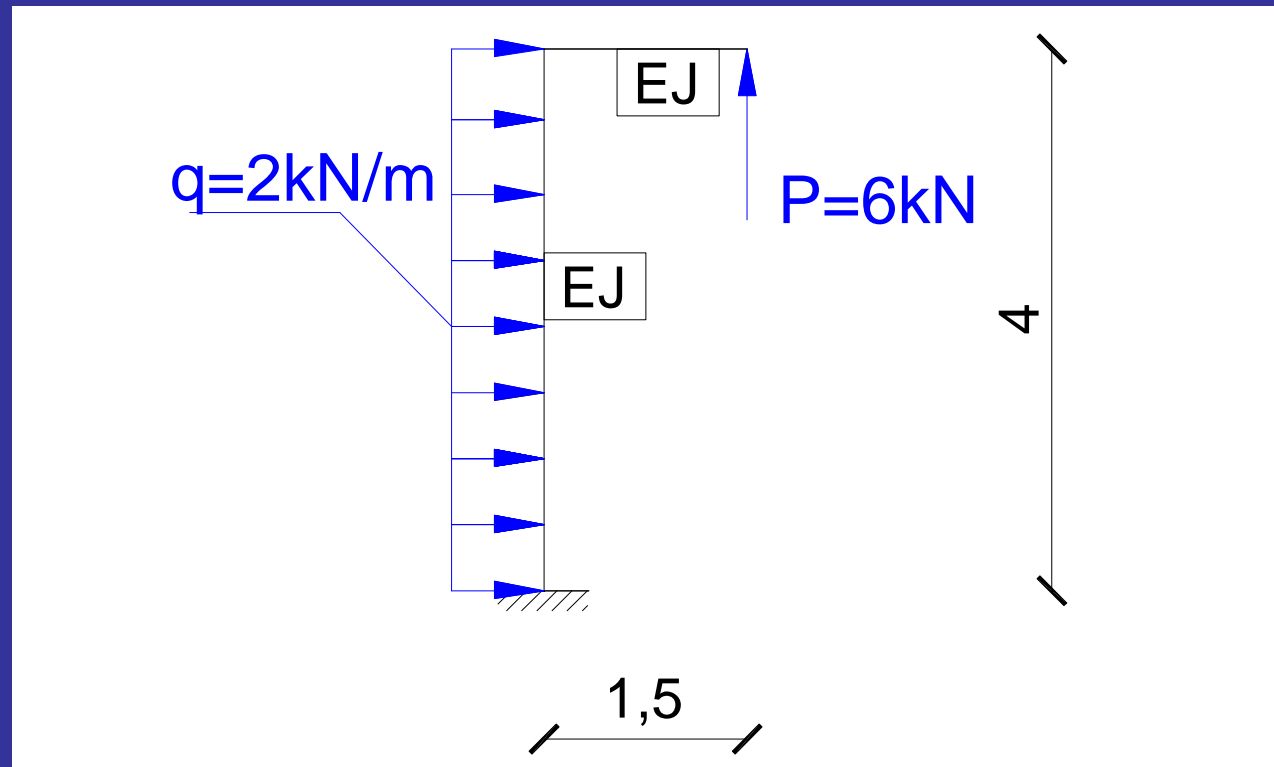
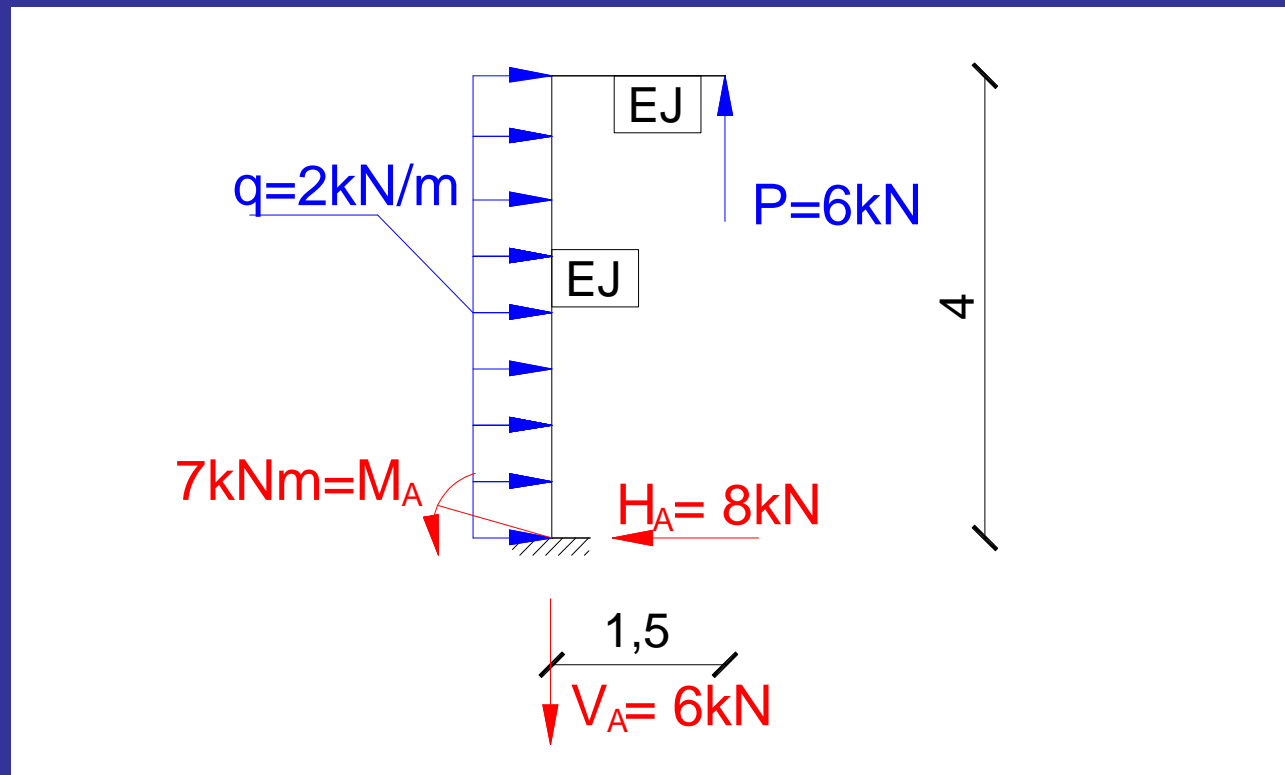


Zadanie: Narysuj odkształconą postać ramy. Poszczególne przemieszczenia wyznacz z zasady prac wirtualnych.



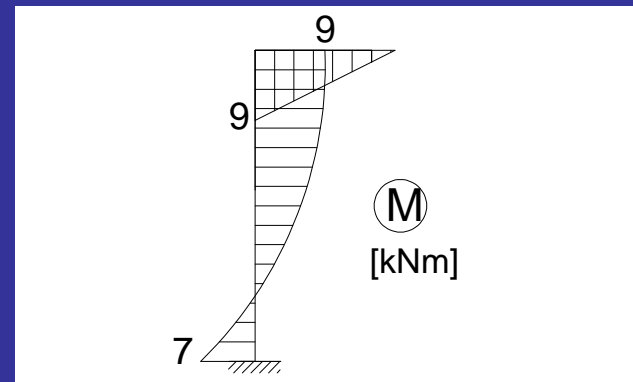
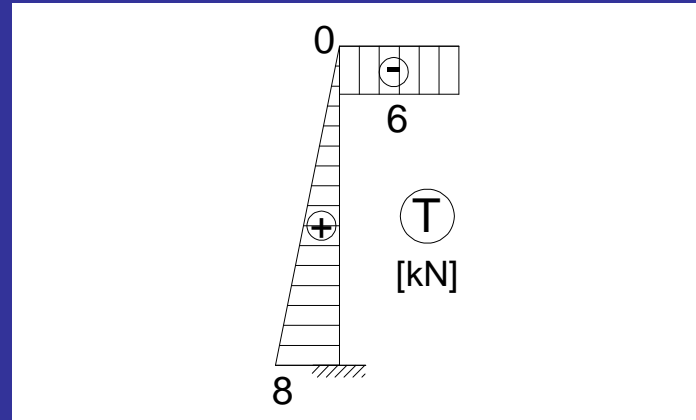
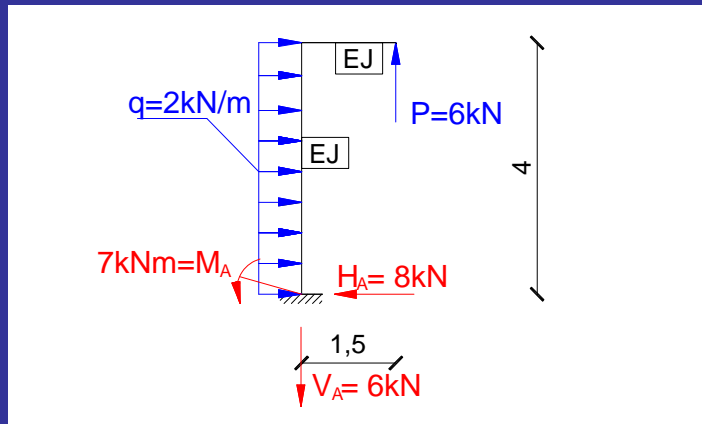
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Wyznaczenie reakcji



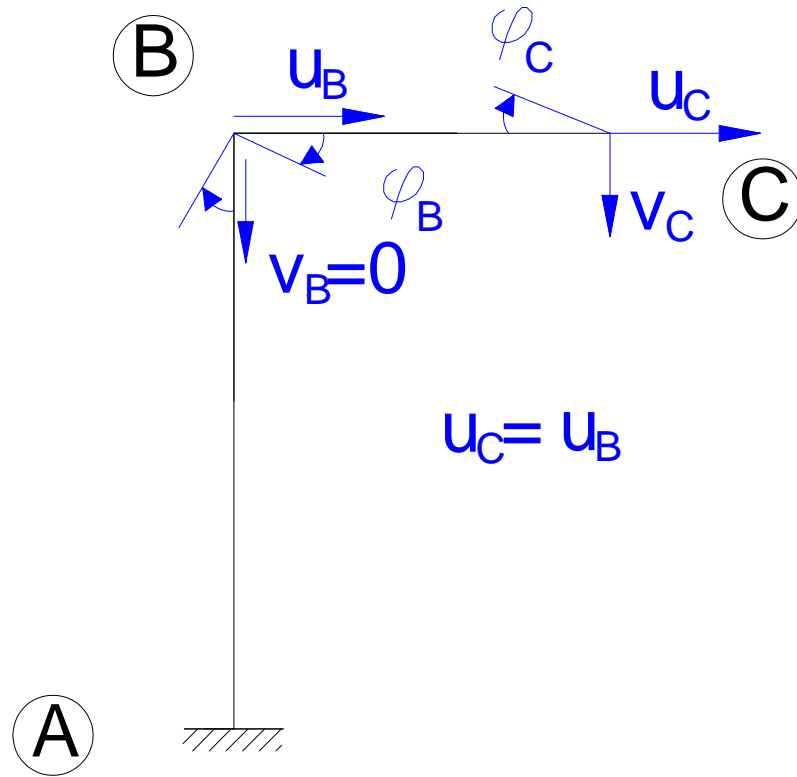
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Wykresy sił wewnętrznych



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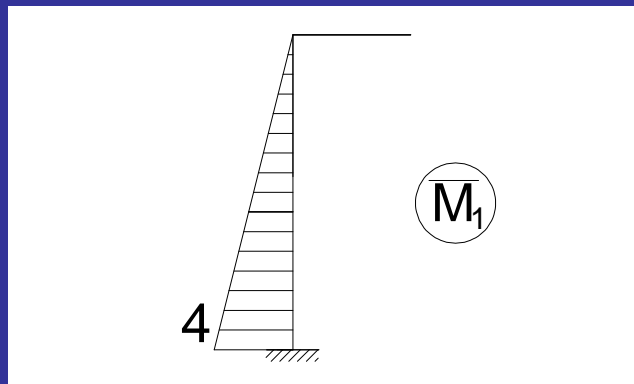
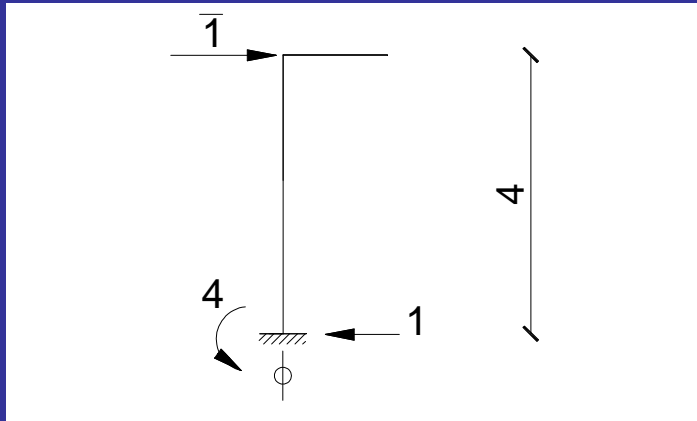
Możliwe przemieszczenia w ramie



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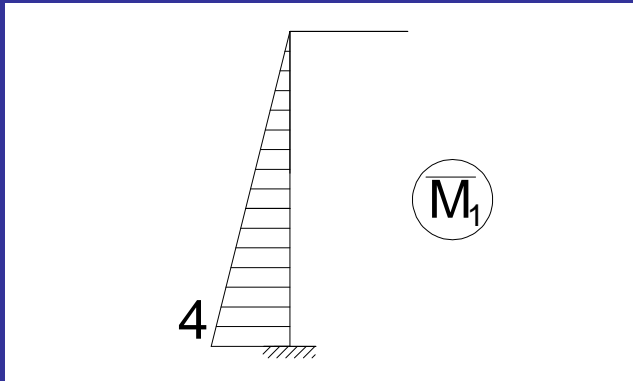
Wyznaczenie przemieszczeń

Przemieszczenie poziome ramy



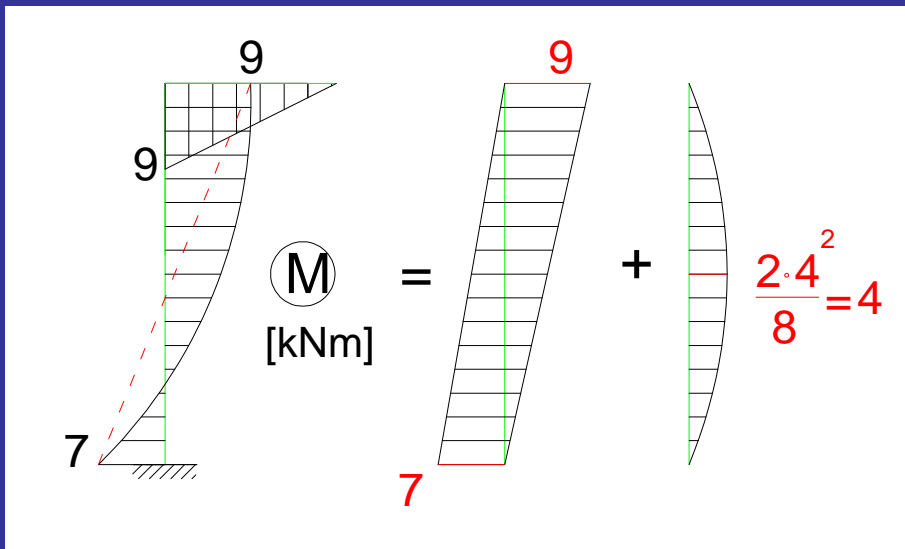
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Wyznaczenie przemieszczeń



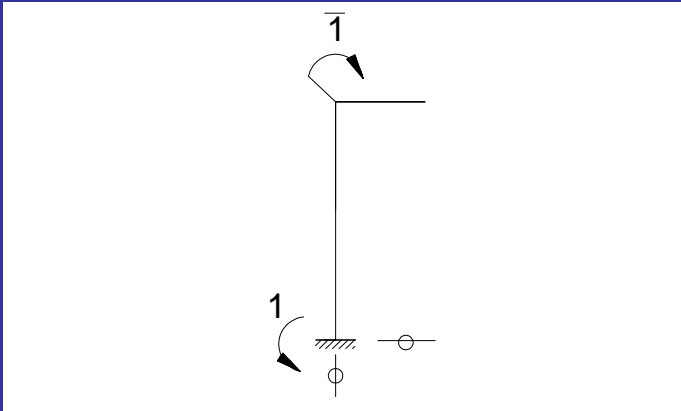
Przemieszczenie poziome ramy

$$u_B = \frac{1}{EI} \left(\frac{1}{2} \cdot 7 \cdot 4 \cdot \frac{2}{3} \cdot 4 - \frac{1}{2} \cdot 9 \cdot 4 \cdot \frac{1}{3} \cdot 4 \right) - \frac{1}{EI} \left(\frac{2}{3} \cdot \frac{2 \cdot 4^2}{8} \cdot 4 \cdot \frac{1}{2} \cdot 4 \right) = \frac{-8}{EI}$$

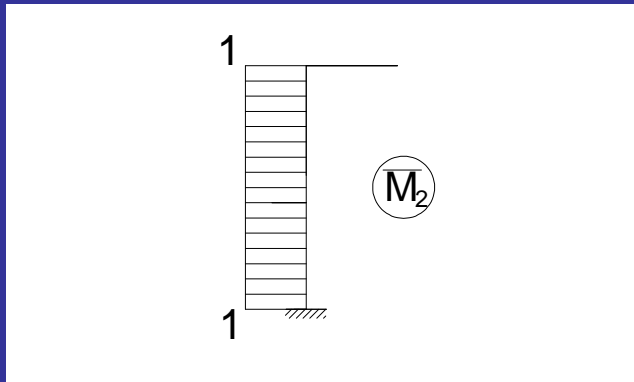


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Wyznaczenie przemieszczeń

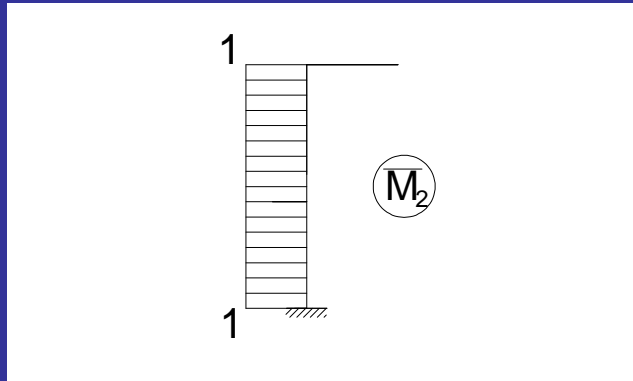


Kąt obrotu w punkcie B



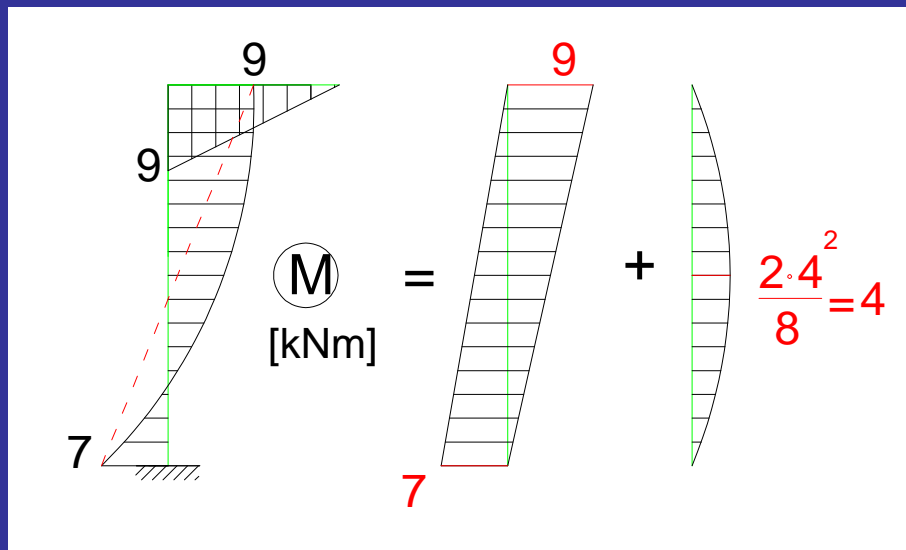
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Wyznaczenie przemieszczeń



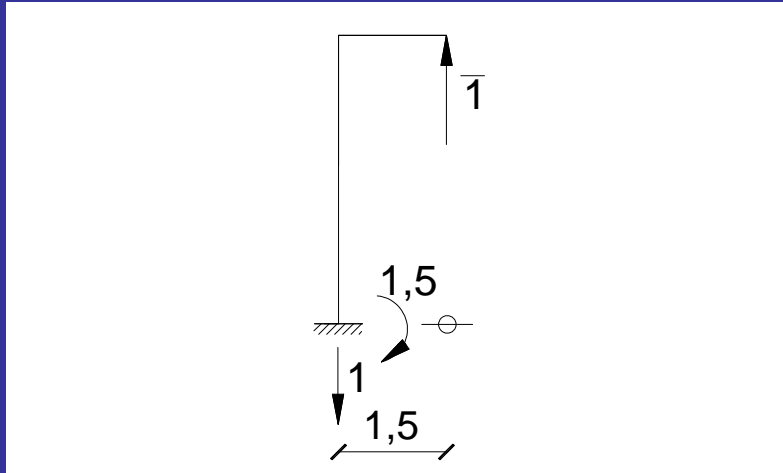
Kąt obrotu w punkcie B

$$\begin{aligned}\varphi_B &= \frac{1}{EI} \left(\frac{1}{2} \cdot 7 \cdot 4 \cdot 1 - \frac{1}{2} \cdot 9 \cdot 4 \cdot 1 \right) \\ &= -\frac{1}{EI} \left(\frac{2}{3} \cdot \frac{2 \cdot 4^2}{8} \cdot 4 \cdot 1 \right) \\ &= \frac{-44}{3EI} = \frac{-14,66}{EI}\end{aligned}$$

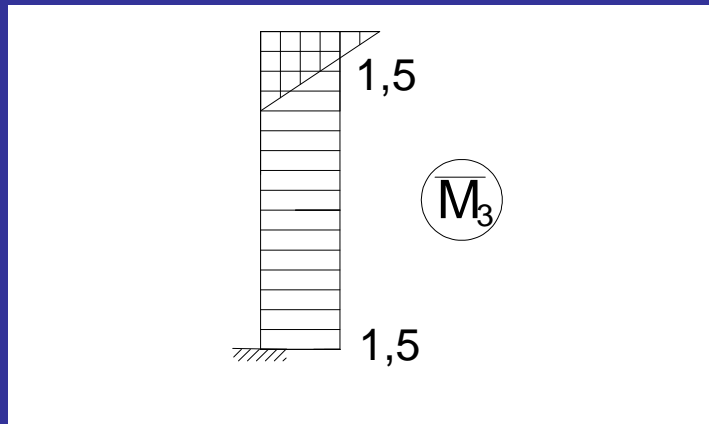


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Wyznaczenie przemieszczeń

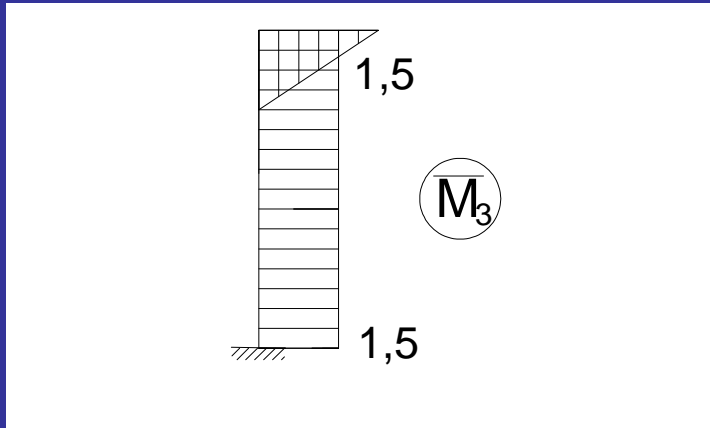


Przemieszczenie pionowe
końca wspornika



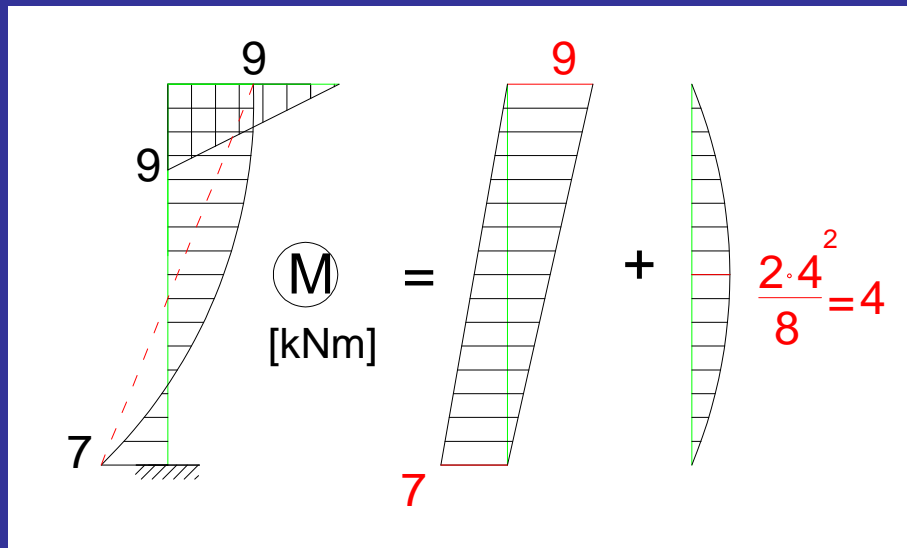
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Wyznaczenie przemieszczeń



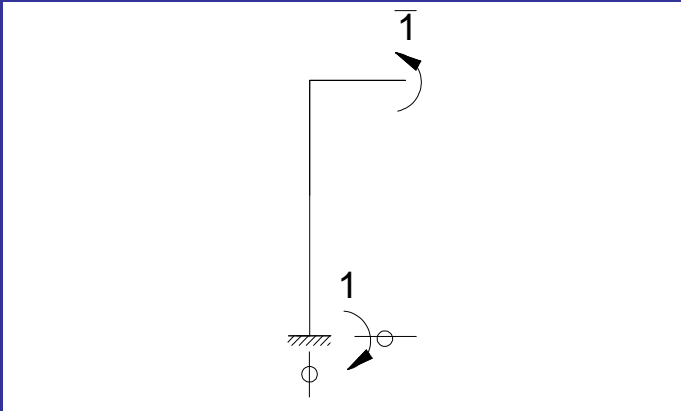
Przemieszczenie pionowe
końca wspornika

$$v_c = \frac{1}{EI} \left(-\frac{1}{2} \cdot 7 \cdot 4 \cdot 1,5 + \frac{1}{2} \cdot 9 \cdot 4 \cdot 1,5 \right) + \frac{1}{EI} \left(\frac{2}{3} \cdot \frac{2 \cdot 4^2}{8} \cdot 4 \cdot 1,5 + \frac{1}{2} \cdot 9 \cdot 1,5 \cdot \frac{2}{3} \cdot 1,5 \right) = \frac{115}{4EI} = \frac{28,75}{EI}$$

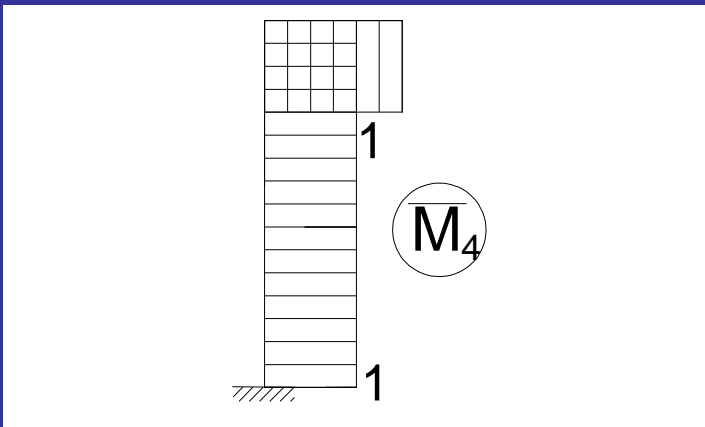


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Wyznaczenie przemieszczeń

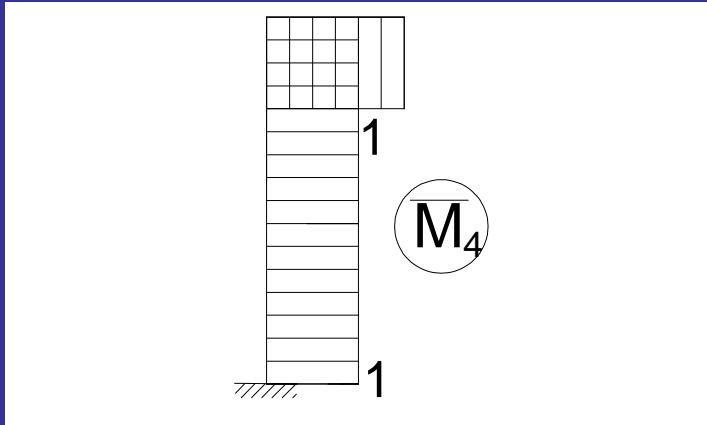


Kąt obrotu na końcu wspornika



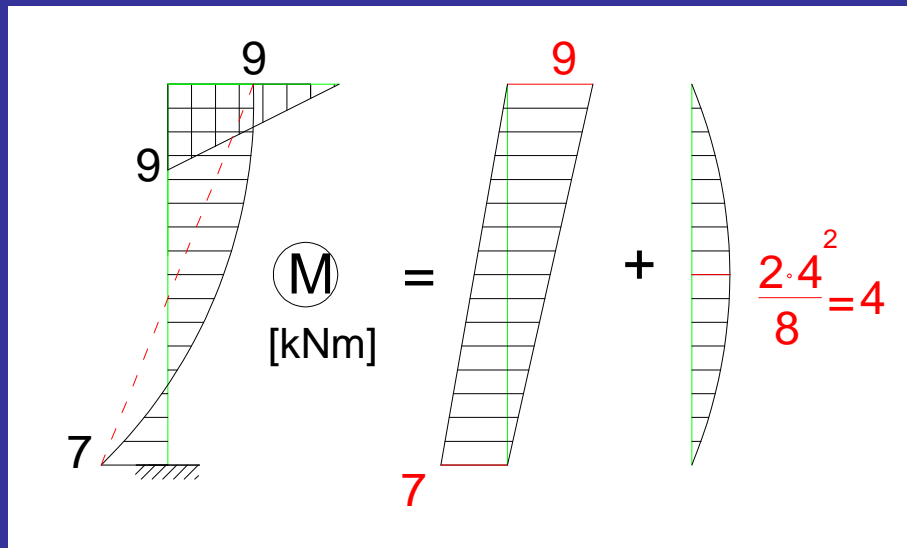
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Wyznaczenie przemieszczeń



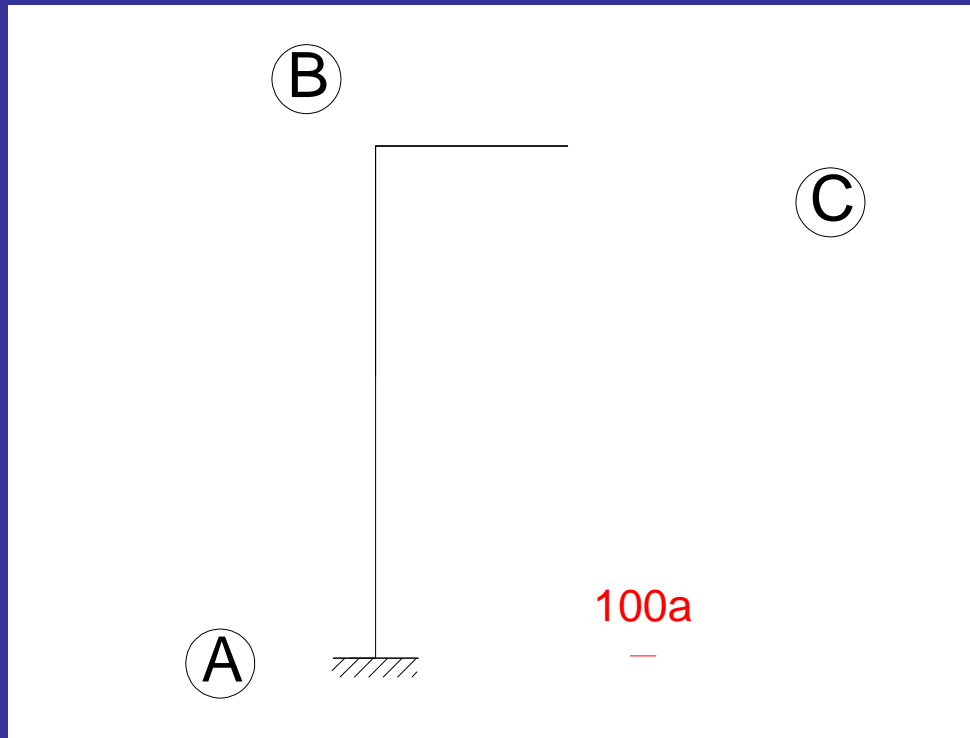
Kąt obrotu na końcu wspornika

$$\begin{aligned} \varphi_c &= \frac{1}{EI} \left(-\frac{1}{2} \cdot 7 \cdot 4 \cdot 1 + \frac{1}{2} \cdot 9 \cdot 4 \cdot 1 \right) \\ &+ \frac{1}{EI} \left(\frac{2}{3} \cdot \frac{2 \cdot 4^2}{8} \cdot 4 \cdot 1 + \frac{1}{2} \cdot 9 \cdot 1,5 \cdot 1 \right) \\ &= \frac{257}{12EI} = \frac{21,62}{EI} \end{aligned}$$



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Odkształcona postać ramy



Przemieszczenia:

$$u_B = u_C = -\frac{8}{EI} = -\frac{96}{12EI} = -96a$$

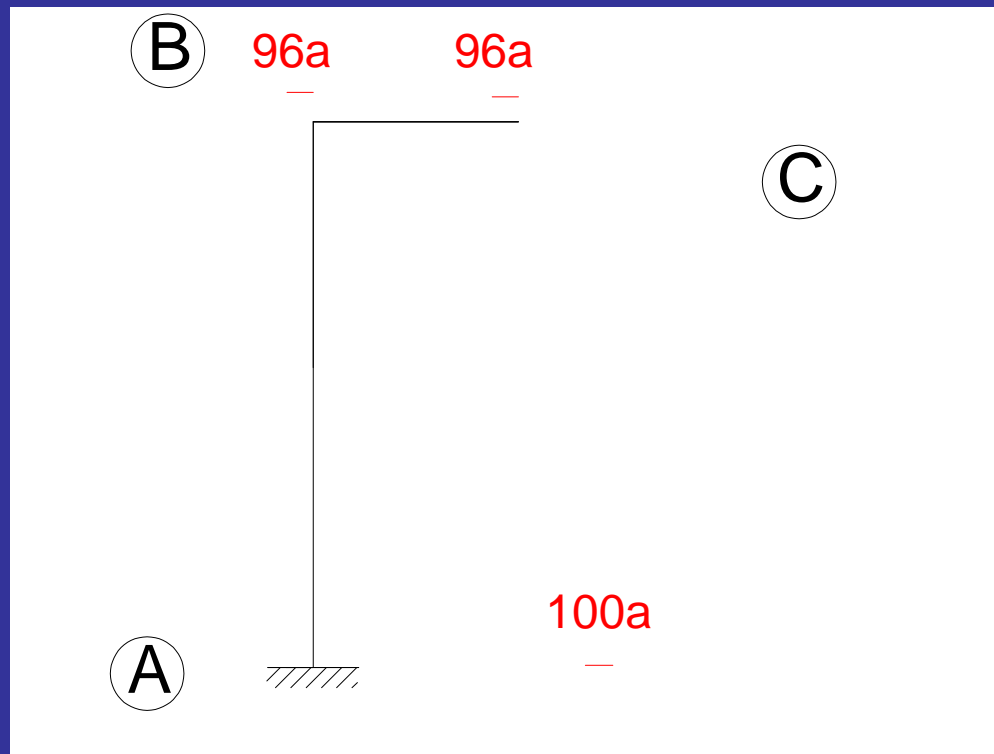
$$\varphi_B = -\frac{44}{3EI} = \frac{-176}{12EI} = -176a$$

$$v_C = \frac{115}{4EI} = \frac{345}{12EI} = 345a$$

$$\varphi_C = \frac{257}{12EI} = 257a$$

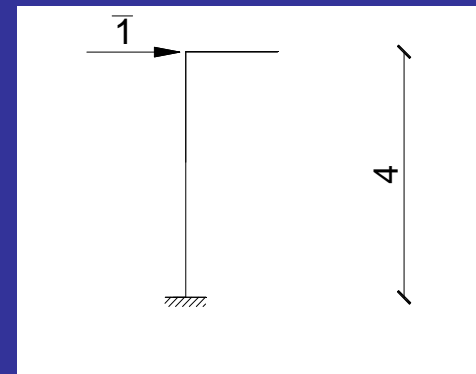
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Odształcona postać ramy



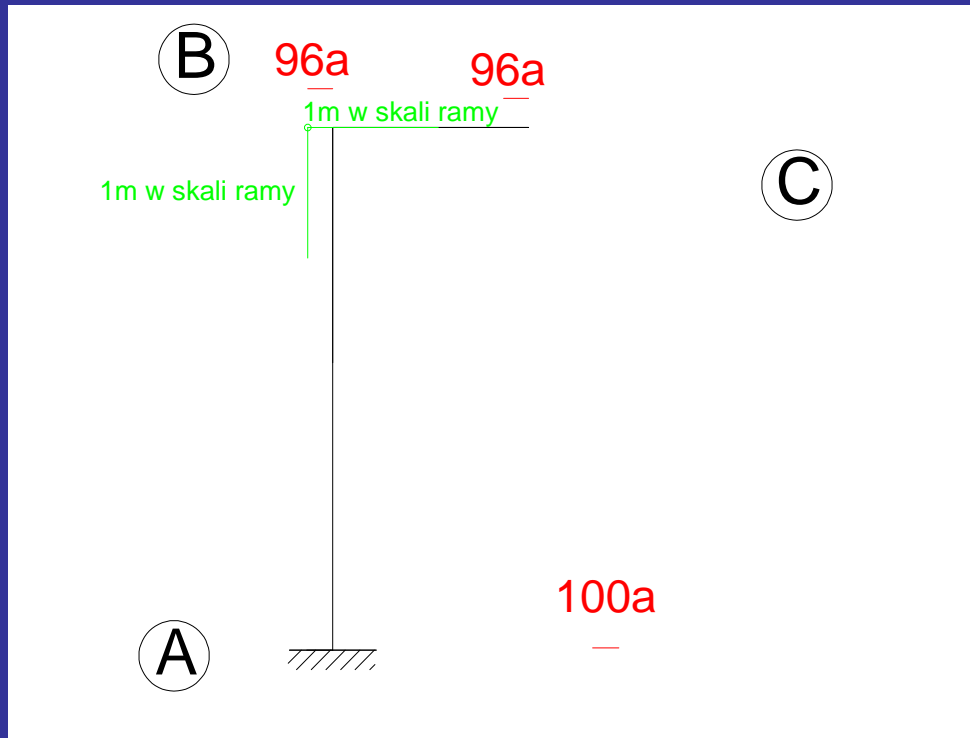
Przemieszczenia:

$$u_B = u_C = -\frac{8}{EI} = -\frac{96}{12EI} = -96a$$



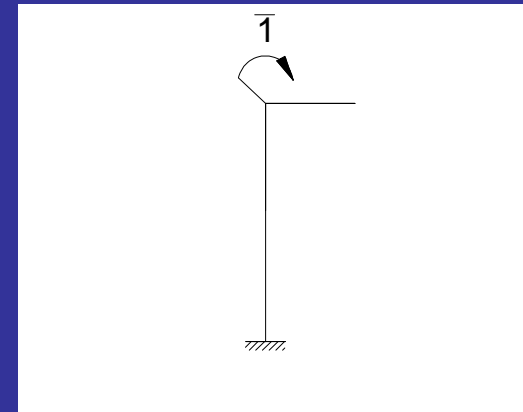
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Odształcona postać ramy



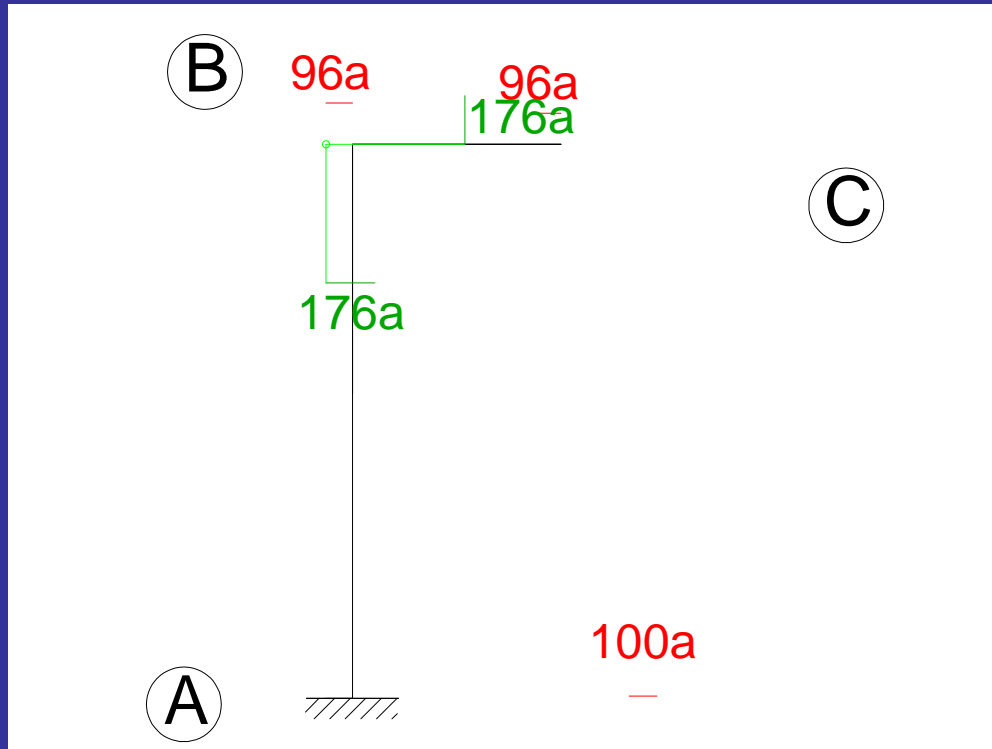
Przemieszczenia:

$$\varphi_B = -\frac{44}{3EI} = \frac{-176}{12EI} = -176a$$



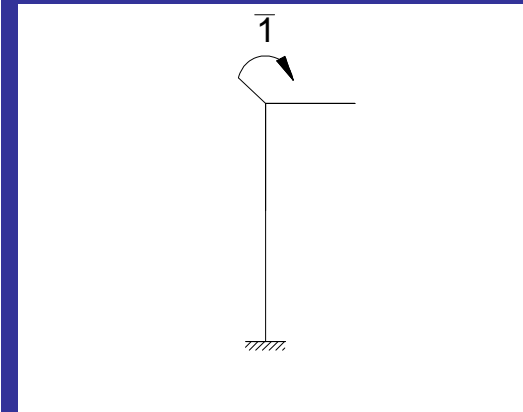
dr inż. Hanna Weber

Odształcona postać ramy



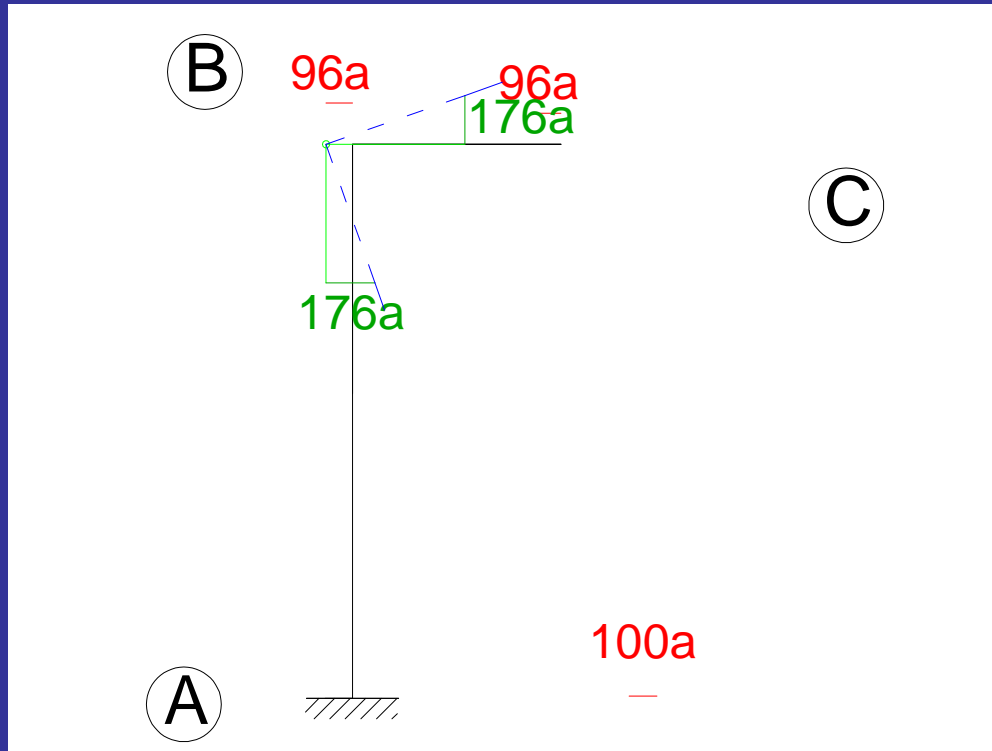
Przemieszczenia:

$$\varphi_B = -\frac{44}{3EI} = \frac{-176}{12EI} = -176a$$



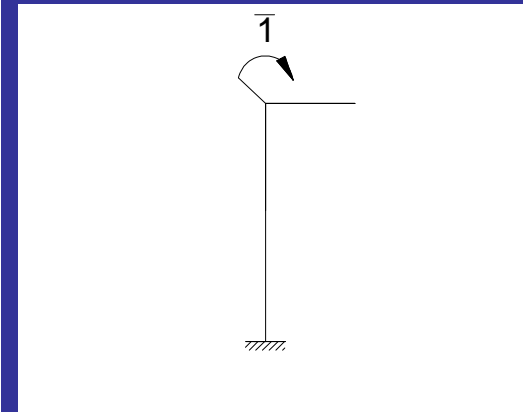
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Odształcona postać ramy



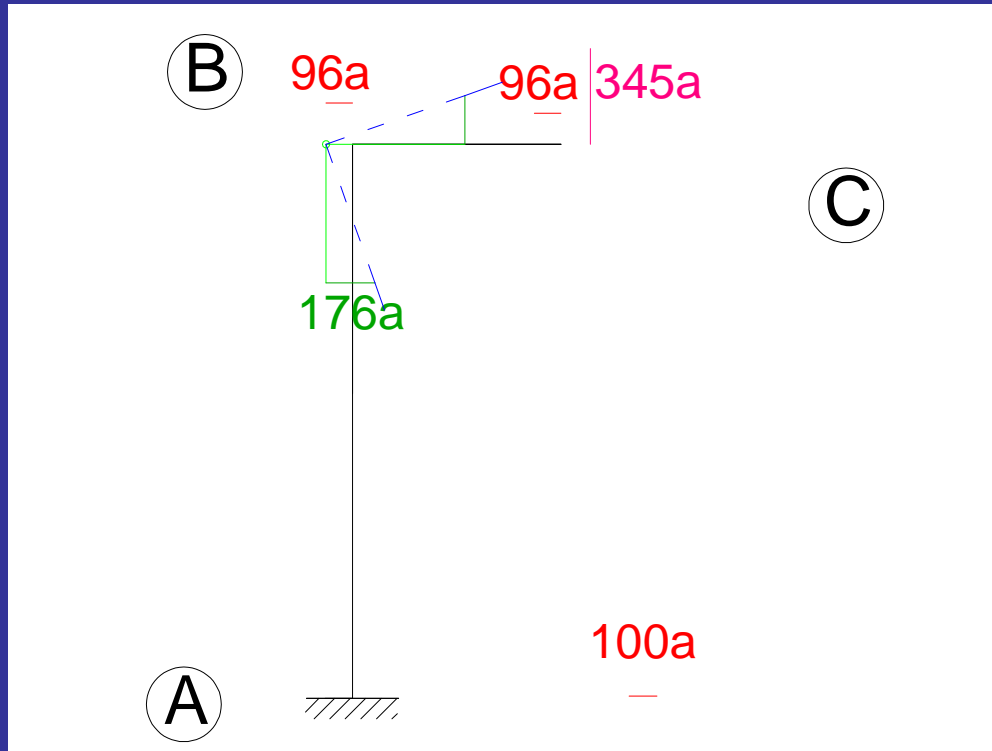
Przemieszczenia:

$$\varphi_B = -\frac{44}{3EI} = \frac{-176}{12EI} = -176a$$



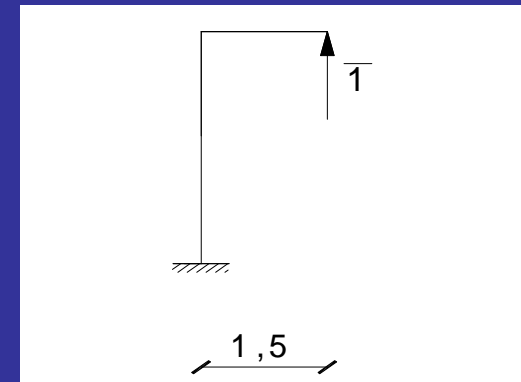
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Odkształcona postać ramy



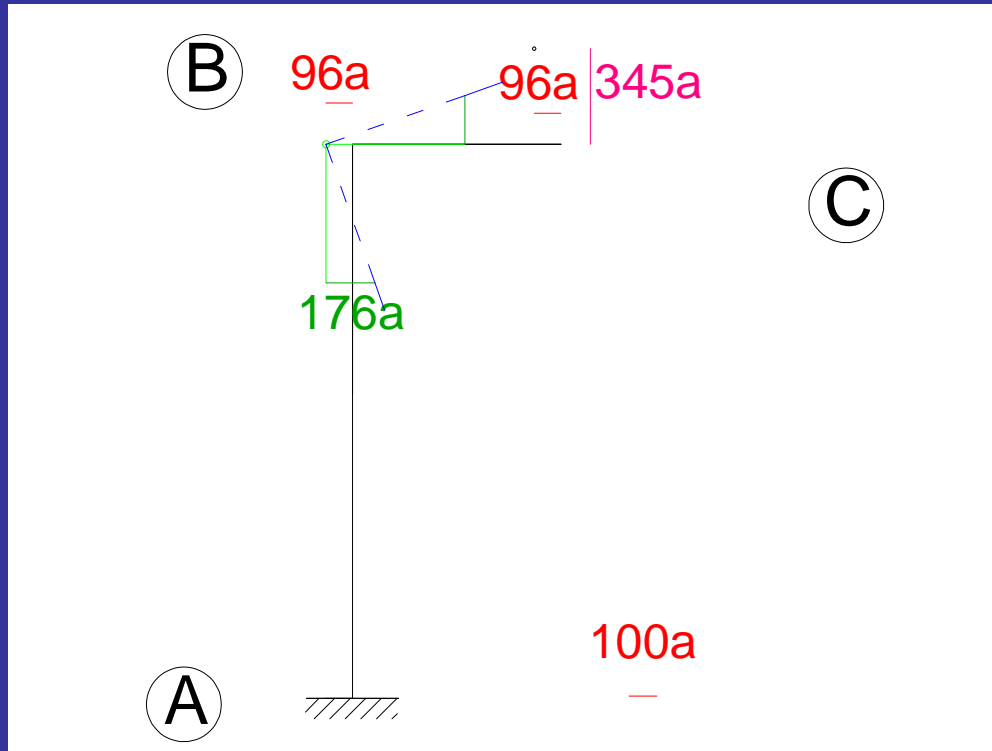
Przemieszczenia:

$$v_C = \frac{115}{4EI} = \frac{345}{12EI} = 345a$$



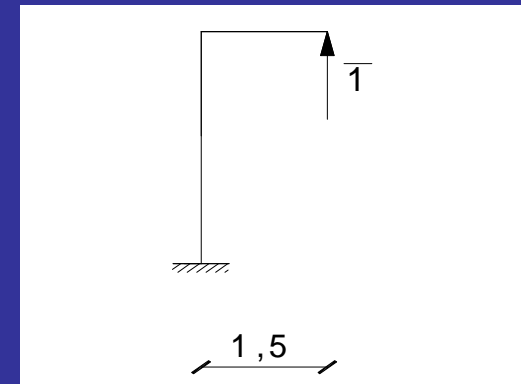
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Odkształcona postać ramy



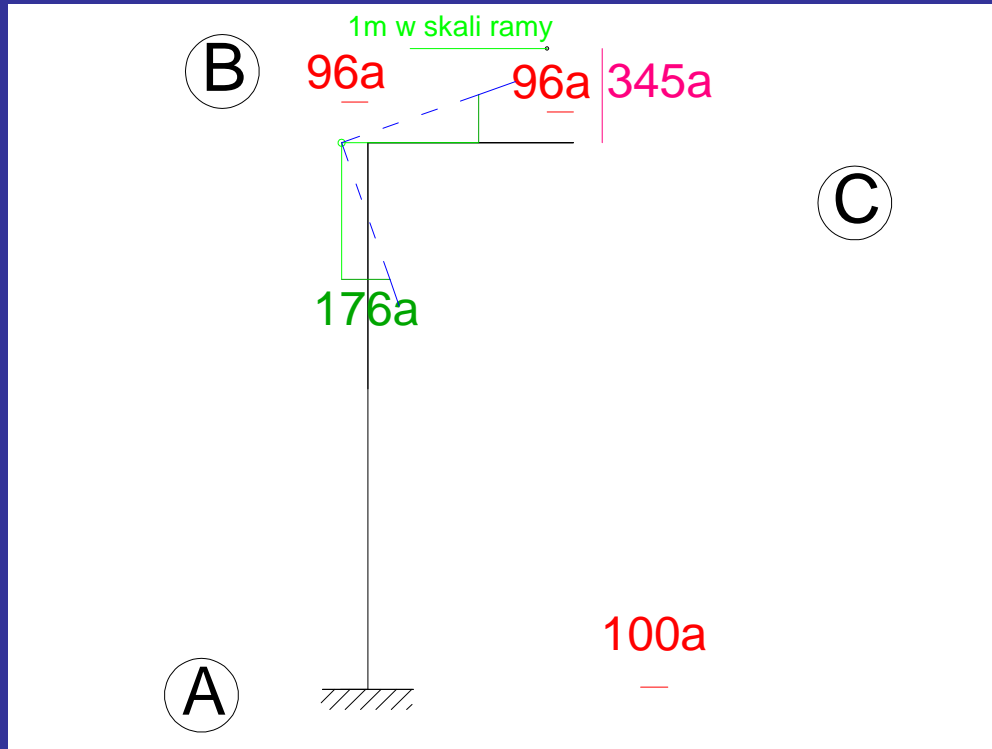
Przemieszczenia:

$$v_C = \frac{115}{4EI} = \frac{345}{12EI} = 345a$$



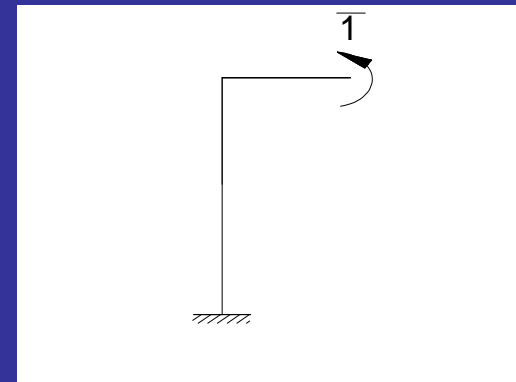
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Odształcona postać ramy



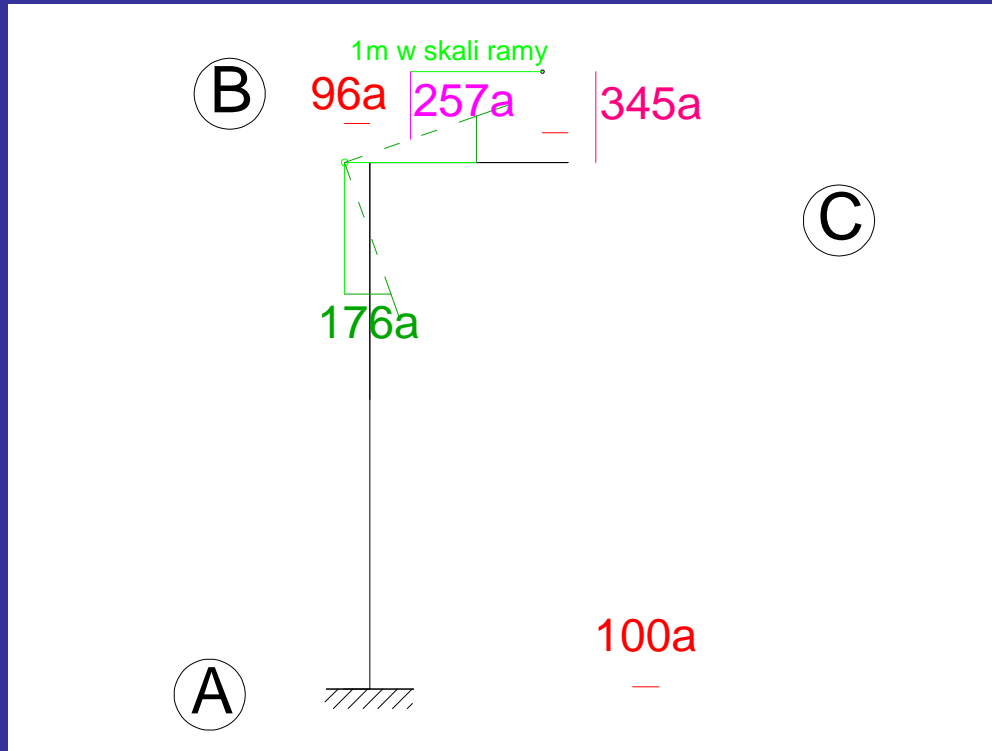
Przemieszczenia:

$$\varphi_C = \frac{257}{12EI} = 257a$$



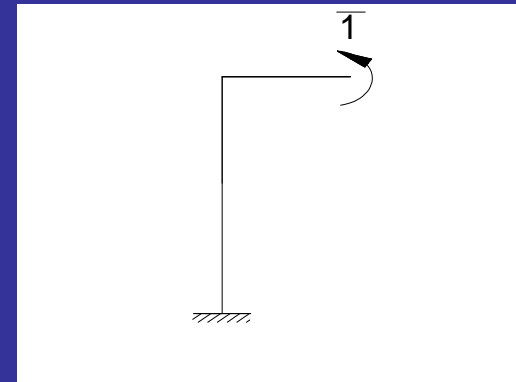
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Odształcona postać ramy



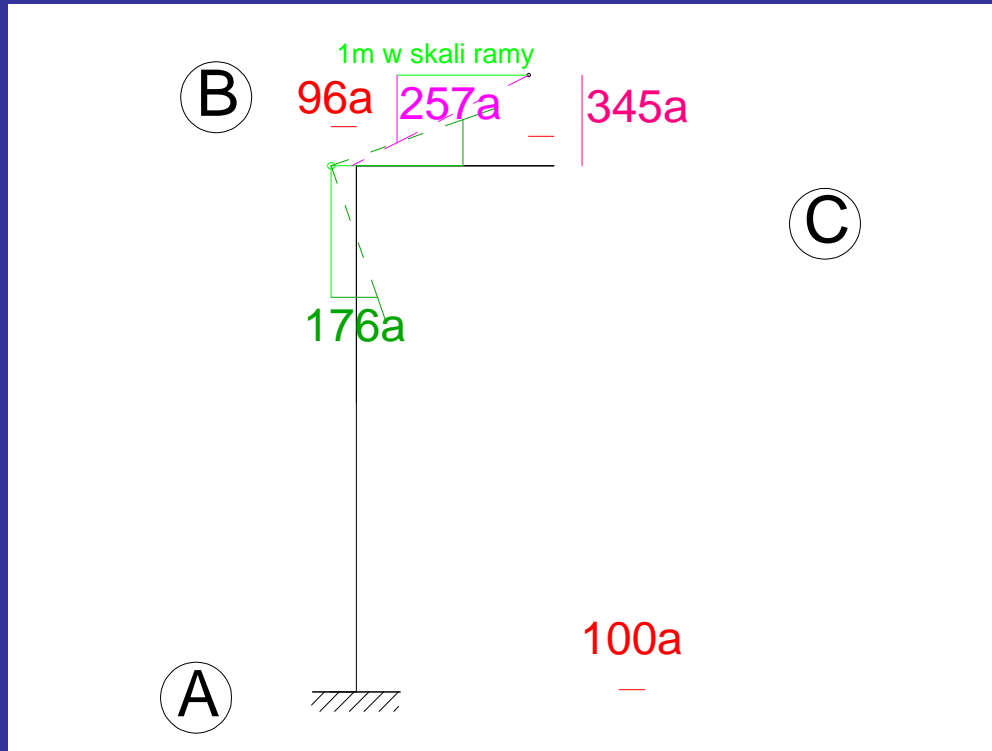
Przemieszczenia:

$$\varphi_C = \frac{257}{12EI} = 257a$$



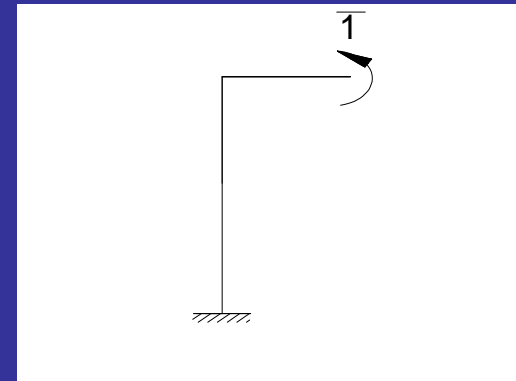
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Odształcona postać ramy

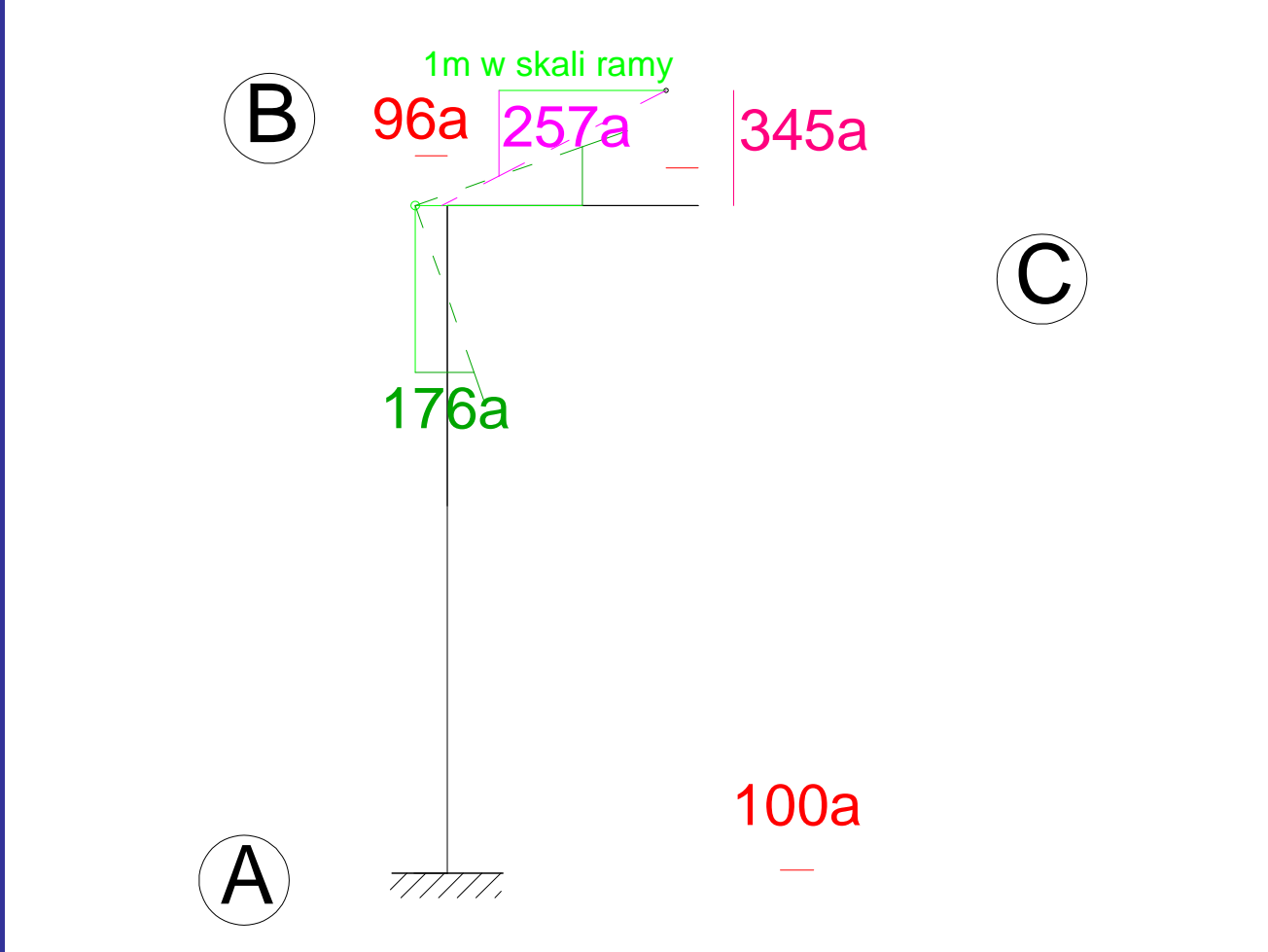


Przemieszczenia:

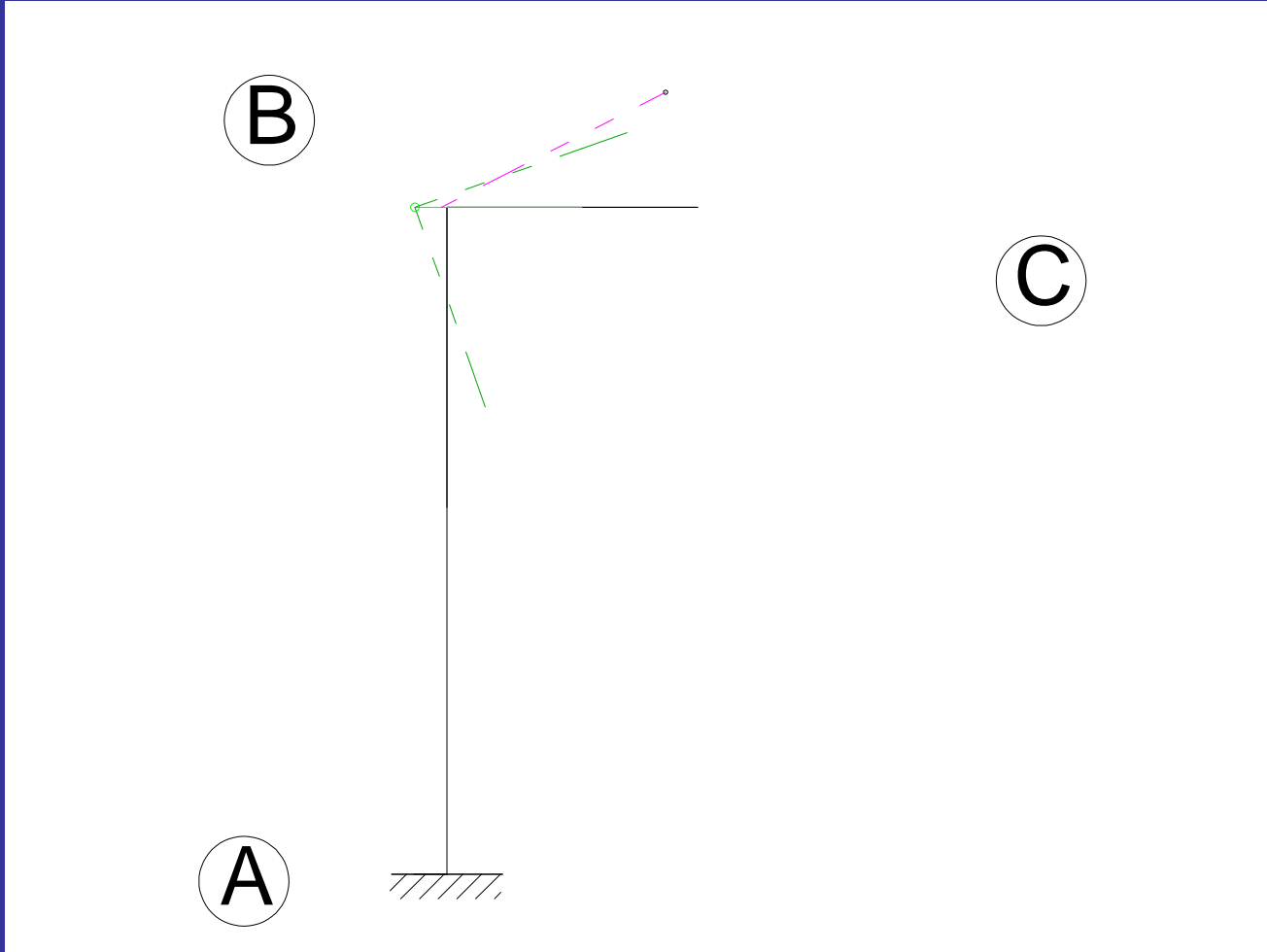
$$\varphi_C = \frac{257}{12EI} = 257a$$



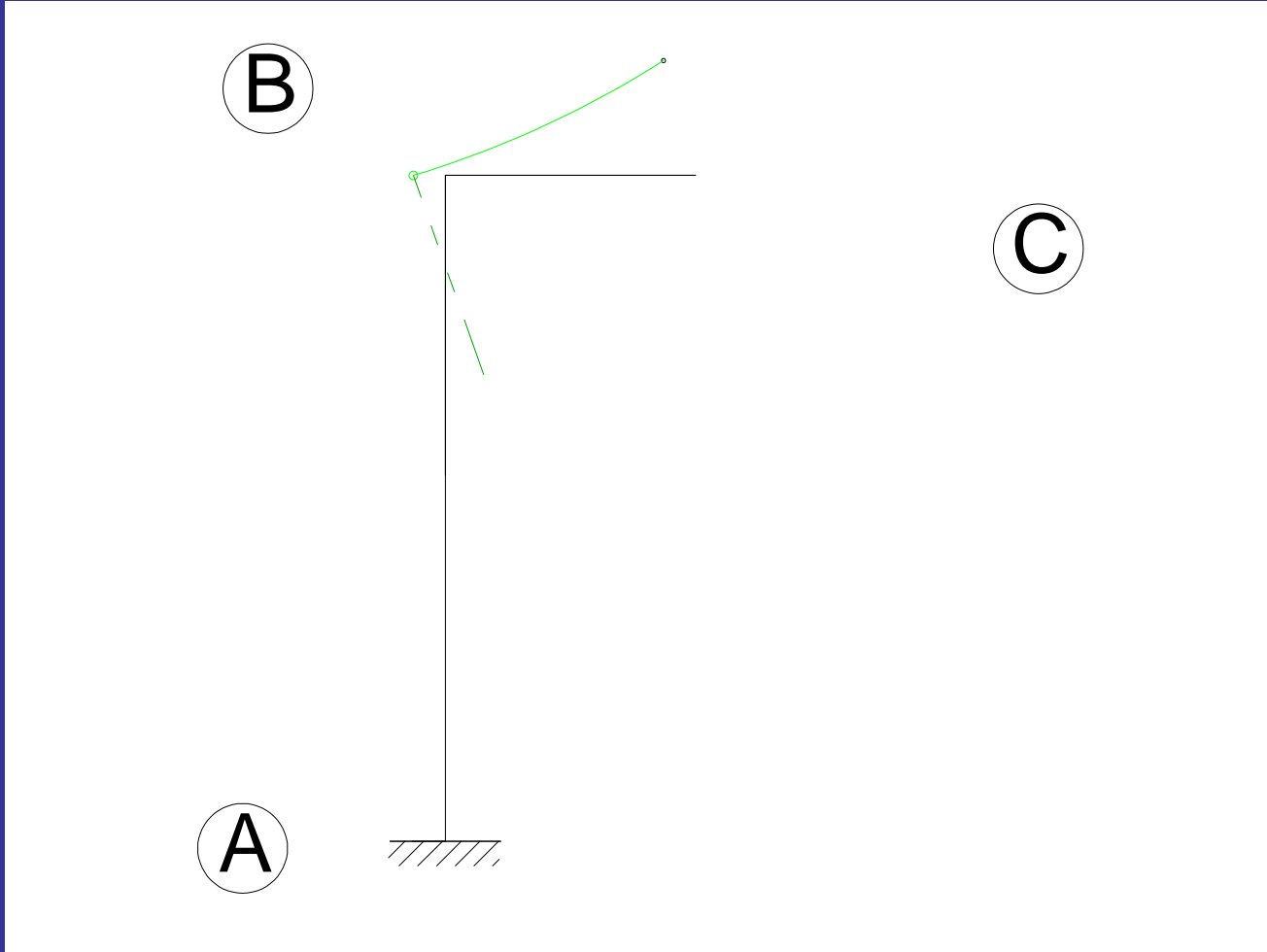
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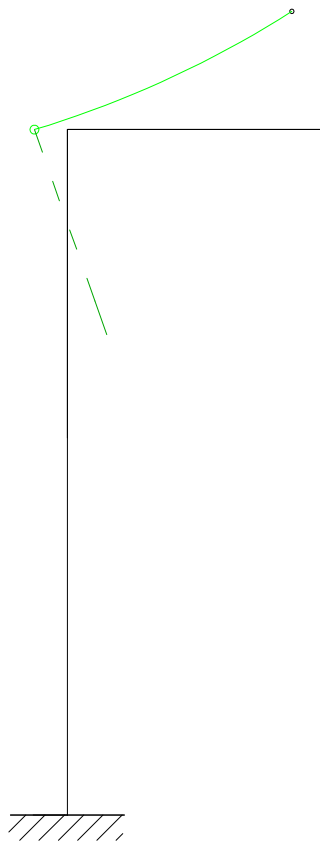


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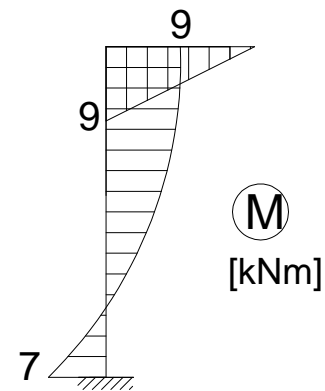
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(B)



(C)

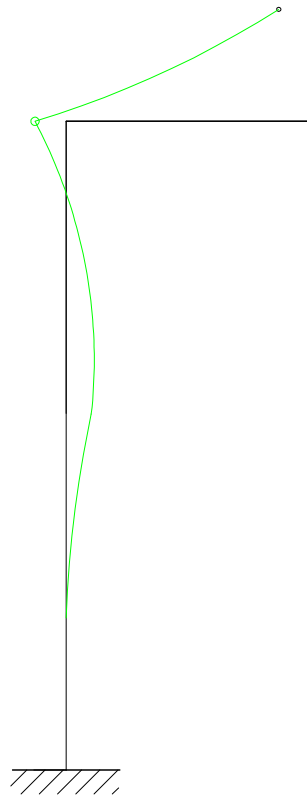
(A)



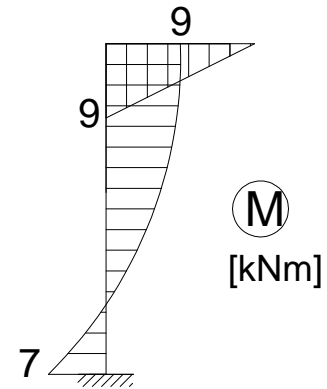
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(B)

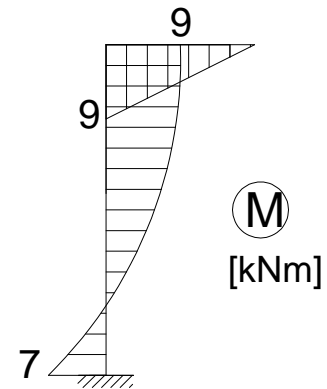
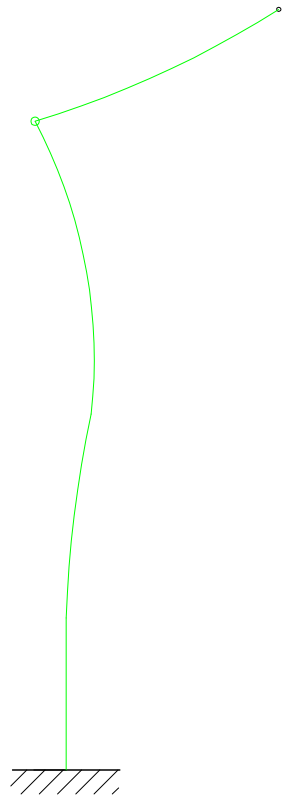
(A)



(C)



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