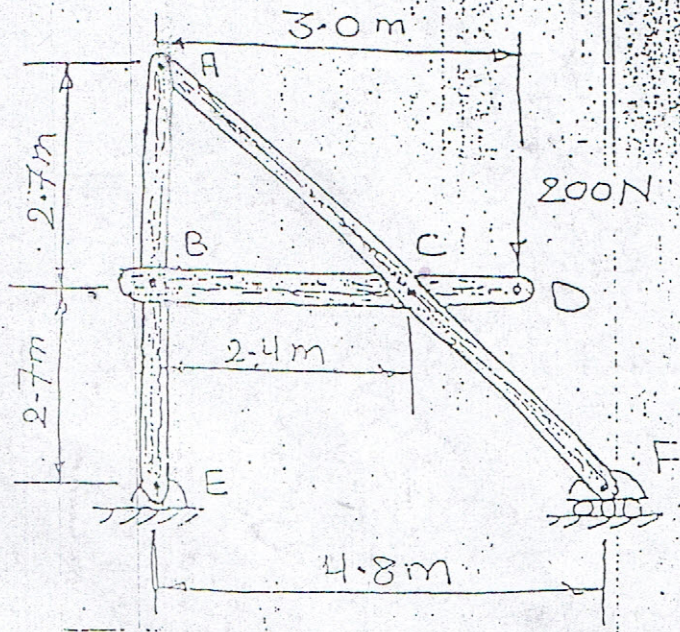
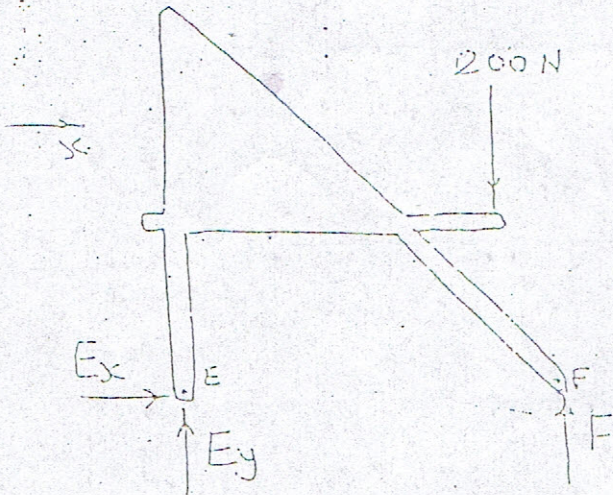


Determine the components of the forces acting on each member of the frame shown in figure. Solution:- (F.B.D)



From (F.B.D) :

$$\sum F_x = 0 \Rightarrow \boxed{E_x = 0}$$

$$\sum M_E = 0 \quad (+)$$

$$F \times 4.8 - 200 \times 3 = 0 \Rightarrow \boxed{F = 125 \text{ N}}$$

$$\sum F_y = 0, \quad E_y + F - 200 = 0 \Rightarrow \boxed{E_y = 75 \text{ N}}$$

الفرام بتجزئته الى اجزائها
 لتسهيل حساب بقية الاجزاء

Member BCD

$$\sum M_B = 0 \quad (+)$$

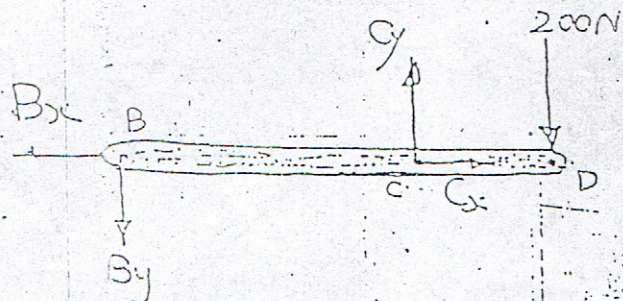
$$C_y \times 2.4 - 200 \times 3 = 0$$

$$\Rightarrow \boxed{C_y = 250 \text{ N}}$$

$$\sum F_y = 0 \quad \bar{C}_y - 200 - B_y = 0$$

250

$$\Rightarrow \boxed{B_y = 50 \text{ N}}$$



Member ACF

$$\sum M_A = 0 \quad (+)$$

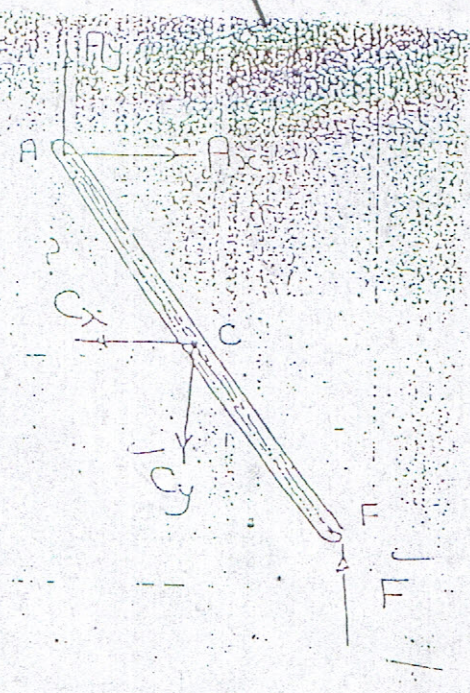
$$F \times 4.8 - C_y \times 2.4 - C_x \times 1.7 = 0$$

$$\Rightarrow C_x = 0$$

$$\sum F_x = 0 \Rightarrow A_x = 0$$

$$\sum F_y = 0$$

$$A_y + F - C_y = 0 \Rightarrow A_y = 125 \text{ N}$$



Return to member BCD

$$\sum F_x = 0 \Rightarrow B_x = 0$$

الآن انتهي حل السؤال

ولكن كما نرى من الحل اننا نحتاج الى التوازن

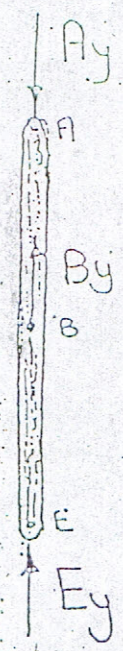
member ABE

$$\sum F_y = 0$$

$$E_y + B_y - A_y = 0$$

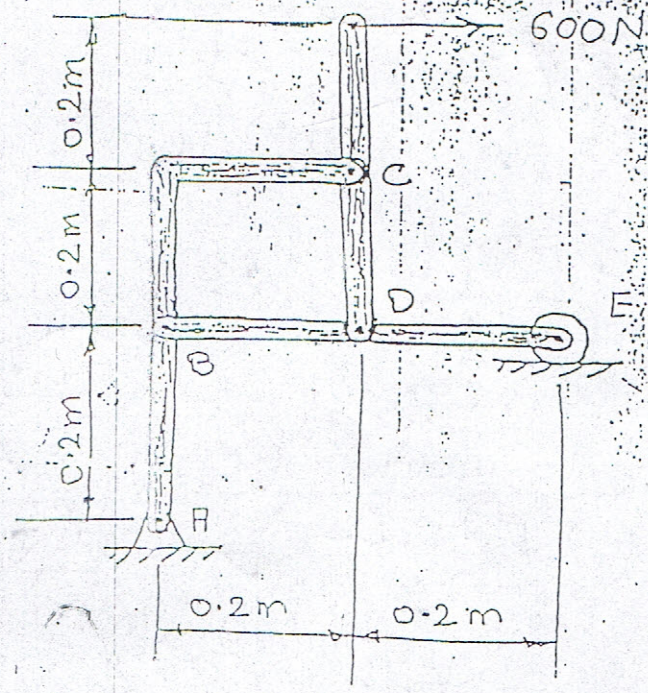
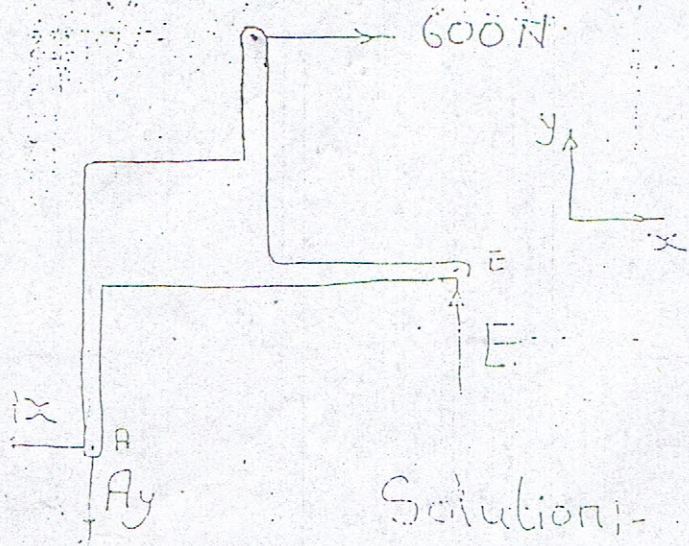
$$75 + 50 - 125 = 0$$

$$125 - 125 = 0 \quad \text{O.K.}$$



Determine the forces supported by the pins at C, B & D for the loaded frame shown in figure.

(F.B.D)



Solution:-

From (F.B.D)

$$\sum M_A = 0 \quad (+) \quad E \times 0.4 - 600 \times 0.6 = 0 \Rightarrow E = 900 \text{ N}$$

$$F_x = 0 \quad 600 - A_x = 0 \Rightarrow A_x = 600 \text{ N}$$

$$F_y = 0 \quad E - A_y = 0 \Rightarrow A_y = 900 \text{ N}$$

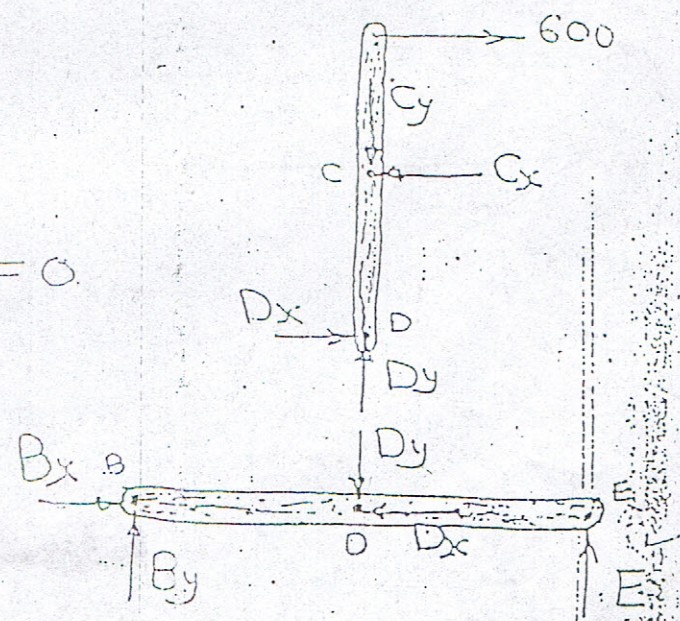
تقسیم به اجزای
مختلف در راستای

member BDE

$$\sum M_B = 0 \quad E \times 0.4 - D_y \times 0.2 = 0 \Rightarrow D_y = 1800 \text{ N}$$

$$\sum F_y = 0$$

$$B_y + E - D_y = 0 \Rightarrow B_y = 900 \text{ N}$$



بسیار

Member CD

$$\sum M_c = 0 \Rightarrow D_x \times 0.2 - 600 \times 0.2 = 0$$

$$\Rightarrow \boxed{D_x = 600 \text{ N}}$$

$$\sum F_x = 0 \Rightarrow D_x + 600 - C_x = 0 \Rightarrow \boxed{C_x = 1200 \text{ N}}$$

$$\sum F_y = 0 \Rightarrow D_y - C_y = 0 \Rightarrow \boxed{C_y = 1800 \text{ N}}$$

Return to member BDE

$$\sum F_x = 0 \Rightarrow B_x - D_x = 0 \Rightarrow \boxed{B_x = 600 \text{ N}}$$

الى هنا انتهى حل السؤال
وللتأكد من صحة الحل ندرس توازن الضلع :-

Member ABC

$$\sum F_x = 0$$

$$C_x - B_x - A_x = 0$$

$$1200 - 600 - 600 = 0 \quad \text{O.K.}$$

$$\sum F_y = 0$$

$$C_y - B_y - A_y = 0$$

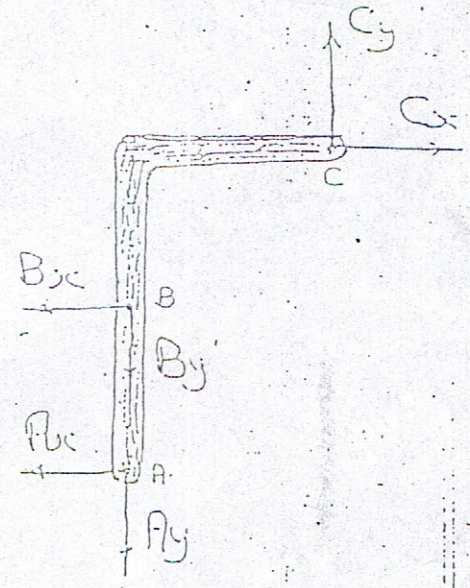
$$1800 - 900 - 900 = 0 \Rightarrow 1800 - 1800 = 0 \quad \text{O.K.}$$

$$\sum M_B = 0 \quad (+)$$

$$C_y \times 0.2 - C_x \times 0.2 - A_x \times 0.2 = 0$$

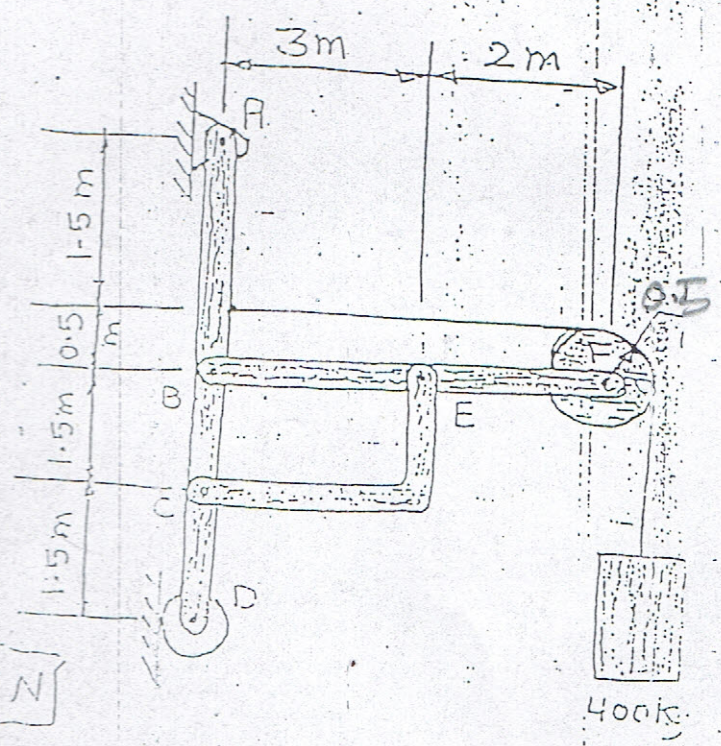
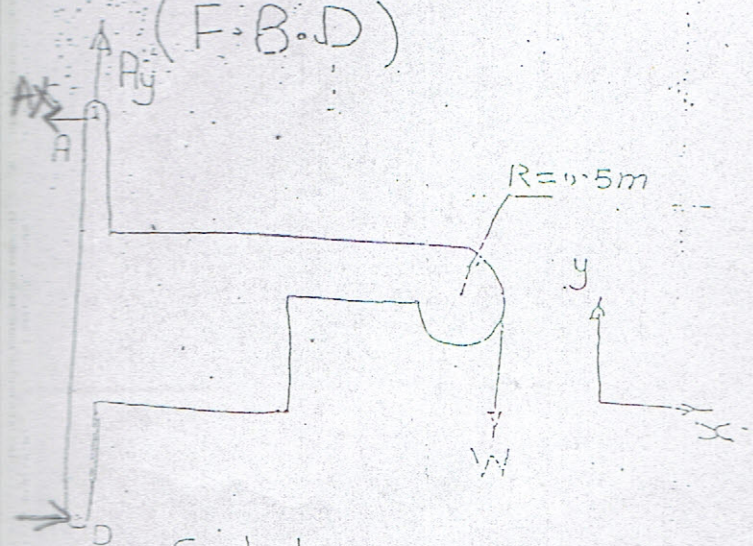
$$1800 \times 0.2 - 1200 \times 0.2 - 600 \times 0.2 = 0$$

$$360 - 240 - 120 = 0 \Rightarrow 360 - 360 = 0 \quad \text{O.K.}$$



suspended load of (400 kg). Determine the components of forces acting on each member of the frame.

(F.B.D)



Solution:-

$$W = m \times g = 400 \times 9.81 \Rightarrow W = 3924 \text{ N}$$

From (F.B.D)

$$\sum M_A = 0 \quad (+)$$

(لاحظ نضرب قطر البكرة !)

$$D \times 5 - W \times 5.5 = 0 \Rightarrow D = 4316.4 \text{ N}$$

✓
✓
✓

$$\sum F_x = 0$$

$$D - A_x = 0 \Rightarrow A_x = 4316.4 \text{ N}$$

$$\sum F_y = 0$$

$$A_y - W = 0 \Rightarrow A_y = 3924 \text{ N}$$

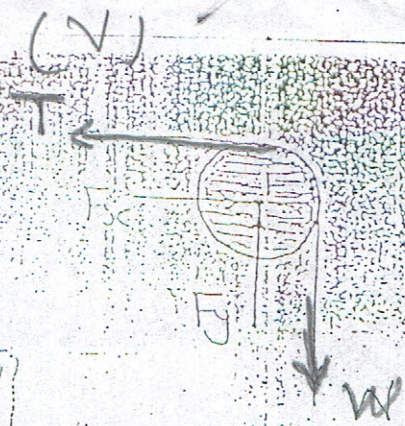
الآن نضع بكثرتنا ال frame الى اقلع ونقوم بدراسة اقلع

يسبق

Pulley F

$$T = W = 3924 \text{ N}$$

الشد متساوي على
جانبي البكرة



$$\sum F_x = 0, F_x - T = 0 \Rightarrow$$

$$F_x = 3924 \text{ N}$$

$$\sum F_y = 0, F_y - W = 0 \Rightarrow$$

$$F_y = 3924 \text{ N}$$

Member BEF

$$\sum M_B = 0 \quad (+)$$

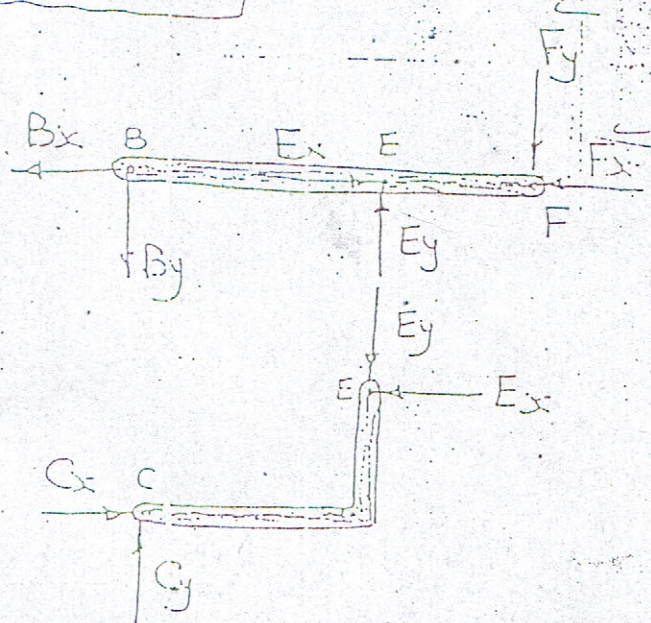
$$E_y \times 3 - F_y \times 5 = 0$$

$$\Rightarrow E_y = 6540 \text{ N}$$

$$\sum F_y = 0$$

$$E_y - F_y - B_y = 0$$

$$\Rightarrow B_y = 2616 \text{ N}$$



Member CE

$$\sum M_C = 0 \quad (+)$$

$$E_x \times 1.5 - E_y \times 3 = 0 \Rightarrow$$

$$E_x = 13080 \text{ N}$$

$$\sum F_x = 0, C_x - E_x = 0 \Rightarrow$$

$$C_x = 13080 \text{ N}$$

$$\sum F_y = 0, C_y - E_y = 0 \Rightarrow$$

$$C_y = 6540 \text{ N}$$

Return to member BEF

$$\sum F_x = 0, E_x - F_x - B_x = 0 \Rightarrow$$

$$B_x = 9156 \text{ N}$$

منبع

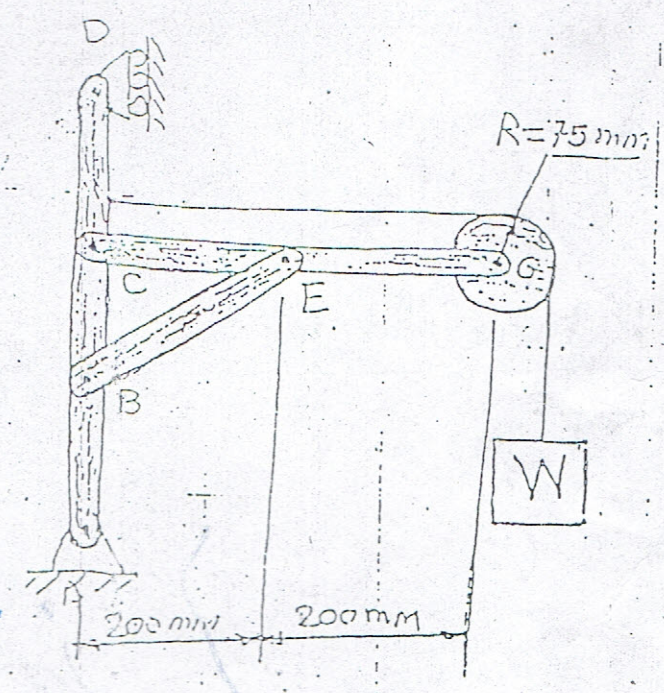
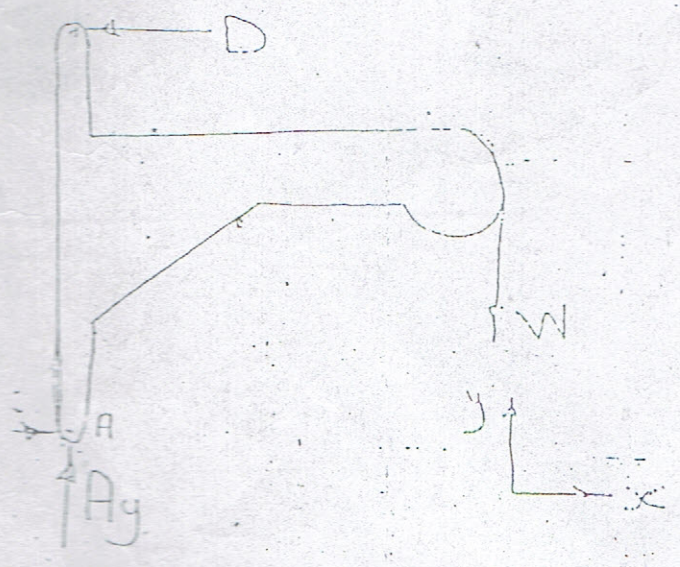
الى بقول الشد متساوي على جانبي البكرة

$$174.6 - 13734 - 7848 + 15107.4 = 0 \Rightarrow 21582 - 21582 = 0 \quad \circ \cdot \kappa$$

EX ⑥

الدور الثاني / 1999 - 1991

The frame shown in figure supports a suspended weight ($W = 180\text{N}$). Determine the forces on members ABCD and CEG. (F.B.D)



(8)

From (P.B.D)

$\sum M_A = 0 \text{ (+)}$ $D \times 0.45 - W \times 0.475 = 0 \Rightarrow D = 190 \text{ N}$

$\sum F_x = 0$ $A_x - D = 0 \Rightarrow A_x = 190 \text{ N}$

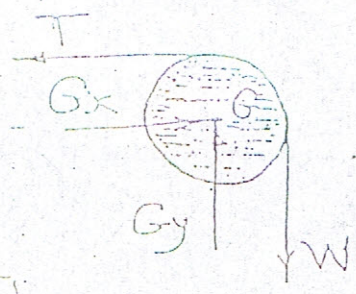
$\sum F_y = 0$ $A_y - W = 0 \Rightarrow A_y = 180 \text{ N}$

الآن نسوم بتجزئة ال frame الى اجزاء ونسوم بدورها
انزاتها

pulley G

$T = W = 180 \text{ N}$

الشدة على جانبي
البكرة متساوية



$\sum F_x = 0$ $G_x - T = 0 \Rightarrow G_x = 180 \text{ N}$

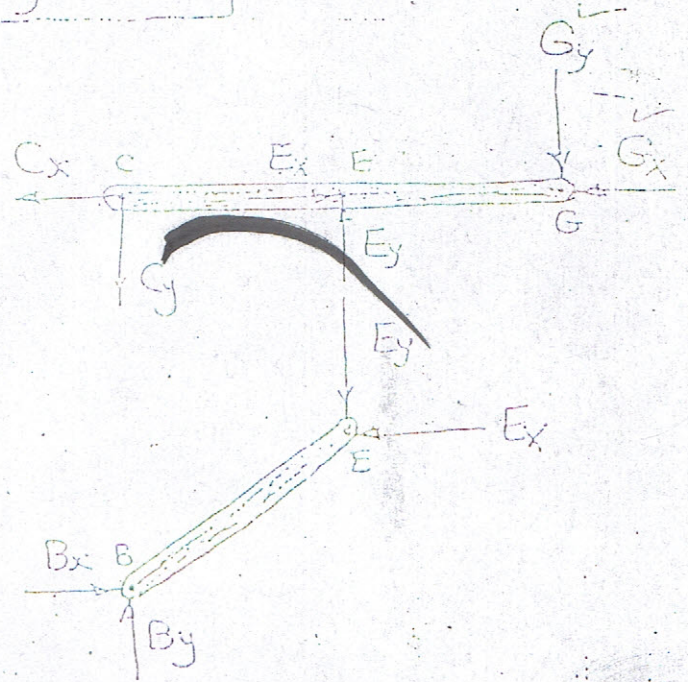
$\sum F_y = 0$ $G_y - W = 0 \Rightarrow G_y = 180 \text{ N}$

Member CEG

$\sum M_c = 0 \text{ (+)}$

$E_y \times 0.2 - G_y \times 0.4 = 0 \Rightarrow E_y = 360 \text{ N}$

$\sum F_y = 0$ $E_y - G_y - C_y = 0 \Rightarrow C_y = 180 \text{ N}$



Member BE

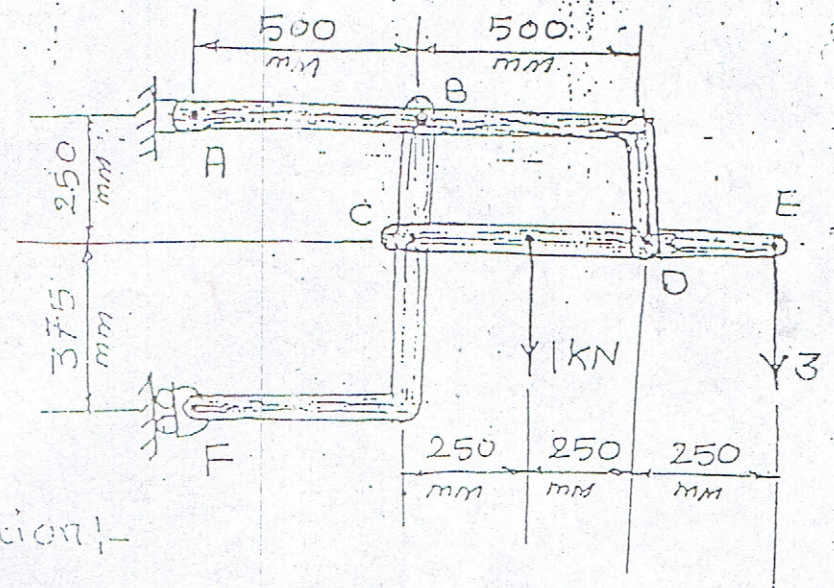
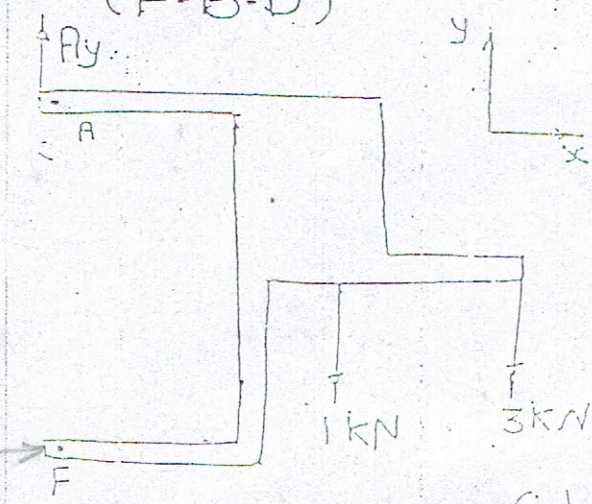
$\sum M_B = 0$ $E_x \times 0.15 - E_y \times 0.2 = 0 \Rightarrow E_x = 480 \text{ N}$

$\sum F_x = 0$ $B_x - E_x = 0 \Rightarrow B_x = 480 \text{ N}$

$\sum F_y = 0$ $B_y - E_y = 0 \Rightarrow B_y = 360 \text{ N}$

or the frame shown in figure determine all forces acting on member ABD.

(F.B.D)



Solution:-

From (F.B.D)

$$\sum M_A = 0 \quad (+)$$

$$F \times 0.625 - 1 \times 0.75 - 3 \times 1.25 = 0 \Rightarrow \boxed{F = 7.2 \text{ kN}}$$

$$\sum F_x = 0 \Rightarrow F - A_x = 0 \Rightarrow \boxed{A_x = 7.2 \text{ kN}}$$

$$\sum F_y = 0 \Rightarrow A_y - 1 - 3 = 0 \Rightarrow \boxed{A_y = 4 \text{ kN}}$$

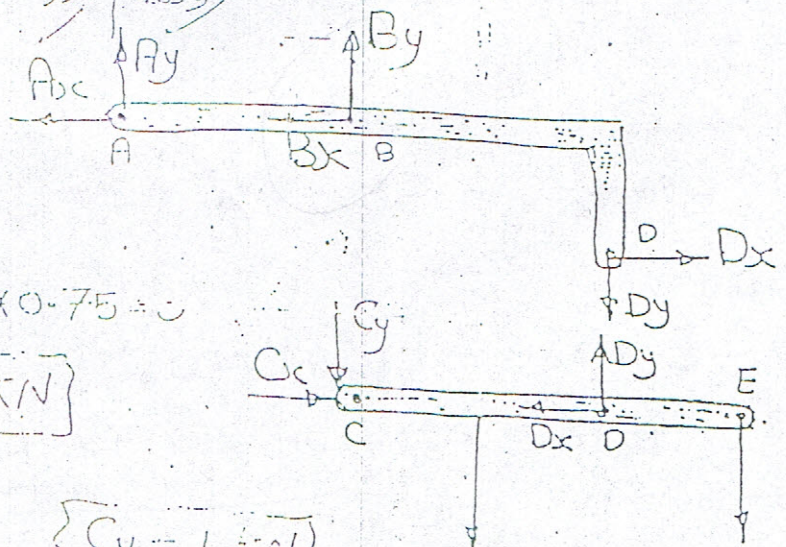
الآن ننتقل إلى مقطع المبر CDE
ونفس الدراسة التوازنية!

member CDE

$$\sum M_C = 0 \quad (+)$$

$$D_y \times 0.5 - 1 \times 0.25 - 3 \times 0.75 = 0 \Rightarrow \boxed{D_y = 5 \text{ kN}}$$

$$\sum F_y = 0 \Rightarrow D_y - 3 - 1 - C_y = 0 \Rightarrow \boxed{C_y = 1 \text{ kN}}$$



Member ABD

(4)

$$\sum M_B = 0 \quad \begin{matrix} 5 \\ 4 \end{matrix}$$

$$D_x \times 0.25 - D_y \times 0.5 - A_y \times 0.5 = 0 \Rightarrow \boxed{D_x = 18 \text{ kN}}$$

$$\sum F_x = 0$$

$\therefore \boxed{C_x = D_x}$ ردود
ظاح
(CDE)

$$D_x - A_x - B_x = 0 \Rightarrow \boxed{B_x = 10.8 \text{ kN}}$$

$$\sum F_y = 0$$

$$B_y + A_y - D_y = 0 \Rightarrow \boxed{B_y = 1 \text{ kN}}$$

الى هنا انتهى حل السؤال
وللتأكد من صحة الحل نطبق شروط الاتزان على C

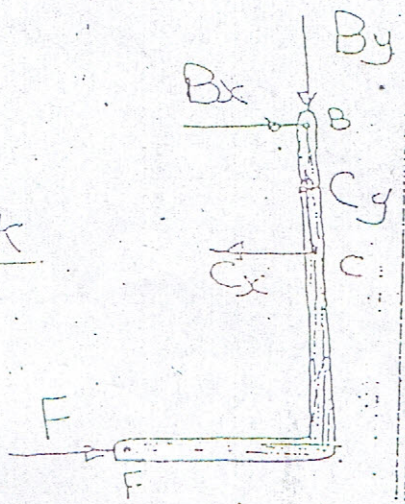
Member BCF

$$\sum F_x = 0 \quad \begin{matrix} 18 \\ 70.8 \\ 72 \end{matrix} \quad C_x - B_x - F = 0 \Rightarrow$$

$$8 - 10.8 - 7.2 = 0 \Rightarrow 18 - 18 = 0 \quad \underline{0 \text{ k}}$$

$$\sum F_y = 0 \quad C_y - B_y = 0$$

$$\Rightarrow 1 - 1 = 0 \quad \underline{0 \text{ k}}$$



$$\sum M_C = 0 \quad (+)$$

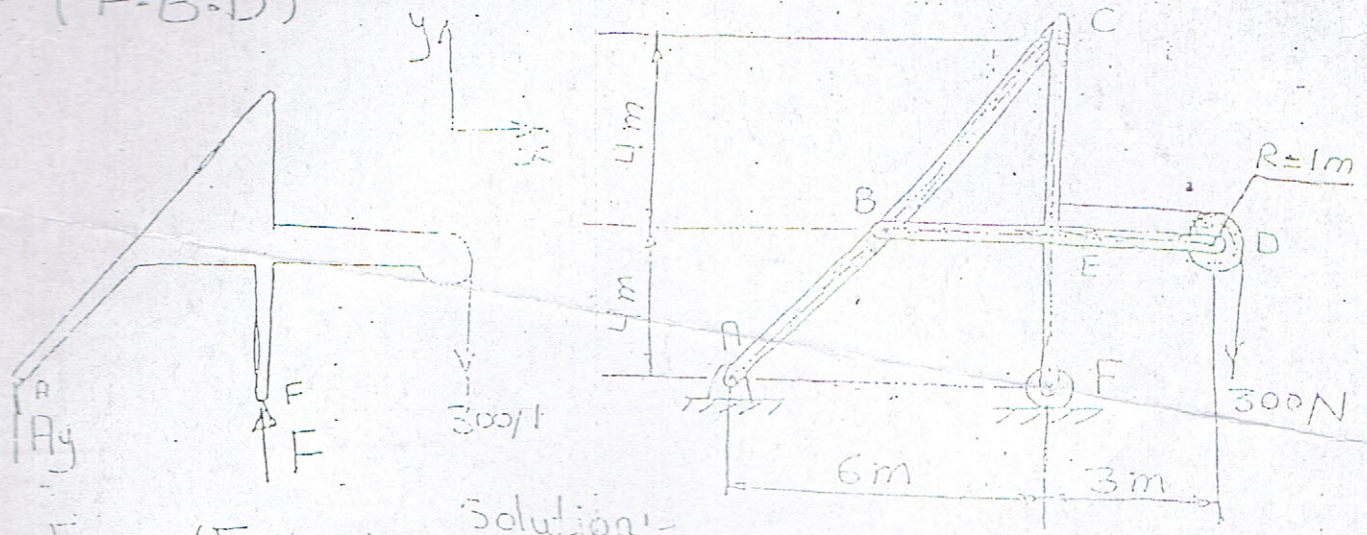
$$F \times 0.375 - B_x \times 0.25 = 0 \Rightarrow 72 \times 0.375 - 10.8 \times 0.25 = 0$$

$$\Rightarrow 2.7 - 2.7 = 0 \quad \underline{0 \text{ k}}$$



Ex 7) Determine the horizontal and vertical components of forces in all the pins for the frame shown in figure

(F.B.D)



Solution:-

From (F.B.D)

$$\begin{aligned} \sum M_A = 0 \text{ (clockwise)} & \Rightarrow F \times 6 - 300 \times 10 = 0 \Rightarrow \boxed{F = 500 \text{ N}} \\ \sum F_y = 0 & \Rightarrow F - 300 - A_y = 0 \Rightarrow \boxed{A_y = 200 \text{ N}} \\ \sum F_x = 0 & \Rightarrow \boxed{A_x = 0} \end{aligned}$$

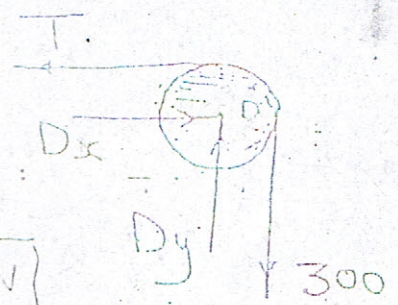
الآن ندرس تجزئة الـ Pulley في الخواص ونقسم بدلالة

التوازن

Pulley D

$$\boxed{T = 300 \text{ N}}$$

التوتر في الحبل
يساوي القوة المطبقة



$$\sum F_x = 0 \Rightarrow D_x - T = 0 \Rightarrow \boxed{D_x = 300 \text{ N}}$$

$$\sum F_y = 0 \Rightarrow D_y - 300 = 0 \Rightarrow \boxed{D_y = 300 \text{ N}}$$

لدينا

MEMBER BED

1) $\sum M_B = 0$ (+)

$E_y \times 3 - D_y \times 6 = 0$



$\Rightarrow E_y = 600 \text{ N}$

2) $\sum F_y = 0$ $\Rightarrow E_y - D_y - B_y = 0$

$\Rightarrow B_y = 300 \text{ N}$

Member CEF

3) $\sum M_C = 0$ (+)

$F \times 3 - E_x \times 4 = 0$

$\Rightarrow E_x = 225 \text{ N}$

$\sum F_x = 0$

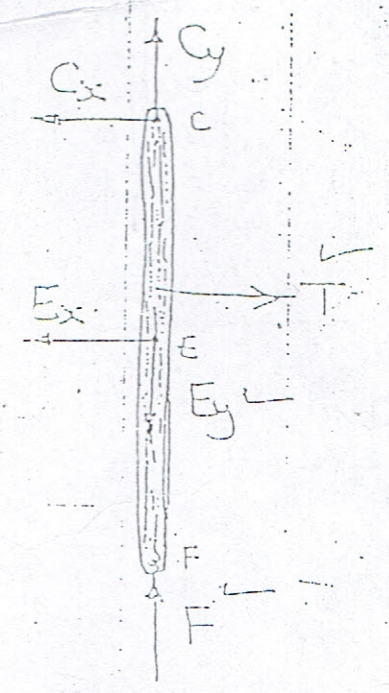
$F - E_x - C_x = 0$

$\Rightarrow C_x = 75 \text{ N}$

$\sum F_y = 0$

$F + F - E_y = 0$

$\Rightarrow C_y = 100 \text{ N}$



Return to member BED

$\sum F_x = 0 \Rightarrow B_x + E_x - D_x = 0$

$\Rightarrow B_x = 75 \text{ N}$

النتيجة النهائية هي: $B_x = 75 \text{ N}$, $B_y = 300 \text{ N}$, $C_x = 75 \text{ N}$, $C_y = 100 \text{ N}$, $E_x = 225 \text{ N}$, $E_y = 600 \text{ N}$, $D_x = 225 \text{ N}$, $D_y = 600 \text{ N}$.

Member ABC

$\sum F_x = 0 \Rightarrow C_x - B_x = 0 \Rightarrow 75 - 75 = 0$ o.k.

$\sum F_y = 0 \Rightarrow B_y - D_y - C_y = 0$

$300 - 200 - 100 = 0$

$300 - 300 = 0$ o.k.

