NATIONAL EXAMS – December 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

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

1. The beam AB in Figure 1 is a welded steel plate girder, rigidly supported at A and B. Design an adequate section to satisfy:

   (a) Flexure;
   (b) Shear; and
   (c) Flexure-shear interaction.

   [Assume that the load bearing plates are of adequate size.]

2. Figure 2 shows a prestressed concrete girder. Design the girder, allowing no tension in the cross-section. Show the profile of the prestressing steel.

3. Figure 3 shows a rigid reinforced concrete frame. Using the Limit States Design Method, design a section for member BC to satisfy moment and shear. Show the layout of the reinforcing.

4. For the reinforced-concrete frame, in Figure 3, determine:

   (a) An adequate cross-section of the beam-column AB, carrying out the required strength and stability checks.

   (b) An estimate for the long-term vertical deflection at the midpoint of BC.

5. The cross-section of a composite steel-reinforced concrete bridge is shown in Figure 4. The bridge is to be designed as simply-supported, spanning one-way. The design span length and live load are given in Figure 4. Assuming complete interaction between the steel box girders and the concrete:

   (a) Design the composite cross-section, assuming uniform load distribution.

   (b) Calculate the required number of shear stud connectors between the steel box girders and the concrete slab.

   [Assume the steel box girders are adequately braced.]

6. The rigid frame in Figure 3 is to be designed in steel using the Plastic Method of Design. All members have the same plastic moment capacity.

   (a) Select a section for the members.
   (b) Design the welded corner at C.

   [Assume lateral support at load locations and at BC.]

7. Referring to Question 6: Design (a) the beam-column AB; and, (b) the size of the reinforced concrete footing at D.

NOTE: Lateral Support Provided @ 2m Interval

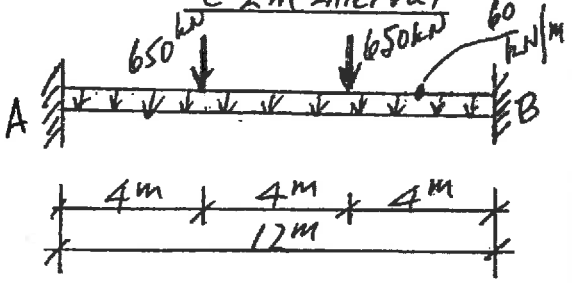

FIGURE 1

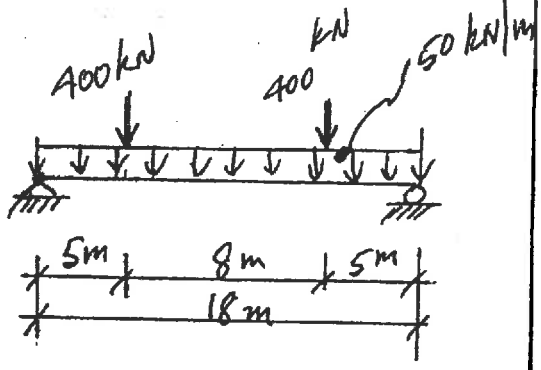

FIGURE 2

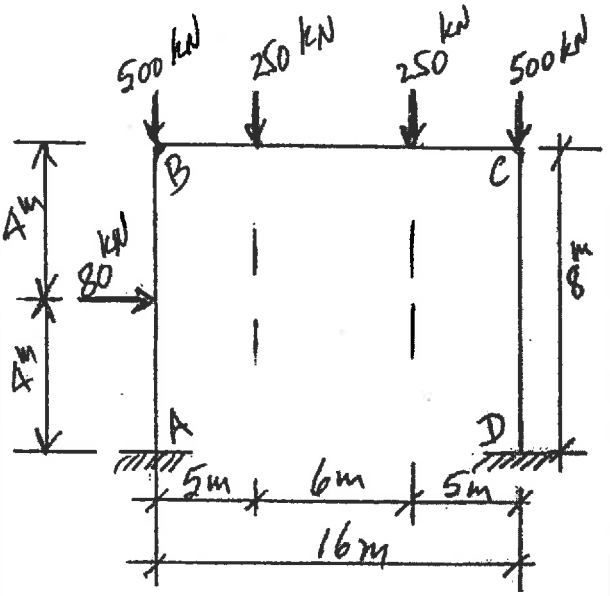

FIGURE 3

NOTE: Design Span Length = 16 m
Design Live Load = 18 kPa

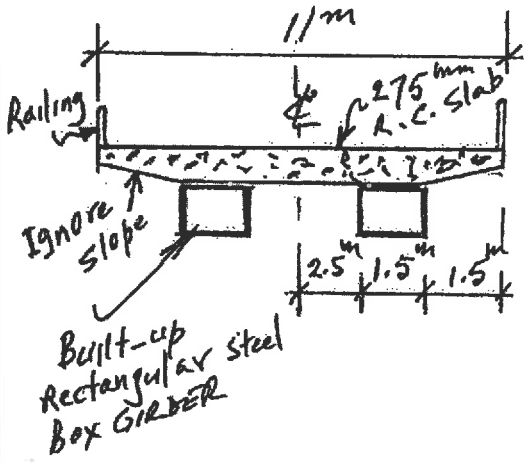

FIGURE 4