ETHIOPIAN ROADS AUTHORITY (ERA)

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REHABILITATION OF TRUNK ROAD
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MARCH, 1998

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

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PREFACE

In response to a request from the Government of the Federal Democratic Republic of Ethiopia the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of Trunk Road and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ethiopia a study team from November 23 to December 28, 1997.

The team held discussions with the officials concerned of the Government of Ethiopia, 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 Ethiopia 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 Federal Democratic Republic of Ethiopia for their close cooperation extended to the teams.

March, 1998

Kimio Fujita
President
Japan International Cooperation Agency

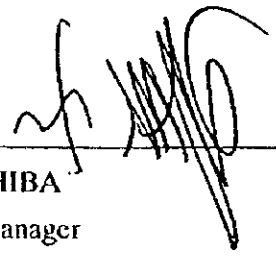
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Rehabilitation of Trunk Road in the Federal Democratic Republic of Ethiopia.

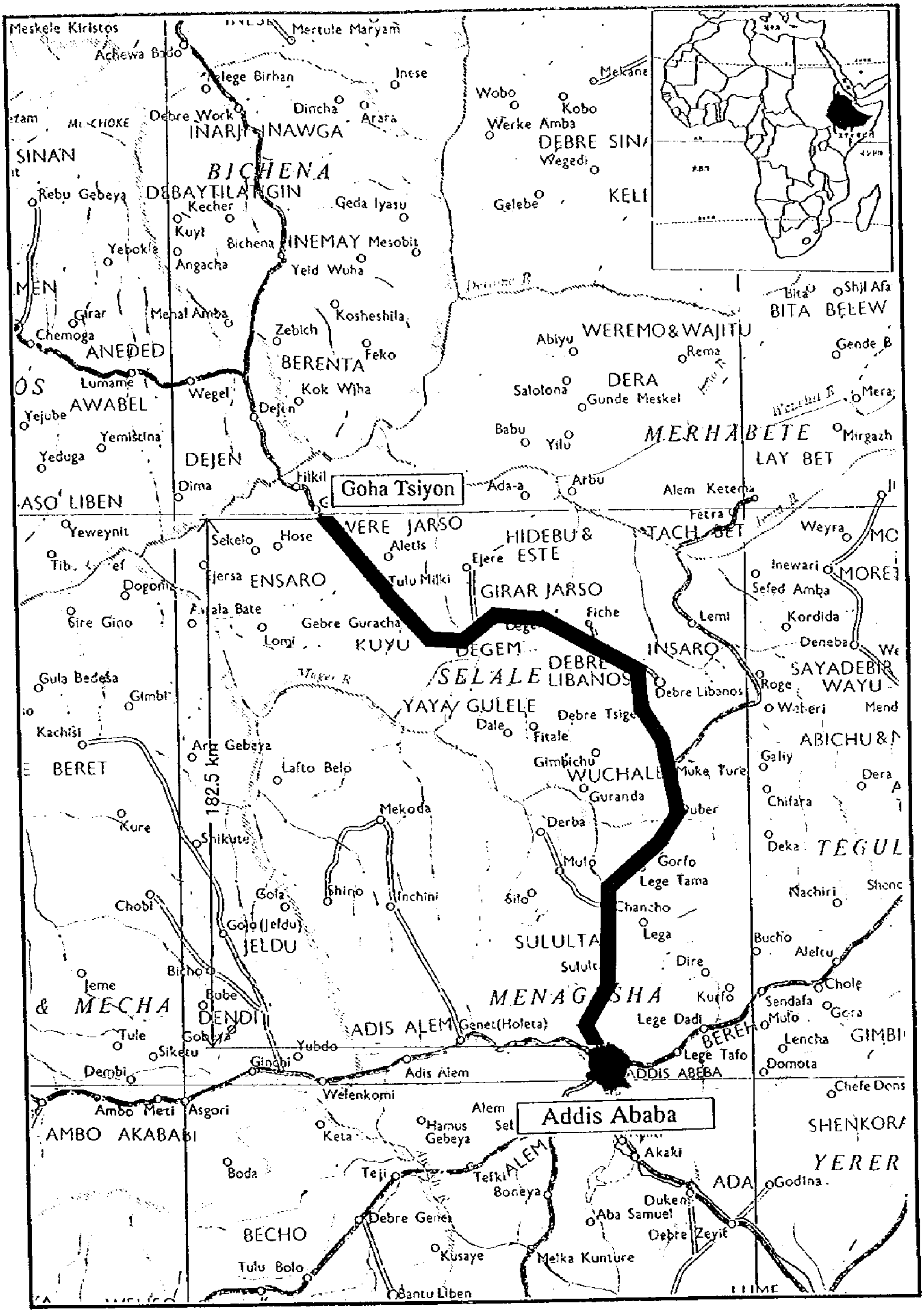
This study was conducted by the Joint Venture of Construction Project Consultants, Inc. and Nippon Koei Co., Ltd., under a contract to JICA, during the period from November 13, 1997 to March 25, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ethiopia 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.

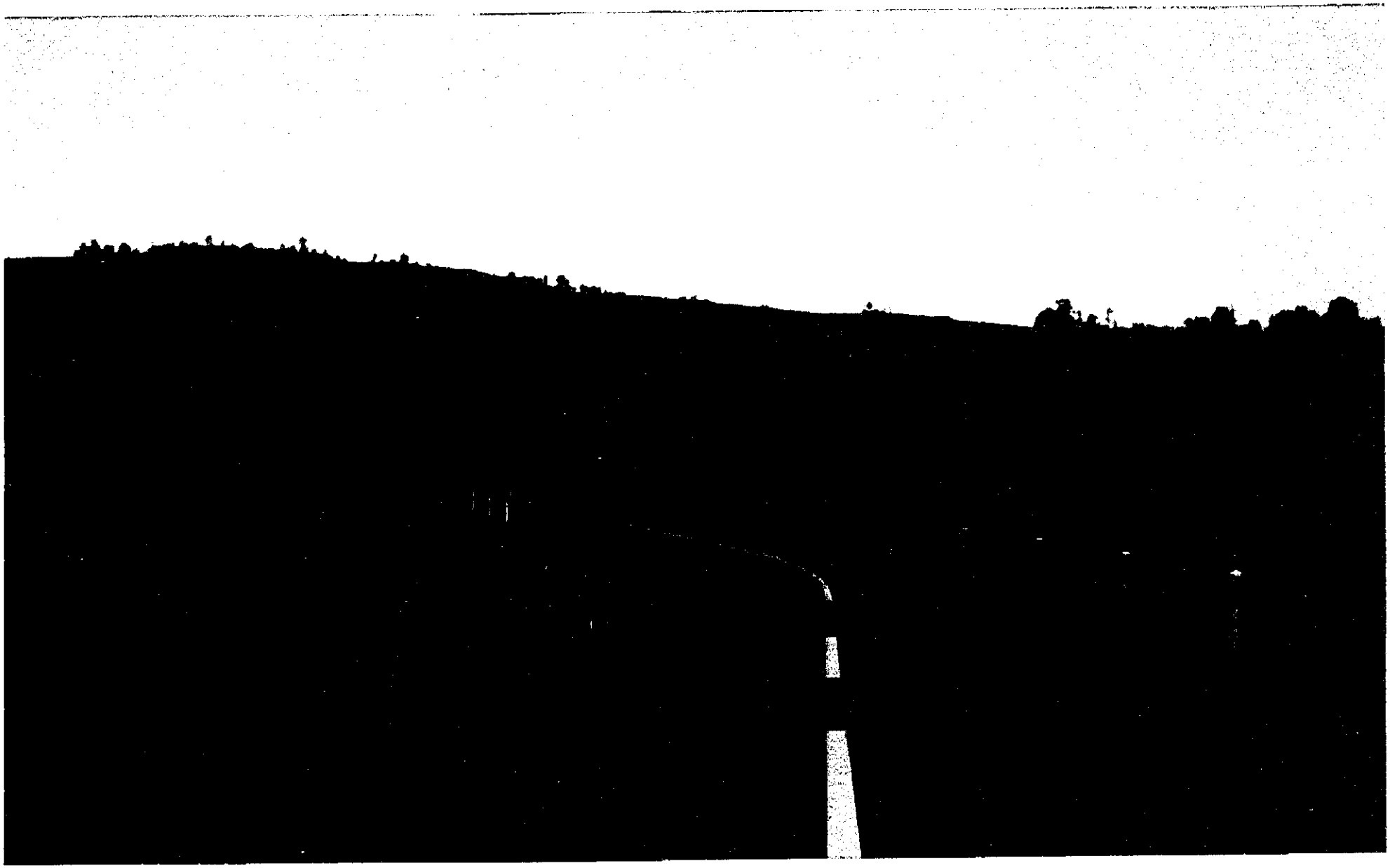
Very truly yours,



Kimio CHIBA
Project Manager
Basic Design Study Team on
the Project for Rehabilitation of Trunk Road
in the Federal Democratic Republic of Ethiopia
Construction Project Consultants, Inc.



LOCATION MAP



Perspective km104(Bridge No. B-014)

ABBREVIATIONS

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway Transportation Officials
AC	Asphalt Concrete
ADLI	Agricultural Development–Led Industrialization
ARA	Addis Ababa Roads Authority
ASTM	American Society for Testing and Materials
CBR	California Bearing Ratio
DBST	Double Bitumen Surface Treatment
DCP	Dynamic Cone Penetrometer
EF	Equivalence Factor
ERA	Ethiopian Roads Authority
ERP	Economic Recovery Program
ERRP	Economic Recovery & Reconstruction Program
ESA	Equivalent Standard Axle
ESCP	Ethiopian Standard Code of Practice
EU	European Union
FY	Financial Year
GNP	Gross National Product
GOE	Government of Ethiopia
GPS	Geographical Positioning System
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt für Wiederaufban
LAA	Los Angeles Abrasion
MDD/OMC	Maximum Dry Density/Optimum Moisture Content
MOTC	Ministry of Transport and Communications
ODA	Overseas Development Administration (UK)
RSDP	Road Sector Development Program
RTA	Road Transport Authority
SN	Structural Number
TRL	Transport Research Laboratory of UK
US$	US Dollar
¥	Yen

Basic Design Study Report
on
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CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

The Ethiopian economy declined in the 1980s due to diversion of resources from productive activities to war, the application of misguided economic policies and the effects of draught. Particularly, it fell into negative growth during the last few years. Soon after the Transitional Government of Ethiopia (TGA) was established in 1991, the Economic Recovery and Reconstruction Program (ERRP) was implemented, for which the World Bank agreed to extend US$670 million in order to improve the international balance of payment. In parallel with ERRP the economic reform program was started under IMF/World Bank structural adjustment program, which covers reform on financial and budgetary system, strengthening of supply side and privatization of public enterprises. Development of road sector, water resources and agriculture are given the highest priority under ERRP.

Agriculture remains the most important corner stone of the Ethiopian economy. It accounts for 45% of GDP and 85% of total employment. Although the agricultural sector will continue to be the backbone of the economy for the foreseeable future, the Government's Agricultural Development-Led Industrialization (ALDI) strategy envisages a shift in emphasis to industry and services in the medium and long term. The growth in agricultural output, which constitute the primary basis for growth in the economy, is dependent on a reliable transport system that efficiently integrates the producing area with the market. Thus improvement of infrastructure, particularly the road network, is considered essential to this end.

The road network in Ethiopia consists of 23,813 km of trunk, major link and regional roads. Of this, paved roads are limited to 3,478 km (approximately 15%). Further, the existing network has deteriorated a lot to the extent that only 23% of paved road is presently in good condition.

Under these circumstances the Road Sector Development Program (RSDP) was formulated in 1996. RSDP is intended to increase the road density from 0.43 km to 0.54 km per 1,000 population and from 21 km to 38 km per 1,000 km^2, and to bring about 68% of the roads to a good condition in ten years (1997–2007). RSDP-1 (1997–2002), which set the target at 0.46 km/1,000 population and 27 km/1,000 km^2 and 60% in good condition, was started in 1997. Institutional reforms, enhanced capacity and financial provisions for road network management, decentralization and privatization are other major components of RSDP to realize a self-sustainable road policy.

North-Western Corridor (Addis Ababa – Debre Markos – Gondar – Eritrean border) is one of the most important trunk roads. It traverses the northwestern part of Oromia, Amhara

and Tygre Regions, the highest agricultural producing areas of the country. Forty-six percent of major crops and 45% of Livestock (number of head) of the country are produced in the area of influence of this Corridor. This entire Corridor is programmed for rehabilitation or upgrading under RSDP-1, particularly Addis Ababa–Goha Tsiyon forming a principal section of this Corridor is placed as the highest priority.

Considering this priority and the urgency of the rehabilitation of this Corridor, the Government of Ethiopia prepared a detailed design for Addis Ababa–Debre Markos section in 1996 by the Government's own fund, and requested the Government of Japan for Grant Aid for the implementation of the project.

A Preliminary Study was conducted by the Japan International Cooperation Agency (JICA) from August 9, 1997 to September 7, 1997. As a result of this study, Addis Ababa–Debre Markos section was divided into three sections in order of priority and the basic policy of Grant Aid for the project was set out.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Content of the Project

2.1 Objective of the Project

Northwest Trunk Road (Addis Ababa – Debre Markos – Gondar – Eritrean border) is one of the most important corridors which runs through the Oromia, Amhara and Tygre Regions which are high agricultural producing areas. The targeted Addis Ababa – Goha Tsiyon road forms a principal section of the Northwest Trunk Road. The area served by this road produces 46% of the crops and 45% of the livestock population of the country. This area has not experienced any serious drought in the past.

The Government of Ethiopia places the highest priority on the agricultural sector under its Agriculture Development–Led Industrialization (ALDI) strategy. The success of ALDI critically depends on the transportation system, i.e. growth in agricultural output depends on a reliable transport system to integrate producing areas with the market.

The Road Sector Development Program (RSDP) was started in 1997 and will span a period of ten years (1997- 2007). The Government intends to increase the road density from 0.43 km to 0.54 km per 1000 population and from 21 km to 27 km per 1,000 km^2, and to bring about 68% of the roads to a good condition by means of the RSDP.

The objectives of the Project for Rehabilitation of Trunk Road in the Federal Democratic Republic of Ethiopia (hereinafter referred to as "The Project") are to accelerate the RSDP through implementing the rehabilitation program of the Addis Ababa – Goha Tsiyon section of 182.5 km, which is given one of the highest priorities under RSDP-1 (1997 - 2002).

2.2 Basic Concept of the Project

2.2.1 Targeted Section

The original request from the Government of Ethiopia covers Addis Ababa – Debre Markos road of approximately 300 km. However, taking into account funds available, construction period required, and priority, it was decided that the Addis Ababa – Goha Tsiyon section of 182.5 km will be covered under the Project.

In spite of the fact that rehabilitation of Addis Ababa – Debre Markos has the highest priority under RSDP-1 it is reasonable to consider phased implementation, in view of the schedule of the Debre Markos – Gondar program, which will be started in 1998.

2.2.2 Examination of the Content of the Project

(1) Design Criteria

The existing Detailed Design which was prepared by ERA in 1997 (Consultant: Parkman, UK) (hereinafter referred to as "ERA's D/D") was closely reviewed by this Basic Design study from technical and economical points of view. The comparison of design concept between ERA's D/D and Basic Design is shown in Table 2.1.

Table 2.1 Comparison of Design Criteria between ERA's D/D and Basic Design

	Item	ERA's D/D	Basic Design	Reason
1.	Design Standards Geometric Design Pavement Design Bridge Design	 AASHTO TRL Road Note No. 6 TRL Road Note No. 31 AASHTO	 AASHTO TRL Road Note No. 6 TRL Road Note No. 31 AASHTO	Appropriate.
2.	Road Alignment	Including significant changes	Basically follow the existing alignment	The existing alignment itself does not deviate from the standard. To avoid large cut and fill, thus reducing construction costs.
3.	Road width	Carriageway 7.0 m Shoulder 1.5 m	Carriageway Mountainous 6.5 m Other 7.0 m Shoulder To be changed by sub-section.	Appropriate to change according to traffic, terrain and environment.
4.	Pavement	Base course 20 cm AC binder course 5 cm AC surface course 5 cm	Base course To change by sub-section AC binder course To be omitted AC surface course 5 cm	Cumulative ESAL for design can be lower than that of ERA's D/D.
5.	Bridge	Upper structure to be replaced where serious damages observed,		Reasonable.
6.	Drainage Structure	To be extended according to widening of road width.		Reasonable.

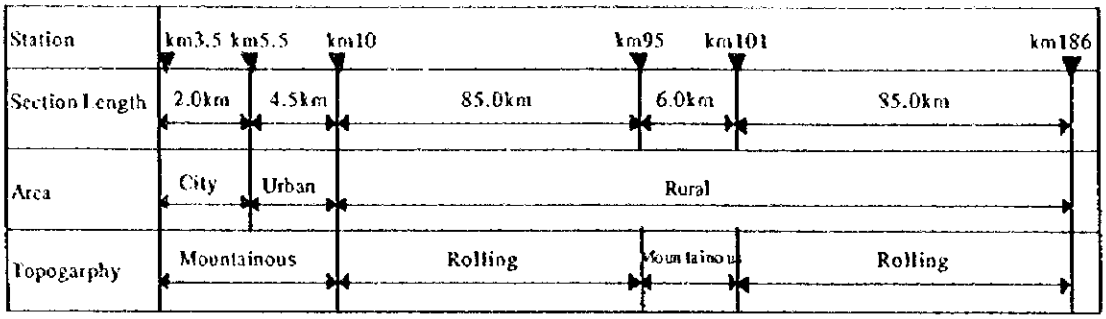
(2) Deign Concept

1) Road

Design concept is summarized as follows:

Sub-Sections

Sub-sections determined by area and topography along the targeted road are summarized in Fig. 2.1.



Notes: Station in accordance with ERA's kilometer posts.
Km3.5 = Start point of the Project.
Km186 = End point of the Project.

Fig. 2.1 Determination of Sub-sections

Geometry

Alignment of the existing road is basically in accordance with the standards to be adopted, i.e. AASHTO or TRL Road Note No. 6, thus large alignment changes are not required.

Road Width

ERA adopts 7.0 m of carriageway and 1.5 m of shoulder (both sides) for five major trunk roads. The basic design follows the same width except for the mountainous sections, where a 6.5 m carriageway and a 1.0 m shoulder are to be adopted. However, for the section km5.0 – km10.0 (mountainous and urban area) a 3.0 m shoulder on the hill-side is adopted.

Note: The five major trunk roads are as follows:

(1) Mojo ~ Awash ~ Mile
(2) Woldiya ~ Adigrat ~ Zalambessa
(3) Debre Markos ~ Gondar
(4) Awash ~ Kulubi ~ Dire Dawa ~ Harer
(5) Alemgena ~ Hosaina ~ Sodo

Table 2.2 Outline of the Geometry to be Adopted

Items	Description
Project length	Start point : Station km3.5 (3.5 km from Menelik II Square) End point : Station km186.0 (Goha Tsiyon) Length : 182.5 km
Horizontal alignment	Basically follow the existing road except widening at curved sections. For mountainous sections, minor re-alignment will be made to the extent that it will not induce excessive earthwork.
Vertical alignment	Follow existing alignment.
Road width	km3.5~km5.5 Carriageway 7.0 m, Shoulder 2.5m (both sides), Pedestrian 3.0 m (both sides) km5.5~km10.0 Carriageway 6.5 m, Shoulder 3.0m (hill-side), 1.0m (valley-side) km10.0~km95.0 Carriageway 7.0 m, Shoulder 1.5m (both sides) km95.0~km101.0 Carriageway 6.5 m, Shoulder 1.0m (both sides) km101.0~km186.0 Carriageway 7.0 m, Shoulder 1.5m (both sides)

Pavement Structure

The following standards were examined for pavement design:

1. TRL Overseas Road Note No. 31 (A guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries), TRL Road Note No. 29 was also referred to.

2. AASHTO (Guide for design of pavement structures)

3. Asphalt Institute Manual Series No. 17 for overlay structure (USA)

ERA's D/D indicates that pavement structure designed by TRL Road Note No. 31 is more economical compared to AASHTO, say by about 25%. Thus, TRL Road Note No. 31 is to be used for the Basic Design.

Cumulative ESA for 20 years design period was calculated at 5.6×10^6 ESAL, which falls into Class T5 (3.0×10^6 – 6.0×10^6 ESAL) of TRL Road Note No. 31.

CBR-value (Californian Bearing Ratio) of subgrade at every 1.5 km was derived from the DCP data by ERA's D/D. Deflection data were also referred to. Then, several sub-sections by CBR-value were determined.

2) Bridges

Outline of the Existing Bridges

The existing drainage structures with span length of over 6.0 m were categorized as bridges by the ERA's D/D. Nineteen bridges were investigated in the Basic Design study. The outline is as follows:

Construction year

Seventeen (17) bridges were constructed in the 1940s and one in 1994. The construction year of the remaining bridge is not known.

Superstructure

Sixteen (16) bridges are RC T-girders with single span of 7-12 m, of which 15 with 4-girders and one with 5-girders. One bridge is RC T-girder with double spans and 5-girders. The remaining 2 are stone arch bridges.

Width

Seventeen (17) bridges were widened to the present width 25 years ago.

Abutment

All bridges are constructed with stone masonry abutments.

Outline of the structure is summarized in Table 2.3.

Table 2.3 Outline of the Structure of the Existing Bridges

Bridge No.	Station (km)	Construction	Type of superstructure	Type of abutment/pier	Span (B m)	Width (W m)
B001	21.95	1940's	Single span reinforced concrete T- girder	Gravity type of stone masonry	7.0	9.0
B002	23.90	〃	〃	〃	9.6	8.4
B003	39.06	〃	〃	〃	8.7	7.7
B004	42.40	〃	〃	〃	11.7	8.2
B005	48.08	〃	〃	〃	8.0	7.7
B006	51.80	〃	〃	〃	8.0	7.7
B007	53.05	〃	〃	〃	8.0	7.4
B008	55.90	〃	〃	〃	9.0	7.3
B009	60.10	〃	〃	〃	8.0	7.3
B010	60.65	〃	〃	〃	11.0	4.4
B011	62.10	〃	〃	〃	12.0	4.8
B012	65.60	〃	〃	〃	2×8.0	7.6
B013	67.45	1994	2 span single support reinforced concrete T- girder	〃	2×20.0	7.3
B014	104.00	1940's	3 span stone masonry arch	〃	3×9.0	7.6
B015	124.00	〃	Single span stone masonry arch	〃	8.0	7.3
B016	141.50	〃	Single span reinforced concrete T- girder	〃	8.8	7.7
B017	148.05	〃	〃	〃	6.0	7.4
B018	158.50	〃	〃	〃	8.4	9.2
B019	181.60	unknown	Single span reinforced concrete T- girder (5 girders)	〃	7.0	7.8

" 〃 " = the same as the above

Condition of the Existing Bridges

For all RC-girder bridges constructed in the 1940s, observed defects were as follows:

- Exposure and corrosion of reinforcing bars in girders
- Cracks and splitting of concrete in girders
- Honeycomb and inadequate cover in girders
- Infiltration of rain from deck slab
- Damage of rail
- Inadequate maintenance

From observation of the superstructure it is supposed that carbonation of concrete and corrosion of reinforcing bars are progressing, which will result in serious deterioration of the structure. Regarding the substructure, no serious defects in stone masonry abutment such as settlement, cracks, shoving, sliding have been observed. This is because the structures are standing on a rock foundation and experienced no serious flood or earthquake in the past.

As for stone masonry arch bridges (B014 and B015) no serious defects in the structures have been observed except damages of rail, clogging of drainage pipe and erosion of adjacent road shoulder.

Evaluation of the Superstructure

Defects of the existing superstructure are summarized as follows:

1. Exposure and corrosion of main reinforcing bars in main girders
2. Corrosion of stirrup bars in main girders due to infiltration of rain from deck slab
3. Corrosion of reinforcing bars in deck slab
4. Efflorescence caused by cracks and corrosion of reinforcing bars
5. Carbonation of concrete

According to the criteria on evaluation of RC girder bridges by the Public Works Research Institute, Ministry of Construction Japan, soundness of the existing bridges are judged as Category I or II conditions.

Note: Category I = Very serious condition
Category II = Serious condition, need detailed investigation for strengthening measures.

Load Carrying Capacity

Assuming design parameter of the existing girders, the load bearing capacity was calculated by the Basic Design. Results of the analysis are summarized as follows:

1. Design capacity (wheel load 6.25t) was revealed to be sufficient for normal traffic, but excessive stress is being produced in members (e.g. due to corrosion of reinforcing bars), which will cause rapid deterioration of the structure.

2. The present capacity cannot cope with over-loaded vehicles (equivalent wheel load 14t), which could cause total destruction.

Examination of Strengthening Methods

The following strengthening methods were examined:

1. Splicing steel plate to the soffit of the girder, and epoxy injection to give additional strength to girder.

2. Protective coating or sheeting on the deck slab to prevent corrosion to reinforcing bars from seepage of surface water.

3. Remove all loose material such as honeycombing, spalling of concrete, efflorescence, etc. and give new coating.

Through these strengthening methods, progress of deterioration of the structure can be slowed down to some extent but there is a question about their effectiveness because the reinforcing bars are largely corroded causing concrete spalling. Under such circumstances, replacement of the superstructure rather than strengthening by the above mentioned methods is recommended from the technical and economical points of view.

Bridges to be Replaced

As a result of above examination the bridges to be replaced under the Project are summarized in Table 2.4, where the bridges B007, B009, B010, B011 and B017 can be replaced by RC slab culverts, i.e. the span length can be reduced to less than 5m, which is also recommended in the ERA's D/D.

Regarding the substructure, extension of the width is needed for the bridges to be replaced.

Table 2.4 Bridges to be Replaced under the Project

Bridge No.	Station (km)	Condition of Super-Structure	Condition of Substructure	Superstructure	Substructure
B001	21.95	Moderate defects (no exposure of reinforcing bars) Need 1.5 m for pedestrians on both sides.	No sign of defect. Need opening of channel and gabion mattress to protect bed.	Replace	Extension
B002	23.90	Moderate defects (exposure of reinforcing bars, spalling and cracks in concrete) Need 1.5 m of pedestrian on both sides.	No sign of defect. Need protection of abutment from erosion.	Replace	Extension
B003	39.06	Trace of repair mortar. Need 2.5 m pedestrian on both sides.	Need protection of bed.	Replace	Extension
B004	42.40	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect.	Replace	Extension
B005	48.08	Moderate defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect.	Replace	Extension
B006	51.80	Moderate defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect.	Replace	Extension
B007	53.05	Moderate defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect. Need minor repair on wing wall.	Replace by slab culvert	
B008	55.90	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect. Need protection of bed.	Replace	Extension
B009	60.10	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect. Need opening of channel.	Replace by slab culvert	
B010	60.65	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	Loose spots on masonry but no settlement. Need some strengthening work.	Replace by slab culvert	
B011	62.10	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect.	Replace by slab culvert	
B012	65.60	Moderate defects. (exposure of reinforcing bars, spalling of concrete)	No sign of defect.	Replace	Extension
B013	67.45	No sign of defect. Need minor repair of railing, installation of safety post.	No sign of defect. Need minor repair.	–	–
B014	104.00	No sign of defect. Need minor repair of railing, installation of safety post.	No sign of defect. Need minor repair.	–	–
B015	124.00	No sign of defect. Need minor repair of railing, installation of safety post.	No sign of defect. Need minor repair.	–	–

Bridge No.	Station (km)	Condition of Super-Structure	Condition of Substructure	Superstructure	Substructure
B016	141.50	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete) Need 1.5 m for pedestrians on both sides.	No sign of defect. Need minor repair. Need opening of channel and gabion mattress to protect bed.	Replace	Extension
B017	148.05	Serious defects (exposure of reinforcing bars, spalling and cracks in concrete)	No sign of defect. Need minor repair.	Replace by slab culvert	
B018	158.50	Serious defects. Trace of repair with mortar. Need 2.5 m for pedestrians on both sides.	No sign of defect. Need gabion mattress to protect bed.	Replace	Extension
B019	181.60	No serious defect. Need coping of parapet and repair of railing.	No sign of defect. Need gabion mattress to protect bed.	–	–

3) Culvert

The type of culvert on the targeted road are classified as follows:

1. Reinforced concrete girder and slab with stone masonry abutment (Structurally same as the existing bridge but span length less than 5m)
2. Reinforced concrete slab with stone masonry abutment
3. Concrete pipe
4. Corrugated metal pipe
5. Stone masonry arch
6. Reinforced concrete box culvert

Exposure of reinforcing bars, spalling, honeycomb in RC girders and slabs are observed, but are not so serious as to require total replacement. Thus, rehabilitation is to be limited to extension of the existing structure to meet the planned road width.

The targeted culverts are summarized in Table 2.5.

Table 2.5 Targeted Culvert

Type	Number	Number of culverts targeted
Reinforced concrete girder and slab (G+SLAB)	8	8
Slab (SLAB)	198	174
Concrete pipe (C.PIPE)	90	60
Corrugated metal pipe (A.PIPE)	26	5
Stone masonry arch (A.ARCH)		
km3.5-10	32	32
km10-186	15	6
Reinforced concrete box (R.C.BOX)	1	1
Others	8	8
Total	378	294

2.2.3 Results of Examination

Through the above examination, the basic concept of the Project formulated is summarized to rehabilitate the Addis Ababa – Goha Tsiyon road of 182.5 km to an all-weather asphalt concrete road, which includes replacement of superstructure for 15 bridges and extension of 294 culverts on the road, to meet the standards for increasing traffic.

2.3 Basic Design

2.3.1 Design Concept

(1) Natural Condition

The project road is located in Sheva highland at altitudes of 2,500 m – 3,300 m. Annual average rainfall ranges from 1,000 mm – 1,500 mm, where the rainy season extends from June to September, while from October to January there is almost no rain. Local downpours are usual in the rainy season. Annual average temperature remains at 10℃ - 15℃. Topography of the project site is mountainous or hilly, and Goha Tsiyon (end point of the project) is located at the edge of Blue Nile valley (Abay Gorge). Geologically, basalt rock and its conglomerate layers are observed. From Northeast to Southwest runs the great trough, placing the project area in an earthquake zone.

The most significant characteristic of the project area is its high altitude. Since mechanical work will be dominant for the project, decrease of productivity of the equipment caused by low atmospheric pressure should be considered. Also, since the paving work of asphalt concrete is affected seriously by rain, the meteorological records were examined in detail for estimation of possible working days.

Safety factors for earthquake and run-off were considered for bridge design and drainage capacity, respectively.

(2) Social Condition

The end point of targeted road is at 182.5 km from Addis Ababa. It can be said that the project area is rather near to the capital, thus facilitating procurement of material and equipment from the local market. Regarding social infrastructure, there is electricity supply, but as interruption of power is usual, construction work cannot rely on it.

The targeted road is the only access from the capital to the Northwest region. Since commodity freight and public transportation for passengers are the dominant traffic on the road, any interruption of traffic by the works will seriously affect the social and economical activities in the area. Appropriate diversion road or facilities together with safety measures should be provided while work is underway.

(3) Local Construction Industries

1) Labor

Local engineers, technicians and labor will be procured in Addis Ababa. Since the number of technicians for paving and equipment operators are limited in Ethiopia, necessary numbers of technicians for the purpose of controlling and training of local workers will be brought from Japan.

2) Related Laws and Regulations

Regarding labor regulation the Proclamation No. 42/1993(January, 1993) and No. 88/1994 (February, 1994) shall be the basis.

Regarding land acquisition the Proclamation No. 66/1997(March, 1997) shall be the basis, where all land is the Government's property and ERA can " use, free of charge, land and such other resources and quarry substances required for the purpose of construction and maintenance of highways, camp, storage of equipment and other required services; provided however, that ERA shall pay compensation in accordance with the law for properties on the land it uses".

(4) Use of Local Construction Companies and Consultants

Thirteen construction companies and several consultants are registered with ERA in the field of road maintenance projects. The use of these companies for the Project is recommended to support the Government's privatization policy.

(5) Procurement of Construction Equipment and Material

There is no leasing company of construction equipment in Ethiopia. Also there is no available equipment owned by the construction companies or ERA , most of which are used for road maintenance projects at present and it is not possible to lease-out for a long term project. Particularly, there is no asphalt concrete mixing plant and crushing plant available, which is essential for the Project.

(6) Operation and Maintenance Capability of the Executing Agency

ERA itself has some 20 years experience in asphalt concrete paving work. As asphalt concrete is being applied for several on-going projects under RSDP, it is very possible that the technique will be acquired soon by local contractors also in parallel with the completion of these projects, thus maintenance of the Project road after completion can be assured technically.

Regarding maintenance of bridges and drainage structures to be constructed under the Project no problems are anticipated because stone masonry work will be given preference for the structural design, and Ethiopia has a long history of using this technique. Also, there are sufficient quantities of good quality stone along the Project road.

(7) Scope and Level of Facilities

1) Road Alignment

Since the Project aims at "rehabilitation of the existing facilities" it will not incorporate large-scale up-grading works. Consequently, the alignment will follow the existing one as much as possible except where the existing alignment causes difficulties for smooth traffic flow and safety.

2) Road Width

Road width basically follows a 7.0m carriageway and 1.5m-shoulder. However, for the sections in Addis Ababa and mountainous areas it will be changed to ensure smooth traffic flow and safety.

3) Pavement Structure

Thickness of asphalt concrete surface course is to be 5 cm. That of base course is to be designed according to subgrade CBR.

4) Bridge and Culvert

The design has taken into account:

1. Maximum use of local materials to facilitate maintenance
2. Maximum use of the existing stone masonry structure
3. Use of economical type of railing
4. Use of simple structure to facilitate the work

Bridges

Superstructures in serious condition are to be replaced by RC T-girders and substructures are to be extended.

Slab Culvert

RC slab and stone masonry abutment will be extended using the same type of structure as the existing one.

(8) Implementation Schedule

Construction period was determined as 5 years due to the following reasons:

The work items which critically affect the overall construction period are mobilization and preparatory work, earthwork and pavement work. Productivity of crushing plant and asphalt concrete plant are also important factors to determine the period.

1) Mobilization and preparatory Work

There is no available construction equipment in Ethiopia for the Project. Most of them are to be imported from Japan, consequently, the period required for procurement, ocean transport, inland transport, set-up of plants and site camp, etc. shall be taken into account. Particularly, considerable time for customs clearance is anticipated at Assab port. Thus, 6 months is anticipated for the mobilization and preparatory work.

2) AC Surface Course

Paving work of asphalt concrete is affected seriously by rain. From experience days with more than 5 mm rainfall are not appropriate for paving work. The number of such days per year in the project area is estimated at 78 days from meteorological data. Adding this to the number of holidays and accidental interruptions, the average number of working days for paving is estimated at 195 days per year. On the other-hand average productivity for AC paving is estimated at 1900m2/day according to Guidelines of the Ministry of Construction, Japan. Consequently, the period required for paving work is estimated as follows:

Area	:	1,795,646 m^2
Productivity per day	:	1,900 m^2
Working days per year	:	195 days
Period required	:	4.8 years

3) Capacity of Plant Required

Three possible quarries are found along the Project road (total length 182.5 km), i.e. km28.5km, km105 and km167. Therefore, crushing plant and AC plant are to be set-up near these quarries. Each plant set will be moved according to work progress. (The work will start from Addis Ababa.) Opening of two quarries simultaneously is not recommendable because it involves a double set of plant and other related equipment, consequently pushing up construction costs. The capacity of crushing plant and AC plant was determined as 120t/h and 60t/h, respectively.

Crushing Plant

Aggregates required	:	600,167 t
Plant capacity	:	120 t/h
Productivity	:	96 t/h (work efficiency 80%)
Working days per year	:	220 days
Working hours per day	:	6 h
Period required	:	4.7 years

Asphalt Plant

AC required	:	208,795 t
Plant capacity	:	60 t/h
Productivity	:	42 t/h (work efficiency 70%)
Working days per year	:	195 days
Working hours per day	:	6 h
Period required	:	4.2 years

Consequently, the overall schedule determined is summarized in Fig. 2.6

Work Item	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Mobilization & Preparation of Work						
Earthwork						
Base Course						
Surface Course						
Bridges						
Drainages						
Ancillaries						

Fig. 2.6 Construction Schedule

2.3.2 Basic Design

(1) Overall Plan

1) Road

Geometry of the targeted road was categorized into 4 types; (A), (B),(C) and (D), according to topography and area characteristics. Pavement structure was also categorized into 4 types; (A), (B), (C) and (D) according to subgrade CBR.

Geometry

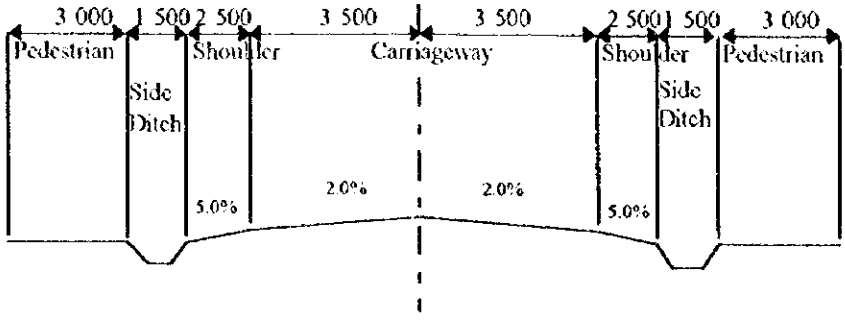
Geometry by sub-section is summarized in Table 2.7, and cross section of each type is shown in Fig. 2.2.

Table 2.7 Geometry of Targeted Road by Sub-section

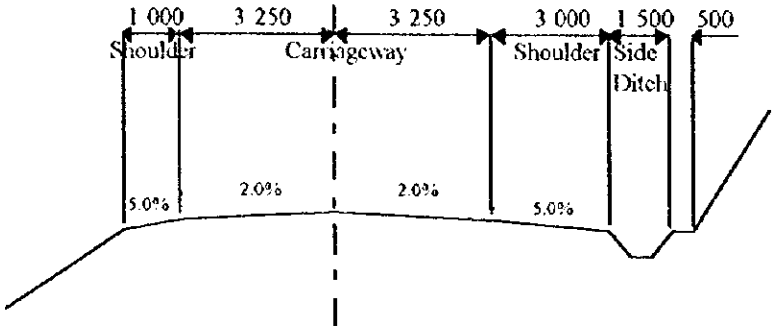
Cross Section Type	Sub-section	Section Length	Road Width	Area	Topography
(A)	km 3.5 ~ km 5.5	2.0 km	Carriageway 3.5m × 2 lanes Shoulder 2.5m × both sides Pedestrian 3.0m × both sides	City	Mountainous
(B)	km 5.5 ~ km 10.0	4.5 km	Carriageway 3.25m × 2 lanes Shoulder 1.0m × valley side 3.0m × mountain side	Urban	Mountainous
(C)	km 10.0 ~ km 95.0 km 101.0 ~ km 186.0	85.0 km 85.0 km	Carriageway 3.5m × 2 lanes Shoulder 1.5m × both sides	Rural	Rolling
(D)	km 95.0 ~ km 101.0	6.0 km	Carriageway 3.25m × 2 lanes Shoulder 1.0m × both sides	Rural	Mountainous

Cross Section Type (A)	2.0 km
Cross Section Type (B)	4.5 km
Cross Section Type (C)	170.0 km
Cross Section Type (D)	6.0 km
Total	182.5 km

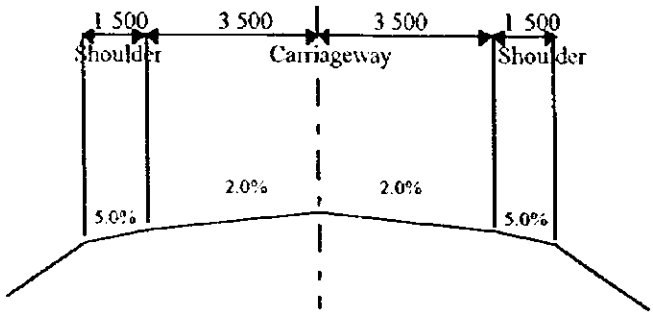
Type (A) Length 2.0 km



Type (B) Length 4.5 km



Type (C) Length 170.0 km



Type (D) Length 6.0 km

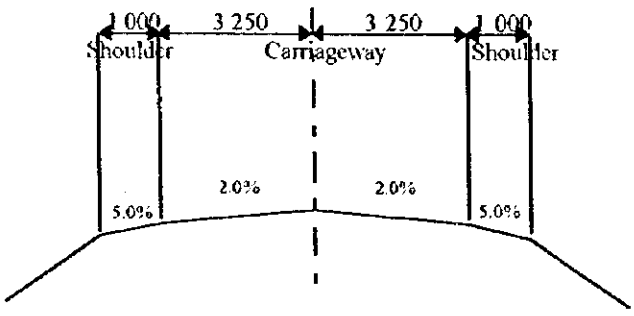


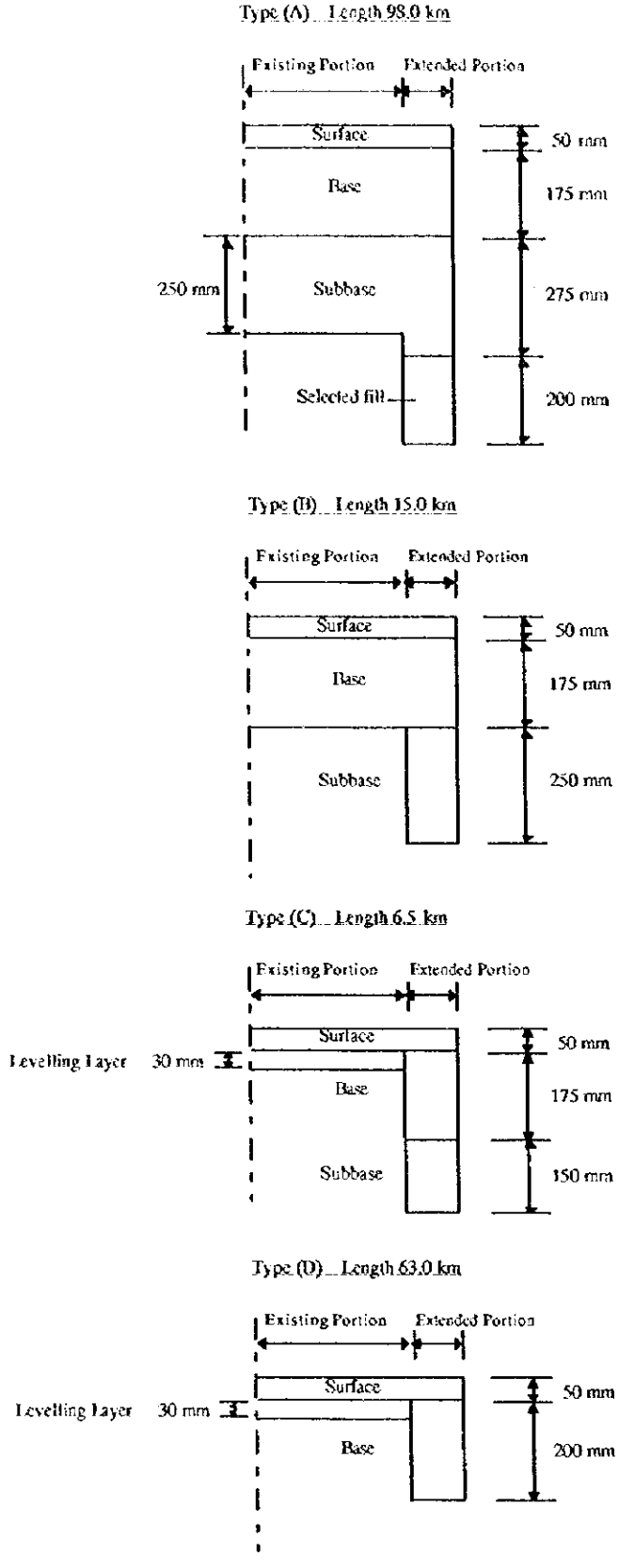
Fig. 2.2 Cross Section by Geometric Type

Pavement Structure

Pavement structure by sub-section is summarized in Table 2.8, and cross section of each type is shown in Fig. 2.3.

Table 2.8 Pavement Structure of Targeted Road by Sub-section

Pavement Type	Sub-section	Section Length	Pavement Structure Designed			
			Existing Portion of Carriageway		Extended Portion of Carriageway	
			Structure	Combined CBR	Structure	Subgrade CBR
(A)	km 10.0 ~ km 23.0	13.0 km	Surface 5 cm	9%	Surface 5 cm	4%
	km 44.0 ~ km 75.0	31.0 km	Base 17.5 cm		Base 17.5 cm	
	km 101.0 ~ km 143.0	42.0 km	Subbase 15 cm		Sub-base 27.5 cm	
	km 159.0 ~ km 171.0	12.0 km			Selected fill 20 cm	
(B)	km 171.0 ~ km 186.0	15.0 km	Surface 5 cm	12%	Surface 5 cm	10%
			Base 17.5 cm		Base 17.5 cm	
					Sub-base 25 cm	
(C)	km 3.5 ~ km 10.0	6.5 km	Surface 5 cm	15%	Surface 5 cm	15%
			Levelling Layer 3 cm (av)		Base 17.5 cm	
					Sub-base 15 cm	
(D)	km 23.0 ~ km 44.0	21.0 km	Surface 5 cm	30%	Surface 5 cm	30%
	km 75.0 ~ km 101.0	26.0 km	Levelling Layer 3 cm (av)		Base 20 cm	
	km 143.0 ~ km 159.0	16.0 km				
Pavement Type (A) 98.0 km Pavement Type (B) 15.0 km Pavement Type (C) 6.5 km Pavement Type (D) 63.0 km Total 182.5 km						



Note: Thickness of the "Levelling Layer" indicates average thickness.

Fig. 2.3 Cross Section by Pavement Type

2) Bridge

Out of 15 bridges scheduled for replacement, the existing span length of B001 is to be changed from 7.0m to 10.0m because the flow capacity is not sufficient for the discharge volume. B007, B009, B010, B011 are to be replaced by slab culvert (span length <5.0m) because discharge volume calculated by ERA's D/D justifies it. Particularly, since the adjacent road alignment of the above 4 bridges are to be improved, new construction is needed in any case, thus from economical point of view, slab culvert is justified. As a result, the superstructures of 10 bridges are to be replaced by new RC slabs, and those of 5 bridges by slab culverts, as summarized in Table 2.9.

Table 2.9 Bridge schedule

Bridge No.	Station (km)	Replace-ment	Changed to Slab Culvert	Repair	Span Length (m)	Carriageway Width (m)	Pedestrian Width (m)	Bridge Width (m)
B001	21.95	●			10.0	7.32	1.5	11.12
B002	23.90	●			9.6	7.32	1.5	11.12
B003	39.06	●			8.8	7.32	2.5	13.12
B004	42.40	●			11.7	7.32	0.8	9.72
B005	48.08	●			8.0	7.32	0.8	9.72
B006	51.80	●			8.0	7.32	0.8	9.72
B007	53.05		◎		(4.0)			12.60*
B008	55.90	●			9.0	7.32	0.8	9.72
B009	60.10		◎		(3.0)			10.60*
B010	60.65		◎		(4.0)			20.00*
B011	62.10		◎		(4.0)			30.30*
B012	65.60	●			(2.0)	7.32	0.8	9.72
B013	67.45			○	2×20.0			8.90
B014	104.00			○	3×9.0			8.42
B015	124.00			○	8.0			8.00
B016	141.50	●			8.8	7.32	1.5	11.12
B017	148.05		◎		(3.0)			10.60*
B018	158.50	●			8.4	7.32	2.5	13.12
B019	181.60			○	7.0			8.12

() : Width of Culvert

* : Length of Culvert

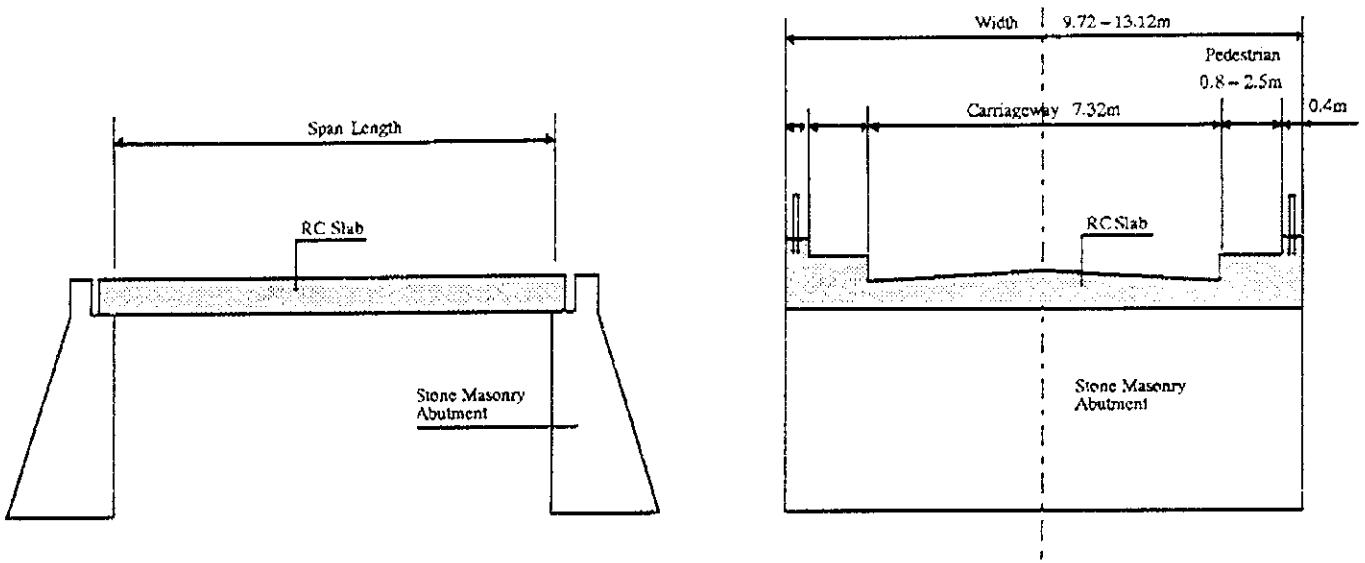


Fig. 2.4.1 RC Slab Bridge

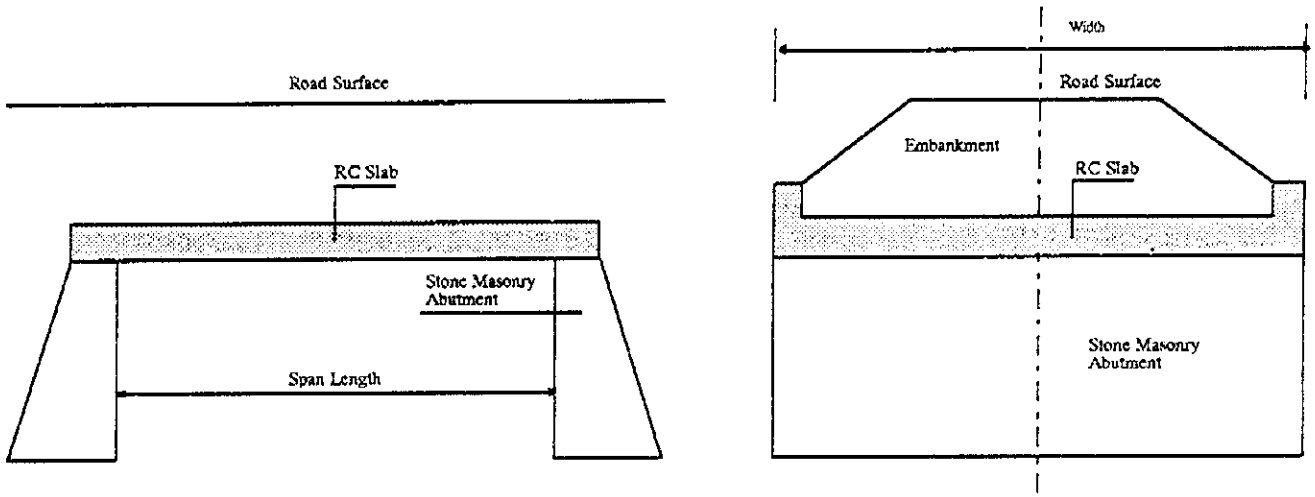


Fig. 2.4.2 RC Slab Culvert

3) Culvert

The existing culverts are to be extended to meet the planned road width. The extension can be on both sides or only one side according to the planned road alignment, e.g. culverts within km5.5 – km10 are to be extended to hill-side (cutting side) only. Culvert of C001 is to be extended in accordance with street planning of Addis Ababa. The culvert schedule is summarized in Table 2.10.

Table 2.10 Culvert Schedule

Existing Culvert	Extension Type	Dimension	Number	Remarks
RC T-girder	In-situ RC Slab culvert	3m < span < 5m	8	
RC Slab	Pre-cast RC Slab culvert	span < 3m	174	for span = 3.0 m, in-situ
Concrete pipe	Pre-cast RC pipe culvert	ϕ 600mm	60	Of which
Corrugate metal pipe	Pre-cast RC pipe culvert	ϕ 600mm	5	14 places double
Stone masonry arch	In-situ RC Slab culvert	3m < span < 5m	6	
	Pre-cast RC Slab culvert	span < 3m	32	for span = 3.0 m, in-situ
Box culvert	In-situ RC Slab culvert	3m < span < 5m	1	
Others	In-situ RC Slab culvert	3m < span < 5m	2	
	Pre-cast RC Slab culvert	span < 3m	6	
	In-situ RC Slab culvert	3m < span < 5m	17	
	Pre-cast RC Slab culvert	span < 3m	212	for span = 3.0 m, insitu
	Pre-cast RC pipe culvert	ϕ 600mm	65	Of which 14 places double
	Total		294	

(2) Design Standards and Criteria

1) Road

Geometry

AASHTO and TRL Road Note No. 6 were applied for the design. Criteria of the geometric design by sub-section are summarized in Table 1.11.

Table 2.11 Criteria of the Geometric Design

Station	km3.5	km5.5	km10.0	km95.0	km101.0	km186.0
Section Length	2.0 km	4.5 km	85.0 km	6.0 km	85.0 km	
Design Speed	40.0 km/h		60.0 km/h (40.0 mph)	40.0 km/h (30.0 mph)	60.0 km/h (40.0 mph)	
Max. Gradient	11.0%		6.0%	8.0%	6.0%	
Min. Radius	R = 30.0 m		R = 85.0 m	R = 30.0 m	R = 85.0 m	
Min. Sight Distance	350.0 m (1,100 ft)		460.0 m (1,500 ft)	350.0 m (1,100 ft)	460.0 m (1,500 ft)	
Carriageway Width	7.0 m (22.0 ft)	6.5 m (20.0 ft)	7.0 m (22.0 ft)	6.5 m (20.0 ft)	7.0 m (23.0 ft)	
Shoulder Width	2.5 m (4.0 ft)	1 m, 3 m (4.0 ft)	1.5 m (4.0 ft)	1.0 m (4.0 ft)	1.5 m (4.0 ft)	
Cross Section Type	(A)	(B)	(C)	(D)	(C)	

Note: Figures in ( ) indicate mile or feet.

Pavement Structure

a. ESAL

Cumulative number of equivalent standard axle loads at 5.6×10^6 ESAL for 20 years design period was applied. ESAL was estimated in accordance with ERA's D/D, where traffic growth rate of 4% for large bus, and of 6% for cargo truck and trailer truck are assumed, as shown in Table 2.12

Table 2.12 Estimation of ESAL

	AADT in 1994	Growth Rate up to 2000	AADT in 2000	Growth Rate up to 2020	8.2 t Equivalent	Cumulative ESAL $\times 10^6$
Sedan	105	1%	111	4%	nil	–
Bus (small)	87	1%	92	4%	nil	–
Bus (large)	47	1%	50	4%	1.0	0.272
Cargo Truck	181	1%	191	6%	3.2	4.103
Trailer Truck	30	1%	32	6%	5.7	1.225
Total	450		476			5.600

Source: ERA's DD

b. Subgrade CBR

DCP field data by ERA's D/D were analyzed to determine design CBR. The result is summarized in Table 2.13.

Table 2.13 Design CBR by Sub-section

From	To	Design CBR	Length
km 3.5	km 10.0	CBR = 15%	L = 6.5 km
km 10.0	km 23.0	CBR = 4%	L = 13.0 km
km 23.0	km 44.0	CBR = 30%	L = 21.0 km
km 44.0	km 75.0	CBR = 4%	L = 31.0 km
km 75.0	km 101.0	CBR = 30%	L = 26.0 km
km 101.0	km 143.0	CBR = 4%	L = 42.0 km
km 143.0	km 159.0	CBR = 30%	L = 16.0 km
km 159.0	km 171.0	CBR = 4%	L = 12.0 km
km 171.0	km 186.0	CBR = 10%	L = 15.0 km

c. Pavement Structure

The pavement structure corresponding to traffic class T5 ($3.0 \times 10^6 - 6.0 \times 10^6$ ESAL) was selected from TRL Road Note 31. The result is shown in Table 2.14.

Table 2.14.1 Pavement Structure Determined – Existing Portion –

Unit: mm

Combined CBR	9%	12%	15%	30%
Surface	50	50	50	50
Base	175	175	–	–
Subbase	250	–	–	–

Table 2.14.2 Pavement Structure Determined – Extended Portion –

Unit: mm

	S=2 CBR=3%, 4%	S=4 CBR=8～14%	S=5 CBR=15～29%	S=6 CBR=30%+
Design CBR	4%	10%	15%	30%
Surface	50	50	50	50
Base	175	175	175	200
Subbase	275	250	150	-
Selected fill	200	-	-	-

1) Bridge and Culvert

Design Standards

Standard Specification for Highway Bridges (AASHTO) and Ethiopian Standard Code of Practice (ESCP:1983) were applied for the design.

Live Load

HS-20-44 vehicular load was applied for carriageway load.

Seismic Load

Seismic load was considered in accordance with the ESCP.

Design Method

"Load Factor Design Method" (AASHTO) was used for evaluation of strength against failure load, and "Design Load Method" was used to evaluate serviceability.

Strength of Material

Strength of material applied for the design is as follows:

a. Concrete – Compressive strength at 28 days

Slab bridge	240 kgf/cm^2
In-situ curb and parapet coping	210 kgf/cm^2
Abutment	210 kgf/cm^2
Slab culvert	210 kgf/cm^2
Surrounding concrete for pipe culvert	180 kgf/cm^2

b. Reinforcing bar – Yield strength 4,200 kgf/cm^2 (conforming to ASTM Specification)

Determination of Superstructure

As span length of all targeted bridges is less than 10m, the RC structure was adopted from the economic point of view and to facilitate the works.

Geometry

Carriageway width : 7.32m

Pedestrian width : Min. 0.8m (both sides), mound-up type 20 cm

CHAPTER 3

IMPLEMENTATION PLAN

Chapter 3 Implementation Plan

3.1 Implementation Plan

3.1.1 Implementation Concept

(1) Project Implementation Agency

In case the Project is implemented on the basis of Japan's Grant Aid, the overall structure of the Project implementation will be as shown in Fig. 3.1.

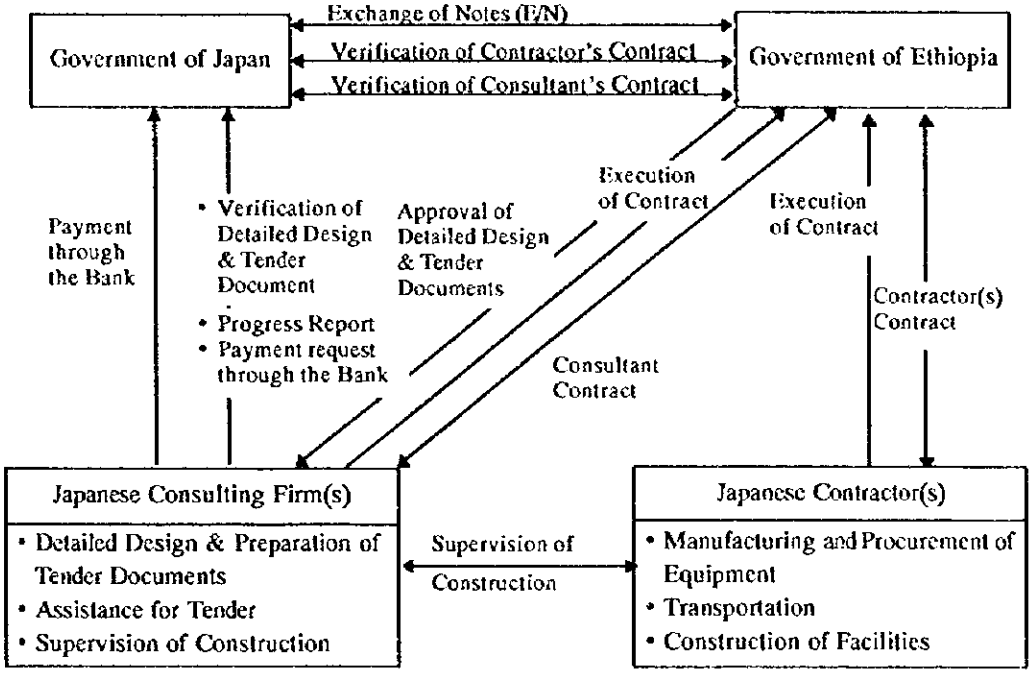


Fig. 3.1 Overall Structure of the Project Implementation

Implementation agency of the Project is the Ethiopian Road Authority (ERA).

In accordance with Japan's Grant Aid system, Japanese consulting firm(s) will undertake the detailed design and supervision of the Project based on a contract between the ERA and the said firm(s), and Japanese general construction company(ies) will undertake the construction based on the contract(s) between the ERA and the said company(ies).

Since Japan's Grant Aid is executed within the framework of the Japanese Government's budgetary system, plural times of the Exchange of Notes, Consultant(s)

Contract, Contractor(s) Contract is required in the case where the project extends beyond one fiscal year. (this does not necessarily mean that the same number of times is required as the number of Japanese Government's fiscal years).

(2) Consultant(s)

In accordance with Japan's Grant Aid system, Japanese consulting firm(s) will be employed for engineering services for the Project.

Soon after the Exchange of Notes (E/N) between the Government of Japan and the Government of Ethiopia, ERA will conclude a contract with the Japanese consulting firm(s).

The said firm(s) will provide engineering services for the construction which include detailed design, preparation of contract documents, assistance for tender(s) and contract and supervision of construction, in accordance with the contract until completion of construction of the Project.

(3) Contractor(s)

ERA will conclude the contract between the Japanese general construction company(ies) who is(are) awarded the tender(s) in open competitive tender(s) from the viewpoint of technical capability and cost competitiveness.

The said company(ies) will execute the construction in accordance with the contract.

(4) Local Engineer(s)

ERA shall assign full-time counterpart(s) from its permanent employees for the Project, who will work together with the Consultant in various aspects of the Project. The Consultant will employ local engineer(s) or consultant(s) to execute his services in Ethiopia.

(5) Local Sub Contractor(s)

The Contractor(s) will be recommended to employ local sub-contractor(s) as much as possible for the construction of the Project.

(6) Technicians from Japan

The Contractor(s) will be recommended to dispatch technicians from Japan for the construction of the Project, who will cover operation and maintenance of crushing plant, asphalt concrete plant, construction equipment, mechanical and electrical work and blasting. The technician shall provide on-the-job training for local employees in an appropriate way.

3.1.2 Special Notes for Implementation

Special attention should be paid to the following points.

- All Ethiopian laws and regulations shall be abided by throughout the entire construction period.
- Careful consideration shall be given to prevent any adverse affect from the construction work, i.e., noise, vibration and waste water, etc., on the surrounding area.
- The work schedule shall take into consideration local labor conditions including religious holidays.
- Transportation of the equipment for construction use shall not cause any damage to existing roads and structures.
- Due attention shall be paid throughout the construction period to safety of vehicles and pedestrians on Project roads.
- Every care shall be taken to avoid damage to third parties.
- Every care shall be taken to avoid damage to the existing facilities during transportation of equipment and material to be imported.

3.1.3 Scope of Works

Any costs which relate to land acquisition required for the Project for both permanent works and temporary works shall be the responsibility of the Government of Ethiopia. The costs for removal or diversion of public facilities such as power line,

telecommunication line, water supply, etc. which will be affected by the Project shall be the responsibility of the Government of Ethiopia.

3.1.4 Consultant's Supervision Plan

(1) Principles

In case the Project is implemented by Japan's Grant Aid, the consultant should thoroughly understand the background of the Project, contents of the Basic Design Study Report, Japan's Grant Aid system and the contents of the Exchange of Notes (E/N) between the Government of Japan and the Government of Ethiopia.

(2) Scope of the Consulting Services

Following the E/N, the consultant will enter into a consultant contract with the ERA. The scope of consulting works is given below.

1) Detailed Design

- Preparation of detailed design and tender documents,
- Securing of approval of tender documents by ERA,
- Assisting ERA in the tender and tender evaluation. Witnessing of the contracts,
- Confirmation of the scope and progress of the measures to be undertaken by the Government of Ethiopia prior to the commencement of Project-related construction work.

2) Work Supervision

- Issue of notice to proceed,
- Preparation of pre-work report,
- Discussions with parties involved in construction work prior to the commencement of the work,

- Securing of official approval for the work schedule and holding of work schedule meetings,
- Securing of official approval for work drawings,
- Witnessing of the inspection of materials/equipment, witnessing of construction work and the issue of the relevant instruction as and when deemed necessary,
- Inspection of interim progress of the work. Inspection for final hand over and issue of final acceptance certificates,
- Preparation of monthly progress reports throughout the construction period,
- Conducting of all necessary work for final hand over,
- Preparation of final report and undertaking of the Project completion procedure,
- Inspection and preparation of report prior to the expiration of Defect Liability period.

(3) Important Points to Note

1) Detailed Design

- Reconfirmation of Procurement Conditions

  Reconfirmation of the procurement conditions of materials and equipment identified at the basic design stage is necessary. As the construction materials and equipment will be procured locally where possible, it is important to check whether they meet the requirements and specifications set out by the basic design.

- Preparation of and Briefing on Tender and Contract Documents

  The contents of the Tender and Contract documents which include drawings and specifications shall comply with the objectives of the Grant Aid and shall be thoroughly examined and discussed with ERA during the Detailed Design

so that they can be authorized as official tender and contract documents of the Project.

2) Works Supervision

- Progress Control

The overall implementation schedule which is anticipated at present is shown in Table 2.1. Since the Project will be implemented under Japan's Grant Aid system, the actual work schedule to be prepared as part of the detailed design should reflect certain conditions attached to this system. As the work shall be completed as planned, strict progress control should be conducted.

- Quality Control

As the materials and equipment to be procured in Ethiopia are not always of uniform quality, the specifications which will be established as part of the detailed design may be changed. In the case of such change, proper quality control of the materials should be conducted to ensure that the original design requirements are maintained.

- Supervisors

Supervisors of the Consultant should be mobilized to the Project site as soon as the notice to proceed is issued to the contractor. At least one full-time supervisor responsible for construction should be on-site throughout the construction period. Engineers in such special fields as road, structure, material and pavement will be dispatched at appropriate times.

3.1.5 Procurement Plan

(1) Materials

Procurement plan for the major materials to be used for the Project is shown in Table 3.1.1.

Table 3.1.1 Procurement Plan for Materials

Item	Procurement Plan		
	Ethiopia	Japan	Third Countries
Cement	○		
Admixture		○	
Steel Bar	○		
Wood, Scaffold Board	○		
Plywood	○		
Explosive	○		
Guard Rail, Safety Sign	○		
Electric Cable	○		
Asphalt	○		
Fuel, Lubricant	○		
Survey and Testing Equipment		○	
Radio and Telecommunication Equipment	○		
Office Equipment	○		
Road Marking Paint		○	

(2) Equipment

There is no leasing company of construction equipment, nor available equipment owned by the construction companies in Ethiopia or ERA. Procurement plan for the major construction equipment to be used for the Project is shown in Table 3.1.2.

Table 3.1.2 Procurement Plan for Materials

Construction Equipment	Procurement Plan		
	Ethiopia	Japan	Third Countries
Asphalt Plant		○	
Crushing Plant		○	
Asphalt Finisher		○	
Concrete Mixing Plant		○	
Air Compressor		○	
Tire Roller		○	
Macadam Roller		○	
Wheel Loader		○	
Motor Grader		○	
Bull Dozer		○	
Dump Truck, Cargo Truck		○	

(3) Transportation Period Required

Transportation period required for the equipment and materials to be procured in Japan is estimated to be about 4.5 months. The details are as follows:

1.	Preparation in Japan Ex-factory, Packing, Transport Customs Shipment	30 days
2.	Ocean Transport (Japan ~ Assab)	30~45 days
3.	Debarkation, Customs at Assab	30~40 days
4.	Inland Transport (Assab ~ Site)	10 days
5.	Customs at Addis Ababa	10 days
	Total	135 days

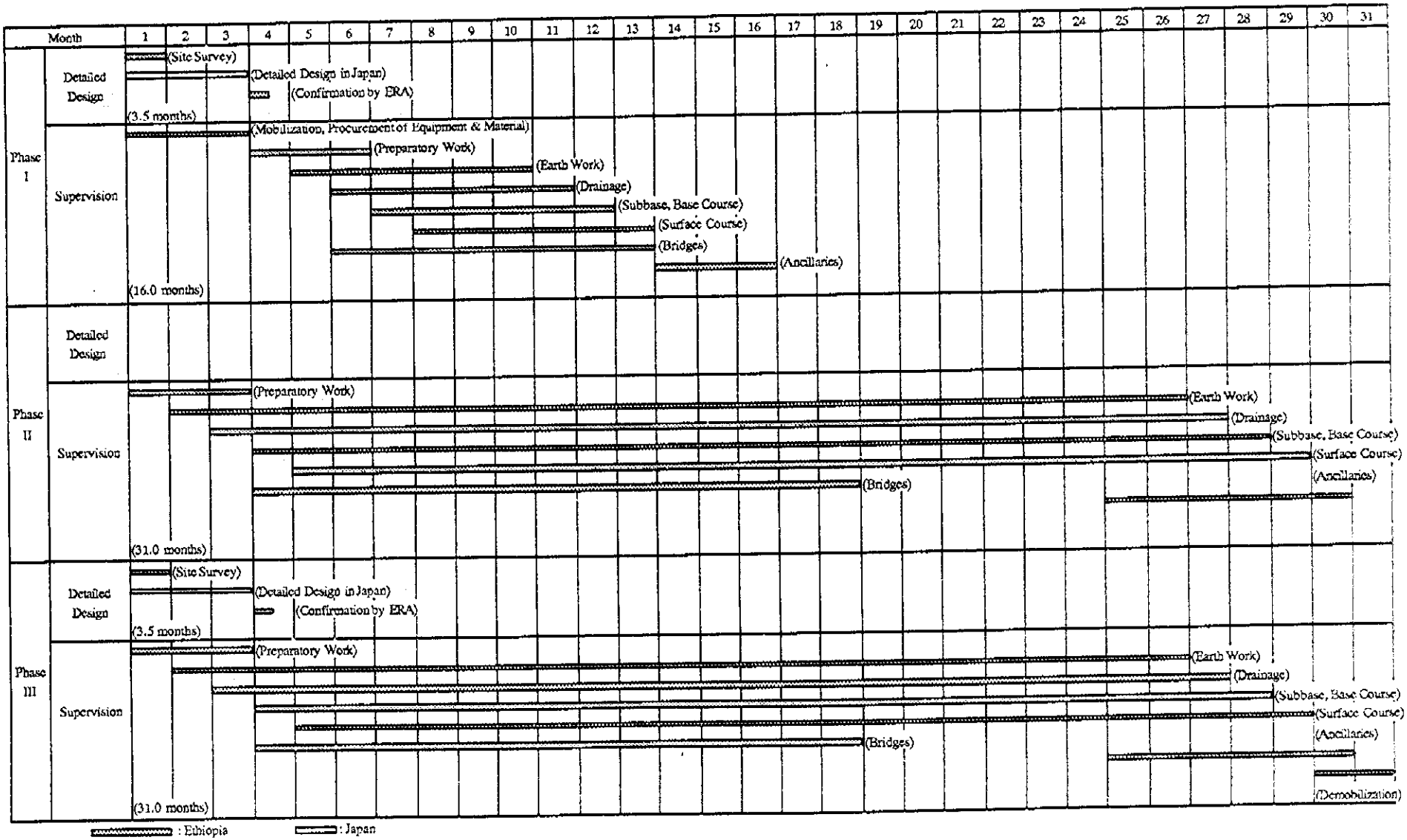
3.1.6 Implementation Schedule

Seventy (70) months including detailed design is anticipated for the Project. To accelerate implementation and to review the project cost in the middle of the implementation three-phased program is considered most suitable in the framework of Japan's Grant Aid system. Where, the first phase covers one fiscal year, and second and third phase each covers three fiscal years. Phased schedule is shown in Table 3.2, and construction schedule in each phase is shown in Table 3.3.

Table 3.2 Phased Schedule

Phase	Station	Road Length Covered	Bridges	Drainages
I	km 3.5 ~ km 5.5	2.0 km	0	0
II	km 5.5 ~ km 95.0	89.5 km	13	134
III	km 95.0 ~ km 186.0	91.0 km	6	160
Total	km 3.5 ~ km 186.0	182.5 km	19	294

Table 3.3 Implementation Program



3.1.7 Obligation of Recipient Country

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

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

(2) To secure land necessary for the execution of the Project, such as temporary offices, working areas, storage yards and others, and removal and/or diversion of public facilities such as electric cable, telecommunication line, water supply.

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

(4) To ensure prompt unloading customs clearance at the port of disembarkation in Ethiopia and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.

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

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

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

(8) To bear the following bank changes based on the banking arrangement:

1) Advising commission of authorization to pay
2) Payment commission

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

(10) To bear all the expenses, other than those covered by the Grant, necessary for the Project.

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

(12) To coordinate and solve any issues related to the section which is maintained under the Region 14 with Addis Ababa Roads Authority (ARA).

3.2 Project Cost Estimation

3.2.1 Project Cost Borne by the Government of Ethiopia

Project cost to be borne by the Government of Ethiopia is estimated at Birr 2,600,000 and is as follows:

Compensation for crops	Birr	205,000
Diversion of water pipe line	Birr	1,500,000
Diversion of electricity cable	Birr	500,000
Diversion of telecommunication cable	Birr	485,000
Total	Birr	2,690,000

3.3 Operation and Maintenance Costs

Maintenance costs required annually after completion of the Project is estimated as shown in Table 3.4. The result is as follows:

Routine Maintenance	Birr	0.90 million
Periodic Maintenance	Birr	1.07 million
Total	Birr	1.97 million

Thus, the required maintenance costs could be secured if the same amount of budget as 1997/98 will be allocated from the Road Fund and the government budget for Alemugena Maintenance District.

Table 3.4 Estimation of the Maintenance Costs after Completion of the Project

Road length (Addis Ababa ~ Goha Tsiyon)	182.5 km
Pavement width	7.0 m
Shoulder width	1.5 m

(1) Routine Maintenance (annually)

Item	Work category	Unit	Unit Price Birr	Work load per year	Amount Birr	Remarks
11	Asphalt patching	m^2	78.5	2,555	200,568	0.2% of the total pavement area
12	Pavement repair	m^2	94.8	2,555	242,214	0.2% of the total pavement area
21	Culvert cleaning	place	582.3	183	106,561	
22	Ditch cleaning (manual)	m	5.5	9,125	50,188	5.0% of the total road length
23	Ditch reshaping (mechanical)	m	6.9	9,125	62,963	5.0% of the total road length
31	Shoulder grading	m	6.9	18,250	125,925	10.0% of the total road length
32	Bush clearing	m^2	0.7	5,475	3,833	1.0% of the total road length
55	Other routine maintenance	km	167.2	183	30,598	
90	Overhead	LS			82,285	10%
Total					905,135	

(2) Periodic Maintenance (every 8 years)

Item	Work category	Unit	Unit Price Birr	Work load per year	Amount Birr	Remarks
40	Partial repair	m^2	111.1	3,194	354,853	2.0% of the total pavement area per 8 years
41	Base course	m^2	20.3	3,194	64,838	2.0% of the total pavement area per 8 years
42	Surface treatment	m^2	6.7	7,984	53,493	10.0% of the total pavement area per 8 years
44	AC overlay	m^2	30.5	7,984	243,512	5.0% of the total pavement area per 8 years
46	Shoulder rehabilitation	m^2	14.2	6,844	97,185	10.0% of the shoulder per 8 years
47	Concrete/Stone masonry repair	m^3	340.0	50	17,000	$50m^3$ per year
48	DBST	m^2	8.2	7,984	65,469	5.0% of the total pavement area per 8 years
51	Stone masonry	m^3	397.7	50	19,885	$50m^3$ per year
90	Overhead	LS	1,388.9		91,624	10%
Total					1,066,707	

Note: Generally periodic maintenance is to be executed in every seven to eight years. The above mentioned cost indicates the average cost converted into yearly basis.

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION

Chapter 4 Project Evaluation and Recommendation

4.1 Project Effect

The targeted Addis Ababa–Goha Tsiyon section forms a principal section of North-Western Corridor, which traverses the northwestern part of Oromia, Amhara and Tygre Regions. The area of influence of the Corridor produces 46% of major crop (teff, barley, wheat and maize) and 45% of livestock (number of head of cattle and sheep) of the country. Population receiving benefit from the Project is estimated at 9.6 million, which represents 17% of the country.

The Project will enable reliable and cost-effective transport for agricultural products from the northwestern part of the country to Addis Ababa. It will proceed the Government's Agricultural Development–Led Industrialization (ALDI) strategy, consequently contribute to the national economy.

In addition to the direct benefits such as vehicle operating cost savings, time savings, the following indirect benefit are expected:

- To stimulate agricultural production and marketing, particularly those of cash crops in the area of influence of the access road from Addis Ababa to northwestern regions. It also contributes to revitalization of the mining industry (cement industry) along the route and transport industry.
- To stimulate economic activities by facilitating traffic and reducing transport costs, consequently, contributes to stability of commodity prices.
- To promote settlement of rural population by development of the rural economy.
- To facilitate the access of the rural population to social services such as medical, educational services, etc.

The Project also contributes to the upgrading of basic human needs for the population in the area of influence. Regarding management of the Project the Ethiopian side has sufficient capabilities for the implementation. Also, appropriate maintenance of the road and sufficient fund allocation from Road Fund after completion of the Project is confirmed.

Present situation and problems of the road sector, measures to be taken under the Project and positive impacts and extent of the Project is summarized in Table 4.1.

As significant positive effect is expected from the Project, Japan's Grant Aid Assistance for the implementation of the Project can be justified and implementation at an early stage is recommended.

Table 4.1 Project Evaluation

Present Situation	Measures to be taken under the Project	Positive impacts and extent of the Project
1) A total of 23,813 km of the road network in Ethiopia have seriously deteriorated during the last decade due to inappropriate maintenance, which hinders smooth transportation and has adverse effects on the economy. 2) Addis Ababa–Goha Tsiyon section of 182.5 km, forming a principal section of North-Western Corridor, is surface-treated road with narrow shoulders. Deterioration of pavement and shoulder is progressing mainly due to the recent increasing traffic, and needs rehabilitation to prevent further destruction. 3) The targeted section has the highest priority under RSDP-1. The Government prepared a detailed design for Addis Ababa-Debre Markos section by its own fund. However, implementation has not materialized due to a shortage of funds. 4) The area of influence of the North-Western Corridor is the most important agricultural producing area of the country. To proceed with the Government's Agricultural Development–Led Industrialization strategy, reliable access from this area to Addis Ababa is indispensable.	1) To rehabilitate the Addis Ababa–Goha Tsiyon section of 182.5 km to asphalt concrete road with appropriate geometric standards.	1) To save vehicle operating costs and time, and reduce maintenance costs. 2) To facilitate transportation of agricultural products from the influence area to Addis Ababa. 3) To stimulate production and improve productivity in the influence area, thus promote settlement of local population and revitalize rural economy. 4) To reduce regional disparities by up-grading regional economy, consequently contribute to the national economy. 5) To provide reliable access for the rural population to the social services such as medical and educational service, and contribute to social stability.

4.2 Recommendation

As described above, Japan's Grant Aid Assistance for the implementation of the Project can be justified. However, if the comprehensive training program of the Government materializes in the near future, the benefits from the Project will be maximized during the life of the asset.