

## **Chapter 16 Construction Plan and Cost Estimate**

### **Appendix 16.1 Construction Cost of Each Project Road**

#### **Package 1: Arterial Roads**

- (1) Ohio Road
- (2) Sokoine Drive
- (3) Kivukoni Front
- (4) Gerezani Road
- (5) Bandari Road
- (6) Quantities and Cost of Bridges

#### **Package 2: The Middle Ring Road**

- (1) Morocco Road
- (2) New Kigogo Road
- (3) Missing Link
- (4) Chang'ombe Road

#### **Package 1: Trunk Roads**

- (1) New Bagamoyo Road
- (2) Uhuru Road
- (3) Kilwa Road



Appendix 16 .1 Construction Cost of Package 1: Ohio Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	3,500	4,260	220	14,910,000	770,000	15,680,000
Embankment (common)	m3	0	5,680	300	0	0	0
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	0	30,250	30,250	0	0	0
Pipe culvert, D600 (Type A)	m	60	70,120	70,120	4,207,200	4,207,200	8,414,400
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	1,995	13,400	13,400	26,733,000	26,733,000	53,466,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	0	37,520	30,690	0	0	0
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	100	140,620	46,870	14,062,000	4,687,000	18,749,000
Manhole	no.	6	122,170	122,170	733,020	733,020	1,466,040
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	0	13,410	1,490	0	0	0
Subbase course, CBR 30%	m3	2,550	22,400	2,490	57,120,000	6,349,500	63,469,500
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	1,020	22,510	2,500	22,960,200	2,550,000	25,510,200
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	10,200	12,350	1,370	125,970,000	13,974,000	139,944,000
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	4,490	8,150	1,440	36,593,500	6,465,600	43,059,100
Kerb stone	m	2,100	7,250	3,900	15,225,000	8,190,000	23,415,000
Overlay (t=100mm)	m2	9,450	13,670	1,520	129,181,500	14,364,000	143,545,500
<b>5. Miscellaneous work</b>							
Road lighting	no.	16	2,692,760	299,200	43,084,160	4,787,200	47,871,360
Traffic signals	no.	3	2,923,680	324,850	8,771,040	974,550	9,745,590
Lane marking 15cm	m	4,900	390	40	1,911,000	196,000	2,107,000
Information signs	no.	16	38,320	25,540	613,120	408,640	1,021,760
Shelters at bus stops	no.	0	1,523,800	169,310	0	0	0
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other works</b>							
Construction approach road with gravel	m2	210	12,280	3,070	2,578,800	644,700	3,223,500
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	1,125	22,580	1,190	25,402,500	1,338,750	26,741,250
Relocation of electric lines	m	1,375	6,180	330	8,497,500	453,750	8,951,250
Relocation of telephone lines	m	1,125	5,550	290	6,243,750	326,250	6,570,000
Disposal of abundant ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>544,797,290</b>	<b>98,153,160</b>	<b>642,950,450</b>

Appendix 16.1.1 Construction Cost of Package 1: Kivukoni Front

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	930	4,260	220	3,961,800	204,600	4,166,400
Embankment (common)	m3	23,000	5,680	300	130,640,000	6,900,000	137,540,000
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	4,500	3,460	3,460	15,570,000	15,570,000	31,140,000
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	0	30,250	30,250	0	0	0
Pipe culvert, D600 (Type A)- Ext. of sidewalk 8 x 20m	m	160	70,120	70,120	11,219,200	11,219,200	22,438,400
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	120	112,380	112,380	13,485,600	13,485,600	26,971,200
L-side ditch	m	770	13,400	13,400	10,318,000	10,318,000	20,636,000
U-shaped drain ditch (0.3 x 0.3m)-Ext. of sidewalk	m	840	31,230	25,550	26,233,200	21,462,000	47,695,200
U-shaped drain ditch (0.4 x 0.5m)	m	0	37,520	30,690	0	0	0
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit (39 + Ext. of sidewalk 8 = 47)	no.	47	140,620	46,870	6,609,140	2,202,890	8,812,030
Manhole	no.	4	122,170	122,170	488,680	488,680	977,360
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	0	13,410	1,490	0	0	0
Subbase course, CBR 30%	m3	337	22,400	2,490	7,548,800	839,130	8,387,930
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	135	22,510	2,500	3,038,850	337,500	3,376,350
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	1,346	12,350	1,370	16,623,100	1,844,020	18,467,120
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	4,160	8,150	1,440	33,904,000	5,990,400	39,894,400
Sidewalk, Extension up to the fish market (8 m x 840m)	m2	6,720	8,150	1,440	54,768,000	9,676,800	64,444,800
Kerb stone (900 m + Ext. of sidewalk 840 m = 1,740 m)	m	1,740	7,250	3,900	12,615,000	6,786,000	19,401,000
Overlay (t=100mm)	m2	3,664	13,670	1,520	50,086,880	5,569,280	55,656,160
<b>5. Miscellaneous work</b>							
Road lighting	no.	16	2,692,760	299,200	43,084,160	4,787,200	47,871,360
Traffic signals	no.	3	2,923,680	324,850	8,771,040	974,550	9,745,590
Lane marking 15cm	m	2,100	390	40	819,000	84,000	903,000
Information signs	no.	16	38,320	25,540	613,120	408,640	1,021,760
Shelters at bus stops	no.	0	1,523,800	169,310	0	0	0
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	2	14,777,000	6,038,000	29,554,000	12,076,000	41,630,000
<b>6. Other works</b>							
Construction approach road with gravel	m2	0	12,280	3,070	0	0	0
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	300	22,580	1,190	6,774,000	357,000	7,131,000
Relocation of electric lines	m	0	6,180	330	0	0	0
Relocation of telephone lines	m	25	5,550	290	138,750	7,250	146,000
Disposal of abundant ships in the harbor	ton	500	132,170	14,690	66,085,000	7,345,000	73,430,000
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,060	0	0	0
<b>Total</b>					<b>552,949,320</b>	<b>138,933,740</b>	<b>691,883,060</b>

Appendix 16 .1 Construction Cost of Package 1: Sokoine Drive

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		
			Foreign	Local	Foreign	Local	Total
			Portion	Portion	Portion	Portion	(Tsh.)
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	1,386	4,260	220	5,904,360	304,920	6,209,280
Embankment (common)	m3	6,250	5,680	300	35,500,000	1,875,000	37,375,000
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	597	244,190	81,400	145,781,430	48,595,800	194,377,230
Gravity wall, concrete class C	m3	410	79,690	79,690	32,672,900	32,672,900	65,345,800
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	0	30,250	30,250	0	0	0
Pipe culvert, D600 (Type A)	m	60	70,120	70,120	4,207,200	4,207,200	8,414,400
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	1,070	13,400	13,400	14,338,000	14,338,000	28,676,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	0	37,520	30,690	0	0	0
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	54	140,620	46,870	7,593,480	2,530,980	10,124,460
Manhole	no.	6	122,170	122,170	733,020	733,020	1,466,040
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	0	13,410	1,490	0	0	0
Subbase course, CBR 30%	m3	774	22,400	2,490	17,337,600	1,927,260	19,264,860
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	553	22,510	2,500	12,448,030	1,382,500	13,830,530
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	0	12,350	1,370	0	0	0
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	2,210	18,400	2,040	40,664,000	4,508,400	45,172,400
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	2,360	8,150	1,440	19,234,000	3,398,400	22,632,400
Kerb stone	m	1,180	7,250	3,900	8,555,000	4,602,000	13,157,000
Overlay (t=100mm)	m2	4,860	13,670	1,520	66,436,200	7,387,200	73,823,400
<b>5. Miscellaneous work</b>							
Road lighting	no.	28	2,692,760	299,200	75,397,280	8,377,600	83,774,880
Traffic signals	no.	12	2,923,680	324,850	35,084,160	3,898,200	38,982,360
Lane marking 15cm	m	2,750	390	40	1,072,500	110,000	1,182,500
Information signs	no.	28	38,320	25,540	1,072,960	715,120	1,788,080
Shelters at bus stops	no.	0	1,523,800	169,310	0	0	0
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other works</b>							
Construction approach road with gravel	m2	110	12,280	3,070	1,350,800	337,700	1,688,500
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	590	22,580	1,190	13,322,200	702,100	14,024,300
Relocation of electric lines	m	590	6,180	330	3,646,200	194,700	3,840,900
Relocation of telephone lines	m	890	5,550	290	4,939,500	258,100	5,197,600
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>547,290,820</b>	<b>143,037,100</b>	<b>690,347,920</b>

Appendix 16.1 Construction Cost of Package 1: Gerezani Road

Description	Unit	Quantity	Unit Rate (Tab.)		Amount		Total (Tab.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	4,500	4,260	220	19,170,000	990,000	20,160,000
Embankment (common)	m3	3,900	5,680	300	22,152,000	1,170,000	23,322,000
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	430	244,190	81,400	105,001,700	35,002,000	140,003,700
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	0	30,250	30,250	0	0	0
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	2,770	13,400	13,400	37,118,000	37,118,000	74,236,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	0	37,520	30,690	0	0	0
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,280	8,390	0	0	0
Catch pit	no.	139	140,620	46,870	19,546,180	6,514,930	26,061,110
Manhole	no.	0	122,170	122,170	0	0	0
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	0	13,410	1,490	0	0	0
Subbase course, CBR 30%	m3	1,683	22,400	2,490	37,699,200	4,190,670	41,889,870
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	1,122	22,510	2,500	25,256,220	2,805,000	28,061,220
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	5,610	12,350	1,370	69,283,500	7,685,700	76,969,200
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	7,100	8,130	1,440	57,865,000	10,224,000	68,089,000
Kerb stone	m	2,840	7,250	3,900	20,590,000	11,076,000	31,666,000
Overlay (t=100mm)	m2	12,780	13,670	1,520	174,702,600	19,425,600	194,128,200
<b>5. Miscellaneous work</b>							
Road lighting	no.	12	2,692,760	299,200	32,313,120	3,590,400	35,903,520
Traffic signals	no.	3	2,923,680	324,850	8,771,040	974,550	9,745,590
Lane marking 15cm	m	6,630	390	40	2,585,700	265,200	2,850,900
Information signs	no.	12	38,320	25,540	459,840	306,480	766,320
Shelters at bus stops	no.	2	1,523,800	169,310	3,047,600	338,620	3,386,220
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other works</b>							
Construction approach road with gravel	m2	560	12,280	3,070	6,876,800	1,719,200	8,596,000
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	600	22,580	1,190	13,548,000	714,000	14,262,000
Relocation of electric lines	m	1,420	6,180	330	8,775,600	468,600	9,244,200
Relocation of telephone lines	m	1,700	5,550	290	9,435,000	493,000	9,928,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>674,197,100</b>	<b>145,071,950</b>	<b>819,269,050</b>

Appendix 16.1 Construction Cost of Package 1:Bandari Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	7,900	4,260	220	33,654,000	1,738,000	35,392,000
Embankment (common)	m3	33,300	5,680	300	189,144,000	9,990,000	199,134,000
Sodding	m2	6,505	1,850	210	12,034,250	1,366,050	13,400,300
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	300	262,970	87,660	78,891,000	26,298,000	105,189,000
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	723	522,150	174,050	377,514,450	125,838,150	503,352,600
Pier and Abutment, concrete class-A	m3	2,564	160,400	53,470	411,265,600	137,097,080	548,362,680
Steel Plate Girder	ton	0	6,923,600	364,400	0	0	0
Cast in place pile (D=1,000 mm)	m	1,140	43,240	14,410	49,293,600	16,427,400	65,721,000
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	116	30,250	30,250	3,509,000	3,509,000	7,018,000
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	2,370	13,400	13,400	31,758,000	31,758,000	63,516,000
U-shaped drain ditch (0.3 x 0.3m)	m	380	31,230	25,550	11,867,400	9,709,000	21,576,400
U-shaped drain ditch (0.4 x 0.5m)	m	1,740	37,520	30,690	65,284,800	53,400,600	118,685,400
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	208	140,620	46,870	29,248,960	9,748,960	38,997,920
Manhole	no.	4	122,170	122,170	488,680	488,680	977,360
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	0	13,410	1,490	0	0	0
Subbase course, CBR 30%	m3	5,023	22,400	2,490	112,515,200	12,507,270	125,022,470
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	3,588	22,510	2,500	80,765,880	8,970,000	89,735,880
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	0	12,350	1,370	0	0	0
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	14,350	18,400	2,040	264,040,000	29,274,000	293,314,000
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	10,750	8,150	1,440	87,612,500	15,480,000	103,092,500
Kerb stone	m	4,200	7,250	3,900	30,450,000	16,380,000	46,830,000
Overlay (t=100mm)	m2	15,050	13,670	1,520	205,733,500	22,876,000	228,609,500
<b>5. Miscellaneous work</b>							
Road lighting	no.	44	2,692,760	299,200	118,481,440	13,164,800	131,646,240
Traffic signals	no.	3	2,923,680	324,850	8,771,040	974,550	9,745,590
Lane marking 15cm	m	10,030	390	40	3,911,700	401,200	4,312,900
Information signs	no.	3	38,320	25,540	114,960	76,620	191,580
Shelters at bus stops	no.	2	1,523,800	169,310	3,047,600	338,620	3,386,220
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other works</b>							
Construction approach road with gravel	m2	860	12,280	3,070	10,560,800	2,640,200	13,201,000
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains: D 150mm - D 300mm	m	1,200	22,580	1,190	27,096,000	1,428,000	28,524,000
Relocation of electric lines	m	1,380	6,180	330	8,528,400	455,400	8,983,800
Relocation of telephone lines	m	1,300	5,550	290	7,215,000	377,000	7,592,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>2,262,797,760</b>	<b>552,712,580</b>	<b>2,815,510,340</b>

**Quantities and Cost of Bridges on Bandari Road**

Description	Unit	Quantities		Unit Rate (Tsh.)				Amount		Total (Tsh.)
		Gerezani Bridge	Bandari Bridge	Total	Foreign Portion		Local Portion			
					Foreign Portion	Local Portion	Foreign Portion	Local Portion		
<b>2. Structural work</b>										0
Concrete block wall, concrete class C, 180kg	m <sup>2</sup>	0	0	0	3,460	0	3,460	0	0	0
Box culvert, concrete class B, 240kg	m <sup>3</sup>	0	0	0	262,970	0	262,970	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m <sup>3</sup>	0	0	0	244,190	0	244,190	0	0	0
Gravity wall, concrete class C	m <sup>3</sup>	0	0	0	79,690	0	79,690	0	0	0
RC Hollow Slab, concrete class -A	m <sup>3</sup>	437	286	723	469,800	156,600	113,221,800	339,665,400	113,221,800	452,887,200
Pier and Abutment, concrete class-A	m <sup>3</sup>	1,237	1,327	2,564	160,400	53,470	137,097,080	411,265,600	137,097,080	548,362,680
Steel Plate Girder	ton			0	5,071,100	266,900	0	0	0	0
Cast in place pile (D=1,000)	m	1,140		1,140	43,240	14,410	16,427,400	49,293,600	16,427,400	65,721,000
Concrete Pile D=450	m			0	32,130	1,690	0	0	0	0
Improvement of foundation	m <sup>3</sup>	0	0	0	16,050	1,780	0	0	0	0
							800,224,600	266,746,280		1,066,970,880



Appendix 16.1 Construction Cost of Package 2: New Kigogo Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	30,000	1,290	70	38,700,000	2,100,000	40,800,000
Removal of existing pavement material (t=70cm)	m3	1,250	5,500	290	6,875,000	362,500	7,237,500
Excavation (common)	m3	21,270	4,260	220	90,610,200	4,679,400	95,289,600
Embankment (common)	m3	27,000	5,680	300	153,360,000	8,100,000	161,460,000
Sodding	m2	1,100	1,850	210	2,035,000	231,000	2,266,000
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	15,340	3,460	3,460	53,076,400	53,076,400	106,152,800
Box culvert, concrete class B, 240kg	m3	1,526	262,970	87,660	401,292,220	133,769,160	535,061,380
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	190	30,250	30,250	5,747,500	5,747,500	11,495,000
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	200	34,700	34,700	6,940,000	6,940,000	13,880,000
Pipe culvert, D1000	m	200	112,380	112,380	22,476,000	22,476,000	44,952,000
L-side ditch	m	0	13,400	13,400	0	0	0
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	5,460	37,520	30,690	204,859,200	167,567,400	372,426,600
U-shaped drain ditch (1.0 x 1.0m)	m	400	43,800	35,840	17,520,000	14,336,000	31,856,000
Side drain with stone pitching	m	1,200	10,260	8,390	12,312,000	10,068,000	22,380,000
Catch pit	no.	274	140,620	46,870	38,529,880	12,842,380	51,372,260
Manhole	no.	14	122,170	122,170	1,710,380	1,710,380	3,420,760
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	4,140	13,410	1,490	55,517,400	6,168,600	61,686,000
Subbase course, CBR 30%	m3	12,040	22,400	2,490	269,696,000	29,979,600	299,675,600
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	10,350	22,510	2,500	232,978,500	25,875,000	258,853,500
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	41,400	12,350	1,370	511,290,000	56,718,000	568,008,000
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	27,600	8,150	1,440	224,940,000	39,744,000	264,684,000
Kerb stone	m	5,520	7,250	3,900	40,020,000	21,528,000	61,548,000
Overlay (t=100mm)	m2	0	13,670	1,520	0	0	0
<b>5. Miscellaneous work</b>							
Road lighting	no.	56	2,692,760	299,200	150,794,560	16,755,200	167,549,760
Traffic signals	no.	4	2,923,680	324,850	11,694,720	1,299,400	12,994,120
Lane marking 15cm	m	12,880	390	40	5,023,200	515,200	5,538,400
Information signs	no.	4	38,320	25,540	153,280	102,160	255,440
Shelters at bus stops	no.	4	1,523,800	169,310	6,095,200	677,240	6,772,440
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	2	14,777,000	6,038,000	29,554,000	12,076,000	41,630,000
<b>6. Other work</b>							
Construction approach road with gravel	m2	1,730	12,280	3,070	21,244,400	5,311,100	26,555,500
Construction and Removal of temporary road with gravel	m2	9,660	12,280	3,070	118,624,800	29,656,200	148,281,000
Relocation of water mains; D 150mm - D 300mm	m	2,760	22,580	1,190	62,320,800	3,284,400	65,605,200
Relocation of electric lines	m	1,550	6,180	330	9,579,000	511,500	10,090,500
Relocation of telephone lines	m	1,000	5,550	290	5,550,000	290,000	5,840,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>2,811,119,640</b>	<b>694,497,720</b>	<b>3,505,617,360</b>

Appendix 16.1 Construction Cost of Package 2: Morocco Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		
			Foreign	Local	Foreign	Local	Total
			Portion	Portion	Portion	Portion	(Tsh.)
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	36,000	1,290	70	46,440,000	2,520,000	48,960,000
Removal of existing pavement material (t=70cm)	m3	2,400	5,500	290	13,200,000	696,000	13,896,000
Excavation (common)	m3	29,260	4,260	220	124,647,600	6,437,200	131,084,800
Embankment (common)	m3	29,000	5,680	300	164,720,000	8,700,000	173,420,000
Sodding	m2	740	1,850	210	1,369,000	155,400	1,524,400
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	8,100	3,460	3,460	28,026,000	28,026,000	56,052,000
Box culvert, concrete class B, 240kg	m3	463	262,970	87,660	121,755,110	40,586,580	162,341,690
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	1,460	16,050	1,780	23,433,000	2,598,800	26,031,800
<b>3. Drainage work</b>							
Pipe culvert, D300	m	289	30,250	30,250	8,742,250	8,742,250	17,484,500
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	1,550	34,700	34,700	53,785,000	53,785,000	107,570,000
Pipe culvert, D1000	m	150	112,380	112,380	16,857,000	16,857,000	33,714,000
L-side ditch	m	0	13,400	13,400	0	0	0
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	7,090	37,520	30,690	266,016,800	217,592,100	483,608,900
U-shaped drain ditch (1.0 x 1.0m)	m	200	43,800	35,840	8,760,000	7,168,000	15,928,000
Side drain with stone pitching	m	880	10,260	8,390	9,028,800	7,383,200	16,412,000
Catch pit	no.	355	140,620	46,870	49,920,100	16,638,850	66,558,950
Manhole	no.	14	122,170	122,170	1,710,380	1,710,380	3,420,760
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	4,810	13,410	1,490	64,502,100	7,166,900	71,669,000
Subbase course, CBR 30%	m3	16,835	22,400	2,490	377,104,000	41,919,150	419,023,150
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	12,025	22,510	2,500	270,682,750	30,062,500	300,745,250
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	0	12,350	1,370	0	0	0
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	48,100	18,400	2,040	885,040,000	98,124,000	983,164,000
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	35,800	8,150	1,440	291,770,000	51,552,000	343,322,000
Kerb stone	m	7,160	7,250	3,900	51,910,000	27,924,000	79,834,000
Overlay (t=100mm)	m2	5,600	13,670	1,520	76,552,000	8,512,000	85,064,000
<b>5. Miscellaneous work</b>							
Road lighting	no.	72	2,692,760	299,200	193,878,720	21,542,400	215,421,120
Traffic signals	no.	14	2,923,680	324,850	40,931,520	4,547,900	45,479,420
Lane marking 15cm	m	16,710	390	40	6,516,900	668,400	7,185,300
Information signs	no.	14	38,320	25,540	536,480	357,560	894,040
Shelters at bus stops	no.	8	1,523,800	169,310	12,190,400	1,354,480	13,544,880
Bus station (Type A)	no.	1	117,145,000	45,357,000	117,145,000	45,357,000	162,502,000
Bus station (Type B)	no.	3	14,777,000	6,038,000	44,331,000	18,114,000	62,445,000
<b>6. Other work</b>							
Construction approach road with gravel	m2	2,260	12,280	3,070	27,752,800	6,938,200	34,691,000
Construction and Removal of temporary road with gravel	m2	12,530	12,280	3,070	153,868,400	38,467,100	192,335,500
Relocation of water mains; D 150mm - D 300mm	m	3,580	22,580	1,190	80,836,400	4,260,200	85,096,600
Relocation of electric lines	m	5,030	6,180	330	31,085,400	1,659,900	32,745,300
Relocation of telephone lines	m	2,200	5,550	290	12,210,000	638,000	12,848,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>3,577,254,910</b>	<b>828,762,450</b>	<b>4,506,017,360</b>

Appendix 16.1 Construction Cost of Package 2; Missing Link

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	2,361	4,260	220	10,057,860	519,420	10,577,280
Embankment (common)	m3	12,230	5,680	300	69,466,400	3,669,000	73,135,400
Sodding	m2	3,047	1,850	210	5,636,950	639,870	6,276,820
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 190kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	47	30,250	30,250	1,421,750	1,421,750	2,843,500
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	0	13,400	13,400	0	0	0
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	1,450	37,520	30,690	54,404,000	44,500,500	98,904,500
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	73	140,620	46,870	10,265,260	3,421,510	13,686,770
Manhole	no.	14	122,170	122,170	1,710,380	1,710,380	3,420,760
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	1,125	13,410	1,490	15,086,250	1,676,250	16,762,500
Subbase course, CBR 30%	m3	3,938	22,400	2,490	88,211,200	9,805,620	98,016,820
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	2,813	22,510	2,500	63,320,630	7,032,500	70,353,130
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	11,250	12,350	1,370	138,937,500	15,412,500	154,350,000
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	3,750	8,150	1,440	30,562,500	5,400,000	35,962,500
Kerb stone	m	1,500	7,250	3,900	10,875,000	5,850,000	16,725,000
Overlay (t=100mm)	m2	0	13,670	1,520	0	0	0
<b>5. Miscellaneous work</b>							
Road lighting	no.	16	2,692,760	299,200	43,084,160	4,787,200	47,871,360
Traffic signals	no.	0	2,923,680	324,850	0	0	0
Lane marking 15cm	m	3,500	390	40	1,365,000	140,000	1,505,000
Information signs	no.	2	38,320	25,540	76,640	51,080	127,720
Shelters at bus stops	no.	0	1,523,800	169,310	0	0	0
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other work</b>							
Construction approach road with gravel	m2	140	12,280	3,070	1,719,200	429,800	2,149,000
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	0	22,580	1,190	0	0	0
Relocation of electric lines	m	0	6,180	330	0	0	0
Relocation of telephone lines	m	0	5,550	290	0	0	0
Disposal of abundant ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	1	177,490,000	19,721,000	177,490,000	19,721,000	197,211,000
<b>Total</b>					<b>723,690,680</b>	<b>126,188,380</b>	<b>849,879,060</b>

Appendix I6.1 Construction Cost of Package 2: Chang'ombe Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	1,000	5,500	290	5,500,000	290,000	5,790,000
Excavation (common)	m3	21,500	4,260	220	91,590,000	4,730,000	96,320,000
Embankment (common)	m3	7,737	5,680	300	43,946,160	2,321,100	46,267,260
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	0	262,970	87,660	0	0	0
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	416	30,250	30,250	12,584,000	12,584,000	25,168,000
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	0	34,700	34,700	0	0	0
Pipe culvert, D1000	m	30	112,380	112,380	3,371,400	3,371,400	6,742,800
L-side ditch	m	0	13,400	13,400	0	0	0
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	5,530	37,520	30,690	207,485,600	169,715,700	377,201,300
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	277	140,620	46,870	38,951,740	12,982,990	51,934,730
Manhole	no.	2	122,170	122,170	244,340	244,340	488,680
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	3,555	13,410	1,490	47,672,550	5,296,950	52,969,500
Subbase course, CBR 30%	m3	9,166	22,400	2,490	205,318,400	22,823,340	228,141,740
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	8,888	22,510	2,500	200,068,880	22,220,000	222,288,880
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	35,550	12,350	1,370	439,042,500	48,703,500	487,746,000
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	13,950	8,150	1,440	113,692,500	20,088,000	133,780,500
Kerb stone	m	5,580	7,250	3,900	40,455,000	21,762,000	62,217,000
Overlay (t=100mm)	m2	9,450	13,670	1,520	129,181,500	14,364,000	143,545,500
<b>5. Miscellaneous work</b>							
Road lighting	no.	56	2,692,760	299,200	150,794,560	16,755,200	167,549,760
Traffic signals	no.	9	2,923,680	324,850	26,313,120	2,923,650	29,236,770
Lane marking 15cm	m	13,020	390	40	5,077,800	520,800	5,598,600
Information signs	no.	9	38,320	25,540	344,880	229,860	574,740
Shelters at bus stops	no.	2	1,523,800	169,310	3,047,600	338,620	3,386,220
Bus station (Type A)	no.	0	117,145,000	45,357,000	0	0	0
Bus station (Type B)	no.	2	14,777,000	6,038,000	29,554,000	12,076,000	41,630,000
<b>6. Other works</b>							
Construction approach road with gravel	m2	1,250	12,280	3,070	15,350,000	3,837,500	19,187,500
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	1,400	22,580	1,190	31,612,000	1,666,000	33,278,000
Relocation of electric lines	m	2,790	6,180	330	17,242,200	920,700	18,162,900
Relocation of telephone lines	m	1,300	5,550	290	7,215,000	377,000	7,592,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>1,865,655,730</b>	<b>401,142,650</b>	<b>2,266,798,380</b>

Appendix 16.1 Construction Cost of Package 3: New Bagamoyo Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	107,500	1,290	70	138,675,000	7,525,000	146,200,000
Removal of existing pavement material (t=70cm)	m3	3,483	5,500	290	19,156,500	1,010,070	20,166,570
Excavation (common)	m3	35,005	4,260	220	149,121,300	7,701,100	156,822,400
Embankment (common)	m3	79,700	5,680	300	452,696,000	23,910,000	476,606,000
Sodding	m2	31,375	1,850	210	58,043,750	6,588,750	64,632,500
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	600	262,970	87,660	157,782,000	52,596,000	210,378,000
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	0	30,250	30,250	0	0	0
Pipe culvert, D600 (Type A)	m	380	70,120	70,120	26,645,600	26,645,600	53,291,200
Pipe culvert, D600 (Type B)	m	439	34,700	34,700	15,233,300	15,233,300	30,466,600
Pipe culvert, D1000	m	36	112,380	112,380	4,045,680	4,045,680	8,091,360
L-side ditch	m	3,180	13,400	13,400	42,612,000	42,612,000	85,224,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	0	37,520	30,690	0	0	0
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	8,930	10,260	8,390	91,621,800	74,922,700	166,544,500
Catch pit	no.	160	140,620	46,870	22,499,200	7,499,200	29,998,400
Manhole	no.	178	122,170	122,170	21,746,260	21,746,260	43,492,520
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	7,270	13,410	1,490	97,490,700	10,832,300	108,323,000
Subbase course, CBR 30%	m3	21,810	22,400	2,490	488,544,000	54,306,900	542,850,900
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	14,540	22,510	2,500	327,295,400	36,350,000	363,645,400
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	72,700	12,350	1,370	897,845,000	99,599,000	997,444,000
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	41,760	8,150	1,440	340,344,000	60,134,400	400,478,400
Kerb stone	m	8,600	7,250	3,900	62,350,000	33,540,000	95,890,000
Overlay (t=100mm)	m2	4,500	13,670	1,520	61,515,000	6,840,000	68,355,000
<b>5. Miscellaneous work</b>							
Road lighting	no.	86	2,692,760	299,200	231,577,360	25,731,200	257,308,560
Traffic signals	no.	12	2,923,680	324,850	35,084,160	3,898,200	38,982,360
Lane marking 15cm	m	20,070	390	40	7,827,300	802,800	8,630,100
Information signs	no.	12	38,320	25,540	459,840	306,480	766,320
Shelters at bus stops	no.	8	1,523,800	169,310	12,190,400	1,354,480	13,544,880
Bus station (Type A)	no.	1	117,145,000	45,357,000	117,145,000	45,357,000	162,502,000
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other work</b>							
Construction approach road with gravel	m2	3,300	12,280	3,070	40,524,000	10,131,000	50,655,000
Construction and Removal of temporary road with gravel	m2	15,050	12,280	3,070	184,814,000	46,203,500	231,017,500
Relocation of water mains; D 150mm - D 300mm	m	8,600	22,580	1,190	194,188,000	10,234,000	204,422,000
Relocation of electric lines	m	4,500	6,180	330	27,810,000	1,485,000	29,295,000
Relocation of telephone lines	m	4,400	5,550	290	24,420,000	1,276,000	25,696,000
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>4,351,302,550</b>	<b>740,417,920</b>	<b>5,091,720,470</b>

Appendix 16.1 Construction Cost of Package 3: Uhuru Road

Description	Unit	Quantity	Unit Rate (Tab.)		Amount		Total (Tab.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	0	1,290	70	0	0	0
Removal of existing pavement material (t=70cm)	m3	0	5,500	290	0	0	0
Excavation (common)	m3	14,700	4,260	220	62,622,000	3,234,000	65,856,000
Embankment (common)	m3	3,000	5,680	300	17,040,000	900,000	17,940,000
Sodding	m2	0	1,850	210	0	0	0
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	0	3,460	3,460	0	0	0
Box culvert, concrete class B, 240kg	m3	130	262,970	87,660	34,186,100	11,395,800	45,581,900
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	360	30,250	30,250	10,890,000	10,890,000	21,780,000
Pipe culvert, D600 (Type A)	m	0	70,120	70,120	0	0	0
Pipe culvert, D600 (Type B)	m	60	34,700	34,700	2,082,000	2,082,000	4,164,000
Pipe culvert, D1000	m	0	112,380	112,380	0	0	0
L-side ditch	m	1,890	13,400	13,400	25,326,000	25,326,000	50,652,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	5,480	37,520	30,690	205,609,600	168,181,200	373,790,800
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	0	10,260	8,390	0	0	0
Catch pit	no.	386	140,620	46,870	54,279,320	18,091,820	72,371,140
Manhole	no.	4	122,170	122,170	488,680	488,680	977,360
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	2,444	13,410	1,490	32,774,040	3,641,560	36,415,600
Subbase course, CBR 30%	m3	9,776	22,400	2,490	218,982,400	24,342,240	243,324,640
Base course, selected materials, CHR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	7,332	22,510	2,500	165,043,320	18,330,000	183,373,320
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	0	12,350	1,370	0	0	0
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	24,440	18,400	2,040	449,696,000	49,857,600	499,553,600
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	16,000	8,150	1,440	130,400,000	23,040,000	153,440,000
Kerb stone	m	10,500	7,250	3,900	76,125,000	40,950,000	117,075,000
Overlay (t=100mm)	m2	28,080	13,670	1,520	383,853,600	42,681,600	426,535,200
<b>5. Miscellaneous work</b>							
Road lighting	no.	64	2,692,760	299,200	172,336,640	19,148,800	191,485,440
Traffic signals	no.	8	2,923,680	324,850	23,389,440	2,598,800	25,988,240
Lane marking 15cm	m	17,200	390	40	6,708,000	688,000	7,396,000
Information signs	no.	8	38,320	25,540	306,560	204,320	510,880
Shelters at bus stops	no.	1	1,523,800	169,310	1,523,800	169,310	1,693,110
Bus station (Type A)	no.	1	117,145,000	45,357,000	117,145,000	45,357,000	162,502,000
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other work</b>							
Construction approach road with gravel	m2	1,370	12,280	3,070	16,823,600	4,205,900	21,029,500
Construction and Removal of temporary road with gravel	m2	0	12,280	3,070	0	0	0
Relocation of water mains; D 150mm - D 300mm	m	3,120	22,580	1,190	70,449,600	3,712,800	74,162,400
Relocation of electric lines	m	3,120	6,180	330	19,281,600	1,029,600	20,311,200
Relocation of telephone lines	m	0	5,550	290	0	0	0
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>2,297,362,300</b>	<b>520,547,030</b>	<b>2,817,909,330</b>

Appendix 16.1 Construction Cost of Package 3: Kilwa Road

Description	Unit	Quantity	Unit Rate (Tsh.)		Amount		Total (Tsh.)
			Foreign	Local	Foreign	Local	
			Portion	Portion	Portion	Portion	
<b>1. Earthwork</b>							
Clearing and stripping (t=70cm)	m2	9,000	1,290	70	11,610,000	630,000	12,240,000
Removal of existing pavement material (t=70cm)	m3	1,300	5,500	290	7,150,000	377,000	7,527,000
Excavation (common)	m3	30,371	4,260	220	129,380,460	6,681,620	136,062,080
Embankment (common)	m3	27,500	5,680	300	156,200,000	8,250,000	164,450,000
Sodding	m2	20,561	1,850	210	38,037,850	4,317,810	42,355,660
<b>2. Structural work</b>							
Concrete block wall, concrete class C, 180kg	m2	2,500	3,460	3,460	8,650,000	8,650,000	17,300,000
Box culvert, concrete class B, 240kg	m3	250	262,970	87,660	65,742,500	21,915,000	87,657,500
Reinforced retaining walls, concrete class A, 240kg	m3	0	244,190	81,400	0	0	0
Gravity wall, concrete class C	m3	0	79,690	79,690	0	0	0
RC hollow slab, concrete class -A	m2	0	469,800	156,600	0	0	0
Pier and Abutment, concrete class-A	m3	0	160,400	53,470	0	0	0
Cast in place pile (D=1,000)	m	0	43,240	14,410	0	0	0
Improvement of foundation	m3	0	16,050	1,780	0	0	0
<b>3. Drainage work</b>							
Pipe culvert, D300	m	34	30,250	30,250	1,028,500	1,028,500	2,057,000
Pipe culvert, D600 (Type A)	m	228	70,120	70,120	15,987,360	15,987,360	31,974,720
Pipe culvert, D600 (Type B)	m	150	34,700	34,700	5,205,000	5,205,000	10,410,000
Pipe culvert, D1000	m	48	112,380	112,380	5,394,240	5,394,240	10,788,480
L-side ditch	m	470	13,400	13,400	6,298,000	6,298,000	12,596,000
U-shaped drain ditch (0.3 x 0.3m)	m	0	31,230	25,550	0	0	0
U-shaped drain ditch (0.4 x 0.5m)	m	1,220	37,520	30,690	45,774,400	37,441,800	83,216,200
U-shaped drain ditch (1.0 x 1.0m)	m	0	43,800	35,840	0	0	0
Side drain with stone pitching	m	5,995	10,260	8,390	61,508,700	50,298,050	111,806,750
Catch pit	no.	85	140,620	46,870	11,952,700	3,983,950	15,936,650
Manhole	no.	80	122,170	122,170	9,773,600	9,773,600	19,547,200
<b>4. Pavement work</b>							
Improved subgrade (t=1.0m)	m3	5,143	13,410	1,490	68,967,630	7,663,070	76,630,700
Subbase course, CBR 30%	m3	15,429	22,400	2,490	345,609,600	38,418,210	384,027,810
Base course, selected materials, CBR 80	m3	0	18,780	18,780	0	0	0
Base course, cement stabilized, UCS 30kg/m2	m3	12,857	22,510	2,500	289,411,070	32,142,500	321,553,570
Asphalt concrete Type 1 (BC t=5cm, SC t=5cm)	m2	51,430	12,350	1,370	635,160,500	70,459,100	705,619,600
Asphalt concrete Type 2 (BC t=10cm, SC t=5cm)	m2	0	18,400	2,040	0	0	0
Sidewalk, base course(t=10cm), asphalt surface(t=3cm)	m2	31,150	8,150	1,440	253,872,500	44,856,000	298,728,500
Kerb stone	m	6,230	7,250	3,900	45,167,500	24,297,000	69,464,500
Overlay (t=100mm)	m2	7,000	13,670	1,520	95,690,000	10,640,000	106,330,000
<b>5. Miscellaneous work</b>							
Road lighting	no.	62	2,692,760	299,200	166,951,120	18,550,400	185,501,520
Traffic signals	no.	4	2,923,680	324,850	11,694,720	1,299,400	12,994,120
Lane marking 15cm	m	14,540	390	40	5,670,600	581,600	6,252,200
Information signs	no.	4	38,320	25,540	153,280	102,160	255,440
Shelters at bus stops	no.	7	1,523,800	169,310	10,666,600	1,185,170	11,851,770
Bus station (Type A)	no.	1	117,145,000	45,357,000	117,145,000	45,357,000	162,502,000
Bus station (Type B)	no.	0	14,777,000	6,038,000	0	0	0
<b>6. Other work</b>							
Construction approach road with gravel	m2	3,110	12,280	3,070	38,190,800	9,547,700	47,738,500
Construction and Removal of temporary road with gravel	m2	10,900	12,280	3,070	133,852,000	33,463,000	167,315,000
Relocation of water mains; D 150mm - D 300mm	m	6,230	22,580	1,190	140,673,400	7,413,700	148,087,100
Relocation of electric lines	m	3,165	6,180	330	19,559,700	1,044,450	20,604,150
Relocation of telephone lines	m	3,315	5,550	290	18,398,250	961,350	19,359,600
Disposal of abandoned ships in the harbor	ton	0	132,170	14,690	0	0	0
Embankment of Existing Railway Line (TRC)	Sum	0	177,490,000	19,721,000	0	0	0
<b>Total</b>					<b>2,976,527,580</b>	<b>534,213,740</b>	<b>3,510,741,320</b>





## **Chapter 17 Environmental Impact Assessment**

**Appendix 17.1 Location Map of Resettlement Survey**

**Appendix 17.2 Forecast Condition of Flood Discharge**

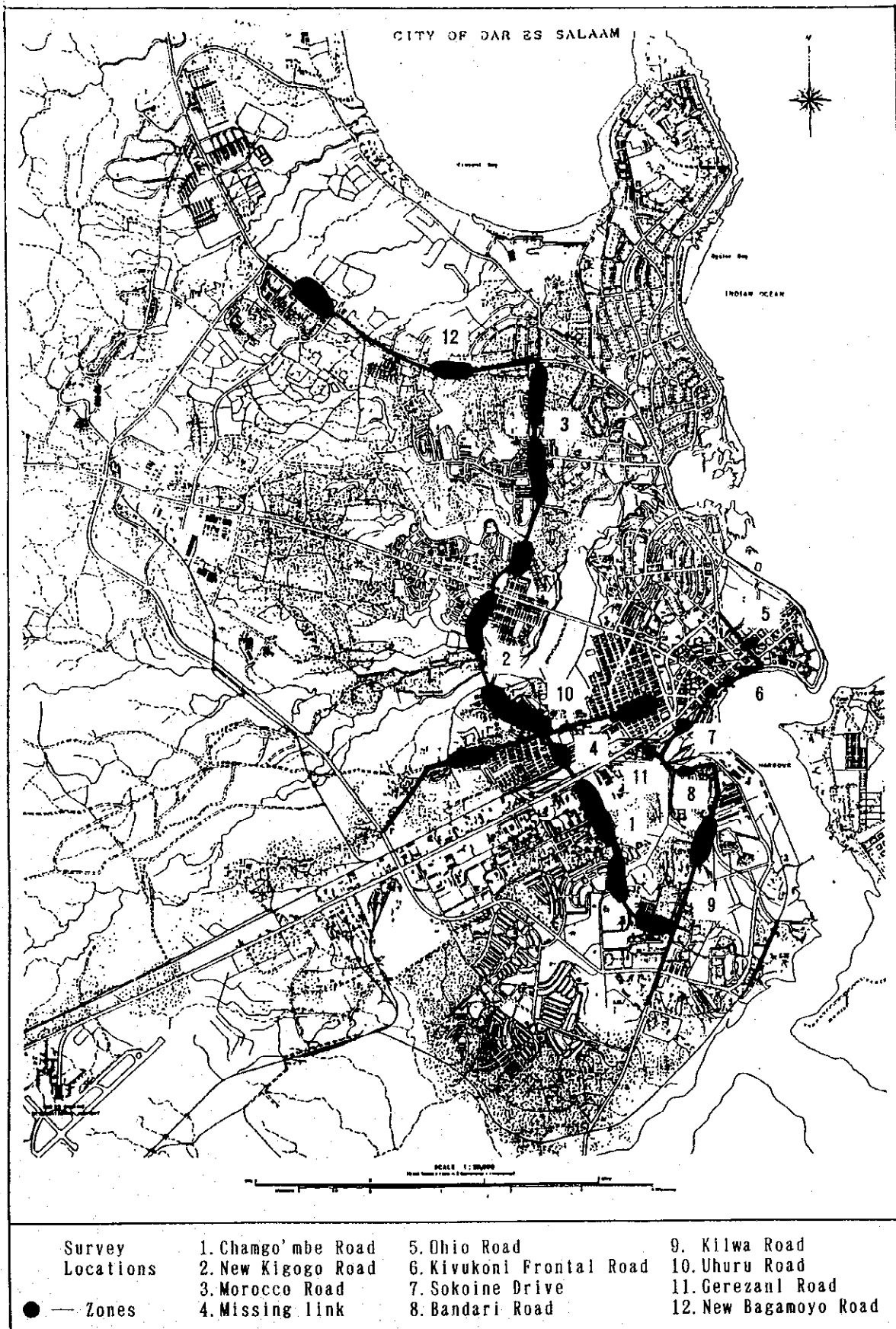
**Appendix 17.3 Forecast Condition for Air Pollution**

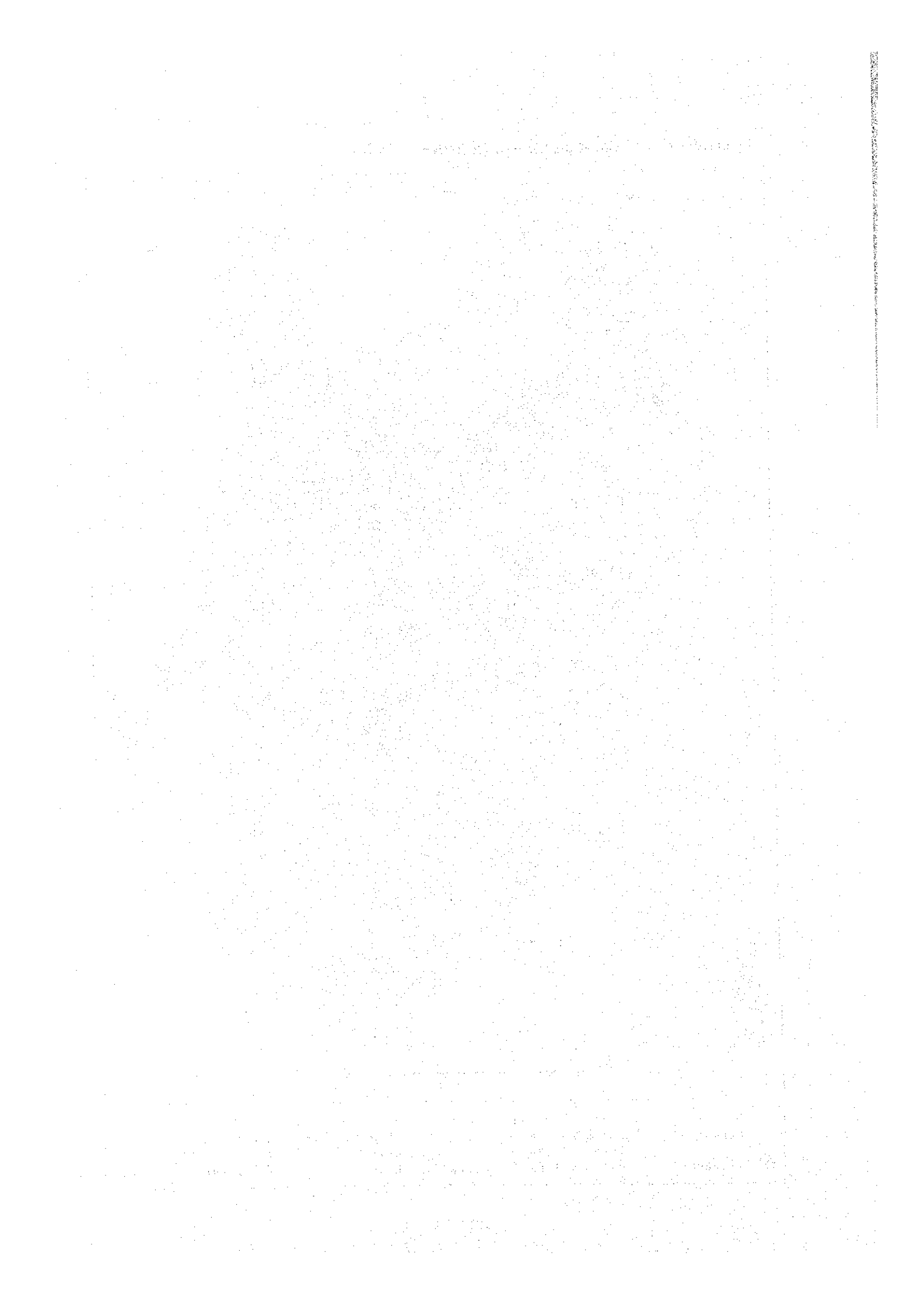
**Appendix 17.4 Noise Forecast Condition**

**Appendix 17.5 Vibration Forecast Condition**



# Appendix 17.1 Location Map of Resettlement Survey





## Appendix 17.2 Forecast Condition of Flood Discharge

### (1) Rational Formula

$$Q_p = \frac{1}{3.6} f \cdot r \cdot A$$

Where,  $Q_p$  : Peak runoff  
 $f$  : Runoff Coefficient  
 $A$  : River basin (km<sup>2</sup>)

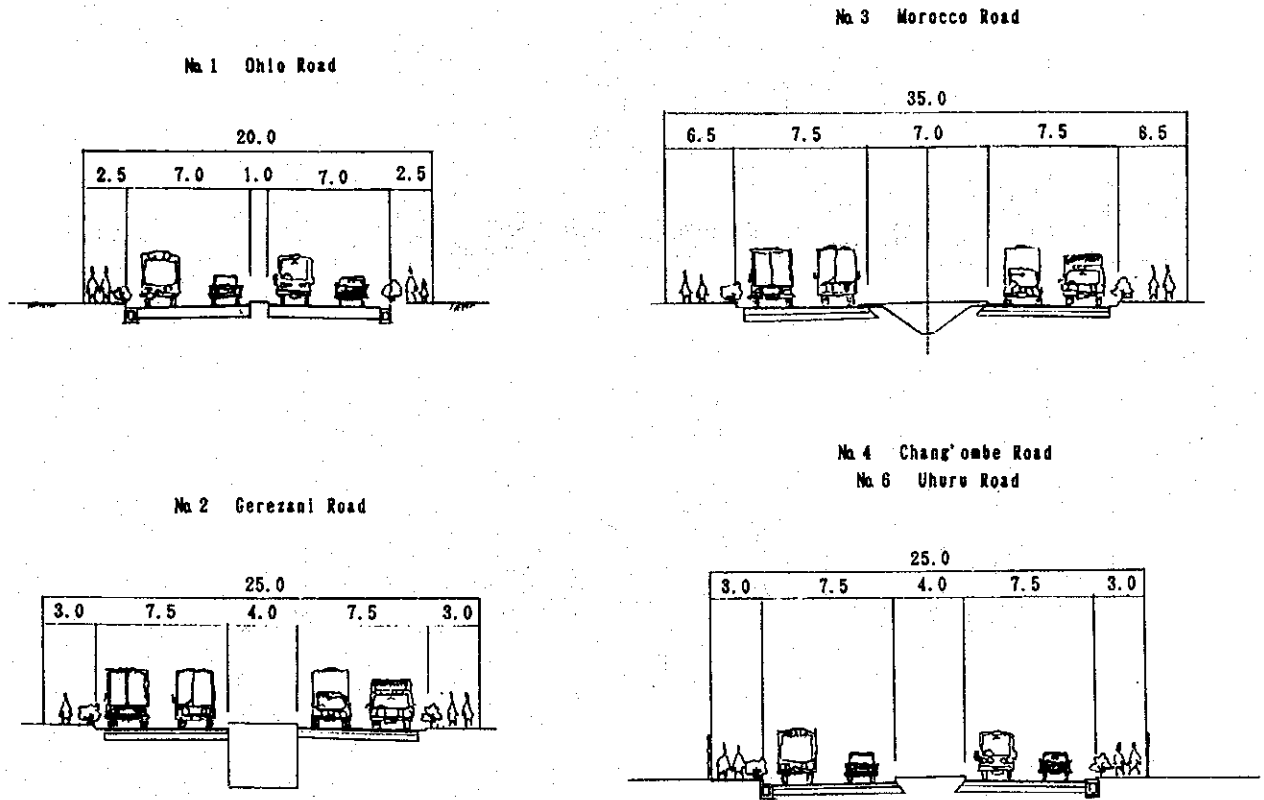
(2) Values of runoff coefficient are reported by a joint committee of the American Society of civil engineers.

Average Runoff Coefficient by Different Use of Area		Average Runoff Coefficient by Different Construction	
Business	0.50~0.95	Streets	0.70~0.95
Downtown areas	0.70~0.95	Asphalt	0.70~0.95
Neighborhood areas	0.50~0.70	Concrete	0.80~0.95
Residential	0.25~0.75	Brick	0.70~0.85
Single-family areas	0.30~0.50	Sidewalk, parking place	0.75~0.85
Multi units, detached	0.40~0.60	Roofs	0.75~0.95
Multi units, attached	0.60~0.75	Lawns: Sandy soil	0.05~0.20
Apartment dwelling areas	0.50~0.70	Slop Flat   ~2%	0.05~0.10
Suburban	0.25~0.40	Average 2~7%	0.10~0.15
Industrial	0.50~0.90	Steep   7%	0.15~0.20
Light areas	0.50~0.80	Lawns: Heavy soil	0.13~0.35
Heavy areas	0.60~0.90	Slop Flat   ~2%	0.13~0.17
Green zon, etc.	0.10~0.40	Average 2~7%	0.18~0.22
Parks, cemeteries	0.10~0.25	Steep   7%	0.25~0.35
Play ground	0.20~0.35		
Railroad yard areas	0.20~0.40		
Vnimproved ares	0.10~0.30		



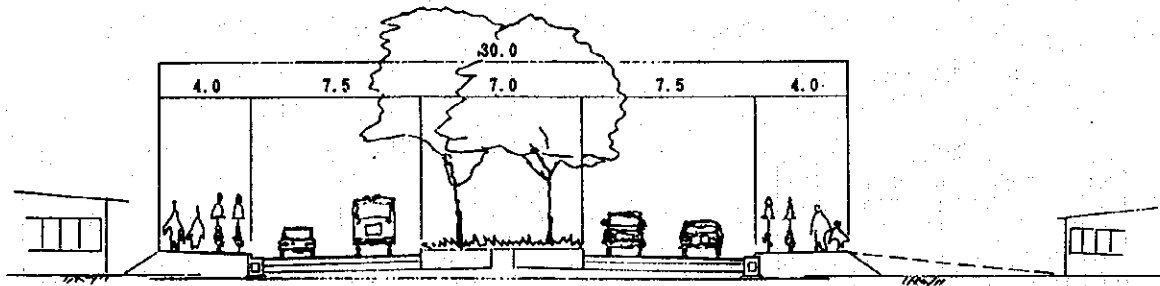
## Appendix 17.3 Forecast Condition for Air Pollution

### (1)-1 Component of road cross section of forecast position

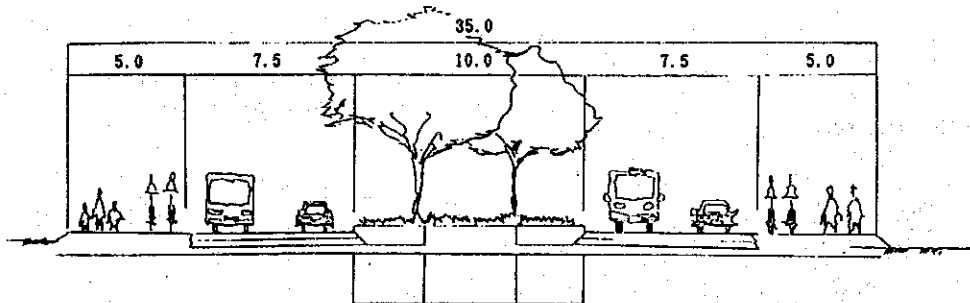


(1)-2 Component of road cross section of forecast position

No 5 New Bagamoyo Road

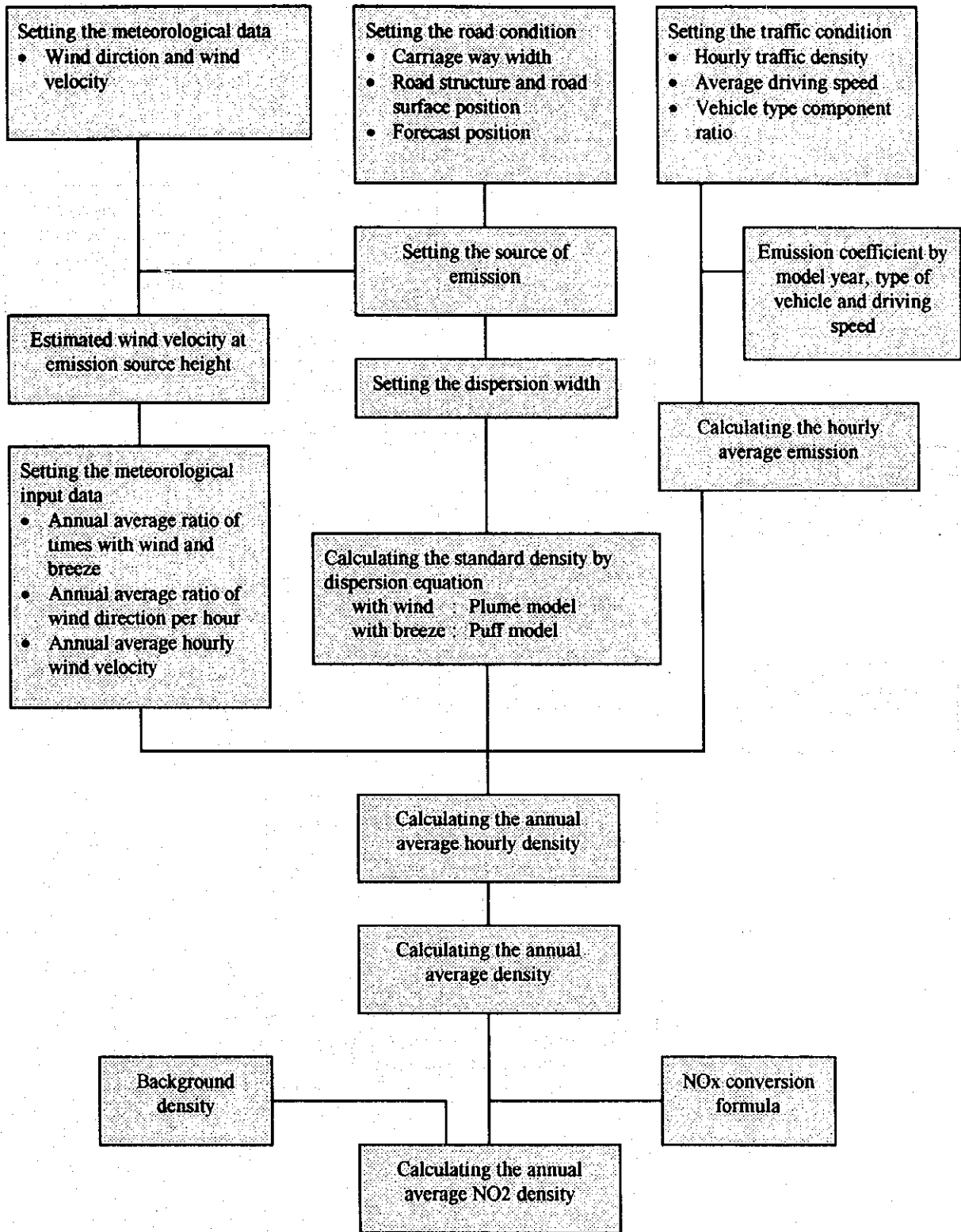


No 7 Kilwa Road

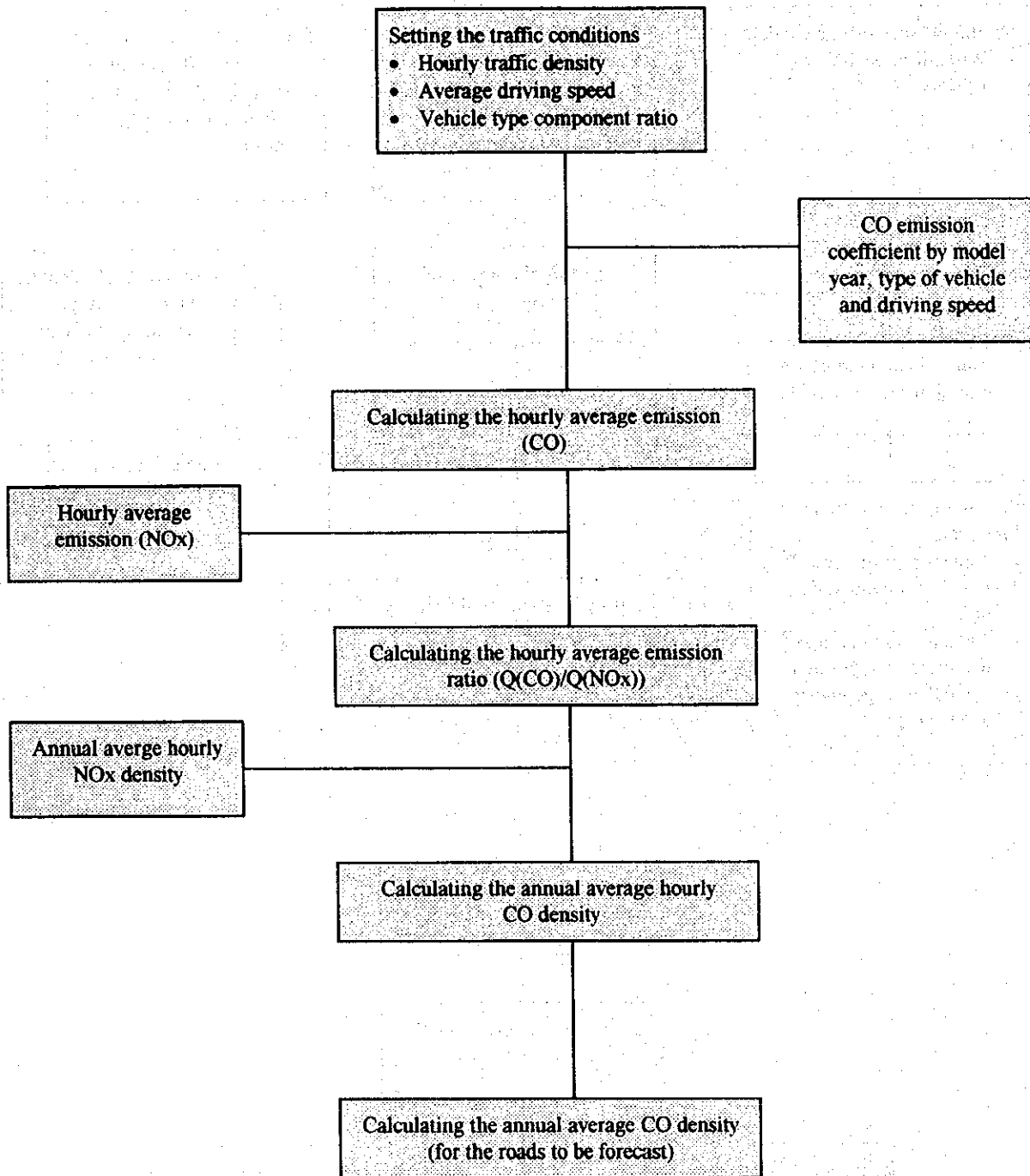




(2) Calculation procedure for nitrogen dioxide forecast



(3) Calculation procedure for carbon monoxide (CO) forecast



(4) Forecast formula

- (a) The following Plume model is used when it is blowing (wind velocity of over 1 m/sec.)

$$C(x, y, z) = \frac{Q}{2\pi \cdot u \cdot \sigma_y \cdot \sigma_z} \exp\left(-\frac{y^2}{2\sigma_y^2}\right) \left[ \exp\left\{-\frac{(z-H)^2}{2\sigma_z^2}\right\} + \exp\left\{-\frac{(z+H)^2}{2\sigma_z^2}\right\} \right]$$

Where,

- $c(x, y, z)$  : density (ppm) at points (x, y, z)  
 $Q$  : emission strength (cc/s)  
 $u$  : Average wind velocity (m/s)  
 $H$  : Height of emission source (m)  
 $\sigma_y, \sigma_z$  : Diffusion width in horizontal (y) and perpendicular (x) directions (m)  
 $x$  : Leeward distance in wind direction (m)  
 $y$  : Horizontal distance at a right angle to x-axis (m)  
 $z$  : Perpendicular distance at a right angle to x-axis (m)

- (b) The following Puff model is used when it is breezing (wind velocity of 1 m/sec. or less)

$$C(x, y, z) = \frac{Q}{(2\pi)^{3/2} \cdot \alpha^2 \cdot \gamma} \left[ \frac{1 - \exp\left(-\frac{\ell}{t_0^2}\right)}{2\ell} + \frac{1 - \exp\left(-\frac{m}{t_0^2}\right)}{2m} \right]$$

Where,

$$\ell = \frac{1}{2} \left\{ \frac{x^2 + y^2}{\alpha^2} + \frac{(z-H)^2}{\gamma^2} \right\}, \quad m = \frac{1}{2} \left\{ \frac{x^2 + y^2}{\alpha^2} + \frac{(z+H)^2}{\gamma^2} \right\}$$

- $t_0$  : Time corresponds to initial diffusion width(s)  
 $\alpha, \gamma$  : Coefficient of diffusion width

- (c) Setting the diffusion width

- Diffusion width used when it is blowing ( $U > 1.0$  m/s)

- Diffusion width in the perpendicular direction ( $\alpha z$ )

$$\alpha z = 1.5 + 0.31 \cdot L^{0.83}$$

Where,

- $L$  : Distance from the carriage way end ( $L = x - W/2$ )  
 $x$  : Leeway distance in the wind direction (m)

W : Carriage way width

Note that  $\sigma_z = 1.5$  when  $x < W/2$

- Diffusion width in the horizontal direction ( $\sigma_y$ )

$$\sigma_y = W/2 + 0.46 \cdot L^{0.81}$$

Note that  $\sigma_y = 2$  when  $x < W/2$

- Diffusion width used when it is breezing ( $U = < 1.0$  m/s)

- Time corresponds to initial diffusion width ( $t_0$ )

$$t_0 = W/2 \cdot \alpha$$

Where,

W : Carriage way width (m)

x : Leeway distance in the wind direction (m)

$\alpha$  : Coefficient of diffusion width show below

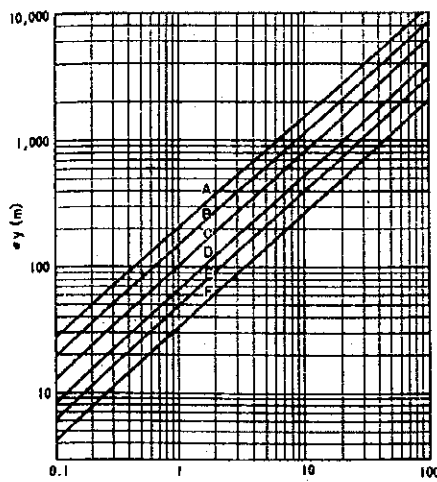
- Coefficient of diffusion width ( $\alpha, \gamma$ )

$$\alpha = 0.3$$

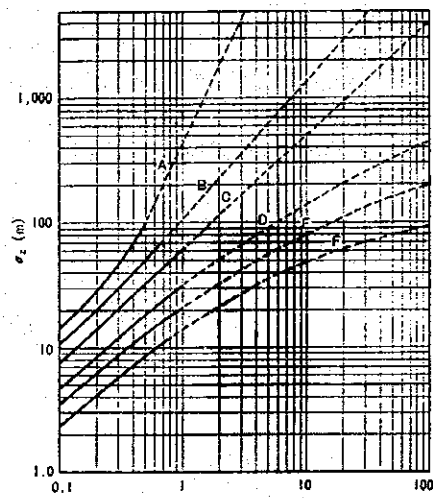
$$\gamma = 0.18 \text{ (in the daytime)}$$

$$= 0.09 \text{ (at night)}$$

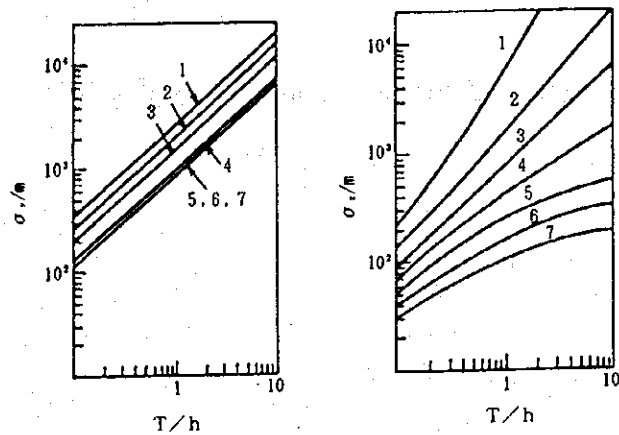
where daytime refers to the time from 7:00 am. to 7:00 pm. and the night from 7:00 pm. to 7:00 am.



Pasquill-Gifford ( $\sigma_y : x$ )



Pasquill-Gifford ( $\sigma_z : x$ )



Turner

(d) Convert  $\text{NO}_x$  into  $\text{NO}_2$

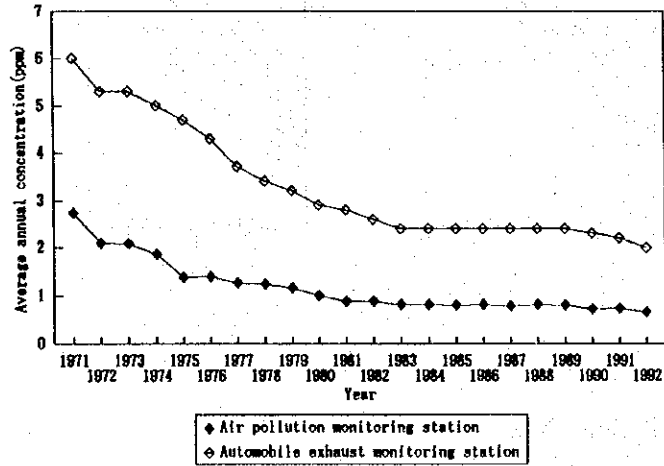
$$[\text{NO}_2] = 0.0801 [\text{NO}_x]^{0.701}$$

Note: To obtain the  $\text{NO}_x$  conversion formula shown below, the average of the values of all the general environment air monitoring stations located in the same municipalities as those of the roadside automobile exhaust monitoring stations was subtracted from the value of the roadside automobile exhaust monitoring station, using the average value of the nationwide  $\text{NO}_x$  and  $\text{NO}_2$  of the general environment air monitoring stations collected by Environment Agency during the period from fiscal 1972 to 1985. Then the concentration of  $\text{NO}_x$  and  $\text{NO}_2$  considered to be attributable to the road was calculated to obtain the regression formula according to the least-square method.

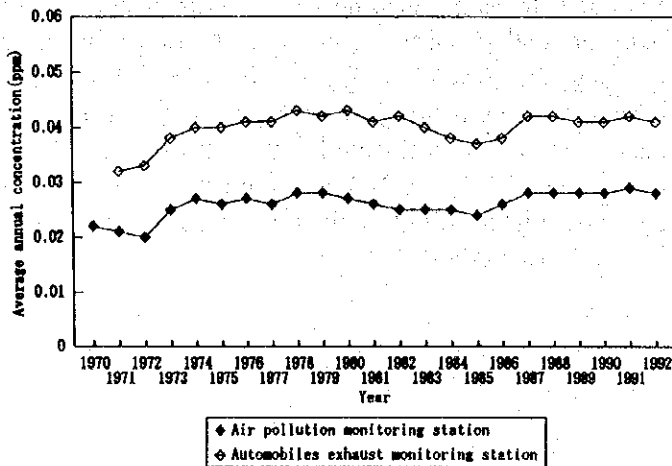
(e) The Existing Condition of Air Pollution in Japan

(Source: White Paper on Environment)

The change of annual average of NO<sub>2</sub> density

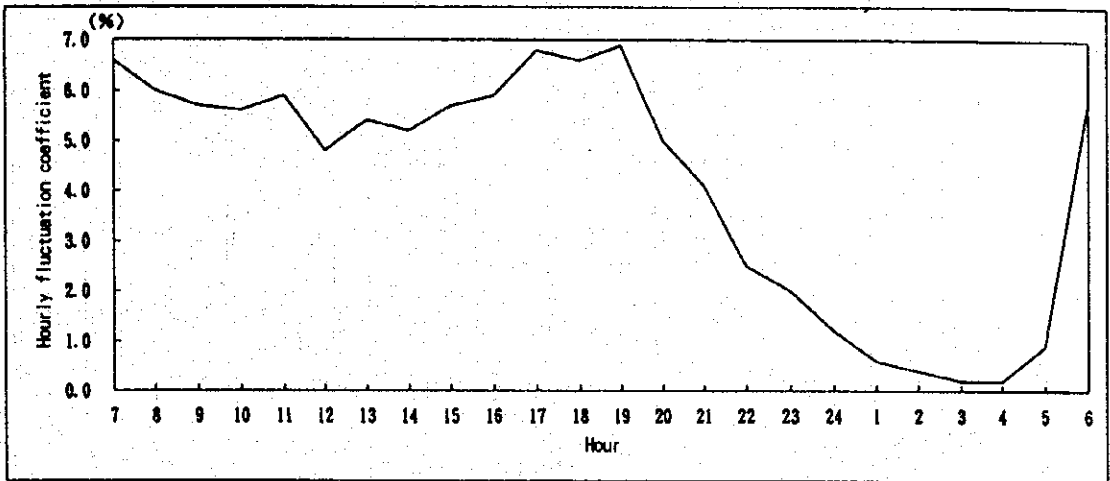


The change of the annual average of NO density



(5) Traffic Conditions

(a) Hourly fluctuation coefficient and mixing rate of different types of vehicles



Hour	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6
Hourly fluctuation coefficient	6.6	6.0	5.7	5.6	5.9	4.8	5.4	5.2	5.7	5.9	6.8	6.6	6.9	5.0	4.1	2.5	2.0	1.2	0.6	0.4	0.2	0.2	0.9	5.8

Hourly fluctuation coefficient at Morocco Road

(b) Hourly traffic density of each cross section (2000 A.D.)

Time	Hourly fluctuation coefficient	Ohio Road			Cerezani Road			Morocco Road			Chang'ombe Road			New Bagamoyo Road			Uhuru Road			Kilwa Road		
		small vehicle	large vehicle	total	small vehicle	large vehicle	total	small vehicle	large vehicle	total	small vehicle	large vehicle	total	small vehicle	large vehicle	total	small vehicle	large vehicle	total	small vehicle	large vehicle	total
7	6.6	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,414	686	2,100	1,198	445	1,643
8	6.0	1,339	242	1,581	1,340	241	1,581	1,340	241	1,581	1,340	241	1,581	1,340	241	1,581	1,285	624	1,909	1,088	405	1,493
9	5.7	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,221	593	1,814	1,034	385	1,419
10	5.6	1,250	225	1,475	1,250	225	1,475	1,249	225	1,474	1,250	225	1,475	1,250	225	1,475	1,200	582	1,782	1,016	378	1,394
11	5.9	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,264	613	1,877	1,071	398	1,469
12	4.8	1,072	193	1,265	1,072	193	1,265	1,073	192	1,265	1,072	193	1,265	1,072	193	1,265	1,028	499	1,527	871	324	1,195
13	5.4	1,206	217	1,423	1,206	217	1,423	1,206	217	1,423	1,206	217	1,423	1,206	217	1,423	1,156	562	1,718	980	364	1,344
14	5.2	1,161	209	1,370	1,161	209	1,370	1,161	209	1,370	1,161	209	1,370	1,162	209	1,371	1,114	541	1,655	943	351	1,294
15	5.7	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,273	229	1,502	1,221	593	1,814	1,034	385	1,419
16	5.9	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,317	237	1,554	1,264	613	1,877	1,071	398	1,469
17	6.8	1,517	274	1,791	1,517	274	1,791	1,517	274	1,791	1,517	274	1,791	1,517	274	1,791	1,457	707	2,164	1,234	459	1,693
18	6.6	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,473	266	1,739	1,414	686	2,100	1,198	445	1,643
19	6.9	1,540	278	1,818	1,540	278	1,818	1,540	278	1,818	1,540	278	1,818	1,540	278	1,818	1,478	718	2,196	1,251	466	1,717
20	5.0	1,116	201	1,317	1,116	201	1,317	1,116	201	1,317	1,116	201	1,317	1,116	201	1,317	1,071	520	1,591	906	338	1,244
21	4.1	915	165	1,080	915	165	1,080	915	165	1,080	915	165	1,080	915	165	1,080	879	426	1,305	743	277	1,020
22	2.5	558	101	659	558	101	659	558	101	659	558	101	659	558	101	659	536	260	796	453	169	622
23	2.0	446	81	527	447	80	527	447	80	527	447	80	527	447	80	527	428	208	636	363	135	498
0	1.2	268	48	316	268	48	316	268	48	316	268	48	316	268	48	316	257	125	382	218	81	299
1	0.6	134	24	158	134	24	158	134	24	158	134	24	158	134	24	158	129	62	191	109	40	149
2	0.4	89	16	105	89	16	105	89	16	105	89	16	105	89	16	105	85	42	127	72	27	99
3	0.2	45	8	53	45	8	53	45	8	53	45	8	53	45	8	53	43	21	64	36	14	50
4	0.2	45	8	53	45	8	53	45	8	53	45	8	53	45	8	53	43	21	64	36	14	50
5	0.9	201	36	237	201	36	237	201	36	237	201	36	237	201	36	237	192	94	286	163	61	224
6	5.8	1,295	233	1,528	1,295	233	1,528	1,295	233	1,528	1,295	233	1,528	1,295	233	1,528	1,243	603	1,846	1,052	392	1,444
total	100.0	22,322	4,023	26,345	26,835	8,706	35,541	31,581	10,076	41,657	18,100	7,927	26,027	5,561	5,852	11,413	21,422	10,399	31,821	18,141	6,750	24,891



(c) Average driving speed

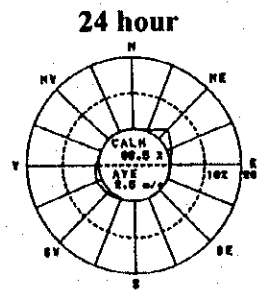
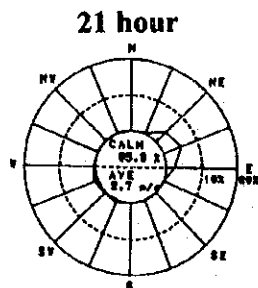
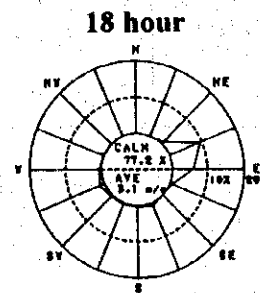
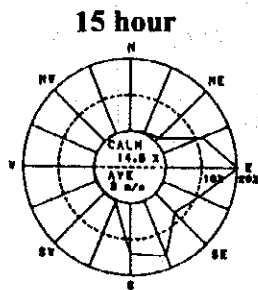
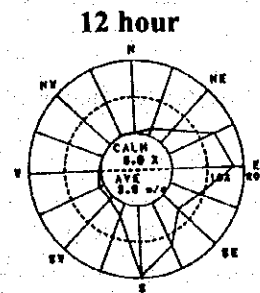
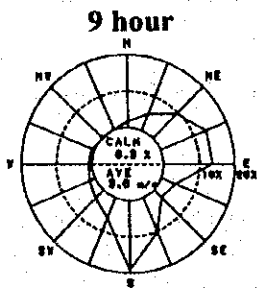
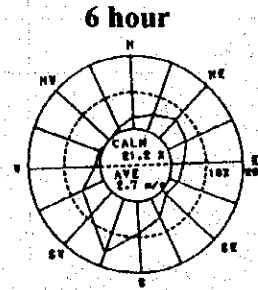
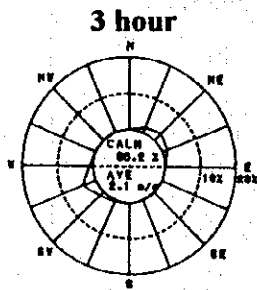
Road Name	Location No.	Average driving speed (km/h)
Ohio	1	40
Gerezani	2	40
Morocco	3	60
Chang'ombe	4	60
New Bagamoyo	5	80
Uhuru	6	60
Kilwa	7	80

(d) Emission coefficient for nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO)

Pollutant		Nitrogen oxides NO <sub>x</sub>		Carbon monoxide CO	
Type of vehicles		Small vehicle	Large vehicle	Small vehicle	Large vehicle
Driving Speed	40 km/h	0.237	3.69	1.22	1.83
	60 km/h	0.266	2.93	0.758	1.55
	80 km/h	0.546	3.46	0.776	1.21

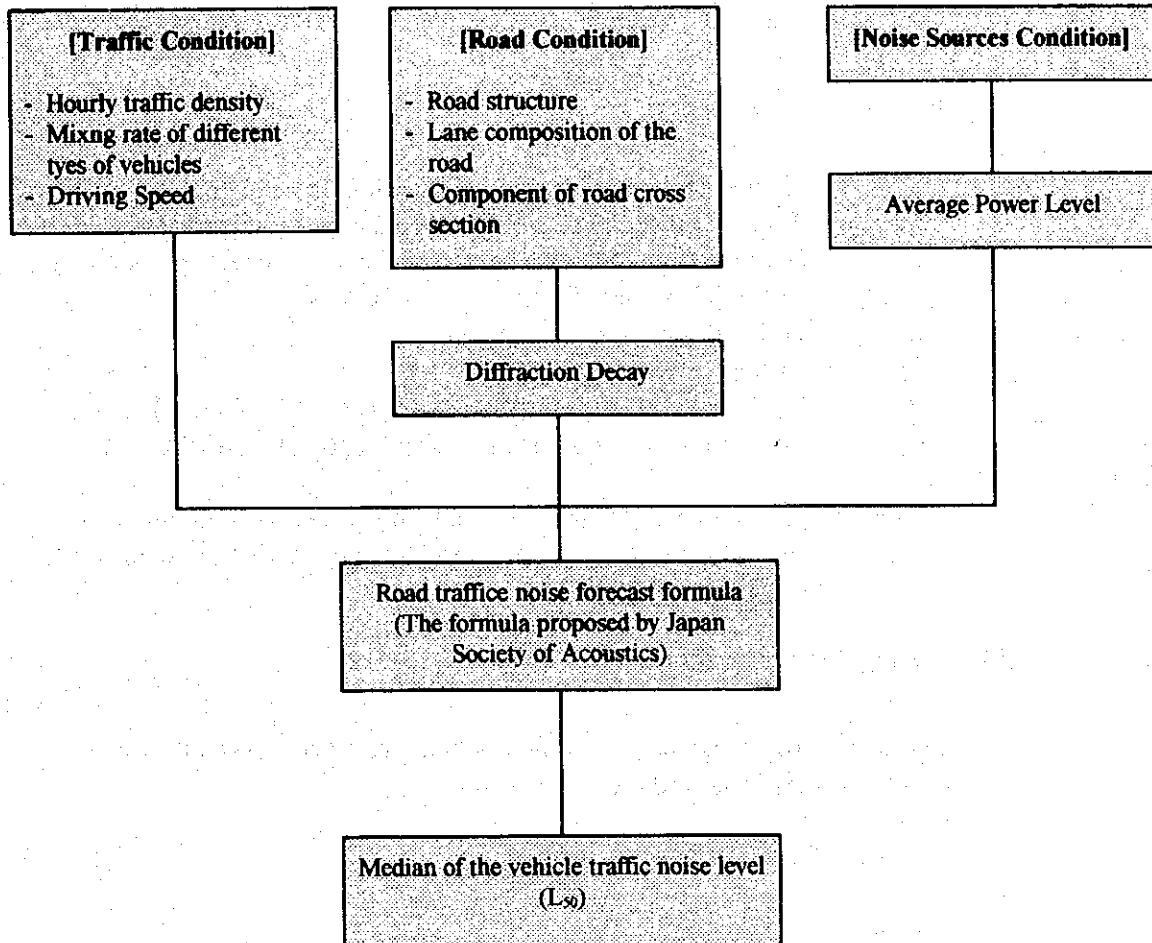
Note: The Construction Ministry

- (6) The hourly wind direction and velocity throughout the year based on the data observed in the year 1992 at Dar es Salaam.



## Appendix 17.4 Noise Forecast Condition

### (1) Road traffic noise level forecast procedure



(2) Road traffic noise forecast

- (a) Forecast formula (The formula proposed by the Japan Society of Acoustics)

$$L_{50} = L_w - 8 - 20 \log_{10} \ell + 10 \log_{10} \left( \pi \frac{\ell}{d} \cdot \tanh 2\pi \frac{\ell}{d} \right) + \alpha_d + \alpha_i$$

Where,

- $L_{50}$  : Median of the road traffic noise (dB(A))
- $L_w$  : Average power level produced from each vehicle (dB(A))
- $\ell$  : Distance from the noise source to the noise receiving point (m)
- $d$  : Average headway distance,  $d = 1000 V/N$
- $N$  : Traffic density (vehicles/hour)
- $V$  : Average driving speed (km/hour)
- $\alpha_d$  : Correction value for diffraction decay (dB(A)) (See Fig. 18)
- $\alpha_i$  : Correction value for various reasons (dB(A)) (See Fig. 18)

Note : The predictive formula shown below is based on the one-row interval equi-power model formulated by the Japan Society of Acoustics in March 1977.

- (b) Average power level:  $L_w$

The second regulation shown in the following equation is used for the average power level of the vehicle noise:

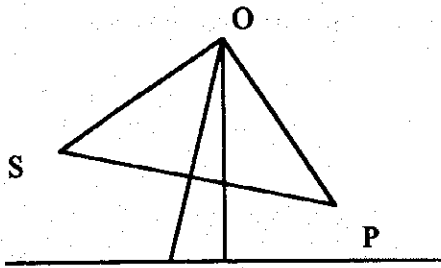
$$L_w = 86 + 0.2V + 10 \log_{10} (a_1 + 5a_2)$$

Where,

- $L_w$  = Average power level (dB (A))
- $V$  : Average driving speed (km/hour)
- $a_1$  : Mixing rate of small vehicle
- $a_2$  : Mixing rate of large vehicle  
(Note that  $a_1 + a_2 = 1.0$ )

Note : The second-stage convention represents the target value for vehicle noise tolerance. The target value for vehicle noise tolerance during accelerated travel (maximum instantaneous value) was shown in two stages in "A method of setting a long-term vehicle noise tolerance" which was reported by the Central Council in June 1976. The regulation in the first stage was represented in the fiscal 1979 regulation, while the second stage regulation was enforced from 1982 to 1987.

(c) Correction value for diffraction decay :  $\alpha_d$



O : Apex of the acoustic obstacle

P : Position of noise receiving point

S : Noise source (0.3 high from the road surface)

- For  $0.5 \leq \delta$  :  $-9 \cdot \log_{10} \delta - 14.3$
- For  $0.07 \leq \delta < 0.5$  :  $-2.7 (\log_{10} \delta)^2 - 10.5 \cdot \log_{10} \delta - 14.5$
- For  $0.01 \leq \delta < 0.07$  :  $-3 \cdot \log_{10} \delta - 9.5$
- For  $-0.001 \leq \delta < 0.01$  :  $-10 \cdot \log_{10} \delta (0.2 + 2.5 \delta) - 10$
- For  $-0.015 \leq \delta < -0.001$  :  $0.24 \cdot \log_{10} |\delta| - 2.2$
- For  $-0.3 \leq \delta < -0.015$  :  $2 \cdot \log_{10} |\delta| + 1$

Note: It should be noted that roads are flat in structure and noise diffraction does not occur in the present prediction; therefore, correction value  $\alpha_d$  is not taken into account.

(d) Correction value  $\alpha_i$  on general roads for various reasons :  $\alpha_i$

Structure	Height above road surface	Distance from the shoulder													
		0	5	10	20	30	40	50	60	70	80	90	100	120	160
Fill up	12-40			-0.5	-2.5	-3.5	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-5.0	-6.0
	7.0			-2.5	-4.5	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-6.0	-7.0
	3.5			-4.0	-5.5	-6.0	-6.0	-6.5	-6.5	-7.0	-7.0	-7.0	-7.0	-8.0	-9.0
	1.2	-3.0	-4.5	-5.5	-6.5	-6.5	-7.5	-7.0	-7.0	-7.5	-7.5	-8.0	-8.0	-9.0	-10.0
Cut	12-40			0	0	-0.5	-1.5	-2.5	-3.5	-4.0	-4.0	-4.0	-4.0	-5.0	-6.0
	7.0			-1.5	-1.5	-2.5	-3.5	-4.0	-4.5	-4.5	-5.0	-5.0	-5.0	-6.0	-7.0
	3.5			-2.5	-3.5	-4.0	-4.5	-4.5	-5.0	-5.0	-5.0	-5.0	-5.0	-6.0	-7.0
	1.2	-2.5	-3.5	-4.5	-5.0	-5.5	-5.5	-6.0	-6.0	-6.0	-6.0	-6.5	-6.5	-7.5	-8.5
Elevated	12-40		-2.0	-3.5	-5.0	-5.0	-5.0	-4.5	-4.0	-3.5	-4.0	-4.0	-4.5	-5.5	-6.5
	7.0		-1.0	-2.5	-3.5	-3.5	-4.0	-4.0	-4.0	-3.5	-4.0	-4.0	-4.5	-5.5	-6.5
	3.5		0	-1.0	-2.5	-3.5	-3.5	-3.5	-3.5	-3.5	-4.0	-4.0	-4.5	-5.5	-6.5
	1.2	+3.0	+1.0	0	-1.5	-2.0	-2.5	-3.0	-3.5	-3.5	-4.0	-4.0	-4.5	-5.5	-6.5
Flat	12-40		-4.5	-2.5	-3.0	-3.0	-3.0	-3.5	-3.5	-4.0	-4.0	-4.0	-4.0	-5.0	-6.0
	7.0		-4.0	-3.0	-3.5	-4.0	-4.5	-5.0	-5.5	-5.5	-5.5	-5.5	-5.5	-6.5	-7.5
	3.5		-4.5	-4.5	-5.0	-6.0	-6.5	-7.0	-7.5	-8.0	-8.5	-8.5	-8.5	-9.5	-10.5
	1.2	-2.5	-7.0	-7.5	-8.5	-8.5	-9.0	-9.5	-10.0	-10.5	-11.0	-11.0	-11.0	-12.0	-13.0

(3) Construction noise forecast

Construction noise will be forecast at the height of 1.2 meters over the road surface.

(a) Forecast formula

The point noise source propagation theoretical formula in the semi-free space is used as the forecast formula.

$$L = P_{wL} - 20 \log_{10} l - 8$$

Where,

- L : Noise level l (m) away from the noise source (dB (A))
- $P_{wL}$  : Noise source power level (dB (A))
- l : Distance from the noise source to the noise receiving point (m)

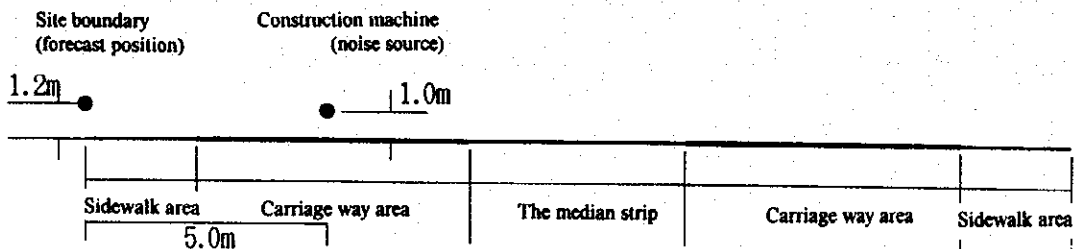
When more than one construction machines are used simultaneously, the following formula is used to get the composite level of the noise from each of the construction.

$$L = 10 \log_{10} \left( 10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \dots + 10^{\frac{L_n}{10}} \right)$$

Where,

- L : Composite noise level (dB (A))
- $L_1 \sim L_n$  : Noise level of each construction machine (dB (A))

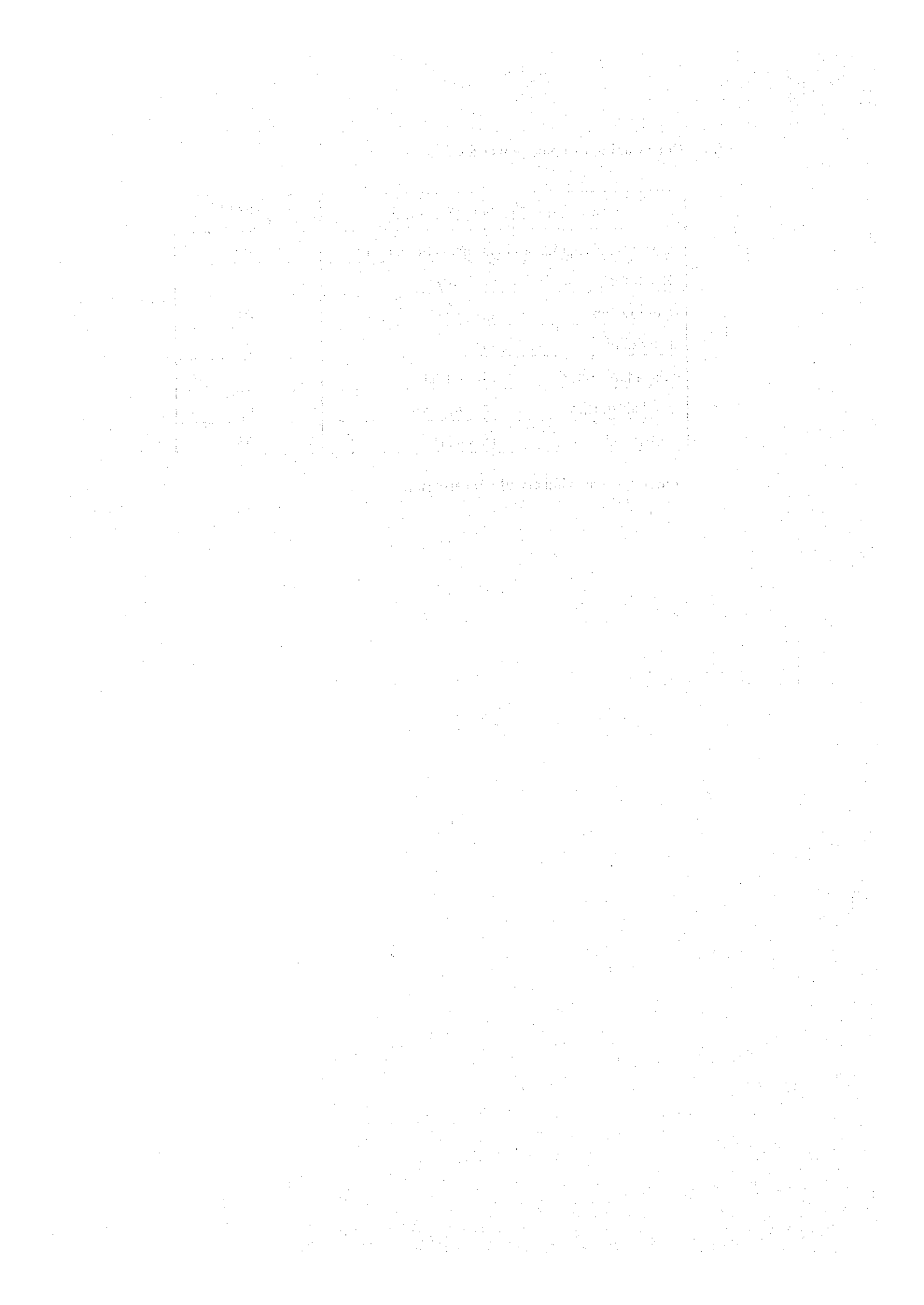
(b) Noise source position and forecast position



(c) Construction machine power level

Construction Machine (Standard)	Noise Power Level (dB(A))
Concrete shredding and compression equipment	92
Back hoe (0.6 m <sup>3</sup> )	92
Dump truck (10 ~ 11t)	101
Bulldozer (7t)	95
Macadam roller (10 ~ 12t)	95
Asphalt finisher (4.5m)	92
Tire roller (8 ~ 20t)	95

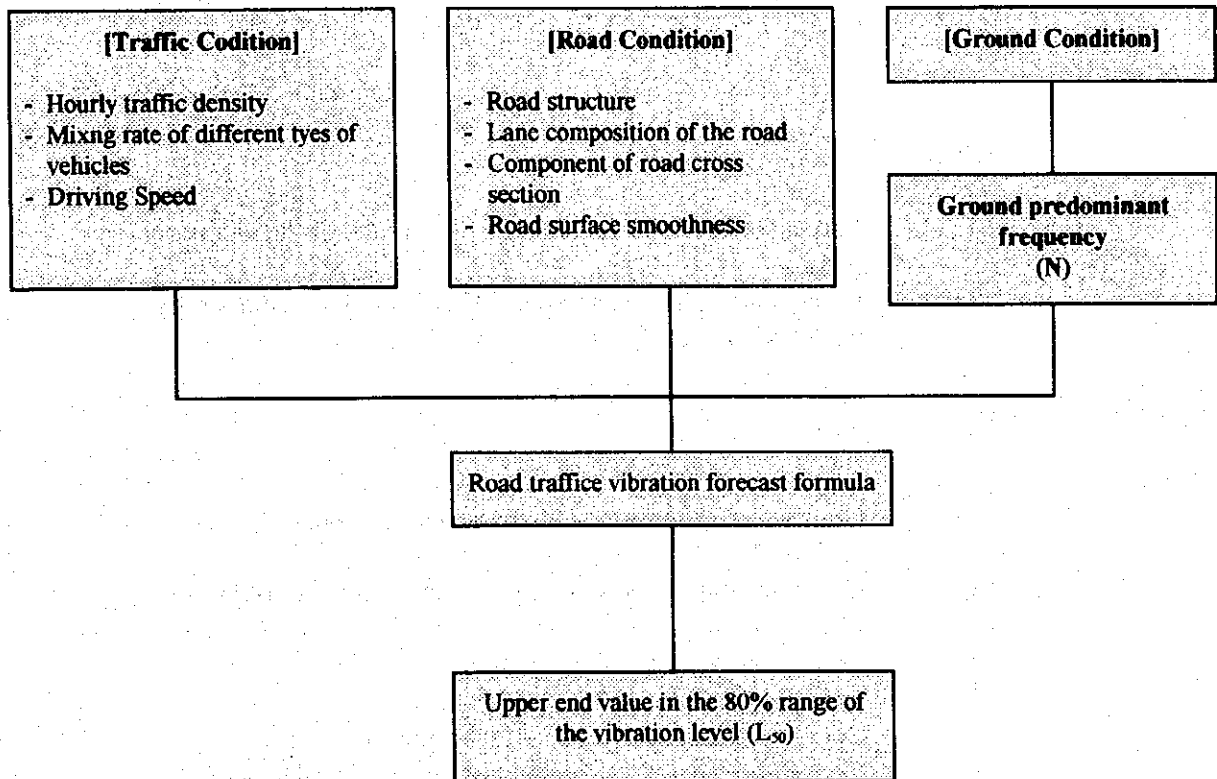
Source : The Ministry of Construction





## Appendix 17.5 Vibration Forecast Condition

### (1) Road traffic vibration level forecast procedure



(2) Road traffic vibration forecast

(a) Forecast formula (The formula proposed by the engineering laboratory of the Japanese Construction Ministry)

$$L_{10} = a \log_{10} (\log_{10} Q^*) + b \log_{10} V + c \log_{10} M + d + \alpha_0 + \alpha_r + \alpha_s - \alpha_l$$

Where,

$L_{10}$  : Forecast upper end value in the 80% range of the vibration level (dB)

$Q^*$  : Equivalent traffic density per 500 sec. per lane (number of vehicles/500 sec./lane)

$$Q^* = \frac{500}{3600} \times \frac{1}{M} (Q_1 + 13 Q_2)$$

$Q_1$  : Hourly traffic density of small vehicles (number of small vehicles/hour)

$Q_2$  : Hourly traffic density of large vehicles (number of large vehicles/hour)

$V$  : Average driving speed (km/hour)

$M$  : Total number of upper and lower lanes

$\alpha_0$  : Correction value for road surface smoothness (dB)

$\alpha_r$  : Correction value for ground predominant frequency (dB)

$\alpha_s$  : Correction value for road structure (dB)

$\alpha_l$  : Decay by distance (dB)

a, b, c, d: Fixed numbers

**Coefficient for Road Traffic Vibration Forecast Formula**

Road Structure	Fixed Number			
	a	b	c	d
Flat Road	65	6	4	35

(b) Correction value for road surface smoothness :  $\alpha_{\sigma}$

**Correction Value for Road Smoothness**

Road Structure	Coefficient	Correction Value
Flat Road	Roughness in the longitudinal direction (mm)	$14 \log_{10} \sigma$

(c) Correction value for ground predominant frequency:  $\alpha_f$

$$\alpha_f = -20 \cdot \log_{10} f \text{ (flat road)}$$

When,  $f \geq 8$  Hz

f : Ground predominant frequency (Hz)

$$f = 8.4 N^{1/3}$$

When,

f : The estimated value for ground predominant frequency (Hz)

N : Average value for N (from the surface to 10 m under the ground)

**The Estimated Value for Ground Predominant Frequency**

(Unit: Hz)

Road Name	Number	N	Ground Predominant Frequency
Ohio	1	16.25	21.3
Gerezani	2	8.7	17.3
Morocco	3	4.7	14.1
Chang' ombe	4	17.5	21.8
New Bagamoyo	5	17.5	21.8
Uhuru	6	17.5	21.8
Kilwa	7	17.5	21.8

(d) Correction value for road structure:  $\alpha_s$

$$\alpha_s = 0 \text{ (flat road)}$$

(e) Decay by distance:  $\alpha_1$

$$\alpha_1 = \beta \frac{\log_{10}(r/5+1)}{\log_{10} 2}$$

Where,

$r$  : Distance from the control point (m)

$\beta$  : Vibration level decay per double distance (dB)

### Vibration Level Decay per Double Distance

Road Structure		$\beta$ (dB)
Flat Road	Sandy Land	$\beta=0.119 L'_{10} - 3.2$
	Clay	$\beta=0.060 L'_{10} - 1.6$

Note:  $L'_{10}$  : Vibration level at control point (dB)

$$L'_{10} = a \log_{10} (\log_{10} Q^*) + b \log_{10} V + c \log_{10} M + d + \alpha_s + \alpha_r + \alpha_s +$$

### (3) Construction Vibration Forecast

(a) Forecast formula

$$L = L_0 - 8.7 \lambda (r - r_0) - 20 \log_{10} (r/r_0)^n$$

Where,

$L$  : Vibration level  $r$  (m) away from the vibration source (dB)

$L_0$  : Vibration level  $r_0$  (m) away from the vibration source (dB)

$\lambda$  : Fixed number of decay by inner ground

$n$  : Fixed number by the types of vibration

The body wave propagated at the free surface of semi-infinity figure  $n=2$

The body wave propagated at the infinity figure  $n=1$

Surface wave  $n=1/2$

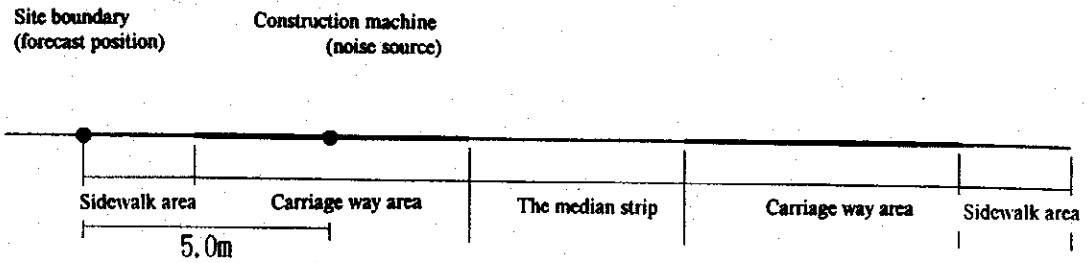
$$L = 10 \log_{10} (10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \dots + 10^{\frac{L_n}{10}})$$

Where,

$L$  : Composite vibration level (dB)

$L_1 \sim L_n$  : Vibration level of each construction machine (dB)

(b) Vibration source position



(c) Distance from vibration source to the control point: 7m

Construction Machine (Standard)	Vibration Level (dB)
Concrete shredding and compression equipment	51
Back hoe (0.6 m <sup>3</sup> )	57
Dump truck (10 ~ 11t)	52
Bulldozer (7t)	66
Macadam roller (10 ~ 12t)	48
Asphalt finisher (4.5m)	51
Tire roller (8 ~ 20t)	48

Source: The Ministry of Construction



## **Chapter 19 Evaluation on Project Implementation**

**Appendix 19.1 Economic Investment/Maintenance Cost**

**Appendix 19.2 Cost Components and Calculation, VOC**

**Appendix 19.3 VOC Component Cost in Response to Speed**

**Appendix 19.4 Unit VOC in Response to Speed**

**Appendix 19.5 Vehicle Running Distance and Time**

**Appendix 19.6 Saving of Fuel Consumption, in the Year 2000**





Appendix 19.1 Economic Investment / Maintenance Cost

Unit : Tsh. million

	Case 1			Case 1.1			Case 1.2			Case 2		
	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance
1995	5,314	-	-	-	-	-	5,314	-	-	-	-	-
1996	5,587	2	-	5,585	-	-	-	2	-	-	-	-
1997	6,034	4	-	6,034	2	-	-	2	-	-	-	-
1998	-	6	-	-	4	-	-	2	-	6,400	-	-
1999	-	6	-	-	4	-	-	2	-	6,118	-	-
2000	-	6	350	-	4	-	-	2	350	-	-	-
2001	-	6	352	-	4	352	-	2	-	-	-	-
2002	-	6	457	-	4	457	-	2	-	-	-	-
2003	-	6	-	-	4	-	-	2	-	-	-	688
2004	-	6	-	-	4	-	-	2	-	-	-	451
2005	-	6	350	-	4	-	-	2	350	-	-	-
2006	-	6	352	-	4	352	-	2	-	-	-	-
2007	-	6	457	-	4	457	-	2	-	-	-	-
2008	-	6	-	-	4	-	-	2	-	-	-	688
2009	-	6	-	-	4	-	-	2	-	-	-	451
2010	-	6	350	-	4	-	-	2	350	-	-	-
2011	-	4	352	-	4	352	-	-	-	-	-	-
2012	-	2	457	-	2	457	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	688
2014	-	-	-	-	-	-	-	-	-	-	-	451
2015	-	-	-	-	-	-	-	-	-	-	-	-

Unit : Tsh. million

	Case 2.1			Case 2.2			Case 2.3			Case 3		
	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance	Investment	Routine Maintenance	Periodical Maintenance
1995	-	-	-	-	-	-	-	-	-	5,314	-	-
1996	-	-	-	-	-	-	-	-	-	5,587	2	-
1997	-	-	-	-	-	-	-	-	-	6,038	4	-
1998	3,456	-	-	-	-	-	2,944	-	-	6,400	6	-
1999	2,453	2	-	3,664	-	-	-	2	-	6,118	10	-
2000	-	3	-	-	1	-	-	2	-	-	12	350
2001	-	3	-	-	1	-	-	2	-	-	12	352
2002	-	3	-	-	1	-	-	2	-	-	12	457
2003	-	3	295	-	1	-	-	2	393	-	12	688
2004	-	3	197	-	1	254	-	2	-	-	12	451
2005	-	3	-	-	1	-	-	2	-	-	12	350
2006	-	3	-	-	1	-	-	2	-	-	12	352
2007	-	3	-	-	1	-	-	2	-	-	12	457
2008	-	3	295	-	1	-	-	2	393	-	12	688
2009	-	3	197	-	1	254	-	2	-	-	12	451
2010	-	3	-	-	1	-	-	2	-	-	12	350
2011	-	3	-	-	1	-	-	2	-	-	10	352
2012	-	3	-	-	1	-	-	2	-	-	8	457
2013	-	3	295	-	1	-	-	2	393	-	6	688
2014	-	1	197	-	1	254	-	-	-	-	2	451
2015	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 19.2 Cost Components and Calculation, VOC

1. Fuel Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Fuel Consumption Rate : (l/1000km)	41.0	83.3	111.1	200.0	200.0	200.0	111.1
Economic Fuel Cost : (Tsh/l)	208.5	208.5	208.5	183.8	183.8	183.8	208.5
Fuel Cost (Tsh/km)	8.5	17.4	23.2	36.8	36.8	36.8	23.2

2. Engine Oil Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Oil Consumption Rate: (l/1000km)	0.5	1	1	2	4	4	1
Economic Oil Cost : (Tsh/l)	550	550	550	476	476	476	550
Engine Oil Cost (Tsh/km)	0.3	0.6	0.6	1.0	1.9	1.9	0.6

3. Tyre & Tube Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Economic Tyre Cost (Tsh/set)	71,750	97,265	139,600	285,180	992,663	936,103	139,600
Average Tyre Life: (km)	90,000	80,000	70,000	60,000	40,000	40,000	70,000
Tyre & Tube Cost (Tsh/km)	0.8	1.2	2.0	4.8	24.8	23.4	2.0

#### 4. Repair & Maintenance Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Economic Vehicle Cost: (1000Tsh)	1,410	4,185	5,028	14,751	47,480	36,405	5,028
5% of Economic Cost: (1000Tsh/year)	71	209	251	738	2,374	1,820	251
Annual Running Distance (km):	20,000	25,000	39,000	67,000	80,000	94,000	39,000
Repair & Maintenance Cost (Tsh/km)	3.6	8.4	6.4	11.0	29.6	19.4	6.4

#### 5. Crew Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
No. of Crew:	-	-	Driver:1	Driver:1	Driver:1 Assistant:1	Driver:1 Conductor:1 Turnboy:1	Driver:1
Annual Amount of Wage (1000Tsh)	-	-	552	552	756	1,104	552
Annual Running Distance (km)	20,000	25,000	39,000	67,000	80,000	94,000	39,000
Crew Cost (Tsh/km)	-	-	14.2	8.2	9.5	11.7	14.2

#### 6. Overhead Cost

Item	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Economic Vehicle Cost: (1000Tsh)	1,410	4,185	5,028	14,751	47,480	36,405	5,028
Factor to be Multiplied(%):	-	-	5	7	10	7	6
Overhead Cost: (1000Tsh/year)	-	-	251	1,033	4,748	2,548	301
Annual Running Distance (km)	20,000	25,000	39,000	67,000	80,000	94,000	39,000
Overhead Cost (Tsh/km)	-	-	6.4	15.4	59.3	27.1	7.7

Appendix 19.3 VOC Component Cost in Response to Speed

1. Fuel Cost Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	11.1	22.6	44.1	69.9	69.9	64.4	44.1
16	9.8	20.0	37.1	58.9	58.9	55.2	37.1
24	8.8	17.9	30.6	48.6	48.6	46.0	30.6
32	7.9	16.2	25.1	39.7	39.7	38.3	25.1
40	7.4	15.1	22.2	35.3	35.3	34.5	22.2
48	7.2	14.8	21.0	33.1	33.1	32.7	21.0
56	7.3	15.0	20.6	32.8	32.8	33.8	20.6
64	7.6	15.4	21.3	33.8	33.8	33.8	21.3
72	8.0	16.3	23.2	36.8	36.8	36.8	23.2
80	8.5	17.4	25.7	40.8	40.8	40.8	25.7
88	9.1	18.6	27.8	44.2	44.2	44.2	27.8

2. Engine Oil Cost Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	0.5	1.1	1.1	1.8	3.6	3.4	1.1
16	0.5	1.0	1.0	1.7	3.3	3.0	1.0
24	0.4	0.9	1.0	1.6	3.0	2.7	1.0
32	0.4	0.8	0.9	1.5	2.8	2.4	0.9
40	0.4	0.7	0.8	1.3	2.6	2.3	0.8
48	0.4	0.7	0.8	1.3	2.3	2.2	0.8
56	0.3	0.7	0.7	1.2	2.2	2.1	0.7
64	0.3	0.6	0.6	1.1	2.1	2.0	0.6
72	0.3	0.6	0.6	1.0	1.9	1.9	0.6
80	0.3	0.6	0.6	0.9	1.8	1.8	0.6
88	0.3	0.6	0.7	1.1	2.1	2.1	0.7

## 3. Tyre / Tube Cost

Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	0.5	0.8	1.2	2.8	14.9	13.5	1.2
16	0.5	0.8	1.2	2.8	14.9	13.5	1.2
24	0.5	0.8	1.2	2.8	14.9	14.3	1.2
32	0.6	0.9	1.3	3.1	16.1	16.1	1.3
40	0.6	0.9	1.6	3.8	19.8	18.2	1.6
48	0.7	1.1	1.8	4.3	22.3	21.0	1.8
56	0.8	1.2	2.0	4.8	24.8	23.4	2.0
64	0.9	1.4	2.3	5.5	28.5	26.7	2.3
72	1.0	1.5	2.6	6.2	32.2	30.4	2.6
80	1.2	1.8	3.0	7.2	37.2	35.1	3.0
88	1.4	2.1	3.5	8.4	43.4	39.9	3.5

## 4. Repair / Maintenance Cost

Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	2.3	5.3	4.4	7.6	20.4	13.2	4.4
16	2.4	5.6	4.6	7.9	21.3	14.0	4.6
24	2.6	6.1	4.9	8.4	22.7	14.7	4.9
32	2.7	6.3	5.1	8.8	23.6	15.5	5.1
40	2.8	6.5	5.3	9.1	24.5	16.2	5.3
48	3.0	7.0	5.6	9.6	25.9	17.1	5.6
56	3.1	7.2	5.9	10.1	27.3	17.8	5.9
64	3.3	7.7	6.1	10.4	28.2	18.6	6.1
72	3.4	7.9	6.4	11.0	29.6	19.4	6.4
80	3.6	8.4	6.6	11.3	30.5	20.1	6.6
88	3.7	8.6	6.9	11.9	31.9	21.0	6.9

## 5. Crew Cost

Unit : Tsh/km

Category	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Amount	-	-	6.4	15.4	59.3	27.1	7.7

Remark: Amount invariable to the change of speed

## 6. Overhead Cost

Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	-	-	27.8	66.9	257.6	117.6	27.8
16	-	-	19.8	47.6	183.3	84.0	19.8
24	-	-	14.9	35.9	138.2	62.9	14.9
32	-	-	11.2	26.9	103.6	47.2	11.2
40	-	-	9.0	21.7	83.6	37.9	9.0
48	-	-	7.4	17.8	68.5	31.4	7.4
56	-	-	6.4	15.4	59.3	27.1	6.4
64	-	-	5.6	13.5	51.9	23.7	5.6
72	-	-	5.0	12.0	46.2	20.9	5.0
80	-	-	4.5	10.8	41.6	18.9	4.5
88	-	-	4.1	9.9	38.1	17.2	4.1





Appendix 19.4 Unit VOC in Response to Speed

Unit : Tsh/km

Speed(km)	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
10	14.4	29.8	85.0	164.4	425.7	239.2	86.3
16	13.2	27.4	70.1	134.3	341.0	196.8	71.4
24	12.3	25.7	59.0	112.7	286.7	167.7	60.3
32	11.6	24.2	50.0	95.4	245.1	146.6	51.3
40	11.2	23.2	45.3	86.6	225.1	136.2	46.6
48	11.3	23.6	43.0	81.5	211.4	131.5	44.3
56	11.5	24.1	42.0	79.7	205.7	131.3	43.3
64	12.1	25.1	42.3	79.7	203.8	131.9	43.6
72	12.7	26.3	44.2	82.4	206.0	136.5	45.5
80	13.6	28.2	46.8	86.4	211.2	143.8	48.1
88	14.7	29.9	49.4	90.9	219.0	151.5	50.7

Remark: Each value is the aggregate of 6 cost components shown in Appendix 19.3



**Appendix 19.5 Vehicle Running Distance and Time**

**I. Basic Case with Project**

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	20,160.2	7,322.9	5,766.5	2,598.5	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	11,923.5	353,916.2	101,864.7	64,619.2	25,771.6	12,802.2	56,894.3
	20~25	4,671.6	58,509.8	11,399.6	1,761.6	281.9	2,638.4	14,838.8
	25~30	10,063.8	87,722.9	29,085.4	11,527.9	3,768.9	6,203.0	26,719.4
	30~35	6,997.0	120,140.9	33,696.4	13,296.0	2,939.3	5,573.6	20,461.0
	35~40	10,268.9	160,199.2	54,268.9	17,063.9	6,187.5	6,197.0	29,402.8
	40~45	6,724.1	78,614.4	27,522.3	11,203.1	2,465.6	5,230.7	28,766.4
	45~50	17,139.0	139,345.4	38,308.4	14,822.0	3,033.5	8,094.3	49,258.3
	50~55	5,255.8	72,638.6	30,584.1	15,217.8	6,578.8	11,690.2	27,788.1
	55~60	5,922.3	154,422.4	41,495.2	15,920.0	7,090.4	6,617.5	28,443.7
	60~65	3,035.5	37,936.7	14,805.2	9,016.6	3,296.5	5,741.5	11,537.6
	65~70	854.4	37,315.2	4,694.4	1,401.6	484.8	1,400.0	3,739.2
	70~75	4,677.2	72,419.8	20,733.5	6,846.3	5,052.3	2,478.7	17,678.7
	75~80	23,202.6	343,228.3	96,414.4	36,817.3	18,819.7	19,071.2	68,992.5
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		2,801.0	48,752.1	14,406.3	7,030.9	2,684.6	2,334.4	9,982.6

**II. Without Package A**

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	16,207.3	5,666.3	5,803.2	2,601.9	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	26,019.6	578,493.1	161,269.7	77,478.4	29,971.1	21,502.8	113,051.3
	20~25	2,496.4	55,022.3	15,100.9	4,978.4	1,090.3	484.3	4,997.3
	25~30	14,607.8	231,371.7	75,539.1	33,185.9	14,328.4	13,142.8	58,399.2
	30~35	10,845.1	135,153.8	41,765.2	18,354.7	6,007.8	6,758.9	29,673.5
	35~40	11,783.1	122,395.7	38,604.2	10,208.7	3,063.5	8,684.7	35,341.4
	40~45	5,330.7	72,653.7	24,620.3	15,957.2	6,544.6	11,415.7	26,720.1
	45~50	13,545.8	108,862.9	37,784.2	15,411.6	3,686.4	8,834.3	41,148.0
	50~55	3,744.2	76,693.9	23,430.2	7,410.5	2,886.5	2,465.5	10,215.0
	55~60	1,336.0	20,953.0	5,841.0	2,907.0	2,038.0	735.0	1,243.0
	60~65	1,183.2	47,994.8	7,883.2	1,591.2	487.6	1,610.4	6,170.8
	65~70	1,657.6	25,924.4	7,175.8	2,641.7	907.8	1,959.7	12,331.0
	70~75	9,605.8	198,989.6	62,850.6	18,268.7	9,613.7	9,752.4	39,932.6
	75~80	8,279.3	188,177.4	57,064.9	15,712.0	8,424.0	8,398.0	24,032.3
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,366.2	60,495.6	17,950.9	8,061.9	3,139.9	2,790.6	12,566.9

**III. Without Package A, but with Middle Ring Road**

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	16,434.5	5,771.5	5,808.3	2,601.9	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	19,765.4	448,994.6	124,939.6	70,860.1	27,479.1	18,226.8	88,950.7
	20~25	1,930.0	50,797.9	13,239.7	3,722.5	844.5	164.9	2,606.5
	25~30	12,374.2	186,169.2	58,172.1	17,993.3	6,632.9	7,079.2	42,416.5
	30~35	12,687.8	192,187.9	61,333.1	28,336.7	10,595.2	10,159.9	45,975.2
	35~40	14,144.2	127,456.3	35,217.4	9,809.5	3,530.3	6,875.9	35,129.5
	40~45	1,062.0	13,932.0	6,888.6	2,121.6	1,042.8	2,088.0	5,562.0
	45~50	15,458.6	126,411.9	42,225.9	15,766.0	3,501.9	9,385.0	45,792.7
	50~55	4,133.7	46,885.9	19,125.8	10,491.6	4,913.0	9,561.8	22,206.1
	55~60	3,454.0	47,846.0	15,420.7	8,167.4	3,379.0	4,636.5	10,093.2
	60~65	5,455.4	120,935.2	31,688.9	12,840.2	4,397.8	7,330.6	23,831.0
	65~70	2,207.8	70,424.0	18,152.5	6,597.7	3,087.0	1,408.2	11,040.7
	70~75	3,955.1	124,479.2	33,297.0	10,697.2	6,101.3	7,278.1	24,344.9
	75~80	13,806.5	240,880.1	78,144.4	23,299.2	11,724.9	10,838.1	39,535.9
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,110.3	54,471.3	16,122.9	7,511.5	2,915.3	2,538.7	11,413.3

IV. Without Package A, but with New Bagamoyo Road

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	20,163.6	7,349.7	5,766.5	2,598.5	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	15,294.1	469,226.3	132,732.1	70,663.7	28,382.8	16,232.4	81,168.8
	20~25	5,910.6	93,015.6	18,633.6	4,874.2	1,073.7	2,838.1	16,830.7
	25~30	9,509.6	80,416.9	26,703.6	12,330.9	4,354.4	5,900.8	25,003.6
	30~35	6,011.0	98,646.2	28,917.1	13,718.5	3,875.5	6,400.5	20,262.8
	35~40	13,112.7	177,022.2	57,383.6	20,500.9	7,490.9	8,420.7	33,922.8
	40~45	6,181.5	86,427.6	33,779.7	16,860.3	5,747.9	11,120.0	35,942.1
	45~50	16,434.2	134,442.6	44,156.7	24,590.4	6,249.7	13,629.3	54,591.4
	50~55	4,640.0	68,618.9	20,580.0	5,728.2	1,709.9	2,993.4	17,005.7
	55~60	1,765.0	23,884.9	6,810.0	3,587.3	2,337.5	1,277.9	1,903.7
	60~65	2,251.2	33,045.0	11,108.9	2,722.4	1,127.1	1,948.7	8,810.2
	65~70	4,119.0	106,438.4	25,903.9	9,181.3	4,753.9	3,291.4	14,462.7
	70~75	3,127.4	53,124.6	14,509.0	5,684.2	2,567.6	1,989.7	12,858.0
75~80	22,379.4	346,643.5	100,720.6	32,310.5	17,981.1	18,406.9	67,549.4	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		2,954.1	54,178.5	15,884.3	7,522.8	2,900.6	2,555.7	11,008.1

V. Without Package B

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	18,572.1	6,571.4	5,557.8	2,473.3	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	22,965.6	448,120.0	129,335.5	68,902.4	28,019.0	18,483.0	78,920.7
	20~25	3,415.2	66,983.2	14,226.4	3,995.5	1,097.7	1,908.4	6,811.5
	25~30	27,182.4	205,826.4	67,964.0	35,500.6	11,136.4	14,870.1	73,684.9
	30~35	6,952.8	156,656.2	49,866.3	20,620.6	6,170.4	4,614.7	18,916.9
	35~40	9,333.4	142,333.1	48,301.8	17,660.1	6,081.5	11,461.1	44,076.3
	40~45	5,596.7	94,085.0	30,945.9	9,876.2	4,120.3	8,365.2	23,602.4
	45~50	4,490.0	71,486.2	19,504.7	4,926.9	1,839.4	2,697.2	18,409.6
	50~55	3,212.5	50,261.2	15,437.1	6,079.2	2,079.7	3,256.2	13,690.8
	55~60	4,693.3	135,426.6	36,199.1	12,284.0	6,748.6	3,430.1	22,550.6
	60~65	3,021.6	55,702.4	16,843.1	4,912.3	1,701.4	1,829.8	10,110.8
	65~70	1,036.4	43,769.1	6,895.8	2,347.1	938.9	1,450.1	3,863.2
	70~75	9,261.6	191,208.0	59,284.9	15,396.1	6,763.8	6,141.0	30,033.2
75~80	9,574.1	227,953.1	68,154.6	23,431.9	11,572.4	10,339.0	32,118.3	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,390.0	57,288.8	17,101.0	7,819.6	3,014.7	2,615.1	11,172.7

VI. Without Package B, but with City Center Arterial Roads

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	17,496.6	6,237.4	5,557.8	2,473.3	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	16,598.6	367,095.6	105,557.7	67,463.7	27,612.5	16,360.1	66,659.4
	20~25	6,057.5	79,936.1	16,611.8	4,559.2	945.8	3,198.0	16,712.8
	25~30	13,312.3	139,570.7	50,705.1	17,667.5	7,522.7	7,361.5	26,982.9
	30~35	11,250.8	169,341.7	49,182.6	23,111.9	4,931.2	6,147.0	36,124.0
	35~40	17,760.4	191,684.6	60,156.0	18,659.9	4,509.9	7,239.0	50,774.0
	40~45	3,407.6	58,857.4	20,799.0	5,202.7	1,531.6	5,156.5	17,789.4
	45~50	5,528.7	70,531.7	20,659.3	6,263.8	2,443.1	4,435.0	20,893.9
	50~55	4,424.8	59,738.6	15,909.1	5,129.4	2,498.9	3,590.4	13,185.6
	55~60	5,721.5	147,300.5	42,448.0	17,326.9	9,387.4	8,861.8	31,329.1
	60~65	2,102.2	16,768.9	8,353.2	6,403.8	1,786.8	6,885.6	13,766.6
	65~70	4,614.0	120,015.8	30,303.5	8,307.6	4,329.5	2,954.5	15,546.9
	70~75	6,292.8	168,832.9	45,375.8	14,386.5	5,650.8	5,594.4	21,675.2
75~80	13,664.5	202,975.7	68,067.2	27,253.7	13,491.1	12,296.8	46,721.5	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,169.6	52,597.1	15,610.4	7,422.7	2,847.5	2,446.9	10,596.1

VII. Without Package B, but with Kilwa Road

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	19,186.6	7,171.0	5,766.5	2,598.5	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	15,709.9	368,314.1	109,032.8	64,148.3	26,277.5	13,244.3	58,423.1
	20~25	5,268.0	61,681.2	11,710.8	3,734.1	778.4	2,711.2	15,188.4
	25~30	25,063.5	151,642.2	48,233.6	32,597.4	9,032.1	12,028.0	69,016.4
	30~35	7,384.4	155,960.4	48,207.4	16,638.0	4,878.3	5,870.0	22,285.2
	35~40	9,389.2	143,370.9	46,984.3	14,153.6	3,300.4	4,134.0	30,149.6
	40~45	3,518.0	74,036.4	25,786.0	9,104.0	3,756.5	6,274.6	16,246.1
	45~50	7,279.3	92,901.1	25,341.4	7,027.8	2,144.5	4,202.6	23,702.6
	50~55	9,275.0	196,214.5	59,082.5	24,352.8	11,710.4	14,442.6	45,292.8
	55~60	2,169.6	73,505.8	27,068.2	6,600.3	2,753.8	4,909.9	13,081.6
	60~65	2,031.4	41,454.4	16,290.1	7,769.9	3,540.6	4,515.2	8,963.0
	65~70	1,808.2	60,380.8	10,321.1	3,033.2	1,943.3	2,562.7	10,515.9
	70~75	4,066.3	84,070.1	22,381.0	6,521.8	3,964.0	1,535.1	10,161.2
75~80	17,773.0	303,041.2	86,227.2	28,419.8	13,537.1	14,522.5	56,752.0	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,155.1	52,212.5	15,624.8	7,520.7	2,865.8	2,400.5	10,576.3

VIII. Without Package B, but with Uhuru Road

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	18,249.8	6,840.3	5,652.9	2,515.0	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	20,895.2	419,478.2	122,578.5	66,504.0	26,789.5	17,358.8	73,697.2
	20~25	3,415.2	67,168.3	14,285.9	4,011.8	1,104.0	1,908.4	6,811.5
	25~30	26,168.3	202,312.4	65,761.9	35,505.6	10,873.2	12,769.0	71,819.2
	30~35	8,920.0	209,820.1	63,583.3	23,304.5	7,877.8	5,634.8	28,397.1
	35~40	5,168.2	68,062.9	23,134.0	7,064.4	2,063.7	2,028.3	20,167.1
	40~45	2,875.4	48,812.8	17,579.1	6,530.0	2,357.6	4,122.0	14,486.6
	45~50	6,287.1	91,263.9	23,568.4	5,915.6	2,567.5	3,216.5	21,935.7
	50~55	8,670.2	198,226.0	59,430.5	21,551.0	9,941.3	14,079.1	46,954.8
	55~60	6,150.3	94,207.9	30,980.6	11,138.1	5,680.1	8,532.5	22,546.8
	60~65	1,076.8	22,838.0	5,925.6	1,196.4	739.6	896.8	4,238.4
	65~70	1,036.4	44,094.6	6,753.4	2,454.3	985.9	1,450.1	3,863.2
	70~75	2,211.2	104,155.2	27,706.4	7,616.0	3,690.4	3,437.6	9,634.4
75~80	17,861.4	283,205.7	90,702.2	32,726.9	13,418.6	15,008.2	55,628.3	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,283.0	55,566.7	16,581.2	7,664.1	2,956.4	2,474.7	10,900.1

IX. Without Packages A and B

Running Distance (km/day)		Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
Speed (km)	0~10	223.8	17,177.6	6,098.8	5,689.7	2,481.6	0.0	103.5
	10~15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15~20	35,963.3	668,449.1	192,660.2	82,206.9	31,604.3	25,433.0	129,744.1
	20~25	3,759.7	76,270.0	15,247.7	8,322.2	2,403.0	2,031.8	10,828.0
	25~30	34,706.2	450,386.6	150,428.3	73,472.3	25,930.1	34,497.2	129,750.3
	30~35	7,073.6	102,815.6	32,219.1	13,331.6	3,693.7	4,604.6	19,772.1
	35~40	4,771.8	72,541.7	22,848.9	3,929.3	2,205.0	944.9	10,545.6
	40~45	5,923.1	130,753.2	39,905.6	11,370.7	6,111.6	3,320.6	19,223.9
	45~50	1,745.3	29,016.0	9,188.1	2,729.9	1,022.3	1,490.9	6,415.0
	50~55	1,269.5	41,858.3	12,490.1	4,832.1	2,696.9	914.4	1,597.0
	55~60	5,856.0	101,875.1	38,579.9	8,814.5	6,949.3	2,650.6	17,935.2
	60~65	493.2	9,449.4	2,288.4	382.8	42.6	315.6	3,647.4
	65~70	2,018.8	57,368.0	11,218.6	3,690.4	1,111.9	3,044.1	12,422.8
	70~75	2,189.3	107,509.6	29,413.8	7,732.1	3,688.0	3,426.0	9,604.9
75~80	4,664.8	130,290.4	40,045.9	10,179.0	6,223.0	8,178.4	24,017.5	
80~	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Running Time (hours/day)		3,938.9	69,348.1	20,775.5	8,914.6	3,465.7	3,068.8	13,855.8



**Appendix 19.6 Saving of Fuel Consumption, in the Year 2000**

Discription	Motor Cycle	Passenger Car	Light G.V.	Medium G.V.	Heavy G.V.	Bus	Mini-bus
<b>1.Total Running</b>							
Distance (km/day): Without Project Case	110,658	1,995,761	602,633	236,683	96,163	90,852	395,607
<b>2.Total Running</b>							
Distance (km/day): With Project Case	110,959	1,736,570	512,195	225,279	88,369	93,738	384,644
<b>3.Fuel Cost (Tsh/km):</b>							
	8.5	17.4	23.2	36.8	36.8	36.8	23.2
<b>4.Fuel Price (Tsh/litre):</b>							
	251	251	251	191	191	191	251
<b>5.Fuel Costs Required (1000Tsh): Without Project Case (1.x 3.)</b>							
	940	34,726	13,981	8,710	3,538	3,343	9,178
<b>6.Fuel Costs Required (1000Tsh): With Project Case (2.x 3.)</b>							
	943	30,216	11,882	8,290	3,251	3,449	8,923
<b>7.Fuel Volume Consumed (1000litre): Without Project Case (5./4.)</b>							
	3.7	138.4	55.7	45.6	18.5	17.5	36.6
<b>8.Fuel Volume Consumed (1000litre): With Project Case (6./4.)</b>							
	3.7	120.4	47.3	43.4	17.0	18.1	35.6
<b>Saving (1000litre) of Fuel Consumption (7.-8.)</b>							
	0.0	18.0	8.4	2.2	1.5	- 0.6	1.0

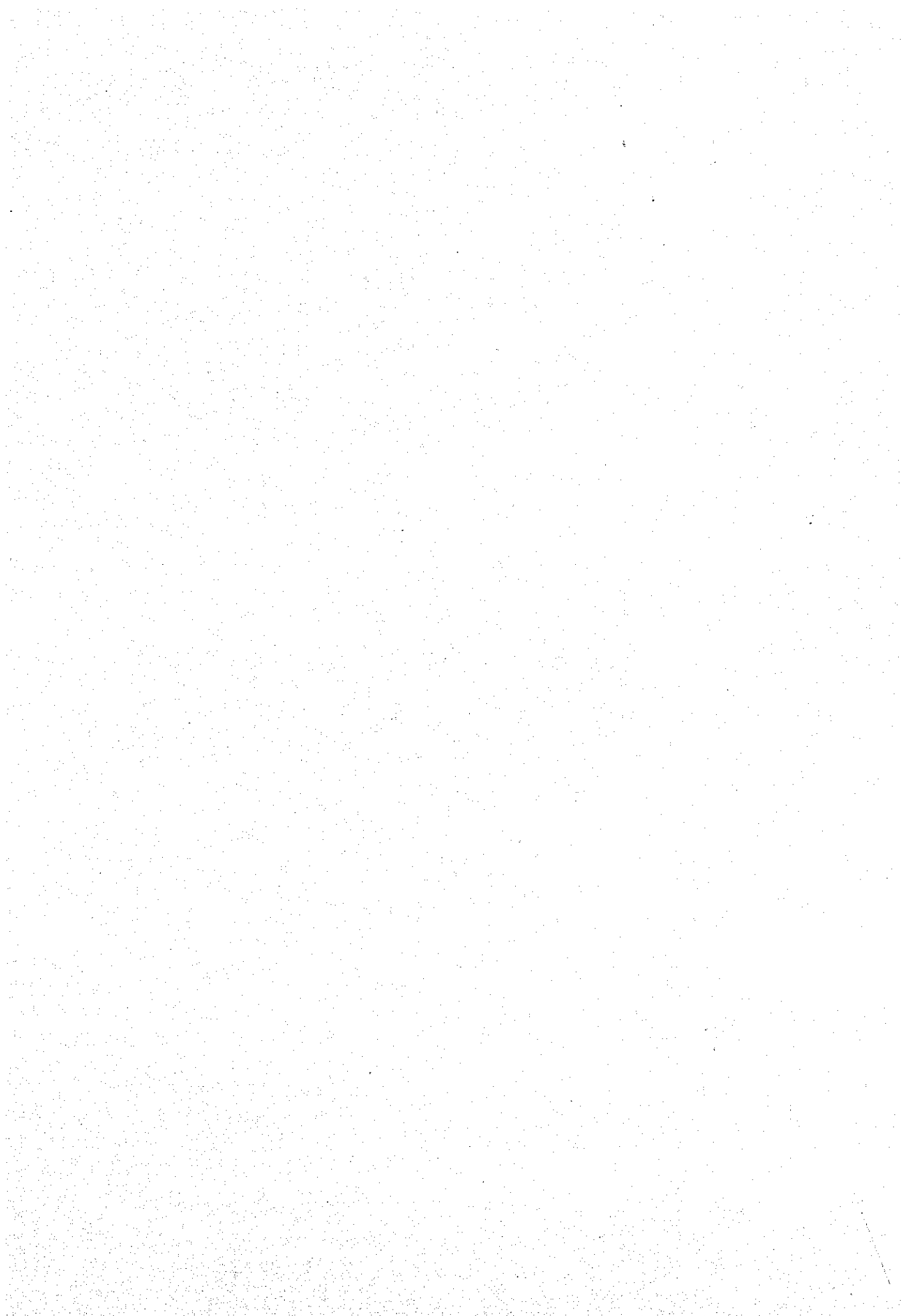
**Total Saving of Fuel Consumption per Day: 30.5 thousand litre (aggregate of Volume of both gasoline and diesel oil consumed by each vehicle type)**

**Remarks (1): With Project Case = joint Implementation of Packages A and B**

**(2): Yearly amount of saved fuel consumption: 30.5 x 365 days = 11.1 million litre.**







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