Ministry of Transportation
The Republic of Ghana

No.

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR

REHABILITATION OF NATIONAL TRUNK ROAD N8

IN

THE REPUBLIC OF GHANA

DECEMBER 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSTRUCTION PROJECT CONSULTANTS, INC.

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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 Rehabilitation of National Trunk Road N8 and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ghana a study team from April 2 to May 15, 2008.

The team held discussions with the officials concerned of the Government of Ghana, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Ghana in order to discuss a draft basic design, and as a 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.

December 2008

Eiji Hashimoto

Vice-President

Japan International Cooperation Agency

December 2008

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Rehabilitation of National Trunk Road N8 in the Republic of Ghana.

This study was conducted by Construction Project Consultants, Inc., under a contract to JICA, during the period from March, 2008 to December, 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ghana and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

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

Very truly yours,

Hideaki Morita

Project manager,

Basic design study team on the Project for Rehabilitation of National Trunk Road N8

Construction Project Consultants, Inc.

SUMMARY

SUMMARY

(1) Country Profile

The Republic of Ghana (hereinafter referred to as "Ghana") is a country located in West Africa. Its total land area is 239,000 km^2 which is approximately two thirds (2/3) of Japan and it has a population of 23 million people. Ghana faces the Gulf of Guinea to the south and borders Cote d'Ivoire (Ivory Coast) to the west, Togo to the east, and Burkina Faso to the north. The climate of northern part of the country is savanna and the southern part is tropical rainforest. Since the Ashanti region, which is the target site, belongs to the tropical rainforest zone, the mean monthly temperature is 21 to 32℃ with the rainy season being subdivided into a major rainy season in May and June and minor rainy season in September and October. The annual mean rainfall is 600mm along the coastal region and 1,500mm (similar to that of Tokyo) in the central region.

Major industries in Ghana typically depend on primary products and greatly rely on agriculture and underground resources. Since these products are primarily controlled by international market prices, the economic structure is unstable. Since the implementation of structural adjustments in 1983, Ghana achieved 3% to 5% economic growth in the latter half of the 1980s and earned a good reputation Sub-Saharan Africa. However, due to a sudden rise in oil prices and major imported goods and a slump in prices for major exported goods such as cacao and gold since 1999, the national economic situation has deteriorated substantially. In March 2001, Ghana applied for debt relief under the Heavily Indebted Poor Countries (HIPCs) initiative. At the same time, Ghana has strived for economic reconstruction by taking steps toward a macro economy. Since 2003, steady economic management has continued due to an increase in revenue from cacao and overseas remittances so that GDP growth rate has remained high at 5.9% to 6.4%. However, due to regional disparity in the recent development process, poverty in the northern savanna and southern forest zones is worsening thus threatening to destabilize the Ghanaian economy.

(2) Background, Details and Outline of the Requested Project

In major programs such as the long-term economic and social development plan (Ghana Vision 2020) and the "Growth and Poverty Reduction Strategy (GPRS) II 2006-2009," the promotion of traffic infrastructure development in supporting Ghana's growth is recommended. With respect to road improvement, in addition to the development of access roads and trunk roads between urban centers and their markets, the development of a north-south international road connecting the east-west road which is being developed by the Economic Community of West African States (ECOWAS) is considered a top priority.

The road network in Ghana is a major factor in socio-economic activities. Major economic products are shipped from the Port of Takoradi located in the west southward via National Trunk Road N8, which is the target road, from the economic block mainly in Kumasi, an inland production-based city and accumulation center. On the other hand, imported goods are transported from the Port of Tema near the capital Accra in the east to all regions of Ghana. This distribution route is an important route for major

economic activities in Ghana connecting the Accra economic block, the inland Kumasi economic block and the western economic block in a triangular shape. At the same time, since it connects the northern savanna and southern forest zones where regional disparities have become a problem in recent years, the route is important in the transportation of farm products in the north such as yams and other farm products and timber in the south to ports and the other major economic blocks. Furthermore, it is an important distribution route for landlocked nations such as Burkina Faso, Mali and Niger.

In the road network in Ghana, in line with the increase in traffic volume associated with economic growth since the 1970s, as a result of a sharp increase in large-sized vehicles overloaded with construction materials and primary products, pavement has deteriorated rapidly at each location. Between 1990 and 1994 the target road was improved with asphalt concrete pavement through a Japanese yen loan but has rapidly deteriorated, exceeding the point where it can be repaired through the Ghanaian periodical maintenance, so the road requires immediate repair. In response, in February 2006 Ghana submitted a request to the Japanese Grant Aid Scheme for road improvements and repair of a total length of 176km, including improvements to two bridges along the section. Although the necessity of the request is considered to be sufficient since the economic infrastructure of Ghana is a lifeline for neighboring landlocked countries, it was necessary to confirm and examine the following items. Accordingly, the Japan International Cooperation Agency (JICA) conducted a preliminary study entitled the "Anwiankwanta/Yamoransa Road Rehabilitation Project" in July and August, 2007.

Items confirmed and examined in Preliminary Study

① Depending on the section, since no particular problems with regard to drivability have been reported, the present road pavement condition and the degree of bridge damage in each section have not been identified.

② Even though the service life was set at 20 years in the loan aid project, some sections are already facing drivability problems less than 15 years after completion. The cause for this is unknown.

③ Since it has also been reported that some sections may be serviceable if sufficient maintenance is carried out, past maintenance systems and methods in Ghana should be verified.

④ Although the project aims for road improvements, due to the long distance of 176km and possibility of involuntary resettlement in line with large-scale construction work on some sections, the Project is classified as Category B under the JICA Guidelines of Environmental and Social Considerations. Accordingly, it will be necessary to confirm and examine the need for environment-related procedures.

As the result of the preliminary study, with respect to the above-mentioned ① and ②, in addition to the increase in traffic load which substantially exceeded estimates at the time of the design, it has become clear that significant damage has occurred due to the influence of materials (pavement materials) and the natural environment (rainfall and underground water). It has also been clarified that some sections of the road with no drivability problems at the present time are nearing the end of their life span. With respect to ③, it is apparent that the section approximately 16km from Anwiankwanta, where it has been remarkably damaged, has been repaired by Ghana independently. With respect to ④, although shops and

residences, etc. in the vicinity of the two proposed bridges were confirmed and large-scale involuntary resettlement has not occurred, some signs of the impact are unclear, so it remains Category B. Based on the current situation, from the viewpoint of urgency, the preliminary study reached the conclusion that the badly damaged section approximately 60km from Assin Praso (including Assin Praso Bridge) to Anwiankwanta heading south is of highest priority.

Based on the above-mentioned results, it was decided to carry out a Basic Design study on the section approximately 60km from Assin Praso where the degree of priority is regarded to be high in the preliminary study as the section subject to the study.

(3) Outline of the Study Findings and Project Contents

In response to the above, JICA dispatched a Basic Design Study Team to Ghana between April 2 and May 15, 2008. The Study Team again confirmed the background and contents of the request through discussions with concerned parties in Ghana. At the same time, they examined the existing road conditions, natural conditions (topographic and geological features), the site conditions including traffic volume and Ghanaian road design standards, etc. After returning to Japan, based on the study findings, the project contents were examined and a draft Basic Design Report was prepared. After implementing the Basic Design, the Study Team was dispatched to Ghana between October 16 and 25, 2008 to explain the draft Basic Design Report, to discuss and confirm the undertakings taken by the Ghanaian side at which time approval was obtained.

In the field survey, due to the serious amount of deterioration from the road foundation to the surface layer along the entire length of the target road, it was confirmed that the entire length should be repaired. As the result of confirming the connecting point with the existing road in the vicinity of the Assin Praso Bridge, which is the starting point, and a site approximately16km (in the suburbs of Bekwai) from Anwiankwanta, the end point which is presently under road repair with the Ghanaian side, the entire target section was acknowledged to be 59.9km.

Ghanaian standards were applied as the road standards. The road alignment of the existing road meets Ghanaian standards and so special consideration was given in order to prevent, whenever possible, the relocation of roadside homes and public facilities by tracing the present road from the viewpoint of minimizing the social and environmental impacts. In addition, with respect to the examination of pavement repair, an increase in traffic volume is anticipated and the current traffic volume and load which can withstand the anticipated traffic volume were examined and reflected in the designs.

The existing Assin Praso Bridge in the target section should be reconstructed due to the lack of structural soundness and insufficient width and height. Options examined for the bridge reconstruction include selection of a location that minimizes the social and environmental impact, the establishment of assumed water level, and the most cost-effective bridge type. Although it will be necessary to remove the existing bridge in the future, since the bridge can be effectively utilized exclusively for pedestrians, the load conditions can be sharply reduced. Therefore, at Ghana's request the present bridge will remain.

Based on the above results, the final plan is outlined in the following table.

Outline of the Project

Description	Project Components
Target Section	59.9km (between Assin Praso to Bekwai on N8 road)
Road Width	11.3m (carriageway 3.65m×2, shoulder 2.0m×2)
Planned Axle Load	Design axle load 13t, Load capacity 27 million ESAL
Climbing Lane	Right lane; 1.68km from 43.5km, Left lane;1.29km from 45.2km
Pavement (Carriageway)	
- Surface Course	14cm (asphalt concrete wearing course = 4cm, binder course =5cm＋5cm)
- Base course	20cm (mechanically stabilized crushed stone))
- Sub-base course	20cm (locally available materials)
Pavement (Shoulder)	
- Surface Course	3cm (asphalt concrete wearing course)
Major Structure	
- Culvert	127 spots. (necessary for repairs under the Project at existing 139 spots)
- Bridge	1 No. (3 spans, total length of 98.0m, existing bridge reconstruction) Superstructure ・ Structure type : PC 3-span continuous rigid-frame bridge (cantilever) Sub-structure ・ Abutment foundation : Concrete shaft pile (D=2.00m, L=10 to 11m) ・ Bridge pier foundation : Spread footing Note: The existing bridge remains and will be effectively utilized by the Ghanaian side as a pedestrian bridge.
Incidental facilities	
- Intersection Improvement	1 location (main junction between the starting and end points)
- Road Marking	Center lines, side lined, arrow, etc.
- Protective facilities	Guard post, Barrier at major structure area and road bend.
- Kilometer Post	Installation in the interval of 1km

(4) Project Period and Estimated Project Cost

In the case of implementing the Project through Japan's Grant Aid Scheme, the total construction period required will be approximately 48 months (8 months for the detailed design and 40 months for the construction work). The project will be implemented in accordance with Japan's Grant Aid scheme and the cost will be determined before concluding the Exchange of Notes (E/N) for the Project.

(5) Verification of Relevance of the Project

The following direct and indirect effects can be expected through the implementation of the Project. It is expected to benefit 23 million residents in Ghana.

[Direct Effects]

① By improving the drivability and securing smooth traffic flow, the average transit time over the 59.9km distance between the starting and end points will be shortened from 90 minutes to 47 minutes.

② By increasing the carriageway width on Assin Praso Bridge, the safe traveling speed will be improved from the present 10km/hr to 80km/hr.

③ By improving Assin Praso Bridge, the allowable load for safe passing on the bridge will be improved from 12.0t which is the present design vehicle load to 24.5t, the Ghanaian standard.

④ By improving road surfaces, 9km of dangerous conditions on uneven pavement will be improved to safer conditions for the entire section.

[Indirect Effects]

① By shortening transit times, the transportation cost for passing freight will be reduced.

② By installing bus stops, stopping lanes and slow down zones (humps) in order to separate pedestrians and bicycles from passing vehicles, relevant road safety will be improved.

③ By installing climbing lanes, lower speed requirements in the mountainous section will be relaxed.

④ By improving road surface conditions, transportation capacity will be increased in inter-regional physical distribution.

⑤ Since the target route will be able to function as a regional trunk road thereby encouraging domestic and international distribution and human exchange, the revitalization of social and economic activities is expected.

⑥ By improving the reliability of the road, including securing smooth drivability and avoiding traffic blockages, this will contribute to regional development, correction of regional disparities, expansion in market zones and improvement in accessibility to medical and educational institutions.

As was described earlier, the Project is expected to bring significant benefits to all of Ghana and will contribute widely to improving the convenience for residents. The Project is therefore judged to be significant if it is implemented through Japan's Grant Aid Scheme as the requested Japanese assistance. With respect to maintenance after the completion of the facilities, based on its past achievements, the implementing agency in Ghana appears to have sufficient expertise to maintain the road after its completion and take future measures over the long term. In order to permanently display the effects of the improvements gained through the Project, Ghana is required to appropriately control overloaded vehicles presently regulated.

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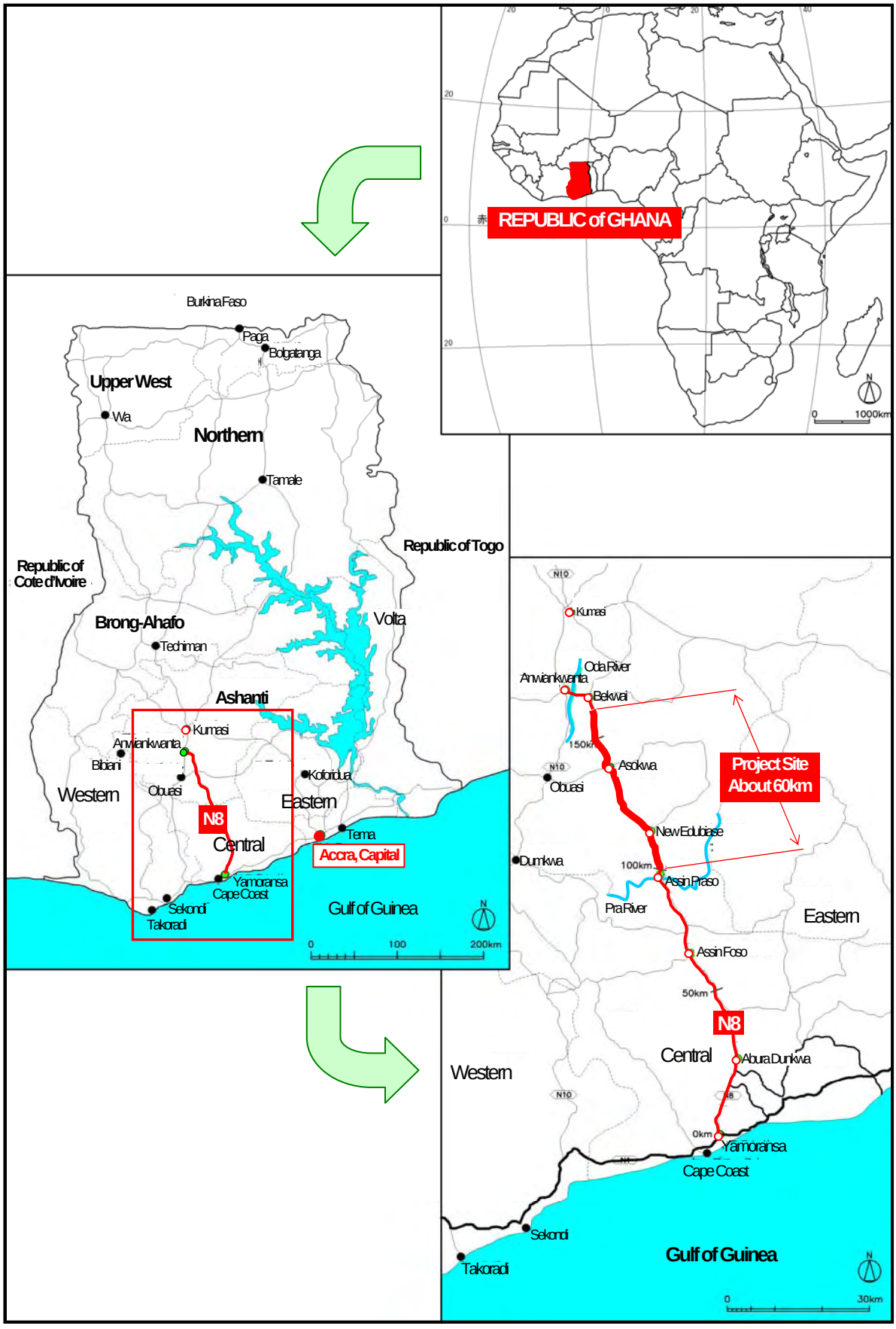
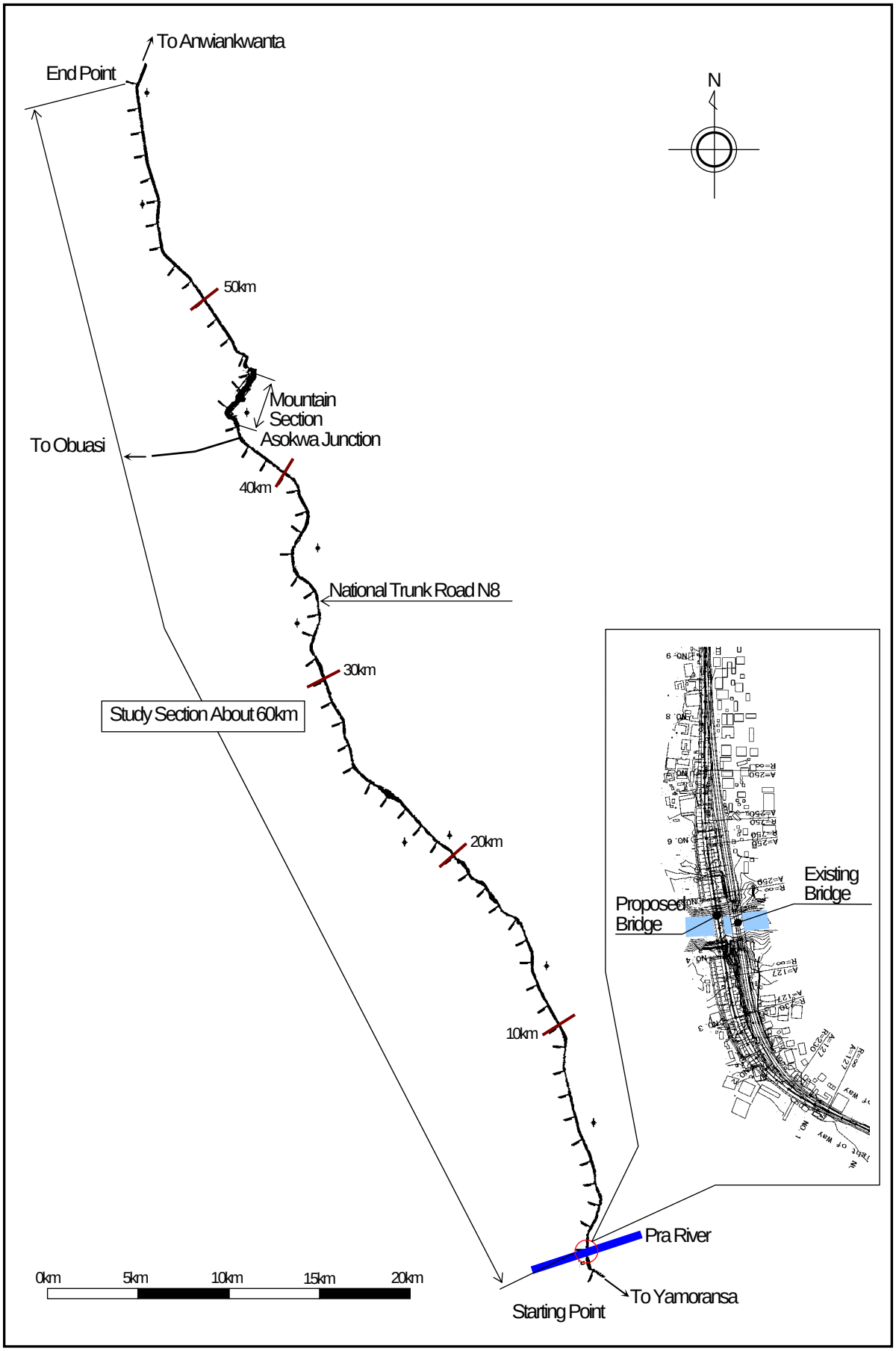


LOCATION MAP



Study Section Route Map

Perspective (Vicinity of Assin Praso Bridge/Present Road onn the Right Side)

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ABBREVIATIONS

[General]

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
AfDB	Africa Development Bank
ALCS	Axle Load Control Strategy
BADEA	Arab Bank for Economic Development
BMU	Bridge Management Unit
CBR	California Bearing Ratio
DANIDA	Danish International Development Agency
DFR	Department of Feeder Roads
DBST	Double Bituminous Surface Treatment
DUR	Department of Urban Roads
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessment
EIS	Environmental impact Statement
EP	Environmental Permit
EPA	Environmental Protection Agency
ESAL	Equivalent Single Axle Load
ERP	Economic Recovery Programme
EU	Europe Union
GHA	Ghana Highway Authority
GOG	Government of Ghana
GDP	Gross Domestic Product
GPRS	Ghana Poverty Reduction Strategy
GTZ	German Technical Co-operation
HIPCs	Highly Indebted Poor Country
IDA	International Development Association
IEE	Initial Environmental Evaluation
IMF	International Monetary Fund
IRI	International Roughness Index
JICA	Japan International Co-operation Agency
KfW	Kreditanstalt fül Wiederaufbau
MOT	Ministry of Transportation
MMU	Mobile Maintenance Unit
OJT	On the Job Training
ORET	Development – Dilated Export Transactions
OPEC	Organization of Petroleum Exporting Countries
PER	Preliminary Environmental Report

ROW	Right of Way
RSDP	Road Sector Development Programme
WB	World Bank

[Currency]

GHC	Ghana Cedi
US$	United State Dollar
¥	Japanese Yen

[Unit]

cm	Centimeter
km	Kilometer
km/hr	Kilometer per Hour
m	Meter
m^2	Square Meter
m^3	Cubic Meter
mm	Millimeter
m/s	Meter per Second
%	Percent
kg	Kilogram

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background and Overview of Request for Grant Aid

Ghana's primary export products of timber, cacao, gold, manganese and bauxite are mainly produced and collected in and southwards of the economic zone based around the country's second city of Kumasi (population approximately 1,170,000 as of 2000). From there, products are transported along National Trunk Road N8 (the Project target route) and are exported from the Port of Takoradi, the second largest port in Ghana.

In addition, imported commodities are transported from the Port of Tema in the vicinity of the capital Accra to all regions of Ghana. Since these transportation routes connect the Accra economic block including the capital Accra and the Port of Tema, the Kumasi inland economic block, and the Ghana western economic block mainly near the Port of Takoradi, this region is referred to as the Golden Triangle of the Ghanaian economy.

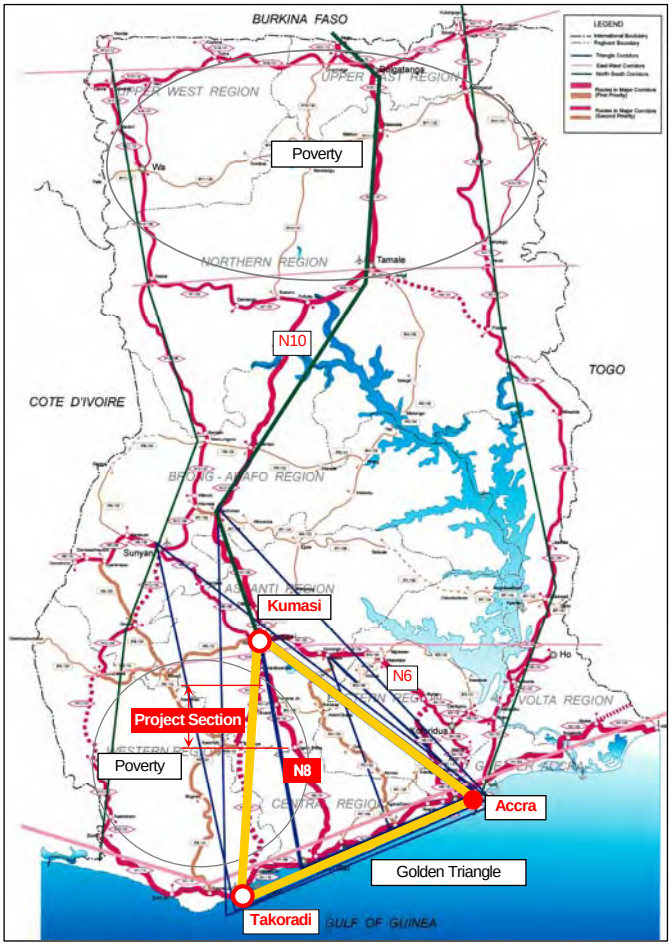

Fig. 1-1 Major Economic Zone, Impoverished Areas and Road Network in Ghana

The transportation route for major commodities to landlocked neighboring countries such as Burkina Faso, Mali and Niger conventionally passed through the Port of Abidjan in neighboring Cote d'Ivoire. However, since physical distribution has been disrupted by political instability in Cote d'Ivoire since September 2002, such commodities have had to be transported via Ghana. As a result, the flow of transit freight for landlocked nations increased from less than 10,000t in 1997 to 1.12t million in 2005. Around 80% of the transit freight is handled at the Port of Tema, however, since the handling capacity of this port has nearly reached its limit; the flow of transit freight via the Port of Takoradi is expected to increase in the future. Accordingly, National Trunk Road N8, a route which connects the Port of Takoradi and landlocked countries, is considered to be an important distribution route for those countries.

National Trunk Road N8 underwent improvements with the paving of asphalt concrete (AC paving) under Japanese yen loans between 1990 and 1994. However, the road paving has since become considerably damaged due to increased traffic volume and problems such as overloading, etc. Particularly along a section of approximately 30km from Anwiankwanta to the coast, drivability of the road has deteriorated

significantly. In response, in February 2006 Ghana submitted a request to the Japanese Grant Aid Scheme for road improvements and rehabilitation of a total length of 176 km, including improvements to two bridges along the section. Although the necessity of the request is considered to be sufficient since the economic infrastructure of Ghana is a lifeline for neighboring landlocked countries, it was necessary to confirm and examine the following items. Accordingly, the Japan International Cooperation Agency (JICA) conducted a preliminary study entitled the "Anwiankwanta/Yamoransa Road Rehabilitation Project" between July and August 2007.

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① Since no particular problems with regard to drivability have been reported on some sections, the pavement situation and the degree of bridge damage in each section are unclear.

② Even though the service life was set at 20 years in the loan aid project, some sections are already facing drivability problems less than 15 years after completion. The cause for this is unknown.

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As a result of the preliminary study, with respect to the above-mentioned ① and ②, in addition to the increase in traffic load which substantially exceeded estimates at the time of the design, it has become clear that significant damage has occurred due to the impact of materials and the natural environment. It has also been clarified that some sections of the road with no drivability problems at the present time are nearing the end of their life span. With respect to ③, it is apparent that the section approximately 16km from Anwiankwanta, where it has been remarkably damaged, has been repaired by Ghana independently. With respect to ④, although shops and residences, etc. in the vicinity of the two proposed bridges were confirmed and large-scale involuntary resettlement has not occurred, some signs of the impact are unclear, so it remains Category B in the JICA Guidelines for Environmental and Social Conditions.

Based on the current situation, from the viewpoint of urgency, the preliminary study reached the conclusion that the badly damaged section approximately 60km from Assin Praso (including Assin Praso Bridge) to Anwiankwanta heading south is of highest priority.

Based on the above-mentioned findings of the preliminary study, since the section of approximately 60km from Assin Praso (including Assin Praso Bridge) to approximately 16km south of Anwiankwanta was considered to be of high priority in the preliminary study, this section will be subject to the Study. The aim of the Study is to confirm the necessity and relevance of the requested Japanese assistance, to conduct an appropriate Basic Design, and formulate a project plan and estimate the project cost as a Grant Aid Scheme.

1-2 Natural Conditions

(1) Natural Conditions in the vicinity of the Project Site

1) Topographic Features

The target section moves north from the starting point and passes through mountains just past the Asokwa Intersection at around the 43 km point. This mountainous section, which comprises low hills with an elevation of between approximately 100~150 m, forms the local water divide running in the east-west direction. Accordingly, surface water from local rainfall either flows southwards from the divide into Pra River or northwards into Oda River. The terrain around the target road generally comprises undulated terrain except for this mountainous area; settlements are scattered around on the tops of hills, and swamps can be found at the bottoms of some valleys. The major local crops such as timber, cacao, oil palm and cassava, etc. are cultivated in areas around the road.

2) Weather Conditions

The annual air temperature variation in the target area is small. The rainy season lasts for six months between May and October and is subdivided into a major rainy season between May and June and a minor rainy season between September and October. The annual average precipitation is 600mm along the coastal region and 1,500mm in the central region (the target sites are inland). Except for the dry season which occurs between November and February, the number of rainy days tends to be large even though the amount of rainfall is small.

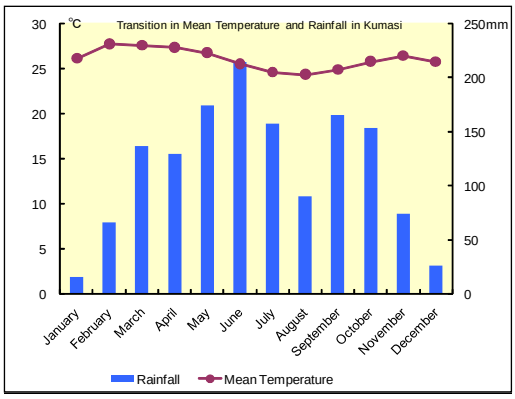


Fig. 1-2 Weather Conditions at Project Site

3) Water Level at Pra River

The Ghana Highway Authority (GHA) has conducted water level observations at Assin Praso Bridge for 43 years since 1965. At the time of the field survey, based on the results of this collected data and from interviews, it has been confirmed that the current maximum water level was established when the water level rose to the deck slab level of the present bridge during a flood in 1968. Since the difference in elevation between the location of the existing bridge and 42km upstream is 15m, the river bed gradient on the upstream side is 0.03%. In addition, for 40km on the downstream side there is very little gradient too, so it can be said that Pra River in the vicinity of the existing bridge is flat. The water depth under the existing bridge at the time of the field survey in April 2008 was approximately 0.5m to 1.8m and there was almost no flow. However, at the time of the field survey conducted in October 2008, the water depth was approximately 5m and a flow rate of 1m to 2m/s was observed.

4) Geological Features at Project Sites

Although soil property in the vicinity of the target road is mainly composed of auburn laterite and is suitable for road construction material, there is some grayish-white and red sandy soil exist which erodes easily during rain. Consequently, these soil properties should be taken into account during planning.

With respect to the Assin Praso Bridge, a boring survey on both side of existing river banks were conducted on both sides of the bank of the existing bridge by the local consultant in 1991. According to this, since sandy silt and gravel exist 10m from the ground surface, the N value indicating the strength of ground fluctuates from 5 to 50. In deep spots approximately 10m from the ground surface, there is granite bedrock.

5) Earthquakes

An outbreak of several earthquakes in the past in 1862, 1939 and 1997 was confirmed in the vicinity of Accra, the capital of Ghana. Consequently, necessary considerations for earthquakes are included in the design standards for structures in Ghana.

(2) Implementation of Survey on Natural Conditions

In the field survey, the following natural conditions were investigated.

1) Topographical Survey

A topographical survey of the section subject to the Study (approximately 60km) commenced on April 7 as local commissioned work. The surveying work included reference point surveying and differential leveling. The surveying work was completed during the site investigation period.

- Reference point surveying : Total length of 60km, every approximately 1.5km
- Topographical survey : Total length of 60km, 50m of road width
- Differential leveling : Total length of 60km

2) Soil Test

a. Material Survey

- Borrow Pits

Concerning borrow pits for embankment materials, based on hearings with the GHA, information in existing documents and local interviews, survey was carried out on the feasibility of borrow pits in the plan with regard to quality, reserves, transportation distance, accessibility to the actual site and cost. In the field survey, laboratory tests were conducted on samples of embankment soil from seven of the proposed borrow pit locations and sand from two of the pits approximately 5km within the target road section.

Fig. 1-3. Location of Quarry

・ Aggregate quarry

With respect to aggregate for pavement and concrete, there are several aggregate quarries near the Study road that have been utilized in past projects.

The four places were selected as proposed sites for aggregate quarry. As Aponsie district is regarded as the most promising site in terms of quality, size of reserves, transportation distance, cost and accessibility to the actual site for collecting aggregate, laboratory tests were conducted on collected aggregate samples.

b. Test pits of existing pavement and DCP

By excavating test pits on the target road shoulders, thickness of each layer of the existing pavement was confirmed. Also, dynamic corn penetration testing (hereinafter referred to as "DCP") was conducted in order to grasp the bearing capacity of the road bed. In addition, laboratory tests were conducted on samples collected from the test pits.

Fig. 1-4 Working Scenes at Test Pit

3) Geological Survey

For the estimated supporting base foundation of the Assin Praso Bridge, the bearing layer of the bridge foundation was estimated from existing boring data and the on-site observation. Since granite is cropped out on the riverbed of Pra River at Assin Praso Bridge, it is judged to be appropriate for the bridge supporting foundation.

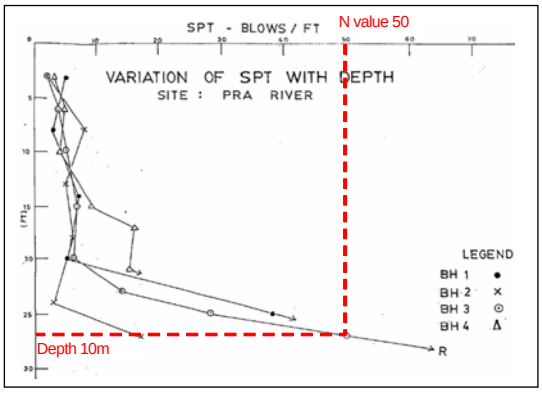


Fig. 1-5 Boring Data with N value

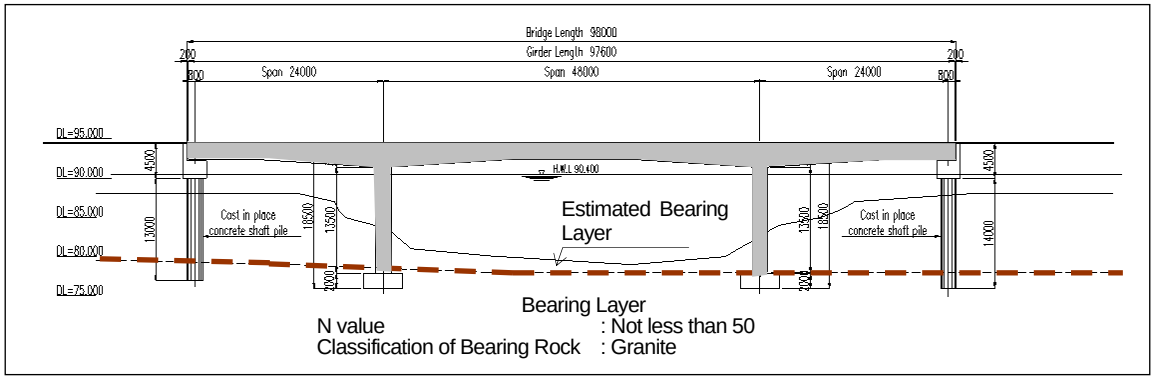


Fig. 1-6 Estimated Bearing Layer for the Assin Praso Bridge

1-3 Environmental and Social Considerations

(1) Environmental Administration Body

The Environmental Protection Agency (hereinafter referred to as "EPA") of the Ministry of Science and Environment has jurisdiction over environmental conservation, legislation and environmental policies as the environmental administration body. The Environmental Assessment and Audit Department of the Environmental Compliance and Enforcement Division is responsible for environmental impact assessment (hereinafter referred to as "EIA"). Five personnel at the Environmental Assessment and Audit Department of EPA register projects that may require an EIA, review scoping reports and approve survey items, whereas, each regional office of the EPA carries out field survey.

(2) EIA Institution

According to the Environmental Impact Assessment Regulation (LI1652) established by the EPA in 1999, the competent government agency implements an EIA on all road and bridge construction projects (including major road improvements) and submits the results to the EPA. A project cannot move onto the implementation stage until an environmental permit is issued. For the EPA examination and issuance of an environmental permit, a fee corresponding to the project contents and scale should be paid from the implementing agency to the EPA.

(3) EIA by GHA

The Safety and Environment Department in the GHA is composed of four sections. Four personnel who belong to the Environmental Section are in charge of GHA-related environmental problems such as an EIA investigation, preparation and applications for EPA. There are no relevant environmental sections at regional offices, and the GHA Environment Department handles nearly 20 road and bridge projects annually.

(4) Scoping and Category Settlement

As a result of the scoping, although it is anticipated that the Project will have an impact on environmental factors such as land acquisition, house relocation, water usage, infrastructure facilities, plants, water pollution, noise and vibration, the impacts are considered to be minor and temporary. Accordingly, the Project is categorized as B (having potential to impart minor impact on the local environment and society) under the JICA Guidelines for Environmental and Social Considerations.

(5) Environmental and Social Considerations

Based on the findings of the environmental and social considerations study, mitigation measures on anticipated impacts should be reflected in the Basic Design. Accordingly, the relevant items will be reviewed and measures for the mitigation of environmental load during the works will be examined and reflected in the implementation plan. Also, it will be necessary to monitor the items indicated in Table 1-1during implementation of the Project.

Table 1-1 Environmental Load and Mitigation Measures in the Project

	Target Item	Main Contents	Countermeasures	Monitoring Point	
				Before Works	During Works
①	Land use and local economy	Impact on houses and stores from construction of the road and bridge access road	- Minimize impacts through readjusting the road and bridge access road alignment and adjusting the execution plan. - Provide appropriate relocation compensation and secure land according to GHA standards.	- Confirmation of the design and execution plan - Confirmation of progress in relocation procedures and land acquisition on the Ghanaian side	-
②	Infrastructure	Possibility that construction of the bridge access road will lead to transfer of power lines, telephone lines and electric poles, etc.	- The GHA will hold preliminary talks with related agencies (electricity, telephone, water supply) and take appropriate measures under the Ghanaian scope of works.	- Confirmation of relocation situation on the Ghanaian side	-
③	Noise, vibration and dust	Concern over the impact on local residents of noise, vibration and dust generated in the works	- Adopt work methods that entail minimal noise and vibration. - Regularly sprinkle water in order to limit generation of dust.	- Confirmation of the execution plan and execution method	- Confirmation that works are being executed appropriately - Confirmation that water sprinkling is being implemented appropriately
④	Traffic controls and accidents	Possibility of accidents occurring during the works. Traffic controls will be required during the works.	- Basically conduct single side works in order to minimize traffic interruptions. - Assign traffic controllers in order to appropriately guide traffic. - Erect works information boards at appropriate intervals in order to give notice to passing traffic.	- Confirmation of the execution plan	- Confirmation that works and traffic control are being executed appropriately - Confirmation that works information signs, etc. are appropriately established
⑤	Solid waste	Construction waste (asphalt paving, waste oil, etc.) from the works, and construction and general waste from the base camp will be generated.	- Properly dispose of waste at the designated waste disposal site.	- Securing and confirmation of disposal site	- Confirmation that waste disposal is being executed appropriately
⑥	Natural disasters	Examine measures for prevention and mitigation of accident risk due to rainfall during works under the bridges	- Avoid implementing base works (abutment works) during the rainy season. - Ensure works safety through establishing temporary cut-off embankments.	- Confirmation of the execution plan and temporary installation plan	- Confirmation that temporary cut-off embankments are appropriately established.
⑦	Water pollution	Examine the timing and method of bridge base (abutment) works.	- Avoid implementing base works (abutment works) during the rainy season to prevent runoff of muddy water. - Establish temporary cut-off embankments in order to prevent runoff of muddy water caused by the works.	- Confirmation of the execution plan and temporary installation plan	- Confirmation that temporary cut-off embankments are appropriately established.

(6) Environmental Permit (EP) and Land Acquisition Procedure and Situation

1) Environmental Permit (EP)

EIA Implementation and EP Acquisition Procedure

The EIA procedures necessary to implement the Project, which were confirmed with a representative from the safety and environment division at GHA, are as indicated in Figure 1-7.

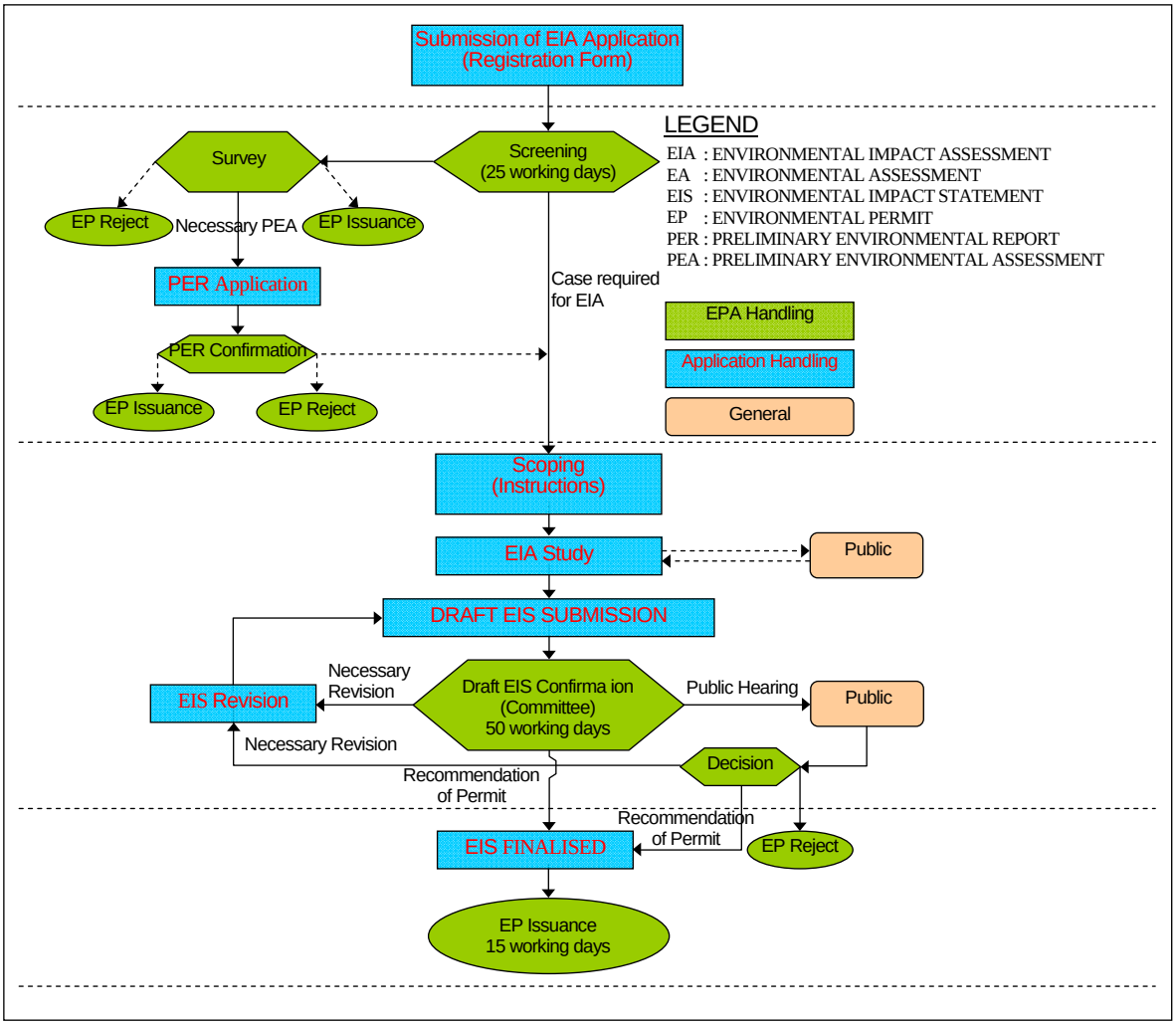


Fig. 1-7 EIA Procedures in Ghana

Procedures for Environmental Permit Acquisition

① Project registration

- GHA submitted an “Environmental Impact Assessment (EIA) application” (one A4 document + location map) to the Environmental Protection Agency (EPA) on April 16 in 2008.

② Screening implementation

- EPA judged the procedures necessary for the registered project.
- The EPA deemed the following procedures from scoping onwards to be required as a result of the screening.

- The GHA submitted the screening results to the JICA office at the end of May.

③ Implementation of scoping study and preparation of draft EIA report

- By conducting an EIA study including alternatives (especially for the Assin Praso Bridge reconstruction project under the Project), GHA prepared a draft EIA report. This process was publicly announced to newspapers and the alternatives were compared and examined. The Study Team informed GHA of the draft plans (such as bridge locations and climbing lanes) by mid June and GHA compiled a draft EIA report based on the said contents.

④ Submission of draft EIA

- GHA submitted a draft EIA report (Environmental Impact Statement) to EPA on August 3.

⑤ Draft EIA report review

- EPA reviewed (approximately 50 business days) and provided instructions on necessary revisions or investigation to GHA.

⑥ Submission of EIA report and acquisition of environmental permit

- Upon reflecting the results reviewed by EPA, GHA submitted a final EIA report in order to obtain an environmental permit (EP) from the EPA.

GHA is responsible for implementing and taking care of the study cost and services charges for appraisal and issuance of the environmental permit. When GHA submits an application, the service charge for appraisal and issuance of the permit is 13,200 Ghanaian cedi = approximately ¥1.3 million. Since the EP has an expiration date, if construction work does not commence within 18 months from its issuance, it becomes necessary to acquire a new EP. Incidentally, the GHA counterparts have reported in writing that the environmental permit for the Project is scheduled to be acquired on January 26, 2009.

2) Land and Houses, etc.

Procedure for Acquisition of Land and Houses, etc.

The width of the right of way (ROW) in the proposed section will be 60m (30m on both the right and left sides from the center of the existing road). As the geometric design of the existing road satisfies the required value as a trunk road, it is desirable to plan road improvement by tracing the existing road alignment under the Project. Consequently, new land will be required to a temporary yard near Assin Praso Bridge and detours.

In due consideration of the above-mentioned conditions, with respect to land acquisition including temporary utilization, the procedures confirmed by valuation section of GHA are described as follows.

① Confirmation of land owners (onsite, registry documents)
② Confirmation of onsite conditions (surveying, land usage conditions)
③ Calculation of land appraised value
④ Explanation to land owners (as needed, negotiation with cooperation from the district office or local chief)

⑤ Obtaining of consensus from landowners
⑥ Payment of 50% of the appraised value (usually paid in advance by the contractor and refunded later by the GHA)
⑦ Preparation of reports and acquisition of approval from district office (land valuation board)
⑧ Payment of the remaining 50% value

Situation regarding Acquisition of Land and Houses, etc.

In the Project, new site land will only need to be secured around Assin Praso Bridge. Study was conducted on houses and crops in the affected area at the time of the field survey in May 2008, and the scope and size of impacts were examined with GHA. The acquisition of consent from land owners located in the affected area will be dealt with by the following process.

i) Submission of the planned schematic diagram from the consultant to GHA (June 2008)
ii) Submission of a draft Basic Design from the consultant to GHA (September 2008)
iii) Implementation of a field survey (four weeks, the above-mentioned ① and ②) based on the draft Basic Design by the survey group of GHA
iv) Analysis on the results of the field survey and settlement of eligible persons by GHA (four weeks, the above-mentioned ③ and ④)
v) Explanation to and acquisition of consent from land and building owners (end of November 2008, the above-mentioned ⑤)

At the present time, the above-mentioned process until iii) has been completed and process iv) is underway. Within the field surveys implemented by GHA in procedure ii), basic consent has been obtained from land and house owners, etc. regarding land acquisition and the relocation of houses and stores. Regarding this point, the GHA counterparts have reported in writing that the basic agreement has been finalized.

Concerning temporary yards and detours for construction work, since these facilities can be installed away from existing residential districts, there will be no major impact which entails the relocation of houses.

1-4 Other Relevant Issues

When examining the Project, in order to deal with human immunodeficiency virus (hereinafter referred to as “HIV”), it will be necessary to incorporate HIV countermeasures into the basic conditions for works implementation.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

As the central pillar of national planning, Ghana formulated a long-term economic and social development plan (Ghana Vision 2020) in 1995 with the goal of raising social status and living standards as a middle income nation by the year 2020. It is now developing human resources, urban and local areas, and the social and economic environment. The "Growth and Poverty Reduction Strategy (GPRS) II 2006-2009" was formulated in 2005 in order promote traffic infrastructure development for supporting private sector-led growth as one of the major objectives. As a promotional step for traffic infrastructure development in GPRS II, the development of access roads or trunk roads between cities and markets is recommended. At the same time, the development of a north-south international road connecting to the east-west road being developed by the Economic Community of West African States (ECOWAS) is regarded to be a priority policy. Consequently, these plans and programs including the development of transport routes in Ghana and the neighboring landlocked nations are regarded as the overall goal of the Project. The Ministry of Transportation (MOT), the implementing agency, formulated the Road Sector Development Program (RSDP) and considers it to be an urgent task to develop a road network that will promote transportation efficiency for freight and passengers and stimulate economic growth. The Project target section from Assin Praso to Bekwai is a part of National Trunk Road N8, which is a major trunk road in Ghana, and is an important route for international distribution to adjacent landlocked countries. Accordingly, the Project aims at securing smooth and stable transportation of people and commodities through improving the target road. As a result, through revitalizing the movement of people and goods in Ghana and landlocked neighboring countries, the Project aims to promote economic growth in Ghana and revitalize the regional economy of West Africa.

2-1-2 Project Outline

The Project will improve 59.9km of National Trunk Road N8 between Assin Praso and Bekwai in order to achieve the above-mentioned objectives.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The target road in the Study contributes to Ghana's social and economic development as part of a major trunk road network serving the nation, and it is an important route in the transportation of goods to neighboring inland countries. Although the section of the road subject to the Study was improved with asphalt concrete through Japanese yen loans between 1990 and 1994, the existing level of damage cannot be repaired in the periodical maintenance activities currently implemented. Moreover, the existing bridge built over Pra River between Assin Praso, the starting point of the target section, and Adanse Praso has

become deteriorated over 72 years of use. Also, since the bridge isn't wide enough, the target section of road has become a bottleneck in the major trunk road network and requires immediate improvement. Considering the status of the target road in Ghana, the basic principles on design for the purpose of securing smooth and safe traffic flow are described in the Project as follows.

1) Basic Policy on Road Design

① The requirements of a trunk road shall be satisfied.
② A plan that harmonizes with the major trunk road network including other sections shall be examined.
③ A plan that fits the existing right of way (ROW) shall be examined (by tracing the existing road, effectively utilizing existing pavement and structures whenever possible, and minimizing negative social and environmental impacts).
④ A plan that takes cost reduction into consideration shall be examined.
⑤ Traffic volume and characteristics (large vehicles, small vehicles, bus transportation and pedestrians) shall be examined and reflected in the plan.
⑥ A plan that takes traffic safety measures such as installation of safety facilities in urban areas shall be examined (to ensure safe and smooth road traffic flow).
⑦ It shall be possible to keep the road in good condition over the long term through simple maintenance.

2) Basic Policy on Bridge Design

① An appropriate load capacity that conforms to the present Ghanaian design standards shall be secured.
② A road width that conforms to the present Ghanaian design standard shall be secured.
③ The safety and convenience for vehicles and pedestrians shall be taken into account.
④ Bridge reconstruction shall be planned with minimal social and environmental impact.

(2) Design Principles

The grant aid project has been planned based on the following principles in order to contribute to the implementation of RSDP for the purpose of securing a reliable and smooth road network in Ghana. In conducting the design, consideration has been given to the request of the Government of Ghana for improving National Trunk Road N8 between Assin Praso and Bekwai and the results of the field survey and discussions.

1) Target Section

Since pavement has become deteriorated over the entire target section, it is necessary to conduct improvement over the entire target section. As a result of conducting a detailed survey and examining the plans in the Study, it has been decided to implement road improvements over a section of 59.9km.

2) Design Criteria

In the design of the proposed road, Ghanaian road and bridge standards shall be applied in principle. Also, standards of the American Association of State Highway and Transportation Officials,

hereinafter referred to as "AASHTO standards," and Japanese standards (the Explanation and Application of the Road Structure Ordinance compiled by the Japan Road Association), etc. shall be referred to where necessary.

3) Road Standards

Road standards were examined by applying the Ghanaian standards (trunk road level) in a similar manner as with existing roads. Alignment was examined by tracing the existing road in order to minimize the relocation of roadside houses or public facilities. Similar to present roads, the design speed shall be 40km/hr in the mountainous section and 80km/hr along other sections.

4) Pavement Plan

Design load necessary for the pavement plan was calculated assuming design axle load of 13t and design life of 15 years according to the Ghanaian standard. Pavement was designed in the class of 27 million axle load (local trunk road level in Japan) calculated by converting the cumulative traffic load in the design period into the standard axle load (conversion of 8.2t) based on the traffic volume in the proposed section obtained in the field survey.

5) Rehabilitation Plan

By categorizing into sections according to the existing pavement conditions, the minimal necessary rehabilitation method appropriate for each section was examined so as to promote cost reduction. With respect to sections where the impact of stagnant water on the surrounding areas or underground water is anticipated, the road shall be rised (overlaid) for necessary case. Other general rehabilitation shall be planned in due consideration of cost and the procurement conditions of materials and equipment.

6) Structure Plan

a. Assin Praso Bridge

The Assin Praso Bridge is suffering from deterioration. Moreover, because the width of the bridge including the sidewalk is only 5.6m compared to the 7.3m carriageway width required on National Trunk Road N8, the bridge can only allow alternate one-way traffic. Also, since the installed height of superstructure members is low (4.6m) compared to the 5.2m clearance limit prescribed in Ghanaian standards, superstructure members have been damaged by collisions from vehicles. Moreover, the allowable load at the time of the design (12 ton vehicle load) is drastically insufficient from the present standard (24.5 ton of vehicle load). Under such circumstances, the existing bridge requires urgent reconstruction. Therefore, the idea to construct a new bridge downstream of the existing bridge was proposed in the Project based on an examination of the overall construction cost including temporary structures and relocation of a few houses. In addition, although it will be necessary to remove the existing bridge in the future, since it can be utilized effectively as a bridge exclusively for pedestrians, the present bridge will remain at Ghana's request.

b. Road Traversing Culverts

Existing road traversing culverts with problems such as nonconformance with the present Ghanaian standards, difficult maintenance or poor structural soundness will be replaced.

(3) Measures for Natural Environmental Conditions

Metrological conditions and hydrological factors shall be reflected in the road plan, road drainage facility plan and construction plan. The topographic and geological features will be effectively utilized in the road plan, structure plan and construction plan. The specific natural conditions that need to be deal with are described below.

1) Topographic Features

The lowest elevation over the Project section is approximately 90m above mean sea level around Assin Praso Bridge, which is the starting point of the Project. A flat area approximately 90m above sea level continues for approximately 8.5km, followed by gently rolling terrain up to an altitude of 220m at the 43km point. From that point onward, a 3km section between 43.5km and 46.5km is mountainous. In the section between 43.5km and 45.1km of 1.6km section is an uphill grade of 6 to 8% continues until the 45.12km point (top of a mountain pass, altitude 320m). From the top of the mountain pass in the direction of the end point, a downhill slope continues at 7 to 6% until an altitude of 260m at the 46.5km point, where the mountainous zone ends. After that, mild rolling terrain continues down in the direction of the end point to an altitude of 210m. Moreover, the target road passes through low-lying marshy land with fragile ground in some valley parts. Accordingly, the road design has been compiled to fully reflect the diversity of conditions, i.e. flat parts, mountain parts and other conditions, along the target section.

2) Weather Conditions

The annual temperature variation in the target area is small. The rainy season lasts for six months between May and October and is subdivided into a major rainy season between May and June and a minor rainy season between September and October. The annual average precipitation is 600mm in the coastal region and 1,500mm in the central region. Except for the dry season which occurs between November and February, when very little rainfall occurs, the number of rainy days is large, and these conditions will be reflected in the implementation plan.

3) Water Level of Pra River

The Ghana Highway Authority (GHA) has conducted water level observations at Assin Praso Bridge since 1965. At the time of the field survey, from the results of this data and from interviews, it has been confirmed that the current maximum water level was established when the water level rose to the deck slab of the present bridge during a flood in 1968. Although Pra River in the vicinity of the existing bridge is flat, the water depth rises to approximately 5m to 6m in the rainy season and the flow becomes 1m/s to 2m/s. The river conditions will be sufficiently examined and reflected in planning for the height of the bottom of the girders at the bridge (vertical clearance) and examination of the connecting road.

4) Geological Features at Project Sites

Soil property in the vicinity of the target road is mainly composed of auburn laterite and also contains some grayish-white and red sandy soil which erodes easily during rain. According to the boring survey conducted at Assin Praso Bridge (surveyed by the local consultant in 1991), in deep spots approximately 10m from the ground surface, granite bedrock was confirmed. The above-mentioned features at the project sites will be adequately considered and shall be reflected in the Project.

5) Consideration of Seismic Force

Based on the Ghanaian bridge design standards, a 0.1 lateral seismic coefficient shall be adopted.

(4) Policy on Socio-economic Conditions

1) Response to Changes in Traffic Load

Corresponding to the pavement deterioration resulting from overloaded vehicles or the liberalization of economic activities in the West Africa economic block, 13t/axle, which is the ECOWAS standard, is presently applied to the pavement sepcifications. Consequently, the planning for design will be exammined in due consideration of the load conditions. By analyzing the existing pavement conditions and effectivley utilizing these to the maximum, the ideal cost and construction period will be examined.

2) Consideration for towns and villages

There are 22 towns and villages along the target road where the existing households are concentrated. Markets are periodically held along the target road so that commercial activities are a source of revenue for local residents who sell daily necessities, sundries and garden produce grown in the vicinity. This shall be therefore reflected in the plan and the safety and convenience of local residents will be taken into consideration, for example, bus stop locations, stopping lanes, and traffic speed restrictions in these towns and villages. Concerning stalls selling local products at bus stops on the road between Accra and Kumasi, new facilities will not be installed since there are small-sized shops have been already established along the target road.

(5) Policy on Construction and Procurement Conditions

1) Policy on General Construction Situation

Legislation related to employment of local personnel under the Project falls under the Ghanaian Labor Act. Accordingly, workers shall be employed in conformity to rules regarding minimum wage and working hours, etc. by job classification in the Act. As road and bridge improvement projects are being implemented through the assistance of Japan and other donors, etc. in recent years, foreign public works contractors in Ghana have opened their offices and have contracted road and bridge development projects. As a result, local contractors have participated as sub-contractors in some cases. It is therefore judged to be sufficiently possible for Japanese contractors (suppliers) to procure labor locally under the Project.

2) Policy on Construction Materials and Equipment Procurement

Major construction materials such as aggregate, cement and timber are locally available in Ghana. With respect to procurement of crushed stone for road construction, if aggregate is to be produced through direct quarrying, mining license are necessary, so it will take a few months for procedures in general. Consequently, when taking construction period and quantity consumed into account, it is realistic to effectively utilize local crushed stone companies or contractors. In addition, with respect to a permit for blasting work in the case of digging, in a similar manner as mentioned above, permits will be dealt with effectively by utilizing local contractors. The rock quarries that produced poor quality stone seems regarded as one of the factors behind pavement deterioration on the existing road were excluded from the examination of procurement sites. For cement procurement, as there are a few local companies producing cement in Ghana at the present time, procurement sources will be examined after sufficiently confirming qualitative and quantitative stability of supply. Since other major bridge construction materials (such as PC steel products, expansion devices, supports and liner plates) are difficult to procure locally, procurement from neighboring nations will be examined in due consideration of quality, quantity and economic efficiency. In addition, fuel imported from the Ivory Coast and Nigeria is locally available.

3) Policy on Construction Machinery Procurement

Most of the locally available construction machinery is obsolete and it will take time to procure spare parts when machinery breaks down. Procurement of machinery to be utilized for long hours at the construction sites will be considered from Japan and a third country. However, machinery to be utilized for short hours such as cranes shall be procured locally.

(6) Policy on Effective use of Local Contractors

There are thousand of contractors who are related to road construction work in Ghana and are classified into five categories from A to E based on the scale of order intake of public works, technical skills and capital, etc. Of those, 17 firms are classified in Category A and Category B and can contract road construction work autonomously. for the firms capable of subcontracting the planned construction (road improvement and bridge reconstruction) are J. ADOM LIMITED, Cymain Co. LTD and FACOL ROADS LTD. Both companies are local contractors and have much experience in road and bridge reconstruction work in Ghana. Accordingly, these firms will be utilized as subcontractors.

(7) Policy on Competency of Management and Maintenance of Implementing Agencies

1) Maintenance Issues

Approximately ¥2.2 billion for routine maintenance such as patching was approved as the budget for the request, although the cost of completed works came to approximately ¥1.1 billion (FY2007). Alternatively, whereas the proposed extension of routine maintenance is 12,16km, work was only executed on 8,115km. In other words, approximately 30% of the requested work was not implemented and more than 40% of the budget was left over. In addition, whereas the requested extension for periodic maintenance was 601km, work was only implemented on 209km, and more than

80% of the budget was unused. Consequently, road maintenance work in Ghana is not carefully budgeted to meet targets and the implementation setup is inefficient.

It is necessary to establish an implementation setup and realize more appropriate budget requests and efficient allocations on the assumption of future damage conditions. Incidentally, the World Bank and some of other donors provide technical assistance for road maintenance work.

Table 2-1 Approval for Maintenance and Completed Conditions (FY 2007)

Item	Implementation Plan		Approval		Results			
	Target Distance (km)	Amount (¥100 million)	Target Distance (km)	Amount (¥100 million)	Target Distance (km)	Ratio (%)	Amount (¥100 million)	Ratio (%)
Routine Maintenance	12,168	19.0	12,168	22.1	8,115	67	10.5	55
	90%	11%	94%	20%	94%		15%	
Periodic Maintenance	601	32.5	221	10.2	209	35	6.7	21
	4%	19%	2%	9%	2%		9%	
Repair Project	770	120.5	491	80.3	347	45	54.9	46
	6%	70%	4%	71%	4%		76%	
New Development	0	0.0	0	0	0	-	0	-
	0%	0%	0%	0%	0%		0%	
Total	13,539	172.0	12,880	112.6	8,671	64	72.1	42

Remark : Ratio of expenditure for approved budget=general account =65%, financial resources for roads=33%, donor aids=2%

Source : RSDP Program Management Report, Dec 2007, GHA

2) Maintenance Conditions

Road maintenance implemented by GHA can be divided into periodic repair, routine maintenance and recurrent maintenance. Periodic repair includes large-scale construction work such as overlaying of paved roads, paving of unpaved roads, and standard tailoring; whereas routine maintenance refers to road gutter or culvert cleaning, and small-scale work for pavement repair such as patching. Recurrent maintenance, weeding or gutter cleaning is conducted by individual contractors six times a year. Since such road maintenance work has been commissioned to the private sector since the first half of 1980, almost all work is implemented through commissioning except for urgent repairs. A plan shall be examined under the Project in due consideration of the implementation conditions of maintenance work.

Table 2-2 GHA Maintenance System

Maintenance Scale			Place to commission	Remark
1	Periodic Repairs	Once every 3 years	Private commissioning, 2-year contract	Existing pavement repair in specific sections of 4 to 5km and sealing
2	Routine Maintenance	Annually	Private commissioning, 2-year contract	Pothole monitoring, patching work
3	Recurrent	6 times a year	Contact with individual, one-year contract	Weeding along 30km large sections and 5km small sections, gutter cleaning

(8) Policy on Establishment of Scale and Components for Proposed Facilities

1) Starting and End Points of the Project

a. Starting Point

Since the horizontal alignment at the starting point of the Project will change up to 30m from the present road accompanying the Assin Praso Bridge reconstruction, an access road to the present road is necessary. For connecting to the existing road, an optimal spot that smoothly connects the horizontal and vertical alignment of the present road shall be extracted.

b. End Point

Although the end point of the Project should be connected to the end point of the section undergoing road repairs by Ghana 16km from Anwiankwanta, the relevant section will be completed in March 2009. Consequently, an optimal connection spot shall be extracted and set up based on the latest geometric factors of the rehabilitation section obtained during the field survey. From the above-mentioned results, the distance between the starting and end points of the Project will be 59.9km.

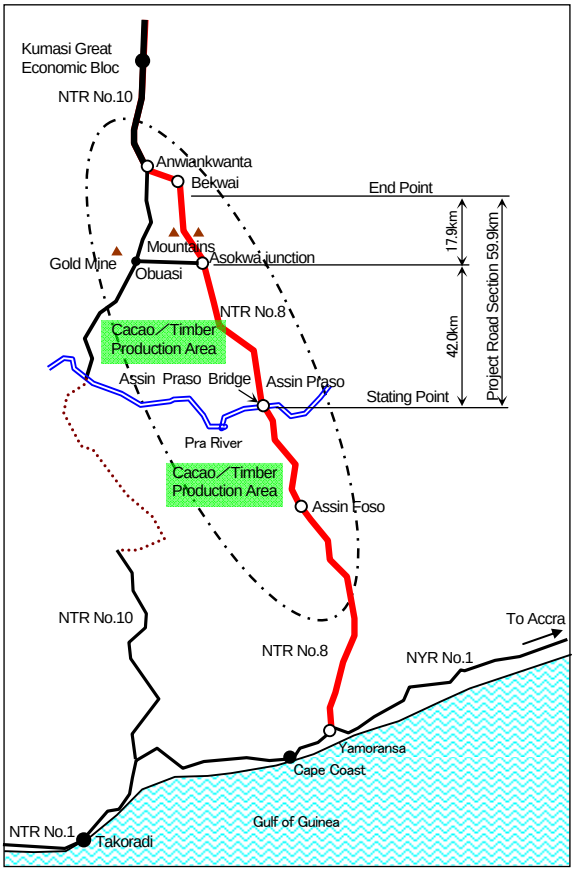


Fig. 2-1 Proposed Section

The general condition of present road between Assin Praso and Anwiankwanta including the target section is passable, even in areas where the road is in poor condition. The road between Yamoransa and Assin Praso is also in relatively stable condition due to the GHA maintenance. Following completion of repairs on the above 16km section in March 2009 and rehabilitation under the Project, flow of traffic on the entire National Trunk Road N8 will be secured.

2) Road Geometry

a. Applicable Standards

In the Project, the Ghanaian standards will be observed as applicable standards. Compared to the shoulder width of 2.0m in the initial request, although 2.5m is the present standard in GHA, as a result of discussions with the Ghanaian side, a shoulder width of 2.0m shall be applied since the Project aims at improving the existing road.

In the section subject to the Study, the stretch from the Assin Praso Bridge starting point to the Asokwa intersection at around 42km passes through a gentle plain of approximately 0.3%

gradient. The road from Asokwa intersection passes through a mountainous section (6.0 to 8.0% longitudinal slope), after which it passes through gently undulated terrain to the end point. The present horizontal and vertical alignments satisfy the 80km/hr design speed on the general section and 40km/hr on mountainous section in conformity with the "Explanation and Application of Road Structure Ordinance" compiled by the Japan Road Association.

b. Geometry

Alignment of the existing road is based on a design speed of 80km/hr in general sections and 40km/hr in the mountainous section. In the plan, as alignment of the existing road satisfies the preferred design speed, the existing road under stable conditions where compaction has progressed due to traffic load will be effectively utilized to the maximum. At the same time, a plan to trace the existing road alignment shall be examined so as to minimize the impact on society and the environment.

i Horizontal Alignment

In the plan, although the existing road shall be traced, in the section of new bridge construction associated with Assin Praso Bridge improvement, the center of the proposed road will be shifted 30m on the downstream side from the center of the existing road. Therefore, horizontal alignment for linking to the existing road shall be examined before and after the section. With respect to the climbing lane, the existing road alignment can be traced by effectively utilizing existing shoulders for the climbing lanes.

ii Vertical Alignment

In a similar manner as with the horizontal alignment, the existing alignment shall be traced for vertical alignment. However, a proposed height in due consideration of the maximum water level of Pra River will be necessary at the starting point for the Assin Praso Bridge improvement. This section will be located approximately 4m higher than the existing road. Vertical alignment shall be changed for some sections by raising (bulking up) embankment at some trough (road valley) part. The locations of changed vertical alignment are shown as follows.

Table 2-3 Locations of Vertical Alignment Changed (Rising)

Location (Distance)	Distance	Application	Remarks
0 to 1km	1.0km	Embankment construction on a new route 0 to 7m (4m raising from the existing road)	Vertical alignment changed due to access road construction associated with the Assin Praso Bridge improvement
1 to 1.7km	0.7km	Embankment construction within low marsh section from the end point of the bridge construction (1m raising from the existing road)	Raising of the existing embankment section
15.7 to 17.5km	1.8km	Embankment construction within low marsh section (0.5m raising from the existing road)	Raising of the existing embankment section
18.1 to 19.3km	1.2km	Embankment construction within low marsh section (0.5m raising from the existing road)	Raising of the existing embankment section
46.0 to 46.7km	0.7km	Embankment construction within low marsh section (1.0m raising from the existing road)	Raising of embankment on the section of entire pavement surface scattered
51.4 to 59.9km	8.5km	0.5m or 1m raising from the existing road	Raising of embankment on the section of entire pavement surface scattered in the vicinity of the end point
Total	13.9km		

iii Mountainous Section

Based on the inclination, the present traffic volume and 20% ratio of large vehicles, the installation of climbing lanes along the mountainous section will be examined. When considering climbing lanes, major civil works entailing the destabilization of existing cuttings and fillings will be avoided. Consequently, land other than ROW in the mountainous section is unnecessary.

3) Existing Pavement Rehabilitation

a. Policy of Pavement Rehabilitation Plan

In the examination of pavement structures in the plan was conducted based on evaluation of existing pavement conditions obtained from the findings of various investigations implemented during the field survey. In due consideration of the assumed traffic quality and quantity, the effective utilization of existing pavement, cost reduction and social and environmental impact, etc., methods of application will be examined so as to obtain the maximum effect with minimum cost.

b. Applicable Standards

In the plan, by sufficiently utilizing the existing road where the natural rolling compaction is well-developed due to continuous traffic load, it is necessary to take measures for coping with damage causes and conditions, to examine traffic volume forecast and to take steps toward conforming to the 13t limit for the present axle load. In addition, the design life of pavement will be examined to conform to 15 years in the Ghanaian standards.

c. Aggregate for Pavement

One of the reasons for the extreme deterioration of pavement on the target section has been the large traffic load exceeding the initial design traffic load. Another reason is thought to be the quality of the pavement materials. Pavement materials locally available around construction sites include granite mainly composed of quartz with relatively large crystals, feldspar and mica, which are utilized for sub-base course (roadbed) aggregate in asphalt concrete (AC). Although this local aggregate conforms to strength and abrasion testing, care is needed when using as AC aggregate because it has poor adhesion (peeling caused by heating) to asphalt. In the plan, the local aggregate le will be checked and the procurement sources for aggregate will be examined based on the past results.

d. Basic Rehabilitation Method

Based on the findings of the field survey, appropriate rehabilitation methods shall be examined according to the level of damage on each section by understanding the background and causes of the damage and taking cost reduction into consideration.

i Causes of Present Pavement Damage

In some spots such as sag sections and so on, the surface layer has become completely separated and scattered, while the surface is still intact in other parts. The causes behind these conditions are as follows. .

Table 2-4 Present Pavement Damage Conditions

Road Deterioration Type	Location	Cause
Scattering of pavement surface layer	Area of road sagging	Water may have penetrated into cracks on pavement surface and stagnated in sagging spots on the road causing the pavement to collapse.
	Higher underground water level spot	Due to the effects of underground water, the foundation of the road was affected and then collapsed.
	Culverts	This is noticeable on the corrugated steel pipe installation probably due to the effects of culverts and water.
Crater (pitting) of surface	Culverts, others	Impact of structural damage on culvert installation or impact of subsidence due to utilization of inappropriate patching materials
Patching site, potholes	Higher underground water level, marsh, cut-embankment border, etc.	Impact of surface water or underground water, impact of road foundation
Alligator cracks	Marsh Culverts	Impact of underground water or road foundation, impact of structural damage at the corrugated steel pipe installation or impact of subsidence at back-filling spot
Vertical and horizontal linear cracks	Outbreak across the road	Impact of surface water or underground water, progress of surface layer deterioration

ii Damage Conditions by Road Section

The findings of the analysis and examination of the survey implemented in order to confirm the state of damage of the target road are described as follows. In the surface properties survey, with respect to the present road load bearing capacity survey or the roughness survey, when the findings of previous surveys are compiled, it can be divided into the following 11 locations by condition of the target road. Approximately 70% of the total section is in relatively favorable condition, and the middle part is especially good. In addition, although the condition of the latter part is poor, the mountainous section is in relatively good condition. This is because traffic volume in the mountain part has been reduced due to vehicles making diversions in order to avoid the bad quality road on the other side of the mountains.

Table 2-5 Damage Conditions on Each Section

No.	Location	Distance	Condition	Remarks
1	0 - 2km	2.0km	Poor	The condition is poor due to the swell of road, subsidence at culvert spots and water holes, etc.
2	2 - 7km	5.0km	Fair	Although patched sites stand out slightly, both deflection and roughness are noticeable in some spots.
3	7 - 11km	4.0km	Poor	Due to many patched sites, both deflection and roughness are commonly seen.
4	11 - 15km	4.0km	Good	Few patched sites so deflection and roughness are favorable.
5	15 - 20km	5.0km	Poor	Similar to 3, many spots with serious alligator cracks. In some places the entire surface has deteriorated.
6	20 - 32.5km	12.5km	Fair	Despite concentrated patching and scattered pavement, both deflection and roughness are favorable.
7	32.5 - 43km	10.5km	Good	Despite some patching and potholes; condition is similar to 4.
8	43 - 46km	3.0km	Fair	Despite some patching and deflection, both deflection and roughness are average.
9	46 - 46.8km	0.8km	Bad	Due to patching across the surface and scattering of some pavement, deflection can be observed across the entire surface.
10	46.8 - 51.3km	4.5km	Good	Despite scattering at culverts and some potholes, condition is similar to 4.
11	51.3 - 60.0km	8.7km	Bad	Due to large-scale scattering of pavement at spots where the road sags and a lot of patching, roughness is poor and deflection is significant.

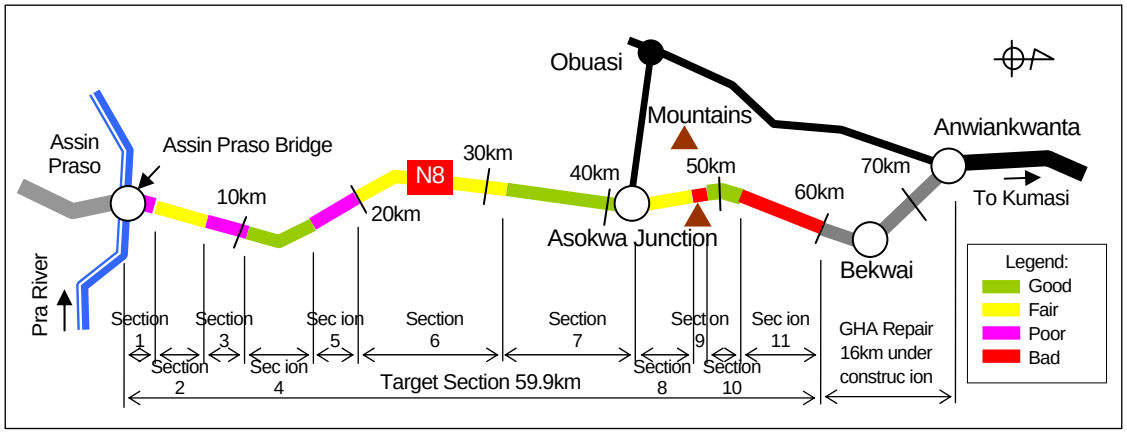


Fig. 2-2 Road Damage Conditions on Each Section

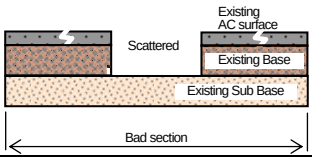
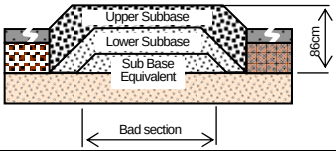
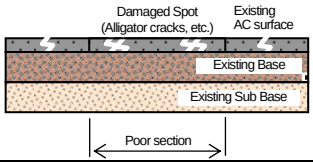
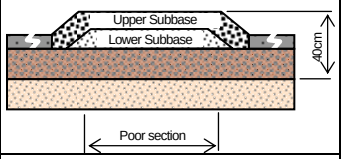
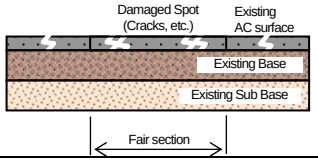
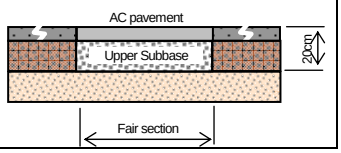
4) Pavement Rehabilitation Plan

The target road has been maintained and is in relatively favorable condition even at the present time because many locations show less than 0.6mm deflection under the Study. Accordingly, the first step toward road improvement is to rehabilitate necessary spots of the existing pavement and to improve entire sections of the target road to the same level of bearing capacity. As a second step, after the improvements have been made, overlay pavement with a thickness suitable for the assumed traffic load will be applied. This is the most suitable method for road rehabilitation in the plan.

a. Rehabilitation Step-1

In the first step of the existing pavement improvement, rehabilitation will be conducted according to the condition of the existing pavement by location and then the entire section will be restored to the same level of bearing capacity. The target section will be 58km, except for approximately 2km in the vicinity of the starting point where a new road will be constructed using a new route. Hereinafter, the standard rehabilitation methods by condition of each location are illustrated.

Table 2-6 Standard Rehabilitation Method by Section

Section	Rehabilitation Method	Scope	Rehabilitation Step -1	
			Before Rehabilitation (Present State)	After Rehabilitation
Section with large-scale scattered pavement	86cm rise by suitable material on the existing pavement	Whole Area		
Section with problems on deflection volume and AC surface layer	40cm rise by suitable material on the existing pavement	Damaged Spots		
Section without problems on deflection volume and AC surface layer	Rehabilitation of existing pavement	Damaged Spots		

Concerning the rehabilitation of the third type of section shown above, i.e. sections where pavement that hasn't been rised has suffered patching, alligator cracks and potholes, three methods can be considered as shown in Table 2-7. After examining the most suitable rehabilitation methods by taking the applicability of each method and the present damage conditions, cost and materials and equipment procurement conditions into account, type C is the optimal method for rehabilitation to the damaged existing pavement under the plan.

Table 2-7 Three Rehabilitation Methods for Existing Pavement Recovery

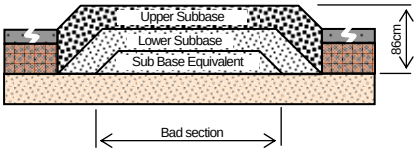
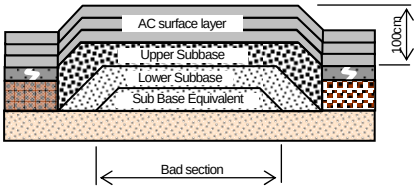
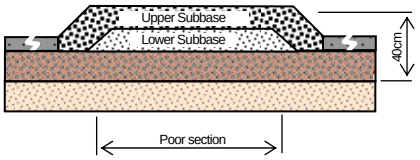
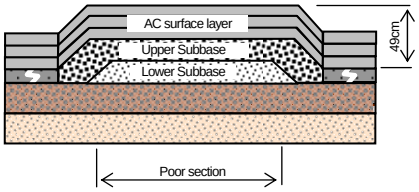
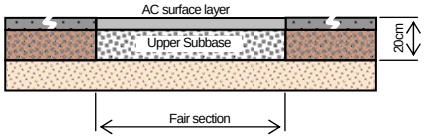
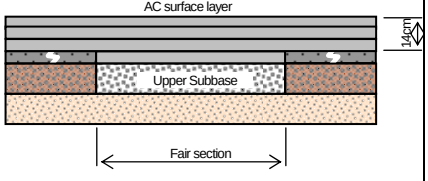
Rehabilitation Type	Rehabilitation Method	Applica-bility	Procure-ment	Cost	Remark
Type-A	Rehabilitation using asphalt materials (replacement of DBM layer)	Fair	Fair	Fair	▪ Road can be opened after the application at an early stage. ▪ Materials cost is higher than in Type C.
Type-B	Recycled roadbed effective use of existing AC surface layer)	Fair	Bad	Bad	▪ The occurrence of waste materials can be restrained. ▪ High equipment costs make this method uneconomical.
Type-C	Crushed ballast roadbed (rehabilitation through AC surface layer+base)	Fair	Good	Good	▪ General application and layer to be improved is also thick.

Remarks : DBM (Dense Bitumen Macadam) = Asphalt treated permeable base material AC = Asphalt concrete

b. Rehabilitation Step-2

The second step for road improvement under the plan is to overlay an asphalt concrete layer on the Step-1 pavement surface layer with a suitable thickness for the estimated future traffic load. In this application work, the road surface will be flattened using asphalt materials to level necessary spots of the Step-1 pavement surface. Then, an asphalt concrete layer with the necessary thickness will be overlaid.

Table 2-8 Implementation of Pavement Rehabilitation Step-2

Section	Rehabilitation Step -1	Rehabilitation Step -2	
Section with large-scale scattered pavement			Raising from existing road by 1m
Section with problems on deflection volume and AC surface layer			Raising from existing road by 49cm
Section without problems on deflection volume and AC surface layer			14cm overlay on the existing road

5) Shoulder Pavement

With respect to the pavement of road shoulders, Ghanaian standards have been modified from the use of asphalt surface treatment (BST: Bituminous Surface Treatment) to asphalt concrete (AC) pavement, which has been adopted for projects since 2001. Under the plan, an AC structure with minimum thickness was examined.

6) Assin Praso Bridge Improvement

a. Existing Bridge Conditions

In the field survey, damage conditions at the present Assin Praso Bridge and the surrounding conditions (such as land usage, geographical and geological features, hydrology and traffic volume) were confirmed. The existing bridge conditions are described as follows.

⇒ 72 years have elapsed since the construction of the Assin Praso Bridge. Diagonal members of the bridge indicate limit loads. The loads are 12t for trucks, 18t for trailers and 100 pounds/ft^2 for crowds. Under the present traffic conditions, approximately 2,600 units, including large trailers and vehicles pass by each day. It is confirmed that some large vehicles for cement transport drastically exceed the limit load.

⇒ With respect to the substructure of the bridge, due to inappropriate treatment on the pedestal of the upper part of the bridge pier on the right bank when placing a concrete joint, water is seeping out from the concrete joint and has spread to the substructure. However, the strength of the concrete on the bridge pier appears to be fine.

⇒ On the substructure of the bridge, transverse members connecting truss materials on both sides were removed and simple substitute steel materials have been installed. Handrail pipes are partially deformed which is an indication that vehicle collisions have taken place. Although all rivet joints were considered to have been installed at the time of construction, most of them have been replaced with high-tension bolts.

⇒ All bridge deck drainage pipes were covered with asphalt when the bridge deck was repaired. There are also cracks at the positions of cross girders entirely on wheel guard concrete. Rain water has spread from the cracks inviting corrosion on the flower beam under the deck slabs.

⇒ Since the bearing (support) surface was covered by soil and weeds are growing, this invites or promotes corrosion. Due to the huge impact of vehicle load, some of the bearings (supports) of stringers are buried in the pedestal so the stringers are directly on the pedestals.

⇒ When large-sized trailers cross, a considerable swing can be felt in the center of the bridge. In addition, the width is inadequate for vehicles to pass in both directions at the same time.

⇒ GHA conducted a soundness survey of the Assin Praso Bridge on October 15, 2003. The survey results showed that there are no particular problems. However, in the Study, in order to secure safe and reliable traffic flow for vehicles utilizing National Trunk Road N8, from the results the bridge should be rebuilt immediately due to corrosion on the cross girders and stringers and swing during large vehicle traffic.

b. Existing Bridge Peripheral Conditions

i Topography

The terrain is generally flat both upstream and downstream of the existing bridge. There is a small swamp downstream on the left bank of the bridge, so special attention should be given when examining the new location for bridge construction.

ii Geological Features

According to the boring survey data on both banks of the existing bridge (surveyed by the local consultant in 1991), as the layer approximately 10m from the ground surface contains sandy silt and sand gravel, the N value indicating ground strength ranges from 5 to 50. Less than 10m under the ground surface is a layer of granite bedrock. In the plan, these conditions should be considered when selecting the foundation.

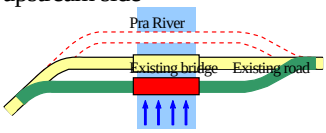
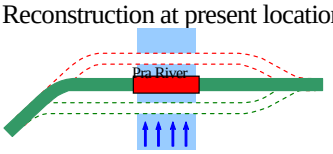
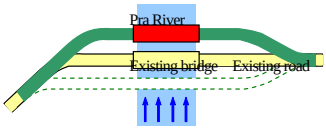
iii Hydrology

Since the difference in elevation of Pra River bed 42km upstream of the existing bridge is 15m, the river bed slope is 0.03%. There is almost no slope until 40km downstream, therefore the riverisessentially flat. Water depth under the existing bridge at the time of the field survey was 0.5 to 1.8m and there was almost no flow. GHA has been observing the water level of Pra River for 43 years since 1965. As the result of this data and an interview survey, it is confirmed that, during a flood in 1968, the maximum water level rose to the crown of the deck slabs on the present bridge. Whether a new bridge is constructed or the existing bridge is repaired, an allowance for the maximum water level should be taken into account.

c. Comparison of Bridge Improvement Options

It is possible to examine the following three options as shown in Table 3-9. In the case of constructing a new bridge upstream or downstream of the existing bridge, the existing bridge will need to be removed some time in the future due to its extreme deterioration. However, based on the request from the Ghanaian side, utilizing the existing bridge exclusively for pedestrians is deemed to be possible since load conditions will drop significantly. Therefore, the existing bridge should only be removed in the case where a new bridge is constructed at the same location as the existing one.

Table 2-9 Bridge Improvement Options

Option	Description	Features
Option-1 : New bridge construction on the upstream side 	1) Construction of new bridge upstream of the existing bridge 2) Opening to traffic on new bridge 3) Retention of former bridge	▪ Relocation of existing houses (about 29 residences) ▪ Cheaper construction cost than reconstruction at present location ▪ Future removal of present bridge to be undertaken by the recipient side
Option-2 : Reconstruction at present location 	1) Traffic detour by constructing a temporary bridge 2) Removal of former bridge 3) Construction of new bridge 4) Opening to traffic on new bridge 5) Removal of temporary bridge	▪ Effective if no land exists ▪ Increase in construction cost related to temporary bridge
Option-3 : New bridge construction on the downstream side 	1) Construction of a new bridge on the downstream side of the existing bridge 2) Opening to traffic on new bridge 3) Retention of former bridge	▪ Relocation of fewer existing houses than that of the option upstream (about 13 residences) ▪ Cheaper construction cost than reconstruction at present location ▪ Future removal of present bridge to be undertaken by the recipient side

d. Policy on Examination of Optimal Improvement Option

In the plan, an optimal improvement plan shall be studied to include major examination items such as total construction cost including temporary structures and relocation of fewer existing houses. Of the examined items, Option-3 (construction of a new bridge downstream of the existing bridge) can be recommended. The number of existing houses affected by the recommended Option-3 will be 13 residences. In addition, the distance between the new bridge and existing bridge should be 30m downstream from the center of the existing bridge taking into consideration road alignment to connect with the existing bridge and surrounding conditions.

7) Incidental Road Facilities Improvement

a. Culverts

Three types of culverts, i.e. box culverts, concrete pipe and corrugated metal pipes, are presently installed at 139 locations in total. In the plan, based on confirmation of onsite drainage systems, in due consideration of structural soundness, local installation conditions and conformity to the present GHA standards, the existing structures shall be improved.

Table 2-10 Overview of Culvert Types

Type	Size	No.	Ratio (%)	Remark
Box Culvert	Not less than 3m×3m	8	6	No problems
Concrete Pipe	D=60cm	27	19	Non-conformity to GHA standards
	D=110cm	4	3	No problems
Corrugated Metal Pipe	More than D=100cm	100	72	Many problems such as inviting road collapse
Total		139	100	

b. Roadway Drainage System

The standard soil gutters (4.0m wide by 1.0m deep) are installed for the existing drainage system. In the villages, there are soil gutters covered by concrete and U-shape gutters (50cm×50cm) in some sections. At locations of steep slope in the mountainous section, U-shape gutters (50cm×50cm to 100cm×100cm) are installed. In villages, poor drainage has been confirmed in areas of large grade differences between shoulder edges and adjoining parts and parts where the drainage facilities have been damaged or removed. Accordingly, it is necessary to examine the installation of drainage facilities to the areas in need.

Existing gutters affected by the Project shall be restored to the same present structures. However, since gutters and existing shoulders beside the gutters are damaged in the villages, installation of concrete gutters shall be examined for essential locations.

c. Incidental Facilities

The target road is a regional trunk route connecting the inland area mainly in Kumasi in the central region of Ghana and the coastal area such as the Port of Takoradi. At the same time, it serves as an international road connecting inland nations and the Port of Takoradi. However, villages are scattered along the target road and commercial activities are carried out. Accordingly, the convenience or safety of local residents shall be taken into account.

- Parking lanes : Bus stops (each village on roadside), separated stopping lanes (Funso)
- Pedestrian crossings : Schools, hospitals, villages, etc.
- Road signs : Necessary spots
- Protective structures : Necessary spots
- Speed reducing structures : Examination of hump pavement

(9) Policy on Construction Method /Procurement method and Construction Period

1) Construction Method

a. Roads

Based on the findings of the existing pavement survey, approximately 70% of the target section still maintains a load bearing capacity to some degree. Accordingly, a construction method that effectively utilizes the existing road to the maximum shall be applied.

By dividing the road into sections according to damage situation based on the results of an analysis of damage conditions, a suitable construction method for each section shall be selected. Furthermore, when taking impact on the pavement deterioration of the existing road into consideration, since the quality of aggregate to be utilized is an important factor in the plan, feasibility regarding the quality and quantity of procurement sources shall be sufficiently examined.

b. Bridges

Bridge type shall be selected in due consideration of cost, construction period and future maintenance, etc. In addition, by comparing structural features, workability, economic efficiency, maintenance and landscape, the most appropriate structural type will be examined. With respect to materials and equipment to be utilized for construction work, as locally available materials are limited, after considering economic efficiency and quality, the options of local procurement, third country procurement or procurement from Japan will be examined. With respect to the substructure, based on existing geological survey data (compiled by a local consultant in 1991) and the findings of the field survey, the granite load bearing layer is judged to be distributed at a depth of approximately 10m from the present ground at the side of the existing bridge. Moreover, the underground water level is low and no spring water is anticipated. Therefore, a construction method that does not require special excavators and that takes the present natural conditions into account will be selected. In the Project, geological survey was not conducted because geological data for the existing bridge already existed and the position of the new bridge was not yet decided, however, it will be necessary to implement geological survey when conducting the field surveys for the detailed design.

2) Construction Materials and Equipment Procurement Method

Although universal machinery is locally available, some machines will be procured and transported from Japan. Locally produced cement will be procured, whereas, reinforcing bars and PC steel wires should be procured from Japan or a third country.

3) Construction Period

Based on large-scale construction work such as road extension of approximately 60km, the construction period shall be examined in due consideration of the following.

① Since some construction materials and equipment will be procured from Japan, a period is needed to transport equipment over a long distance to the project sites.

② Ghana has the minor rainy season between May and June and the major rainy season between September and October. Although there is little rainfall during the other months, there are many days of rain.

③ As it is shallow from the riverbed to the bedrock bearing ground at the construction spot of Assin Praso Bridge over Pra River, it is difficult to apply cut-off walls using steel sheet piles. During the rainy season, the water level is high so construction below the river water level shall not be done.

④ Since the target road passes through several blocks such as Assin Praso, the public utilities (electricity, water supply and telephone system) should be relocated by the recipient side and a relocation period should be sufficiently anticipated.

⑤ During the construction work, although minimum disruption to general traffic is planned through the use of detours, in some sections where detours are impossible, construction will be conducted utilizing single-lane traffic. Traffic safety should be sufficiently secured.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

(1) Scope and Scale of Proposed Facilities

The request of the Project is to improve the target section. Although the target section was 60km (based on the preliminary study), the total section was set at 59.9km after the starting and end points were confirmed with the Ghanaian side regarding the connection with the existing road near Assin Praso (the starting point) and the 16km section between Anwiankwanta and the suburbs of Bekwai, which is being repaired by the Ghanaian side.

With respect to Assin Praso Bridge, a new bridge will be constructed 30m downstream and the Ghanaian side plans to retain the existing bridge exclusively for pedestrian use.

As the result of confirming and analyzing the existing culverts and concrete pipes, culverts and box culverts more than 90cm diameter will be effectively utilized; whereas, concrete pipe culverts less than 90cm in diameter that do not satisfy the GHA standards will be replaced with 90cm diameter pipes and corrugated pipes will be replaced with concrete structures.

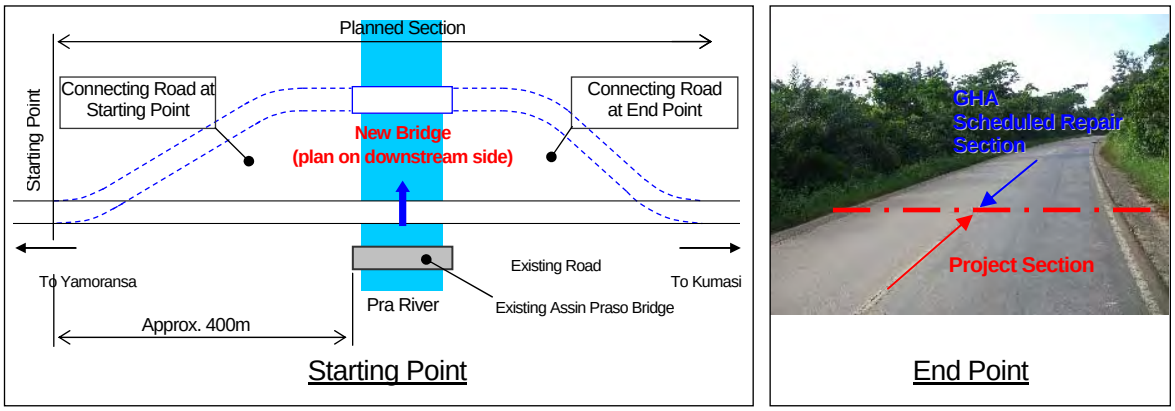


Fig. 2-3 Starting and End Points of Proposed Section

(2) Overview of Basic Plan

The examination and results of designs based on the basic policy are described as follows.

Table 2-11 Plan Overview

Description	Project Components
Target section	59.9km (between Assin Praso to Bekwai on N8 road)
Road width	11.3m (carriageway 3.65m×2, shoulder 2.0m×2)
Planned axle load	Design axle load 13t, Load capacity 27 million ESAL
Climbing lane	Right lane; 1.68km from 43.5km, Left lane;1.29km from 45.2km
Pavement (carriageway)	
- Surface course	14cm (asphalt concrete wearing course = 4cm, binder course =5cm＋5cm)
- Base course	20cm (mechanically stabilized crushed stone))
- Sub-base course	20cm (locally available materials)
Pavement (shoulder)	
- Surface course	3cm (asphalt concrete wearing course)
Major structure	
- Culvert	127 spots. (necessary for repairs under the Project at existing 139 spots)
- Bridge	1 No. (3 spans, total length of 98.0m, existing bridge reconstruction) Superstructure ・ Structure type : PC 3-span continuous rigid-frame bridge (cantilever) Sub-structure ・ Abutment foundation : Concrete shaft pile (D=2.00m, L=10 to 11m) ・ Bridge pier foundation : Spread footing Note: The existing bridge remains and will be effectively utilized by the Ghanaian side as a pedestrian bridge.
Incidental facilities	
- Intersection Improvement	1 location (main junction between the starting and end points)
- Road marking	Center lines, side lined, arrow, etc.
- Protective facilities	Guard post, Barrier at major structure area and road bend.
- Kilometer posts	Installation at intervals of 1km

Table 2-12 Design Specifications and Standards

	Examined Item	Applicable Standards, etc. in the Project	Remarks
1	Target section	59.9km section on International Trunk Road No. 8 (Assin Praso Bridge improvement, repair of 127 culverts)	The distance from existing Pra River Bridge to the end point of the GHA road rehabilitation section is approximately 59.5km. When the connections with adjacent sections at the starting and end points are also included, the combined Project target section comes to 59.9km.
2	Road classification	Trunk road (highway)	Ghanaian road classification
3	Topography	Terrain of Project road section is mildly rolling flat location (partially mountainous section)	
4	Applicable design standards (geometric)	Ghanaian standards were applied. Japanese standards, etc. were adopted as needed.	The standards generally utilized in Ghana were taken into account.
5	Road alignment	Design speed of 80km/hr for main line, 40km/hr for mountainous section	Existing road alignment was utilized
6	Road width	7.3m of carriageway width	Ghanaian road design standards were taken into account.
7	Pavement structure	American AASHTO Guide for Design of Pavement Structures 1993 was considered.	Conformity to applicable standards on adjoining section, etc. was taken into account.
8	Traffic classification by pavement design	Equivalent Single Axle Load (ESAL) of 18kip during in-service period was applied.	Conformity to applicable standards on adjoining section, etc. was taken into account.
9	Bridge design load	Specifications for Highway Bridges compiled by the Japan Road Association, B live load (equivalent to BC, HB37.5 unit)	It was judged by discussions with the Government of Ghana at the time of field survey.
10	Incidental facilities, road markings, etc.	Ghanaian design standards were applied.	The standards generally utilized in Ghana were taken into account.

2-2-2-2 Facility Plan

(1) Road Plan

1) Design Section

The section subject to the Project will be 59.9km of the road extension from Assin Praso to the end point of the GHA repair section near Bekwai by applying the Ghanaian trunk road standards.

2) Design Conditions

a. Design Standards

Ghanaian design standards will be applied as the design standards under the Project. In addition, as the occasion arises, Japanese standards and American standards (American Association of State Highway and Transportation Officials: AASHTO), etc. will be appropriately examined. The major road design standards in Ghana are listed as follows.

1. Standard Details for Urban and Trunk Roads, March 1991
2. Pavement Design Manual, August 1998
3. Overlay Design Method-Design Manual, July 1998
4. Quality Assurance Procedures in the design and Construction of Road Pavement, Dec 1996
5. Standard Methods of Testing for Soils and Gravels used in Pavement Work, Oct. 1996
6. Specification for Road Maintenance Work, Jan. 1996

For design axle load, GHA prescribes 13t for pavement design axle load, which are therefore taken into account in the examination of designs.

b. Road Geometric Design and Design Speed

In due consideration of scale, topography and the continuity with the adjoining section, the design speed of the proposed road will be 80km/hr except for the mountainous section. The mountainous section extending 3.0km after the section of 43.5km will be an exception. If the design speed of 80km/hr is applied to this section, since this would require major civil engineering works, it would deviate from the scope of rehabilitation of the present road as the purpose of the Project. Accordingly, a design speed of 40km/hr will be applied because the existing road can be traced. The standard design values to be applied under the Project are shown as follows.

Table 2-13 Standard Design Values for the Project

Item		Unit	Application
Design speed		Km/hr	80 (40 for mountainous section)
Right of way (ROW) width		m	60
Number of lanes		No.	2
Carriageway width		m	7.3
Shoulder width		m	2.0
Cross fall on carriageway		%	2.5
Cross fall on shoulder		%	3.0
Minimum curve radius		m	230
Maximum gradient		%	4 (maximum=8.0)
Super-elevation (maximum)		%	6
Fill slope	Granular soil	angle	1:1.5 to 2.0 (depend on soil type)
Cut slope	Hard rock	angle	1:0.5
	Decomposed rock	angle	1:0.75
	Other rock	angle	1:1.0 to1.5 (depend on soil type)
Pavement classification		-	Carriageway = asphaltic concrete (AC), shoulder = AC

3) Road Profile

a. General Section

For carriageway width under the Project, 3.65m of the standard trunk road width in Ghana will be adopted. Although National Trunk Road No. 8 is category class 1 in Ghana and 2.5m shoulder width indicated in the present Ghanaian design standards is necessary, 2.0m similar to the existing shoulder width in the request, which was confirmed after discussions with the Ghanaian side, will be applied. Moreover, in order to minimize the impact of water on the road in valley sections, the existing road height has been rised by between 0.5~1.0m.

b. Mountainous Section

For the establishment of climbing lanes, considering that the ratio of large vehicles passing along the target road is high at over 20% and the climbing speed is less than 20km/hr, which is less than half of 40km/hr, climbing lanes will be established in the mountainous section. In order to minimize the impact on the presently stable slope face, the existing shoulder of the uphill lane will be widened for a climbing lane. Accordingly, shoulders at the side of the new climbing lane will not be installed so that this section will have single-sided shoulder. The width of the climbing lane will be 3.5m according to the Ghanaian design standard. Climbing lanes will be installed over 1.68km from the 43.5km point on the right lane and over 1.29km from the 45.2km point on the left lane.

Fig. 2-4 Climbing Lane

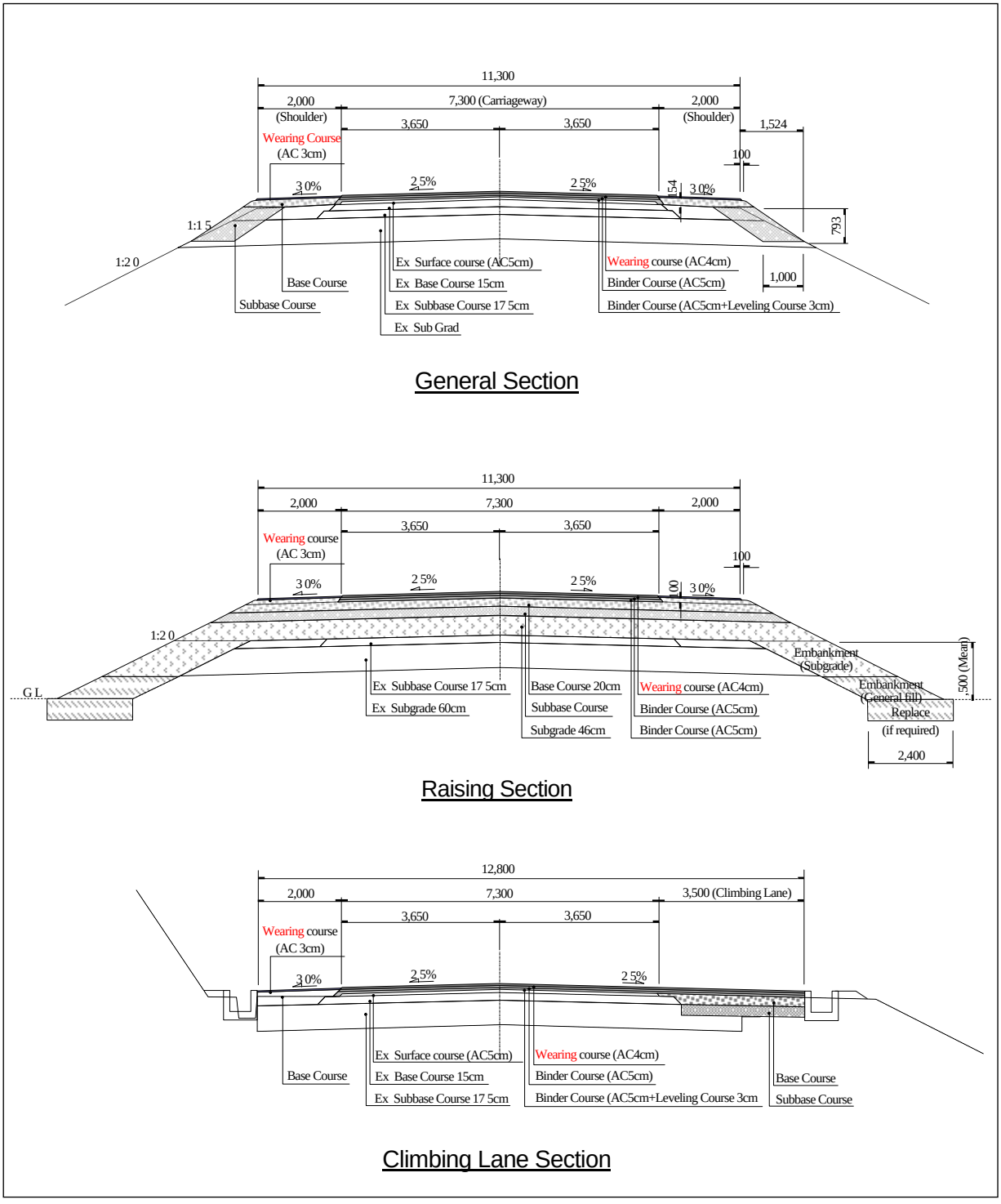


Fig. 2-5 Typical Road Cross Section

4) Pavement Design

Pavement design will be examined in conformity to the AASHTO Guide for Design of Pavement Structures (1993), which is utilized in Ghana.

Design conditions to be utilized in pavement design are listed as follows.

▪ Design period	:	15 years between 2013 and 2027
▪ Design axle load	:	13 tons
▪ Traffic load (W18)	:	18kip equivalent single load (ESAL) for in-service period
▪ Reliability (R)	:	Probability is 95% within the assumed traffic load and pavement strength (standard deviation ZR = -1.645, standard deviation of load and pavement strength S0 = 0.40)
▪ Serviceability criteria	:	Initial serviceability index P0 = 4.2 (results of AASHTO road testing) End serviceability index Pt = 2.5 (AASHTO standard value for trunk roads)
▪ Modulus of rigidity (MR)	:	15,000
▪ Pavement layer coefficient	:	Asphalt concrete surface layer a = 0.44 Crushed rock base (CBR=80) a = 0.14 Granular sub-base (CBR=30) a = 0.13
▪ Drainage coefficient	:	Crushed rock base m = 1.0 Granular sub-base m = 1.0

5) Traffic Volume and Traffic Load

The annual average daily traffic (AADT) to be utilized in the pavement design was 2,861 units per day as a result of analyzing the traffic volume during the field survey. The future traffic growth rate was examined based on the vehicle categories in the GHA standard assuming that traffic volume grows Concerning axle load per vehicle type, the results of 27 million axles of the design traffic load in the planning period were obtained by utilizing the AASHO standards and converting the load of vehicles passing through the road within the planning period into the standard axle load [18-kip (8.2t) converted single axle load, ESAL].

6) Required Pavement Structural number

In the pavement design under the Project, based on the basic formula (nomogram chart for flexible pavement design, see Fig. 2-6) for flexible pavement in accordance with the AASHTO Guide, SN=4.8 was obtained

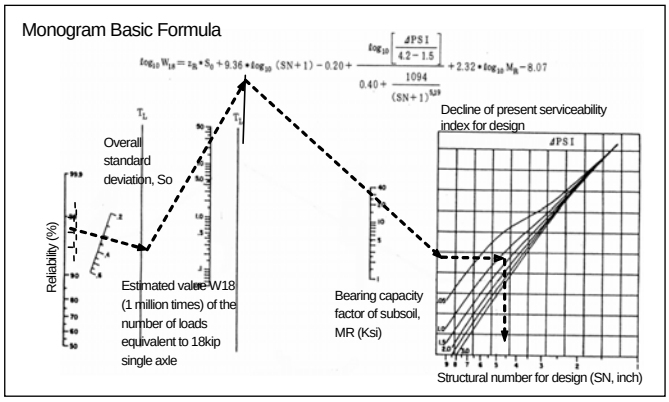


Fig. 2-6 Monogram for Flexible Pavement Design

as a result of calculating the pavement structural number (SN) allowable for the assumed traffic load necessary for the proposed road,.

7) Overlay Thickness

Since the existing road conditions are relatively stable in the plan, after rehabilitation of necessary spots on the existing pavement, an asphalt layer shall be overlaid on the upper part. The existing pavement was constructed by 5cm asphalt surface course, 15cm base course and 17.5cm sub-base course. The pavement structural number (SN) indicating the pavement strength at the time of constructing existing pavement is regarded as 2.60. Compared to this, the general pavement structure index in the existing pavement section is considered to be 2.38 as the surface layer of the road was damaged based on the flexible amount of the existing road or surface conditions. (Refer to the following table.)

Table 2-14 Existing Pavement Structure Index

Item	Thickness		Coefficient		Structural number (SN)	
	cm	inch (a)	Designing Time (b)	Present Time (c)	Designing Time (a)×(b)	Present Time (a)×(c)
AC Surface	5.0	1.97	0.44	0.33	0.87	0.65
Base Course	15.0	5.91	0.14	0.14	0.83	0.83
Sub-base Course	17.5	6.89	0.13	0.13	0.90	0.90
Total					2.60	2.38

Note: Concerning the existing AC course, the coefficient of 0.33 for damaged course has been adopted.

By examining the thickness of the overlay necessary for future traffic load in due consideration of the existing pavement strength under the plan, the total SN (2.38) of the existing road and the overlay layer can satisfy the necessary SN (4.8). The composition of the required overlay layer is shown as follows.

AC surface course : 4cm
AC base course : 10cm (5cm+5cm)
Total 14cm

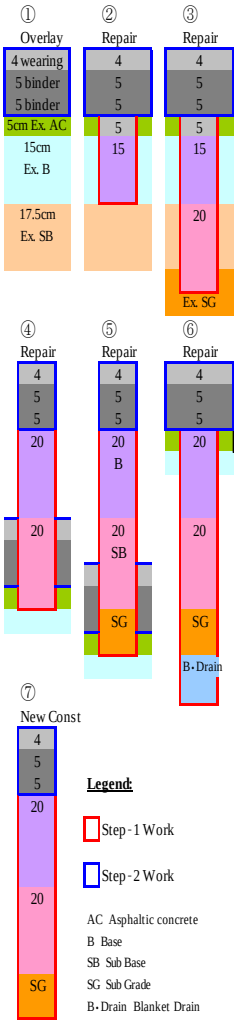
The overlay layer obtained through the above-mentioned calculation will be applied as Rehabilitation Step-2 after improving the existing pavement through Rehabilitation Step-1.

8) Partial Rehabilitation of Existing Pavement

As a preceding stage in the case of applying the above-mentioned overlay layer, the rehabilitation method for the existing pavement at necessary spots according to pavement damage is shown as follows. As for a rehabilitation method suitable for each damage type, seven types will be established.

Table 2-15 Existing Pavement Rehabilitation Method by Damage Type

Bearing capacity	Damage type	Smoothness	Repair type (Step-1)	Deflection	Smoothness
Bearing capacity					
Good (Minor deflection)	1/2 Good/sealed	- Smooth	① -	<0.6mm	<6m/km
	3 Vertical & horizontal cracks	Smooth	① -		<6m
		Not smooth	② AC5cm+Base15cm		>6m
	4 Alligator cracks	Smooth	② AC5cm+Base15cm		<6m
		Not smooth	② AC5cm+Base15cm		>6m
	5 Undulation	Patch repair	② AC5cm+Base15cm		>6m
		General spot	② AC5cm+Base15cm		>6m
		Culvert spot	② AC5cm+Base15cm		>6m
	6 Pothole	Smooth	② AC5cm+Base15cm		<6m
		Not smooth	② AC5cm+Base15cm		>6m
	7 Patch repair	Smooth	① -		<6m
		Not smooth	② AC5cm+Base15cm		>6m
	- Low landfill spot	Sag	④ Base20cm+S.Base20cm		
	8 Scattered pavement	Sag	⑤ Base20cm+S.Base20cm+S.Grade46cm		>6m
		High ground water level	⑥ Base20cm+S.Base20cm+S.Grade46cm+B.Drain		>6m
		Culvert	③ AC5cm+Base15cm+S.Base20cm		>6m
Shortage (Large deflection)	1/2 Good/sealed	- Smooth	④ Base20cm+S.Base20cm	>0.6mm	<6m
	3 Vertical & horizontal cracks	Smooth	④ Base20cm+S.Base20cm		<6m
		Not smooth	④ Base20cm+S.Base20cm		>6m
	4 Alligator cracks	Smooth	④ Base20cm+S.Base20cm		<6m
		Not smooth	④ Base20cm+S.Base20cm		>6m
	5 Undulation	Patch repair	④ Base20cm+S.Base20cm		>6m
		General spot	④ Base20cm+S.Base20cm		>6m
		Culvert spot	④ Base20cm+S.Base20cm		>6m
	6 Pothole	Smooth	④ Base20cm+S.Base20cm		<6m
		Not smooth	④ Base20cm+S.Base20cm		>6m
	7 Patch repair	Smooth	④ Base20cm+S.Base20cm		<6m
		Not smooth	④ Base20cm+S.Base20cm		>6m
		Sag	⑤ Base20cm+S.Base20cm		
	8 Scattered pavement	Sag	⑥ Base20cm+S.Base20cm+S.Grade46cm		>6m
		High ground water level	⑦ Base20cm+S.Base20cm+S.Grade46cm+B.Drain		>6m
		Culvert	④ Base20cm+S.Base20cm+S.Grade46cm		>6m



Note: Rehabilitation through Step-2 = 4cm+5cm+5cm overlay

9) Road Damage and Rehabilitation Method

In the next paragraph, diagrams showing the damage condition, strength, surface smoothness, past repair history and repair method in the plan are shown.

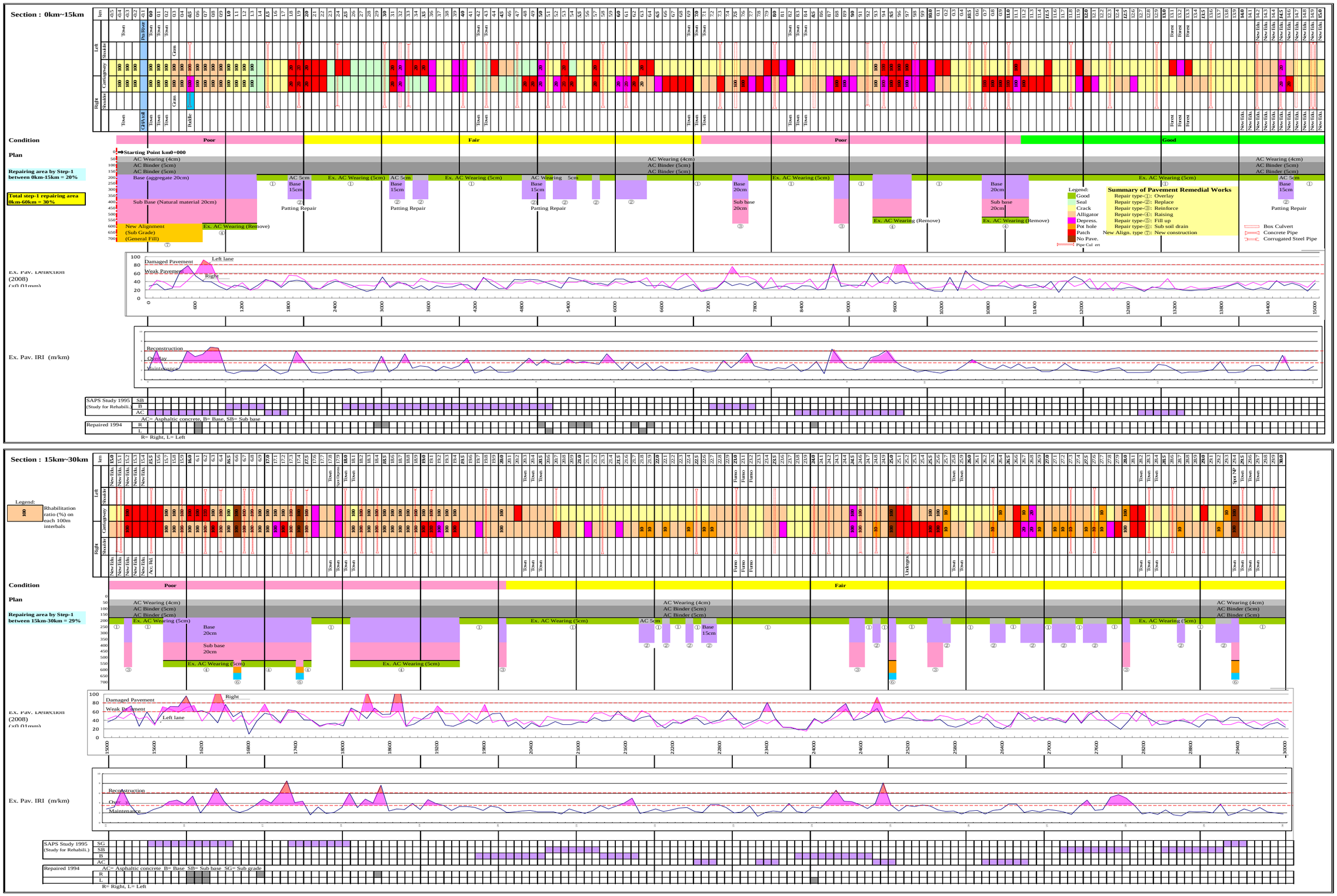


Fig. 2-7 (1) Road Damage and Rehabilitation Method (1/2)

Fig. 2-7 (2) Road Damage and Rehabilitation Method (2/2)

Table 2-16 (1) Inventory by Repair Type (1/2)

Station	Length of Section (m)	Repair Type ① Rate of Repair		Repair Type ② Rate of Repair		Repair Type ③ Rate of Repair		Repair Type ④ Rate of Repair		Repair Type ⑤ Rate of Repair		Repair Type ⑥ Rate of Repair		Repair Type ⑦ Rate of Repair	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
0 km- 400 ~ 0 km- 100	300													100%	100%
0 km- 100 ~ 0 km+ 0	100	Assin Praso Bridge													
0 km+ 0 ~ 0 km+ 700	700													100%	100%
0 km+ 700 ~ 1 km+ 400	700							100%	100%						
1 km+ 400 ~ 1 km+ 800	400	100%	100%												
1 km+ 800 ~ 2 km+ 100	300	80%	80%	20%	20%										
2 km+ 100 ~ 3 km+ 100	1,000	100%	100%												
3 km+ 100 ~ 3 km+ 300	200	80%	80%	20%	20%										
3 km+ 300 ~ 3 km+ 400	100	100%	100%												
3 km+ 400 ~ 3 km+ 600	200	80%	100%	20%	0%										
3 km+ 600 ~ 4 km+ 800	1,200	100%	100%												
4 km+ 800 ~ 5 km+ 0	200	100%	80%		20%										
5 km+ 0 ~ 5 km+ 100	100	80%	80%	20%	20%										
5 km+ 100 ~ 5 km+ 200	100	100%	100%												
5 km+ 200 ~ 5 km+ 300	100	100%	80%		20%										
5 km+ 300 ~ 5 km+ 400	100	80%	80%	20%	20%										
5 km+ 400 ~ 5 km+ 500	100	100%	80%		20%										
5 km+ 500 ~ 5 km+ 700	200	100%	100%												
5 km+ 700 ~ 5 km+ 800	100	80%	80%	20%	20%										
5 km+ 800 ~ 6 km+ 0	200	100%	100%												
6 km+ 0 ~ 6 km+ 300	300	100%	80%		20%										
6 km+ 300 ~ 6 km+ 400	100	80%	80%	20%	20%										
6 km+ 400 ~ 7 km+ 500	1 100	100%	100%												
7 km+ 500 ~ 7 km+ 700	200	100%	0%				100%								
7 km+ 700 ~ 8 km+ 800	1,100	100%	100%												
8 km+ 800 ~ 9 km+ 0	200	100%	0%				100%								
9 km+ 0 ~ 9 km+ 300	300	100%	100%												
9 km+ 300 ~ 9 km+ 800	500							100%	100%						
9 km+ 800 ~ 10 km+ 700	900	100%	100%												
10 km+ 700 ~ 11 km+ 100	400	100%	0%					0%	100%						
11 km+ 100 ~ 11 km+ 200	100							100%	100%						
11 km+ 200 ~ 11 km+ 300	100	100%	0%					0%	100%						
11 km+ 300 ~ 14 km+ 500	3,200	100%	100%												
14 km+ 500 ~ 14 km+ 600	100	80%	80%	20%	20%										
14 km+ 600 ~ 14 km+ 700	100	100%	80%	0%	20%										
14 km+ 700 ~ 15 km+ 200	500	100%	100%												
15 km+ 200 ~ 15 km+ 300	100					100%	100%								
15 km+ 300 ~ 15 km+ 700	400	100%	100%												
15 km+ 700 ~ 16 km+ 600	900							100%	100%						
16 km+ 600 ~ 16 km+ 700	100											100%	100%		
16 km+ 700 ~ 17 km+ 400	700							100%	100%						
17 km+ 400 ~ 17 km+ 500	100											100%	100%		
17 km+ 500 ~ 17 km+ 600	100							100%	100%						
17 km+ 600 ~ 18 km+ 100	500	100%	100%												
18 km+ 100 ~ 19 km+ 500	1,400							100%	100%						
19 km+ 500 ~ 20 km+ 0	500	100%	100%												
20 km+ 0 ~ 20 km+ 100	100					100%	100%								
20 km+ 100 ~ 21 km+ 800	1 700	100%	100%												
21 km+ 800 ~ 22 km+ 0	200	100%	90%	0%	10%										
22 km+ 0 ~ 22 km+ 100	100	100%	100%												
22 km+ 100 ~ 22 km+ 200	100	100%	90%	0%	10%										
22 km+ 200 ~ 22 km+ 400	200	100%	100%												
22 km+ 400 ~ 22 km+ 500	100	100%	90%	0%	10%										
22 km+ 500 ~ 22 km+ 600	100	100%	100%												
22 km+ 600 ~ 22 km+ 800	200	100%	90%	0%	10%										
22 km+ 800 ~ 24 km+ 500	1,700	100%	100%												
24 km+ 500 ~ 24 km+ 700	200					100%	100%								
24 km+ 700 ~ 24 km+ 800	100	100%	100%												
24 km+ 800 ~ 24 km+ 900	100	100%	90%	0%	10%										
24 km+ 900 ~ 25 km+ 0	100	100%	100%												
25 km+ 0 ~ 25 km+ 100	100											100%	100%		
25 km+ 100 ~ 25 km+ 500	400	100%	100%												
25 km+ 500 ~ 25 km+ 700	200					100%	100%								
25 km+ 700 ~ 25 km+ 800	100	90%	90%	10%	10%										
25 km+ 800 ~ 26 km+ 300	500	100%	100%												
26 km+ 300 ~ 26 km+ 400	100	100%	90%	0%	10%										
26 km+ 400 ~ 26 km+ 500	100	90%	100%	10%	0%										
26 km+ 500 ~ 26 km+ 700	200	100%	100%												
26 km+ 700 ~ 26 km+ 800	100	90%	80%	10%	20%										
26 km+ 800 ~ 26 km+ 900	100	80%	80%	20%	20%										
26 km+ 900 ~ 27 km+ 0	100	100%	90%	0%	10%										
27 km+ 0 ~ 27 km+ 100	100	100%	100%												
27 km+ 100 ~ 27 km+ 400	300	100%	90%	0%	10%										
27 km+ 400 ~ 27 km+ 500	100	100%	100%												
27 km+ 500 ~ 27 km+ 700	200	100%	90%	0%	10%										
27 km+ 700 ~ 27 km+ 800	100	90%	90%	10%	10%										
27 km+ 800 ~ 28 km+ 0	200	100%	100%												
28 km+ 0 ~ 28 km+ 100	100					100%	100%								
28 km+ 100 ~ 28 km+ 700	600	100%	100%												
28 km+ 700 ~ 28 km+ 800	100	100%	90%	0%	10%										
28 km+ 800 ~ 29 km+ 200	400	100%	100%												
29 km+ 200 ~ 29 km+ 300	100	100%	90%	0%	10%										
29 km+ 300 ~ 29 km+ 400	100	90%	100%	10%	0%										
29 km+ 400 ~ 29 km+ 500	100											100%	100%		
29 km+ 500 ~ 30 km+ 500	1,000	100%	100%												
30 km+ 500 ~ 30 km+ 600	100	100%	90%	0%	10%										
30 km+ 600 ~ 30 km+ 700	100	100%	100%												
30 km+ 700 ~ 30 km+ 900	200	100%	90%	0%	10%										
30 km+ 900 ~ 31 km+ 400	500	100%	100%												

Table 2-16 (2) Inventory by Repair Type (2/2)

Station	Length of Section (m)	Repair Type ① Rate of Repair		Repair Type ② Rate of Repair		Repair Type ③ Rate of Repair		Repair Type ④ Rate of Repair		Repair Type ⑤ Rate of Repair		Repair Type ⑥ Rate of Repair		Repair Type ⑦ Rate of Repair	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
31 km+ 400 ~ 31 km+ 500	100	100%	90%		10%										
31 km+ 500 ~ 31 km+ 600	100	100%	100%												
31 km+ 600 ~ 31 km+ 700	100	90%	90%	10%	10%										
31 km+ 700 ~ 31 km+ 800	100	100%	100%												
31 km+ 800 ~ 31 km+ 900	100	90%	100%	10%											
31 km+ 900 ~ 32 km+ 0	100	100%	100%												
32 km+ 0 ~ 32 km+ 300	300					100%	100%								
32 km+ 300 ~ 32 km+ 500	200	100%	100%												
32 km+ 500 ~ 32 km+ 600	100	100%	90%		10%										
32 km+ 600 ~ 32 km+ 800	200	100%	100%												
32 km+ 800 ~ 32 km+ 900	100	90%	100%	10%											
32 km+ 900 ~ 33 km+ 200	300	100%	100%												
33 km+ 200 ~ 33 km+ 300	100	90%	90%	10%	10%										
33 km+ 300 ~ 34 km+ 0	700	100%	100%												
34 km+ 0 ~ 34 km+ 100	100	90%	80%	10%	20%										
34 km+ 100 ~ 34 km+ 200	100	100%	100%												
34 km+ 200 ~ 34 km+ 300	100	90%	80%	10%	20%										
34 km+ 300 ~ 34 km+ 900	600	100%	100%												
34 km+ 900 ~ 35 km+ 0	100	90%	100%	10%											
35 km+ 0 ~ 36 km+ 100	1,100	100%	100%												
36 km+ 100 ~ 36 km+ 200	100	90%	90%	10%	10%										
36 km+ 200 ~ 36 km+ 500	300	100%	100%												
36 km+ 500 ~ 36 km+ 600	100	100%	90%	0%	10%										
36 km+ 600 ~ 36 km+ 900	300	100%	100%												
36 km+ 900 ~ 37 km+ 100	200					100%	100%								
37 km+ 100 ~ 37 km+ 500	400	100%	100%												
37 km+ 500 ~ 37 km+ 600	100	100%	90%		10%										
37 km+ 600 ~ 38 km+ 0	400	100%	100%												
38 km+ 0 ~ 38 km+ 200	200					100%	100%								
38 km+ 200 ~ 40 km+ 100	1,900	100%	100%												
40 km+ 100 ~ 40 km+ 200	100	90%	100%	10%											
40 km+ 200 ~ 40 km+ 400	200	100%	90%		10%										
40 km+ 400 ~ 41 km+ 800	1,400	100%	100%												
41 km+ 800 ~ 42 km+ 200	400	100%	0%			0%	100%								
42 km+ 200 ~ 43 km+ 0	800	100%	100%												
43 km+ 0 ~ 43 km+ 100	100	90%	100%	10%											
43 km+ 100 ~ 43 km+ 200	100	100%	100%												
43 km+ 200 ~ 43 km+ 300	100	90%	80%	10%	20%										
43 km+ 300 ~ 43 km+ 400	100	80%	80%	20%	20%										
43 km+ 400 ~ 43 km+ 500	100	90%	90%	10%	10%										
43 km+ 500 ~ 43 km+ 600	100	80%	90%	20%	10%										
43 km+ 600 ~ 43 km+ 800	200	80%	80%	20%	20%										
43 km+ 800 ~ 43 km+ 900	100	100%	100%												
43 km+ 900 ~ 44 km+ 0	100	80%	0%	20%	100%										
44 km+ 0 ~ 44 km+ 100	100	100%	100%												
44 km+ 100 ~ 44 km+ 300	200	100%	80%		20%										
44 km+ 300 ~ 44 km+ 600	300	100%	100%												
44 km+ 600 ~ 44 km+ 700	100.0			100%	100%										
44 km+ 700 ~ 44 km+ 800	100	100%	100%												
44 km+ 800 ~ 45 km+ 0	200	100%	80%		20%										
45 km+ 0 ~ 45 km+ 100	100	90%	100%	10%											
45 km+ 100 ~ 45 km+ 600	500	100%	100%												
45 km+ 600 ~ 45 km+ 700	100			100%	100%										
45 km+ 700 ~ 46 km+ 0	300	100%	100%												
46 km+ 0 ~ 46 km+ 400	400									100%	100%				
46 km+ 400 ~ 46 km+ 500	100											100%	100%		
46 km+ 500 ~ 46 km+ 600	100									100%	100%				
46 km+ 600 ~ 46 km+ 700	100											100%	100%		
46 km+ 700 ~ 46 km+ 800	100									100%	100%				
46 km+ 800 ~ 48 km+ 500	1,700	100%	100%												
48 km+ 500 ~ 48 km+ 600	100											100%	100%		
48 km+ 600 ~ 49 km+ 500	900	100%	100%												
49 km+ 500 ~ 49 km+ 600	100	90%	90%	10%	10%										
49 km+ 600 ~ 49 km+ 700	100	100%	100%												
49 km+ 700 ~ 49 km+ 800	100	100%	90%		10%										
49 km+ 800 ~ 49 km+ 900	100	100%	100%												
49 km+ 900 ~ 50 km+ 0	100	100%	90%		10%										
50 km+ 0 ~ 50 km+ 100	100	100%	100%												
50 km+ 100 ~ 50 km+ 300	200	100%	90%		10%										
50 km+ 300 ~ 50 km+ 400	100	90%	100%	10%											
50 km+ 400 ~ 50 km+ 500	100	100%	100%												
50 km+ 500 ~ 50 km+ 600	100					100%	100%								
50 km+ 600 ~ 50 km+ 900	300	100%	90%		10%										
50 km+ 900 ~ 51 km+ 0	100	100%	100%												
51 km+ 0 ~ 51 km+ 100	100	100%	90%		10%										
51 km+ 100 ~ 51 km+ 400	300	100%	100%												
51 km+ 400 ~ 53 km+ 800	2,400							100%	100%						
53 km+ 800 ~ 54 km+ 900	1 100									100%	100%				
54 km+ 900 ~ 55 km+ 700	800							100%	100%						
55 km+ 700 ~ 55 km+ 900	200									100%	100%				
55 km+ 900 ~ 56 km+ 400	500							100%	100%						
56 km+ 400 ~ 56 km+ 700	300									100%	100%				
56 km+ 700 ~ 57 km+ 100	400							100%	100%						
57 km+ 100 ~ 57 km+ 400	300									100%	100%				
57 km+ 400 ~ 59 km+ 500	2 100							100%	100%						
Total	59 900														Total
Length of Repair (m)		43,225		2,921		3,629		4,494		2,420		2,420		691	59,800
Area of Repair (m^2)		315,543		21,323		26,492		32,806		17,666		17,666		5,044	436,540

10) Earthwork Plan

a. General Parts

A plan to effectively utilize the existing road to the maximum shall be formulated by tracing the existing road. Accordingly, mainly the overlay method where the existing pavement can be effectively utilized shall be examined in the plan. In addition, where necessary road rising will be examined at spots affected by water. The standard slope gradient of embankment on both overlay end sides will be 1 : 1.5 in due consideration of the locally available soil texture.

b. Mountainous Section

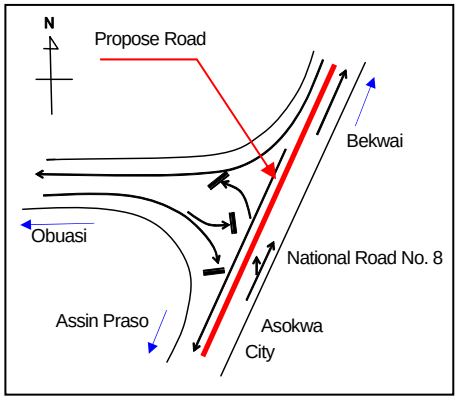
Although surface subsidence can be seen at two spots on the large-scale embankment parts on the mountainous section, cracks on the surface layer pavement or traces of land sliding in the vicinity were confirmed so that ground for progressive slide could not be revealed. Despite traces of erosion on the slope due to spring runoff on the large-scale embankment in the said section, the slope is essentially stable so large-scale earthwork is unnecessary.

11) Intersection Plan

a. Asokwa Intersection (at 42.4km)

Although traffic flow is well managed by the present intersection model, inflow from some directions is hindered due to the disappearance of road markings. Consequently, ensuring safe and smooth traffic flow will be examined by following the existing intersection model and inspecting road markings (zebra and guidance arrows).

Table 2-17 Image of Intersection Plan Overview

Intersection Configuration	Remarks
Asokwa Intersection 	The aim of the plan is to follow the existing intersection model. On the assumption that the main road will be the target road under the Project and the subordinate road will be the road between Asokwa and Obuasi, traffic flow within the intersection shall be taken into account in the plan.

b. Access Roads, etc.

i General Driveway

Driveways to houses along the target road confirmed at the time of the field survey will be smoothed using 3cm asphalt concrete pavement (AC pavement) in a similar manner as shoulders under the Project.

ii Branch Road

Branch roads to be connected to the target road are confirmed to be AC pavement and other application (random paving or gravel road). 4cm pavement will be applied to all branch roads (5.5m to 20.0m) in the same way as the pavement surface layer in the Project.

iii Entrance to Petrol Station

It is expected that large vehicles will come and go at the entrance of the existing gas station, so base course and AC pavement will be applied to the necessary spots.

iv Drainage Waterway at Access Road

Transversal pipes and drains at a spot connecting to an access road will be planned in conformity to the Ghanaian standard minimum diameter of 60cm.

(2) Bridge Plan

1) Bridge Location

It is possible to establish three options, i.e. construction on the upstream side, construction on the downstream side, and removal of the existing bridge (refer to the following table) regarding location of the improved Assin Praso Bridge. Upon comparing options from the viewpoint of road alignment, social and environmental impact, implementation and temporary construction plan and cost, Option 3 (to construct a new bridge downstream of the existing bridge) will be recommended as the optimal option in the Project due to the lower overall construction cost and relocation of fewer houses.

Table 2-18 Options for Assin Praso Bridge Improvement

Item	Option 1	Option 2	Option 3
Bridge Spot	30m upstream side	Existing bridge spot	30m downstream side
Social and environmental impact	Relocation of 29 houses	Relocation of several houses	Relocation of 13 houses
Land acquisition	Partially necessary	Temporary bridge construction period is necessary.	Partially necessary
Building procedures	1. New bridge construction (Remaining existing bridge)	1. Temporary bridge installation 2. Existing bridge removal 3. New bridge construction 4. Temporary bridge removal	1. New bridge construction (Remaining existing bridge)
Construction cost comparison	1.02	1.06	1.00
Judging rank	Poor	Fair	Good

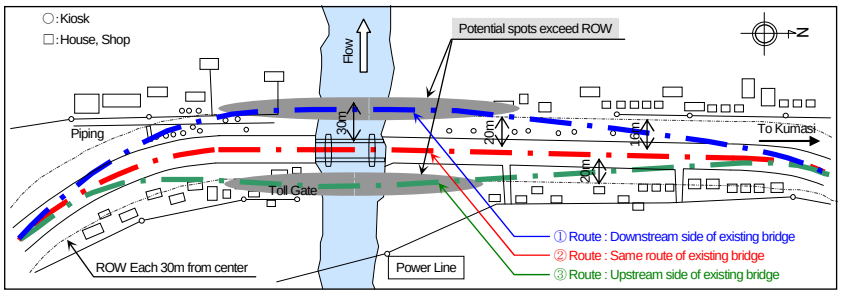


Fig. 2-8 Options for Assin Praso Bridge

The new bridge will be 30m downstream of the existing bridge in due consideration of alignment to connect with the existing road and the surrounding conditions. The number of existing houses to be affected by the Project will be 13 residences. Although the right of way (ROW) width will be 60m in total including 30m each side from the center of the existing road, due to the application of the downstream option, a permanent site of approx. 10,000m^2 should be obtained by the Ghanaian side.

2) Design Standards

The following standards and specifications will be mainly applied to technical standards pertaining to the Ghanaian bridge designs.

① British Standard BS5400 (Part 1 to 10), 1988, British Standard Institution
② Loads for Highway Bridges, BD37/01, 2001, Highway Agency UK

In addition, BD37/01, 2001 will be applied to load conditions, so a HB load of 3.5 units under BD37/01 will be adopted. Since these load conditions are the same as the B live load in the Japanese Specifications for Roads, the Japanese Specifications for Road Bridges will be adopted.

3) Horizontal Design Seismic Coefficient

A horizontal design seismic coefficient of 0.1 adopted for all areas in Ghana will be applied.

4) Plan Overview

a. Bridge Length

Although it is preferable to construct a new bridge 30m downstream of the existing bridge, in this case, contracting restrictions for a bridge in the proximity should be taken into account. Accordingly, in the case of constructing a new bridge, in order to prevent any hindrance to the river downstream, the existing bridge location and a new bridge piers will be matched on the straight line in the downstream direction of the river, and the center span length of the new bridge will be 48m, which is the same as the existing bridge. In addition, the optimal span length between both sides will be 24m (half of the center span length), so the bridge length compared to the existing bridge length of 82m will be 98m (L=48.0+24.0×2+(0.20 [joint gap]+0.80 [girder edge])×2).

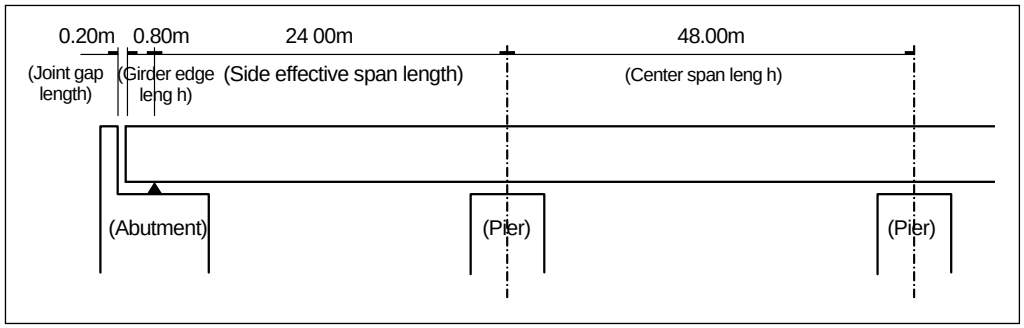


Fig. 2-9 Superstructure Span Length

b. Bridge Cross Sections

As the carriageway width of the bridge part will be 8.3m (3.65m carriageway × 2 + border line ×2) and the sidewalk width will be 3.0m (1.5m×2), it will be 11.3m in total. When adding a handrail width of 0.8m (0.4m×2) on both edges to this, the total width of the bridge will be 12.1m. Although the Ghanaian side requests that the present bridge remain exclusively for pedestrian use even after the completion of a new bridge, 72 years have elapsed since the present bridge was built, so its service life is considered to be inferior to that of the new bridge. Sidewalks will therefore be installed on the new bridge. In addition, 1.5m will be adopted as the minimum width a person holding baggage can pass through safely. Utility ducts to accommodate public utilities will be installed under the sidewalk.

5) Proposed New Bridge Height

By considering the maximum water level (rise in water level on the existing bridge deck) observed in 1968, the assumed girder height (approximately 3m) and allowance height (approximately 1m) will be added to this, so a location approximately 4m higher from the existing road surface will be the bridge deck height. By adopting this height, a new bridge and approach road will be constructed in a relatively high location. In this plan which includes incidental facilities, consistency with the surrounding environment will be taken into account.

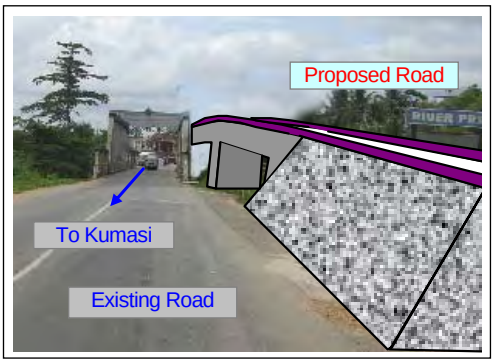


Fig.2-10 Image of Planned Bridge Height

6) Bridge Form

a. Superstructure

i Fundamentals

Since standards for construction of an adjacent bridge will need to be applied and these will limit the new bridge pier location, a 3-span bridge of similar design as the existing bridge will be appropriate.

ii Superstructure Type

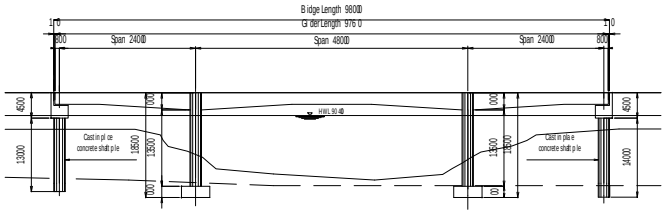
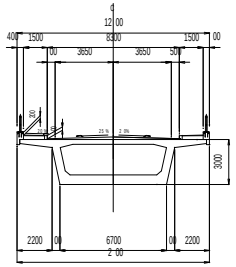
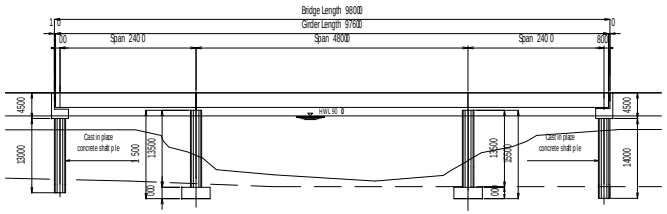
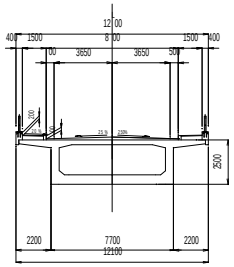
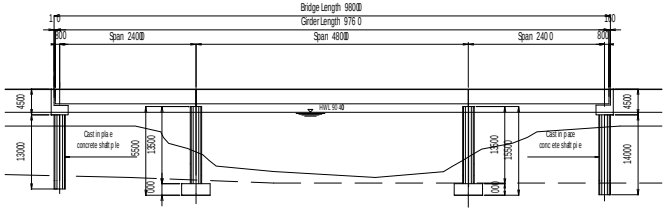
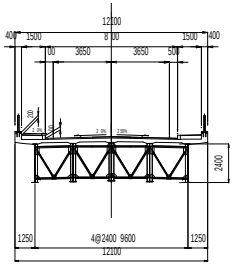
Although the existing bridge is a through bridge type in which major components are exposed on a bridge deck, in order to avoid serious damage to the bridge as a result of collisions by large vehicles, a deck bridge will be applied to the superstructure. The feasible bridge types in the Project are shown as follows.

1) PC 3-span box girder bridge (overhanging erection)
2) PC 3-span continuous box girder bridge
3) Steel 3-span continuous steel girder bridge

By comparing and examining the options, from the viewpoint of structural rationality, workability, maintenance, economic efficiency and landscape, the most suitable option for the Project will be a PC 3-span box girder bridge (overhanging erection).

Hereinafter, the features of each type and evaluation results in order of application to the Project are illustrated.

Table 2-19 Bridge Pier and Abutment Location and Estimated Line of Supporting Base

Comparison Table of Bridge types					
	Side View	**Sectional View**		**Brief Comment**	**Overall Judgment**
Plan 1	**PC 3-span rigid-frame bridge**		**Item**	**Evaluation**	◎
			Structure	A span ratio is 1:2 as a rigid-frame structure, so it is most suitable.	
			Workability	Due to a cantilever system, large-sized heavy machinery is not necessary.	
			Economical Efficiency	Due to no transport of large-sized heavy machinery, economical efficiency is superior to other plans	
			Maintenance	No problems arise in maintenance due to a concrete bridge.	
			Landscape	Due to a non-uniform section on side face, landscape is superior.	
			Overall Judgment	Compared to other plans, structure, workability and landscape is superior, so this plan can be recommended. Construction period. Superstructure 15 months Substructure 14 months	
Plan 2	**Continuous PC 3-span box girder bridge**		**Item**	**Evaluation**	○
			Structure	A span ratio is not well-balanced as a continuous type	
			Workability	Due to a girder erection, large-sized heavy machinery and girder manufacturing yard are necessary.	
			Economical Efficiency	Although large-sized heavy machinery should be transported, there is no difference in economical efficiency	
			Maintenance	Due to a concrete bridge, no problems arise in maintenance.	
			Landscape	Due to uniform section on side face, landscape is inferior.	
			Overall Judgment	Compared to plan 1, structure, workability and landscape are inferior. Construction period. Superstructure 17 months Substructure 14 months	
Plan 3	**Continuous PC 3-span steel plate bridge**		**Item**	**Evaluation**	○
			Structure	A span ratio is not well-balanced as a continuous type	
			Workability	Due to a girder erection, large-sized heavy machinery and girder manufacturing yard are necessary.	
			Economical Efficiency	Although large-sized heavy machinery should be transported, there is no difference in economical efficiency	
			Maintenance	By utilizing weathering steel, no problems arise.	
			Landscape	Due to uniform section on side face, landscape is inferior.	
			Overall Judgment	Compared to plan 1, structure, workability and landscape is inferior. Construction period. Superstructure 16 months Substructure 14 months	

b. Substructure

i Basic Plan

The acceptable criterion for favorable load bearing layer shown in the Specifications for Roads and its Commentary (Substructure Edition) (N value of 30 or more) was applied to the estimated supporting base of the Assin Praso Bridge upon confirming the existing boring data (surveyed by the local consultant in 1991) and onsite observations. In the examination of the plan, in due consideration of the inclination, etc. of the present ground, and assuming that depth with an N value of 50, at which the entire foundation is regarded to definitely exceed 30, the supporting layer shall be estimated. Based on the examination, the supporting layer of the new bridge foundation will be at a depth of 10m from the ground surface (altitude of 80m or deeper). The supporting layer contains the same granite from the quarry site as aggregate in the vicinity of the target road and will be appropriated for the supporting base of the bridge. In addition, spread foundation will be applied to the assumed construction site due to rock outcropping on the river bed and the shallowness of the supporting layer. Since the proposed surface height to a supporting layer is over 10m, a pile foundation will be applied to abutments on both sides. Caisson type piles will be adopted for the pile foundation method in due consideration of locally available construction equipment. In the Project, geological survey was not conducted because geological data for the existing bridge already existed and the position of the new bridge was not yet decided, however, it will be necessary to implement geological survey when conducting the field surveys for the detailed design.

ii. Substructure Type

An oval-coin shape pier will be assumed for the structural type in due consideration of the impact on the river, and inverted T-shape abutments will be examined as the general structural type. In addition, the footing of the bridge pier will be embedded at least 1m from the river bed due to the impact of scouring. Hereinafter, the bridge pier and abutment location and estimated line of supporting base are illustrated.

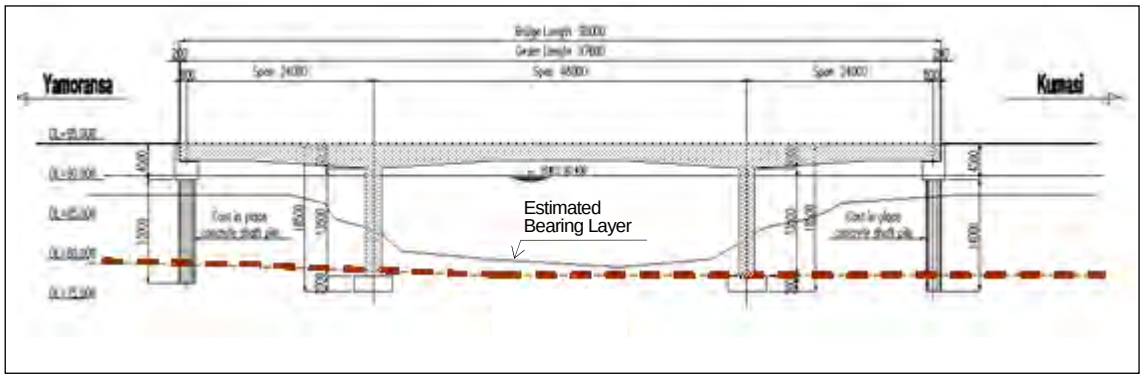


Fig. 2-11 Bridge Pier and Abutment Location and Estimated Line of Supporting Base

7) Bridge General View

Overview of the superstructure and substructure after compiling the above-mentioned examination results and bridge general view are illustrated as follows.

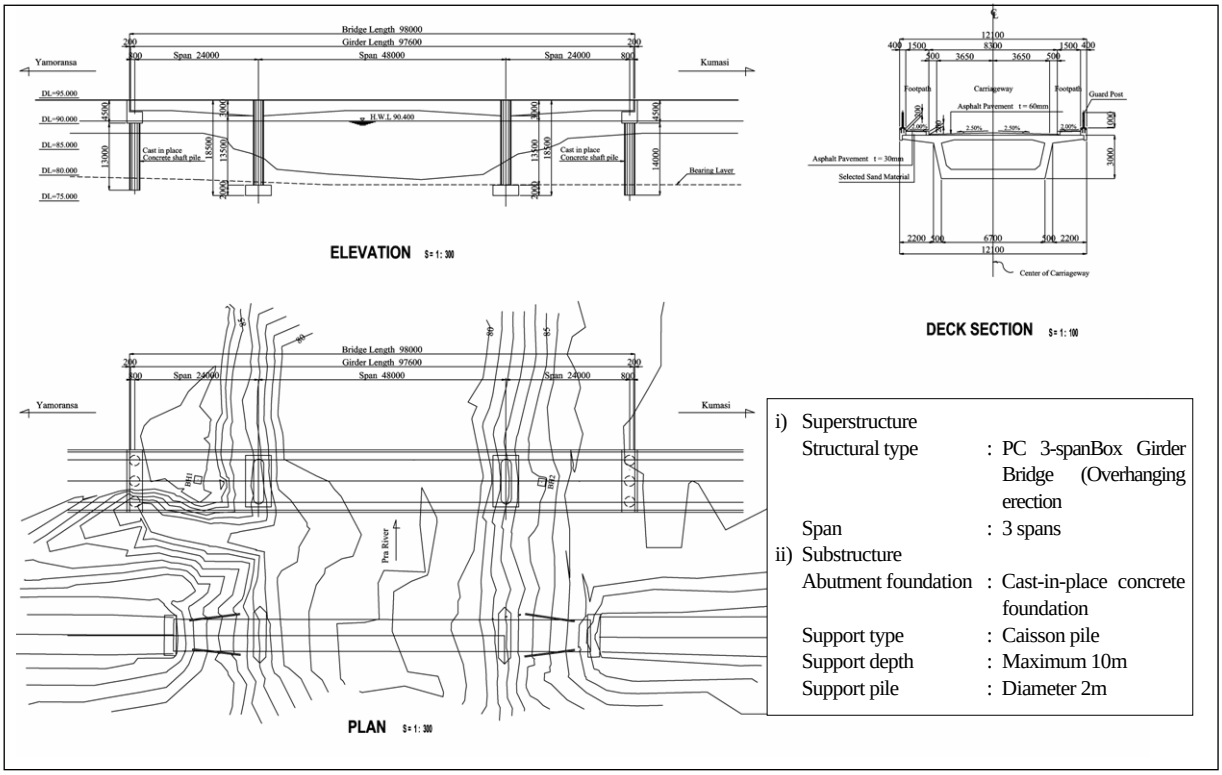


Fig. 2-12 Bridge General Plan

8) Bridge Revetment Work

The flow rate and flow velocity at the time of high-water level on Pra River at the bridge location under the plan are calculated to be 131㎥/sec and 2.1m/sec respectively. In due consideration of the flow velocity at the time of high-water level, revetment of 10m will be installed respectively from both edges of the abutment in order to protect the front of the abutment.

9) Retaining of Existing Bridge

In the case of retaining the existing bridge, guard posts will be installed at the connecting point with the new bridge to prevent the entry of vehicles into the existing bridge in order to secure the bridge exclusively for pedestrians.

2-2-2-3 Incidental Road Facilities Plan

(1) Culverts and Gutters

1) Transversal Drain Structures

At the target section, box culverts, corrugated pipe culverts and concrete pipe culverts are installed at 139 locations in total. The condition of culverts and a culvert rehabilitation plan in due consideration of the compatibility with the Ghanaian standards are shown as follows.

Table 2-20 Rehabilitation Method for Transversal Drain Structures

Transversal Structure	Problem	Rehabilitation Method	Existing	Repair
Box culvert	No structural problems have arisen with the box culverts in the target section.	These can be periodically maintained so that the culverts are inapplicable to rehabilitation in the plan.	8	0
Corrugated pipe	The bottoms of the corrugated pipes are corroded encouraging peripheral sand and earth to subside. Cracks or subsidence can be observed at some spots on the road surface of the upper part of culverts.	Corrugated pipes will no longer be used and will be replaced with concrete drainage pipes.	101	104
Concrete pipe	Some 60cm diameter concrete pipes do not satisfy the present Ghanaian standards of 90cm and therefore there are problems with maintenance.	Taking maintenance into consideration, the Ghanaian standard of more than 90cm concrete pipes will be applied.	30	26
Total			139	127

2) Drain Gutters

Mainly V-shape excavating soil gutters are installed at the existing sites and concrete structure gutters are installed in some sections such as blocks. With respect to these roadside soil gutters, since roads may be affected if smooth drainage has not been ensured, it is planned to install drain gutters in the section necessary for drainage improvement. Furthermore, the original shape of the gutters in villages has deteriorated due to the frequent coming and going of vehicles and pedestrians and cannot maintain a drainage function, so concrete protective gutters will be installed at necessary spots.

(2) Retaining Walls

Retaining walls will be installed at necessary locations by paying attention to the following points.

- Due to the large difference in elevation between the village area and the road, the sections where road improvement under the plan will affect existing facilities
- Sections where it is necessary to prevent large-scale cutting and filling.

(3) Guard Fence Work

1) Rigid Protective Retaining Walls

In the improvement of the Assin Praso Bridge, due to the high embankment at the connecting spot between the new bridge and access road, rigid protective retaining walls will be installed in order to prevent vehicles from falling into the river and to protect the bridge body.

2) Guard Posts

The existing guard rails will be removed in line with road improvement under the plan. Consequently, guard posts will be installed at necessary locations such as the existing guard rail installation spots, etc. In addition, since the climbing lane for the proposed section will be a single side shoulder, posts will be installed to allow pedestrians to enter the carriageway.

(4) Safety Facilities

1) Carriageway Markings

In accordance with Ghanaian standards, a road centerline and side track will be installed. By planning appropriate road markings at the Asokwa intersection, it is planned to secure safe and smooth traffic flow. Crosswalks will be installed at spots where pedestrians frequently cross over to schools, etc.

2) Humps

GHA requested the installation of humps along the target section for the purpose of controlling traffic accidents associated with the road improvement. The shape and location in the case of installing humps in each village will be decided in due consideration of the Ghanaian standards and previous cases.

(5) Kilometer Posts, etc.

From the viewpoint of effective utilization of road maintenance, kilometer posts at a certain distance will be installed. For maintaining road transversal drain structures, culvert beacons (same structure as guard posts) at one spot on one side of all culverts will be installed.

(6) Parking Strips (Lay-byes), Bus Stops

The installation of bus stops at each village will be examined. Funso which has a relatively large open-air market in the 23km vicinity of the road could become a hindrance to smooth traffic flow on the target road and be a safety concern for roadside residents due to the hustle and bustle and congestion during the market hours. Therefore, parking strips and bus stops will be examined based on the present market scale and congestion conditions. The shape of the parking strip and bus stops will conform to Ghanaian standards.

2-2-3 Basic Design Drawings

The basic design drawings based on the above-mentioned basic plan are shown as follows. Each drawing is attached as an appendix.

Table 2-21 List of Basic Design Drawings

Item	Description	No. of Drawings
1	Standard Road Cross Section, Road Plan and Profile	14
2	Structural General View of Major Structures	22
3	Bridge General View and Major Town Section Details	9

2-2-4 Implementation Plan /Procurement Plan

2-2-4-1 Implementation Concept

(1) Basic Policy on Implementation

In due consideration of the implementation of the Project through Japan's Grant Aid Scheme, the basic principles in implementing the plan are described as follows.

① Construction methods and work schedule suitable for the local weather conditions, terrain, regional features and national conditions shall be planned.
② General construction methods shall be planned by taking into consideration the maintenance capability of the recipient side so that it will not require special construction machinery after in-service.
③ When formulating the implementation plan, the social and environmental conditions and security of traffic safety shall be taken into account.
④ For contributing to the regional economy, locally procured equipment and materials shall be effectively utilized to the maximum.

(2) Procurement Policy

1) Labor

In order to contribute to the creation of employment opportunities, promotion of technology transfer and the revitalization of the regional economy, local engineers and workers shall be effectively utilized to the maximum. However, if jobs that are difficult to handle with the Ghanaian technical standards are necessary, to dispatch of skilled workers from Japan or a third country shall be examined.

2) Construction Materials

Policy on procurement of construction materials is described as follows.

① Locally available products shall be procured as much as possible for economical efficiency and easy procurement.
② If imported products are normally available on the market in Ghana, procurement of these products shall be examined.
③ If construction materials are difficult to obtain locally, procurement from Japan or a third country shall be examined upon considering price, quality and delivery date.
④ With respect to procurement of crushed stone for road construction, if aggregate is to be produced through direct quarrying, mining rights are necessary, so it will take a few months for procedures in general. Consequently, when taking construction period and quantity consumed into account, it is realistic to effectively utilize local crushed stone companies or contractors. In addition, with respect to permission for blasting work in the case of digging, in a similar manner as mentioned above, permits will be dealt with effectively by utilizing local contractors.

3) Construction Machinery

Policy on procurement of construction machinery is described as follows.

① For economical efficiency and easy procurement, the leasing of construction machinery owned by local contractors shall be examined primarily.

② If construction machinery is difficult to procure locally, procurement from Japan or a third country will be examined upon considering easiness, security and economical efficiency (transport cost and rental fee)..

2-2-4-2 Implementation/Procurement Conditions

(1) Implementation Conditions

1) Observance of Labor Standards

Disputes with workers will be avoided and safety will be secured through observing the present Ghanaian construction legislation and respecting local working conditions and labor customs.

2) Social and Environmental Considerations during the Construction Period

① Construction methods that minimize dust, etc. along village sections shall be applied.

② Plants, etc. which discharge noise and dust shall be established in areas away from houses. .

③ Waste materials from the construction work shall be transported to an appropriate site for filling in order not to have an impact on the surrounding environment.

④ Waste water from plants shall be appropriately treated and drained into rivers, etc. in accordance with Ghanaian standards.

⑤ Work shall be implemented based on the environmental management plan contained in the EIA report.

3) Land Acquisition and Relocation of Houses

Since idle land exists to the rear of existing residential land, it will be relatively easy to acquire land in line with the road construction and relocation of houses, and basic consent has already been secured from land owners and house owners. In future it will be confirmed that the Ghanaian side is appropriately reaching preliminary agreements and paying deposits, etc.

4) Security of Safety during Construction Work

① Since it is necessary to restrict lanes (single-side traffic), safety facilities (barricades, color cones and rotating lamps) and traffic wardens will be arranged.

② Due to the increase in construction vehicle traffic, the GHA will necessary to hold public hearings for local residents and other measures.

5) Necessity for On-site Communication Means

The use of cellular phones at the project sites is possible, so construction-related personnel will have cellular phones. Furthermore, a traffic safety management system will be set up for the purpose of ensuring safety for general traffic and local residents by ensuring telecommunications means such as portable-type transceivers for traffic wardens.

6) Respect for Local Customs

In the case of formulating an implementation plan, the work schedule shall be examined in due consideration of local customs.

7) Traffic Safety

A plan to ensure efficient and rational traffic flow shall be examined by constructing detours at necessary spots while paying attention to safety.

8) HIV Countermeasures

As HIV preventive measures should be taken for personnel who are engaged in the Project, HIV measures shall be included in the schedule control plan.

9) Customs Clearance Situation

The implementation plan shall be formulated in due consideration of the required number of days for import, unloading and customs clearance.

10) Schedule Adjustment

The implementation policies to be taken by Ghana shall be sufficiently confirmed and adjusted.

(2) Procurement Conditions

Important points to consider in procurement under the Project are listed as followed.

① A procurement plan that doesn't hinder the construction process shall be set up.
② Locally produced products shall be procured as much as possible in order to contribute to the revitalization of the regional economy.
③ Concerning construction materials and equipment that are difficult to locally obtain, procurement from Japan or a third country shall be considered in due consideration of the certainty of quality, ease of procurement and economical efficiency.
④ Products to be procured from Japan or a third country shall be unloaded at the Port of Tema, which is the principal port of Ghana. Construction machinery and general freight (materials) will be transported inland by trailers and trucks respectively.

2-2-4-3 Scope of Work

The undertakings of both the Government of Japan and the Government of Ghana in the implementation of the Project are outlined as follows.

(1) Scope of Work by Japan

1) Construction Work

Improvement work for the existing road of a total length of 59.9km at the target section

- Earth work, roadbed work, foundation course and surface course work, structures (including bridge), road construction such as incidental facilities and necessary construction-related temporary construction

- Establishment of temporary facilities (base camp, plant yards, offices and warehouses, etc.)

2) Labor, Construction Materials and Equipment Procurement

Procurement of construction materials for roads and structures, and construction machinery

3) Safety Measures

Safety control and measures related to the implementation of the construction work

4) Consultancy Services

Preparation of detailed designs, tender documents and contracts, assistance of tendering, construction work supervision

(2) Scope of Work by Ghana

1) Acquisition of Construction Permits

Acquisition of construction permits pertaining to the Project by MOT prior to bidding by contractors

2) Customs Clearance and Tax Exemption

Facilitating of customs clearance and tax exemption in Ghana based on a list of imports for construction materials and equipment prepared prior to the commencement of construction work

3) Land Acquisition

Securing of lands necessary for construction of facilities, such as the base camp shown in the "implementation plan" and securing of places to dispose waste and surplus soil to be discharged in association with construction work

4) Relocation of Public Utilities

- Relocation of obstacles (such as water supply pipes, electric and telephone lines [refer to Table 2-29 for quantities]).
- Arrangement of MOT supervisory personnel associated with the relocation and securing of related cost

5) Others

- Facilitating of entry into and stay in Ghana of Japanese nationals engaged in the implementation of the Project
- Appointment of counterparts (C/P) and securing of their personnel and related costs

2-2-4-4 Consultant Supervision

(1) Implementation Process of Consultancy Services

In the case of implementing the Project, the Exchange of Notes (E/N) with respect to the grant aid shall be signed between both the Government of Japan and the Government of Ghana. After the conclusion of the E/N, the Grant Agreement (G/A) shall be concluded between Japan International Cooperation Agency (JICA) and the Government of Ghana as a prerequisite. After the signing of the E/N and the G/A, based on the written recommendation issued by Japan International Cooperation Agency (JICA), in accordance with the scope and procedures of the Japanese Grant Aid Scheme, the Consultant will conclude a consultancy agreement with the Ghana Highway Authority (GHA), which is the implementing agency of the Government of Ghana. Following the conclusion of the agreement, the Consultant will carry out a detailed design, tender assistance services and work supervision. Hereinafter, the major services included in the consultancy agreement are described.

1) Tender Documents Preparation Stage

In accordance with the results of the Basic Design Study Report, the Consultant will prepare a detailed design for each facility and tender documents in order to obtain approval from the Ghanaian side.

2) Tender Stage

GHA will select Japanese-national contractors by means of open bidding with the assistance of the Consultant. Representatives from the Government of Ghana who participate in the tender and construction contract should possess the authority to approve related contracts and be able to judge technical matters. The tender assisting services are descried below.

① Pre-qualification (PQ) examination
② Public announcement of bidding
③ Bidding and evaluation of bids
④ Contract conclusion

3) Work Supervision System (On-site Supervision System by the Consultant)

After the conclusion of a construction contract, the Consultant will issue a commencement of work to contractors and start work supervision by personnel permanently stationed at the local site. The Consultant shall report on the construction progress to the Ghanaian side during the work supervision, and shall provide remedies and recommendations on work progress, quality, safety, payments and construction work to contractors. In addition, the Consultant shall report periodically to the Japanese Embassy in Ghana and the JICA Ghana office. Furthermore, the Consultant shall conduct a completion (defect) inspection one year after the completion of the work supervision.

2-2-4-5 Quality Control Plan

In the quality control system, a laboratory shall be provided at the base camp for carrying out quality control testing on soil quality, asphalt pavement and concrete necessary for the implementation of construction work to procure materials. As for a personnel plan, one work supervision engineer (material) will act as general manager for all tests. The major items for a quality control plan associated with the construction of the Project are shown in the following table.

Table 2-22 List of Major Quality Control Items

Item			Test Method	Test Frequency
Base (Brushed Stone)	Mixed materials		Liquid limit, plasticity index	Each mixing
			Grain size distribution	
			Aggregate strength test	
			Aggregate density test	
			Maximum dry bulk density (compaction test)	
	Laying		Density test (degree of compaction)	Once / day
Prime Coat, Tack Coat	Materials	Bituminous material	Quality certificate	For each material type
			Temperature and quantity at storing and spraying time	For each delivery
Asphalt	Materials	Bituminous material	Quality certificate and composition analysis table	For each material type
		Aggregate	Grain size distribution	Each mixing, Once / month
			Water absorption coefficient	For each material type
			Aggregate strength test	
	Mixing test		Stability	Each mixing
			Flow value	
			Percentage of air voids	
			Stability	
			Design asphalt content	
	Paving		Mixing temperature	As required
			Laying temperature	For each material type
			Sampling, Marshall stability test	About once / day
Concrete	Materials	Cement	Quality certificate, results of chemical and physical test	For each material type
		Water	Results of composition test	For each material type
		Admixture	Quality certificate, composition analysis table	For each material type
		Fine aggregate	Specific gravity in absolute dry condition	For each material type
			Grain size distribution, fineness modulus	
			Rate of clay agglomerate and soft fine pieces	
		Coarse aggregate	Specific gravity in absolute dry condition	For each material type
			Grain size distribution	
	At mixing test time		Compressive strength test	Each mixing
	At placing time		Slump test	For each material type
			Air content	For each material type
			Temperature	For each material type
	Strength		Compressive strength test (7^{th} and 28^{th}days)	For each material type
Reinforcing Bar	Materials		Quality certificate, results of tensile test	For each lot

Note : Quality control items and components were set up in accordance with the AASHTO standards.

2-2-4-6 Procurement Plan

(1) Labor

As described in the policy on construction conditions, since local contractors have personnel with experience of road and bridge construction, local workers will be employed in principle.

However, with respect to bridge foremen bridge specialists, since no such job positions exist in Ghana, Japanese-national skilled workers who are versed in bridge types (PC3-span rigid-frame box girder bridge) and the construction method (PC cantilever erection) to be adopted in the Project will be dispatched.

(2) Construction Materials

Table 2-23 shows the construction materials according to the procurement source.

Table 2-23 Procurement Sources for Major Construction Materials

Material Name	Procurement Source		Remarks
	Ghana	Japan	
[General Materials]			
Bituminous materials	●		
Cement	●		
Aggregate for pavement	●		
Reinforcing bars	●		
Aggregate for concrete	●		
Crushed stones	●		
Wood materials (plywood, square timber, plate)	●		
Fuel	●		
Lubricants	●		
Paints	●		
Shaped steel, steel pipes	●		
Stainless steel pipes		●	
Steel forms for manufacturing curb stone		●	
[Bridge Construction Materials]			
Liner plates		●	
Steel forms for manufacturing main bridge girders		●	
PC cables		●	
Anchorage fittings		●	
Expansion devices		●	
Bearings		●	
Erection materials		●	

1) General materials

Since the field survey confirmed that general construction materials (bituminous materials, cement, reinforcing bars and wood materials produced in Ghana or imported from overseas are available on the market, these items will be locally procured.

However, bridge construction-related materials such as PC steel materials, anchorage fittings, expansion devices, bearings and bridge steel forms for manufacturing main girders to be utilized for bridge superstructure are difficult to locally procure. Accordingly, these will be procured from Japan in due consideration of the secured quality, quantity and ease of procurement.

Although concrete pipes are locally manufactured and can be procured, survey found them to have inferior quality. Therefore, steel forms will be procured from Japan and the pipes will be manufactured at the base camp.

Furthermore, fuel imported from Côte d'Ivoire or Nigeria is locally available.

2) Crushed Stone for Pavement and Aggregate for Concrete

There are several aggregate quarries in the vicinity of the target road (see Figure 2-13). The Study did not examine those quarries that comprise produce stone quality that is hard to work, since this is thought to be one of the reasons for pavement degradation on the existing road. After that, four quarries were selected as proposed sites for aggregate quarry as shown in Table 2-24 based on past experience (works based on yen loans from 1990~1994) and transportation distances.

Table 2-24 Overview of Proposed Sites for Aggregate Quarry

Place Name	Place・Location	Remarks
Aponsie	Spot about 22km to the south from Assin Praso Bridge. About 300m inside from National Trunk Road No.8.	It was developed when the existing road was constructed. Presently small amounts of aggregate are manually produced.
Kwapie	Spot about 12km to the north from Obuasi. About 200m inside from Obuasi - Kumasi Road.	It was developed when the adjacent Anwiankwanta-Kumasi road was constructed. Presently small amounts of aggregate are manually produced.
Buoho-1	Quarry sites are being developed at 3 spots in Buoho district about 11km to the north of Kumasi and each site produces crushed stone. The production scale is 70 to 80ton/day.	It is being utilized for on-going repair construction for the 16km section at the end point conducted by GHA. The transportation distance is 42km so that it takes time to pass through the built-up area in Kumasi.
Buoho-2	Spot in the above -mentioned area and on the opposite side sandwiching the national road.	This quarry site was developed for the presently on-going Kumasi - Techiman road. It cannot be utilized for any other intended use. It takes time to pass through the built-up area in Kumasi.

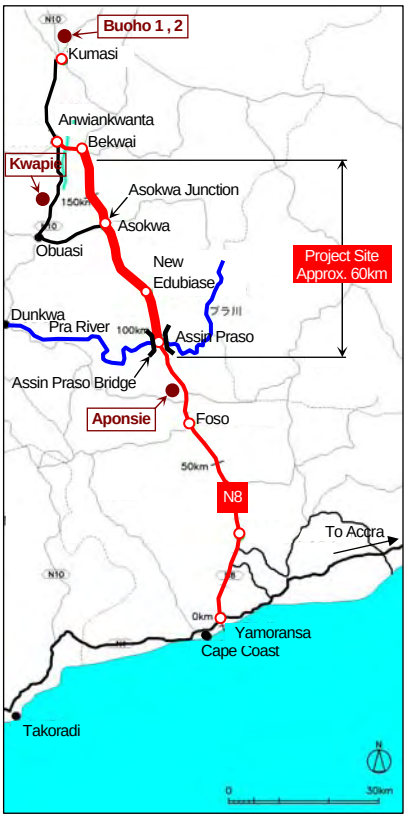


Fig. 2-13 Location Map of Quarry

By examining these proposed sites from the viewpoint of quality, size of reserves, transportation distance, cost and accessibility to works sites, the quarry in Aponsie district was regarded to be the best proposed site for collecting aggregate, and indoor tests were conducted on aggregate from here. Incidentally, from the results of the site survey, it was confirmed that aggregate obtained from the other three proposed sites also possesses sufficient quality for use as paving aggregate and concrete aggregate.

Moreover, as a result of surveying locally procurable materials, it was confirmed that local operators have established crusher plants at two quarries in Buoho district and are manufacturing and selling crushed stone and aggregate. Moreover, it was confirmed that these materials provide sufficient quality.

Based on economic comparison of the above quarry sites and materials, since transportation distances from all the proposed quarries to the road construction sites are long (approximately 60 km) and since it is not possible to procure stone crushing plants in Ghana, it has been decided to use materials purchased from Buoho district in the Project.

3) Bridge superstructure materials

Since it is difficult to locally procure bridge superstructure materials such as PC steel materials, anchorage fittings, expansion devices, bearings and bridge steel forms for manufacturing main girders, etc., they will be procured from Japan in due consideration of the secured quality, quantity and ease of procurement.

(3) Construction Equipment

1) Construction Machinery

Since the field survey found most of the required construction machinery to be locally available, it will be procured locally. However, as concrete-related machinery (concrete plant, truck mixer and concrete pump vehicle) is difficult to locally procure, it will be procured from Japan in due consideration of easy procurement and certainty. The procurement sources of major construction machinery are shown in the following table.

Table 2-25 Major Machinery List

Machine Name	Specifications	Lease / Purchase	Procurement Source		Remarks
			Ghana	Ghana	
Bulldozer	15ton, 21ton	Lease	●		
Back hoe	0.13m^3, 0.45m^3, 0.8m^3	Lease	●		
Wheel loader	1.2m^3, 2.1m^3	Lease	●		
Dump truck	4ton, 10ton	Lease	●		
Truck with crane	6t loading, 2.9t lifting	Lease	●		
Truck crane	5ton, 16ton	Lease	●		
Rough terrain crane	20ton, 25ton	Lease	●		
Road roller	Macadam 10 to 12ton	Lease	●		
Vibrating roller	3 to 4ton	Lease	●		
Vibrating roller	0.5 to 0.6ton, 0.8 to 1.1ton	Lease	●		
Tire roller	8 to 20ton	Lease	●		
Motor grader	3.1m	Lease	●		
Asphalt distributor	6,000ℓ	Lease	●		
Engine generator	20 to 300KVA	Lease	●		
Air compressor	5.0m^3/min	Lease	●		
Asphalt finisher	2.4 to 6.0m	Lease	●		
Asphalt plant	60ton/hr	Lease	●		
Aggregate plant	100ton/hr	Lease	●		
Concrete plant	Tilting-type 0.5m^3	Rental Fee		●	
Truck mixer	3.0 to 3.2m^3	Rental Fee		●	
Concrete pump vehicle	90 to 110m^3/hr	Rental Fee		●	

2) Electric Power and Water Supply

The planned base camp site does not possess infrastructure lifelines for supply of electricity, water or gas, etc. Accordingly, supply facilities have been planned as follows.

a. Electric Power

Electricity for use in the works and for domestic living purposes will be supplied from generators (to be purchased based on the results of comparison). Table 2-26 shows the locations of use, capacity and quantities of generators.

Table 2-26 Generator Arrangement

Place of Use	Rated Capacity	Quantity	Remarks
Office power	20 KVA	2	Daytime x 1 unit, nighttime x 1 unit
Dormitory power	20 KVA	1	
Processing plant power	20 KVA	1	For use in the reinforcing bar and formwork plant
Works power	20 KVA	1	For use in miscellaneous works and repair and maintenance of construction machinery and vehicles, etc. in the base camp

b. Water Supply

Since water of adequate quality for the works can be taken from Pra River, this will be used.

Also, based on the experience gained during construction based on loan aid around 15 years ago, since water quality in this area is sufficient for drinking, a well will be constructed on the base camp to provide domestic water supply. This water will also be used in the concrete plant.

c. Fuel gas

Propane gas will be purchased.

3) Telecommunications

Mobile phones can be used for communications over almost the entire target section. In areas that are out of range of radio waves, wireless radios will be used for controlling traffic and so on.

(4) Borrow Pits

Concerning borrow pits for embankment materials, based on hearings with the GHA, information in existing documents and local interviews, survey was carried out on the feasibility of borrow pits in the plan with regard to quality, reserves, transportation distance, accessibility to the actual site and cost. In the field survey, laboratory tests were conducted on samples of embankment soil from seven of the proposed borrow pit locations and sand from two of the pits approximately 5km within the target road section.

(5) Transportation of Construction Materials and Equipment

1) Transport Routes

After shipping from a Japanese major port (the Keihin District is assumed), the Japanese products will be transported by sea and be unloaded at the Port of Tema or the Port of Takoradi in Ghana. After the customs clearance, the products will be transported by trucks to the project site.

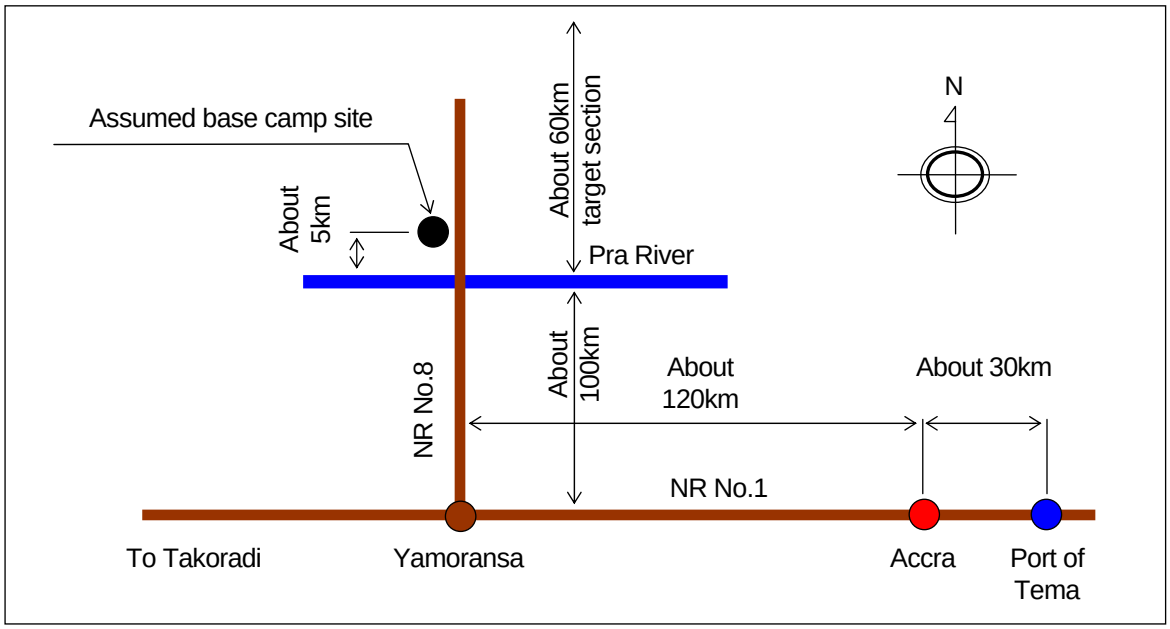


Fig. 2-14 Transport Route Overview

2) Port of Unloading

In Ghana, the major ports for unloading are the Port of Tema and the Port of Takoradi. The Port of Tema is located approximately 30km to the east of the capital Accra. Since a large-scale unloading facilities have been installed, there are no obstacles to the unloading of construction machinery and materials (container transport is also possible) to be procured under the Project. The Port of Takoradi is located approximately 260km to the west of Accra. However, it is a much smaller scale and the condition of unloading facilities has not been substantiated, in particular, it is difficult to unload construction machinery. Consequently, the Port of Tema will be the unloading port in the Project.

3) Inland Transport Routes

In the inland transportation from the Port of Tema to the project site, construction machinery will be transported by trailers, whereas, general construction materials will be transported by trucks. The transport routes are illustrated in Fig. 2-14. Although the distance from the Port of Tema to Yamoransa (junction between National Trunk Roads No. 1 and No.8) is approximately 150km, favorable asphalt pavement is applied over the whole route and road surface conditions are favorable so that there are no obstacles in the transportation of construction materials and machinery, etc. The distance between Yamoransa and the expected base camp is approximately 105km. Although the whole route is paved, pot holes are scattered along this section. However, there are no obstacles in transporting construction materials and machinery, etc.

4) Number of Days Required for Transportation

On the assumption of transportation from Japan, the required number of days from the shipping time to arrival at the project site will be 60 days as follows.

▪ Ocean Transport	: Japanese Major Port	→	Port of Tema Unloading	:	45 days
▪ Customs Clearance	:			:	14 days
▪ Inland Transport (About 250km)	: Port of Tema	→	Base Camp	:	1 days
Total					60 days

2-2-4-7 Soft Component (Technical Assistance) Plan

Technical levels in Ghana have reached a certain standard and planned road maintenance is carried out. Moreover, since it should be possible to conduct adequate road maintenance through effectively utilizing the pavement management system already adopted by GHA, the soft component program was judged to be unnecessary.

Areas where there is thought to be a strong potential for technical support are as follows: training for forecasting of pavement deterioration and improvement of routine maintenance, and OJT for counterpart technicians concerning road repairs and so on.

2-2-4-8 Implementation Schedule

(1) Setting of the Construction Period

The total length of the target section is long at 59.9km and the impact of the main rainy season which normally occurs between May and June and minor rainy season between October and November should be taken into account in the plan. Aside from these rainy seasons there is very little rainfall except between November and February. Since the number of rainy days tends to be relatively high, construction work should be carefully planned. Consequently, in due consideration of the project scale and restricted conditions, construction work is expected to take approximately two years for the Assin Praso Bridge construction and approximately four years for road-related construction.

1) Construction section : Of the 76km from Assin Praso (site where Assin Praso Bridge will be constructed) to Anwiankwanta, the section of 59.9km from Assin Praso (excluding the section 16km on the side of Anwiankwanta and on-going road maintenance by Ghana)

2) Description : Earth work (such as cutting and filling), pavement (such as surface layer, base course and roadbed), drain structures (such as pipe culverts, water inlets and outlets, gutters), incidental facilities (such as carriageway markings, signs, traversal water channel and retaining walls) and bridge (Assin Praso Bridge)

Hereinafter, the period required for rehabilitation of the target road and construction of a new bridge and the implementation schedule assuming a four-year national bond and one phasing project are shown.

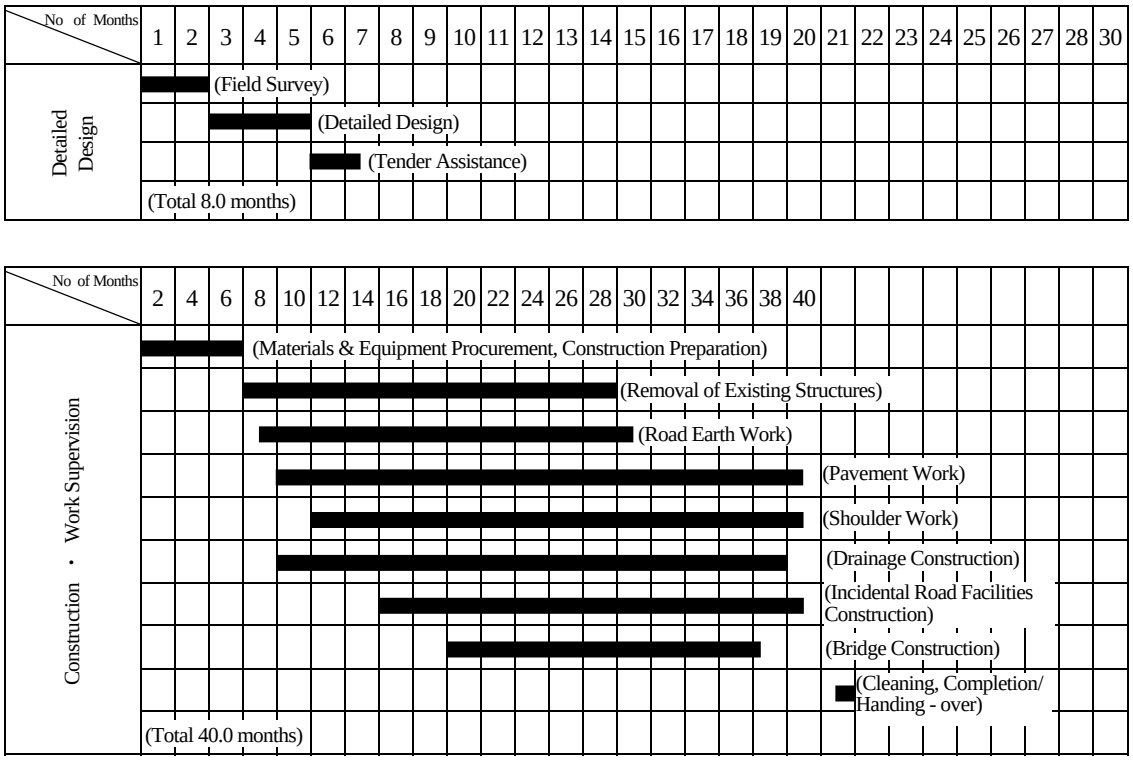
Table 2-27 Assumed Construction Period

Term	Period	Description
1st year	6 month	Preparatory works (plant installation, trial mixing, trial application) and earthworks along the section from Asokwa Junction (42km + 200m) to the end point (59km + 500)
2nd year	12 month	Completion of pavement along the section (17.3km) from Asokwa Junction (42km + 200m) to the end point (59km + 500m) and Assin Praso Bridge
3rd year	12 month	Completion of pavement along the section (24.9km) from the start point (0km-400) to 24km + 600m and Assin Praso Bridge
4th year	10 month	Completion of pavement along the section (17.6km) from 24km + 600m to Asokwa Junction (42km + 200m)

(2) Project Implementation Schedule

The project implementation schedule prepared in accordance with the procedures for Japan's Grant Aid Scheme is shown as follows.

Table 2-28 Project Implementation Schedule (Draft)



2-3 Obligations of the Recipient Country

2-3-1 General Requirements of the Japanese Grant Aid Project

Although the general requirements to be undertaken by Ghana have already been confirmed in the Minutes of Discussions (M/D) agreed on by both governments, the contents are described as follows.

- Land required for the implementation of the Project shall be secured prior to the commencement of the construction work.
- Customs duties, domestic taxes and other surcharges arising in the recipient country with respect to the provision of products and services in accordance with the verified contracts shall be exempt for Japanese nationals.
- Necessary conveniences and assistance to Japanese nationals who enter and stay in the recipient country for the implementation of the Project shall be provided with respect to the provision of products and services.
- Procedures for social and environmental considerations in Ghana and necessary surveys shall be carried out.

2-3-2 Specific Requirements of the Project

Specific requirements other than the general requirements for the Grant Aid Scheme are described as follows.

(1) Land Acquisition for Road Construction Related to the Project, Removal and Relocation of Existing Possessed Objects

In the implementation of the Project, the securing of land or removal and relocation of the existing occupying objects will arise. Since occupying objects have been confirmed on the roadside of the target road and in suburban areas and villages, the Ghanaian side should confirm the year when they become targeted by the construction work and make the necessary budget arrangements.

1) Relocation and Removal of Existing Facilities and Utilities

The water supply pipe (4-inch diameter) crossing the road which occupies the inside of the existing drain pipe (corrugated metal pipe culvert) was confirmed at a spot between 23km and 24km on the target road in the field survey. Since the right of way (ROW) width confirmed by GHA is 60m (30m on the right and left sides from the center of the existing road), 4m from both ends is regarded to be the range for the installation of public utilities. Accordingly, it is necessary to relocate the water supply pipes (relocate to the spot underground not affected by construction work) at least 52m x 2 = 104m. In addition, with respect to existing electric and telephone lines, medium voltage electric lines should be relocated

Fig.2-15 Existing Obstacle (Water Supply Pipe)

approximately 2.3km in villages and at the sections assumed for bank raising; whereas, telephone lines should be relocated approximately 300m from the existing spot to a site that will not be affected by the construction.

Although the actual relocations will depend on the scale of the target objects, it will take approximately two weeks to relocate small objects.

With respect to the cost for relocating public utilities, GHA will prepare 1.5 million dollars (approximately ¥155 million) for the planned total length of 80km based on the past project records. This amount is approximately 0.3% of the GHA annual budget and is judged to be a sufficiently feasible expenditure.

2) Land Acquisition

On the assumption that a new bridge will be constructed on the downstream side, there is a possibility that existing houses or stalls in the vicinity of Assin Praso Bridge may have to be relocated. For this, at the time of deciding the necessary project land based on the basic design, a site survey by personnel from the GHA Environmental Division and Land Valuation Division, representatives of local self-governing bodies and the Land Valuation Board (LVB) in Ghana will be conducted.

General houses, stalls, crops and land in the affected area will be subject to land acquisition survey. A compensation cost (the GHA Land Valuation Division prescribes an amount for each region) will be calculated and then paid to each property owner. In general, the relocation procedures will be completed in approximately two months.

The compensation cost associated with the relocation of general houses in the vicinity of Assin Praso Bridge, which was confirmed at the time of the field survey, is estimated to be approximately 9,400GHC (wooden houses) to 14,100GHC (concrete houses), approximately 900GHC for 1,000m^2 of land, and approximately 80GHC (cassava) to 900GHC (cocoa) for 1,000m^2 of crops.

3) Necessary Requirements for the Project to be Undertaken by Ghana

Securing of land, classification of removal and relocation of the existing occupying objects and expenses arising in the implementation of the Project are outlined as follows. The total cost for major items is estimated to be approximately ¥109 million and will be equivalent to approximately 70% of the budgeted ¥155 million to be prepared by GHA in order to implement the Project. Accordingly, this is a feasible amount within the budget. Accordingly, Ghana should prepare the necessary budgetary provisions and ensure its smooth implementation.

Table 2-29 Requirements to be Undertaken by Ghana

(1GHC = ¥110.71)

Item	Classification	Description	Unit	Quantity	Unit Cost (GHC)	Burden Amount (GHC)
① Land acquisition		Land acquisition associated with new road improvement (60m of ROW width and total length of about 59.9km)	m^2	10,000	0.9	9,000
② House relocation	Concrete buildings	Relocation of houses located on the planned ROW width	house	3	14,100	42,300
	Wooden		house	10	9,400	94,000
Item total						136,300
③ Temporary yards		Security of 4-year construction yard for contractors	m^2	50,000	0.8	40,000
④ Electric line relocation		Relocation of existing public utilities, which becomes obstacles for construction work, prior to the commencement of work	m	2,400	250	600,000
⑤ Telephone line relocation			m	400	250	100,000
⑥ Water supply pipe relocation			m	104	250	26,000
⑦ Banking charges (A/P expenses)			-	1	-	72,000
Grand total						983,300

(2) Completion of Various Procedures Necessary for Road Construction and Acquisition of Permits by Ghana

The Ghanaian side should take various procedures (EP acquisition, land acquisition, relocation of houses, etc., and bank arrangements) related to the road construction and appropriate the burden of expenses in the budget.

(3) Necessary Procedures for Installation of Detours at Present Traffic

On sections where detours are needed due to the implementation of road improvements under the Project, procedures will need to be taken in order to temporarily lease land.

(4) Security of Temporary Yards

Temporary yard land for contractors should be secured (assuming approximately 5km in the direction from Assin Praso to Kumasi) as follows.

- Temporary yard base camp (including asphalt and concrete plants) : 50m×250m
- Required time : 4 years

(5) Holding of Project Explanation Meeting for Roadside Residents in Proposed Section

After signing the E/N for an official decision on the implementation of the Project, the implementing agency will need to promptly hold a project explanatory meeting for roadside residents and other local representatives. Explanations in this meeting are likely to cover the following items: ①

contents of the project, ② request for cooperation, ③ safety control measures, ④ noise countermeasures and execution methods, ⑤ liaison window for dealing with complaints and inconveniences, etc.

(6) Traffic Safety

Motorists should be made to obey the instructions of traffic controllers during the construction work.

(7) Thorough Notice to Through Traffic of Inconveniences during Construction

As it is anticipated the works will cause inconvenience to through traffic, the public should be thoroughly informed of the effects via media such as television, radio and newspapers.

2-4 Project Operation and Maintenance Plan

As the operation and maintenance system for facilities after completion of the Project, the road maintenance department of the Ghana Highway Authority (GHA) head office will implement a road maintenance plan, and the Ashanti regional office which has jurisdiction over the target section under the Project will carry out road maintenance.

(1) Routine Maintenance

Necessary routine maintenance repair work to be carried out throughout the year for the project road is listed as follows.

① Patching (filling pot holes) on road surface
② Repair of base course as needed
③ Road surface forming/shaping
④ Cleaning and repair of gutters or transversal drain structures

(2) Periodic Maintenance

Assumed repair work to be carried out for approximately five years following completion of the works as periodic maintenance for the project road is listed as follows.

① Road surface repair
② Base course repair
③ Repair of structures
④ Repair of shoulders

The regional office of GHA has maintained that no institutional problems have arisen at the present time. Since early repair of damage is particularly important for the Project, it is required to carry out sufficient routine inspections and patrols.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Cost to be borne by the Ghana side.

The Ghana side will need to provide some 983,300 GHC (New Ghana Cedi, approximately ¥109 million) to cover the cost of relocating obstructions, securing the necessary land, etc..

1)	Land acquisition cost	:	9,000 GHC (approximately ¥ 1.0 million)
2)	Relocation of houses	:	136,300 GHC (approximately ¥15.0 million)
3)	Security of construction temporary yard	:	40,000 GHC (approximately ¥ 4.4 million)
4)	Relocation of electric lines and poles	:	600,000 GHC (approximately ¥66.5 million)
5)	Relocation of telephone lines and poles	:	100,000 GHC (approximately ¥11.1 million)
6)	Relocation of water supply pipes	:	26,000 GHC (approximately ¥ 2.9 million)
7)	Cost of A/P issuance	:	72,000 GHC (approximately ¥ 8.0 million)

(2) Estimation Conditions

The estimation conditions are as follows:

①	Estimation point	:	May 2008
②	Exchange rate	:	US$1 = 107.97 yen (mean rate from November 2007 to April 2008) 1GHC = 110.71 yen (GHC: Ghana cedi)
③	Execution and procurement term	:	Assuming works based on A bonds, the term required for implementation design, tender auxiliary work and the works shall be 48 months as indicated in the implementation schedule.
④	Others	:	Estimation shall be implemented based on the Grant Aid Scheme of the Government of Japan

2-5-2 Operation and Maintenance Cost

Major maintenance for the target road to be improved under the Project will include routine and periodic maintenance listed in Table 2-30. The amount of maintenance (annual average conversion) that is converted into Japanese yen during the Project period is estimated to be approximately ¥26 million. This is equivalent to 0.9% of 2007 Ghana's maintenance budget of approximately ¥29.13 billion and this burden amount is considered to be of a sufficiently feasible scale.

Table 2-30 Major Maintenance Items and Cost

(1GHC=¥110.71)

Form	Cycle	Description	Specifications	Unit	Unit (GHC)	Work Amount	Frequency	Cost (GHC)
Routine	Every year	Patching	1% of road surface area	m^2	16.40	4,380	12	861,984
		Roadbed repair	1% of road surface area	m^2	15.72	4,500		848,880
		Shoulder repair	2% of shoulder area	m^2	11.14	4,800		641,664
		Structure cleaning	25% of the total quantity	spot	73.47	35		30,857
							Subtotal-I	2,383,385
Periodic	5th year	Roadbed repair	2% of the total pavement area	m^2	15.72	9,000	3	424,440
		Overlay	2% of the total pavement area	m^2	13.82	8,760		363,190
		Shoulder repair	4% of shoulder area	m^2	11.14	9,600		320,832
		Structure repair	5% of the total quantity	spot	5400	7		113,400
							Subtotal-II	1,221,862
							Total of routine and periodic maintenance -III (=I+II)	3,605,247
Operation and maintenance cost▪			10% of III	formula	-	-		360,525
Total								3,965,772
Annual Cost								264,385

2-6 Other Relevant Issues

The Ghanaian side is required to pay special attention to the following matters in order to smoothly implement the requested Japanese assistance and to fully display and maintain the project effects.

① Although design and construction is planned in order to minimize the environmental and social impact during construction work taking into consideration that the target road passes through residential areas, slight impacts (such as vibration, noise and dust outbreak and traffic congestion) cannot be avoided. It is therefore important to obtain the understanding of roadside residents in advance by sufficiently explaining the impacts of construction work.

② The Ghanaian side should carry out sufficient maintenance after the completion of repairs to the target section and maintain favorable driving conditions. The 16m section repaired by GHA and the south section (approximately 100km between Assin Praso and Yamoransa) should be fully maintained so as to secure safe and smooth traffic flow on all sections of National Trunk Road N8.

③ The axle observation post presently under construction should be completed in order to secure measures for overloaded vehicles.

④ If the road is repaired, vehicle passing speed can be increased. Safe traffic flow should therefore be secured through enlightenment activities on traffic safety for roadside residents and road users.

CHAPTER 3

PROJECT EVALUATION AND ECOMMENDATIONS

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effects

As the condition of the target road, which is a part of the trunk road network of Ghana, will be improved in order to secure safe and smooth traffic, the Project is expected to benefit 23 million citizens in Ghana. The expected project effects are shown in Table 3-1.

Table 3-1 Project Effects

Current Situation & Problems	Remedial Measures under the Project (Requested Japanese Assistance)	Direct Effects & Degree of Improvement	Indirect Effects & Degree of Improvement
The target road connects major economic blocks in Ghana in a triangular shape and is an important route for economic activity. In recent years, the road has also connected the savanna zone in north and forest zone in south where disparities with other domestic areas have been a problem; moreover, it is regarded as an important distribution route for landlocked countries bordering Ghana. Due to an increase in traffic volume in the Ghanaian road network associated with economic growth from the 1970s, the increase in vehicles overloading construction materials or primary products on platforms has been remarkable since the beginning of the 1990s. As measures for finding a way out of problems on rapid pavement deterioration throughout Ghana in this period, the control of overloaded vehicles is being reinforced and design specifications of pavement are being changed (from 8.2t/axle to 13t/axle). Although the target road was improved by asphalt concrete pavement through Japan's yen loan between 1990 and 1994, as similar with the above, pavement conditions have become rapidly deteriorated so that safe and smooth traffic is being hindered.	・ Road repair	① By improving the drivability and securing smooth traffic flow, the average transit time over the 59.9km distance between the starting and end points will be shortened from 90 minutes to 47 minutes. ② By improving Assin Praso Bridge, the carriageway width on the bridge will be increased so that the safe travelling speed will be improved from the present 10km/hr to 80km/hr. ③ By improving Assin Praso Bridge, the allowable load for safe passing on the bridge will be improved from 12.0t which is the present design vehicle load to 24.5t, the Ghanaian standard. ④ By improving road surfaces, 9k of dangerous conditions on uneven pavement will be improved to safer conditions for the entire section.	① By shortening the transit time, the transportation cost for passing freights will be reduced. ② By installing bus stops, stopping lanes and slow down zones (humps) in order to separate pedestrians and bicycles from passing vehicles, relevant road safety will be improved. ③ By installing climbing lanes, lower speed requirements in the mountainous section will be relaxed. ④ By improving road surface conditions, it will contribute to an increase in the conveying capacity of inter-regional physical distribution. ⑤ By displaying its function as a regional trunk road and encouraging domestic and international distribution and human exchange, the revitalization of social and economic activities is expected. ⑥ By improving the reliability of the road, including securing smooth drivability and avoiding traffic blockages, this will contribute to regional development, correction in regional gaps, expansion in the market zone and improvement in accessibility to medical and educational institutions.

3-2 Recommendations

3-2-1 Recommendations to be Taken by the Recipient Side

(1) Undertakings by the Ghanaian Side

The Ghanaian side is required to certainly carry out EP acquisition, security of ROW for the target section and completion of various procedures by the time that the construction of the facilities under the Project is approved by the Japanese Cabinet so as not to hinder the implementation of the Project. Incidentally, the GHA counterparts have reported in writing that the environmental permit for the Project is scheduled to be acquired on January 26, 2009.

Moreover, within the field survey implemented by the GHA, basic agreement has been obtained from the owners of land and houses, etc. regarding land acquisition and relocation of houses and stalls. Regarding this point, the GHA counterparts have reported in writing that the basic agreement has been finalized.

(2) Education on Traffic Safety

Due to the improvement of surface conditions through the implementation of the Project, the travelling speed will be faster than the present speed. Consequently, it is desirable for the Ghanaian side to provide educational activities on traffic safety for drivers and local residents using the road to avoid any serious traffic accidents.

(3) Continual Maintenance Work

Maintenance work, in particular surface repairs and the removal of sediment and impediments from drains, is extremely important for keeping the road in good condition in the long term. Road maintenance not only keeps running conditions good, it is also necessary for extending the useful life of pavement and structures. In order to implement adequate maintenance on a sustained basis, it is necessary to secure the corresponding budget, and judging from the aforementioned maintenance budget in Ghana, the local side should be able to handle the financial side of maintenance following completion of the Project.

However, since administrative problems such as not making effective use of available budgets exist on the local side, it will be necessary to establish a proper implementation setup and to conduct appropriate budget requests and efficient budget allocations based on the expected road damage and necessary maintenance work in the future.

(4) Regulation on Overloaded Vehicles

As the target road is regarded as an extremely important route for passengers and commodities to Ghana and adjacent landlocked nations, if favorable pavement conditions for the target road are continuously maintained, it will become extremely important in displaying the project effects. In line with domestic economic growth in Ghana since the 1970s, as a result of a dramatic increase in large-sized overloaded vehicles associated with an increase in road traffic, the rapid deterioration of pavement has become a problem in each region of the nation. As one step, the control of overloaded vehicles is being

intensified and an axle observation post is under construction at the 42km point along the target section. Furthermore, since a change in pavement specifications was announced from the design aspects, a design axle load of 13t/axle is being applied at the present time.

In due consideration of the circumstances, the Project will adopt a 13t/axle design axle load, which is the present Ghanaian standard, and the design period will be 15 years.

Accordingly, in order for the target road to maintain favorable conditions and to fully display its functions, it is essential that Ghana control overloaded vehicles as a requisite.

3-2-2 Technical Cooperation and Coordination with Other Donors

The Project target section is part of National Trunk Road N8 and trunk roads connecting to this section such as National Trunk Roads N1, N6 and N10 are being improved through the support of aid organizations and other donors. However, since each project is under construction or has been completed, it appears direct coordination in technical cooperation with the Project will not arise.

APPENDICES

1. Study Team Members
2. Study Schedules
3. List of Interviewees
4. Minutes of Discussions (M/D)
5. List of Reference Materials Obtained
6. Other Reference Materials/Information

APPENDIX 1
STUDY TEAM MEMBERS

(1) Field Survey Stage

Table A-1 Study Team Members (Field Survey)

Assignment	Name	Affiliation
Team Leader	Kunihiro Yamauchi	Resident Representative, JICA Ghana Office
Project Coordinator	Masahiko Egami	Transport and Electricity Team, Operation Group I, Grant Aid Management Department, JICA
Chief Consultant/Road Traffic Planner/ Social and Environmental analysis	Hideaki Morita	Construction Project Consultants Inc.
Road Designer I (Geometric)	Kazuharu Koishikawa	Construction Project Consultants Inc.
Road Designer II (Structure)	Sueo Hisose	Construction Project Consultants Inc.
Bridge Designer	Takeo Mogami	Construction Project Consultants Inc.
Construction Planner/Cost Estimator	Shin Onoda	Construction Project Consultants Inc.
Natural Conditions Survey (Geology)	Kuniaki Nishijima	Construction Project Consultants Inc.
Natural Conditions Survey (Topography and Hydrogy)	Yuichi Kitamura	Construction Project Consultants Inc.

(2) Explanation of the Draft Basic Design Stage

Table A-2 Study Team Members (Explanation of the Draft Basic Design)

Assignment	Name	Affiliation
Team Leader	Masato Kumagai	Deputy Resident Representative, JICA Ghana Office
Project Coordinator	Makoto Kanagawa	Project Administration Officer for Project Study Division I, Grant Aid and Loan Support Department, JICA
Chief Consultant/Road Traffic Planner/ Social and Environmental analysis	Hideaki Morita	Construction Project Consultants Inc.
Road Designer I (Geometric/Structure)	Kazuharu Koishikawa	Construction Project Consultants Inc.

APPENDIX 2
STUDY SCHEDULES

(1) Field Survey Stage : 2/April – 15/May, 2008

Tentative Schedule

No.	Mth.	Day		JICA		Consultant						
				Team Leader JICA Ghana office, Resident representative	Project coordinator Grant Aid Management Department, JICA	Chief consultant / Road Planner / Specialist on the Social & Environment	Road Designer I	Road Designer II	Bridge Designer	Construction Planner / Estimator	Natural Investigation (Geology)	Natural Investigation (Survey & Drainage)
				Kunihiro YAMAUCHI	Masahiko EGAMI	Hideaki MORITA	Kazuharu KOISHIKAWA	Sueo HIROSE	Takeo MOGAMI	Sin ONODA	Kuniaki NISHIJIMA	Yuichi KITAMURA
1		2	We		Tokyo ->	Tokyo～Dubai						
2		3	Th		->Accra(20:10) by BA081	Dubai～Accra(12:00) by EK787						Tokyo～Dubai
3		4	Fr	08:30 Meeting with JICA office 11:00 C/C on MOFEP (Mr.Nyako;020-2015508) 14:00 C/C on MOT (Mr. Boakye; 021-665608) 15:00 C/C on GHA (Mr. Konadu; 024-4233497)				Site Invest. arrangement				Dubai～Accra
4		5	Sa	Accra -> Kumasi Site Investigation (Stay in Kumasi) (C/P: Mr. Lamptey 0244-234881)								Site Invest. arrangement
5		6	Su	Site Investigation Kumasi -> Accra, Internal meeting								Internal meeting
6		7	Mo	08:00 C/C on EOJ (TENTATIVE) 09:00 Discussion with GHA (Inception report)				Site Invest. arrangement				Site Invest. arrangement
7		8	Tu		Discussion with GHA			Site Investigation				Site Investigation
8		9	We		Discussion with GHA on M/D				Tokyo～Dubai			
9		10	Th	10:00 Signing of M/D with MOFEP, MOT and GHA, PM: Report to EOJ and JICA office (Egami: Accra(22:25) -> London by BA078)					Dubai～Accra			
10		11	Fr		->London(6:25) /(19:00)->	Discussion (GHA)						
11		12	Sa		-> Tokyo(14:45) by JL402	Site Investigation						
12	Apr	13	Su			Site Investigation、Internal meeting						
13		14	Mo			Site Investigation						
14		15	Tu									
15		16	We									
16		17	Th									
17		18	Fr									
18		19	Sa									
19		20	Su			Site Investigation、Internal meeting						
20		21	Mo			Site Investigation						
21		22	Tu									
22		23	We									
23		24	Th									
24		25	Fr									
25		26	Sa									
26		27	Su			Site Investigation、Internal meeting						
27		28	Mo			Discussion (GHA)						
28		29	Tu					Accra～	Data correction		Data correction	
29		30	We					Dubai～	Accra～	Site Investigation	Accra～	Site Investigation
30		1	Th	Labour's day		Site Investigation		～Tokyo	Dubai～		Dubai～	
31		2	Fr						～Tokyo		～Tokyo	
32		3	Sa									
33		4	Su			Internal meeting				Internal meeting		Internal meeting
34		5	Mo			Report to MOT, GHA, Report to EOJ, JICA office				Data correction		
35		6	Tu			Accra(17:30) -> by EK788				Accra～		
36		7	We			Dubai～				Dubai～		
37	May	8	Th			～Tokyo				～Tokyo		Site Investigation
38		9	Fr									
39		10	Sa									
40		11	Su									
41		12	Mo									Data correction
42		13	Tu									Accra～
43		14	We									Dubai～
44		15	Th									～Tokyo

Regend EOJ: Embassy of Japan
MOFEP: Ministry of Finance and Economic Planning, MOT: Ministry of Transportation, GHA: Ghana Highway Authority

(2) Mission to Explain the Draft Basic Design Stage : 16 – 25 October, 2008

Date		Mr. KUMAGAI	Mr. KANAGAWA	Consultant	Ms. Enomoto	Mr. Tanaka, Mr. Christopher
Oct. 16	Thu			Dept. Narita		
Oct. 17	Fri			Arrv. Accra 1500 Meeting with JICA Ghana Office		
10月18日	Sat		0900 Dept. Nairobi (KQ508) 1140 Arrv. Accra	Preparation for discussion		
			14 : 00 Accra→19 : 00 Obuasi (by car)			
10月19日	Sun		8:00 Obuasi 9:00 Anwiankwanta 10:00 Bekwai 12:00 Praso 14:00 Yamoransa 16:30 Takoradi 19:00 Yamoransa 21:00 Accra	1630 Accra		1130 Accra 1400 Yamoransa 16:30 Takoradi 19:00 Yamoransa 21:00 Accra
10月20日	Mon	0900 Meeting with JICA Ghana Office 1100 MOFEP 1400 MOT、GHA				
10月21日	Tue	Discussion with GHA				
10月22日	Wed	Discussion with GHA Sign on M/D				
10月23日	Thu	0900 Meeting with JICA Ghana Office 1030 Report to EOJ				
			Dept. Accra			
10月24日	Fri		Dubai			
10月25日	Sat		Arrv. Japan			

＊ MOFEP: Ministry of Finance and Economic Planning
MOT: Ministry of Transportation
GHA: Ghana Highway Authority

APPENDIX 3
LIST OF INTERVIEWEES

(1) Field Survey Stage

1) Ministry of Finance and Economic Planning (MOFEP)

Mr. Yaw Okyere-Nyako	Acting Director External Resource Mobilization -Bilateral
Mr. Samuel Abu-Bonsrah	Head of Japan, China, South Korea DeskExternal Resource Mobilization (Bilateral) Division

2) Ministry of Transportation (MOT)

Hon. Dr. Richard ANANE	Minister of Transportation
Hon. Magnus OPARE ASAMOAH	Deputy Minister of Transportation
Mr. Alex Twumasi BOAKYE	Acting, Director
Mr. E. A. KWAKYE	Transport Adviser
Mr. G.K. KUMOR	Director, (Administration)
Ms. Gloria NOI	Deputy Director (Human Resource Dev.)
Mr. E. SIADAH	Staff
Mr. Charles AFETIERNU	Staff

3) Ghana Highway Authority (GHA)

Mr. Eric Oduro KONADU	Chief Executive
Mr. Martin hMENSAH	Deputy Chief Executive (Administration)
Mr. K.B. DARFOOR	Acting Deputy chief Executive (Development)
Ms. Janice A. OMANI	Assistant Engineer (Survey & Design)
Mr. E.A. MILLS	Principal Engineer (Geod) – Survey & Design
Mr. Charles J. RHABBLES	Director (Planning)
Mr. Ofori FRIMPONG	Acting Director (RSE)
Mr. Aminu Issaka ABUBAKAR	Acting Director (Bridges)
Mr. Gordon AMATEY	Design Engineer (Survey & Design)
Mr. Michael A. ABBEY	Director of Contracts
Mr. Lawrence LAMPTEY	Principal Engineer (Materials)
Mr. D.K. SINTIM-ABOAKYE	Director (Materials)
Ms. Rita OHENE-SARFO	Principal Engineer (Environment)
Mr. Kofi ARCHER-KWAGYAN	Principal Valuer

4) Embassy of Japan in Ghana

Yutaka Nakamura	Counsellor
Yukiyo Oda	Economic Adviser

5) JICA Ghana Office

Kunihiro Yamauchi	Resident Representative
Masato Kumagai	Deputy Resident Representative

Yukinari Tanaka	Assitant Resident Representative
Mr. Christopher Nuoyel	Program Officer/Infrastructure

(2) Mission to Explain the Draft Basic Design Stage

1) Ministry of Transportation (MOT)

Mr. Alex Twumasi BOAKE	Ag, Chief Director
Mr. Peter Ofori-Asumadu	Ag, Director Policy & Planning

2) Ministry of Finance and Economic Planning (MOFEP)

Mr.Yaw Okyere-Nyako	Director of External Resource Mobilization (Bilateral) Division
Mr. Samuel Abu-Bonsra	Head, Japan & Korean, Dep., External Resource Mobilization (Bilateral) Division

3) Ghana Highway Authority (GHA)

Mr. E Oduro-Asumadu	Chief Executive
Mr. Kwasi B. Darfoor	Acting Deputy Chief Executive, Development
Mr. Peter Dagadu	Director of Bridges
Mr. Omusu Sekyere Antwi	Principal Engineer, Bridges
Mr. Ofori Frimpong	Principal Engineer, Road Safety & Environment
Ms. Rita Ohene Sarpong	Principal Engineer, Road Safety & Environment
Mr. K. N. Aboagye	Director of Survey & Design
Mr. Lawrence L. L. Lamptey	Principal Engineer, Materials
Mr. Joseph Amedruke	Principal Engineer, Materials
Mr. Arche-Kwagyam	Principal Valuer

4) Embassy of Japan in Ghana

Yutaka Nakamura	Counsellor
Yoko Anazawa	First Secretary

5) JICA Ghana Office

Masato Kumagai	Deputy Resident Representative
Yukinari Tanaka	Assitant Resident Representative
Yuko Enomono	Program Staff
Mr. Christopher Nuoyel	Program Officer/Infrastructure

APPENDIX 4
MINUTES OF DISCUSSIONS

(1) Field Survey Stage

Minutes of Discussions
on the Basic Design Study
on the Project for the Rehabilitation of National Trunk Road N8
in the Republic of Ghana

Based on the results of the Preliminary Study, the Government of Japan decided to conduct a Basic Design Study on the Project for the Rehabilitation of National Trunk Road N8 (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Republic of Ghana (hereinafter referred to as "Ghana") the Basic Design Study Team (hereinafter referred to as "the Team"), which was headed by Mr. Kunihiro Yamauchi, Resident Representative of the JICA Ghana Office, and is scheduled to stay in the country from April 3 to May 13, 2008.

The Team held discussions with the officials of the Government of Ghana and conducted a field survey at the study area.

In the course of discussions and field survey, both sides confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Accra, April 9, 2008

Kunihiro Yamauchi
Leader
Basic Design Study Team
Japan International Cooperation Agency

A. Twumasi Boakye
Acting Chief Director
Ministry of Transportation
The Republic of Ghana

Samuel Abu-Bonsrah
Acting Head
External Resource Mobilization(Bilateral) Division
Ministry of Finance and Economic Planning
The Republic of Ghana

Eric Oduro- Konadu
Chief Executive
Ghana Highway Authority
The Republic of Ghana

ATTACHMENT

1. Objective of the Project

The objective of the Project is to rehabilitate the National Trunk Road N8 between Assin Praso and Anwiankwanta, in order to promote economic growth and reduce poverty.

2. Project Site

The Project site is located in Ashanti Region, as shown in Annex-1.

3. Responsible and Implementing Organizations

- The responsible ministry is Ministry of Transportation (MOT).
- The implementing agency is Ghana Highway Authority (GHA).
- The organization charts of MOT and GHA are shown in Annex-2.

4. Items Requested by the Government of Ghana

After discussions with the Team, the Project components were confirmed as below:

- Rehabilitation of National Trunk Road N8 between Assin Praso and Anwiankwanta (approximately 60km), including the reconstruction of Assin Praso Bridge.

  Starting point: Assin Praso Bridge

  End point: The end point of the sectional rehabilitation project by GHA, i.e. 16km from Anwiankwanta

JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

The Ghanaian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Ghana as explained by the Team and described in Annex-3 and Annex-4 of the Minutes of Discussions signed by both parties on August 1, 2007.

6. Schedule of the Study

6-1. The consultants will proceed with further studies in Ghana until May 13, 2008.

6-2. JICA will prepare the draft report in English and dispatch a mission in order to explain its contents. The Team explained that the timing of the dispatch of the mission needs to be set in October 2008, considering the Study schedule and the timing of appraisal of the Project by the Government of Japan. The Ghanaian side agreed to accept the mission in October 2008.

6-3. In case that the contents of the report are accepted in principle by the Government of Ghana, JICA will complete the final report and send it to the Government of Ghana by

the end of December 2008.

7. Environmental and Social Considerations

7-1. Both sides confirmed that Environmental Permit is necessary for the Project in accordance with the Environmental Assessment Regulations of the Government of Ghana, and that GHA shall obtain the permission for the Project through the following procedures.

1) GHA shall submit the Registration Form for screening in respect of the Environmental Impact Assessment (EIA) procedure to the Environmental Protection Agency (EPA) of Ghana by April 18, 2008. GHA shall report the result of the screening by EPA to JICA Ghana Office before the end of May 2008.
2) GHA shall prepare a scoping and a draft EIA reports in accordance with the response by EPA. The draft EIA report shall be prepared based on the tentative feasible option, which shall be communicated by the Team to GHA before the middle of June 2008.
3) GHA shall submit the draft EIA report to EPA before the end of June 2008, complete the necessary procedures for EIA and obtain the Environmental Permit by the end of November 2008. GHA shall report the result of EIA to JICA Ghana Office by the same date.

7-2. GHA shall bear the expenses of EIA procedures.

7-3. GHA shall secure the necessary land for the Project in accordance with the Ghanan law. The expenses of the procedures and compensation to the local residents should be borne by GHA. GHA shall hold meetings and/or negotiate with land owners and confirm the consensus on the expropriation and/or temporary use of land necessary for the Project by the end of November 2008. GHA shall report the results to JICA Ghana Office by the same date and complete the land acquisition before the commencement of the Project.

7-4. The Team shall provide GHA with necessary information of outline design, before the middle of September 2008 for GHA's smooth execution of above mentioned procedures.

8. Other Relevant Issues

8-1. The name of the Project is "the Project for the Rehabilitation of National Trunk Road N8".

8-2. The following undertakings shall be done by GHA at its expense before the commencement of the Project.

- Relocation of existing utilities (power, telecommunication lines, water lines, etc.), if necessary,
- Removal of the existing Assin Praso Bridge, if necessary,
- Securing and clearance of the temporary yard and land for detour, and
- Securing of the site for borrow pit and disposal area.

8-3. GHA shall secure enough budget and personnel necessary for the maintenance of the road rehabilitated by the Project.

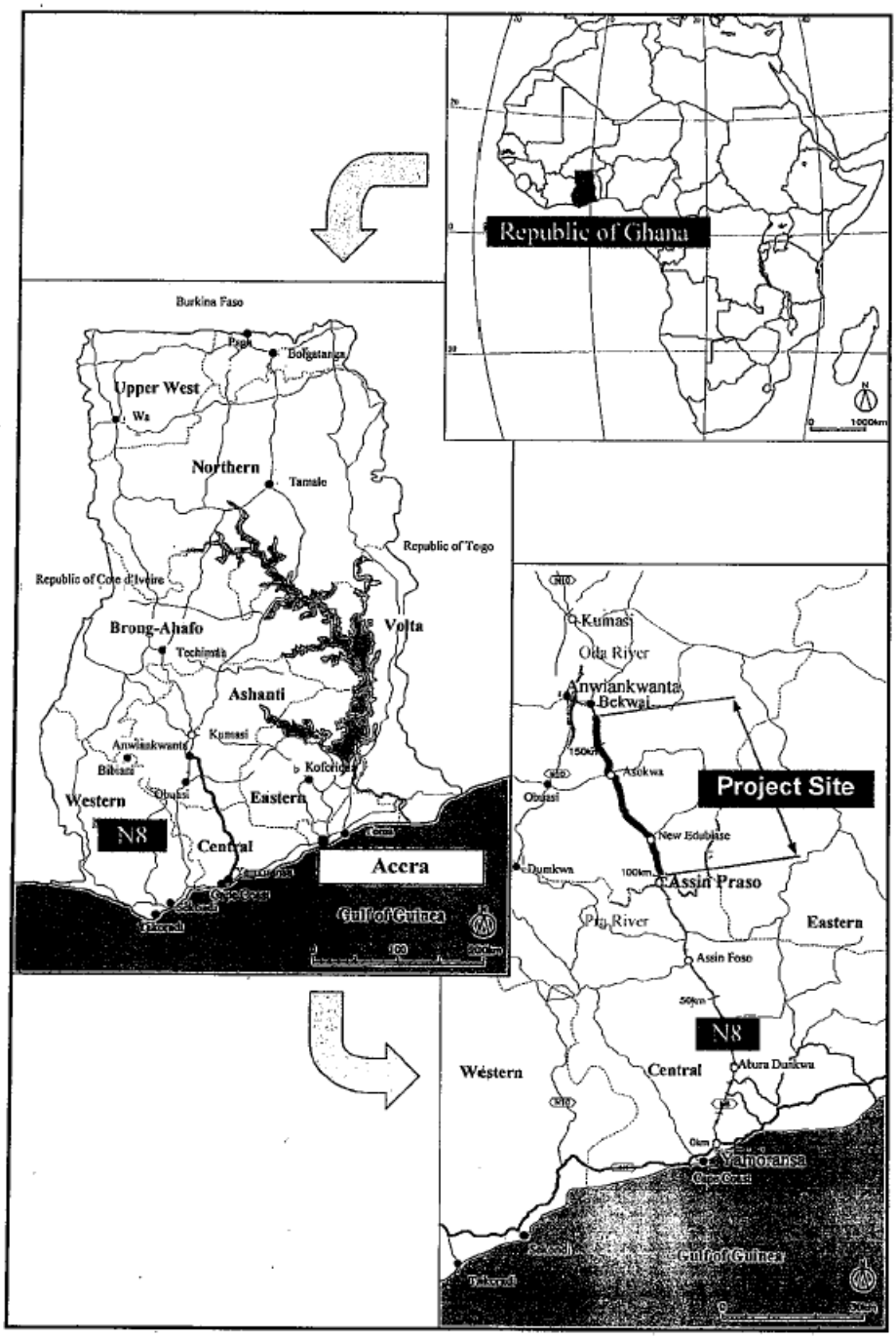
8-4. GHA ensured that there is no overlap of similar support by other donors for the Project.

8-5. The Ghanaian side shall submit the answers to the Questionnaire submitted by the Team by April 11, 2008.

8-6. The Ghanaian side shall provide necessary number(s) of counterpart personnel to the Team during the period of the study in Ghana.

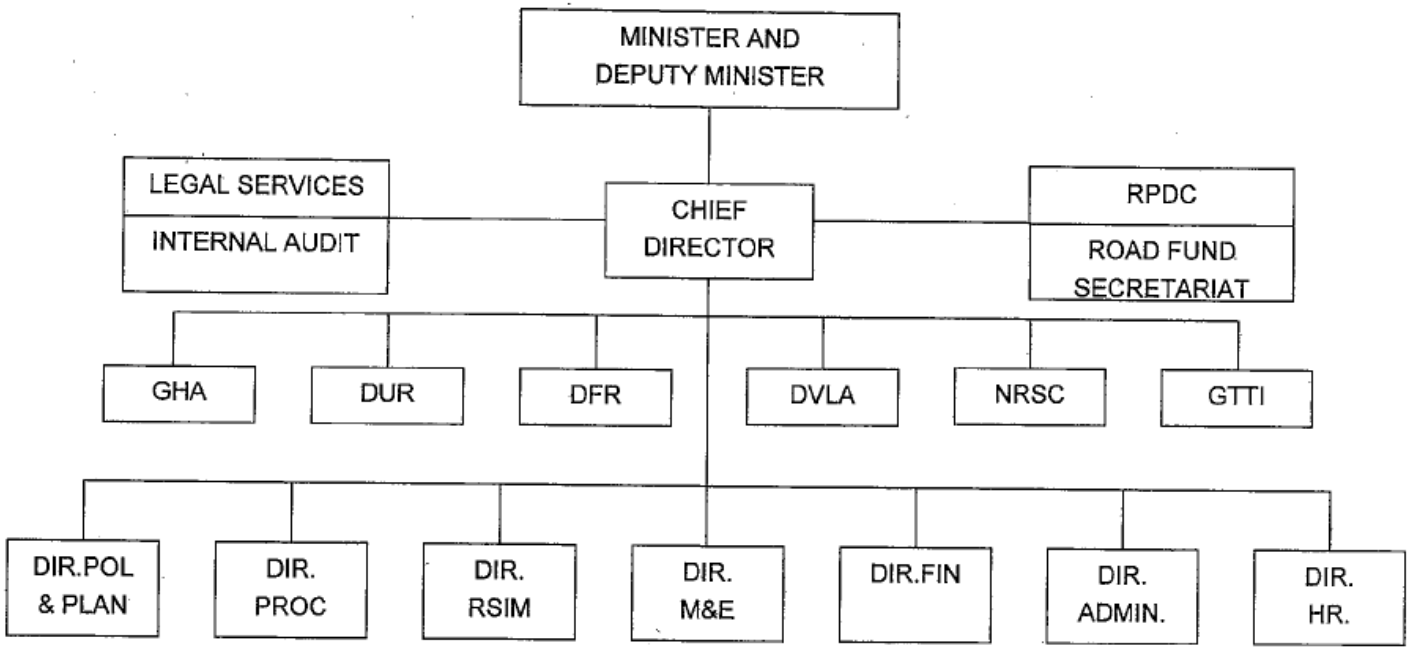
Annex-1: Location Map

Annex-2: Organization Chart of MOT and GHA



Location Map

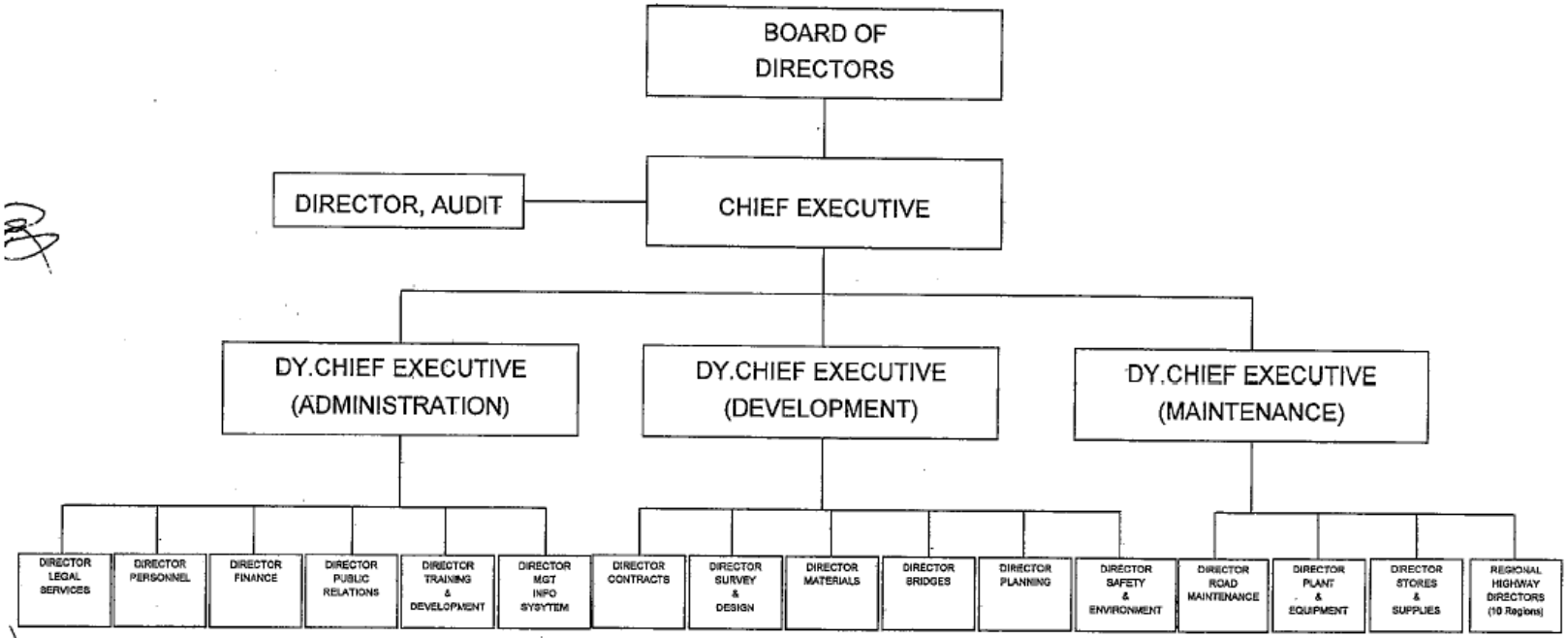
ORGANISATIONAL STRUCTURE OF THE MINISTRY OF TRANSPORTATION



ABBREVIATIONS

1. RPDC – ROAD PROGRAMME AND DONOR CORDINATION
2. DVLA - DRIVER AND VEHICLE LICENCING AUTHORITY
3. DUR – DEPARTMENT OF URBAN ROADS
4. DFR – DEPATMENT OF FEEDER ROADS
5. NRSC – NATIONAL ROAD SAFETY COMMISION
6. RSIM – RESEARCH STATTICS AND INFORMATION MANAGEMENT
7. GTTI – GHANA TECHNICAL TRAINING INSTITUTE
8. M & E – MONITORING AND EVALUATION
9. ADMIN - ADMINISTRATION
10. PROC – PROCUREMENT
11. GHA – GHANA HIGHWAY AUTHORITY
12. HR – HUMAN RESOURCES
13. FIN – FINANCE
14. POL.& PLAN – POLICY AND PLANNING

ORGANISATIONAL STRUCTURE OF GHANA HIGHWEY AUTHORITY



(2) Explanation of the DBD Stage

Minutes of Discussions
on the Basic Design Study
on the Project for the Rehabilitation of National Trunk Road N8
in the Republic of Ghana
(Explanation on Draft Report)

In April, 2008, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for the Rehabilitation of National Trunk Road N8 (hereinafter referred to as "the Project") to the Republic of Ghana (hereinafter referred to as "Ghana"), and through discussions, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the Study.

In order to explain and to consult with the concerned officials of the Government of Ghana on the components of the draft report, JICA sent to Ghana the Basic Design Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Masato Kumagai, Senior Representative, JICA Ghana Office, from October 16 to October 25, 2008.

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

Accra, October 22, 2008

Masato Kumagai
Leader
Basic Design Explanation Team
Japan International Cooperation Agency
Japan

Alex Twumasi-Boakye
Acting Chief Director
Ministry of Transportation
The Republic of Ghana

Yaw Okyere-Nyako
Director
External Resource Mobilization (Bilateral) Division
Ministry of Finance and Economic Planning
The Republic of Ghana

Eric Oduro-Konadu
Chief Executive
Ghana Highway Authority
The Republic of Ghana

ATTACHMENT

1. Components of the Draft Report

The Ghanaian side agreed and accepted in principle the components of the draft report of the Basic Design Study explained by the Team.

2. Japan's Grant Aid Scheme

The Japanese side explained the procedure of Japan's Grant Aid Scheme and the Ghanaian side understands it.

3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed items and send it to the Ghanaian side by the end of December, 2008.

4. Cost Estimation

Both sides agreed that the Project Cost Estimation, as attached in Annex-1, should never be duplicated or released to any third parties before the signing of all the contracts for the Project.

5. Undertakings by the Ghanaian side

5-1. Environmental and Social Considerations

Both sides confirmed that Environmental Permit is necessary for the Project in accordance with the Environmental Assessment Regulations of the Government of Ghana. Furthermore, the Ghanaian side agreed that Ghana Highway Authority (GHA) shall obtain the permit for the Project at its own expense by the end of November, 2008 and report to JICA Ghana Office immediately after the issuance of the permit.

5-2. Removal and Relocation of Existing Utilities

Ghanaian side agreed that GHA will take necessary measures to remove or relocate existing utilities (power, telecommunication lines, water lines, etc.), including the coordination with other authorities concerned, at its own expense before the commencement of the Project.

5-3. Land Acquisition

GHA shall secure the necessary land for the Project in accordance with the Ghanaian law. The expenses of the procedures and compensation to the property owners should be borne by GHA. GHA shall hold meetings and/or negotiate with the property owners and confirm the consensus on the expropriation and/or temporary use of land necessary for the Project as shown in the following schedule.

- Identification of persons to be compensated based on the results of a field survey by the

survey group of GHA, by the middle of November, 2008.

- Explanation to and acquisition of consents from each property owner, by the end of November, 2008.

GHA shall report the results to JICA Ghana Office by the same date and complete the land acquisition before the commencement of the Project.

5-4. Maintenance after the Project

The Japanese side explained and requested necessary measures (e.g. strict enforcement of the axle load control) and budget allocation for maintenance of the road, bridge and other related facilities included in the Project after the completion of the Project, and the Ghanaian side agreed that GHA shall take necessary actions to maintain it properly at its own expense.

5-5. Other Relevant Issues

1) Both sides reconfirmed that the following undertakings for the Project will be borne by the Ghanaian side.
   - Budget allocation for the commissions for the banking services, including the Authorization to Pay (A/P), based upon Banking Arrangement (B/A),
   - Necessary arrangement for the tax exemption of imported equipment, materials and machinery of the Consultant and Contractor of the Project,
   - Securing and clearance of the temporary yard and land for detour, and
   - Securing of the site for borrow pit and disposal area.
2) The Team explained the tentative schedule of the Project, indicating that the construction will start 8 months after the Exchange of Notes between the Government of Ghana and Japan, which will follow the submission of the final report.

Annex-1: Project Cost Estimation

CONFIDENTIAL

Annex-1

Project Cost to be Borne by Japan's Grant Aid

This Page is closed
due to the confidentiality.

APPENDIX 5
LIST OF REFERENCE MATERIALS OBTAINED

No.	Description	Type	Original ・Copy	Published by	Year
1	Axel Load Control Status Report (Dec.2007)	Document	Copy	GHA	2007
2	Daily Graphic Article EU supports road Projects in E. Region	News Paper	Copy	Daily Graphic	2008
3	The Ghanaian Times article MCA road projects to begin Sept.	News Paper	Copy	The Ghanaian Times	2008
4	The Ghanaian Times article Road Construction Industry collapsing.as payment arrears mount	News Paper	Copy	The Ghanaian Times	2008
5	Transport SectorDeve lopment Partners' Conference 2006-2007 Review Report VolumeII /Draft/	Document	Copy	Aviation, port Authority, MOT	
6	Accident Data on Anwiankwanta-Yamoransa Road (From 2000-2006)	Document	Copy		
7	Road Sector Development Programme (RSDP) Programme Management Report Fource Quarter 31st Dec.,2008	Document	Copy	GHA	2007
8	Maintenance Organization Structure	Document	Copy	GHA	
9	Standard Details, Road Signs and Markings for urban and Trunk Roads	Document	Copy	Ministry of Roads and Highways	
10	Traffic Calming Measures Desing guideline Vewsion 2 -Feb. 2008	Document	Copy	GHA	2008
11	Terms of referencefor Consultancy Services for the Design Review and Construction Supervision	Document	Copy	GHA	
12	Traffic Counting Stations Zone 1 (Northan, upper West and East reagions)	Document	Copy	GHA	
13	Hydrogical Data on Pra at Assin Praso	Document	Copy	Hydrogical Services Department	
14	Adminstrative flow chart of the EA procedure	Document	Copy		
15	Adminstrative flow chart of the EA procedure	Document	Copy		
16	"Rehabililitation N8 and the Reconstruction od Assin Praso Bridge" Environmental Impact Assessment Registration Form	Document	Copy	GHA	2008