NATIONAL EXAMS – December 2018

16-Civ-B2, Advanced Structural Design

3 Hours 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. This is a **"CLOSED BOOK"** examination. Design 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 workbook.

3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.

4. All questions are of equal value.

5. **All loads shown are unfactored.**

USE THE FOLLOWING DESIGN DATA

Design in	SI

Concrete	$f'_c = 30$ MPa
Structural Steel	$f_y = 350$ MPa
Rebar	$f_y = 400$ MPa

Prestressed Concrete	f_c (at transfer) = 35 MPa $f'_c = 50$ MPa $n = 6$ $f_{ult.} = 1750$ MPa $f_y = 1450$ MPa $f_{initial} = 1200$ MPa Losses in prestress = 240 MPa

Marks for:
Question 1: (14 + 6)
Question 2: (14 + 6)
Question 3: (15 + 5)
Question 4: (14 + 6)
Question 5: (12 + 6 + 2)
Question 6: (12 + 6 + 2)
Question 7: (12 + 8)

1. The rigid frame in Fig. 1 is to be designed in reinforced concrete construction. Using the Limit State Design method, design member BCD, for flexure and shear. Sketch the reinforcing details for member BCD. Assume the same stiffness for all members.

   [Assume lateral support is provided where necessary.]

2. Using the same R.C. frame in Fig. 1, design member DEF as a beam-column and sketch the reinforcing details.

3. Estimate the long-term deflection at mid-span of BCD in Fig. 1. Also, estimate the size of the support footing at F. Assume a value for the soil bearing capacity of 500 kPa.

4. Figure 2 shows a loaded steel rigid frame to be designed using the Plastic Method of Design. The members have the same plastic moment capacity, as shown M_p.

   (a) Select an adequate steel section.
   (b) Design a welded corner connection at D.

   [Assume lateral support is provided at all joints and load locations.]

5. The loaded prestressed concrete girder in Fig. 3 is to be designed with no tension.

   (a) Design the corresponding section, and determine the area and profile of the post-tensioned steel.

6. A simply-supported pedestrian bridge is to be designed in composite steel-concrete construction. The bridge has a span of 16m, a width of 12m, and a concrete deck slab of 240 mm deep. The deck is supported by five equally-spaced steel beams at 3m apart. Using unshored construction, and assumed uniform load distribution:

   (a) Design the cross-section;
   (b) Determine the numbers of shear connectors required.

   [Assume the steel beams are adequately braced.]

7. A 2-span continuous welded plate girder, each span being 12m long, Fig. 4, is to be designed using the stiffened-web approach. Design the section adequate for bending and shear and their interaction.

   Note: Lateral support provided @ 2.0 m intervals.

   [Assume adequate size for the load-base plates.]

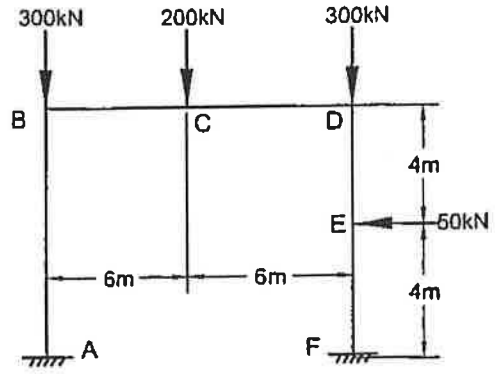

FIGURE1 NOT TO SCALE

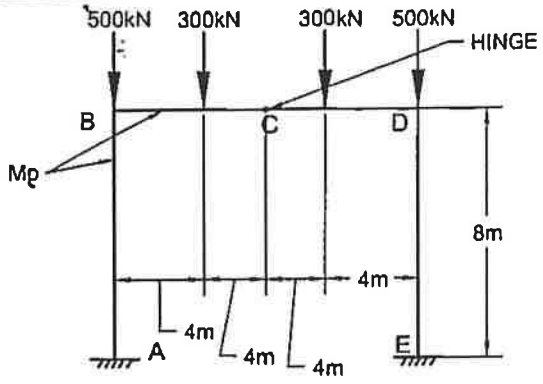

FIGURE2 NOT TO SCALE

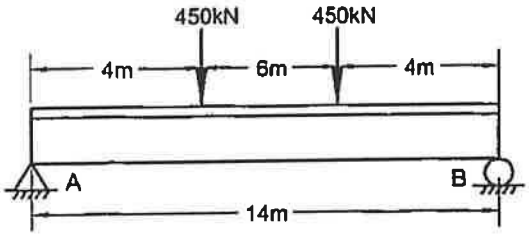

FIGURE 3

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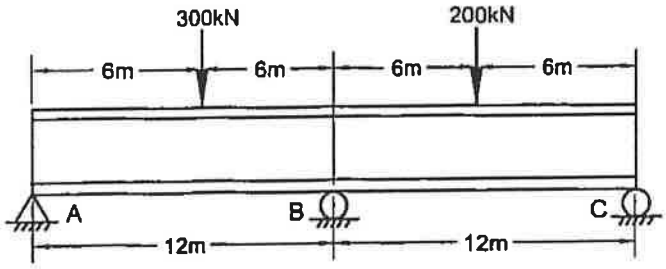

FIGURE 4

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