
UNIVERSITI SAINS MALAYSIA

KSCP EXAMINATION
Academic Session 2007/2008

June 2008

EAS 253/3 – Theory Of Structures
[Teori Struktur]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **NINE** (9) printed pages before you begin the examination.

*[Sila pastikan kertas peperiksaan ini mengandungi **SEMBILAN** (9) muka surat bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper consists of **SIX** (6) questions. Answer **FIVE** (5) questions only. All questions carry the same marks.

*[**Arahan:** Kertas ini mengandungi **ENAM**(6) soalan. Jawab **LIMA** (5) soalan sahaja. Semua soalan membawa jumlah markah yang sama.]*

You may answer the question either in Bahasa Malaysia or English.

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

All questions **MUST BE** answered on a new page.

*[Semua soalan **MESTILAH** dijawab pada muka surat baru.]*

Write the answered question numbers on the cover sheet of the answer script.

[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

1. (a) For the structures shown in Figure 1(i) and (ii) below, check the corresponding statical determinacy.

Semak kebolehtentuan statik untuk struktur yang ditunjukkan dalam Rajah 1(i) dan (ii).

[4 marks / markah]

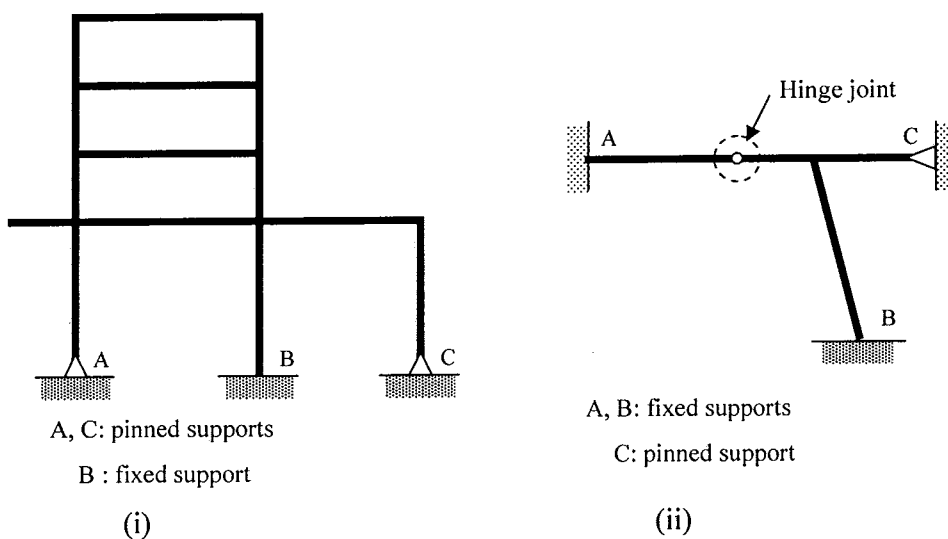


Figure / Rajah 1

- (b) Figure 2 shows a cantilever frame subjected to a horizontal load of 50kN at point B and a uniformly distributed load of 15kN/m along member BC. The distributed load is acting in direction perpendicular to the axis of member BC. Point A is fixed. Draw the shear force and bending moment diagrams for the frame. Sketch also the qualitative deflected shape.

Rajah 2 menunjukkan satu struktur kerangka. Satu beban ufuk tertumpu 50kN bertindak pada titik B manakala satu beban teragih seragam 15kN/m bertindak di sepanjang anggota BC. Arah tindakan beban teragih seragam adalah bersudut tepat kepada paksi anggota BC. Titik A adalah penyokong tegar. Lukiskan gambarajah daya ricih dan momen lentur untuk kerangka berkenaan. Lakarkan juga bentuk terpesong kualitatif.

[16 marks / markah]

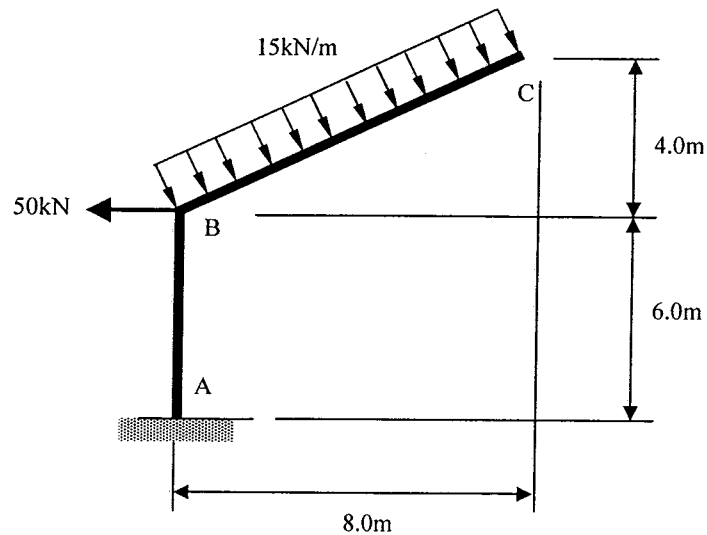


Figure / Rajah 2

2. The beam shown in Figure 3 is subjected to two concentrated loads of 100kN and 50kN at B and D, respectively. Determine the slope and vertical displacement at point B and D of the beam using the **conjugate-beam method** and assume the modulus of elasticity of the beam as 200GPa. The beam has a moment of inertia $210 \times 10^6 \text{ mm}^4$.

Rasuk yang ditunjukkan dalam Rajah 3 menanggung dua beban tertumpu 100kN dan 50kN iaitu masing-masing di B dan D. Tentukan cerun dan anjakan pugak di B dan D rasuk tersebut dengan menggunakan kaedah rasuk-konjugat dan anggap modulus keanjalan rasuk sebagai 200GPa. Rasuk tersebut mempunyai momen inersia $210 \times 10^6 \text{ mm}^4$.

[20 marks / markah]

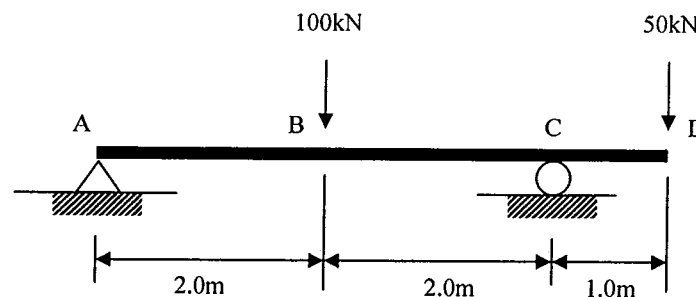


Figure / Rajah 3

3. (a) Figure 4(a) shows four plane trusses. Check for the statical determinacy of the trusses.

Rajah 4(a) menunjukkan empat kekuda satah. Semak kebolehtentuan statik kekuda berkenaan.

[4 marks / markah]

- (b) Figure 4(b) shows a plane trusses with pinned supports at A and E. Find the reactions at supports A and E.

Rajah 4(b) menunjukkan satu kekuda satah yang dicemat di penyokong A dan E. Kira nilai daya tindakbalas di penyokong A dan E.

[6 marks / markah]

- (c) Determine forces in member BD, CD and CE for the truss shown in Figure 4(b) by using section method and classify whether they are in tension or compression.

Kira daya dalam anggota BD, CD, dan CE bagi kekuda dalam Rajah 4(b) menggunakan kaedah keratan. Nyatakan sama ada anggota tersebut mengalami daya mampatan atau tegangan.

[6 marks / markah]

- (d) Determine forces in member AB and AC for the truss shown in Figure 4(b) by using joint method. Classify whether they are in tension or compression.

Kira daya bagi anggota AB dan AC menggunakan kaedah sambungan. Nyatakan samada anggota tersebut mengalami daya mampatan atau tegangan.

[4 marks / markah]

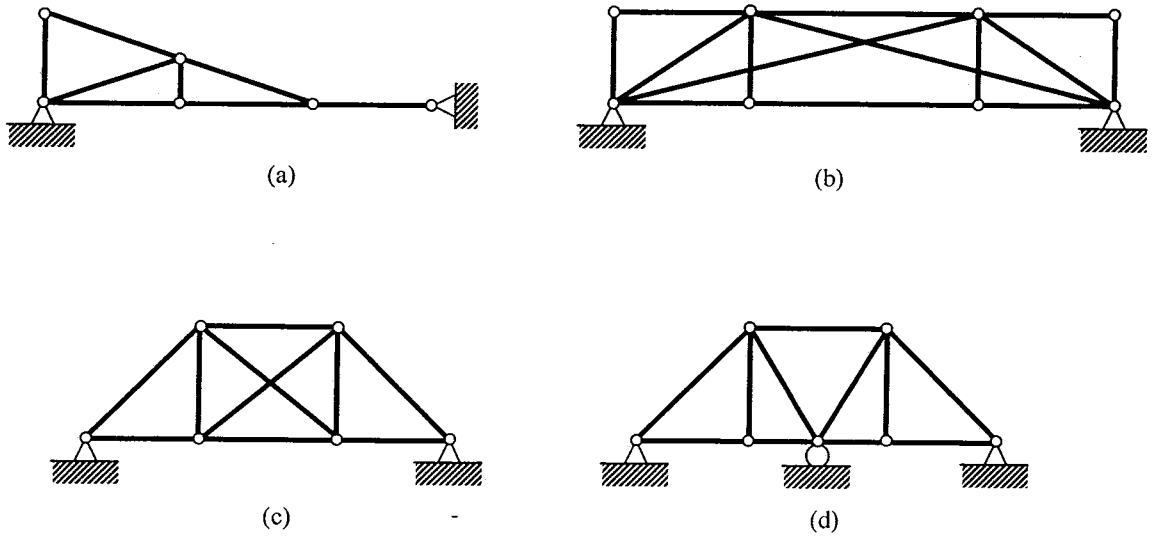


Figure /Rajah 4(a)

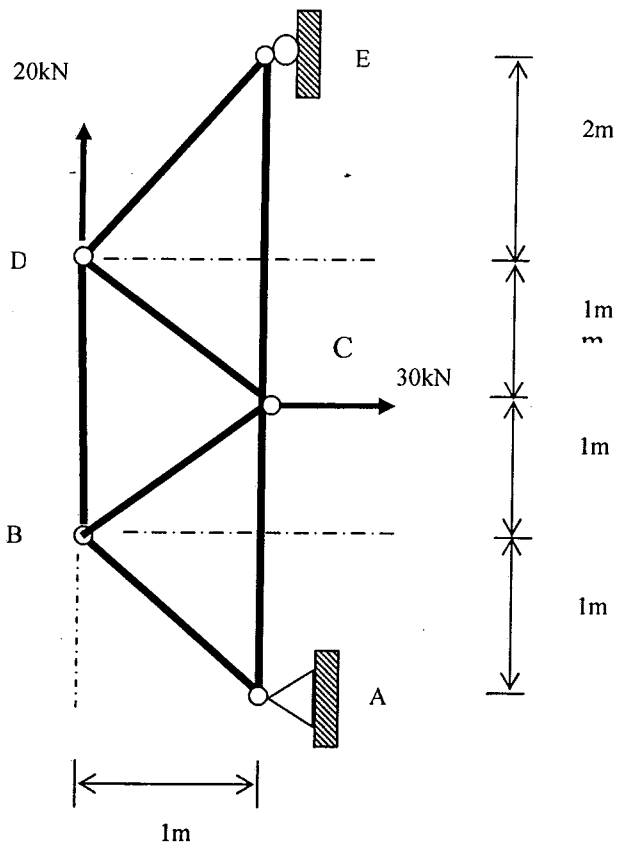


Figure /Rajah 4(b)

4. Describe briefly **TWO (2)** characteristics of cables.

Jelaskan dengan ringkas **DUA (2)** ciri kabel.

[2 marks / markah]

(a) A symmetrical cable system shown in Figure 5 carries **TWO (2)** point loads of 30kN and a uniformly distributed load of 5kN/m between the supports A and B with a span of 40m. Determine:

- (i) The lowest point of the cable from support A and support reactions.
- (ii) The maximum and minimum tension between A and B (T_{min} and T_{max}).
- (iii) The tension in anchor cables (T_A' and T_B'), vertical and horizontal reactions at supports (R_{VA} , R_{HA} and R_{VB} , R_{HB}).
- (iv) The allowable stress of the cable if the diameter of the circular cable is 0.1m.

Satu sistem kabel simetri seperti yang ditunjukkan dalam Rajah 5, menanggung beban teragih seragam sebanyak 5kN/m dan **DUA (2)** beban tumpu 30kN di sepanjang rentang antara kedua-dua penyokong A dan B yang berjarak 40m antara satu sama lain. Kira:

- (i) Kedudukan terendah kabel dari penyokong A dan tindakbalas di penyokong.
- (ii) Nilai tegangan maksima dan minima kabel antara penyokong A dan B (T_{min} dan T_{max}).
- (iii) Tegangan kabel sauh (T_A' dan T_B'), tindakbalas menegak dan mengufuk di penyokong (R_{VA} , R_{HA} dan R_{VB} , R_{HB}).
- (iv) Tegangan kabel tersebut sekiranya garis pusat kabel bulat adalah 0.1m.

[18 marks / markah]

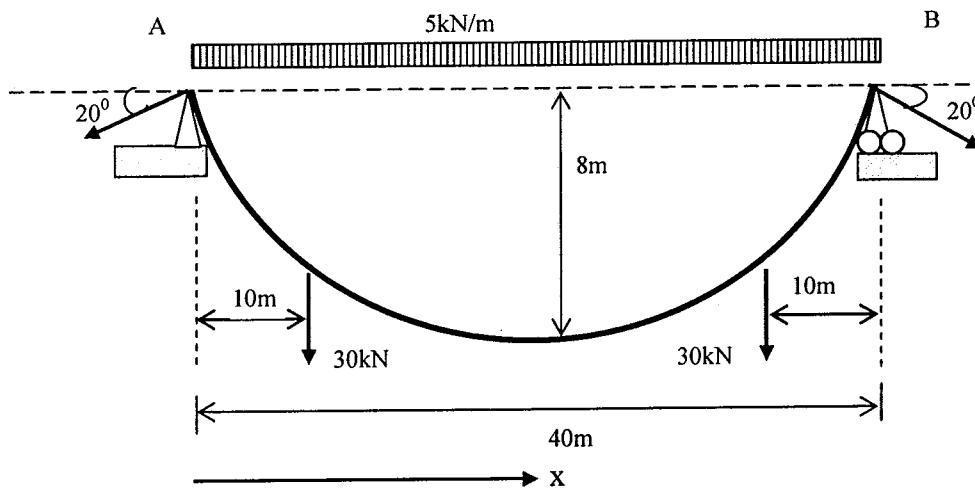


Figure / Rajah 5

5. (a) What is the main different between the arch structures and the cable structures?
Apakah perbezaan utama antara struktur gerbang dan struktur kabel?

[2 marks / markah]

- (b) Unsymmetrical three pinned arch shown in Figure 6 is in the form of $y = \frac{4hx(L-x)}{L^2}$, where $L = 40$ m and $h = 8$ m. Support A is 2.88m lower than support F. It is designed to carry a uniformly distributed load of 5kN/m spanning 26m on span CDEF and two point loads of 20kN and 10kN at point B and E, respectively. Joint A, D and F are hinged.

Determine:

- (i) Support reactions at A and F.
- (ii) Bending moment at B and D.
- (iii) Shear force, Q and thrust, N at point B and D (with loading).
- (iv) Sketch the bending moment diagram of the arch.

Gerbang tiga engsel tidak simetri dalam Rajah 6 dibentuk dari persamaan $y = \frac{4hx(L-x)}{L^2}$, iaitu $L = 40$ m dan $h = 8$ m. Penyokong A berada 2.88m ke bawah daripada penyokong F. Ia direkabentuk untuk membawa beban teragih seragam sebanyak 5kN/m di sepanjang rentang 26m di bahagian CDEF dan dua beban titik 20KN dan 10KN masing-masing di titik B dan E. Sambungan A, D dan F adalah engsel.

Tentukan:

- (i) *Daya tindakbalas di penyokong A dan F.*
- (ii) *Momen lentur di titik B dan D.*
- (iii) *Daya ricih, Q dan daya paksi N di titik B dan D (dengan beban keaan)*
- (iv) *Lakarkan rajah moment lentur untuk gerbang tersebut.*

[18 marks / markah]

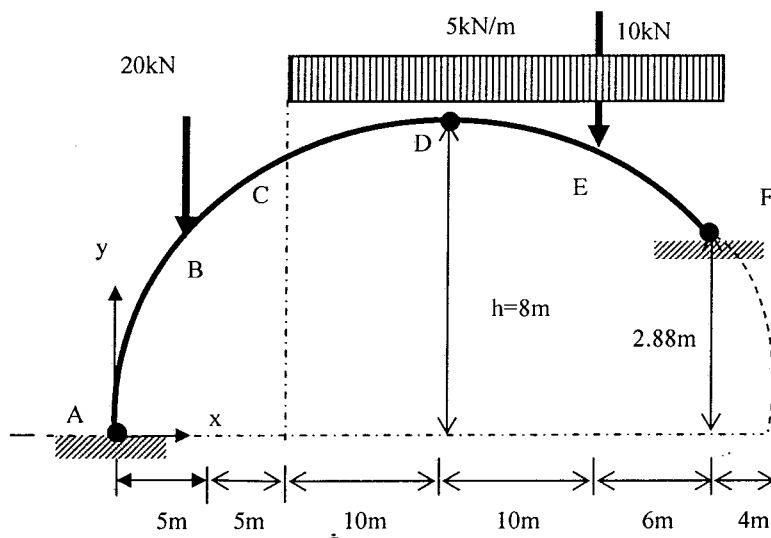


Figure / Rajah 6

6. A beam subjected to a moving load which travel from A to D is shown in Figure 7(a). The beam is pinned supported at A and supported by a roller at C and D.

Satu rasuk menanggung beban bergerak dari A ke D ditunjukkan dalam Rajah 7 (a). Rasuk tersebut disokong cemat di A dan disokong rola di C dan D.

- (a) Draw the influence lines diagram for the vertical reaction at both supports, shear force at B and bending moment at B. Plot numerical values at every 2.0 m interval.

Lukiskan gambarajah garis imbas bagi tindak balas di kedua-dua pen sokong, daya ricih di B dan momen lentur di B. Plotkan nilai berangka pada setiap 2.0m selaan.

[12 marks / markah]

- (b) Determine the maximum positive shear and maximum positive moment at B if the beam is subjected to a series of moving concentrated load as shown in Figure 7 (b).

Tentukan daya ricih maksimum positif dan momen lentur maksimum positif sekiranya rasuk menanggung beban titik bersiri seperti ditunjukkan dalam Rajah 7 (b).

[8 marks / markah]

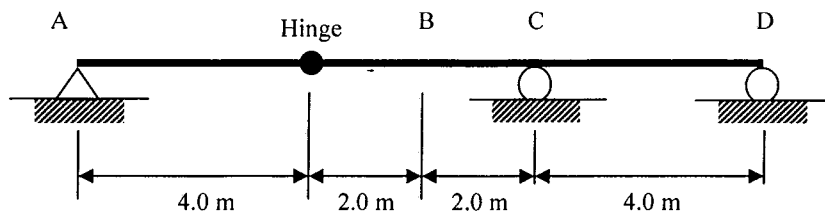


Figure / Rajah 7(a)

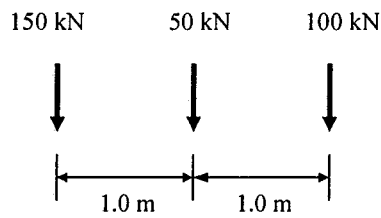


Figure / Rajah 7(b)

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