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 : 2024/2025

DCC30103: HIGHWAY AND TRAFFIC ENGINEERING

TARIKH : 12 DISEMBER 2024
MASA : 8.30 PAGI - 10.30 PETANG (2 JAM)

Kertas ini mengandungi **LAPAN (8)** 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 4 lane freeway (concession toll-road) with an average daily traffic of 7286 vehicles, which 20% is unladen commercial vehicles weight >1.5 tons. Average Daily Trafic (ADT) based on HPU survey (from 06:00 to 22.00 hours) is given as Table A1(a);

Kelaskan rekabentuk kategori trafik bagi lebuh raya 4 lorong (lebuhraya konsesi bertol) dengan purata trafik harian 7268 kenderaan, di mana 20% daripadanya adalah kenderaan pedagangan dengan berat tanpa muatan > 1.5 tan. Purata Lalulintas Harian (PLH) berdasarkan bancian HPU (dari 06:00 hingga 22:00) adalah berdasarkan Jadual A1(a) yang diberikan;

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

CV1	600
CV2	400
CV3	300
CV4	100
Lane distribution factor, L *Faktor agihan lorong, L*	two lanes in one direction *dua lorong dalam satu arah*
Terrain factors, T *Faktor muka bumi, T*	flat *rata*
Design life, n *Hayat rekabentuk, n*	20 years *20 tahun*
Assumed Annual Traffic Growth rate, r *Anggaran Kadar Pertumbuhan Lalulintas Tahunan, r*	4.0 *4.0%*

[10 marks]

[*10 markah*]

CLO2 (b) Traffic lights are traffic control tools that are designed to reduce conflicts and to ensure the safety of road users and pedestrians. If a two-phase traffic light is to be provided at a four-leg intersection with the traffic flow and lane width as in Table A1(b). While the lost time of each phase that is caused by the start delay is 2 seconds and the time between greens is 8 seconds. Assume the yellow time is 3 seconds. Determine the diagram of 2-phase traffic light for the intersection.

Lampu isyarat adalah alat kawalan trafik yang disediakan bagi tujuan mengurangkan konflik dan memastikan keselamatan pengguna jalan raya dan pejalan kaki. Sekiranya sebuah lampu isyarat 2 fasa hendak disediakan di satu simpang empat dengan aliran bagi lalu lintas dan lebar lorong adalah seperti Jadual A1(b). Manakala masa hilang setiap fasa yang disebabkan oleh kelengahan permulaan adalah 2 saat dan masa antara hijau 8 saat. Andaikan masa kuning ialah 3 saat. Tentukan gambarajah diagram bagi lampu isyarat dua fasa bagi simpang empat tersebut.

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

Approach *Cabang aliran*	NORTH *UTARA*	SOUTH *SELATAN*	EAST *TIMUR*	WEST *BARAT*
Saturation Flow (pcu/hr) *Aliran tepu (ukp/j)*	1500	1500	1200	1200
Traffic Flow (pcu/hr) *Aliran lalulintas (ukp/j)*	500	400	300	250

[15 marks]

[*15 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) The works ministry recorded an increase of 13.6% of road accidents cases of road accidents on major highways in 2023 with 23,216 cases compared to 20,444 cases on year 2022. Explain the factors that cause road accident.

Kementerian Kerja Raya merekodkan peningkatan 13.6% kes kemalangan jalan raya di lebuh raya utama pada tahun 2023 iaitu sebanyak 23,216 kes berbanding 20,444 kes pada tahun 2022. Terangkan faktor-faktor yang menyebabkan kemalangan jalan raya.

[10 marks]

[*10 markah*]

CLO2 (b) The pavements are broadly classified into two categories, namely, flexible pavements and rigid pavements. There are specific causes that contribute to the failure of each type of pavement. Select **FIVE (5)** categories of flexible pavement damages.

*Turapan secara amnya dikelaskan kepada dua kategori, iaitu, turapan boleh lentur dan turapan tegar. Terdapat sebab khusus yang menyumbang kepada kegagalan setiap jenis turapan. Pilih **LIMA (5)** kategori kerosakan bagi turapan boleh lentur.*

[5 marks]

[*5 markah*]

CLO2 (c) A Pothole is a depression on a road surface caused by water and traffic, usually asphalt pavement, where traffic has removed broken pieces of the pavement. Recommend the procedure to repair the problem.

Lopak terjadi akibat tekanan yang dihasilkan di permukaan jalan. Biasanya turapan asfalt akan terlerai disebabkan oleh aggregat telah pecah dan meregang. Berdasarkan kenyataan tersebut, cadangkan proses kerja untuk membaiki masalah tersebut.

[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) According to The Public Works Department (JKR), roads in Malaysia are divided into several categories. Identify **FIVE (5)** road categories.
*Menurut Jabatan Kerja Raya (JKR), jalan raya di Malaysia terbahagi kepada beberapa kategori. Kenal pasti **LIMA (5)** kategori jalan raya.*

[5 marks]
[*5 markah*]

CLO1 (b) The design of an asphalt concrete (AC) mixture includes the selection of the best blend of aggregates and the optimum asphalt content to meet the required specifications in road constructions. The physical properties of aggregates are also essential in determining the performance of asphalt concrete mixture for road pavement. Explain **FIVE (5)** characteristics of a desired asphaltic concrete mixture.
*Reka bentuk campuran konkrit asfalt merangkumi pemilihan campuran agregat yang terbaik dan kandungan asfalt yang optimum untuk memenuhi spesifikasi yang diperlukan dalam pembinaan jalan raya. Sifat fizikal agregat juga memainkan peranan penting dalam menentukan prestasi turapan jalan. Terangkan **LIMA (5)** ciri campuran asfalt yang memenuhi kriteria yang diperlukan.*

[10 marks]
[*10 markah*]

CLO1 (c) Aggregate and bitumen are the common materials used in road construction with flexible pavement method. These materials need to be tested to ensure maximum capability before on-site usage. Choose **FOUR (4)** tests on road construction materials with the purpose of each test.

*Agregat dan bitumen adalah bahan yang biasa digunakan dalam pembinaan jalan dengan kaedah turapan lentur. Bahan ini perlu diuji untuk memastikan keupayaannya sebelum boleh digunakan dalam pembinaan. Pilih **EMPAT (4)** ujian ke atas bahan pembinaan jalan raya beserta tujuan setiap ujian.*

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Illustrate flexible pavement design with a correct label.

Lakarkan reka bentuk turapan boleh lentur beserta label yang betul.

[5 marks]

[*5 markah*]

CLO1 (b) The roads of the earlier times depended solely on stone, gravel and sand for construction and water was used as a binding agent. Nowadays, the flexible pavement is widely used because it is more practical and economical. Determine **FIVE (5)** steps of road surface construction according to the flexible pavement.

*Jalan-jalan pada zaman dahulu hanya bergantung pada batu, kerikil dan pasir untuk pembinaan dan air digunakan sebagai agen pengikat. Pada masa kini, turapan boleh lentur lebih digunakan secara meluas kerana turapan ini lebih praktikal dan ekonomi untuk digunakan. Tentukan **LIMA (5)** langkah pembinaan permukaan jalan mengikut pembinaan turapan boleh lentur.*

[10 marks]

[*10 markah*]

CLO1 (c) Flexible Pavements are constructed from bituminous or unbound material with layered design system. Explain **ONE (1)** function of each layer in the pavement.
*Turapan boleh lentur terdiri daripada bahan berbitumen atau bahan tidak terikat dengan sistem rekabentuk yang berlapis. Terangkan **SATU (1)** fungsi untuk setiap lapisan bagi turapan boleh lentur.*

[10 marks]
[*10 markah*]

QUESTION 3
SOALAN 3

CLO1 (a) Interpret rigid pavement.
Tafsirkan turapan tegar.

[5 marks]
[*5 markah*]

CLO1 (b) Explain **FOUR (4)** types of joints in rigid pavement.
*Terangkan **EMPAT (4)** jenis sambungan pada turapan tegar.*

[10 marks]
[*10 markah*]

CLO1 (c) Determine **THREE (3)** types of rigid pavement.
*Tentukan **TIGA (3)** jenis turapan tegar*

[10 marks]
[*10 markah*]

QUESTION 4

SOALAN 4

CLO1 (a) The main purpose of traffic a control device is to provide information to road users so they can safely move along highway, street, and pedestrian lanes. Identify **FIVE (5)** basic criteria of a traffic control device.

*Tujuan utama peranti kawalan lalu lintas adalah untuk memberikan maklumat kepada pengguna jalan raya agar mereka dapat bergerak dengan selamat di sepanjang lebuh raya, sepanjang jalan dan laluan pejalan kaki. Kenal pasti **LIMA (5)** kriteria asas peranti kawalan tersebut.*

[5 marks]

[*5 markah*]

CLO1 (b) Traffic control devices are needed to ensure the efficacy of the traffic flow. effective system. Explain **FOUR (4)** types of traffic control devices.

*Peranti kawalan lalu lintas diperlukan untuk memastikan keberkesanan aliran lalulintas. Terangkan **EMPAT (4)** jenis peranti kawalan lalu lintas.*

[10 marks]

[*10 markah*]

CLO1 (c) Road signs are used to regulate traffic flow to give instructions and guideline to road users. With the availability of suitable road signs, it is hoped that the availability of proper road signs may increase the efficiency of road users. Determine **THREE (3)** categories of road signs according to their function.

*Papan tanda jalan digunakan untuk mengatur perjalanan lalu lintas, memberi arahan dan panduan kepada pengguna jalan. Diharapkan dengan adanya papan tanda jalan yang sesuai mampu meningkatkan keberkesanan penggunaan jalan raya oleh pengguna. Tentukan **TIGA (3)** kategori papan tanda berdasarkan fungsinya.*

[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

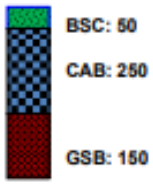
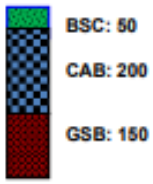
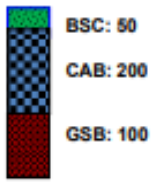
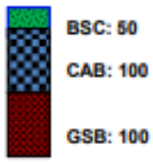
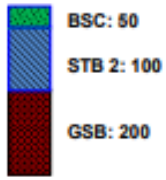
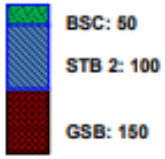
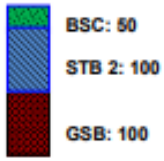
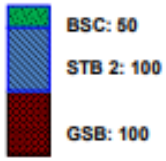
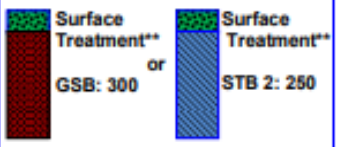
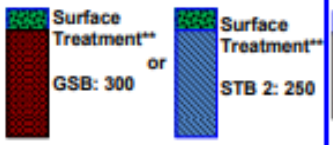
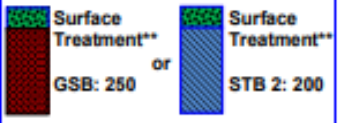
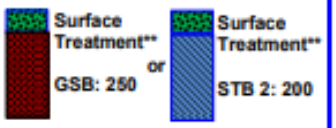
TABLE 2.5: Traffic Categories used in this Manual (ESAL = 80 kN)

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**

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)

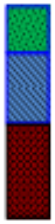
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base	 BSC: 140 CAB: 200 GSB: 150	 BSC: 140 CAB: 200 GSB: 150	 BSC: 120 CAB: 200 GSB: 100	 BSC: 100 CAB: 200 GSB: 100
Deep Strength: Stabilised Base	 BSC: 120 STB 2: 150 GSB: 200	 BSC: 120 STB 2: 150 GSB: 150	 BSC: 100 STB 2: 120 GSB: 150	 BSC: 100 STB 2: 120 GSB: 150
Full Depth: Asphalt Concrete Base	 BSC: 50 BB: 100 GSB: 250	 BSC: 50 BB: 100 GSB: 200	 BSC: 50 BB: 100 GSB: 150	 BSC: 50 BB: 80 GSB: 150

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

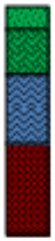
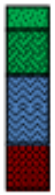
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base	 BSC: 50 BC: 130 CAB: 200 GSB: 200	 BSC: 50 BC: 130 CAB: 200 GSB: 200	 BSC: 50 BC: 130 CAB: 200 GSB: 150	 BSC: 50 BC: 130 CAB: 200 GSB: 100
Deep Strength: Stabilised Base	 BSC: 50 BC: 100 STB 1: 150 GSB: 200	 BSC: 50 BC: 100 STB 1: 150 GSB: 150	 BSC: 50 BC: 100 STB 1: 100 GSB: 150	 BSC: 50 BC: 100 STB 1: 100 GSB: 100
Full Depth: Asphalt Concrete Base	 BSC: 50 BC/BB: 160 GSB: 200	 BSC: 50 BC/BB: 150 GSB: 150	 BSC: 50 BC/BB: 130 GSB: 150	 BSC: 50 BC/BB: 130 GSB: 100

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

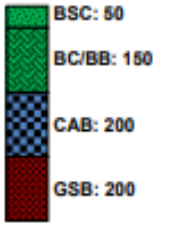
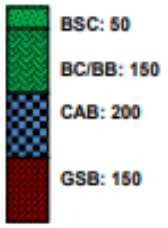
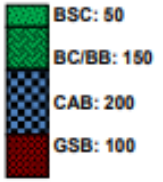
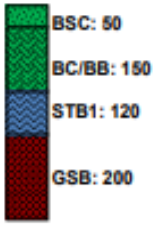
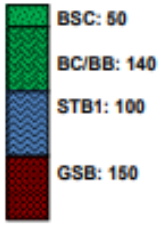
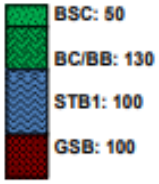
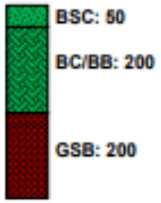
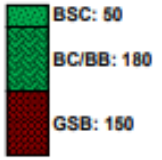
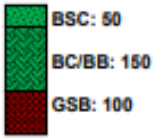
Pavement Type	Sub-Grade Category			
	SG 1: CBR 5 to 12	SG 2: CBR 12.1 to 20	SG 3: CBR 20.1 to 30	SG 4: CBR > 30
Conventional Flexible: Granular Base	Sub-Grade Improvement is Recommended			
Deep Strength: Stabilised Base				
Full Depth: Asphalt Concrete Base				

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

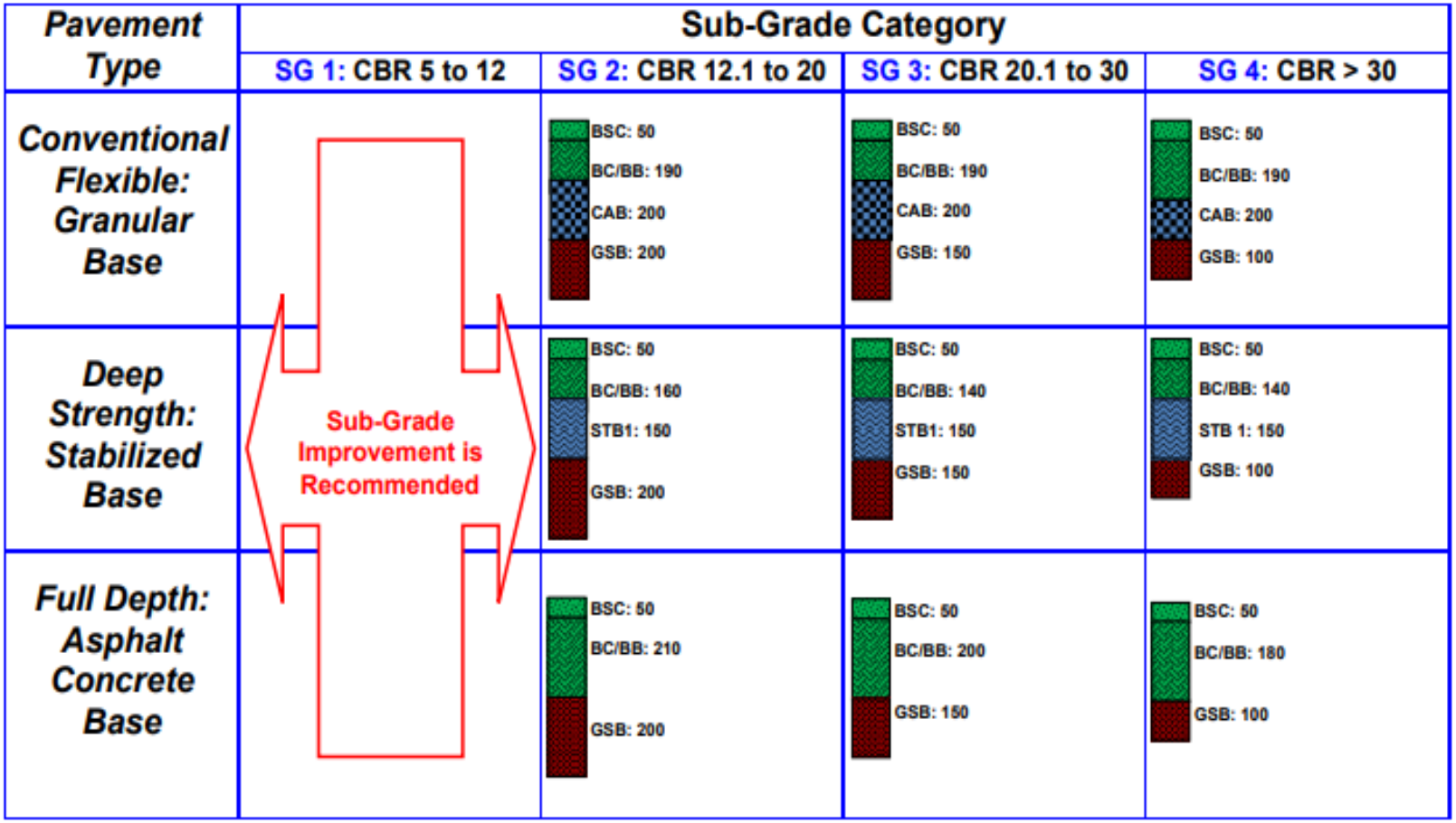
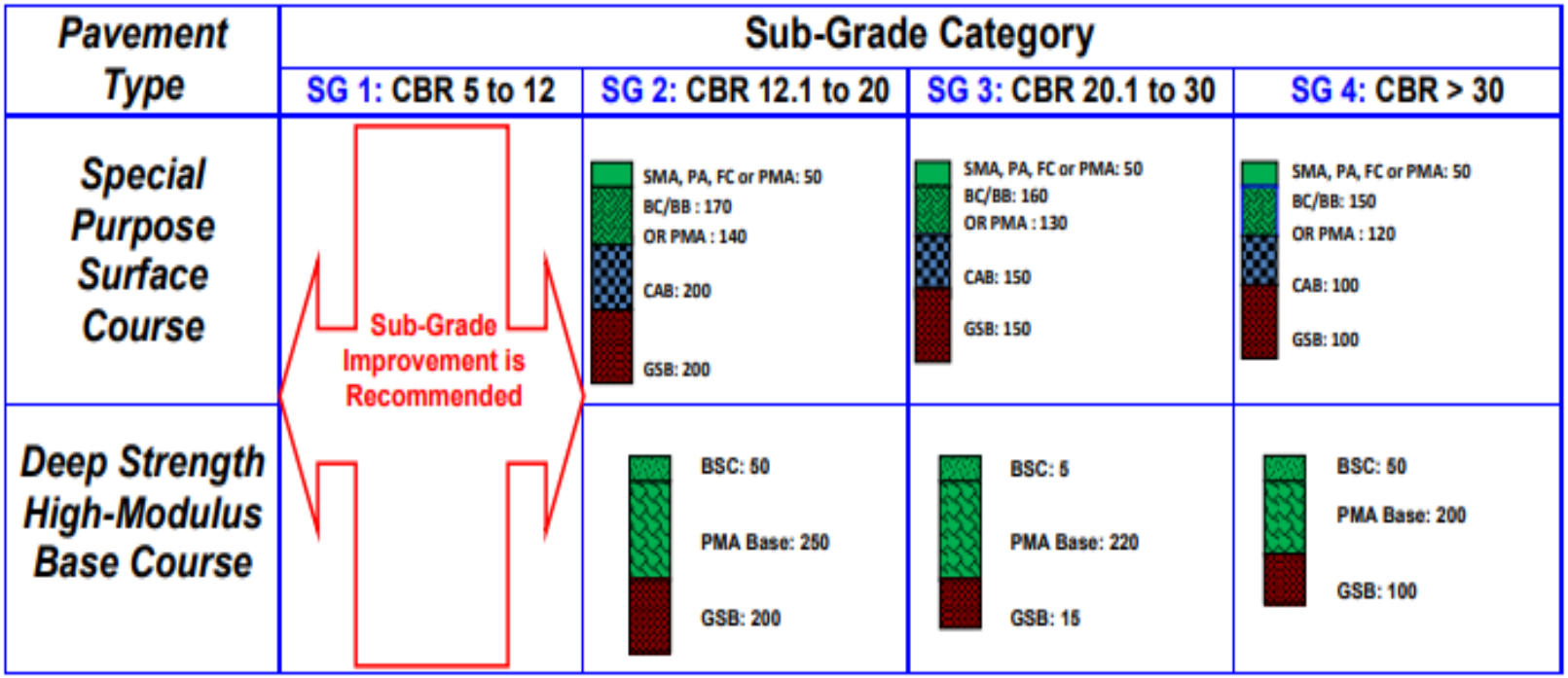


FIGURE 3.6: Pavement Structures for Traffic Category T 5: > 30.0 million ESALs (80 kN)

(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