No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR RECONSTRUCTION
OF
ATHI AND IKUTHA BRIDGES
IN
THE REPUBLIC OF KENYA

SEPTEMBER 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
ORIENTAL CONSULTANTS CO., LTD.
JAPAN BRIDGE & STRUCTURE INSTITUTE, INC.

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PREFACE

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Athi and Ikutha Bridges and entrusted the study to the Japan International Cooperation Agency (JICA).

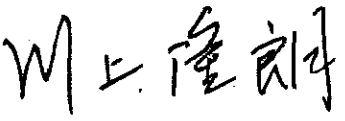
JICA sent to Kenya a study team from February 11 to March 19, 2001.

The team held discussions with the officials concerned of the Government of Kenya, 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 Kenya in order to discuss a draft basic design from June 21 to June 27, 2001, and as this result, the present report was finalized.

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

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

September, 2001



Takao Kawakami

President
Japan International Cooperation Agency

September, 2001

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Reconstruction of Athi and Ikutha Bridges in the Republic of Kenya.

This study was conducted by the joint venture between Oriental Consultants Company Limited and Japan Bridge & Structure Institute, Inc., under a contract to JICA, during the period from February to September, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Kenya 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.

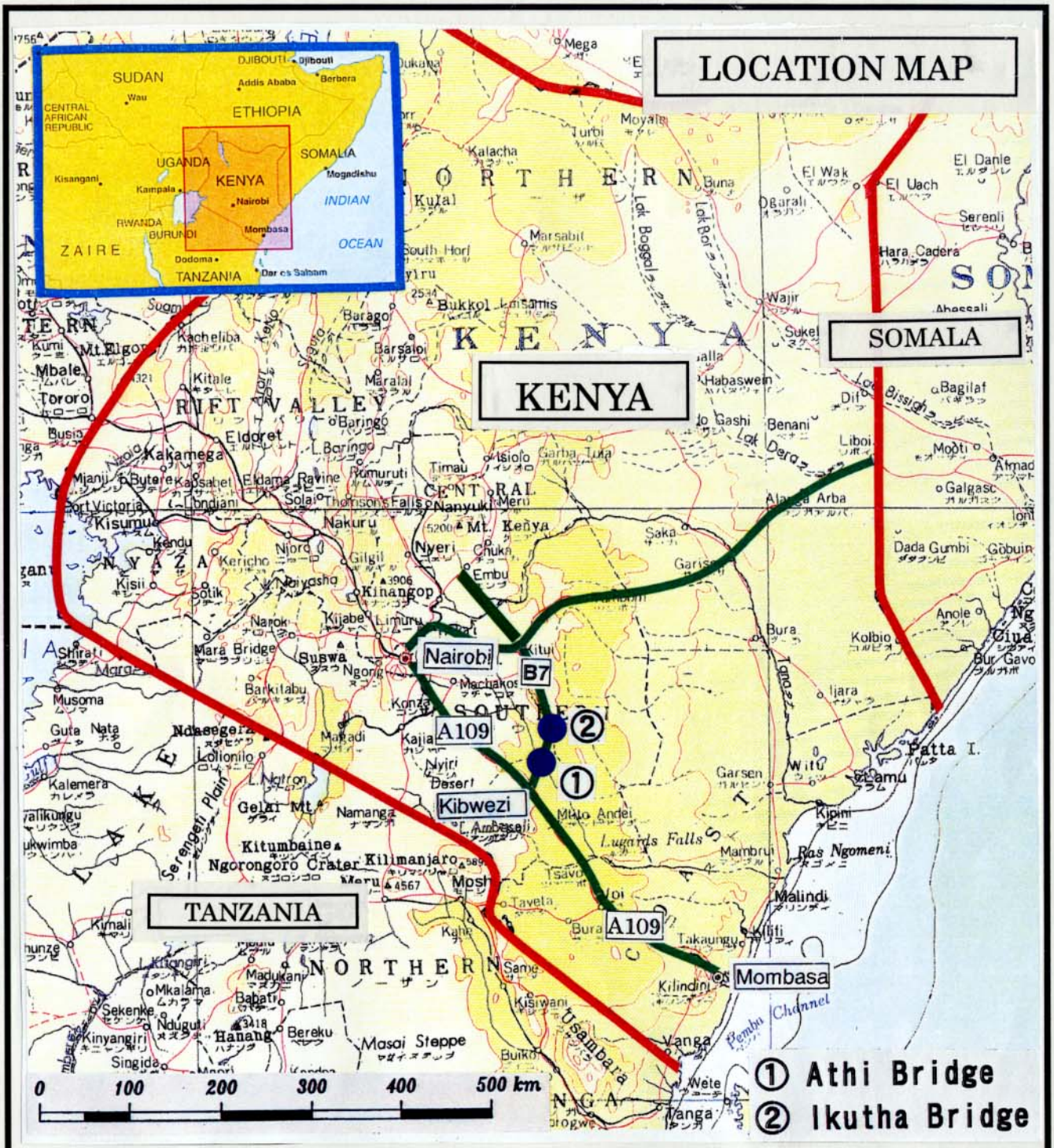
Very truly yours,

Nobuhiro Kuboya

Project Manager,

Basic design study team on
The Project for Reconstruction of Athi
and Ikutha Bridges in Kenya

The joint venture between
Oriental Consultants Company Limited and
Japan Bridge & Structure Institute, Inc.



THE PROJECT FOR RECONSTRUCTION OF ATHI AND IKUTHA BRIDGES IN THE REPUBLIC OF KENYA

The Perspective of Athi Bridge

The Perspective of Ikutha Bridge

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Abbreviations

A Authorities and Agencies

AfDB	African Development Bank
COMESA	Common Market for Eastern and Southern Africa
DAC	Development Assistance
DANIDA	Danish International Development Authority
DECO	District Environmental Conservation Officer
DO	District Officer
DRE	District Roads Engineer
EC	European Communities
EEC	European Economic Community
EU	European Union
EU	Environmental Unit
OECD	Organization for Economic Cooperation and Development
OECF	The Overseas Economic Cooperation Fund
DSSO	District Social Services Officer
GNP	Gross National Product
IMF	International Monetary Fund
IDA	International Development Association
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JRA	Japan Road Association
KEFRI	Kenya Forest Research Institute
MOH	Ministry of Health
MOH	Medical Officer of Health
MORPW	Ministry of Roads and Public Works
NGO	Non-Governmental Organization
NIES	Newly Industrializing Economies
PBO	Provincial Bridges Officer
PMO	Provincial Materials Office
PWO	Provincial Work Office
RD	Road Department
RMI	Road Maintenance Initiative
SIDA	Swedish International Development Agency
UNHCR	United Nations High Commissioner for Refugees

B Other Abbreviations

A	Area
AADT	Annual average daily traffic
@	At the rate
B	B（Live load）
B/D	Basic Design
BS	British Standard
CBR	California Bearing Ratio
C.L	Center Line
cm	Centimeter
cm^2	Square centimeter
D/F	Draft Final Report

DIN	Deutsche Industrie Normen
$	Dollar
Ec	Young's modules of concrete
Es	Young's modules of steel
Esp	Modules of elasticity
Ex	Existing
El	Elevation
H	Height
HB	HB（Live Load of BS5400）
HWL	High water level
I	Coefficient of impact
Kgf/cm^2	Kilogram force per square centimeter
Kgf/cm^3	Kilogram force per cubic meter
Kgf/mm^2	Kilogram force per square millimeter
Ksh	Kenya shilling
K £	Kenya Pound（1K £ 20Ksh）
Km	Kilometer
Km^2	Square kilometer
Km/h	Kilometer per hour
KS	Kenya standard
L	Length
l	Length
LWL	Low water level
m	Meter
M	Million
m^2	Square meter
m^3	Cubic meter
m^3/s	Cubic meter per Second
MSL	Mean sea level
N	N-value or Number of wheel load application
n	Number of Ratio of Es to Ec
N/mm^2	Newton force per square millimeter
KN/mm^2	Kilo Newton force per square millimeter
%	Percent
Φ	Diameter
PC	Prestressed concrete
RC	Reinforced concrete
S	Scale
SD	Deformed Steel
σck	Allowable stress of concrete
σsa	Allowable stress of steel bar
t	Ton or Thickness
W	Width
W.L	Water level

Summary

Kenya depends mostly on roads for land transport (96% for passengers and 87% for freight transport). Roads in Kenya can be divided into classified and unclassified roads, with the total length of road network being 151,000 km. Of the total length, 63,300 km, including 3,760 km is for international trunk roads while 2,800 km is for domestic trunk roads, are classified road which account for about 42.2 % of the total length. Though the road network is relatively well developed, the ratio of paved road is only about 14% of the total length. Except for sections of classified road, poor road surface and lagging maintenance of road drainage facilities caused frequent inudation during rainfall. Besides, because of lack of proper implementation of road maintenance, road damage is found in many places even in the trunk national road between cities. In certain locations, roads are so damaged as to expose base course and subgrade, not only threatening safe traffic, but also being a factor in traffic accidents.

Most of bridges in Kenya are outdated and more than 30 years old. Small bridges are rehabilitated and reconstructed through self-help efforts. As regards to large bridges, however, only a few could be rehabilitated or reconstructed because of budget and technology restrictions. Many small and medium rivers in Kenya are dried up without flow in the dry season, and there are submerged structures called “drift” in many river crossings of reginal roads. Immediately after rainfall in the rainy season, the water level rises to make vehicle traffic impossible, causing hindrance to the road transport.

The eighth National Development Plan (1997～2001) highlights an efficient and organized road network as extremely important for achievement of socioeconomic targets of the national development plan, asserting that road and bridge development is a priority matter. According to this plan, maintenance of road functions is preferred and the fuel tax is assigned to the necessary funds. At the same time, the plan aims at strengthening of operation of the road maintenance organizations as well as technical and policy-making functions. In addition, the Roads 2000 Maintenance Plan and others were established to improve road maintenance and an increase in employment opportunities via road development projects, utilization of private enterprises, and the fostering of native contractors is part of this plan.

While rehabilitation and maintenance of the road network has proceeded in this way, abnormal rainfall possibly due to “El Nino” caused flooding from 1997 to 1998. In 1997, floods caused the destruction of many small and medium bridges in the coastal area of the Indian Sea. In January 1998, many small and medium bridges were washed away in the central and western parts of Kenya, causing new difficulties for the development of the road network.

Under these circumstances, Kenya found it difficult to cope with these damages within the scope of road improvement plan that Kenya had pushed forward based on the National Development Plan. Therefore, in 1998, Kenya requested Japan to grant aid for the reconstruction of bridges damaged by flooding, specifically, a total of five bridges including Athi and Ikutha bridges in Eastern Province and Marere, Eshueshu, and Mwache bridges in Coast Province.

The two bridges of Athi and Ikutha in the East Province are located on the domestic trunk road, B-class Road B7. Of three bridges in the Coast Province, Marere and Eshueshu bridges are on major C-class roads while Mwache bridge is on a secondary D-class road.
Road B7 is a trunk road of Kenya, with a length of about 313 km, running from Embu at the fringe on the south side of Mt Kenya through the East Province to Kibwezi at an intersection with Road A109. This road intersects with National Roads B6, B3, and C97 running radial from Nairobi. This is an important route connecting with radial roads to the east without passing through Nairobi.

In response to the request, the Japanese Government selected the two bridges of Athi and Ikutha under the request, because they are high priorities and highly beneficial in Kenya, and dispatched a basic design study team for a period from February 10 to March 21, 2001 to the site, which conducted field surveys and discussions with their Kenya counterparts.

After return to Japan, the study team performed in-depth studies further concerning the bridge location, bridge length, road alignment, bridge type, access roads, and construction method on the basis of in-situ study results. The team performed the basic design of bridge and road, calculation of the approximate work quantity, development of the implementation plan, and estimation of the approximate project cost. During a period from June 20 to 29, 2001, the study team held a briefing of the basic design and compiled the result in the basic design study report.

The basic construction of bridge and access roads in the Athi and Ikutha Bridges is outlined below on the basis of this basic design study results.

Type of facilities		Athi Bridge	East Province, boundary between Kitui and Makueni District
Reconstruction to a bridge	Bridge type	Prestressed concrete four-span connected composite girder bridge	
	Bridge length	120.0m（30.0m×4 spans）	
	Bridge width	11.0m（(sidewalk) 1.5m＋（carriageway）(3.5m＋0.5m)×2＋（sidewalk）1.5m）	
	Road length	540m（200m＋340m）	
	Construction	Bridge ① Foundation : Spread foundation (A1, P1, P2, P3, A2) ② Substructure : Inverted-T type abutment x 2（A1, A2）, Wall type pier x 3（P1, P2, P3） ③ Superstructure : PC four-span connected composite girder bridge ④ Auxiliary works : Handrail H= 1,100 mm、Kerb = 200 mm ⑤ Bridge surface work: Concrete pavement T= 5 cm	
	Others	Access road ① Pavement : Surface layer（two layers of bitumen）, base t= 300 mm（base course 150mm, subbase course 150mm） ② Road work : Width 10m (shoulder 1.5m ＋carriageway 3.5m ×2 ＋ shoulder 1.5m) ③ Auxiliary works: Drainage facilities, guard rails	
		River section ① Revetment : 1 set （mortar masonry/around abutments, A1, A2）	

Type of facilities		Ikutha Bridge	East Province, Kitui District
Reconstruction of bridge	Bridge type	Prestressed concrete three-span connected composite girder bridge	
	Bridge length	75.0m（25.0m×3 spans）	
	Bridge width	9.5m（(sidewalk) 1.5m＋（carriageway）(3.5m＋0.5m)×2 ）	
	Road length	445m（268m＋177m）	
	Construction	Bridge ① Foundation : Spread foundation（A1, P1, P2, A2） ② Substructure : Inverted-T abutment x 2（A1, A2）,wall type pier x 2（P1, P2） ③ Superstructure : PC three-span connected composite girder bridge ④ Auxiliary works: Handrail H= 1,100 mm, Kerb H= 200 mm ⑤ Bridge surface work: Pavement T=5 cm（concrete pavement）	
	Others	Access road ①Pavement : Surface (two layers of bitumen), base t= 300 mm（base course 150mm, subbase course 150mm） ②Road work :Width 10m (shoulder 1.5m ＋ carriageway 3.5m ×2 ＋ shoulder 1.5m) ③Auxiliary works : Guardrail	
		River section ① Revetment : 1 set（Mortar masonry /around abutment A1）	

Direct and indirect effects of this project are as shown in the table below.

1) Direct effects

Direct effects expected within the project area are summarized in the table below.

Direct effects of the project

Present state and problems	Measures of the project	Direct effects of the project and degree of improvement
1. Existing piers are washed away during flood and left as it is. Due to scouring and collision of drift wood, there is a danger of breakdown, bridge collapse.	- Reconstruction of the new bridge and raising of the road along with embedment of abutment/pier and slope protection of access road are made to ensure the structure that can resist flooding.	- Through assuring of year-round traffic throughout the year and improvement of travel, people's livelihood may be stabilized by ensuring medical and safety in case of emergencies for current bridge users.
2. Two bridges covered by the project are temporary Bailey bridges with a weight limitation applied of 25 ton. Industrial large trucks cannot pass over the bridges.	- Reconstruction to create concrete bridges through the application of the current bridge design live loads HA and HB30 units that are based on the Kenyan standard.	- Industrial large sized vehicle will be passable. - Mass transport becomes possible, causing decrease in freight cost and its time.
3. Being Bailey bridges, these bridges have a width of only about 4 m. Vehicle traffic is alternating using one lane.	- On the basis of projections of future traffic volume and the B7 road improvement plan, a carriageway width of 8 m with two lanes will be constructed.	- Elimination of alternating traffic will ensure smooth vehicle traffic.
4. Being Bailey bridges, these bridges have no sidewalk, resulting in a mixture of pedestrians, bicycles, and vehicles on the bridge, which is not safe.	- A 1.5 m wide sidewalk will be provided on both sides in the case of Athi Bridge where there are many pedestrians and on one side in the case of Ikutha Bridge where there are relatively few pedestrians.	- Separation of sidewalk and carriageway ensures higher traffic safety for both pedestrians and drivers.
5. The existing Athi Bridge is shorter relative to the river width upstream and downstream of the bridge, creating a bottleneck in the river flow and thus an obstruction. There is also a high possibility of drift wood, etc. striking against abutment and pier.	- The Athi Bridge length was extended by just under 20 m to 120 m in consideration of the river condition upstream and downstream of the bridge. - Both bridges will have a clearance appropriate to the high water level expected once in 50 years. The span was also extended.	- The bridge safety will be enhanced through reduction of the possibility of drift wood colliding with abutment and pier.

2) Indirect effects

Reconstruction of Athi and Ikutha Bridges will make improvements currently underway on B7 Road in Kenya more effective, offering indirect effects in the flow from the outside to inside of project area and among areas outside the project area.

Indirect effects of the project

Present state and problems	Measures of the project	Indirect effects of the project and degree of improvement
1. Large vehicles exceeding 25t cannot run on B7 road covered by the project, making detour.	- Reconstruction to create concrete bridges through the application of the current bridge design live loads HA and HB30 units that are based on the Kenyan standard.	- Promotion of freight transportation caused of ensuring road traffic function of B7 road will make local economy of Makueni and Kitui revitalizing. - Ensuring road traffic function of B7 road will contribute scheme on road network improvement what is planned by Kenya.
2.There are many other damaged bridges in covered area.	Due to reconstruction, existing bailey bridges at Athi and Ikutha will be surplus.	- Surplus parts of bridges can be diverted other damaged bridges.

As described above, implementation of the project is expected to offer substantial effects and contribute widely to improvement of residents' BHN. Accordingly, it is confirmed that grant aid for a part of cooperation projects is confirmed to be acceptable. Moreover, it is considered that the counterpart system is sufficient and problem free in terms of human and financial resources for operation and management of the project.

Improvement and development on following points will make this project further effective:

① Extension of the access road on the left bank of Athi Bridge
- Improvement of the existing road of approximately 3 km as an access road to existing B7 road

② Implementation of the improvement plan of the whole of B7 road
- Improvement of road alignment appropriate as the B class road
- Rehabilitation of drifts at crossings of small rivers
- Improvement of road pavement：Improvement from gravel road to asphalt concrete paving.

(Appendices)

1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in Recipient Country
4. Minutes of Discussion
5. Cost Estimation Borne by the Recipient Country
6. Other Relevant Data
7. References