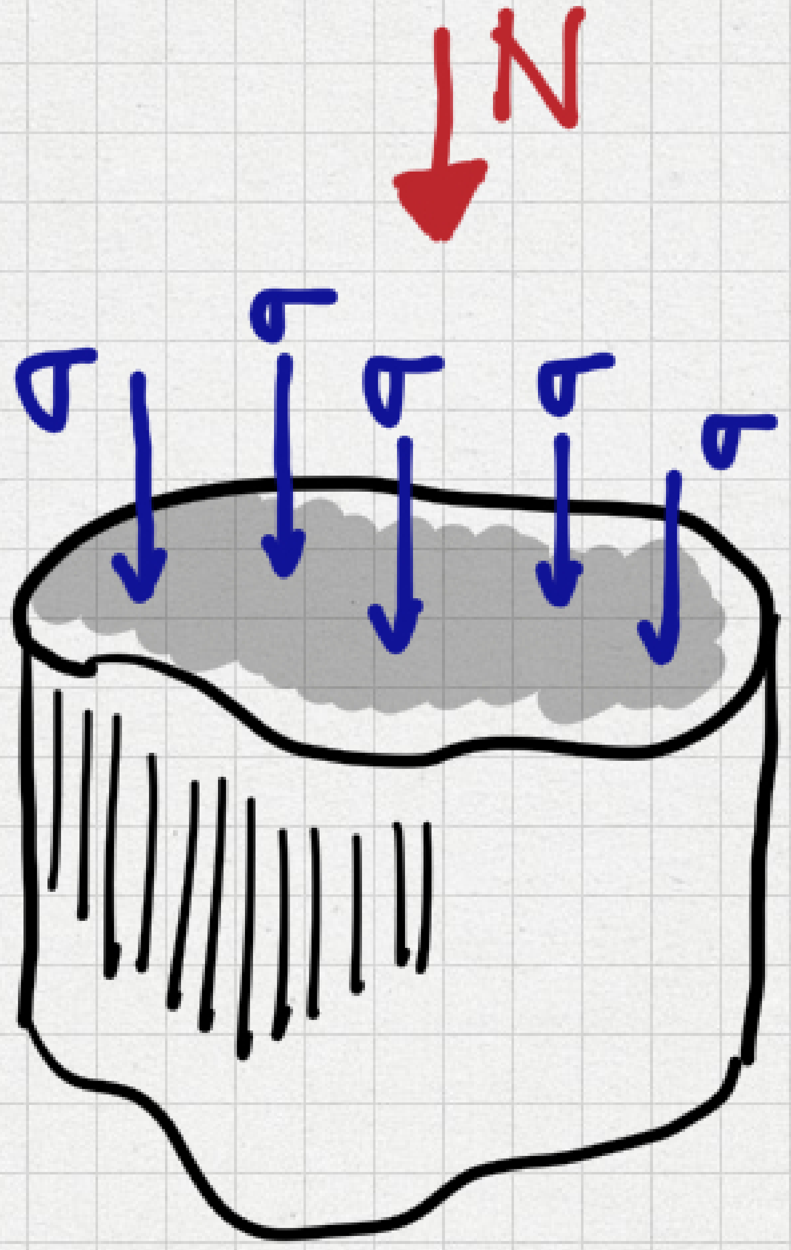
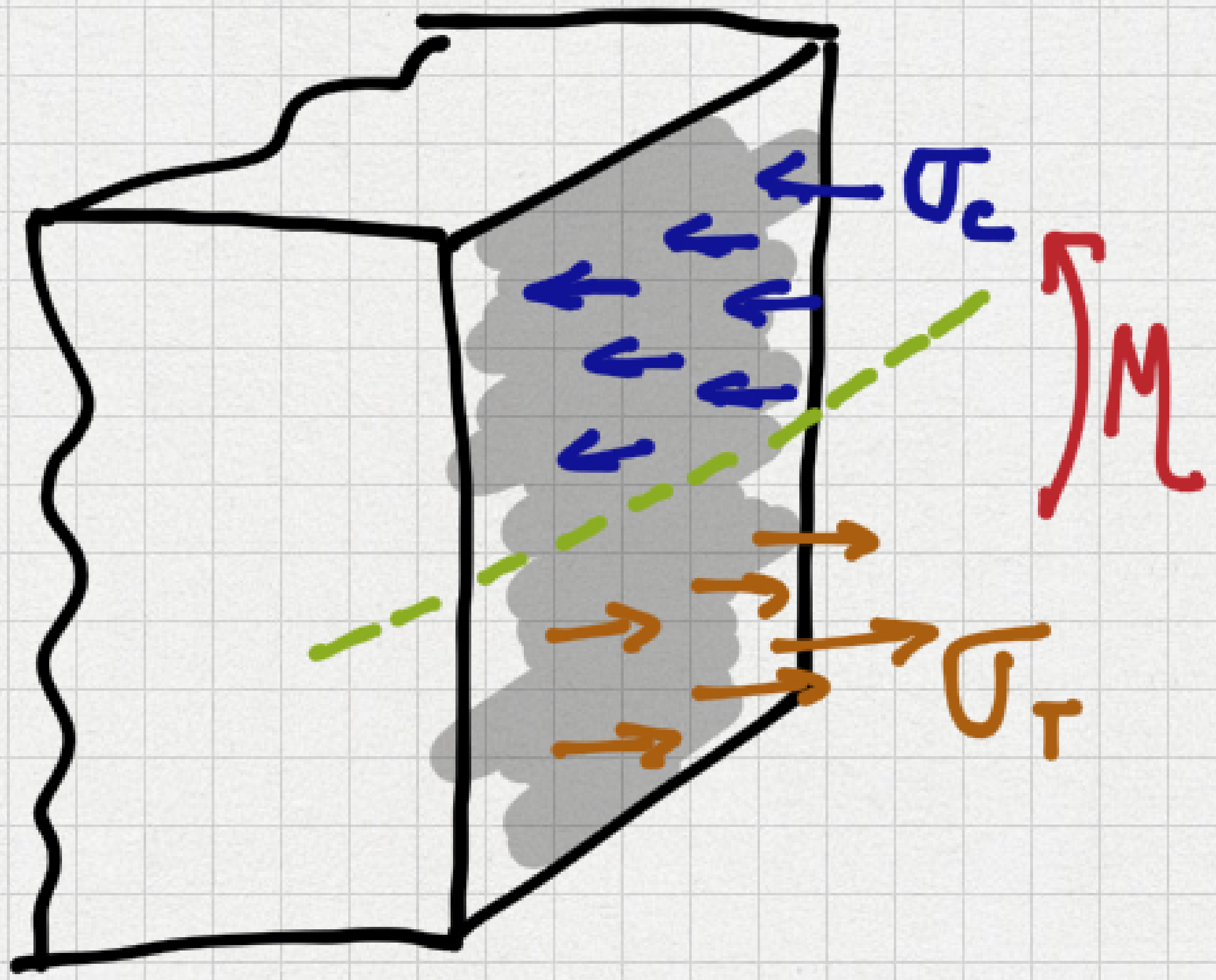
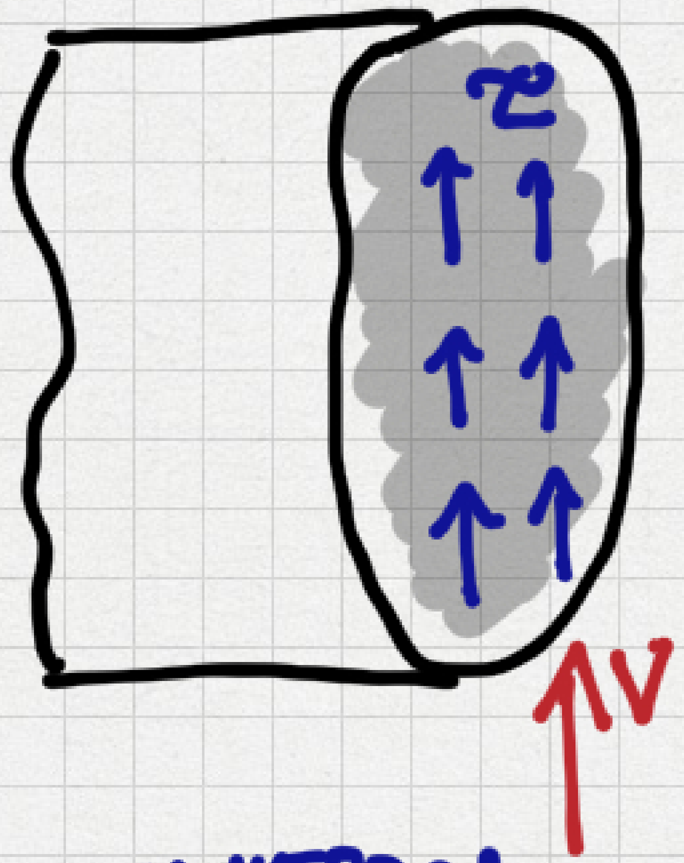
# TIPO DE ESFUERZOS



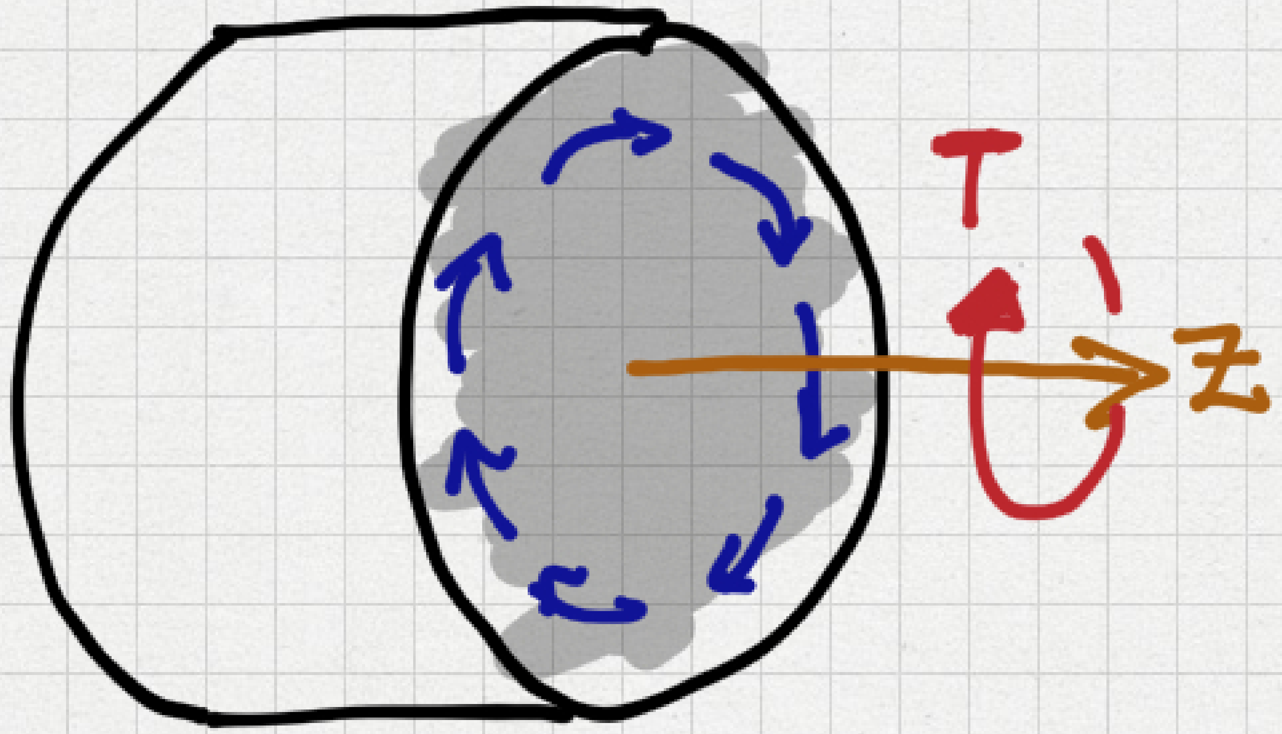

ESFUERZOS NORMALES




ESFUERZOS DE FLEXIÓN

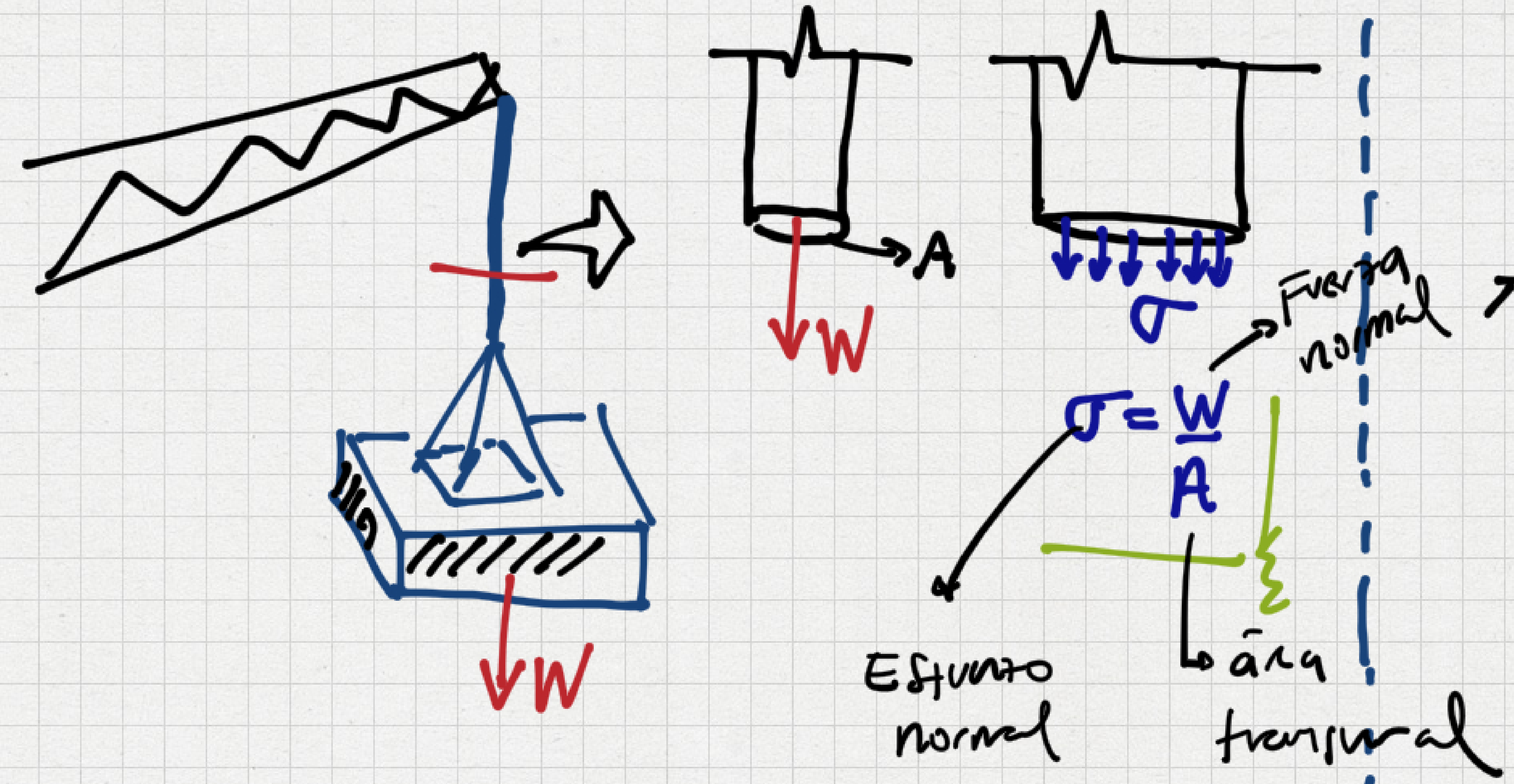



ESFUERZOS CORTANTES

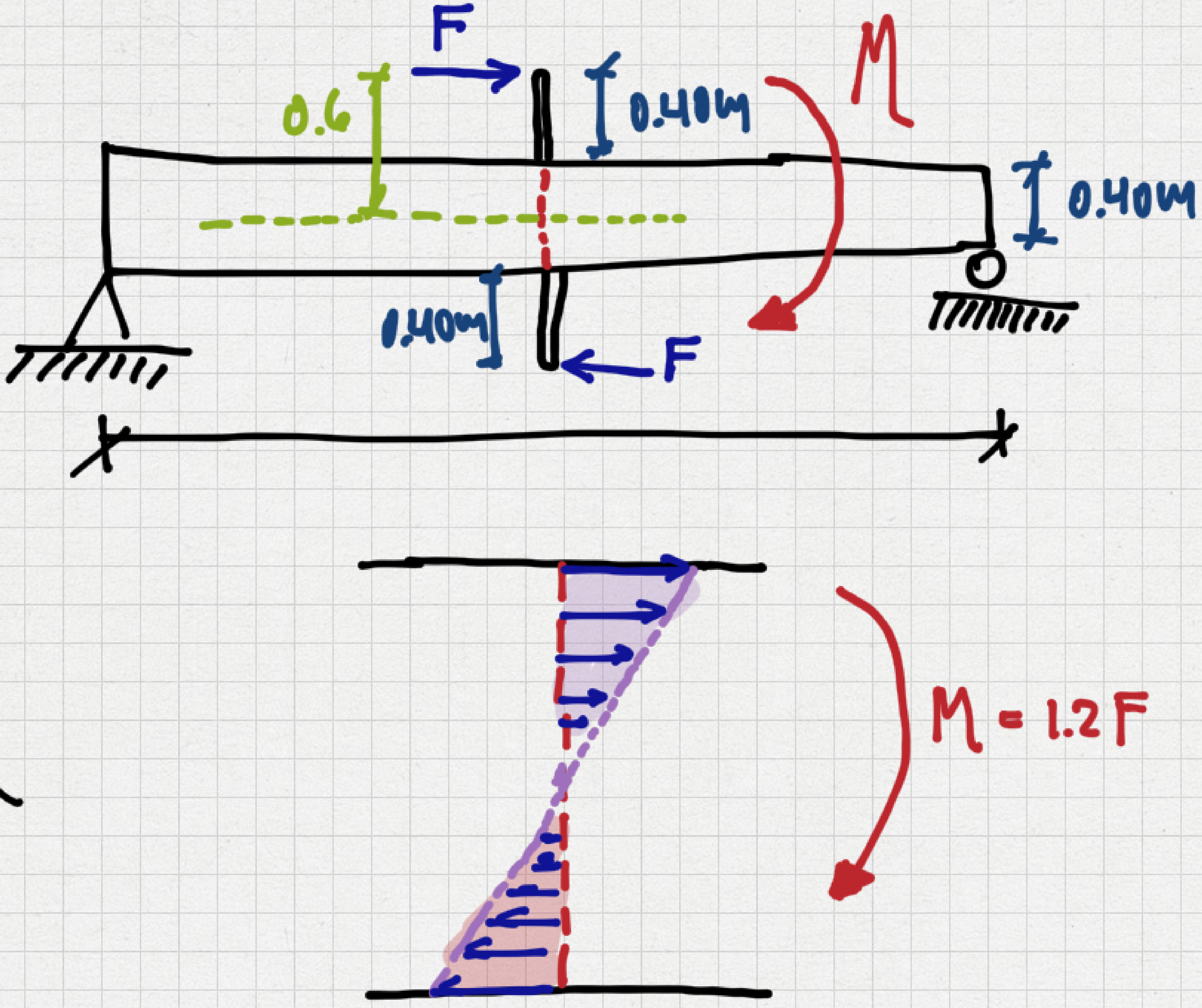


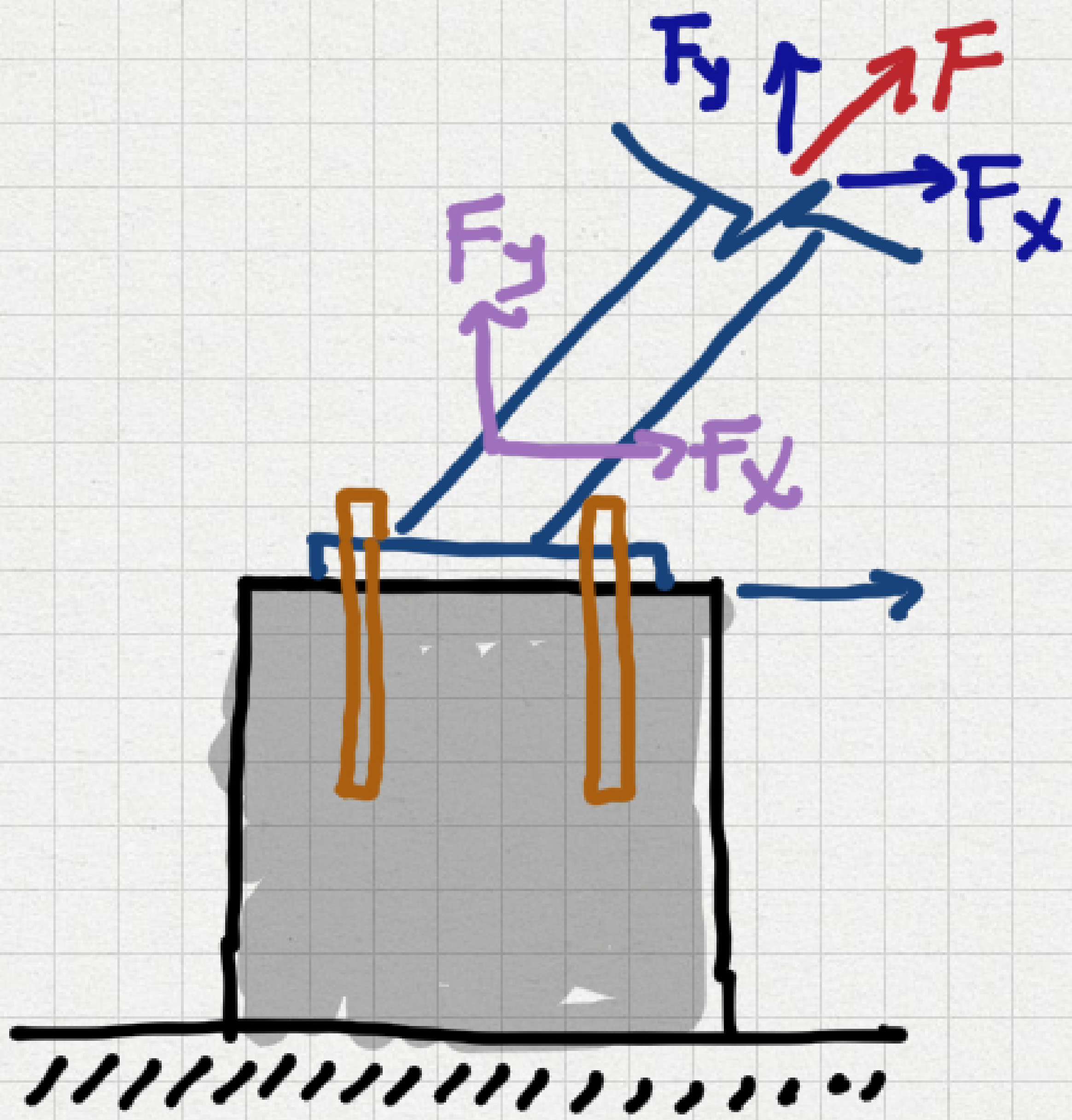

ESFUERZO TORSIONAL

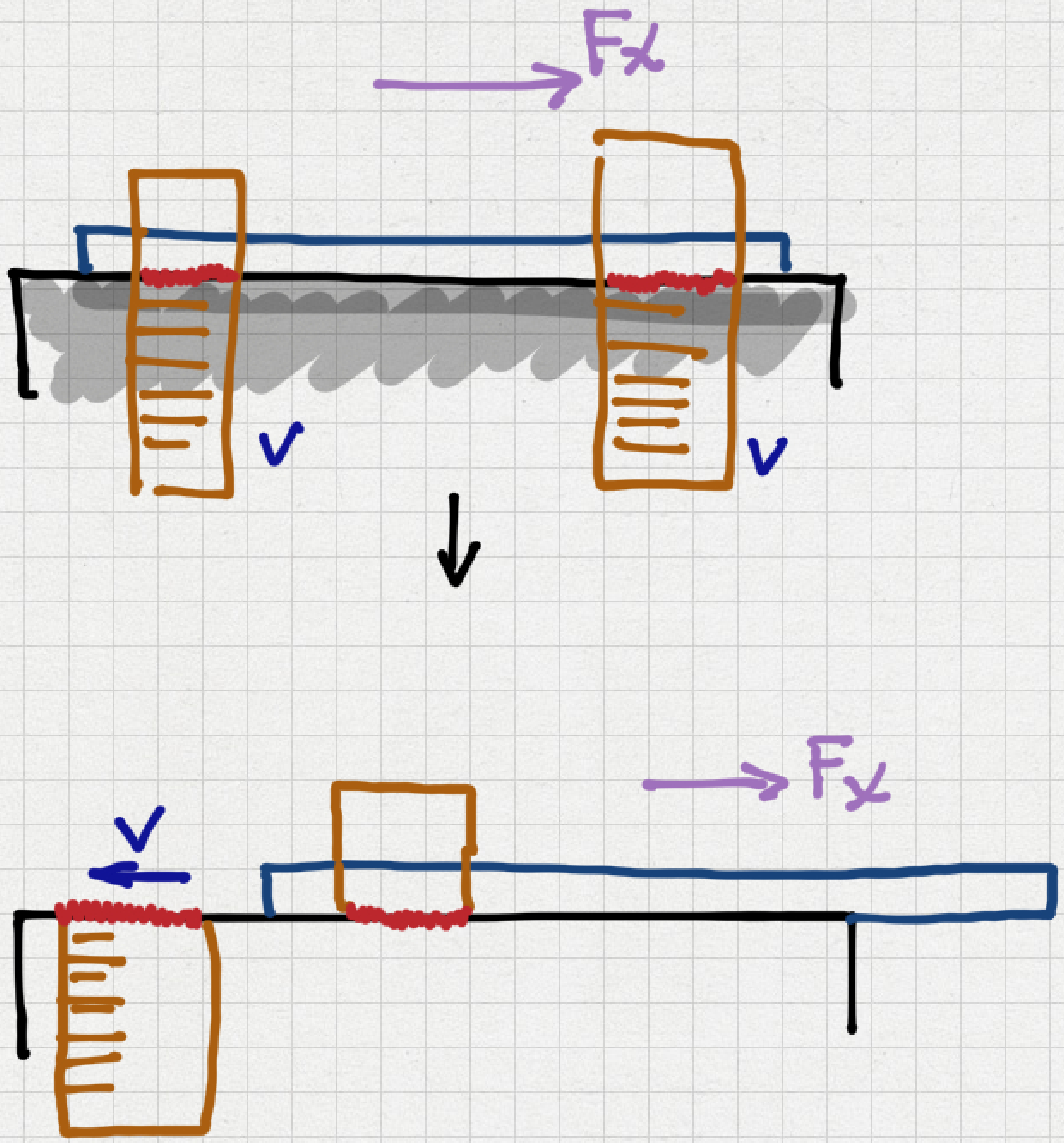
# Ejemplos aplicativo




$$\sigma = \frac{W}{A}$$





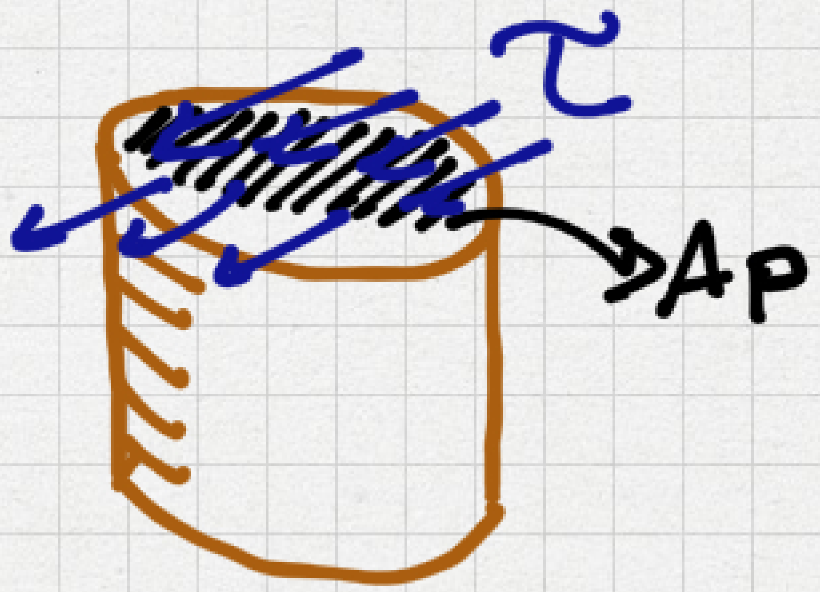




$$\tau = \frac{V}{A_p}$$

Esfuerzo cortante

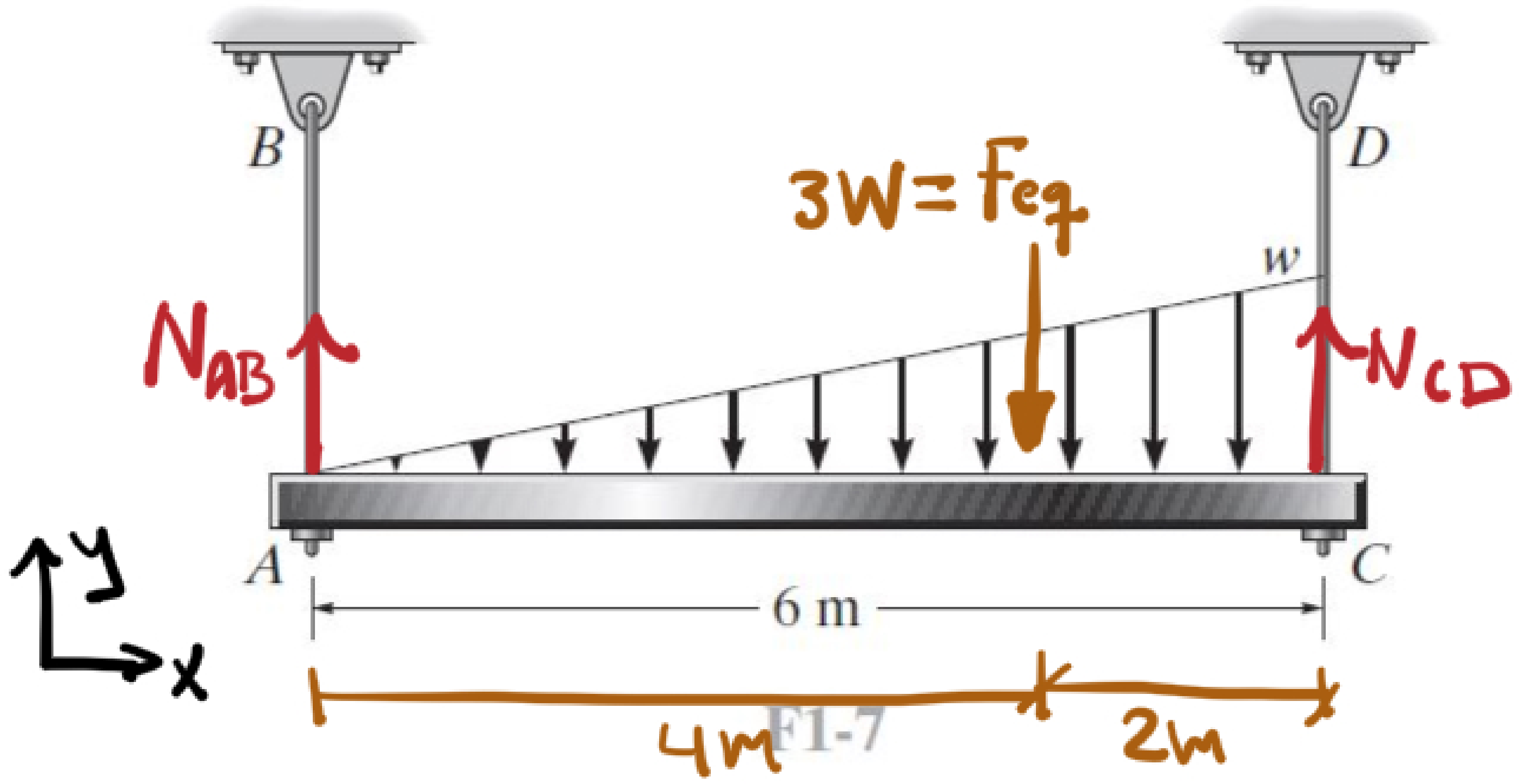
Fuerza cortante

Área de corte



## Ejemplos :

**F1-7.** La viga uniforme está sostenida por dos barras $AB$ y $CD$ que tienen áreas de sección transversal de 10 mm$^2$ y 15 mm$^2$, respectivamente. Determine la intensidad $w$ de la carga distribuida de modo que el esfuerzo normal promedio en cada barra no sea superior a 300 kPa. $\rightarrow 0.3\,N/mm^2$




F1-7

$$F_{eq} = (6)(w)/2 \rightarrow F_{eq} = 3W$$

Dato : $1\,KPa = 0.001\,N/mm^2$ $\Big|$ $\sigma = \dfrac{N}{A} \rightarrow N = \sigma A$

$$A_{AB} = 10\,mm^2 \rightarrow N_{AB} = (0.3)(10) = 3N$$

$$A_{CD} = 15\,mm^2 \rightarrow N_{CD} = (0.3)(15) = 4.5N$$

$$\Sigma M_A = 0;\quad (N_{CD})(6) = (3W)(4) \rightarrow N_{CD} = 2W$$

$$\Sigma F_y = 0;\quad N_{AB} + N_{CD} = 3W \qquad \rightarrow N_{AB} = W$$

**Alt. 1 :** $N_{CD} = 2W = 4.5N \rightarrow W = 2.25N$ ✓

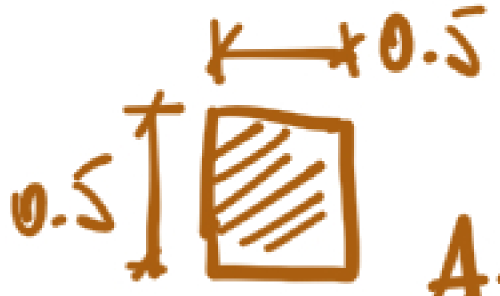
$N_{AB} = W = 2.25N$ ✓

**Alt. 2 :** $N_{AB} = W = 3N \rightarrow W = 3N$

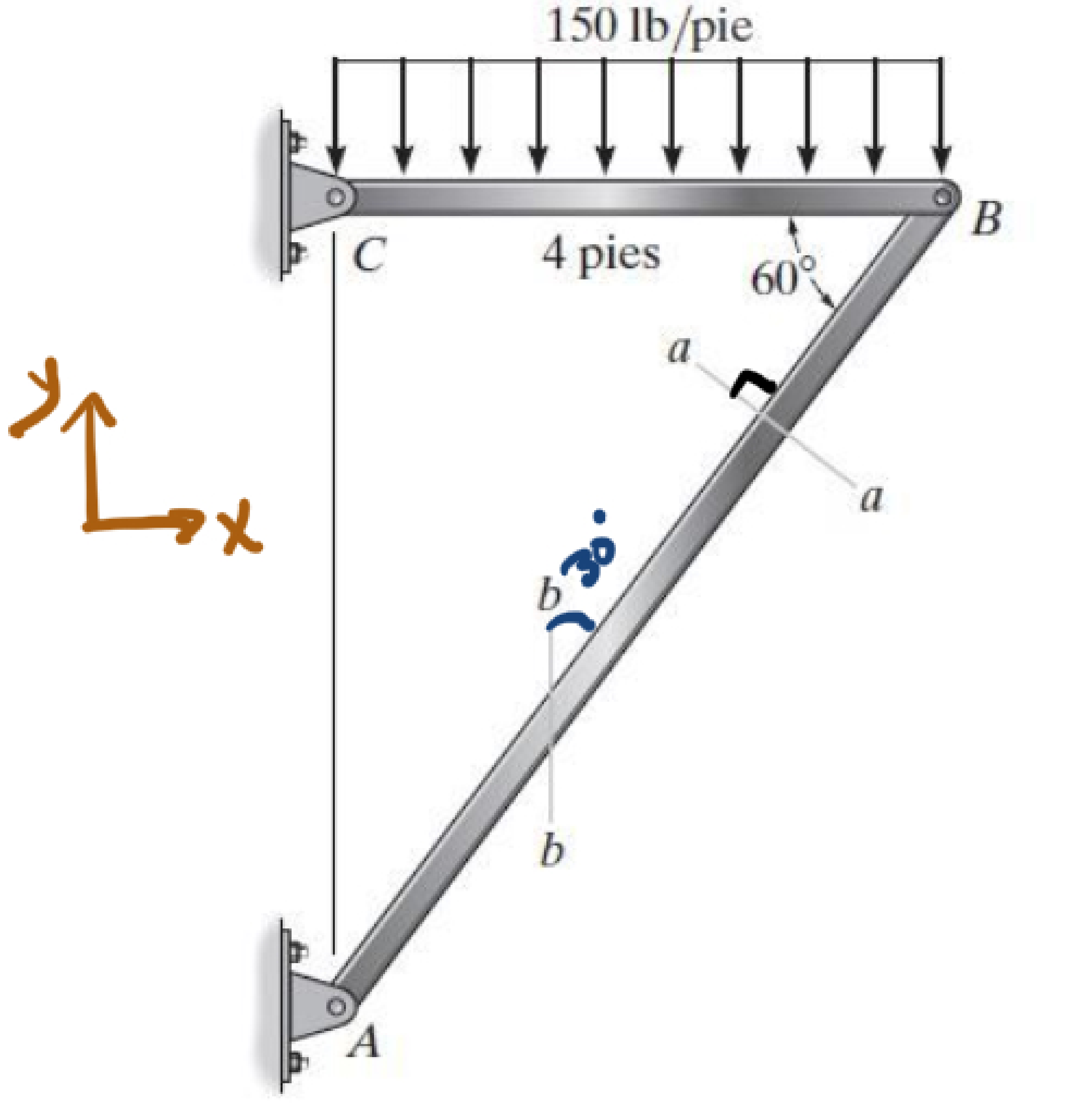
$N_{CD} = 2W \rightarrow N_{CD} = 6N$

**1-71.** Determine el esfuerzo normal promedio en la sección *a-a* y el esfuerzo cortante promedio en la sección *b-b* del elemento *AB*. La sección transversal es cuadrada con 0.5 pulg por lado.

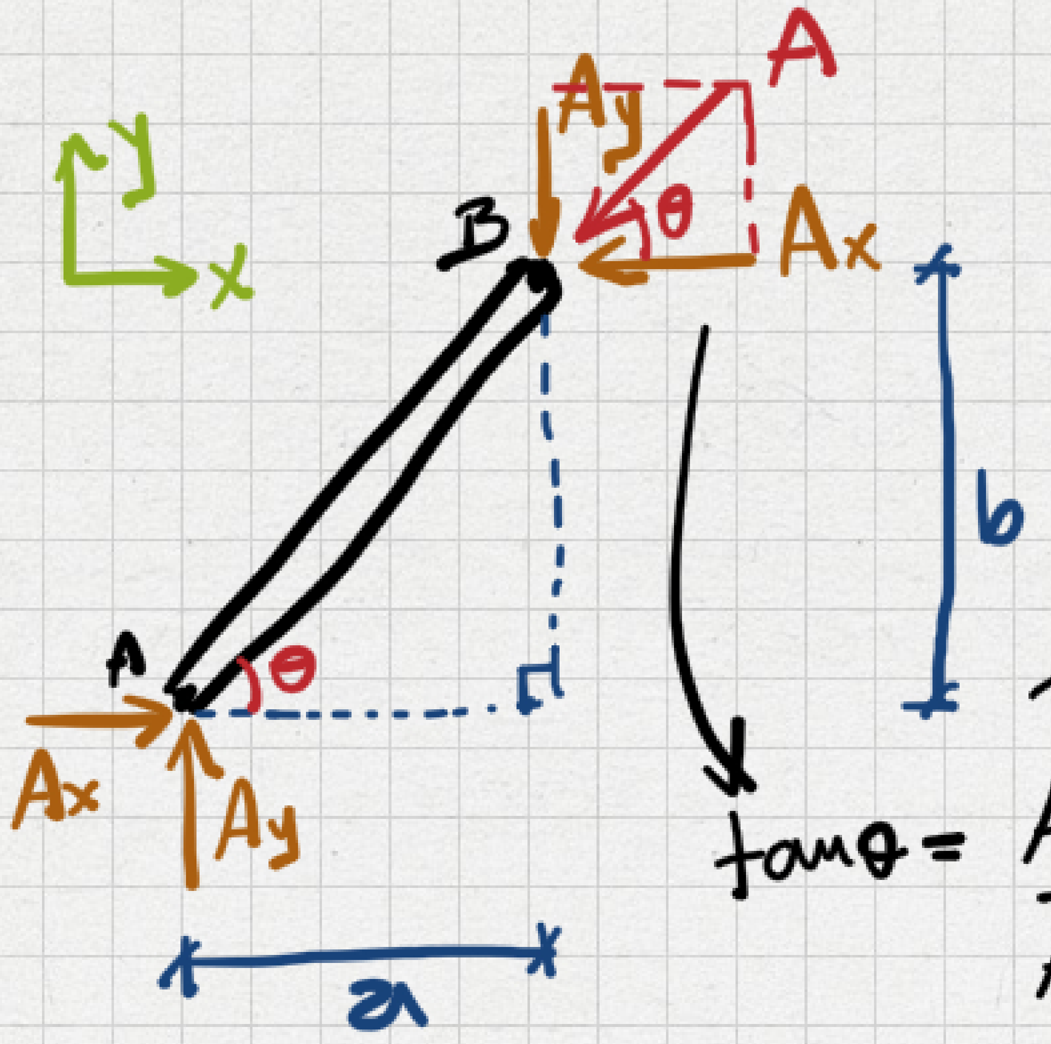
1




$A_T = 0.25\,\text{pulg}^2$




Prob. 1-71



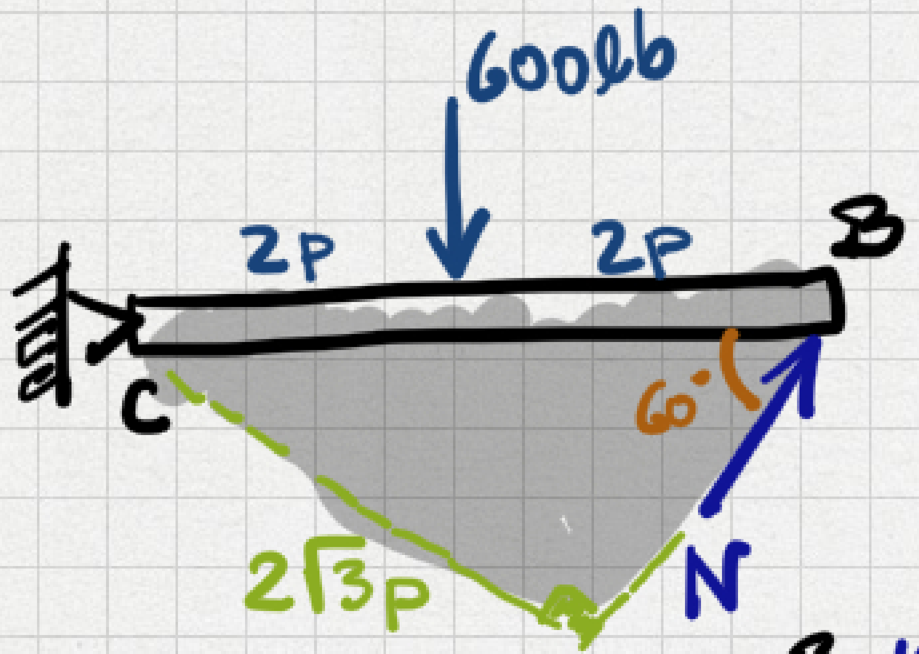

$\Sigma M_A = 0$

$(A_x)(b) = (A_y)(a)$

$\dfrac{A_x}{A_y} = \dfrac{a}{b}$ → Biela (articulado en sus 2 extremos)

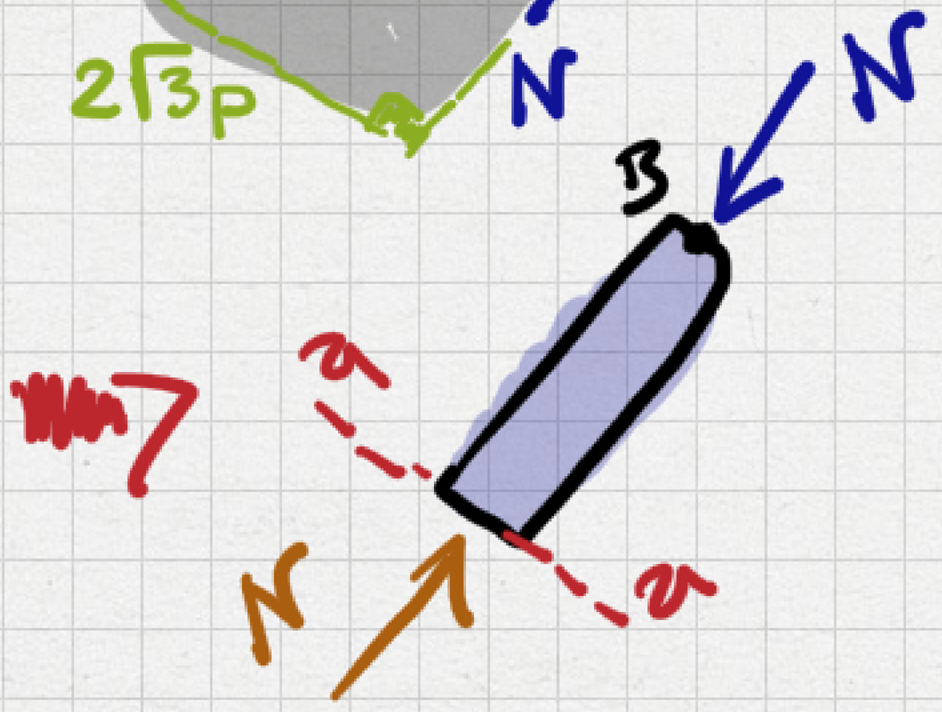
$\tan\theta = \dfrac{A_y}{A_x} = \dfrac{b}{a}$

Tracción o compresión



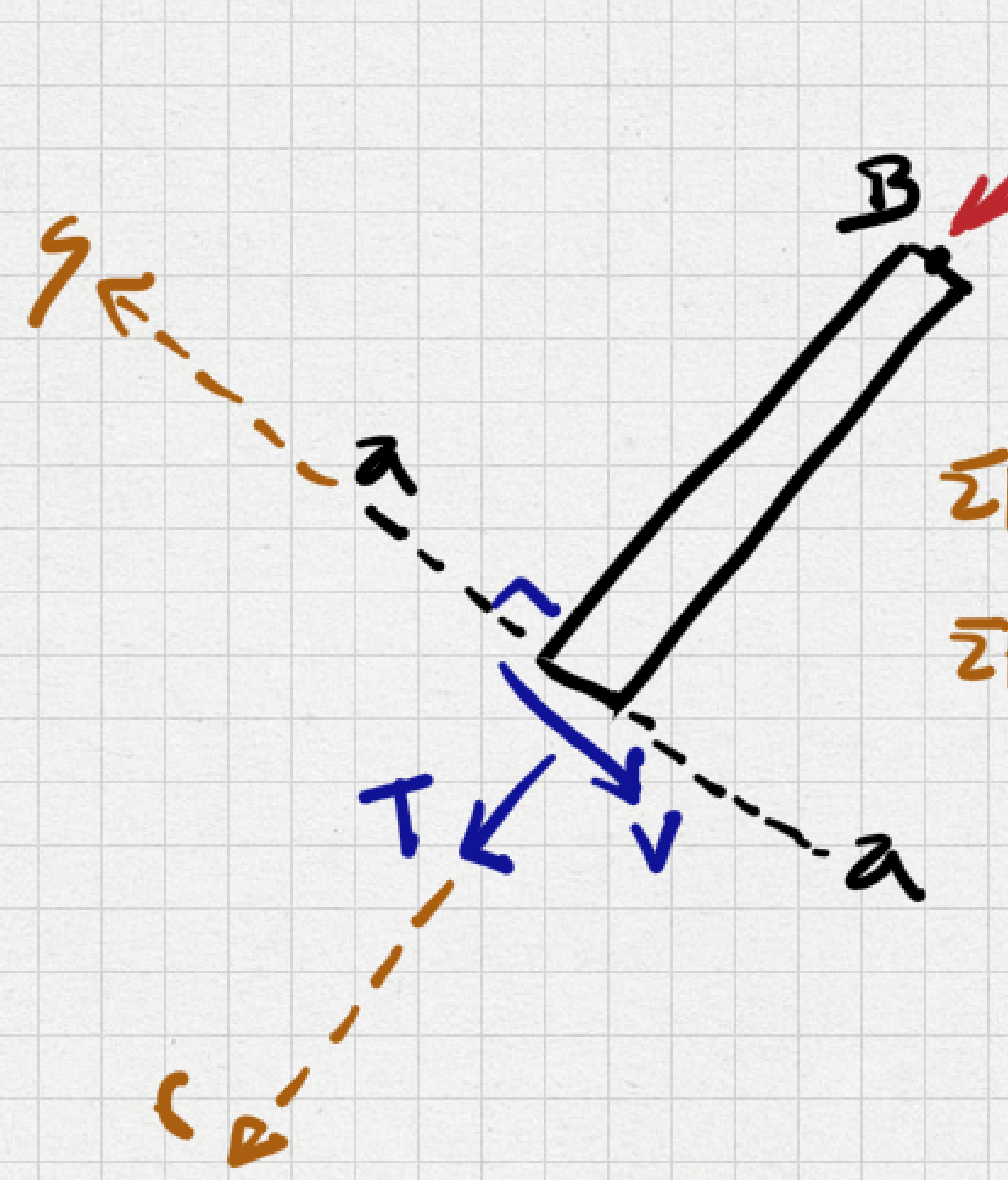

$\Sigma M_C = 0;\ (N)(2\sqrt{3}) = (600)(2)$

$N = 200\sqrt{3} = 346.41\ \text{lb}$

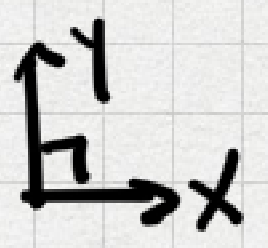



$\sigma_{aa} = \dfrac{N}{A_T} = \dfrac{200\sqrt{3}}{0.25}$

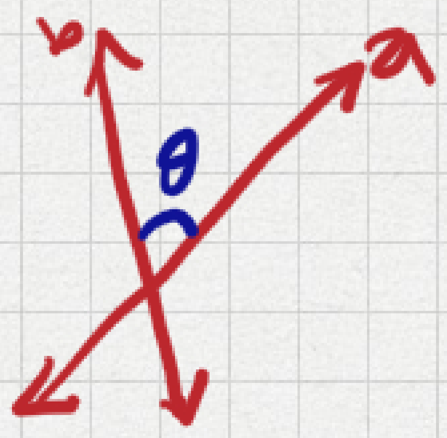
$\sigma_{aa} = 1385.64\ \dfrac{\text{lb}}{\text{pulg}^2}$




$\Sigma F_x = 0$
$\Sigma F_y = 0$

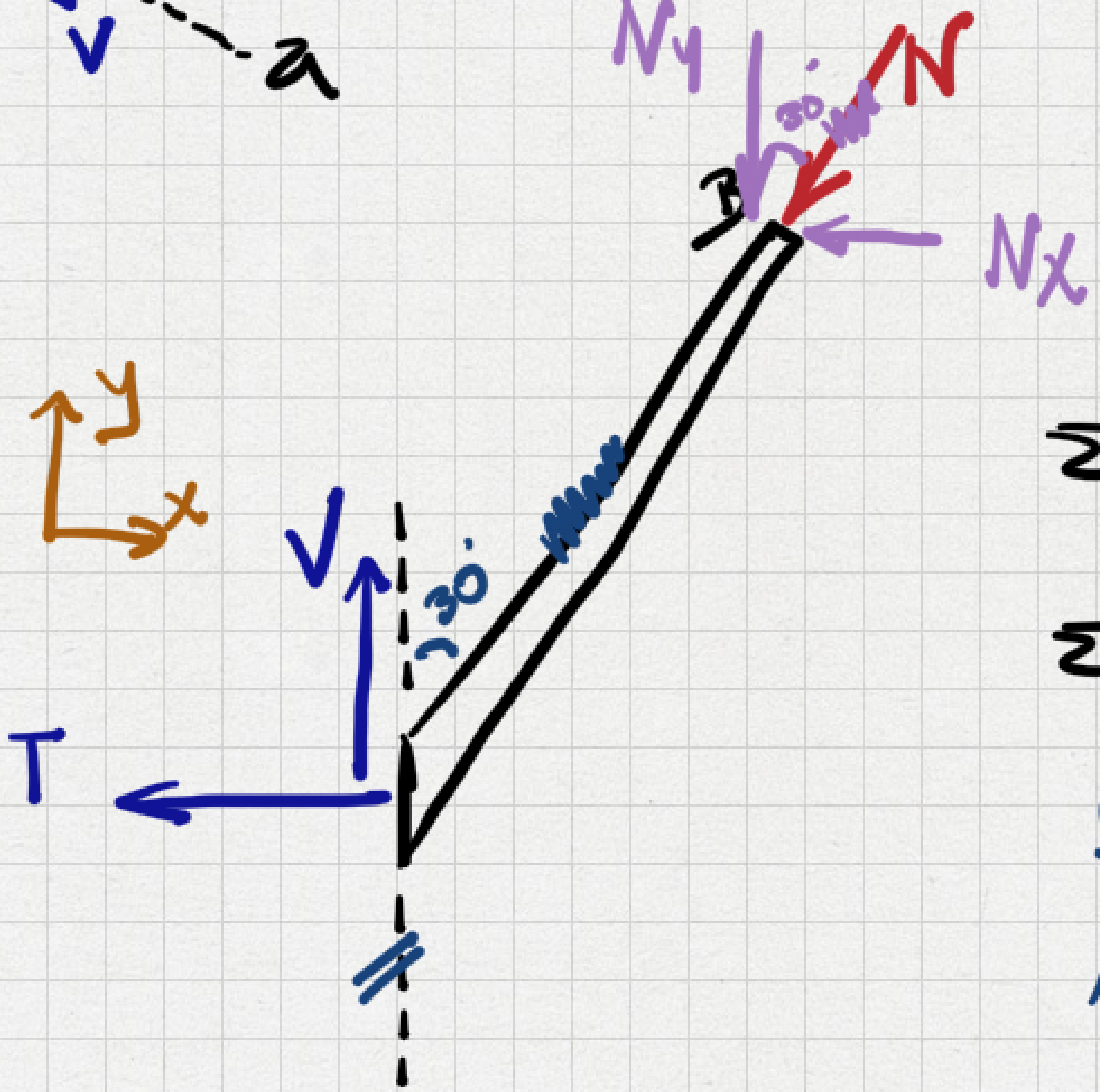



$\Sigma F_a = 0$
$\Sigma F_b = 0$




$\Sigma F_r = 0;\ T + N = 0 \rightarrow T = -N$

$\Sigma F_s = 0;\ V = 0$




$N_x = N\,\text{sen}\,30° = (200\sqrt{3})(1/2) = 100\sqrt{3}\,N$

$N_y = N\cos 30° = (200\sqrt{3})(1/\sqrt{3}) = 200\,N$

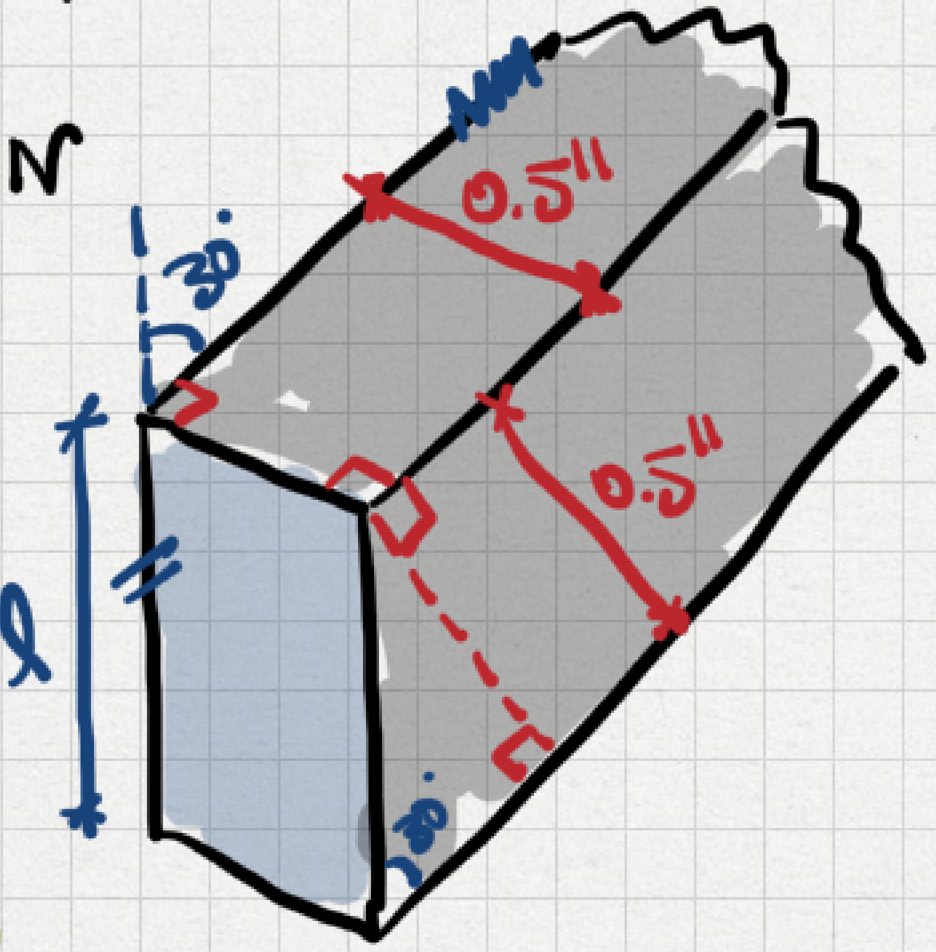
$\Sigma F_x = 0;\ T + N_x = 0 \rightarrow T = -N_x \rightarrow T = -100\sqrt{3}\,N$

$\Sigma F_y = 0;\ V = N_y \rightarrow V = 200\,N$

$l = 0.5 \times \csc 30° = 1''$

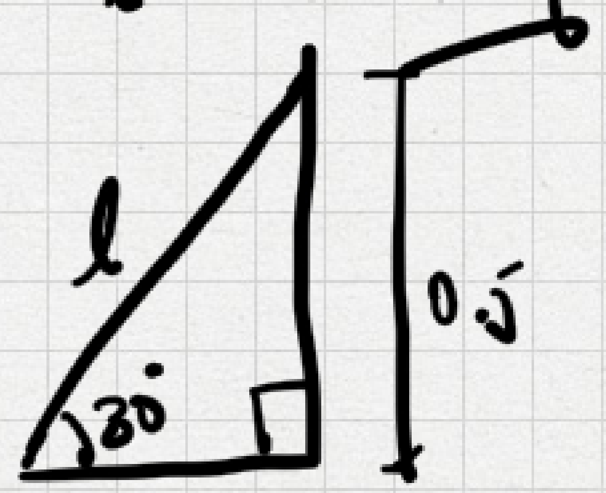
$A_c = (0.5)(1) = 0.5\ \text{pulg}^2$

$\therefore\ \tau = \dfrac{200}{0.5} \rightarrow \tau = 400\,\text{lb/pulg}^2$

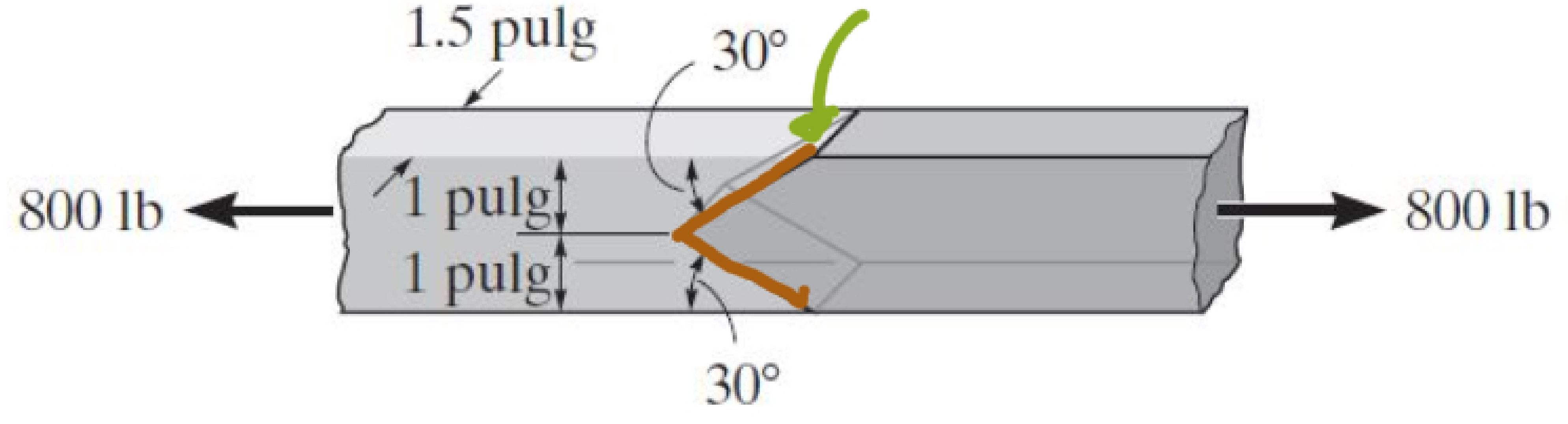



$\text{sen}\,30° = \dfrac{0.5}{l}$

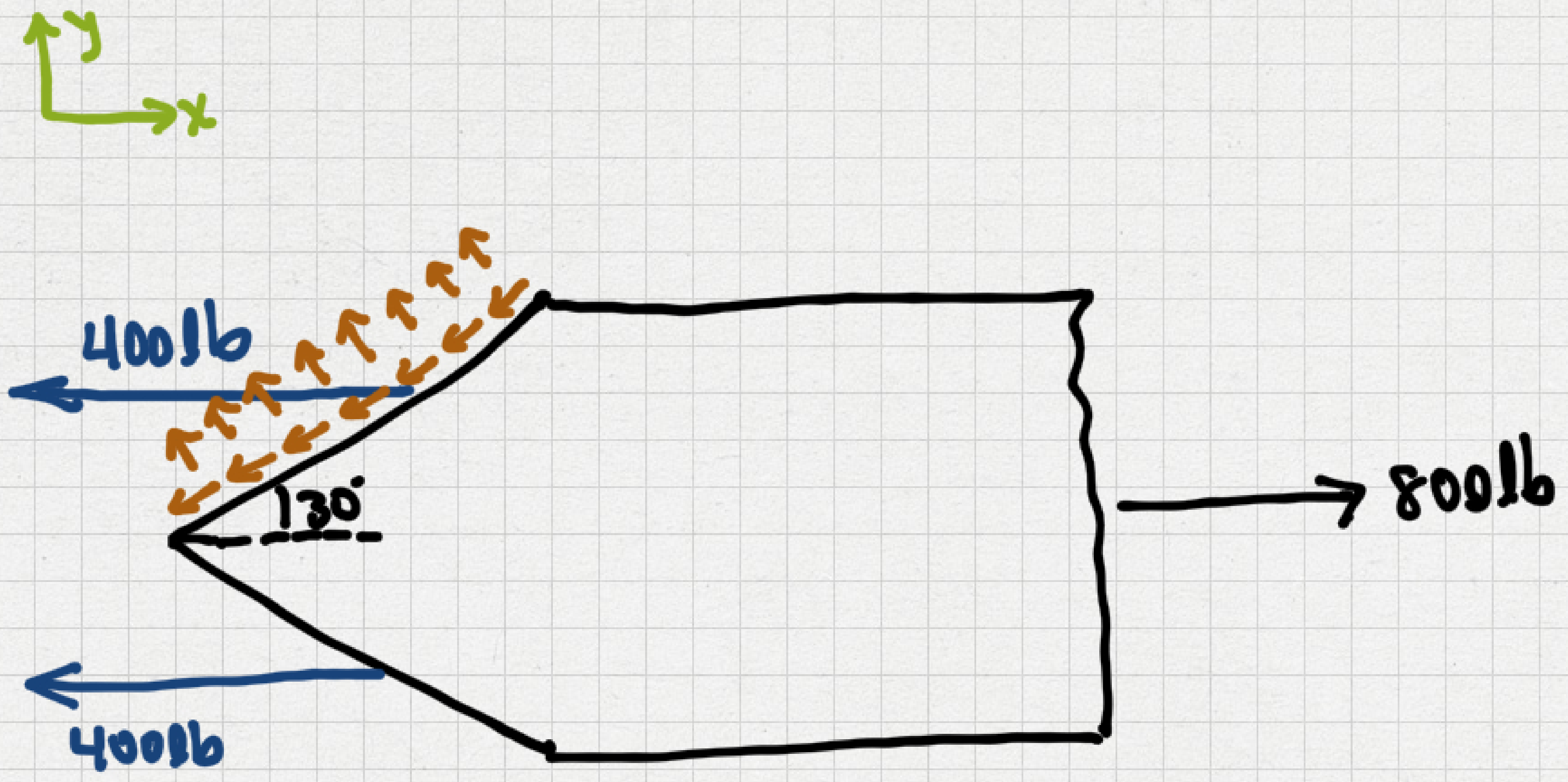
$l = 0.5\csc 30°$

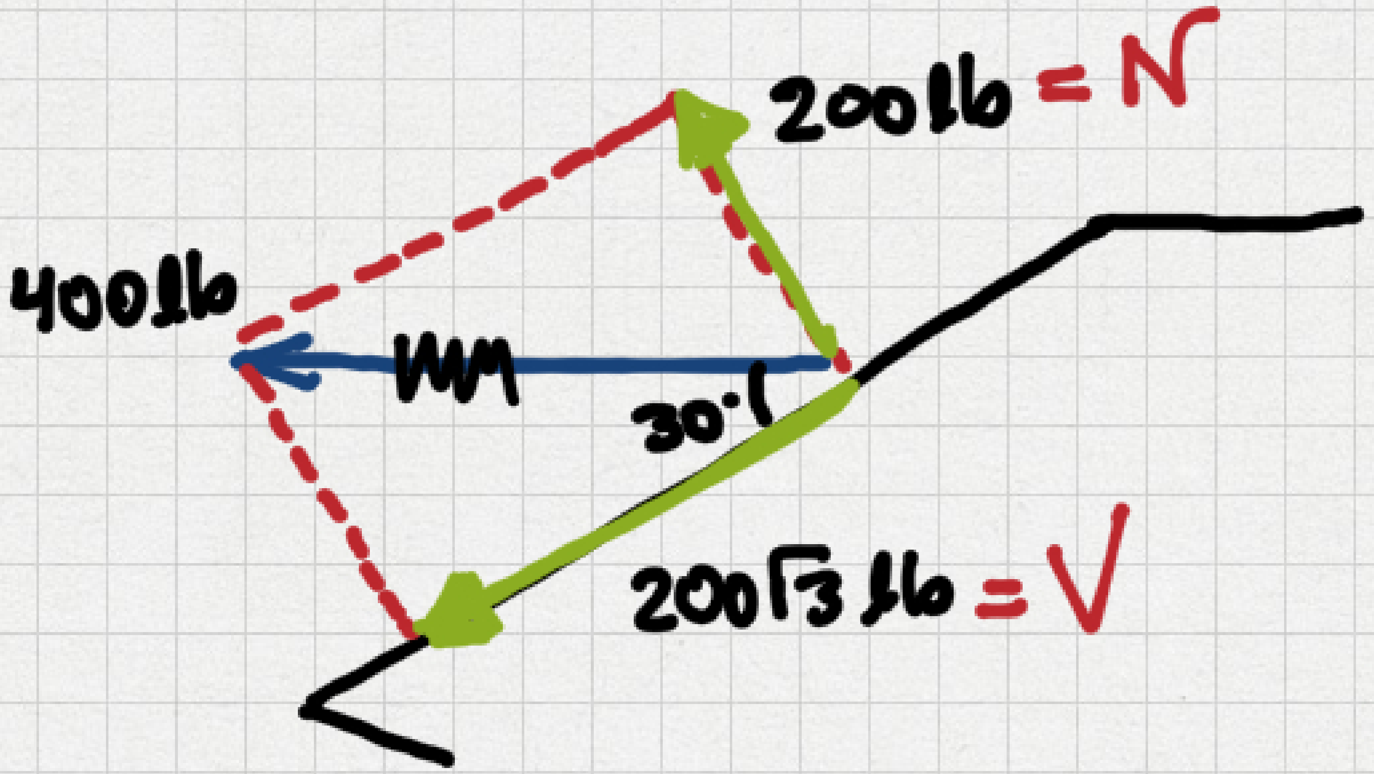


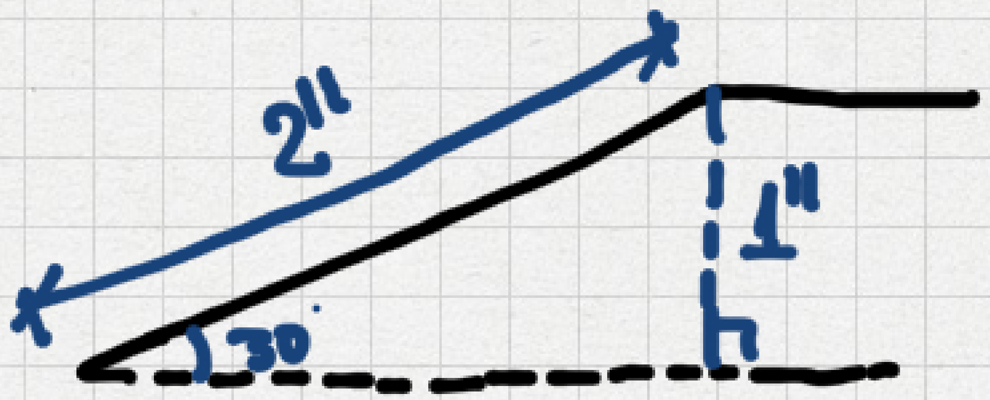
**1-38.** Los dos elementos usados en la construcción de un fuselaje para avión se unen entre sí mediante una soldadura "boca de pez" a 30°. Determine el esfuerzo normal promedio y cortante promedio sobre el plano de cada soldadura. Suponga que cada plano inclinado soporta una fuerza horizontal de 400 lb.




**Prob. 1-38**




$A = (2)(1.5) = 3 \text{ pulg}^2$

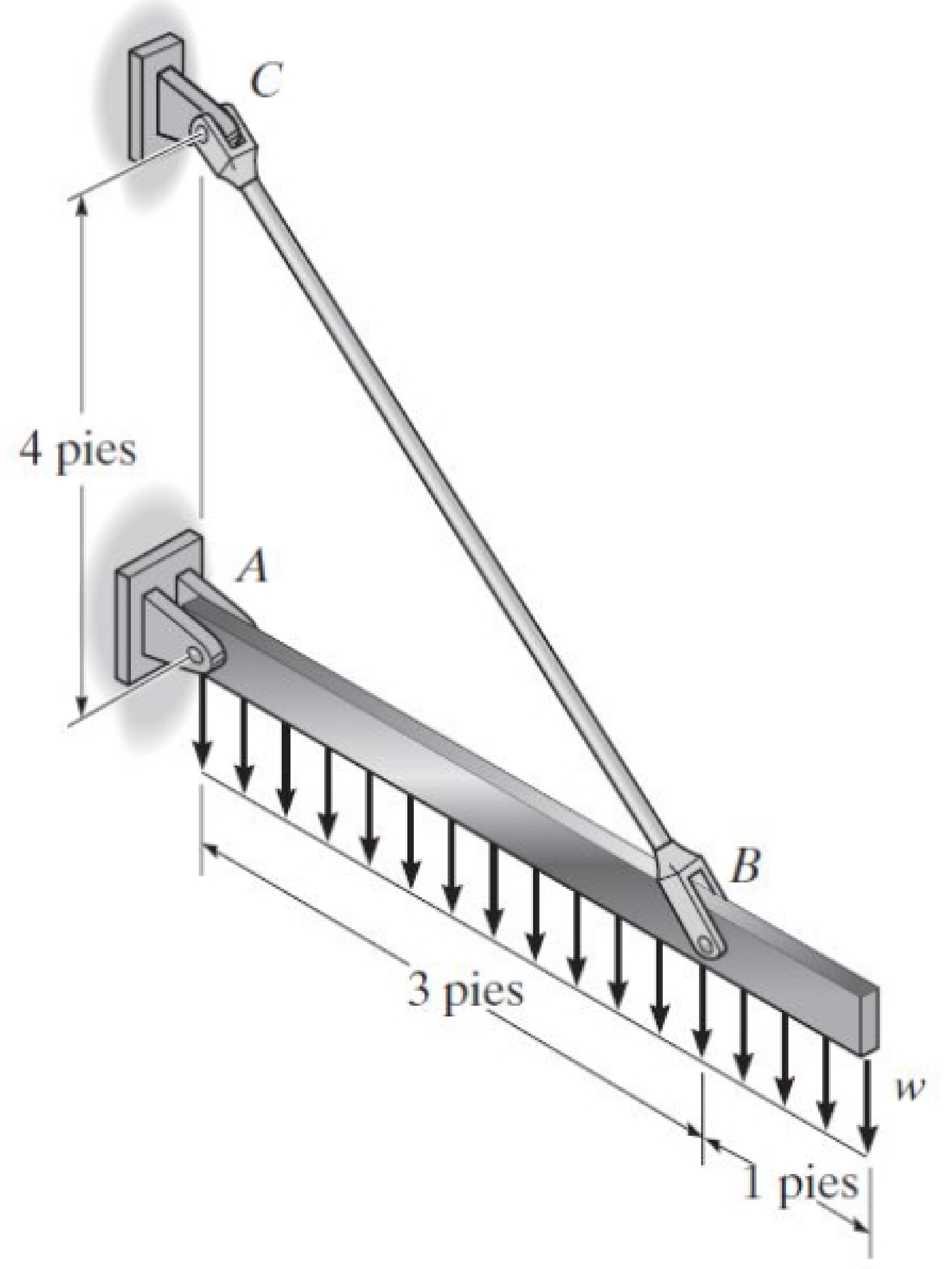
$\sigma_N = \dfrac{200 \text{ lb}}{3}$

$\sigma = 66.67 \text{ lb/pulg}^2$

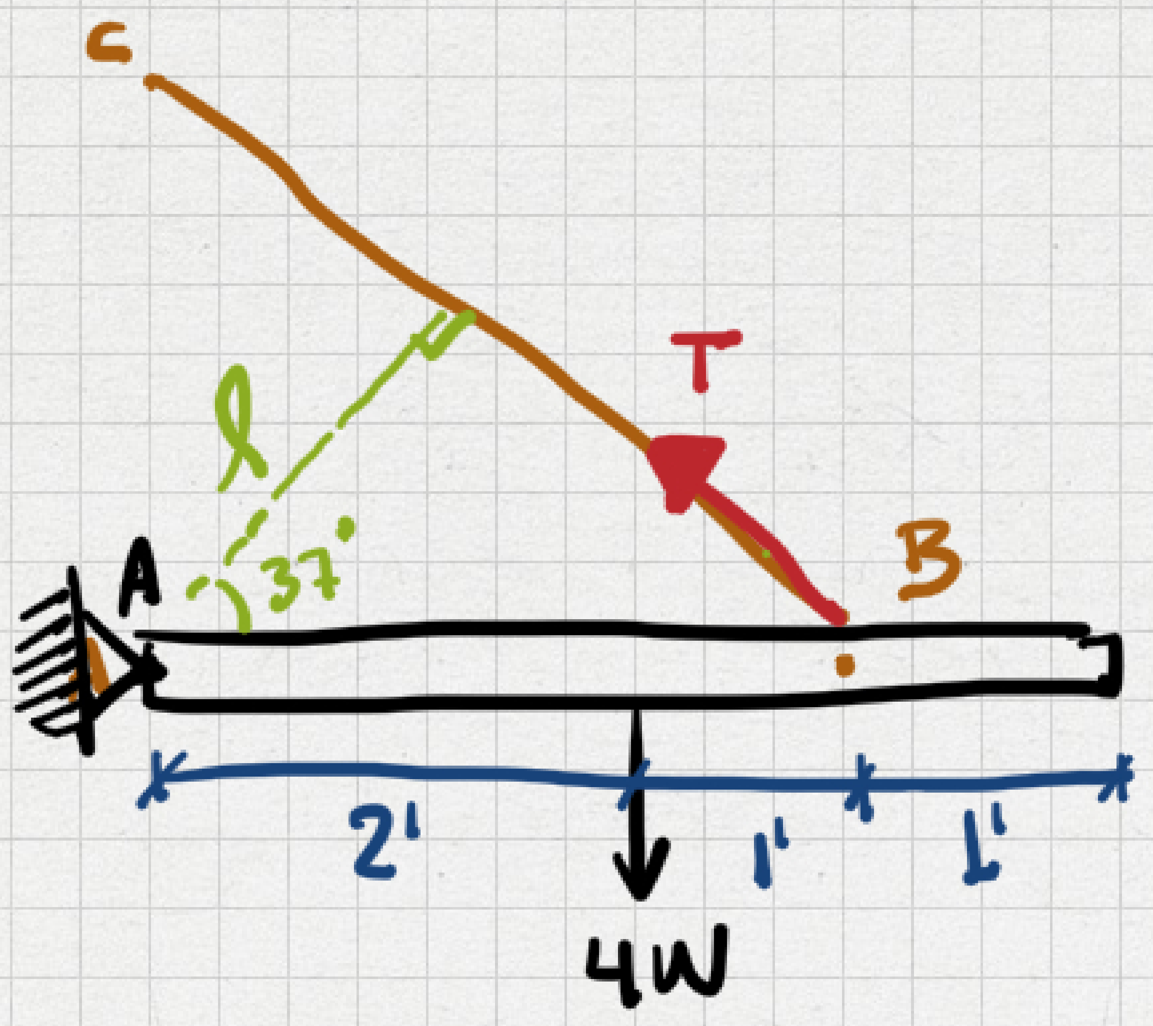
$\tau = \dfrac{200\sqrt{3}}{3}$

$\tau = 115.47 \text{ lb/pulg}^2$

**1-94.** Si el esfuerzo cortante permisible para cada uno de los pernos de acero de 0.30 pulg de diámetro en $A$, $B$ y $C$ es $\tau_{perm} = 12.5$ ksi y el esfuerzo normal permisible para la barra de 0.40 pulg de diámetro es $\sigma_{perm} = 22$ ksi, determine la máxima intensidad $w$ de la carga uniformemente distribuida que puede suspenderse de la viga.




Probs. 1-93/94



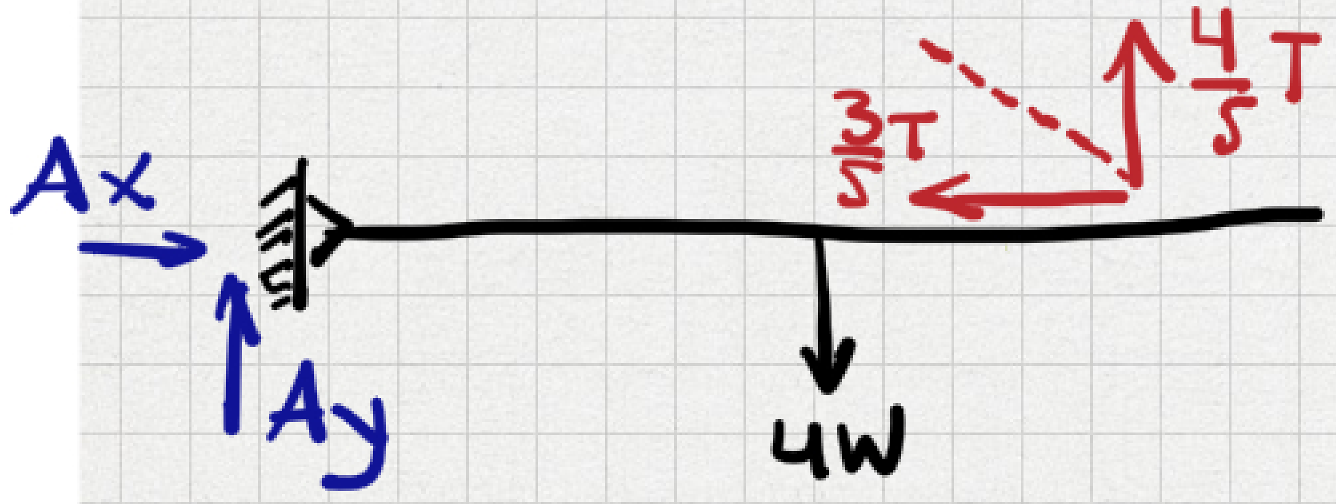

$$l = 3 \times \cos 37^\circ$$

$$l = 3 \times \frac{4}{5} = \frac{12'}{5}$$

$$\Sigma M_A = 0; \quad (4w)(2) = (T)(l)$$

$$T = \frac{8w}{l} = \frac{8w}{12/5}$$

$$\boxed{T = \frac{10w}{3}}$$




$$\Sigma F_x = 0; \quad A_x = \frac{3}{5}T = \frac{3}{5}\left(\frac{10w}{3}\right) = 2w$$

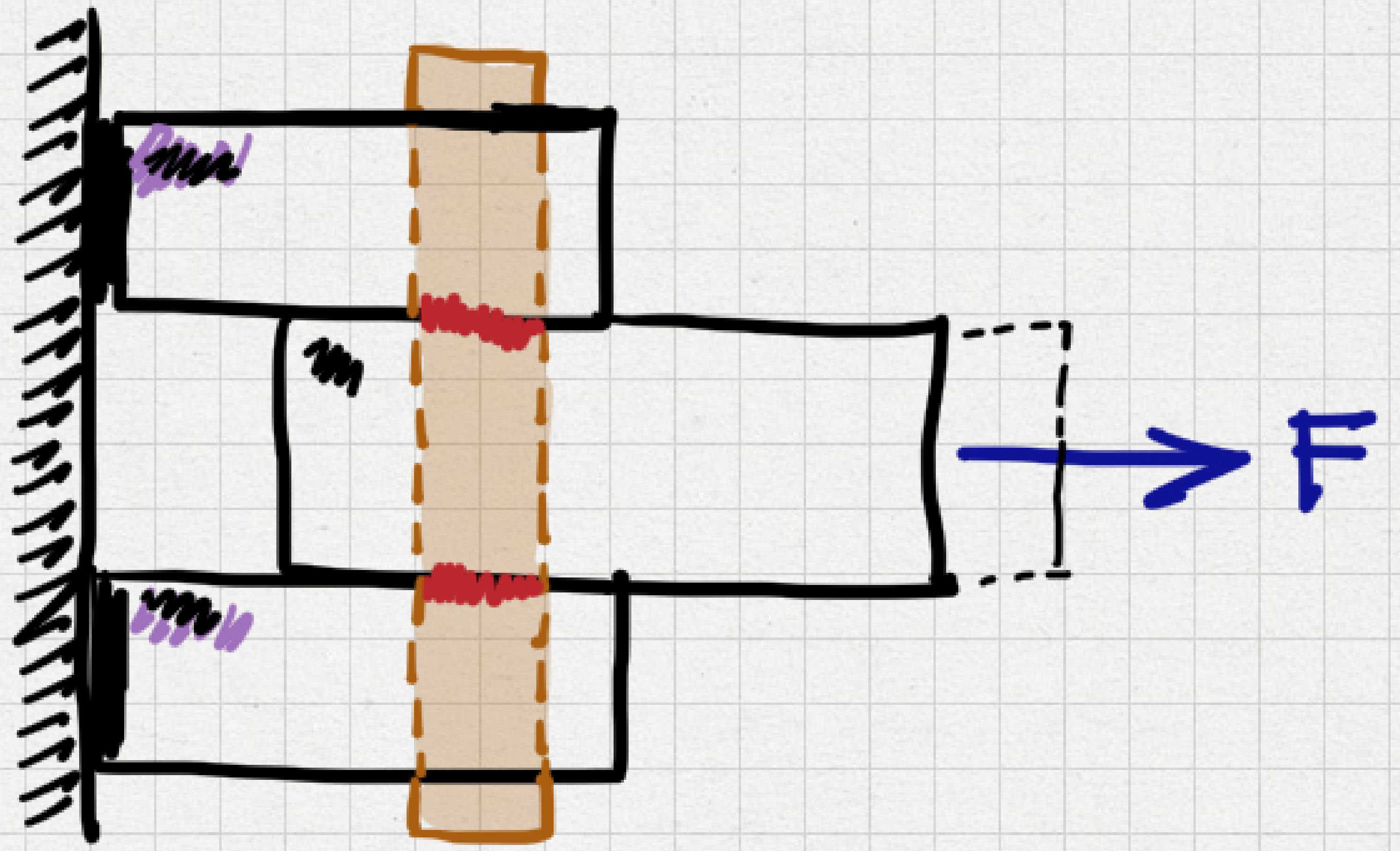
$$\Sigma F_y = 0; \quad A_y + \frac{4}{5}T = 4w \rightarrow A_y = \frac{4}{3}w$$

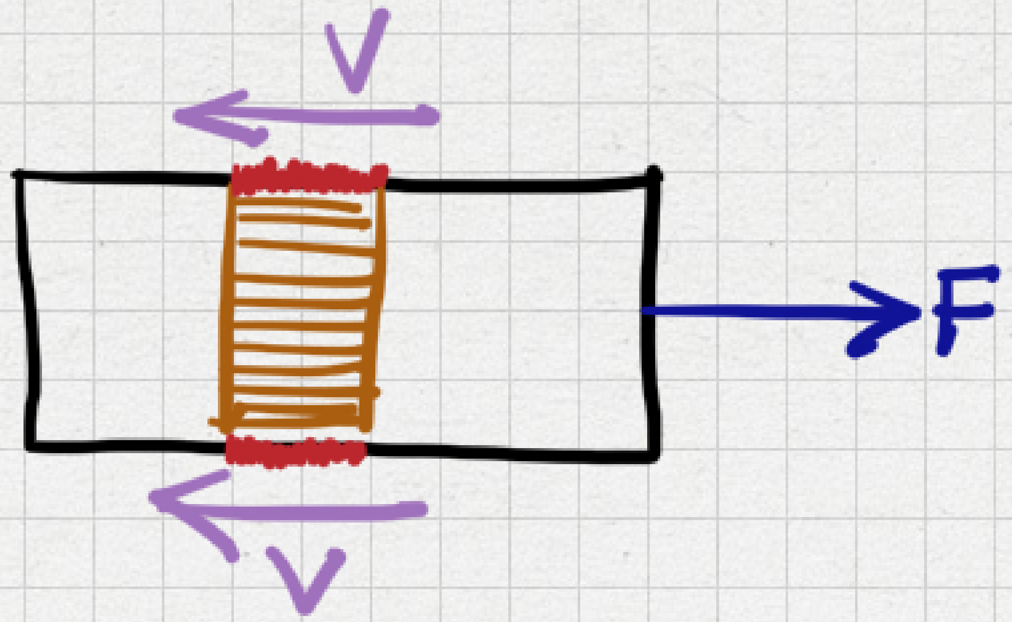
$$4w - \frac{4}{5}\left(\frac{10}{3}\right)$$

$$R_A = \sqrt{A_x^2 + A_y^2}$$

$$\boxed{R_A = 2.404w}$$

$$\boxed{R_C = T = \frac{10w}{3}}$$




$2V = F \rightarrow V = \frac{F}{2}$

## PUNTO "A"

$R_A = 2.404W \rightarrow V_A = \frac{R_A}{2} \rightarrow V_A = 1.202W$

$A_P = \frac{\pi}{4}(0.3^2) = 0.070685 \text{ pulg}^2$

$\tau_P = 12.5 \text{ ksi} = 12.5 \text{ klb/pulg}^2$

$\tau_P = \frac{V}{A_P} \rightarrow V = (12.5)(A_P) \rightarrow V = 883.57 \text{ lb}$

$W = 735.08 \text{ lb/pulg}$

## PUNTO "B"

$T = \frac{10W}{3} \rightarrow V_B = \frac{T}{2} \rightarrow V_B = \frac{5W}{3}$

$A_p = \frac{\pi}{4}(0.3^2)$

$\tau_p = 12.5 \text{ ksi} \rightarrow V = 883.57 \text{ lb}$

$W = 530.14 \text{ lb/pulg}$

RPTA.

## PUNTO "C"

$T = \frac{10W}{3} \rightarrow V_C = \frac{5W}{3}$ ; $V = 883.57 \text{ lb}$

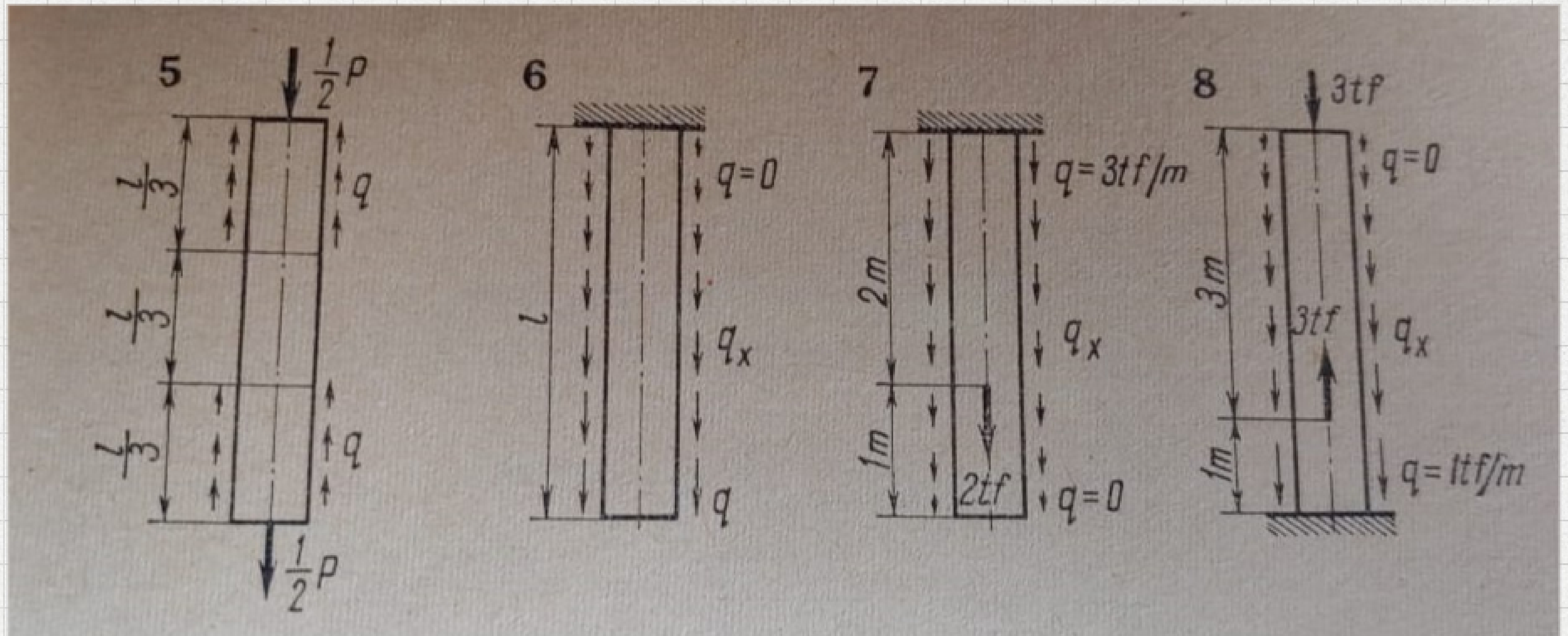
Cable:

$\sigma_p = 22ksi = 22000\ lb/pulg^2$

$A_b = \frac{\pi}{4}(0.4^2) = 0.12566\ pulg^2$

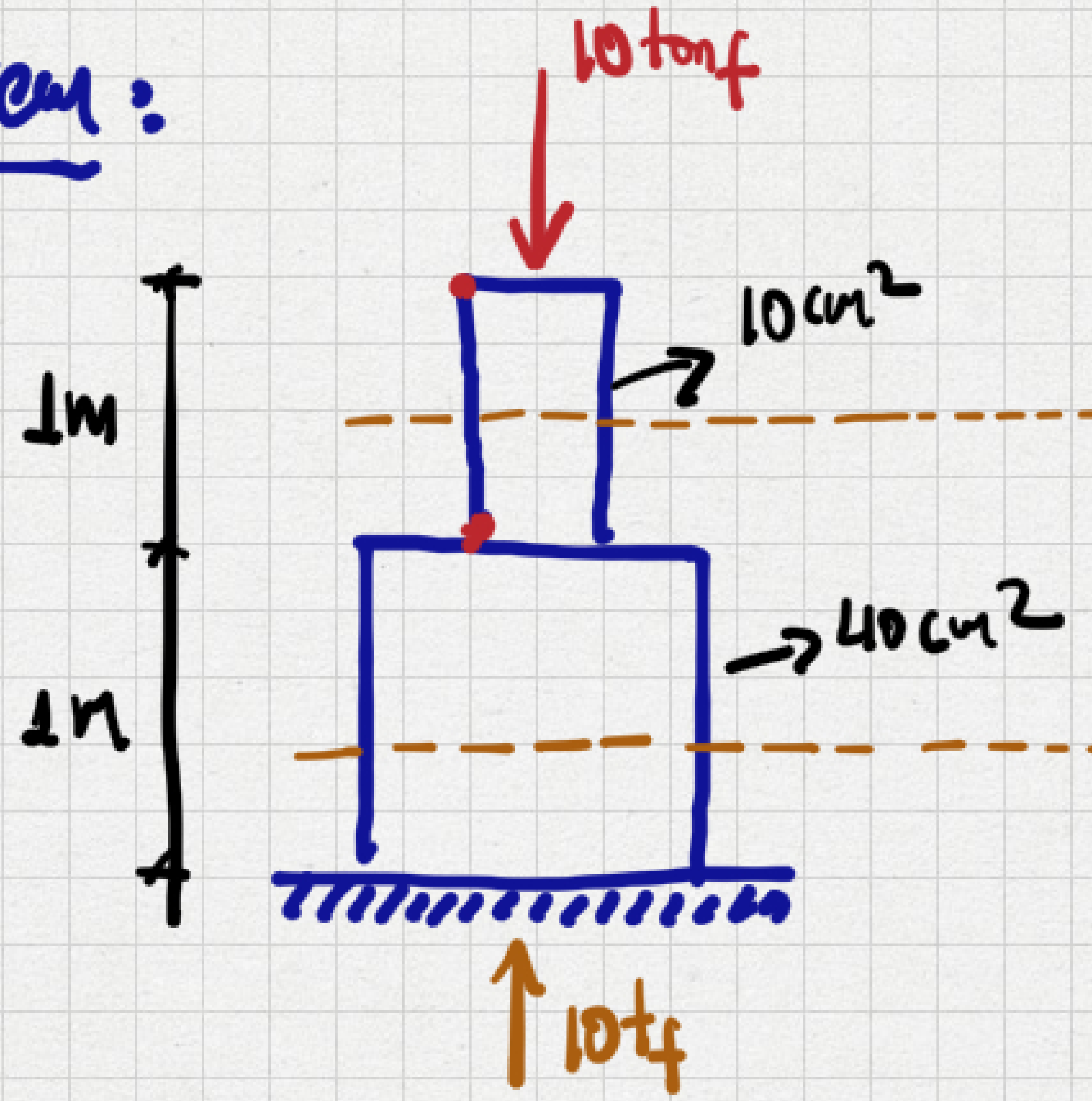
$N = \sigma_p \times A_b = (22000)(0.12566) \rightarrow N = 2764.52\ lb$

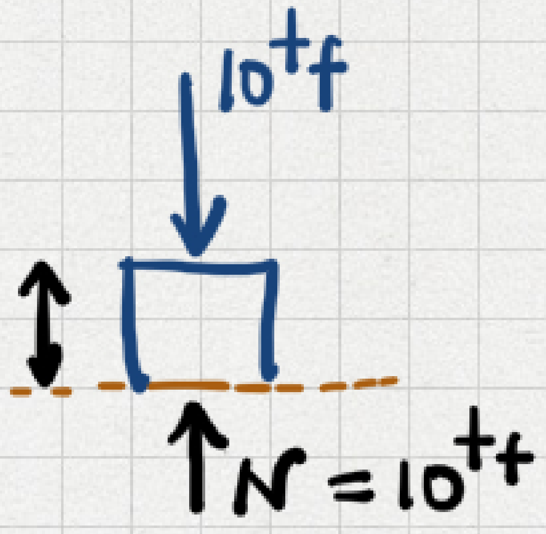
$T = \frac{10W}{3} \rightarrow W = 829.35\ lb/pulg$



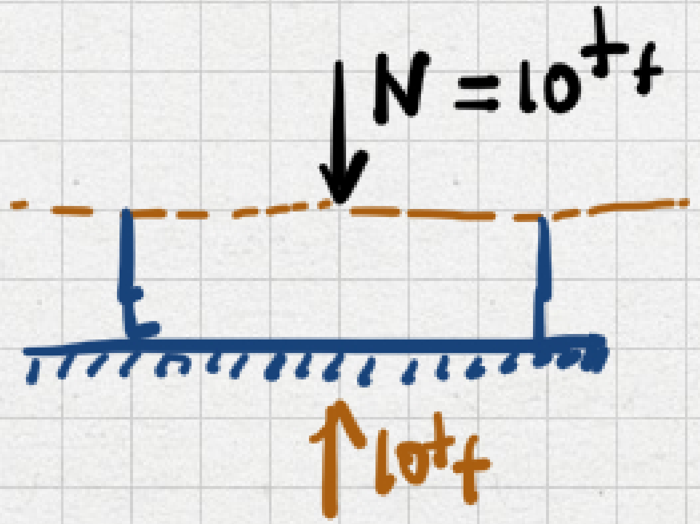

§ 2. *Tensiones normales, alargamiento absoluto y energía potencial*

**Ejem:**



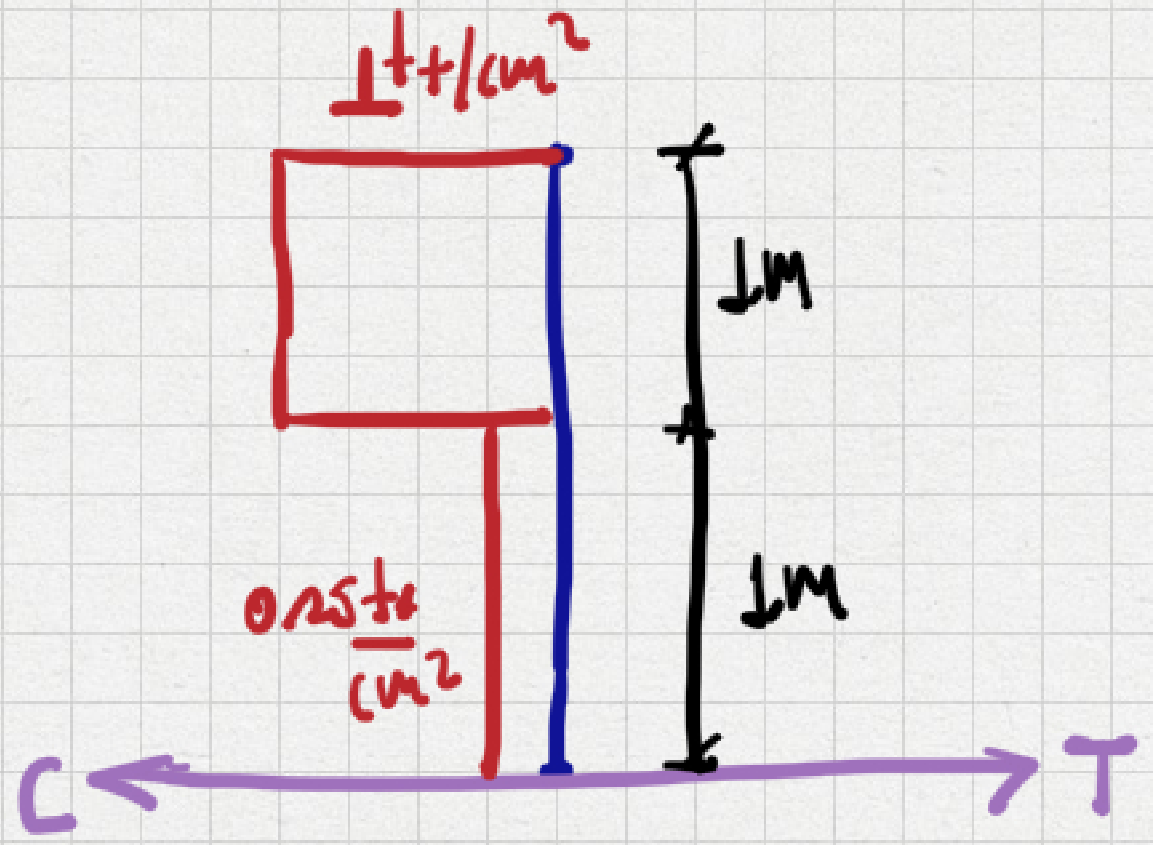



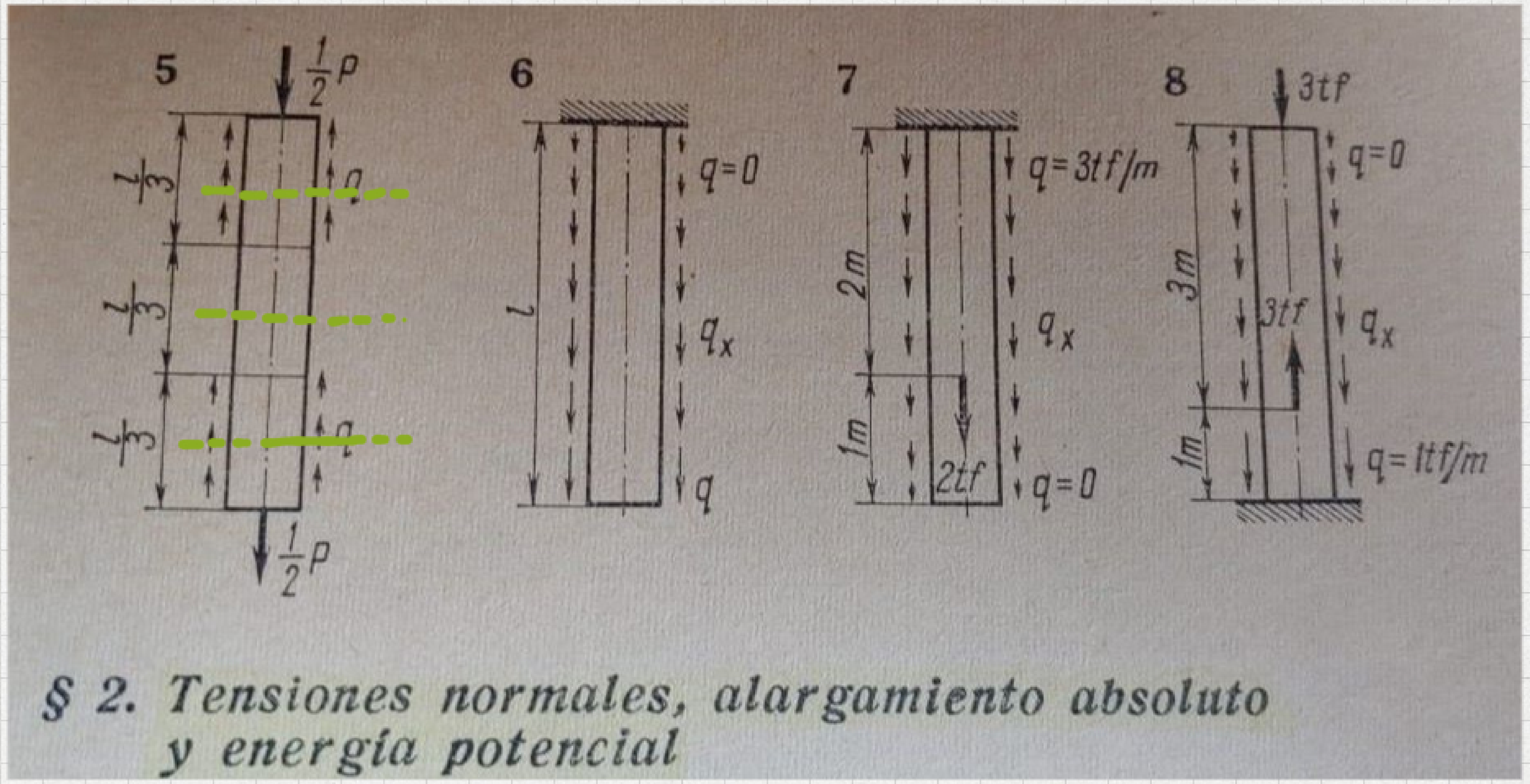

$$\sigma = \frac{10}{10} = 1\ tf/cm^2$$



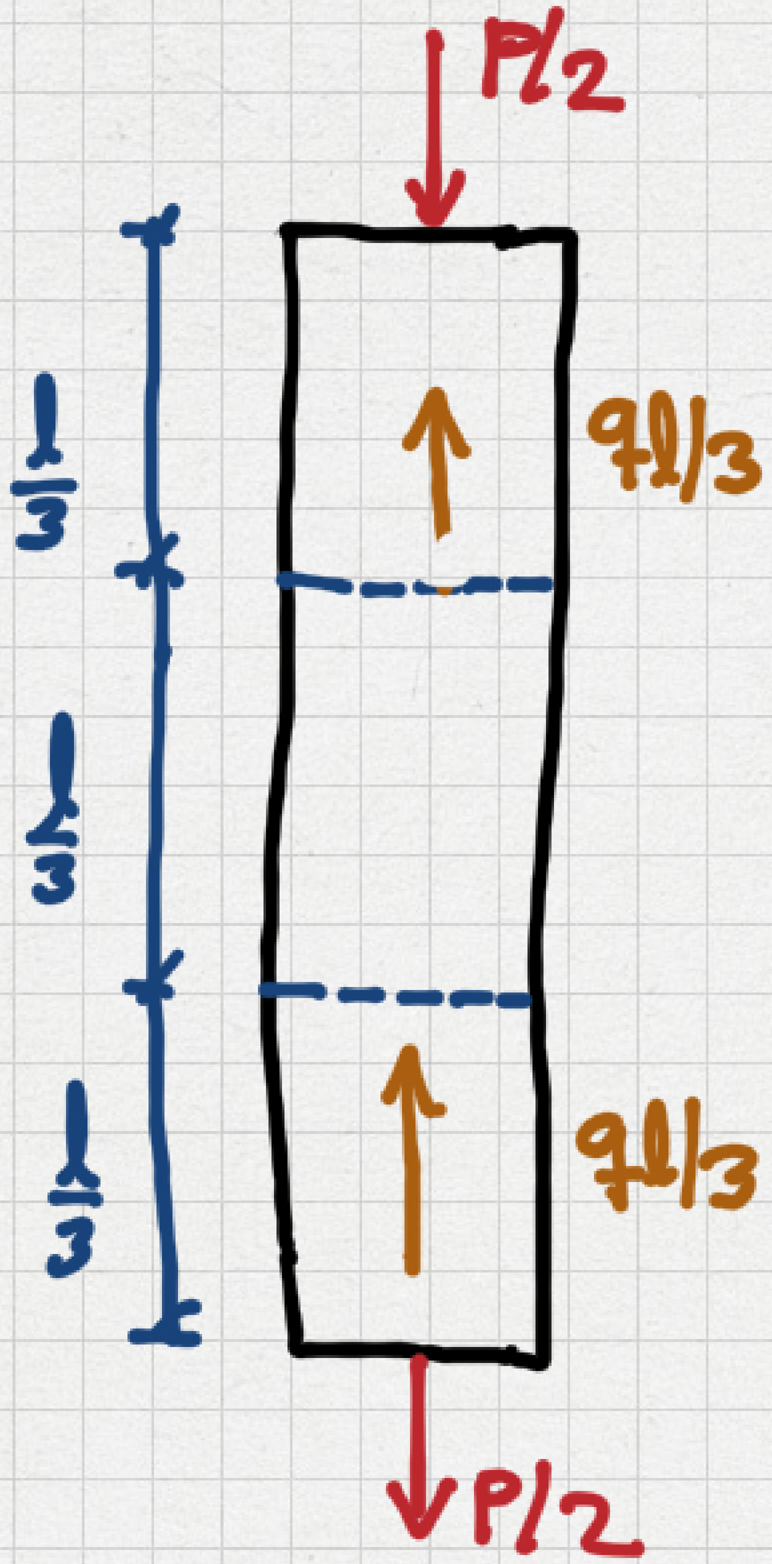

$$\sigma = \frac{10}{40} = 0.25\ \frac{tf}{cm^2}$$

DIAGRAMA DE ESFUERZOS NORMALES






## Ejemplo 5

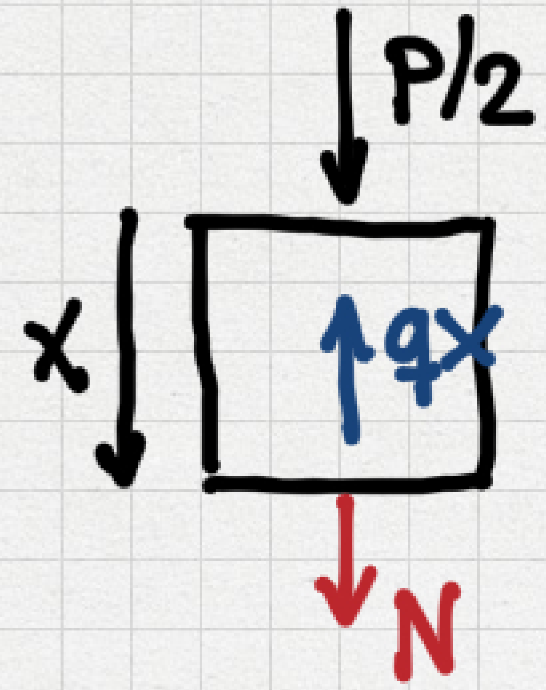



$\Sigma F_y = 0$

$$\frac{ql}{3} + \frac{ql}{3} = \frac{P}{2} + \frac{P}{2}$$

$$\frac{2ql}{3} = P \rightarrow \boxed{q = \frac{3P}{2l}}$$

$$\hookrightarrow \frac{ql}{3} = \frac{P}{2}$$

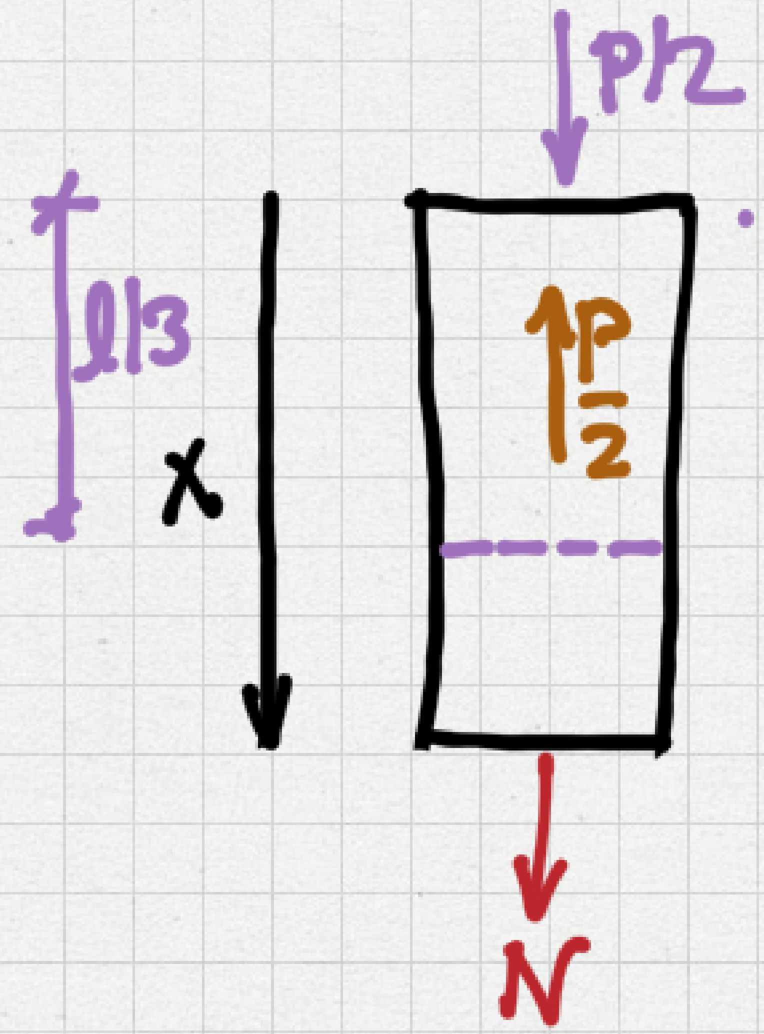



$$\frac{P}{2} + N = qx \rightarrow N = \frac{3P}{2l}x - \frac{P}{2}$$

$x = 0 \rightarrow N = -P/2$

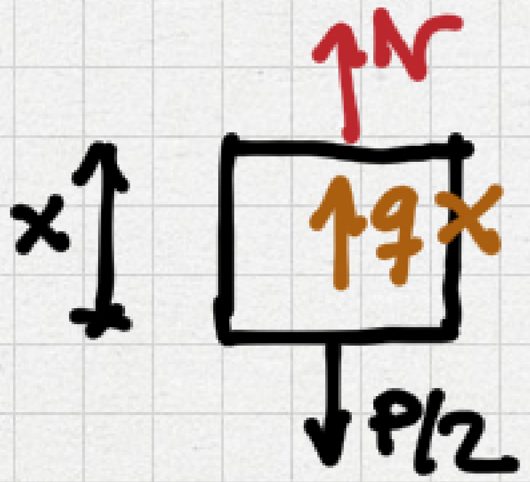
$x = l/3 \rightarrow N = 0$

$0 \leq x \leq l/3$




$$\frac{P}{2} = \frac{P}{2} + N \rightarrow N = 0$$

$l/3 \leq x \leq 2l/3$

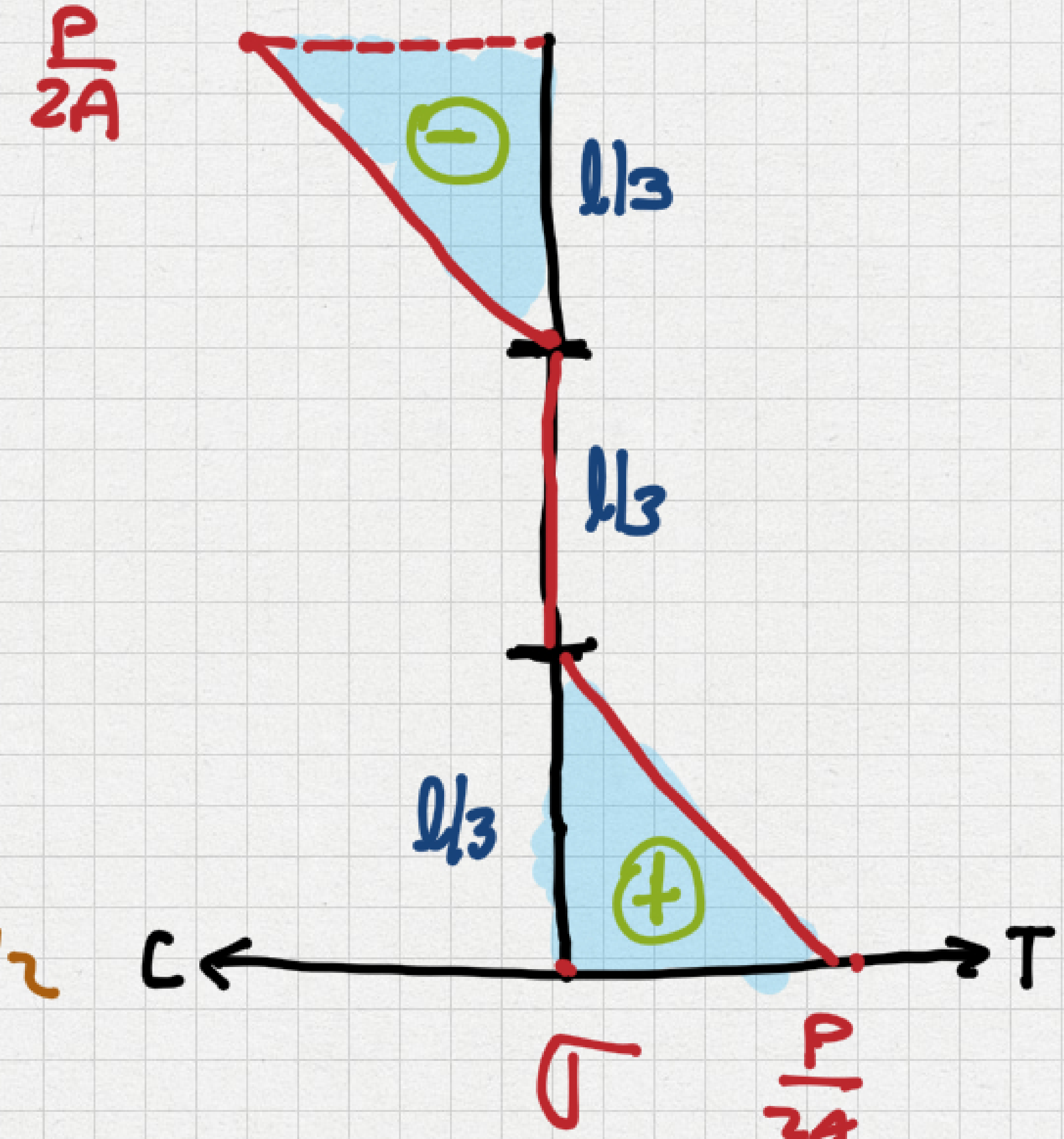



$$N + qx = \frac{P}{2} \rightarrow N = \frac{P}{2} - \frac{3P}{2l}x$$

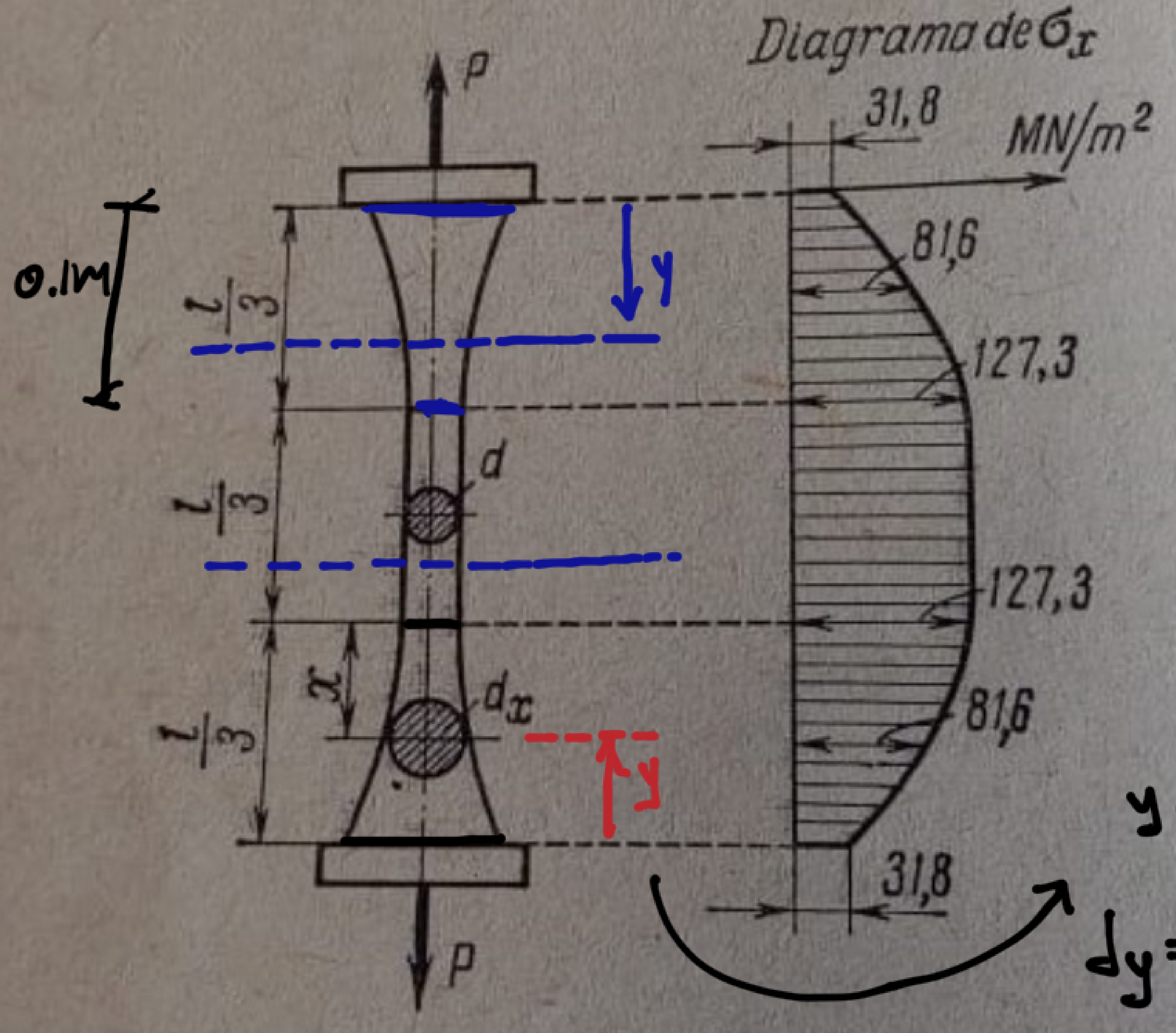
$x = 0 \rightarrow N = P/2$

$x = l/3 \rightarrow N = 0$

$0 \leq x \leq l/3$



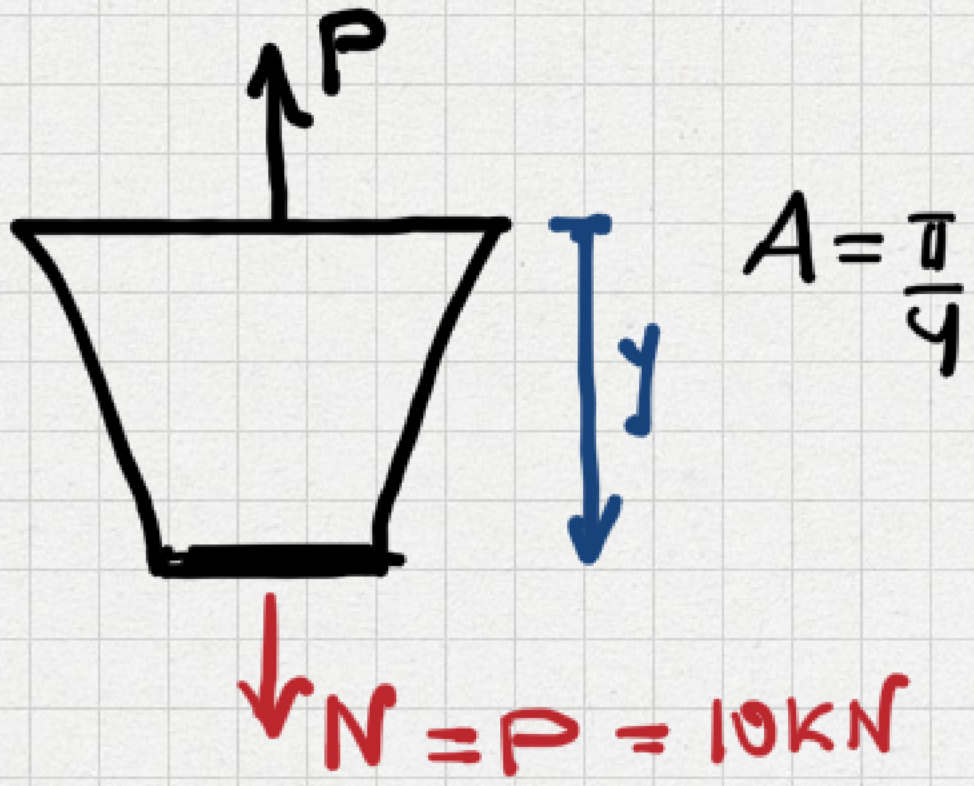
**Ejemplo 2.** Construir el diagrama de $\sigma_x$, calcular $\Delta l$ y $U$, si $P = 10$ kN; $l = 0{,}3$ m; $d = 0{,}01$ m; $d_x = (0{,}01 + x^2)$ m; $E = 2 \cdot 10^5$ MN/m² (fig. 2).




$$y + x = l/3 = 0.1$$

$$d_y = 0.01 + (0.1 - y)^2$$

Fig. 2




$$A = \frac{\pi}{4}\left[0.01 + (0.1-y)^2\right]^2$$

$$\sigma = \frac{10 \times 10^3}{\frac{\pi}{4}\left[0.01 + (0.1-y)^2\right]^2}$$

para $y = 0 \rightarrow \sigma = 31.83$ MN/m²

para $y = 0.1 \rightarrow \sigma = 127.32$ MN/m²