

National Examinations – May 2014

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. However Handbooks and textbooks are permitted. **No notes on the Handbooks, textbooks or loose sheets are allowed.** Candidates may use one of two calculators, the Casio or Sharp approved models.
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. (5 + 10 + 5)
- A2. (6 + 7 + 7)
- A3. (4 + 4 + 12)
- B1. (6 + 8 + 6)
- B2. (4 + 4 + 12)
- B3. (10 + 10)
- C1. (10 + 10)

Part A (Do two of three questions)

- A1. The ends of the steel wide flange beam, W530 x 92, G40.21 350W, in Fig. A1 are fixed to rigid columns, W610 x 125. Design a welded connection at B to transfer both moment and shear at B for the applied load shown. **Note:** Use the Steel Handbook to obtain the values of moment and shear at B.
- A2. A pedestrian bridge cross-section built-up from 20 mm G40.21-350W steel plates is shown in Fig. A2. Determine the moments of resistance of the cross-section about the centroidal axes x-x and y-y.
- A3. The ends of a 18-m long pedestrian bridge, whose steel-section is shown in Fig. A2 are subjected to a horizontal compressive force, P_f . The force is applied at C, a distance of 80 mm below the c.g. and along the y-y axis. The ends of the bridge can be assumed to be hinged. Calculate the maximum factored load, P_f that the bridge can sustain horizontally.

Part B (Do two of three questions)

- B1. Figure B1 shows a loaded reinforced concrete determinate frame. Determine the dimensions of a rectangular cross-section and the required amount and layout of steel reinforcing for member ABC, to satisfy both moment and shear requirements. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.
- B2. Design the column CD for the reinforced concrete frame in Fig. B1. The column can be assumed short. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.
- B3. Figure B3 shows the cross-section of a reinforced concrete culvert. For the given dimensions and steel reinforcing, 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. Single span oblique sawn timber purlins are required for a roof. Using treated D. Fir-L select structural grade, in wet service conditions, design the purlins to satisfy the following conditions: Purlin spacing = 2.2 m; Purlin span = 5 m, Roof pitch = 20.0°

Specified dead load (including weight of purlin) = 1.00 kPa;

Specified live load = 2.6 kPa. Assume standard duration of load.

