

## ZADATAK

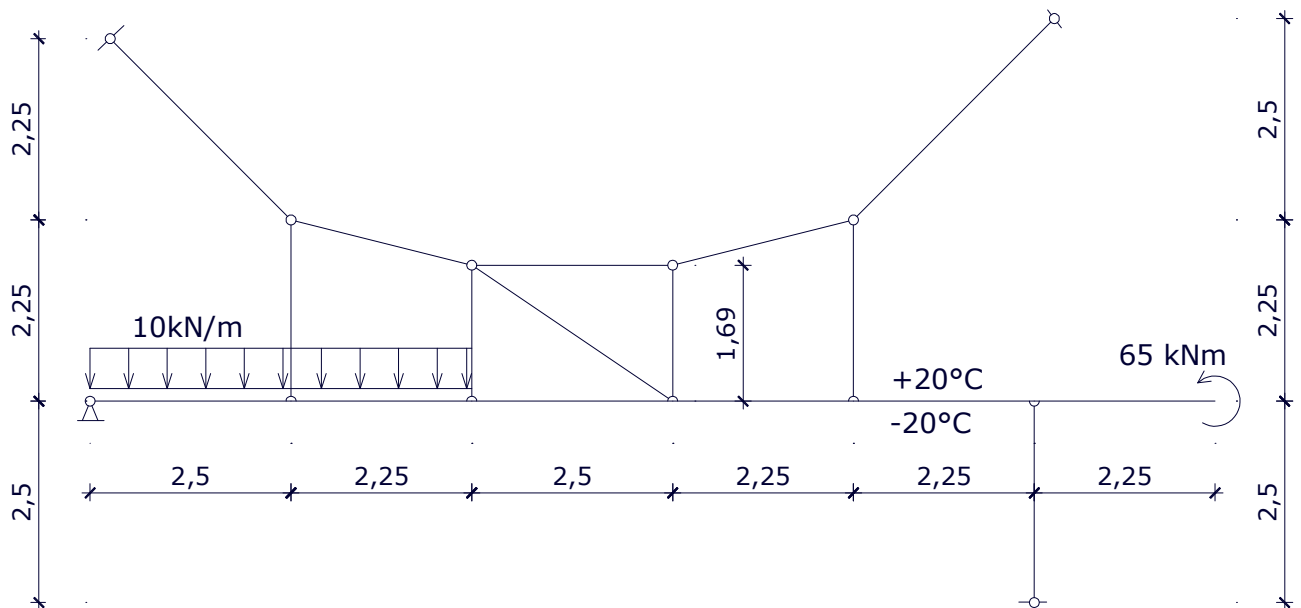
Za zadani sistem metodom sila odrediti M,T,N dijagrame.

Grede i stupovi:

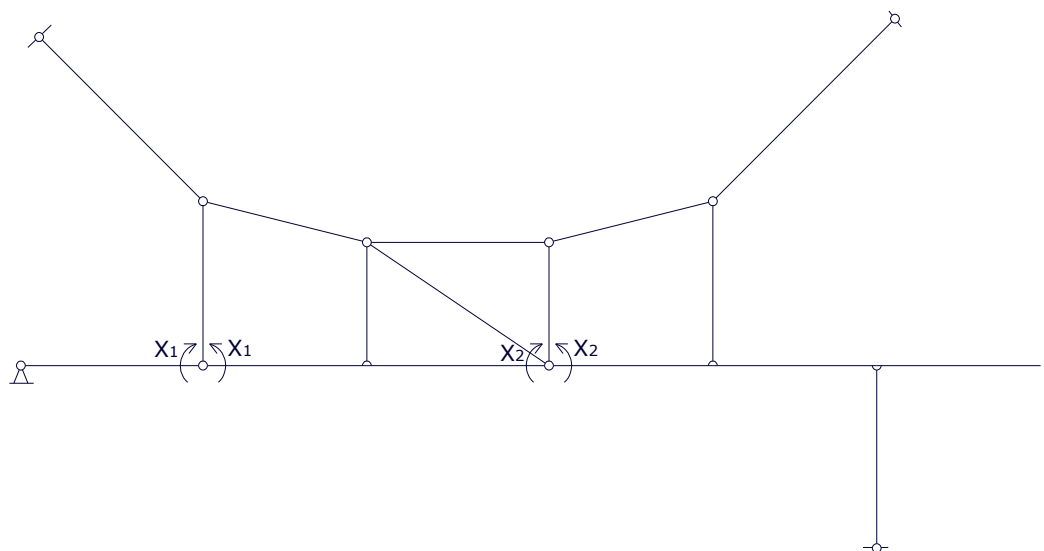
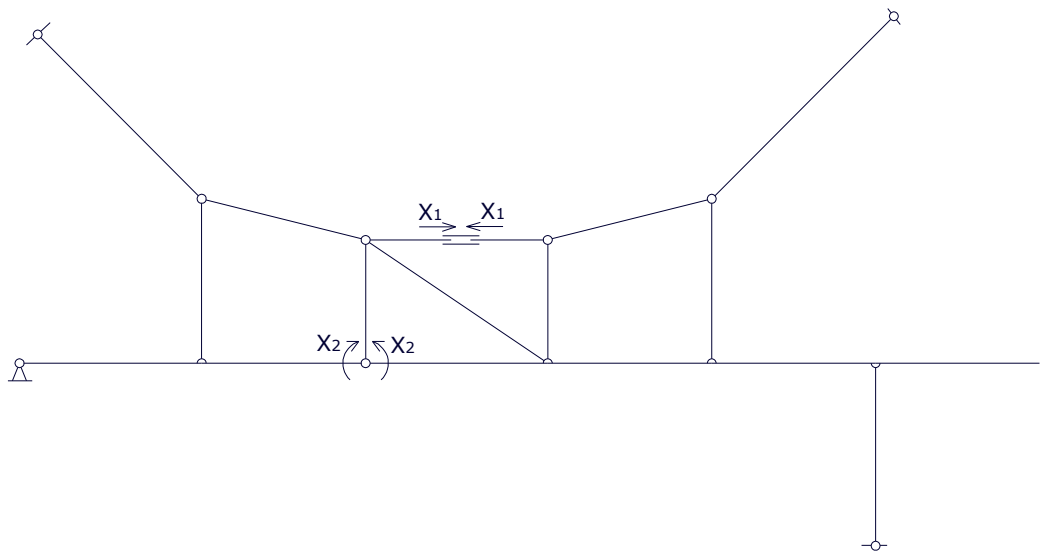
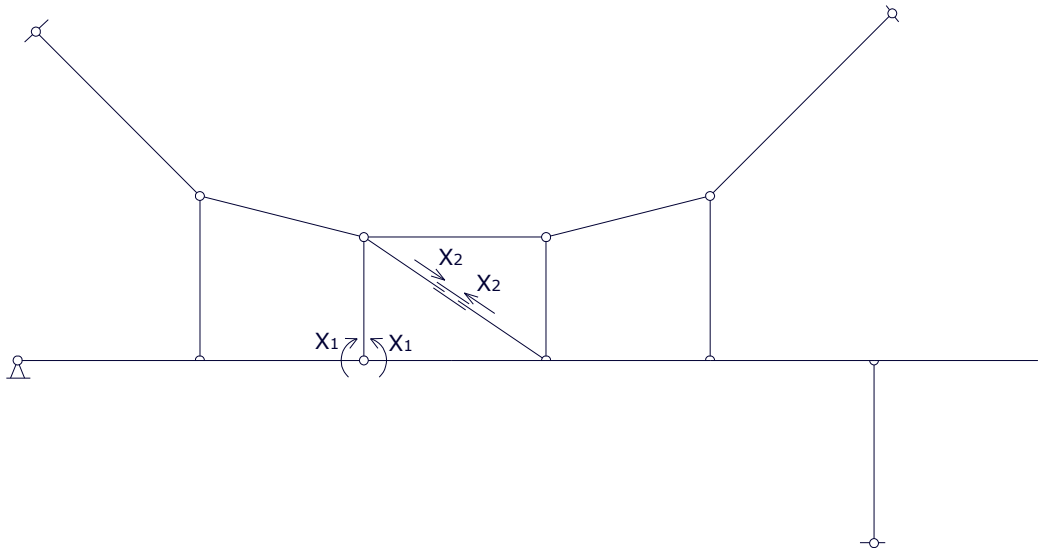
$$\begin{aligned} b/h &= 36/72[\text{cm}] & F_1 &= b \cdot h = 0,36 \cdot 0,72 = 0,2592\text{m}^2 \\ E_1 &= 3 \cdot 10^7 \text{ kN/m}^2 \Rightarrow & I_1 &= \frac{bh^3}{12} = \frac{0,36 \cdot 0,72^3}{12} = 1119,74 \cdot 10^{-5} \text{ m}^4 \\ \alpha_t &= 10^{-5} \text{ K}^{-1} \end{aligned}$$

Štapovi:

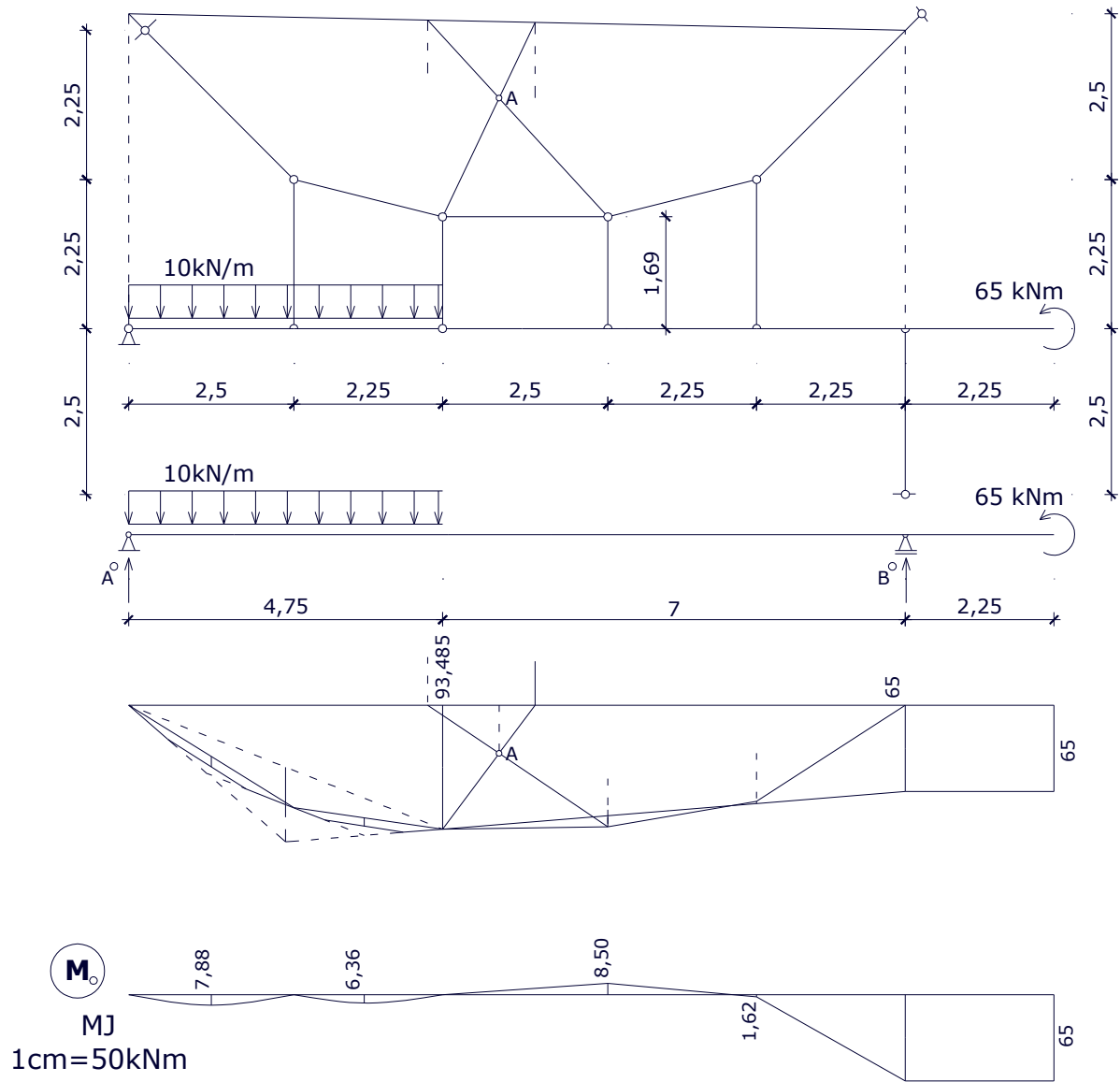
$$\begin{aligned} b/h &= 6/6[\text{cm}] \Rightarrow F_2 = 0,06^2 = 3,6 \cdot 10^{-3} \text{ m}^2 \\ E_2 &= 2 \cdot 10^8 \text{ kN/m}^2 \\ \alpha_t &= 10^{-5} \text{ K}^{-1} \end{aligned}$$



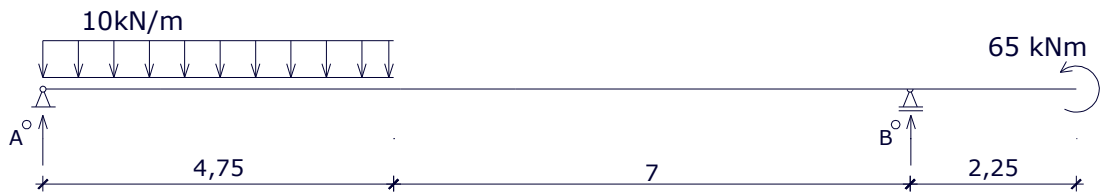
# OSNOVNI SISTEMI



# ODREĐIVANJE DIJAGRAMA $M_0$



## PROSTA GREDA



## REAKCIJE:

$$\sum M_A = 0 \Rightarrow -10 \cdot 4,75^2 / 2 + 65 + B^0 \cdot 11,75 = 0 \Rightarrow B = \frac{1}{11,75} (112,81 - 65)$$

$$\mathbf{B^0 = 4,069 \text{ kN}}$$

$$\sum M_B = 0 \Rightarrow -A^0 \cdot 11,75 + 65 + 10 \cdot 4,75 \cdot 9,375 = 0 \Rightarrow A = \frac{1}{11,75} (510,31)$$

$$\mathbf{A^0 = 43,431 \text{ kN}}$$

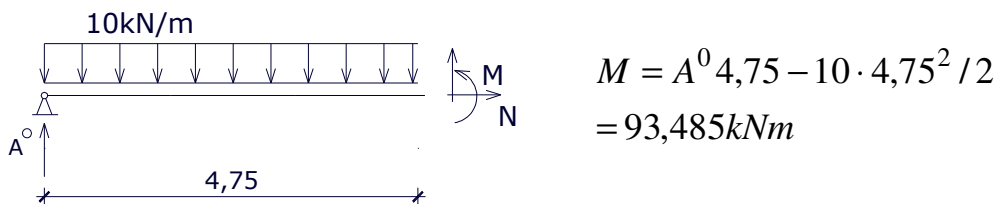
$$\sum F_x = 0 \Rightarrow \mathbf{A^H = 0 \text{ kN}}$$

Kontrola:

$$\sum F_y = 0 \Rightarrow A^0 - q \cdot 4,75 + B^0 = 0 \Rightarrow 43,431 + 4,069 - 47,5 = 0$$

$$\mathbf{0 = 0}$$

## MOMENT U KARAKTERISTIČNOJ TOČKI



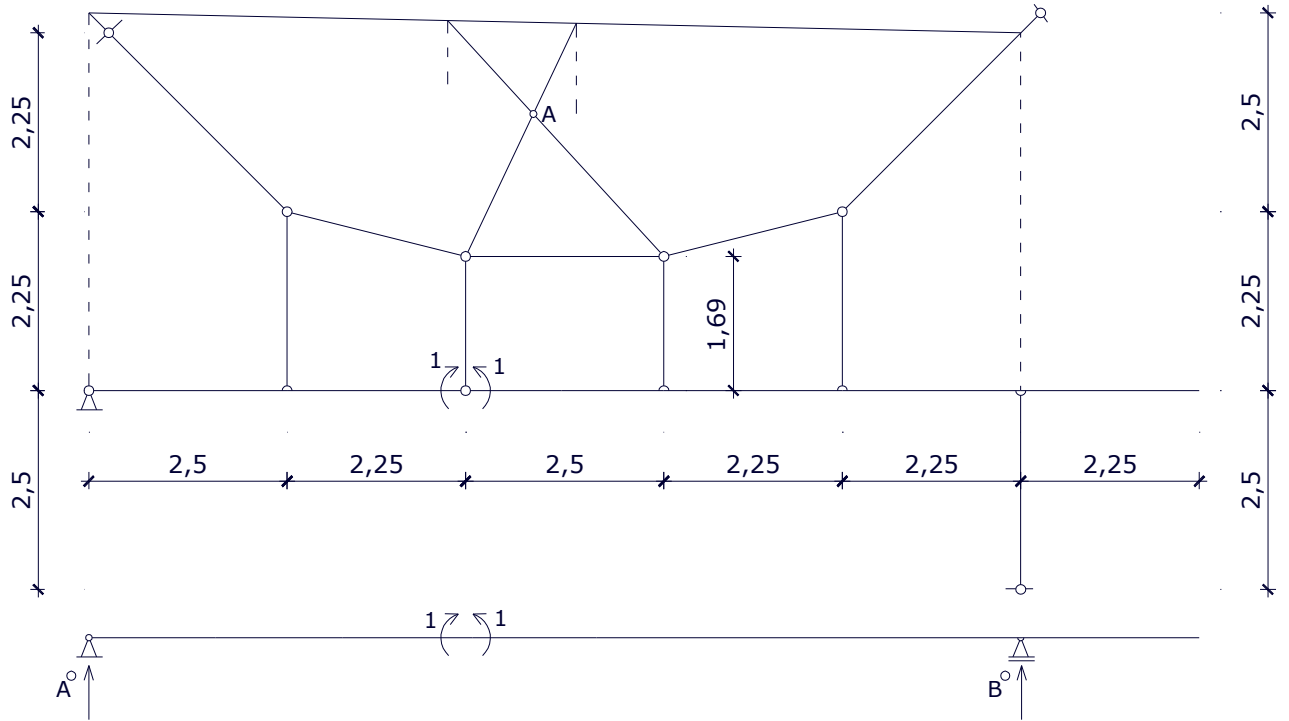
$$M = A^0 \cdot 4,75 - 10 \cdot 4,75^2 / 2$$
$$= 93,485 \text{ kNm}$$

## PROVJES PARABOLE (q=10kN/m')

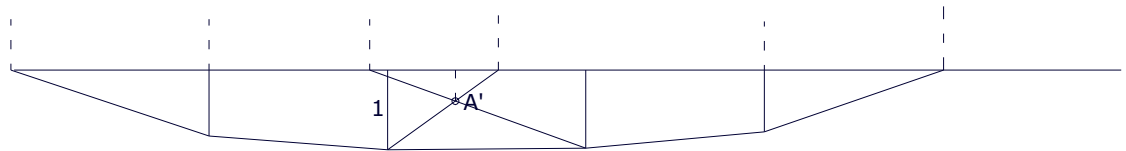
Raspona 4,75m

$$f = \frac{ql^2}{8} = \frac{10 \cdot 4,75^2}{8} = 28,203 \text{ kNm}$$

# ODREĐIVANJE DIJAGRAMA $m_1$

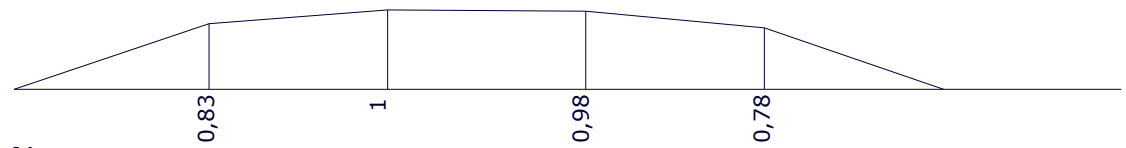


$m_{01}$

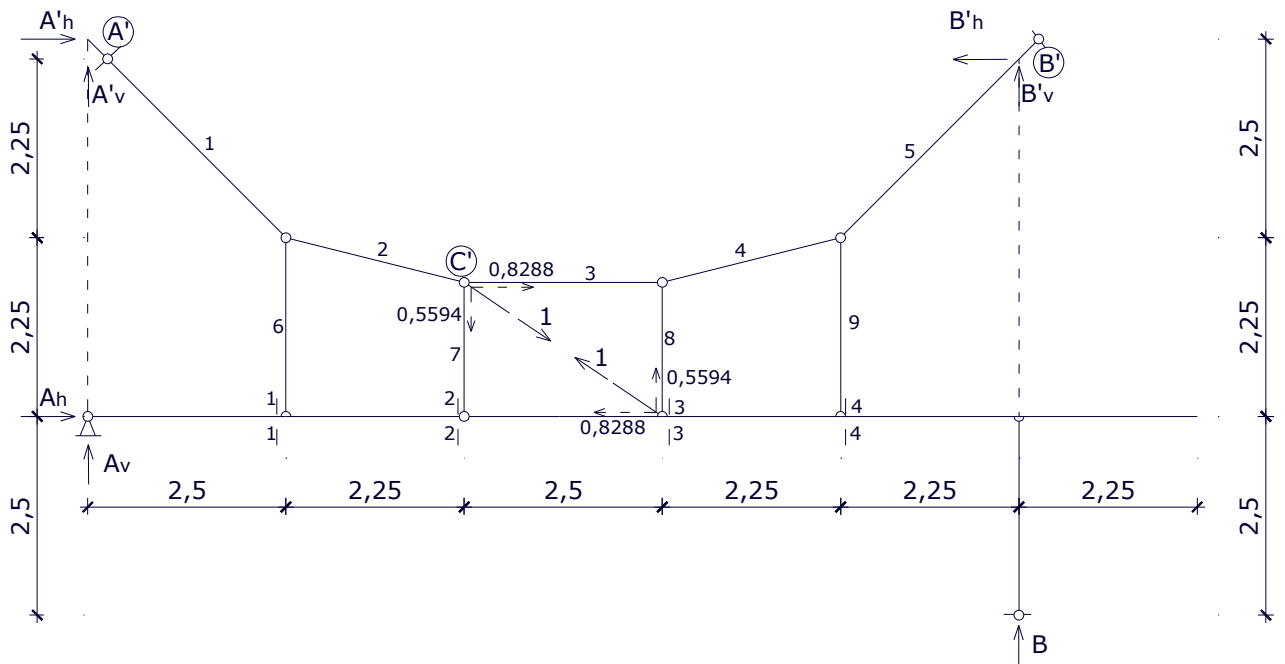


$m_1$

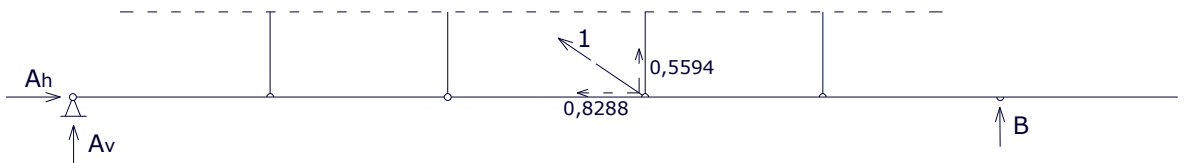
MJ  
1cm=1kNm



## ODREĐIVANJE DIJAGRAMA $m_2$

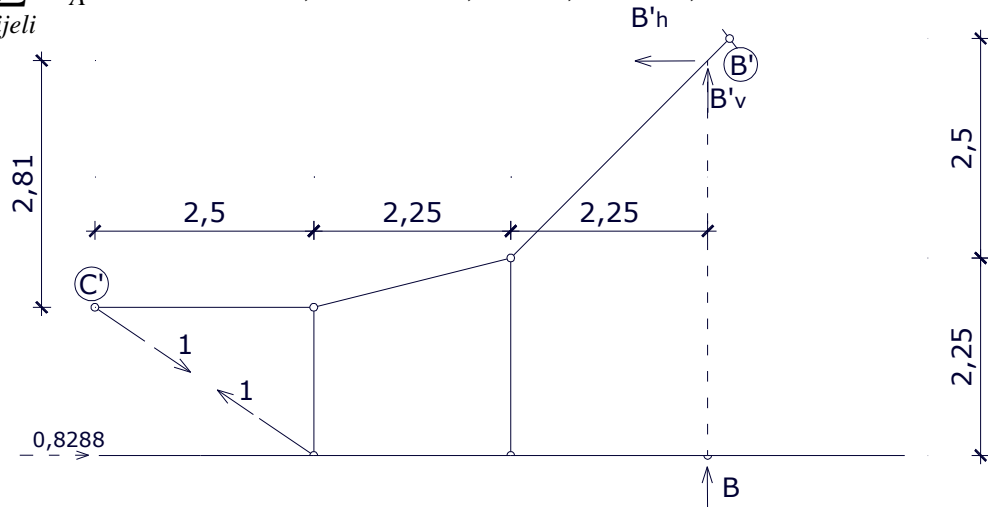


### REAKCIJE:



$$\sum F_X = 0 \Rightarrow A^h = 0,8288$$

$$\sum_{\text{cijeli}} M_{A'} = 0 \Rightarrow -B^{h'} 0,25 + B^{v'} 11,75 + 0,8288 \cdot 4,75 = 0$$



$$\sum_{\text{desno}} M_{C'} = 0 \Rightarrow B^{v'} 7,0 + B^{h'} 2,8125 + 0,8288 \cdot 1,6875 = 0$$

$$\Rightarrow B^{h'} = -(2,488B^{v'} + 0,4973)$$

-uvrstimo u gornju jednađbu

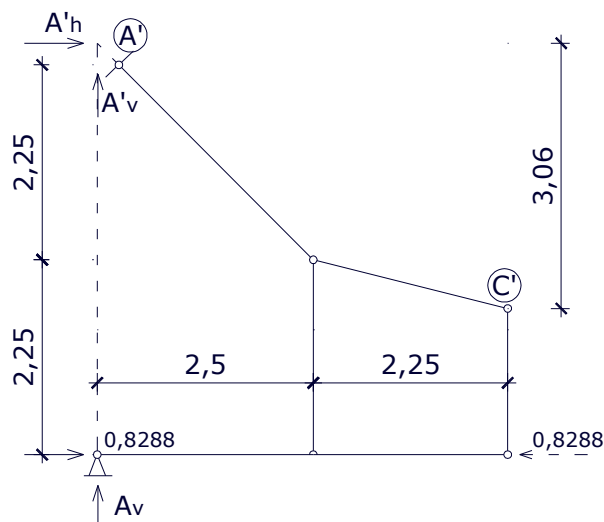
$$0,25(2,48B^{iv} + 0,4973) + B^{iv}11,75 = -3,9370$$

$$12,3722B^{iv} = -4,0613$$

$$B^{iv} = -0,3282$$

$$B^{ih} = 0,3167$$

$$\sum_{cijeli} M_{B'} = 0 \Rightarrow -A^{ih}0,25 - A^{iv}11,75 + 0,8288 \cdot 4,75 = 0$$



$$\sum_{ljevo} M_{C'} = 0 \Rightarrow -A^{ih}3,0625 - A^{iv}4,75 = 0 \Rightarrow A^{iv} = -0,6447A^{ih}$$

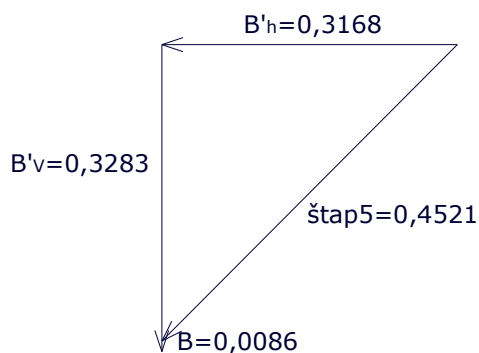
-uvrstimo u gornju jednadžbu

$$7,3256A^{ih} = -3,7298$$

$$A^{ih} = -0,5091$$

$$A^{iv} = 0,3283$$

### SILE A<sup>v</sup>, B, štap 1, štap 5



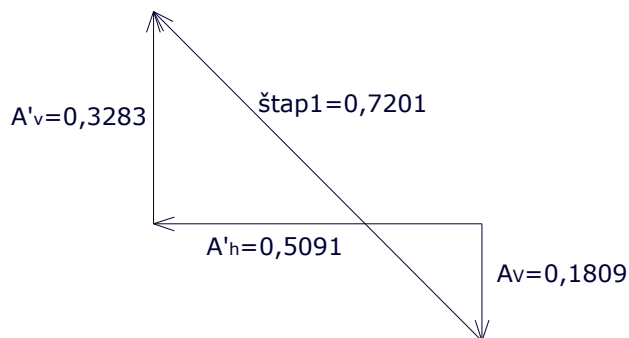
uvjet:

$$\vec{B}^{ih} + \vec{B}^{iv} = \vec{\text{štap5}} + \vec{B}$$

očitano(AutoCAD):

$$\check{S}5 = 0,4521(\text{tlak})$$

$$B = 0,0086 \downarrow$$



uvjet:

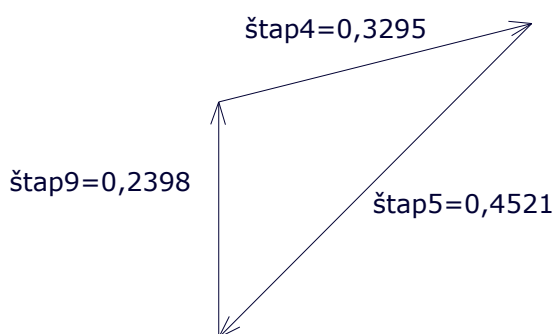
$$\vec{A}^h + \vec{A}^v = \vec{\text{štap1}} + \vec{A}^v$$

očitano(AutoCAD):

$$\check{S}1 = 0,7201(\text{vlak})$$

$$A^v = 0,1809 \downarrow$$

## SILE 4,6,8,9



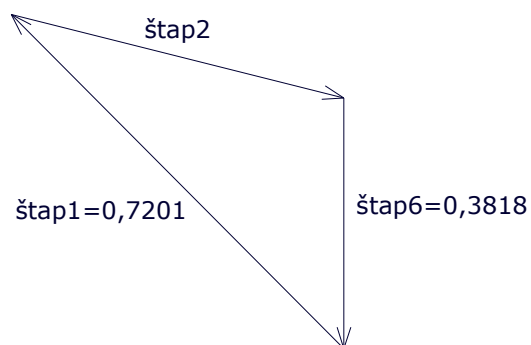
uvjet(ravnoteža čvora):

$$\vec{4} + \vec{5} + \vec{9} = 0$$

očitano(AutoCAD):

$$\check{S}9 = 0,2398(\text{tlak})$$

$$\check{S}4 = 0,3295(\text{tlak})$$



uvjet(ravnoteža čvora):

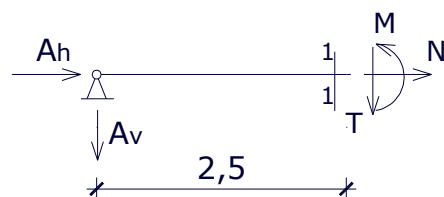
$$\vec{1} + \vec{2} + \vec{6} = 0$$

očitano(AutoCAD):

$$\check{S}6 = 0,3818(\text{vlak})$$

## MOMENTI U KARAKTERISTIČNIM TOČKAMA

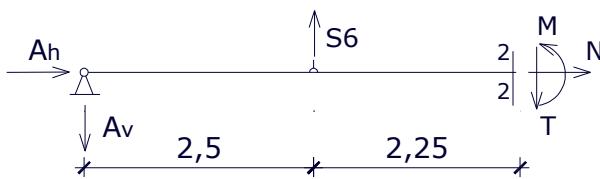
### Presjek 1-1



$$M_1 = -A_v \cdot 2,5 = -0,4522$$

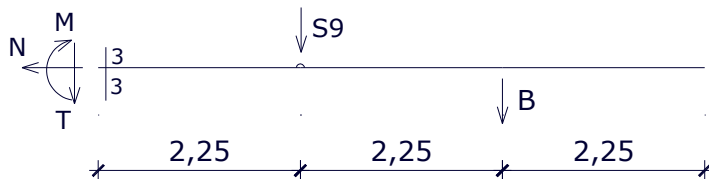


### Presjek 2-2 (kontrola)



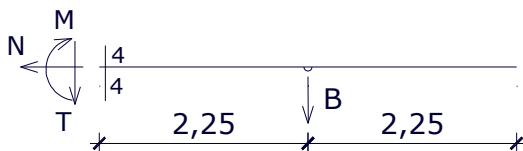
$$M_2 = -A_v \cdot 4,75 + S_6 \cdot 2,25 = 0 \Rightarrow 0 = 0$$

### Presjek 3-3



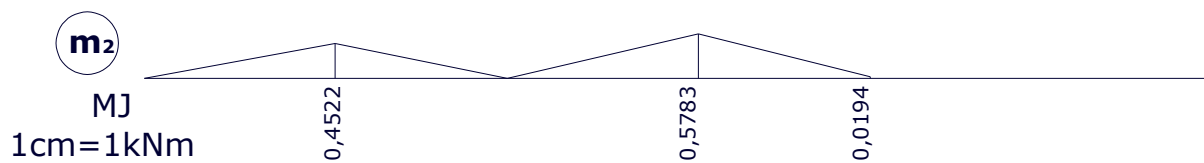
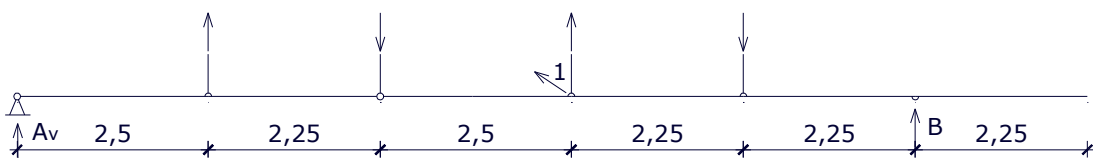
$$M_3 = -B \cdot 4,5 - S_9 \cdot 2,25 = -0,5783$$

### Presjek 4-4



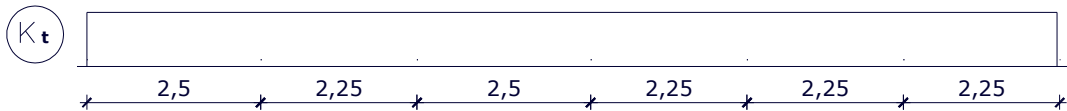
$$M_4 = -B \cdot 2,25 = -0,0194$$

### DIJAGRAM m<sub>2</sub>



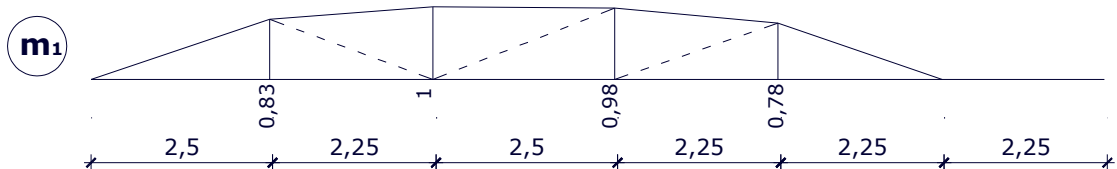
## UTJECAJ TEMPERATURE (dijagram $\kappa_t$ )

$$\kappa_t = \alpha_t \frac{\Delta t}{h} = 10^{-5} \frac{20 - (-20)}{0,72} = 5,56 \cdot 10^{-4}$$



## KOEFICIJENTI POPUSTLJIVOSTI

### Koeficijent $\delta_{11}$



$$\delta_{11} = \int \frac{m_1^2}{E_1 I_1} dx$$

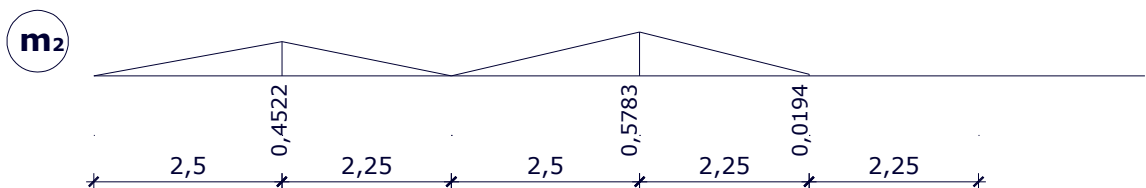
$$\delta_{11} = \frac{1}{E_1 I_1} \left[ \left( 0,83 \cdot \frac{2,5}{2} \right) \left( 0,83 \cdot \frac{2}{3} \right) + \left( 0,83 \cdot \frac{2,25}{2} \right) \left( 0,83 \cdot \frac{2}{3} + \frac{1}{3} \right) + \left( \frac{2,25}{2} \right) \left( \frac{2}{3} + \frac{0,83}{3} \right) + \right.$$

$$\left. \left( 1 \cdot \frac{2,5}{2} \right) \left( 1 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,98 \right) + \left( 0,98 \cdot \frac{2,5}{2} \right) \left( 0,98 \cdot \frac{2}{3} + \frac{1}{3} \right) + \left( 0,98 \cdot \frac{2,25}{2} \right) \left( \frac{2 \cdot 0,92}{3} + \frac{0,78}{3} \right) + \right.$$

$$\left. \left( 0,78 \cdot \frac{2,25}{2} \right) \left( 0,78 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,98 \right) + \left( 0,78 \cdot \frac{2,25}{2} \right) \left( \frac{2}{3} \cdot 0,78 \right) \right] = \frac{1}{E_1 I_1} (0,57408 + 0,82792 +$$

$$1,06125 + 1,24166 + 1,20866 + 1,00695 + 0,74879 + 0,4563) = \frac{7,12668}{E_1 I_1}$$

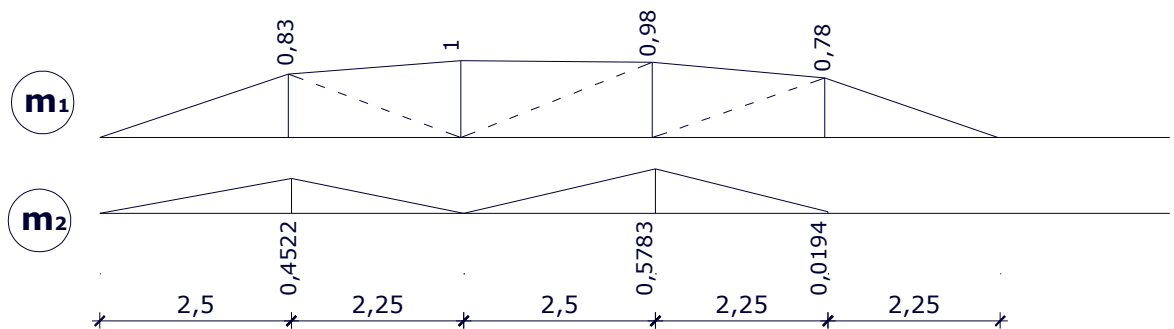
### Koeficijent $\delta_{22}$



$$\delta_{22} = \int \frac{m_2^2}{E_1 I_1} dx$$

$$\begin{aligned} \delta_{22} = \frac{1}{E_1 I_1} & \left[ \left( 0,4522 \cdot \frac{2,5}{2} \right) \left( 0,4522 \cdot \frac{2}{3} \right) + \left( 0,4522 \cdot \frac{2,25}{2} \right) \left( 0,4522 \cdot \frac{2}{3} \right) + \right. \\ & \left( 0,5783 \cdot \frac{2,5}{2} \right) \left( 0,5783 \cdot \frac{2}{3} \right) + \left( 0,5783 \cdot \frac{2,25}{2} \right) \left( 0,5783 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,0194 \right) + \\ & \left. \left( 0,0194 \cdot \frac{2,25}{2} \right) \left( 0,0194 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,5783 \right) + \left( 0,0194 \cdot \frac{2,25}{2} \right) \left( 0,0194 \cdot \frac{2}{3} \right) \right] = \\ \frac{1}{E_1 I_1} (0,17041 + 0,15336 + 0,27869 + 0,2550 + 0,00449 + 0,00029) & = \frac{0,86226}{E_1 I_1} \end{aligned}$$

### **Koeficient $\delta_{12} = \delta_{21}$**



$$\delta_{12} = \int \frac{m_1 m_2}{E_1 I_1} dx = \int \frac{m_2 m_1}{E_1 I_1} dx = \delta_{21}$$

$$\begin{aligned} \delta_{12} = \frac{1}{E_1 I_1} & \left[ \left( 0,83 \cdot \frac{2,5}{2} \right) \left( 0,4522 \cdot \frac{2}{3} \right) + \left( 0,83 \cdot \frac{2,25}{2} \right) \left( 0,4522 \cdot \frac{2}{3} \right) + \right. \\ & \left( 1 \cdot \frac{2,25}{2} \right) \left( 0,4522 \cdot \frac{1}{3} \right) + \left( 1 \cdot \frac{2,5}{2} \right) \left( 0,5783 \cdot \frac{1}{3} \right) + \left( 0,98 \cdot \frac{2,5}{2} \right) \left( 0,5783 \cdot \frac{2}{3} \right) \\ & + \left( 0,98 \cdot \frac{2,25}{2} \right) \left( 0,5783 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,0194 \right) + \left( 0,78 \cdot \frac{2,25}{2} \right) \left( 0,0194 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,5783 \right) \\ & \left. \left( 0,78 \cdot \frac{2,25}{2} \right) \left( 0,0194 \cdot \frac{2}{3} \right) \right] = \frac{1}{E_1 I_1} (0,31277 + 0,28149 + 0,16957 + 0,24096 + \end{aligned}$$

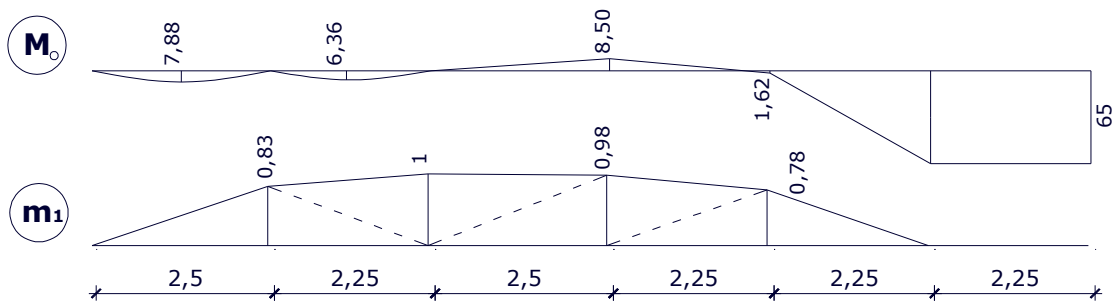
$$+ 0,47228 + 0,43218 + 0,18050 + 0,011349) = \frac{2,1011}{E_1 I_1}$$

## SLOBODNI ČLANOVI

### Član $\delta_{10}$

$$\delta_{10} = \delta_{10}^v + \delta_{10}^t = \int \frac{m_1 M_0}{E_1 I_1} dx + \int m_1 \kappa_t dx$$

Član  $\delta_{10}^v$  (utjecaj zadanog opterećenja):



$$\delta_{10}^v = \int \frac{m_1 M_0}{E_1 I_1} dx$$

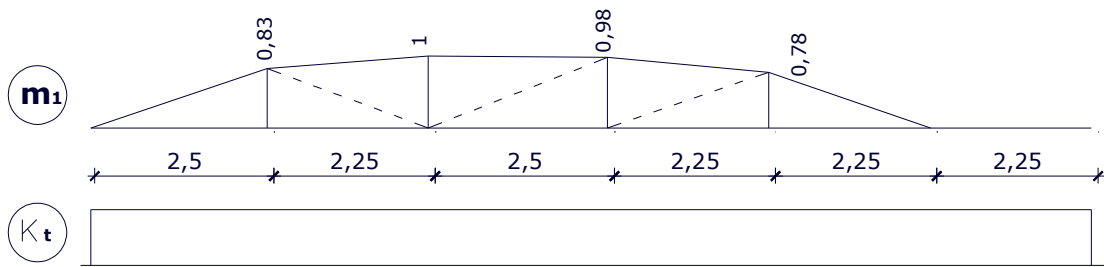
$$\delta_{10}^v = \frac{1}{E_1 I_1} \left[ \left( 7,88 \cdot 2,5 \cdot \frac{2}{3} \right) \left( -0,83 \cdot \frac{1}{2} \right) + \left( 6,36 \cdot 2,25 \cdot \frac{2}{3} \right) \left( -\frac{1}{2} - \frac{0,83}{2} \right) + \right.$$

$$\left. \left( 8,5 \cdot \frac{2,5}{2} \right) \left( \frac{1}{3} + 0,98 \cdot \frac{2}{3} \right) + \left( 8,5 \cdot \frac{2,25}{2} \right) \left( 0,98 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,78 \right) + \left( 1,62 \cdot \frac{2,25}{2} \right) \left( -\frac{0,98}{3} - \frac{2}{3} \cdot 0,78 \right) \right.$$

$$\left. + \left( 1,62 \cdot \frac{2,5}{2} \right) \left( -0,78 \cdot \frac{2}{3} \right) + \left( 65 \cdot \frac{2,25}{2} \right) \left( -\frac{1}{3} \cdot 0,78 \right) \right] = \frac{1}{E_1 I_1} (-5,450 - 8,729 + 10,483 +$$

$$8,734 - 1,543 - 0,948 - 19,012) = \frac{-16,466}{E_1 I_1}$$

Član  $\delta_{10}^t$  (utjecaj temperature):



$$\delta_{10}^t = \int m_1 \kappa_t dx \quad \kappa_t = \alpha_t \frac{\Delta t}{h} = 10^{-5} \frac{20 - (-20)}{0,72} = 5,56 \cdot 10^{-4}$$

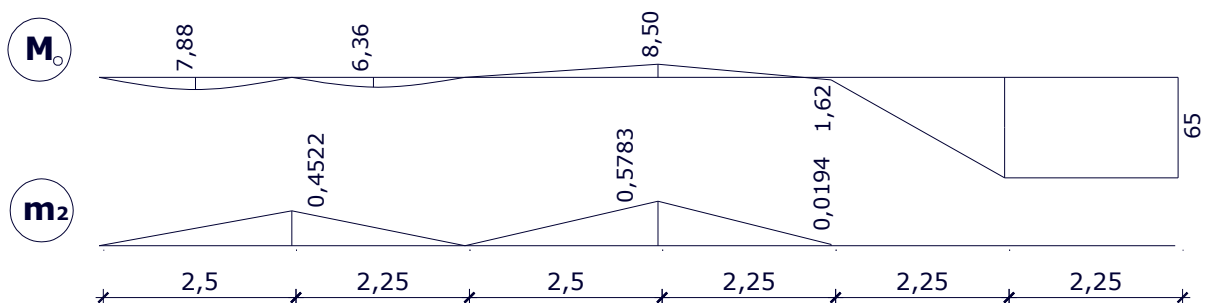
$$\begin{aligned} \delta_{10}^t &= \kappa_t \left( 0,83 \cdot \frac{2,5}{2} + 0,83 \cdot \frac{2,25}{2} + 1 \cdot \frac{2,25}{2} + 1 \cdot \frac{2,5}{2} + 0,98 \cdot \frac{2,5}{2} + 0,98 \cdot \frac{2,25}{2} + \right. \\ &0,78 \cdot \frac{2,25}{2} + 0,78 \cdot \frac{2,25}{2} \left. \right) = \kappa_t (1,037 + 0,933 + 1,125 + 1,25 + 1,225 + 1,1025 + 0,875 \cdot 2) \\ &= \kappa_t \cdot 8,429 \end{aligned}$$

$$\text{Član } \delta_{10} = \frac{-16,466}{E_1 I_1} + 8,429 \kappa_t$$

**Član  $\delta_{20}$**

$$\delta_{20} = \delta_{20}^v + \delta_{20}^t = \int \frac{m_2 M_0}{E_1 I_1} dx + \int m_2 \kappa_t dx$$

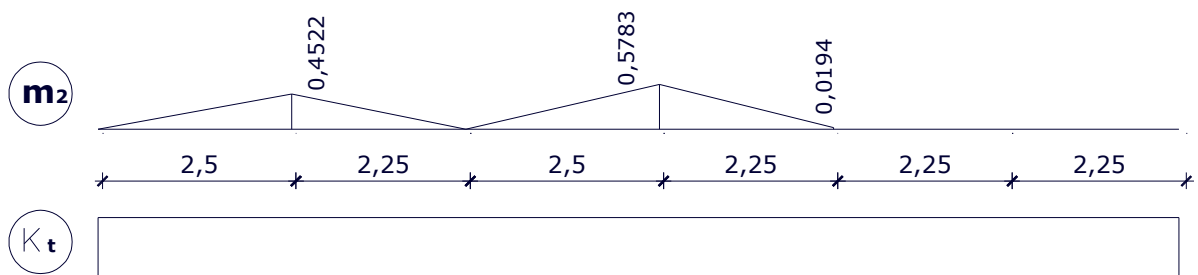
Član  $\delta_{20}^v$  (utjecaj zadanog opterećenja):



$$\delta_{20}^v = \int \frac{m_2 M_0}{E_1 I_1} dx$$

$$\begin{aligned}
\delta_{20}^v &= \frac{1}{E_1 I_1} \left[ \left( 7,88 \cdot 2,5 \cdot \frac{2}{3} \right) \left( -0,4522 \cdot \frac{1}{2} \right) + \left( 6,36 \cdot 2,25 \cdot \frac{2}{3} \right) \left( -\frac{1}{2} \cdot 0,4522 \right) + \right. \\
&\quad \left. \left( 8,5 \cdot \frac{2,5}{2} \right) \left( 0,5783 \cdot \frac{2}{3} \right) + \left( 8,5 \cdot \frac{2,25}{2} \right) \left( 0,5783 \cdot \frac{2}{3} + \frac{1}{3} \cdot 0,0194 \right) + \right. \\
&\quad \left. \left( 1,62 \cdot \frac{2,5}{2} \right) \left( -0,0194 \cdot \frac{2}{3} - \frac{1}{3} \cdot 0,5783 \right) + \left( 65 \cdot \frac{2,25}{2} \right) \left( -\frac{1}{3} \cdot 0,0194 \right) \right] \\
&= \frac{1}{E_1 I_1} (-2,9694 - 2,1569 + 4,0962 + 3,7485 - 0,3749 - 0,4728) \\
&= \frac{1,8706}{E_1 I_1}
\end{aligned}$$

Član  $\delta_{20}^t$  (utjecaj temperature):



$$\delta_{20}^t = \int m_2 \kappa_t dx \quad \kappa_t = \alpha_t \frac{\Delta t}{h} = 10^{-5} \frac{20 - (-20)}{0,72} = 5,56 \cdot 10^{-4}$$

$$\begin{aligned}
\delta_{10}^t &= \kappa_t \left( 0,4522 \cdot \frac{2,5}{2} + 0,4522 \cdot \frac{2,25}{2} + 0,5783 \cdot \frac{2,5}{2} + 0,5783 \cdot \frac{2,25}{2} + 0,0194 \cdot \frac{2,25}{2} \right) \\
&= \kappa_t (0,5653 + 0,5087 + 0,7228 + 0,6506 + 0,0218) \\
&= \kappa_t \cdot 2,4693
\end{aligned}$$

$$\text{Član } \delta_{20} = \frac{1,8706}{E_1 I_1} + 2,4693 \kappa_t$$

## JEDNADŽBE KONTINUITETA

$$\delta_{11}X_1 + \delta_{12}X_2 + \delta_{10} = 0$$

$$\delta_{21}X_1 + \delta_{22}X_2 + \delta_{20} = 0$$

---

$$7,12668X_1 + 2,1011X_2 + E_1I_1\kappa_t \cdot 8,429 - 16,466 = 0$$

$$2,1011X_1 + 0,86226X_2 + E_1I_1\kappa_t \cdot 2,4693 + 1,8706 = 0$$

---

$$7,12668X_1 + 2,1011X_2 = -1573,054 + 16,466$$

$$2,1011X_1 + 0,86226X_2 = -460,8306 - 1,8706$$

---

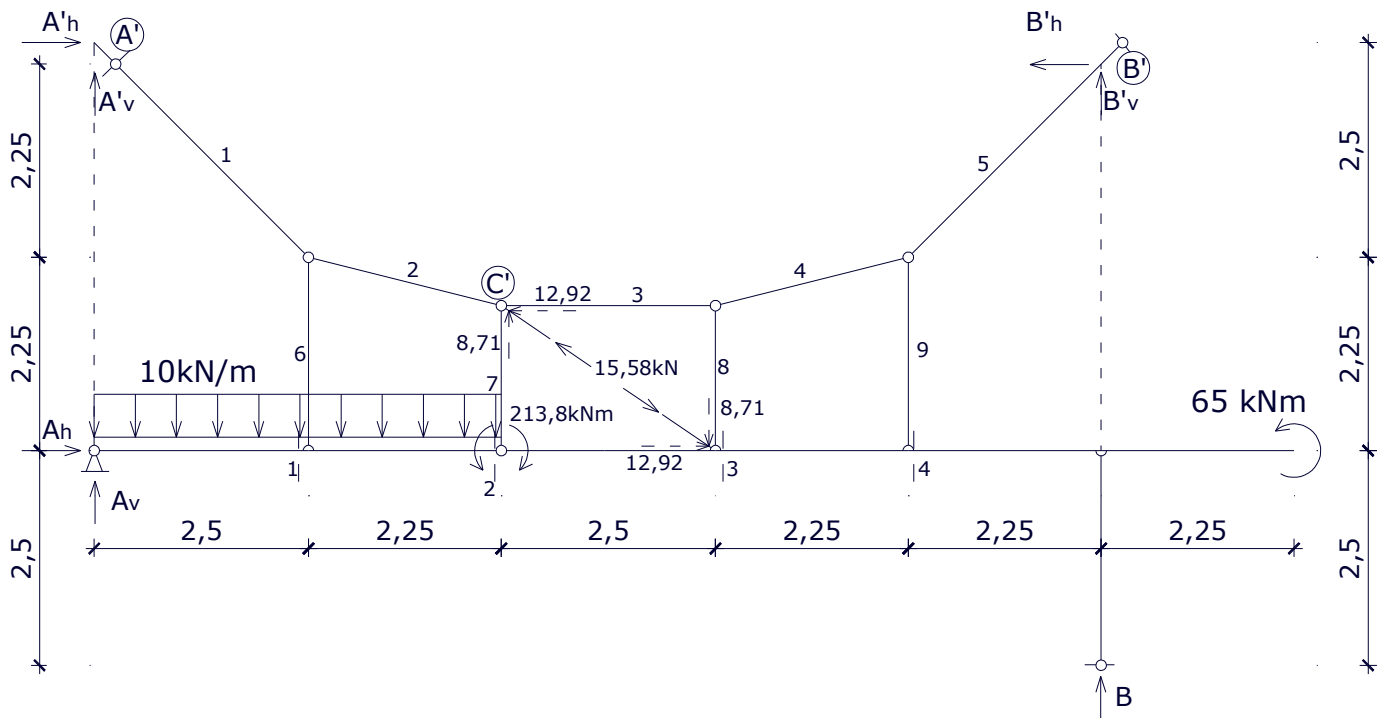
$$X_1 = -220,218 - 0,4104X_2 - \text{iz druge jednadžbe, uvrstimo u prvu}$$
$$-1569,423 - 2,9248X_2 + 2,1011X_2 = -1556,59$$

$$X_2 = \frac{12,833}{-0,8237} = -15,58kN$$

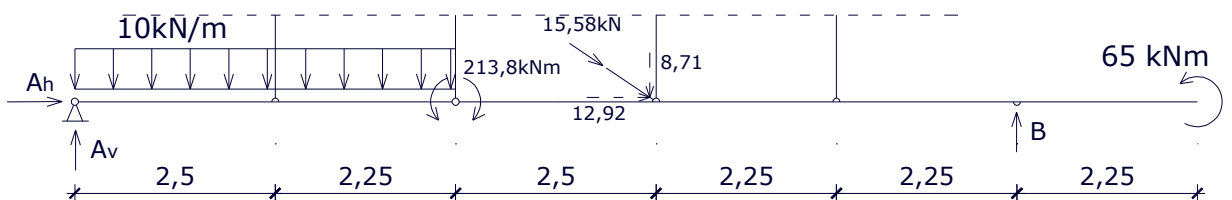
$$X_1 = -220,218 - 0,4104 \cdot (-15,58) = -213,8kNm$$

**Rješenje:  $X_1 = -213,8kNm$ ;  $X_2 = -15,58kN$**

# Rješavanje osnovnog sistema opterećenog zadanim opterećenjem i silama $X_1, X_2$

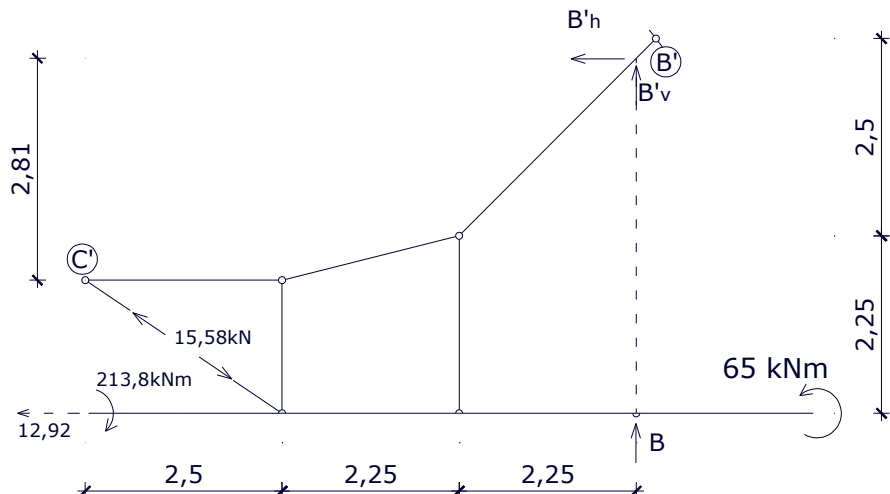


## REAKCIJE:



$$\sum F_X = 0 \Rightarrow A^h = -12,92 \text{ kN}$$

$$\sum_{\text{cijeli}} M_{A'} = 0 \Rightarrow -B'^h \cdot 0,25 + B'^v \cdot 11,75 + 65 - 10 \cdot \frac{4,75^2}{2} = 0$$





$$\sum_{\text{desno}} M_{C'} = 0 \Rightarrow B^{iv} 7,0 + B^{ih} 2,8125 - 12,92 \cdot 1,6875 + 65 - 213,8 = 0$$

$$\Rightarrow B^{ih} = -2,488B^{iv} + 60,658$$

-uvrstimo u gornju jednađbu

---

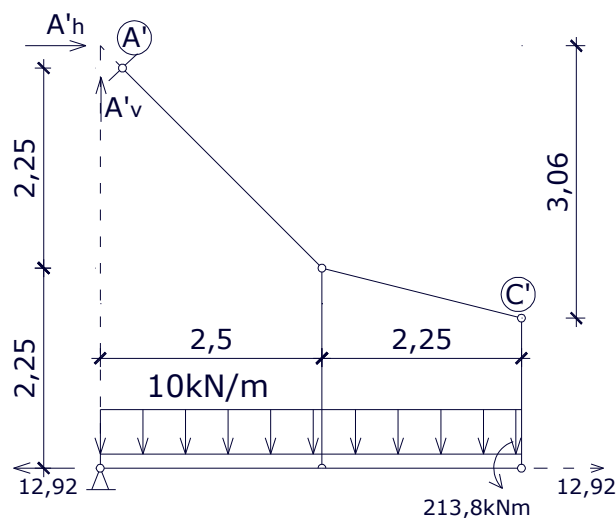
$$0,25(2,48B^{iv} - 60,658) + B^{iv} 11,75 = 47,812$$

$$12,3722B^{iv} = 62,977$$

$$B^{iv} = 5,09 \text{ kN}$$

$$B^{ih} = 47,989 \text{ kN}$$

$$\sum_{\text{cijeli}} M_{B'} = 0 \Rightarrow -A^{ih} 0,25 - A^{iv} 11,75 + 65 + 10 \cdot 4,75 \cdot 9,375 = 0$$



$$\sum_{\text{ljevo}} M_{C'} = 0 \Rightarrow$$

$$-A^{ih} 3,0625 - A^{iv} 4,75 + 213,8 + 10 \cdot \frac{4,75^2}{2} = 0 \Rightarrow A^{iv} = -0,6447A^{ih} + 68,76$$

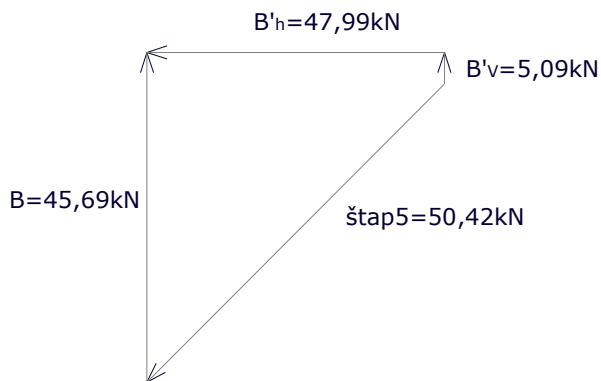
-uvrstimo u gornju jednađbu

$$-7,3256A^{ih} = -297,623$$

$$A^{ih} = 40,628 \text{ kN}$$

$$A^{iv} = 42,566 \text{ kN}$$

## SILE A<sup>v</sup>, B, štap 1, štap 5



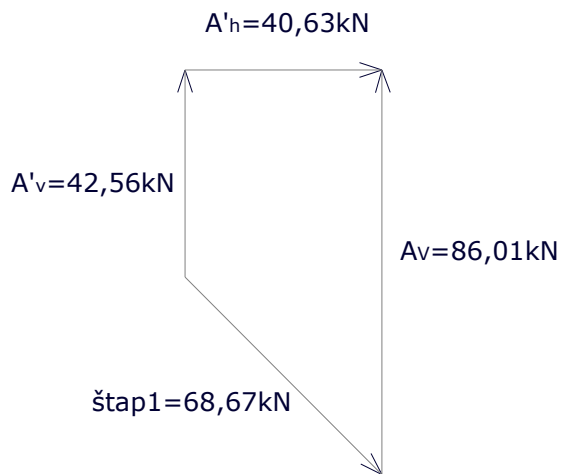
uvjet:

$$\vec{B}^h + \vec{B}^v = \vec{\text{štap5}} + \vec{B}$$

očitano(AutoCAD):

$$\check{S}5 = 50,42 \text{ kN (tlak)}$$

$$B = 45,69 \text{ kN } \uparrow$$



uvjet:

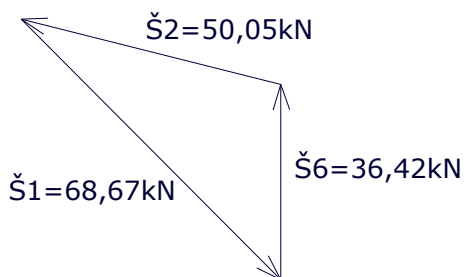
$$\vec{A}^h + \vec{A}^v = \vec{\text{štap1}} + \vec{A}^v$$

očitano(AutoCAD):

$$\check{S}1 = 68,67 \text{ kN (tlak)}$$

$$A^v = 86,01 \text{ kN } \uparrow$$

## SILE Š2, Š3, Š4, Š6, Š7, Š8, Š9



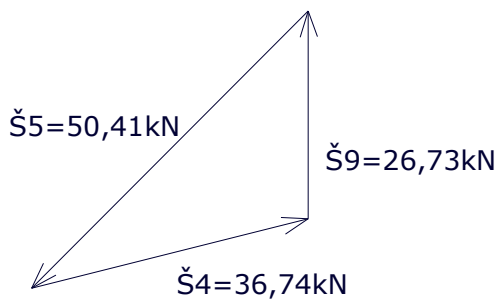
uvjet(ravnoteža čvora):

$$\vec{\check{S}}1 + \vec{\check{S}}2 + \vec{\check{S}}6 = \vec{0}$$

očitano(AutoCAD):

$$\check{S}2 = 50,05 \text{ (tlak)}$$

$$\check{S}6 = 36,42 \text{ (tlak)}$$



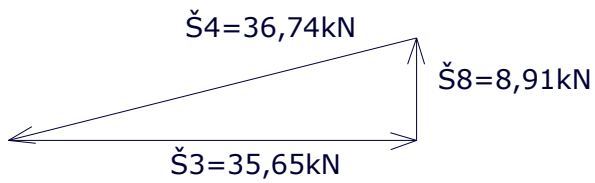
uvjet(ravnoteža čvora):

$$\vec{\check{S}}4 + \vec{\check{S}}5 + \vec{\check{S}}9 = \vec{0}$$

očitano(AutoCAD):

$$\check{S}4 = 36,74 \text{ kN (tlak)}$$

$$\check{S}9 = 26,73 \text{ kN (tlak)}$$



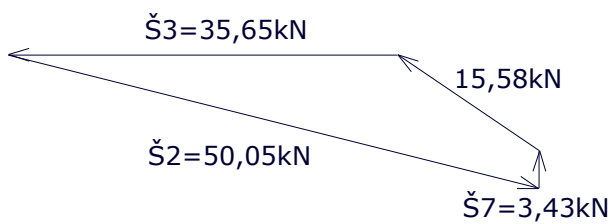
uvjet(ravnoteža čvora):

$$\vec{Š3} + \vec{Š4} + \vec{Š8} = \vec{0}$$

očitano(AutoCAD):

$$Š3 = 35,65 \text{ kN (tlak)}$$

$$Š8 = 8,91 \text{ kN (tlak)}$$



uvjet(ravnoteža čvora):

$$\vec{Š2} + \vec{Š3} + \vec{Š7} + \vec{X}_1 = \vec{0}$$

očitano(AutoCAD):

$$Š7 = 3,43 \text{ kN (tlak)}$$

### SILE U ŠTAPOVIMA:

$$Š1 = 68,67 \text{ kN}$$

$$Š2 = 50,05 \text{ kN}$$

$$Š3 = 35,65 \text{ kN}$$

$$Š4 = 36,74 \text{ kN}$$

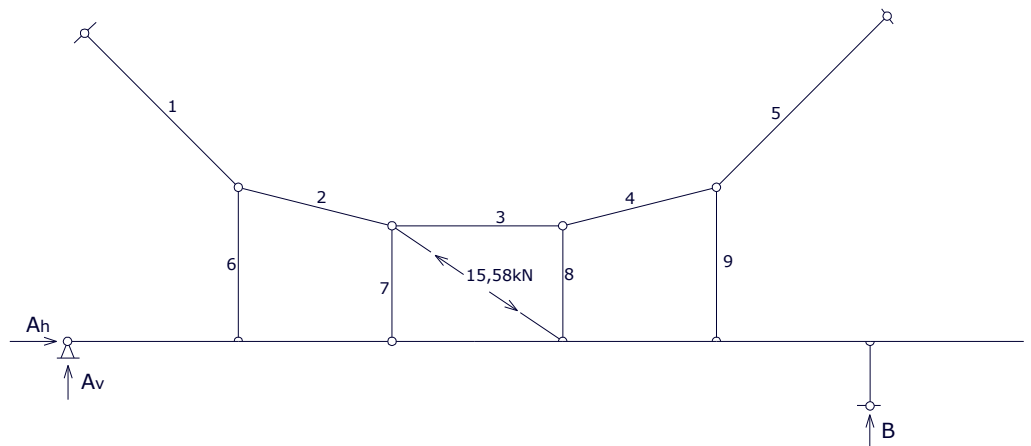
$$Š5 = 50,41 \text{ kN}$$

$$Š6 = 36,42 \text{ kN}$$

$$Š7 = 3,43 \text{ kN}$$

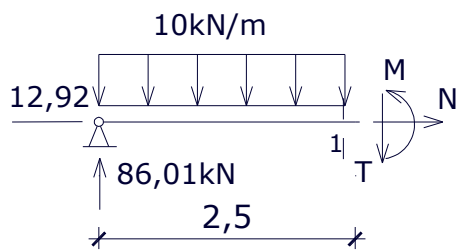
$$Š8 = 8,91 \text{ kN}$$

$$Š9 = 26,73 \text{ kN}$$



## MOMENTI U KARAKTERISTIČNIM TOČKAMA

### Presjek 1-1



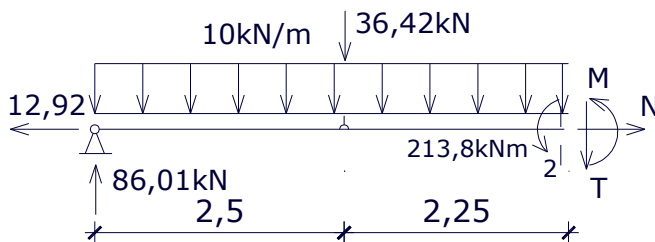
$$M = 86,01 \cdot 2,5 - 10 \frac{2,5^2}{2} = 183,78 \text{ kNm}$$

$$N = 12,92 \text{ kN}$$

$$T_L = 86,01 - 25 = 61,01 \text{ kN}$$

$$T_D = T_L - 36,42 = 24,59 \text{ kN}$$

### Presjek 2-2



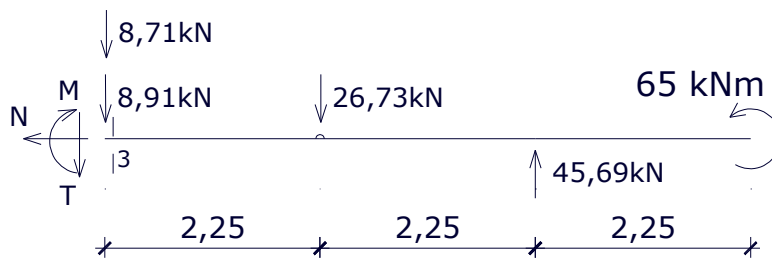
$$M = 86,01 \cdot 4,75 - 10 \frac{4,75^2}{2} - 36,42 \cdot 2,25 - 213,8 = 0 \Rightarrow 0 = 0$$

$$N = 12,92 \text{ kN}$$

$$T_L = 86,01 - 47,5 - 36,42 = 2,09 \text{ kN}$$

$$T_D = T_L - 3,43 = -1,34 \text{ kN}$$

### Presjek 3-3



$$M = 65 + 45,69 \cdot 4,5 - 26,73 \cdot 2,25 = 210,46 \text{ kNm}$$

$$N = 12,92 \text{ kN}$$

$$T_L = 8,71 + 8,91 + 26,73 - 45,69 = -1,34 \text{ kN}$$

$$T_D = T_L - 8,71 - 8,91 = -18,96 \text{ kN}$$

### Presjek 4-4



$$M = 65 + 45,69 \cdot 2,25 = 167,8 \text{ kNm}$$

$$N = 0$$

$$T_L = 26,73 - 45,69 = -18,96 \text{ kN}$$

$$T_D = T_L - 26,73 = -45,69 \text{ kN}$$

### Presjek 5-5



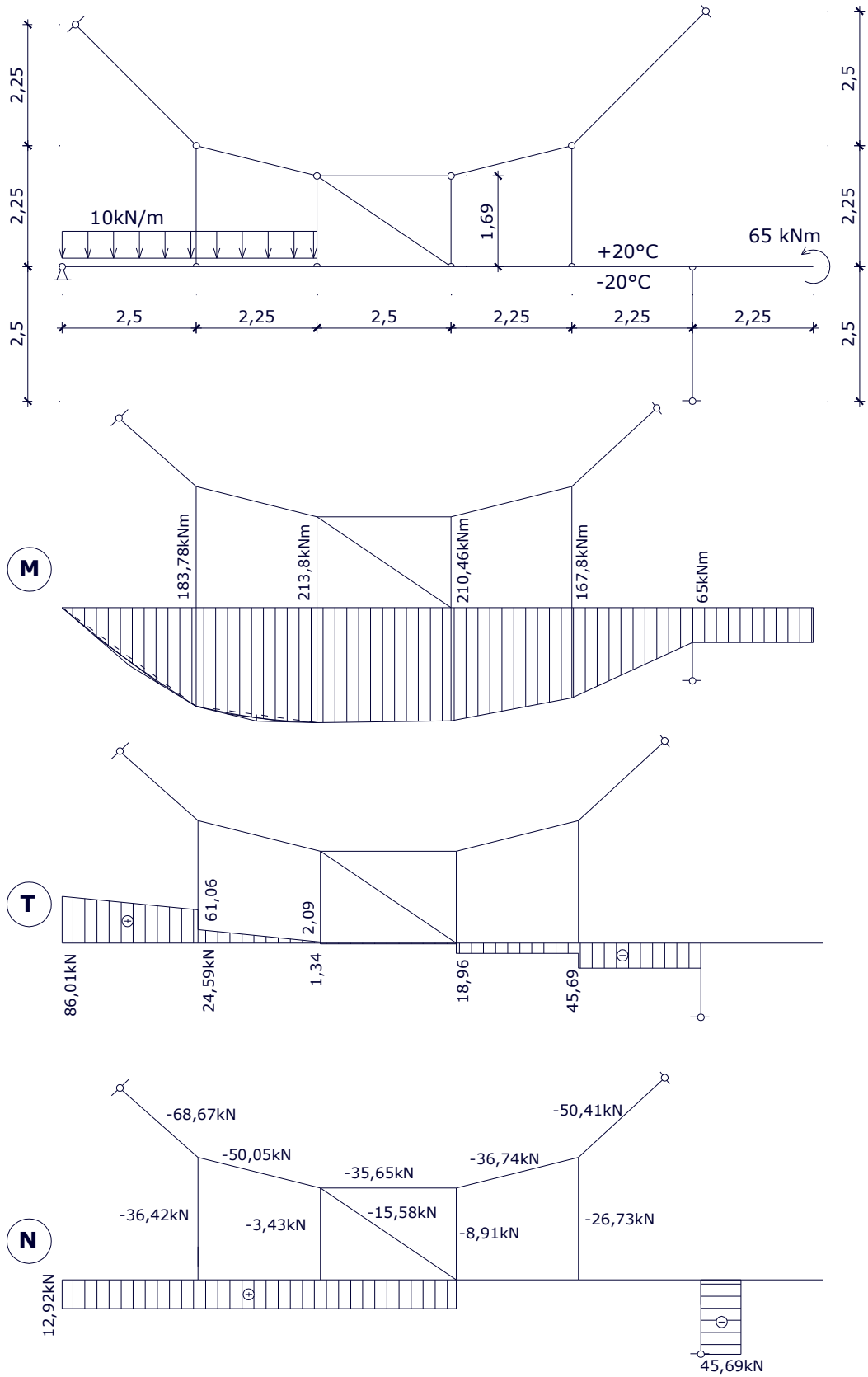
$$M = 65 \text{ kNm}$$

$$N = 0$$

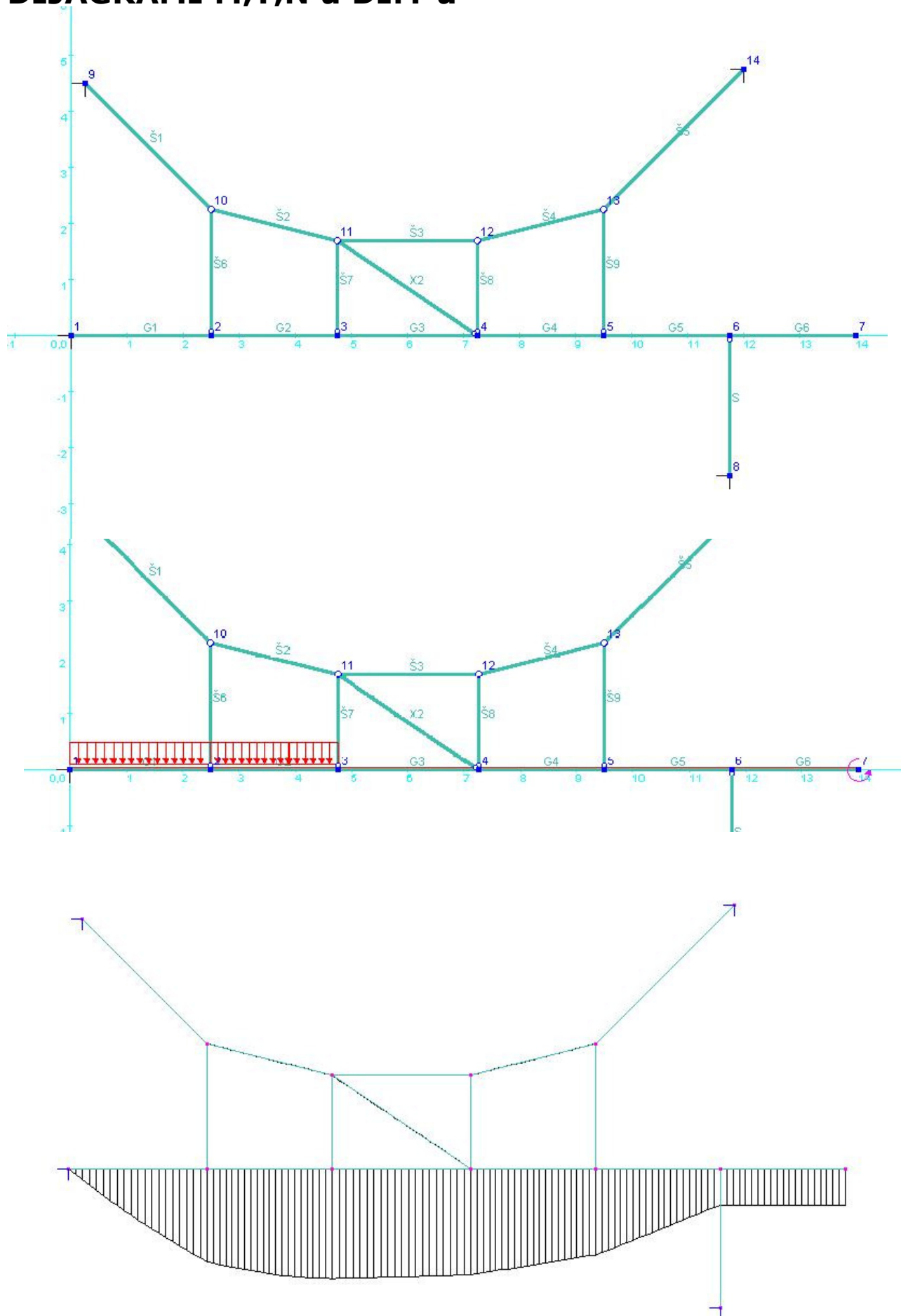
$$T_L = -45,69 \text{ kN}$$

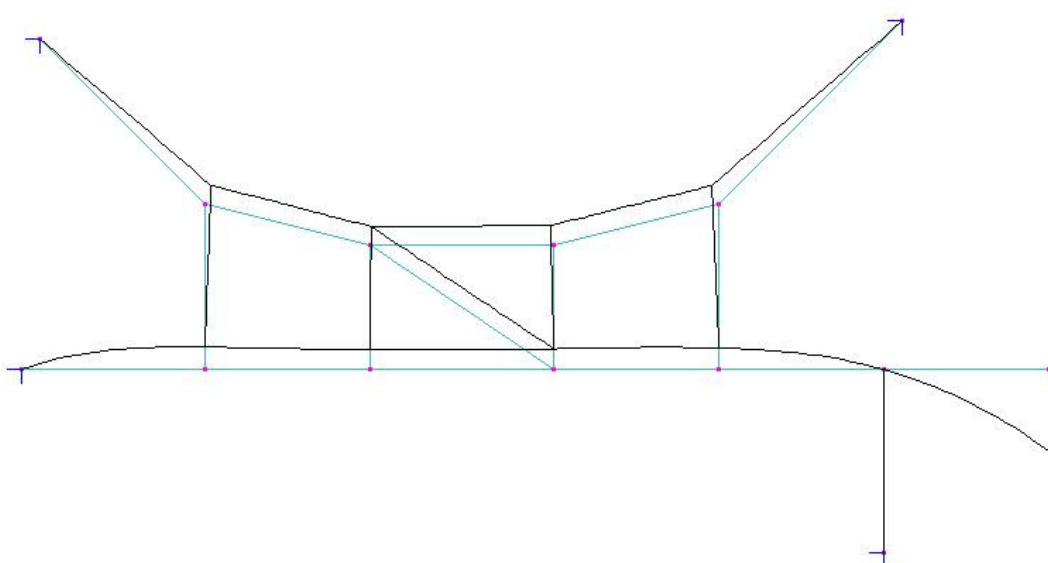
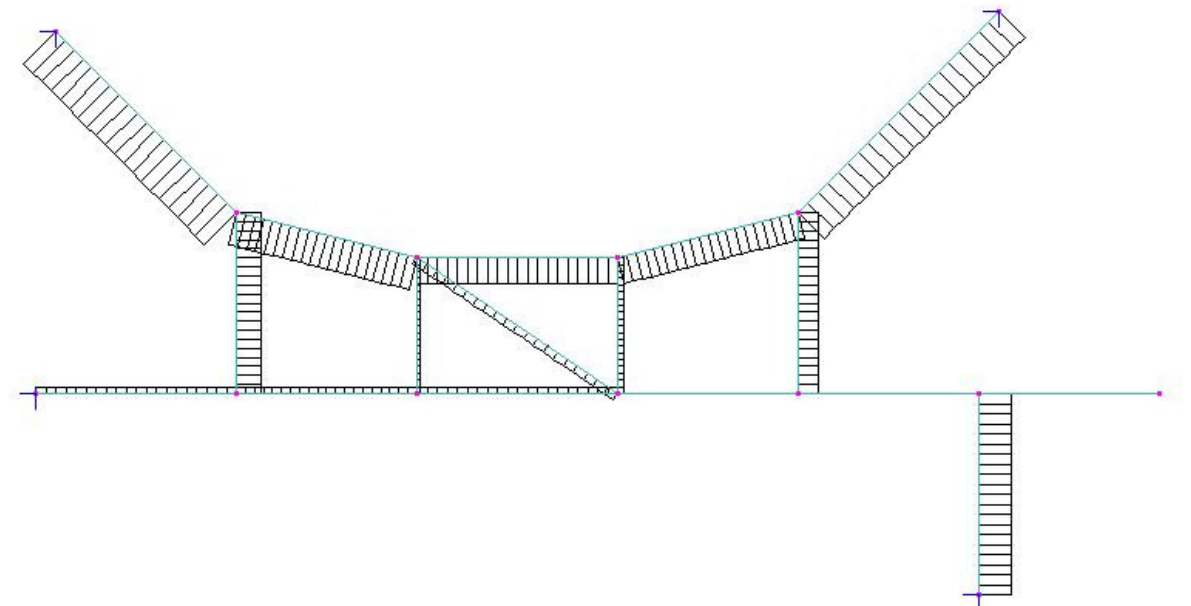
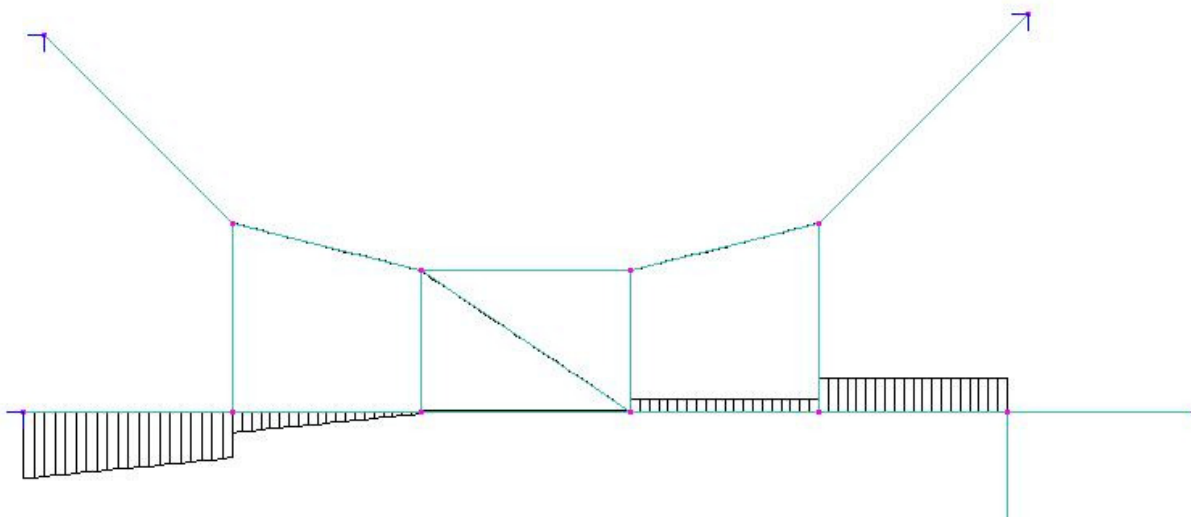
$$T_D = T_L + 45,69 = 0 \text{ kN}$$

# DIJAGRAMI M,T,N METODOM JEDINIČNE SILE



# DIJAGRAMI M,T,N u DIM-u







Degrees of Freedom: 30

Nodal displacements:

nd	u_i	v_i	phi_i
1:	0	0	0.000709341
2:	2.45579e-06	0.000604506	-1.82111e-05
3:	4.66601e-06	0.000525235	-1.87187e-05
4:	7.1218e-06	0.000557396	3.61233e-05
5:	7.1218e-06	0.000579215	-5.65953e-05
6:	7.1218e-06	-1.28493e-05	-0.00057007
7:	7.1218e-06	-0.00221197	-0.0013847
8:	0	0	-2.84872e-06
9:	0	0	0.000149143
10:	0.000159837	0.000511308	0
11:	2.44215e-05	0.00051402	0
12:	-8.71267e-05	0.000538573	0
13:	-0.000188414	0.00050392	0
14:	0	0	-0.000138467

Element end forces:

el	N_ij	T_ij	M_ij	N_ji	T_ji	M_ji
G1:	-7.6385	79.4238	0	7.6385	-54.4238	167.309
G2:	-7.6385	24.6005	-167.309	7.6385	-2.10051	197.348
G3:	-7.6385	-2.6846	-197.348	7.6385	2.6846	190.637
G4:	0	-15.8721	-190.637	0	15.8721	154.925
G5:	0	-39.9665	-154.925	0	39.9665	65
G6:	0	0	-65	0	0	65
S:	39.9665	0	0	-39.9665	0	0
Š1:	56.2353	0	0	-56.2353	0	0
Š2:	40.9882	0	0	-40.9882	0	0
Š3:	32.1259	0	0	-32.1259	0	0
Š4:	33.1146	0	0	-33.1146	0	0
Š5:	45.4328	0	0	-45.4328	0	0
Š6:	29.8233	0	0	-29.8233	0	0
Š7:	4.78511	0	0	-4.78511	0	0
Š8:	8.03147	0	0	-8.03147	0	0
Š9:	24.0944	0	0	-24.0944	0	0
X2:	9.21579	0	0	-9.21579	0	0

Reactions:

nd	R_x	R_y	M
1:	-7.6385	79.4238	
8:	0	39.9665	
9:	39.7644	-39.7644	
14:	-32.1259	-32.1259	