

**BASIC DESIGN STUDY REPORT
ON THE PROJECT
FOR
REHABILITATION OF BRIDGES
ON THE ASMARA-MASSAWA ROAD
IN
THE STATE OF ERITREA**

JULY 2004

**JAPAN INTERNATIONAL COOPERATION AGENCY
CONSTRUCTION PROJECT CONSULTANTS, INC.
AND
NIPPON KOEI CO., LTD.**

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PREFACE

In response to a request from the Government of the State of Eritrea, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of Bridges on the Asmara - Massawa Road in the State of Eritrea and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Eritrea a study team two times from March 9th to March 23rd, 2003 and from January 18th to February 27th, 2004.

The team held discussions with the officials concerned of the Government of Eritrea, 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 Eritrea in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the State of Eritrea for their close cooperation extended to the teams.

July , 2004

Yasuo Matsui
Vice-President
Japan International Cooperation Agency

July, 2004

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Rehabilitation of Bridges on the Asmara – Massawa Road in the State of Eritrea.

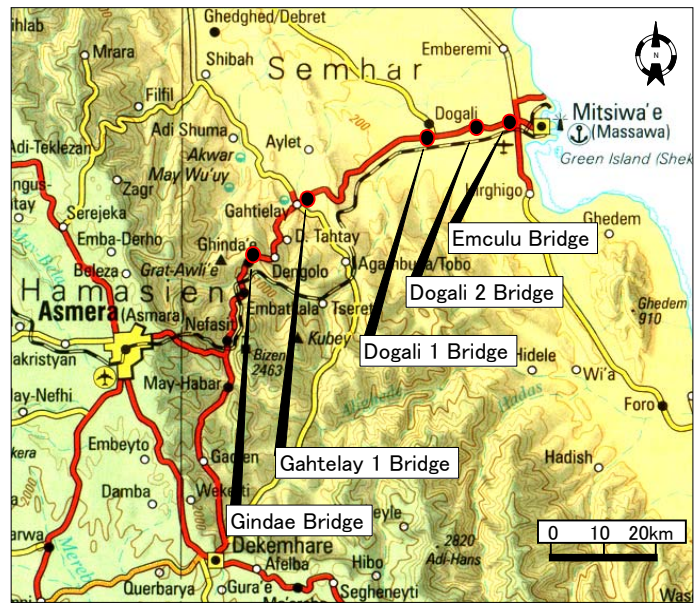
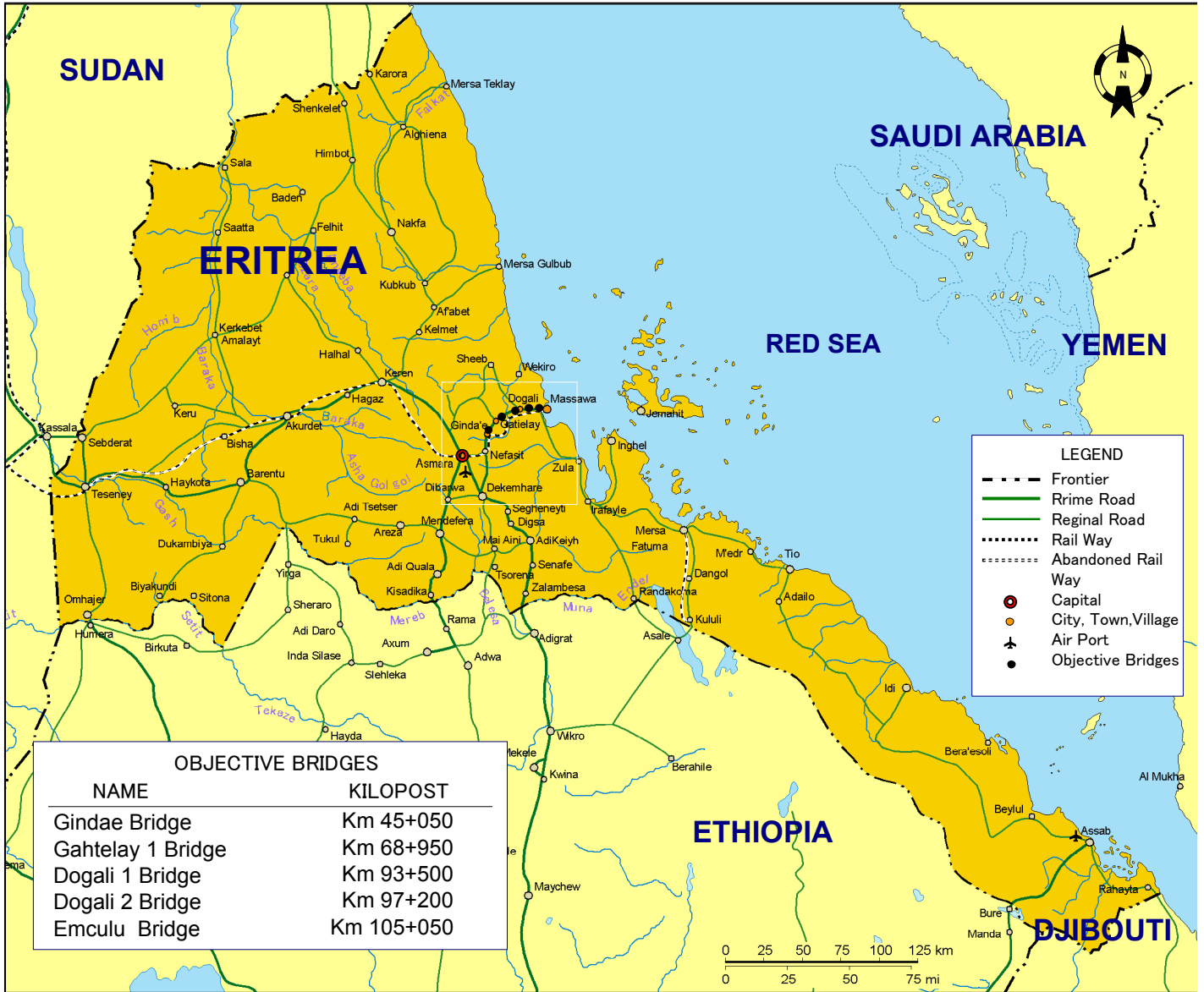
This study was conducted by the joint venture between Construction Project Consultants, Inc., and Nippon Koei Co., Ltd., under a contract to JICA, during the period from March, 2003 to July, 2004. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Eritrea 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.

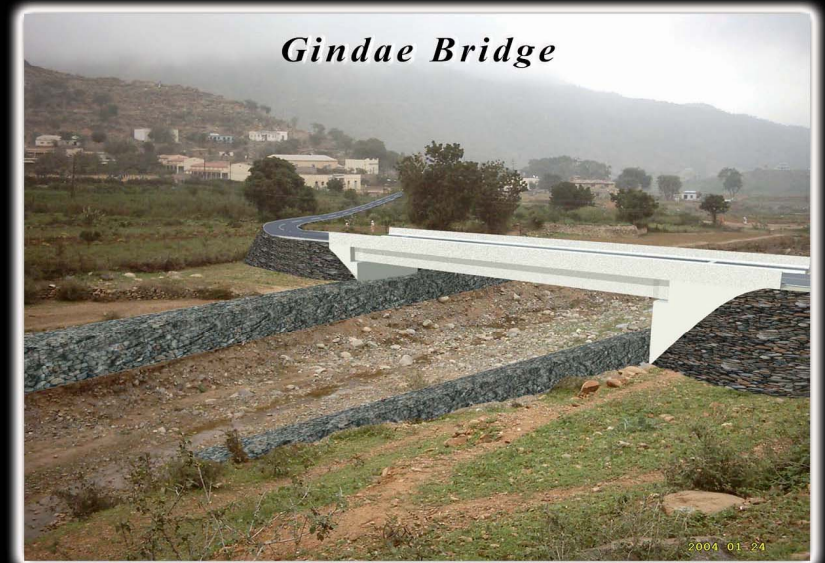
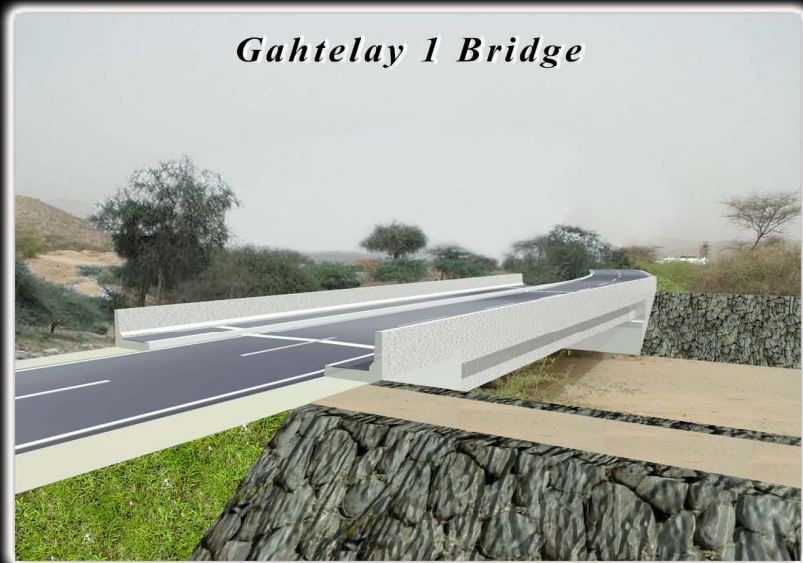
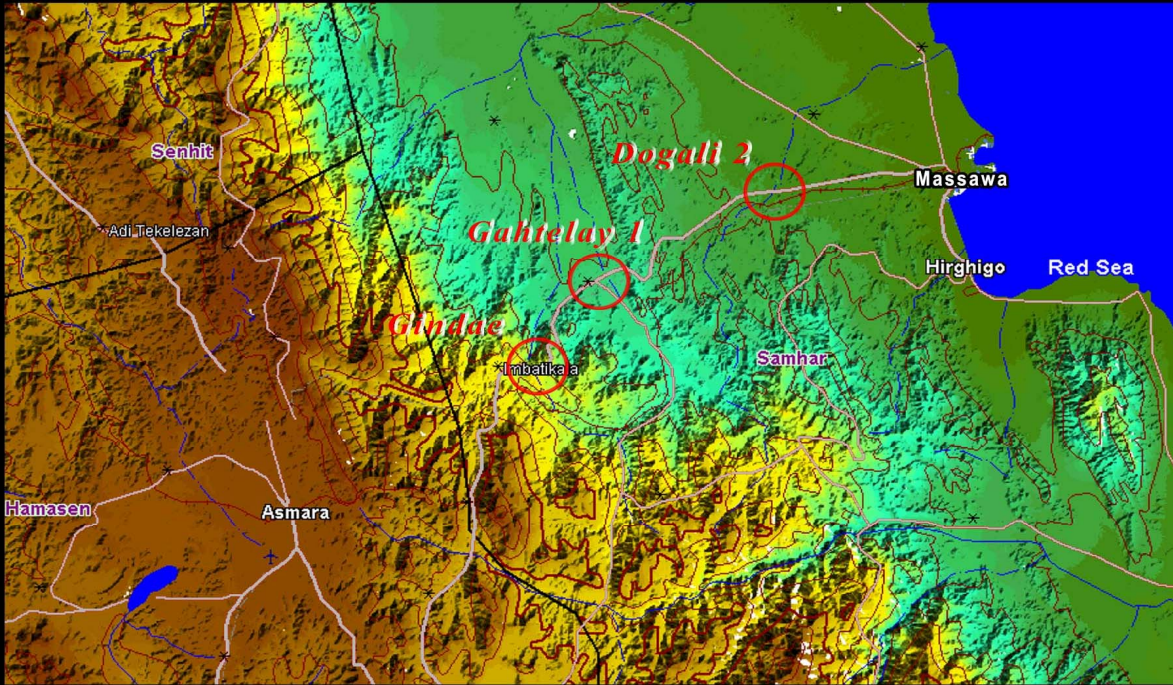
Very truly yours,



Shozo Inoue
Project Manager
Basic design study team on the
Project for Rehabilitation of Bridges
on the Asmara – Massawa Road in the
State of Eritrea
The joint venture between
Construction Project Consultants, Inc.
and Nippon Koei Co.,Ltd.



LOCATION MAP
 THE PROJECT FOR REHABILITATION OF BRIDGES ON THE ASMARA–MASSAWA ROAD
 IN THE STATE OF ERITREA



PERSPECTIVE

List of Tables

| | | |
|------------|---|----|
| Table 2.1 | Observation Records of Temperature, Humidity and Rainfall in Gindae City..... | 5 |
| Table 2.2 | Observation Records of Temperature, Humidity and Rainfall in Massawa City | 5 |
| Table 2.3 | Expected Period and Maximum Horizontal Acceleration..... | 6 |
| Table 2.4 | Proposed Design Seismic Horizontal Coefficient | 6 |
| Table 2.5 | Geometric Standard Criteria | 13 |
| Table 2.6 | Summary of Scale and Details Regarding Facility..... | 14 |
| Table 2.7 | Relation between Span Length and Type of Superstructure | 15 |
| Table 2.8 | Comparison of Two Alternatives Bridge Types..... | 17 |
| Table 2.9 | Quality Control Tests Plan | 37 |
| Table 2.10 | Indicative Procurement Schedules of Materials | 38 |
| Table 2.11 | Indicative Procurement Schedule of Construction Equipment..... | 39 |
| Table 2.12 | Implementation Schedule..... | 41 |
| Table 2.13 | Work Items to be Undertaken by Eritrean Side (Gindae Bridge) | 43 |
| Table 2.14 | Work Items to be Undertaken by Eritrean Side (Gahtelay 1 Bridge) | 44 |
| Table 2.15 | Work Items to be Undertaken by Eritrean Side (Dogali 1 Bridge)..... | 44 |
| Table 2.16 | Work Items to be Undertaken by Eritrean Side (Dogali 2 Bridge)..... | 45 |
| Table 2.17 | Work Items to be Undertaken by Eritrean Side (Emculu Bridge) | 46 |
| Table 2.18 | Approximate Project Costs | 48 |
| Table 2.19 | Approximate Costs to be borne by Eritrean side..... | 48 |
| Table 2.20 | Approximate Maintenance Cost | 49 |
| Table 3.1 | Effect of Project Implementation and Expected Improvement | 50 |

List of Figures

| | | |
|-------------|---|----|
| Figure 2.1 | Standard Cross Section..... | 13 |
| Figure 2.2 | Standard Cross Section of Two Alternatives | 16 |
| Figure 2.3 | Actual Bridge Condition of Dogali 1 Bridge..... | 20 |
| Figure 2.4 | Actual Bridge Condition of Emculu Bridge | 21 |
| Figure 2.5 | Basic Design Drawing for Gindae Bridge..... | 22 |
| Figure 2.6 | Basic Design Drawing for Gahtelay 1 Bridge | 23 |
| Figure 2.7 | Basic Design Drawing for Dogali 1 Bridge..... | 24 |
| Figure 2.8 | Basic Design Drawing for Dogali 2 Bridge..... | 25 |
| Figure 2.9 | Basic Design Drawing for Emculu Bridge | 26 |
| Figure 2.10 | General Location Plan of Construction Base Camp..... | 32 |
| Figure 2.11 | Location Plan of Base Camp in Gindae Bridge Construction Site..... | 32 |
| Figure 2.12 | Location Plan of Base Camp in Dogali 2 Bridge Construction Site | 33 |

Abbreviations

| | | |
|--------|---|--|
| AASHTO | : | American Association of State Highway and Transportation Officials |
| EDA | : | Eritrean Demining Authority |
| EIA | : | Environmental Impact Assessment |
| E/N | : | Exchange of Note |
| EU | : | European Union |
| F/S | : | Feasibility Study |
| GDP | : | Gross Domestic Product |
| GNI | : | Gross National Income |
| JICA | : | Japan International Cooperation Agency |
| MACC | : | Mine Action Coordination Center |
| NGO | : | Non Governmental Organization |
| PC | : | Pre-stressed Concrete |
| RC | : | Reinforced Concrete |
| RRPE | : | Recovery and Rehabilitation Program for Eritrea |
| RSDP | : | Road Sector Development Program |
| RSEP | : | Road Sector Engineering Program |
| RTCD | : | Road Transport Construction Department |

Summary

The State of Eritrea has a coastline of about 1,000 km along the Red Sea and has borders with Sudan in the west, Ethiopia and Djibouti in the east. Its area is about 125 thousand km² and has a population of 4.2 million (World Bank Report, 2001). The GNI per capita is reported to be \$US170 (World Bank Report, 2002).

Since its independence in 1993, Eritrea has been making efforts to reconstruct its economy and infrastructure that were heavily damaged due to 30-year of military struggle for independence. In May of 1993, World Bank prepared a post-war reconstruction plan (RPPE). The proposed plans included improvement of agricultural, industrial production, and social infrastructure in addition to development of some other sectors such as human resources. The estimated cost in this plans amounted to 160 million US dollars. The Asmara-Massawa road (110 km), on which the bridges for this project are located, was constructed with a financial support (grant aid) from European Development Fund as part of the above RPPE from 1993 to 1997. After that, another plan titled “Road Sector Development Program (RSDP)” was formulated with a support of World Bank in September 2003. The program aims at preparing a mid and long term development plan for the road sector that is considered a key factor for promoting social and economic development of Eritrea. This development plan is currently regarded as the superior plan in the road sector and 15-year action plans for road development, maintenance, and institutional strengthening were prepared accordingly. The plans include many complementary measures such as proposition of road policy, measures for traffic safety, introduction of charging system for users, and guidelines for EIA. In the RSDP, the Asmara-Massawa road is evaluated as the most important route. In fact the road directly connects two major cities: Massawa, the largest international trade port in Eritrea and Asmara, the capital. As much as 98 % of the export and import (mostly imports) is distributed to all parts of the country through this road by way of the capital Asmara. Since there is no alternative for this road, the Asmara-Massawa road is recognized as the sole lifeline for Eritrea and is rated as having the greatest priority.

The road was constructed in the 1930’s together with the objective bridges for this project. After the independence in 1993, improvement on the alignment of the route, drainage system improvement, asphalt pavement, and installation of facilities for traffic safety were carried out up to 1997 with a financial assistance from EU. Small bridges of less than 25 m in length were also improved. However, the six major bridges, targeted in this project, that are 25 m or longer were not included in the EU-funded implementation and have been left unimproved up to present. These bridges considerably lost their structural soundness due to aging and collision

by vehicles and some have their principal components left broken. However, they still serve as they are in spite of danger they impose (One out of the six bridges were found to have sufficient structural soundness). Meanwhile, as the Asmara-Gindae section of the road (about 45 km) is in the mountains, large vehicles are expected to slow down when they pass each other and especially at bends, where they are even forced to stop and wait. RSDP proposes improvement of such conditions for the next five years. The proposal includes such measures as widening of the road at bends, introduction of crawler and stand-by lanes, repair of road shoulders, and installation of facilities for traffic safety. On top of that, 46 % of the trucks are over loaded and this excessive load on the road is anticipated to cause some damage on the pavement. In order to restrict the load on trucks, devices to check the weight of a truck (truck scale) have been introduced in Asmara recently. They are also being installed in Massawa. The Government of the State of Eritrea now handles these, above described, problems of mountain road and overloading, on its own. However; it has difficulty in addressing the problems of major bridges of over 25 m due to financial and technical restrictions. Leaving the bridges as they are will possibly cause hindrance to the traffic on Asmara-Massawa road, and may lead to negative effect on the Eritrean economy. Therefore the rehabilitation of the bridges is an urgent and worthwhile project.

In this context, in 2000, the Government of the State of Eritrea requested the Government of Japan for Grant Aid for the rehabilitation of these six bridges to secure safe traffic on Asmara-Massawa road. The six objective bridges with a length of over 25 m are as follows: Gindae bridge (length: 46 m, reinforced concrete single-span-arch bridge), Gahtelay 1 bridge (length: 29 m, reinforced concrete single-span-arch bridge), Gahtelay 2 bridge (length: 35 m, reinforced concrete single-span-arch bridge), Dogali 1 bridge (length: 139 m, reinforced concrete, three-span-arch bridge), Dogali 2 bridge (length: 30 m, reinforced concrete single-span-arch bridge), Emculu bridge (length: 132 m, reinforced concrete, three-span-arch bridge).

In response to a request from the Government of the State of Eritrea, the Government of Japan decided to conduct a basic design study and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA dispatched the first study team to the site in March 2003 in order to select the bridges for the basic design by examining the soundness of the proposed six bridges. As a result, one of the six bridges, Gahtelay 2, was excluded for the reason of having sufficient soundness. The new bridge constructions have been proposed to Gindae, Gahtelay 1 (Replacement of superstructure) and Dogali 2. And, repair works have been proposed to Dogali 1 bridge and Emculu bridge.

The dispatch of the second study team for more detailed investigation on natural conditions etc., originally planned for June 2003 was delayed due to the effect of explosion of left-over landmines that occurred within the study area in March 2003. The study was finally conducted in January and February 2004, after it was confirmed that the removal of remaining landmines in the study area had been completed in December 2003 upon the request of demining through the diplomatic channel of the Government of Japan. The study team has conducted the further examination of bridge rehabilitation plans in Japan. The results were compiled and the draft report of the basic design was presented to the Government of the State of Eritrea in May 2004. The Government of the State of Eritrea agreed the results of the basic design.

The study team carefully examined all the proposed six bridges, which were originally requested to be reconstructed, for their structural soundness, functions, social importance and cost of rehabilitation and concluded that the bridge's components that are still sound should be reused and the broken and damaged parts should be repaired to their original state. The rehabilitation methods were studied accordingly. In addition, the following specifications of bridge facilities and dimensions were determined based on the results of hydrological analysis, topographic and geological surveys, and survey on local construction condition. For Gindae bridge, the study team decided to reconstruct a completely new bridge after having compared a rehabilitation plan of the existing bridges and the construction plan of new Gindae bridge that is a part of bypass construction plan of Eritrea.

| Bridge Name | Gindae | Gahtelay 1 | Dogali 1 | Dogali 2 | Emculu |
|--------------------------|---|--|--|--|--|
| Method of Rehabilitation | Construction of new bridge | Replacement of superstructure | Repair of damaged portions in superstructure | Construction of new bridge | Repair of damaged portions in superstructure |
| Location | 800 m downstream from the existing one, follows site of the Bypass plan | Site of existing bridge | --- | 20 m upstream from the existing bridge | --- |
| Altitude | EL=908 m | EL=314 m | EL=103 m | EL=95 m | EL=37 m |
| Present traffic volume | 814 vehicle/day | 593 vehicle/day | 593 vehicle/day | 593 vehicle/day | 593 vehicle/day |
| Crossing river | Gindae river | Sabarugum river | Dogali river | Wazipu river | Over river |
| Bridge length | L=39.000 m | L=29.900 m | L=139.400 m | L=34.900 m | L=132.300 m |
| Width | Lane: 7.50 m Sidewalk: 1.5 m each, both sides | Lane: 7.50 m Sidewalk: 1.5 m each, both sides | Lane: 6.20 m Sidewalk: 1.8 m each, both sides | Lane: 7.50 m Sidewalk: 1.5 m each, both sides | Lane: 6.20 m Sidewalk: 1.8 m each, both sides |
| River protection | Wet masonry | Wet masonry | --- | Wet masonry | --- |

The period of project implementation under the grant-aid scheme of Japan is estimated to be six months for detailed design study (including tender process) and 20.5 months for construction. The approximate cost for the project implementation is estimated to be 690 million yen (Japanese side: 647 million yen, Eritrean side: 43 million yen).

During the project implementation, appropriate coordination with the other relevant projects such as the bypass road construction at Gindae bridge and construction of temporary roads by Eritrea will be necessary. The study team had a meeting with the Eritrean authorities to discuss this issue. The both sides confirmed the importance of the issue and agreed on the implementation schedule. The Minutes of Discussions on the proceedings and the results of the meeting were prepared. The Department of Infrastructure, Ministry of Public Works is in charge of project implementation and they have sufficient capability to prepare for the project implementation and procure their share of project budget.

This project is an important part of a series of post war economic rehabilitation projects in Eritrea that mainly focus on improvement of infrastructure since independence. The number of people who will benefit from the project is about 1.08 millions. In addition, implementation of this project will also serve to reduce crossing time over the rivers and consequently reduce maximum retaining time by four minutes for the newly constructed and partly replaced bridges and extend the life span for the repaired bridges. In this way, reliability of traffic between Asmara and Massawa will be improved and it will enable smooth transportation of commodities to all over the country. The prices will remain reasonable and stable as a result. On top of that, the project will introduce PC reinforced concrete bridges for the first time in Eritrea and it is expected to bring in new technologies on bridge construction and rehabilitation. For this reason, this project is worthwhile and is justified as a grant-aid project of Japan.

Preface
Letter of Transmittal
Location Map/ Perspective
List of Figures & Tables
Abbreviations
Summary

TABLE OF CONTENTS

| | <u>Page</u> |
|---|-------------|
| Chapter 1 Background of the Project | 1 |
| Chapter 2 Contents of the Project | 3 |
| 2-1 Basic Concept of the Project | 3 |
| 2-2 Basic Design of the Requested Japanese Assistance | 4 |
| 2-2-1 Design Policy | 4 |
| 2-2-1-1 Basic Policy | 4 |
| 2-2-1-2 Policy for Natural Condition | 5 |
| 2-2-1-3 Policy for Social Conditions | 8 |
| 2-2-1-4 Policy of Construction Conditions | 8 |
| 2-2-1-5 Policy of Procurement of Local Contractor | 9 |
| 2-2-1-6 Policy of Management and Maintenance Control Ability of the Execution Agency | 10 |
| 2-2-1-7 Policy of Standard of Facilities | 10 |
| 2-2-1-8 Policy of Construction Schedule | 12 |
| 2-2-2 Basic Plan | 13 |
| 2-2-2-1 Design Criteria | 13 |
| 2-2-2-2 Facility Design | 14 |
| 2-2-3 Basic Design Drawings | 19 |
| 2-2-4 Implementation Plan | 27 |
| 2-2-4-1 Implementation Policy | 27 |
| 2-2-4-2 Implementation Condition | 27 |
| 2-2-4-3 Scope of Works | 28 |
| 2-2-4-4 Consultant Supervision | 29 |
| 2-2-4-5 Quality Control Plan | 37 |
| 2-2-4-6 Procurement Plan | 38 |
| 2-2-4-7 Implementation Schedule | 40 |
| 2-3 Obligations of Recipient Country | 42 |
| 2-3-1 Common Items of Japan's Grant Aid Scheme | 42 |

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR REHABILITATION OF BRIDGES
ON THE ASMARA-MASSAWA ROAD IN THE STATE OF ERITREA

| | | |
|-----------|---|----|
| 2-3-2 | Special Items of the Project | 42 |
| 2-3-2-1 | Construction works to be undertaken by Eritrea..... | 42 |
| 2-3-2-2 | Other items to be undertaken by Eritrea..... | 46 |
| 2-4 | Project Operation Plan..... | 47 |
| 2-5 | Cost Estimation..... | 48 |
| 2-5-1 | Project Cost..... | 48 |
| 2-5-2 | Project Maintenance Cost | 49 |
| Chapter 3 | Project Evaluation and Recommendation..... | 50 |
| 3-1 | Project Effect | 50 |
| 3-2 | Recommendations | 51 |

Appendices

1. Member List of the Survey Team
2. Survey Schedule
3. List of Party Concerned in Eritrea
4. Minutes of Discussion
5. Other Relevant Data

Chapter 1 Background of the Project

Chapter 1 Background of the Project

Since its independence in 1993, Eritrea has been making efforts to reconstruct its economy and infrastructure that were heavily damaged due to the 30-year of military struggle for independence. In the May of 1993, World Bank prepared a post-war reconstruction plan (RPPE) which included improvement of agricultural, industrial production, and social infrastructure. The Asmara-Massawa road (110 km) constructed originally in the 1930's, on which the bridges for this project are located, was improved with a financial support (grant aid) from European Development Fund from 1993 to 1997 as part of the above RPPE. While that improvement targeted the betterment of road facilities conditions including the rehabilitation of small bridges of less than 25 m in length, the six major bridges, targeted in this project, that are 25 m or longer were not included in the EU-funded implementation and have been left unimproved up to present. These bridges considerably lost their structural soundness due to aging and collision by vehicles and some have their principal components left broken. However, they still serve as they are in spite of danger they impose (One out of the six bridges were found to have sufficient structural soundness).

Meanwhile, as the Asmara-Gindae section of the road (about 45 km) is in the mountains, large vehicles are expected to slow down when they pass each other and especially at bends, where they are even forced to stop and wait. RSDP proposes improvement of such conditions for the next five years. The proposal includes such measures as widening of the road at bends, introduction of crawler and stand-by lanes, repair of road shoulders, and installation of facilities for traffic safety. On top of that, 46 % of the trucks are over loaded and this excessive load on the road is anticipated to cause some damage on the pavement. In order to restrict the load on trucks, devices to check the weight of a truck (truck scale) have been introduced in Asmara recently. They are also being installed in Massawa. The Government of the State of Eritrea now handles these, above described, problems of mountain road and overloading, on its own. However; it has difficulty in addressing the problems of major bridges of over 25 m due to financial and technical limitations. Leaving the bridges as they are will possibly cause hindrance to the traffic on Asmara-Massawa road, and may lead to negative effect on the Eritrean economy. Therefore the rehabilitation of the bridges is an urgent and worthwhile project.

In this context, in 2000, the Government of the State of Eritrea requested the Government of Japan for Grant Aid for the rehabilitation of these six bridges to secure safe traffic on Asmara-Massawa road. The six bridges proposed for rehabilitation are listed in the following table.

| Bridge Name | Length (m) | Distance from Asmara (km) | Remarks |
|-------------|------------|---------------------------|----------------------------------|
| Gindae | 46 | 45 | Single span concrete arch bridge |
| Gahtelay 1 | 29 | 69 | Single span concrete arch bridge |
| Gahtelay 2 | 35 | 70 | Single span concrete arch bridge |
| Dogali 1 | 139 | 94 | 3 span concrete arch bridge |
| Dogali 2 | 30 | 97 | Single span concrete arch bridge |
| Emculu | 132 | 105 | 3 span concrete arch bridge |

In response to a request from the Government of the State of Eritrea, the Government of Japan decided to conduct a basic design study and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA dispatched the first study team to the site in March 2003, in order to select the bridges for the basic design by examining the soundness of the proposed six bridges. As a result, one of the six bridges, Gahtelay 2, was excluded for the reason of having sufficient soundness. The result of the first field study was compiled as an interim report. The dispatch of the second study team, originally planned for June 2003 was delayed due to the effect of explosion of left-over landmines that occurred within the study area in March 2003. The study was finally conducted in January and February 2004, after it was confirmed that the removal of remaining landmines in the study area had been completed in December 2003. Before the commencement of the second field study, the following items on the target bridges and on basic design policies were agreed between Eritrean side and Japanese side.

Gindae bridge : A new bridge is constructed as part of bypass road (about 3.3 km), construction project executed by Eritrea. The existing bridge will be used only for light vehicles.

Gahtelay 1 bridge : The superstructure of the existing bridge is replaced

Gahtelay 2 bridge : No need for replacement or repair, excluded from the project

Dogali 1 bridge : Repair of the existing bridge

Dogali 2 bridge : A new bridge is constructed in the vicinity of the existing bridge

Emculu bridge : Repair of the existing bridge

In the second field study, surveys on natural conditions etc. were conducted at the sites of the five bridges selected for the basic design. This field study was followed by further examination of bridge rehabilitation plans conducted in Japan. The result was compiled and the draft report of the basic design was presented to the Government of the State of Eritrea in May 2004. The Government of the State of Eritrea agreed and accepted the components of the draft report.