National Examinations – May 2013

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:	CSA-S16 (latest edition)
Concrete:	CAN/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. (4 + 16)
A3. (12 + 8)
B1. (4 +12 + 4)
B2. (12 + 8)
B3. (10 + 10)
C1. (10 + 6 + 4)

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

A1. Figure A1 shows a steel cross-section fabricated from two back-to-back, C310 x 45 steel channels, welded to one plate, 20 mm thick x 260 mm wide. Determine the section moments of resistance about the two centroidal axes, x-x and y-y. All steels are G40.21 350W grade.

A2. A overhanging 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, 406.4 mm OD and thickness of 9.53 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, and 6 m in height. Calculate the maximum factored load, P_F, that can be applied.

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

B1. The overhanging reinforced concrete Beam in Figure B1 is loaded with the live load shown. Determine the dimensions of a rectangular cross-section and steel requirements for moment and shear. Account for the self-weight of the beam. Use f_c' = 35 MPa and f_y = 400 MPa.

B2. A triple-T reinforced concrete cross-section for a building floor system is shown in Figure B2. Calculate its moment (M_R) and the shear (V_R) resistances. Use f_c' = 35 MPa and f_y = 400 MPa.

B3. For the determinate reinforced concrete frame, shown loaded in Figure B3, 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.

Part C (Do question C1)

C1. Check whether a 241 x 343 mm No. 1 D. Fir-L is satisfactory as a single span floor beam for the following conditions:

Beam spacing = 2.5 m;
Beam span = 5.0 m;
Specified dead load (including self-weight) = 2.0 kPa;
Specified live load = 2.5 kPa;
L/180 deflection limit based on total load;
L/360 deflection limit based on live load.

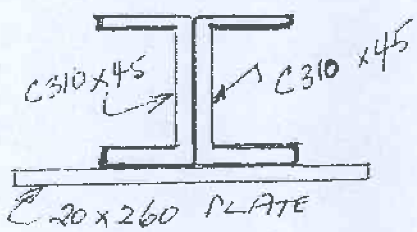

FIGURE A1

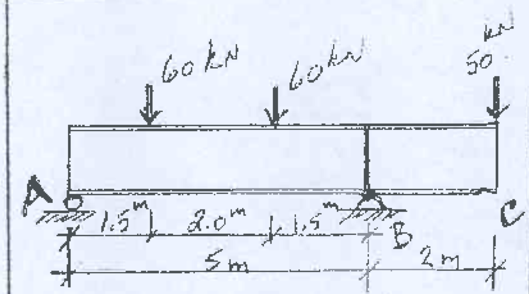

FIGURE A2

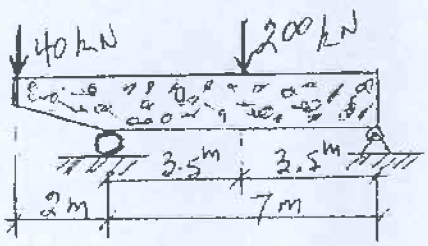

FIGURE B1

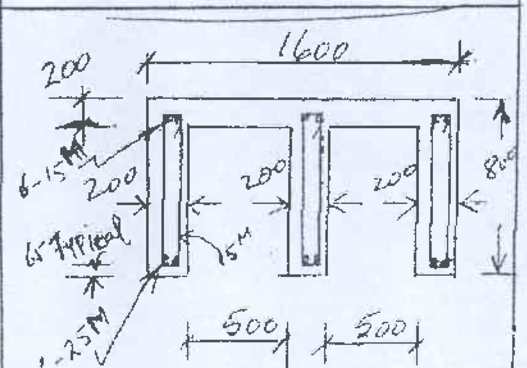

FIGURE B2

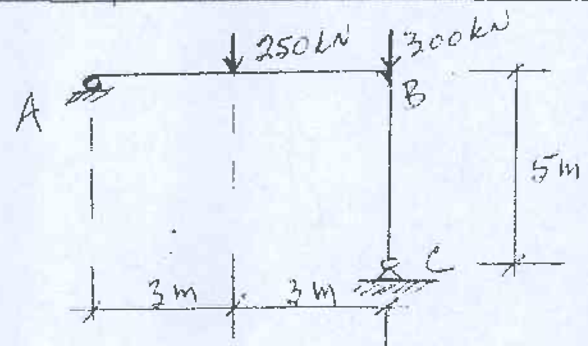

FIGURE B3