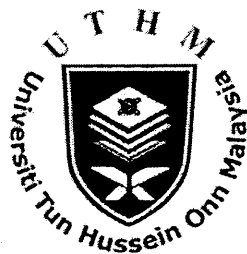


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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA
FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013**

COURSE NAME : STEEL STRUCTURE AND
TIMBER DESIGN

COURSE CODE : BFC 43003/BFC 4033

PROGRAMME : 4 BFF

EXAMINATION DATE : DECEMBER 2012/JANUARY 2013

DURATION : 3 HOURS

INSTRUCTION : ANSWER **THREE (3)**
QUESTIONS ONLY IN **PART A**
AND ALL QUESTIONS IN
PART B

DESIGN SHOULD BE BASED
ON:
BS EN 1993
MS 544: PART 2: 2001

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

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PART A (ANSWER THREE (3) QUESTIONS ONLY)

Q1 A simply supported beam with size $356 \times 171 \times 51$ kg/m UB section grade S275 steel is loaded by uniformly distributed loading consists of permanent action of 8 kN/m and variable action of 6 kN/m as shown in Figure **Q1(a)**.

Assume the beam is only restrained laterally and torsionally at the supports and the beam is sitting on the section of $914 \times 419 \times 388$ kg/m UB (S275) at each end as detailed in Figure **Q1(b)**. By ignoring the self weight of the beam;

(a) Check lateral buckling resistance (15 marks)

(b) Resistance of web to transverse forces due to concentrate load at support. (10 marks)

Q2 Figure **Q2** shows a $254 \times 254 \times 73$ kg/m UC grade S275 steel section under combined bending and compression. Check the adequacy for;

(a) Compression resistance (6marks)

(b) Bending moment resistance (4marks)

(c) Buckling resistance in compression (15marks)

Given:

Material resistance factor, $\gamma_{M0} = \gamma_{M1} = 1.0$

Buckling length, $L_{cr} = 1.0L$ for both axis.

Q3 The simply supported roof truss is subjected to dead, live and wind loads as shown in Figure **Q3**.

Design data are given as follows:

Span	= 27 m
Truss spacing	= 6 m
Spacing of node points	= 2.25 m

- (a) Check section classification for a section made from double angle 2/100 x 100 x 10L back to back with a 10 mm gap in steel grade S275.

(4 marks)

- (b) Check the capacity of the bottom chord member (1-2) where the maximum ultimate tension force is 442.2 kN. Use double angle 2/100 x 100 x 10L back to back with a 10 mm gap in steel grade S275 using a 20 mm diameter bolt.

(4 marks)

- (c) Check the capacity of the diagonal chord member (3-2) where the maximum ultimate compression force is 300 kN. Use double angle 2/100 x 100 x 10L back to back with a 10 mm gap in steel grade S275.

(15 marks)

Q4 Figure Q4 show the “simple joint” of the end plate beam connected to column flange. The connection is using non-preloaded bolts. Determine:

- (a) the resistance of bolt connection

(14 marks)

- (b) the size of fillet weld if 100 kN load is applied.

(11 marks)

PART B (ANSWER ALL QUESTIONS)

Q5 (a) Describe **Five (5)** factors that affecting the strength and durability of timber.

(5 marks)

(b) A solid bronze Merbau timber with 4.5 m height is used as central column of a banquet hall. The column is axially loaded and connected to glue laminated rafters at the top and concrete foundation at the bottom as shown in Figure **Q5**. Given:

Surface area of column = 150mm × 250mm

Grade = Standard grade, SG4 and dry timber

Load condition = Long term, no load sharing

(i) Determine the buckling condition and critical slenderness ratio of the column.

(6 marks)

(ii) Calculate the maximum allowable axial action that the column can adequately support.

(6 marks)

(iii) If a round timber column is used under medium term of the load, $P=350\text{kN}$, design the column and verify its stability. Given $k_8 = 0.6962$.

(8 marks)

BAHAGIAN A (JAWAB TIGA (3) SOALAN SAHAJA)

S1 Satu rasuk sokong mudah bersaiz $356 \times 171 \times 51$ kg/m UB gred S275 dibebani dengan beban teragih seragam yang terdiri daripada beban mati 8 kN/m dan beban hidup 6 kN/m seperti yang ditunjukkan dalam Rajah **Q1(a)**.

Anggap rasuk hanya dikekang sisi pada sokong dan rasuk tersebut terletak diatas rasuk bersaiz $914 \times 419 \times 388$ kg/m UB (S275) pada kedua-dua hujung seperti perincian pada Rajah **Q1(b)**. Dengan mengabaikan beban sendiri rasuk;

(a) semak rintangan lengkokan sisi

(15 markah)

(b) rintangan web terhadap beban melintang akibat beban tumpu.

(10 markah)

S2 Rajah **Q2** menunjukkan sebatang tiang keluli bersaiz $254 \times 254 \times 73$ kg/m UC yang bergred S275 dikenakan kombinasi beban lenturan dan mampatan. Semak rintangan tiang tersebut terhadap:

(a) Rintangan mampatan

(6 markah)

(b) Rintangan momen lenturan

(4 markah)

(c) Rintangan lengkokan dalam mampatan

(15 markah)

Diberi:

Faktor rintangan bahan, $\gamma_{M0} = \gamma_{M1} = 1.0$

Panjang lengkokan, $L_{cr} = 1.0L$ bagi kedua-dua paksi.

S3 Kekuda bumbung dikenakan beban mati, hidup dan angin seperti ditunjukkan dalam Rajah **Q3**.

Data rekabentuk diberi seperti berikut:

Panjang rentang = 27 m

Jarak kekuda = 6 m

Jarak di antara titik nod = 2.25 m

- (a) Semakan klasifikasi keratan untuk suatu keratan yang dibuat daripada sesiku kembar 2/100 x 100 x 10L secara belakang ke belakang dengan jarak 10 mm menggunakan keluli gred S275

(4 markah)

- (b) Semak keupayaan anggota bawah (1-2) di mana daya tegangan maksimum adalah 442.2 kN. Dengan menggunakan sesiku kembar bersaiz 2/100 x 100 x 10L secara belakang ke belakang dengan jarak 10 mm menggunakan keluli gred S275 dan diameter bolt 20 mm.

(6 markah)

- (c) Semak keupayaan anggota condong (3-2) di mana daya mampatan maksimum adalah 300 kN. Dengan menggunakan sesiku kembar bersaiz 100 x 100 x 10L secara belakang ke belakang dengan jarak 10 mm menggunakan keluli gred S275.

(15 markah)

S4 Rajah Q4 menunjukkan “sambungan mudah” bagi sambungan plat hujung rasuk ke bebibir tiang. Sambungan menggunakan bolt pra-pembebanan. Tentukan:

- (a) Rintangan bagi sambungan bolt

(14 markah)

- (b) Saiz kimpal kambi jika beban 100 kN dikenakan

(11 markah)

BAHAGIAN B (JAWAB SATU SOALAN SAHAJA)

S5 (a) Terangkan **Lima (5)** faktor yang mempengaruhi kekuatan dan ketahanan lasakan kayu

(5 markah)

(b) Sebatang kayu Merbau keras berwarna gangsa dengan ketinggian 4.5 m digunakan sebagai tiang tengah sebuah dewan jamuan. Tiang tersebut dikenakan beban paksi dan disambung dengan rasuk bumbung terpaku berlaminasi di bahagian atas dan asas konkrit pada bahagian bawahnya seperti yang ditunjukkan dalam Figure **Q5**. Diberi:

Luas permukaan tiang = $150\text{mm} \times 250\text{mm}$

Gred = Gred standard, SG4 dan kayu kering

Keadaan beban = Jangka masa panjang, tiada perkongsian beban

(i) Tentukan keadaan pesongan dan nisbah kelangsingan yang paling kritikal bagi tiang tersebut.

(6 markah)

(ii) Kira maksimum beban paksi dibenarkan yang boleh ditampung oleh tiang.

(6 markah)

(iii) Sekiranya tiang kayu bulat digunakan di bawah jangka sederhana beban, $P = 350 \text{ kN}$, rekabentuk tiang dan dapatkan kestabilan tiang tersebut. Diberi $k_8 = 0.6962$.

(8 markah)

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$G_k = 8 \text{ kN/m}$ $Q_k = 6 \text{ kN/m}$

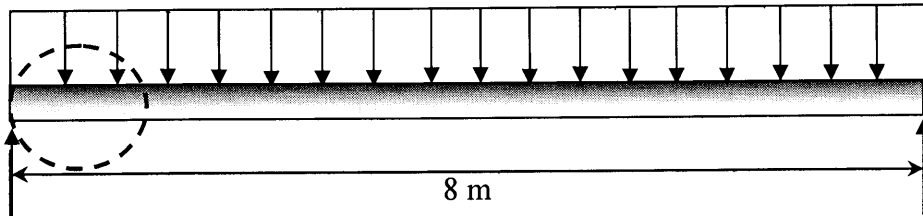


FIGURE Q1(a)

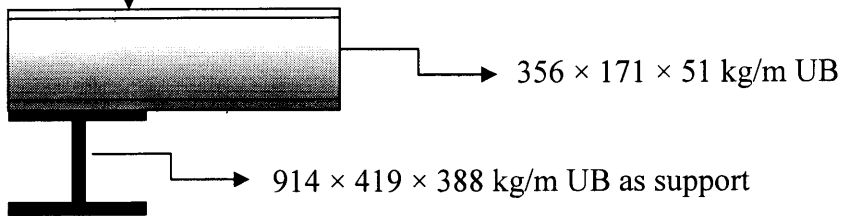


FIGURE Q1(b)

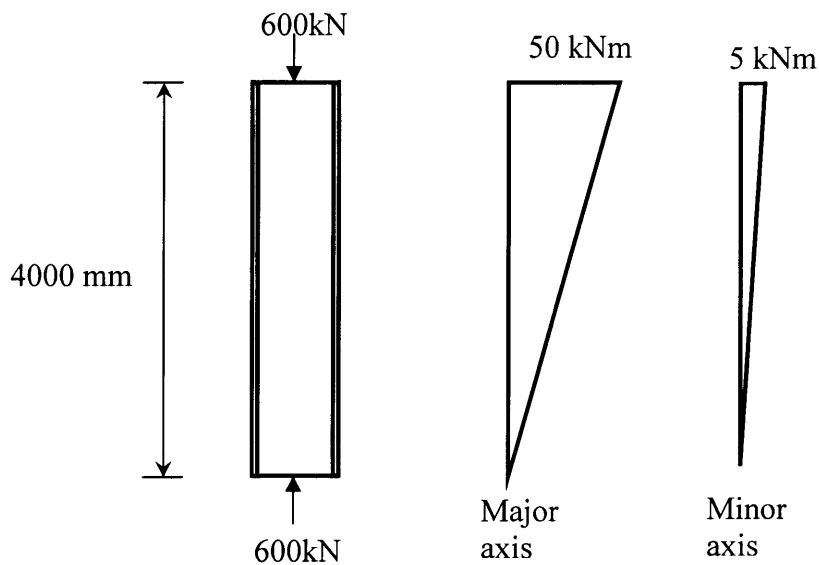


FIGURE Q2

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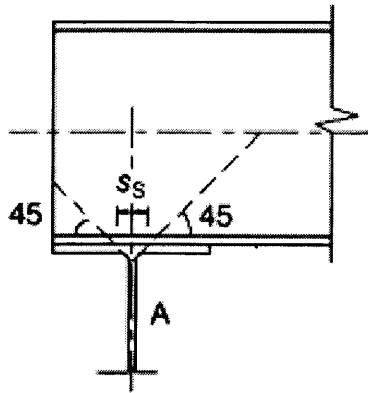
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APPENDIX



Stiff bearing length, $s_s \approx 2t_f + t_w + r$

$$M_{cr} = \frac{\pi^2 E I_z}{L_{cr}^2} \left[\frac{I_w}{I_z} + \frac{L_{cr}^2 G I_T}{\pi^2 E I_z} \right]^{0.5}$$

Bolt Area

d (mm)	8	10	12	14	16	18	20	22	24	27	30
A (mm²)	50	78	113	154	201	254	314	380	452	573	707
A_s (mm²)	36	58	84	115	157	192	245	303	353	459	561