1) $\sum F_x = 0$ $6 - R_{cx} - R_{Bx} = 0$ (1

   $\sum F_y = 0$ $R_{cy} - 3 - 4 = 0$ $\Rightarrow$ $\underline{R_{cy} = 7\,t}$

   $\sum M_c = 0$ $R_{Bx} \cdot 6 - 4 \times 1{,}6 - 6 \times 4 - 3 \cdot 4{,}8 = 0$

   $$R_{Bx} = 7{,}47\,t$$

   reemplazando en ①

   $$6 - R_{cx} - 7{,}47 = 0$$

   $$R_{cx} = -1{,}47\,t$$

   $\boxed{5\ PTOS}$

2) Det. de ángulos:

   a) $tg\,\alpha = \dfrac{4{,}8}{6{,}0} = 0{,}8$ $sen\,\alpha = 0{,}6247$ $cos\,\alpha = 0{,}78009$

   $$\alpha = 38{,}6598°$$

   b) $tg\,\beta = \dfrac{4{,}0}{1{,}6} = 2{,}5$ $sen\,\beta = 0{,}9285$ $cos\,\beta = 0{,}3714$

   $$\beta = 68{,}1986°$$

   c) $tg\,\gamma = \dfrac{2{,}0}{3{,}2} = 0{,}625$ $sen\,\gamma = 0{,}53$ $cos\,\gamma = 0{,}848$

   $$\gamma = 32{,}0054°$$

   d) $tg\,\delta = \dfrac{2{,}0}{1{,}6} = 1{,}25$ $sen\,\delta = 0{,}7809$ $cos\,\delta = 0{,}6247$

   $$\delta = 51{,}34° = 90 - \alpha$$

   $\boxed{5\ PTO}$

   e) $90° - \beta = 21{,}8014°$

3) Cálculo de esfuerzos en barras
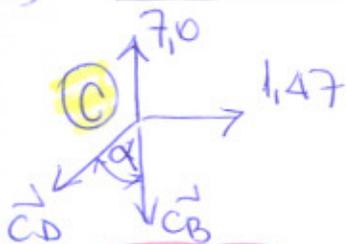
   $\sum F_x = 0$

   $1{,}47 - \vec{CD}\,sen\,\alpha = 0$ $\Rightarrow$ $\vec{CD} = \dfrac{1{,}47}{0{,}6247} = 2{,}35\,t$

   $\sum F_y = 0$

   $7{,}0 - \vec{CD} \cdot cos\,\alpha - \vec{CB} = 0$

   $\vec{CB} = 7{,}0 - 2{,}35 \cdot 0{,}78009$ $\Rightarrow$ $\vec{CB} = 5{,}17\,t.\,(T)$

   $\boxed{2\,PTO}$

$$\vec{BD} \qquad 5.17$$

$$7.47$$

$$\textcircled{B}$$

$$\Sigma F_x = 0 \qquad \qquad \textcircled{2}$$
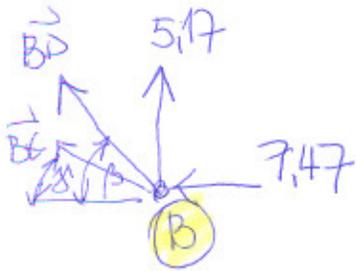
① $\quad -\vec{BD} \cdot 0.3714 - \vec{BG} \cdot 0.848 - 7.47 = 0 \big| \cdot 0.9285$

$$\Sigma F_y = 0$$

② $\quad \vec{BD} \cdot 0.9285 + \vec{BG} \cdot 0.53 + 5.17 = 0 \big| \cdot 0.3714$

$$\textcircled{①} + \textcircled{②}$$

$$-\vec{BG} \cdot 0.848 \cdot 0.9285 - 7.47 \cdot 0.9285 =$$

$$+ \vec{BG} \cdot 0.53 \cdot 0.3714 + 5.17 \cdot 0.3714 = 0$$

$$\vec{BG} = -\frac{4.9896}{0.5905} = -8.45 \, t \textcircled{C}$$

$$2 \, PTD$$

reemp. en ①

$$-\vec{BD} \cdot 0.3714 - (-8.45 \cdot 0.848) - 7.47 = 0$$

$$\vec{BD} = -0.82 \, t \qquad \textcircled{C}$$

$$3.0 \qquad \vec{AE}$$

$$\vec{AF}$$

$$90 - \alpha$$

$$\textcircled{A}$$

$$\Sigma F_x = 0$$
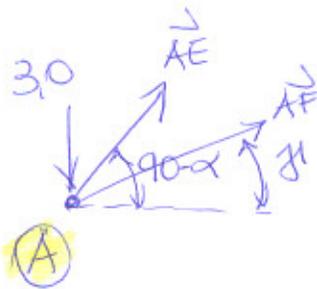
$$\vec{AE} \cdot sen \, \alpha + \vec{AF} \cdot cos \, \beta = 0$$

① $\quad 0.6247 \, \vec{AE} + 0.848 \, \vec{AF} = 0 \qquad / \cdot 0.7809$

$$\Sigma F_y = 0$$

$$\vec{AE} \cdot cos \, \alpha + \vec{AF} \cdot sen \, \beta - 3.0 = 0$$

② $\quad \vec{AE} \cdot 0.7809 + \vec{AF} \cdot 0.53 = 3 \qquad / \cdot 0.6247$

$$\textcircled{①} - \textcircled{②}$$

$$0.848 \cdot 0.7809 \cdot \vec{AF} - 0.53 \cdot 0.6247 \, \vec{AF} = -3 \cdot 0.6247$$

$$\vec{AF} = \frac{-1.8741}{0.3311}$$

$$2 \, PTD$$

$$\vec{AF} = -5.66 \, t \qquad (c)$$

$$\vec{AE} \cdot 0.6247 + 0.848 \cdot (-5.66) = 0$$

$$\vec{AE} = +7.68 \, t \quad (T)$$

t $2{,}35$

$-\vec{DE}\cdot sen\,\alpha - 0{,}82\cdot cos\beta \ldots$

$-0{,}6247\cdot\vec{DE} - 0{,}82\cdot 0{,}3714 + 2{,}35\cdot 0{,}6247 = 0$

$\vec{DE} = +1{,}86\ t$ (T)

2 PTO

$\Sigma F_y = 0$

$-4 - \vec{DE}\cdot cos\,\alpha + 0{,}82\cdot sen\beta - \vec{DG} + 2{,}35\cdot cos\,\alpha = 0$

$-4 - 1{,}86\cdot 0{,}7809 + 0{,}82\cdot 0{,}9285 - \vec{DG} + 2{,}35\cdot 0{,}7809 = 0$

$\vec{DG} = -2{,}86\ t$ (c)

$\Sigma F_x = 0$

$+5{,}66\cdot cos\gamma + \vec{FG} = 0$

$\vec{FG} = -4{,}8\ t$ (c)

2 PTO
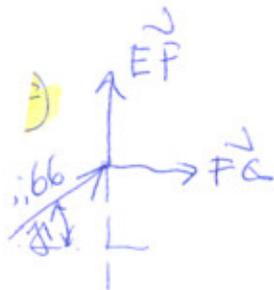
$\Sigma F_y = 0$

$+5{,}66\cdot sen\gamma + \vec{EF} = 0$

$\vec{EF} = -3{,}0\ t$ (c)
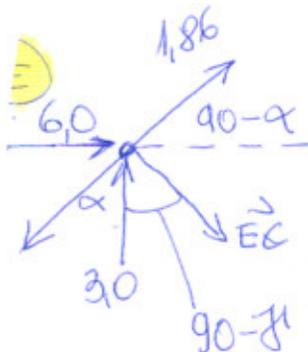
$\Sigma F_x = 0$

$6{,}0 - 7{,}68\cdot sen\,\alpha + 1{,}86\cdot sen\,\alpha + \vec{EG}\cdot cos\gamma = 0$

$6{,}0 - 7{,}68\cdot 0{,}6247 + 1{,}86\cdot 0{,}6247 + \vec{EG}\cdot 0{,}848 = 0$

$\vec{EG} = -2{,}79\ t$ (c)

5 PTO

Conclusión:

La Barra más traccionada s $\vec{AE} = 7{,}68\ t$. $L = 2{,}$

$ANGULO = 51{,}34°$ $a = 1{,}6\,N$

4) Diseñar barra + traccionada

$51{,}34° > 45°$ $\therefore$ $h > \dfrac{160}{90} = 1{,}8\ cm.$

$\dfrac{L}{i} \geqslant 240 \Rightarrow i \geqslant \dfrac{160}{240} = 0{,}67\ cm.$

15 P

$\therefore$ $f_t \leqslant F_t \Rightarrow \dfrac{I}{A_{neta}} \leqslant 0{,}6\,F_f$

$A_{neta} \geqslant \dfrac{7.680}{0{,}6\cdot 2700} = 4{,}74$

Perfil CA $80 \times 40 \times 3,q$

$A = 5,03 \ cm^2$

$r_x = 3,08 \ cm$

$r_y = 1,45 \ cm$

$h = 4 \ cm$

$e = 3 \ mm$

$\bar{x} = 1,45 \ cm$

$$\frac{L}{i} = \frac{160}{1,45} = 110,3 < 240 \quad OK.$$

$$\frac{h}{a} = \frac{4}{160} > \frac{1}{90} \quad OK$$

$$0,025 > 0,011 \quad OK$$

$$f_t = \frac{7680}{5,03} = 1.526,8 \ \frac{Kg}{cm^2} < 1.620 \ \frac{Kg}{cm^2}$$

OK.

(5) Diseño de rótula en C:

$$R = \sqrt{7^2 + 1,4^2} = 7,15 \ t.$$

perno $A325-N \Rightarrow \phi \ 22 \ mm$ $\quad A = 3,8 \ cm^2$

(9 PTOS)

$$f_v = \frac{7.150}{2 \times 3,80} = 940,8 \ \frac{Kg}{cm^2} < 1.050 \ \frac{Kg}{cm^2} \quad OK$$
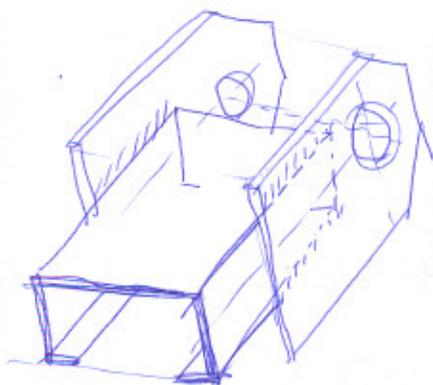
(6) Espesor del flange para aplastamiento.

Carga aplicada unitaria $\dfrac{7.150}{2700 \cdot 2} = 1,33 \ t.$

(9 PTOS)

$e > 5 \ mm$

$$f_{ap} = \frac{7.150}{2,2 \times 0,5 \times 2} \leq 1,35 \ F_f$$

$$3.250 \ \frac{Kg}{cm^2} \leq 3.645 \ \frac{Kg}{cm^2} \quad OK$$

(7) Soldadura de barra BC.

Supongo la misma selección de perfil CA $80 \times 40 \times 15 \times 3 \ mm$

$h_1 = 1,45 \ cm$

$h_2 = 4,0 - 1,45 = 2,55 \ cm$
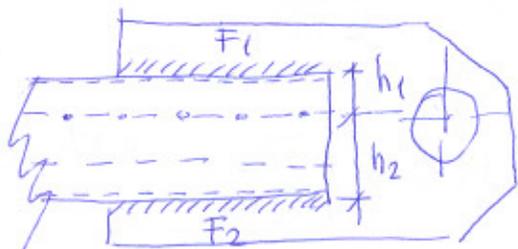
Carga aplicada al tración = 2,35 t. (en barra DC)

$$2(F_1 + F_2) = 2,35\ t$$

$$F_1 \cdot 1.45 - F_2 \cdot 2,55 = 0$$

$$2,55 F_1 + 1.45 F_1 = \frac{2,35 \times 2.55}{2}$$

$$4 F_1 = 3.0$$

$$F_1 = 0,75\ t$$

$$F_2 = 0.43\ t$$

9 PTO

espesor del perfil = 3 mm

"   " flange = 5 mm.

Soldadura AM = 4011 (AWS 6011) $\Rightarrow$ $F_v = 950\ Kg/cm^2$

para el perfil $F_v = 0.4 \times 2700 = 1.080\ Kg/cm^2$.

$\therefore$ $F_v = 950\ Kg/cm^2$ (manda resistencia de la soldadura).

$\therefore$ T.55 $S\ min = 4\ mm$

$S\ máx = 5\ mm.$

$\therefore$ escojo $S = 4\ mm$

$$S_{nf} = 0,707 \cdot 0,4 = 0,2828\ cm$$

para F_1 $f_v \le F_v$

$$\frac{F_1}{l_{ef_1} \cdot S_{nf}} < 950 \Rightarrow \frac{750}{l_{ef_1} \cdot 0,2828} \le 950 \Rightarrow l_{ef_1} = 2,8\ cm.$$

$$l\ real_1 = 2,8 + 2 \cdot 0,5 = 3,8\ cm$$

para F_2 $\frac{430}{l_{ef_2} \cdot 0,2828} \le 950$ $l_{ef_2} = 1,6\ cm$ $l\ real_2 = 1,6 + 2 \cdot 0,5 = 2,6\ cm.$

Nota: Hay que recordar que