National Examinations – December 2014

98-Civ-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:	CAN/CSA-S16 (latest edition)
Concrete:	CAN/CSA-A23.3 (latest edition)
Timber:	CAN/CSA-086 (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, unless otherwise specified.**

Marks for:
A1 - (10 + 10)
A2 - (20)
A3 - (12 + 8)
B1 - (10 +10)
B2 - (12 + 8)
B3 - (12 + 8)
C1 - (10 + 5 + 5)

Part A (Do <u>two</u> of three questions)

A1. The steel cross-section shown in Figure A1 is fabricated from 25 mm G40.21 350W steel plates. Determine the section moments of resistance about the two centroidal axes x-x and y-y. (Ignore all bracings ab, cd, etc.).

A2. A steel column, having the same cross-section as that in Question A1, is subjected to a vertical load P_f applied at N along the x-x axis at an eccentricity of 500 mm from the centroid O. The column is 6 m high and hinged at its two ends. Calculate the maximum factored load P_f that the column can carry. (Ignore bracings ab, cd, etc.).

A3. The simply-supported steel I-beam W360x79 of G40.21 350W with an overhang, is made up of two equal lengths, AB and BC, as shown in Figure A3. Design a welded rigid connection at B to transfer both flexure and shear at B for the given loading.

Part B (Do <u>two</u> of three questions)

B1. The reinforced concrete double hollow section shown in Figure B1 is reinforced with 24-30M longitudinal bars and 15M ties spaced at 250 mm. Calculate the moment of resistance and shear resistance of the cross-section.

Use $f_c' = 35$ MPa and $f_y = 400$ MPa.

B2. Figure B2 shows the profile of a determinate reinforced concrete frame, ABC. Design a rectangular cross-section and the reinforcing for flexure and shear for beam AB. Show the layout of the reinforcement. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.

B3. For the determinate reinforced concrete frame, shown loaded in Figure B2, design a square cross-section and the corresponding reinforcing for the column BC. Assume the column is short, pinned at C and monolithic at B. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.

Part C (Do question C1)

C1. Two 130 x 304 mm Douglas fir glulam beams are supported by hangers that are bolted to a continuous 175 x 228 mm Douglas fir glulam column. The specified dead and snow loads, transferred from each beam to the column are 12 kN and 24 kN, respectively. Design the connection using 1 in. diameter bolts. The thickness of steel hangers is 8 mm. Show all the dimensions, i.e. end distance, edge distance, etc.

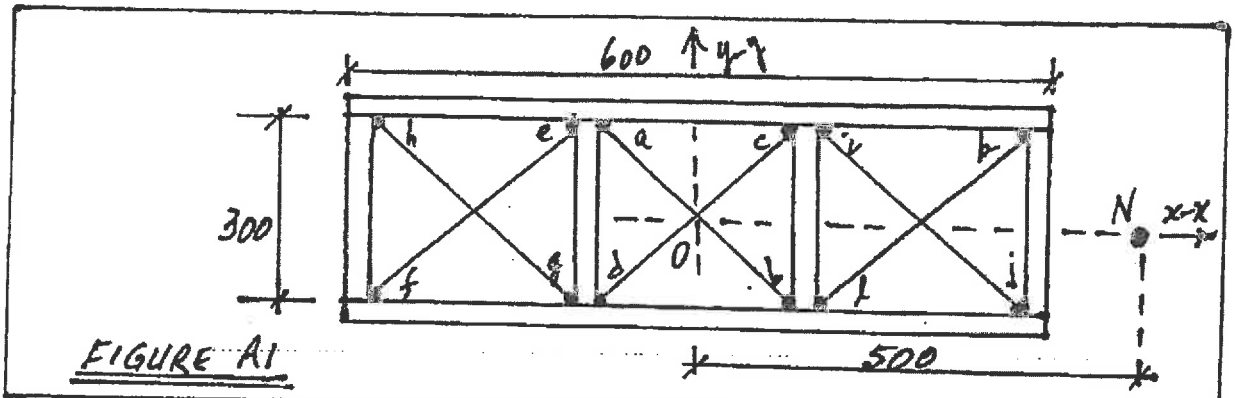

FIGURE A1

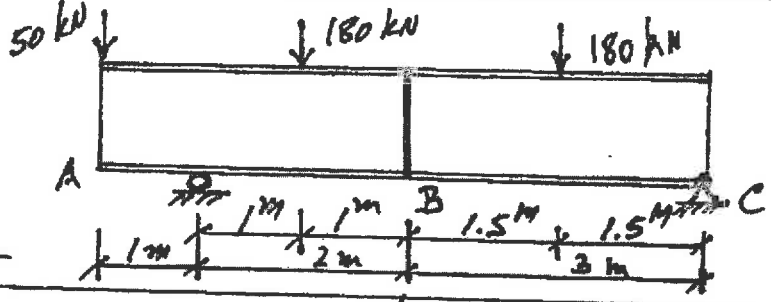

FIGURE A3

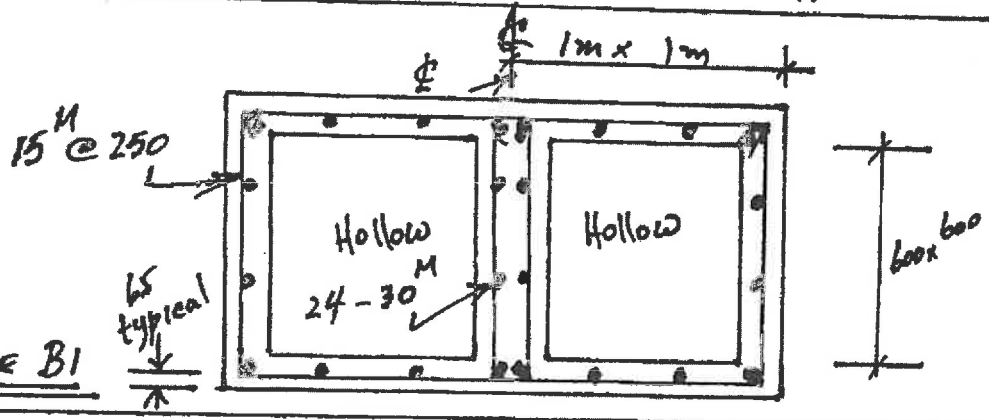

FIGURE B1

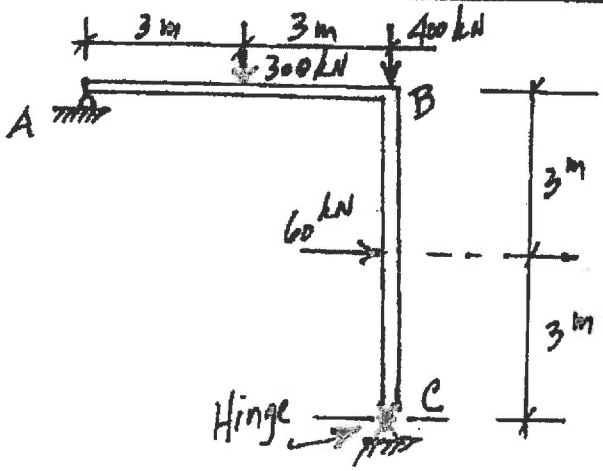

FIGURE B2