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Hong Kong Institute

of

Vocational Education

香港專業教育學院

[redacted]

HD in Civil Engineering

(EG314101)

[redacted]

Steelwork Design

(C O N 4 3 3 4)

[redacted]

AY 2015/16

Semester Two Examination

11 May 2016

1:30 pm – 3:30 pm

[redacted]

Notes :

1. The result of this examination will not be counted if you do not meet the minimum attendance requirement governed by the General Academic Regulations of your programme unless approval from the Campus Principal has been granted.
2. This paper consists of **Six (6)** pages including this cover page.
3. **There are two sections in this paper. Section A contains a compulsory question with a total of 40 marks. Section B is comprised of choice questions and carries a total of 60 marks.**
4. **Answer ALL questions in Section A. Answer ANY TWO (2) questions in Section B.**
5. All symbols have their usual meaning unless otherwise defined.
6. All dimensions are in millimeter unless otherwise stated.
7. All figures are NOT necessary to scale.

8. Examination Data:

   THIRTY-FIVE (35) pages of examination data are provided for reference.

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SECTION A: COMPULSORY QUESTION (40%)

AQ.1 **Figure Q.1a** shows a plan layout of 5 numbers of steel beams supporting two identical concrete slabs. You may assume the compression flanges of the steel beams are fully restrained from lateral torsional buckling. All the steel members are of grade 355. All steel beams are simply supported. The thickness of slab is 200 mm. Finishes loads and live loads are 2 kN/m^2 and 2 kN/m^2 respectively. Determine the following items.

(i) Calculate the factored load intensity (in kN/m^2) of the slabs. (4 marks)

(ii) Calculate the maximum factored shear forces and bending moments of B-1 and B-2 (self-weight of each steel beam should be considered, $g = 9.81\ m/s^2$). (8 marks)

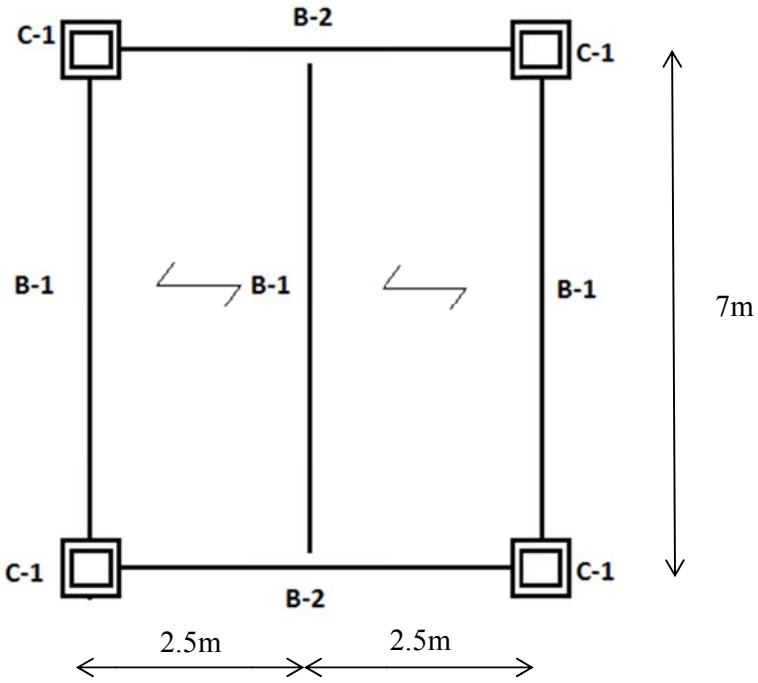
(iii) Find the section classes of the steel beams B-1 and B-2. (4 marks)

(iv) Check the adequacy of steel beam B-1 against shear, bending and deflection. (10 marks)

(v) Check the adequacy of steel beam B-2 against bending and deflection. (7 marks)

(vi) Assuming there is no load eccentricity, check the adequacy of the fillet weld connection betweem C-1 and B-1/B-2 (**see Figure Q.1b**). Class 42 electrode is used. (7 marks)

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Beam B-1: 356 x 171 x 51 kg/m UB
Beam B-2: 305 x 165 x 54 kg/m UB
Column C-1 : Square Hollow Section

Figure Q.1a

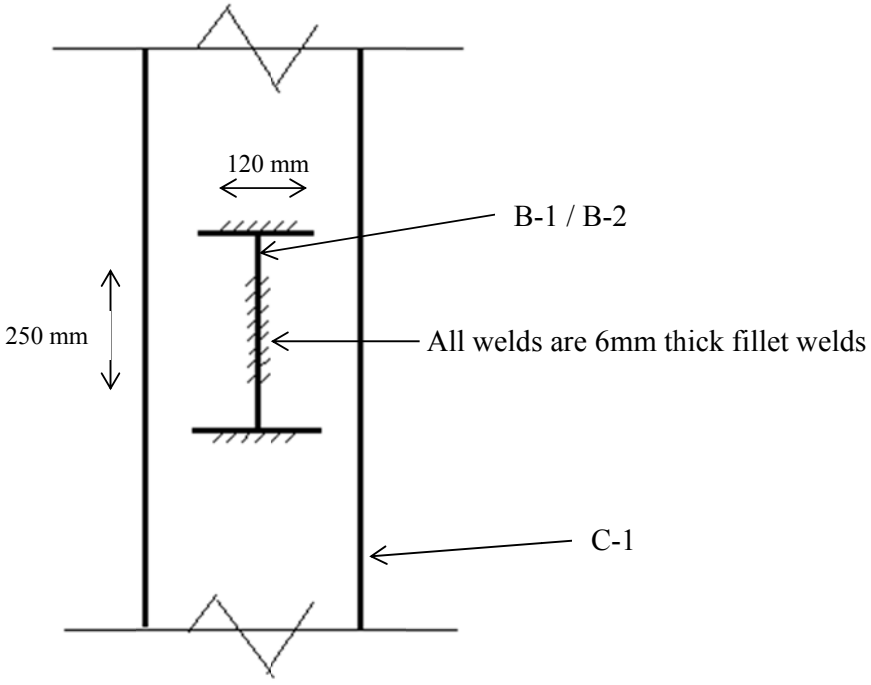


Figure Q.1b

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Section B – Answer any TWO questions in this Section.

BQ.2 Two 20 mm thick steel plates are bolted to the flanges of a 254 x 254 x 8 kg/m UC to form a bracket as shown in **Figure Q.2**. All steel members and bolts are of Grade S355 and Grade 8.8 respectively. Two point loads P1 & P2 having eccentricities from the centerline of the steel column are applied to the bracket. The setting out of the bolts is as shown.

(i) Determine the maximum resultant load of the bolt group. (12 marks)

(ii) Check the adequacy of M20 grade 8.8 bolts for the connections. Assume all the holes for the bolts are standard holes. Checking of the connected part is required. (18 marks)

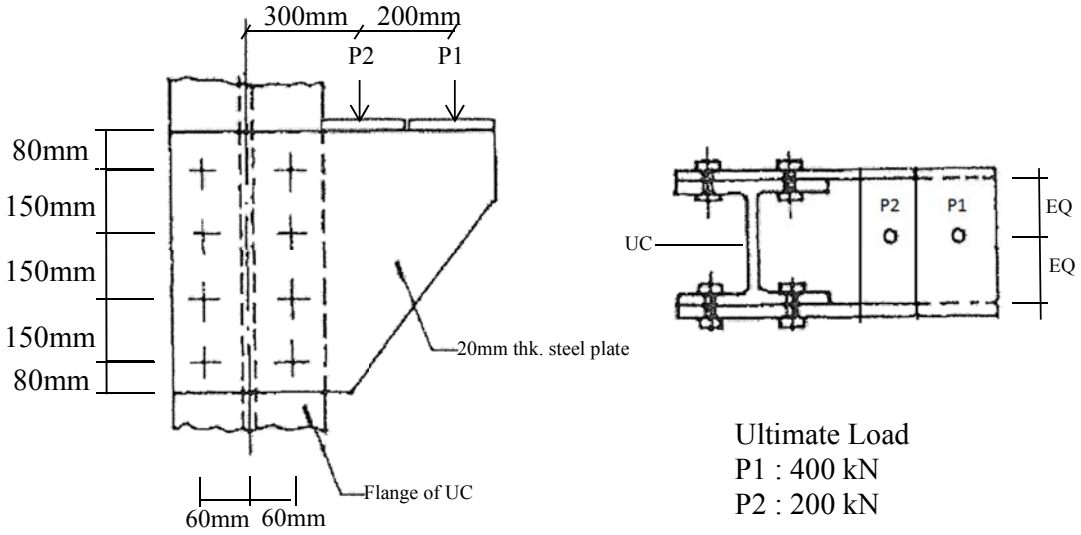


Figure Q2

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BQ.3 A 7.0 m long braced steel column in a non-sway frame is subjected to factored end loads as shown below. The column is fixed at the both ends. Assume that the ***K*** value for effective length is 0.7, check the adequacy of the column section of 254 x 254 x 167 kg/m UC (***Grade S355***).

Given:

Factored axial load = 1600 kN
Factored moment about ***x-x*** axis, $M_{x\text{-}x}$ at top of column = +130 kNm
Factored moment about ***x-x*** axis, $M_{x\text{-}x}$ at bottom of column = +45 kNm
Amplification factor $P\text{-}\Delta\text{-}\delta$ effect in ***x-x*** axis = 1.1
Factored moment about ***y-y*** axis, $M_{y\text{-}y}$ at top of column = +70 kNm
Factored moment about ***y-y*** axis, $M_{y\text{-}y}$ at bottom of column = -40 kNm
Amplification factor $P\text{-}\Delta\text{-}\delta$ effect in ***y-y*** axis = 1.2
Factored moment amplified for $P\text{-}\Delta\text{-}\delta$ effect governing M_b:
M_{LT} = 1.2 x 130 = 156 kNm
(Note: Positive sign for clockwise moment; negative sign for anti-clockwise moment)

(30 marks)

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BQ.4

(a) State two examples of Ultimate Limit States and Serviceability Limit States repectively for steel structure design. (4 marks)

(b) A simply supported Grade 355 steel beam 406 x 178 x 74 kg/m with span of 5.5 m is subjected to the following uniformly distributed load (UDL) conditions. Lateral restriants on compression flanges of the steel beam are provided at the end supports only.

- Dead Load = 10 kN/m
- Dead load (self weight of steel beam)
- Imposed Load = 3 kN/m

(i) Calculate the maximum bending moment and shear force. (6 marks)

(ii) Determine the classification of the steel section. (2 marks)

(iii) Check the shear capacity of the steel beam. (3 marks)

(iv) Calculate the buckling resistance moment M_b of the steel beam by using accurate values of parameter u and v in calculation of λ_{LT}. (12 marks)

(v) If the beam is applied with brittle finishes, check whether the beam will exceed the deflection limit. (3 marks)

- END OF PAPER -