First Semester Examination
2017/2018 Academic Session

January 2018

EAL337 – Pavement Engineering
(*Kejuruteraan Turapan*)

Duration: 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of FIFTEEN (15) pages of printed material including appendix before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA BELAS (15) 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). Three Quarries A, B and C, are all able to supply granite aggregates for an asphalt road construction project. The properties of aggregates from each quarry are shown in **Table 1**. The quarries are sited not far from each other. Assuming you as a road contractor is required to lay asphalt on the following projects:

- The bridge deck of a mega project such as the Penang Second Bridge that requires durable and high quality asphalt mixes made of cubical aggregates.
- Paving works for a JKR state road linking Parit Buntar and Tanjong Piandang under constrained budget.
- Paving works that requires aggregates to be highly resistant to abrasive forces during production and construction.

*Tiga buah Kuari A, B dan C, dapat membekalkan agregat granit untuk sebuah projek pembinaan jalan raya asfalt. Ciri agregat ditunjukkan di dalam **Jadual 1**. Ketiga-tiga kuari terletak berhampiran di antara satu sama lain. Andaikan anda seorang kontraktor jalan dikehendaki menurap asfalt untuk projek pembinaan berikut:*

- *Dek jambatan sebuah projek mega seumpama Jambatan Kedua Pulau Pinang yang memerlukan asfalt yang tahan lasak lagi berkualiti baik dan diperbuat daripada agregat berbentuk kubik.*
- *Kerja penurapan untuk jalan negeri dibawah bidang kuasa JKR yang menghubungkan Parit Buntar dan Tanjong Piandang di bawah kekangan bajet.*
- *Kerja penurapan yang memerlukan agregat yang dapat merintangi daya lelasan semasa penghasilan dan pembinaan.*

Table 1/*Jadual 1*

Granite Aggregate Properties/ *Ciri Agregat Granit*	Quarry A/ *Kuari A*	Quarry B/ *Kuari B*	Quarry C/ *Kuari C*
Number of crushed faces/ *Bilangan permukaan terhancur*	All/*semua*	All/*semua*	All/*semua*
Flakiness Index/ *Indeks kekepingan*	8%	25%	23%
Aggregate Crushing Value/ *Nilai agregat terhancur*	11%	29%	35%
Soundness/ *Ketahanan*	2%	6%	20%
Los Angeles Abrasion Value/ *Nilai lelasan Los Angelas*	20	12	69
Polished Stone Value/ *Nilai batu tergilap*	52	53	45
Relative Cost/ (RM/ton) *Kos Relative/ (RM/tan)*	High/ *Tinggi*	Medium/ *Sederhana*	Low/ *Rendah*

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(i). Which quarry is the most appropriate source of aggregate supply to each of the above scenario. Justify your answer.

Untuk setiap senario, kuari manakah yang paling sesuai sebagai sumber agregat. Berikan justifikasi anda.

[6 marks/*markah*]

(ii). During aggregate production and processing, state the type of crusher that was used by each individual Quarry A and B. Justify your answer.

Semasa proses penghasilan agregat, namakan jenis penghancur yang digunakan oleh Kuari A dan B. Berikan justifikasi anda.

[3 marks/*markah*]

(iii). From the aggregate test data, one of the above quarry is producing weathered granite aggregate. Name the quarry and justify your answer.

Daripada data ujian agregat, sebuah daripada kuari tersebut di atas menghasilkan agregat granit terluluhawa. Namakan kuari tersebut dan berikan justifikasi anda.

[2 marks/*markah*]

(b). Pavement surfacings skid resistance depends on texture depth and is important to ensure safe passage of vehicles.

Rintangan kelincir permukaan turapan bergantung kepada kedalaman tekstur dan amat penting untuk menjamin keselamatan lalu lintas.

With the aid of a sketch, show **TWO (2)** sources of texture that contributes to skid resistance. With the aid of a sketch, describe the principles used to measure pavement texture depth using the sand patch method.

*Berbantukan lakaran, tunjukkan **DUA (2)** sumber tekstur yang menyumbang kepada rintangan kelincir. Berbantukan lakaran, terangkan prinsip ujian yang digunakan untuk menyukat kedalaman tekstur menggunakan kaedah tampalan pasir.*

[5 marks/*markah*]

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(i). Explain the effects of the following factors on the value of skid resistance measured in terms of skid resistance value (SRV):

- pavement age
- traffic volume

Terangkan kesan faktor berikut ke atas nilai rintangan kelincir yang disukat di dalam unit nilai rintangan kelincir (SRV):

- *Usia turapan*
- *Isipadu lalu lintas*

[4 marks/*markah*]

2. (a). In Malaysia, one criterion used to classify a bitumen is its softening point. Explain the concept used to determine the softening point of a bitumen in the laboratory.

Di Malaysia, satu kriteria yang digunakan untuk mengklasifikasikan bitumen ialah berdasarkan nilai titik lembutnya. Terangkan konsep yang digunakan untuk menentukan nilai titik lembut bitumen di makmal.

[4 marks/*markah*]

(b). A bitumen sample is delivered to your laboratory from a supplier. You decided to test for its purity. Name the laboratory test that you will conduct and explain its test principles.

Anda menerima satu sampel bitumen di makmal daripada pembekal. Anda membuat keputusan untuk menyukat ketulenan bitumen tersebut. Namakan ujian makmal dan prinsip ujian makmal yang akan anda lakukan.

[4 marks/*markah*]

(c). (i). After several years in service, bitumen aged and alligator cracks start to form along the wheel path. Explain the **FOUR (4)** mechanisms causing bitumen aging or hardening.

*Selepas beberapa tahun dalam perkhidmatan, bitumen terusia dan retak buaya mula muncul disepanjang laluan roda. Terangkan **EMPAT (4)** mekanisme yang menyebabkan bitumen terusia dan mengeras.*

[4 marks/*markah*]

(ii). During which stage in the life of a bitumen that it is subjected to the highest rate of aging or hardening. Explain the causes and severity of aging during that stage.

Dalam kitaran hayat sesuatu bitumen, peringkat manakah yang bahan tersebut terdedah kepada kadar pengusiaan dan pengerasan yang paling tinggi. Terangkan punca dan keamatan pengusiaan pada peringkat tersebut.

[4 marks/*markah*]

(iii). A binder is designated as grade PG64-22. What is the meaning of each alphabet and number in this new bitumen grading system. The penetration of this bitumen in its virgin state is 95 dmm. After 8 years in service, the penetration of its recovered binder is 18 dmm. Calculate its Aging Index.

Gred suatu bahan pengikat ialah PG64-22. Apakah maksud setiap huruf dan nombor di dalam sistem penggredan baru untuk bitumen ini. Nilai penusukan bitumen lazim ialah 95 dmm. Selepas 8 tahun dalam perkhidmatan, penusukan pengikat olehan semula ialah 18 dmm. Kira Indeks Penuaan.

[4 marks/*markah*]

3. (a). The most common asphalt mixture type used on Malaysian roads is asphaltic concrete AC14. In this mix type, explain the function of the coarse aggregate, fine aggregate, filler and bitumen.

Campuran asfalt yang lumrah digunakan di Malaysia ialah konkrit asfalt AC14. Dalam campuran ini, terangkan fungsi agregat kasar, agregat halus, bahan pengisi dan bitumen.

[5 marks/*markah*]

(b). The composition of an asphalt mixture AC14 is shown in **Table 2**. A conventional bitumen grade 60/70 was used as the binder. Aggregates and binder were mixed at 160^{o}C. The resultant compacted mixture data and Marshall stability test results are shown in **Table 3**.

*Komposisi campuran asfalt AC14 ditunjukkan di dalam **Jadual 2**. Bitumen lazim gred 60/70 digunakan sebagai pengikat. Agregat dan bitumen dicampur pada suhu 160^{o}C. Data campuran terpadat dan keputusan ujian kestabilan Marshall ditunjukkan di dalam **Jadual 3***.

Table 2/*Jadual 2*

Material/*Bahan*	Percentage/ *Peratusan* (%)	Specific Gravity/ *Graviti Tentu* (g/cm^3)
Coarse Aggregate/ *Agregat Kasar*	45	2.65
Fine Aggregate/*Agregat Halus*	50	2.68
Filler/*Pengisi*	5	3.01
Bitumen/*Bitumen*	Variety/*Pelbagai*	1.02

Table 3/*Jadual 3*

Bitumen Content/ *Kandungan Bitumen* (%)	Sample Height/ *Ketinggian Sampel* (mm)	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)
4.0	61.7	1173.8	668.2	1175.9	7.1	2.1
5.0	66.8	1213.7	707.1	1217.2	15.3	3
6.0	61.3	1095.1	636.9	1100.2	10.6	4.2

From the results shown in **Tables 2 and 3**, calculate the aggregate and mix specific gravities and plot the following relationships:

- Density versus bitumen content
- Air voids versus bitumen content
- Corrected stability versus bitumen content **(use the Marshall stability coefficients given in the Appendix)**
- Flow versus bitumen content
- Voids filled with bitumen versus bitumen content
- Voids in mineral aggregate versus bitumen content

Choose the relevant relationships to determine the Optimum Bitumen Content (OBC) according to JKR method. **Table 4** shows the limiting values stipulated in the JKR specifications. Tabulate the mix properties at the OBC and compare the results with the JKR specifications. Comment on the mixture conformity to the JKR specifications.

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*Daripada keputusan yang ditunjukkan di dalam **Jadual 2 dan 3**, kira graviti tentu campuran agregat dan campuran, dan plot kehubungan berikut:*

- *Ketumpatan lawan kandungan bitumen*
- *Lompang udara lawan kandungan bitumen*
- *Kestabilan terpinda lawan kandungan bitumen **(guna pekali Marshall yang diberikan di dalam Lampiran)***
- *Aliran lawan kandungan bitumen*
- *Lompang terisi bitumen lawan kandungan bitumen*
- *Lompang dalam agregat mineral lawan kandungan bitumen*

*Pilih kehubungan yang berkaitan untuk menentukan kandungan bitumen optimum (OBC) menurut kaedah JKR. **Jadual 4** menunjukkan had nilai di dalam spesifikasi JKR. Jadualkan ciri campuran pada OBC dan bandingkan keputusan dengan spesifikasi JKR. Nyatakan komen anda tentang pematuhan campuran ini kepada spesifikasi JKR*

Table 4/*Jadual 4*

Property/Ciri	Specification/Spesifikasi
Stability/*Kestabilan*, kN	> 8
Flow/*Aliran*, mm	2 – 4
Stiffness/*Ketegaran*, N/mm	> 2000 N/mm
Air Voids/*Lompang Udara*, %	3 - 5
Voids Filled with Bitumen/*Lompang Terisi Bitumen*, %	70 - 80

[15 marks/*markah*]

4. Malaysian Highway Authority (MHA) is a responsible body to execute the design, construction, regulation, operation and maintenance of interurban highways in Malaysia. As an engineer of MHA, you are appointed to design a road pavement for a 6-lane freeway (concession toll road, 3-lane for one way) with an average daily traffic (two ways) of 9000 vehicles, of which 15% are commercial vehicles with an un-laden weight > 1.5 tons, and the traffic composition is as shown in **Table 5**.

*Lembaga Lebuhraya Malaysia (LLM) adalah sebuah badan yang bertanggungjawab untuk melaksanakan reka bentuk, pembinaan, pengawalan, operasi dan penyelenggaraan lebuhraya antara bandar di Malaysia. Sebagai seorang jurutera LLM, anda dilantik untuk merekabentuk lebuh raya 6 lorong (jalan konsesi bertol, 3 lorong untuk satu arah) dengan trafik harian purata (dua arah) sebanyak 9000 kenderaan, di mana 15% adalah kenderaan perdagangan dengan berat tanpa beban > 1.5 tan, dan komposisi trafik adalah seperti yang ditunjukkan dalam **Jadual 5**.*

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Table 5: Traffic composition
Jadual 5: Komposisi Trafik

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 sambung sendi (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:
Lane distribution factor, L = 0.7
Terrain factor, T = 1.0
Design traffic = 20 years
Total Growth Factor (TGF) = 33.06

Results of subgrade testing are as follows:
Subgrade properties
CBR mean = 142 MPa
CBR standard deviation = 25 MPa
Normal deviate = 1.645

Maklumat tambahan untuk proses rekabentuk seperti yang disenaraikan dibawah:
Faktor pengagihan lorong, L = 0.7
Faktor muka bumi, T = 1.0
Reka bentuk lalu lintas = 20 tahun
Jumlah faktor pertumbuhan (TGF) = 33.06

Keputusan ujian subgred adalah seperti berikut:
Ciri subgred
Purata CBR = 142 MPa
Sisihan piawai CBR = 25 MPa
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,

Tentu dan terangkan struktur turapan yang dipilih,

State all assumptions made.

Nyatakan semua anggapan yang dibuat.

[20 marks/*markah*]

5. (a). In Malaysia, most quarries produce asphalt mixtures via the drum or continuous mixing method. With the aid of a sketch, show the main components and operation method of asphalt mix production using this plant type.

Di Malaysia, kebanyakan kuari menghasilkan campuran asfalt melalui kaedah gelendong atau berterusan. Berbentukan lakaran, tunjukkan komponen utama dan kaedah operasi penghasilan asfalt melalui kaedah ini.

[5 marks/*markah*]

(b). Asphalt pavements must be compacted according to correct procedures to ensure smooth and durable road surfacings. A typical JKR State Road that has been in service for several years, exhibits the following pavement surface distress:

- Slippage of the new surfacings over the old surfacings
- The surface texture and riding quality are poor.
- Some road sections exhibit very short waves, generally less than 0.5 m apart.
- Some road sections are bumpy with short waves generally spaced 0.5 to 1.0 m apart and the layer thickness is not uniform.
- Some road sections exhibit long waves generally greater than 3 m apart.
- Thin bitumen layer was seen on the road surface that can be very slippery during rain.
- From extracted cores, air voids is high and surface tends to fail prematurely under traffic loading.

For each of the situation above, identify the probable sources of construction and materials problems and propose appropriate mitigation measures.

Turapan asfalt mestilah dipadat menurut kaedah yang betul untuk memastikan permukaan yang tidak beralun lagi tahan lasak. Masalah permukaan berikut berlaku ke atas sebuah Jalan Negeri JKR yang telah beroperasi selama beberapa tahun:

- *Kegelinciran lapisan baru di atas lapisan lama.*
- *Tekstur permukaan dan kualiti tunggangan tidak baik.*
- *Terdapat gelombang yang sangat pendek, umumnya jarak kurang daripada 0.5 m, pada sebahagian seksyen jalan raya.*
- *Terdapat gelombang yang pendek, umumnya jarak di antara 0.5 hingga 1.0 m dan tebal lapisan yang tidak sekata pada sebahagian seksyen jalan raya.*
- *Terdapat gelombang panjang, umumnya jarak melebihi 3 m, pada sebahagian seksyen jalan raya.*
- *Kelihatan lapisan nipis bitumen di atas permukaan jalan yang menjadi sangat licin semasa hujan.*
- *Daripada teras yang dikorek, lompang udara agak tinggi dan permukaan gagal sebagai akibat tindakan beban lalu lintas.*

Untuk setiap keadaan di atas, kenal pasti kemungkinan punca masalah pembinaan dan bahan dan cadangan penyelesaian yang sesuai.

[15 marks/*markah*]

6. (a). Driving comfort is greatly influenced by the pavement performance. Explain **TWO (2)** factors that affect the performance of the flexible pavement.

*Keselesaan pemanduan oleh pengguna banyak dipengaruhi oleh prestasi turapan. Terangkan **DUA (2)** faktor yang mempengaruhi prestasi turapan boleh lentur.*

[4 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 results 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.

[8 marks/*markah*]

(c). **Figures 1 (a) to (c)** show different types of failures or distresses on flexible pavements. Based on the Figures, describe the problem with reference to the following.

Rajah 1 (a) hingga (c) *menunjukkan pelbagai jenis kegagalan atau kerosakan yang berlaku ke atas turapan boleh lentur. Berdasarkan rajah tersebut, huraikan permasalahan itu dengan merujuk kepada perkara berikut.*

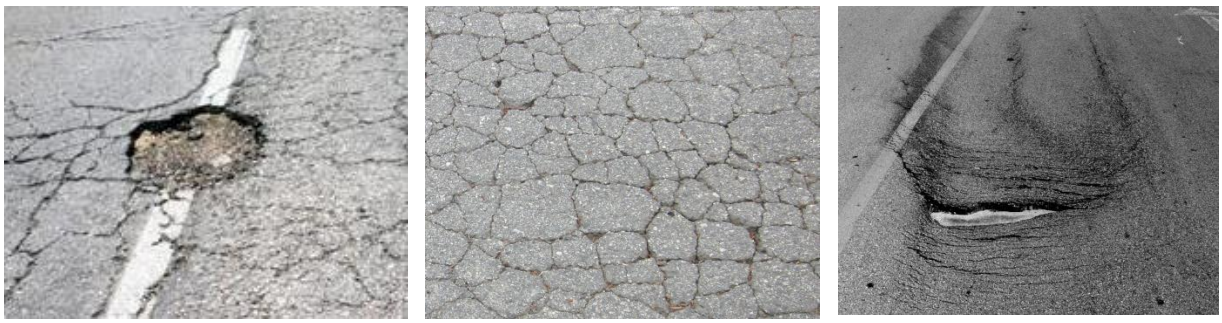
(i). Types of pavement distress

Jenis kerosakan turapan

(ii). Possible causes and suggestions of maintenance approaches

Punca kerosakan dan kaedah penyelenggaran yang dicadangkan

[8 marks/*markah*]



(a) **(b)** **(c)**

Figure 1: Flexible Pavement Distresses
Rajah 1: Kerosakan Turapan Boleh Lentur

APPENDIX /*LAMPIRAN*

Marshall Stability Coefficients

Volume of Specimen (cm^3)	Approximate Thickness of Specimen. mm	in	Correlation Ratio
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	1.92
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	0.86
574 to 585	71.4	2 13/16	0.83
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

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Appendix: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: 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: 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: 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	 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

Appendix: 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	 BSC: 50 BC/BB: 150 CAB: 200 GSB: 200	 BSC: 50 BC/BB: 150 CAB: 200 GSB: 150	 BSC: 50 BC/BB: 150 CAB: 200 GSB: 100
Deep Strength: Stabilised Base		 BSC: 50 BC/BB: 150 STB1: 120 GSB: 200	 BSC: 50 BC/BB: 140 STB1: 100 GSB: 150	 BSC: 50 BC/BB: 130 STB1: 100 GSB: 100
Full Depth: Asphalt Concrete Base		 BSC: 50 BC/BB: 200 GSB: 200	 BSC: 50 BC/BB: 180 GSB: 150	 BSC: 50 BC/BB: 150 GSB: 100

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Appendix: 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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