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 I : 2025/2026

DCC30103 : HIGHWAY AND TRAFFIC ENGINEERING

TARIKH : 23 NOVEMBER 2025
MASA : 2.30 PETANG – 4.30 PETANG (2 JAM)

Kertas soalan ini mengandungi **SEBELAS (11)** 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 paper consists of **TWO (2)** subjective questions. Answer **ALL** questions.
ARAHAN:
*Kertas ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO2 (a) In pavement engineering, the thickness of pavement is influenced by several design factors. Analyze **FOUR (4)** design factors that affect pavement thickness in relation to the structural performance and long-term durability of the pavement.
*Dalam kejuruteraan turapan, ketebalan turapan jalan dipengaruhi oleh beberapa faktor reka bentuk. Analisis **EMPAT (4)** faktor reka bentuk yang mempengaruhi ketebalan turapan dan jelaskan bagaimana setiap faktor menyumbang kepada prestasi struktur serta ketahanan jangka panjang turapan.*

[10 marks]
[*10 markah*]

CLO2 (b) Syarikat Majujaya has been awarded a contract by the federal government to construct a new four-lane freeway connecting Miri and Limbang in a rolling terrain area. The project requires an appropriate pavement design to accommodate both current and future traffic demands. Recommend the suitable pavement layer for deep strength structure of this freeway. Given that the Average Daily Traffic (ADT) is 8,561 vehicles in both directions, of which 25% are commercial vehicles with an unladen weight exceeding 1.5 tons. This traffic data is obtained from a 16-hour survey by Highway Planning Unit (HPU). The following design parameters are provided in Table A1 (a).

Syarikat Majujaya telah dianugerahkan kontrak oleh kerajaan persekutuan untuk membina sebuah lebuh raya baharu empat lorong yang menghubungkan Miri dan Limbang di kawasan berbukit bergelombang. Projek ini memerlukan reka bentuk turapan yang sesuai bagi menampung permintaan trafik semasa dan masa hadapan. Cadangkan struktur turapan yang sesuai bagi lebuh raya berketahanan tinggi ini. Diberi Purata Trafik Harian (ADT) adalah sebanyak 8,561 kenderaan bagi kedua-dua arah, di mana 25% daripadanya merupakan kenderaan komersial dengan berat tanpa muatan melebihi 1.5 tan. Data trafik ini diperoleh daripada tinjauan 16 jam oleh Unit Perancangan Lebuh Raya (HPU). Parameter reka bentuk yang diberikan adalah seperti berikut Jadual A1(a).

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

Design life / *Jangka hayat reka bentuk*	20 years / *20 tahun*
Annual traffic growth / *Kadar pertumbuhan trafik tahunan*	4%
CBR mean / *Purata nilai CBR tanah asas*	18.5%
CBR standard deviation / *Sisihan piawai CBR tanah asas*	4.4%
Probability 85% (Normal deviate) / *Kebolehpercayaan 85% (Nilai sisihan piawai normal*	1.282

[15 marks]

[*15 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) A one-way road system is a system where traffic moves in a single direction. Discover **FIVE (5)** advantages and disadvantages of providing a one-way road system.

*Sistem jalan sehala adalah laluan trafik dalam satu arah. Kenal pasti **LIMA (5)** kelebihan dan kelemahan penyediaan sistem jalan sehala.*

[10 marks]

[*10 markah*]

CLO2 (b) Highway maintenance is a continuous process that involves keeping and repairing an existing road. Classify **FIVE (5)** maintenance operations regarding road systems.

*Penyelenggaraan lebuh raya merupakan satu proses berterusan yang melibatkan kerja-kerja mengekalkan dan membaik pulih jalan sedia ada. Klasifikasikan **LIMA (5)** operasi penyelenggaraan berkaitan sistem jalan raya.*

[5 marks]

[*5 markah*]

CLO2

(c) Asmadiana, a technician from the Public Works Department (JKR), conducted a routine check on Jalan Q256 located at KM26. Recommend a preventive measure to mitigate the type of damage illustrated in Figure A2(c).

Asmadiana, seorang juruteknik daripada Jabatan Kerja Raya (JKR), telah menjalankan pemeriksaan rutin di Jalan Q256 pada lokasi KM26. Cadangkan langkah pencegahan bagi mengelakkan kerosakan seperti dalam Rajah A2(c) daripada berlaku.

Figure A2(c) / *Rajah A2(c)*

[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) The enforcement of road-related Acts and legislation in Malaysia aims to protect public safety, safeguard health, and ensure efficiency in the transportation system. Identify **FIVE (5)** agencies responsible for enforcing road laws and regulations in Malaysia.
*Penguatkuasaan Akta dan perundangan yang berkaitan jalan raya di Malaysia bertujuan untuk melindungi keselamatan orang awam, menjaga kesihatan, serta memastikan kecekapan dalam sistem pengangkutan. Kenal pasti **LIMA (5)** agensi yang bertanggungjawab dalam menguatkuasakan undang-undang dan peraturan jalan raya di Malaysia.*

[5 marks]
[*5 markah*]

CLO1 (b) Aggregates are classified based on their mineral, chemical, and physical characteristics. Determine **FOUR (4)** physical properties of aggregates that are commonly tested to evaluate their performance in engineering applications.
*Agregat diklasifikasikan berdasarkan sifat mineral, kimia dan fizikal. Tentukan **EMPAT (4)** sifat fizikal agregat yang biasanya diuji untuk menilai prestasinya dalam aplikasi kejuruteraan.*

[10 marks]
[*10 markah*]

CLO1

(c) In road engineering, various laboratory tests are conducted to evaluate the quality and suitability of construction materials. Explain Aggregate Impact Value test and Penetration Test.

Dalam kejuruteraan jalan raya, pelbagai ujian makmal dijalankan untuk menilai kualiti dan kesesuaian bahan binaan. Terangkan Ujian Hentaman Aggregate dan Ujian Penusukan.

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) In Malaysia, there are two common types of pavements, one of them is flexible pavement. Illustrate the diagram of the flexible pavement structure and label each layer accordingly.

Di Malaysia, terdapat dua jenis jalan turapan yang biasa digunakan, dan salah satunya ialah turapan lentur. Lukiskan rajah struktur turapan lentur dan labelkan setiap lapisannya dengan betul.

[5 marks]

[*5 markah*]

CLO1 (b) Flexible pavement is one of the most common types of roads used in Malaysia. Explain the function of each layer in a flexible pavement structure based on its role in road performance.

Turapan lentur ialah salah satu jenis jalan raya yang paling biasa digunakan di Malaysia. Jelaskan fungsi setiap lapisan dalam struktur turapan lentur berdasarkan peranannya terhadap prestasi jalan raya.

[10 marks]

[*10 markah*]

CLO1 (c) In highway engineering, the construction of a road surface using flexible pavement requires several systematic stages to ensure quality and durability. Determine **FIVE (5)** main steps involved in the construction of a flexible pavement road surface along with the purpose of each step.

*Dalam kejuruteraan jalan raya, pembinaan permukaan jalan menggunakan turapan lentur memerlukan beberapa peringkat yang sistematik bagi memastikan kualiti dan ketahanannya. Tentukan **LIMA (5)** langkah utama yang terlibat dalam pembinaan permukaan jalan turapan lentur berserta tujuan bagi setiap langkah tersebut.*

[10 marks]

[*10 markah*]

QUESTION 3
SOALAN 3

CLO1 (a) Rigid pavement is commonly constructed using several types of engineering materials. Identify **FIVE (5)** materials that are typically used in the construction of rigid pavement.
*Turapan tegar biasanya dibina dengan menggunakan beberapa jenis bahan kejuruteraan. Kenal pasti **LIMA (5)** bahan yang lazimnya digunakan dalam pembinaan turapan tegar.*

[5 marks]
[*5 markah*]

CLO1 (b) Rigid pavement is a type of concrete pavement constructed using cement concrete or reinforced concrete slabs. Unlike flexible pavement, rigid pavement provides little or no flexibility under load. With the aid of a diagram, explain **TWO (2)** types of rigid pavement.
*Turapan tegar ialah sejenis turapan konkrit yang dibina menggunakan konkrit simen atau papak konkrit bertetulang. Tidak seperti turapan lentur, turapan tegar hampir tidak mempunyai kelenturan di bawah beban. Dengan bantuan rajah, jelaskan **DUA (2)** jenis turapan tegar*

[10 marks]
[*10 markah*]

CLO1 (c) There are several types of rigid pavement commonly used in road construction. Determine **FIVE (5)** advantages and disadvantages of rigid pavement.
*Terdapat beberapa jenis turapan tegar yang lazim digunakan dalam pembinaan jalan raya. Tentukan **LIMA (5)** kelebihan dan kelemahan turapan tegar.*

[10 marks]
[*10 markah*]

QUESTION 4

SOALAN 4

CLO1 (a) At a busy junction, several regulation signboards are placed. Explain **ONE (1)** regulation signboard and how drivers should act when they see it.

*Di sebuah persimpangan yang sibuk, beberapa papan tanda peraturan diletakkan. Terangkan **SATU (1)** papan tanda peraturan dan bagaimana pemandu perlu bertindak apabila mereka melihatnya.*

[5 marks]

[*5 markah*]

CLO1 (b) Traffic control devices are essential in ensuring smooth, safe, and efficient traffic movement. They function to guide, regulate and inform road users so that accidents and unnecessary delays can be avoided. To achieve this, all traffic control devices are designed uniformly and in compliance with established standards. Determine **FIVE (5)** characteristics of traffic control devices that provide convenience to road users.

*Peranti kawalan trafik adalah penting bagi memastikan pergerakan lalu lintas yang lancar, selamat dan berkesan. Ia berfungsi untuk membimbing, mengawal serta memaklumkan pengguna jalan raya supaya kemalangan dan kelewatan yang tidak perlu dapat dielakkan. Bagi mencapai tujuan ini, semua peranti kawalan trafik direka bentuk secara seragam dan mematuhi piawaian yang telah ditetapkan. Tentukan **LIMA (5)** ciri-ciri peranti kawalan trafik yang memberi kemudahan kepada pengguna jalan raya.*

[10 marks]

[*10 markah*]

CLO1

(c) On highways, drivers rely on informational signboards, such as those indicating fuel stations, hospitals, and exit directions, to make safe and informed decisions. Explain **THREE (3)** all these signs can assist drivers and the potential problems that may arise if such signs are missing or ignored.

*Di lebuh raya, pemandu bergantung kepada papan tanda maklumat seperti stesen minyak, hospital, dan arah keluar untuk membuat keputusan yang selamat dan tepat. Terangkan **TIGA (3)** cara semua papan tanda ini dapat membantu pemandu dan masalah yang mungkin timbul sekiranya papan tanda tersebut tiada atau diabaikan.*

[10 marks]

[*10 markah*]

SOALAN TAMAT

BUKU RUMUS DCC30103 – HIGHWAY AND TRAFFIC ENGINEERING

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%

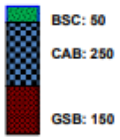
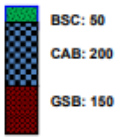
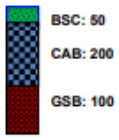
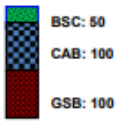
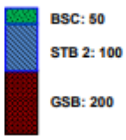
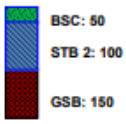
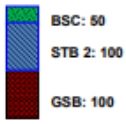
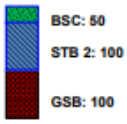
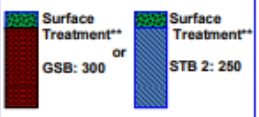
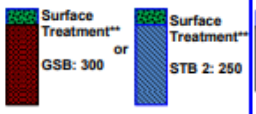
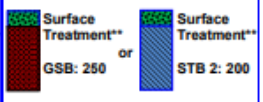
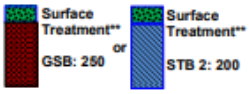
TABLE 2.6: Classes of Sub-Grade Strength (based on CBR) used as Input in the Pavement Catalogue of this Manual

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)

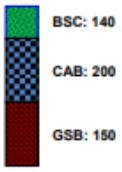
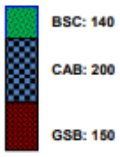
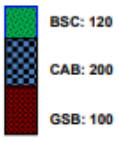
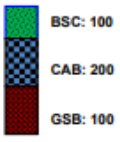
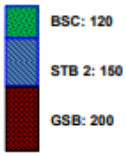
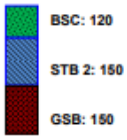
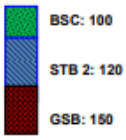
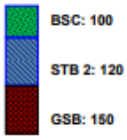
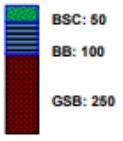
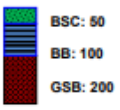
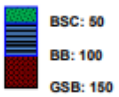
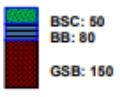
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

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

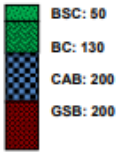
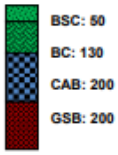
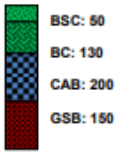
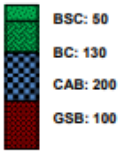
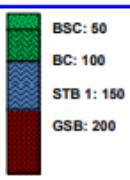
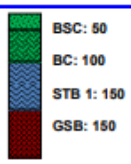
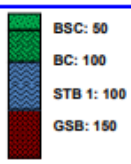
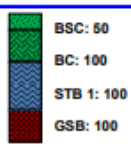
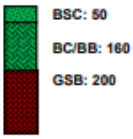
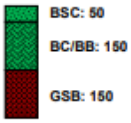
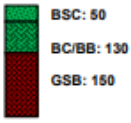
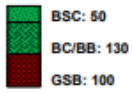
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

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

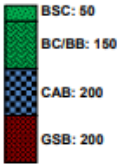
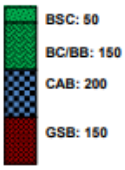
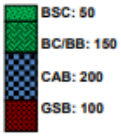
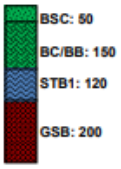
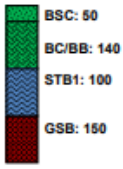
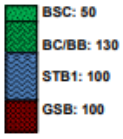
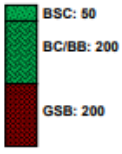
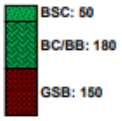
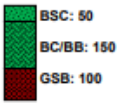
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base				
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

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

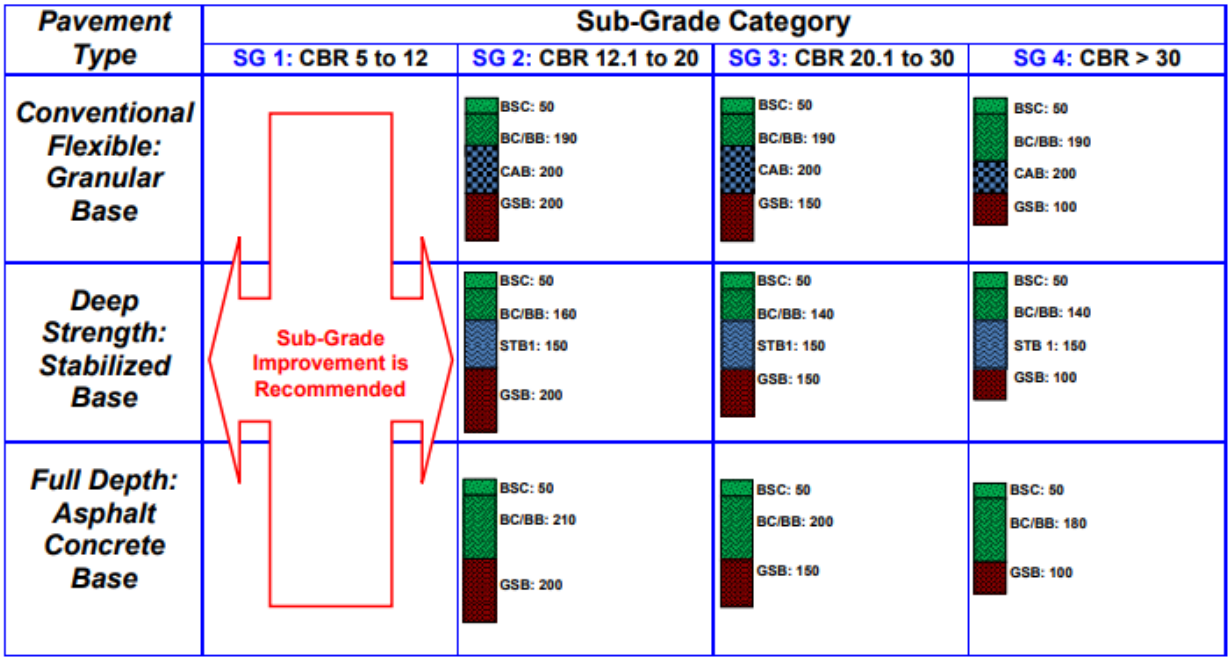
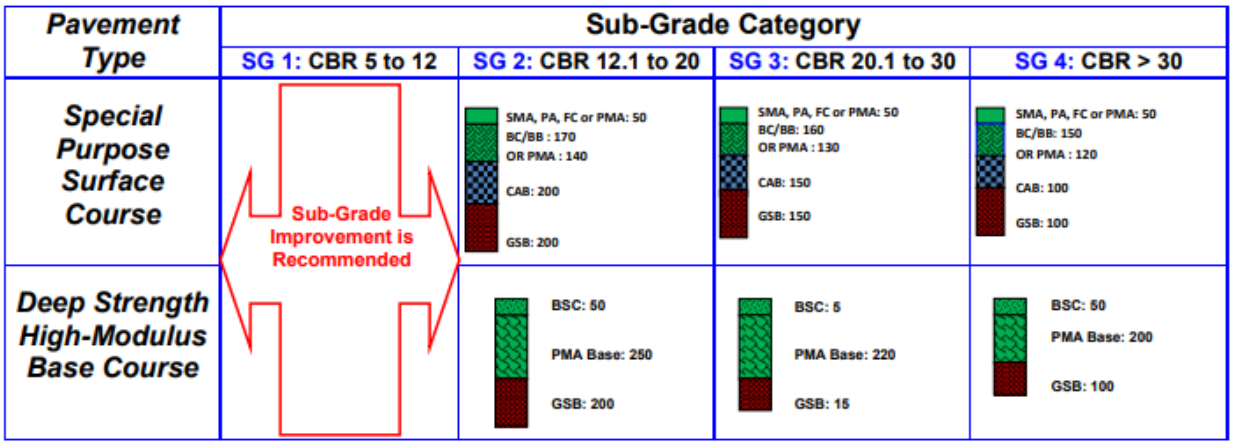


FIGURE 3.6: Pavement Structures for Traffic Category T 5: > 30.0 million ESALs (80 kN)
(Use of Polymer Modified Asphalt)



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