

National Exams May 2012

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:	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. (12 + 8)
- A2. (12 + 8)
- A3. (10 + 10)
- B1. (4 + 8 + 8)
- B2. (12 + 8)
- B3. (10 + 10)
- C1. (10 + 6 + 4)

Part A (Do two of three questions)

- A1. The steel beam ABC in Figure A1 is supported by a steel tie at B and a bolted connection to a beam-column AD. Design the beam ABC for the loads shown, using G40.21 350W grade steel.
- A2. (a) Check the adequacy of the beam-column AD in Figure A1 to carry the loads shown. All steels are G40.21 350W grade. Assume the column is fixed at the bottom and laterally supported at the top.
- (b) Design the bolted connection at A.
- A3. Figure A3 shows a steel cross-section fabricated from a channel section C380 x 50, reinforced with two plates, each 20 mm thick x 172 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.

Part B (Do two of three questions)

- B1. Design the beam in Figure A1, using reinforced concrete construction. Use a rectangular cross-section and show the profiles of the reinforcing steel for both moment and shear. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B2. Figure B2 shows the cross-section of a tunnel. Calculate the moment of resistance, M_r , and shear resistance, V_r , of the section. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B3. Figure B3 shows a reinforced concrete determinate frame. Design a square section for column BC. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.

Part C (Do question C1)

- C1. A floor, 8 m x 10 m, in a farm building is to be constructed of plywood sheets on No. 1 D.Fir-L joists. Design the simply supported joists for the following conditions:

Span = 8 m;
Specified dead load = 1.8 kPa;
Specified live load = 3 kPa;
Wet service conditions, and untreated.

[Assume any other data that may be required.]

