

Name in Arabic :  
Number:

Lecture time :

KING SAUD UNIVERSITY  
COLLEGE OF ENGINEERING  
CIVIL ENGINEERING DEPARTMENT

STEEL STRUCTURES : CE 473  
SECOND SEMESTER, 1426/1427 H  
TIME : 90 min

FIRST MID TERM EXAM

Answer all problems in the provided spaces

**Problem 1 :**

A tension member made of W 100x19.3 was spliced using two plates of thickness 10 mm each and width of 80 mm as shown in figure, with 5 M12, A325 bolts on each side of web (all dimensions in mm)

For steel ,  $F_y = 250$  MPa,  $F_u = 400$  MPa

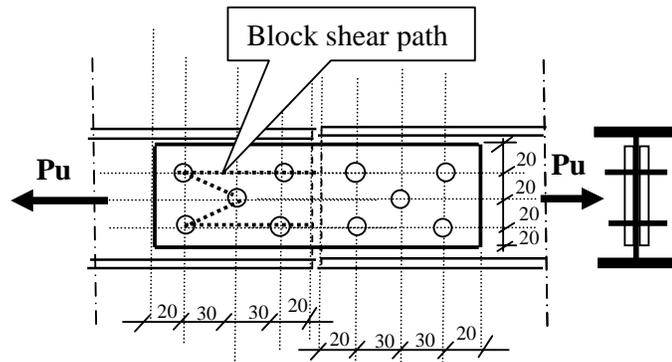
For bolts :  $F_u = 620$  MPa,  $F_v = 400$  MPa

For one W 100 x 19.3

$A = 2480$  mm<sup>2</sup>

Flange width = 103 mm, flange thickness = 8.8 mm

Depth (d) = 106 mm, Web thickness = 7.1 mm

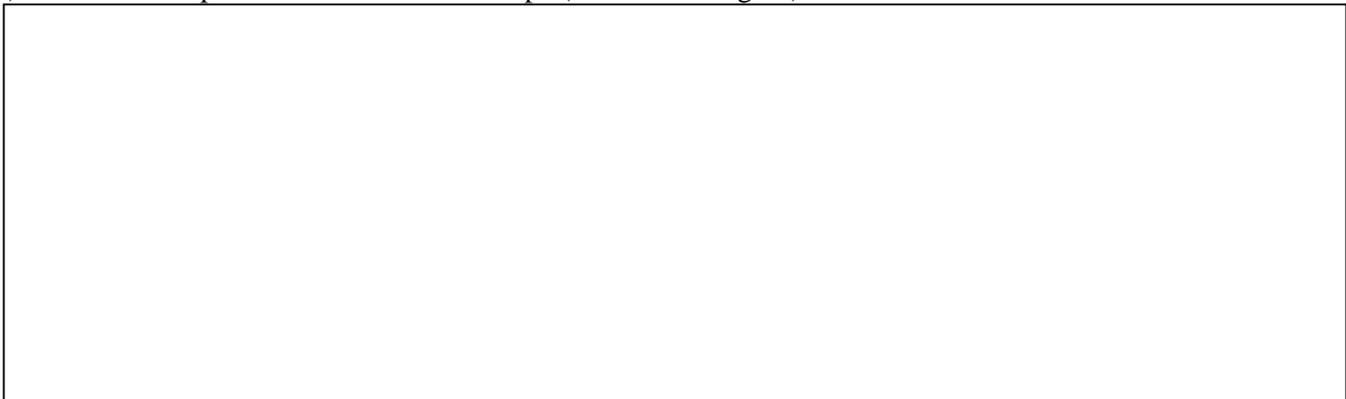


1- Determine the maximum tensile strength of the W 100 x 19.2 , Consider

a) Yielding at  $A_g$

b) Fracture at  $A_e$

c) Block shear rupture in web of the W –shape (as shown in figure)



Maximum Tensile strength of W 100x19.2 =

2- What would be the minimum plate thickness to avoid tensile fracture in plates  
If  $P_u = 300 \text{ kN}$

Minimum thickness of splice plate =

3- Determine the maximum strength of bolts, assume  $\mu = 0.50$  and standard holes, Consider:

a) Slip-critical connection

b) Shear failure

c) Bearing failure of plates

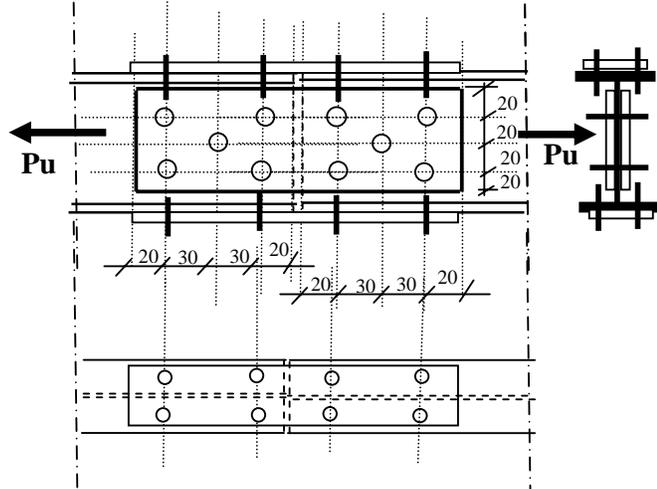
Maximum strength of bolts =

d) will the bolts be sufficient to resist  $P_u = 320 \text{ kN}$  ? Why?  
If bolts are not sufficient what would be the failure mode of bolts?



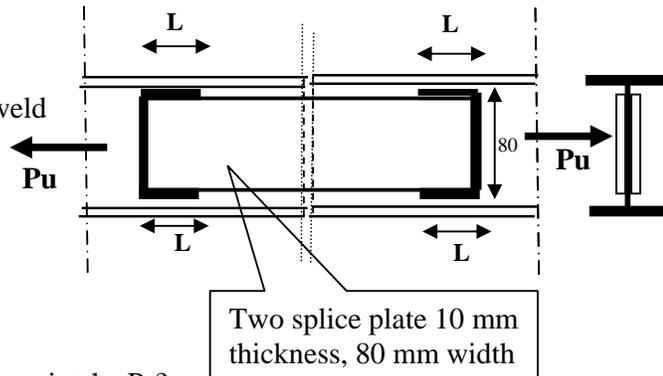
- 4- If two additional splice plates were added at top and bottom flanges of W 100 x 19.3, with 4 M 12 A325 bolts at each side of plate, as shown in Figure;

What would be the factored tensile strength of W100 x 19.3, considering the tensile fracture at the effective area?



**Problem 2 :**

If the two splice plates 80x 10 mm were welded to the web of the W 100x 19.3 with a transversal weld of length equal 80mm, and size of 8mm, **on both sides**, as shown in figure, and if,  $P_u = 500$  kN. and  $F_{E70} = 500$  MPa



1- Will the transversal weld only be sufficient to resist the  $P_u$ ?  
Consider,

- a) Failure of transversal weld

- b) Tensile fracture of cover plate

Is the transversal weld sufficient? Why?

2- If the transversal weld is not sufficient to resist the  $P_u$ , what would be the required length of longitudinal weld (L) needed for the splice? Consider;

a) Failure of longitudinal weld

b) Shear fracture of cover plate

Required length of longitudinal weld =

**Hint**

$$\text{If } 0.6 * F_u * A_{nv} > F_u * A_{nt} \text{ , } \phi R_n = 0.75 * (0.6 * F_u * A_{nv} + F_y * A_{gt})$$
$$\text{If } 0.6 * F_u * A_{nv} < F_u * A_{nt} \text{ , } \phi R_n = 0.75 * (F_u * A_{nt} + 0.6 * F_y * A_{gv})$$