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Hong Kong Institute

of

Vocational Education

香港專業教育學院

[redacted]

HD in Civil Engineering

(EG524101)

[redacted]

Steelwork Design

(C O N 4 3 3 4)

[redacted]

AY 2017/18

Semester 8 Examination

xx May 2018
7:00 pm – 9:00 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 **FIVE (5)** 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 the compulsory question in Section A. Answer ANY TWO (2) questions in Section B.**
5. All symbols have their usual meaning unless otherwise defined.
6. All figures are **NOT** necessary to scale.

Examination Data:

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

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SECTION A: COMPULSORY QUESTION (40%)

Q.1 (a) Layout of steel beams supporting solid concrete slabs is as shown in **Figure Q.1**. The compression flanges of the steel beams are **fully restrained** from lateral torsional buckling by the concrete slabs. Assuming all beams are carrying brittle finishes.

- The concrete slabs are 175 mm thick with 1.5 kN/m^2 finishes.
- The imposed load on the slabs is 5.0 kN/m^2.
- All steel beams are Grade S355 and simply supported at their ends.
- Unit weight of concrete is assumed to be 24.5 kN/m^3.

(i) Find the section classes of steel Beam A and Beam B. (4 marks)

(ii) Determine the design load intensity (kN/m^2) carried by the slab. (4 marks)

(iii) With the consideration of steel beam self-weight, determine the maximum bending moment and shear force of Beam A and Beam B. (8 marks)

(iv) Detemine the bending capacity, shear capacity and deflection of Beam A and Beam. (24 marks)

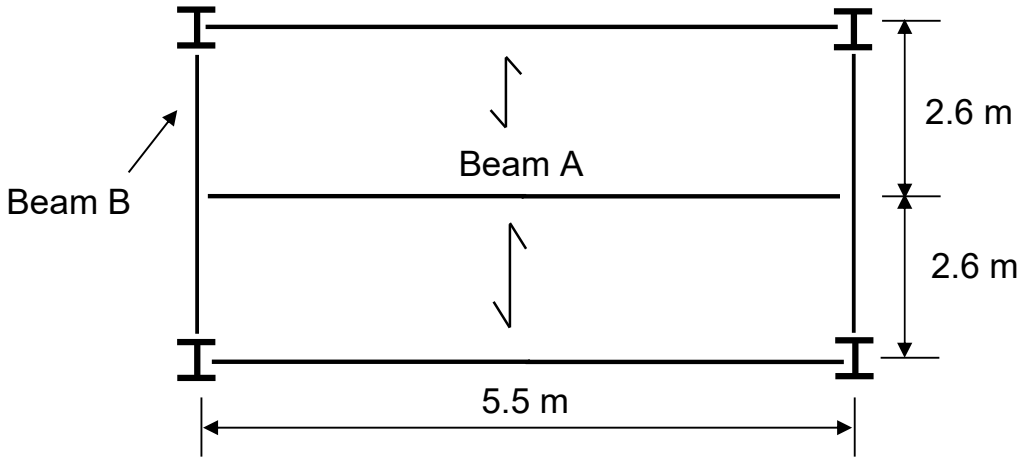


Figure Q.1

Beam A section: 305 x 165 x 40 kg/m UB
Beam B section: 356 x 171 x 51 kg/m UB

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Section B – Answer any TWO questions in this Section

BQ.1 (a) A tension splice connection as shown in ***Figure Q2(a)*** is subjected to a tensile load of DL=150 kN and LL=300 kN. The main plate is 22 mm thick and the cover plates are 12 mm thick. All steel plates are of ***Grade S355***.

(i) Show that the cover plates and main plate have adequate strength to resist the design tensile load; (5 marks)

(ii) Design the weld length of **6mm fillet weld** for the connection. Given that Class 42 electrodes are to be used; (6 marks)

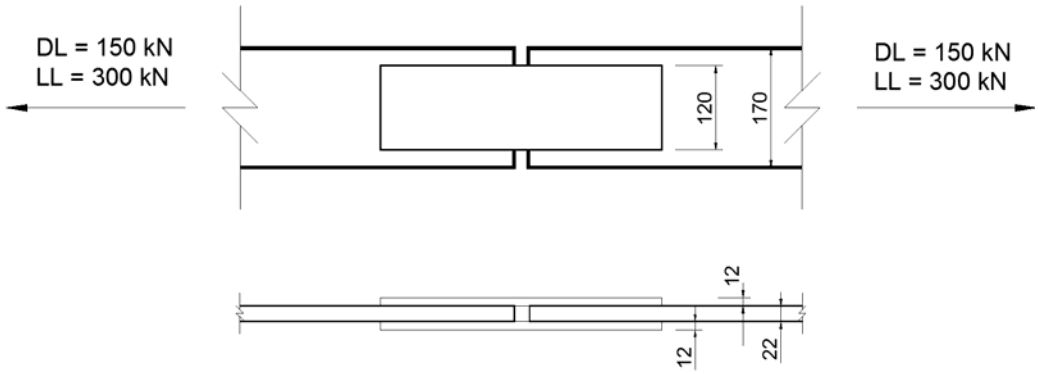


Figure Q.2a
(All dimension in mm)

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(b) The steel bracket as shown in ***Figure Q2(b)*** is subjected to a design load of 400 kN. All the bolts are ***M20 Grade 8.8*** bolts, and steel members are of ***Grade S355***.

(i) Hence check the adequacy of the bolts for the bracket connection. (9 marks)

(ii) Determine the shear and bearing capacity of the bolts; (10 marks)

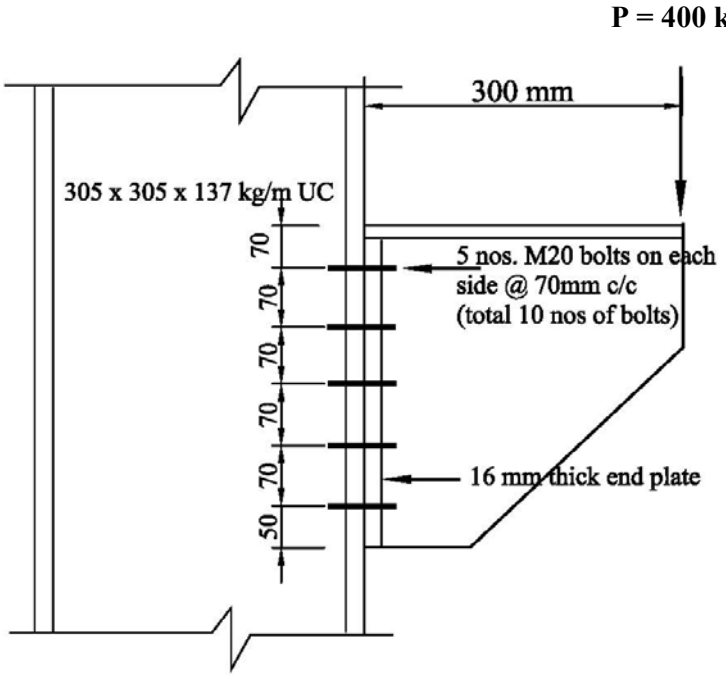


Figure Q2(b) ***(dimension in mm)***

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Q3 A **305 x 305 x 158 kg/m UC (Grade S355)** braced steel column in a non-sway frame with 5 **m** effective height is subjected to factored end loads as shown below. (30 marks)

Given:
Factored axial load = 1500 kN
Factored moment about x-x axis, $M_{x\text{-}x}$ at top of column = +100 kNm
Factored moment about x-x axis, $M_{x\text{-}x}$ at bottom of column = +50 kNm
Amplification factor P-Δ-δ effect in x-x axis = 1.1
Factored moment about y-y axis, $M_{y\text{-}y}$ at top of column = +90 kNm
Factored moment about y-y axis, $M_{y\text{-}y}$ at bottom of column = -38 kNm
Amplification factor P-Δ-δ effect in y-y axis = 1.16
Factored moment amplified for P-Δ-δ effect governing M_b:
M_{LT} = 100 x 1.1 = 110 kNm
(Note: Positive sign for clockwise moment; negative for anti-clockwise moment)

(a) Determine the class of the steel column section. (4 marks)
(b) Check the cross section capacity of the column. (6 marks)
(c) Check the buckling resistance of the column. (20 marks)

Q4 A simply supported steel beam with brittle finishes and a span of **6.0 m** is subjected to a uniformly distributed load and the maximum factored loading data are given as follows. **Lateral restriants on compression flange of the steel beam are provided at the end supports only**. The sectional dimentions of the beam is 406 x 178 x 74 kg/m UB (Grade S355).

- Design Moment = 190 kNm
- Design Shear Force = 450 kN

(a) Determine the class of beam section. (2 marks)
(b) Calculate the shear capacity of the steel beam. (5 marks)
(c) Check the buckling moment resistance of the steel beam by using accurate values of parameters ***u*** and ***v*** in the calculation of λ_{LT}. (13 marks)
(d) Check the deflection limit if the beam is under an unfactored imposed load of 48 kN/m along the whole span. (4 marks)
(e) Sketch the lateral torsional buckling diagram of steel beam if there is additional point load and lateral restraint are provided in the mid-span of the beam. (6 marks)

- END OF PAPER -