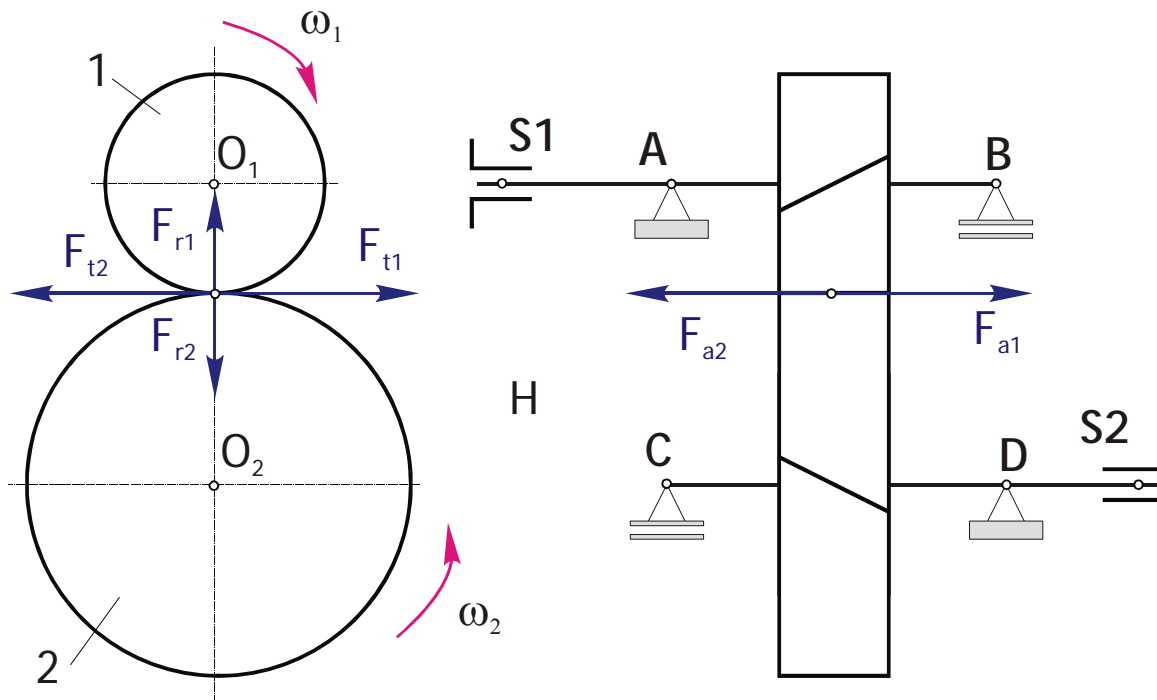


ANALIZA OPTEREĆENJA ZUPČASTOG PRENOSNIKA

vežba

B4



PRETHODNI PRORAČUN POGONSKOG VRATILA

vežba

B5

G1 Sile i sheme opterećenja vratila

Cilindrični zupčanik

Obimna sila $F_{t1} = \frac{2T_1}{d_{w1}}$

$F_{t2} = F_{t1}$

$F_{t1} = 2527.516 \text{ N}$

Radijalna sila $F_{r1} = F_{t1} \tan(\alpha_{wt})$

$F_{r2} = F_{r1}$

$F_{r1} = 923.523 \text{ N}$

Aksijalna sila $F_{a1} = F_{t1} \tan(\beta)$

$F_{a2} = F_{a1}$

$F_{a1} = 537.24 \text{ N}$

Rastojanje između oslonaca A i B

preporuka $l_1 = 1.5b_1 = 210 \text{ mm}$

$l_1 = 210 \text{ mm}$

A oslonac je nepokretan, B oslonac je pokretan

G2 Otpori oslonaca u V ravni

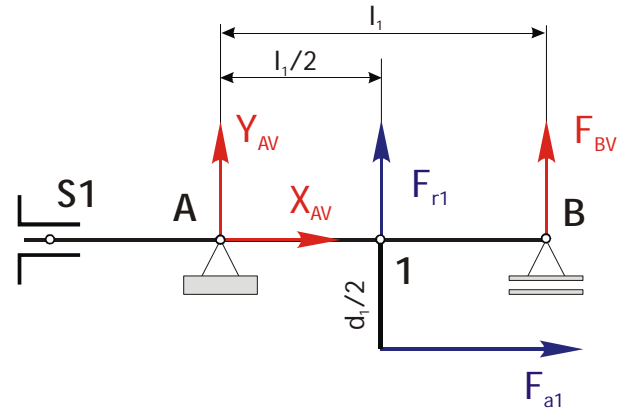
Given

$$\sum X_i = 0 \quad X_{AV} + F_{a1} = 0$$

$$\sum Y_i = 0 \quad Y_{AV} + F_{r1} + F_{BV} = 0$$

$$\sum M_A = 0 \quad F_{r1} \frac{l_1}{2} + F_{a1} \frac{d_1}{2} + F_{BV} l_1 = 0$$

[V]



Otpori oslonaca su

$$X_{AV} = -537.24 \text{ N}$$

$$Y_{AV} = -242.065 \text{ N}$$

$$F_{BV} = -681.458 \text{ N}$$

G3 Otpori oslonaca u H ravni

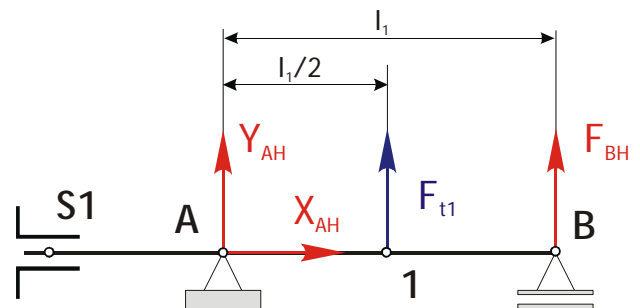
Given

$$\sum X_i = 0 \quad X_{AH} = 0$$

$$\sum Y_i = 0 \quad Y_{AH} + F_{t1} + F_{BH} = 0$$

$$\sum M_A = 0 \quad F_{t1} \frac{l_1}{2} + F_{BH} l_1 = 0$$

[H]



Otpori oslonaca su

$$X_{AH} = 0 \text{ N}$$

$$Y_{AH} = -1263.758 \text{ N}$$

$$F_{BH} = -1263.758 \text{ N}$$

G4 Momenti savijanja u H ravni

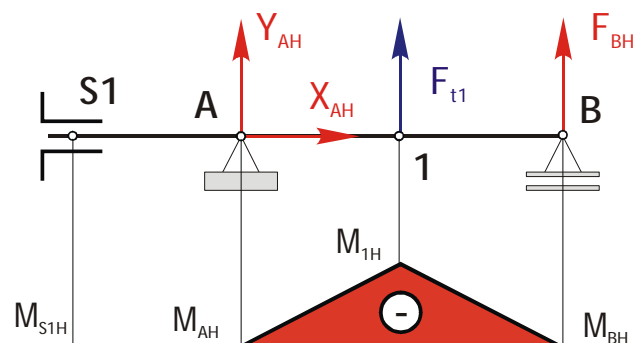
$$M_{S1H} = 0 \text{ N m}$$

$$M_{AH} = 0 \text{ N m}$$

$$M_{1H} = F_{BH} \frac{l_1}{2} \quad M_{1H} = -132.695 \text{ N m}$$

$$M_{BH} = 0 \text{ N m}$$

[H]



G5 Momenti savijanja u V ravni

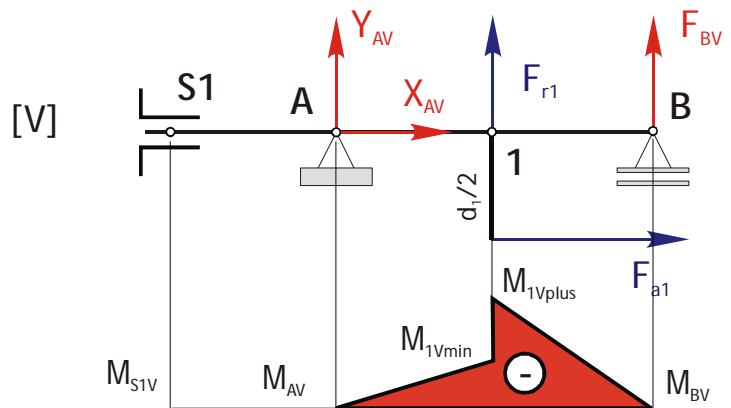
$$M_{S1V} = 0 \text{ N m}$$

$$M_{AV} = 0 \text{ N m}$$

$$M_{1-\epsilon V} = Y_{AV} \frac{l_1}{2} \quad M_{1-\epsilon V} = -25.417 \text{ N m}$$

$$M_{1+\epsilon V} = F_{BV} \frac{l_1}{2} \quad M_{1+\epsilon V} = -71.553 \text{ N m}$$

$$M_{BV} = 0 \text{ N m}$$



G6 Rezultujući moment savijanja

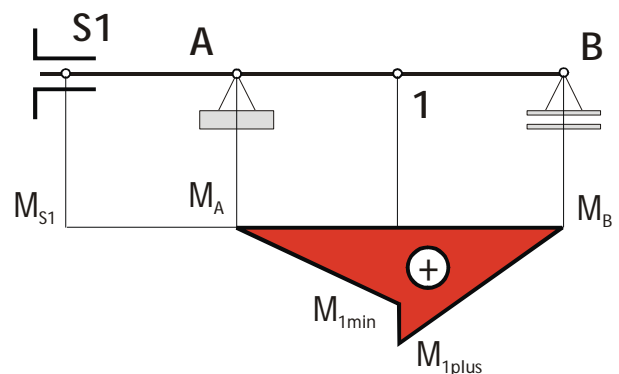
$$M_{S1} = \sqrt{M_{S1H}^2 + M_{S1V}^2} \quad M_{S1} = 0 \text{ N m}$$

$$M_A = \sqrt{M_{AH}^2 + M_{AV}^2} \quad M_A = 0 \text{ N m}$$

$$M_{1-\epsilon} = \sqrt{M_{1H}^2 + M_{1-\epsilon V}^2} \quad M_{1-\epsilon} = 135.107 \text{ N m}$$

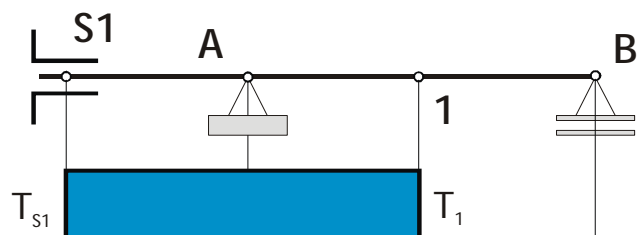
$$M_{1+\epsilon} = \sqrt{M_{1H}^2 + M_{1+\epsilon V}^2} \quad M_{1+\epsilon} = 150.757 \text{ N m}$$

$$M_B = \sqrt{M_{BH}^2 + M_{BV}^2} \quad M_B = 0 \text{ N m}$$



G7 Merodavni moment uvijanja

$$T = T_1 \quad T_1 = 216.582 \text{ N m}$$



G8 Materijal vratila

Materijal vratila **E335 (Č0645)**

Zatezna čvrstoća

Tab. 2.1 str. 18 K

$$R_m = 600 \frac{\text{N}}{\text{mm}^2}$$

Табела 2.1. ПОДАЦИ О МЕХАНИЧКИМ КАРАКТЕРИСТИКАМА
ОДАБРАНИХ МАШИНСКИХ МАТЕРИЈАЛА. МЕРЕ у N/mm²

	Ознака	Затезна чврстоћа R_m	Граница развлачења $R_e^* R_p^*$			Затезна издрж. $\sigma_{D(0)}$
Конструкциони челици	Č.0270	340..420	210	200	190	200..230
	Č.0370	370..430	240	230	220	220..250
	Č.0460	420..500	260	250	240	240..280
	Č.0545	500..600	300	290	280	280..340
	Č.0645	600..700	340	330	320	320..380
	Č.0745	700..850	370	360	350	350..430

Savojna Dinamička izdržljivost pri naizmenicno promenljivom opterećenju

Tab. 2.1 str. 19 K

$$\sigma_{D(-1)s} = 280 \frac{\text{N}}{\text{mm}^2}$$

Savojna Izdržljivost $\sigma_{D(0)}$	Uvojna $\tau_{D(0)}$	Zatezna $\sigma_{D(-1)}$	Savojna Izdržljivost $\sigma_{D(-1)}$	Uvojna $\tau_{D(-1)}$	Tvrdoća HB	Oznaka
230..280	120..150	100..140	150..200	80..120	95..120	Č.0270
260..310	140..180	120..140	170..200	100..120	105..125	Č.0370
300..350	150..180	130..170	190..240	110..140	120..140	Č.0460
350..420	170..240	160..200	220..270	130..160	140..170	Č.0545
400..480	200..230	200..240	280..330	160..190	170..195	Č.0645
430..540	220..270	220..280	300..380	170..220	195..240	Č.0745

Uvojna Dinamička izdržljivost pri jednosmernom promenljivom opterećenju

Tab. 2.1 str. 19 K

$$\tau_{D(0)u} = 200 \frac{\text{N}}{\text{mm}^2}$$

Koeficijent svodenja napona $\alpha = \frac{\sigma_{D(-1)s}}{2\tau_{D(0)u}}$

$\alpha = 0.7$

G9 Rezultujući (idealni, svedeni) momenti savijanja

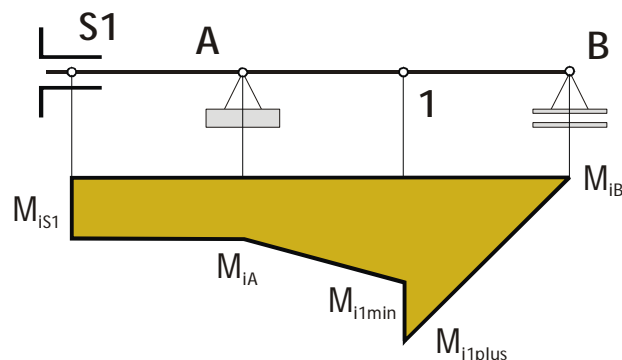
$$M_{iS1} = \sqrt{M_{S1}^2 + (\alpha T)^2} \quad M_{iS1} = 151.607 \text{ N m}$$

$$M_{iA} = \sqrt{M_A^2 + (\alpha T)^2} \quad M_{iA} = 151.607 \text{ N m}$$

$$M_{i1-\epsilon} = \sqrt{M_{1-\epsilon}^2 + (\alpha T)^2} \quad M_{i1-\epsilon} = 203.073 \text{ N m}$$

$$M_{i1+\epsilon} = \sqrt{M_{1+\epsilon}^2 + (\alpha T)^2} \quad M_{i1+\epsilon} = 213.805 \text{ N m}$$

$$M_{iB} = \sqrt{M_B^2} \quad M_{iB} = 0 \text{ N m}$$



G10 Idealni prečnici

Stepen sigurnosti

$$S_{\min} = 4$$

Opterećenje		
Statičko	Dinamičko	
	jednosmerno promenljivo	naizmjenično promenljivo
$S_{\min} = 2$	$S_{\min} = 3$	$S_{\min} = 4$

Dozvoljeni napon na savijanje

$$\sigma_d = \frac{\sigma_{D(-)S}}{S}$$

$$\sigma_d = 70 \frac{N}{mm^2}$$

$$d_{iS1} = \sqrt[3]{\frac{32M_{iS1}}{\pi \sigma_d}}$$

$$d_{iS1} = 28.046 \text{ mm}$$

$$d_{i1} = \sqrt[3]{\frac{32M_{i1+\epsilon}}{\pi \sigma_d}}$$

$$d_{i1} = 31.451 \text{ mm}$$

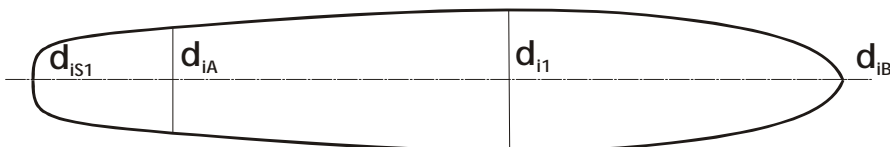
$$d_{iA} = \sqrt[3]{\frac{32M_{iA}}{\pi \sigma_d}}$$

$$d_{iA} = 28.046 \text{ mm}$$

$$d_{iB} = \sqrt[3]{\frac{32M_{iB}}{\pi \sigma_d}}$$

$$d_{iB} = 0 \text{ mm}$$

Idealni oblik vratila



G11 Stvarni prečnici

Zbog žleba za klin na mestu spojnice S1 prečnik povećavamo 20%

$$d_{S1r} = 1.2d_{iS1}$$

$$d_{S1r} = 33.655 \text{ mm}$$

usvajam

$$d_{S1} = 40 \text{ mm}$$

Na mestu ležaja A, prečnik vratila treba uskladiti sa standardnim prečnicima za ležaj

$$d_A = 50 \text{ mm}$$

Zbog žleba za klin na mestu zupčanika 1 prečnik povećavamo 20%

$$d_{1r} = 1.2d_{i1}$$

$$d_{1r} = 37.742 \text{ mm}$$

usvajam

$$d_{v1} = 55 \text{ mm}$$

Na mestu ležaja B, prečnik vratila treba uskladiti sa standardnim prečnicima za ležaj

$$d_B = 50 \text{ mm}$$

