University : EL-Mansoura
Faculty : Engineering
Structural Eng. Dept.
Date: September, 1st, 2013

بسم الله الرحمن الرحيم

Final M. Sc. Examination
Steel Structures.
Time allowed: 3 hours

Any Data Missing can be Reasonably Assumed.
Egyptian Code LRFD and steel tables may be used.

All Sketches Should be Clear.
(Maximum Grade 100 Marks).

Question No.1: (15 Marks)

1-2): Derive the Design Resistance of Spiral Shear Connectors at Elastic and Plastic Ranges in the Composite Steel Beams (Cross Section of Beam may be Assumed as T-Section with Haunches). (10 marks)

1-2): How to Derive the Improved Formula to Calculate the Actual Deflection due to Concentrated Load at Mid-Span of the Composite Beam in Elastic Range. (5 Marks)

Question No.2: (15 Marks)

State Briefly with Clear Sketches for the Following:

2-1): Reasons that the Load and Resistance Factor Design (LRDF) Method is an Improved Method for Design of Steel Structures than other Methods.

2-2): According to Classify the Degree of Composite Action between Steel Beam and Concrete Slab, try to Determine the Formula for each Composite Action.

2-3) Advantages and Disadvantages of Composite Columns.

Question No.3: (15 Marks)

Figure (1) shows an intermediate main system of the industrial Hall for Steel Factory. The spacing between Frames is equal to 8.0m, and the dimensions of this hall are 160*20ms. If the calculated design ultimate Axial Strength and ultimate moment about the major axis of the column "A-D" are 250.0 t and 10.0t.m respectively.

Required: Check of Axial Compression, Flexure and interaction of bending for composite column "A-D" given in Fig.1.

Data given: Steel Grade ST52 ($F_{u,s}$=5.2 t/cm^2, $F_{y.s.}$=3.6 t/cm^2), Steel Reinforcement of Grade 36/52, $F_{c.u.}$ of concrete=400kg/cm^2, C_1=0.7, C_2= 0.48, C_3 = 0.2, Es = 2100t/cm^2,& E_c = 240 t/cm^2, Side sway is permitted.

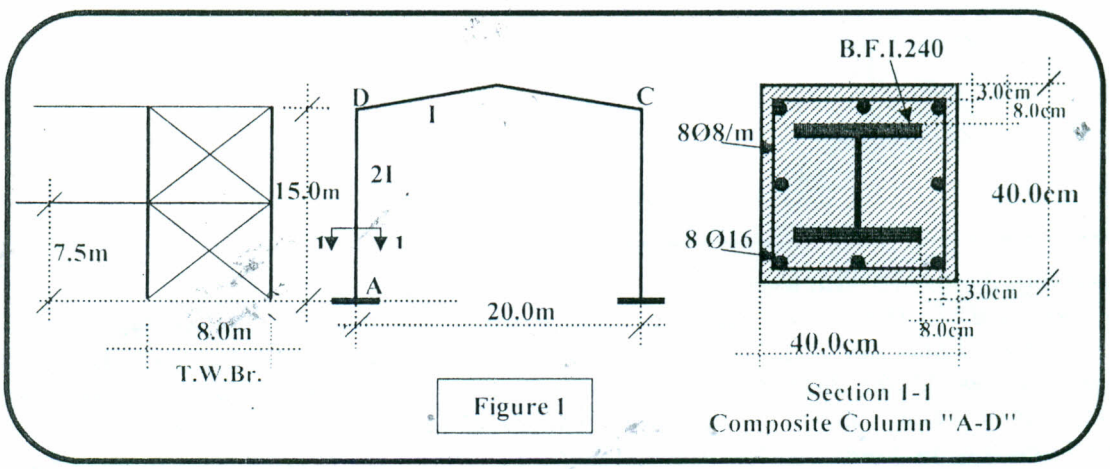


Figure 1

P.T.O.

Question No.4: (20 Marks)

Figure (2) Shows an Interior Composite Box Girder for a Steel Roadway Bridge and its Length is equal to 20m. The Dimensions of Cross Section for this Girder are also Given in Fig. (2). The Equivalent $W_{D.L.1}$=(weight of steel + own weight of slab)=4t/m`, $W_{D.L.2}$=(Weight of cover)=1.2 t/m` and $W_{L.L.}$=8t/m`. It is Assumed Fully Composite Interaction is Achieved between the Steel Beam and Concrete Slab. Use Steel Grade 44. By using LRFD Method, It is required:

- *Check for Design Requirements of the Composite Box Girder Given in Fig.(2) as a Simple Beam. Also, this Check must Include Deflection and Shear Stresses.*
- *Calculate and Draw the Plastic Distribution of the Normal Stresses on the Cross Section of this Beam.*

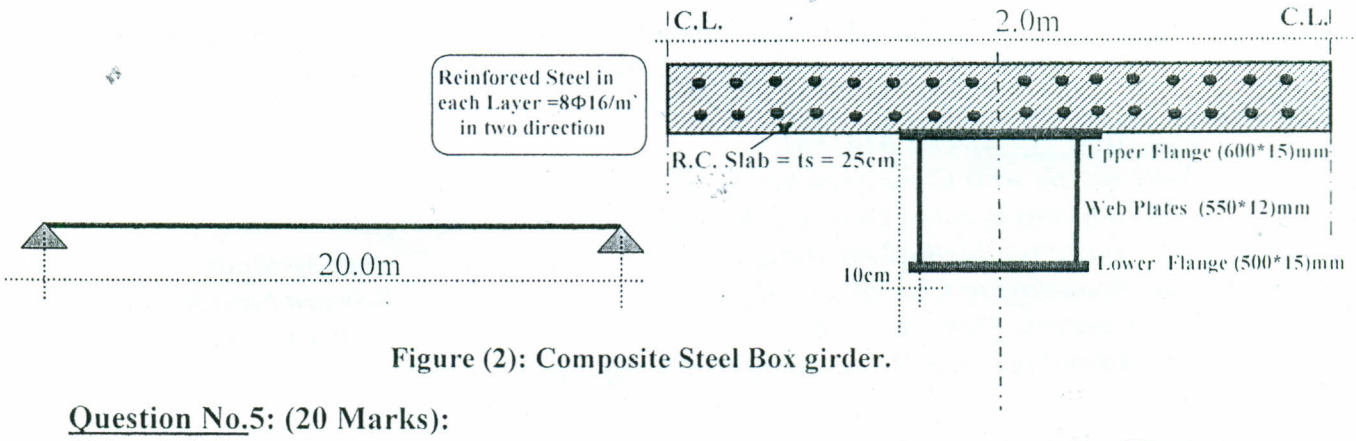


Figure (2): Composite Steel Box girder.

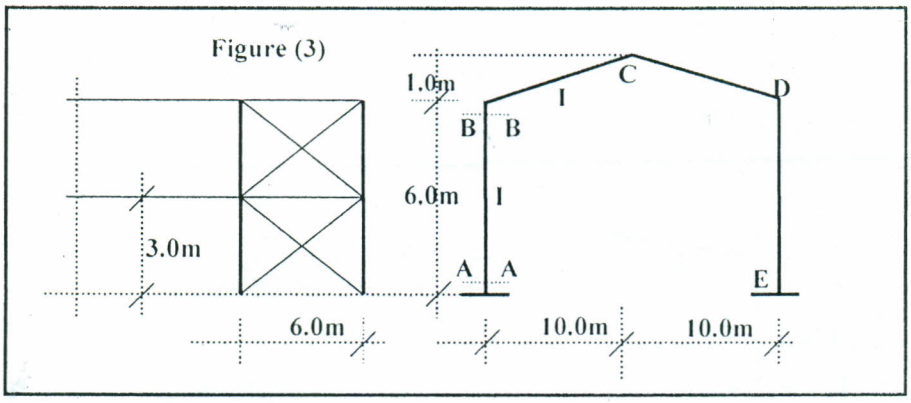
Question No.5: (20 Marks):

Using LRFD method, Design the Beam column (A-B) of the Frame shown in Figure (3) including axial effect, bending effect, combined effect and shear stresses. The Straining Actions are as follows:

-At Section "A-A" M_U = 7.00 t.m., P_U = 10t Compression, and Q_U = 5.0t

-At Section "B-B" M_U = 20.0 t.m., P_U = 10t Compression, and Q_U = 5.0t

-Use Steel 52 (F_y=3.6t/cm^2 & F_U=5.2t/cm^2), bolts Ø20 (6.8 grade) and Side Sway Permitted



Question No.6: (15 Marks):

By Using LRFD, Design an I.P.E. Section to be Used as a Beam to Support Machines in a Floor of an Industrial Building. The Beam Carries an Equivalent Uniformly Distributed Dead Load of 1.2 t/m` Including its Own Weight, and an Equivalent Uniformly Distributed Live Load of 0.4t/m`. the Beam Span is 6.0m and is Simply Supported to Other Main Beams. The Compression Flange of the Beam is Fully Laterally Unsupported. Use steel 37 having F_y=2.4t/m^2.

Examiner

Prof. Dr. Saad EL-Deen Abdrabou