National Examinations – May 2018

07-Str-A2, Elementary Structural Design

3 Hour Duration

NOTES

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.

2. This is a **"CLOSED BOOK"** examination. Handbooks and textbooks are permitted. **No notes or sheets are allowed.** Candidates may use one of two calculators, the Casio or Sharp approved models. You must indicate the type of calculator being used (i.e. write the name and model designation of your calculator on the first inside left-hand sheet of the exam work book).

3. Solutions must be to the following standards:

Steel:	CSA-S16 (latest edition)
Concrete:	CSA-A23.3 (latest edition)
Timber:	CSA-O86 (latest edition)

4. A total of **five** solutions is required. Only the first five as they appear in your answer book will be marked.

   Do **two** questions from Part A.
   Do **two** questions from Part B.
   Do the **one** question in Part C.

5. All questions are of equal value.

6. **All loads shown are unfactored.**

Marking Scheme:

A1. (10 + 10)
A2. (10 + 10)
A3. (8 + 6 + 6)
B1. (10 + 10)
B2. (8 + 6 + 6)
B3. (10 + 5 + 5)
C1. (8 + 6 + 6)

Part A (Do two of three questions)

A1. A steel round hollow section of G40.21 350W Class H, 355.6 mm OD and thickness of 7.95 mm, is used as a column, 10 m long. The column is subjected to a vertical bracket load P_f, applied at an eccentricity of 0.6 m. The column is hinged at the top and rigidly fixed at its base. Calculate the maximum factored load, P_f, that can be applied.

A2. A loaded steel stub beam W360 x 79, G40.21 350W, is a cantilever welded to a steel column which is W610 x 140 (G40.21 350W). The stub beam is loaded at its end by a concentrated load of 100 kN.

(a) Design the connection between the steel beam and the column;
(b) Check the adequacy of the beam W360 x 79 to carry the load.

A3. Figure A3 shows a cross-section fabricated from 20mm G40.21 350W steel plates. Check the stability of the members, and hence determine the cross-section moments of resistance about the two centroidal axes: x-x and y-y.

Part B (Do two of three questions)

B1. A double-T cross-section of reinforced concrete beam is shown in Figure B1. Calculate its moment (M_r) and shear (V_r) resistances. (Use $f_c' = 35$ MPa and $f_y = 400$ MPa).

B2. A 6-m long reinforced concrete column has the same cross-section shown in Figure B2. The column can be assumed to be fixed at the bottom and pinned at the top. The column is subjected to: A concentrated horizontal wind load of P_F is applied at its mid-height, and a axial load applied at the top of 10 P_F. Calculate the maximum load P_F that it can carry. (Use $f_c' = 35$ MPa and $f_y = 400$ MPa).

B3. A overhanging reinforced concrete beam is loaded as shown in Figure B3. Determine the dimensions of its rectangular cross-section and the steel reinforcements to satisfy moment and shear. Take into account the self-weight of the beam. (Use $f_c' = 35$ MPa and $f_y = 400$ MPa.)

Part C (Do question C1)

C1. A 130 x 228 mm 20f-Ex Spruce-Pine glulam column is loaded as follows:

Specified axial load = 10 kN dead load + 35 kN live load; concentrated wind load of 10 kN applied at mid-height. The column is 5 m high and it is restrained in the weak direction. Calculate P_f, P_r, M_f and M_r for one load case, namely: dead plus live plus wind loads.

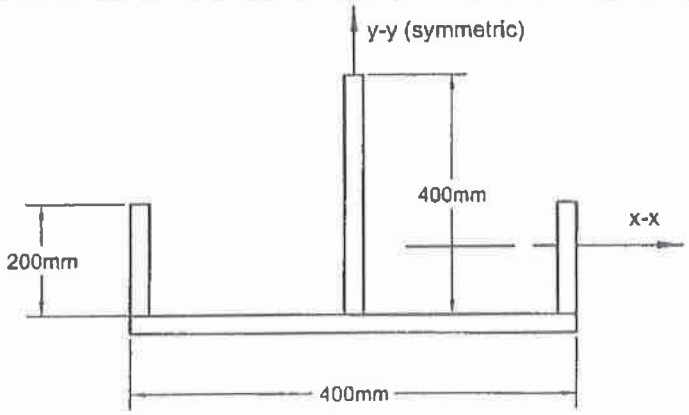
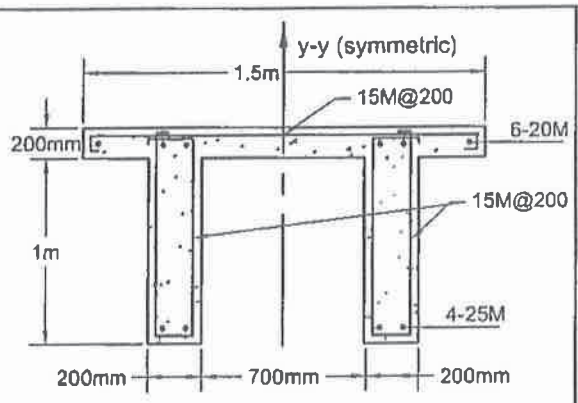


FIGURE A3

NOT TO SCALE



NOT TO SCALE

FIGURE B1

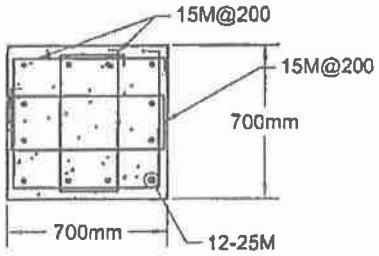


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FIGURE B2

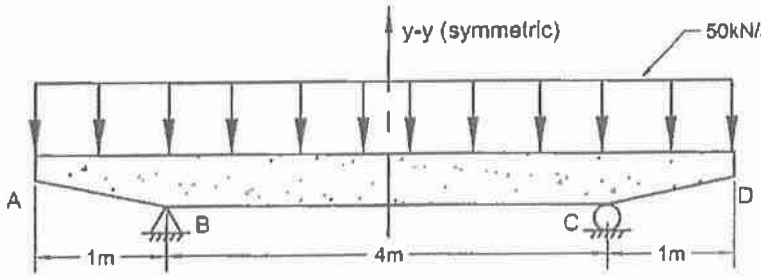

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FIGURE B3