



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA
FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010**

SUBJECT NAME : STRUCTURAL STEEL AND
TIMBER DESIGN

SUBJECT CODE : BFC 4033

COURSE : 4 BFF

EXAMINATION DATE : APRIL / MEI 2010

DURATION : 3 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS
FROM **PART A** AND **ONE (1)**
QUESTION FROM **PART B**.
DESIGN SHOULD BE BASED
ON:
BS 5950: PART 1: 2000
MS 544: PART 2: 2001

THIS PAPER CONSISTS OF SIXTEEN (16) PAGES

PART A: ANSWER ALL QUESTIONS

- Q1** (a) Answer the following questions:
- (i) List **Four (4)** types of steel sections widely used as structural components. (4 marks)
 - (ii) State **Two (2)** situations that web bearing capacity need to be checked for a flexural member. (3 marks)
 - (iii) Why the centroids of all members in a truss connection design should ideally intersect at a point. (2 marks)
 - (iv) What is the difference between simple joint and rigid joint? (2 marks)
 - (v) When and why would an engineer specify the use of high-strength friction bolts on a steel connection? (4 marks)
- (b) (i) List **Four (4)** species of timber in SG 4 based on MS 544: Part 2: 2001 (4 marks)
- (ii) Structural safety, economic and aesthetic values are the main factors that normally accounted in design. Briefly explain **Two (2)** additional criteria that probably could be considered in designing process of a timber structure. (6 marks)
- Q2** (a) A simply supported beam shown in Figure **Q2(a)** is fully restrained along its length and has stiff bearing of 75 mm under the concentrated load.
- (i) Draw the shear force and bending moment diagrams. (5 marks)
 - (ii) The 610 x 229 x 101 kg/m UB grade S275 is class 1 plastic and the shear for the beam is low. Check the moment capacity. (3 marks)
 - (iii) Check the web bearing and buckling under the concentrated load. (7 marks)

- (b) A simply supported beam as shown in Figure **Q2(b)** is a dressed sawn timber beam of Cengal with nominal size of 100 mm x 200 mm.

Given,

Moisture content	:	17%
Timber grade	:	Standard
Type of structure element	:	Joist
Spacing between 10 members	:	600 mm c/c
Underside notch, h_e	:	100 mm

- (i) Calculate the applied loads of P and w by ignoring the self weight of the beam.
(2 marks)
- (ii) Do checking and give comment for the bending stress design consideration.
(3 marks)
- (iii) Determine the deflection and give comment towards your final finding obtained.
(5 marks)
- Q3** (a) Figure **Q3** shows a continuous steel column carrying a maximum axial load of 450 kN from the upper floor. The first floor beams connected to the column are simple construction. The maximum reaction of the beams for R1 and R2 is 150 kN and 200 kN respectively. The top and bottom ends of the columns at both directions are pinned.
- (i) Calculate the maximum axial load and nominal moments.
(7 marks)
- (ii) Check the adequacy of the column section.
(8 marks)
- (b) A pinned ended interior column with 4.5 m length is loaded by a pure axial load of 150 kN. This timber column is designed by using a dressed sawn timber of SG 4 without any size is stated. If a client prefers for a round timber column,

Given,

Duration of loading	:	Long term
Load sharing	:	None
Timber grade	:	Select
I_{xx} or I_{yy}	:	$\frac{1}{4} \pi r^4$

- (i) calculate the nominal diameter of column if $\lambda = 72$. (3 marks)
- (ii) do checking and give comment for the compressive stress design consideration. (7 marks)

PART B: ANSWER ONE (1) QUESTION ONLY

Q4 Figure **Q4** shows a roof truss where the purlins are located on the top nodes. The spacing between trusses is 5 m.

Given,

Imposed load on plan, Q_k : 0.75 kN/m²
 Total dead load on slope, G_k : 0.5 kN/m²
 (steel roofing, insulation, self weight
 of purlins and trusses)

- (a) Calculate the design concentrated load on the top nodes. (5 marks)
- (b) Using the method of section or other suitable methods, calculate the force on member JD. (7 marks)
- (c) If the member JD consist of an equal angle of 100 x 65 x 8 L of steel grade S275, check the capacity of the member if the ends of the members are:
- (i) connected by two bolts of 20 mm nominal diameter. (7 marks)
- (ii) welded with grade 42 electrode. (6 marks)

Q5 Figure **Q5(a)** shows a floor plan of a simple construction steel structure. Cast in-situ slab of 125 mm thick is used as the flooring system. All primary beams carry a brick wall of 3 m high. While, Figure **Q5(b)** shows the proposed connection for the primary beam AB to the column.

Given,

Weight of concrete : 24 kN/m³
 Weight of brickwall : 2.6 kN/m²
 Finishes and services : 1.5 kN/m²
 Imposed load : 3.0 kN/m²

- (a) Calculate the design load P on the connection as shown in Figure **Q5(b)**. (9 marks)
- (b) Determine the appropriate diameter of the bolt for the connection. Use grade 8.8 bolt and steel grade S275. (10 marks)

(c) Proposed with the aid of sketches the connection between;

(i) beam AC and the column

(3 marks)

(ii) secondary beam and the primary beam.

(3 marks)

BAHAGIAN A: JAWAB SEMUA SOALAN

- S1** (a) Jawab soalan-soalan berikut:
- (i) Senaraikan **Empat (4)** jenis keratan keluli yang digunakan secara meluas untuk elemen struktur. (4 markah)
 - (ii) Nyatakan **Dua (2)** keadaan keupayaan galas web yang perlu disemak untuk anggota lenturan. (3 markah)
 - (iii) Mengapa centroid bagi semua anggota pada sambungan kekuda yang direkabentuk secara idealnya perlu bertemu pada satu titik? (2 markah)
 - (iv) Apakah perbezaan antara sambungan mudah dan sambungan tegar? (2 markah)
 - (v) Bila dan mengapakah jurutera akan menetapkan penggunaan bolt ricih berkekuatan tinggi pada sambungan keluli? (4 markah)
- (b)
- (i) Senaraikan **Empat (4)** spesis kayu yang terdapat dalam SG 4 berdasarkan kepada MS544: Part2: 2001 (4 markah)
 - (ii) Keselamatan struktur, ekonomi and nilai estetika merupakan faktor utama yang biasanya diambilkira dalam rekabentuk. Terangkan dengan ringkas **Dua (2)** faktor tambahan yang berkemungkinan boleh dipertimbangkan dalam proses merekabentuk bagi sesebuah struktur. (6 markah)
- S2** (a) Satu rasuk disokong mudah seperti yang ditunjukkan dalam Rajah **Q2(a)** adalah dihalang sisi sepanjang rentangnya dan mempunyai galas kukuh selebar 75 mm di bawah beban tumpu.
- (i) Lukiskan gambarajah daya ricih dan momen lentur. (5 markah)
 - (ii) Keratan 610 x 229 x 101 kg/m UB gred S275 ialah kelas 1 plastik dan ricih untuk rasuk adalah rendah. Semak keupayaan momen. (3 markah)

- (iii) Semak keupayaan gelas dan lengkokan web di bawah beban tumpu.
(7 markah)
- (b) Rasuk tupang mudah seperti pada Rajah **Q2(b)** merupakan kayu jenis Cengal siap diketam dengan saiz nominal 100 mm x 200 mm.
- Diberi,
- | | | |
|-------------------------|---|------------|
| Kandungan lembapan | : | 17 % |
| Gred kayu | : | Standard |
| Jenis elemen struktur | : | Gelegar |
| Jarak antara 10 anggota | : | 600 mm c/c |
| Takukan bawah, h_e | : | 100 mm |
- (i) Kirakan beban kenaan P dan w dengan mengabaikan berat sendiri rasuk.
(2 markah)
- (ii) Lakukan semakan dan beri komen untuk pertimbangan rekabentuk tegasan lentur.
(3 markah)
- (iii) Tentukan pesongan dan beri komen terhadap hasil akhir yang telah diperolehi.
(5 markah)
- S3** (a) Rajah **Q3** menunjukkan satu tiang keluli selanjur membawa beban paksi maksimum 450 kN dari tingkat atas. Rasuk-rasuk tingkat satu yang disambungkan kepada tiang adalah secara pembinaan mudah. Tindakbalas maksimum rasuk untuk R1 dan R2 masing-masing ialah 150 kN dan 200 kN. Keadaan hujung tiang pada bahagian atas dan bawah untuk kedua-dua arah adalah pin.
- (i) Kirakan daya paksi maksimum dan momen nominal.
(7 markah)
- (ii) Semak kesesuaian keratan tiang.
(8 markah)
- (b) Sebatang tiang dalaman di pin hujung dengan panjang 4.5 m dibebani dengan beban paksi sebanyak 150 kN. Tiang kayu ini direkabentuk menggunakan kayu diketam dari SG 4 tanpa sebarang saiz yang dinyatakan. Sekiranya seorang pelanggan menginginkan tiang berbentuk bulat,

Diberi,

Jangka masa pembebanan	:	Jangka panjang
Perkongsian beban	:	Tiada
Gred kayu	:	Select
I_{xx} or I_{yy}	:	$\frac{1}{4} \pi r^4$

- (i) kira saiz diameter nominal tiang jika $\lambda = 72$. (3 markah)
- (ii) lakukan semakan dan beri komen untuk pertimbangan rekabentuk tegasan mampatan. (7 markah)

BAHAGIAN B: JAWAB SATU (1) SOALAN SAHAJA

S4 Rajah **Q4** menunjukkan kekuda bumbung di mana gulung-gulung berada di atas nod. Jarak antara kekuda ialah 5 m.

Diberi,

$$\begin{aligned} \text{Beban kenaan atas pelan, } Q_k &= 0.75 \text{ kN/m}^2 \\ \text{Jumlah beban mati atas cerun, } G_k &= 0.5 \text{ kN/m}^2 \\ &\text{(bumbung keluli, penebat, beban sendiri} \\ &\text{gulung-gulung dan kekuda)} \end{aligned}$$

- (a) Kirakan beban tumpu rekabentuk pada nod atas. (5 markah)
- (b) Kirakan daya dalam anggota JD menggunakan kaedah keratan atau kaedah lain yang sesuai. (7 markah)
- (c) Jika anggota JD terdiri daripada keratan sesiku sama kaki 100 x 65 x 8 L dengan gred keluli S 275, semak keupayaan anggota JD jika hujungnya adalah;
- (i) disambung dengan dua bol berdiameter nominal 20 mm. (7 markah)
- (ii) dikimpal dengan elektrod gred 42. (6 markah)

S5 Rajah **Q5(a)** menunjukkan pelan lantai satu struktur pembinaan keluli mudah. Konkrit tuang disitu setebal 125 mm digunakan pada system lantai. Semua rasuk utama membawa beban dinding bata setinggi 3 m. Rajah **Q5(b)** menunjukkan sambungan yang dicadangkan bagi rasuk utama AB ke tiang.

Diberi,

$$\begin{aligned} \text{Berat konkrit} &: 24 \text{ kN/m}^3 \\ \text{Berat dinding bata} &: 2.6 \text{ kN/m}^2 \\ \text{Kemasan dan servis} &: 1.5 \text{ kN/m}^2 \\ \text{Beban kenaan} &: 3.0 \text{ kN/m}^2 \end{aligned}$$

- (a) Kirakan beban rekabentuk P pada sambungan seperti yang ditunjukkan dalam Rajah **Q5(b)**. (9 markah)
- (b) Tentukan diameter bolt yang sesuai untuk sambungan tersebut. Gunakan bolt bergred 8.8 dan gred keluli S275. (10 markah)

(c) Cadangkan dengan bantuan lakaran sambungan antara;

(i) rasuk AC dan tiang

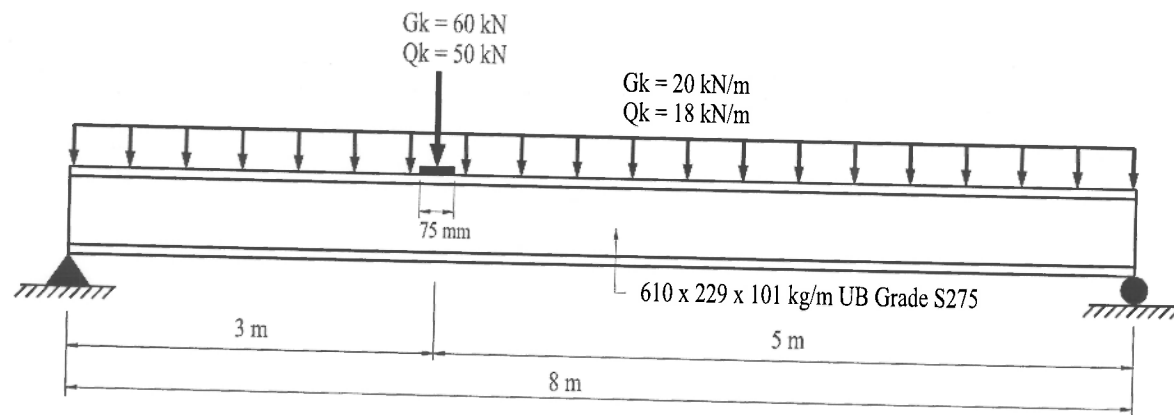
(3 markah)

(ii) rasuk sekunder ke rasuk utama.

(3 markah)

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**FIGURE O2(a)**

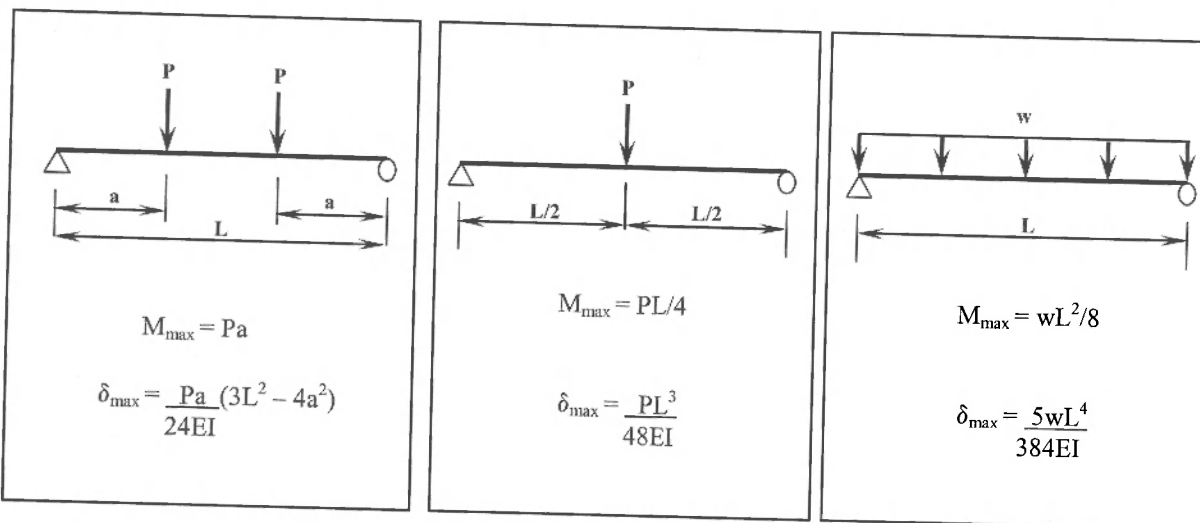
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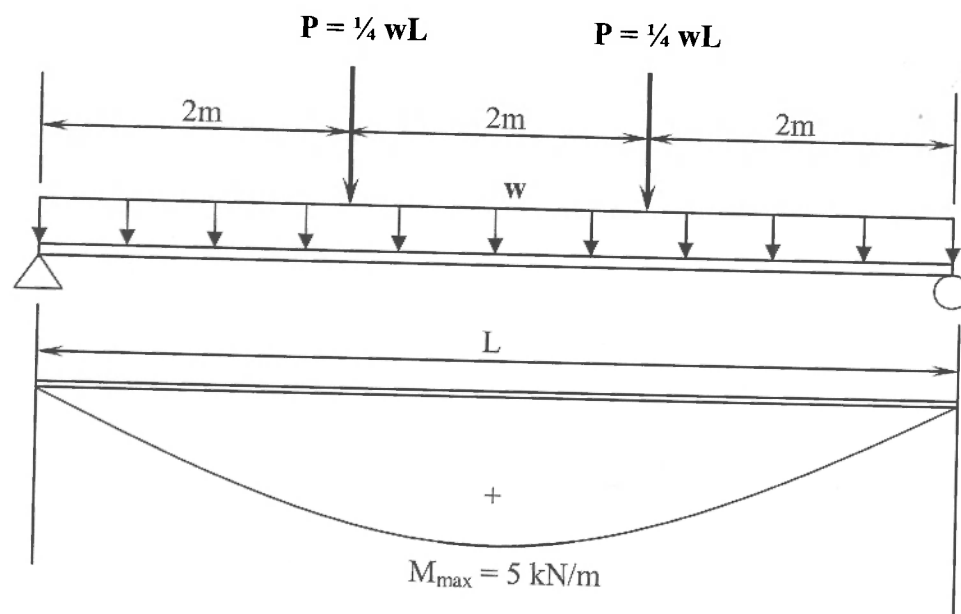
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$$\Delta_s = \frac{19.2M_{\max}}{AE}$$

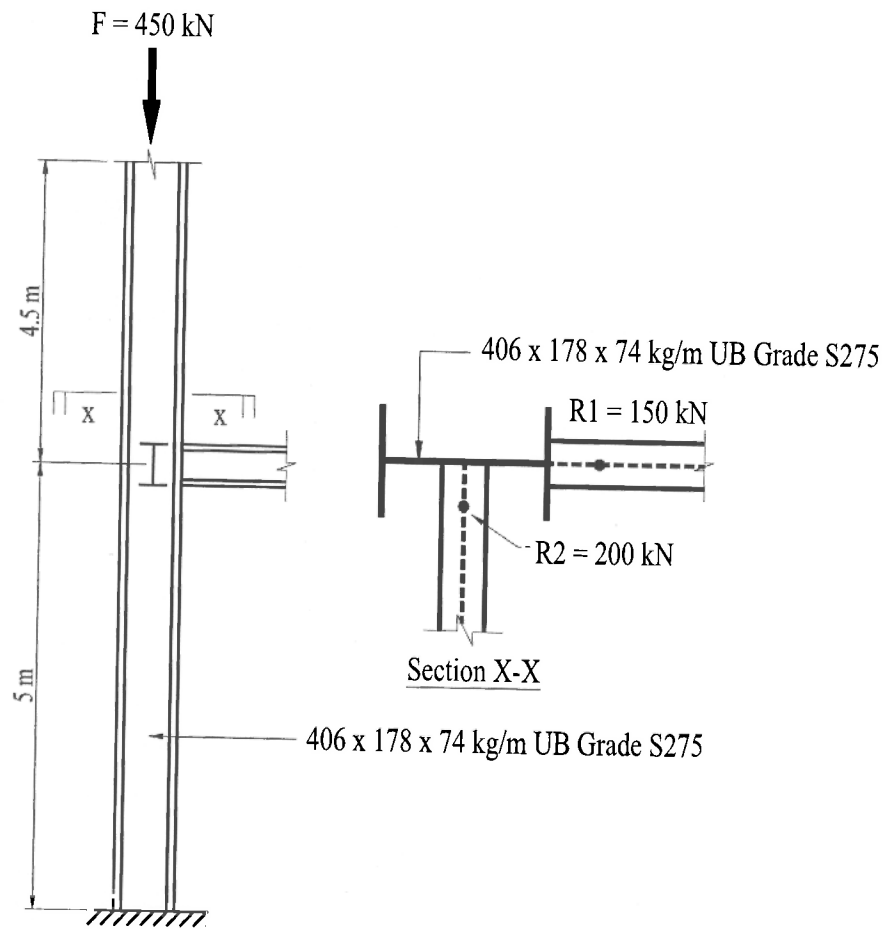


Bending Moment Diagram

FIGURE O2(b)

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**FIGURE O3**

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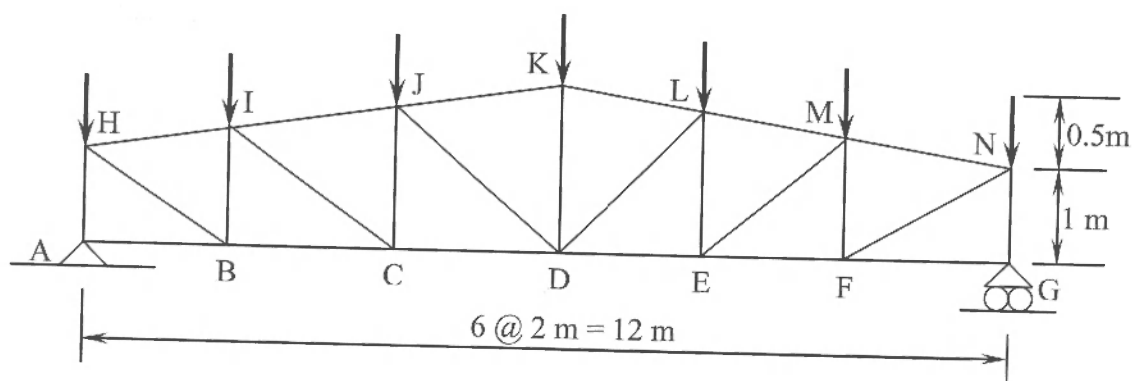


FIGURE Q4

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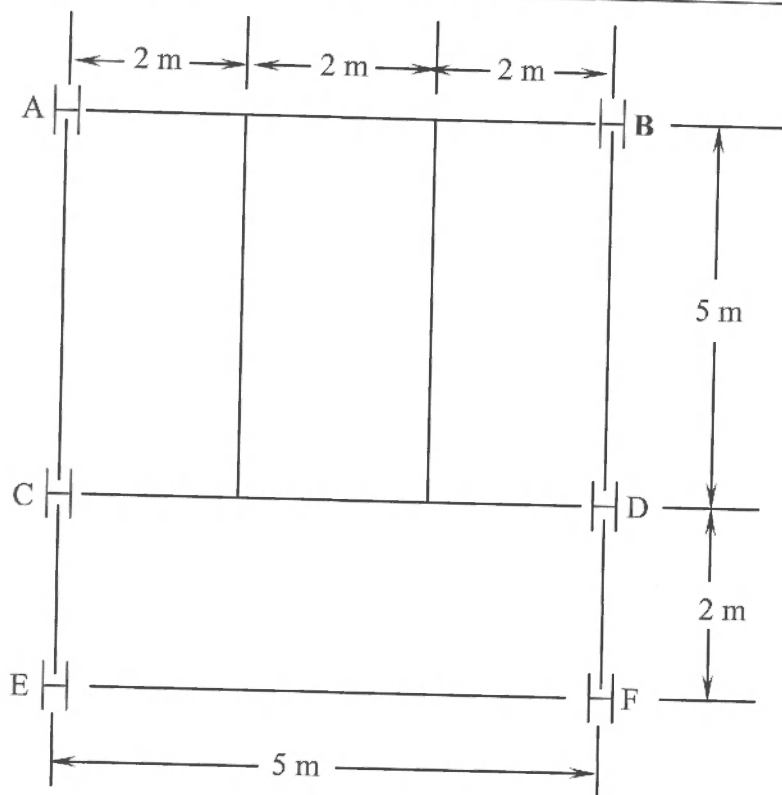


FIGURE Q5(a)

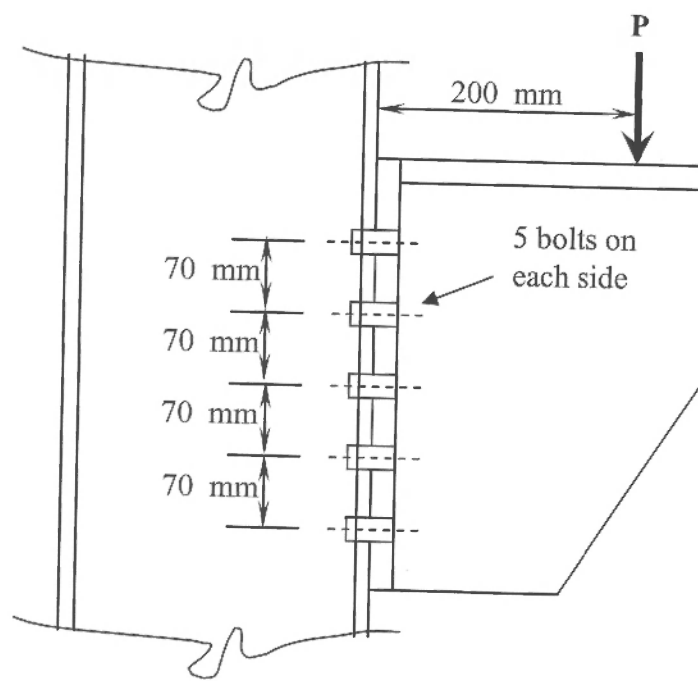


FIGURE Q5(b)