MINISTRY OF TRANSPORT
THE SOCIALIST REPUBLIC OF VIETNAM

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR RECONSTRUCTION OF BRIDGES IN CENTRAL AREA

MARCH 2002

JAPAN INTERNATIONAL COOPERATION AGENCY
PACIFIC CONSULTANTS INTERNATIONAL
ORIENTAL CONSULTANTS CO., LTD.

PREFACE

In response to a request from the Government of Socialist Republic of Vietnam, the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Bridges in the Central Area of Viet Nam and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Vietnam a study team from August 5 to September 8 and from October 4 to November 17, 2001.

The team held discussions with the officials concerned of the Government of Vietnam, and conducted a field survey at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Vietnam 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 of the Government of the Socialist Republic of Vietnam for their close cooperation extended to the teams.

March 2002

Takaaki Kawakami
President
Japan International Cooperation Agency

March 2002

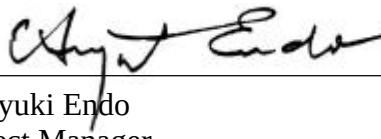
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Reconstruction of Bridges in the Central Area of Viet Nam in the Socialist Republic of Vietnam.

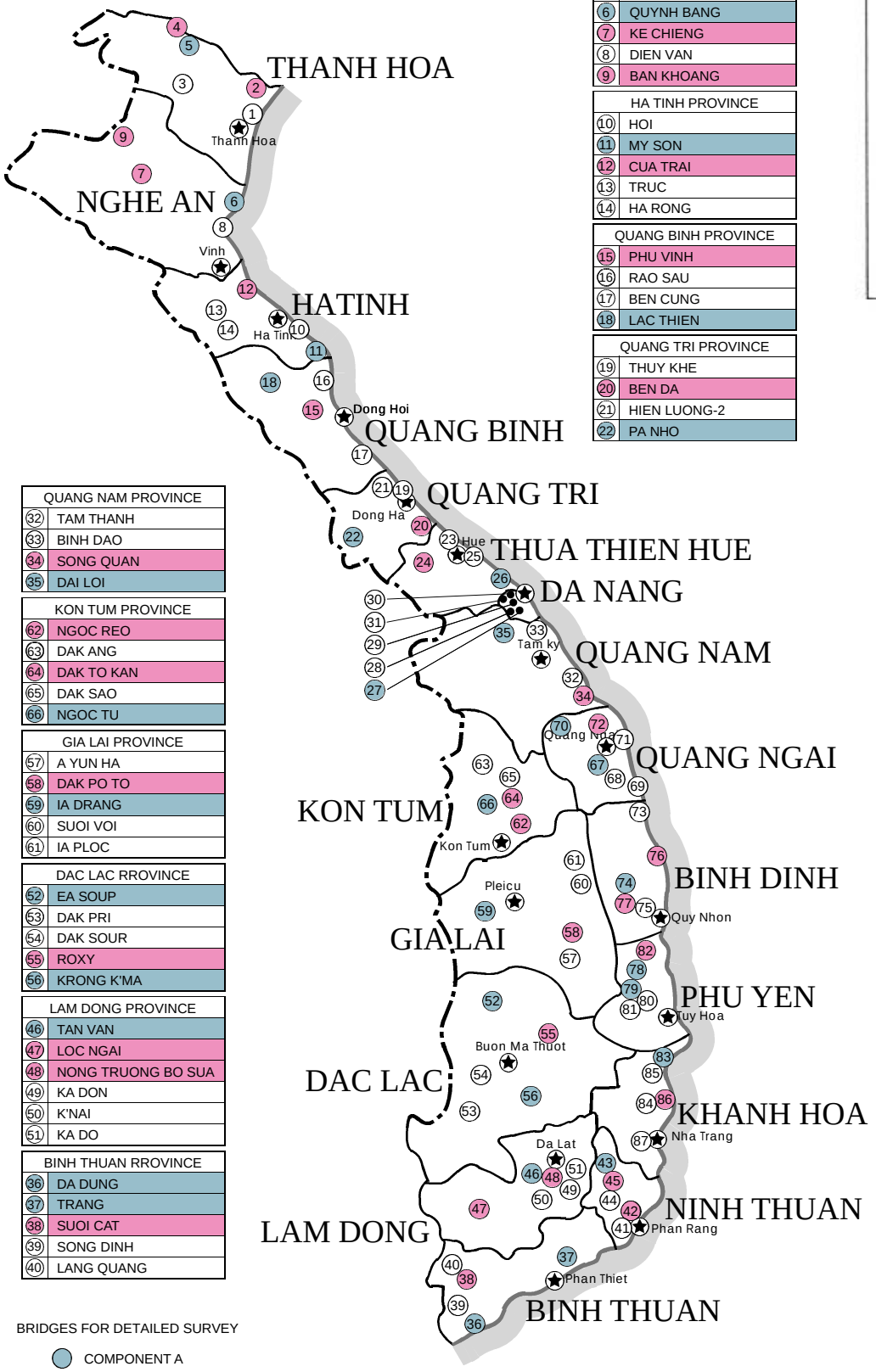
This study was conducted by the Joint Venture between Pacific Consultants International and Oriental Consultants Co., Ltd. under a contract to JICA, during the period from July, 2001 to March, 2002. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Vietnam and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

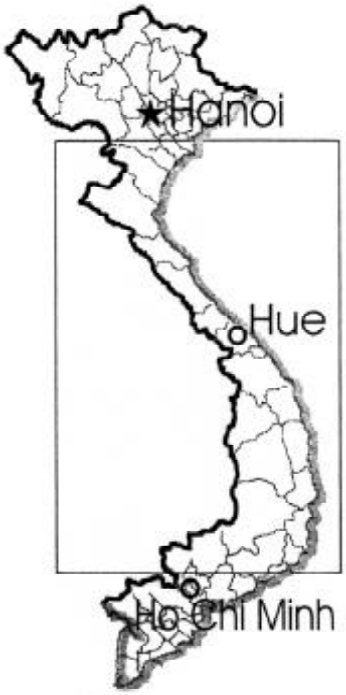
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Hiroyuki Endo
Project Manager,
Basic Design Study Team on the Project for Reconstruction of Bridges in the Central Area of Viet Nam
The Joint Venture between
Pacific Consultants International and
Oriental Consultants Co., Ltd.





THANH HOA PROVINCE	
1	NAM KHE
2	CHINH DAI
3	PHUC HUNG
4	THACH QUANG
5	THACH DINH

NGHE AN PROVINCE	
6	QUYNH BANG
7	KE CHIENG
8	DIEN VAN
9	BAN KHOANG

HA TINH PROVINCE	
10	HOI
11	MY SON
12	CUA TRAI
13	TRUC
14	HA RONG

QUANG BINH PROVINCE	
15	PHU VINH
16	RAO SAU
17	BEN CUNG
18	LAC THIEN

QUANG TRI PROVINCE	
19	THUY KHE
20	BEN DA
21	HIEN LUONG-2
22	PA NHO

THUA THIEN HUE PROVINCE	
23	SIA
24	NA MAY
25	DUONG THANH
26	KHE DUONG

DA NANG CITY	
27	HOI PHUOC
28	DA NHAY
29	———
30	SAP
31	———

QUANG NAM PROVINCE	
32	TAM THANH
33	BINH DAO
34	SONG QUAN
35	DAI LOI

KON TUM PROVINCE	
62	NGOC REO
63	DAK ANG
64	DAK TO KAN
65	DAK SAO
66	NGOC TU

GIA LAI PROVINCE	
57	A YUN HA
58	DAK PO TO
59	IA DRANG
60	SUOI VOI
61	IA PLOC

DAC LAC RROVINCE	
52	EA SOUP
53	DAK PRI
54	DAK SOUR
55	ROXY
56	KRONG K'MA

LAM DONG PROVINCE	
46	TAN VAN
47	LOC NGAI
48	NONG TRUONG BO SUA
49	KA DON
50	K'NAI
51	KA DO

BINH THUAN RROVINCE	
36	DA DUNG
37	TRANG
38	SUOI CAT
39	SONG DINH
40	LANG QUANG

QUANG NGAI RROVINCE	
67	XA CAI
68	PHUOC XA
69	———
70	DO
71	KHE KY
72	SONG SAU

BINH DINH PROVINCE	
73	TRUONG XUAN
74	BA LE
75	HOA PHONG
76	DAO LONG
77	TRUONG DINH

PHU YEN PROVINCE	
78	TRA O
79	TRA BUONG
80	SUOI CAU 1
81	SUOI CAU 2
82	DA LOC

KHANH HOA PROVINCE	
83	NGOI NGAN
84	CHAY
85	SONG GOC
86	TIEN DU
87	BE

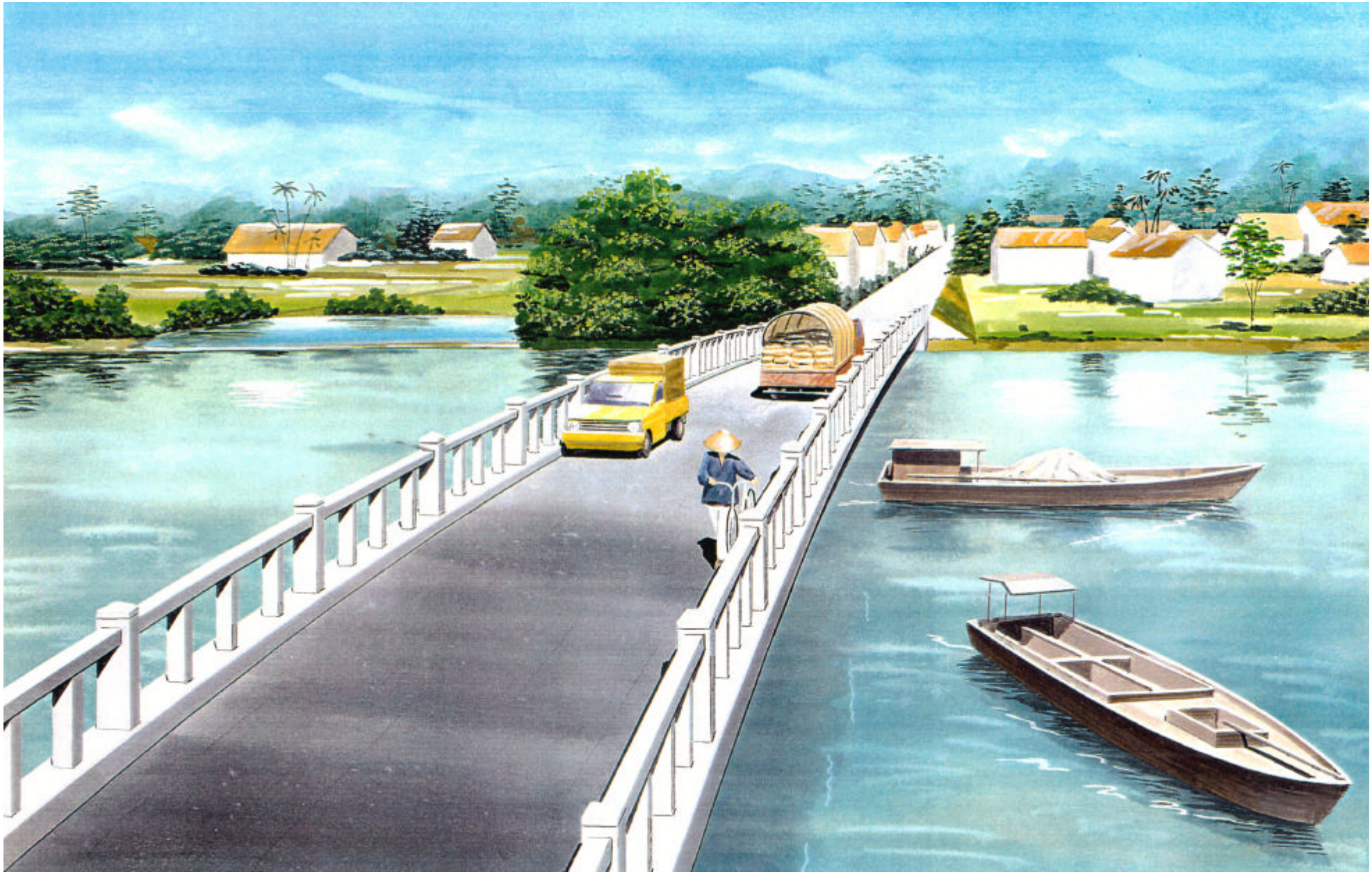
NINH THUAN PROVINCE	
41	HUN NAM
42	TUAN TU
43	TAM NGAN
44	SONG THANG
45	CAU GAY

BRIDGES FOR DETAILED SURVEY

COMPONENT A

COMPONENT B

BRIDGE LOCATION MAP



PERSPECTIVE

Photographs of Bridge Sites

1. Component A (Bridge C.T)

Photo-1 NO.6 Quynh Bang Bridge
(Nghe An Prov.)

Photo-2 NO.11 My Son Bridge
(Ha Tinh Prov.)

Photo-3 NO.27 Hoi Phuoc Bridge
(Da Nang City)

Photo-4 NO.37 Trang Bridge
(Binh Thuan Prov.)

Photo-5 NO.56 Krong K'Ma Bridge
(Dac Lac Prov.)

Photo-6 NO.67 Xa Cai Bridge
(Quang Ngai Prov.)

Photo-7　NO.78 Tra O Bridge
(Phu Yen Prov.)

Photo-8　NO.83 Ngoi Ngan Bridge
(Khan Hoa Prov.)

2. Component B (Steel Girder Procurement Type)

Photo-1　NO.4 Thach Quang Bridge
(Tanh Hoa Prov.)

Photo-2　NO.9 Ban Khoang Bridge
(Nghe An Prov.)

Photo-3　NO.20 Ben Da Bridge
(Quang Binh Prov.)

Photo-4　NO.42 Tuan Tu Bridge
(Ninh Thuan Prov.)

Photo-5　NO.48 Nong Truong Bo Sua Bridge
(Lam Dong Prov.)

Photo-6　NO.62 Ngoc Reo Bridge
(Kon Tum Prov.)

Photo-7　NO.72 Song Sau Bridge
(Quang Ngai Prov.)

Photo-8　NO.82 Da Lac Bridge
(Phu Yen Prov.)

LIST OF FIGURES

		Page
Figure 2-1	Typical PC Girder Type Bridge	2 -19
Figure 2-2	Typical Steel Girder Type Bridge	2 -20
Figure 2-3	Footing Position in the Pile Foundation	2 -21
Figure 2-4	Typical Road Cross Section	2 -22
Figure 2-5	Slope Protection Works	2 -23
Figure 2-6	Pier Protections	2 -24
Figure 2-7	Cross Sections for Bridges	2 -26
Figure 2-8	Cross Sections for Approach Roads	2 -26
Figure 2-9	Seismic Intensity Map	2 -28
Figure 2-10	Locations of Borrow Pits and Crushed Stone Sources	2 -41
Figure 2-11	Locations of Borrow Pits and Crushed Stone Sources	2 -42

LIST OF TABLES

		Page
Table 2-1	The 84 Candidate Bridges	2 - 2
Table 2-2	Evaluation Results	2 - 5
Table 2-3	Selections from 84 Candidate Bridge	2 - 9
Table 2-4	Summary of 2nd Survey Results	2 -11
Table 2-5	Corrosion Resistant Steel Girder Procurement Type Bridges	2 -14
Table 2-6	Water Levels by the Field Survey	2 -16
Table 2-7	Clearance and Freeboard	2 -17
Table 2-8	Substructures and Foundation Type	2 -21
Table 2-9	Selection of Soft Ground Treatment Method	2 -24
Table 2-10	Highway Design Speed and Traffic Volume	2 -25
Table 2-11	Design Speed and Road Width	2 -26
Table 2-12	Unit Weights of Materials	2 -29
Table 2-13	Strength of Concrete	2 -29
Table 2-14	Allowable Stress of Reinforcing Bar	2 -29
Table 2-15	Steel Tensile Strength	2 -29
Table 2-16	Geometric Design	2 -30
Table 2-17	Embankment Height and Slope	2 -30
Table 2-18	Summary of Bridges (Bridge C.T Bridges)	2 -31
Table 2-19	Summary of Bridges (Steel Girder Procurement Type Bridges)	2 -33
Table 2-20	Grouping of Bridges	2 -35
Table 2-21	Cement Factories in Vietnam	2 -40
Table 2-22	Sources of Aggregate and Embankment Material	2 -43
Table 2-23	Procurement Plan for Major Construction Materials	2 -46
Table 2-24	Procurement Plan for Major Construction Equipment	2 -48
Table 2-25	Transportation Distance for Major Materials	2 -50
Table 2-26	Transportation Distance for Steel Girders (Component B)	2 -54
Table 2-27	Maintenance and Operation Schedule	2 -57
Table 2-28	Activities in Soft Component Work	2 -60

ABBREVIATIONS

Authorities and Agencies

AASHTO	:	American Association of State Highway and Transportation Officials
JICA	:	Japan International Cooperation Agency
MOPI	:	Ministry of Planning & Investment
MOT	:	Ministry of Transport
PMU	:	Project Management Unit
SPC	:	State Planning Committee

Other Abbreviations

A	:	Ampere
A/P	:	Authorization to Pay
Ave.	:	average
Br.	:	Bridge
CBR	:	California Bearing Ratio
Cm	:	centi meter
DBST	:	Double Bituminous Surface Treatment
GDP	:	Gross Domestic Product
H	:	Height
HP	:	horsepower
Km	:	kilometer
Km/h	:	Kilometer per hour
Km^2 or sq.km	:	Square kilometer
L	:	litter
Lm	:	Linear meter
Max.	:	Maximum
Min.	:	Minimum
No.	:	Numbers
PC	:	Prestressed Concrete
PVC Pipe	:	vinyl chloride pipe
RC	:	Reinforced Concrete
VND	:	Vietnamese Dong
Veh.	:	Vehicles
VPD	:	Vehicles Per Day

W	:	Width
m^2 sq.m	:	Square meter
m^3 or cum.	:	cubic metro
mm^2	:	Square Millimeter
t	:	Ton
t/h	:	Ton per hour
t/m^2	:	Ton per square meter
¥	:	Yen
$	:	Dollar
ϕ	:	Diameter
%	:	Per cent

Summary

Summary

The Socialist Republic of Vietnam (hereafter referred to as "Vietnam") is located along the eastern edge of the Indochina Peninsula, bordered by China on the north, Laos on the west, and Cambodia on the southwest. The land area of Vietnam is roughly 87 % of that of Japan, at 329,560 square kilometers. The population as of 1999 is 76.3 million.

The government of Vietnam introduced the "Doi Moi" policy in 1986 as a measure to restore the domestic economy in the aftermath of the war, through which vigorous development has been carried out in all sectors. In November of 1998, the Ministry of Transport (MOT) made public the "Road Development Plan for 2020" in which three major areas, i.e., the northern mountain area, the precipitous central mountain area, and the Mekong Delta area; are singled out for road development. At present the central area of Vietnam is the least developed and economically backward region, for which bridge construction and upgrading of roads are urgent issues.

The area involved in the present project comprises the eighteen central provinces (inclusive of Da Nang municipality), stretching 1,300 km from Thanh Hoa province in the north to Binh Thuan province in the south; however with a width of only 50 to 200 km from east to west.

With the exception of Da Nang, the percentage of the GDP occupied by the agricultural, forestry, and fishing sectors in all provinces is higher than the national average, six provinces being at more than 50 %. This indicates an economic structure which relies heavily upon primary industries. Again with the exception of Da Nang, the GDP per capita in each province is below the national average, accounting for a total of approximately 21.5 million people, or 97 % of the region's population and 28 % of the Vietnamese national total. There are many places in the central area still lacking proper road and bridge facilities, and many areas are cut off and isolated when water levels rise during the rainy season, bringing about delay in regional development, stagnation of socioeconomic activities, not to mention considerable inconvenience in the daily lives of inhabitants. For these reasons, there is a need to replace or newly construct bridges along secondary routes and other routes vital to inhabitants' livelihood.

Based on these circumstances, the Vietnamese government in March 2001 requested for Japan's government for the improvement of 87 bridges in the central area.

The Japanese government responded to the request for grant aid cooperation by directing the Japanese International Cooperation Agency (JICA) to conduct a basic design study.

JICA sent the Basic Design Study Team to conduct the on-site preliminary survey from August 5 to September 8, 2001; and the secondary survey from October 4 to November 17 the same year. Confirmation of the contents of the request was made through explanation and discussion of the Inception Report with the Vietnamese government. It was found that some discrepancies had arisen between the time of the initial request and the present status due to the either construction of temporary bridges or budget securing for such, therefore three (3) bridges which have been constructed were removed from the list, the number was changed from 87 to 84.

Along with carrying out an on-site survey of the requested 84 bridges, the team surveyed and collected data relating to the executing organization and its level of competence, operational and maintenance ability, priority projects and relations to other donor countries, as well as the social importance of each bridge site within the sphere of the project.

Eventually 45 bridges were selected as applicable to grant aid, based on the following: (a) the condition of the existing bridge, (b) traffic volume, (c) economic situation, (d) economic benefits, (e) contribution to minority tribes, (f) condition of access road and/or existence of plans for improvement, (g) period of impassability per year. Each bridge was evaluated according to the above items and assigned order of priority.

Among the 45 selected bridges, 22 were classified as "Bridge Construction Type" and the remaining 23 as "Steel Girder Procurement Type" based upon certain evaluating criteria (see below).

(a) Criteria for "Bridge Construction Type" (22 selected)

- The bridge must be technically difficult for construction by local contractor
- Land acquisition for the construction site is uncomplicated
- Access to construction site is smooth
- Technology transfer of the bridge itself is practicable

(b) Criteria for "Steel Girder Procurement Type" (23 selected)

- The supplied girder must be easy enough for the Vietnamese contractor to manage
- The supplied girder must be maintainable following construction

Following classification, detailed bridge surveys, topographical and geological surveys, hydrological survey and traffic volume survey were conducted, after which basic design and construction plans/estimates for all 45 bridges were put together to form the Basic Design Report.

JICA sent a Study Team from January 6 to January 15, 2002 to explain the Basic Design Report, to which the Vietnamese authorities agreed to following discussion and confirmation. The contents of the plan are shown in Table 1 below.

Table 1 Contents of Project

Contents of Project		
Bridge Construction Type (22 bridges)	Newly constructed bridges	6 bridges (all PC)
	Replacement of damaged bridges	16 bridges (13 PC, 3 steel)
Steel Girder Procurement (23 bridges)	Newly constructed bridges	9 bridges (all steel)
	Replacement	14 bridges (all steel)
	Soft component	Japanese engineers are sent to monitor and oversee the substructure construction by Vietnamese contractors as well as produce a manual for the girder erection of the superstructure in order to raise engineering standards and ensure early completion.

The project execution period for “Bridge Construction Type” bridges is 22 months over a period of three fiscal years, broken down into a period of 4 months for detailed design work, and 18 months for procurement. In the case of procurement and soft component for “Steel Girder Procurement Type” bridges, 4.5 months will be set aside for detailed design and 8.5 months as procurement; a total of 12.5 months.

The executing agency for this project is the Ministry of Transport, and operation/management is under the charge of PMU 18. Judging from the operation and management record (the completed “Project for Construction of Bridges in Northern Area” and ongoing “Project for Reconstruction of Bridges in Mekong Delta Area”, both under Japanese grant aid) of both the MOT and PMU 18, it can be said that the present establishment is sufficient for the administration of this project.

Direct effects of the completion of this construction are as follows:

- More consistent transportation availability

  With replaced or new bridges, transportation along existing roads will be more dependable.

- Safer passage

  By replacing outmoded or deteriorated bridges, safer passage will be ensured.

- Year-round transportation

  With construction of bridges over rivers which cannot be forded in the rainy season, year-round transportation will be made available.

- Alleviation of detour routing

  Extra costs now caused by detouring will be mitigated by the replacement of bridges which now serve only pedestrians or have load restrictions of 10 tons or lower.

Furthermore, the following indirect effects also:

- Promotion of local economical activities

  With consistent transportation made available, faster shipping of agricultural products is made possible, thereby invigorating the agricultural industries.

- Raised living standards

  Access to schools, hospitals are improved, and constant transportation of goods and living standards of local inhabitants are raised. The same can be stated concerning minority tribes who inhabit nearby areas.

- Regional effect

  The construction of bridges which alleviate bottlenecks in the regional transportation network does not only directly effect the local inhabitants, but by dramatically improving the transportation infrastructure as an important industrial base, the economy and industrial development of the surrounding region in addition to project area itself will be favorably affected in the longer term.

- National effect

  From the national viewpoint, the regional effect mentioned above would at the same time contribute by helping to rectify inter-regional social and economic disparities for a more well-balanced overall national development.

In light of the fact that this project would be extremely effective in the expeditious completion of the road network and that it would contribute economically to the lives of inhabitants along the roads on which the bridges are located, thereby raising living standards, this project is deemed appropriate to be executed under Japanese grant aid.

Furthermore, it would be impossible to maintain the function of the project without the necessary maintenance following its completion. Therefore, it is necessary that each province monitors bridges and access roads as well as bank protection especially in times of flooding and that the slightest damage be repaired in its first stage. Each province needs to provide the minimum budget for such expenses.

TABLE OF CONTENTS

Preface
Letter of Transmittal
Location Map/Perspective/Photographs of Bridge Sites
Lists of Figures and Tables
Abbreviations
Summary

Page

CHAPTER 1 BACKGROUND OF THE PROJECT ..... 1 - 1

CHAPTER 2 CONTENTS OF THE PROJECT ..... 2 - 1

2.1 Basic Concept of the Project ..... 2 - 1
2.1.1 Revision and Confirmation of Request ..... 2 - 1
2.1.2 Candidate Bridges ..... 2 - 1
2.1.3 Preliminary Selection of Project Bridges ..... 2 - 3
2.1.4 Classification into Component A (Bridge Construction) and Component B (Steel Girder Procurement) ..... 2 - 7
2.1.5 Detailed Bridge Survey ..... 2 -10
2.2 Basic Design of the Requested Japanese Assistance ..... 2 -12
2.2.1 Design Policy ..... 2 -12
2.2.2 Basic Design ..... 2 -15
2.2.3 Basic Design Drawings ..... 2 -30
2.2.4 Implementation Plan for Bridge Construction (Component A) ..... 2 -35
2.2.4.1 Implementation Plan ..... 2 -35
2.2.4.2 Implementation Conditions ..... 2 -36
2.2.4.3 Scope of Works ..... 2 -36
2.2.4.4 Consultant Supervision ..... 2 -37
2.2.4.5 Procurement Plan ..... 2 -39
2.2.5 Implementation Plan for Girder Procurement (Component B) ..... 2 -52
2.2.5.1 Implementation Policy ..... 2 -52
2.2.5.2 Procurement Conditions ..... 2 -52
2.2.5.3 Scope of Works ..... 2 -52
2.2.5.4 Consultant Supervision ..... 2 -53
2.2.5.5 Procurement Plan ..... 2 -54
2.2.5.6 Implementation Schedule ..... 2 -54
2.3 Obligations of Recipient Country ..... 2 -56
2.4 Project Operation and Maintenance Plan ..... 2 -57
2.5 Other Relevant Issues ..... 2 -59
2.5.1 Soft Component Plan ..... 2 -59

CHAPTER 3 PROJECT EVALUATION ..... 3 - 1

3.1 Project Effect ..... 3 - 1
3.2 Issues and Recommendations ..... 3 - 2
3.3 Project Evaluations ..... 3 - 2
3.4 Conclusions ..... 3 - 3

Basic Design Drawings

Component A (Bridge Construction)

General Views of the Sites

General Views of the Bridges

Component B (Steel Girders Procurement)

General Views of the Bridges

Appendices

1. Member List of the Survey Team
2. Survey Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Cost Estimation Borne by the Recipient Country
6. Other Relevant Data
7. Bridge Survey Results
8. Natural Conditions Survey Results - Topographic/Geotechnical
9. Natural Conditions Survey Results - Hydrological
10. Traffic Volume Survey Results
11. Soft Component

Chapter 1 Background of the Project

Chapter 1 Background of the Project

Following the previous war in Vietnam, in order to alleviate the economic gap between the economic center Ho Chi Minh City in the south and regions in the north including Hanoi, the development of National Highway Route 1 has been carried out and promoted as a major transportation measure to that purpose.

This economic strategy, followed by the Doi Moi Policy of the 1980s succeeded in raising the GDP growth rate to 8 - 9% in real terms.

As the next economic measure, the government undertook to alleviate the economic disparities between urban and rural districts and is presently carrying out measures to develop rural social infrastructure. As one link in the social infrastructure development of provincial regions, bridges have been developed in the north as well as Mekong Delta areas. The economic effects of these bridges is expected to be significant.

At present, the narrowing of the gap between the disparate economic levels of the central region, being the least developed part as well as the poorest part of the country, and the rest of Vietnam remains to be the greatest concern. Raising the quality of life particularly in areas removed from National Route 1 is of utmost concern in this matter.

The Central Area of Vietnam as dealt with in this survey is divided into three areas, namely, the north-central coastal area, the south-central coastal area, and the central highlands area. The entire area is rather narrow east to west, being no wider than 50 km at places, and the Truong Son mountain range closely approaches the coastline throughout.

This unique geological characteristic means that rivers in the area flow rather rapidly and often bring about flooding in the lowlands. It also makes the development of large-scale water resources nearly impossible, causing delayed economic development in the survey area as compared to the areas around Hanoi and Ho Chi Minh City.

The inhabitants of the rural areas of the central area chiefly subsist on agriculture, forestry, and fishing, in other words, primary industries; and the majority live below poverty level. Minority mountain tribes are also widely distributed throughout the area.

Beginning with the restoration of bridges subsequent to the end of the war and continuing with repairs and maintenance projects following yearly floods, efforts at maintaining the bridge network have been carried out in the area, but the infrastructure remains weak. Furthermore, due to lack of sufficient budget it is often the case that construction of temporary bridges is the most efficient solution available, though even these are often severely damaged to the point that even pedestrian traffic is impossible, to say nothing of light vehicular traffic. During the rainy season, many areas are thus cut off and isolated from the market destinations of their agricultural products, gravely effecting economic activities. This can be said to be one of the major causes of poverty in the area. In addition, other social activities such as medical treatment, education, and administrative services are also greatly effected; therefore the quality of life in the region suffers as well as the economy.

In light of these problems and along the same lines as the previous, projects of “Construction of Bridges in Northern Area” and “Reconstruction of Bridges in Mekong Delta Area” the government of Vietnam has requested the Japanese government for grant aid assistance regarding a selection of 87 particularly urgent bridge projects from among eighteen provinces in the Central Area as candidates for construction/replacement with the purpose of upgrading the lives of inhabitants as well as their economic activities.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

2.1.1 Revision and Confirmation of Request

The Inception Report was jointly discussed by the Vietnamese and Japanese sides and the contents of the request were confirmed. Due to the fact that some bridges originally requested were deleted or replaced by others due to the fact that they were constructed, or implementation plans were drawn up for them; after submission of the request to the Japanese government.

The aforementioned reconsideration of bridges for assistance took place due to a change of situation occurring since the time of the original request by the Vietnamese government, which constructed or procured funds for the construction of temporary bridges as an emergency measure following the disastrous flooding in 1999.

Eventually three bridges were deleted and nine bridges replaced with alternative bridges from among those originally requested by the Vietnamese government. The total number of candidate bridges was revised from 87 to 84, and 84 bridges were defined as candidate bridges and agreed upon by both parties.

2.1.2 Candidate Bridges

The 84 candidate bridges are shown in Table 2-1.

Table 2-1 The 84 Candidate Bridges

Province	Br.No.	Priority	Bridge Name	Exisisting Bridge			Pro. Br. L(m)
				Chrac.	L(m)	W(m)	
THANH HOA	1	1	NAM KHE	×	-	-	100
	2	2	CHINH DAI	△	19	1.8	30
	3	3	PHUC HUNG	○	100	2.1	120
	4	4	THACH QUANG	×	-	-	100
	5	5	THACH DINH	○	87	3.0	90
NGHE AN	6	1	QUYNH BANG	○	60	5.9	80
	7	2	KE CHIENG	×	-	-	30
	8	3	DIEN VAN	×	-	-	90
	9	4	BAN KHOANG	×	-	-	90
HA TINH	10	1	HOI	×	-	-	62
	11	2	MY SON	○	38	3.0	105
	12	3	CUA TRAI	○	40	2.3	50
	13	4	TRUC	×	-	-	90
	14	5	HA RONG	○	38	1.8	120
QUANG BINH	15	1	PHU VINH	△	36	2.0	50
	16	4	RAO SAU	×	-	-	70
	17	2	BEN CUNG	×	-	-	75
	18	3	LAC THIEN	△	74	1.5	80
QUANG TRI	19	1	THUY KHE	×	-	-	
	20	2	BEN DA	×	-	-	50
	21	3	HIEN LUONG 2	×	-	-	100
	22	4	PA NHO	○	19	2.6	40
THUA THIEN	23	1	SIA	○	30	3.9	30
	24	2	NA MAY	×	-	-	90
	25	3	DUONG THANH	○	50	1.7	50
	26	4	KHE DUONG	×	-	-	36
DA NANG CITY	27	1	HOI PHUOC	×	—	—	70
	28	2	DA NHAY	○	100	6.0	120
	29						
	30	3	SAP	×	-	-	70
	31						
QUANG NAM	32	1	TAM THANH	○	96	3.8	100
	33	3	BINH DAO	○	60	5.0	60
	34	4	SONG QUAN	×	38X6	Spillway	60
	35	2	DAI LOI	△	54	1.2	60
BINH THUAN	36	1	DA DUNG	○	73	4.4	90
	37	2	TRANG	○	21	3.4	40
	38	3	SUOI CAT	○	28	4.2	30
	39	4	SONG DINH	○	40	4.2	45
	40	5	LANG QUANG	○	50	4.0	50
NINH THUAN	41	5	HUN NAM	×	-	-	70
	42	1	TUAN TU	○	61	2.5	65
	43	4	TAM NGAN	△	80	1.4	80
	44	2	SONG THANG	△	85	2.4	90
	45	3	CAU GAY	○	62	4.5	65
LAM DONG	46	1	TAN VAN	○	71	6.0	75
	47	3	LOC NGAI	△	38	1.2	40
	48	2	NONG TRUONG BO SUA	○	64	4.5	75
	49	-	KA DON	△	21	3.8	
	50	-	K'NAI	△	7	1.0	
	51	4	KA DO	○	55	4.2	100
DAC LAC	52	1	EA SOUP	○	46	4.4	50
	53	5	DAK PRI	○	25	4.5	100
	54	4	EA SOUR	○	38	4.0	60
	55	3	ROXY	○	20	4.3	30
	56	2	KRONG K'MAR	○	66	4.0	75
GIA LAI	57	1	A YUN HA	○	110	3.5	100
	58	2	DAK PO TO	×	42x3	submerged	60
	59	3	IA DRANG	○	35	3.7	60
	60	4	SUOI VOI	○	27	4.5	
	61	5	IA PLOC	×	—	—	
KON TUM	62	5	NGOC REO	×	30x4	submerged	50
	63	1	DAK ANG	△	103	1.6	100
	64	4	DAK TO KAN	×	50x3.5	submerged	70
	65	2	DAK SAO	×	—	—	
	66	3	NGOC TU	△	5	1.0	60
QUANG NGAI	67	1	XA CAI	○	60	3.2	70
	68	2	PHOUG XA	○	44	2.2	50
	69						
	70	3	DO	X	(52)		80
	71	4	KHE KY	○	84	3.2	90
	72	5	SONG SAU	○	46	4	60
BINH DINH	73	1	TRUONG XUAN	○	100	2.2	100
	74	2	BA LE	○	34	3	50
	75	3	HOA PHONG	○	95	2.2	100
	76	4	DAO LONG	○	49	2.1	50
	77	5	TRUONG DINH	○	38	3	45
PHU YEN	78	3	TRA O	○	12	3.5	40
	79	2	TRA BUONG	×	-	-	60
	80	4	SUOI CAU 1	×	-	-	
	81	5	SUOI CAU 2	×	-	-	
	82	1	DA LOC	○	19	1.0	40
KHANH HOA	83	2	NGOI NGAN	○	47	3.5	50
	84	4	CHAY	○	32	4.5	35
	85	3	SONG GOC	×	-	-	85
	86	1	TIEN DU	○	28	3.5	45
	87	5	BE	△	55	1.5	55

Priority: Priority in Province

○ :Vehicle Bridge
△ :Pedestrian Bridge
× :No Bridge

2.1.3 Preliminary Selection of Project Bridges

(1) Preliminary Screening of the 84 Candidate Bridges

Through preliminary screening, the following 11 bridges were deleted from the 84 candidate bridges:

① Bridges already constructed, or under construction or for which plans for construction have been prepared

② Bridges longer than 100 m, which are not suitable for construction under Japanese Grant Aid Scheme

③ Bridges for which access roads are very poor and have no plans for improvement, making it impossible to transport materials/equipment for bridge construction

As a result of this screening, bridges for Japanese Grant Aid were preliminarily selected from the remaining 73 bridges, agreed upon with the Vietnamese side.

(2) Selection of bridges by Priority Ranking Method

The need for replacement or new construction of bridges as selected by the Government of Vietnam was confirmed by a bridge survey. The decision process of whether or not to include bridges in the project was assisted by a scoring method, as shown below.

1) Evaluation Indicators applied for selection

Evaluation indicators are selected in consideration of the characteristics of the study area, which is recognized as being an area suffering from more severe economic conditions than other areas of the country; also frequently suffering damage by flood.

(A) As indicators to evaluate the importance of the candidate bridges:

① Conditions of the existing bridge

The following items will be considered as the conditions of the existing bridge:

- Whether or not a bridge exists at the requested site
- Load limitation of the bridge
- Type of the bridge: for pedestrians only or for vehicles

② Traffic volume: including pedestrians, bicycles and motorbikes in addition to vehicles

(B) As indicators to consider the severe economic conditions of the central area:

③ Economic condition of provinces: GDP/capita

④ Social and economic impact on local people using the candidate bridge

- Social impact: Access to schools, hospitals, clinics and markets
- Economic impact: Transportation demand; including transport of agricultural, fishery and forestry products

⑤ Impact on ethnic minorities: existence of ethnic minorities in the area affected by bridge reconstruction

(C) As an indicator to maximize the effects of this project:

⑥ Conditions of the access roads to the bridge and plan for improvement

(D) As an indicator to consider as an area which suffers damage by flood

⑦ Period of impassability due to yearly flooding

2) Grade and Weight of Each Indicator

① Bridge Conditions (Weight: 6 points)

5	Destroyed by war or flood
4	Load limit 1 - 5 tons Temporary pedestrian bridge plus riverbed road
3	Load limit 5 - 10 tons Floating bridge or pontoon
2	Load limit 10 - 15 tons Pedestrian bridge, submergible road, no existing bridge
1	Load limit over 15 tons

② Traffic Volume (Weight: 5 points)

5	Converted volume: over 1000
4	Converted volume: 700 - 999
3	Converted volume: 400 - 699
2	Converted volume: 100 - 399
1	Converted volume: less than 100

Converted volume calculated as follows:
Vehicle: 1, Motorcycle: 0.3, Bicycle/Pedestrian: 0.1

③ Economic Condition (GDP/capita) (Weight: 4 points)

5	GDP/capita less than US$200
4	200 ~ 249
3	250 ~ 349
2	350 ~ 399
1	More than 400

④ Social and economic impact on local people using the candidate bridges

Access to schools, hospitals/clinics and markets - Maximum 7 points
Transportation of agricultural/forestry products - Maximum 3 points

⑤ Impact on ethnic minorities

Maximum - 5 points

⑥ Upgrading of access road

Maximum - 5 points

⑦ Period of impassability due to yearly flooding

Maximum - 5 points

3) Results of Priority Ranking

The 73 candidate bridges were evaluated by the indicators mentioned above and the total score for each bridge calculated by unit points for each indicator according to its weight. According to the total score, all 73 candidate bridges are classified into 6 classes from A to E. The range of the total score for each class and classification results are shown in Table 2-2.

Table 2-2 Evaluation Results

Rank	Range of Total Score	No. of Bridges
A	80-100	7
B	60-79	36
C-1	50-59	17
C-2	40-49	11
D	20-39	2
E	0-20	0
Total		73

The preliminary selection of the candidate bridges was undertaken according to the following procedure.

① The 43 Bridges receiving high priority scores (A or B) were selected, and six (6) bridges eventually omitted, making a total of 37. These bridges were left out for the reasons described below:

No.23 Sia Bridge (Thua Thien Hue Province)

It was confirmed that a new bridge for vehicles is under construction 600m downstream of the candidate bridge. The traffic passing on the candidate bridge can be expected to shift to the new bridge.

No.33 Bin Dao Bridge (Quang Nam Province)

This bridge carries an irrigation channel making it necessary to raise the bridge level to ensure navigation clearance. This requires large-scale improvement of the approach sections of the irrigation channel, and is thus not appropriate as a bridge under the Grant Aid Scheme due to scale.

No.51 Ka Do Bridge (Lam Dong Province)

The discharge of a dam upstream affects flood flows at this bridge site. Although the maximum discharge of the dam has been recorded as 1,600 m^3/s, the capacity of the river section at the bridge site is only 400 m^3/s and spillways were constructed on both approach roads to the bridge to accommodate overflow water during floods. Since improvement of the river section will be required in addition to the bridge replacement, it is not appropriate as a bridge under the Grant Aid Scheme due to the large scale.

In addition, since No. 46 Tan Van Bridge will be replaced in this project, it can be used as an alternative route.

No.68 Phuoc Xa Bridge and No.71 Khe Ky Bridge (Quang Ngai Province)

Since all five candidate bridges requested by Quang Ngai Province were ranked A or B, the two lowest scoring bridges were omitted in consideration of the balance of the number of selected bridges among provinces.

No.75 Hoa Hong (Binh Dinh Province)

Since four candidate bridges requested by Binh Dinh Province were ranked A or B, the lowest scoring bridge is omitted in consideration of the balance of the number of selected bridges among provinces.

② The following eight bridges were selected from among the candidate bridges ranked as C-1 in addition to the bridges selected in procedure ①, in consideration of balance of numbers among provinces.

Province	Br. No/Br. Name	Remarks
Thanh Hoa	No.2: Chinh Dai	- It will have great socio-economic impact on local people. - Upgraded plan will be implemented in the near future.
Nghe An	No.9: Ban Khoang	- No existing bridge; impassable period due to flooding long. - It will contribute to improvement of the livelihood of minorities.
Ha Tinh	No.12: Cua Trai	- Low load capacity of the existing bridge - It will have socio-economic impact on local people.
Quang Binh	No.15: Phu Binh	- High traffic volume
	No.18: Lac Thien	- It will have great socio-economic impact on local people. - The bridge sometimes becomes impassable in rainy season.
Ninh Thuan	No.45: Cau Gay	- Damage level on the bridge is relatively high. - Upgraded plan will be implemented in the near future.
Lam Dong	No.47: Loc Ngai	- It will contribute to improvement of the livelihood of minorities. - Upgraded plan will be implemented in the near future.
Phu Yen	No.78: Tra O	- It will have great socio-economic impact on local people. - Upgraded plan will be implemented in the near future.

As a result of the preliminary selection, 45 bridges were selected as the bridges to be reconstructed/newly-constructed from among the 73 candidate bridges. (See Table 2-3)

2.1.4 Classification into Component A (Bridge Construction) and Component B (Steel Girder Procurement)

In this project there are two components, namely Component A (Bridge Construction) and Component B (Steel Girder Procurement).

Component A (Bridge Construction) :

All works, design, construction and construction supervision of bridges, approach roads and riverbank protection will be executed under Japanese Grant Aid Scheme.

Component B (Steel Girder Procurement) :

Steel girders of bridges will be supplied under Japanese Grant Aid Scheme, and girder erection and surface work will be executed by Vietnamese side. Moreover

Vietnamese side will execute design, construction and construction supervision of substructures, approach roads and riverbank protection.

Classification into two components has been carried out in the following way:

1) Component A (Bridge Construction)

Structures satisfying the following criteria were chosen as most appropriate for immediate construction by Japanese Grant Aid.

- Construction of the bridge is technically rather difficult, since special materials are used, or a special technique is required.
- There is no specific problem in accessing the bridge site.
- Land acquisition is not a major concern.
- Technology transfer is properly executed.

2) Component B (Steel Girder Procurement)

Structures satisfying the following criteria were judged most suitable for construction by the Vietnamese Government, with assistance by the Japanese Government limited to supply of steel girders, and limited technical assistance.

- Conditions are good for girder erection.
- Maintenance is easy in future.
- Accessibility to the bridge site is not so satisfactory.
- No complex foundation is required.

The procedure of preliminary selection for the 45 bridges and classification into Components is shown in Table 2-3.

Table 2-3 Selection from 84 Candidate Bridges

Province	Br. No	Priority of Prov.	Name of Bridge	Existing Bridge Condition			Proposed Length (m)	Out of Proiect Scope	Priority Calculation									Results		Remarks
				Situation	Length (m)	Width (m)			Bridge Condition ①	Traffic Condition No of Veh	Traffic Condition ②	Economic Condition GDP/cap	Economic Condition ③	Social Impact ④	Impact on Minority ⑤	Upgrade Plan of Access Rd. ⑥	Impassable duration ⑦	Priority Score	Priority Rank	Compo. A (Construction)	Compo. B (Girder Procurement)	
THANH HOA	1	1	NAM KHE	×	-	-	100		5	0	1		5	0				55	C-1			
	2	2	CHINH DAI	○	19	1.8	30		2	100	2		5	9		5		56	C-1		◎	
	3	3	PHUC HUNG	○	100	2.1	120	×				175										
	4	4	THACH QUANG	×	-	-	100		5	60	1		5	8		5	5	73	B		◎	
	5	5	THACH DINH	○	87	3.0	90		3	700	4		5	5				63	B	◎		
NGHE AN	6	1	QUYNH BANG	○	60	5.9	80		3	3500	5		5	7				70	B	◎		
	7	2	KE CHIENG	×	-	-	30		2	740	4	175	5	7			5	64	B		◎	
	8	3	DIEN VAN	×	-	-	90		2	100	1		5	2				39	D			
	9	4	BAN KHOANG	×	-	-	90		2	50	1		5	7	5		5	54	C-1		◎	
HA TINH	10	1	HOI	×	-	-	62		2	0	1		5	1		5		43	C-2			
	11	2	MY SON	○	38	3.0	105		4	240	2	160	5	6			5	65	B	◎		
	12	3	CUA TRAI	○	40	2.3	50		4	50	1		5	5				54	C-1		◎	
	13	4	TRUC	×	-	-	90		2	45	1		5	7		5		49	C-2			
	14	5	HA RONG	○	38	1.8	120	×														
QUANG BINH	15	1	PHU VINH	○	36	2.0	50		2	400	3	155	5	4				51	C- 1		◎	
	16	4	RAO SAU	×	-	-	70		2	10	1		5	7			5	49	C-2			
	17	2	BEN CUNG	×	-	-	75		2	3	1		5	3			5	45	C-2			
	18	3	LAC THIEN	○	74	1.5	80		2	250	2		5	7			3	52	C-1	◎		
QUANG TRI	19	1	THUY KHE	Under Construction				×														
	20	2	BEN DA	×	-	-	50		5	100	1	176	5	8			5	68	B		◎	
	21	3	HIEN LUONG 2	×	-	-	100		2	0	1		5	5				42	C-2			
	22	4	PA NHO	○	19	2.6	40		4	310	2		5	8			3	65	B	◎		
THUA THIEN	23	1	SIA	○	30	3.9	30		3	3900	5		4	1				60	B			Bridge at 600m downstream side is under construction
	24	2	NA MAY	×	-	-	90		2	450	3	206	4	9	5		5	62	B		◎	
	25	3	DUONG THANH	○	50	1.7	50		2	550	3		4	5				48	C-2			
	26	4	KHE DUONG	×	-	-	36		5	350	2		4	8		5		69	B	◎		
DA NANG CITY	27	1	HOI PHUOC	X	(20)		70		5	180	2		2	10	1	1	5	65	B	◎		
	28	2	DA NHAY	○	100	6	120	×														
	29	3										370										
	30	4	SAP	×	—	—	70		5	75	1		2	3	1	0	2	49	C-2			
	31	5																				
QUANG NAM	32	1	TAM THANH	○	95	3.8+3.5	100		3	724	4		5	0	0	0	0	58	C-1			
	33	3	BINH DAO	○	60	5	60		3	4,500	5	176	5	4	0	1	0	68	B			Irrigation channel attached with the bridge is also required to replace
	34	4	SONG QUAN	Submerged	38	6	60		2	435	3		5	10	0	5	5	67	B		◎	
	35	2	DAI LOI	○	54	1.2	60		2	250	2		5	10	0	4	4	60	B	◎		
BINH THUAN	36	1	DA DUNG	○	73	4.4	90		2	1750	5		5	9		5		71	B	◎		
	37	2	TRANG	○	21	3.4	40		4	275	2		5	6	5	5	5	75	B	◎		
	38	3	SUOI CAT	○	28	4.2	30		4	1940	5	170	5	9	5	5		88	A		◎	
	39	4	SONG DINH	○	40	4.2	45		2	320	2		5	6		5		53	C-1			
	40	5	LANG QUANG	○	50	4.0	50		3	170	2		5	2		5		55	C-1			
NINH THUAN	41	5	HUN NAM	×	-	-	70		2	10	1		5	2			3	42	C-2			
	42	1	TUAN TU	○	61	2.5	65		4	340	2		5	7	5	5	5	76	B		◎	
	43	4	TAM NGAN	△	80	1.4	80		4	16	1	197	5	9	5	5		68	B	◎		
	44	2	SONG THANG	○	85	2.4	90		4	90	1		5	7				56	C-1			
	45	3	CAU GAY	○	62	4.5	65		4	75	1		5	5		5		59	C-1		◎	
LAM DONG	46	1	TAN VAN	○	71	6.0	75		3	1300	5		5	8	5	5		81	A	◎		
	47	3	LOC NGAI	△	38	1.2	40		2	30	1		5	5	5	5		52	C-1		◎	
	48	2	NONG TRUONG BO SUA	○	64	4.5	75		4	210	2	190	5	5	5	5		69	B		◎	
	49	-	KA DON	Under Construction				×														
	50	-	K'NAI	Under Construction				×														
	51	4	KA DO	○	55	4.2	100		2	720	4		5	8	5	5	3	73	B			Improvement of the river section is also required
DAC LAC	52	1	EA SOUP	○	46	4.4	50		3	180	2		4	10	5	5	5	69	B	◎		
	53	5	DAK PRI	○	25	4.5	100		2	100	2		4	5	5	5	5	58	C-1			
	54	4	DAK SOUR	○	38	4.0	60		2	280	2	221	4	3	5	5	3	54	C-1			
	55	3	ROXY	○	20	4.3	30		3	630	3		4	8	5	5		67	B		◎	
	56	2	KRONG K'MAR	○	66	4.0	75		3	230	2		4	8	5	5		62	B	◎		
GIA LAI	57	1	A YUN HA	○	110	3.5	100		3	745	4		5	1	0	0	0	59	C-1			Balance in the number of the selected bridge between provinces
	58	2	DAK PO TO	Submerged	42	3.0	60		2	169	2		5	10	5	5	5	67	B		◎	
	59	3	IA DRANG	○	35	3.7	60		3	1,160	5	161	5	10	5	5	5	88	A	◎		
	60	4	SUOI VOI	Constructed by province				×														
	61	5	IA PLOC	Constructed by province				×														
KON TUM	62	5	NGOC REO	Submerged	30	4.0	50		2	165	2		5	10	5	5	5	67	B		◎	
	63	1	DAK ANG	○	103	1.6	100		2	47	1		5	5	5	0	0	47	C-2			
	64	4	DAK TO KAN	Submerged	50	3.5	70		2	190	2	160	5	10	5	3	4	64	B		◎	
	65	2	DAK SAO	Impossible to deliver equipment				×					5									
	66	3	NGOC TU	○	5	1.0	60		4	330	2		5	10	5	5	3	77	B	◎		
QUANG NGAI	67	1	XA CAI	○	60	3.2	70		5	460	3		5	10	0	4	5	84	A	◎		
	68	2	PHOUC XA	○	44	2.2	50		4	1.050	5		5	4	0	3		76	B			Balance in the number of the selected bridge between provinces
	69	3										165										
	70	4	DO	X	(52)		80		5	180	2		5	10	0	5	5	80	A	◎		
	71	5	KHE KY	○	84	3.2	90		3	2.970	5		5	4	0	4		71	B			Balance in the number of the selected bridge between provinces
	72	6	SONG SAU	○	46	4	60		4	720	4		5	10	0	3	5	82	A		◎	
BINH DINH	73	1	TRUONG XUAN	○	100	2.2	100		4	72	1		5	0	0	0	0	49	C-2			
	74	2	BA LE	○	34	3	50		5	450	3		5	10	0	4	5	84	A	◎		
	75	3	HOA PHONG	○	95	2.2	100		4	960	4	189	5	5	0	2	1	72	B			Balance in the number of the selected bridge between provinces
	76	4	DAO LONG	○	49	2.1	50		4	650	3		5	10	0	3	1	73	B		◎	
	77	5	TRUONG DINH	○	38	3	45		4	560	3		5	10	0	5	1	75	B		◎	
PHU YEN	78	3	TRA O	○	12	3.5	40		2	215	2		5	5		5		52	C-1	◎		
	79	2	TRA BUONG	×	-	-	60		4	75	1		5	9	5	5		68	B	◎		
	80	4	SUOI CAU 1	Completion of Spillway by Province				×				179										
	81	5	SUOI CAU 2	Completion of Spillway by Province				×														
	82	1	DA LOC	○	19	1.0	40		4	85	1		5	7	5	5	1	67	B		◎	
KHANH HOA	83	2	NGOI NGAN	○	47	3.5	50		4	150	2		3	9		5		60	B	◎		
	84	4	CHAY	○	32	4.5	35		3	190	2		3	5		5		50	C-1			
	85	3	SONG GOC	×	-	-	85		2	100	2	306	3	5		2.5		42	C-2			
	86	1	TIEN DU	○	28	3.5	45		4	300	2		3	9		5		60	B		◎	
	87	5	BE	△	55	1.5	55		2	10	1		3	2				31	D			
			Score=(1)*6+(2)*5+(3)*4+(4)+(5)+(6)+(7)															22		23		

Bridge Condition

5	No existing bridge because it has been swept away by flood
4	1-5ton limitation or temporary pedestrian or vehicle crossing on the riverbed
3	5-10ton limitation or floating bridge
2	10-15ton limitation or pedestrian bridge only
1	more than 15ton

Traffic Condition

5	More than 1000 vehicles or equivalent
4	700-999 vehicles
3	400-699 vechiles
2	100-399 vechiles
1	Less than 100 vechiles

Social Impacts

7	Access to school, hospital and market
3	Agricultural production, logging and others

Impassable Duration in a Year

5	More than 10days
3	More than a few days
1	A few hours

Rank	
A	80-100
B	60-79
C-1	50-59
C-2	40-49
D	0-39

2.1.5 Detailed Bridge Survey

Detailed bridge survey was conducted in order to obtain necessary data and information for basic design of 45 bridges (22 Component A bridges, [Bridge Construction] and 23 Component B bridges, [Steel Girder Procurement]).

Table 2-4 shows summary of second survey results.

The following items for the Grant Aid Scheme were reconfirmed for each bridge:

- Effects on social and economic conditions
- Urgency of bridge replacement due to dangerous condition of existing bridges
- Reasonable project size (bridge size)
- Technical difficulty of bridge design and construction for Vietnamese side

The following items were reconfirmed for bridge planning and design:

- Classification of provincial/district/commune roads and bridge/road width
- Bridge length and span arrangement
- Bridge center line (on existing bridge or upstream/downstream)
- Control points (temples, graves, schools, hospitals, etc.)
- Water levels (Highest in history, highest every year, lowest)
- Starting point/ending point of approach road
- Land acquisition/ demolishing of houses for bridge construction
- Relocation of utilities (electric, telephone and water line)

The following items were confirmed for construction planning and cost estimate:

- Manufacturing yard for PC girders (component A), assembling yard for steel girders (component B), camp and office space, material stockyard, etc.
- Sand borrow pits of sand, coarse aggregate, embankment material, etc.

Table 2-4 Summary of 2nd Survey Results

Province	Bridge No.	Name of Bridge	Existing Bridge				Proposed Bridge													Site Information
			Length (m)	Span (m)	Width (m)	Type of Bridge	Length (m)	Span (m)	Width (m)	Road Grade	Determination Factor of Length and Span	Design W.L (H.W.L) (m)	Position Related to the Existing Bridge	Resettlement & facilities to be affected: No. of affected houses: Right Bank	Resettlement & facilities to be affected: No. of affected houses: Left Bank	Resettlement & facilities to be affected: Others	Navigation Clearance or Freeboard		Comp. A or B	Girder Type	
THANH HOA	2	CHINH DAI	19.0	16+3	1.8	H-beam	30.10	29.5	5.5	D	Pier is not constructed in river.	11.60	About 55m DS	Some houses	X		○	Same to existing one	B	Steel	Need retaining wall (4～5m)
	4	THACH QUANG	No Bridge				99.20	3×32.5	5.5	D	River width 80m, and HHWL	37.50	About 15m DS	X	X		×	0.5	B	Steel	River width=80m
	5	THACH DINH	87.0	-	3.0	Floating	92.30	30+30+30	5.5	P	River width and geographical feature are taken into consideration.	29.50	About 25m DS	1house	X		×	0.5	A	PC	No floating logs
NGHE AN	6	QUYNH BANG	60.0	5@12.0	5.9	H-beam	74.30	3x24.0	5.5	P	Set back a little with both banks.	15.50	About 10m DS	Some houses	×	shrimp pond	○	Same to existing one	A	PC	
	7	KE CHIENG	No Bridge				30.10	29.5	4.5	C	1 span	80.10	About 15m DS	X	X		×	0.5	B	Steel	River width 21m
	9	BAN KHOANG	No Bridge				81.20	3 x 26.5	5.5	D	River width and geographical feature are taken into consideration.	100.40	About 50m US		A few houses		×	0.5	B	Steel	River width 70m
HA TINH	11	MY SON	38.0	9+10+10+9	3.0	Con. Slab	86.30	27+30+27	5.5	D	Pier is not constructed in river.	60.60	75m DS	A few houses	X		×	0.5	A	PC	Winded river
	12	CUA TRAI	40.0	4@10.0	2.3	H-beam	54.20	3×17.5	4.5	C	High water area is covered.	8.40	10m DS	X	X		×	0.5	B	Steel	
QUANG BINH	15	PHU VINH	36.0	4@9.0	2.0	Wooden	48.15	2×23.5	5.5	D	No problem to construct piers in river.	21.00	50m DS	X	X		×	0.5	B	Steel	
	18	LAC THIEN	46.5	46.5	1.5	Suspension	65.30	18+27+18	5.5	D	Geographical feature is taken into consideration.	40.50	10m DS	X	X		×	0.5	A	PC	
QUANG TRI	20	BEN DA	No Bridge				54.15	2×26.5	5.5	P	2 span bridge, because 1 existing pier is left.	49.80	Same position	X	X		×	0.5	B	Steel	
	22	PA NHO	19.0	19.0	2.6	H-beam	54.20	3×17.5	5.5	D	Flood water volume is taken into consideration.	81.40	Same position	X	X		×	1.0	A	Steel	Narrow site space
THUA THIEN HUE	24	NA MAY	No Bridge				90.20	3×29.5	5.5	P	90m from bank to bank (same span)	79.90	Same position	X	X		×	1.0	B	Steel	
	26	KHE DUONG	No Bridge				42.15	2×20.5	4.5	C	River width and geographical feature are taken into consideration.	121.20	100m US	X	1 house		×	0.5	A	Steel	Cemetery on right bank
DA NANG CITY	27	HOI PHUOC	No Bridge				65.30	3×21.0	5.5	P	River width is taken into consideration.	51.00	Same position	1 hut	X		×	0.5	A	PC	
QUANG NAM	34	SONG QUAN	38.0	-	6.0	-	57.20	17.5+20.5+17.5	5.5	P	Width of upstream was taken into account.	80.60	Same position	X	X		×	0.5	B	Steel	
	35	DAI LOI	54.0	Uncountable	1.2	Wooden	65.30	3×21.0	5.5	D	River width is taken into consideration.	52.30	About 10m DS	Some houses	1 house		×	0.5	A	PC	
BINH THUAN	36	DA DUNG	73.0	13+3@20	4.4	Bailey	92.30	3×30.0	5.5	P	Set back a little with both banks.	14.70	About 15m US	×	8houses		×	0.5	A	PC	φ250 Waterpipe attached
	37	TRANG	21.0	12+9	3.4	Con. Slab	65.30	3x21.0	5.5	P	Pier is not constructed in river.	61.40	About 10m DS	×	2houses		×	0.5	A	PC	Winded river
	38	SUOI CAT	28.0	28.0	4.2	Bailey	30.10	29.5	5.5	D	Same length to existing bridge	70.20	About 15m DS	2houses	×		×	0.5	B	Steel	
NINH THUAN	42	TUAN TU	61.0	7@9.0	2.5	Con. Slab	63.20	3×20.5	5.5	P	Bridge length is from bank to bank ,River flow is slow	10.90	About 15m US	×	×		×	0.5	B	Steel	River affected by tide
	43	TAM NGAN	60.0	60.0	1.4	Suspension	71.30	21+27+21	5.5	P	Pier is not constructed in river centre.	127.70	100m US	×	3houses		×	1.0	A	PC	
	45	CAU GAY	62.0	14+2@10+2@14	2.5	Con. Slab	63.20	3×20.5	5.5	D	River width and geographical feature are taken into consideration.	120.20	About 15m US	×	×		×	1.0	B	Steel	
LAM DONG	46	TAN VAN	71.0	6@11.9	6.0	H-beam	80.30	24+30+24	5.5	P	Downstream erosion of left-bank is taken into consideration	748.70	10-15m US	2houses	1house		×	1.0	A	PC	
	47	LOC NGAI	38.0	38.0	1.2	Suspension	42.15	2×20.5	5.5	D	Pier is constructed at shoal.	751.10	About 15m US	×	×		×	1.0	B	Steel	
	48	NONG TRUONG BO SUA	64.0	13+25+2@13	4.5	Bailey	72.20	20.5+29.5+20.5	5.5	D	Set back 5m with both banks.	898.80	15-20m US	×	2houses		×	1.0	B	Steel	
DAC LAC	52	EA SOUP	46.0	3@15.3	4.4	Bailey	59.30	18+21+18	5.5	P	Torrent at the time of a flood. Avoided to set pier in river.	20.00	About 20m DS	1workhouse	×		×	1.0	A	PC	Water width = 27m
	55	ROXY	19.0	2@9.5	1.0	H-beam	30.10	29.5	5.5	P	-	9.50	About 70m US	2houses	×	School yard	×	1.0	B	Steel	
	56	KRONG K'MAR	66.0	3@22.0	4.4	Effel	71.30	21+27+21	5.5	D	Water level is always high. Long center span.	12.00	About 20m US	2houses	×		×	1.0	A	PC	
GIA LAI	58	DAK PO TO	42.0	-	3.0	submerged	66.20	17.5+29.5+17.5	5.5	P	River flow is quick. Avoided to set pier in river centre.	9.30	Same position	×	×		×	1.0	B	Steel	
	59	IA DRANG	35.0	3@11.7	3.7	H-beam	57.20	14.5+26.5+14.5	4.5	C	River flow is quick. Avoided to set pier in river.	11.80	Same position	1house?	×		×	1.0	A	Steel	
KON TUM	62	NGOC REO	No Bridge				42.15	2×20.5	5.5	P	High water area of paddy field is covered.	9.10	Same position	X	X		×	1.0	B	Steel	River width 25m
	64	DAK TO KAN	No Bridge				72.20	3×23.5	5.5	P	Natural bank and H.W.L are taken into consideration.	6.60	Same position	2 houses	X		×	1.0	B	Steel	River width 50m
	66	NGOC TU	48.0	48.0	1.0	Suspension	68.30	21+24+21	5.5	D	To avoid for proposed substructure to hit existing.	8.20	Same position	X	1 house		×	1.0	A	PC	
QUANG NGAI	67	XA CAI	60.0	5@12.0	3.2	Con. Slab	73.04	7x10.4	5.5	D	Flood field is taken into consideration.	62.80	About 10m US	X	1 hut		×	0.5	A	PC	
	70	DO	No Bridge				83.30	3×27.0	5.5	P	River curve and Sedimentary boulder are taken into consideration.	62.30	Same position	X	X		×	0.5	A	PC	
	72	SONG SAU	46.0	15+16+15	4.0	H-beam	63.20	3×20.5	5.5	D	High water area of paddy field is covered.	41.70	About 10m US	X	X		×	0.5	B	Steel	
BINH DINH	74	BA LE	34.0	4@8.5	3.0	Con. Slab	43.55	2×21.0	5.5	D	Riverbed slope is slow	11.50	Same position	×	×		×	0.5	A	PC	
	76	DAO LONG	49.0	4@12.3	2.1	Con. Slab	54.20	3×17.5	4.5	C	No driftwood	99.40	About 15m US	×	×		×	0.5	B	Steel	
	77	TRUONG DINH	37.0	8+2@10+9	3.0	Con. Slab	48.15	2×23.5	5.5	D	No erosion	8.40	About 15m US	4houses	×		×	0.5	B	Steel	
PHU YEN	78	TRA O	12.0	12.0	3.5	H-beam	33.80	33.0	5.5	P	Fast-flow and erosion are taken into consideration	13.70	2or3m US	×	×		×	1.0	A	PC	
	79	TRA BUONG	No Bridge				62.61	6x10.4	5.5	P	Torrent at the time of a flood. Avoided to set pier in river	11.20	Same position	×	×		×	1.0	A	PC	
	82	DA LOC	18.6	6@3.1	1.0	Wooden	36.15	2x17.5	5.5	P	Erosion doesn't become a problem	9.60	Same position	×	×		×	1.0	B	Steel	
KHANH HOA	83	NGOI NGAN	47.0	8@6.0	1.2	Wooden	49.55	2×24.0	5.5	D	Bridge length is same to existing one. Almost no river-flow	9.80	About 10m DS	×	×		×	0.5	A	PC	River attached by tide
	86	TIEN DU	28.0	3@9.3	1.0	H-beam	48.15	2×23.5	5.5	D	River width of upstream. No obstacles to construct pier.	10.80	Same position	×	×		×	0.5	B	Steel	

[Road Grade] P : Province, D : District, C : Commune

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

(1) Natural Conditions

The project area covers a length of about 1,300 km from south to north of the central area of Vietnam. It is divided roughly into three parts: northern part, central part, and southern part according to meteorological conditions.

In the northern part, the difference of rainfall between the rainy season and the dry season is high. In the central part, the rain concentrates in the rainy season more than other parts, and flood damage arises nearly every year. In the southern area, a type of squall peculiar to the Torrid Zone is common, and the flood damage occurs. Therefore, a bridge length should be set up which secures sufficient river flow capacity.

However, at sites where the area around the bridge is widely inundated by flood with slow flow velocity, restricted access during flooded periods based on previous high flood level will be considered.

The rivers at the proposed bridges are minor rivers or tributaries, so water level and flow data hardly exist. Therefore, the design water level is determined based on the results of interview regarding the previous maximum water level. Verification of those water levels is then examined by the flux and the water level calculated on the basis of area rainfall data. The embankment around an abutment is protected by the riprap against the erosion at the time of flood. Furthermore, riverbank protection and stone work against scouring should be carried out on the riverbank and around piers where rapid flow is expected at flood.

As for the geological feature in the project area, the area mainly consists of metamorphic rock, volcanic rock, and sedimentary rock, and is constituted by the alluvial deposition layer in lowland plain near the seashore.

The bridge's bearing stratum differs greatly in a seashore plain area and in the western foothill area. In the seashore plain area, it is about 20 m deep, in the western mountains hilly area, it is less than 10 m in depth.

Therefore, in case a bearing stratum is quite deep; a pile foundation is recommended, in case a bearing stratum is relatively shallow; a spread foundation is recommended.

Since the embankment for approach roads on the soft ground may cause severe differential settlement and slip circle failure, ground treatment should be considered.

The project area is located in a seismically inactive area, the but impact of seismic forces on the bridge should be taken into consideration based on the description of Seismic Intensity Map of Vietnamese Standard.

(2) Social Conditions

The project bridges are to be designed taking account of the following social issues:

- Land acquisition: The alignment of the proposed bridges should be planned so as to avoid as little land acquisition and compensation for houses, farmland and ponds as possible.

- Detour road during construction: Present service level is secured in case a detour road is required for bridge construction.

(3) Construction Conditions

Local contractors have had the opportunity to take part in major projects in recent Japanese Grant Aid Projects including bridge reconstruction in the Northern District and bridge construction in the Mekong Delta area and other donor projects. Their technical capabilities have been improving steadily, however less experience of large or complicated projects leaves their technical capability limited. Through this project, Japanese engineers will aim to facilitate the further technology transfer to local engineers, and in particular assist with developing construction management and quality control skills.

(4) Use of Local Contractors and Materials

Bridge construction in Vietnam is at present carried out by state-owned construction enterprises acting as part of a Government Agency. These enterprises will be employed since they have shown good performance in previous projects.

Wherever possible, locally available materials and equipment shall be used in the project.

(5) Management Capability of Government Agency

Construction and maintenance of national roads has been implemented by the Ministry of Transport, and other local roads are under the People's Committee of each province or country.

One Project Management Unit (PMU) within the MOT, PMU-NO.18, is in charge of the projects undertaken by overseas assistance. PMU-NO.18 has previously successfully worked on National Road No.1 and National Road No.18 projects and on the project for Reconstruction of Bridges in the Northern Districts and Mekong Delta Area. Accordingly, it has sufficient staff and technical capability to implement the project and to maintain the bridges in good condition after completion of the project.

(6) Scale and Design Standard for Bridges

The scale of bridges of both bridge construction type and steel girder procurement type are limited to a bridge length of less than 100 meters in accordance with the project concept. The following Vietnamese standards are applied as the design standard for bridges and approach roads in this project.

- Vietnamese design standards for bridge and road
- Live load of H13-X60 in the Vietnam Standard
- Bridge width is 5.5m(Provincial and District Road) and 4.5m (Commune Road)
- Road class: V and VI in Vietnamese Standard

(7) Corrosion Resistant Steel Girder Procurement

Corrosion resistant steel is popular for use as a low maintenance material in developed countries, whilst the consideration of the location and exposure conditions should be required. In this project, it was planned to use the corrosion resistant material in certain locations, where access to the site is difficult, distance from the coastline is far and maintenance would otherwise be a burden. This type is applied to 9 bridges out of the 23 steel girder procurement type bridges. The selected bridges are listed in Table 2-5.

Table 2-5 Corrosion Resistant Steel Girder Procurement Type Bridges

Province	Bridge No.	Bridge Name
Thanh Hoa	4	Tach Quang
Nghe An	7	Ke Chieng
	9	Ban Khoang
Lam Dong	47	Loc Ngai
	48	Nong Truong Bo Sua
Dac Lac	55	Roxy
Gia Lai	58	Dak Po To
Kon Tum	62	Ngoc Reo
	64	Dak To Kan

(8) Construction Schedule

The average monthly rainfall is more than 240 mm in the project area and the rainy season of the central part is about 3 months later than the northern and southern parts. In the northern area, rainy season is from May to October. In the central part, there is much rain compared with other areas from August to January. On the other hand, in the southern area, the rainy season with squalls is from May to October.

Appropriate construction plans for the proposed bridges will be made in consideration of these natural factors mentioned above. Accordingly, substructure construction and soft ground treatment for approach roads should be carried out in the dry season and superstructures constructed in the rainy season.

(9) Soft Component

There are 23 bridges on the project which are to be constructed by the Vietnam Government using steel girders supplied by Japanese Government. A steel girder erection manual will be provided as part of this project as well as establishing monitoring system for substructure construction by Vietnamese side with a assistance from Japanese engineers. It is hoped in this way to encourage capacity building of the domestic construction industry, and to carry out transfer of technology to local engineers.

2.2.2 Basic Design

(1) Design Water Levels

i) Design Water Levels

Max H.W.L, Ordinary H.W.L and L.W.L were set up on the basis of interview results undertaken during two site surveys. The Max H.W.L was applied as the design water level shown in Table 2-6. These design water levels were deemed appropriate by the water level calculated based on the rainfall data nearby the bridge site.

Notes:
Max H.W.L. = Previous highest water level
Ordinary H.W.L = Highest water level annually
L.W.L. = Lowest water level

ii) Rivers for navigation

For Chinh Dai (No. 2) bridge of Thanh Hoa Province and Quynh Bang (No. 6) bridge of Nghe An Province, the same clearance is to be secured under the existing bridge by Vietnamese side.

iii) Special Consideration to Xa Cai (No. 67) bridge of Quang Ngai Province and Tra Buong (No. 79) bridge of Phu Yen Province

Since both bridges are located in a flood field, the entire approach road and a surrounding area of each are mostly inundated during seasonal flooding entire at the previous highest water level. Moreover, since the flood flow velocity is small, even if it overflows the bridge, a possibility of suffering from serious damage on a bridge is assumed to be small. Therefore, a bridge whose access is restricted at flood times at the previous highest water level is planned for both bridges. However, the bridge surface level is set to clear the average annual flood level.

Table 2-6 Water Levels by the Field Survey

Br.No.	Name	EL of Water level			Note (Max. year)
		Max HWL	Ord. HWL	LWL	
2	CHINH DAI	11.60	10.00	7.30	(1992)
4	THACH QUANG	37.50	35.30	26.40	(1984)
5	THACH DINH	29.50	28.70	20.70	(1985)
6	QUYNH BANG	15.50	14.70	12.40	(1962)
7	KE CHIENG	80.10	78.20	74.10	(1978)
9	BAN KHOANG	100.40	98.60	96.10	(1954)
11	MY SON	60.60	59.20	47.00	(1975)
12	CUA TRAI	8.40	7.40	3.50	-
15	PHU VINH	21.00	20.50	16.20	(1985)
18	LAC THIEN	40.50	36.40	30.40	(1943)
20	BEN DA	49.80	49.10	45.00	(1979)
22	PA NHO	81.40	80.80	75.80	(1978)
24	NA MAY	79.90	79.20	73.40	(2000)
26	KHE DUONG	121.20	120.30	118.20	(2000)
27	HOI PHUOC	50.90	50.30	44.90	(2000)
34	SONG QUAN	80.60	78.70	76.00	(2000)
35	DAI LOI	52.30	51.70	46.30	(2000)
36	DA DUNG	14.70	12.00	5.90	(1999)
37	TRANG	61.40	60.40	55.90	(1999)
38	SUOI CAT	70.20	69.10	67.70	(1999)
42	TUAN TU	10.90	10.50	7.70	(2000)
43	TAM NGAN	127.70	127.10	125.00	(2000)
45	CAU GAY	120.20	119.00	116.600	(2000)
46	TAN VAN	748.70	748.00	745.50	(2000)
47	LOC NGAI	751.10	747.80	746.00	(2000)
48	NT BO SUA	898.80	898.10	893.60	(1995)
52	EA SOUP	20.00	18.80	10.40	(1983)
55	ROXY	9.50	8.00	6.90	(1989)
56	KRONG K'MAR	12.00	10.10	5.30	(1989)
58	DAK PO TO	9.30	8.50	5.80	(1997)
59	IA DRANG	11.80	9.10	7.100	(1987)
62	NGOC REO	9.10	8.10	7.30	(1996)
64	DAK TO KAN	6.60	5.60	4.00	(1996)
66	NGOC TU	8.20	7.70	5.50	(1996)
67	XA CAI	62.80	61.90	58.40	(1999)
70	DO	62.30	60.90	57.50	(1964)
72	SONG SAU	41.70	41.20	37.40	(1999)
74	BA LE	11.50	10.20	8.00	(1986)
76	DAO LONG	99.40	98.10	95.80	(1991)
77	TRUONG DINH	8.40	7.30	5.60	(1999)
78	TRA O	13.70	12.40	9.10	(1985)
79	TRA BUONG	11.20	10.20	7.30	(1986)
82	DA LOC	9.60	8.80	6.00	(1986)
83	NGOI NGAN	9.80	8.80	7.90	(2000)
86	TIEN DU	10.80	9.80	8.70	(2000)

(2) Bridge Design

The concept of bridge plan is defined as follows on the basis of experience obtained in the two field survey results and previous similar projects in Vietnam such as Reconstruction Bridges in the Northern District and Construction Bridges in the Mekong Delta Area:

i) River Conditions

As discussed earlier in the section on hydraulic analysis, bridges and approach roads shall satisfy the following basic criteria.

① River Cross Section

The required cross-sectional area of flow will be provided at each bridge site in consideration with flood situation around the bridge site. It is reflected in determination of bridge length.

② Design Water Levels

As discussed in the section on design concepts, the design water levels are given in Table 2-6.

③ Navigation Clearance

Navigation clearance in terms of width and height is required to allow passage of ships and boats on the rivers. In this project, two bridges were required to secure the same clearance as existing bridge by Vietnamese side.

④ Freeboard under Girders

It sets up as follows:

Table 2-7 Clearance and Freeboard

Vertical height on road	H = 4.5m
Clearance between flood stage and bottom of girder	Flat area : H = 0.5m Mountainous and driftwood area : H = 1.0m

In addition, refer to table 1-4 for each bridge.

ii) Superstructure Type

① Bridge C.T Bridges (22 bridges)

Since bridge lengths are assumed to range from around 30 m to 100 m in this project, an appropriate span for the proposed bridges will be from 20 m to 30 m in consideration with the river condition and geological condition. Therefore, post-tensioned PC girder type will be appropriate for this span in consideration with economic aspect and the previous experience in Vietnam.

The pre-tensioned PC girder type is found to be difficult to transport due to road conditions. Finally post-tensioned P.C. girder type was designed.

However, a steel girder type is adopted when the fabrication yard of PC beam cannot secure enough space adjacent to the site. (As a result, Steel Girder is adopted to No. 22 Pa Nho bridge, No. 26 Khe Duong bridge, No. 59 Ia Drang bridge)

In consideration of resistance capability against flood flow, the RC slab (span length about 10 m) type was adopted to bridges whose access is restricted at the time of a flood at the previous highest water level.

Typical PC bridge cross-section and side view are shown in Figure 2-1.

② Steel Girder Procurement Type Bridges

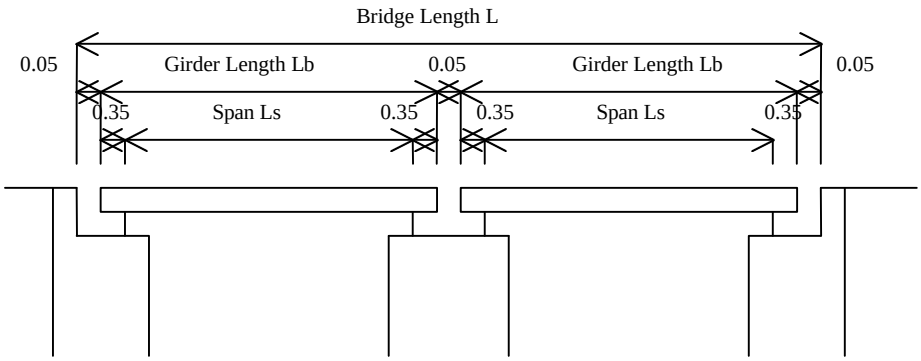
Based on experience gained in the projects for Reconstruction of Bridges in Northern Vietnam and Mekong Delta Area, the girder types are selected as follows:

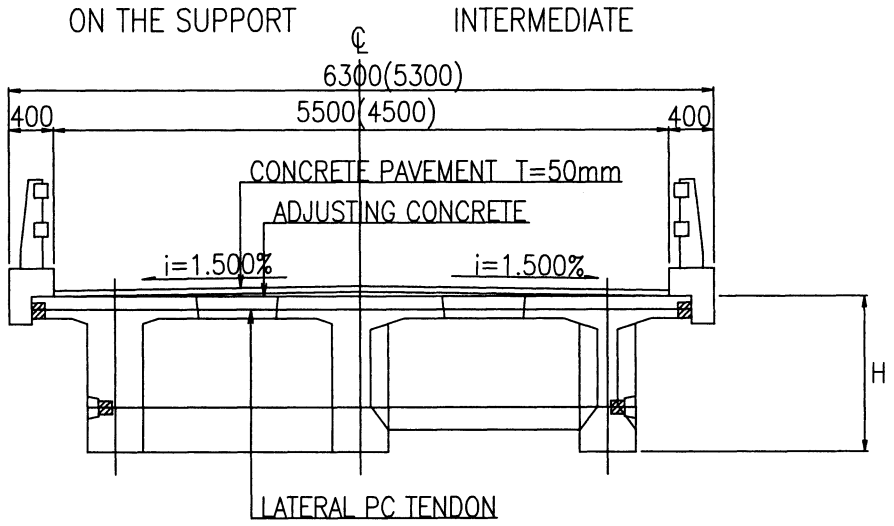
Girder Length L $\leqq$ 20 m H-section steel girder
Girder Length L $>$ 20 m I-section steel girder (Built Up Steel Girder)

Composite girder was selected for economical reasons.

Refer to 2-1 (7) regarding corrosion resistant steel.

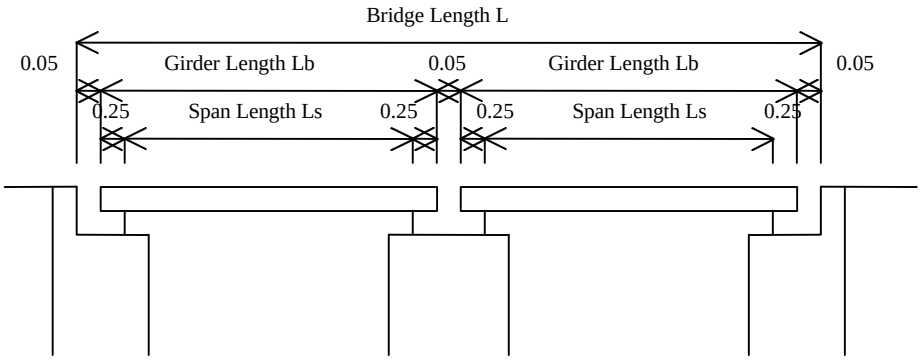
The typical side views and cross sections of steel girders are shown in Figure 2-2.

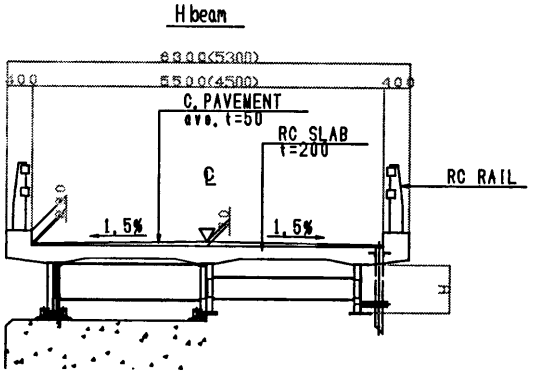


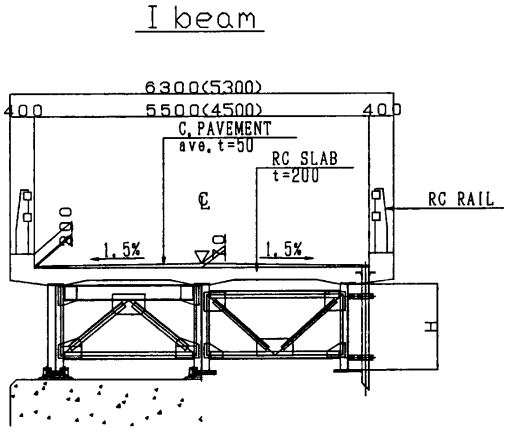


Span Length Ls (m)	Girder Length Lb (m)	Girder Height (m)	Girder Type
15	15.700	0.75	T-Girder
18	18.700	0.90	T-Girder
21	21.700	1.05	T-Girder
24	24.700	1.25	T-Girder
27	27.700	1.35	T-Girder
30	30.700	1.40	T-Girder
33	33.700	1.50	T-Girder

Figure 2-1 Typical PC Girder Type Bridge







Span Length Ls (m)	Girder Length Lb (m)	Girder Height (m)	Girder Type
14.5	15.000	0.55	H 桁
17.5	18.000	0.75	H 桁
20.5	21.000	1.10	I 桁
23.5	24.000	1.20	I 桁
26.5	27.000	1.30	I 桁
29.5	30.000	1.40	I 桁
32.5	33.000	1.50	I 桁

Figure 2-2 Typical Steel Girder Type Bridge

iii) Substructure and Foundation

The types of substructure and foundation selected are shown in Table 2-8.

Table 2-8 Substructures and Foundation Type

Substructure Foundation	Type	Reasons for Selection
Abutment	Inverted T	Commonly used in abutment design for economic reasons
Pier	Wall	Less obstacle to river flow so that it has advantage against scouring.
	Pile-bent	It is used when the flow velocity is slow and there is little possibility of scouring; also economical.
Foundation	Spread footings	Adopted when reliable bearing stratum is present at shallow depth
	Driven precast piles (and steel piles)	RC 400 mm square pile was adopted from economic aspect and transportability. It is difficult to drive at great depth or medium layer containing boulders and stones. In such case driven steel pipe piles of 600 mm diameter are used for the depth greater than 24 m.

The maximum length of RC square pile will be set at 24 m (12 m x 2) because, unlike the Mekong delta, it is expected that the concrete piles of low strength become difficult since stones and boulder exist at the project site. Therefore, steel pipe piles are adopted for the following sites.

- Sites where the middle layers consist of a layer with N value of over 20
- Sites where pile length for a bridge becomes more than 24 m (12 m x 2)

In consideration of construction efficiency and economic aspect, the type as shown in Figure 2-3 is adopted for piles foundation.

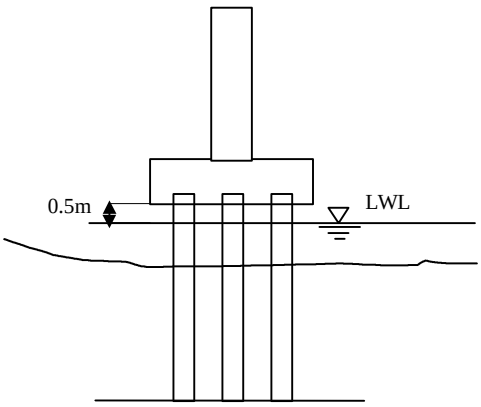


Figure 2-3 Footing Position in the Pile Foundation

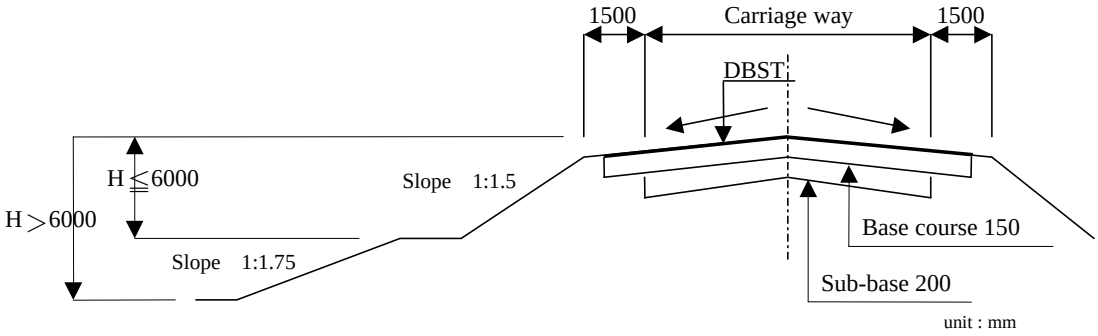
iv) Approach Roads and River Revetment (22 No. Bridge C.T Bridges)

The geometric design for approach roads follows Vietnam Standards TCVN 4054: 1998. Details of design geometry are given in Table 2-16.

① Approach Roads

The width of approach roads are of two types, 4.5 m and 5.5 m. The length, vertical gradient and linear alignment of approach roads were planned based on topography and existing land use conditions at each bridge site.

The typical cross section of the approach roads with 1.5 m shoulder on both sides was planned based on existing road conditions in Vietnam, and side slopes were determined depending on the embankment height, as shown in Figure 2-4.



DBST : Double Bitumen Surface Treatment

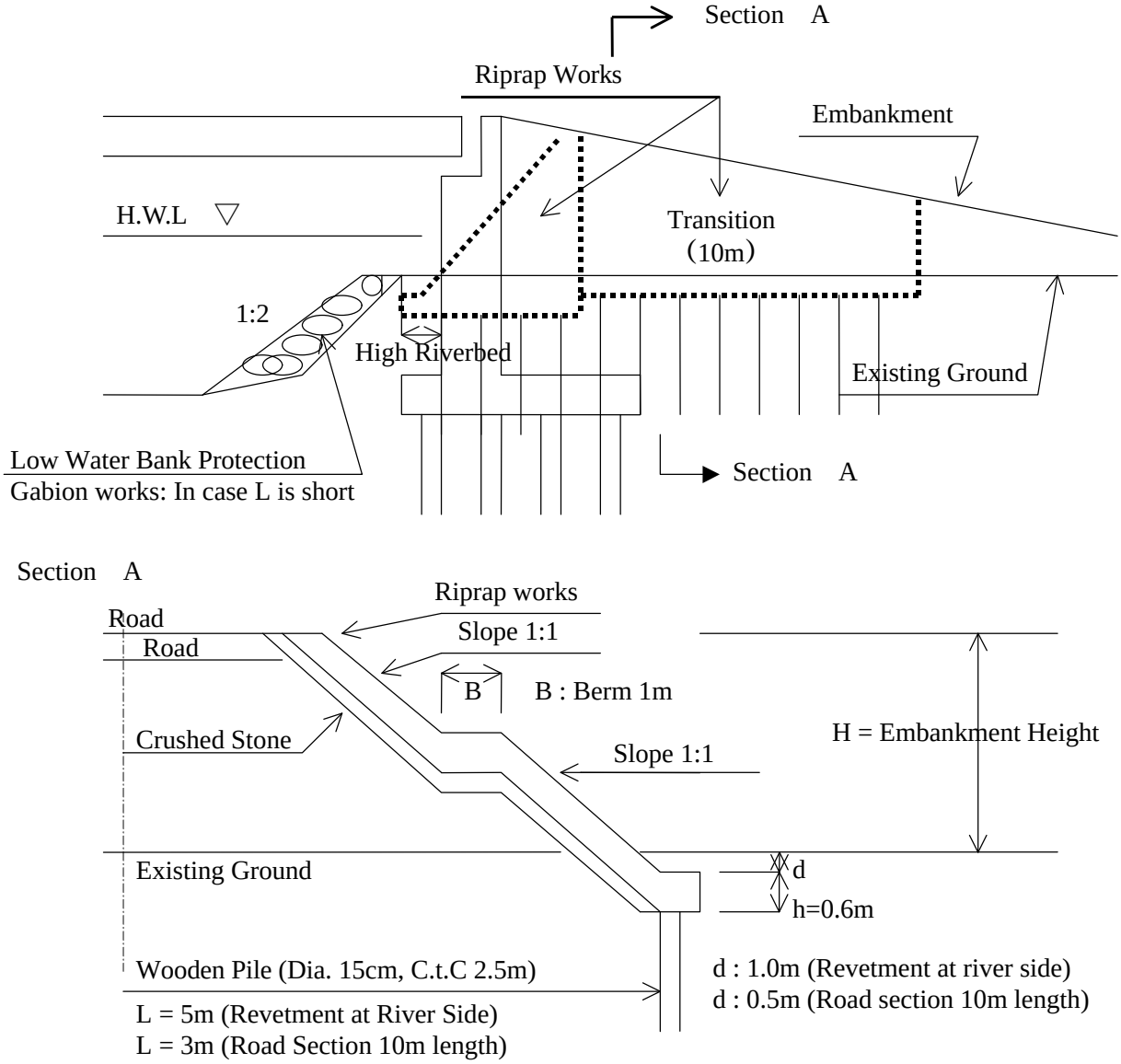
Figure 2-4 Typical Road Cross Section

② Revetment and Riverbed Protection

Abutments of the proposed bridge are set back from the water line. However, in the flood season, some scouring due to high flow velocity is anticipated around bridges. Also erosion of approach embankments by flood flows is a concern.

Riprap is adopted up to the design water level in order to protect the approach road up to 10m from the abutment. On the riverbank, a gabion will be used for protection as a flexible, durable and economic measure. The typical cross section is illustrated in Figure 2-5.

Furthermore, at the time of a flood, approach roads where the flow velocity is rapid are to be covered by gabions and riprap.



Note) Slope 1:1 (Revetment at River Side) ~ 1:1.5 (Road Section 10m length)

Figure 2-5 Slope Protection Works

③ Pier Foundation Protection

Where scouring is expected around pier with pile foundation, the pier should be protected by stones. Its area is indicated in Figure 2-6 according to presumed scouring depth.

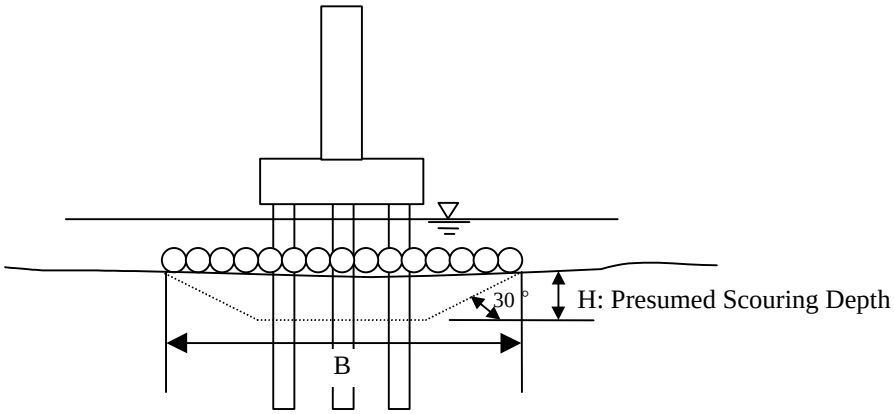


Figure 2-6 Pier Protections

④ Ground Treatment

In order to construct high embankments for approach roads to bridges, improvement of the soft ground is required at some bridge sites.

The following methods were considered for treatment of soft ground.

i) Sand drain method
ii) Plastic board drain method
iii) Sand compaction method
iv) Precast RC pile

The advantages of the four methods are illustrated in Table 2-9.

Table 2-9 Selection of Soft Ground Treatment Method

Item	Method			
	Sand Drain	Plastic Board Drain	Sand Compaction	Precast Pile
Diameter (mm)	400	65	700	400 x 400
Increase in Strength of Sub Soil (kg/cm^2)	C = 0.3 ⇒ 1.0	C = 0.3 ⇒ 0.5	C = 0.3 ⇒ 3.0	-
Characteristic	Most popular	Construction rate is high	Range of application is wide	No Settlement
Depth for practical application	30 m	15 m	35 m	30 m
Minimum Spacing	1.2 m	0.9 m	1.2 m	1.0 m
Construction Speed	300 m/day	2,500 m/day	150 m/day	120 m/day
Ratio of Cost	1.0	0.2	2.4	11.0
Other	Many Satisfactory Results	Many Satisfactory Results in Vietnam		

From the above, plastic board drain method shall be applied for this project because of low construction cost and previous success.

(3) Design Criteria

i) Design Standards

The following Vietnamese design standards are adapted to the project. In addition to the standards listed below, Japanese Standards and AASHTO standards were also used where required.

- HIGHWAY-SPECIFICATIONS FOR DESIGN, TCVN4054: 1998 (VIETNAM)
- DESIGN SPECIFICATIONS FOR BRIDGES AND CULVERTS ON THE BASIS OF LIMIT STATES-MINISTRY OF TRANSPORT AND COMMUNICATION, No.2057 QD/Kt14 1979 (VIETNAM)
- DESIGN CRITERIA OF HIGHWAY, TCVN4054-85 (VIETNAM)

ii) Design Methodology

Structural members are designed by the allowable stress method under design load, and also checked by the limit state method in accordance with the Vietnamese Standard.

iii) Relation between Design Traffic Volume and Design Speed

According to Vietnamese Design Standards (i.e. TCVN 4054-85 and 1998), highways are divided into six classes depending on the importance of the highways and traffic volume. Table 2-10 shows, for each of these classes, the maximum safe design speed under normal conditions.

Table 2-10 Highway Design Speed and Traffic Volume

	I	II	III	IV	V	VI
Average Daily Traffic Volume	> 6000	3000～6000	1000～3000	300～1000	50～300	< 50
Design Speed	80 - 60	80 - 60	80 - 60	60 - 40	40 - 20	25 - 15
No. of lanes	6	4	2	2	2 (v = 40) 1 (v = 20)	1

Since bridges in the Project are located in the rural area of the central area of Vietnam, the road classes IV, V and VI were selected based on the site traffic survey result. In principle, the design speed should be 40 km/h for Provincial Roads and 25 km/h for District Roads and Commune Roads.

Table 2-11 Design Speed and Road Width

	Design Speed V (km/hr)				
	20	25	40	60	80
Lane Width (m)	3.50	3.50	3.50	3.50	3.50
Shoulder width (m)	2 x 1.50	2 x 1.50	2 x 1.50	2 x 2.50	2 x 3.00

iv) Road and Bridge Cross Section

In this project, the width of bridges on provincial and district roads is 5.5 m, sufficient for two trucks (2.5 m wide) to pass each other. Bridges on commune roads are 4.5m in width, determined based on category **VI** specification (design speed 25 km/h) adding a margin of 0.5 m on both sides, allowing a truck and a sedan to pass each other.

The cross sections of the bridges are shown in Figures 2-7 and 2-8.

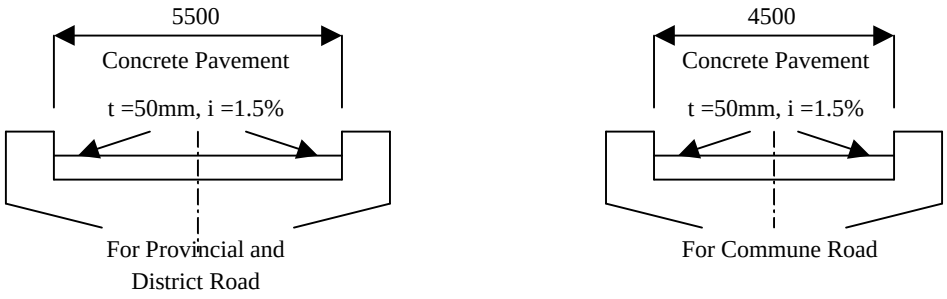


Figure 2-7 Cross Sections for Bridges

units : mm

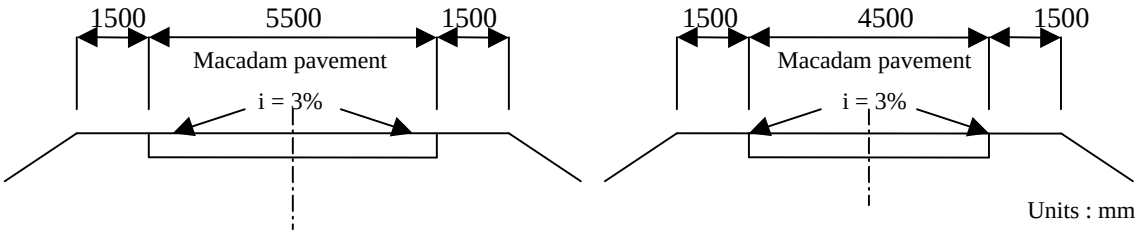


Figure 2-8 Cross Sections for Approach Roads

v) Design Load

① Live Load

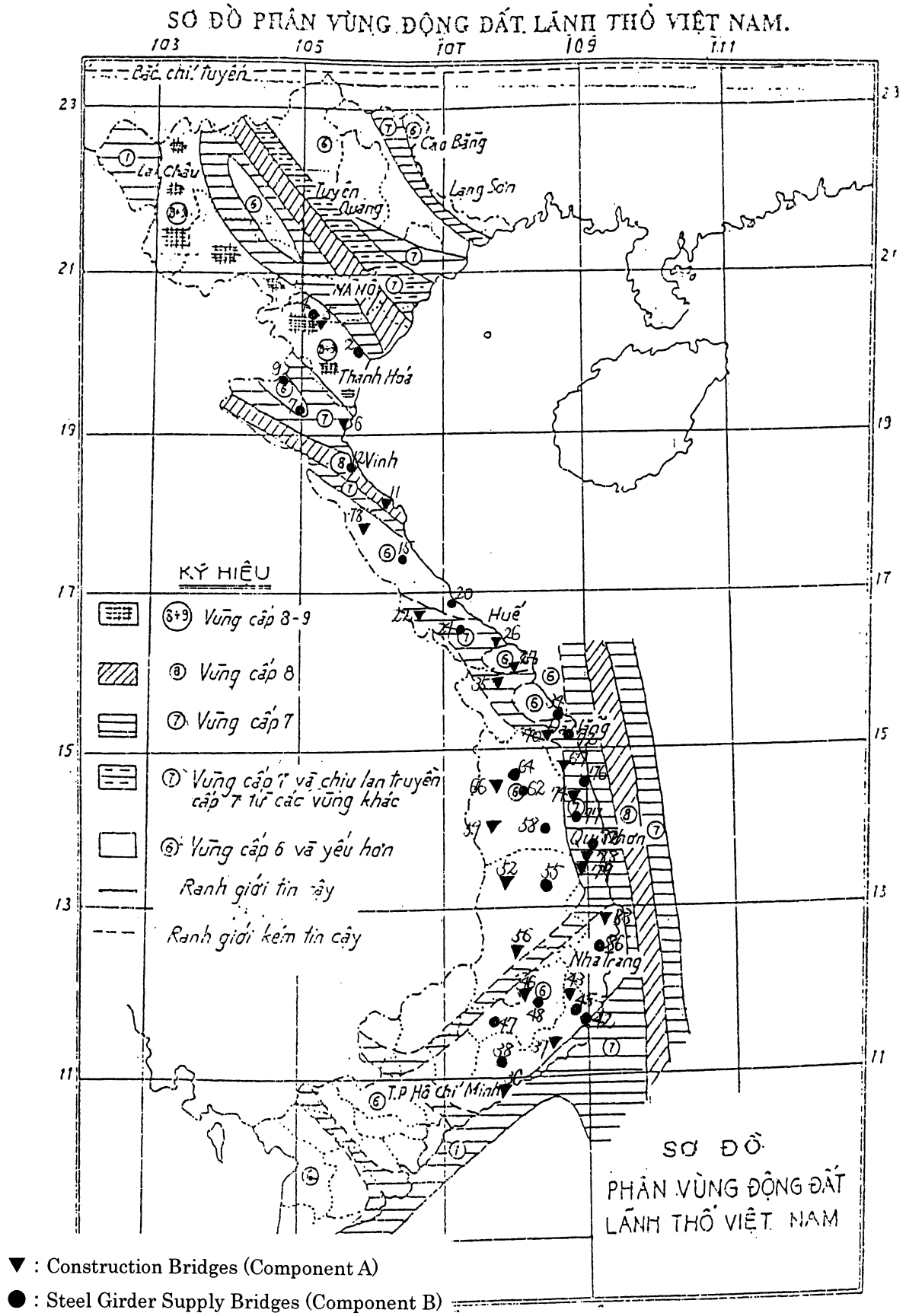
Bridges were designed with H13 and X-60 live loading as described in the Vietnamese Standard for local roads.

② Seismic Horizontal Force

In accordance with AASHTO and Vietnam Standard 22TCN-221-95, horizontal seismic coefficient Kh = 0.16 (Thanh Hoa and Ha Tinh Province), and Kh = 0.05 (other provinces) are adopted.

vi) Other Load

- Dead Load
- Live Load, including impact load
- Wind Loads
- Influence of creep of concrete
- Influence of dry shrinkage of concrete
- Earth Pressure
- Static pressure of water
- Water pressure in flood
- Buoyancy
- Settlement
- Ship Impact



▼ : Construction Bridges (Component A)

● : Steel Girder Supply Bridges (Component B)

Figure 2-9 Seismic Intensity Map

vii) Design Criteria

① Materials and unit weights

Table 2-12 Unit Weights of Materials

Designation	Self-weight kN/m^3	Designation	Self-weight kN/m^3
Steel	78.5	Cement, Mortar	21.5
Concrete reinforced	25.0	Asphalt Pavement	23.0
Prestressed Concrete	25.0	Concrete Pavement	23.5
Non-reinforced concrete	23.5	Timber	8.0

② Strength of materials

In principal, compressive strength of concrete are specified in Vietnam Bridge Standard No. 2057 QD/Kt14 article 5.12 and reinforcing bars in article 5.13.

Table 2-13 Strength of Concrete

Designation	Strength (N/mm^2)
PC Girder (Pre-tension)	40
PC Girder (Post-tension)	35
Slab	30
Abutment, Pier	21
Concrete Pile	30

Table 2-14 Allowable Stress of Reinforcing Bar

Designation	Yield Strength (N/mm^2)
Round Bar (A-I)	σ py = 190
Deformed Bar (A-II)	σ py = 240
Deformed Bar (A-III)	σ py = 300

The basic strength of steel for plate girders are specified below in accordance with Japanese Standard or AASHTO.

Table 2-15 Steel Tensile Strength

Designation	Tensile strength (N/mm^2)	Remarks
SS400, SM400	410-520	Normal Steel
SM490, SM490Y	500-620	Normal Steel
SM520	530-650	Normal Steel
SMA400W	410-550	Corrosion resistant Steel
SMA490W	500-620	Corrosion resistant Steel

③ Road Geometric Standards

Road geometric standards set out in Vietnam Standard TCVN 4054 1998 were used for this project.

Table 2-16 Geometric Design

Item	Unit	Design Standard	
Design Speed	Km/hr	40	25
Horizontal alignment			
Minimum curve radius	m	60	15
Minimum curve length	m	70	45
Minimum transition curve length	m	35	25
Super elevation runoff		1/100	1/100
Minimum length of sight distance	m	40	20
Vertical alignment			
Maximum gradient	%	8	9
Minimum radius of crest (凸)	m	700	200
Minimum radius of sag (凹)	m	450	100
Minimum vertical curve length	m	30	25
Cross section			
Cross fall	%	3	3
Maximum super-elevation	%	6	6

④ Embankment Height and Slope

The embankment height and slope are specified in Vietnam Bridge Standard TCVN4054: 1998.

Table 2-17 Embankment Height and Slope

Kind of soil	Slope (H < 6m)	Slope (6m < H < 12m)
Sand and Clay	1:1.5	1:1.75

(4) Basic Bridge Design Summary

Results of the basic design for the construction type bridges are summarized in Table 2-18 and for the steel girder procurement type bridges in Table 2-19.

2.2.3 Basic Design Drawings

Basic Design Drawings are shown at the end of this volume.

Table 2-18 Summary of Bridges (Bridge C.T Bridges)

Province			THANH HOA	NGHE AN	HA TINH	QUANG BINH	QUANG TRI	THUA THIEN HUE
Bridge No.			5	6	11	18	22	26
Name of Bridge			THACH DINH	QUYNH BANG	MY SON	LAC THIEN	PA NHO	KHE DUONG
Existing Bridge			Pontoon Br.	Metal Br.	Con. Br.	Sus, Br.	Metal Br.	No Br.
Horizontal Alignment			Gentle Curve	straight	Curve	Gentle Curve	Gentle Curve	R: Staraight L: T Junction
Vertical Alignment			5% ↙ ↘ 3%	8% ↙ ↘ 7%	8% ↙ ↘ 8%	8% ↙ ↘ 7%	0.3% ↙ ↘ 4%	8% ↙ ↘ 8%
Bridge Length(m)			92.30	74.30	86.30	65.30	54.20	42.15
Span Length(m)			30+30+30	3@24.0	27+30+27	18+27+18	3@17.5	2@20.5
Clear Width(m)			5.5	5.5	5.5	5.5	5.5	4.5
Type of Structure	Super-Structure		PC Girder	PC Girder	PC Girder	PC Girder	Steel Girder	Steel Girder
	Sub-Str.	Abutment	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE
		Pier	Wall Type	Pile Bent Type	Wall Type	Wall Type	Wall Type	Wall Type
	Foundation		Steel Pile	Steel Pile	Steel Pile and Spread	RC Precast Pile	Steel Pile	RC Precast Pile
	Abutment Protection		Riprap	Riprap	Riprap	Riprap	Riprap	Riprap
Length of Approach Roads(m)			R=157,L=97	R=94,L=143	R=76,L=68	R=83,L=51	R=60,L=64	R=74,L=77

Province			DA NANG CITY	QUANG NAM	BINH THUAN		NINH THUAN	LAM DONG
Bridge No.			27	35	36	37	43	46
Name of Bridge			HOI PHUOC	DAI LOI	DA DUNG	TRANG	TAM NGAN	TAN VAN
Existing Bridge			No Br.	Wooden Br.	Bailey Br.	Con.Slab Br.	Sus. Br.	Metal Br.
Horizontal Alignment			R: Gentle Curve L: Straight	Gentle Curve	Straight	Gentle Curve	R: T Junction L: Straight	R: Straight L: Gentle Curve
Vertical Alignment			2.6% ↙ ↘ 8%	8% ↙ ↘ 8%	6% ↙ ↘ 5%	3% ↙ ↘ 2%	4% ↙ ↘ 4%	4% ↙ ↘ 4%
Bridge Length(m)			65.30	65.30	92.30	65.30	71.30	80.30
Span Length(m)			3@21.0	3@21.0	3@30.0	3@21.0	21+27+21	24+30+24
Clear Width(m)			5.5	5.5	5.5	5.5	5.5	5.5
Type of Structure	Super-Structure		PC Girder	PC Girder	PC Girder	PC Girder	PC Girder	PC Girder
	Sub-Str.	Abutment	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE
		Pier	Wall Type	Wall Type	Wall Type	Wall Type	Wall Type	Wall Type
	Foundation		Steel Pile	RC Precast Pile	Spread	Spread	Spread	Spread
	Abutment Protection		Riprap	Riprap	Riprap	Riprap	Riprap	Riprap
Length of Approach Roads(m)			R=92,L=112	R=86,L=65	R=153,L=171	R118,L=118	R=23,L=157	R=102,L=97

Province			DAC LAC		GIA LAI	KON TUM	QUANG NGAI	
Bridge No.			52	56	59	66	67	70
Name of Bridge			EA SOUP	KRONG K'MAR	IA DRANG	NGOC TU	XA CAI	DO
Existing Bridge			Bailly Br.	Effel	Metal Br.	Suspention Br.	Con.Slab Br.	No Br.
Horizontal Alignment			Gentle Curve	Gentle Curve	Gentle Curve	Straight	Straight	R: Straight L: Gentle Curve
Vertical Alignment			6% ↙ ↘ 5%	8% ↙ ↘ 8%	0.3% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 3%	0.3% ↙ ↘ 8%
Bridge Length(m)			59.30	71.30	57.20	66.20	73.04	83.30
Span Length(m)			18+21+18	21+27+21	14.5+26.5+14.5	21+24+21	7@10.4	3@27.0
Clear Width(m)			5.5	5.5	4.5	5.5	5.5	5.5
Type of Structure	Super-Structure		PC Girder	PC Girder	Steel Girder	PC Girder	RC Slab	PC Girder
	Sub-Str.	Abutment	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE
		Pier	Wall Type	Wall Type	Oval Type	Wall Type	Pile Bent Type	Wall Type
	Foundation		Spread	RC Precast Pile	Spread	Spread	RC Precast Pile	Spread
	Abutment Protection		Riprap	Riprap	Riprap	Riprap	Riprap	Riprap
Length of Approach Roads(m)			R=125,L=98	R=126,L=90	R=93,L=71	R108,L=108	R=99,L=65	R=53,L=58

Province			BINH DINH	PHU YEN		KHANH HOA
Bridge No.			74	78	79	83
Name of Bridge			BA LE	TRA O	TRA BUONG	NGOI NGAN
Existing Bridge			Con. Slab Br.	Metal Br.	No Br.	Wooden Br.
Horizontal Alignment			Straight	Straight	Straight	R: Gentle Curve L: Straight
Vertical Alignment			8% ↙ ↘ 8%	7% ↙ ↘ 4%	6% ↙ ↘ 0.3%	4% ↙ ↘ 4%
Bridge Length(m)			43.55	33.80	62.61	49.55
Span Length(m)			2@21.0	33.0	6@10.4	2@24.0
Clear Width(m)			5.5	5.5	5.5	5.5
Type of Structure	Super-Structure		PC Girder	PC Girder	RC Slab	PC Girder
	Sub-Str.	Abutment	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE	RC INVERTED T-TYPE
		Pier	Wall Type	-	Pile Bent Type	Wall Type
	Foundation		RC Precast Pile	RC Pile and Spread	RC Precast Pile	RC Precast Pile
	Abutment Protection		Riprap	Riprap	Riprap	Riprap
Length of Approach Roads(m)			R=64,L=78	R=143,L=90	R=129,L=70	R=93,L=93

Table 2-19 Summary of Bridges (Steel Girder Procurement Type Bridges)

Province	THANH HOA		NGHE AN		HA TINH	QUANG BINH
Bridge No.	2	4	7	9	12	15
Name of Bridge	CHINH DAI	THACH QUANG	KE CHIENG	BAN KHOANG	CUA TRAI	PHU VINH
Existing Bridge	Metal Br. For Pede.	No Bridge	No Bridge	No Bridge	Metal Br.	Wooden Br.
Horizontal Alignment	R: T Junction L: Gentle Curve	straight	straight	Curve	Gentle Curve	R: Gentle Curve L: T Junction
Vertical Alignment	8% ↙ ↘ 8%	0.3% ↙ ↘ 0.3%	3% ↙ ↘ 8%	8% ↙ ↘ 0.3%	8% ↙ ↘ 8%	8% ↙ ↘ 4%
Bridge Length(m)	30.10	99.20	30.10	81.20	54.20	48.15
Span Length(m)	29.5	3@32.5	29.5	3@26.5	3@17.5	2@23.5
Clear Width(m)	5.5	5.5	4.5	5.5	4.5	5.5
Super-Structure	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder

Province	QUANG TRI	THUA THIEN HUE	QUANG NAM	BINH THUAN	NINH THUAN	
Bridge No.	20	24	34	38	42	45
Name of Bridge	BEN DA	NA MAY	SONG QUAN	SUOI CAT	TUAN TU	CAU GAY
Existing Bridge	No Bridge	No Bridge	Submerged Br.	Bailey Br.	Con. Slab Br.	Con. Slab Br.
Horizontal Alignment	straight	Gentle Curve	Gentle Curve	straight	Gentle Curve	Gentle Curve
Vertical Alignment	8% ↙ ↘ 8%	8% ↙ ↘ 8%	0.3% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 8%	5% ↙ ↘ 8%
Bridge Length(m)	54.15	90.20	57.20	30.10	63.20	63.20
Span Length(m)	2@26.5	3@29.5	17.5+20.5+17.5	29.5	3@20.5	3@20.5
Clear Width(m)	5.5	5.5	5.5	5.5	5.5	5.5
Super-Structure	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder

Province	LAM DONG		DAC LAC	GIA LAI	KON TUM	
Bridge No.	47	48	55	58	62	64
Name of Bridge	LOC NGAI	NONG TRUONG BO SUA	ROXY	DAK PO TO	NGOC REO	DAK TO KAN
Existing Bridge	Suspention Br.	Biley Br.	Metal Br.	spillway	spillway	spillway
Horizontal Alignment	Gentle Curve	Curve	Gentle Curve	straight	Gentle Curve	straight
Vertical Alignment	0.3% ↙ ↘ 0.3%	0.3% ↙ ↘ 3%	6% ↙ ↘ 6%	8% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 8%
Bridge Length(m)	42.15	72.20	30.10	66.20	42.15	72.20
Span Length(m)	20.5+20.5	20.5+29.5+20.5	29.5	17.5+29.5+17.5	2@20.5	3@23.5
Clear Width(m)	5.5	5.5	5.5	5.5	5.5	5.5
Super-Structure	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder

Province	QUANG NGAI	BINH DINH		PHU YEN	KHANH HOA
Bridge No.	72	76	77	82	86
Name of Bridge	SONG SAU	DAO LONG	TRUONG DINH	DA LOC	TIEN DU
Existing Bridge	Metal Br.	Con. Slab Br.	Con. Slab Br.	Wooden Br.	Metal Br.
Horizontal Alignment	straight	Gentle Curve	Gentle Curve	straight	straight
Vertical Alignment	8% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 8%	8% ↙ ↘ 8%
Bridge Length(m)	63.20	54.20	48.15	36.15	48.15
Span Length(m)	3@20.5	3@17.5	2@23.5	2@17.5	2@23.5
Clear Width(m)	5.5	4.5	5.5	5.5	5.5
Super-Structure	Steel Girder	Steel Girder	Steel Girder	Steel Girder	Steel Girder

2.2.4 Implementation Plan for Bridge Construction (Component A)

2.2.4.1 Implementation Plan

(1) Implementation Policy

Component A consists of the construction of twenty-two small to medium sized bridges in eighteen provinces in the central area of Vietnam. The concept of implementing this component A under grant aid is summarized as follows:

- Component A is executed in three (3) phases.
- These bridges are divided into 3 groups according to phase separation mentioned above, as shown in Table 2-20.

Table 2-20 Grouping of Bridges

Group	Bridge No.	Group	Bridge No.	Group	Bridge No.
Northern Part (7 Brs.)	5	Central part (8 Brs.)	35	Southern Part (7 Brs.)	36
	6		59		37
	11		66		43
	18		67		46
	22		70		52
	26		74		56
	27		78		83
			79		

- Basically, PC post tension beams manufactured in the fabrication yard are applied to superstructure of component A. However, a steel girder may also be adopted in case a sufficient fabrication yard for PC girders is not available adjacent to the bridge site.
- An appropriate erection method should be selected in consideration of river conditions at each bridge site, characterized by sudden rise of water level by concentrated heavy rain and relatively rapid flow in the central area of Vietnam.
- In order to minimize the construction costs, construction equipment and temporary construction materials shall be reused for other bridges. Furthermore, materials and equipment shall be procured from local markets as much as possible, if the quality and quantity is acceptable.
- Local construction companies should be actively employed in the project as there are six companies with satisfactory achievements in the previous medium sized bridge projects. Furthermore, there is at least one construction company in each province engaged in the construction and maintenance of small-scale bridges and roads.

- Considering the limited number of local engineers with rich experience in bridge construction, site engineers in charge of each respective construction site working under the Japanese engineers, may be brought from a third country.

- Considering the dispersed locations of the project bridges and simultaneous construction of multiple bridges, the head office of the contractor and the consultant will be set up in Hanoi, while the contractor shall set up a regional office to supervise bridge construction at each bridge site, within convenient access of the sites, having favorable working conditions and communication facilities.

- In cases where existing bridges are replaced by newly constructed bridges, the construction of diversion roads and temporary bridges, as well as removal of existing bridges will also be included in this project.

2.2.4.2 Implementation Conditions

The main objective of this project is to construct bridges. Basic structures of these bridges are determined as follows in consideration of construction conditions and maintenance burden:

Superstructure:	Pre-stressed Concrete Girder or I-shaped Steel Girder
Substructure:	Inverted T abutment and Wall-type pier
Foundation:	Reinforced Concrete Pile and Steel Pipe Pile or Spread Foundation

Although these structure types are common in Vietnam and their construction is not complicated, the important issues to implement this component are as follows:

- To complete bridge construction within the planned period, it is important for the contractor to establish a well organized management system for construction schedule, quality, equipment and materials and labors. In addition, supervision by the consultant is also vital.

- Safety education and safety measures generally practiced in Japan shall be followed on the sites in order to improve working standards and to avoid labor-related accident.

- It is important, throughout the construction period, to take safety measures in order to safeguard local residents and passing vehicles against accidents.

2.2.4.3 Scope of Works

For the implementation of the project under the Grant Aid of the Japanese government, work shall be shared by the Japanese and the Vietnam governments as described hereafter.

i) Responsibilities to be borne by the Japanese Government

- Construction of bridges, approach roads and revetment

- Removal of existing bridges and construction of temporary detour bridges (in the case of bridges replacing the existing ones on same alignment)
- Construction and removal of temporary roads and bridges for the construction work
- Installation and removal of camps and construction yards for the construction work
- Procurement of materials, equipment and labor required for the above construction work
- Supervision of the above construction work
- Consultancy services required for implementation of the project

ii) Responsibilities to be borne by the Government of Vietnam

- Land acquisition of the construction sites and securing of lands necessary for temporary works (PC girder manufacturing yard, stockpile area of materials and equipment and equipment repair shops, shops of reinforcement, PC (prestressing tendons) and formwork, etc.)
- Provision of access roads to bridge construction sites
- Compensation for relocation of houses within the construction sites
- Removal or relocation of utilities, such as electric cables, telephone cables and water pipes
- Removal of existing bridges in case proposed bridge is constructed away from existing bridge
- The exemption of tax on materials and equipment imported for the project, and the expeditious processing of custom clearance
- The exemption of custom fees and taxation for the Japanese and the third party nationals entering Vietnam to work on the project, and exemption from other financial obligations

2.2.4.4 Consultant Supervision

i) Basic Policy on Detailed Design and Construction Supervision

① Basic Policy on Detailed Design

The basic policy on the detailed design is as follows:

- A field survey during the detailed design period will be conducted to reconfirm the site details, and will include supplementary studies related to the construction/estimate, and additional topographic survey as well as geotechnical investigation based upon results of the basic design.

- After completion of the detailed design, the results will be presented to the Vietnamese authorities, and discussions will be held for agreement.

② Basic Policy on Construction Supervision

The basic policy on the construction supervision will be as follows:

- Construction supervision should be undertaken in collaboration with both Japanese and Vietnamese engineers because twenty-two bridges are planned to be constructed or replaced simultaneously.

- The role of site engineers is to smoothly implement project. Particularly, careful supervision on the construction schedule shall be required. Moreover, a support organization for this project will be established in Japan to assist site engineers. In addition, the Japanese engineers will make utmost efforts to transfer technical skills and knowledge to local engineers.

ii) Construction Supervision

The engineers dispatched to the sites will perform the following construction supervision works.

① Approval of Construction Schedule and Construction Drawings

Supervisors will inspect and approve the construction schedule and shop drawings submitted by the contractor, checking its conformity to the requirements set in the contract documents, contract drawings, specifications, etc.

② Schedule Control

Supervisors will receive progress reports from the contractor, and give instructions necessary to ensure completion of the project on schedule.

③ Quality Control

Supervisors will examine the quality of works and approve construction materials and construction methods by making reference to the contract drawings and specifications.

④ Inspection of Completed Construction Works

Supervisors will inspect and give approval of the completed works, and final quantities for payment by checking as-built drawings.

⑤ Issuing of Certification

Supervisors will issue the necessary certificates for payment, for completion of construction and for expiry of the warranty period to the contractor.

⑥ Submittal of Reports

Supervisors will inspect the monthly reports and as-built drawings and photographs prepared by the contractor in order to submit them to the Vietnamese authorities, JICA and others. Furthermore, the supervisors will prepare the final report at completion of construction and submit it to JICA.

iii) Construction Supervision Organization

Considering the construction contents and time schedule, the assignment of Japanese engineers engaged in construction supervision services will be as set out below. In addition, as many local engineers as possible shall be employed, with the aim of saving cost and for the purpose of technology transfer.

- Project Manager

  The project manager will visit bridge sites at the time of commencement and completion of each bridge, or as required.

- Resident Engineer

  The resident engineer will be upon assignment permanently until the completion of the construction and will conduct general supervision of construction. The engineers will also be present for the warranty inspection held one year after completion of each project phase.

- Substructure Engineer

  The substructure engineer will visit sites as required during substructure construction.

- Geotechnical Engineer

  The geotechnical engineer will visit sites as required during soft ground treatment works.

2.2.4.5 Procurement Plan

1) Materials

① Basic Policy

Principally, typical construction materials shall be procured from local sources. However, special products or those which cannot be procured locally in sufficient quantity and quality within the project schedule, will be obtained from Japan or from a third country.

② Materials Procurement Situation

The procurement situations of the major construction materials required for this project are as set out below:

a) Cement

Cement manufactured in Vietnam is mostly Portland cement and its supply is adequate for domestic demand. The major cement plants in the northern part of the project area are namely HOANG THACH (Thanh Hoa province), BIN SON (Hai Phong City) and CHIN PHONG (Hai Phong City), and SAO MAI (Kein Giang province) in the southern part.

b) Aggregates

The location of borrow pits and crushed stone sources are shown in Figure 2-10.

Moreover, the source of aggregate and embankment material is shown in Table 2-21.

Table 2-21 Cement Factories in Vietnam

VNCA Members	Location of Plant	Annual Product	Method	Facilities
HE DUONG Cement Co.	Ninh Van, Hoa Luu Dist, Ninh Binh Province; Tel 84-30-860637; Fax 84-30-860566. Director: Mr Nguyen Van Diep	162,000 t/ year	Wet type	Vertical Shaft Clinker
HOANG THACH Cement Co.	Minh Tan, Kim Mon Dist, Ha Duong Prv, Vietnam.; Tel: 84-32-821097; Fax: 84-32-821098	2.3 million t/ year	Dry type	Rotary Type Clinker
ANG SON – QUANG BINH Cement Co.	Van Ninh, Ang Son Dist, Quang Binh Prov., Tel: 84-52-872019; Fax 84-52-872246	88,000 t/ year	Dry type	Vertical Shaft Clinker
LA HIEN Cement Co.	La Hien, Vo Nhai Dist, Thai Nguyen Prov; Tel: 84-280-829154; Fax: 84-280-829154	88,000 t/ year	Dry type	Vertical Shaft Clinker
BIM SON Cement Co.	Bim Son town, Thanh Hoa Prov; Tel: 84-37-824242; Fax: 8-37-824046	1.2 million t/ year	Wet type	Rotary Type Clinker
BUT SON Cement Co.	Thanh Chau Dist, Ha Nam Prov	1.4 million t/ year	Dry type	Rotary Type Clinker
CHINFONG HAIPHONG Cement Co. (J.V)	Trang Kenh, Minh Duc, Thuy Nguyen Hai Phong; Tel: 84-31-875480; Fax: 84-31-875479	1.4 million t/ year	Dry type	Rotary Type Clinker
MORNING STAR Cement Co. (J. V)	Hon Chong, Kien Giang Prov	1.8 million t/ year	Dry type	Rotary Type Clinker
HA TIEN Cement Co.	Hanoi Road, km 7, Ho Chi Minh City	1.0 million t/ year	Cement Grinding Plant	
NGHI SON Cement Co. (JV of Japan & Vietnam)	Nghi Son, Tinh Gia Dist, Thanh Hoa Prov; Tel: 84-4-9343260; Fax: 84-4-9343257	2.3 million t/ year	Dry type	Rotary Type Clinker
HATIEN - KIEN GIANG Cement Co.	Binh Quan, Ha Tien Dist, Kien Giang Prov; Tel: 84-77-854374; Fax: 84-77-854362	88,000 t/ year	Dry type	Vertical Shaft Clinker
HAI PHONG Cement Co.	No2 Hanoi road, Hai Phong City; Tel: 84-31-842013; 84-31-842012	540,000 t/ year	Wet type	Rotary Type Clinker
TIEN SON Cement Co.	Hong Quang, Ung Ha Dist, Ha Tay Prov; Tel: 84-34-882232; Fax: 84-34-775129	88,000 t/ year	Dry type	Vertical Shaft Clinker

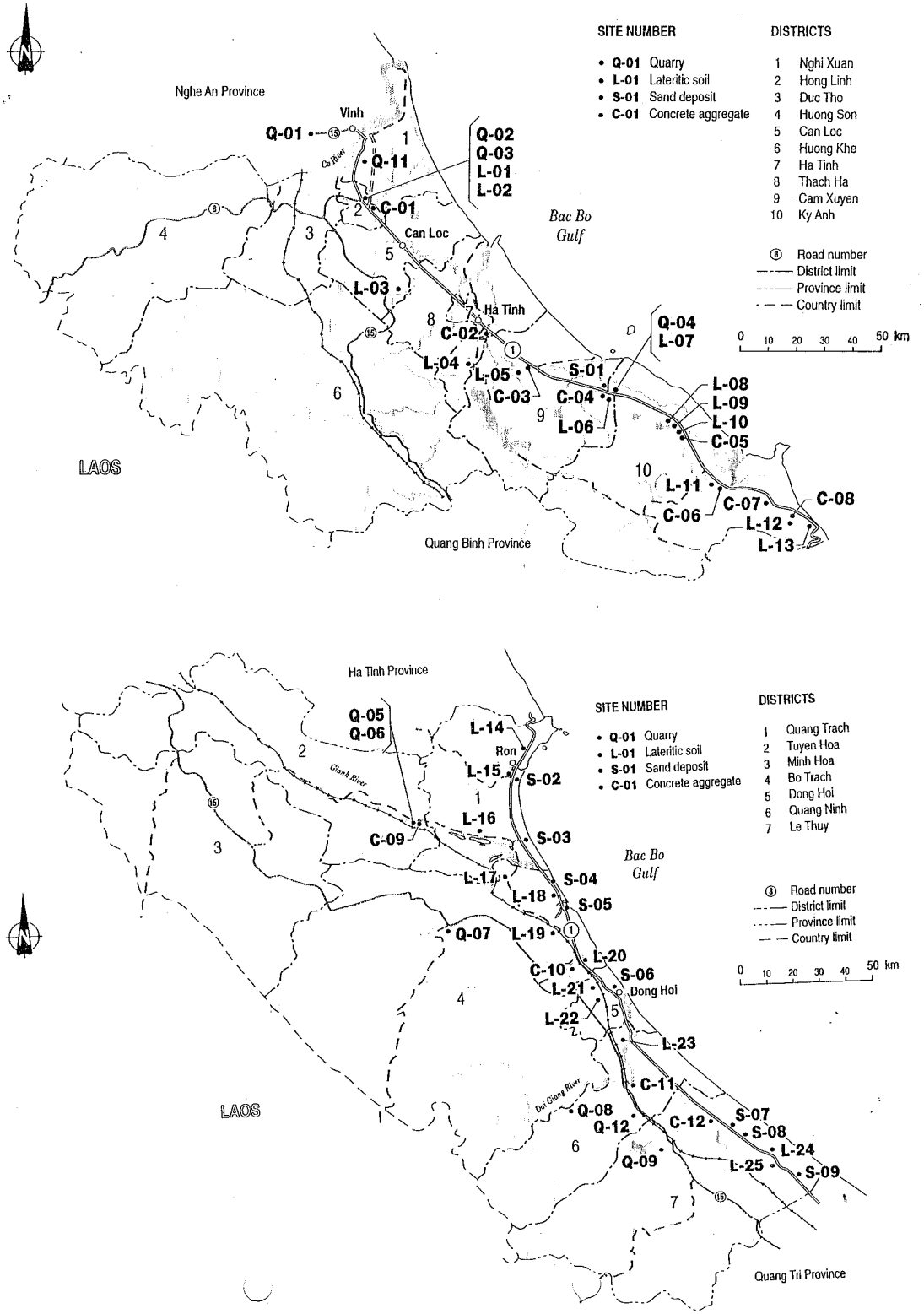
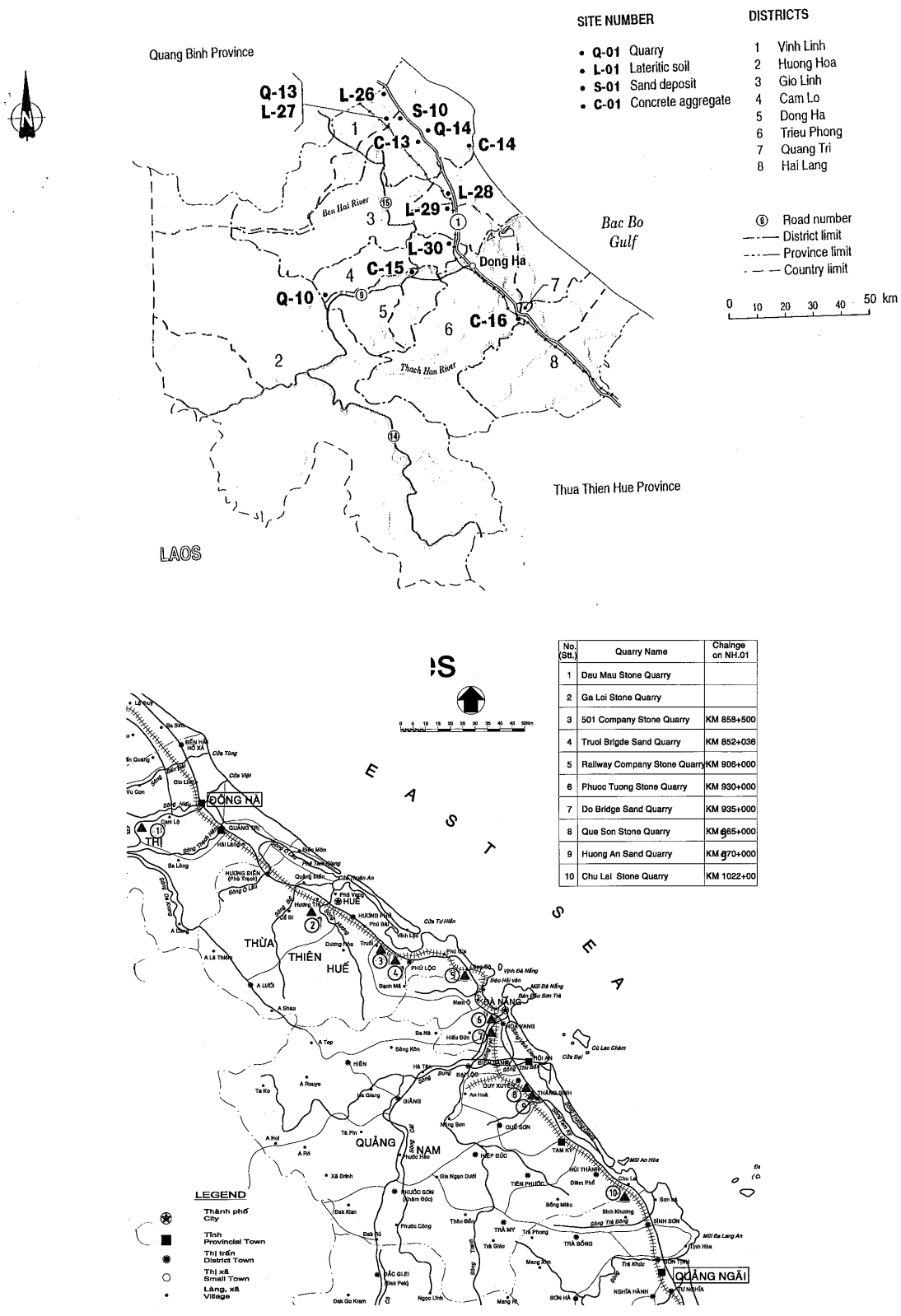


Figure 2-10 Locations of Borrow Pits and Crushed Stone Sources (1/2)



No. (Stt.)	Quarry Name	Chainge on NH.01
1	Dau Mau Stone Quarry	
2	Ga Loi Stone Quarry	
3	501 Company Stone Quarry	KM 858+500
4	Truoi Brigde Sand Quarry	KM 852+036
5	Railway Company Stone Quarry	KM 906+000
6	Phuoc Tuong Stone Quarry	KM 930+000
7	Do Bridge Sand Quarry	KM 935+000
8	Que Son Stone Quarry	KM 965+000
9	Huong An Sand Quarry	KM 970+000
10	Chu Lai Stone Quarry	KM 1022+00

Figure 2-11 Locations of Borrow Pits and Crushed Stone Sources (2/2)

Table 2-22 Sources of Aggregate and Embankment Material

Province	Br. No.	Br. Name	Crushed Stone	Sand	Embank. Material
THANH HOA	(5)	THACH DINH	20km road trans. LY THONG Area	40km water trans. VAM HA Area	2km road trans.
NGHE AN	(6)	QUYNH BANG	12k road trans. HOANG MAI Area	4km road trans.	12km road trans. HOANG MAI Area
HA TINH	(11)	MY SON	50km road trans. VOI Area	40km road trans. SONG RAC River	5km road trans. KY SON Area
QUANG BINH	(18)	LAC THIEN	3km road trans. LA MAT Area	24km road trans. DONG LE Area	1km road trans. MINH HOA Area
QUANG TRI	(22)	PA NHO	34km road trans. DAU MAU Area	63km road trans. DONG HA Area	10km road trans. LANG VAY Area
THUA THIEN	(26)	KHE DUONG	20km road trans. DA BAC Area	32km road trans. TRUI Area	10km road trans. PHU GIA Area
DA NANG CITY	(27)	HOI PHUOC	26km road trans. PHUOC TUONG Area	8km road trans. TUY LOAN Area	15km road trans. HOA CAM Area
QUANG NAM	(35)	DAI LOI	30km road trans. HOAI NHON Area	25km road trans. A NGHIA Area	15km road trans. SON GA Area
BINH THUAN	(36)	DA DUNG	14km road trans. East side	8km road trans. East side	8km road trans. East side
	(37)	TRAN	4km road trans. TA DON Area	4km road trans. TA DON Area	4km road trans. TA DON Area
NINH THUAN	(43)	TAM NGAN	17km road trans. Along NH 20	40km road trans. Airport Area	17km road trans. Along NH 20
LAM DONG	(46)	TAN VAN	50km road trans. Along NH 20	2km road trans. Upstream	25km road trans. Along NH 20
DAC LAC	(52)	EA SOUP	55km road trans. South side	32km road trans. South side	55km road trans. South side
	(56)	KRONG K'MAR	10km road trans. NH 27, West side	15km road trans. NH 27, West side	15km road trans. NH 27, West side
GIA LAI	(59)	IA DRANG	42km road trans. PLEI KU Area	42km road trans. PLEI KU Area	25km road trans. Along NH 19
KON TUM	(66)	NGOC TU	10km road trans. NGOC TU Area	14km road trans. KON DAU Area	14km road trans. KON DAU Area
QUANG NGAI	(67)	XA CAI	40km road trans. MY TRANG Area	8km road trans. SON VE River	16km road trans. DUAN LAT Area
	(70)	DO	60km road trans. CHU LAI Area	52km road trans. TRA KHUC River	10km road trans. TRA PHU Area
BINH DINH	(74)	BA LE	54km road trans. Along NH 1	6km road trans. NH 1, East side	25km road trans. Along NH 1
PHU YEN	(78)	TRA O	12km road trans. Along Pro.Rd. 642	10km road trans. CAU River, East-South	3km road trans. Pro.Rd. 641, North-We.
	(79)	TRA BUONG	5km road trans. Along Pro.Rd. 642	12km road trans. CAU River, East side	20km road trans. Pro.Rd. 641, North
KHANH HOA	(83)	NGOI NGAN	69km road trans. NHA TRANG Area	69km road trans. NHA TRANG Area	25km road trans. Along NH 1

c) Reinforcing Steel Bar

All the steel-manufacturing companies of Vietnam belong to a part of Vietnam Steel Corporation (VSC). In recent years, domestic production of reinforcing steel bar exceeds domestic demand and the product is exported to Cambodia and Laos. The major steel factories are VSC-POSCO (Hai Phong City) and NASTEEL-VINA・VINAUSTEEL (Bac Thai Province) in the northern part and VINAKYOUEI (Ba Ria Vung Tau Province), VIET-THANH・VIKIMCO (HCM City), VICASA (Don Nai Province) and TAY DO STEEL (Can Tho province) in the southern part.

According to VINA KYOUEI, reinforcing steel bars currently manufactured are D 10, 12, 13, 14, and 16, 18, 19, 20, 22, 25, 28 and 32 mm. These correspond to JIS standard (JIS G3112) of Japan.

d) PC Strand/Ducts, Steel for Girders and Temporary Works

High tensile strands for PC construction and ducts are manufactured in Japan, India and Korea. Steel for girders and temporary works (Steel Pipe Pile, Sheet Pile and H section) are generally imported from Japan or China and Korea.

e) Concrete Precast Products

PC girders, RC piles and RC Pipe culverts are locally available. The factory manufacturing PC girders is named Concrete Company No.620 (Binh Duong Province), which belongs to the Cienco-6 Group and is one of the few ISO-9002 registered companies. It produces I shaped girders of 33 m and 24.5 m length, and T shaped girders of 18.6 m and 12.5 m length, with a production capacity of one hundred girders per month.

However, in this project, girders cannot be conveyed by barge to all bridge sites. Moreover, land transportation of girders to the bridge site is also difficult due to long distance to the site and road conditions such as deteriorated surface and unsuitable alignments for transportation. Accordingly, post tensioned PC girders will be manufactured at adjacent to the sites.

f) Formwork/Falsework/Scaffolding/Timber for Temporary Works

Materials for formwork/falsework/scaffolding as well as all timber for temporary works can be procured in the local market.

g) Ready Mixed Concrete and Asphalt Hot Mix

Although ready mixed concrete can be procured in HCM City, there are no concrete mixing plants which can supply concrete for the project around the sites. There are some concrete mixing plants situated in the area of Da Nang City, PHU YEN province, and BINH THUAN province, but they cannot supply it for the project because it is used for manufacture

of a concrete secondary product. Therefore, the portable mixer (with a weighing meter gauge) with volume batching shall be used on the sites.

There are also several asphalt concrete hot mix plants along National Highway No.1. Most of them are accessible to the sites.

h) Miscellaneous

- Water for Ready Mixed Concrete

The installation of wells is basically required to obtain clean water for concrete mixing at each bridge site for the following reasons:

- Generally the project area has poor water supply facilities. Therefore, it is difficult to get clean water from public water supply system.
- At sites close to coastal areas (No. 6, No. 67 and No. 83), only salty water is available from the rivers.
- At river sections not affected by tide, river water often becomes muddy after rain.

- Bridge Bearings and Expansion Joints

Bridge bearings and expansion joints for bridges shall be imported from Japan, due to reliable quality.

③ Procurement Plan of Materials

Considering issues mentioned above, the procurement plan of major construction materials is shown in Table 2-23.

Table 2-23 Procurement Plan for Major Construction Materials

Material	Specification	Source			Remarks
		Vietnam	Japan	Third Country	
Embank. fill		○			Source in each Provinces
Upper-sub Base Material	Stabilized	○			Source in each Provinces
Lower-sub Base Material	Crushed stone	○			Source in each Provinces
Coarse Aggregate	Crushed stone	○			Source in each Provinces
Fine Aggregate	Sand	○			Source in each Provinces
Quarry stone	25～30cm	○			Source in each Provinces
Asphalt cement		○			Import, Da Nang City
Portland Cement	Portland Cement	○			Thanh Hoa（NGHI SON Cement） Ho Chi Minh（SAO MAI Cement）
Admixture		○			Import, Da Nang City
Reinforce-Ment	Deformed	○			Hai Phong（VINAUSTEEL, VSC-POSCO） Ho Chi Minh（VINA KYOUEI）
PC Strand	12.7mm		○		to Hai Phong or Ho Chi Minh Port
Sheath	φ50mm		○		to Hai Phong or Ho Chi Minh Port
Anchorage	7T13M130		○		to Hai Phong or Ho Chi Minh Port
Steel girder			○		to Hai Phong or Ho Chi Minh Port
PC girder		○			Manufacture at bridge site
RC Pile		○			Manufacture at bridge site
Steel pipe pile				○	to Da Nang Port
Bearing (Rubber)			○		to Hai Phong or Ho Chi Minh Port
Bearing (Steel)			○		to Hai Phong or Ho Chi Minh Port
Expansion Joint	25mm		○		to Hai Phong or Ho Chi Minh Port
Traffic sign	Speed, Weight	○			from Province Capital
Plywood		○			from Province Capital
Wood (temporary use)		○			from Province Capital
Falsework, Scaffolding		○			from Province Capital
Sheet Pile	Ⅳ type			○	to Da Nang Port
Temporary bridge girder		○			from Da Nang
Steel cover plate	1*2*0.2m	○			from Da Nang
H shape steel	H shape, etc.			○	to Da Nang Port
Fuel		○			from Province Capital

2) Construction Machinery and Equipment

① Basic Policy

The procurement policy on construction equipment follows that of construction materials. Accordingly, typical construction machinery and equipment should be procured locally in consideration of the present conditions mentioned below. However, large-scale or special construction equipment should be procured from Japan because of limited availability on the local market.

② Procurement Condition of Construction equipment

Although generally there are no leasing companies supplying construction equipment in Vietnam, typical construction machinery and equipment may be locally available for this project as some larger scale local companies own equipment such as bulldozers, dump trucks, etc.

On the other hand, availability of heavy equipment from Japan, USA and Korea, etc., has recently increased, replacing older equipment from the former USSR and China.

Accordingly, some major construction companies possess heavy machinery required for placing piles and for erection. However, although special machinery and equipment for placing piles and girder erection may be available, their number will be limited.

Regarding procurement of the erection girder, it is confirmed that only a limited number (about 3 sets) exist in the major construction companies. Since in this project, multiple (7 to 8) bridges will be constructed simultaneously, some equipment shall be brought from Japan, as shown in Table 2-24.

As for the concrete mixing plant, although simple pot mixers (0.35 m^3) are used in many cases for minor bridge construction in Vietnam, a portable mixer (0.50 m^3) with weighing devices will be used in this project for placing of beam concrete, etc., because a high quality of mixed concrete is required. This mixer (0.50 m^3) will also be brought from Japan for this project.

③ Procurement Plan for Construction Equipment

Based on the current local procurement conditions, the procurement plan of major construction machinery and equipment is shown in Table 2-24.

Table 2-24 Procurement Plan for Major Construction Equipment

Equipment	Specification	Supply Source			Remarks
		Vietnam	Japan	Third Country	
Earth work/Road					
Bulldozer	11t, 15t, 21t	○			
Back hoe	0.45m^3, 0.7m^3	○			
Clamshell	0.6m^3	○			
Motor Grader	2.7m, 3.8m	○			
Tire Roller	8-20t	○			
Vibration Roller	0.8-1.1t	○			
Macadam Roller	10-12t	○			
Tamping machine	60-100kg	○			
Dump truck	4t, 8t	○			
Water spreader	5500 ltr	○			
Asphalt sprayer	200 ltr	○			
Demolishing work					
Breaker w/ back hoe	600kg	○			
Concrete breaker	20kg		○		
Concrete Work					
Wheel loader	1.2m^3	○			
Portable conc. mixer	0.5m^3, w/ weight gauge		○		
Pot mixer	0.35m^3	○			
Truck mixer		○			
Vibrator		○			
Transport Work					
Truck w/ 3t crane	4t	○			
Truck	8t	○			
Trailer (low bed)	32t	○			
Fork lift	1t	○			
PC Girder Erection	1*2*0.2m				
Erection girder (1 set)	30t	○(1/2)	○(1/2)		
PC Girder Manufacturing					
Tension Jack, pump			○		
Grout mixer, pump			○		
Dewatering					
Water pump (electric)	3”, 4”	○			
Water pump (engine)	2”, 3”	○			
Piling Work					
Diesel hammer	2.5t, 3.5t	○			
Base machine	35t, 40t	○			
Vibro hammer	40kw, 60kw		○		

Equipment	Specification	Supply Source			Remarks
		Vietnam	Japan	Third Country	
Common use					
Crawler crane	40t			○	
Crawler crane	50t			○	
Wheel crane	20t, 25t, 40t	○			
Welding machine	200 A, 300A	○			
Re-bar cutter, bender		○			
Generator	50, 100, 200kva	○			
Air compressor	$3.5m^3$ -$15m^3$			○	
4WD			○		
Sedan			○		
Pick up truck			○		

3) Transport Plan of Materials and Construction Machinery/Equipment

① Routes and Distance of Transportation for Procurement from Vietnam

Materials such as embankment fill, sand and crushed stone shall be procured locally. Other construction equipment and materials shall be transported to construction site from neighboring cities, or from Hai Phong Port or Saigon Port.

The transportation distance for materials and equipment are as shown in Table 2-25.

② The Routes and Time Period of Transportation for Procurement from Japan

The routes and period of transportation for materials and equipment procured from Japan is set based on the recent practice as follows:

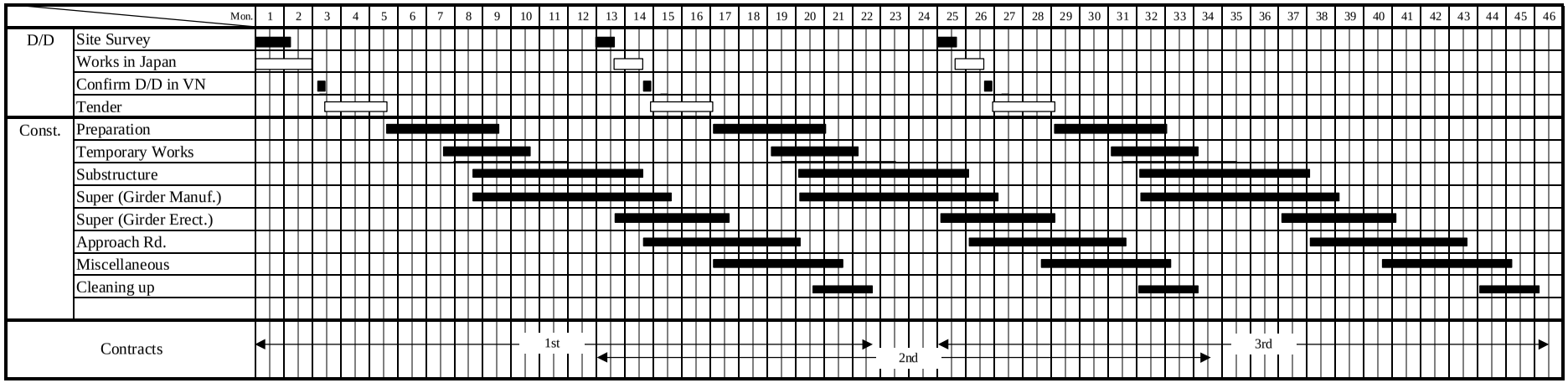
Packing and Loading	Factory ～ Sea Port in Japan	0.25
Shipping	Japanese Sea Port ～ Hai Phong and Ho Chi Minh Sea Port	0.50
Custom Clearance	Hai Phong and Ho Chi Minh Sea Port	0.25
Land Transportation	Sea Port ～ construction sites	0.20
	Total	1.20 months

Table 2-25 Transportation Distance for Major Materials

PROVINCE	BR NO.	BR. NAME	CAPITAL	DISTANCE BETWEEN CAPITAL AND SITE	DISTANCE BETWEEN SOURCE AND SITE								
					RE-BAR	CEMENT	ADDITIVE & NON-SHRINK	COARSE AGGREGATE,	SAND	EMBANK. FILL	WOOD	PLY-WOOD	IMPORT MATERIALS FR JAPAN
					HAI PHONG & HO CHI MINH	THANH HOA	DA NANG	IN PROVINCE	IN PROVINCE	IN PROVINCE	PROVINCE CAPITAL	PROVINCE CAPITAL	HAI PHONG OR HO CHI MINH
THANH HOA	(5)	THACH DINH	THANH HOA	61	246	95	671	20	40	2	61	61	246
NGHE AN	(6)	QUYNH BANG	VINH	72	323	68	544	12	4	12	72	72	323
HA TINH	(11)	MY SON	HA TINH	75	505	250	388	50	40	5	75	75	505
QUANG BINH	(18)	LAC THIEN	DONG HOI	123	633	378	382	3	24	1	123	123	633
QUANG TRI	(22)	PA NHO	DONG HA	70	752	497	243	34	63	10	70	70	752
THUA THIEN	(26)	KHE DUONG	HUE	56	804	549	57	20	32	10	56	56	804
DA NANG CITY	(27)	HOI PHUOC	DA NANG	31	874	619	19	26	8	15	31	31	874
QUANG NAM	(35)	DAI LOI	TAM KY	39	881	626	27	30	25	15	39	39	881
BINH THUAN	(36)	DA DUNG	PHAN THIET	73	261	261	261	14	8	8	73	73	261
	(37)	TRAN	PHAN THIET	18	206	206	206	4	4	4	18	18	206
NINH THUAN	(43)	TAM NGAN	PHAN RANG	41	374	374	374	17	40	17	41	41	374
LAM DONG	(46)	TAN VAN	DA LAT	48	468	468	468	50	2	25	48	48	468
DAC LAC	(52)	EA SOUP	BUON MA THUOT	69	691	691	691	55	32	55	69	69	691
	(56)	KRONG K'MAR	BUON MA THUOT	50	672	672	672	10	15	15	50	50	672
GIA LAI	(59)	IA DRANG	PLAY KU	42	846	846	846	42	42	25	42	42	846
KON TUM	(66)	NGOC TU	KON TUM	59	910	910	524	10	14	14	59	59	910
QUANG NGAI	(67)	XA CAI	QUANG NGAI	53	838	738	138	40	8	16	53	53	838
	(70)	DO	QUANG NGAI	14	872	738	138	62	52	10	14	14	872
BINH DINH	(74)	BA LE	QUY NHON	54	691	691	691	54	6	25	54	54	691
PHU YEN	(78)	TRA O	TUY HOA	59	622	622	622	12	10	3	59	59	622
	(79)	TRA BUONG	TUY HOA	65	628	628	628	5	12	20	65	65	628
KHANH HOA	(83)	NGOI NGAN	NHA TRANG	69	512	512	512	69	69	25	69	69	512

(6) Implementation Schedule

Tentative Project Implementation Schedule (Component A, Bridge Construction)
(Phase II)



Notes: Bridges in each Contract

1st Contract (7Brs.):	5,6,11,18,22,26,27
2nd Contract (8Brs.):	35,59,66,67,70,74,78,79
3rd Contract (7Brs.):	36,37,43,46,52,56,83

Legend

□ : Works in Japan

■ : Works in Vietnam

2.2.5 Implementation Plan for Girder Procurement (Component B)

2.2.5.1 Implementation Policy

Component B includes supply of steel girders for 23 small to medium size bridges in 18 provinces. The concept of implementing this component under Japanese Grant Aid is summarized as follows:

- Specifications of steel girder are determined based on the detailed design conducted by the Consultant. In order to reduce maintenance costs, a corrosion resistant steel girder will be applied to 9 bridges in mountainous area.

- Girders are delivered (loading, ocean transportation, inland transportation and handing over at the warehouse of the Department of Transport in each Province) by the Contractor.

- The government of Vietnam will take full responsibility for completing this type of bridge. The consultant who conducted the detailed design will review the design drawings before the commencement of the construction as well as rendering of supervision assistance. This is referred to as the soft component of this project, 2-1 Design Policy (9).

- This component will be divided into two (2) packages (north and central parts, and south part), considering different construction period due to meteorological condition.

2.2.5.2 Procurement Conditions

The 23 bridges for which steel girders are to be supplied (procured) are located throughout a vast area in the central region of the country, therefore efficient management of schedule, sufficiently skilled labour, procuring of materials and equipment, construction supervision, etc., by Vietnamese consultants is essential.

As Soft Component, monitoring by Japanese engineers to substructures construction to be done by Vietnamese side as well as manuals publication for steel girder erection. It is also necessary is that safe construction to neighboring residents and vehicles passing by.

2.2.5.3 Scope of Works

The implementation of Component B in the project anticipates sharing of responsibilities between the governments of Japan and Vietnam as follows:

i) Responsibilities to be borne by the Japanese government

- Supply of steel girders for bridge construction. The supply includes main girders, cross beam, splice plates, high tensile bolts, bridge bearings, expansion joints, drain pipes, coating material and erection apparatus.

- Transportation of steel girders to the specified warehouse of the Department of Transport (DOT) in each province.

- The consultant services necessary for the implementation of the works. (Detailed design, cost estimate of superstructure and supervision assistance)

- Soft component related to substructures and superstructures construction

ii) Responsibilities to be borne by the Government of Vietnam

- Transportation of steel girders with accessories and equipment supplied under Japanese Grant Aid from the warehouse of DOT in each province to the bridge sites.

- Erection of the steel girders and construction of bridge deck and bridge surface works (curb, hand rails, expansion joints, etc.)

- Design and construction of substructures and foundations, approach roads, revetment, slope protection, etc.

- Removal of existing bridges and construction of temporary detour roads.

- Provision and restoration of construction yards

- Provision of materials, equipment necessary for provision and restoration of construction yard

- Construction supervision of provision and restoration of construction yard

- Land acquisition of the construction sites and provision of the lands (Lease of lands) land for construction yard the temporary works

- Compensation for relocation of houses in the construction sites

- Removal or relocation of utilities, such as electric cables, telephone cables and water pipes

- Consultancy services necessary to the implementation of the project

- The exemption of tax on the materials and equipment imported for the project, and the expeditious processing of custom clearance

- The exemption from custom fees and taxation for the Japanese and the third party nationals entering Vietnam to work on the project, and exemption from other financial obligations

Refer to Appendix 2 for Cost Estimation borne by the government of Vietnam.

2.2.5.4 Consultant Supervision

Consultant supervision consists of detailed design works and supervision assistance, conforming to soft component. The basic concept of the detailed design is as described in 2-4-1 (4) (Consultant Supervision).

2.2.5.5 Procurement Plan

i) Procurement of Materials

Steel girders and accessories will be procured form Japan for the following reasons:

- Steel plates are imported from overseas, as mentioned in 2.2.4.5, 1), ②, d), Procurement Plan.
- Steel girders adapted to the project including corrosion resistant steel girders for 9 bridges, which is difficult to be procured from third country.

ii) Transportation Route and Period

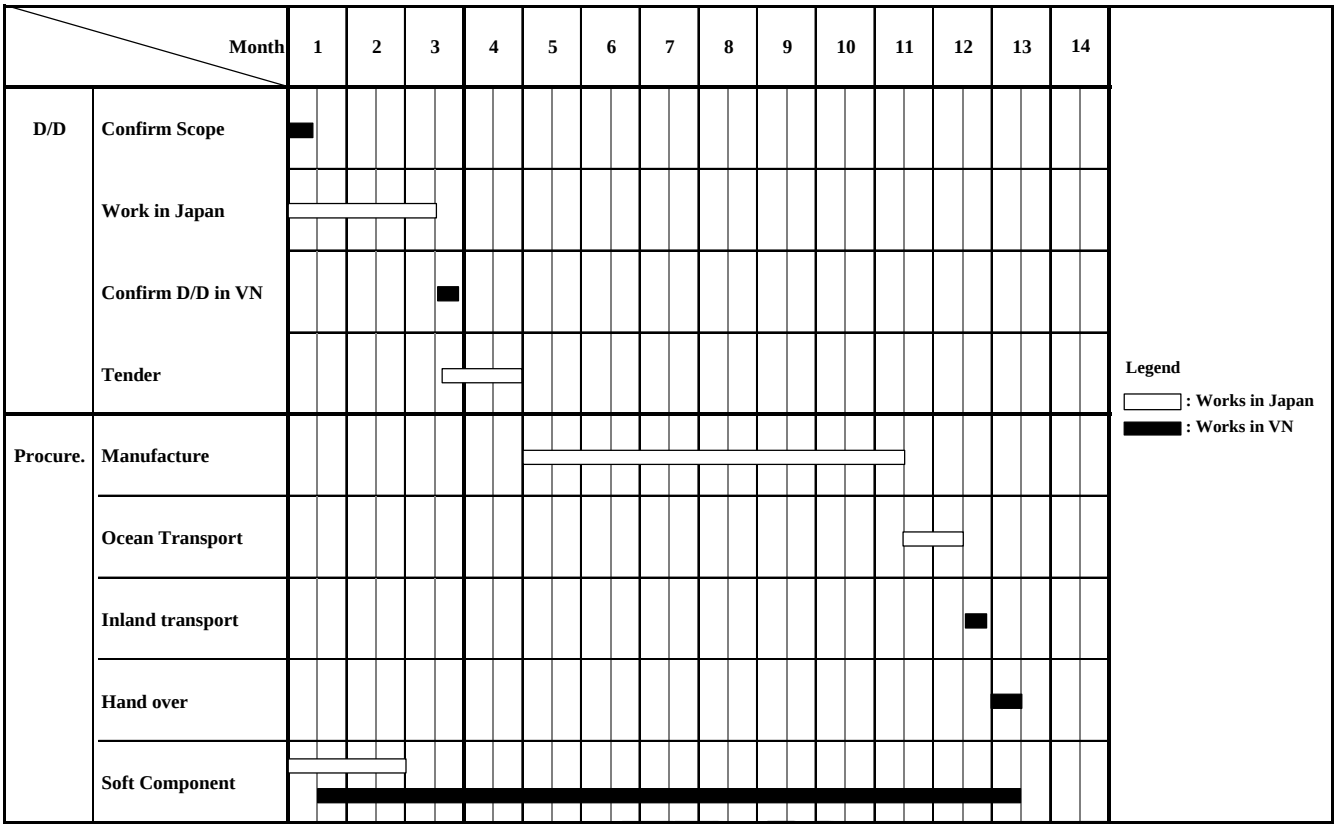
The transportation period for materials and equipment to be procured from Japan is about 1.2 months, as shown in 2.2.4.5, 3). Road transportation, as shown in Table 2-26, will be adopted for the inland transportation route of materials to the warehouse of the Department of Transport in each province.

2.2.5.6 Implementation Schedule

Table 2-26 Transportation Distance for Steel Girders (Component B)

PROVINCE	BR. NO.	BR. NAME	DISTANCE TO CAPITAL (km)		THROUGH
			FROM DA NANG	FR HAI PHONG OR HO CHI MINH	
ThANH HOA	(2)	CHINH DAI	626	182	NH-1
	(4)	THACH QUANG	626	182	NH-1
NGHE AN	(7)	KE CHIENG	478	330	NH-1
	(9)	BAN KHOANG	478	330	NH-1
HA TINH	(12)	CUA TRAI	430	378	NH-1
QUANG BINH	(15)	PHU VINH	280	528	NH-1
QUANG TRI	(20)	BEN DA	186	622	NH-1
THUA THIEN	(24)	NA MAY	118	690	NH-1
QUANG NAM	(34)	SONG QUAN	79	867	NH-1
BINH THUAN	(38)	SUOI CAT	823	196	NH-1
NINH THUAN	(42)	TUAN TU	676	343	NH-1
	(45)	CAU GAY	676	343	NH-1
LAM DONG	(47)	LOC NGAI	798	299	NH-1,NH-27,NH-20
	(48)	NONG TRUONG BO SUA	798	299	NH-1,NH-27,NH-20
DAC LAC	(55)	ROXY	593	350	NH-1,NH-26,NH-14
GIA LAI	(58)	DAK PO TO	500	539	NH-1,NH-19,NH-14
KON TUM	(62)	NGOC REO	547	586	NH-1,NH-19,NH-14
	(64)	DAK TO KAN	547	586	NH-1,NH-19,NH-14
QUANG NGAI	(72)	SONG SAU	144	875	NH-1
BINH DINH	(76)	DAO LONG	330	689	NH-1
	(77)	TRUONG DINH	330	689	NH-1
PHU YEN	(82)	DA LOC	449	570	NH-1
KHANH HOA	(86)	TIEN DU	571	448	NH-1
TOTAL			11,083	10,921	

Tentative Project Implementation Schedule (Component B, Steel Girder Supply)



2.3 Obligations of Recipient Country

Obligations of Recipient Country are as follows for each component:

(1) Component A (Bridge C.T)

① Acquisition of the construction sites and securing of the lands necessary to perform the temporary works (PC girder manufacturing yard, stockpile area of materials and equipment and equipment repair shops, shops of reinforcement, PC (prestressing tendons) and formwork, etc.)
② Provision of access roads to bridge construction sites
③ Compensation for relocation of houses within the construction sites
④ Removal or relocation of utilities, such as electric cables, telephone cables and water pipes
⑤ Removal of existing bridges in case proposed bridge is constructed away from existing bridge
⑥ The exemption of tax on the materials and equipment imported for the project, and the expeditious processing of custom clearance
⑦ The exemption of custom fees and taxation for the Japanese and the third party nationals entering Vietnam to work on the project, and exemption from other financial obligations

(2) Component B (Steel Girder Procurement Type)

① Transportation of materials and equipment supplied under Japanese Grant Aid from sources in province capitals to the bridge sites
② Erection of steel girders supplied under Japanese Grant Aid and construction of bridge deck and bridge surface works (curb, hand rails, expansion joints, etc.)
③ Design and construction of substructures and foundations, approach roads, revetment, slope protection, etc.
④ Removal of existing bridges and construction of temporary detours
⑤ Construction and removal of construction yards
⑥ Provision of materials, equipment necessary for the above construction
⑦ Construction supervision of the above construction works
⑧ Acquisition of the construction sites and provision of the lands (Lease of lands) necessary to perform the temporary works
⑨ Compensation for relocation of houses within the construction sites
⑩ Removal or relocation of utilities, such as electric cables, telephone cables and water pipes
⑪ Consultancy services necessary to the implementation of the project
⑫ The exemption of tax on the materials and equipment imported for the project, and the expeditious processing of custom clearance
⑬ The exemption from custom fees and taxation for the Japanese and the third party nationals entering Vietnam to work on the project, and exemption from other financial obligations

2.4 Project Operation and Maintenance Plan

(1) Operation and Maintenance System

Large-scale repair works will not be necessary until 20 to 30 years after the completion of bridges, if the operation and maintenance routine mentioned in (2) is followed. Painting of corrosion resistant steel is not required. Therefore, the operation and maintenance after the completion of this project will be carried out following the present system, under the control of the Department of Transportation in each province.

(2) Operation and Maintenance Method

1) Periodic Inspection and Maintenance

Though the main objective of this project is the construction of 45 bridges, the approach roads are included in the operation and maintenance objectives. The operation and maintenance is carried out as explained in the Table 2-27.

Table 2-27 Maintenance and Operation Schedule

	Item	Maintenance and Repairing Works	Interval
Bridge	① Drain Pipe	Clearing of sediments	3 months
	② Expansion Joint	Repairing of metal and seal rubber	3 months
	③ Handrail	Repairing damages by traffic accidents	3 months
	④ Bridge Bearings	Removal of earth deposits	6 months
	⑤ Concrete Pavement	Repairing of cracks	6 months
	⑥ Steel Girder	Repairing of corrosion and paint peeling off	1 year
	⑦ Substructure River Protection	Removal of drifting logs, grasses	6 months
		Inspect and removal of scour	6 months
Road	① Road Surface	Patching, smoothing	3 month
	② Shoulder/ slope	Planting (turf), reinforcement of earth, repairing riprap	3 month
River Bank	① around abutment	Repair of riprap/gabion	6 months
	② Riverbank	Repair of riprap/gabion	6 months

It is important to keep records of the results of periodic inspection in the road registers and to assess the bridge condition in order to establish the repair schedule. Therefore, a periodic inspection procedure must be established from the outset.

2) Maintenance of Asphalt Pavement

Minor maintenance (Patching, Leveling), of the surface of the bridges and approach roads are done during periodic inspection. Also, considering the life span of asphalt pavement, overlay should be carried out every ten years.

3) Steel Girder Painting

Minor painting maintenance of the steel girders will be carried out during periodic inspections. Also, considering the life span of paints, overall painting should be carried out every ten years.

(3) Operation and Maintenance Cost

1) Periodic Inspection and Maintenance

Periodic inspection, minor repair/maintenance will be executed under the direct management of the Ministry of Transport in each province. The cost for operation and maintenance per year is estimated as shown below:

Personal expenses (engineer, worker):

Personnel	18 provinces x 40 million VND	=	720 million VND
Materials	50 % of above	=	360 million VND
Equipment (Vehicle, etc)	18 provinces x 25 million VND	=	450 million VND
Total			1,530 million VND

2) Maintenance of Asphalt Pavement

The maintenance of asphalt pavement is entrusted to a local construction company and the estimate for a period of ten years is shown below.

Component A	1,034 m^2 x 22 brs. x 0.09 million VND	=	2,047 million VND
Component B	691 m^2 x 23 brs. x 0.09 million VND	=	1,430 million VND
Total			3,477 million VND

3) Steel Girder Painting

The painting of steel girders is entrusted to a local construction company and the estimate for a period of ten years is shown below.

Component A	404 m^2 x 3 brs. x 0.095 million VND	=	115 million VND
Component B	404 m^2 x 23 brs. x 0.095 million VND	=	883 million VND
Total			998 million VND

4) Annual Operation and Maintenance Cost

1,530 + 1/10 (3,447 + 998) = 1,978 million VND

2.5 Other Relevant Issues

2.5.1 Soft Component Plan

Reconstruction of bridges on rural roads in Vietnam is being carried out through the projects for Reconstruction of Bridges in Northern Area (1995 - 1997) and Construction of Bridges in Mekong Delta Area (2001 - 2005). The number of bridges, which are to be newly built or replaced under these projects, is almost the half the number requested for Japanese grant aid. The remaining half is to be constructed by Vietnam.

Therefore the target of the Soft Component is to develop sustainability of bridge construction throughout Vietnam. In this the technology transfer to Vietnamese engineers in the following aspects are included:

① Construction schedule control
② Quality control
③ Safety control
④ Operation and Maintenance control

In addition to the above monitoring, steel girder erection manuals will also be put out.

The period of operation of the Soft Component will be during 2002, in which the Vietnam side constructs foundations and substructures.

Three Japanese engineers will be dispatched to Vietnam, since the area of the project is vast; 1,300 km from north to south.

Table 2-28 Activities in Soft Component Work

Overall Goal : Sustainable Development of Bridge Construction Engineering Goal of Soft Component : Establishing of Advanced Technology for Steel Girder Bridges Erection and Level Up of Substructure Construction Technology			
Results	Activities	Work period	Output
Level up of Substructures Construction • Schedule of substructures • Quality assurance of substructures • Safe construction of substructures	• Review of design and construction plan of substructures done by Vietnamese side • Monitoring of substructures for Schedule, Quality, Tolerance, Safety, etc.	• During substructure construction by Vietnamese side	• Report of monitoring
Bridge girder erection technology	• Technology transfer of steel girder erection • Publication of manuals for Schedule, Quality, Safety, etc.	• From detailed design to completion of procurement	• Manuals for schedule, quality, tolerance, safety controls, etc.

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3.1 Project Effect

Direct effects of the completion of this construction are as follows:

- More consistent transportation availability

  With replaced or new bridges, transportation along existing roads will be more dependable. Inconvenience will be alleviated for commuting schoolchildren and hospital out-patients, more consistent shipping of daily necessities will be made possible, and easier access to the markets will be made available.

- Safer passage

  By replacing outmoded or deteriorated bridges, safer passage will be ensured.

- Year-round transportation

  With construction of bridges over rivers which cannot be forded in the rainy season, year-round transportation will be made available.

- Alleviation of detour routing

  Extra costs now caused by detouring will be mitigated by the replacement of bridges which now serve only pedestrians or have load restrictions of 10 tons or lower.

Furthermore, the following indirect effects also:

- Promotion of local economical activities

  With consistent transportation made available, faster shipping of agricultural products is made possible, thereby invigorating the agricultural industries.

- Raised living standards

  Access to schools, hospitals are improved, and constant transpiration of goods and living standards of local inhabitants are raised. The same can be stated concerning minority tribes who inhabit nearby areas.

- Regional effect

  The construction of bridges which alleviate bottlenecks in the regional transportation network does not only directly effect the local inhabitants, but by dramatically improving the transportation infrastructure as an important industrial base, the economy and industrial development of the surrounding region in addition to project area itself will be favorably affected in the longer term.

- National effect

  From the national viewpoint, the regional effect mentioned above would at the same time contribute by helping to rectify inter-regional social and economic disparities for a more well-balanced overall national development.

Situation and issues	Effect in the project	Benefits
Existing situation of 45 bridges	• Construction of 22 bridges (by Japan) • Construction of 23 bridges by Vietnam with procured steel girders (from Japan)	① Year-round passage ② Safe passage ③ Safe and quick passage of inhabitants and agricultural products
Operation and maintenance	Improved Operation and maintenance system	① Periodical inspection ② Improved system and technology ③ Improved bridge construction engineering due to “Soft Component”

3.2 Issues and Recommendations

This project is recommended for Grant Aid by the Government of Japan since it will contribute to the early completion of the road network, to development of the region, and to the improvement of living conditions of the inhabitants of the central area.

The capacity of the Government of Vietnam to operate and maintain the project bridges has been assessed and it is concluded that it is adequate.

Unit of the Ministry of Transport, Projects Management Unit 18, has recently successfully completed construction of a similar project, "Project for the Reconstruction of Bridges in the Northern Area"

It is emphasized that maintenance must not be neglected following execution of the project; otherwise the benefits of the project will be reduced in the medium and long term. In particular, such maintenance must include assurance of the required cross sectional area below the bridges prior to the flood season, inspection for damage to bank protection during the flood season, and immediate repair of even minor damage. At the very least, funds for such inspection and repair must be provided.

3.3 Project Evaluations

(1) Evaluation of Project

The benefits that will be provided through completion of the project are principally improved economic growth in low-income areas. This will have a direct benefit on poverty alleviation.

- Road network improvement will allow year-round shipment of agricultural products and forestry-products.

- Upgrading of road to year-round transportation leads to safe movement of goods to local residents.

- Improved access to markets, schools, and hospitals leads to improvement in local resident's living conditions.

- Improved transport links within the project area not only promotes economic development within the region, but also will cross project boundaries leading to increased trade with other areas.

It is clear that there are strong positive benefits to implementing the project.

3.4 Conclusions

It is judged that this project is quite recommendable for Grant Aid by the Government of Japan, since great effects are expected and it would contribute to improved basic human needs.

Moreover, it is considered that existing organization of operation, maintenance management is satisfactory in terms of working force and budget. With improvement of management system and operation and maintenance technology, this project will be more efficiently executed.