National Examinations – May 2011

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. (12 + 8)
A3. (4 + 8 + 8)
B1. (12 + 8)
B2. (4 + 8 + 8)
B3. (10 + 10)
C1. (8 + 6 + 6)

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

A1. Figure A1 shows a steel cross-section fabricated from 20 mm G40.21 350W steel plates. Determine the section moments of resistance about the two centroidal axes, x-x and y-y.

A2. A simply-supported steel I-beam, W610 x 241, of G40.21 350W, is made up of two lengths, AB and BC, as shown in Figure A2. Design a welded rigid connection at B to transfer both flexure and shear at B for the given loads.

A3. A steel round hollow section, of G40.21 350W Class H, 355.6 mm OD and thickness of 6.35 mm, is used as a column. The column is subjected to a vertical bracket load P_F, applied at an eccentricity of 0.8 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.

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

B1. Figure B1 shows the cross-section of a reinforced concrete box culvert. 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 overhanging reinforced concrete beam is loaded as shown in Figure B2. Determine the dimensions of its rectangular cross-section and the steel reinforcements to satisfy moment and shear. Show the layout of the reinforcing steel. <u>Take into account the self-weight of the beam</u>. (Use $f_c' = 35$ MPa and $f_y = 400$ MPa.)

B3. Design a hollow square cross-section for a reinforced concrete column 10 m in height, supporting an eccentric load, P_F, applied along its centroidal axis at an eccentricity of 0.5 m from its centroid,. The column is hinged at its top and bottom.

Part C (Do question C1)

C1. The roof of a building requires the use of single span oblique sawn timber purlins. Using preservative-treated D. Fir-L select structural grade, in dry service conditions, design the purlins to satisfy the following conditions: Purlin spacing = 2.25 m; Purlin span = 6 m, Roof pitch = 20^{O}.

Specified dead load (including weight of purlin) = 1.00 kPa;
Specified live load = 1.8 kPa. Assume standard duration of load.

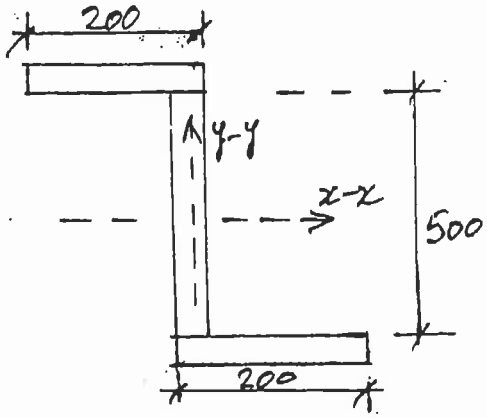

FIGURE A1

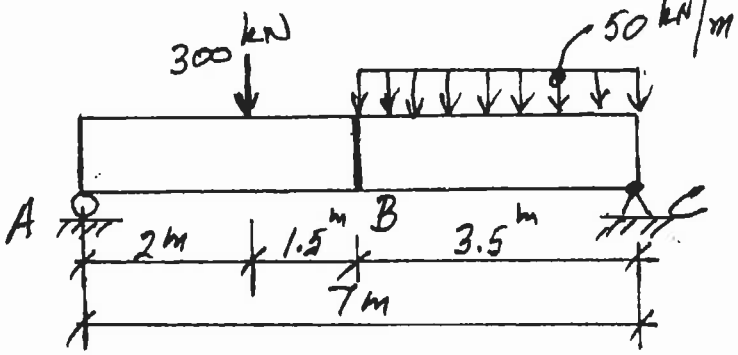

FIGURE A2

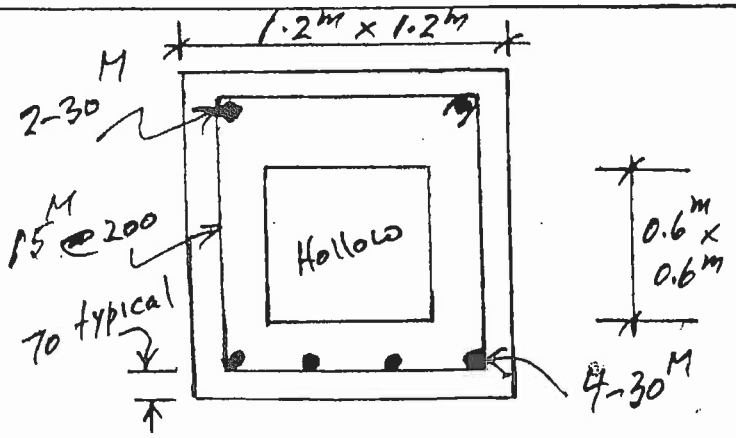

FIGURE B1

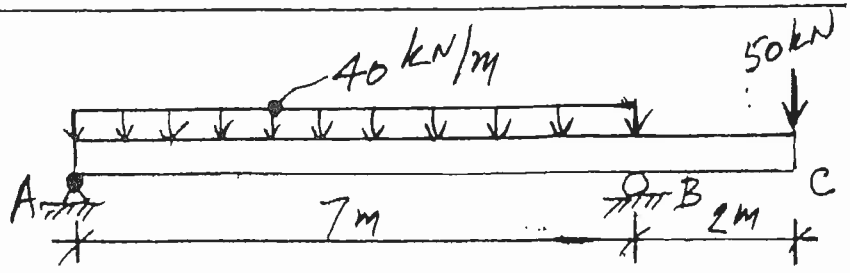

FIGURE B2