National Examinations – December 2009

07-Str-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. A built-up steel cross-section is shown in Figure A1. It is fabricated from G40.21-350W steel. Determine the section moments of resistance about the two centroidal axes x-x and y-y.

A2. A simply-supported steel beam, with an overhang is loaded as shown in Figure A2. The beam has the same cross-section as that in Question A1. Determine whether the beam cross-section has adequate shear and moment capacities to carry the specified load.

A3. For the determinate steel frame in ABCD, loaded as shown in Figure A3, design:

(a) the column CD, assuming lateral support at C and D; and,
(b) the welded connection at B.

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

B1. Figure A3 shows the profile of a determinate reinforced concrete frame, ABCD. Design a rectangular cross-section and the reinforcing for flexure and shear for beam BC. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.

B2. A reinforced concrete section has dimensions and reinforcement as shown in Figure B2. Calculate its moment of resistance, M_R and the shear resistance, V_R. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.

B3. The cross-section in Figure B2 is to be used in the design of a beam-column. Check whether it can carry the loads on column CD in Figure A3.

Part C (Do question C1)

C1. Use D.Fir-L Select Structural Grade to design oblique sawn timber purlins under the following conditions:

Purlin spacing = 1.6 m
Purlin span = 5.5 m
Roof pitch = ¼
Specified dead load = 0.60 kPa
Specified live load = 2.8 kPa
Standard duration of load; Dry service conditions, and no treatment.

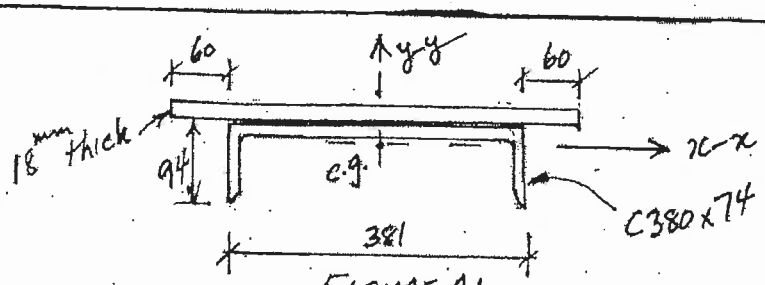

FIGURE A1

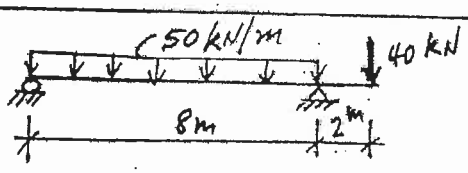

FIGURE A2

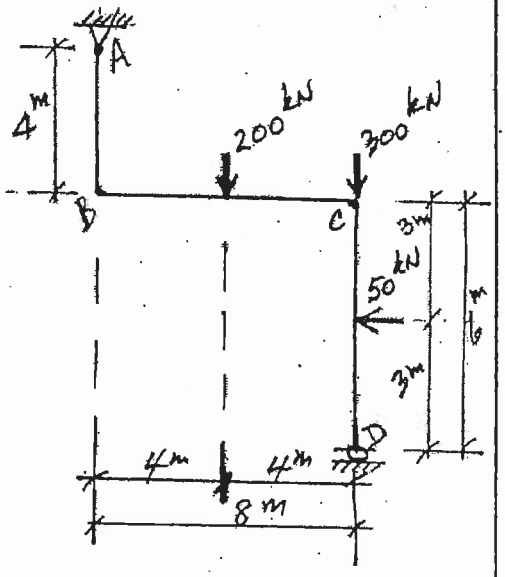

FIGURE A3

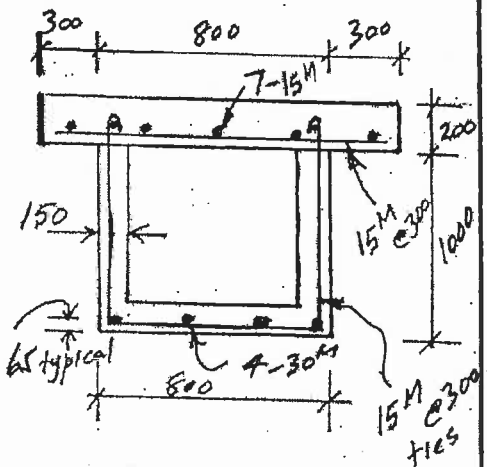

FIGURE B2