December 2019 Examinations

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 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.**

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 beam section for each span (not to be the same) and provide a full moment connection detail to be applied at point B. Beams do not need to be the same depth.

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. Referring to the sway frame in Figure 2, the fabricator wishes to make the system our of one section (member AB, BD and DF are all to be the same W section). What W section can be used for this system?

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

B1. For the beam shown in Figure 4 design a reinforced concrete cross-section which can resist the moment and shear forces which develop. Assume a concrete strength of 35MPa and a width to depth ratio of 1 to 3. The beams are to be spaced at 2m on center.

B2. Referring to Figure 3; Design a reinforced concrete cross-section for portion A-B of member A-B-C, assume the cross section is to be square and the concrete shall have a compressive strength of 35MPa.

B3. For the frame in Figure 3 design a rectangular footing with a 4 to 1 ratio member ABC, to resist the factored forces. Assume an ultimate bearing capacity of 200kPa. 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 4 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 and verify all stresses at each stage. The concretes strength at the strand release is 30MPa. Beams are located at 2m on center.

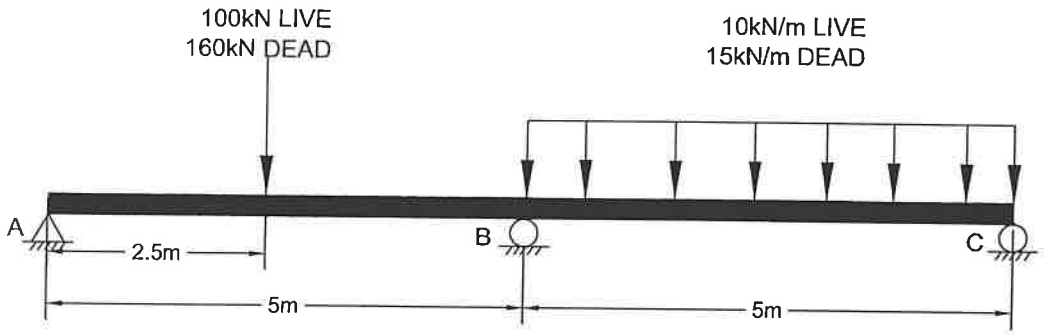
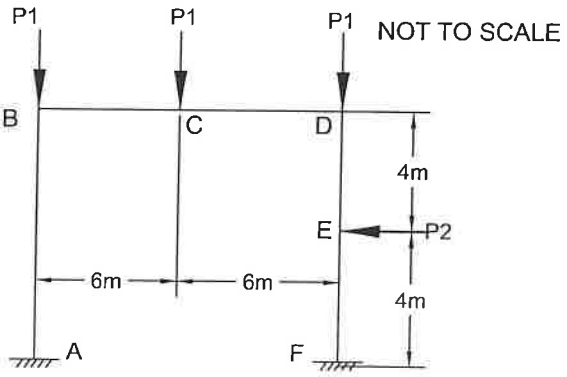


FIGURE 1

NOT TO SCALE



NOT TO SCALE

FIGURE2

P1
100kN LIVE
180kN DEAD

P2
150kN LIVE

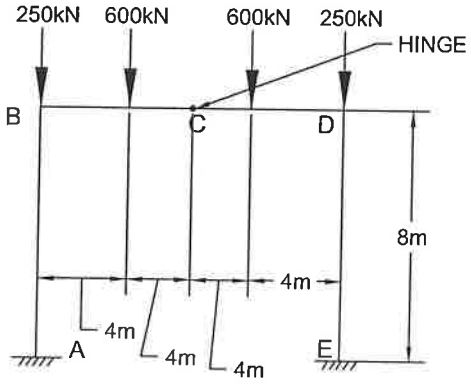


FIGURE 3

NOT TO SCALE

W1
LIVE 1.5 kPa
DEAD 1.0 kPa

P1
LIVE 2.5kN
DEAD 3.0kN

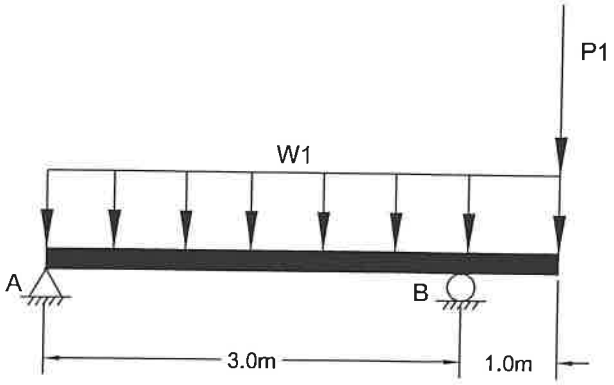


FIGURE 4

NOT TO SCALE