## 8.7 ANNUAL MAINTENANCE COST

The following items must be taken into account in the estimation of the annual bridge maintenance cost:

a) Rubber Expansion Joint

In the maintenance of rubber expansion joint, it is necessary to change the whole every 10 years. The unit cost of renewing per meter of rubber expansion joint is estimated at 30,000 K.Shs. per meter.

b) Resurfacing of Bridge

The resurfacing of the carriageway of the bridge surface is to be carried out once every 10 years. The unit cost of resurfacing per square meter of carriageway with a thickness of 5 cm is estimated at 200 K.Shs. per sq.m.

c) Road Marking, Lighting, Kerb, Clearing and Others

The unit maintenance cost of the above is estimated at 30,000 K.Shs. per year per bridge.

The bridge maintenance cost is shown in Table 8–14, but the approach road maintenance cost is not estimated for the reason that it is the same as the maintenance cost of the existing road.

**Table 8–14 ANNUAL MAINTENANCE COST OF BRIDGE**

(In 1,000 K.Shs, 1983 price)

| Year | | Cost | Year | | Cost | Year | | Cost |
|---|---|---|---|---|---|---|---|---|
| 1 | A.D. 1990 | 30 | 9 | A.D. 1998 | 30 | 17 | A.D. 2006 | 30 |
| 2 | 1991 | 30 | 10 | 1999 | 1,614 | 18 | 2007 | 30 |
| 3 | 1992 | 30 | 11 | 2000 | 30 | 19 | 2008 | 30 |
| 4 | 1993 | 30 | 12 | 2001 | 30 | 20 | 2009 | 1,614 |
| 5 | 1994 | 30 | 13 | 2002 | 30 | 21 | 2010 | 30 |
| 6 | 1995 | 30 | 14 | 2003 | 30 | 22 | 2011 | 30 |
| 7 | 1996 | 30 | 15 | 2004 | 30 | 23 | 2013 | 30 |
| 8 | 1997 | 30 | 16 | 2005 | 30 | 24 | 2014 | 30 |

# 9. ECONOMIC ANALYSIS

The details are reported in Technical Report (Economic Analysis).

## 9.1 GENERAL

### 9.1.1 Standpoints and Objectives

a) The objective of this economic analysis on this project is to analyze the investment efficiency of this project from the Kenyan national economic and social standpoints.

b) It is essential for calculation of the efficiency to asess economic benefit and economic cost of this project taking account of objectives and characteristics of the project and characteristics of the related area including Kilifi Town where the project would be visualized.

c) There are following decision criteria led from the national economic and social standpoints, on which the project should or should not be adopted.

i) The investment efficiency of the project which is expressed numerically.

ii) Social and economic impacts of the project on the related area.

### 9.1.2 Premises

(1) Base Case for This Economic Analysis

To arrive at the tangible estimate of benefit (benefit expressed in monetary term) and cost of this project, a number of scenarios may be introduced with different premises or assumptions made.

The scenario for the base case analysis has the following premises:

| | | |
|---|---|---|
| a) | Construction period | : Six (6) years, 1984 ∿ 1989 |
| b) | Project cost | : 359,608,000 K.shs, at 1983 constant price |
| c) | Project fund | : From abroad |
| d) | Future traffic volumes | : Described in Chapter 2 |
| e) | Level of ferry service | : Maintaining at the existing level |

(2) Premises for Estimation of Economic Benefit and Economic Cost

a) Economic cost

The economic cost of this project consists purely of project cost and maintenance cost as no additional occurence cost is required to realise this project. A number of bridge alternative designs have been thoroughly scrutinized in this feasibility study. Subsequently, five (5) sets of project casting have been estimated. However, alternative (3)–1 is chosen as the base for this economic analysis. Alternative (3)–1 has an estimated total cost of 359,608,000 K.shs at 1983 constant price.

b) Projection of traffic volumes

The traffic projection study in Chapter 2 is adopted in this analysis. The summary of the projection is shown in Table 9–1.

**Table 9–1 PROJECTION OF TRAFFIC VOLUMES**

(Unit: Vehicle/Day)

| Year | Total | Normal Traffic Volumes | Induced Traffic Volumes |
|---|---|---|---|
| 1983 | 983 | 983 | |
| 1990 | 1,814 | 1,396 | 418 |
| 2000 | 3,037 | 2,337 | 700 |
| 2010 | 5,038 | 3,877 | 1,161 |

c) Level of ferry service

Even if the project will not be realized (Without Project case), the existing transportation service by ferry should be preserved in future.

In the Without Project case, it become a vital factor what level of the ferry service have to be assumed. The level of the service would consequently affect the expansion plan of the ferry facilities.

In this analysis, it is assumed that the existing level will be kept in future. The service level at present is as follows.

| | |
|---|---|
| Time required to cross the cleek by ferry | 8 minutes |
| Average waiting time of vehicle for ferry service | 8 minutes |
| Total | 16 minutes |

### 9.1.3 Scope of Economic Analysis

(1) Scope

As shown in Fig. 9–1, the scope of this economic analysis consits of the following issues.

a) Analysis of the economic benefit of this project and the selection of tangible benefit.

b) Estimation and projection of fundamental data for the calculation of the economic benefit and cost.

i) Traffic volumes

ii) Conversion factors for values at market price base into the ones at economic price base

iii) Induced added value coefficients

iv) Time values

v) Vehicle operating costs

vi) Travel time saved by the project.

c) Calculation of the tangible benefit and the economic cost of the project

d) Calculation of indices of the investment efficiency, including those for sensitivity analysis.

e) Conclusions

(2) Tangible Benefit and Intangible Benefit

As shown in Fig. 9–2, this project will bring twelve (12) kinds of benefit to the Kenya national and the related local area's economics and societies.

a) Among the benefit, the following kinds of benefit are selected as the tangible items for the project.

i) Benefit of increasing Kenyan GDP through the demand for domestic goods and services for the construction of the facilities.

ii) Benefit due to avoided cost for expansion and maintenance of the ferry facilities.

iii) Benefit due to travel time savings

iv) Benefit due to induced traffic

v) Benefit due to vehicle operating costs savings.

b) On the other hand, the following are the kinds of intangible benefit generated by this project.

i) Benefit due to on increase of employment

ii) Technology transfer

iii) Benefit due to an improvement of transport service

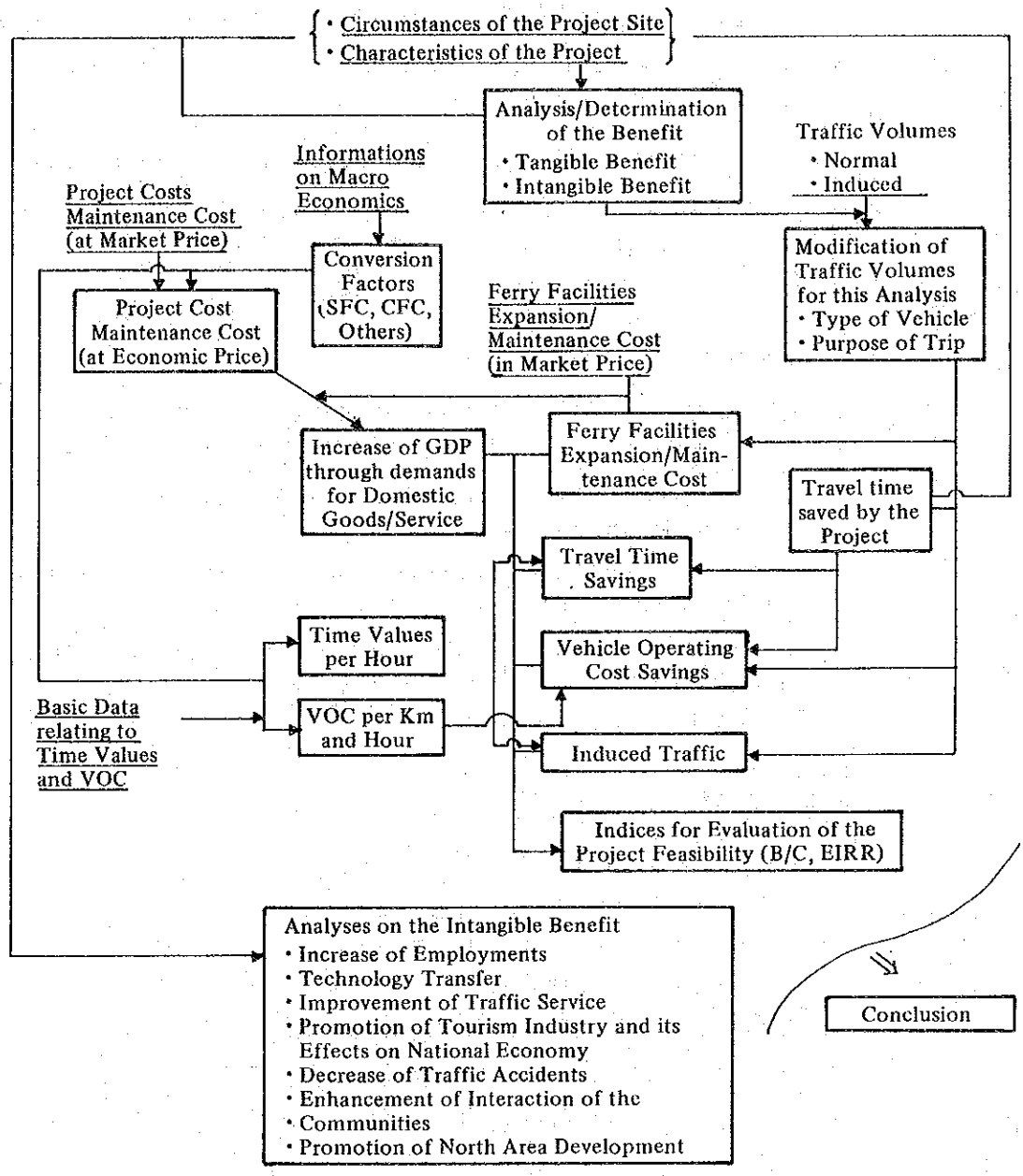
iv) Benefit due to a decrease of traffic accidents

v) Promotion of tourism and its effects on the Kenyan national economy.

vi) Benefit in enhancing the interaction between the local communities

vii) Promotion of the North Area Development

c) In the calculation of the tangible benefit, it should be noted that benefit enjoyed by the tourist, personal and other vehicles are excluded. In such a case, results of the benefit analysis can be regarded as conservative.




Legend
Underlined Item : Basic Data for the Economic Analysis
Boxed Item : Item to be analysed or projected
Boxed Item with thick line : Benefit and Cost of the Project

**Fig. 9–1 SCOPE OF ECONOMIC ANALYSIS**

| Source / Period | Function of the Bridge | Expenditure for the Bridge/Road Construction | Technology to Construct the Bridge |
|---|---|---|---|
| Construction | | D, IT<br>Increase of Employment<br>ID, T<br>Increase of GDP | D, IT<br>Technology Transfer |
| Usage | D, T<br>Ferry Facilities Expansion/Maintenance Costs (Available Cost)<br>D, T<br>Travel Time Saving<br>ID, T<br>Induced Traffic<br>D, T<br>Vehicle Operating Cost Saving<br>D, IT<br>Improvement of Traffic Service including Making Vehicle Large<br>ID, IT<br>Promotion of Tourism Industry and Economic Effects of the Industry<br>ID, IT<br>Enhancement of Interaction of the Community through e.g Increase of Ability to Cope with Emergencies<br>ID, IT<br>Decrease of Traffic Accidents<br>ID, IT<br>Promotion of the North Area Development<br>・Agriculture ・Forestry | | |

Fig. 9–2 BENEFIT OF KILIFI BRIDGE PROJECT

### 9.1.4 Evaluation of Base Price and Conversion Factors

(1) Evaluation of the Base Price

a) Values at economic price (its concept is similar to the International/ National Bordes Price) are used in the evaluation of the project. Economic benefit and economic cost are expressed in this price.

The values at economic price can be calculated by subtracting the values which depend on the Kenyan social and economic system from the values at market price.

b) Values of goods and services imported for the project are equal to the values at economic price due to the assumption that import duty and other taxes are not imposed on them.

On the other hand, the values of the domestic goods and services demanded by the project and the economic benefit of the project are converted to economic price base from its market price base.

(2) Conversion Factors for the Evaluation of Base Price

To convert the values of the domestic goods and services and the fundamental data for the calculation of the economic benefit which are expressed previously at market price to the ones at economic price, the following conversion factors are used as shown in Table 9–2.

**Table 9–2 CONVERSION FACTORS FOR VALUES AT DOMESTIC MARKET PRICE**

| | |
|---|---|
| Standard Conversion Factor (SCF) | 0.920 |
| Conversion Factor for Consumers' Goods (CFC) | 0.935 |
| Conversion Factor for Unskilled Labor Cost | 0.935 |
| Conversion Factor for Local Materials Cost | 0.834 |
| Conversion Factor for Local Fuel Cost | 0.167 |
| Conversion Factor for Local Other Cost | 0.552 |
| Conversion Factor for Land Acquisition Cost | 0.920 |
| Conversion Factor for Compensation | 0.920 |
| Conversion Factor for Local Engineering Fee | 0.935 |
| Conversion Factor for Local Part of Contengency | 0.727 |

### 9.1.5 Indices of Investment Efficiency and Evaluation Period

a) The investment efficiency of the project calculated from the tangible benefit and the economic cost is expressed in the form of a Benefit Cost Ratio (B/C) or an Economic Internal Rate of Return (EIRR).

b) The evaluation period of the project is thirty (30) years from 1984 to 2013.

## 9.2 ECONOMIC COST OF PROJECT

### 9.2.1 Economic Cost

The Project cost at market price and at economic price is shown in Table 9–3.

**Table 9–3 PROJECT COST**

(Unit: 1,000 K.shs, 1983 Constant/Economic Price)

| At \ Year | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | Total |
|---|---|---|---|---|---|---|---|
| Financial Price | 6,382 | 12,767 | 50,967 | 90,171 | 119,230 | 80,091 | 359,608 |
| Economic Price | 6,275 | 12,552 | 48,288 | 84,020 | 113,088 | 75,548 | 339,771 |
| Economic Cost/Financial Cost | | | | | | | 94.5 |

The above project cost consists of the bridge and approach road construction costs, engineering fee, land acquisition cost, compensation and contingency.

### 9.2.2 Maintenance Cost

The maintenance cost including the operating cost for the facilities constructed by the project is shown in Table 9–4.

**Table 9–4 ANNUAL MAINTENANCE COST**

(Unit: 1,000 K.shs, 1983 Constant/Economic Price)

| Year \ at | Financial Price | Economic Price |
|---|---|---|
| 1990 ∿ 1998 | 30 | 25 |
| 1999 | 1,614 | 1,346 |
| 2000 ∿ 2008 | 30 | 25 |
| 2009 | 1,614 | 1,346 |
| 2010 ∿ 2013 | 30 | 25 |

### 9.2.3 Salvage Values of Facilities at the End of 2013

Calculated with the following assumptions, the total salvage value of the facilities at economic price at end of 2013 is 175,733,000 K.shs at 1983 Economic price.

a) Depreciation period : Bridge 50 Years
Road 50 Years

b) Beginning year of the depreciation : 1990 (i.e. first year of beginning in use of the facilities)

c) None depreciable assests : Land acquisition cost and compensation

d) Method of depreciation : Straight line depreciation

## 9.3 TANGIBLE BENEFIT OF PROJECT

### 9.3.1 Benefit of Increasing Kenya GDP through Demand for Domestic Goods and Services in Construction Stage of Facilities

(1) Mechanism in Generating the Benefit

Construction of the project facilities would induce additional activities in a number of related industries in supplying domestic goods and services demanded by the project. These industries will bring in incremental added values (i.e. GDP) as a consequence.

(2) Computation of the Benefit

$$B = \sum_{i=1}^{4} X_i \times V_i$$

B: Value of the benefit at economic price

$X_i$: Domestic materials, fuel cost, labor cost and other costs at economic price

$V_i$: Induced added value coefficients of the related industries

(3) Value of the Benefit

**Table 9–5 BENEFIT OF INCREASING KENYA GDP**

(Unit: 1,000 K.shs, 1983 Economic Price)

| Year | Economic Price |
|---|---|
| 1984 | 1,077 |
| 1985 | 2,154 |
| 1986 | 5,740 |
| 1987 | 14,067 |
| 1988 | 13,022 |
| 1989 | 10,456 |

### 9.3.2 Benefit Due to Avoided Cost of Expansion and Maintenance of the Ferry Facilities

(1) Reason why the expansion and maintenance costs are evaluated as the economic benefit of the project.

It is the social need of the coastal area for the existing level of ferry service to be maintained in future by expansion and maintenance of the ferry facili-

ties so as to match the growth of traffic volumes. To respond to the need, the Kenya Government must finance the costs, whatever the condition of the financial balance of the business will become. However, when the bridge is constructed and is in use, the existing ferry transportation will fall into disuse and no further costs will be incurred for the construction and maintenance of the ferry facilities. Therefore, these avoided costs may be regarded as benefits accruing from the bridge.

(2) Computation of This Benefit

The methodology is shown in Fig. 9–3.

The value of the benefit is calculated with th e following factors.

a) Traffic volumes (in P.C.U.) at 50th highest hour in a year.

b) Maximum practical carrying capacities (in P.C.U.) per hour of the ferries in that year.

The year when expansion of the ferry facilities will be needed and the capacities to be expanded will be apparent as a result of the two factors. The expansion and maintenance costs are calculated by multiplying.

c) Unit price of purchase/construction of the each facility by the capacities to be expanded, and

d) Maintenance cost estimated on the plan of the expansion.

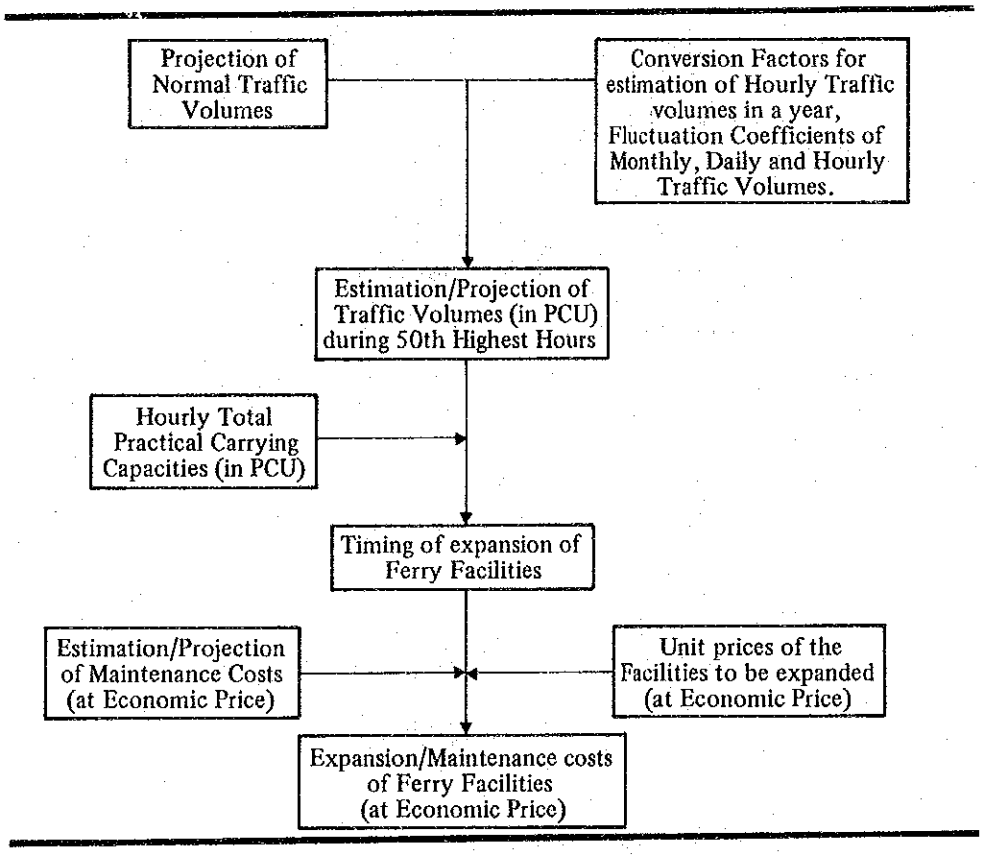



**Fig. 9–3 METHOD OF CALCULATION OF BENEFITS FOR FERRY FACILITIES**

(3) Expansion and Maintenance Costs of the Ferry Facilities

a) Unit prices of purchase/construction of the ferry facilities.

Unit prices of purchase/construction of the facilities at market and economic prices estimated with informations on Kilifi creek and the design of the facilities are shown in Table 9–6.

**Table 9–6 PURCHASE/CONSTRUCTION COSTS OF FERRY FACILITIES**

(Unit: 1,000 K shs, 1983 Constant/Economic Price)

| Facility / at | Ferry (1 Ferry) | Jetty and Approach Road (1 Pair) | Dock (1 Unit) | Office Building (1 Block) |
|---|---|---|---|---|
| Market Price | 15,000 | 27,396 | | 238 |
| Economic Price | 15,000 | 25,417 | 15,886 | 214 |

b) The year when the expansion of the ferry facilities will be needed and the capacities to be expanded. The expansion plan of the ferry facilities are shown in Table 9–7.

**Table 9–7 EXPANSION PLAN OF FERRY FACILITIES – (PURCHASE/CONSTRUCTION BASE) –**

| Facilities / Year | | Jetty and Approach Raod | Dock | Office Building |
|---|---|---|---|---|
| 1986 | 1 (Likoni Type) | 1 Pair | | |
| 1997 | 3 (ditto) | | 1 Unit | 1 Block |
| 2001 | 2 (ditto) | | | |
| 2007 | 1 (ditto) | 1 Pair | | |

c) Maintenance cost of the ferry facilities

It is estimated on the plan of the expansion and the related data.

d) Expansion and maintenance costs

Expansion and maintenance costs of the ferry facilities which will occur in Without Project case are shown in Table 9–8.

Table 9–8 PROJECT OF PURCHASE/CONSTRUCTION COST AND OPERATING MAINTENANCE COST OF FERRY FACILITIES – (SUMMARY TABLE) –

(Unit: 1,000 K.shs, 1983 Economic Price)

| Year | Total | Purchase or Construction Cost | Operating and Maintenance Cost | Personnel Cost | General Administration Cost | Fuel and Engine Oil | Maintenance Costs of Ferry | Maintenance Costs of Jetty/and Approach Road/Deck |
|---|---|---|---|---|---|---|---|---|
| 1983 | 3,438 | | 3,438 | 1,221 | 122 | 1,542 | 553 | |
| 1986 | 44,386 | 40,417 | 3,969 | 1,221 | 122 | 1,983 | 641 | |
| 1987 | 5,571 | | 5,571 | 1,221 | 122 | 2,700 | 784 | 744 |
| 1990 | 6,024 | | 6,025 | 1,221 | 122 | 3,077 | 860 | 744 |
| 1997 | 68,178 | 61,100 | 7,078 | 1,221 | 122 | 3,956 | 1,035 | 744 |
| 1998 | 3,895 | | 8,895 | 2,443 | 244 | 4,146 | 1,318 | 744 |
| 2000 | 9,724 | | 9,724 | 2,443 | 244 | 4,837 | 1,456 | 744 |
| 2001 | 40,139 | 30,000 | 10,139 | 2,443 | 244 | 5,183 | 1,525 | 744 |
| 2007 | 52,353 | 40,417 | 11,936 | 2,443 | 244 | 6,680 | 1,825 | 744 |
| 2008 | 12,956 | | 12,956 | 2,443 | 244 | 6,910 | 1,871 | 1,488 |
| 2010 | 13,874 | | 13,874 | 2,443 | 244 | 7,675 | 2,024 | 1,488 |
| 2013 | Δ 10,293 | Δ 25,543 [1)] | 15,250 | 2,443 | 244 | 8,822 | 2,253 | 1,488 |

1) Salvage Values

### 9.3.3 Benefit Due to Travel Time Savings

(1) Kilifi Creek Crossing Time Saved by the Project

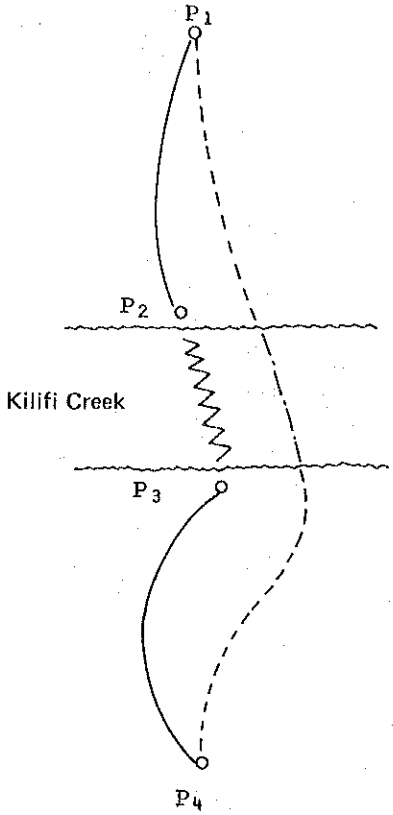
a) Time for a vehicle to cross the Kilifi creek in Without Project case and With Project case.

Fig. 9–4 shows the kinds of time which are required for a vehicle to pass the planned area (the length of the planned road is 4,116 m and the bridge will be installed at center of the area) in both cases.

Waiting time of a vehicle for the ferry service consists of following components.

i) Average waiting time in the case where hourly traffic do not exceed the hourly maximum practical transportation capacities of the ferries.

ii) Additional waiting times in case of any excess traffic.




| Without Project Case | With Project Case |
|---|---|
| * Vehicle running time between the points $P_1$ and $P_2$<br>* Vehicle waiting time for ferry service at the point $P_2$<br>* Time to cross the creek by ferry (between the points $P_2$ and $P_3$)<br>* Waiting Times of Matatu and Bus for their passengers<br>* Vehicle running time between the points $P_3$ and $P_4$ | * Vehicle running time between the points $P_1$ and $P_4$ |

Legend

—— : Existing Roads
---- : Planned Roads
∿∿ : Ferry Transportation
—·— : Planned Bridge

**Fig. 9–4 TIMES CONSUMED TO PASS THROUGH PLANNED AREA IN THIS PROJECT**

b) Saving on Kilifi creek crossing time for a vehicle

| | | |
|---|---|---|
| i) | Without Project case | 21'24"* + α |
| | Running time on the existing road | 5'24" |
| | Average waiting time for ferry service | 8' + α |
| | Time required to cross the creek by ferry | 8' |
| ii) | With Project case | 3'11" |
| | i) – ii) | 18'13"* + α |

Note * : As to Matatu and bus, 3 minutes in waiting time for their passengers are added to the time described above.

c) Annual hours saved by the project, when passing through the planned area

i) Formula

$$H_{it} = T_i \times V_{it}$$

$H_{it}$ : Annual hours saved by type of vehicles
$T_i$ : Kilifi creek crossing time for a vehicle per trip by type of vehicle
i : Type of vehicle
t : Year (1990 ∿ 2013)

ii) Tourist, personal and other vehicles are not included in the traffic volumes described above.

The annual hours saved by the project are shown in Table 9–9.

**Table 9–9 ANNUAL HOURS SAVED BY THE PROJECT, WHEN PASSING THROUGH THE PROJECT PLANNED AREA**

(Unit: Hours/Year)

| Type of vehicle / Year | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus | (for Reference) Tourism | |
|---|---|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | | | |
| (1989) | 25,814 | 18,059 | 29,550 | 29,027 | 13,406 | 17,033 | 6,315 | 10,747 |
| 1990 | 27,033 | 18,833 | 31,357 | 30,467 | 14,071 | 17,807 | 6,869 | 11,522 |
| 1991 | 28,362 | 19,166 | 32,776 | 31,907 | 14,735 | 18,711 | 7,423 | 12,741 |
| 1992 | 29,692 | 19,742 | 34,711 | 33,458 | 15,510 | 19,485 | 7,977 | 13,627 |
| 1993 | 31,132 | 20,718 | 36,647 | 23,899 | 16,175 | 20,517 | 8,753 | 14,845 |
| 1994 | 32,572 | 21,493 | 38,583 | 36,672 | 17,062 | 21,421 | 9,417 | 16,065 |
| 1995 | 34,117 | 22,047 | 40,635 | 38,437 | 17,834 | 22,449 | 10,301 | 17,501 |
| 1996 | 35,563 | 23,045 | 43,357 | 39,995 | 18,724 | 23,485 | 11,189 | 19,056 |
| 1997 | 37,336 | 23,709 | 45,809 | 42,100 | 19,610 | 24,646 | 12,076 | 20,607 |
| 1998 | 39,108 | 24,595 | 48,519 | 44,094 | 20,496 | 25,808 | 13,184 | 22,380 |
| 1999 | 40,993 | 25,481 | 51,229 | 46,199 | 21,493 | 26,969 | 14,292 | 24,152 |
| 2000 | 42,860 | 26,259 | 54,036 | 48,437 | 22,513 | 28,264 | 15,393 | 26,246 |
| 2001 | 44,825 | 27,271 | 47,072 | 50,658 | 23,609 | 29,587 | 16,713 | 28,333 |
| 2002 | 46,864 | 27,587 | 60,261 | 52,736 | 24,595 | 30,840 | 12,169 | 30,910 |
| 2003 | 42,969 | 28,251 | 63,617 | 55,173 | 25,592 | 32,131 | 19,610 | 33,458 |
| 2004 | 51,074 | 28,916 | 67,229 | 57,500 | 26,811 | 33,679 | 21,383 | 36,449 |
| 2005 | 53,400 | 29,360 | 70,972 | 60,048 | 28,030 | 35,098 | 23,266 | 39,441 |
| 2006 | 55,696 | 30,025 | 74,918 | 62,711 | 29,261 | 36,643 | 25,135 | 42,862 |
| 2007 | 58,202 | 30,492 | 78,598 | 65,596 | 30,697 | 38,351 | 27,220 | 46,363 |
| 2008 | 60,515 | 31,059 | 83,373 | 68,739 | 32,076 | 40,056 | 29,595 | 50,245 |
| 2009 | 63,261 | 31,464 | 88,393 | 71,570 | 33,237 | 41,209 | 32,129 | 54,620 |
| 2010 | 65,903 | 31,803 | 93,390 | 74,668 | 34,679 | 43,611 | 34,889 | 59,260 |
| 2011 | 68,499 | 32,254 | 98,823 | 78,030 | 36,282 | 45,547 | 37,846 | 64,183 |
| 2012 | 71,292 | 32,417 | 104,556 | 81,675 | 38,140 | 47,666 | 41,007 | 69,633 |
| 2013 | 74,301 | 32,895 | 110,842 | 86,137 | 40,381 | 50,025 | 44,513 | 75,740 |

(2) Time values

a) Definition of time value

i) In this economic analysis, time value is defined as follows.

Time value of vehicle users is the value which they would otherwise gain by utilizing the time for other purposes.

On the other hand, the time value of goods transported by vehicles is the value which the goods would depreciate propotionately to the transportation time. In other words, it is the value the goods would gain due to the time saved in the transportation process.

ii) However, cost for operating a vehicle, including the crew cost of commercial vehicle has a different concept from that of the time value of an ordinary passenger.

b) Passenger numbers and their time values

The numbers of riders or passenger is calculated by subtracting the numbers of crew from an average numbers of users of a vehicle.

**Table 9–10 PASSENGER NUMBERS**

(Unit: Persons/Vehicle)

| | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus |
|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | |
| A | 2.97 | 2.50 | 15.98 | 2.70 | 2.44 | 35.78 |
| B | – | – | 2.0 | 2.70 | 2.44 | 2.0 |
| C=A–B | 2.97 | 2.50 | 13.98 | – | – | 33.78 |

A : Average Number of Persons who use a Vehicle, estimated on our Traffic Survey at Kilifi March 1933.

B : Number of Drives, Conductor and Assistant

C : Number of Persons whose Time Values are evaluated in Economic Analysis.

c) Time values by type of vehicle in 1983

The time values in 1983 estimated on the incomes of the vehicle users, waiting charge of heavy goods vehicle and the numbers of riders whose time values are evaluated are shown in Table 9–11.

**Table 9–11 TIME VALUES PER HOUR IN 1983**

(Unit: K.shs/Hour/Vehicle)

| Type of Vehicle / at | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus |
|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | |
| Market Price | 94 | 84 | 99 | | | 240 |
| Economic Price | 88 | 79 | 93 | 40 | 150 | 224 |

d) Projection of Time Value

i) Time values of Car, Light Goods Vehicle (both of owner and Matatu) and Bus will increase by 2.5% every year on the assumption of the growth of incomes of the vehicle users in future.

ii) On the other hand, the future time values of Medium and Heavy Goods Vehicles are assumed to remain at the present level.

(3) Benefit due to Time Savings

The values of the benefit calculated with

a) Annual hours saved by the project

b) Time values

the benefit for the time savings are shown in Table 9–12.

**Table 9–12 BENEFIT DUE TO TIME SAVINGS**

(Unit: 1,000 K.shs, 1983 Economic Price)

| Type of Vehicle / Year | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus | Total |
|---|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | | |
| (1989) | 2,633 | 1,661 | 3,191 | 1,161 | 2,011 | 4,429 | 15,086 |
| 1990 | 2,838 | 1,770 | 3,481 | 1,219 | 2,111 | 4,737 | 16,156 |
| 1991 | 3,035 | 1,840 | 3,704 | 1,276 | 2,210 | 5,108 | 17,173 |
| 1992 | 3,266 | 1,954 | 4,026 | 1,338 | 2,327 | 5,456 | 18,367 |
| 1993 | 3,539 | 2,093 | 4,361 | 1,396 | 2,426 | 5,888 | 19,703 |
| 1994 | 3,746 | 2,235 | 4,707 | 1,467 | 2,559 | 6,298 | 21,012 |
| 1995 | 4,026 | 2,337 | 5,079 | 1,537 | 2,675 | 6,757 | 22,411 |
| 1996 | 4,303 | 2,512 | 5,550 | 1,600 | 2,809 | 7,257 | 24,031 |
| 1997 | 4,630 | 2,655 | 6,001 | 1,684 | 2,942 | 7,813 | 25,725 |
| 1998 | 4,967 | 2,804 | 6,550 | 1,764 | 3,074 | 8,362 | 27,521 |
| 1999 | 5,370 | 2,981 | 7,070 | 1,848 | 3,224 | 8,981 | 29,474 |
| 2000 | 5,743 | 3,151 | 7,673 | 1,937 | 3,377 | 9,638 | 31,519 |
| 2001 | 6,141 | 3,354 | 8,275 | 2,026 | 3,541 | 10,326 | 33,663 |
| 2002 | 6,608 | 3,476 | 8,979 | 2,109 | 3,689 | 11,041 | 35,902 |
| 2003 | 7,052 | 3,644 | 9,670 | 2,207 | 3,939 | 11,792 | 38,304 |
| 2004 | 7,559 | 3,846 | 10,488 | 2,300 | 4,022 | 12,663 | 40,878 |
| 2005 | 8,063 | 3,993 | 11,356 | 2,402 | 4,205 | 13,548 | 43,567 |
| 2006 | 8,633 | 4,173 | 12,287 | 2,508 | 4,389 | 14,474 | 46,464 |
| 2007 | 9,254 | 4,360 | 13,204 | 2,624 | 4,605 | 15,532 | 49,579 |
| 2008 | 9,864 | 4,535 | 14,340 | 2,750 | 4,811 | 16,603 | 52,923 |
| 2009 | 10,565 | 4,725 | 15,646 | 2,863 | 4,986 | 17,811 | 56,591 |
| 2010 | 11,269 | 4,898 | 16,904 | 3,987 | 5,202 | 19,014 | 60,274 |
| 2011 | 12,056 | 5,096 | 18,381 | 3,121 | 5,442 | 20,360 | 64,456 |
| 2012 | 12,833 | 5,252 | 19,866 | 3,267 | 5,721 | 21,831 | 68,770 |
| 2013 | 13,716 | 5,461 | 21,614 | 3,445 | 6,057 | 23,512 | 73,835 |

### 9.3.4 Benefit due to Induced Traffic

(1) Mechanism of Generation of Induced Traffic ana Values of the Benefit per Induced Trip.

a) Without doubt, the Kilifi Bridge and its approach road will improve the level of accessibility and save a great deal of productive economic travel time. These impacts will induce directly or indirectly through its contribution to the economic growth in the related area, a generation of additional traffic.

b) With this assertion, the time is halved and applied to the computation of the benefit per induced trip.

(2) Computation of This Benefit

$$B_{it} = \frac{1}{2} TV_{it} \times V^{I}_{it} \times 365 \times TC_i$$

B : Values of this benefit (annual)
TV : Time Value
$V^I$ : Daily induced traffic volumes (Vehicles/day) excluding the traffic volumes for tourism personal and others.
TC : Kilifi Creek crossing time for a vehicle saved by the project (Hour/vehicle)
Car, LG (Owner), MG, HG : 0.3036 H/Vehicle
LG (Matatu), Bus : 0.3536 H/Vehicle

The benefit for the induced traffic are shown in Table 9–13.

**Table 9–13 BENEFIT DUE TO INDUCED TRAFFIC**

(Unit: 1,000 K.shs, 1983 Economic Price)

| | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus | Total |
|---|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | | |
| (1989) | 396 | 250 | 480 | 177 | 299 | 634 | 2,256 |
| 1990 | 425 | 266 | 522 | 182 | 316 | 704 | 2,415 |
| 1991 | 457 | 277 | 562 | 191 | 332 | 758 | 2,577 |
| 1992 | 488 | 302 | 610 | 199 | 349 | 813 | 2,761 |
| 1993 | 526 | 325 | 661 | 208 | 366 | 870 | 2,956 |
| 1994 | 561 | 334 | 713 | 219 | 382 | 930 | 3,139 |
| 1995 | 608 | 364 | 773 | 230 | 399 | 1,010 | 3,384 |
| 1996 | 650 | 374 | 834 | 242 | 416 | 1,077 | 3,593 |
| 1997 | 694 | 403 | 904 | 253 | 440 | 1,166 | 3,860 |
| 1998 | 746 | 417 | 983 | 264 | 449 | 1,239 | 4,093 |
| 1999 | 806 | 454 | 1,061 | 277 | 474 | 1,332 | 4,404 |
| 2000 | 861 | 472 | 1,154 | 290 | 499 | 1,430 | 4,706 |
| 2001 | 919 | 504 | 1,246 | 301 | 524 | 1,531 | 5,025 |
| 2002 | 1,000 | 524 | 1,350 | 315 | 549 | 1,640 | 5,378 |
| 2003 | 1,061 | 550 | 1,453 | 328 | 565 | 1,753 | 5,710 |
| 2004 | 1,140 | 575 | 1,578 | 344 | 598 | 1,867 | 6,103 |
| 2005 | 1,213 | 603 | 1,707 | 359 | 623 | 2,018 | 6,523 |
| 2006 | 1,305 | 632 | 1,851 | 355 | 648 | 2,141 | 6,932 |
| 2007 | 1,392 | 658 | 1,999 | 392 | 682 | 2,300 | 7,423 |
| 2008 | 1,499 | 680 | 2,162 | 410 | 706 | 2,487 | 7,894 |
| 2009 | 1,592 | 706 | 2,349 | 428 | 740 | 2,639 | 8,454 |
| 2010 | 1,696 | 734 | 2,540 | 445 | 773 | 2,614 | 8,802 |
| 2011 | 1,814 | 762 | 2,757 | 465 | 806 | 3,000 | 9,604 |
| 2012 | 1,945 | 772 | 2,972 | 488 | 839 | 3,222 | 10,238 |
| 2013 | 2,060 | 782 | 3,221 | 508 | 881 | 3,458 | 10,910 |

### 9.3.5 Benefit Due to Vahicle Operating Cost Savings

(1) Contents of the Benefit

a) This project will bring following two kinds of benefit on saving of the vehicle operating.

i) Fuel, repair and other costs savings due to the improvement on the approach road and the bridge.

ii) Kilifi creek crossing time savings

b) Vehicle running condition will be much improved on the planned road than on the existing road. However, the planned road is longer than the existing road, with the result that more fuel, repair and other costs are incurred.

c) On the other hand, the 'Kilifi creek crossing time saved by the proje is a kind of benefit of the project in the sense that the saved time can be used for other purposes.

(2) Computation of This Benefit

a) Increase of vehicle operating variable cost (minus benefit)

i) Vehicles of all types and trip purposes in the normal traffic are evaluated, because all vehicles that use the planned road will be not able to avoid the minus benefit.

ii) Formula

$$B_{it} = V_{it} \times 365 \times VOCV_i$$

B : Values of the benefit
V : Daily traffic volumes
VOCV: Marginal increase of vehicle operating variable cost to run through the planned area.

b) Increasing opportunity for other trips (plus benefit)

i) There are three components of fundamental information for the calculation of this benefit.

* Kilifi creek crossing time saved by the project.
* Vehicle operating cost depending on vehicle owning period (Vehicle operating fixed cost in the VOC).
* Realization ratio of the saved time being used for other trips.

ii) Traffic volumes for tourism, personal and albers are as well excluded from the volumes to be evaluated in the benefit.

iii) Time values of medium and heavy goods

Vehicles are estimated on their vehicles operating fixed costs. Traffic volumes of the two types of vehicle are rules out in line with the above estimation.

iv) In this analysis, realization ratio of the asaved time being used for other trips is set at 0.5.

v) Formula

$$B_{it} = ½ \times VOCF_i \times T_{it}$$

B : Values of the benefit
VOCF : Vehicle operating fixed cost per operating hour (K.shs/Hour/Vehicle)
T : Annual hours saved by the project, when passing through the project planned area
i : Types of vehicle
t : Year (1990 ∿ 2013)

(3) Vehicle Operating Cost

a) Contents of vehicle operating cost

Taking into account the characteristics and the accuracy of the related information collected at Mombasa, sub-classifications and definitions of the vehicle operating costs in this analysis are as follows:

i) Variable costs . . . . costs being proportional to the running Kms.

* Fuel
* Engine Oil
* Replacement/Repair costs . . . . Replacement costs for tyres and parts and personal costs for the repair are included in these costs.

ii) Fixed costs . . . . costs generated with ownership of a vehicle.

* Depreciation
* Interest costs . . . . costs from a loan for the purchase of a new car.
* Crews' costs . . . . wages of driver, conductor and assistant of commercial vehicle.
* General administration costs . . . costs of cmmercial vehicle. Tax/ duty e.g. licence fee is not included.
* Insurance costs.

b) Vehicle operating cost per kilo meters

The result unit vehicle operating costs are shown in Table 9–14 and Table 9–15.

**Table 9–14 VEHICLE OPERATING COST (VOC) PER KILO METERS – (ECONOMIC PRICE BASE) –**

(Unit: K.shs/Km, 1983 Economic Price)

| Type of Vehicle / VOC Item | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus |
|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | |
| Variable Costs | 0.901 | 1.397 | 1.397 | 2.284 | 4.189 | 2.533 |
| Fuel | 0.686 | 0.979 | 0.979 | 1.640 | 3.055 | 1.603 |
| Engine Oil | 0.024 | 0.037 | 0.037 | 0.067 | 0.084 | 0.078 |
| Repair | 0.191 | 0.381 | 0.381 | 0.577 | 1.050 | 0.852 |
| Fixed Costs | 0.884 | 1.454 | 2.048 | 2.907 | 10.479 | 7.786 |
| Depreciation | 0.411 | 0.958 | 0.958 | 0.695 | 3.489 | 4.559 |
| Interest Costs | 0.258 | 0.271 | 0.271 | 0.442 | 2.070 | 0.966 |
| Crew Costs | | | 0.594 | 0.818 | 1.164 | 0.701 |
| General Administration | | | | 0.584 | 1.168 | 0.758 |
| Insurance Costs | 0.215 | 0.225 | 0.225 | 0.368 | 2.588 | 0.802 |
| Total | 1.785 | 2.851 | 3.445 | 5.191 | 14.668 | 10.319 |

c) Vehicle operating fixed cost per operating hour [1)]

**Table 9–15 FIXED COST IN VOC PER OPERATING HOUR – (ECONOMIC PRICE BASE) –**

(Unit: K.shs/Hour, 1983 Economic Price)

| Type of Vehicle / Fixed Costs Item | Car | Light Goods Vehicle | | Medium Goods Vehicle | Heavy Goods Vehicle | Bus |
|---|---|---|---|---|---|---|
| | | Owner | Matatu | | | |
| Description | 6.58 | 26.09 | 26.09 | 18.35 | 74.54 | 48.70 |
| Interest Costs | 4.13 | 7.37 | 7.37 | 11.79 | 44.23 | 41.28 |
| Crew Costs [2)] | | | 16.18 | 21.85 | 24.86 | 29.97 |
| General Administration | | | | 12.48 | 24.96 | 32.39 |
| Insurance Costs | 3.44 | 6.14 | 6.14 | 9.83 | 55.29 | 34.40 |
| Total | 14.15 | 39.60 | 55.78 | 74.50 | 223.88 | 186.74 |

Note 1) : It is assumed that annual operating hours are 1872 hours uniformly for all types of vehicle.

2) : The following number of crews is assumed.

| | |
|---|---|
| Matatu | 2.0 persons |
| MG | 2.7 persons |
| MG | 2.44 persons |
| Bus | 2.0 persons |

(4) Benefit due to Total Vehicle Operation Cost

Benefit due to vehicle operating cost savings the estimated benefit of the total vehicle operating costs are shown in Table 9–16.

Table 9–16 BENEFIT DUE TO VEHICLE OPERATING COST SAVINGS
– (ECONOMIC PRICE BASE) –

(Unit: 1,000 K.shs, 1983 Economic Price)

| Year | Benefit due to vehicle Operating Cost Savings | VOC Proportionate to Running Kms Saved by the Project | VOC Depending on Vehicle Owning Period Saved by the Project |
|---|---|---|---|
| (1989) | 2,703 | Δ 252 | 2,955 |
| 1990 | 2,836 | Δ 266 | 3,102 |
| 1991 | 2,962 | Δ 279 | 3,241 |
| 1992 | 3,094 | Δ 294 | 3,388 |
| 1993 | 3,260 | Δ 308 | 3,568 |
| 1994 | 3,406 | Δ 326 | 3,732 |
| 1995 | 3,566 | Δ 341 | 3,907 |
| 1996 | 3,752 | Δ 358 | 4,110 |
| 1997 | 3,934 | Δ 378 | 4,312 |
| 1998 | 4,129 | Δ 398 | 4,527 |
| 1999 | 4,318 | Δ 419 | 4,737 |
| 2000 | 4,530 | Δ 439 | 4,969 |
| 2001 | 4,750 | Δ 462 | 5,212 |
| 2002 | 4,956 | Δ 483 | 5,439 |
| 2003 | 5,172 | Δ 507 | 5,679 |
| 2004 | 5,421 | Δ 533 | 5,954 |
| 2005 | 5,656 | Δ 559 | 6,215 |
| 2006 | 5,912 | Δ 586 | 6,498 |
| 2007 | 6,174 | Δ 615 | 6,789 |
| 2008 | 6,461 | Δ 647 | 7,108 |
| 2009 | 6,760 | Δ 680 | 7,440 |
| 2010 | 7,060 | Δ 713 | 7,773 |
| 2011 | 7,385 | Δ 748 | 8,133 |
| 2012 | 7,725 | Δ 788 | 8,513 |
| 2013 | 8,113 | Δ 826 | 8,939 |

### 9.3.6 Summary of Tangible Benefits

Five kinds of tangible benefit described above are summarized as shown in Table 9–17.

a) During the most active period of the construction, 1987 ∿ 1989, annual value of 13 to 17 million K.shs (1983 economic price) of the benefit due to demand for domestic goods and services can be expected.

b) In 1990, that is, the year of beginning in use of the bridge, total values of the tangible benefit will be 27.4 million K.shs, and in 2010, 90.0 million K.shs, about 3.3 times of that in 1990. The magnification is higher than 2.8 times in the traffic volumes during the same period. It is mainly brought about by the time values which will annually grow at 2.5% in future.

## Table 9-17 ECONOMIC BENEFITS OF THE PROJECT

(Unit: 1,000 K.shs, 1983 Economic Price)

| Benefit / Year | Increasing GDP through Domestic Demand | Ferry Facilities Expansion and Maintenance Costs | Time Saving | Induced Traffic | Vehicle Operating Cost Saving | VOC Propertionate to Running kms | VOC Depending on Vehicle Owning Period | Total Benefit |
|---|---|---|---|---|---|---|---|---|
| 1984 | 1,077 | | | | | | | 1,077 |
| 1985 | 2,154 | | | | | | | 2,154 |
| 1986 | 5,740 | | | | | | | 5,740 |
| 1987 | 14,067 | | | | | | | 14,067 |
| 1988 | 13,022 | | | | | | | 13,022 |
| 1989 | 10,456 | | | | | | | 10,456 |
| 1990 | | 6,024 | 16,156 | 2,415 | 2,836 | Δ 266 | 3,102 | 27,431 |
| 1991 | | 6,174 | 17,173 | 2,577 | 2,962 | Δ 279 | 3,241 | 28,886 |
| 1992 | | 6,325 | 18,367 | 2,761 | 3,094 | Δ 294 | 3,388 | 30,547 |
| 1993 | | 6,476 | 19,703 | 2,956 | 3,260 | Δ 308 | 3,568 | 32,395 |
| 1994 | | 6,626 | 21,012 | 3,139 | 3,406 | Δ 326 | 3,732 | 34,183 |
| 1995 | | 6,777 | 22,411 | 3,384 | 3,566 | Δ 341 | 3,907 | 36,138 |
| 1996 | | 6,927 | 24,031 | 3,593 | 3,752 | Δ 358 | 4,110 | 38,303 |
| 1997 | | 68,178 | 25,725 | 3,860 | 3,934 | Δ 378 | 4,312 | 101,697 |
| 1998 | | 8,895 | 27,521 | 4,093 | 4,129 | Δ 398 | 4,527 | 44,638 |
| 1999 | | 9,310 | 29,474 | 4,404 | 4,318 | Δ 419 | 4,737 | 47,506 |
| 2000 | | 9,724 | 31,519 | 4,706 | 4,530 | Δ 439 | 4,969 | 50,479 |
| 2001 | | 40,139 | 33,663 | 5,025 | 4,750 | Δ 462 | 5,212 | 83,577 |
| 2002 | | 10,553 | 35,902 | 5,378 | 4,956 | Δ 483 | 5,439 | 56,789 |
| 2003 | | 10,829 | 38,304 | 5,710 | 5,172 | Δ 507 | 5,679 | 60,015 |
| 2004 | | 11,106 | 40,878 | 6,103 | 5,921 | Δ 533 | 5,954 | 63,508 |
| 2005 | | 11,382 | 43,567 | 6,523 | 5,656 | Δ 449 | 6,215 | 67,128 |
| 2006 | | 11,658 | 46,464 | 6,932 | 5,912 | Δ 586 | 6,498 | 70,966 |
| 2007 | | 52,353 | 49,579 | 7,423 | 6,174 | Δ 615 | 6,789 | 115,529 |
| 2008 | | 12,956 | 52,923 | 7,894 | 6,461 | Δ 647 | 7,108 | 80,234 |
| 2009 | | 13,414 | 56,591 | 8,454 | 6,760 | Δ 620 | 7,440 | 25,219 |
| 2010 | | 13,879 | 60,274 | 8,802 | 7,060 | Δ 713 | 7,773 | 90,010 |
| 2011 | | 14,332 | 64,456 | 9,604 | 7,385 | Δ 748 | 8,133 | 95,777 |
| 2012 | | 14,792 | 68,770 | 10,238 | 7,725 | Δ 788 | 8,513 | 101,525 |
| 2013 | | 15,250 | 73,835 | 10,910 | 8,113 | Δ 826 | 8,939 | 108,108 |
| S.V | | Δ 25,543 | | | | | | Δ 25,543 |

c) Values of the benefit due to time savings is the largest among the five (5) components of the tangible benefit. It occupies a share of sixty (60) to seventy (70) percent of the total values of the tangible benefit.

Values of the benefit due to avoided cost for expansion/maintenance of the ferry facilities, the benefit due to induced traffic and the benefit due to vehicle operating cost savings follows those of the benefit due to time savings in sequence.

## 9.4 INVESTMENT EFFICIENCY OF PROJECT

### 9.4.1 Basic Case

Induces which express the investment efficiency are as follows.

(1) Net Present Values (NPV)*

| | |
|---|---|
| a) Economic Cost | 200,331,000 K.shs. |
| b) Economic Benefit | 217,882,000 K.shs. |
| c) NPV (b) – a)) | 17,551,000 K.shs. |

Note * : • in 1983
• Annual discount rate 12%

(2) Benefit Cost Ratio (B/C) 1.088

(3) Economic Internal Rate of Return (EIRR) 12.89%

### 9.4.2 Sensitivity Analysis

(1) Factors for Sensitivity Analysis

The following factors which would exert a great influence on the investment efficiency of this project are,

a) Project cost

b) Construction period

On the cost factor, two alternatives, a 10% increase and a 10% decrease from the project cost of the base case are suggested for the analysis. Two variation on the construction period, a longer (seven (7) years, 1984 ∿ 1990) and a shorter (five (5) years, 1984 ∿ 1988) periods proposed for the analysis.

(2) B/C and EIRR of Each Case

The B/Cs and EIRRs of the nine (9) cases, created by a combination of the three variations of the two factors are shown in Table 9–18.

Table 9–18 BENEFIT COST RATIOS AND ECONOMIC INTERNAL RATES OF RETURN OF THE PROJECT, CHANGING THE PROJECT COST AND THE CONSTRUCTION PERIOD

i) Benefit Cost ratios

(Unit: %)

| Project Cost / Construction Period | 10% Increase | Base | 10% Decrease |
|---|---|---|---|
| One Year Prolongation (7 years) | 0.982 | 1.065 | 1.168 |
| Base (6 years) | 1.001 | 1.088 | 1.192 |
| One Year Shortening (5 years) | 1.008 | 1.094 | 1.200 |

ii) Economic Internal Rate of Return

(Unit: %)

| Project Cost / Construction Period | 10% Increase | Base | 10% Decrease |
|---|---|---|---|
| One Year Prolongation (7 years) | 11.81 | 12.65 | 13.62 |
| Base (6 years) | 12.01 | 12.89 | 14.22 |
| One Year Shortening (5 years) | 12.08 | 12.97 | 14.02 |

### 9.4.3 Summary of Investment Efficiency of Project

From the results of the economic indices analysis on the Base Case and the sensitivity analysis, the following facts are emphasized.

a) Even in the most unfavorable circumstance with a 10% increase of the project cost accompanied by a one year prolongation of the construction period, the EIRR is 11.87%.

This rate is near to the 12% of capital poortunity cost in Kenya.

Accordingly, it can be confidently said that this project is a highly feasible project, judging it on the very tangible benefit even through it is only a part of the total economic benefit of this project.

b) Naturally, the greater the project cost, the lower the investment efficiency and vice versa. Likewise the longer the construction period, the lower the efficiency and vice versa.

c) An increase/decrease of the project cost exerts a higher influence on the efficiency than prolongation/shortening of the construction period.

It follows that more careful attention should be paid to the control over the project cost than over the construction period at the construction stage.

## 9.5 INTANGIBLE BENEFIT

The kinds of intangible benefit, benefit whose value can not be measured in monetary term are as follows.

a) Benefit due to an increase of employment

b) Technology transfer

c) Benefit due to an improvement of transport service

d) Benefit due to a decrease in traffic accidents

e) Promotion of tourism and its effects on the Kenya national economy

f) Benefit in enhancing the interaction between the local communities

g) Promotion of the north area development

These kinds of the benefit are by no means independent of each other. In fact, many of these kinds of benefit are closely interrelated, as taken up in next section.

### 9.5.1 Improvement in Transport Functions and Its Impacts on Local Community

a) With the implementation of this project, transport services will be greatly improved in comparison with the existing ferry transportation.

i) Improved hourly traffic performance

ii) Removal of restriction on heavy goods vehicle with weight exceeding 15 tons.

iii) Improved safety

iv) Improved stability

b) An improvement on the safety in crossing the Kilifi creek is resulted as the planned road has a better surface and an uniform gradient than the existing road.

This improved safety level would help to reduce the number of traffic accidents.

c) All traffic will be able to pass over the creek at any time when the bridge and its approach road are operational. With this efficient link, the Kilifi Country Authority would be able and ready at all time to respond to any emergency.

d) The bridge would function as an important communication linkage, enabling the people on both sides of the creek to interact freely; bringing the residents to converge and utilise the facilities at the center where the Kilifi country capital is located.

e) The road connection of the creek and the resultant improvement of transport services would inevitably contribute considerably to the promotion of the north area development.

Specific plans for the development of tourist, agriculture, livestock and forest industries are currently being implemented.

### 9.5.2 Increase of Employments at Construction Stage

a) A few hundred jobs are expected to be created once the project gets underway.

**Table 9–19 LOCAL EMPLOYEES FOR CONSTRUCTION OF FACILITIES**

(Unit: Man-Days, Persons)

| | Man-Days Employed [1)] | Number of Local Employees[2)] |
|---|---|---|
| 1986 | 26,033 | 113 |
| 1987 | 45,000 | 196 |
| 1988 | 40,583 | 176 |
| 1989 | 48,400 | 210 |

1): Assumption that Daily Wage of local Employee is 60K.shs.
2): Assumption that Working days in a year are 230 days.

As shown in Table 9–19 from 1987 to 1989, approximately 200 employees will be hired through the years.

b) This creation of local employment will not only give the area an economic stimulus through their consumption expenditure but also contribute to social stability.

### 9.5.3 Technology Transfer

Many kinds of foreign technologies will be applied to construct the cable stayed concrete girder bridge proposed by this study. These technologies will be transferred to Kenyans.

### 9.5.4 Promotion of Tourist Industry and Its Effects on Kenya National Economy

(1) Tourist Traffic

Although the tourist traffic is not evaluated in the benefit assessment, a projection for this traffic volume is shown below.

**Table 9–20 PROJECTION OF TOURIST TRAFFIC**

(Unit: Vehicles/Day)

| Year | A For Tourism | B Total Traffic Volumes | A/B (%) |
|---|---|---|---|
| 1983 | 94 | 983 | 9.6 |
| 1990 | 216 | 1,314 | 11.9 |
| 2000 | 489 | 3,037 | 16.1 |
| 2010 | 1,106 | 5,038 | 22.0 |

(2) Economic and Social Benefit Brought by Tourism

a) Inclusion of the tourist traffic volume into the benefit assessment would undaubtedly further increase the overall tangible benefit.

b) A growth in tourist industry would mean more foreign currency for Kenya, and ultimately leads to a growth of the GDP.

c) A boom in the tourist industry would encourage investments for tourist facilities such as hotels and other services, thus bringing more prosperity to the local community.

Tourist traffic comprises up to 9.6% of the total traffic volume in 1983 and 22.0% in the year 2010. The inclusion of such a relatively high proportion of traffic volume bring about a further increase of 9–10% and 17–18% of the total tangible benefit in 1990 and 2010 respectively.

This increase would in turn raise the EIRR to more than 12.89%.

Tourists expenditure has the same multiplier effect as the increase of consumption for domestic goods. Tourist demand for services and goods would altimately bring about more economic benefits, contributing to the growth of GDP.

**Table 9–21 BENEFIT OF INCREASING KENYA GDP THROUGH TOURIST EXPENDITURE**

(Unit: 1,000 K.shs, 1983 Economic Price)

| Year | A<br>The Benefit | B<br>Total Tangible Benefits | A/B<br>(%) |
|---|---|---|---|
| 1990 | 9,355 | 27,431 | 34.1 |
| 2000 | 21,133 | 50,479 | 41.9 |
| 2010 | 47,873 | 90,010 | 53.2 |

## 9.6 CONCLUSIONS OF ECONOMIC ANALYSIS

a) This project is judged to be a firmly beneficial project from the interests of the Kenya national economy and society. It has been shown that even in the most unfavorable circumstance, that is, a 10% increase of the project cost combined with one year prolongation of the construction period from the base case, its EIRR is 11.81% which is near to the 12% of capital opportunity cost in Kenya.

b) Moreover, huge amount f the various intangible benefit on the national and local economies and societies can be expected from this project. These kinds of intangible benefit do in fact play a role to warrant the acceptance of this project.

c) Organisations related to this project so far should pull their efforts together in helping the realization of this project.

As the project gets underway, full attentions should be paid to keep the project cost within the cost boundary suggested and to shorten the construction period if possible.

# 10. FINANCIAL ANALYSIS AND IMPLEMENTATION PROGRAM

The details are reported in Technical Report (Financial Analysis).

## 10.1 GENERAL

### 10.1.1 Standpoints and Objectives

a) Realization and implementation of a project would impose many kinds of impacts on the business entity through the life span of the project. The objective of this financial analysis is to analyze the likely monetary impact on the business entity.

b) The following issues should in particular be analyzed in the event where the foreign currencies will be raised from abroad.

i) What will be the situation of the balance of revenue and expenditures of the business in the future?

ii) How will the project cost and the maintenance cost be raised? What is the possibility of repayment of the project cost?

c) Along with the financial issues, managerial organization of the project and training of personnels can often become important issues. Especially, in case that the planned project is in competition with a simular private business or in case that the project needs a structurally new managerial organization, the above issues will become as important as the financial issues. However, it seems reasonable to assume that the existing organization and personnels relied on to carry out the project.

### 10.1.2 Premises of Financial Analysis

(1) Base Case in This Financial Analysis

Base case in this analysis bears the following premises which are similar to those in the economic analysis.

a) Construction period : Six(6) years, 1984 – 1989
b) Project cost : 359,608,000 K.shs at 1983 constant raise
c) Project fund : From abroad
d) Future traffic volumes : Described in chapter 2
e) Level of ferry service : Maintaining at the existing level
f) Toll charge of the bridge : Free

(2) As to Without Project Case and With Project Case

a) Consider the Without Project case in this analysis, the bridge will not be constructed and the existing ferry transportation facilities will be continued into the future. The ferry service will be kept at the

i) existing level of service, and

ii) be free of any charge.

b) Consider the With Project case in this analysis, the bridge and its approach road will be constructed and that the existing ferry facilities will be abandoned when the new facilities come into use.

In addition,

i) the level of passing service will be considerably improved than the existing road, and

ii) the toll charge of the bridge will be free.

### 10.1.3 Scope of Financial Analysis

As shown in Figure 10–1, the scope of this financial analysis consists of the following items:

a) Estimation/projection of fundamental data for this analysis excluding those prepared in the former chapter.

i) Projection of related prices.

ii) Current and investment expenditure on roads in Kenya.

b) Estimation of the project cost at current price.

c) Analysis on the method of fund raising for the project cost and maintenance cost.

d) Plans for the raising of the project cost and of its repayment.

e) Analysis on the possibility of raising a domestic fund as the local currency for the project.

f) (For reference) Analysis on the toll charge of the bridge.

g) (For reference) Influence of the toll charge revenue on the balance of revenue and expenditure of the business entity.

h) Conclusions.

### 10.1.4 Evaluation (Indication) Price Used in This Analysis

(1) Evaluation (Indication) Price for the Project Cost

It is an important matter to know the amount and timing of the fund to be raised with regards to the creditors and borrowers. In an usual transaction, the amount of money which is quoted not at the price of a certain basic year (the amount of money indicated at constant price) but rather at the price of the particular year (the amount of money indicated at current price or nominal price) is used. Accordingly, the project cost at current price is used in this analysis.

(2) Evaluation (Indication) Price for the Balance of Revenue and Expenditure of the Business Entity.

a) The balance of revenue and expenditure should be made known to the creditors and borrowers of the project fund. It is desirable to indicate the balance at current price.

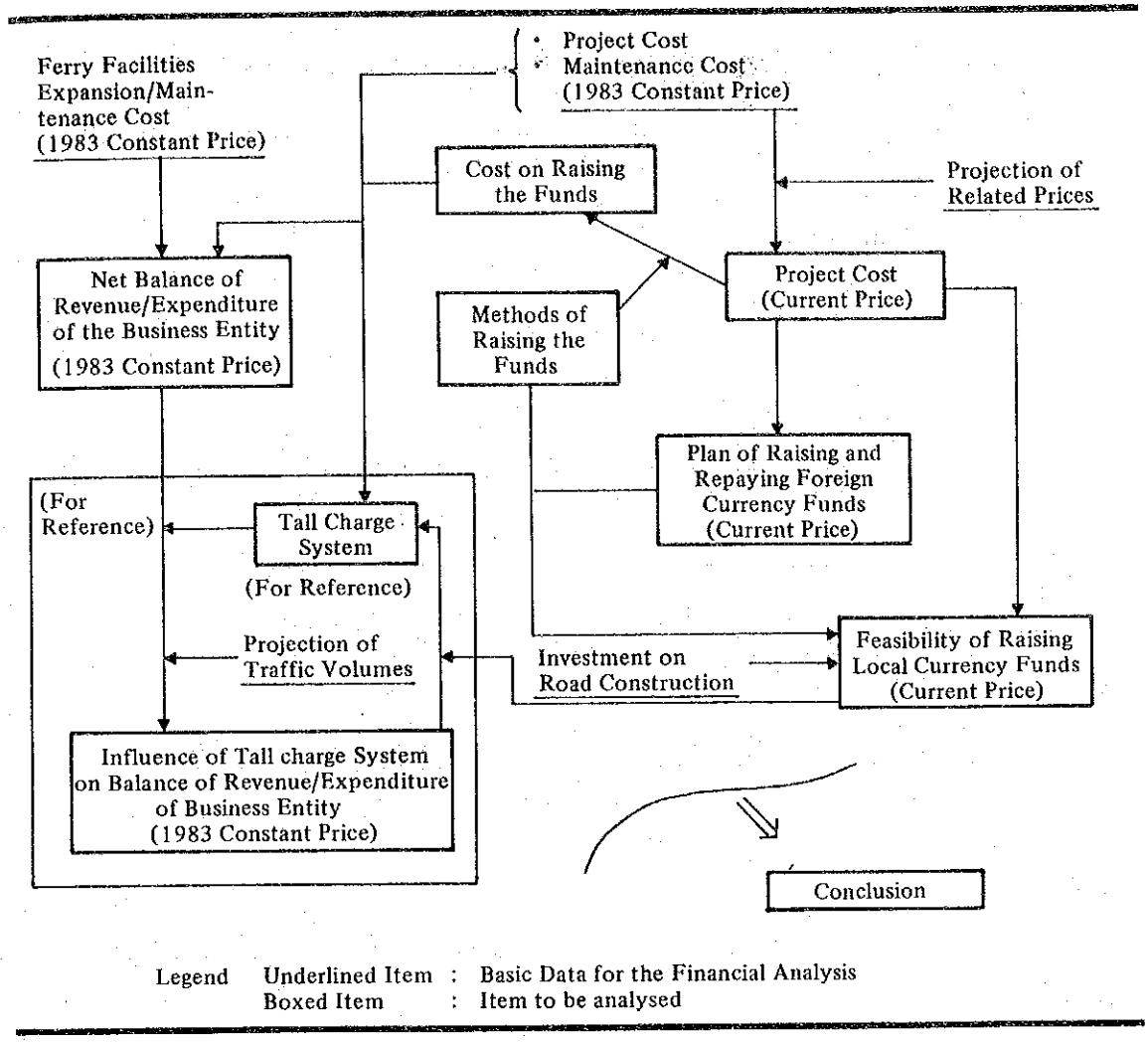



**Fig. 10–1 SCOPE OF THE FINANCIAL ANALYSIS**

b) To get the balance at current price, it is indispensable to convert the projected revenue and maintenance cost at constant price to those at current price.

c) To do this, it is also indispensable to forecast the prices related the above items through the evaluation period of this project.

d) However, some problems are inherent in the projection and use of the related prices.

   i) It is very difficult to accurately forecast the prices.

   ii) The forecast prices by themselfs would display great influences on the balance.

e) In this financial analysis, the balance of revenue and expenditure of the business entity and the related data at 1983 constant price are used to avoid the problems described in d).

## 10.2 ESTIMATION OF PROJECT COST AT CURRENT PRICE

The project cost at 1983 constant price has been described in the previous chapter (see 9.2). Taking account of the rises in the related prices from 1984 to 1989, the project coxt at current price is estimated on the one at 1983 constant price.

### 10.2.1 Forecast of Related Prices

The annual increasing rates of the related prices used in the estimation of the project cost at current price are shown in Table 10–1.

Table 10–1 PROJECTION OF ANNUAL INCREASING RATE OF UNIT PRICE

(Unit: %/Year)

| Items | Rate (%) |
|---|---|
| Synthetic Price | 13.8 |
| Consummer Price | 14.5 |
| Capital Goods Price | 12.0 |
| Wage Earnings per Employee | 11.6 |
| Import Unit Price | 10.5 |

### 10.2.2 Project Cost at Current Price

The estimated project cost at current price is shown in Table 10–2. The cost is 1.61 times of the project cost at 1983 constant price.

## 10.3 RAISING OF PROJECT FUNDS

### 10.3.1 Conditions and Methodology

(1) Conditions

Four (4) likely creditors for the project fund are enumerated.

a) African Development Fund (ADF)

b) Japanese LDC Untied Loan

c) Private Bank in Kenya

d) Kenya National Treasury

Conditions for raising the funds from the these responders are shown in Table 10–3.

(2) Methodology

Following method of raising the project cost and the maintenance cost is supposed in this analysis.

**Table 10–2 PROJECT COST AT CURRENT PRICE BY FOREIGN CURRENCY (F.C) AND LOCAL CURRENCY (L.C)**

(Unit: 1,000 K.Shs., at current price)

| Working Item \ Year | | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | Total |
|---|---|---|---|---|---|---|---|---|
| Engineering | F.C | 5,129 | 11,336 | 4,697 | 5,192 | 5,735 | 6,335 | 38,424 |
| | L.C | 1,295 | 2,890 | 1,209 | 1,349 | 1,506 | 1,681 | 9,930 |
| | | 6,424 | 14,226 | 5,906 | 6,541 | 7,241 | 8,016 | 48,354 |
| Bridge Construction | F.C | | | 44,584 | 74,371 | 142,251 | 91,513 | 352,719 |
| | L.C | | | 10,001 | 18,878 | 32,424 | 20,376 | 81,679 |
| | | | | 54,585 | 93,249 | 174,675 | 111,889 | 434,398 |
| Approach Road Construction | F.C | | | | 13,412 | | 8,414 | 21,826 |
| | L.C | | | | 11,365 | | 7,486 | 18,851 |
| | | | | | 24,777 | | 15,900 | 40,677 |
| Land Acquisitions | F.C | | | | | | | |
| | L.C | | | 2,376 | | | | 2,376 |
| | | | | 2,376 | | | | 2,376 |
| Compensation | F.C | | | | | | | |
| | L.C | | | 520 | | | | 520 |
| | | | | 520 | | | | 520 |
| Sub-Total | F.C | 5,129 | 11,336 | 49,281 | 92,975 | 147,986 | 106,262 | 412,969 |
| | L.C | 1,295 | 2,890 | 14,106 | 31,592 | 33,930 | 29,543 | 113,356 |
| | | 6,424 | 14,226 | 63,387 | 124,567 | 181,916 | 135,805 | 526,325 |
| Contengency | F.C | 513 | 1,134 | 4,928 | 9,298 | 14,798 | 10,627 | 41,298 |
| | L.C | 129 | 289 | 1,410 | 3,159 | 3,391 | 2,953 | 11,331 |
| | | 642 | 1,423 | 6,338 | 12,457 | 18,689 | 13,580 | 52,629 |
| (Total) Project Cost | F.C | 5,642 | 12,470 | 54,209 | 102,273 | 162,784 | 116,889 | 454,267 |
| | L.C | 1,424 | 3,179 | 15,516 | 34,751 | 37,321 | 32,496 | 124,687 |
| | | 7,066 | 15,649 | 69,725 | 137,024 | 200,105 | 149,385 | 578,954 |

**Table 10–3 PROBABLE METHODS OF FUNDING PROJECT COST**

| Condition | | African Development Fund (ADF) | Japanese LDC United Loan | Domestic | |
|---|---|---|---|---|---|
| | | | | Commercial | National Treasury |
| Scope of Financing | | • At maximum 90% of project cost<br>• Operating fund are added to scope of financing case by case. | • Full part of foreign currency of project cost | It depends on negotiation | No Limitation |
| Term of Financing (Term of Repayment of Fund) | | 50 years | 30 years | It depends on negotiation however, longest term of 10 years is supposed. | No Limitation |
| Method of Repayment | Term of Grace | First 10 years | First 10 years, however it is applied only to the principal, and interest must be paid every year. | None | – |
| | Interest Rate | 0% | 4.0% | 19% | 0% |
| | Yearly Amount of Payment | • For the second 10 years, 1% of principal.<br>• For the remainder 30 years, 3% of the principal. | For the remainder 20 years, 5% of the principal plus interest of the every year. | Supposition: uniform amount repayment of principal and interest. | Not needed |
| Others | | Commission, 0.75% of the principal at end of 50th year. | • The loan should be used during the first 7 ∿ 8 years.<br>• Construction of contractors are limited to those of LDC and Japan | | |

Source (1) ADF Lending Policy 26 May, 1982
(2) Overseas Economic Cooperation Fund, Japan
(3) Hearing Survey

**Table 10–4 SUPPOSED METHOD OF RAISING FUNDS FOR PROJECT COST AND MAINTENANCE COST**

| From | Costs to be Raised |
|---|---|
| Abroad | • Foreign Currency of the Project Cost |
| Kenya National Treasury | • Local Currency of the Project Cost<br>• Maintenance Cost<br>• Interest due to Raise the part of Foreign Currency of the Project Costs from abroad |

It seems possible to raise the project fund from commercial banks in Kenya. The annual interest rate is however very high at 19% and no revenue can be expected to relief the burden of interest.

### 10.3.2 Plan for Raising the Foreign Currency of Project Cost and its Repayment

(1) Plan for Raising the Foreign Currency of the Project Cost

The foreign currency of the project cost shown in Table 10–2 is summarized as follows.

The project cost at current price are calculated to use the following factors.

a) Term of financing is 30 years.

b) Interest rate is 4.0%.

c) For first 10 years, only the interest must be paid.

d) After 10 years, principal plus interest must be paid.

The amount of money is equal to the fund to be raised by the Kenya Government from abroad for the implementation of this project.

**Table 10–5 FOREIGN CURRENCY**

(Unit: 1,000 K.Shs, at Current Price)

| Year | Construction Cost |
|---|---|
| 1984 | 5,642 |
| 1985 | 12,470 |
| 1986 | 54,209 |
| 1987 | 102,273 |
| 1988 | 162,784 |
| 1989 | 116,889 |
| Total | 454,267 |

(2) Plan of Repayment

Annual amount of repayment consists of following components:

a) Annual amount of repayment of the part of foreign currency of the project cost (shown in above table 10–5, it is called the capital to be repaid hereafter)

b) Annual interest on the capital

In the following table, the annual amount of repayment for the loan from abroad is shown.

The outstanding capital and interest at the end of 2013 will be 118,451,000 K.Shs at current price.

### 10.3.3 Fund Raising for Local Currency of Project

Part of the local currency of the project consists of the following components at different period.

a) Construction period (1984 – 1989)

i) The local currency of the project cost

ii) Interest on the foreign currency of the project cost

b) Operation period (1990 – 2013)

i) Maintenance cost

ii) Repayment of the foreign currency (capital and interest)

**Table 10–6 ANNUAL AMOUNT OF REPAYMENT OF CAPITAL AND INTEREST –(BASE CASE)–**

| Year | Repayment of Caiital (1,000 K.shs, Current Price) | Interest (1,000 K.shs, Current Price) | Total 1,000 K.shs, current Price) | Total (1,000 K.shs, (1983 Constant Price) |
|---|---|---|---|---|
| 1985 | | 226 | 226 | 175 |
| 1986 | | 724 | 724 | 491 |
| 1987 | | 2,893 | 2,893 | 1,725 |
| 1988 | | 6,984 | 6,984 | 3,660 |
| 1989 | | 13,495 | 13,495 | 6,216 |
| 1990 | | 18,171 | 18,171 | 7,518 |
| 1991 | | 18,171 | 18,171 | 6,513 |
| 1992 | | 18,171 | 18,171 | 5,769 |
| 1993 | | 18,171 | 18,171 | 5,110 |
| 1994 | | 18,171 | 18,171 | 4,526 |
| 1995 | 282 | 18,171 | 18,453 | 4,071 |
| 1996 | 906 | 18,159 | 19,065 | 3,725 |
| 1997 | 3,616 | 18,123 | 21,739 | 3,762 |
| 1998 | 8,730 | 17,979 | 26,709 | 4,095 |
| 1999 | 16,869 | 17,629 | 34,498 | 4,685 |
| 2000 | 22,713 | 16,955 | 39,668 | 4,771 |
| 2001 | 22,713 | 16,046 | 38,759 | 4,170 |
| 2002 | 22,713 | 15,138 | 37,851 | 3,642 |
| 2003 | 22,713 | 14,229 | 36,942 | 3,180 |
| 2004 | 22,713 | 13,320 | 36,033 | 2,774 |
| 2005 | 22,713 | 12,412 | 35,125 | 2,419 |
| 2006 | 22,713 | 11,503 | 34,216 | 2,107 |
| 2007 | 22,713 | 10,595 | 33,308 | 1,835 |
| 2008 | 22,713 | 9,686 | 32,399 | 1,596 |
| 2009 | 22,713 | 8,778 | 31,491 | 1,388 |
| 2010 | 22,713 | 7,869 | 30,582 | 1,206 |
| 2011 | 22,713 | 6,961 | 29,674 | 1,046 |
| 2012 | 22,713 | 6,052 | 28,765 | 907 |
| 2013 | 22,713 | 5,144 | 27,857 | 786 |

(1) Amount of Local Currency Needed to be Raised during the Construction Period.

The amount is summarized from Table 10–2 and Table 10–6 as shown in Table 10–7.

**Table 10–7 AMOUNT OF LOCAL CURRENCY NEED TO BE RAISED DURING THE CONSTRUCTION PERIOD**

(Unit: 1,000 K.shs, current price)

| Year | Local Currency of the Project Costs | Interest on the Foreign Currency of the Project Costs | Total |
|---|---|---|---|
| 1984 | 1,424 | | 1,424 |
| 1985 | 3,179 | 226 | 3,405 |
| 1986 | 15,516 | 724 | 16,240 |
| 1987 | 34,751 | 2,893 | 37,644 |
| 1988 | 37,321 | 6,984 | 44,305 |
| 1989 | 32,496 | 13,495 | 45,991 |
| Total | 124,687 | 24,322 | 149,009 |

a) Current and investment expenditure on roads in Kenya by different agencies have been fluctuating over the years as shown in Table 10–8.

**Table 10–8 CURRENT AND CAPITAL EXPENDITURE ON ROADS IN KENYA**

(Unit: 1,000 K.shs, Current Price)

| Year | Central Government 2) 4) | Municipal Councils 2) | Town, Country and Urban Councils 1) | Total |
|---|---|---|---|---|
| 1978 | 862,200 | 46,280 | 37,080 | 945,560 |
| 1979 | 1,129,600 | 45,960 | 6,240 | 1,181,800 |
| 1980 | 1,148,800 | 61,100 | 8,240 | 1,218,140 |
| 1981 | 1,543,600 | 47,020 3) | 4,620 3) | 1,595,240 3) |

1) Data Source: Statistical Abstract 1982
2) Data Source: Economic Survey 1983
3) Provisional
4) Fiscal at year

b) During the most active period (1987 – 1989) at the construction stage, the annual amount of local currency needed to be raised for this project amounts to 2.4% – 2.9% of the current and investment expenditure in Kenya in 1981. As the budget for road in Kenya during the same period will be considered to increase, the above ratio in fact will become lower than 2.4% – 2.9%.

Judging from the budget for road in Kenya, it seems to be possible to raise the fund from the Kenya National Treasury and Local Governments.

(2) Amount of Local Currency Needed to be Raised during the Operation Period.

The amount is summarized from Table 10–6* as follows.

a) A large part of the amount need to be raised during the operation period (1990 – 2013) consists of the amount of repayment to the capital and its interest.

b) However, the annual amount at most does not exceed the expenditure on road of the Town, Country and Urban councils in 1979.

Accordingly, it seems also possible to raise the amount from the Kenya National Treasury and Local Governments.

Note *: Synthetic Price index is used as a deflator for conversion of the values at current price to ones at 1983 constant price.

**Table 10–9 AMOUNT OF LOCAL CURRENCY NEEDED TO BE RAISED DURING OPERATION PERIOD (1990 ∿ 2013)**

(Unit: 1,000 K.shs, 1983 Constant Price)

| Year | Maintenance Costs | Amount of Repayment of Capital and Interest | Total |
|---|---|---|---|
| 1990 | 30 | 7,518 | 7,548 |
| 1991 | 30 | 6,513 | 6,543 |
| 1992 | 30 | 5,769 | 5,799 |
| 1993 | 30 | 5,110 | 5,140 |
| 1994 | 30 | 4,526 | 4,556 |
| 1995 | 30 | 4,071 | 4,101 |
| 1996 | 30 | 3,725 | 3,755 |
| 1997 | 30 | 3,762 | 3,792 |
| 1998 | 30 | 4,095 | 4,125 |
| 1999 | 1,614 | 4,685 | 6,299 |
| 2000 | 30 | 4,771 | 4,801 |
| 2001 | 30 | 4,170 | 4,200 |
| 2002 | 30 | 3,642 | 3,672 |
| 2003 | 30 | 3,180 | 3,210 |
| 2004 | 30 | 2,774 | 2,804 |
| 2,005 | 30 | 2,419 | 2,449 |
| 2006 | 30 | 2,107 | 2,137 |
| 2007 | 30 | 1,835 | 1,865 |
| 2008 | 30 | 1,596 | 1,626 |
| 2009 | 1,614 | 1,389 | 3,002 |
| 2010 | 30 | 1,206 | 1,236 |
| 2011 | 30 | 1,046 | 1,076 |
| 2012 | 30 | 907 | 937 |
| 2013 | 30 | 786 | 816 |

### 10.3.4 Possibility of Road Users' Bearing Maintenance Cost, Repayment of Project Cost and Interest on Fund

(1) Present Situation of Toll Charges in Kenya

a) Toll charges at New Nyali Bridge are as follows.

**Table 10–10 TOLL CHARGE AT NEW NYALI BRIDGE – (SINGLE JOURNEY CASE) –**

(Unit: K.shs/Trip)

| Items | Toll Charge Price |
|---|---|
| Passenger car/Station wagon not exceeding 1 1/2 ton | 1 |
| Commercial vehicle and Bus Fare weight not exceeding 5 tons | 2 |
| Commercial vehicle and Bus Fare weight 5 tons to 11 tons | 5 |
| Commercial vehicle and Bus Fare weight exceeding 11 tons | 10 |
| Tanker and Lorry | 15 |
| Motorcycle, Rickshaws, Bicycles pedestrians | Free |

b) On the other hand, ferry toll at Likoni crossing managed by a private company is 8 – 9 times higher than the toll charges at New Nyali Bridge.

(2) Balance of Revenue and Expenditure of the Business Entity in Case of Introduction of New Nyali Toll Charges.

a) Toll charges are not collected in principle at the Kilifi Bridge in this analysis. Accordingly, the balance consists of only the expenditure of the business entity.

b) If the same toll charges as those at the New Nyali Bridge are introduced at the Kilifi Bridge, the following balance can be projected:

In the table,

i) The expenditure in Without Project case consists of not only expansion/maintenance costs for ferry facilities but construction/maintenance costs for toll gates.

ii) The expenditure in With Project case consists of interest on a part of the foreign currency of this project and construction/maintenance costs for toll gates, along with the project cost and maintenance cost.

iii) Toll charge revenues in both Without and With Project cases are calculated at toll charge rates of the New Nyali Bridge.

c) Balance of revenue and expenditure of the business entity in both Without and With Project cases.

i) During the construction period (1984 – 1989), the balance of the business entity in With Project case will become worse than that in Without Project case. This is because the project cost is considerably

## Table 10-11 BALANCE OF EXPENDITURE AND REVENUE OF BUSINESS ENTITY -- (COLLECTING TALL CHARGES CASE) --

(Unit: 1,000 K.shs; 1983 Constant Price)

| Case / Year | A Without Project Case | | | B With Project Case | | | A – B Net | | |
|---|---|---|---|---|---|---|---|---|---|
| | Expenditure | Revenue | Net Revenue | Expenditure | Revenue | Net Revenue | Expenditure | Revenue | Net Revenue |
| 1984 | 4,081 | | Δ 4,081 | 6,382 | | Δ 6,382 | 2,301 | | Δ 2,301 |
| 1985 | 4,289 | | Δ 4,289 | 12,942 | | Δ 12,942 | 8,653 | | Δ 8,653 |
| 1986 | 46,893 | | Δ 46,893 | 51,458 | | Δ 51,458 | 4,565 | | Δ 4,565 |
| 1987 | 6,330 | | Δ 6,330 | 91,896 | | Δ 91,896 | 85,566 | | Δ 85,566 |
| 1988 | 6,508 | | Δ 6,508 | 122,890 | | Δ 122,890 | 116,382 | | Δ 116,382 |
| 1989 | 8,452 | | Δ 8,452 | 88,074 | | Δ 88,074 | 79,622 | | Δ 79,622 |
| 1990 | 7,160 | 1,082 | Δ 6,078 | 8,172 | 1,405 | Δ 6,767 | 1,012 | 323 | Δ 689 |
| 1991 | 7,338 | 1,134 | Δ 6,204 | 6,840 | 1,473 | Δ 5,367 | Δ 498 | 339 | 837 |
| 1992 | 7,514 | 1,192 | Δ 6,322 | 6,096 | 1,549 | Δ 4,547 | Δ 1,418 | 357 | 1,775 |
| 1993 | 7,692 | 1,251 | Δ 6,441 | 5,437 | 1,624 | Δ 3,813 | Δ 2,255 | 373 | 2,628 |
| 1994 | 7,868 | 1,316 | Δ 6,552 | 4,853 | 1,710 | Δ 3,143 | Δ 3,015 | 394 | 3,409 |
| 1995 | 8,046 | 1,379 | Δ 6,667 | 4,991 | 1,793 | Δ 3,198 | Δ 3,055 | 414 | 3,469 |
| 1996 | 8,222 | 1,453 | Δ 6,769 | 4,489 | 1,884 | Δ 2,605 | Δ 3,733 | 431 | 4,169 |
| 1997 | 69,524 | 1,525 | Δ 68,001 | 4,035 | 1,981 | Δ 2,054 | Δ 65,489 | 456 | 65,945 |
| 1998 | 10,367 | 1,604 | Δ 8,763 | 3,611 | 2,079 | Δ 1,532 | Δ 6,756 | 475 | 7,231 |
| 1999 | 10,355 | 1,684 | Δ 9,171 | 4,787 | 2,185 | Δ 2,602 | Δ 5,568 | 501 | 6,069 |
| 2000 | 11,342 | 1,768 | Δ 9,574 | 2,796 | 2,296 | Δ 500 | Δ 8,546 | 528 | 9,074 |
| 2001 | 41,830 | 1,853 | Δ 39,977 | 2,414 | 2,407 | Δ 7 | Δ 39,416 | 554 | 39,970 |
| 2002 | 12,182 | 1,942 | Δ 10,240 | 2,085 | 2,524 | 439 | Δ 10,097 | 582 | 10,679 |
| 2003 | 12,534 | 2,031 | Δ 10,503 | 1,802 | 2,637 | 835 | Δ 10,732 | 606 | 11,338 |
| 2004 | 12,887 | 2,132 | Δ 10,755 | 1,560 | 2,771 | 1,211 | Δ 11,327 | 639 | 11,966 |
| 2005 | 13,238 | 2,235 | Δ 11,003 | 1,353 | 2,902 | 1,549 | Δ 11,885 | 667 | 12,552 |
| 2006 | 13,591 | 2,341 | Δ 11,250 | 1,176 | 3,040 | 1,864 | Δ 12,415 | 699 | 13,114 |
| 2007 | 56,339 | 2,453 | Δ 53,886 | 1,025 | 3,186 | 2,161 | Δ 55,314 | 733 | 56,047 |
| 2008 | 15,089 | 2,573 | Δ 12,516 | 897 | 3,339 | 2,442 | Δ 14,192 | 766 | 14,958 |
| 2009 | 15,629 | 2,697 | Δ 12,932 | 2,372 | 3,502 | 1,130 | Δ 13,257 | 805 | 14,062 |
| 2010 | 16,169 | 2,825 | Δ 13,344 | 696 | 3,670 | 2,974 | Δ 15,473 | 845 | 16,318 |
| 2011 | 16,709 | 2,964 | Δ 13,745 | 618 | 3,847 | 3,229 | Δ 16,091 | 883 | 16,974 |
| 2012 | 17,248 | 3,110 | Δ 14,138 | 553 | 4,037 | 3,484 | Δ 16,695 | 927 | 17,622 |
| 2013 | 17,788 | 3,263 | Δ 14,525 | 499 | 4,232 | 3,733 | Δ 17,289 | 969 | 18,258 |

higher than the expension/maintenance costs for the ferry facilities.

ii) However, after the new facilities is operational, (1990 – 2013), net profit will be expected after the year 2002. On the other hand, in Without Project case, the net losses will be enlarged as year goes by.

iii) The conclusion is that the With Project case will give higher chance of improving the balance of the business entity than the Without Project case in spite of the harder burden on the balance during the construction period.

(3) Toll Charges Needed to Cover the Maintenance Cost or Maintenance/ Project Costs

a) The project cost, maintenance cost of the bridge, road and toll gate and toll charge revenue at 1983 present value in With Project case are as follows.

(Unit: 1,000 K.shs, 1983 Present Value)

| | | |
|---|---|---|
| i) | Project cost | 225,390 |
| ii) | Maintenance cost | 18,253 |
| iii) | Toll charge revenue | 7,987 |

b) The profit will be expected after 2002.

However, it is clear as shown above that, the toll charge revenue during the operating period (1990 – 2013) will not be enough to cover the maintenance cost during the same period.

c) The toll charge rates needed to cover the maintenance cost during the operating period would be as follows.

**Table 10–12 TOLL CHARGES TO COVER THE MAINTENANCE COST DURING THE OPERATING PERIOD**

(Unit: K.shs/Trip, 1983 Constant Price)

| Items | Toll Charge Price |
|---|---|
| Car, Light Goods Vehicle | 2 |
| Medium Goods Vehicle | 4 |
| Heavy Goods Vehicle | 20 |
| Bus | 2 |

d) The toll charges needed to cover the project cost and the maintenance cost are too high in comparison with the toll charges at New Nyali.

## 10.4 CONCLUSION

### 10.4.1 Investment Requirement for this Project

On the basis of the financial analysis, the investment requirement during the construction period is estimated as shown in Table 10–13.

**Table 10–13 INVESTMENT REQUIREMENT**

(Unit: 1,000 K.shs, Current Price)

| Year | Foreign Currency | Local Currency | Total |
|---|---|---|---|
| 1984 | 5,642 | 1,424 | 7,066 |
| 1985 | 12,470 | 3,405 | 15,875 |
| 1986 | 54,209 | 16,240 | 70,449 |
| 1987 | 102,273 | 37,644 | 139,917 |
| 1988 | 162,784 | 44,305 | 207,089 |
| 1989 | 116,889 | 45,991 | 162,880 |
| Total | 454,267 | 149,009 | 603,276 |

### 10.4.2 Fund Raising for Investment Requirement

During the most active period (1987 – 1989) at the construction stage, the annual amount of the total investiment requirement and the local currency requirement needed to be raised for this project amounts to 6.4% – 10.2% and 2.4% – 2.9% of the investiment expenditure in Kenya in 1981 respectively.

When the foreign currency will be raised from abroad, it seems to be possible to raise the fund for the local currency from the Kenya National Treasury.

### 10.4.3 Implementation Schedule

Judging from the construction method, preliminary engineering, economic analysis and financial analysis, the implementation schedule is arrived. The construction schedule is shown in Table 10–14.

*Table 10--14* **IMPLEMENTATION SCHEDULE**

| Working Item | | | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|
| Engineering and Evaluation | | | | | | | | |
| Land Acquisition and Compensation | | | | | | | | |
| Temporary & Other Works | | | | | | | | |
| Bridge | Foundations | $P_1$ | | | | | | |
| | | $P_2$ | | | | | | |
| | Abutments | $A_1$ | | | | | | |
| | | $A_2$ | | | | | | |
| | Towers | $P_1$ | | | | | | |
| | | $P_2$ | | | | | | |
| | Superstructure | | | | | | | |
| | Surface and Facilities | | | | | | | |
| Roads | Approach Roads | | | | | | | |
| | Access Roads | | | | | | | |

# APPENDIX

# Appendix 1 DATA FOR DESIGN OF BRIDGE

## 1. Wind Load

There has been no wind observation station in Kilifi. The nearest station to Kilifi where we can get wind records is Mombasa Pas Serani Station.

Table A–1 shows the monthly maximum instantaneous wind speed recorded in five years from 1967 to 1971 at Ras Serani Station.

**Table A–1 MONTHLY MAXIMUM INSTANTANEOUS WIND SPEED AT RAS SERANI**

(Unit: Knots)

| Month/Year | 1967 | 1968 | 1969 | 1970 | 1971 | Max |
|---|---|---|---|---|---|---|
| J | – | 16 | 16 | 19 | 26 | 26 |
| F | – | 16 | 20 | 15 | 22 | 22 |
| M | 17 | 17 | 20 | 26 | 24 | 26 |
| A | 19 | 15 | 26 | 30 | 26 | 30 |
| M | 25 | 18 | 36 | 30 | 32 | 36 |
| J | 26 | 19 | 33 | 30 | 32 | 33 |
| J | 22 | 22 | 28 | 30 | 34 | 34 |
| A | 25 | 19 | 25 | 26 | 25 | 26 |
| S | 21 | 19 | 28 | 26 | 20 | 28 |
| O | 18 | 19 | 20 | 18 | 15 | 20 |
| N | 16 | 18 | 14 | 16 | 10 | 18 |
| D | 15 | 14 | 14 | 20 | 15 | 20 |

Based on the above data, the maximum instantaneous wind speed is found out as 40.5 knots. So the basic wind speed for 10-minutes (Vo) is found out as follows:

$$Vo = 40.5 \times 0.66 = 26.73 \text{ knots}$$

And the basic design wind speed (V) is

$$V = 26.73 \times 1.4 = 37.42 \text{ knots (18 m/sec)}$$

However, we have to consider that the data are not for those at bridge site itself and the wind is strongly influenced by the topographical features of the bridge site. Finally, we assume the basic design wind speed as 30 m/sec.

## 2. Effect of Temperature

The range of effective bridge temperature shall be assumed in accordance with the data recorded at three stations in Malindi, Kilifi and Mombasa. These are as shown in Table A–2.

Table A–2 TEMPERATURE IN MALINDI, KILIFI AND MOMBASA

| Station | Malindi Airport | Kilifi, Kibarani Experimental Stn. | Mombasa Port Reitz Airport |
|---|---|---|---|
| Absolute Maximum | 35.5°C | 37.2°C | 37.3°C |
| Mean Monthly Maximum | 31.9 | 32.2 | 32.7 |
| Annual Mean | 26.1 | 26.1 | 26.3 |
| Mean Monthly Minimum | 21.4 | 20.8 | 20.3 |
| Absolute Minimum | 16.6 | 15.6 | 14.1 |

For the concrete bridge, the range of effective bridge temperature shall be ±5°C in considering the difference between mean monthly maximum and mean monthly minimum.

For the steel bridge it shall be ±25°C. This is based on the difference between the temperature of steel increased which will be assumed to be maximum 50°C and the absolute minimum which is approximately 15°C.

### 3. Comparison of Live Load

(1) The comparison of bending moment due to TL–20 and B.S. Loadings in simple supported beam. (Refer to Table A–3)

Kind of loading

a) J.R.A. (Japan Road Association) : TL–20

b) B.S. (British Standards) : HA Loading

c) B.S. : HA loading combined with HB–25 loading

Variation of span length

$\ell$ = 60 m, $\ell$ = 90 m, $\ell$ = 120 m

Table A–3 THE VALUE OF BENDING MOMENT

| Span \ Load | J.R.A. TL–20 | B.S. HA Loading | B.S. HA Loading HB-25 Loading |
|---|---|---|---|
| $\ell$ = 60 m | 2,416 t-m (1.0) | 2,879 t-m (1.19) | 2,819 t-m (1.17) |
| $\ell$ = 90 m | 4,770 (1.0) | 5,207 (1.09) | 5,125 (1.08) |
| $\ell$ = 120 m | 7,378 (1.0) | 7,943 (1.08) | 7,969 (1.08) |

(2) Increment of member force

According to the above table, the ratio of bending moment due to B.S. loading to that due to TL–20 loading does not exceed 1.08.

Hence, in this bridge (now under study) the ratio will not exceed 1.08, since the lengths of influence lines of members of the bridge are very long. On the other hand, the ratios (R) of live load to dead load in the representative member forces are given in Table A–4.

**Table A–4 RATIO (R)**

| Member \ R | R = L/D |
|---|---|
| Main Girder | < 0.6 |
| Cable | < 0.3 |
| Tower | < 0.4 |

Hence, the increments of member forces due to the application of B.S. instead of TL–20 are calculated as R x 0.08.

The result is shown below.

| | |
|---|---|
| Main Girder | 0.6 x 0.08 = 0.048 |
| Cable | 0.3 x 0.08 = 0.024 |
| Tower | 0.4 x 0.08 = 0.032 |

# Appendix 2 JETTY CONSTRUCTION COST ESTIMATE

### Jetty Construction Cost

An expansion plan for the jetty is considered as compared with the bridge construction plan.

This jetty construction cost is used in the economic analysis study. The rough construction quantities and cost for the jetty would be expanded are shown in Table A–5 and A–6.

**Table A–5 ROUGH CONSTRUCTION QUANTITIES OF THE JETTY EXPANSION**

| Item | | Quantity |
|---|---|---|
| Site Clearance | | 9,800 $m^2$ |
| Excavation | Class 1 | 68,740 $m^3$ |
| | Class 2 | 31,960 $m^3$ |
| Pavement | | 9,800 $m^2$ |
| Concrete | | 5,000 $m^2$ |
| Form | | 600 $m^2$ |
| Earth Drainage | | 500 $m^2$ |
| Office Building | | 80 $m^2$ |
| Other Road Facilities | | 300 m |

**Table A–6 ROUGH CONSTRUCTION COST OF THE JETTY EXPANSION**

(In 1,000 K.Shs.)

| Item | F.C. | L.C. | Total |
|---|---|---|---|
| Construction | 14,121 | 12,261 | 26,382 |
| Land Acquisition | – | 60 | 60 |
| Total | 14,121 | 12,321 | 26,442 |

Note: 1) Engineering fee is included in the construction cost.
2) Maintenance cost should be added to and taken as 3% of the construction cost per annum.

## Appendix 3 LIST OF STAFFING

## 1. Ministry of Transport and Communication (MOTC) of KENYA

1) Mr. W.P. WAMBURA
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2) Mr. KILIKA
   Engineer in Chief of MOTC

3) Mr. S. M. KIGURU
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5) Mr. S. ASFAW
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6) Mr. D.E.M. MWASI
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7) Mr. J.M. WANYOIKE
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Quantity Survey

5) Mr. Akihiro KIMURA

Traffic Engineering

6) Mr. Yoshiteru SUNAGO

Economic and Financial Analysis.

7) Mr. Yoshihiro DAICHO

Geotechnical Engineering

# Appendix 4 LIST OF REPORTS

**1. The followings reports are submitted to the Kenya Government.**

1) Inception Report
2) Progress Report
3) Interim Report
4) Draft Final Report
5) Draft Final Report (Preliminary Engineering Plans)
6) Final Report (Executive Summary)
7) Final Report (Main Volume)
8) Final Report (Preliminary Engineering Plans)
9) Technical Report of Economic Analysis
10) Technical Report of Financial Analysis.

JICA