8.5 Bridge Design

1) Standard Design

Where the proposed discharge volume is greater than the capacity of a culvert, bridges are to be constructed. The heavy rainfall during the rainy season in the Project Area limits practical work methods. Although the substructure is to be constructed in rainless periods of the dry season, a superstructure which requires no support work would be desirable, and a superstructure which is economical, easily built, and inexpensive maintenance-wise would be even more desirable. For the purpose of this Project, (1) reincorced concrete T girder bridge, (2) pre-tension prestressed concrete slab bridge, and (3) steel H beam bridge or steel plate girder bridge are conceivable. (1) is economical and easily built but requires support while under construction and therefore entails a longer construction period. Both of (3) can be erected easily and at any time of the year but maintenance cost will be high. (2) is easily erected and involves a low maintenance cost and a lower construction cost than the steel girder bridge. Therefore, pre-tension prestressed concrete bridges will be erected under this Project.

Pre-tension prestressed concrete slab bridges of 30 feet span and of 50 feet span are currently standard in Sierra Leone, and therefore these two types will be used for the Project.

2) Mabole Bridge

The Mabole Bridge is the longest of the bridges to be erected. The length of the existing Mabole Bridge is 332.2 feet. In consideration of the proposed discharge volume and the river shape, and also in order to minimize the work period, piers should be as few as possible. The 3-span design is the most desirable because the sub-structure construction can be completed in a single dry season. Either post-tension prestressed concrete girder bridge or a steel plate girder bridge may be constructed for the total length of 324 feet with 3-spans. The comparative study

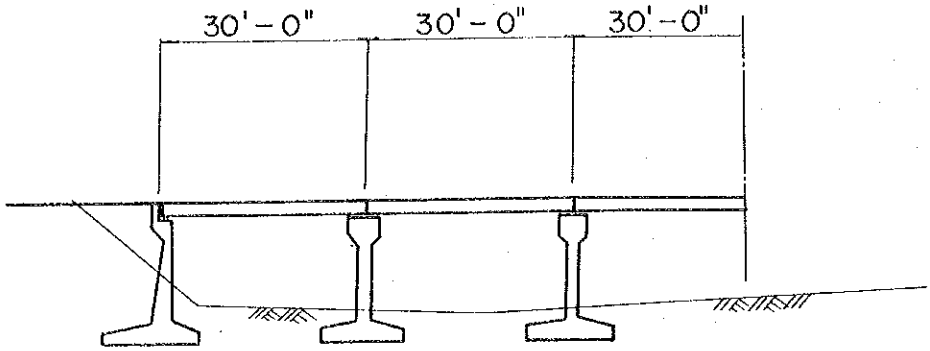
(see Appendix 5-7) made at a bridge construction site with the same foundation and shallow bearing layer as this site, indicated the use of a direct foundation. In such cases, the post-tension prestressed concrete girder bridge is economical and presents no construction problems. Therefore, the Mabole Bridge will be constructed as such.

The standard bridges (spans of 30 feet, 50 feet, and 108 feet) are outlined in Figure 8-2.

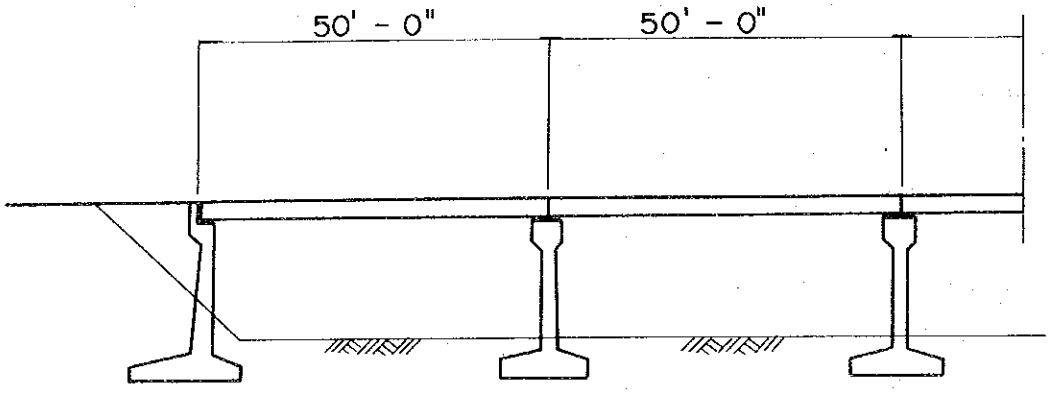
3) Bridge Plan

A bridge erection plan was formulated on the basis of a hydrological analysis made in 3.8 above and the existing river cross section. Both the 30 feet span and 50 feet span are to be used for bridges other than the Mabole Bridge, but both are not to be used in the same bridge, so that work is simplified.

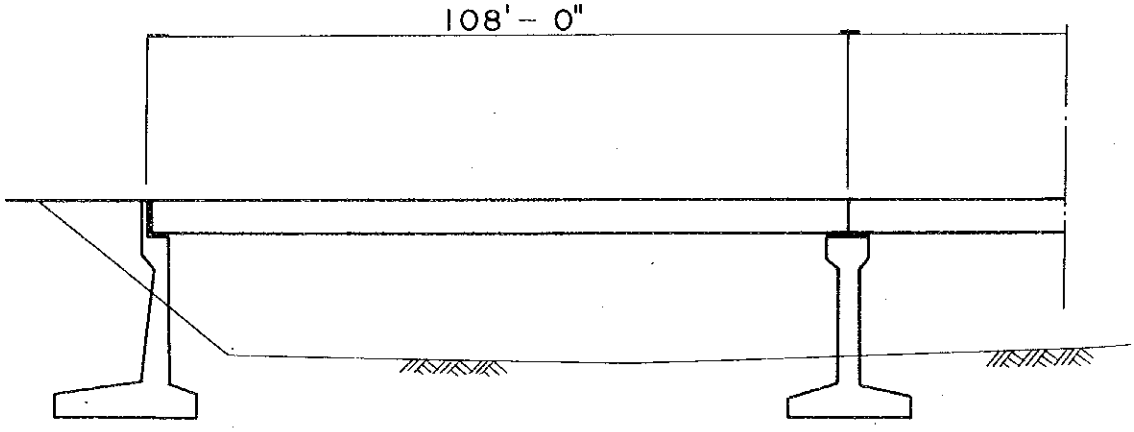
Abutments and beams of each bridge are to be designed in accordance with the particular proposed height and ground height, with effort to standardize them as much as possible. Bridge type to be actually constructed, their abutments and pier height will be as shown in the next table.



SPAN LENGTH 30 feet



SPAN LENGTH 50 feet



SPAN LENGTH 108 feet

Fig. 8-2 STANDARD BRIDGES

Table 8-5 List of Proposed Bridges to be Installed

Unit: feet

Location		Width	Bridge Length			Abutment Height	Pier Height	Water Direction
Km	Mile		Span Length	No. of Span	Bridge Length			
5 + 90	3.7	32	30	1	30	18	-	R
8 + 00	5.0	32	108	3	324	34	34	L
13 + 20	8.3	32	30	1	30	20	-	L
22 + 20	13.9	32	30	1	30	18	-	L
26 + 30	16.4	32	30	1	30	24	-	L
27 + 20	17.0	32	50	2	100	22	18	L
34 + 00	21.3	32	30	1	30	18	-	L
35 + 20	22.0	32	30	1	30	20	-	L
43 + 10	26.6	32	30	2	60	20	16	L
45 + 40	28.4	32	30	1	30	15	-	L
51 + 20	32.0	32	50	1	50	20	-	L
60 + 30	37.7	32	30	3	90	18	15	L
64 + 10	40.0	32	30	1	30	14	-	L
64 + 90	40.6	32	30	1	30	14	-	L
67 + 00	41.9	32	50	1	50	20	-	L
74 + 20	46.4	32	50	2	100	24	20	L

Note: Water direction "R" means that water flows from left side to right side of the road toward Kamakwie.

Source: JICA Mission

8.6 Pavement Design

1) Material

The pavements must have sufficient thickness to withstand traffic load, must be of a dynamically balanced structure of layers from wearing course to sub-base course, must utilize locally available materials to the fullest extent, must be economical, and must use a rationalized work method.

As stated in 3.2, the existing road is unpaved and of silty sandy clay soil with some gravel content. A field soil survey proved that this existing road surface can be used as a sub-grade of the new road.

Selected material with a relatively fine grain size obtained from silty sandy clay soil with some gravel content found frequently in roadside areas is to be used as material for the sub-base course. A crushed stone base course has greater uniform bearing capacity and higher reliability than selected material base course, and prevents rainwater penetration, which washes away base course material. Therefore, pavement surface using a crushed stone base course is not damaged very much, requires little maintenance expense, and guarantees smooth operation of vehicles for a long period of time. However, the total cost of the road will be very high when a crushed stone base course is used because the construction cost will be about 1.4 times greater with crushed stones than with selected material; to keep the cost of the base course to a reasonable level, the use of a mixture of selected material and crushed stones prepared at site is considered. A crushed stone content of above 20% is estimated, subject to testing at the time of detailed designing and final decision based on test construction just prior to actual construction. A comparison indicates that pavement cost will be approximately 23% (1,200,000 Leone) higher with the composite materials than with selected materials, but pavement made with composite materials will remain in a favourable condition for a relatively long period of time and will require little maintenance expense. Therefore, the composite

materials are to be used in this Project.

Asphalt concrete which uses crushed granite and that which uses surface dressing, (spray-and-chip treatment) which is presently common in Sierra Leone, are possible for surface work. Easily procurable crushed granite will probably be used as an aggregate for asphalt concrete. However, crushed granite does not mix well with asphalt, is of a flat shape and is not hard enough as an ingredient of asphalt concrete. Surface dressing will be more desirable for this Project, because material procurement will be easy and a homogenous quality can be expected.

2) Design Standard

The Pavement Structure Design Standard of Sierra Leone, which follows "Road Note 31*," is to be used in this Project. Under this Standard, the useful life of the Project is 10 years, provided that necessary overlays will be applied as necessary, and depending on the future increase in the traffic volume. Under the Standard, the pavement structure is to be designed on the basis of the design CBR value of the base course soil and the traffic volume, preferably on that estimated for the time after 10 years of the road service, as expressed in terms of the number of commercial vehicles. This recommendation is to be followed for the purpose of this Project.

3) Traffic Volume

Assuming that the service of the upgraded road commences in 1985 and that the road will have a useful life of 10 years, the traffic volume in 1995 and in the target year of 2010 is estimated by vehicle type and by road section. The heaviest traffic is estimated to occur in the Panlap - Mabole Section, which is to be used in calculations as the representative value for the entire Project Road.

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* "A guide to the Structural Design of Bitumen-Surface Roads in Tropical and Sub-Tropical Countries" Overseas Unit Transport and Road Research Laboratory, United Kingdom

Table 8-6 Future Traffic Volume between Panlap and Mobole

Section	Kind of Vehicles	1985	1995	
			Numbers	Rate (%)
Panlap	Cars	34	109	12.4
(	Pickups & Vans	87	131	4.2
)	Trucks & Buses	64	96	4.1
Mabole	Extra Heavy Vehicles	29	46	4.7

Source: JICA Mission

4) Design CBR

The soil along the road has been indicated as silty sand clay with a gravel content, mostly falling under A-2-6 or A-2-7 by the ASSHO Classification, by a soil survey conducted at 5-mile intervals.

The CBR values observed in 10 representative locations ranged from a maximum of 160 to a minimum of 26. A uniform pavement thickness is to be used throughout the entire extension of the road in consideration of the work and pavement thickness designing method.

The high CBR value is believed to be due to compacting under a cumulative load of a long time and, therefore, is not applicable to the sections where the work is to be done newly. The CBR value calculated on the basis of experience with similar soils came to 40.5. Therefore, a design CBR value of at least 25 is assumed for the Project Area throughout the total extension.

5) Pavement Structure Determination

Following the pavement determination diagram of Road Note 31, the pavement structure presented below has been determined on the basis of the basic data discussed above.

Type A is for general use, and Type B is for use in parts where the existing road surface is of a clayey soil. Rainwater seeping into clayey soil is liable to damage the base course, thus shortening the life of the pavement. In order to prevent this, an impervious layer is to be installed.

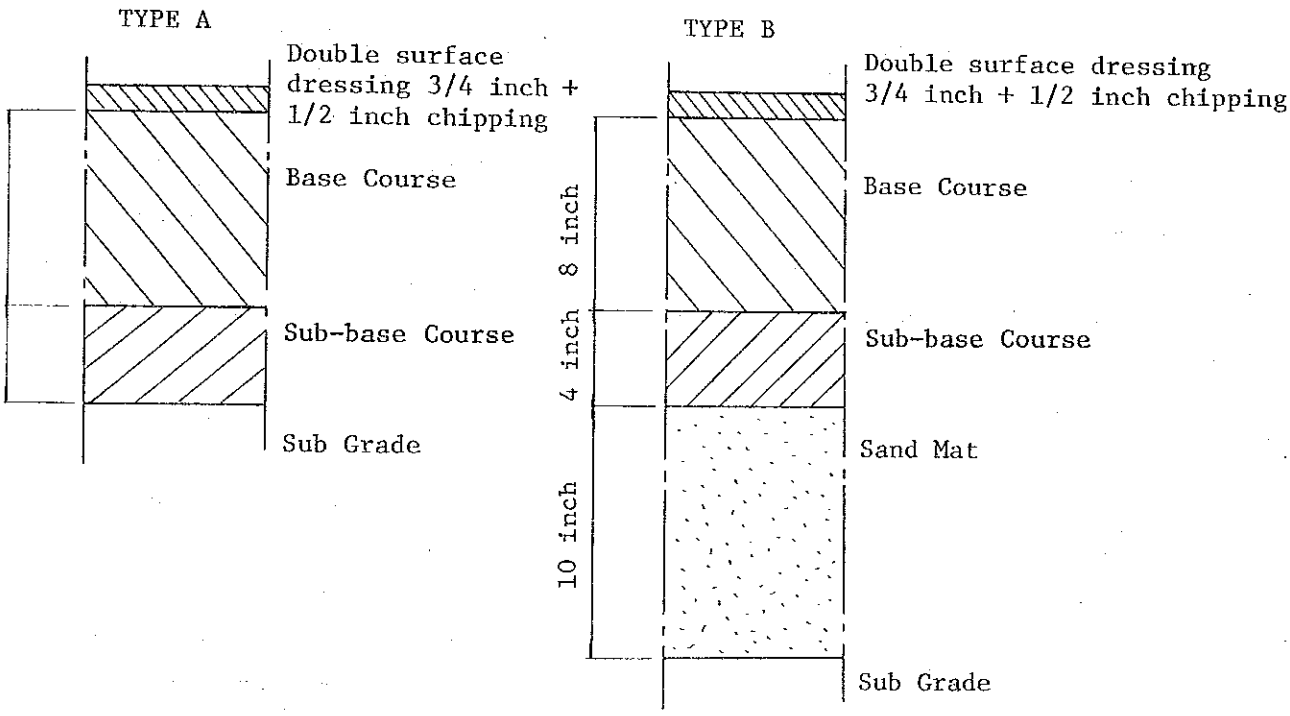


Fig. 8-3 Pavement Structure

8.7 Traffic Control Facility Design

In order to facilitate the safety and smooth flow of traffic over the Project Road, various traffic control facilities are to be installed. Channelization is to be introduced to major junctions, including those at terminal points. To assure the safety of and service to pedestrians in villages, through-traffic is to be isolated by providing bus stops, parking zones, and sidewalks.

1) Junctions

The shape and scale of junctions depend on the traffic volume, type composition, road standard, and design speed. In the case of the Project Road, the traffic is not very heavy but the design speed is high. Therefore, it is important that drivers approaching a junction can see each other and that the crossing of driving courses is held to a minimum. To achieve this, channeling islands and independent lanes are to be installed, by which traffic flowing in different directions with different speeds will be separated from each other. These measures will result in channels of traffic, which will prevent traffic confusion and control traffic division and merging and flow angles.

2) Bus Stop

For service to roadside villages and for the maintenance of a smooth flow of through-traffic, bus stops are to be installed. Future flow of passengers and the element of alignments should be considered in determining bus stop locations, but, for the time being, bus stops are to be established as necessary in small villages where no parking zone will be established. Stopping buses can disturb other vehicles moving over the Project Road at a high speed, and, therefore, bus stop bays are to be provided away from the main road with accompanying "speed changing" lanes in such a manner as to minimize the effect of stopping buses on the traffic capacity and running speed of the main road.

3) Parking Zone and Sidewalk

Parking zones are to be provided for vehicles used in the service of inhabitants of major villages where the number of pedestrians and vehicles are large. Pedestrians, through-traffic, and parked vehicles can be separated, to facilitate a safe and smooth traffic flow, by the installation of these parking zones and sidewalks. Guardrails are to be installed at high embankments of curves or bridge accesses and in villages where houses are concentrated.

CHAPTER 9

CONSTRUCTION SCHEDULE

CHAPTER 9

CONSTRUCTION SCHEDULE

9.1 Construction Method

Both Alternatives A and B are upgrading work. The earthwork, bridge work, and pavement work are to be accomplished not by any special method but by an ordinary method. Matters necessary for the actual work need to be reviewed in detail at the time of detailed designing, but this report considers construction method only to the extent necessary for understanding an outline of the work, for determining a general work schedule, and for estimating the construction cost.

1) Earthwork

Earth from cutting work is to be used for embankments whenever possible, but when the hauling distance is excessive, the earth may be spoiled, and borrowed earth from nearby locations may be used. The existing road must be kept open to traffic even during the upgrading work. In order to minimize hindrance to the passing traffic, borrowing is to be done by the side-borrow method taken from one side. In parts where a new road is to be constructed, borrowing is to be from both sides. In upgrading parts surrounded by rice paddies or water channels where side-borrowing is impossible, embankment work is to be done by moving earth with a bulldozer, power shovel, and dump truck. In this case also, work should be done on one lane at a time so that ordinary traffic can pass through.

The cutting and embankment under this Project will involve silty sand clay with a gravel content, whose water content greatly influences the degree of soil compaction and workability. The cone index necessary to support the operation of construction equipment is at least 3 for 15-ton bulldozers and at least 5 for 21-ton bulldozers. In the rainy season, the natural water content of soil rises, impairing the workability of

construction equipment. Therefore, it is believed that the major earthwork should be limited to the dry season.

2) Culvert Work

Two different types of culvert work must be considered. In parts where the existing road is to be upgraded, all the existing culverts are to be demolished and replaced by new ones. A detour must be temporarily provided in order to handle traffic while this work is being done. Excavation, detouring of water, support work, and the construction of traffic detour roads necessary for the installation of new culverts should all be done during a dry season for safety. In parts where a new road is to be constructed, culvert work may be done almost any time because traffic need not be allowed during the work, provided that July, August, and September, when rainfall is the heaviest, is avoided for the detouring of water in view of the danger involved.

3) Bridge Work

Bridges are also to be constructed by two different methods, one involving the sections in which the existing road is to be upgraded and the other involving the section where a new road is to be constructed. In the upgrading sections, the existing bridges are to be demolished and new bridges are to be constructed. In order to accommodate the traffic during this work, a temporary bridge will be necessary. Bridge work may extend to two years depending on the size of the substructure, in which case the temporary bridge must withstand flooding in the rainy season. In the new road construction sections, bridge work must be coordinated with the progress of earthwork on both sides of the bridge which are to be used for the bridge work.

The erection of a superstructure will be easy because of the precast concrete girders. The work will be hardly affected by weather, but July, August, and September should be avoided for the safety of workmen. All superstructures, except that of the Mabole Bridge, are factory precast and will break easily. They should be transported carefully in order to

prevent breakage in transit. Superstructures can be easily erected, and the period of work can be minimized by the use of a crane, but the crane must be transported on embankments and, therefore, strong attention should be paid to safety.

Construction of a temporary bridge over the Mabole will be difficult in view of the river's breadth and discharge volume. Therefore, for the purpose of the new bridge work, the existing bridge, which is aged and can only withstand a weight of up to about 20,000 pounds, must be used with care, particularly for the transport of a heavy component. The sub-structure work should be completed in one dry season. Otherwise, cofferdam work will be very difficult. After full preparatory work, two abutments and two piers should be started at the same time. The superstructure will use girders to be cast on site, and therefore, a casting yard will be needed in the vicinity. Quality control should be strictly accomplished so that the girders will have the defined allowable-stress strength.

4) Pavement Work

Pavement work must be accomplished so that each layer is homogenous and satisfies the designated quality and thickness requirements. Otherwise, the road, after being opened for use, will lose surface flatness, possibly quickening the damaging of the road. The subgrade will consist of both the existing road portion and the widened portion with different degrees of compaction. Therefore, the widened portion must be compacted with optimum water content by adequate water spraying in a dry season; the water content is too high for this work in rainy seasons.

The sub-base course work will utilize silty sandy clay soil with gravel content, and soil with fine particles and no large gravel should be selected for use whenever possible. For sub-base course work, the soil should be fully compacted with optimum water content, and the work should be done with full attention to the flatness of the course. A sub-base course which is not flat may not be easily compensated by base or wearing course and, therefore, may not result in a road surface which is flat.

The same soil with a supplementary crushed stone admixture for better viscosity is to be used as base course material. Because the crushed stone admixture is to be accomplished on site, the components should be fully stirred by the use of a stabilizer in order to obtain the designated composition. Spraying and compacting should done thoroughly to assure the uniformity of the finished base course.

The wearing course work must be done when the base course is dry and, therefore, should be done in a dry season. Asphalt solvent should be sprayed uniformly by a heating distributor, if possible, or, at least by an engine sprayer, and chips must be spread uniformly over the asphalt. When the work is inevitably divided into two halves of the road width in order to allow the passage of traffic, care should be used so that the adjoining part will be smooth and without level difference.

Most of the pavement work can be done only in a dry season. Concentrated work in a short construction period can result in the shortage of crushed stones or chips. Therefore, the production of crushed stones and chips should be started in a rainy season so that there will be an adequate stock of these materials.

9.2 Bill of Quantities

Major quantities have been obtained for both Alternatives A and B based on preliminary design. These quantities have been used in determining a rough work schedule and in making a preliminary estimate of the construction cost.

The quantities have been arrived at as totals, based on the designs drawn according to the basic policy of the upgrading work and on the results of the road inventory survey, bridge inventory survey, and topographical survey. The quantities are listed by work type.

Table 9-1 Bill of Quantities for Alternative Plans A and B

Work Items	Unit	Bill of Quantities			Total
		Alternative A	Alternative B		
			Stage 1	Stage 2	
Earth work					
Site clearance & grubbing	arce	50	45	6	51
Fell trees 2ft dia.	Sq.yd	35,000	34,000	4,200	38,200
Strip top soil	Sq.yd	99,600	80,600	39,000	119,600
Soil excavation	Cu.yd	1,005,200	867,800	206,000	1,073,800
Excavation of rippable rock	Cu.yd	3,300	3,300	-	3,300
Embankment	Cu.yd	606,000	556,300	113,000	669,300
Riprap slop protection	Sq.yd	195,700	176,300	34,800	211,100
Side ditch	ft.	78,300	70,800	15,600	86,400
Culvert					
Pipe culvert dia.3ft	ft	6,798	6,798	417	7,215
Pipe culvert dia.4ft	ft	105	105	-	105
Pipe culvert dia.5ft	ft	63	63	-	63
Box culvert 5 x 5ft	ft	33	33	-	33
Box culvert 7 x 7ft	ft	333	333	-	333
Box culvert 10 x 10ft	ft	675	675	-	675
Box culvert 13 x 13ft	ft	249	249	-	249
Box culvert 10 x 10ft double	ft	33	33	-	33
Bridge					
30ft span bridge	Sq.yd	1,345	1,345	-	1,345
50ft span bridge	Sq.yd	1,380	1,380	-	1,380
Mabole bridge	Sq.yd	1,152	-	1,152	1,152
Pavement	Sq.yd	673,300	664,200	68,500	732,700
Miscellaneous work					
Junction	place	5	5	-	5
Bus stop	place	10	10	-	10
Sidewalk	ft.	1,800	1,800	-	1,800

Source: JICA Mission

9.3 Construction Schedule

A rough construction schedule has been determined on the basis of the natural conditions of the work site, the existing road condition, the various work conditions as revealed by the preliminary design, and a full consideration of the following points:

a) Although rainfall is heavy in the Project Area from May through October, the work should be suspended only in July, August, and September, when rainfall is particularly heavy according to weather records.

b) Because construction equipment and materials are to be brought to the site using the existing road, the construction work must be accomplished with proper care so as not to hinder the passage of ordinary traffic.

c) Because construction equipment and materials are to be transported over the existing road, they will cross the existing bridges and culverts. The inventory survey has indicated, however, that the width and load-bearing capacity of some of the bridges and culverts are not necessarily adequate for the purpose, and the transport of equipment and materials will be subject to certain limitations.

d) The period of culverts construction and the period of substructure work (cofferdam, support work) for bridges, particularly the Mabole Bridge, will be limited by the rainy season. Therefore, the sequential order of work elements should be fully reviewed.

e) Because of the precast girders, bridge superstructures will be under tension prior to their erection and, therefore, can break easily by a small impact. The methods of transport and erection of superstructures must be selected carefully.

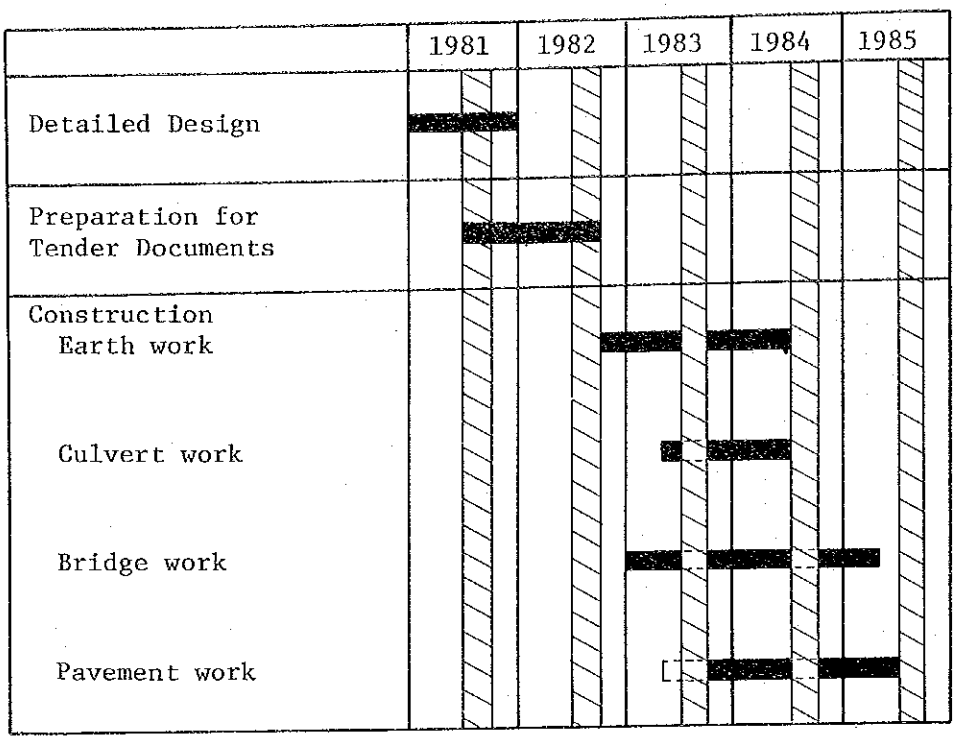
f) Mud and sand can be washed away and slopes damaged during the construction work, particularly earthwork, by heavy rains in the wet season. Effective measures to prevent such damages should be explored.

g) The finish of pavements can greatly affect the road-user benefit. Therefore, quality and work control should be accomplished by a statistical method so that the work will result in a uniform and good pavement.

h) The production of crushed stones and other construction materials can affect the progress of construction work. Therefore, so that the work will not be delayed, such materials should be produced and stocked in response to the overall work progress situation.

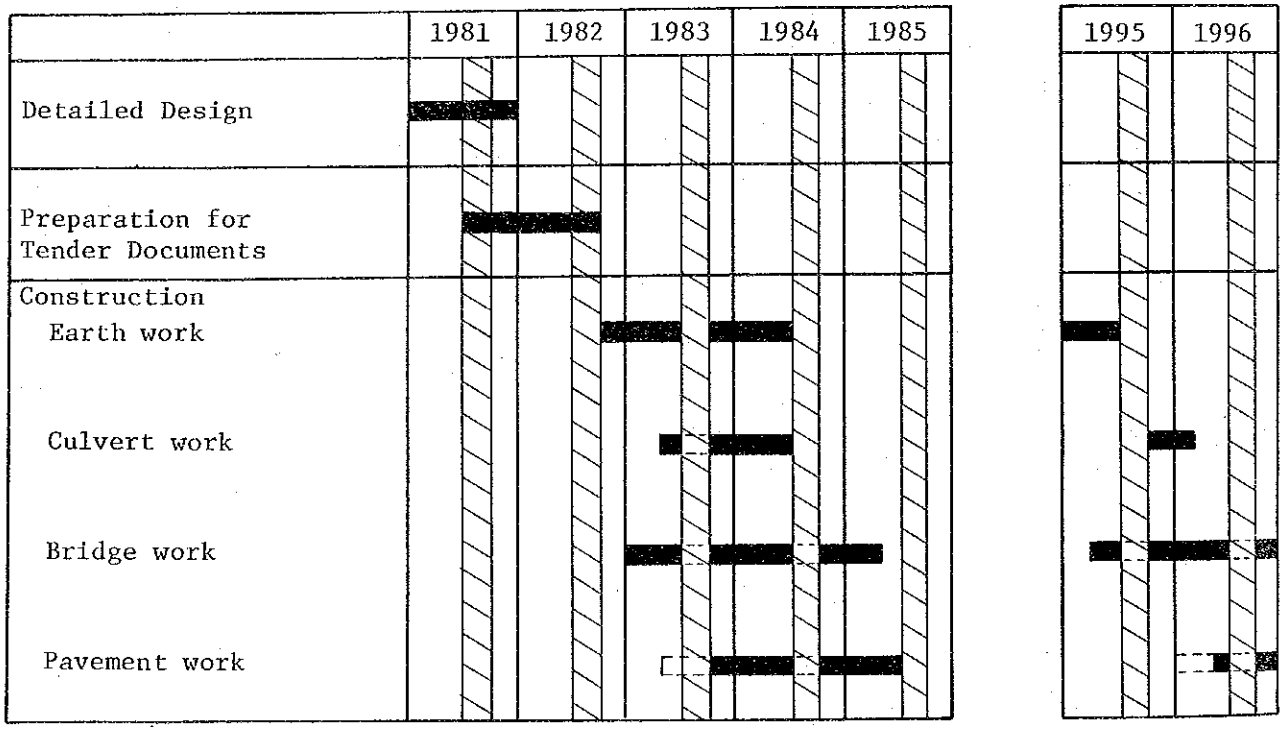
i) In case the construction work would impose any serious inconvenience on the inhabitants living near by, temporary by-passes for construction should be provided in order to conserve their present conditions for daily life.

Construction schedule for Alternatives A and B is presented in Fig. 9-1 and Fig. 9-2.



Source: JICA Mission

Fig. 9-1 Construction Schedule for Alternative Plan A



Note : ▨ Suspension period of construction because of heavy rainfall.

Fig. 9-2 Construction Schedule for Alternative Plan B

Source: JICA Mission

9.4 Construction Cost

The preliminary construction cost has been arrived at by multiplying the unit prices by major work quantities and totalling the products of multiplications. The unit costs are unit material cost, unit machinery cost, and unit labour cost, as revealed through a field survey and tabulated in the form of a breakdown table.

From the data gathered, the preliminary construction cost is expressed in terms of 1978 prices both for the local currency portion and the foreign currency portion. Total construction cost (fiscal cost) including price contingency is as listed in the table below.

Table 9-2 Preliminary Construction Cost for Alternative Plan A
(Financial Cost)

(Unit: 1,000 Leones)

	Local	Foreign	Total
Direction Construction Cost	3,874	9,561	13,435
Physical Contingency	194	478	672
Engineering & Administration	293	1,051	1,344
Price Contingency	387	956	1,343
Total	4,748	12,046	16,794

Source: JICA Mission

Table 9-3 Preliminary Construction Cost for Alternative Plan B
(Financial Cost)

(Unit: 1,000 Leones)

	Stage 1		Stage 2		Total
	Local	Foreign	Local	Foreign	
Direction Construction Cost	3,417	8,562	629	1,704	14,312
Physical Contingency	171	428	32	85	716
Engineering & Administration	259	938	49	181	1,427
Price Contingency	342	856	63	170	1,431
Total	4,189	10,784	773	2,140	17,886

Source: JICA Mission

9.5 Maintenance Cost

Constant maintenance work is indispensable in order to preserve the function of the Road at a given level. Maintenance work can be classified into routine maintenance, which is accomplished periodically each year, and remedial maintenance, which is done once every several years. Routine maintenance is accomplished by patching road-surface potholes, removing corrugations, clearing roadside trees and bushes, and cleaning culverts and side ditches. Remedial maintenance involves chiefly surface overlay or surface repair. The costs of these two types of maintenence have been estimated by the cumulative method for both Alternatives A and B for each year up to 2010.

Table 9-4 Maintenance Cost

(Unit: 1,000 Leones)

	Alternative A	Alternative B
1986	20.8	20.8
1987	20.8	20.8
1989	20.8	20.8
1990	281.6	243.3
1991	20.8	20.8
1992	20.8	20.8
1993	20.8	20.8
1994	20.8	20.8
1995	281.6	243.3
1996	20.8	20.8
1997	20.8	20.8
1998	20.8	20.8
1999	20.8	20.8
2000	281.6	281.6
2001	20.8	20.8
2002	20.8	20.8
2003	20.8	20.8
2004	20.8	20.8
2005	338.1	338.1
2006	77.3	77.3
2007	77.3	77.3
2008	77.3	77.3
2009	77.3	77.3
2010	338.1	338.1

Source: JICA Mission

CHAPTER 10

PROJECT ASSESSMENT

CHAPTER 10

PROJECT ASSESSMENT

10.1 Economic Assessment Method

The economic assessment of a project is accomplished fundamentally by quantifying and comparing the required cost of the project and the benefits to be brought about by project implementation. Important methodological terms are summarized and follows:

1) DCF Analysis

Both the cost and the benefit of a project occur over a number of years, and therefore, costs and benefits over the years must be adjusted for price fluctuations and coverted into values of the base year in order for them to be comparable. Cash flow which has been translated into values of the base year using a certain discount ratio is referred to as discounted cash flow (DCF). The base year of this Project is 1983 for the discounted cash flow analysis.

2) With-and-Without Comparison

The cost and benefit attributable to a project are the differences between those in a "with the project" situation and those in a "without the project" situation. However, a with-and-without comparison is not a comparison of the future against the present, and, therefore, project benefit is estimated on the basis of future agricultural and traffic prospects with-and-without, as discussed in Chapter 5 and 6.

Benefits to be estimated are:

a) Direct Benefit (Road User Benefit): This is the benefit which accrues to road users from reduction in running cost due to road development. However, in the case of development (induced) traffic, one half of such savings is deemed as the benefit, under the concept of consumers' surplus.

b) Development Benefit: This is the value-added of agricultural production increment brought about by road development. The value of agricultural products is usually arrived at by deducting production, storage, and transport costs from market price. When the market price is artificially set under, for instance, the price policy of the government, and when this price is substantially different from the free market price of the same product, a properly adjusted calculated price (potential price) must be used for benefit estimation. A calculated price has been used for rice and fertilizers.

3) Economic Cost

The road construction cost indicated in Chapter 9 is the financial cost required for the implementation of the Project and includes some items which are not expenses to the national economy of Sierra Leone (and therefore, the financial cost must be adjusted to an economic cost for such items as listed below).

a) Import Tax: Imported materials will represent a fair portion of the construction cost, but, from the standpoint of national economy, import taxes paid on imports are not an expense but a transfer of funds and, therefore, excluded from economic cost.

b) Reserve for Price Fluctuation: Because both the cost and the benefit are expressed in fixed 1978 prices for a DCF analysis, the reserve for price inflation is excluded from the economic cost.

c) Approximately 20% of the labour cost included in the local currency portion is wages paid to engineers and skilled labourers, the remainder being for unskilled labourers.

Because there are a large number of unemployed people (including the potentially jobless) in the Project Area (according to the officials of the Ministry of Planning), the opportunity cost of unskilled labour (potential labour wages) should be applied for the cost of unskilled labour instead of the wages actually paid. An estimation of the opportunity cost of unskilled

labour in the Project Area was impossible, however, due to the non-availability of necessary data, and therefore, two extreme cases were applied, namely, the case wherein the entire amount of wages in the labour market is considered the cost (Case 1) and the case wherein the potential labour wage is considered to be zero (Case 2).

4) Assessment Criteria

Usual indicators are used as criteria for judging the economic feasibility of a project: a) internal rate of return (I.R.R.), b) net present value (N.P.V.), and c) benefit cost ratio (B/C ratio). These indicators are defined as follows:

a) I.R.R. is the discount ratio (r) which satisfies the following equation:

$$\sum_{n} \frac{Cn}{(1 + r)^n} = \sum_{n} \frac{Bn}{(1 + r)^n}$$

b) $N.P.V. = \sum_{n} (Bn - Cn)/(1 + r)^n$

c) $B/C \text{ ratio} = \dfrac{\sum_{n} Bn \,/\, (1 + r)^n}{\sum_{n} Cn \,/\, (1 + r)^n}$

Wherein, n = nth year
Cn = Cost in nth year
Bn = Benefit in nth year
r = discount ratio

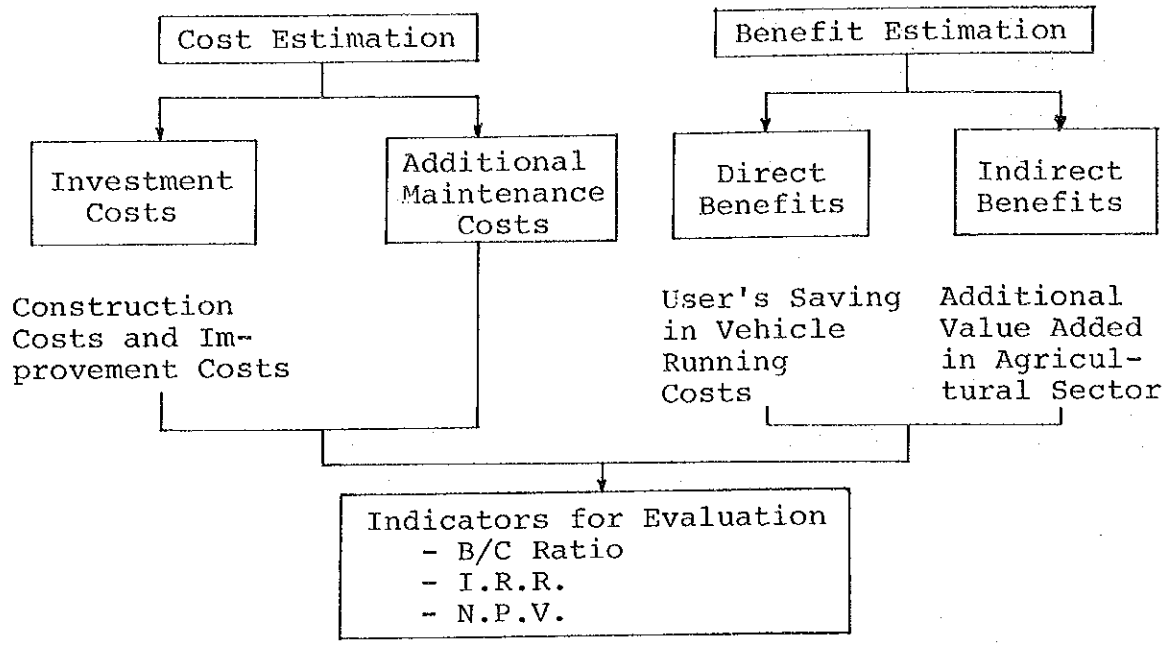


Fig. 10-1 Method of Analysis

The analysis method explained heretofore is summarized in Fig. 10-1.

10.2 Benefit Estimation

1) Direct Benefit

The direct benefit accurable from a new road construction/improvement is calculated as road user benefits from convenience of passage (running benefit) and reduction in travel time (time benefit). For the present estimation, however, no time benefit is assumed and only the running benefit is estimated.

The running benefit can be arrived at by deducting the running cost on a new road from the running cost on the existing road.

Table 10-1 Running Costs by Typical Vhichles (1978)

	Paved Surfaces			Laterite Surfaces		
	Good	Fair	Bad	Good	Fair	Bad
A) Passenger car						
Fuel	3.99	4.44	4.80	4.80	5.45	6.00
Engine oil	0.18	0.21	0.24	0.24	0.30	0.42
Tyres	1.48	1.63	1.76	1.76	1.97	2.21
Depreciation	7.78	9.66	12.31	12.31	16.97	22.40
Interest	3.15	3.48	3.88	3.88	4.58	5.04
Insurance	1.64	1.81	2.02	2.02	2.39	2.63
Maintenance	1.79	2.03	2.34	2.34	2.88	3.14
Total	20.01	23.26	27.35	27.35	34.54	41.84
B) Van, pickup*						
Fuel	4.69	5.27	5.69	5.69	6.54	7.20
Engine oil	0.23	0.27	0.31	0.31	0.38	0.52
Tyres	2.21	2.42	2.60	2.60	2.89	3.21
Depreciation	9.73	11.87	14.82	14.82	20.13	26.19
Interest	4.10	4.75	4.89	4.89	5.73	6.27
Insurance	1.87	2.04	2.25	2.25	2.64	2.89
Maintenance	2.24	2.62	2.92	2.92	3.55	3.92
Total	25.07	29.24	33.48	33.48	41.86	50.20
C) Light truck**						
Fuel	7.90	8.57	9.23	9.23	10.90	12.99
Engine oil	0.44	0.53	0.60	0.60	0.74	0.96
Tyres	4.01	4.39	4.74	4.74	5.19	5.77
Depreciation	9.72	11.87	14.92	14.92	21.27	27.34
Interest	3.81	4.23	4.77	4.77	5.38	5.97
Insurance	2.06	2.30	2.63	2.63	2.95	3.29
Maintenance	5.15	6.17	7.11	7.11	8.61	9.99
Total	33.09	38.06	44.00	44.00	55.04	66.31
D) Extra heavy vehicle						
Fuel	5.07	5.46	5.91	5.91	7.10	8.87
Engine oil	0.48	0.60	0.72	0.72	0.91	1.06
Tyres	17.53	19.27	20.88	20.88	23.07	25.41
Depreciation	15.29	18.54	22.94	22.94	33.99	47.79
Interest	4.13	4.59	5.16	5.16	6.88	8.60
Insurance	1.60	1.77	2.00	2.00	2.66	3.33
Maintenance	7.34	7.42	8.72	8.72	11.22	12.90
Total	51.44	57.65	66.33	66.33	85.83	107.96

* Based on 20% Land Rover operating cost and 80% passenger car operating cost.

** Based on 20% Land Rover operating cost and 80% Light Bus cost.

Source: Ministry of Works

Based on the values of running cost per unit of travel distance by road surface condition and by vehicle type (see Table 10-1), the running benefit per unit of travel distance to be generated by the Project Road has been calculated and shown in Table 10-2.

Included in the total benefit are 100% of running benefit in the case of normal traffic and 50% of running benefit in the case of development (induced)traffic. As for diverted traffic, 100% of the calculated running cost savings by diversion is included in the total benefit.

Table 10-2 Savings in Running Costs per Road Section

Section	(Mile) Distance	Transition*	Savings in Operating Costs per Road Section (cents/mile)			
			Car	Van, Pickups	Truck Bus	E.H.V.**
Panlap-Mabole	5.0	LF PG	14.53	16.79	21.95	34.39
Mabole-Sendugu	17.4	LF PG	14.53	16.79	21.95	34.39
Sendugu-Masaktaba	5.2	LF PG	14.53	16.79	21.95	34.39
Masaktaba-Bankabi	16.2	LF PG	14.53	16.79	21.95	34.39
Bankabi-Kenedi	4.3	LB PG	21.83	25.13	33.22	56.52
Kamalo-Kamakwie	5.0	LB PG	21.83	25.13	33.22	56.52

* The transition from road conditions is one section to those:
LF means Laterite Surface, Fair
LB means Laterite Surface, Bad
PG means Paved Surface, Good

** E.H.V.: Extra Heavy Vehicle

Source: JICA Mission

Table 10-3 Running Benefit of Diverted Traffic

Vehicle Type	Running Cost (Le) per Vehicle		Benefit
	Before Diversion	After Diversion	(Le/vehicle)
Car	19.84	17.25	2.59
Van, Pickup	24.05	21.61	2.44
Bus, Truck	31.62	28.52	3.10
E.H.V.	49.31	44.34	4.97

Note: Route before diversion: Distance of 57.45 miles on laterite surface, fair

Route after diversion : Distance of 86.20 miles on paved surface, good.

Source: JICA Mission

The results of direct benefit estimations through the foregoing process are shown in Table 10-4. The cumulative total of yearly benefits from 1985 through 2010 is Le 29.3 million, 31% of which derives from passenger flow traffic and 69% from goods flow traffic. 92% of total benefit is attributable to normal traffic (that without project implementation), 1% to diverted traffic, and 7% to development traffic.

Table 10-4 Direct Benefit

(1,000 Le)

Year	Passenger	Freight	Total
1985	362	279	641
1990	461	328	789
1995	587	388	975
2000	749	448	1,197
2005	957	502	1,459
2010	1,226	529	1,754
Total	18,448	10,762	29,210

Note : Total means the accumulated sum for a continuous period between 1985 and 2010, not simply the sum of the benefits for each year indicated in this table.

Source: JICA Mission

2) Development Benefit

The value-added ratios of agricultural products as estimated by data obtained from the Ministry of Agriculture and Natural Resources and SLPMB are summarized in Table 10-5 (and discussed in detail in Appendix). Likewise, the value-added ratios of livestock products per animal are summarized in Table 10-6.

The development benefit in the agricultural sector is calculated by multiplying the quantity increase in agricultural products due to the Project Road construction (that is, quantity with the Project less quantity without the Project) presented in Table 5-6 in Chapter 5 by the unit market prices of the products and, further, by the value-added ratios presented in Table 10-5 and 10-6. Exception should be noted for rice, which is an import-substitute commodity and whose domestic price is regulated by the Government: the potential price, which is estimated at 0.085 Leone per pound (of unhulled rice) based on entry (the national border) price is used instead of the market price.

Economic Price of Rice at the Project Site

			Le/ton
CIF at Freetown		313.00	
Clearing, handling, etc.		5.00	
Transportation cost:			
From Freetown to Makeni		30.00	
From Makeni to the Project Site*		15.00	
Marketing Cost		5.00	
Economic price of milled rice at the Project Site		258.00	Le/ton
	=	0.12	Le/lb
Economic price of paddy rice at the Project Site**		0.085	Le/lb

* Cost of 1/2 distance from Makeni to Kamakwie

** Milling rate from paddy to milled rice is 65%

Source: JICA Mission

Table 10-5 Value Added Ratio of Agricultural Production by Crops

	Under Present Yield				Under Maximum Yield			
	Yield (lbs/acre)	Gross Return (Le/acre)	Net Value Return (Le/acre)	Added Ratio(%)	Yield (lbs/acre)	Gross Return (Le/acre)	Net Value Return (Le/acre)	Added Ratio (%)
1. Swamp Rice	1,300	110.5	91.4	82.7	2,800	238.0	192.8	81.0
2. Upland Rice	1,000	85.0	70.3	82.7	1,800	153.0	118.6	77.5
3. Maize	900	54.0	49.8	92.2	1,800	108.0	83.9	77.7
4. Guinea Corn	1,500	75.0	70.8	94.4	2,300	115.0	90.9	79.0
5. Millet	1,300	78.0	64.8	72.0	2,300	138.0	42.5	70.5
6. Cassava	4,500	90.0	64.8	72.0	7,200	144.0	101.5	70.5
7. Sweet Potato	2,900	87.0	76.5	87.9	4,000	120.0	92.9	76.8
8. Groundnuts	1,000	80.0	72.1	90.1	1,700	136.0	114.3	84.0
9. Tobacco	1,100	583.0	343.0	58.8	1,300	689.0	375.2	54.4
10. Orange	9,000	180.0	116.3	92.4	13,200	264.0	221.1	83.8
11. Mango	4,400	132.0	126.0	95.4	6,600	196.0	234.3	88.8
12. Banana	2,900	116.0	101.5	87.5	4,400	176.0	137.8	78.3

Source: JICA Mission

Table 10-6 Value Added Ratio of Livestock Raising

	Weight (lbs/head)	Gross Return (Le/head)	Net Return (Le/head)	Value Added Ratio (%)
1. Cattle	440	150.0	135.0	90.0
2. Sheep	55	44.0	39.6	90.0
3. Goats	51	40.8	36.8	90.2

Source: JICA Mission

The results of development benefit estimations are shown in Table 10-7. The development benefit which may be expected in the year 2010 is 5,500,000 Leones, and the cumulative total of this benefit up through 2010 is 66,300,000 Leones. Of this total, 91% is attributable to agricultural production, and the remaining 9%, to livestock production.

Table 10-7 Value Added

	1985	1990	1995	2000	2010	Total*
Swamp Rice	2.	95.	237.	438.	769.	9006.
Upland Rice	7.	288.	657.	1118.	2105.	24903.
Maize	0.	17.	39.	65.	115.	1417.
Guinea Corn	0.	4.	9.	14.	22.	296.
Millet	0.	14.	31.	50.	81.	1067.
Cassava	0.	12.	24.	37.	55.	777.
Sweet Potato	0.	7.	15.	24.	40.	520.
Groundnuts	3.	116.	276.	490.	990.	11126.
Tobacco	2.	60.	142.	253.	470.	5389.
Orange	0.	18.	143.	177.	212.	3526.
Mango	0.	3.	26.	29.	31.	560.
Banana	0.	15.	18.	21.	22.	447.
Total	15.	649.	1617.	2717.	4911.	59034.
Cattle	14.	92.	182.	286.	540.	6456.
Sheep	1.	4.	8.	13.	24.	289.
Goats	1.	7.	13.	21.	40.	476.
Total	16.	103.	204.	319	604.	7221.

Note : Total means the accumulated sum for a continuous period between 1985 and 2010, not simply the sum of the benefit for each year indicated in this table.

Source: JICA Mission

10.3 Economic Assessment of Alternatives

1) Development Cost Adjustment

The Project Road construction cost indicated in Chapter 9 has been adjusted into economic costs of Alternatives A and B, respectively, as shown in Table 10-8. In said Table, Case 1 conceives of the economic cost as the financial cost sans import taxes and price contingency and Case 2, as the

financial cost sans import taxes, price contingency, and unskilled labour portion of the labour cost. The ratio of the economic cost to the total financial cost is about 74% in Case 1 and about 68% in Case 2 (see Appendix T for the detail of estimation).

2) Estimation Results Indicators of Evaluation

Based on the benefits and costs discussed heretofore and tabulated in Table 10-9, three indicators (internal rate of return, net present value, and benefit/cost ratio) of the value of the Project Road are estimated as shown in Table 10-10. Discount rates used in the calculation of net present value (NPV) and benefit/cost (B/C) ratio were:

Interest rate of small NDB loans	10%
Interest rate of the Commercial Bank	12%
NCDB interest rate	15%
Minimum interest on loans from private financial institutions	20%

The internal rate of return (IRR), as estimated, is from 14% to 16%, which is fairly high for a road improvement project in an agricultural area. As seen from NPV and B/C ratio shown in said Table, the breakdown point of this Project in terms of discount ratio is in the vicinity of 15% by NCDB.

Table 10-8 Economic Cost of Road Construction

(1,000 Le)

Year	Financial Cost		Economic Cost			
			Case 1		Case 2	
	A	B	A	B	A	B
1983	5,866.7	5,230.6	4,398.9	3,919.9	4,053.6	3,629.0
1984	5,463.6	4,871.2	3,995.8	3,560.5	3,650.5	3,269.6
1985	5,463.6	4,871.2	3,995.8	3,560.5	3,650.5	3,269.6
1995	-	1,601.3	-	1,347.7	-	1,242.8
1996	-	1,311.8	-	1,058.2	-	953.3
Total	16,793.9	17,886.1	12,390.5	13,446.8	11,354.6	12,364.3

Source: JICA Mission

Table 10-9 Costs and Benefits for 1983 to 2010

(1,000 Le)

Year	Benefits	Costs			
		Case 1		Case 2	
		A	B	A	B
1983	0.0	4398.9	3919.9	4053.6	3629.0
1984	0.0	3995.8	3560.5	3650.5	3269.6
1985	0.0	3995.8	2560.5	3650.5	3269.6
1986	810.4	0.0	0.0	0.0	0.0
1987	975.6	20.8	20.8	20.8	20.8
1988	1162.4	20.8	20.8	20.8	20.8
1989	1346.3	20.8	20.8	20.8	20.8
1990	1540.8	281.6	243.3	281.6	243.3
1991	1840.6	20.8	20.8	20.8	20.8
1992	2078.9	20.8	20.8	20.8	20.8
1993	2307.1	20.8	20.8	20.8	20.8
1994	2546.2	20.8	20.8	20.8	20.8
1995	2796.7	281.6	1347.7	281.6	1242.8
1996	3058.8	20.8	1058.2	20.8	953.3
1997	3333.1	20.8	20.8	20.8	20.8
1998	3620.0	20.8	20.8	20.8	20.8
1999	3920.0	20.8	20.8	20.8	20.8
2000	4233.5	281.6	281.6	281.6	281.6
2001	4529.2	20.8	20.8	20.8	20.8
2002	4836.5	20.8	20.8	20.8	20.8
2003	5156.1	20.8	20.8	20.8	20.8
2004	5488.1	20.8	20.8	20.8	20.8
2005	5833.0	338.1	338.1	338.1	338.1
2006	6103.1	77.3	77.3	77.3	77.3
2007	6381.6	77.3	77.3	77.3	77.3
2008	6668.7	77.3	77.3	77.3	77.3
2009	6964.7	77.3	77.3	77.3	77.3
2010	7269.9	338.1	338.1	338.1	338.1

Source: JICA Mission

Table 10-10 Indicators for Project Evaluation

Alternative		Case 1		Case 2	
		A	B	A	B
1.	IRR (%)	14.4	15.2	15.2	16.0
2.	NPV (mil Le)				
	D.R. 10%	7368.2	7982.2	8312.8	8841.7
	12	3321.2	4041.7	4249.9	4875.2
	15	- 691.4	141.8	215.2	942.2
	20	-4319.7	-3381.5	-3446.9	-2624.6
3.	B/C Ratio				
	D.R. 10%	1.62	1.71	1.76	1.85
	12	1.29	1.37	1.40	1.49
	15	0.94	1.01	1.02	1.10
	20	0.60	0.64	0.65	0.71

Note: D.R. = Discount Rate

Source: JICA Mission

Because the foreign currency portion, which will probably be borrowed from a foreign country, of the total cost of this Project is very large (being about 72% of the total investment fund), the NPV of this Project will be 30,000,000 Leones to 40,000,000 Leones and the Sierra Leone economy will enjoy a substantial benefit from this Project if external borrowings can be obtained in the form of a soft loan with a low interest of 3% to 5%. As for the economy of the Project, there is little difference between Alternatives A and B.

3) Sensitivity Analysis

The Project costs and benefits are quantified under a large number of assumptions, some of which are not founded on rigid facts, in the absence of statistical data and other information. Therefore, it is important that the degree by which the conclusion (the value indicators as estimated) will be affected by wrong assumptions (or the sensitivity of conclusion to assumption) be estimated.

Table 10-11 Sensitivity Analysis (in case 1 for Alternative A)

Conditions	IRR (%)	Sensitivity
1. 10% rise of construction cost	13.3	0.7
2. Population growth rate 0.1% less than expected	10.7	3.8
3. Agricultural productivity (yield) 10% less than expected	12.5	1.2
4. Propensity to ride a car of 2% (Cf. 3% for base case)	13.8	0.4
5. Assuming present road conditions are good	12.6	—

Source: JICA Mission

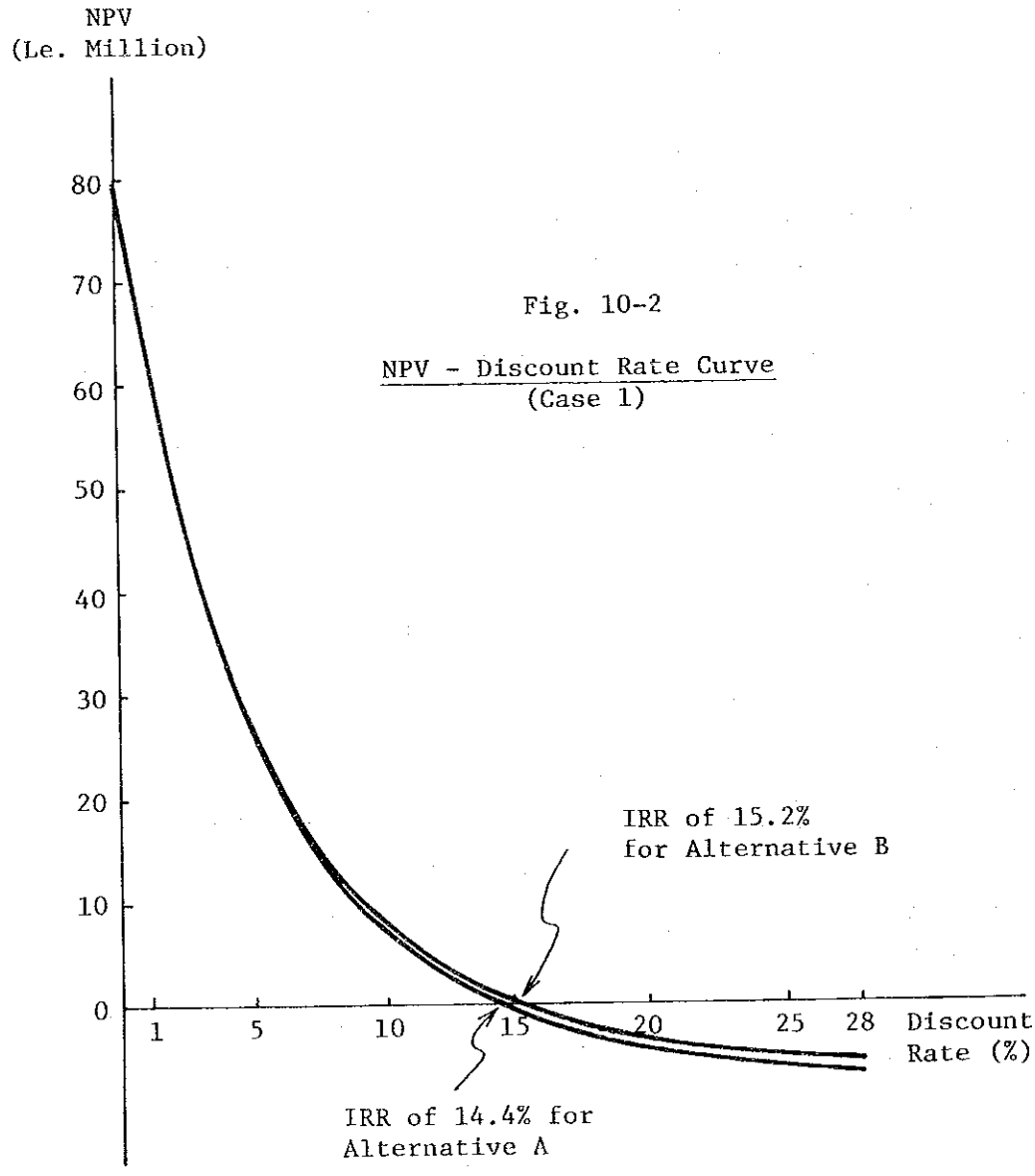


Fig. 10-2

NPV - Discount Rate Curve
(Case 1)

Only Alternative A, Case 1, is subjected to this sensitivity test because (a) the values of the indicators, as estimated, vary little from one case to another, (b) Alternative A, Case 1, which shows the lowest economy, will be the most sensitive to any changes in conditions assumed, and (c) Alternatives A and B show quite similar NPV-discount ratio curves and, therefore, will have similar sensitivities.

The IRR has been calculated under a number of conditional changes in Table 10-11. "Sensitivity" shows the rate of percentage change in IRR to percentage change in condition. A sensitivity value in excess of 1 indicates a situation where a conditional change is amplified and brings about a greater consequential change.

In Table 10-11, IRR is most sensitive to population change. Therefore, the level of minimum population change which will damage the economy of this Project is estimated (this is called "risk analysis"). If, for instance, the minimum IRR to make the development project feasible is 10%, the population increase rate must be at least 1.2% (average per annum) without the Project and 18.8% with the Project. Likewise, when the actual construction cost exceeds the estimate by 23% or more, the IRR is pushed down to below 10%. Also, if an IRR of 5% or more becomes acceptable due to a soft loan, this Project will remain feasible even with a price increase of 64%. Likewise, with a 2.5% IRR, an 82% price increase will still be tolerable.

10.4 Overall Assessment

The economic assessment of this Road Construction Project shows favourable results, as seen above. In addition, Project implementation will bring about incalculable benefits, including:

a) The discouragement of population outflow from villages to urban areas, thereby mitigating population pressures in cities. The effect of this Project in this area is roughly estimated at a cumulative total up through the year 2010 of 36,000 people.

b) The improvement of rural inhabitants' income, thereby minimizing existing regional gaps.

c) The intensification of regional integration between Sierra Leone and Guinea.

d) The improved maintenance of security in remote areas.

In this view, a very early implementation of this Project will be most desirable to Sierra Leone.

A choice between Alternatives A and B based on economic analysis is difficult (with little difference in economy between the two). If sufficient funds can be obtained for early investment, Alternative A should be selected for an earlier accomplishment of high-standard road services.

The difference between Alternatives A and B in the amount of investment during 1983 to 1985 is chiefly because of the Mabole Bridge construction timing, which is delayed until the second stage (1995 - 1996) under Alternative B. Although the load-bearing capacity of the existing bridge over the Mabole is estimated at about 10 tons, safety may not be fully guaranteed when larger and heavier trucks and equipment will be used in Sierra Leone in the future, in view of the age of the existing bridge (the date of construction is unknown), and the bridge should be closed to heavy vehicles through appropriate traffic control measures. This situation adds to the desirability of Alternative A over Alternative B.

ANNEX

ANNEX

JICA Survey Team Activities

1. Scope of Works in Sierra Leone
2. Principal Members of Survey Works
3. Negotiating Authorities
4. The Table of Progression
5. Mobilization Records as of 25th November, 1979

JICA SURVEY TEAM ACTIVITIES

After arriving in Freetown on August 24, 1979, a meeting were held between the JICA Survey Team and the Ministry of Works' staffs on August 25 at which the contents of the Inception Report were discussed together with survey schedules. The members of the Survey Team and the counterpart staffs assigned by the Ministry of Works went to the project site for understanding present conditions, and for collecting preliminary information and data at the end of August. After the short field reconnaissance, the Survey Team came back to Freetown and the preparation work for the survey was commenced from August 31 to split into different groups. The detailed site investigation and the data collction for both economic and engineering fields were carried out from September 1st up to November 22 at the project site and also in Freetown. The Interim Report was prepared by the JICA Team, which was submitted to the Ministry of Works on November 27. Major survey works carried out by the JICA Survey Team from August 22 to December 4 are listed below.

1. Scope of Works in Sierra Leone

(A) Infrastructure Survey Works (Directory)

- (1) Socio-Economic Survey
- (2) Agro-Economic Survey
- (3) Transportation Survey
  - a. Economic Survey
  - b. Traffic Survey

(4) Engineering Survey
   a. Reconnaissance of Existing Condition
   b. Decision Designation of the Re-aligned Portion
   c. Topographic Survey
   d. Meteo-Hydrological Survey
   e. Soil and Material Investigation
   f. Investigation of the Mabole River and Bridge

(5) Confirmation of Design Standard

(6) Data Collection
   a. Socio-Economic Problem
   b. Agro-Economic Problem
   c. Transportation Economic Problem
   d. Engineering (Civil Engineering)
      i. Criteria
      ii. Cost estimation
      iii. Specification on construction
      iv. Maintenance regulation
      v. Material on construction
      vi. Topographic map and survey control
      vii. National road net works
   e. Authorities Organization Charts

(7) Preparation of Alternative Plan

(8) Preliminary Study on the Development Possibility and Traffic Forecast

(9) Preliminary Evaluation on the Alternative Plan

(10) Observation on Existing Condition and Situation for the Economic Survey and Civil Engineering

(11) The Interim Reports

(B) Administration (Indirectly)

(1) Courtesy Call on the Authorities Concerned

(2) Project Control (Ministry of Works)

(3) Business Control (Head Office in Japan)

(4) General Affairs Control
   a. Payment and Expectation
   b. Accounting and Verification

c. Japanese Unit and Safety
d. Local Unit and Safety
e. Security
f. Vehicle Dispatching and Maintenance
g. Communication and Reference from Makeni to Freetown
h. Purchasing and Repairing of equipments
i. Fuel Supply and Emergency Measuring
j. Water Supply and Emergency Measuring
k. Electric Power Supply and Emergency Measuring
l. Travel Schedule and Reservation
m. Clearing, Packing and Send Off

(5) The Memorial Document on the Co-operation Works

(6) Japanese Advisory Committee and Embassy

(7) The Written Estimate for the Alternation Contract

2. Principal Members of Survey Works

(A) Counterpart Experts from the Ministry of Works

(1)	Professional Head	Mr. C.O. Boston-Mammah
(2)	Deputy Resident Engineer	Mr. N. Nat Vandy
(3)	Senior Exective Engineer	Mr. A.M. Iscandari
(4)	Area Engineer, Makeni	Mr. I.M. Kebbay
(5)	Exective Engineer	Mr. Adewole Thomas Davies
(6)	Soil Engineer	Mr. K.D. Kotoko-Smith
(7)	Surveyor, Draughtman	Mr. Ojumiri Cole
(8)	Surveyor, Draughtman	Mr. H.B. Martyn
(9)	Surveyor, Draughtman	Mr. S.A. Kamara
(10)	Instructor of Roads Training School	Mr. Anthony J.B. Lansana

(B) The Member of Infrastructure Survey Team

Advisors

(1) Mr. Minoru Enomoto
(2) Mr. Kenichi Ogasawara
(3) Mr. Takenori Harigai
(4) Mr. Fumio Takahashi

Team Members

(1)	Team Leader	Mr. Khoichi Fukurono
(2)	Agro-Economist	Mr. Masasaburo Shimamura
(3)	Transportation Economist	Mr. Tetsuo Wakui
(4)	Traffic Planner	Mr. Isamu Asakura
(5)	Senior Highway Engineer	Mr. Akira Manda
(6)	Highway Engineer	Mr. Toshifumi Tanaka

3. Negotiating Authorities

(A) The Ministry of Works

Minister of Works	Hon. Edward J. Kargbo
Permanent Secretary	Mr. Julius D. Sandy
Professional Head	Mr. C.O. Boston-Mammah
Deputy Professional Head	Mr. S.E. Taylor-Lewis
Chief Engineer, Highway	Mr. A.S. Jones-Dove
Deputy Resident Engineer	Mr. Nat Vandy
Senior Exective Engineer	Mr. A.M. Iscandari
Area Engineer - Makeni	Mr. I.M. Kebbay

(B) Other Relevant Authorities and Organizations

The Ministry of External Affairs
The Ministry of Transport and Communication
The Ministry of Agriculture and Natural Resources
The Ministry of Trade and Industry

The Ministry of Foreign Affaris

The Ministry of Lands and Survey

The Ministry of Labour

The Ministry of Development

The Ministry of Agriculture and Forestry

Headquarter of Police Officer

Cooperative for American Relief Everywhere (CARE)

Port Authorities

Sierra Leone Produce Marketing Board (SLPMB)

Northern Province Integrated Agricultural Development Project

Bombali District Headquarter

Northern Area Office, the Ministry of Agriculture and Forestry

The Ministry of the Interior, Northern Province

District Police, Northern Province

James International Overland, Cargo Transport Co.

African Transport Co.

Edward Davis and Associates Consulting Engineers

Techsult and Co., Ltd. Consulting Engineers

THE TABLE OF PROGRESSION

25th NOVEMBER 1979

SCOPE OF WORKS	AUG.	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
A. INFRASTRUCTURE SURVEY WORKS:					
1. SOCIO-ECONOMIC SURVEY					
2. AGRO-ECONOMIC SURVEY					
3. TRANSPORTATION SURVEY					
4. ENGINEERING SURVEY					
5. DATA COLLECTION					
6. OBSERVATION, EXISTING CONDITIONS					
7 THE INTERIM REPORTS					
B. ADMINISTRATION:					
1. COURTESY CALL ON THE AUTHORITIES					
2. PROJECT CONTROLS (SIERRA LEONE)					
3. BUSINESS CONTROL (JAPAN)					
4. GENERAL AFFAIRS CONTROLS					
5. OFFICIAL TRAVEL					

5. Mobilization Records (105 days)

Description	Man	Day	Qty	Remarks
A. Infrastructure Survey Works				
(1) Socio-economic survey	3	21	63	
(2) Agro-economic survey	3	41	123	
(3) Transportation survey	3	33	99	Economic O-D traffic
(4) Engineering survey	26	7	182	
a. Reconnaissance	8	7	56	53 miles
b. Decision designation	2	2	4	Ditto
c. Topographic survey	38	46	1,748	20 miles
d. Meteo-hydrological survey	26	13	338	180 points
e. Soil and material	18	40	720	15 materials
f. Invest. Moboleh bridge	4	4	16	L=100m
(5) Data collection	7	58	406	Freetown, Makeni
(6) Concept Planning	6	22	132	
(7) Observation	6	16	96	
(8) The interim reports	9	42	378	
Total	159	352	4,361	
B. Administration				
(1) Courtesy call	10	16	160	
(2) Project control	1	52	52	
(3) Business control	1	26	26	
(4) General affairs control	3	111	333	
(5) The memorial document	1	12	12	
(6) Japanese adv. committee	6	16	96	
(7) The written estimate	1	2	2	
Total	23	235	681	
C. Vehicle and Instrument				
(1) Vehicle	6 cars	89	534	19,000 miles
(2) Instrument	2 sets	46	9s	geod. survey
(3) Soil laboratory	1 set	37	37	Lab. testing