SULIT

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

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

**SESI I : 2022/2023**

# DCC30103: HIGHWAY AND TRAFFIC ENGINEERING

**TARIKH : 15 DISEMBER 2022**
**MASA : 02.30 PETANG - 04.30 PETANG (2 JAM)**

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Kertas ini mengandungi **LAPAN (8)** halaman bercetak.

Bahagian A: Struktur (2 soalan)
Bahagian B: Esei (4 soalan)

Dokumen sokongan yang disertakan : Buku Rumus

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**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)** structured questions. Answer **ALL** questions.

***ARAHAN :***

*Bahagian ini mengandungi **DUA (2)** soalan berstruktur. Jawab **SEMUA** soalan.*

**QUESTION 1**

***SOALAN 1***

CLO2
C4

(a) Road maintenance is a continuous process that involves keeping and repairing the existing road. Road maintenance is to control the rate of damage and to ensure the safety towards the road users or the public. Explain the types of highway maintenance in Malaysia.

*Penyenggaraan jalan ialah kerja-kerja berterusan yang seperti menjaga dan memperelokkan jalan serta bahagian-bahagian jalan yang telah siap dibina. Penyenggaraan jalan raya adalah untuk mengawal kadar kerosakkan jalan dan memastikan ia selamat untuk digunakan oleh penguna jalan raya. Terangkan jenis-jenis penyenggaraan jalan raya di Malaysia.*

[10 marks]

[*10 markah*]

CLO2
C5

(b) Design a road pavement for a 2 – lane highway with an average daily traffic of 3000 vehicles for both directions (24-hour period), 18% are from commercial vehicle with an un-laden weight > 1.5 tons.

By using the JKR 5/85 amendment 2013 method. Determine the Design Traffic (First Year of Design Period), Design Traffic (Traffic Category) and Sub-Grade Strength (Sub-Grade Category).

Use the data given in Table A1(b

*Rekabentuk ketebalan turapan untuk lebuh raya 2 lorong dengan purata trafik harian 3000 kenderaan untuk kedua – dua arah (dalam tempoh 24 jam), 18% daripadanya adalah kenderaan pedagangan dengan berat tanpa muatan > 1.5 tan.*

*Dengan mengunakan kaedah JKR ATJ 5/85 pindaan 2013. Tentukan Rekabentuk lalulintas (Jangkamasa rekabentuk pada tahun pertama), Rekabentuk lalulintas (Kategori lalulintas) dan Kekuatan Sub-gred (Kategori Sub-gred).*

*Gunakan maklumat yang diberikan dalam Jadual A1(b).*

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

| | |
|---|---|
| Lane Distribution factors, L / *Faktor agihan lorong, L* | 1 lane per direction / *1 lorong dalam satu arah* |
| Terrain factor, T/ *Faktor muka bumi, T* | Rolling / *Guling* |
| Design life, n / *Hayat rekabentuk, n* | 20 years / *tahun* |
| Annual traffic growth, r / *Pertumbuhan Lalulintas Tahunan, r* | 4% |
| Mean Modulus / *Purata Modulus* | 170 MPa, |
| Standard Deviation / *Sisihan Piawai* | 28 MPa |
| 95% Reliability (Normal Deviate) / *95% kebolehpercayaan (Sisihan Normal)* | 1.645 |
| Pavement Type / *Jenis Turapan* | Conventional Flexible : Ganular Base. / *Turapan Lentur Konvensional :Asas Granular* |

[15 marks]

[*15 markah*]

**QUESTION 2**

***SOALAN 2***

CLO2 C4 (a) Traffic management is an organisation that arrange, guide and control the moving traffic, including pedestrians, cyclists and all types of vehicles. Explain the purpose of traffic management.

*Pengurusan lalulintas ialah organisasi, susunan, panduan dan kawalan kepada pergerakan lalulintas termasuklah pejalan kaki, penunggang basikal dan semua jenis kenderaan. Terangkan tujuan pengurusan lalulintas.*

[10 marks]

[*10 markah*]

CLO2 C5 (b) A fixed time 2 -phased signal should be provided at Four-legs intersection. The traffic flow and saturation flow are as in Table A2(b). The lost time per phase due to starting delays in 2 seconds and the intergreen interval is 8 seconds. Assume Amber time = 3 seconds. Estimate the time phase diagram for each phase.

*Lampu isyarat 2 fasa hendaklah disediakan di satu simpang empat. Aliran bagi lalulintas dan aliran tepu adalah seperti Jadual A2(b). Masa hilang setiap fasa yang disebabkan oleh kelengahan permulaan adalah 2 saat dan masa antara hijau 8 saat. Andaikan masa kuning ialah 3 saat. Kirakan masa setiap fasa mengunakan rajah.*

***Table A2(b)/ Jadual A2(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 | 320 | 250 |

[15 marks]

[*15 markah*]

**SECTION B: 50 MARKS**

***BAHAGIAN B: 50 MARKAH***

**INSTRUCTION:**

This section consists of **FOUR (4)** essay questions. Answer **TWO (2)** questions only.

***ARAHAN:***

*Bahagian ini mengandungi **EMPAT (4)** soalan esei. Jawab **DUA (2)** soalan sahaja.*

**QUESTION 1**

***SOALAN 1***

CLO1
C2

(a) Explain **FIVE (5)** the importance of law enforcement act related to roads and road laws.

*Jelaskan **LIMA (5)** kepentingan penguatkuasaan undang-undang dan akta jalanraya diadakan.*

[10 marks]

[*10 markah*]

CLO1
C3

(b) The total load of truck is 280kN and it is distributed through three axles. Based on the Figure B1(b), find out the equivalent load factor **IF** all loads are borne by single axle.

*Beban keseluruhan trak adalah 280kN dan ia diedarkan melalui tiga gandar. Berdasarkan Rajah B1(b), carikan faktor beban setara **JIKA** semua beban ditanggung oleh gandar tunggal.*


Figure B1(b) / *Rajah B1(b)*

[5 marks]

[*5 markah*]

CLO1 C3

(c) Traffic control devices are divided into three major groups. Identify each function with an example for all the following group.

*Peranti kawalan trafik terbahagi kepada tiga kumpulan utama. Kenalpasti setiap fungsi beserta contoh untuk setiap kumpulan tersebut.*

[10 marks]

[*10 markah*]

**QUESTION 2**

***SOALAN 2***

CLO1 C2

(a) Aggregate, fillers, bitumen, cement and steel reinforcement are the materials used in highway construction. These materials need to be tested before being able to be used in construction.

Recognize **FIVE (5)** types of tests with the objectives of each test for aggregate or bitumen.

*Agregat, pengisi, bitumen, simen dan tetulang keluli adalah bahan yang digunakan dalam pembinaan lebuh raya. Bahan-bahan ini perlu diuji sebelum dapat digunakan dalam pembinaan.*

*Kenalpasti **LIMA (5)** jenis ujian beserta objektif ujian untuk agregat atau bitumen.*

[10 marks]

[*10 markah*]

CLO1 C3

(b) Identify **FIVE (5)** important properties of aggregate.

*Kenalpasti **LIMA (5)** ciri-ciri penting untuk agregat.*

[5 marks]

[*5 markah*]

CLO1 C3

(c) An asphalt concrete mixture must be designed, produced and placed in order to obtain the desirable mixture compound. Select characteristics of asphaltic concrete mixture.

*Campuran konkrit asfalt mesti direkabentuk, dihasilkan mengikut turutan untuk mendapatkan hasil campuran yang baik. Kenalpasti ciri-ciri untuk campuran konkrit asphalt.*

[10 marks]

[*10 markah*]

**QUESTION 3**

***SOALAN 3***

CLO1 C2

(a) Describe every layer of flexible pavement with suitable diagram.

*Terangkan setiap lapisan jalan turapan lentur mengunakan rajah yang sesuai.*

[10 marks]

[*10 markah*]

CLO1 C3

(b) Explain the functions of prime coats during road construction of flexible pavement.

*Terangkan fungsi salut perdana semasa kerja-kerja pembinaan turapan lentur.*

[5 marks]

[*5 markah*]

CLO1 C3

(c) Explain the process of construction for road surface for flexible pavement.

*Terangkan proses pembinaan permukaan jalan bagi turapan lentur*

[10 marks]

[*10 markah*]

**QUESTION 4**

***SOALAN 4***

CLO1 C2 (a) Explain **THREE (3)** types of rigid pavement.

*Jelaskan **TIGA (3)** jenis-jenis turapan tegar.*

[10 marks]

[*10 markah*]

CLO1 C3 (b) Write down the advantage of Rigid Pavement.

*Tuliskan kelebihan turapan tegar.*

[5 marks]

[*5 markah*]

CLO1 C3 (c) Determine the methods of rigid pavement between manual and mechanical.

*Tentukan kaedah turapan tegar antara manual dan mekanikal.*

[10 marks]

[*10 markah*]

Notes

Assessment items for this course have covered elements of the Dublin Problem: DP1, DP2 and DP3 as mention in FEIST.

**SOALAN TAMAT**

# BUKU RUMUS DCC30103

## DESIGN JUNCTION

**S = 525W or S = 160W**

**L = Total Lost time + [Total (inter green-yellow)]**

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

**y = Q/S**

$$g\ phase = (Co - L)\frac{(y\ phase)}{Y}$$

**G phase = g phase + loss time – yellow time**

## FLEXIBLE PAVEMENT DESIGN

1. From traffic counts for the project under consideration (information provided by **HPU** for the past 5 or more years), determine: -

   a. Initial **Average Daily Traffic in one direction (ADT);** the average should be based on a minimum of 3 days, 24 hours per day. If traffic count covers a time period of 06:00 to 22:00 hours, multiply the traffic count reported by HPU with a factor of 1.2.

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

$$ESAL_{Y1} = [ADT_{vc1} \times LEF_1 + ADT_{vc2} \times LEF_2 + \ldots + ADT_{vc4} \times LEF_4] \times 365 \times L \times T$$

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

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

**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** |

**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 |

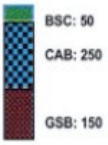
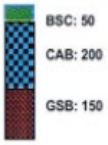
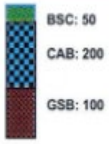
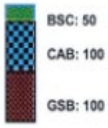
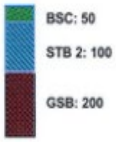
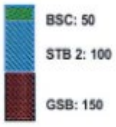
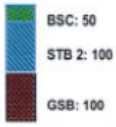
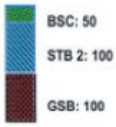
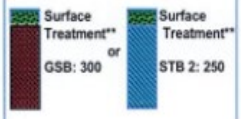
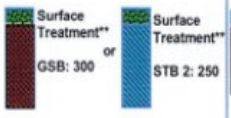
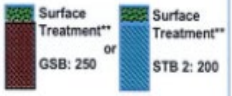
**TABLE 2.5: Traffic Categories used in this Manual (ESAL = 80 kN)**

| 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)

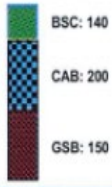
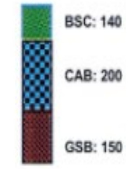
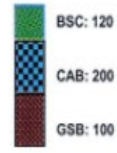
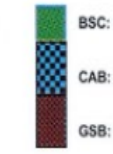
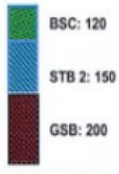
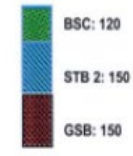
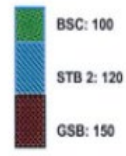
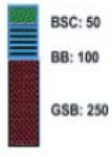
| Pavement Type | Sub-Grade Category | | | |
|---|---|---|---|---|
| | SG 1: CBR 5 to 12 | SG 2: CBR 12.1 to 20 | SG 3: CBR 20.1 to 30 | SG 4: CBR > 30 |
| Conventional Flexible: Granular Base |  |  |  |  |
| Deep Strength: Stabilised Base |  |  |  |  |
| Full Depth: Asphalt Concrete Base |  |  |  |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

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

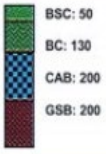
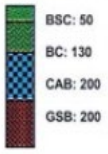
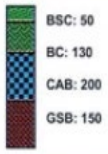
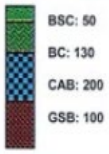
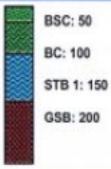
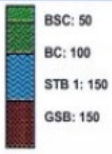
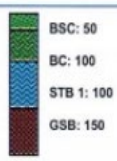
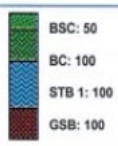
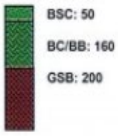
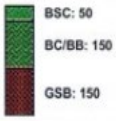
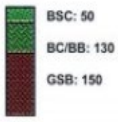
| Pavement Type | Sub-Grade Category | | | |
|---|---|---|---|---|
| | SG 1: CBR 5 to 12 | SG 2: CBR 12.1 to 20 | SG 3: CBR 20.1 to 30 | SG 4: CBR > 30 |
| Conventional Flexible: Granular Base |  |  |  |  |
| Deep Strength: Stabilised Base |  |  |  |  |
| Full Depth: Asphalt Concrete Base |  |  |  |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

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

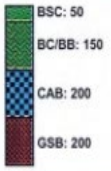
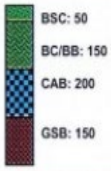
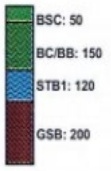
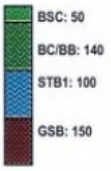
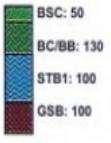
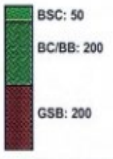
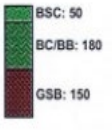
| Pavement Type | Sub-Grade Category | | | |
|---|---|---|---|---|
| | SG 1: CBR 5 to 12 | SG 2: CBR 12.1 to 20 | SG 3: CBR 20.1 to 30 | SG 4: CBR > 30 |
| Conventional Flexible: Granular Base |  |  |  |  |
| Deep Strength: Stabilised Base | |  |  |  |
| Full Depth: Asphalt Concrete Base | |  |  |  |

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

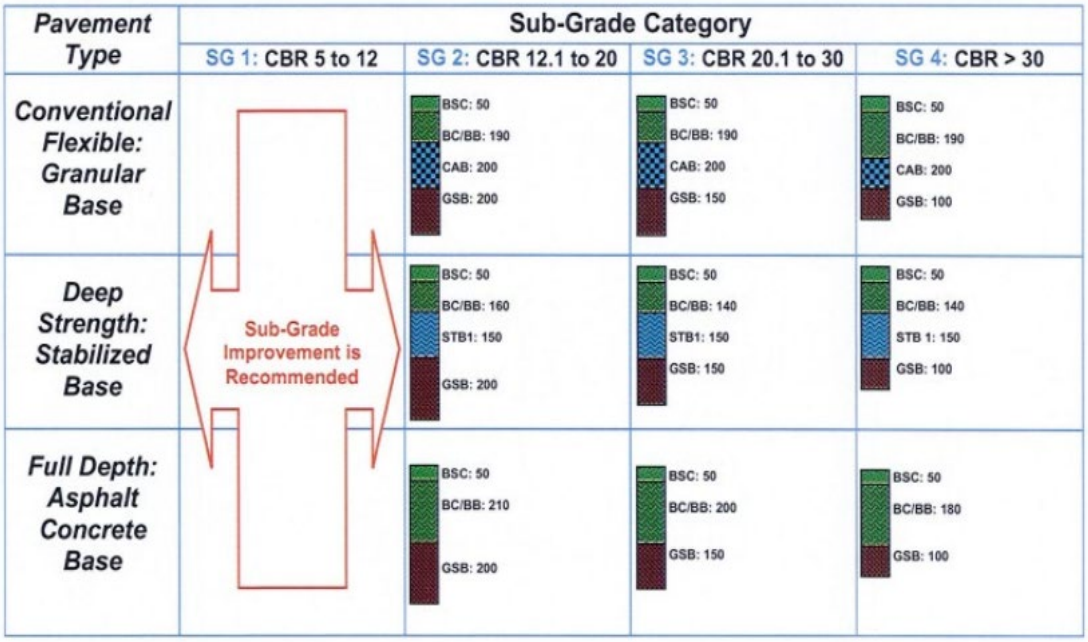



FIGURE 3.6: Pavement Structures for Traffic Category T 5: > 30.0 million ESALs (80 kN)

(Use of Polymer Modified Asphalt)