

National Examinations – December 2010

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.**

Marking Scheme:

- A1. (4+16)
- A2. (8+6+6)
- A3. (4+10+6)
- B1. (5+10+5)
- B2. (6 +7+7)
- B3. (4+10+6)
- C1. (8+6+6)

Part A (Do two of three questions)

- A1. A light standard post in Figure A1 is made of steel round hollow section of G40.21 350W class H, 273.1 mm OD and thickness of 7.95 mm. The 10-m post is a free standing column at the top and rigidly fixed to a concrete foundation. The post is subjected to two cantilevered loads, diametrically opposite to each other. Calculate the maximum factored load, P_F , that can be carried.
- A2. A built-up steel cross-section is shown in Figure A2. It is fabricated from G40.21 350W steel. Determine the section moments of resistance about the two centroidal axes x-x and y-y.
- A3. The loaded steel beam W360 x 51, G40.21 350W, in Figure A3 is a cantilever welded to the steel column, W610 x 125 of G40.21 350W.
- (a) Design the connection between the steel beam and the column;
(b) Check the adequacy of the beam W360 x 51 to carry the loads shown.

Part B (Do two of three questions)

- B1. Figure B1 shows the profile of a determinate reinforced concrete frame, ABCDE. Design a rectangular cross-section for beam BCD, and the reinforcing to satisfy flexure and shear. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B2. For the reinforced concrete frame in Figure B1, design the column DE. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B3. A triple-T cross-section of reinforced concrete is shown in Figure B3. Calculate its moment (M_r) and shear (V_r) resistances. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.

Part C (Do question C1)

- C1. The determinate frame ABCDE in Figure B1 is to be designed in timber for a temporary facility. Design a Douglas-fir glulam rectangular section for the member BCD, loaded as shown, to satisfy the following conditions: (a) permanent load duration; (b) wet service conditions; and, (c) untreated. Ignore the dead weight of the frame.

[Assume any other data that may be required.]

