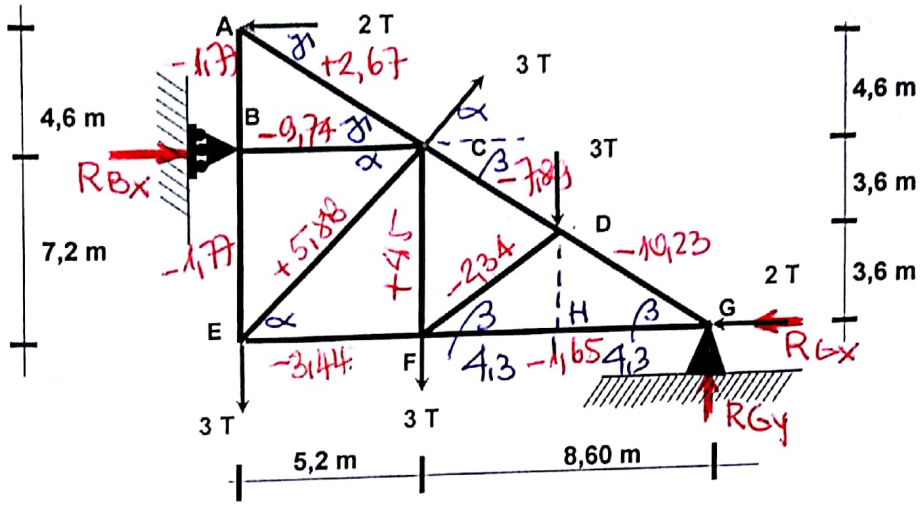
ESTRUCTURAS METALICAS — CERTAMEN Nº 1
INGENIERIA EN CONSTRUCCION — PARTE 2 : 70 PUNTOS
FECHA: 18.04.2017

PREGUNTA 2: ACERO A 270 ES — PERNOS A 325 N



DETERMINAR ESFUERZOS EN LAS BARRAS — DISEÑAR LA BARRA MAS TRACCIONADA EN PERFIL Ø

DISEÑAR UNA UNION ROTULADA EN "G" PARA CIZALLE DOBLE

- DETERMINAR Ø PERNO
- ESPESOR DEL O LOS FLANGES SEGÚN SU DISEÑO
- DIBUJE SU PROPUESTA DE DISEÑO

1.- DET. ÁNGULOS

$\alpha = \text{arctg}\left(\frac{7,2}{5,2}\right) = 54,162° \Rightarrow \text{Sen}\alpha = 0,8107 \quad \cos\alpha = 0,5855$

$\beta = \text{arctg}\left(\frac{7,2}{8,6}\right) = 39,936° \Rightarrow \text{Sen}\beta = 0,642 \quad \cos\beta = 0,767$

$\gamma = \text{arctg}\left(\frac{4,6}{5,2}\right) = 41,496° \Rightarrow \text{Sen}\gamma = 0,6626 \quad \cos\gamma = 0,749$

$FH = HG = 4,3\ m$ ya que $\frac{AE}{EG} = \frac{DH}{HG} \Rightarrow HG = FH = 4,3\ m.$

2.- REACCIONES

$\Sigma F_x = 0 \quad R_{Bx} - 2 + 3 \cdot 0,5855 - 2 - R_{Gx} = 0$

$\therefore R_{Bx} - R_{Gx} = 2,2435\ [T]$

$\Sigma F_y = 0$

$-3 + 3 \cdot 0,8107 - 3 - 3 + R_{Gy} = 0$

$R_{Gy} = 6,57\ [T]$ ✓

$\Sigma M_{(G)} = 0$

$+2 \times 11,8 - R_{Bx} \cdot 7,2 - 3 \cdot 0,8107 \cdot 8,6 - 3 \cdot 0,5855 \cdot 7,2 + 3 \cdot 13,8 + 3 \cdot 8,6 + 3 \cdot 4,3 = 0$

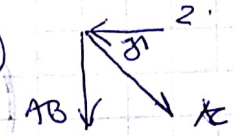
$R_{Bx} = 9,74\ [T]$

$\therefore R_{Gx} = 9,74 - 2,24 = 7,5\ [T]$

$\therefore R_G = \sqrt{7,5^2 + 6,57^2} = 9,97\ [T]$

3.- ESFUERZOS EN LAS BARRAS

en nudo (A)



$\Sigma F_x = 0 \quad -2 + AC \cdot 0{,}749 = 0$

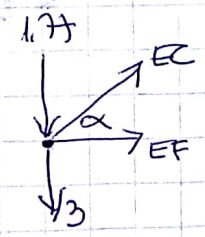
$AC = 2{,}67$ [T] tracción.

$\Sigma F_y = 0$

$-AB - 2{,}67 \cdot 0{,}6626 = 0$

$AB = -1{,}77$ [T] compresión.

Nudo (E)



$\Sigma F_y = 0$

$-3 - 1{,}77 + EC \cdot 0{,}8107 = 0$

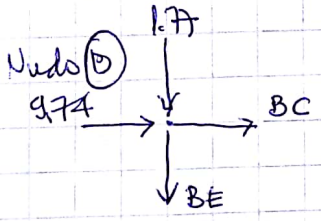
$EC = 5{,}88$ [T] tracción.

$\Sigma F_x = 0$

$5{,}88 \cdot 0{,}5855 + EF = 0$

$EF = -3{,}44$ [T] compresión.

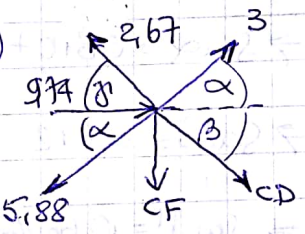
Nudo (B)



$\Sigma F_x = 0 \quad 9{,}74 + BC = 0 \Rightarrow BC = -9{,}74$ [T] compr.

$\Sigma F_y = 0 \quad -1{,}77 - BE = 0 \Rightarrow BE = -1{,}77$ [T] comp.

Nudo (C)



$\Sigma F_x = 0$

$9{,}74 - 2{,}67 \cdot 0{,}749 - 5{,}88 \cdot 0{,}5855 + 3 \cdot 0{,}5855 + CD \cdot 0{,}767 = 0$

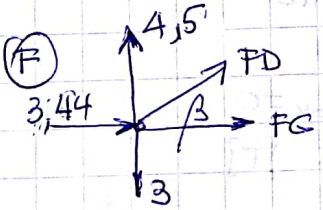
$CD = -7{,}89$ [T] Compresión

$\Sigma F_y = 0$

$2{,}67 \cdot 0{,}6626 + 3 \cdot 0{,}8107 - 5{,}88 \cdot 0{,}8107 - CF - (-7{,}89 \cdot 0{,}642) = 0$

$CF = 4{,}5$ [T] tracción.

Nudo (F)



$\Sigma F_y = 0$

$4{,}5 + FD \cdot 0{,}642 - 3 = 0$

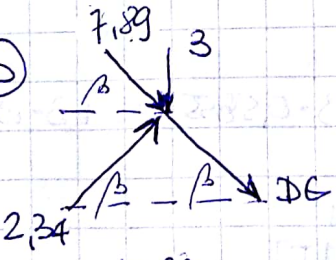
$FD = -2{,}34$ [T] compresión.

$\Sigma F_x = 0$

$3{,}44 + (-2{,}34 \cdot 0{,}767) + FG = 0$

$FG = -1{,}65$ [T] Compresión.

nudo (D)

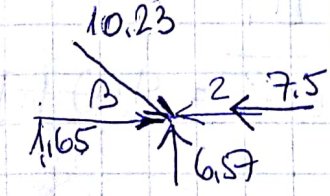


$\Sigma F_x = 0$

$7{,}89 \cdot 0{,}767 + 2{,}34 \cdot 0{,}767 + DG \cdot 0{,}767 = 0$

$DG = -10{,}23$ [T] compresión

nudo (G)



$\Sigma F_x = 0$

$10{,}23 \cdot 0{,}767 + 1{,}65 - 2 - 7{,}5 = 0$

$-0{,}004 \sim 0$ // OK //

$\Sigma F_y = 0$

$-10{,}23 \cdot 0{,}642 + 6{,}57 = 0$

$0 = 0$ // OK.

4_1 = Diseñar

∴ Barra + traccionada $\vec{EC} = 5{,}88$ [t] $L = \sqrt{5{,}2^2 + 7{,}2^2} = 8{,}88$ m

$\alpha = 54{,}16 > 45°$

$\lambda \leq 240 \quad \wedge \quad \frac{h}{a} \geq \frac{1}{90}$

$i \geq \frac{888}{240} = 3{,}7$ cm $\wedge$ $h \geq \frac{520}{90} = 5{,}78$ cm.

entonces $Ft = 0{,}6 \cdot 2700 = 1.620$ Kg/cm²

$ft = \frac{5880}{An} \leq 1620$ Kg/cm²

$An \geq 3{,}63$ cm²

Perfil ⊗ necesario.

⊗ 4"h" x 5,54 $D = 11{,}43$ cm (exterior)

$A = 7{,}06$ cm²

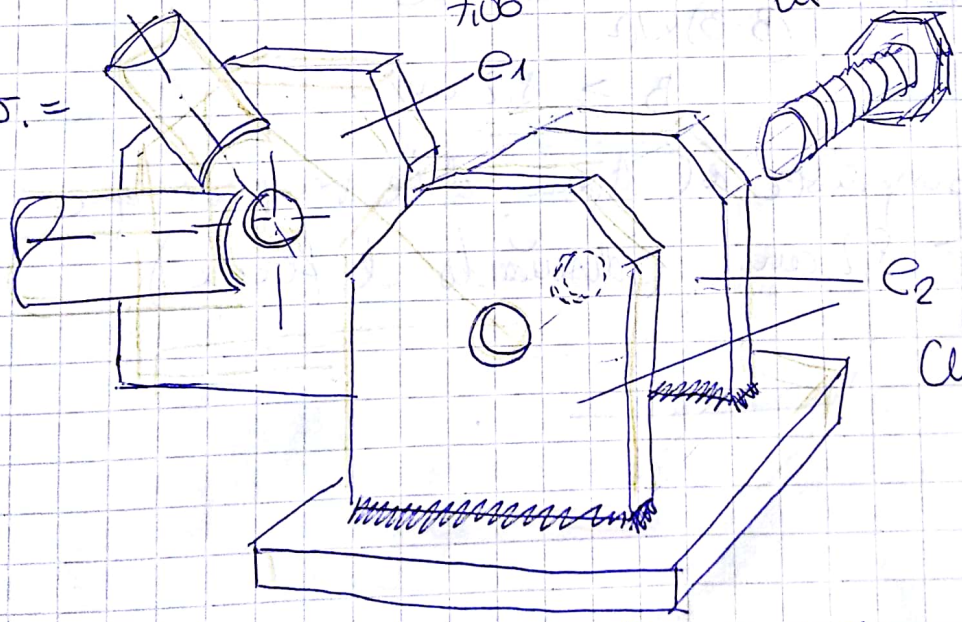
$r = i = 3{,}97$

$\lambda = \frac{888}{3{,}97} = 223{,}7 < 240$ OK//.

$h = 11{,}43 > 5{,}78$ OK//.

$ft = \frac{5880}{7{,}06} = 832{,}9 \frac{Kg}{cm^2} < 1620$ Kg/cm² OK///.

$5_1 =$



cizalle doble

⌀ Perno A325N $R = 9{,}97$ (T) $A = 5{,}73$ cm²

$D = 27$ mm

$fv = \frac{9970}{5{,}73 \times 2} = 870 \frac{Kg}{cm^2} < 1050 \frac{Kg}{cm^2}$ OK//

6.- Aplastamiento tensión unitaria

$$\frac{9970}{2700} = 3{,}7 \Rightarrow e_1 = 12\ mm.$$

Flange e_1

$$f_{ap(e_1)} = \frac{9970}{1{,}2 \times 2{,}7} = 3077{,}2\ \frac{kg}{cm^2} < 3645\ \frac{kg}{cm^2}\ OK$$

Flange e_2

$$\frac{9970/2}{2700} = 1{,}85 \Rightarrow e_2 = 6\ mm$$

$$f_{ap(e_2)} = \frac{9970/2}{0{,}6 \times 2{,}7} = 3077{,}2 < 3645\ \frac{kg}{cm^2}$$

OK

7.- Desgarramiento del flange.

$$D = d + 0{,}3 = 2{,}7 + 0{,}3 = 3{,}0\ cm.$$

$$A_n = (B-3) \times 1{,}2$$

$$f_t \leq F_t$$

$$\frac{9970}{(B-3) \times 1{,}2} \leq 1620$$

$$B \geq 8{,}2\ cm.$$

∴ El proyectista del diseño debe verificar que $B \geq 8{,}2$ cm (diseñando el flange).