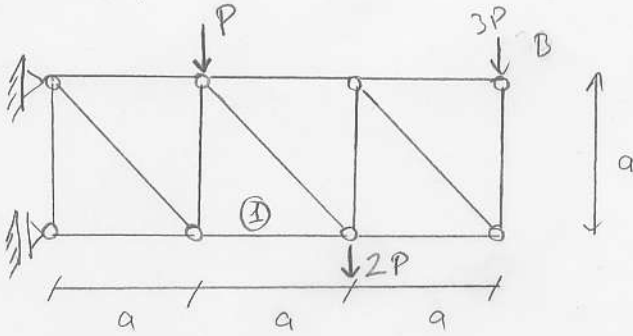


Statik 2. Vize Sınavı

Prof. Dr. İbrahim Bakırtaş

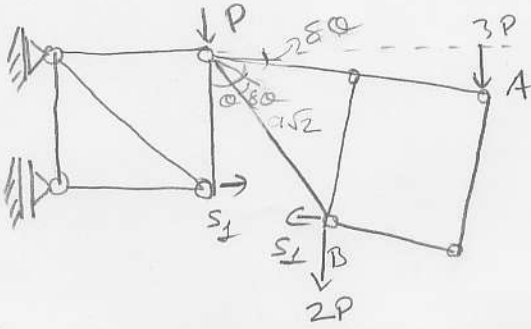
10.05.06

Soru 1.



Şekildeki kafes sisteminde
① numaralı çubuk kuvvetini hesaplayınız.
(Virtüel iş yöntemi ile)

S_1 çubuğunu kaldırıp bu halde olan sisteme bir virtüel yer değiştirme verelim.



$$x_B = a\sqrt{2} \cdot \sin \theta$$

$$y_B = a\sqrt{2} \cdot \cos \theta$$

$$\delta x_B = -a\sqrt{2} \cos \theta \delta \theta$$

$$\delta y_B = -a\sqrt{2} \sin \theta \delta \theta$$

$$\delta y_A = 2a \delta \theta$$

$$1 - \delta \theta = \delta \theta$$

$$\Rightarrow \delta y_A = 2a \delta \theta$$

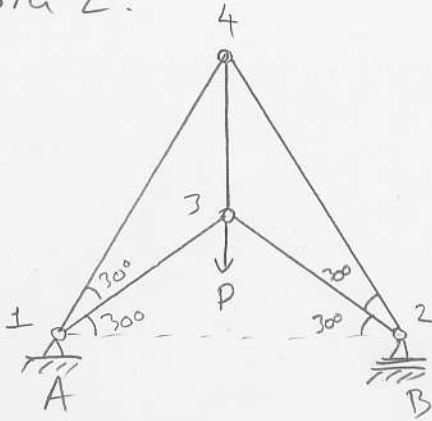
$\Rightarrow$ Dış kuvvetlerin işini 0'a eşitlersek $\Rightarrow$

$$3P \cdot 2a \delta \theta + 2P \cdot a\sqrt{2} \sin \theta \delta \theta + S_1 \cdot a\sqrt{2} \cos \theta \delta \theta = 0$$

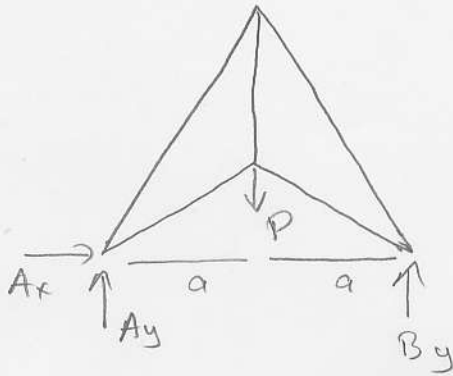
$$-P(6 + 2\sqrt{2} \sin \theta) = S_1 \cdot \sqrt{2} \cos \theta \Rightarrow$$

$$S_1 = \frac{-P(6 + 2\sqrt{2} \sin \theta)}{\sqrt{2} \cos \theta} = \frac{-P(6 + 2\sqrt{2} \cdot \frac{\sqrt{2}}{2})}{\sqrt{2} \cdot \frac{\sqrt{2}}{2}} = \frac{-P(6 + 2)}{1} = -8P //$$

Soru 2.



Şekildeki kafes sistemin
aşağı kuvvetlerini bulunuz.



$$\sum M_A = 0 \Rightarrow$$

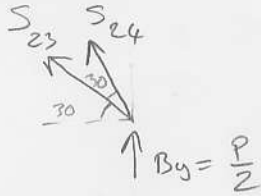
$$P \cdot a - B_y \cdot 2a = 0 \Rightarrow B_y = \frac{P}{2}$$

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

$$\sum F_y = 0 \Rightarrow A_y + B_y - P = 0$$

$$A_y + \frac{P}{2} - P = 0 \Rightarrow A_y = \frac{P}{2}$$

B noktasında denge denklemleri yazılırsa



$$\sum F_x = 0 \Rightarrow -S_{23} \cdot \cos 30 - S_{24} \cdot \cos 60 = 0$$

$$S_{23} \frac{\sqrt{3}}{2} + \frac{S_{24}}{2} = 0$$

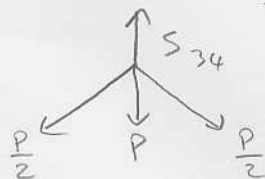
$$\sum F_y = 0 \Rightarrow S_{24} \cdot \sin 60 + S_{23} \cdot \sin 30 + \frac{P}{2} = 0$$

$$S_{24} \cdot \frac{\sqrt{3}}{2} + \frac{S_{23}}{2} + \frac{P}{2} = 0$$

$$\frac{S_{23}}{2} - \frac{3}{2} S_{23} + \frac{P}{2} = 0 \Rightarrow S_{23} = \frac{P}{2} \Rightarrow S_{24} = -\frac{P\sqrt{3}}{2} //$$

$$\text{Sinetriden } S_{13} = P/2 \quad S_{14} = -P\sqrt{3}/2 //$$

Ortogonalda

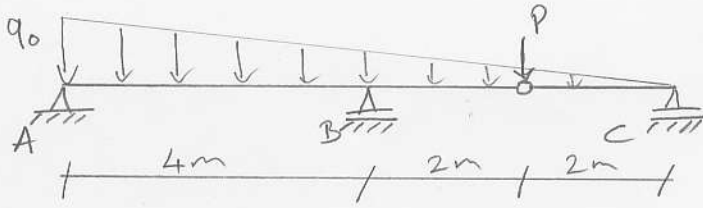


$$\sum F_y = 0 \Rightarrow$$

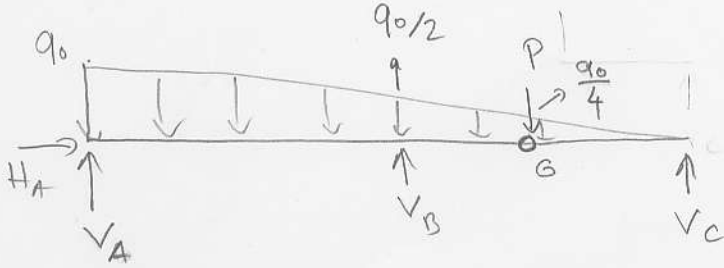
$$S_{34} - P - 2 \frac{P}{2} \cdot \cos 60 = 0 \Rightarrow$$

$$S_{34} - P - \frac{P}{2} = 0 \Rightarrow S_{34} = 3P/2$$

Soru 3,



Şekildeki Gerber kirişinin dayanak tepkilerini bulunuz.



$$\uparrow \sum M_G = 0 \Rightarrow \frac{q_0 \cdot 4}{2} \cdot \frac{2}{3} - V_C \cdot 2 = 0 \Rightarrow V_C = \frac{q_0}{3} //$$

$$\uparrow \sum M_A = 0 \Rightarrow q_0 \cdot \frac{8}{2} \cdot \frac{8}{3} - V_B \cdot 4 - V_C \cdot 8 + P \cdot 6 = 0 \Rightarrow$$

$$q_0 \cdot \frac{32}{3} - 4V_B - \frac{q_0}{3} \cdot 8 + P \cdot 6 = 0 \Rightarrow 6P + \frac{30q_0}{3} = 4V_B$$

$$\Rightarrow V_B = \frac{3}{2}P + \frac{15}{6}q_0 //$$

$$\uparrow \sum F_y = 0 \Rightarrow V_A + V_B + V_C - P - q_0 \cdot 8 = 0 \Rightarrow$$

$$V_A + \frac{3P}{2} + \frac{15}{6}q_0 + \frac{q_0}{3} - P - q_0 \cdot 4 = 0$$

$$V_A = \frac{17}{12}q_0 - \frac{P}{2} //$$

$$\sum F_x = 0 \Rightarrow H_A = 0 //$$

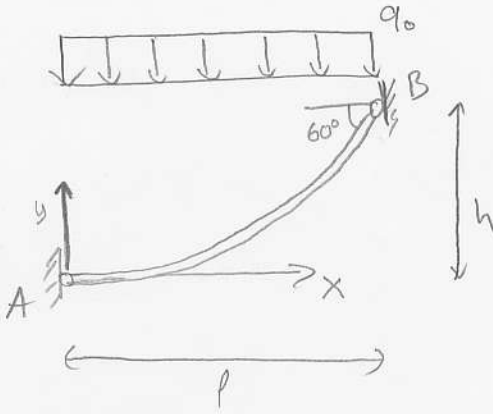
$$\text{Kontrol } \uparrow \sum M_B = 0 \Rightarrow -\frac{q_0 \cdot 4}{2} \cdot 3 - \frac{3q_0}{4} \cdot \frac{2}{3} \cdot 6$$

$$+ \left(\frac{17}{12}q_0 - \frac{P}{2} \right) \cdot 6 + \left(\frac{3P}{2} + \frac{15}{6}q_0 \right) \cdot 2 \stackrel{?}{=} 0$$

$$-\frac{18}{4}q_0 - \frac{36}{4}q_0 + \frac{17}{2}q_0 + \frac{15}{3}q_0 \stackrel{?}{=} 0$$

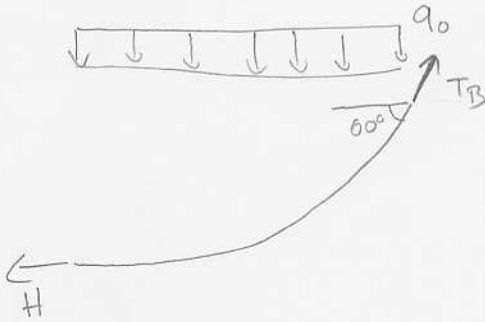
$$-\frac{54}{4}q_0 + \frac{34+20}{4}q_0 = 0 \quad \checkmark$$

Soru 4.



Yatayda düzgen yayılı yük etkisindeki kabloların denklemini ve A ucu ile B ucundaki kablo kuvvetlerini bulunuz.

(A'da kablo yatay)



$$\sum M_B = 0 \Rightarrow$$

$$H \cdot h - q_0 \cdot l \cdot \frac{l}{2} = 0 \Rightarrow H = \frac{q_0 l^2}{2h}$$

$$T_B \cdot \cos 60 = H = \frac{q_0 l^2}{2h} \Rightarrow T_B = \frac{q_0 l^2}{h}$$

$$\sum F_y = 0 \Rightarrow T_B \cdot \sin 60 - q_0 \cdot l = 0 \Rightarrow T_B = \frac{q_0 \cdot l \cdot 2}{\sqrt{3}}$$

$$\Rightarrow \frac{q_0 \cdot l \cdot 2}{\sqrt{3}} = \frac{q_0 l^2}{h} \Rightarrow \boxed{h = \frac{\sqrt{3} l}{2}}$$

$$y'' = \frac{q_0}{H} \Rightarrow H = \frac{q_0 l^2 \cdot 2}{2 \sqrt{3} l} = \frac{q_0 \cdot l}{\sqrt{3}}$$

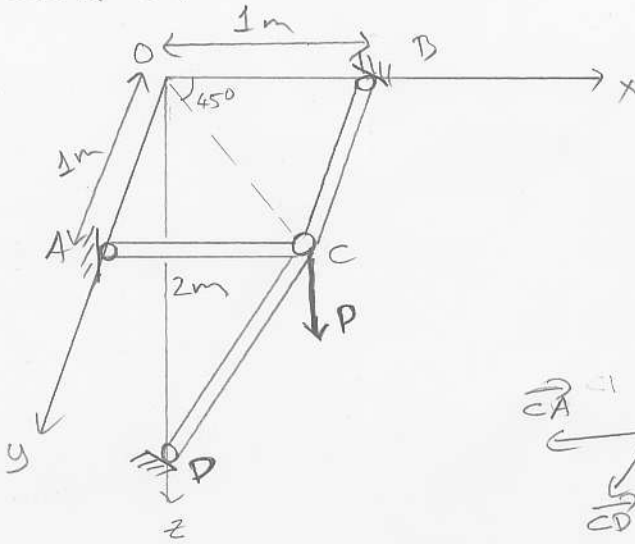
$$\Rightarrow y'' = \frac{q_0 \sqrt{3}}{q_0 \cdot l} \Rightarrow y' = \frac{x \sqrt{3}}{l} + A \quad y = \frac{x^2 \sqrt{3}}{2l} + Ax + B$$

$$y(x=0) = 0 \Rightarrow B = 0 \quad y(x=l) = h = \frac{\sqrt{3} l}{2} \Rightarrow$$

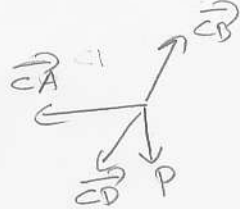
$$\frac{\sqrt{3} l}{2} = \frac{l^2 \sqrt{3}}{2l} + A l \Rightarrow A = 0 \Rightarrow$$

$$\boxed{y = \frac{x^2 \sqrt{3}}{2l}}$$

Soru 5.



Şekildeki 03 çubuktan oluşan taşıyıcı sistemin CA, CB, CD çubuk kuvvetlerini bulunuz.



$$\vec{CA} = -CA\vec{i}$$

$$\vec{CB} = -CB\vec{j}$$

$$\vec{r}_{CD} = -\vec{i} - \vec{j} + 2\vec{k} \Rightarrow \vec{\lambda}_{CD}$$

CD çubuğundaki
kuvvetin
vektörü

(CD doğrultusundaki birim vektör)

$$\vec{\lambda}_{CD} = \frac{\vec{r}_{CD}}{|\vec{r}_{CD}|} = \frac{-\vec{i} - \vec{j} + 2\vec{k}}{\sqrt{1^2 + 1^2 + 4}} = \frac{-\vec{i} - \vec{j} + 2\vec{k}}{\sqrt{6}}$$

$$= -0,4\vec{i} - 0,4\vec{j} + 0,8\vec{k}$$

$$\vec{CD} = CD(-0,4\vec{i} - 0,4\vec{j} + 0,8\vec{k})$$

Düseyde denge yazarsak, sadece CD kuvvetinin $\vec{k}$ birim vektör yönündeki kuvveti denklemden yer alır; dolayısıyla

$$\sum F_z = 0 \Rightarrow \sum F_z = 0 \Rightarrow$$

$$+0,8CD + P = 0 \Rightarrow CD = -\frac{P}{0,8} = -1,25P$$

$$\sum F_y = 0 \Rightarrow -CB + 1,25P \cdot 0,4 = 0 \Rightarrow CB = 1,25 \cdot 0,4P$$

$$CB = 0,5P$$

$$\text{Simetriden } CA = CB = 0,5P$$