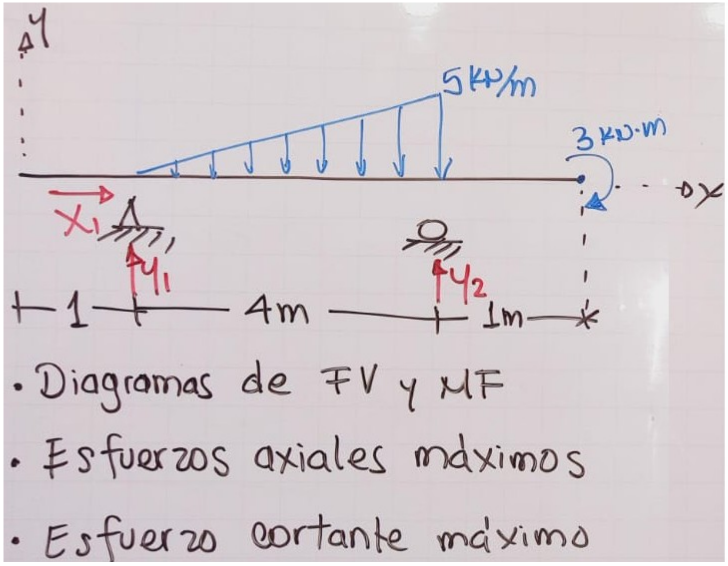
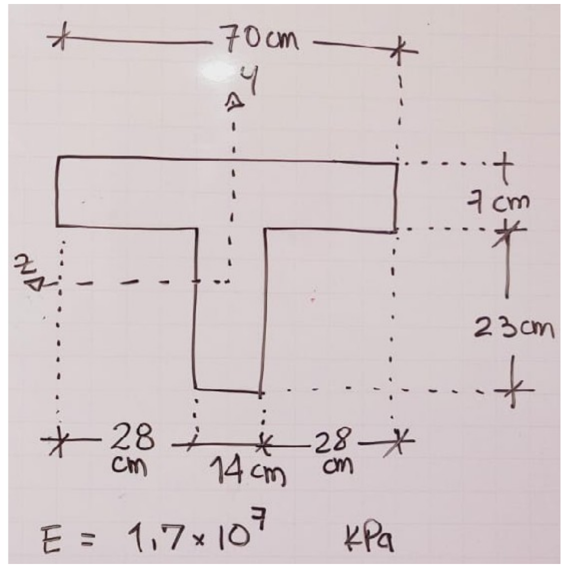



#1: [CaseMode := Sensitive, InputMode := Word]

#2: $\left[Y1 :=, X1 :=, Y2 :=, E = 1.7 \cdot 10^{7}, Iz :=, Ycg :=\right]$

#3: $\begin{bmatrix} FV1(x) := & FV2(x) := & FV3(x) := \\ MF1(x) := & MF2(x) := & MF3(x) := \end{bmatrix}$

**Cálculo de equilibrio:**

#4: $$\begin{bmatrix} X1 = 0 \\ Y1 + Y2 - \dfrac{5 \cdot 4}{2} = 0 \\ Y2 \cdot 4 - \dfrac{5 \cdot 4}{2} \cdot \dfrac{2}{3} \cdot 4 - 3 = 0 \end{bmatrix}$$

#5: $$\left[X1 := 0,\ Y1 := \frac{31}{12},\ Y2 := \frac{89}{12}\right]$$

#6: $$[X1 = 0 \wedge Y1 = 2.583333333 \wedge Y2 = 7.416666666]$$

**Cálculo del centroide de la sección, usando subarea 1 la losa superior de 70*7 y subarea 2 el alma central de 14*23:**

#7: $$\begin{bmatrix} A1 := 0.7\cdot 0.07 & ycg1 := 0.23 + \dfrac{0.07}{2} \\ A2 := 0.14\cdot 0.23 & ycg2 := \dfrac{0.23}{2} \\ A := A1 + A2 & Ycg := \dfrac{A1\cdot ycg1 + A2\cdot ycg2}{A} \end{bmatrix}$$

#8: $$\begin{bmatrix} A1 := 0.049 & ycg1 := 0.265 \\ A2 := 0.0322 & ycg2 := 0.115 \\ A := 0.0812 & Ycg := 0.2055172413 \end{bmatrix}$$

#9: $$\begin{bmatrix} A1 := \dfrac{49}{1000} & ycg1 := \dfrac{53}{200} \\ A2 := \dfrac{161}{5000} & ycg2 := \dfrac{23}{200} \\ A := \dfrac{203}{2500} & Ycg := \dfrac{149}{725} \end{bmatrix}$$

**Cálculo de la inercia centroidal:**

#10: $$\begin{bmatrix} I1 := \dfrac{1}{12}\cdot 0.7\cdot 0.07^3 & I2 := \dfrac{1}{12}\cdot 0.14\cdot 0.23^3 \\ Iz1 := I1 + (ycg1 - Ycg)^2\cdot A1 & Iz2 := I2 + (ycg2 - Ycg)^2\cdot A2 \end{bmatrix}$$

#11: $$\begin{bmatrix} I1 := 2.000833333\cdot 10^{-5} & I2 := 0.0001419483333 \\ Iz1 := 0.0001933800634 & Iz2 := 0.0004057748791 \end{bmatrix}$$

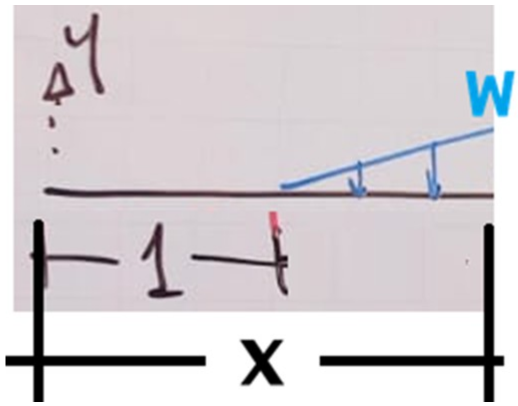
#12: $$\begin{bmatrix} I1 := \dfrac{2401}{120000000} & I2 := \dfrac{85169}{600000000} \\ Iz1 := \dfrac{4878979}{25230000000} & Iz2 := \dfrac{51188501}{126150000000} \end{bmatrix}$$

#13: $Iz := Iz1 + Iz2$

#14: $Iz := 0.0005991549425$

#15: $Iz := \dfrac{651581}{1087500000}$

**Carga w(x) en cualquier punto del tramo de 4m:**




#16: $\dfrac{w}{x - 1} = \dfrac{5}{4}$

#17: $w := \dfrac{5 \cdot x}{4} - \dfrac{5}{4}$

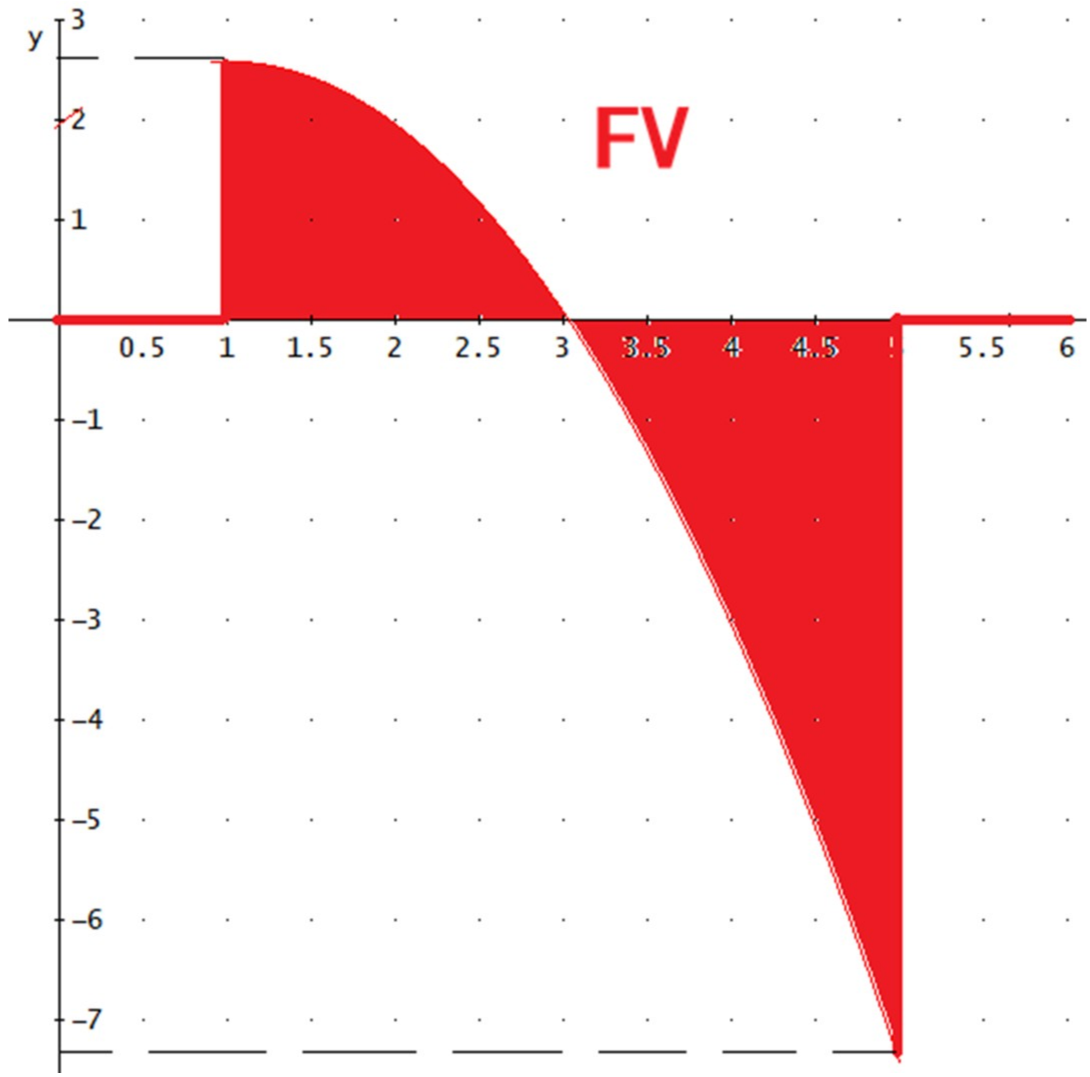
#18: $w = 1.25 \cdot x - 1.25$

## Diagrama de fuerza cortante:

#19: $$\begin{bmatrix} FV1(x) := 0 \\ FV2(x) := Y1 - \dfrac{w \cdot (x - 1)}{2} \\ FV3(x) := Y1 - \dfrac{5 \cdot 4}{2} + Y2 \end{bmatrix}$$

#20: $$\begin{bmatrix} FV1(x) := 0 \\ FV2(x) := - 0.625 \cdot x^2 + 1.25 \cdot x + 1.958333333 \\ FV3(x) := 0 \end{bmatrix}$$

#21: $$\left[\begin{array}{c} FV1(x) := 0 \\ FV2(x) := -\frac{5\cdot x^2}{8} + \frac{5\cdot x}{4} + \frac{47}{24} \\ FV3(x) := 0 \end{array}\right]$$




Cortante máximo se presenta en FV2(5)

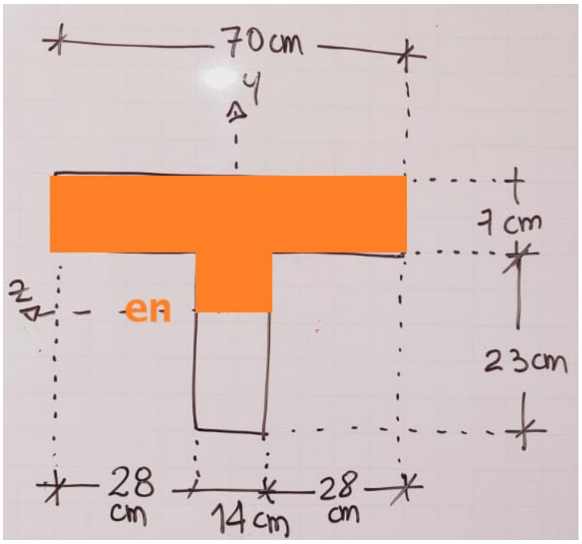
#22: $FVmax := FV2(5)$

#23: $$FVmax := -7.416666666$$

#24: $$FVmax := -\frac{89}{12}$$

**Esfuerzos cortantes en el punto de fuerza cortante máxima:**

Eje neutro:

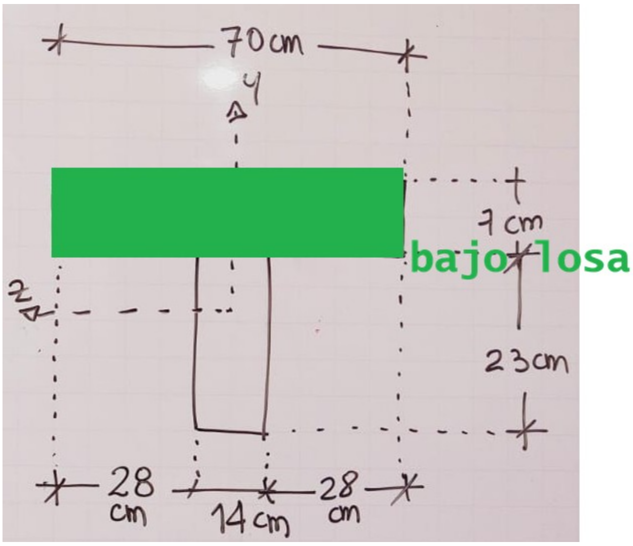



#25: $$\left[\begin{array}{c} Yen := \dfrac{A1\cdot\left(0.3 - Ycg - \dfrac{0.07}{2}\right) + 0.14\cdot(0.23 - Ycg)\cdot\dfrac{1}{2}\cdot(0.23 - Ycg)}{A1 + 0.14\cdot(0.23 - Ycg)} \\ Qen := (A1 + 0.14\cdot(0.23 - Ycg))\cdot Yen \\ \tau en := -\dfrac{FVmax\cdot Qen}{Iz\cdot 0.14} \end{array}\right]$$

#26: $$\left[\begin{array}{c} Yen := \dfrac{A1\cdot 0.05948275862 + 0.14\cdot 0.02448275862\cdot\dfrac{1}{2}\cdot 0.02448275862}{A1 + 0.14\cdot 0.02448275862} \\ Qen := 0.0524275862\cdot 0.05639423382 \\ \tau en := -\dfrac{FVmax\cdot 0.002763317457}{Iz\cdot 0.14} \end{array}\right]$$

#27: $$\left[\begin{array}{c} Yen := 0.05639423382 \\ Qen := 0.002956613555 \\ \tau en := 261.418394 \end{array}\right]$$

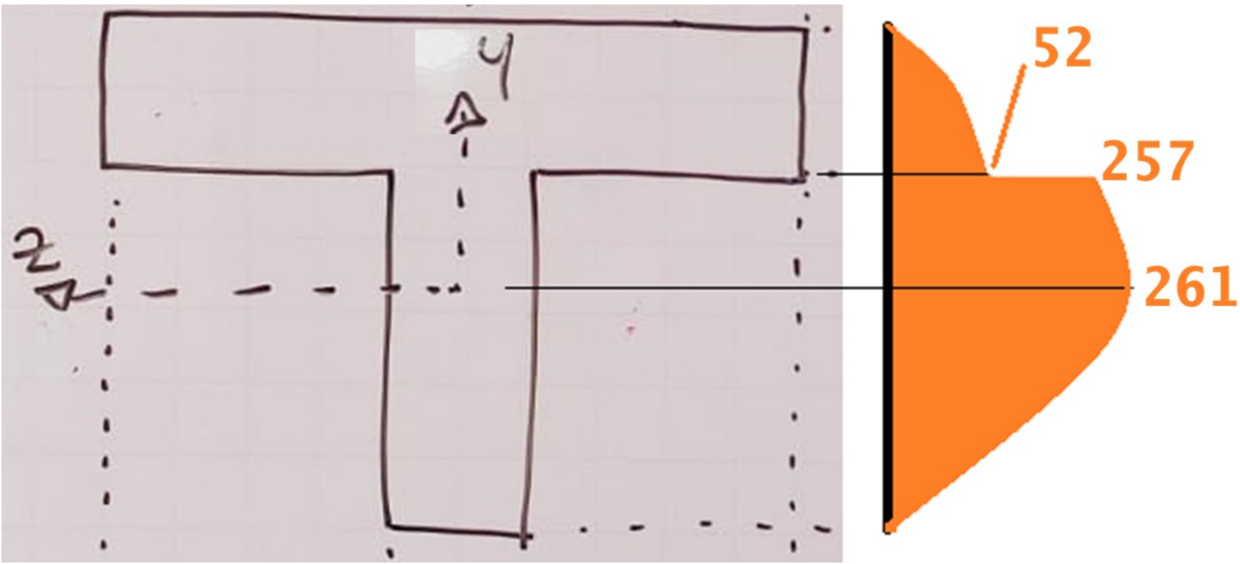
Bajo la losa:




#28: $$\left[\begin{array}{cc} Ybl := 0.23 - Ycg + \dfrac{0.07}{2} & Qbl := A1 \cdot Ybl \\ \tau bl1 := - \dfrac{FVmax \cdot Qbl}{Iz \cdot 0.7} & \tau bl2 := - \dfrac{FVmax \cdot Qbl}{Iz \cdot 0.14} \end{array}\right]$$

#29: $$\left[\begin{array}{cc} Ybl := 0.05948275862 & Qbl := 0.002914655172 \\ \tau bl1 := 51.54170202 & \tau bl2 := 257.7085101 \end{array}\right]$$

**Gráfico de esfuerzo cortante en la sección con mayor fuerza cortante:**




**Esfuerzo cortante máximo de 261 KPa**

**Diagrama de momento flector:**

#30:

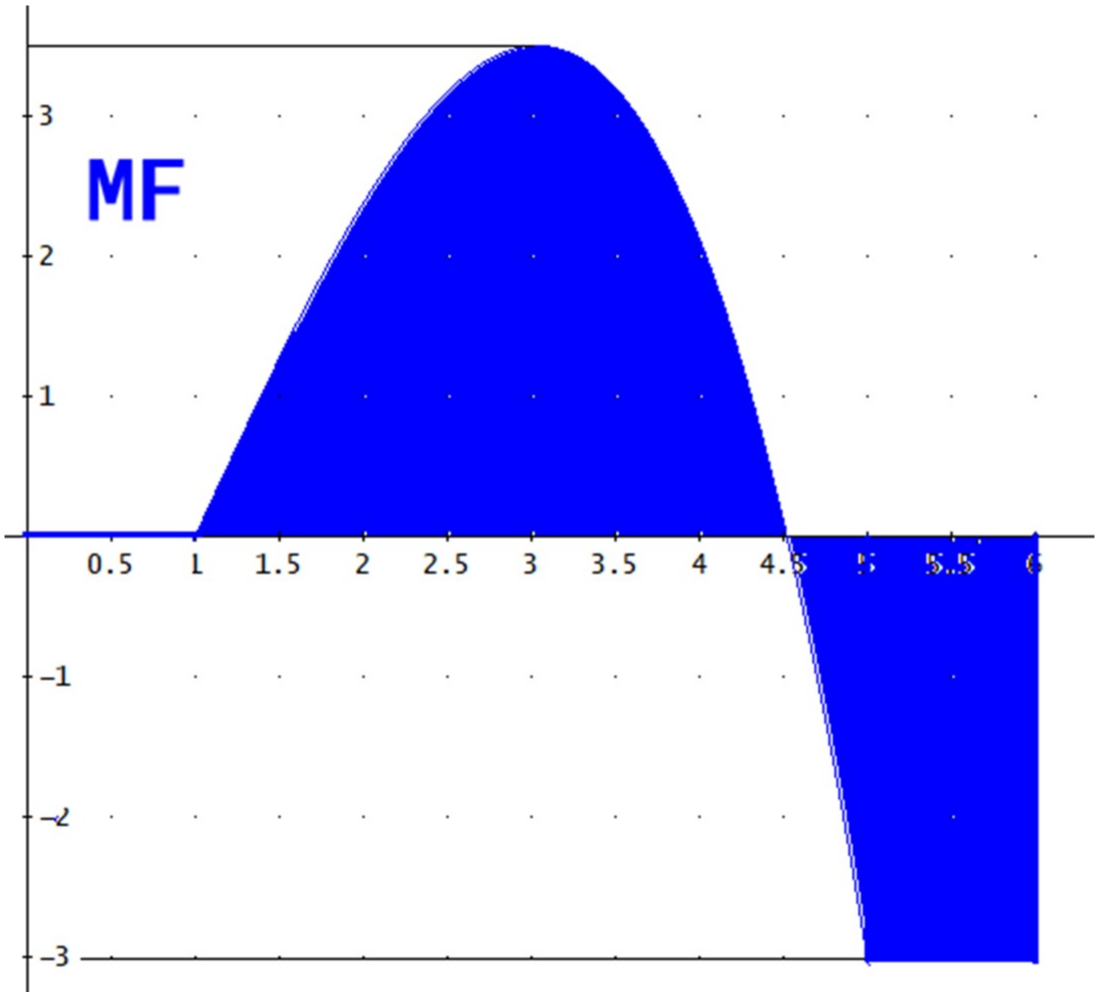
$$\left[\begin{array}{c} MF1(x) := 0 \\ MF2(x) := Y1\cdot(x-1) - \dfrac{w\cdot(x-1)}{2}\cdot\left(\dfrac{1}{3}\cdot(x-1)\right) \\ MF3(x) := Y1\cdot(x-1) - \dfrac{5\cdot 4}{2}\cdot\left(x - 1 - \dfrac{2}{3}\cdot 4\right) + Y2\cdot(x-5) \end{array}\right]$$

#31:

$$\left[\begin{array}{c} MF1(x) := 0 \\ MF2(x) := -\dfrac{5\cdot x^3}{24} + \dfrac{5\cdot x^2}{8} + \dfrac{47\cdot x}{24} - \dfrac{19}{8} \\ MF3(x) := -3 \end{array}\right]$$

#32:

$$\left[\begin{array}{c} MF1(x) := 0 \\ MF2(x) := -\,0.2083333333\cdot x^3 + 0.625\cdot x^2 + 1.958333333\cdot x - 2.375 \\ MF3(x) := -3 \end{array}\right]$$




**El momento flector positivo máximo de 3.5KN.m ocurre en FV2(x)=0, osea en 3.03m, y momento flector negativo máximo de 3 KN.m en x=5m**

#33: FV2(x) = 0

#34: $$- \frac{5 \cdot x^2}{8} + \frac{5 \cdot x}{4} + \frac{47}{24} = 0$$

#35: $$x = -1.03306009 \vee x = 3.03306009$$

#36: MF2(3.03306009)

#37: $$3.501381267$$

Esfuerzos axiales en los puntos de momentos máximos:

#38:
$$\begin{bmatrix} \sigma1Arriba = -\dfrac{MF2(3.03306009)\cdot(0.3 - Ycg)}{Iz} & \sigma1Abajo = -\dfrac{MF2(3.03306009)\cdot(-Ycg)}{Iz} \\ \sigma2Arriba = -\dfrac{(-3)\cdot(0.3 - Ycg)}{Iz} & \sigma1Abajo = -\dfrac{(-3)\cdot(-Ycg)}{Iz} \end{bmatrix}$$

#39:
$$\begin{bmatrix} \sigma1Arriba = -552.1445917 & \sigma1Abajo = 1201.015243 \\ \sigma2Arriba = 473.0800928 & \sigma1Abajo = -1029.03553 \end{bmatrix}$$

**Los esfuerzos axiales máximos ocurren en las fibras inferiores. El esfuerzo axial a compresión máximo de 1 029KPa ocurre en x=5m hasta 6m y el esfuerzo axial a tracción máximo de 1209KPa ocurre en x=3.03m.**