NATIONAL EXAMS – May 2012

98-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. 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 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

1. Figure 1 shows a rigid reinforced concrete frame. Using the Limit States Design Method, design a section for member BCD to satisfy moment and shear. Show the layout of the reinforcing.

2. (a) Design a cross-section of the beam-column AB in Figure 1.

   (b) Estimate the size of the footing at A, assuming a soil-bearing capacity of 500 kPa.

3. A simply-supported pedestrian bridge, 16 m in span, is to be designed in composite steel-concrete construction. The bridge cross-section is shown in Figure 2. Using shored construction, design the cross-section for a live load of 11 kPa, ignoring the self weight of the steel beams. Assume 100% interaction between the steel beams and the concrete slab.

   [Note: the steel beams are laterally supported.]

4. Figure 3 shows a prestressed concrete girder. Design the girder, allowing no tension in the cross-section. Show the profile of the prestressing steel.

5. A continuous steel plate-girder is shown in Figure 4. Design a section to satisfy moment, shear and their interaction.

6. A steel rigid frame ABC, Figure 5, is to be designed using the Plastic Method of Design. The members' plastic moment capacities are shown:

   (a) Select the sections for the members.

   (b) Design a welded corner connection at B.

   [Assume lateral support at the load locations and at B.]

7. In Figure 5:

   (a) Check whether the section chosen for member BC in Question 6 can satisfactorily perform as a beam-column.

   (b) Estimate the horizontal displacement at D.

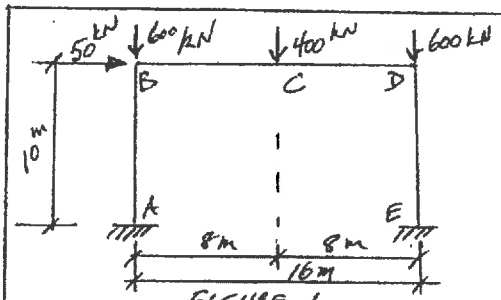

FIGURE 1

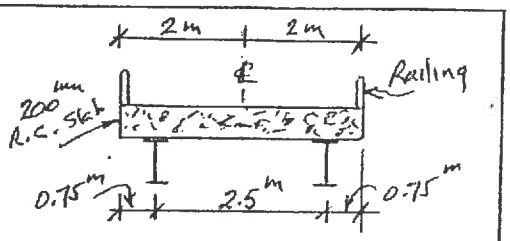

FIGURE 2

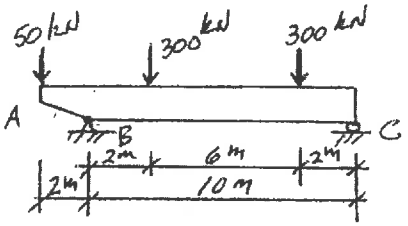

FIGURE 3

NOTE: Lateral support is provided @ 3 m interval.

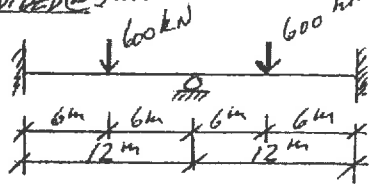

FIGURE 4

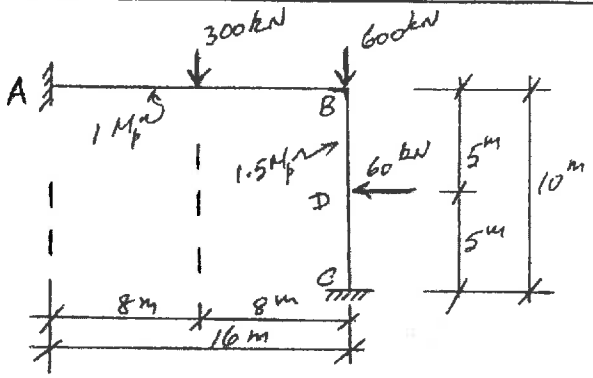

FIGURE 5