

National Examinations – December 2012

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. 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 are 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. | (10 + 10) |
| A2. | (4 + 16) |
| A3. | (12 + 8) |
| B1. | (4 + 12 + 4) |
| B2. | (12 + 8) |
| B3. | (10 + 10) |
| C1. | (10 + 6 + 4) |

Part A (Do two of three questions)

- A1. Figure A1 shows the cross-section of a steel beam built-up from 20 mm G40.21 350W steel plates. Calculate the moments of resistance of the cross-section about the centroidal axes, x-x and y-y.
- A2. The steel cross-section of Question A1 is used as a column, pinned at its top and bottom. The column is 8 m high and it is subjected to a vertical load P_f applied at D along the axis y-y, 100 mm from the centroid O. Calculate the maximum factored load, P_f that the column can carry.
- A3. The loaded steel beam W310 x 45, G40.21 350W, in Figure A3 is simply supported by two identical columns, W610 x 241 of G40.21 350W. Design the connections between the steel beam and the columns. Also, check the capacity of the steel beam 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 and the reinforcing for flexure and shear of beam BCD and the corner connection at B. Show the layout of the reinforcement. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B2. For the reinforced concrete frame in Figure B1, design the column AB, assuming that the column is short. Use $f'_c = 35$ MPa and $f_y = 400$ MPa.
- B3. A cross-section of a reinforced concrete box 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. An exterior bearing stud wall is subjected to the following specified loads: Vertical dead load = 12 kN/m; vertical snow load = 30 kN/m; wind pressure = 0.7 kPa. The stud spacing is 300 mm and the stud length = 4.0 m. Design the stud wall under wet service condition, and untreated. Assume that buckling about the weak axis is prevented.

[Assume any other data that may be required.]

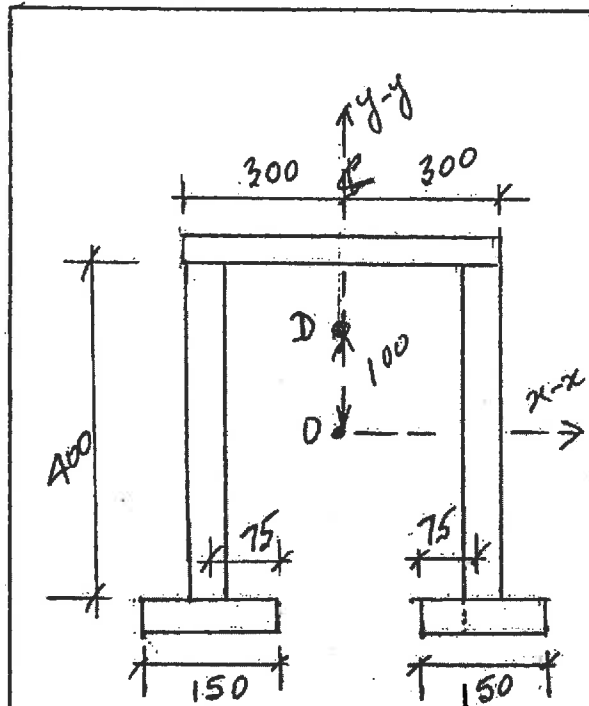


FIGURE A1

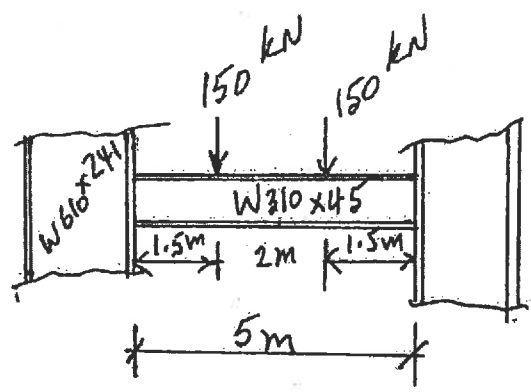


FIGURE A3

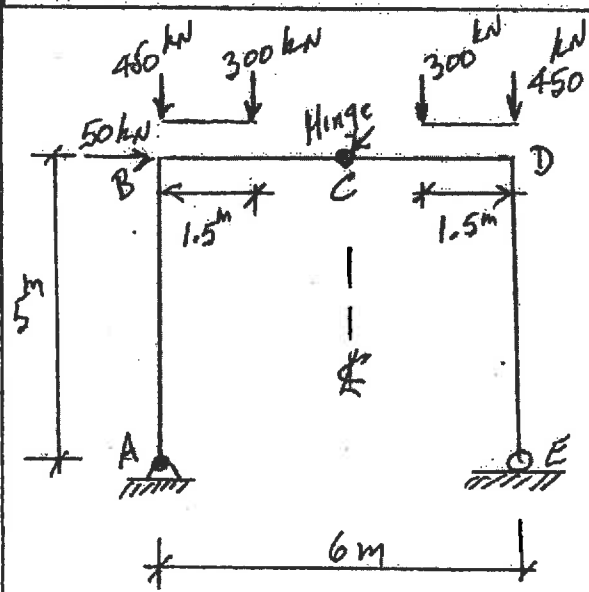


FIGURE B1

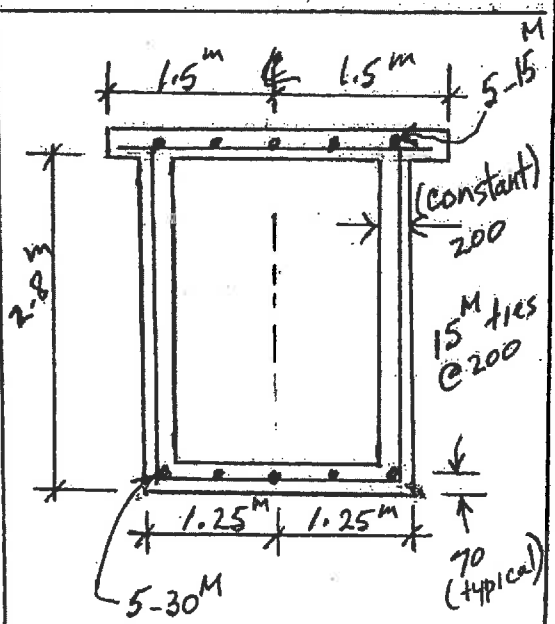


FIGURE B3