— The asphalt is excessively hard and brittle and the cracks seem to be initiated from the surface.

— The road pavement outside the airport and in Nairobi city demonstrate similar type crack.

Therefore, it is desirable that the pavement be constructed with non-bituminous materials to prevent cracks.

Consequently, in order to prevent cracks and to maintain the base, and to some foreign comency by obtaining medicials locully; it is recommended to adopt case-A pavement styructure.

5.1.4 PAVEMENT MATERIALS

(1) Subbase

The material for the subbase is graded crushed stone.

The specifications of the material are as shown below. The traffic class is T2 as specified in the Materials Required based on Chart SB3 (Page 7.22) of the Road Design Manual Part III.

① Stone class: A

② Grading : 0/30 mm

③ Stone Requirements:

- LAA Max. 45
- ACV Max. 32
- SSS Max. 20
- FI Max. 35
- CR Max. 30

The work execution methods and compaction standards are as stated below.

④ Minimum thickness of compacted layer : 100 mm

Maximum thickness of compacted layer : 200 mm

⑤ Laying: by paver or grader

⑥ Compaction:

• Dry density

– Average dry density: Min. 98% MDD (V.H.)

– No result below 96% MDD (V.H.)

• Specific Gravity

– Average dry density : Min. 85% of S.G.

– No result below 82% of S.G.

• Compaction moisture content : between 80% and 105% OMC (V.H.)

• Compaction equipment: Pneumatic tyred rollers

Vibratory rollers

Steel wheeled rollers

(2) Base

The material of the base is lean concrete.

In accordance with the Material Requirements, based on Chart B7 (Page 7.30) of the Road Design Manual Part III, the following materials have been selected;

① Stone Grading: 0/30

② Coarse Aggregate (2 mm) Requirements:

– CR: Min. 80%

– FI: Max. 25%

– LAA: Max. 35

– ACV: Max. 28

③ Combined Aggregate Requirements:

– Fines (passing 0.425 mm): Non-Plastic

– Sand Equivalent: Min. 30

– S.S.S.: Max. 12%

– Organic matter: Max. 0.3%

④ Cement amount : 4% (Portland cement)

⑤ UCS (7 days cure) of Lean Concrete: Min. 7,000 kN/m^2

ICS (28 days cure) of Lean Concrete: Min. 10,000 kN/m^2

Split tensile strength (28 days cure) of Lean Concrete:

Min. 1,000 kN/m^2

The work execution methods and compaction standards are as stated below.

⑥ Minimum thickness of compacted layer: 150 mm

Maximum thickness of compacted layer: 250 mm

⑦ Mixing : in stationary plant

⑧ Laying: by paver

⑨ Compaction:

– Minimum dry density: 96% Target density established in test part BS 5835 and 85% Specific gravity of stone (Oven-dry value)

– Compaction moisture content: between OMC - 2 and OMC (Modified AASHTO)

– Time allowed to complete compaction and finishing: 4 hours

⑩ Protection and curing:

– Time allowed to place protection: 4 hours

– No traffic permitted for the first 7 days

– Protection by a bituminous seal coat (preferably emulsion)

(3) Surfacing

The material for Surfacing is Asphalt concrete.

The specifications of the material are shown below. The traffic class is T2 as specified in the Materials Required based on Chart S2a (Page 7.36) of the Road Design Manual Part III.

① Type of asphalt concrete: Type I

② Coarse aggregate class: b

③ Mix grading:

– Wearing course: 0/14

– Binder course: 0/20

④ Bitumen content:

– Wearing course: 6.5

– Binder course: 5.5

⑤ Coarse Aggregate:

– LAA Max. 35

– ACV Max. 28

– SSS Max. 12

– FI Max. 25

⑥ Kineral Filler

– Non Plastic

– Passing 0.425 mm: 100%

– Passing 0.075 mm: Min. 75%

– Bulk density in toluene 0.5-0.9 g/ml

⑦ Fine Aggregate:

– Sand Equivalent: Min. 40

– S.S.S: Max. 12%

⑧ Type of mix:

- Wearing course:

– Bitumen grade: 80/100

– Crushing Ratio: 100%

– Marshall Stability: 9.000 N

– Flow Value: 2-4 mm

– Voids in total mix: 3-5 %

- Binder course:

– Bitumen grade: 80/100

– Crushing Ratio: 100%

– Marshall Stability: 7,000 N

– Flow Value: 2-4 mm

– Voids in total mix: 3-7 %

The work execution methods and compaction standards are as stated below.

⑨ Minimum thickness of compacted layer: 50 mm

⑩ Mixing: in stationary plant, bitumen temperatures: 120°-140° C

⑪ Laying: by paver, Min. temperature 125°C

⑫ Compaction:

– Min. mix density: 96% Laboratory design Marshall density

– Min. temperature at end of compaction: 70°C

– Compaction equipment to suit layer thickness but generally:

– Steel wheeled rollers (5-7 kg/mm of roll width)

– Pneumatic tyred rollers (Min. 2 tonnes per wheel)

(4) Prime coat

In accordance with Prime coat Material Requirements, based on Chapter 7 (Page 7.11) of the Road Design Manual Part III, the following materials have been selected;

① Binder: MC30

Note, if this is sufficient, with cut-back asphalt, or nor must be checked when it is used.

② The rate: 1.0l/m^2 (Road Design Manual Part III, Page 7.11)

(5) Tack coat

In accordance with the Material Requirements based on Chapter 7 (Page 7.11) of the Road Design Manual Part III, the following materials have been selected;

① Type of binder: MC 3000 (Medium curing cut-backs)

② The rate: 0.6l/m^2 (Road Design Manual Part III Page 7.12)

(6) Surface dressing for sholder

Conditions for examination of the material for surface dressing are as stated below;

– Average No. of commercial vehicles per day: 1000~1200

– Type of surface: Normal

– Climatic area: intermediate

– Traffic v.p.d: +2000

– Climate: Temperate

– Surface Texture: Primed base

– Chippigs: Flaky

In accordance with the Material Requirements, based on Chart S1b (Page 7.32) of the Road Design Manual Part III, the following materials have been selected;

① Type of binder: KI-60 (or MC 3000)

② Chipping class and size:

– First seal = 10/14

– Second seal = 3/6

③ Chipping spread rate:

In accordance with the Chart S1d (Graph 1, Page 7.34) of the Road Design Manual Part III, Chipping spread rate are as follows;

First seal = 13.2×0.001 $m^3/m^2 \times 1.1 = 14.5 \times 0.001$ m^3/m^2

(ALD=10 mm)

Second seal = 4.0×0.001 m^3/m^2 (ALD = 3 mm)

④ Binder spray rate:

In accordance with the Chart S1d (Graph 2, Page 7.34) of the Road Design Manual Part III Chipping spread rate are as follows.

Total Residual binder spray rate: $1.9 l/m^2$

(Total chipping spread rate = 18.5×0.001 m^3/m)

However, the following corrections will be made.

Traffic v.p.d correction factor = 0.85

Climate correction factor = 1.03

Surface texture correction factor = 1.00

Chipping correction factor = 0.95

Total Residual binder spray rate $= 1.9 \times 0.85 \times 1.03 \times 1.0 \times 0.95$

$= 1.58 l/m^2$

Therefore,

First seal = 1.3 l/m^2

Second seal = 0.3 l/m^2

The work execution methods and compaction standards are as stated below;

⑤ Spraying: by bitumen distributor

⑥ Spreading the chipping:

– By mechanical spreader

– Time allowed (after spraying) to spread chipping: 1 minute

⑦ Rolling:

– Preferably by pneumatic tyred rollers (Minimum: 1 tonne per wheel)

– Steel wheeled rollers of less than 8 tonnes accepted

– Time allowed (after spraying) to start rolling: 2 minutes

5.2 RAMPS (SLIP ROADS)

5.2.1 TRAFFIC

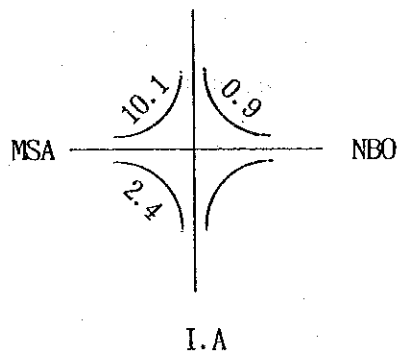
The cumulative number of ESA for each ramp was calculated using the following procedure.

- The future traffic (pcu) on each ramp was obtained from Figs. VI-5-4, VI-5-5, VI-5-6, VI-5-7 and VI-5-8 in the Feasibility Study Report.
- The composite ratio by vehicle types was obtained from the last column of Table VI-4-4 in the feasibility study report.
- The future traffic (pcu) on each ramp was broken down into vehicle types using the composit ratio.
- The actual traffic value was obtained from PCU using conversion factors which were given in Table VI-4-4 in the Feasibility Study Report.
- The ESA of the actual traffic value on each ramp was calculated using the Equivalent Factor (EF) of Table 9.2.1 in Material Branch Report No. 455.
- The ESA of each ramp of the design period was calculated for two terms (1997-2000, 2001-2006) corresponding to different growth rates.

5.2.2 TRAFFIC DISTRIBUTION AT EACH JUNCTION IN THE DESIGN PERIOD

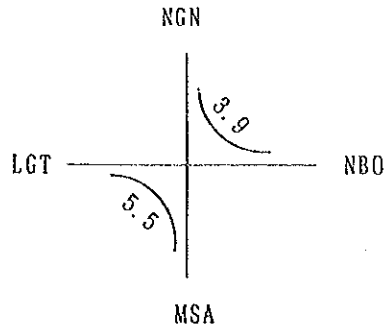
(1) Mombasa Junction

Ramp (Slip road)	ESA ($x10^6$)
MSA — Bypass	10.1
Bypass — MSA	10.1
MSA — I.A	2.4
I.A. — MSA	2.3
NBO — Bypass	0.9
Bypass — NBO	0.9



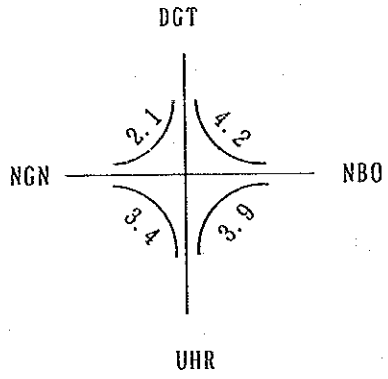
(2) Uhuru Monument Junction (UHR Jn)

Ramp (Slip road)	ESA (x10^6)
NGN — NBO	3.9
NBO — NGN	3.9
MSA — LGT	5.5
LGT — MSA	5.5



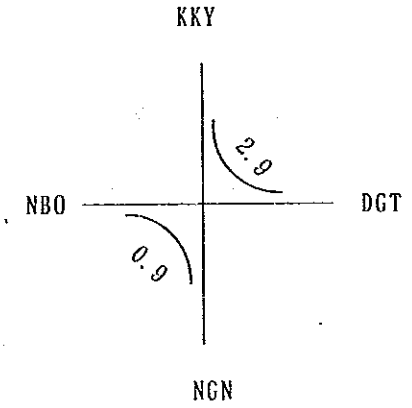
(3) Ngong Road Junction (NGN Jn)

Ramp (Slip road)	ESA (x10^6)
DGT — NBO	4.2
UHR — NGN	3.4
UHR — NBO	3.9
NGN — DGT	2.1



(4) Dagoretti Junction (DGT Jn)

Ramp (Slip road)	ESA (x10^6)
KKY — DGT	2.9
DGT — KKY	2.9
NGN — NBO	0.9
NBO — NGA	0.9



Note: MSA:Mombasa, I.A:Industrial Area, NGN:Ngong, NBO:Nairobi, LGT:Langatta, DGT:Dagoretti, UHR:Uhuru Monument Jn, KKY:Kikuyu Jn

Mombasa Road Junction Traffic in 2000

Direction	BYPASS				NBO				I.A				MSA			
pcu	NBO	I.A	MSA	Total	I.A	MSA	BP	Total	MSA	BP	NBO	Total	BP	NBO	I.A	Total
C/T	300	1,725	5,075		—	6,175	300		800	925	—		5,075	5,875	800	
L.V	192	1,104	3,248		—	3,952	192		512	592	—		3,248	3,760	512	
M.V	48	276	812		—	988	48		128	148	—		812	940	128	
H.V	48	276	812		—	988	48		128	148	—		812	940	128	
B	12	69	203		—	247	12		32	37	—		203	235	32	
MT																
Total	600	3,450	10,150			12,350	600		1,600	1,850			10,150	11,750	1,600	
Actual No																
C/T	300	1,725	5,075		—	6,175	300		800	925	—		5,075	5,875	800	
L.V	192	1,104	3,248		—	3,952	192		512	592	—		3,248	3,760	512	
M.V	24	138	406		—	494	24		64	74	—		406	470	64	
H.V	24	138	406		—	494	24		64	74	—		406	470	64	
B	6	35	102		—	124	6		16	19	—		102	118	16	
MT																
Total	546	3.140	9,237		0	11,239	546		1,456	1,684			9,237	10,693	1,456	
ESA EF																
M.V 0.9	22	124	365			445	22		58	67			365	423	58	
H.V 8.57	137	788	2,320			2,822	137		366	422			2,320	2,685	366	
O.T 12.8	102	589	(1,732)			2,108	102		273	316			(1,732)	2,005	273	
B 0.45	3	16	46			56	3		7	9			46	53	7	
Total	264	1,517	2 ,731			5,431	264		704	814			2,731	5,166	704	
ESA_{1997}	228	1,310	2,019			4,691	228		608	703			3,855	4,463	607	
$T_{1997-2000}$	0.3	1.4	2.3			5.3	0.2		0.6	0.8			2.3	5.1	0.7	
$T_{2000-2007}$	0.7	4.3	7.8			15.6	0.7		1.7	2.0			7.8	12.8	1.7	
	1.0	5.7	10.1			20.9	0.9		2.3	2.8			10.1	17.9	2.4	

Note ESA: Equivalent Single Axle, EF: Equivalence Factor O.T: Oil-tanker T: Accumulated ESA
MSA: MOMBASA, NBO: NAIROBI, I.A: INDUSTRIAL AREA

Uhuru Monument Junction Traffic in 2000

Direction	NGN				NBO				MSA				LGT			
pcu	NBO	MSA	LGT	Total	MSA	LGT	NGN	Total	LGT	NGN	NBO	Total	NGN	NBO	MSA	Total
C/T	1,656	2,832			—	5,760	1,656		2,328	2,832	—			5,760	2,328	
L.V	1,139	1,947			—	3,960	1,139		1,601	1,947	—			3,960	1,601	
M.V	276	472			—	960	276		388	472	—			960	388	
H.V	311	531			—	1,080	311		437	531	—			1,080	437	
B	69	118			—	240	69		97	118	—			240	97	
MT																
Total	3,451	5,900				12,000	3,451		4,850	5,900				12,000	4,850	
Actual No																
C/T	1,656	2,832			—	5,760	1,656		2,328	2,832	—			5,760	2,328	
L.V	1,139	1,947			—	3,960	1,139		1,601	1,947	—			3,960	1,601	
M.V	138	236			—	480	138		194	236	—			480	194	
H.V	156	266			—	540	156		219	266	—			540	219	
B	35	59			—	120	35		49	59	—			120	49	
MT																
Total	3,124	5,340			0	10,860	3,124		4,391	5,340				10,860	4,391	
ESA EF																
M.V 0.9	124	212				432	124		174	212				432	175	
H.V 8.57	891	1,520				3,085	891		1,251	1,520				3,085	146	
O.T 12.8	(666)	1,135				2,304	(666)		(934)	1,135				2,304	934	
B 0.45	16	27				54	16		22	27				54	22	
ESA_{2000}	1,031	2,894				5,875	1,031		1,447	2,894				5,857	1,277	
i_1	0.05	0.05				0.05	0,05		0.05	0.05				0.05	0.05	
ESA_{1997}	890	1,310				5,075	890		1,250	2,499				5,059	1,250	
$T_{1997-2000}$	1.0	2.8					1.0		1.4					5.8	1.4	
$T_{2000-2007}$	2.9	8.3					2.9		4.1					16.3	4.1	
i_2	0.03	0.03					0.03		0.03	0.03				0.03	0.03	
$T_{1997-2007}$	3.9	11.1					3.9		5.5					22.1	5.5	

Note ESA: Equivalent Single Axle, EF: Equivalence Factor O.T: Oil-tanker T: Accumulated ESA
NGN: NGONG, NBO: NAIROBI, MSA: MOMBASA, LGT: LANGATA

Ngong Road Junction Traffic in 2000

Direction	DGR				NBO				UHR				NGN			
pcu	NBO	UHR	NGN	Total	UHR	NGN	DGR	Total	NGN	DGR	NBO	Total	DGR	NBO	UHR	Total
C/T	907		490		858	833	907		539		858		490	1,691	539	
L.V	592		320		560	544	592		352		560		320	1,104	352	
M.V	148		80		140	136	148		88		140		80	276	88	
H.V	204		110		193	187	204		121		193		110	380	121	
B	—		—		—						-			240	97	
MT																
Total	1,850		1,000		1,750	1,700	1,850		1,100		1,750		1,000	3,450	1,100	
Actual No																
C/T	907		490		858	833	907		539		858		490	1,691	539	
L.V	592		320		560	544	592		352		560		320	1,104	352	
M.V	74		40		70	68	74		44		70		40	138	44	
H.V	102		55		97	94	102		61		97		55	190	61	
B																
MT																
Total	1,675		905		1,585	1,539	1,675		996		1,585		905	3,123	996	
ESA EF																
M.V 0.9	67		36		63	61	67		40		63		36	124	40	
H.V 8.57	583		314		554	537	583		349		554		314	1,085	349	
O.T 12.8	435		235		413	401	435		521		414		234	810	260	
B 0.45																
ESA_{2000}	1,085		585		1,030	999	1,085		910		1,081		584	2,019	649	
ESA_{1997}	885		477		889		885		786		890		476		560	
i_1	0.07		0.07		0.05		0.07		0.05		0.05		0.07		0.05	
$T_{1997-2000}$	1.0		0.5		1.0		1.0		0.9		1.0		0.5		0.6	
$T_{2000-2007}$	3.2		1.4		2.8		3.2		2.5		2.9		1.6		1.8	
i_2	0.05		0.05		0.03		0.05		0.03		0.03		0.05		0.03	
$T_{1997-2007}$	4.2		1.9		3.8		4.2		3.4		3.9		2.1		2.4	

Note ESA: Equivalent Single Axle, EF: Equivalence Factor O.T: Oil-tanker T: Accumulated ESA
DGR: DAGORETTI, NBO: NAIROBI, UHR: UHURU MONUMENT, NGN: NGONG

Dagoretti Junction Traffic in 2000

Direction	KKY				NBO (KRN)				NGN			DGR			
pcu	NBO	NGN	DGR	Total	KKY	DGR	NGN	Total	DGR	NBO	Total	KKY	NBO	NGN	Total
C/T			539				196			196		539			
L.V			319				116			116		319			
M.V			88				32			32		88			
H.V			143				52			52		143			
B			11				4			4		11			
MT															
Total			1,100				400			400		1,100			
Actual No															
C/T			539				196			196		539			
L.V			319				116			116		319			
M.V			44				16			16		44			
H.V			72				26			26		72			
B			6				2			2		6			
MT															
Total			980				356			356		980			
ESA EF															
M.V 0.9			40				14			14		40			
H.V 8.57			411				149			149		411			
O.T 12.8			307				111			111		307			
B 0.45			3				1			1		3			
ESA_{2000}			761				275			275		761			
ESA_{1997}			621				237			237		621			
i_1			0,07				0.07			0.05		0.07			
$T_{1997-2000}$			0.7				0.2			0.2		0.5			
$T_{2000-2007}$			2.2				0.7			0.7		2.2			
i_2			0.05				0.05			0.03		0.05			
$T_{1997-2007}$			2.9				0.9			0.9		2.9			

Note ESA: Equivalent Single Axle, EF: Equivalence Factor O.T: Oil-tanker T: Accumulated ESA
KKY: KIKUYU, NBO: NAIROBI, NGN: NGONG, DGR: DAGORETTI

5.2.3 PAVEMENT STRUCTURE

According to the previously mentioned traffic distribution and ROAD NOTE 29, the pavement structures of the ramps at each junction and main road are as follows;

Road	Thickness of Layer (mm) Subbase	Base	(Wearing course +) Surfacing (Basecourse)
Junction			
Mombasa	150	200	120 (40 + 80)
Uhuru Monument	150	180	100 (40 + 60)
Ngong Road	150	180	100 (40 + 60)
Dagoretti	150	180	100 (40 + 60)
Thogoto	150	180	100 (40 + 60)
Kikuyu Town	150	180	100 (40 + 60)
Kikiyu	150	200	120 (40 + 80)
Main Road	150	200	120 (40 + 80)

Pavement material

Subbase	:	Graded crushed stone
Base	:	Lean concrete (High qualitative cement-stabilized material)
Surfacing	:	Asphalt concrete

5.2.4 PAVEMENT STRUCTURE OF SLIP ROAD A OF KIKUYU TOWN JN [RELOCATED ROAD (C63)]

According to information from the Material Branch, the existing pavement structure of C63 is as follows.

Surfacing	:	Double surfacing dressing (25 mm)
Base	:	Graded crushed stone (130 mm)
Subbase	:	Graded crushed stone (100 mm)

This pavement structure was reviewed using the traffic survey in the

Feasibility Study for Nairobi Bypass and the following results were obtained.

Refering to Table V -2-3 of the feasibility study report, total traffic volume of medium and heavy vehicles on C63 in 1986 is 287 (=171 + 116). The distribution of vehicle types is as follows.

	AADT	EF	Actual traffic
M.V.	171	0.9	154
H.V.	79	8.57	677
O.T.	37	12.8	473
B	37	0.45	17

1321: Both directions

Traffic volume in 1997(t)

$t_1 = t_{1986} \times (1 + i)^{11}$

$t_1 = (154+17)/2 \times (1+0.035)^{11}$

$= 85$

$t_2 = (677+473)/2 \times (1+0.035)^{11}$

$= 575$

Cumulative traffic volume T

$T_1 = 365 \times t_1 \times \frac{(1+i)n - 1}{i}$

$= 365 \times 85 \times \frac{(1+0.025)^{10} - 1}{0.025}$

$= 0.3 \times 10^6$

$T_2 = 365 \times t_1 \times \frac{(1+i)n - 1}{i}$

$= 365 \times 575 \times \frac{(1+0.035)^{10} - 1}{0.035}$

$= 2.4 \times 10^6$

$T = T_1 + T_2$

$= 2.7$

i : refering to Table VI-2-2 in F/S report

Refering to Road Note 29 the pavement structure is as follows;

Surfacing : 80 mm

Base (Lean concrete) : 170 mm

Subbase (Graded crushed stone) : 150 mm

5.2.5 PAVEMENT MATERIALS FOR SLI ROADS (RAMPS)

The pavement Materials for the slip roads are the same as those for the main road. Refer to Section 5.1.4.

5.3 APPROACH ROADS

5.3.1 GENERAL

The pavement structure of the approach roads, to the junctions, is to be essentially the same as the existing pavement structure.

5.3.2 PAVEMENT STRUCTURE OF EXISTING "C" CLASS ROAD

The pavement structure of approach roads, to the junctions, is according to the information from Material branch as follows;

Surface dressing : 25 mm

Base (Graded crushed stone) : 130 mm

Subbase (Graded crushed stone) : 100 mm

5.3.3 PAVEMENT STRUCTURE OF UNDERPASS (C58) AT UHURU MONUMENT JUNCTION

Accumulated ESA from 1997 to 2000 : $T_{1997\text{-}2007}$

$T_{1997\text{-}2007}$ = 22.1 (Both directions), refering to "Uhuru Monument Junction Traffic in 2000"

ESA from Nairobi Bypass : T_r

T_r = 5.5 ･･･ preferring to "5.2 TRAFFIC DISTRIBUTION AT EACH JUNCTION"

Total ESA for pavement design : $T_{1997\text{-}2007}$

$T_{1997\text{-}2007} = 22.1 \times 1/2 + 5.5$

$= 16.5$

Pavement structure, refering to Road Note No.29, is as follows:

Surfacing : 150 mm

Base(Lean concrete) : 200 mm

Subbase(Graded crushed stone) : 150 mm

5.3.4 PAVEMENT MATERIALS FOR APPROACH ROADS

(1) Pavement materials other than those for road C63

1) Subbase

The material for the subbase is a graded crushed stone.

The specifications of this material are shown below. The traffic class is T5 as specified in the Material Required based on Chart SB3 (Page 7.22) of the Road Design Manual Part III.

① Stone class : C

② Grading : 0/60 mm

③ Stone Requirements:

– LAA Max. 50

– ACV Max. 35

– SSS Max. 20

– FI Max. 35

The work execution methods and compaction standards are the same as for the subbase of the main road (refer to section 5.1.2).

2) Base

The material for the base also is graded crushed stone. Specifications of this material are as shown below. The traffic class is T5 as specified in the Material Required based on the Chart B4 (Page 7.26) of the Road Design Manual Part III.

① Stone class : C

② Grading: 0/40 mm

③ Stone Requirements:

– LAA Max. 45

– ACV Max. 32

– SSS Max. 12

– FI Max. 30

– CR Max. 60

The work execution methods and compaction standards are as stated below.

④ Minimum thickness of compacted layer : 125 mm

Maximum thickness compacted in one layer: 200 mm

⑤ Laying: by paver or grader

⑥ Compaction:

– Dry density

– Average dry density : Min. 98% MDD (V.H.)

– No result below 96% MDD (V.H.)

– Specific Gravity

– Average dry density: Min. 85% of S.G

– No result below 82% of S.G

– Compaction moisture content: between 80 and 105% OMC (V.H.)

– Compaction equipment:

– Pneumatic tyred rollers (Min. 3 tonnes per wheel)

– Vibratory rollers (Min. 2kg/mm of roll width)

3) Surface dressing for approach roads and shoulders

Conditions for examining the material for surface dressing are as stated below.

– Average No. of commercial vehicles per day:

– Approach road: 1000 ~ 2000

– Shoulder: 20

– Type of surface: Normal

– Climatic area: intermediate

– Traffic v.p.d:

– Approach road: +2000

– Shoulder : 0 – 100

– Climate: Temperate

– Surface Texture: Primed base

– Chippings: Flaky

In accordance with the Material Requirements, based on Chart S1b (Page 7.32) of the Road Design Manual Part III, the following materials have been selected;

① Type of binder: KI-60 (or MC 3000)

② Chipping class and size:

Approach road: First seal = 10/14

Second seal = 3/6

Shoulder of Approach roads:

Single seal = 3/6

Second seal = 3/6

③ Chipping spread rate:

In accordance with Chart S1d (Graph 1, Page 7.34) of the Road Design Manual Part III, Chipping spread rates are as follows;

Approach road: First seal

$= 13.2 \times 0.001 m^3/m^2 \times 1.1$

$= 14.5 \times 0.001\ m^3/m^2$ (ALD = 10 mm)

Second seal = $4.0 \times 0.001 m^3/m^2$ (ALD = 3 mm)

Shoulder of Approach road:

Single seal = $4.8 \times 0.001 m^3/m^2 \times 1.1$

= $5.3 \times 0.001\ m^3/m^2$ (ALD = 3 mm)

④ Binder spray rate:

In accordance with Chart S1d (Graph 2, Page 7.34) of the Road Design Manual Part III, Chipping spread rates are as follows;

Approach road:

Total residual binder spray rate: $1.9 l/m^2$

(Total chipping spread rate = $18.5 \times 0.001 m^3/m$)

However, the following corrections will be made.

Traffic v.p.d correction factor = 0.85

Climate correction factor = 1.03

Surface texture correction factor = 1.00

Chipping correction factor = 0.95

Total residual binder spray rate

= $1.9 \times 0.85 \times 1.03 \times 1.0 \times 0.95$

= $1.58 l/m^2$

Therefore,

First seal = $1.3\ l/m^2$

Second seal = $0.3 l/m^2$

Shoulder:

Total residual binder spray rate: $0.5 l/m^2$

However, the following corrections will be made.

Traffic v.p.d correction factor = 1.13

Climate correction factor = 1.03

Surface Texture correction factor = 1.06

Chippings correction factor = 0.95

Total residual binder spray rate

$$= 0.5 \times 1.13 \times 1.03 \times 1.0 \times 0.95$$

$$= 0.6 l/m^2$$

4) Prime coat

Material specifications are as shown below. The base is Open textured materials as specified in Materials Required based on Charter 7 (Page 7.11) of the Road Design Manual Part III.

① Binder: MC70

Note: if it is sufficient, with cut-back asphalt, or not must be checked when it is used.

② The rate: $1.0 l/m^2$ (Road Design Manual, Part III Page 7.11)

5) Tack coat

In accordance with the Material Requirement, based on Chapter 7 (Page 7.11) of the Road Design Manual Part III, the following materials have been selected;

① Type of binder: MC 3000 (Medium curing cut-backs)

② The rate: $0.6 l/m^2$ (Road Design Manual Part III, Page 7.12) 9

(2) Pavement materials for road C63

The pavement Materials for approach road C63 are the same as those for the main road. Refer to section 5.1.4.

5.4 SERVICE ROADS

5.4.1 PAVEMENT DESIGN

The pavement of the service roads along the Bypass is to be as follows;

Design condition:

Traffic T = Initial daily number

= 15-50 (Both directions)

Change	Subgrade strength,	T,	Gravel wearing course: D1 (mm)
H15 + 980	S4	15	150
19 + 480	S4	15	150
23 + 760	S4	15	150
24 + 980	S4	15	150

Note: Designed by ROAD DESIGN MANUAL PART III.

Initial daily number is assumed due to no traffic count.

Initial daily number of traffic is assumed due to no traffic count, but traffic is a very little.

5.4.2 PAVEMENT MATERIALS FOR SERVICE ROADS

Service roads are Gravel roads.

The specifications of the material are given below. The initial daily number of commercial vehicles is under 150 and it has wet areas as specified in the Materials Required based on Chart GWC (Page 13.5) of the Road Design Manual Part III.

① Gravel Class: 2

② Grading after compaction: 0/40 mm

③ Plasticity modulus: Min. 20 — Max. 1,200

④ Plasticity index: Min. 5 — Max. 20

⑤ CBR at 95% MDD (Modified AASTO) and 4 days soak: Min. 20

Either the Korean or Church site, out of the sites surveyed, will be selected as the gravel material site on the condition that, the above specified quality is obtained and that the required volume (about 4,000 m^3) can be secured.

Conditions for collection are as stated below.

Average over burden: 0.7 m

Average thickness: 0.8 m

The work execution methods and compaction standards are as stated below.

⑥ Minimum thickness of compacted layer: 125 mm

Maximum thickness compacted in one layer: 200 mm

⑦ Laying: by grader

⑧ Compaction:

– Minimum dry density: 95% MDD (Modified AASHTO)

– Compaction moisture content:

between 80% and 105% OMC (Modified AASHTO)