SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DCC30103 : HIGHWAY AND TRAFFIC ENGINEERING

TARIKH : 15 MEI 2025
MASA : 2.30 PETANG - 4.30 PETANG (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.
Bahagian A: Subjektif (2 soalan)
Bahagian B: Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A : 50 MARKS
BAHAGIAN A : 50 MARKAH

INSTRUCTION:
This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO2

(a) Classify the traffic category design for four-lane freeways (concession toll-road) with an average daily traffic (ADT) of 9,870 vehicles, of which 15% are commercial vehicles with an unladen weight exceeding 1.5 tons. The design traffic category is determined using the JKR 5/85 Amendment 2013 method for a 20 year design life, considering flat terrain, a 5% annual traffic growth rate, and a CBR value of 12.1%. Table A1(a) provides ADT data based on the HPU survey (conducted from 06:00 to 22:00 hours).
Klasifikasikan rekabentuk kategori trafik untuk lebuh raya empat lorong (jalan bertol konsesi) dengan purata trafik harian (ADT) sebanyak 9,870 kenderaan, di mana 15% daripadanya adalah kenderaan komersial dengan berat tanpa muatan melebihi 1.5 tan. Kategori rekabentuk trafik ditentukan menggunakan kaedah JKR 5/85 Pindaan 2013 untuk jangka hayat rekabentuk selama 20 tahun, dengan mengambil kira rupa bumi rata, kadar pertumbuhan trafik tahunan 5% dan nilai CBR sebanyak 12.1%. Jadual A1(a) menyediakan data ADT berdasarkan tinjauan HPU (dijalankan dari jam 06:00 hingga 22:00).

Table A1(a) */ Jadual A1(a)*

Class / *Kelas*	Traffic Count /*Bilangan Trafik*
CV1	900
CV2	550
CV3	400
CV4	95

[10 marks]

[*10 markah*]

CLO2 (b) Based on the Table A1(b), recommend the timing for designing traffic light control. Given an amber time of 3 seconds, a lost time of 2 seconds, and an intergreen period of 5 seconds for both phases.

Berdasarkan Jadual A1(b), cadangkan pemasaan untuk merekabentuk kawalan lampu isyarat. Diberi masa kuning selama 3 saat, masa hilang selama 2 saat dan tempoh antara hijau selama 5 saat untuk kedua-dua fasa.

Table A1(b) / *Jadual A1(b)*

	Vehicle Types / *Jenis Kenderaan*	North/ *Utara*	South/ *Selatan*	East/*Timur*	West/*Barat*
Flow/ *Aliran*	Car/ *Kereta*	300	255	580	690
	Motorcycle /*Motosikal*	150	120	150	120
	Bus/ *Bas*	45	40	50	40
	Heavy Vehicle/ *Kenderaan Berat*	60	58	54	80
Saturated Flow(pcu/hr) / *Aliran Tepu (ukp/j)*		1970	1970	3160	3160

[15 marks]

[*15 markah*]

QUESTION 2
SOALAN 2

CLO2 (a) Effective traffic management helps reduce congestion and enhance road user safety. Explain **FIVE (5)** objectives of traffic management in Malaysia.
*Pengurusan trafik yang berkesan membantu mengurangkan kesesakan dan meningkatkan keselamatan pengguna jalan raya. Terangkan **LIMA (5)** objektif pengurusan trafik di Malaysia.*

[10 marks]
[*10 markah*]

CLO2 (b) Road maintenance is a continuous process that involves keeping and repairing the existing road. Specify the importance of routine maintenance in ensuring road user safety.
Penyelenggaraan jalan adalah proses berterusan yang melibatkan pemeliharaan dan pembaikan jalan sedia ada. Nyatakan kepentingan penyelenggaraan rutin dalam memastikan keselamatan pengguna jalan raya.

[5 marks]
[*5 markah*]

CLO2 (c) Road cracks refer to cracks or fissures that are visible on the pavement surface due to various factors. This condition affects road performance, durability, and safety. Recommend the procedures to fix that problem.
Keretakan jalan merujuk kepada rekahan atau retakan yang kelihatan pada permukaan turapan disebabkan pelbagai faktor. Keadaan ini menjejaskan prestasi, ketahanan dan keselamatan jalan raya. Cadangkan prosedur untuk menyelesaikan masalah berkenaan.

[10 marks]
[*10 markah*]

SECTION B : 50 MARKS
BAHAGIAN B :50 MARKAH

INSTRUCTION:
This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions only.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan subjektif. Jawab **DUA (2)** soalan sahaja.*

QUESTION 1
SOALAN 1

CLO1 (a) Identify **TWO (2)** categories of roads in Malaysia and identify the party responsible for maintaining process.
*Kenalpasti **DUA (2)** kategori jalan raya di Malaysia dan kenalpasti pihak yang bertanggungjawab untuk proses penyelenggaraan.*

[5 marks]
[*5 markah*]

CLO1 (b) The aggregates play the important roles in the pavement and bears the load of the vehicle before distributing it to the lower layer. Determine the **FIVE (5)** key characteristics of a good aggregate for road construction.
*Agregat memainkan peranan utama dalam turapan dan menanggung beban kenderaan sebelum mengagihkannya ke lapisan bawah. Tentukan **LIMA (5)** ciri utama agregat yang baik untuk pembinaan jalan raya.*

[10 marks]
[*10 markah*]

CLO1

(c) Asphalt concrete mixes are designed for specific functions, such as paving roads, parking lots, and airports. Explain **FIVE (5)** characteristics of Asphaltic mix concrete.

*Campuran konkrit asfalt direkabentuk untuk fungsi tertentu seperti turapan jalan, tempat letak kenderaan dan lapangan terbang. Terangkan **LIMA (5)** ciri-ciri campuran konkrit asfalt.*

[10 marks]

[*10 markah*]

QUESTION 2
SOALAN 2

CLO1 (a) Describe the flexible pavement structure with the aid of a labeled diagram.
Huraikan struktur turapan lentur dengan bantuan gambar rajah berlabel.

[5 marks]
[*5 markah*]

CLO1 (b) Flexible Pavements are constructed from bituminous or unbound material and the stress is transmitted to the sub-grade through the lateral distribution of the applied load with depth. Determine the preparation of materials for each layer in the flexible pavement structure, including the aggregate and bitumen handling before the pavement construction process.
Turapan Lentur dibina daripada bahan bitumen atau tidak terikat dan tegasan dihantar ke sub-gred melalui pengagihan sisi beban yang dikenakan dengan kedalaman. Tentukan penyediaan bahan untuk setiap lapisan turapan lentur, termasuk cara agregat dan bitumen dikendalikan sebelum proses pembinaan turapan.

[10 marks]
[*10 markah*]

CLO1 (c) Flexible pavement is a type of road structure consisting of multiple layers designed to gradually distribute traffic loads to the subgrade. Explain the construction process of flexible pavement from site preparation to the completion of the wearing course.
Turapan lentur ialah sejenis struktur jalan yang terdiri daripada pelbagai lapisan yang direka untuk mengagihkan beban trafik secara beransur-ansur ke subgred. Terangkan proses pembinaan turapan lentur dari penyediaan tapak hingga penyiapan lapisan haus.

[10 marks]
[*10 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Rigid pavement has different characteristics compared to flexible pavement. Identify the **FIVE (5)** main characteristics of rigid pavement.

*Turapan tegar mempunyai ciri-ciri yang berbeza berbanding turapan lentur. Kenalpasti **LIMA (5)** ciri utama turapan tegar.*

[5 marks]

[*5 markah*]

CLO1 (b) Rigid pavement is more expensive than other type of roads. It is referred to as rigid pavement because it does not allow flexibility. With the aid of diagrams, explain about Jointed Reinforced Concrete Pavement (JRC) and Continuous Reinforced Concrete Pavement (CRCP).

Turapan tegar lebih mahal daripada jenis jalan lain. Ia dirujuk sebagai turapan tegar kerana ia tidak membenarkan fleksibiliti. Dengan bantuan gambar rajah, terangkan mengenai Turapan Konkrit Bertetulang Bersambung (JRC) dan Turapan Konkrit Bertetulang Berterusan (CRCP).

[10 marks]

[*10 markah*]

CLO1 (c) The construction of cement concrete slab pavements involves several important steps to ensure strength, durability, and long-term performance. Determine the **TEN (10)** processes in order of construction of cement concrete slab pavement.

*Pembinaan turapan papak konkrit simen melibatkan beberapa langkah penting untuk memastikan kekuatan, ketahanan dan prestasi jangka panjang. Tentukan **SEPULUH (10)** proses pembinaan turapan papak konkrit simen.*

[10 marks]

[*10 markah*]

QUESTION 4
SOALAN 4

CLO1 (a) Traffic control devices serve several essential purposes in managing and regulating roadways. Identify **FIVE (5)** purposes of traffic control devices.
*Peranti kawalan lalu lintas menyediakan beberapa tujuan penting dalam mengurus dan mengawal selia jalan raya. Kenal pasti **LIMA (5)** tujuan peranti kawalan lalu lintas.*

[5 marks]
[*5 markah*]

CLO1 (b) Traffic control signs help ensure road safety, regulate traffic efficiently and provide clear guidance for road users. Explain the characteristic for **TWO (2)** category of traffic control signs.
*Papan tanda kawalan lalu lintas membantu memastikan keselamatan jalan raya, mengawal lalu lintas dengan cekap dan memberikan panduan yang jelas kepada pengguna jalan raya. Terangkan ciri-ciri bagi **DUA (2)** kategori papan tanda kawalan lalu lintas.*

[10 marks]
[*10 markah*]

CLO1 (c) Road markings and delineations are used to regulate traffic or to warn or guide road users. They may be used either alone or to supplement other traffic control devices. With the aid of a diagram write **FIVE (5)** types of road markings.
*Tanda jalan dan pembahagi jalan digunakan untuk mengawal lalu lintas atau untuk memberi amaran atau memberi panduan kepada pengguna jalan raya. Ia boleh digunakan sama ada secara bersendirian atau untuk menambah peranti kawalan trafik lain. Dengan bantuan gambarajah tulis **LIMA (5)** jenis tanda jalan.*

[10 marks]
[*10 markah*]

SOALAN TAMAT

FLEXIBLE PAVEMENT DESIGN FORMULA

$$ESAL_{Y1} = ADT \times 365 \times P_{CV} \times 3.7 \times L \times T$$

$$ESAL_{Y1} = [ADT_{VC1} \times LEF_1 + ADT_{VC2} \times LEF_2 + \ldots + ADT_{VC4} \times LEF_4] \times 365 \times L \times T$$

$$Design\ Traffic\ ESAL_{DES} = ESAL_{Y1} \times \frac{[(1 + r)^n - 1]}{r}$$

$$Design\ Traffic\ ESAL_{DES} = ESAL_{Y1} \times TGF$$

$$Design\ Input\ Value = Mean - (Normal\ Deviate \times Standard\ Deviation)$$

TABLE 2.1: Axle Configuration and Load Equivalence Factors (LEF) based on Traffic Categories used by HPU

Vehicle		Load Equivalence Factor (LEF)
HPU Class Designation	Class	
Cars and Taxis	C	0
Small Lorries and Vans (2 Axles)	CV1	0.1
Large Lorries (2 to 4 Axles)	CV2	4.0
Articulated Lorries (3 or more Axles)	CV3	4.4
Buses (2 or 3 Axles)	CV4	1.8
Motorcycles	MC	0
Commercial Traffic (Mixed)	CV%	3.7

TABLE 2.2: Lane Distribution Factors

Number of Lanes (in ONE direction)	Lane Distribution Factor, L
One	**1.0**
Two	**0.9**
Three or more	**0.7**

Note: *Traffic in the primary design lane (one direction) decreases with increasing number of lanes.*

TABLE 2.3: Terrain Factors

Type of Terrain	Terrain Factor, T
Flat	**1.0**
Rolling	**1.1**
Mountainous/Steep	**1.3**

Note: *As terrain changes from flat to mountainous topography, the percentage of road sections with steep slopes and with curves increases, thus increasing stresses and strains in pavement structures due to breaking, acceleration and cornering of commercial vehicles.*

TABLE 2.4: Total Growth Factors (TGF)

Design Period (Years)	Annual Growth Rate (%)					
	2	3	4	5	6	7
10	10.95	11.46	12.01	12.58	13.18	13.82
15	17.29	18.60	20.02	21.58	23.28	25.13
20	24.30	26.87	29.78	33.06	36.79	41.00
25	32.03	36.46	41.65	47.73	54.86	63.25
30	40.57	47.58	56.08	66.44	79.06	94.46

TABLE 2.5: Traffic Categories used in this Manual (ESAL = 80 kN)

Traffic Category	Design Traffic (ESAL x 10^6)	Probability (Percentile) Applied to Properties of Sub-Grade Materials
▪ T 1	**≤ 1.0**	≥ 60%
▪ T 2	**1.1 to 2.0**	≥ 70%
▪ T 3	**2.1 to 10.0**	≥ 85%
▪ T 4	**10.1 to 30.0**	≥ 85%
▪ T 5	**> 30.0**	≥ 85%

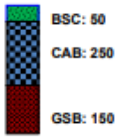
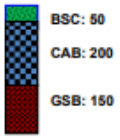
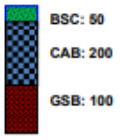
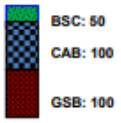
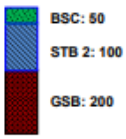
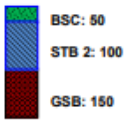
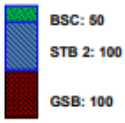
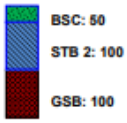
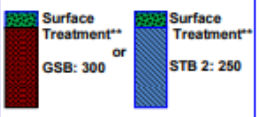
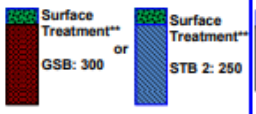
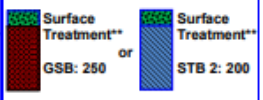
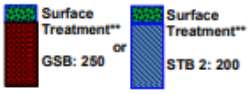
TABLE 2.6: Classes of Sub-Grade Strength (based on CBR) used as Input in the Pavement Catalogue of this Manual

Sub-Grade Category	CBR (%)	Elastic Modulus (MPa)	
		Range	Design Input Value
▪ SG 1	**5 to 12**	50 to 120	**60**
▪ SG 2	**12.1 to 20**	80 to 140	**120**
▪ SG 3	**20.1 to 30.0**	100 to 160	**140**
▪ SG 4	**> 30.0**	120 to 180	**180**

TABLE 3.1: Conceptual Outline of Pavement Structures used in this Manual

Pavement Structure	**Traffic Category (based on million ESALs @ 80 kN)**				
	≤ 1	***1 to 2***	***2.1 to 10***	***10.1 to 30***	***> 30***
	T 1	**T 2**	**T 3**	**T 4**	**T 5**
▪ **Combined Thickness of Bituminous Layers**	**5 cm**	**10 cm**	**18 cm**	**20 cm**	**24 cm**
Crushed Aggregate Road Base + Sub-Base for Sub-Grade CBR of:					
○ **5 to 12**	**25+15 cm**	**20+15 cm**	**20+20 cm**	**NR**	**NR**
○ **12.1 to 20**	**20+15 cm**	**20+15 cm**	**20+20 cm**	**20+20 cm**	**20+20 cm**
○ **20.1 to 30**	**20+10 cm**	**20+10 cm**	**20+15 cm**	**20+15 cm**	**20+15 cm**
○ **> 30**	**20 cm**	**20+10 cm**	**20+10 cm**	**20+10 cm**	**20+10 cm**

FIGURE 3.1: Pavement Structures for Traffic Category T 1: < 1.0 million ESALs (80 kN)

Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Stabilised Base with Surface Treatment*				

Notes:

* *Full Depth Asphalt Concrete Pavement is not recommended for this Traffic Category.*

** *Single or Double Layer Chip Seal or Micro-Surfacing.*

FIGURE 3.2: Pavement Structures for Traffic Category T 2: 1.0 to 2.0 million ESALs (80 kN)

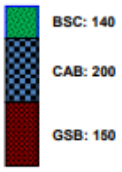
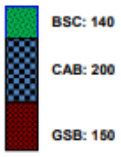
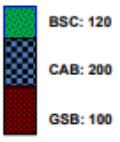
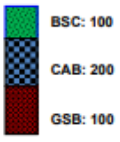
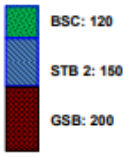
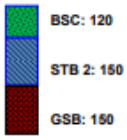
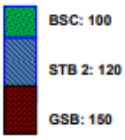
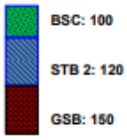
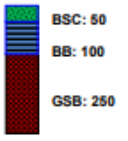
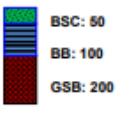
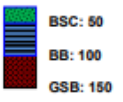
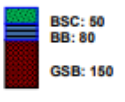
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

FIGURE 3.3: Pavement Structures for Traffic Category T 3: 2.0 to 10.0 million ESALs (80 kN)

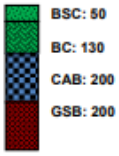
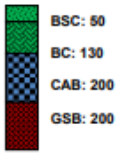
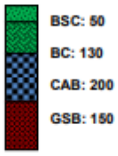
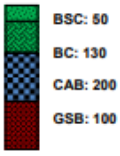
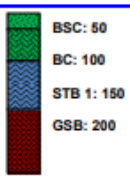
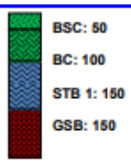
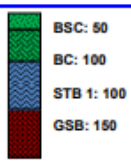
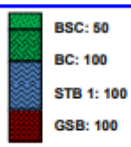
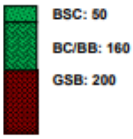
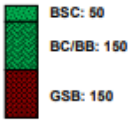
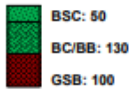
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

FIGURE 3.4: Pavement Structures for Traffic Category T 4: 10.0 to 30.0 million ESALs (80 kN)

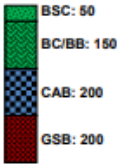
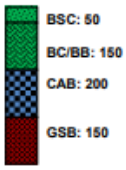
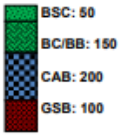
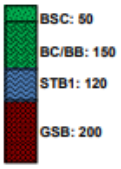
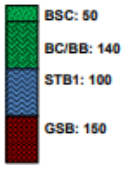
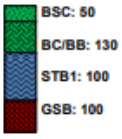
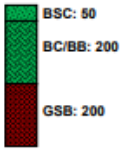
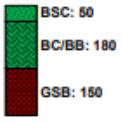
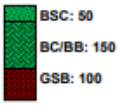
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

FIGURE 3.5: Pavement Structures for Traffic Category T 5: > 30.0 million ESALs (80 kN)

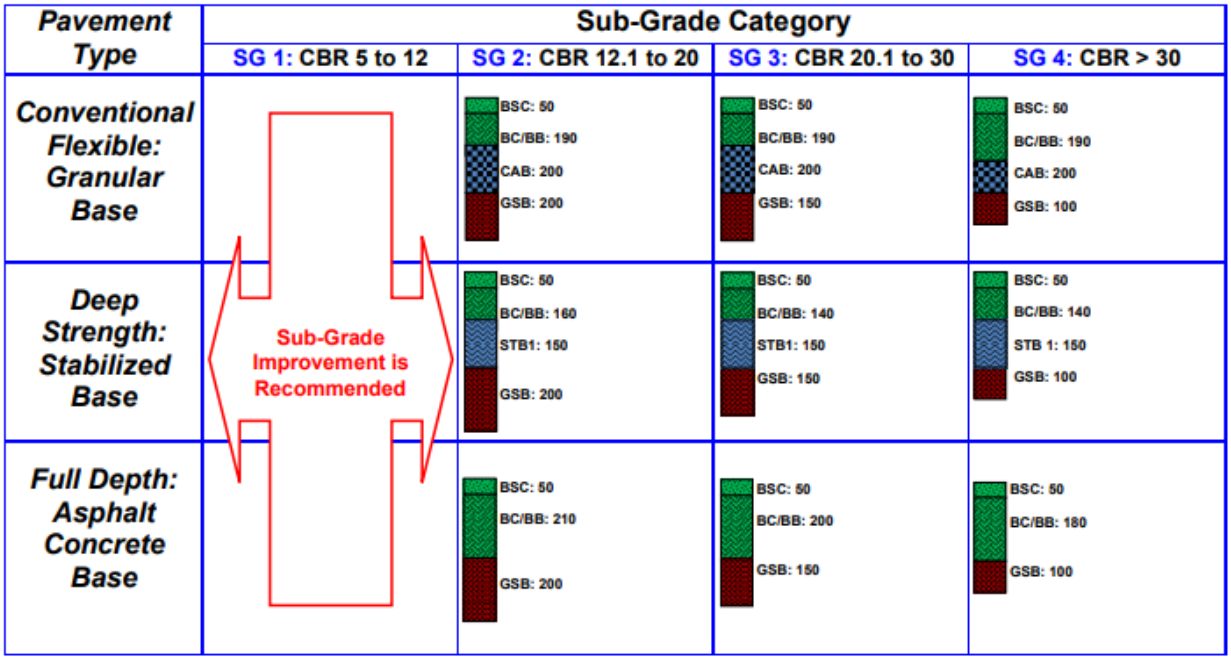
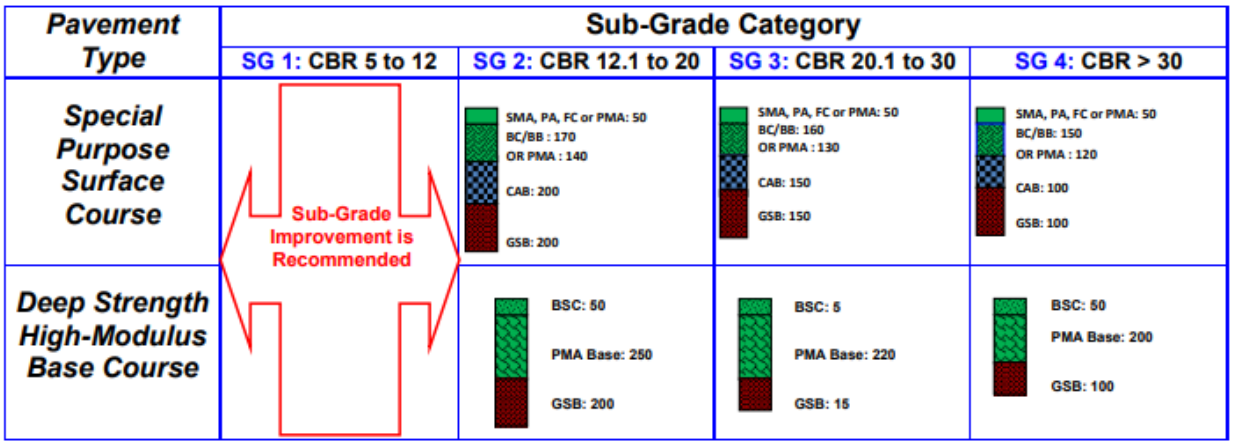


FIGURE 3.6: Pavement Structures for Traffic Category T 5: > 30.0 million ESALs (80 kN)
(Use of Polymer Modified Asphalt)



JUNCTION DESIGN FORMULA

$$S = 525W \; or \; S = 160W$$

$$L = \sum Lost\ Time + \sum (Intergreen\ time - yellow\ time)$$

$$C_o = \frac{1.5L + 5}{1 - Y}$$

$$y = \frac{Q}{S}$$

$$g_{phase} = \frac{y_{phase}}{Y}(C_o - L)$$

$$G_{phase} = g_{phase} + lost\ time - yellow\ time$$

Table 6-I

Relationship between effective lane width and saturation flow

w (m)	3.0	3.25	3.5	3.75	4.0	4.25	4.5	4.75	5.0	5.25
s (pcu/h)	1845	1860	1885	1915	1965	2075	2210	2375	2560	2760

Table 6-5

Conversion factors to pcu's

Vehicle Type	Equipment pcu value
Passenger cars	1.00
Motor cycles	0.33
Light vans	1.75
Medium lorries	1.75
Heavy lorries	2.25
Buses	2.25

Table 6-2

Correction factor for the effect of gradient

Correction Factor, Fg	Description
0.85	for upward slope of 5%
0.88	for upward slope of 4%
0.91	for upward slope of 3%
0.94	for upward slope of 2%
0.97	for upward slope of 1%
1.00	for level grade
1.03	for downward slope of 1%
1.06	for downward slope of 2%
1.09	for downward slope of 3%
1.12	for downward slope of 4%
1.15	for downward slope of 5%

Table 6-3

Correction Factor for the effect of turning radius

Correction Factor, Ft	Description
0.85	for turning radius R < 10 m
0.90	for turning radius where 10 m < R < 15 m
0.96	for turning radius where 15 m < R < 30 m

Table 6-4

Correction factors for turning traffic

% turning traffic	Factor for right-turn, Fr	Factor for left-turn, F1
5	0.96	1.00
10	0.93	1.00
15	0.90	0.99
20	0.87	0.98
25	0.84	0.97
30	0.82	0.95
35	0.79	0.94
40	0.77	0.93
45	0.75	0.92
50	0.73	0.91
55	0.71	0.90
60	0.69	0.89