(1)

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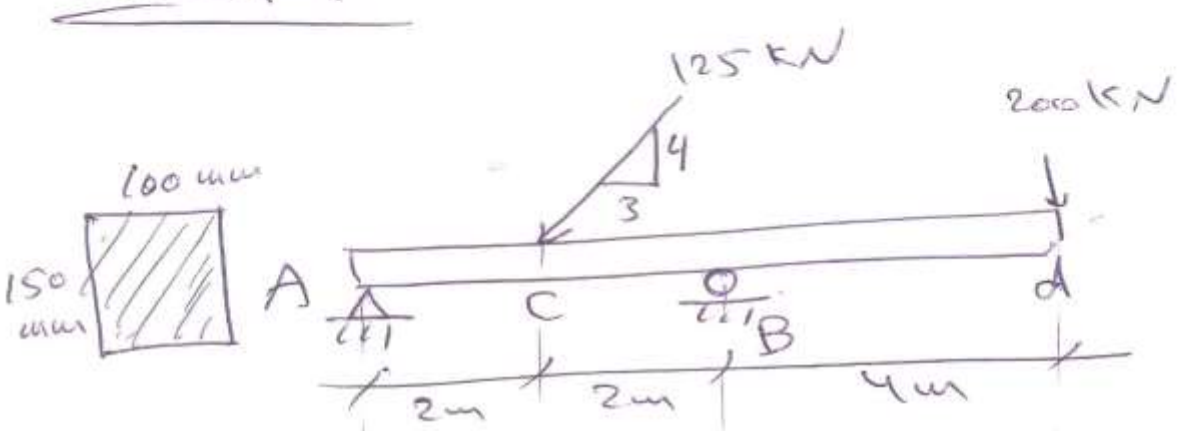
Example

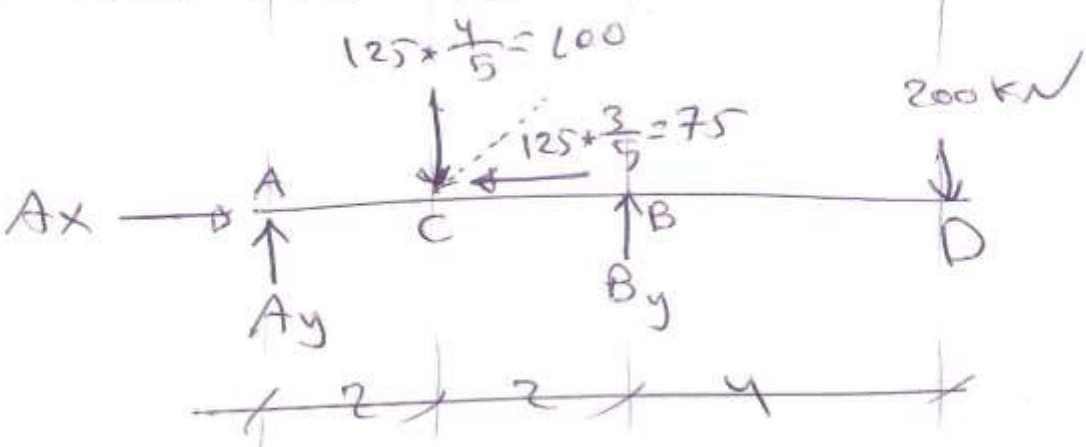


(1) Draw Axial force, shear force, Bending Moment diagrams

(2) Find Normal Stresses @ A, B, C, D if the cross section of Beam 100×150 mm

Solution :-

(1) Find Ax, Ay, By ; Reactions



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(2)

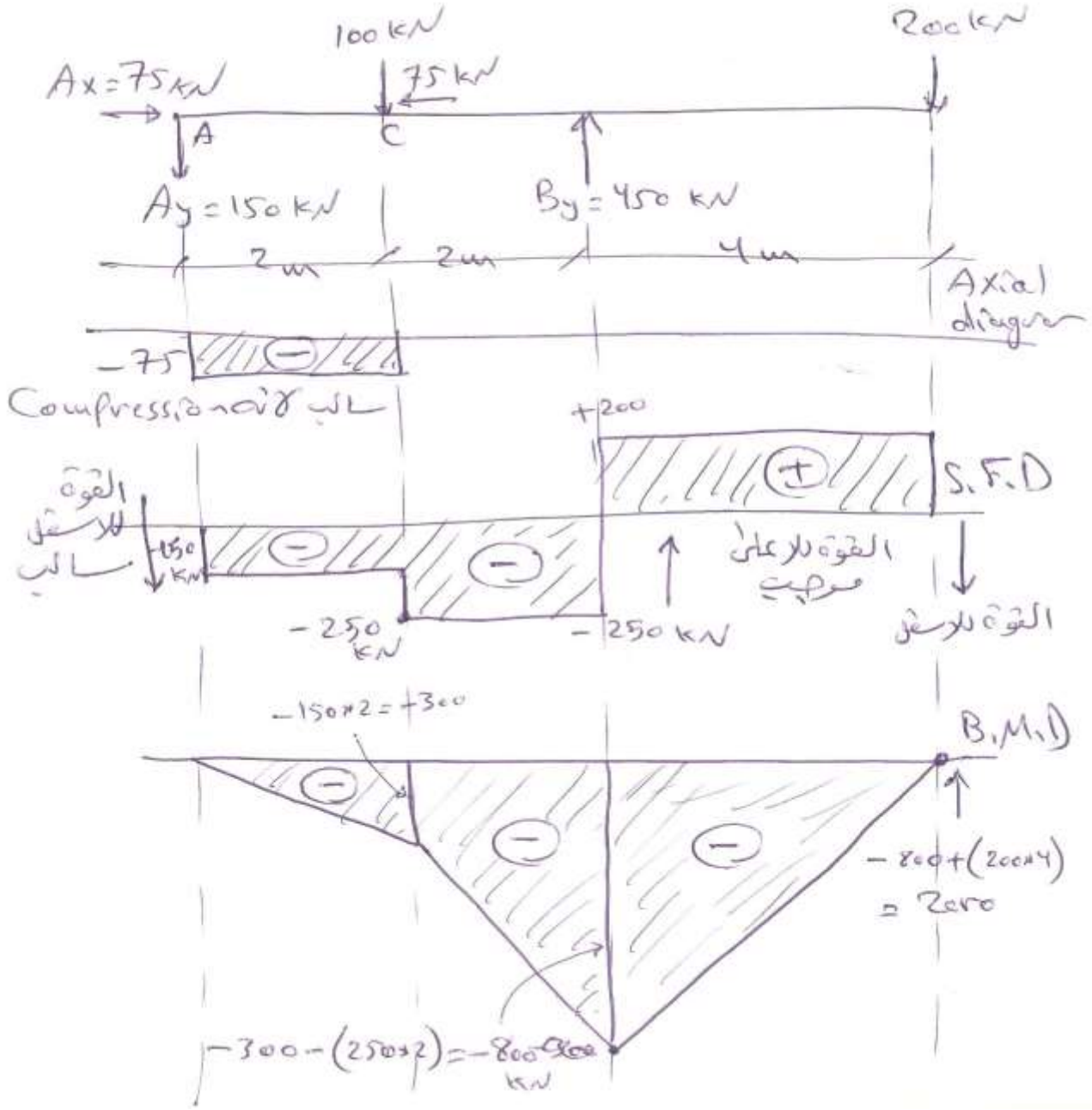
$+\rightarrow \sum F_x = 0 \Rightarrow A_x = 75\ kN \rightarrow$

$+\circlearrowleft \sum M_A = 0 \Rightarrow 100*2 - B_y*4 + 200*8 = 0$

$\therefore B_y = 450\ kN \uparrow$

$+\uparrow \sum F_y = 0 \Rightarrow A_y - 100 + 450 - 200 = 0$

$\therefore A_y = 150\ kN \downarrow$



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(3)

لايجاد ال Normal stresses لكل نقطة فيجب ان نوجدها على جانبي كل نقطة ما عدا بداية ال Beam ونهاية ال Beam المتعرض لقوة عمودية على المقطع.

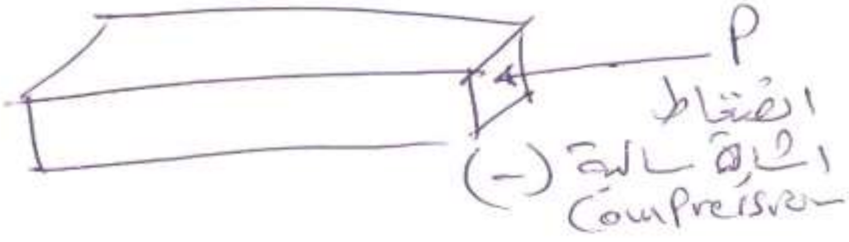
اي ان كل نقطة يخرج σ_{Right} & σ_{Left} (سكما)

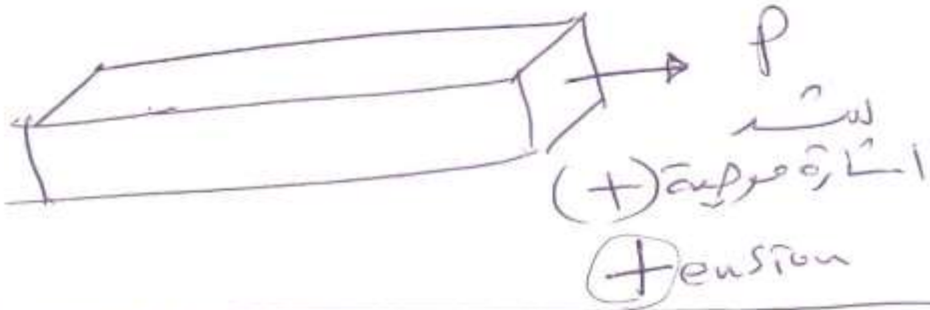
قانون ال Normal stress هو

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

حيث P = مقدار القوة العمودية على ال Cross section

A = مساحة ال Cross section





ملاحظة: انظر الرسم ال (Axial diagram) تجد الجزء AC هو يحتوي على قوة عمودية على المقطع.

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(4)

$$\sigma_{A\,Right} = -\frac{75 * 1000\ N}{100\ mm * 150\ mm} = 5\ N/mm^2 = 5\ MPa$$

1000 * نضرب N الى KN تحويل من

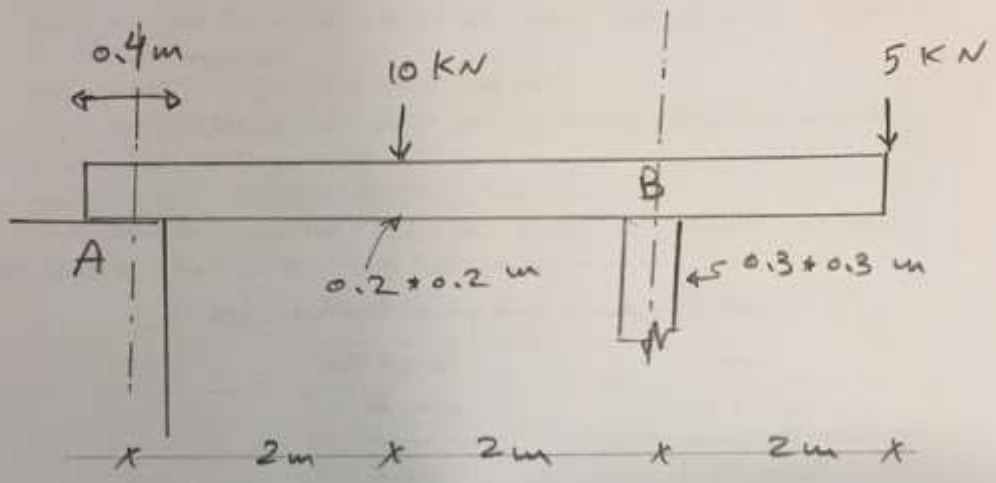
$$\sigma_{C\,left} = -\frac{75 * 1000\ N}{100\ mm * 150\ m} = 5\ MPa$$

وتسمى ميكا باسكال
Mega Pascal

$$1\ \frac{N}{mm^2} = 1\ MPa$$

$$\sigma_{C\,Right} = \frac{Zero}{100\ mm * 150\ mm} = Zero\ N/mm^2$$

(1) A beam is loaded as shown in the Figure below. Determine the bearing stress at A and B.



$+\circlearrowright \Sigma M \text{ at } A = 0$

$10 * 2 - By * 4 + 5 * 6 = 0 \Longrightarrow By = 12.5 \text{ KN} \uparrow$

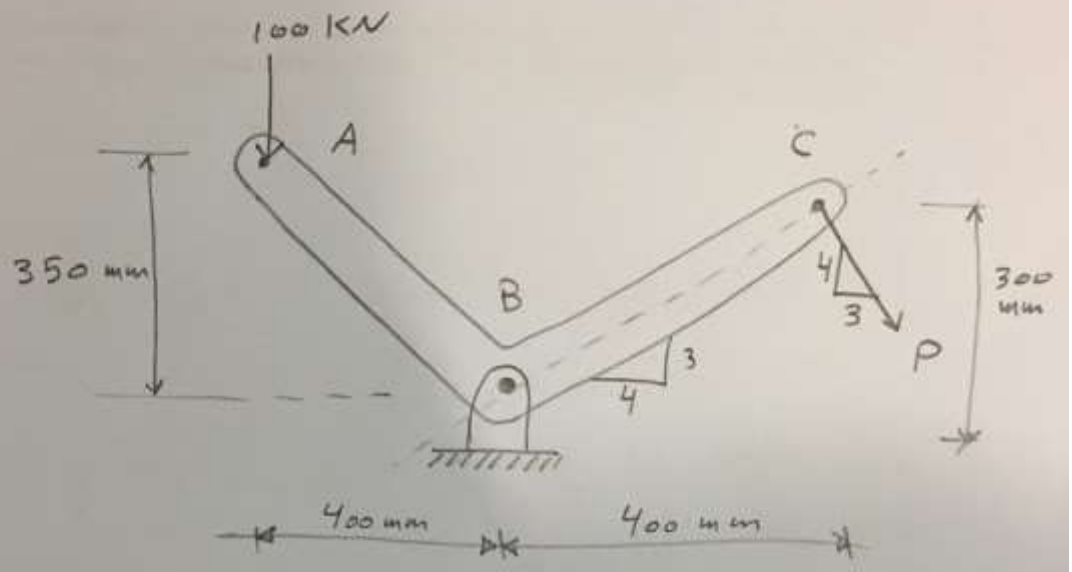
$+\uparrow \Sigma F_y = 0$

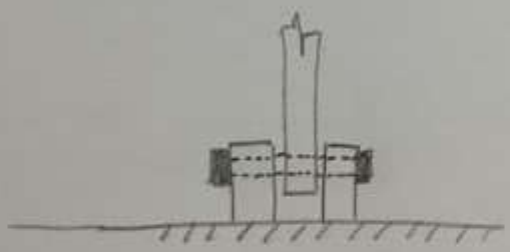
$Ay - 10 + 12.5 - 5 = 0 \Longrightarrow Ay = 2.5 \text{ KN} \uparrow$

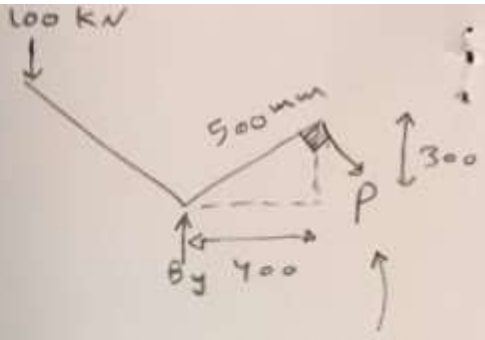
$$\text{Bearing stress at } A = \frac{2.5 * 10^3}{400 * 200} = 0.03125 \text{ MPa}$$

$$\text{Bearing stress at } B = \frac{12.5 * 10^3}{200 * 300} = 0.208 \text{ MPa}$$

Q The Mechanism shown in the Figure below is in equilibrium. Determine the shearing stress at the Pin B if its diameter is 50 mm.







القوة P عمودية على الذراع BC

$\therefore (2) +\circlearrowleft \Sigma M_B = 0$

$P(500) - 100 * 400 = 0$

$P = 80 \text{ kN}$

$+\uparrow \Sigma F_y = 0$

$B_y - 100 - 80\left(\frac{4}{5}\right) = 0$

$B_y = 164 \text{ kN} \uparrow$

$\pm\rightarrow \Sigma F_x = 0$

$80 * \left(\frac{3}{5}\right) - B_x = 0 \Longrightarrow B_x = 48 \text{ kN}$

∴ محصلة القوة في B هي :

$B = \sqrt{48^2 + 164^2} = 170.88 \text{ kN}$

$\therefore \text{shearing stress at Pin} = \frac{170.88 * 10^3}{\frac{\pi}{4}(50)^2} = 87 \text{ MPa}$

$\text{shearing stress at bolt} = \frac{87}{2} = 43.5 \text{ MPa}$