National Examinations – May 2014

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. 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.

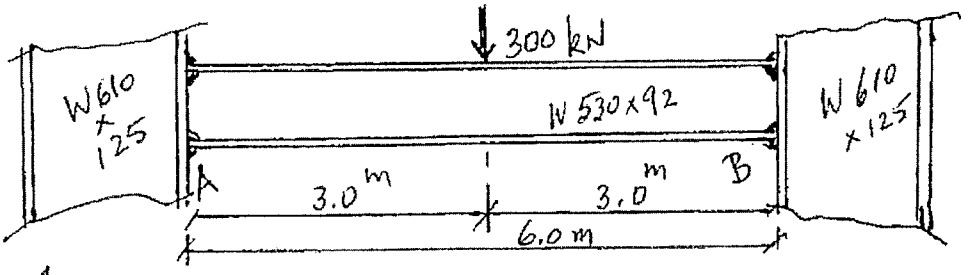

FIGURE A1

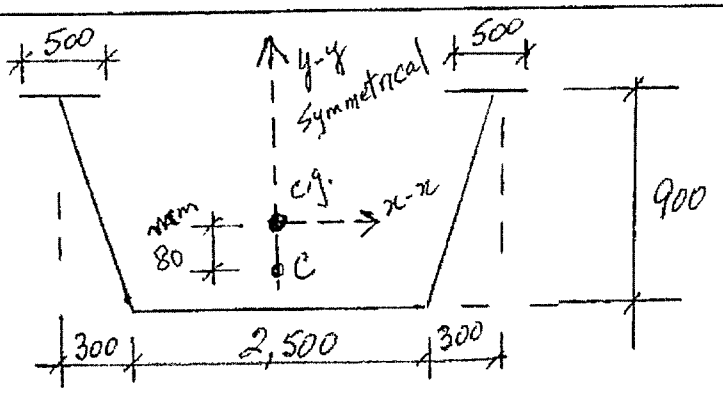

FIGURE A2

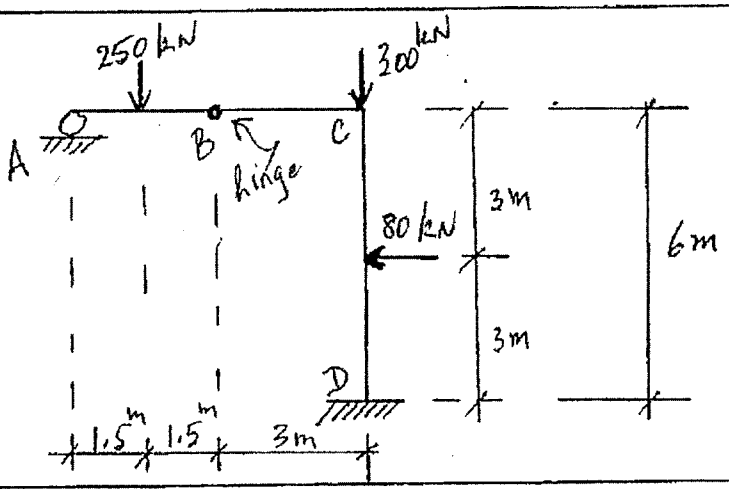

FIGURE B1

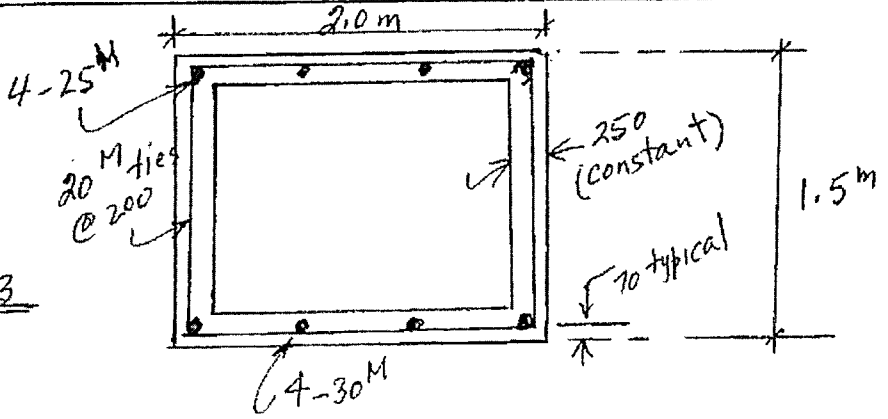

FIGURE B3