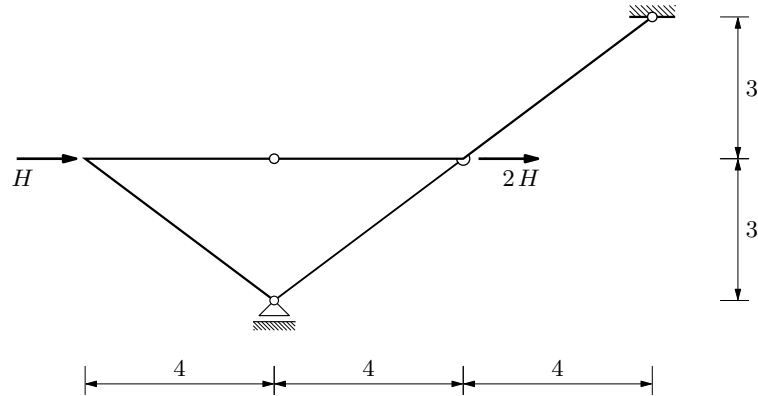


# GS 1. — 4. veljače 2025.

## Zadatak 2.

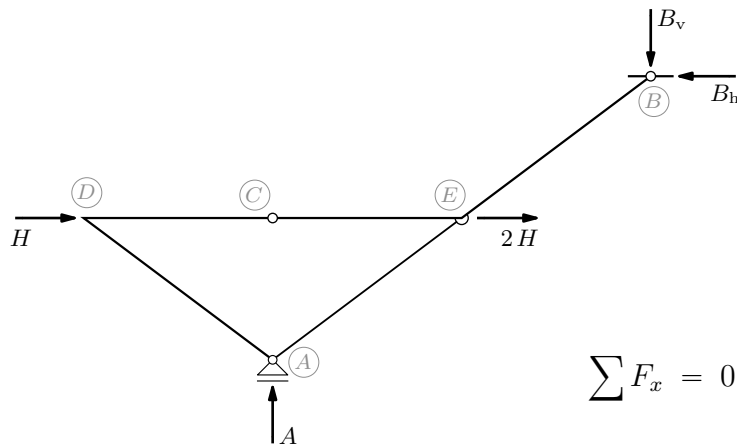
Nacrtajte dijagrame unutarnjih sila!

$$H = 125 \text{ kN}$$



vrijednosti reakcija:

tri su komponente reakcija, pa su dovoljne jednadžbe ravnoteže sistema kao cjeline



$$\sum F_x = 0 : H + 2H - B_h = 0$$

$$B_h = 3H = 375 \text{ kN}$$

$$\sum M_{/B} = 0 : 3 \cdot (3H) - 8 \cdot A = 0$$

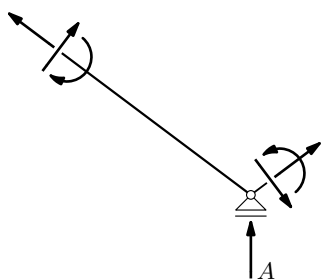
$$A = \frac{9}{8}H = 140,625 \text{ kN}$$

$$\sum M_{/A} = 0 : -3 \cdot (3H) - 8 \cdot B_v + 6 \cdot B_h = 0$$

$$B_v = -\frac{9}{8}H + \frac{3}{4}B_h = -\frac{9}{8}H + \frac{9}{4}H = \frac{9}{8}H = 140,625 \text{ kN}$$

provjera:  $\sum F_z = -A + B_v = -140,625 + 140,625 = 0$

vrijednosti unutarnjih sila i dijagrami:



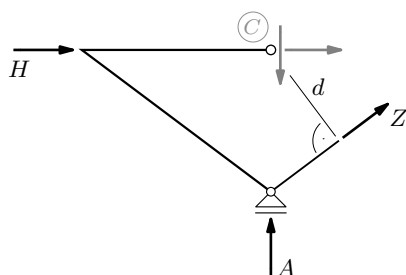
hmm... šest nepoznatih sila?

da, ali štap  $\{A, E\}$  ima zglobove na oba kraja i nije opterećen; znači, štap  $\{A, E\}$  je zglobni štap, pa u njemu postoji samo uzdužna sila; dakle, četiri nepoznate sile; ipak, još je uvijek jedna previše...

zglobni štap... možda zatega? a tu je i zglob  $C$ !

nije li zadani sistem trozglobni okvir sa zategom? malo čudan, doduše...

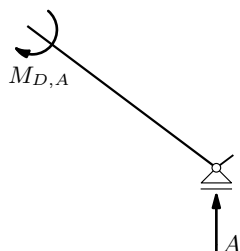
vrijednost sile u zategi:



$$\sum_{\text{lijevo}} M_{/C} = 0 : 0 \cdot H + 0 \cdot A + d \cdot Z = 0$$

$$Z = 0$$

vrijednosti momenata savijanja:



u (zglobnom) ležaju  $A$ :  $M_A = 0$

$$\sum_{\{A,D\}} M_{/D} = 0 : -M_{D,A} + 4 \cdot A = 0$$

$$M_{D,A} = 4 \cdot A = 562,5 \text{ kNm}$$

između  $A$  i  $D$  nema opterećenja, pa je odsječak dijagrama odsječak pravca

ravnoteža čvora  $D$  [skicirajte!]:  $M_{D,C} = -M_{D,A} = -562,5 \text{ kNm}$

u zglobu  $C$ :  $M_C = 0$

između  $D$  i  $C$  nema opterećenja, pa je  $\mathcal{E}$ td.

„kroz zglob” momentni dijagram prolazi bez loma:  $M_{E,C} = M_{D,C} = -562,5 \text{ kNm}$

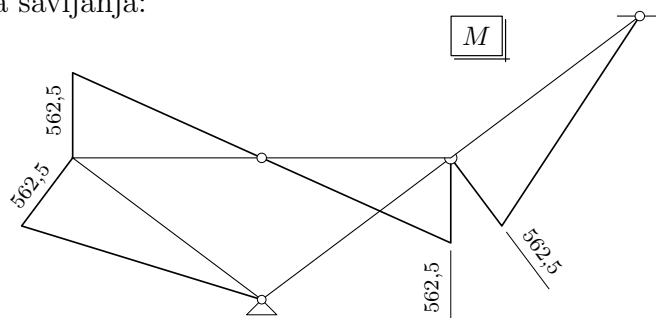
ravnoteža čvora  $E$  [skicirajte!]:  $M_{E,B} = -M_{E,C} = 562,5 \text{ kNm}$

u (zglobnom) ležaju  $B$ :  $M_B = 0$

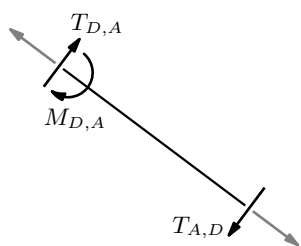
$$\text{provjera [skicirajte!]: } \sum_{\{B,E\}} M_{/E} = -M_{E,B} - 4 \cdot B_v + 3 \cdot B_h$$

$$= -562,5 - 4 \cdot 140,625 + 3 \cdot 375 = 0$$

dijagram momenata savijanja:



vrijednosti poprečnih sila:



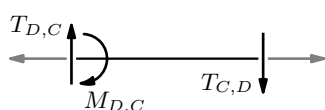
$$\sum_{\{A,D\}} M/A = 0 : -\ell_{\{A,D\}} T_{D,A} - M_{D,A} = 0$$

$$T_{D,A} = -\frac{M_{D,A}}{\ell_{\{A,D\}}} = -\frac{562,5}{5} = -112,5 \text{ kN}$$

ili

$$\sum_{\{A,D\}} M/D = 0 : -M_{D,A} - \ell_{\{A,D\}} T_{A,D} = 0$$

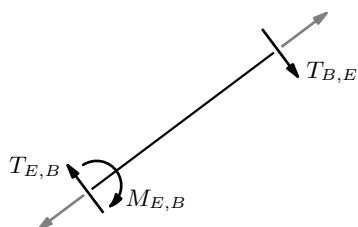
$$T_{A,D} = -\frac{562,5}{5} = -112,5 \text{ kN}$$



$$\sum_{\{D,C\}} M/C = 0 : -M_{D,C} - \ell_{\{D,C\}} T_{D,C} = 0$$

$$T_{D,C} = -\frac{M_{D,C}}{\ell_{\{D,C\}}} = -\frac{-562,5}{4} = 140,625 \text{ kN}$$

$$T_{C,E} = T_{D,C} = 140,625 \text{ kN}$$

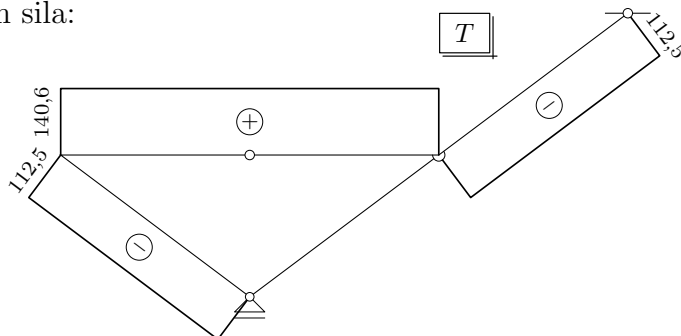


$$\sum_{\{B,E\}} M/B = 0 : -M_{E,B} - \ell_{\{B,E\}} T_{E,B} = 0$$

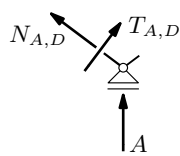
$$T_{E,B} = -\frac{M_{E,B}}{\ell_{\{B,E\}}} = -\frac{562,5}{5} = -112,5 \text{ kN}$$

(izvedeni izrazi za vrijednosti poprečnih sila mogu se shvatiti i kao izrazi za nagibe odsječaka momentnoga dijagrama, što je, kao što znate, geometrijska interpretacija statičkoga diferencijalnog odnosa  $T(x) = M'(x)$ )

dijagram poprečnih sila:

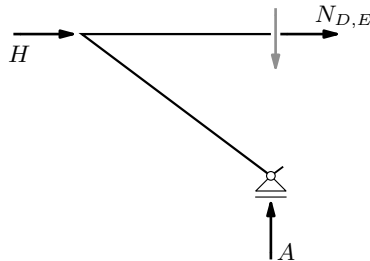


vrijednosti uzdužnih sila:



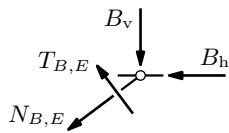
$$\sum_A F_x = 0 : -\frac{4}{5} N_{A,D} + \frac{3}{5} T_{A,D} = 0$$

$$N_{A,D} = \frac{3}{4} T_{A,D} = \frac{3}{4} \cdot (-112,5) = -84,375 \text{ kN}$$



$$\sum_{\text{lijevo}} F_x = 0 : H + N_{D,E} = 0$$

$$N_{D,E} = -H = -125 \text{ kN}$$



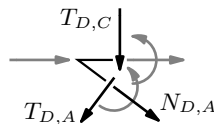
$$\sum_B F_x = 0 : -\frac{4}{5} N_{B,E} - \frac{3}{5} T_{B,E} - B_h = 0$$

$$N_{B,E} = -\frac{3}{4} T_{B,E} - \frac{5}{4} B_h$$

$$= -\frac{3}{4} \cdot (-112,5) - \frac{5}{4} \cdot 375$$

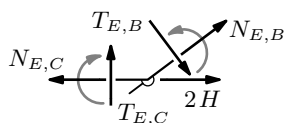
$$= -384,375 \text{ kN}$$

provjere:



$$\sum_D F_z = \frac{4}{5} T_{D,A} + \frac{3}{4} N_{D,A} + T_{D,C}$$

$$= \frac{4}{5} \cdot (-112,5) + \frac{3}{5} \cdot (-84,375) + 140,625 = 0$$



$$\sum_E F_x = -N_{E,D} + \frac{4}{5} N_{E,B} + \frac{3}{5} T_{E,B} + 2H$$

$$= -(-125) + \frac{4}{5} \cdot (-384,375) + \frac{3}{5} \cdot (-112,5) + 2 \cdot 125$$

$$= 0$$

$$\sum_E F_z = -T_{E,C} + \frac{3}{5} N_{E,B} + \frac{4}{5} T_{E,B}$$

$$= -(-140,625) + \frac{3}{5} \cdot (-384,375) + \frac{4}{5} \cdot (-112,5) = 0$$

dijagram uzdužnih sila:

