

1) Za ravn prikazan na slici odrediti reakcije oslonaca i nacrtati statičke dijagrame. Dato je: $a, F, q = \frac{2F}{a}$

Uslovi ravnoteže

$\sum F_x = 0; \quad X_B = 0$

$\sum F_y = 0;$

$F + R_A - F - F + R_B - Fq = 0$

$Fq = q \cdot \frac{3a}{2} = \frac{2F}{a} \cdot \frac{3a}{2} = 3F$

$R_A + R_B = 4F$

$\sum M_G^l = 0;$

$F \cdot 3a + R_A \cdot 2a - Fq \cdot \frac{1}{3} \cdot 3a = 0$

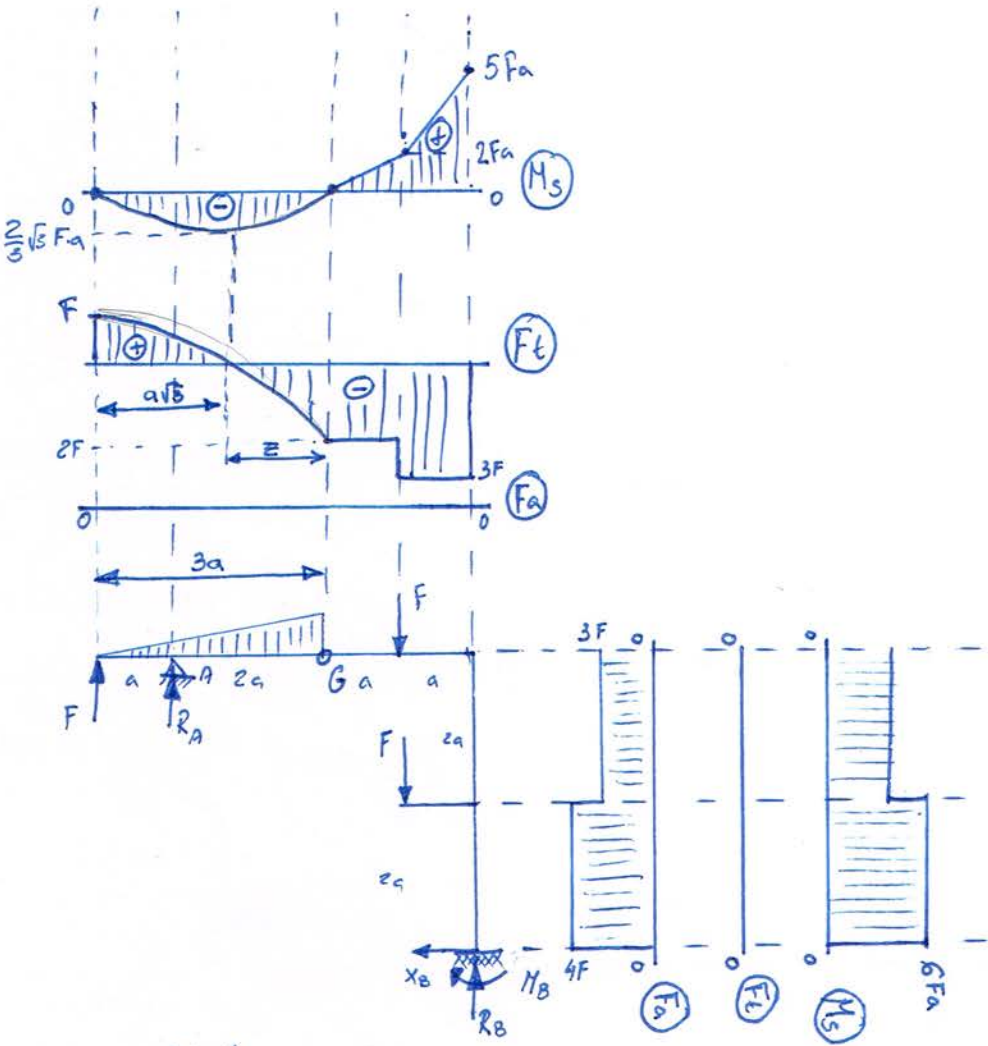
$3Fa + 2Ra \cdot a - 3Fa = 0$

$R_A = 0; \quad R_B = 4F$

$\sum M_G^d = 0;$

$R_B \cdot 2a - F \cdot a - Fa - M_B = 0$

$M_B = 6Fa$



* analitički izraz za transverzalan silu za proizvoljni poprečni presjek određeni koordinatom z:

$F_t(z) = F - \frac{3a-z}{2} \cdot 2z; \quad \frac{z}{2} = \frac{3a-z}{3a}$

$F_t(z) = F - \frac{(3a-z)^2}{3a^2} \cdot F; \quad z = \frac{3a-z}{3a^2} \cdot 2F$

$F_t(z) = 0; \quad F - \frac{(3a-z)^2}{3a^2} \cdot F = 0$

$(3a-z)^2 = 3a^2$

$z = 3a \pm \sqrt{3}a; \quad z = 3a - \sqrt{3} \cdot a$

* moment savijanja u poprečnom presjeku određenoj koordinatom z:

$M_s = Fa\sqrt{3} - Fq \cdot \frac{1}{3} \cdot a\sqrt{3} = ; \quad Fq = \frac{a\sqrt{3}}{2} \cdot q'$

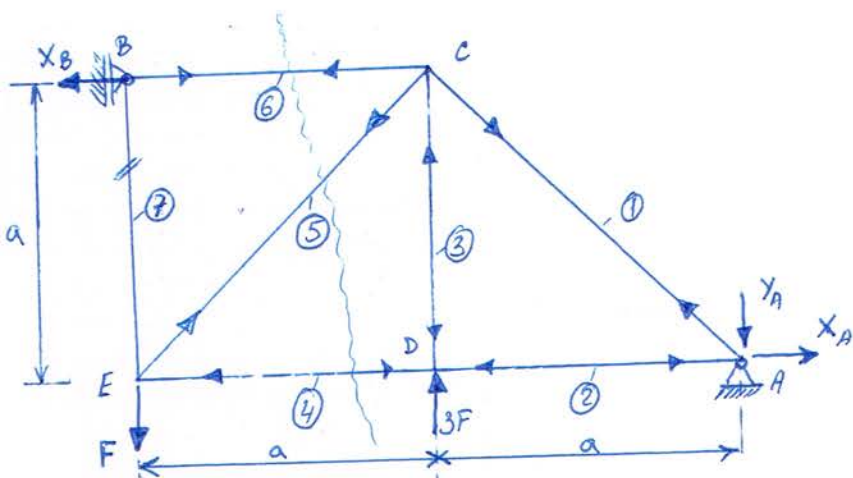
$= Fa\sqrt{3} - \frac{a\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{3a} \cdot 2F \cdot \frac{a\sqrt{3}}{3} =$

$= Fa\sqrt{3} - \frac{Fa\sqrt{3}}{3}$

$M_s = \frac{2}{3} \sqrt{3} \cdot Fa$

$\frac{z'}{2} = \frac{a\sqrt{3}}{3a}$
 $z' = \frac{a\sqrt{3}}{3a} \cdot \frac{2F}{a}$

2) Za rešetku prikazanu na slici, odrediti reakcije u osloncima.
 Odrediti intenzitet i karakter sila u štapovima: a) metodom čvora
 b) krovninom met.
 c) Riterovom metodom



$$(1) \sum M_A = 0;$$

$$3F \cdot a - F \cdot 2a - X_B \cdot a = 0$$

$$\boxed{X_B = F}$$

$$(2) \sum F_x = 0;$$

$$X_B - X_A = 0$$

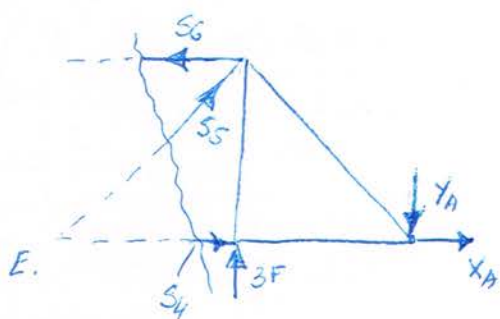
$$\boxed{X_A = F}$$

$$(3) \sum F_y = 0;$$

$$3F - F - Y_A = 0$$

$$\boxed{Y_A = 2F}$$

c) Riterova metoda - metoda preseka



$$\sum F_y = 0; -Y_A + S_5 \cdot \frac{\sqrt{2}}{2} + 3F = 0$$

$$\boxed{S_5 = F\sqrt{2}}$$

$$\sum M_E = 0; S_6 \cdot a - Y_A \cdot 2a + 3F \cdot a = 0$$

$$\boxed{S_6 = F}$$

$$\sum F_x = 0; -S_6 + S_4 + S_5 \cdot \frac{\sqrt{2}}{2} + X_A = 0$$

$$\boxed{S_4 = F}$$

a) Čvor A:



$$\sum F_x = 0; X_A + S_2 - S_1 \cdot \cos 45^\circ = 0$$

$$S_2 - S_1 \cdot \frac{\sqrt{2}}{2} = -F$$

$$\sum F_y = 0; S_1 \cdot \sin 45^\circ - Y_A = 0$$

$$S_1 \cdot \frac{\sqrt{2}}{2} = 2F$$

$$\boxed{S_1 = 2F\sqrt{2}} \text{ - istezanje}$$

$$\boxed{S_2 = F} \text{ - pritisak}$$

Čvor E:

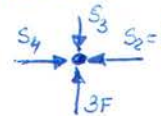


$$\sum F_y = 0;$$

$$S_3 \cdot \cos 45^\circ - F = 0$$

$$\boxed{S_3 = F\sqrt{2}} \text{ - istezanje}$$

Čvor D:



$$\sum F_x = 0; S_4 - S_3 = 0$$

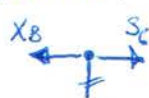
$$\boxed{S_4 = F} \text{ - pritisak}$$

$$\sum F_y = 0;$$

$$-S_3 + 3F = 0$$

$$\boxed{S_3 = 3F} \text{ - pritisak}$$

Čvor B:



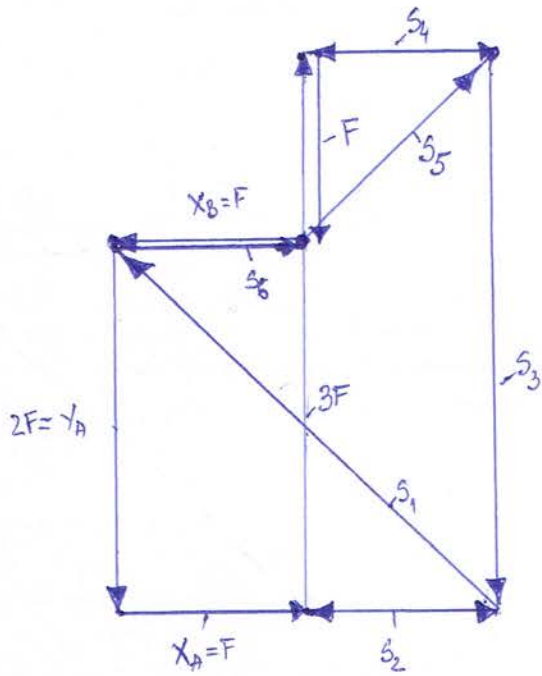
$$\sum F_y = 0; \boxed{S_7 = 0}$$

$$\sum F_x = 0; \boxed{X_B = S_6}$$

$$\boxed{S_6 = F} \text{ - istezanje}$$

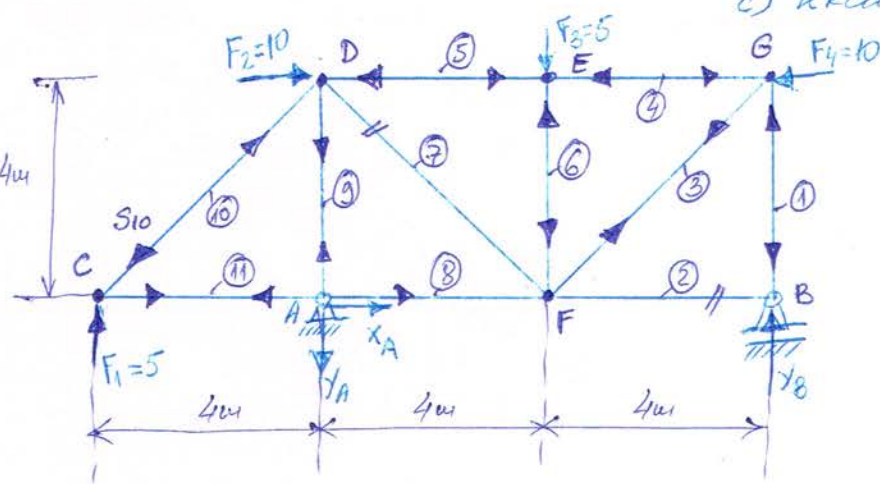
b) Krawonina metoda

$|F| = 2,5 \text{ cm}$



- $S_1 = 2F\sqrt{2}$ - istezanje
- $S_2 = F$ - pritisk
- $S_3 = 3F$ - pritisk
- $S_4 = F$ - pritisk
- $S_5 = F\sqrt{2}$ - istezanje
- $S_6 = F$ - istezanje
- $S_7 = 0$

3) Za rešetkasti nosač prikazan na slici, odrediti reakcije u oštrocima
 Naći sile u štapovima: a) metodom čvora
 b) Riterovom metodom
 c) kremoninom metodom



$$\sum M_A = 0;$$

$$Y_B \cdot 8 - 5 \cdot 4 - 5 \cdot 4 + 10 \cdot 4 - 10 \cdot 4 = 0$$

$$Y_B = 5 \text{ kN}$$

$$\sum F_y = 0;$$

$$Y_B - Y_A + 5 - 5 = 0$$

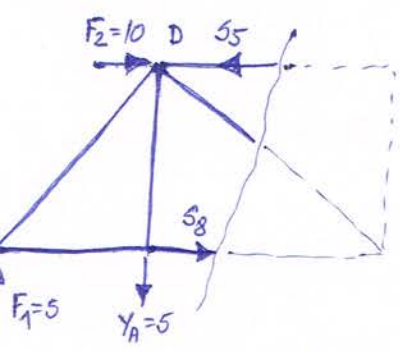
$$Y_B = Y_A; Y_A = 5 \text{ kN}$$

$$\sum F_x = 0;$$

$$X_A - 10 + 10 = 0$$

$$X_A = 0$$

b) Riterova metoda



$$\sum F_y = 0; F_1 - Y_A + S_7 \cdot \cos 45^\circ = 0$$

$$S_7 = 0$$

$$\sum M_B = 0; 5 \cdot 4 - S_8 \cdot 4 = 0$$

$$S_8 = 5$$

$$\sum F_x = 0;$$

$$F_2 + S_8 - S_5 = 0$$

$$S_5 = 15$$

čvor E:

$$\sum F_x = 0;$$

$$S_5 - S_4 = 0$$

$$S_4 = 15 \text{ - pritisk}$$

$$\sum F_y = 0;$$

$$S_8 - F_3 = 0$$

$$S_8 = 5 \text{ - pritisk}$$

čvor B:

$$\sum F_x = 0$$

$$S_2 = 0$$

$$\sum F_y = 0;$$

$$-S_1 + Y_B = 0$$

$$S_1 = 5 \text{ - pritisk}$$

čvor G:

$$\sum F_y = 0$$

$$S_1 - S_3 \frac{\sqrt{2}}{2} = 0$$

$$S_3 = 5\sqrt{2} \text{ - istezanje}$$

a)

čvor C:

$$\sum F_y = 0;$$

$$F - S_{10} \cdot \cos 45^\circ = 0$$

$$S_{10} = F\sqrt{2}$$

$$S_{10} = 5\sqrt{2} \text{ - pritisk}$$

$$\sum F_x = 0;$$

$$S_{11} - S_{10} \cdot \cos 45^\circ = 0$$

$$S_{11} = 5 \text{ - istezanje}$$

čvor A:

$$\sum F_y = 0; S_9 - Y_A = 0$$

$$S_9 = 5 \text{ - istezanje}$$

$$\sum F_x = 0; S_8 - S_{11} = 0$$

$$S_8 = 5 \text{ - istezanje}$$

čvor D:

$$\sum F_y = 0;$$

$$S_{10} \cdot \frac{\sqrt{2}}{2} - S_9 + S_7 \frac{\sqrt{2}}{2} = 0$$

$$5 - 5 + S_7 \frac{\sqrt{2}}{2} = 0$$

$$S_7 = 0$$

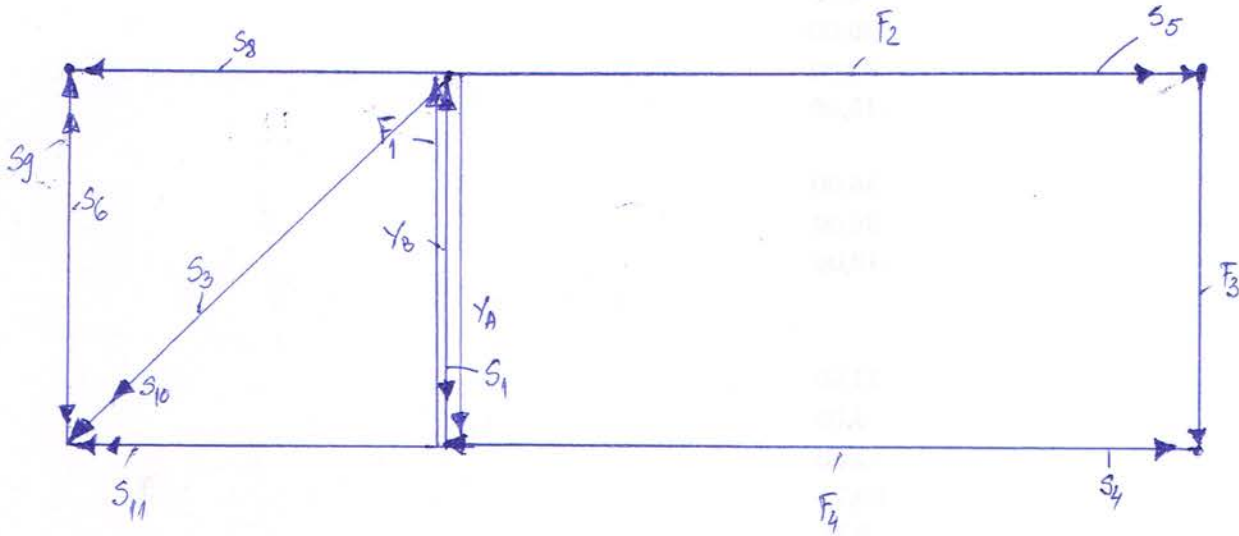
$$\sum F_x = 0$$

$$F_2 + S_{10} \frac{\sqrt{2}}{2} - S_5 = 0$$

$$S_5 = 15 \text{ - pritisk}$$

c) Krenonina metoda

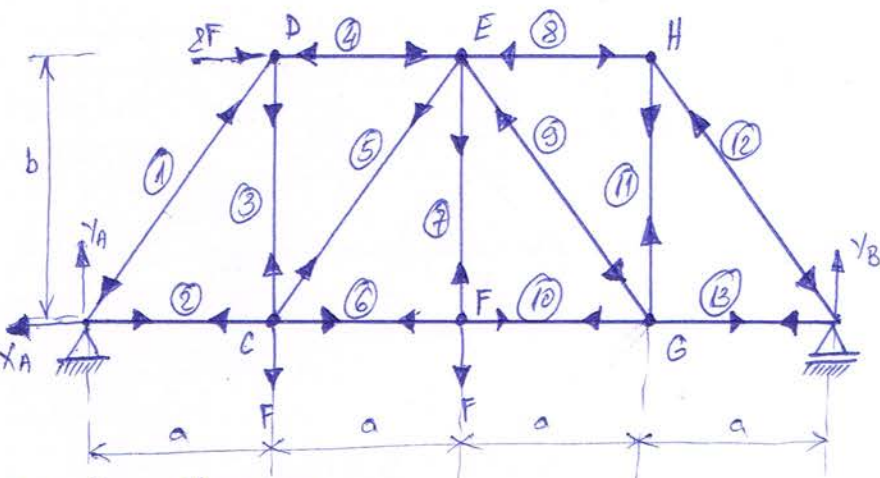
1 KN = 1cm



	istezanje	pritisak
S ₁		5
S ₂	0	0
S ₃	5√2	
S ₄		15
S ₅		15
S ₆		5
S ₇	0	0
S ₈	5	
S ₉	5	
S ₁₀		5√2
S ₁₁	5	

④ Analytički odrediti reakcije veza za dati ravninski rešetkasti nosač.
Metodom čvora odrediti intenzitet i karakter sile u svim štapovima.

$b = 3,5$; $a = 2,5$; $F = 10$



* sile u štapovima

čvor A:

$\sum F_y = 0;$

$Y_A - S_1 \cdot \frac{3,5}{4,3} = 0$

$S_1 = 9,83$ - pritisk

$\sum F_x = 0;$

$S_2 - S_1 \cdot \frac{2,5}{4,3} - X_A = 0$

$S_2 = 25,71$ - istezanje

čvor D:

$\sum F_x = 0;$

$2F + S_4 \cdot \frac{2,5}{4,3} - S_4 = 0$

$S_4 = 25,71$ - pritisk

$\sum F_y = 0;$

$S_1 \cdot \frac{3,5}{4,3} - S_3 = 0$

$S_3 = 9,83$ - istezanje

$b = \sqrt{2,5^2 + 3,5^2} = 4,30$

čvor C:

$\sum F_y = 0;$

$S_3 - F + S_5 \cdot \frac{3,5}{4,3} = 0$

$S_5 = 0,20$ - istezanje

$\sum F_x = 0$

$-S_2 + S_5 \cdot \frac{2,5}{4,3} + S_6 = 0$

$S_6 = S_2 - S_5 \cdot \frac{2,5}{4,3}$

$S_6 = 25,59$ - istezanje

čvor F:

$\sum F_x = 0; S_{10} = S_6; S_{10} = 25,59$ - istez.

$\sum F_y = 0; S_7 = F; S_7 = 10$ - istezanje

čvor B:

$\sum F_y = 0; Y_B - S_{12} \cdot \frac{3,5}{4,3} = 0$

$S_{12} = 14,74$ - pritisk

$\sum F_x = 0;$

$S_{12} \cdot \frac{2,5}{4,3} - S_3 = 0$

$S_3 = 8,56$ - istezanje

⑤ reakcije oslonaca

$\sum F_x = 0;$

$2F - X_A = 0$

$X_A = 2F = 20$

$\sum F_y = 0;$

$Y_A + Y_B - F - F = 0$

$Y_A + Y_B = 2F$

$\sum M_A = 0;$

$2F \cdot b + F \cdot a + F \cdot a - Y_B \cdot 4a = 0$

$Y_B = \frac{2F \cdot b + F \cdot a + F \cdot a}{4a}$

$Y_B = 12; Y_A = 8$

čvor H:

$\sum F_y = 0; S_{12} \cdot \frac{3,5}{4,3} - S_{11} = 0$

$S_{11} = 11,99$ - istezanje

$\sum F_x = 0;$

$S_8 - S_{12} \cdot \frac{2,5}{4,3} = 0$

$S_8 = 8,57$ - pritisk

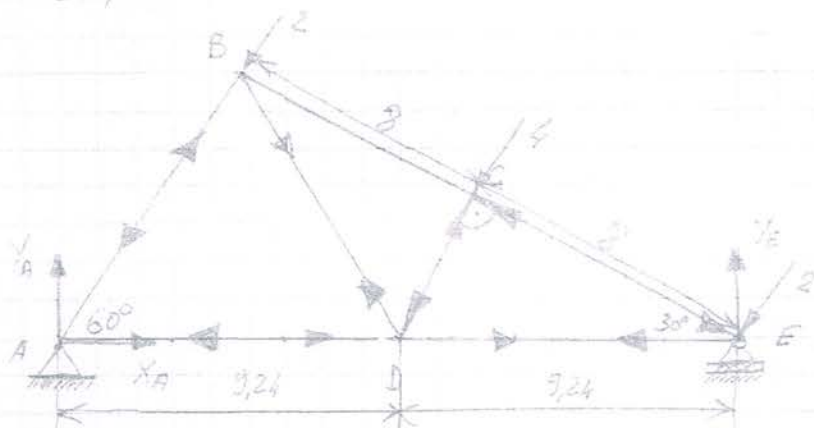
čvor G:

$\sum F_y = 0$

$S_{11} - S_9 \cdot \frac{3,5}{4,3} = 0$

$S_9 = 14,73$ - pritisk

4) Za rešetkasti nosač prikazan na slici, odrediti sile u stupovima



$$\sum F_x = 0$$

$$X_A - 2 \cdot \cos 60^\circ - 4 \cdot \cos 60^\circ - 2 \cdot \cos 60^\circ = 0$$

$$X_A = 4$$

$$\sum M_A = 0$$

$$Y_E \cdot 18,48 - 48 - 2 \cdot 16 = 0$$

$$Y_E = 3,46$$

$$\sum F_y = 0$$

$$Y_A + Y_E - 2 \cdot \sin 60^\circ - 4 \cdot \sin 60^\circ - 2 \cdot \sin 60^\circ = 0$$

$$Y_A = 3,47$$

ČVOR E

$$\sum F_y = 0; \quad Y_E - 2 \cdot \sin 60^\circ - F_{EC} \cdot \sin 30^\circ = 0$$

$$F_{EC} = \frac{Y_E - 2 \cdot \sin 60^\circ}{\sin 30^\circ}$$

$$F_{EC} = 3,46 \text{ kN} \ominus$$

$$\sum F_x = 0; \quad F_{ED} + 2 \cdot \cos 60^\circ - F_{EC} \cdot \cos 30^\circ = 0$$

$$F_{ED} = 2,000 \text{ kN} \oplus$$

ČVOR C

$$F_{BC} = F_{CE} = 3,46 \text{ kN} \ominus$$

$$F_{CD} = 4 \text{ kN} \ominus$$

ČVOR D

$$\sum F_x = 0$$

$$F_{DA} + F_{DE} - F_{BD} \cdot \cos 60^\circ - F_{DC} \cdot \cos 60^\circ = 0$$

$$F_{BD} = 4,0 \text{ kN} \oplus$$

ČVOR A

$$\sum F_y = 0;$$

$$Y_A - F_{AB} \cdot \sin 60^\circ = 0$$

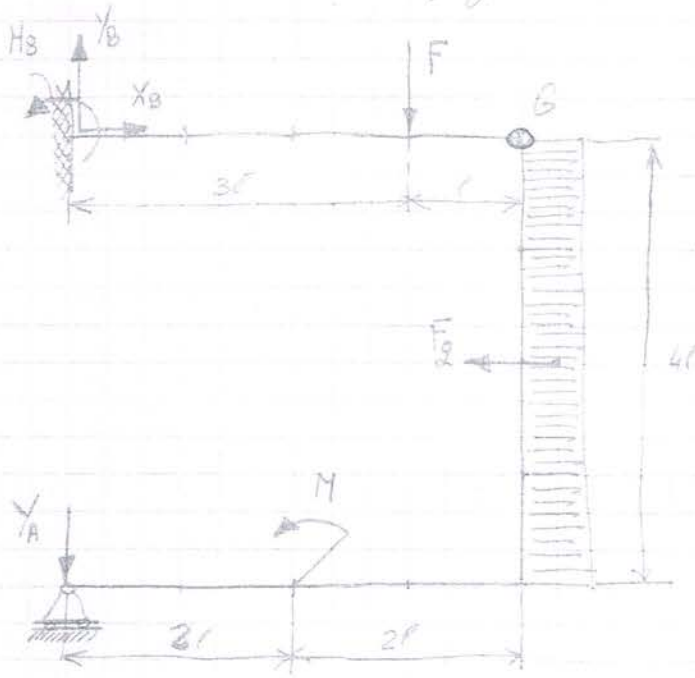
$$F_{AB} = 4,0 \text{ kN} \ominus$$

$$\sum F_x = 0;$$

$$Y_A - F_{AB} \cdot \cos 60^\circ - F_{AD} = 0$$

$$F_{AD} = 2,0 \text{ kN} \ominus$$

④ ta ravn perlozan na slici, odrediti reakcije oslonaca i nacrtati statičke dijagrame



$$q = \frac{F}{l}; \quad F_g = q \cdot 4l = 4F$$

$$M = 4Fl$$

$$\sum M_G^D = 0;$$

$$F_g \cdot 2l - Y_A \cdot 4l - M = 0$$

$$Y_A = \frac{4F \cdot 2l - 4Fl}{4l}$$

$$Y_A = F$$

$$\sum F_y = 0; \quad Y_B - F - Y_A = 0$$

$$Y_B = 2F$$

$$\sum F_x = 0; \quad X_B - F_g = 0$$

$$X_B = 4F$$

$$\sum M_B^D = 0;$$

$$Y_B \cdot 4l - F \cdot l - M_B = 0$$

$$M_B = 7Fl$$

