

National Examinations - December 2003

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. Any non-communicating calculator is permitted. This is an “**OPEN BOOK**” examination. Note to candidates: 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)
Concrete:	CAN/CSA-A23.3 (latest)
Timber:	CAN/CSA-086.1 (latest)
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.

Part A (Do two of three questions)

- A1. Figure A1 shows a steel cross-section fabricated from 16 mm G40.21 300W steel plates. Determine the section moments of resistance about the two centroidal axis, a-a and b-b.
- A2. The steel round hollow section, of G40.21 350W class H, 323.9 mm OD and thickness of 7.95 mm, is used as a column. The column, shown in Fig A2, is subjected to a vertical bracket load, P_F , applied at an eccentricity of 1.5 m. The column is free standing at the top and rigidly fixed at its base. Calculate the maximum factored load, P_F , that can be applied.
- A3. Figure A3 shows a fillet weld connection. A 12 mm steel plate, of G40.21 300W, is welded to a steel member with two 6 mm fillet welds, using an electrode E480 XX. Calculate the maximum factored load P_F kN that can be applied to the connection.

Part B (Do two of three questions)

- B1. The reinforced concrete beam in Figure B1 is loaded with the live load shown. Determine the dimensions of the rectangular cross-section and steel requirements for moment and shear. Take into account the self-weight of the beam. Use $f_c' = 35$ MPa and $f_y = 400$ MPa.
- B2. The cross-section of a reinforced concrete box beam has the dimensions and reinforcement shown in Fig. B2. Calculate the moment of resistance, M_R , and the shear resistance, V_R .
Use $f_c' = 35$ MPa and $f_y = 300$ MPa.
- B3. The cross-section shown in Fig. B2 is used for a column 5 m long. The column can be assumed to be effectively pinned at both ends. The column is subjected to an axial load at the top as well as a concentrated horizontal wind load of 50 kN at its mid-height. Calculate the maximum factored axial load P_F that it can support.
Use $f_c' = 35$ MPa and $f_y = 300$ MPa.

Part C (Do question C1)

- C1. An isolated joist of 4 m span is to be loaded with a specified central concentrated dead load of permanent duration. The joist is unseasoned 38 x 286 mm Douglas-fir No. 2 grade, treated with a fire-retardant material, simply supported with ends held in position to prevent lateral displacement and rotation. Assume wet service conditions. Deflection should not exceed 6 mm. What is the maximum concentrated load the beam can carry? Take into account the self-weight of the beam.

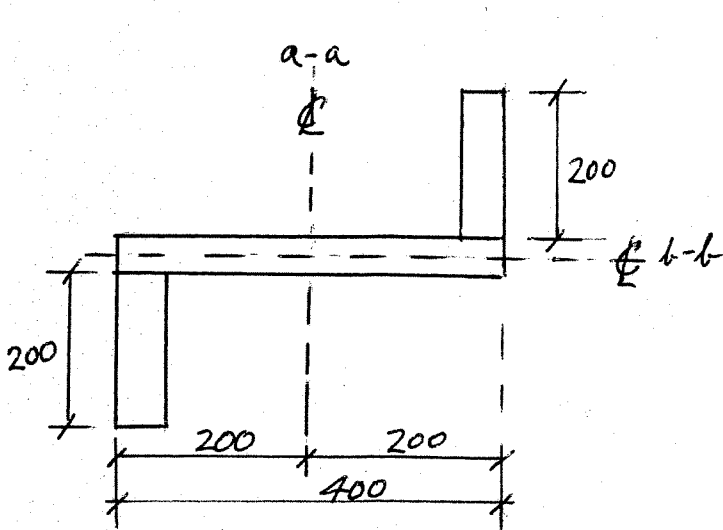


FIGURE A1

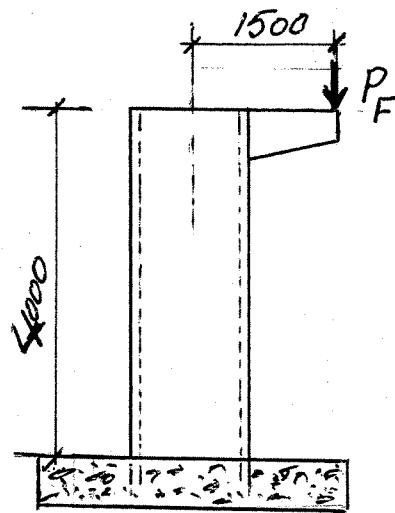


FIGURE A2

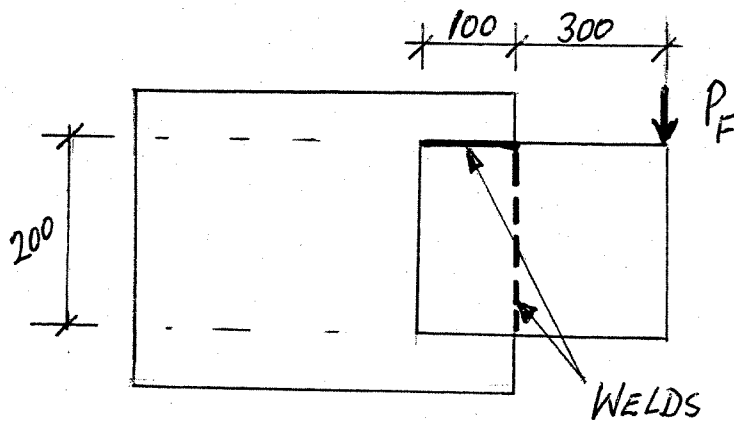


FIGURE A3

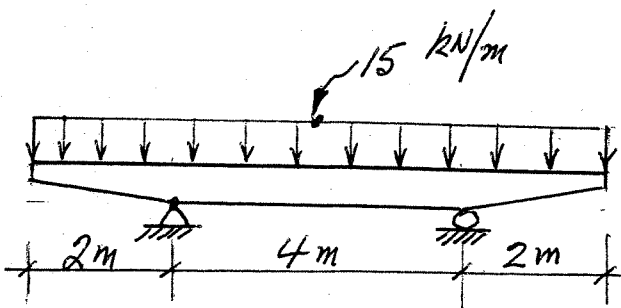


FIGURE B1

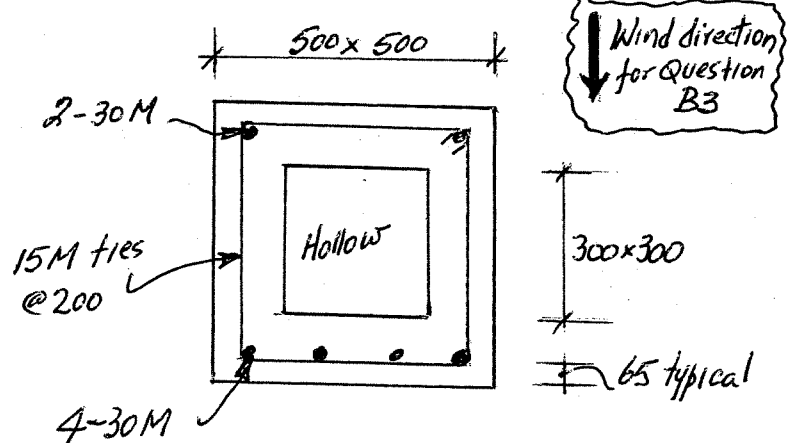


FIGURE B2