National Examinations – May 2009

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**.

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

A1. The loaded determinate frame ABC in Figure A1 is to be designed in steel of G40.21 350W. Design an appropriate steel section for member BC, satisfying both moment and shear. (Ignore the self-weight of members.)

A2. For the steel frame in Figure A1, design:
(a) the beam-column AB, and
(b) the welded connection at B.

A3. The cross-section shown in Figure A3 is constructed of steel half round section of G40.21 350W class H, 323.9 mm OD and thickness of 7.95 mm, and four steel plates of G40.21 350W each 10 mm thick. Determine the section moments of resistance about the centroidal axes x-x and y-y.

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

B1. Figure B1 shows the cross-section of a reinforced concrete box. Calculate the moment of resistance M_r and the shear resistance V_r of the section. 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 B1. 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 at its mid-height, and an axial load 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. <u>Take into account the self-weight of the beam</u>. (Use $f_c' = 35$ MPa and $f_y = 400$ MPa.)

Part C (Do question C1)

C1. The determinate frame ABC in Figure A1 is to be designed in timber for a storage building. Design a Douglas-fir glulam rectangular section for the frame, loaded as shown, to satisfy the following conditions: (a) permanent load duration; (b) dry service conditions; and, (c) treated.

<u>[Assume any other data that may be required]</u>.

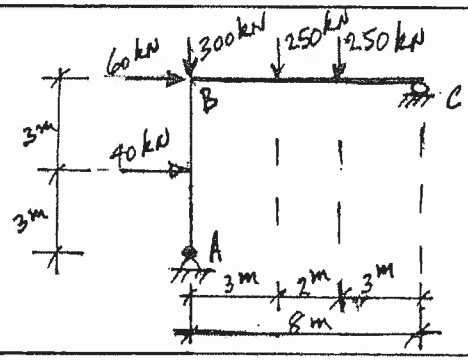

FIGURE A1

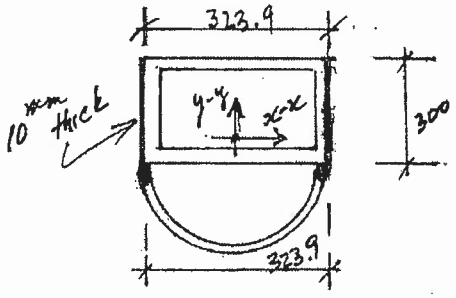

FIGURE A3

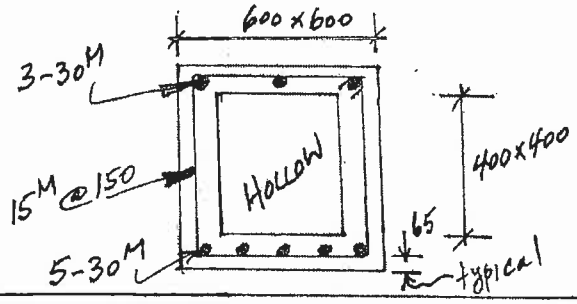

FIGURE B1

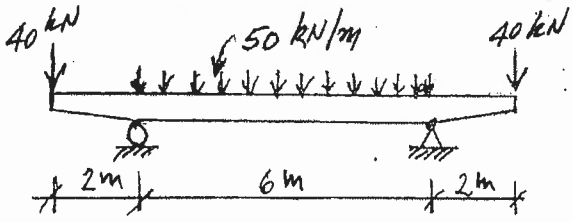

FIGURE B3

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Marking Scheme

(12 + 8)	A1.
(12 + 8)	A2.
(10 + 10)	A3.
(12 + 8)	B1.
(6 + 7 + 7)	B2.
(5 + 10 + 5)	B3.
(8 + 6 + 6)	C1.