First Semester Examination
Academic Session 2018/2019

December 2018/January 2019

EAL337 – Pavement Engineering
(*Kejuruteraan Turapan*)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of **TWENTY (20)** pages of printed material including appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA PULUH (20)** muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

*[**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan,versi Bahasa Inggeris hendaklah digunapakai.]

(1). (a). Aggregate laboratory tests are simulative in nature. Describe how does the following laboratory tests simulate what is happening in the field:

- Los Angeles abrasion value test
- Polished stone value test

Ujian aggregat di makmal bersifat simulatif. Terangkan bagaimanakah ujian berikut mensimulasi apa yang berlaku di tapak:

- *Ujian nilai lelasan Los Angeles*
- *Ujian nilai batu tergilap*

[4 marks/*markah*]

(b). Two Quarries A and B are producing aggregate whose properties are shown in **Table 1**. The limiting values in the JKR specifications are also given in **Table 1**.

*Dua Kuari A dan B menghasilkan agregat yang cirinya ditunjukkan di dalam **Jadual 1**. Had nilai menurut spesifikasi JKR juga ditunjukkan di dalam **Jadual 1**.*

(i). Compare and contrast between the aggregate properties produced in each quarry in terms of:

- Aggregate shape
- Aggregate resistance to compressive strength
- Aggregate resistance to the adverse effects of the weather
- Aggregate ability to resist abrasive forces

Bandingkan persamaan dan perbezaan ciri agregat di setiap kuari berdasarkan:

- *Bentuk agregat*
- *Rintangan kekuatan mampatan agregat*
- *Keupayaan agregat merintangi kesan buruk cuaca*
- *Keupayaan agregat merintangi daya lelasan*

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(ii). From the test results shown in **Table 1**, which quarry is producing limestone? Justify your answer based on the aggregate test results. What will happen to traffic safety if this aggregate type is used for the wearing course?

*Daripada keputusan ujian yang ditunjukkan di dalam **Jadual 1**, kuari manakah yang menghasilkan batu kapur? Berikan justifikasi berpandukan keputusan ujian agregat. Apakah yang akan terjadi kepada keselamatan lalu lintas jika agregat jenis ini digunakan pada lapisan penghausan?*

(iii). What type of crusher is used by each Quarry A and B? Justify your answer based on the aggregate flakiness test results.

Penghancur jenis apakah yang digunakan oleh setiap Kuari A dan B? Berikan justifikasi berpandukan keputusan ujian kekepingan agregat.

[10 marks/*markah*]

Table 1/*Jadual 1*

Quarry/ *Kuari*	**Water Absorption/ *Penyerapan Air* (%)**	**Flakiness Index/ *Indeks Kekepingan* (%)**	**Aggregate Crushing Value/ *Nilai Penghancuran Agregat* (%)**	**Soundness/ *Ketahanan* (%)**	**Los Angeles Abrasion Value/ *Nilai Lelasan Los Angeles* (%)**	**Polished Stone Value/ *Nilai Penggilapan Agregat***	**Affinity to Bitumen/ *Daya Tarikan kepada Bitumen***
A	0.5	7	16	2	18	51	Poor/ *Buruk*
B	0.7	24	21	2	22	44	Excellent/ *Sangat Baik*
Limiting Values/ *Had Nilai*	2	25	25	18	25	40	-

(c). Filler is typically used to produce asphalt mixes. Any material passing the 75 micron sieve can be a good candidate for filler. Explain **THREE (3)** functions of filler, its typical quantity and name **THREE (3)** materials that can be utilised as filler.

*Bahan pengisi lazim digunakan untuk penghasilan campuran asfalt. Sebarang bahan yang melepasi ayak bersaiz 75 mikron berpotensi untuk dijadikan sebagai bahan pengisi. Jelaskan **TIGA (3)** fungsi bahan pengisi, kuantiti lazim dan namakan **TIGA (3)** bahan yang boleh digunakan sebagai bahan pengisi.*

[6 marks/*markah*]

(2). (a). Emulsions can be either anionic or cationic. Assume two emulsions X and Y, are delivered to your laboratory. Describe a simple laboratory test that you will conduct to identify the followings:

Bahan emulsi wujud dalam bentuk anionik atau kationik. Andaikan dua emulsi X dan Y, di bekalkan kepada makmal anda. Terangkan satu ujian makmal mudah yang bakal anda lakukan untuk mengenalpasti berikut:

(i). whether both emulsions are made using the same or different electrostatic charges.

sama ada kedua-dua emulsi diperbuat daripada caj elektrostatik yang sama atau berlainan.

(ii). whether the emulsion type is anionic or cationic.

sama ada jenis emulsi adalah anionik atau kationik.

(iii). An emulsion is to be used as a prime coat material on top of a roadbase material made of granite aggregates. Justify which emulsion type is the most suitable for this aggregate type.

Bahan emulsi bakal digunakan sebagai salut perdana di atas permukaan bahan tapak jalan yang diperbuat daripada agregat granit. Berikan justifikasi jenis emulsi yang paling sesuai untuk agregat jenis ini.

[6 marks/*markah*]

(b). Bitumen is a visco-elastic material whose properties depend on temperature and time of loading.

Bitumen ialah bahan visko-elastik yang cirinya bergantung kepada suhu dan tempoh pembebanan.

(i). Describe how a bitumen will behave when subjected to:

- High temperature.
- Short time of loading.

Terangkan bagaimana tingkahlaku bitumen sekiranya ditindaki:

- *Suhu tinggi.*
- *Tempoh pembebanan singkat.*

(ii). Explain **TWO (2)** reasons why modified binders are developed. What is the role of the modifier to make modified bitumen as an ideal bitumen for all road applications.

*Jelaskan **DUA (2)** alasan kenapa bahan pengikat terpinda dibangunkan. Apakah fungsi bahan peminda untuk menghasilkan bitumen terpinda sebagai bitumen yang ideal untuk semua aplikasi jalan raya.*

[8 marks/*markah*]

(c). The linear relationship between logarithmic of penetration and test temperature of a bitumen penetration grade 100 is shown in **Figure 1**. The logarithmic of penetration at 15^{o}C is shown in **Figure 1**. Calculate the Penetration Index and softening point of this bitumen sample.

*Kehubungan lelurus di antara logaritma penusukan dan suhu suatu bitumen bergred penusukan 100 ditunjukkan di dalam **Rajah 1**. Nilai logaritma penusukan pada suhu 15^{o}C ditunjukkan di dalam **Jadual 1**. Kira Indeks Penusukan dan suhu titik lembut sampel bitumen ini.*

[6 marks/*markah*]

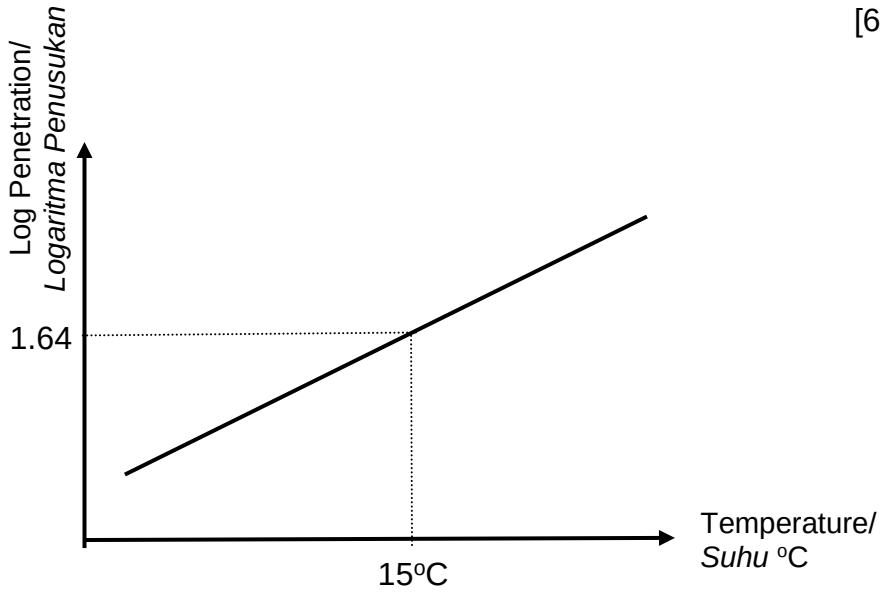

Figure 1/ *Rajah 1*

(3). (a). Using the available aggregates stockpiles stated in **Table 2**, you are required to compute the stock percentage for both aggregates (A and B), and their blend proportions in order to meet the final gradation based on the target gradation limits using trial and error method.

*Menggunakan stok agregat yang tersedia seperti ditunjukkan di dalam **Jadual 2**, anda dikehendaki mengira peratusan stok untuk kedua-dua agregat (A dan B), dan perkadaran gabungannya untuk memenuhi penggredan akhir berdasarkan had penggredan sasaran menggunakan kaedah percubaan dan ralat.*

Table 2/*Jadual 2*

Aggregate Size/ *Saiz Agregat* (mm)	**Aggregate Stockpiles/*Stok Agregat***		**Target Gradation/ *Gradasi Sasaran* (% Passing (*% Terlepas*)**
	A	**B**	
	% Passing *% Terlepas*	**% Passing *% Terlepas***	
14	100	100	100
10	90	100	80-100
5	30	100	70-100
3.35	7	88	40-80
1.18	3	47	20-65
0.425	1	32	7-40
0.150	0	24	3-20
0.075	0	0	2-10

[6 marks/*markah*]

(b). The aggregate composition in mix type asphaltic concrete AC10 incorporating hydrated lime as filler, is shown in **Table 3**. Mixes were compacted and tested for volumetric properties and Marshall properties. The laboratory test results are shown in **Table 4**, while **Table 5** shows the Malaysian Public Works Department specification limits.

*Komposisi agregat campuran konkrit asfalt AC10 yang menggabungkan bahan pengisi kapur terhidrat, ditunjukkan di dalam **Jadual 3**. Campuran dipadat dan diuji untuk ciri volumetrik dan Marshall. Keputusan ujian makmal ditunjukkan di dalam **Jadual 4**, manakala **Jadual 5** menunjukkan had spesifikasi Jabatan Kerja Raya Malaysia.*

Table 3/*Jadual 3*

Material/ *Bahan*	**Percentage/ *Peratusan* (%)**	**Specific Gravity/ *Graviti Tentu* (g/cm^3)**
Coarse Aggregate *Agregat Kasar*	46.0	2.66
Fine Aggregate *Agregat Halus*	52.0	2.69
Filler (Hydrated Lime) *Pengisi (Kapur Terhidrat)*	2.0	2.78
Bitumen *Bitumen*	Variety *Pelbagai*	1.017

Table 4/*Jadual 4*

Sample No./ *No. Sampel*	**Sample Height/ *Tinggi Sampel (mm)***	**Bitumen Content/ *Kandungan Bitumen* (%)**	**Mass in Air/ *Jisim di Udara* (g)**	**Mass in Water/ *Jisim di dalam Air* (g)**	**Mass Saturated Surface Dried/ *Jisim Permukaan Kering Tepu (g)***	**Measured Stability/ *Kestabilan Terukur* (kN)***	**Flow/ *Aliran* (mm)**
1	58.7	4.5	1206.8	658.1	1176.2	7.2	2.0
2	63.5	5.5	1216.9	698.2	1211.9	13.9	2.8
3	66.1	6.5	1280.4	655.4	1199.6	8.3	3.9

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Table 5/*Jadual 5*

Property/ *Ciri*	**Specification/ *Spesifikasi***
Stability/*Kestabilan*, kN	≥ 8
Flow/*Aliran*, mm	≤ 2 - 4
Air Voids/*Lompang Udara*, %	3 - 5
Voids Filled With Bitumen/*Lompang Terisi Bitumen*, %	75 - 82

From the results shown in **Table 3** and **Table 4**, calculate the specific gravity of aggregate mixture and plot the following relationships:

*Daripada keputusan yang ditunjukkan di dalam **Jadual 3** dan **Jadual 4**, kira graviti tentu campuran agregat dan plot kehubungan berikut:*

- Mix density versus bitumen content
  Ketumpatan campuran lawan kandungan bitumen

- Mix air voids versus bitumen content
  Lompang udara campuran lawan kandungan bitumen

- Mix stability versus bitumen content
  Kestabilan campuran lawan kandungan bitumen

- Flow versus bitumen content
  Aliran lawan kandungan bitumen

- Mix voids filled with bitumen versus bitumen content
  Lompang terisi bitumen campuran lawan kandungan bitumen

Where appropriate, use coefficients given in **APPENDIX 1**. Explain why does the density versus bitumen content curve exhibit a distinct peak? From the graphs plotted, determine the optimum bitumen content. Compare the value obtained with the JKR specifications and write down your comments.

*Jika perlu, gunakan pekali yang diberikan di dalam **LAMPIRAN 1.** Terangkan kenapakah lengkung ketumpatan lawan kandungan bitumen mempamerkan satu puncak yang nyata? Daripada graf yang diplot, tentukan kandungan bitumen optimum. Bandingkan nilai yang diperolehi dengan spesifikasi JKR dan nyatakan komen anda.*

[14 marks/*markah*]

(4). Malaysian Highway Authority is a responsible body to execute the design, construction, regulation, operation and maintenance of interurban highways in Malaysia. As an engineer of the agency, you are appointed to design a road pavement for a 4-lane freeway (concession toll road, 2-lane for one way) with an average daily traffic (two ways) of 10,000 vehicles, of which 15% are commercial vehicles with an un-laden weight > 1.5 tons, and the traffic composition is as shown in **Table 6**.

*Lembaga Lebuhraya Malaysia adalah sebuah badan yang bertanggungjawab untuk melaksanakan reka bentuk, pembinaan, pengawalan, operasi dan penyelenggaraan lebuhraya antara bandar di Malaysia. Sebagai seorang jurutera dalam agensi tersebut, anda diarahkan untuk merekabentuk lebuh raya 4 lorong (jalan konsesi bertol, 2 lorong untuk satu arah) dengan trafik harian purata (dua arah) sebanyak 10,000 kenderaan, di mana 15% adalah kenderaan komersil dengan berat tanpa beban > 1.5 tan, dan komposisi trafik adalah seperti yang ditunjukkan dalam **Jadual 6**.*

Table 6/*Jadual 6*

HPU class designation/ *Penetapan Kelas*	**Composition (%) *Komposisi (%)***
Cars and Taxis *Kereta dan Teksi*	60
Small trucks and vans (2 axles) *Trak kecil dan van (2 gandar)*	15
Large trucks (2 to 4 axles) *Trak besar (2 hingga 4 gandar)*	8
Articulated trucks (3 or more axles) *Trak pengangkut (3 atau lebih gandar)*	5
Buses (2 or 3 axles) *Bas (2 atau 3 gandar)*	6
Motorcycles *Motosikal*	6

Additional information for the design process as listed underneath:

Maklumat tambahan untuk proses rekabentuk seperti yang disenaraikan di bawah:

Lane distribution factor, *L* = 0.7

Faktor pengagihan lorong, L = 0.7

Terrain factor, *T* = 1.0

Faktor muka bumi, T = 1.0

Design traffic = 20 years

Reka bentuk lalu lintas = 20 tahun

Total Growth Factor (TGF) = 33.06

Jumlah faktor pertumbuhan (TGF) = 33.06

Results of subgrade testing are as follows:
Keputusan ujian subgred adalah seperti berikut:

Subgrade properties
Ciri subgred

CBR mean = 142 MPa
Purata CBR = 142 MPa

CBR standard deviation = 25 MPa
Sisihan piawai CBR = 25 MPa

Normal deviate = 1.645
Sisihan normal = 1.645

(a). Determine the traffic category and the subgrade category based on the available information

Tentukan kategori lalu lintas dan kategori subgred berdasarkan maklumat yang disediakan

(b). Decide and explain the chosen pavement structure,

Tentukan dan terangkan struktur turapan yang dipilih,

Where appropriate, use **APPENDIX 2.** State all assumptions made.

*Jika perlu, rujuk **LAMPIRAN 2**. Nyatakan semua anggapan yang dibuat.*

[20 marks/*markah*]

(5). (a). Imagine that you an entrepreneur that decided to purchase an asphalt mixing plant after several years of buying hot mix asphalt from the supplier. In order to choose between drum mixing or batch mixing for your plant, you need to justify the advantages and disadvantages of both methods. State your decision and explain the reasons of choosing the asphalt mixing plant compare to the other one.

Bayangkan anda adalah seorang usahawan yang telah memutuskan untuk membeli sebuah loji campuran asfalt setelah beberapa tahun membeli asfalt campuran panas daripada pembekal. Bagi memilih di antara loji gelendong atau loji kelompok, anda perlu melakukan justifikasi terhadap kelebihan dan kekurangan bagi kedua-dua kaedah pencampuran. Nyatakan keputusan anda dan jelaskan sebab-sebab anda memilih loji campuran asfalt tersebut berbanding loji campuran asfalt yang lain.

[6 marks/*markah*]

(b). Sketch the aggregate gradations of asphaltic concrete and porous asphalt. Describe **TWO (2)** advantages of pavements constructed using porous asphalt compared to dense asphaltic concrete.

*Lakarkan penggredan agregat campuran jenis konkrit asfalt dan asfalt berliang. Terangkan **DUA (2)** kebaikan turapan yang dibina menggunakan asfalt berliang berbanding konkrit asfalt tumpat.*

[4 marks/*markah*]

(c). In the context of asphalt paving practice at site, write short notes on best practices during the following road construction activities and state the reasons for doing so. Where possible, provide sketches.

Dalam konteks kaedah praktik penurapan asfalt di tapak, tulis nota ringkas berkaitan amalan terbaik berikut semasa aktiviti pembinaan jalan dan nyatakan alasan berbuat demikian. Tunjukkan lakaran jika bersesuaian.

(i). Spraying tack coat on the binder course surface before laying the wearing course.

Menyembur salut perdana di atas permukaan lapisan pengikat sebelum perletakan lapisan penghausan.

(ii). Transferring mix from the tip truck to the paver hopper.

Memindah campuran daripada trak ke corong tuang jentera penurap.

(iii). Folding the wings of the paver hopper.

Melipat sayap corong tuang jentera penurap.

(iv). Compaction of the longitudinal joint by the roller compactor.

Pemadatan sambungan membujur oleh pemadat gelekan.

[10 marks/*markah*]

(6). (a). As a road engineer, you need to ensure that the road design is safe, environmental friendly and convenient to be used by the road users. Based on your knowledge, elaborate **THREE (3)** factors from the engineering perspective on how to tackle the pavement damage problems from the point of road design, road construction and road maintenance.

*Sebagai seorang jurutera jalan raya, anda harus memastikan turapan yang direkabentuk adalah selamat, mesra alam sekitar dan selesa digunakan oleh pengguna jalan raya. Berdasarkan pengetahuan anda, terangkan **TIGA (3)** faktor dari persepktif kejuruteraan bagaimana untuk mengatasi masalah kerosakan turapan dari sudut reka bentuk jalan, pembinaan jalan dan penyenggaraan jalan.*

[6 marks/*markah*]

(b). Emergency maintenance is considered as activities that cannot be pre-estimated with any certainty. The activities include works to repair roads or bridges due to landslide or washout, which result in road being cut or rendered impassable. Whenever a serious landslide occurs on a road, it would be closed immediately. Based on this fact, discuss the purpose of the road closure and the possible types of work and machineries required to accomplish the maintenance work.

Penyelenggaraan kecemasan dianggap sebagai aktiviti yang tidak dapat dianggarkan dengan tepat. Aktiviti ini termasuk kerja-kerja untuk membaiki jalan atau jambatan akibat tanah runtuh atau kegelinciran,yang mengakibatkan jalan terputus atau terhalang tidak boleh dilalui. Apabila berlaku gelongsoran serius terhadap jalan raya, ia akan ditutup dengan segera. Berdasarkan fakta ini, bincangkan tujuan penutupan jalan dan kemungkinan jenis kerja dan jentera yang diperlukan untuk menyiapkan kerja penyelenggaraan.

[6 marks/*markah*]

(c). Prior to ensuring a good serviceability level of road pavements, it is essential to perform preventive maintenance before they are irreparably damaged. Explain the purpose of preventive maintenance and its trigger. Then, list **THREE (3)** examples of preventive maintenance works and explain the processes and materials involved.

Bagi memastikan tahap kebolehkhidmatan jalanraya yang baik, adalah penting untuk menjalankan penyelenggaraan pencegahan sebelum kerosakan itu tidak dapat dirawat. Terangkan tujuan penyelenggaraan pencegahan dan pencetusnya. Kemudian, ilustrasikan ***TIGA (3)*** *contoh kerja penyelenggaraan pencegahan dan terangkan proses yang terlibat.*

[8 marks*/markah*]

APPENDIX 1 / *LAMPIRAN 1*

Volume of Specimen, cm^3	Approximate Thickness of Specimen.		Correlation Ratio
	mm	in	
200 to 213	25.4	1	5.56
214 to 225	27.0	1 1/16	5.00
226 to 237	28.6	1 1/8	4.55
238 to 250	30.2	1 3/16	4.17
251 to 264	31.8	1 1/4	3.85
265 to 276	33.3	1 5/16	3.57
277 to 289	34.9	1 3/8	3.33
290 to 301	36.5	1 7/16	3.03
302 to 316	38.1	1 1/2	2.78
317 to 328	39.7	1 9/16	2.50
329 to 340	41.3	1 5/8	2.27
341 to 353	42.9	1 11/16	2.08
354 to 367	44.4	1 3/4	2.92
368 to 379	46.0	1 13/16	1.79
380 to 392	47.6	1 7/8	1.67
393 to 405	49.2	1 15/16	1.56
406 to 420	50.8	2	1.47
421 to 431	52.4	2 1/16	1.39
432 to 443	54.0	2 1/8	1.32
444 to 456	55.6	2 3/16	1.25
457 to 470	57.2	2 1/4	1.19
471 to 482	58.7	2 5/16	1.14
483 to 495	60.3	2 3/8	1.09
496 to 508	61.9	2 7/16	1.04
509 to 522	63.5	2 1/2	1.00
523 to 535	65.1	2 9/16	0.96
536 to 546	66.7	2 5/8	0.93
547 to 559	68.3	2 11/16	0.89
560 to 573	69.8	2 3/4	0.96
574 to 585	71.4	2 13/16	0.93
586 to 598	73.0	2 7/8	0.81
599 to 610	74.6	2 15/16	0.78
611 to 625	76.2	3	0.76

NOTES:

1. The measured stability of a specimen multiplied by the ratio for the thickness of the specimen equals corrected stability for a 63. 5 mm (2 1/2 -in) specimen.
2. Volume –thickness relationship in based on a specimen diameter of 101.6 mm (4 in.).

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APPENDIX 2/ *LAMPIRAN 2*

Appendix 2.1:Load Equivalence Factor (LEF)

Vehicle		Load Equivalence Factor (LEF)
HPU class designation	**Class**	
Cars and taxis	C	0
Small trucks and vans (2 axles)	CV1	0.1
Large trucks (2 to 4 axles)	CV2	4.0
Articulated trucks (3 or more axles)	CV3	4.4
Buses (2 or 3 axles)	CV4	1.8
Motorcycles	MC	0
Commercial traffic (mixed)	CV%	3.7

Appendix 2.2: Traffic Category

Traffic categories	Design Traffic (ESAL x 10^6)
T1	≤ 1.0
T2	1.1 to 2.0
T3	2.1 to 10.0
T4	10.1 to 30.0
T5	> 30

Appendix 2.3: Classes of Sub-grade Strength (based on CBR)

Sub-grade category	CBR (%)	Elastic Modulus (MPa)	
		Range	**Design Input Value**
SG1	5 to 12	50 to 120	60
SG2	12.1 to 20	80 to 140	120
SG3	20.1 to 30.0	100 to 160	140
SG4	> 30.0	120 to 180	180

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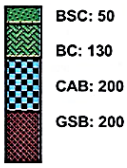
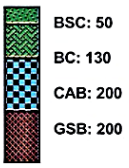
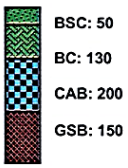
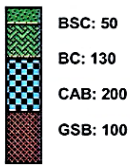
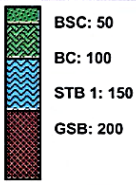
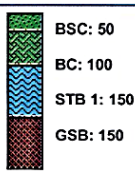
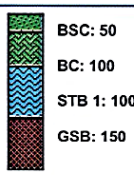
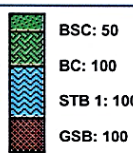
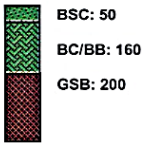
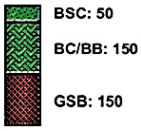
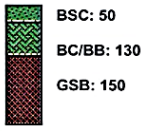
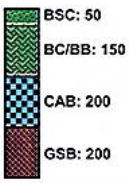
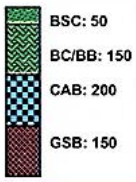
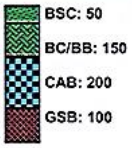
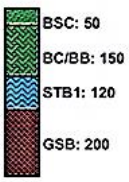
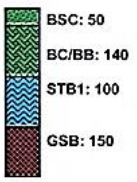
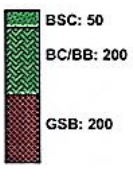
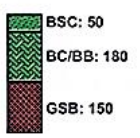
Appendix 2.4: Pavement Structures for Traffic Category T3: 2.0 to 10.0 million ESALs

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				

Appendix 2.5: Pavement Structures for Traffic Category T4: 10.0 to 30.0 million ESALs

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				

...20/-

Appendix 2.6: Pavement Structures for Traffic Category T5: > 30.0 million ESALs

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	BSC: 50 BC/BB: 190 CAB: 200 GSB: 200	BSC: 50 BC/BB: 190 CAB: 200 GSB: 150	BSC: 50 BC/BB: 190 CAB: 200 GSB: 100
Deep Strength: Stabilized Base		BSC: 50 BC/BB: 160 STB1: 150 GSB: 200	BSC: 50 BC/BB: 140 STB1: 150 GSB: 150	BSC: 50 BC/BB: 140 STB 1: 150 GSB: 100
Full Depth: Asphalt Concrete Base		BSC: 50 BC/BB: 210 GSB: 200	BSC: 50 BC/BB: 200 GSB: 150	BSC: 50 BC/BB: 180 GSB: 100

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