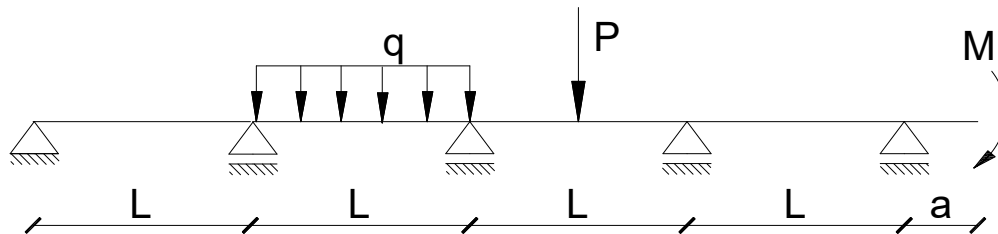


Belki ciągłe – belki statycznie niewyznaczalne na wielu podporach przegubowych.

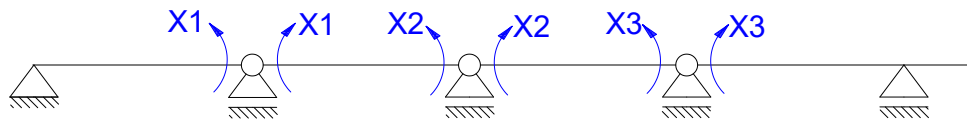
Przy tworzeniu schematu, korzystne pod względem obliczeniowym jest wprowadzanie przegubów do środkowych podpór przegubowych, ewentualnie do skrajnej jeżeli jest ona utwierdzeniem.

Wówczas do całkowania powstają nam prostsze wykresy – głównie trójkąty.

Nigdy nie wprowadzamy przegubu do skrajnej podpory przegubowej!



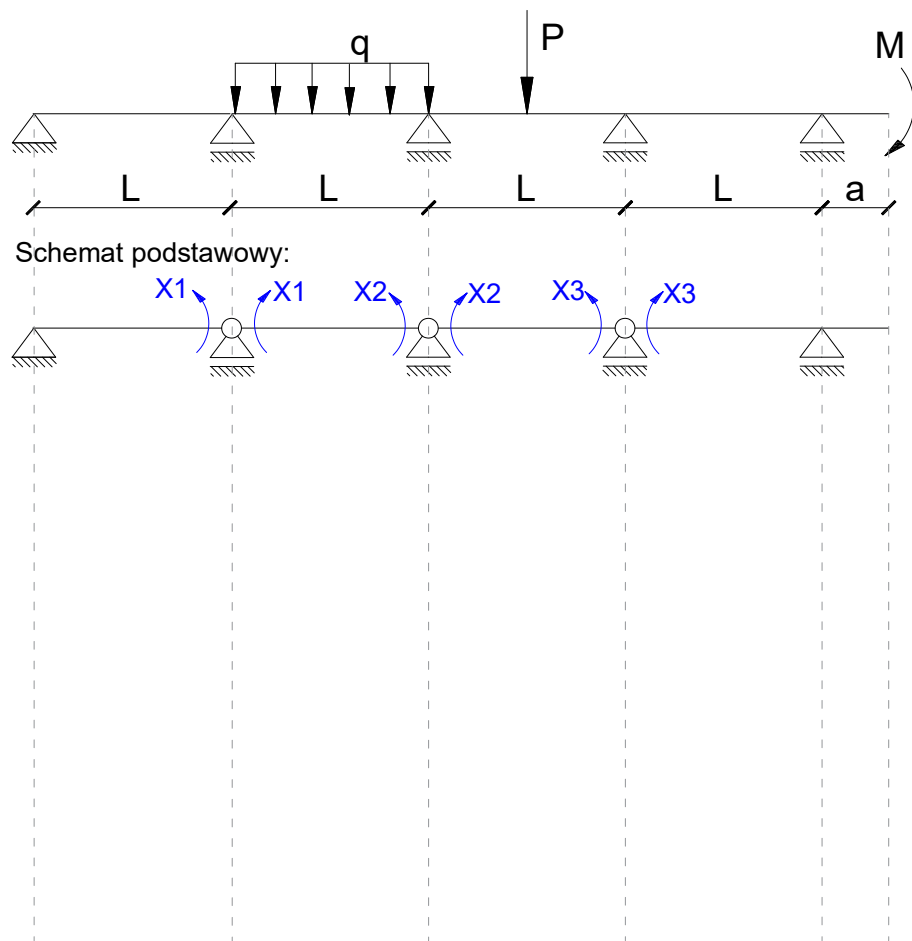
Schemat podstawowy:

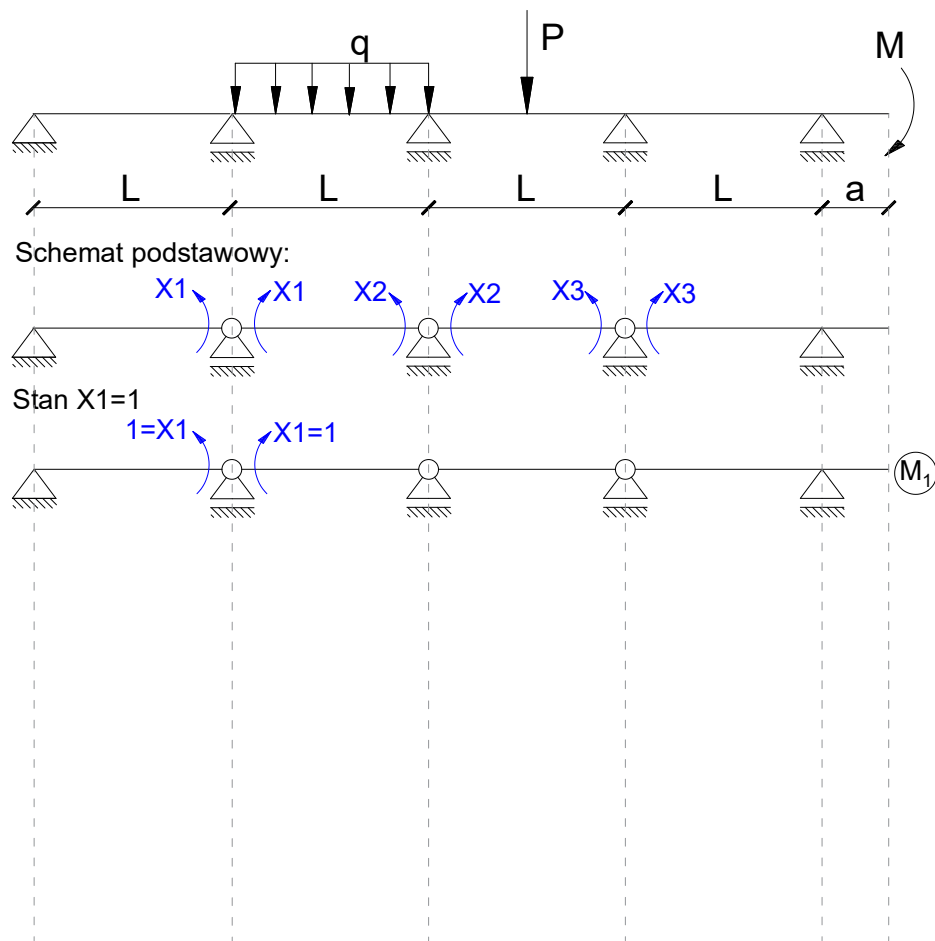


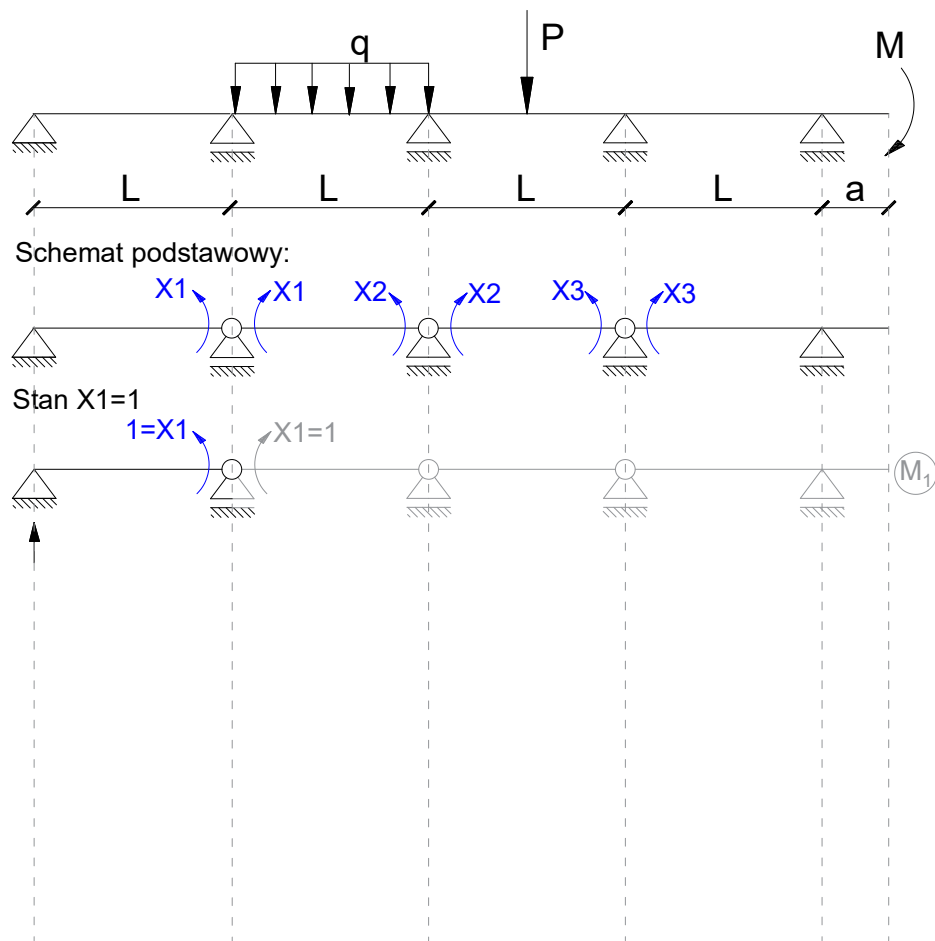
Stopień statycznej niewyznaczalności układu:

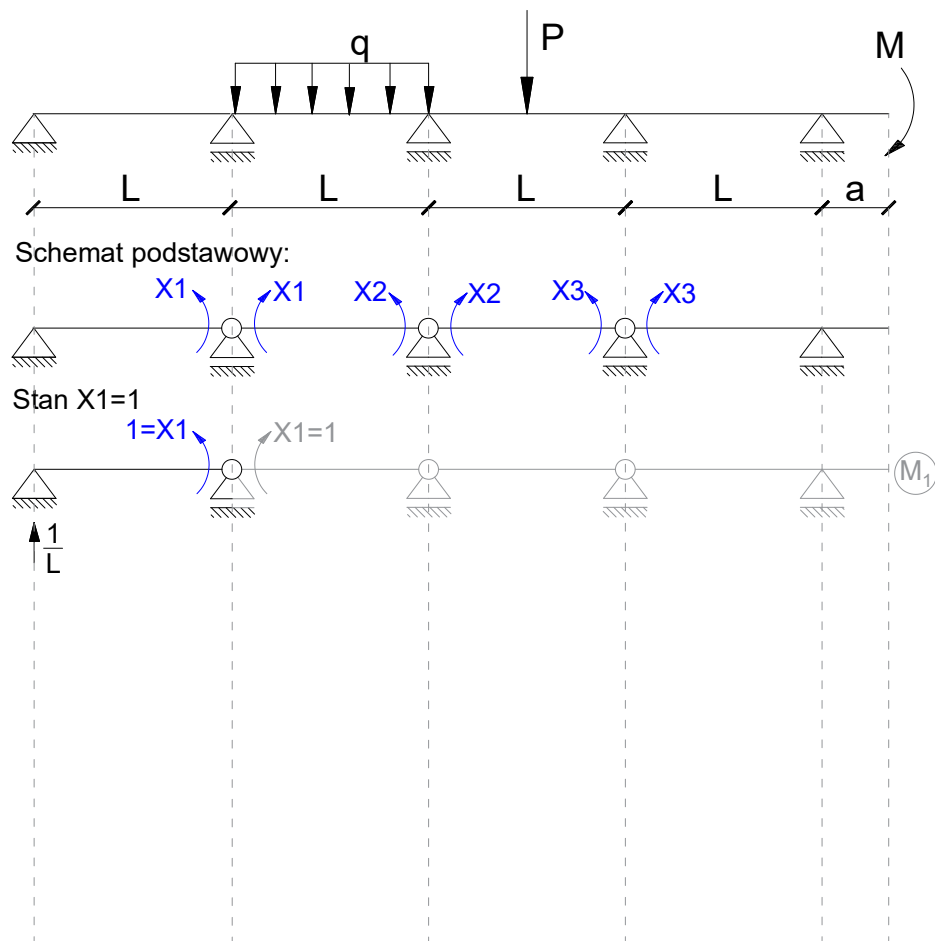
$$n_s = lr - lp - 3 = 6 - 0 - 3 = 3$$

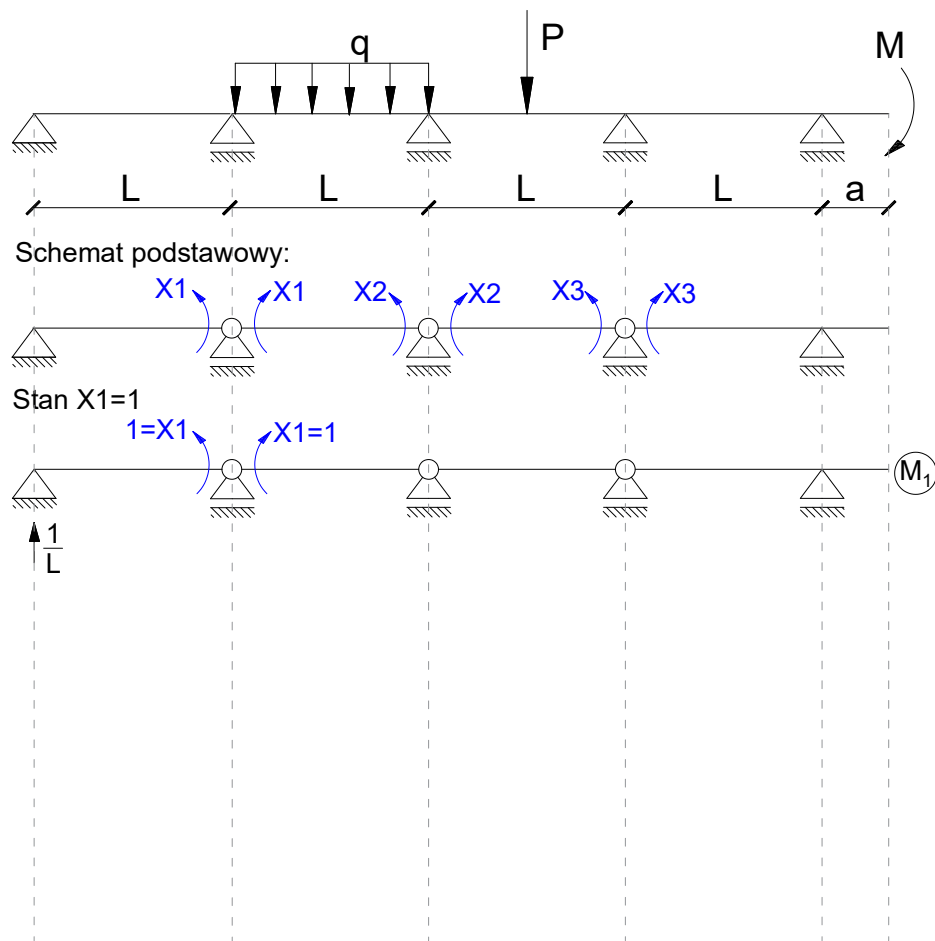
Belka trzykrotnie statycznie niewyznaczalna.

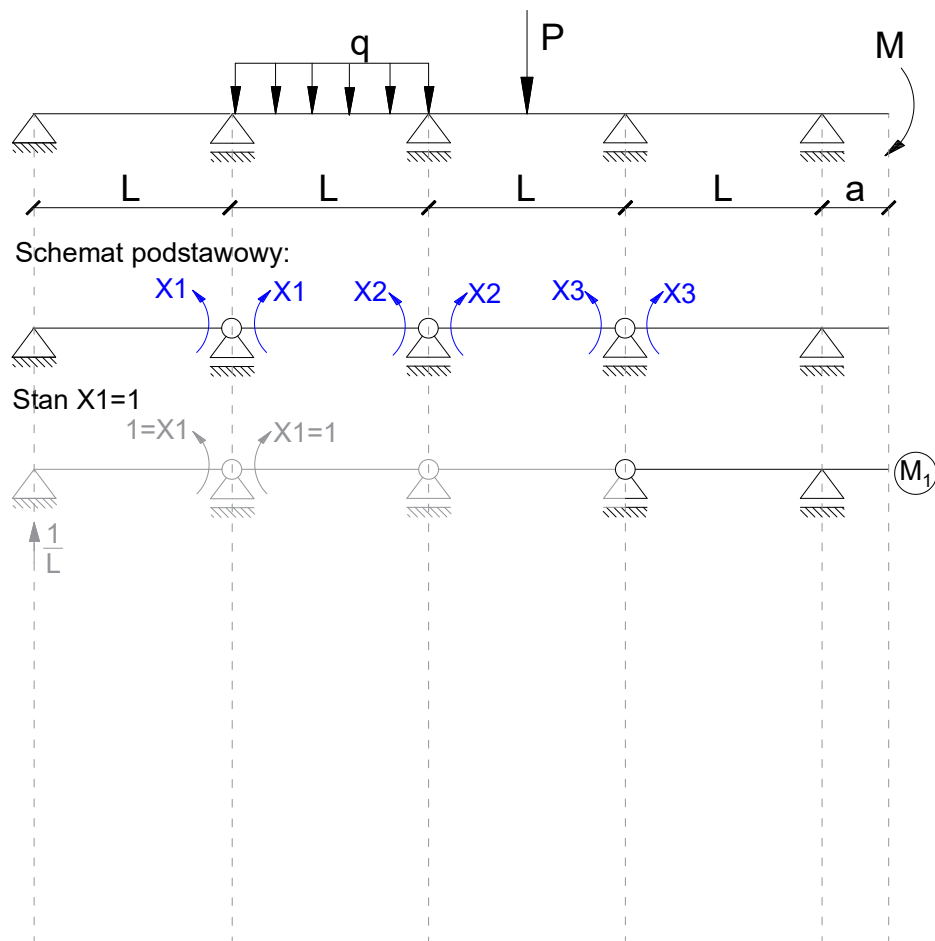


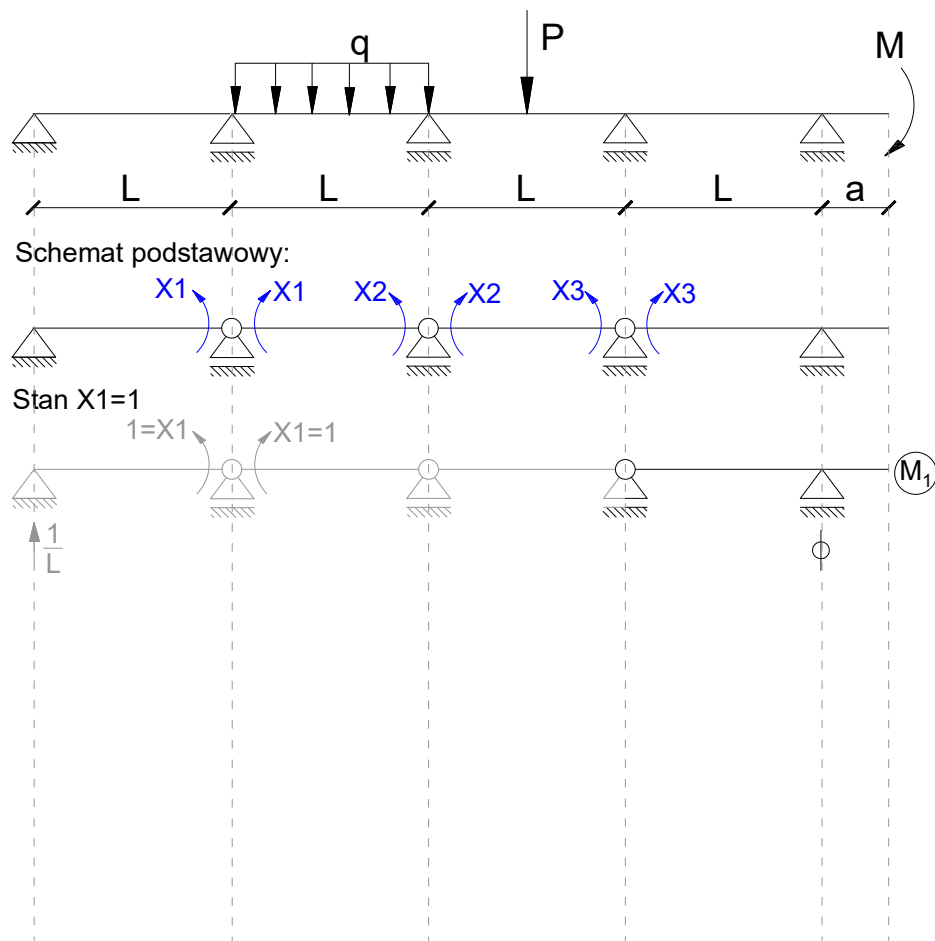


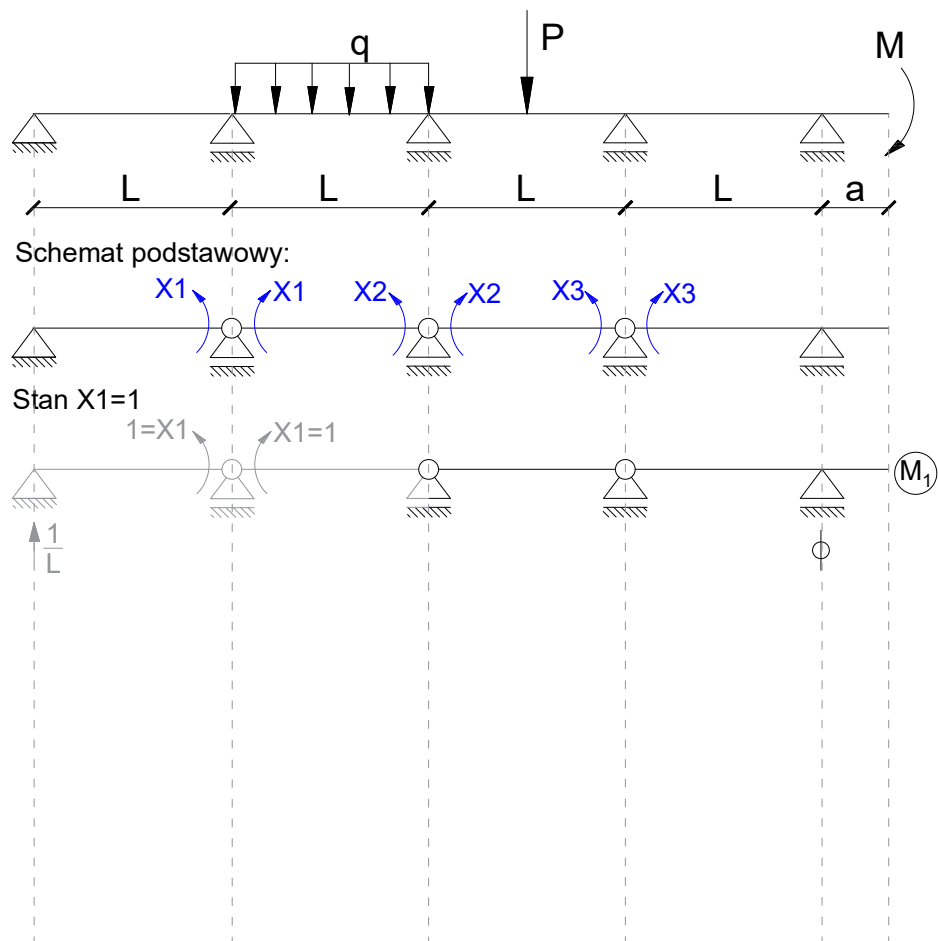


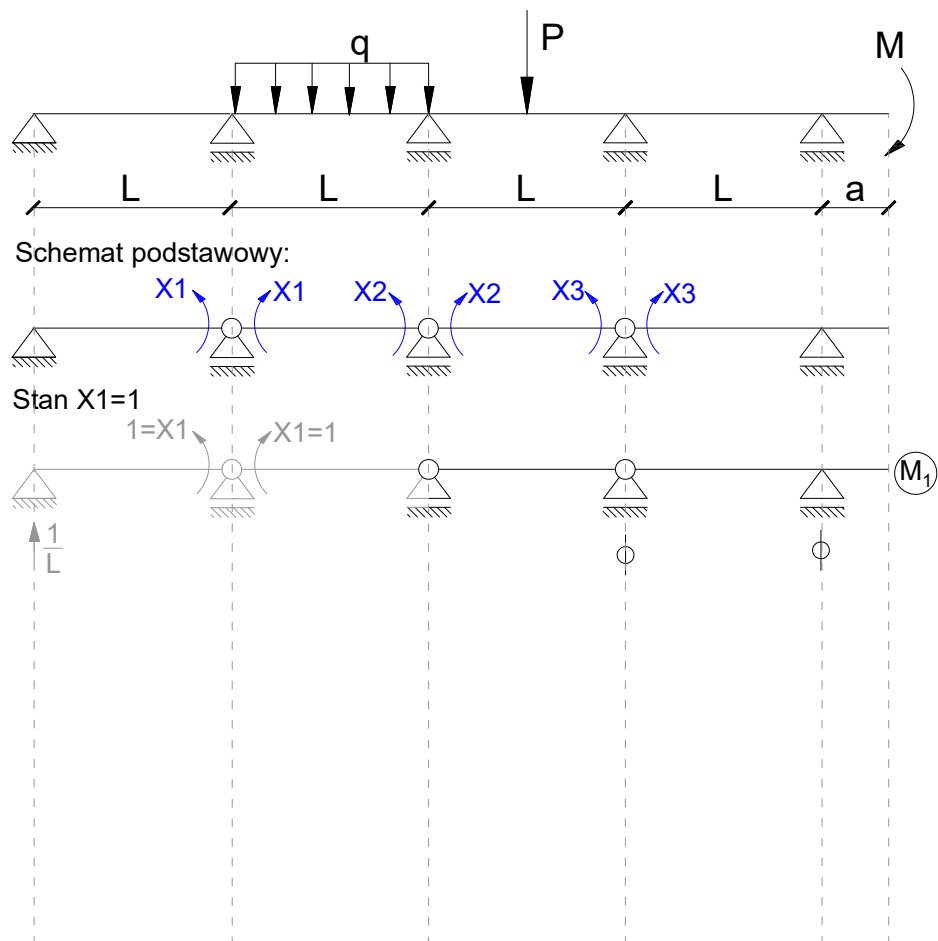


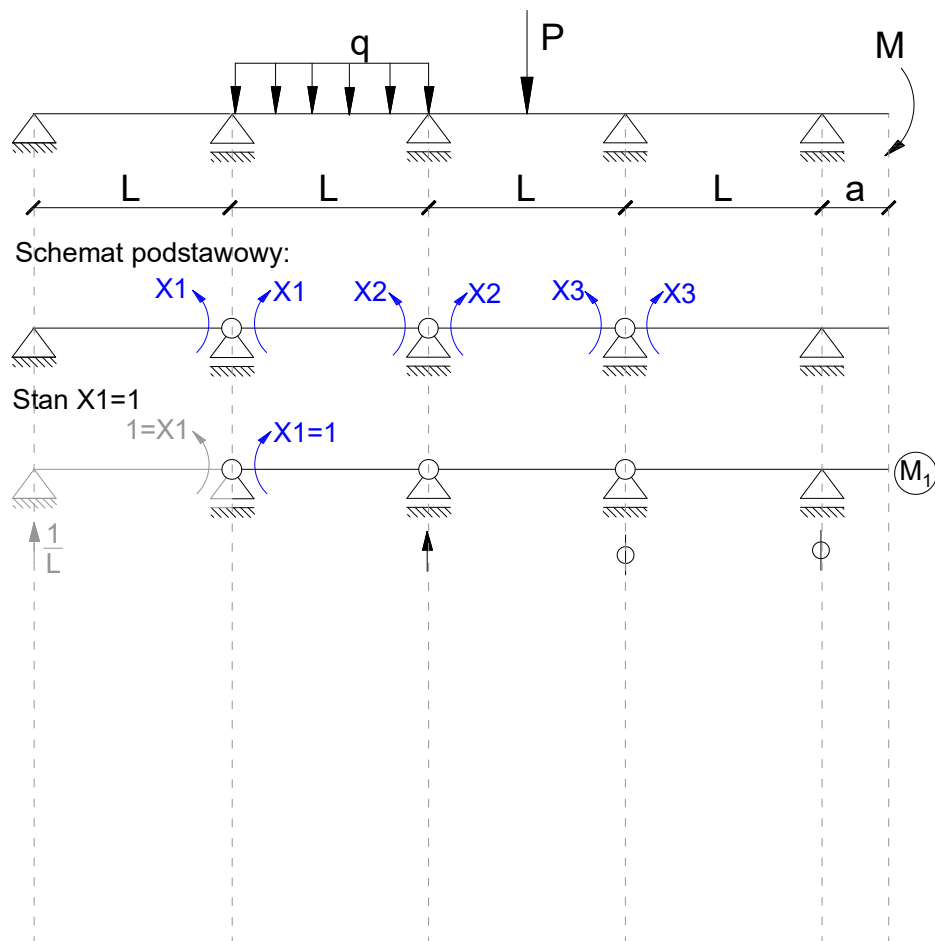


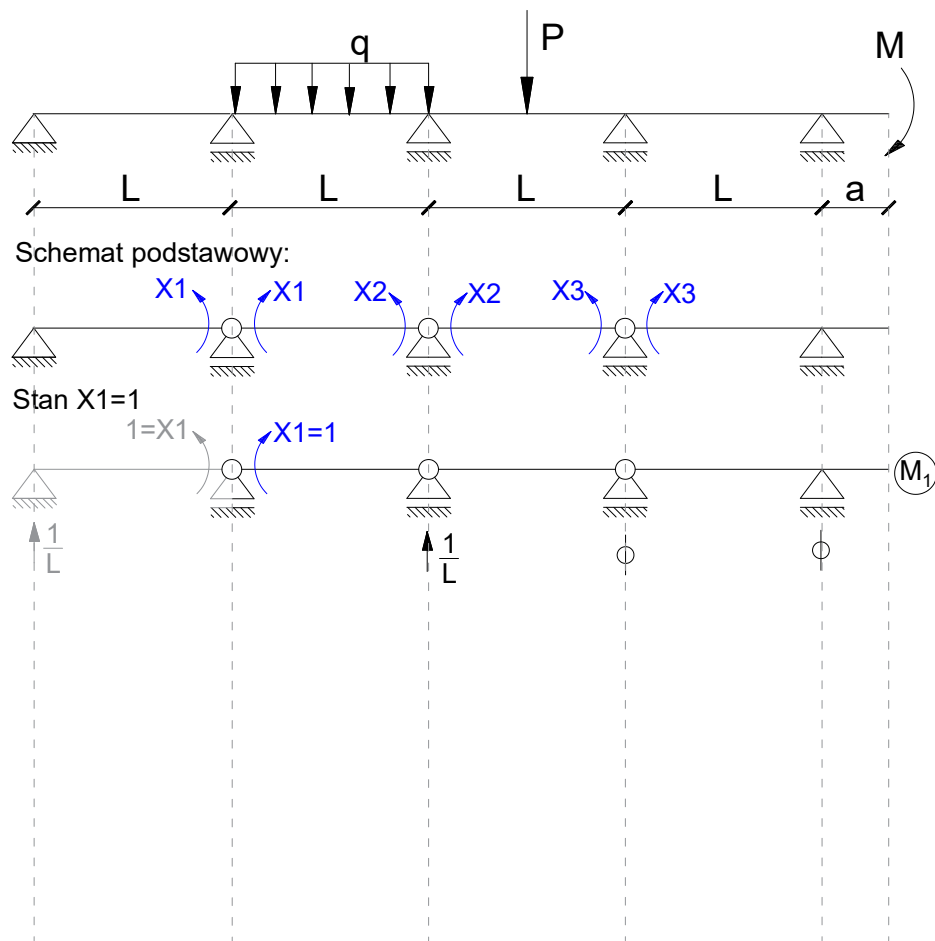


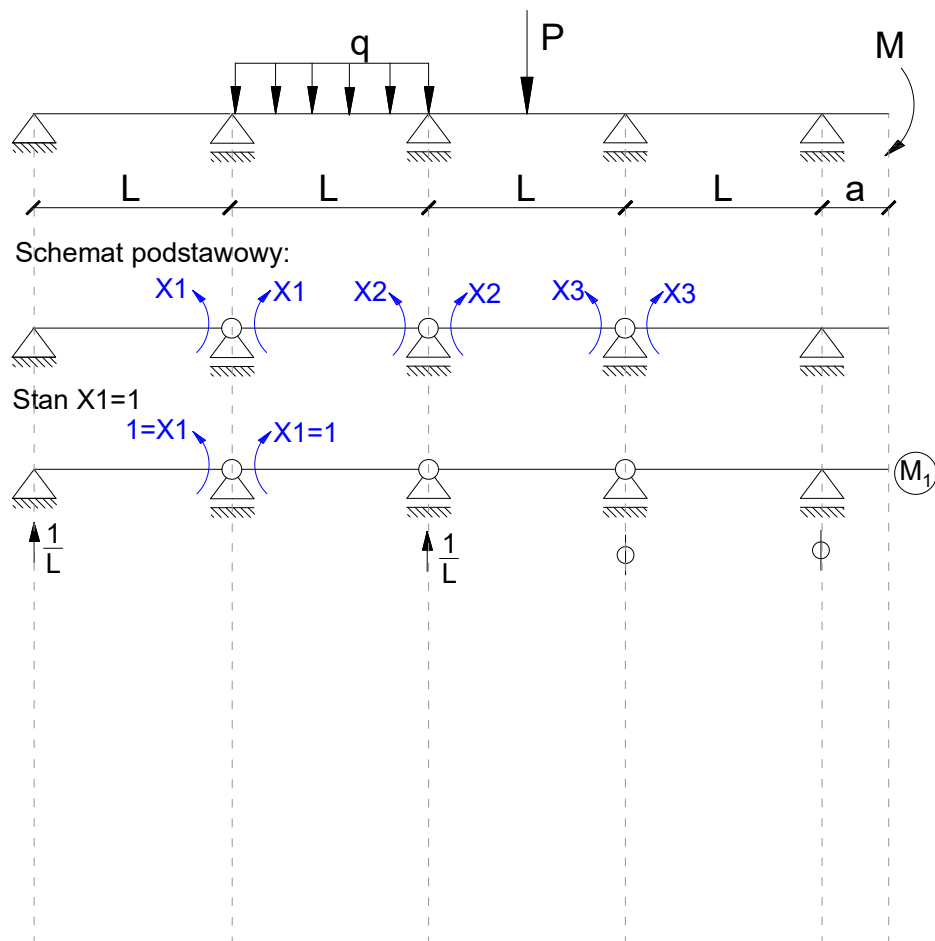


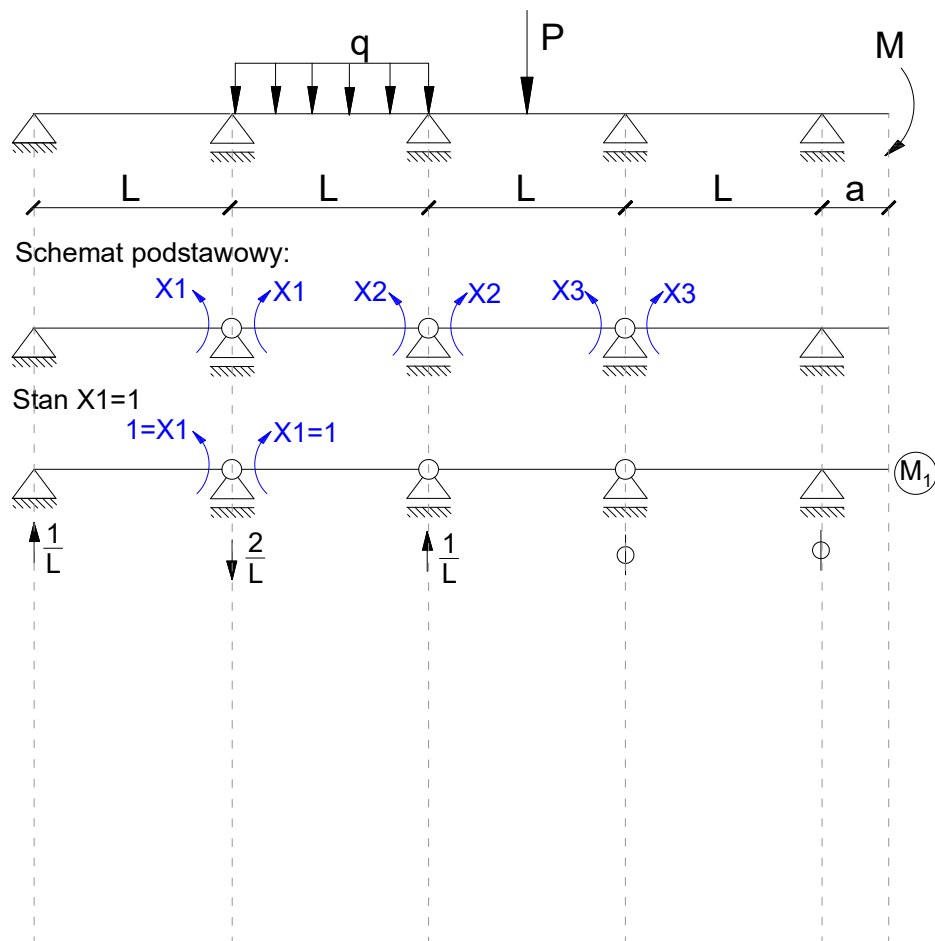


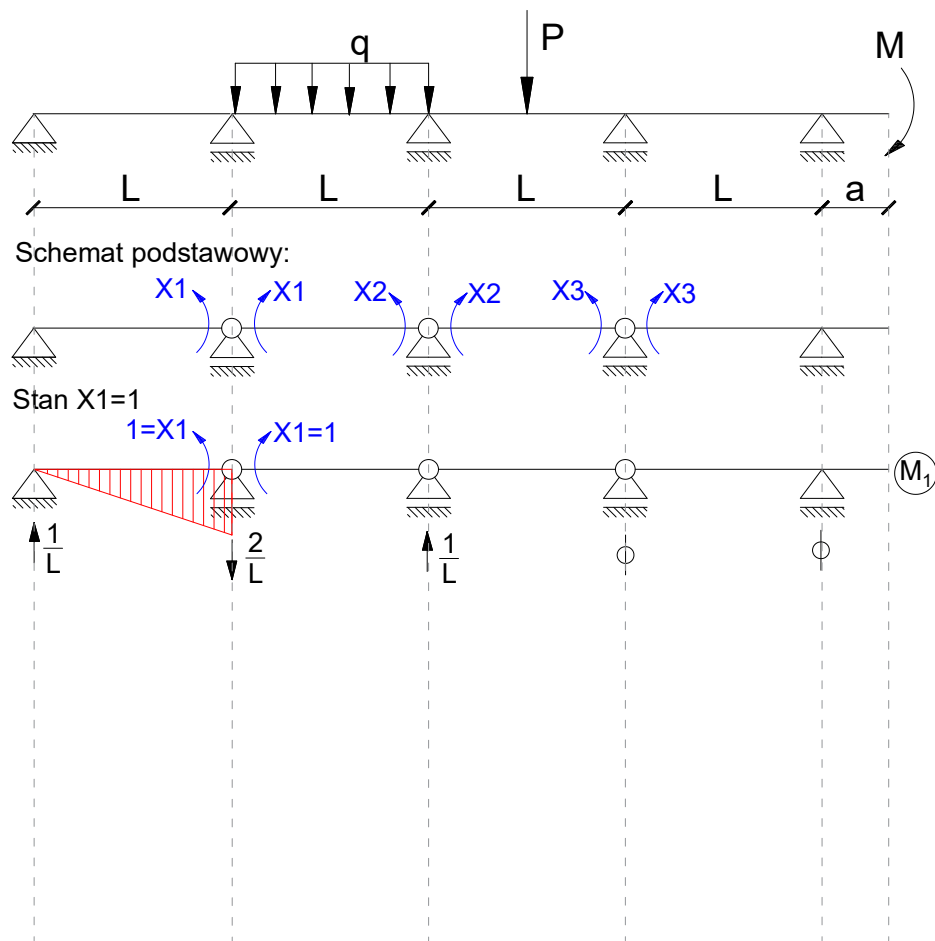


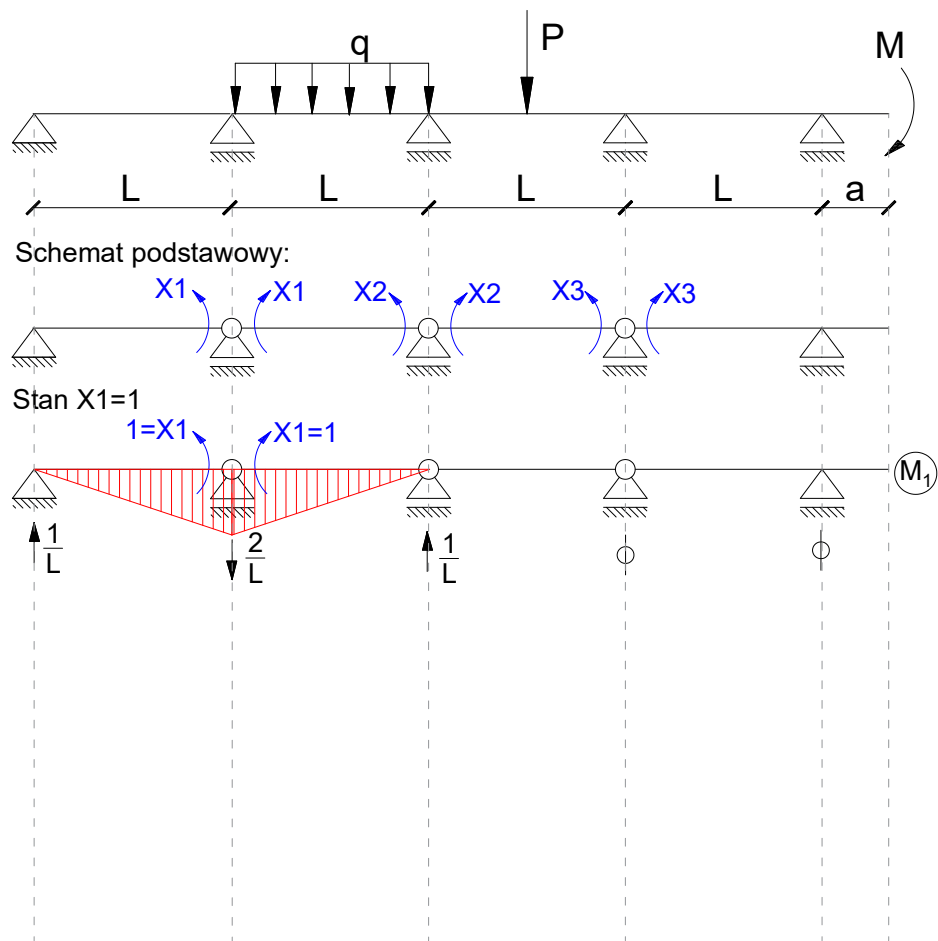


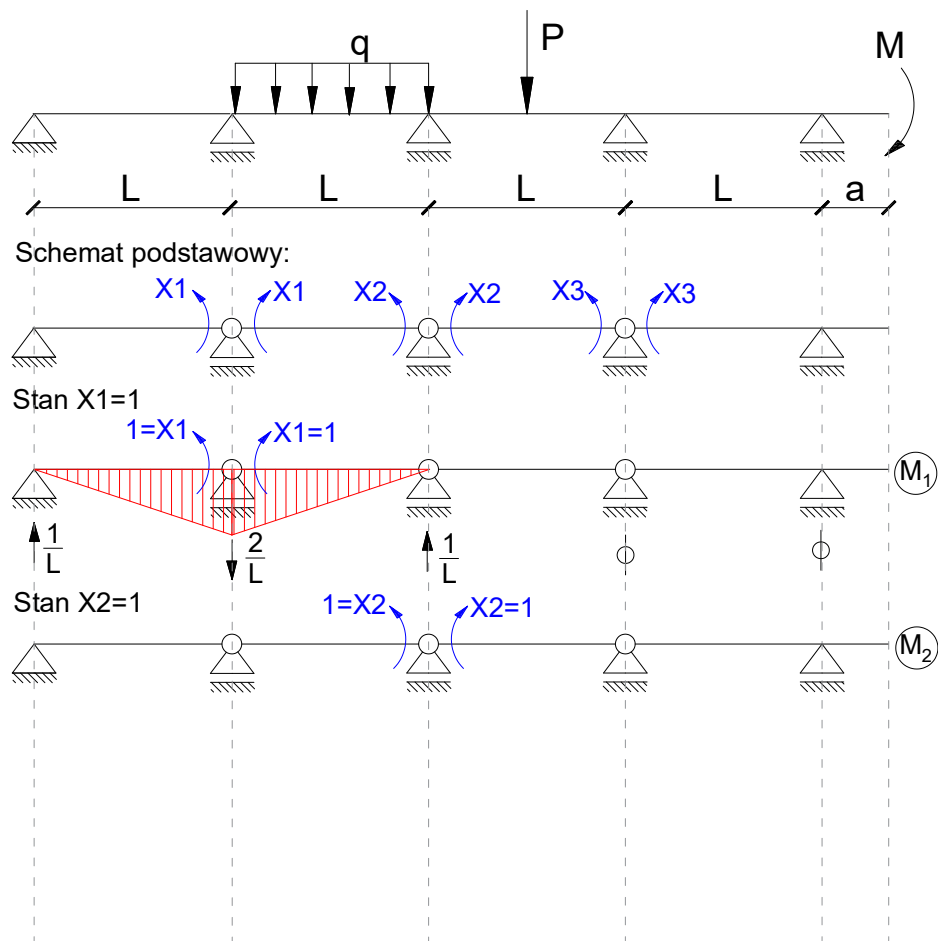


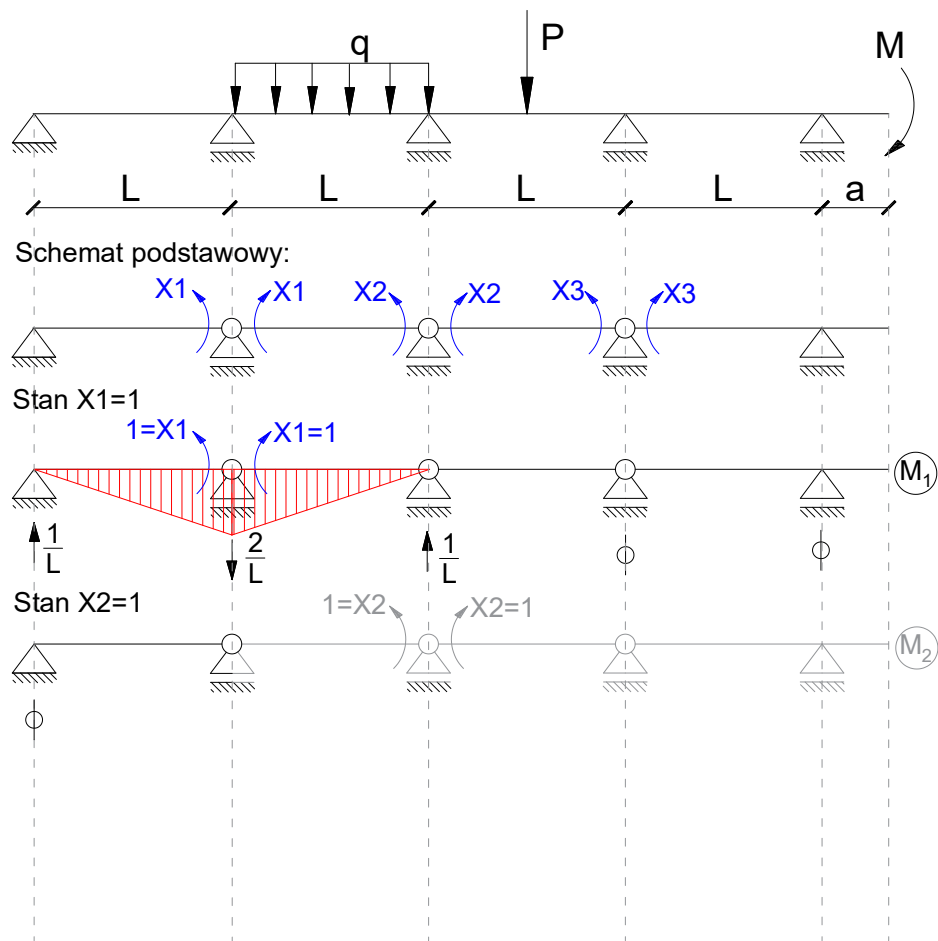


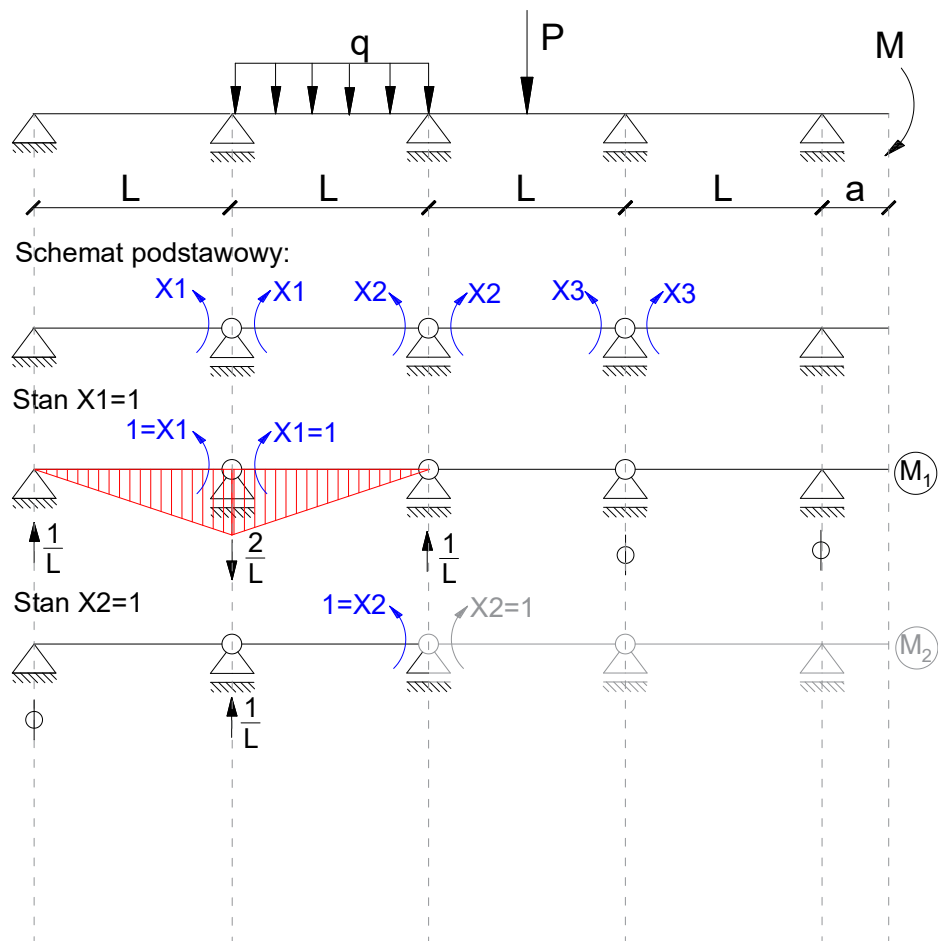


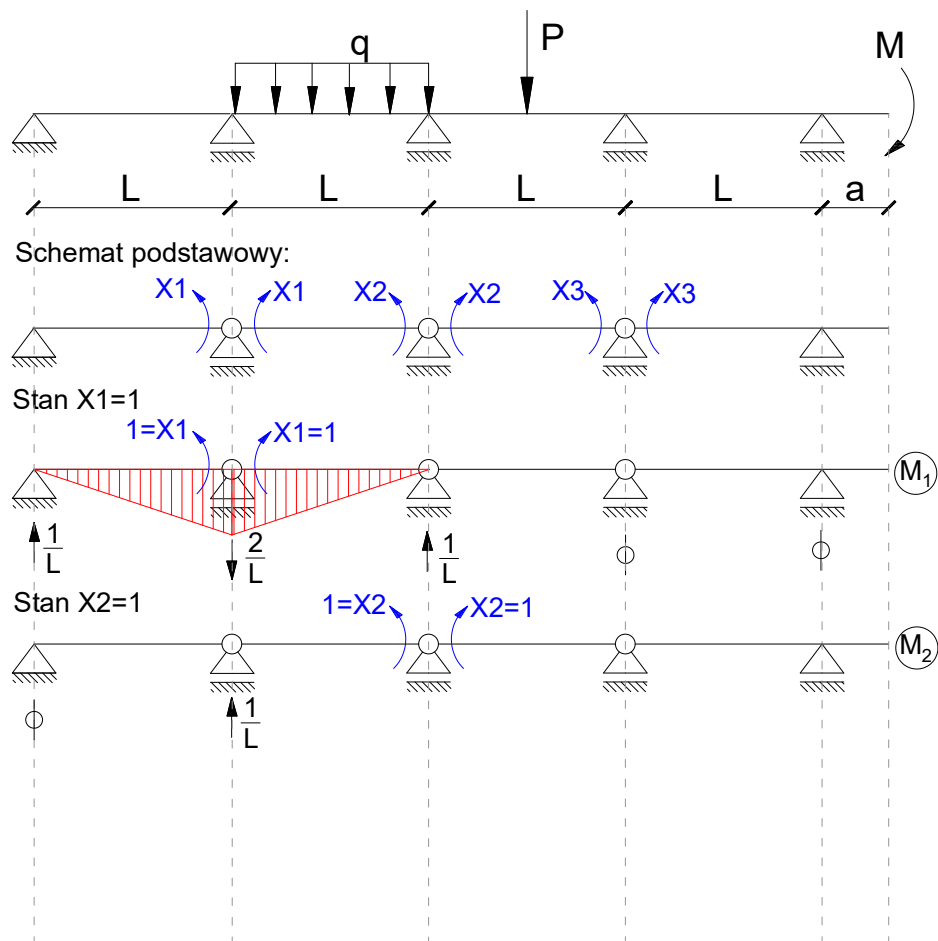


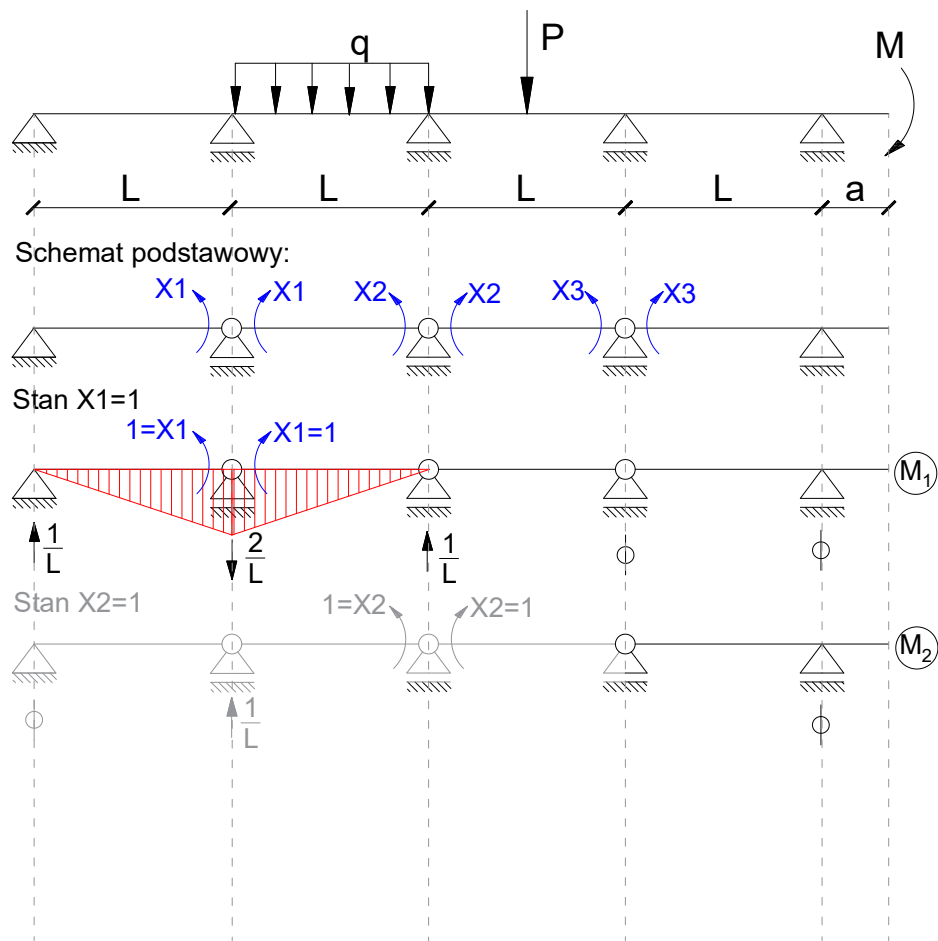


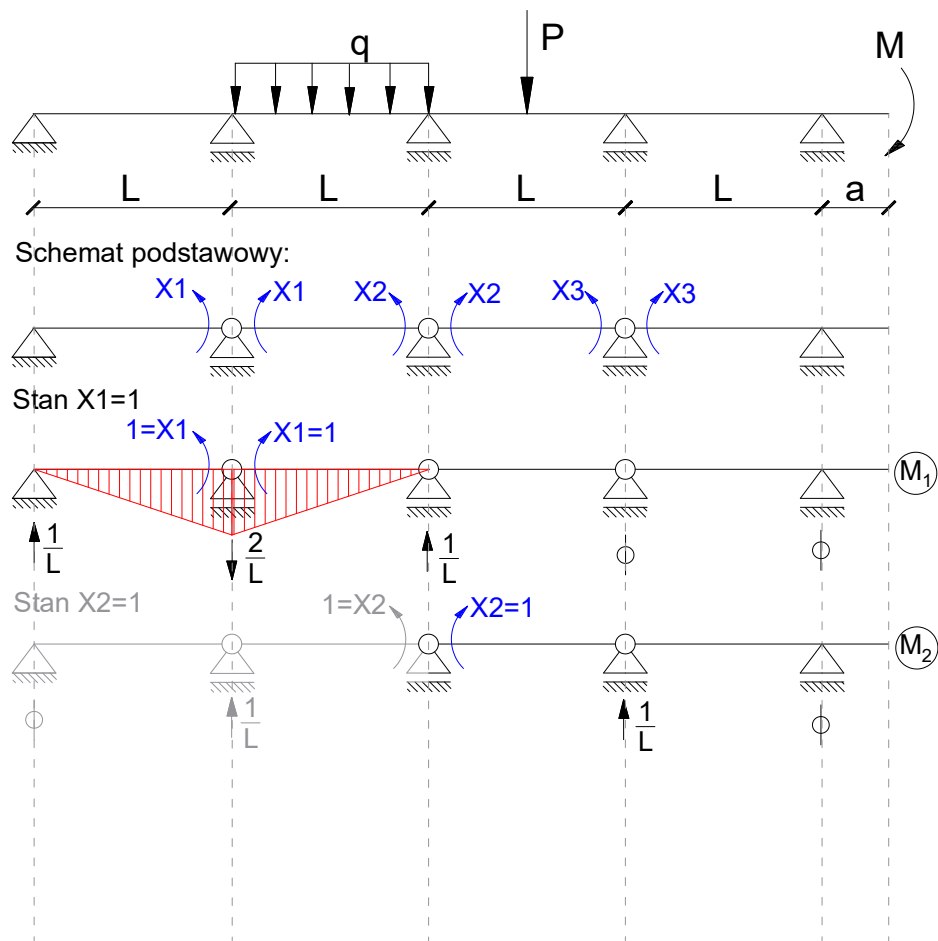


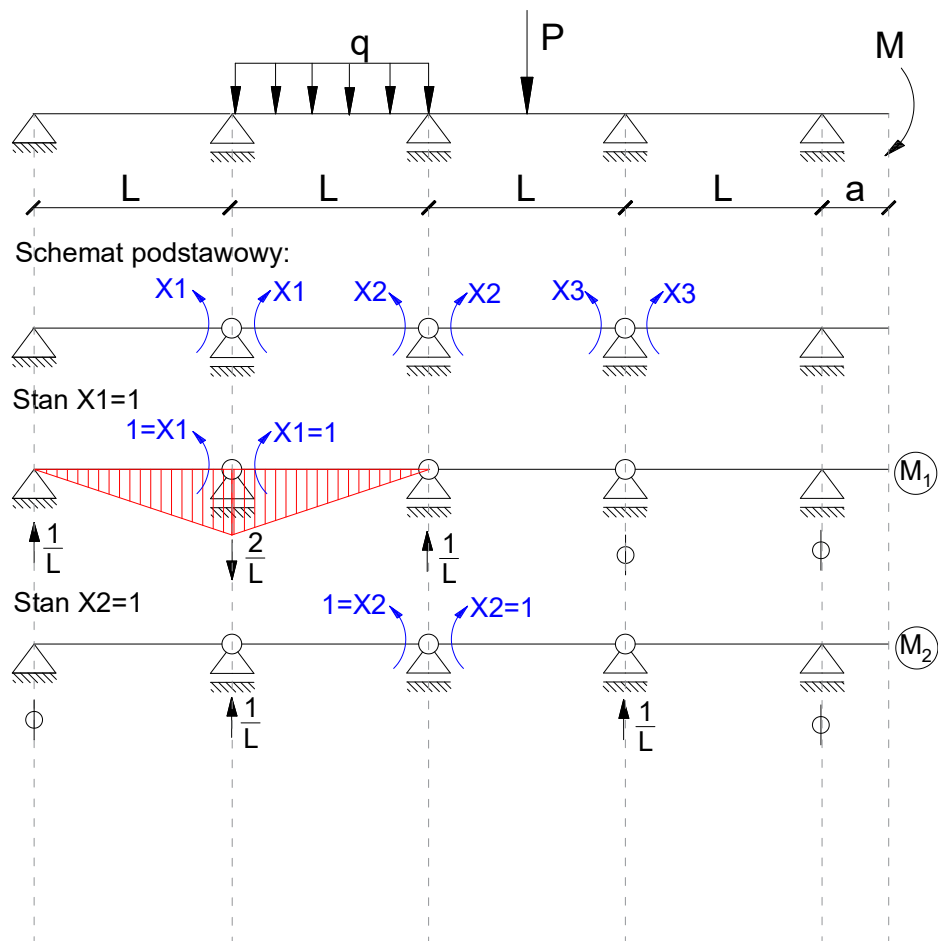


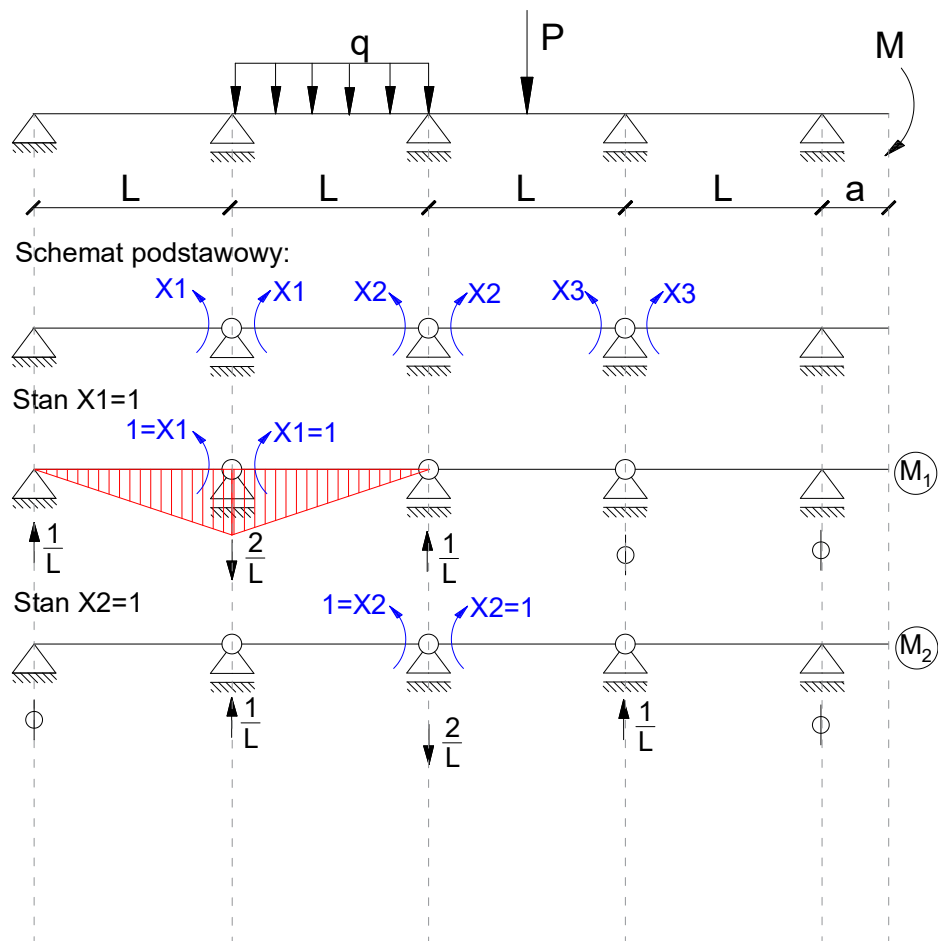


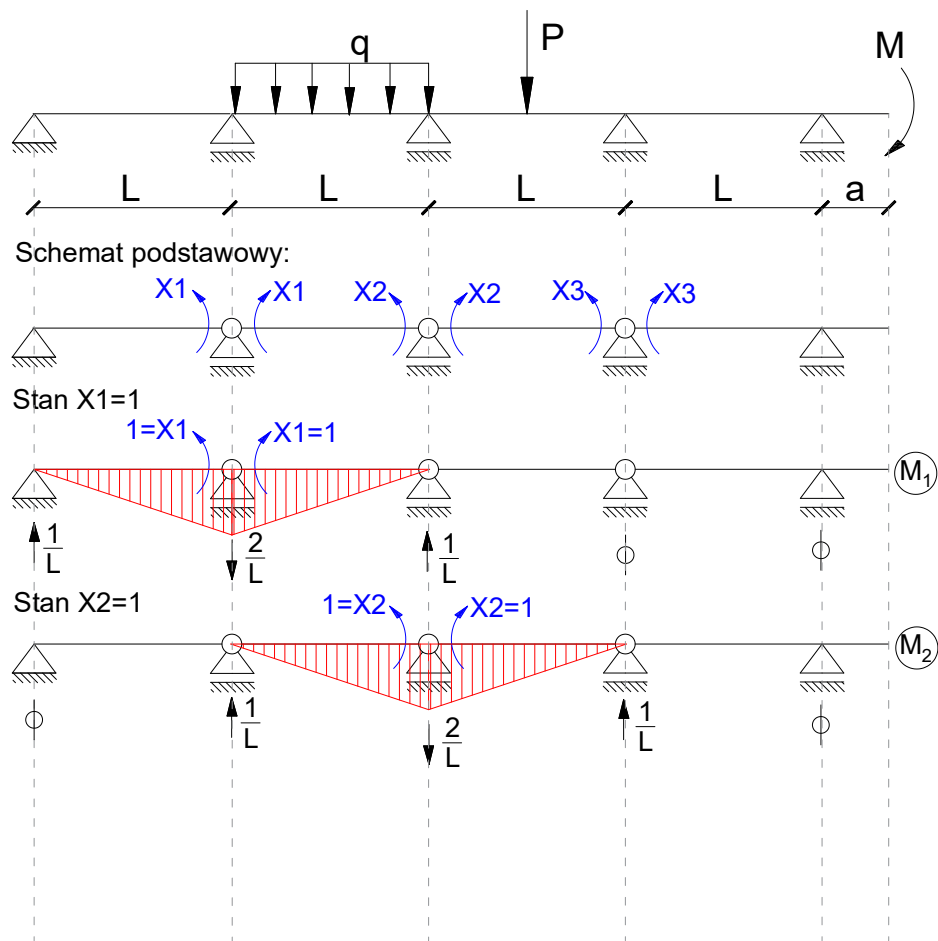


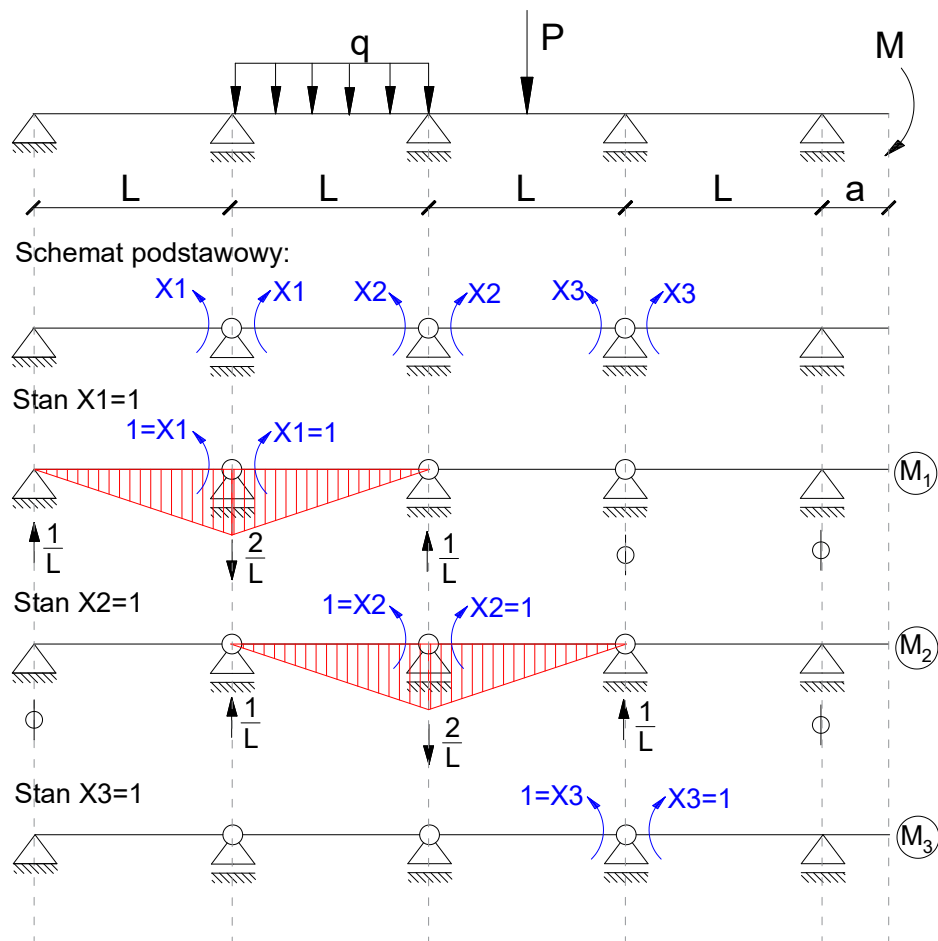


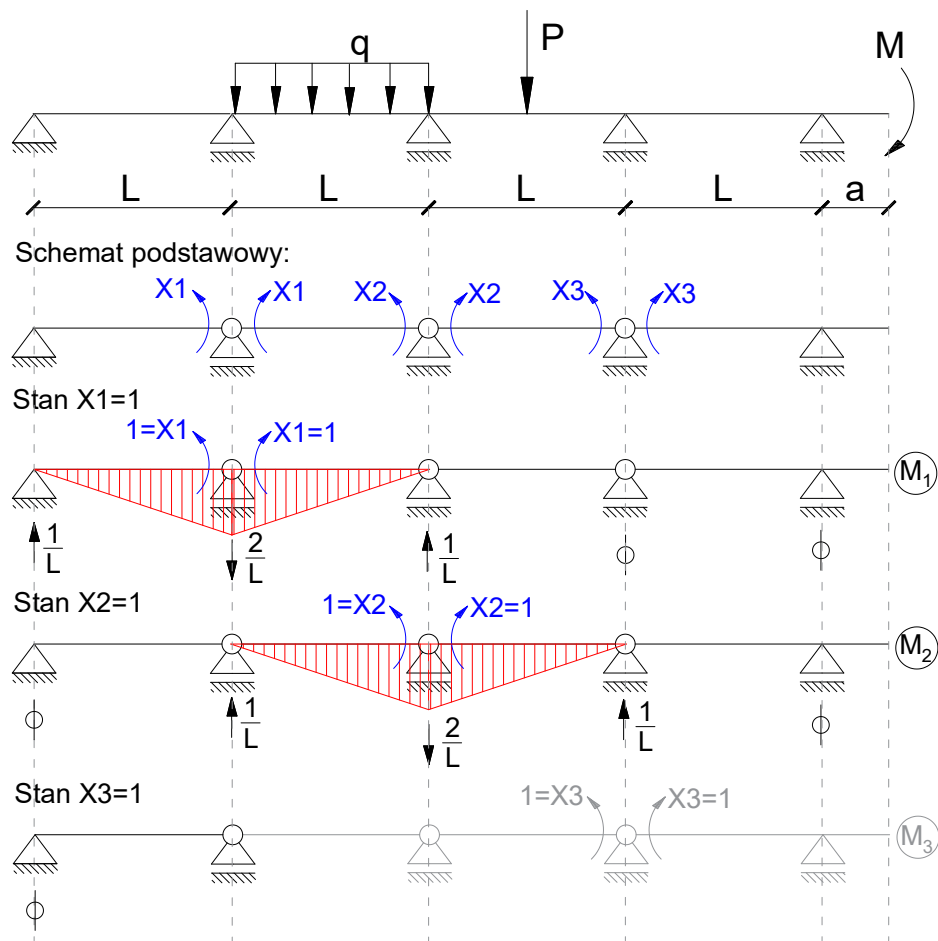


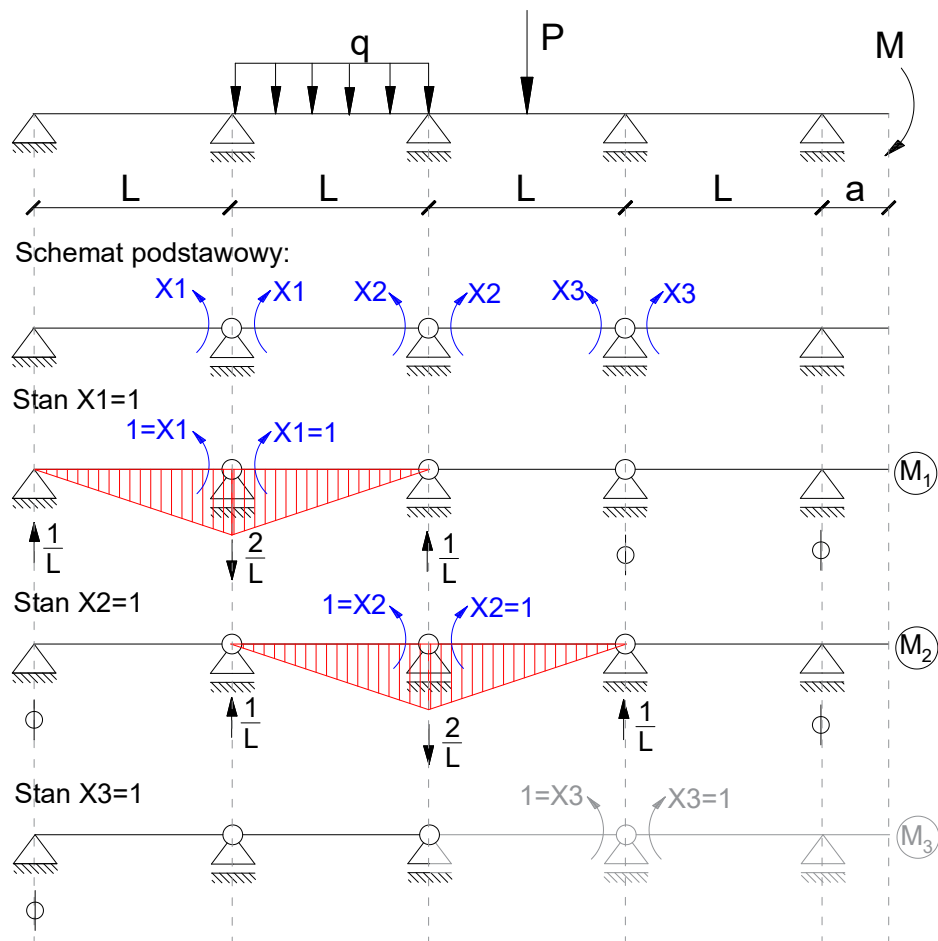


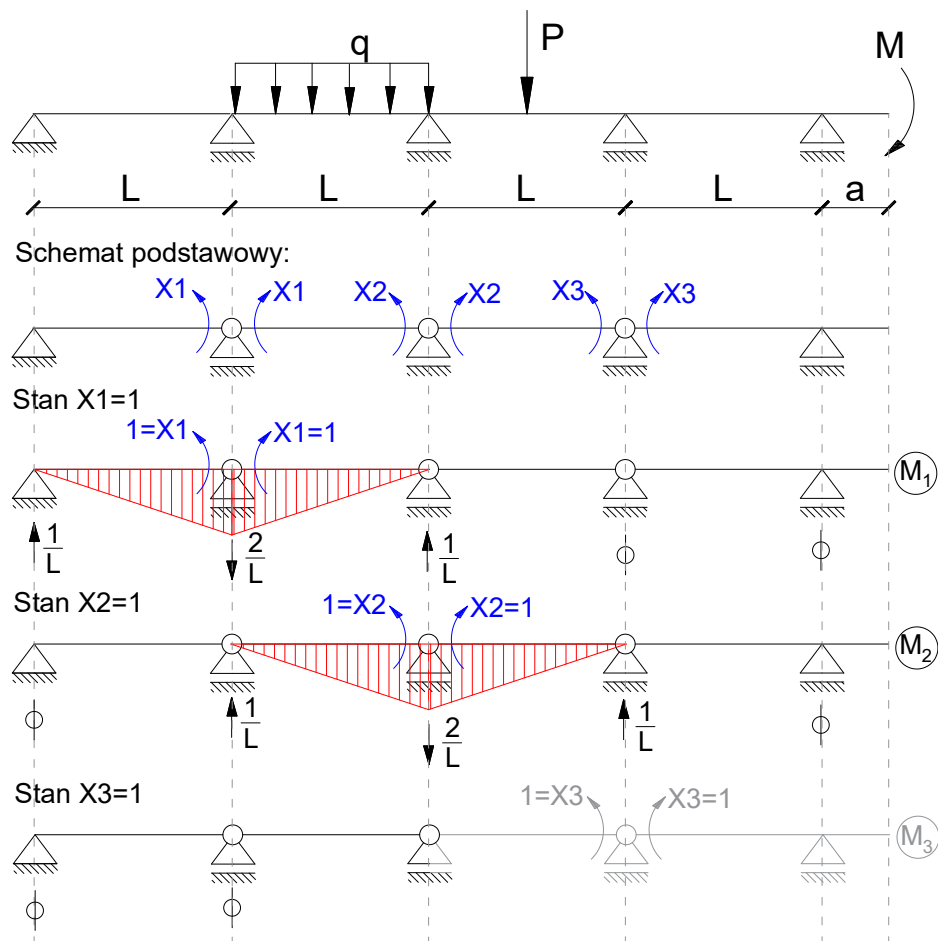


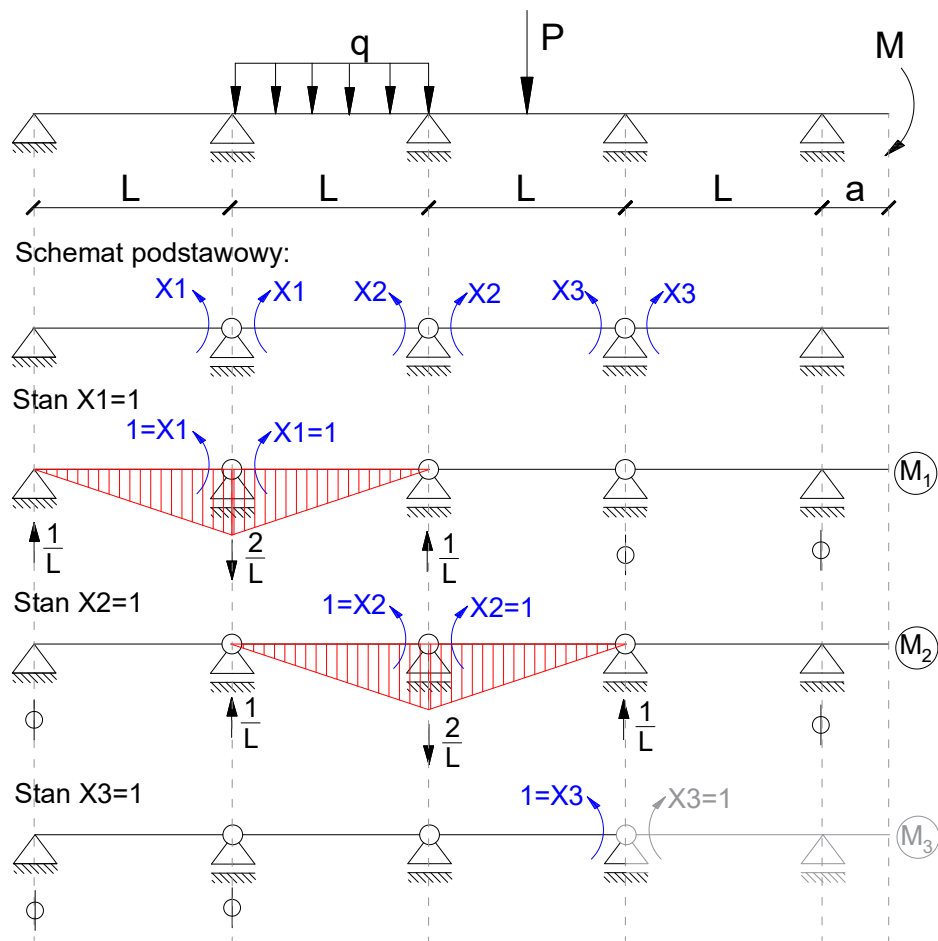


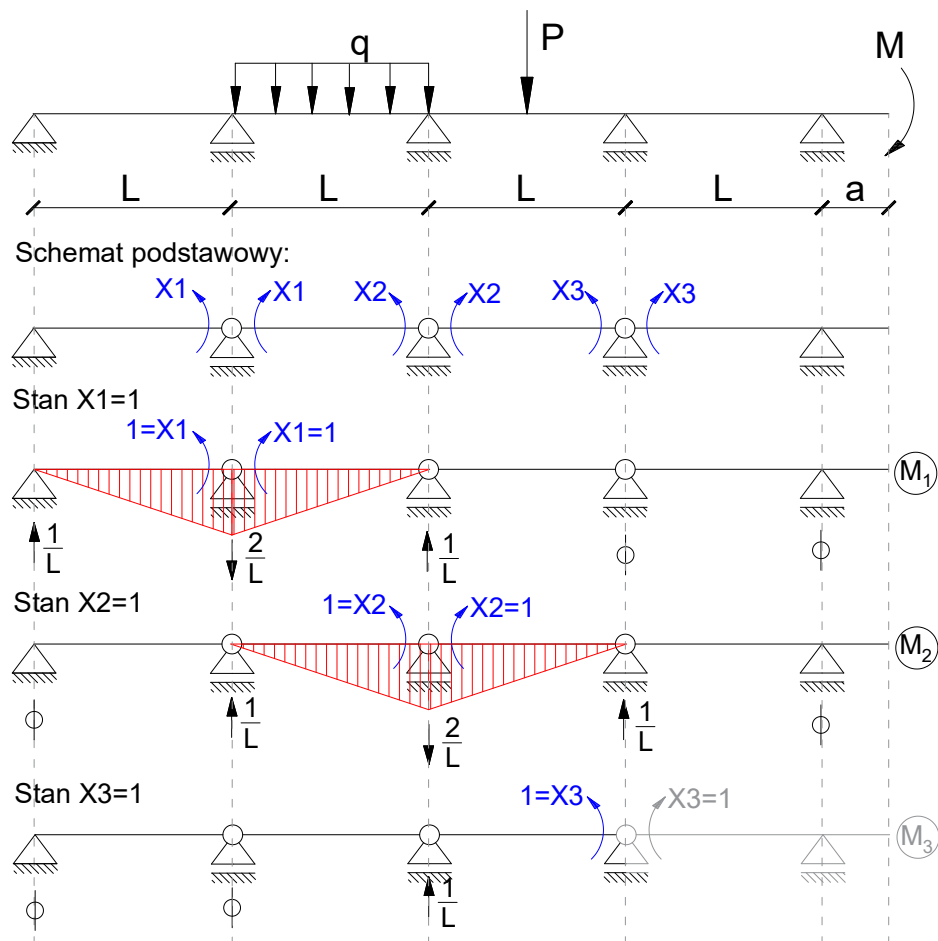


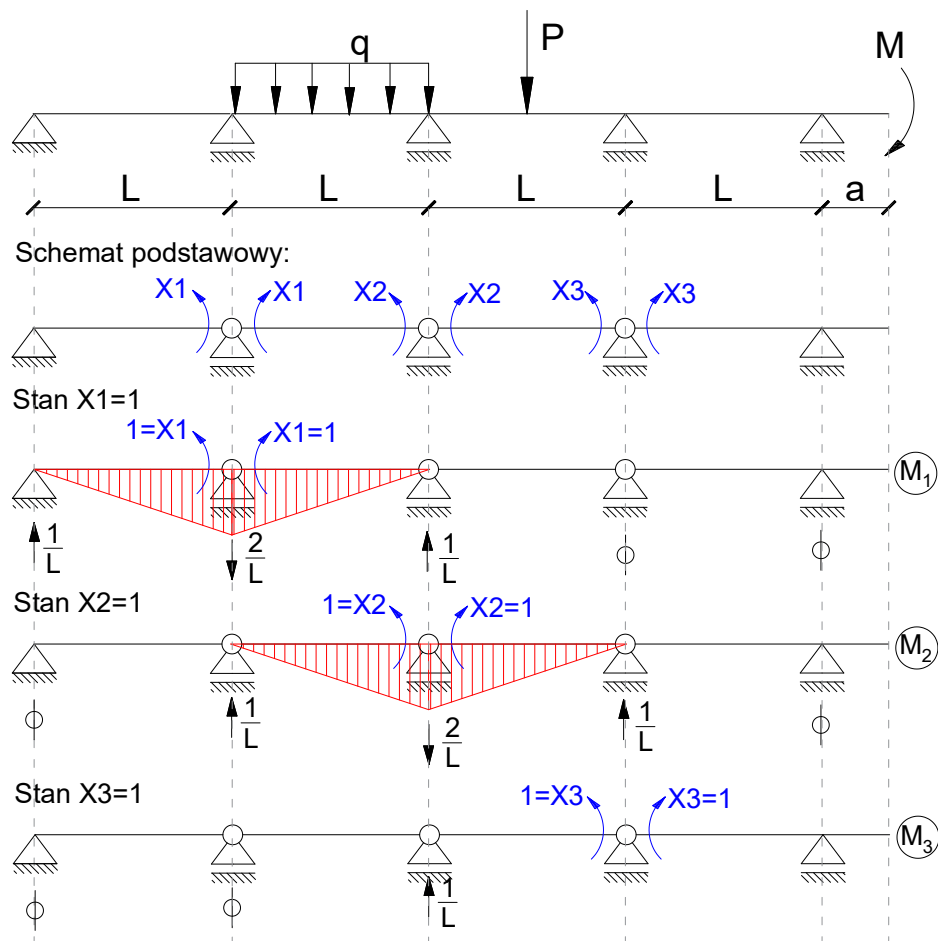


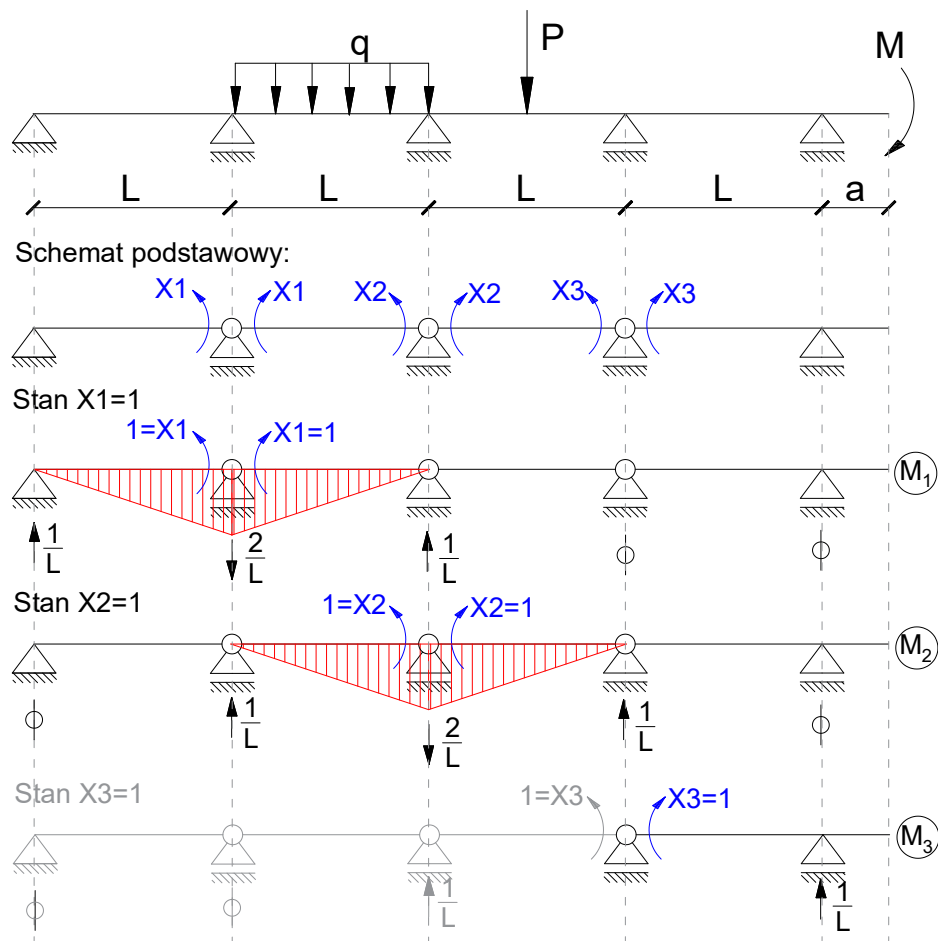


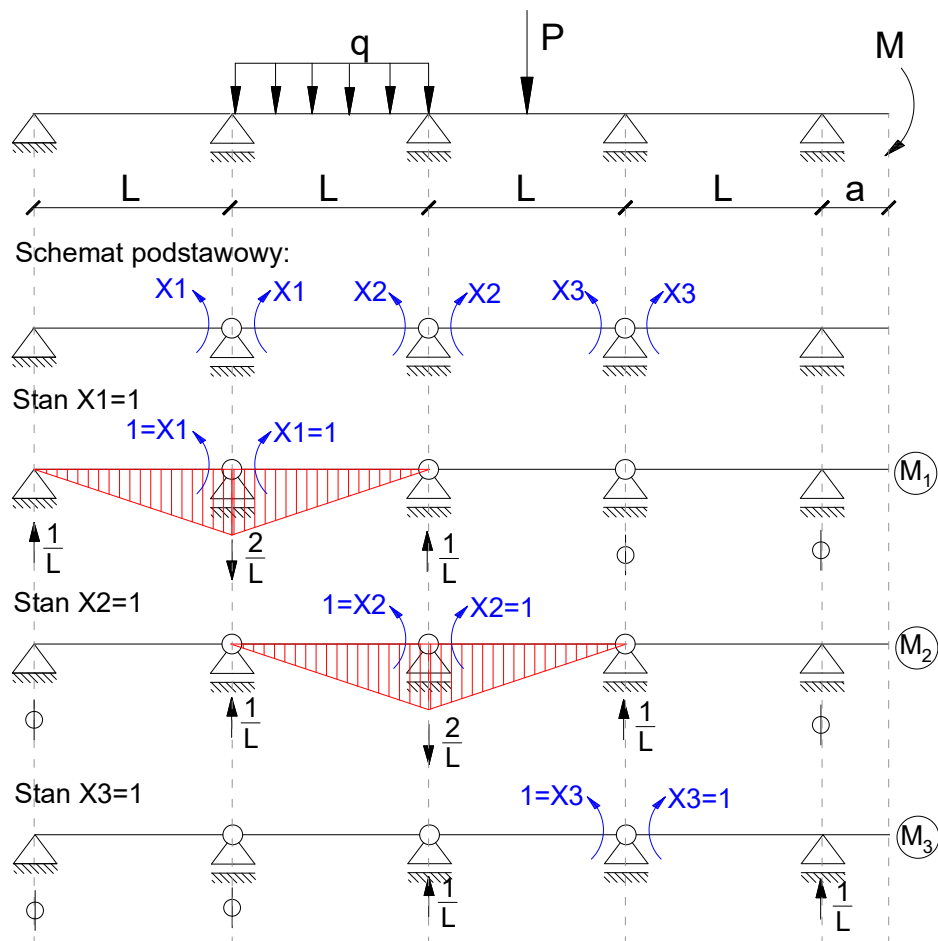


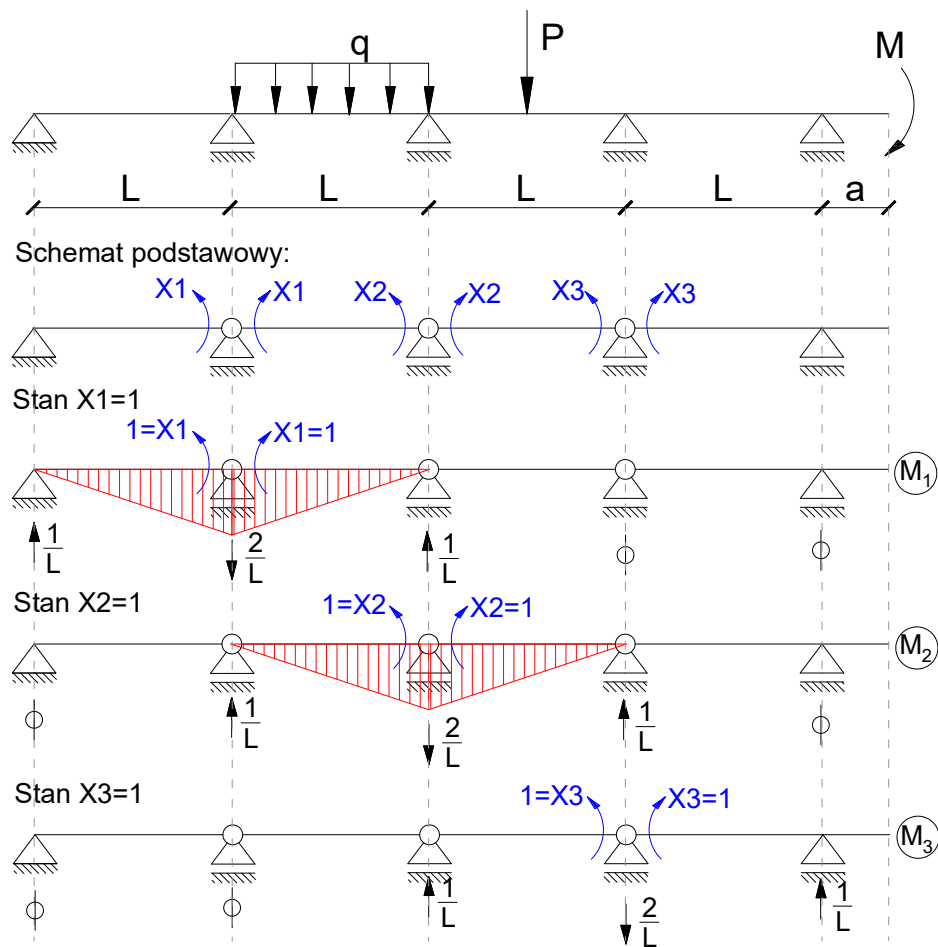


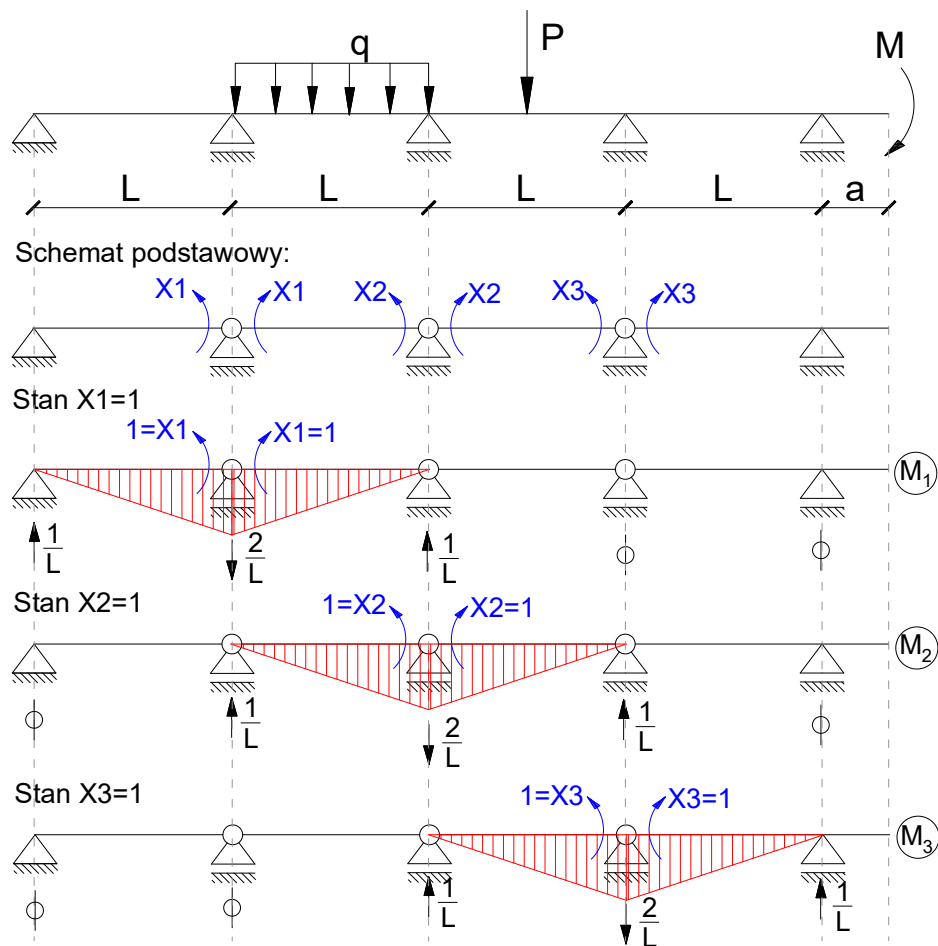


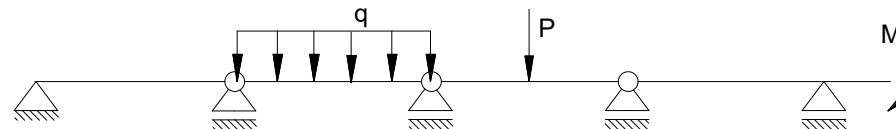
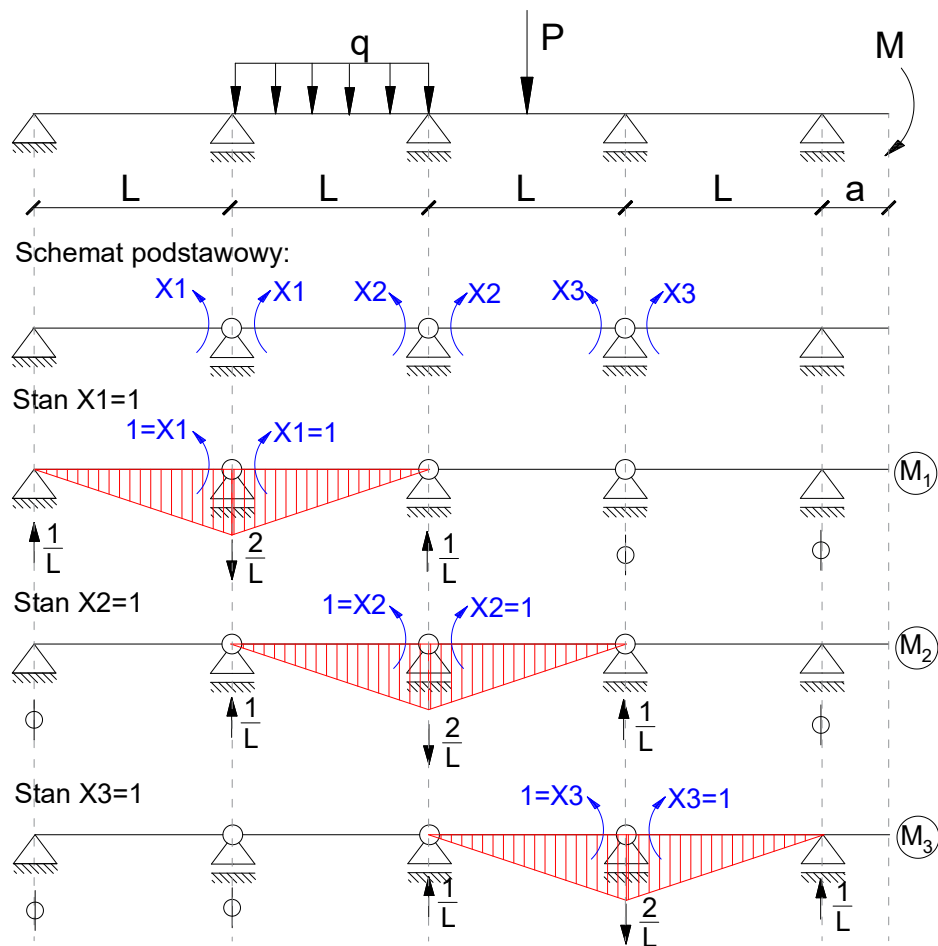


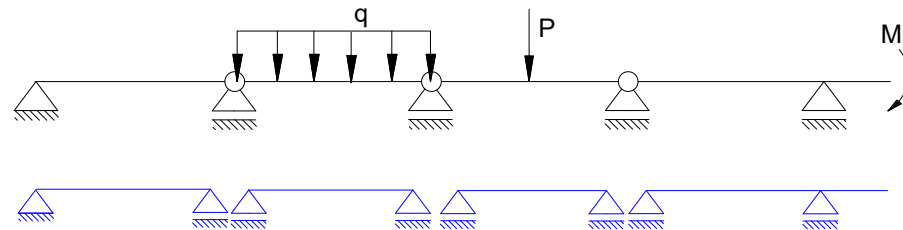
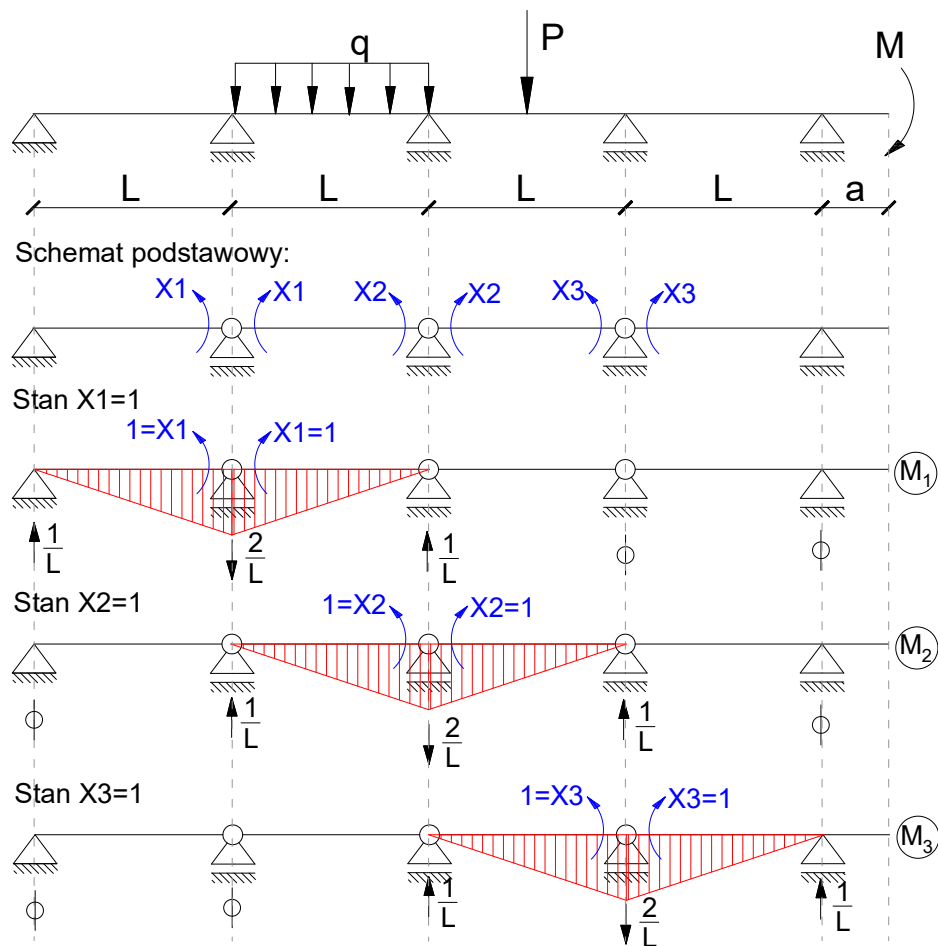


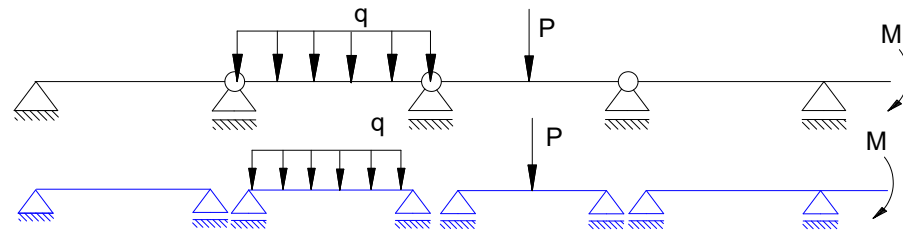
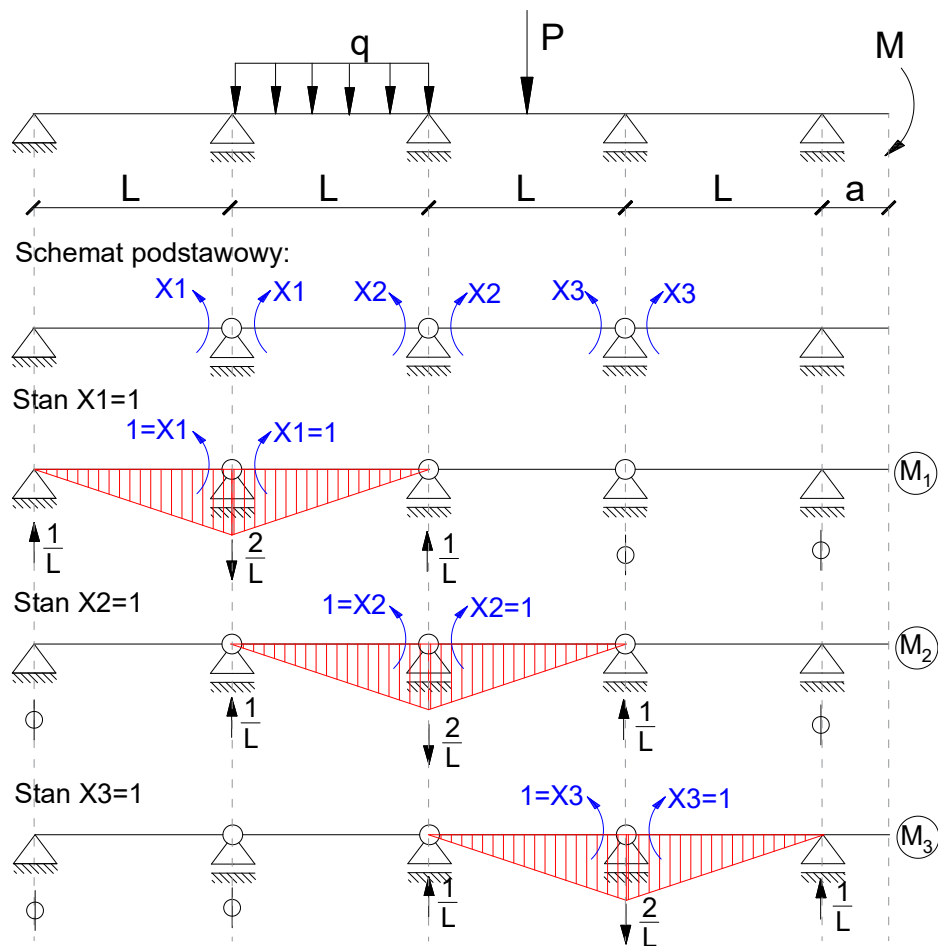


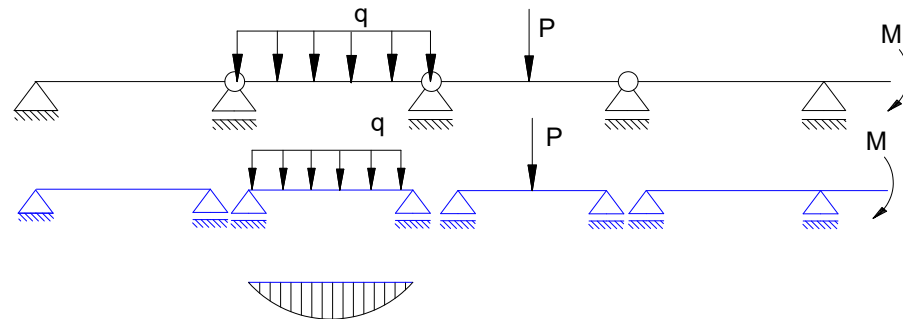
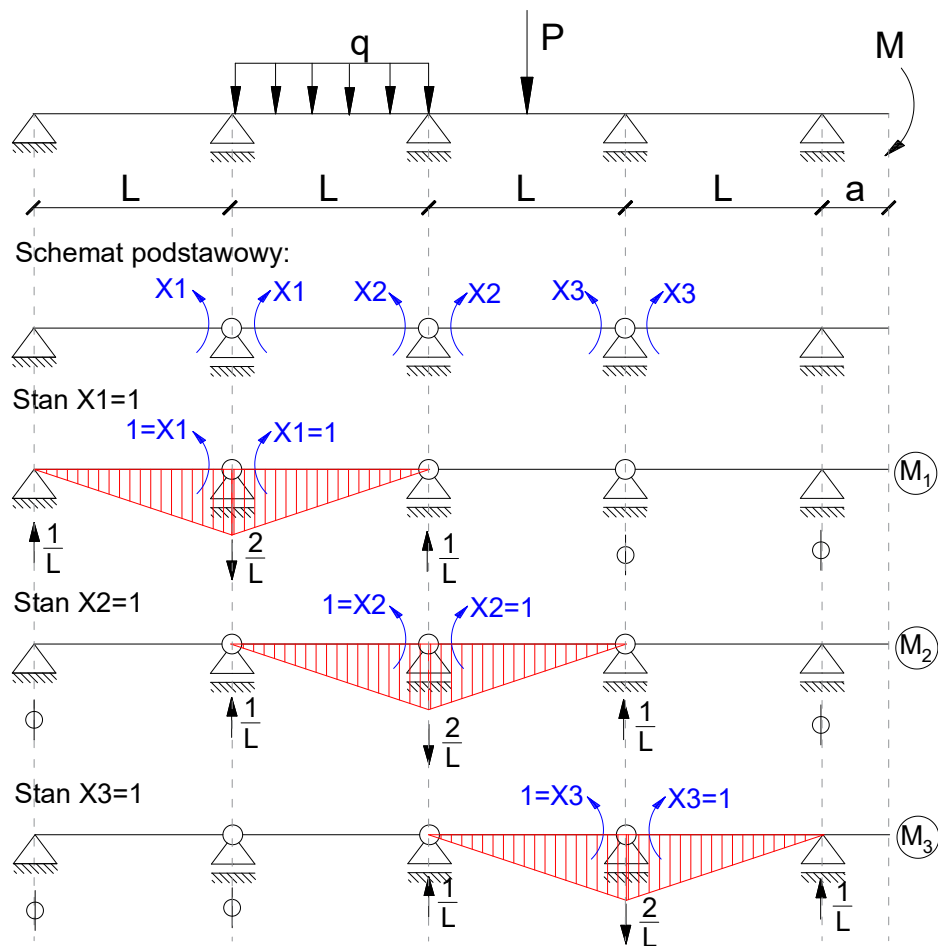


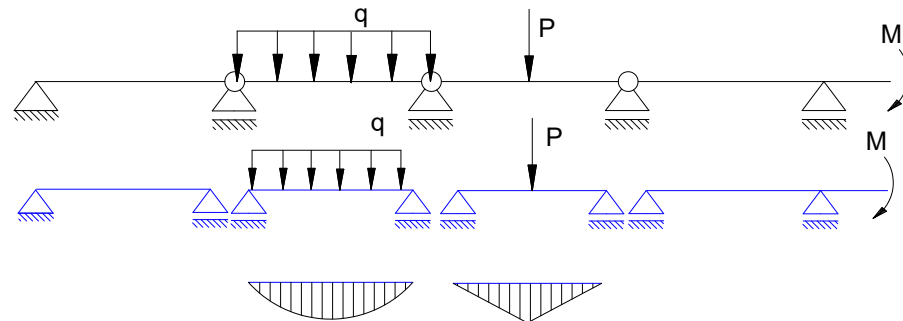
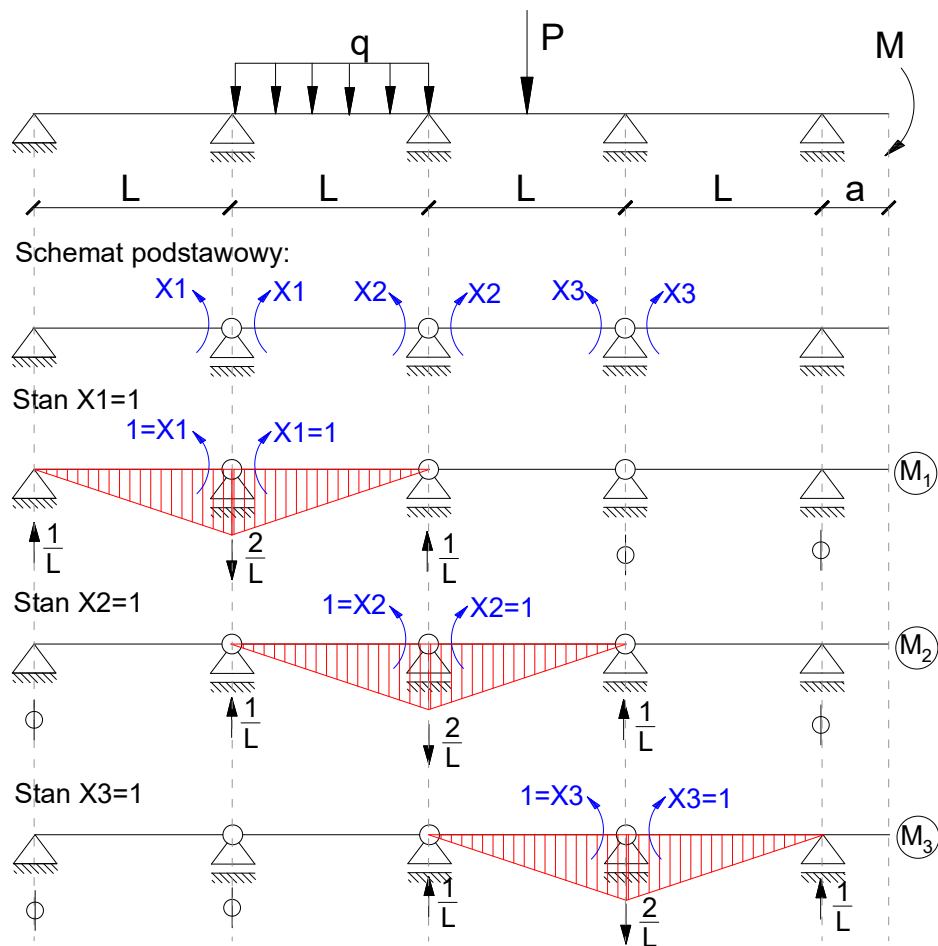


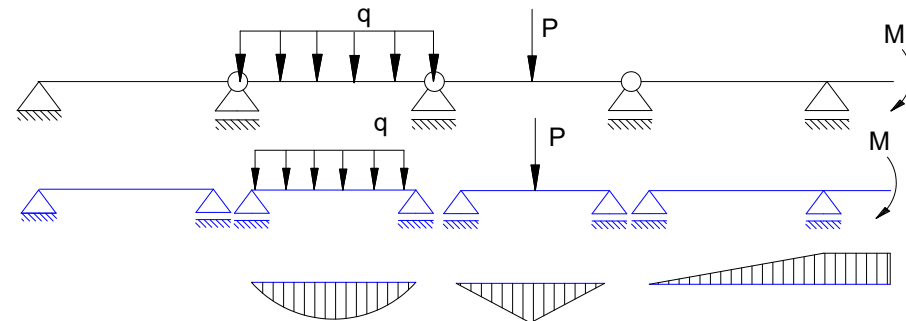
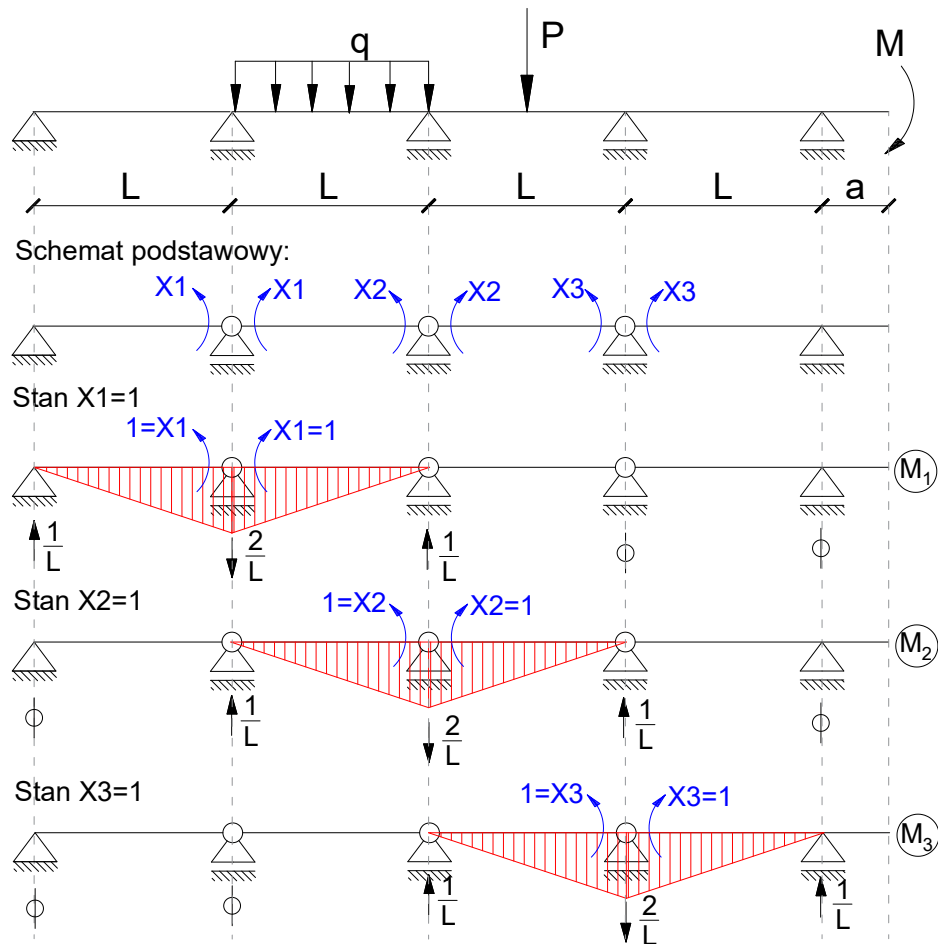


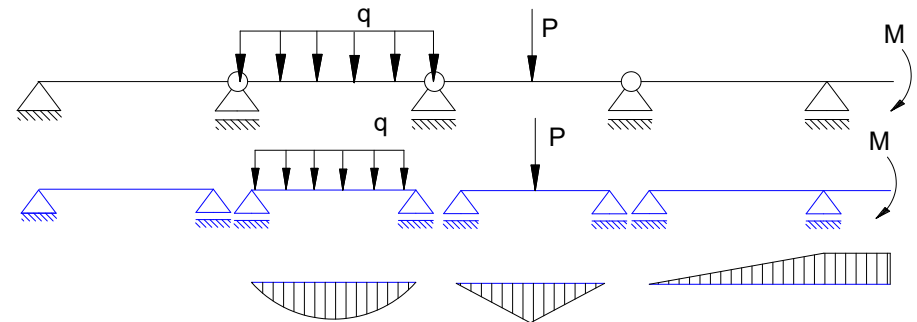
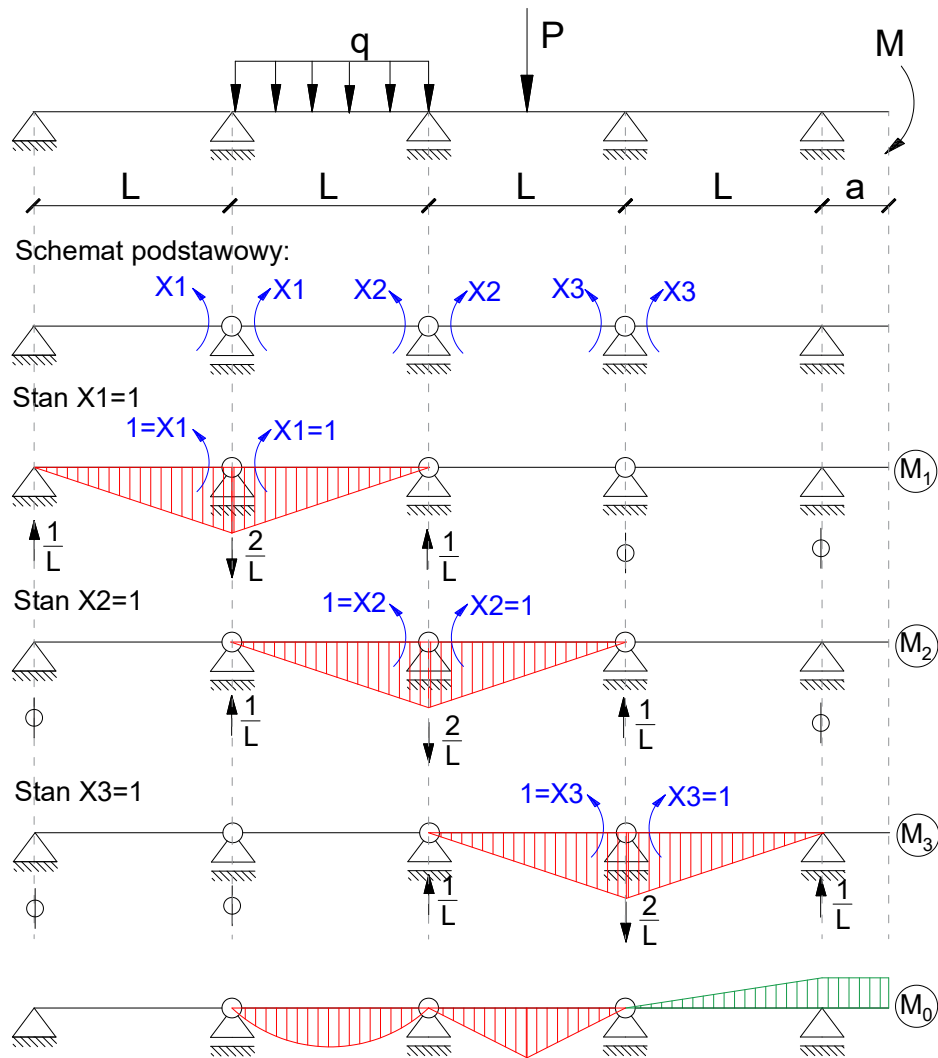


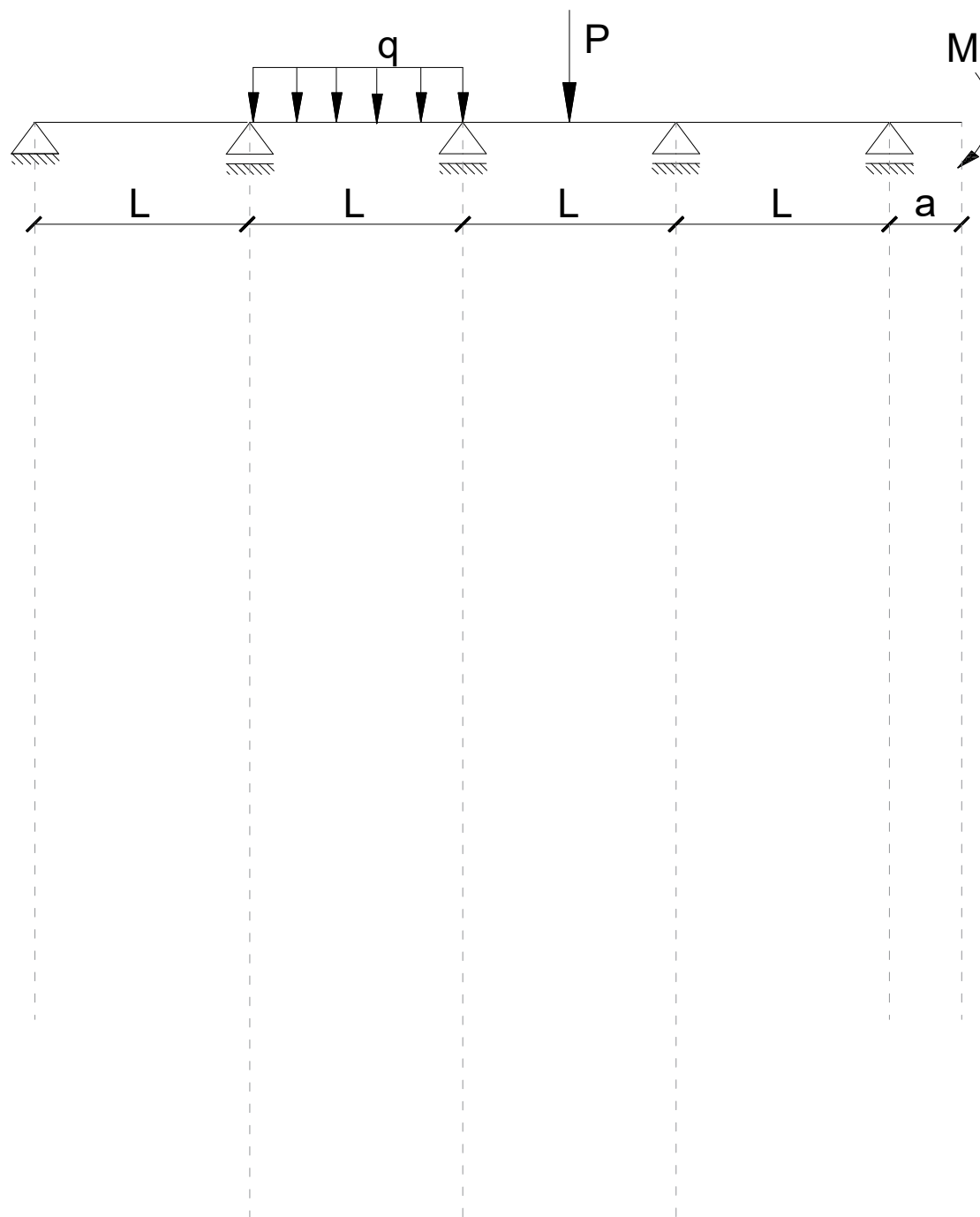




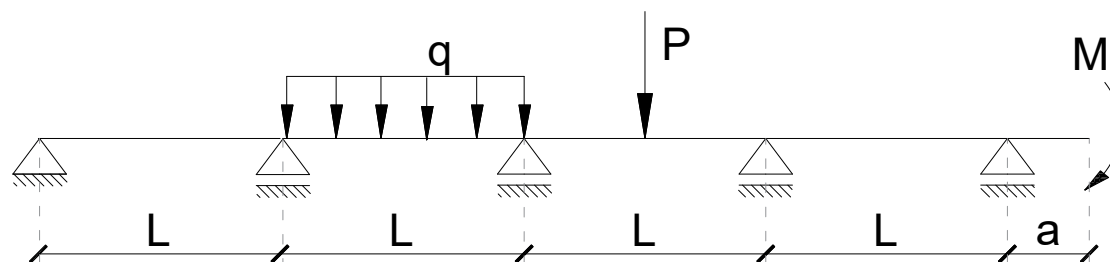




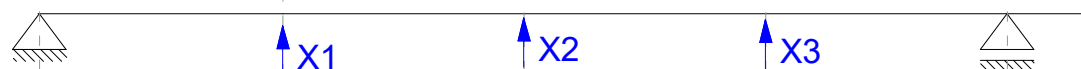




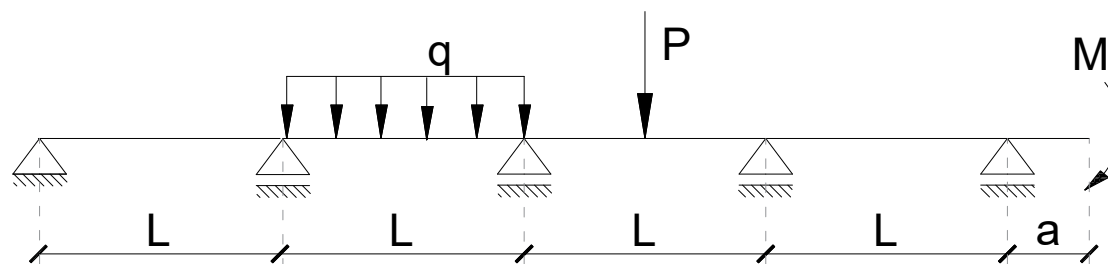
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



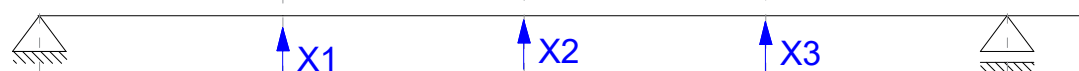
Schemat podstawowy:



Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



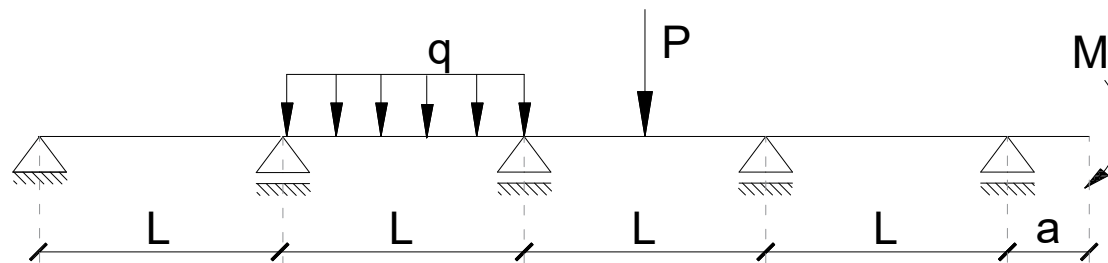
Schemat podstawowy:



Stan $X_1=1$



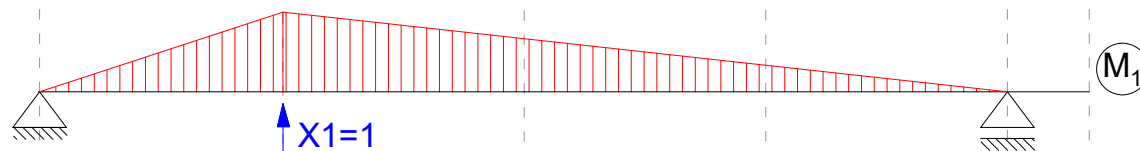
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



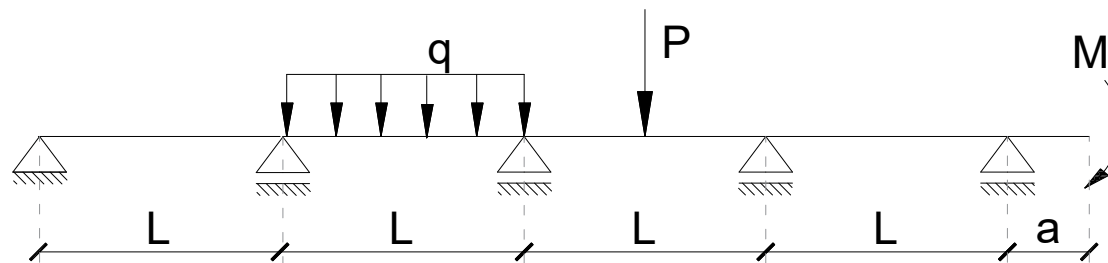
Schemat podstawowy:



Stan $X_1=1$



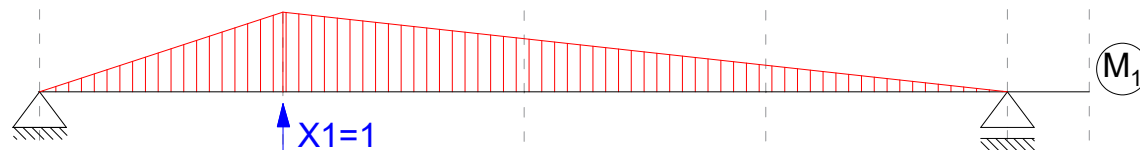
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



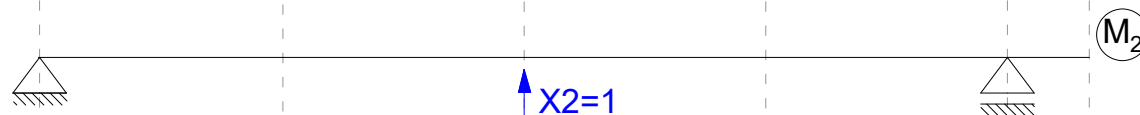
Schemat podstawowy:



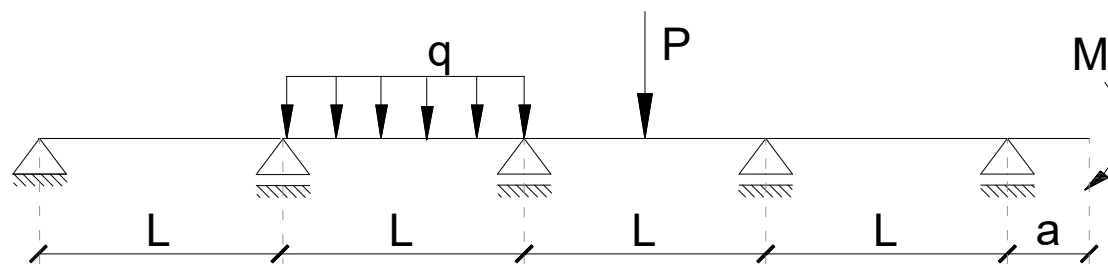
Stan $X_1=1$



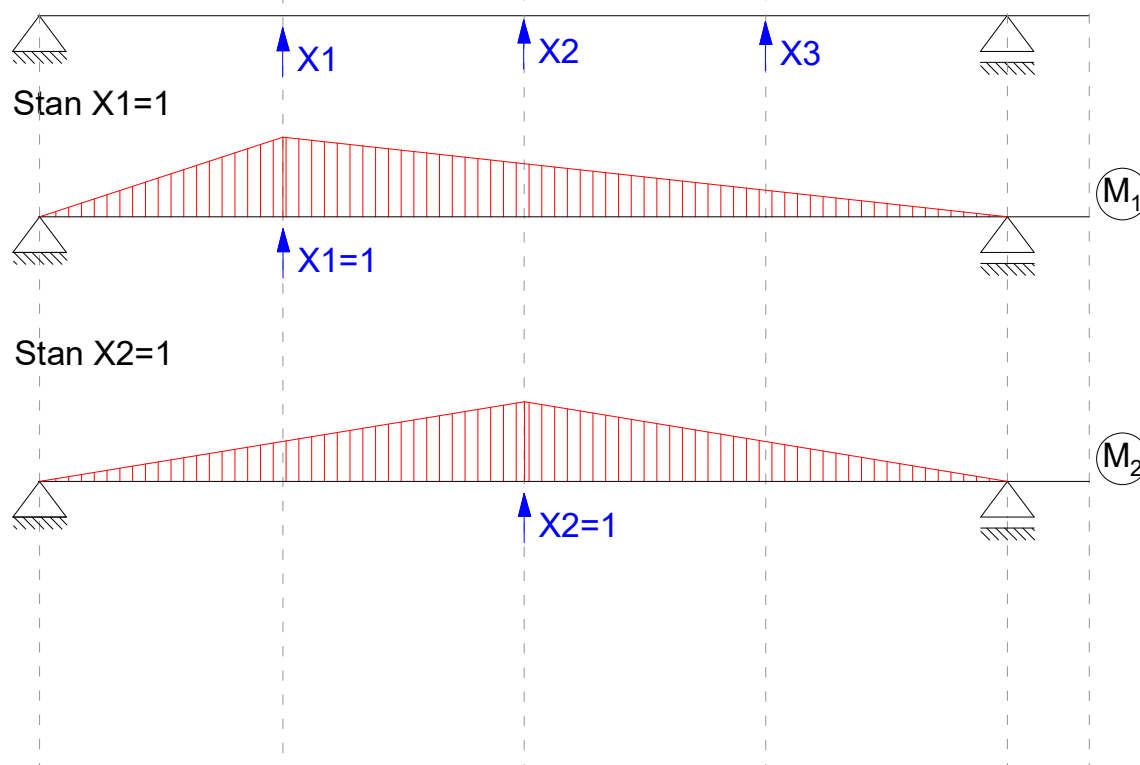
Stan $X_2=1$



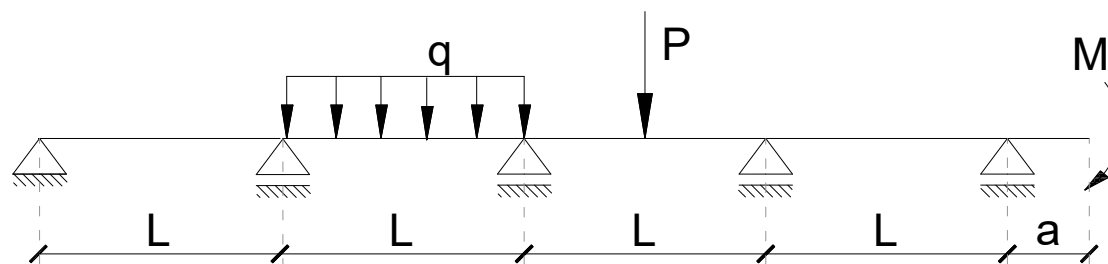
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



Schemat podstawowy:

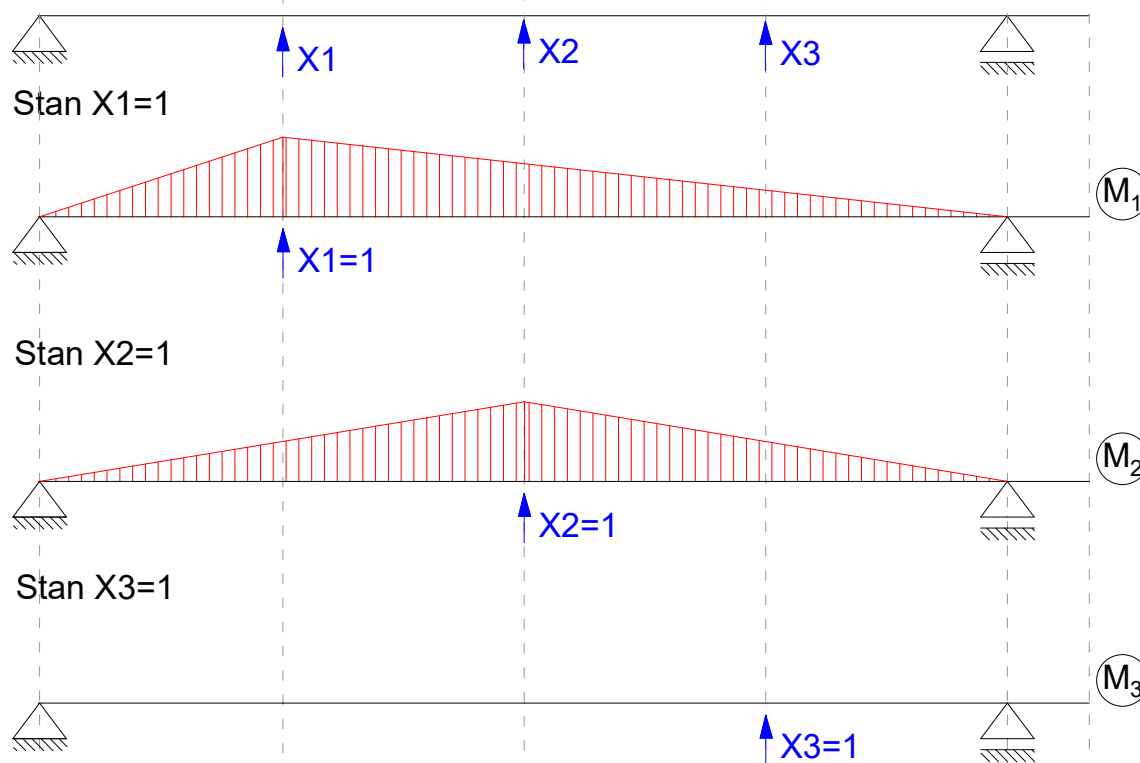


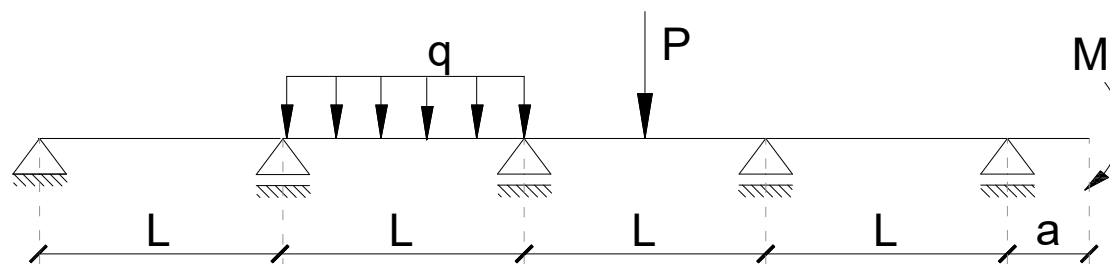
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



Schemat podstawowy:

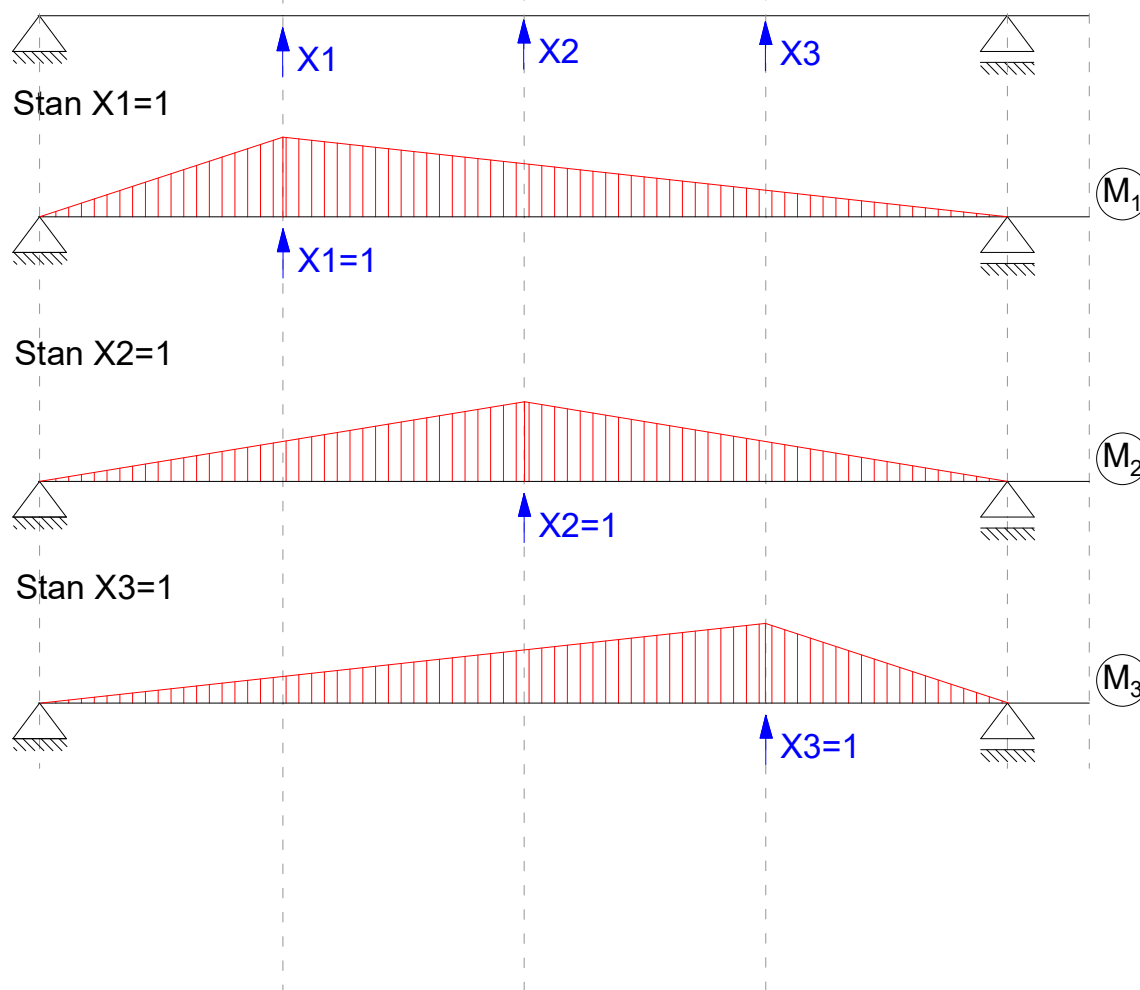
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

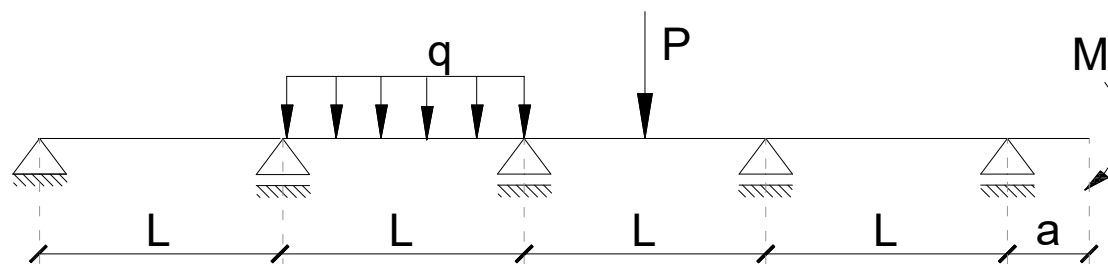




Schemat podstawowy:

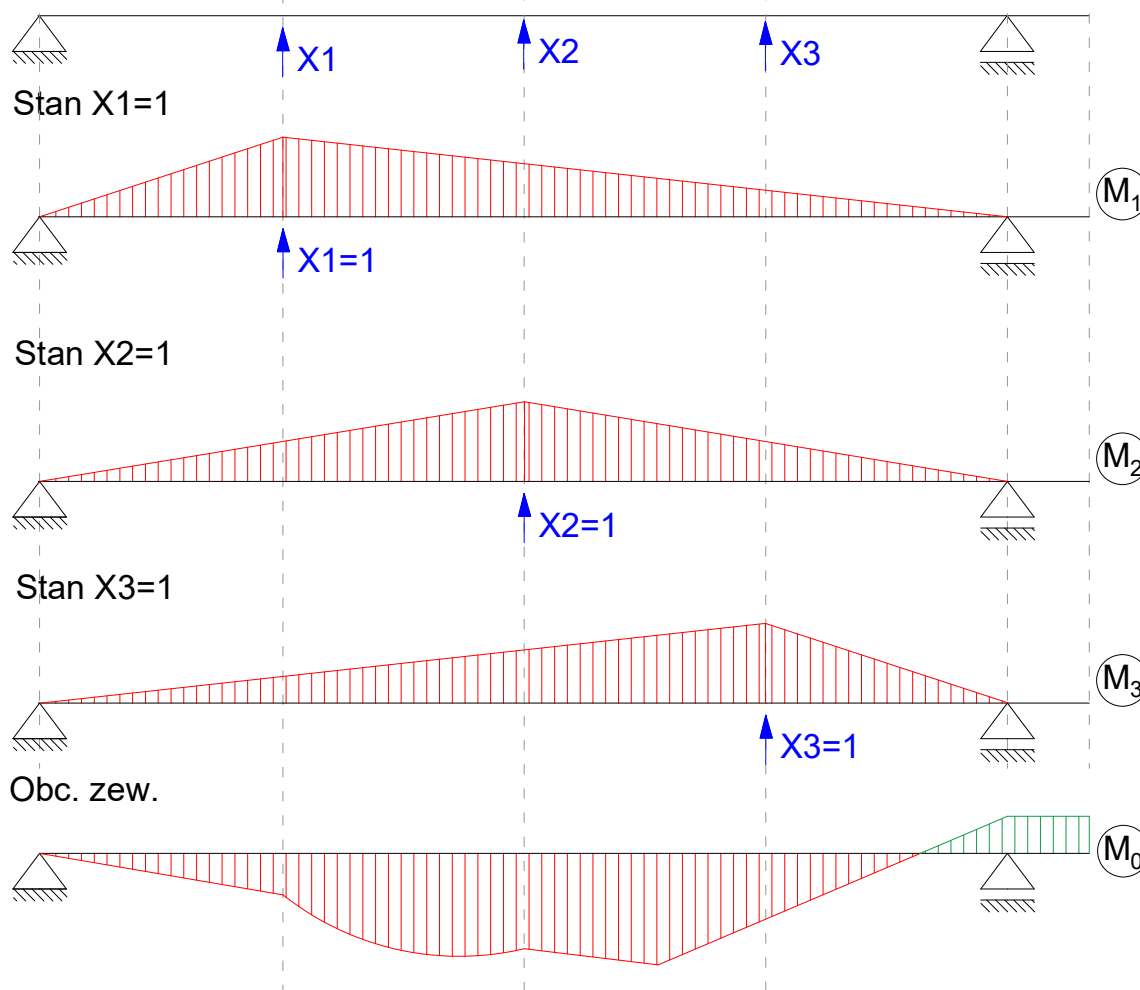
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

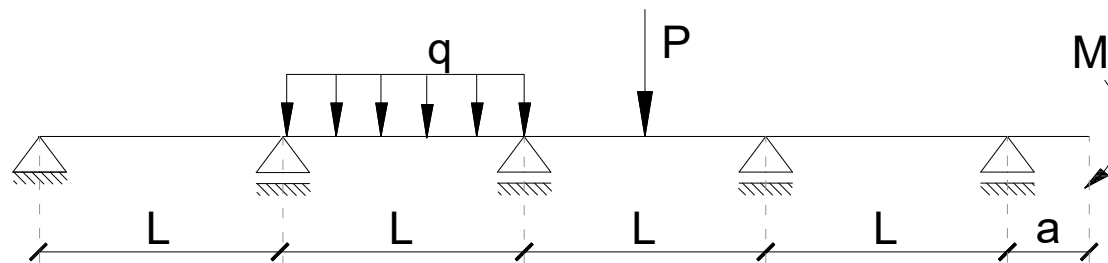




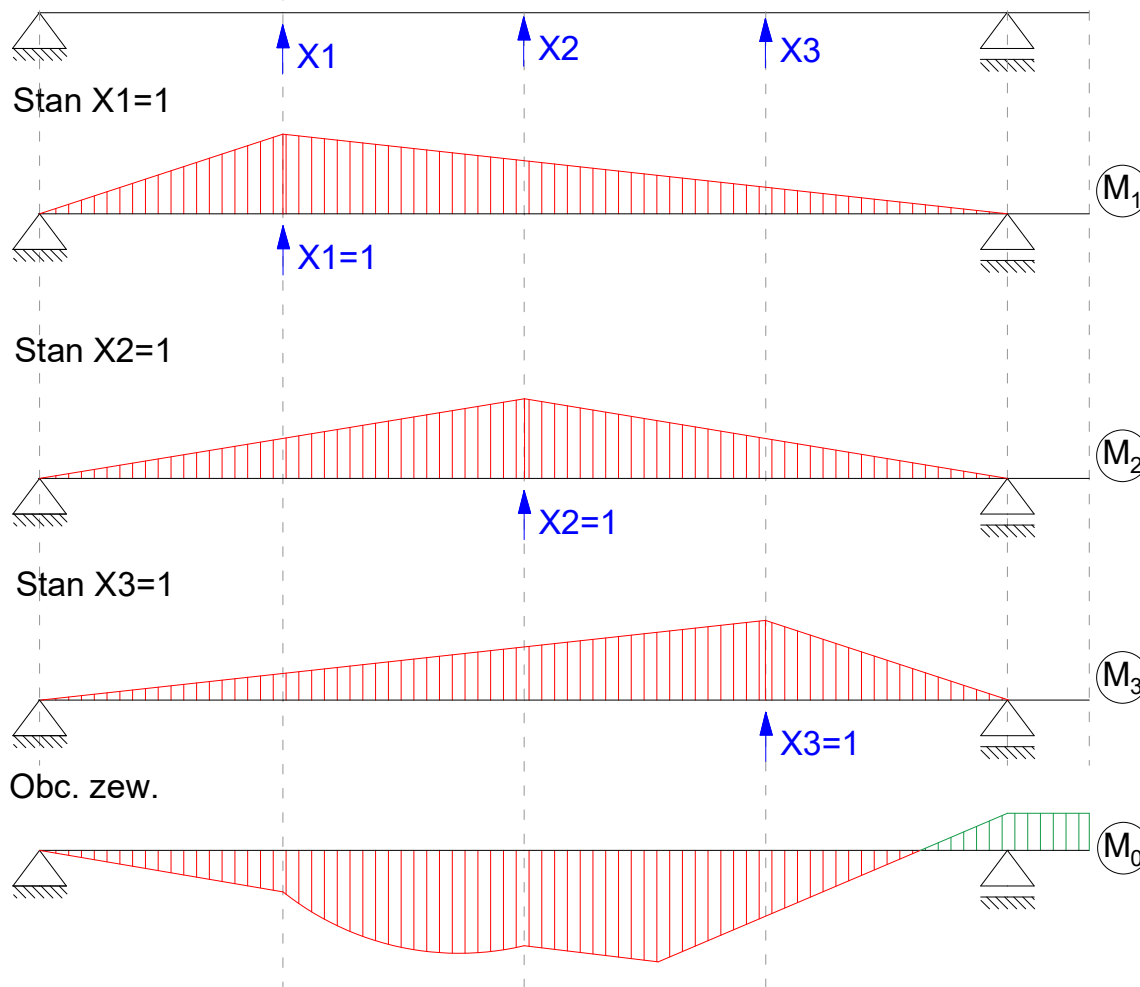
Schemat podstawowy:

Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



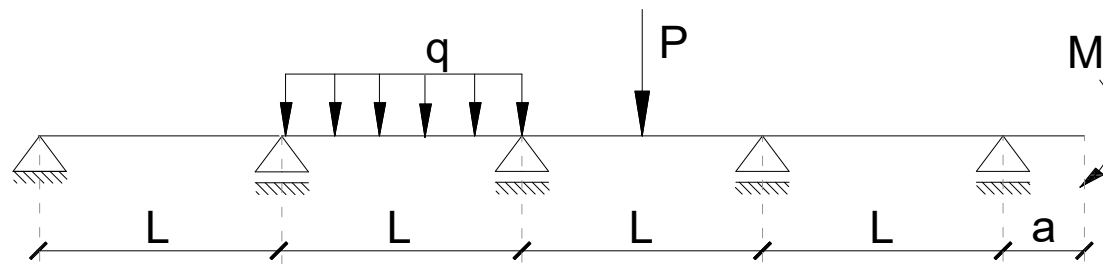


Schemat podstawowy:

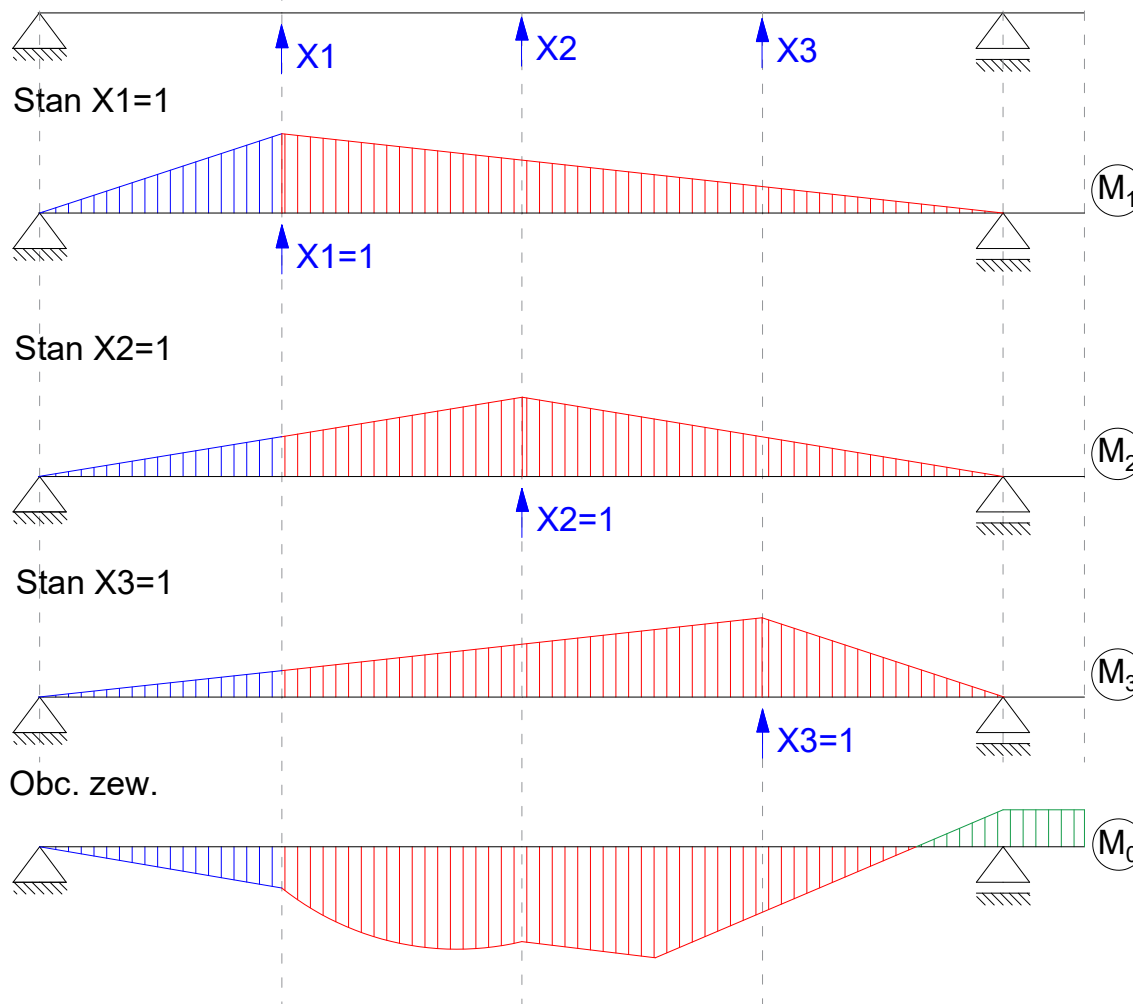


Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

Jednakże całkowanie jest wówczas o wiele bardziej złożone ponieważ po podziale powstają głównie trójkąty i trapezy.

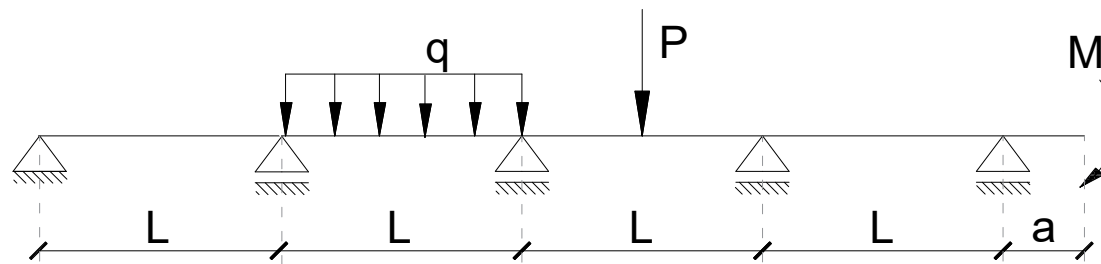


Schemat podstawowy:



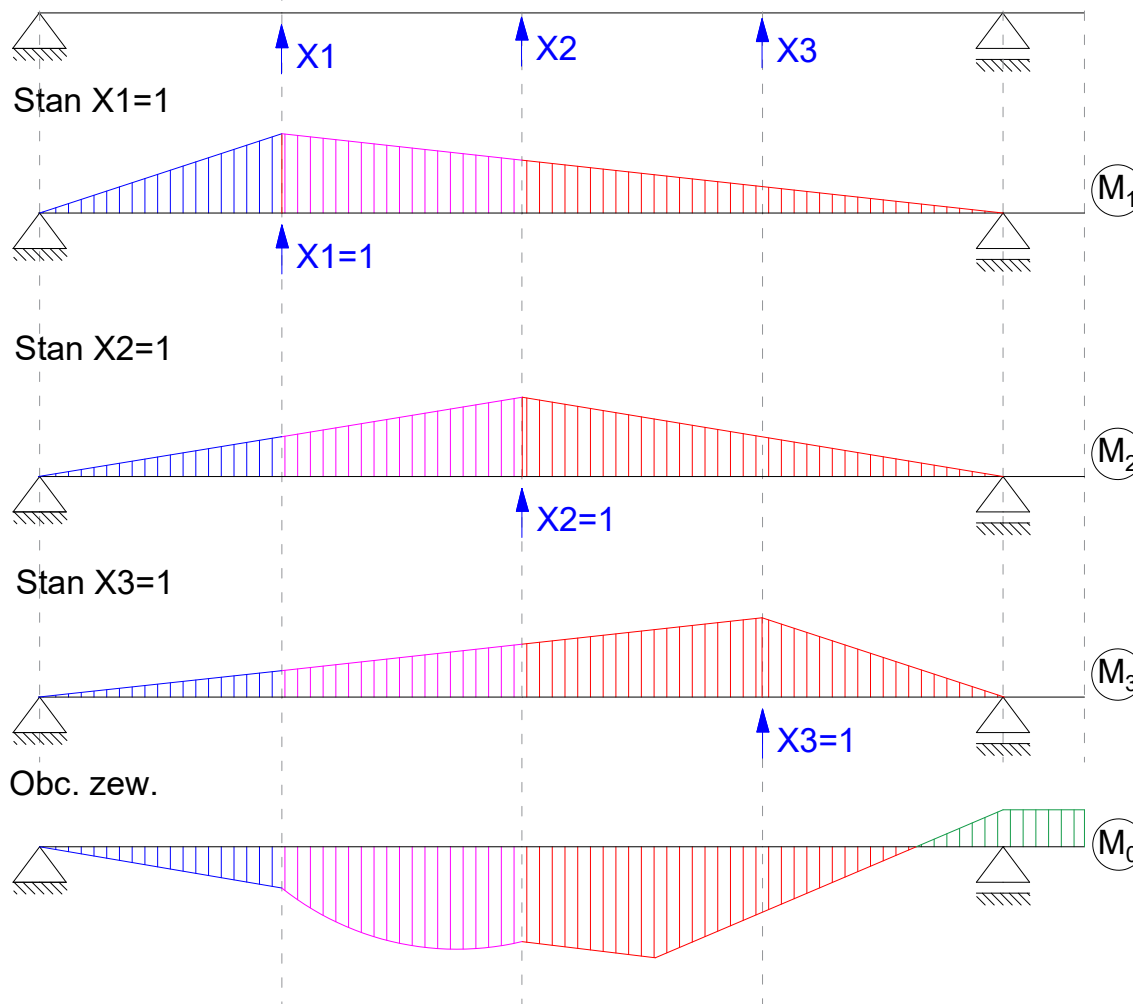
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

Jednakże całkowanie jest wówczas o wiele bardziej złożone ponieważ po podziale powstają głównie trójkąty i trapezy.

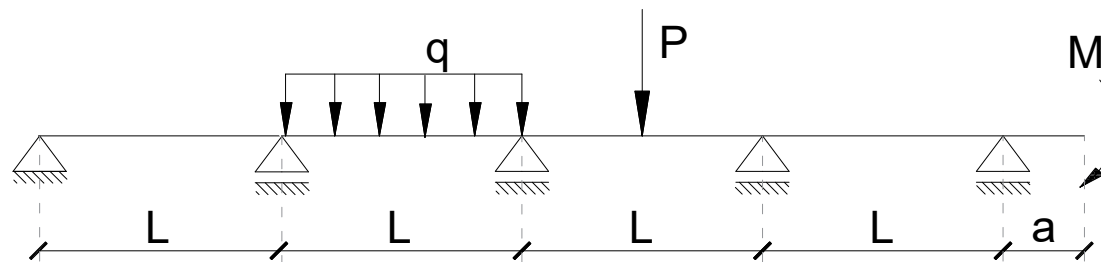


Schemat podstawowy:

Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

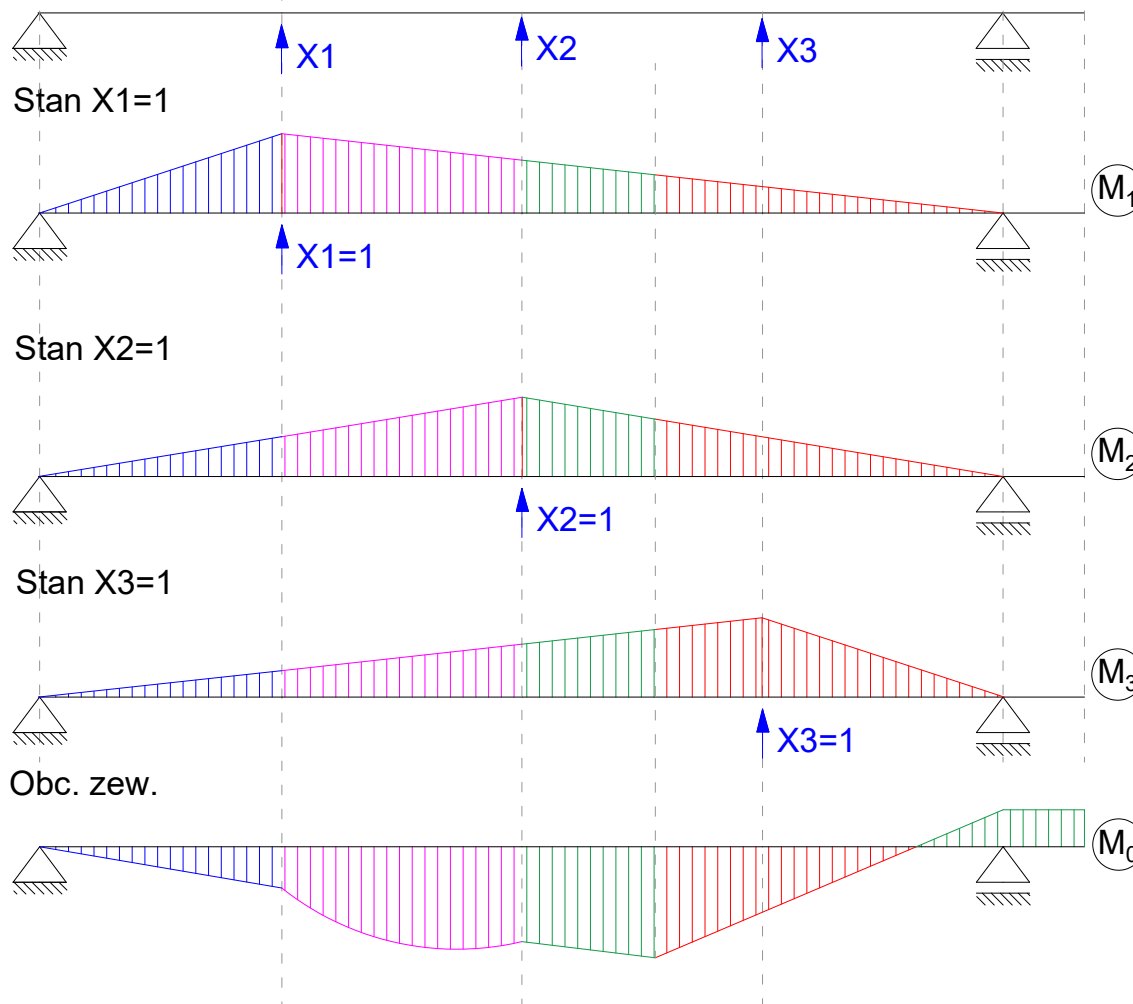


Jednakże całkowanie jest wówczas o wiele bardziej złożone ponieważ po podziale powstają głównie trójkąty i trapezy.

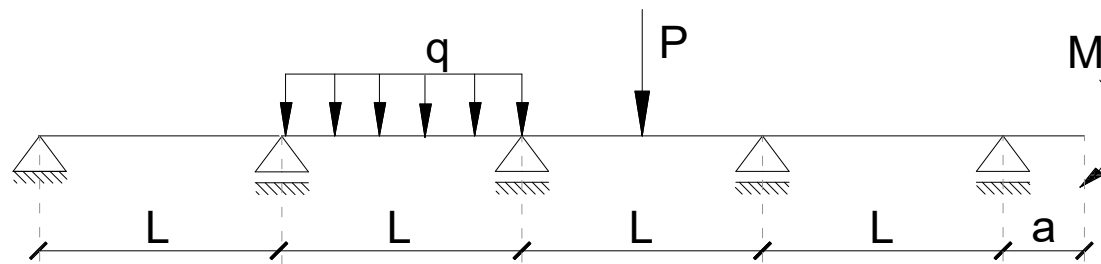


Schemat podstawowy:

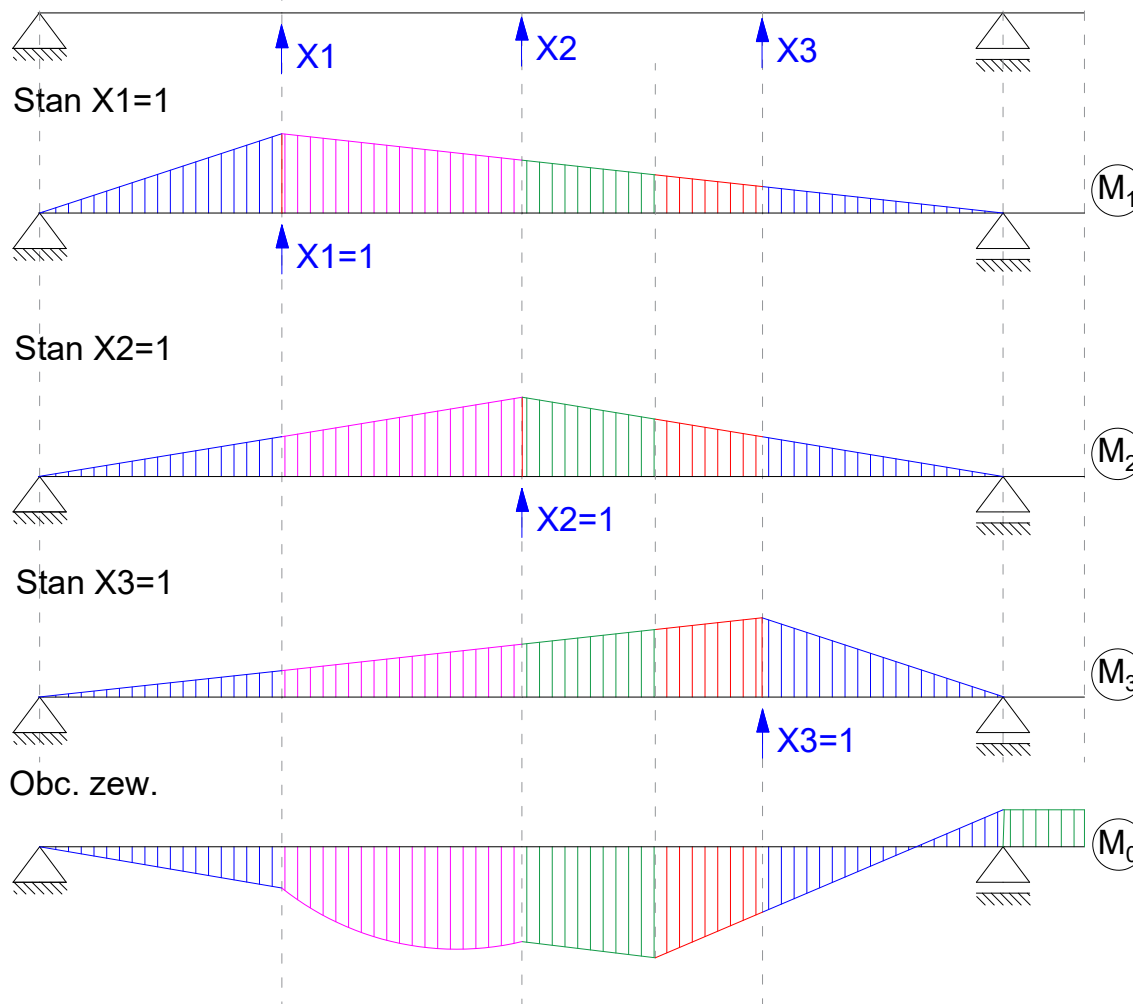
Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.



Jednakże całkowanie jest wówczas o wiele bardziej złożone ponieważ po podziale powstają głównie trójkąty i trapezy.



Schemat podstawowy:



Przy tworzeniu schematu podstawowego można również usuwać reakcje w podporach.

Jednakże całkowanie jest wówczas o wiele bardziej złożone ponieważ po podziale powstają głównie trójkąty i trapezy.

Belki statycznie niewyznaczalne z przegubem

Belki statycznie niewyznaczalne z przegubem

Przy tworzeniu schematu, można wprowadzać przeguby lub usuwać reakcje.

Belki statycznie niewyznaczalne z przegubem

Przy tworzeniu schematu, można wprowadzać przeguby lub usuwać reakcje.

Uwaga!

Belki statycznie niewyznaczalne z przegubem

Przy tworzeniu schematu, można wprowadzać przeguby lub usuwać reakcje.

Uwaga!

Przy tworzeniu schematu podstawowego metody sił przez wprowadzanie przegubu, nie wolno ustalić schematu, w którym trzy przeguby znajdują się na jednej linii, a środkowy nie ma podparcia.

Belki statycznie niewyznaczalne z przegubem

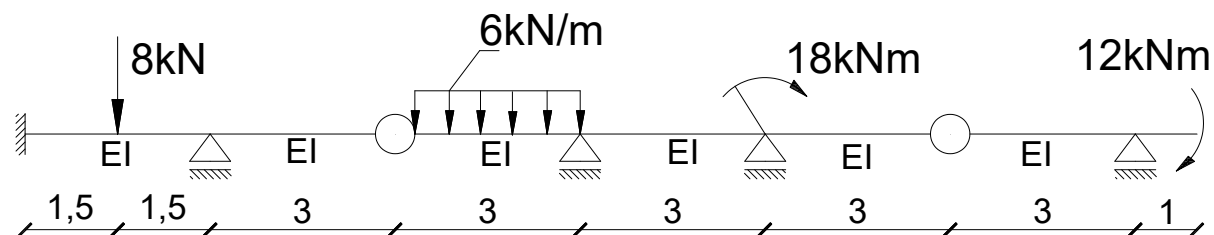
Przy tworzeniu schematu, można wprowadzać przeguby lub usuwać reakcje.

Uwaga!

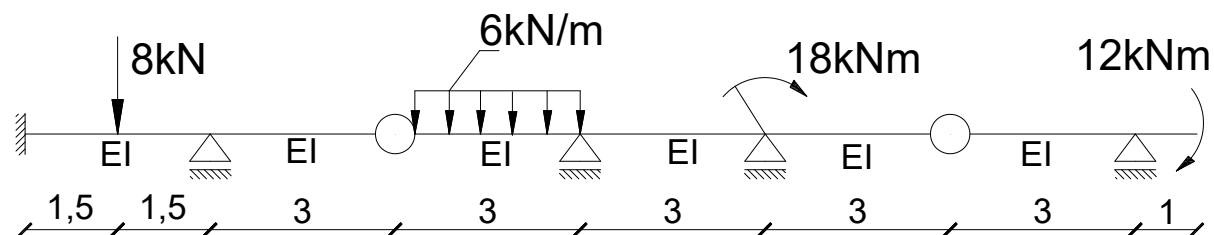
Przy tworzeniu schematu podstawowego metody sił przez wprowadzanie przegubu, nie wolno ustalić schematu, w którym trzy przeguby znajdują się na jednej linii, a środkowy nie ma podparcia.

Nigdy nie wprowadzamy przegubu do skrajnej podpory przegubowej!

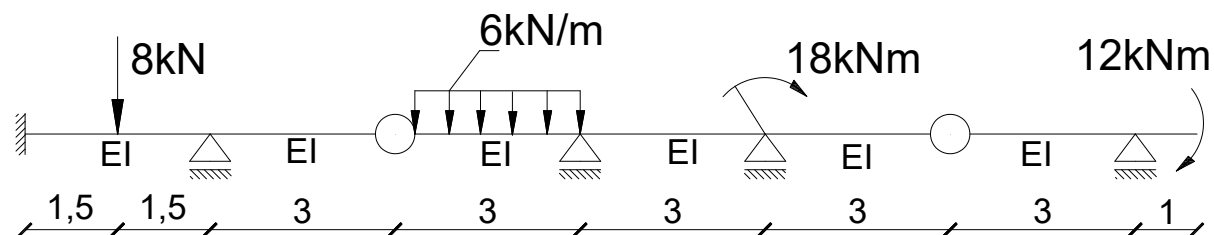
Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

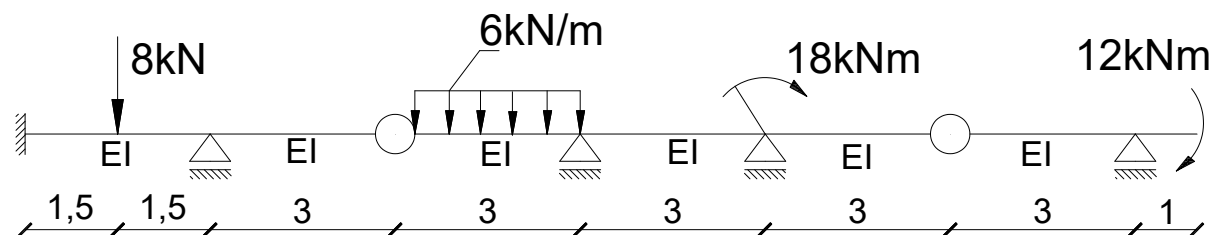


Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



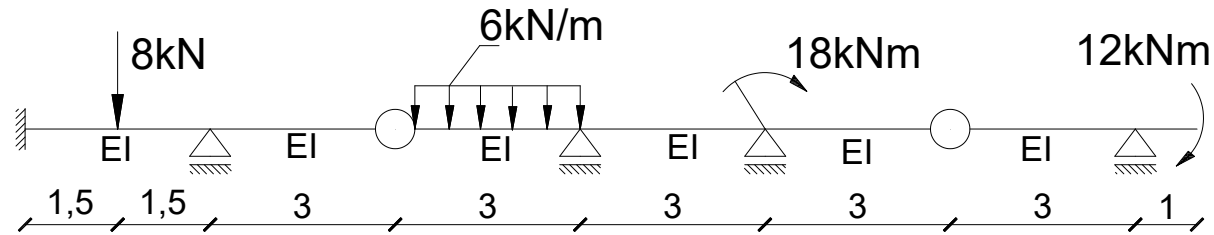
$$n_s = lr - lp - 3$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



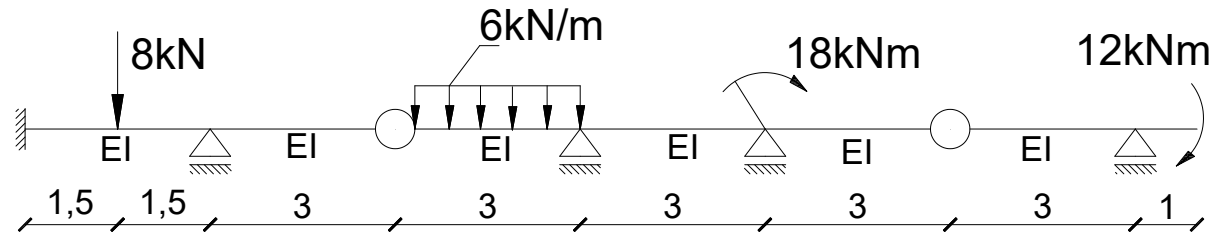
$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2$$

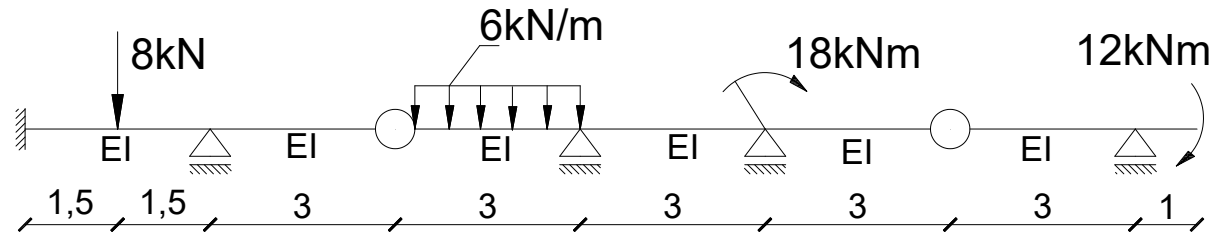
Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

dr inż. Hanna Weber

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

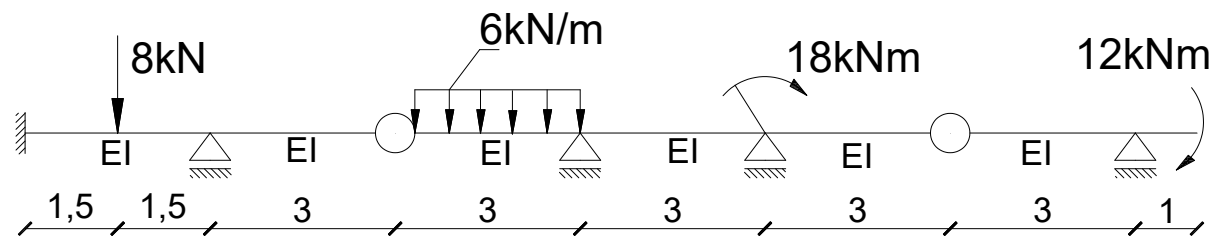


Schematy podstawowe:

$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

dr inż. Hanna Weber

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



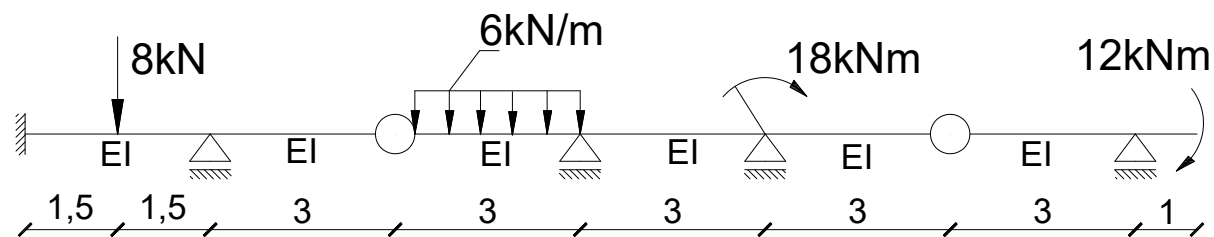
Schematy podstawowe:



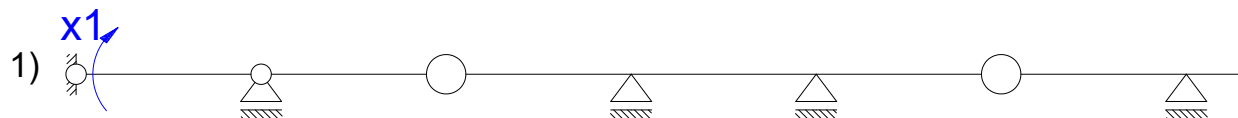
$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

dr inż. Hanna Weber

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



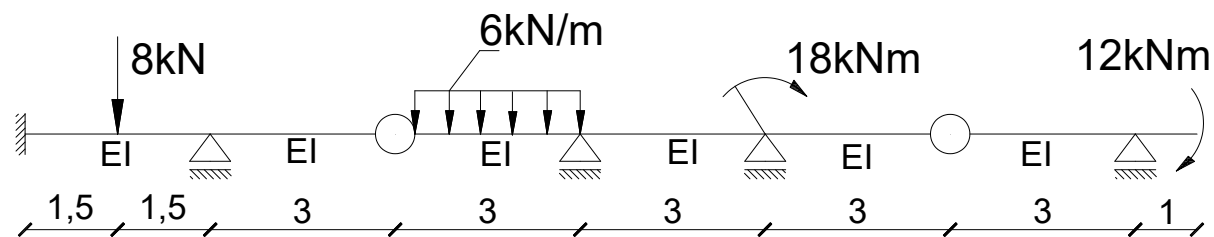
Schematy podstawowe:



$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

dr inż. Hanna Weber

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

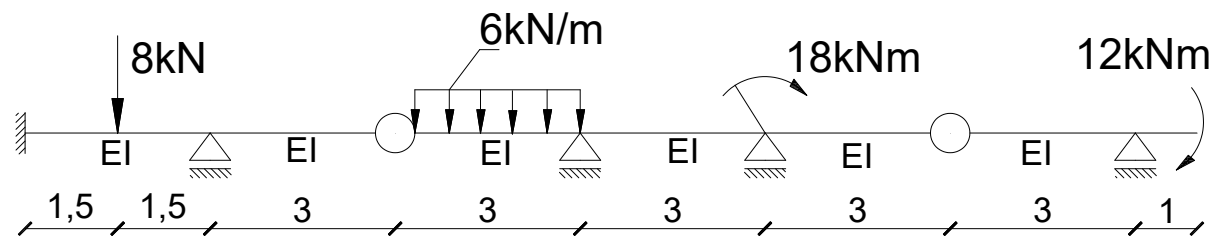


Schematy podstawowe:



$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

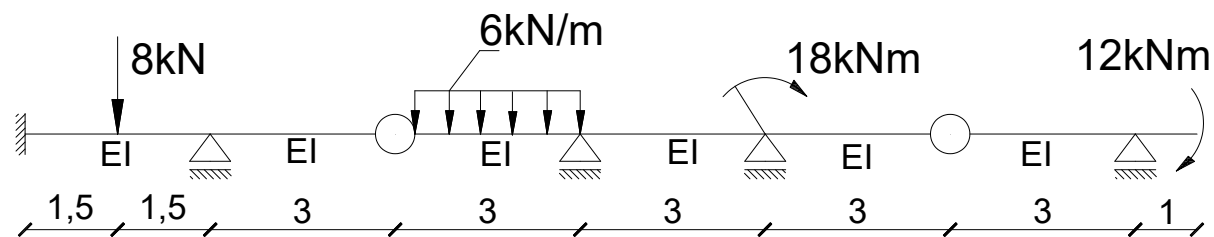


Schematy podstawowe:

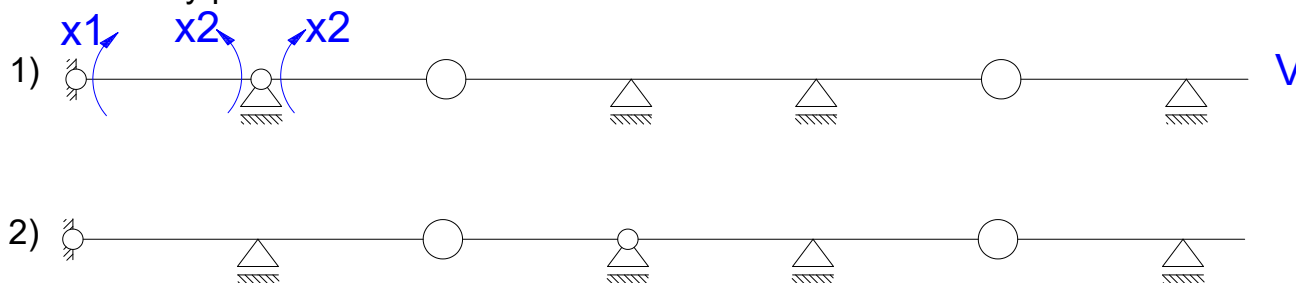


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

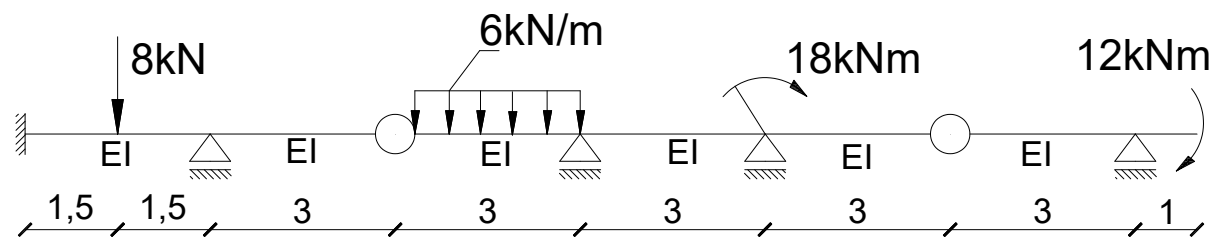


Schematy podstawowe:

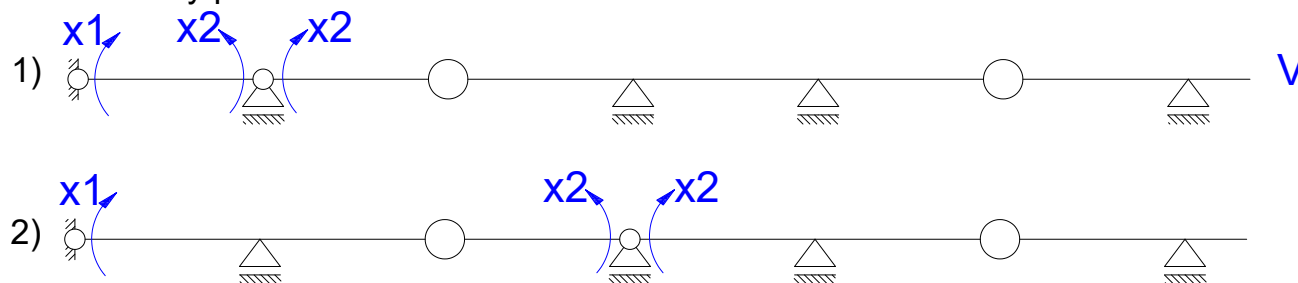


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

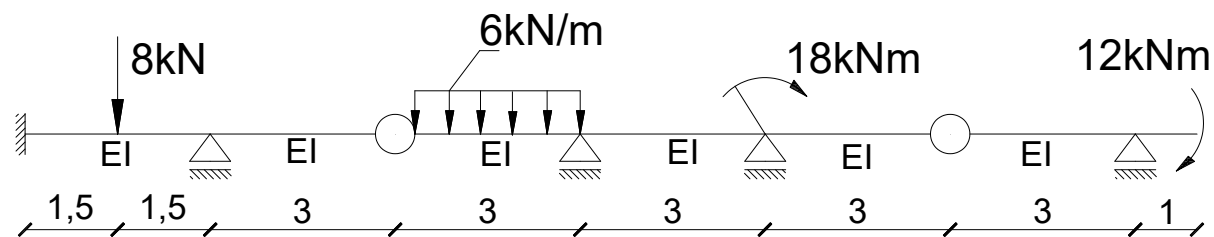


Schematy podstawowe:

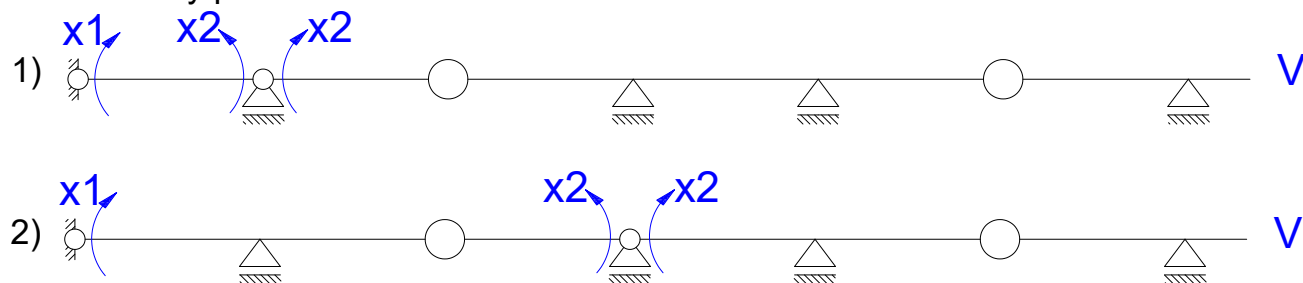


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

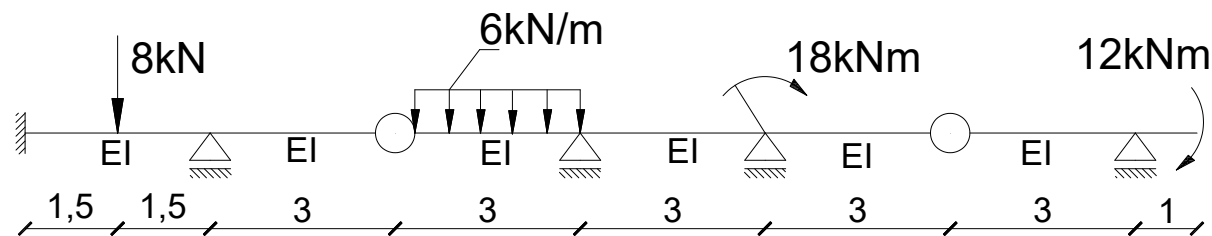


Schematy podstawowe:

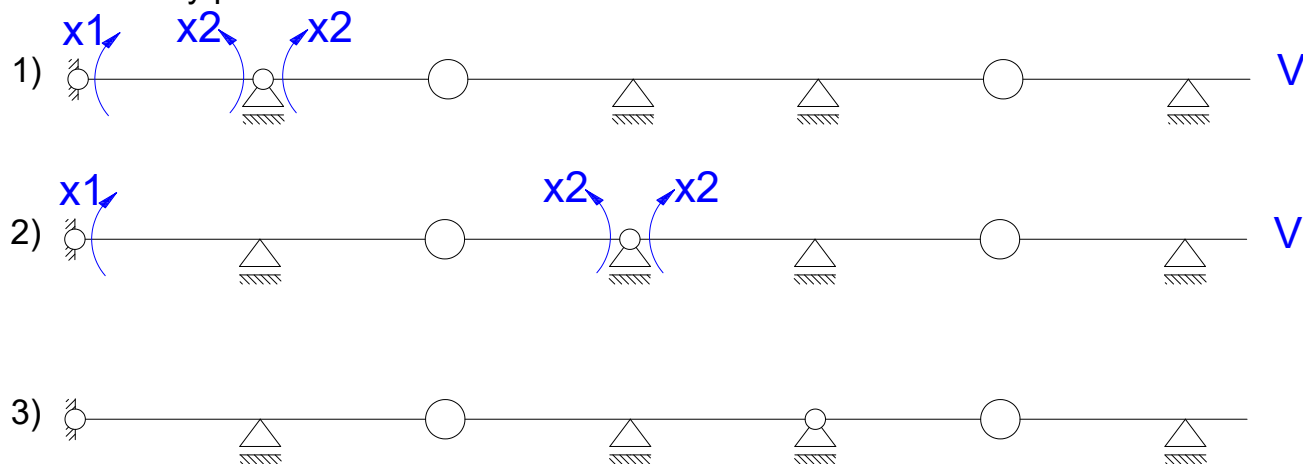


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

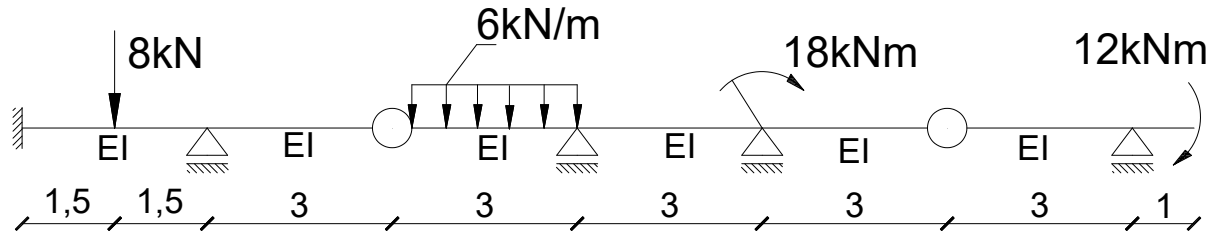


Schematy podstawowe:

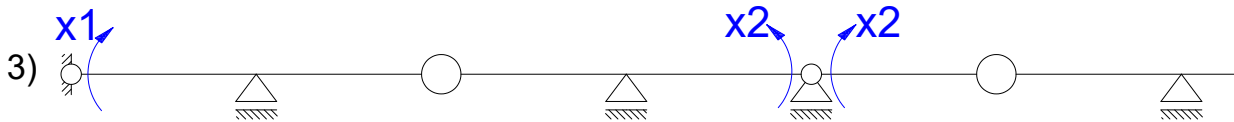
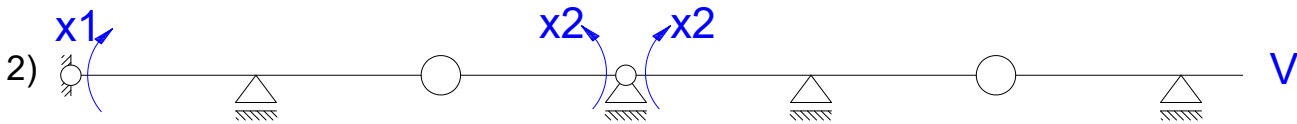
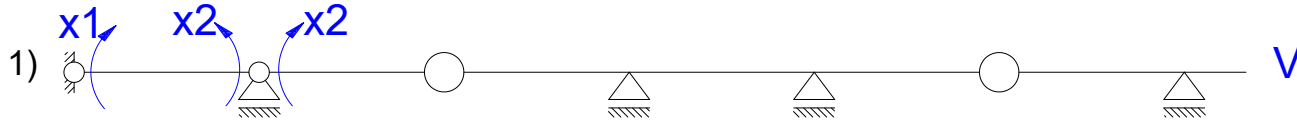


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



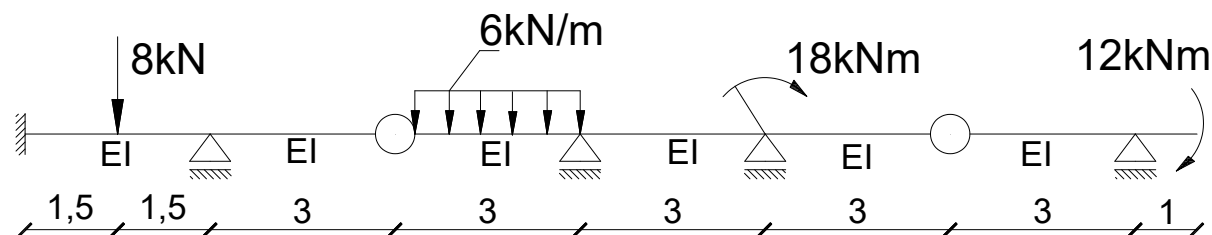
Schematy podstawowe:



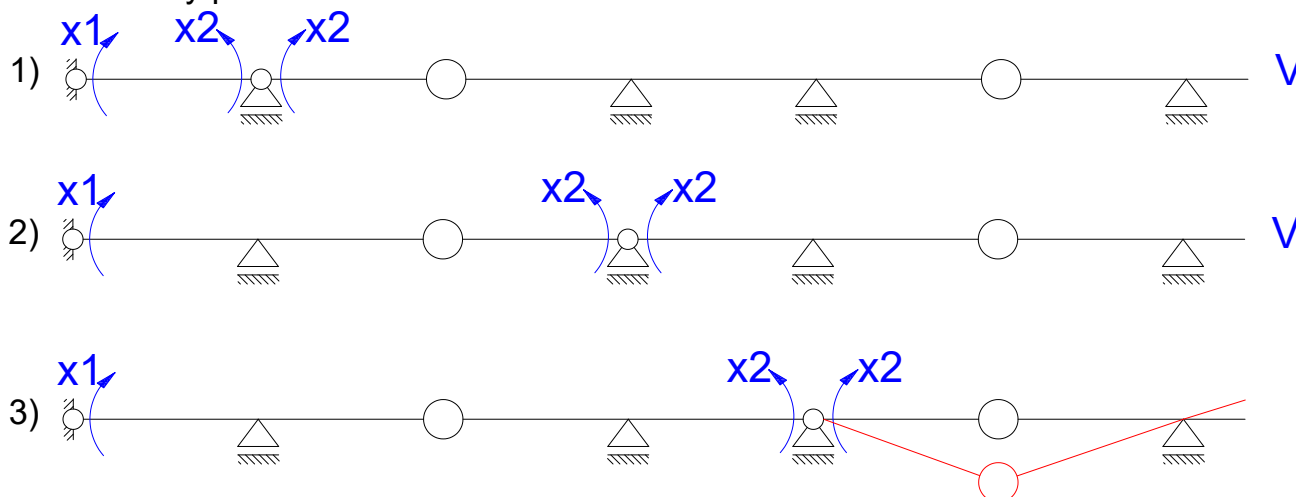
$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

dr inż. Hanna Weber

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

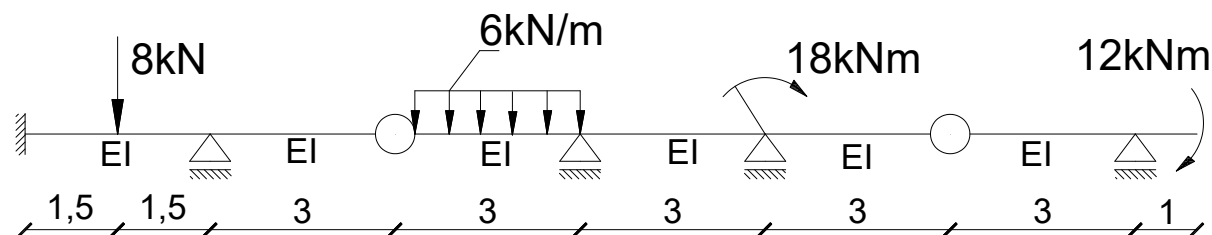


Schematy podstawowe:

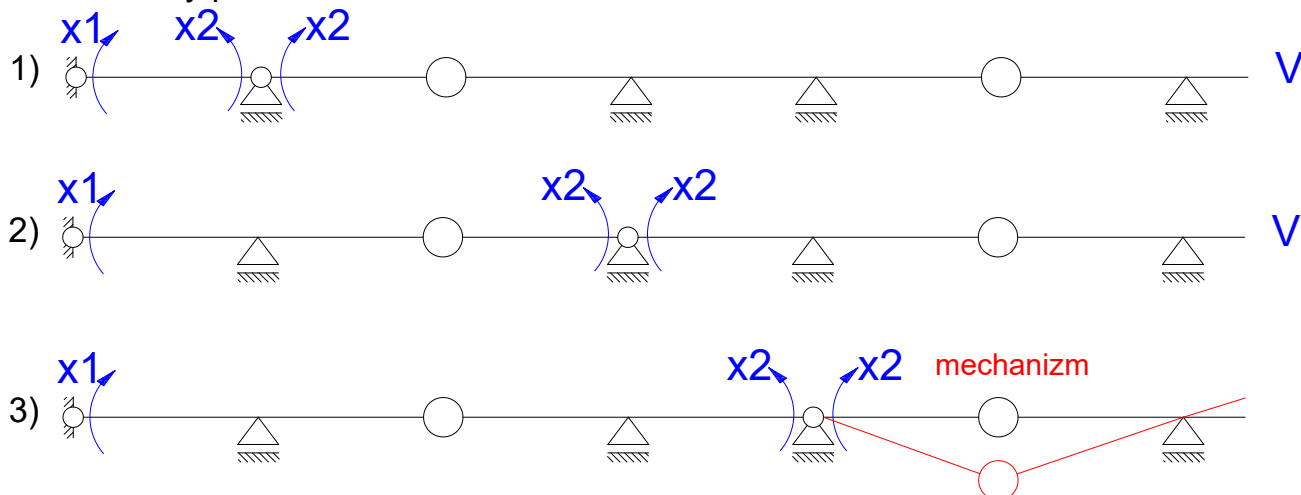


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

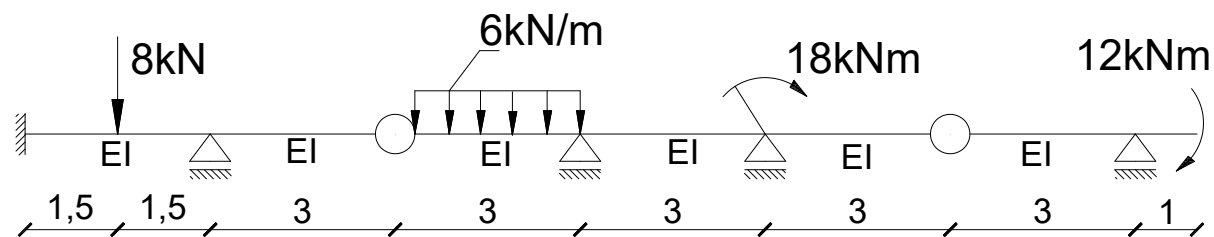


Schematy podstawowe:

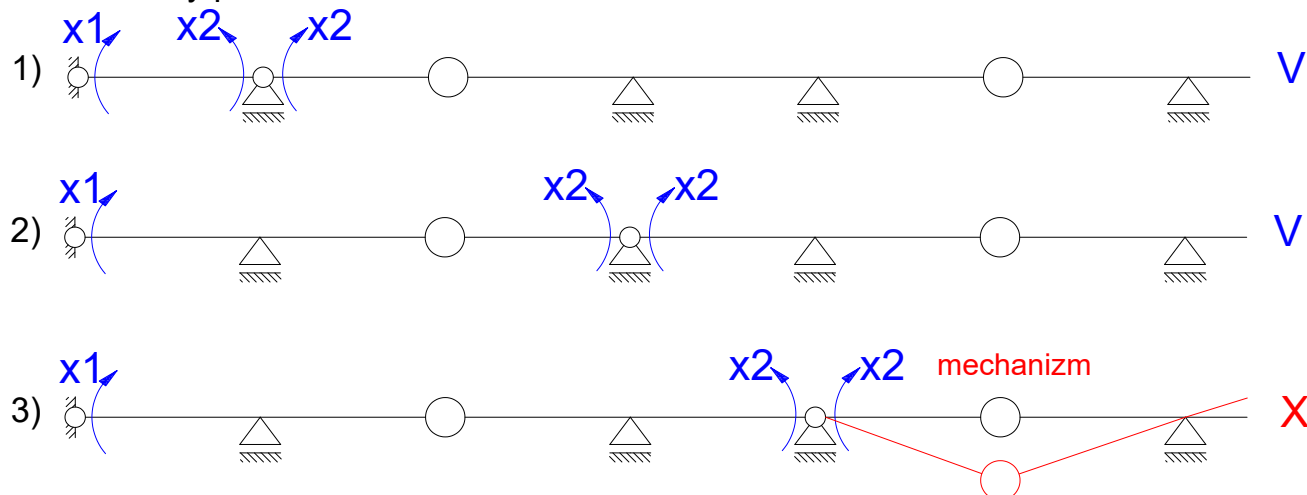


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

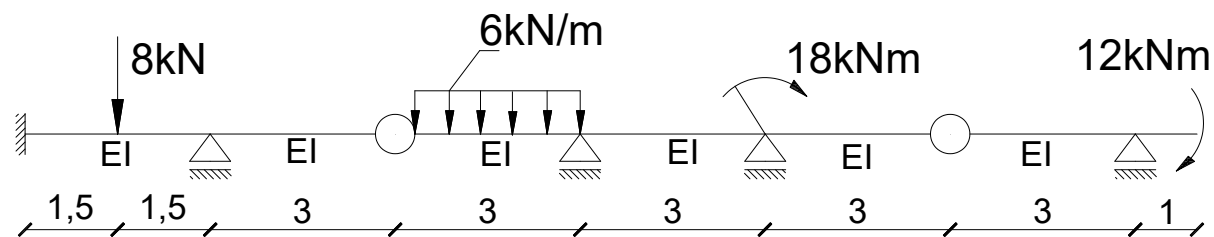


Schematy podstawowe:

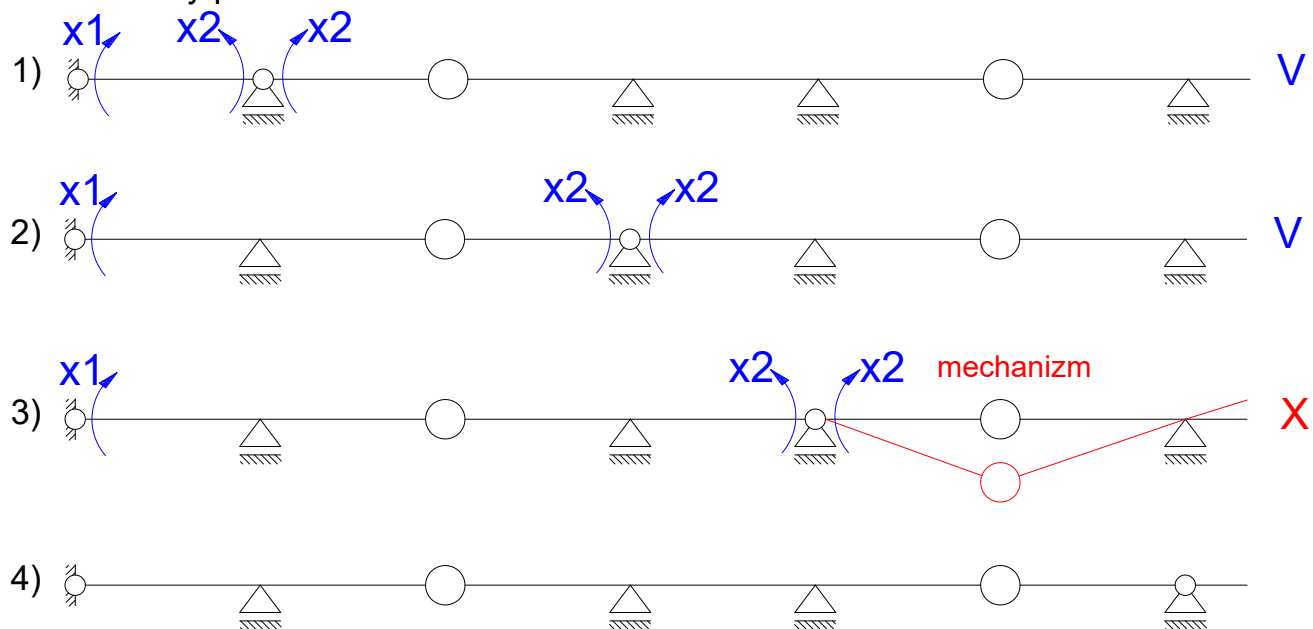


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

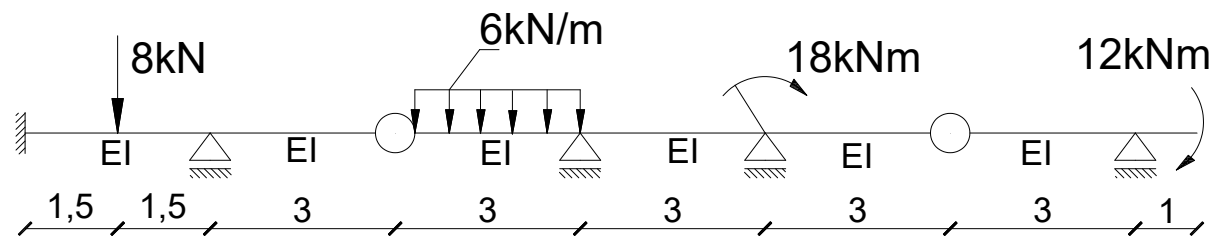


Schematy podstawowe:

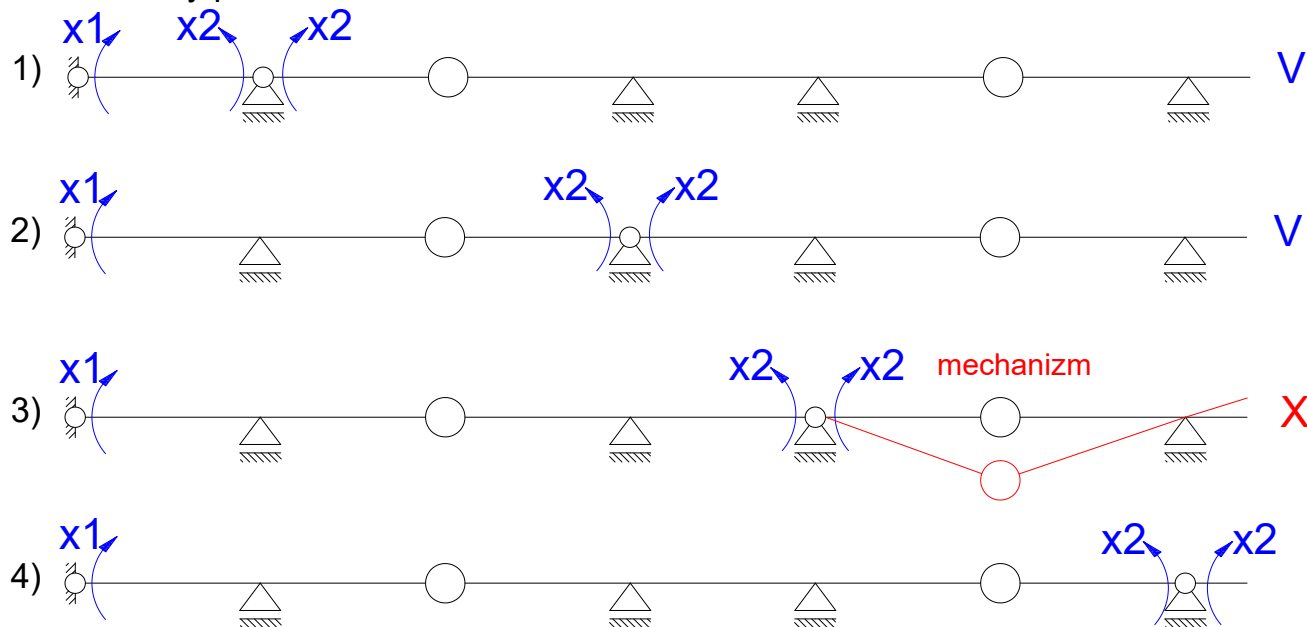


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

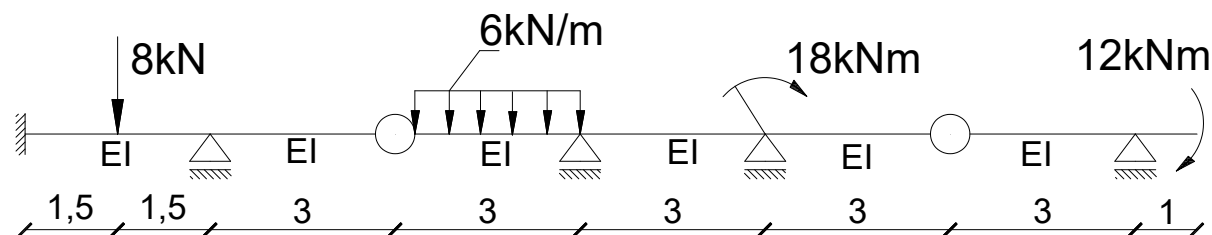


Schematy podstawowe:

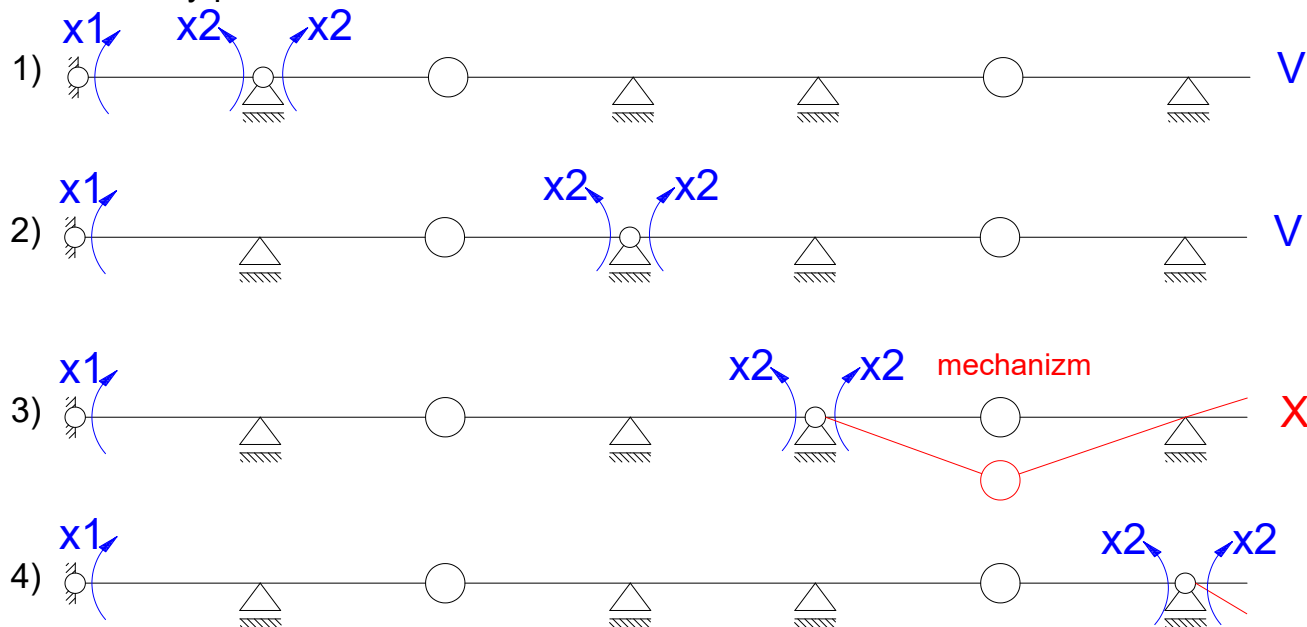


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

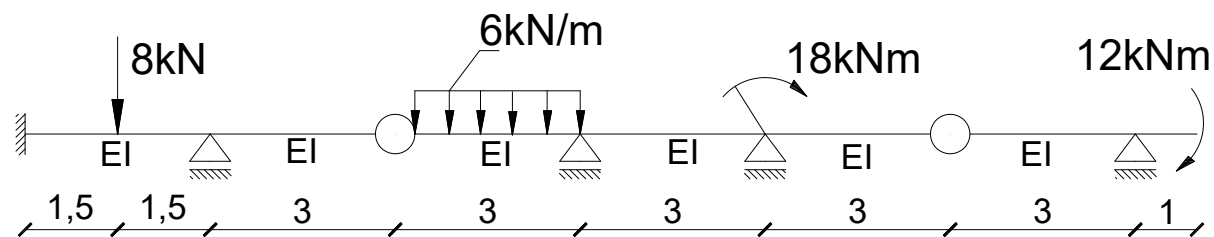


Schematy podstawowe:

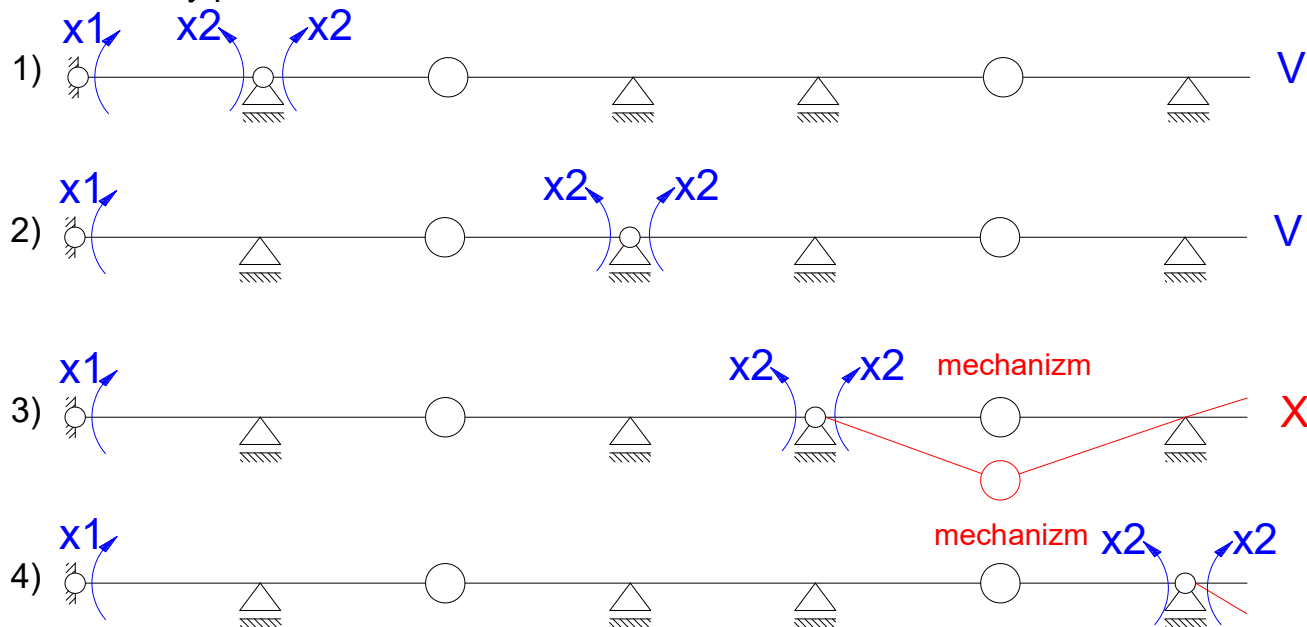


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

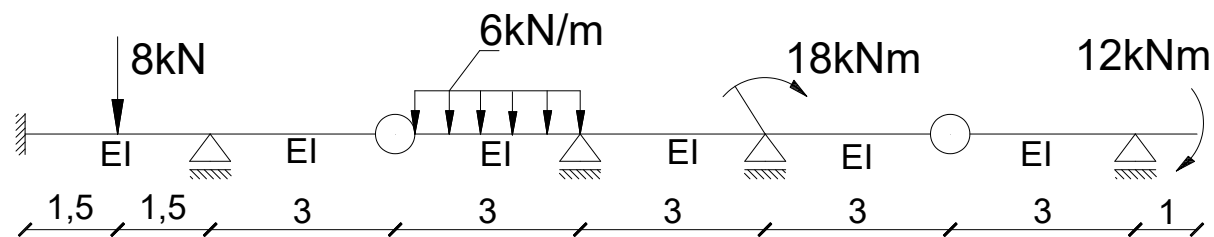


Schematy podstawowe:

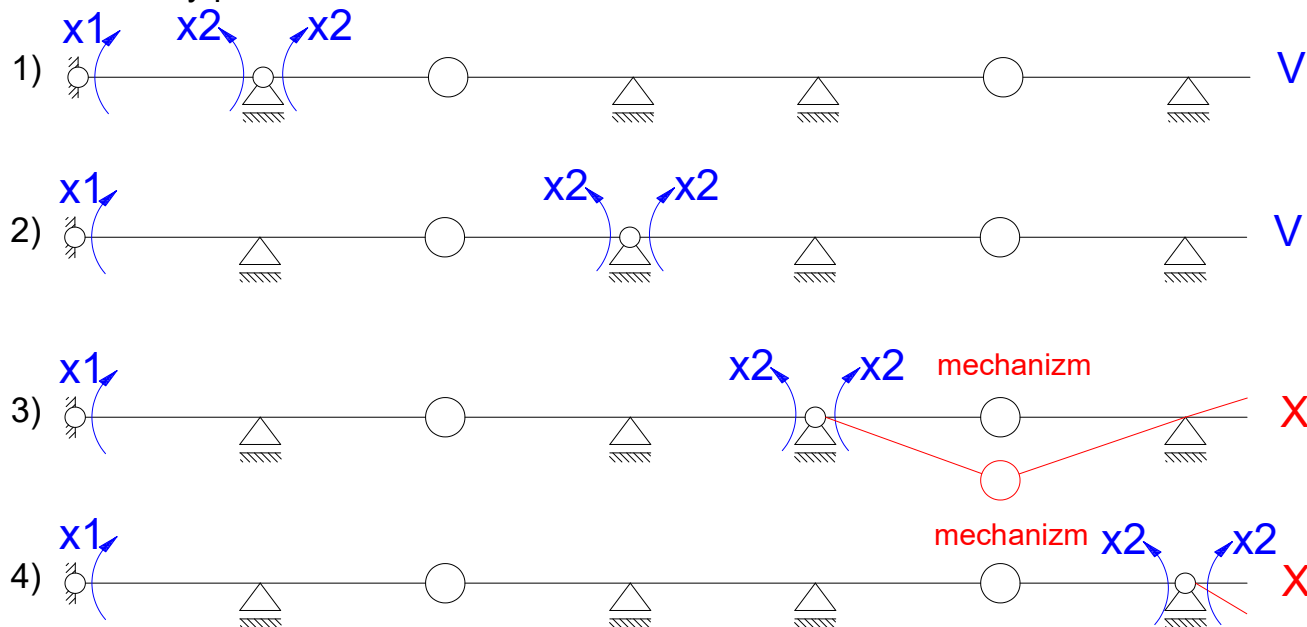


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

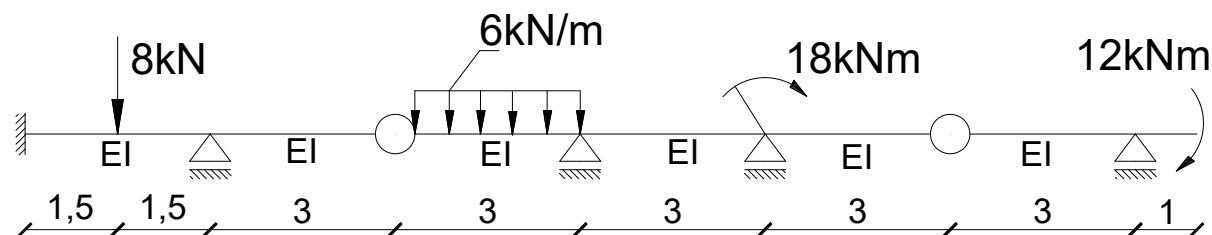


Schematy podstawowe:

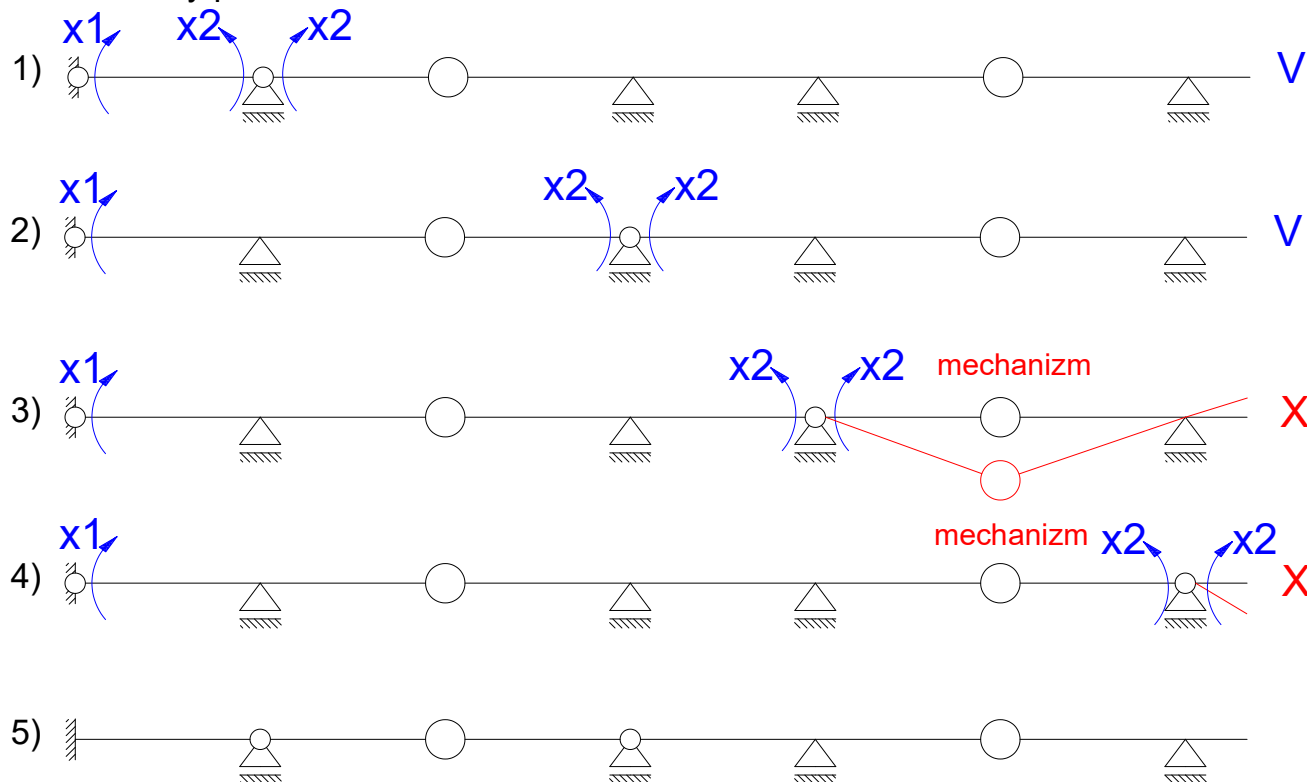


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

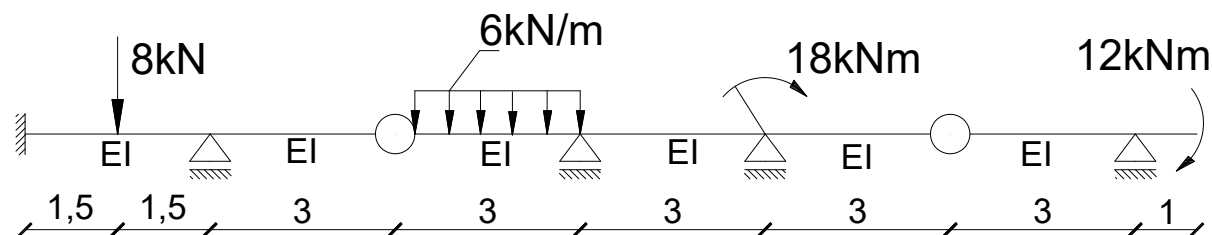


Schematy podstawowe:

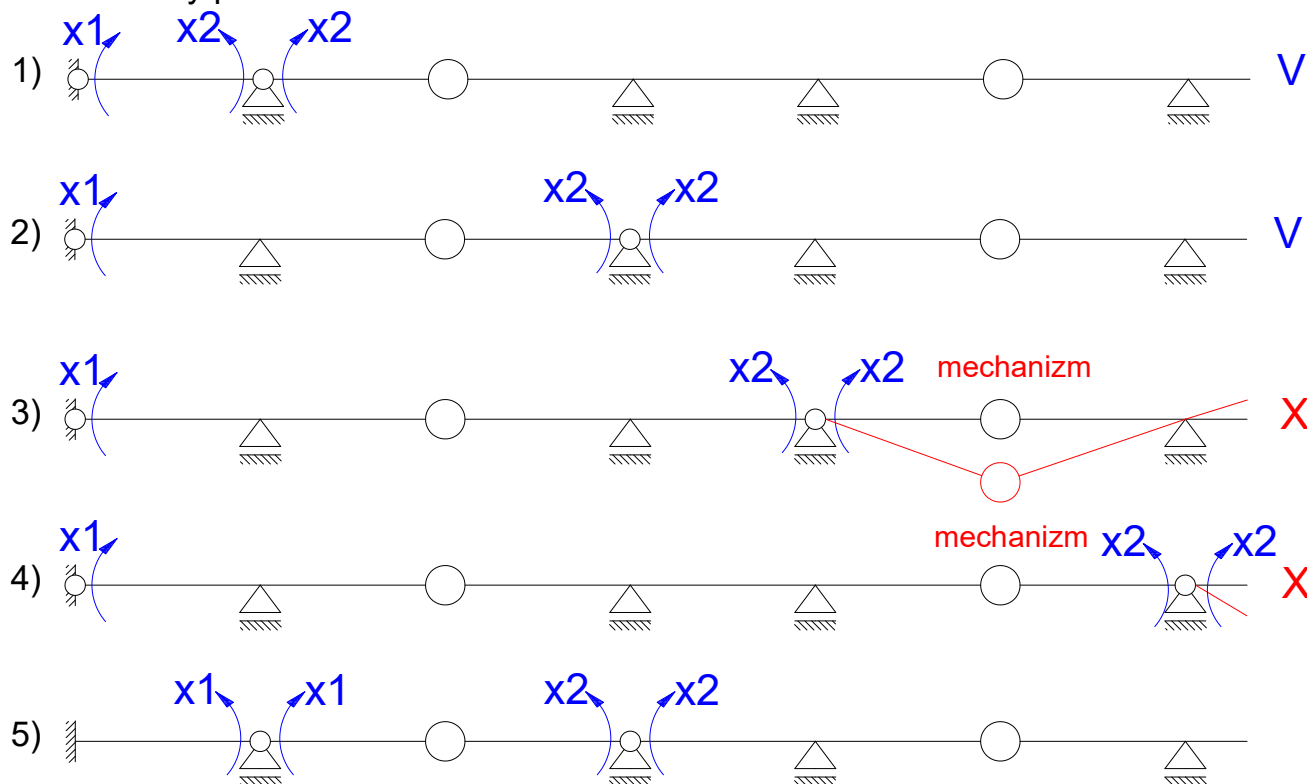


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

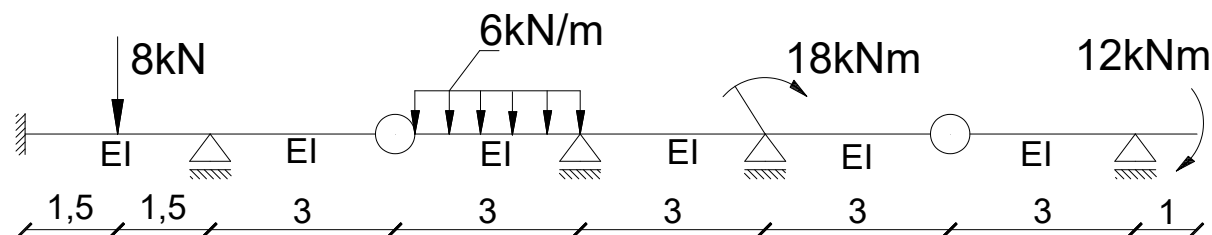


Schematy podstawowe:

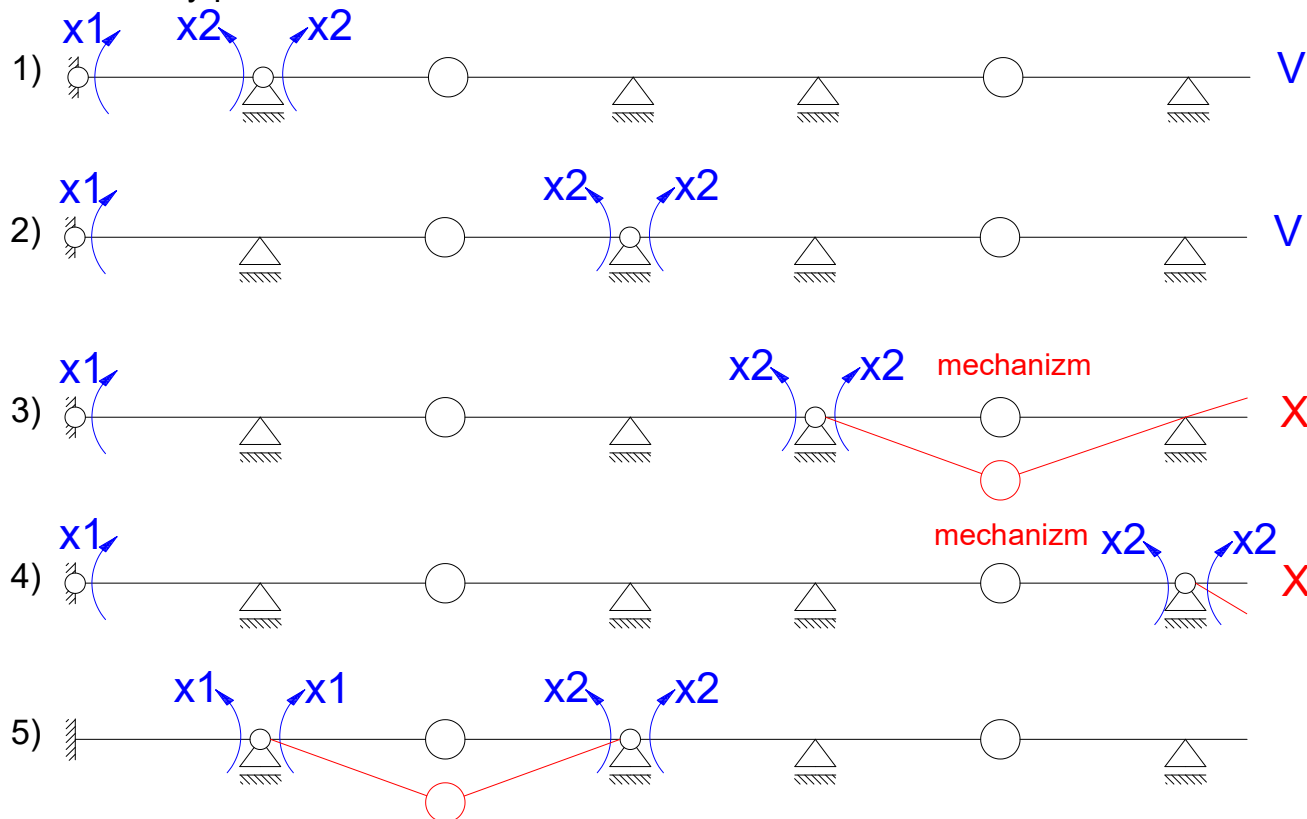


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

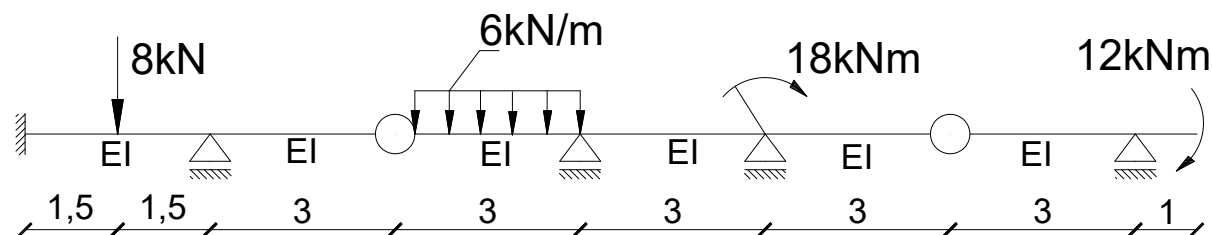


Schematy podstawowe:

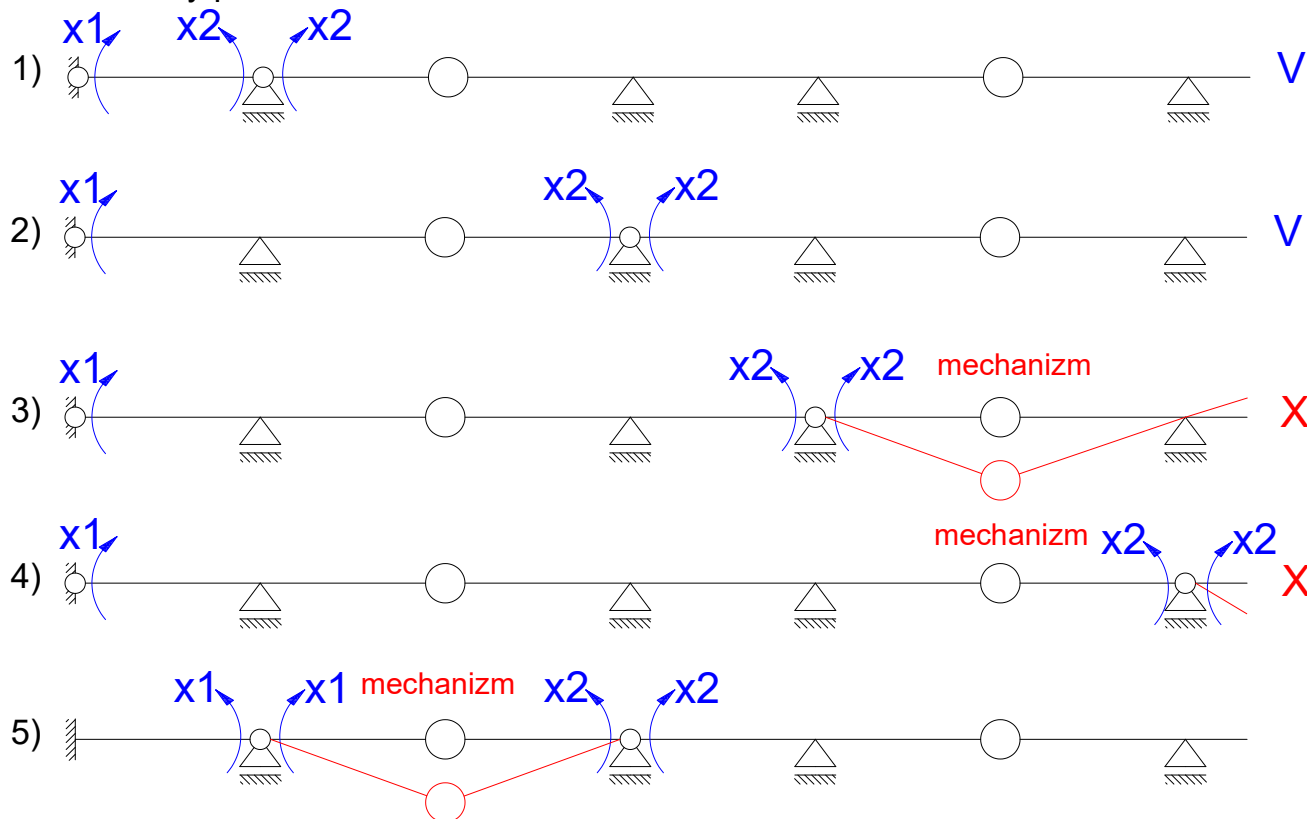


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

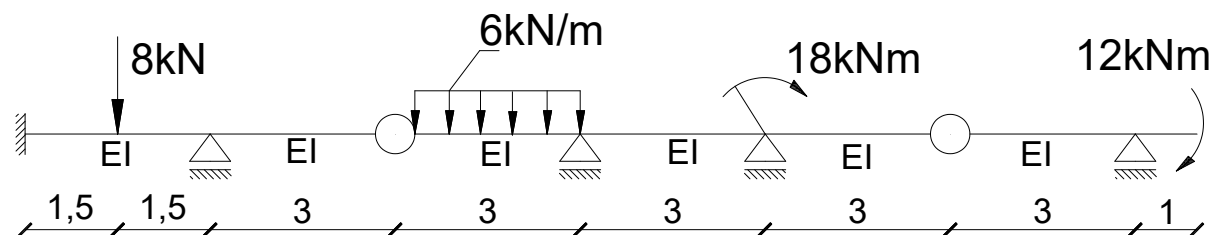


Schematy podstawowe:

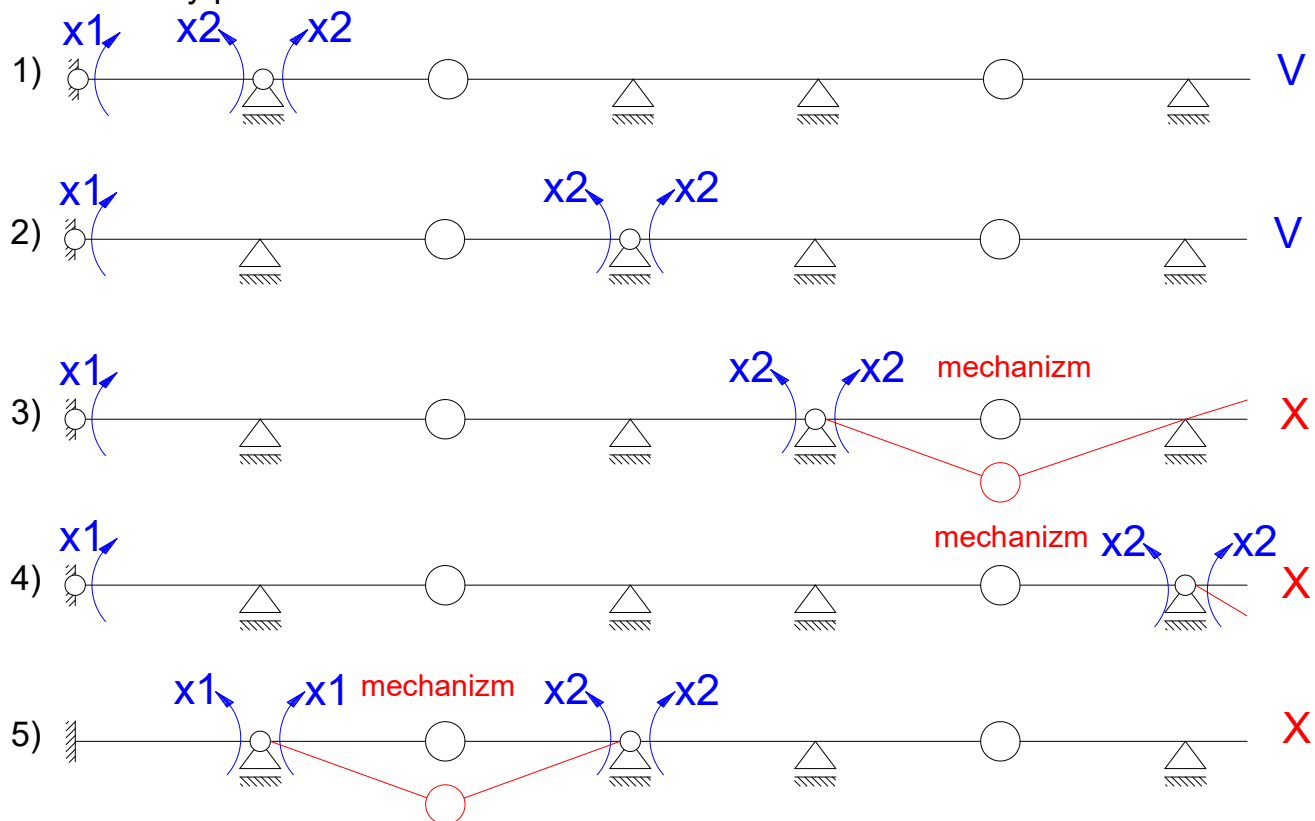


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.

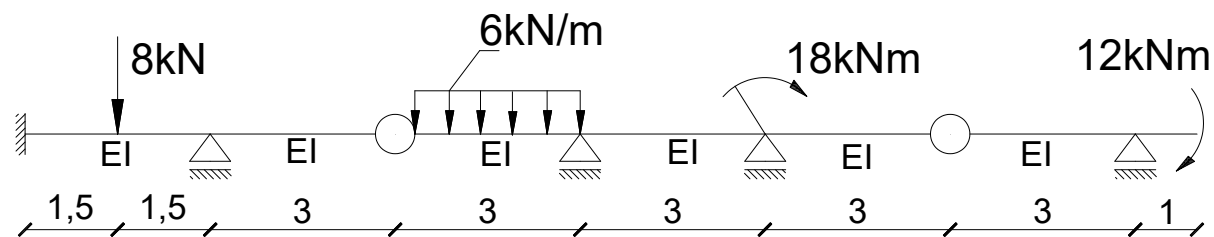


Schematy podstawowe:

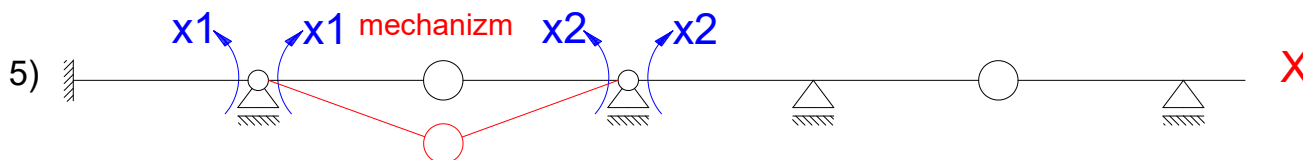
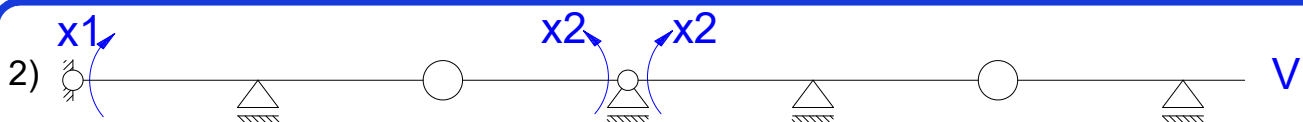


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

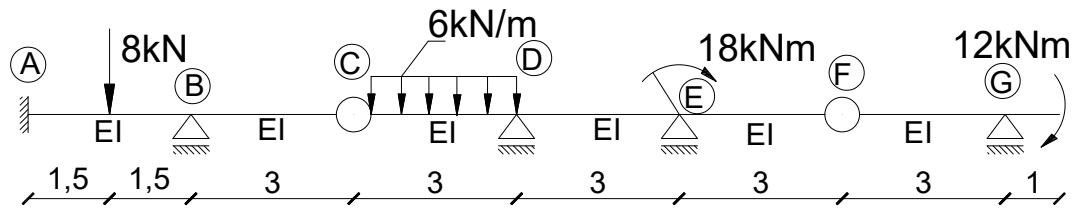
Zadanie: Narysuj wykresy sił wewnętrznych. Zadanie rozwiąż metodą sił.



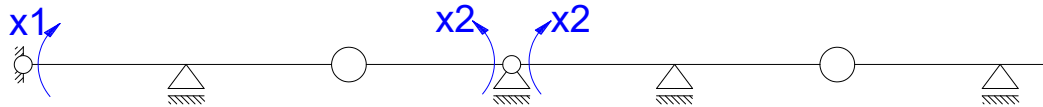
Schematy podstawowe:

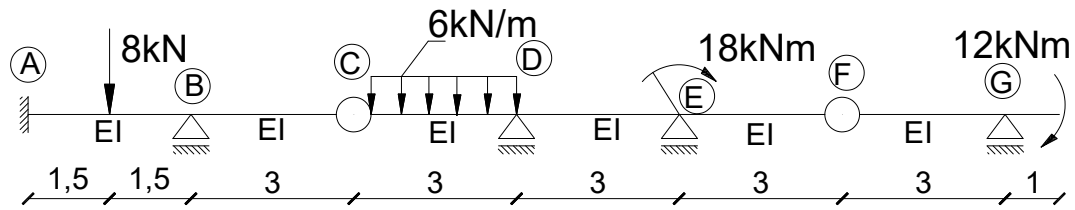


$$n_s = lr - lp - 3 = 7 - 2 \cdot 1 - 3 = 2 \quad \text{Belka dwukrotnie statycznie niewyznaczalna}$$

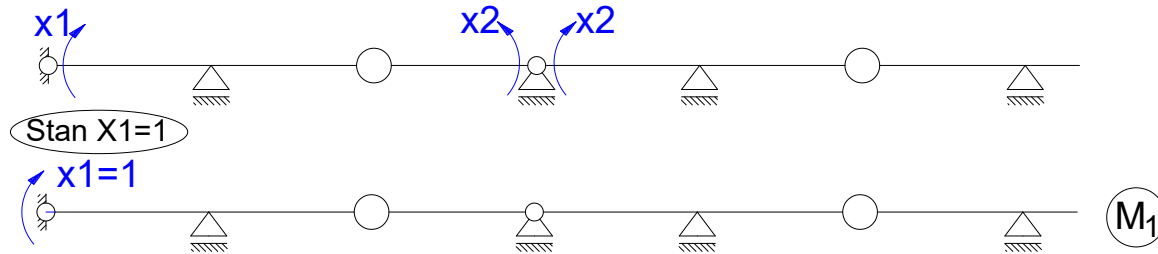


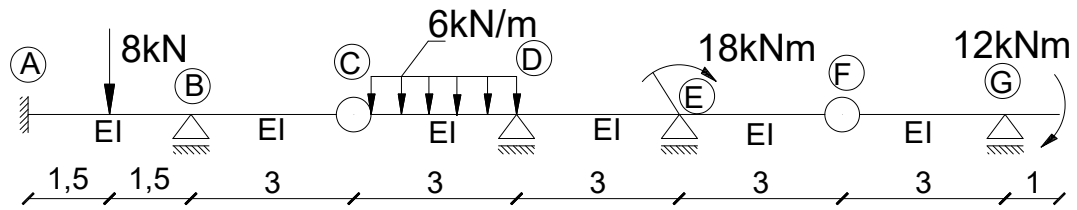
Schemat podstawowy:



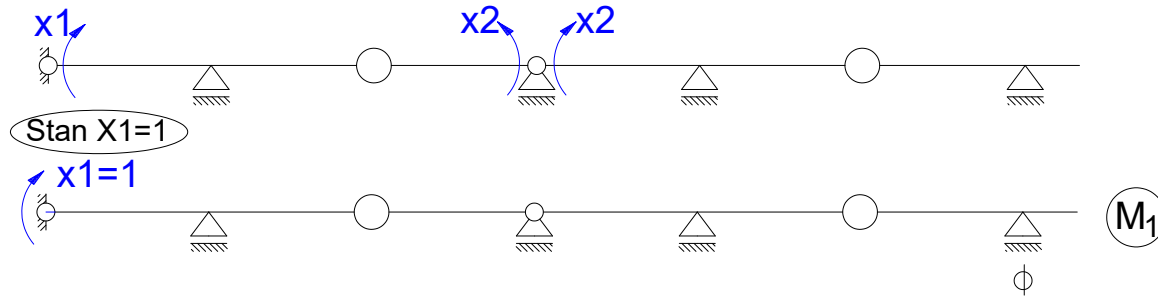


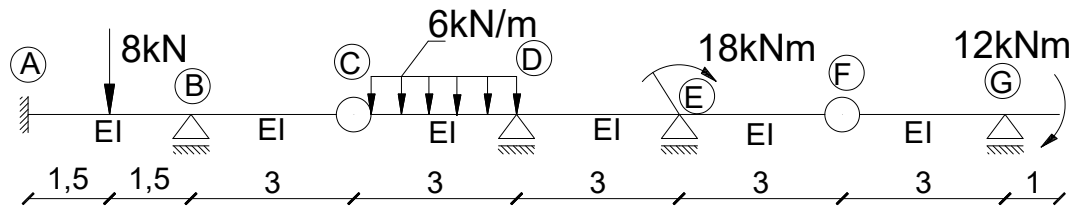
Schemat podstawowy:



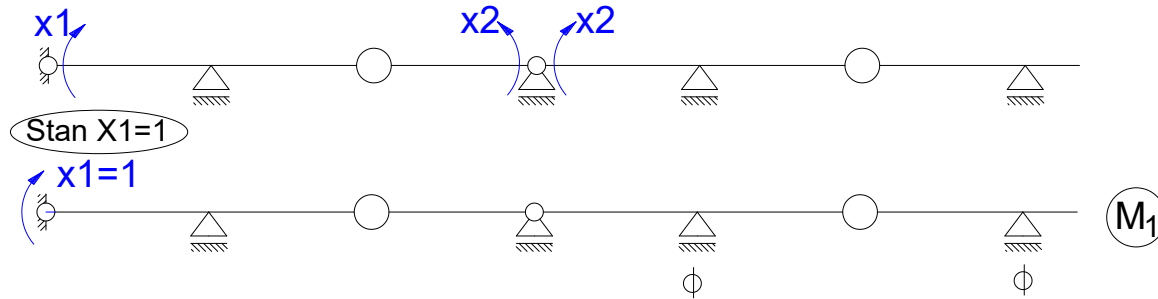


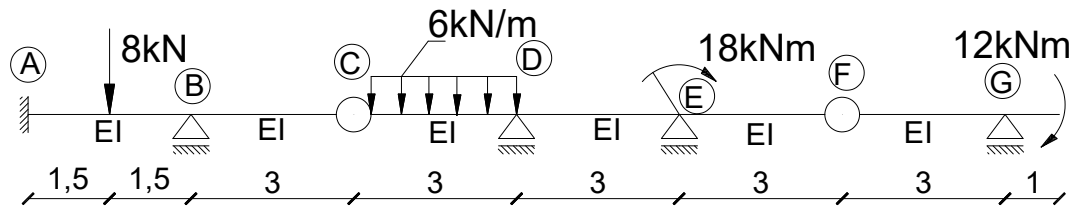
Schemat podstawowy:



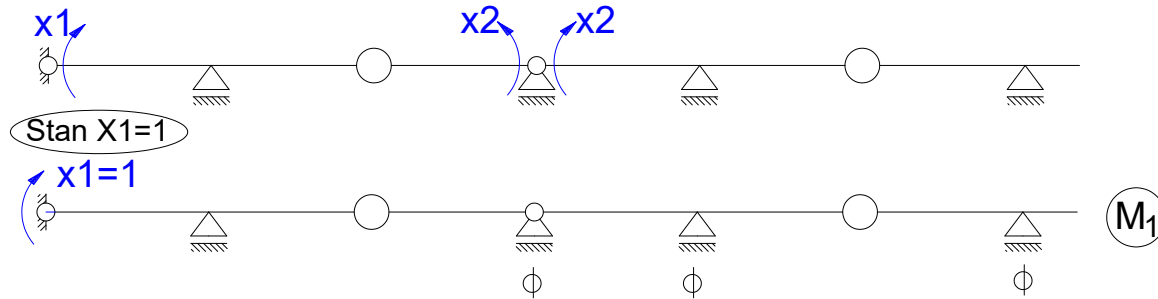


Schemat podstawowy:

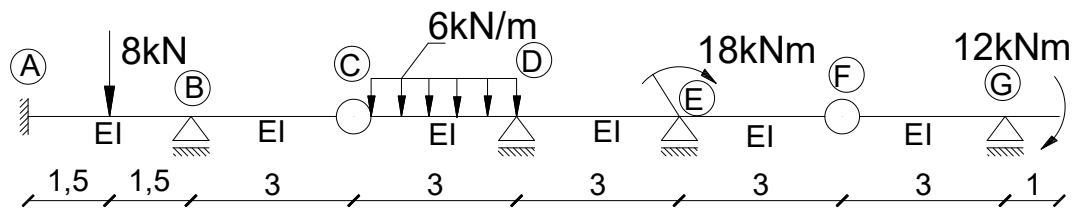




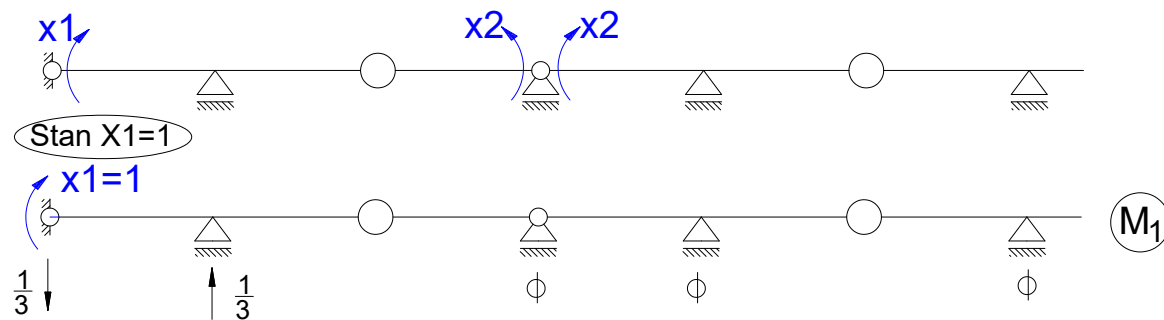
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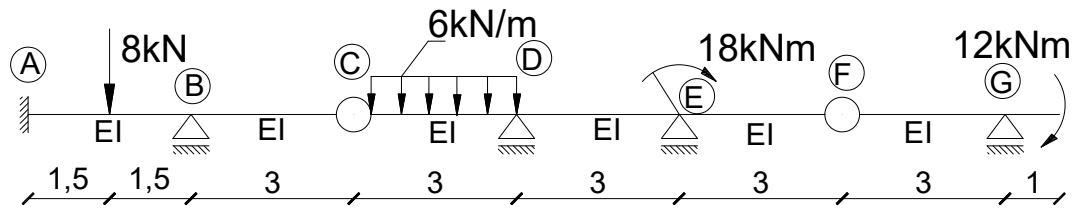




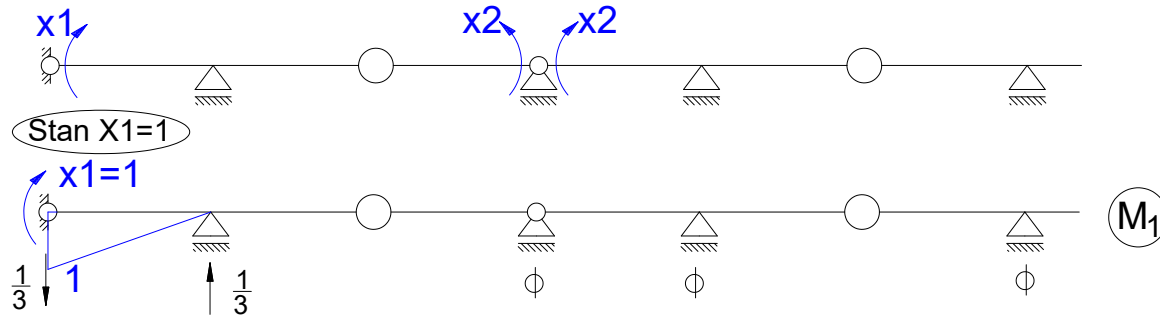


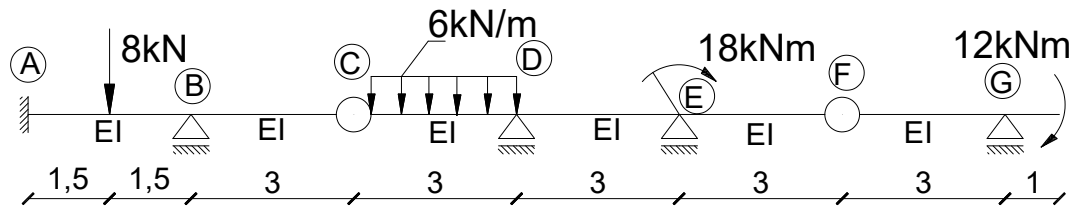
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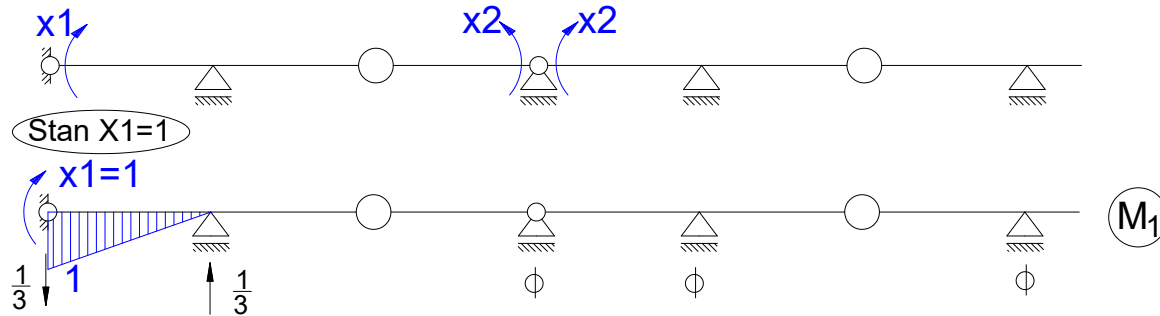


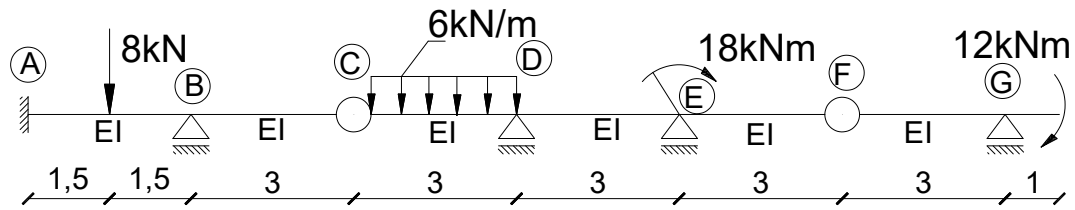
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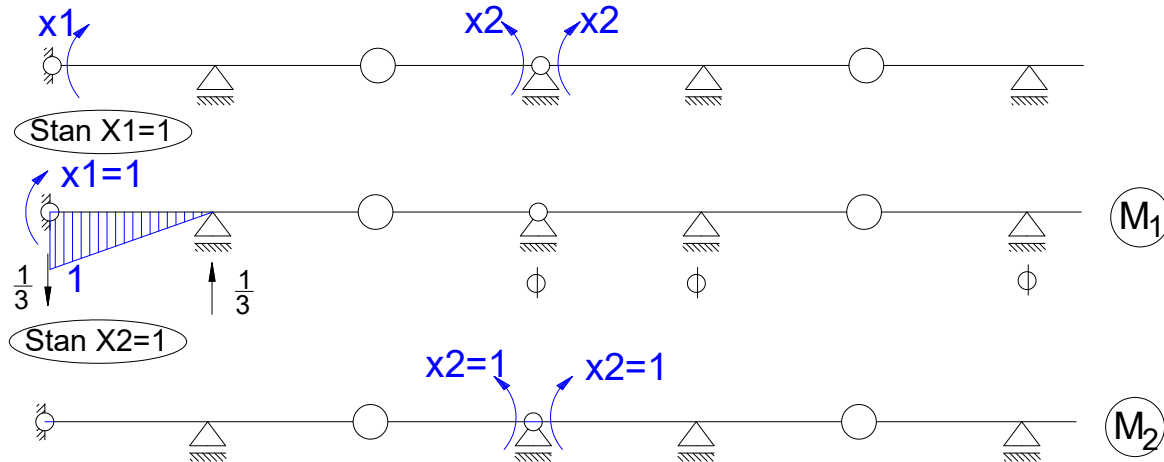


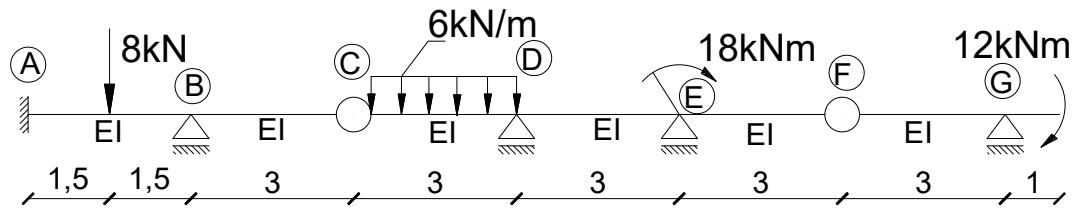
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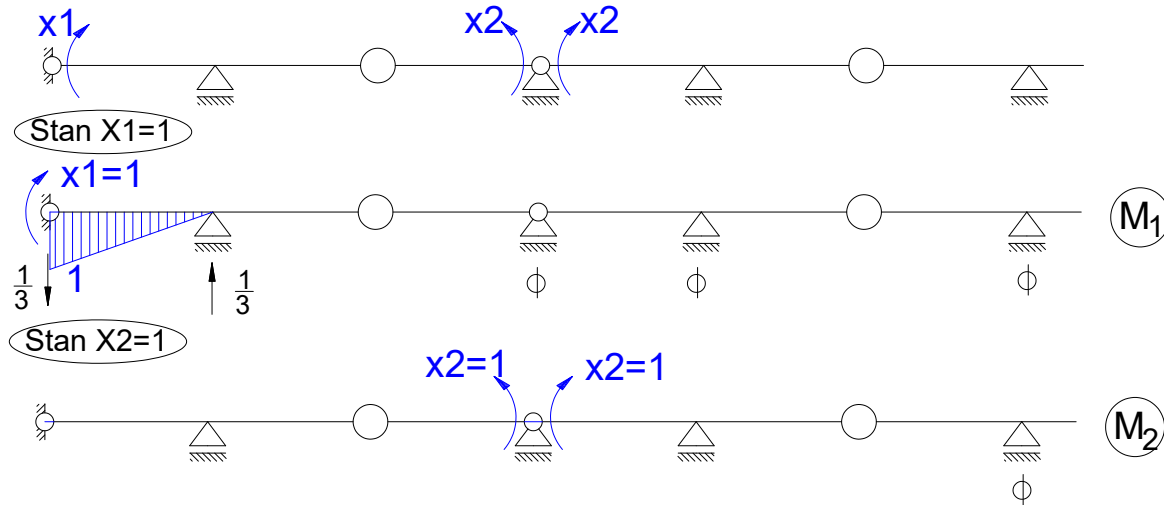


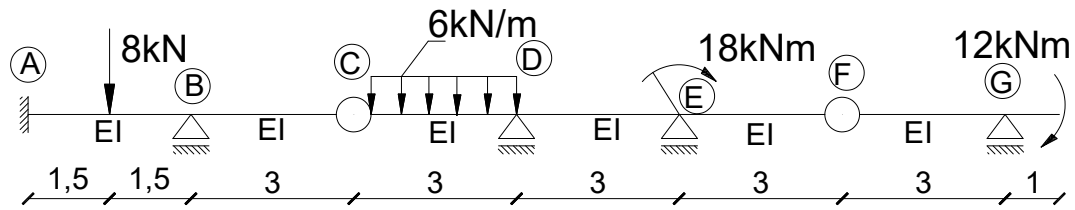
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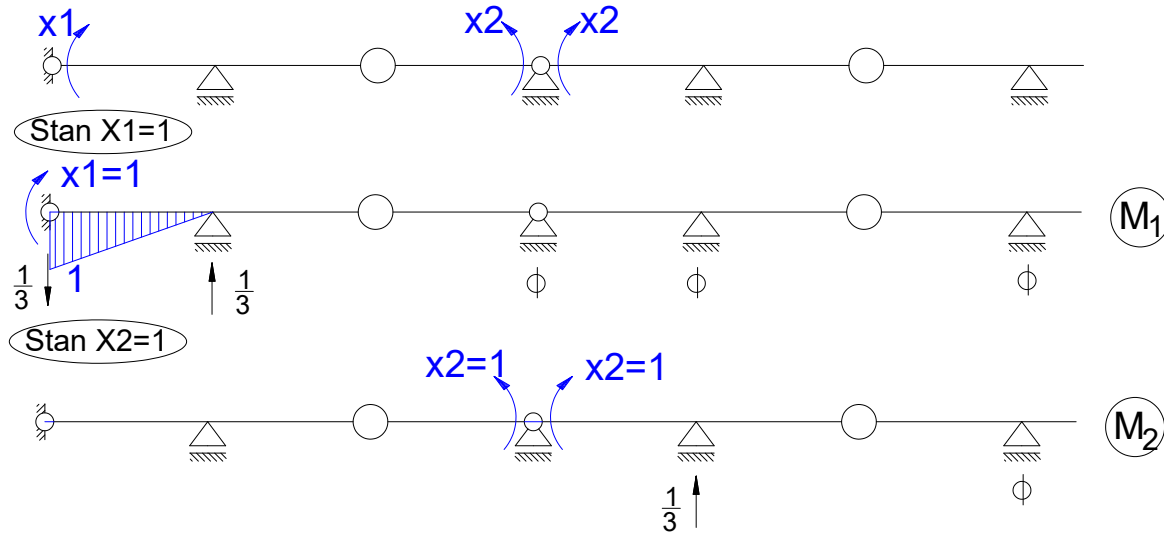


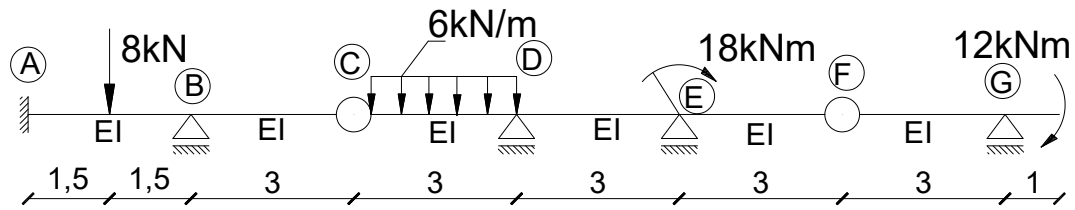
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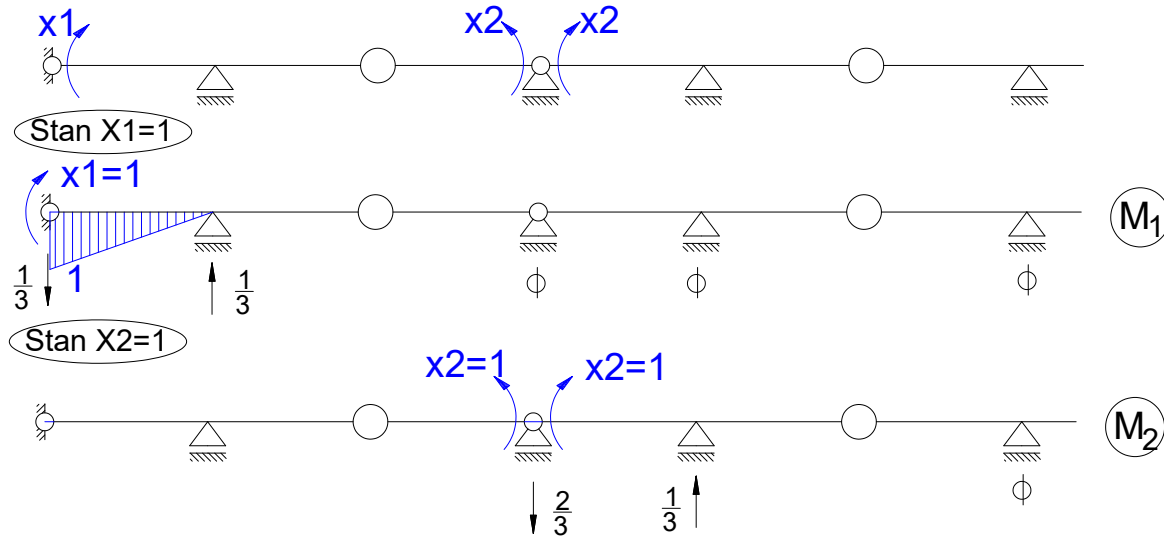


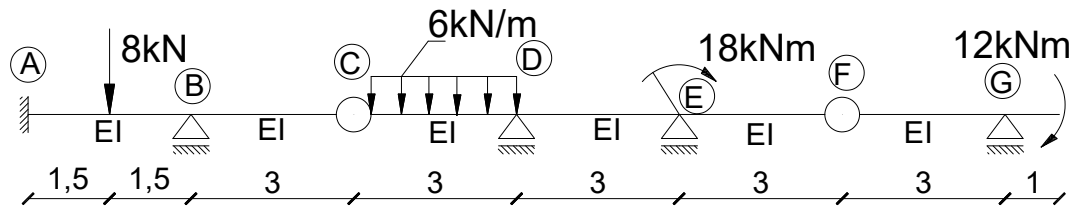
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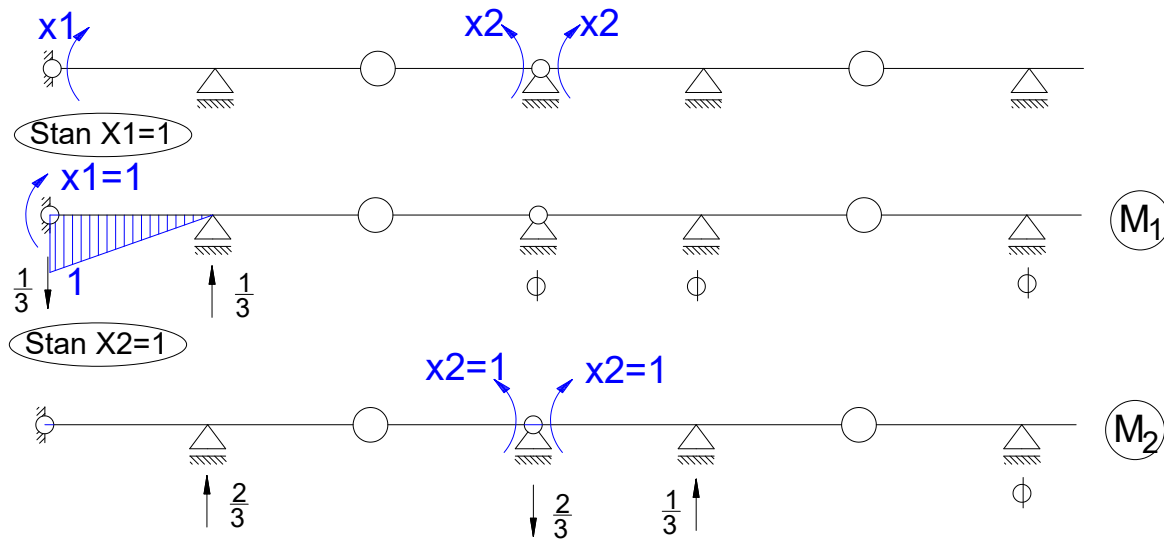


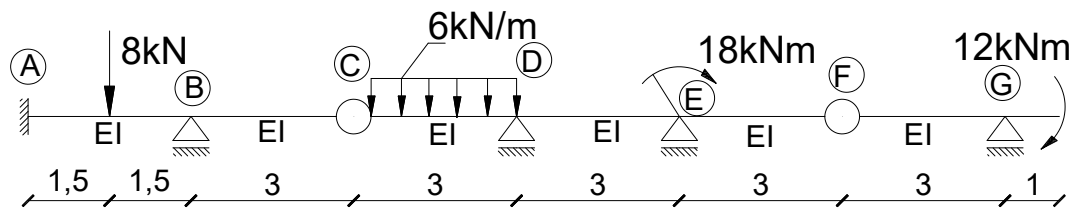
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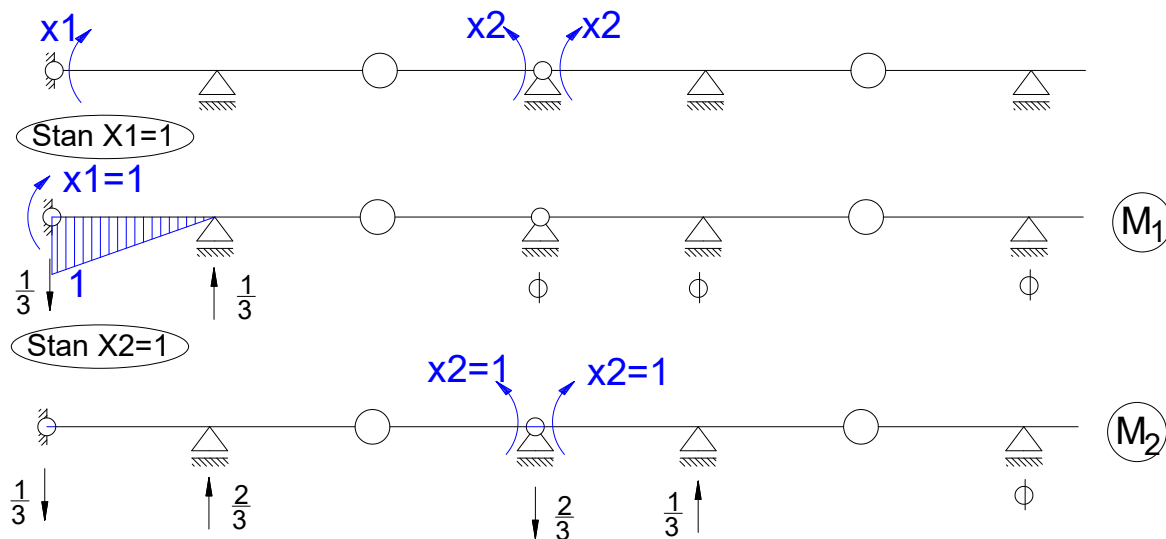


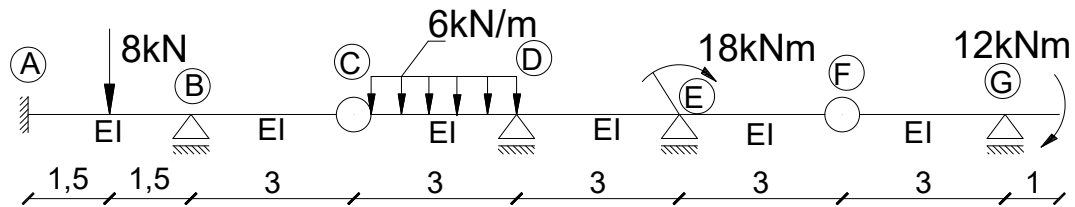
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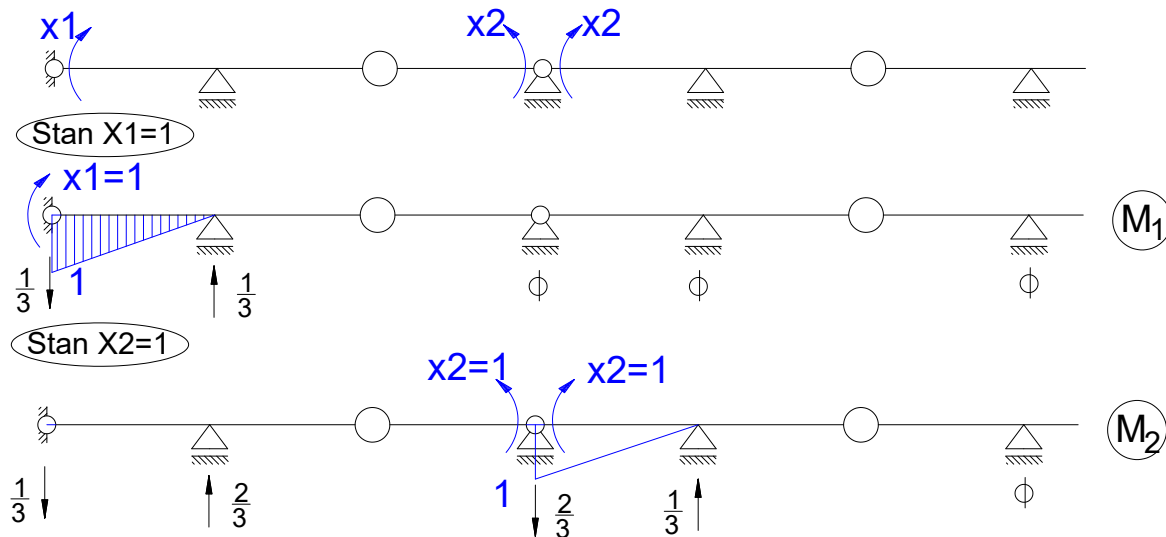


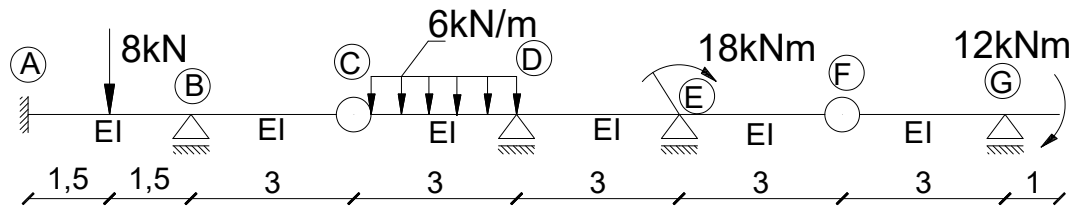
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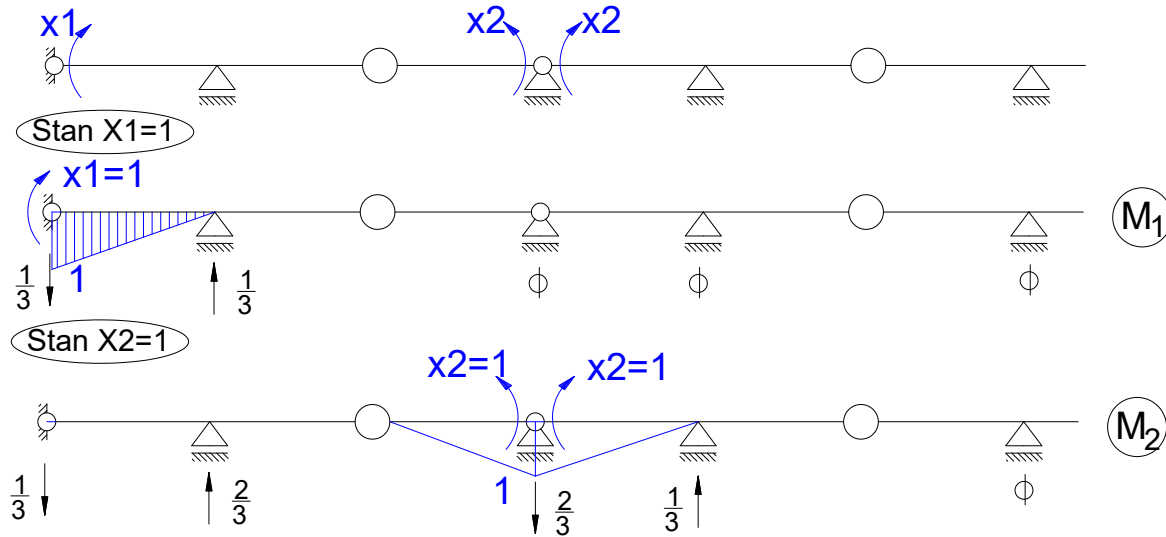


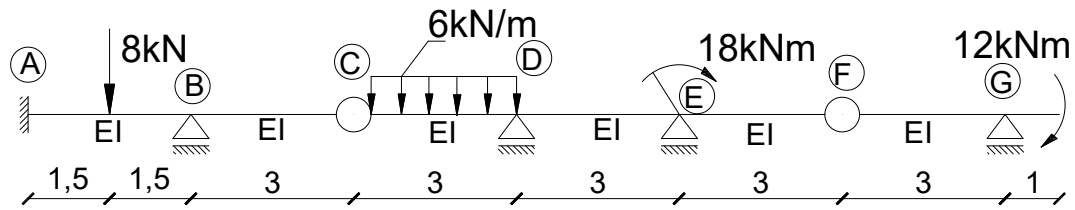
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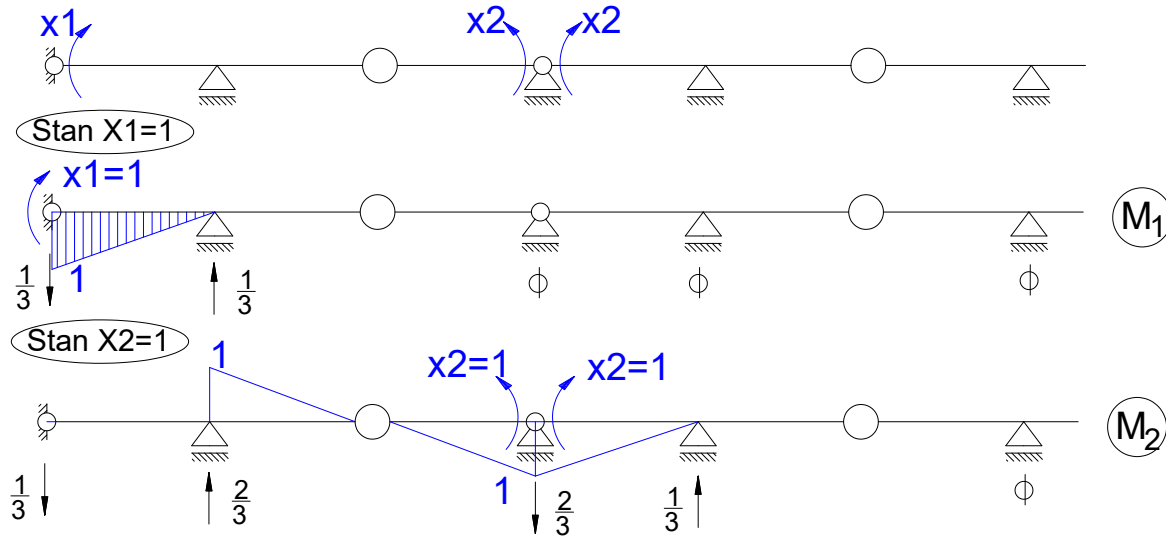


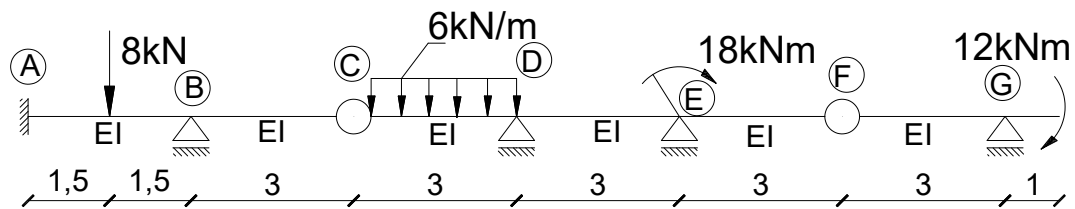
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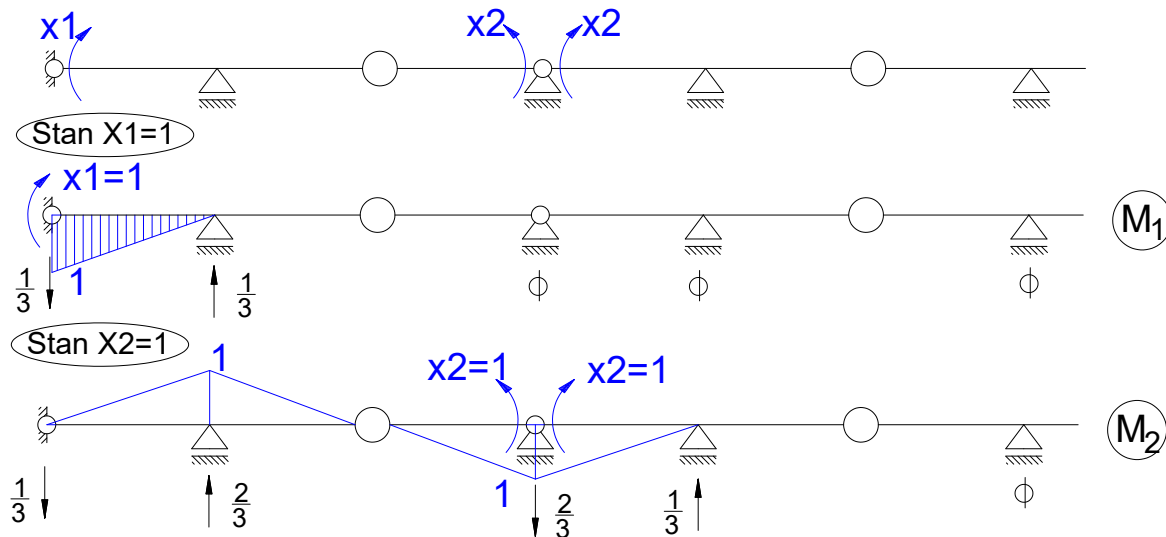


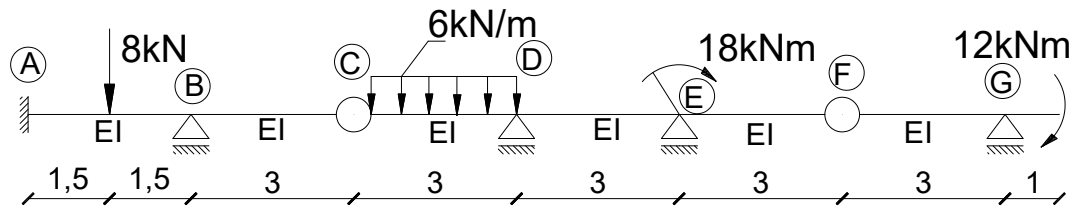
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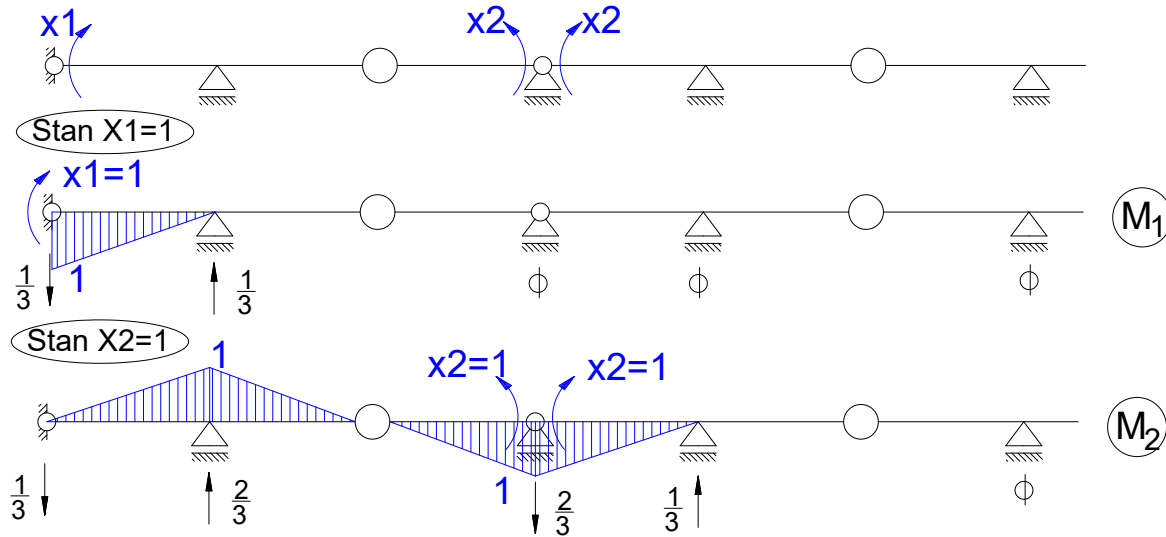


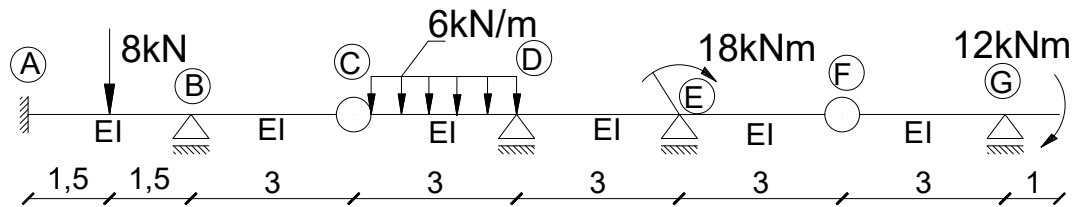
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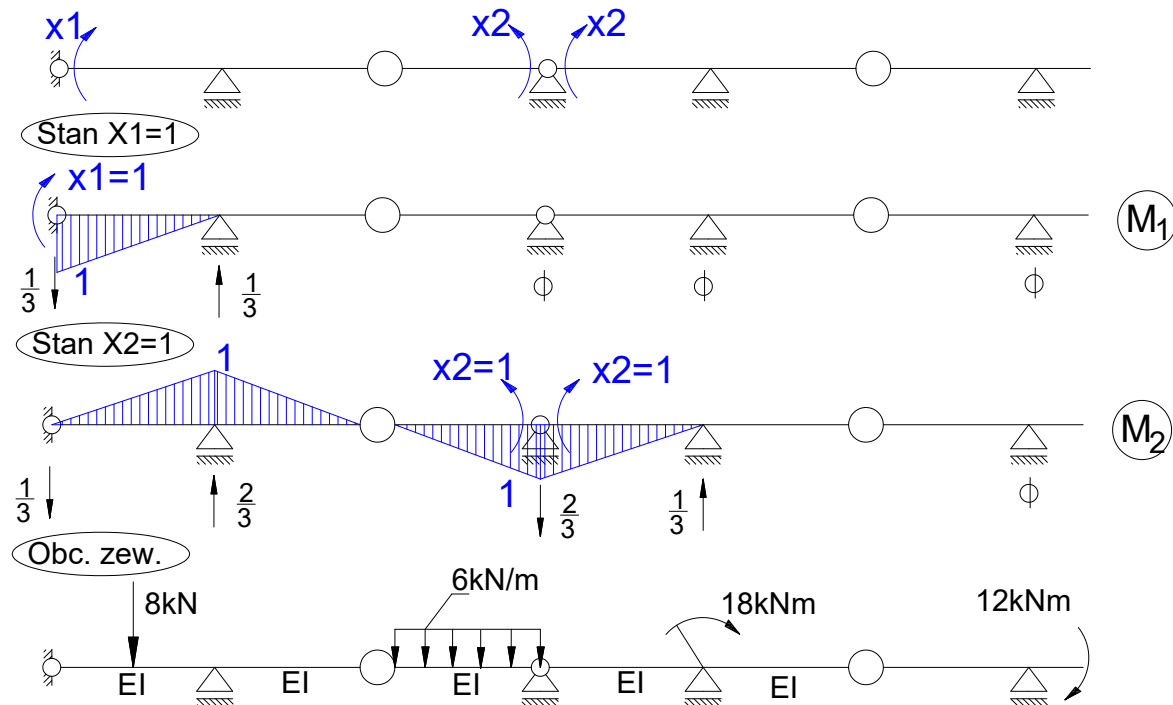


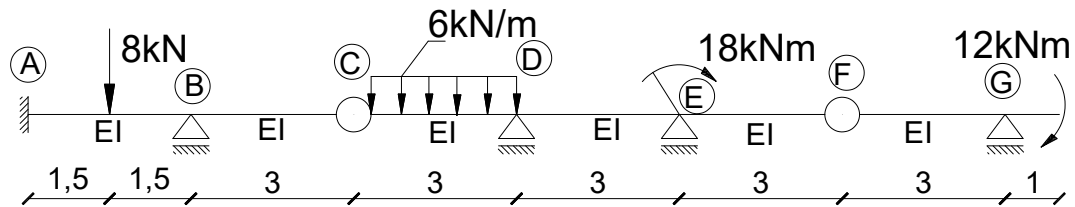
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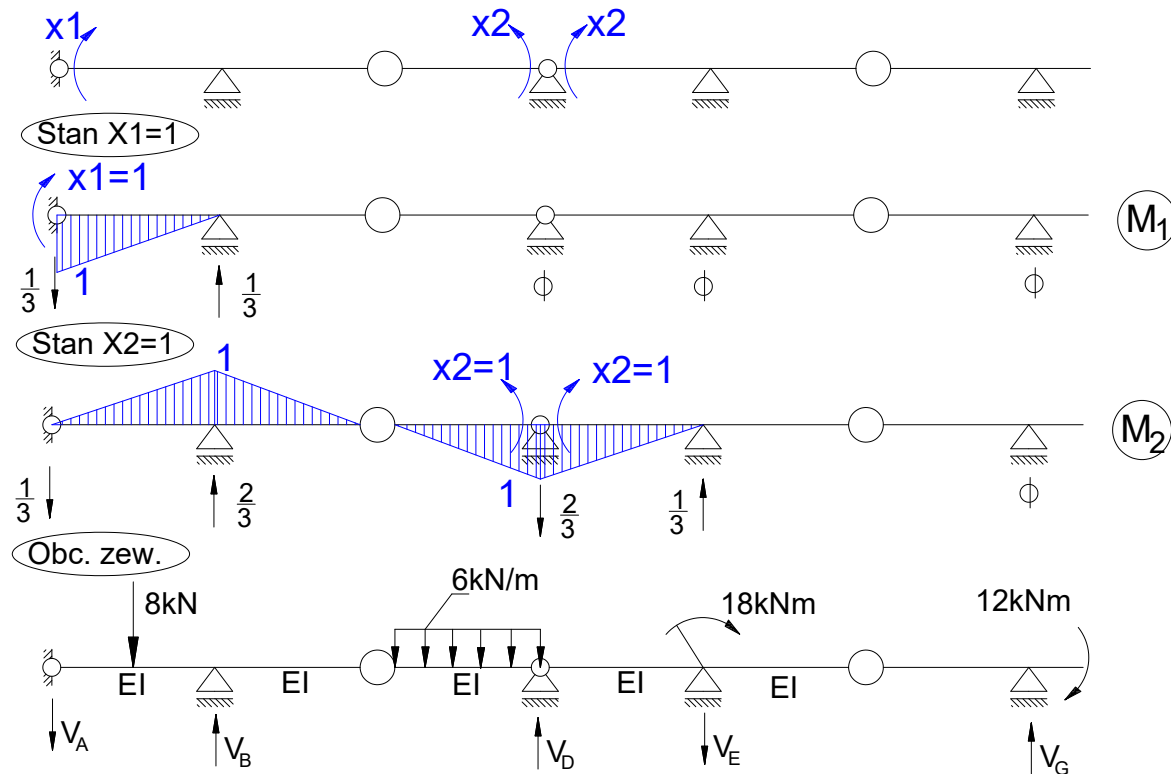


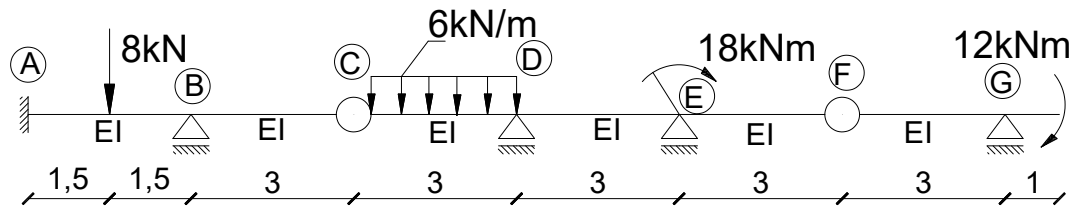
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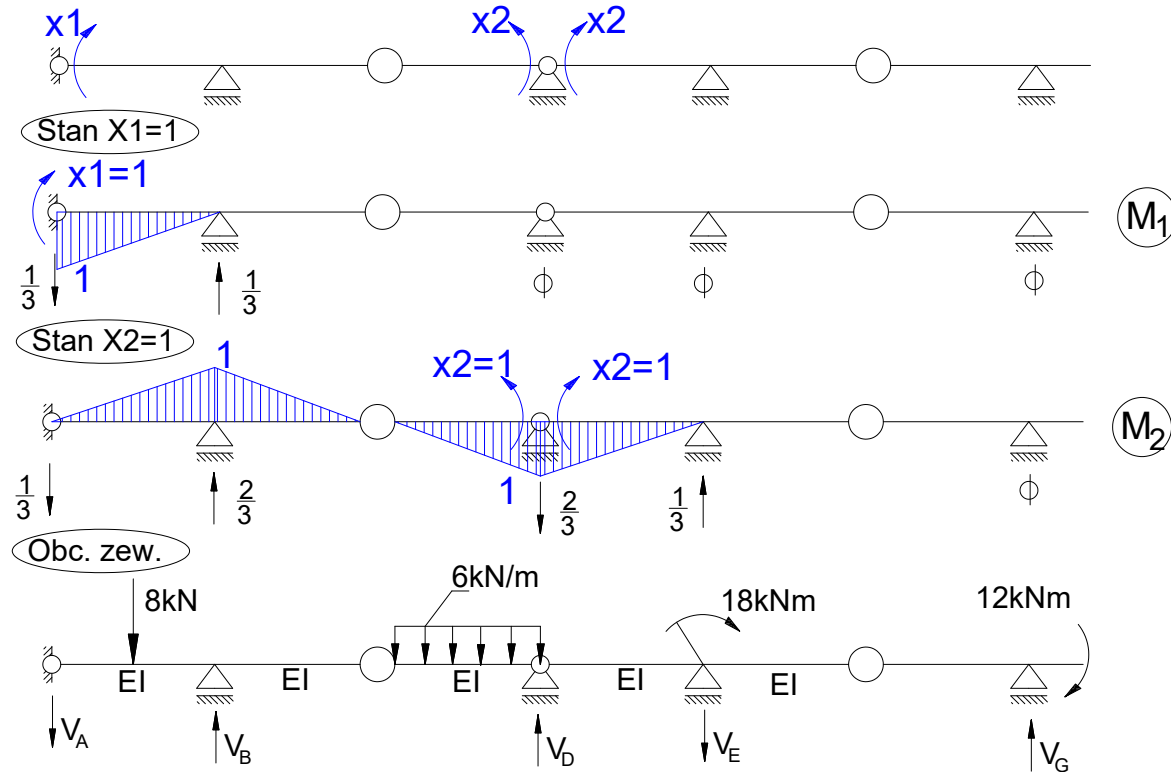
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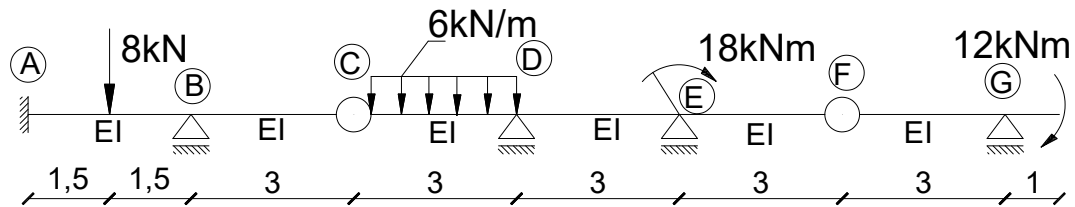




$$\sum M_{FP} = 12 - V_G \cdot 3 = 0$$

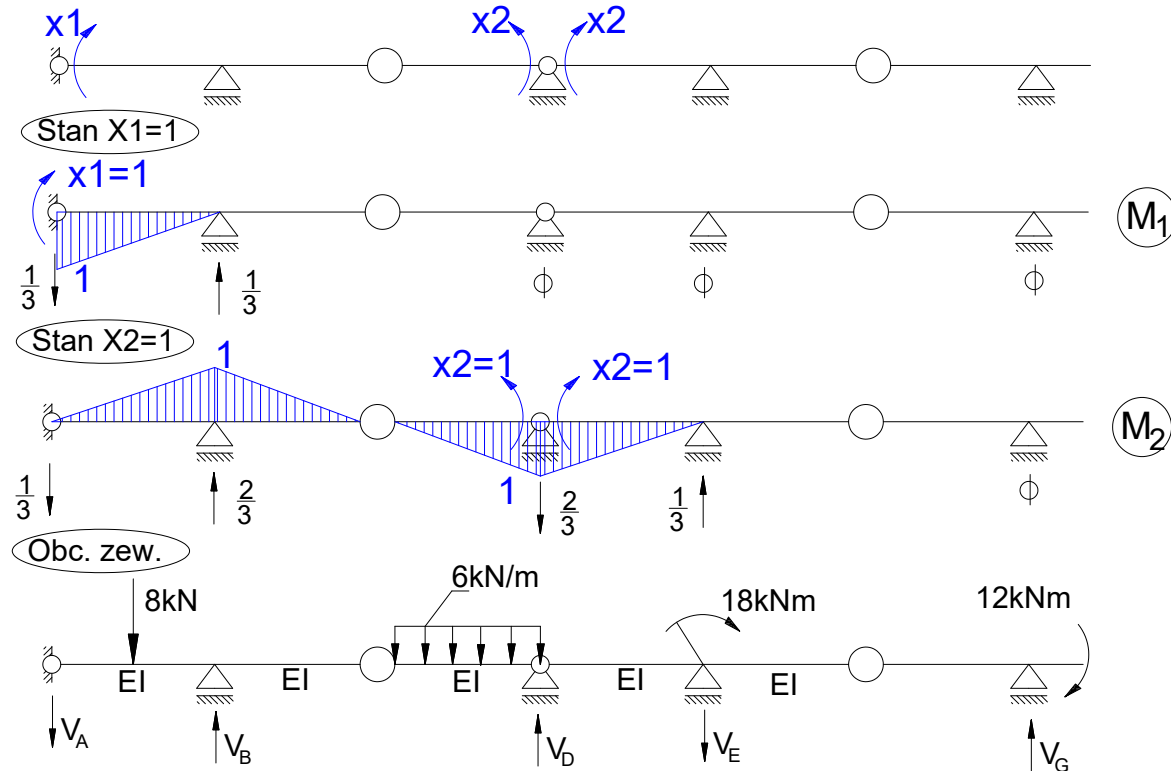
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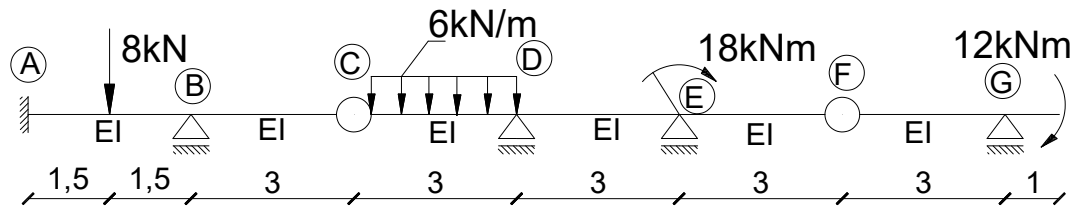




$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

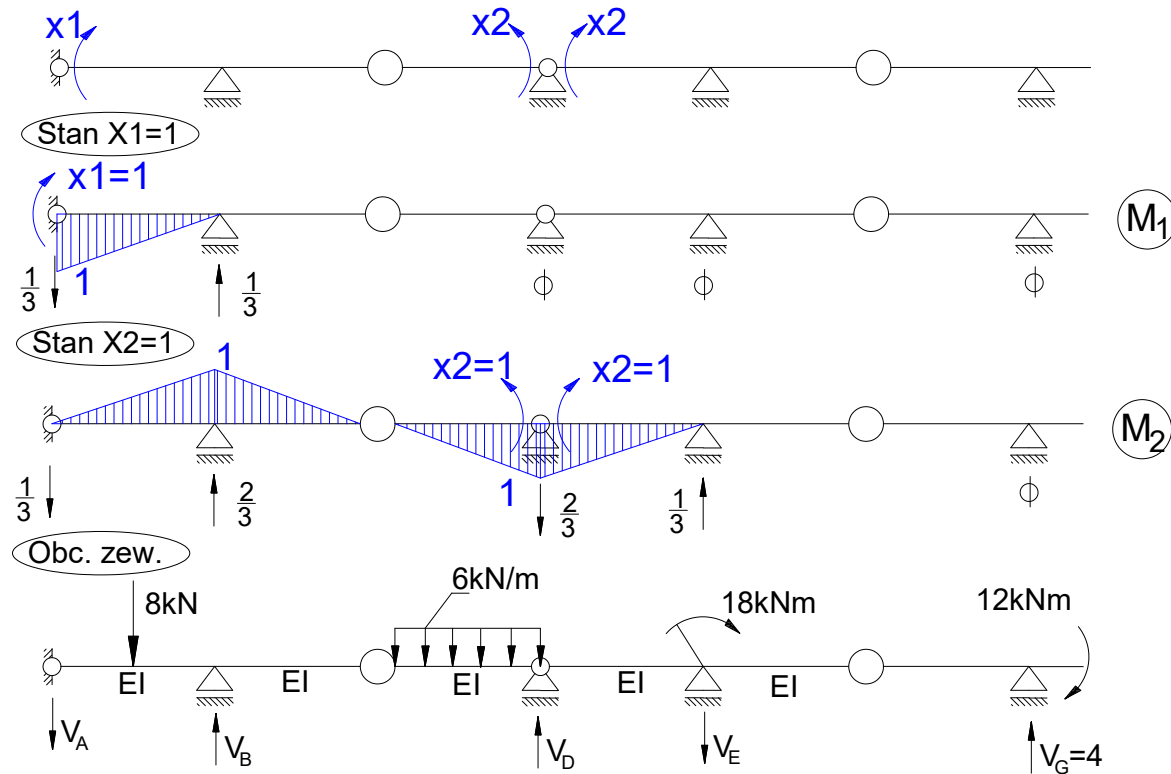
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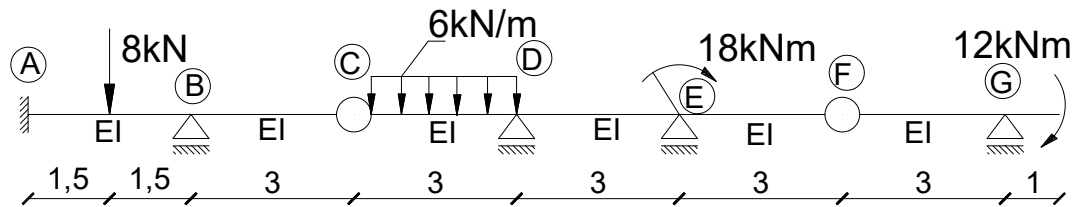




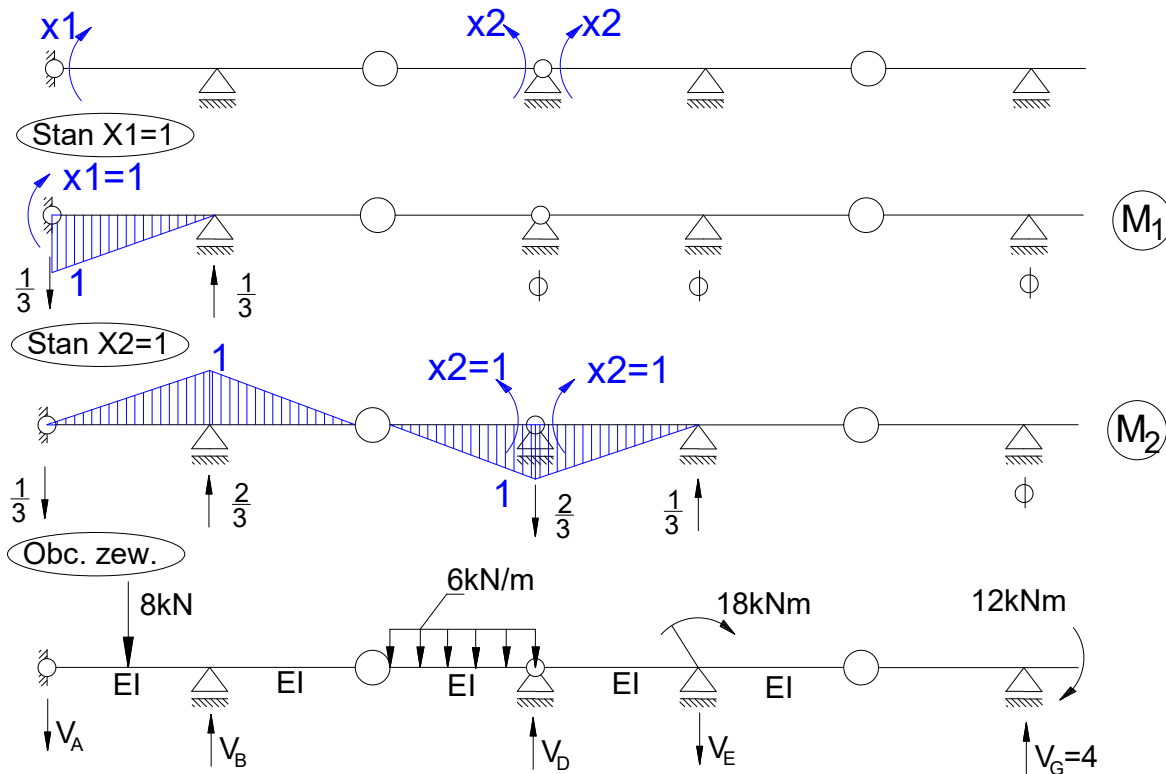
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

Schemat podstawowy:



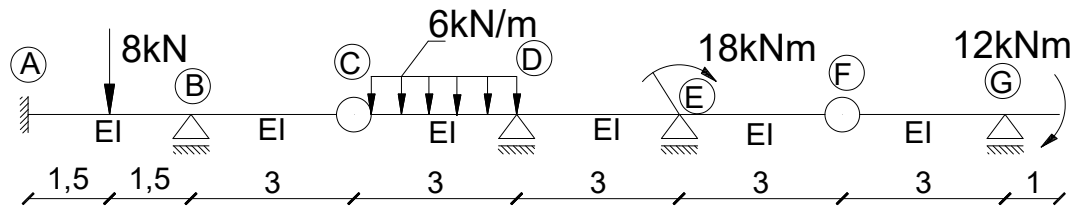


Schemat podstawowy:

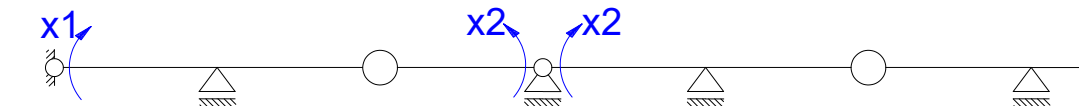


$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

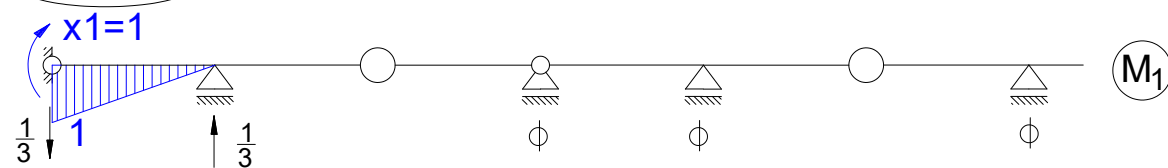
$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$



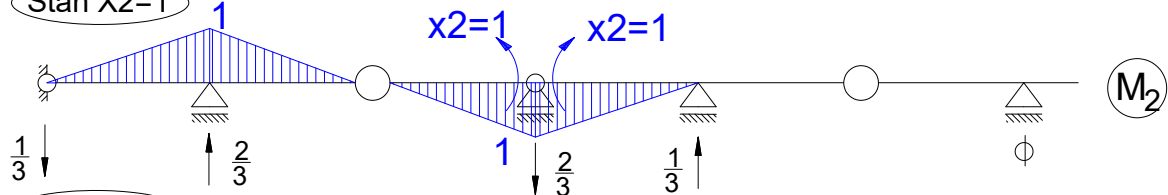
Schemat podstawowy:



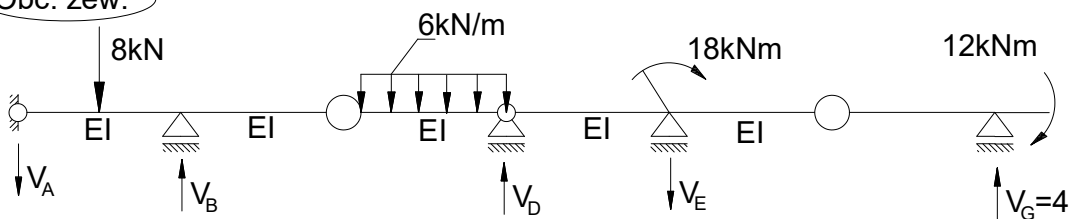
Stan $X_1=1$



Stan $X_2=1$



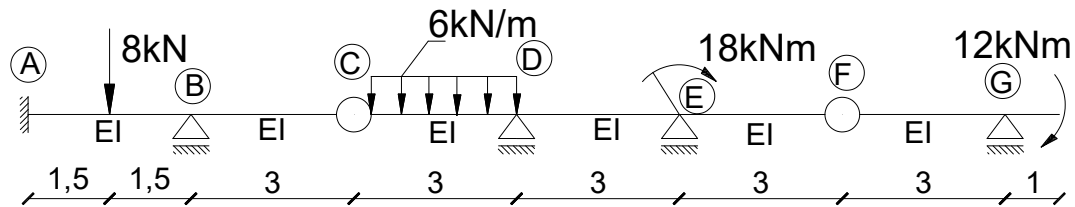
Obc. zew.



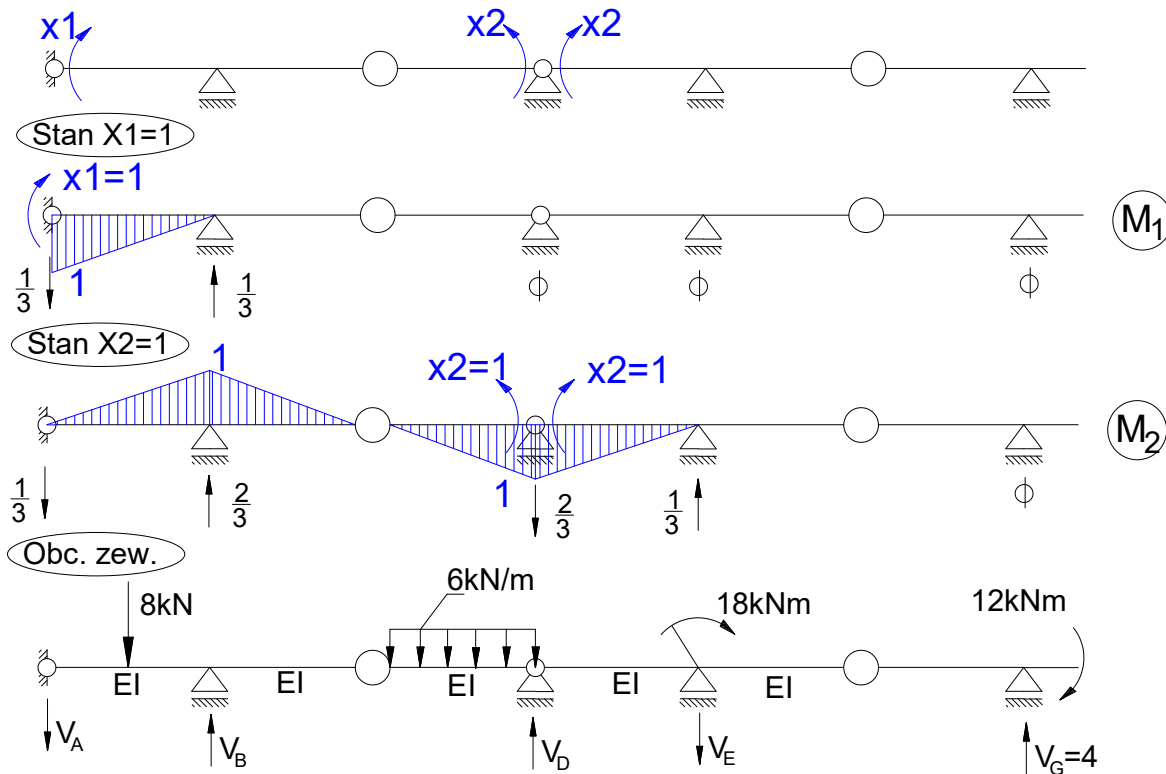
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4 \text{ kN}$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3}$$



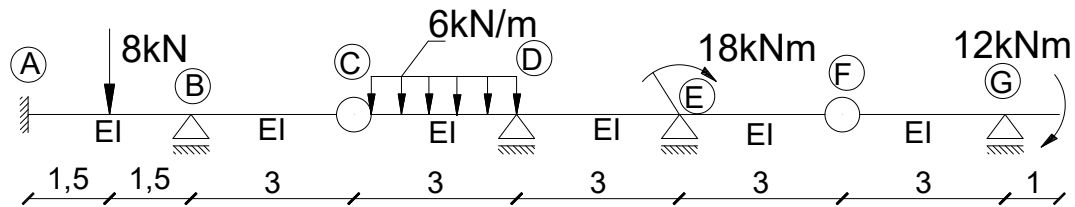
Schemat podstawowy:



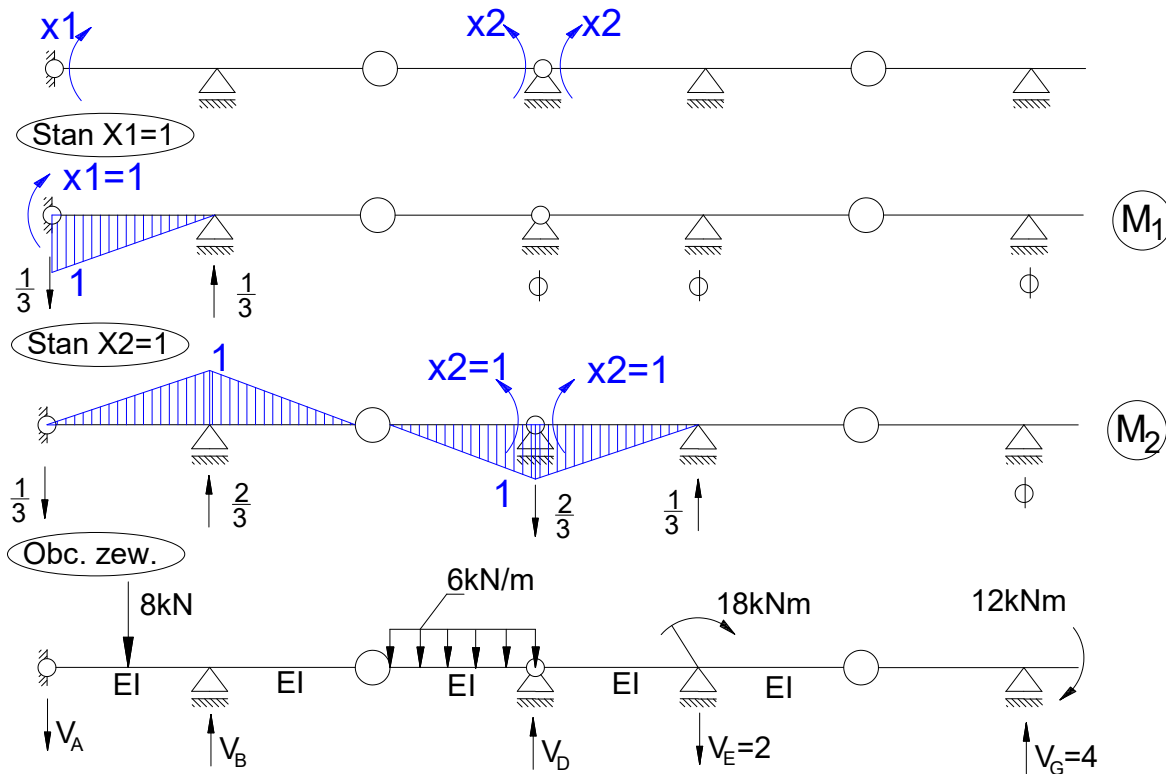
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$



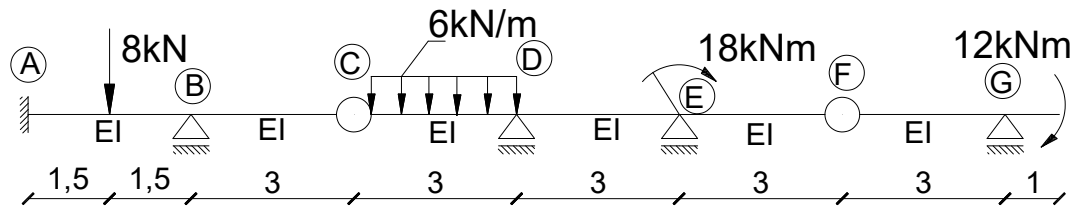
Schemat podstawowy:



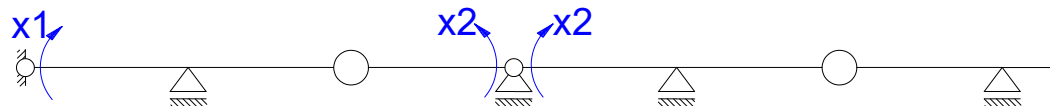
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

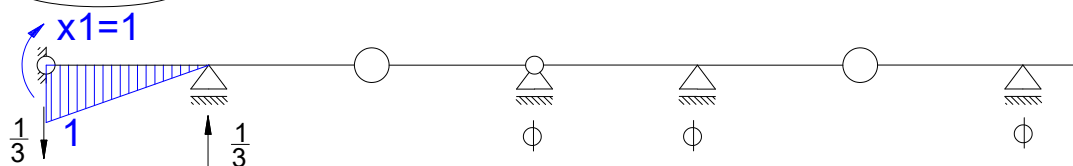
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$



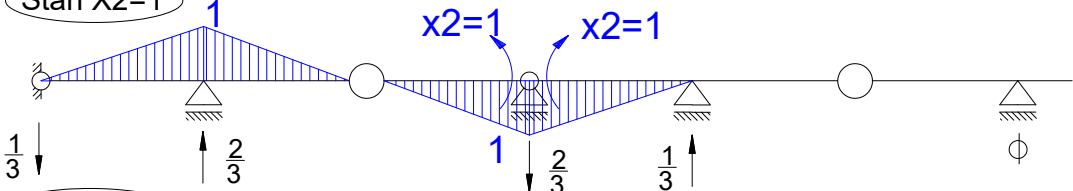
Schemat podstawowy:



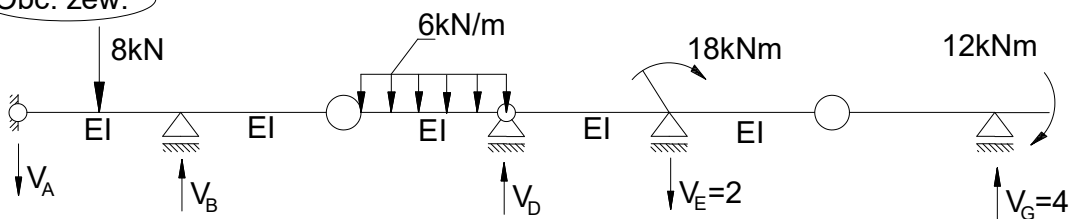
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



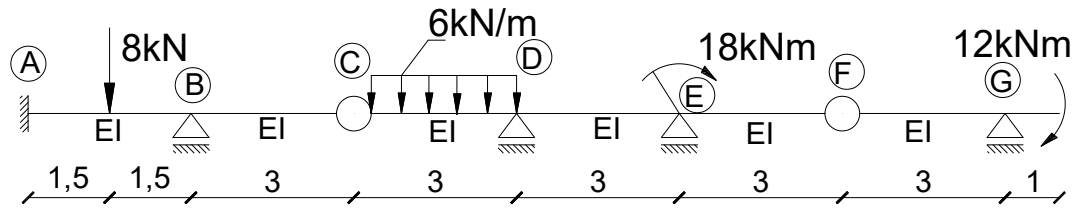
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

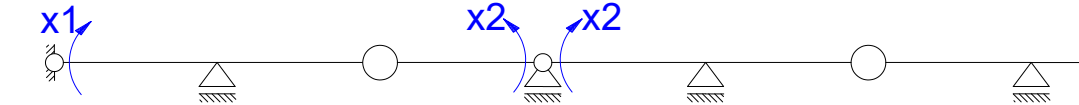
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

$$\textcircled{M_1} \quad \sum M_{CP} = 12 - 4 \cdot 12 + 18 + 2 \cdot 6 + 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0$$

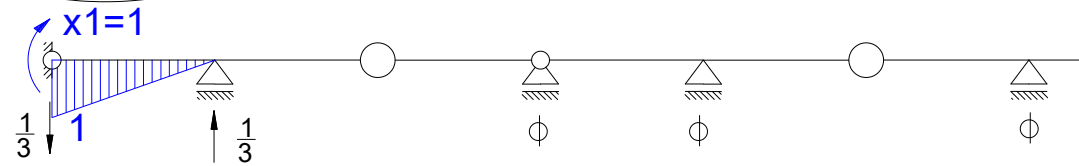
$\textcircled{M_2}$



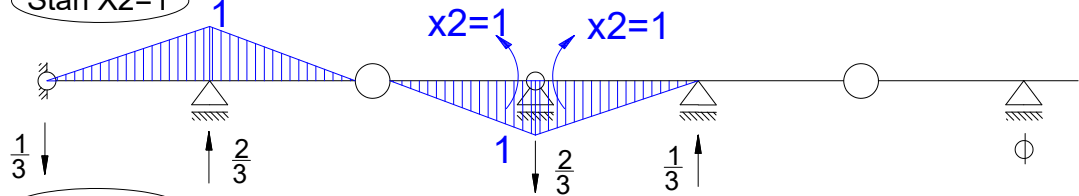
Schemat podstawowy:



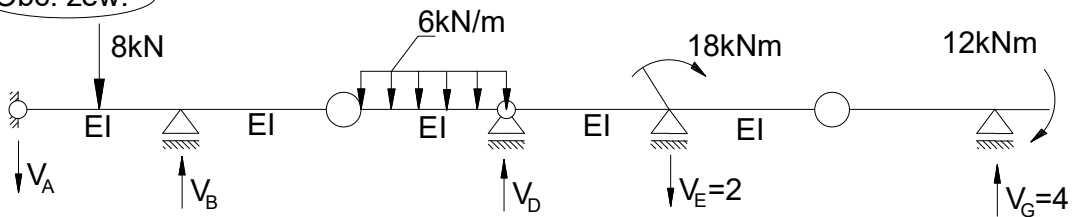
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



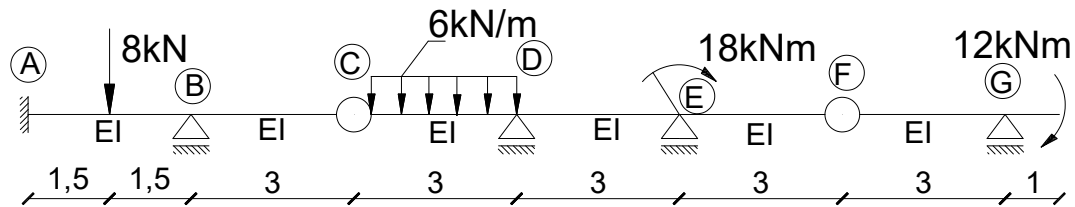
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

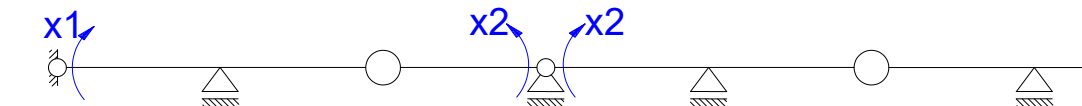
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

$$\begin{aligned} \textcircled{M_1} \quad \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &\quad + 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

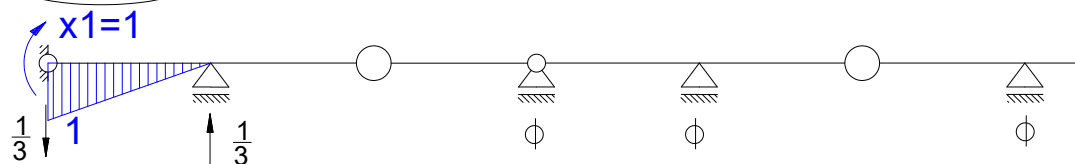
$\textcircled{M_2}$



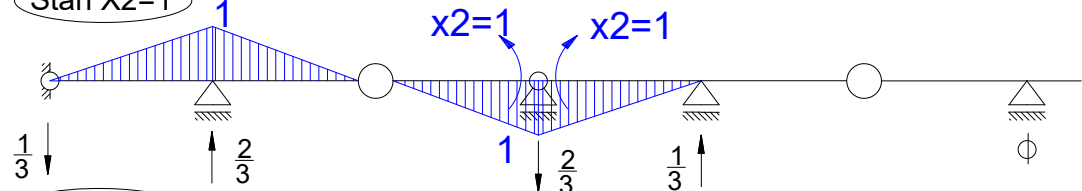
Schemat podstawowy:



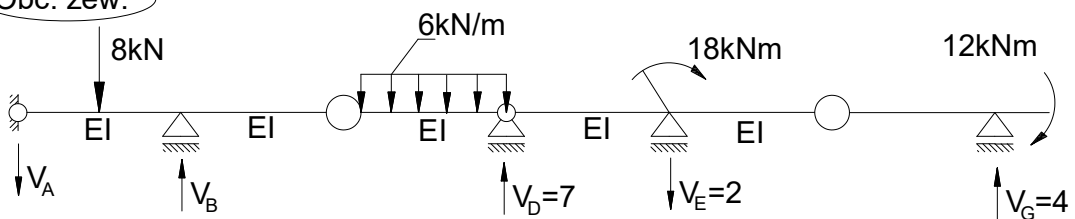
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.

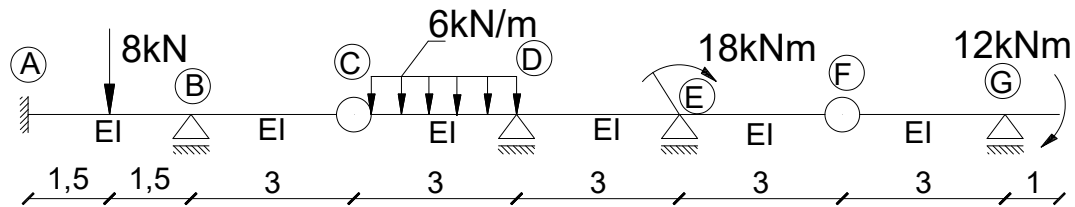


$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

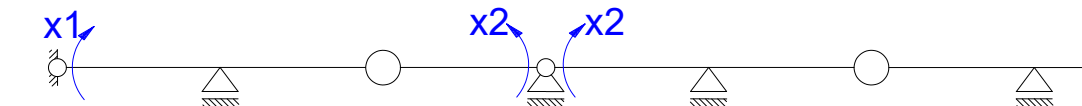
$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

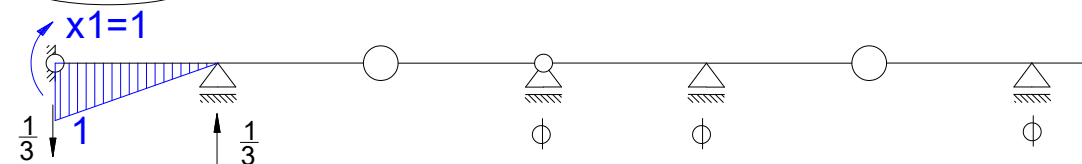
$$\begin{aligned} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &\quad + 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$



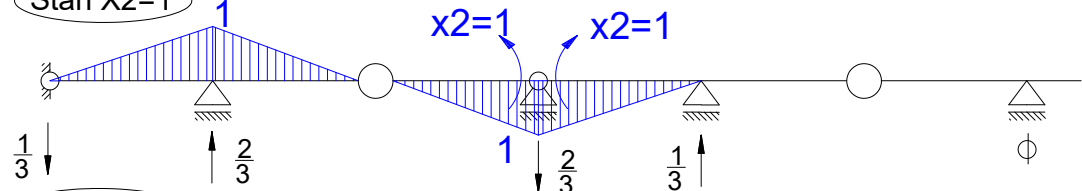
Schemat podstawowy:



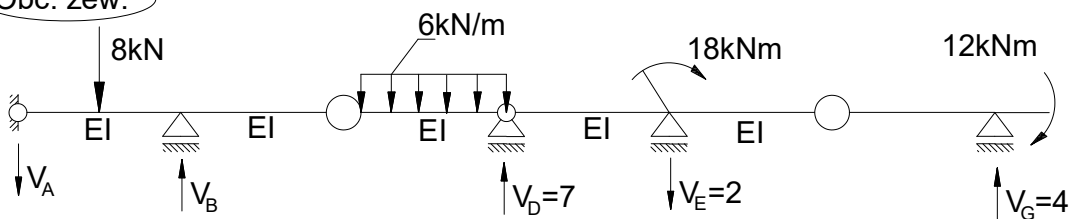
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



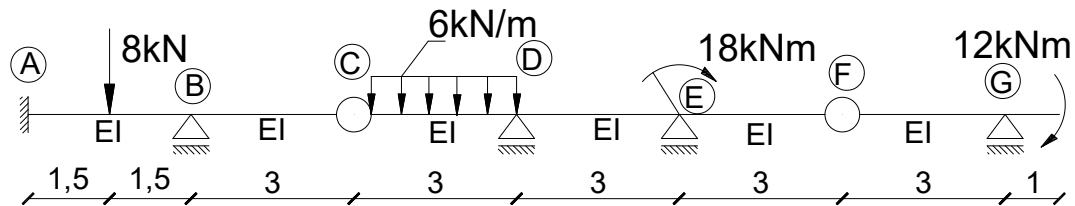
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4 \text{ kN}$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

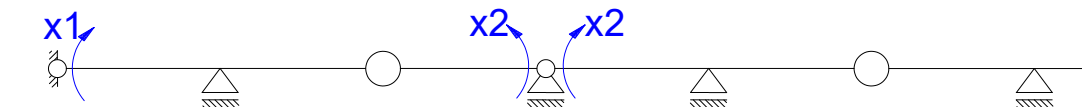
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2 \text{ kN}$$

$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7 \text{ kN} \end{aligned}$$

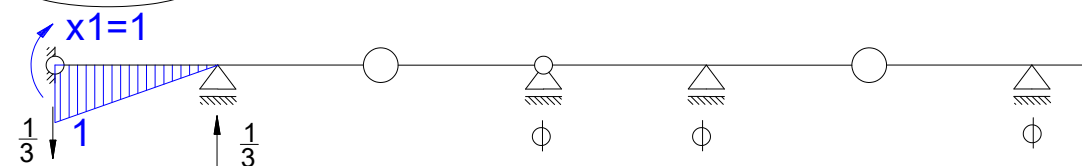
$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \end{aligned}$$



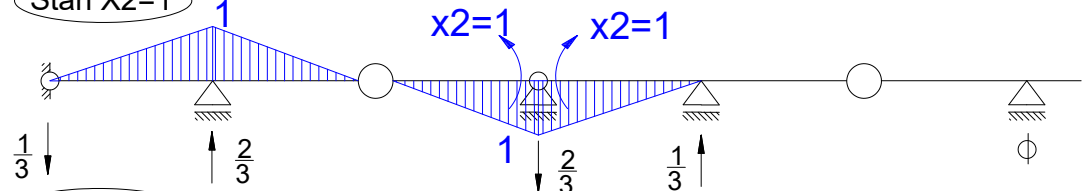
Schemat podstawowy:



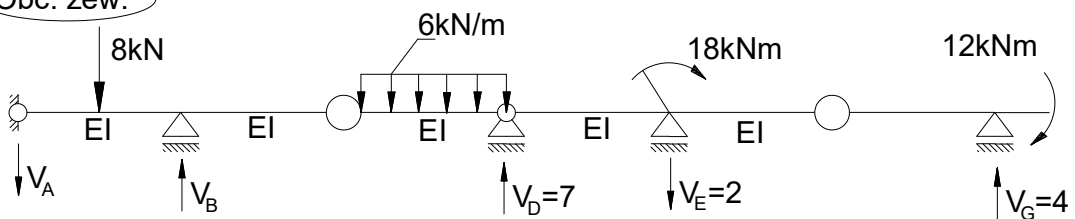
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



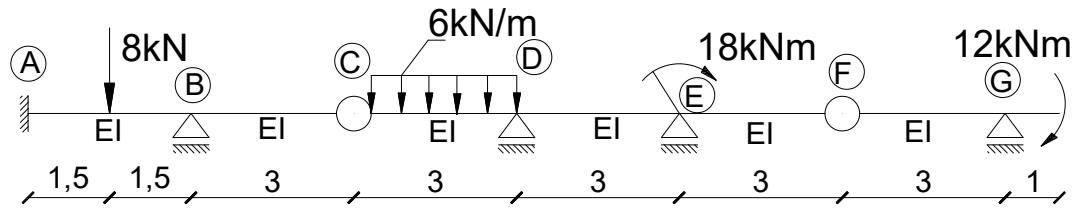
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

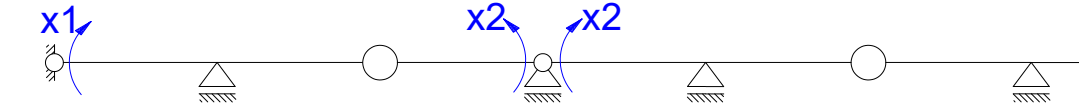
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

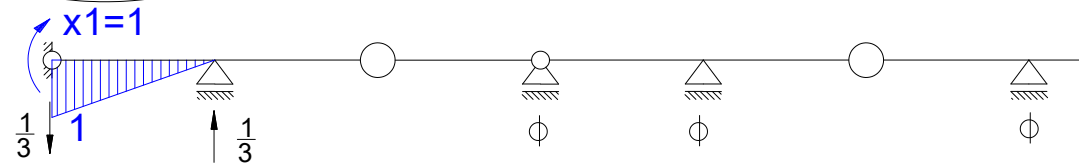
$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \\ &\rightarrow V_B = 22kN \end{aligned}$$



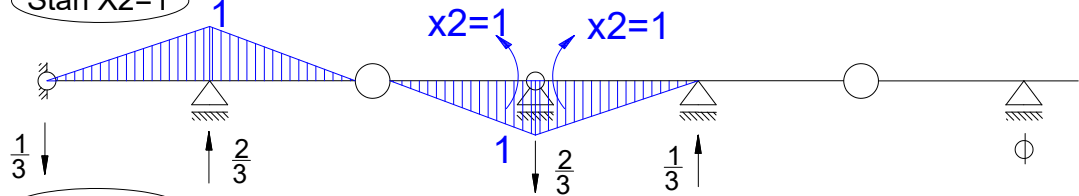
Schemat podstawowy:



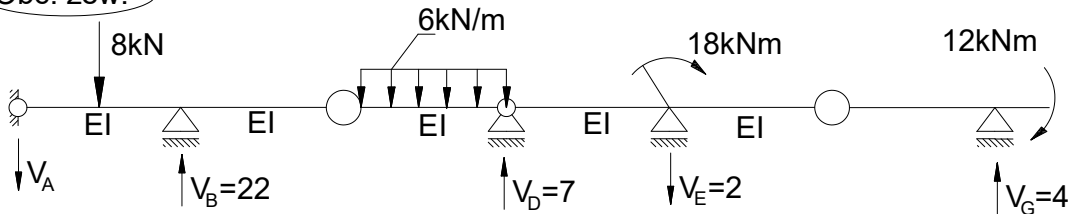
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



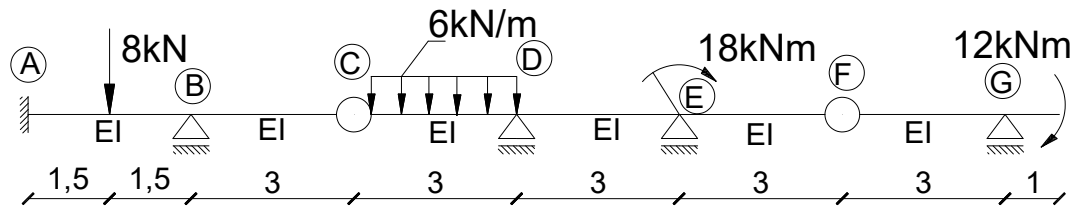
$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

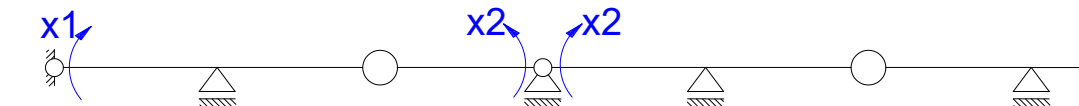
$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

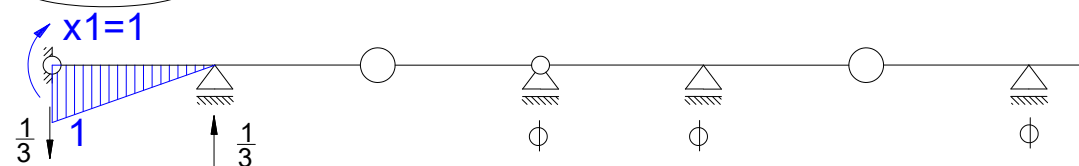
$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \\ &\rightarrow V_B = 22kN \end{aligned}$$



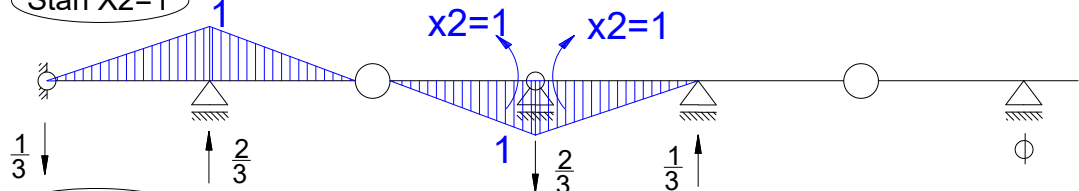
Schemat podstawowy:



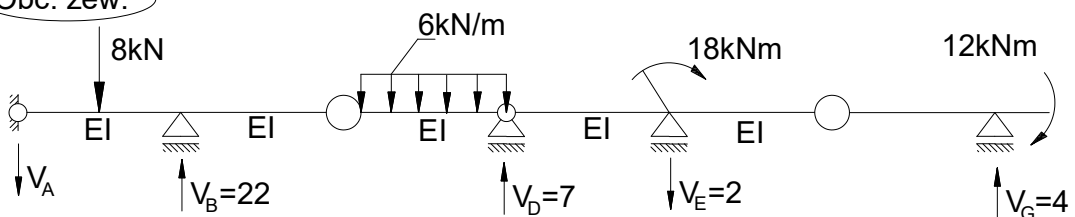
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

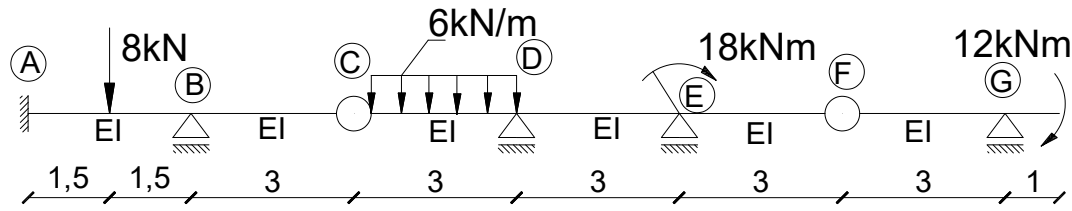
$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

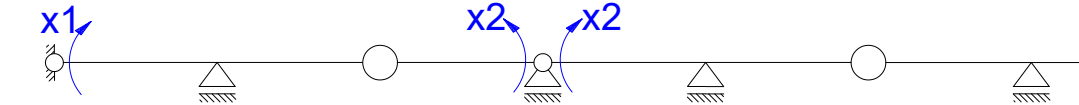
$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \\ &\rightarrow V_B = 22kN \end{aligned}$$

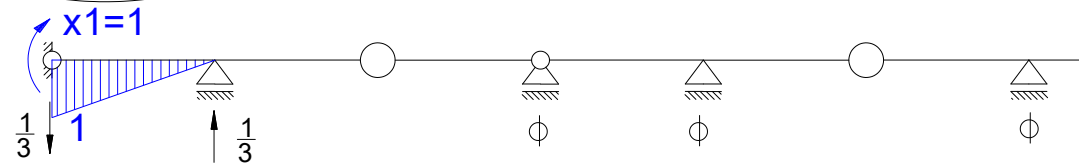
$$\sum R_Y = -V_A - 8 + 22 - 6 \cdot 3 + 7 - 2 + 4 = 0$$



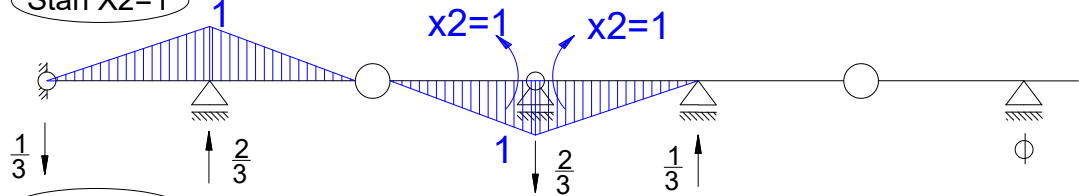
Schemat podstawowy:



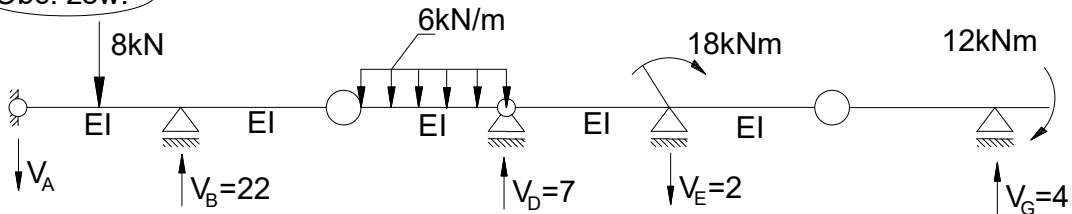
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

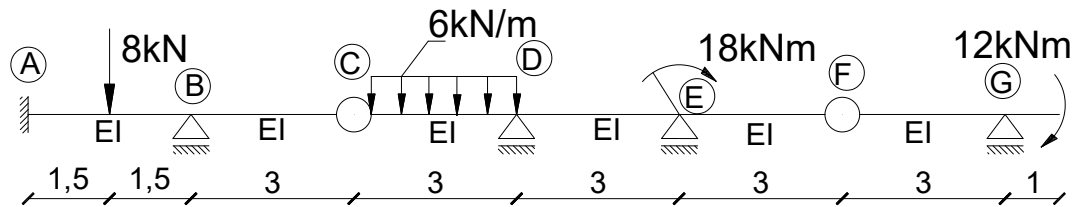
$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

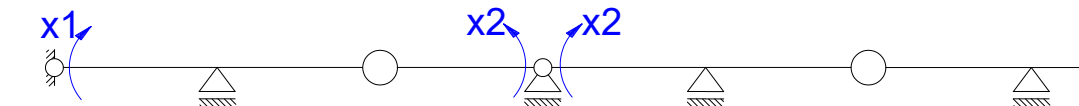
$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \\ &\rightarrow V_B = 22kN \end{aligned}$$

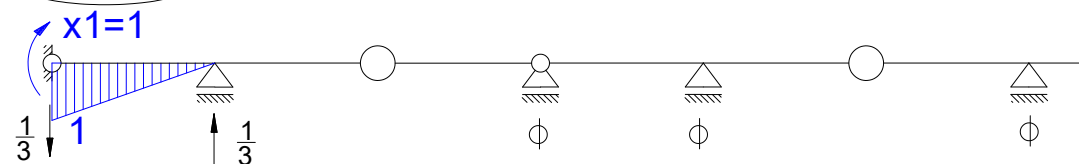
$$\begin{aligned} \sum R_Y &= -V_A - 8 + 22 - 6 \cdot 3 + 7 - 2 + 4 = 0 \\ &\rightarrow V_A = 5kN \end{aligned}$$



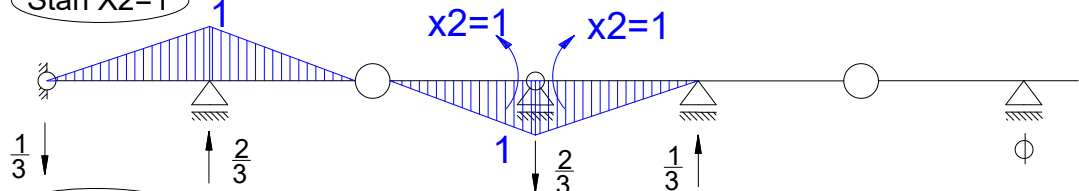
Schemat podstawowy:



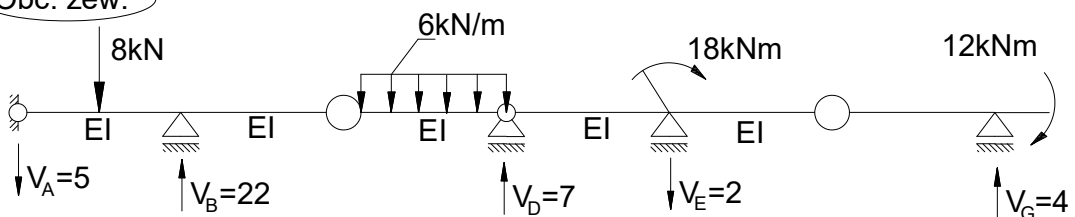
Stan $X_1=1$



Stan $X_2=1$



Obc. zew.



$$\sum M_{FP} = 12 - V_G \cdot 3 = 0 \rightarrow V_G = \frac{12}{3} = 4kN$$

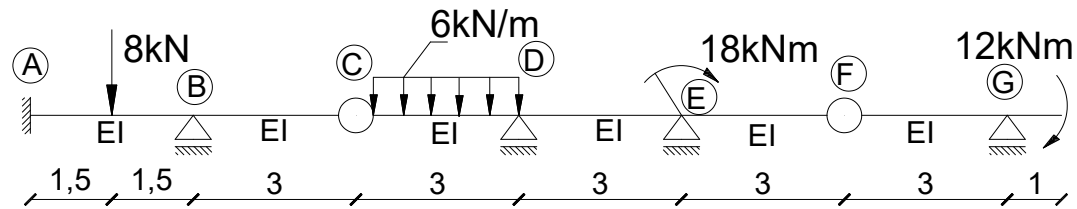
$$\sum M_{DP} = 12 - 4 \cdot 9 + 18 + V_E \cdot 3 = 0$$

$$\rightarrow V_E = \frac{-12 + 36 - 18}{3} = 2kN$$

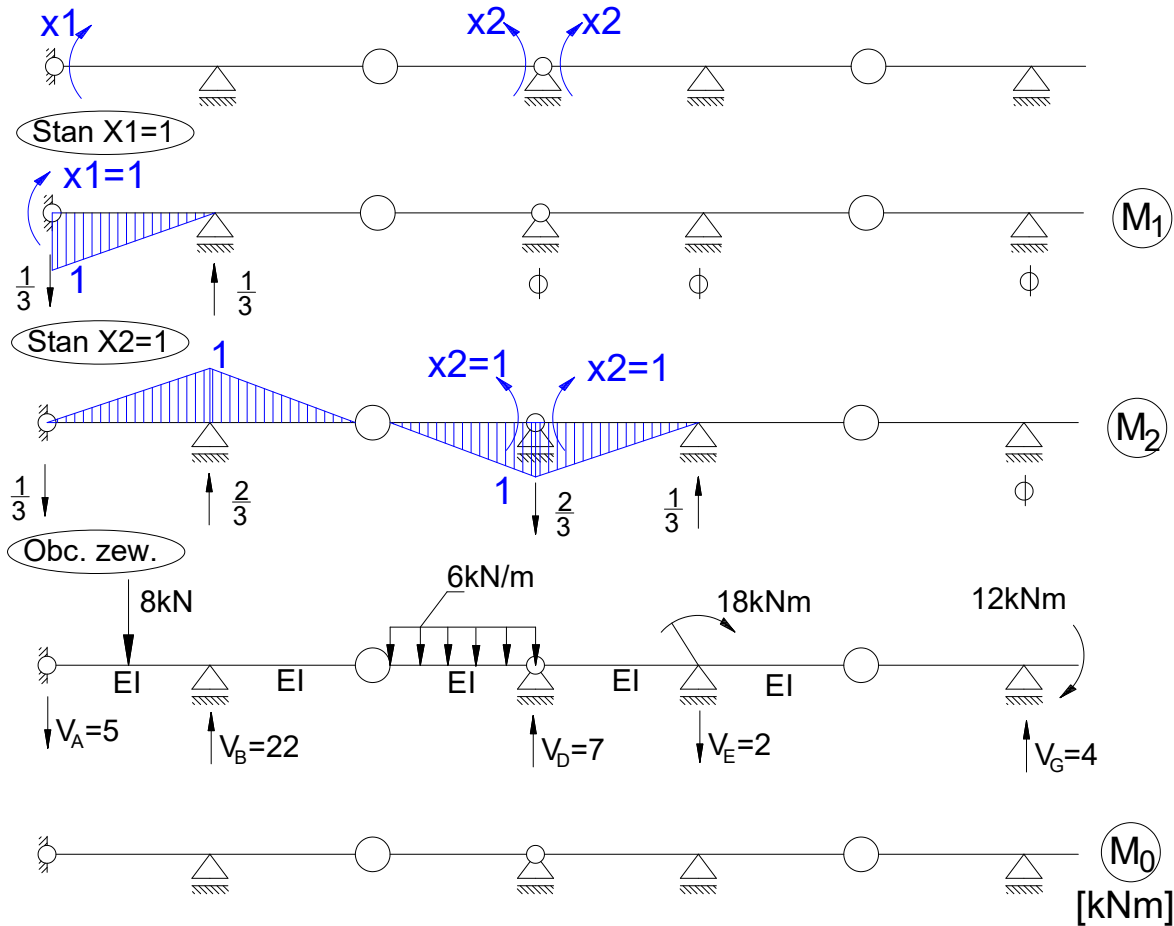
$$\begin{aligned} \textcircled{M_1} \sum M_{CP} &= 12 - 4 \cdot 12 + 18 + 2 \cdot 6 \\ &+ 6 \cdot 3 \cdot 1,5 - V_D \cdot 3 = 0 \\ &\rightarrow V_D = 7kN \end{aligned}$$

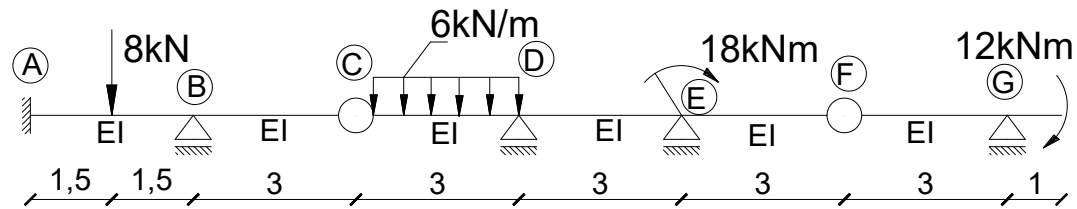
$$\begin{aligned} \textcircled{M_2} \sum M_A &= 12 - 4 \cdot 18 + 18 + 2 \cdot 12 \\ &+ 6 \cdot 3 \cdot 7,5 - 7 \cdot 9 + 8 \cdot 1,5 - V_B \cdot 3 = 0 \\ &\rightarrow V_B = 22kN \end{aligned}$$

$$\begin{aligned} \sum R_Y &= -V_A - 8 + 22 - 6 \cdot 3 + 7 - 2 + 4 = 0 \\ &\rightarrow V_A = 5kN \end{aligned}$$

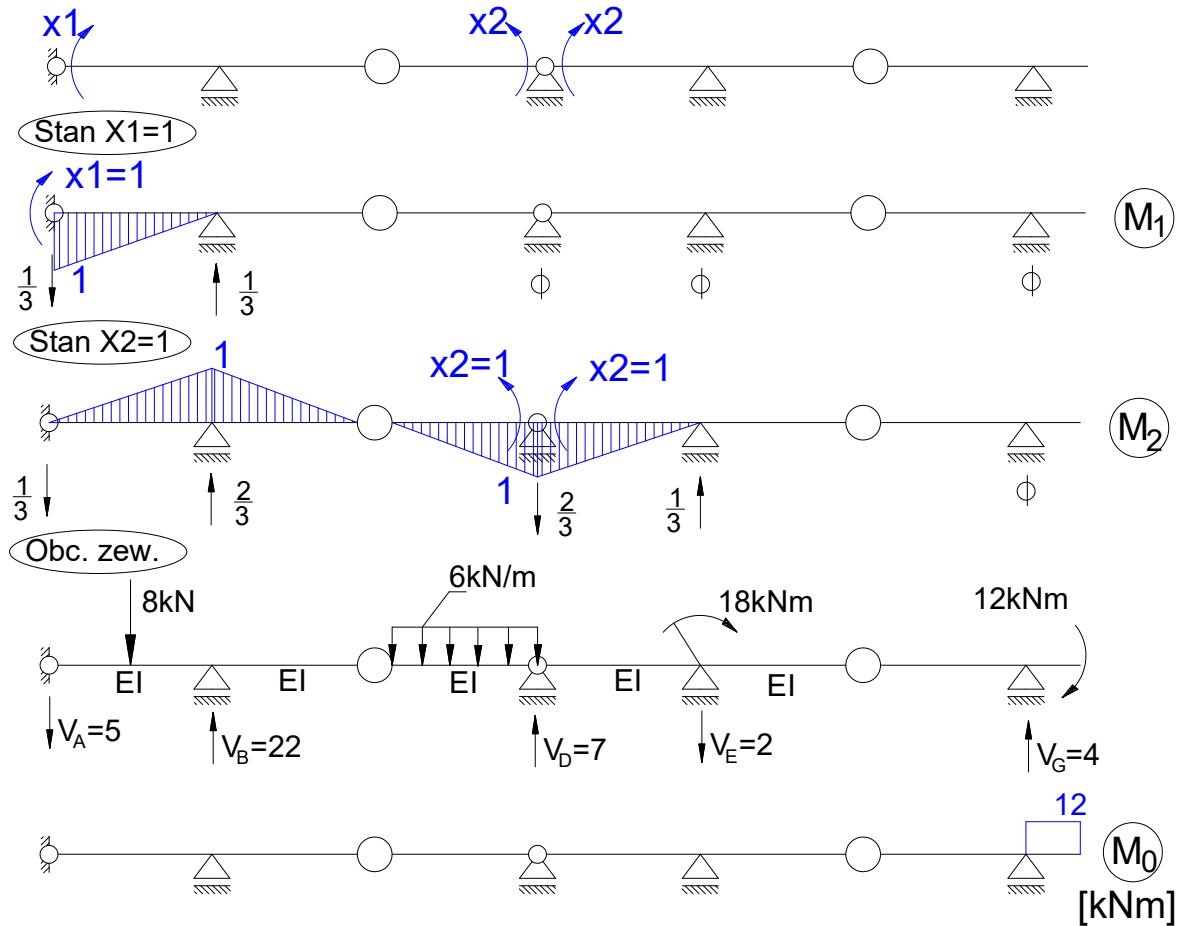


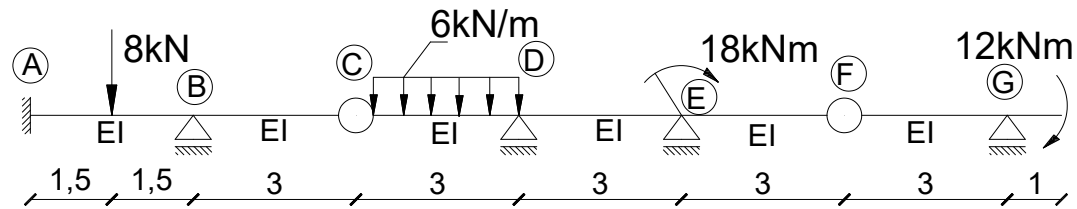
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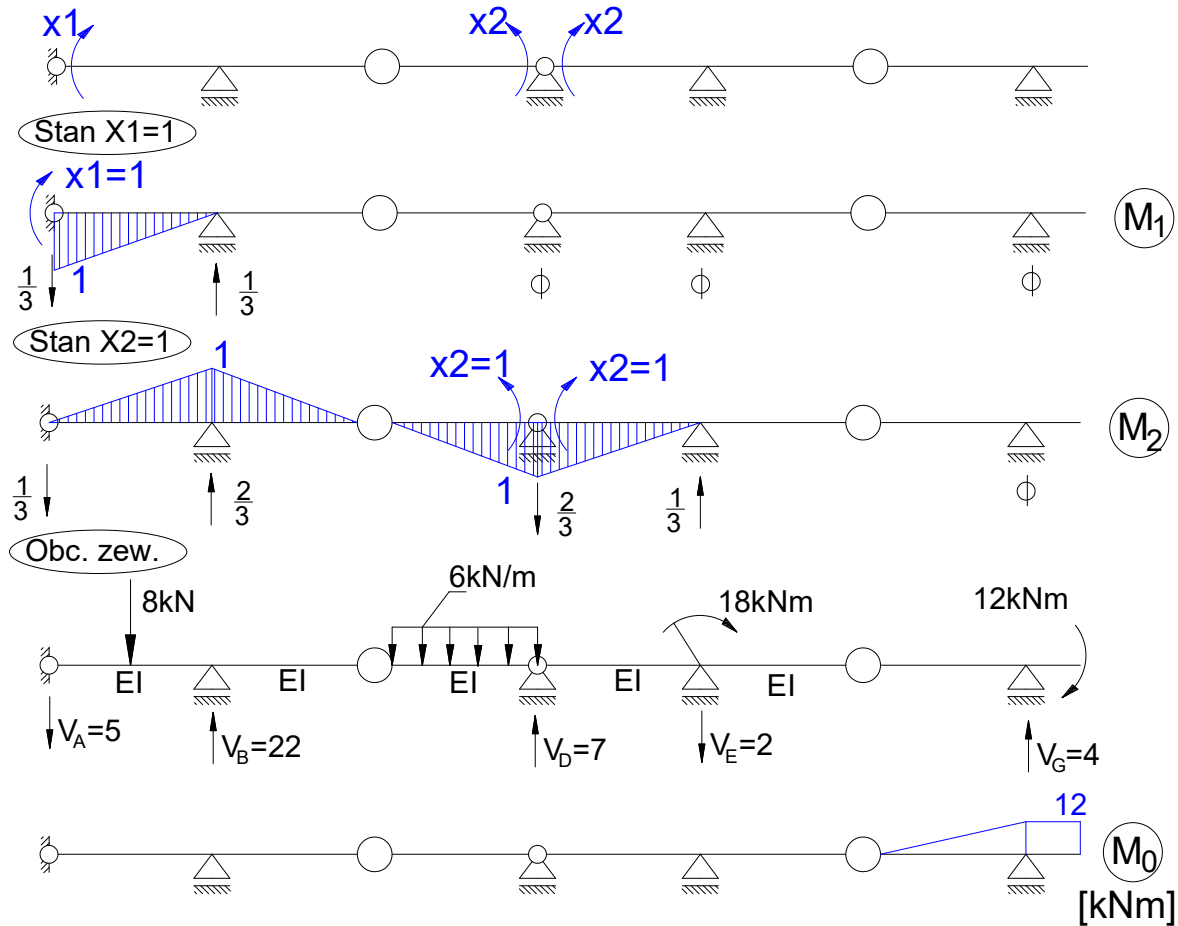


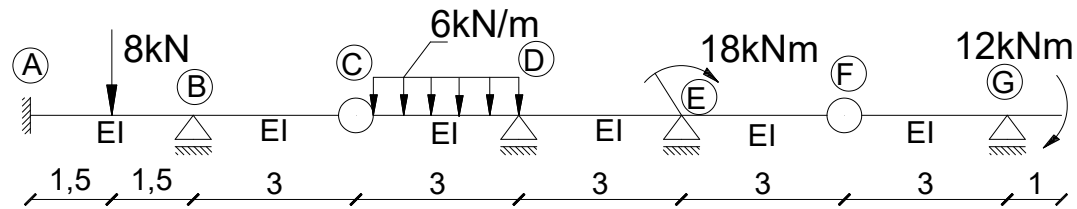
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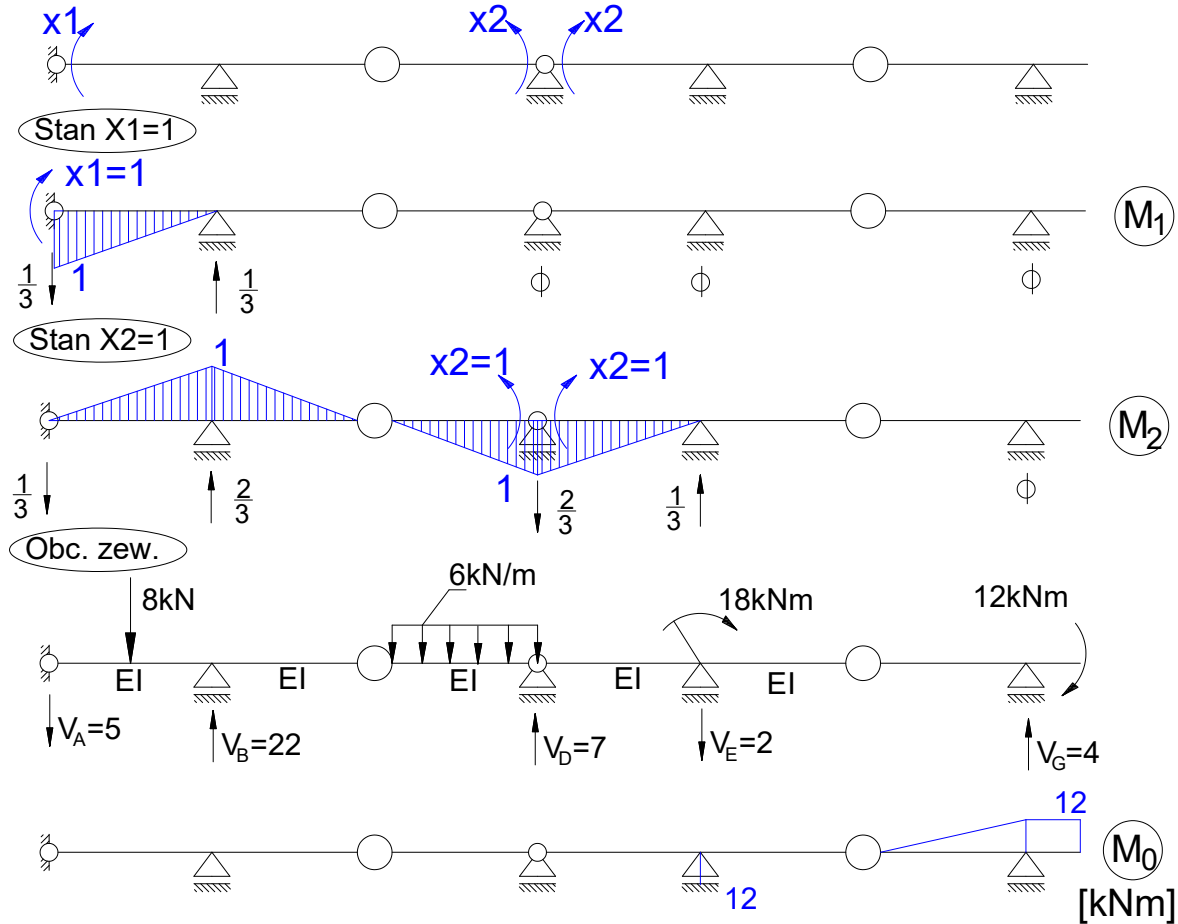


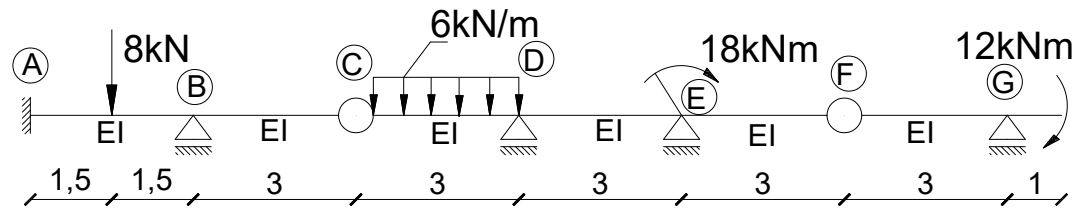
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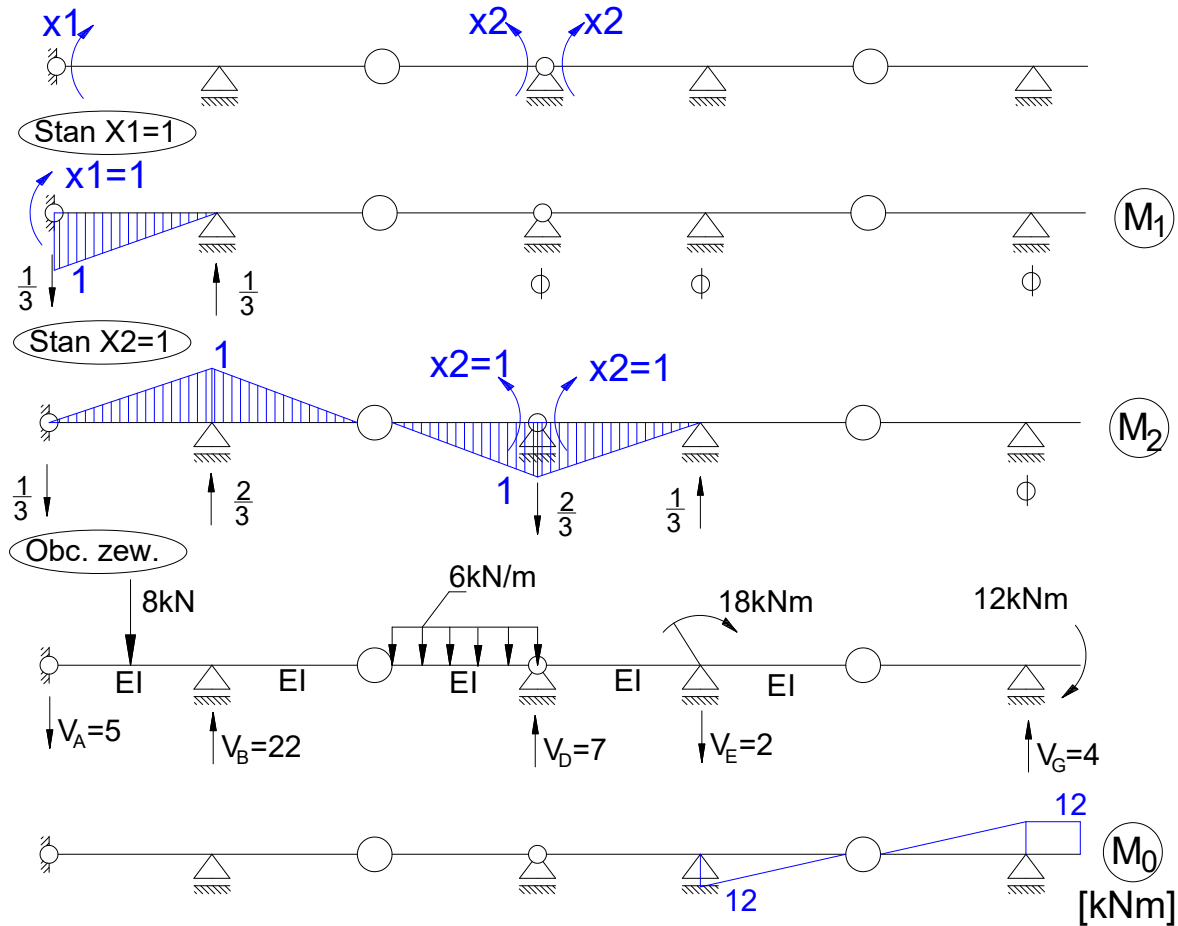


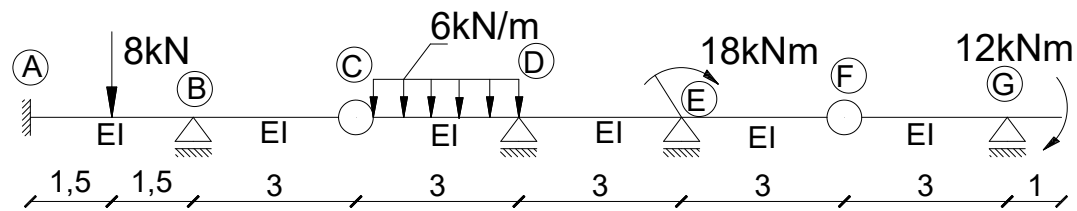
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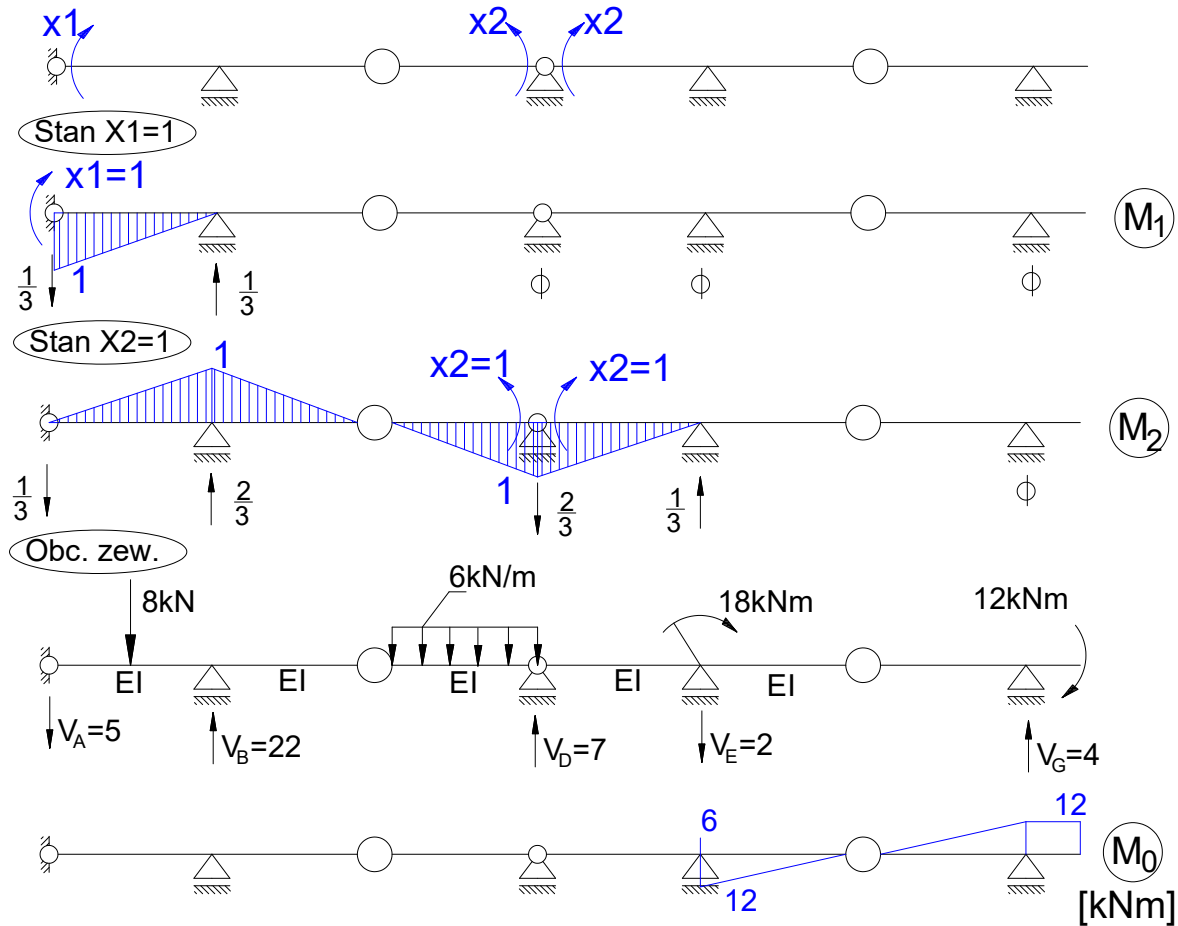


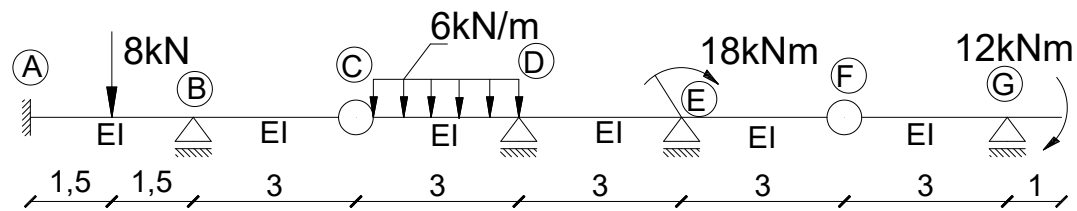
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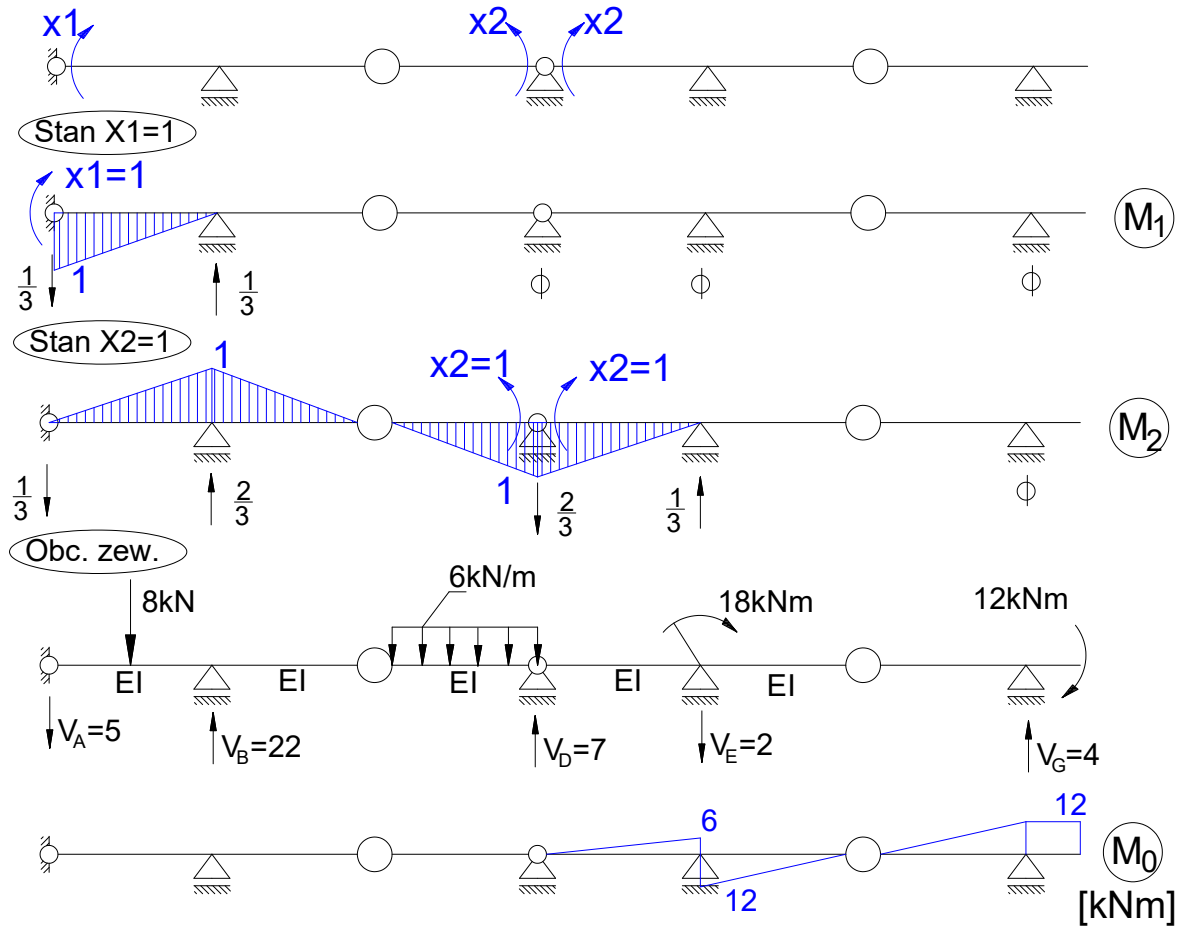


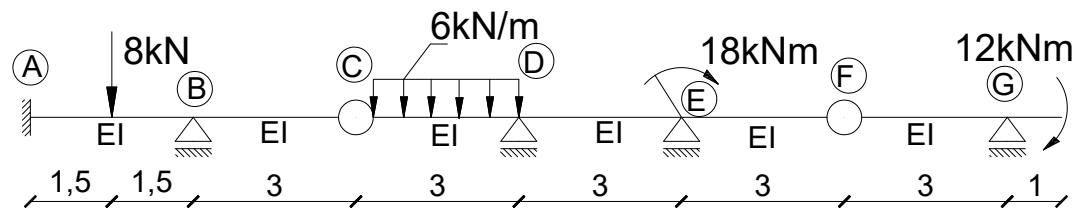
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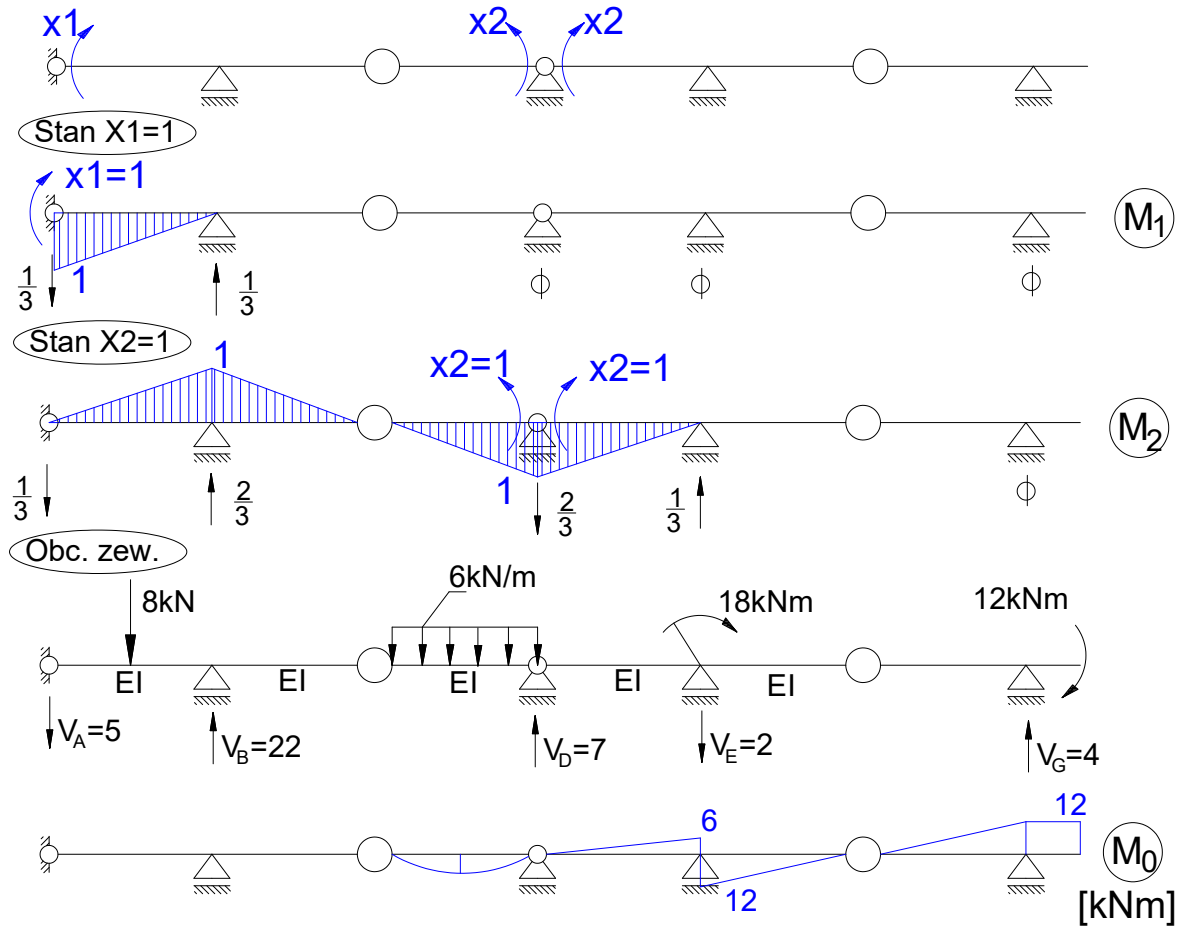


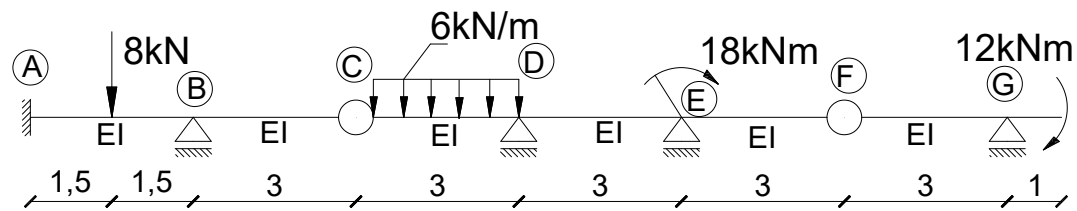
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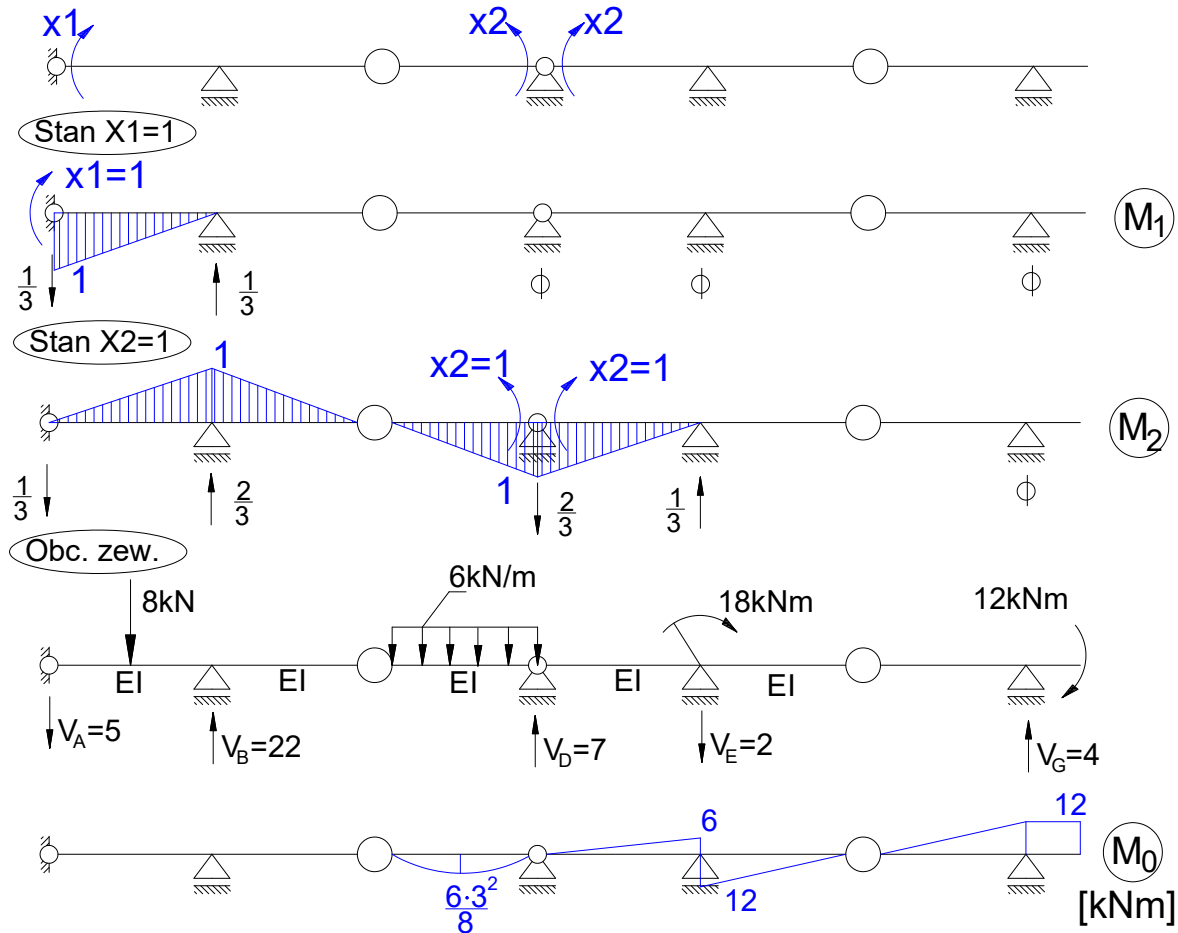


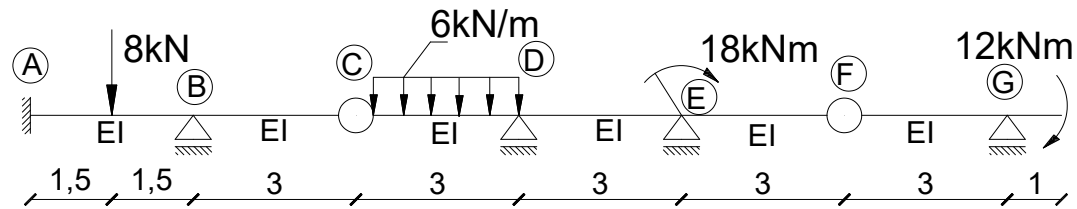
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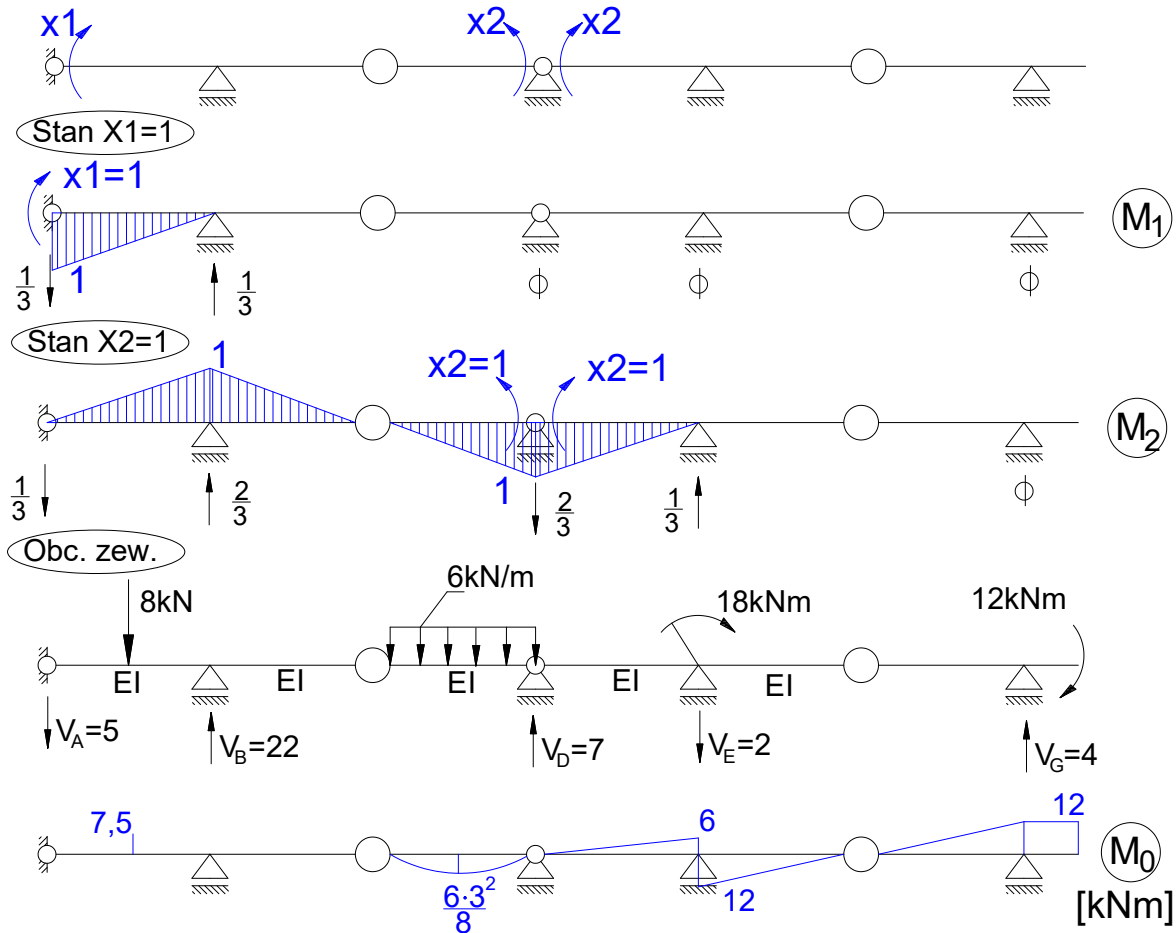


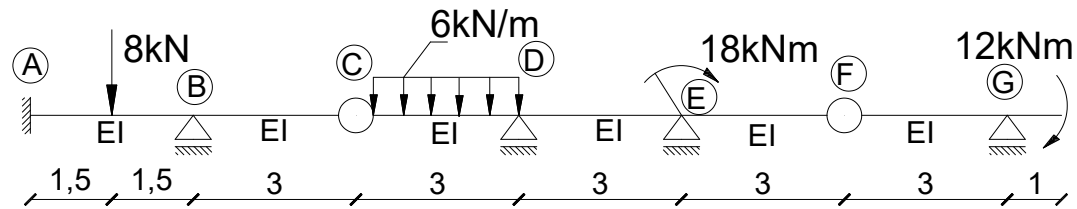
Schemat podstawowy:



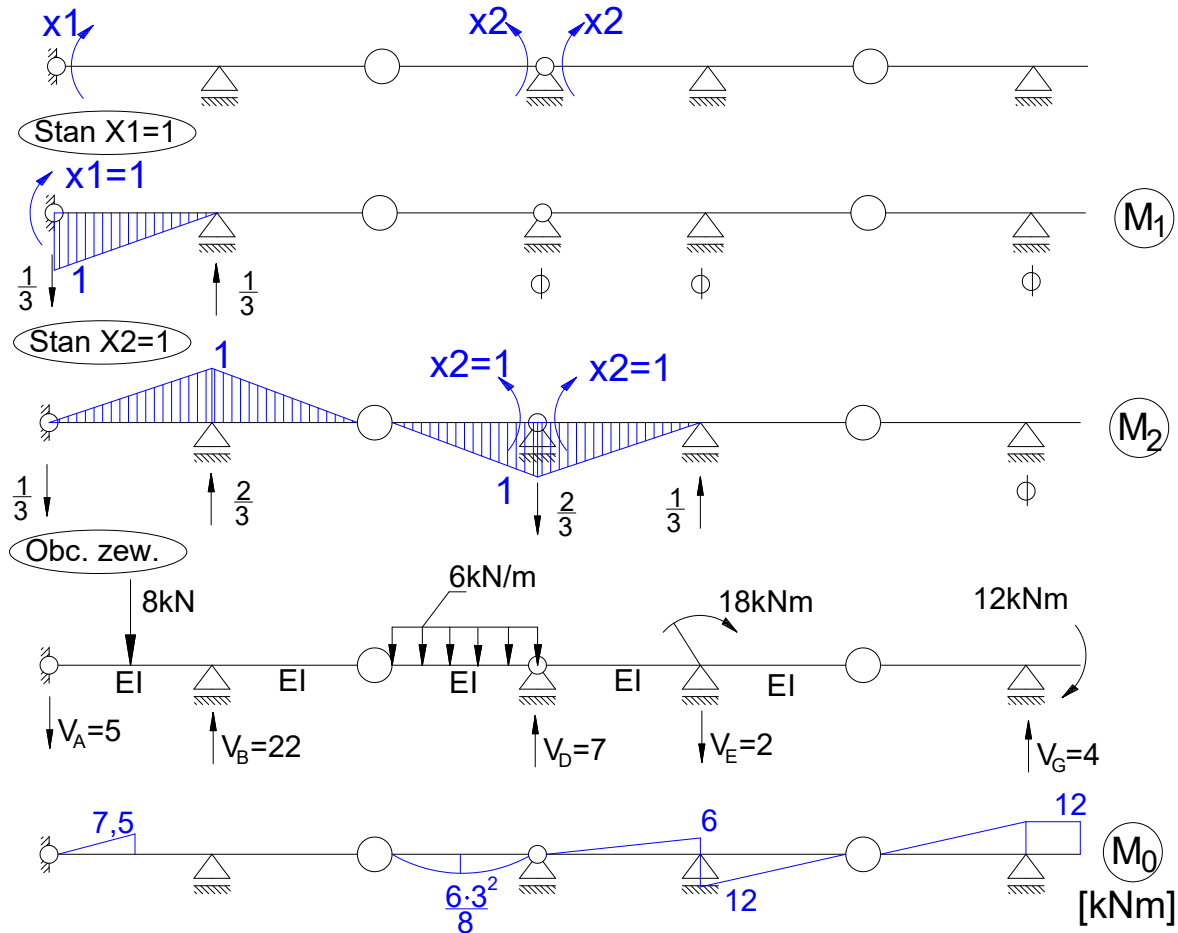


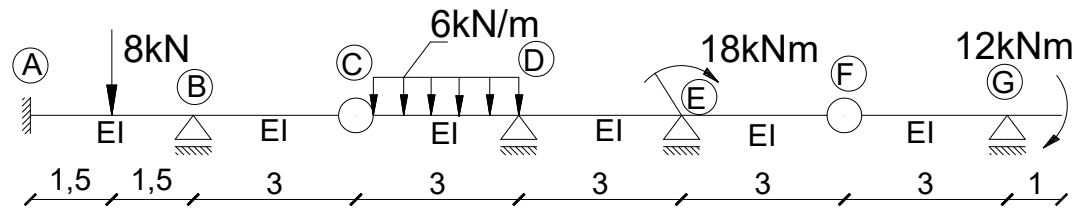
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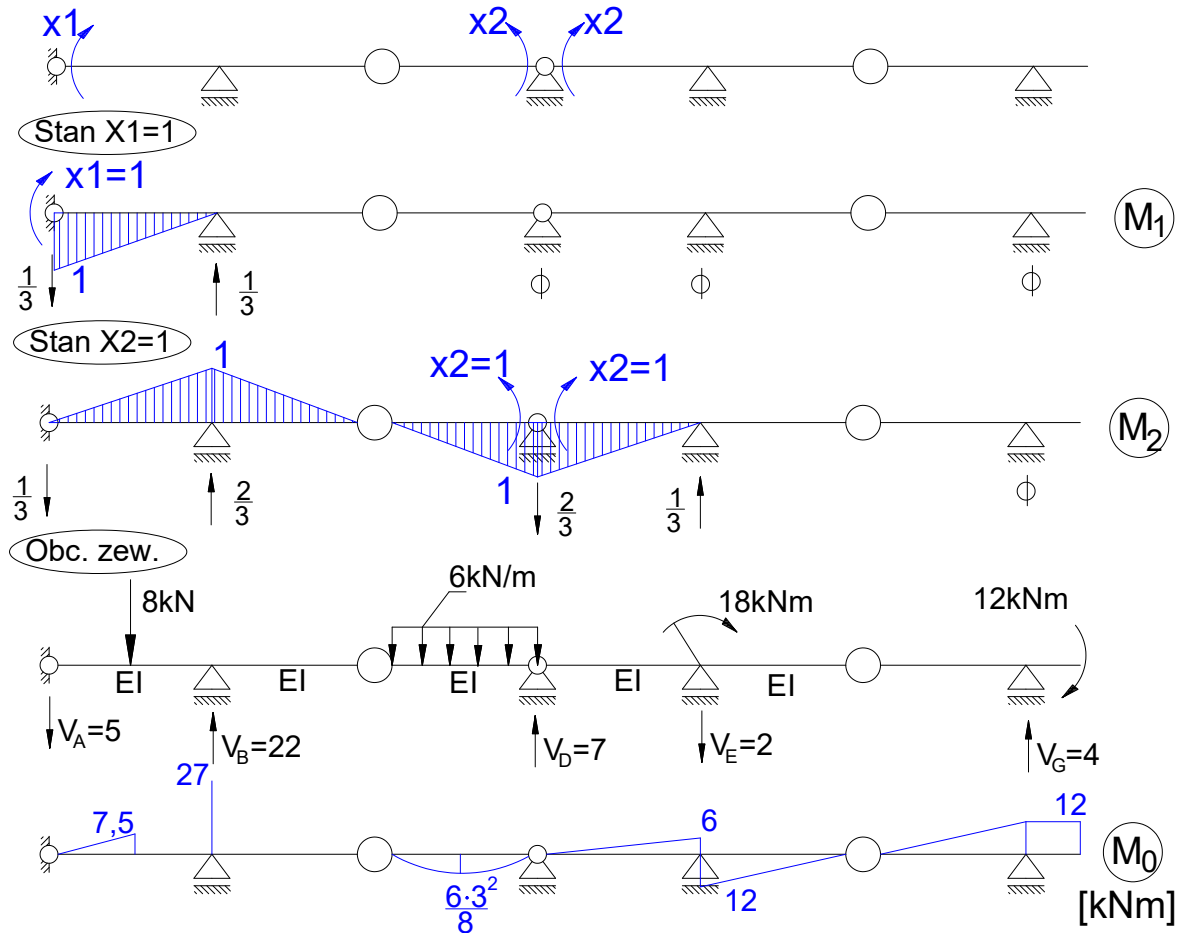


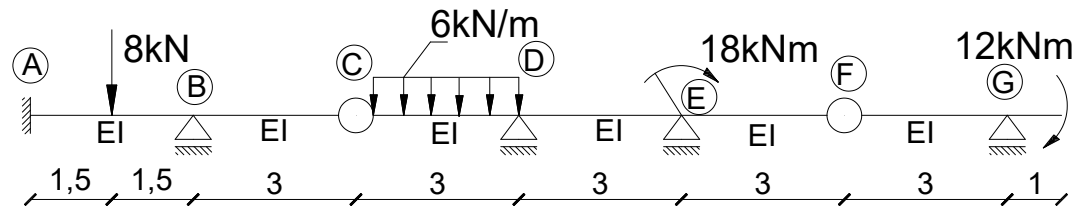
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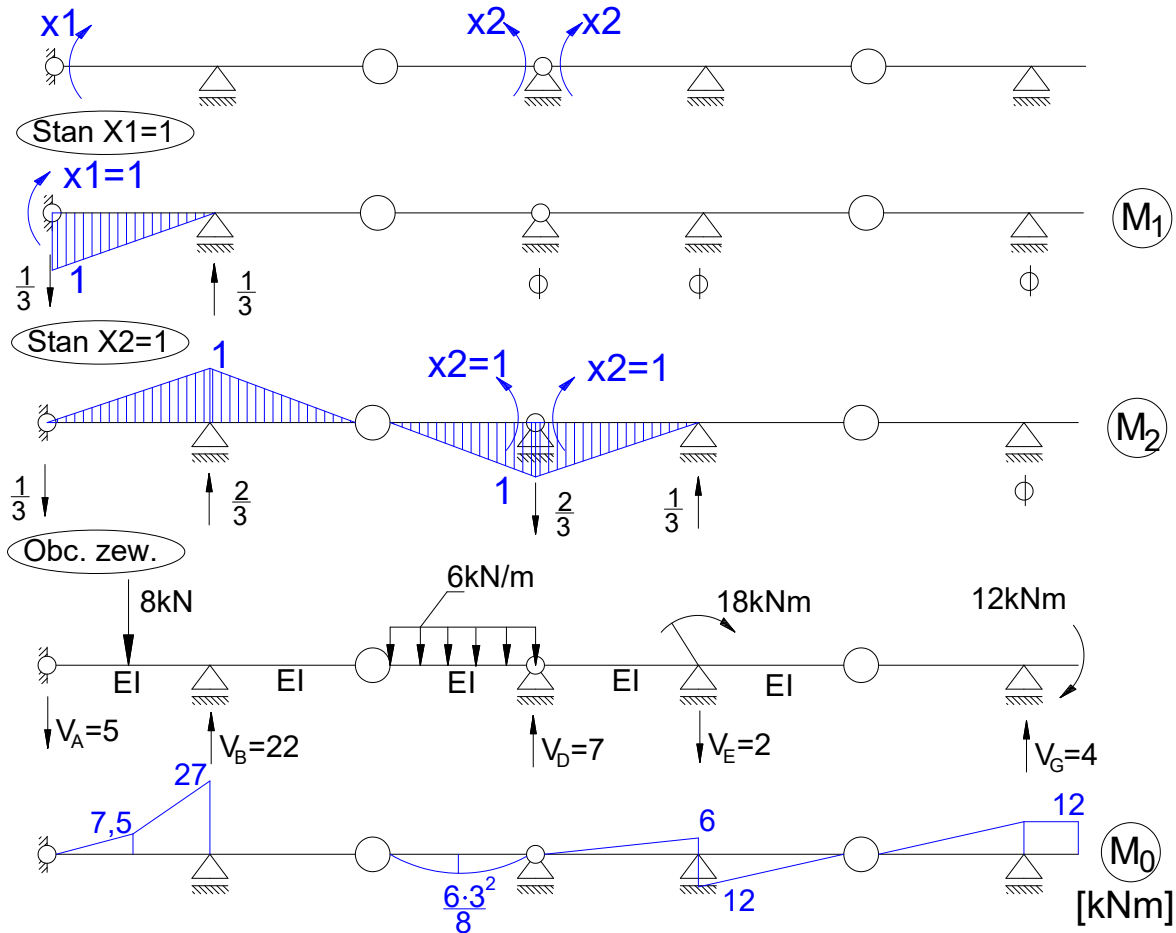


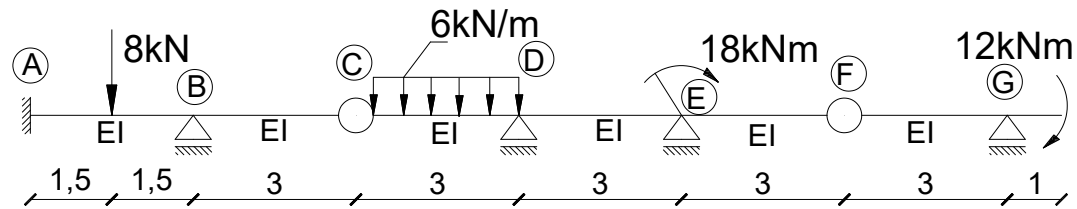
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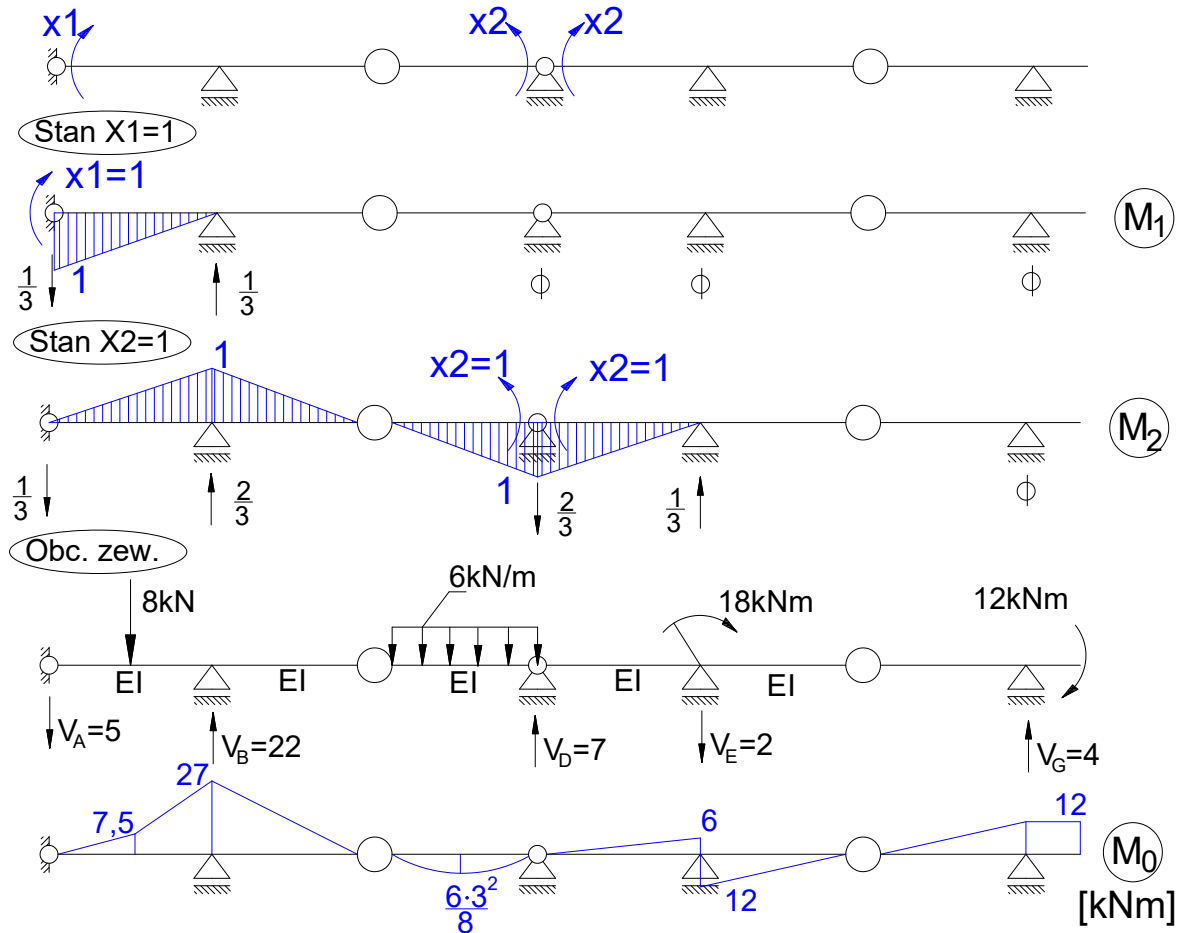


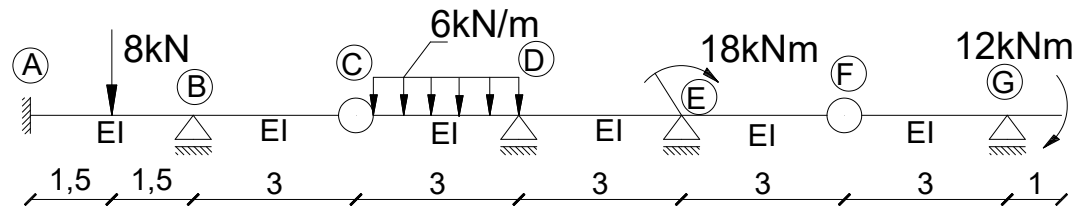
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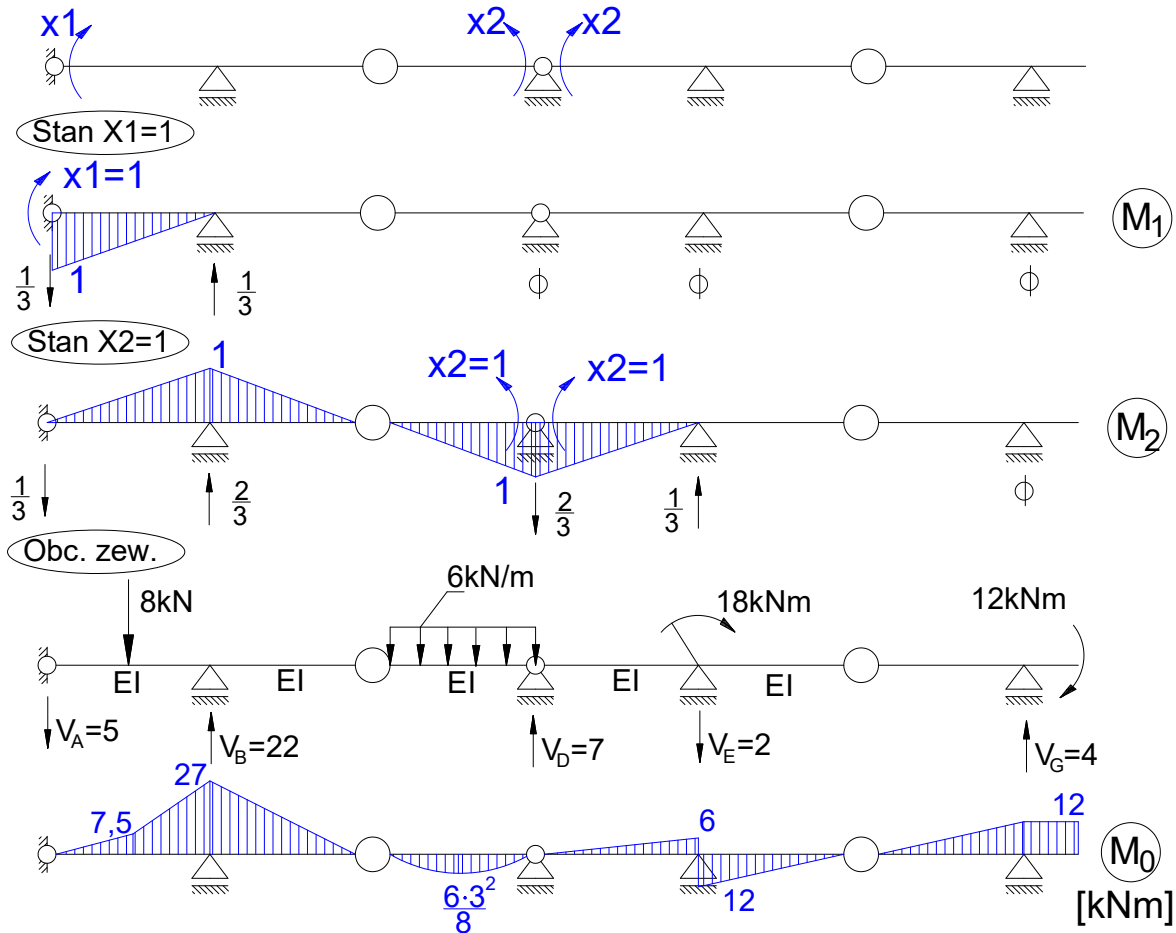


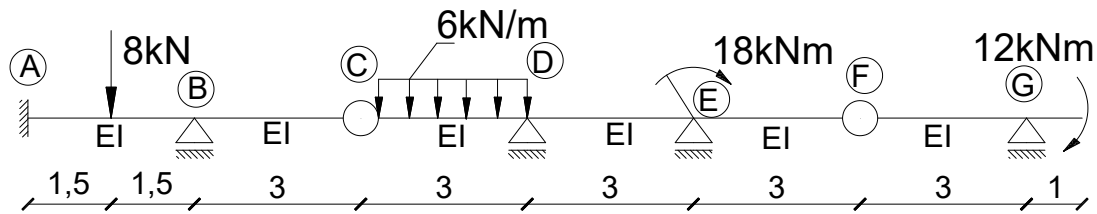
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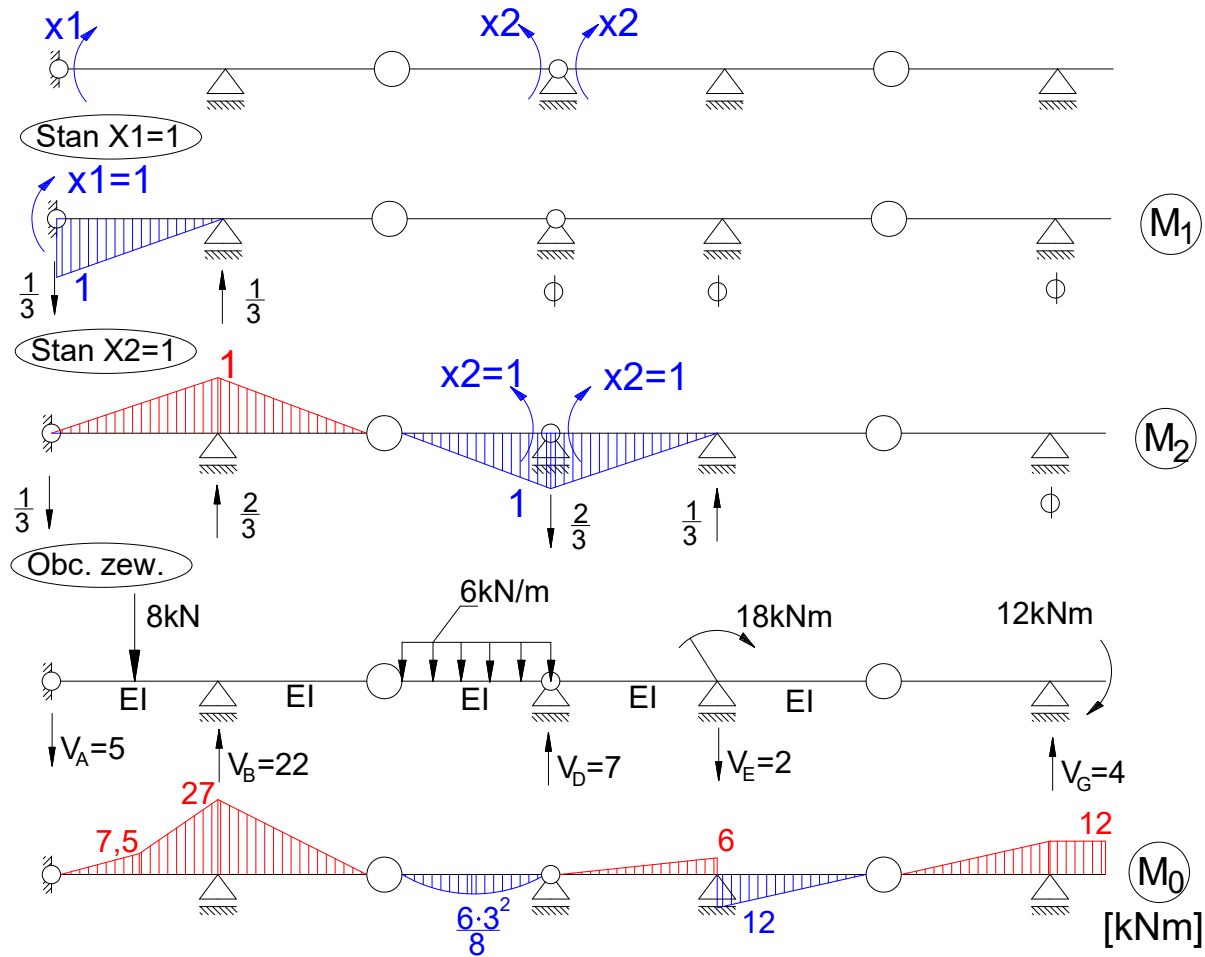


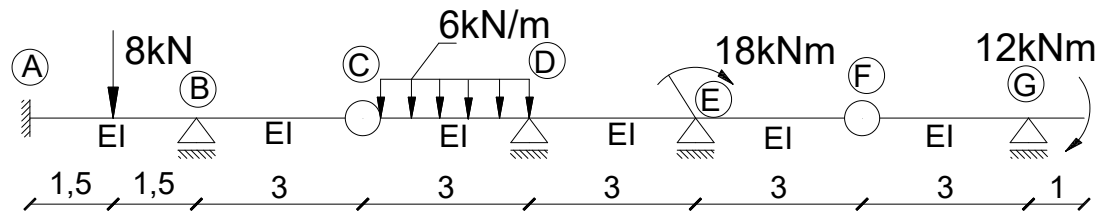
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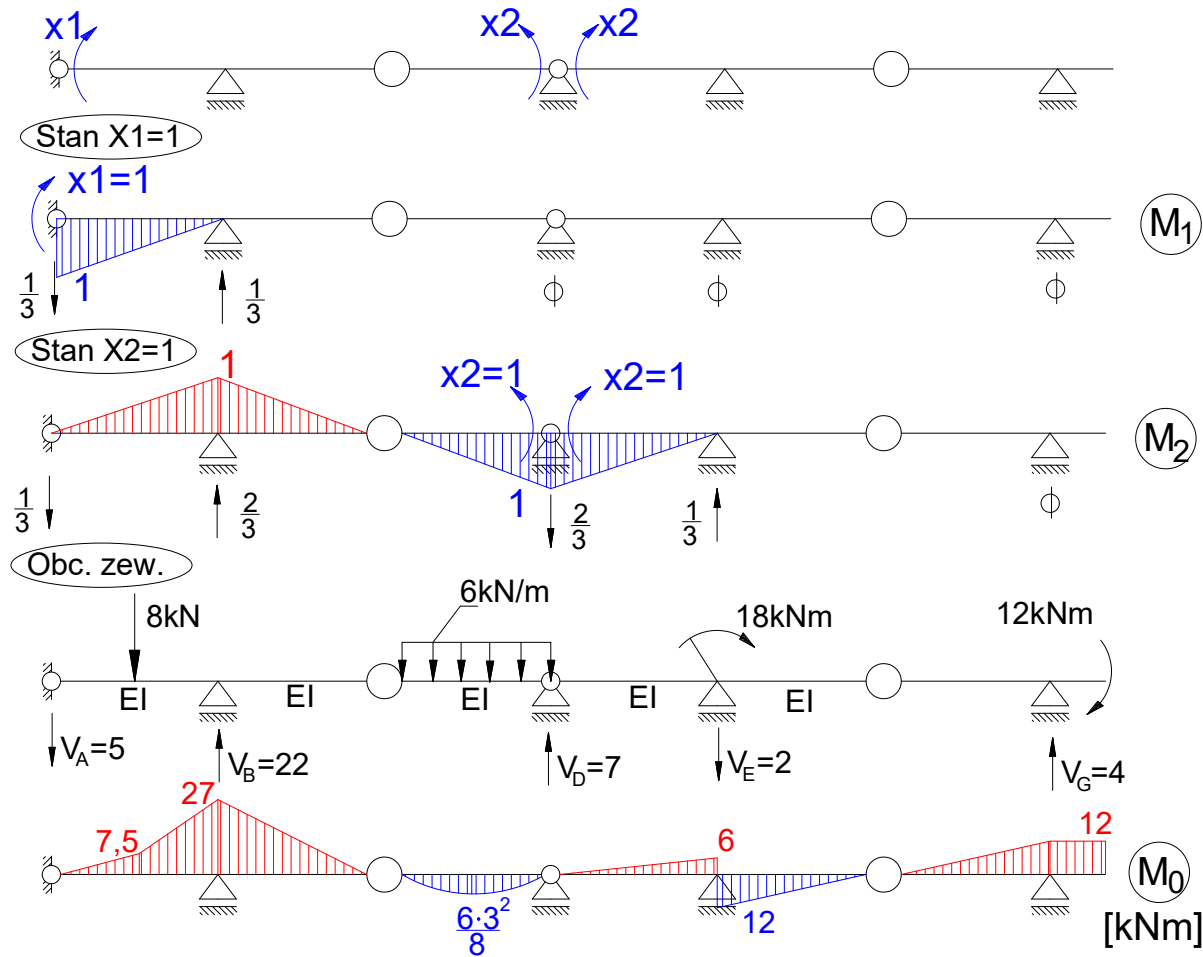
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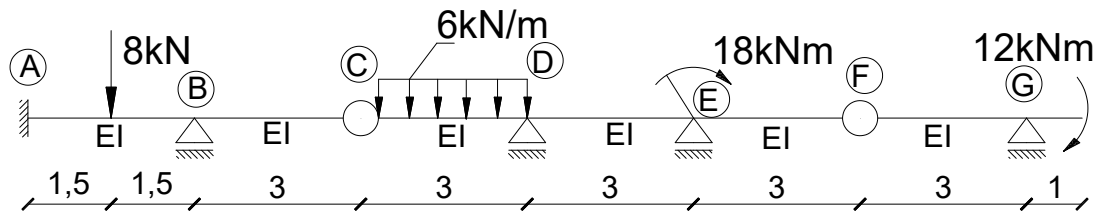




$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1$$

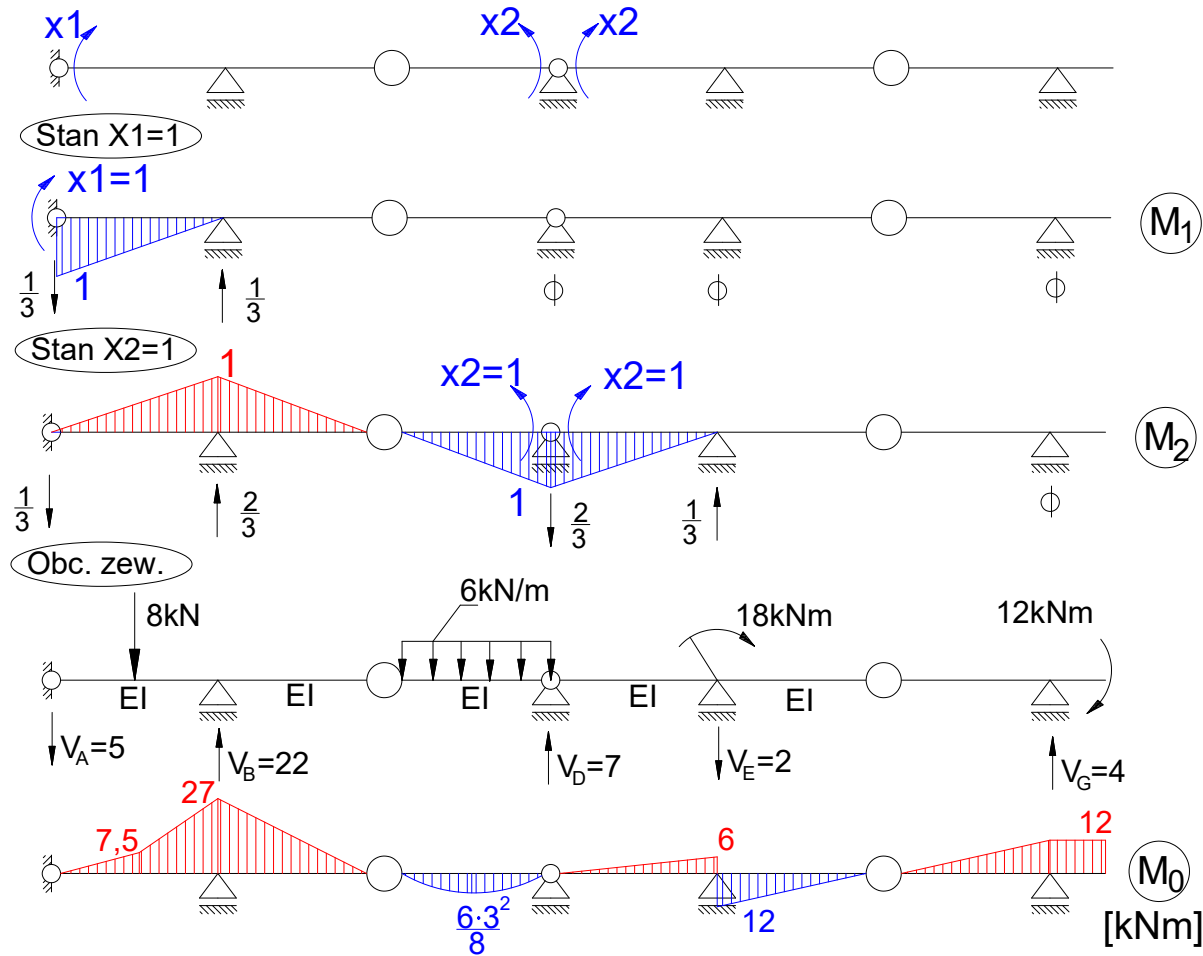
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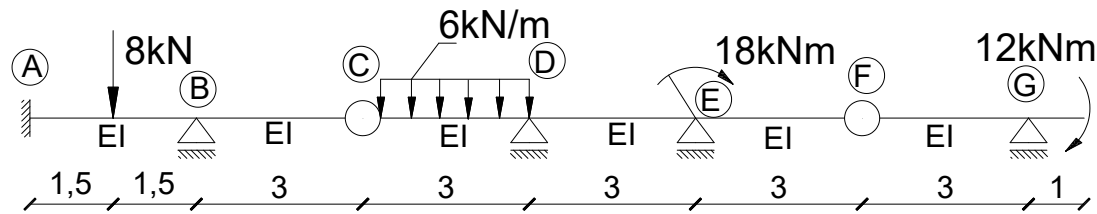




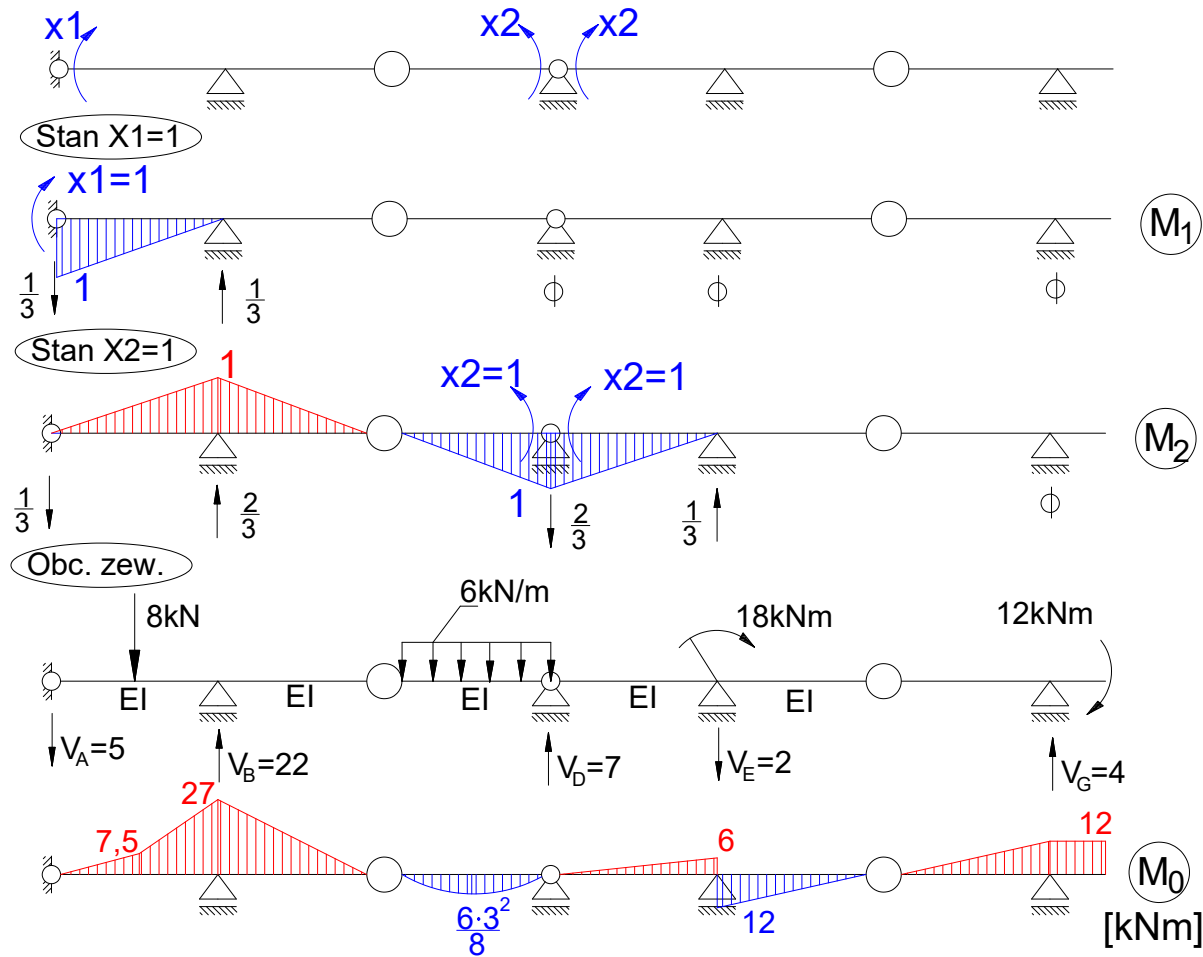
$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

Schemat podstawowy:



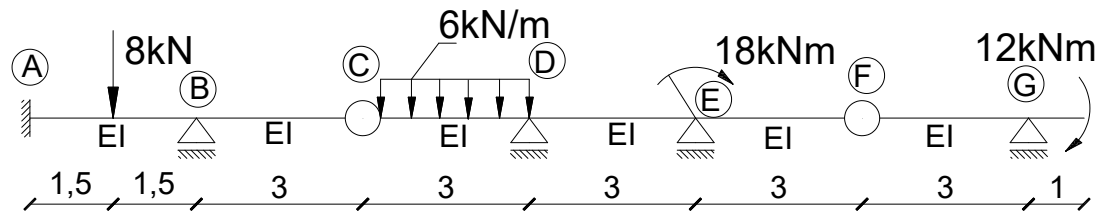


Schemat podstawowy:

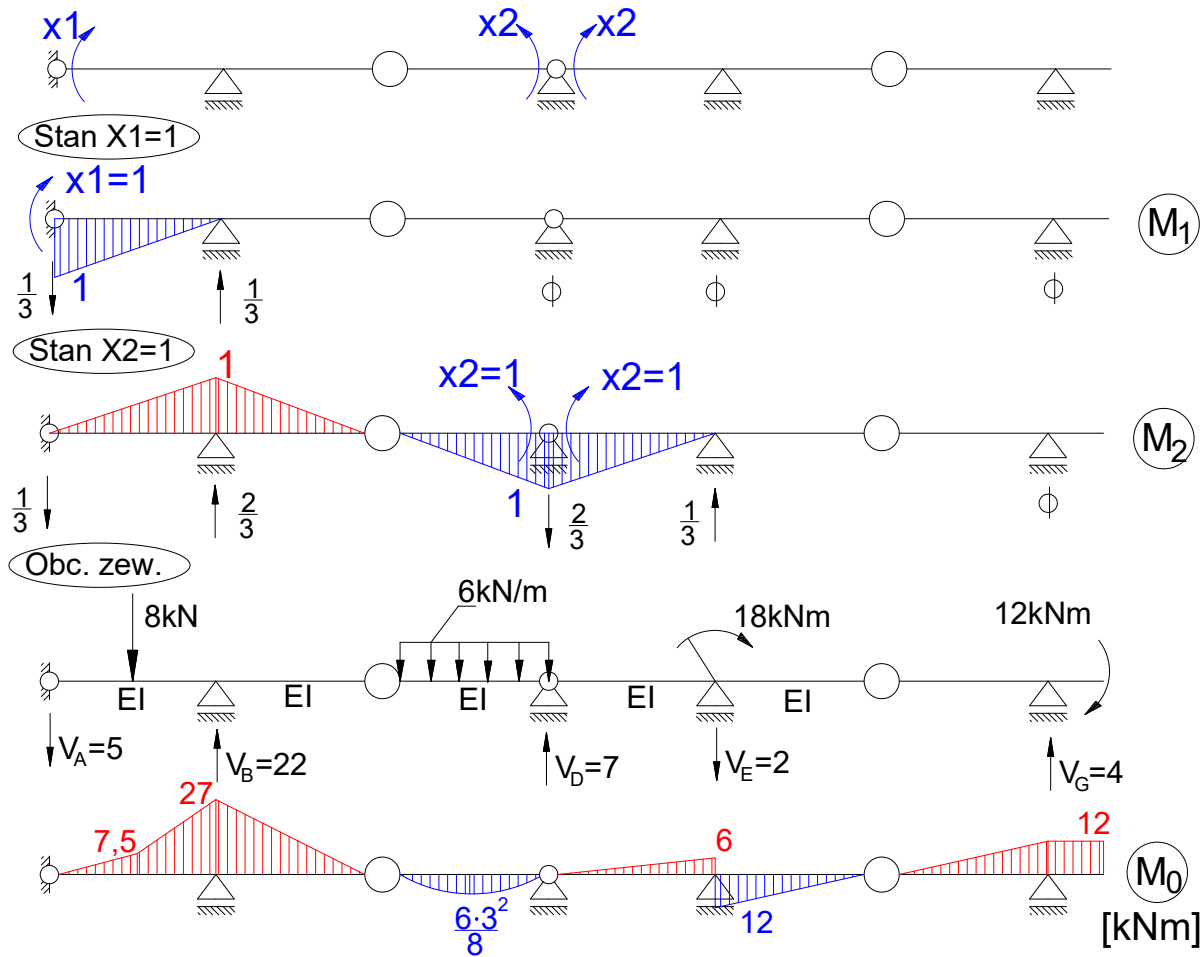


$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

$$\delta_{12} = \frac{1}{EI} \left(-\frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{1}{3} \cdot 1 \right)$$

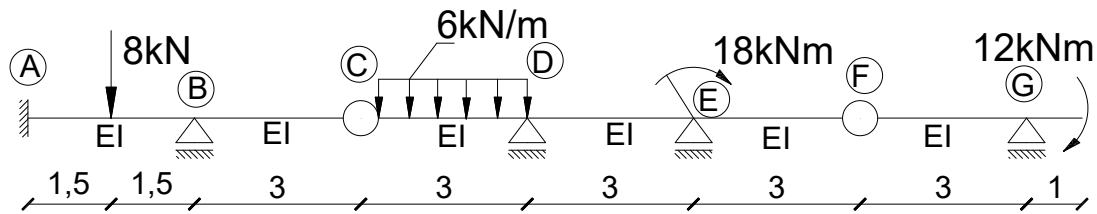


Schemat podstawowy:

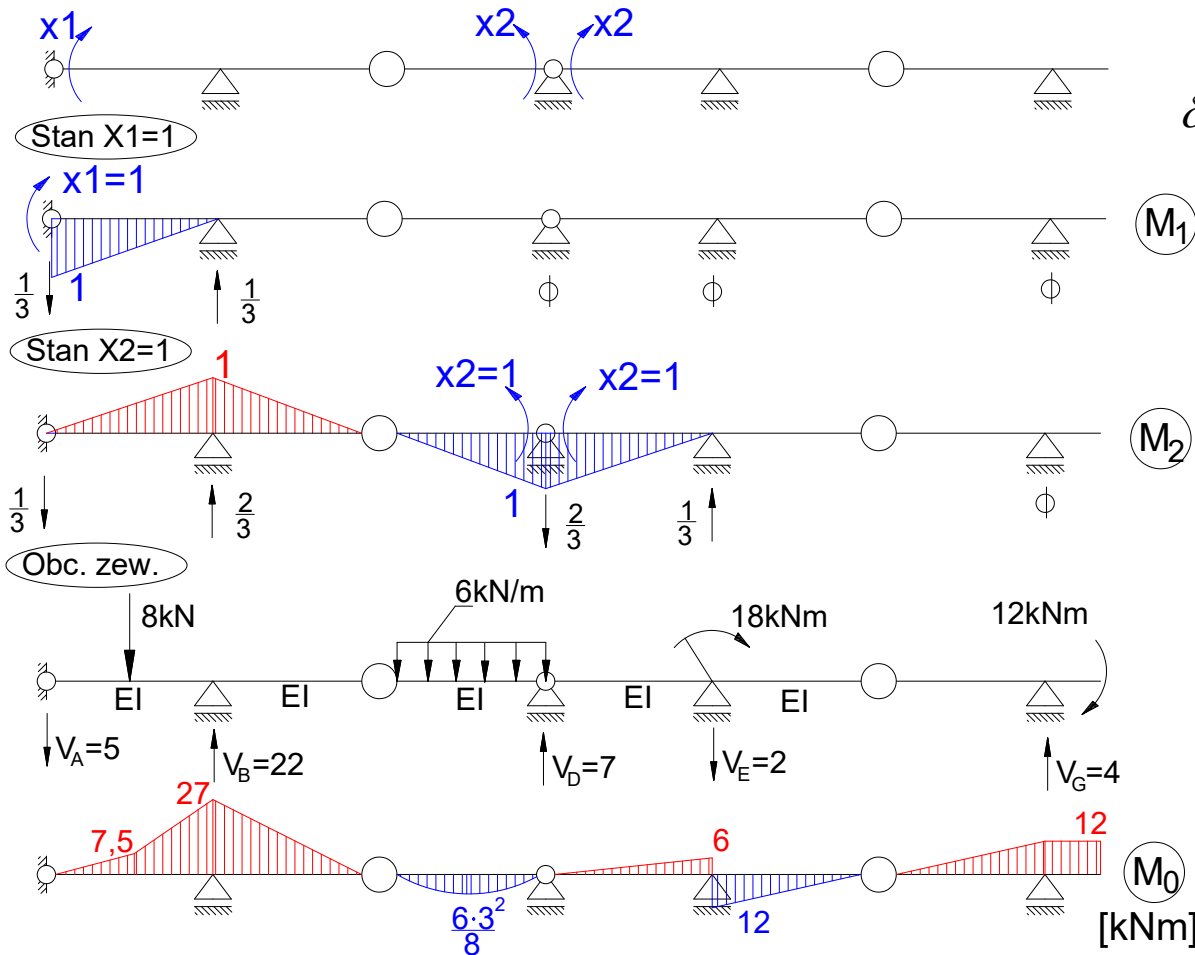


$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

$$\delta_{12} = \frac{1}{EI} \left(-\frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{1}{3} \cdot 1 \right) = -\frac{1}{2EI}$$



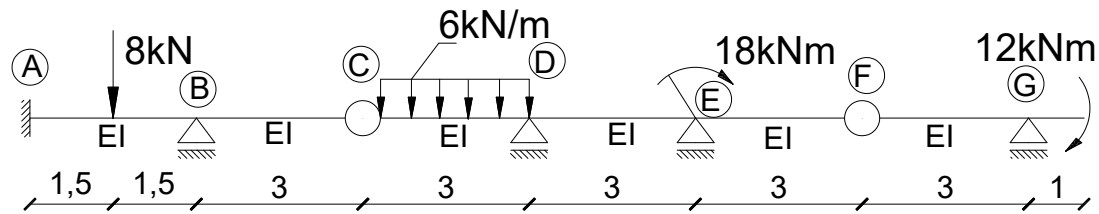
Schemat podstawowy:



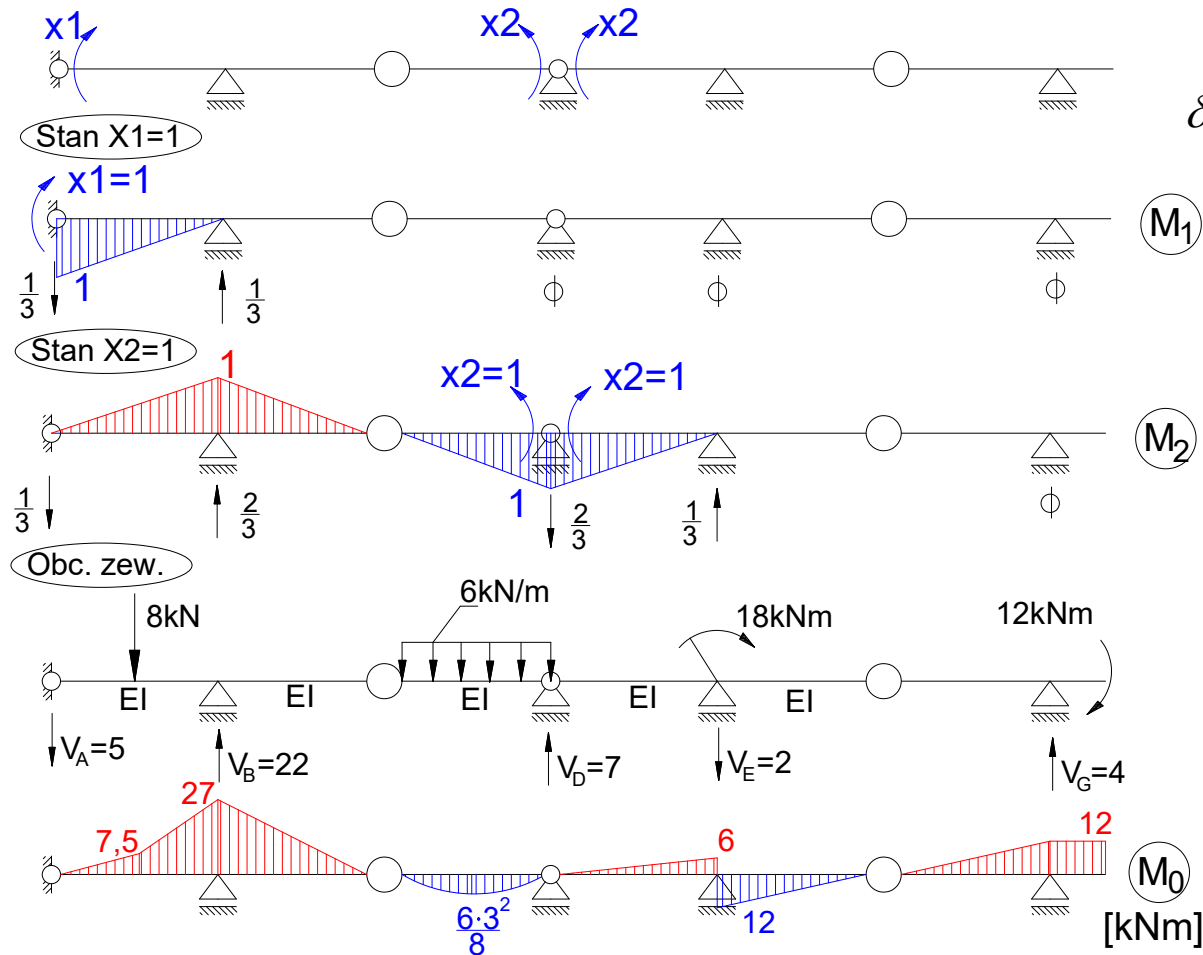
$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

$$\delta_{12} = \frac{1}{EI} \left(-\frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{1}{3} \cdot 1 \right) = -\frac{1}{2EI} = \delta_{21}$$

$$\delta_{22} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 \cdot 4$$



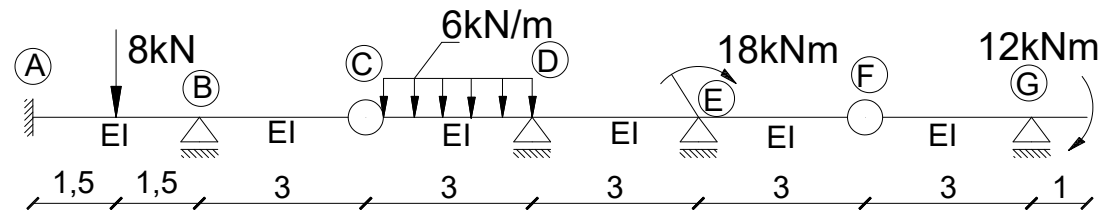
Schemat podstawowy:



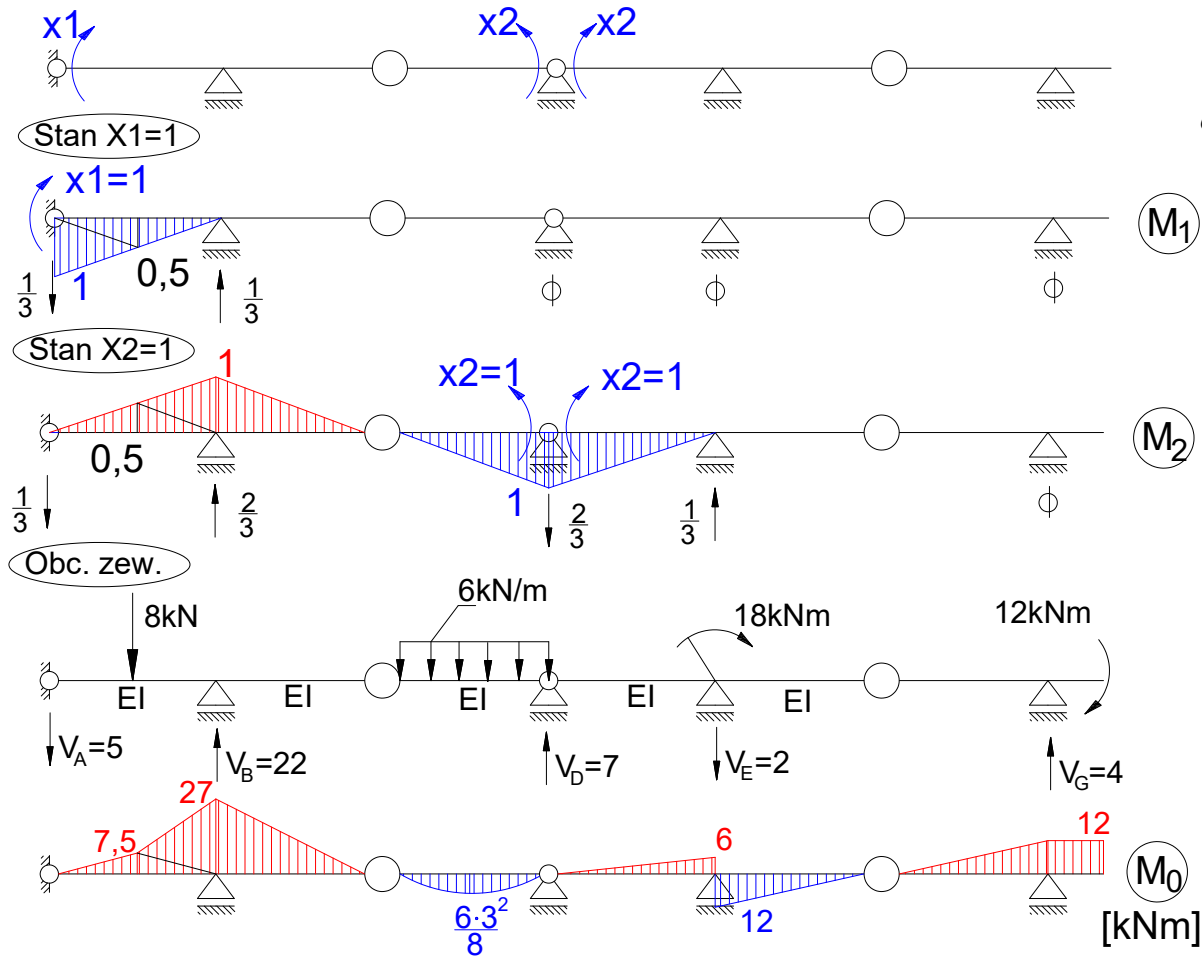
$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

$$\delta_{12} = \frac{1}{EI} \left(-\frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{1}{3} \cdot 1 \right) = -\frac{1}{2EI} = \delta_{21}$$

$$\delta_{22} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 \cdot 4 = \frac{4}{EI}$$



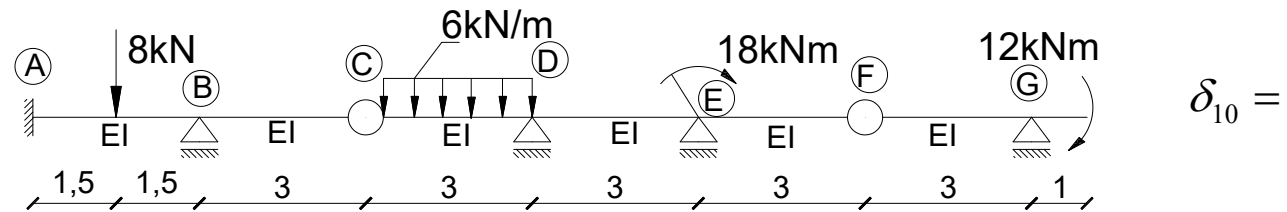
Schemat podstawowy:



$$\delta_{11} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 = \frac{1}{EI}$$

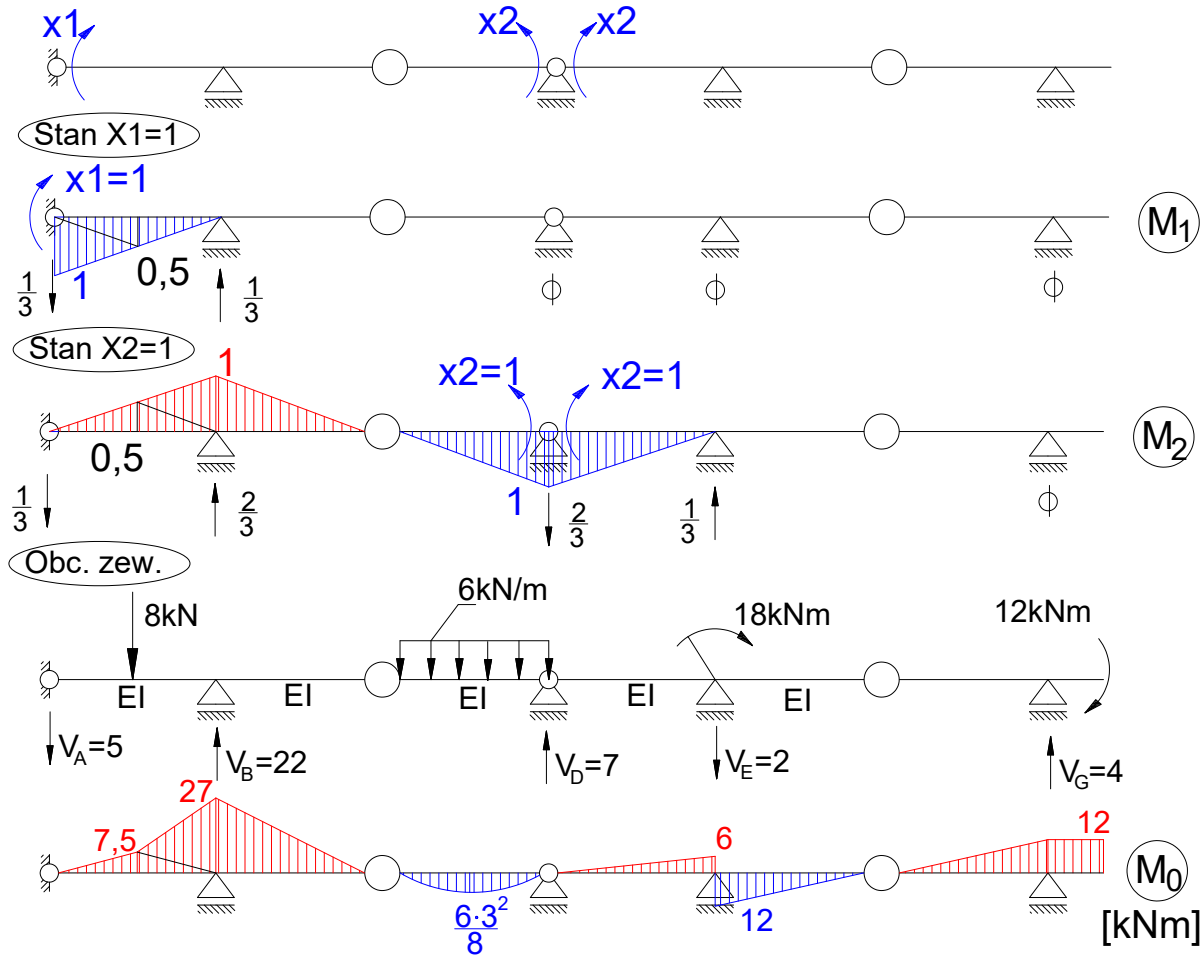
$$\delta_{12} = \frac{1}{EI} \left(-\frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{1}{3} \cdot 1 \right) = -\frac{1}{2EI} = \delta_{21}$$

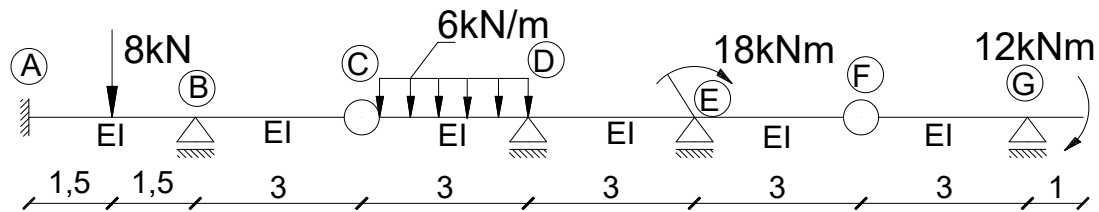
$$\delta_{22} = \frac{1}{EI} \frac{1}{2} \cdot 1 \cdot 3 \cdot \frac{2}{3} \cdot 1 \cdot 4 = \frac{4}{EI}$$



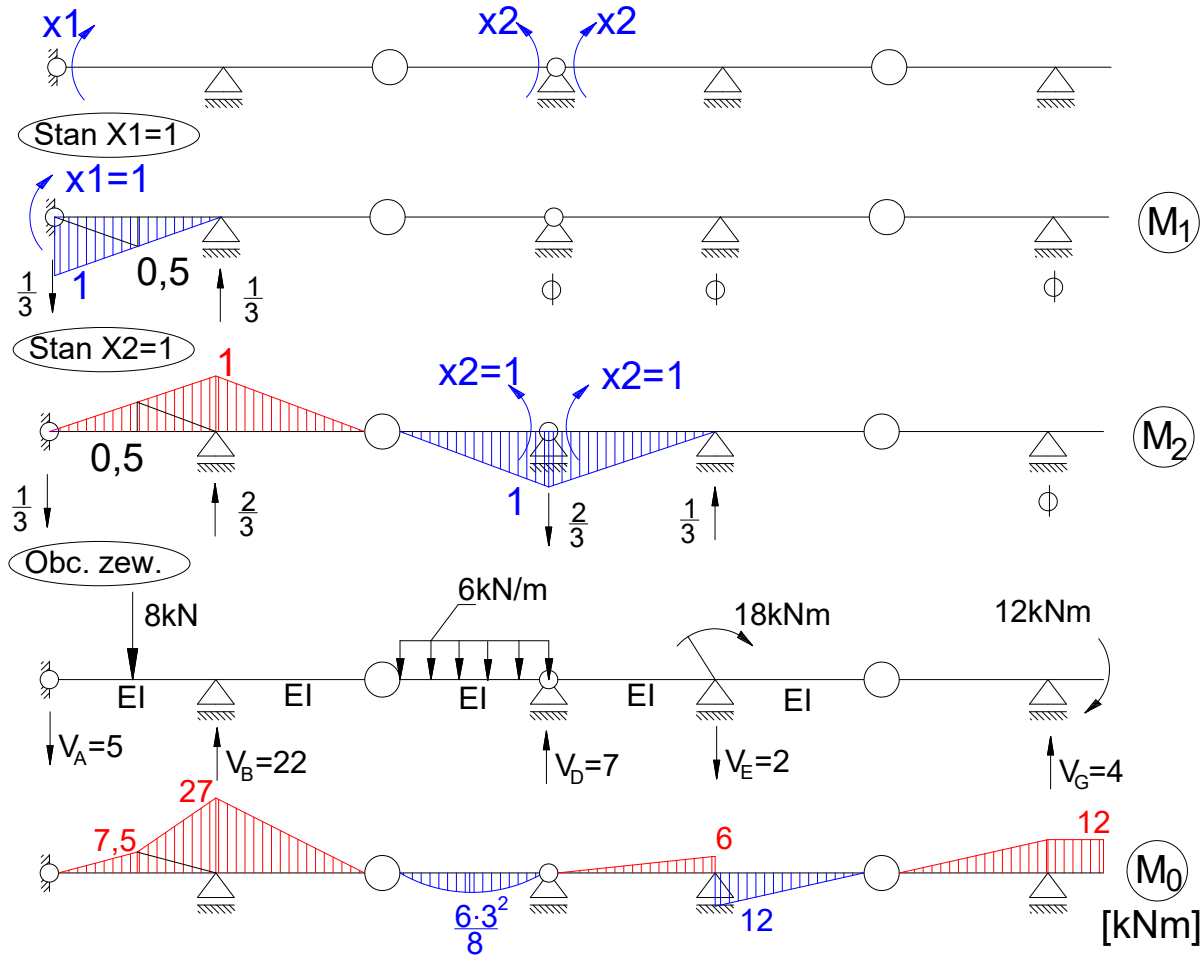
$$\delta_{10} =$$

Schemat podstawowy:

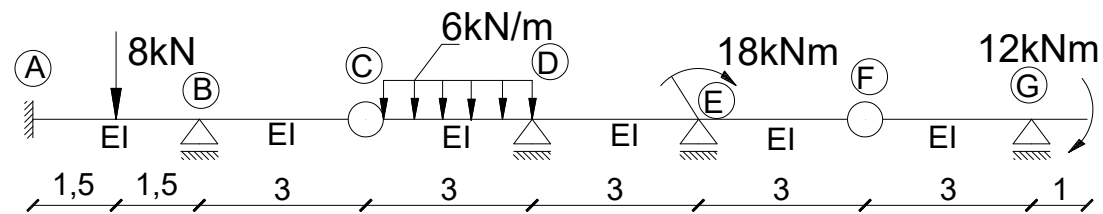




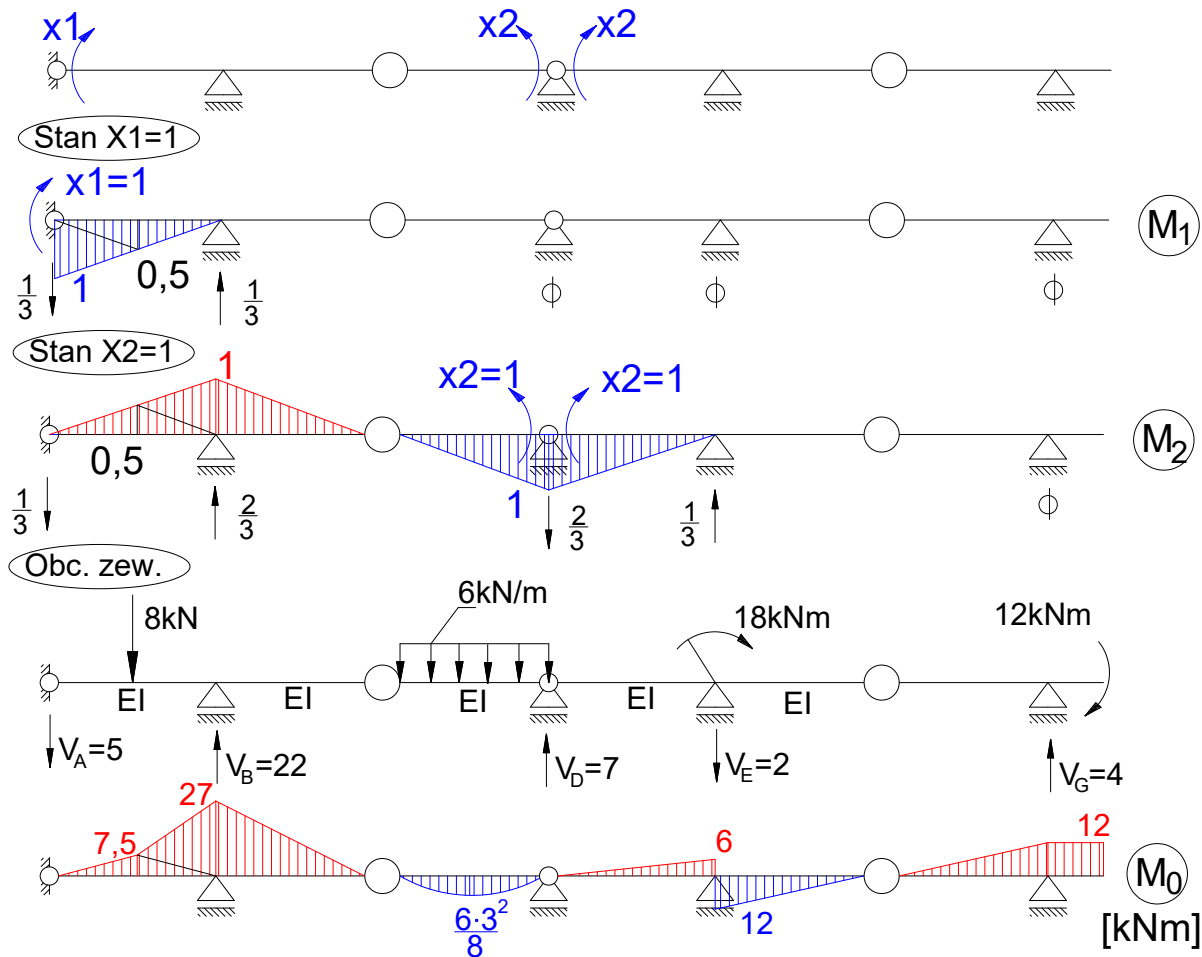
Schemat podstawowy:



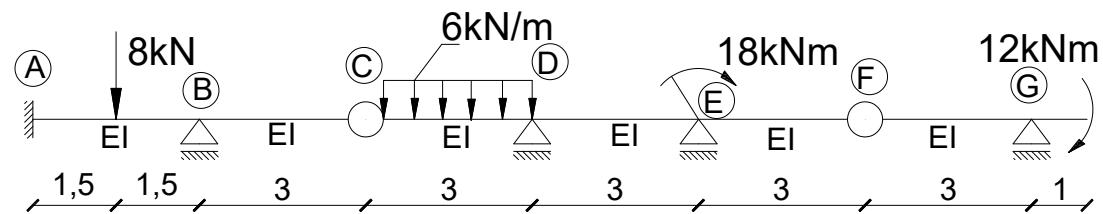
$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right)$$



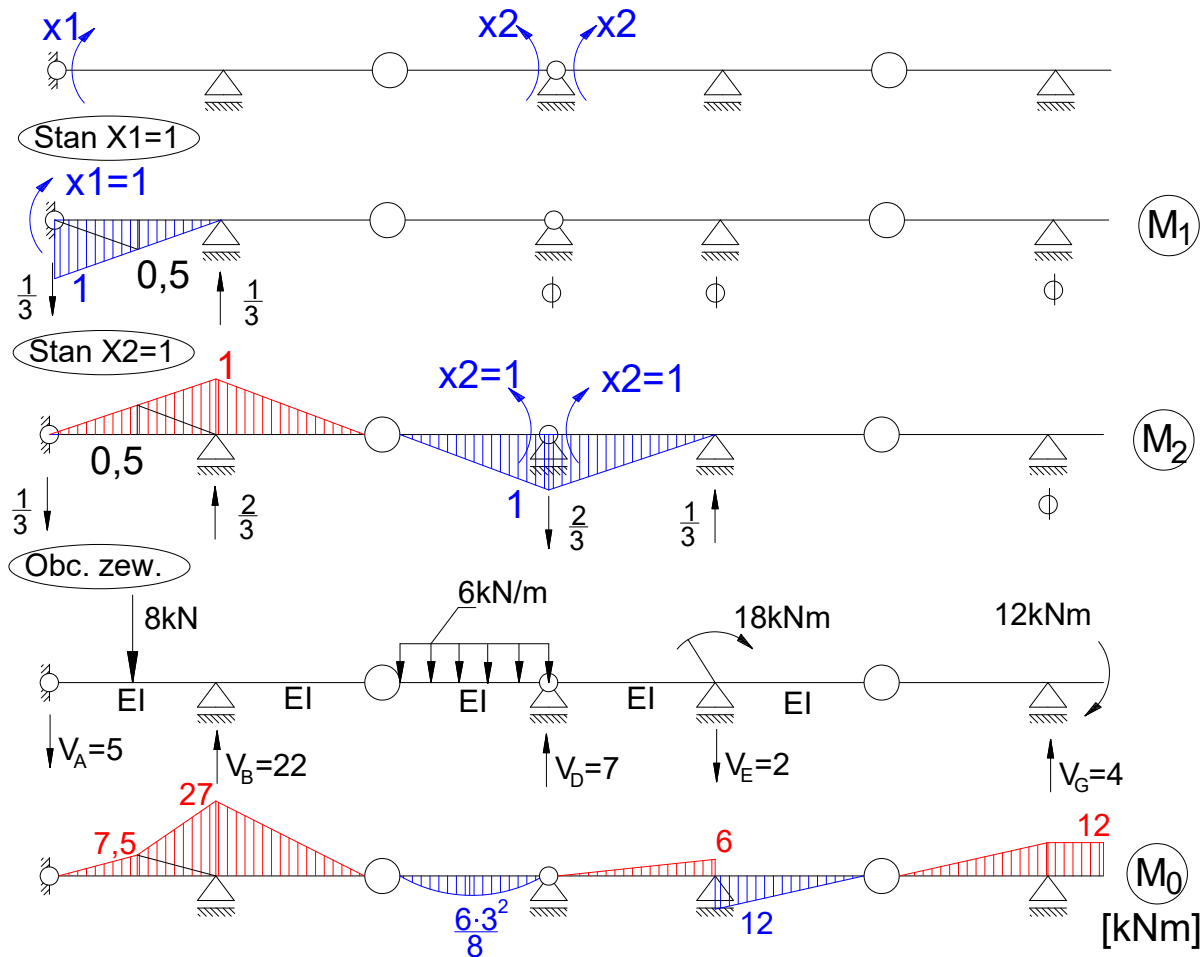
Schemat podstawowy:



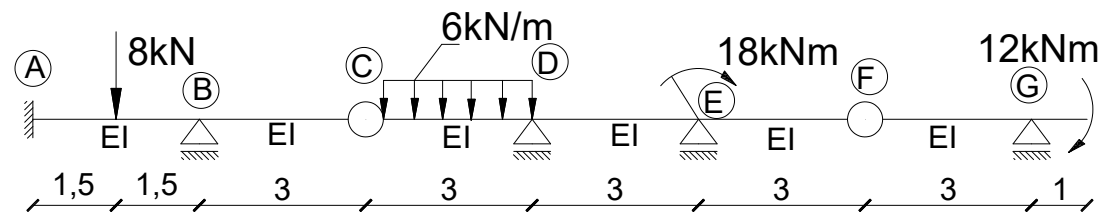
$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right)$$



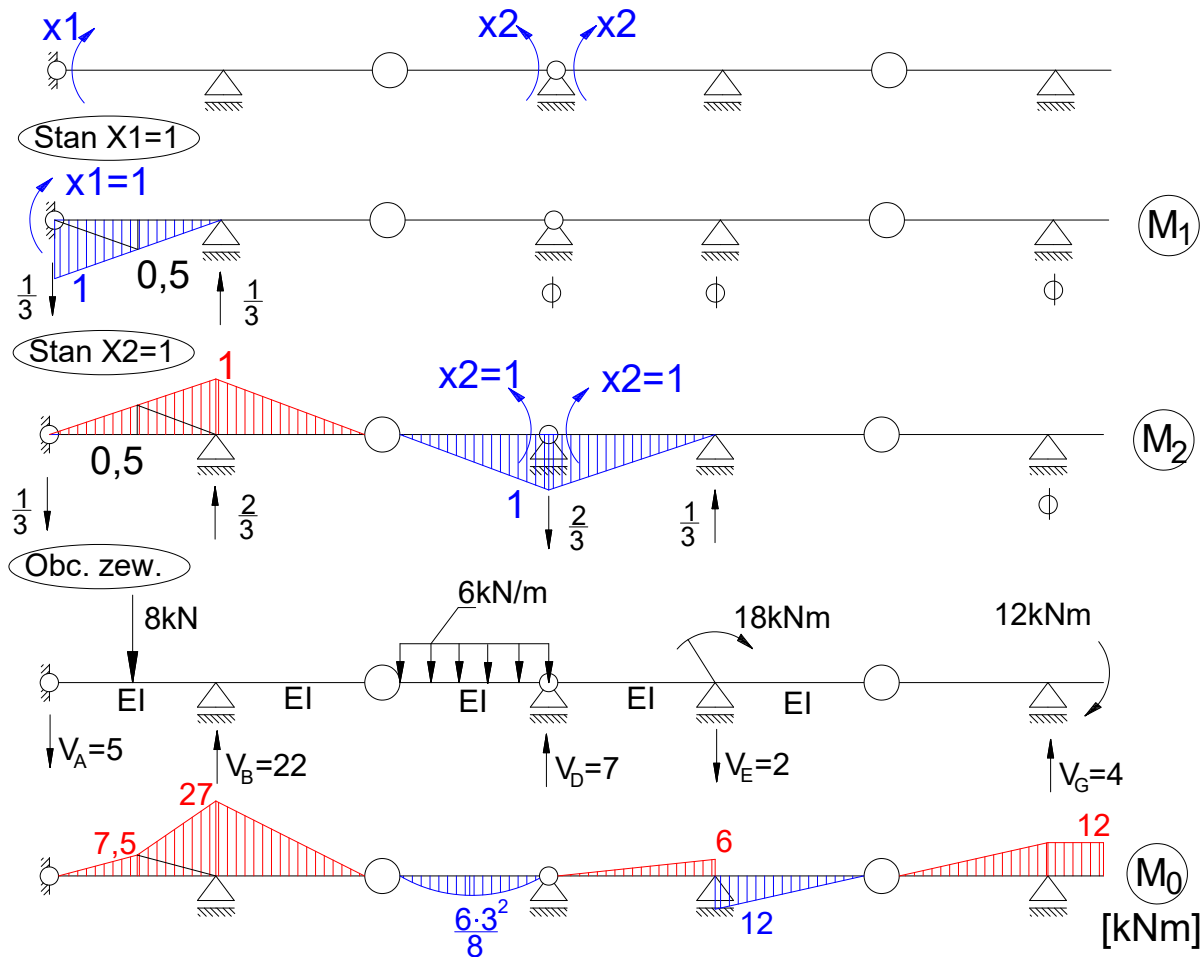
Schemat podstawowy:



$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

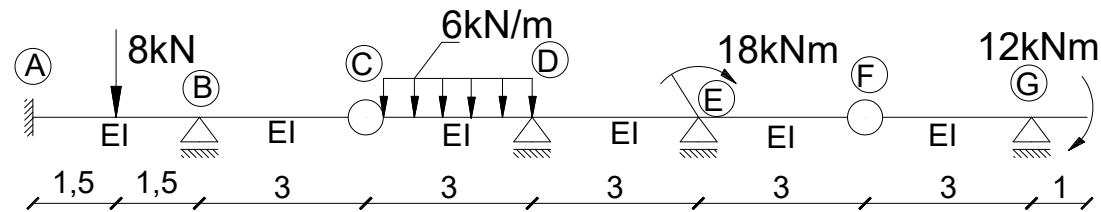


Schemat podstawowy:

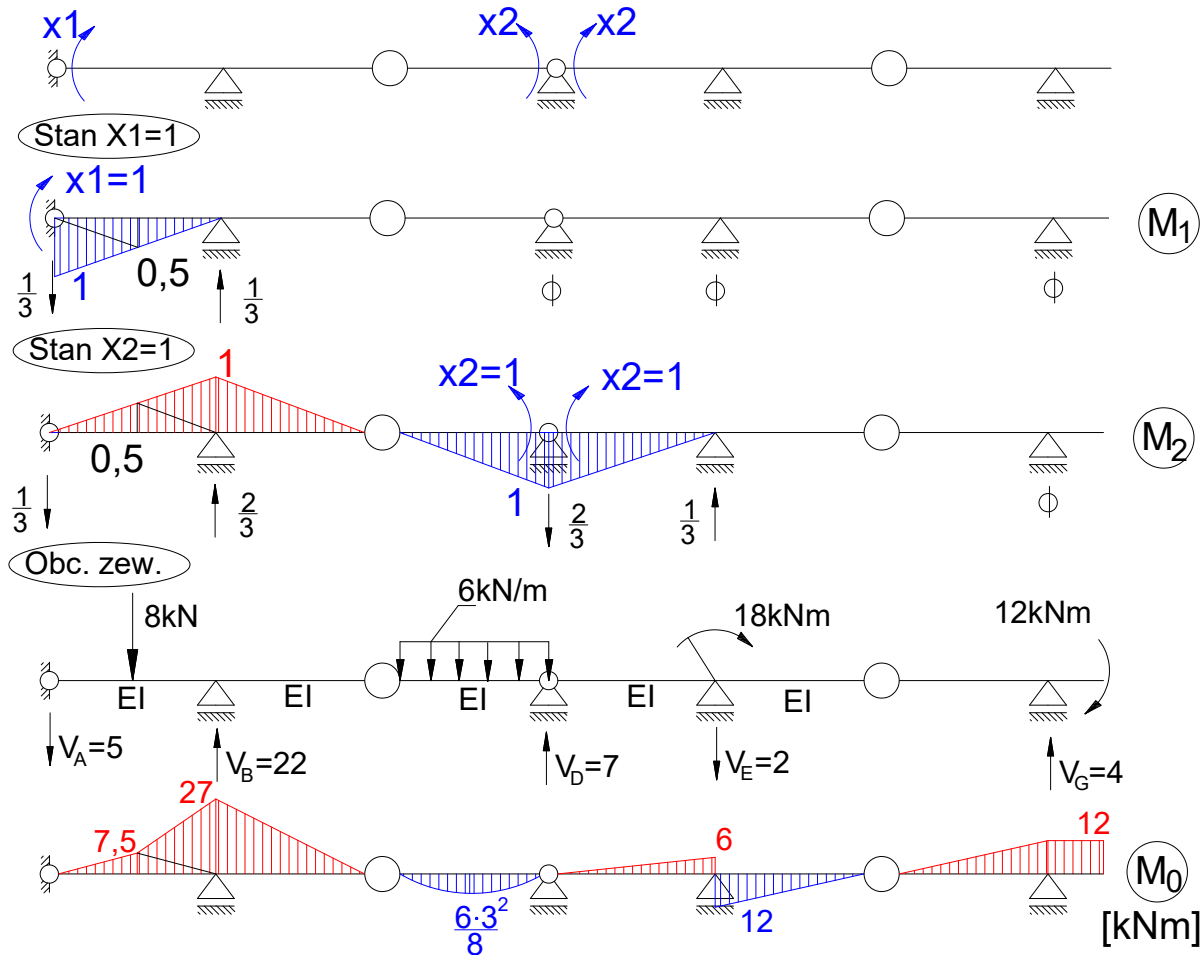


$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\delta_{20} =$$

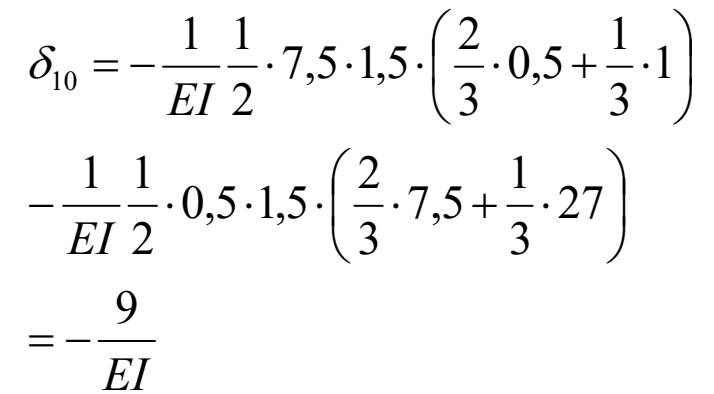


Schemat podstawowy:



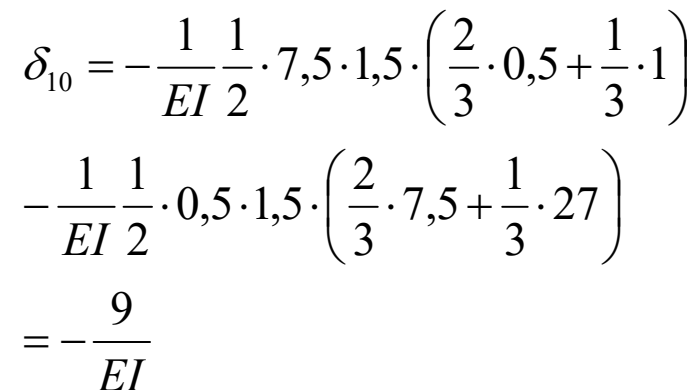
$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\delta_{20} = \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5$$

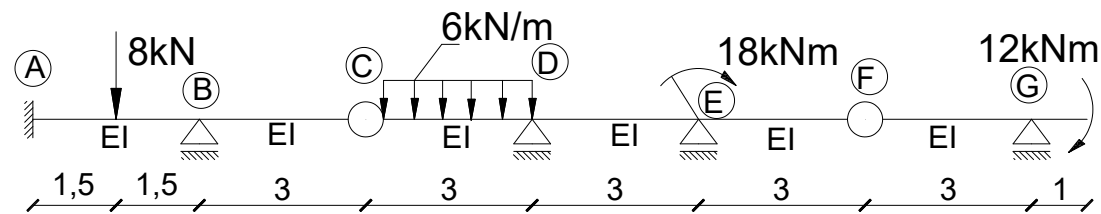


$$\delta_{20} = \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5$$

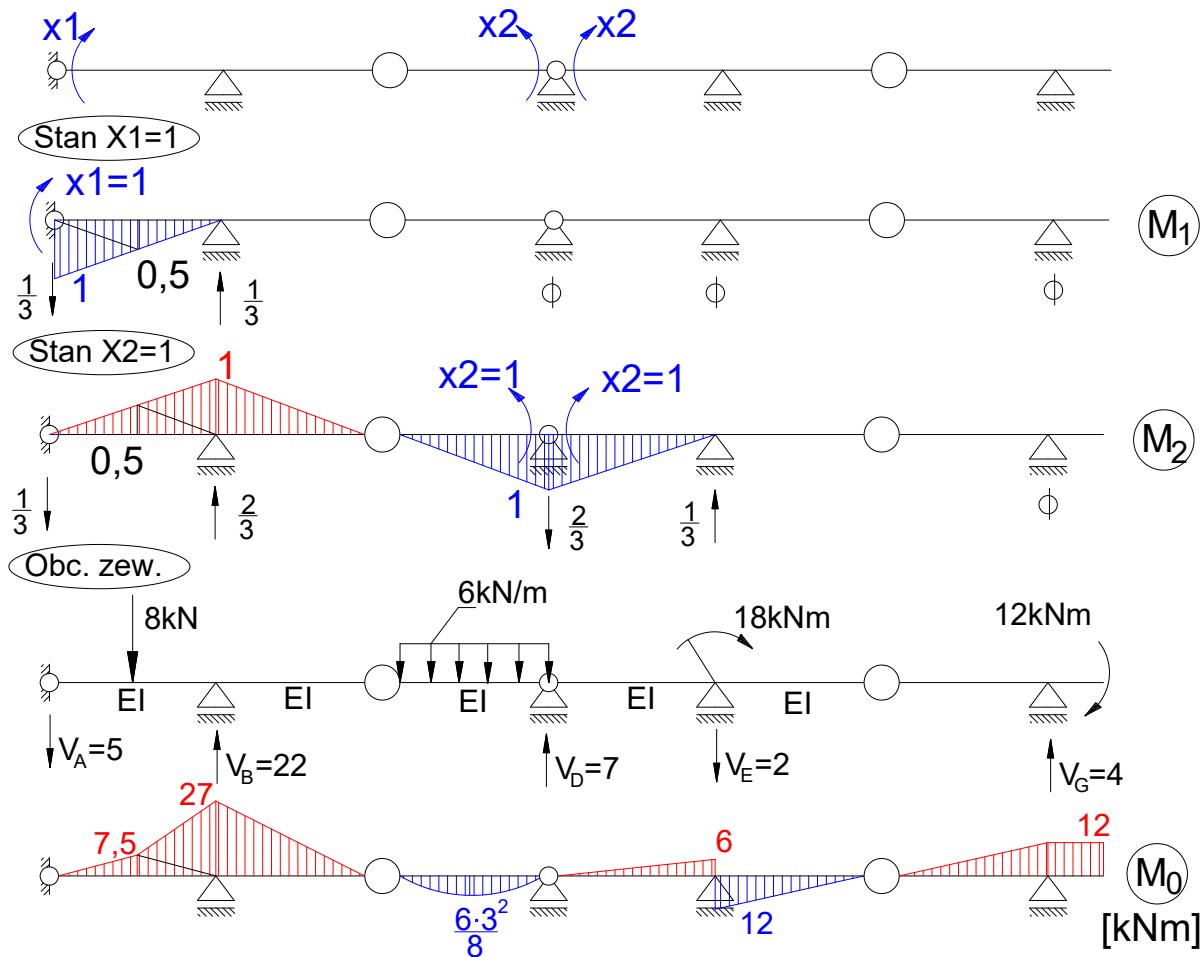
$$+ \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right)$$



$$\begin{aligned}\delta_{20} &= \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5 \\ &+ \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) \\ &+ \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 1 + \frac{1}{3} \cdot 0,5 \right)\end{aligned}$$

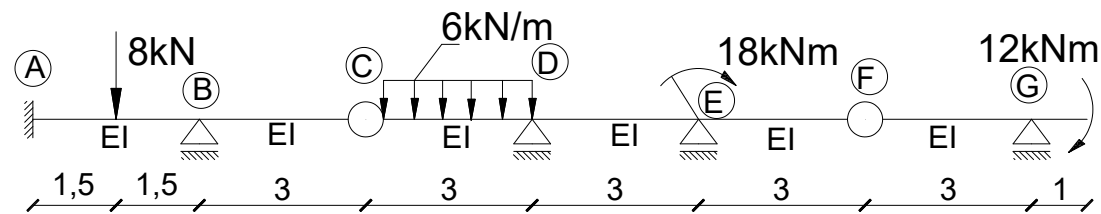


Schemat podstawowy:

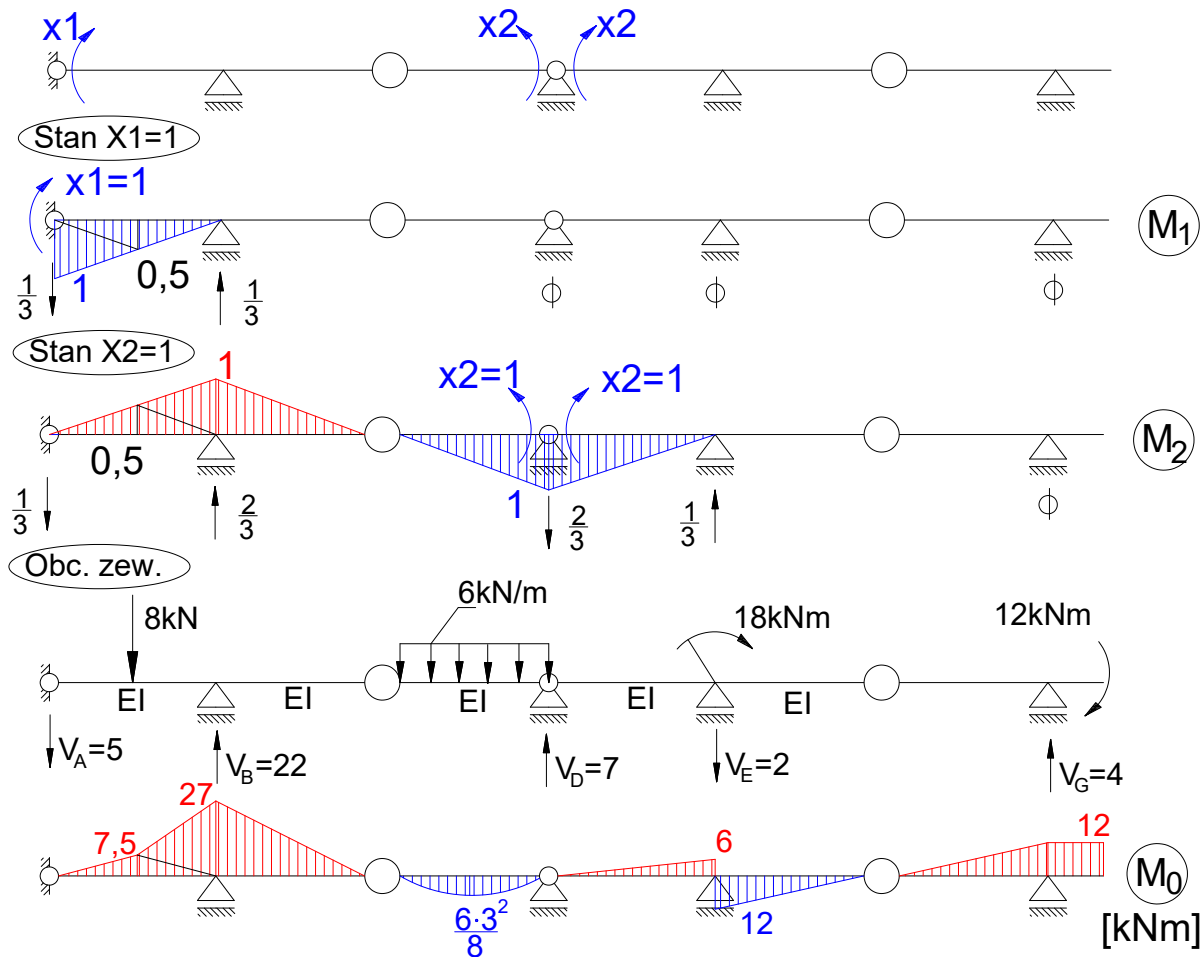


$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\delta_{20} = \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5 + \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 1 + \frac{1}{3} \cdot 0,5 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 3 \cdot \frac{2}{3} \cdot 1$$

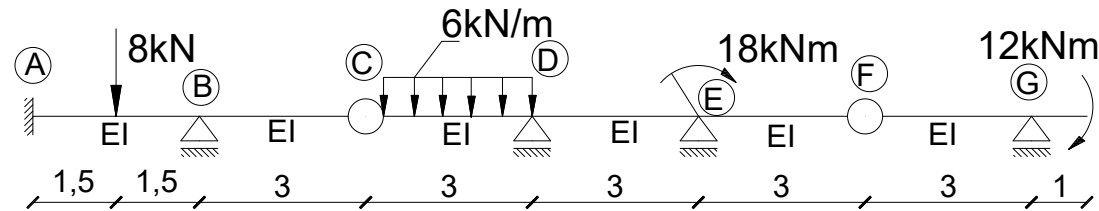


Schemat podstawowy:

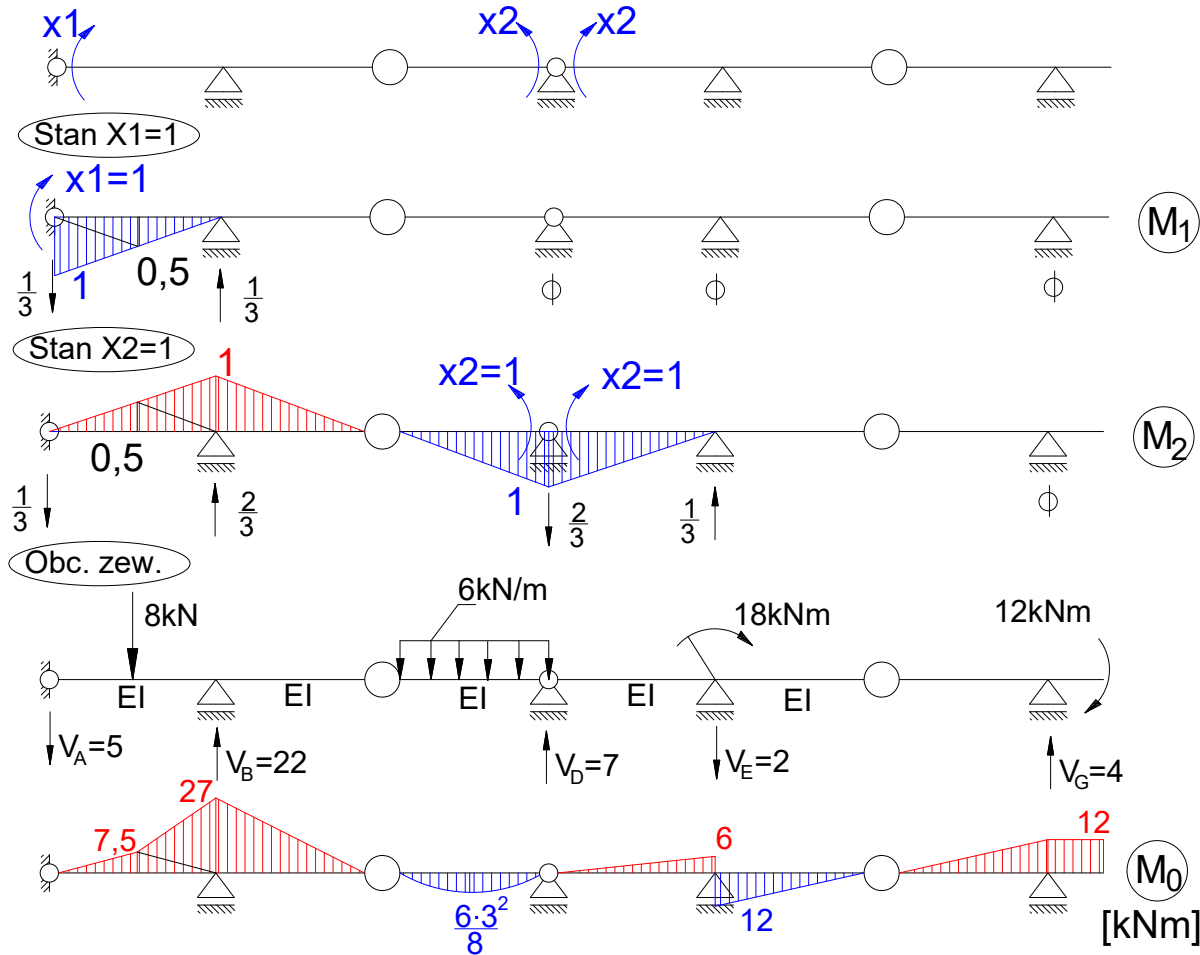


$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\delta_{20} = \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5 + \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 1 + \frac{1}{3} \cdot 0,5 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 3 \cdot \frac{2}{3} \cdot 1 + \frac{1}{EI} \frac{2}{3} \cdot \frac{6 \cdot 3^2}{8} \cdot 3 \cdot \frac{1}{2} \cdot 1$$

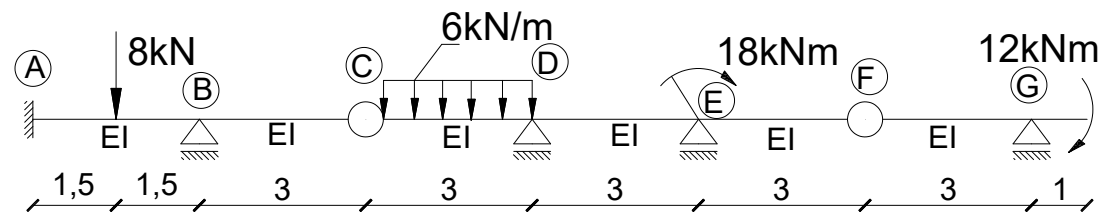


Schemat podstawowy:

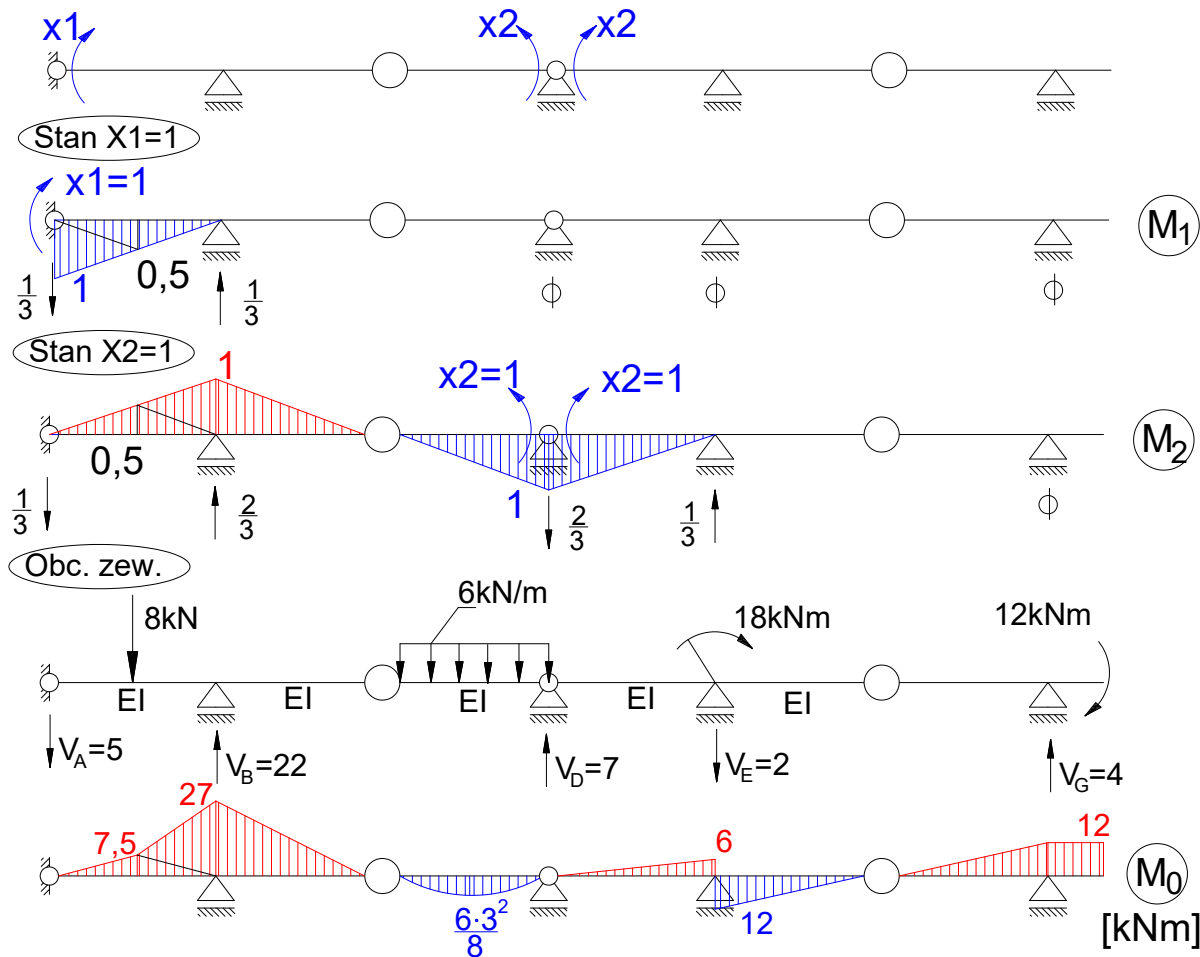


$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\delta_{20} = \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5 + \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 1 + \frac{1}{3} \cdot 0,5 \right) + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 3 \cdot \frac{2}{3} \cdot 1 + \frac{1}{EI} \frac{2}{3} \cdot \frac{6 \cdot 3^2}{8} \cdot 3 \cdot \frac{1}{2} \cdot 1 - \frac{1}{EI} \frac{1}{2} \cdot 6 \cdot 3 \cdot \frac{1}{3} \cdot 1$$



Schemat podstawowy:



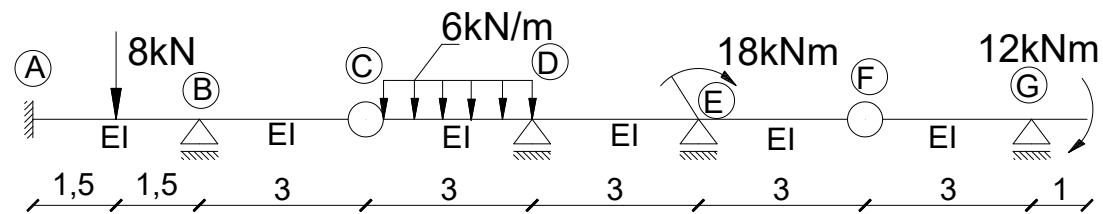
$$\delta_{10} = -\frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) - \frac{1}{EI} \frac{1}{2} \cdot 0,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 7,5 + \frac{1}{3} \cdot 27 \right) = -\frac{9}{EI}$$

$$\begin{aligned} \delta_{20} = & \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \frac{2}{3} \cdot 0,5 \\ & + \frac{1}{EI} \frac{1}{2} \cdot 7,5 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 0,5 + \frac{1}{3} \cdot 1 \right) \\ & + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 1,5 \cdot \left(\frac{2}{3} \cdot 1 + \frac{1}{3} \cdot 0,5 \right) \\ & + \frac{1}{EI} \frac{1}{2} \cdot 27 \cdot 3 \cdot \frac{2}{3} \cdot 1 \\ & + \frac{1}{EI} \frac{2}{3} \cdot \frac{6 \cdot 3^2}{8} \cdot 3 \cdot \frac{1}{2} \cdot 1 \\ & - \frac{1}{EI} \frac{1}{2} \cdot 6 \cdot 3 \cdot \frac{1}{3} \cdot 1 = \frac{53,25}{EI} \end{aligned}$$

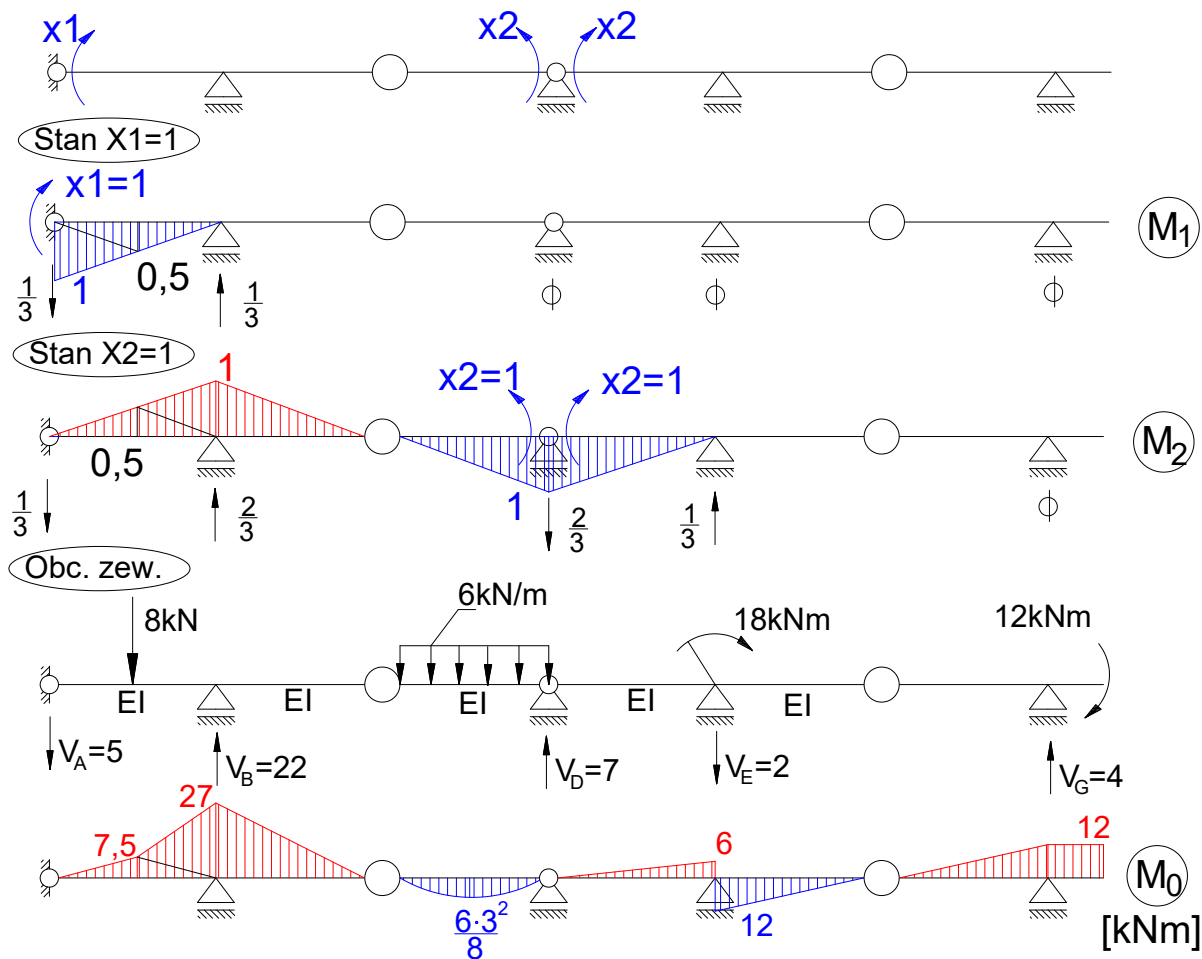


$$\delta_{11} \cdot X1 + \delta_{12} \cdot X2 + \delta_{10} = 0$$

$$\delta_{21} \cdot X1 + \delta_{22} \cdot X2 + \delta_{20} = 0$$



Schemat podstawowy:

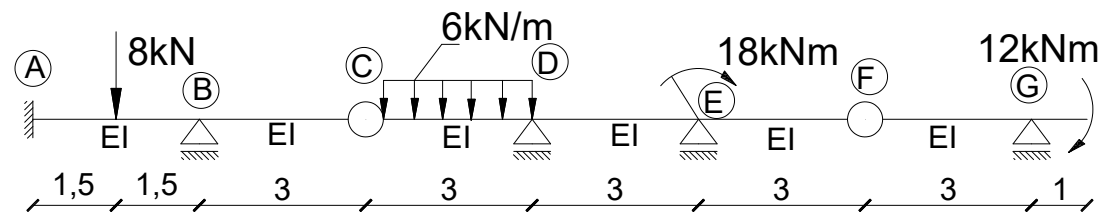


Układ równań metody sił:

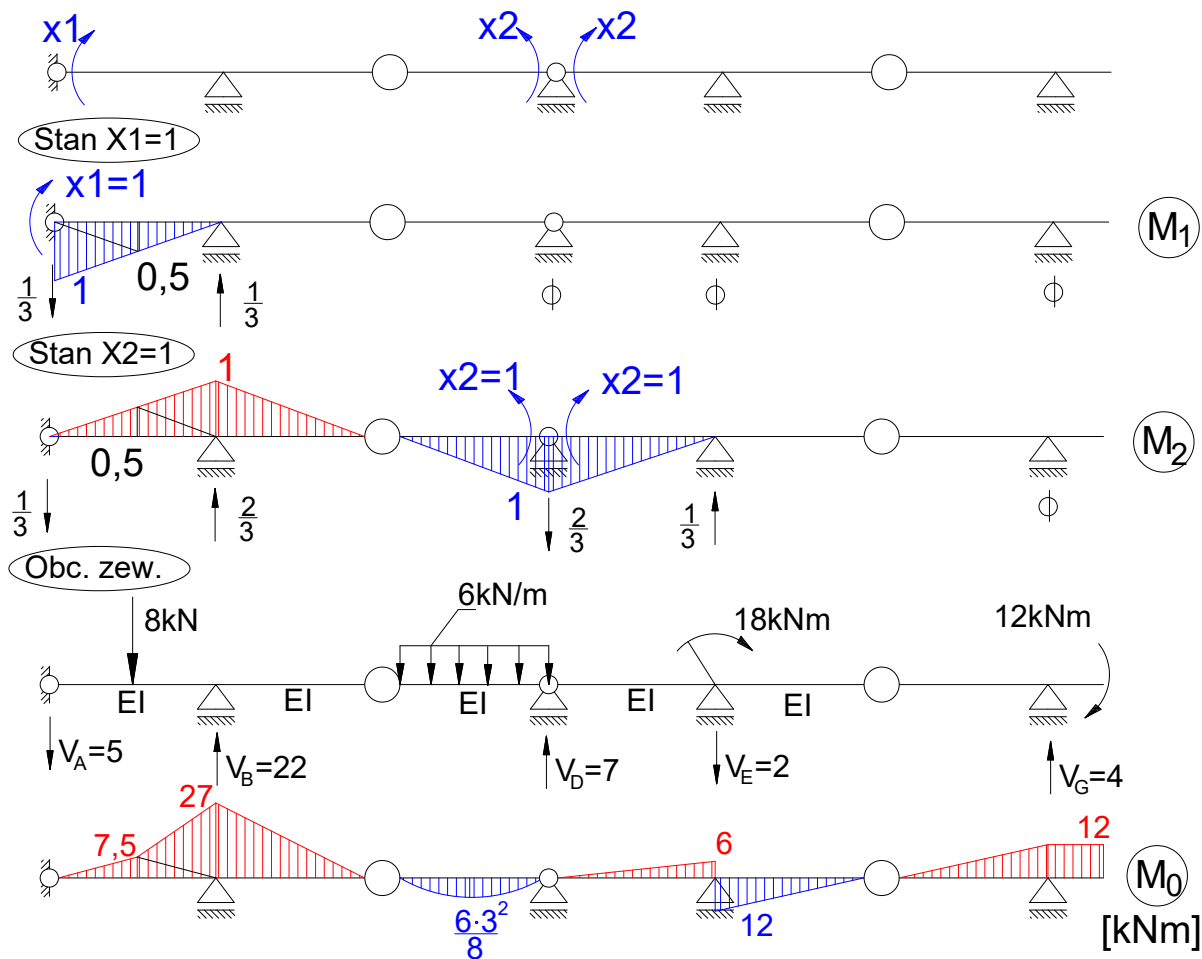
$$\delta_{11} \cdot X_1 + \delta_{12} \cdot X_2 + \delta_{10} = 0$$

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

$$\begin{aligned} (M_1) \quad & \frac{1}{EI} \cdot X_1 - \frac{1}{2EI} \cdot X_2 - \frac{9}{EI} = 0 \\ & -\frac{1}{2EI} \cdot X_1 + \frac{4}{EI} \cdot X_2 + \frac{53,25}{EI} = 0 \end{aligned}$$



Schemat podstawowy:



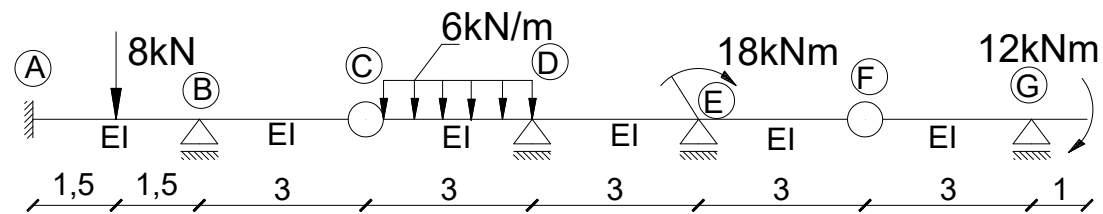
Układ równań metody sił:

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

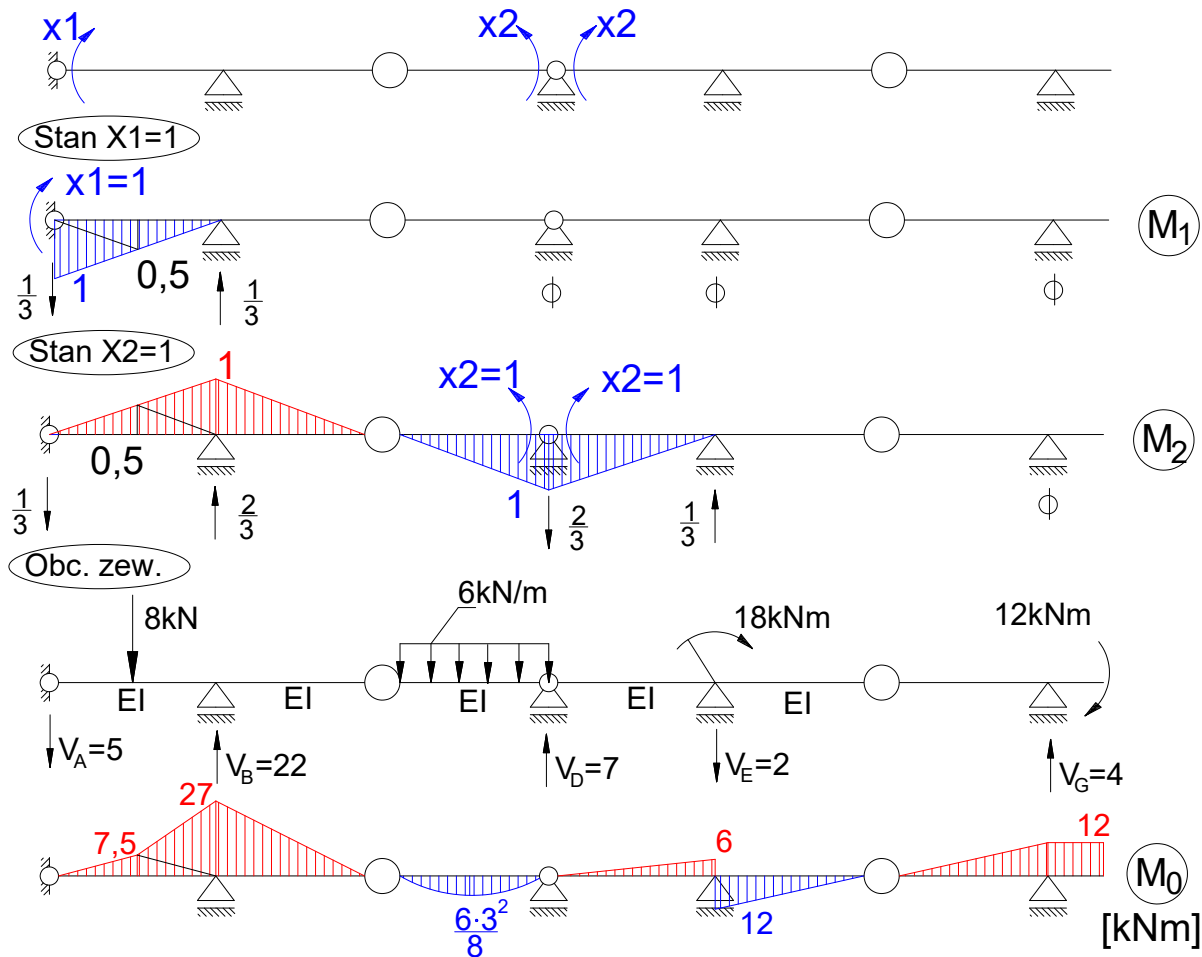
$$\delta_{21} \cdot X_1 + \delta_{22} \cdot X_2 + \delta_{20} = 0$$

$$\begin{aligned} (M_1) \quad & \frac{1}{EI} \cdot X_1 - \frac{1}{2EI} \cdot X_2 - \frac{9}{EI} = 0 \\ & -\frac{1}{2EI} \cdot X_1 + \frac{4}{EI} \cdot X_2 + \frac{53,25}{EI} = 0 \end{aligned}$$





Schemat podstawowy:



Układ równań metody sił:

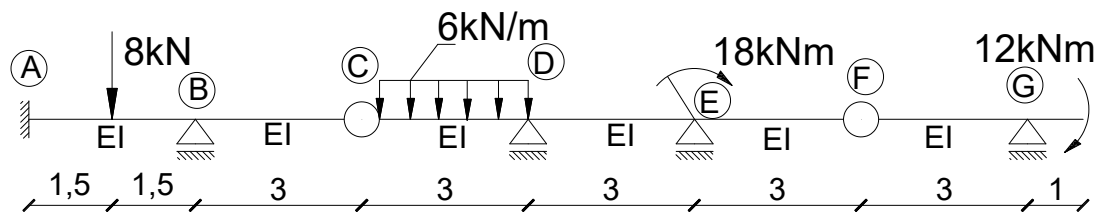
$$\delta_{11} \cdot X1 + \delta_{12} \cdot X2 + \delta_{10} = 0$$

$$\delta_{21} \cdot X1 + \delta_{22} \cdot X2 + \delta_{20} = 0$$

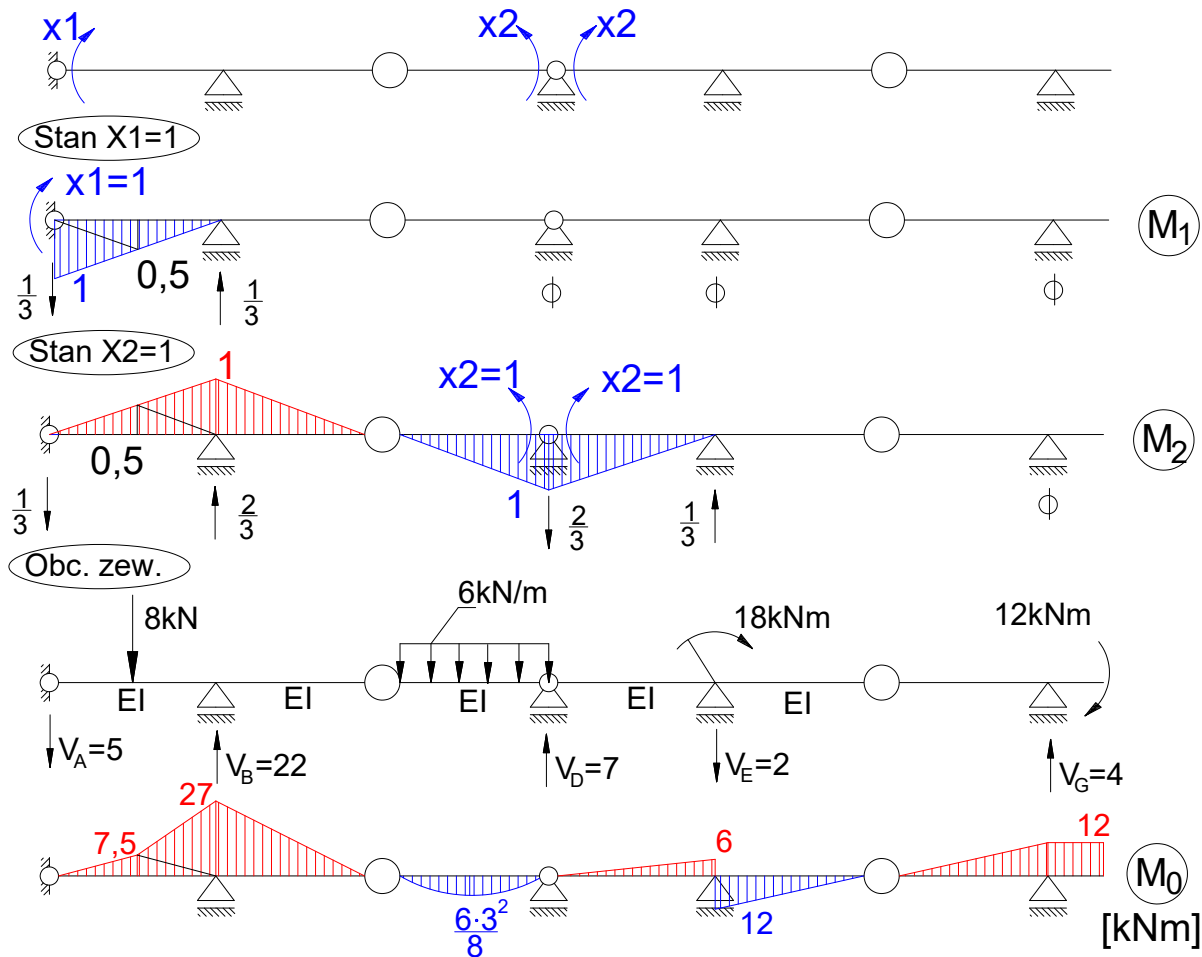
$$\begin{aligned} (M_1) \quad & \frac{1}{EI} \cdot X1 - \frac{1}{2EI} \cdot X2 - \frac{9}{EI} = 0 \\ & -\frac{1}{2EI} \cdot X1 + \frac{4}{EI} \cdot X2 + \frac{53,25}{EI} = 0 \end{aligned}$$

$$X1 = 2,5 \text{ kNm}$$

$$X2 = -13 \text{ kNm}$$

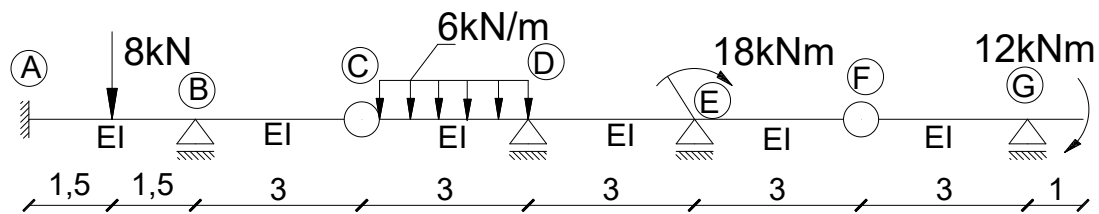


Schemat podstawowy:

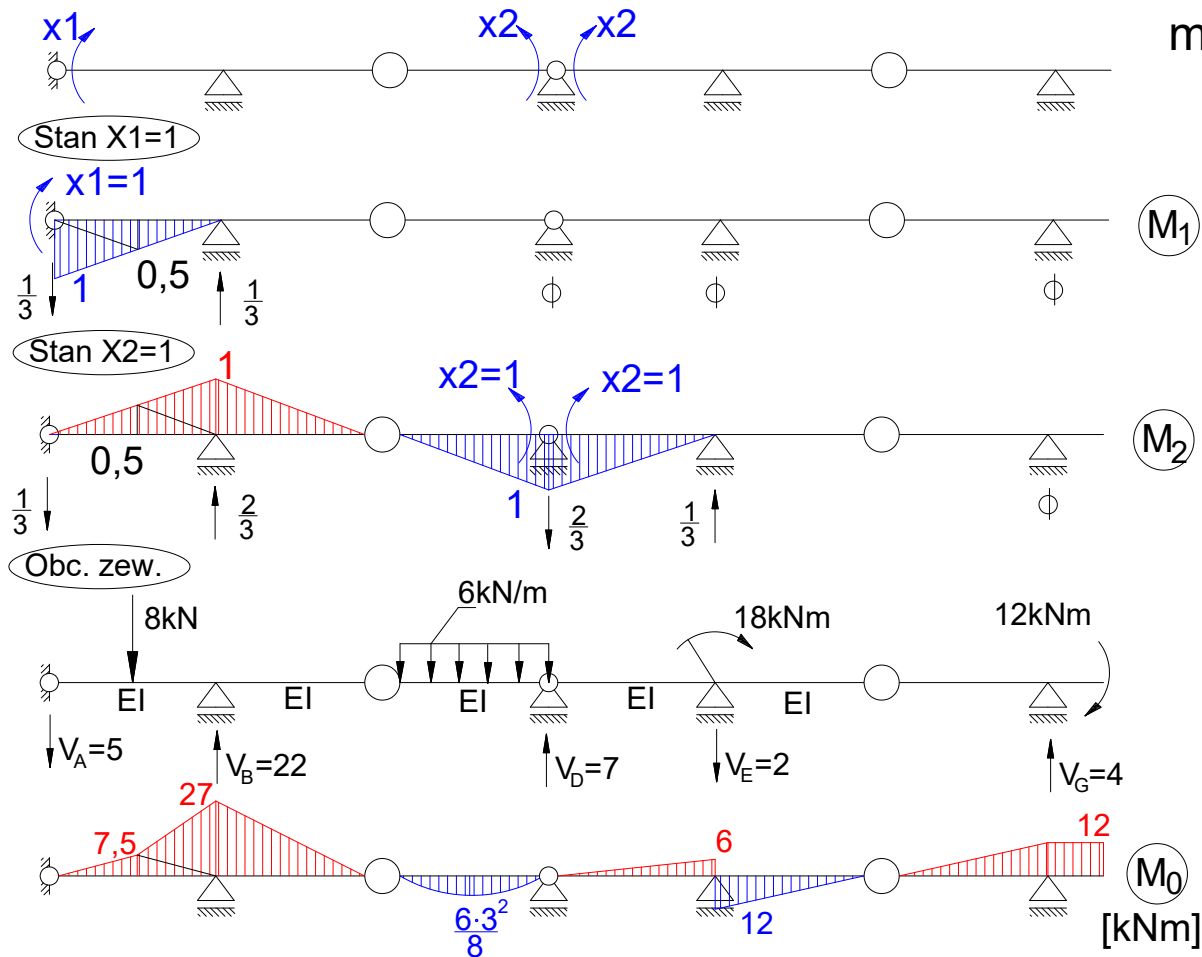


$$X_1 = 2,5 \text{ kNm}$$

$$X_2 = -13 \text{ kNm}$$



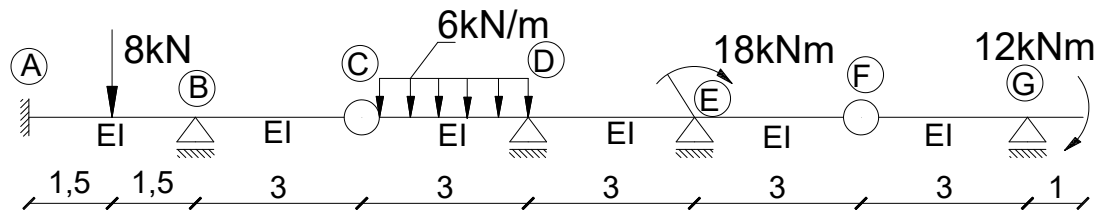
Schemat podstawowy:



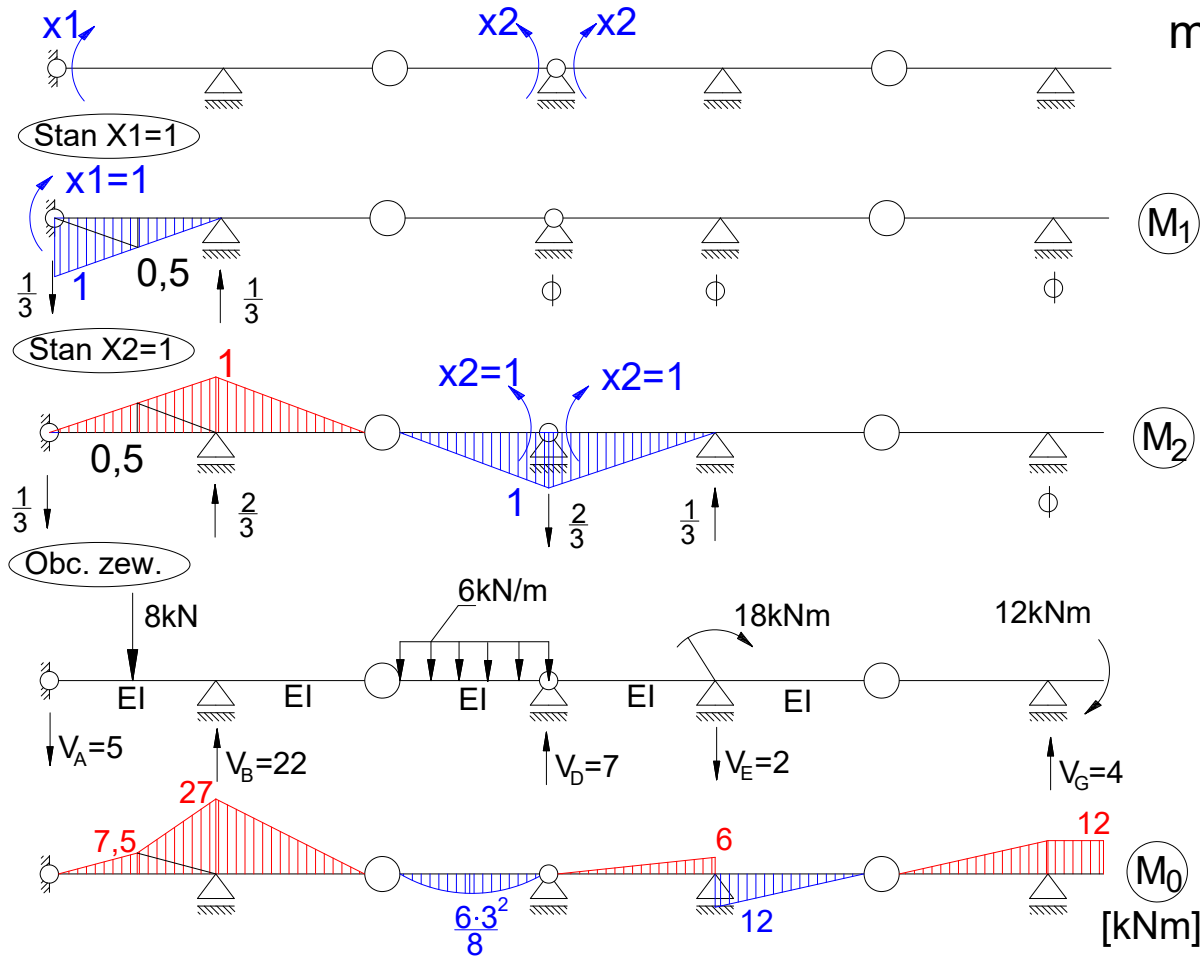
$$X_1 = 2,5 \text{ kNm}$$

$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:



Schemat podstawowy:

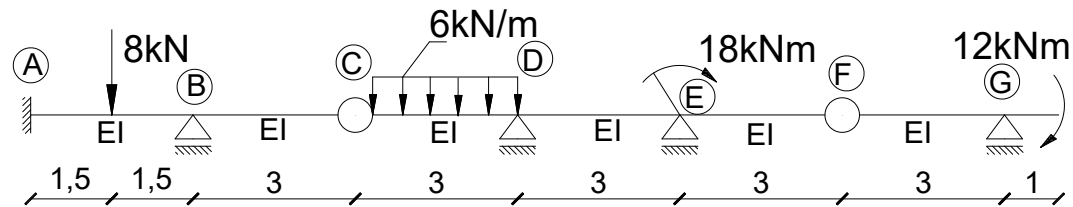


$$X_1 = 2,5 \text{ kNm}$$

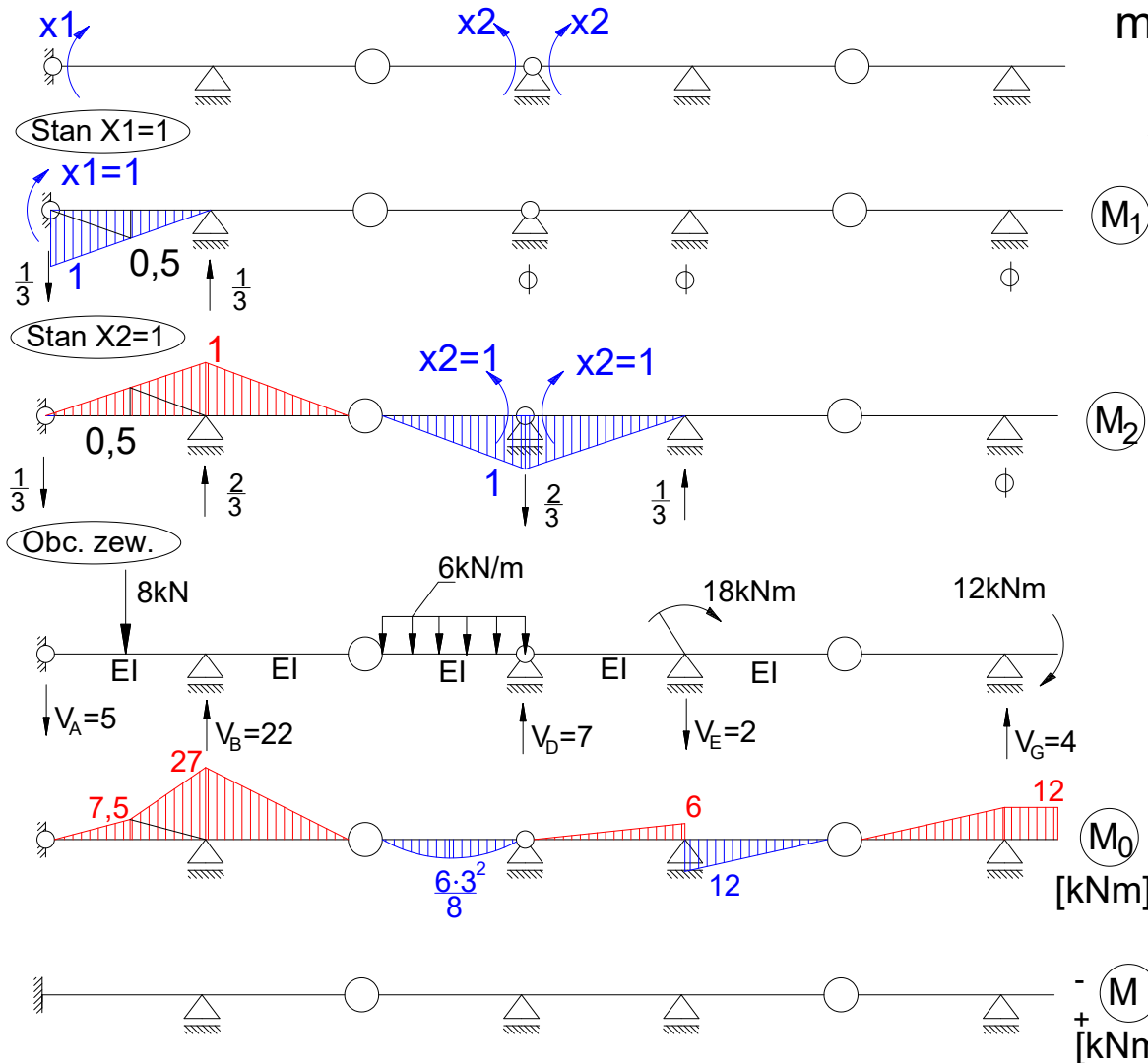
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

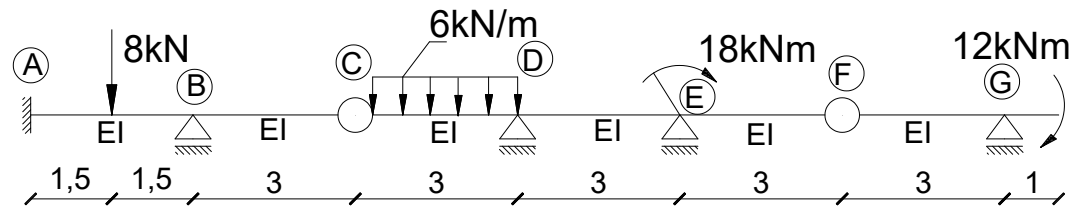


$$X_1 = 2,5 \text{ kNm}$$

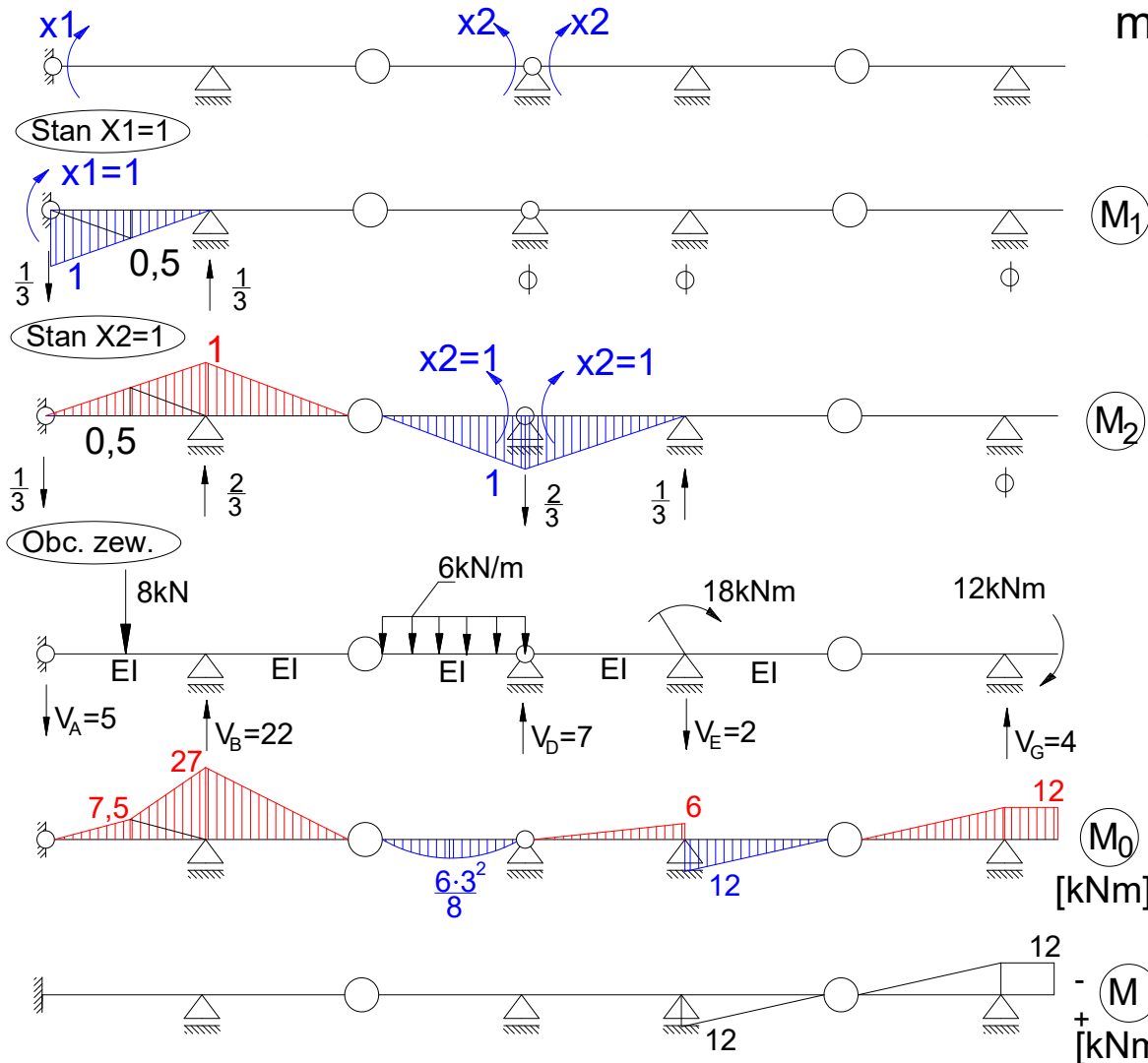
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

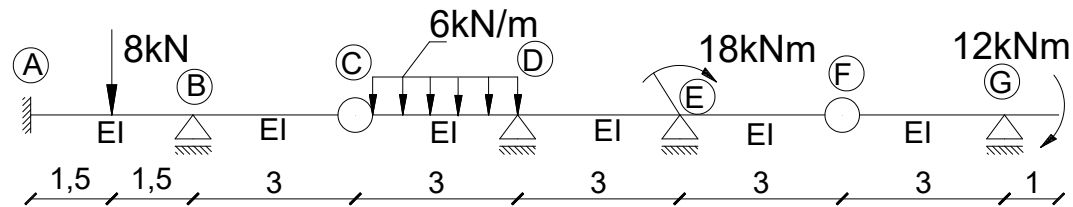


$$X_1 = 2,5 \text{ kNm}$$

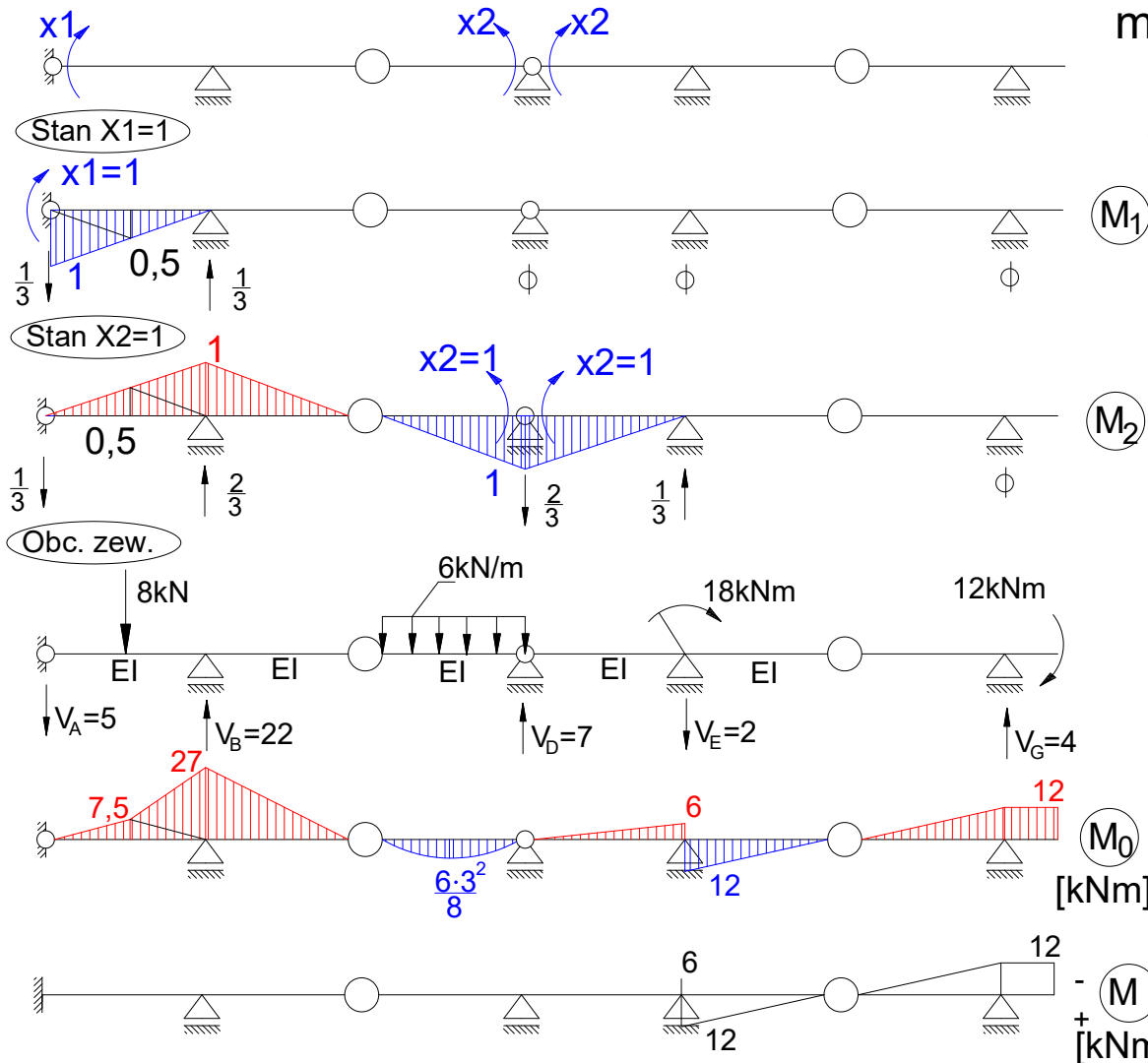
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

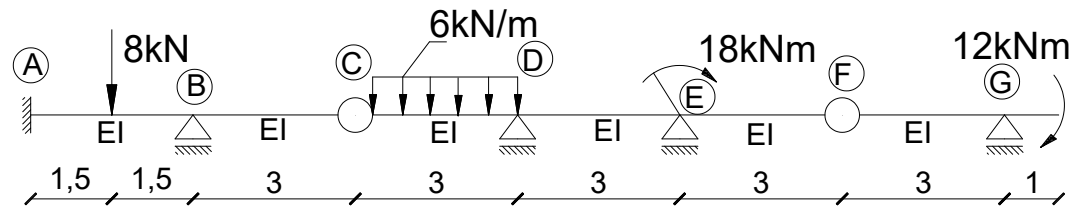


$$X1 = 2,5 \text{ kNm}$$

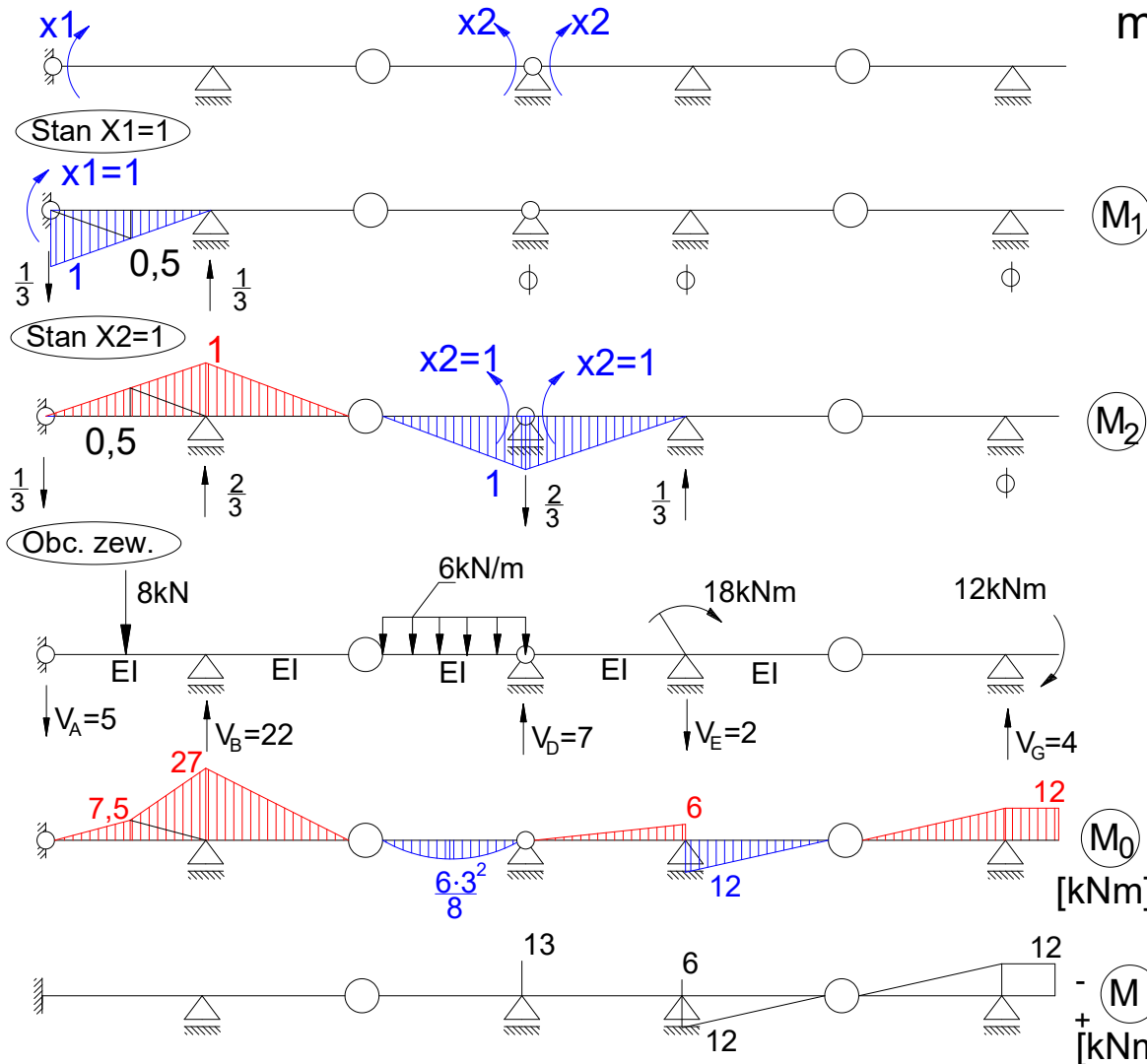
$$X2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X1 + M_{i2} \cdot X2 + M_0$$



Schemat podstawowy:

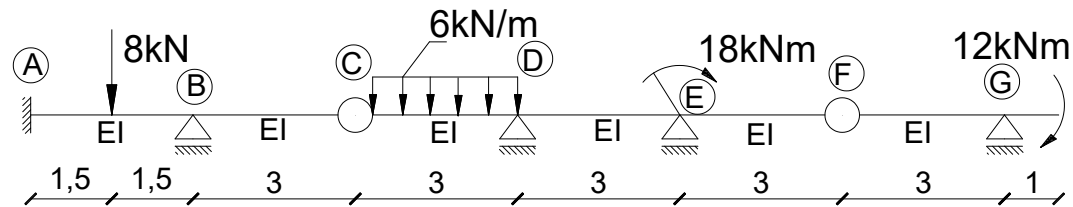


$$X_1 = 2,5 \text{ kNm}$$

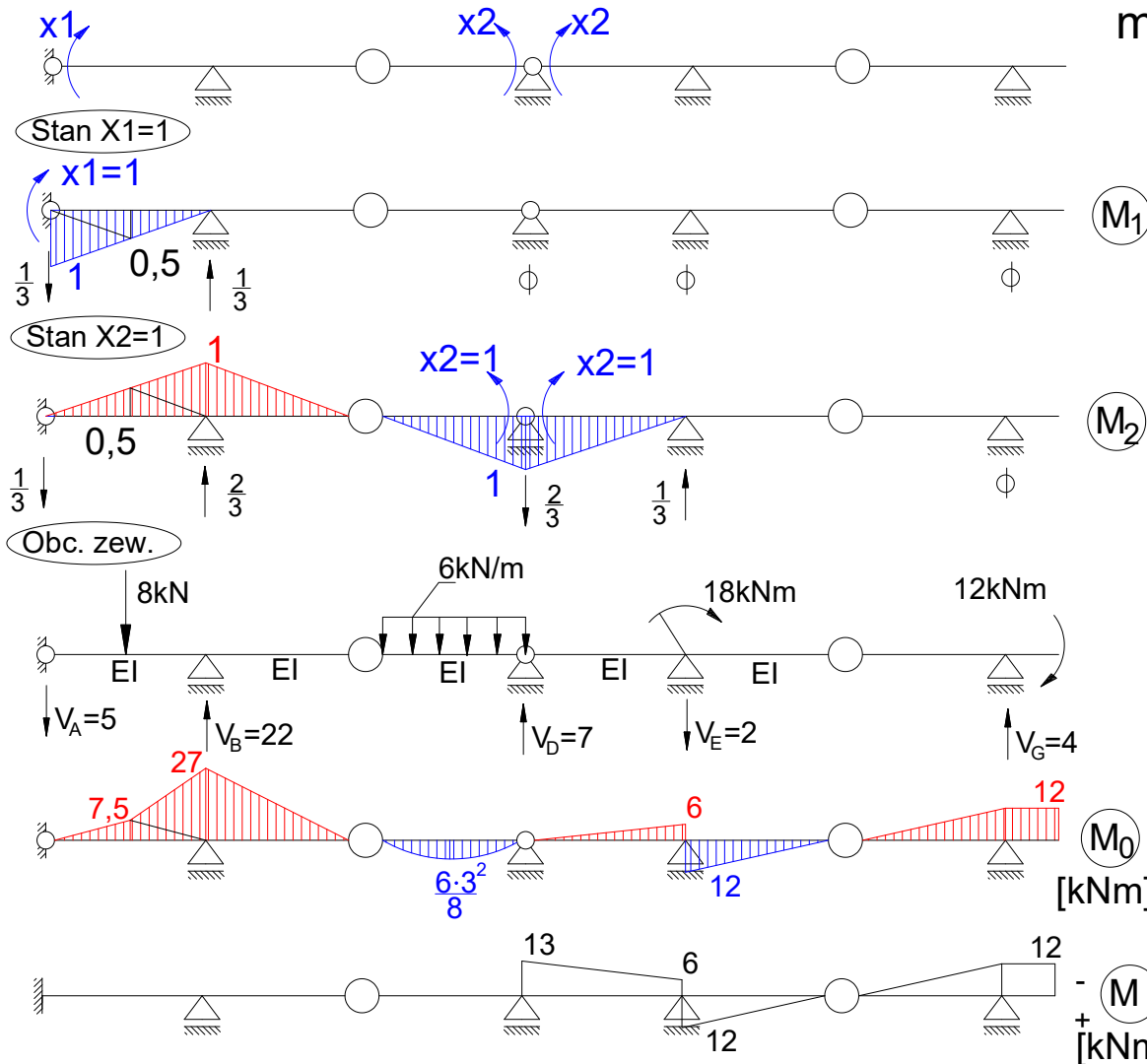
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

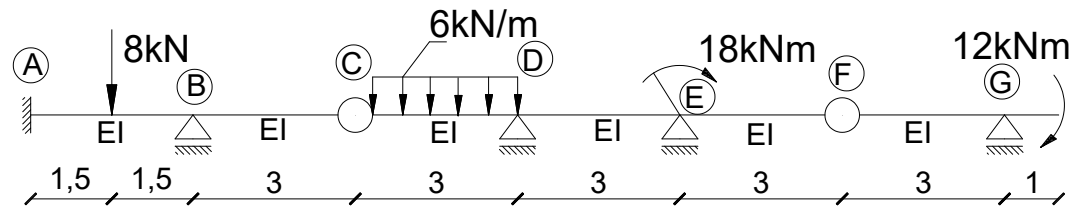


$$X_1 = 2,5 \text{ kNm}$$

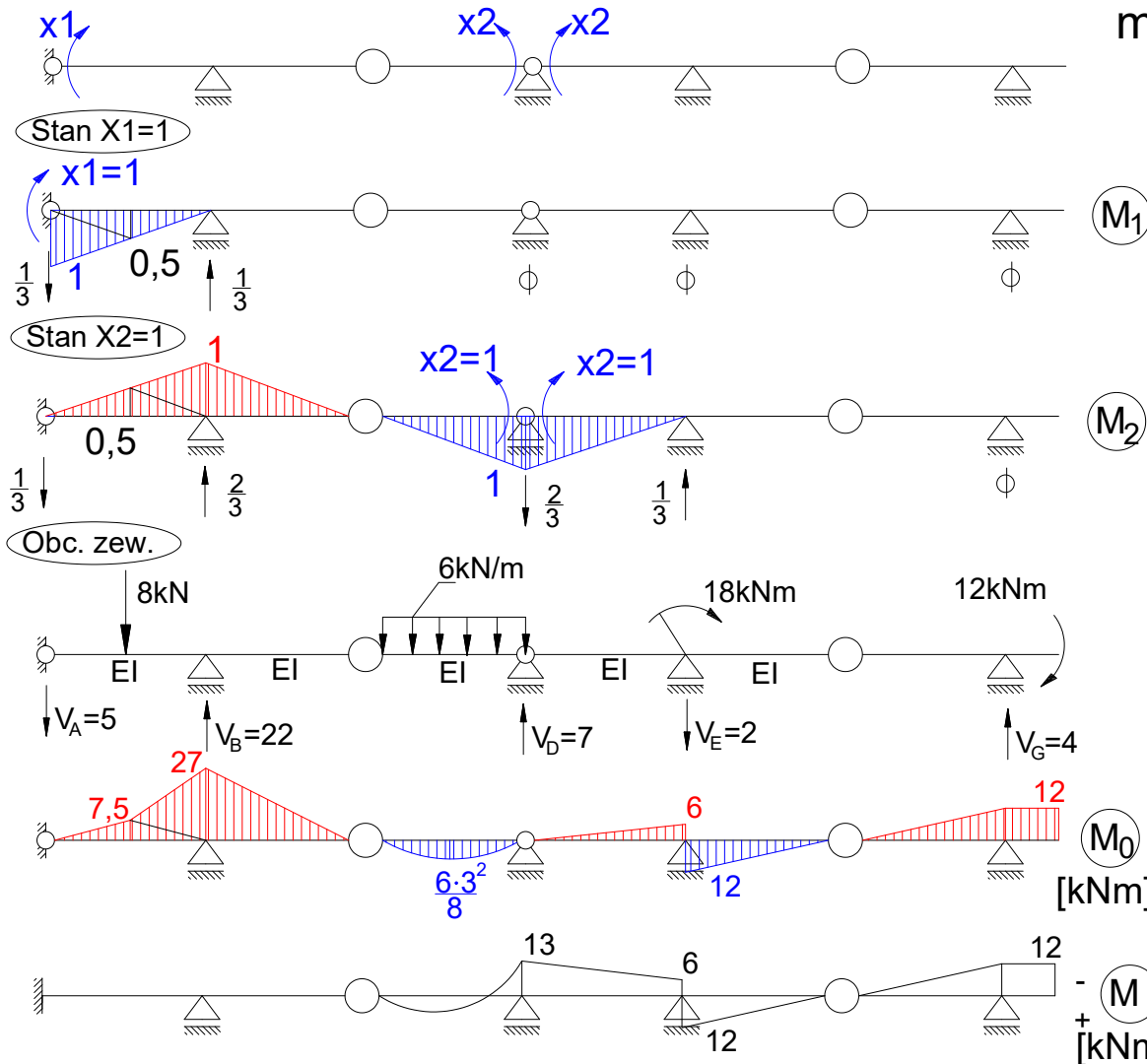
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

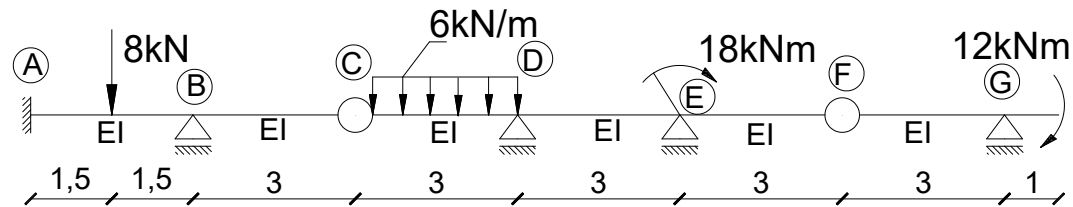


$$X_1 = 2,5 \text{ kNm}$$

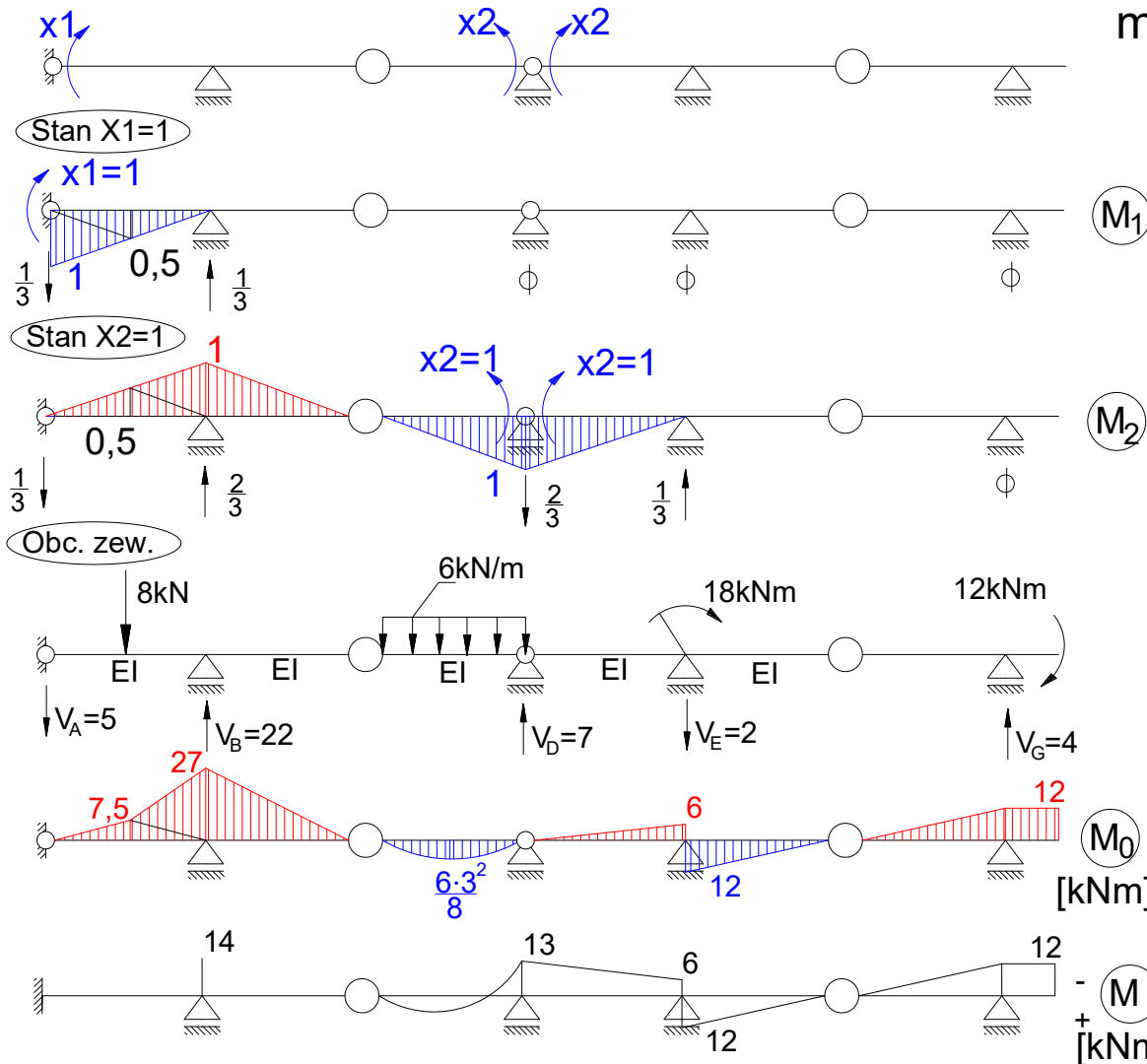
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

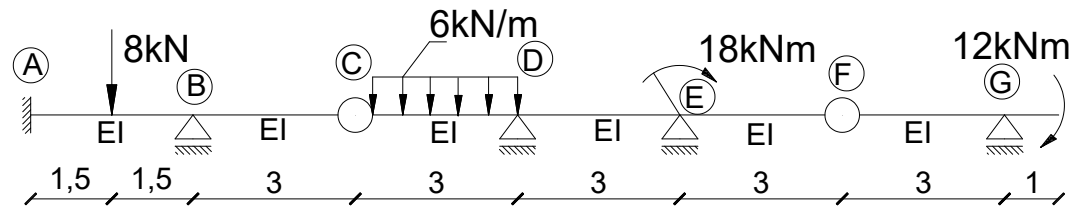


$$X_1 = 2,5 \text{ kNm}$$

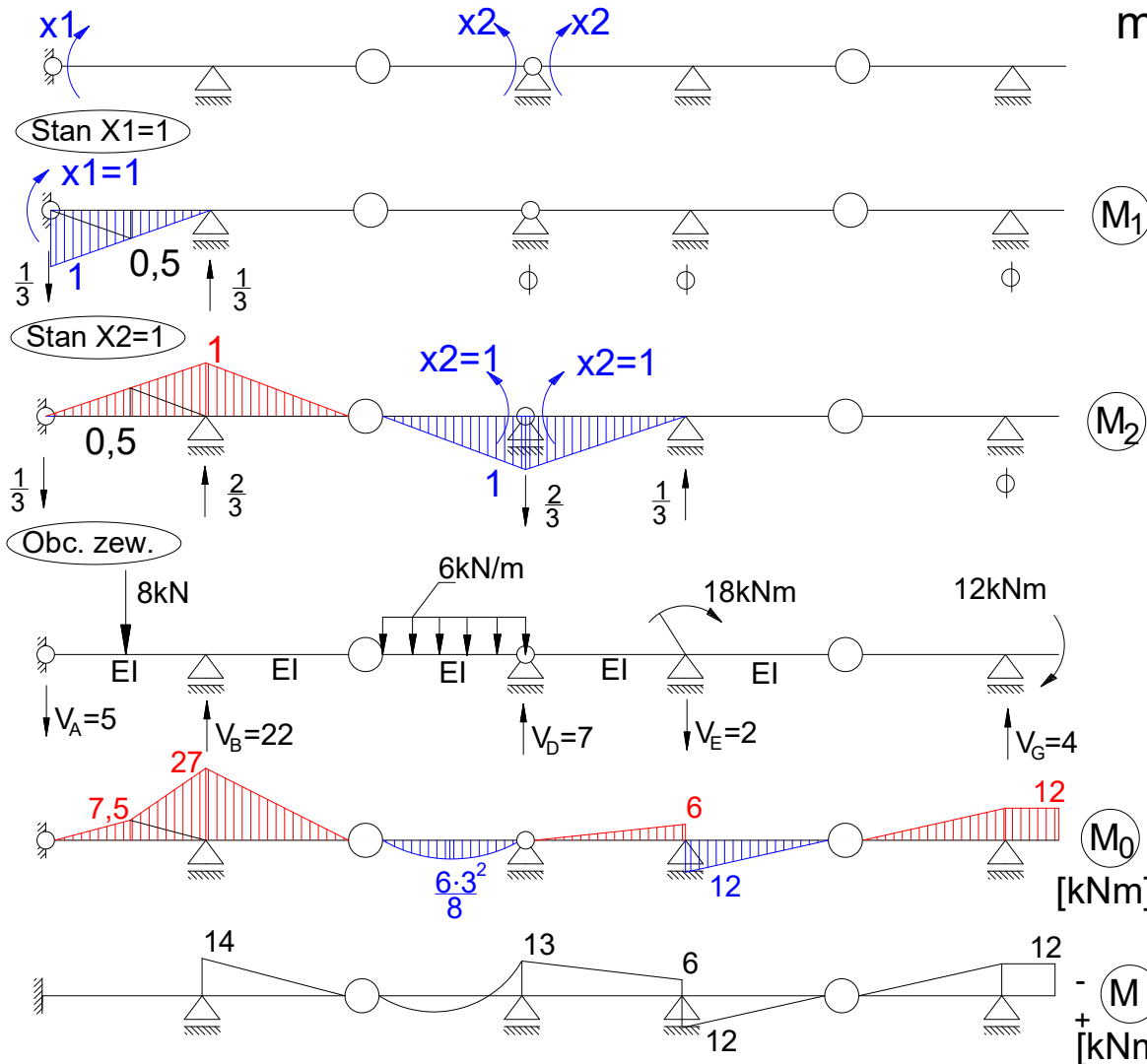
$$X_2 = -13 \text{ kNm}$$

Wyznaczenie końcowego wykresu momentów:

$$M_i = M_{i1} \cdot X_1 + M_{i2} \cdot X_2 + M_0$$



Schemat podstawowy:

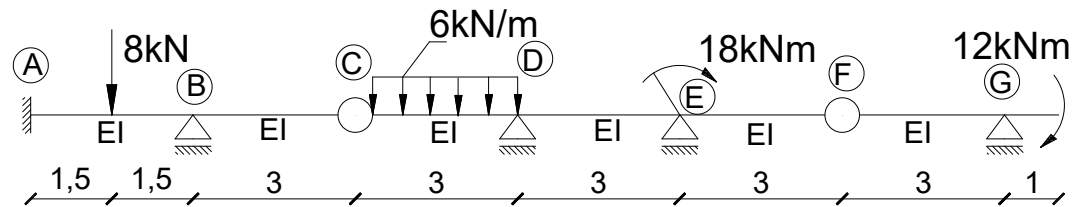


$$X_1 = 2,5 \text{ kNm}$$

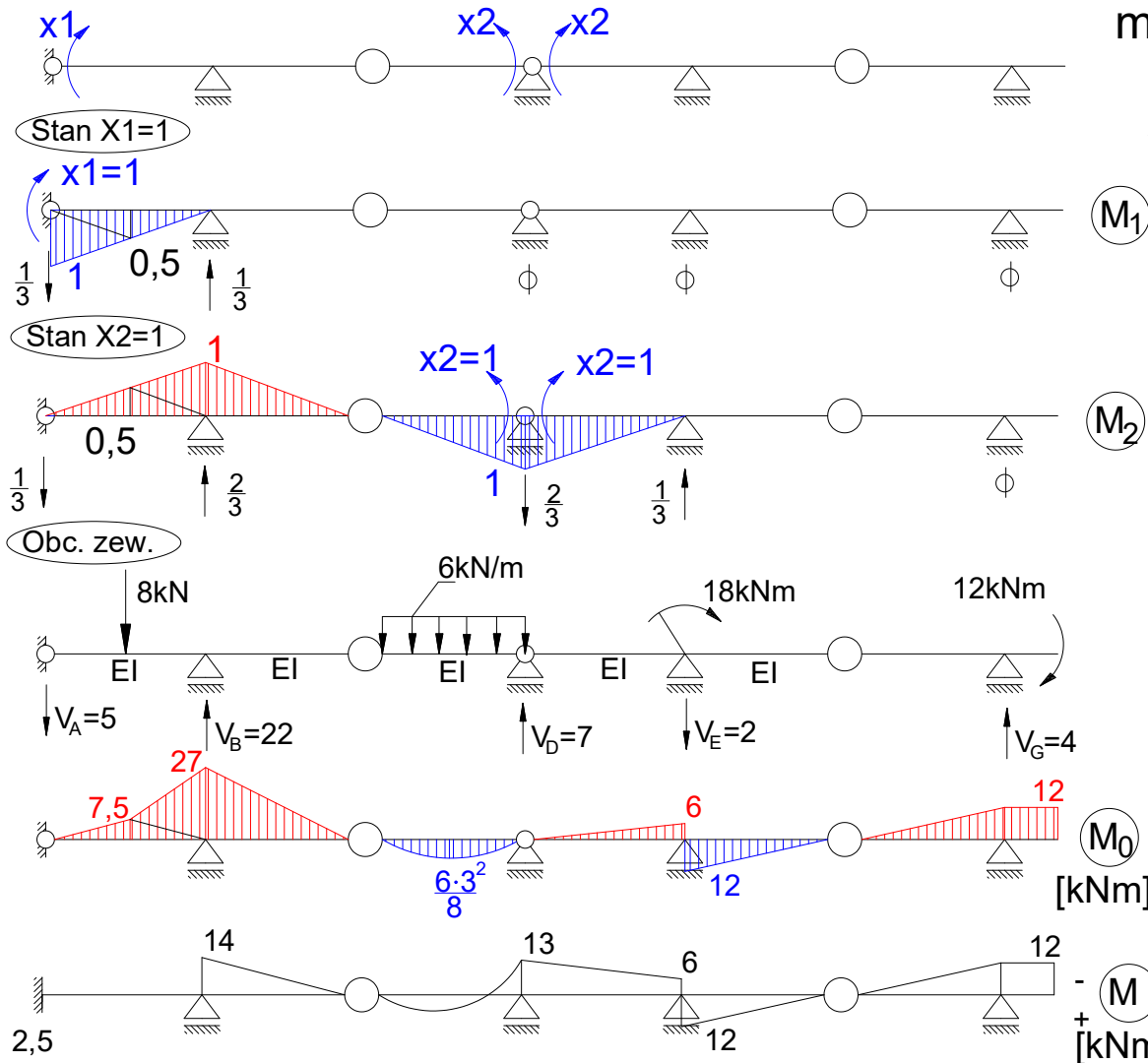
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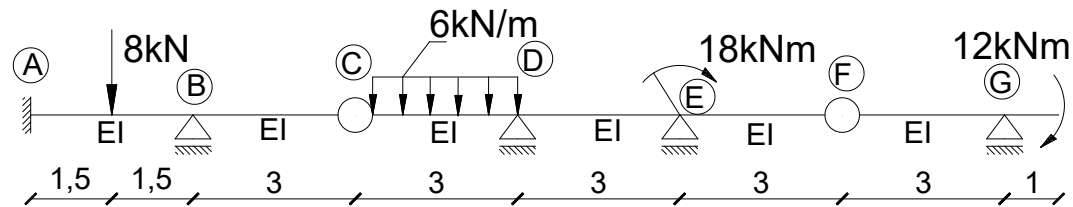


$$X_1 = 2,5 \text{ kNm}$$

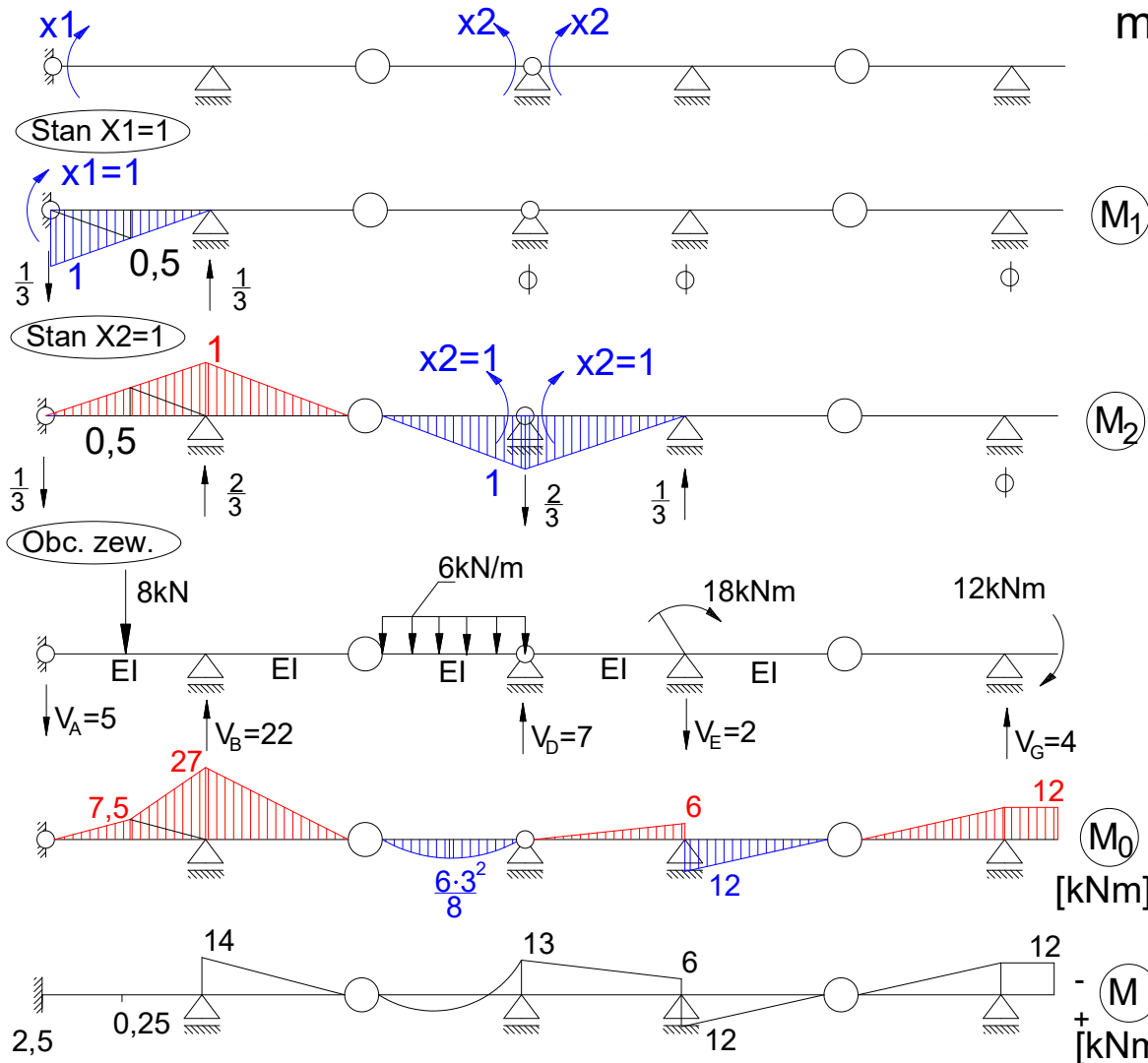
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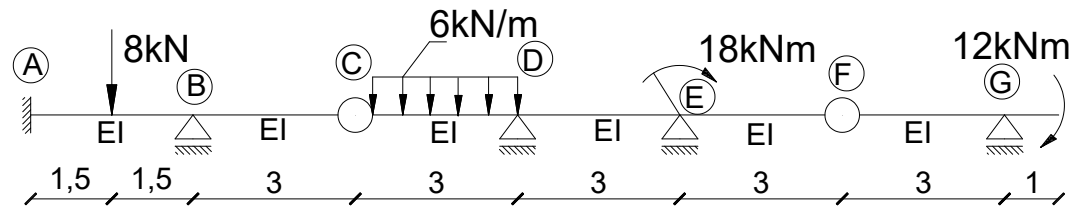


$$X_1 = 2,5 \text{ kNm}$$

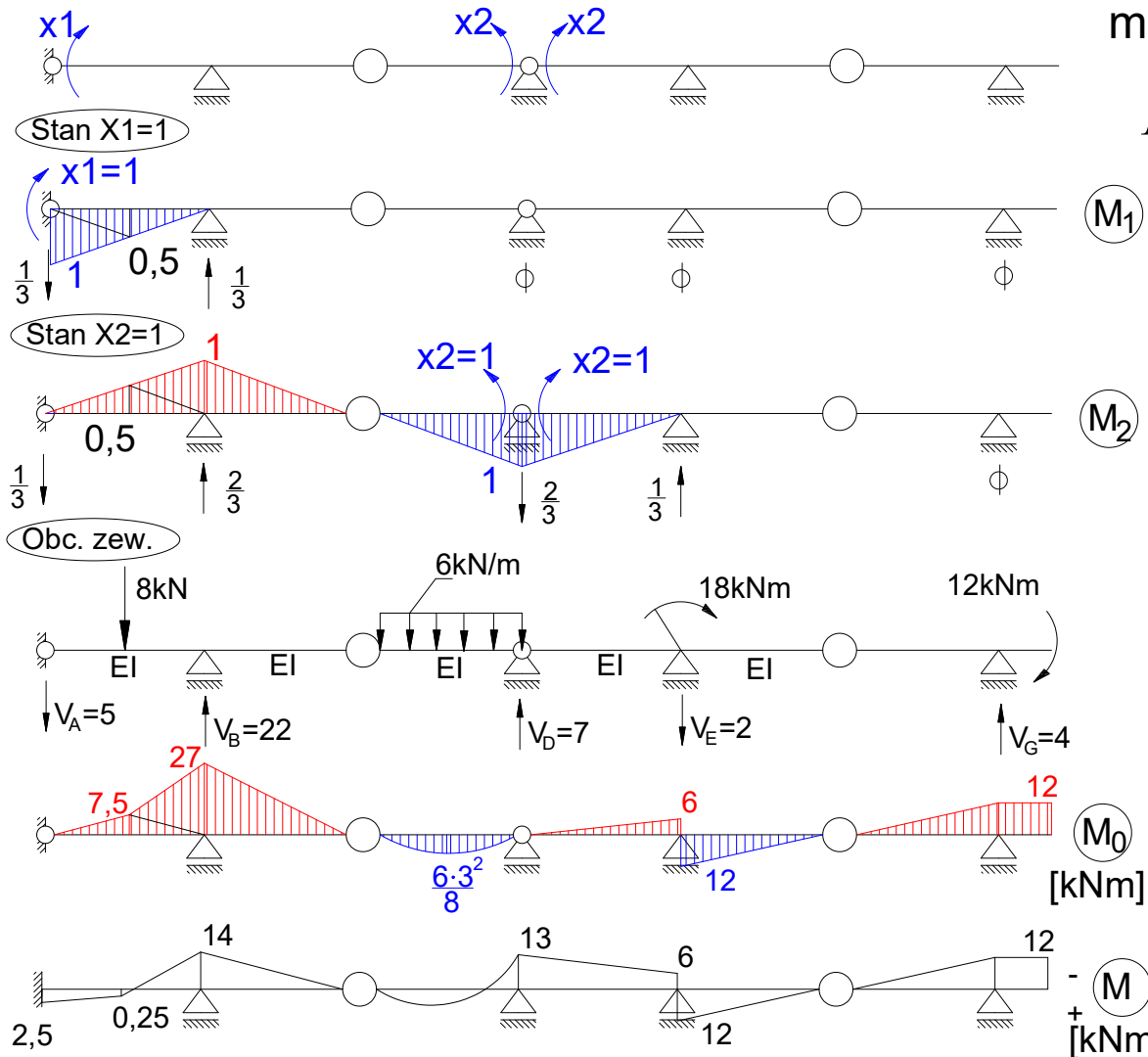
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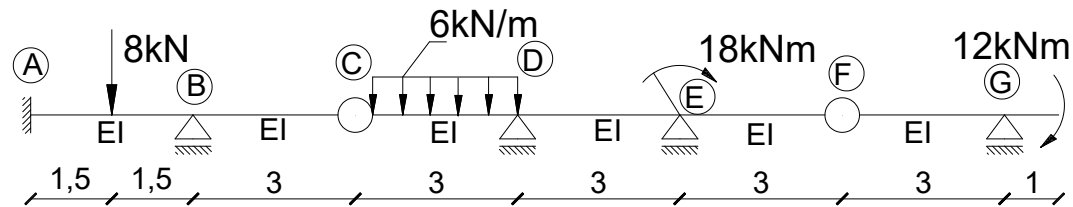


$$X_1 = 2,5 \text{ kNm}$$

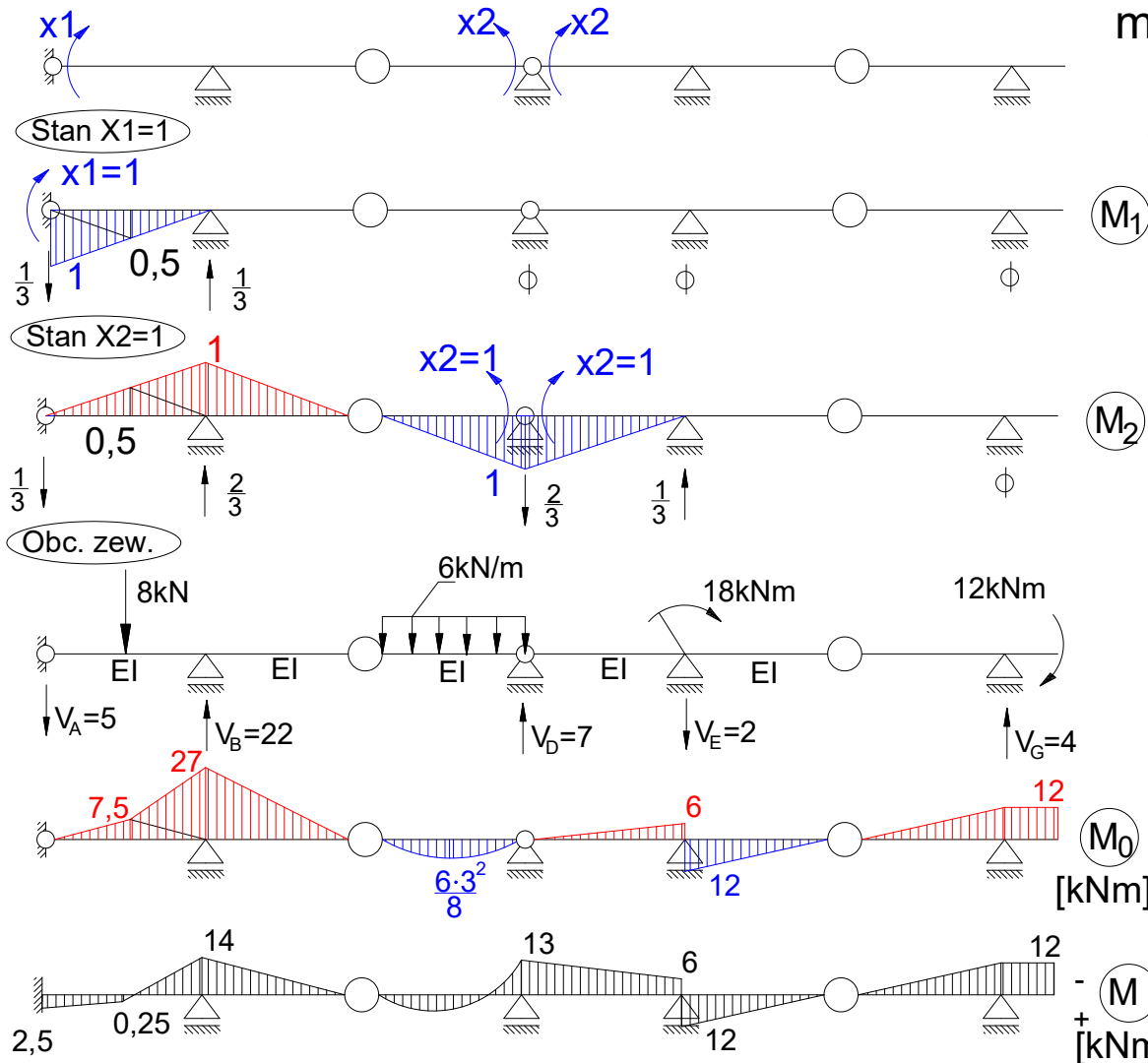
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Schemat podstawowy:



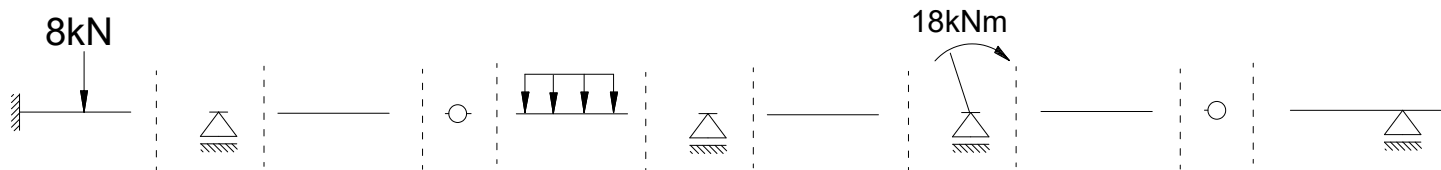
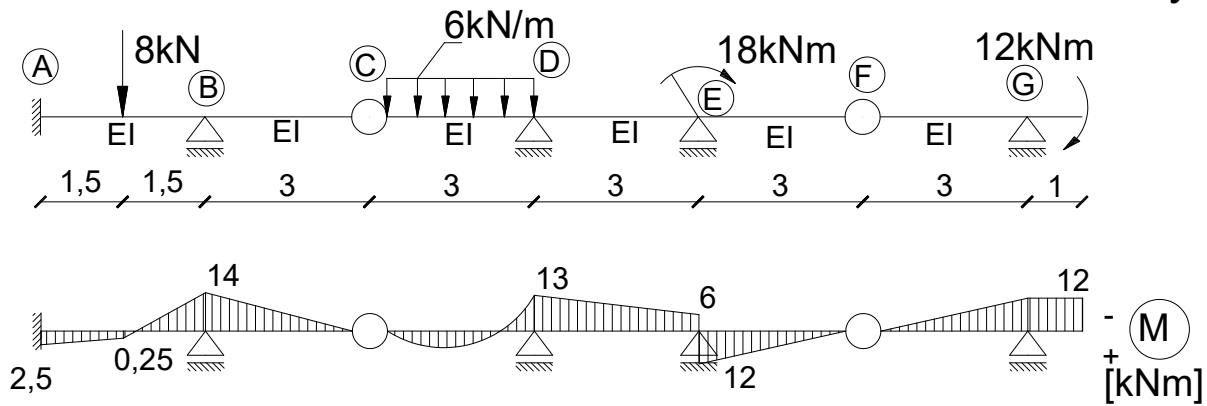
$$X1 = 2,5 \text{ kNm}$$

$$X2 = -13 \text{ kNm}$$

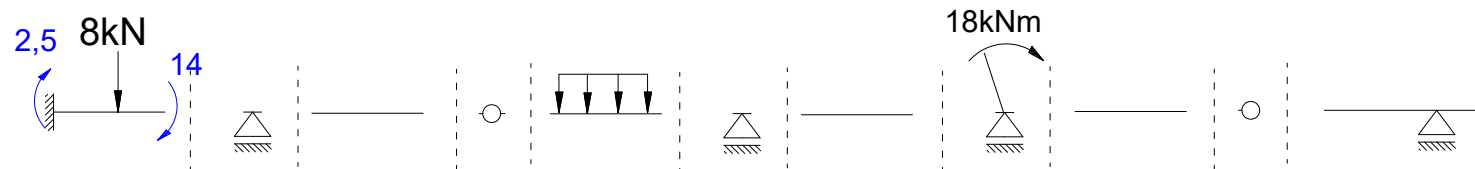
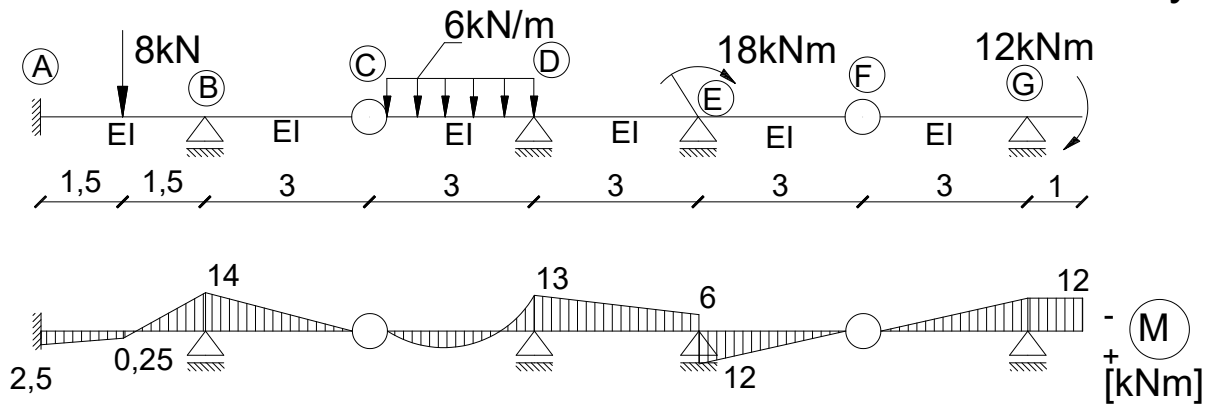
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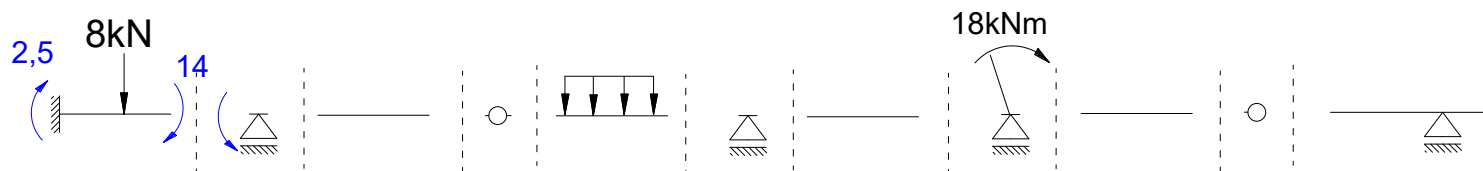
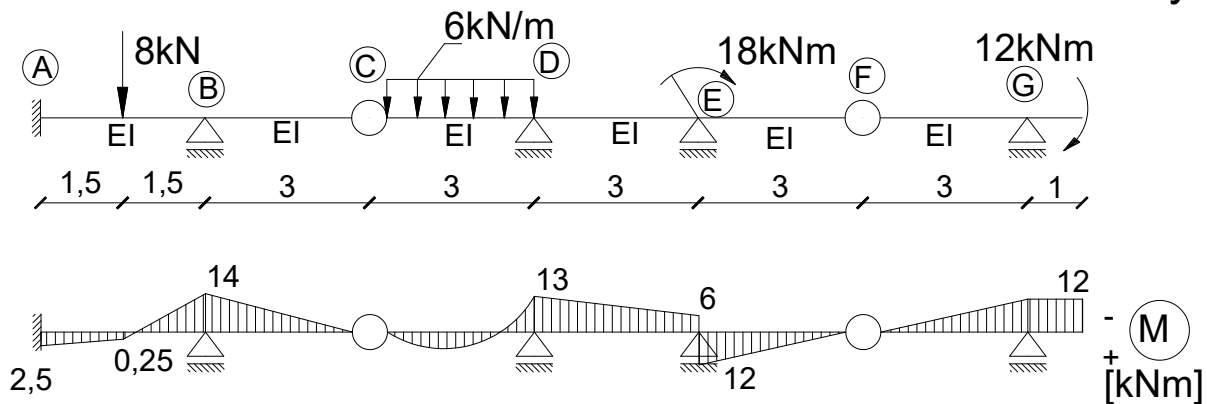
Wyznaczenie sił tnących:



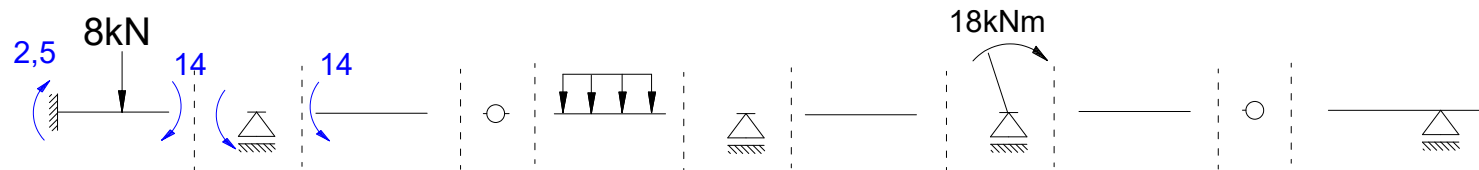
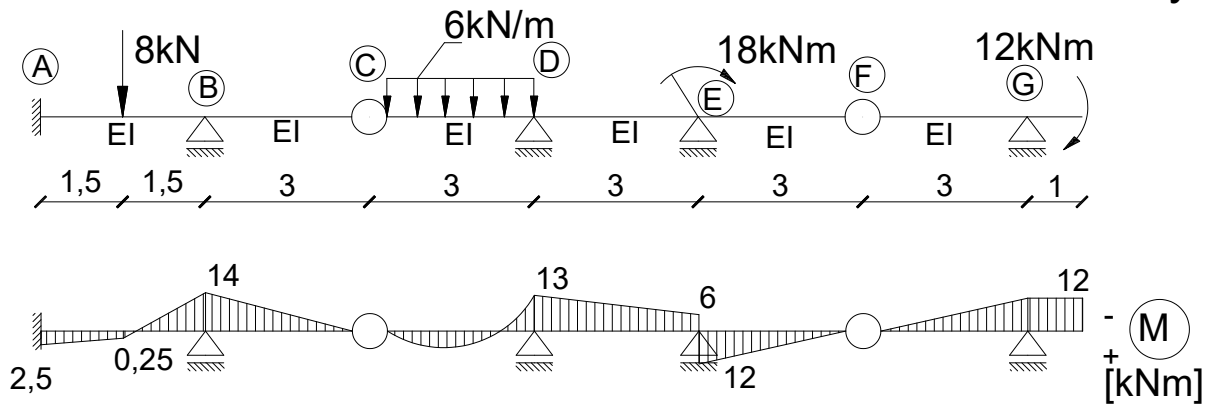
Wyznaczenie sił tnących:



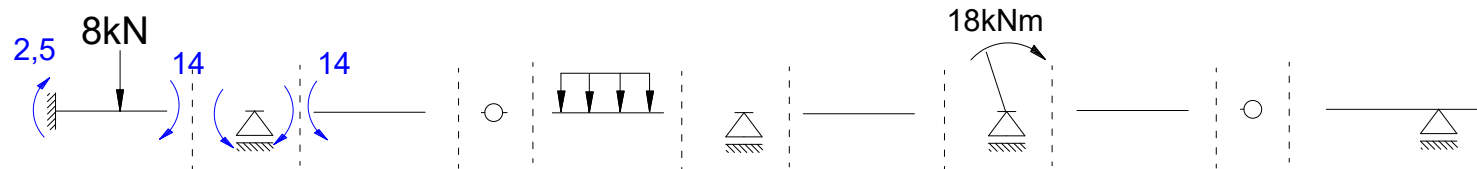
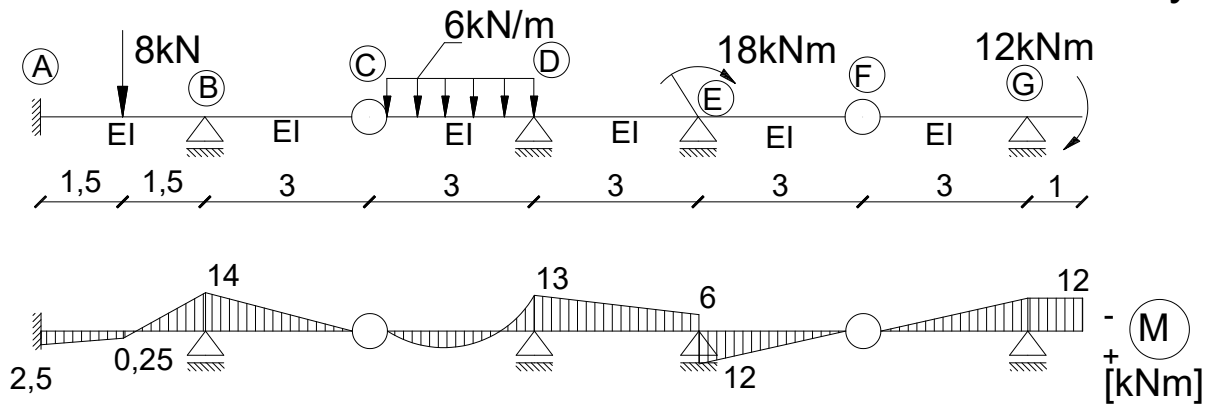
Wyznaczenie sił tnących:



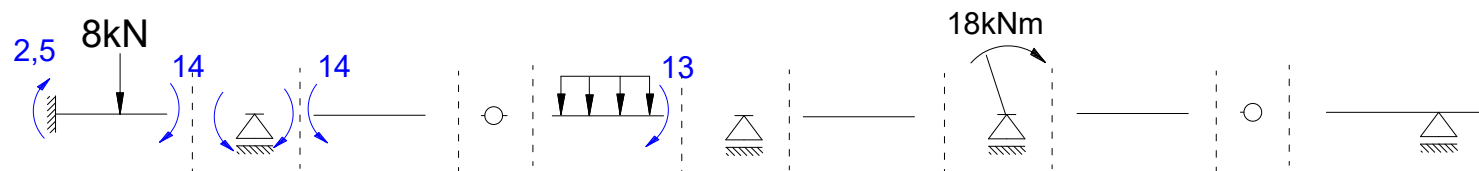
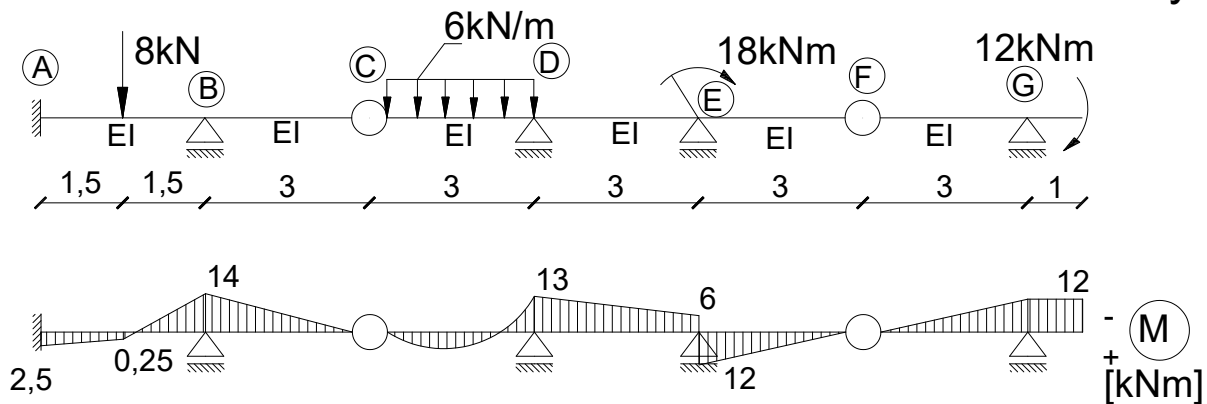
Wyznaczenie sił tnących:



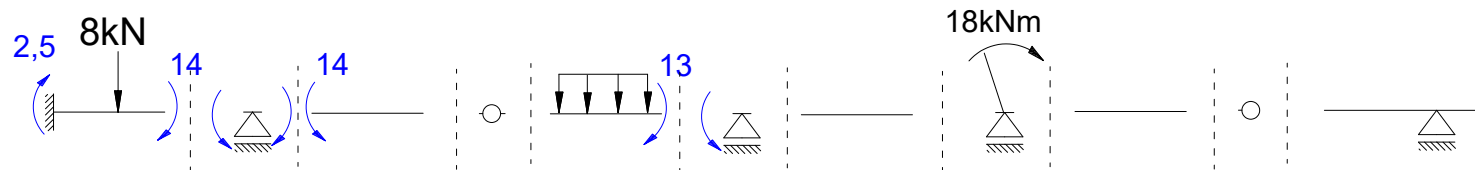
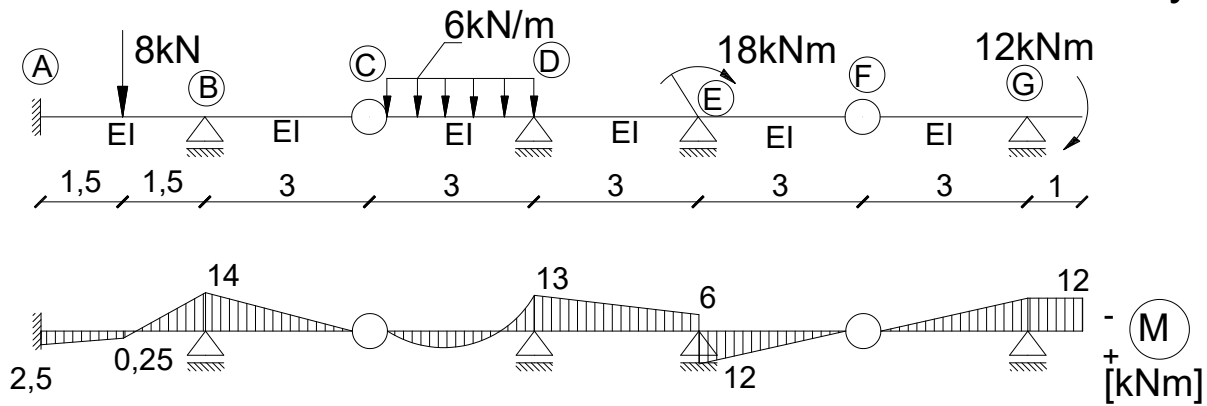
Wyznaczenie sił tnących:



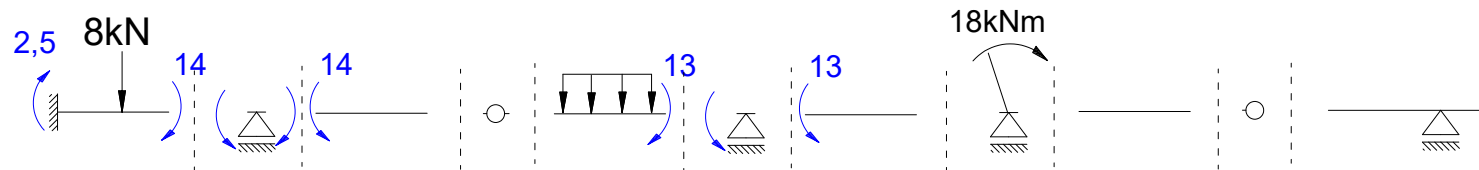
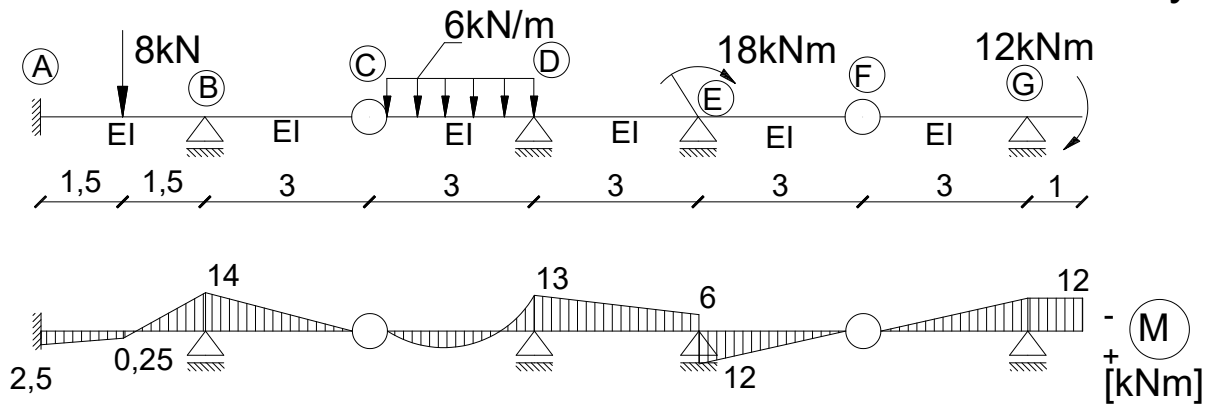
Wyznaczenie sił tnących:



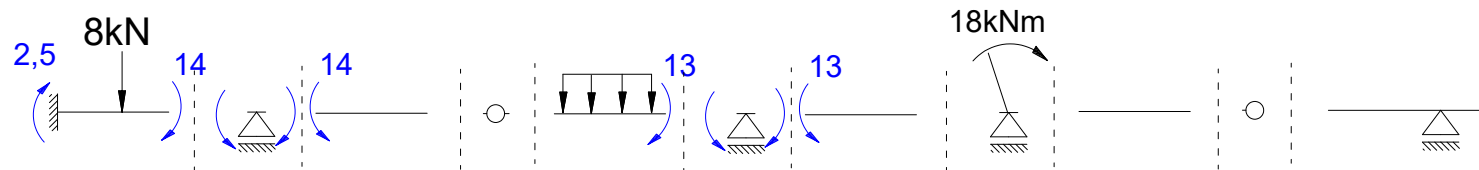
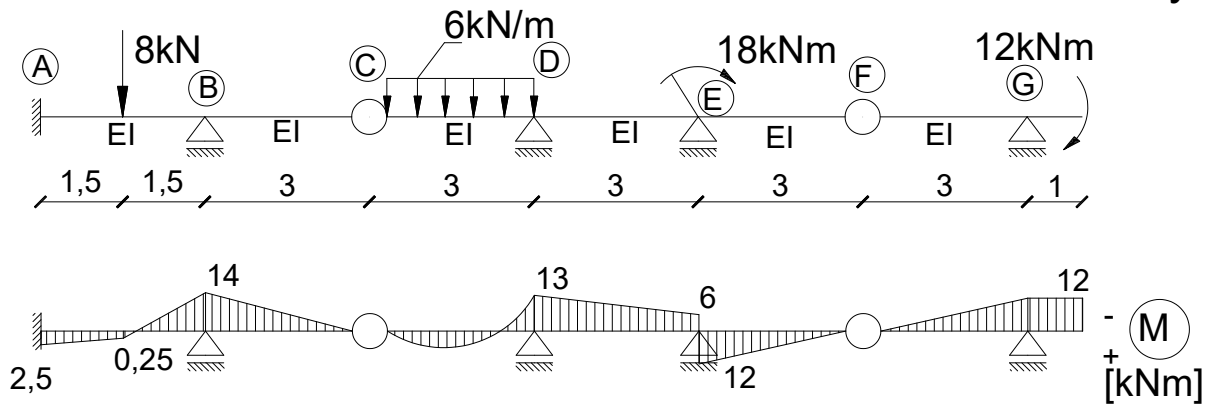
Wyznaczenie sił tnących:



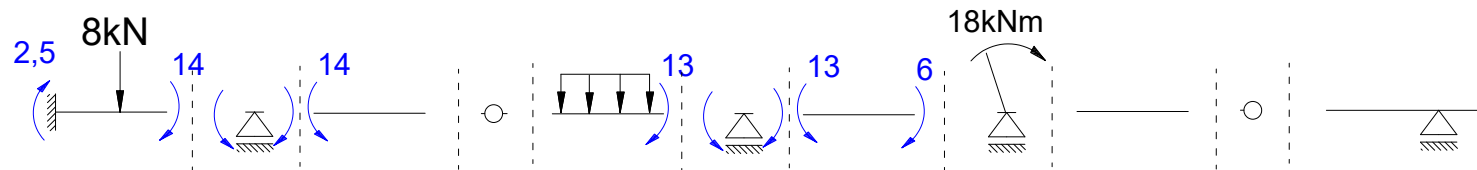
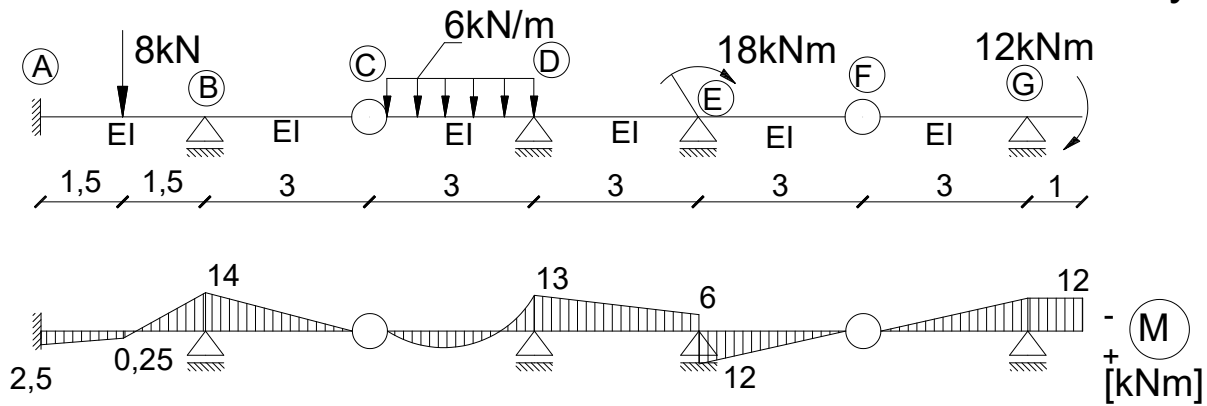
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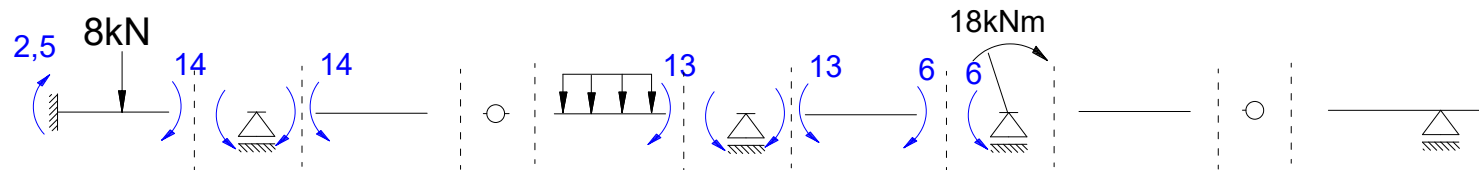
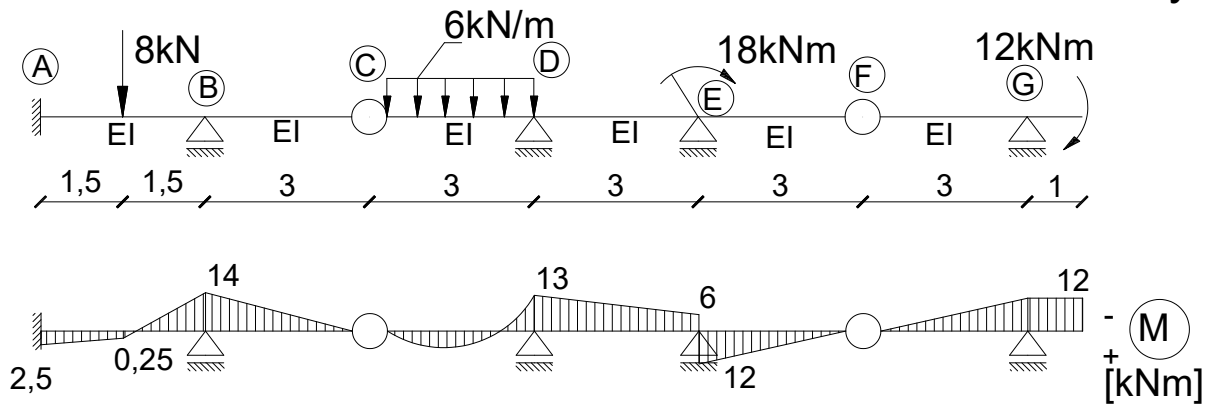
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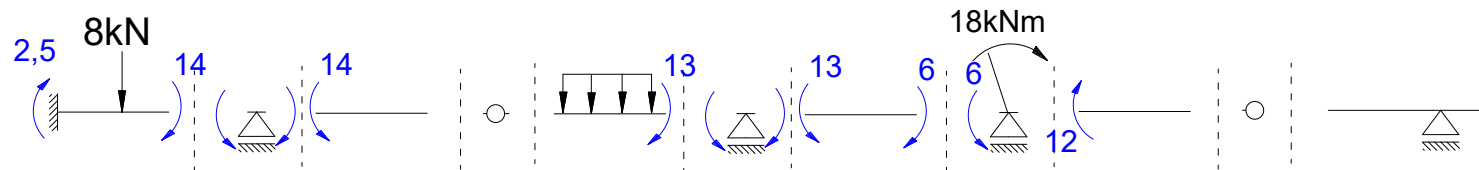
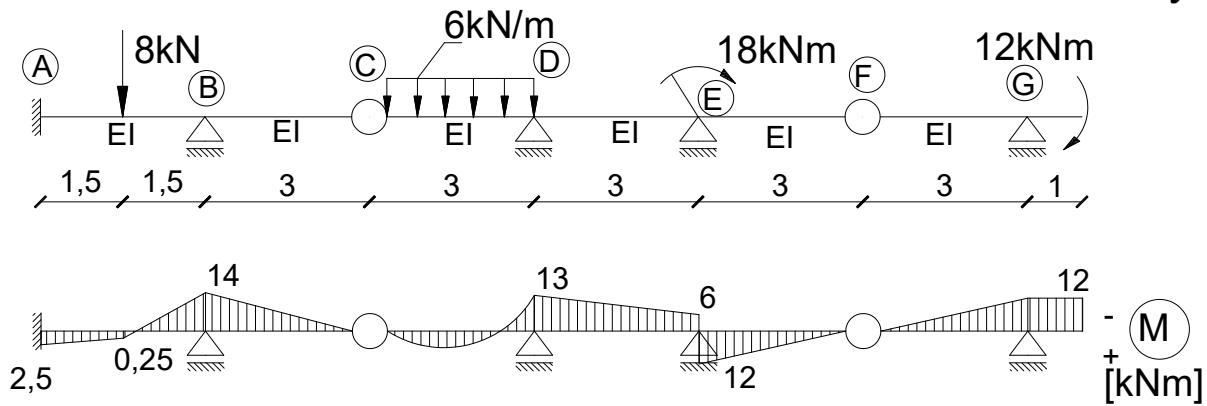
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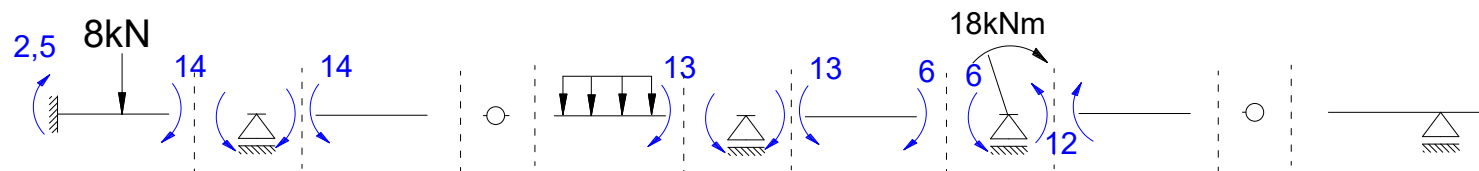
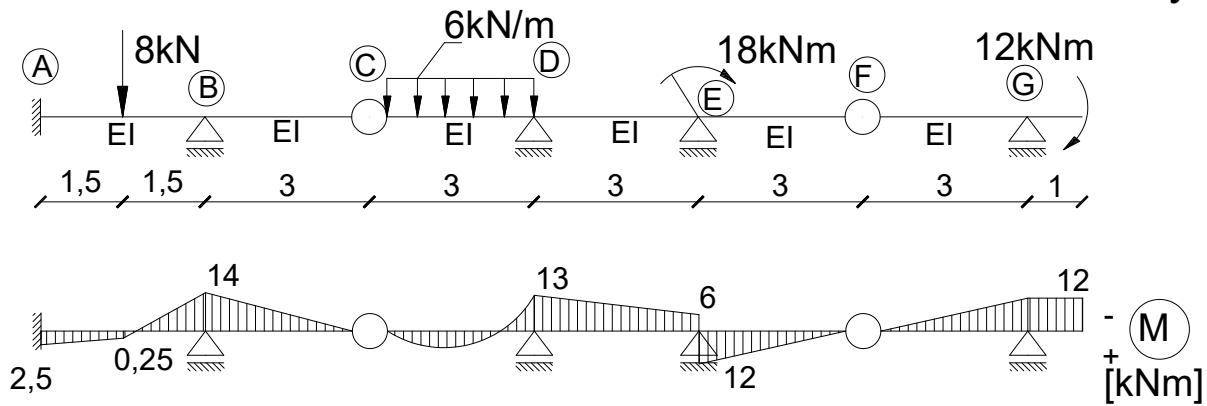
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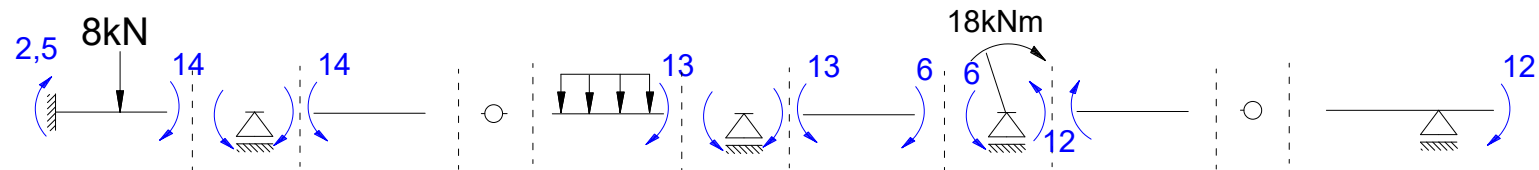
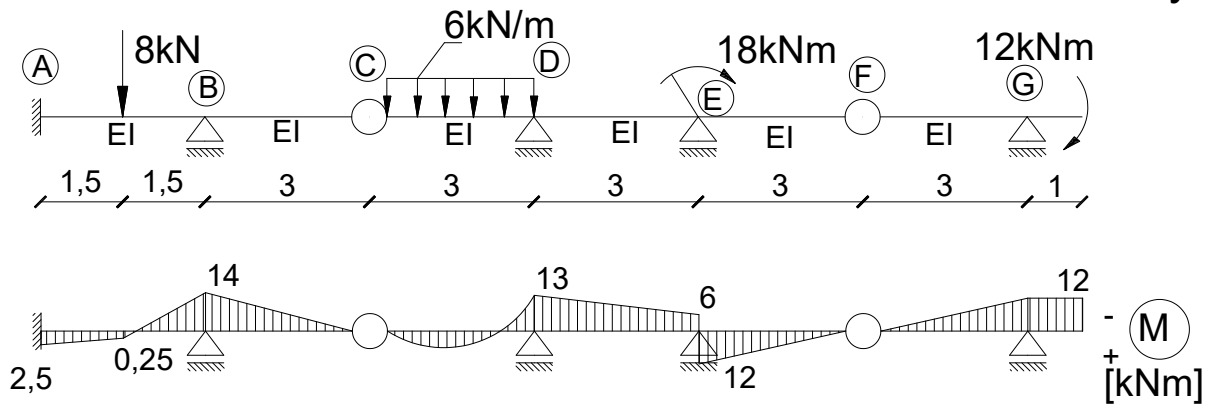
Wyznaczenie sił tnących:



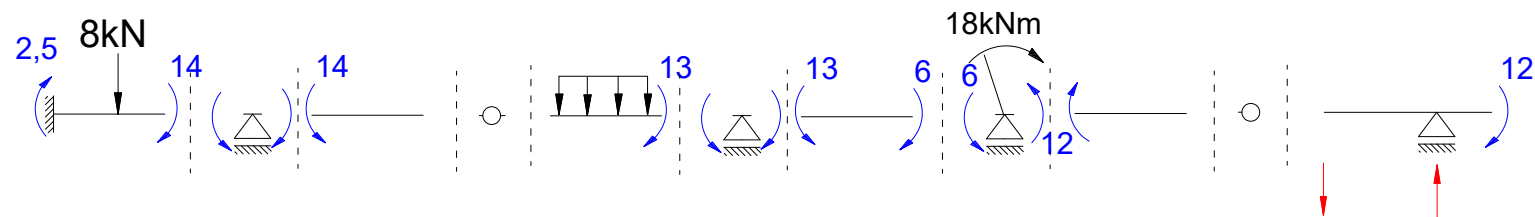
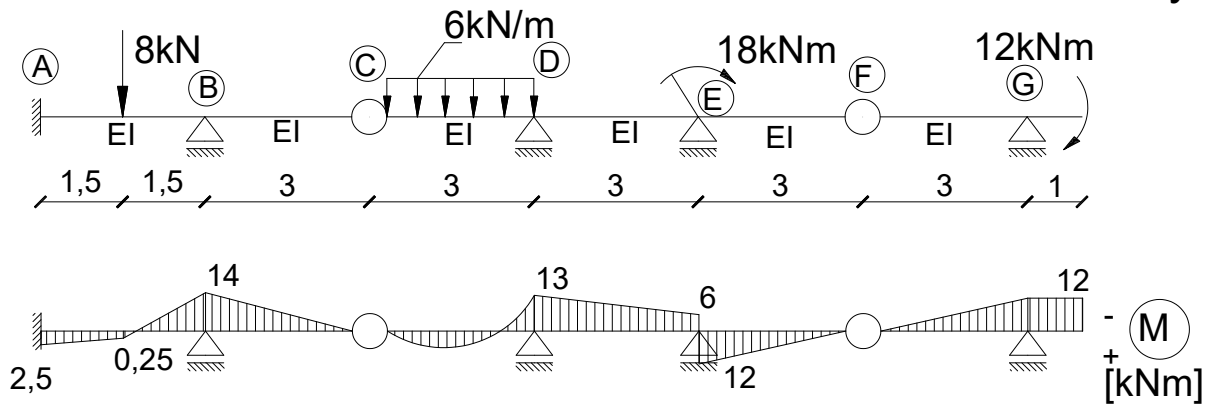
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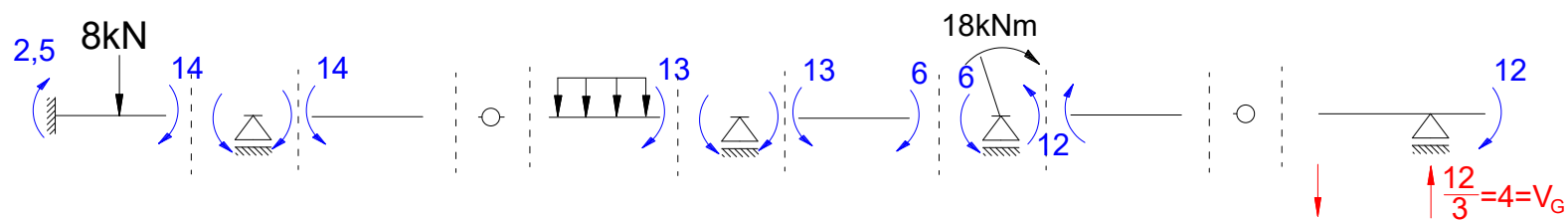
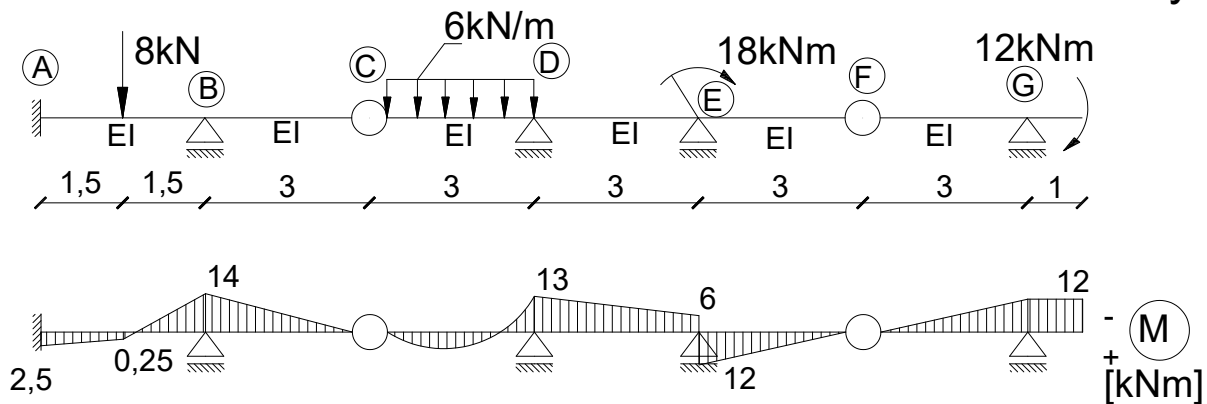
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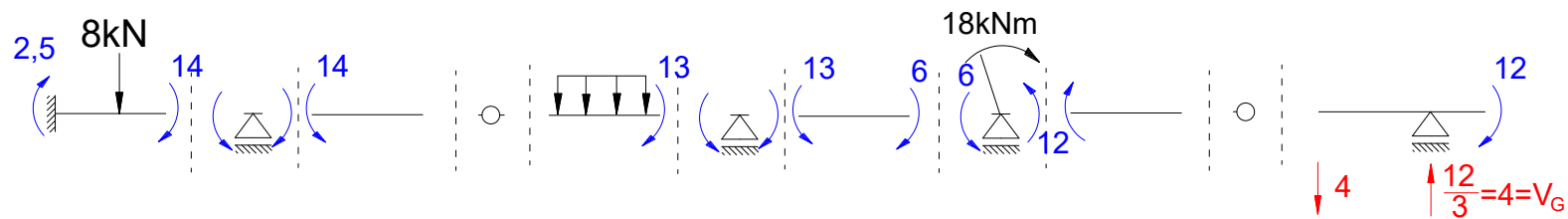
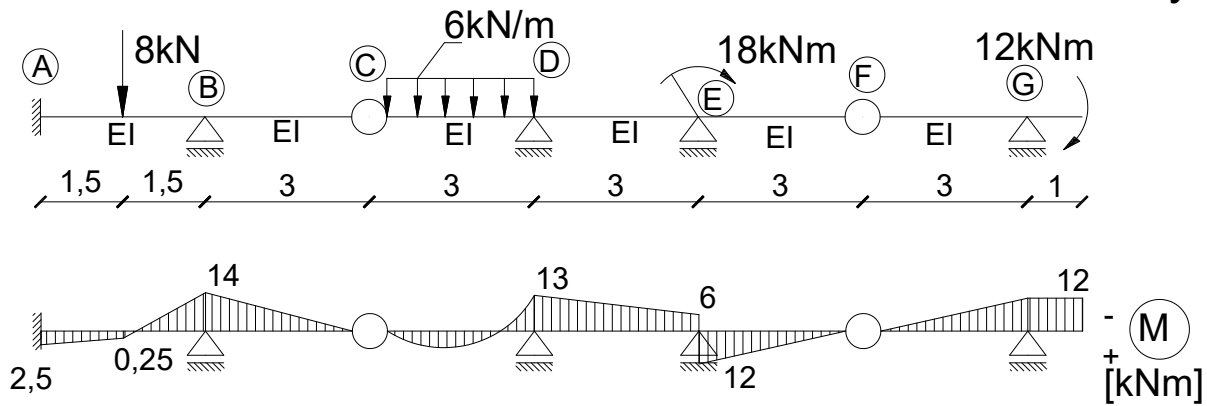
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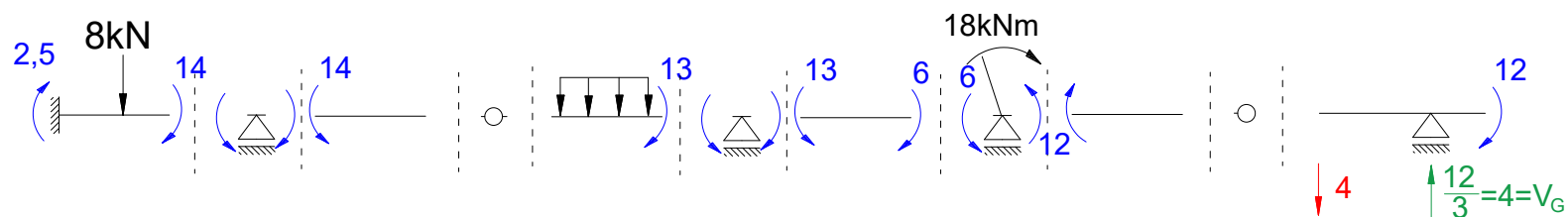
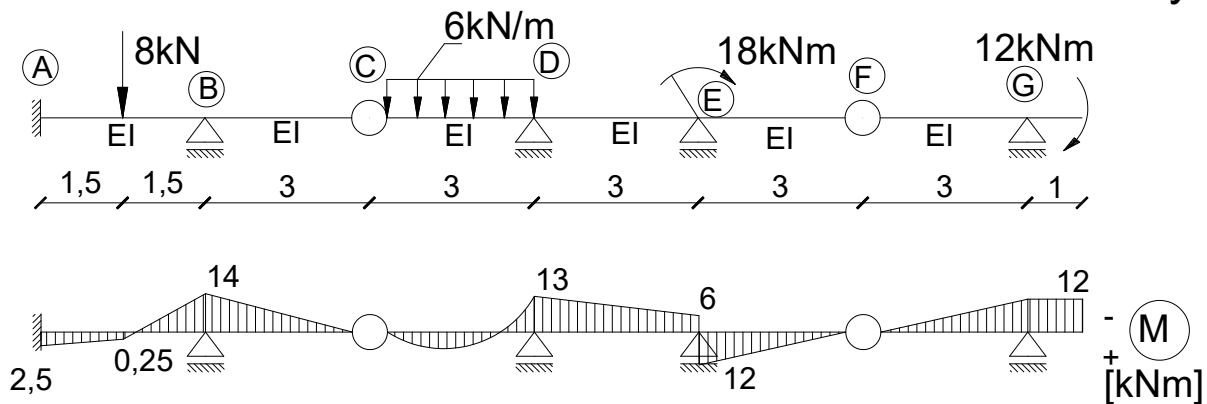
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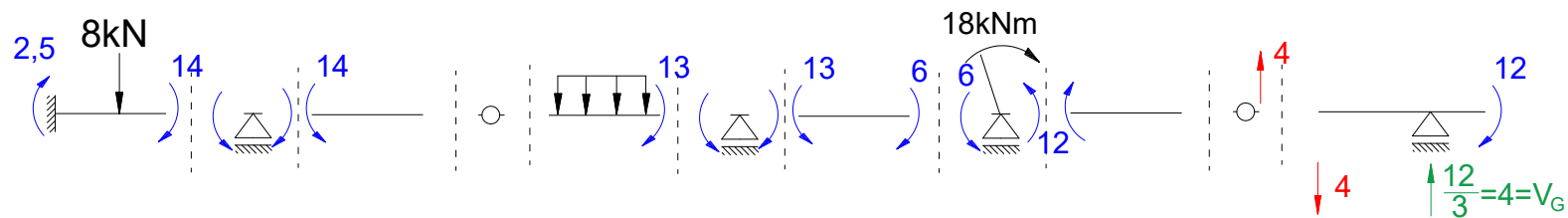
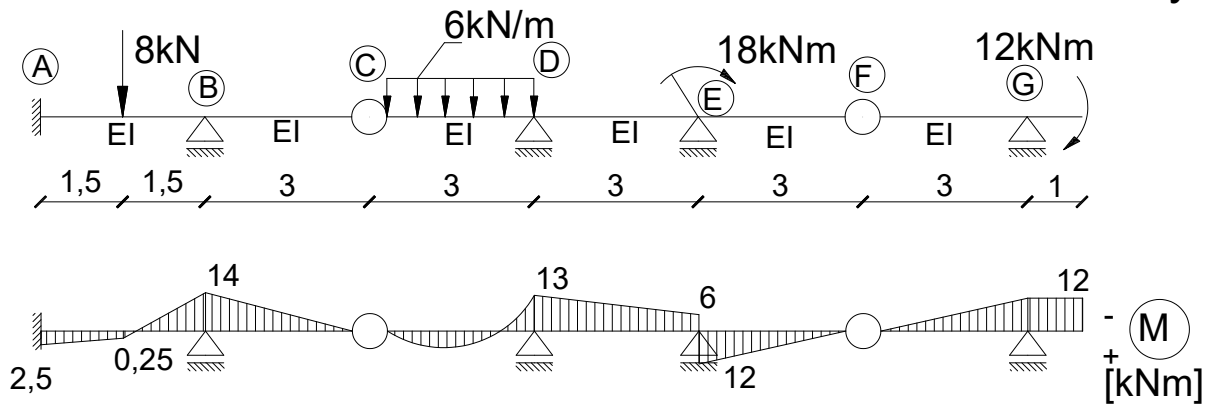
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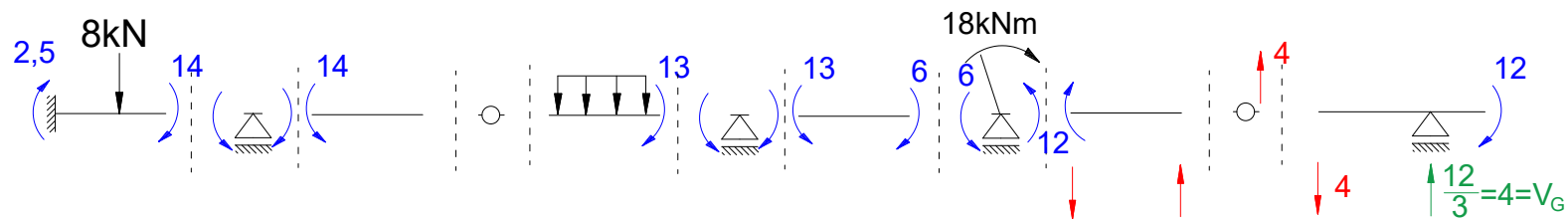
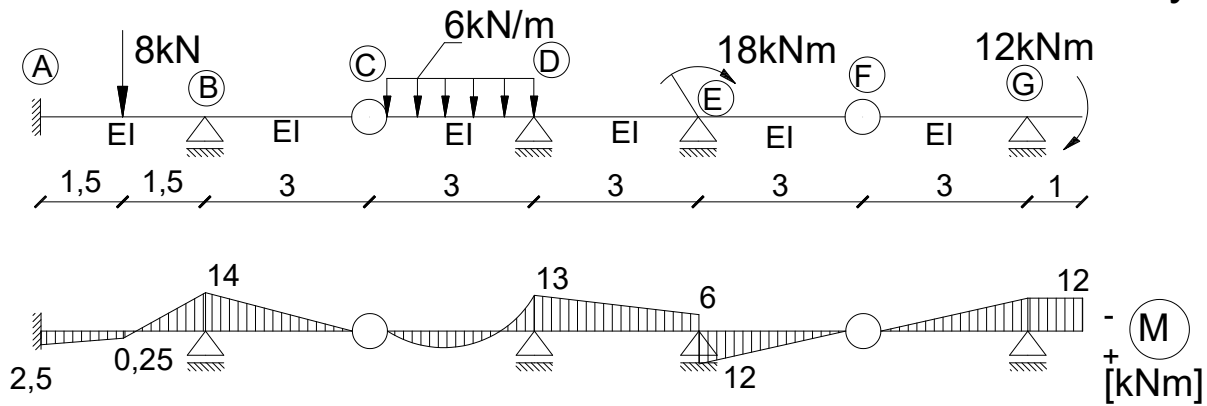
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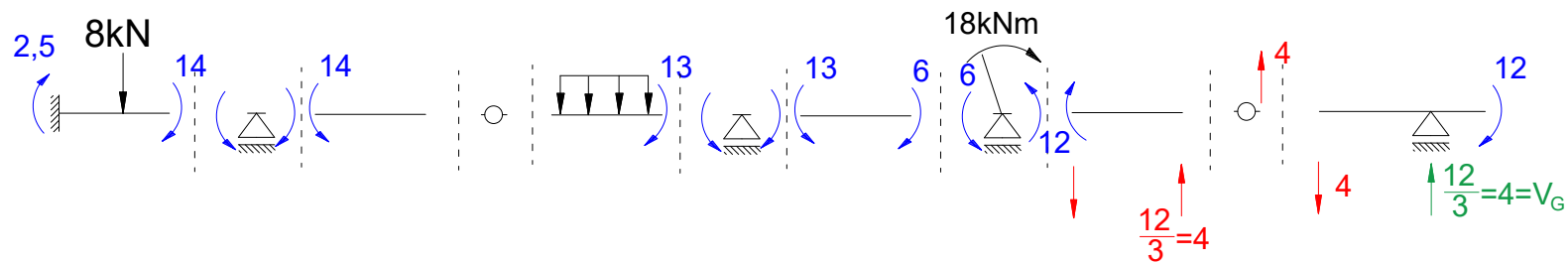
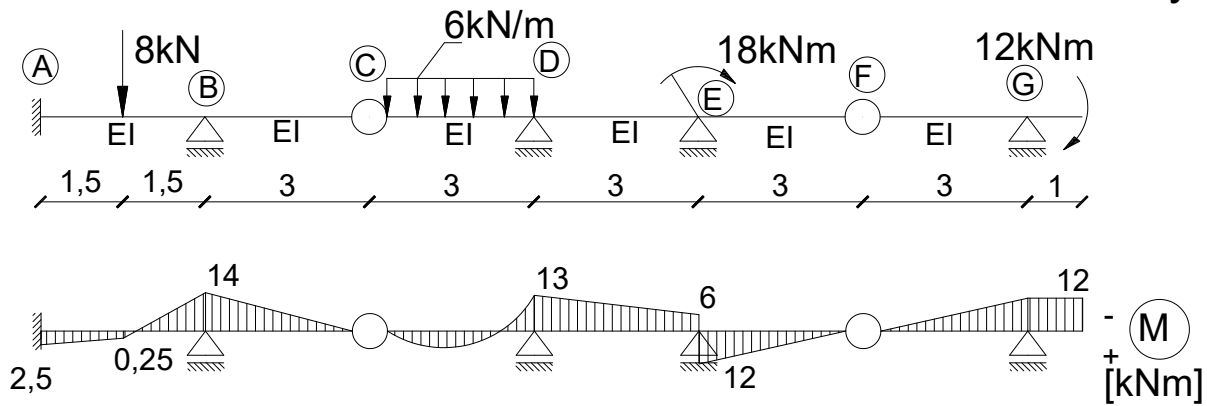
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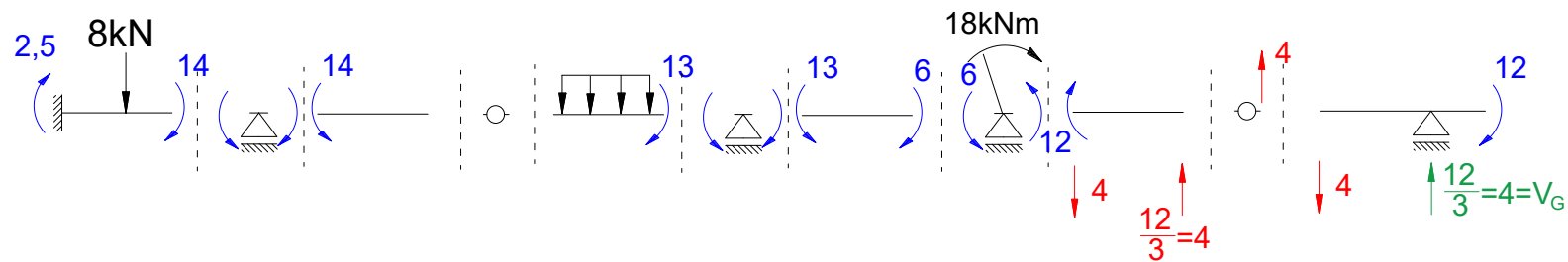
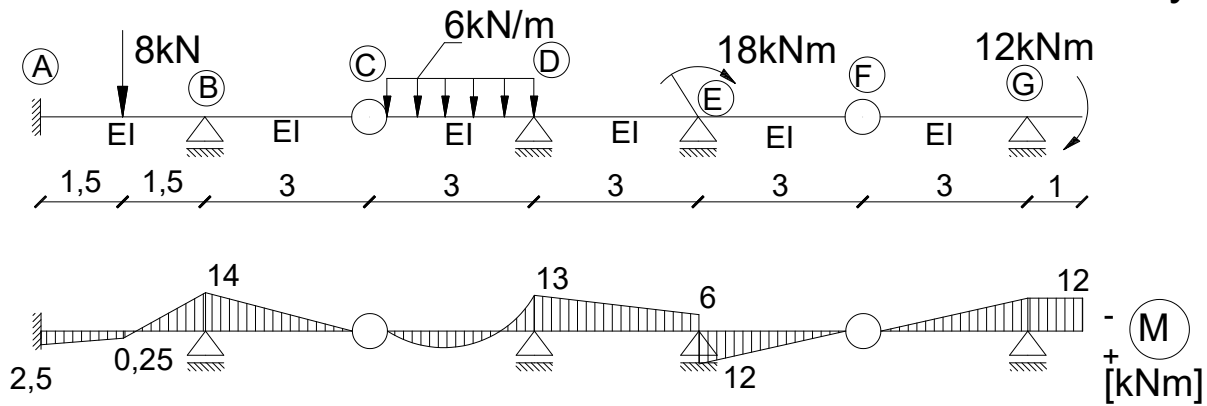
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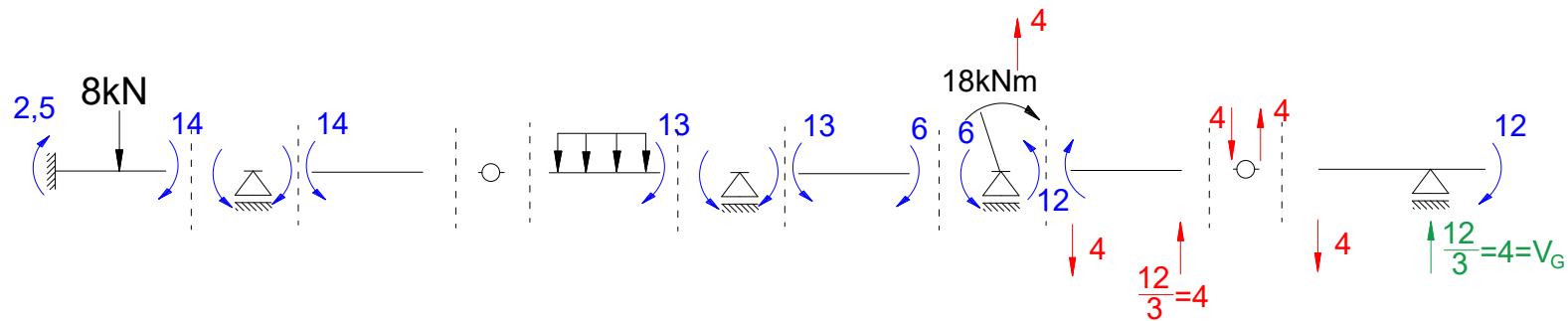
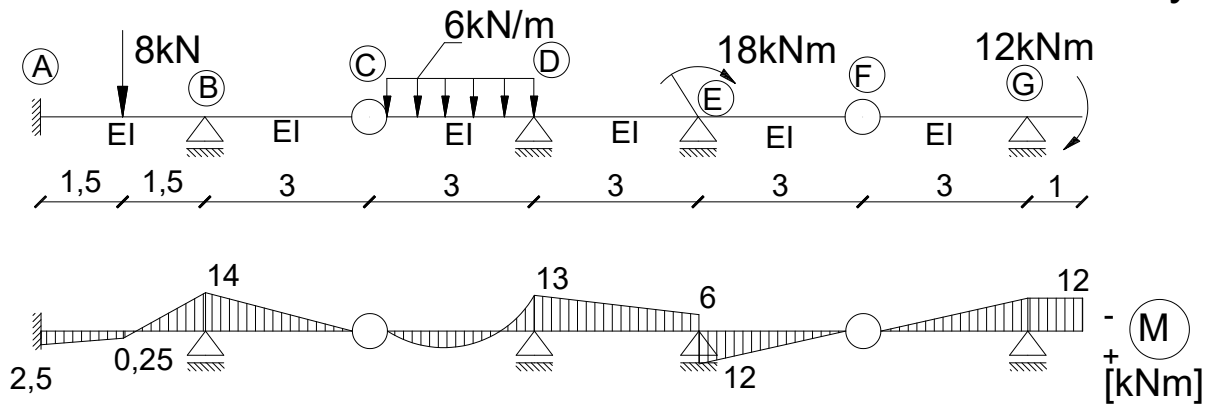
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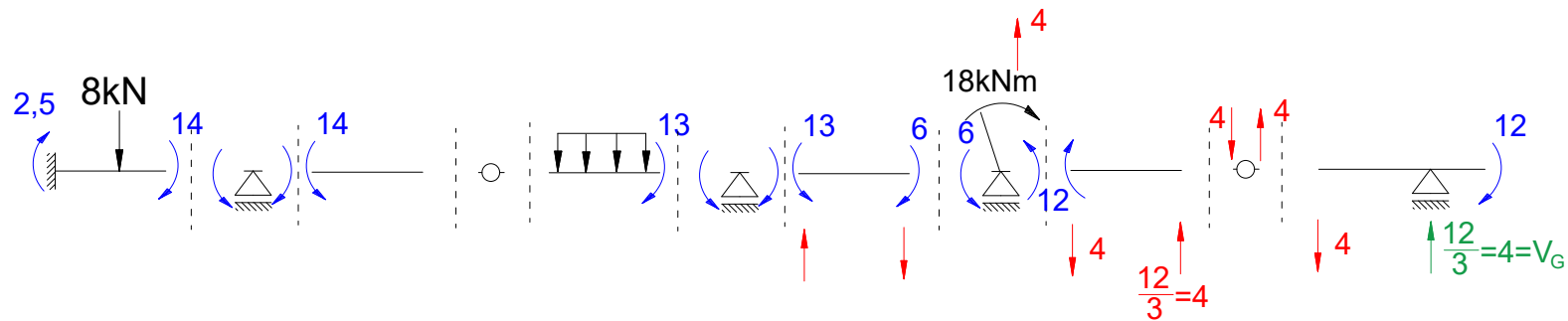
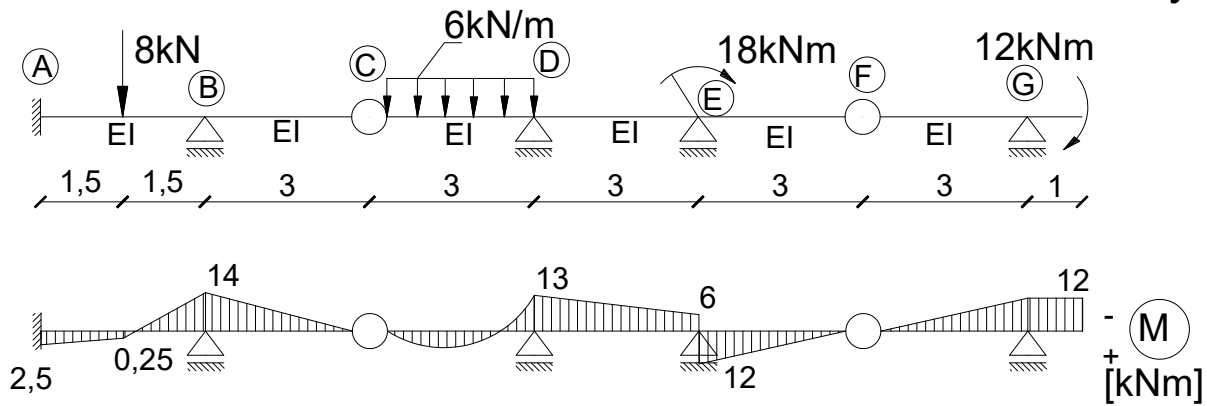
Wyznaczenie sił tnących:



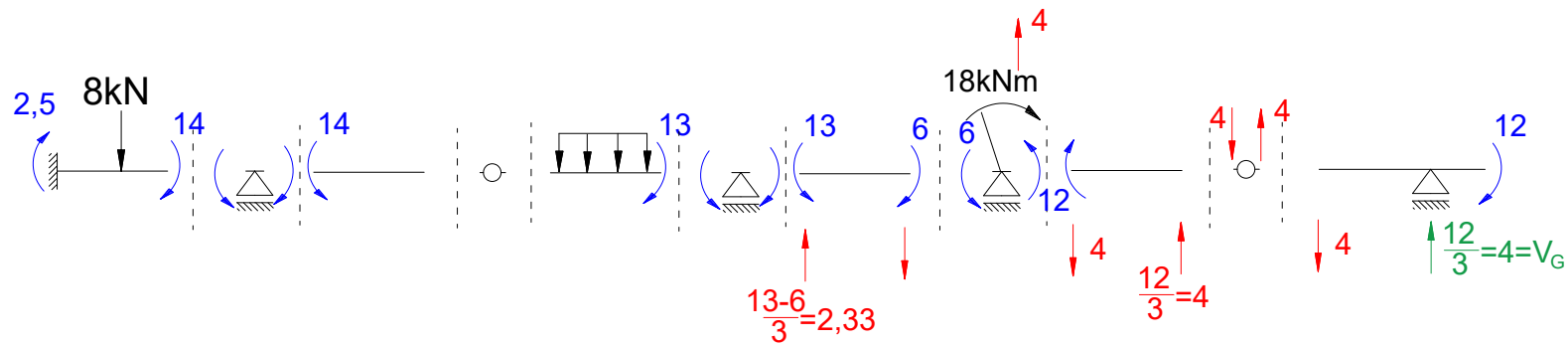
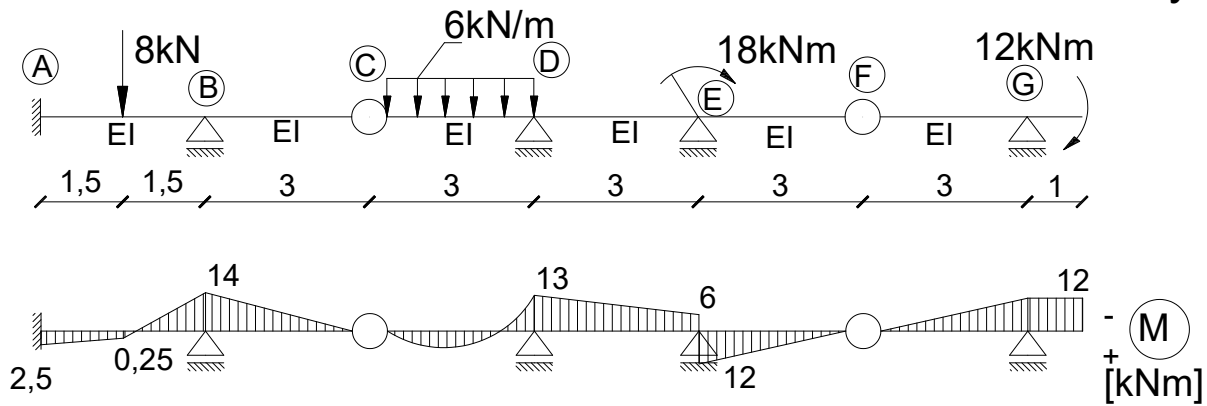
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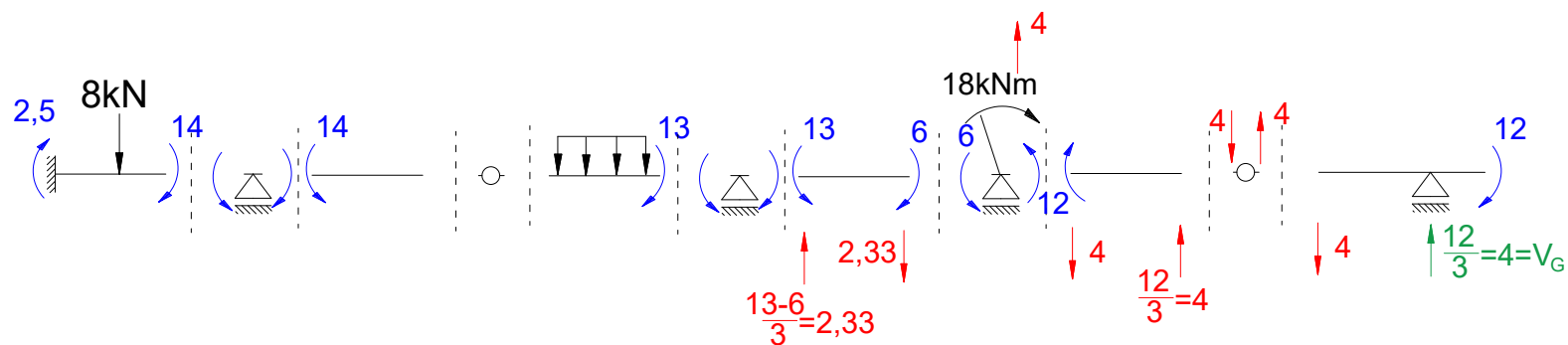
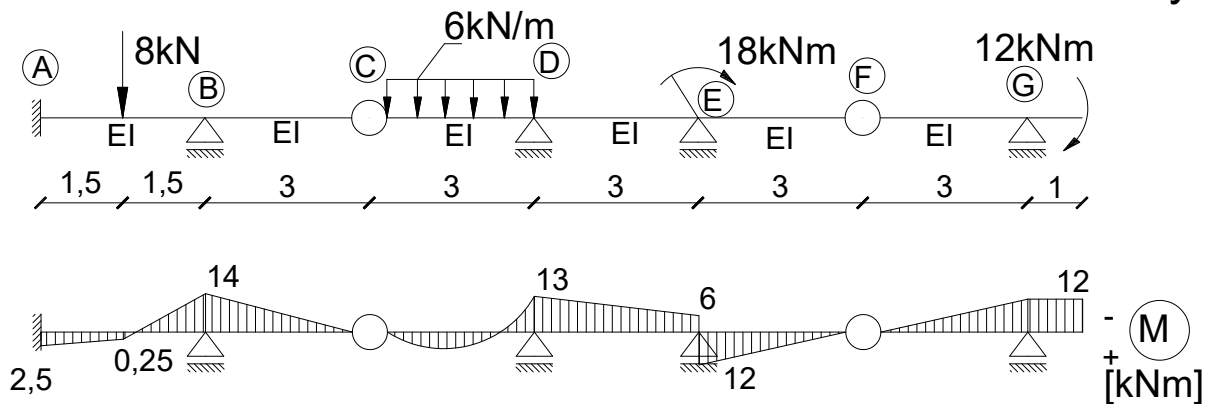
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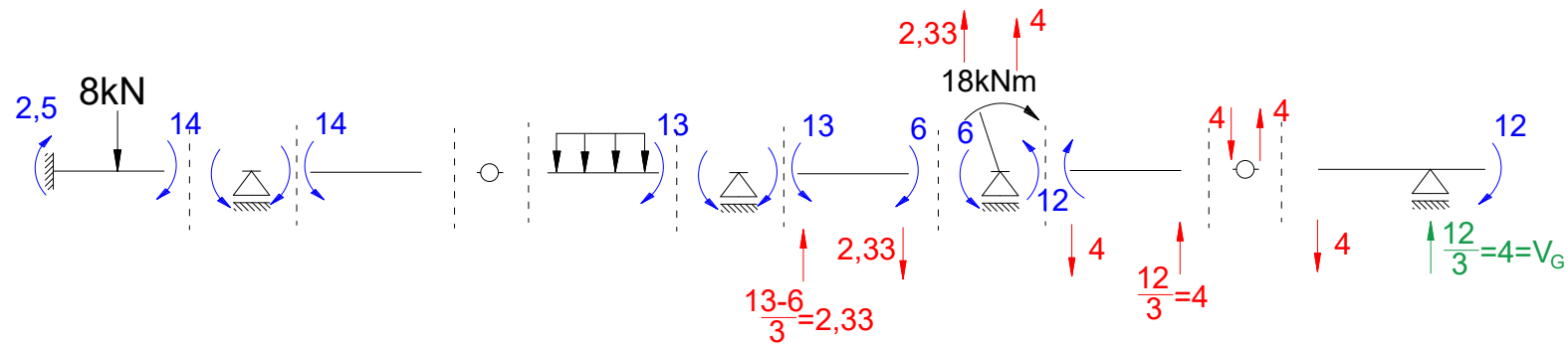
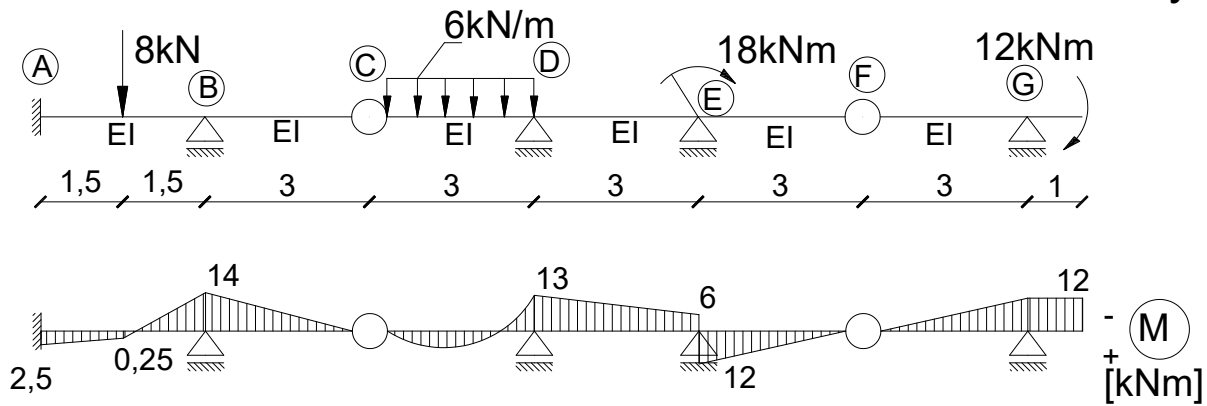
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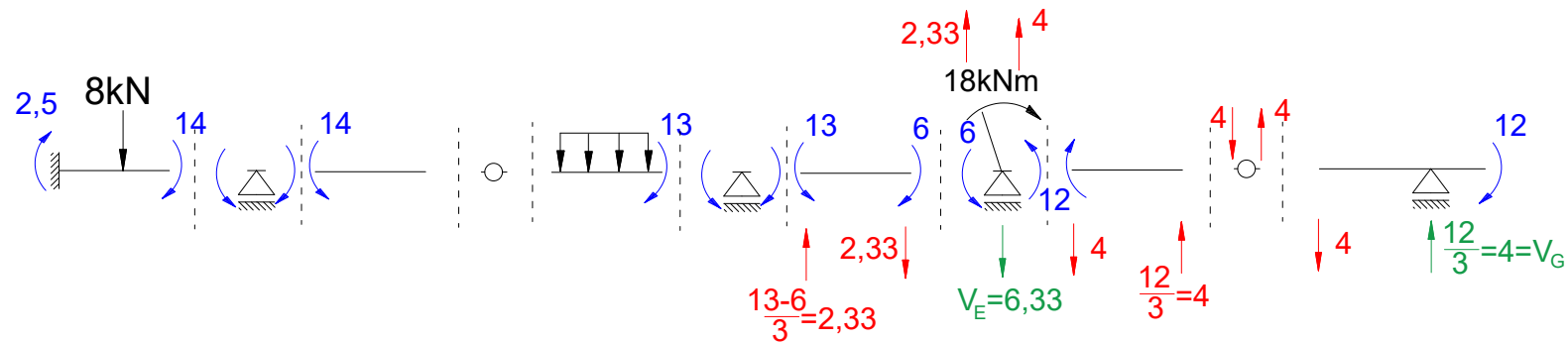
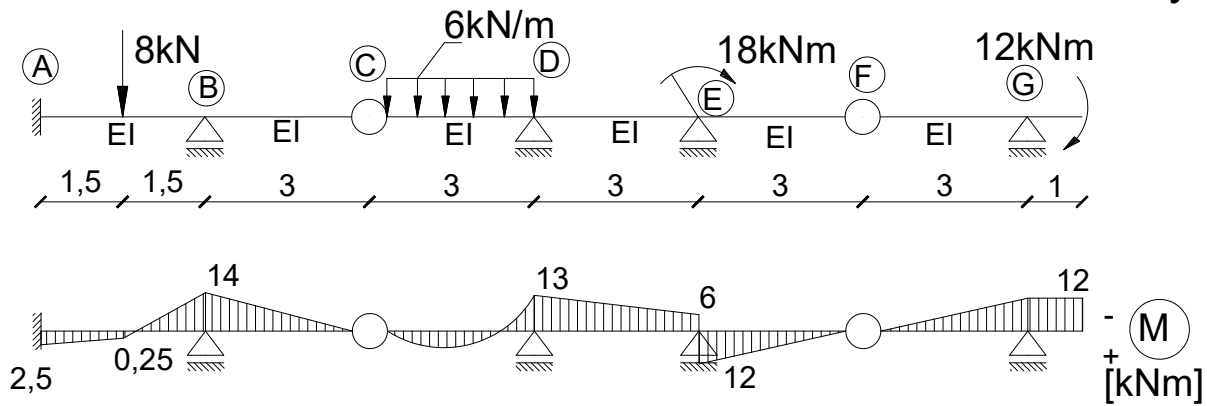
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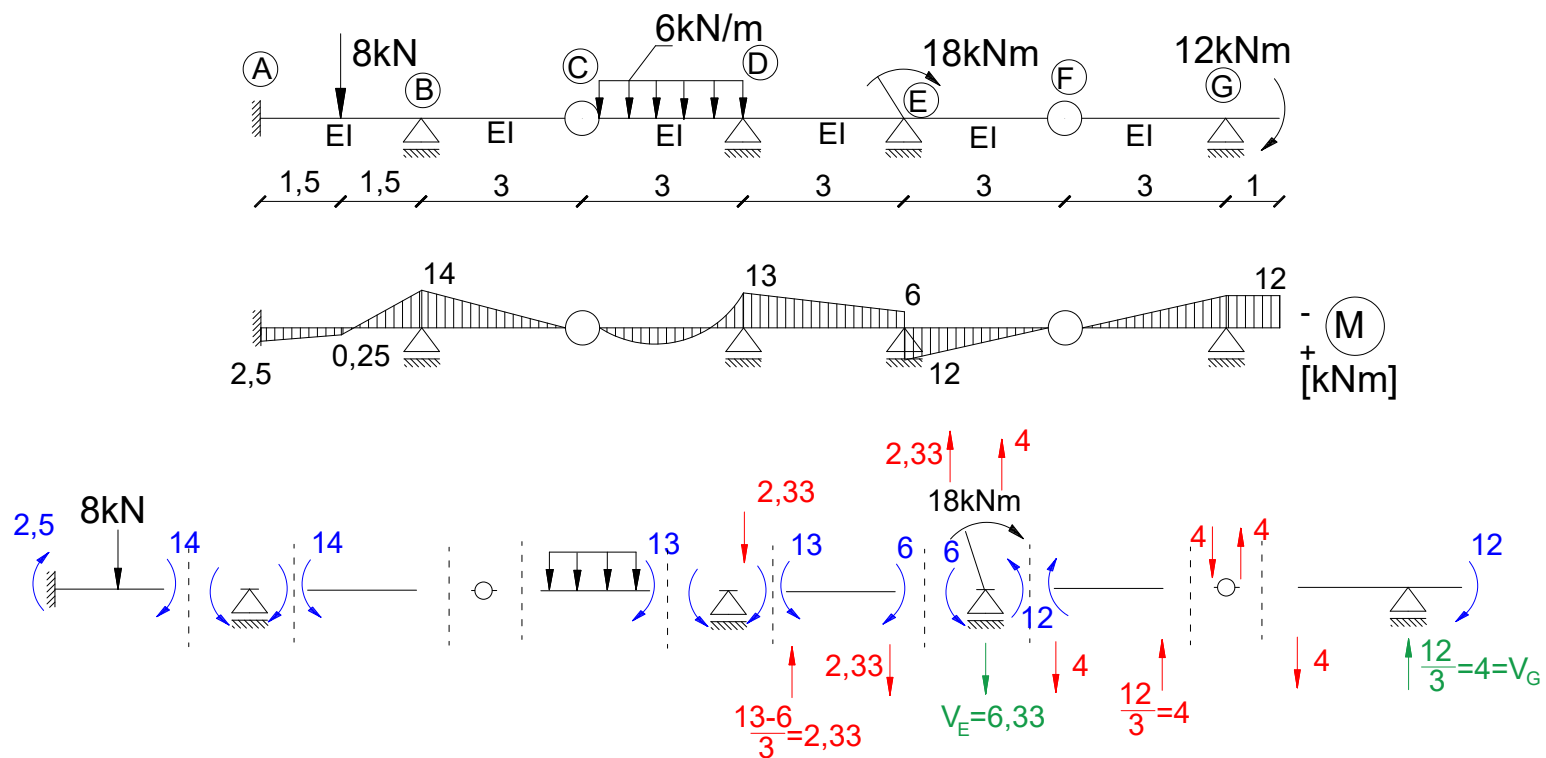
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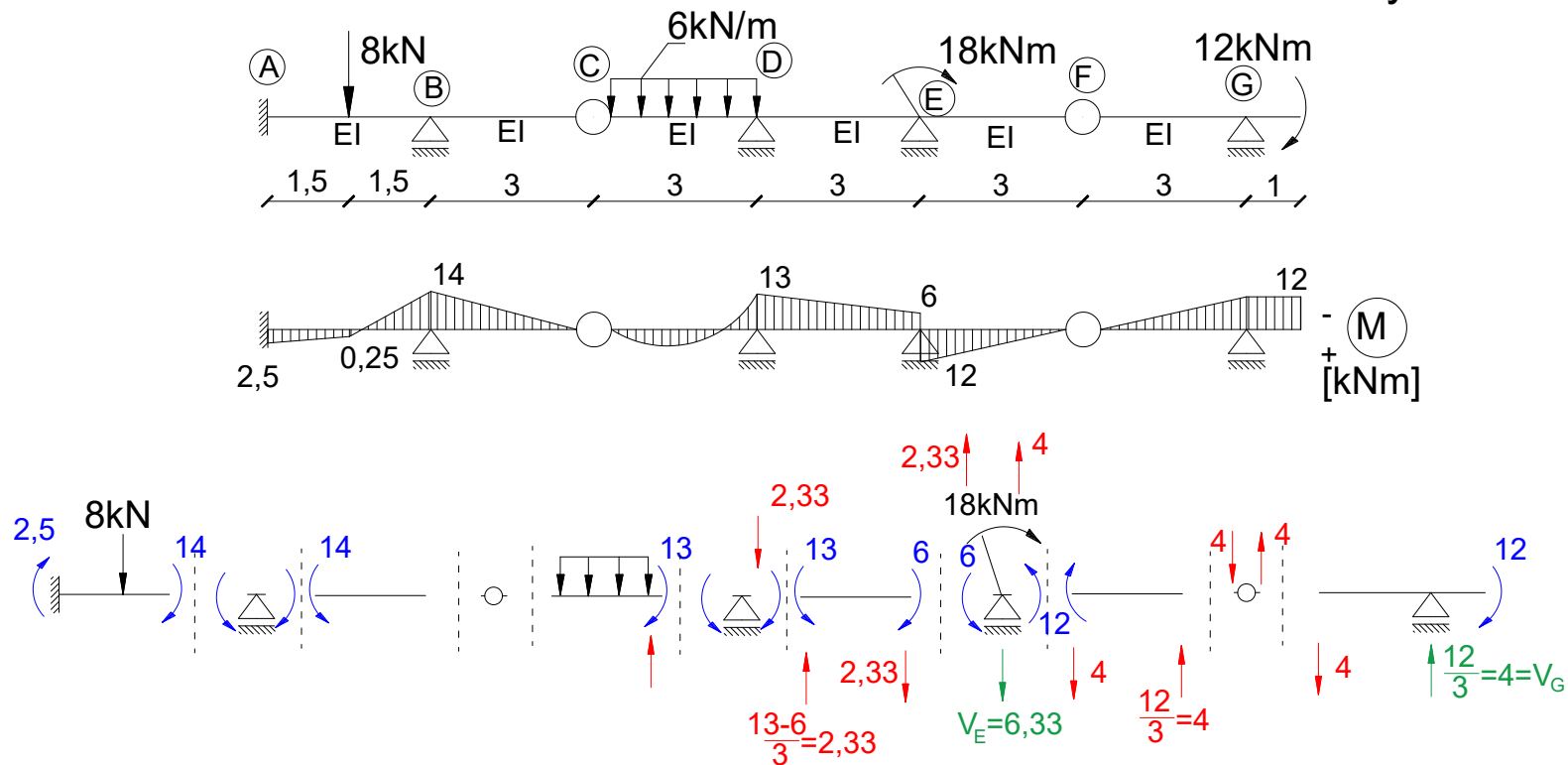
Wyznaczenie sił tnących:



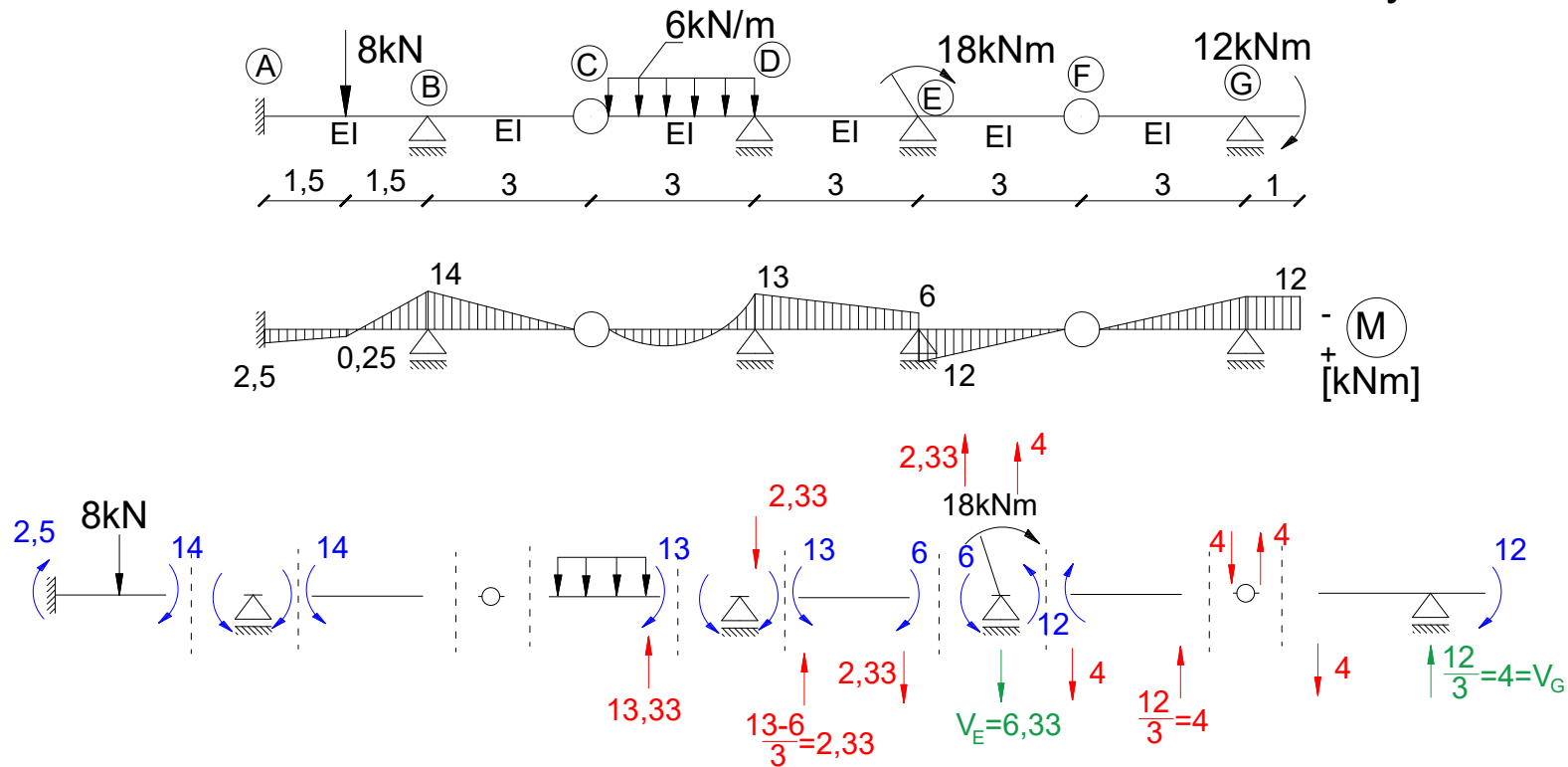
dr inż. Hanna Weber



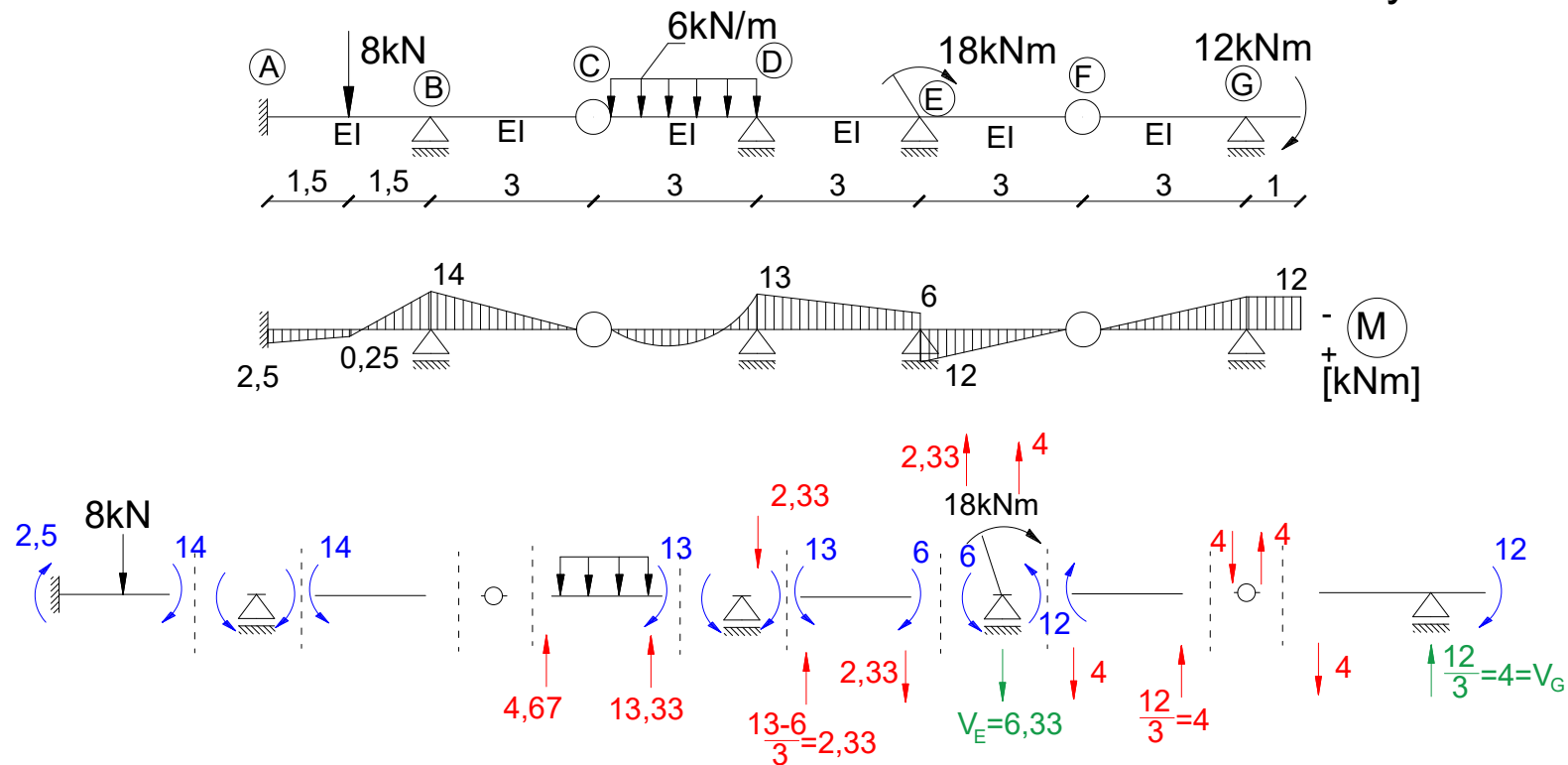
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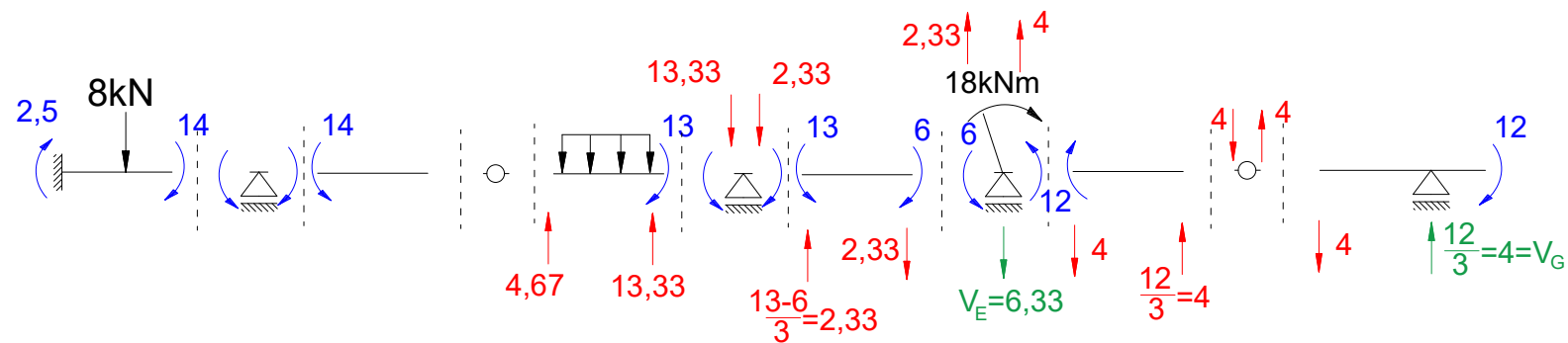
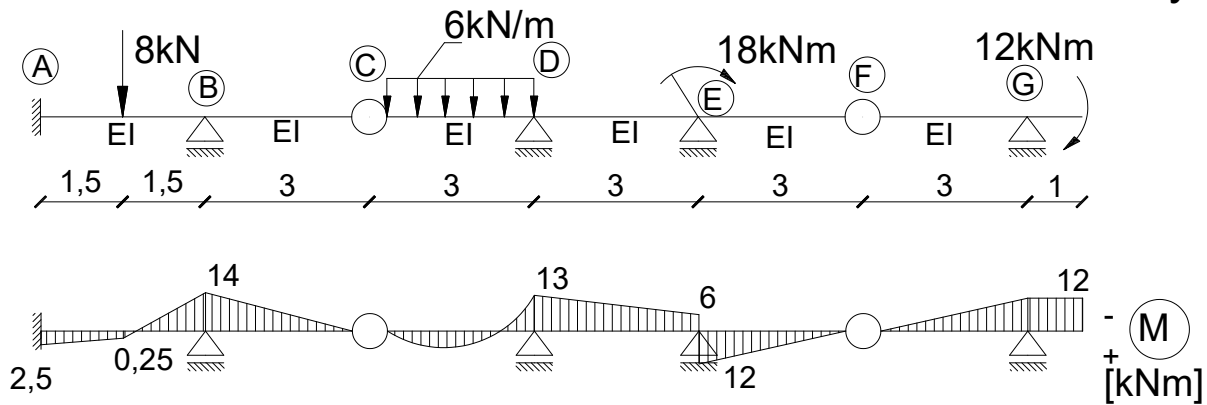
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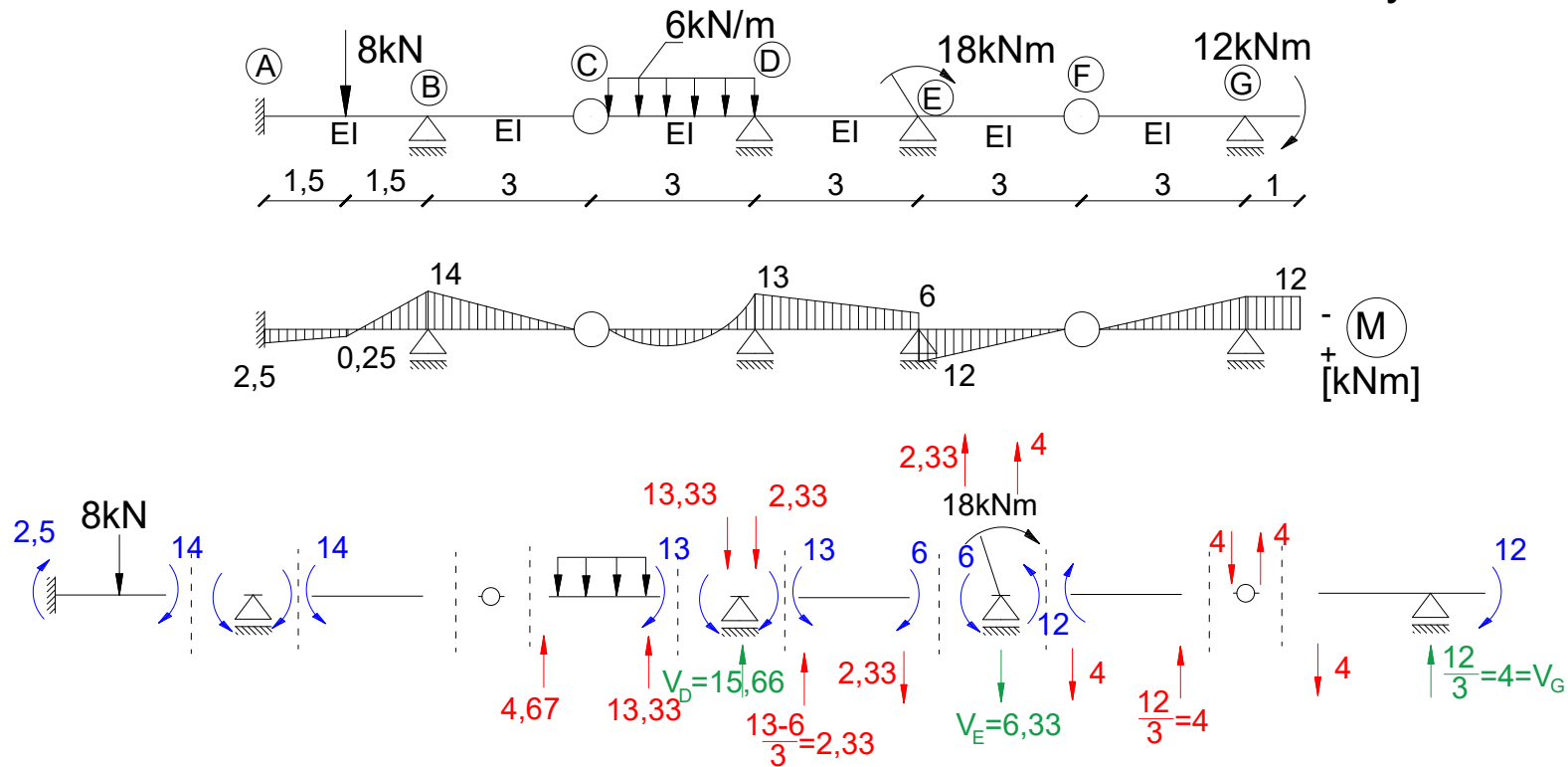
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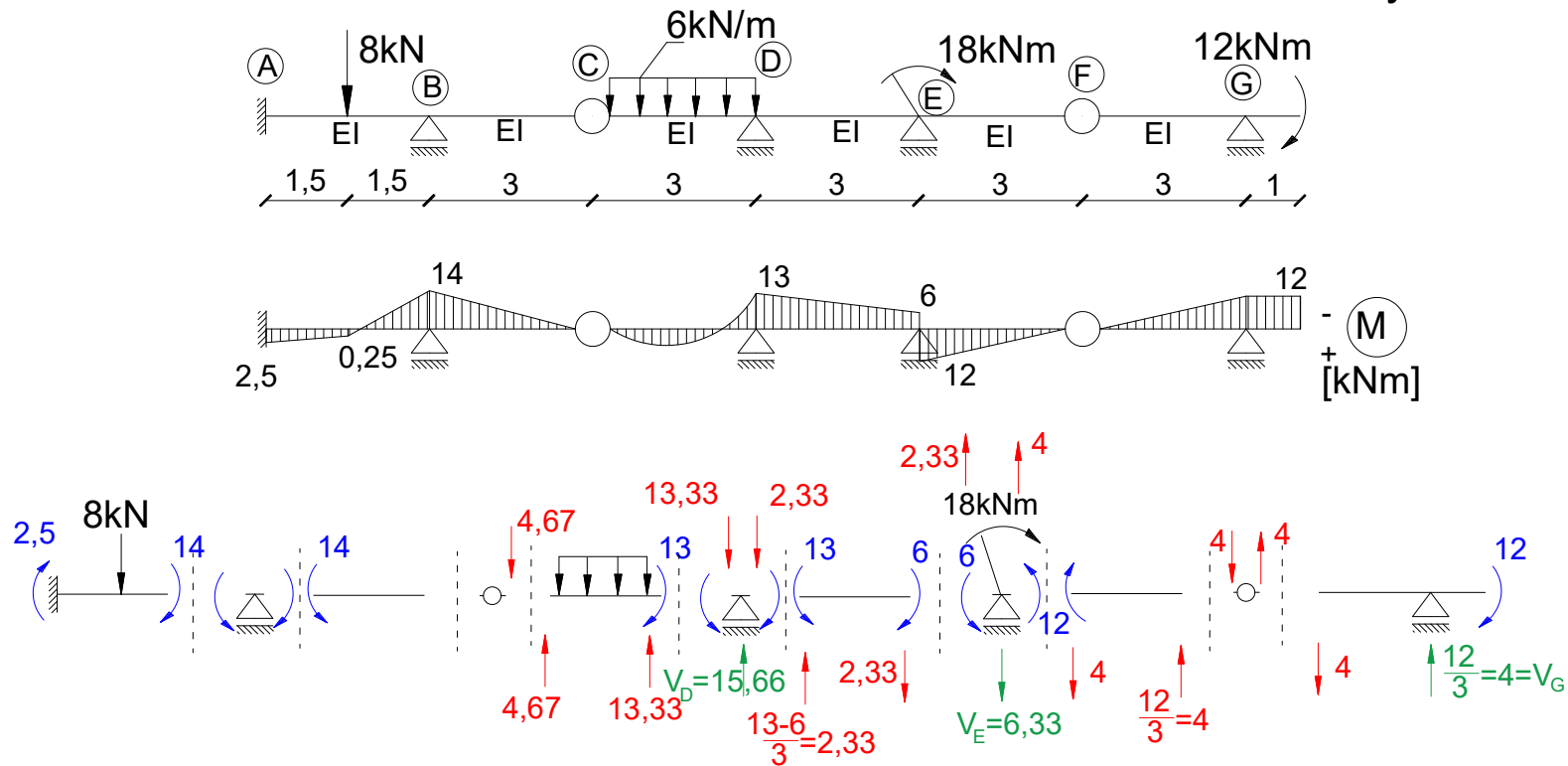
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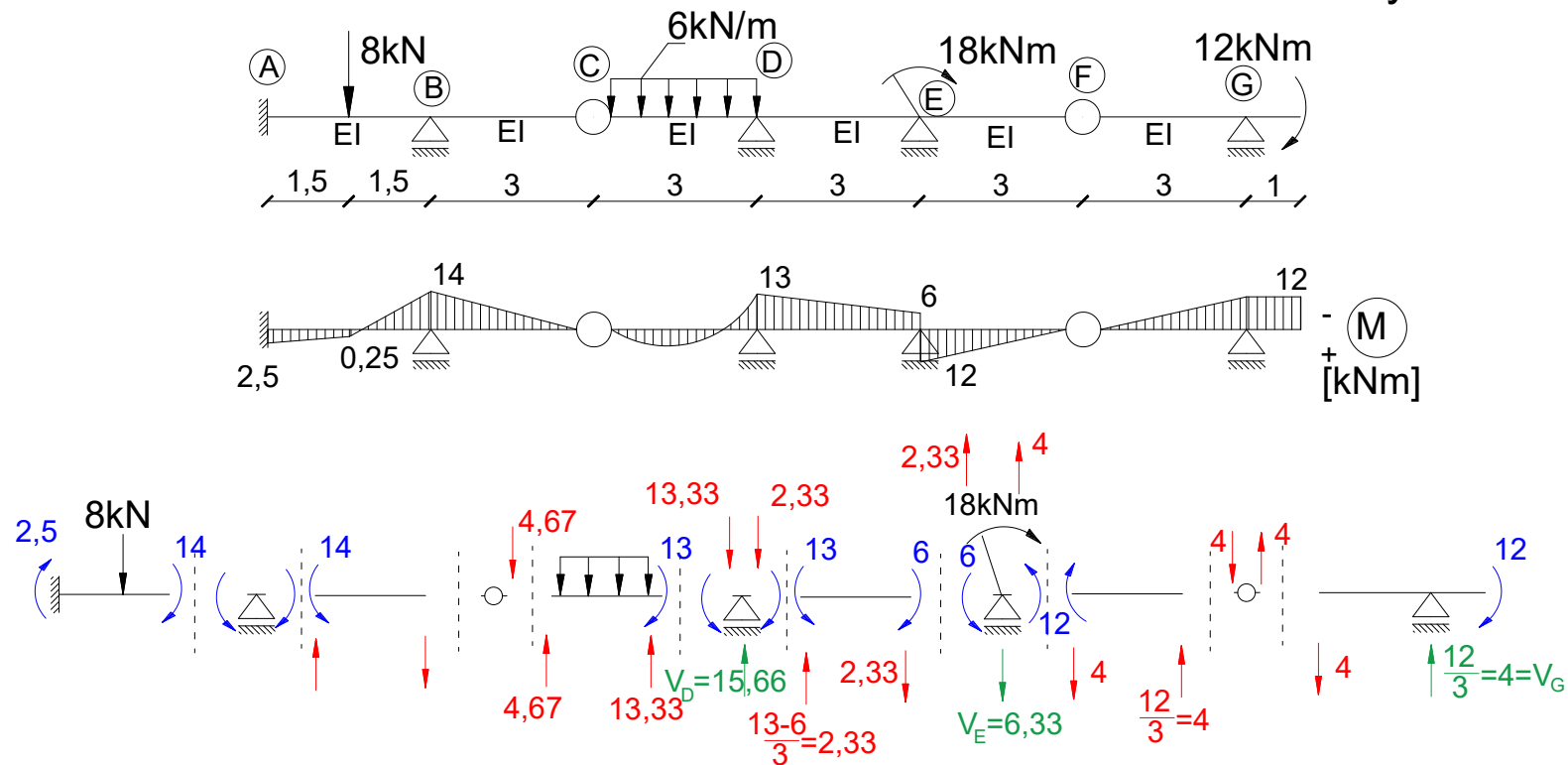
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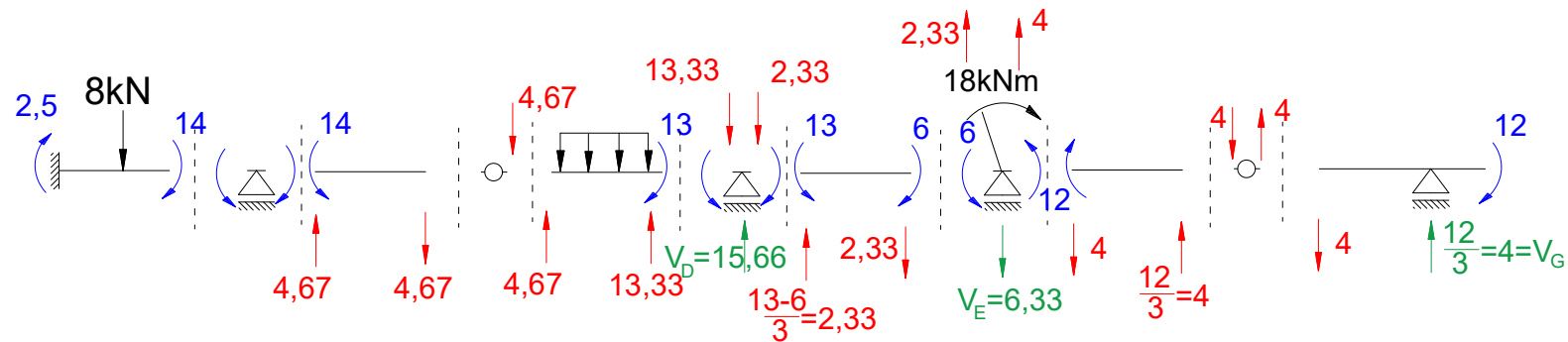
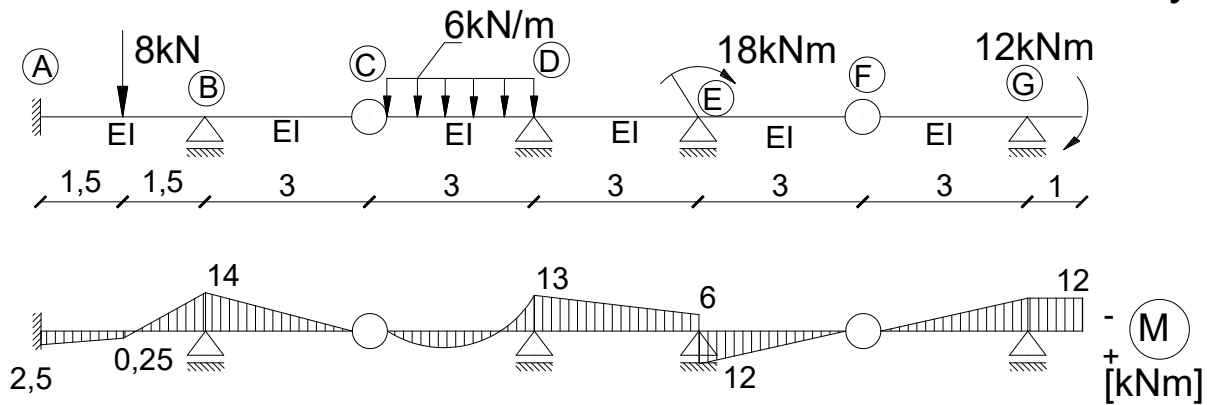
Wyznaczenie sił tnących:



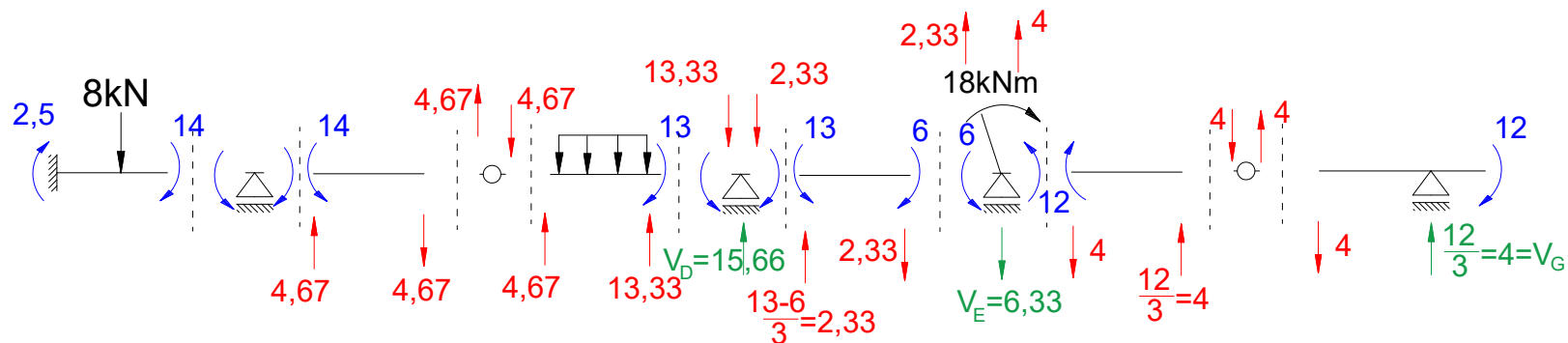
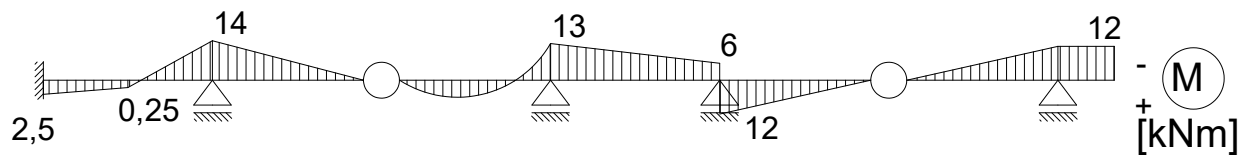
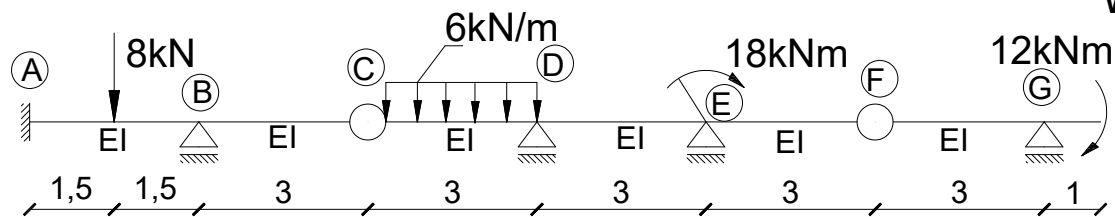
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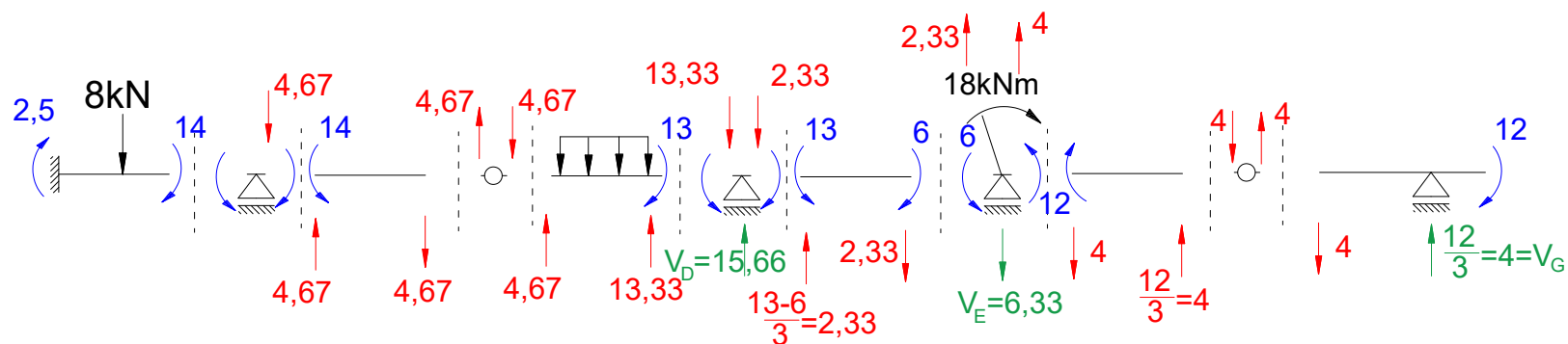
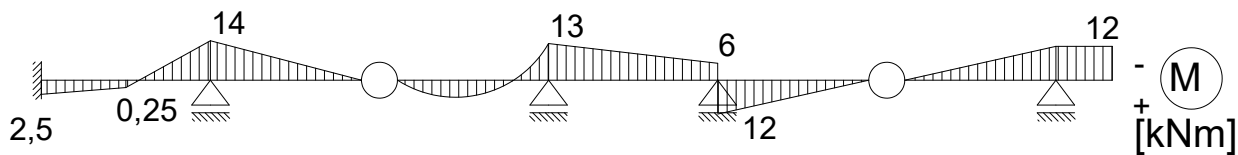
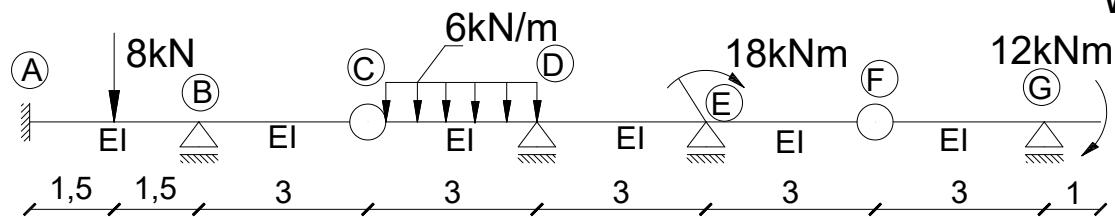
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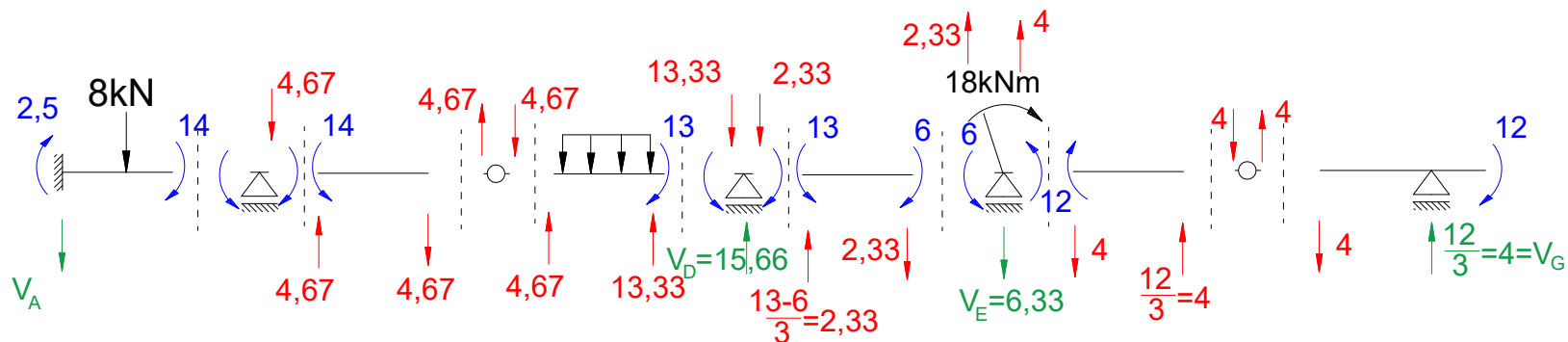
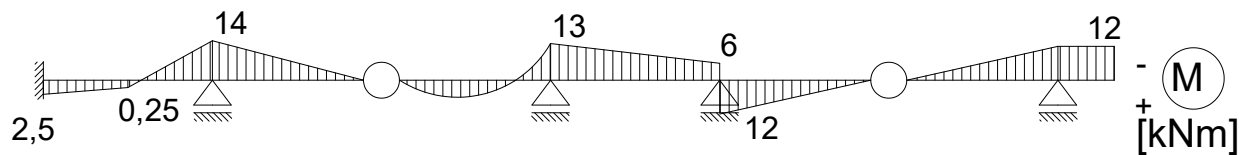
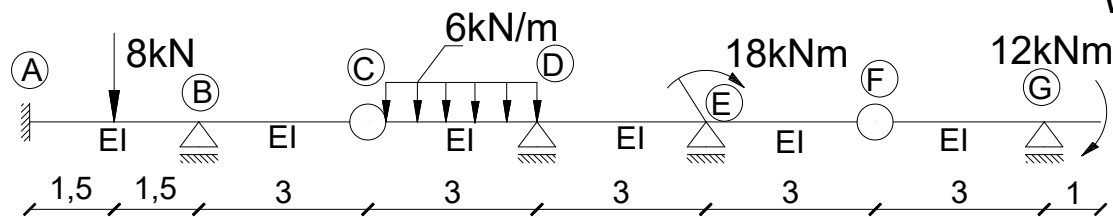
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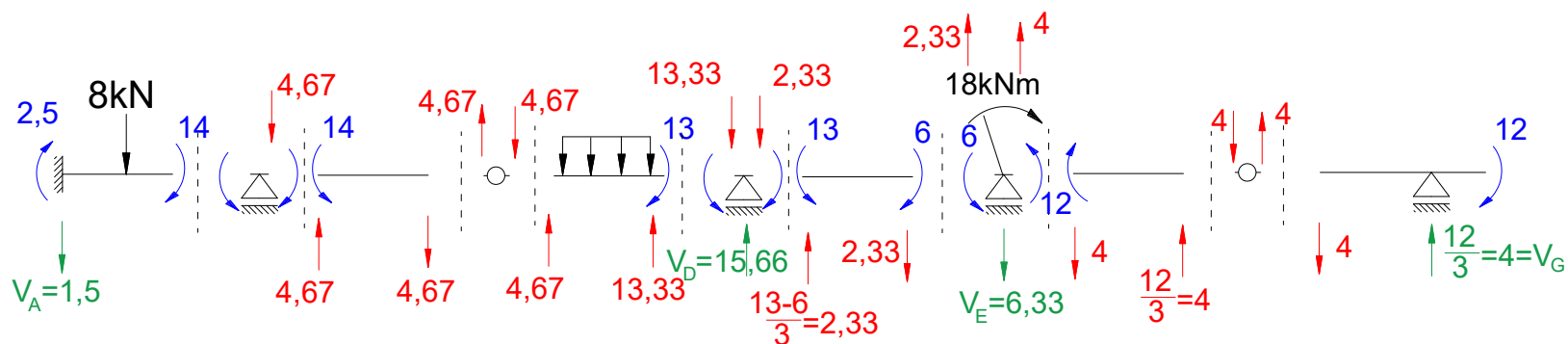
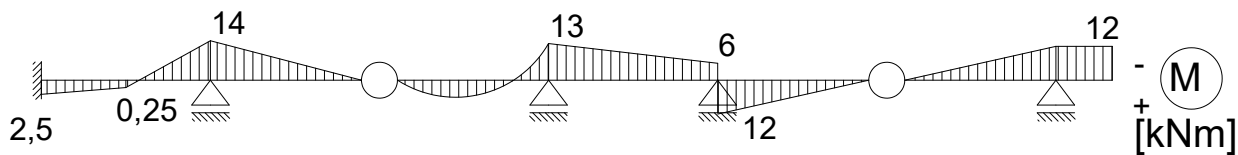
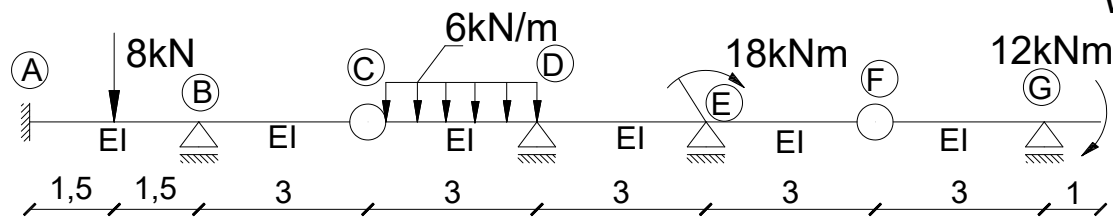
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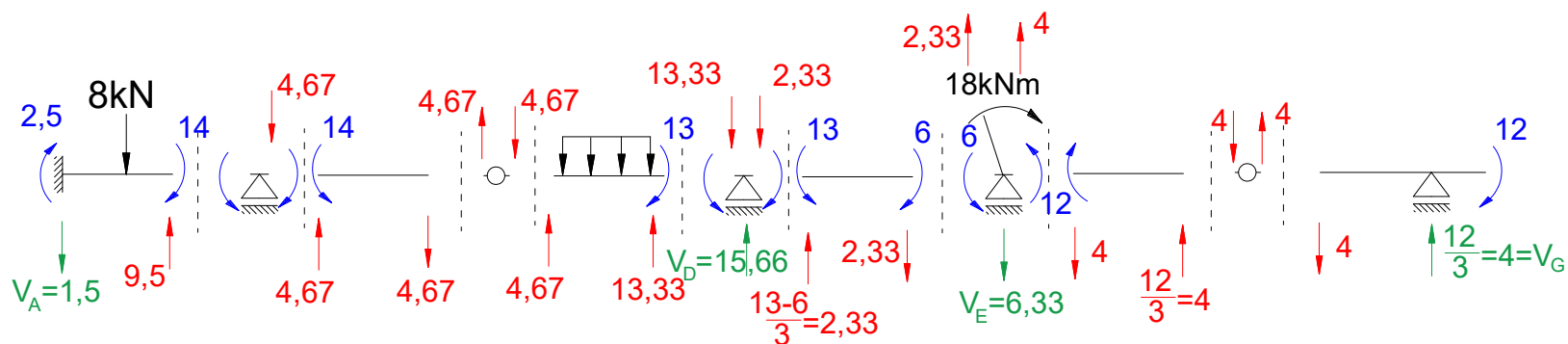
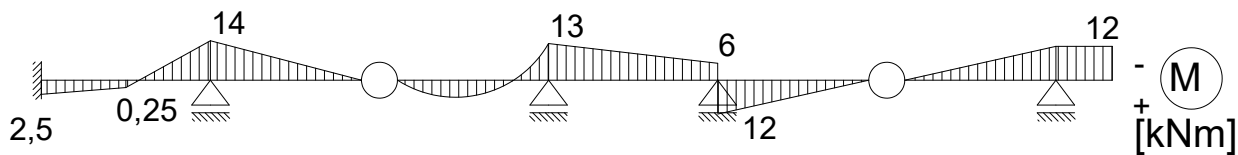
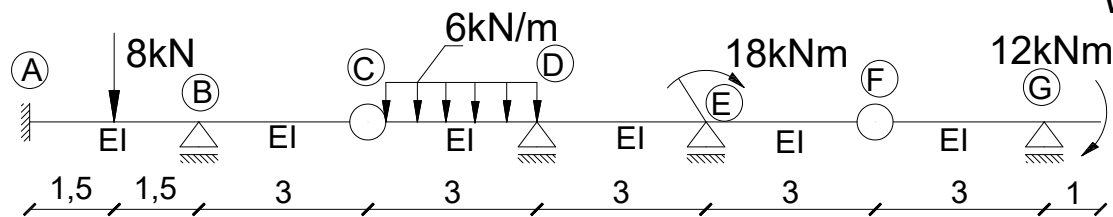
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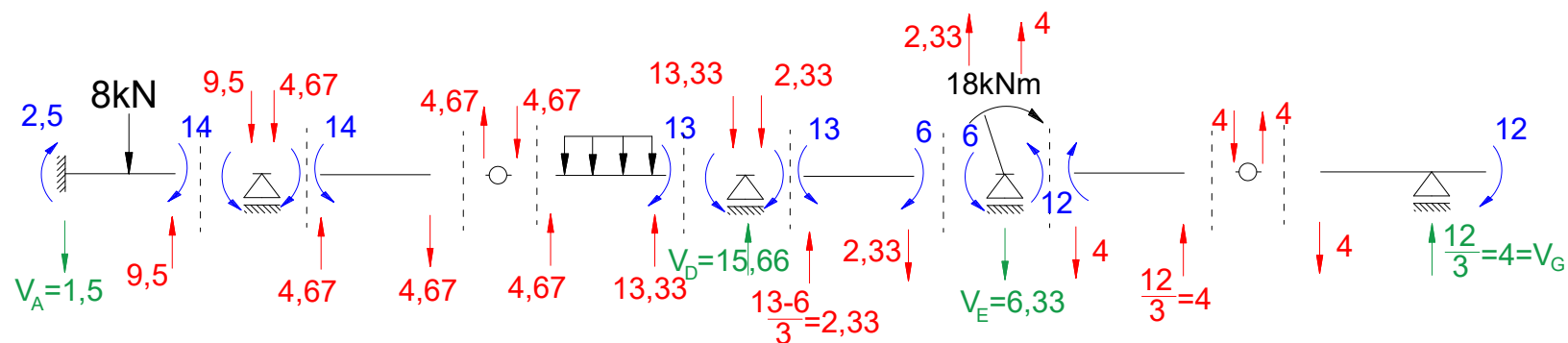
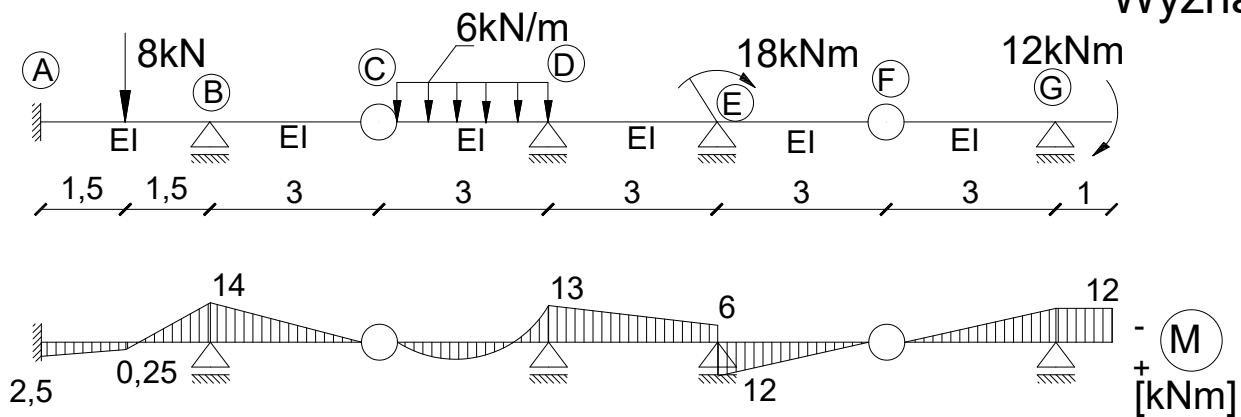
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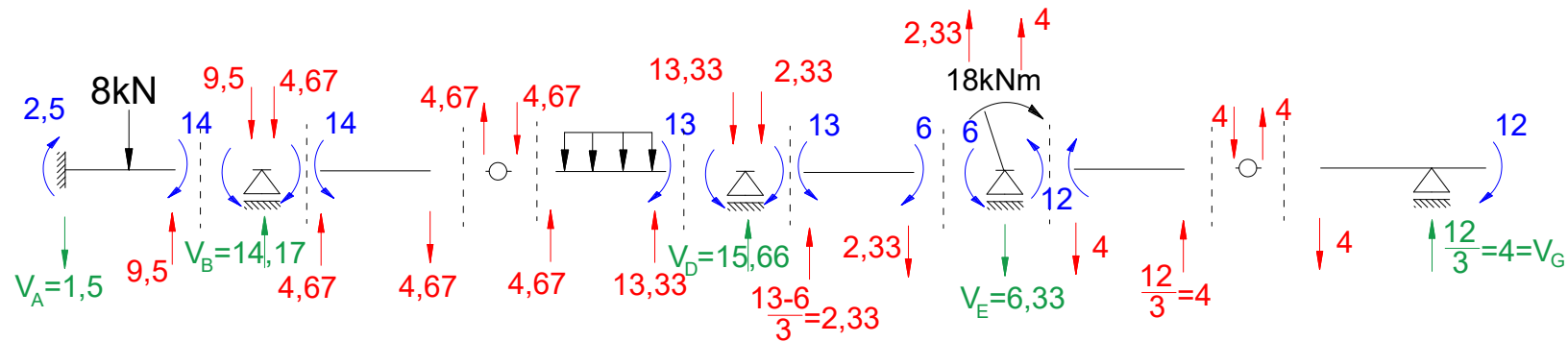
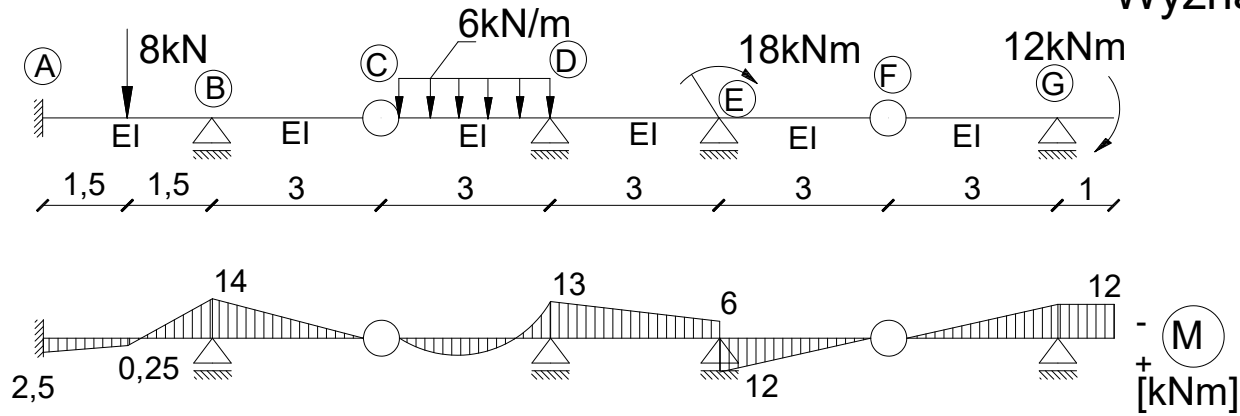
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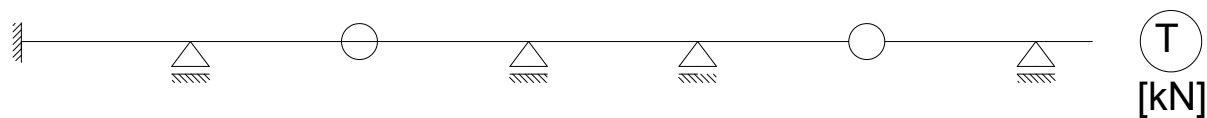
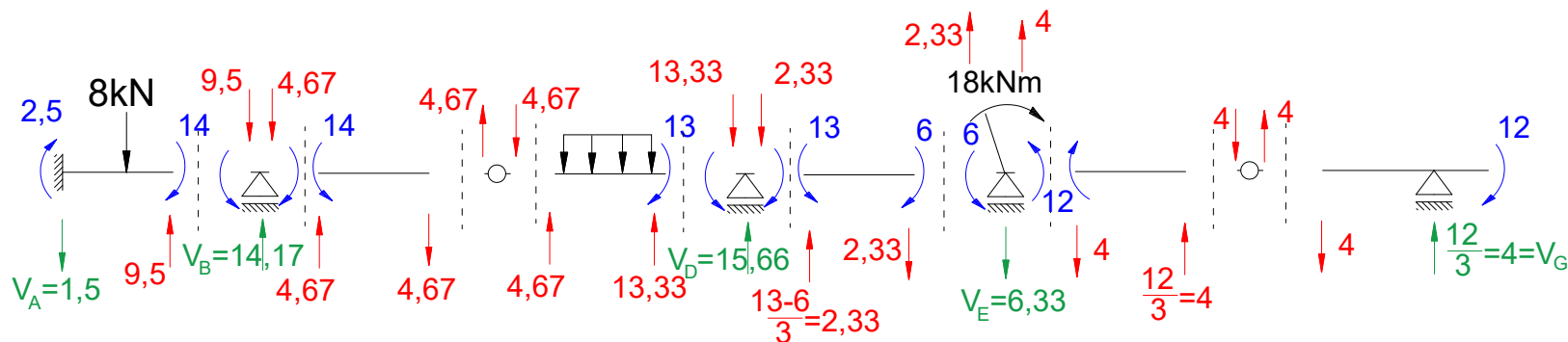
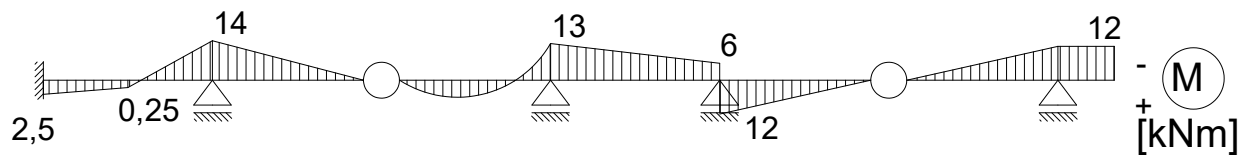
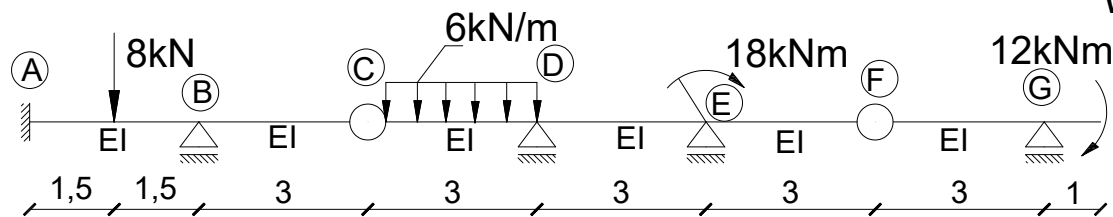
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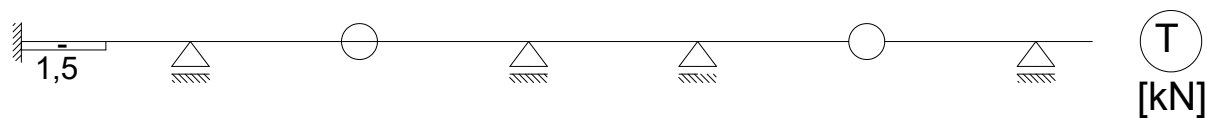
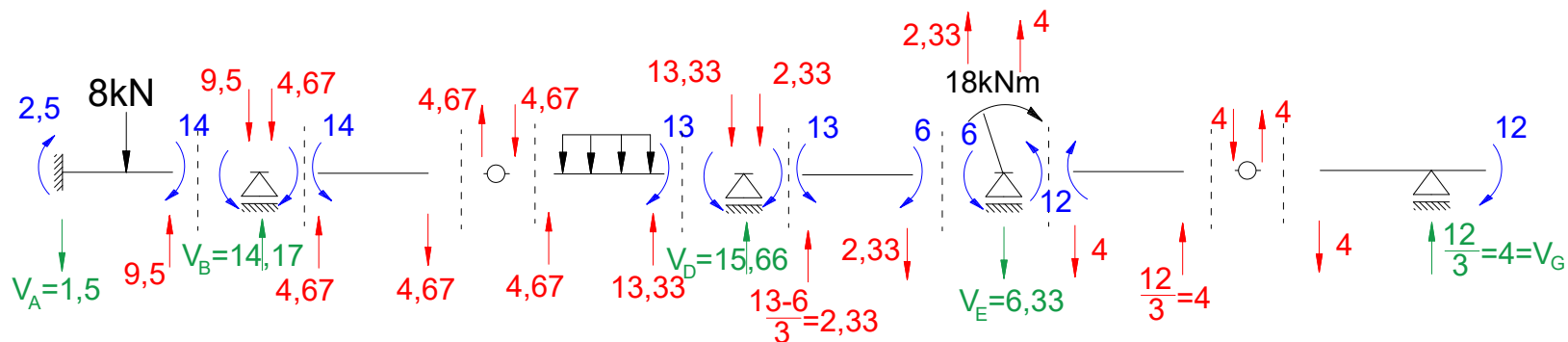
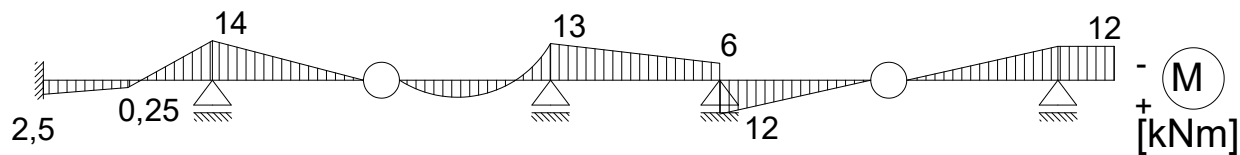
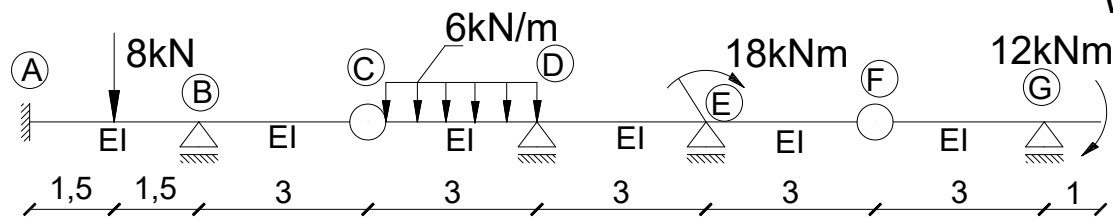
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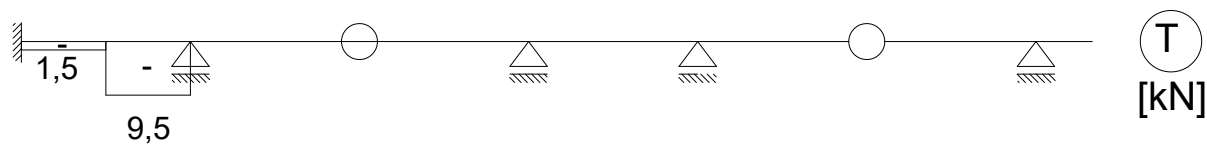
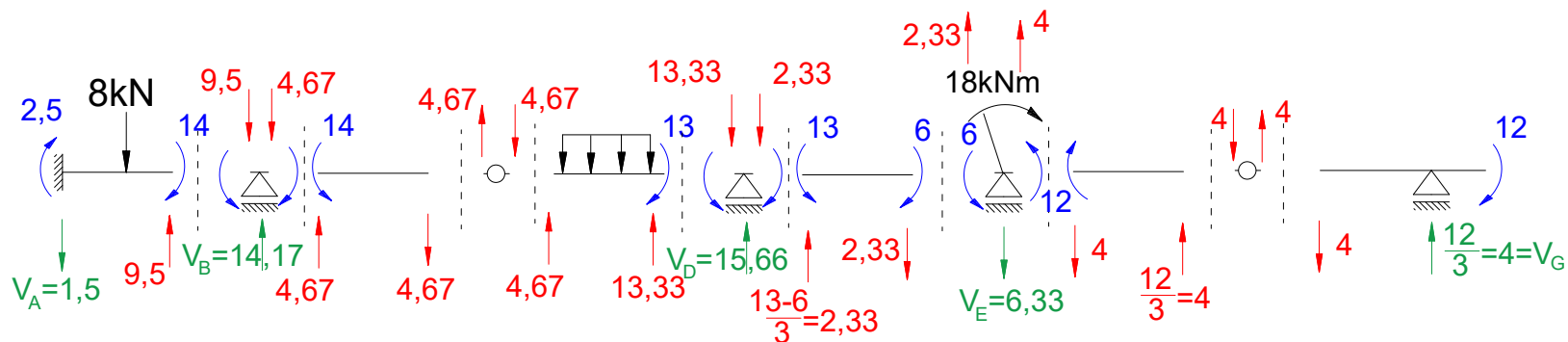
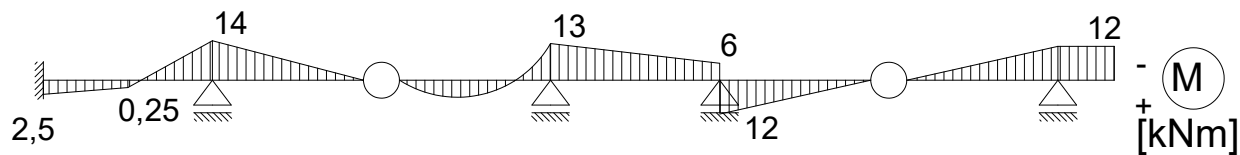
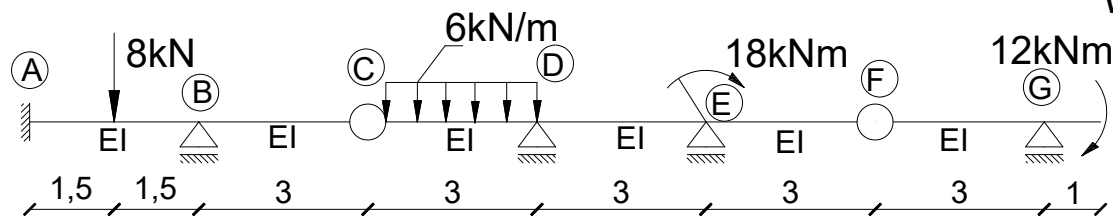
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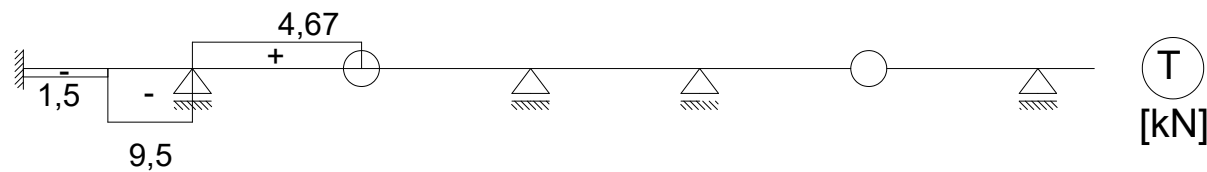
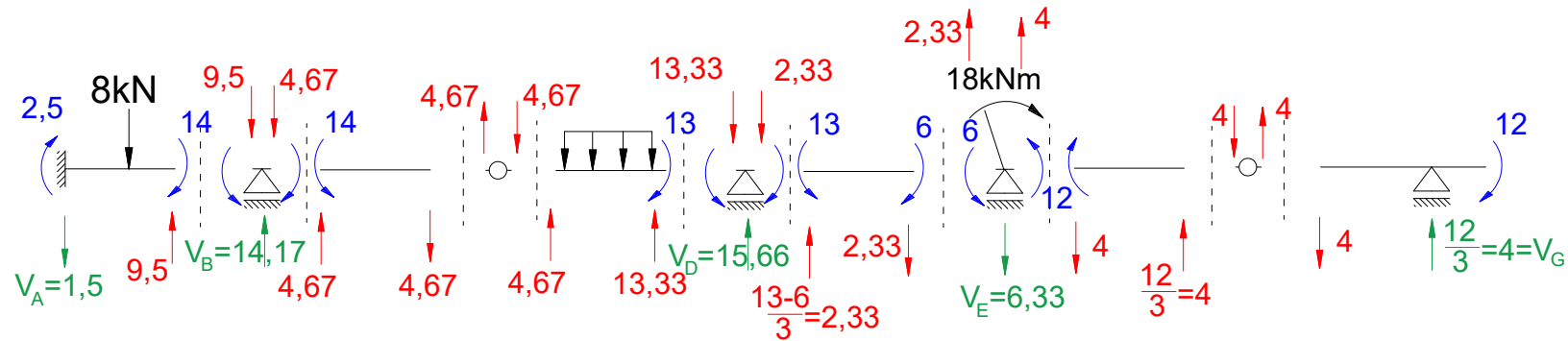
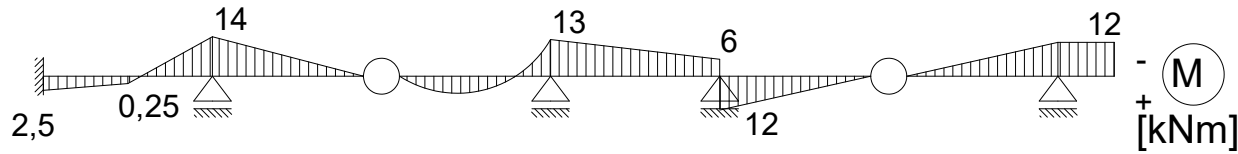
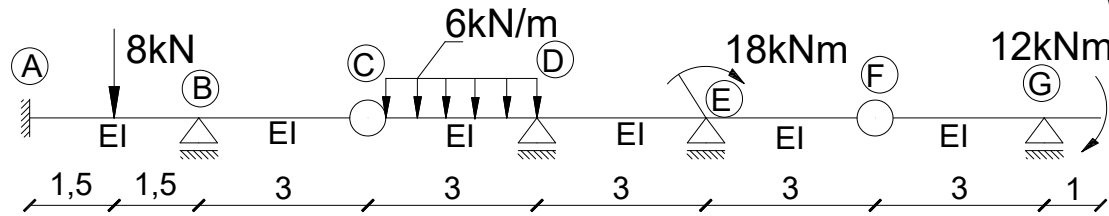
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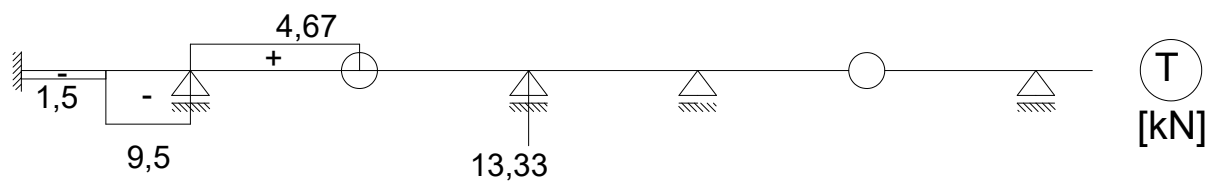
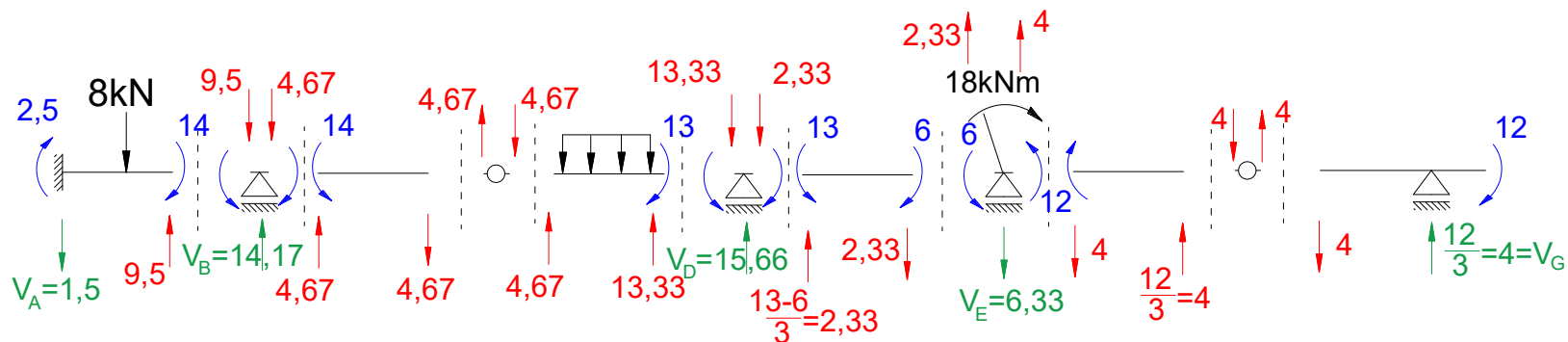
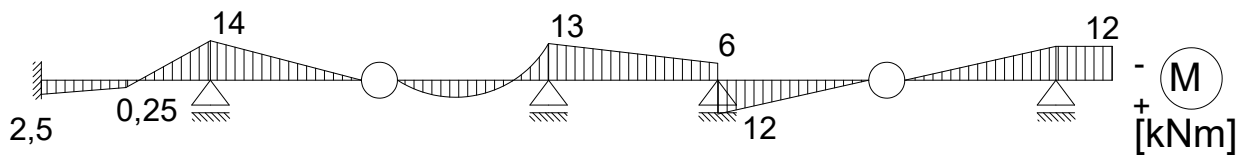
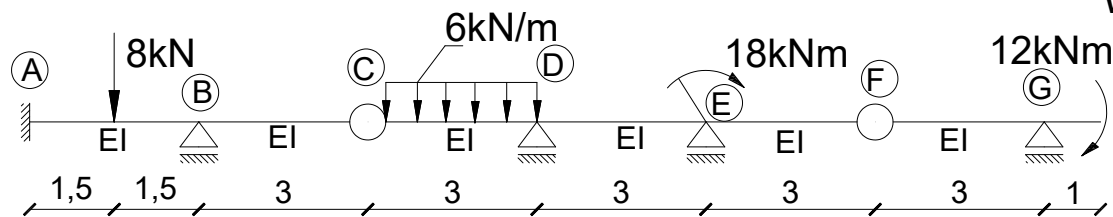
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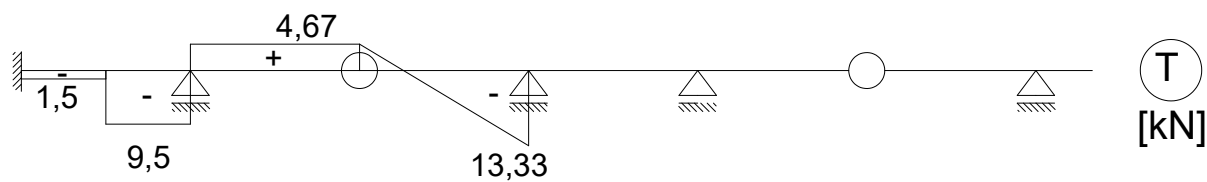
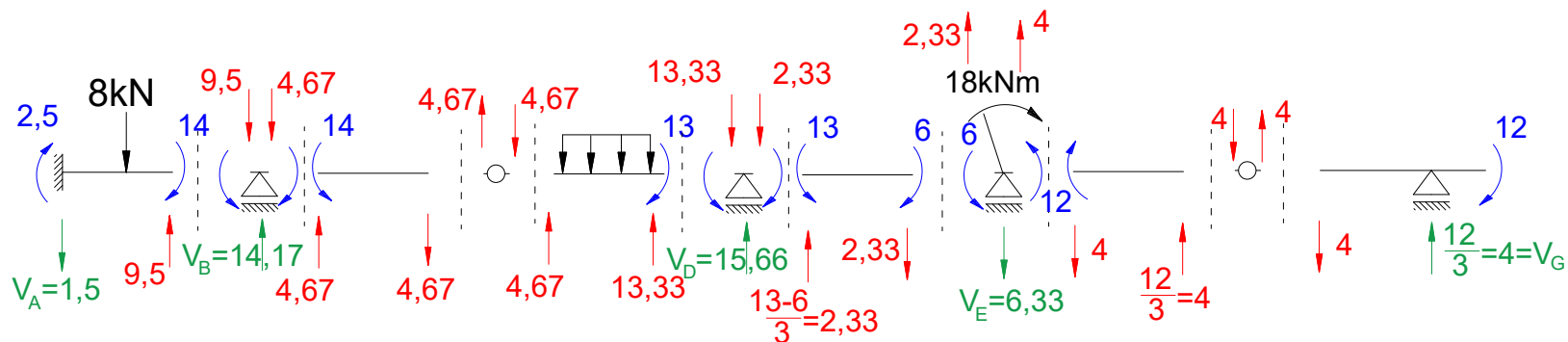
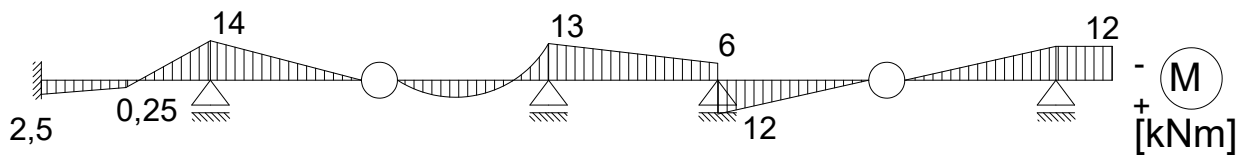
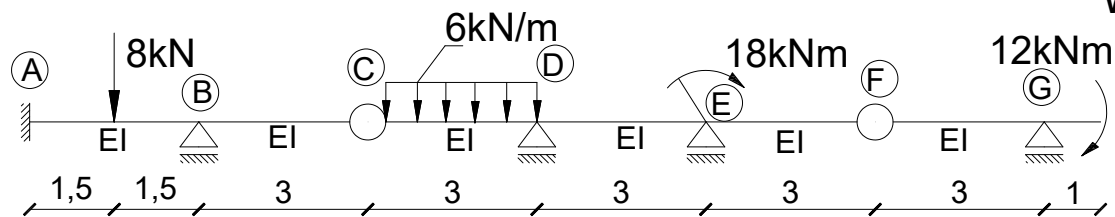
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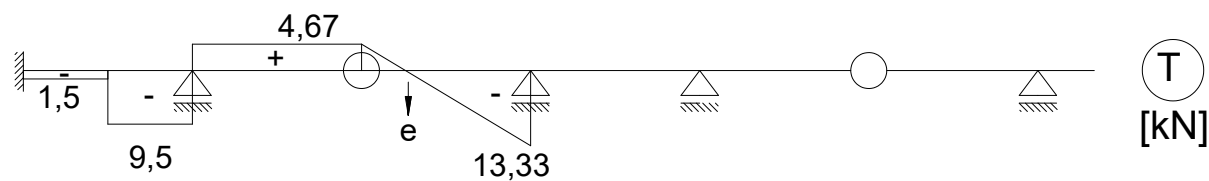
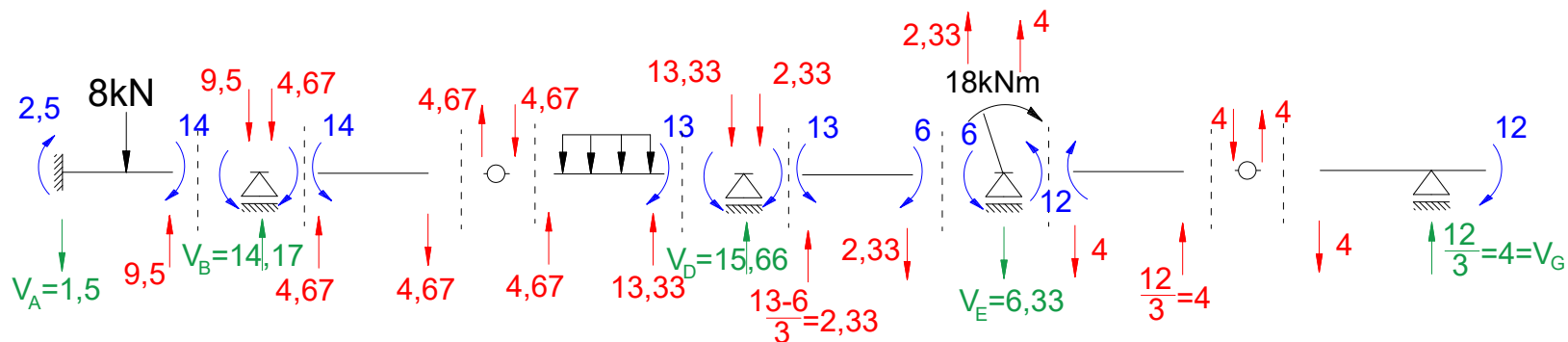
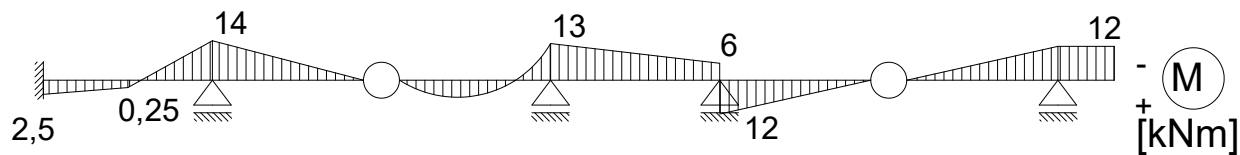
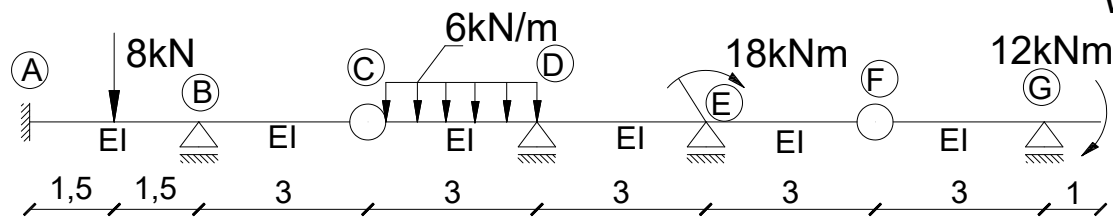
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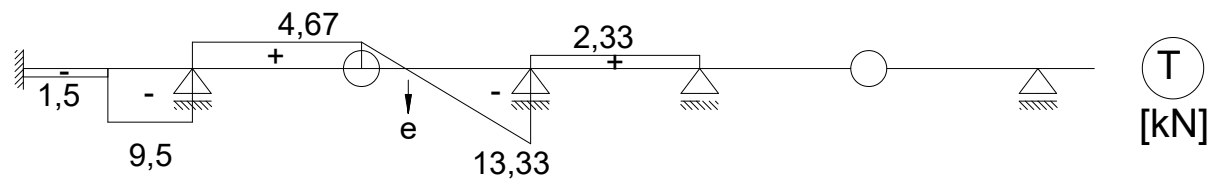
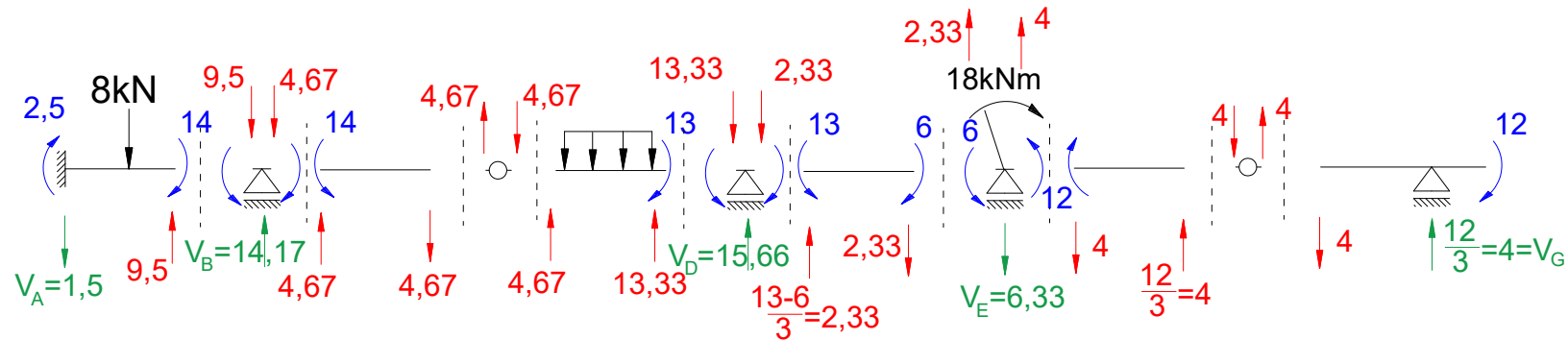
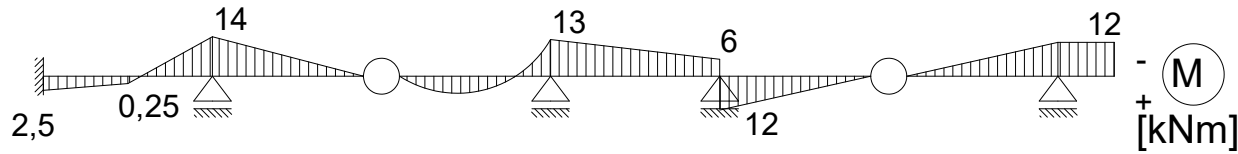
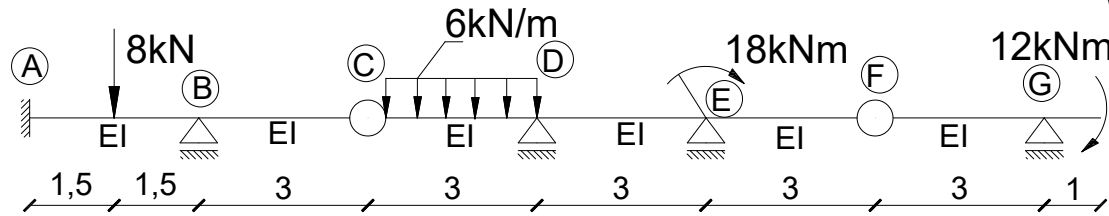
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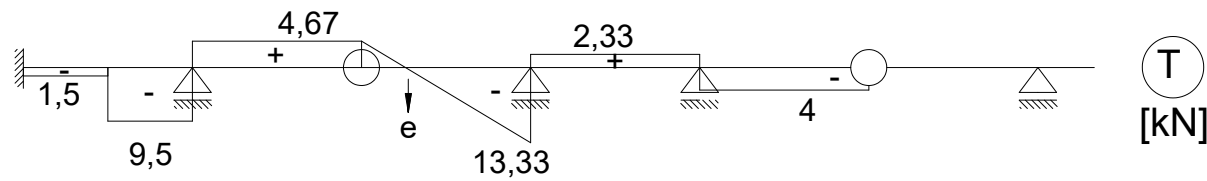
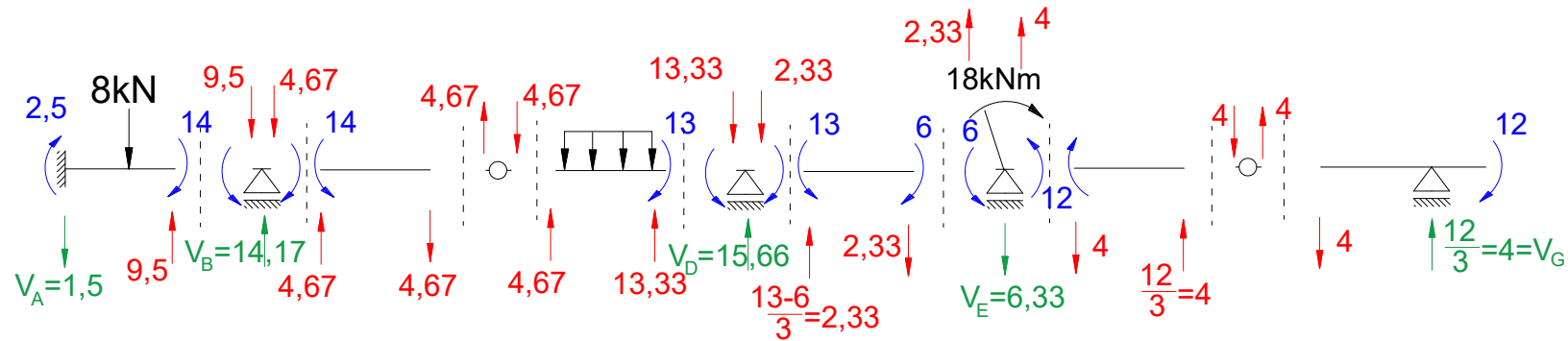
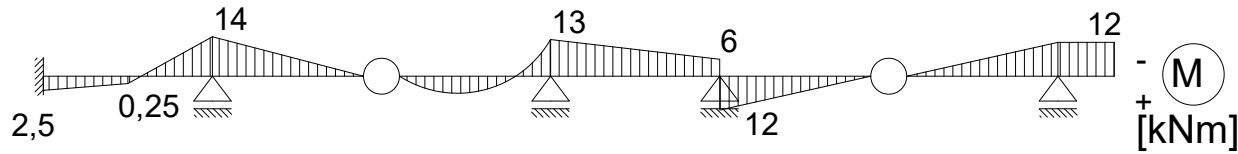
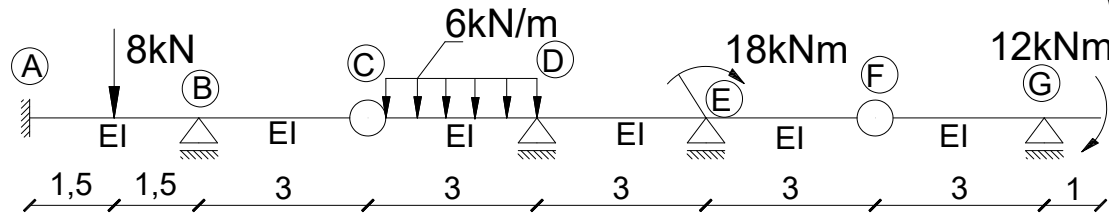
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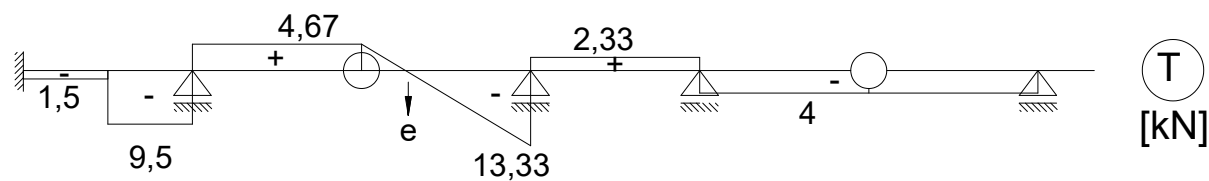
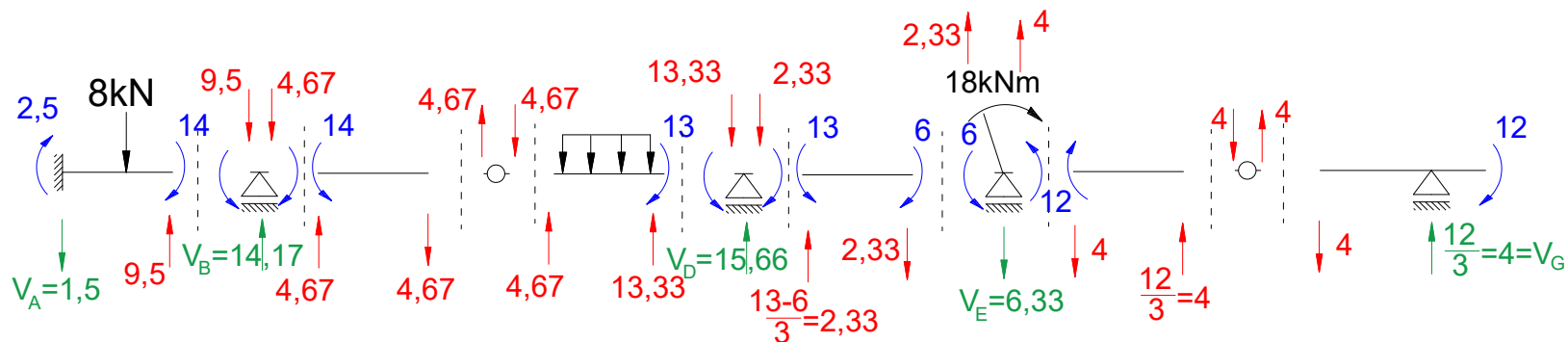
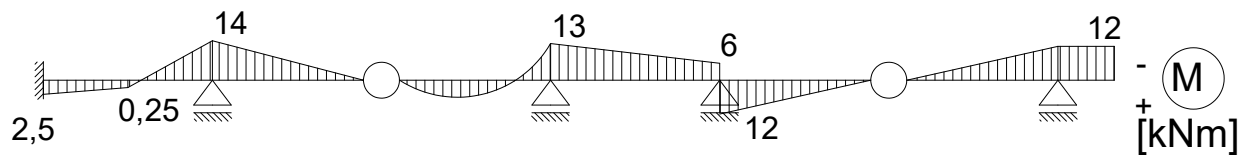
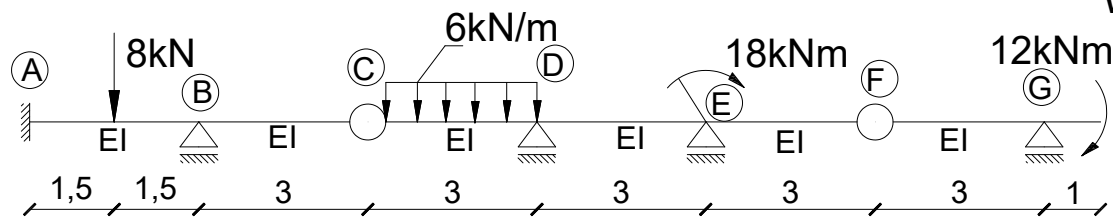
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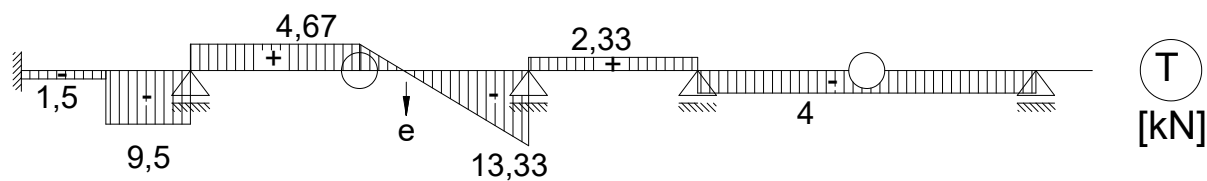
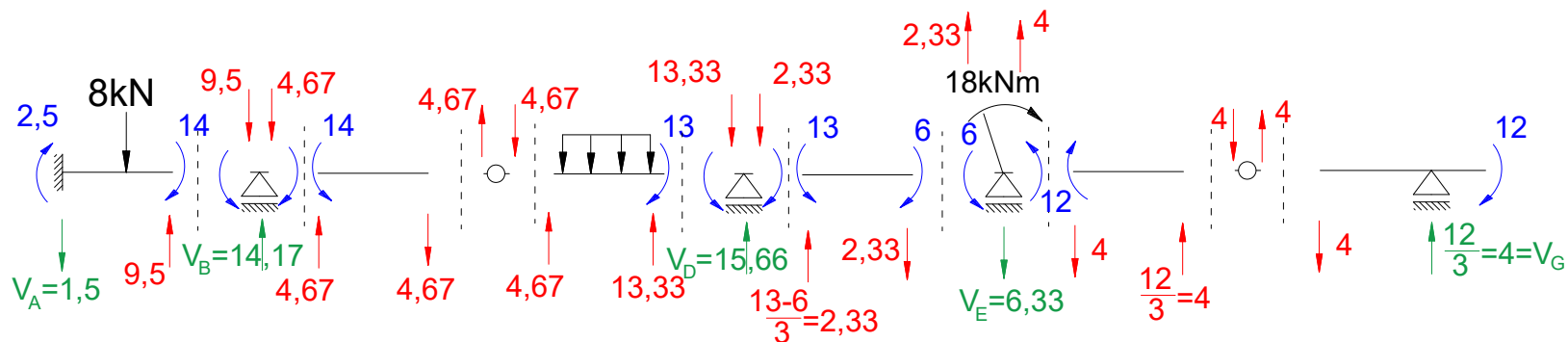
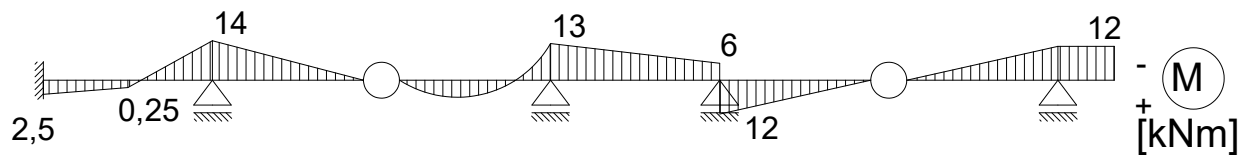
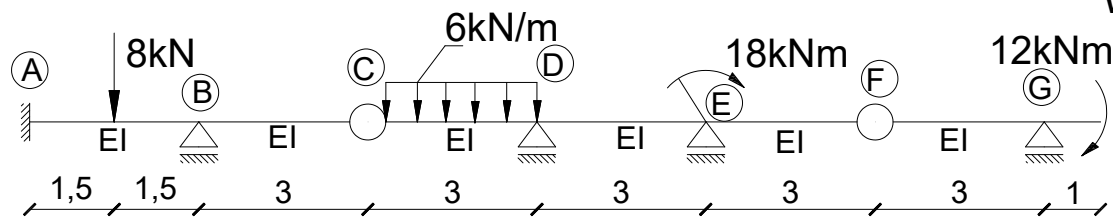
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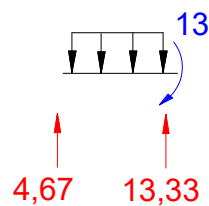
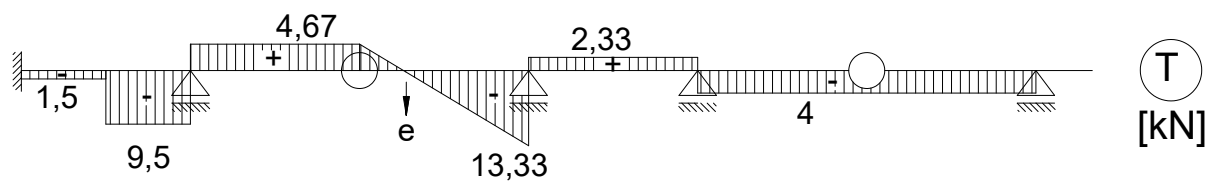
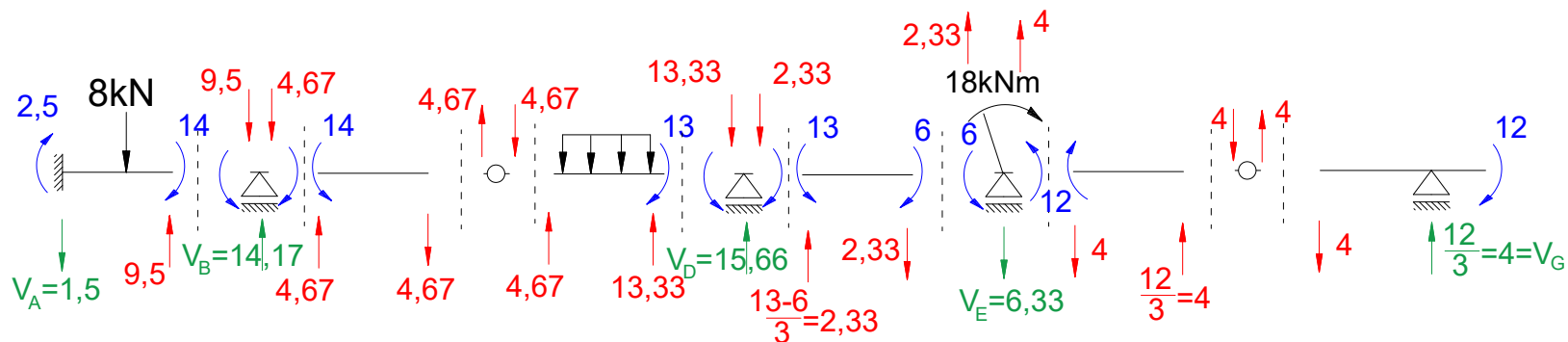
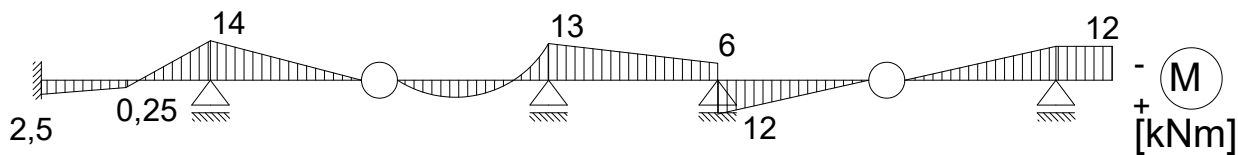
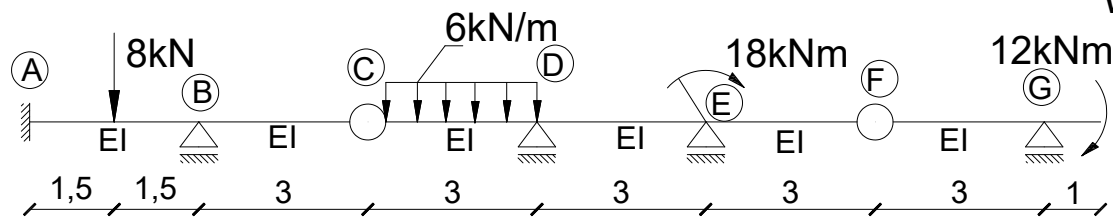
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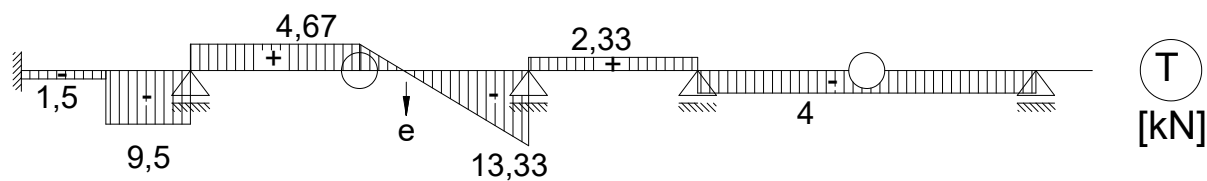
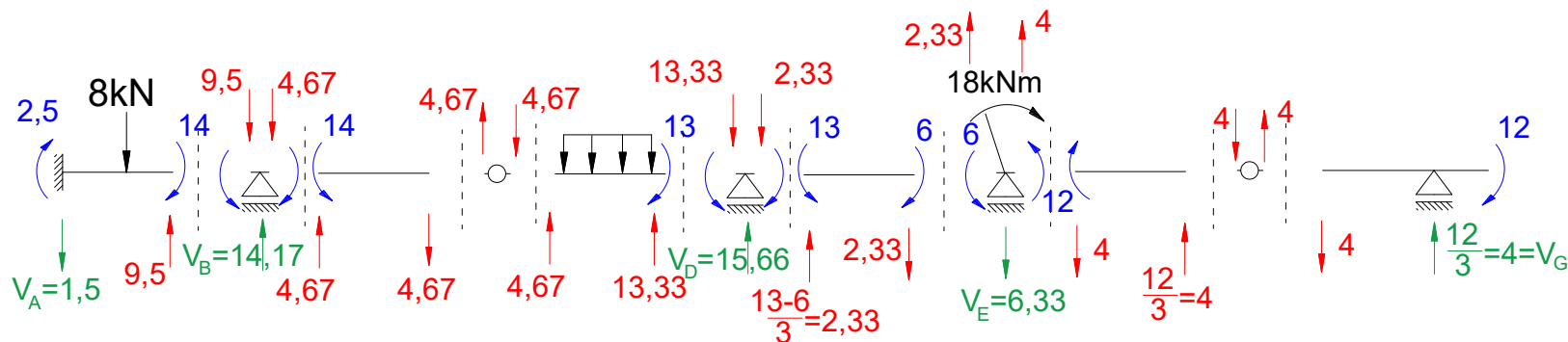
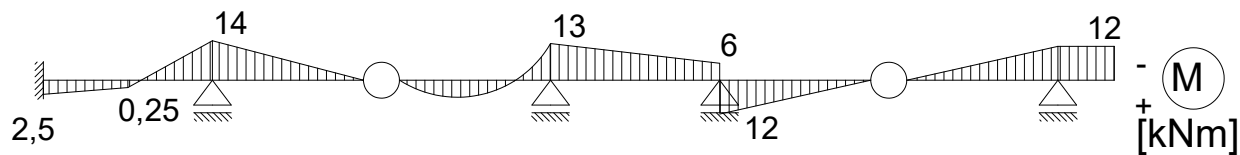
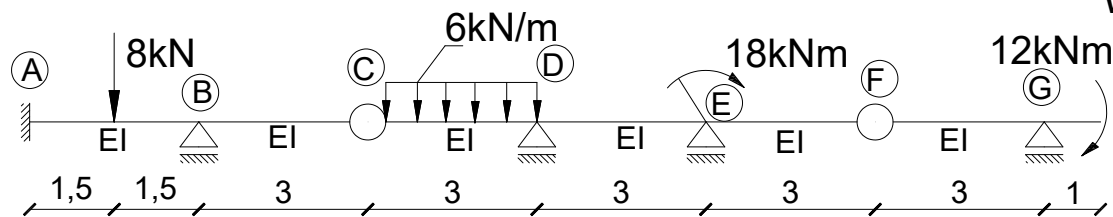
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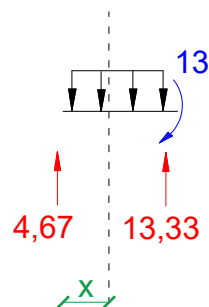
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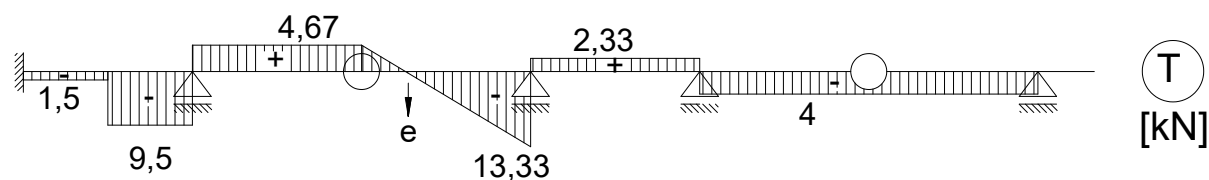
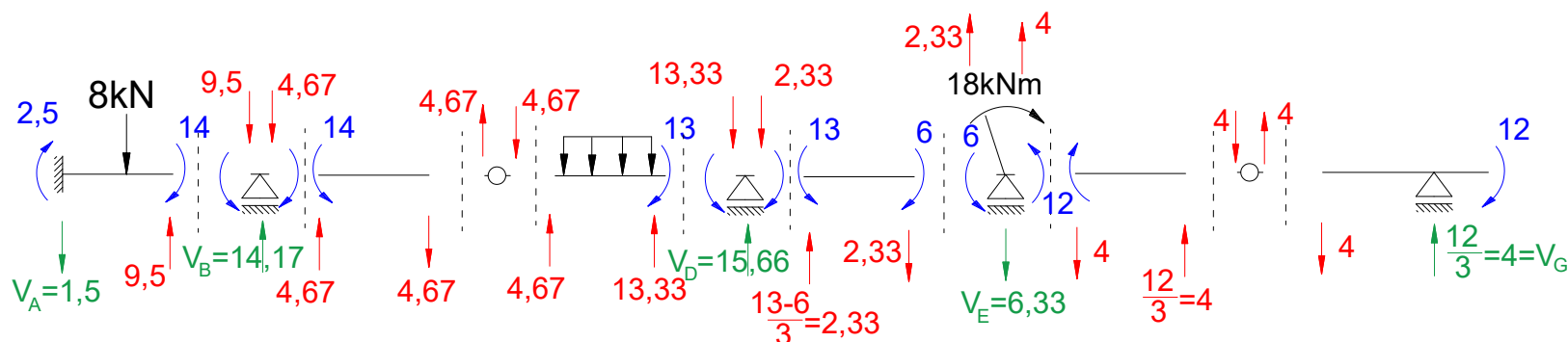
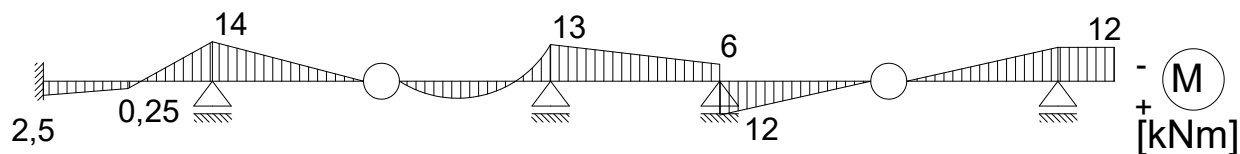
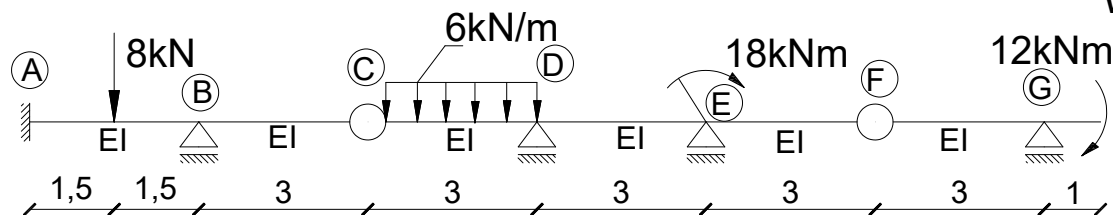
Wyznaczenie sił tnących:



Wyznaczenie ekstremum:

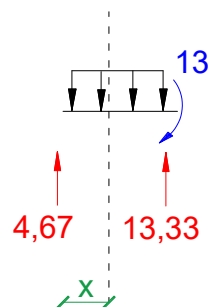


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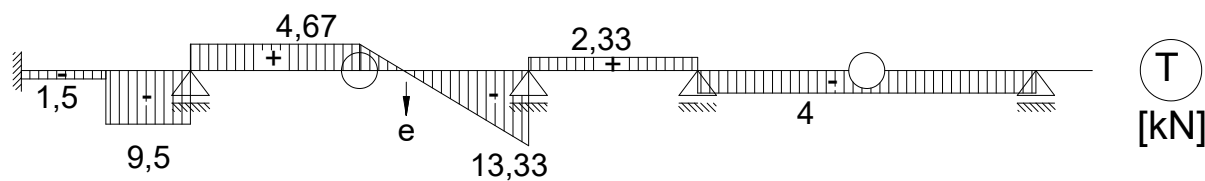
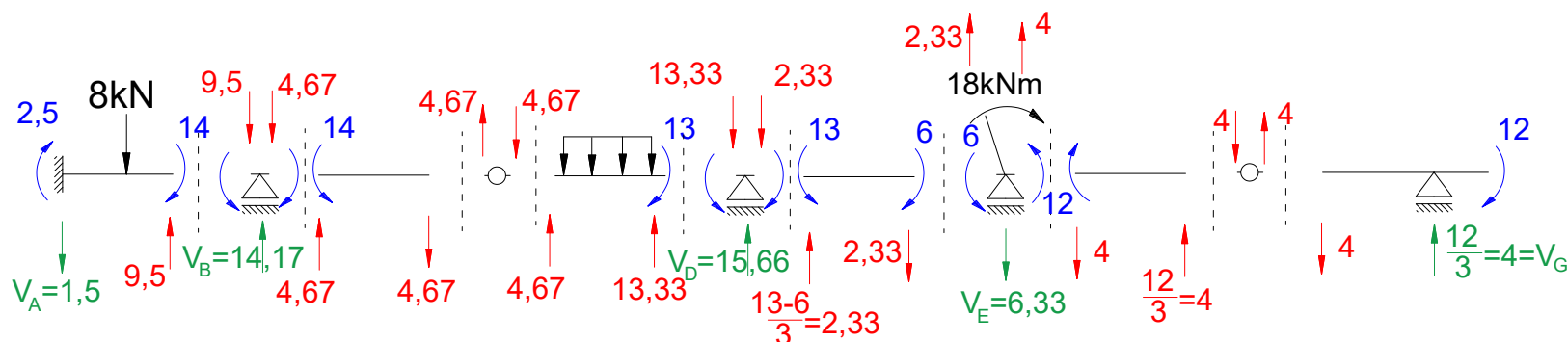
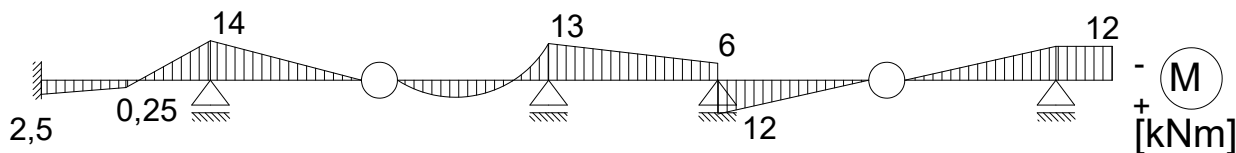
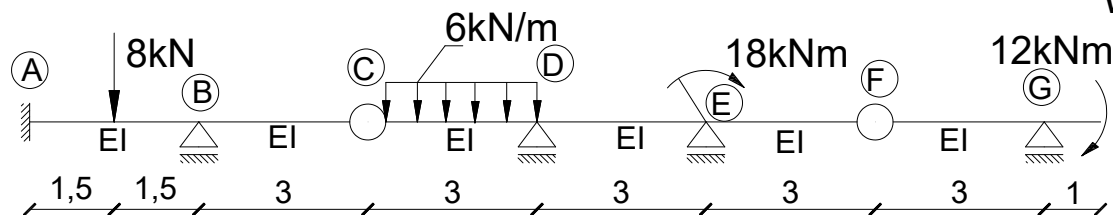


Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0$$

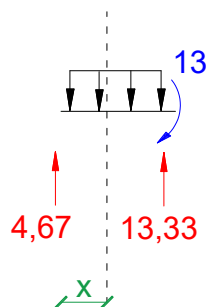


Wyznaczenie sił tnących:

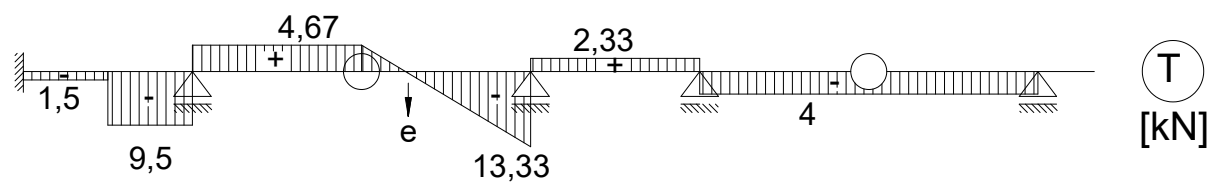
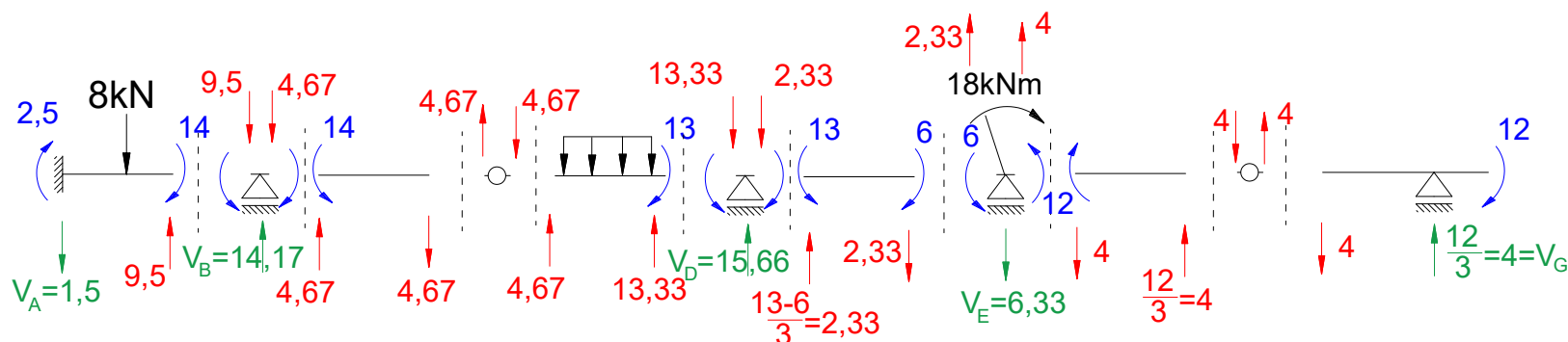
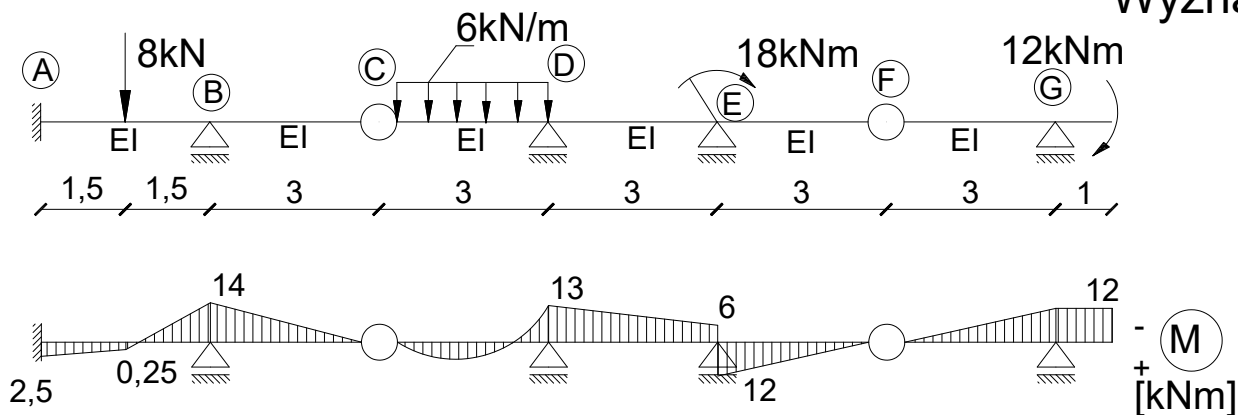


Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6}$$

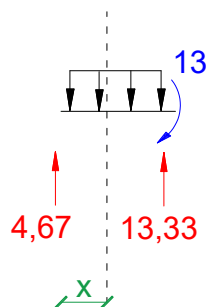


Wyznaczenie sił tnących:

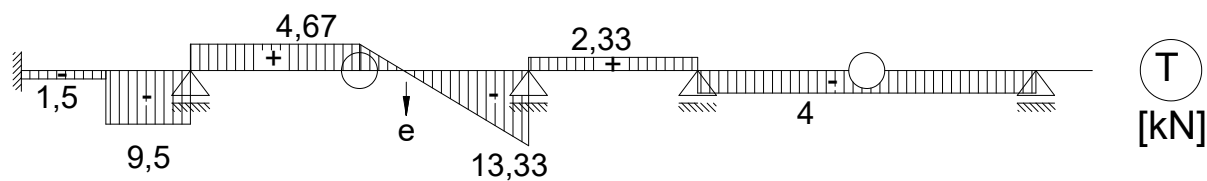
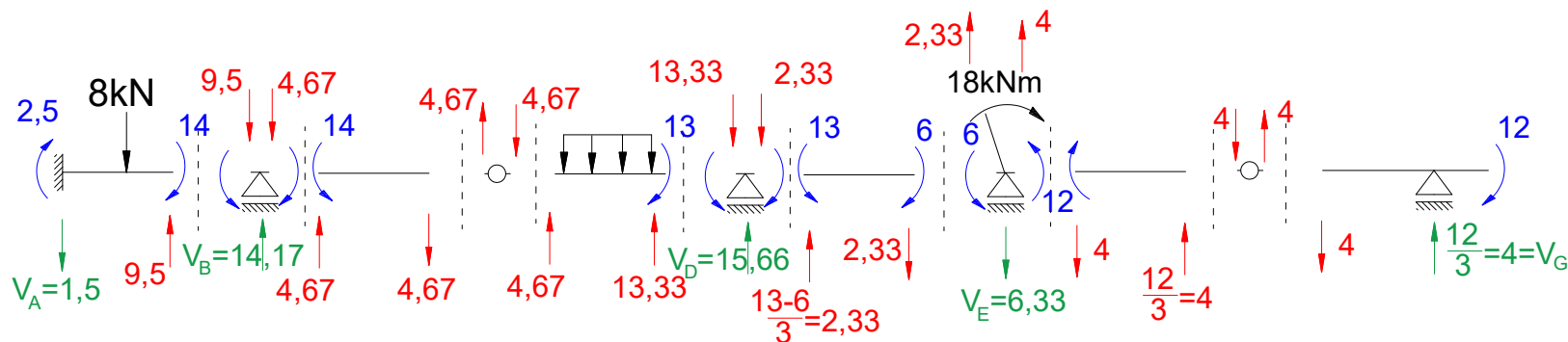
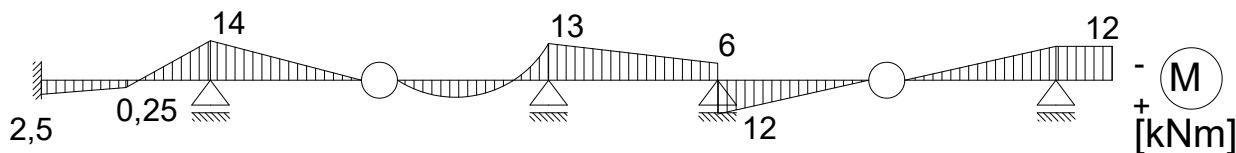
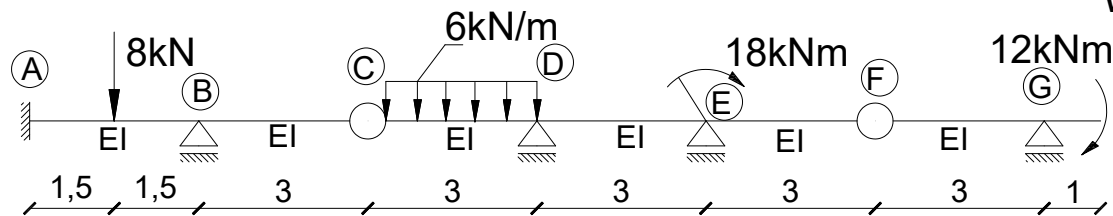


Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6} = 0,78m$$



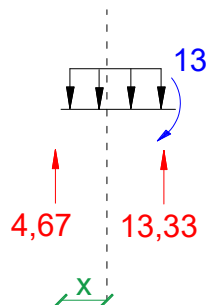
Wyznaczenie sił tnących:



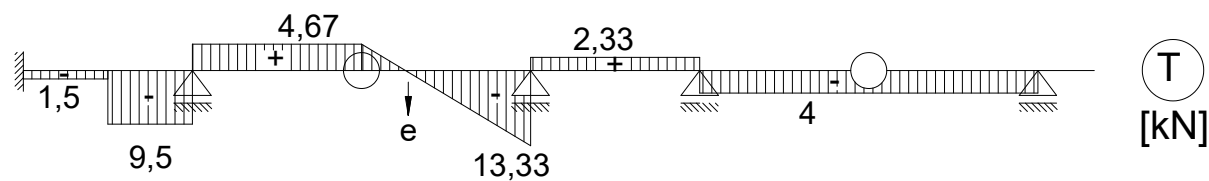
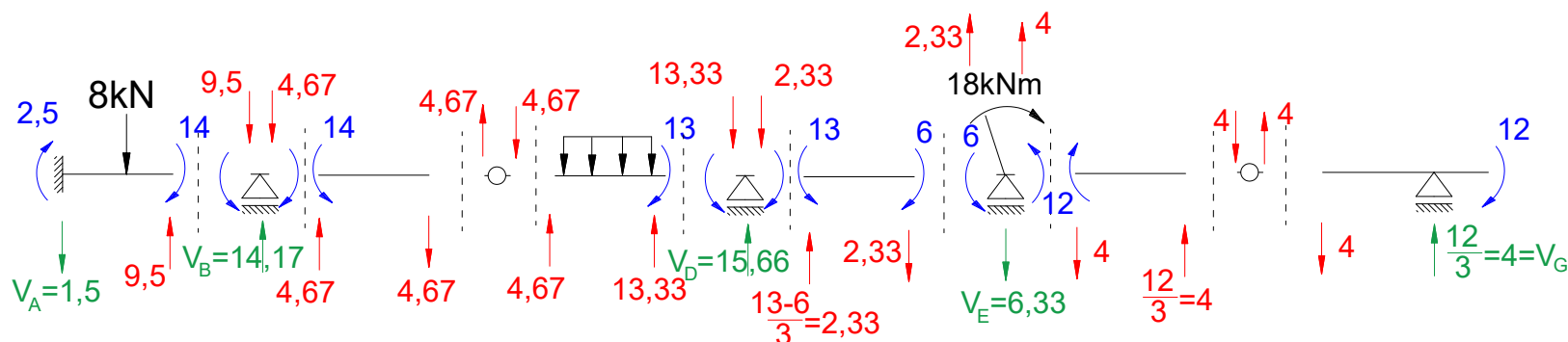
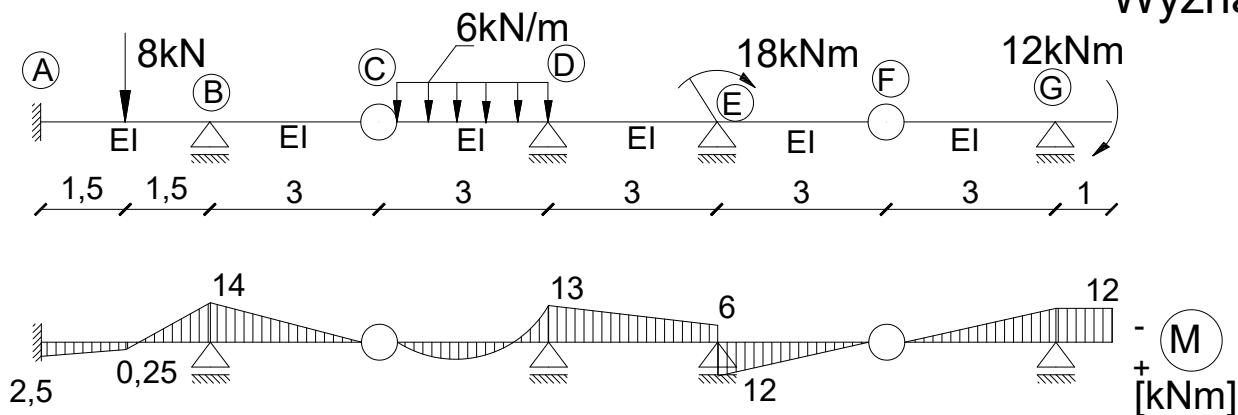
Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6} = 0,78m$$

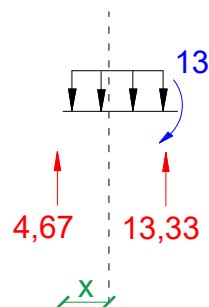
$$M[x = 0,78] =$$



Wyznaczenie sił tnących:



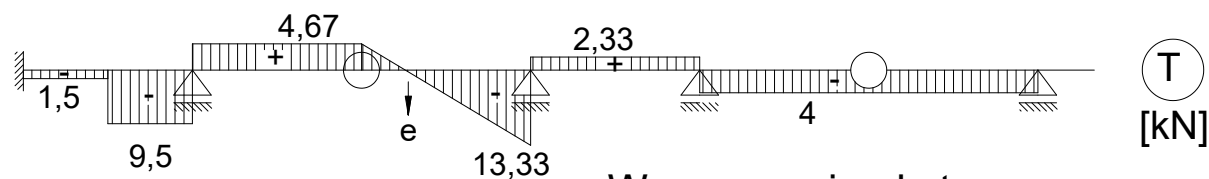
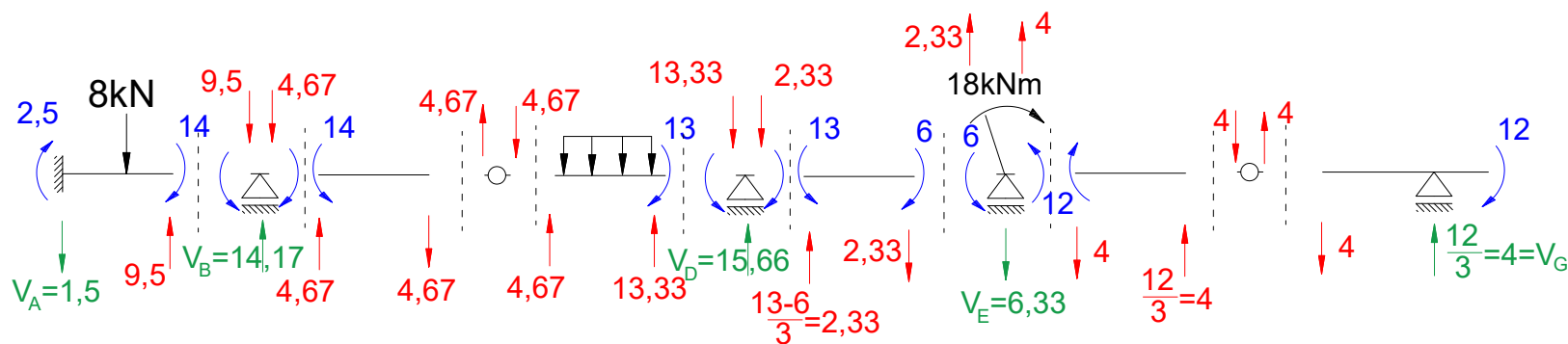
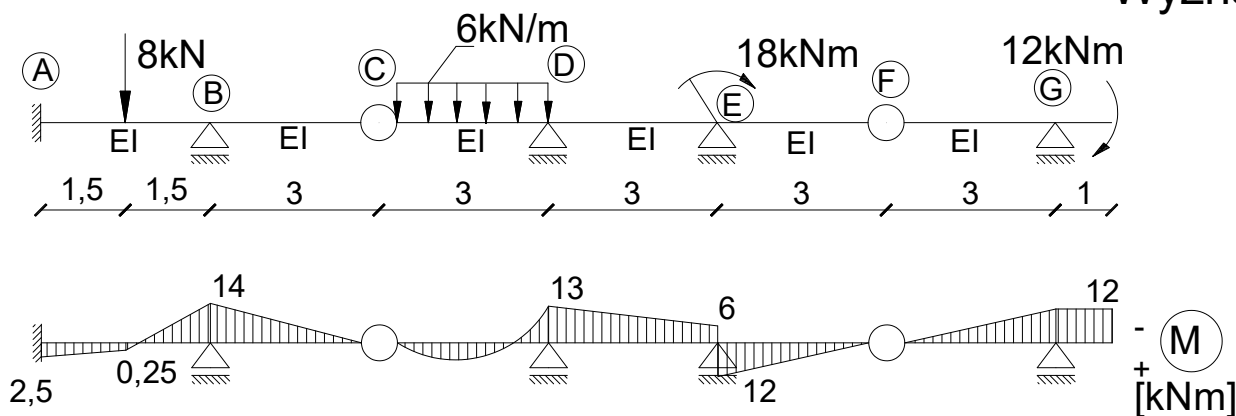
Wyznaczenie ekstremum:



$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6} = 0,78m$$

$$M[x = 0,78] = 4,67 \cdot 0,78 - \frac{6 \cdot 0,78^2}{2}$$

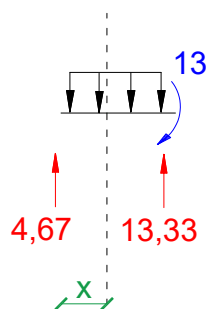
Wyznaczenie sił tnących:



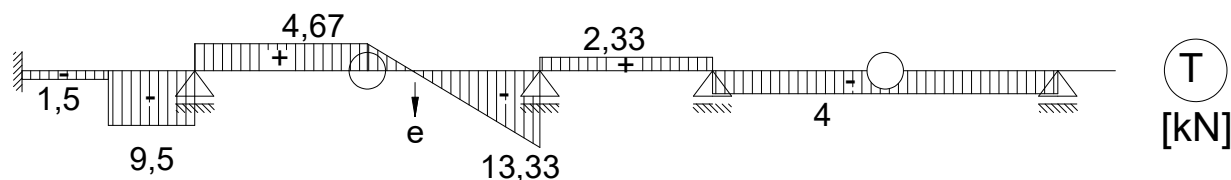
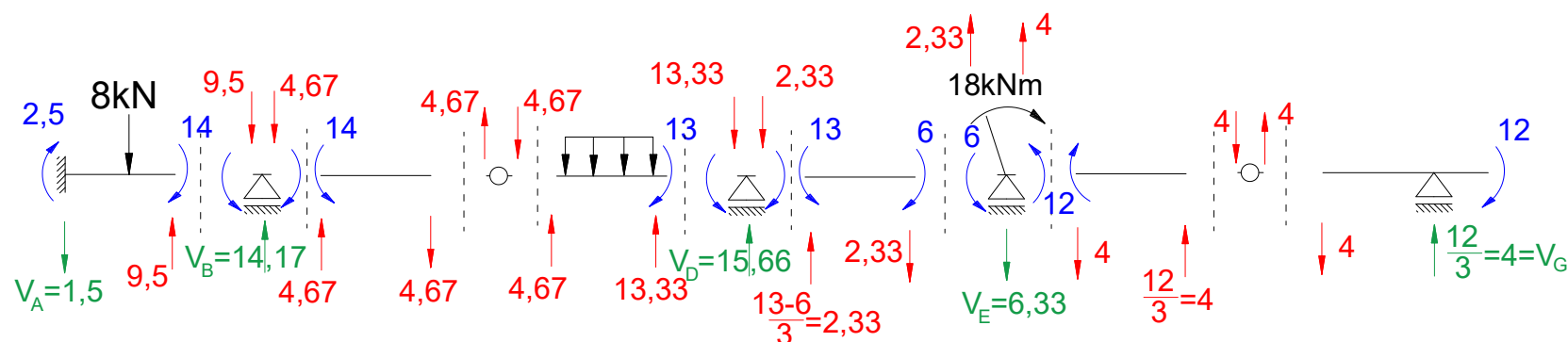
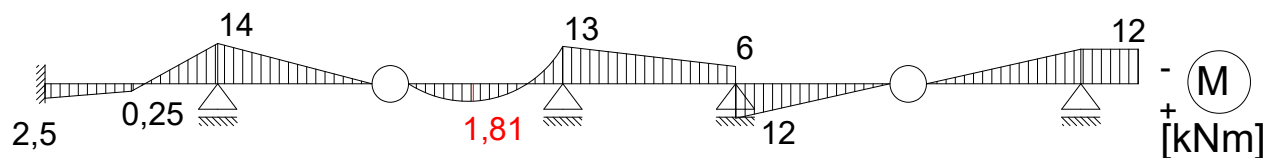
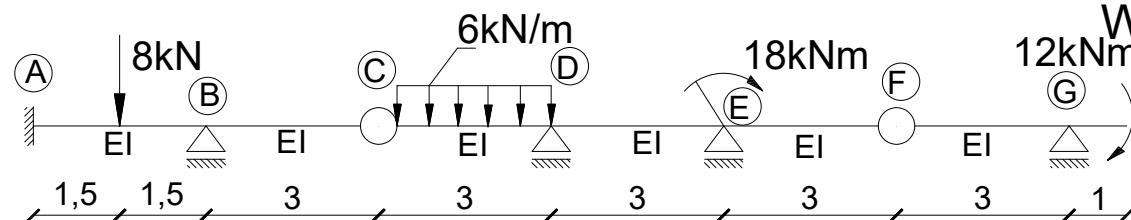
Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6} = 0,78m$$

$$M[x = 0,78] = 4,67 \cdot 0,78 - \frac{6 \cdot 0,78^2}{2} = 1,81kNm$$



Wyznaczenie sił tnących:



Wyznaczenie ekstremum:

$$T[x] = 4,67 - 6x = 0 \rightarrow x = \frac{4,67}{6} = 0,78m$$

$$M[x = 0,78] = 4,67 \cdot 0,78 - \frac{6 \cdot 0,78^2}{2} = 1,81kNm$$

