December 2019 Examinations

16-Civ-A2, Elementary Structural Design

3 Hour Duration

Notes:

1. If doubts exist as to the interpretation of the any question, the candidate is urged to submit with the answer paper a clear statement of any reasonable 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 indicated 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 latest editions of the following standards:
   a. Steel : CAN/CSA S16
   b. Concrete: CAN/CSA A23.3
   c. Timber: CAN/CSA O86

4. A total of five solutions are required. Only the first five as they appear in your answer book will be marked. If more than one solution is provided for a given question only the first will be marked. If you change your answer strike out your answer with an "X" that you no longer wish to have graded.
   a. Do **TWO (2)** questions from Part A
   b. Do **TWO (2)** questions from Part B
   c. Do **ONE (1)** question from Part C

5. All questions within a given section are of equal value

6. **All loads shown are unfactored unless otherwise stated.**

7. **All structural steel sections unless otherwise noted shall be assumed to be G40.21 300W, all reinforcement in concrete shall be assumed to be 400W unless noted otherwise.**

Marking Scheme
A1 (20)
A2 (20)
A3 (20)
B1 (20)
B2 (20)
B3 (20)
C1 (20)

Part A (Do TWO (2) of three (3) questions)

A1. Referring to figure A1, The truss shown is subject to the service loads reported in the figure. Design the compression member FG out of back to back angles. Also provide the space (as appropriate) for the interconnection of the angle to achieve the design forces. You may assume a 10mm gap between angles.

A2. You have been engaged to design steel connections for a steel fabricator. One of the designs requires you to provide connections for a W200x27 beam to a W200x59 columns flange. Design the following:

a.) Design a shear connection that will support 60% of the maximum laterally supported uniformly distributed load the beam can carry assuming it is 5m long.

b.) Design a welded splice for the W200 assuming it is being made up of two pieces of steel. The design moment to be resisted is 40kN-m and the design shear at the splice location is 50kN. Assume the fabricator wishes to only use fillet welds combined with splice plate(s) on the web and flanges.

A3. A composite beam and deck system made up of W360x72 at 1000mm o.c. is to span 8m. The deck when cast is to be 100mm thick concrete (25MPa). The shear studs to be used have an ultimate stress capacity of 415MPa and will have a diameter of 16mm. Assuming 100% connection and that the system is shored during casting determine the ultimate moment of the composite W360.

Part B (Do TWO (2) of three (3) questions)

B1. The Tee section shown in Figure B1 is part of an interior one-way simply supported system determine the ultimate moment and shear resistance of the section. Assuming the beams are spaced at 1250mm o.c.,and are made of 30MPa concrete.

B2. Design a 6m high square reinforced concrete column assuming that the member is subject to a uniformly distributed lateral load of 5kN/m (wind) and the column must carry an axial live load of 150kN and an axial dead load of 300kN. Assume both ends are pinned. Use concrete with a capacity of 25MPa, assume the column will be located inside a building. Check against all load combinations.

B3. Design the beam shown in Figure B3 to resist the load shown. Assume f'c = 35MPa. Assume the architect wishes to have a beam that is 900mm deep and 400mm wide.

Part C (Do question C1)

C1. Design the wood beam shown in Figure C1 assuming it is in a wet condition and is to be made using standard dimensional lumber (built-up members). Assume the beam is repeated along the length of a building at a spacing of 0.9m. Assume the available wood is SPF No. 1 or 2.

P1
75kN LIVE
90kN DEAD

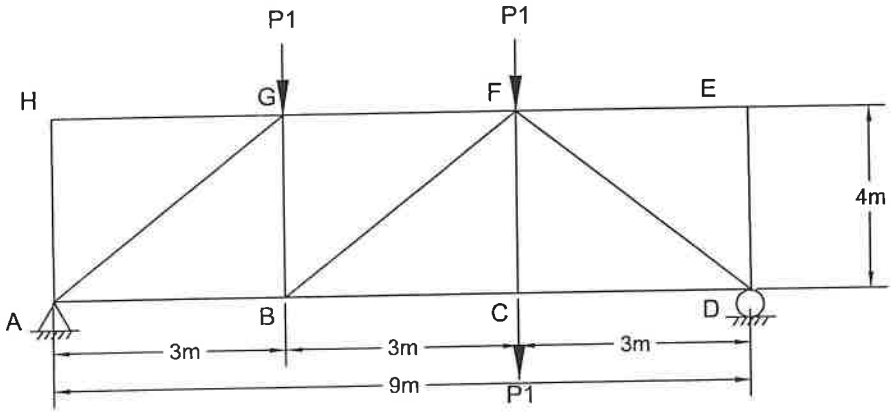

FIGURE A1

NOT TO SCALE

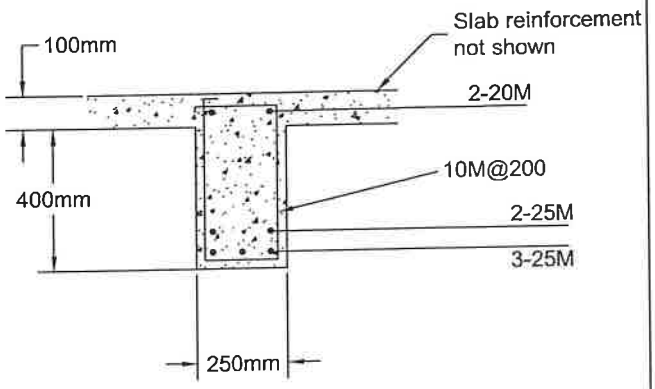

FIGURE B1

NOT TO SCALE

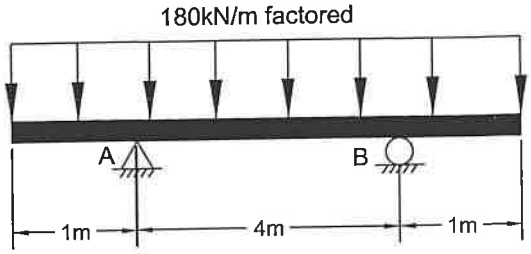

FIGURE B3

NOT TO SCALE

W1
LIVE 1.5 kPa
DEAD 1.0 kPa

P1
LIVE 2.5kN
DEAD 3.0kN

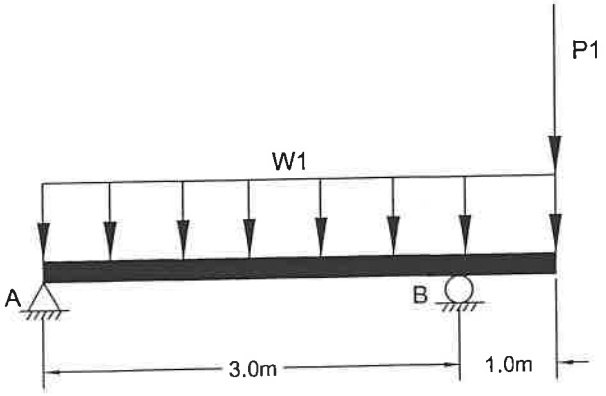

FIGURE C1

NOT TO SCALE