MINISTRY OF ROADS & HIGHWAYS
THE REPUBLIC OF GHANA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTION
OF
SMALL SCALE BRIDGES
IN
THE REPUBLIC OF GHANA

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

MINISTRY OF ROADS & HIGHWAYS
THE REPUBLIC OF GHANA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTION
OF
SMALL SCALE BRIDGES
IN
THE REPUBLIC OF GHANA

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

PREFACE

In response to a request from the Government of the Republic of Ghana the Government of Japan decided to conduct a basic design study on the Project for Construction of Small Scale Bridges and entrusted the study to the Japan International Cooperation Agency (JICA).

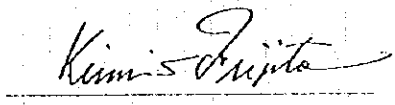
JICA sent to Ghana a study team from November 29 to December 20, 1995.

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

March 1996



Kimio Fujita
President
Japan International Cooperation Agency

March, 1996

Letter of Transmittal

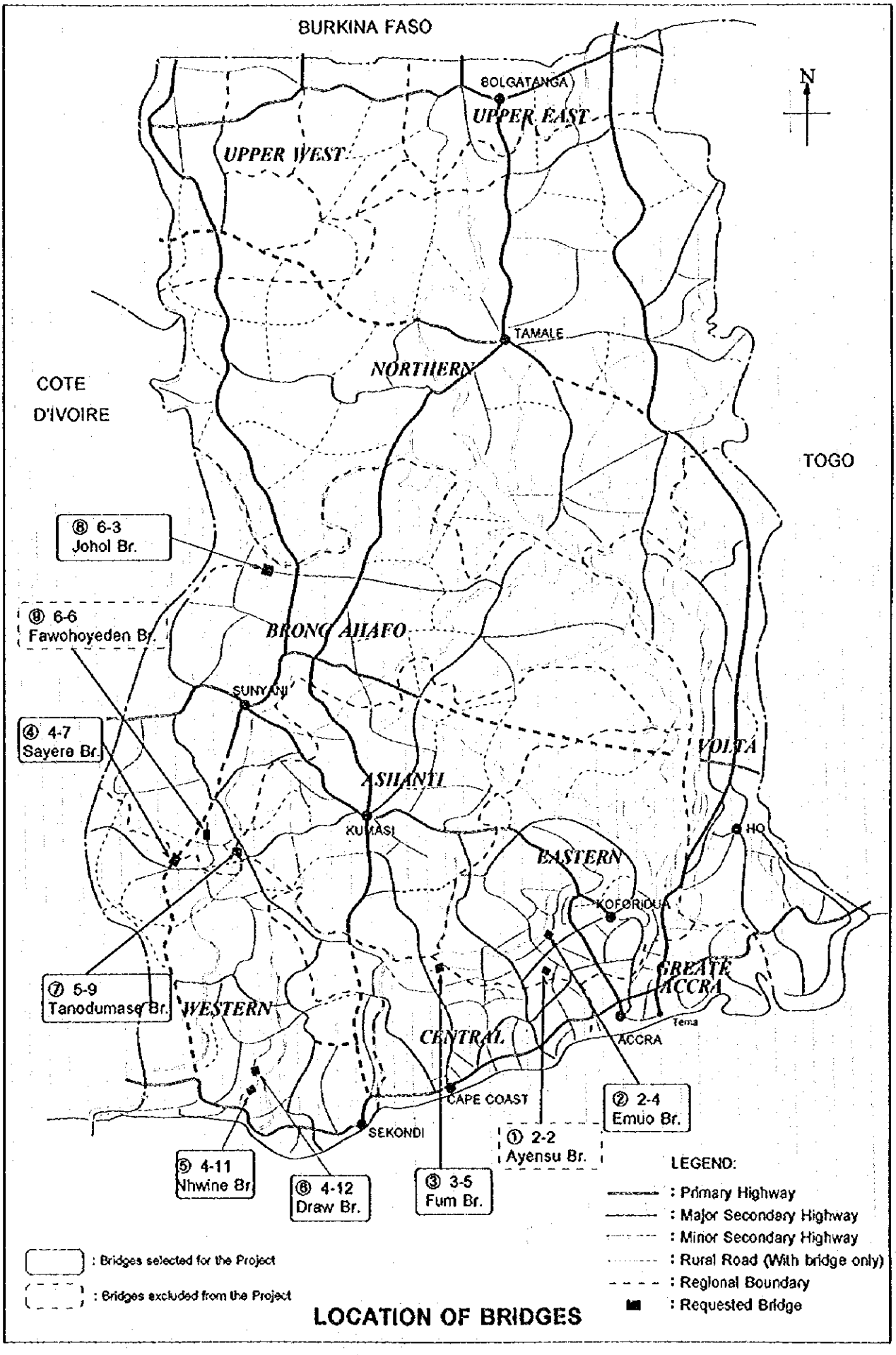
We are pleased to submit to you the basic design study report on the Project for Construction of Small Scale Bridges in the Republic of Ghana.

This study was conducted by Katahira & Engineers International, under a contract to JICA, during the period from November 24, 1995 to March 29, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ghana and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

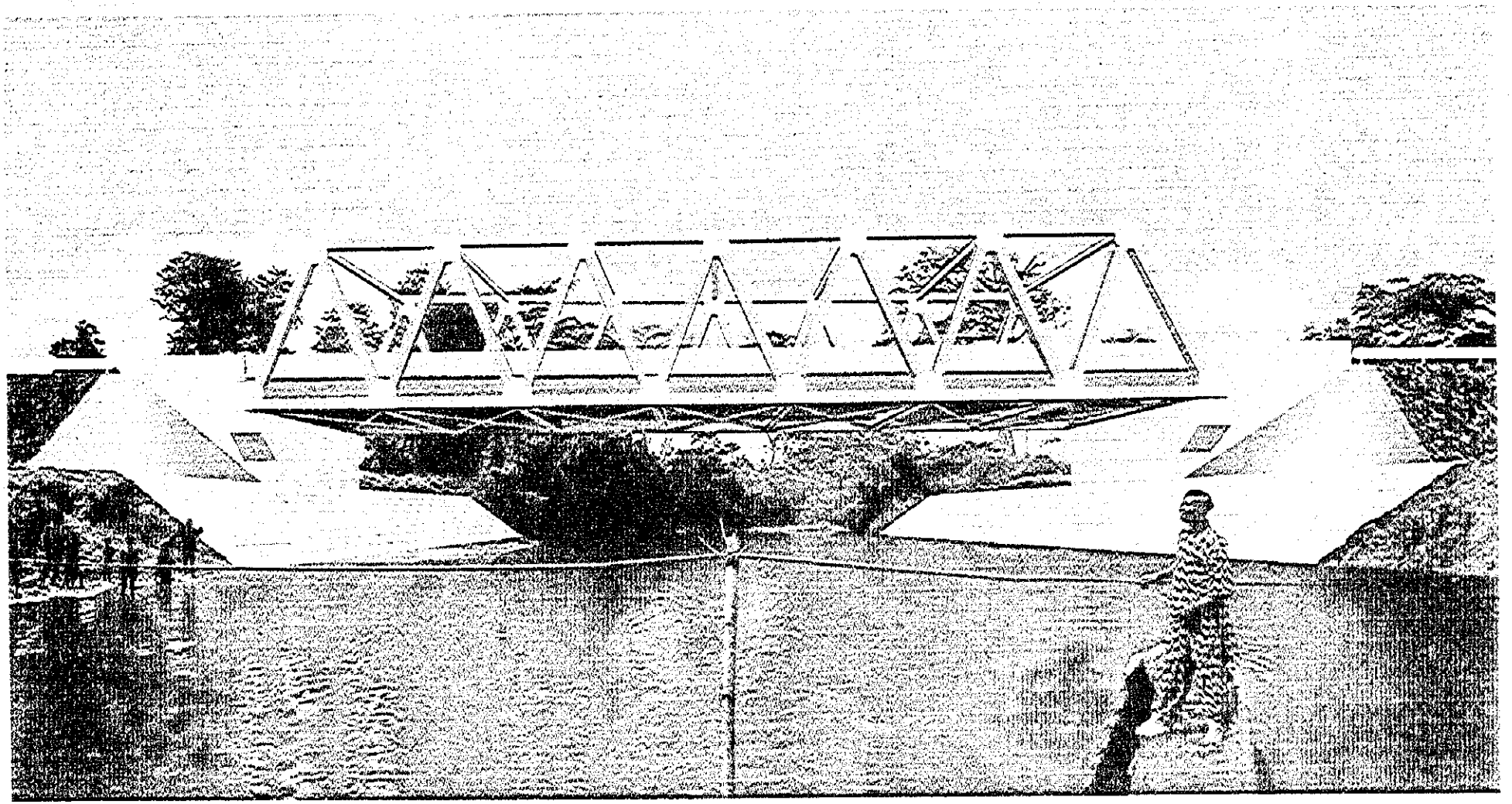
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Minoru Miura
Project manager
Basic Design Study Team on the Project for
Construction of Small Scale Bridges
Katahira & Engineers International



LOCATION OF BRIDGES



TANODUMASE BRIDGE

PERSPECTIVE

ABBREVIATIONS

AADT	: Average Daily Traffic Volume
DFR	: Department of Feeder Roads
DUR	: Department of Urban Roads
ERP	: Economic Recovery Program
GDP	: Gross Domestic Product
GHA	: Ghana Highway Authority
IMF	: International Monetary Fund
IDA	: International Development Association
JICA	: Japan International Cooperation Agency
JIS	: Japan Industrial Standard
JRA	: Japan Road Association
MRH	: Ministry of Roads & Highways
PC	: Prestressed Concrete
PIP	: Public Investment Program
RC	: Reinforced Concrete

CONTENTS

Appendices

1. Member List of the Survey Team
2. Survey Schedule
3. List of Parties concerned in the Republic of Ghana
4. Minutes of Discussions
5. General View of Bridges
6. Plan & Profile of Approach Roads
7. Scheme of Construction Methods
8. Summary of Design Calculation
9. References

CHAPTER 1 BACKGROUND OF THE PROJECT

Ghana is a medium-size country (239,000 sq. km) with a widely scattered population estimated at about 14 million. More than 70% live in rural areas. The country's economic potential is great: it has vast timber resources, its agricultural possibilities are considerable, and it was once the world's leading cocoa producer. Mineral resources include manganese, bauxite, gold, and diamonds, and petroleum exploration is under way.

In spite of the country's potential, there was a deterioration in the Ghanaian economy from 1970 to 1982, with GDP declining at an average rate of 0.5% per annum and real per capita income falling by 30%. Export earning dropped 52% in this period. The falling per capita income over this period resulted in greater incidence of poverty, growing unemployment. Deterioration in the roads, railways, and the other infrastructure was also very evident.

It was against this background that the Government of Ghana introduced the Economic Recovery Program (ERP) in 1983 to stabilize the economy, to improve producer incentives, to encourage private sector participation in economic development, and to rebuild the country's social, economic, and physical infrastructure.

Agriculture is the mainstay of the Ghanaian economy, contributing more than 70% of exports and about 50% of GDP. It employs about 60% of the labor force. Since the ERP was introduced, recovery has been brought about mainly by the performance of the cocoa and forestry industries However, growth in agriculture is slow due to impediments such as the poor condition of the transport infrastructure, a weak marketing system, and the poor state of agricultural support services.

Ghana has a well developed road network and road transport is the dominant mode in Ghana's transport system. However, the road network has suffered more than a decade of neglect of proper maintenance and almost all the roads have deteriorated. Although recent projects are gradually improving road conditions, particularly for trunk roads, feeder roads are still in a generally poor state. In many rural areas, transport costs account for up to 75% of marketing costs as a result of the poor state of the feeder road network.

Under these conditions, the Government of Ghana has initiated a series of programs to develop feeder roads. However, streams without bridges and weak timber bridges along feeder roads still remain and obstruct the transportation of agricultural products and access to social services for the rural population.

To construct these bridges, the Government of Ghana has formulated the Project for Small Stream Bridges Rehabilitation and requested Japan's grant aid assistance to procure prefabricated

steel bridge materials and equipment. The Government of Japan conducted a basic design study on the project in 1995, and procurement of prefabricated steel bridges and equipment for the construction of selected 21 bridges among the 35 requested bridges was proposed. The implementation of the project started in September 1995.

Among the requested bridges, 9 bridges were excluded from the project since the prefabricated steel bridges are inapplicable or the construction is difficult for Ghanaian contractors despite the fact that they have a high necessity and large socioeconomic effects.

This time, the Government of Ghana has requested Japan's grant aid assistance for the construction of the 9 bridges. The list of the requested bridges is shown in Table 1.1-1.

Table 1.1-1 REQUESTED BRIDGES

Bridge No.	Bridge Name	Region	Road Name
2-2	Ayensu	Eastern	Takorase-Krudua
2-4	Emuo	Eastern	Osenase-Apinamang
3-5	Fum	Central	Akonfudi-Asibirim
4-7	Sayere	Western	Nkatieso-Agyemandiem-Abuom
4-11	Nhwine	Western	Asaasetre-Banso-Kwesikrom
4-12	Draw	Western	Asaasetre-Banso-Kwesikrom
5-9	Tanodumase	Ashanti	Bibiani-Asiberem
6-3	Johol	Brong Ahafo	Banda-Kankan
6-6	Fawohoyeden	Brong Ahafo	Fawohoyeden-Atronie

CHAPTER 2 OUTLINE OF THE PROJECT

2.1 Objectives of the Project

Along feeder roads, river crossings without bridges cut roads and weak timber bridges limit heavy vehicles and are obstructing transportation of agricultural products to markets and access to social services for the rural population. Such a poor state of feeder roads poses a serious constraint to the recovery of the national economy by increasing agricultural productions and to raise the standard of rural life, that are the goals of the national development plan.

To improve feeder roads, the Government of Ghana through the Department of Feeder Roads (DFR) is implementing a series of feeder road maintenance and rehabilitation projects. The Government of Japan has extended grant aid assistance for procurement of prefabricated steel bridge materials and equipment necessary for construction of 21 bridges along feeder roads, in response to the request of the Government of Ghana.

Among the requested bridges, 9 bridges were excluded from the project since the prefabricated steel bridges are inapplicable or the construction is difficult for Ghanaian contractors despite the fact that they have a high necessity and large socioeconomic effects.

This project aims to construct high priority bridges among these 9 bridges under Japan's grant aid. Design and construction supervision will be undertaken by a Japanese consultant and construction of the bridges will be undertaken by a Japanese contractor. The responsible implementing organization is the DFR.

2.2 Conditions of the Project Sites

Conditions of the requested bridge sites are surveyed and summarized as shown in the following tables:

- Table 2.2-1 Topographic and geological conditions of the sites
- Table 2.2-2 Conditions of the roads connecting the sites
- Table 2.2-3 Socioeconomic conditions in the project affected areas

Table 2.2-1 TOPOGRAPHIC AND GEOLOGICAL CONDITIONS OF THE SITES (1/3)

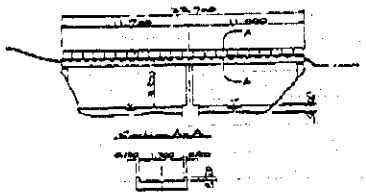
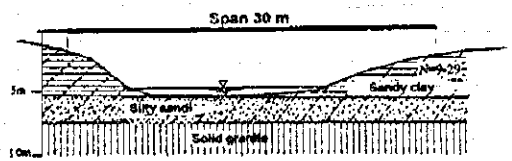
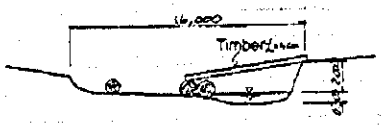
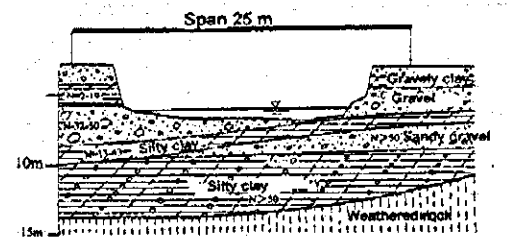
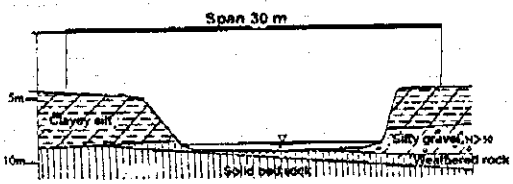
Site	Existing Bridge Condition	Topographic Condition	Geological Condition	River Condition
2-2 Ayensu	 A foot bridge (width is 1.3 m) is existing. Feed erroad which is passable for vehicle, terminates just before the site. Vehicles can not go a cross the river to reach the Takorase Village.	The terrain around the site is little hilly. The site location is at the upper reaches of Ayensu River. The site is sorrounded by farms growing mainly cocoa.	 The surface is covered by about 3 m thick gravel layer which contains silty clay (N-value 10~20). Beneath it, about 2 m thick silty clay layer (N>20) exists. Bearing strata which is solid granite which surface exists around 5 m deep from the surface. Ground waterlevel is about 4 m deep.	Width : 20 m Depth : LWL=0.4m, HWL=4.4m Velocity : 0.7m/s Alignment: Winding to the right. Bank :Left side is steep, right side is gentle. Use :For washing, drinking, bathing.
2-4 Emuo	 Collapsed bridge made of RC is seen on the riverbed. The timber bridge which existed in 1994 was also washed out. A poor temporary bridge made of timber is installed across the river. Vehicles can not cross the river.	The site is located at the foot of high moutain chains (altitude 300 to 900 m) which surround the north and the east sides of the site. The river becomes steep from the site to the upperstream, while it becomes gentle at the downstream. The plain extending from at the foot of the mountain chains is farms, where mainly cocoa, cassava, banana are cultivated. Logging is prohibited in the mountains since it is reserved forest.	 Around 2 m thick gravely clay layer and silty clay layer exist alternatively from the ground surface. Silty clay layer containing cobble stones which is bearing strata exist around 6 m deep from the ground.	Width : 15 m Depth : LWL=1.3m, HWL=4.0m Velocity : 0.5m/s Alignment: Winding Bank :Both sides are steep and low (1 to 2m). Being eroded. Use :For washing, drinking, bathing.
3-5 Fum	Collapsed RC pipe culvert is remaining in the river. Water is streaming, on both sides of the pipes. It seems that the capacity of the pipe culvert had been too small for the discharge.	Fum River is a branch of Pra River which is very large. They join around 3 km downstream from the site. The site is located between the foot of gentle mountains and plains along Pra River. The site is surrounded by steep slopes at the left bank, and gentle hills at the right side. The area is growing mainly cocoa, cassava, banana.	 A 3 to 4 m thick clayey silt layer is deposited on solid bed rock. Groundwater level is about 5 m deep.	Width : 12 m Depth : LWL=0.3m, HWL=5.0m Velocity : 0.8m/s Alignment: Winding Riverbed: Gravel is deposited. Bank : 3 to 4 m high. Right bank is being eroded. Solid rock is exposed at upstream left side bank. Use :For washing, drinking, bathing.

Table 2.2-1 TOPOGRAPHIC AND GEOLOGICAL CONDITIONS OF THE SITES (2/3)

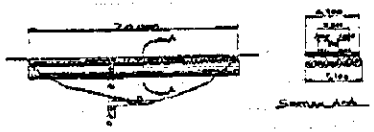
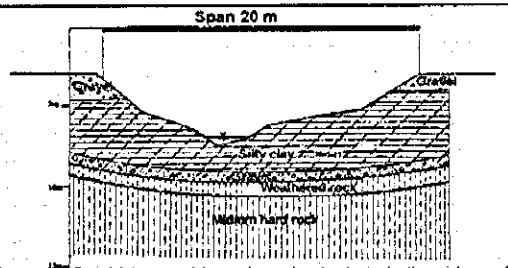
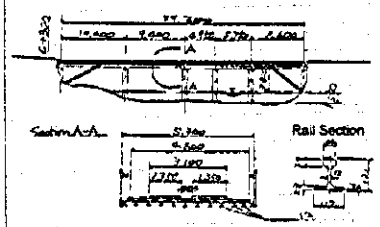
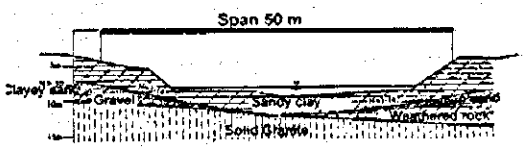
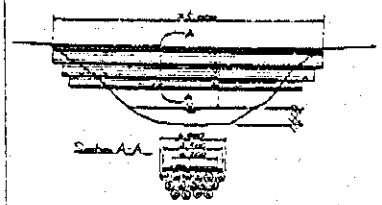
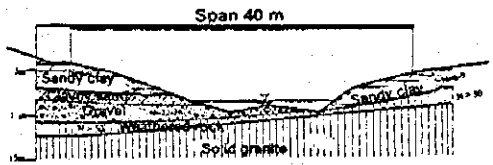
Site	Existing Bridge Condition	Topographic Condition	Geological Condition	River Condition
4-7 Sayere	 Timber bridge is existing. Trailer trucks carting logs are running on the bridge with minimal speed.	Sayere River originates south of the site and runs down to the north passing through the site. It streams down to the Ivory Coast after joining with Bia River which is a large river Narrow plain along the river is extended between forest mountains on both sides of the site. The area is tropical rainy climate. Other than forestry, cocoa cultivation is very developed.	 Around 1.5m thick gravel layer is embanked at both sides of approaches. Original surface layer is silty clay (N-value=5 to 10) which is deposited 5 m deep. Beneath it, a 1m thick gravel layer (N=20 to 25) containing quartz is deposited on solid bed rock.	Width : 10 m Depth : LWL=0.3m、HWL=4.5m Velocity : 0.2m/s Alignment: Winding to the left at site. Bank :Around 3m high. Bank is not eroded and covered by grasses. Use :No house is around the site.
4-11 Nhmine	 The bridge made of steel rails and timbers is e existing. Trailer trucks are passing over the bridge with minimal speed.	The site is located in forest mountain area. The road is extended over the small mountains, so the road is very steep at many sections. The roads at both approaches slope down to the river. However Nhwine River runs in a mountainous area, the velocity is slow and sand is deposited on the river bed since the site is located near the junction with downstream of Ankobra River. The site is sorrounded by forest and scattered farms of cocoa, cassava, bananas and etc.	 The top layer is a 3 m thick sandy clay containing cobbolestones of quartz (N=2 to 14) at both sides of approaches. Beneath it, clayey sand layer containing cobble stones of quartz (N>50) is deposited on solid bed rock surface of which is at 5 m deep at the 1st approach, while clayey sand layer (N=25 to 41) is deposited on the bed rock at 6 m deep at the 2nd approach.	Width : 35 m Depth : LWL=1.5m、HWL=7.0m Velocity : 0.3m/s Alignment: Winding to the right at site. River bed: Sand is deposited Bank : Left bank is steep and being eroded. Right bank is gentle and deposited by. Use :No house is around the site.
4-12 Draw	 A timber bridge is existing. Many timbers have been used since the span is long.	The site is located about 13 km from Nhwime Bridge to the deeper mountain. The topoghraphy and the road alignment become steeper. Draw River is a branch of Ankobara River located above the Nhine River. The river banks and riverbed slopes are steep. Washed out trees are lying in the river. The area is tropical rain forest.	 The surface layer is 2m thick sandy clay (N=6 to 8) deposited at both approaches. Beneath it, clayey sand layer and gravel layers (N=22 to 26) are deposited alternatively at 5 m deep, then weathered granite is deposited to 6m at the 1st approach, while the weathered granite exists from 2m to 3.7m deep at the 2nd approach. Solid granite is existing beneath the weathered granite.	Width : 15 m Depth : LWL=1.0m、HWL=7.5m Velocity : 0.8m/s Alignment: Curved gently to the right. Riverbed: Covered by grass. Rocks are exposed. Bank :Steep and deep valley Use :No house is around the site.

Table 2.2-1 TOPOGRAPHIC AND GEOLOGICAL CONDITIONS OF THE SITES (3/3)

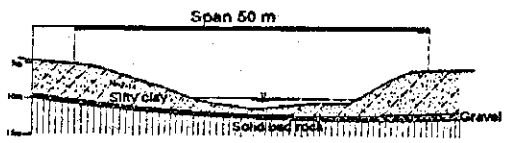
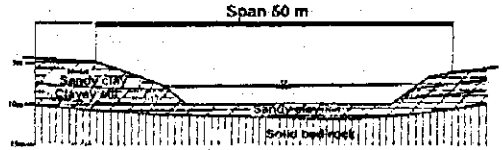
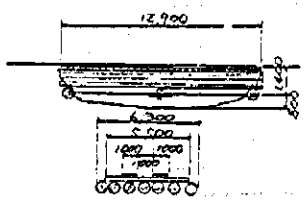
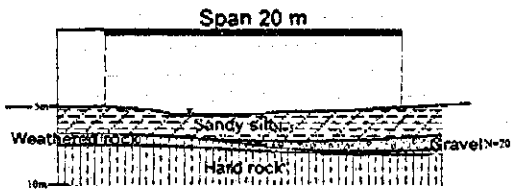
Site	Existing Bridge Condition	Topographic Condition	Geological Condition	River Condition
5-9 Tanodumase	No bridge exists. A small boat is used for crossing the river.	The site is located at middle reaches of Tano River which is large. The river is winding and several km wide plain is developed along the river. Mountains exist near the site at Tanodumase side, while about 1m wide flat bush is expanded the other side. Beyond the bush, gentle hills spread out, which are used for growing mainly cocoa.	 The surface layer is 5 to 6 m thick silty fine sand (N=2 to 14). Beneath it, around 0.7 m thick weathered rock/gravel layer deposited over bed solid rock.	Width : 24 m Depth : LWL=2.0m、HWL=8.0m Velocity : 0.2m/s Alignment: Straight at site. Riverbed: Large cobblestones (1 to 3m) lie on the riverbed. Bank : 3 to 5m high. Bank is hard and steep. Use :For washing, bathing
6-3 Johol	No bridge exists. Access roads are under-conctruction to connect the site with the higher class roads at both sides.	The site is located on Tain River which is a branch of Black Volta River. The site is about 4 km distant from the junction of the rivers. Topography there is a very flat and wide plain which expanedes along Black Volta River. The area is midland of the country of Ghana. The climate there is relatively dry. The site is surrounded by scattered farms, bush and forests of small trees.	 Around 3m thick sandy clay layer (N=4 to 6) coveres the ground surface. Beneath it, clayey silt layer (N=9 to 13) is deposited over solid bed rock which surface is around 6 m deep.	Width : 25 m Depth : LWL=3.0m、HWL=7.5m Velocity : 1.0 m/s Alignment: Straight at site. Riverbed: Erosion is progressing. Large cobble stones have appeared. Bank : 5 to 7m high and steep. Use :No houses are around the site
6-6 Fawohoye-den	 Timber bridge is existing. The river is shallow and small in dry seasons.	The topography is hilly and the road has many steep sections. Fawohoyeden River is a small branch of upper reaches of Tano River. The site is sorrounded by hills; howeve,r the river slope is gentle and the river is winding. It is a cocoa farming area.	 The surface layer is about 1m thick sandy silt (N=5 to 6). Beneath it, about 1 m thick weathered rock layer at 1st approach and about 1 m thick sand and gravel layers are deposited over bed rock.	Width : 10 m Depth : LWL=0.5m、HWL=2.3m Velocity : 0.2 m/s Alignment: The river is widened and deepened at the site due to damming at downstream. Riverbed: Covered by silty sand. Bank : Banks are about 1m high. Banks are not eoded, and covered by grasses. Use : For drinking, washing

Table 2.2-2 CONDITIONS OF ROADS CONNECTING THE SITES (1/2)

Site	Road Section	Road Length (km)	Road Class	Road No.	Road Width (m)	Surface Type	Surface Condition	Steepest Grade(%)	Largest Veh. Passable	Speed (km/hr)	Temporary Bridge	Remarks
2-2 Ayensu	Accra - Nswam	32	Primary	4	7	Asphalt	Good	4	Trailer	60	None	
	Nswam - Mepong	28	2ndary	41	7	Asphalt	Good	3	Trailer	60	None	
	Mepong - Jct.Takorase	3	2ndary	413	7	Asphalt	Good	3	Trailer	60	None	
	Jct.Takorase - Site	3	Primary	-	3	Earth	Bad	3	Small truck	20	None	
2-4 Emuo	Accra - Nswam	32	Primary	4	4	Asphalt	Bad	4	Trailer	60	None	
	Nswam - Osenase	55	2ndary	41 / 421	7	Asphalt	Good	3	Trailer	60	None	
	Osenase - Site	9	2ndary	163	6	Gravel	Good	4	Trailer	50	None	
	Site - Kobreso	3	2ndary	163	3	Gravel	Fair	5	Medium truck	30	None	
	kobreso - Apinaman	8	2ndary	163	3	Gravel	Fair	5	Medium truck	30	None	
3-5 Fum	Accra - Yamaransa	130	Primary	1	7	Asphalt	Fair	3	Trailer	60	None	
	Yamasransa - Assin Akonfode	83	2ndary	17	7	Asphalt	Good	4	Trailer	60	None	
	Assin Akonfode - Ayite	9	Feeder	-	5	Gravel	Good	4	Medium truck	30	None	
	Ayite - End of road	2	Feeder	-	3	Earth	Bad	5	Jeep	-	None	
	End of road - Site	0.2	Feeder	-	Footpath	Earth	Bad	10	Pedestrian	-	None	
	Site - Aworoso	0.2	Feeder	-	Footpath	Earth	Bad	3	Pesestrian	-	None	
	Aworoso - Asibrem	8	Feeder	-	3	Gravel	Bad	5	Small truck	30	None	
	Asibrem - Swedro	20	Feeder	-	3	Gravel	Bad	5	Small truck	30	None	
4-7 Sayere	Kumasi - Bibiani	90	2ndary	45	7	Asphalt	Fair	4	Trailer	60	None	
	Bibiani - Awaaso	31	2ndary	62	6	Gravel	Fair	6	Trailer	40	None	
	Awaaso - Bekwai	10	2ndary	622	7	Asphalt	Fair	4	Trailer	60	None	
	Bekwai - Wiaso	21	2ndary	621	6	Gravel	Fair	6	Trailer	50	None	
	Wiaso - Sefwi Asanwenso	40	2ndary	621 / 45	6	Gravel	Fair	5	Trailer	50	Bailey (36m)	
	Sefwi Asawenso - Jct. old road	21	2ndary	8 (Propo'd)	4	Gravel	Fair	8	Trailer	30	Bailey (15m)	Proposed Primary Road No.8
	Jct. old road - Adwadiem	3	2ndary	8 (Propo'd)	4	Gravel	Fair	4	Trailer	30	None	Proposed Primary Road No.8
	Adwadiem - Site	1	2ndary	8 (Propo'd)	4	Gravel	Fair	4	Trailer	30	None	Proposed Primary Road No.8

Table 2.2-2 CONDITIONS OF ROADS CONNECTING THE SITES (2/2)

Site	Road Section	Road Length (km)	Road Class	Road No.	Road Width (m)	Surface Type	Surface Condition	Steepest Grade(%)	Largest Veh. Passable	Speed (km/hr)	Temporary Bridge	Remarks
4-11 Nwhine	Accra - Essiama	294	Primary	1	7	Asphalt	Good	3	Trailer	60	None	
	Essiama - Bukazo	5	Primary	1	6	Asphalt	Good	5	Trailer	60	None	
	Bukazo - Asastre Market	7	Primary(old)	1 (old)	6	Gravel	Good	3	Trailer	50	Bailey(12m), Timber	
4-12 Draw	Asastre Market - Site (4-11)	12	Feeder	-	6	Gravel	Good	8	Trailer	30	None	
	Site (4-11) - JCT. Banso	8	Feeder	-	6	Gravel	Fair	10	Trailer	30	None	
	JCT. Banso - Site (4-12)	5	Feeder	-	5	Gravel	Fair	10	Trailer	30	None	
5-9 Tanodu-mase	Kumasi - Bibiani	90	2ndary	45	7	Asphalt	Good	4	Trailer	60	None	
	Bibiani - JCT. Tanodumase	6	2ndary	62	4	Gravel	Fair	10	Midium truck	30	None	
	JCT. Tanodumase - Site	8	Feeder	-	4	Gravel	Fair	8	Midium truck	30	None	Proposed 2ndary
	Site - Asibrim	3	Feeder	-	4	Earth	Bad	10	Jeep	-	None	Proposed 2ndary
6-3 Johol	Kumasi - Techiman	115	Primary	6	7	Asphalt	Fair	4	Trailer	60	None	
	Techiman - Wenchi	33	Primary	8	7	Asphalt	Good	4	Trailer	60	None	
	Wenchi - Tingokurom	45	Primary	8	7	Asphalt	Good	4	Trailer	60	None	
	Tingokurom - Site	6.3	2ndary	82	-	Constructing	-	3	-	-	None	Under construction
	Site - Ngre	20	2ndary	82	-	Constructing	-	3	-	-	None	Under construction
	Ngre - Banda	8	2ndary	82	5	Gravel	Good	2	Trailer	50	None	
	Banda - Wenchi	61	2ndary	821 / 822	5	Earth	Fair	4	Medium truck	30	Bailey (40m)	
6-6 Fawohoye-den	Kumasi - Bekyem	60	2ndary	4	7	Asphalt	Good	4	Trailer	60	None	
	Bekyem - Goaso	70	2ndary	46	7	Asphalt	Good	5	Trailer	60	None	
	Goaso - Ayomso	9	2ndary	452	5	Gravel	Fair	7	Large truck	50	None	
	Ayomso - Fawohoyeden	4	2ndary	452	4	Gravel	Fair	7	Large truck	40	None	
	Fawohoyeden - Site	1	2ndary	452	4	Gravel	Fair	7	Large truck	30	None	
	Site - Akrodie	4	2ndary	452	4	Earth	Bad	7	Medium truck	30	Timber(10m)	

Table 2.2-3 SOCIOECONOMIC CONDITIONS IN THE PROJECT AFFECTED AREA (1/2)

Site	Vicinity	Town/Village in affected area			Public Facilities in affected area	Land use		Remarks
		Town/Village	Population	Distance from site(km)	Facility (each)	Crops	Surplus production(ton/year)	
2-2 Ayensu	The site is located about 3 km along a 3m wide earth road from the junction with Secondary Road No.413. The road teminates before the site and a foot bridge crosses the river. About 100 houses are seen after the site in Takorase Village. Anokwase Village is located at the downstream. Beyond the Takorase, there are 5 or 6 villages which are connected to cities by another road. A train station is locted near the site; however, it is not used by the people here.	Takorase	800	0.3	PS (1), SS (1)	Cocoa	1000	Summary of affected area: Population : 1,100 persons School : 2 each Area : 7 km^2 Arable area : 6 km^2 Forest : 0 km^2 Surpls products :1,500 ton/year
		Anokwasa	300	0.8		Cassava	200	
						Coconut	300	
2-4 Emuo	The site is located about 9 km from Osenase Town along good gravel road. Asuofon and Budukurom Villages are neighborhood before the site. Akwaten, the biggest town in this area, is located just after the site. Beyond it, the road reaches the primary road after passing Kereso. Weekly markets are opened at Akwaten and Koreso. Buyers from the cities come to the market. Children of Asuofon and Budukurom pass the site to go to school.	Akwaten	8,000	0.3	PS(3), SS(2)	Cocoa	3,000	Summary of affected area: Population : 17,500 persons School : 9 each Area : 60 km^2 Arable area : 25 km^2 Forest : 10 km^2 Surpls products :5,550 ton/year
		Kobreso	5,300	3.3	PS(1), SS(1)	Cassava	500	
		Budukurom	1,200	1.5		Banana	850	
		Asuofori	3,000	5.0	PS(1), SS(1)	Yam	500	
						Palm	300	
						Cocoyam	400	
3-5 Fum	Around 5 towns are located along the road from Assin Akonfode to the site. Awaroso village is located just after the site and 3 villages listed right are located within 10 km from the site. The people there used to access markets through the site until the pipe culvert collapsed. Now they access the other side market along mountainous road, which is impassable in rainy seasons. Migration of farmers to this area is still popular here.	Awaroso	200	0.2		Cocoa	5,000	Summary of affected area: Population : 19,200 persons School : 2 each Area : 50 km^2 Arable area : 45 km^2 Forest : 0 km^2 Surpls products :9,000 ton/year
		Kano	5,000	3.3		Cassava	1,500	
		Asibrem	8,000	6.5	PS(1)、SS (1)	Banana	1,300	
		Nukukuaso	6,000	8.0		Corn	1,200	
4-7 Sayere	The road traverses the western regions of the country and is the future Primary Road No.8. This road is connecting the towns listed on the right with Goaso and Sefwi Asanwenso which are major towns in this area to transport local products every day. However, in rainy seasons, the northern route becomes impassable. It is tropical rainy climate and cocoa plantations are very developed in this area.	Adwumadiem	4,000	1.5	PS(1)、SS(1)、HS(1)	Cocoa	12,600	Summary of affected area: Population : 22,600 persons School : 15 each Area : 150 km^2 Arable area : 45 km^2 Forest : 100 km^2 Surpls products :14,865 ton/year
		Sayareso	2,000	1.0	PS(1)	Cassava	240	
		New Sayereso	2,000	3.0	PS(1)	Banana	675	
		Nakete	3,000	4.8	PS(1)、SS(1)	Cocoyam	650	
		Manukrom	3,000	7.5	PS(1)、SS(1)	Corn	700	
		Nfanti	2,000	11.5	PS(1)			
		Anymaye	2,600	12.5	PS(1)、SS(1)			
		Asubura	4,000	15.0	PS(1)、SS(1)、HS(1)			

Note:- The population and production data were obtained by hearing survey of the local people.
- PS;Primary school, SS:Secondary school, HS:High school

Table 2.2-3 SOCIOECONOMIC CONDITIONS IN THE PROJECT AFFECTED AREA (2/2)

Site	Vicinity	Town/Village in affected area			Public Facilities in affected area	Land use		Remarks
		Town/Village	Population	Distance from site(km)	Facility (each)	Crops	Surplus production(ton/year)	
4-11 Nhwine	The site is located about 12 km along gravel road from Asastre Market which is the biggest market in this area. Banso Town which opens weekly market is the only town located in this area after the site. The area after the site is forest. Other than Banso, Nameless small villages or families are scuttered in the forest in this area.	Banso Families	7,000 2,000	10.0 (Scattered)	PS(1)、SS(1)	Cocoa Cassava Banana Palm	600 200 200 200	Summary of affected area: Population : 7,000 persons School : 2 each Area : 165 km^2 Arable area : 15 km^2 Forest : 150 km^2 Surpls products :1,200 ton/year
4-12 Draw	The site is located about 13 km distant from Nhwine Bridge to the deeper forest. The area around the site is very deep forest. Trees are logged by a licenced lumber company. Small villages or families scattered in the area are doing small scale farming in the forest.	Families	2,000	(Scattered)	None	Cocoa Cassava Banana Palm	250 80 80 80	Summary of affected area: Population : 2,000 persons School : 0 each Area : 100 km^2 Arable area : 10 km^2 Forest : 90 km^2 Surpls products : 490 ton/year
5-9 Tanodumase	The site is located 14 km along feeder road from Sibiani which is connected to Kumasi with asphalted good road. Tanodumase Town is adjacent to the site. Towns listed on the right are located the opposite side of Tanodumase. People there use boats to cross the site or detour to use bridges at aroung 60 km upstream or 30 km downstream.	Asibrim Opponkurom Pafo Motopini	9,000 4,500 6,500 7,000	3.0 11.5 11.0 9.0	PS(1)、SS(1) PS(1) PS(1) PS(1)、SS(1)	Cocoa Cassava Banana Rice	2,800 1,400 1,200 2,700	Summary of affected area: Population :27,000 persons School : 6 each Area : 60 km^2 Arable area : 40 km^2 Forest : 20 km^2 Surpls products :8,100 ton/year
6-3 Johol	The site is located along a new road which is under construction between Tingokurom and Banda. Tingokurom is a town located along primary road just before the road crosses Black Volta River. The site is located 7 km from Tingokurom to the west and 28 km from Banda to the east. The towns listed on the right are located within 15km from Banda. Earth road is connected with these towns and southern cities presently. This road ends before Black Volta River	Ngre Fawoman Banda Bugasi Sabiyi Bofe	1,500 1,500 5,000 9,000 2,000 1,000	20.0 14.0 28.0 42.0 38.0 44.0	PS(1) PS(1)、SS(1)、HS(1) PS(1)、SS(1)、HS(1) PS(1)、SS(1) PS(1)	Cassava Yam Cashew Corn	4,800 1,400 600 4,000	Summary of affected area: Population :20,000 persons School : 11 each Area : 500 km^2 Arable area : 500 km^2 Forest : 0 km^2 Surpls products :10,800 ton/year
6-6 Fawohoyeden	The site is located between Fawohoyeden Town and Akrodie Town. The distance from the site to Fawohoyeden is 1 km and to Akrodie is 4 km. Goaso is the major town in this area. Cargos and travelers of both towns do not need to pass this site to go to Goaso, so traffic at this site is not heavy.	Fawohoyeden	2,500	0.5	PS(2)、SS(2)	Cocoa Cassava Banana	1,000 200 300	Summary of affected area: Population : 2,500 persons School : 4 each Area : 7 km^2 Arable area : 6 km^2 Forest : 0 km^2 Surpls products :1,500 ton/year

Note:- The population and production data were obtained by hearing survey of the local people.
- PS:Primary school, SS:Secondary school, HS:High school

2.3 Basic Concept of the Project

2.3.1 Evaluation of priority of the requested bridges

(1) Method of priority evaluation

Concept of the priority evaluation

Bridges with high construction necessity and socioeconomic effect should be evaluated as high priority.

Evaluation items are as follows:

(a) Level of accessibility over the river for vehicles (Present bridge condition)
(b) Availability of detour and/or distance of detour
(c) Traffic volume
(d) Population depending on the bridge
(e) Amount of production/potential production of the area which depends on the bridge
(f) Importance of the road
(g) Level of construction difficulty for local contractors

Bridges which have not been constructed due to construction difficulty should be given very high priority to be constructed under Japan's grant aid.

Priority evaluation criteria

Priority order of the bridges are obtained by comparing the total points of the evaluation points which express level of construction necessity or socioeconomic effect of the evaluation items.

The criteria of evaluating points are established as shown in Table 2.3-1. In the table, the points are distributed to the levels of conditions so that the highest level is 10 while the least is 0. The evaluation points are multiplied by the weights which express importance of the items.

(2) Result of the priority evaluation

The results of the priority evaluation are shown in Table 2.3-2. The priority order of each bridge is shown in the lowest line of the table. The traffic volumes used in the evaluation were estimated as described in the following section.

Table 2.3-1 CRITERIA OF PRIORITY POINT

Evaluation Items	Evaluation point (P)	Weight
(a) Present bridge condition	- No bridge passable for vehicles: P=10 - Timber bridge passable for vehicles:P=5	1.0
(b) Detour availability/ distance	- No detour for vehicles in all seasons:P=10 - In case detour is available, P = D x 10/50 (where, D<50) P = 10 (where, D>50) (D(km) is additional road length to detour)	1.0
(c) Traffic volume (AADT)	P= AADT x 10/75 (75 is the largest AADT of the bridges)	1.0
(d) Affecting population	P= population x 10/27,000 (27,000 is the largest population of the bridges)	1.0
(e) Arable area (sq.km)	P=Arable area x 10/50 (50sq.km is wide enough to make large productions to be evaluated as P=10)	1.0
(f) Road class	Secondary/primary road: P=10 Feeder road: P=5	1.0
(g) Construction difficulty	Difficult: P=10, Relatively difficult:P=5, Easy: P=2	1.5

(3) Estimation of traffic volumes (AADT)

The traffic volumes of the sites where bridges exist were counted by a simple method, while the traffic volumes where no bridge exists were estimated using the following method. The estimated traffic volumes of the requested bridge site are shown in Table 2.3-3.

AADT = A1 x Population + A2 x Forest area (sq.km) + A3 x Surplus Production (ton/year)

Where, A1=1/1,100, A2=1/8, A3=1/360

Population, Forest area and Surplus production of the project affected area are referred to in Table 2.2-3 in Section 2.2. The coefficient A1, A2 and A3 were obtained by a regressional analysis of the known traffic volumes.

Table 2.3-2 PRIORITY OF REQUESTED BRIDGES

Evaluation Item \ Bridge	Weight	2-2 Ayensu		2-4 Emuo		3-5 Fum		4-7 Sayere		4-11 Nhwine	
		Condition	Point	Condition	Point	Condition	Point	Condition	Point	Condition	Point
(a)Present bridge condition	1.0	Foot bridge	5	Washed out	10	Collapsed	10	Timber	5	Timber	5
(b)Detour availability/ Distance	1.0	None	10	25	5	No in rainy	10	No in rainy	10	No in rainy	10
(c)Traffic volume	1.0	5	1	33	4	43	6	75	10	30	4
(d)Affecting population	1.0	1,100	0	17,500	6	19,200	7	22,600	8	7,000	3
(e)Arable area (sq.km)	1.0	6	1	25	5	45	9	45	9	15	3
(f)Road class	1.0	Feeder	5	2ndary	10	Feeder	5	2ndary	10	Feeder	5
(g)Construction difficulty	1.5	Little diffcult	5	Little diffcult	5	Little diffcult	5	Little diffcult	5	Difficult	10
Total points		30		48		55		60		45	
Priority order		8		5		4		3		6	

Item \ Bridge	Weight	4-12 Draw		5-9 Tanodumase		6-3 Johol		6-6 Fawohoyeden	
		Condition	Point	Condition	Point	Condition	Point	Condition	Point
(a)Present bridge condition	1.0	Timber	5	None	10	None	10	Timber	5
(b)Detour availability/ Distance	1.0	No in rainy	10	40	8	30	6	15	0
(c)Traffic volume	1.0	20	3	50	7	49	7	15	2
(d)Affecting population	1.0	2,000	1	27,000	10	20,000	7	2,500	1
(e)Arable area (sq.km)	1.0	10	2	40	8	500	10	6	1
(f)Road class	1.0	Feeder	5	2ndary	10	2ndary	10	2ndary	10
(g)Construction difficulty	1.5	Difficult	10	Difficult	10	Difficult	10	Easy	2
Total points		41		68		65		22	
Priority order		7		1		2		9	

Table 2.3-3 ESTIMATED TRAFFIC VOLUME

Bridge \ Data	Population	Forest area (sq.km)	Surplus production (ton/year)	AADT (veh./day)
2-2 Ayensu	1,100	0	1,500	5
2-4 Emuo	17,500	10	5,550	33
3-5 Fum	19,200	0	9,000	43
4-7 Sayere	22,600	100	14,865	75 *
4-11 Nhwine	7,000	150	1,200	30 *
4-12 Draw	2,000	90	490	20 *
5-9 Tanodumase	27,000	20	8,100	50
6-3 Johol	20,000	0	10,800	49
6-6 Fawohoyeden	2,500	0	1,500	15 *

Note : AADT with * are counted traffic volumes.

2.3.2 Selection of bridges for the project

Based on the priority evaluation, the 7 bridges evaluated as having high priority are selected to be constructed under this project. Ayensu and Fawohoyeden Bridges are excluded since their priority is relatively low.

The basic design of the bridges excluded from the project is included in this study for reference.

2.3.3 Basic specifications of the bridges

The basic specifications of the project bridges were discussed between the DFR and the study team and are proposed as follows. The detailed specifications of the project bridges are described in Section 2.4.

(1) Design speed

The design speed of the bridges and the approach roads are proposed based on the criteria shown in Table 2.3-4.

Table 2.3- 4 CRITERIA OF DESIGN SPEED (km/hr)

Road Class \ Terrain	Flat	Rolling	Mountainous
Secondary National Roads	60	40	30
Feeder Roads	40	30	20

Source : Road Design Guidelines, GHA

The design speed of each bridge is shown in Table 2.3-5.

Table 2.3-5 DESIGN SPEED

Bridge No.	Bridge Name	Road Class	Terrain	Design Speed
2-2	Ayensu	Feeder Road	Flat	40
2-4	Emuo	2ndary Road	Rolling	40
3-5	Fum	Feeder Road	Rolling	30
4-7	Sayere	2ndary Road	Rolling	40
4-11	Nhwine	Feeder Road	Roll'g/Mount's	30
4-12	Draw	Feeder Road	Roll'g/Mount's	30
5-9	Tanodumase	2ndary Road	Flat	60
6-3	Johol	2ndary Road	Flat	60
6-6	Fawohoyeden	2ndary Road	Roll'g/Mount's	30

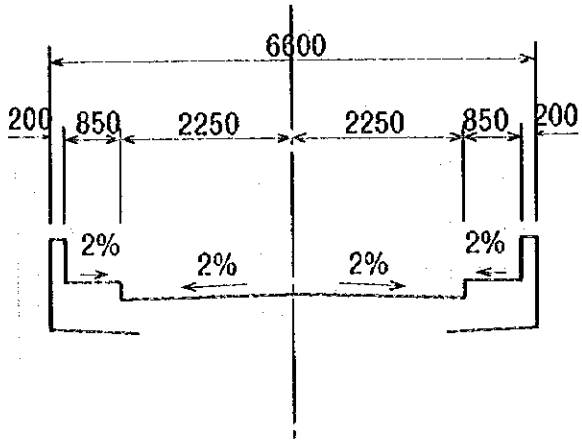
(2) Design live load (Vehicle load)

Since heavy trucks carrying cocoa and lumber are expected to pass over the bridges frequently, "B Live Load" specified in the Bridge Design Specification of Japanese Road Association is proposed for designing the bridges. The specification specifies that all highway bridges except light bridges shall be designed with "B Live Load".

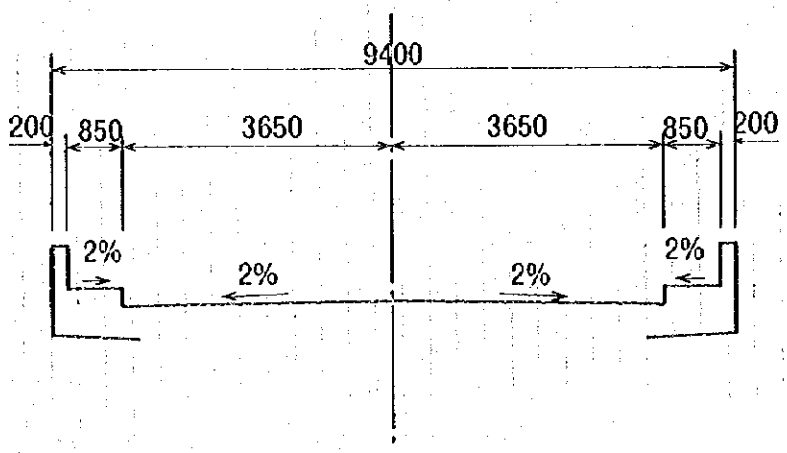
The Japanese design specification is applied for design of the bridges. However, the safety of the bridges are checked with "HA Loading" of the British Standards which is the common specification in Ghana.

(3) Bridge width

The Standard widths for single lane bridges and two lane bridges specified in the Bridge Design Guidelines, GHA are applied for the bridges. The components of the bridge widths are shown in Figure 2.3-1.



SINGLE LANE BRIDGE



TWO LANE BRIDGE

Figure 2.3-1 COMPONENT OF BRIDGE WIDTH

Width type (number of lanes) for each bridge is proposed based on the following considerations:

Bridges along secondary roads should be basically two lane since the secondary roads are the components of the national highway network which are required to carry heavy traffic rapidly, while bridges along feeder roads should be basically single lane since feeder roads are generally low standard and carry little traffic.

However, bridges along secondary roads having little traffic demand are proposed to be single lane, and bridges along feeder roads having heavy traffic demand are proposed to be two lane. The criteria of little and heavy traffic demand are as follows:

Little traffic demand ; roads which fulfill all of the following conditions :

- Present road width is narrower than 3m.
- AADT is less than 50.
- Design speed is less than 30 km/hr.

Heavy traffic demand ; roads which fulfill all of the following conditions :

- Present road width is wider than 6 m.
- AADT is more than 200.
- Design speed is more than 60 km/hr.

Based on the criteria, width type of each bridge is proposed as shown in Table 2.3-6.

Table 2.3-6 BRIDGE WIDTH TYPE (NO. OF LANES)

Bridge No.	Bridge Name	Road Class	Road Width (m)	AADT (Veh/d)	D. Speed (km/hr)	No.of Lanes
2-2	Ayensu	Feeder Road	3	5	40	1
2-4	Emuo	2ndary Road	6	33	40	2
3-5	Fum	Feeder Road	3	43	30	1
4-7	Sayere	2ndary Road	4	75	40	2
4-11	Nhwine	Feeder Road	6	30	30	1
4-12	Draw	Feeder Road	5	20	30	1
5-9	Tanodumase	2ndary Road	4	50	60	2
6-3	Johol	2ndary Road	7	49	60	2
6-6	Fawohoyeden	2ndary Road	4	15	30	1

2.4 Basic Design of the Bridges

2.4.1 Design concept

Basic design of the bridges is conducted based on the following concepts:

(1) Location, length and elevation of bridge

- Locations and lengths of the bridges are proposed based on the site discussions with the DFR engineers and technical discussion of the study team.

- Locations of the bridges are examined to be optimum against road alignments, rivers, detouring and others.

- Detours during construction and demolition of existing bridges are planned based on the site discussion with the DFR engineers

- Locations of the abutments are examined to align with riverbanks.

- Elevations of the bridges are proposed based on the maximum flood levels which are obtained by hearing and observation surveys since hydraulic data were not available.

(2) Superstructure type

- The most optimum types are proposed after comparative study of superstructure types in aspects of cost, construction ease, material source, maintenance needs and others.

(3) Substructure

- Substructures are planned based on the site conditions of topography and geology.
- Foundations are planned to be embedded into the ground to gain required structural stability and to be safe against future scouring.

(4) Approach roads

- Approach roads are planned based on the geometric standard specified in Road Design Guidelines, GHA.
- Gravel surfacing is proposed as it is common for secondary roads and feeder roads.

(5) Revetment

- Grouted riprap on slopes of riverbanks and embankment of abutments is proposed to protect slopes against erosion.
- Gabions are proposed to be installed at foundations of riverbank revetments to prevent scouring.

(6) Design criteria

- Design specifications and guidelines specified by the GHA and the DFR are applied to this project basically. However, their provisions are examined by the study team for their appropriateness.

- The site conditions should be reflected in the design criteria.

- Design criteria are finally proposed after discussion and agreement between the DFR and the study team.

- Design methods specified in Japanese Specifications are adopted in this project.

2.4.2 Design criteria

(1) Design specifications
- Highway Bridge Specifications, 1994 issued by Japan Road Association (JRA)
- Guide for Bridge Design, 1991 issued by GHA
- Road Design Specification, 1983 issued by JRA
- Road Design Guide, 1991 issued by GHA

(2) Design Load
- Dead load : railing, sidewalk, pavement, slab, haunch, girders
- Live load : B live load (specified in specifications of JRA)
- Temperature variation: between +8 ℃ and +51 ℃ (specified in guidelines of GHA)
- Wind : 27 m/sec (specified in guidelines of GHA)
- Seismic coefficient : 0.08 (specified in guidelines of GHA)

(3) Material designation
- Concrete : Superstructure ; 300 kg/sq.cm

: Railing ; 240 kg/sq.cm
: Substructure ; 240 kg/sq.cm

- Reinforcing bars : SD295 (Japan Industrial Standard, JIS)

- Steel girders : SS400 / SM490y (JIS)

(4) Road geometric standards

Design speed (km/hr)	60	40	30
Minimum radius (m)	130	50	30
Sight distance (m)	75	40	30
Maximum grade (%)	5	7	8

(5) Other criteria

Vertical clearance : 5.0 m (above roadway)
Freeboard : 1.0 m (between HWL and girder bottom)
Unit system : CGS system (kgf, cm)

2.4.3 Planning of bridge layout

(1) Location of proposed bridge

Location of proposed bridges are examined and planned with the following considerations:

- To minimize construction cost.
- To ease construction.
- To make road alignment smooth.
- To provide detours during construction
- To minimize removal of existing structures.

(2) Bridge length

The bridge lengths are distances between both abutments. Locations of abutments are determined based on site inspections and technical study based on geological and

topographical data. Major items considered in the determination of the locations of the abutments are as follows:

- River widths between abutments are wide enough to discharge floods.
- Floods flow smoothly and do not endanger abutments and approach embankments by scouring.
- Riverbank protections can be constructed to be aligned with the natural riverbanks.
- Abutment foundations can be installed on sound ground.
- Construction of abutments is not difficult.
- Bridge lengths are short enough to be economical

Based on above, the bridge lengths are determined as shown in Table 2.4-1.

(3) Span layout

Span layout for each bridge is studied. In the study, following points are considered:

- Total construction costs including temporary works should be minimal.
- Piers should not be planned where river is deep and fast.
- Piers should not be installed at center of rivers.
- Spans should be large enough to discharge floods.

The span layout for each bridge is proposed as shown in Table 2.4-1.

Table 2.4-1 BRIDGE LENGTH AND SPAN

Bridge No.	Bridge Name	Bridge length	Span layout
2-2	Ayensu	30 m	1 x 30 m
2-4	Emuo	25 m	1 x 25 m
3-5	Fum	30 m	1 x 30 m
4-7	Sayere	20 m	1 x 20 m
4-11	Nhwine	50 m	1 x 50 m or 20m+30m
4-12	Draw	40 m	1 x 40 m
5-9	Tanodumase	50 m	1 x 50 m
6-3	Johol	45 m	1 x 45 m
6-6	Fawohoyeden	20 m	1 x 20 m

2.4.4 Study of applicable bridge types

The range of span lengths of the bridges are from 20 to 50m. In general, the bridge

types listed in Table 2.4-2 are commonly used for such span bridges. Applicability of each type for this project is studied in the table and the following types are selected:

- Steel plate girder
- Steel truss
- RC T-girder

In the study, the following technical aspects are discussed and commented on:

- To construct PC type bridges, production of high quality concrete (350 kg/sq.cm) at sites is required. It is not easy to furnish heavy equipment and control staff to produce such concrete at rural sites. Precast block method, that is construction of PC bridges by connecting parts of precast girders at site, is also difficult because of transporting the precast blocks and connecting girders.

- Composite structure type plate girder is less costly. However, this structure type is not selected for this project since it requires well controlled quality of deck slab concrete.

2.4.5 Selection of span layouts and bridge types

Span layout schemes and applicable bridge types of each bridge are summarized as shown in Table 2.4-3, as a result of study above.

Table 2.4-3 SPAN LAYOUT AND BRIDGE TYPE

Bridge No.	Bridge Name	Span layout scheme	Applicable bridge type
2-2	Ayensu	1 x 30 m	Steel plate girder
2-4	Emuo	1 x 25 m	Steel plate girder
3-5	Fum	1 x 30 m	Steel plate girder
4-7	Sayere	1 x 20 m	Steel plate girder RC T-beam
4-11	Nhwine	1 x 50 m 20 m + 30 m	Steel truss Steel plate girder
4-12	Draw	1 x 40 m	Steel truss
5-9	Tanodumase	1 x 50 m	Steel plate girder
6-3	Johol	1 x 45 m	Steel plate girder
6-6	Fawohoyeden	1 x 20 m	Steel plate girder RC T-beam

Table 2.4-2 SELECTION OF APPLICABLE BRIDGE TYPES

Bridge Type		Spans Commonly Applied (m)	Construction Difficulty	Structural Applicability	Material Availability	Applicability	Remarks
Steel Type	Plate Girder (composite)	10 to 45	Difficult	Inapplicable	Available (imported)	Inapplicable	Construction of deck slab with required quality is difficult.
	Plate Girder (non-composite)	20 to 40	Easy	Applicable	Available (imported)	Applicable	Selected
	Box Girder	40 to 50	Difficult	Applicable	Available (imported)	Inapplicable	Transporting large size box girders is difficult.
	Truss	40 to 50	Easy	Applicable	Available (imported)	Applicable	Selected
Prestressed Concrete Type	Hollow Slab	15 to 30	Difficult	Applicable	Available (imported)	Inapplicable	Production of high quality concrete at sites is difficult.
	T-Beam	20 to 35	Difficult	Applicable	Available (imported)	Inapplicable	Production of high quality concrete at sites is difficult.
	Composite I-beam	20 to 35	Difficult	Applicable	Available (imported)	Inapplicable	Production of high quality concrete at sites is difficult.
	Simple Box Girder	20 to 45	Difficult	Applicable	Available (imported)	Inapplicable	Production of high quality concrete at sites is difficult.
Reinforced Concrete Type	Hollow Slab	10 to 15	Easy	Inapplicable	Available (local)	Inapplicable	Applicable span is too short.
	T- Girder	10 to 20	Easy	Applicable	Available (local)	Applicable	Selected

On the 3 bridges having comparative span layout scheme and bridge types, a comparative study is made as shown in Table 2.4-4, and appropriate ones are selected.

2.4.6 Design of superstructures

(1) Girder arrangement

Comparative schemes of girder intervals with corresponding deck slab thickness are compared as shown in Table 2.4-5. As a result of comparison of their costs, 3 girders for single lane bridges and 4 girders for two lane bridges are proposed.

Table 2.4-5 COMPARISON OF GIRDER ARRANGEMENT

Lane Type	No. of Girders (each)	Girder Interval (m)	Cantilever Slab Length (m)	Deck Slab Thickness (m)
Single lane	3	3.00	1.80	0.24
	4	2.20	1.10	0.19
	5	1.10	1.10	0.18
Two lane	3	3.00	1.70	0.24
	4	2.40	1.10	0.20
	5	1.80	1.10	0.19

(2) Girder depth

Girder depths planned for the bridges are proposed after comparison of several different depths which are based on commonly used "depth - span ratio". A "depth - span ratio" of around 1/15 is applied for the steel plate girders.

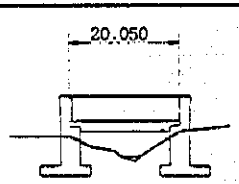
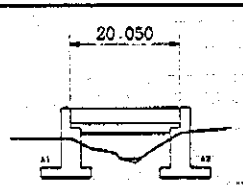
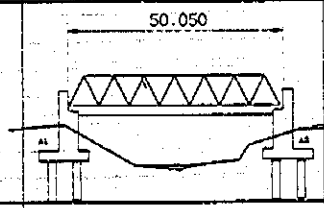
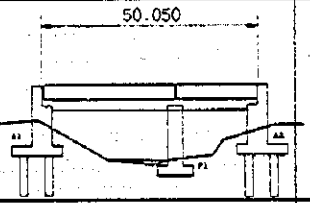
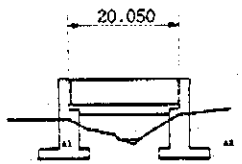
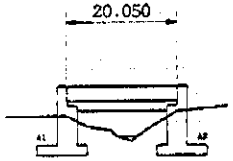
(3) Expansion joints

To prevent dropping of water and mud on the steel girders and bearings and to provide smoothness for traffic, expansion joints are planned to be installed between girder ends and backwall of abutments. A rubber type expansion joint which is simple and low cost is proposed. The sizes of the expansion joints are designed based on the amount of movement which is caused by temperature variation.

(4) Bearings

As commonly used, line bearings made of cast iron are proposed for steel plate girders,

Table 2.4-4 COMPARISON OF SPAN LAYOUT AND BRIDGE TYPE

	Sayere Bridge		Nhwine Bridge		Fawohoyeden Bridge	
	RC T-beam Type	Steel Plate Girder type	Steel Truss Type	2 span Steel Plate Girder Type	RC T-beam Type	Steel Plate Girder type
Bridge Layout						
Sructural Feature	Girder depth (2.2m) is bigger than that of steel type. It results in higher and longer approach roads. Stiffness of RC girders is more than steel girder's which cause less vibration by traffic.	Girder depth (1.5m) is smaller than that of RC girder type. It results in lower and shorter approach roads. Stiffness of steel girders is less than RC girder's which causes more vibration by traffic.	Girder depth (1.0m.) is smaller than of plate girder type. No pier doesn't obstruct floods.	Girder depth (1.6m) is bigger than truss type. Pier obstructs floods.	Girder depth (2.2m) is bigger than that of steel type. It results in higher and longer approach roads . Stiffness of RC girders is more than steel girder's which causes less vibration by traffic.	Girder depth (1.5m) is smaller than that of RC girder type. It results in approach roads lower and shorter. Stiffness of steel girders is less than RC girder's which causes more vibration by traffic.
Construction Difficulty	On site works which are construction of falsework on river and concreting girders repuire long period. Crane is not required in construction. Construction method is easy.	Construction period is shorter than RC girder type. Crane is required for erection steel girders.	Erection of truss is more complicated than erection of plate girder type. Period longer than that of plate girder is required for erection. Transportaion of truss members is easier than that of plate girder. Construction of pier in river is not required.	Construcion of a pier in river is required. Plate girder members to be transported are larger than truss member. Erection of plate girders is easier than erection of truss. Construction period is shorter than truss type.	On site works which are construction of falsework on river and concreting girders require a long period. Crane is not required in construction. Construction method is easy.	Construction period is shorter than RC girder type. Crane is required for erection steel girders.
Maintenance Needs	Concrete bridge is maintenace free.	Repainting of steel girders is required around every 10 years.	Repainting of steel girders is required around every 10 years. Repainting on truss is more constly than that of plate girder type.	Repainting of steel girders is required around every 10 years.	Concrete bridge is maintenace free.	Repainting of steel girders is required around every 10 years.
Construction Cost	0.79	1.00	1.25	1.00	0.79	1.00
Selection	This type is selected since it is economical and construction is easy.	——	——	This scheme is selected since the construction cost is less and construction is easy.	This type is selected since it is economical and construction is easy.	——

Note: The construction cost in the table shows ratios of construction cost when steel plate girder type is 1.00.

and plate bearings made of cast iron with bronze are proposed for steel truss bridges. Neoprene bearings are proposed for RC T-girder bridges.

(5) Painting

Steel members are planned to be painted with an undercoat in factories and the finish coats applied on sites.

(6) Camber adjustment

Camber adjustment is bending up girders to compensate for the sag caused by dead loads. Cambers will be applied to the girders in the course of fabrication in factories.

(7) Railings

A type of galvanized steel pipe railings installed on top of concrete wall parapets is proposed.

(8) Bridge elevation

Bridge elevations which are represented by elevations of top of center of deck slabs are planned based on the highest flood elevations (HWL) + freeboard (1 m) + girder depths + Deck slab and haunch (0.4 m). The proposed bridge elevations are shown in Table 2.4-6.

The elevations used in this study are locally established based on the temporary bench marks installed by the study team.

(9) Design of superstructures

The major components of the bridges are planned based on structural calculations, and basic plans of the bridges are developed from these. Summary of the results of the structural calculations are shown in Appendix 8, and the general views of the proposed bridges are shown in Appendix 5.

Table 2.4-6 BRIDGE ELEVATION

Bridge No.	Bridge Name	HWL	Girder Depth	Bridge Elevation
2-2	Ayensu	80.00	1.60	83.00
2-4	Emuo	181.00	1.60	184.10
3-5	Fum	141.00	1.60	144.00
4-7	Sayere	160.00	2.20	163.80
4-11	Nhwine	41.50	1.60	44.50
4-12	Draw	49.00	1.00	51.40
5-9	Tanodumase	110.20	1.40	113.10
6-3	Johol	131.00	1.40	133.90
6-6	Fawohoyeden	171.00	2.20	174.40

2.4.7 Design of substructures

Abutment type

Inverted-T type abutments, which are common for 5 to 10 m high abutments, are proposed for all the bridges. Approach slabs are planned to be installed behind abutments to prevent depressions on backfills.

Pier type

The circular column type pier is proposed since it can avoid disturbance to the stream line when the river changes its angle against the bridge.

Foundation type

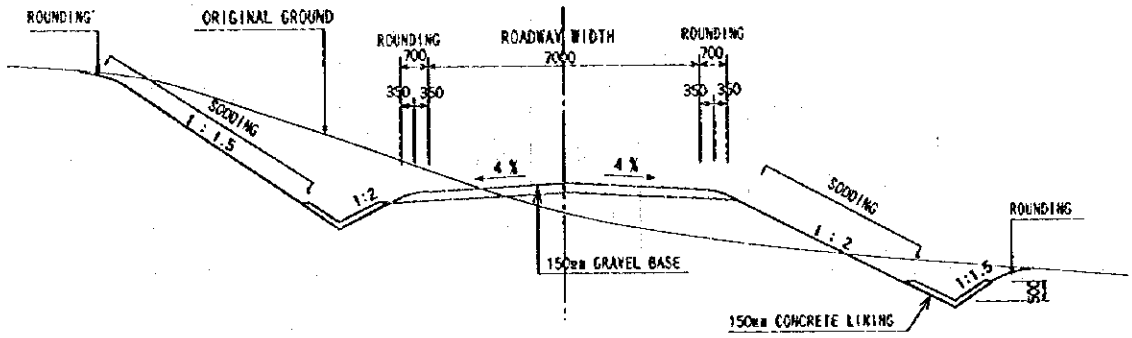
Spread type foundations are planned for all substructures except abutments of Nhwine Bridge since their bearing strata is not deep from the ground surface.

For abutments of Nhwine Bridge, steel H-pile foundation is proposed. To drive the piles, a vibro hammer which is needed for driving steel sheet pile cofferdams, can be utilized.

The results of the stability analysis of the substructures are summarized in Appendix 8.

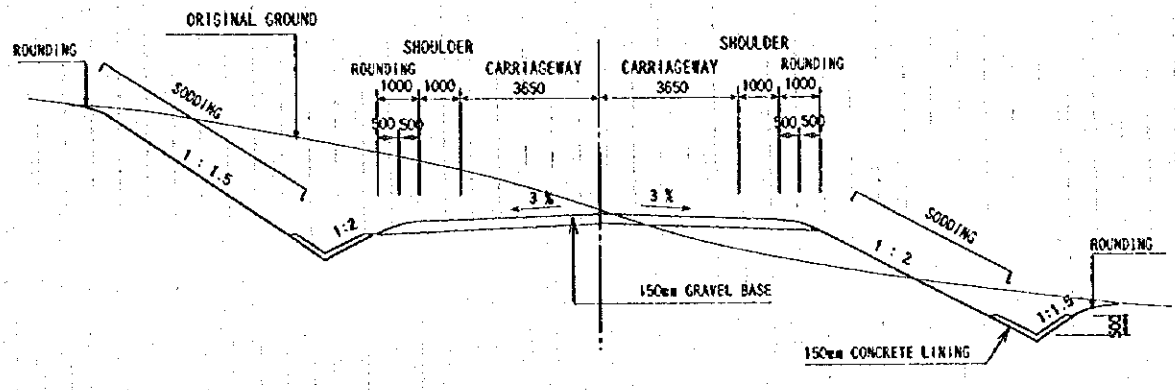
2.4.8 Design of approach roads

The typical cross sections of approach roads for single lane bridges and two lane bridges are shown in Figure 2.4-1.



CUT SECTION FILL SECTION

APPROACH ROAD FOR SINGLE LANE BRIDGES



CUT SECTION FILL SECTION

APPROACH ROAD FOR TWO LANE BRIDGES

Figure 2.4-1 TYPICAL CROSS SECTION OF APPROACH ROADS

Guardrails are proposed to be installed along approach roads where embankment is higher than 3 m. Galvanized metal beam type guardrails which are maintenance free are proposed.

The approach roads for the bridges are designed based on the geometric standards and the typical cross sections. The plan and profile of approach roads are shown in Appendix 6.

2.4.9 Design of Revetment and scouring protection

Grouted riprap revetment which can be constructed with local materials and intensive local labor is proposed for revetment structure. Gabions are proposed for scouring protection to protect revetments and abutments. A typical section of revetment and scouring protection is shown in Figure 2.4-2.

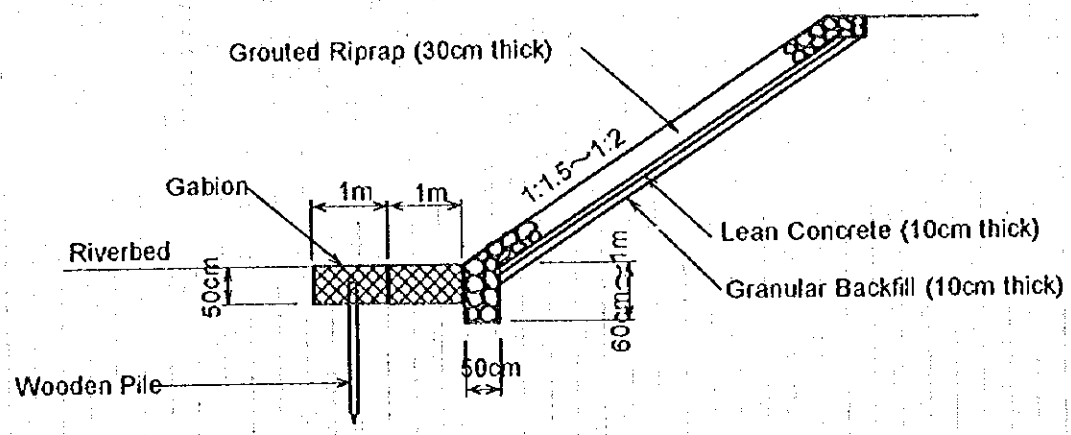


Figure 2.4-2 TYPICAL SECTION OF REVETMENT AND SCOURING PROTECTION

2.4.10 Summary of construction works

A summary of construction works is shown in Table 2.4-7.

Table 2.4-7 SUMMARY OF CONSTRUCTION WORKS (1/2)

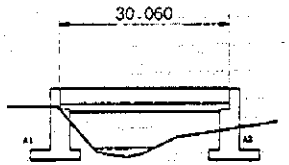
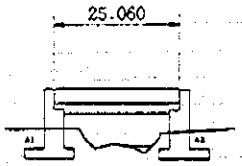
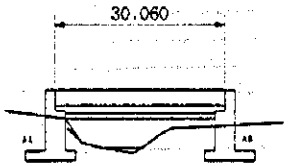
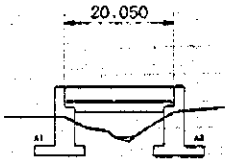
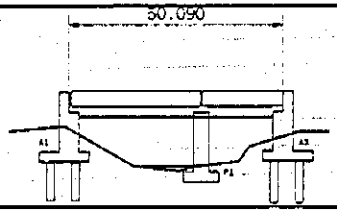
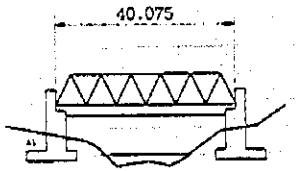
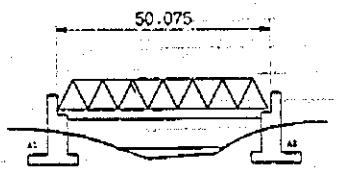
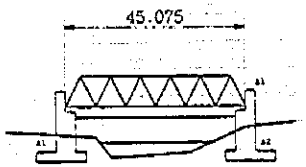
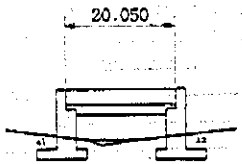
No.	Bridge NO.	Bridge Name	Bridge Layout	Superstructure	Substructure/Revetment/Approach Road	Remarks
1	2 – 2	Ayensu		Steel Plate Girder Bridge Length : 30.060m Bridge Elevation : 83.000	Substructure (Foundation) A 1 :Spread footing A 2 :Spread footing Revetment A1 side : Grouted riprap (A =273 m2) A2 side : Grouted riprap (A =219 m2) Approach Road A1 side : Embankment = 570 m3 Cut = 7 m3 A2 side : Embankment =2,919 m3 Cut =17 m3	This bridge is excluded from this project.
2	2 – 4	Emuo		Steel Plate Girder Bridge Length : 25.060m Bridge Elevation : 184.100	Substructure (Foundation) A 1 :Spread footing A 2 :Spread footing Revetment A1 side : Grouted riprap (A =413 m2) A2 side : Grouted riprap (A =430 m2) Approach Road A1 side : Embankment =3,176 m3 Cut =37 m3 A2 side : Embankment =3,671 m3 Cut =21 m3	
3	3 – 5	Fum		Steel Plate Girder Bridge Length : 30.060m Bridge Elevation : 144.000	Substructure (Foundation) A 1 :Spread footing A 2 :Spread footing Revetment A1 side : Grouted riprap (A =417 m2) A2 side : Grouted riprap (A =364 m2) Approach Road A1 side : Embankment =4,223 m3 Cut =3 m3 A2 side : Embankment =2,910 m3 Cut =3 m3	
4	4 – 7	Sayere		R C Girder Bridge Bridge Length : 20.050m Bridge Elevation : 163.800 (Girder Height : 2.200m)	Substructure (Foundation) A 1 :Spread Footing A 2 :Spread Footing Revetment A1 side : Grouted riprap (Along River 20m A =419 m2) A2 side : Grouted riprap (Along River 20m A =369 m2) Approach Road A1 side : Embankment =3,008 m3 Cut =6 m3 A2 side : Embankment =4,042 m3 Cut =0 m3	
5	4 – 1 1	Nhwine		Steel Plate Girder Bridge Length : 50.090m Span Arrangement : 29.250m +19.350m Bridge Elevation : 44.500	Substructure (Foundation) A1 & A2 :Steel H-beam Pile (400mm x 400mm x 24nos.) P1 :Spread footing Revetment A1 side : Grouted riprap (A =389 m2) A2 side : Grouted riprap (A =441 m2) Approach Road A1 side : Embankment =1,710 m3 Cut =69 m3 A2 side : Embankment =3,534 m3 Cut =72 m3	

Table 2.4-7 SUMMARY OF CONSTRUCTION WORKS (2/ 2)

No.	Bridge No.	Bridge Name	Bridge Layout	Superstructure	Substructure/Revetment/Approach Road	Remarks
6	4－12	Draw		Steel Tuss Bridge Bridge Length: 40.075m Bridge Elevation : 51.400	Substructure (Foundation) A 1 :Spread Footing A 2 :Spread Footing Revetment A1 side :Grouted riprap (A =372 m2) A2 side :Grouted riprap (A =424 m2) Approach Bridge A1 side : Embankment =272 m3 Cut =469 m3 A2 side : Embankment =2,273 m3 Cut =113 m3	
7	5－9	Tanodumase		Steel Truss Bridge Bridge Length : 50.075m Bridge Elevation : 113.100	Substructure (Foundation) A 1 :Spread Footing A 2 :Spread Footing Revetment A1 side : Grouted riprap (A =441 m2) A2 side : Grouted riprap (A =527 m2) Approach Road A1 side : Embankment =3,545 m3 Cut =0 m3 A2 side : Embankment =6,759 m3 Cut =0 m3	
8	6－3	Johol		Steel Truss Bridge Bridge Length : 45.075m Bridge Elevation : 133.900	Substructure (foundation) A 1 :Spread Footing A 2 :Spread Footing Revetment A1 side : Grouted riprap (A =189 m2) A2 side : Grouted riprap (A =243 m2) A1 & A2 side :Steel sheet pile L = 6 m x 64 m Approach Road Left : Embankment =3,626 m3 Cut =0 m3 Right : Embankment =4,211 m3 Cut =0 m3	
9	6－6	Fawohoyeden		R C Girder Bridge Bridge Length : 20.050m Bridge Elevation : 174.400	Substructure (Foundation) A 1 :Spread Footing A 2 :Spread Footing Revetment A1 side : Grouted riprap (A =189 m2) A2 side : Grouted riprap (A =243 m2) Approach Road A1 side : Embankemnt =3,900 m3 Cut =0 m3 A2 side : Embankment =3,898 m3 Cut =0 m3	This bridge is excluded from this project.

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation concept

The following are the basic conditions for implementing this project:

- This project, if approved, will be implemented in accordance with the provisions of Japan's Grant Aid Program after the signing of the Exchange of Notes between the Government of Japan and the Republic of Ghana.
- The Department of Feeder Roads (DFR) is the responsible agency for implementing the project.
- The detailed design, tenders and construction supervision of the bridges will be undertaken by a Japanese consultant firm in accordance with a contract between the DFR and the consultant.
- The construction of the bridges will be undertaken by the successful Japanese tenderer in awarding the contract with the DFR.

The following are the concepts in implementation planning:

- The bridges will be constructed by a contractor employing labor from local subcontractors.
- Materials and equipment necessary for the project will be procured in Ghana as far as is available. Items unavailable locally will be procured from Japan or third countries. The country procured from will be selected based on their cost, quality and time required.
- The construction method and progress schedule of the project will be planned reflecting local conditions of climate, topography, geology, transportation and others.
- Easy and low cost methods of construction will be proposed for the project especially for erection of girders and construction of substructures in rivers.
- Organizations for construction and supervision for the project will be proposed based on standardization of specifications for construction and construction supervision.
- Detours during construction will be planned to maintain ways for present traffic.
- Development of access roads for transportation of construction materials and equipment will be planned. Work of reinforcing weak bridges will be planned.

3.1.2 Construction plan

(1) Construction of cofferdams

Construction of substructures and revetments are scheduled to be implemented in dry seasons. However, temporary cofferdams are required during construction of structures located below low water levels (LWL).

A sandbag fill cofferdam is proposed where LWL is not deeper than around 1 m, while a steel sheetpile cofferdam is proposed where LWL is deeper than 1 m. The construction methods are explained with illustrations in Appendix 7.

The methods of construction of cofferdams for the bridges are proposed as shown in Table 3.1-1.

Table 3.1- 1 COFFERDAM CONSTRUCTION METHOD

Bridge No.	Bridge Name	LWL Depth (m)	Cofferdam Type	Remarks
2-2	Ayensu	0.4	Sandbag fill	
2-4	Emuo	1.3	Steel sheetpile	
3-5	Fum	0.3	Sandbag fill	
4-7	Sayere	0.3	Sandbag fill	
4-11	Nhwine	1.5	Steel sheetpile	
4-12	Draw	1.0	Sandbag fill	
5-9	Tanodumase	2.0	Sandbag fill	Shallow where abutments are
6-3	Johol	3.0	Steel sheetpile	
6-6	Fawohoyeden	0.5	Sandbag fill	

(2) Girder erection method

Steel girder erection

Following methods are commonly used for erection of steel girders:

- Direct erection method using truck cranes and bents
- Launching method using extension girders
- Cable hanging erection method

Among the above, direct erection method using truck cranes and bents is proposed for the erection of the steel girders in this project since this method is simple and easy and special technique is not required. The erection method is explained with illustrations in Appendix 7. To provide working stages for truck cranes, platforms will be constructed across the rivers. The required capacity of the truck cranes is around 40 tons.

RC girder erection

RC T-girders are planned to be concreted on the sites. Forms and falsework of the RC T-girders will be constructed directly on the river during dry seasons.

(3) Detour plans

Construction of temporary detour bridges are planned where existing bridges are to be demolished before the construction. Plans for construction of temporary detour bridges are shown in Table 3.1-2.

Table 3.1-2 DETOUR TEMPORARY BRIDGE CONSTRUCTION

BridgeNo.	Bridge Name	Existence of bridge	Location of new bridge	Timing of demolition	Necessity of detour bridge
2-2	Ayensu	Foot br.	14m downstream	After const.	No need
2-4	Emuo	None	-	-	No need
3-5	Fum	None	-	-	No need
4-7	Sayere	Timber	Existing bridge	Before const.	Need
4-11	Nhwine	Timber	8m downstream	Before const.	Need
4-12	Draw	Timber	8m downstream	Before const.	Need
5-9	Tanodumase	None	-	-	No need
6-3	Johol	None	-	-	No need
6-6	Fawohoyeden	Timber	10m downstream	After const.	No need

3.1.3 Scope of Works

The Undertakings of the Government of Japan and Ghana are listed in Table 3.1-3.

Table 3.1-3 UNDERTAKINGS OF THE GOVERNMENTS

Items	Contents	Undertaken by		Remarks
		Japan	Ghana	
Design	Detailed design	o		
Material Procurement	Procurement	o		
	Customs clearance		o	
	Development of access road		o	
	Transportation	o		
Preparation Works	Land acquisition		o	
	Demolition of existing bridges	o		Demolition before construction
Construction	Construction of Bridges	o		
	Demolition of existing bridges		o	Demolition after construction
	Construction supervision	o		
	Development of access roads		o	
Maintenance	Maintenance of bridges		o	

The cost to be shouldered by the Government of Ghana is roughly estimated as follows:

- Rehabilitation of access roads (2.2 km)	: 200 Million Cedi
- Grading and resurfacing of access roads (31 km)	: 400 Million Cedi
Total	600 Million Cedi

3.1.4 Consultant supervision

A Japanese consultant firm will supervise the implementation of the project on behalf of the DFR. The consultant will carry out the detailed design, assistance in tendering and construction supervision in accordance with the consultant contract.

(1) Detailed Design

The major works in the detailed design to be carried out by the consultant are as follows:

- Supplementary site survey
- Detailed design of the bridges and the related structures
- Preparation of drawings and specifications
- Construction planning and cost estimation
- Preparation of tender documents

The necessary time for the detailed design is 3 months.

(2) Assistance in Tendering

- Tender publication
- Pre-qualification
- Tendering
- Tender evaluation
- Contract facilitation

The necessary time for assistance in tendering is 2.5 months.

(3) Construction Supervision

The main work items to be executed by the consultant are as follows:

- Inspection and approval of site surveys
- Inspection and approval of construction planning
- Quality control
- Progress control
- Measurement of work

- Inspection of safety aspects
- Final inspection and turnover

The construction period is 12 months. To successfully carry out supervision, two consultants are required to be stationed on the site during the whole period of construction.

3.1.5 Procurement plan

Plan of procurement of materials necessary for the project is shown in Table 3.1-4.

Table 3.1-4 MATERIAL PROCUREMENT PLAN

Items	Procured From		Remarks
	Ghana	Japan / Third Country	
1. Construction Materials			
Gravel (foundation fill, base course)	o		Local made
Cement	o		Local made
Sand	o		Local made
Crushed stone	o		Local made
Reinforcing bars	o		Local made
Steel plate girders		o	
Steel trusses		o	
Bearings		o	
Field paint		o	
Nonshrink mortar		o	
Sod	o		Local made
Cobble stone	o		Local made
PVC pipe (ϕ =100)	o		Imported
RC pipe (ϕ = 600, 1000)	o		Local made
Guardrails		o	
Gabions		o	
2. Temporary Work Materials			
Planks (for forms)	o		Local made
Plywood (for forms)	o		Local made
Nails	o		Local made
Lumber (for falsework)	o		Local made
Planks (for falsework)	o		Local made
Steel sheetpile		o	
Steel H-beams (for cofferdams)		o	
Sandbags	o		Local made
Steel girder erection tools		o	
Erection bolts		o	
Drift pins		o	
Welding wire		o	
Fuel, oil	o		Local/Imported
Oxygen, Acetylene	o		Local made

Plan of procurement of equipment necessary for the project is shown in Table 3.1-5.

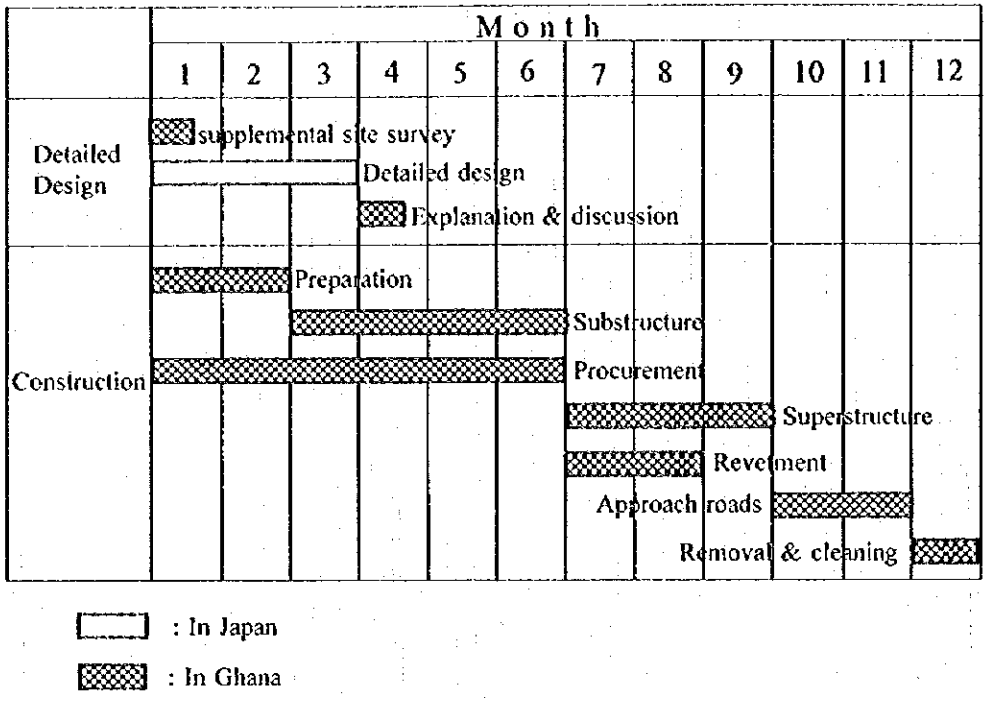
Table 3.1-5 EQUIPMENT PROCUREMENT PLAN

Items	Procured From		Remarks
	Ghana	Japan / Third Country	
Backhoe (0.6 cu.m)		o	
Wheel loader (1.4 cu.m)		o	
Bulldozer (14 t)		o	
Motor grader (3.1 m)		o	
Road roller (8 t)		o	
Dump truck (8 t)		o	
Truck (8 t)		o	
Agitator truck (3.0 cu.m)		o	
Trailer truck (35 t)		o	
Truck crane (15 t)		o	
Truck crane (25 t)		o	
Truck crane (30 t)		o	
Truck crane (40 t)		o	
Diesel hammer (3.5 t)		o	
Vibro hammer (40 kw)		o	
Generator (20 KVA)		o	
Generator (35 KVA)		o	
Generator (200 KVA)		o	
Air compressor (3.5 cu.m/min)		o	
Concrete mixer (0.35 cu.m)	o		Imported
Concrete vibrator	o		Imported
Concrete bucket (0.5 cu.m)		o	
Water pump (100m/m)		o	
Water pump (150m/m)		o	
Water pump (200m/m)		o	
Bar bender		o	
Bar cutter		o	
Gas cutter		o	
Concrete breaker (20kg)		o	
Jack hammer		o	
Tamper (60 kg)	o		Imported
Arc welder (300 A)	o		Imported

3.1.6 Implementation schedule

The implementation schedule for detailed design and construction, which will be borne by Japan's Grant Aid, is shown in Table 3.1-6.

Table 3.1-6 IMPLEMENTATION SCHEDULE



3.1.7 Necessary Measures to be taken by the Government of Ghana

The following necessary measures should be taken by the Government of Ghana on condition that the Grant Aid by the Government of Japan is extended to the Project:

(1) To provide data and information necessary for the Project.

(2) To secure the land necessary for the execution of the Project, such as the land for bridges, temporary offices, working areas, storage yards and others.

(3) To clear the sites prior to the commencement of the construction.

(4) To make passable all roads and bridges leading to the Project sites before the commencement of inland transportation of materials and equipment.

(5) To demolish existing bridges according to the construction schedule which will be provided in the later stage.

(6) To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

(7) To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Ghana and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid.

(8) To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Ghana with respect to the supply of the products and services under the verified contracts.

(9) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the Republic of Ghana and stay therein for the performance of their work.

(10) To provide necessary permissions, licences and other authorizations for implementing the Project, if necessary.

(11) To maintain and use properly and effectively the facilities constructed under the Project.

(12) To coordinate and solve any issues related to the project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

3.2 Bridge Maintenance Plan

The project bridges require yearly cleaning and inspection as routine maintenance and repair of damage when it occurs as special maintenance. Special inspection is required after floods.

The DFR is responsible for the maintenance of bridges along feeder roads. Routine maintenance of bridges is executed in the course of routine maintenance of roads and drainages. Routine maintenance crews are set up and operated under the regional Engineers. As defects are found on bridges during routine maintenance, they are reported to the DFR Headquarters. The DFR formulates special maintenance projects based on detailed inspections and procures community labor teams and/or contractors to repair the bridges.

The routine maintenance activities required for the project bridges are shown in Table 3.2-1. As special maintenance, the steel bridges require repainting when they get rusty (repainting around every 10 years is expected).

Table 3.2-1 ROUTINE MAINTENANCE ACTIVITIES FOR THE BRIDGES

Cleaning parts of the bridges	- Drainages - Expansion Joints - Deck slabs - Top of piers and abutments
Inspection items on superstructures	- Rust or deformation on steel members - Functional defect of bearings
Inspection items on substructures and revetments	- Settlement - Scouring - Cracks

The cost necessary for maintenance of the project bridges yearly is estimated as follows:

- Cleaning and inspection	:	3.6 Million Cedi
- Repainting	:	5.2 Million Cedi
Total		8.8 Million Cedi

The maintenance costs are estimated with the following assumptions:
- Cleaning and inspection will be executed once a year.
- Repainting of steel girders will be executed every 10 years.

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

4.1 Project Effect

The major direct effects of implementing the project are as follows:

Increase of agricultural production

Difficulty in transportation of local products to the market due to lack of bridges and weak timber bridges along the roads constitutes a disincentive to farmers to produce marketable surplus in the rural areas. Providing the transportation means by constructing the bridges will increase the production since they can sell their products with profitable prices.

Reduction of transport cost

Such poor road conditions resulted in the transport cost account for up to 75% of marketing cost. Development of the roads by constructing the bridges will reduce the transport cost, which will result in increase of farmgate prices and increase of competitiveness of the products in the market. The transportation distances from the project areas to the markets will be shortened by connecting the roads with the bridges. (A total of 115 km will be shortened by 4 bridges.)

Development of rural life

Due to lack of public transportation means, the people in the project area can hardly access the high schools, clinics, and other social facilities in towns. After constructing the bridges, public buses will be operated for the people to access such facilities easily. Also, the increase of income of the people due to increase of production and reduction of transport cost will result in a rise in their standard of life. (Total population depending on the bridges is 115,300)

Development of road network

This project constructs bridges which have not been built due to construction difficulty, despite the fact that they are located along important links of the road network. By constructing the bridges, the road network development will be thrust toward the completion of the road network in the country. Reconstruction of the timber bridges, which limit heavy vehicles from passing over them and used to collapse every several years, by permanent bridges means providing safe and reliable roads for traffic.

4.2 Recommendations

Since the project will greatly contribute to the socioeconomic development of the country, and the implementation organization is considered to have sufficient capability to manage the project, it is concluded to be appropriate to implement this project under Japan's grant aid.

For effective use of the project bridges, it is essential that the roads connected to the bridges are passable and maintained in good condition. These roads are scheduled to be improved before the opening of the bridges and maintained by the DFR.

As this project will be implemented, the regional development plans of the areas should be reviewed. Specially, development of systems and facilities for marketing local products, and expansion of public transportation systems for rural people to access social services easily, is recommended.

APPENDICES

APPENDIX 1. MEMBER LIST OF THE STUDY TEAM

Field Survey

Mr. Nobuhiko HANAZATO	Team Leader, Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA)
Mr. Minoru MIURA	Chief Consultant/Road & Bridge Planner, Katahira & Engineers International
Mr. Takasi ONO	Bridge Engineer, Katahira & Engineers International
Mr. Takeshi HIRANO	Survey Engineer, Kokusai Kogyo Co., Ltd.
Mr. Masao AIZAWA	Geotechnical Engineer, Katahira & Engineers International
Mr. Soemu OSHITA	Construction Planner/Cost Estimator, Katahira & Engineers International

Explanation of Draft Basic Design

Mr. Nobuhiko HANAZATO	Team Leader, Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA)
Mr. Minoru MIURA	Chief Consultant/Road & Bridge Planner, Katahira & Engineers International
Mr. Takasi ONO	Bridge Engineer, Katahira & Engineers International

APPENDIX 2. SURVEY SCHEDULE

Field Survey (Nov.28-Dec.22, 1995)

Date	Activities
Nov. 28 (Tue)	- Study team left Tokyo.
Nov. 29 (Wed)	- Arrival at Accra.
Nov. 30 (Thu)	- Courtesy call on JICA, Embassy and DFR.
Dec. 1 (Fri)	- Discussion with DFR.
Dec. 2 (Sat)	- Site survey.
Dec. 3 (Sun)	- Site survey.
Dec. 4 (Mon)	- Discussion with DFR. - Site survey.
Dec. 5 (Tue)	- Discussion with DFR. - Site survey.
Dec. 6 (Wed)	- Signing on Minutes of Discussions. - Report to JICA & Embassy. - Mr. Hanazato left Accra for Tokyo.
Dec. 7 (Thu)	- Site survey. - Data collection. - Discussion with DFR.
Dec. 8 (Fri)	- Site survey. - Data collection.
Dec. 9 (Sat)	- Site survey. - Data collection.
Dec. 10 (Sun)	- Site survey. - Data collection.
Dec. 11 (Mon)	- Site survey. - Data collection. - Discussion with DFR.
Dec. 12 (Tue)	- Site survey. - Data collection.
Dec. 13 (Wed)	- Site survey. - Data collection.
Dec. 14 (Thu)	- Site survey. - Data collection.
Dec. 15 (Fri)	- Site survey. - Data collection. - Discussion with DFR.
Dec. 16 (Sat)	- Site survey. - Data collection.
Dec. 17 (Sun)	- Site survey. - Data collection.
Dec. 18 (Mon)	- Discussion with DFR.
Dec. 19 (Tue)	- Report to JICA & Embassy.
Dec. 20 (Wed)	- Study team left Accra.
Dec. 21 (Thu)	- Arrival at London.
Dec. 22 (Fri)	- Arrival at Tokyo.

Explanation of Draft Basic Design (Feb.28-Mar.10,1996)

Date	Activities
Feb. 28 (Wed)	- Mr. Miura & Mr. Ono left Tokyo.
Feb. 29 (Thu)	- Arrival at Accra.
Mar. 1 (Fri)	- Courtesy call on JICA, Embassy, Ministry of Finance, Ministry of Roads & Highways and DFR. - Mr. Hanazato arrived at Accra.
Mar. 2 (Sat)	- Discussion with DFR.
Mar. 3 (Sun)	- Discussion within the team.
Mar. 4 (Mon)	- Discussion with DFR.
Mar. 5 (Tue)	- Signing on Minutes of Discussions. - Report to JICA & Embassy. - Mr. Hanazato left Accra for Tokyo.
Mar. 6 (Wed)	- Site survey
Mar. 7 (Thu)	- Mr. Miura & Mr. Ono left Accra arrived at London
Mar. 8 (Fri)	- Inspection of construction material factory.
Mar. 9 (Sat)	- Mr. Miura & Mr. Ono left London.
Mar. 10 (Sun)	- Arrival at Tokyo.

APPENDIX 3. MEMBER LIST OF PARTY CONCERNED IN THE REPUBLIC OF GHANA

Ministry of Finance

Dr. William A. Adote	Director, International Economic Relations Division
Mrs. Agenes Batsa	Head of Bilaterals
Mr. Kwasi Opoku	International Economic Relations Division

Ministry of Roads and Highways

Dr. Ato Quarshie	Minister
Mr. Alhaji Amadu Seidu	Deputy Minister
Mr. K. Abbey Sam	Chief Director

Department of Feeder Roads (DFR)

Mr. C. D. Antwi	Director
Mr. Alex Twumasi Boakye	Deputy Director (Planning)
Mr. Martin hMensa	Acting Deputy Director (Development)
Mr. A. T. Essifie	Acting Deputy Director (Maintenance)
Mr. S. K. K. Gardiner	Principal Engineer (Development)
Mr. K. Opon Tutu	Principal Engineer (Maintenance)
Mr. J. A. N. Klu	Principal Quantity Surveyor
Mr. Ofori Amanfo Duku	Senior Planning Officer

Ghana Highway Authority (GHA)

Mr. Maxwell G. Anafi	Director (Planning)
Mr Robert Ofori	Director of Bridge

Embassy of Japan

Mr Akihisa Tanaka	Ambassador
Mr. Makoto Wakasugi	Minister
Mr. Junji Yamasaki	First Secretary

JICA Ghana Office

Mr Akio Yatsubayasi	Director
Mr Toshiharu Kai	Duputy Director

APPENDIX 4. MINUTES OF DISCUSSIONS

Field Survey

Minutes of Discussions
on
Basic Design Study
on
The Project for Construction of Small Scale Bridges
in
the Republic of Ghana

In response to a request from the Government of the Republic of Ghana (hereinafter referred to as "the GOG"), the Government of Japan decided to conduct a Basic Design Study on the Project for Construction of Small Scale Bridges (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Republic of Ghana a Basic Design Study Team (hereinafter referred to as "the Team") headed by Mr. Nobuhiko HANAZATO, Second Basic Design Study Division, Grant Aid Study & Design Department, JICA, which is scheduled to stay in the country from November 29 to December 20, 1995.

The Team held discussions with the concerned officials of the GOG and conducted a field survey at the Project sites.

Both parties have confirmed the main items described on the attached sheets.
The team will proceed to continue the works and prepare a Draft Basic Design.

Accra, December 6, 1995

Mr. Nobuhiko HANAZATO
Leader
Basic Design Study Team
Japan International Cooperation Agency

Dr. William A. ADOTE
Director
International Economic Relations Division
Ministry of Finance

Mr. K. Abbey SAM
Chief Director
Ministry of Roads and Highways

Mr. C. D. AMIWI
Director
Department of Feeder Roads
Ministry of Roads and Highways

ATTACHMENT

1. OBJECTIVE

The objective of the Project is to construct permanent bridges to replace old log bridges which have deteriorated due to severe weather and age, and are hindering the safe transportation in the Project area. By constructing the new bridges, all weather access will be provided to ensure basic transport facilities in the Project area, and to relieve the communities from suffering in their daily life. And in the long term view, socio-economic activities will be encouraged hence to contribute to the development of the Project area.

2. PROJECT IMPLEMENTING AGENCY

The Department of Feeder Roads of the Ministry of Roads and Highways is responsible for the administration and execution of the Project.

3. PROJECT SITES

The sites of the proposed bridges are shown in Annex-1 which consist of 2 bridges in Eastern Region, 1 bridge in Central Region, 3 bridges in Western Region, 1 bridge in Ashanti Region and 2 bridges in Brong Ahafo Region.

4. MAJOR ITEMS REQUESTED BY THE GOG

As a result of a series of discussions, the bridges listed in Annex-2 are finally requested with priority order by the GOG. The Japanese side will conduct field survey on the listed 9 bridge sites during their stay in the country. However, the items to be covered by the Project will be finalized on the basis of further study, analysis and discussions among the concerned authorities in Japan.

5. JAPAN'S GRANT AID SCHEME

The GOG has understood the system of Japan's Grant Aid explained in Annex-3.

6. NECESSARY MEASURES TO BE TAKEN BY THE GOG

The GOG will take necessary measures described in Annex-4 for smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

7. CONSTRUCTION OF THE PROJECT RELATED ROADS

All the roads to the proposed bridges shall be constructed/improved by March 1998 by the GOG.

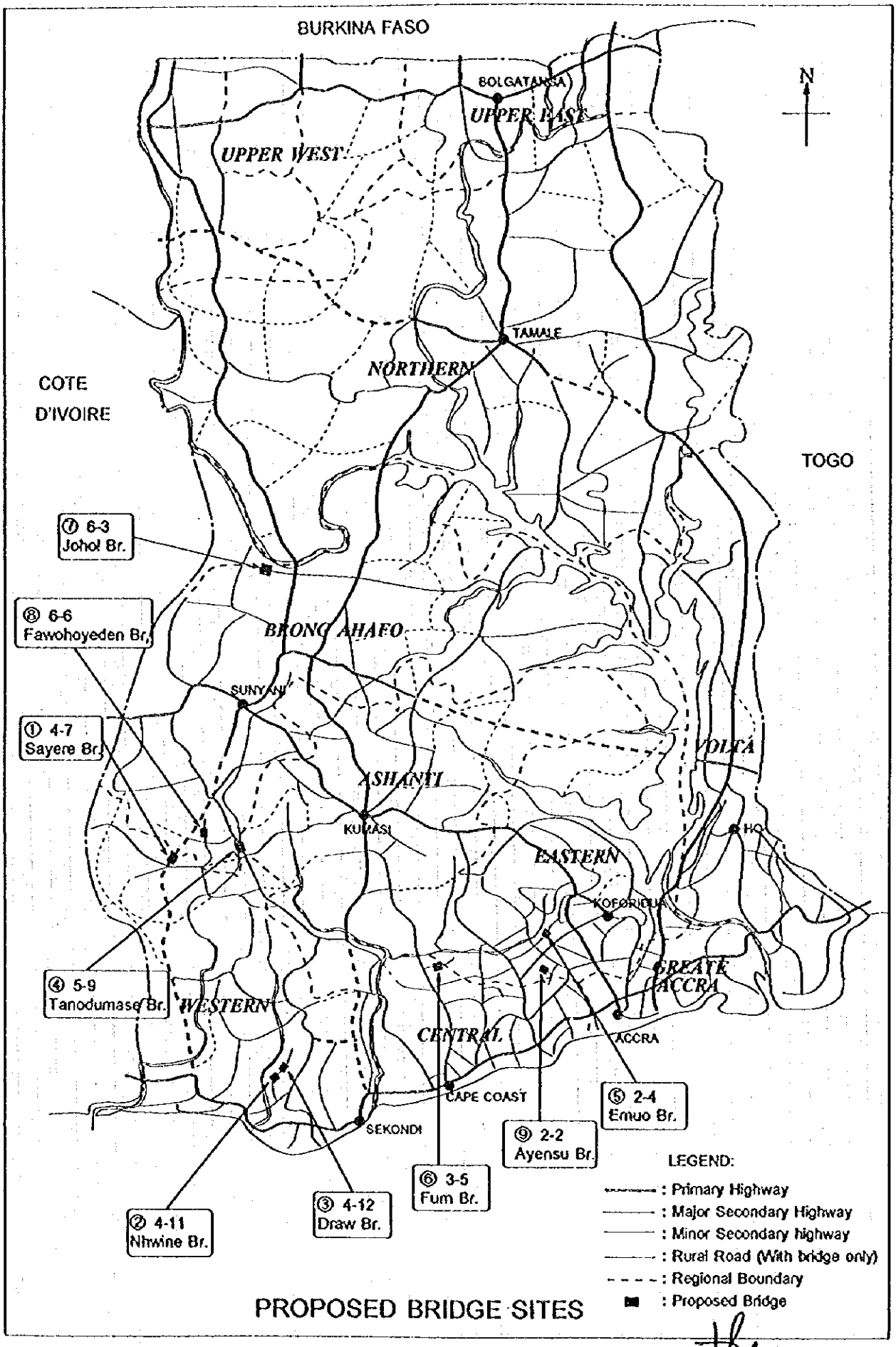
8. FURTHER SCHEDULE OF THE STUDY

i) The Team will proceed to further studies in Ghana until December 20, 1995.

ii) Based on the results of studies, JICA will prepare a Draft Basic Design and dispatch a team in the beginning of February 1996 in order to explain and confirm its contents.

iii) Upon acceptance of the Draft Basic Design by the GOG, JICA will complete the Basic Design Report and forward it to the GOG by April 1996.

Annex-1


BURKINA FASO
BOLGATANGA
UPPER EAST
UPPER WEST
N
TAMALE
NORTHERN
COTE
D'IVOIRE
TOGO
⑦ 6-3
Johol Br.
⑧ 6-6
Fawohoyeden Br.
BRONG AHAFO
SUNYANI
① 4-7
Sayere Br.
VOLTA
ASHANTI
KUMASI
HO
EASTERN
KOFORIDUA
GREATER
ACCRA
④ 5-9
Tanodumase Br.
WESTERN
CENTRAL
ACCRA
CAPE COAST
⑤ 2-4
Emuo Br.
SEKONDI
⑨ 2-2
Ayensu Br.
⑥ 3-5
Fum Br.
③ 4-12
Draw Br.
② 4-11
Nhwine Br.
LEGEND:
: Primary Highway
: Major Secondary Highway
: Minor Secondary highway
: Rural Road (With bridge only)
: Regional Boundary
: Proposed Bridge
PROPOSED BRIDGE SITES

Annex-2

REQUESTED BRIDGES FOR THE PROJECT
(Ranked in order of priority)

Priority Ranking	Region	Bridge No.	Bridge Name	Road Name
1	Western	4-7	Sayere	Nkatieso-Agyemandiem-Abuom
2	Western	4-11	Nhwine	Asaasetre-Banso-Kwesikrom
3	Western	4-12	Draw	Asaasetre-Banso-Kwesikrom
4	Ashanti	5-9	Tanodumase	Bibiani-Asiberem
5	Eastern	2-4	Emuo	Osenase-Apinamang
6	Central	3-5	Fum	Akonfudi-Asibirim
7	B/Ahafo	6-3	Johol	Banda-Kankan
8	B/Ahafo	6-6	Fawohoyeden	Fawohoyeden-Atronie
9	Eastern	2-2	Ayensu	Takorase-Krudua

Annex-3

Japan's Grant Aid Scheme

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Government of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"),

conducted by JICA on a requested project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project

e) Estimation of costs of the Project

The contents of the original request are not necessary approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to team must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

(1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

(2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

(3) To secure buildings prior to the procurement in case the installation of the equipment.

(4) To ensure prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

(6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Annex-4

NECESSARY MEASURES TO BE TAKEN BY THE GOG

The following necessary measures should be taken by the GOG on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.

2. To secure the land necessary for the execution of the Project, such as the land for bridges, temporary offices, working areas, storage yards and others.

3. To clear the sites prior to the commencement of the construction.

4. To make passable all roads and bridges leading to the Project sites before the commencement of inland transportation of materials and equipment.

5. To demolish existing bridges according to the construction schedule which will be provided in the later stage.

6. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

7. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Ghana and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid.

8. To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Ghana with respect to the supply of the products and services under the verified contracts.

9. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the Republic of Ghana and stay therein for the performance of their work.

10. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.

11. To maintain and use properly and effectively the facilities constructed under the Project.

12. To coordinate and solve any issues related to the project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

Explanation of Draft Basic Design

Minutes of Discussions
on
the Basic Design Study
on
the Project for Construction of Small Scale Bridges
in
the Republic of Ghana

(Explanation on the Draft Basic Design)

In December 1995, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Construction of Small Scale Bridges (hereinafter referred to as "the Project") to the Republic of Ghana (hereinafter referred to as "GOG"). After the assessment of the data and information obtained through the study, JICA has prepared the Draft Basic Design on the Project.

In order to explain and consult the GOG on the components of the Draft Basic Design, JICA sent to the GOG a Study Team headed by Mr. Nobuhiko HANAZATO, Second Basic Design Study Division, Grant Aid Study & Design Department, JICA, which is scheduled to stay in the country from February 29 to March 7, 1996.

As a result of discussions, both parties have confirmed the main items described in the attached sheets.

Accra, March 5, 1996

Mr. Nobuhiko HANAZATO
Leader
Basic Design Study Team
Japan International Cooperation Agency

Dr. William A. ADOTE
Director
International Economic Relations Division
Ministry of Finance

Mr. J. L. LAMPTEY
Acting Chief Director
Ministry of Roads and Highways

Mr. C. D. ANTWI
Director
Department of Feeder Roads
Ministry of Roads and Highways

ATTACHMENT

1. OBJECTIVE

The objective of the Project is to construct permanent bridges to replace old log bridges which have deteriorated due to severe weather and age, and are hindering the safe transportation in the Project area. By constructing the new bridges, all weather access will be provided to ensure basic transport facilities in the Project area, and to relieve the communities from suffering in their daily life. And in the long term view, socio-economic activities will be encouraged hence to contribute to the development of the Project area.

2. PROJECT IMPLEMENTING AGENCY

The Department of Feeder Roads of the Ministry of Roads and Highways is responsible for the administration and execution of the Project.

3. PROJECT SITES

The sites of the proposed bridges are shown in Annex-1.

4. DRAFT BASIC DESIGN

The GOG has in principal agreed to the components of the Draft Basic Design proposed by the Team, with some minor changes agreed during the meetings. These amendments will be incorporated in the Basic Design.

5. JAPANESE GRANT AID PROGRAMME

The GOG has understood the system of Japanese Grant Aid Programme explained in Annex-2.

6. NECESSARY MEASURES TO BE TAKEN BY THE GOG

The GOG will take necessary measures described in Annex-3 for smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

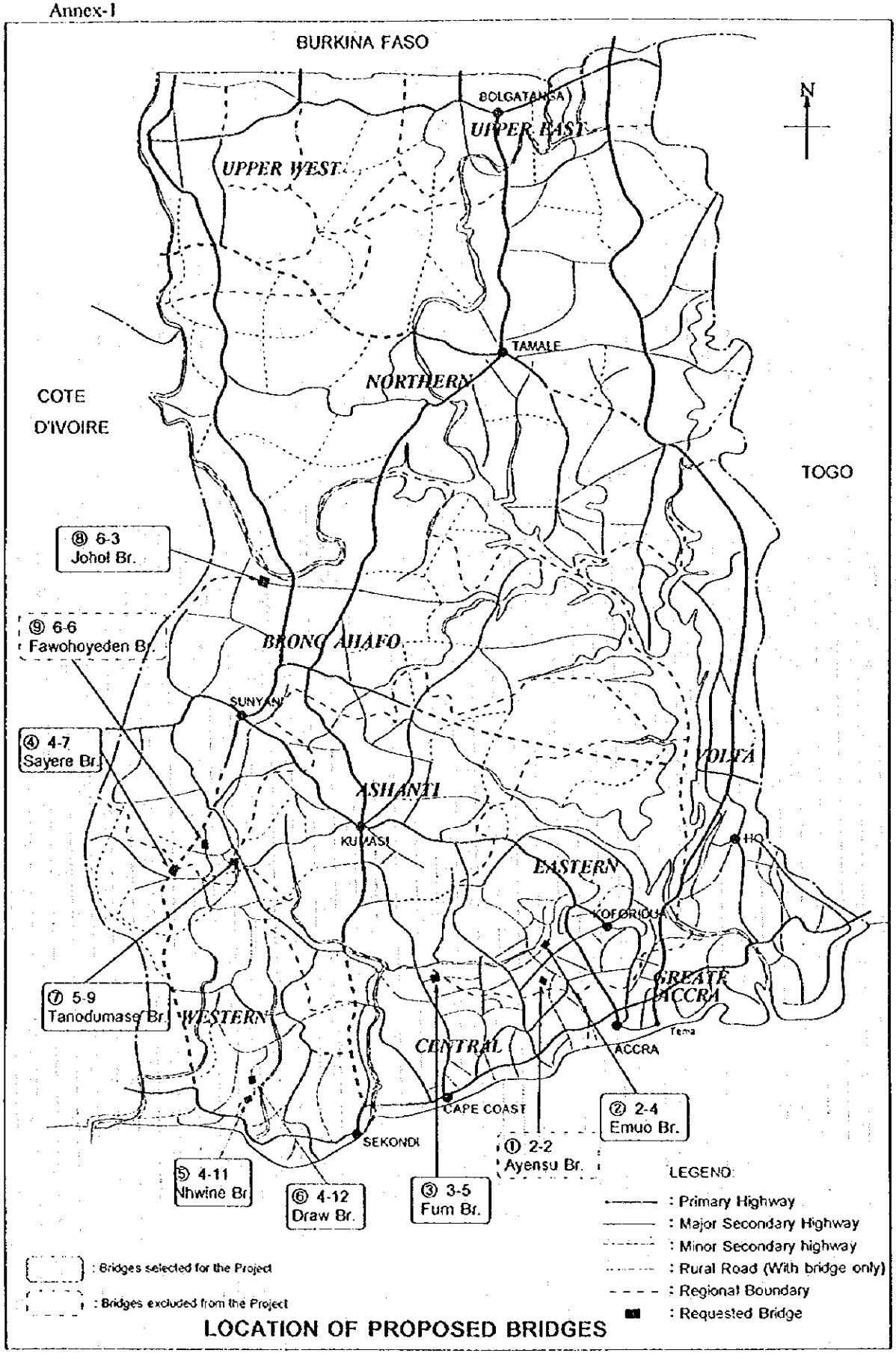
7. CONSTRUCTION OF THE PROJECT RELATED ROADS

All the roads to the proposed bridges shall be constructed/improved by March 1998 by the GOG.

8. FURTHER SCHEDULE OF THE STUDY

JICA will complete the Basic Design Report and forward it to the GOG by April 1996.

Annex-1



LOCATION OF PROPOSED BRIDGES

Annex-2

Japan's Grant Aid Scheme

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Government of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study")

conducted by JICA on a requested project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project

e) Estimation of costs of the Project

The contents of the original request are not necessary approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the Implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to team must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. The "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertaking required of the Government of the Recipient Country

In the implementation of the Grant Aid project, recipient country is required to undertake such necessary measures as the following:

(1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

(2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

(3) To secure buildings prior to the procurement in case the installation of the equipment.

(4) To ensure prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

(6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the

Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Annex-3

NECESSARY MEASURES TO BE TAKEN BY THE GOG

The following necessary measures should be taken by the GOG on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.

2. To secure the land necessary for the execution of the Project, such as the land for bridges, temporary offices, working areas, storage yards and others.

3. To clear the sites prior to the commencement of the construction.

4. To make passable all roads and bridges leading to the Project sites before the commencement of inland transportation of materials and equipment.

5. To demolish existing bridges according to the construction schedule which will be provided in the later stage.

6. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

7. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Ghana and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid.

8. To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Ghana with respect to the supply of the products and services under the verified contracts.

9. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the Republic of Ghana and stay therein for the performance of their work.

10. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.

11. To maintain and use properly and effectively the facilities constructed under the Project.

12. To coordinate and solve any issues related to the project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.