Analysis revealed that only two intersections, namely New Bagamoyo/Morocco Road intersection and Morogoro/Shekilango Road intersection are not saturated intersection against existing peak hour traffic and most of observed intersections are recognized as over saturated intersection to the existing peak hour traffic.

Considering the future traffic increasew on the trunk road network, the major intersection on the priority roads should be controlled by traffic signal.

(3) Imporvement by Grade Separation

Considering the desirable future trunk road network in Dar es Salaam as well as to cope with the traffic demand, major intersections across dual carriageways should be improved to the grade separated intersection in the near future.

The necessity of grade separated intersection was studied for all major intersections in Dar es Salaam assuming that the existing intersections are properly maintained by signal controlled system at the projected year of 2000. The study method is presented in Appendix 12.3.

The study revealed that the following five (5) intersections will have the overflowing traffic in the year of 2000 so that they need to be improved to the grade separated intersections in the Long-term Plan:

- Pugu/Port Access Roads Intersection
- Pugu/Midle Ring Roads Intersection
- Pugu/Msinbazi Roads Intersection
- Midle Ring/Morogoro Roads Intersection
- Midle Ring/Uhuru Roads Intersection

12.2.5 Supplemental Sub-soil and Pavement Survey

Supplemental sub-soil and pavement survey including laboratory tests were conducted to obtain necessary data and information required for the subsequent preliminay design of overlay and

reconstruction of pavement for the selected high priority roads with a total length of 104 km approx.

(1) Sampling

In phase 1, 29 no. of bore holes were made by hand auger to examine soil classification and CBR value of the existing roads. In phase 2, 21 nos. of bore holes were additionally conducted to refine the soil data on the proposed roads. Two test pits were also investigated at proposed Kunduchi and Ubungo borrow areas. Location of subsoil tests for CBR sampling and tests was shown in Appendix 12.4.

(2) Test Results

Laboratory tests were carried out based on AASHTO standards and results were presented in Appendix 12.5.

(3) Sub-soil Conditions in the Project Area

On the basis of test results as well as the existing data, sub-soil conditions map in the projects area was developed as shown in Fig. 12.3.

(4) Determination of Design CBR

Design CBR value were calculated using the following formula:

$$\text{Design CBR} = \text{Average value of CBR} - \frac{\text{Max. CBR} - \text{Min. CBR}}{d2}$$

where d2 is obtained from the table below:

Nos. of Value Available	3	4	5	6	7	8	9	10 or more
	1.91	2.24	2.48	2.67	2.83	2.96	3.08	3.13

As the results, CBR values obtained in phase 1 were modified on the basis of the above calcultation and final figure of CBR was presented in Table 12.4.

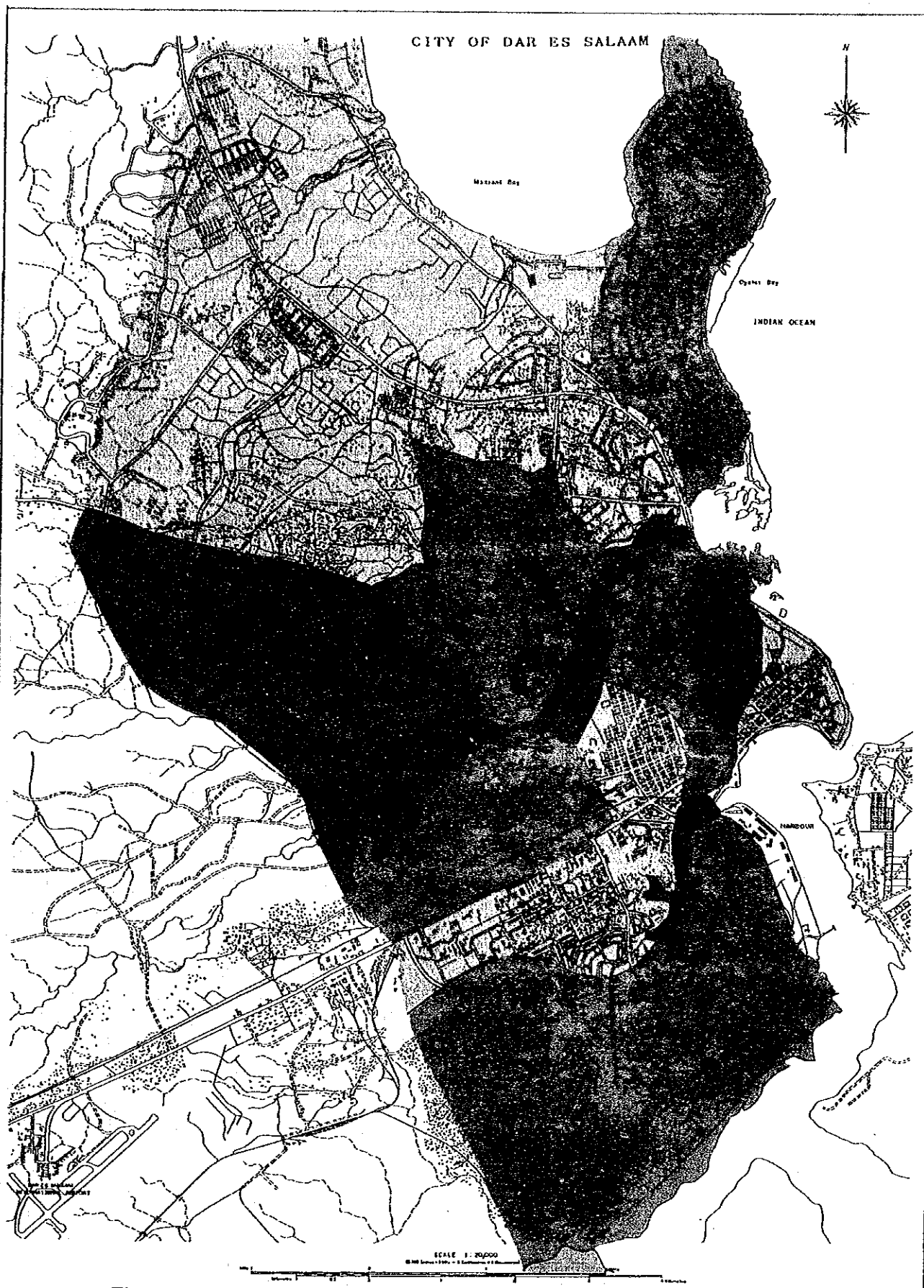


Fig. 12 3 Subsoil condition in the Project

Gravel Sand (A-1-a & A-1-b)
Fine Sand A-3
Silty Sand A-2-4
Silt Clayey Sand (A-2-6)
Clayey Silt Lime & Plastic Clayey Sand (A-2-7)
Silt Clay, Clay (A-4, 5 and 6)

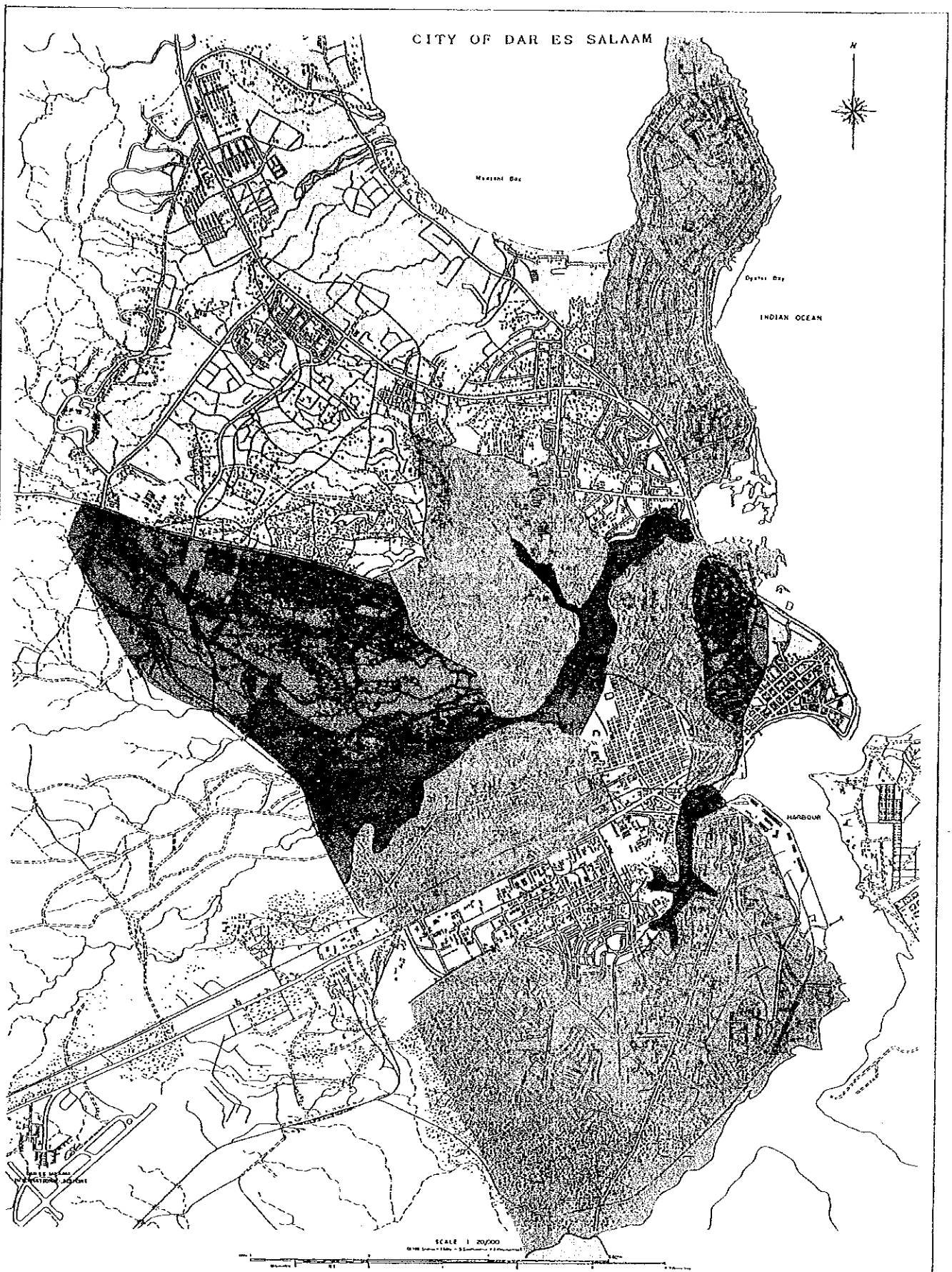


Fig. 12 3 Subsoil condition in the Project

Gravel Sand (A-1-a & A-1-b)
Fine Sand A-3
Silty Sand A-2-4
Silt Clayey Sand (A-2-6)
Clayey Silt Lime & Plastic Clayey Sand (A-2-7)
Silt Clay, Clay (A-4, 5 and 6)

Fig. 12.3 Subsoil condition in the Project

- Gravel Sand (A-1-a & A-1-b)
- Fine Sand A-3
- Silty Sand A-2-4
- Silt Clayey Sand (A-2-6)
- Clayey Silt Lime & Plastic Clayey Sand (A-2-7)
- Silt Clay, Clay (A-4, 5 and 6)

Table 12.4 Estimated CBR Value of Project Roads

Name of Road	Length (km)	Nos. of Soil Test	Estimated CBR Value
1. Upanga Road	1.8	2	8
2. New Bagamoyo Road	8.0		
Up to Mpakani Junction	(8.0)	3	8
3. Morogoro Road	5.7		
Morogoro Road up to Port Access	(5.7)	3	8
Beyond Port Access up to 4.5km	-	1	6
4. Chang'ombe Area Roads	19.2		
Chang'ombe Area Roads	(14.6)	3	8
Chang'ombe Road	(4.6)	1	10
5. Kariakoo Area Roads	31.6		
Kariakoo Area Roads	(30.0)	3	8
Msimbazi Road	(1.6)	1	8
6. Mwinjuma Area Roads	16.7		
Mwinjuma Area Roads	(3.9)	1	10
Morocco Road	(3.5)	3	10
Shekilango Road	(3.8)	4	6
Kinondoni Road	(0.7)	8	8
Makanya Road	(5.0)	3	8
7. Central Area Roads	20.9		
Central Area Roads	(10.3)	1	8
Bandari Road	(2.2)	1	8
Nkrumah Street	(0.3)	1	8
Sokoine Drive	(0.8)	1	8
Gerezani Street	(1.2)	1	8
Kivukoni Street	(1.0)	1	8
Maktaba Street	(0.9)	1	8
Ohio Street	(1.0)	1	8
Ocean Drive	(3.2)	1	8
Total	104.1 km		

12.2.6 Pavement Structural Survey

(1) Sampling

Supplementary pavement structural survey was conducted on the proposed overlay sections in Central Area, Chang'ombe Area and Kariakoo Area to examine the effective thickness of the existing pavement. A total of 24 pieces of samplings were were additionally obtained at the proposed roads. Location of samplings are shown in Appendix 12.6.

(2) Results of Survey

Structural components of the pavement on the existing roads were summarized as shown in Appendix 12.7.

(3) Effective Thickness of Existing Pavement

On the basis of the data obtained through the surveys, effective thickness of pavement structure on the proposed roads were examined. Table 12.5 shows the results of estimation on the effective thickness of the pavement.

12.2.7 Road Inventory and Drainage Survey

Supplementary road inventory survey was conducted to obtain the pavement width of the existing roads as shown below where the overlay and reconstruction of pavement are proposed as the improvement measures:

- Central area roads
- Chang'ombe area roads
- Kariakoo area roads
- Mwinjuma area roads
- A part section of New bagamoyo road

Survey also includes the measurement of shoulder and sidewalk width, type and dimentions of intersections, and other structures.

Drainage survey was carried out paying attention to the direction of water flow and type and dimention of culverts and side drainage.

Table 12.5 Effective Thickness of Existing Pavements

Name of Project Road	Length (km)	Nos. of Samplings	Effective Thickness (mm)
1. Upanga Road	1.8	1	30+120=150
2. New Bagamoyo Road	8.0		
Up to Mpakani Junction	(8.0)	2	30+120=150
3. Morogoro Road	5.7		
Morogoro Road up to Port Access	(5.7)	4	70+165=235
Beyond Port Access up to 4.5km	-	1	70+120=190
4. Chang'ombe Area Roads	19.2		
Chang'ombe Area Roads	(14.6)	3	50+200=250
Chang'ombe Road	(4.6)	5	25+220=245
5. Kariakoo Area Roads	31.6		
Kariakoo Area Roads	(30.0)	5	20+150=170
Msimbazi Road	(1.6)	3	35+250=285
6. Mwinjuma Area Roads	16.7		
Mwinjuma Area Roads	(3.9)	3	20+100=120
Morocco Road	(3.5)	5	35+130=165
Shekilango Road	(3.8)	5	10+110=120
Kinondoni Road	(0.7)	-	-
Makanya Road	(5.0)	2	50+100=150
7. Central Area Roads	20.9		
Central Area Roads	(10.3)	4	25+250=275
Bandari Road	(2.2)	1	60+120=180
Nkrumah Street	(0.3)	1	25+250=275
Sokoine Drive	(0.8)	1	25+250=275
Gerezani Street	(1.2)	1	60+120=180
Kivukoni Street	(1.0)	1	25+250=275
Maktaba Street	(0.9)	1	25+250=275
Ohio Street	(1.0)	1	25+250=275
Ocean Drive	(3.2)	3	50+180=230
Total	104.1 km		

Note: Effective Thickness = Surface + Base/Sub-base thickness

12.3 Preliminary Engineering Design

12.3.1 Design Criteria

The proposed Morogoro and New Bagamoyo Roads are expected to be functioned as major radial roads which forcus on the Central Area of the City with a high design standards.

The design criteria to be applied for those widening sections shall be a high standard to meet the requirement of function as shown in Table 12.6.

Table 12.6 Design Criteria for Widening Sections

Design	Morogoro Road	Upanga Road	New Bagamoyo Road
Design Speed	80 km/hr	60 km/hr	80 km/hr
Minimum Radius	300 m	150 m	300 m
Maximum Gradient	5 %	6 %	5 %
Pavement Width	4 lanes (2x2x3.75m)	4 lanes (2x2x3.50m)	4 lanes (2x2x3.75m)
Shoulder	1.50-2.50m	0.50 m	1.50-2.50m
Median Strip	7.50 m	0.50 m	7.50-10.0m
Sidewalk	2x3.50 m	2x3.00 m	2x3.50 m
Minimum Sigth Distance	115 m	75 m	115 m

As for the area roads, the present design standards including roadway width shall be maintained as it is, since the improvement measures proposed for the area roads are either pavement overlay or reconstruction of pavement with minor drainage improvement, where no improvements on alignment and width of the area roads migth be required.

12.3.2 Project Length by Improvement Measures

The project roads by improvement measures were reviewed on the basis of the supplementary field survey and topographic maps obtained.

The length of project road by improvement measures was summarized in Table 12.7 and as shown in Fig. 12.4 through 12.6. Detailed of road length was presented in Appendix 12.8.

It is noted that the project length of Morogoro Road has been changed and collected to 5.7 km (original estimation was 5.0 km), and total project length of Category A should be changed from 103.4 km to 104.1 km accordingly.

12.3.3 Geometric Design

Since the Project aimes at improvement of the existing roads with overalay, reconstruction and widening, no major change of alignments were proposed in the Project.

However, in some sections of New Bagamoyo and Morogogo Roads, small change in alignments were proposed to obtain proper sight and stopping distances.

Typical cross sections to be applied for the project were presented in Fig. 12.7.

As for the widening sections of Morogoro and New Bagamoyo Roads, median strips or central reserves were provided to separate the oppositing traffic stream taking into account the safety of the traffic.

12.3.4 Intersection Design

Intersections to be provided on the proposed widening sections should be designed carefully on the baisis of the future traffic volume paying attention to the right-turnning traffic.

Priority intersections controlled with a traffic signpost or road marking were provided where the project roads cross the minor roads.

Table 12.7 Summary of Project Length by Improvement Measures

Name of Roads	Total Length (km)	Maintenance (km)	Overlay (km)	Reconstruction (km)	Widening (km)
P-1 Morogoro road	5. 72	–	–	–	5. 72
–Up to Morocco J	5. 72	–	–	–	5. 72
P-2 New Bagamoyo road	9. 79	2. 25	2. 30	1. 38	3. 86
Upanga road	1. 86	–	0. 30	0. 23	1. 33
New Bagamoyo road	7. 93	2. 25	2. 00	1. 15	2. 53
–Up to Morocco J.	3. 53	1. 00	–	–	2. 53
–Beyond Morocco J.	4. 40	1. 25	2. 00	1. 15	–
P-5 Mwinjuma Area Group	16. 73	0. 35	7. 03	9. 35	–
Mwinjuma area roads	2. 15	–	0. 75	1. 40	–
Mwinjuma L-1	1. 50	–	–	1. 50	–
Morocco road	3. 58	–	2. 78	0. 80	–
Kinondoni road	0. 70	0. 35	–	0. 35	–
Shekilango road	3. 80	–	2. 00	1. 80	–
Makanya road	5. 00	–	1. 50	3. 50	–
P-7 Central Area Group	20. 98	0. 20	17. 08	3. 70	–
Central Area roads	9. 80	–	6. 1	3. 7	–
Bandari road	2. 20	0. 20	2. 0	–	–
Nkrumah road	0. 36	–	0. 36	–	–
Sokoine road	0. 82	–	0. 82	–	–
Gerezani road	1. 39	–	1. 39	–	–
Kivukoni road	1. 22	–	1. 22	–	–
Maktaba road	0. 93	–	0. 93	–	–
Ohio road	0. 96	–	0. 96	–	–
Ocean road	3. 30	–	3. 30	–	–
P-8 Kariakoo Area Group	31. 68	3. 30	3. 70	24. 68	–
Kariakoo Area roads	30. 00	3. 30	2. 02	24. 68	–
Msimbazi road	1. 68	–	1. 68	–	–
P-9 Chango' mbe Area Group	19. 20	5. 38	4. 78	9. 04	–
Chango' mbe Area roads	14. 60	2. 55	3. 01	9. 04	–
Chango' mbe road	4. 60	2. 83	1. 77	–	–
Total	104. 10	11. 48	34. 89	48. 15	9. 58

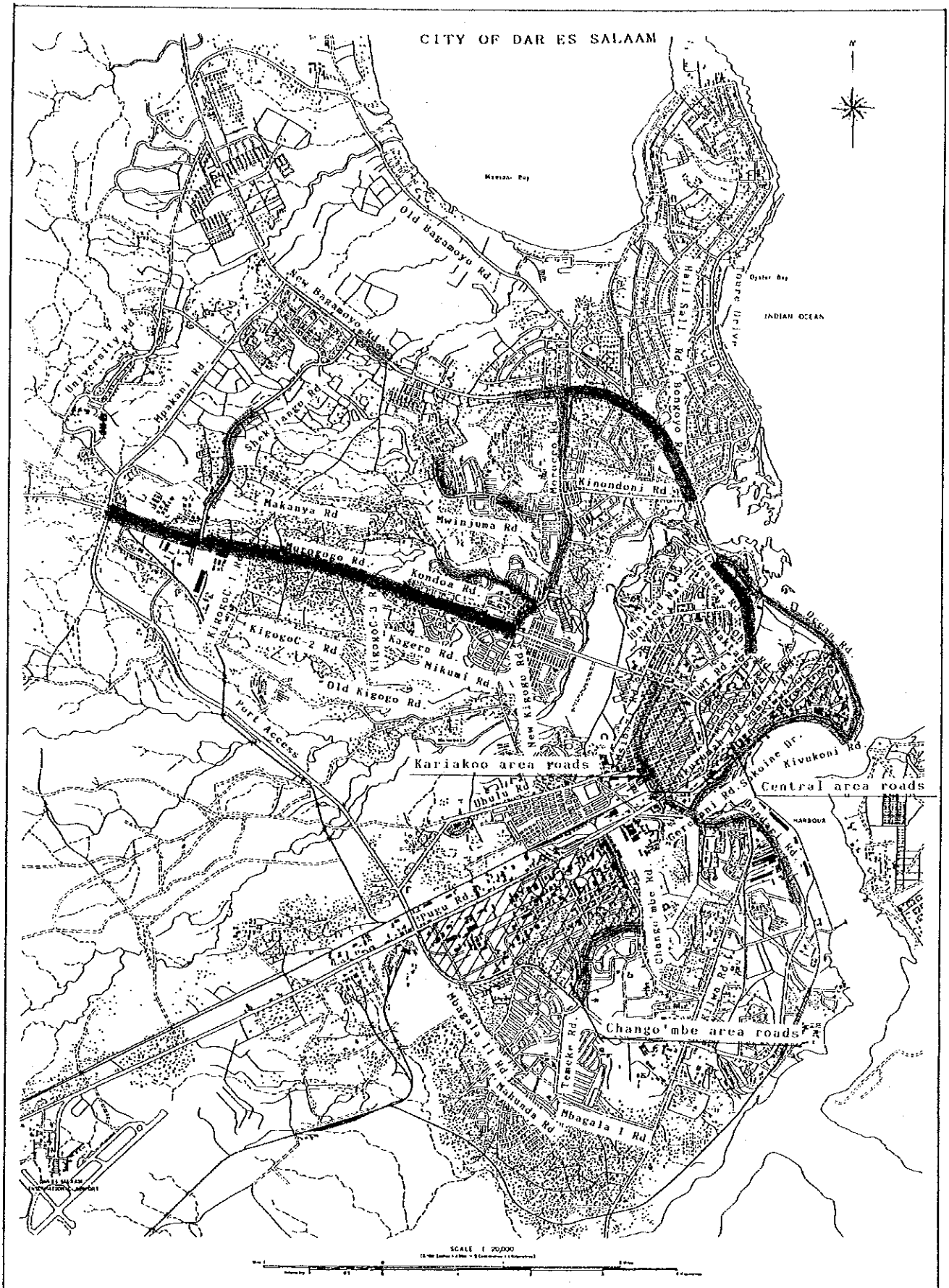


Fig 12.4. Project Roads by Improvement Measures (Summary)

- Maintenance
- Overlay
- Reconstruction
- Widening

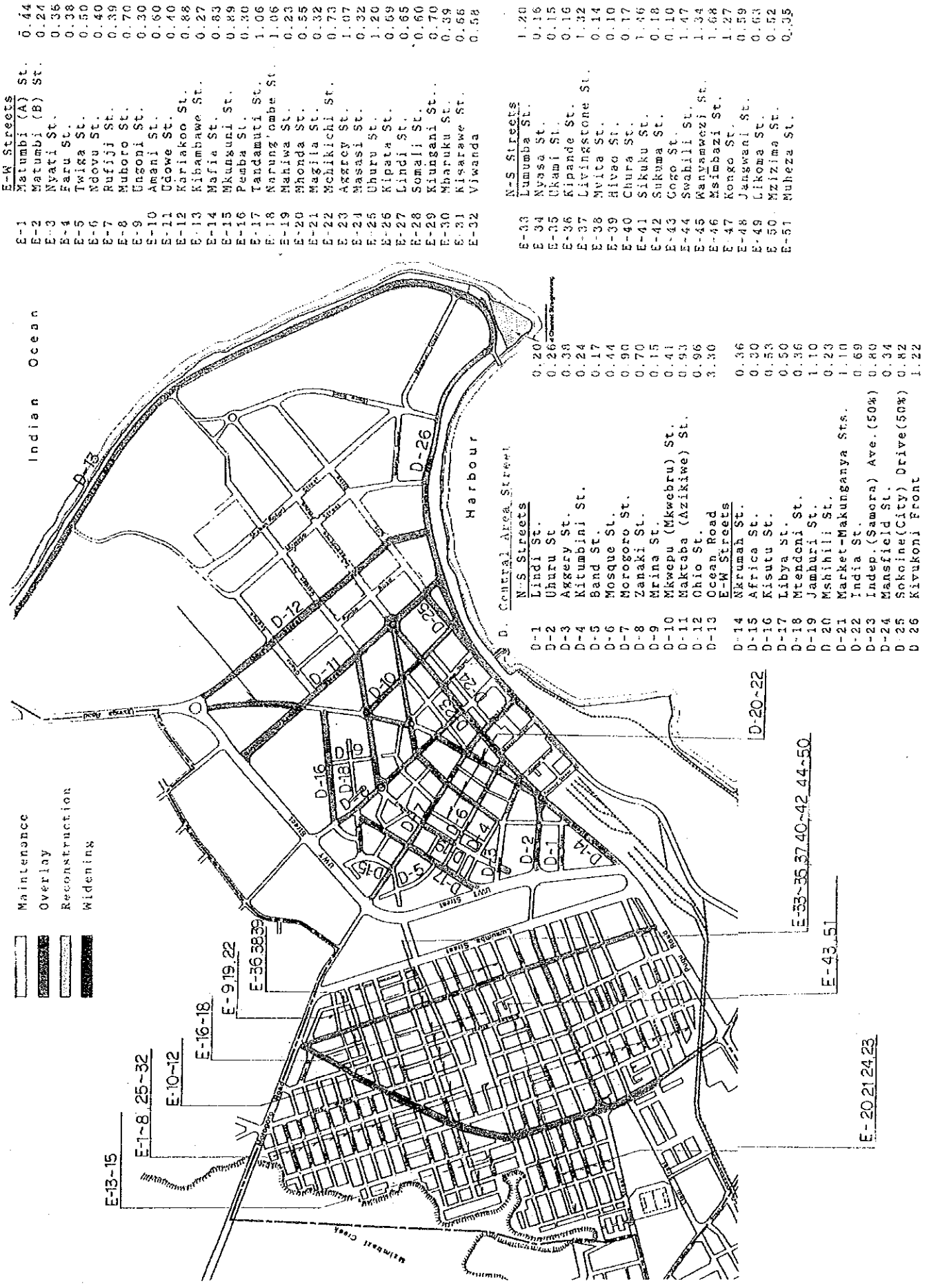


Fig 12.5 Detailed Improvement Measures of Central and Kariakoo Area Roads

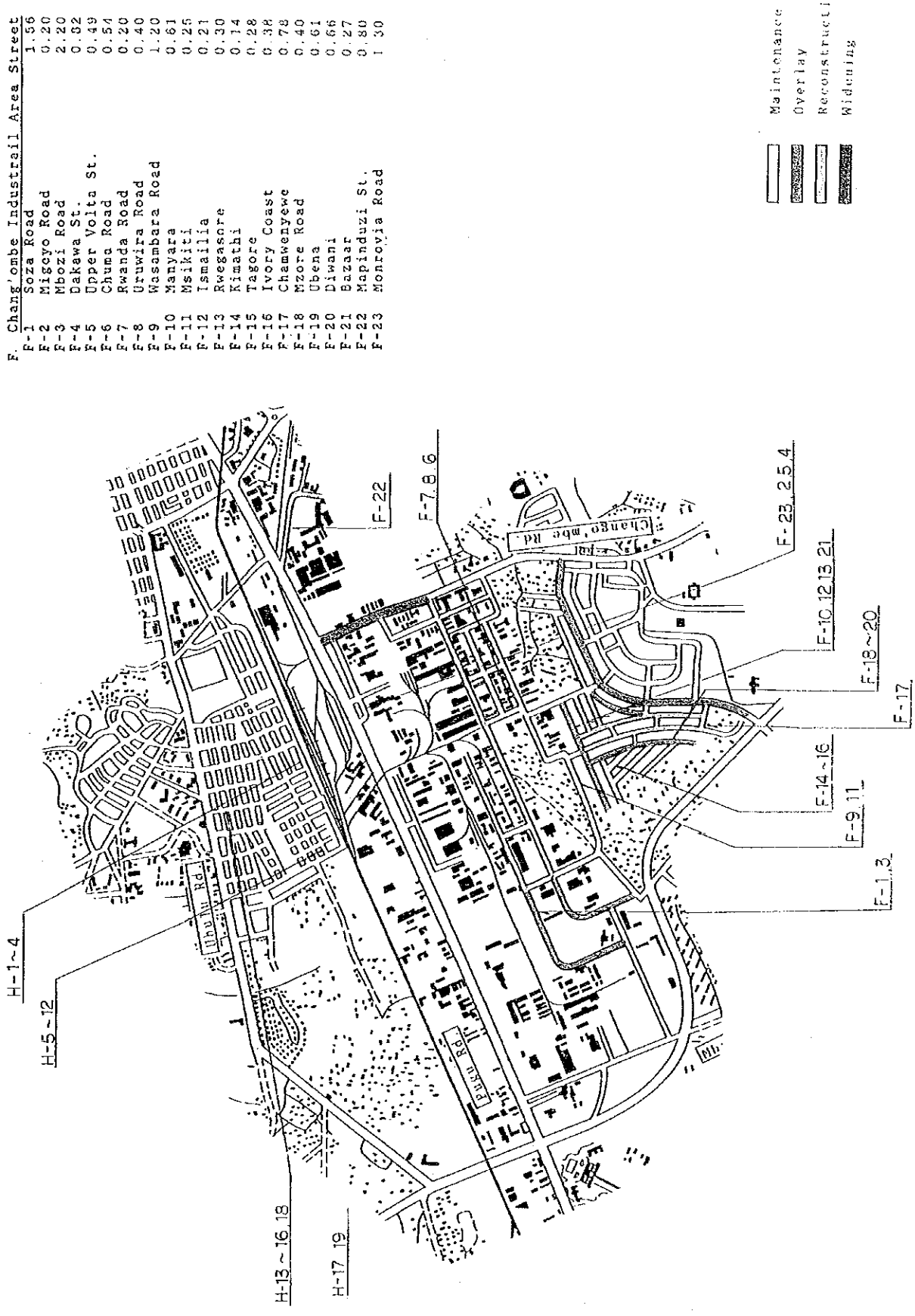
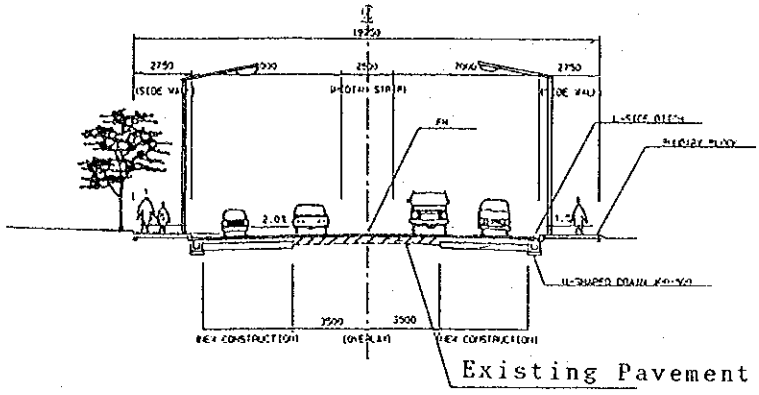
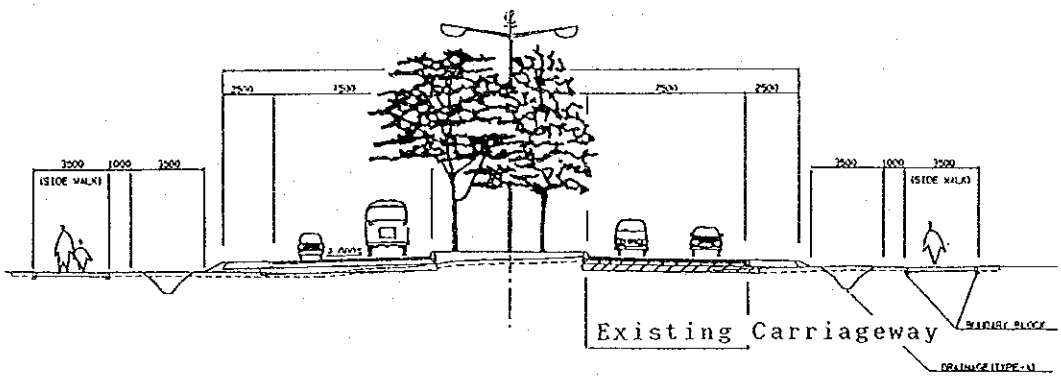


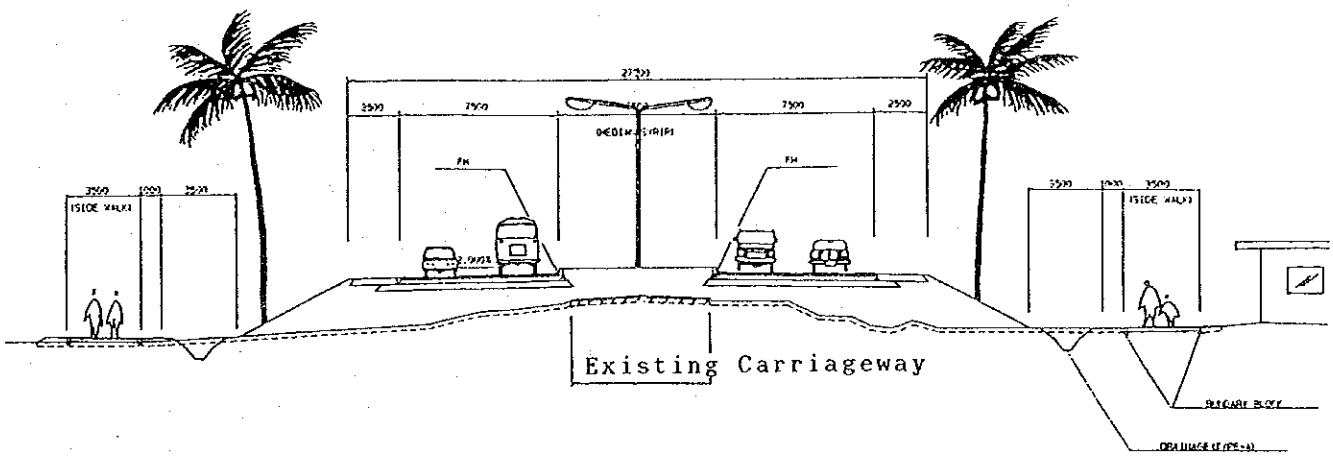
Fig 12.6 Detailed Improvement Measures of Chang'ombe Area Roads



Upanga Road



New Bagamoyo Road



Morogoro Road

Fig. 12.7 Typical Cross Sections of Proposed Roads

The storage lanes for right-turning traffic will be provided within the widthof the median strip proposed on Morogoro and New Bagamoyo Roads.

Where the project roads cross over the major roads (collector roads) or the heavily trafficked roads, intersections should be be designed with the facilities of traffic signals. Junction at Tanganyika Motor on Upanga Road controlled by roundabout should also be improved to the signal contolled intersection.

The study Team conducted the analysis on traffic movement at major junctions on the proposed roads. As the result, the Study Team recommendes to provide signal controlled intersections at the following ten (10) junctions:

Morogoro Road	; 1.	Port Access Junction
	2.	Shekilango Road Junction
	3.	New Kigogo Road Junction
Upanga Road	; 4.	Maktaba Street Junction
	5.	Tanganyika Motor Junction
New Bagamoyo Road	; 6.	Haile Sellasie Road Junction
	7.	Old Bagamoyo Road Junction
	8.	Morocco Road Junction
	9.	Shekilamgo Road Junction
	10.	Mpakani Road Junction

Improvement of Tanganyika Motors Roundabout

As for the Tanganyika Motors Junction, the Study Team recommendes the improvement proposal which allows right-turning traffic from UWT street into Ohio street and left-turning traffic from Ohio Street into UWT street. Instead, the entrance of Upanga Road at Tanganyika Motors roundabout will be closed so as to obtain smooth traffic flow in the new intersection controlled by traffic signals.

The Study Team recommends to improve the Maktaba-Upanga street junction and Maktaba-UWT junction to enable it to cater for the additional traffic which was using the section of Upanga Road which will then be having a dead end at the Tanganyika Motors roundabout.

12.3.5 Bus Bay and On/Off Loading Bay for Goods at Manzese

Bus service playes an important role in the public transport system in Dar es Salaam, so that special arrangement may be necessary to ensure that services can be effectively maintained and to avoid delays due to traffic congestion.

Since the proposed roads of Morogoro, Upanga and New Bagamoyo are used as main bus routes, they should include bus bays and passenger shelters where necessary. Bus bays should be located where they might not interfere with the flow of traffic or restrict visibility on bends or at junctions.

As for Morogoro Road, special type of bus bay and on/ off loading bay should be considered at Manzese area for large passengers as well as for goods and products brought to the nearby market.

12.3.6 Pavement Design

The pavement design was made for each road on the basis of data and information obtained through the sub-soil and pavement structural survey and future traffic volume estimated.

Type of pavement structure has been determined taking into consideration the availability of suitable aggregate for pavement interms of production, quality and prices. The following are the materials to be used for the pavement structures:

- Surface course ; Pre-mixes Asphalt Concrete, t=5.0cm)
- Base course ; Mechanically Stabilized Gravel, 2 in. - dust, CBR value more than 30%
- Sub-base course; Crusher run, 3 in. - dust, CBR value more than

Required thickness of pavement overlay was calcultated in accordance with the pavement component analysis developed by the Asphalt Institute in 1977 as stated in Chapter 10. The result of calculation was given in Table A-12-6.

Following is the calculation method employed for pavement design made on New Bagamoyo Road for reference:

(1) Overlay Design

New Bagamoyo Road

1. Initial Daily Traffic (IDT) in 1994 = 1,429 vehicle/day
   (Numbers of Heavey/Medium/Bus Traffic)
2. Estimated average gross mass of heavey trucks = 18,000 kg
3. Single-axle load limit = 8,165 kg
4. Initial Traffic Number (ITN) = 549
5. Design Period = 10 years
6. Traffic growth rate Heavey/Medium = 2.0 %
   Bus = 5.0 %
7. Initial Traffic Number adjustment factor
   Heavey/Medium = 0.55
   Bus = 0.80
8. DTN = 413 x 0.55 + 68 x 0.80 = 284
9. Design Subgrade Strength Value = CBR 8
10. Full-depth Asphalt Pavement Thickness, Ta = 200 mm
11. Effective Thickness, Te = 100 mm
12. Overlay Thickness, To-Ta - Te = 100 mm

(2) Reconstruction/Widening Design

Same calculation method of overlay was applied for the design of reconstruction and widening of pavements as follow:

New Bagamoyo Road

1. Initial Daily Traffic (IDT) in 1994 = 1,429 vehicle/day
   (Numbers of Heavey/Medium/Bus Traffic)
2. Estimated average gross mass of heavey trucks = 18,000 kg
3. Single-axle load limit = 8,165 kg
4. Initial Traffic Number (ITN) = 549
5. Design Period = 20 years
6. Traffic growth rate Heavey/Medium = 2.0 %
   Bus = 5.0 %
7. Initial Traffic Number adjustment factor
   Heavey/Medium = 1.21
   Bus = 2.86

8. DTN = 413 x 1.21 + 68 x 2.86 = 696
9. Design Subgrade Strength Value = CBR 8
10. Full-depth Asphalt Pavement Thickness, Ta = 245 mm
11. Coefficients of Each Structural Component

Surface course	e1	= 1.0
Base course	e2	= 0.35
Sub-base course	e3	= 0.25

12. Thickness of Each Strctutal Components

Surface course	Te1	= 10 cm
Base course	Te2	= 20 cm
Sub-base course	Te3	= 30 cm

Calculation of pavement thickness on each project roads are shown in Appendix 12.9 and summarized in Table 12.8.

12.3.7 Drainage Design

Drainage structures are one of the most important factors to keep the road in safe condition for traffic and to extend the life of road structures, especially pavement.

Superelevation (or crossfalls) of carriageways, footways, etc. should be sufficient to ensure the rapid drainage of surface water without causing any discomfort and danger of road users.

Minimum superelevation of carriageway applied for the project is 2.0 %. Surface water will be collected by means of sideditch and discharged through a piped drainage to the existing storm drainage system.

As stated in Chapter 7, most of the exsiting area roads are served by served by lined channel and underground piped systems, though they are not maintained properly. These existing drainage systems should be used as they are as much as possible without any improvement since the systems will be working well if daily or routine maintenance is done properly.

Drainage design was conducted employing the following criteria:

Table 12.8 Summary of Overlay and Reconstruction Design

Link No.	Name of Roads	Road Length (km) ①	Estimated CBR Val. (%) ②	Desige Period Overlay (Year) ③	Desige Period Recon. (Year) ④	Design Traffic Number (DTN) Overlay (2004) ⑤	Design Traffic Number (DTN) Recon. (2014) ⑥	Full-depth Thickn (TA) Overlay (2004) ⑦	Full-depth Thickn (TA) Recon. (2014) ⑧	Effective Thickness (Te) (mm) ⑨	Overlay Leng. (km)	Overlay Thick. (mm) ⑦-②	Reconstruction Leng. (km)	Reconstruction Structure (cm)
P-1	Morogoro road	5.72	–	–	–	–	–	–	–	–	–	–	–	–
	*-Up to Port Ac. J.	5.72	8	10	20	514	1314	230	245	120	–	–	–	10-20-30
P-2	New bagamoyo road	9.79	–	–	–	–	–	–	–	–	2.30	–	1.38	–
	*Upanga road	1.33	8	10	20	284	748	225	235	125	–	100	–	10-20-30
	-Centrual area road	0.53	8	10	20	8	16	135	150	120	0.30	25	0.23	5-15-25
	New bagamoyo road													
	*-Up to Morocco J.	3.53	8	10	20	–	696	–	235	–	–	–	–	–
	-Beyond Morocco J.	4.40	8	10	20	284	696	225	235	110	2.00	100	1.15	10-20-30
P-5	Mwinjuma road	16.73	–	–	–	–	–	–	–	–	7.03	–	9.35	–
	Mwinjuma road	2.15	10	10	20	104	270	170	185	55	0.75	100	1.40	7-20-25
	Mwinjuma L-1	1.50	10	10	20	–	13	–	100	–	–	–	1.50	5-15-25
	Morocco road	3.58	10	10	20	138	318	175	185	80	2.78	100	0.80	7-20-25
	Kinondoni road	0.70	10	10	20	–	146	–	165	–	–	–	0.35	5-15-25
	Shekilango road	3.80	6	10	20	57	128	195	215	55	2.00	100	1.80	10-20-30
	Makanya road	5.00	8	10	20	4	8	125	135	80	1.50	50	3.50	5-15-25
P-7	Centrual Area Group	20.98	–	–	–	–	–	–	–	–	17.08	–	3.70	–
	Central Area roads	9.80	8	10	20	8	16	135	150	120	6.10	25	3.70	5-15-25
	Bandari road	2.20	8	10	20	280	–	205	–	95	2.00	100	–	–
	Nkrumah road	0.36	8	10	20	7	–	100	–	120	0.36	25	–	–
	Sokoine road	0.82	8	10	20	244	–	205	–	120	0.82	80	–	–
	Gerezani road	1.39	8	10	20	273	–	205	–	95	1.39	100	–	–
	Kivukoni road	1.22	8	10	20	66	–	175	–	120	1.22	60	–	–
	Maktaba road	0.93	8	10	20	44	–	175	–	120	0.93	60	–	–
	Ohio road	0.96	8	10	20	8	–	135	–	120	0.96	25	–	–
	Ocean road	3.30	8	10	20	7	–	100	–	110	3.30	25	–	–
P-8	Kariakoo Area Group	31.68	–	–	–	–	–	–	–	–	3.70	–	24.68	–
	Kariakoo Area roads	30.00	8	10	20	27	57	160	165	75	2.02	90	24.68	5-15-25
	Msimbazi road	1.68	8	10	20	327	–	210	–	130	1.68	80	–	–
P-9	Chango' mbe Area Group	19.20	–	–	–	–	–	–	–	–	3.01	–	9.04	–
	Chango' mbe Area	14.60												
	-Factory area roads	7.61	8	10	20	58	179	175	200	110	1.35	70	5.41	7-20-25
	-Residence area roads	6.99	8	10	20	7	13	100	100	55	1.66	25	3.63	5-15-25
	Chango' mbe road	4.6	10	10	20	257	–	185	–	120	1.77	70	–	–

*Widening

(1) Culvert Design

- Minimum dimension of pipe culvert shall be 600 mm for ease of maintenance.
- Pipe culvert shall be designed using concrete headwalls, wing walls, protective aprons and toes.

(2) Ditches

- Roadside ditch should be covered with grouted riprap to prevent erosion of road structures and cut slope.
- Minimum dimention of roadside ditch should be 40cm x 50cm (Width x Height)

12.3.8 Utilities Relocation and Protection Design

The existing utility services should be relocated or protected properly so that repair and maintenance operations for the services may not hinder traffic and accelerate the deterioration of the road structures after open to traffic.

It is advised that the position of underground mains (pipes) should be accurately recorded to facilitate repair work and minimize obstruction and traffic delay.

Water Mains

Water mains laid along the proposed widening sections of Upanga, New Bagamoyo and Morogoro roads are mostly laid beneath the existing footways at 2 meter in depth approxi., so that the construction of widening may not interfere with these water mains.

Some of the hydrants located along roadside with protection of concrete walls may be affected by the road construction so that they must be relocated by the agency concerned to the suitable place outside of proposed carriageway before commencing the widening works.

Telephone Cables

The existing underground telephone cables laid along Upanga and New Bagamoyo Roads will be affected by the construction of widening and be replaced to the suitable place.

According to the officials concerned, the telephone cable systems in Dar es Salaam will be improved with a finacial assistance of third country and construction will be started in sometime early 1990.

The Study Team advises that new cables should be laid neaby the road boundary either on left or rigth side where footway will be provided under the road improvement project . Depth of the duct for new cables should be not less than 70 cm beneath the footway.

Electric Wires and Poles

There are plenty electric wires and poles located along roadside and cross the existing roads where widening works are proposed. The following numbers of poles should be relocated to outside the carriageway:

Approx. Numbers of Electric Wire/Poles to be Relocated

- Morogoro Road 70 nos.
- Upanga Road 25 nos.
- New Bagamoyo Road 40 nos.

12.3.9 Road Lighting and Other Facilities

Road Lighting Colunms

Since the function of proposed roads are classified into arterial road with a high design standards, lighting will be required to facilitate the safe of traffic movements including pedestrians. It will be efficient by night and should look well by day.

Lighting columns should be installed with a interval ranging from 40 m to 60 m within the median strips or footways. The colunms should be sited to minimize the obstruction of foot-

way and ensure the necessary clearances from the carriageway.

Traffic Signs/Carriageway Marking

On heavily trafficked urban roads like Upanga, New Bagamoyo and Morogoro roads, traffic signs are essential to prevent congestion and danger. Warning, restriction and information signs should be installed at proper location so as to allow ample time for any necessary actions.

Carriageway marking will be used not only to define traffic lanes but also to guide vehicles at junction and indicate the position of stop and waiting lanes.

Type and dimention of signs and carriageway marking should conform to the statutory instruments and regulations of authority concerned.

Trees

There are grown-up trees planted on both side along Upanga and New Bagamoyo Roads. They should be retained as they are as much as possible so as to keep better environment along the project roads.

12.3.10 Traffic Signal Design

Signal installations should be designed to meet peak conditions with appropriate reserve capacity taking into consideration the trafffic volume, turning movements for each peak priod and estimated rate of growth.

As stated in sub-clause 12.3.3 "Intersection Design", the Study Team recommended to provide the signal controlced intersections at two (2) places on Upanga, five (5) on New Bagamoyo and three (3) on Morogoro Roads. Since these roads are heavily conjested with an ADT of more than 15,000 vehicles, the linking signal system should be introducted to minimize the intereference to the through traffic stream. This sytem is quite effective when intersections are very close to each other.

12.3.11 Pedestrian Bridge

The pedestorian bridge, the first pedestrian bridge in Dar es Salaam, will be constructed across Morogor Road at Manzese market area. Since the bridge is located where many people and drivers are forcusing to the market everyday, it will be the object of public attention.

Therefore the bridge should be designed taking into consideration not only the economic and structural aspects but also aethethic point of view.

Feature of the proposed bridge are as shown below:

- Location : Proposed Bus Terminal at Manzese
- Purpose : Pedestrian bridge
- Type of Bridge : Prestressed Hollow Slab Concrete (PC)
- Bridge Length : 48 m
- Span Arrangement: 10.1 x 2@12.25 x 10.1
- Bridge Width : 5 m
- Step Width : 3 m

Bridge design was conducted in accordance with Road Bridge Design Mannual published by Japan Road Association with design conditions as shown below:

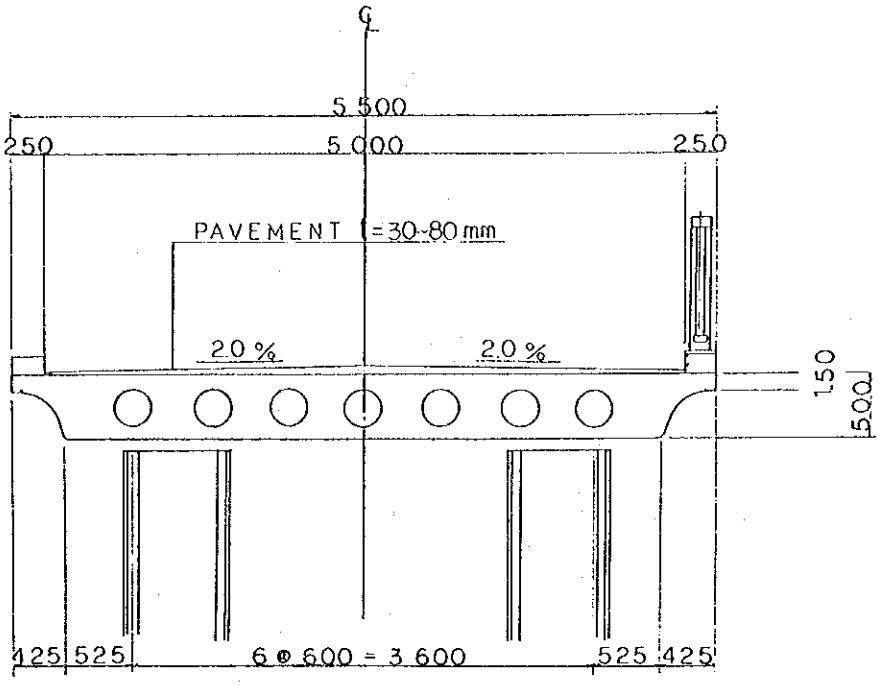
- Live load (Pedestrian load): 350 kg/sq.m
- Earthquick load : Not applicable

Vertical clearance applied for the bridge was 5.0m in minimum, taking into account the large country buses carrying goods and products on their top.

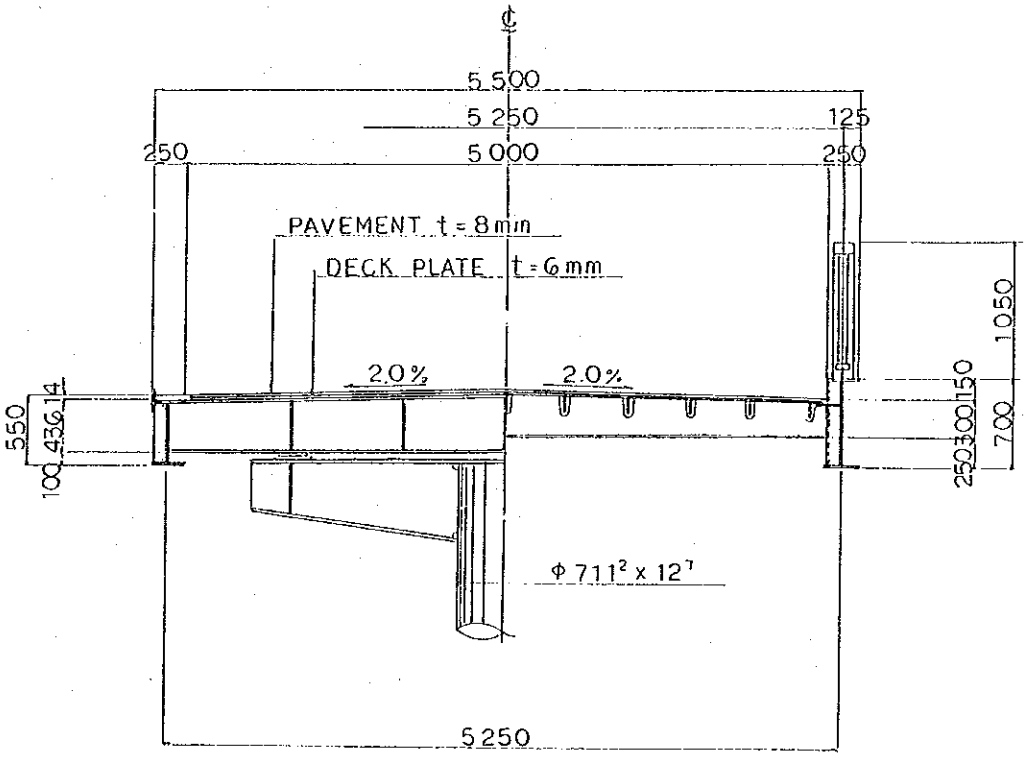
Alternative study was conducted to find the most reasonable pedestrian bridge. The following alternative bridges were considered:

Alternative 1 : Prestresses Concrete Hollow Slab Bridge
Alternative 2 : Metal Plate Floor Bridge

The result of comparative study was presented in Fig. 12.8 and Table 12.9.



Alternative 1: Prestressed Concrete Hollow Slab Bridge



Alternative 2: Metal Plate Floor Bridge

Fig 12.8 Typical Cross Section of Alternative Bridges

Table 12.9 Alternative Study on Pedestrian Bridge at Manzese

Items of Evaluation	Alternative 1 PC Hollow Slab	Alternative 2 Metal Plate Floor
1. Project Cost - Super Structure - Sub Structure	46,300 Million (34,500) (11,800)	41,300 Million (40,800) (6,500)
2. Workability	Stagings required for construction of the super-structure will interefere with public traffic.	No staging works are required.
3. Maintenance	Maintenance cost is very small.	Painting is required at every 7 years.
4. Aethetic View	Excelent	Good
5. Technology Transfer	New technology	Ordinary technology
6. Conclusion	The Study Team recommendes PC Hollow Slab Bridge from the view point of construcion and maintenance costs as well as aethetic aspect and technology transfer.	

12.3.12 Buildings/Houses to be Removed

The buildings and houses irregularly occupied within the road reserve are not so many with the exception of Morogoro Road.

The government should compensate and demolish the following numberes of buildings and houses before commencing the projects:

Morogoro Road

Private houses

Type A: House built of concrete (Large) 5 Nos.

Type B: House built of bricks (Small) 13 Nos.

CHAPTER 13 CONSTRUCTION PLAN AND SCHEDULE

13.1 General

The construction works consist mainly of the improvement of road structures in Category A, the urgent repair of pot-holes in Category B and the improvement of road maintenance system in Category C. The salient features of Category A, which is the main feature of this project, are summarized in Table 13.1.

The construction planning described in this report is prepared based on design structures taking into consideration the prevailing mechanized construction methods, similar international projects and so on.

The direct construction cost is estimated based on construction planning and unit costs of labour, material and equipment. Such unit costs consist of local and/or foreign currency allotments in accordance with their origins.

13.2 Construction Plan and Schedule

13.2.1 Construction Conditions

(1) Workable Days and Working Hours

Based on the suspension days occured due to rainfall and other given conditions such as Sundays and national holidays, the workable days for the construction planning are shown below.

Work item	Annual workable days
- Earth Works	228 days
- Pavement Works	216 days
- Drainage Works	252 days

Daily working hours are set at 8 hours for Mondays to Fridays and 6.5 hours for Saturdays. Total working hours per week are fixed at 46.5 hours.

Table 13.1 Project Principal Features

NAME OF ROADS	Total Length (km)	Section of Maintenance level (km)	Category A (1) Overlay (km)	(2) Reconst-ruction (km)	(3) Widening (km)	(4) Drainage Structure (km)	(5) Bus bay (nos.)	(6) Inter-section (nos.)	(7) Lightng (nos.)	(8) Signal (nos.)
1. New bagamoyo	**9.8**	**2.3**	**2.3**	**1.4**	**3.9**	**0.2**	**19**	**4**	**91**	**7**
1.1 Up to Morocco J.	3.5	1.0	0.0	0.0	2.5	0.1	3	3	25	4
1.1 Beyond Morocco J.	4.4	1.3	2.0	1.2	0.0	0.0	12	0	0	1
1.13 Upanga	1.9	0.0	0.3	0.2	1.3	0.0	4	1	66	2
2. 1.4 Morogoro (Up to Port Ac.J.)	**5.7**	**0.0**	**0.0**	**0.0**	**5.7**	**0.2**	**16**	**2**	**98**	**3**
3. Chang'ombe Area Group	**19.2**	**5.4**	**4.8**	**9.0**	**0.0**	**0.0**	**0**	**0**	**0**	**0**
3.F Chang'ombe area	14.6	2.6	3.0	9.0	0.0	0.0	0	0	0	0
2.17 Chang'ombe	4.6	2.8	1.8	0.0	0.0	0.0	0	0	0	0
4. Kariakoo Area Group	**31.7**	**3.3**	**3.7**	**24.7**	**0.0**	**0.0**	**0**	**0**	**0**	**0**
3.E Kariakoo area	30.0	3.3	2.0	24.7	0.0	0.0	0	0	0	0
1.11 Msimbazi	1.7	0.0	1.7	0.0	0.0	0.0	0	0	0	0
5. Mwinjuma Area Group	**16.7**	**0.4**	**7.0**	**9.4**	**0.0**	**0.0**	**12**	**8**	**0**	**0**
2.7 Mwinjuma	2.2	0.0	0.8	1.4	0.0	0.0	0	0	0	0
3.I Mwinjuma,L-1	1.5	0.0	0.0	1.5	0.0	0.0	0	0	0	0
1.2 Morocco	3.6	0.0	2.8	0.8	0.0	0.0	12	8	0	0
1.3 Kinondoni	0.7	0.4	0.0	0.4	0.0	0.0	0	0	0	0
2.5 Shekilango	3.8	0.0	2.0	1.8	0.0	0.0	0	0	0	0
2.8 Makanya	5.0	0.0	1.5	3.5	0.0	0.0	0	0	0	0
6. Central Area Group	**21.0**	**0.2**	**17.1**	**3.7**	**0.0**	**0.0**	**0**	**0**	**0**	**3**
3.D Central area	9.8	0.0	6.1	3.7	0.0	0.0	0	0	0	0
1.8 Bandari	2.2	0.2	2.0	0.0	0.0	0.0	0	0	0	0
1.15.1 Nkrumah	0.4	0.0	0.4	0.0	0.0	0.0	0	0	0	0
1.15.3 Sokoine	0.8	0.0	0.8	0.0	0.0	0.0	0	0	0	0
1.15.4 Gerezani	1.4	0.0	1.4	0.0	0.0	0.0	0	0	0	0
1.15.5 Kivukoni	1.2	0.0	1.2	0.0	0.0	0.0	0	0	0	0
1.15.6 Maktaba	0.9	0.0	0.9	0.0	0.0	0.0	0	0	0	3
1.15.7 Ohio	1.0	0.0	1.0	0.0	0.0	0.0	0	0	0	0
1.15.8 Ocean	3.3	0.0	3.3	0.0	0.0	0.0	0	0	0	0
Total	**104.1**	**11.5**	**34.9**	**48.1**	**9.6**	**0.4**	**47**	**14**	**189**	**13**

(2) Natural Material Sources

Coarse aggregate used in concrete and asphalt pavement is assumed to be procured from the Mikese area which is located at a distance of 140 Km from Dar es Salaam City.

In concrete and asphalt pavement fine aggregate is assumed to be procured from the Mpiji River deposit which is located at a distance of 45 Km from Dar es Salaam City.

Rock materials for base and sub-base course pavement are assumed to be procured from the Kunduchi area which is located at a distance of 20 Km from Dar es Salaam City.

Soil materials for the road embankments are assumed to be procured from the area which is located along Port Access Road.

(3) Public Supply for Construction Works

In general, existing roads will be utilized as access roads for construction purposes. Unpaved or narrow roads such as temporary access roads to quarry sites will require periodical repair and maintenance.

Though electric power cable lines are distributed, power will be obtained from diesel generators installed at sites in case of sudden cuts in power.

Water for construction use will be distributed from river water which will necessitate the installation of a purification plant beside the plant yard in the temporary facility area.

Although a telecommunication system is distributed, its capacity to accept new lines immediately is inefficient. Under such circumstances, it will be necessary to install a radio communication system.

(4) Construction Method

Construction works will commence after land acquisition and relocation of public utilities has been decided upon by

the Government of Tanzania, if necessary.

All the construction works for the Project will be executed on a contract basis emplying contractor(s) who will be selected through competitive bidding. A mechanized construction method will be applied in principle from the perspective of work efficiency and economy. All construction works will be supervised by an engineering consultant firm.

Construction work for improvement of road structures and repair of pot-holes will be required to control the traffic system, to insure the safty of labourers and to minimize traffic interruption. Prior to the commencement of construction work, the planning of detours shall be examined in consideration of the existing traffic flow and system.

13.2.2 Temporary Construction Facilities

Temporary facilities shall be provided prior to the commencement of construction work. A general layout for temporary facilities will be examined taking into account the availability of quantities and qualities of materials and land area. The layout plan is shown in Appendix 13.1.

(1) Temporary Buildings and Related Structures

Offices and quarters for construction personnel engaged in this project such as the Client, the Engineers and the Contractors shall be provided in the area of temporary facilities.

The provision of labour camps near the construction sites will also be necessary.

For the purpose of fluent execution of the major works, warehouses, work shops, repair shops, motor pool yards, laboratories and medical clinics should also be provided.

(2) Construction Plant

a. Asphalt Plant

One number of asphalt plant of 30 ton/hr in capacity will be installed in the area of temporary facilities taking into account the critical need of asphalt pavement in the fiscal year 1992/93 for the Morogoro and Kariakoo groups.

b. Crushing Plant

Two crushing plants will be provided for base and sub-base course pavement. Each plant has a capacity of 30 ton/hr. One will be utilized in processing base and sub-base course materials. The other will be utilized in crushing coral stone materials to maintain a ranged proportion of base course specification.

13.2.3 Construction Package

A contract of this project will be signed between DCC, which is the representative of the Government of Tanzania, and one main contractor.

The project consists of three construction packages classified as Category A to C which consider the nature of principal features.

(1) Category A

Category A is classified as the improvement of road structures which includes overly, reconstruction, widening, bus bays, intersections, drainage structures, road lighting system and traffic signals. These improvements are categorized into six(6) work lots mentioned below in consideration of prioritization in the Master Plan Study.

-LOT A-1 New bagamoyo group : 9.79 Km
-LOT A-2 Morogoro road : 5.72 Km
-LOT A-3 Chang'ombe area group: 19.20 Km
-LOT A-4 Kariakoo area group : 31.68 Km
-LOT A-5 Mwinjuma area group : 16.73 Km
-LOT A-6 Central area group : 20.98 Km

(2) Category B

Category B is classified as urgent repair of pot-holes for 206 km. This work will be conducted by one(1) lot as specified in LOT B-1.

(3) Category C

Category C is classified as the improvement of road maintenance system for all roads in the Dar es Salaam City area, which includes the three (3) work lots mentioned below.

-LOT C-1 Construction of main depot
-LOT C-2 provision of maintenance equipment
-LOT C-3 Guidance and training

13.2.4 Construction Plan and Schedule

Construction plan, and construction schedule for the three categories are described in this section.

The construction time schedule of the Project is prepared taking into account of prevailing construction methods and construction conditions. The Order of construction is decided from the result of priorization in the Master Plan.

The total construction period is set at four years. A breakdown of the construction period in each Category is mentioned below.

-Category A
-LOT A-1 : 1990.April - 1992.March(2 years)
-LOT A-2 : 1991.April - 1993.March(2 years)
-LOT A-3 : 1991.April - 1992.March(1 year)
-LOT A-4 : 1992.April - 1993.March(1 year)
-LOT A-5 : 1993.April - 1994.March(1 year)
-LOT A-6 : 1990.April - 1991.March(1 year)

-Category B

-LOT B-1 : 1990.Dec. - 1992.Mar. (16 months)

-Category C

-LOT C-1 : 1990.Dec. - 1992.Oct. (11 months)

-LOT C-2 : 1990.Dec. - 1992.Oct. (11 months)

-LOT C-3 : 1991.Apr. - 1994.Mar. (36 months)

In order to keep to the above mentioned construction period, the necessary numbers of plant and equipment is examined by work quantity and production rate, and is shown in Table 13.2.

In accordance with construction package classification described in Section 13.2.3, an outline of the construction planning and methods is given below.

(1) LOT A

a) Overlay

Overlay work consists of asphalt pavement work ranging from 25 mm to 100 mm in thickness and, if necessary, cleaning and flushing of existing drainage system prior to the pavement work.

b) Reconstruction

Reconstruction work will begin with the removal of existing pavement. Following this, if necessary, the re-installation of existing drainage work will be carried out. Finally, road pavement work will be carried out on each specified road.

c) Widening

Road widening work will be devided into three stages. In the first stage, one side lane(s) along the existing roads will be constructed including related structures. After completion of the first stage consturction, oposit side lane(s) will begin in the second stage of construction work. In the final stage, central reserve construction work will be performed on the existing road.

Table 13.2 Required Numbers of Plant and Equipment

Particular	Spec.	Required Numbers
1.Bulldozer	21 t	2 Numbers
2.Bulldozer,w/ripper	32 t	1 Number
3.Tractor shovel	3.2 m^3	1 Number
4.Wheel loader	2.1 m^3	1 Number
5.Backhoe	0.6 m^3	1 Number
6.Backhoe	0.4 m^3	1 Number
7.Dump truck	11 t	34 Numbers
8.Dump truck	8 t	14 Numbers
9.Cargo truck	6 t	2 Numbers
10.Asphalt cooker	4 m^3	3 Numbers
11.Truck crane	4.9 t	2 Numbers
12.Truck crane	20 t	2 Numbers
13.Macadam roller	10 t	2 Numbers
14.Asphalt finisher	2.4 m	2 Numbers
15.Engine sprayer	0.4 m^3	2 Numbers
16.Emulsion sprayer	200 l	2 Numbers
17.Asphalt kettle	400 l	2 Numbers
18.Motor grader	3.1 m	2 Numbers
19.Tire roller	8 t	2 Numbers
20.Vibrating roller	4 t	2 Numbers
21.Vibrating roller	0.5 t	2 Numbers
22.Plate compactor	90 kg	2 Numbers
23.Rammer	60 kg	2 Numbers
24.Water tanker	8 kl	2 Numbers
25.Vacuum car	4 m^3	2 Numbers
26.Truck mixer	3.2 m^3	2 Numbers
27.Asphalt plant	30 t/h	1 Number
28.Screening plant	30 t/h	2 Numbers
29.Concrete mixer	0.5 m^3	1 Number
30.Crushing plant	30 t/h	1 Number
31.Water jet	5 lit.	2 Numbers
32.Concrete vibrator	45 mm	2 Numbers
33.Diesel generator	50 kVA	10 Numbers
34.Diesel generator	10 kVA	10 Numbers
35.Air compressor	5.0 m^3	2 Numbers
36.Vacuum pump	80 mm	2 Numbers

d) Drainage Structure

For the purpose of improving existing drainage systems, new cross drainage pipes will be installed under the existing roads at specified sections. This work will be divided into three stages. In the first stage, drainage pipes will be installed under both sidewalk portions. Following that, asphalt pavement for temporary roads will be constructed on both sidewalk portions. In the final stage, drainage pipes will be installed under the existing road portion.

e) Bus bay

Bus bay construction work is a kind of widening work. Major work will consist of the construction of road pavement, boundary blocks and installation of bus stop roof. If necessary, as in the case of Morogoro Road, the installation of a side drainage system will be needed to prevent flooding.

f) Intersection

Construction of intersection will begin with the removal of existing roundabout structures. After that, pavement work will be carried out including related structural work. In addition to the above, controlled or uncontrolled traffic signals will be installed on New Bagamoyo road, Upanga road and Morogoro road.

(2) LOT B

The urgent repair of pot-holes in LOT B-1 consists of the removal of existing pavement followed by repavement work to fill in the void. For the purpose of labour safety and to minimize anticipated traffic congestion, sign boards and rubber cones shall be provided under the control of watchmen.

(3) LOT C

a) Main depot

The main depot includes the construction of buildings and related facilities,as well as the provision of repair shop equipment and instruments. Land clearing and grading works will be carried out by the government's direct force prior to the construction of the buildings and related

facilities. Building construction work will be performed taking into account the existing methods and materials in Tanzania.

b) Provision of Maintenance Equipment

During construction of the main depot, maintenance equipment will be procured from foreign countries. Immediately after delivery, operation and maintenance guidance will be given to local operators and mechanics by the contractor.

13.3 Cost Estimate

13.3.1 Conditions for Cost Estimate

(1) Price Level and Exchange Rate

All costs for the Project are estimated on the price level of October in 1989.

The exchange rates of (1) the United States doller ($) converted into Tanzanian Shillings (TShs.) and Japanese Yen (¥) are TShs.144.0 and ¥ 144.0 respectively.

(2) Currency of Cost Estimate

The currency for cost estimate is expressed in Tanzanian Shillings for local currency component and in Japanese Yen for foreign currency component, respectively. Total project cost is expressed in Tanzanian Shillings.

The local and the foreign currency components include the following items respectively;

a) Local currency components

- Labour cost
- Cost of local materials
- Mechanic and managing cost for repair of plant and equipment
- Port charges at Dar es Salaam Seaport

- Inland transportation cost and insurance
- Contractor's site expense
- General expense
- Physical contingency
- Engineering service
- Relocation of public utilities
- Government administration expense
- Land compensation cost

b) Foreign currency component

- Cost of construction experts
- Cost of imported materials
- Depreciation,maintenance and management costs of plants and equipment
- Freight charge and insurance cost
- Contractor's site expense and general expense
- Engineering service
- Physical contingency
- Procurement cost for public utilities

(3) Constitution of the Project Cost

The project cost is estimated in accordance with the construction cost, plants and equipment costs including installation cost, the costs for contingency and engineering service and the costs for nomplementary works. Constitution of the project cost is described below.

a) Construction cost

- Direct cost for temporary works
- General cost for temporary works
- Transportation and packing cost
- Direct construction cost
- Cost for site expense of the Contractor
- Cost for construction experts
- General expense
- Provision of plant and equipment cost

b) Physical contingency

c) Engineering service cost

- Direct expense
- Direct personnel cost
- Indirect cost

d) Relocation of Public Utilities

- Water supply
- Power supply

e) Government Administration Expense

- Government staff
- Office expense
- Direct cost

f) Land Compensation Cost

- Land acquisition cost
- Temporary rental cost

(4) Constitution of Unit Price

The unit price of each work item consists of the cost of labour, materials and equipment. The contractor's indirect cost and mark up are excluded from these unit prices.

a) Labour Cost

The local labour cost is computed in the local currency component in the cost estimate. The rates of labour wage are shown in Table 13.3.

b. Material Cost

Prices of locally procured materials are canvassed from Dar es Salaam City area, and foreign materials are assumed to be procured from Japan. Such unit costs of material are listed in Table 13.4.

c) Plant and Equipment Expense

The expense of each plant and equipment is calculated using a rate of F.O.B.price at shipping ports in foreign countries (tentatively using chart of Japan). Each hourly or daily plant and equipment cost is shown in Table 13.5.

Table 13.3 Labour Wage

Particular	Basic Wage (TShs./day)	Charges (TShs./day)	Total wage (TShs./day)
1.Foreman	600	150	750
2.Mechanic	480	120	600
3.Electrician	480	120	600
4.Operator A	480	120	600
5.Operator B	375	95	470
6.Assistant operator	300	75	375
7.Driver	300	75	375
8.Mason	300	75	375
9.Rigger	300	75	375
10.Welder	300	75	375
11.Pipe fitter	300	75	375
12.Pavement worker	300	75	375
13.Steel worker	300	75	375
14.Concrete worker	250	65	315
15.Carpenter	300	75	375
16.Skilled labour	300	75	375
17.Semi-skilled labour	250	65	315
18.Common labour	150	40	190

Note:

(1) Working hour

- from Mon. to Fri.;7:30-16:30(Lunch 12:00-13:00)
- Saturdays ;7:30-14:00

(2) Overtime Rate

- Weekday ; 25 % up
- Midnight; 50 % up
- Sundays ; 50 % up

Table 13.4 Unit Cost of Materials

Particular	Unit	F/C portion (TShs.)	L/C portion (TShs.)
1.Light oil	lit.	0	33
2.Gasoline	lit.	0	77
3.Lubricant	lit.	0	267
4.Cement,ordinary	ton	0	10,615
5.Water-reduce agent	kg	320	0
6.Deformed bars	ton	66,000	0
7.Round bars	kg	63	0
8.Channel steel	ton	62,000	0
9.Corrugated sheet	sq.m	1,000	0
10.Timber	cu.m	0	23,600
11.Plywood,2.4x0.1x0.01	pc.	0	405
12.Form oil	lit.	0	59
13.Annealed iron wire	kg	90	0
14.Nail	kg	116	0
15.Metal form,0.3x1.5m	pc.	2,510	0
16.Hunch form,0.1x1.5m	pc.	2,960	0
17.Cone	no.	27	0
18.Separator	m	70	0
19.Pipe support,48.6mm	m	340	0
20.Concrete pipe,1000mm	m	0	16,900
21.Straight asphalt	ton	34,000	0
22.Asphalt emulsion	kg	48	0
23.Coral stone	ton	0	700
24.Coarse aggregate	ton	0	1,130
25.Fine aggregate	ton	0	700

13.3.2 Unit Price

The direct construction cost is estimated on the unit price basis multiplying the unit price of work by the corresponding work quantity. The unit price is estimated based on the construction method described in the chapter 13.2.4. Unit prices for major work items are listed in Table 13.6.

13.3.3 Major Work Quantities

According to the structural design based on the site survey results, work quantities are calculated for each selected road, and major work quantities are shown in Table 13.7.

Detailed quantity calculations for each work item are presented in Appendix 13.2.

13.3.4 Complementary Works

Implementation of the construction works will require relocation of public utilities such as electricity power cable lines and water main valves and land compensation to keep necessary construction areas prior to the commencement of the construction works through the direct force of the Government of Tanzania. Scope of such complementary works is described as follows;

(1) Relocation of electricity power supply cable lines

Total length of relocation works is assumed to be 16.7km, out of which total length, 3.5km in New Bagamoyo Road, 1,8km in Upanga Road and 11.4 km in both sides of Morogoro Road are estimated. The breakdown of the cost components in the foreign and the local currency portions are categorized below.

a) Foreign Currency Portion

- Procurement cost of power cable lines for 16.7 km

Table 13.5 Plant and Equipment Expense

Particular	Spec.	Unit	F/C portion (TShs.)	L/C portion (TShs.)
1.Bulldozer	21 t	hr	6,613	614
2.Bulldozer,w/ripper	32 t	hr	11,279	1,013
3.Tractor shovel	3.2 m^3	hr	7,413	684
4.Wheel loader	2.1 m^3	hr	3,904	360
5.Backhoe	0.6 m^3	hr	3,698	309
6.Backhoe	0.4 m^3	hr	2,658	222
7.Dump truck	11 t	hr	1,532	139
8.Dump truck	8 t	hr	1,203	109
9.Cargo truck	6 t	hr	816	74
10.Asphalt cooker	4 m^3	hr	9,642	812
11.Truck crane	4.9 t	hr	1,779	194
12.Truck crane	20 t	hr	3,910	480
13.Macadam roller	10 t	hr	1,642	174
14.Asphalt finisher	2.4 m	hr	4,047	429
15.Engine sprayer	0.4 m^3	hr	169	8
16.Emulsion sprayer	200 l	day	869	40
17.Asphalt kettle	400 l	day	775	42
18.Motor grader	3.1 m	hr	3,022	286
19.Tire roller	8 t	hr	2,006	215
20.Vibrating roller	4 t	hr	1,805	172
21.Vibrating roller	0.5 t	hr	567	38
22.Plate compactor	90 kg	day	840	41
23.Rammer	60 kg	day	877	43
24.Water tanker	8 kl	hr	1,875	157
25.Vacuum car	4 m^3	hr	2,249	188
26.Truck mixer	3.2 m^3	hr	1,800	152
27.Asphalt plant	30 t/h	hr	16,426	1,534
28.Screening plant	30 t/h	day	20,681	1,223
29.Concrete mixer	0.5 m^3	day	6,011	407
30.Crushing plant	30 t/h	day	51,879	3,068
31.Water jet	5 lit.	day	707	63
32.Concrete vibrator	45 mm	day	473	23
33.Diesel generator	50 kVA	day	4,167	315
34.Diesel generator	10 kVA	day	1,521	115
35.Air compressor	5.0 m^3	day	4,948	372
36.Vacuum pump	80 mm	day	3,389	233

Table 13.6 Unit Price List for Major Work Items

(Exchange Rate : 1.0US$ = TShs.144.0 = JYE 144.0)

Item No.	Work	Unit	F/C Portion (TShs.)	L/C Portion (TShs.)	Total (TShs.)
1.EARTH WORKS					
E-1	Clearing and removal of unsuitable materials	sq.m	55	25	80
E-2	Waste excavation,common	cu.m	335	135	470
E-3	Waste excavation,rock	cu.m	530	200	730
E-4	Embankment, borrowed material	cu.m	370	150	520
E-5	Embankment, excavated material	cu.m	230	60	290
E-6	Removal of existing pavement	cu.m	470	200	670
2.PAVEMENT WORKS					
P-2	Sub-base course pavement	cu.m	930	1,930	2,860
P-3	Base course pavement	cu.m	1,630	2,400	4,030
P-4	Shoulder pavement	cu.m	1,470	2,830	4,300
P-5	Prime coat	sq.m	65	5	70
P-6(F)	Asphalt pavement, t=50,100mm	ton	4,210	1,630	5,840
P-7	Sidewalk	sq.m	390	460	850
P-8	Kerb stone	lin.m	310	880	1,190
P-9	Boundary block	lin.m	180	550	730
3.DRAINAGE WORKS					
D-1	Side riprap drainage	sq.m	70	280	350
D-2(B)	Side flume drainage, 400 x 500	lin.m	1,930	4,140	6,070
D-3	L-shaped side ditch	lin.m	590	1,180	1,770
D-6	Pipe culvert,type A, diam.= 600mm	lin.m	2,950	11,750	14,700
D-7(B)	Pipe culvert,type B, diam.= 600mm	lin.m	1,130	8,300	9,430
D-8	Re-installation of existing drainage	lin.m	780	380	1,160

Table 13.7 Major Work Quantities

Item No.	Description		Unit	Quantity						
				Total	LOT A-1	LOT A-2	LOT A-3	LOT A-4	LOT A-5	LOT A-6
	1.Earth Works									
E-1	Clearing and removal of unsuitable materials		sq.m	301,000	95,000	206,000				
E-2	Waste excavation	common	cu.m	145,000	19,000	51,000	13,000	37,000	20,000	5,000
E-3	Waste excavation	rock	cu.m	10,700	10,700					
E-4	Embankment	borrowed material	cu.m	45,100	11,900	33,200				
E-5	Embankment	excavated material	cu.m	30,400	9,700	20,700				
E-6	Removal of existing pavement		cu.m	63,800	4,300	9,600	12,400	22,600	7,400	7,500
	2.Pavement Works									
P-2	Sub-base course pavement		cu.m	121,000	21,000	32,000	13,000	33,000	15,000	7,000
P-3	Base course pavement		cu.m	84,300	13,600	20,300	9,300	26,600	10,400	4,100
P-4	Shoulder pavement		cu.m	9,100	2,000	7,100				
P-5	Prime coat		sq.m	441,000	75,000	95,000	51,000	136,000	57,000	27,000
P-6	Asphalt pavement		ton	114,000	20,000	22,000	12,000	22,000	19,000	19,000
P-7	Sidewalk		sq.m	68,400	25,800	40,400			2,200	
P-8	Kerb stone		lin.m	18,400	5,500	12,900				
P-9	Boundary block		lin.m	45,300	14,200	30,400			700	
	3.Drainage Works									
D-1	Side riprap drainage		sq.m	10,600	2,400	8,200				
D-2(B)	Side flume drainage	400 x 500	lin.m	4,700	4,700					
D-3	L-shaped side ditch		lin.m	8,900	6,200	2,000			700	
D-4&5	Catch pit and Man hole		nos.	240	140	80			20	
D-7(A)	Pipe culvert	Diam.= 300 mm	lin.m	640		640				
D-6&7(B)	Pipe culvert	Diam.= 600 mm	lin.m	3,490	750	2,740				
D-7(C)	Pipe culvert	Diam.= 1,000 mm	lin.m	360	180	180				
D-8	Re-installation of existing drainage		lin.m	4,990			1,750	2,500		740
	4.Others									
O-1	Road lighting pole	L type	nos.	66	66					
O-2	Road lighting pole	Y type	nos.	123	25	98				
O-3	Traffic signal		sec.	11	8	3				
O-4	Pedestrian bridge		no.	1		1				
O-5	Relocation of utilities	Telephone line	lin.m	11,000	5,300	5,700				
O-6	Relocation of utilities	Water supply valb	nos.	5	5					
O-7	Relocation of utilities	Power supply	lin.m	16,700	5,300	11,400				

b) Local Currency Portion

- Demolition works for 16.7 km
- Re-installation works for 16.7 km

(2) Relocation of telephone cable lines

Total length of relocation works is assumed to be 11.0km, out of which total length, 3.5km in New Bagamoyo Road, 1,8km in Upanga Road and 5.7km in both sides of Morogoro Road are estimated for the implementation of the Project. On the other hand, according to official concerns, the telephone cable system in the Dar es Salaam City area will be improved with a financial assistance of third country commencing from early 1990, then relocation cost shall not be included in this project.

(3) Relocation of water main valves

Total numbers of relocation works is assumed to be five (5) which are included in the widening section of the new Bagamoyo Road. The breakdown of the cost components in the foreign and the local currency portions are categorized below.

a) Foreign Currency Portion

- Procurement cost of water main valves for 5 numbers

b) Local Currency Portion

- Installation works of the new valves for 5 numbers
- Plug works of the existing valves for 5 numbers

(4) Land compensation

Land compensation cost is consist of land acquisition cost for permanent facilities and land rental charges for the temporary facilities. Such necessary land compensation cost will be inluded in the local currency portion. Land classifications and necessary quantities are shown below.

- Relocation of small brick houses : 13 numbers
- Relocation of large concrete houses : 5 numbers
- Temporary use area : 2.5 Ha.(approx.)

13.3.5 Estimated Project Cost

The total project cost for the short-term plan consists of construction cost for category A to C, physical contingency and Engineering service cost, and local cost for relocation of public utilities, government administration expense and land compensation cost.

The table of the total project cost is shown in Table 13.8, and the summary of the total project cost is shown in Table 13.9 as follows;

The physical contingency is assumed to be around 9.5 % of the total cost for the preparatory works, construction works, and the indirect expense.

The engineering service cost is assumed to be around 12 % of the total cost for the preparatory works, construction works, and the indirect expense.

It is noted that the cost items from A to C are estimated assuming that the works will be conducted on the basis of an international contractor, while the cost items from D to F are assumed to be conducted by the Tanzanian Government.

The summary cost of LOT A and breakdown of LOT A cost are shown in Table 13.10 and 13.11 respectively.

Table 13.8 Total Project Cost

Exchange Rate:1.0US$=TShs.144.0=JYE144.0

Description	F/C Portion (Mil.TShs.)	L/C Portion (Mil.TShs)	Total (Mil.TShs)
A.Construction Cost			
A-1 Temporary Works	399.0	171.3	570.3
A-1-1 Direct Works	15.9	11.5	27.4
A-1-2 General Works	77.0	120.3	197.3
A-1-3 Transportation	306.1	39.5	345.6
A-2 Construction Works	1,588.6	1,150.6	2,739.2
A-2-1 Category A	1,299.1	970.2	2,269.3
1)LOT A-1 New Bagamoyo	(320.4)	(217.2)	(537.6)
2)LOT A-2 Morogoro	(398.3)	(316.3)	(714.6)
3)LOT A-3 Chang'ombe	(104.4)	(79.4)	(183.8)
4)LOT A-4 Kariakoo	(223.5)	(193.7)	(417.2)
5)LOT A-5 Mwinjuma	(138.3)	(100.1)	(238.4)
6)LOT A-6 Central	(114.2)	(63.5)	(177.7)
A-2-2 Category B	102.7	87.3	190.0
A-2-3 Category C	186.8	93.1	279.9
1)LOT C-1 Main depot	(87.0)	(93.1)	(180.1)
2)LOT C-2 Equipment	(99.8)	(0.0)	(99.8)
3)LOT C-3 Guidance	(0.0)	(0.0)	(0.0)
A-3 Indirect Expense	368.0	86.1	454.1
A-3-1 Site Expense	197.3	17.1	214.4
A-3-2 Construction expert	75.4	0.0	75.4
A-3-3 General Expense	95.3	69.0	164.3
Total of A	2,355.6	1,408.0	3,763.6
B.Physical Contingency	220.9	135.5	356.4
C.Engineering Service	360.0	90.0	450.0
Total of A to C	2,936.5	1,633.5	4,570.0
D.Relocation Cost	70.0	50.0	120.0
E.Administration Cost	0.0	23.0	23.0
F.Land Compensation	0.0	30.0	30.0
Total of D to F	70.0	103.0	173.0
Grand Total (A to F)	3,006.5	1,736.5	4,743.0

Table 13.9 Summary of the Project Cost

(Exchange Rate : 1.0 US$ = 144 TShs.= ¥ 144)

	Items	Foreign Component (Mil.Tshs.)	Local Component (Mil.TShs.)	Total Amount (Mil.TShs.)
A	Construction Cost	2,355.6	1,408.0	3,763.6
B	Physical Contingency	220.9	135.5	356.4
C	Engineering Service	360.0	90.0	450.0
	Total of A to C	2,936.5	1,633.5	4,570.0
D	Relocation Cost	70.0	50.0	120.0
E	Administration Expense	0.0	23.0	23.0
F	Land Compensation Cost	0.0	30.0	30.0
	Total of D to F	70.0	103.0	173.0
	Grand Total (A to F)	3,006.5	1,736.5	4,743.0

13.3.6 Maintenance Cost

Road maintenance works will start after completion of the construction works in the short-term plan. Such maintenance cost include office staff personnel and labours, running cost for office building, construction materials, running cost for repair shop, and replacement cost of equipment.

Annual maintenance cost is estimated at TShs. 9.14×10^6.

13.4 Implementation Agency and Organization Chart

DCC will be responsible for the implementation of the Project and act as the execution agency for the Project in corporation with MOCW. Project office will be established under the City Engineer of DCC for smooth operation and progress of the Project.

Table 13.10 Summary Cost of LOT A

Exchange Rate : 1.0 US$ = T.Shs.144.0 = JYE 144.0

NAME OF ROAD	FOREIGN PORTION (T.Shs.)	LOCAL PORTION (T.Shs.)	TOTAL (T.Shs.)
A-1 New bagamoyo Group	320,360,000	217,258,000	537,618,000
(1) New bagamoyo,up to Morocco J.	163,437,000	127,571,000	291,008,000
(2) New bagamoyo,beyond Morocco J.	35,496,000	24,283,000	59,779,000
(3) Upanga road	121,427,000	65,404,000	186,831,000
A-2 Morogoro Road	398,261,000	316,318,000	714,579,000
A-3 Chang'ombe Area Group	104,467,000	79,377,000	183,844,000
(1) Chang'ombe area roads	94,875,000	75,703,000	170,578,000
(2) Chang'ombe road	9,592,000	3,674,000	13,266,000
A-4 Kariakoo Area Group	223,514,000	193,649,000	417,163,000
(1) Kariakoo area roads	203,957,000	186,095,000	390,052,000
(2) Msimbazi road	19,557,000	7,554,000	27,111,000
A-5 Mwinjuma Area Group	138,282,000	100,079,000	238,361,000
(1) Mwinjuma area roads	21,925,000	16,328,000	38,253,000
(2) Mwinjuma,L-1 road	10,322,000	10,005,000	20,327,000
(3) Morocco road	37,490,000	22,416,000	59,906,000
(4) Kinondoni road	3,205,000	3,070,000	6,275,000
(5) Shekilango road	38,351,000	25,440,000	63,791,000
(6) Makanya road	26,989,000	22,820,000	49,809,000
A-6 Central Area Group	114,254,000	63,489,000	177,743,000
(1) Central area roads	53,407,000	40,025,000	93,432,000
(2) Bandari road	14,680,000	5,684,000	20,364,000
(3) Nkrumah road	1,044,000	405,000	1,449,000
(4) Sokoine drive	6,981,000	2,698,000	9,679,000
(5) Gerezani road	14,078,000	5,451,000	19,529,000
(6) Kivukoni road	7,441,000	2,842,000	10,283,000
(7) Maktaba road	8,255,000	3,184,000	11,439,000
(8) Ohio road	2,738,000	1,068,000	3,806,000
(9) Ocean road	5,630,000	2,132,000	7,762,000
TOTAL OF LOT A	1,299,138,000	970,170,000	2,269,308,000

Table 13.11 Breakdown of LOT A Cost

(Unit:TShs.)

	TOTAL	Overlay	Reconstruct.	Widening	Drainage	Bus bay	Intersec.	Bridge	Lighting	Signal
A-1 New Bagamoyo Group	537,618,000	19,929,000	33,443,000	292,301,000	4,451,000	16,111,000	49,063,000	0	51,920,000	70,400,000
(1) New bagamoyo,up to Morocco	291,008,000	0	0	204,993,000	3,264,000	3,892,000	24,409,000	0	19,250,000	35,200,000
(2) New bagamoyo,beyond Morocco	59,779,000	19,208,000	29,924,000	0	0	10,647,000	0	0	0	0
(3) Upanga road	186,831,000	721,000	3,519,000	87,308,000	1,187,000	1,572,000	24,654,000	0	32,670,000	35,200,000
A-2 Morogoro Road	714,579,000	0	0	499,272,000	4,337,000	49,726,000	27,876,000	31,508,000	75,460,000	26,400,000
A-3 Chang'ombe Area Group	183,844,000	32,880,000	150,964,000	0	0	0	0	0	0	0
(1) Chang'ombe area roads	170,578,000	19,614,000	150,964,000	0	0	0	0	0	0	0
(2) Chang'ombe road	13,266,000	13,266,000	0	0	0	0	0	0	0	0
A-4 Kariakoo Area Group	417,163,000	47,313,000	369,850,000	0	0	0	0	0	0	0
(1) Kariakoo area roads	390,052,000	20,202,000	369,850,000	0	0	0	0	0	0	0
(2) Msimbazi road	27,111,000	27,111,000	0	0	0	0	0	0	0	0
A-5 Mwinjuma Area Group	238,361,000	64,961,000	164,318,000	0	0	9,082,000	0	0	0	0
(1) Mwinjuma area roads	38,253,000	7,773,000	30,480,000	0	0	0	0	0	0	0
(2) Mwinjuma,L-1 road	20,327,000	0	20,327,000	0	0	0	0	0	0	0
(3) Morocco road	59,906,000	32,115,000	18,709,000	0	0	9,082,000	0	0	0	0
(4) Kinondoni road	6,275,000	0	6,275,000	0	0	0	0	0	0	0
(5) Shekilango road	63,791,000	19,529,000	44,262,000	0	0	0	0	0	0	0
(6) Makanya road	49,809,000	5,544,000	44,265,000	0	0	0	0	0	0	0
A-6 Central Area Group	177,743,000	107,287,000	70,456,000	0	0	0	0	0	0	0
(1) Central area roads	93,432,000	22,976,000	70,456,000	0	0	0	0	0	0	0
(2) Bandari road	20,364,000	20,364,000	0	0	0	0	0	0	0	0
(3) Nkrumah road	1,449,000	1,449,000	0	0	0	0	0	0	0	0
(4) Sokoine drive	9,679,000	9,679,000	0	0	0	0	0	0	0	0
(5) Gerezani road	19,529,000	19,529,000	0	0	0	0	0	0	0	0
(6) Kivukoni road	10,283,000	10,283,000	0	0	0	0	0	0	0	0
(7) Maktaba road	11,439,000	11,439,000	0	0	0	0	0	0	0	0
(8) Ohio road	3,806,000	3,806,000	0	0	0	0	0	0	0	0
(9) Ocean road	7,762,000	7,762,000	0	0	0	0	0	0	0	0
TOTAL OF LOT A	2,269,308,000	272,370,000	789,031,000	791,573,000	8,788,000	74,919,000	76,939,000	31,508,000	127,380,000	96,800,000

Organization system shall be established among the Client, the Engineer and the Contractor. According to the organization chart, every kinds of meetings will be held for the implementation of the Project. This project organization chart is shown in Figure 13.1 as for only reference.

13.5 Implementation Programme

Total implementation period from the commencement of detailed design work to the end of the whole construction works will be estimated at 52 months.

Pre-construction stage will start from January 1990 and end in April 1990 including Exchange of Notes between the government of Japan and DCC, detailed design, tendering and assistance for negotiation and contract signing.

Immediately after finishing contract signing between DCC and the contractor, construction works will start from May 1990. Construction period for the project is estimated at four (4) years or 48 months.

Whole implementation schedule is shown in Figure 13.2.

13.6 Annual Disbursement Schedule

Fiscal year for the disbursement scudule is assumed to start in April and end in March next year. According to the implementation schedule mentioned in the previous chapter, the project cost for the short-term plan is assumed to be disbursed as shown in Table 13.12.

The summary of the annual disbursement schedule is given in Table 13.13 as follows:

Table 13.13 Summary of Annual Disbursement Schedule

(Exchange Rate : 1.0 US$ = 144 TShs.= ¥ 144)

YEAR	FOREIGN PORTION (Mill.TShs.)	LOCAL PORTION (Mill.TShs.)	TOTAL (Mill.TShs.)
(1)Total Construction Works			
1990/91	874.9	495.1	1,370.0
1991/92	937.3	452.7	1,390.0
1992/93	830.8	529.2	1,360.0
1993/94	293.5	156.5	450.0
TOTAL	2,936.5	1,633.5	4,570.0
(2)Complementary Works			
1990/91	40.0	28.2	68.2
1991/92	30.0	65.4	95.4
1992/93	0.0	7.4	7.4
1993/94	0.0	2.0	2.0
TOTAL	70.0	103.0	173.0

Figure 13.1 Project Organization Chart

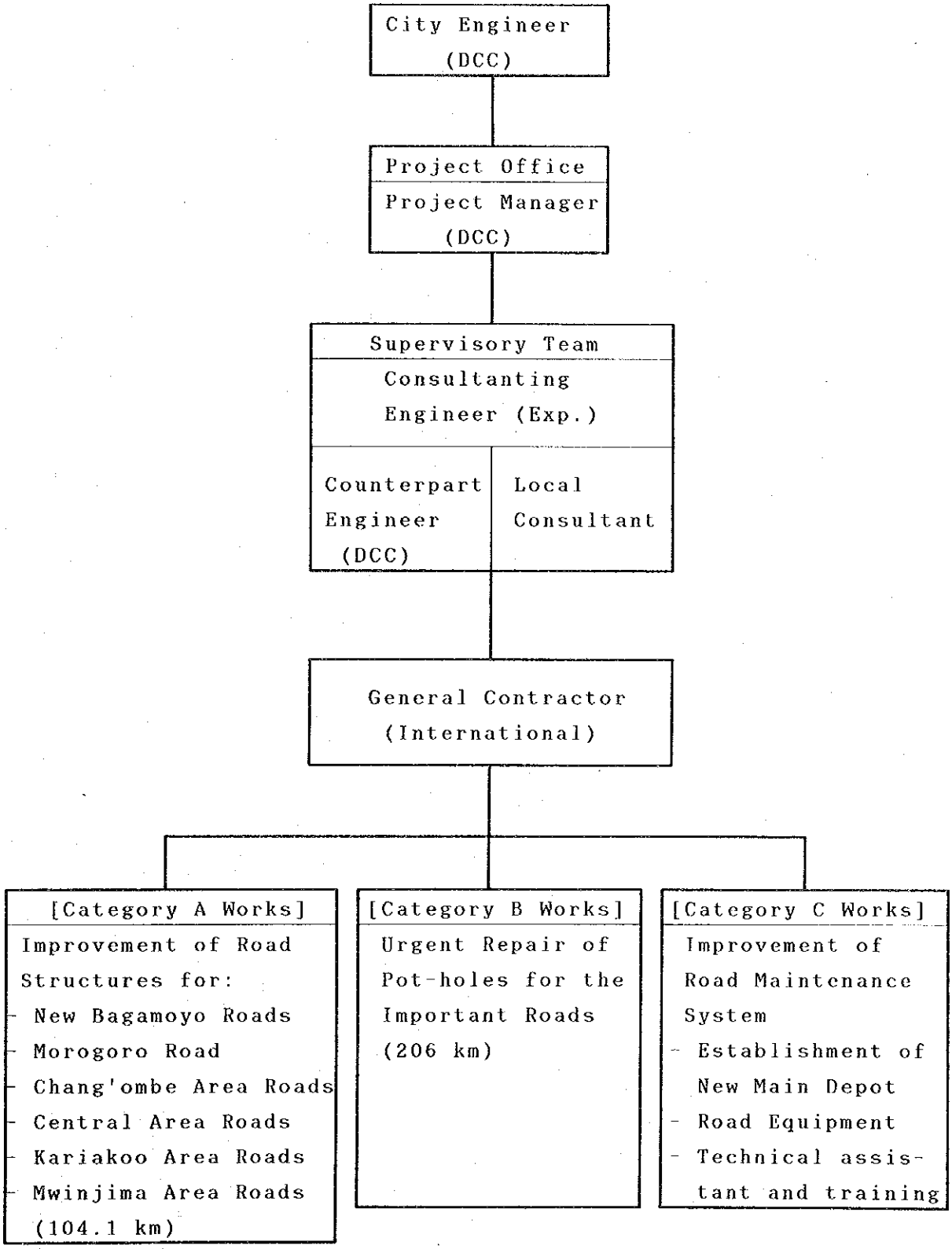


Figure 13.2 Implementation Schedule

DESCRIPTION	ROAD LENGTH	1st Year 1990/91	2nd Year 1991/92	3rd Year 1992/93	4th Year 1993/94
CONTRACT PHASE AND KEY EVENTS		Phase 1 Contract ▼	Phase 2	Phase 3	Phase 4 Completion ▼
PRE-CONSTRUCTION STAGE Detailed design Tendering		—— —			
CONSTRUCTION STAGE Preparatory Works	L.S.				
Category A	104.1 km				
A-1 New Bagamoyo Group	9.8 km		LOT A-1		
A-2 Morogoro Road	5.7 km		LOT A-2		
A-3 Chang'ombe Area Group	19.2 km		LOT A-3		
A-4 Kariakoo Area Group	31.7 km			LOT A-4	
A-5 Mwinjuma Area Group	16.7 km				LOT A-5
A-6 Central Area Group	21.0 km		LOT A-6		
Category B	206 km		LOT B-1		
Category C					
C-1 Main Depot	L.S.		LOT C-1		
C-2 Provision of Equipment	L.S.		LOT C-2		
C-3 Training	L.S.			LOT C-3	

Table 13.12 Annual Disbursement Schedule

(Unit : Million T.Shs.)

Exchange Rate : 1.0 US$ = T.Shs.144.0 = JYE 144.0

Item	Total			1990/91			1991/92			1992/93			1993/94		
	F/C	L/C	total	F/C	L/C	total	F/C	L/C	total	F/C	L/C	total	F/C	L/C	total
A-1 Temporary Works	399.0	171.3	570.3	126.7	70.1	196.8	99.7	38.0	137.7	97.4	34.4	131.8	75.2	28.8	104.0
A-2 Construction Works	1,588.6	1,150.6	2,739.2	429.0	319.9	748.9	538.9	331.3	870.2	482.4	399.3	881.7	138.3	100.1	238.4
2.1 LOT A	1,299.1	970.2	2,269.3	194.3	139.5	333.8	484.1	331.3	815.4	482.4	399.3	881.7	138.3	100.1	238.4
2.1.1 LOT A-1	320.4	217.2	537.6	80.1	76.0	156.1	240.3	141.2	381.5	0.0	0.0	0.0	0.0	0.0	0.0
2.1.2 LOT A-2	398.3	316.3	714.6	0.0	0.0	0.0	139.4	110.7	250.1	258.9	205.6	464.5	0.0	0.0	0.0
2.1.3 LOT A-3	104.4	79.4	183.8	0.0	0.0	0.0	104.4	79.4	183.8	0.0	0.0	0.0	0.0	0.0	0.0
2.1.4 LOT A-4	223.5	193.7	417.2	0.0	0.0	0.0	0.0	0.0	0.0	223.5	193.7	417.2	0.0	0.0	0.0
2.1.5 LOT A-5	138.3	100.1	238.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.3	100.1	238.4
2.1.6 LOT A-6	114.2	63.5	177.7	114.2	63.5	177.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.2 LOT B-1	102.7	87.3	190.0	102.7	87.3	190.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.3 LOT C	186.8	93.1	279.9	132.0	93.1	225.1	54.8	0.0	54.8	0.0	0.0	0.0	0.0	0.0	0.0
2.3.1 LOT C-1	87.0	93.1	180.1	87.0	93.1	180.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.3.2 LOT C-2	99.8	0.0	99.8	45.0	0.0	45.0	54.8	0.0	54.8	0.0	0.0	0.0	0.0	0.0	0.0
A-3 Indirect Expense	368.0	86.1	454.1	96.3	23.7	120.0	127.7	24.6	152.3	111.7	29.6	141.3	32.3	8.2	40.5
Total of A	2,355.6	1,408.0	3,763.6	652.0	413.7	1,065.7	766.3	393.9	1,160.2	691.5	463.3	1,154.8	245.8	137.1	382.9
B. Physical Contingency	220.9	135.5	356.4	61.1	39.8	100.9	71.9	37.9	109.8	64.8	44.6	109.4	23.1	13.2	36.3
C. Engineering Service	360.0	90.0	450.0	161.8	41.6	203.4	99.1	20.9	120.0	74.5	21.3	95.8	24.6	6.2	30.8
Total of A to C	2,936.5	1,633.5	4,570.0	874.9	495.1	1,370.0	937.3	452.7	1,390.0	830.8	529.2	1,360.0	293.5	156.5	450.0
D. Relocation of Public Utilities	70.0	50.0	120.0	40.0	7.0	47.0	30.0	43.0	73.0	0.0	0.0	0.0	0.0	0.0	0.0
E. Administration Expense	0.0	23.0	23.0	0.0	6.2	6.2	0.0	7.4	7.4	0.0	7.4	7.4	0.0	2.0	2.0
F. Land Compensation	0.0	30.0	30.0	0.0	15.0	15.0	0.0	15.0	15.0			0.0			0.0
Total of D to F	70.0	103.0	173.0	40.0	28.2	68.2	30.0	65.4	95.4	0.0	7.4	7.4	0.0	2.0	2.0
Grand Total	3,006.5	1,736.5	4,743.0	914.9	523.3	1,438.2	967.3	518.1	1,485.4	830.8	536.6	1,367.4	293.5	158.5	452.0

CHAPTER 14 ECONOMIC EVALUATION

14.1 Introduction

In this chapter high priority project roads proposed in the previous chapter are economically evaluated. First of all, the estimated project costs for each of the road improvement and rehabilitation projects are economically evaluated in the relation with the expected amounts of benefit produced by each of the projects so as to ascertain the economic feasibility of the projects from the view point of national economy. Second, the socio-economic impacts of the project roads are analysed so as to clarify the role of project roads for the realization of better socio-economic condition in the city of Dar es Salaam and its surrounding areas.

14.2 Economic evaluation of the Project Roads

14.2.1 Procedure

Procedure for economic evaluation is illustrated in Fig. 14.1 in which project roads were finally evaluated through such indicators as Benefit-Cost Ratio(B/C ratio), Net Present Value (NPV) and internal Rate of Return (IRR). For the application of these evaluators cost and benefit expressed in economic tern and stream of them throughout the project life must be defined as well as the preposition of evaluation.
Details of the above are explained in the following sections:

14.2.2 Indicators for Economic Evaluation

Three indicators which consists of B/C ratio, NPV and IRR were applied in the study. Each of the indicators and interpretation of them are explained below:

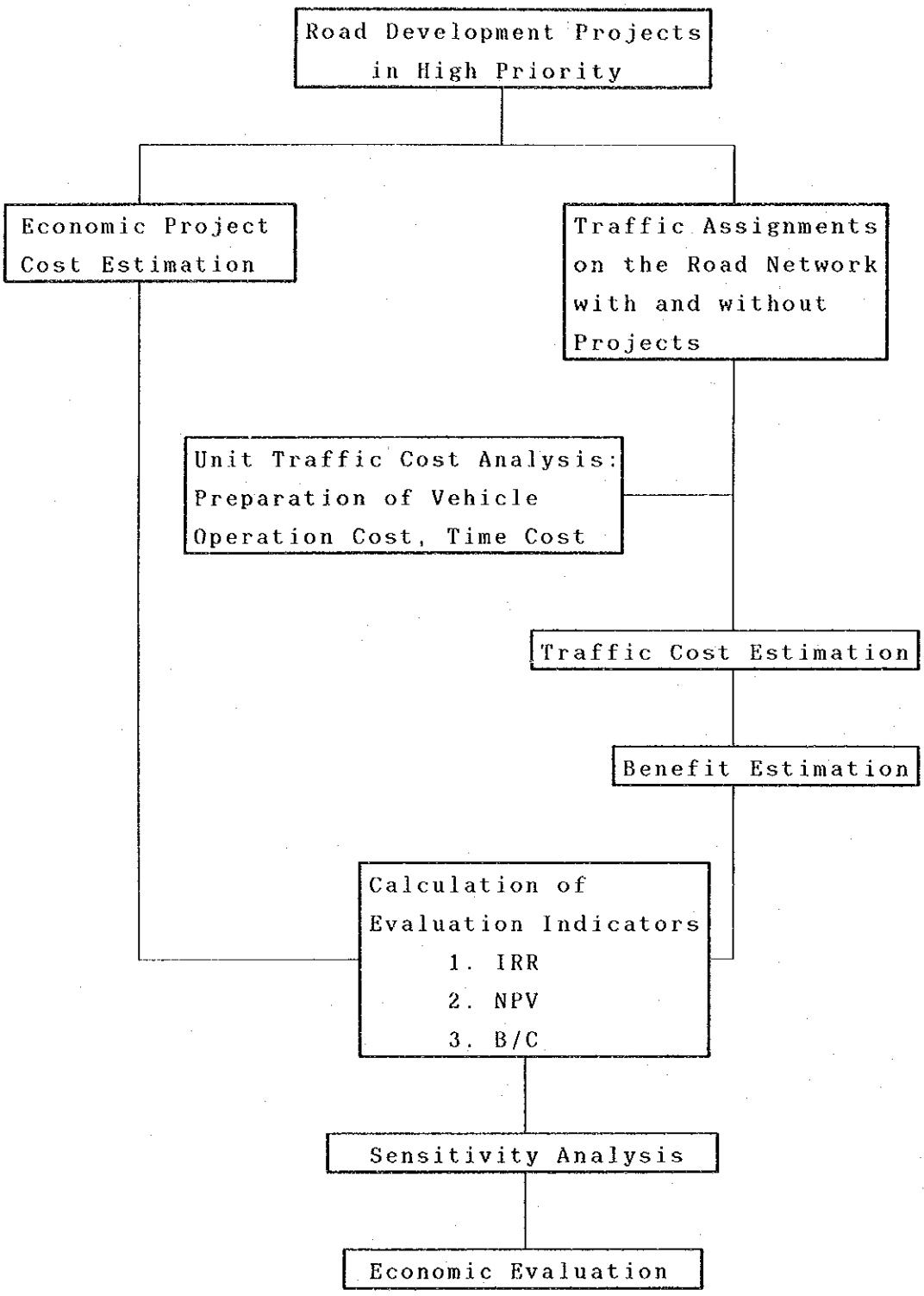


Fig.14.1 Procedure for Economic Evaluation

(1) B/C ratio

B/C ratio= B/C

$$B=\sum_{t=1}^{n} Bt/(1+r)^{t} \qquad C=\sum_{t=0}^{n} Ct/(1+r)^{t}$$

where
Bt: Benefit in the year(t)
Ct: Cost in the year(t)
r : Discount rate
n : Project life in years

B/C ratio is a ratio of discounted benefit to discounted cost. Consequently, a ratio which is greater than 1.0 suggests the project is economically feasible.

(2) NPV

NPV= B(r)-C(r)

$$B=\sum_{t=1}^{n} Bt/(1+r)^{t} \qquad C=\sum_{t=0}^{n=1} Ct/(1+r)^{t}$$

where
Bt: Benefit in the year(t)
Ct: Cost in the year(t)
r : Discount rate
n : Project life in years

NPV is a balance between discounted benefit and discounted cost. Therefore, a positive value of this indicator suggests the project is economically feasible.

(3) IRR

IRR is obtained through the following formula:

$$B(R)-C(R)=0$$

$$B(R)=\sum_{t=1}^{n} Bt/(1+r)^{t} \qquad C(R)=\sum_{t=0}^{n} Ct/(1+r)^{t}$$

where

R : IRR

Bt: Benefit in the year(t)

Ct: Cost in the year(t)

n : Project life in years

IRR is interpreted as a discount rate which gives a break even point between the discounted benefit and cost. Value greater than the assumed opportunity cost of capital in a nation suggests the project is economically feasible.

14.2.3 Preposition for the Calculation of Economic Indicators

For the calculation of economic indicators, following preposition was introduced:

- Projects to be evaluated
  A set of high priority projects contained in Category A and C of the short plan is defined as the base for the evaluation

- Project life
  15 years of project life was assumed.

- Discount Rate
  10 % of discount rate was applied throughout the project life on the basis of estimated opportunity cost of capital in Tanzania.

14.2.4 Estimation of Economic Cost

The project cost explained in Chapter 13 of this report was converted into economic cost through the following procedure:

- Deduction of tax and duty
- Exemption of price escalation

14.2.5 Estimation of Benefit

Benefit from the project was estimated through the following procedure:

- Vehicle Operation Cost (VOC) saving and Time Cost saving were assumed as two of the major sources of benefit from the project

- Total benefit was obtained as the balance of traffic costs between the two cases of traffic assignment, i.e. "without Project Case" and "with Project Case", in which such transfer factors as tax and duty were excluded.

- For the estimation of VOC unit vehicle operating costs were set up for representative vehicles by vehicle type, item of VOC and speed level of each vehicle as shown in Table 14.1 and Appendix 14.1 based on the information from car dealers and report relevant to the study.

- For the estimation of Time Cost, unit time costs were set up on the basis of per capita income in Dar es Salaam, labour participation rate and average number of passengers by vehicle type as shown in Table 14.2. Total benefit for the year of 2000 was estimated at 1952.4 millon Tsh. in which VOC saving and Time Cost saving were 1952.6 millon Tsh. and 197.8 millon Tsh. respectively.

Table 14.1 Unit Vehicle Operation Cost

Vehicle Type　　Unit:Tsh./1000Km

Velocity (Km/h)	Car, Taxi	Light Goods	Medium Goods	Heavy Goods	Bus
under 10	21250.2	30457.7	27759.0	42639.9	39862.1
15	18044.2	25477.8	22913.3	37374.7	32635.5
20	15817.5	22152.4	19743.3	33948.5	29475.3
25	14393.5	19766.8	17494.2	31524.2	27169.9
30	13302.7	18361.5	16159.3	30082.7	25461.2
35	12453.3	16894.8	14794.0	28615.0	24400.4
40	11904.5	16281.4	14203.4	27975.6	23541.1
45	11368.0	15495.1	13468.6	27185.1	23043.4
50	11051.4	15181.4	13161.6	26851.2	22558.8
55	10811.5	14967.5	12948.6	26619.1	22256.5
60	10647.0	15036.8	12992.0	26659.2	22047.0
65	10556.2	15109.6	13041.3	26707.2	22185.2
70	10609.7	15370.9	13261.0	26936.6	22582.4
75	10665.2	15820.4	13649.7	27346.6	22985.6
over 80	10792.1	16643.4	14373.7	28112.3	23733.2

Table 14.2 Unit Time Cost

unit:Tsh./hr.

Vehicle Type	Unit Time Cost
Car, Taxi	4.4
Light Goods	8.0
Medium Goods	15.4
Heavy Goods	15.2
Bus	96.7

14.2.6 Project Cost Stream

(1)Project Cost

Project cost streams for each of the evaluation case were assumed as shown in Table 14.3 according to actual implementation schedule.

Table 14.3 Stream of Project Cost and Benefit

Unit: Million Tsh.

Year	Construction Cost			Maint.	VOC	Time Cost	Total
	Foreign	Local	Total	Cost	Saving	Saving	
1990	119.0	67.2	186.2		-	-	-
1991	440.3	248.7	969.0		-	-	-
1992	635.2	358.8	994.0		-	-	-
1993	771.7	436.0	1207.7	2.4	-	-	-
1994	387.0	218.6	605.6	6.7	340.7	36.3	377.0
1995	62.8	35.5	98.3	13.4	807.6	112.0	919.6
1996	-	-	-	15.2	1026.0	160.3	1186.3
1997	-	-	-	15.2	1482.7	167.1	1649.8
1998	-	-	-	15.2	1546.4	174.3	1720.7
1999	-	-	-	15.2	1612.9	181.8	1794.7
2000	-	-	-	107.0	1682.3	189.6	1871.9
2001	-	-	-	65.6	1754.6	197.8	1952.4
2002	-	-	-	504.9	1802.2	203.1	2005.1
2003	-	-	-	15.2	1850.7	208.6	2059.3
2004	-	-	-	15.2	1900.6	214.3	2114.9
2005	-	-	-	15.2	1952.0	220.0	2172.0
2006	-	-	-	15.2	2004.6	226.0	2230.6
2007	-	-	-	106.8	2058.7	232.1	2290.8
2008	-	-	-	63.0	1557.8	192.5	1750.3
2009	-	-	-	501.1	878.8	79.6	958.4
2010	-	-	-	3.8	180.1	12.1	192.2

(2)Maintenance Cost

Annual outlays for maintenance cost throughout the project life were assumed as shown in the same table, in which periodic overlay was assumed in every seven years since the opening of the roads.

14.2.7 Benefit Flow

Benefit flow throughout the project life was estimated as shown in Table 14.3 in which annual increasing rates of benefit after the opening of the roads were assumed 4.3% up to the year 2000 and 2.7% thereafter.

14.2.8 Resut of Estimated Indicators

Table 14.4 shows the result of estimated economic indicators. From these result it could be concluded that the projects are economically feasible as all the indicators exceed the benchmark values explained in section 2.2 of this chapter. One of the reasons for these relatively higher value of indicators were obtained is that the unit vehicle operating costs were rather highly estimated reflecting the recent inflationary economy in Tanzania.

Table 14.4 Result of Estimated Indicators

B/C*	NPV(M.Tsh.)*	IRR(%)
2.46	4888.4	25.1

*10% of discount rate was assumed

14.2.9 Sensitivity Analysis

Sensitivity analysis was conducted to check of the evaluating system and to get information about possible change in cost and benefit. The analysis was conducted for the conceptual cases in which different levels of benefit and cost were assumed as shown in Table 14.5.

Table 14.5 Result of Sensitivity Analysis

B/C*

Benefit \ Cost	20% up	10% up	Original	10% down	20% down
20% up	2.46	2.68	2.95	3.28	3.69
10% up	2.25	2.46	2.70	3.00	3.38
Original	2.05	2.23	2.46	2.73	3.07
10% down	1.84	2.01	2.21	2.46	2.76
20% down	1.64	1.88	1.97	2.18	2.46

NPV (M.Tsh.)*

Benefit \ Cost	20% up	10% up	Original	10% down	20% down
20% up	5965.2	6200.6	6536.0	6871.3	7206.7
10% up	5041.0	5376.6	5712.0	6047.3	6379.7
Original	4216.9	4552.3	4888.4	5223.0	5558.4
10% down	3392.7	3728.1	4063.5	4398.8	4734.2
20% down	2568.6	3264.0	3239.4	3574.7	3910.1

IRR(%)

Benefit \ Cost	20% up	10% up	Original	10% down	20% down
20% up	25.1	26.8	28.7	30.9	33.4
10% up	23.5	25.1	26.9	29.1	31.5
Original	21.7	23.3	25.1	27.1	29.5
10% down	19.9	21.4	23.1	25.1	27.4
20% down	17.9	19.3	21.0	22.9	25.1

*10% of discount rate was assumed

14.2.10 Supplementary Study

For the more understanding of economic evaluation, two supplementary studies were done here as explaied below:

(1) Study 1: Exclusion of Time Cost Saving from Benefit

As it is generally known that Time Cost Saving is contraversial in nature to count as one of the benefit from the project, especially, in the transportation infrastructure construction project in developing countries in Africa, economic evaluation which excluded Time Cost Saving Benefit from the total benefit was conducted to evaluate the effect. Results are shown in Table 14.6. From which it could be concluded that the project is feasible even if the Time Cost Savig Benefit is out of consideration.

Table 14.6 Result of Economic Evaluation under The Case Excluding The Time Cost Saving Benefit

B/C *	NPV(M.Tsh.) *	IRR(%)
2.20	4023.9	22.9

*10% of discount rate is assumed

(2) Study 2: Evaluation of Individual Project Contained in The Short Plan

For the purpose of evaluating the major projects contained in the short plan of road development following two cases of evaluation were introduced.

a) Study Case 1:
Evaluation of Bagamoyo and Upanga roads up-grading project

b) Study Case 2:
Evaluation of Morogoro road up-grading project

Result of the study is shown in Table 14.7 from which it could be pointed out that Bagamoyo and Upanga road improvement projects are recommended to be implemented in the early phase of construction period.

Table 14.7 Evaluation of Major Projects Contained in The Short-term Plan

Study Case	B/C *	NPV(M.Tsh.) *	IRR(%)
Study Case 1	3.28	2132.1	30.6
Study Case 2	2.62	1793.6	25.3

*10% of discount rate is assumed

14.3 Socio-economic Impact Study

14.3.1 General

It is well known that road infrastructure development projects would come up with a variety of socio-economic effects on the surrounding areas of the projects, as well as such direct effect of traffic cost saving of road users. In this section conceivalble socio-economic effects which would result from the projects are studied for the purpose of directing them for the possible urban development in Dar es Salaam.

14.3.2 Promotion of Efficient Land-Use Plan

It is expected that project roads would exert incentives for the creation of efficient land-use pattern in the city of Dar es Salaam and its surrounding areas. First of all, Bagamoyo road would contribute greatly to the areal develop-

ment of its adjacent areas. Especially proposed residential area development in the north west corner of the city will be highly promoted with the completion of the project.

On the other hand, in the down town area, intensive land-use which is specialized in business and commercial uses would be promoted owing to the functional specialization of each of the land-use centered around the road.

For Morogoro road, almost same effects as the above might be seen, in which lands located near the halfway of the improved section will be exposed to drastically change into more urbanized uses. Mixed land-use in this area, in which industrial and residential land-uses are disorderly located at present will be transformed into higly intensive ones.

Area roads, in the meanwhile, would function as collector or feeder roads to foster higher pattern of land use in their influential areas.

In conclusion, the projects roads are expected to contribute to the early realization of proposed land use master plan in the city of Dar es Salaam.

14.3.3 Realization of Functional Hierarchy among Roads

The Projects would contribute to the amalioration of road traffic situation in the city of Dar es Salaam.

At present, most of the urban traffic in the city is conducted in rather disorderly manner due to inadequacy of road capacities, lack of efficient traffic management policies and lack of enunciated functional road classification for the realization of better circulation of traffic.

With the completion of the projects, road traffic in Dar es Salaam would be more orderly conducted corresponding to the functional advantages of each road. Improved Bagamoyo

Road will function rather as an arterial road for the urban traffic which links the city center to the expanding suburban areas in the north west corner of the city.

Morogoro road, meanwhile, will be used as inter-regional arterial road and/or industrial road in wider areas containing the eastern part of Tanzania.

Area roads,on the other hand, might function as feeder or collector roads for the daily activities of citizens in the city. These roads will be exclusively used by vehicles with such trip purposes as commuting, shopping and delivery.

14.3.4 Enhancement of Urban Amenity

Improved roads would not only enhance the amenity of road users but also that of daily life of citizens. First of all, the improved roads would enhance the level of safety on the road spaces through the separation of pedestrians from vehicles on carriage ways which will result in the reduction of traffic accident. Second, the amenity of urban life will be greatly enhanced with the possible new location of such urban facilities as communication and shopping centers due to the improved accessibility by the projects.

14.3.5 Stimulation of Regional Economy

Improved roads would stimulate the regional economy by strengthening of inter-sectoral economic activities. Industrial activities will be promoted through the efficient input-output relation of products and materials among different sectors in economy, which would result in the income increase of the region.

14.3.6 Incentive Role for the Succeeding Road Development

The completion of projects would trigger another road

development projects in and around the city. These would be motivated by urgent necessity of ring roads, which directly link the northern part of the city to the southern part , bypassing the central area. In junction with the above, traffic managements, which consist of improvement of intersections and traffic signals, must be conducted on the streets in the downtown area, for their expected traffic congestion as the result of the Projects.
Concept of future road development is illustrated in Fig 5.1 in Chapter 5.

14.4 Environmental Considerations

Since the project aims at rehabilitation and improvement of the existing roads but not construction of new roads, environmental study was not specified in the Scope of Works of the Study.

The study team, however, examines whether the project has significant environmental impacts or not; whether such significant impacts are acceptable or not from socio-economic, cultural and technical points of view; and if not, what kind of countermeasures should be taken to conserve or protect the present environment.

Environmental effects or impacts expected to the surrounding areas during and after construction of the projects are as shown below:

14.4.1 Environmental Effects during Construction

(1) Dust and Noise

Dust and noise caused by construction as well as hauling of construction materials from quarry sites and borrow pits are thought of one of the normal construction hazards and indispensable effects related to the highway construction. There effects however can be mitigated if the works on sunday/holiday and in midnight are not allowed or minimized during the construction period.

(2) Traffic Congestion

Traffic congestion may occur during the construction of overlay and reconstruction of pavement on the existing roads, especially in the Central and Karriakoo Areas. As for the widening sections of Morogoro, Upanga and New Bagamoyo roads, the temporary detours should be provided properly so that the construction will not interfere with the traffic flow on the existing road.

14.4.2 Environmental Effects after completion of Projects

(1) Air Pollution

Air Pollution is primarily a function of vehicle condition and traffic volume. Improvement of pavement as well as the enlargement of traffic capacity by widening will reduce the local pollution per vehicle by decreasing acceleration and deacceleration and by increasing speed of vehicle.

(2) Noise

Noise generation will be greater by improvement of existing roads, however, noise level can be attenuated considerable by construction of baffle or dense planting trees. Since there are grown-up street trees planted on both side along Upanga and New Bagamoyo roads, no significant noise pollution will be anticipated.

(3) Separation of Community

Widening of the existing road from 2 to 4 lanes may separate the existing community adjasent to the highway, especially Upanga and New Bagamoyo roads. This environmental effects can be minimized by a provision of pedestrian crossing, either controlled or uncontrolled, at appropriate points to assist pedestrians in crossing the road.

CHAPTER 15 CONCLUSION AND RECOMMENDATIONS

The following are the conclusion and recommendations made by the Study Team on the basis of results of the study through Chapter 1 to Chapter 13.

15-1 CONCLUSION

15-1-1: High Priority Projects to be Implemented in the Short-term Plan

The Study Team concluded that the following high priority projects shall be implemented in the Short-term Plan (1990 - 1994) from the view points of engineering, socio-economy and policy of the Tanzanian Government.

High Priority Projects to be Implemented in the Short-term Plan	Project Length	Estimated Cost
Category A: Improvement of Road Structures	(km)	(TshxM)
(1) Widening and Improvement of Upanga and New Bagamoyo Roads	9.8	890
(2) Widening of Morogoro Road	5.7	810
(3) Chan'gombe Area Roads	19.2	510
(4) Kariakoo Area Roads	31.6	900
(5) Mwinjuma Area Roads	16.9	450
(6) Central Area Roads	20.0	440
Total	104.1	4,000
Category B: Urgent Repair of Pot-holes for the Selected Roads Total	205.9	190
Category C: Improvement of Maintenance System		
(1) Establishment of New Main Depot	1 no.	170
(2) Procurement of Equipment	Sum	110
(3) Technical Assistance/Training	T/A	-
Total		280
Detailed Design/Preparation of Bidding Documents Total		100
Grand Total		4,570

Exchange Rate: US$1.0=Tsh.144=¥144 (As of Nov. 1989)

15-1-2: Project Implementaion Programme

The tentative implementation programme of the Short-term Plan with cost disbursement schedule was prepared by the Study Team as shown below taking into consideration possibility of financial arrangement of the Tanzanian government.

Improvement Measures	Short-term Plan				
	1990	1991	1992	1993	1994
Detailed Design/Tendering	(100)				
Category A: Road Improvement					
(1) Widening of Upanga and New Bagamoyo Roads (9.8km)	(420)	(470)			
(2) Widening of Morogoro Road (5.7km)		(350)	(460)		
(3) Chan'gombe Area Roads (19.2km)		(510)			
(4) Kariakoo Area Roads (31.6km)			(900)		
(5) Mwinjuma Area Roads (16.9km)				(450)	
(6) Central Area Roads (20.0km)	(440)				
Sub-total	860	1330	1360	450	-
Category B: Urgent Repair of Pot-holes for the Selected Roads					
Sub-total	190	-	-	-	-
Category C: Improvement of Maintenance System					
(1) Establishment of New Main Depot	(170)				
(2) Procurement of Equipment	(50)	(60)			
(3) Technical Assistance/Training					
Sub-total	220	60	-	-	-
Annual Fund Required (Total 4,570 M)	1370	1390	1360	450	-

Exchange Rate: US$1.0=Tsh.144=¥144 as of November, 1989.

15-1-3: Summary of the Project Cost

The project cost was calculated on the basis of work quantities and the unit prices obtained through the preliminary engineering design.

Summary of the Project Cost

	Items	Foreing Component (Tsh.M)	Local Component (Tsh.M)	Total Amount (Tsh.M)
A.	Construction Cost	2,356	1,408	3,764
B.	Physical Contingences	221	135	356
C.	Engineering	360	90	450
	Sub-total (A+B+C)	2,937	1,633	4.570
D.	Relocation Cost	70	50	120
E.	Administration Cost	-	23	23
F.	Land Compensation Cost	-	30	30
	Sub-total (D+E+F)	70	103	173
	Total (A to F)	3,007	1,736	4,743

Note 1: Exchange rate: US$1.0= Tsh.144= ¥144 (As of Nov. 1989)

15-1-4 Disbursement Schedule

The government of Tanzania is required to arrange the following amount of annual funds to implement the projects in the Short-term Plan:

Summary of Annual Disbursement Schedule

	Year	Foreign Portion	Local Portion	Total
(1)	Construction Works (Items A to C)			
	1990/91	875	495	1,370
	1991/92	937	453	1,390
	1992/93	831	529	1,360
	1993/94	294	156	450
	Total	2,937	1,633	4,570

Year	Foreign Portion	Local Portion	Total
(2) Complementary Works (Items D to F)			
1990/91	40	28	68
1991/92	30	65	95
1992/93	-	7	7
1993/94	-	2	2
Total	70	103	173

15-1-5: Economic Feasibility and Expected Social Impacts

(1) Economic Feasibility

It is concluded that the Project is technically and economically feasible with very high economic indicators as shown below:

- Benefit/Cost = 2.46
- Net Present Value = Tsh. 4,900 Million

  Internal Rate of Return (IRR) = 25.1%

(2) Direct Benefits

Direct benefits summing up the savings in vehicle operating cost and time cost is expected to be large. An annual benefit derived from the project in 2000 is estimated to be TShs. 1,900 million and total amount over 15 years after completion of the project would be Tshs. 27,000 million.

(3) Socio-economic Impacts Expected

In addition to the above direct benefits, the Project is expected to bring about great indirect effects on the surrounding areas of the project as follows:

- Acceleration of land-use development on the surrounding areas of New Bagamoyo and Morogoro Roads.

- Promotion of intensive land-use in Kariakoo, Chang'ombe, Central and Mwinjuma areas where they are specialized in commercial, industy, business and residencial uses respectively.

- Realization of functional hierarchy among roads, that is, New Bagamoyo road functioning as arterial road, Morogoro road as inter-regional arterial road and area road as feeder road.

- Enhancement of urban amenity by separating pedestrians from vehicles and decrease of traffic accidents.

- Stimulation of regional economy by strengthening of inter-sectoral economic activities as well as by that of inter-region.

- Incentive role for the succeeding road development projects, such as inprovement of intersections and traffic signals on the roads in downtown area of the city.

(4) People and Area Affected by the Project

The Project will exert an influence on a large majority of people and area in Dar es Salaam as shown below:

- Total number of population that will benefit directly from the Project is estimated to be 540,000 people or 40% of the whole population of Dar es Salaam City (1.3 million).

- Total number of population that will benefit indirectly from the Project would be estimated to be 880,000 people or 65 % of the city population.

- Area that will benefit from the project would cover the whole urbanized areas of Dar es Salaam City.

15-1-6 Middle-term and Long-term Plans

The improvement measures to be implemented in the Middle-term and Long-term Plans were summarized as shown below:

(1) Middle-term Plan : 1995 - 1999

- Improvement of Kilwa Road and four (4) area roads includ-

ing Ilala Area, Oyster Area, Kigogo Area and Temeke Area.

(2) Long-term Plan : 2000 - 2005

- Improvement of Middle Ring Road including;
  * Widening of Morocco, New Kigogo and Chang'ombe roads from 2 to 4 lanes,
  * Improvement of intersections by grade separation at Morogoro and Uhuru intersections,
  * Construction of missing link by elevated structure in between New Kigogo and Chang'ombe roads, with grade separated intersection at Pugu Road, and
  * Extension of Chang'ombe road up to Port Access.

- Improvement of the following intersections by grade separation;
  * Intersection of Port Access/Pugu Road
  * Intersection of Pugu Road/Msimbazi Road

15-2 RECOMMENDATIONS

15-2-1 Implementation of Mwinjuma Area Road Projects by Direct Labour of DCC

Total amount required for the implementaion of the high priority projects selected in the Short-term Plan amounts to Tsh. 4,570 million, which seems to be large compared to the annual budget of Tanzanian government.

Therefore when the Tanzanian Government shall be faced with difficulty in financial arrangement, it is recommended that the Mwinjuma area roads (Lot No. A-5) e implemented under the direct labour of the DCC using the road maintenance depot and equipment to be provided under the Category C of this Project.

The reason for selecting Mwinjuma area roads is as shown below:

- The priority of the Mwinjuma area roads is given in lower rank among the projects selected in the Sort-term Plan.

- Construction method and management required for Mwinjuma area roads are not so complicated compared with Morogoro, New Bagamoyo and other area roads where they may require heavy equipments and complicated traffic management during the construction.

- Length of the road to be improved is the shortest among the high priority area roads selected in Category A, thus the fund arrangement of local currency to be prepared by the government might be easy.

In order to smoothly and efficiently implement the project by through direct labour of DCC, the government of Tanzania may be required to make the following arrangement;

(1) Allocation of Sufficient Local Funds

The total amount required for the implementation of the Mwinjuma Area Road Project through direct labour is esti-

mated at Tsh. 270 million approx. so that it may be necessary for the govrnment to allocate an sufficient local fund to the project. An annual cost to be disbursed for the project is estimated as shown below:

Year	Anuual Disbursement
1991	Tsh. 162 million
1992	Tsh. 108 million
Total	Tsh. 270 million

(Tsh. 1.0= ¥ 1.0 as of Nov. 1989)

(2) Establishment of Project Office and Working Units

DCC shall establish the project office and working units in charge of the project under the direct supervision of City Engineer as shown in Fig. 15.1. The project manager, responsible for supervising the working units, will collaborate the work with the construction experts who have an experience in construction management and supervision.

Since DCC may not have a sufficient staff of technicians, operators, mechnaics and administrators required for organizing the working units, the recruitment of additional staff from MOCW, TRM and other agencies is suggested.

(3) Equipment to be used for Mwinjuma Area Road Project

Equipment to be used for the construction of Mwinjuma Area Project may differ from that proposed by the Study Team for routine and daily maintenance as shown in Table 13. 2, Chapter 13. It is recommended therefore to revise the type and number of equipment to be provided under Category C of this Study to meet the requirement of overlay and reconstruction of pavement. A revised equipment list is presented in Table 15.1.

(4) Early Commencement of Mwinjuma Area Road

DCC may be able to start the construction of Mwinjuma Area Road after finishing the arrangement of project office and working units. Fig.15.2 showes the alternative implementation plan assuming that the project of Mwinjuma Area Road commences work soon after new main depot and equip-

ment are provided under Category C.

15-2-2 Necessity on Continuous Investment on Road Maintenance

Dar es Salaam is served by 1,150 km of the existing road network system consisting of 150 km long of arterial road, 65 km of Collector road and 935 km of local road.

As stated in Chapter 9, in order to maintain the road network in DCC properly and timely, the Study Team recommended to the government the annual investment of Tsh. 21 million for road maintenance cost. This cost will be spent for running and operating the main depot including staff salaries, employment of labour and purchasing of materials to be used for road maintenance.

Since present excessive damage of city roads have been caused by a long absence of proper maintenance due to the inadequacy of funds for road maintenance, the government of Tanzania is strongly advided to regularly allocate the necessary funds, to the road maintenance sector in Dar es Salaam.

15-2-3 Improvement of Traffic Management System of the Central Area in Dar es Salaam

In the text, the strengthening of arterial roads by the formation of Central Ring Road in the Midle-term Plan has been proposed first for the improvement of traffic congestion. However the improvement method employed to solve the traffic problems in the central area has not been completely clarified in the text and these problems will increase yearly in accordance with the economic growth and vehicle holding.

In order to completely solve the traffic problems on the central area, an improvement study on the traffic management system under the Medium-term Plan should be required for the mininanization of traffic congestion while respecting the preservation of the existing infrastructure and buildings in

the central area. The following items will be required for the improvement study in addition to the review of the conseptualized traffic plan proposed in the Master Plan.

a) Improvement of Road System
- Promotion of functional hierarchy on road network
- Widening and formation of the Central Ring Road
- Improvement of congested roundabout to signal control

b) Improvement of Traffic Control System
- Introduction of one-way control
- Strengthen of road side parking control
- Review and improvement of road closure

c) Improvement of Parking System
- Improvement of off-street parking lots in and around the central commercial and business area
- Review and improvement of existing facilities and collection system of charge for road side parking.

d) Improvement of Public Transport System
- Improvement of existing bus terminals and stops with improvement of major bus route on the Central Ring Road
- Relocation and Strengthen of the local bus terminal
- Introduction of exclusive or priority lane for buses

15-2-4 Improvement of Middle Ring Road in the Long-term Plan

As stated in "Proposed Future Road Network", clause 5.6, Chapter 6, the Study Team recommended the strengthenning of the road network in Dar es Salaam by improvement of the Middle Ring Road in the Long-term Plan (2000 - 2005) as shown in Fig. 15.3.

The improvement plan proposed by the Study Team is:
- to widen Morocco, New Kigogo and Chang'ombe roads,
- to construct the missing link in between New Kigogo and Chang'ombe, and
- to extend Chang'ombe road up to Port Access.

As shown in Fig. 15.4, the traffic flow in Dar es Salaam will be improved remarkably through the completion of the Middle Ring Road. As a result, the congestion ratio of the existing road network in the City will be decreased to a level between 1.0 and 1.5 where congestion appeares only at the peak hours.

Since the Middle Ring Road plays the vital role in the road network of Dar es Salaam, the Study Team recommends the government of Tanzania to begin the feasibility study at an early stage.

15-2-5 Improvement of Major Intersections in the Long-term Plan

In order to establish a desirable future trunk road network with smooth traffic management of future heavy traffic demand, improvement of the following intersections through grade separation will be considered in the Long-term Plan for the intersections crossing between dual carriagway road on which the future traffic demand will exceed the traffic capacity of signal controlled intersection.

Specifically, the introduction of proposed grade separations on the Midle Ring road will be recommended and the following plan of grade separation will be studied closely as an alternative plan for the future feasibility study of road development in the Long-term Plan. In order to minimize the additional implovement cost and not disturb the through traffic on the future trunk road network under constructed untill the Midle-term Plan, the Midle Ring Road will pass over the crossing roads.

Intersections to be Improved by Grade separation	Type of Interchange
1. Pugu Road/Port Access Rd.	Diamond type
2. Pugu Road/Msinbazi Rd.	Diamond type

Fig. 15.1 Proposed Organization Chart of Mwinjuma Area Project (Direct Labour)

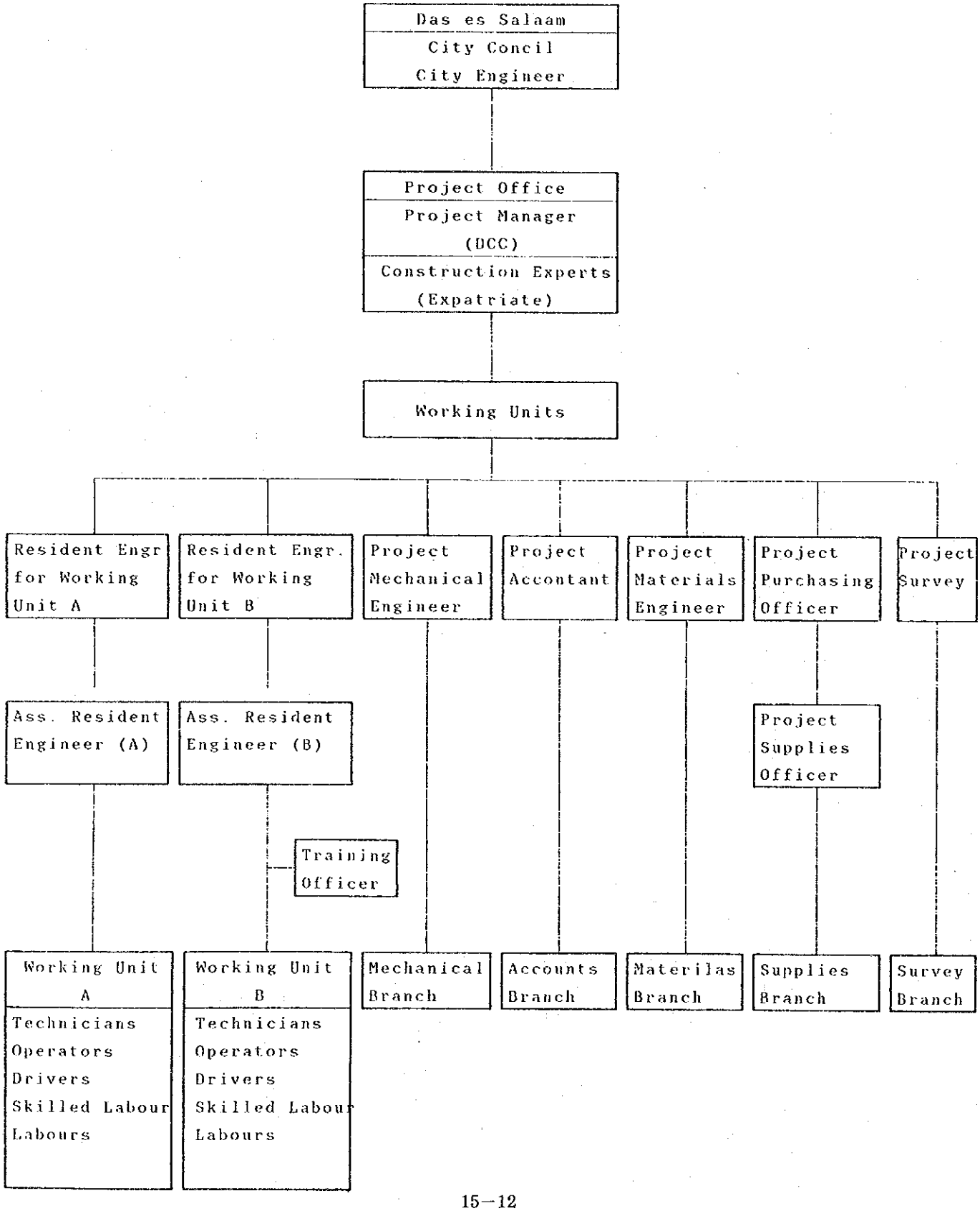


Table 15.1 Road Maintenance Equipment to be Provided
(Direct Labour of DCC)

Type of Equipment	Unit Price (US$)	Number of Equipment	Amount (US$)
Equipment required for overlay and reconstruction of existing pavment in Mwinjuma Area Roads:			
[Phase 1]			
Wheel Loader (1.5 - 1.7 cu.m)	85 000	1	85,000
Vibration Roller (8-10ton)	50,000	1	50,000
Asphalt Finisher (3.6 m)	75,000	1	75,000
Dump Truck (15ton)	69,000	2	138,000
		Total	US$ 348,000
		(Equiv. to	¥ 50,000,000)
[Phase 2]			
Pnematic Tyre Roller (8-10ton)	50,000	1	50,000
Dump Truck (15ton)	70,000	1	70,000
Bulldozer (7ton with ripper)	138,000	1	138,000
Moter Grader	79,000	1	79,000
Pick-up for Supervisory Staff	13,000	3	39,000
7-ton Tipper Truck	39,000	1	39,000
Walk Talky	1,000	4	4,000
		Total	US$ 419,000
		(Equiv. to	¥ 60,000,000)
		Grand Total	US$ 767,000
		(Equiv. to	¥ 110,000,000)

Note: -Exchange Rate US$1.0=¥144.0=Tsh.144.0 As of Nov. 1, 1989