PEPERIKSAAN AKHIR

SES  JUN 2013

CC302: HIGHWAY ENGINEERING

TARIKH  : 31 OKTOBER 2013
TEMPOH  : 2 JAM (11.15 AM - 1.15 PM)

Kertas ini mengandungi SEPULUH (10) halaman bercetak.
Bahagian A: Struktur (10 soalan)
Bahagian B: Esei (4 soalan)
Dokumen sokongan yang disertakan : Tiada

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT
SECTION A: 40 MARKS

BAHAGIAN A: 40 MARKAH

INSTRUCTION:
This section consists of TEN (10) short questions. Answer ALL questions.

ARAHAN:
Bahagian ini mengandungi SEPULUH (10) soalan pendek. Jawab semua soalan.

QUESTION 1

SOALAN 1

State FOUR (4) profession that are involved in construction of roads and highway engineering.

Nyatakan EMPAT (4) profesi yang terlibat dalam kejuruteraan pembinaan jalan raya.

[4 marks]

[4 markah]

QUESTION 2

SOALAN 2

Explain TWO (2) differences between toll highway and federal road in Malaysia.

Terangkan DUA (2) perbezaan di antara lebuhraya bertol dan jalan persekutuan di Malaysia.

[4 marks]

[4 markah]
QUESTION 3

State FOUR (4) earthwork process in highway construction

Nyatakan EMPAT (4) proses kerja-kerja tanah dalam pembinaan jalan raya.

[4 marks]
[4 markah]

QUESTION 4

State FOUR (4) methods for the construction of road base course in flexible pavement.

Nyatakan EMPAT (4) kaedah pembinaan lapisan tapak jalan bagi turapan lentur.

- Small base
- Caked base
- Seed base

[4 marks]
[4 markah]

QUESTION 5

There are a few types of rigid pavement, list FOUR (4) types of rigid pavement.

Turapan tegar terdiri daripada beberapa jenis, Senaraikan EMPAT (4) jenis turapan tegar.

[4 marks]
[4 markah]
QUESTION 6  
SOALAN 6

Describe TWO (2) comparisons between sub-surface drainage and surface drainage.

_Huraikan DUA (2) perbandingan antara saliran sub-permukaan dan saliran permukaan._  
[4 marks]  
[4 markah]

QUESTION 7  
SOALAN 7

Sketch with the aid of a diagram the process seepage through high ground enters into a pavement structure and sub grade.

_Lakarkan rajah, proses penyerapan air dari kawasan tanah tinggi ke dalam struktur turapan dan lapisan subgred._  
[4 marks]  
[4 markah]

QUESTION 8  
SOALAN 8

State an example of traffic control equipment for the following traffic control equipment category:

i. Prohibition Sign

ii. Warning Sign

iii. Guidance Sign

iv. Road Marking
Berikan contoh peranti kawalan trafik bagi setiap kategori peranti kawalan trafik berikut:

i. Papan Tanda Larangan

ii. Papan Tanda Amaran

iii. Papan Tanda Makluman

iv. Penandaan Pada Permukaan Jalan

[4 marks]

[4 markah]

QUESTION 9

SOALAN 9

A road with hierarchy of 05 has a surface width of 7.0 m. It has an initial average daily traffic of 7000cv/day in both directions. The rate of traffic growth is 7%.

Percentage of commercial vehicle is 25%. Design life of flexible pavement is 10 years. The CBR for sub-grade of the road is 5%. Calculate:

i) Annual commercial traffic for one way, \( V_o \).

ii) Cumulative commercial traffic for the design period, \( V_c \).

Sebuah jalan berhierarki 05 mempunyai lebar permukaan 7.0 m. Purata harian trafik permulaan adalah 7000 penumpang/hari bagi kedua-dua arah. Kadar pertumbuhan trafik ialah 7%.

Manakala peratus kenderaan perdagangan ialah 25%. Hayat rekabentuk bagi turapan lentur ialah 10 tahun. Nilai CBR bagi subgred jalan ialah 5%. Tentukan:
i) Tahunan lalulintas perdagangan bagi satu laluan, \( V_o \).

ii) Komulatif lalulintas perdagangan bagi tahun rekabentuk \( V_c \).

[4 marks]

QUESTION 10

SOALAN 10

Road maintenance is a continuous process that involves keeping and repairing of the existing road. Describe TWO (2) purposes on road maintenance.

Penyenggaraan jalan raya merupakan satu proses berterusan yang melibatkan menjaga membaiki jalan sedia ada. Jelaskan DUA (2) tujuan penyenggaraan jalan.

[4 marks]
a) Explain and sketch the structure of the main road according to the following layers:

i) Sub-grade soil
ii) Sub-base
iii) Road Base
iv) Surface layer

Terangkan dan lakarkan struktur jalan utama mengikut lapisan turapan seperti dibawah:

i) Tanah sub-gred
ii) Sub-asas
iii) Lapisan Asas
iv) Lapisan Permukaan

[10 marks]

b) From your observation, identify the types of pavement that commonly constructed in Malaysia?

Discuss the finding to support your opinion.

Daripada pemerhatian anda, kenaplaki jeni-jenis pembinaan turapan di Malaysia.

Bincangkan dapatan tersebut bagi menyokong pendapat anda

[10 marks]
Rigid pavement roads are very high standard. They are costliest among all other types of road. They are called rigid pavements because they do not allow any flexibility. Explain with the aid of a label structure diagram for **FOUR (4)** types of rigid pavement.

*Turapan tegar mempunyai kualiti yang tinggi. Ini sangat mahal berbanding jenis jalan yang lain. Ini dipanggil turapan tegar kerana ia tidak berlaku sebarang lenturan. Terangkan berserta gambarajah struktur berlebel **EMPAT (4)** jenis turapan tegar.*

[20 marks]

[20 markah]
QUESTION 4

SOALAN 4

Road maintenance is a continuous process that involves keeping and repairing the existing road. It is carried out to control the rate of damage and to ensure the safety towards the road users or the public.

Explain the rehabilitation techniques that are listed as below:

i. Restoration
ii. Resurfacing
iii. Recycling
iv. Reconstruction

Penyenggaraan jalanraya merupakan proses berterusan yang melibatkan penjagaan dan pembaikan jalan sediada. Ia dijalankan bagi mengawal kerosakan dan memastikan keselamatan berterusan terhadap pengguna jalan atau orang awam.

Terangkan teknik pemulihan yang disenaraikan dibawah:

i. Penstoran semula.
ii. Penurapan semula
iii. Kitar semula
iv. Pembinaan semula

[20 marks]
[20 markah]

SOALAN TAMAT
PAVEMENT DESIGN FORMULA

Table 3.1  Guide for Equivalence Factor

<table>
<thead>
<tr>
<th>Percentage of selected heavy goods vehicles*</th>
<th>0-15%</th>
<th>16-50%</th>
<th>51-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of road Equivalence Factor</td>
<td>local</td>
<td>trunk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.7</td>
</tr>
</tbody>
</table>

Table 3.2  Maximum Hourly Capacity under ideal conditions

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Passenger Vehicle Units per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilane</td>
<td>2000 per lane</td>
</tr>
<tr>
<td>Two lanes (bothways)</td>
<td>2000 total for bothways</td>
</tr>
<tr>
<td>Three lanes (bothways)</td>
<td>4000 total for bothways</td>
</tr>
</tbody>
</table>

Table 3.3  Carriageway Roadway Reduction Factor

<table>
<thead>
<tr>
<th>Carriageway Width</th>
<th>Shoulder Width</th>
<th>2.00m</th>
<th>1.50m</th>
<th>1.25m</th>
<th>1.00m</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5m</td>
<td></td>
<td>1.00</td>
<td>0.97</td>
<td>0.94</td>
<td>0.90</td>
</tr>
<tr>
<td>7.0m</td>
<td></td>
<td>0.88</td>
<td>0.86</td>
<td>0.83</td>
<td>0.79</td>
</tr>
<tr>
<td>6.0m</td>
<td></td>
<td>0.81</td>
<td>0.78</td>
<td>0.76</td>
<td>0.73</td>
</tr>
<tr>
<td>5.0m</td>
<td></td>
<td>0.72</td>
<td>0.70</td>
<td>0.67</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Table 3.4  Traffic Reduction Factor

<table>
<thead>
<tr>
<th>Type of Terrain</th>
<th>Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>$T = 100/(100+Pc)$</td>
</tr>
<tr>
<td>Rolling</td>
<td>$T = 100/(100+2Pc)$</td>
</tr>
<tr>
<td>Mountainous</td>
<td>$T = 100/(100+5Pc)$</td>
</tr>
</tbody>
</table>

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH
### Table 3.5 Structural Layer Coefficients

<table>
<thead>
<tr>
<th>Component</th>
<th>Type of Layer</th>
<th>Property</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing and Binder Course</td>
<td>Asphalt Concrete</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Dense Bituminous</td>
<td>Stability ≥ 400 kg</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>Macadam</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type 2: Stability</td>
<td>Stability ≥ 300 kg</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Course</td>
<td>Cement Stabilized</td>
<td>Unconfined Compressive strength (7 days)</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30–40 kg/cm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanically</td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>Stabilized crushed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sand, laterite etc.</td>
<td></td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subbase</td>
<td>Crushed aggregate</td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cement Stabilized</td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3.6 Minimum Layer Thickness

<table>
<thead>
<tr>
<th>Type of layer</th>
<th>Minimum thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing Course</td>
<td>4 cm</td>
</tr>
<tr>
<td>Binder Course</td>
<td>5 cm</td>
</tr>
<tr>
<td>Base Course</td>
<td></td>
</tr>
<tr>
<td>Bituminous</td>
<td>5 cm</td>
</tr>
<tr>
<td>Wet Mix</td>
<td>10 cm</td>
</tr>
<tr>
<td>Cement treated</td>
<td>10 cm</td>
</tr>
<tr>
<td>Subbase Course</td>
<td></td>
</tr>
<tr>
<td>Granular</td>
<td>10 cm</td>
</tr>
<tr>
<td>Cement treated</td>
<td>15 cm</td>
</tr>
</tbody>
</table>

### Table 3.7 Standard & Construction Layer Thickness

<table>
<thead>
<tr>
<th>Type of layer</th>
<th>Standard thickness</th>
<th>One layer lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing course</td>
<td>4–5 cm</td>
<td>4–5 cm</td>
</tr>
<tr>
<td>Binder course</td>
<td>5–10 cm</td>
<td>5–10 cm</td>
</tr>
<tr>
<td>Base Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bituminous</td>
<td>5–20 cm</td>
<td>5–15 cm</td>
</tr>
<tr>
<td>Wet mix</td>
<td>10–20 cm</td>
<td>10–15 cm</td>
</tr>
<tr>
<td>Cement treated</td>
<td>10–20 cm</td>
<td>10–20 cm</td>
</tr>
<tr>
<td>Subbase Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granular</td>
<td>10–30 cm</td>
<td>10–20 cm</td>
</tr>
<tr>
<td>Cement treated</td>
<td>15–20 cm</td>
<td>10–20 cm</td>
</tr>
</tbody>
</table>

### Table 3.8 Minimum thickness of Bituminous Layer

<table>
<thead>
<tr>
<th>$T_A$</th>
<th>Total thickness of bituminous layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 17.5 cm</td>
<td>5.0 cm</td>
</tr>
<tr>
<td>17.5 – 22.5 cm</td>
<td>10.0 cm</td>
</tr>
<tr>
<td>23.0 – 29.5 cm</td>
<td>15.0 cm</td>
</tr>
<tr>
<td>&gt; 30.0 cm</td>
<td>17.5 cm</td>
</tr>
</tbody>
</table>
THICKNESS DESIGN NOMOGRAPH

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH