JAPAN INTERNATIONAL COOPERATION AGENCY

No. 1

MINISTRY OF ROADS AND HIGHWAYS
THE REPUBLIC OF GHANA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
SMALL STREAM BRIDGES REHABILITATION
IN
THE REPUBLIC OF GHANA

MARCH 1995

KATAHIRA & ENGINEERS INTERNATIONAL
ORIENTAL CONSULTANTS CO., LTD.

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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 Small Stream Bridges Rehabilitation and entrusted the study to the Japan International Cooperation Agency (JICA).

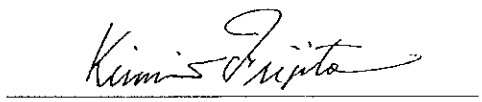
JICA sent to Ghana a study team headed by Mr. Juro Chikaraishi, Director, Third Regional Division, Planning Department, JICA and constituted by members of Katahira & Engineers International and Oriental Consultants Co., Ltd., from December 4 to 23, 1994.

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 report, 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, 1995



Kimio Fujita
President
Japan International Cooperation Agency

March, 1995

Mr. Kimio Fujita,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

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

This study was conducted by Katahira & Engineers International and Oriental Consultants Co., Ltd., under a contract to JICA, during the period November 30, 1994 to March 28, 1995. 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.

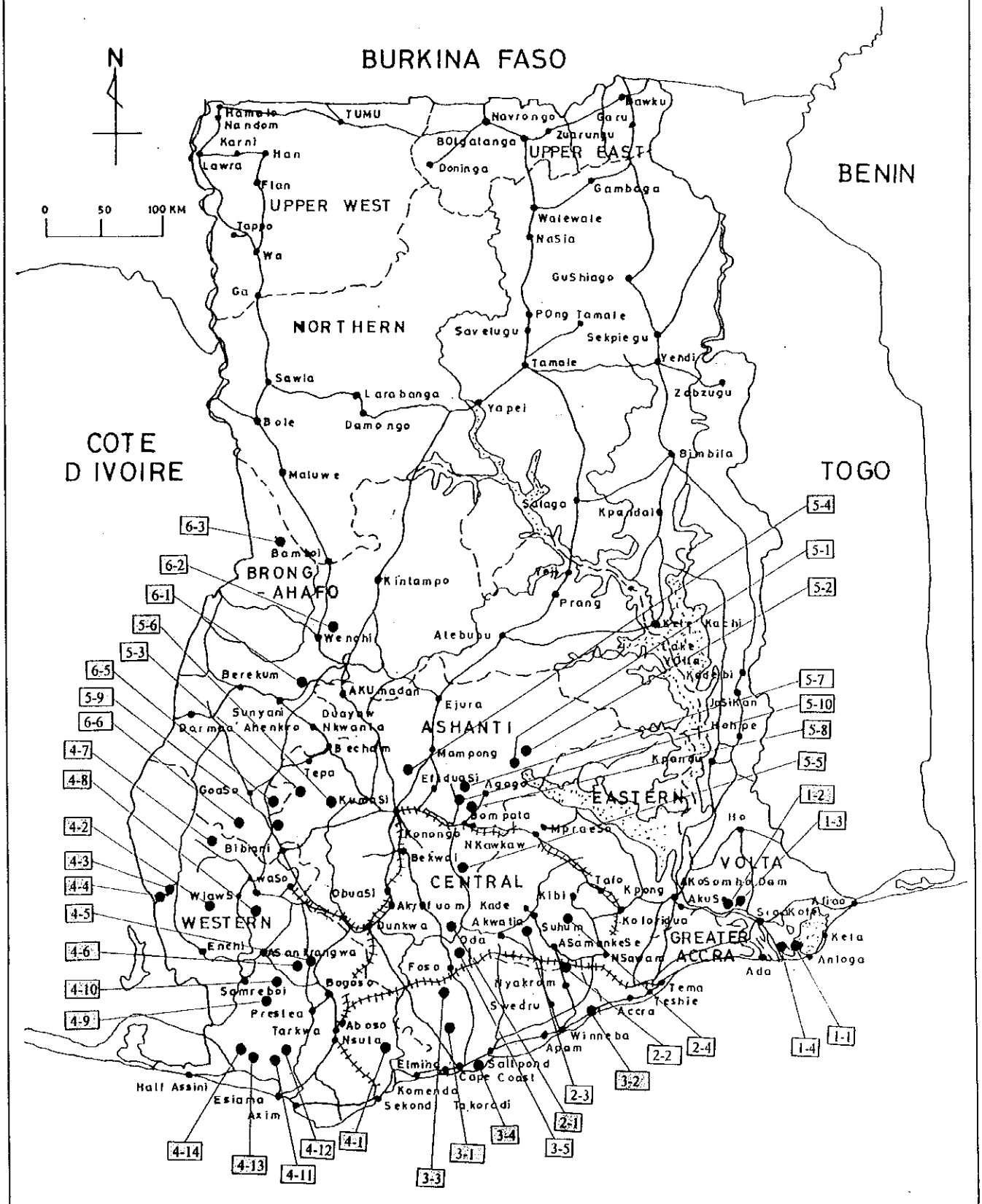
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs. We would also like to express our gratitude to the officials concerned of the Ministry of Roads & Highways, the JICA Ghana Office, the Embassy of Japan in Ghana for their cooperation and assistance throughout our field survey.

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

Very truly yours,

M. Miura

Minoru Miura
Project Manager,
Basic design study team on the Project
for Small Stream Bridges Rehabilitation
Katahira & Engineers International
Oriental Consultants Co., Ltd.



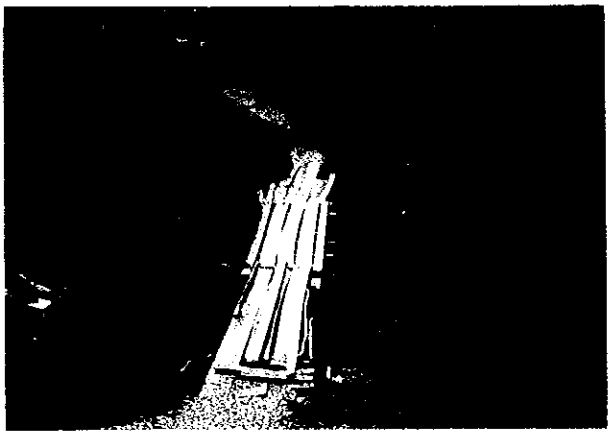
: Bridges for the project (21 brs.)

: Bridges proposed for "facilities construction" project (9 brs.)

: Bridges evaluated as inappropriate for the project (5 brs.)

: Bridges canceled from the request (7 brs.)

PROJECT SITE LOCATION MAP



1-3 Nyivu Bridge Volta Region

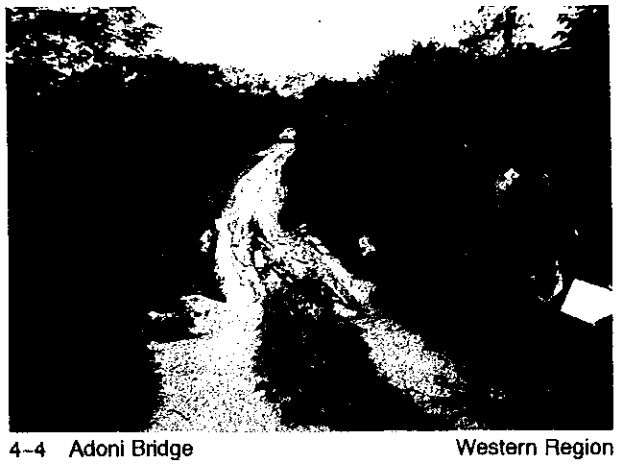
3-1 Kakum Bridge Central Region

3-3 Ochi Bridge Central Region

4-1 Hiwini Bridge Western Region

4-2 Pru Bridge Western Region

4-3 Susan Bridge Western Region



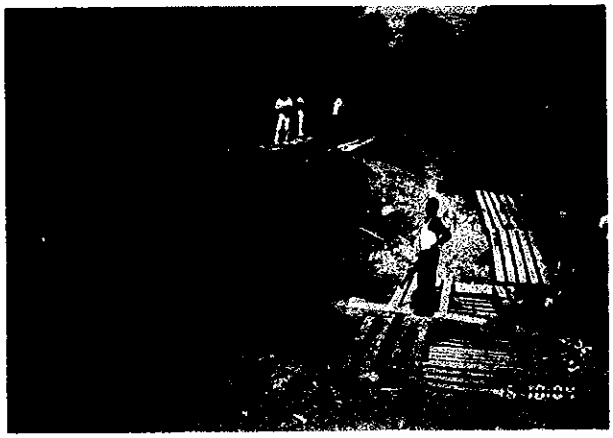
4-4 Adoni Bridge Western Region

Sites of the Project Bridges (1/3)

Photo - 1

4-5 Bura Bridge Western Region

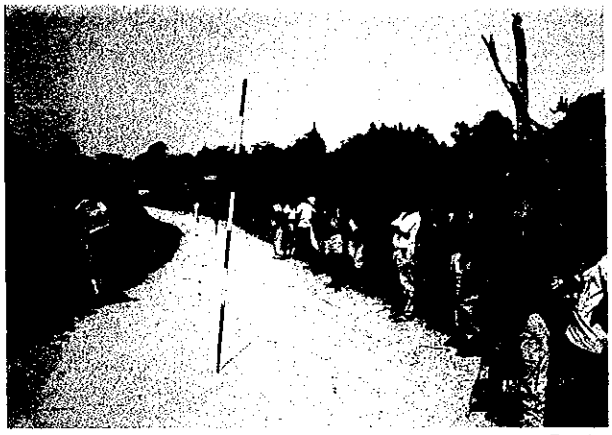
4-6 Yurunsu Bridge Western Region



4-8 Peburu Bridge Western Region

4-9 Samere Bridge Western Region

4-10 Botente Bridge Western Region

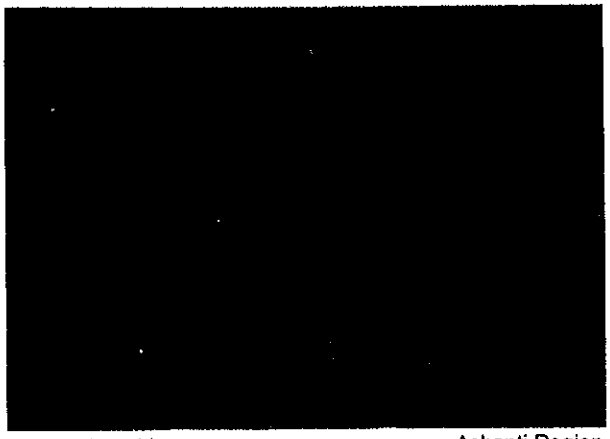


4-13 Djaba Bridge Western Region

4-14 Ayawora Bridge Western Region

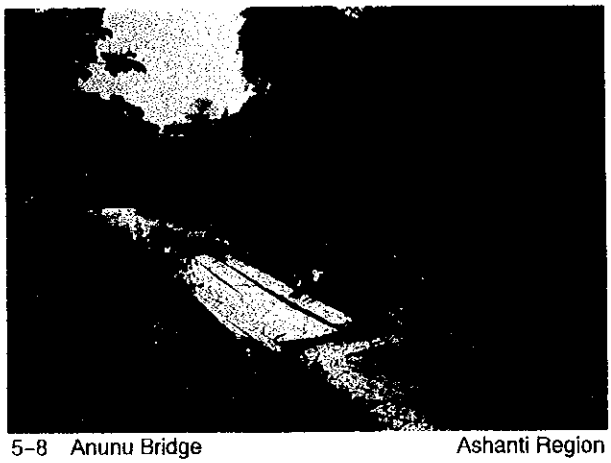
Sites of the Project Bridges (2/3)

Photo - 2



5-4 Ofin Bridge Ashanti Region

5-6 Owabi Bridge Ashanti Region



5-8 Anunu Bridge Ashanti Region

5-10 Anuru Bridge Ashanti Region

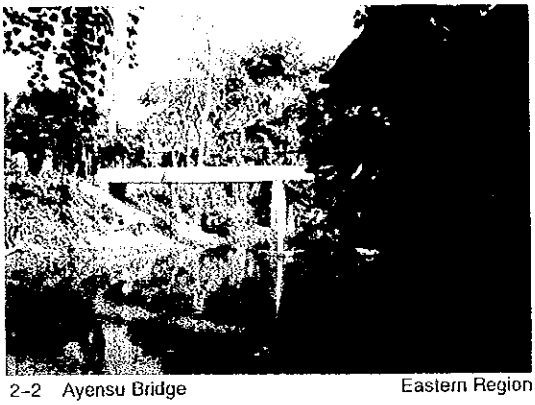
6-1 Tano Bridge Brong-Ahafo Region

6-2 Subin Bridge Brong-Ahafo Region

6-5 Tano Bridge Brong-Ahafo Region

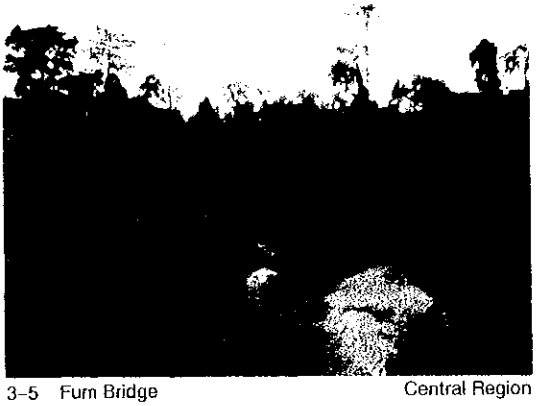
Sites of the Project Bridges (3/3)

Photo - 3

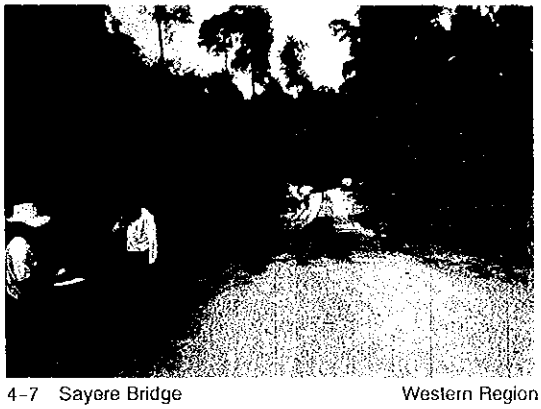


2-2 Ayensu Bridge Eastern Region

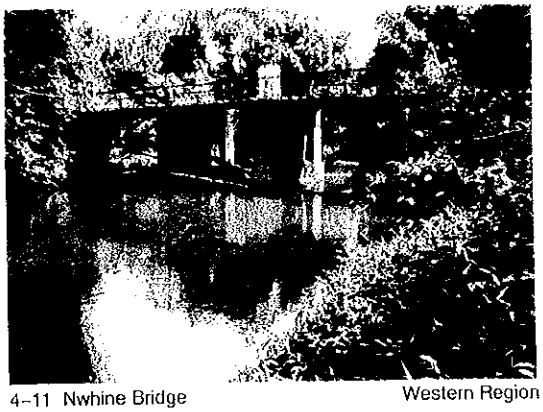
2-4 Emou Bridge Eastern Region



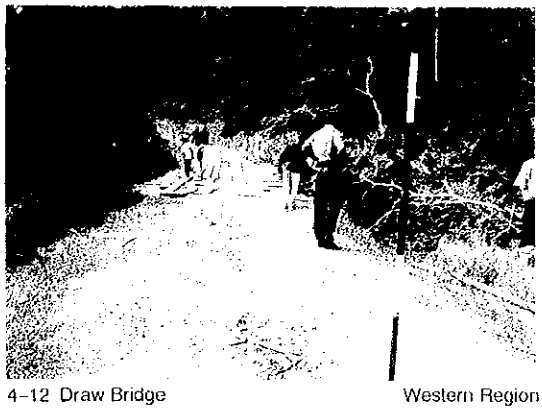
3-5 Furn Bridge Central Region



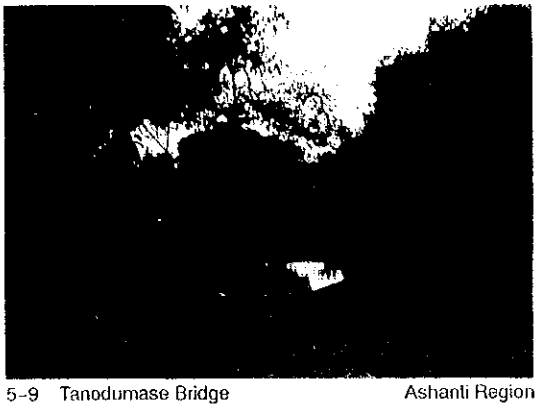
4-7 Sayere Bridge Western Region



4-11 Nwhine Bridge Western Region

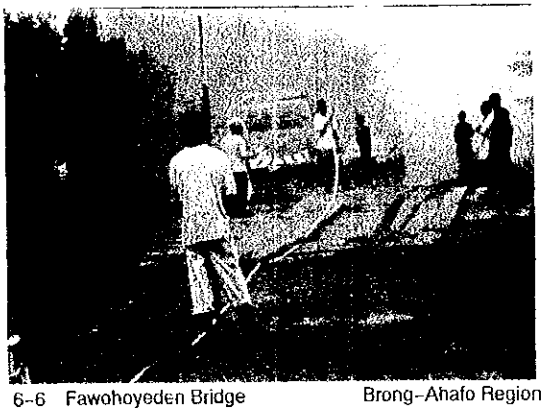


4-12 Draw Bridge Western Region



5-9 Tanodumase Bridge Ashanti Region

6-3 Johol Bridge Brong-Ahafo Region

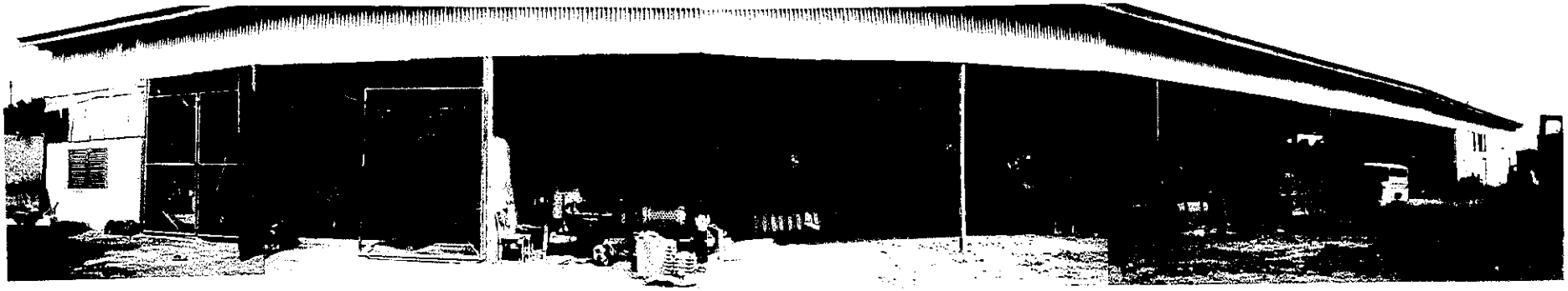


6-6 Fawohoyeden Bridge Brong-Ahafo Region

Site of the Bridges Proposed for
"Facilities Construction" Project

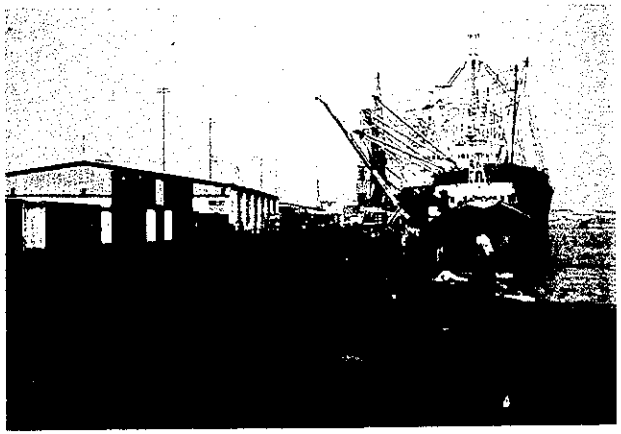
Photo - 4

Okponglo Workshop of the DFR

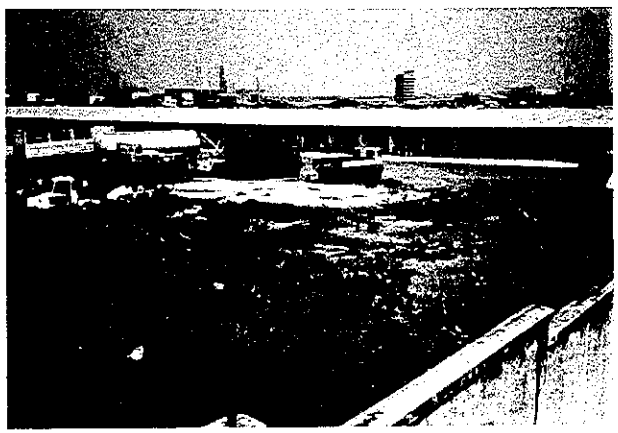


Okponglo Workshop of the DFR

Photo – 5



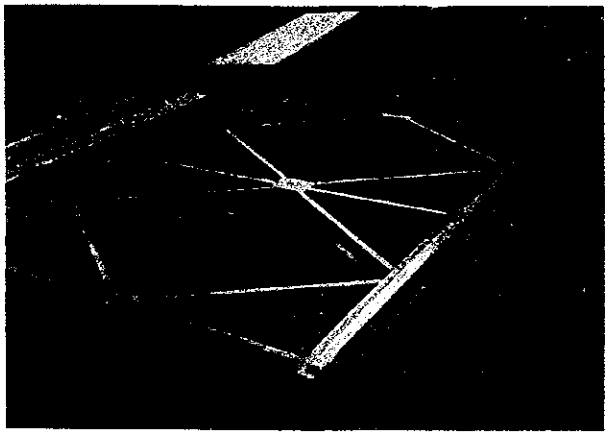
Tema Seaport



Storage yard of Cocoa Board near Tema

Storage yard of Cocoa Board near Tema

Substructures for Bailey bridge
(Dufor-Galasota, Volta Region)



Bailey bridge materials

A Bailey bridge newly constructed
(Kanteaka-Manpong, Western Region)

RC culvert construction
(Asaasefre-Adubrim, Western Region)

Rehabilitation work (Asaasefre-Banso, Western Region)

Reshaping of earth road
(Asaasefre-Adubrim, Western Region)

Construction in Ghana (Feeder Roads Rehabilitation Works)

SUMMARY

The continuous decline of the Ghanaian economy from 1970 to 1982 increased absolute poverty and unemployment. Per capita income in 1980 was half of that in 1970, and the balance of payments situation was so weakened that the country accumulated a large external debt and payments arrears. In addition, the physical infrastructure had deteriorated substantially.

It was against this background that the Government of Ghana introduced the Economic Recovery Program (ERP) in 1983 to stabilize the economy and to rebuild the country's social, economic, and physical infrastructure. 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 the inadequacy of feeder roads, which poses a serious constraint on agricultural production and marketing.

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 Small Stream Bridges Rehabilitation Project and requested Japan's grant aid assistance to procure prefabricated steel bridge materials and equipment necessary for construction of the bridges.

In response to the request of the Government of Ghana, the Government of Japan decided to conduct a basic design study of the Project. Japan International Cooperation Agency (JICA) dispatched the basic design study team from December 4 to 24, 1994 for a field survey in Ghana.

The basic design study team, during its stay in Ghana, confirmed the background, objectives, and contents of the project, collected relevant data, and surveyed the project bridge site conditions. After returning to Japan, the study team evaluated the project in terms of appropriateness, necessity, socioeconomic effects, and other factors based on the results of their surveys, and proposed the basic design of the project and implementation plan.

As a result of the study, 21 bridges in the Volta, Central, Western, Ashanti, and Brong-Ahafo Regions were selected for the project among 28 requested bridges and 14 additionally requested bridges. The project bridge list is shown in the following table. The components of the prefabricated steel bridge materials and equipment to be procured under Japan's grant aid for the project is as follows:

The implementation periods required are 2.5 months for detailed design and 9.5 months for procurement, including transportation and turnover of prefabricated steel bridge materials and equipment.

PROJECT BRIDGE LIST

No.	Br. No.	Br. Name	Region	Road Name	River Name
1	1-3	Nyivu	Volta	Adidome-Juapong	Nyivu
2	3-1	Kakum	Central	Nyameadom-Asomdwee	Kakum
3	3-3	Ochi	"	Akrofuom-Nsuakyir	Ochi
4	4-1	Hwini	Western	Shama Jn.-Mampong-Adansi	Hwini
5	4-2	Pru	"	Agyeman Camp-Kramokrom	Pru
6	4-3	Susan	"	Adonikrom-Jn.-Adonikrom	Susan
7	4-4	Adoni	"	Adonikrom-Jn.-Adonikrom	Adoni
8	4-5	Bura	"	Wasa-Akropong-Anyinabrim	Bura
9	4-6	Yurunsu	"	Wasa-Akropong-Anyinabrim	Yurunsu
10	4-8	Peburu	"	Bopa-Fordjourkrom	Peburu
11	4-9	Samere	"	Pensanum-Amuni	Samere
12	4-10	Botente	"	Pensanum-Amuni	Botente
13	4-13	Djaba	"	Adubrim Jn.-Adubrim	Djaba
14	4-14	Ayawora	"	Adubrim Jn.-Adubrim	Ayawora
15	5-4	Ofin	Ashanti	Agona-Afamanaso	Ofin
16	5-6	Owabi	"	Hiawu-Besease-Ntensere	Owabi
17	5-8	Anunuso	"	Effiduase-Nkwankwanua-Juansa	Anunu
18	5-10	Anuru	"	Kwakuwama-Nobekan	Anuru
19	6-1	Tano	Brong-Ahafo	Chiraa-Asuokwa	Tano
20	6-2	Subin	"	Wenchi-Ofuman	Subin
21	6-5	Aboabo	"	Sienchem-Goaso	Aboabo

Component of the Prefabricated Steel Bridge Materials

		20m span	25m span	Total
Prefabricated Steel Bridge Materials	No. of bridges (brs.)	10	11	21
	Total bridge length (m)	200	275	475
	Weight of steel materials per bridge (t)	21.212	28.006	-
	Total weight of steel materials (t)	212.120	308.066	520.186
Erection Tools	Assembly tools (set)	3		
	Launching tools (set)	3		

Components of the Equipment

Equipment	Number
Cargo trucks (8t)	4
Cargo trucks (4t)	4
Wheel cranes (16t x 3.5m)	2
Wagons (4x4)	2
Semi-trailer (with tractor)	1
Pick-ups (4x4, double cabin)	6

The Department of Feeder Roads (DFR) under the Ministry of Roads and Highways is the executing agency of the project. The Planning and Development Sections of the DFR Headquarters will be responsible for designing and implementing the project, and will involve the DFR Regional Offices in construction supervision and maintenance. The DFR is considered to have sufficient staff, budget, and capability to effectively operate and manage the project.

This project aims to provide efficient transportation facilities by constructing steel bridges and replacing weak timber bridges with steel bridges where agricultural and social development is hindered due to difficulties of transportation. The major direct effects of implementing the project are as follows:

- Local farmers who do not have transportation means to bring their products to market due to lack of bridges can gain the access to market. The resulting decrease in transportation costs will enhance the competitiveness of the agricultural product in the international market and will constitute incentives for farmers to produce marketable surplus products. As a consequence, the project expedites development of the areas affected.

- Local populations which do not have public transportation services to cities, markets, hospitals, and schools can gain such services. Accessibility to social services for local populations will raise the level of their living standards.

Since the project will contribute to the regional development of the Republic of Ghana, it is concluded to be appropriate to implement this project under Japan's grant aid.

The 9 bridges which were excluded from the project because prefabricated steel bridges are not applicable to them or because construction of substructures by local constructors is difficult although their construction necessity is high and the socioeconomic effects are very large are recommended to be constructed under another grant aid in the form of "facilities construction".

TABLE OF CONTENTS

APPENDICES

Tables

Figures

ABBRIBIATIONS

ADF	:	African Development Fund
BS	:	British Standard
DANIDA	:	Danish International Development Agency
DFR	:	Department of Feeder Roads
DUR	:	Department of Urban Roads
ERP	:	Economic Recovery Program
GDP	:	Gross Domestic Product
GHA	:	Ghana Highway Authority
GTZ	:	Deutsche Gesellschaft fur Technische Zusammenarbeit
HTB	:	High Tension Bolt
IMF	:	International Monetary Fund
IDA	:	International Development Association
JICA	:	Japan International Cooperation Agency
JIS	:	Japan Industrial Standard
MRH	:	Ministry of Roads & Highways
ODA	:	Overseas Development Administration (U.K.)
OPEC	:	Organization of Petroleum Exporting Countries
PIP	:	Public Investment Program
USAID	:	United State Agency for International Development

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1

BACKGROUND OF THE PROJECT

1.1 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, a continuous decline of national economy after the early 1970s increased absolute poverty and worsened income distribution. By 1983, per capita income was half that of 1970, and the balance of payments situation was so weakened that the country had accumulated a large external debt and payments arrears, and the physical infrastructure had deteriorated substantially.

It was against this background that the Government 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 75% 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 road 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. The inadequacy of feeder roads poses a serious constraint on agricultural production and marketing. In many rural areas, transport costs account for up to 70% of marketing costs as a result of the poor state of the feeder road network.

Under these conditions, the Government of Ghana has prepared the Public Investment Program (PIP), which is revised each year, to support the goals of the Government's Economic Recovery Program. Based on the PIP, the Government of Ghana has initiated a series of programs to develop feeder roads such as the Cocoa Rehabilitation Project and the National Feeder Roads Rehabilitation and Maintenance Project with the financial assistance of IDA and other countries.

For improvement of trunk road network, the Government of Japan has extended grant aid assistance for the projects of Reconstruction of Beposo Bridge and Providing Equipment for Ghana Highway Authority Workshops.

Rehabilitation and maintenance of feeder roads including bridging over small streams with concrete culverts are being implemented under mentioned projects, however relatively large streams without bridges or with weak timber bridges, which are difficult to construct with local materials, 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 Small Stream Bridges Rehabilitation Project and requested Japan's grant aid assistance for procurement of prefabricated steel bridge materials and equipment necessary for construction of the bridges.

1.2 Outline of the Request

The request made by the Government of Ghana to Japan's grant aid is for assistance for procurement of prefabricated steel bridge materials and equipment necessary for construction of the bridges under Small Stream Bridges Rehabilitation Project.

The contents of the request were confirmed by the study team at the primary meeting in the field survey. As a result of the confirmation, the following changes of the request were proposed by the Government of Ghana:

Change of bridge list

Replacement of 5 bridges among 27 originally requested bridges by new 6 bridges was proposed, since the 5 bridges had already been constructed. The revised bridge list of the request and the bridges deleted from the request are shown in Table 1-1. In the table, the 6 newly requested bridges are indicated with "*".

Change of equipment list

The items and quantities of the equipment of the request were revised based on a review of

equipment needed for the project and equipment owned by the Department of Feeder Roads (DFR). The list of equipment originally requested and revised is shown in Table 1-2.

The change of the request was accepted, and the basic design study of the project was conducted based on the revised request. (Please refer to Appendix 4. Minutes of Discussions.)

Table 1-1 REQUESTED BRIDGE LIST

No.	Bridge No.	Bridge Name	Region	Road Name	River	Requested Bridge Length
1	1-1	Kolo	Volta	Blemeazado-Agortoe	Kolo	25 m
2	1-2	Aklakpa	"	Adidome-Juapong	Aklakpa	35 m
3	1-3	Nyivu	"	Adidome-Juapong	Nyivu	30 m
4	1-4 *	Anor	"	Galosata-Bomingo	Anor	-
5	2-1	Pra	Eastern	Etwereso Jn.-Etwereso Pawudu	Prao	20 m
6	2-2	Ayensu	"	Takorase-Krudua	Ayensu	40 m
7	2-3 *	Birim	"	Akwatia-Kusi	Birim	-
8	3-1 *	Kakum	Central	Nyameadom-Asomdwee	Kakum	-
9	3-2	Ayensu II	"	Winneba-Ojobi	Ayensu	30 m
10	3-3 *	Ochi	"	Akrofuom-Nsuakyir	Ochi	-
11	3-4	Amutu	"	Ekon Jn.-Ekon	Amutu	30 m
12	4-1	Hwini	Western	Shama Jn.-Mampong-Adansi	Hwini	30 m
13	4-2	Pruvu	"	Agyeman Camp-Kramokrom	Pru	20 m
14	4-3	Susan	"	Adonikrom-Jn.-Adonikrom	Susan	20 m
15	4-4	Adoni	"	Adonikrom-Jn.-Adonikrom	Adoni	20 m
16	4-5	Bura	"	Wasa-Akropong-Anyinabrim	Bura	20 m
17	4-6	Yurunsu	"	Wasa-Akropong-Anyinabrim	Yurunsu	20 m
18	4-7	Sayere	"	Nkatieso-Agyemandiem-Abuom	Sayere	25 m
19	5-1 *	Afram	Ashanti	Kwamepong-Nkwanta-Dukusen	Afram	-
20	5-2 *	Ben	"	Kwamepong-Nkwanta-Dukusen	Ben	-
21	5-3	Disri	"	Mpasaaso-Sreso	Disri	20 m
22	5-4	Ofin	"	Agona-Afamanaso	Ofin	20 m
23	5-5	Anum II	"	Praso-Konongo	Anum	30 m
24	5-6	Owabi	"	Hiawu-Besease-Ntensere	Owabi	20 m
25	5-7	Anum	"	Woraso-Abotanso	Anum	35 m
26	6-1	Tano	Brong-Ahafo	Chiraa-Asuokwa	Tano	35 m
27	6-2	Subin	"	Wenchi-Ofuman	Subin	30 m
28	6-3	Johol	"	Banda-Kankan	Johol	30 m
Bridges deleted from the Original Request						
1	-	-	Volta	Atravenu-Galosota	-	30
2	-	-	Central	Amoanda-Fosuansa	-	30
3	-	-	"	Konyako	-	30
4	-	-	Western	Shama Jn.-Mapong-Adansi	Hwini	30
5	-	-	Ashanti	Pippiso	-	15

Note: Bridges with * are newly requested.

Table 1-2 REQUESTED EQUIPMENT LIST

Original Request		Revised Request	
	(Number)		(Number)
Dump truck (4 cu.m)	2	Wheel cranes	2
Cargo trucks (5t)	4	Cargo trucks (8t)	4
Pick-ups (4x4)	12	Pick-ups (4x4)	6
Cross country vehicles	4	Cross country vehicles	2
		Semi-trailers with tractor	1
		Erection tools	2 sets

1.3 Projects of Other Donors

Projects which are related to maintenance, rehabilitation, or improvement of feeder roads, and which are assisted by international organizations or donor countries and are being implemented, are shown in Table 1-3.

Table 1-3 PROJECTS OF OTHER DONORS (Feeder Road Related only)

Project	Outline of Project	Project Area	Duration	Project Cost (Million Cedis)	Donor
Development and Maintenance of Cocoa Roads (Part of Cocoa Rehabilitation Program)	- Development and maintenance of approx.5,000 km of cacao carrying roads, including reshaping, regraveling, improvement,construction of bridges	Western, Brong-Ahafo, Ashanti, Eastern, Central, Volta Regions	1987-96	60,592	IDA ADF
National Feeder Roads Rehabilitation and Maintenance Phase 1	- Rehabilitation of 2,500 km - Regraveling of 2,850 km - Construction of 5,000 culverts - Spot improvement of 720 km - Maintenance & workshop tools - Institutional support	Nationwide	1990-96	87,358	IDA USAID DANIDA OPEC
Northern Region Pilot Infrastructure Project (Part of Transport Rehabilitation Project II)	- Construction of 150 km of low cost roads to provide access to about 50 communities in the Northern Region	Northern Region	1990-96	2,517	IDA
Ghanaian German Co-operation Program for Rural Action (Part of Northern Region Rural Integrated Programe)	- Rehabilitation of 70 km of feeder roads	Northern Region	1994	357	GTZ
Installation of 25 No. Bailey Bridges (Part of Cocoa Rehabilitation Program)	- Construction of 25 Bailey bridges (590 m)	Western, Ashanti Regions	1993-95	2,210	ODA

CHAPTER 2

OUTLINE OF THE PROJECT

CHAPTER 2

OUTLINE OF THE PROJECT

2.1 Objectives of the Project

Along feeder roads, streams without bridges cut roads and weak timber bridges limit and obstruct heavy vehicles from transporting agricultural products to markets. Such a poor state of feeder roads poses a serious constraint in farm production, marketing, mobility, exports, and activities vital for economic recovery and growth.

To improve feeder roads, the Government of Ghana through the DFR is implementing a series of feeder road maintenance and rehabilitation projects. To provide bridging over small streams, concrete culverts are constructed under the projects. To construct relatively long span bridges which are difficult to construct with local materials, the Government of Ghana has requested that the Government of Japan assist in the procurement of prefabricated steel bridge materials.

This project is for construction of bridges along feeder roads using prefabricated steel bridge materials which will be procured by Japan's grant aid. A set of equipment necessary for construction of the project bridges will also be procured by Japan's grant aid.

As a result of the basic design study, 21 bridges among the requested bridges were selected as the subject of the project. The project sites are located in the Volta, Central, Western, Ashanti, and Brong-Ahafo regions.

The responsible implementing organization is the DFR. Design and supervision of fabrication and procurement will be undertaken by a Japanese consultant firm. Design of substructures of the bridges will be undertaken by a Ghanaian consultant, and construction of substructures and installation of the prefabricated steel bridges will be undertaken by Ghanaian constructors under the responsibility of the DFR..

This project aims to provide efficient transportation facilities by constructing steel bridges and replacing weak timber bridges with steel bridges where agricultural and social development is hindered due to difficulties of transportation.

2.2 Study and Examination of the Request

2.2.1 Project Site Survey

A project site survey was conducted to collect data for examination of the appropriateness of the project and for basic planning of the bridges. The items surveyed were as follows:

- Bridge location (address, road name, river name, distance)
- Present bridge condition (bridge type, length, conditions)
- Road condition (road class, width, surface type, condition, traffic volume ADT)
- River condition (depth & width of LWL & HWL, velocity)
- Affected area condition (land use, major products, population)
- Other site conditions (soil type, topography)
- Site photos
- Site sketches and river cross sections

In the project site survey, the data of traffic volume, HWL and population were obtained by a hearing survey of the DFR engineers and the local residents. The river cross sections were surveyed by using measuring tapes and survey poles.

Based on the surveyed data, the basic planning of the project bridges was conducted and the plans were developed on the site sketches and river cross sections.

The above data was compiled in a separate volume of the report. The major items of the site condition data are shown in Appendix 5.

2.2.2 Additional Bridges for the Study

In conducting the project site survey, it was found that some of the request bridges have no access road or no existing road beyond the sites. As a result, 14 new bridges were proposed to be added to the subject bridges of the study to replace the 7 bridges canceled from the request. Finally the site survey was carried out on 35 bridge sites including the additionally requested bridges. The canceled bridge list and their reasons are shown in Table 2-1. The additionally requested bridge list is shown in Table 2-2.

Table 2-1 CANCELED BRIDGE LIST

Br.No.	Br. Name	Region	Road Name	Reason for Cancellation
1-1	Kolo	Volta	Blemeazado-Agortoe	No road beyond
1-4	Anor	"	Gakasita-Bomingo	Ditto
2-3	Birim	"	Akwatia-Kusi	No access road
5-1	Afram	Ashanti	Kwamepong-Nkwanta-Dukusen	Ditto
5-2	Ben	"	Kwamepong-Nkwanta-Dukusen	Ditto
5-3	Disri	"	Mpasaaso-Sreso	Bridge already installed
5-7	Anum	"	Woraso-Abotanso	No access road

Table 2-2 ADDITIONALLY REQUESTED BRIDGE LIST

Br. No.	Br. Name	Region	Road Name	River Name
2-4	Emou	Eastern	Osenase-Apinamang	Emou
3-5	Fum	Central	Akonfudi-Asibirim	Fum
4-8	Peburu	Western	Bopa-Fordjourkrom	Peburu
4-9	Samere	"	Pensanum-Amuni	Samere
4-10	Botente	"	Pensanum-Amuni	Botente
4-11	Nwhine	"	Asaasetre-Banso-Kwesikrom	Nwhine
4-12	Draw	"	Asaasefre-Banso-Kewsikrom	Draw
4-13	Djaba	"	Abudrim Jn.-Adubrim	Djaba
4-14	Ayawora	"	Adubrim Jn.-Adubrim	Ayawora
5-8	Anunuso	Ashanti	Effiduase-Nkwankwanua-Juansa	Anunu
5-9	Tanodumase	"	Bibiana-Asiberem	Tano
5-10	Anuru	"	Kwakuwama-Nobekan	Anuru
6-5	Aboabo	Brong-Ahafo	Sienchem-Goaso	Aboabo
6-6	Fawohoyeden	"	Fawohoyeden-Ayomso	Fawohoyeden

2.2.3 Examination of the Requested Bridges

(1) Examination of the Bridge Type

For the following reasons, prefabricated steel bridge is appropriate bridge type for the project:

- Traffic volume of most feeder roads are small, so single lane light bridge is suitable.
- Long span (more than 15m) concrete bridges are not easy to construct at remote areas.
- Prefabricated steel bridge can be constructed easily without special equipment and technology.

- Prefabricated steel bridges are commonly constructed along feeder roads and secondary highways in Ghana.

(2) Examination of the Feasibility of the Project

The project bridges are planned to be constructed by the DFR contracting local constructors and utilizing prefabricated steel bridge materials to be procured by Japan's grant aid. It is considered that the DFR can cope with the construction of the project bridges base on the following reasons:

- The DFR has experiences of Bailey bridge construction which is similar to this project.
- The DFR is technically supported by the bridge specialists of the GHA in designing and construction supervision of bridges.
- The DFR have sufficient staff, budget and capability to operate and manage the project.
- The bridges selected for the project are easy to be constructed by local constructors.

The requested bridges were examined their appropriateness for the project in terms of necessity, socioeconomic effects and construction ease and other factors, and appropriate ones were selected.

The bridges which were excluded from the project because prefabricated steel bridges are not applicable to them or because substructures by local constructors is difficult although their construction necessity is high and the socioeconomic effects are very large are recommended to be constructed under another grant aid in the form of "facilities construction".

(3) Examination of the Requested Bridges

To examine the appropriateness of the request bridges for the project, the following evaluation criteria were established:

Appropriateness evaluation criteria

Bridges which fulfill the following 3 conditions were judged as appropriate for the project:

(a) Necessity of bridge construction is high (for bridges which fulfill any of the following conditions):
   - Dilapidated or damaged bridge which is dangerous for traffic.
   - Timber bridge which limits traffic.
   - Stream without bridge which requires crossing by ferryboat or ford.

(b) Socioeconomic effects of bridge construction is large (for bridges which fulfill any of the following conditions):
- Present population within the affected area is more than 10,000.
- Present pedestrian traffic volume is more than 500 per day.
- Present vehicle traffic volume is more than 50 per day.
- Present ferryboat passenger traffic volume is more than 200 per day.

(c) Bridge can be constructed without problem (for bridges which fulfill the following conditions):
- Site is applicable to prefabricated steel bridge. The criteria of application of prefabricated steel bridges are described below.
- Access road to site is good or easily reparable for transporting the bridge materials.
- Technically substructures are easy to be designed and constructed by the Ghanaian side.

Criteria of application of prefabricated steel bridges
- The stream is small enough that about 25 m long span bridge can be adopted, since the prefabricated steel bridges to be procured under the project are around 25 m at the longest.
- Traffic volume is small enough that one lane bridge can be adopted since the prefabricated steel bridges to be procured under the project are one lane. Feeder roads which are projected to become components of the highway network should have 2-lane bridges.

The result of the examination of the appropriateness of the request bridges for this project is shown in Table 2-3. The details of the examination are shown in Appendix 6.

The bridges evaluated as appropriate for the project were proposed for the subject of the project. The project bridge list is shown in Table 2-4.

Among the bridges evaluated as inappropriate for this project, bridges having a high necessity and large socioeconomic effects and needed to be constructed by the Japan side since the prefabricated steel bridges are inapplicable or since design and construction of the bridges are difficult for the Ghanaian side are proposed as a candidate of another Japan's grant aid program in the form of "facilities construction". The candidate bridges for the facilities construction project are shown in Table 2-5.

Other bridges evaluated as inappropriate for this project are shown in Table 2-6.

Table 2-3 RESULT OF EXAMINATION OF APPROPRIATENESS OF REQUESTED BRIDGES

(Total)

Study bridges	Requested bridges		28
	Cancelled bridges		7
	Additionally requested bridges		14
	Total		35
Result of examination of appropriateness for this project	Appropriate bridges (Subject of this project)		21
	Inappropriate bridges	Candidate of facilities construction project	9
		Other inappropriate bridges	5

Table 2-4 BRIDGES FOR THE PROJECT

No.	Br. No.	Br. Name	Region	Road Name	River Name
1	1-3	Nyivu	Volta	Adidome-Juapong	Nyivu
2	3-1	Kakum	Central	Nyameadon-Asomdwee	Kakum
3	3-3	Ochi	"	Akrofuom-Nsuakyir	Ochi
4	4-1	Hwini	Western	Shama Jn.-Mampong-Adansi	Hwini
5	4-2	Pru	"	Agyeman Camp-Kramokrom	Pru
6	4-3	Susan	"	Adonikrom-Jn.-Adonikrom	Susan
7	4-4	Adoni	"	Adonikrom-Jn.-Adonikrom	Adoni
8	4-5	Bura	"	Wasa-Akropong-Anyinabrim	Bura
9	4-6	Yurunsu	"	Wasa-Akropong-Anyinabrim	Yurunsu
10	4-8	Peburu	"	Bopa-Fordjourkrom	Peburu
11	4-9	Samere	"	Pensanum-Amuni	Samere
12	4-10	Botente	"	Pensanum-Amuni	Botente
13	4-13	Djaba	"	Adubrim Jn. -Adubrim	Djaba
14	4-14	Ayawora	"	Adubrim Jn. -Adubrim	Ayawora
15	5-4	Ofin	Ashanti	Agona-Afamanaso	Ofin
16	5-6	Owabi	"	Hiawu-Besease-Ntensere	Owabi
17	5-8	Anunuso	"	Effiduase-Nkwankwanua-Juansa	Anunu
18	5-10	Anuru	"	Kwakuwama-Nobekan	Anuru
19	6-1	Tano	Brong-Ahafo	Chiraa-Asuokwa	Tano
20	6-2	Subin	"	Wenchi-Ofuman	Subin
21	6-5	Aboabo	"	Sienchem-Goaso	Aboabo

Table 2-5 CANDIDATE BRIDGES FOR FACILITIES CONSTRUCTION PROJECT

No.	Br.No.	Br. Name	Region	Road Name	River Name	Remarks
1	2-2	Ayensu	Eastern	Takorase-Krudua	Ayensu	A 30 m long span bridge is required.
2	2-4	Emou	Eastern	Osenaso-Apina-mang	Emou	Two-lane bridge is required since it is a secondary road (No. 163).
3	3-5	Fum	Central	Akonfudi-Asi-birim	Fun	A 40 m long span bridge is required.
4	4-7	Sayere	Western	Nkatieso-Agye-mandiem-Abuom	Sayere	Two-lane bridge is required since it is a secondary road (No .8).
5	4-11	Nwhine	Western	Asaasetre-Banso-Kwesikrom	Nwhine	Special equipment and technique are required for sub-structure con-struction.
6	4-12	Draw	Western	Asaasefre-Banso-Kwesikrom	Draw	A 40 m long span bridge is required.
7	5-9	Tanodu-mase	Ashanti	Bibiana-Asiberem	Tano	Two-lane bridge is required since it is a secondary road (No. 62)
8	6-3	Johol	Brong-Ahafo	Banda-Kankan	Johol	Two-lane bridge is required since it is a secondary road (No. 82).
9	6-6	Fa-wohoye-den	Brong-Ahafo	Fawohoyeden-Ayomso	Fawohoye-den	Two-lane bridge is required since it is a secondary road (No. 452).

Table 2-6 OTHER BRIDGES INAPPROPRIATE FOR THIS PROJECT

No.	Br.No.	Br. Name	Region	Road Name	River Name	Remarks
1	1-2	Aklakpa	Volta	Adidome-Juapong	Aklakpa	No road within about 3 km of site.
2	2-2	Pra	Eastern	Etwerso Jn. - Etwereso Pawudu	Pra	No road within about 300 m of site.
3	3-2	Ayensu II	Central	Winneba-Ojobi	Ayensu	Damaged existing RC bridge (backfill of abutment is eroded) is reparable.
4	3-4	Amutu	Central	Ekon Jn.-Ekon	Amutu	Riverbed is passable except during flooding. The necessity of a bridge is uncertain since superstructure construction has long been suspended after completion of sub-structures.
5	5-5	Anum	Ashanti	Praso-Lonongo	Anum	RC bridge to be constructed locally is recommended since it is a 15 m long bridge.

2.2.4 Examination of the Requested Equipment

The use of the requested equipment is for hauling prefabricated steel bridge materials from storage to the construction sites and for transporting the DFR staffs to supervise the construction and maintenance of the project bridges. All of the prefabricated steel bridge materials which are to be procured by Japan's grant aid will be stored in the DFR storage area of the Cocoa Board's storage yard near Tema Seaport. Depending on the progress of the bridge construction, the prefabricated steel bridge materials will be hauled from storage to the sites for handover to constructors who undertake construction of the bridges.

In the implementation of the project, the list of works to be directly undertaken by the DFR and the list of equipment necessary to execute these works are shown in Table 2-7. The requested equipment is also listed in the table according to use. Among the necessary equipment for the works, equipment owned by the DFR and presently available for this project are graders and water tank trucks. The present functioning status of DFR-owned equipment is as shown in Appendix 6.

Table 2-7 EXAMINATION OF REQUESTED EQUIPMENT

Work undertaken by DFR	Required equipment	Requested equipment
1. Hauling materials		
- Hauling		
Large materials (trusses, slabs)	Cargo trucks (large)	Cargo trucks (8t, 4 units)
Small materials (bolts, gussets)	Cargo trucks (medium)	Cargo trucks (4t, 4 units)
- Loading & unloading	Wheel cranes	Wheel cranes (2 units.)
- Supervision of hauling works	Wagons (4x4)	Cross country vehicles (4x4, 2 units.)
- Maintenance of access roads	Graders	None (available from DFR)
	Water tank trucks	None (available from DFR)
2. Supervision of construction & maintenance of bridges	Pick-ups	Pick-ups (6 units)
3. Erection of bridges	Erection tools	Erection tools (2 sets)

As shown in the table, all of the requested equipment is necessary to implement this project. However, the specifications and quantities of the equipment were reviewed, and the most appropriate ones are proposed for this project in Chapter 4.

The components of the erection tools are proposed based on the erection planning in Chapter 3. In this study, the erection tools are proposed to be procured with the prefabricated steel bridge materials and are not included in the equipment.

2.3 Project Description

2.3.1 Execution Agency Implementation Organization

(1) Execution Agency

The road system in Ghana is comprised of 14,430 km of primary/secondary road, 1,700 km of urban arterial roads, and 21,000 km of feeder roads.

The Ministry of Roads and Highways (MRH) is the responsible ministry for construction and maintenance of the roads. MRH is comprised of 3 agencies:

i) The Ghana Highway Authority (GHA): responsible for maintenance and construction of primary and secondary roads.

ii) The Department of Feeder Roads (DFR): responsible for maintenance and construction of feeder roads.

iii) The Department of Urban Roads (DUR): responsible for maintenance and construction of urban roads.

The DFR is the execution agency of this project. The DFR has established in 1981. Prior to the establishment of the DFR, feeder roads were the responsibility of the GHA and other agencies. The DFR has its headquarters in Accra, with 10 regional offices to cover the country-wide feeder road network. It has a total of 798 employees, of which 36 are graduate civil engineers. The DFR carries out all rehabilitation and periodic maintenance and a portion of the routine maintenance works by contract. Its force account operations are limited to road surface routine and recurrent maintenance and emergency repair operations. The organization chart of the DFR and its regional offices are shown in Figures 2-1 and 2-2.

The budget of the DFR for the last 3 years is shown in Table 2-8. The cost for this project to be shouldered by the Government of Ghana will be allocated from the Development Project Budget. The budget for this project is secured as shown in Appendix 9.

The list of equipment owned by the DFR and their present functioning status are showing in Appendix 6.

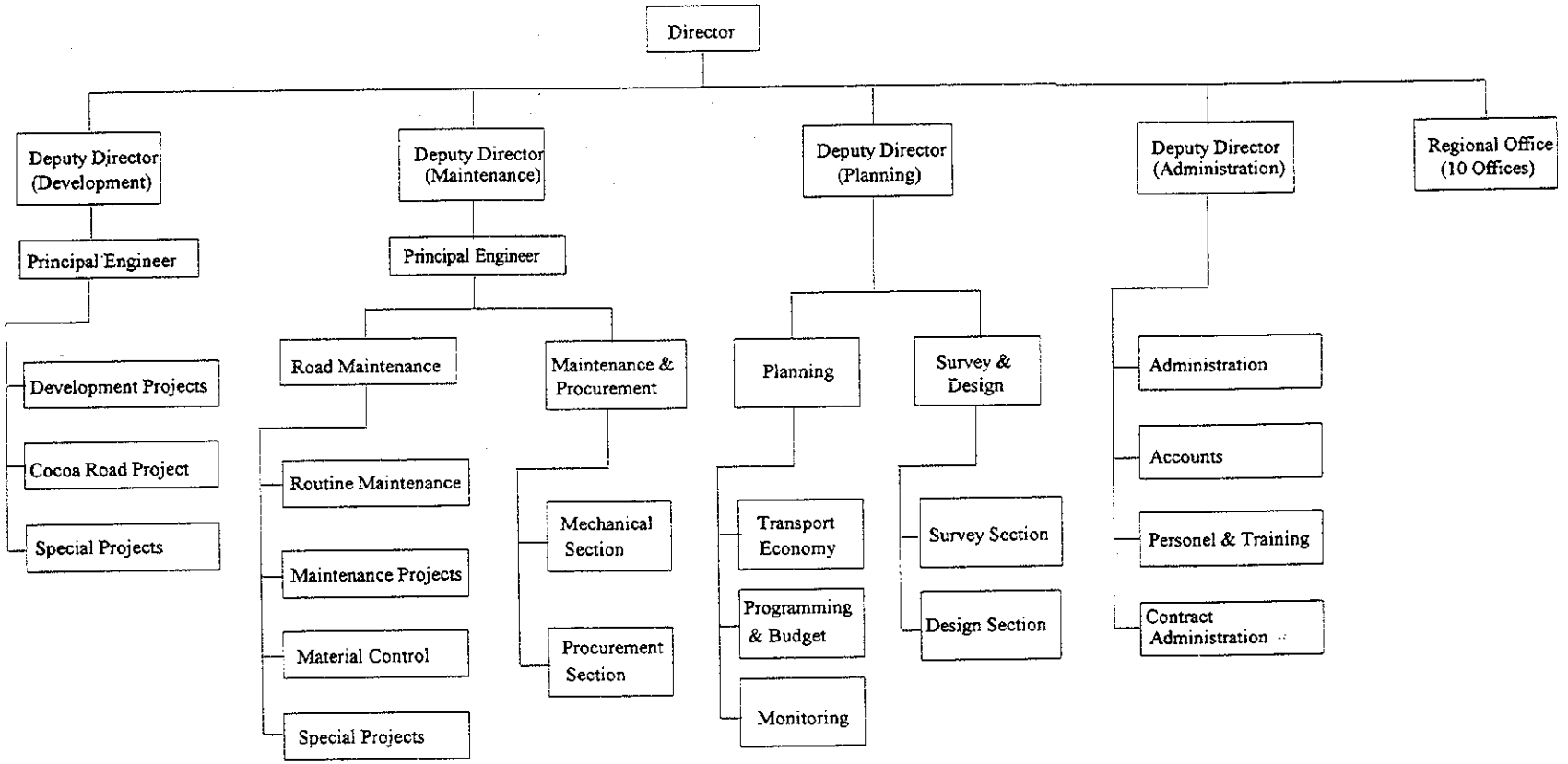


Figure 2-1 ORGANIZATION OF DFR

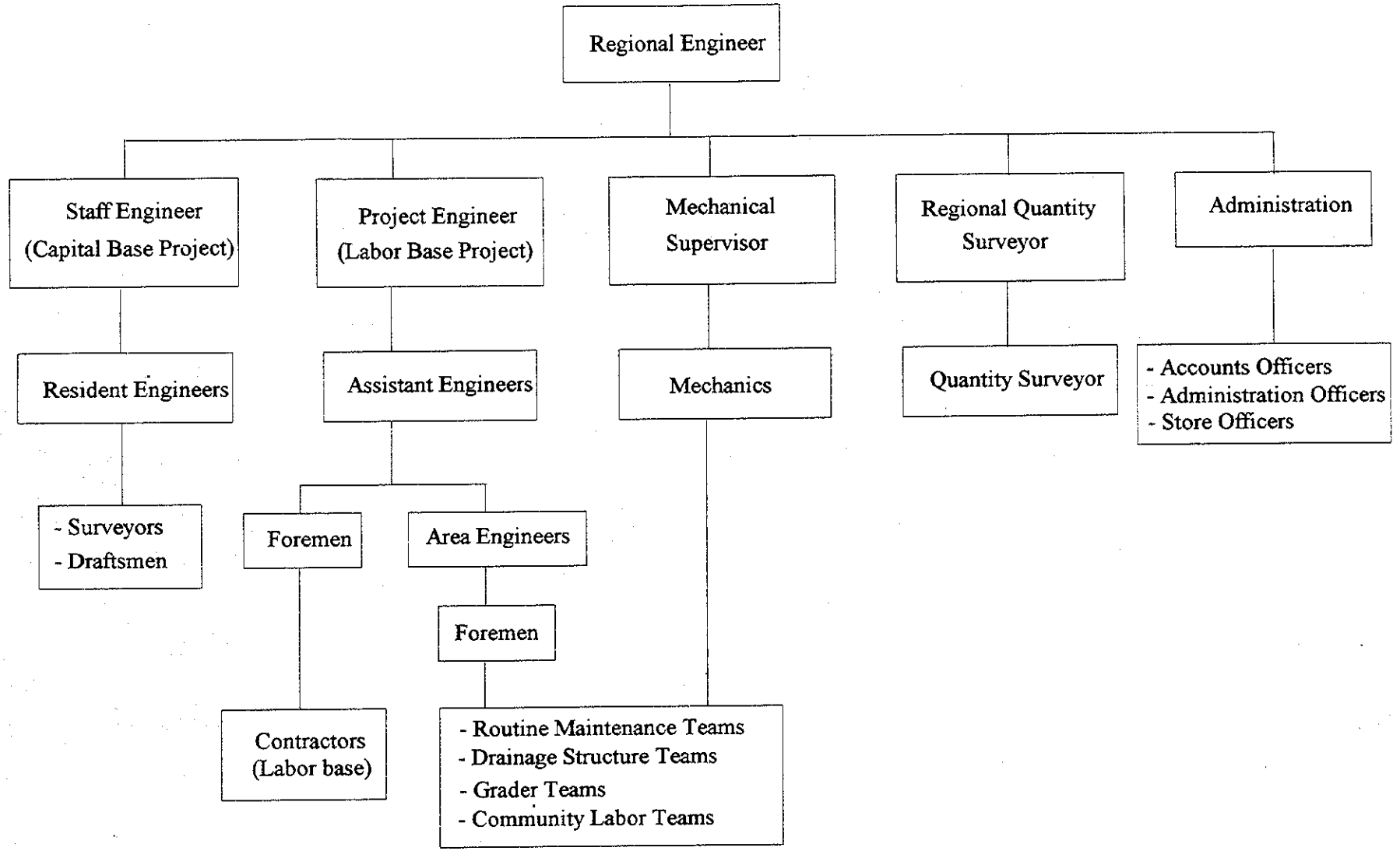


Figure 2-2 ORGANIZATION OF REGIONAL OFFICE

Table 2-8 DFR BUDGET FOR LAST 3 YEARS

Unit: Million Cedis

	1991	1992	1993	1994
Development Projects	14,500	11,700	6,440	12,810
Periodic Maintenance	5,600	1,300	5,410	4,600
Routine Maintenance	860	440	490	1,970
Administration	850	880	890	900
Total	21,810	14,320	13,230	20,280

Source: DFR

(2) Implementation Organization of the Project

The prefabricated steel bridge materials and equipment necessary for construction of the bridges will be procured and delivered to the DFR storage yard near Tema Seaport by Japan's grant aid. The design and procurement supervision of the materials and equipment will be undertaken by a Japanese consultant firm based on a contract with the DFR.

The design and construction of substructures, approach roads, bridge revetments, and erection of the prefabricated steel bridges will be undertaken by the DFR. The design will be contracted by Ghanaian consultant firms and the construction of them will be contracted by Ghanaian constructors. Bridge specialists of the GHA will extend technical assistance in design and construction supervision of the project since the DFR does not have bridge specialists. The implementation organization of the project is shown in Figure 2-3.

2.3.2 Bridge and Equipment Maintenance Plan

(1) Bridge Maintenance Plan

The project bridges require yearly cleaning and inspection as routine maintenance and repair of damage when it occurs as special maintenance.

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 contractors to repair the bridges.

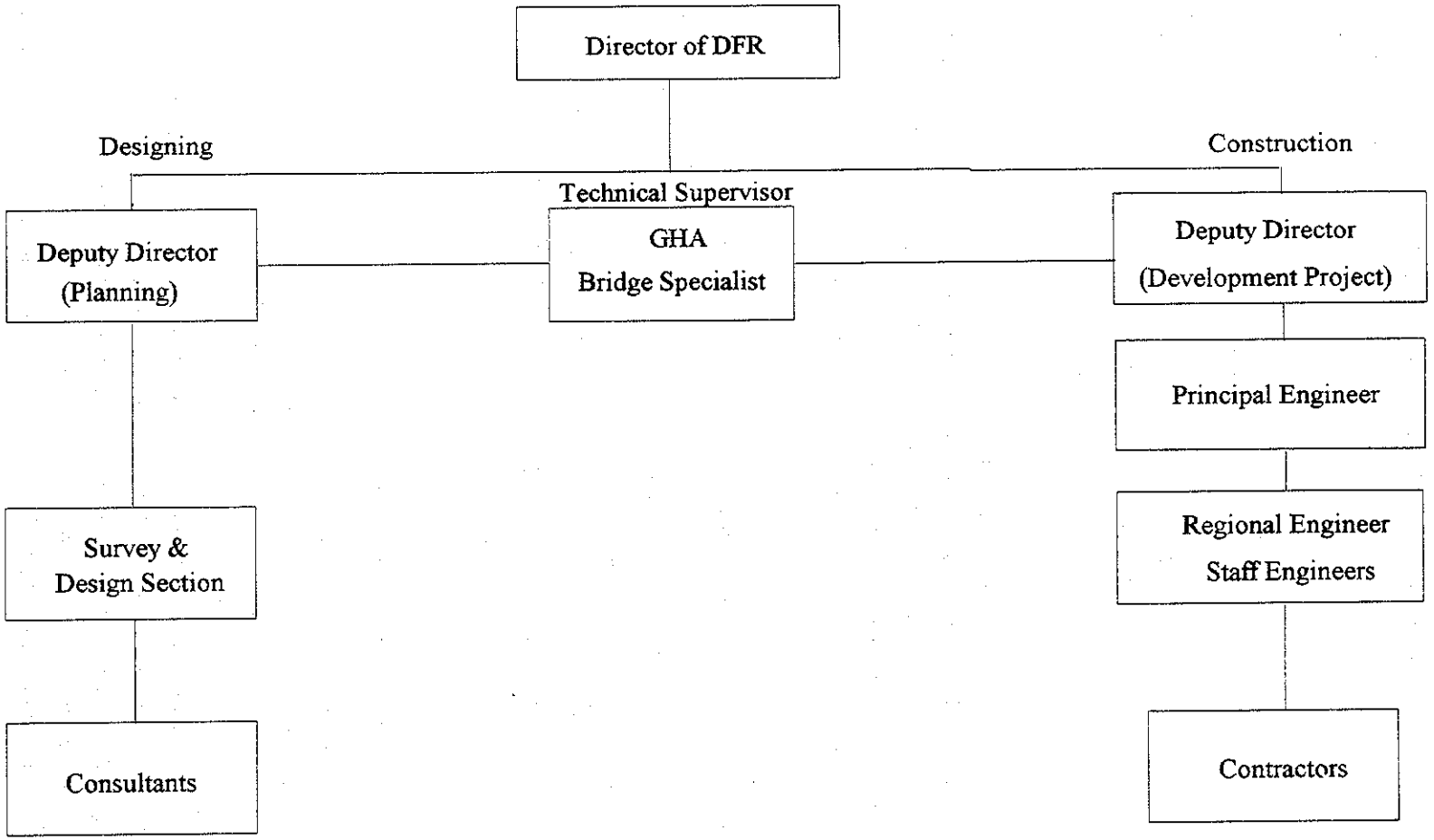


Figure 2-3 IMPLEMENTATION ORGANIZATION OF THE PROJECT

The routine maintenance activities required for the project bridges are shown in Table 2-9. Since the materials of the prefabricated steel bridges are galvanized, periodic re-paint is not required for more than 20 years in case the maintenance will be executed well. The substructures of the bridges seldom require special maintenance.

The cost for maintenance of the project bridges is estimated as 9 Million Cedis annually.

Table 2-9 ROUTINE MAINTENANCE ACTIVITIES FOR THE BRIDGES

1.	Cleaning parts of the bridges: - Drainages - Expansion Joints - Deck slabs - Pier and abutment seats
2.	Inspection items on superstructures: - Rust or deformation on truss and slab members - Functional defect of bearings
3.	Inspection items on substructures and revetments: - Scouring - Settlement - Crack

(2) Equipment Maintenance Plan

The equipment to be procured under this project will be stationed in the Okponglo Workshop of the DFR in Accra, and will be dispatched to the sites as required. After the completion of this project, the equipment will be used for other similar projects.

The DFR workshop provides periodic inspection and oil change for their equipment. The periodic inspection of the equipment is being conducted every 7,000 km run of operation. The DFR workshop does not repair equipment. For repair of the DFR-owned equipment, the DFR orders it to a private repair shop in the city.

The cost for operation and maintenance of the equipment is estimated as 157 Million Cedis annually.

CHAPTER 3

BASIC DESIGN
OF
PREFABRICATED STEEL BRIDGES

CHAPTER 3

BASIC DESIGN OF PREFABRICATED STEEL BRIDGES

3.1 Design Concepts

The design concepts for the basic design of the prefabricated steel bridges were established as follows:

(1) Basic Conditions of this Project

- Detailed design of the prefabricated steel bridges will be undertaken by a Japanese consultant firm. The prefabricated steel bridges will be fabricated in Japan or in other countries.
- Erection of the prefabricated steel bridges, and detailed design and construction of substructures and related structures will be undertaken by the DFR.
- Specifications and configurations of substructures as well as their final locations will be determined based on the result of surveys, analysis, and detailed designs to be undertaken by the DFR.
- Basic specifications and bridge lengths are proposed in this basic design study based on the site data, site sketches, and river cross sections which were obtained in the project site surveys.

(2) Concepts on Design of the Prefabricated Steel Bridges

The prefabricated steel bridges should be designed so as to:

- Reflect local conditions and traffic.
- Be durable and require minimal maintenance.
- Be easily haulable.
- Be erectable by local constructors without special equipment.
- Be economical

3.2 Examination of Design Criteria

(1) Basic Concepts

- Design criteria and specifications presently prevailing in Ghana are basically used.
- Japanese Industrial Standard (JIS) is referred to in the event some bridge components are manufactured in Japan.

- Design criteria adopted in this study are discussed and agreed between the DFR and the study team.

(2) Design Criteria of the Prefabricated Steel Bridges

The design criteria of the prefabricated steel bridges, which were established based on discussions with the DFR, including the bridge engineers of the GHA, are as follows:

(a) Design standard

British Standard 5400 is principally applied to the design.

(b) Live load

The live load applied to the bridge design is regulated by BD37/88 (of the British Department of Transport) with 30 units of HB loading.

(c) Temperature range

Effective temperature range of between +8°C and +51°C for steel bridges is specified.

(d) Wind force

The following Ghanaian practice is applied:

Table 3-1 MEAN HOURLY WIND SPEED IN GHANA (m/sec.)

Condition of Exposure	In open country	In built-up areas
Coast to 160 km inland	21	19
160 - 480 km inland	27	20
More than 480 km inland	36	24

(e) Earthquake force

The following lateral earthquake force is adopted:

Earthquake coefficient: C = 0.08 (for lateral loading)

(f) Freeboard

A minimum value of 1.0 m is secured above HWL.

3.3 Basic Design of Prefabricated Steel Bridges

(1) Determination of Bridge Length

The bridge lengths (equal to span lengths since all proposed bridges are single span bridges) are proposed based on bridge planning utilizing the river cross sections, site sketches, and river flooding data, and referring to the bridge lengths proposed by the DFR in the request and by site surveys of the study team.

Major items to be considered in the determination of the bridge lengths are as follows:

- River widths under the bridges are wide enough to discharge floods.
- Floods flow smoothly and do not endanger abutments and approach embankments by scouring.
- Countermeasures can be taken against changes in river alignment.
- Bridge lengths are short enough to be economical.
- Bridges can be connected to existing roads with smooth alignments.

The proposed bridge lengths of the project bridges are shown in Table 3-2. As shown in the table, the project bridges are comprized of 2 types of bridges, 20 m and 25 m span bridges.

(2) Structure of the Prefabricated Steel Bridges

(a) Structure type

The structure of the prefabricated bridges was examined to find the most appropriate structure against the conditions of construction and their required performance. The criteria for selection of the structure type of the prefabricated steel bridges are as follows:

- Economical.
- Able to be erected without special equipment.
- Easy to assemble and erect.
- Durable and requiring minimal maintenance.

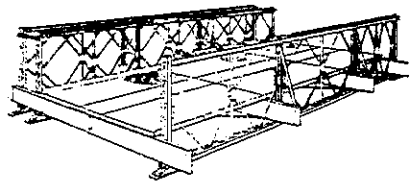
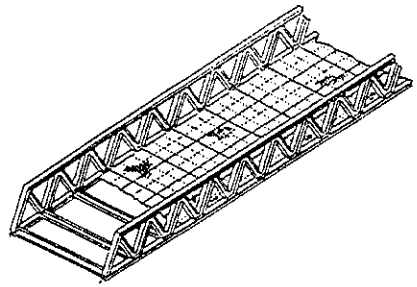
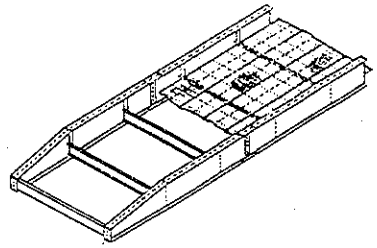
As shown in Table 3-3, the following 3 structure types were compared. It was concluded that the pony truss type is the most appropriate structure for the prefabricated steel bridges for this project.

- Bailey type
- Pony truss type
- Through girder type

Table 3-2 LENGTH OF THE PROJECT BRIDGES

No.	Br. No.	Br. Name	Region	Bridge Length (m)
1	1-3	Nyivu	Volta	25m
2	3-1	Kakum	Central	20m
3	3-3	Ochi	"	25m
4	4-1	Hwini	Western	25m
5	4-2	Pru	"	25m
6	4-3	Susan	"	20m
7	4-4	Adoni	"	25m
8	4-5	Bura	"	25m
9	4-6	Yurunsu	"	20m
10	4-8	Peburu	"	25m
11	4-9	Samere	"	20m
12	4-10	Botente	"	20m
13	4-13	Djaba	"	20m
14	4-14	Ayawora	"	25m
15	5-4	Ofin	Ashanti	20m
16	5-6	Owabi	"	25m
17	5-8	Anunuso	"	25m
18	5-10	Anuru	"	20m
19	6-1	Tano	Brong-Ahafo	25m
20	6-2	Subin	"	20m
21	6-5	Aboabo	"	20m

Table 3-3 COMPARISON OF STRUCTURE TYPES FOR THE PREFABRICATED STEEL BRIDGES

Structure Type	Scheme				
	Main Girder	Material	Pre-fabricated panel (rolled channel)	Rolled H-beam (150x150mm - 250x250mm)	Rolled I-beam
		Maximum length	3.05m	3.5m	5.0m
		Maximum weight	300kg	300kg	900kg
		Field connection	Pin and bolt	HTB	HTB
		Painting	Galvanize	Galvanize	Painting
Features	Design load		As per specification	As per specification	As per specification
	Carriageway width		10' 7" (3.23m) - 23'9" (7.24m)	3.2m - 7.5m	Approx. 3.5m
	Maximum span		80 feet (24.38m)	25m	20m
	Performance for traffic		Vibration occurs	Smooth	Smooth
	Durability		Less durable	Durable	Durable
	Maintenance		Deck panels need frequent repair	Less maintenance	Less maintenance
	Hauling		Easy	Easy	Heavy
	Erection equipment		Small tools	Small tools	Crane & tools
	Erection ease		Light, easy	Light, easy	Heavy
	Erection period		20 days	40 days	15 days
	Weight of max. piece		1.1 t/m	1.1 t/m	1.3 t/m
	Cost		Least cost	Medium	Most cost
Evaluation			Economical but less durable.	Most appropriate since it is durable and easy to construct.	Uneconomical and difficult to construct.

(b) Bridge width

Single lane is proposed for all of the project bridges since the present average daily traffic of the sites is 50 to 200 vehicles per day, and single lane bridges are deemed to be able to carry the traffic in the future.

A 3.2 m wide carriageway, which is the standard of Bailey bridges, is proposed for the bridges. As well, a 0.5 m wide sidewalk is proposed to be provided on the bridges, at the request of the DFR.

Sidewalk structures are compared as shown in Table 3-4. As a result, the installation of curb pieces on the deck slabs to separate the sidewalks from the carriageways is proposed where traffic is large. While sidewalks non-separated from the carriageways are proposed where traffic is small.

(c) Deck slab structure

Steel deck and RC deck slab structures are compared in Table 3-5. As a result, the steel deck slab structure is proposed.

(d) Painting

Galvanizing of all the steel materials is proposed to minimize required maintenance of the bridges.

(e) Field tightening

High tension bolts are proposed for connecting truss members on site. HTB (F8T) M22 is common, and the tightening quality is easy to control.

(f) Materials

Rolled steel SS400 (the JIS designation is 245 N/sq.mm or more yield strength and 400 to 510 N/sq.mm ultimate strength) or equivalent materials are proposed to be used for all of the prefabricated steel bridge materials since it is the most commonly available and is used in similar structures.

(3) Basic Design of the Prefabricated Steel Bridges

Based on the design criteria and structures proposed above, 20 m and 25 m span prefabricated steel bridges are designed and proposed for this project. The plans of the bridges are shown in Figure 3-1.

As a summary of the design calculation, the design forces of the major members of the bridges against their design strength are shown in Table 3-6.

The quantities of the prefabricated steel bridge materials are calculated based on the plans. A summary of the quantities is shown in Table 3-7.

Table 3-4 COMPARISON OF SIDEWALK STRUCTURES

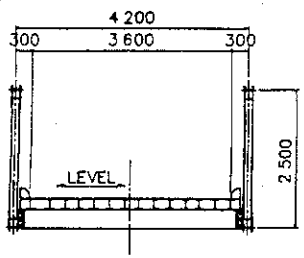
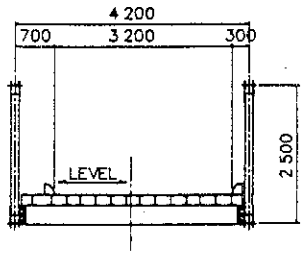
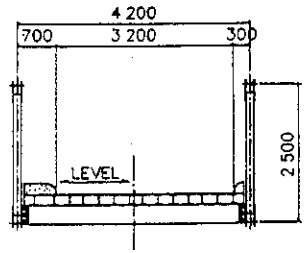
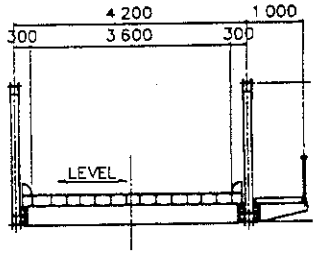
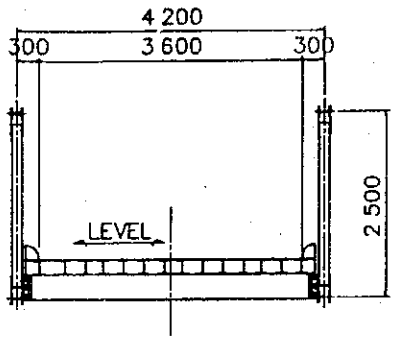
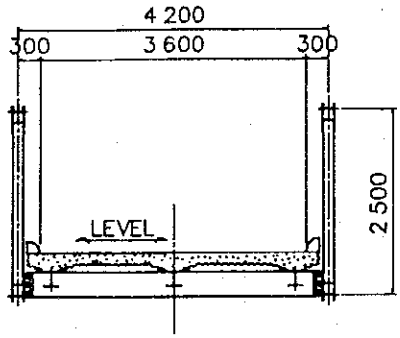
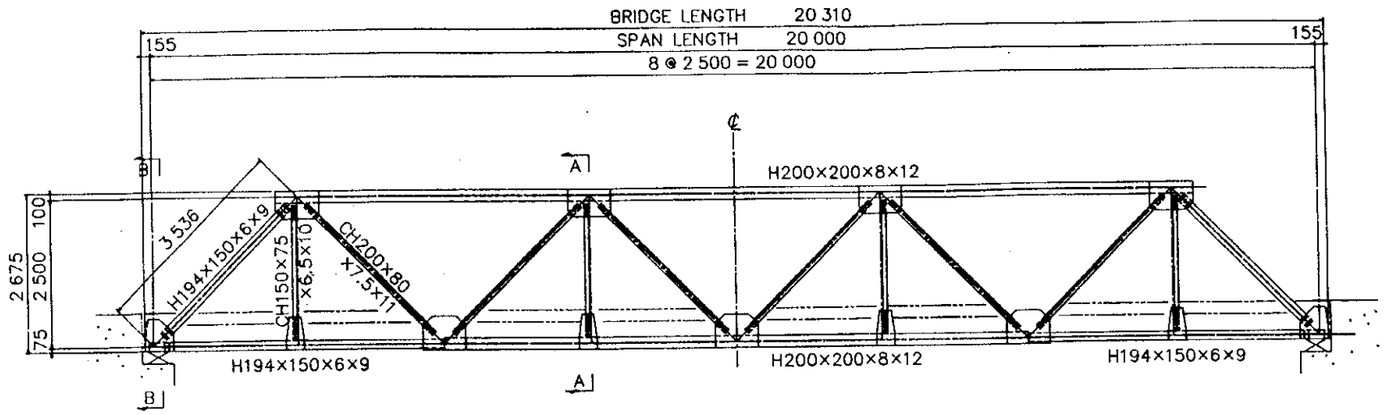
	A. Non-separated	B. Separated	C. Elevated	D. Cantilevered
Types Schemes				
Structure	Sidewalk is not separated from carriageway.	Sidewalk is separated from carriageway by installing curb.	Sidewalk is elevated to separate from carriageway.	Cantilever sidewalk is installed on outside of bridge.
Construction Method	No work	Curb pieces are installed on deck slab with bolts.	Concrete is after curb pieces are installed.	Sidewalk is installed after truss is erected.
Material (whole materials per linear m of bridge)	Steel 1.10 ton/m	Steel 1.10 ton/m	Steel 1.10 ton/m Concrete 0.15 m^3/m	Steel 1.35 ton/m
Cost	Least cost	Least cost	5% more than "B"	15% more than "B"
Pedestrian Safety	Pedestrians are not protected.	Pedestrians are protected by curb.	Pedestrians are protected by curb.	Pedestrians are completely separated from vehicles.
Evaluation	Appropriate for bridges having small traffic since economical and comfortable for pedestrians and vehicles.	Appropriate for bridges having large traffic since economical and safe.	Less economical	Less economical

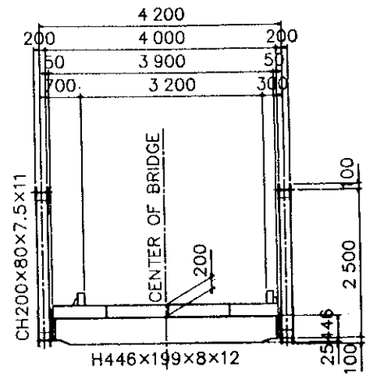
Table 3-5 COMPARISON OF DECK SLAB STRUCTURES

	Steel Deck Slab	RC Deck Slab
Scheme		
Structure	Deck slab panel made of checkered steel plates and H-beams is bolted on cross beams.	Cast-in-place RC slab is constructed with corrugated plate forms.
Construction Method	Prefabricated deck slab panels are bolted on cross beams after trusses are erected.	Concrete is cast after forms and bars are arranged on erected trusses.
Materials (whole materials per linear m of bridge)	Steel (Deck slab): 0.50t/m Steel (Truss) : 0.60t/m Total : 1.10t/m	Steel (Deck slab): 0.15t/m Steel (Truss) : 0.90t/m Steel Total : 1.05t/m Concrete : 0.95m^3/m Bars : 0.25t/m
Cost	Less than RC deck slab	More than steel deck slab since truss members are large.
Required Site Works	Deck slab panels are fabricated in factory. Panels are bolted on cross beams on site.	Arranging forms and bars and concreting on site are required.
Evaluation	Economical and easy to construct.	Uneconomical and requiring many site works.

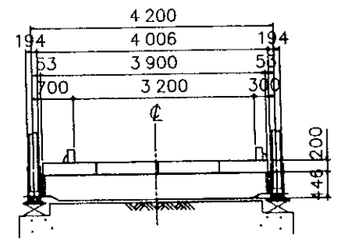
SIDE VIEW



CROSS SECTION
A--A



B--B



PLAN

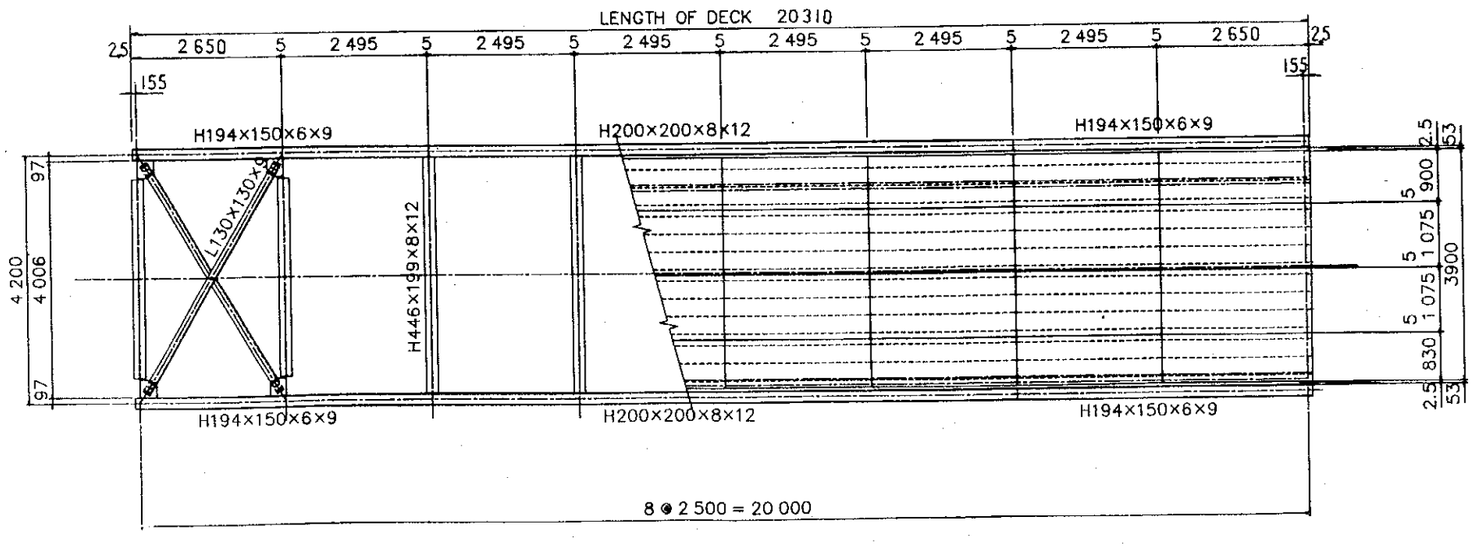
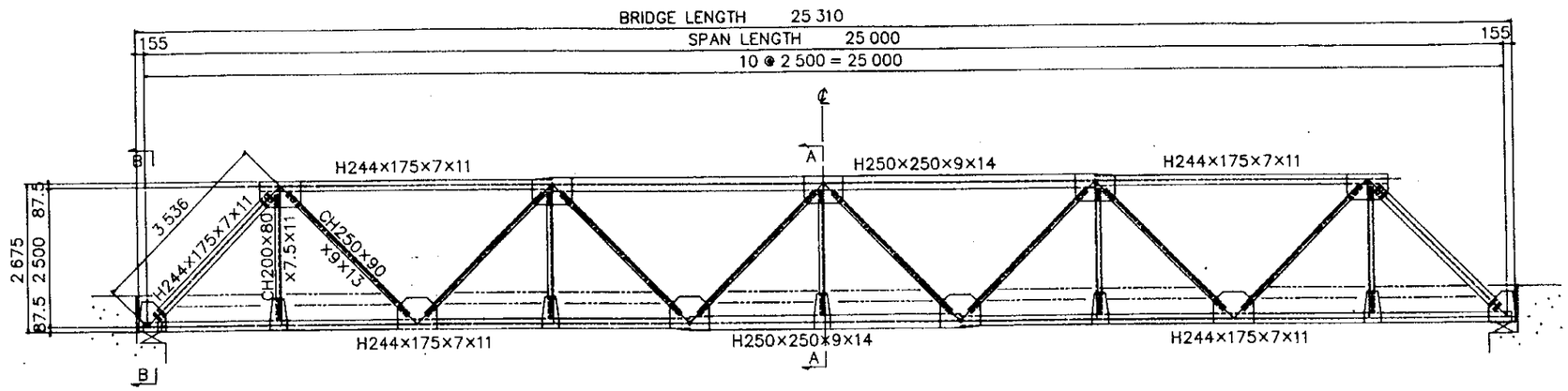


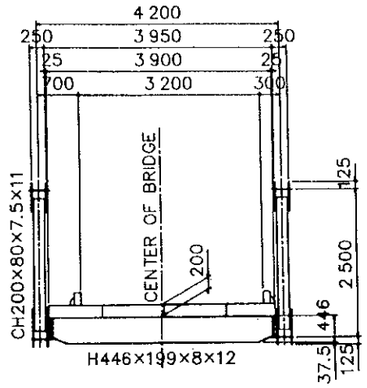
Figure 3-1 PREFABRICATED STEEL BRIDGE (1/3)
(20 M SPAN)

SIDE VIEW

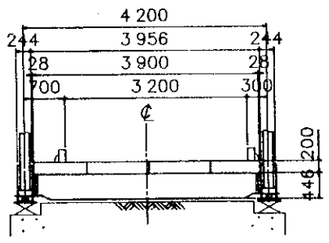


CROSS SECTION

A–A



B–B



PLAN

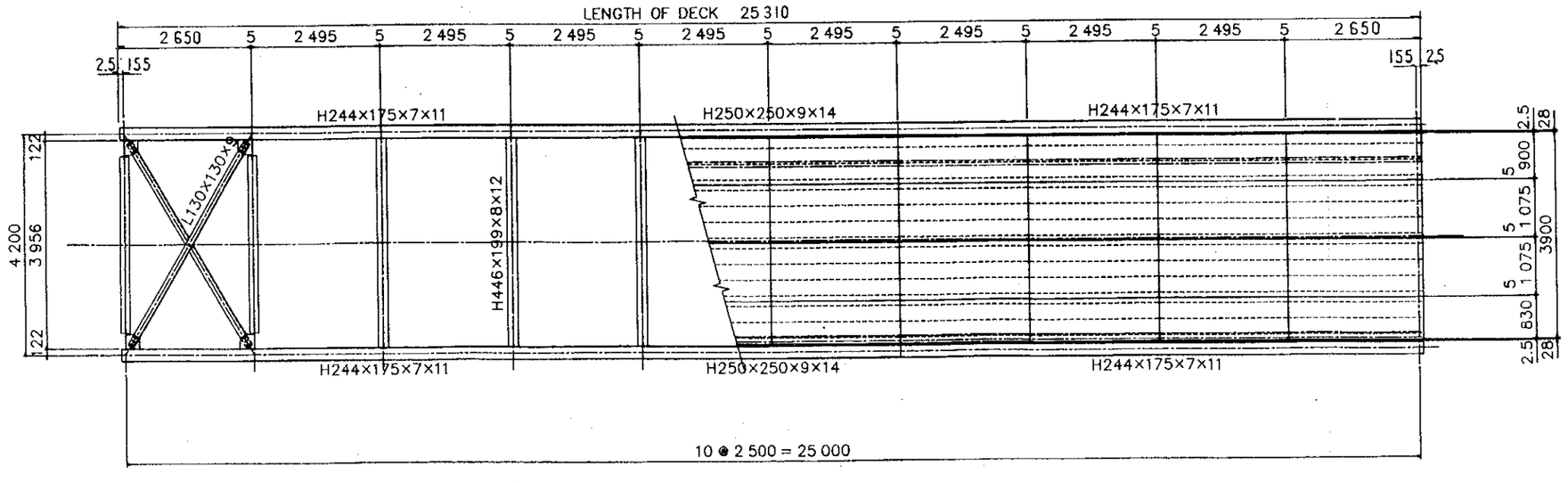
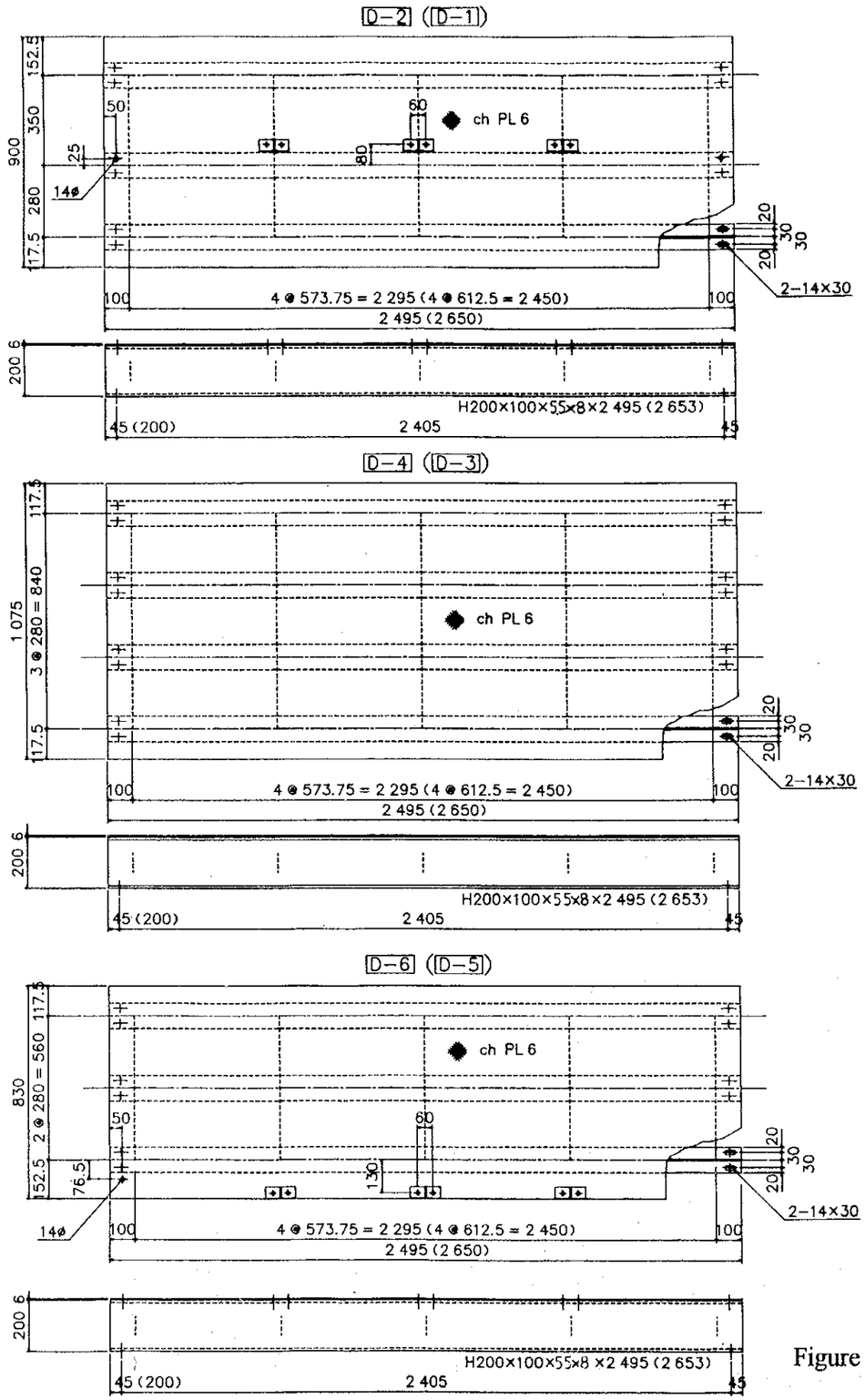
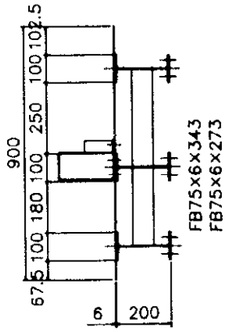
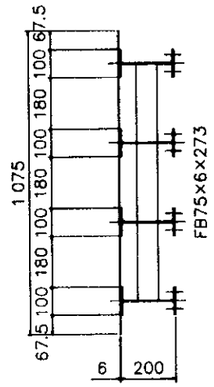
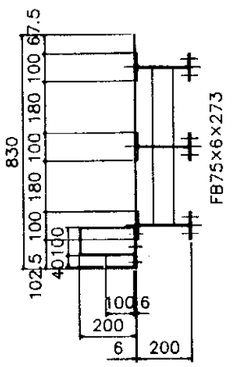


Figure 3-1 PREFABRICATED STEEL BRIDGE (2/3)
(25 M SPAN)







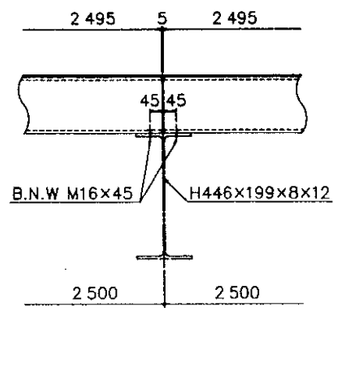


DECK PLATE
SCALE 1:10

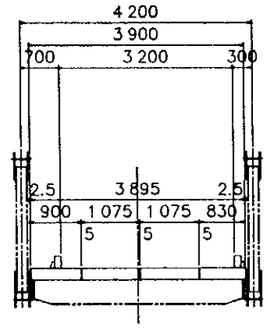
MARKING DIAGRAM

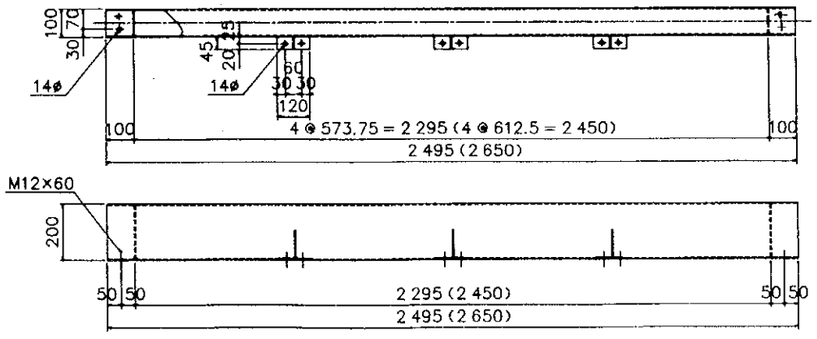
2 650	2 495	2 495	2 495	2 495	2 495	2 495	2 495	2 495	2 650
D-1	D-2	D-2		D-2	D-2	D-2	D-2	D-2	D-1
D-3	D-4	D-4		D-4	D-4	D-4	D-4	D-4	D-3
D-3	D-4	D-4		D-4	D-4	D-4	D-4	D-4	D-3
D-5	D-6	D-6		D-6	D-6	D-6	D-6	D-6	D-5

155 @ 2 500 155
SPAN LENGTH = L



CROSS SECTION





1-□200×100×4.5×2 495 (2 650)
2-R 191×6× 91
3-R 45×6×120
3-R 40×6×100
8-B.N. M12×60

Figure 3-1 PREFABRICATED STEEL BRIDGE (3/3)
(DECK SLAB PANELS)

Table 3-6 SUMMARY OF DESIGN CALCULATION

Member		Material Size	Design Force	Design Strength
20 m Span Bridge	Upper chord	H 200 x 200C x 8/12	Axial force : -100.1 ton	- 104.0 ton
	Lower chord	H 200 x 200C x 8/12	Axial force : 90.4 ton	132.0 ton
		H 194 x 150C x 6/9	Axial force : 40.3 ton	79.3 ton
	Cross beam	H 446 x 190C x 8/12	Bending moment : 19.8 ton'm	23.5 ton'm
	Deck slab	2H 200 x 100C x 5.5/8	Bending moment : 6.0 ton'm	8.7 ton'm
25 m Span Bridge	Upper chord	H 250 x 250C x 9/14	Axial force : -126.5 ton	- 132.6 ton
	Lower chord	H 250 x 250C x 9/14	Axial force : 135.7 ton	191.5 ton
		H 244 x 175C x 7/11	Axial force : 45.2 ton	116.9 ton
	Cross beam	H 446 x 199C x 8/12	Bending moment : 19.8 ton'm	23.5 ton'm
	Deck slab	2H 200 x 100C x 5.5/8	Bending moment : 6.0 ton'm	8.7 ton'm

Table 3-7 SUMMARY OF QUANTITIES OF PREFABRICATED STEEL BRIDGE MATERIALS

(Unit: ton)

Member	Material Designation	Material Shape	Material Size	Quantity per bridge		Grand Total
				20m Span Bridge	25m Span Bridge	
Trusses and Cross Beams	SS400	H-beam	250 x 250 x 9 x 24		2,172	23,892
			244 x 175 x 7 x 11		3,266	35,926
			200 x 200 x 8 x 12	2,586		25,860
			194 x 150 x 6 x 9	1,004		10,040
			446 x 199 x 8 x 12	2,322	2,838	54,438
		C-beam	250 x 90 x 9 x 13		1,702	18,722
			200 x 80 x 7.5 x 11	928	474	14,494
			150 x 75 x 6.5 x 10	338		3,380
		L-beam	130 x 130 x 9	284	284	5,964
			90 x 90 x 10	91	103	2,043
		Plate	t = 25	58	194	2,714
			22	126	126	2,646
			12	10	10	210
			10		1,916	21,075
			9	1,430		14,300
			6	288	352	6,752
	F10T (High tension bolt)	HTB	M22 x 90	60	132	2,052
			M22 x 70	670	724	14,664
			M22 x 65	65	65	1,365
	Sub-total			10,260	14,358	260,538
Deck Slabs	SS400	Checkered PL.	t = 6		4,780	90,940
		H-beam	200 x 100 x 5.5 x 8	6,032	7,516	142,996
		Flat bar	75 x 6	128	160	3,040
		Pipe	200 x 100 x 4.5	812	1,012	19,252
		Plate	t = 6	80	100	1,900
		Bolt	M12 x 50	48	60	1,140
		Bolt	M12 x 45	16	20	380
	Sub-total			10,952	13,648	259,648
Total				21,212	28,006	520,186
Bearings	SC450 (Cast iron)	LB-40 MOV			124	1,364
		LB-40 FIX			123	1,353
		LB-30 MOV		106		1,060
		LB-40 FIX		105		1,050
	Total			211	247	4,827

Note: "Grand total" shows the total quantities of ten 20m span bridges and eleven 25m span bridges.

3.4 Basic Design of Erection Tools

The specifications and quantities of the erection tools are examined and proposed based on the bridge structure, erection method, and erection implementation schedule.

Erection of the prefabricated steel bridges will be executed by local constructors under the direction of the DFR. The erection method and tools necessary are planned as follows:

(1) Erection Method

Comparative schemes of erection methods and evaluations are shown in Table 3-8. As a result, the launching on staging method is proposed. The features of this method are as follows:

- Bridges can be assembled on approach roads, so assembly will be efficient and accurate.
- No special equipment or skilled techniques are required, so the erection cost is low.
- No extension girders, which are costly, are required.
- Embanking of assembly areas is minimal since bridges can be launched little by little as they are partially assembled.
- For erection of prefabricated steel bridges, extension girders are commonly used in Ghana. This method was introduced to improve the cost and to reduce the erection difficulty of the extension girder launching method.

Conceptual figures of the launching on staging method are presented in Appendix 7.

(2) Erection Tools

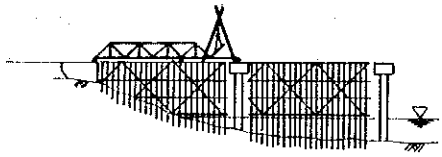
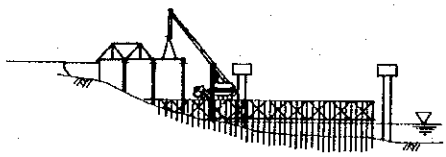
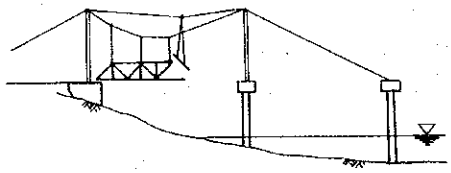
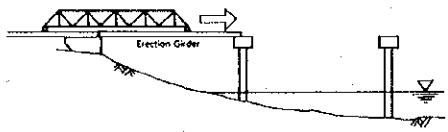
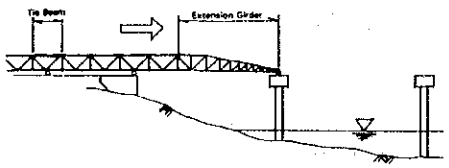
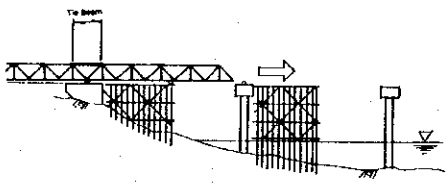
The items and quantities of assembly and launching tools necessary for the launching on staging method were studied.

The proposed items and quantities per set of assembly tools and launching tools are presented in Tables 3-9 and 3-10, respectively.

According to the implementation schedule of this project, erection of 9 bridges is proposed to be executed in the first year and the remaining 12 bridges are to be erected in the second year. The required period for erection of one bridge is estimated at around 40 days, and the workable period for erection is around 6 months a year when no flooding is expected. As a result of the following calculation, 3 sets each of assembly tools and launching tools are proposed to be procured for this project.

12 bridges x 1.3 months ÷ 6 months = 2.6 sets (3 sets required)

Table 3-8 COMPARISON OF ERECTION METHODS

Comparative Erection Schemes		Evaluation	Ease	Cost	Speed	Conclu-sion
Assembly on staging		•impossible during flood season •difficult where river is deep •needed small tools only •no skill needed	B	A	C	B
Truck crane & bent		•impossible during flood season •access road for truck crane needed •no skill needed •fast execution	C	B	A	C
Cable suspension		•no large machines needed •skill needed	C	A	B	C
Erection girder		•erection girder is large •no skill needed •fast, easy, and accurate assembly	A	C	A	B
Extension girder		•extension girder is large •no skill needed •fast, easy and accurate assembly	A	C	A	B
Launching on staging		•impossible in flood season •tools are small •no skill needed •fast, easy, and accurate assembly	B	A	A	A

Note: A: good
B: fair
C: poor

Table 3-9 ASSEMBLY TOOL LIST

Tool	Designation	Quantity
[Survey Tools]		
- Level Gauge	ST900	1 pcs.
- Steel Measuring Tape	50m	1 pcs.
[Assembly Tools]		
- Torque Wrench	7000QLE	4 pcs.
- Socket	36mm	6 pcs.
- 60°C Single Offset wrench	60° X 22mm	10 pcs.
- Sledge hammer, Double Face	#8 (3.5kg)	2 pcs.
- Hand Hammer, Double Face	#3 (1.3kg)	10 pcs.
- Lever Block	1 ton	2 pcs.
- Bolt Clipper	KKW-2	1 pce.
- Wire Clip	10 dia.	20 pcs.
- Crow Bar	L = 1.0m	1 pce.
- Crow Bar	L = 1.5m	1 pce.
- Election Bolt	M22 x 50	300 pcs.
- Drift Pin	24.5 dia.	150 pcs.
[Lifting Equipment]		
- Three Pronged Lift	2 ton	2 pcs.
- Pulley Block	IS-Hooktype	4 pcs.
- Shackle	5/8	4 pcs.
- Pipe	60.5 x 7m	6 pcs.
- Nylon Sling	1.5ton x 3m	8 pcs.
- Portable Winch	NPW2000	2 units
- Steel Wire Rope	12 dia. x 45m	2 rolls
- Stay Wire Rope	12 dia. x 3m	2 pcs.
- Base Beam	H1-150 x 1.5m	2 pcs.
[Scaffolding]		
- Scaffolding	KA3055A	4 set
- Stage Plank	HPS5183	2 pcs.
- Jack Base	KA752	1 pce.
- Ladder	KA3055S	8 pcs.
- Brace	KA14	4 pcs.

Note: The quantites are per one set.

Table 3-10 LAUNCHING TOOL LIST

Tool	Designaiton	Quantity
[Launching Rail]		
- Launching Rail	73.8 kg/m	39 m
- Base Plate	t = 25mm	0.50 ton
[Launching Equipment]		
- Roller	TIL-TANK25	4 pcs.
- Screw Clamp	T-10	16 pcs
- Portable Winch	NPW2000	2 uni
- Pully Block	2S-Hook	2 pcs.
- Pulley Block	1S-Hook	2 pcs.
- Stay Wire Rope	12 dia. x 2m	6 pcs.
- Steel Wire Rope	12 dia.	150m x 2 rolls.
- Roller Staging Beam	H150 x 4m	4 pcs.
- Filler Plate	200 x 6 x 200	16 pcs.
- Filler Plate	200 x 25 x 200	8 pcs.
- Filler Plate	200 x 10 x 200	8 pcs.
- Winch Staging Beam	H150 x 1.5m	6 pcs.
[Jack Up/Down Equipment]		
- Mechanical Jack	25t slide	4 pcs.
- Mechanical Jack	50t slide	2 pcs.
- Saddle	H150 x 0.5mR	32 pcs.

Note: The quantities are per one set.

3.5 Substructures, Approach Roads, and Revetments

Design and construction of substructures, approach roads, and revetments of the project bridges will be undertaken by the DFR. The detailed design of these structures will be carried out based on data of topographic surveys, geological surveys, and hydrological studies.

Therefore, standard structures for this project are introduced in this study for reference for the detailed design and for a rough estimate of construction works and their costs.

(1) Substructures

Abutments are the only substructures since all of the project bridges are single span. The standard abutment proposed for the project is shown in Figure 3-2.

In designing abutments, footings should be embedded into the ground deeply enough to secure their stability against scouring and river erosion in the future. Widths of footings should be determined by stability examinations under loading combinations. Foundation structures should be planned based on the results of geological surveys.

(2) Approach Roads

The approach roads of the bridges should be designed so as to be economical and safe for traffic. The geometric standard for the approach roads is proposed in Table 3-11.

Table 3-11 GEOMETRIC STANDARD OF APPROACH ROADS

Design speed	30 km/hr
Carriageway width	3.6 m
Shoulder width	1.2 m
Minimum radius of curve	30 m
Maximum gradient	8 %
Sight distance	30 m

(3) Revetments

To protect abutments from future scouring, revetments should be plalnned. A standard revetment structure proposed for the project is shown in Figure 3-3.

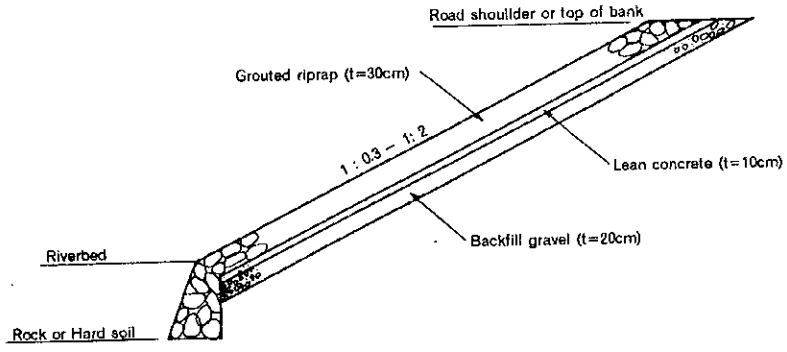
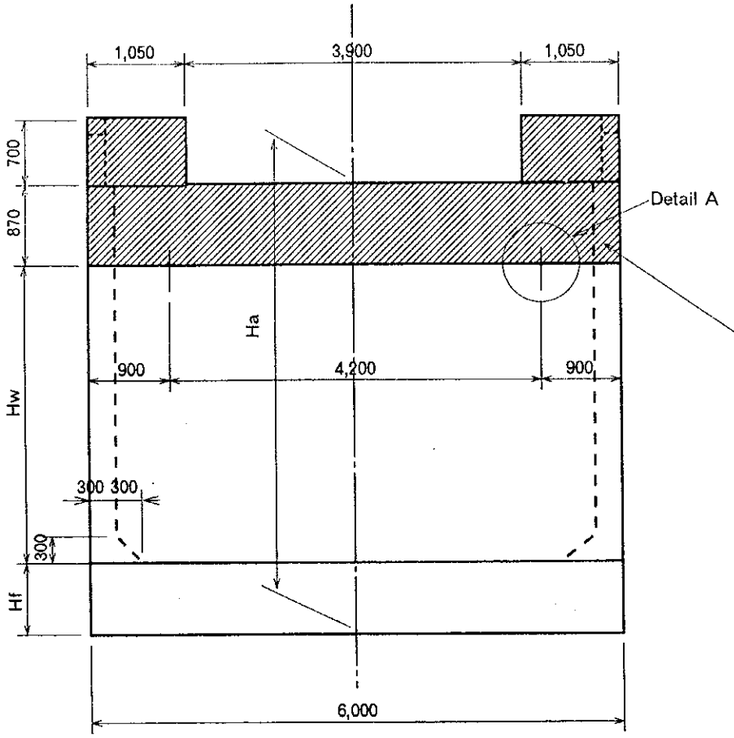


Figure 3-3 STANDARD REVETMENT

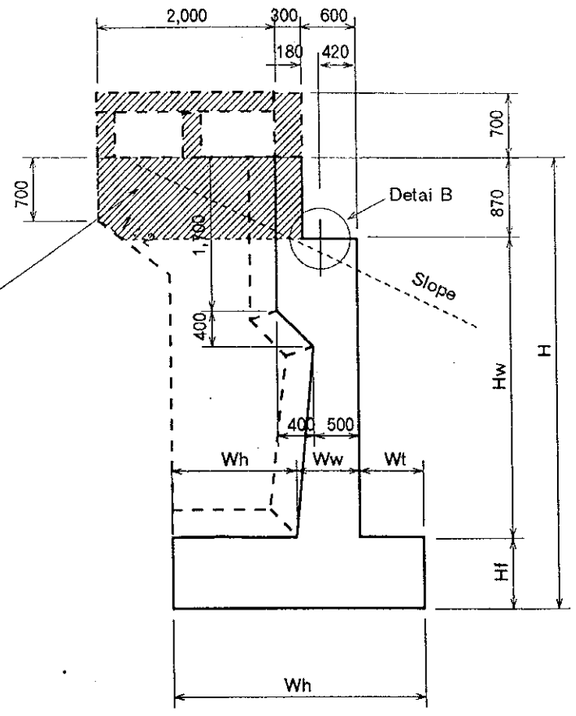
(4) Quantities of Works

A summary of the quantities of substructures, approach roads, and revetments is roughly estimated in Table 3-12.



ELEVATION

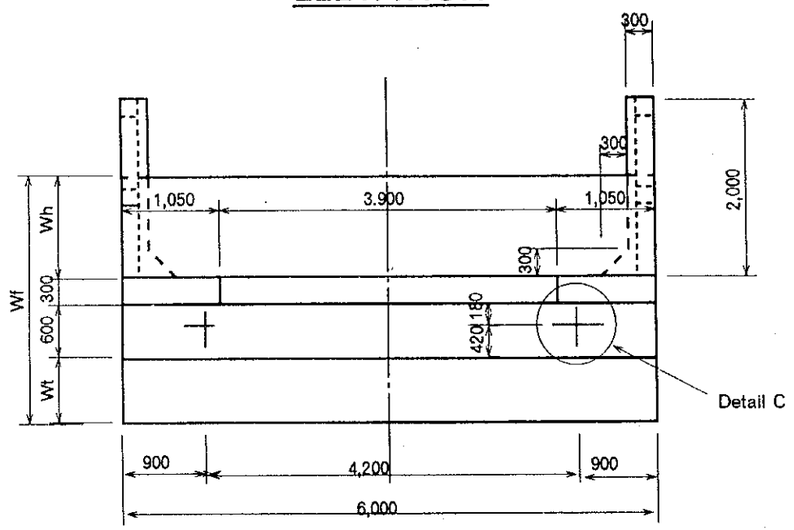
The hatched portions shall be constructed after erection of superstructures.



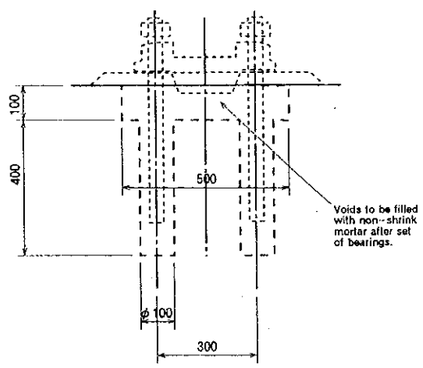
SECTION

DIMENSIONS OF ABUTMENTS (in meter)

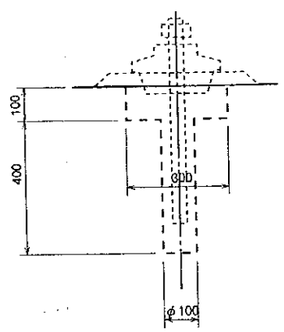
Ha	Hf	Hw	Wf	Wh	Ww	Wt
3.50	0.70	1.93	2.00	1.00	0.50	0.50
4.00	0.70	2.43	2.20	1.10	0.50	0.60
4.50	0.70	2.93	2.50	1.30	0.50	0.70
5.00	0.80	3.33	2.80	1.40	0.60	0.80
5.50	0.80	3.83	3.00	1.60	0.60	0.80
6.00	0.90	4.23	3.30	1.70	0.70	0.90
6.50	0.90	4.73	3.50	1.80	0.70	1.00
7.00	1.00	5.13	4.00	2.10	0.80	1.10
7.50	1.00	5.63	4.20	2.20	0.90	1.10



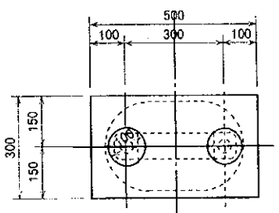
PLAN



Detail A



Detail B



Detail C

DETAILS OF BEARING SEATS

Figure 3-2 STANDARD ABUTMENT

Table 3-12 SUMMARY OF QUANTITIES OF SUBSTRUCTURES, APPROACH ROADS, & REVETMENTS

No.	Bridge No.	Bridge Name	Region	Span (m)	Left Side			Right Side		
					Abut Height (m)	Approach Road (m)	Revetment (m)	Abut Height (m)	Approach Road (m)	Revetment (m)
1	1-3	Nyivu	Volta	25.0	6.0	30.0	10.0 x 20.0	6.0	30.0	10.5 x 20.0
2	3-1	Kakum	Central	20.0	7.0	30.0	7.0 x 20.0	7.0	30.0	7.0 x 20.0
3	3-3	Ochi	"	25.0	7.0	30.0	7.5 x 20.0	6.5	30.0	9.0 x 20.0
4	4-1	Hiwini	Western	25.0	7.5	30.0	10.5 x 20.0	7.5	30.0	11.0 x 20.0
5	4-2	Pru	"	25.0	6.0	30.0	9.0 x 20.0	6.0	30.0	8.5 x 20.0
6	4-3	Susan	"	20.0	7.0	30.0	8.0 x 20.0	7.0	30.0	7.0 x 20.0
7	4-4	Adoni	"	25.0	6.0	30.0	9.0 x 20.0	6.0	30.0	7.0 x 20.0
8	4-5	Bura	"	25.0	6.0	30.0	12.0 x 20.0	6.0	30.0	11.0 x 20.0
9	4-6	Yurunsu	"	20.0	7.0	30.0	10.0 x 20.0	7.0	30.0	9.5 x 20.0
10	4-8	Peburu	"	25.0	6.0	30.0	8.0 x 20.0	6.0	30.0	8.5 x 20.0
11	4-9	Samere	"	20.0	6.0	30.0	8.0 x 20.0	6.0	30.0	8.0 x 20.0
12	4-10	Botente	"	20.0	6.0	30.0	7.5 x 20.0	6.0	30.0	7.5 x 20.0
13	4-13	Djaba	"	20.0	6.0	30.0	9.0 x 20.0	6.0	30.0	9.5 x 20.0
14	4-14	Auawora	"	25.0	7.0	30.0	11.0 x 20.0	7.0	30.0	9.5 x 20.0
15	5-4	Ofin	Ashanti	20.0	6.0	30.0	2.0 x 20.0	-	30.0	-
16	5-6	Owabi	"	25.0	6.0	30.0	5.5 x 20.0	6.0	30.0	5.5 x 20.0
17	5-8	Anunu	"	25.0	7.0	30.0	2.5 x 20.0	7.0	30.0	8.5 x 20.0
18	5-10	Anuru	"	20.0	6.0	30.0	10.0 x 20.0	6.0	30.0	10.5 x 20.0
19	6-1	Tano	Brong-Ahafo	25.0	7.0	30.0	6.5 x 20.0	7.0	30.0	6.5 x 20.0
20	6-2	Subin	"	20.0	5.5	30.0	4.5 x 20.0	5.5	30.0	8.0 x 20.0
21	6-3	Tano	"	20.0	6.0	30.0	8.5 x 20.0	6.0	30.0	7.0 x 20.0

CHAPTER 4

BASIC DESIGN OF EQUIPMENT

CHAPTER 4

BASIC DESIGN OF EQUIPMENT

4.1 Design Concept

The concepts for designing the equipment for the project are as follows:

- The necessity of each item of the equipment requested by the Government of Ghana is discussed in Section 2.2.4, and was judged as appropriate for procurement under this project. However, specifications and quantities are discussed and the most appropriate ones are proposed in this chapter. The items of equipment and their uses are shown in Table 4-1.

- In planning the equipment fleet, specifications and quantities will be examined as to efficient performance, low cost, and sufficient capacity against given work conditions. The combination of equipment in the fleet should be so arranged that trouble with one piece of equipment does not delay the progress of the project as a whole.

- The equipment, which is to be partnered with DFR-owned equipment already in use, should be designed to be compatible with DFR equipment.

- The specifications of the equipment should reflect the local climate and site conditions.

- The model of the equipment should be easily operable by local operators.

Table 4-1 EQUIPMENT ITEMS AND USES

Equipment Item	Equipment Use
Cargo trucks (large)	Hauling large materials
Cargo trucks (medium)	Hauling small materials
Wheel cranes	Loading & unloading materials
Wagons (4x4)	Supervision of hauling materials
Semi-trailer (with tractor)	Hauling graders
Pick-ups	Const. & maintenance supervision

4.2 Examination of Design Conditions

For the design of the equipment fleet, the following work conditions are proposed based on the project implementation schedule.

Bridge construction conditions

– No. of bridges to be constructed	:	21 bridges
– Period of construction	:	2 years (after delivery of bridge materials)
– Period available for construction	:	6 months of dry season (rainy seasons are March to June and September to October)
– Period of substructure construction:		2.4 months per bridge (9 bridges will be constructed in the dry season of the first year and the remaining 12 bridges in the second year)
– Period of erection	:	1.25 month per one bridge (9 bridges will be erected in the dry season of the first year and the remaining 12 bridges will be erected in the second year)

Prefabricated steel bridge materials hauling condition

– Origin	:	Storage of the Cocoa Board near Tema Seaport
– Destination	:	Handover to constructors at the sites
– Packing	:	Bundle or wooden cases
– Weight	:	The freight weight, which includes the net weight of the materials and the weight of the packing, is approximately 50 tons per bridge.

Functional status of DFR owned equipment

The functional status of DFR-owned equipment is shown in Appendix 6. According to Appendix 6, the DFR does not have available any equipment which is necessary for this project. Therefore, all of the equipment necessary for this project is required to be newly procured.

4.3 Basic Design of Equipment

The basic design of equipment is proposed based on the design concepts, the design conditions, and the following prefabricated steel bridge materials hauling plan:

(1) Prefabricated Steel Bridge Materials Hauling Plan

– The hauling equipment will be stationed at the DFR workshop in Accra.

- The period of one hauling trip is 10 days. (A breakdown is shown in Table 4-2).
- One hauling party is proposed. This party will haul materials for one site by one trip. Under this plan, the materials can be hauled to 9 sites in the first year and to 12 sites in the second year within the 6 months of the dry seasons.

Table 4-2 PERIOD OF ONE HAULING TRIP

Activity	Required period
Workshop - Storage yard - Loading	2 days
Storage yard - Unloading site	2 days
Unloading - Handover	2 days
Unloading Site - Workshop	1 day
Inspection and maintenance	1 day
Days off	2 days

(2) Components of the Hauling Fleet

(a) Cargo trucks

A loading capacity of 8 tons is proposed for the large cargo trucks which are assigned to haul such large materials as truss and deck slab members, while a loading capacity of 4 tons is proposed for the medium cargo trucks to haul such small materials as bolts and gussets. The capacity of the cargo trucks is proposed considering road conditions and ease of operation in Ghana. An equal number of 8 ton truck and 4 ton trucks is proposed since the proportion of large to small materials is 2:1. Four each of 8 ton and 4 ton trucks are proposed to be procured based on the following calculation:

No. of trucks = Hauling volume (50 tons)/Truck capacity (8 + 4 tons) = 4 each

(b) Wheel cranes

The packed prefabricated steel bridge materials will be transported to the bridges sites to prevent loss of the materials. Wheel cranes are required to load and unload the materials packages which weigh 0.3 to 3 tons. One wheel crane is proposed for loading at the materials storage yard and another for unloading at the bridge sites.

(c) Wagons (4x4)

One wagon is required for supervising loading materials and hauling and another for managing handover of the materials to constructors at the sites.

(d) Semi-trailers (with tractor)

Grading rough sections of the roads is required to enable the cargo trucks to haul the materials to the bridge sites. A semi-trailer with tractor is required to transport graders from site to site. More than one grader owned by the DFR is available to be mobilized for this project.

(e) Pick-ups

Pick-ups to transfer the DFR staffs and testing apparatus to supervise construction and maintenance of the bridges are required. Six pick-ups are required in the case that one party supervise 2 construction sites.

(3) Specifications of the Equipment

Based on "The Equipment Specification Manual 1989", issued by Japan Mechanized Construction Association, the basic specifications of the equipment are examined and proposed as follows:

(a) Cargo trucks

Dimensions of loading space

The standard dimensions of loading space have enough capacity to haul the assigned freight. The loading space capacity and the required loading space are as follows:

The loading space capacity:

- Cargo truck (8 t) : 6.7 m (length) x 2.3 m (width)
- Cargo truck (4 t) : 5.2 m (length) x 2.0 m (width)
- The total loading space of all the cargo trucks is:
  $(6.7 \times 2.3 + 5.2 \times 2) \times 4 = 103$ sq. m

The required loading space (assuming package heights are 0.6 m):

- 50 freight-tons / 0.6 m = 83 sq. m

Height of loading space

The standard height is 0.4 m, which will prevent the 0.6 m high freight packages from falling off.

(b) Wheel cranes

- The crane performance should be more than 16t x 3.5m, since hanging a 3 ton package at 10 m is the heaviest case in the project.
- The wheel base and the turning radius should be minimal since the working sites are narrow and small. Four-wheel-steerable type is proposed.
- Four-wheel-drive type is proposed since it can move even on soft ground on site.
- The maximum travel speed should be more than 40 km/hr since the crane is required to transfer from site to site.

(c) Wagons (4x4)

- Four-wheel-drive type is required since most of the feeder roads are unpaved and muddy when it rains.
- Air conditioning should be furnished since the temperature is high and unpaved roads are dusty.
- Engine type should be diesel since this type is most common in the DFR.

(d) Semi-trailer (with tractor)

- The semi-trailer should be flat and low floor type for the convenience of loading and unloading graders.
- The loading space should be sufficient to load the graders.

(e) Pick-ups

- Double-seat-cabin type is required since the construction supervising party is composed of 3 to 5 staffs.
- Four-wheel-drive type with air conditioning is required for the same reasons as the wagons above.

(4) Summary of the Basic Design of Equipment

The basic specifications and quantities of the equipment proposed to be procured under this project are summarized in Table 4-3. The detailed specifications of the proposed equipment are shown in Table 4-4.

Table 4-3 SUMMARY OF BASIC DESIGN OF EQUIPMENT

Equipment	Basic Specification	Quantity
Cargo trucks (8 tons)	- Loading capacity 8 tons - Loading space 6.7 m x 2.3 m	4
Cargo trucks (4 tons)	- Loading capacity 4 tons - Loading space 5.2 m x 2.0 m	4
Wheel cranes	- Crane capacity 16 tons x 3.5 m - Four-wheel-drive - Four-wheel-steerable - Travel speed 40 km/hr or more - Minimum turning radius 5 m or less	2
Wagons (4x4)	- Furnished with air conditioning - Diesel Engine	2
Semi-trailer (with tractor)	- Low and flat floor	1
Pick-ups	- Double-seat-cabin - Four-wheel-drive - Furnished with air conditioning	6

CHAPTER 5

IMPLEMENTATION PLAN

Table 4-4 SPECIFICATIONS OF EQUIPMENT (1/2)

HAULING EQUIPMENT											
CARGO TRUCK (8 t)			CARGO TRUCK (4 t)			PICK-UP TRUCK			4WD WAGON		
Item	Unit	Specification	Item	Unit	Specification	Item	Unit	Specification	Item	Unit	Specification
ENGINE MAX. OUTPUT	PS	more than 200	ENGINE MAX. OUTPUT	PS	more than 170	ENGINE MAX. OUTPUT	PS	more than 85	ENGINE MAX. OUTPUT	PS	more than 90
WEIGHT			WEIGHT			WEIGHT			WEIGHT		
· Max. Loading Cap.	kg	more than 7750	· Max. Loading Cap.	kg	more than 4000	· Max. Loading Cap.	kg	more than 500	· Vehicle Weight	kg	more than 1850
· Vehicle Weight	kg	more than 5000	· Vehicle Weight	kg	more than 3100	· Vehicle Weight	kg	more than 1500	· Gross Vehicle Weight	kg	more than 2400
· Gross Vehicle Weight	kg	more than 12900	· Gross Vehicle Weight	kg	more than 7700	· Gross Vehicle Weight	kg	more than 2450			
DIMENSIONS			DIMENSIONS			DIMENSIONS			DIMENSIONS		
· Overall Length	mm	less than 11000	· Overall Length	mm	less than 8500	· Overall Length	mm	less than 4950	· Overall Length	mm	less than 5000
· Overall Width	mm	less than 2500	· Overall Width	mm	less than 2500	· Overall Width	mm	less than 1700	· Overall Width	mm	less than 1950
· Overall Height	mm	less than 3200	· Overall Height	mm	less than 2550	· Overall Height	mm	less than 1750	· Overall Height	mm	less than 1950
· Wheel Base	mm	more than 4500	· Wheel Base	mm	more than 4100	· Wheel Base	mm	more than 2950	· Wheel Base	mm	more than 2700
· Body			· Body			· Body					
Length	mm	more than 6700	Length	mm	more than 5200	Length	mm	more than 1350	SEATING CAP.	person	more than 6
Width	mm	more than 2300	Width	mm	more than 2000	Width	mm	more than 1450			
Height	mm	more than 450	Height	mm	more than 390	Height	mm	more than 415			
ENGINE			ENGINE			CABIN TYPE		Double Cabin	ENGINE		
· Type		Water Cooled Diesel	· Type		Water Cooled Diesel				· Type		Water Cooled Diesel
· Displacement	cc	more than 6900	· Displacement	cc	more than 5700	ENGINE			· Displacement	cc	more than 2800
PERFORMANCE			PERFORMANCE			· Type		Water Cooled Diesel	FUEL TANK CAP.	lit	more than 85
· Max. Travel Speed	km/h	more than 90	· Max. Travel Speed	km/h	more than 90	· Displacement	cc	more than 2500			
· Min. Turning Radius	mm	less than 15500	· Min. Turning Radius	mm	less than 7900				PERFORMANCE		
· Gradeability	tanσ	more than 0.3	· Gradeability	tanσ	more than 0.4	PERFORMANCE			· Max. Torque	kg·m	more than 20
						· Max. Torque	kg·m	more than 15	· Min. Turning Radius	mm	less than 6700
POWER LINE			POWER LINE			· Min. Turning Radius	mm	less than 6700			
· Transmission Type		Synchromesh	· Transmission Type		Synchromesh				POWER LINE		
· No. of speeds		6 F - 1 R	· No. of Speeds		6 F - 1 R	POWER LINE			· No. of Speeds		5 F - 1 R
						· No. of Speeds		5 F - 1 R	· Drive		4WD
BRAKE			BRAKE			· Drive		4WD			
· Type		Hydraulic with Vacuum Booster	· Type		Hydraulic with Vacuum Booster				TIRE		
						TIRE			· Size		7.00-16-6PR
TIRE			TIRE			· Size		6.50-15-6PR	· No. of Tire (without spare)	piece	4
· Size			· Size			· No. of Tire (without spare)	piece	4			
· No. of Tire (without spare)	piece	10-20-14PR 6	· No. of Tire (without spare)	piece	7.50-16-14PR 6				OPTION		
						OPTION			· Air Conditioner		Equipped
						· Air Conditioner		Equipped			

Table 4-4 SPECIFICATIONS OF EQUIPMENT (2/2)

HAULING EQUIPMENT						CRANE					
TRUCK TRACTOR			SEMI-TRAILER			WHEEL CRANE					
Item	Unit	Specification	Item	Unit	Specificaiton	Item	Unit	Specificaiton	Item	Unit	Specificaiton
ENGINE MAX. OUTPUT	PS	more than 320	WEIGHT			ENGINE MAX. OUTPUT	PS	more than 155			
WEIGHT			• Max. Loading Cap.	kg	more than 32000	TRAVELING WEIGHT	kg	more than 19000			
• Max. Combination Weight	kg	more than 45000	• Vehicle Weight	kg	more than 10000						
• Vehicle Weight	kg	more than 7500	• Gross Vehicle Weight	kg	more than 43000	DIMENSIONS					
• Gross Vehicle Weight	kg	more than 16000				• Overall Length	mm	less than 11000			
			DIMENSIONS			• Overall Width	mm	less than 2500			
DIMENSIONS			• Overall Length	mm	less than 12000	• Overall Height	mm	less than 3500			
• Overall Length	mm	less than 6800	• Overall Width	mm	less than 3200	• Wheel Base	mm	more than 3000			
• Overall Width	mm	less than 2500	• Overall Height	mm	less than 1700	• Outrigger Extended	mm	more than 5000			
• Overall Height	mm	less than 3200	• Wheel Base	mm	more than 9600						
• Wheel Base	mm	more than 4300	• Body			ENGINE					
			Length	mm	more than 6500	• Type		Water Cooled Diesel			
ENGINE			Width	mm	more than 3200	• Displacement	cc	more than 6500			
• Type		Water Cooled Diesel	Height	mm	more than 700						
• Displacement	cc	more than 16000				PERFORMANCE					
			PERFORMANCE			• Max. Travel Speed	km/h	more than 40			
PERFORMANCE			• Lower Fitting Radius	mm	less than 2200	• Min. Turning Radius (4W Coordinated Steer)	mm	less than 5700			
• Max. Travel Speed	km/h	more than 90				• Gradeability	tanσ	more than 0.55			
• Front Fitting Radius	mm	less than 14000	TIRE								
• Gradeability	tanσ	more than 0.2	• Size		8.25-16-14PR	CRANE PERFORMANCE					
			• No. of Tire (without spare)	piece	16	• Max. Load	t-m	more than 16-3.5			
POWER LINE						• Max. Boom Length	m	more than 19			
• Transmission Type		Synchromesh				• Slewing Speed	rpm	more than 3			
• No. of speeds		6 F - 1 R				• Tail Radius	m	less than 3.5			
						• Line Speed	m/min	more than 85			
BRAKE						• Max. Lift with Boom	m	more than 19			
• Type		Hydraulic with Vacuum Booster									
						POWER LINE					
TIRE						• Transmission Type		Full - Automatic			
• Size						• No. of Speeds		6F-2F (H/L Change)			
• No. of Tire (without spare)	piece	10-20-14PR 10									
						BRAKE TYPE		Hydraulic with Vacuum Booster			
						TIRE					
						• Size					
						• No. of Tire (without spare)	piece	16-25-24PR 4			

CHAPTER 5

IMPLEMENTATION PLAN

5.1 Basic Conditions

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 Governments of Japan and Ghana.

- The prefabricated steel bridge materials and equipment to be procured by this project with the assistance of Japan's grant aid will be used for construction of the bridges selected in this study.

- The Department of Feeder Roads (DFR) of the Ministry of Roads & Highways is the agency responsible for implementing the project. The DFR is responsible for the detailed design and construction of substructures and related works.

- Detailed design and procurement supervision of the prefabricated steel bridge materials and equipment will be undertaken by a Japanese consultant firm contracted by the DFR. Procurement of the prefabricated steel bridge materials and equipment will be undertaken by a qualified Japanese company contracted by the DFR.

5.2 Implementation Method

(1) Marine Transportation and Turn Over

The prefabricated steel bridge materials and equipment procured under Japan's grant aid will be delivered by sea from Japan or from third countries to Tema Sea Port in Ghana. After landing and customs clearance at the port, all of the prefabricated steel bridge materials will be delivered to the DFR storage in the storage yard of the Cocoa Board near Tema and turned over to the DFR, while the equipment will be delivered to the DFR Okponglo Workshop in Accra and turned over to the DFR.

(2) Land Transportation

The DFR is responsible for the land transportation of the prefabricated steel bridge materials. The materials will be hauled from storage to the bridge sites according to the

erection schedule by cargo trucks procured under this project. Details of the hauling plan are described in Section 4.3.

(3) Erection of the Prefabricated Steel Bridges

The prefabricated steel bridges will be erected by local constructors under contracts by the DFR. The special tools necessary for erection of the bridges will be procured under Japan's grant aid. The erection method is described in Section 3.4, and the conceptual figures of the erection method are shown in Appendix 7.

An erection manual will be prepared as technical assistance and to control the quality of erection works.

5.3 Implementation Supervision Plan

Detailed design, assistance in tendering, and supervision for procurement of the prefabricated steel bridge materials and equipment under Japan's grant aid will be undertaken by a Japanese consultant firm in accordance with the contract concluded between DFR and the consultant. The outline of the works is as follows:

(1) Detailed Design

Major work items in the detailed design of the prefabricated steel bridge materials and equipment to be carried out by the consultant are as follows:

- Preparation of drawings and specifications
- Cost estimate
- Preparation of tender documents

The necessary time for detailed design is 2.5 months.

(2) Assistance in Tendering

The procurement of the prefabricated steel bridge materials and the procurement of equipment will be concluded by separately contracts. The consultant will render the following services during the period from tender notice to procurement contract:

- Tender notice
- Pre-qualification
- Pre-bid conference and tendering
- Tender evaluation
- Contract facilitation

The necessary time for tendering is 2.5 months.

(3) Supervision of Fabrication and Delivery

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

- Review and approval of fabrication plan and specifications prepared by the contractor
- Inspection of quantities and specifications prior to shipment
- Turnover

The estimated period for fabrication of the prefabricated steel bridge materials and equipment is 8 months, and 1 month for marine transportation. Spot supervision is required for the turnover.

The consultant will oversee preparation of an erection manual and guidance for the DFR engineers on erection of the prefabricated steel bridges provided by the materials supplier.

5.4 Procurement Plan

Procurement of the materials and equipment to be procured under Japan's grant aid will be undertaken by a Japanese company contracted by DFR. Since the materials and equipment are not available in Ghana, they will be procured in Japan or third countries. As a result of a comparison between procurement in Japan and third countries, the prefabricated steel bridge materials are proposed to be fabricated by a Japanese steel bridge fabricator in a third country (Thailand) utilizing steel materials exported from Japan or a third country (Korea, England), and the equipment and erection tools are proposed to be procured in Japan.

5.5 Implementation Schedule

The implementation schedule for detailed design and procurement of materials equipment, which will be borne by Japan's grant aid, is shown in Table 5-1.

Table 5-1 IMPLEMENTATION SCHEDULE

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Detailed design	═══	═══	═══							Total 2.5 months)		
Procurement of prefabricated steel bridge materials	═══	═══	═══	═══	═══	═══	═══	═══	Fabrication ═══	Marine transportation ■ Hand over Total 9.5 months)		
Procurement of equipments	═══	═══	═══	═══	═══	═══	═══	═══	Fabrication ═══	Marine transportation ■ Hand over Total 9.5 months)		

5.6 Scope of Work

The Undertakings of the Government of Japan and Ghana are listed in Table 5-2.

Table 5-2 UNDERTAKINGS OF THE GOVERNMENTS

Items	Contents	Undertaken by		Remarks
		Japan	Ghana	
Procurement of prefabricated steel bridge materials	Procurement	o		
	Marine transportation	o		
	Custom clearance		o	
	Turn over at storage	o		
	Storage of materials		o	
	Inland transportation		o	
Procurement of equipments	Procurement	o		
	Marine transportation	o		
	Custom clearance		o	
	Turn over at workshop	o		
	Operation & maintenance		o	
Design, construction and maintenance of bridges	Detailed design of substructures		o	also approach roads, revetments
	Construction		o	including erection
	Maintenance		o	

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

Bridge construction cost	:	¢3,712,328,000
Port clearing charge	:	¢1,645,000
Equipment operation & maintenance cost	:	¢313,341,000
Total	:	¢4,027,314,000

The details of the cost estimate are shown in Appendix 8.

CHAPTER 6

PROJECT EVALUATION AND CONCLUSION

CHAPTER 6

PROJECT EVALUATION AND CONCLUSION

6.1 Effects of the Project

This project aims to provide efficient transportation facilities by constructing steel bridges and replacing weak timber bridges with steel bridges where agricultural and social development is hindered due to difficulties of transportation.

The present conditions of the project bridges (21 bridges) are as follows:

- Washed out or collapsed bridges (4 bridges), which are impassable for vehicles and require travelers to cross streams by ford or ferryboat.

- Timber bridges (12 bridges), which are too weak to carry trucks and buses and are easy to become dilapidated.

- Damaged RC bridges (5 bridges), which are dangerous for traffic and needed to be reconstructed.

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

- Local farmers who do not have transportation means to ship their products to market due to lack of bridges can gain the access to market. The resulting decrease in transportation costs will enhance the competitiveness of the agricultural product in the international market and will constitute incentives for farmers to produce marketable surplus products. As a consequence, the project will expedite development of the areas affected. (Approx. beneficialies are 161,000.)

- Local populations which do not have public transportation services to cities, markets, hospitals, and schools can gain such services. Accessibility to social services for local populations will raise the level of their living standards.

- Technology of prefabricated steel bridge construction will be transferred to the Ghanaian engineers and technicians. (About 10 engineers and 30 technicians will be involved in the project.)

- Employment opportunity will be created by hiring construction workers and purchasing local materials. (About 2,000 man-months are required in the project.)

6.2 Conclusion and Recommendation

As described above, since the project will contribute to the regional development of the Republic of Ghana, it is concluded to be appropriate to implement this project under Japan's grant aid.

There are 9 bridges which were excluded from the project because the prefabricated steel bridges are not applicable to them or construction of substructures by local constructors is difficult although their construction necessity is high and the socioeconomic effects are very large. These bridges are recommended to be constructed under another grant aid in the form of "facilities construction".

Recommendations in implementation of the project are as follows:

- While the prefabricated steel bridge materials are stored in the storage yard, they should not be piled up directly on the ground to be free form rust. The bolts should be stored under roofs.

- The assembly of the prefabricated steel bridges should be supervised by engineers of the DFR or consultants based on the quality control manual which will be prepared for the materials. The assembly work quality control record should be reported to the DFR Headquarters.

- Build-up of mud and dust on the truss chords and abutment seats of the bridges should be removed in the course of routine maintenance to prevent corrosion on steel.

APPENDIX 1

MEMBER LIST OF STUDY TEAM

MEMBER LIST OF STUDY TEAM

Field Study

Mr. Juro CHIKARAISHI	Leader, Director, Third Regional Division, Planning Department, Japan International Cooperation Agency (JICA)
Mr. Akira KASHIMA	Project Coordinator, Deputy Director, Study Review and Coordination Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA)
Mr. Minoru MIURA	Chief Consultant, Katahira & Engineers International
Mr. Akihiko HIROTANI	Bridge Designer, Oriental Consultants Co., Ltd.
Mr. Satoshi KOGAWA	Equipment Planner, Katahira & Engineers International
Mr. Soemu OSHITA	Cost Estimator, Katahira & Engineers International

Draft Report Explanation

Mr. Kenji KIYOMIZU	Leader, Development Specialist, Japan International Cooperation Agency (JICA)
Mr. Yukihiro KOIZUMI	Project Coodinator, Second Basic Design Study Division, Grant Aid Study and Design Department, Japan International Cooperation Agency (JICA)
Mr. Minoru MIURA	Chief Consultant, Katahira & Engineers International
Mr. Akihiko HIROTANI	Bridge Designer, Oriental Consultants Co., Ltd.

APPENDIX 2

SURVEY ITINERARY

SURVEY ITINERARY

Field Study

Date	Activities
Dec. 4 (Sun)	- Mr. Chikaraishi, Mr. Kashima, Mr. Miura, Mr. Kogawa, Mr. Oshita Ar. Accra
Dec. 5 (Mon)	- Courtest call on Embassy of Japan, JICA Ghana Office, Ministry of Finance, Ministry of Roads & Highways, DFR
Dec. 6 (Tue)	- Discussion with DFR
Dec. 7 (Wed)	- Site reconnaissance
Dec. 8 (Thu)	- Discussion with DFR
Dec. 9 (Fri)	- Signing on Minutes of Discussions - Report to Embassy of Japan and JICA Office - Mr. Chikaraishi Lv. Accra - Mr. Hirotani Ar. Accra
Dec. 10 (Sat)	- Site survey
Dec. 11 (Sun)	- Site survey
Dec. 12 (Mon)	- Site survey
Dec. 13 (Tue)	- Site survey - Mr. Kashima Lv. Accra
Dec. 14 (Wed)	- Site survey
Dec. 15 (Thu)	- Site survey - Data correction
Dec. 16 (Fri)	- Site survey - Data correction
Dec. 17 (Sat)	- Site survey - Data correction
Dec. 18 (Sun)	- Site survey - Data correction
Dec. 19 (Mon)	- Discussion with DFR - Site survey - Data correction
Dec. 20 (Tue)	- Corrected data analysis
Dec. 21 (Wed)	- Corrected data analysis
Dec. 22 (Thu)	- Discussion with DFR - Report to JICA Office
Dec. 23 (Fri)	- Mr. Miura, Mr. Hirotani, Mr. Kogawa, Mr. Oshita Lv. Accra to London

Draft Report Explanation

Date	Activities
Feb. 14 (Tue)	- Mr. Miura, Mr. Hirotani Ar. Accra
Feb. 15 (Wed)	- Explanation of Draft Report to DFR - Mr. Kiyomizu, Mr. Koizumi Ar. Accra
Feb. 16 (Thu)	- Courtesy call to JICA Office, Embassy of Japan - Discussion with DFR
Feb. 17 (Fri)	- Project site reconnaissance
Feb. 18 (Sat)	- ditto -
Feb. 19 (Sun)	- ditto -
Feb. 20 (Mon)	- Signing on Minutes of Discussions at Ministry of Finance - Report to JICA Office, Embassy of Japan
Feb. 21 (Tue)	- Mr. Kiyomizu, Mr. Koizumi Lv. Accra to Tokyo - Mr. Miura, Mr. Hirotani Lv. Accra to London
Feb. 22 (Wed)	- Mr. Miura, Mr. Hirotani Ar. London
Feb. 23 (Thu)	- Mr. Miura, Mr. Hirotani visit steel bridge fabricator in U.K.
Feb. 24 (Fri)	- dito -
Feb. 25 (Sat)	- Mr. Miura, Mr. Hirotani Lv. London to Tokyo

APPENDIX 3

MEMBER LIST OF PARTY CONCEDRNED IN THE REPUBLIC OF GHANA

MEMBER LIST OF PARTY CONCERNED

IN THE REPUBLIC OF GHANA

Ministry of Finance & Economic Planning

Mr. Charles Abakah	Director, International Economic Division
Mrs. Agenes Batsa	Head of Bilaterals
Mr. Micheal Baddoo	Senior Economic Planning Officer

Ministry of Roads and Highways

Mr. K. Abbey Sam	Chief Director

Department of Feeder Roads

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)
Mrs. Paulina A. Boamah	Planning Officer
Mr. S. Opoku Aikins	Mechanical Engineer

Ghana Highway Authority

Mr. Robert Ofori	Director of Bridges
Mr. O.S. Antwi	Bridge Engineer

Embassy of Japan

Mr. Toshihiro Kojima	Ambassador
Mr. Makoto Wakasugi	Minister

JICA Ghana Office

Mr. Akio Hirasawa	Director
Mr. Toshiharu Kai	Deputy Director

APPENDIX 4

MINUTES OF DISCUSSIONS

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY
ON
THE PROJECT FOR SMALL STREAM BRIDGES REHABILITATION
IN
THE REPUBLIC OF GHANA

In response to the 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 Small Stream Bridges Rehabilitation (hereinafter referred to as "the Project"), and the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent to Ghana a study team headed by Mr. Juro Chikaraishi, Director of the Third Regional Division, Planning Department, JICA, from December 4 to 23, 1994.

The Team held series of discussions with the officials concerned of the GOG and conducted field surveys at the study area.

In the course of the discussions, Ghanaian side proposed to delete 5 bridges from the original request and to substitute them by 6 new bridges and revised component of equipments (including vehicles). The Japanese side accepted the revision of the original request as Ghanaian side proposed.

Both parties have confirmed the main items described on the attached sheets. The Team will proceed to continue the works and prepare the Basic Design Study Report.

Accra, December 9, 1994

MR. JURO CHIKARAISHI
Leader,
Basic Design Study Team
JICA

Mr. CHARLES ABAKAH
Director,
International Economic Division,
Ministry of Finance and Economic Planning

Mr. K. ABBEY SAM
Chief director,
Ministry of Roads and Highways

Mr. [illegible] ANTWI
Director,
Department of Feeder Roads
Ministry of Roads and Highways

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide construction materials and equipments necessary for bridges which are technically viable for Ghanaian side to construct by themselves among those requested to the Government of Japan as revised as listed in Annex I.

However, the final candidate bridges and equipments for the Project will be decided after further studies.

2. Project Sites

The proposed sites of the Project are located in Regions Volta, Eastern, Central, Western, Ashanti and Brong-Ahafo which are shown in ANNEX II.

3. Executing Agency

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

4. Items Agreed by Both sides

The justification of the Project is judged from the point of view of river conditions, traffic conditions, accessibility and regional development.

As a result, both sides have confirmed the justification for the revised 28 candidate bridges. However, since some bridges seemed difficult to be constructed by Ghanaian side, the Japanese side advised the Ghanaian side to request to the Government of Japan for another grant aid in the form of "facilities construction" rather than "provision of materials" for those bridges. In this case, however, the final decision for "facilities construction" candidate bridges shall be made by Ghanaian side referring the result of the study.

5. Grant Aid System

(1) The GOG has understood the system of Japan's Grant Aid in Annex III as explained by the team.

(2) The GOG will take necessary measures described in ANNEX-IV for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) The consultants will proceed to further studies in Ghana until December 23, 1994.

(2) JICA prepares the Draft Final Report in English and will dispatch a mission in order to explain its contents around February, 1995.

Annex I

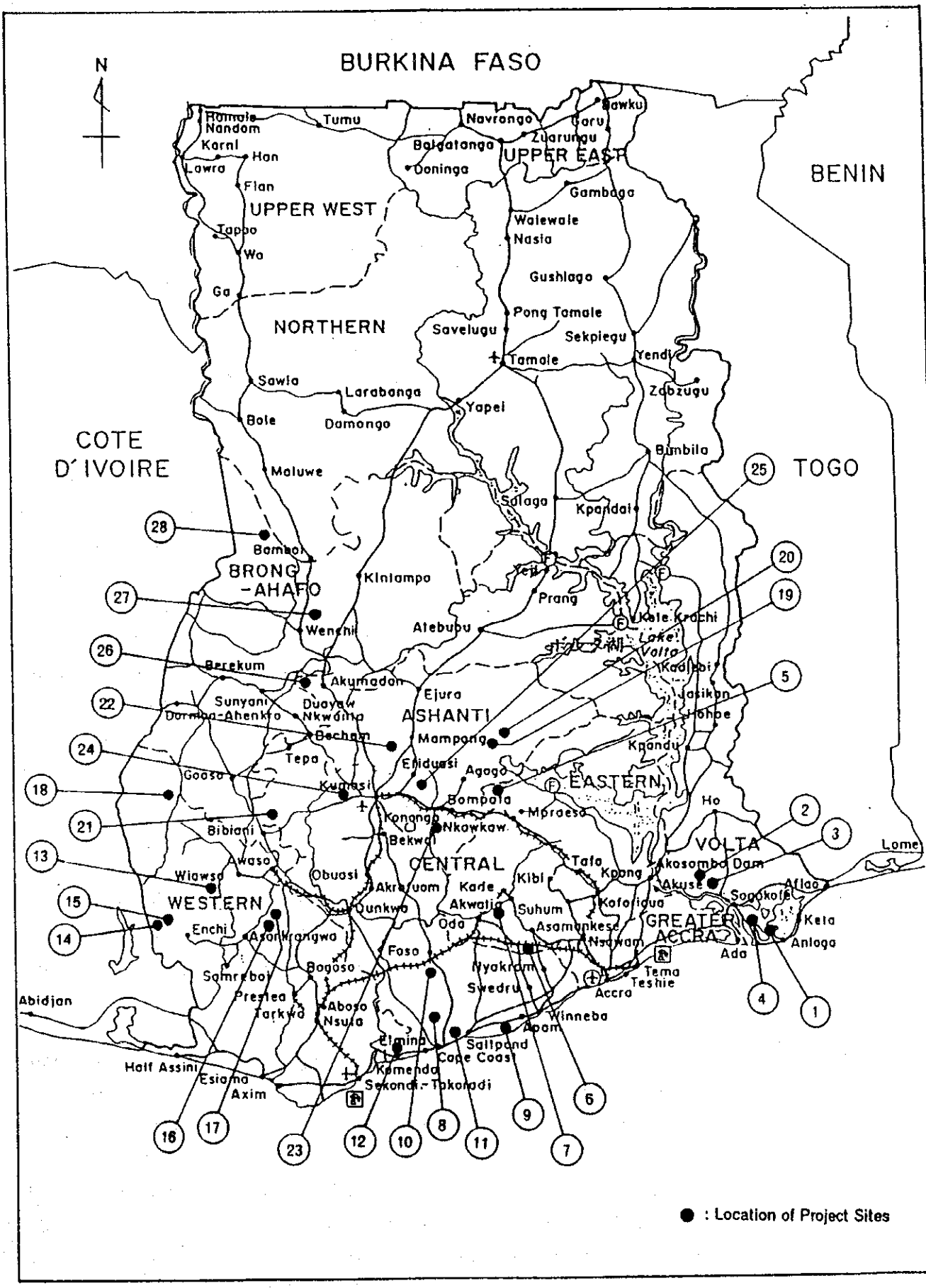
1. List of Bridges

No.	Region	Road Name	River Name
1	Volta	Blemeazado-Agortoe	Kolo
2	ditto	Adidome-Juapong	Aklakpa
3	ditto	Adidome-Juapong	Kolo
4	ditto	Galasota-Bomingo	Anor
5	Eastern	Etwereso Jn.-Etwereso-Pawudu	Pra
6	ditto	Takorase-Krudua	Ayensu
7	ditto	Akwatia-Kusi	Birim
8	Central	Nyameadon-Asomdwee	Kakum
9	ditto	Winneba-Ojobi	Ayensu
10	ditto	Akrofuom-Nsuakyir	Ochi
11	ditto	Ekon Jn.-Ekon	Amutu
12	Western	Shama Jn.-Mampong-Adansi	Hwini
13	ditto	Agyeman Camp-Kramokrom	Pru
14	ditto	Adonikrom Jn.-Adonikrom	Susan
15	ditto	Adonikrom Jn.-Adonikrom	Adoni
16	ditto	Wasa Akropong-Anyinabrim	Bura
17	ditto	Wasa Akropong-Anyinabrim	Yorunsu
18	ditto	Nkatieso-Agyemandiem-Abuom	Sayere
19	Ashanti	Kwamepong Nkwanta-Dukusen	Afram
20	ditto	Kwamepong Nkwanta-Dukusen	Ben
21	ditto	Mpasaaso-Sreso	Disri
22	ditto	Agona-Afamanaso	Ofin
23	ditto	Praso-Konongo	Anum
24	ditto	Hiawu-Besease-Ntensere	Owabi
25	ditto	Woraso-Abotanso	Anum
26	Brong-Ahafo	Chiraa-Asuokwa	Tano
27	ditto	Wenchi-Ofuman	Subin
28	ditto	Banda-Kankan	Johol

2. List of Equipments

- Wheel crane (16 t x 3.5 m) : 2 units
- Cargo truck (8 t) : 4 units
- Cargo truck (4 t) : 4 units
- Pick-up (double cabin, 4x4, diesel) : 6 units
- Cross country vehicle (4x4, diesel) : 2 units
- Semi-trailer with truck tractor : 1 unit
- Erection tools : 2 sets

Annex II Project Site Map



Annex III

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 Governments of Japan and the recipient country

2) First, 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 the Government 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 necessarily 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 them 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 all the expenses and 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 those 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 IV

Necessary measures to be taken by the GOG:

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

2. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangements.

   - Advising commission of Authorization to Pay
   - Payment commission

3. To ensure prompt unloading and customs clearance at ports of disembarkation in Ghana and internal transportation of the products purchased under the Grant, from the delivery site(s) to project sites.

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

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

6. To bear all the expenses other than those to be borne by the Grant, necessary for the bridge construction.

MINUTES OF DISCUSSIONS ON THE BASIC DESIGN STUDY ON THE PROJECT FOR SMALL STREAM BRIDGES REHABILITATION IN THE REPUBLIC OF GHANA (CONSULTATION ON DRAFT REPORT)

In December 1994, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team on the Project for Small Stream Bridges Rehabilitation (hereinafter referred to as "the Project") to the Republic of Ghana and through discussions, field survey and examination of the results in Japan, has prepared the draft report of the study.

In order to explain and to consult the Ghanaian side on the components of the draft report, JICA sent to Ghana a study team, which is headed by Mr. Kenji Kiyomizu, Development Specialist on Civil Engineering, JICA, and is scheduled to stay in the country from February 14 to 21, 1995.

As a result of the discussions and field survey, both parties confirmed the main items described on the attached sheets.

Accra, February 20, 1995

Kenji Kiyomizu.

Mr. Kenji Kiyomizu
Leader,
Basic Design Study Team,
JICA

Mr. Charles Abakah
Director,
International Economic Division,
Ministry of Finance and Economic Planning

Mr. K. Abbey Sam
Chief Director,
Ministry of Roads and Highways

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

ATTACHMENT

1. Components of the draft report

The Government of the Republic of Ghana has agreed and accepted in principle the components of the draft report proposed by the team.

2. Japan's Grant Aid system

(1) The Government of the Republic of Ghana has understood the system of Japan's Grant Aid explained by the team.

(2) The Government of the Republic of Ghana will take necessary measures, described in Annex for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further Schedule

The team will make the final report in accordance with the confirmed items, and send it to the Government of the Republic of Ghana by April 1995.

ANNEX

Necessary measures to be taken by the Government of Ghana;

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

2. To bear the following commissions to the Japanese foreign exchange bank for banking services based upon the Banking Arrangements.
   - Advising commission of Authorization to Pay
   - Payment commission

3. To ensure prompt unloading and customs clearance at ports of disembarkation in Ghana and internal transportation of the products purchased under the Grant, from the delivery site(s) to Project sites.

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

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

6. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the bridges.

7. To construct all bridges within the period of two years after delivery of materials provided under the Grant.

8. To submit progress reports on the construction of bridges by Ghanaian side to JICA Ghana office at least every six (6) months.

20/2/95

APPENDIX 5

EXAMINATION OF APPROPRIATENESS OF THE REQUESTED BRIDGES

EXAMINATION OF APPROPRIATENESS OF THE REQUESTED BRIDGES

No	Br.No.	Bridge Name	Region	Road Name	River Name	Necessity of bridge construction			Socioeconomic effects of bridge construction					Bridge can be constructed without problem					appropri-ateness	Remarks
						Bridge type	Condition	Judgement	Population	Pedestrian	ADT	Boatpssenger	Judgement	Span	Rd.class	Access Rd.	Const.ease	Judgement		
1	1-2	Aklakpa	Volta	Adidome-Juapong	Aklakpa	Timber	Impassable	High	20,000	0	0	100	Large	25 x 3	Feeder	No road	-	No	No	No road within about 3 km of site.
2	1-3	Nyivu	ditto	Adidome-Juapong	Nyivu	Timber	Impassable	High	20,000	1,200	0	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
3	2-1	Pra	Eastern	Etwereso Jn.-Etwereso Pawudu	Pra	No bridge	Impassable	High	10,000	100	0	200	Large	20 x 3	Feeder	No road	-	No	No	No reoad within about 300 m of site.
4	2-2	Ayensu	ditto	Talorase-Krudua	Ayensu	No bridge	Impassable	High	2,000	500	0	0	Large	30	Feeder	Fair	Difficult	No	No	A 30 m long span bridge is required.
5	2-4	Emou	ditto	Osenasf-Apinamang	Emou	Timber	Weak	High	200,000	2,000	200	0	Large	20	2ndary	Fair	Easy	No	No	Tow-lane bridge is required since it is a secondary road (No. 163).
6	3-1	Kakum	Central	Nyamedon-asomdwee	Kakum	Steel PL.	Weak	High	10,000	500	100	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
7	3-2	Ayensu II	ditto	Winneba-Ojobi	Ayensu	R C	Small damage	Low	2,000	300	155	0	Large	25	2ndary	Fair	Easy	No	No	Damaged existing RC bridge (backfill of abutment is eroded) is reparable.
8	3-3	Ochi	ditto	Akrofuom-Nsuakyir	Ochi	Timber	Weak	High	5,000	500	25	0	Large	25	Feeder	Fair	Easy	Yes	Yes	
9	3-4	Amutu	ditto	Ekon Jn.-Ekon	Amutu	No bridge	Dry river	Low	8,000	1,500	0	0	Large	50	Feeder	Fair	Easy	Yes	No	Riverbed is passable except during flooding.
10	3-5	Fum	ditto	Akonfudi-Asibirim	Fum	No bridge	Impassable	High	5,000	500	0	0	Large	40	Feeder	Fair	Difficult	No	No	A 40 m long span bridge is required.
11	4-1	Hiwini	Western	Shama Jn.-Mampong-Adansi	Hiwini	Timber	Impassable	High	6,000	500	0	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
12	4-2	Pru	ditto	Agyeman Camp-Kramokrom	Pru	Timber	Weak	High	8,000	1,500	100	0	Large	25	Feeder	Fair	Easy	Yes	Yes	
13	4-3	Susan	ditto	Adonikrom-Jn.-Adonikrom	Susan	Timber	Weak	High	10,000	2,000	55	0	Large	20	Feeder	Need mainte.	Easy	Yes	Yes	
14	4-4	Adoni	ditto	Adonikrom Jn.-adonikrom	Adoni	Timber	Weak	High	10,000	2,000	55	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
15	4-5	Bura	ditto	Wasa-Akropong-Anyinabrim	Bura	Timber	Weak	High	7,000	1,000	60	0	Large	25	Feeder	Fair	Easy	Yes	Yes	
16	4-6	Yurunsu	ditto	Wasa-Akropong-Anyinabrim	Yurunsu	Timber	Weak	High	7,000	1,000	60	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
17	4-7	Sayere	ditto	Nkatieso-Agyemandiem-Abuom	Sayere	Timber	Weak	High	10,000	300	170	0	Large	20	2ndary	Need mainte.	Easy	No	No	Tow-lane bridge is required since it is a secondary road (No. 8).
18	4-8	Peburu	ditto	Bopa-Fordj	Peburu	Timber	Weak	High	15,000	2,000	35	0	Large	25	Feeder	Fair	Easy	Yes	Yes	
19	4-9	Samere	ditto	Pensanum-Amuni	Samere	Timber	Weak	High	7,000	1,000	50	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
20	4-10	Botente	ditto	Pensanum-Amuni	Botente	Timber	Weak	High	7,000	1,000	50	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
21	4-11	Nwhine	ditto	Asaasefre-Banso-Kwesikrom	Nwhine	Rail G.	Weak	High	10,000	300	125	0	Large	17 x 3	Feeder	Fair	Difficult	No	No	Special equipment and technique are required for substructure construction.
22	4-12	Draw	ditto	Asaasefre-Banso-Kwesikrom	Draw	Timber	Weak	High	10,000	700	100	0	Large	40	Feeder	Fair	Easy	No	No	A 40 m long span bridge is required.
23	4-13	Djaba	ditto	Adubrim Jn.-Adubrim	Djaba	Timber	Weak	High	3,000	1,000	55	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
24	4-14	Ayawora	ditto	Adubrim Jn.-Adubrim	Ayawora	Timber	Weak	High	3,000	1,000	55	0	Large	25	Feeder	Fair	Easy	Yes	Yes	
25	5-4	Ofin	Ashanti	Agona-Afamanaso	Ofin	RC box	Weak	High	3,000	300	140	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
26	5-5	Anum	ditto	Praso-Konongo	Anum	No bridge	Impassable	High	10,000	300	0	0	Large	15	Feeder	Need mainte.	Easy	No	No	RC bridge constructed locally is suitable since it is a short bridge.
27	5-6	Owabi	ditto	Hiawu-Besease-Ntensere	Owabi	No bridge	Washed out	High	10,000	300	0	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
28	5-8	Anunu	ditto	Effiduase-Nkwankwanna-Konongo	Anunuso	R C	Damaged	High	5,000	150	140	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
29	5-9	Tanodumase	ditto	Bibiana-Asiberem	Tano	No bridge	Impassable	High	5,000	0	0	500	Large	45	2ndary	Need mainte.	Easy	No	No	Tow-lane bridge is required since it is a secondary road (No. 62).
30	5-10	Anuru	ditto	Kwakuwama-Nobekan	Anuru	Timber	Weak	High	2,000	200	140	0	Large	20	Feeder	Need mainte.	Easy	Yes	Yes	
31	6-1	Tano	Brong-Ahafo	Chiraa-Asuokwa	Tano	R C	Damaged	High	3,000	200	85	0	Large	25	Feeder	Need mainte.	Easy	Yes	Yes	
32	6-2	Subin	ditto	Wenchi-Ofuman	Subin	R C	Damaged	High	5,000	300	230	0	Large	20	Feeder	Need mainte.	Easy	Yes	Yes	
33	6-3	Johol	ditto	Banda-Kankan	Johol	No bridge	Impassable	High	3,000	200	0	0	Large	45	2ndary	Need mainte.	Easy	No	No	Tow-lane bridge is required since it is a secondary road (No. 82).
34	6-5	Tano	ditto	Siencheu-Goaso	Tano	Timber	Weak	High	150,000	500	130	0	Large	20	Feeder	Fair	Easy	Yes	Yes	
35	6-6	fawohoyeden	ditto	Fawohoyeden-Ayomdo	fawohoyeden	Timber	Weak	High	20,000	150	150	0	Large	20	2ndary	Fair	Easy	No	No	Tow-lane bridge is required since it is a secondary road (No. 452).

Note : The appropriateness evaluation criteria is described in Section 2.2.3.

APPENDIX 6

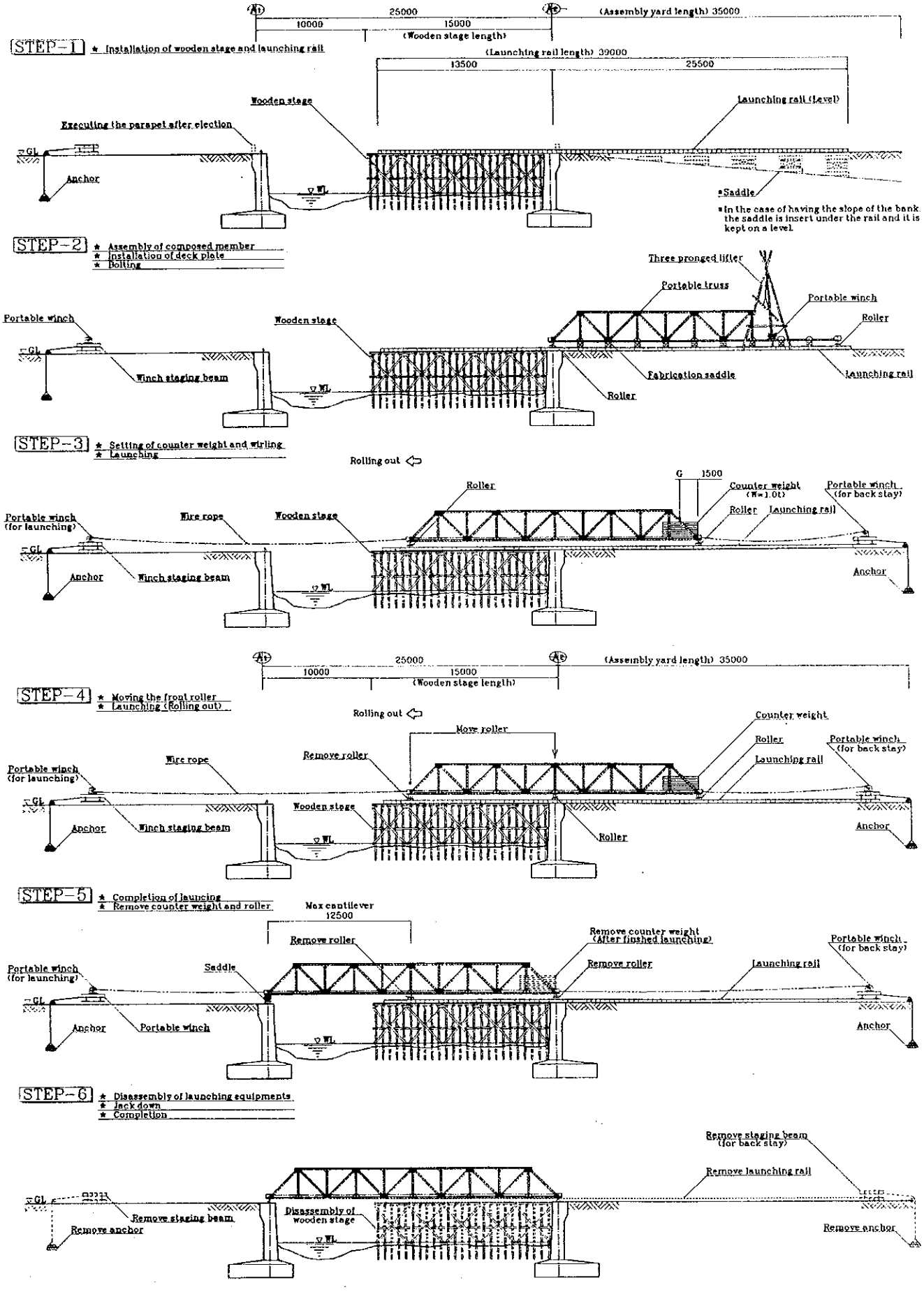
PRESENT FUNCTIONING STATUS OF THE DFR-OWNED EQUIPMENT

PRESENT FUNCTIONING STATUS OF THE DFR-OWNED EQUIPMENT

DESCRIPTION	MODEL	OPERA-TION	STAND -BY	UNDER REPAIR	UNRE-PARABLE	REMARKS
Bulldozer	D6D	5	1	1	4	
Material Carriage	150E	0	0	0	0	
Cargo Truck	10t	0	0	0	0	
Fork Lift	FD4	0	0	0	0	
Motor Grader	SHM5, D720	46	8	8	17	
Tiller Grader	AG400	2	2	0	0	
Semi-Trailer	112E	0	0	1	0	
Lubricator Car	-	1	0	0	0	
Motor Cycle	CG125, TF125	31	13	1	4	
Pick-up Truck	L-200, HILUX	52	0	9	12	
Vibratory Roller	BW65S	19	5	1	10	
Pneumatic Roller	T8TGL	0	3	0	1	
Vibratory Roller	202AD	0	0	0	0	
Vibratory Roller	TV-90	0	0	0	0	
Plain Trailer	VRT-3, 1	0	1	0	1	
Saloon Car	LANCER	2	0	0	1	
Station Wagon	PAJERO	17	0	2	8	
Dump Truck	TK20G	26	6	5	1	
Dozer Shovel	D41S-3	0	2	0	0	
Tiller Tractor	685	32	15	4	3	
Tiller Trailer	AG5T	52	8	4	6	
Water Tank Truck	STB	21	9	2	1	
Wheel Loader	430	0	0	0	0	
Water Pump	3.7km	2	15	3	4	

APPENDIX 7

CONCEPTUAL FIGURES OF ERECTION METHOD



CONCEPTUAL FIGURES OF ERECTION METHOD

APPENDIX 8

ESTIMATED COST BORNE BY THE GOVERNMENT OF GHANA

ESTIMATED COST BORNE BY THE GOVERNMENT OF GHANA

1. Bridge Construction Cost

(Unit : Cedis)

Work	Unit	Quantity	Unit Price	Amount
Substructures	unit	42	33,300,000	1,398,600,000
Developments	m^2	5,200	161,000	837,200,000
Approach roads	m	1,260	444,000	559,440,000
Erection	ton	520.186	1,763,000	917,087,918
Total				3,712,327,918

2. Custom Clearance Fee

(Unit : Cedis)

Item	Unit	Quantity	Amount
Prefabricated steel bridge materials	ton	520.186	
Erection tools	ton	28.104	1,370,725
Cargo trucks (8t) (with spre parts)	unit	4	
Cargo trucks (4t) (with spare parts)	unit	4	80,000
Pick-ups (with spare parts)	unit	6	
Wagon (with spare parts)	unit	2	33,650
Semi-trailer (with tractor, spare parts)	unit	1	39,000
Wheel crane (with spare parts)	unit	2	121,500
Total			1,644,875

3. Equipment Operation & Maintenance Cost (for 2 years)

(Unit : Cedis)

Item	Unit	Quantity	Unit Price	Amount
Fuel	lit	237,440	360	85,478,400
Oil (5% of Fuel)				4,273,920
Operator	man-day	6,452	3,780	24,388,560
Tire & other parts	set	1	128,080,000	128,080,000
Repair expenses	set	1	71,120,000	71,120,000
Total				313,340,880

APPENDIX 9

COMMITMENT OF FUND ALLOCATION BY THE GOVERNMENT OF GHANA

In case of reply the number and date of this letter should be quoted

Our Ref. No. TAP/G/SBD.9

Your Ref. No.....

Tel. No.....

REPUBLIC OF GHANA

MINISTRY OF FINANCE AND ECONOMIC PLANNING
P.O. BOX M 40
ACCRA

.....21st. March,.....1995

SMALL STREAMS BRIDGE REHABILITATION PROJECT
LOCAL CURRENCY COMPONENT

I have the honour to refer to the recent discussions held between the representatives of the Government of Ghana (officials of Ministry of Finance, Ministry of Roads and Highways, Ghana Highway Authority and the Department of Feeder Roads) and the Government of Japan (Basic Design Study Team led by Mr. Kenji Kiyomizu) in Accra on the 20th of February, 1995.

The Government of Ghana hereby gives an undertaking that there will be adequate and timely provision of local currency required for the successful implementation of this project.

DR. KWESI BOTCHWEY
MINISTER OF FINANCE

THE DIRECTOR
GENERAL, GRANT AID DIVISION
J I C A
TOKYO, JAPAN.

(ATTN.: MR. KENJI KIYOMIZU)

cc: The Embassy of Japan
Accra.

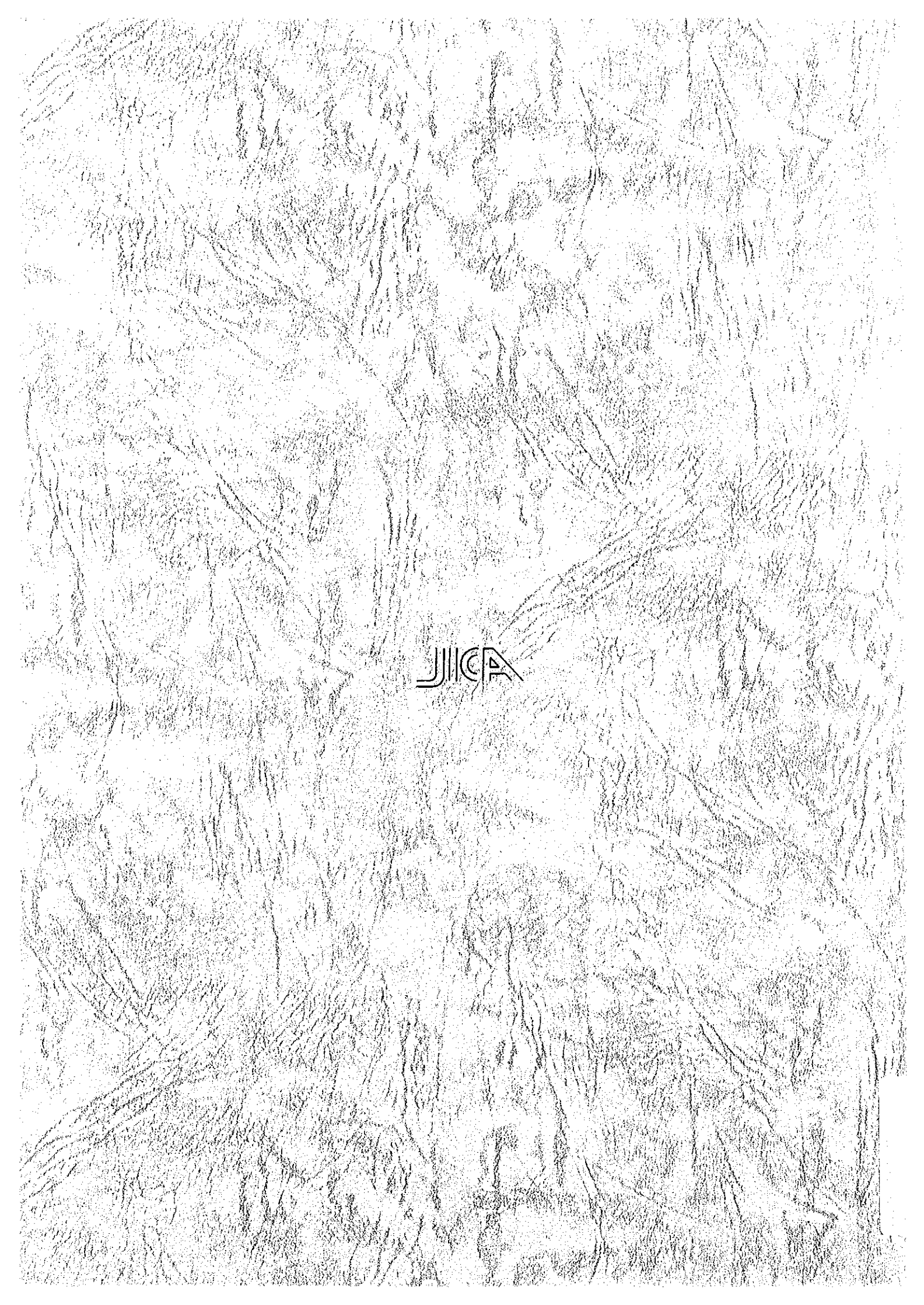
(Attn.: Mr. Yamazaki)

The Resident Representative
J I C A
Accra.

The Hon. Minister
Min. of Roads & Highways
Accra.

The Chief Executive
Ghana Highway Authority, Accra.

The Director
Dept. of Feeder Roads, Accra.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