Name in Arabic : **Lecture time :**
Number:

KING SAUD UNIVERSITY **STEEL STRUCTURES : CE 473**
COLLEGE OF ENGINEERING **SECOND SEMESTER, 1426/1427H**
CIVIL ENGINEERING DEPARTMENT **TIME : 90 min**

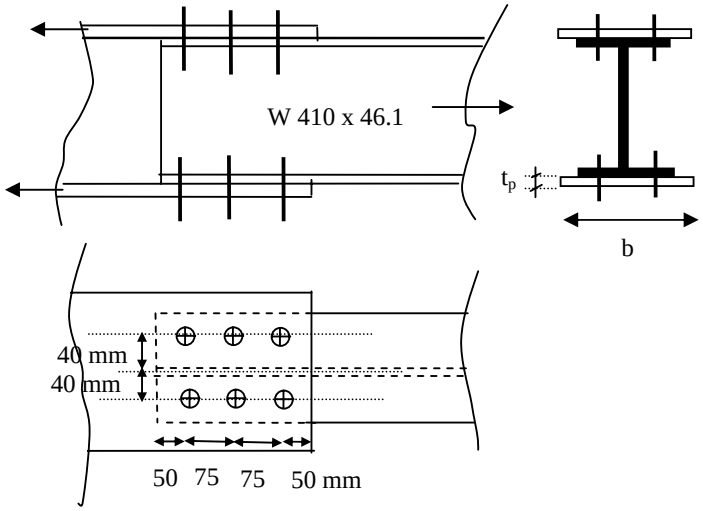
FIRST MID TERM

Answer all problems in the provided spaces

A tension member W 410 x 46.1 is connected by two plates at its flanges as shown in figure by 6 M16 - A325 bolts **at each** flange

(all dimensions in mm)
For steel , Fy =250 MPa, Fu = 400 MPa
For bolts : Fu = 620 MPa, Fv= 400 MPa

Given that for W 410 x 46.1;
$A_g = 5890\ mm^2$, $t_f = 11.2$ mm, $b_f = 140$ mm
d= 403 mm, $t_w = 7.0$ mm



1- Determine the maximum tensile strength of the member based on;

a) Yielding at A_g

b) Fracture at A_e

c) Block shear rupture in flanges of W-shape member

Maximum Tensile strength of W shape member =

2- If the given bolted connection need to be a slip crtical conecction with a friction coefficient equal 0.5 with standard holes and 16 mm bolt diameter, determine the factored resistance of the given connection based on;

(a) Slip critical connection

(b) Shear failure of bolts

(c) Is the connection sufficient to resist a factored tensile force equal 900 kN ? why ?

(d) If the connection is not sufficient , determine the required number of 16mm bolts needed to resist a factored tensile force equale 900 kN, and draw the layout of the bolts in plane.

3- If 10 M16 – A325 bolts are used **<u>at each flange,</u>** and the connection need to resist a factored tensile force equal 900 kN, what is the minimum thickness (t_p) of plates needed ?

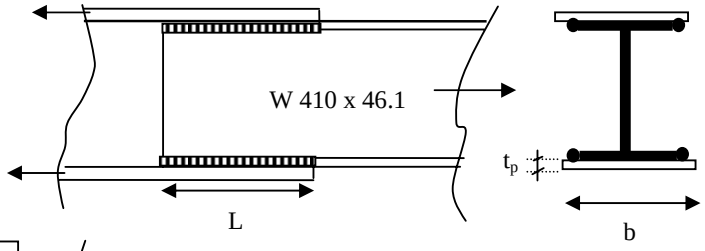
4- If 10 M16 – A325 bolts are used **at each flange,** and the connection need to resist a factored tensile force equal 900 kN, and the thickness of the connecting plates equal 10mm, what would be the required breadth (b) of the connecting plates, based on;

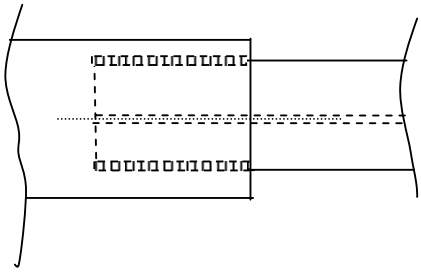
(a) yeilding at Ag

(b) Fracture at Ae

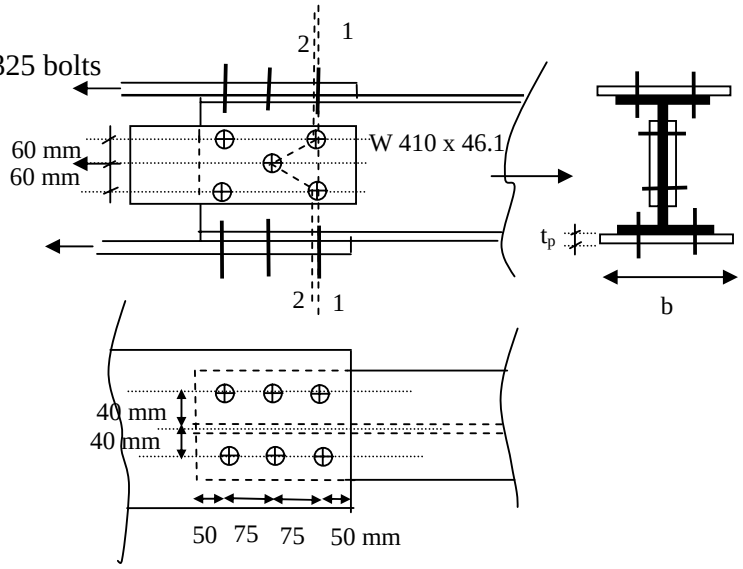
The required breadth (b) of the connecting plates =

5- If the A325 bolts were replaced by longitudinal welds as shown in Figure, to connect the W 410 x 46.1 to the plates, determine the required length of weld needed to resist a factored tensile force equal 900 kN if the size of weld equal 8mm and weld strength F_{Ex} = 700 MPa





6 - If the W 410 x 46.1 is connected also to two side plates as shown in figure with 5 M 16 –A325 bolts determine the effective area based;



on section 1-1

and section 2-2

What would be its factored tensile resistance baced on fracture at effective area?

Some Useful formulas may be needed:

$$\mathbf{U = (1 - x / Lc) < 0.9}$$

If $0.6 * Fu * A_{nv} > Fu * A_{nt}$, $Ø\ R_n = 0.75* (0.6 * Fu * A_{nv} + Fy * A_{gt})$

If $0.6 * Fu * A_{nv} < Fu * A_{nt}$, $Ø\ R_n = 0.75 * (Fu * A_{nt} + 0.6 * Fy * A_{gv})$

$$\mathbf{A_n = A_g + \frac{\sum S^2 t}{4 g} - \sum d_h * t}$$