

Examinations – May 2019

16-Civ-B2, Advanced Structural Design

3 Hour Duration

**Notes:**

1. If doubts exists 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.
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. For the beam shown in Figure 1 determine the most appropriate wide flange section, assume that the beam is only laterally restrained at the support locations
- A2. Assuming the column and beam sections for the frame shown in Figure 2 are the same determine the most appropriate wide flange section to be used.
- A3. For the beam in Figure 1 if the span between A and B is to be of a cross-section depth equal to approximately  $\frac{2}{3}$  of that used in B-C what two wide flange sections are most appropriate? Define the connection between the sections (welded) to ensure continuity.

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

- B1. For the beam shown in Figure 3 design a reinforced concrete cross-section which can resist the moment and shear forces which develop. Assume a concrete strength of 25MPa.
- B2. Referring to Figure 2; if the deck is rigid design the column section C-D using a square reinforced concrete cross-section with a concrete strength of 35MPa.
- B3. For the frame in Figure 2 design a rectangular footing with a 3 to 1 ratio for column AB, to resist the imposed forces. Assume an allowable soil bearing capacity of 150kPa and an ultimate bearing capacity of 225kPa. Detail the connection of the column to the pier assuming a square cross-section. The footing shall be made out of 25MPa concrete.

**Part C (Do question C1)**

- C1. Referring to Figure 3 design a prestressed beam section to resist the defined loading condition. Assume the beam is fabricated by a CSA certified shop, all strands at 1860MPa low relaxation type and the concrete is 40MPa. Define the long-term deflection under dead load.

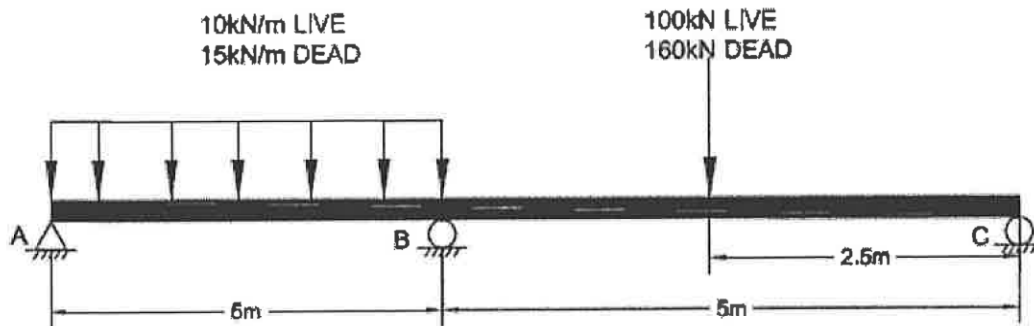


FIGURE 1

NOT TO SCALE

**P1**  
100kN LIVE  
180kN DEAD

**P2**  
200kN LIVE  
360kN DEAD

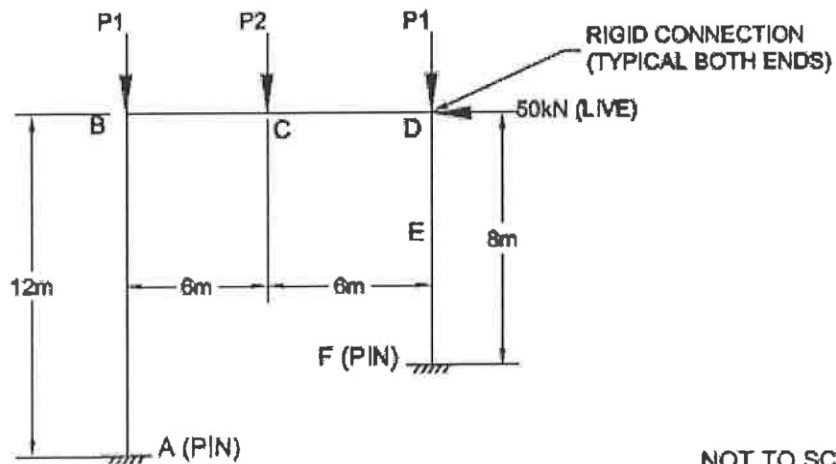


FIGURE 2

NOT TO SCALE

**W1**  
LIVE/SNOW 3 kN/m  
DEAD 4.5 kN/m

**W2**  
WIND 3.6 kN/m  
SNOW 6 kN/m

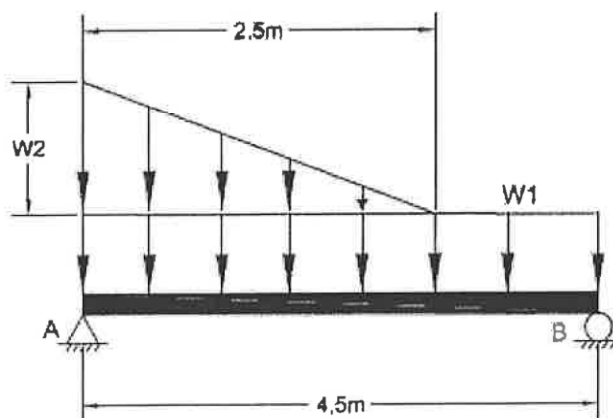


FIGURE 3

NOT TO SCALE