-stressing also need to be imported.	○
Construction	· Girders would be erected by truck cranes with support for · As the RC Slab would be cast in place, curved bridge can easily be adopted.	◎	· Girders are erected by truck cranes with support for girder. · Connecting of Box Girder is difficult.	△	· Pre-cast Slab has good quality and construction period can be short. · In the case of a curved bridge, it is difficult to manufacture accurate members and to adjust the height between slabs.	△
Construction Cost	· This type of bridge with standardized span (25-65m) is the most general and economical plan as a steel bridge. Cost Ratio : 1.00	◎	· As this bridge is short in compared with its typical span length, construction cost is relatively high for Box type girder. Cost ratio : 1.12	△	· As overseas engineers for pre-stressing work are necessary, construction cost is higher than RC Slab. Cost ratio : 1.06	△
Technology Transfer	· This type of bridge has already been constructed in BiH.	○	· This type of bridge has already been constructed in BiH.	○	· Prestressing and precasting of slab work can be transferred.	◎
Maintenance	· Periodical painting (once every 10 years) and general maintenance are necessary.	○	· Periodical painting (once every 10 years) and general maintenance are necessary.	○	· PC Slab has high rigidity and durability so this type has longer life than the RC Slab.	◎
Aesthetics	· The hammer-head structure at top of pier looks unstable.	△	· Only P1 pier is a fixed support, that does not provide a sence of unity.	○	· The span length of the PC slab can be longer than the RC slab, piers can be almost same for the existing bridge.	○
Comprehensive Evaluation	Only steel bridge can lessen the weight of the superstructure, and among the options, Alternative-1 is the most resonable including ○		×		△	

Table 2-10 Comparison of Alternative Superstructure Types for Bogatici Bridge

Type / Item	Alternative 1 4-Span Connected Prestressed Concrete Precast Girder		Alternative 2 4-Span Connected Prestressed Concrete Post-Tension T-Girder		Alternative 3 2-Span Connected Prestressed Concrete Post-Tension T-Girder	
General View						
Structural Characteristics	・Connected bridge has good as ceismicity, mobility and is easy to maintain. ・This has 4 spans to avoid the existing bridge foundations. ・Standard Girder is adopted as a pre-cast girder. ・This has more as ceismicity due to many foundations.	◎	・Connected bridge has good as ceismicity, mobility and is easy to maintain. ・This has 4 spans to avoid the existing bridge foundations. ・PC post-tension girder (field assembly, MOC standard) is adopted. ・This has more as ceismicity due to many foundations.	◎	・Connected Bridge has more asceismicity, better mobility and is easy to maintain. ・PC post-tension girder (field assembly, MOC standard) is adopted. ・As reaction force of pier is large in comparison with Option 1and 2, this option has less asceismicity.	○
Vertical Alignment	・Vertical Alignments is raised 50cm, and girder height =8+16+90+10.5=125cm. ・There is no problem about the vertical alignment of the road.	◎	・Vertical Alignments is raised 80cm, and girder height =8+140+11=160cm. ・This creats a small problem about the vertical alignment of the road.	○	・Vertical Alignments is raised 1.2m, and girder height =8+190+12=210cm. ・This creats a serious problem about the vertical alignment of the road.	△
Construction	・As pre-cast girder is shop-assembly pre-tension type, it has best quality. ・Construction period is shortened owing to shop assembly. ・Pre-cast girder is transported via R18 from vicinity of Sarajevo. ・Girders are erected by truck crane.	◎	・It is difficult to secure a place for an assembly yard.	○	・It is difficult to secure a place for assembly yard. ・It is more difficult to use a temporary yard and to erect the bridge owing to the rise in the vertical alignment.	△
River Condition	・Flow capability is improved. ・Same span length as the existing bridge which has caused no problem in the past.	○	・Flow capability is improved. ・Same span length as the existing bridge which has caused no problem in the pas	○	・As this type has only one pier inside the river, it would not gather much floatage. ・Span length with consideration of skew is 26m, and it is beyond Japanese Specification.	◎
Construction Cost	・As standardized girder (hauling distance is short) can be adopted, this is the most economical plan. Cost Ratio: 1,00	◎	Cost Ratio: 1,07	△	Cost Ratio: 1,13	△
Technology Transfer	・No special technology needs to be transferred as standardized PC girder is adopted.	○	・The probability that the Japanese standardized PC girder would become the standard in Bosnia is low.	○	・The probability that the Japanese standardized PC girder would become the standard in Bosnia is low.	○
Maintenance	・No special maintenance is needed.	◎	・No special maintenance is needed.	◎	・No special maintenance is needed.	◎
Comprehensive Evaluation	This is the most suitable option owing to its economical advantage ○		△		△	

(4) Structure Type for Bridges

1) Osanica Bridge

a) Superstructure Type and Aseismicity

Considering the spacing of girders for the RC deck slab is in the range of 2.5m to 3.0m, 4 girders are required. Continuous girders with less expansion joints are specified for seismic advantage and to minimize the width of bridge-seat on the top of the piers. To prevent girders falling under earthquake conditions, a minimum requirement for bearing-support edge distance is specified.

b) Substructure and Foundation type

In the abutment design, existing spread foundations are expanded on the front side with additional reinforced concrete casting for stability and the upper half of the main wall with bridge seating should be re-concreted. At the re-cycled piers P2, P3 and P4, the hammer head of the pier top should be expanded for the steel girder support arrangement and for prevention of earthquake risk. Moreover, the bottom of the column, which was cracked by the impact of bombardments and the lack of earthquake stress design, should be lined with RC. The box shaped spread footing on the rock ground also should be expanded with prestressed concrete to provide stability during earthquakes. The replacement for the completely destroyed P1 pier is designed with similar shape to the previous pier, that is, an oval-shape column and hammer head, and will be set on the rock base.

2) Bogatici Bridge

a) Superstructure Type and Aseismicity

Pretensioned, Prestressed Concrete T-type girder construction, which meets the BiH standard, was selected and this will improve the resistance to seismic conditions with connection between the slab and girder on piers. Span arrangements were determined to set the new piers between the existing abutments and piers, because the old foundations will be remaining under the riverbed after demolition of the existing bridge.

b) Substructure and Foundation Type Selection

The new pier columns, which will be located in the water course, should be an oval shape to minimize blockage of the water flow and, as they impact on the course of the water flow, the face of the abutment wall and angle of pier columns are to be adjusted to the water flow.

The bearing strata, which contains intermediate layers of silty clay and sandstone exists about 10m below the riverbed surface. Accordingly, a spread foundation system is not

recommended due to the depth. A cast-in-place reinforced concrete (RC) pile was selected as the recommended foundation from the view point of economy and construction speed. Additionally, as a result of the comparison study for pile diameters of 1.0 and 1.2m, 1.2m diameter piles are recommended based on cost as shown in Table 2-11.

Table 2-11 Comparison of the Pile Diameter

Pile Diameter		1.0m dia.				1.2m dia.			
		Abutment		Pier		Abutment		Pier	
		Each	Total	Each	Total	Each	Total	Each	Total
Number of Pile	nos.	8	16	5	15	6	12	4	12
Pile Length	m	12.0	192.0	10.0	150.0	12.0	144.0	8.0	96.0
Number of Footing	nos.	2		3		2		3	
Size of Footing		10.5m x 4.5m		6.5m x 4.5m		10.5m x 5.4m		6.5m x 5.4m	
Cost Ratio		**1.003**				**1.000**			
Determination of the Pile Size		No. of pile and Concrete Stress of pile (Max. size of re-bar is 2-D32mm)				Minimum no. of pile, Length of pile			
Evaluation						Adopt			

The embedment depth of the footing of the abutment was lower than the riverbed with protection around the abutment. The local scour depth of 1.5D (here, "D" is width of column at water course) is considered in the stability analysis of past performance.

(5) Approach Road

The approach roads for the new bridges have to be connected to the existing road with changes to meet the minimum requirement of the geometric standard specified and the pavement composition of the approach roads shall be the same composition as exists. At Osanica Bridge, the existing raised footpath will be renewed for 50m length on both sides. At Bogatici Bridge, the vertical alignment of the roadway on the bridge will be raised up, hence 80m length of approach road at both sides should be reconstructed.

(6) Slope Protection around Abutments

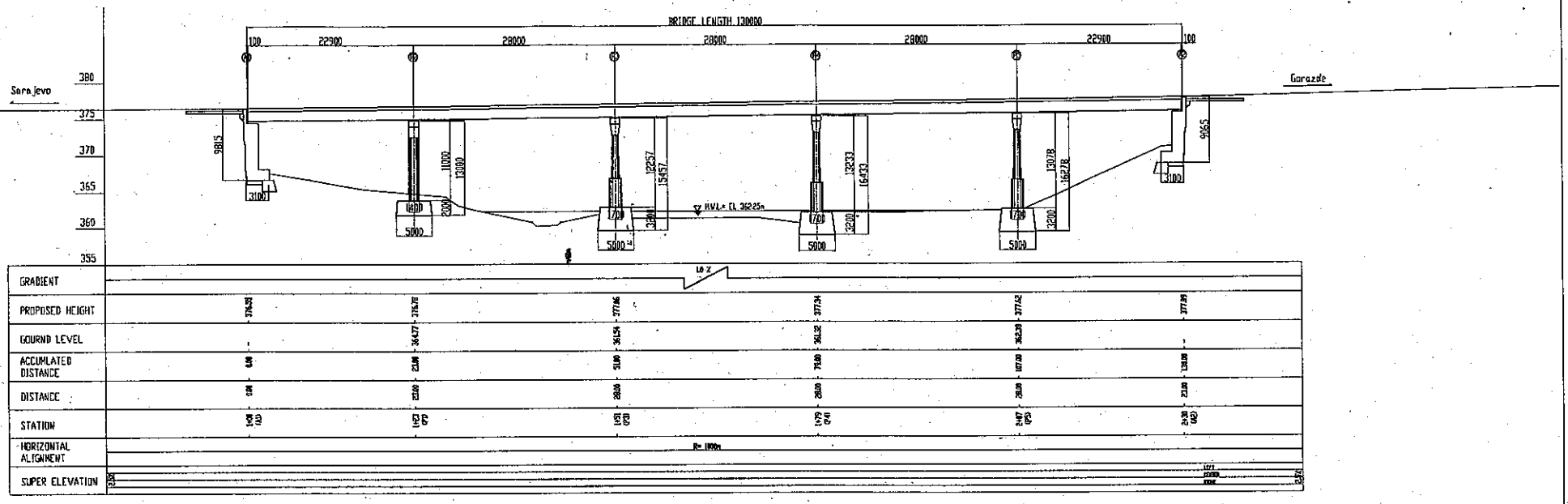
At Bogatici Bridge, abutments are located at the bended bank of the water course. Considering the risk of scouring around the bank of the abutments during a flood, the abutment pile cap should be embedded lower than the riverbed with adequate bank protection. The area of protection should be arranged up to the flood water level due to the abutments being located at a vulnerable embankment in the river course.

- Mortar riprap would be constructed with 1:1.5 slopes around the abutments.
- Geo-textile sheet would be applied at the back side of the riprap in order to restrain the seepage of the embankment soil.

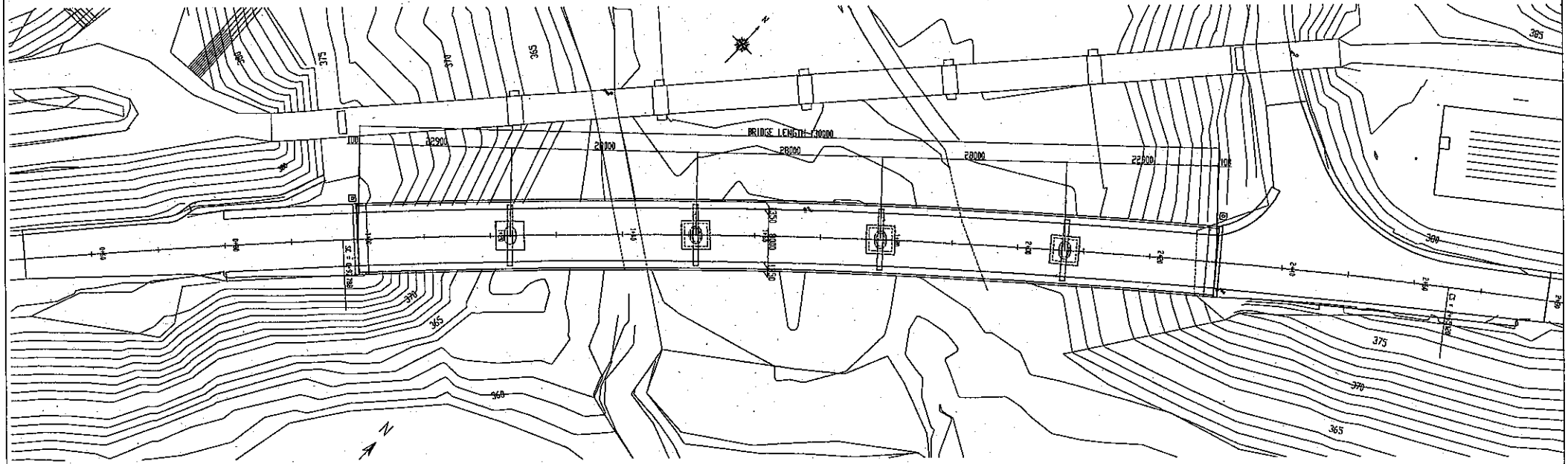
2-2-3 Basic Design Drawings

The basic design drawings consisting of the Osanica Bridge, Bogatici Bridge and approach roads are attached at the end of this report.

OSANICA BRIDGE GENERAL VIEW

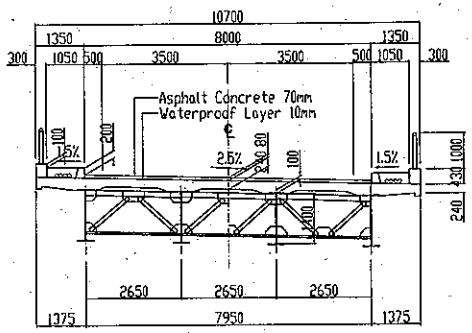


ELEVATION 1/600

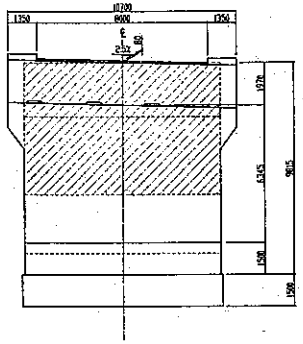


PLAN 1/600

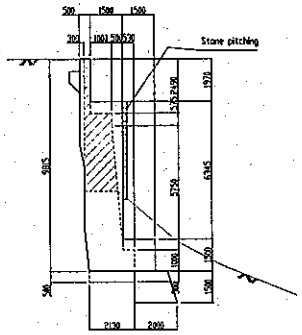
OSANICA BRIDGE GENERAL VIEW

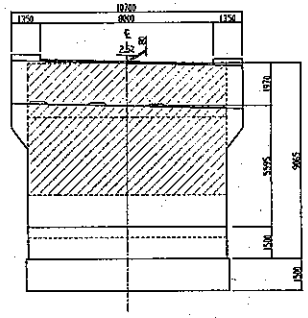


CROSS SECTION 1/150



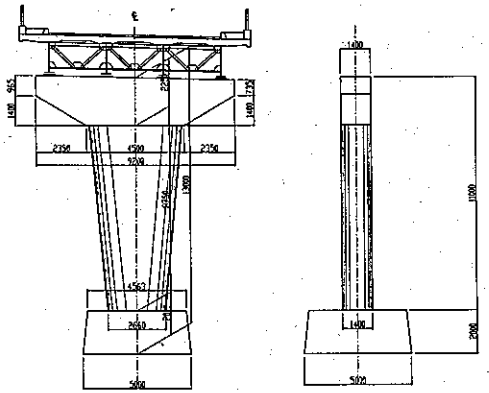
Abutment 1



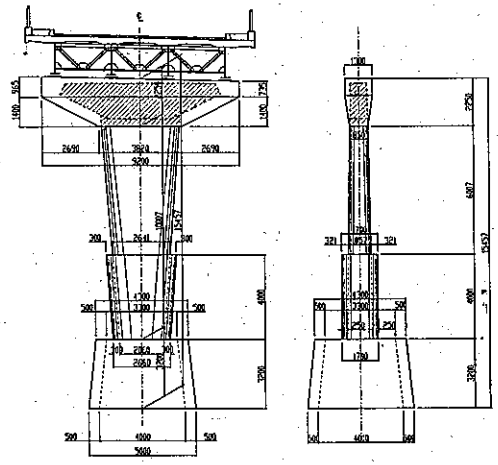


Abutment 2

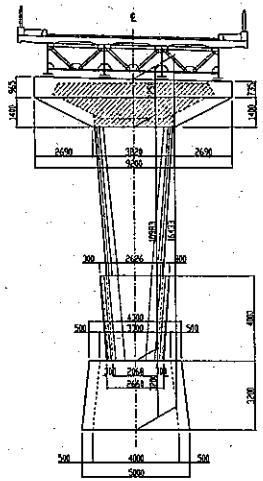
FRONT VIEW 1/200



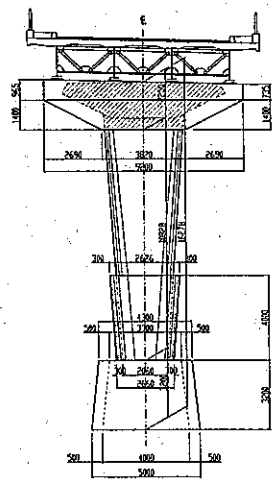
Pier 1



Pier 2



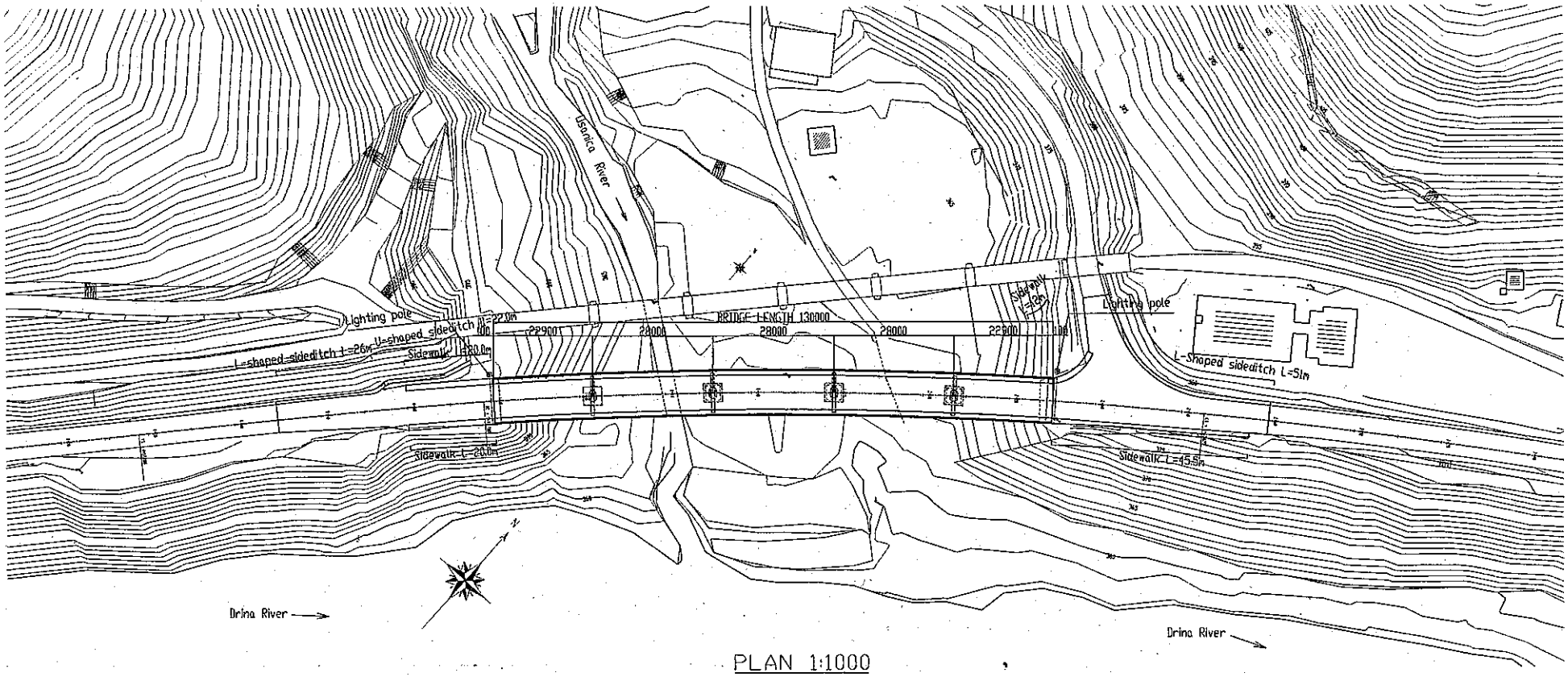
Pier 3



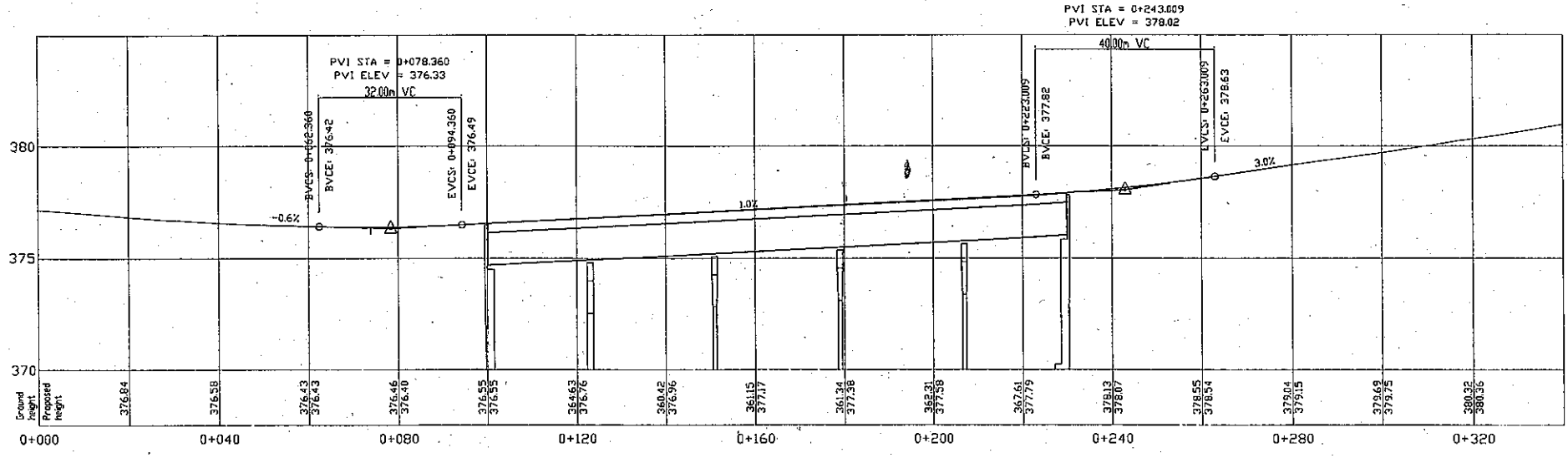
Pier 4

FRONT VIEW 1/200

OSANICA BRIDGE APPROACH ROAD GENERAL VIEW

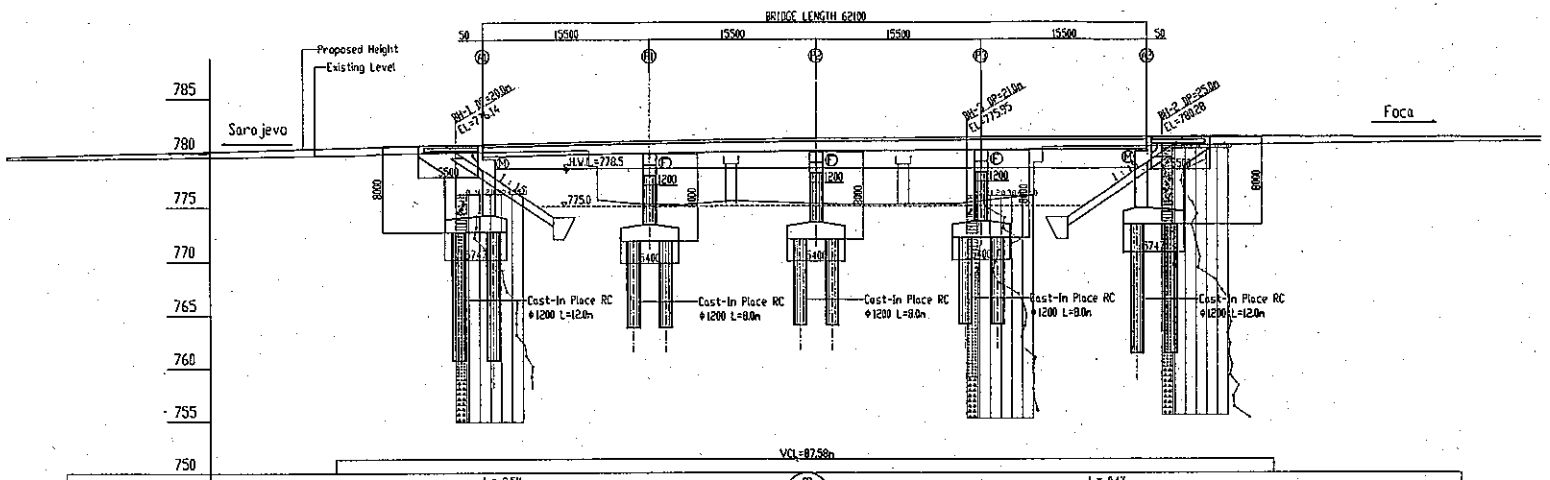


PLAN 1:1000



PROFILE H: 1:1000, V: 1:200

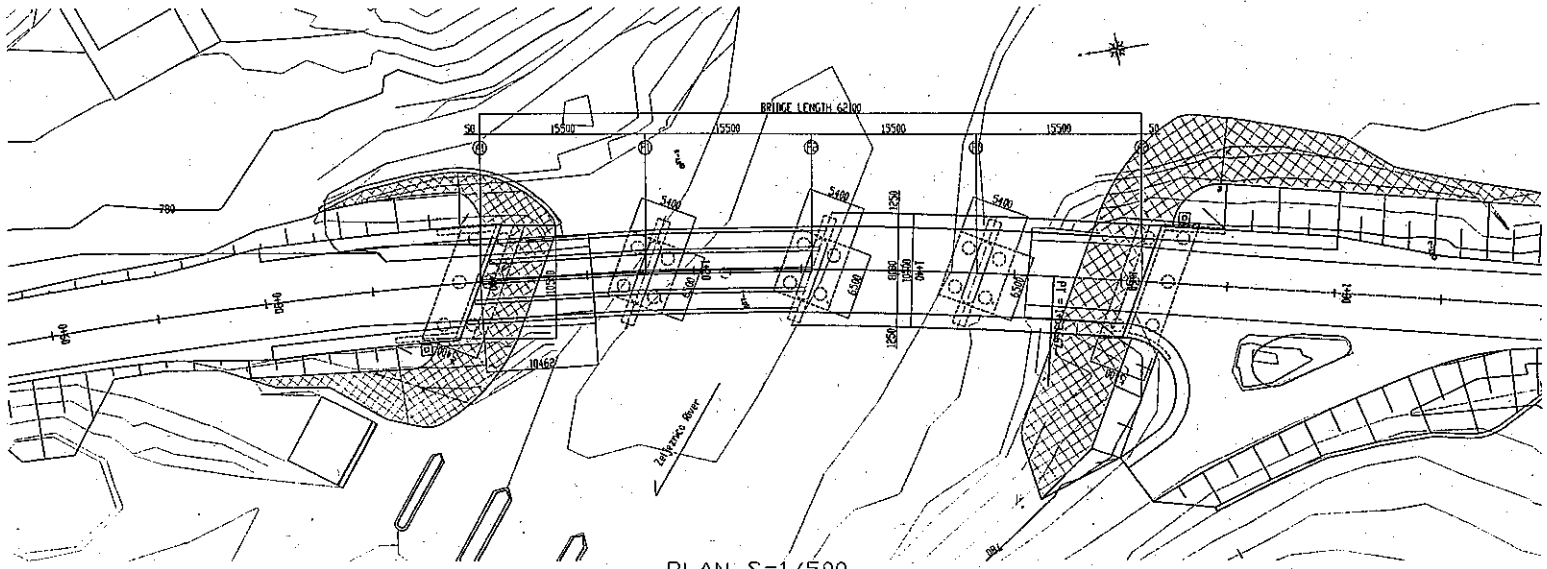
BOGATICI BRIDGE GENERAL VIEW



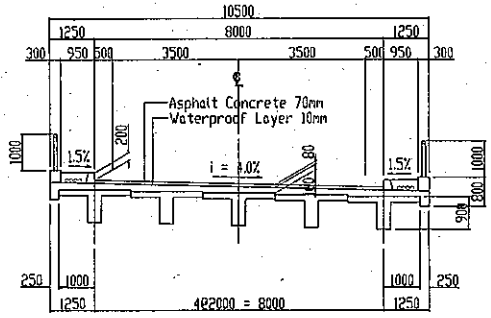
GRADIENT	i = 2.5%				i = 0.4%
PROPOSED HEIGHT	780.75	780.02	780.22	780.34	780.38
GROUND LEVEL	780.00	775.20	775.21	775.46	780.52
ACCUMLATED DISTANCE	0.00	15.55	31.05	46.50	62.10
DISTANCE	0.00	15.55	15.50	15.50	15.55
STATION	1+00 (A1)	1+15.555 (P1)	1+31.05 (P2)	1+46.50 (P3)	1+62.10 (A2)
HORIZONTAL ALIGNMENT	R = 400m				R = ∞
SUPER ELEVATION	4.0%				4.0%

VCL=87.58m

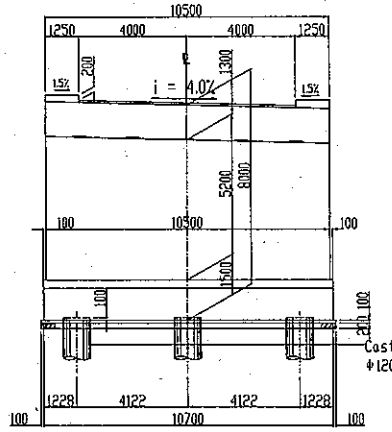
ELEVATION S=1/500



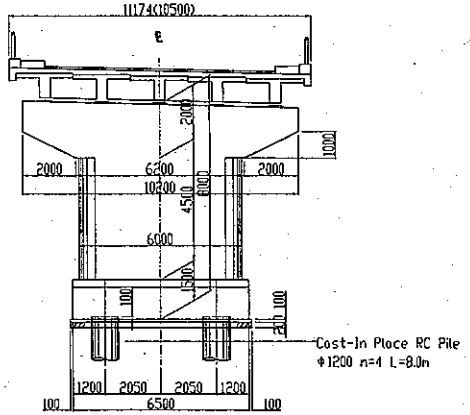
PLAN S=1/500



CROSS SECTION 1/150



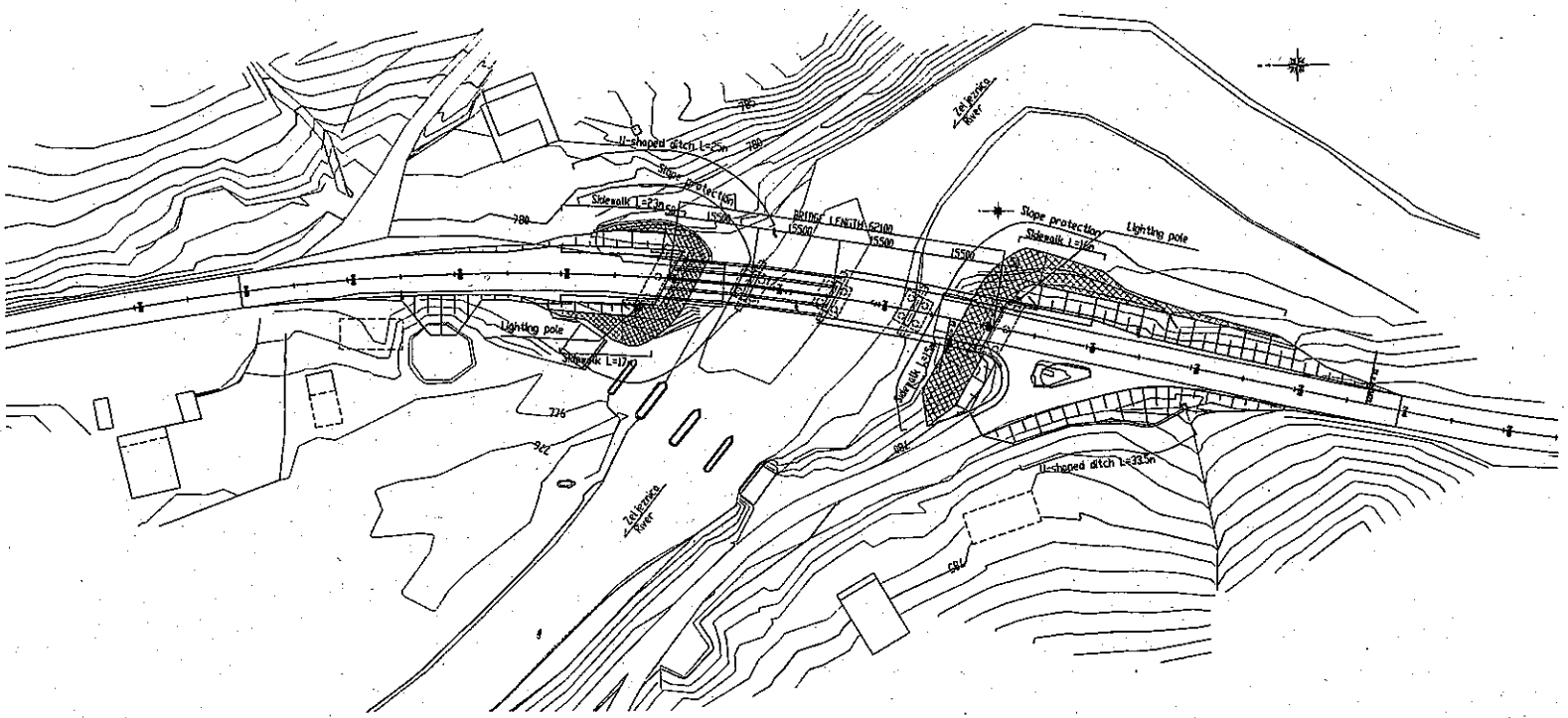
Abutment
A1, A2



Pier
P1~P3

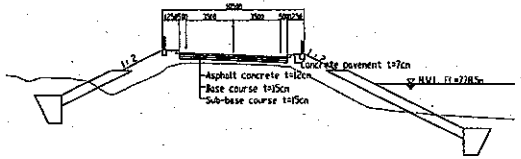
FRONT VIEW 1/200

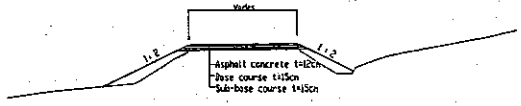
BOGATICI BRIDGE APPROACH ROAD GENERAL VIEW



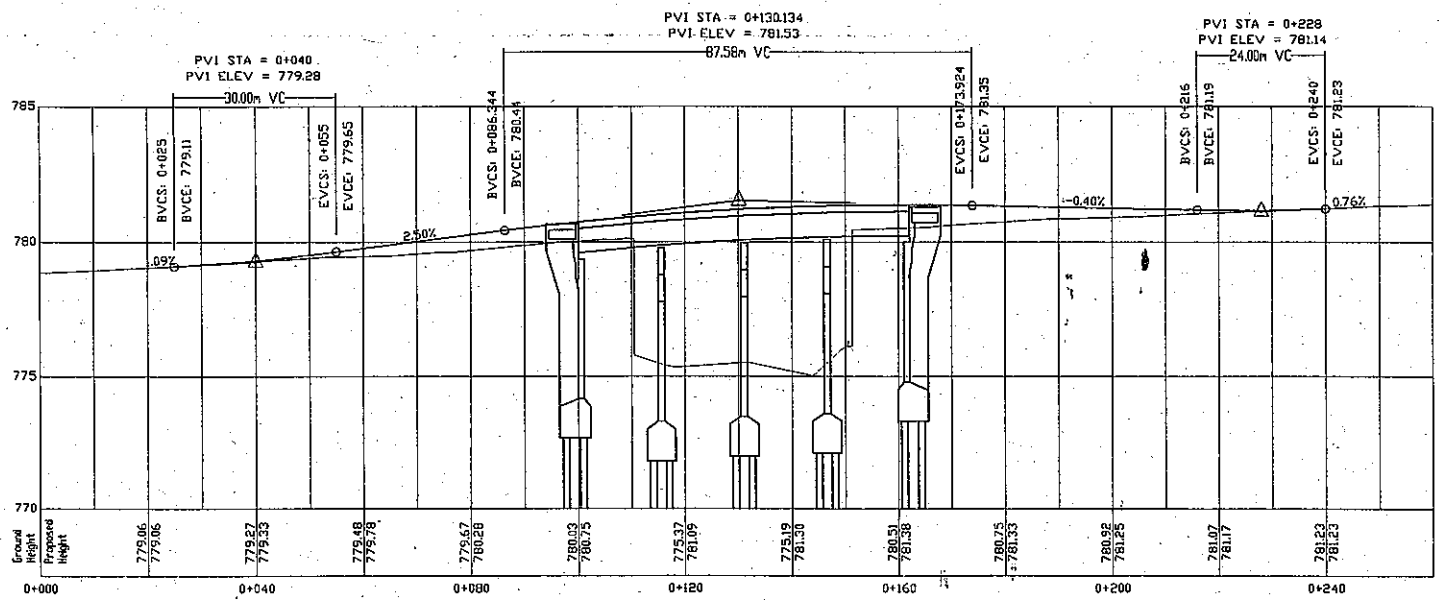
PLAN 1:1000

TYPICAL CROSS SECTION



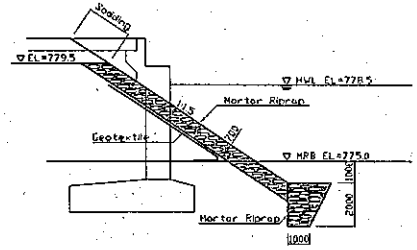


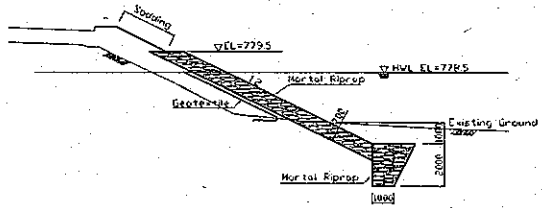
APPROACH ROAD



PROFILE H: 1:1000 V: 1:200

SLOPE PROTECTION





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 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 FBH Government, the consultant and the contractor for the project implementation to be as smooth as possible.
- to consider protective measures for demolition works on the existing bridge. For the Osanica Bridge, existing piers and abutments would be reinforced for the purpose of re-use. In this case, the destroyed superstructure should be removed carefully so as not to damage any re-use structural elements.
- to prepare appropriate construction methods and construction plans to complete all the works before snowfall starts.
- to prepare a practical construction plan taking into account the local rainfall pattern, period required for materials and equipment procurement, and the application of appropriate construction methods.
- to adopt construction methods which do not hamper smooth traffic flow.
- to establish a coordinated maintenance organization among agencies involved.

2-2-4-2 Implementation Conditions

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 labourers by observing the prevailing government laws in BiH and FBH.

(2) Environmental Consideration

Environmental conditions for the construction permit by the Ministry of Physical Planning & Environment of FBH should be cleared through the construction period.

In addition, the construction works of the Project should avoid any adverse impacts such as solid waste disposal from demolishing the old reinforced concrete structures and bituminous pavement, disposal of excavated soil, dust and noise from embankment and pavement works and water

pollution from piling works. As BiH will apply EU Environmental Legislation from February 2003, the construction works should follow this EU legislation.

(3) Tight Security at Job Sites

Special security measures are to be provided by BiH to ensure security and safety of project personnel and property since the bridge sites are located in past war fields.

(4) Religious and Local Restriction

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

(5) Custom Clearance of Import Items

Since BiH has no sea port, most of imported items might arrive via Croatia. 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 re-build bridges on the present major highways, temporary bridges and temporary approaches are required for public traffic diversion. An old railway bridge exists at the Osanica Bridge site.

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

(7) Transportation of Long Size Girder Members

The Works require special transportation of long size steel girders and precast PC girders. Regarding the girder fabrication, sizes of members should be appropriate for existing road geometry.

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 and FBH Government respectively is as follows:

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

1) Demolition and Removal of Existing Bridge and Construction of Facilities

- Demolition and removal of the existing Osanica Bridge and delivery of the resulting solid waste to the disposal areas designated by the FBH 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 FBH 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 and FBH Government

1) Obtaining of Construction Permit

Before distributing the tender documents to the prospective tenderers, the Road Directorate of FBH would have to obtain the construction permit from the Ministry of Physical Planning & Environment of FBH.

2) Re-obtaining of Mine-Free Certificate

Before distributing the tender documents to the prospective tenderers, the Road Directorate of FBH would have to re-obtain the Mine-Free Certificate from BH MAC (BiH Mine Action Center).

3) Land Acquisition and Compensation

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

4) Relocation of Public Utilities

- Development and maintenance of temporary diversion roads, erection and maintenance of a temporary Bogatici Bridge.
- Secure the land for construction yards (plant and material yards, temporary offices, etc.) and disposal areas for solid waste.
- Provision of quarry sites and borrow areas required for sub-section "2-2-4-4(3) Construction Plan".
- Full time assignment of a managing counterpart and budgetary allocation for the Road Directorate's office, transport, and other expenses.

5) Security Measure

- Safeguard the construction sites and construction yards.

6) Others

- Issuance of visa, certificates and other privileges to Japanese nationals and other personnel from third countries necessary for the execution of the Project.
- Exemption of taxes and other levies for the consultant and contractor. Fuel taxes, which are included in the market, should be reimbursed to the consultant and contractor.

2-2-4-4 Consultant Supervision

(1) Schedule of Consulting Services

The project should commence with the signing of an Exchange of Notes (E/N) between two Governments (Japan and BiH) regarding the engineering services and facility construction of the Project. After E/N, JICA would issue a recommendation letter to the Road Directorate of FBH, and then the contract for the consulting service shall be concluded between the Road Directorate of FBH and the Japanese consultant who will provide the following consulting services within the limits of Japan's Grant Aid:

1) Detailed Design and Preparation of Tender Documentation Stage

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

- Design report
- Drawings
- Tender documents

2) Tender (Pre-construction) Stage

The Road Directorate of FBH will select a successful tenderer and conclude the construction contract with him through a competitive tender method among Japanese construction firms. The consultant should assist the Road Directorate of FBH to conduct the following:

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

3) Construction Supervision Stage

The consultant shall perform his duties in accordance with criteria and standards applicable to the construction works and shall exercise the powers vested in him as the Engineer to supervise the field works by the contractor.

The consultant, within his capacity as the Engineer, should directly report to the Road Directorate of FBH and 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 Team Leader.

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

2) Pre-construction Stage

- Team Leader
  Responsible for all the aspects of consulting services during the pre-construction and construction stages.
- Tender Specialist
  Responsible for the preparation of tender document, bid announcement, pre-bid conference and site inspection, and tender and tender evaluation.
- Tender Assistance
  Responsible for the preparation of tender document, including review of drawings.

3) Construction Stage

- Team Leader
  Responsible for all the aspects of consulting services during the construction stages.
- Bridge Engineer
  Responsible for bridge building works.
- Civil Engineer
  Responsible for quality assurance, pilling work and supervision for local stuffs.

(3) Construction Plan

1) Temporary Works

a) Construction Yards

Construction yards should be in a place where sufficient free-board is maintained at least above the 20 year probable floods. Plant and material yards, offices, storage and other facilities would be located in the construction yards. The approximate area of each construction yard will be 3,000m². Conceptual layout plans of the respective construction yards are shown in Figure 2-6 and Figure 2-7.

b) 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 off the present public utilities.

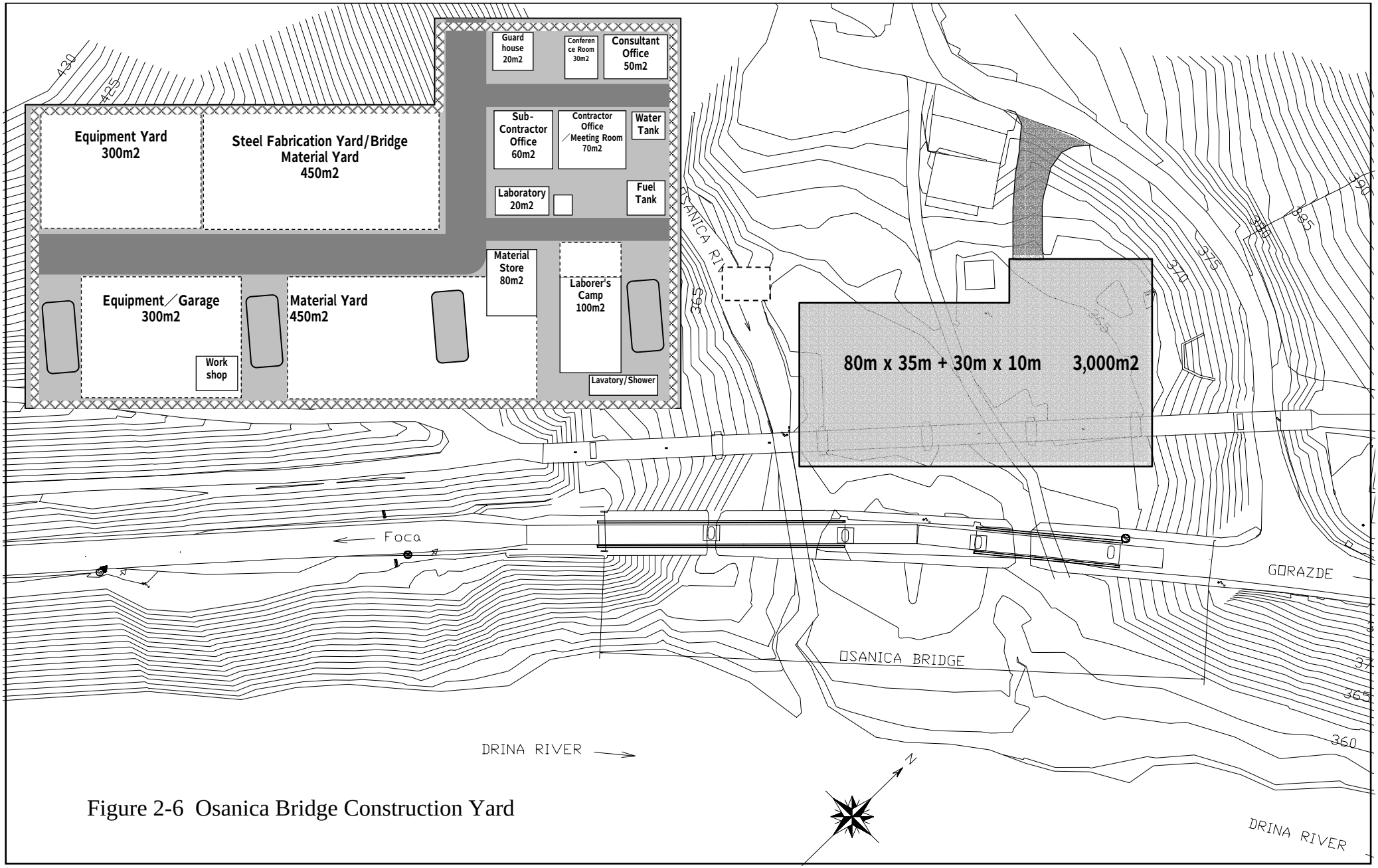


Figure 2-6 Osanica Bridge Construction Yard

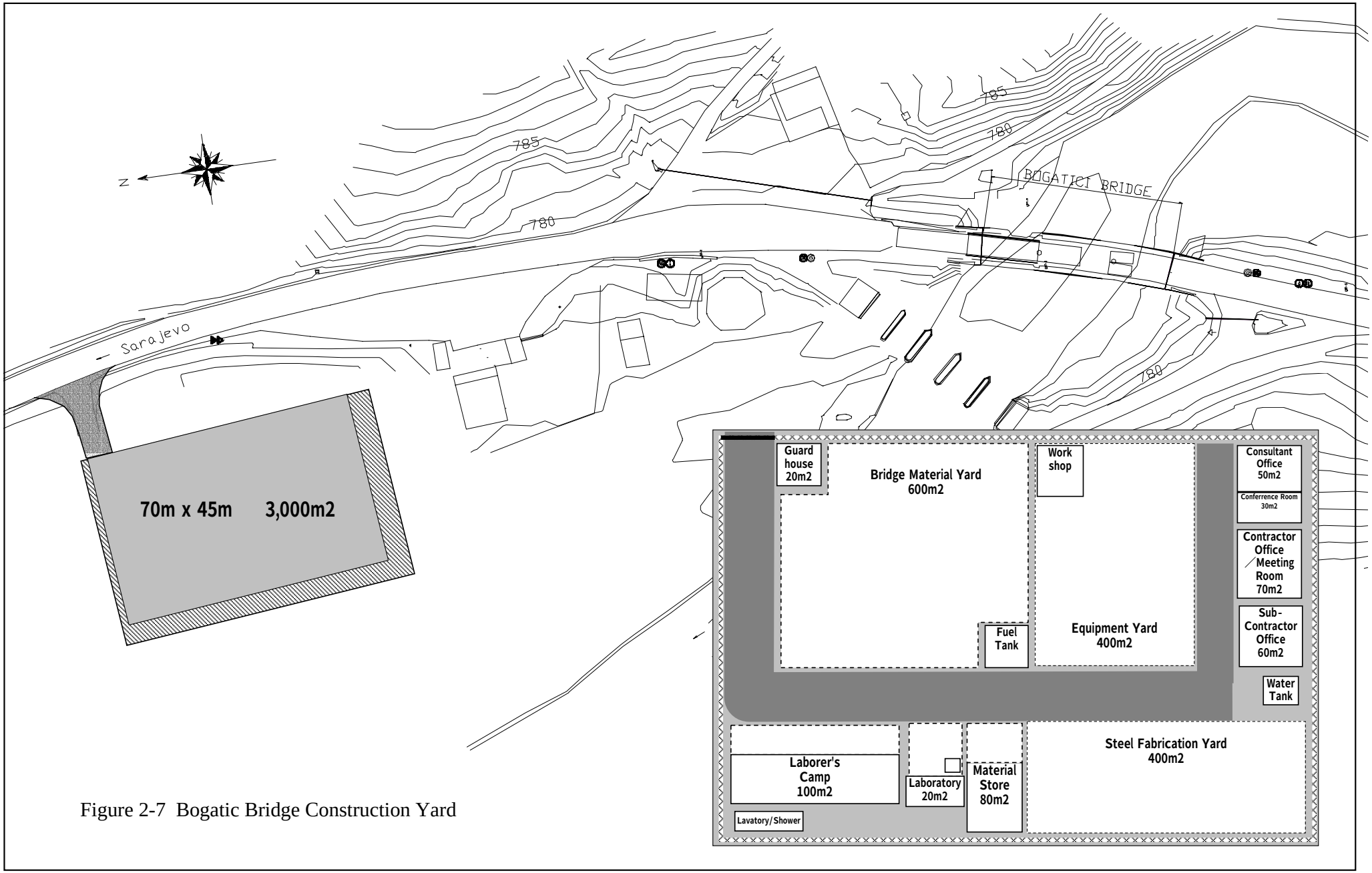


Figure 2-7 Bogatic Bridge Construction Yard

2) Scaffolding and False Work for Demolition of Existing Osanica Bridge

Demolition works for the existing Osanica Bridge should be carefully done by using the scaffolding and false-work experienced in recent bridge restoration in BiH in order to eliminate damage to the re-usable structures.

Conceptual side view of the scaffolding and false-work is shown in Figure 2-8.

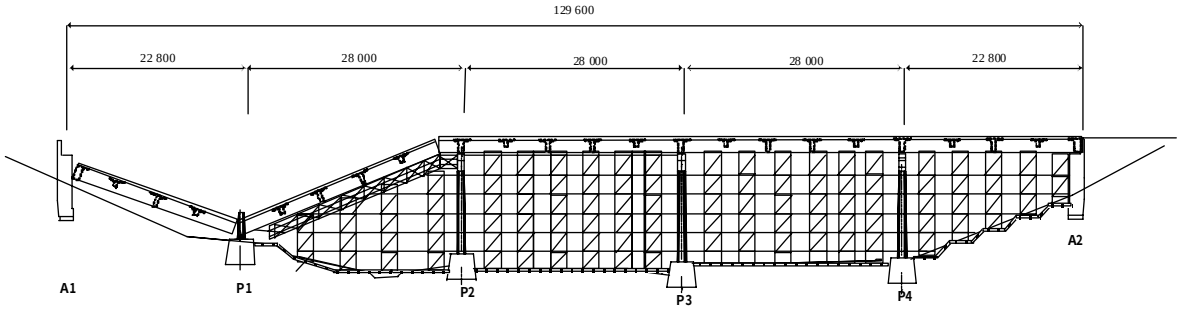


Figure 2-8 Scaffolding and False-work for Osanica Bridge

3) Construction Works

a) Construction Order

As the specific bridge sites are on the life-line roads for livelihood and industries of the people of FBH and RS, the Government of FBH would have to be responsible for develop and open the temporary diversion roads and temporary bridges to the public traffic until the completion of the Project.

Construction order is shown in Figure 2-9 along with flow of public traffic.

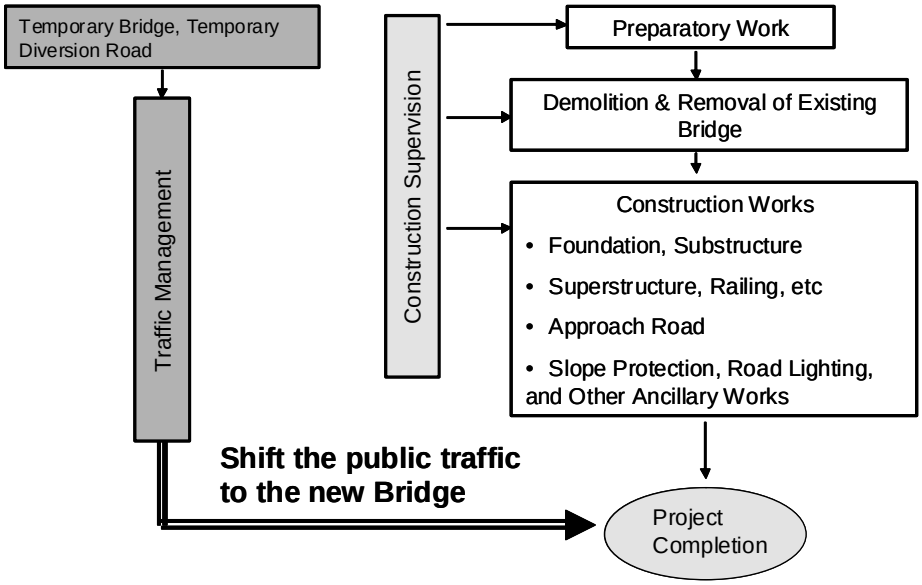


Figure 2-9 Construction Order

b) Supervision

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

c) Traffic Management during the Construction Work

The project roads are mostly 7.0m wide 2 lane roads which may require traffic management during the construction works. These works shall be done using one-lane temporary roads and bridges without interrupting traffic for both directions. This method requires traffic control by the Government of FBH with the assistance of traffic police in Gorazde and Trnovo.

2-2-4-5 Quality Control Plan

The designing of the Project was done according to the Ex-Yugoslavian Standards. 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 2-12.

Table 2-12 Quality Control Tests Plan

Item			Test Method	Frequency
Crushed Rock Base	Mixed Material		Liquid Limit, Liner Shrinkage	Every mixing
			Sieve Gradation	
			TFV soaked & 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
Asphalt Concrete	Material	Bitumen	Quality Certificate & Chemical Analysis	Every material
		Aggregate	Sieve Gradation	Every mixing
			Water Absorption	Every material
			TFV soaked & 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

Item			Test Method	Frequency
Concrete	Material	Cement	Quality Guarantee, Chemical & Physical Analysis	Every material
		Water	Chemical Analysis	Every material
		Admixture	Quality Guarantee, Chemical Analysis	Every material
		Fine	Bulk Specific Gravity Dry	Every material
		Aggregate	Sieve Gradation, Finesse Modulus	
			Clay and Friable Particles	
		Coarse	Bulk Specific Gravity Dry	Every material
		Aggregates	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
Structural Steel	Material		Mill-sheet Mechanical Tests	Each lot
Butt Weld	Factory, Fields		X-ray	Each member
Bolt & Nut	Material Tightening		Quality Certificate, Mechanical Tests Torque Test	Each lot Daily
Paint	Material Field		Quality Certificate, Chemical Analysis Thickness	Each lot Each element
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.

For the Osanica Bridge, steel girders would be fabricated at Zenica in FBH and transported to the site from approximately 150km. Mixtures of cement concrete and asphalt concrete would be procured from the plants in the outskirts of Gorazde, about 21km away from the site.

For the Bogatici Bridge, pre-cast members of pretension PC T girders would be procured from a factory in the outskirts of Sarajevo, approximately 26km away from the site. Mixtures of cement concrete and asphalt concrete would be procured from the plants in Sarajevo City.

Indicative procurement schedule of major materials is shown in Table 2-13.

Table 2-13 Indicative Procurement Schedule of Materials

Item	BiH	Japan	Third Countries	Remarks
Steel Girder	O			Zenica
H. T. Bolt			O	
Pre-cast PC T Beam	O			Sarajevo
Paint			O	
Railing	O			Zenica
Bearing			O	
Drain Pile, etc.	O			Zenica
Natural Stone Curb	O			Jablanica
Scaffold	O			
Asphalt Con. Mix.	O			Sarajevo, Gorazde
Cement Con. Mix.	O			Sarajevo, Gorazde
Aggregate	O			
Cement	O		O	
Gravel, Stone	O			
Admixture	O		O	
Rebar	O			Zenica
Form	O			
Lubricant	O			
Fuel	O			
Bulb			O	
Lighting Pole	O			

(2) Procurement of Construction Equipment

The major construction equipment available in BiH and their capacities are listed in Table 2-14.

Table 2-14 Indicative Procurement Schedule of Construction Equipment

Item	Capacity Spec.	BiH	Japan	Third Countries
Bulldozer	15t	O		
Power Shovel	1.4m^3	O		
Dump Truck	8.0t	O		
Backhoe	0.6m^3	O		
Crawler Crane	40t	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 lit	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 of the project is prepared as per Figure 2-10 taking into account the procedure of the Japanese Grant Aid Scheme.

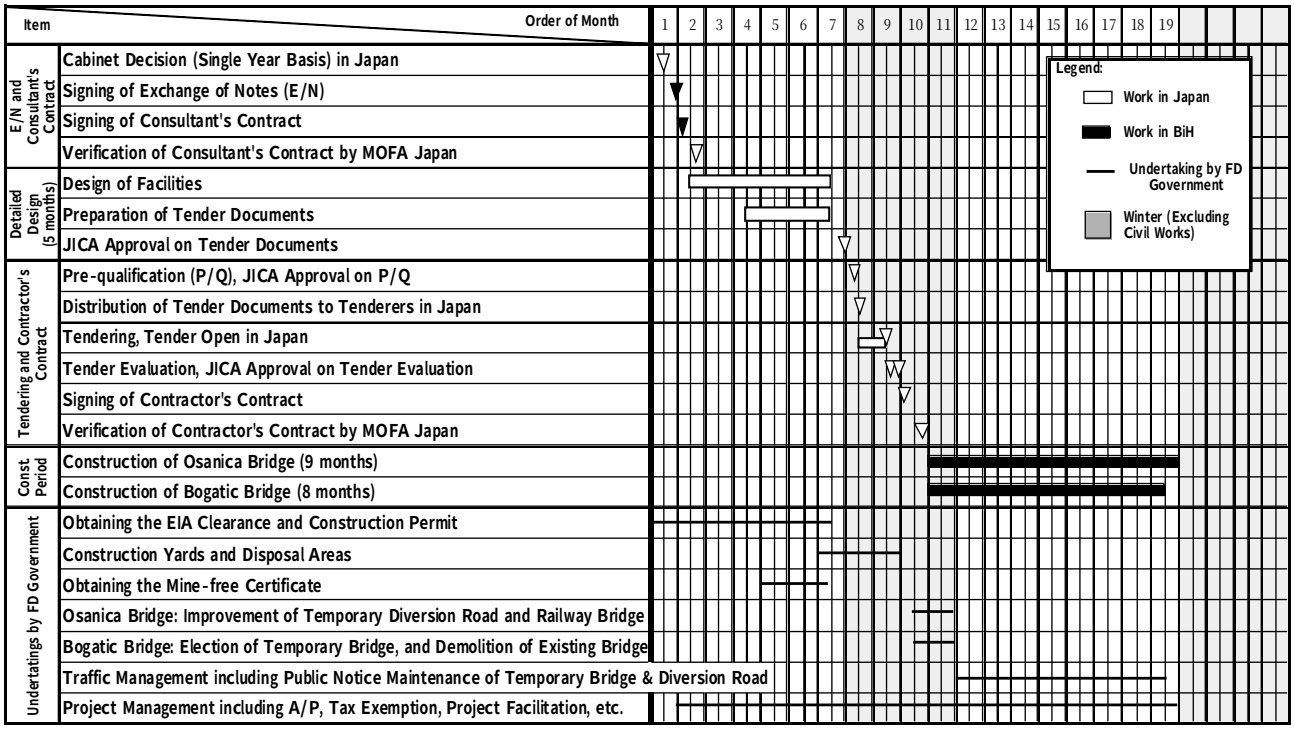


Figure 2-10 Tentative Implementation Schedule

2-3 Obligation of Recipient Country

The following necessary measures should be undertaken by the BiH Government and the FBH Government on condition that the 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 side have already been 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 for the installation of the equipment,
- To ensure provision of 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 Verification 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

- BiH shall construct the temporary roads and temporary bridges before the Project, and demolish or dismantle the old bridges if necessary according to the Basic Design Study, temporary roads, and temporary bridges soon after the Project by their own budget.

  BiH shall construct the detour road and maintain the ex-railway bridge to convert into temporary road bridge at the site of the Osanica Bridge until March 2004 at the end of the construction of Osanica Bridge.

  BiH shall construct the temporary bridge at the site of Bogatici Bridge by March 2004 and remove it around November 2004 after the completion of the construction of Bogatici Bridge.

BiH shall manage the traffic at the site of two bridges in the FBH.

BiH shall complete the relocation of existing utilities (power and communication lines, water lines) which would be obstacles to the construction work by the beginning of the construction work.

- BiH shall obtain the approval for the construction of two bridges in the FBH by the end of October 2003.
- BiH shall secure the land for the construction yard as well as the land fill areas of solid waste disposal from demolishing works of the old bridges by the end of January 2004.
- Since the project of two bridges in the FBH is construction of bridges at the same place in almost the same scale, an EIA on the project is not considered to be necessary, according to the EIA code in the FBH. BiH shall reconfirm the necessity, or otherwise, of EIA on the project to the concerned ministries and/or agencies.
- BiH shall secure the necessary budget and personnel for implementation of the Project and for maintenance of the facilities.
- The mine inspection and clearance necessary for the construction of two bridges (including temporary usage for construction yards, detour etc.) in the FBH has been completed. Hence, the land for the proposed bridges and approach roads are qualified as mine free by the governments of the FBH. During the detailed design stage and the construction stage, the FBH shall obtain certificates from the BiH Mine Action Center (BiHMAC) to make sure that the proposed sites are free from mines.

2-4 Project Operation Plan

2-4-1 Operation and Maintenance Schedule

The operation and maintenance works will be carried out in accordance with the work schedule shown in Table 2-15.

Table 2-15 Operation and Maintenance Schedule

Item	Content of works
Drainage	Removal of deposits in cross drainage and side ditches.
Traffic safety	Repainting of lane markings.
	Repainting of traffic sign boards.
Pavement	Overlaying of asphalt concrete.
Steel girder, and railing	Repainting of steel girders of the Osanica Bridge. Repainting of railings of both bridges.
Road Lighting	Maintenance of lights and 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 2-16. 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 489 million

Table 2-16 Approximate Project Costs

Osanica and Bogatici Bridges (Total bridge length = 192m)

Items			Approximate Amount (Million Japanese Yen)	
Facilities	Osanica Bridge (Length; 130m)	Bridge	198	424
		Approach roads	23	
		Demolition of existing bridge	23	
	Bogatici Bridge (Length; 62m)	Bridge	139	
		Slope Protection	10	
		Approach roads	25	
		Demolition of existing bridge	6	
Detailed design, Construction supervision		65		

2-5-1-2 Condition of Cost Estimate

- Exchange rate: 1.0EUR＝J. Yen 125.36
  (6 months average before March 31, 2003)
  1.0EUR＝1.9558 KM
- Construction period: 9 months
- Others: - On condition that the Project is implemented under Japan's Grant Aid Scheme
  - The above-mentioned exchange rate is to be reviewed by the Japanese Government.

2-5-2 Reconstruction Costs to be borne by the BiH side

Approximate costs required for the undertakings by the BiH side are summarized in Table 2-17:

Table 2-17 Approximate Costs to be borne by the BiH Side

Work Items	Cost (KM)	Remarks
(1) Osanica Bridge: Diversion Road to Ex-railway Bridge	150,000	Approx. diversion road length = 500m
(2) Ilovica-Bogatici Bridge: Temporary Bridge and Temporary Diversion Road	60,000	Approx. temporary bridge length = 30m
(3) Administration of Road Directorate of FBH in connection with the Project Implementation	106,400	Including costs for officers and administrators in charge, banking arrangement, and other office expenditures
(4) Reimbursement of Taxes on Fuel, etc.	53,600	Equivalent to gasoline consumption approx. 70,000 Liter
Total	**370,000**	

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 2-18.

Table 2-18 Estimated Maintenance Costs

Item	Frequency	Approx. Costs (KM)
Drainage	2 times per year	2 x 600 = 1,200
Traffic safety	Every 1 year	4,068
	Every 2 years	2 x 400 = 800
Pavement	Every 6 years	72,300
Steel girder and railing	Every 8 years	140,000
Road Lighting	Every 2 years	3,000
Average maintenance cost per year		37,118

The annual maintenance cost for the Road Directorate of FBH is estimated at KM37,118. This corresponds to 0.14% of total expenditure by the Road Directorate of FBH in the year 2001 that is equivalent to about KM 25.6 million.

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 Condition and Problems	Countermeasures proposed in the Study	Direct Impact and Effects
The existing Osanica and Bogatici bridges had been constructed with reinforced concrete structures more than 40 years ago. During the internal war some parts of the girders and substructure were destroyed by bombardment. Since then the bridges have completely deteriorated due to the lack of effective repair work for the damaged parts and absence of maintenance.	The existing bridges are replaced by new modern bridges, constructed in conformity with the load requirements of the Yugoslavian Standard and also applying the anti-seismic technology. Moreover, the new Bogatici Bridge's opening is designed to cope with the hydrological conditions and the insufficiency of space.	The new bridges will be constructed in accordance with the up-to-date design standards. Therefore, the presently encountered problems would be avoided.
As a makeshift measure, Bailey-type bridges of only 4m wide were temporarily constructed in place of the destroyed structures after the internal war for passage of vehicles and pedestrians. Due to the poor conditions of these bridges, all vehicles must run at low speed during passing and must wait for a long time due to the alternate one-way traffic in each direction.	The bridges are upgraded to have a two-lane carriageway of 8m wide, same as the standard bridges on the trunk roads in BiH.	As the new bridges will have the same width as that of the related trunk roads and their function of traffic handling will be fully recovered, the vehicles' traveling speed of 23 km/h on the Osanica Bridge and 18 km/h on the Bogatici Bridge at present, could be increased up to 80 km/h on both bridges. The long waiting for passing on the Bailey bridges and the traffic entanglement at the crossing point would be resolved, thus avoiding bottlenecks on the roads of BiH.

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 Osanica and Bogatici bridges are located in the territory of FBH, but adjacent to Foca and other areas in RS. Thus, their reconstruction must be of great significance to the people of RS too. Taking this situation into account, it can be expected that the reconstruction of the 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	At present, temporary bridges (of Bailey type) are erected and maintained by SFOR on both of the damaged bridges, mainly for military use. Completion of the reconstruction of the two bridges as permanent structures 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 reconstruction of the two bridges to replace the destroyed 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 Direct Beneficiaries of the Project

Region	Beneficiaries of Osanica Bridge	Beneficiaries of Bogatici Bridge
FBH: Sarajevo Area	---	20,000
RS: Foca Area	36,000	36,000
FBH: Gorazde Area	41,000	41,000
RS: Pale Area	57,000	---
Total	134,000	97,000

Source : Population is quoted from BiHTMAP(JICA)

3-2 Recommendations

The Project, which consists of the reconstruction of two 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 the BiH side and the Japanese side, cooperate closely with each other throughout the Project implementation, from the design stage to the construction stage.