
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

EAS 354/3 – Design Of Timber And Steel Structures
[Rekabentuk Struktur Kayu dan Keluli]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **EIGHT (8)** printed pages before you begin the examination.

*[Sila pastikan kertas peperiksaan ini mengandungi **LAPAN (8)** 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) Discuss **TWO (2)** factors affecting the tension capacity of a structural steel member.

(6 marks)

Bincangkan **DUA (2)** faktor yang mempengaruhi keupayaan tegangan anggota struktur keluli.

(6 markah)

- (b) Determine the maximum tension force that can be resisted by the simple structural tie as shown in Figure 1. Assume all sections as grade S275 steel. The shear area (A_s) and tensile area (A_t) for M16 grade 8.8 bolts is 157 mm^2 .

(14 marks)

Tentukan daya tegangan maksima yang boleh ditanggung oleh struktur pengikat mudah seperti di Rajah 1. Anggap semua keratan sebagai keluli gred S275. Luas ricih (A_s) dan luas tegangan (A_t) untuk bolt M16 bergred 8.8 sebagai 157 mm^2 .

(14 markah)

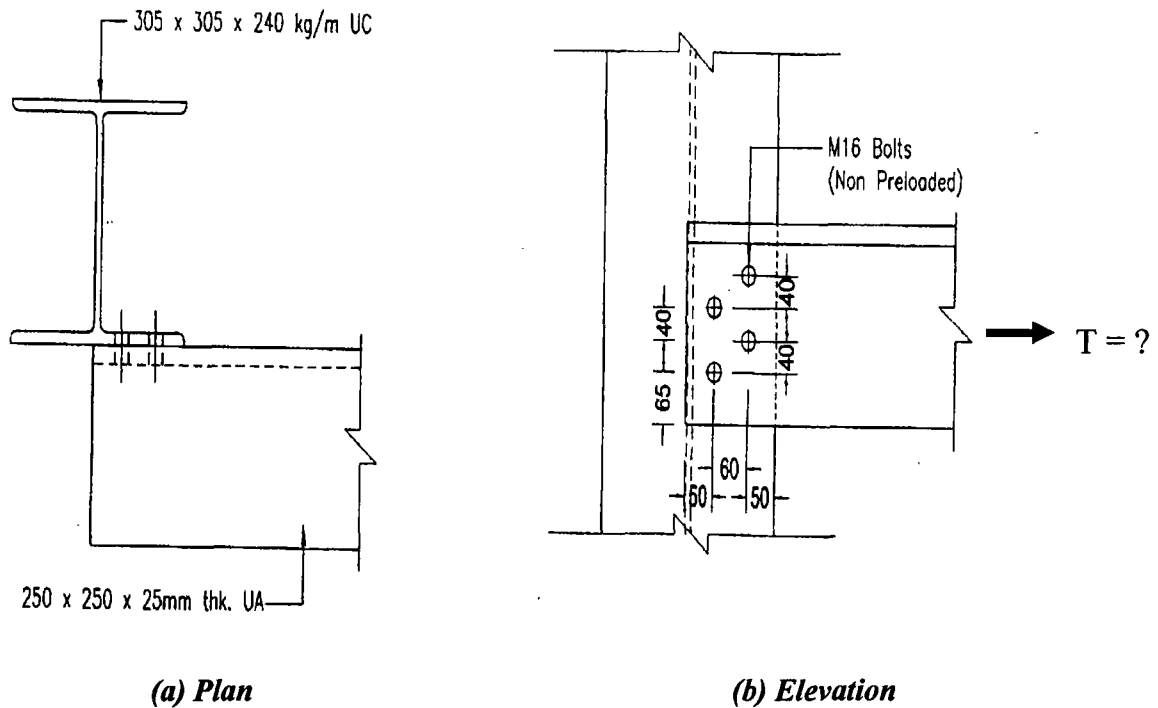


Figure 1 : Simple Tie

2. (a) Figure 2 shows a typical splice connection of a simply supported long span beam. State **ALL** items that need to be checked with respect to the corresponding forces and the assumption to perform such design.

(5 marks)

Rajah 2 menunjukkan satu sambungan sambat tipikal rasuk rentang panjang. Nyatakan **SEMUA** perkara yang perlu disemak berdasarkan daya-daya yang berkaitan dan andaian untuk melakukan rekabentuk tersebut.

(5 markah)

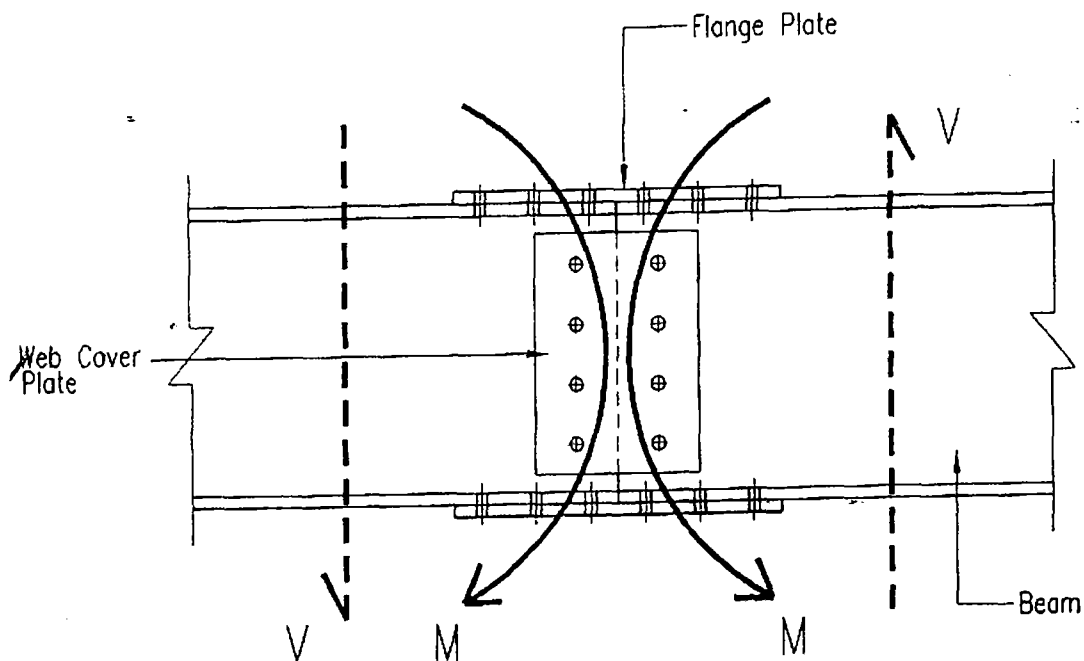


Figure 2 / Rajah 2 : Beam Splice

- (b) Determine the suitable fillet weld size using electrode Class E42 for steel grade S355 side plate connection subjected to 200 kN point load as shown in Figure 3. Sketch the proposed welding scheme if $a = 0.7s$

(10 marks)

Tentukan ketebalan saiz kimpalan kambi menggunakan elektrod Kelas E42 untuk sambungan plat sisi keluli bergred S355 yang dikenakan beban tumpu 200 kN seperti di Rajah 3. Lakar cadangan skema kimpalan sekiranya $a = 0.7s$

(10 marks)

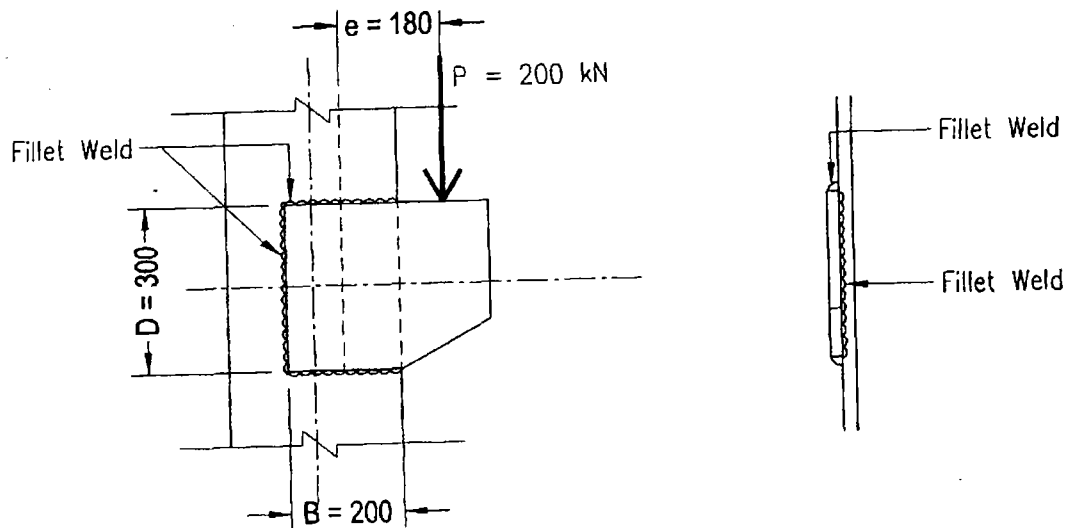


Figure 3 / Rajah 3 : Side Plate Connection

Front Elevation

Side Elevation

- (c) Sketch the outline of truss T1 for 30° pitch roof as shown in Figure 4. Provide relevant dimensions.

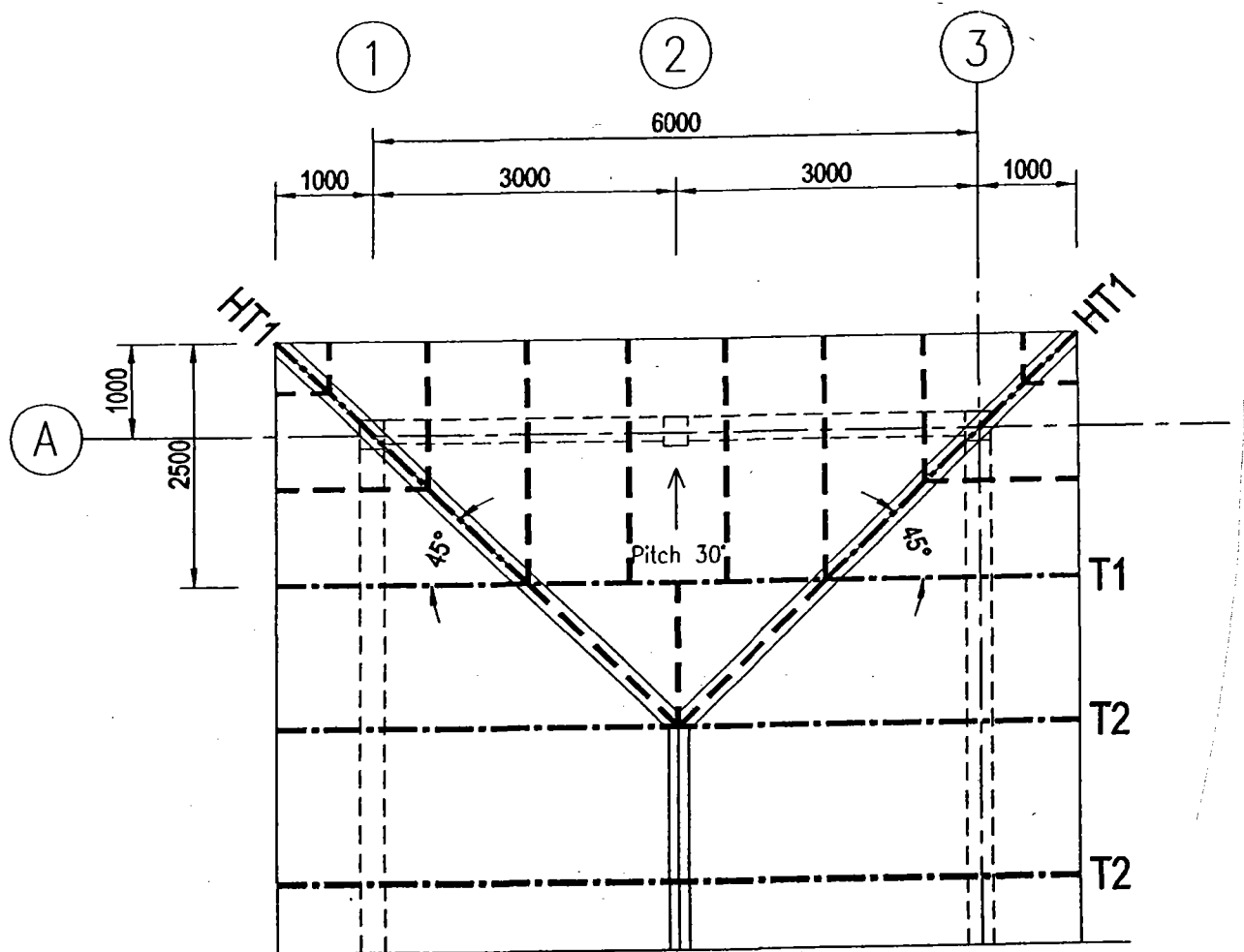
(5 marks)

Lakar garis luar kekuda T1 untuk sudut bumbung 30° seperti di Rajah 4. Sediakan dimensi-dimensi yang berkaitan

(5 markah)

...5/-

2. (c) Instruction : Sketch the outline of truss T1 on this page submit together with answer script.



Roof Trusses Layout Plan
Figure 4 / Rajah 4 : Part Plan of Roof Truss Layout

3. (a) Determine the moment at midspan of simply supported beam with a span of 8.0m subjected to dead load and imposed load of 20kN/m and 10 kN/m, respectively. Carry out the calculation using :

- i. Load factor method (1.8)
- ii. Ultimate limit state method

(10 marks)

Assume section 457 x 191 x 67 UB and steel grade S275.

Tentukan momen pada bahagian tengah rasuk mudah dengan rentang 8.0m yang dikenakan beban mati dan beban kenaan masing-masing 20kN/m dan 10kN/m. Lakukan pengiraan menggunakan :

- i. *Kaedah Faktor Beban (1.8)*
- ii. *Kaedah Rekabentuk Keadaan Had.*

Anggap keratan 457 x 191 x 67 UB dan keluli gred S275.

(5 markah)

- (b) Carry out deflection check at midspan using both methods

(5 marks)

Semak pesongan pada bahagian tengah rasuk menggunakan kedua-dua kaedah tersebut.

(5 markah)

- (c) Briefly explain the differences between short column and slender column

(5 marks)

Terangkan secara ringkas perbezaan tiang pendek dan tiang langsing

(5 markah)

4. (a) Sketch the shape of the following buckling

- (i.) Local flange buckling failure of simple supported beam
- (ii.) Lateral torsional buckling of cantilever beam

(6 marks)

Lakarkan bentuk untuk lengkokan di bawah :

- (i) *Kegagalan Lengkokan Setempat Bebibir untuk rasuk mudah*
- (ii) *Lengkokan Kilasan Sisi untuk rasuk julur*

(6 markah)

- (b) A universal column has an effective length of 4m and is required to carry an ultimate axial load of 3000kN, including selfweight. Design a column using 254 x 254 x 107 UC, steel grade S275. Assuming the end condition at top and bottom of the column provided are rotational restraint.

(14 marks)

Sebuah tiang mempunyai panjang rentang efektif 4m membawa beban paksi muktamad, 3000kN termasuk berat sendiri. Rekabentuk tiang menggunakan keratan 254 x 254 x 107 UC, gred keluli S275. Anggapkan kedua-dua hujung tiang atas dan bawah menyediakan kekangan terhadap putaran

(14 markah)

5. (a) Define the terms headside thickness, pointside thickness, standard penetration and actual penetration of nailed joint.

(5 marks)

Definisikan istilah ketebalan kepala, ketebalan hujung, penusukan piawai dan penusukan sebenar bagi sambungan paku.

(5 markah)

- (b) A suspended timber flooring system cross-section is shown in Figure 5. The flooring system is using tongued and grooved boarding with a self-weight of 0.25kN/m^2 . It carries a plasterboard ceiling of 0.2kN/m^2 . The floor has an effective span of 4 m and is subjected to a domestic imposed load of 1.5kN/m^2 . Design the timber floor joist using timber in strength group SG 5.

(15 marks)

Rajah 5 menunjukkan keratan rentas sistem lantai kayu terampai. Sistem lantai ini menggunakan sambungan papan lidah dan alur mempunyai berat sendiri sebesar 0.2kN/m^2 dan membawa beban siling papan lepa sebesar 0.2kN/m^2 . panjang rentang efektif lantai 4 m dan menanggung beban keanaan domestic sebesar 1.5kN/m^2 . Rekabentuk gelegar lantai kayu dengan menggunakan kumpulan kekuatan kayu SG5.

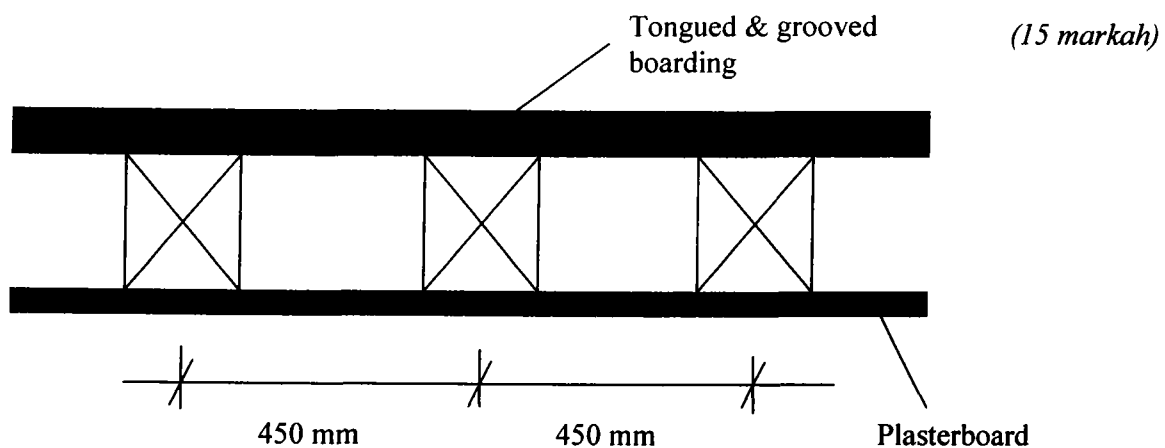


Figure 5 / Rajah 5 : Timber joist floor

6. (a) Figure 6 shows the bolted connection subjected to a long-term eccentric point load of 15kN. The joint consists of two 5 mm thick of steel side. The inner member is SG 4 with the size of 75 x 300 mm joined together by eight M12 bolts. Check the adequacy of the connection.

(12 marks)

Rajah 6 menunjukkan sambungan bolt yang dikenakan beban tumpu sipi untuk tempoh jangka panjang sebesar 15 kN. Sambungan ini mengandungi dua plat keluli setebal 5mm di kedua-dua belah sambungan. Anggota dalaman mempunyai saiz 75 x 300mm dalam kumpulan kekuatan SG4 disambung menggunakan lapan bolt M12. Semak kecekapan sambungan.

(12 markah)

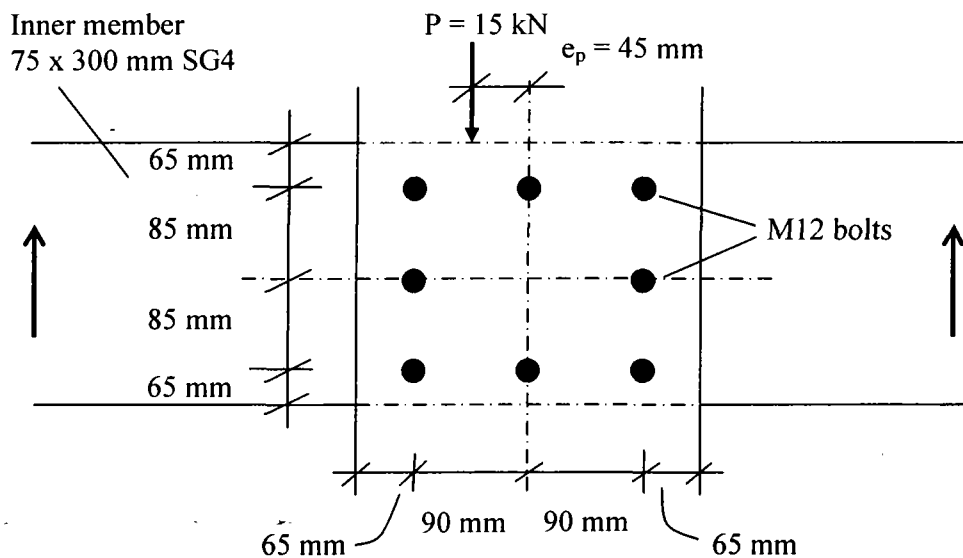


Figure 6 / Rajah 6

- (b) Briefly explain the stress/strain characteristic of timber subject to tensile or compressive stress parallel to the grain and perpendicular to the grain.

(8 marks)

Terangkan dengan ringkas ciri-ciri tegasan/terikan bagi kayu yang dikenakan tegasan mampatan atau tegangan selari dan serenjang dengan ira.

(8 markah)

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