ZADATAK 3.

Za Gerberov nosač prikazan na slici, čija su opterećenja:

$F_1 = 20\sqrt{2}\,kN$, $F_2 = 10\,kN$, $M = 10\,kNm$, $a = 1\,m$,

računskim putem odrediti:

- a) *otpore oslonaca*
- b) *nacrtati osnovne statičke dijagrame*

a) Otpori oslonaca
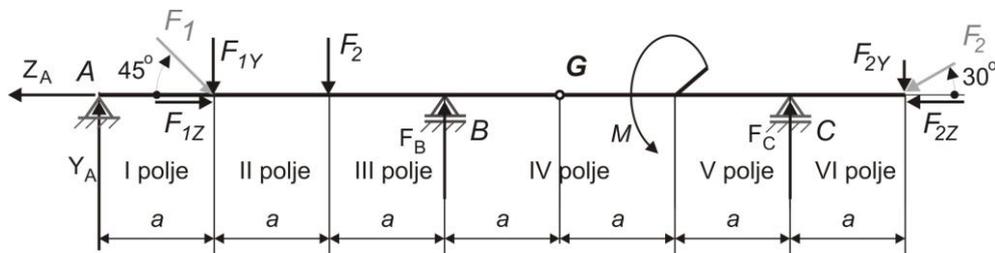
$$F_{1Z} = F_1 cos45° = 20\sqrt{2} \cdot \frac{\sqrt{2}}{2} = 20\,kN$$

$$F_{1Y} = F_1 sin45° = 20\sqrt{2} \cdot \frac{\sqrt{2}}{2} = 20\,kN$$

$$F_{2Z} = F_2 cos30° = 20 \cdot \frac{\sqrt{3}}{2} = 17.3\,kN$$

$$F_{2Y} = F_2 sin30° = 20 \cdot \frac{1}{2} = 10\,kN$$

1) $\sum Z_i = -Z_A + F_{1Z} - F_{2Z} = 0 \rightarrow Z_A$
2) $\sum Y_i = Y_A + F_B + F_C - F_{1Y} - F_2 - F_{2Y} = 0$
3) $\sum M_A = a \cdot F_{1Y} + 2a \cdot F_2 - 3a \cdot F_B - M - 6a \cdot F_C + 7a \cdot F_{2Y} = 0 \rightarrow F_B$
4) $\sum M_G^D = M + 2a \cdot F_C - 3a \cdot F_{2Y} = 0 \rightarrow F_C$

1) $\rightarrow Z_A = F_{1Z} - F_{2Z} = 20 - 17.3 = 2.679\,kN$

4) $\rightarrow F_C = \frac{1}{2a}(3a \cdot F_{2Y} - M) = \frac{1}{2\cdot1}(3 \cdot 1 \cdot 10 - 10) = 10\,kN$

3) $\rightarrow F_B = \frac{1}{3a}(a \cdot F_{1Y} + 2a \cdot F_2 - M - 6a \cdot F_C + 7a \cdot F_{2Y})$

   $F_B = \frac{1}{3\cdot1}(1 \cdot 20 + 2 \cdot 1 \cdot 20 - 10 - 6 \cdot 1 \cdot 10 + 7 \cdot 1 \cdot 10) = 20\,kN$

2) $\rightarrow Y_A = F_{1Y} + F_2 + F_{2Y} - F_B - F_C = 20 + 20 + 10 - 20 - 10 = 20\,kN$

Provera:

$\sum M_B = 3a \cdot Y_A - 2a \cdot F_{1Y} - a \cdot F_2 - M - 3a \cdot F_C + 4a \cdot F_{2Y} = 0$

$\sum M_B = 3 \cdot 1 \cdot 20 - 2 \cdot 1 \cdot 20 - 1 \cdot 1 \cdot 20 - 10 - 3 \cdot 1 \cdot 10 + 4 \cdot 1 \cdot 10 = 0$

Ime i prezime	Broj indeksa	Datum:	Pregledao:

b) Osnovni statički dijagrami

Polje I   0 < z < a
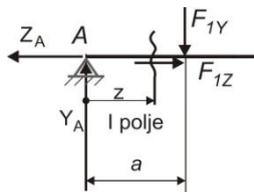
	z=0	z=a=1m
Aksijalna sila: $F_a = Z_A$	$F_a = 2.679 \; kN$	$F_a = 2.679 \; kN$
Transverzalna sila: $F_T = Y_A$	$F_T = 20 \; kN$	$F_T = 20 \; kN$

Moment savijanja sa leve strane:

$M_f = Y_A \cdot z$ $\qquad M_f = 0 \qquad M_f = 20 \; kNm$

Polje II   a < z < 2a

	z=a=1m	z=2a=2m
Aksijalna sila: $F_a = Z_A - F_{1Z}$	$F_a = -17.32 \; kN$	$F_a = -17.32 \; kN$
Transverzalna sila: $F_T = Y_A - F_{1Y}$	$F_T = 0 \; kN$	$F_T = 0 \; kN$

Moment savijanjasa leve strane:

$M_f = Y_A \cdot z - F_{1Y}(z - a)$ $\qquad M_f = 20 \; kNm \qquad M_f = 20 \; kNm$

Polje III   2a < z < 3a
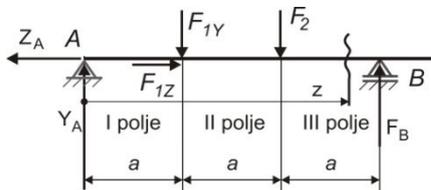
	z=2a=2m	z=3a=3m
Aksijalna sila: $F_a = Z_A - F_{1Z}$	$F_a = -17.32 \; kN$	$F_a = -17.32 \; kN$
Transverzalna sila: $F_T = Y_A - F_{1Y} - F_2$	$F_T = -20 \; kN$	$F_T = -20 \; kN$

Moment savijanja sa leve strane:

$M_f = Y_A \cdot z - F_{1Y}(z - a) - F_2(z - 2a)$ $\qquad M_f = 20 \; kNm \qquad M_f = 0$

Ime i prezime	Broj indeksa	Datum:	Pregledao:

Polje IV   3a < z < 5a
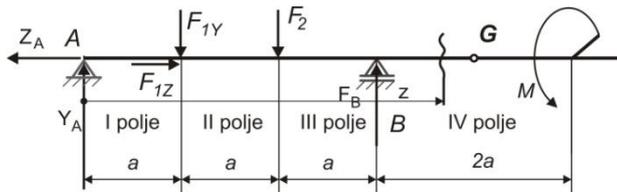
	z=3a=3m	z=5a=5m
Aksijalna sila : $F_a = Z_A - F_{1Z}$	$F_a = -17.32\ kN$	$F_a = -17.32\ kN$
Transverzalna sila: $F_T = Y_A - F_{1Y} - F_2 + F_B$	$F_T = 0$	$F_T = 0$

Moment savijanja sa leve strane:

$M_f = Y_A \cdot z - F_{1Y}(z - a) - F_2(z - 2a) + F_B(z - 3a)$ $M_f = 0$ $M_f = 0\ kNm$

Polje V   5a < z < 6a
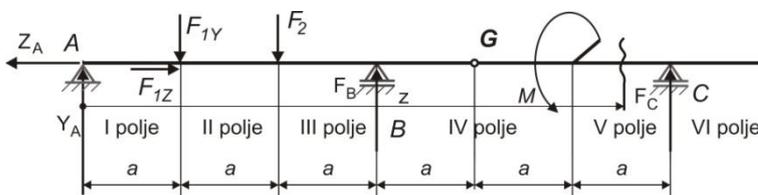
|	z=5a=3m	z=6a=6m
Aksijalna sila : $F_a = Z_A - F_{1Z}$	$F_a = -17.32\ kN$	$F_a = -17.32\ kN$
Transverzalna sila: $F_T = Y_A - F_{1Y} - F_2 + F_B$	$F_T = 0$	$F_T = 0$

Moment savijanja sa leve strane:

$M_f = Y_A \cdot z - F_{1Y}(z - a) - F_2(z - 2a) + F_B(z - 3a) - M$

$M_f = -10kNm$ $M_f = -10\ kNm$

Polje VI   6a < z < 7a
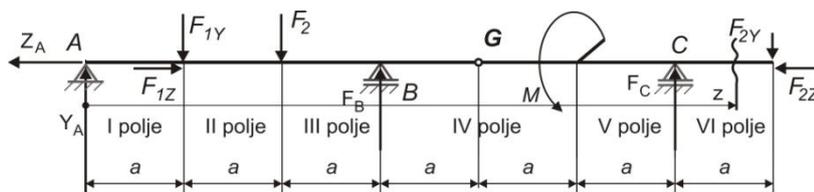
|	z=5a=3m	z=6a=6m
Aksijalna sila : $F_a = Z_A - F_{1Z}$	$F_a = -17.32\ kN$	$F_a = -17.32\ kN$
Transverzalna sila: $F_T = Y_A - F_{1Y} - F_2 + F_B + F_C$	$F_T = 10kN$	$F_T = 10kN$

Moment savijanja sa leve strane:

$M_f = Y_A \cdot z - F_{1Y}(z - a) - F_2(z - 2a) + F_B(z - 3a) - M + F_C \cdot (z - 6a)$

$M_f = -10kNm$ $M_f = 0\ kNm$

Ime i prezime	Broj indeksa	Datum:	Pregledao:

Z_A A 45° F_1 F_{1Y} F_2 G F_{2Y} F_2 30°

F_{1Z} F_B B M F_C C F_{2Z}

Y_A | I polje | II polje | III polje | IV polje | V polje | VI polje

a a a a a a a

$$U_L = \frac{0.5 \text{ m}}{1 \text{ cm}} \qquad U_F = \frac{10 \text{ kN}}{1 \text{ cm}}$$

F_a — Diagram aksijalnih sila

2.679   2.679

Z_A F_{1Z} B G C $(-)$ F_{2Z}

-17.32   -17.32

F_T — Dijagram transverzalnih sila

20   20

Y_A $(+)$ F_{1Y} B G C 10   10 F_C $(+)$ F_{2Y}

F_2 $(-)$ F_B

-20   -20

Dijagram momenta savijanja

Y_A B G -10 -10 M $(-)$ C

$(+)$
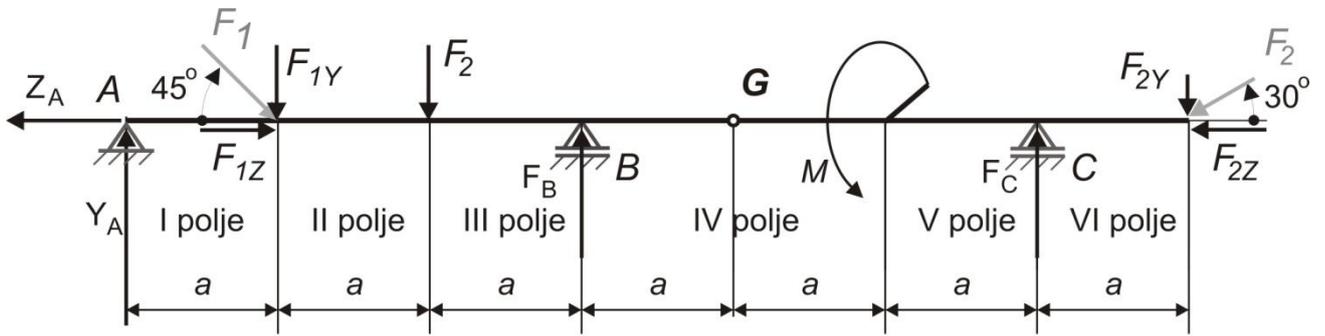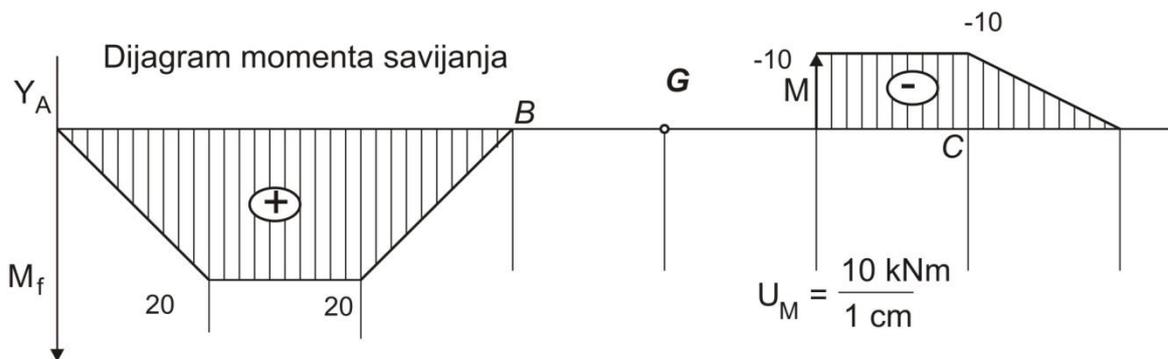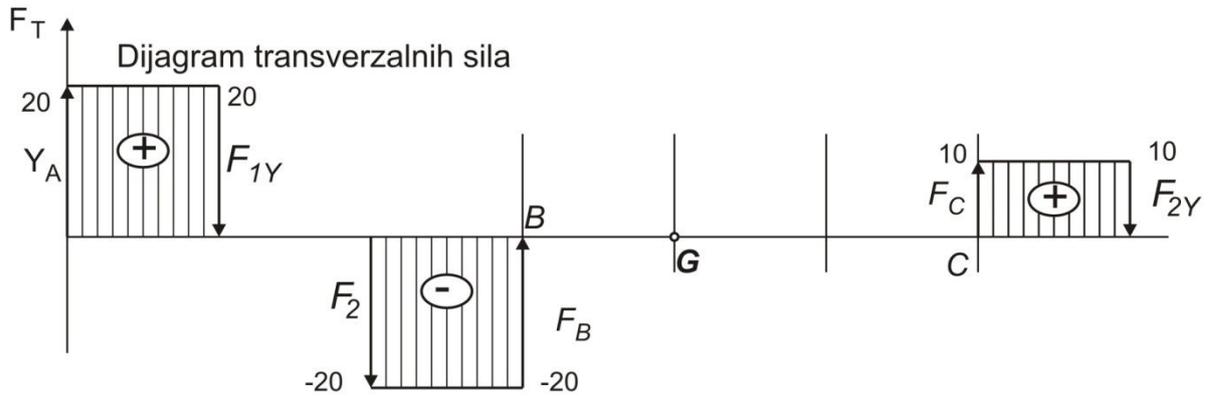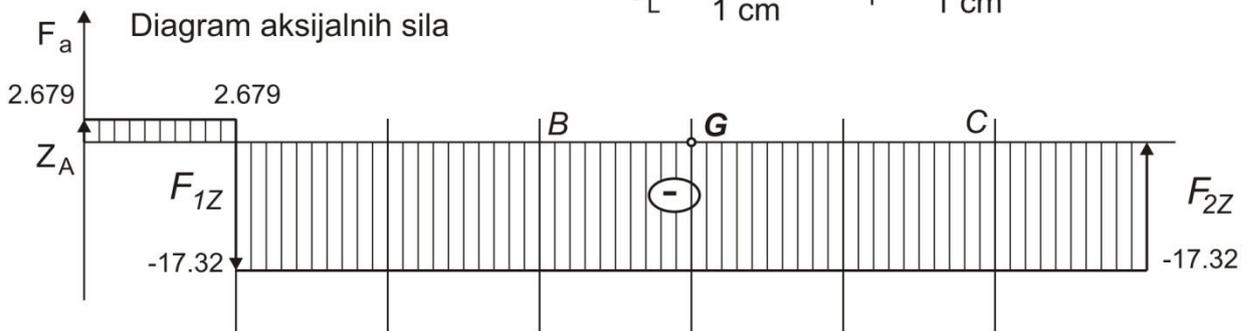
M_f 20   20 $$U_M = \frac{10 \text{ kNm}}{1 \text{ cm}}$$

Ime i prezime	Broj indeksa	Datum:	Pregledao: