

Examinations – May 2019

07-Str-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 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 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 (10+10)

A3 (20)

B1 (20)

B2 (20)

B3 (20)

C1 (20)

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

- A1. A column is made up of two (2) back to back C310x37. There is a 25mm gap between the sections which is filled at 500mm spacings with a spacer plate which is then welded to each of the channels. If the column is to be 6m high (only supported at the top and bottom) what is the maximum factored axial load that can be carried assuming both ends are pinned?
- A2. A 2.5m long cantilevered beam W360x39 is to be moment connected to a W200x71 column to resist a point load of 20kN live load and 30kN dead load. The W360 is lateral restrained only at the column and end of the cantilever.
- (a) Design the connection between the W360 and W200 assume the column is continuous. The shear connection shall be bolted and the moment component resisted through welding.
  - (b) Check the adequacy of the beam to carry the load.
- A3. Referring to Figure A3. The truss shown is made up of only two (2) member sizes; specifically one (1) for all tension members and one (1) for all compression members. Using HSS Class C sections (350W steel) determine what size member best works for the tension members and which member size works best for the compression.

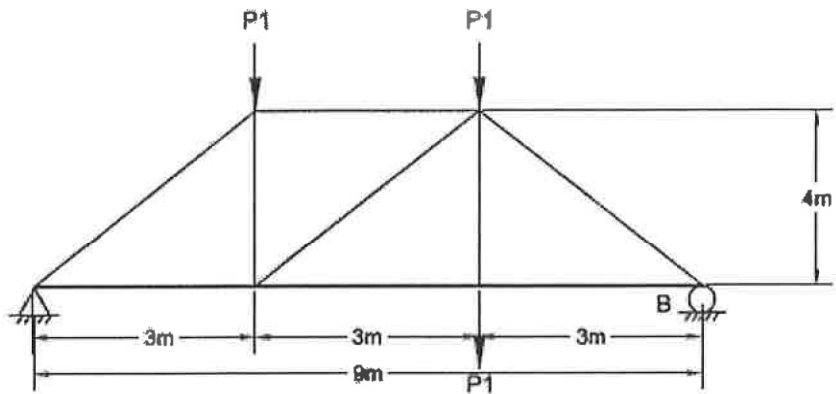
**Part B (Do TWO (2) of three (3) questions)**

- 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 2m o.c., the span is 5m long, and is made of 30MPa concrete.
- B2. Design a 8m high square reinforced concrete column assuming that the member is subject to a lateral point load at mid-height in one direction of 20kN (wind) and the column must carry an axial live load of 300kN and an axial dead load of 400kN. Assume the bottom the top are pinned. Use concrete with a capacity of 30MPa, assume the column will be located inside a building.
- B3. Design the beam shown in Figure B3 to resist the load shown. Assume  $f'_c = 35\text{MPa}$ .

**Part C (Do question C1)**

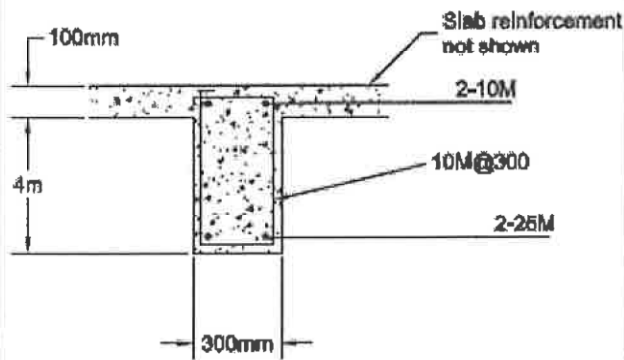
- C1. Design the wood beam shown in Figure C1 assuming it is in a wet condition and is to be made using standard dimensional lumber (built-up members). Assume the beam is repeated along the length of a building at a spacing of 1.2m.

**P1**  
 100kN LIVE  
 180kN DEAD



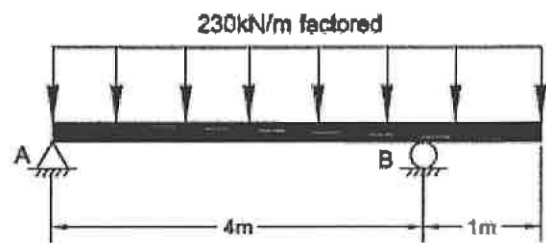
**FIGURE A3**

NOT TO SCALE



NOT TO SCALE

**FIGURE B1**

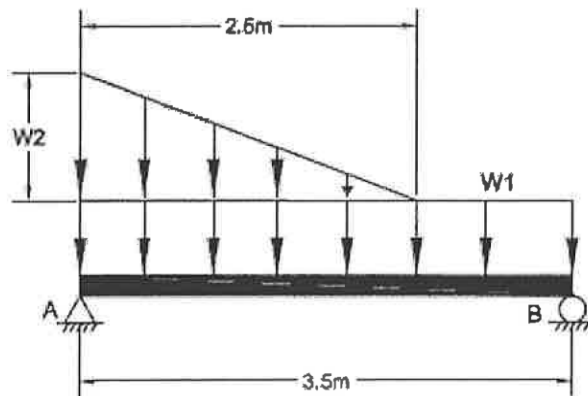


NOT TO SCALE

**FIGURE B3**

**W1**  
 LIVE/SNOW 1.0 kPa  
 DEAD 1.5 kPa  
 WIND 1.2kPa

**W2**  
 SNOW 2.0kPa



NOT TO SCALE

**FIGURE C1**