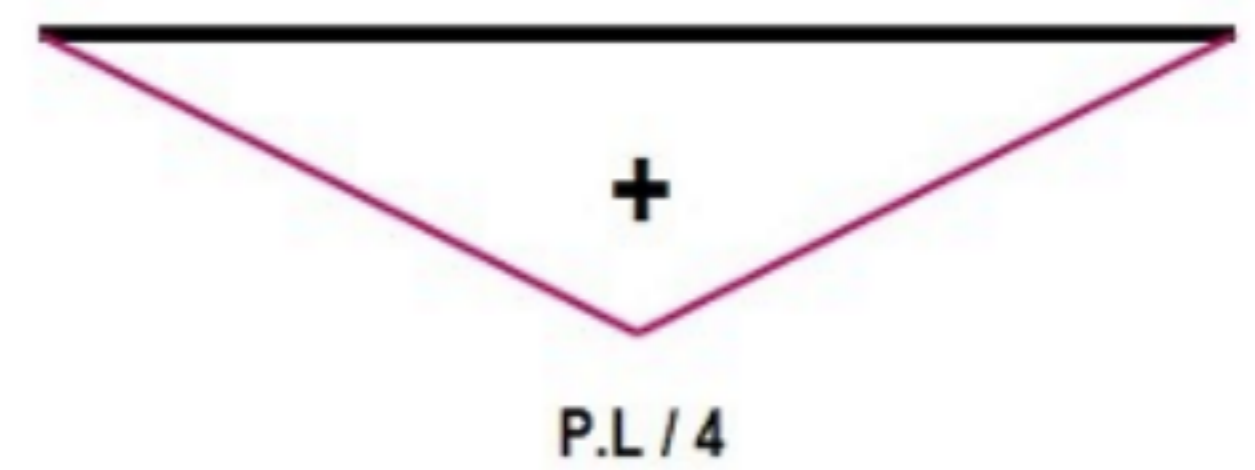
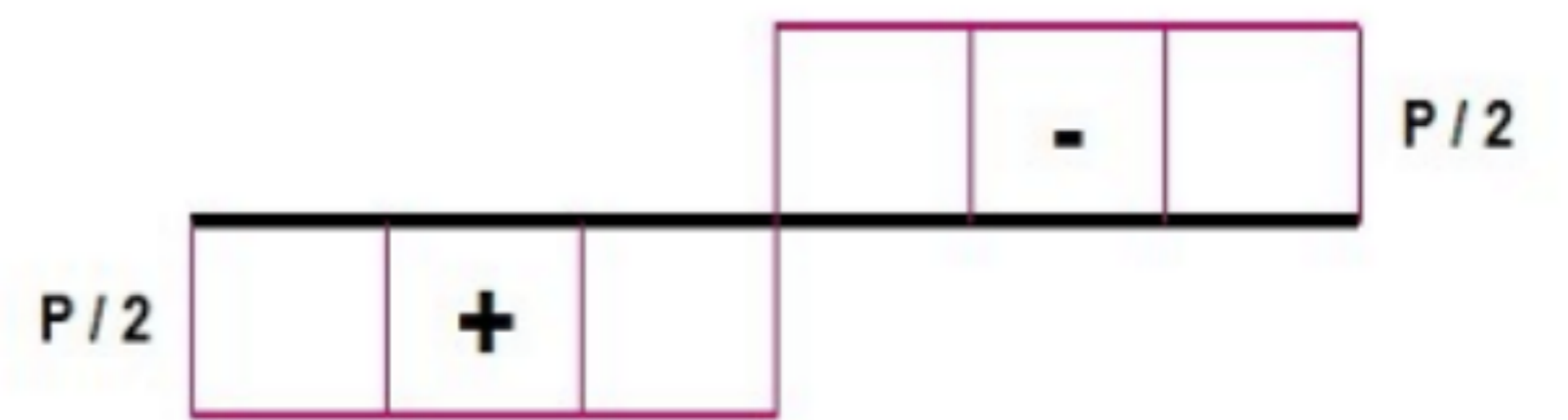
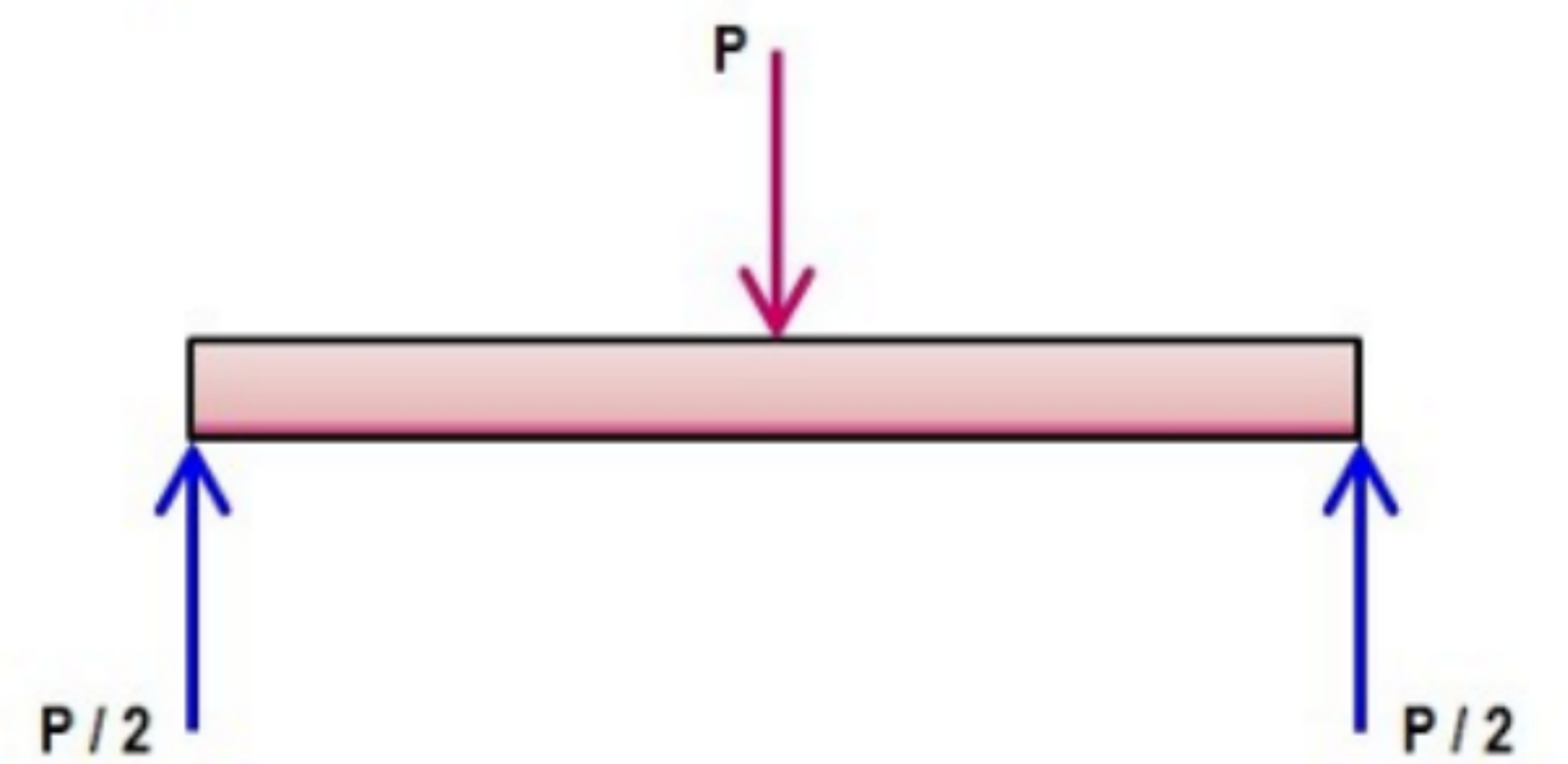
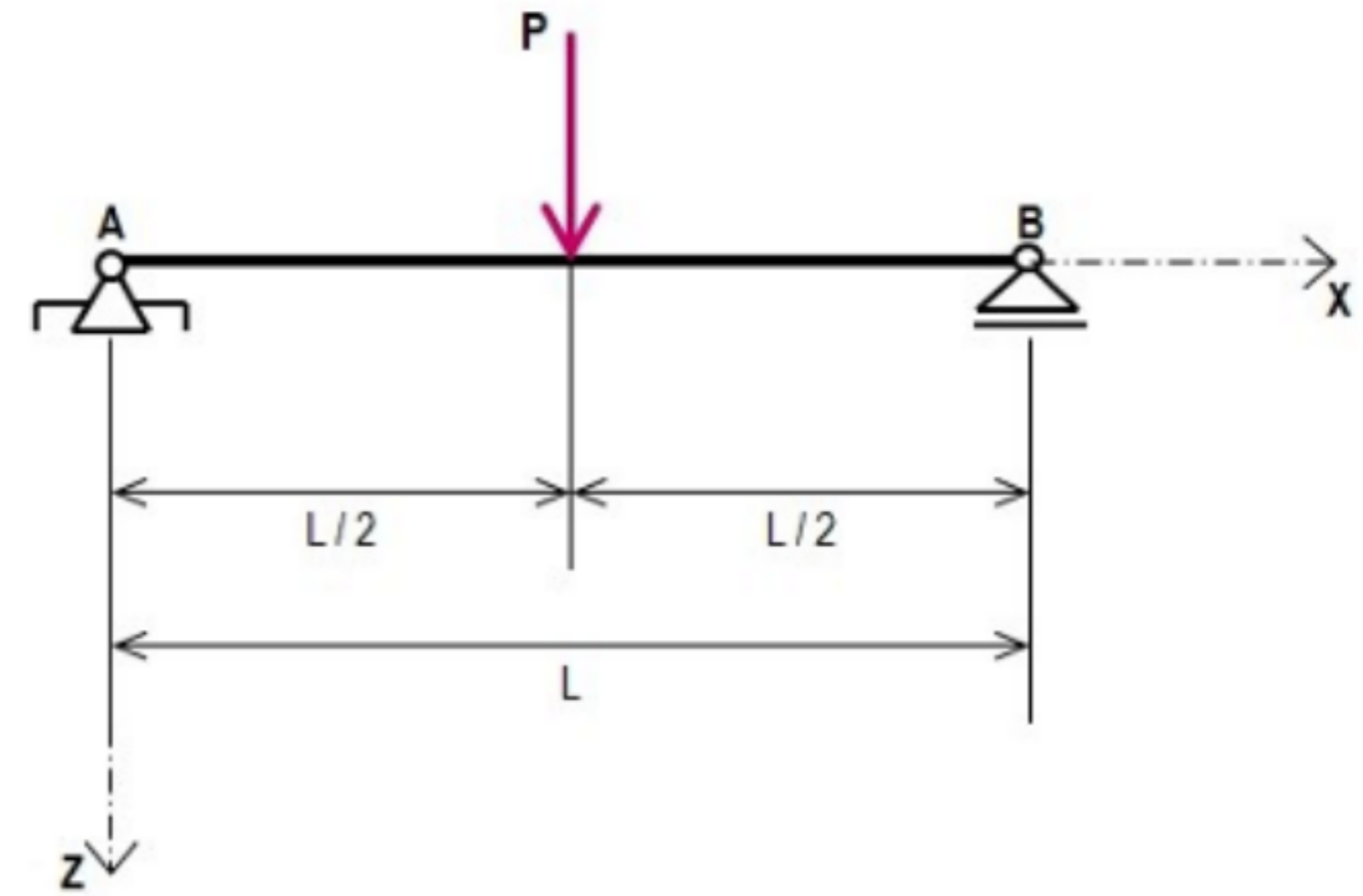
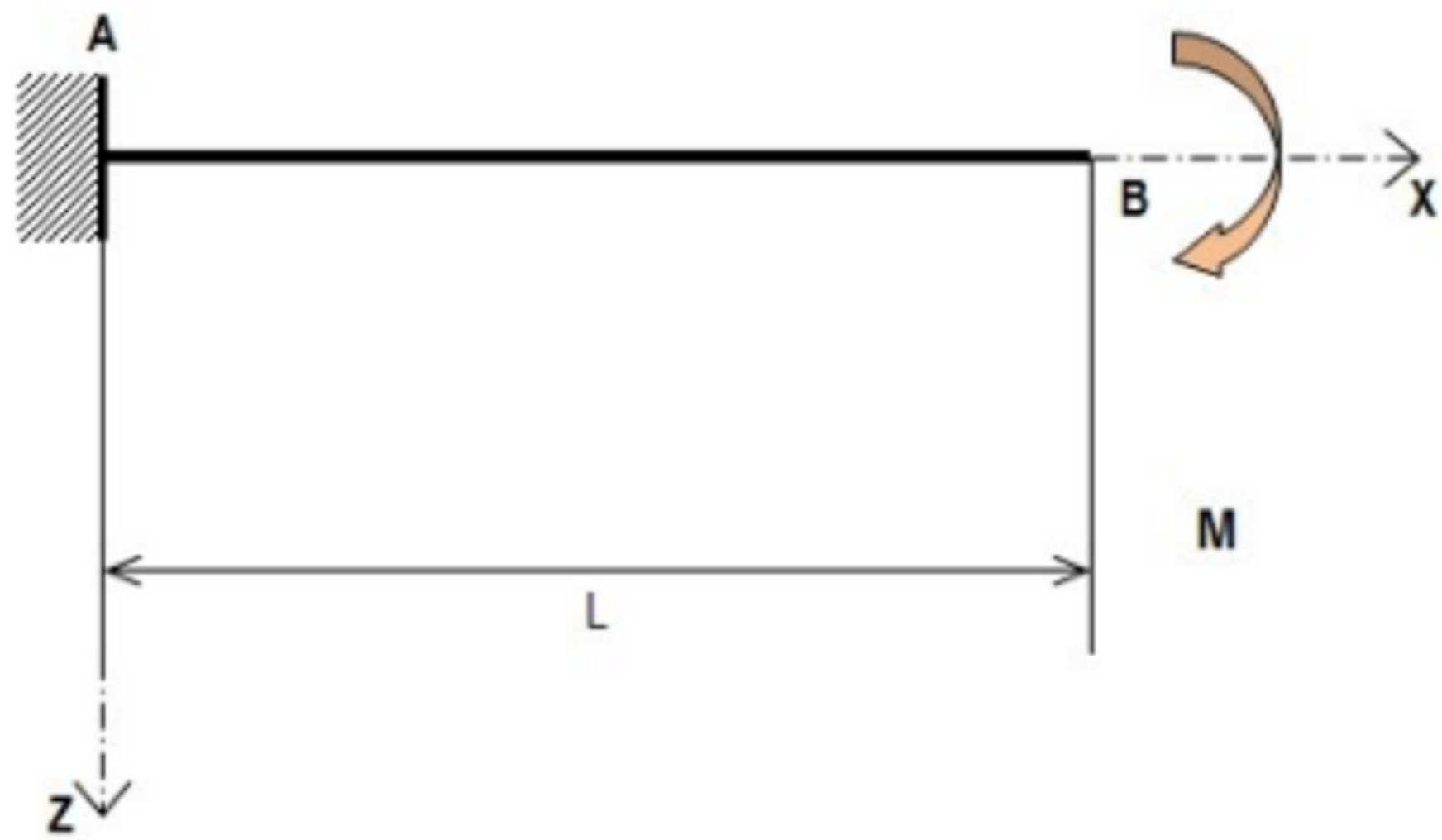


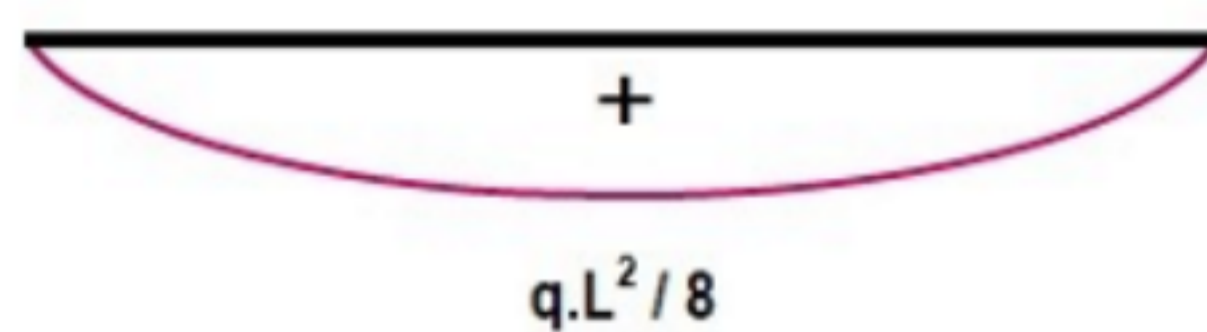
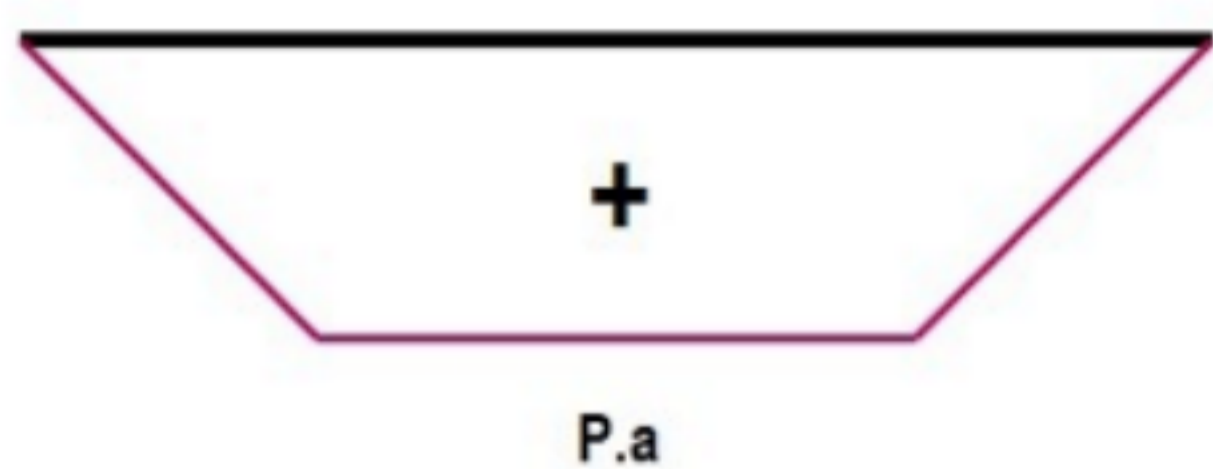
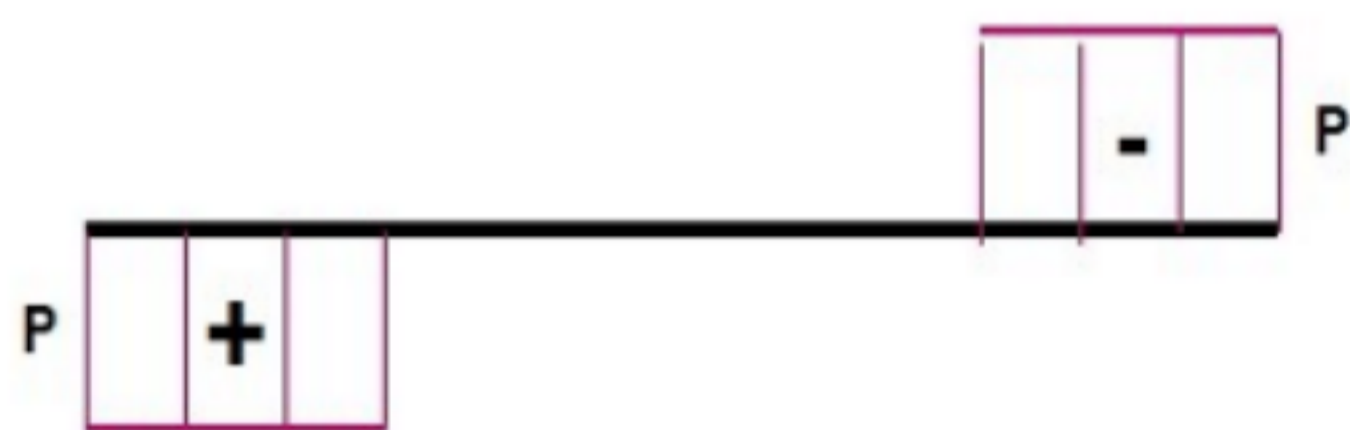
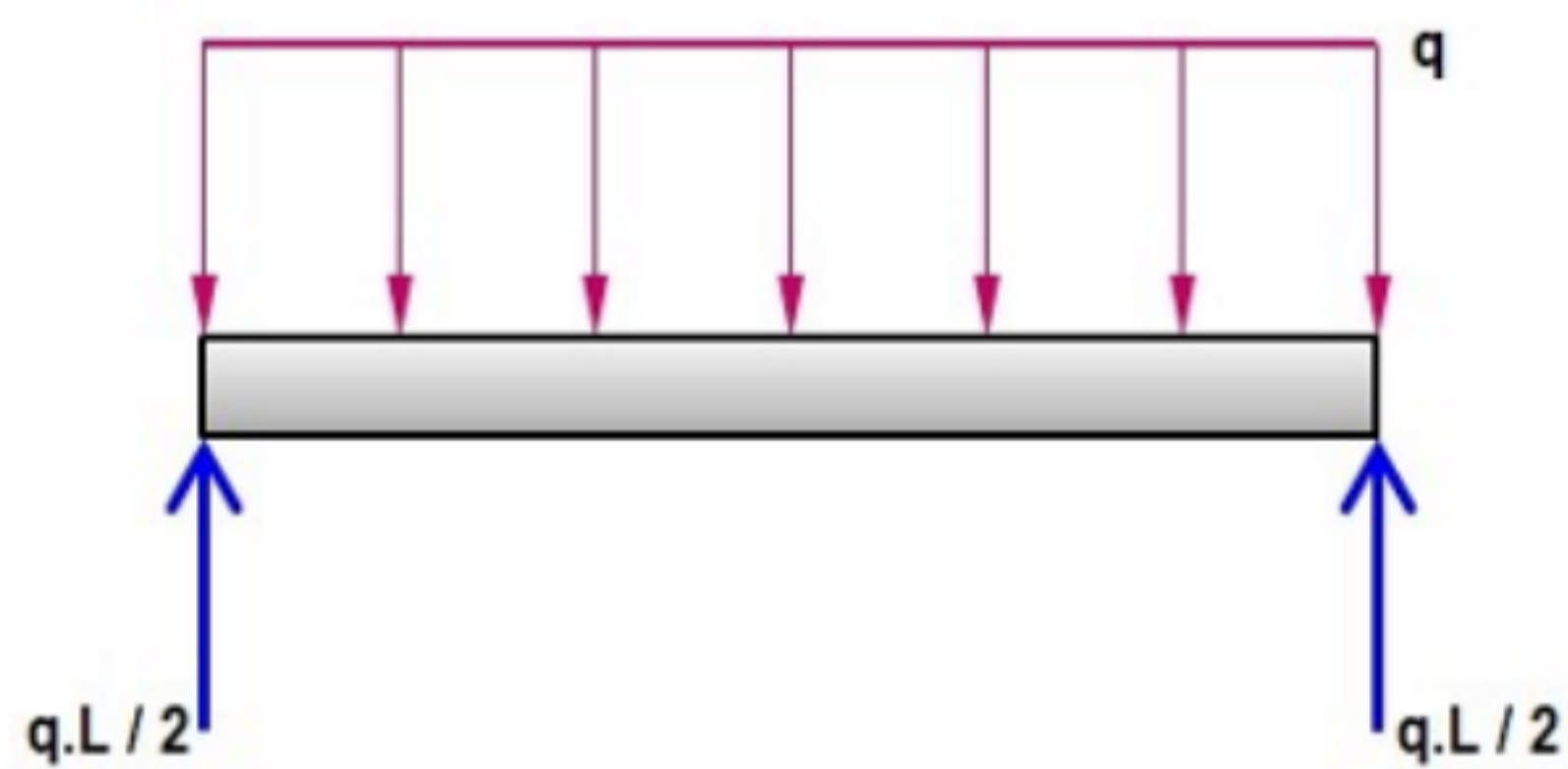
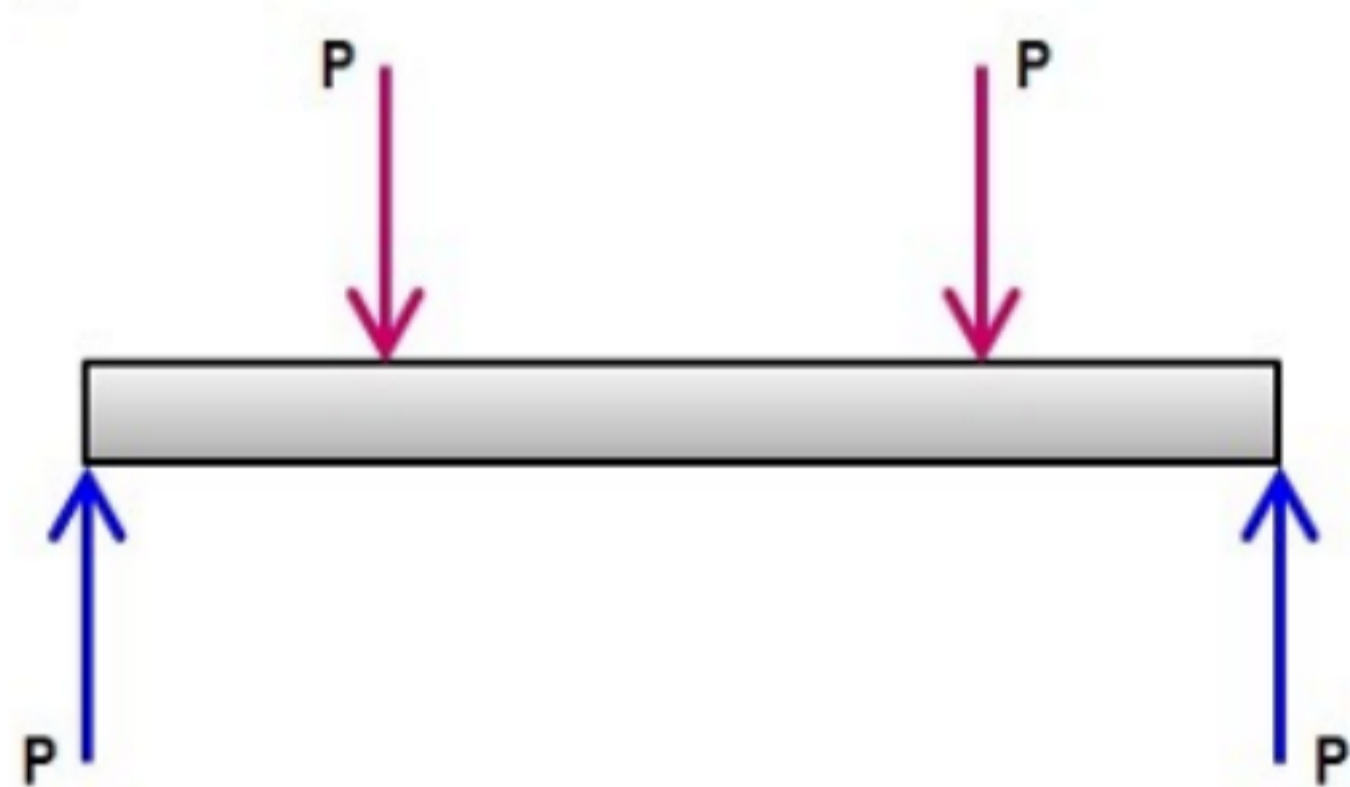
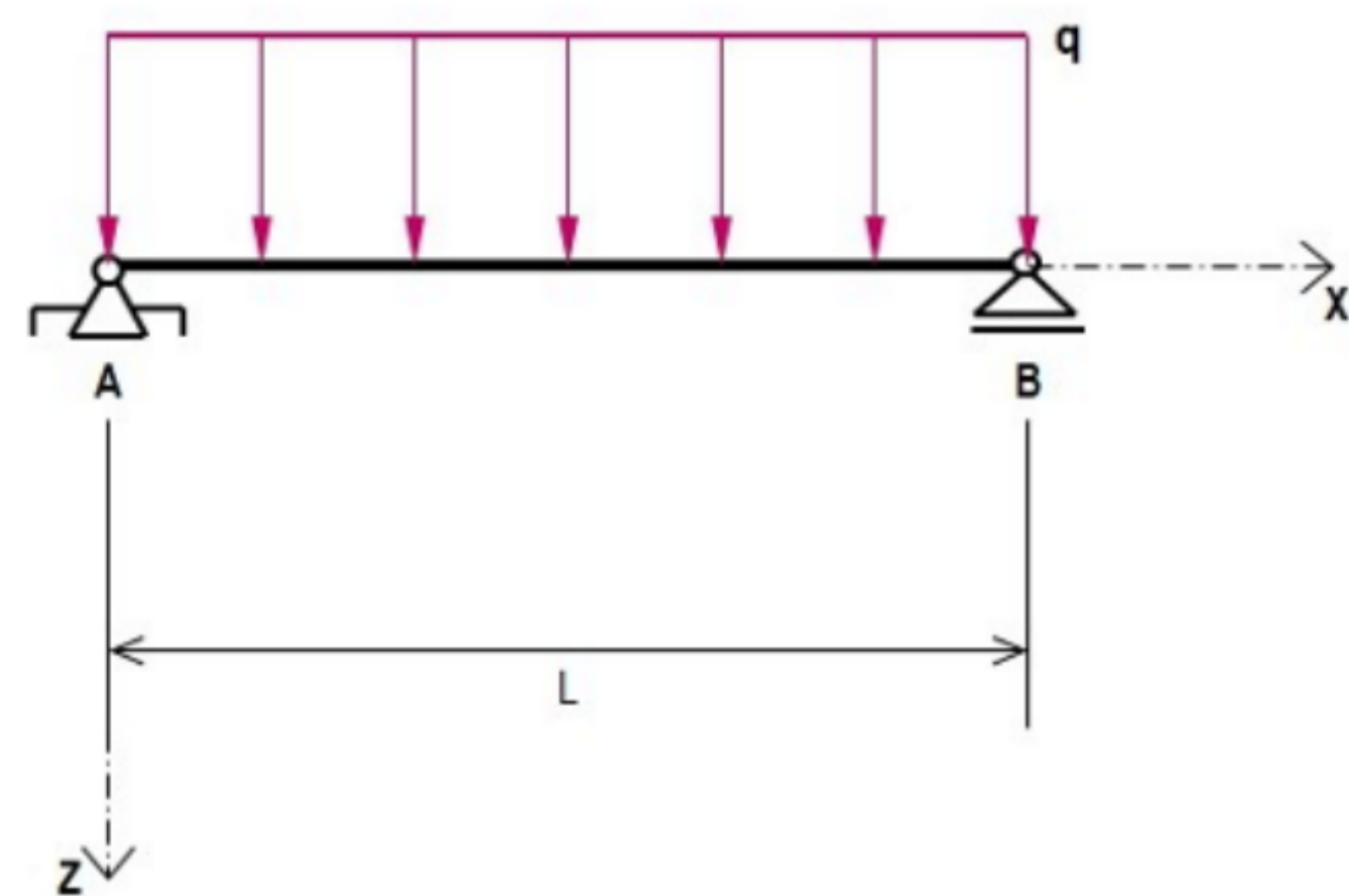
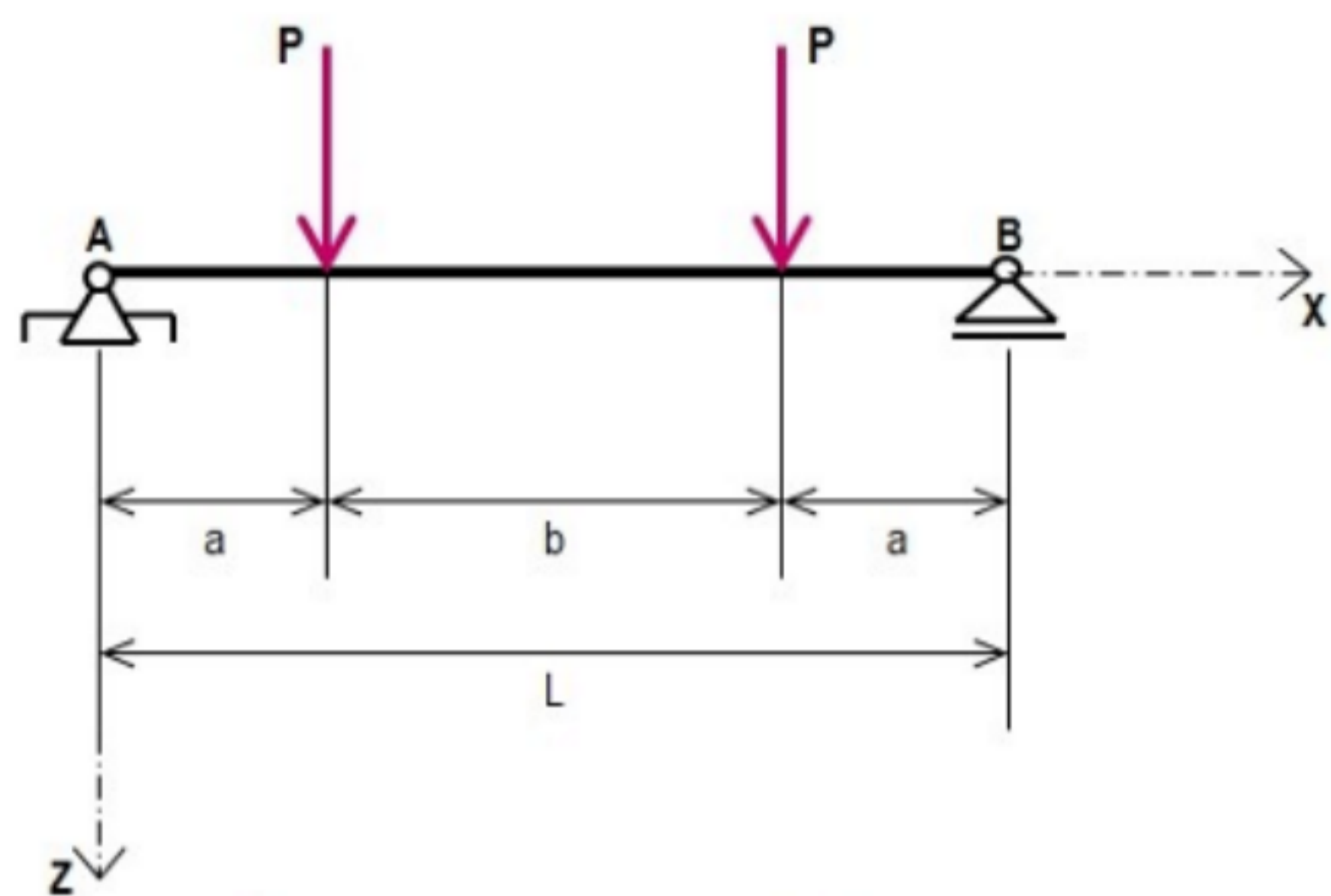
01 - INTRODUCCIÓN:

martes, 1 de junio de 2021 01:37



01 - INTRODUCCIÓN:

martes, 1 de junio de 2021 01:37



$$Q_z(x) = \frac{dM_y(x)}{dx}$$

FLEXIÓN VARIABLE
FLEXIÓN y CORTE.

02 - EJEMPLO INTUITIVO:

martes, 1 de junio de 2021 01:37

2 CASOS DE ANÁLISIS:

- JIGA SIMPLEMENTE APOYADA.
- POR UN CONJUNTO DE TABLAS UNA ENCIMA DE LA OTRA.

i) LAS TABLAS NO ESTÁN VINCULADAS

ii) LAS TABLAS ESTÁN VINCULADAS.

◦ COMO ES LA VINCULACIÓN?

- ADHESIVAS.
- PERNOS
- PASADORES.
- BULONES.
- CLAVOS
- OTRAS.

HIPOTESIS:

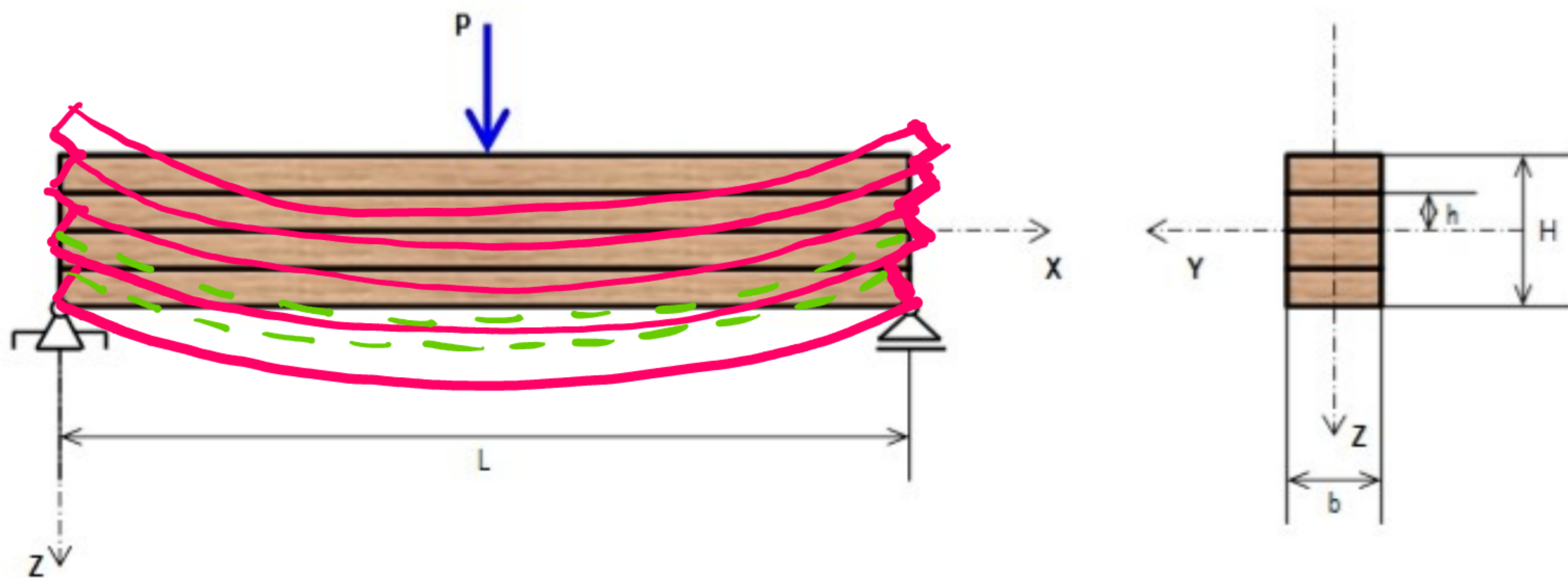
→ LAS TABLAS NO TIENEN ROZAMIENTO EN
TRES ELAS, O SI EXISTE, ÉSTE ES
NULO.

02 - EJEMPLO INTUITIVO:

martes, 1 de junio de 2021 01:37

CASO I: Tablas No Vinculadas

ESQUEMA TIPO "I":



$P_i = \frac{P}{n}$ n : nº DE TABLAS QUE CONFORMAN LA VIGA.

$H = n \cdot h \rightarrow h = H/n$

$I_{y_i} = \frac{bh^3}{12} = \frac{b}{12} \left(\frac{H}{n}\right)^3 = \frac{bH^3}{12n^3}$

$M_{\max, i} = \frac{P_i L}{4} = \frac{PL}{4n}$

$z_{\max, i} = \pm \frac{h}{2}$; $\sigma_{SERV} = \sigma_{TEAR} = \frac{M_{y_i} \cdot z_{\max, i}}{I_{y_i}}$

02 - EJEMPLO INTUITIVO:

martes, 1 de junio de 2021 01:37

CASO I: Tablas No Vinculadas

$$\sigma_{TRAB} = \frac{PL}{An} \frac{k}{2} \frac{1}{\frac{b h^3}{12} \cdot 2} = \boxed{\frac{3}{2} \frac{PL}{nbh^2}} \quad (1)$$

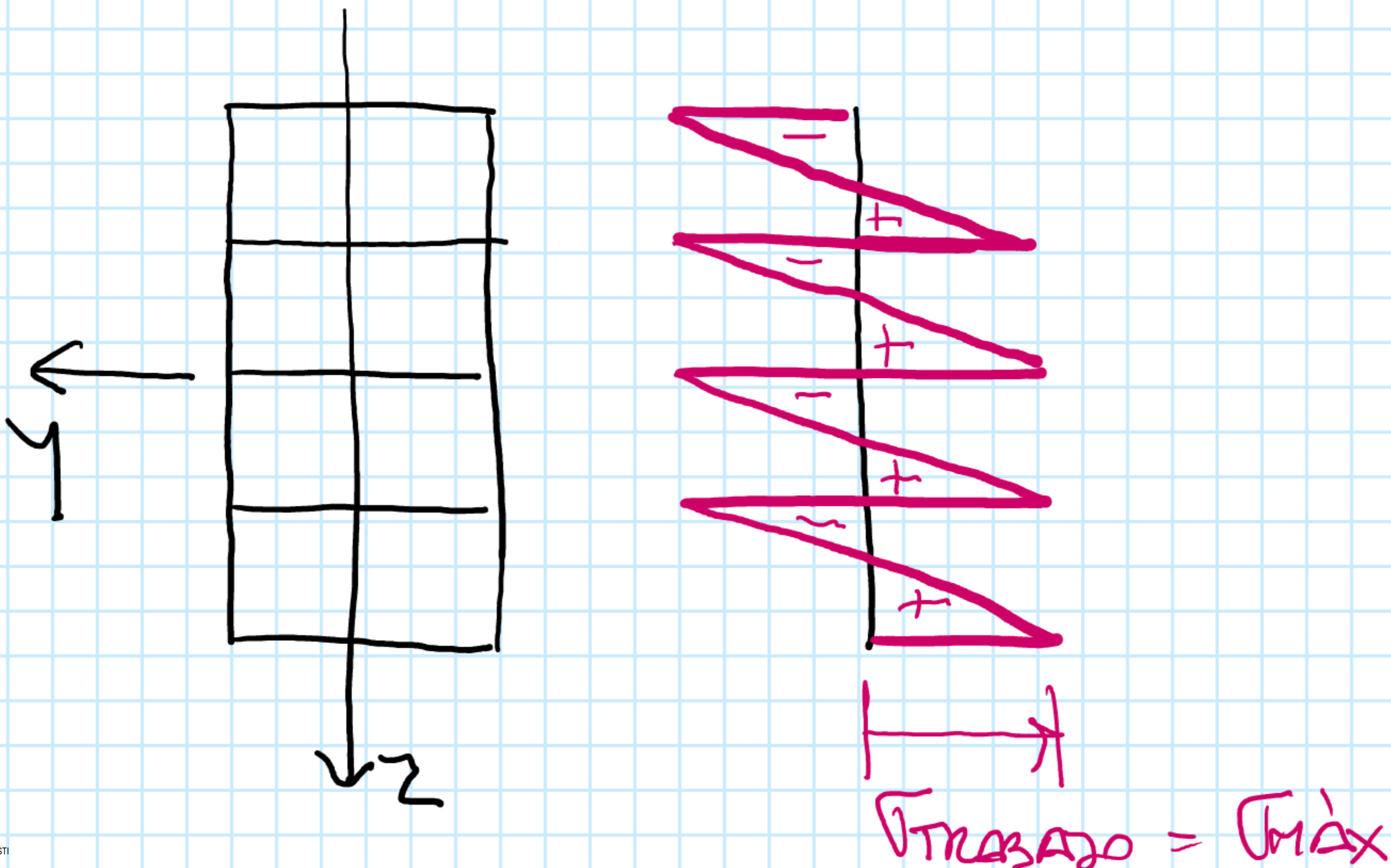
• Si $\sigma_{TRAB} = \sigma_{ADM} \rightarrow$

$$\sigma_{ADM} = \frac{3}{2} \frac{PL}{nbh^2} \rightarrow$$

$$\rightarrow \boxed{P_{ADM,1} = \frac{2}{3} \frac{nbh^2}{L} \cdot \sigma_{ADM}} \quad (2)$$

→ HIPÓTESIS DE BERNOULLI-NAVIER
 P/ CADA TABLA ES VÁLIDA. PERO, NO
 LO ES PARA EL CONJUNTO.

→ DIAGRAMA DE TENSIONES:

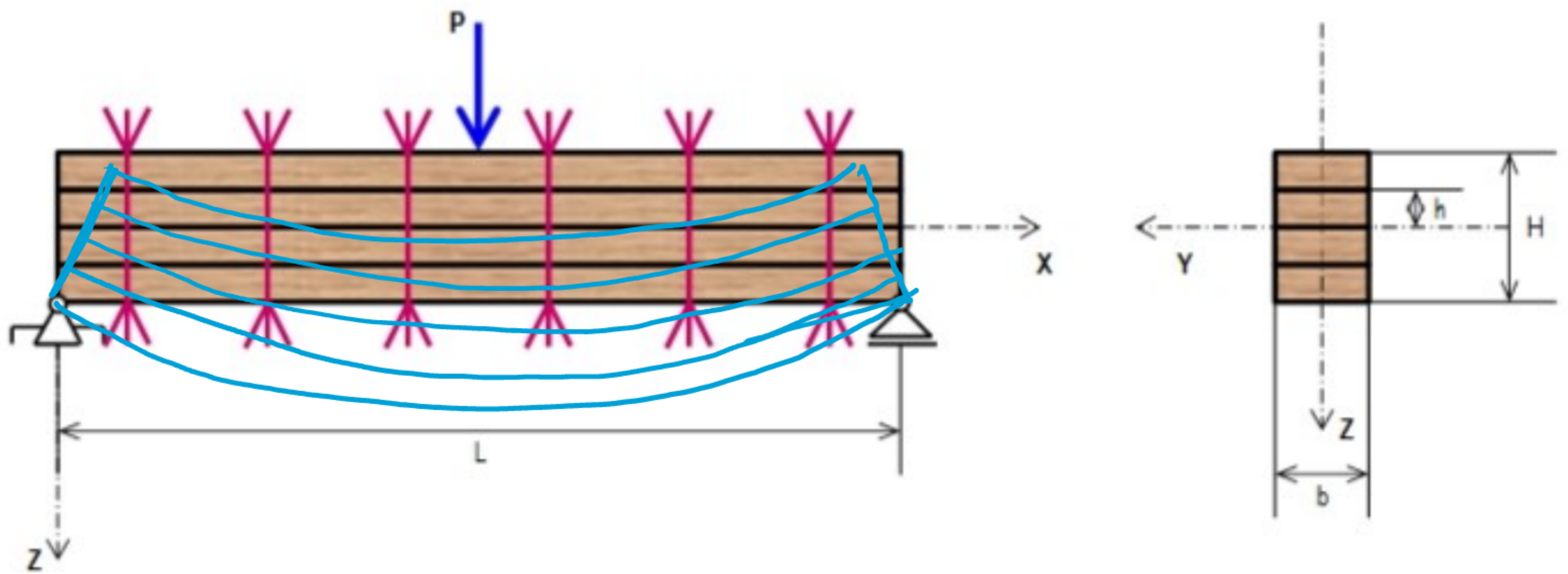


02 - EJEMPLO INTUITIVO:

martes, 1 de junio de 2021 01:37

CASO II: Tablas Vinculadas

ESQUEMA TIPO "II":



$$P ; I_y = \frac{bH^3}{12} ; H = nh$$

$$I_y = \frac{b(nh)^3}{12} = \frac{n^3 bh^3}{12}$$

$$M_y = \frac{PL}{4} \quad \text{momento máximo.}$$

$$z_{\text{máx}} = \frac{H}{2} = \frac{nh}{2}$$

$$\sigma_{\text{seru}} = \sigma_{\text{max}} = \frac{M_y \cdot z_{\text{máx}}}{I_y}$$

$$\sigma_{\text{seru, máx}} = \frac{PL}{4} \cdot \frac{nh}{2} \cdot \frac{1}{\frac{n^3 bh^3}{12}}$$

$$\sigma_{\text{seru, máx}} = \frac{3}{2} \frac{PL}{n^2 bh^2} \quad (3) \quad \text{si } \sigma_{\text{seru}} = \sigma_{\text{adm}}$$

$$P_{\text{adm}, 2} = \frac{2}{3} \frac{n^2 bh^2}{L} \cdot \sigma_{\text{adm}} \quad (4)$$

02 - EJEMPLO INTUITIVO:

martes, 1 de junio de 2021 01:37

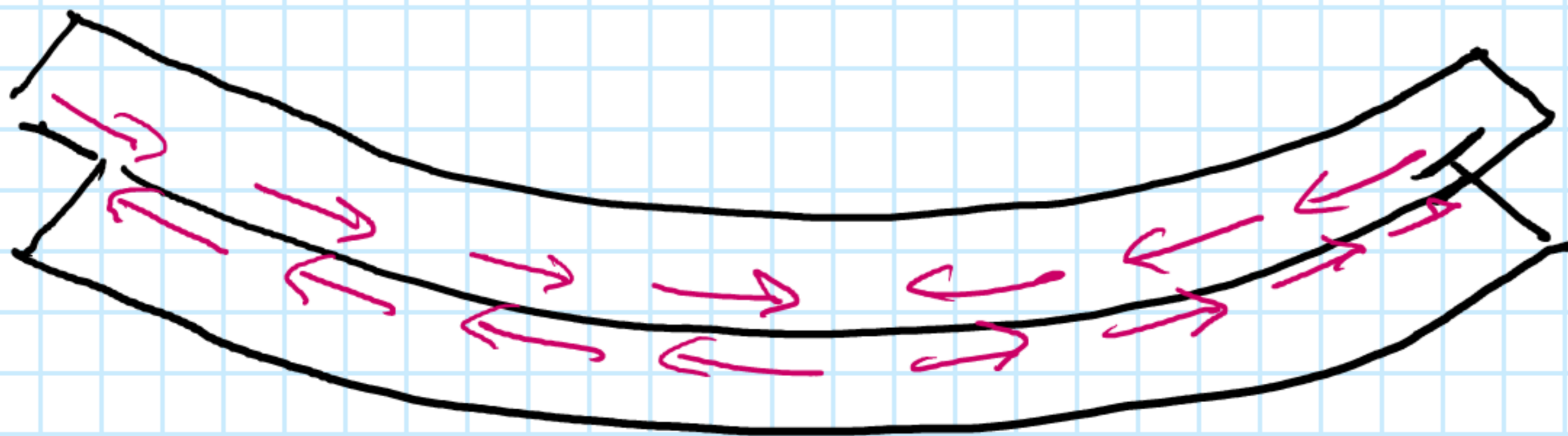
COMPARATIVA ENTRE CARGAS Y TENSIONES ADMISIBLES

$$\frac{P_{ADM, 2}}{P_{ADM, 1}} = \frac{\frac{3}{2} \frac{n^2 b h^2}{1} \cdot \sigma_{ADM}}{\frac{3}{2} \frac{n b h^2}{1} \sigma_{ADM}} = n$$

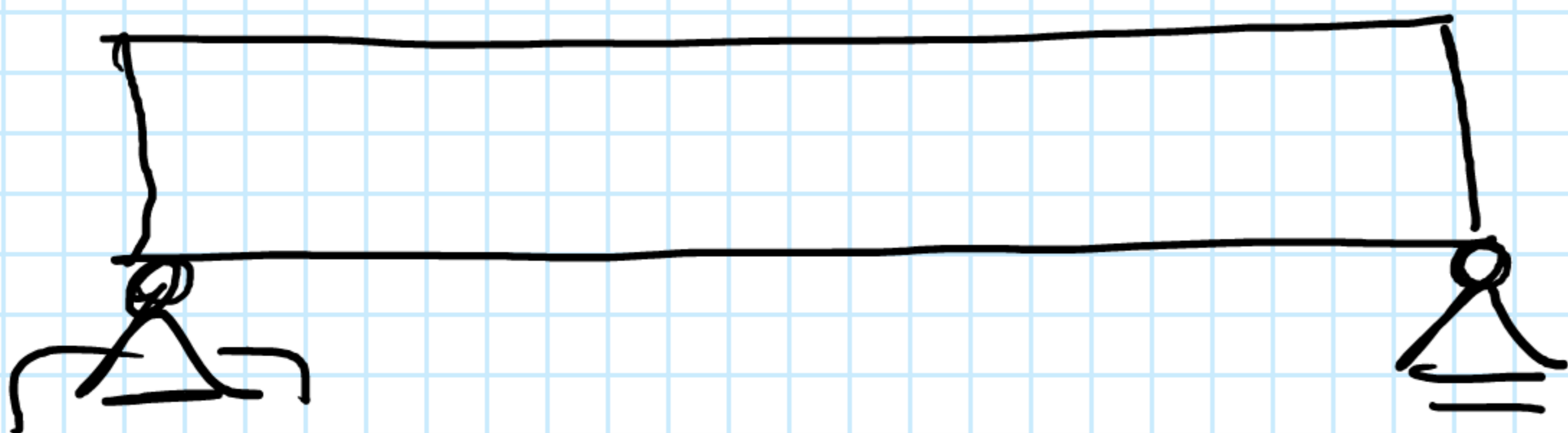
$$P_{ADM, 2} = n \cdot P_{ADM, 1} \quad (5)$$

$$\frac{\sigma_{SERV, 2}}{\sigma_{SERV, 1}} = \frac{\frac{3}{2} \frac{P}{n^2 b h^2}}{\frac{3}{2} \frac{P}{n b h^2}} = \frac{1}{n}$$

$$\sigma_{SERV, 2} = \frac{1}{n} \sigma_{SERV, 1} \quad (6)$$



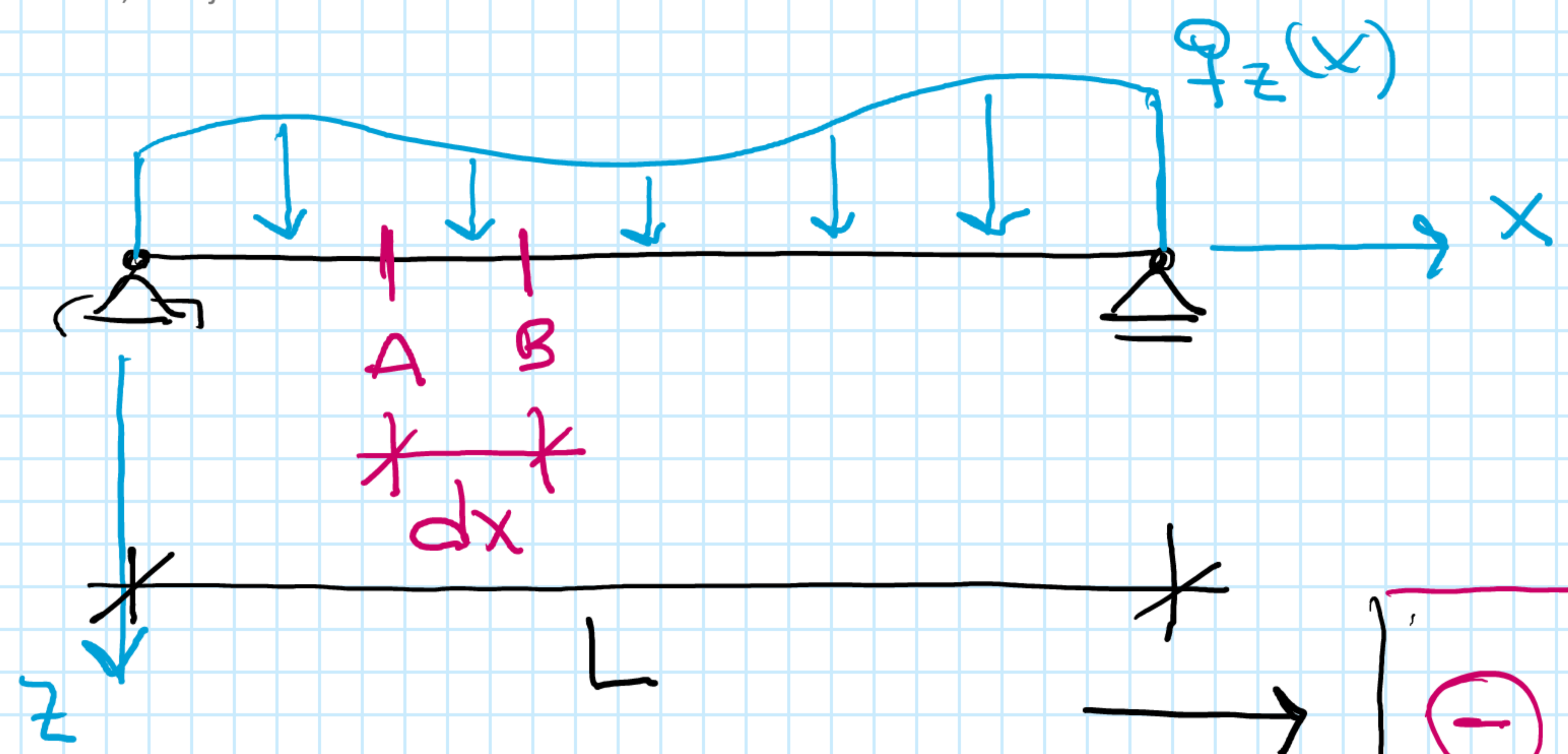
LAS FUERZAS DE
ROZAMIENTO
NO APARECEN



03 - EXPRESIÓN DE JOURAVSKY - COLLIGNON:

martes, 1 de junio de 2021 11:01

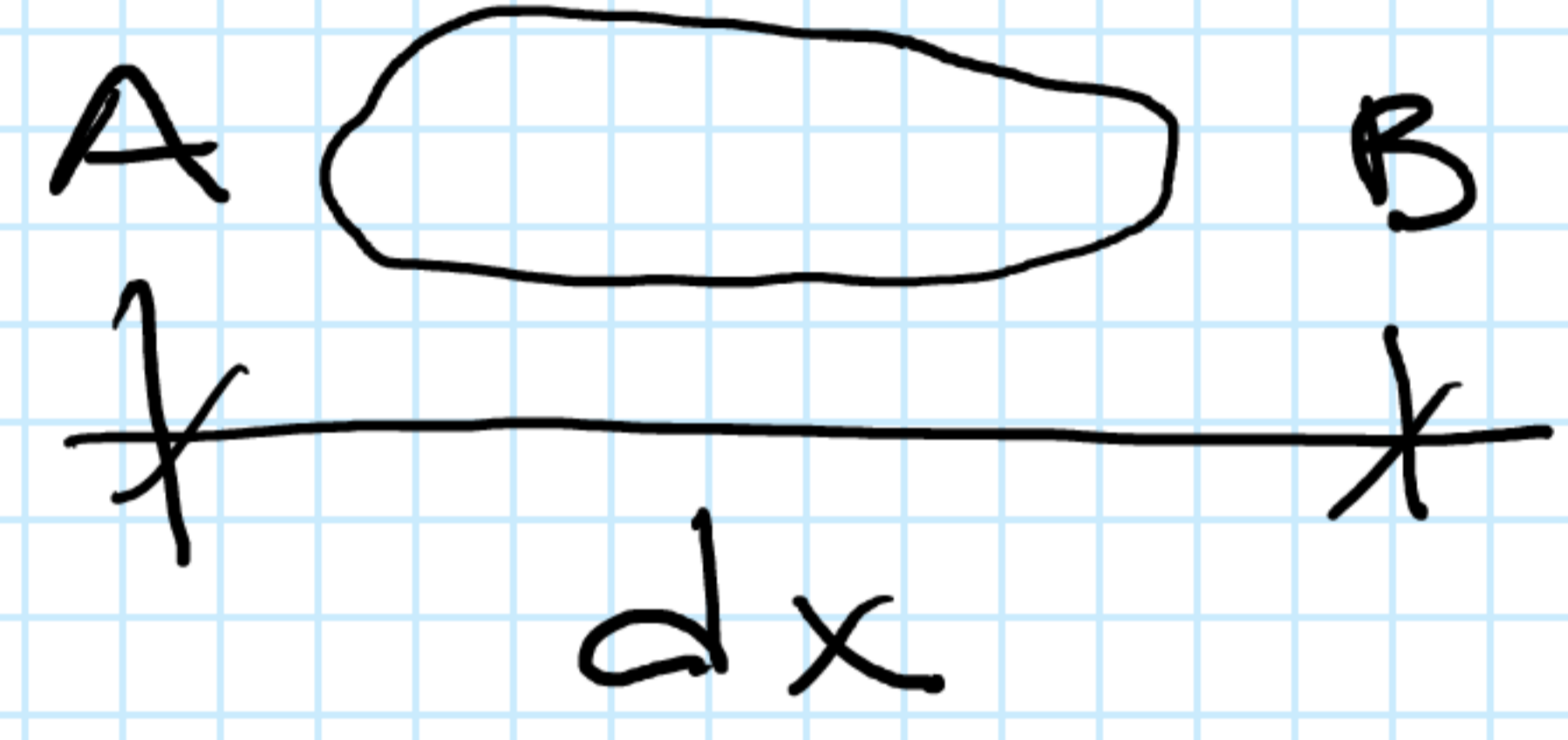
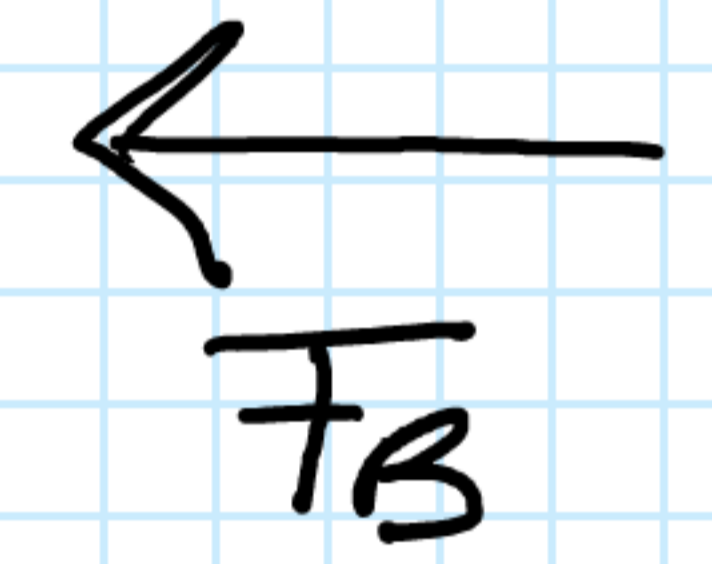
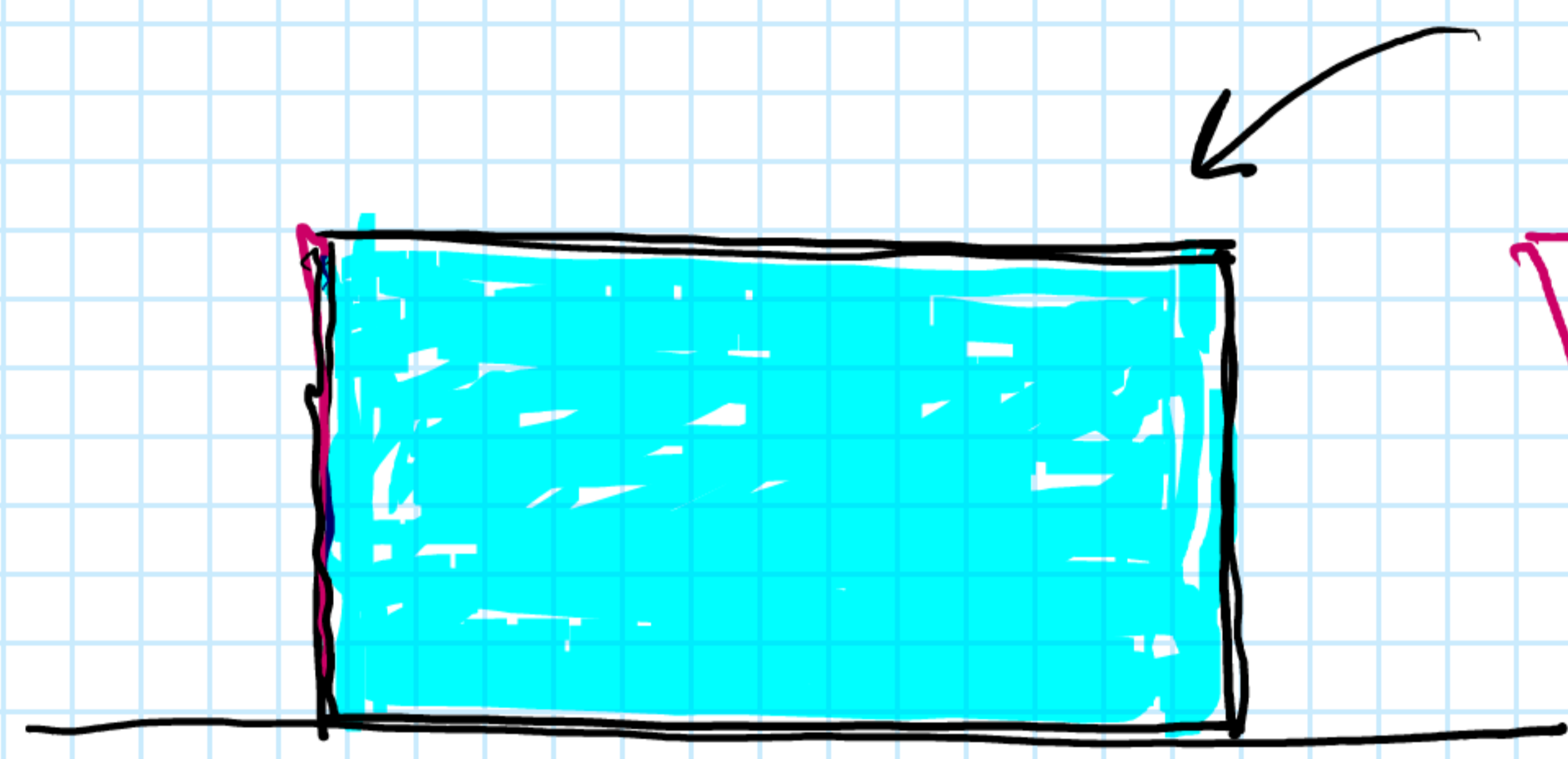
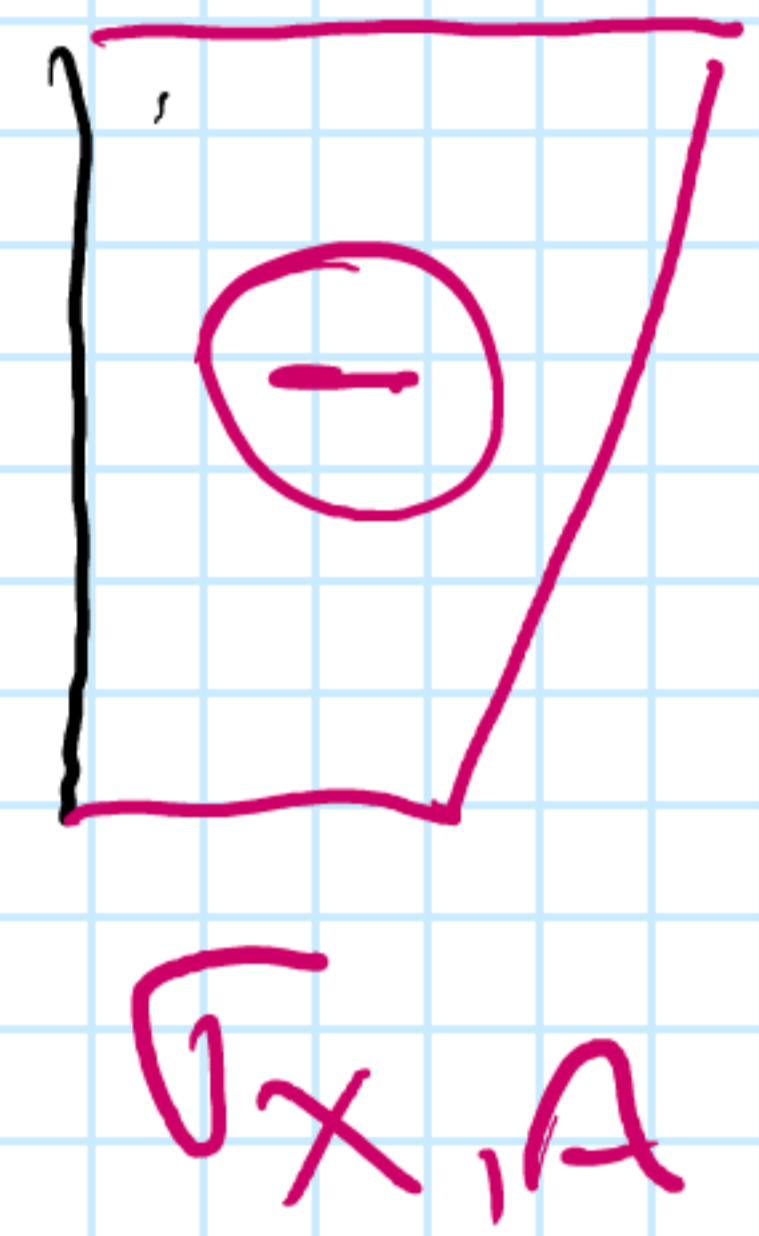
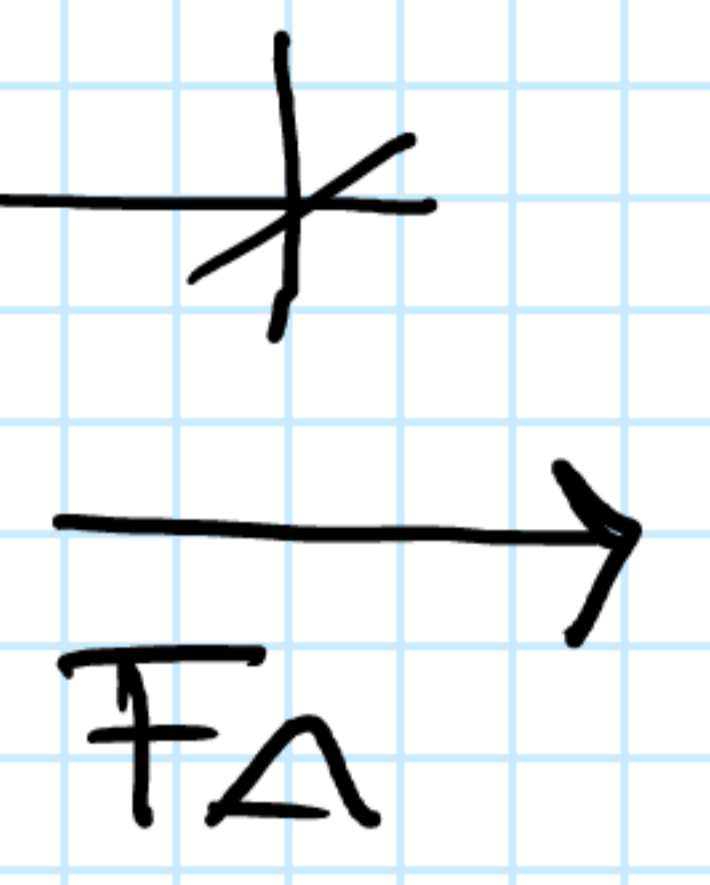
FUBA - EN 6403 2021-1C - 03.05-CLT-FV01 - FV01 2021-06-01



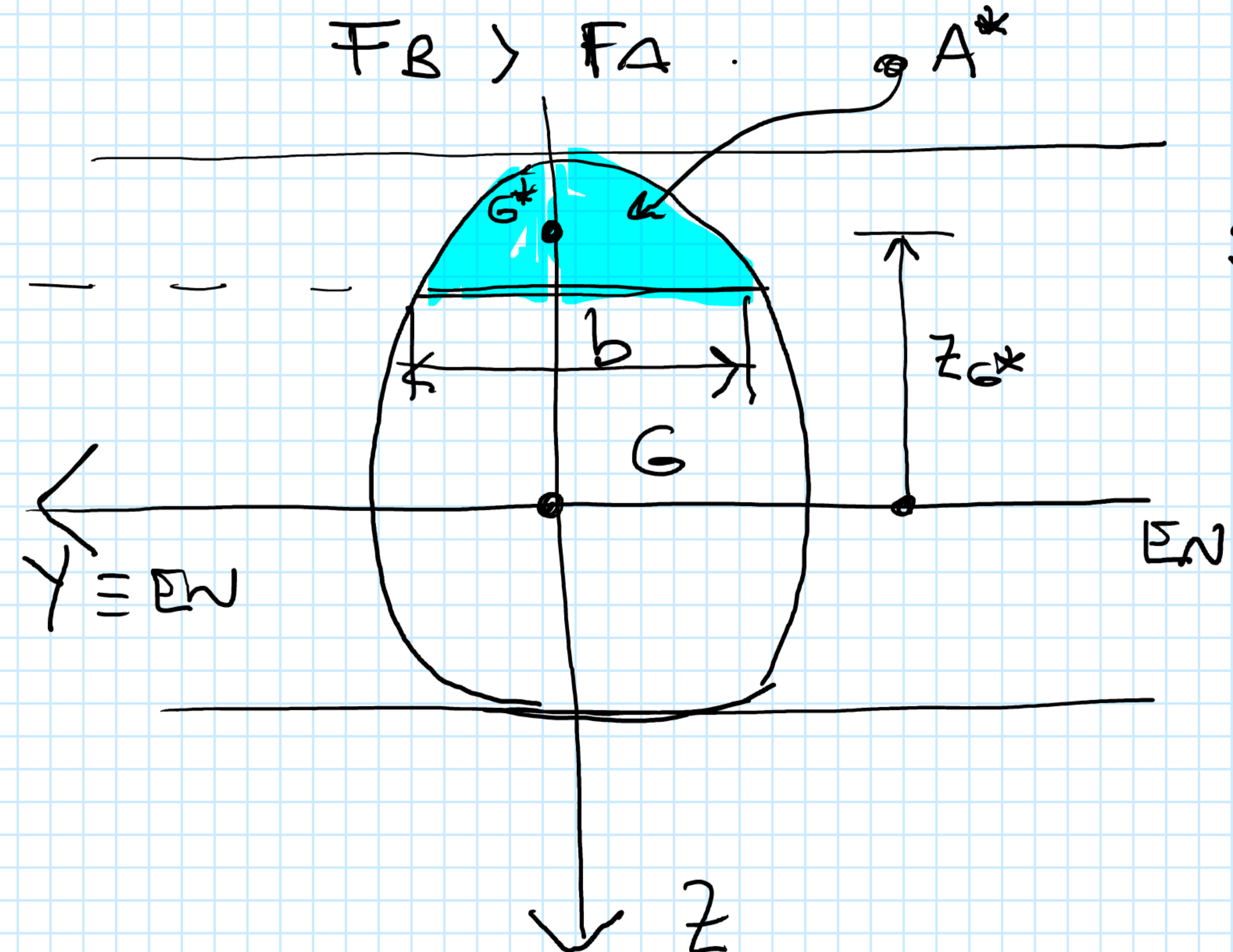
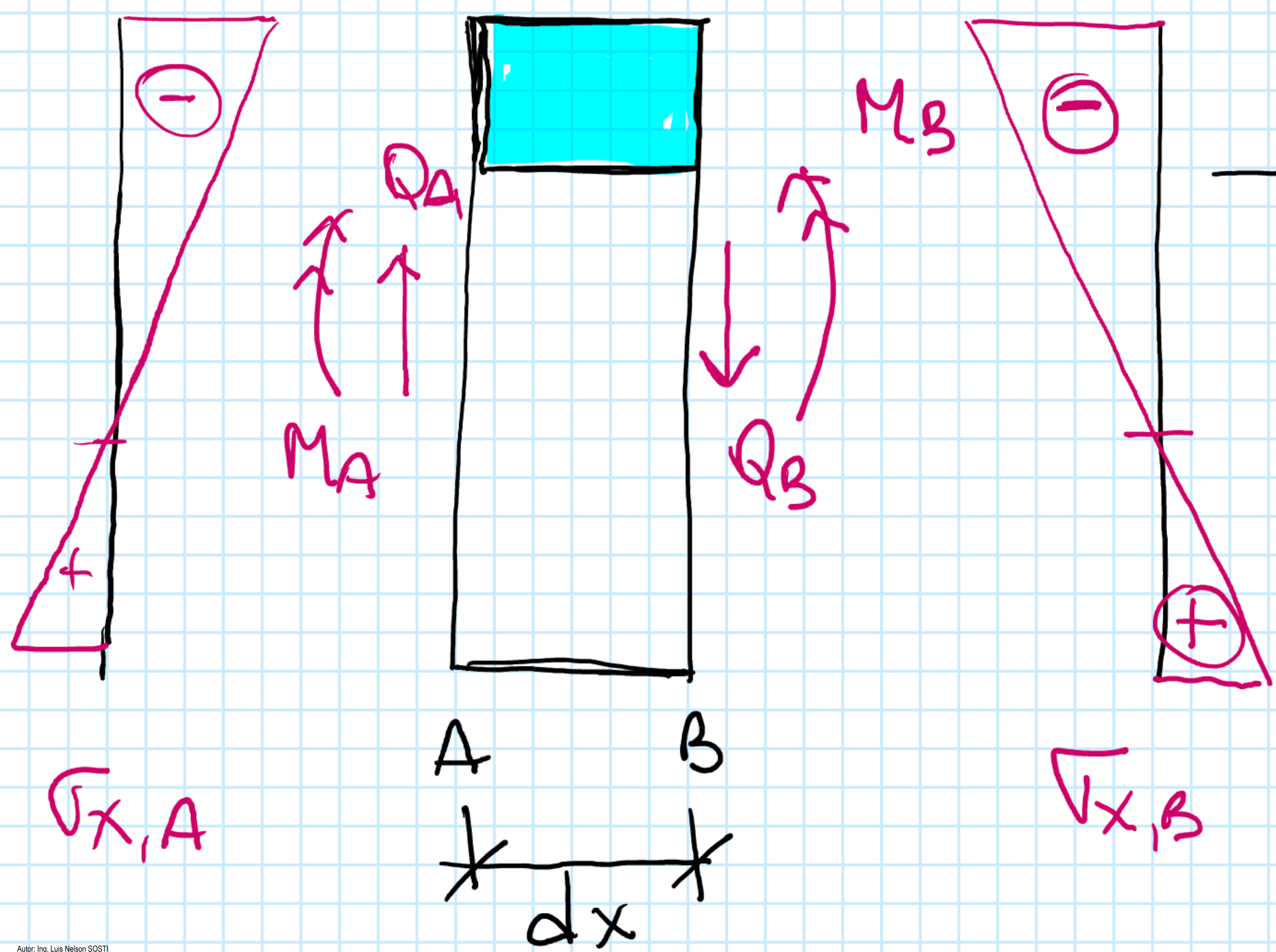
$$M_A = M; \quad M_B > M_A.$$

$$M_B = M + dM. \rightarrow$$

$$\sigma_{x,A} < \sigma_{x,B}.$$



$$F_B > F_A.$$



$$S_{EN}^* = A^* z_G^*$$

03 - EXPRESIÓN DE JOURAVSKY - COLLIGNON:

martes, 1 de junio de 2021 11:01

$$\textcircled{A} \quad F_A = \int_{A^*} \sigma_x^A dA = \int_{A^*} \underbrace{\left(\frac{M_y^A}{I_y} \right)}_{cte} \cdot z dA = \frac{M_y^A}{I_y} \int_{A^*} z dA$$

$$F_A = \frac{M_y^A}{I_y} \cdot S_{EU}^{A^*}; \quad S_{EU}^{A^*} = A^* \cdot z_G^*$$

$$F_A = \frac{M_y^A}{I_y} \cdot A^* \cdot z_G^*$$

$$\textcircled{B} \quad F_B = \int_{A^*} \sigma_x^B dA = \int_{A^*} \underbrace{\left(\frac{M_y^B}{I_y} \right)}_{cte} \cdot z dA = \frac{M_y^B}{I_y} \int_{A^*} z dA$$

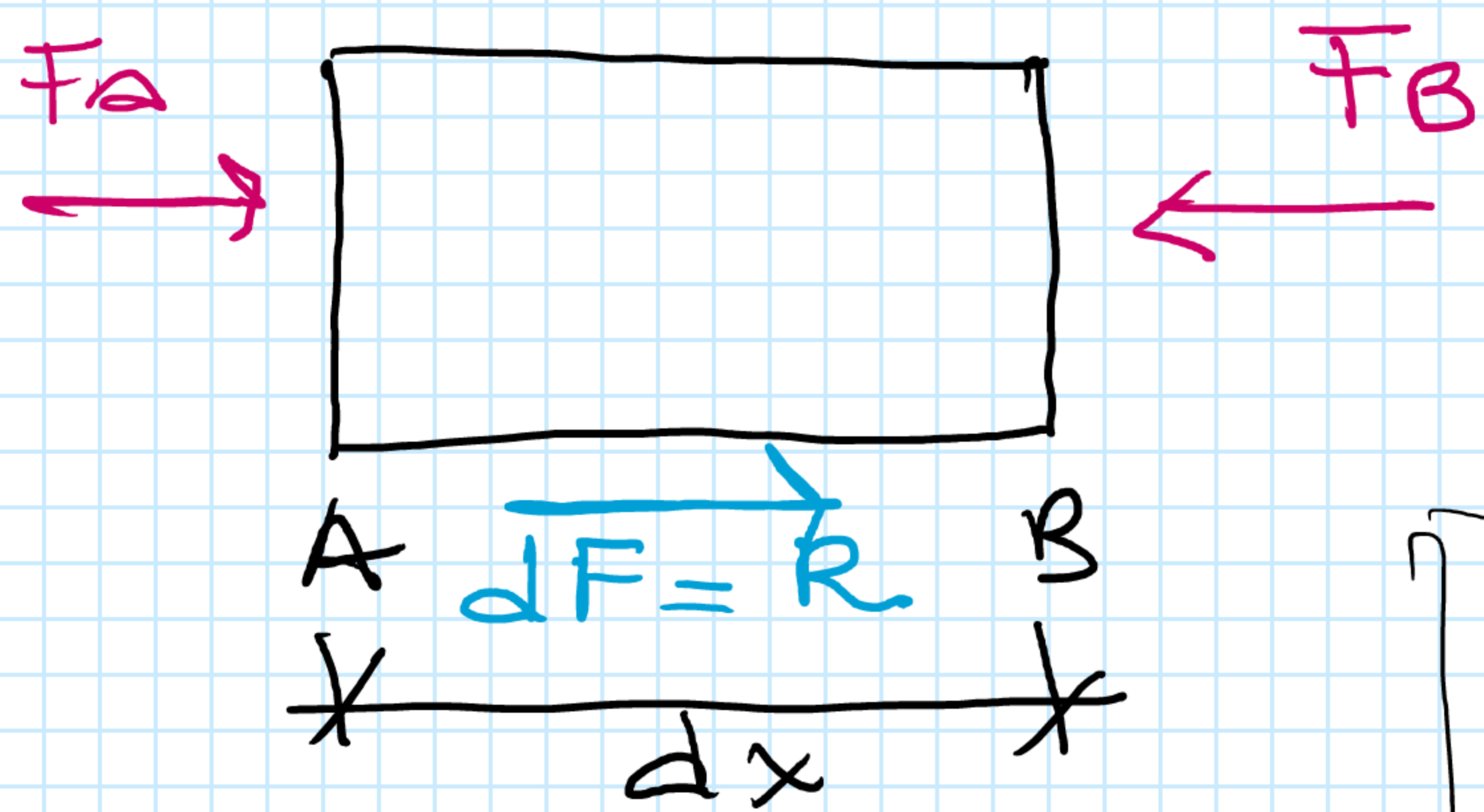
$$F_B = \frac{M_y^B}{I_y} \cdot S_{EU}^{A^*} = \frac{M_y^B}{I_y} \cdot A^* \cdot z_G^*$$

$$M_A < M_B \rightarrow M_B = M_A + dM = M + dM$$

$$F_A = \frac{M_y}{I_y} \cdot A^* \cdot z_G^* \quad ; \quad F_B = \frac{(M_y + dM_y)}{I_y} \cdot A^* \cdot z_G^*$$

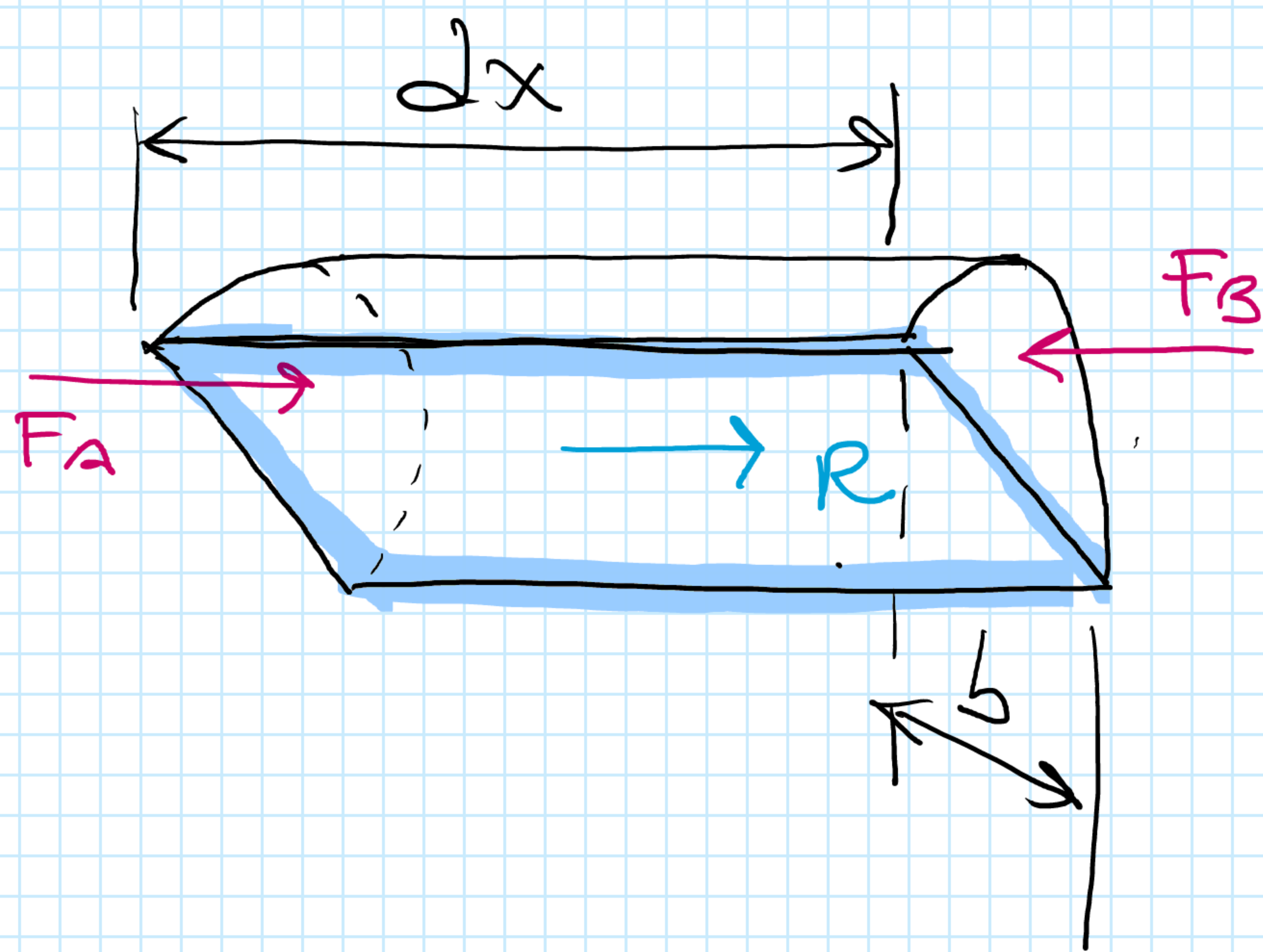
$$F_A + dF = F_B \rightarrow F_A + R = F_B$$

$$R = F_B - F_A$$



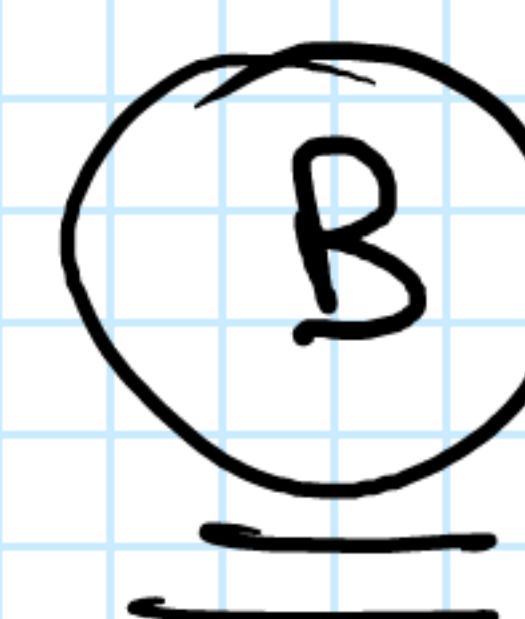
$$R = \left(\frac{M_y + dM_y}{I_y} \right) \frac{A^* z_G^*}{I_y} - \frac{M_y}{I_y} \frac{A^* z_G^*}{I_y}$$

$$R = \frac{dM_y}{I_y} \cdot A^* \cdot z_G^* = \frac{dM_y}{I_y} \cdot S_{EU}^{A^*} \quad \textcircled{A}$$



$$\frac{R}{b dx} = \frac{dF}{b dx} = \tau_m \text{ TENSION TANGENCIAL MEDIA.}$$

$$R = \tau_m \cdot b \cdot dx$$

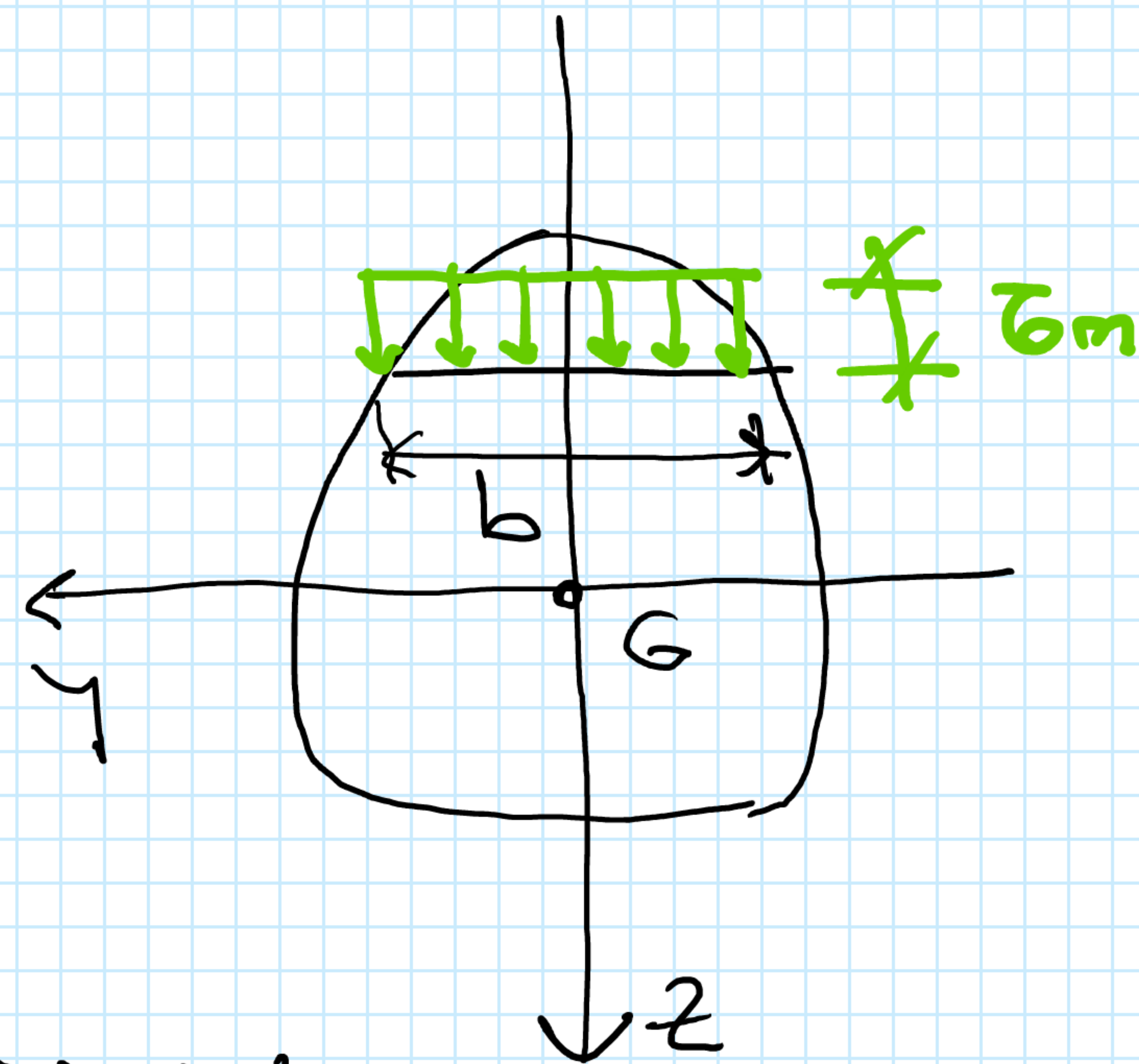
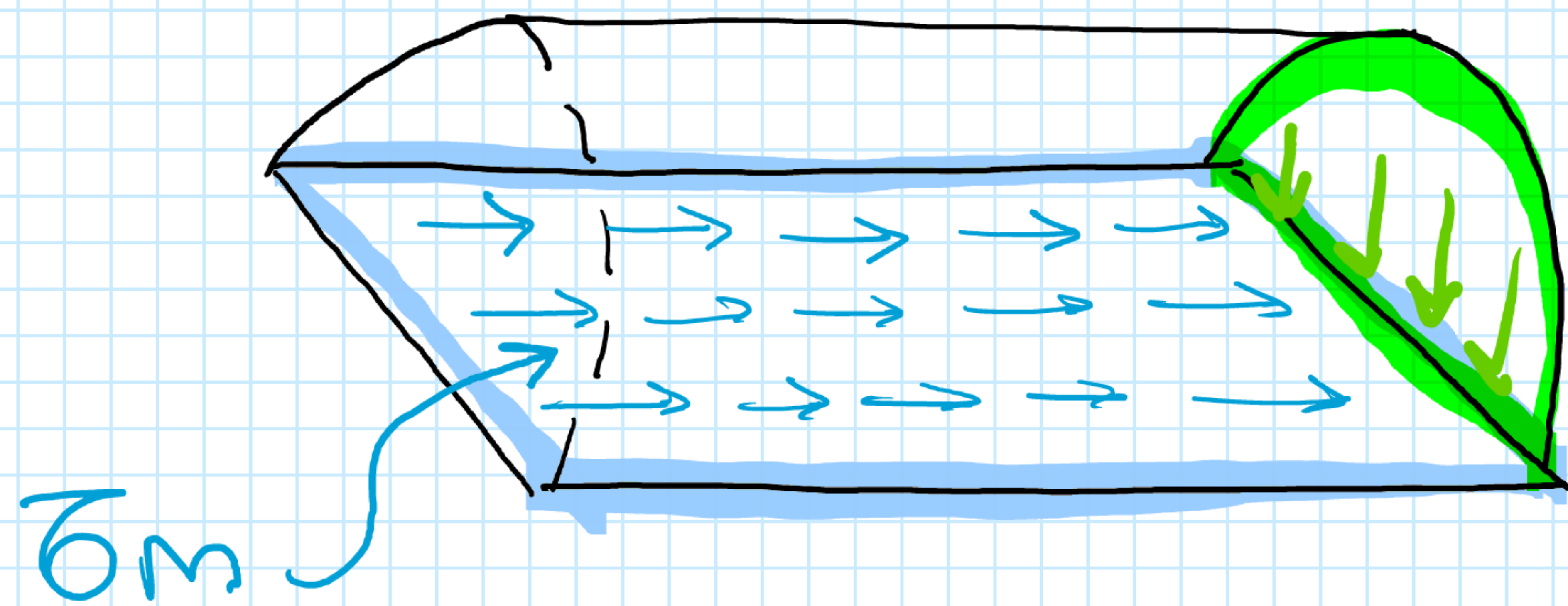


$$\tau_m \cdot b \cdot dx = \frac{dM_y}{I_y} \cdot S_{EW}^*$$

$$\tau_m = \frac{dM_y}{dx} \cdot \frac{S_{EW}^*}{b I_y} \quad Q$$

$$\tau_m = \frac{Q_z}{I_y} \cdot \frac{S_{EW}^*}{b}$$

TEOREMA DE CAUCHY.



$Q_z(y)$: ESFUERZO DE CORTE ACTUANTE EN LA SECCION.

I_y : MOMENTO DE INERCIA DE TODA LA SECCION RESPECTO DEL EJE NEUTRO ($EN \equiv y$).

b : ES EL ANCHO DE CORTE DE LA SECCION QUE TIENDE A DESGALGAR

S_{EW}^* : ES EL MOMENTO DEL AREA DE LA SECCION QUE TIENDE A DESGALGAR.

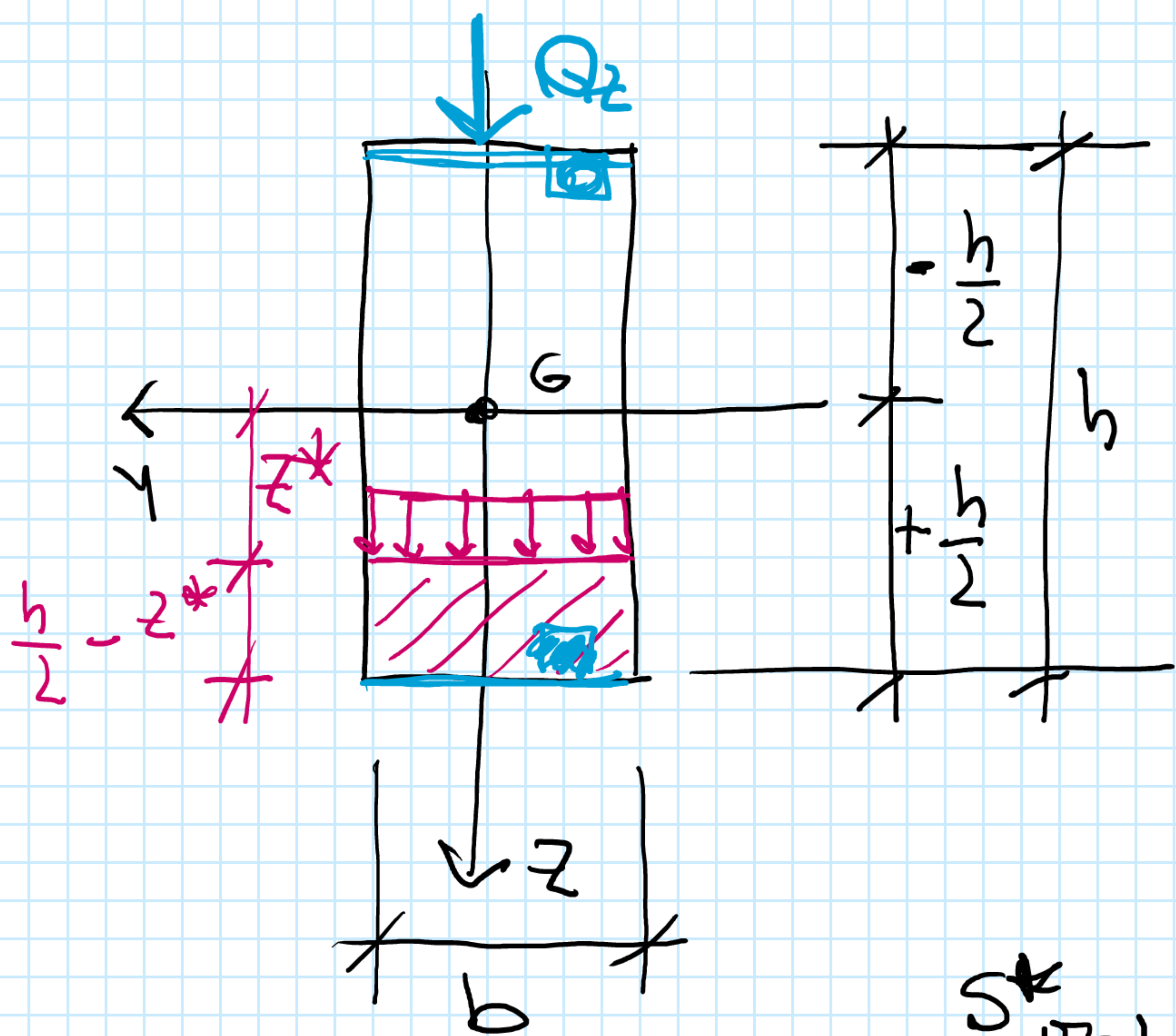
4 - CONSIDERACIONES

martes, 1 de junio de 2021 12:00

- I)- La expresión de Jouravsky-Collignon se desprende de la Fórmula de flexión;
- II) - En la expresión de la fórmula de flexión interviene la Hipótesis de Linealidad Mecánica - HLM;
- III) - $E(T) = E(C)$;
- IV) - Si el elemento estructural no fuera homogéneo, se deberá aplicar el Método de la Sección Transformada;
- V) - A pesar de que en la fórmula de J-C interviene solamente el momento de inercia de la fórmula de flexión, en la expresión final no interviene ninguna otra variable. Esto se debe a que solamente interesa los cambios o variaciones del momento flector;
- VI) - Acá se realizó una metodología indirecta para arribar a la relación entre esfuerzos internos y tensiones provocadas por, precisamente, estos esfuerzos internos.

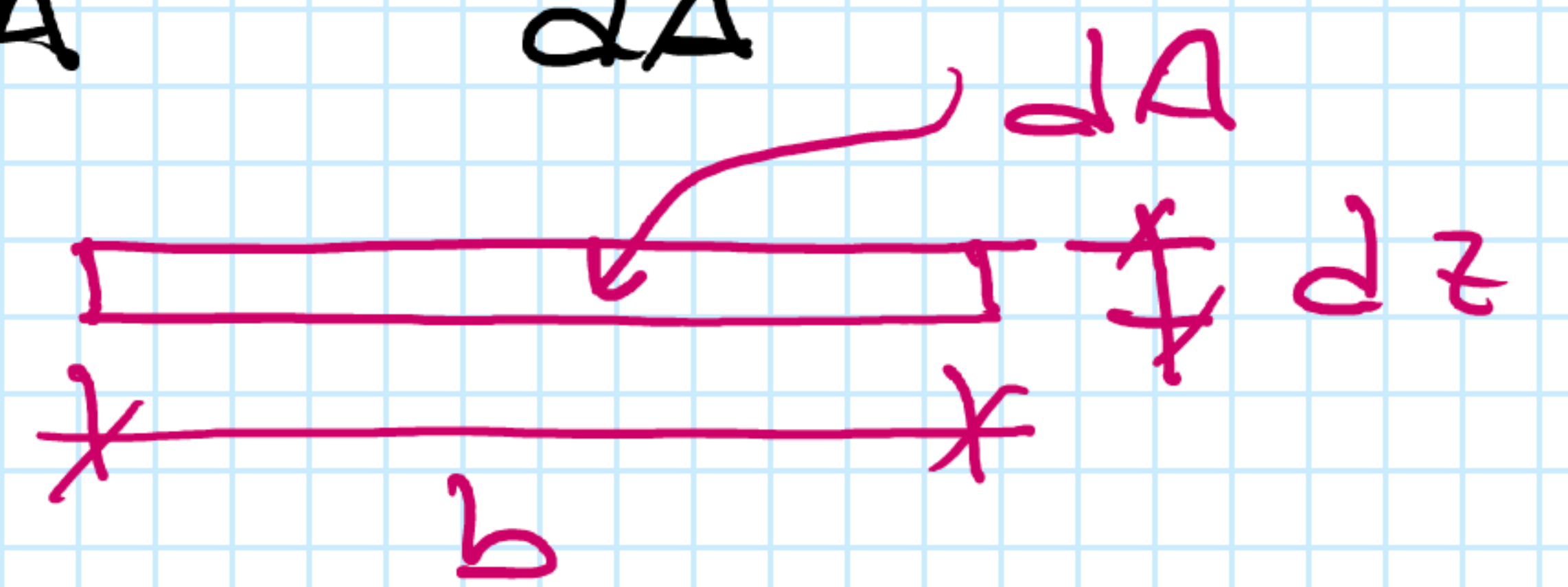
05 - APLICACIÓN A UNA SECCIÓN RECTANGULAR

martes, 1 de junio de 2021 12:13



$Q_z = \text{cte } p \text{ | toda la sección.}$
 $I_y = \dots$
 $b(z) = b = \text{cte.}$
 $S_{Ez}^*(z) \rightarrow \text{varias } U.$

$$S_{Ez}^* = \int_{A^*} z \, dA = \int_{A^*} z \cdot \underbrace{b \cdot dz}_{dA}$$



$$S_{Ez}^* = b \int_{z^*}^{h/2} z \, dz =$$

$$S_{Ez}^* = b \cdot \left(\frac{h}{2} - z^*\right) \cdot \left[z^* + \frac{1}{2} \left(\frac{h}{2} - z^*\right) \right] = b \left(\frac{h}{2} - z^*\right) \left[\frac{1}{4} h + \frac{1}{2} z^* \right]$$

$$= b \left(\frac{h}{2} - z^*\right) \frac{1}{2} \left(\frac{h}{2} + z^*\right) = \frac{1}{2} b \left[\frac{h^2}{4} - z^{*2} \right]$$

$$\tau_m = \frac{Q_z}{\underbrace{\frac{b h^3}{12}}_{I_y}} \cdot \frac{1}{2} \frac{b \left[\frac{h^2}{4} - z^{*2} \right]}{b} = \frac{6 Q_z}{b h^3} \left[\frac{h^2}{4} - z^{*2} \right]$$

$$\tau_m = \frac{3 Q_z}{b h^3} \cdot \frac{h^2}{4} \left[1 - \frac{4}{h^2} z^{*2} \right] = \frac{3}{2} \frac{Q_z}{b h} \left[1 - \left(\frac{2z^*}{h} \right)^2 \right]$$

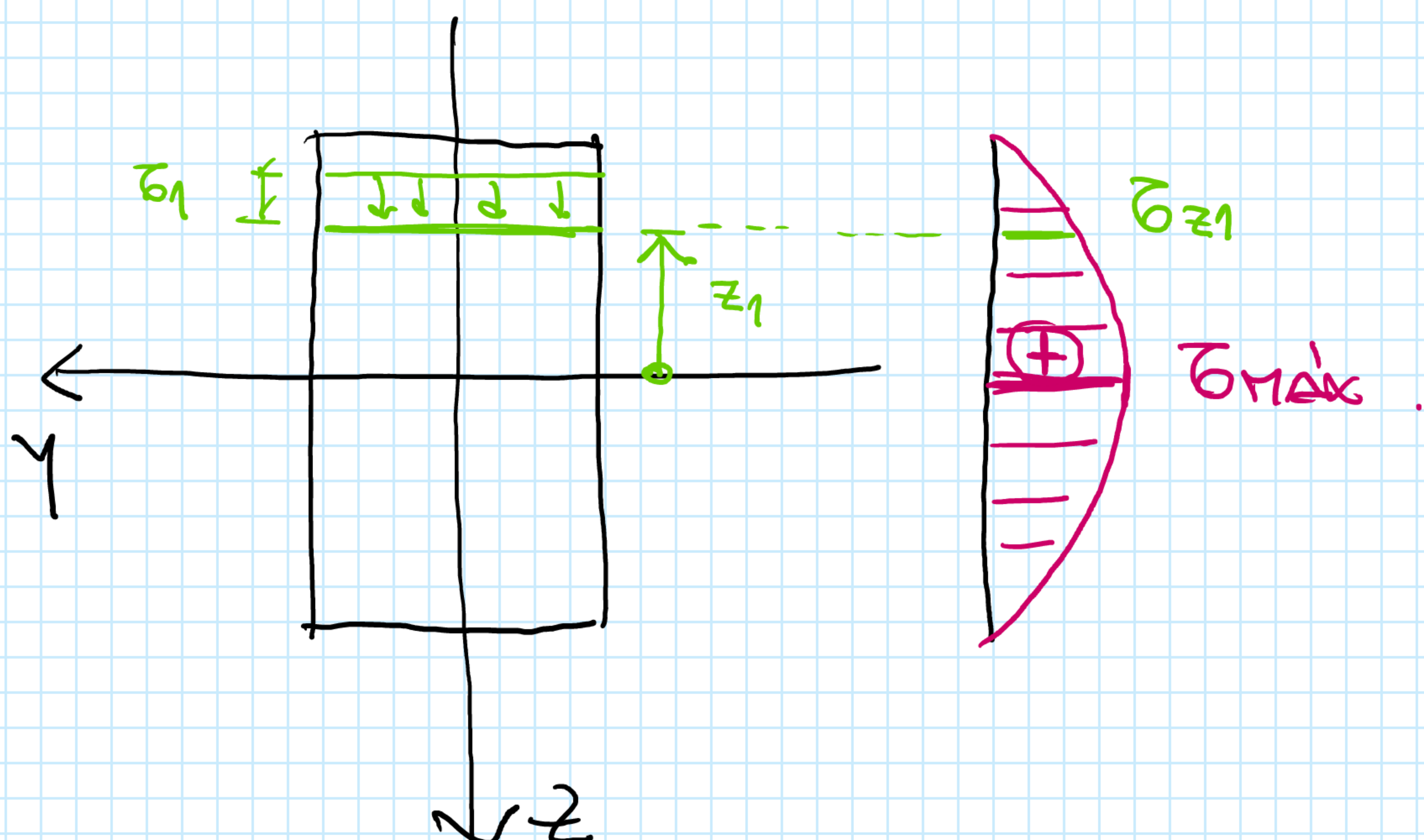
$$\tau_m = \tau_{xz} = \frac{3}{2} \frac{Q_z}{b h} \left[1 - \left(\frac{2z^*}{h} \right)^2 \right]$$

(A) $\tau_{ij} = \tau_{xz}$
 LA NORMAL AL PLANO EN LA CUAL ACCIONAN
 LA DIRECCION DE LAS TENSIONES

DE **(A)**:

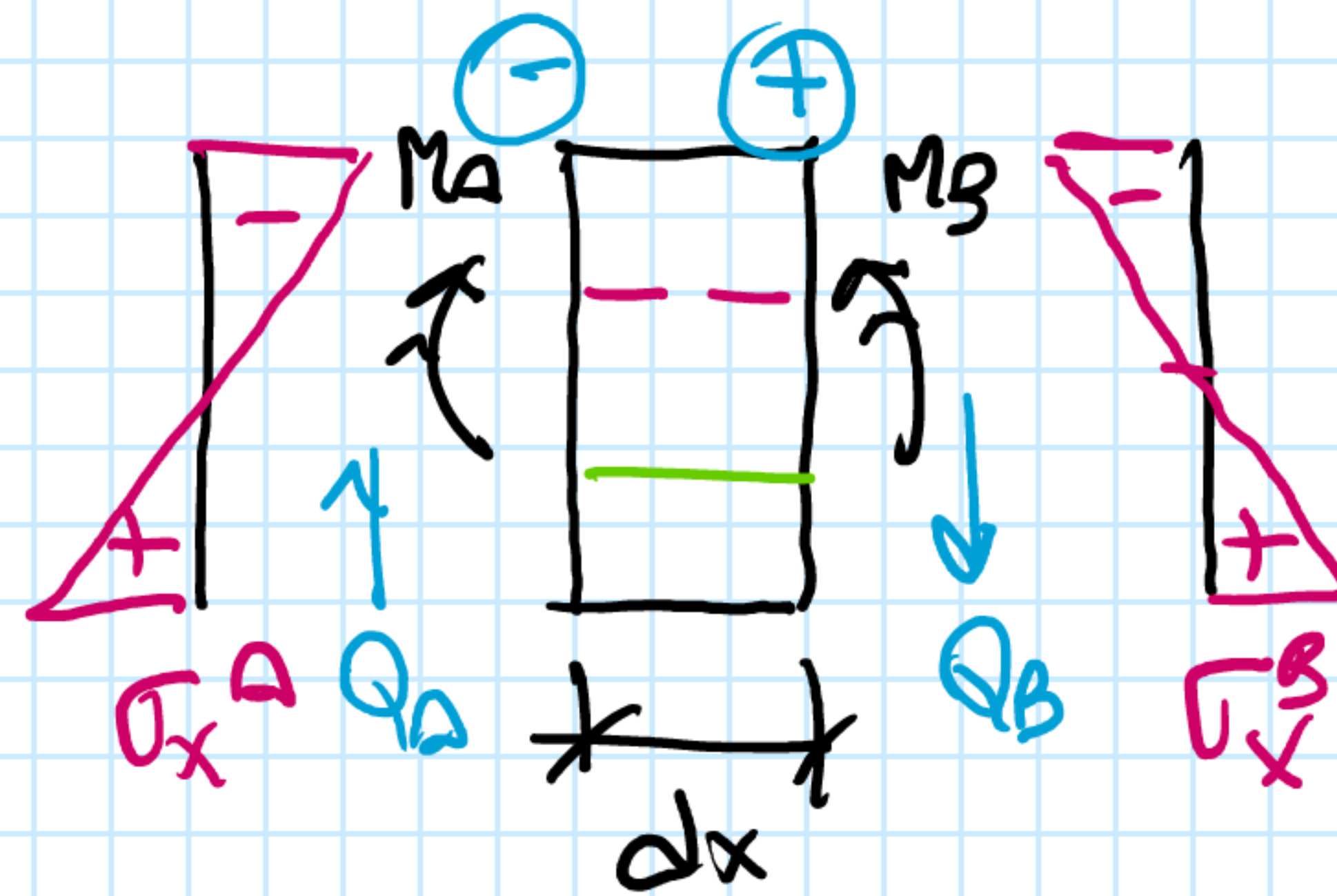
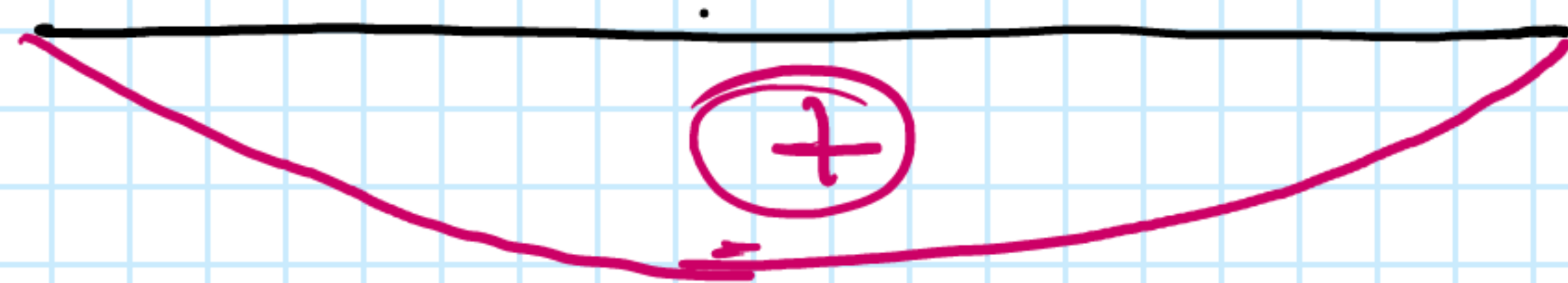
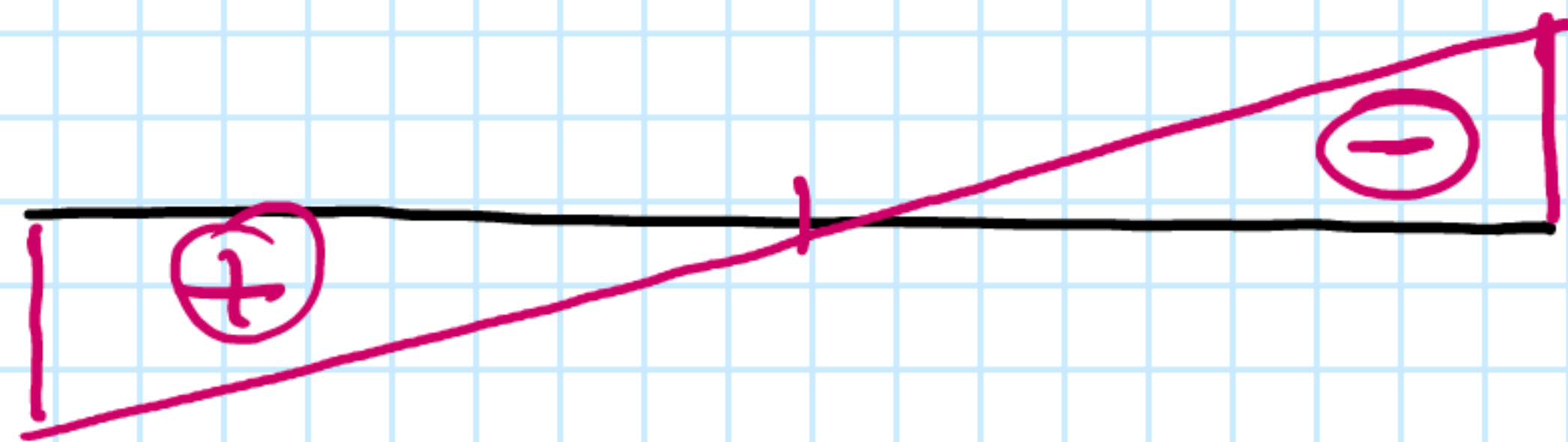
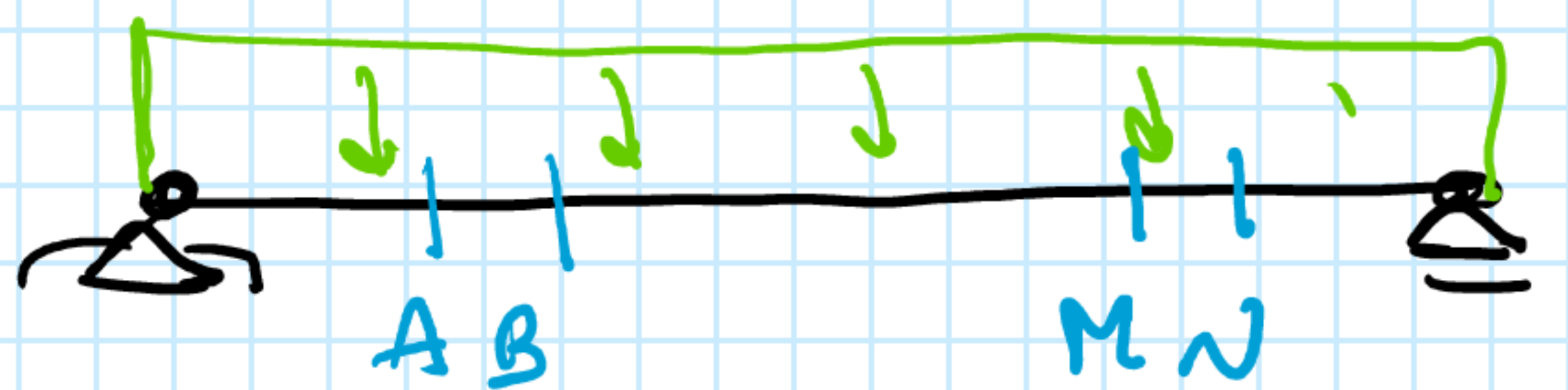
$$z^* = 0 \quad \tau_m = \tau_{xz} = \frac{3}{2} \frac{Q_z}{b h}$$

$$z^* = \pm \frac{h}{2} \quad \tau_m = \tau_{xz} = 0$$

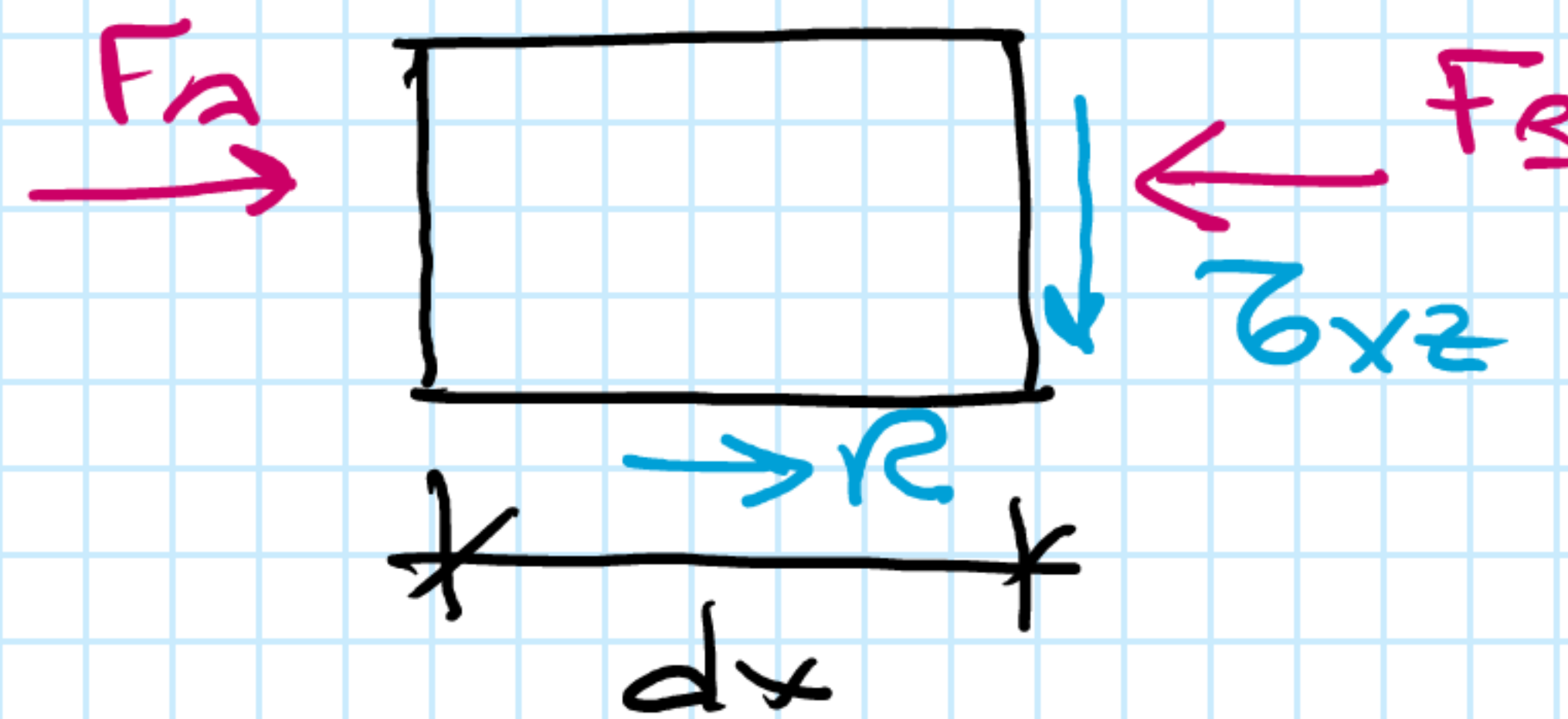


O5 - APLICACIÓN A SECCIÓN RECTANGULAR

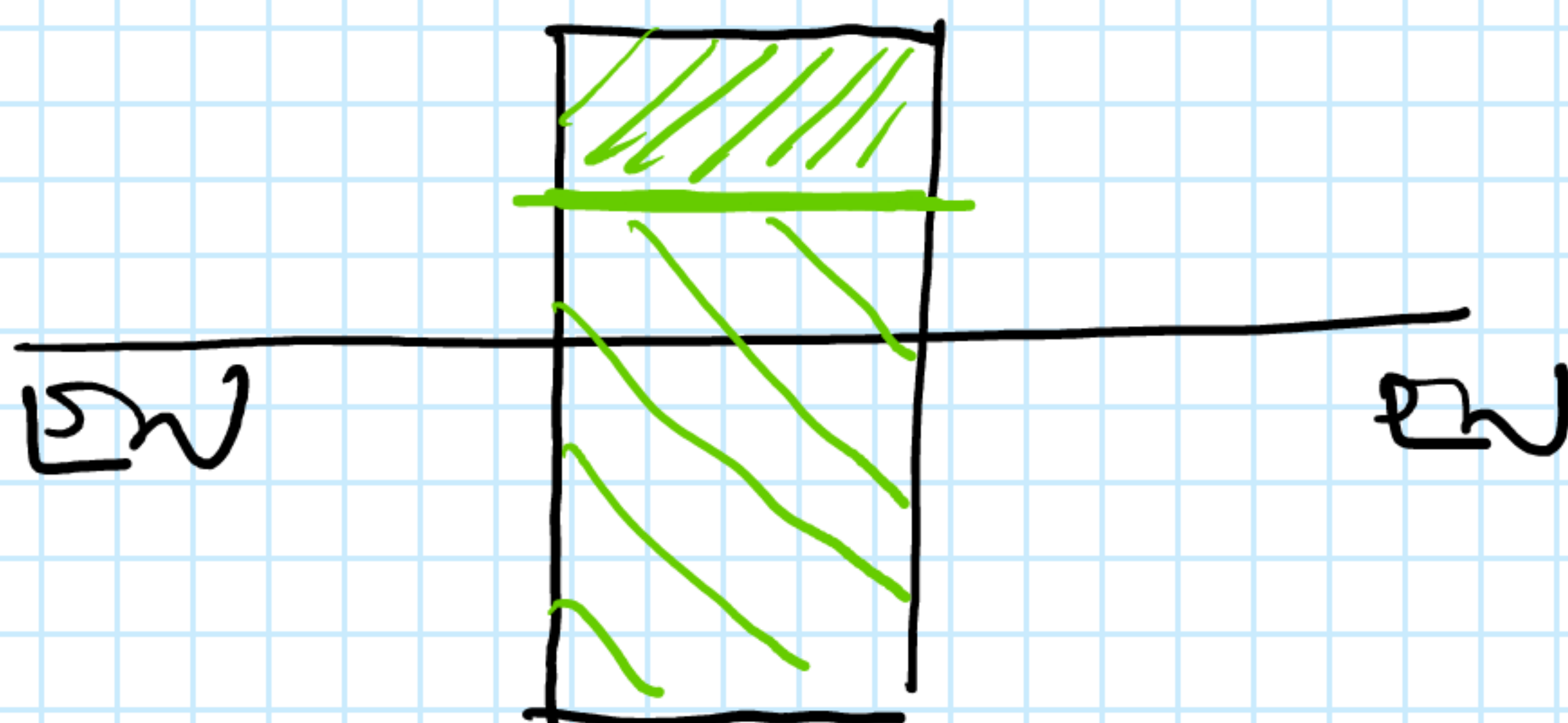
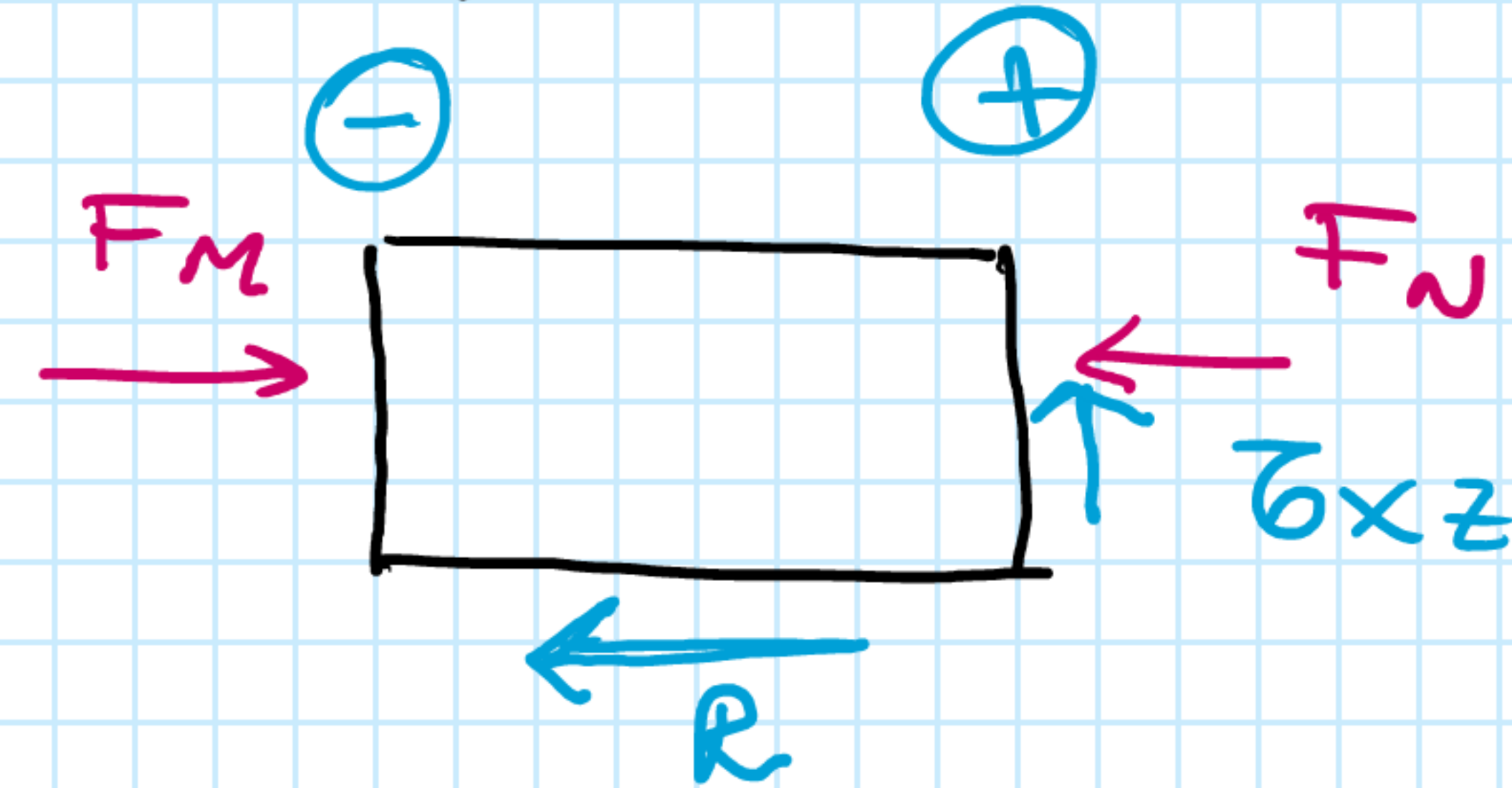
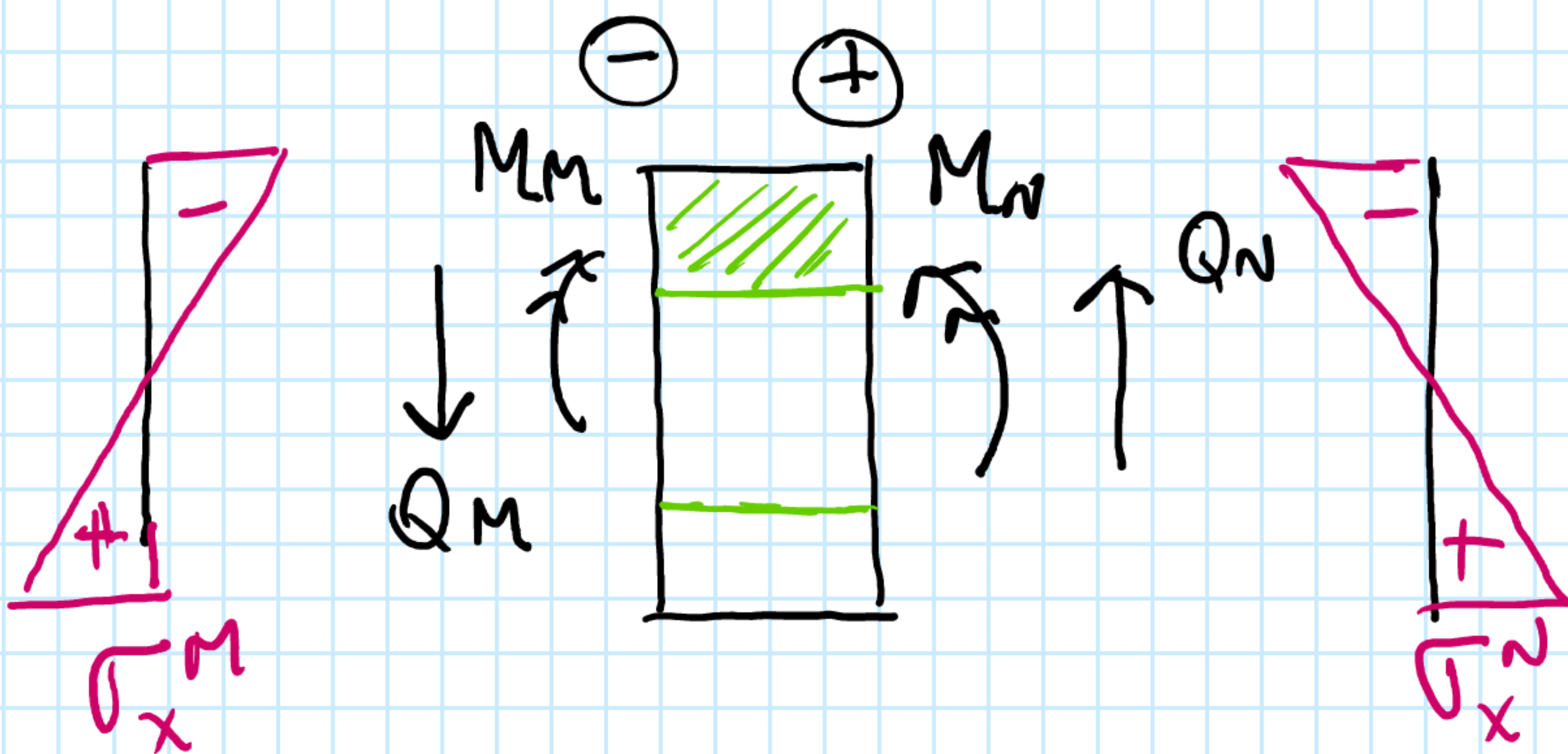
martes, 1 de junio de 2021 12:37



$$M_B > M_A \rightarrow \sigma_{x^B} > \sigma_{x^A} \rightarrow F_B > F_A$$

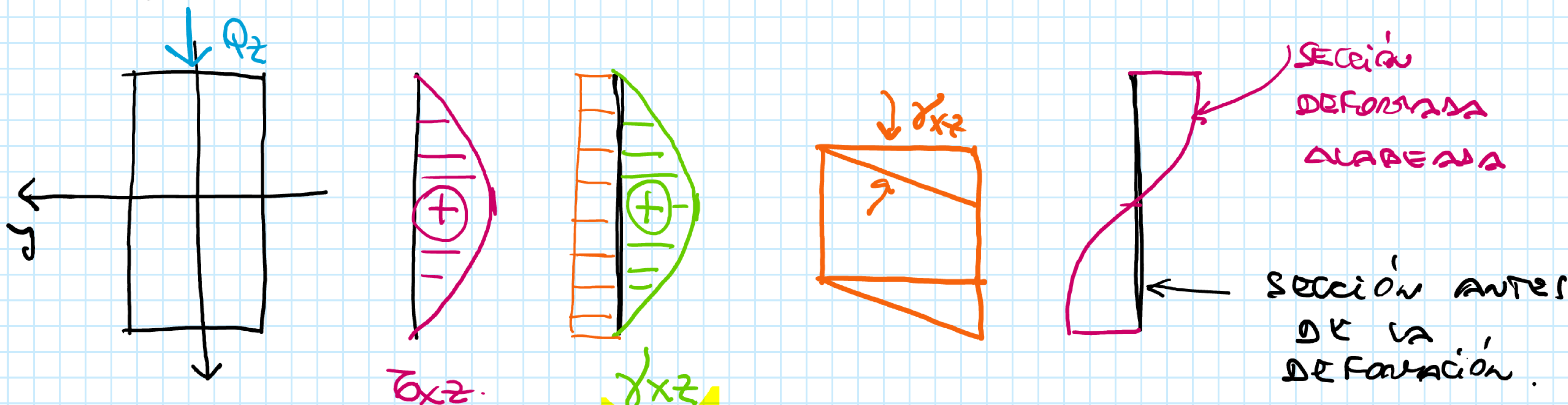


$$M_M > M_N \rightarrow \sigma_x^M > \sigma_x^N \rightarrow F_M > F_N$$



06 - ALABEO DE LAS SECCIONES

martes, 1 de junio de 2021 12:47



$$\tau = G \cdot \gamma \rightarrow \gamma = \frac{\tau}{G}$$

Al ser variable las distorsiones, la sección se termina alabeando; y por lo tanto, deja de ser plana

$$\tau_m = \frac{Q \cdot S^*}{I \cdot b}$$

$$\sigma_x = \frac{M_y}{I_y} \cdot z$$

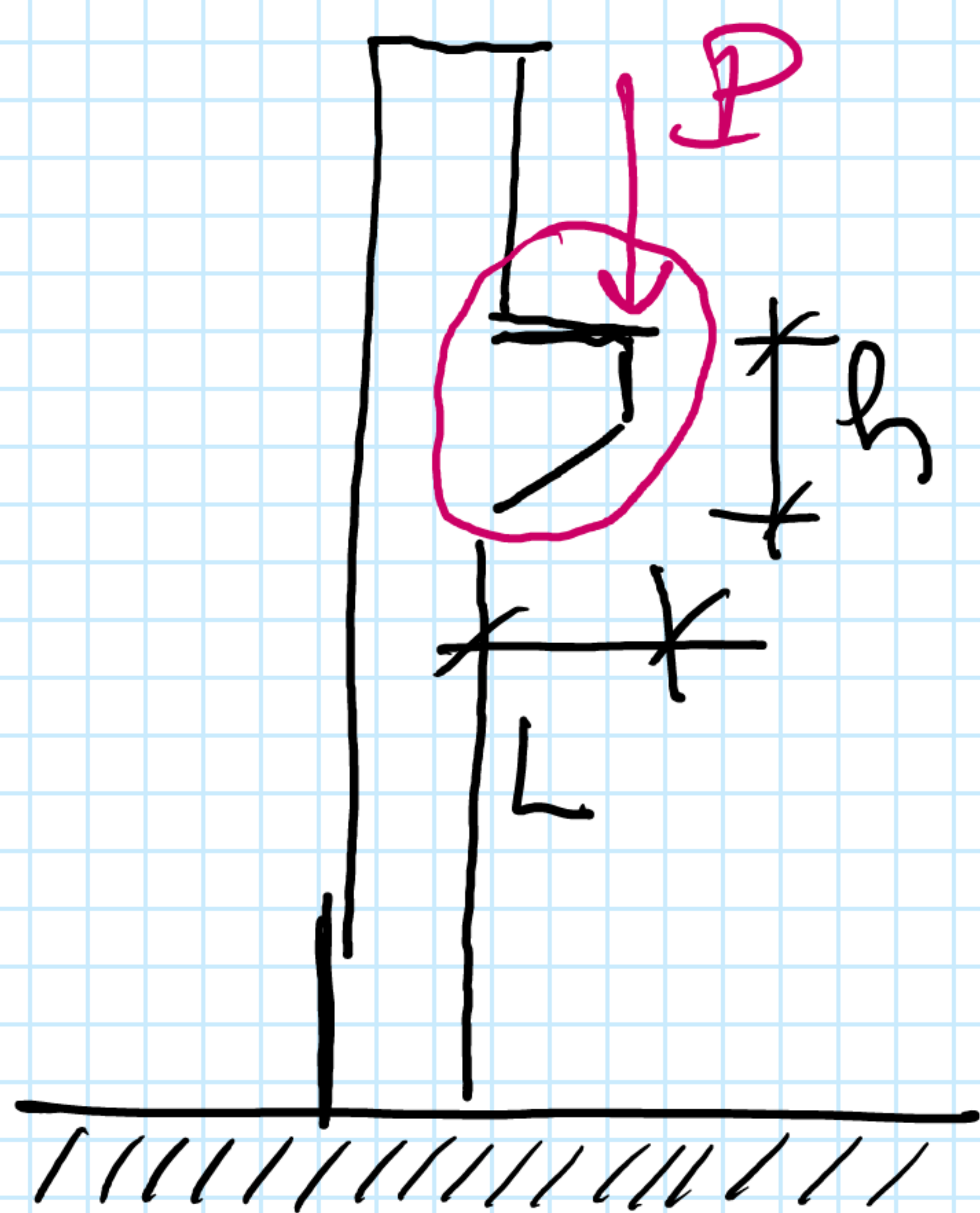
SECCIONES PLANAS

¿CÓMO SALVAMOS ESTO?

→ BARRAS ESBELTAS

$\frac{L}{d} \gg 10 \rightarrow$ las deformaciones

provocadas por el corte son despreciables → y por lo tanto, si bien el alabeo existe, éste es despreciable.



$$\frac{L}{h} \approx 1$$

→ NO SE PUEDE APLICAR LA EXPRESIÓN DE LA FLEXIÓN AL CALCULAR

$$M = PL$$

MENSULA CORTA.

~~FLEXIONES~~

~~$$\sigma_x = \frac{M}{I} \cdot z$$~~

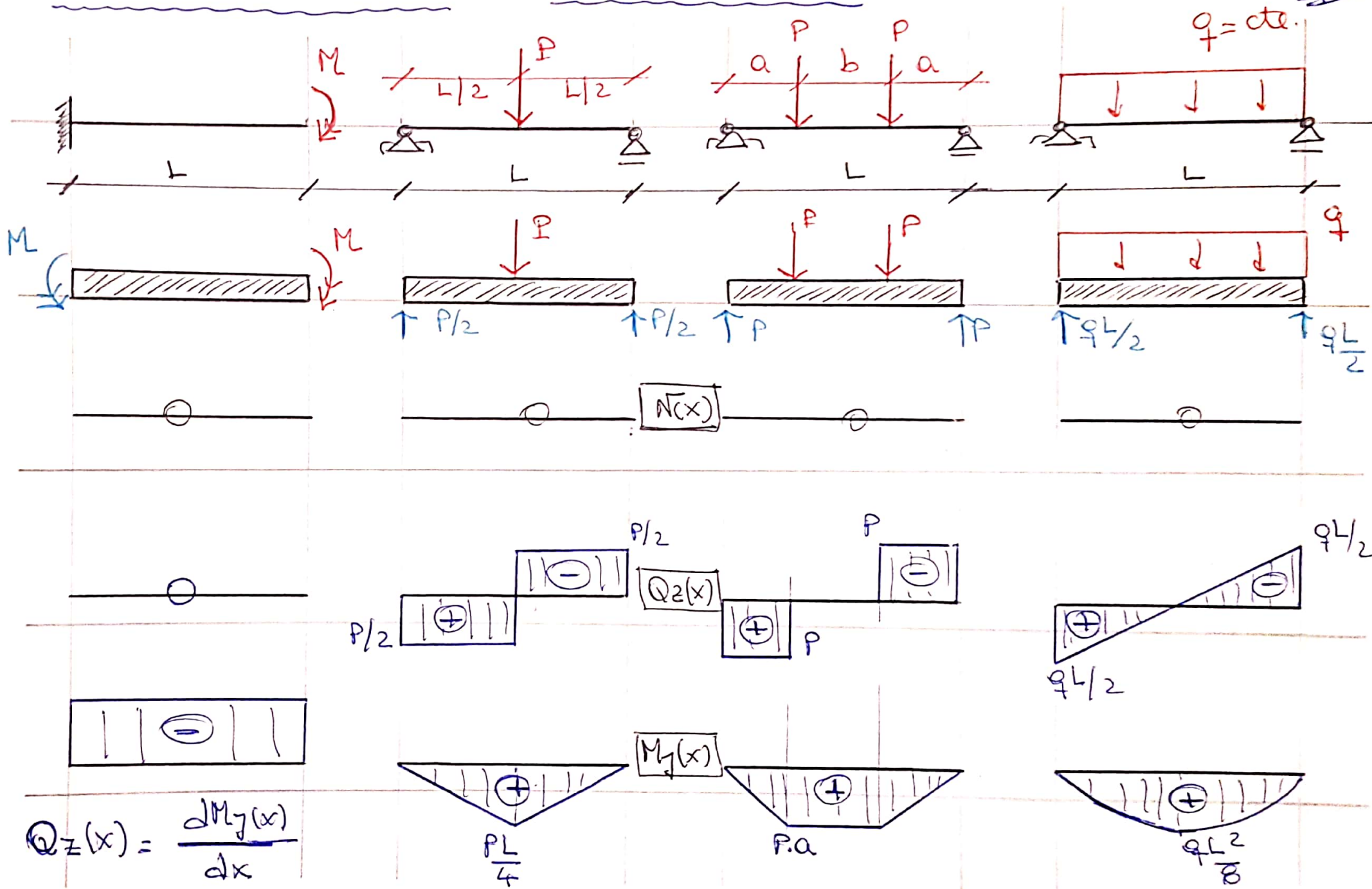
NO SE PUEDE APLICAR.

TAMPOCO SE APLICA D-C

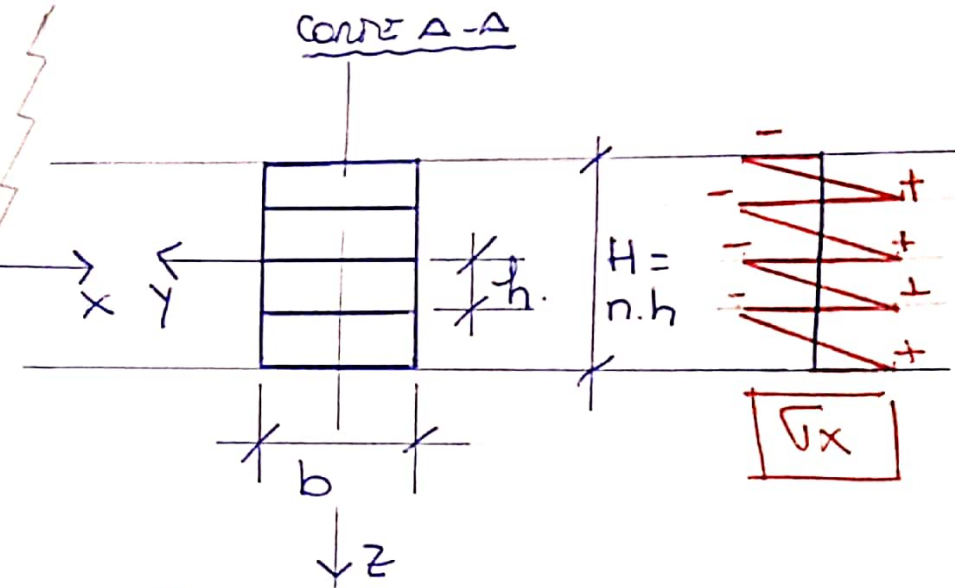
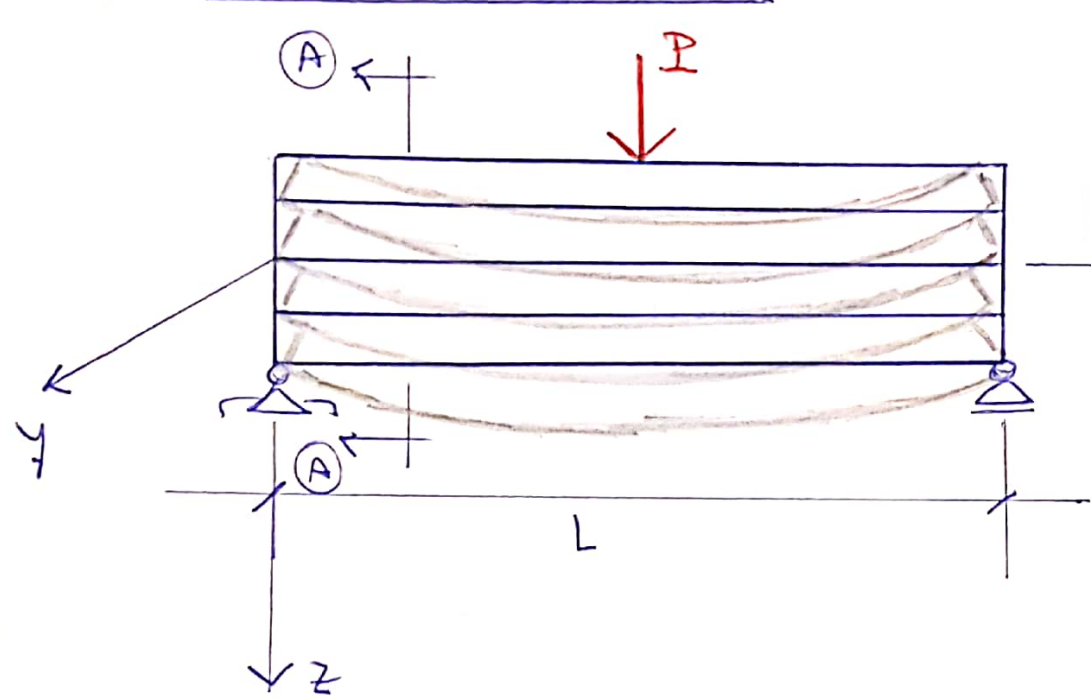
FLEXIÓN VARIABLE

FLEXIÓN Y CORTA:

FIUBA - EII-84.03-2021-TC - 03.05-CLT-FV-01 - FV-01-2021-06-01



02) → EJEMPLO INTUITIVO:



n : N° DE TABLAS QUE CONTIENEN EL ELEMENTO.

→ SUPOSICIÓN DE FUNCIONAMIENTO: SE CONSIDERA QUE EL ROZAMIENTO ENTRE TABLAS ES DESPREZABLE Y DE HECHO SE CONSIDERA RA → NO LO! ⊕ ~~EN~~ LAS TABLAS SON IGUALES.

→ 2 CASOS DE ANÁLISIS

- ⓐ TABLAS NO VINCULADAS
- ⓑ TABLAS VINCULADAS (ADHESIVOS, PERNOS, PASADOROS, CLAVOS, ETC), SOLDADURA).

• 1º CASO : TABLAS NO VINCULADAS → C/ TABLA TRABAJA EN FORMA INDEPENDIENTE CON SU LA OTRA → LO APROXIMAMOS EN LA PROPIA DEFONAMIA.

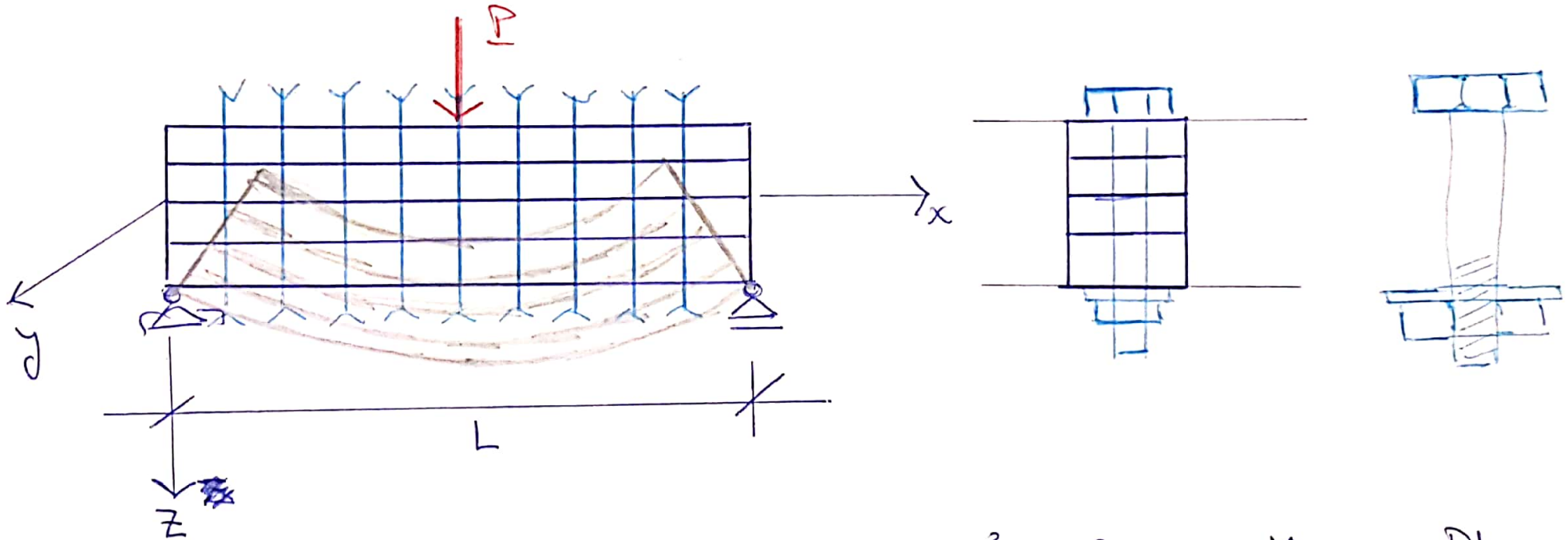
$$P_i = \frac{P}{n} ; I_{y_i} = \frac{bh^3}{12} = \frac{b}{12} \left(\frac{H}{n}\right)^3 = \frac{bH^3}{12n^3} ; M_{\max,i} = \frac{P_i L}{4} = \frac{PL}{4n}$$

$$Z_{\max,i} = \frac{h}{2} ; \sigma_{\text{SUELO MAX}} = \sigma_{\text{TRAB MAX}} = \frac{M_{y_i}}{I_{y_i}} \cdot Z_{\max,i} = \frac{PL}{4n} \cdot \frac{\frac{h}{2}}{\frac{bh^3}{12}} = \boxed{\frac{3}{2} \frac{PL}{nb^2}}$$

• Si $\sigma_{\text{SUELO MAX}} = \sigma_{\text{ADM}}$ → $P_{\text{ADM},1} = \frac{2}{3} \cdot \frac{nb^2}{L} \cdot \sigma_{\text{ADM}}$ (1)

→ HBN SE JUNTAN P/ CADA TABLA PERO NO P/ EL CONJUNTO.

- 2º CASO : TABLAS ESTÁN VINCULADAS → I) NO EXISTE DESLIZAMIENTO DE 1 TABLA RESPECTO DE LA OTRA ; II) → 4/9
 → LAS TABLAS TRABAJAN EN FORMA CONJUNTA.



- P ; $I_y = \frac{bH^3}{12} = \frac{b}{12} \cdot (nh)^3 = \frac{n^3}{12} bh^3$; $M_y = \frac{PL}{4}$

- $Z_{max} = \frac{H}{2} = \frac{nb}{2}$; $\sigma_{señ} = \sigma_{max} = \frac{M_y}{I_y} \cdot Z_{max}$

$$\sigma_{señ} = \sigma_{max} = \frac{PL}{4} \cdot \frac{1}{\frac{bh^3 n^3}{12}} \cdot \frac{1}{2}$$

$$\sigma_{seru} = \sigma_{adm} = \frac{3}{2} \frac{PL}{n^2 b h^2} \rightarrow \text{si } \sigma_{seru} = \sigma_{adm} \rightarrow$$

$$\rightarrow \underline{\underline{P_{ADM,2} = \frac{2}{3} \frac{n^2 b h^2}{L} \cdot \sigma_{ADM}}} \quad (2)$$

3e) COMPARATIVA ENTRE CARGAS Y TENSIONES ADMISIBLES.

$$\frac{P_{ADM,2}}{P_{ADM,1}} = \frac{\frac{2}{3} \frac{n^2 b h^2}{L} \cdot \sigma_{ADM}}{\frac{2}{3} \frac{n b h^2}{L} \sigma_{ADM}} = n \rightarrow \boxed{P_{ADM,2} = n \cdot P_{ADM,1}} \quad (3)$$

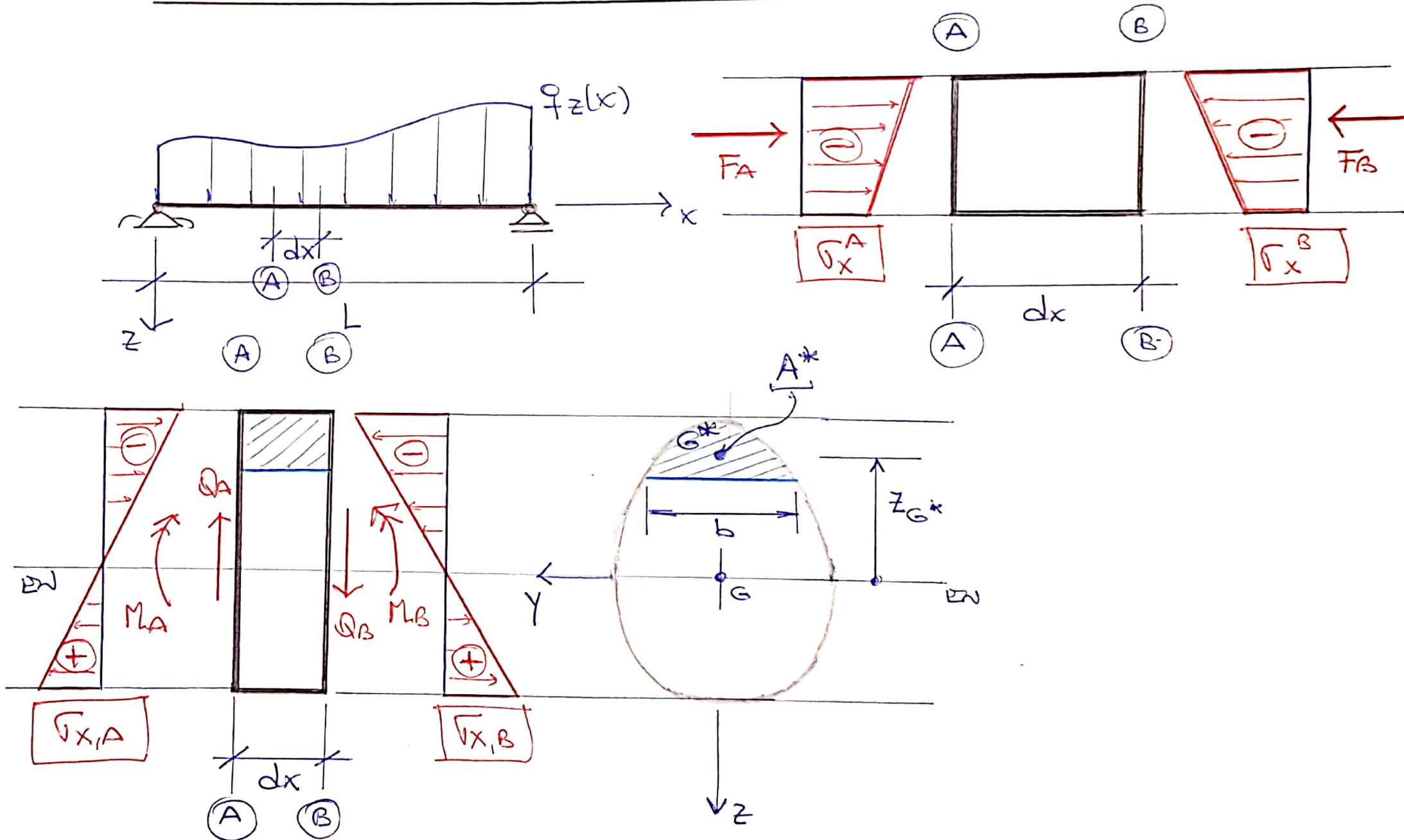


$$\frac{\sigma_{seru,2}}{\sigma_{seru,1}} = \frac{\frac{3}{2} \frac{PL}{n^2 b h^2}}{\frac{3}{2} \frac{PL}{n b h^2}} = \frac{1}{n}$$

$$\boxed{\sigma_{seru,2} = \frac{1}{n} \sigma_{seru,1}} \quad (4)$$



03) → EXPRESION DE JOURNAUSKY - COLLIGNON



$$\textcircled{A} \rightarrow F_A = \int_{A^*} \sigma_x^A dA = \int_{A^*} \underbrace{\frac{M_y^A}{I_y}}_{cte} \cdot z dA = \frac{M_y^A}{I_y} \int_{A^*} z dA \quad \underline{\underline{7/9}}$$

$S_{z0}^{A^*} = S_{z0}^{A^*}$

$$F_A = \frac{M_y^A}{I_y} \cdot S_{z0}^{A^*}; \quad S_{z0}^{A^*} = A^* \cdot z_{G^*};$$

$$F_A = \frac{M_y^A}{I_y} \cdot A^* \cdot z_{G^*} \quad (5)$$

$$\textcircled{B} \rightarrow F_B = \int_{A^*} \sigma_x^B dA = \int_{A^*} \frac{M_y^B}{I_y} z dA = \frac{M_y^B}{I_y} \int_{A^*} z dA$$

$S_{z0}^{A^*} = S_{z0}^{A^*}$

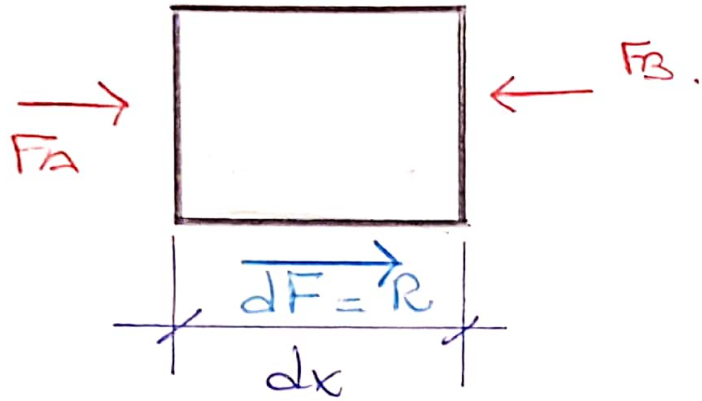
$$F_B = \frac{M_y^B}{I_y} S_{z0}^{A^*} = \frac{M_y^B}{I_y} \cdot A^* \cdot z_{G^*} \quad (6)$$

$$M_A < M_B \rightarrow M_B = \underbrace{M_A}_{M} + dM = M + dM; \quad m_A = M.$$

$$F_A = \frac{M_y}{I_y} \cdot A^* \cdot z_{G^*}; \quad F_B = \frac{(M_y + dM_y)}{I_y} \cdot A^* \cdot z_{G^*}.$$

• COMO $M_B > M_A \rightarrow \sigma_x^B > \sigma_x^A \rightarrow F_B > F_A$

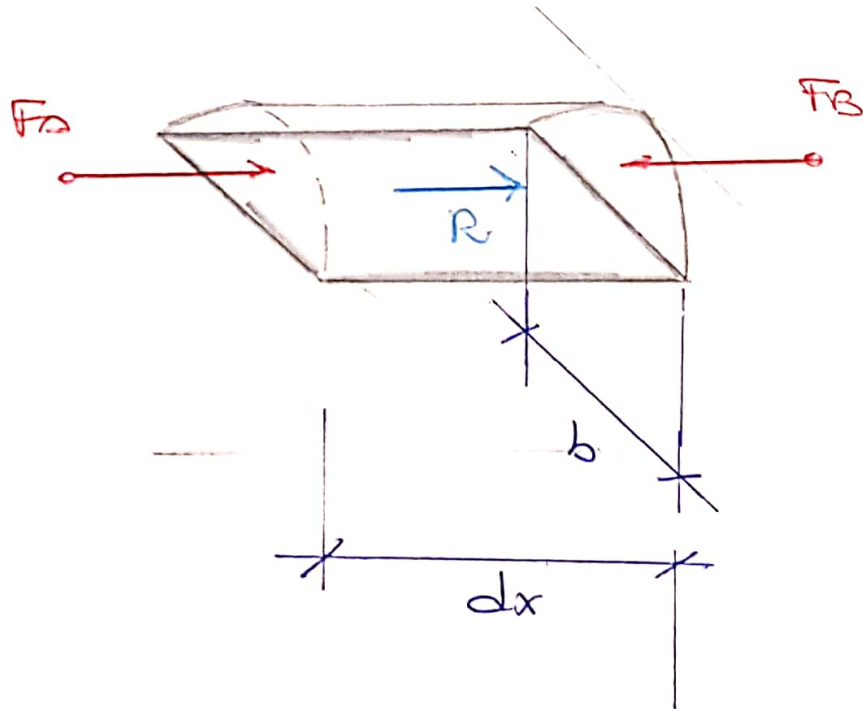
$$F_A + \underbrace{dF}_R = F_B$$



$$F_A + R = F_B \quad (7)$$

$$R = dF = F_B - F_A$$

$$R = dF = \frac{(M_7 + dM_7)}{I_7} \underbrace{A^* z_0^*}_{S_{00}^*} - \frac{M_7}{I_7} \underbrace{A^* z_0^*}_{S_{00}^*}$$



$$dF = \frac{dM_7}{I_7} \cdot S_{00}^* \quad (8)$$

1º SIMPLICACIÓN

$$\frac{dF}{b \cdot dx} = \frac{R}{b \cdot dx} = \tau_m \quad \text{TENSIÓN TANGENCIAL "MEDIA"}$$

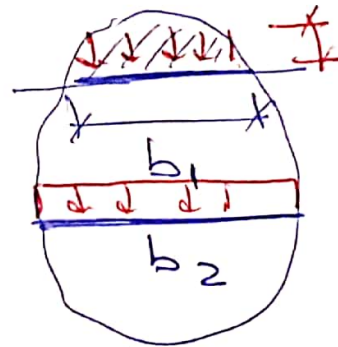
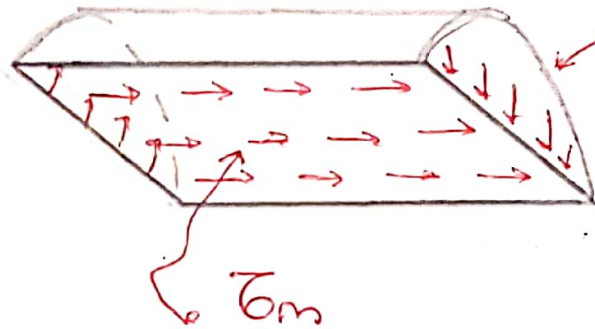
$$dF = \tau_m \cdot b \cdot dx \quad (9)$$

$$\tau_{om} b dx = \frac{dM_y}{I_y} \cdot S_{eq}^*$$

$$\tau_{om} = \frac{dM_y}{dx} \frac{S_{eq}^*}{I_y \cdot b} \rightarrow$$

$$\tau_{om} = \frac{Q_z(x) \cdot S_{eq}^*}{I_y \cdot b}$$

TEOREMA DE CAUCHY



$Q_z(x)$: RESPONDO DE CORTE ACTUANDO EN LA SECCION

$$I_y = I_{eq}$$

b : EL ANCHO DE CORTE DE LA SECCION POR ~~RESBAL~~ RESBAL

S_{eq}^* : MOMENTO ESTÁTICO DE LA SECCION POR RESBAL.

CONSIDERACIONES:

I) LA EXPRESIÓN DE J-C SE DESPRESE DE LA FÓRMULA DE FLEXIÓN.

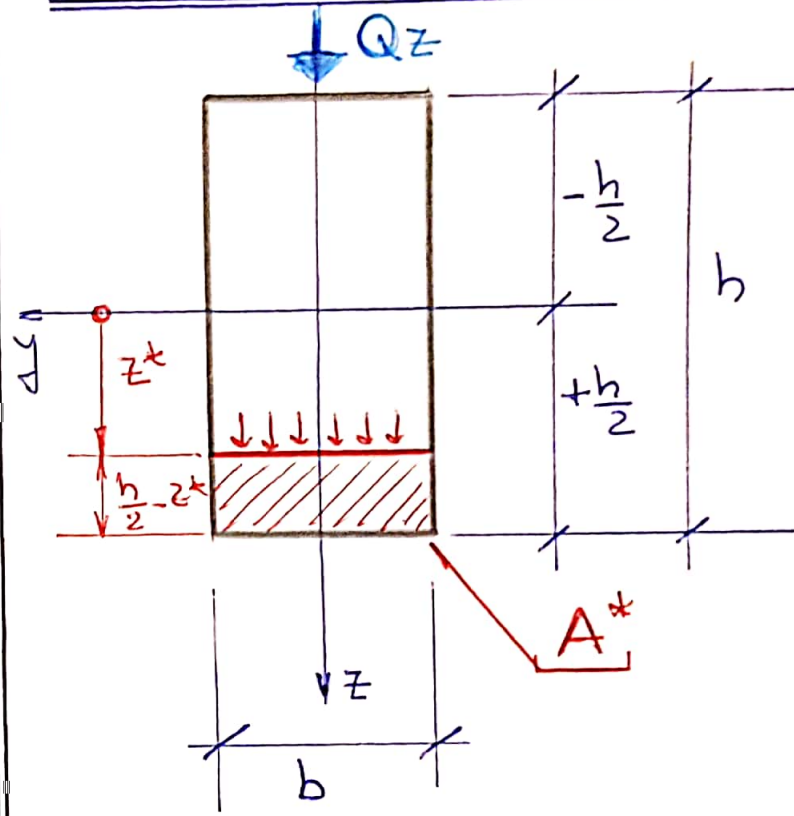
II) EN LA FÓRMULA DE FLEXIÓN $\sigma_x = \frac{M}{I} \cdot z \rightarrow$ INTERCAMBIO LA HLM.

III) $E_T = E_C$.

IV) SI EL MCM. ESTRUCTURAL NO ES HOMOGÉNEO \rightarrow MÉTODOS DE LA SECCIÓN TRANSFORMADA.

V) A PESAR DE "I" \rightarrow NO INTERCAMBIO NINGUNA ~~VARIA~~ ^{VARIA} DE LA FLEXIÓN EN LA EXPRESIÓN FINAL \rightarrow SE DEBE LO PUES INTENSIDAD \rightarrow SON CAMBIOS DE M.

SECCIÓN RECTANGULAR:



$$\tau_{mz} = \frac{Q_z \cdot S_{Oz}^*}{I_{Oz} \cdot b}$$

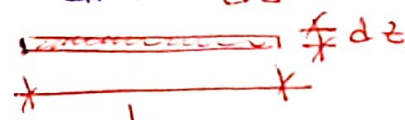
Q_z : ESTRECHO DE CORTES \rightarrow CONSTANTE P/ LA SECCIÓN.

$$I_{Oz} = I_y = \text{cte}$$

$$b(z) = b = \text{cte}$$

$$S_{Oz}^* = S_{Oz}^*(z) \rightarrow \text{VARIA}$$

$$S_{EW}^* = \int_{A^*} z \cdot dA = \int_{A^*} z \cdot \underbrace{b dz}_{dA} = b \cdot \int_{z^*}^{\frac{b}{2}} z dz =$$



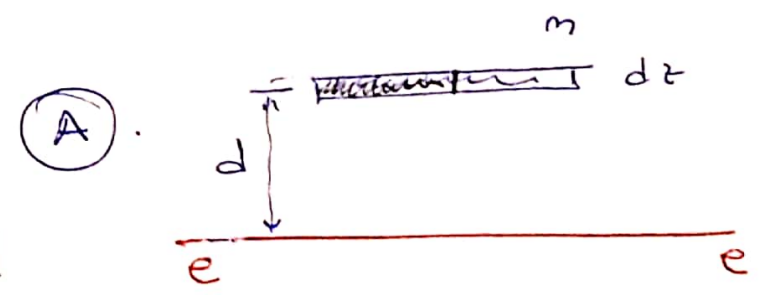
$$= b \cdot \left(\frac{h}{2} - z^*\right) \cdot \left[z^* + \frac{1}{2} \left(\frac{h}{2} - z^*\right) \right] = b \left(\frac{h}{2} - z^*\right) \left[\frac{1}{4} h + \frac{1}{2} z^* \right] =$$

$$= b \left(\frac{h}{2} - z^*\right) \frac{1}{2} \left(\frac{h}{2} + z^*\right) = \frac{1}{2} b \left[\frac{h^2}{4} - (z^*)^2 \right]$$

$$\bar{I}_m = \frac{Q}{\frac{bh^3}{12}} \cdot \frac{1}{2} \left[\frac{h^2}{4} - z^{*2} \right] = \frac{6Q}{bh^3} \left[\frac{h^2}{4} - z^{*2} \right] =$$

$$= \frac{6Q}{bh^3} \cdot \frac{h^2}{4} \left[1 - \frac{4}{h^2} z^{*2} \right] = \frac{3Q}{2bh} \left[1 - \left(\frac{2z^*}{h}\right)^2 \right]$$

$$\bar{I}_m = \bar{I}_{xz} = \frac{3}{2} \frac{Q}{bh} \left[1 - \left(\frac{2z^*}{h}\right)^2 \right]$$



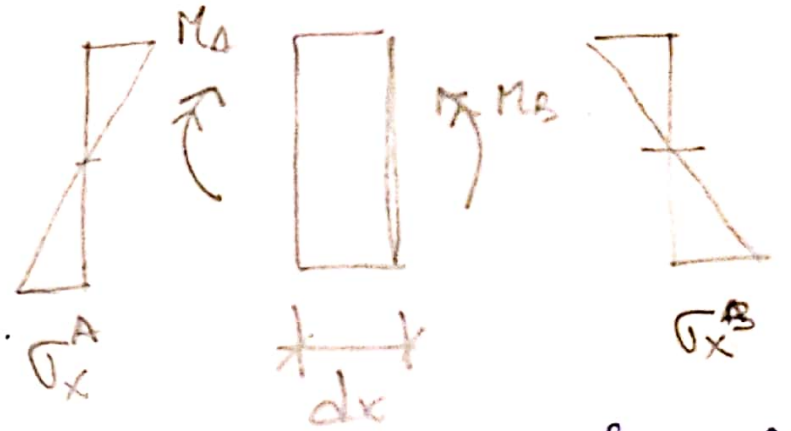
DE (A) :

$$z^* = 0.$$

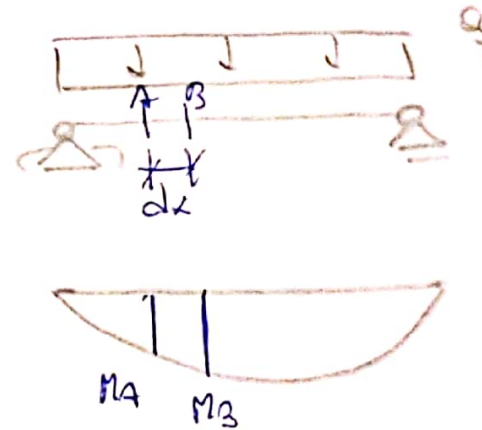
$$\tau_{xz} = \frac{3}{2} \frac{Q}{bh}$$

$$z^* = \frac{h}{2}$$

$$\tau_{xz} = \frac{3}{2} \frac{Q}{bh} \cdot \left[1 - \underbrace{\left(\frac{z \cdot h}{h \cdot z} \right)^2}_1 \right] = 0.$$

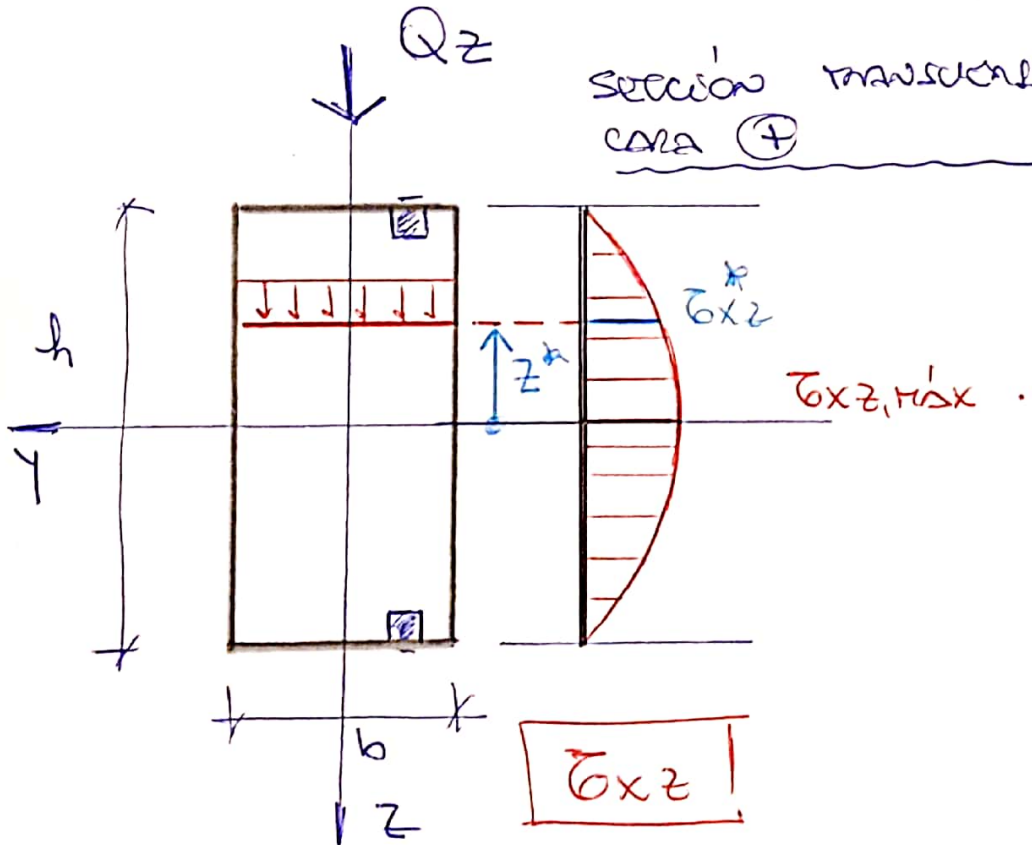


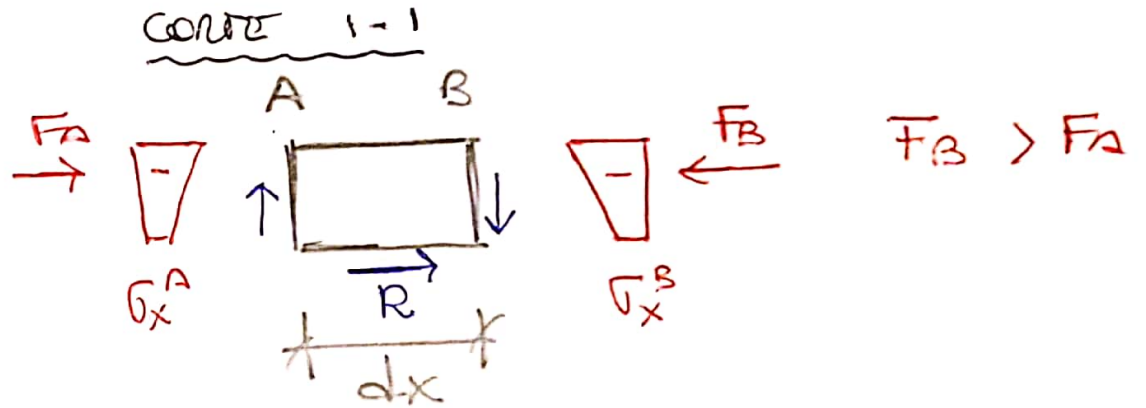
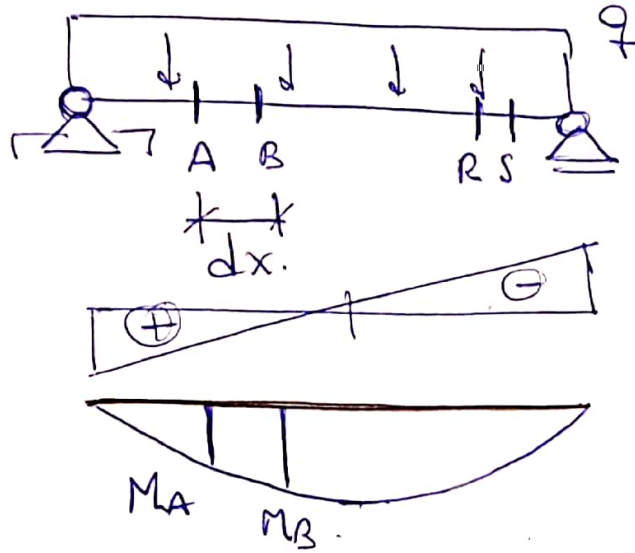
$$M_B > M_A \implies \sigma_x^B > \sigma_x^A$$



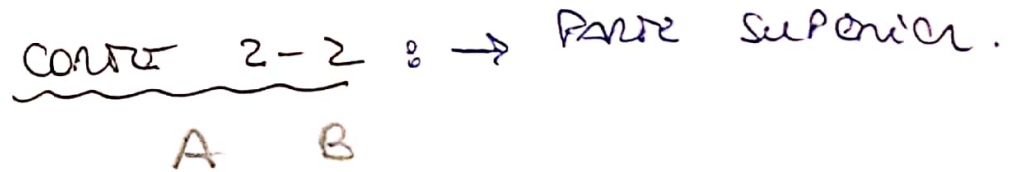
$$\frac{\tau_{xz}(z)}{G} = \gamma_{xz}(z)$$

sección transversal
cara (+)

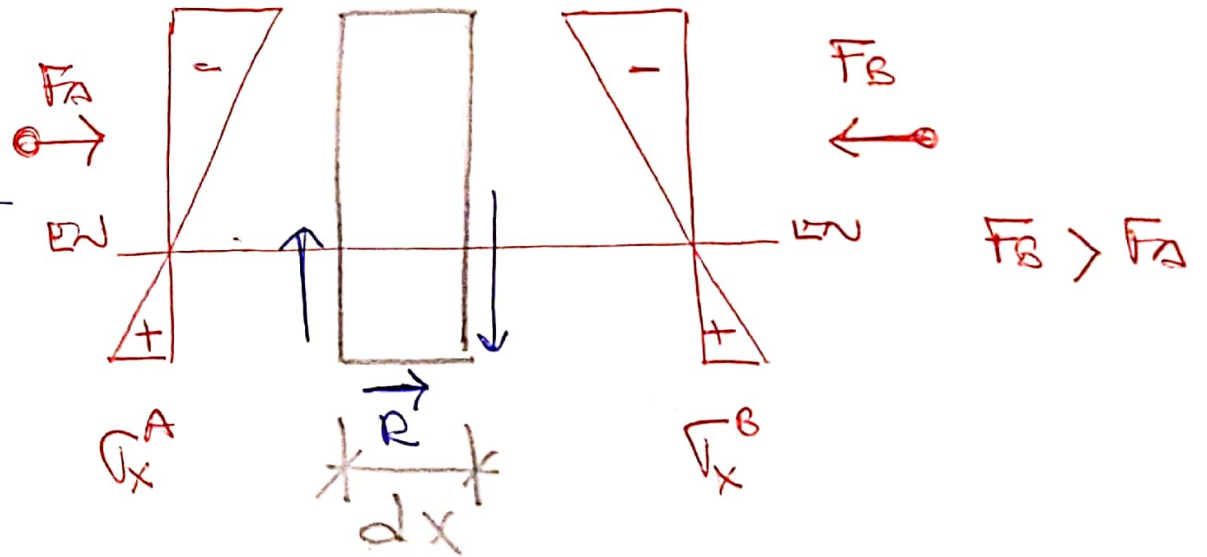
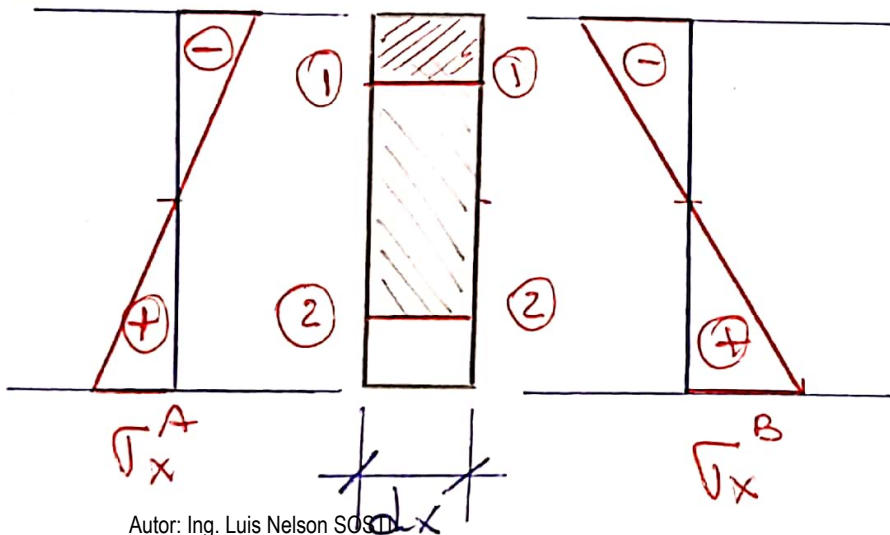




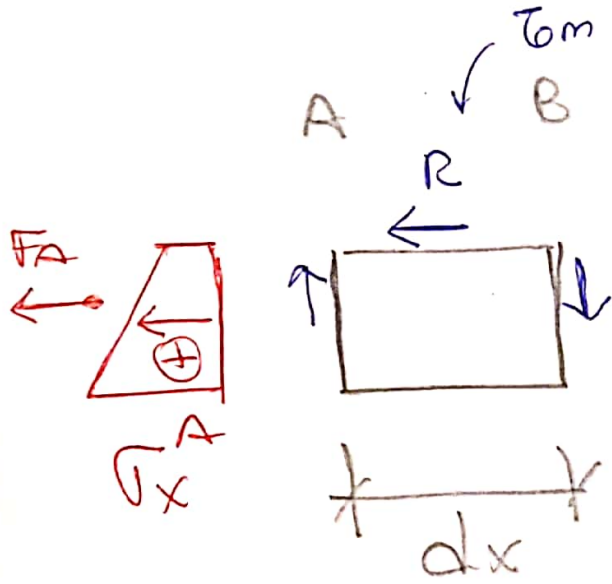
$M_B > M_A \rightarrow V_x^B > V_x^A$



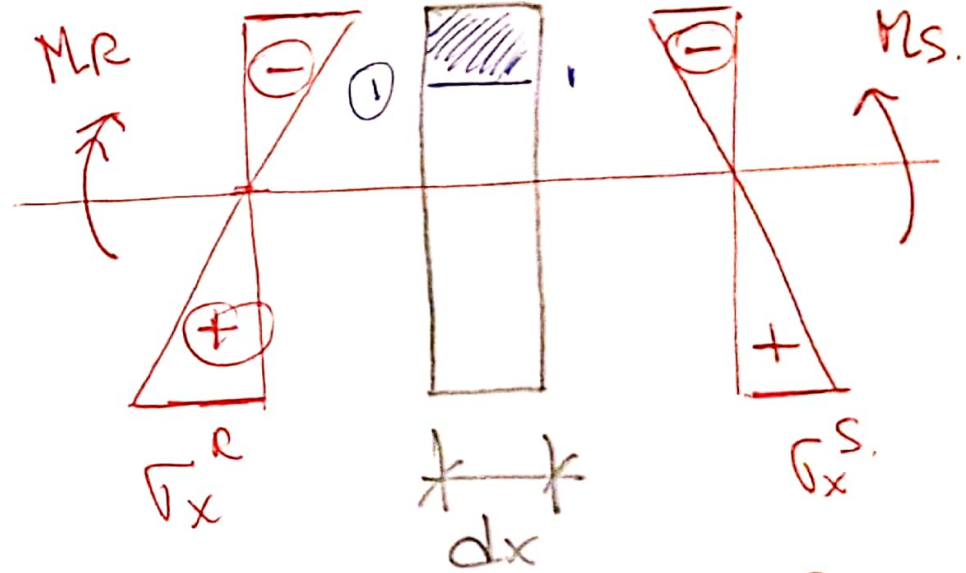
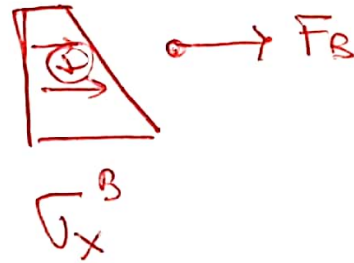
CARA (-) → A B ← CARA (+)



CORTEZ 2-2: → PARTE INFERIOR

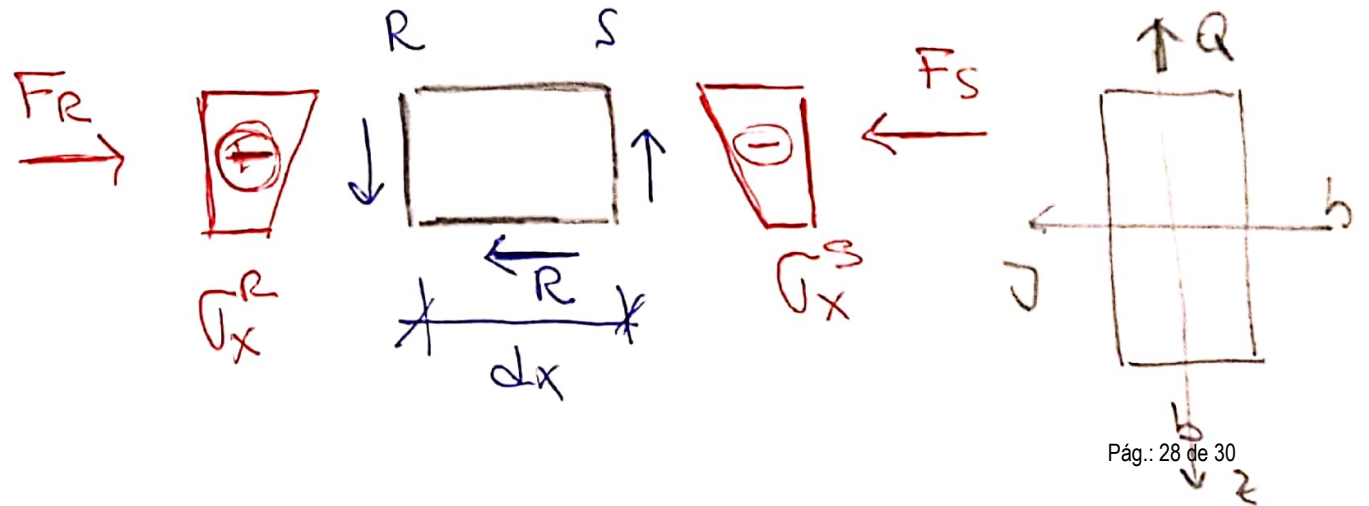


$F_B > F_A$

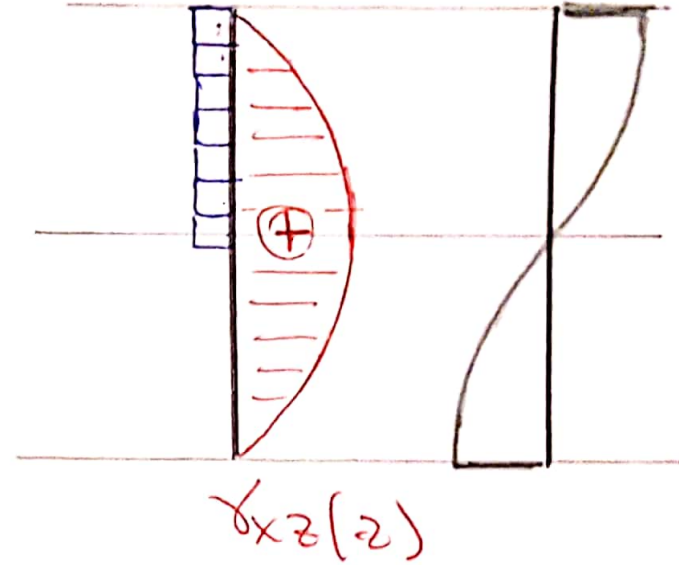
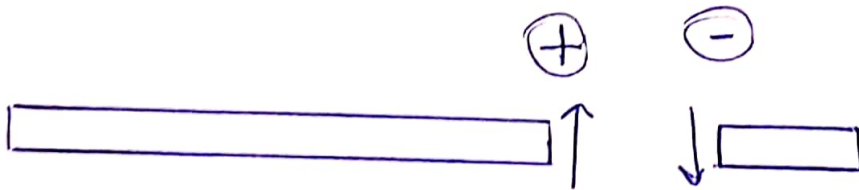
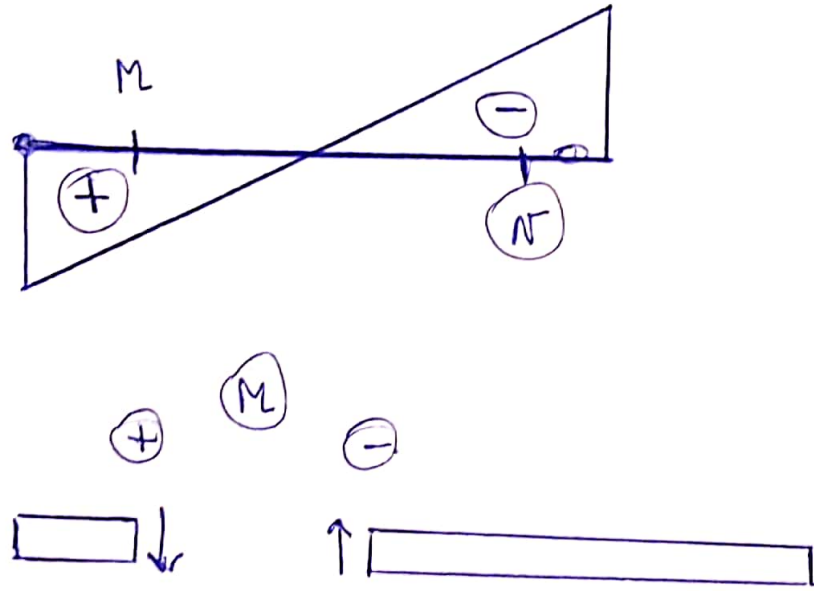


$M_R > M_S \rightarrow \sigma_x^R > \sigma_x^S$

CORTEZ 1-1



$F_R > F_S$



$\sigma_{x2}(z)$

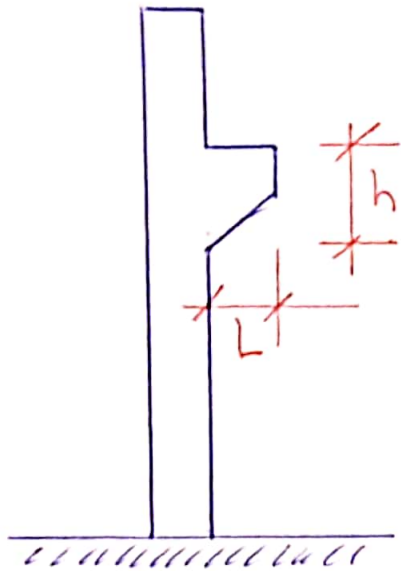
$\frac{\sigma_{x2}(z)}{\epsilon} = \gamma_{xz}(z)$

ALABRO DE LA SECCION

$\sigma_x = \frac{M}{I_y} \cdot z$

BARRAS ESBUERTAS $\frac{L}{d} \geq 10$.

→ LAS DEFORMACIONES POR CURV. SON DEFORMACIONES



$$L \approx h$$

MENSULA
CONTA

