National Examinations – May 2010

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**.

Marking Scheme

A1.	(10 + 10)
A2.	(4 + 8 + 8)
A3.	(12 + 8)
B1.	(4 + 8 + 8)
B2.	(10 + 10)
B3.	(12 + 8)
C1.	(2 + 4 + 7 + 7)

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

A1. Figure A1 shows a steel cross-section fabricated from two 16 mm G40.21 350W steel plates and two W530 X 92 steel sections. Determine the section moments of resistance about the two centroidal axes, a-a and b-b.

A2. The cross-section in Question A1 is used as a column in a building. The column is 7 m high, hinged at the top and rigidly fixed at its base. The column is subjected to an eccentric vertical load, P_f, applied at point G, a distance of 0.5 m from the centroid O of the cross-section. Calculate the maximum factored load, P_f, that the column can carry.

A3. The simply-supported steel I-beam, W530 x 138, of G40.21 350W with an overhang, is made up of two lengths, AB and BC, as shown in Figure A3. Design a bolted 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. Figure B1 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.

B2. For the determinate reinforced concrete frame, shown loaded in Figure B1, design a square cross-section and the corresponding reinforcement for the column BC.

B3. A reinforced concrete section of a culvert has dimensions and reinforcement as shown in Figure B3. Calculate its moment of resistance, M_r and its shear resistance, V_r. Use f_c'=35 MPa and f_y= 400 MPa.

Part C (Do question C1)

C1. A 130 x 190 mm 20f-EX Spruce-Pine glulam column is loaded as follows:
Specified axial load = 8 kN dead load + 35 kN live load; concentrated wind load of 8 kN applied at mid-height. The column is 4.8 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 snow plus wind loads.

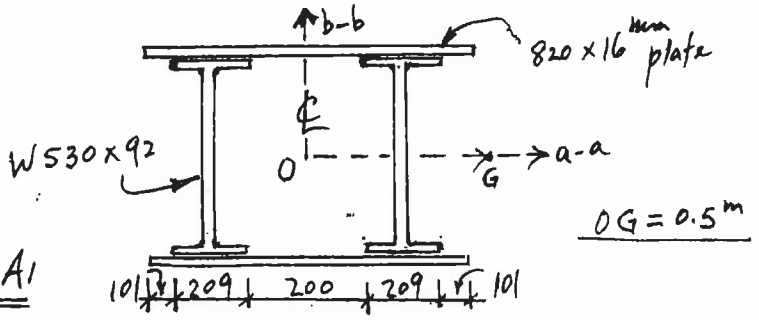

FIGURE A1

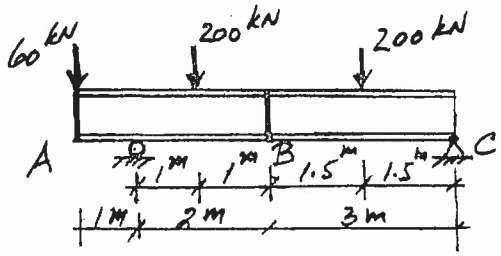

FIGURE A3

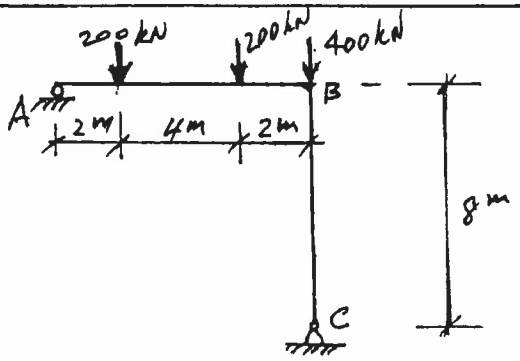

FIGURE B1

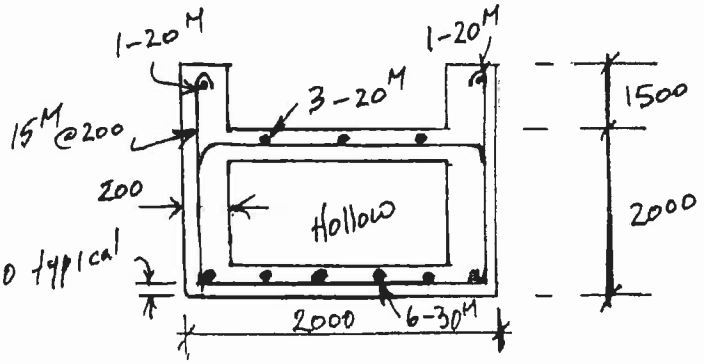

FIGURE B3