King Saud University
College of Engineering
Department of Civil Engineering

FINAL EXAM

CE 473 Steel Structures – 1st Semester 1427 - 28 H

Saturday, 15 Muharam 1428
Time allowed: 3 hrs

Student name	
Student number	
Section	

Total number of Questions: 6

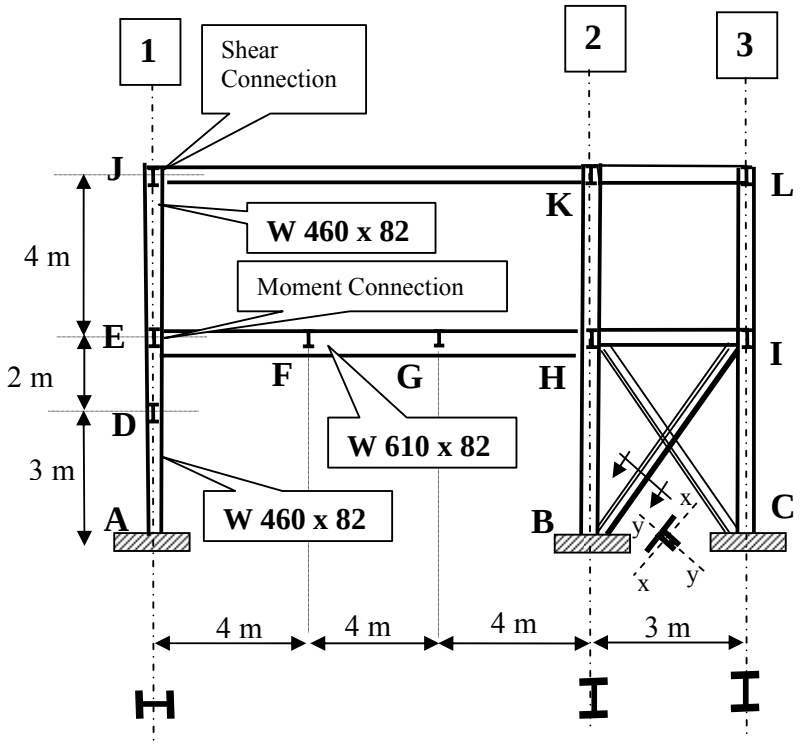
Attempt all questions

Questions	Maximum Marks	Marks obtained
Q ≠ 1	**3**	
Q ≠ 2	**9**	
Q ≠ 3	**8**	
Q ≠ 4	**10**	
Q ≠ 5	**10**	
Q ≠ 6	**10**	
	Total marks	_____ **50**

Total marks obtained (in words):_____

Student name		**Marks obtained for Q1**	
Student number			

The shown steel frame is laterally supported at points D,E,F,G, H, I , J , K and L by longitudinal steel beams, all columns are fixed base. All steel members are made of A36. Beam EFGH is connected to column AE by a moment connection, while beam JK is connected to column EJ by a shear connection. Braces BI and HC are made of double angles, back to back, while all other members are W-shapes.



Question 1: (3 points)

Choose the right answer:

1- For Column AE, buckling in plane is KLx ☐ , KLy ☐

Buckling outside plane is KLx ☐, KLy ☐

2- For Column BH, buckling in plane is KLx ☐ , KLy ☐

Buckling outside plane is KLx ☐, KLy ☐

3- For member BI (double angle back to back), buckling in plane is KLx ☐ , KLy ☐

Buckling outside plane is KLx ☐, KLy ☐

Student name		**Marks obtained for Q2**	
Student number		**Marks obtained for Q3**	

Question 2: (9 points)

For member BI, if KL_x = 3.0m and KL_y = 6.0 m and its factored compression force is 300 kN, **use the LRFD tables** to find the lightest section of double angles for the following two cases and fill the given table;

	Lightest section	weight	Factored resistance
Double equal angles			
Double unequal angles with short leg back to back			

Which section will you select for design ?

Question 3: (8 points)

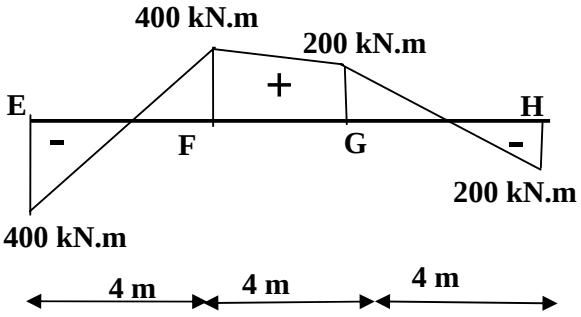
a) Determine the buckling length KL_x and KL_y for column AE

b) Determine the buckling length KL_x and KL_y for column E J

Student name		**Marks obtained for Q4**	
Student number			

Question 4: (10 points)

If the factored bending moment of beam EFGH is as shown in figure, and its section is W 610 x 82. The upper flange of the beam is laterally supported at F and G. The upper and lower flange of the beam is laterally fixed at E and H.



a) Determine the beam factored positive moment strength.

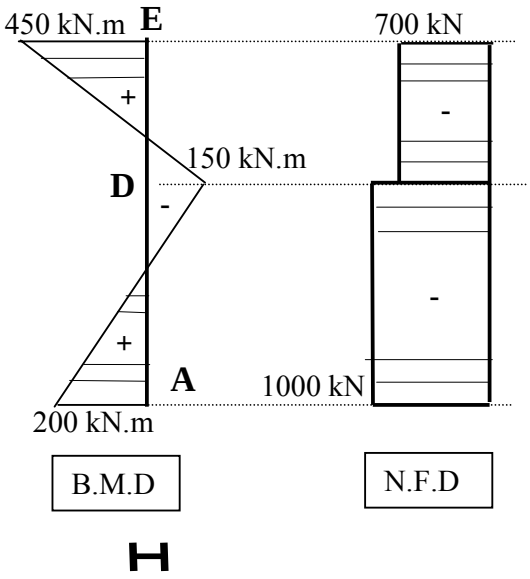
b) Determine the beam factored negative moment strength

c) Is the beam strength safe for both positive and negative moments?

Student name		**Marks obtained for Q5**	
Student number			

Question 5: (10 points)

If column ADE has the shown factored bending moment and normal force diagrams, and it is laterally supported at D and E , and it's section is W 460 x 82.



a- Check the safety of the column for part DE only , if KL_x = 4.20 m and KL_y = 2.5 m

For W 460 x 82

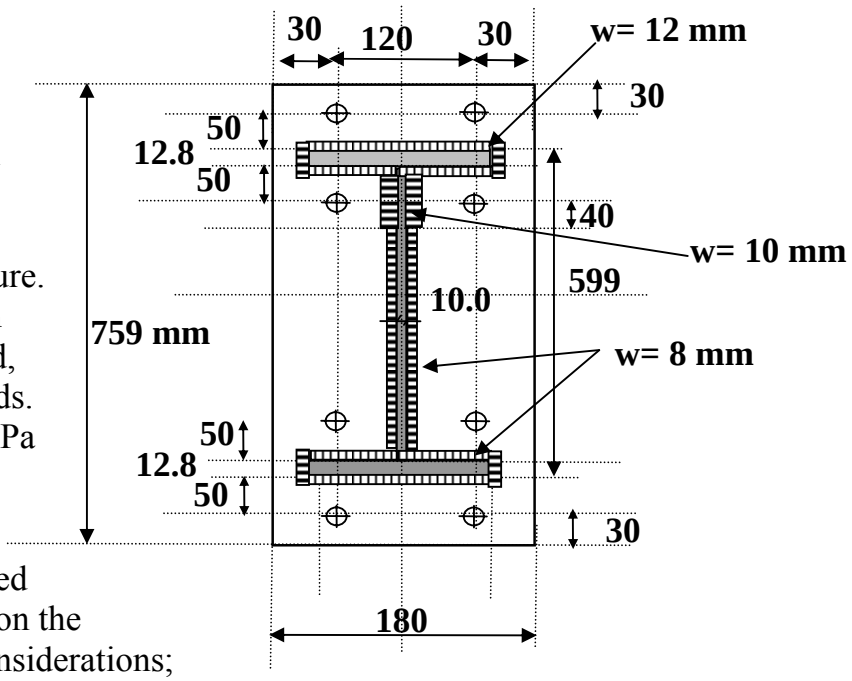
A =	**ϕM_p=**
b_f =	**ϕM_r =**
t_f =	**L_p =**
h =	**L_r =**
t_w =	
r_x =	
r_y =	

H

Student name		Marks obtained for Q6 (1)	
Student number			

Question 6: (10 points)

If the connection between beam EFGH (W 610 x 82) and column ADE (W 460 x 82) is made as a moment connection with an end-plate connection, as shown in figure. The end-plate thickness is 22 mm and 8- M20 A325 bolts were used, with the shown sizes of fillet welds. If F_{vb}= 400 MPa and F_{ub} = 620 MPa and F_{EX}= 480 MPa



1-Determine the maximum factored Shear force that can be applied on the given connection, taking into considerations;

a) Slip critical connection (standard holes and μ= 0.5)

b) Shear failure of bolts

c) Bearing failure of plates

d) Shear failure of web fillet welds

Maximum applied factored Shear force =

Student name		**Marks obtained for Q6 (2)**	
Student number		**Marks obtained for Q6 (3)**	

2- Determine the maximum factored moment that can be applied to the given connection, taking into consideration;

a) Tensile failure of bolts

b) Failure of flange fillet welds

c) Maximum applied factored Bending moment

3- For the given B.M.D and N.F.D of column ADE, shown in question 5, determine the minimum base plate length for the column (W460x82) if its base plate breadth is 300 mm, so that no tensile stresses occurs underneath it.

Hence calculate the maximum compressive stresses under the base plate, and draw the stress distribution.