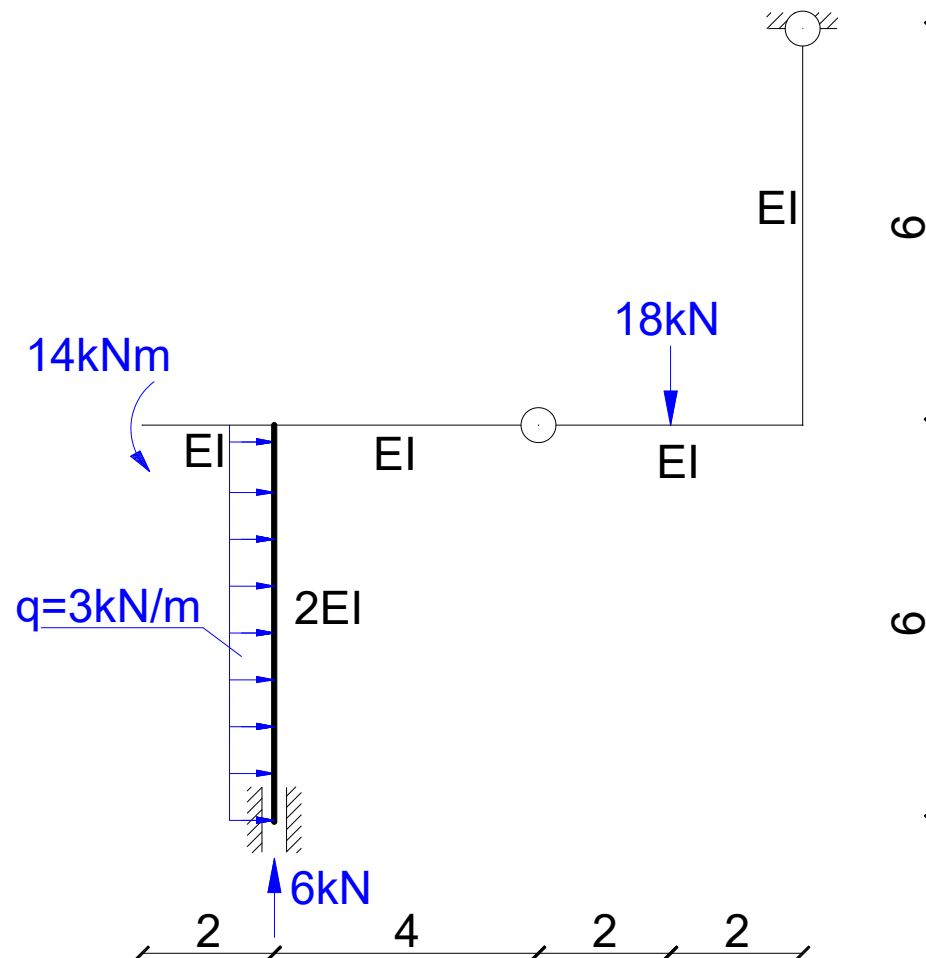
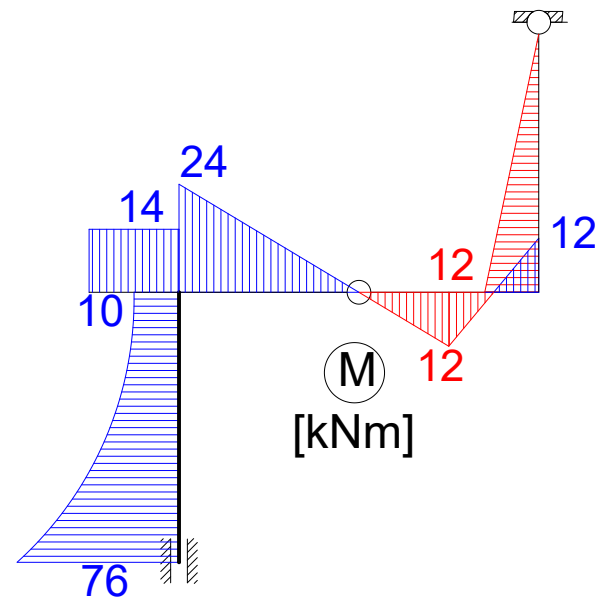
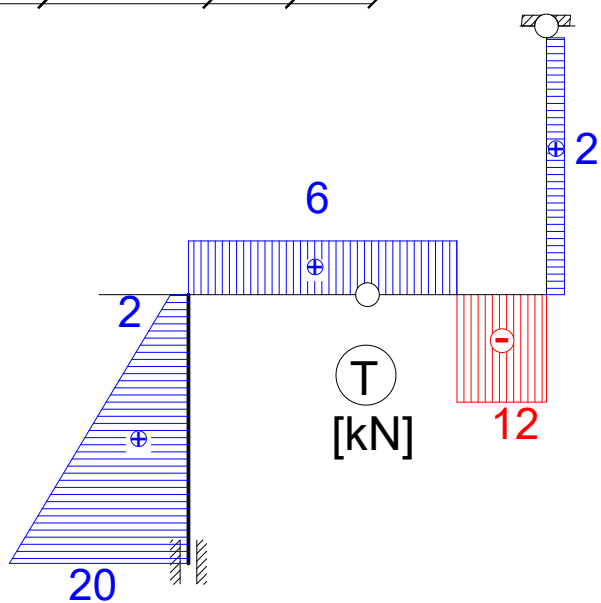
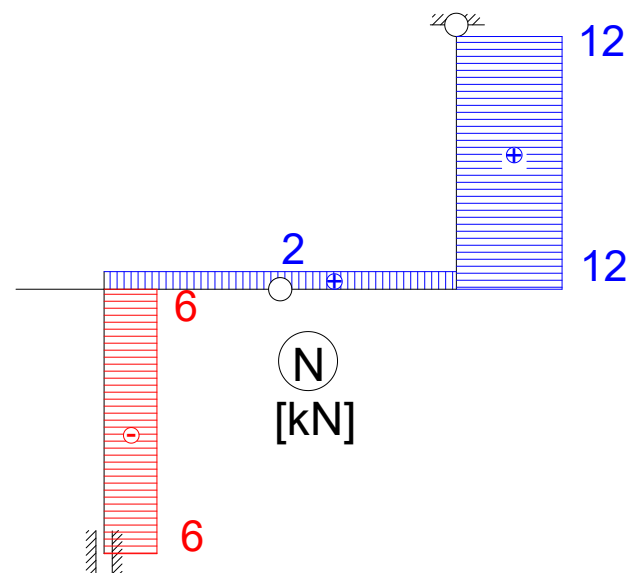
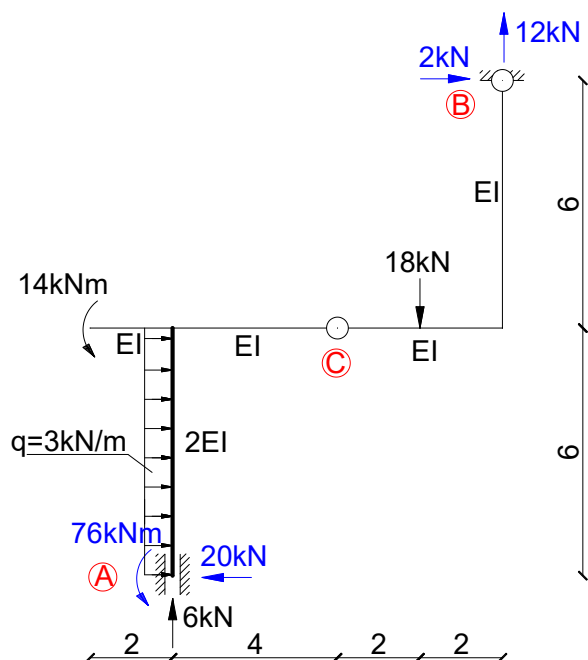


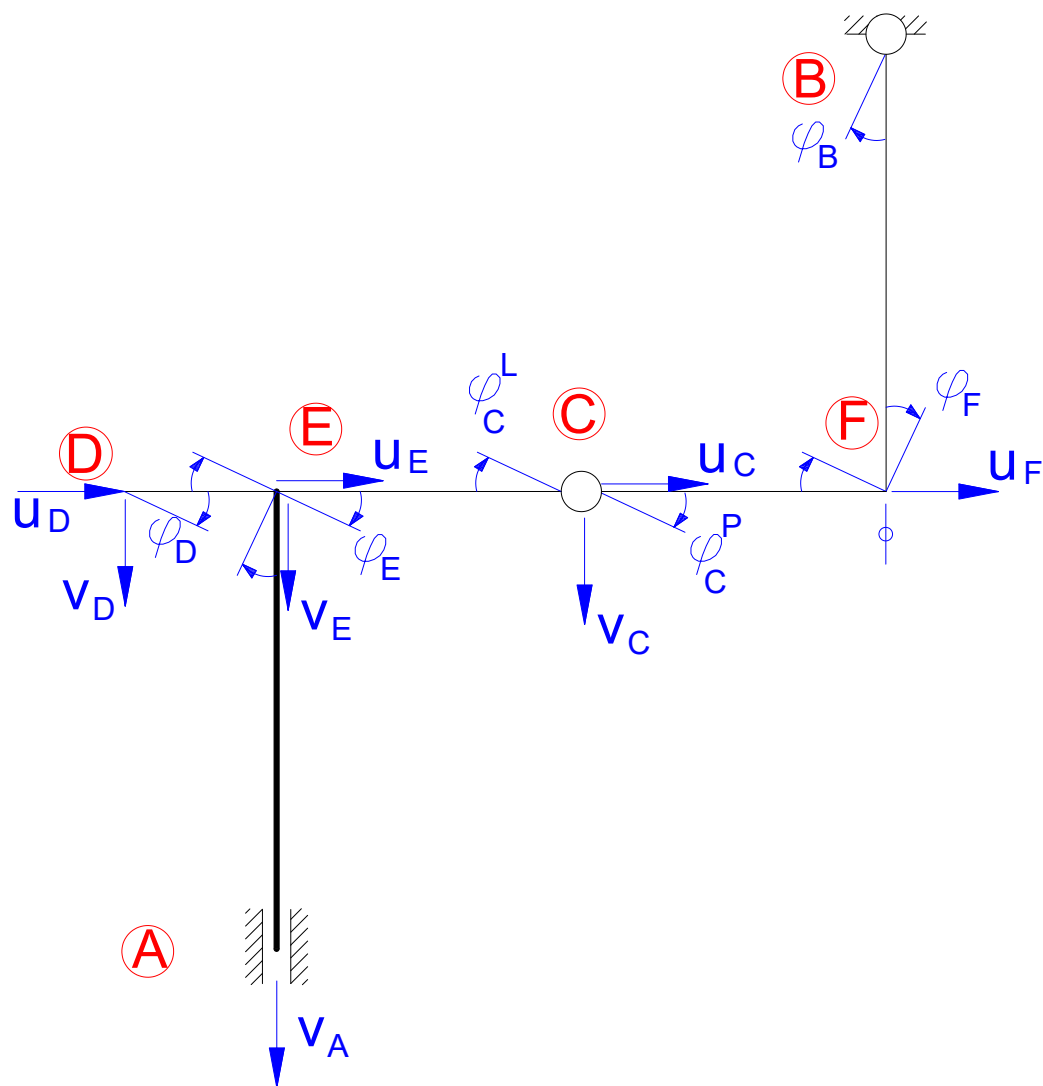
Obliczenia przemieszczeń z zasady prac wirtualnych:



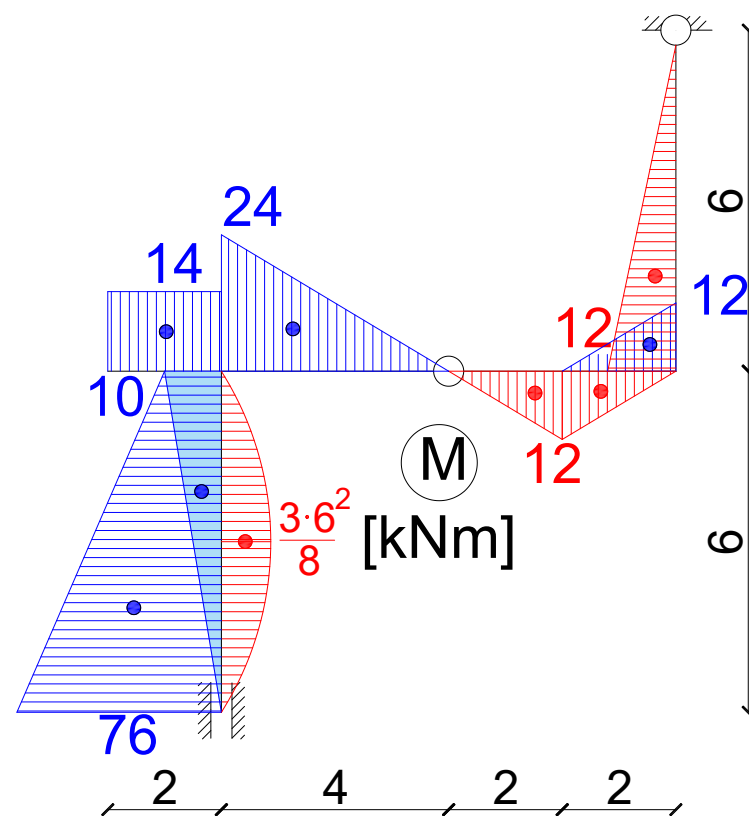
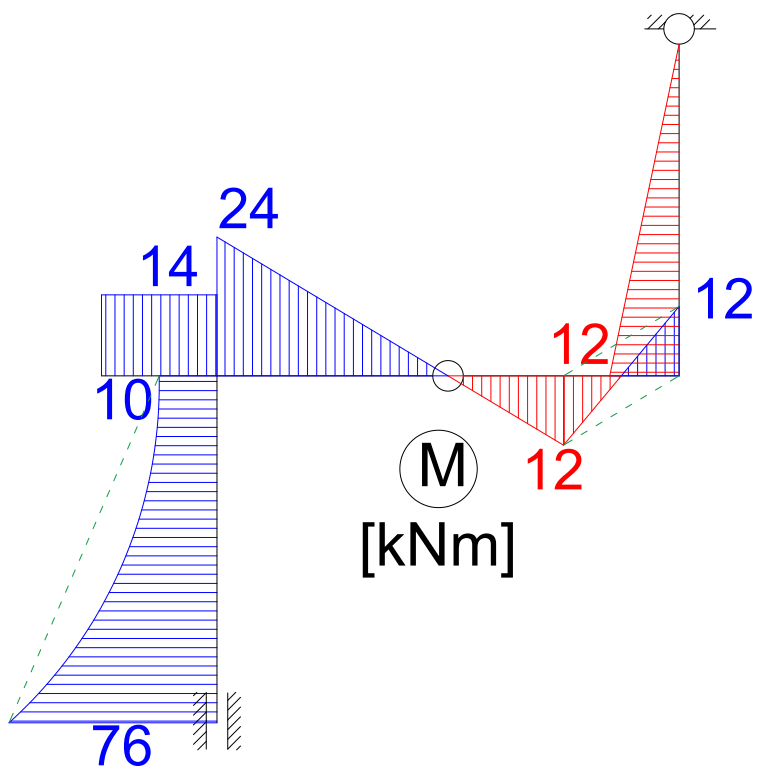
Wykresy sił wewnętrznych:



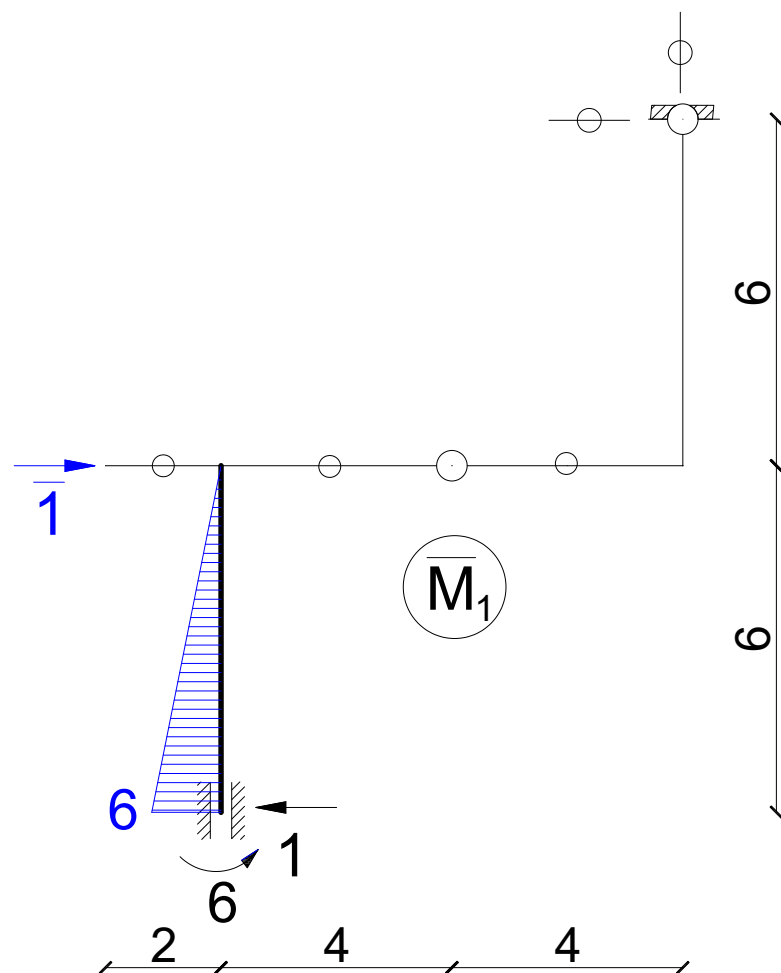
Wyznaczenie przemieszczeń w węzłach:



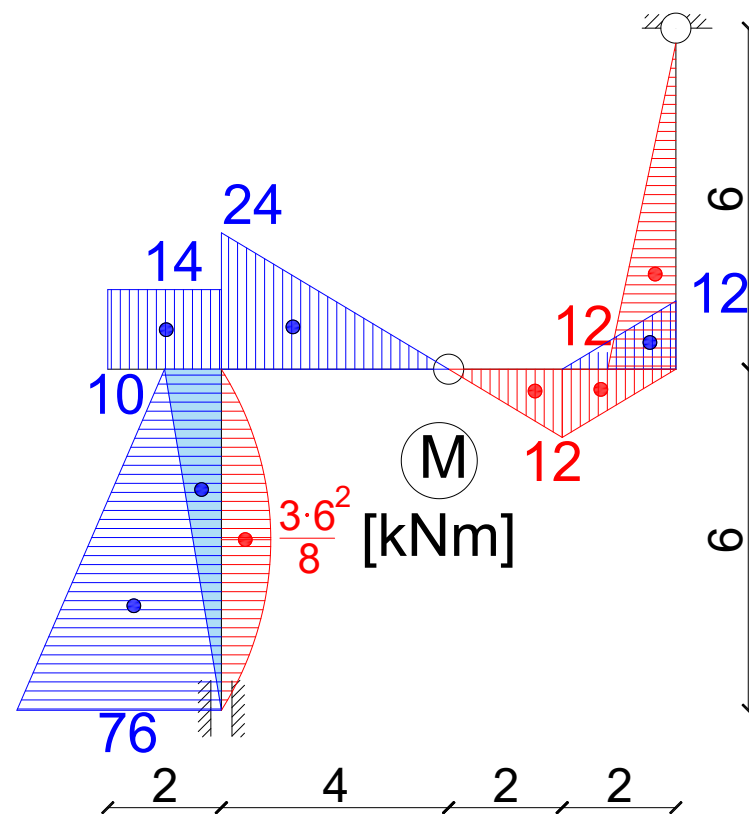
Podział wykresów do całkowania:



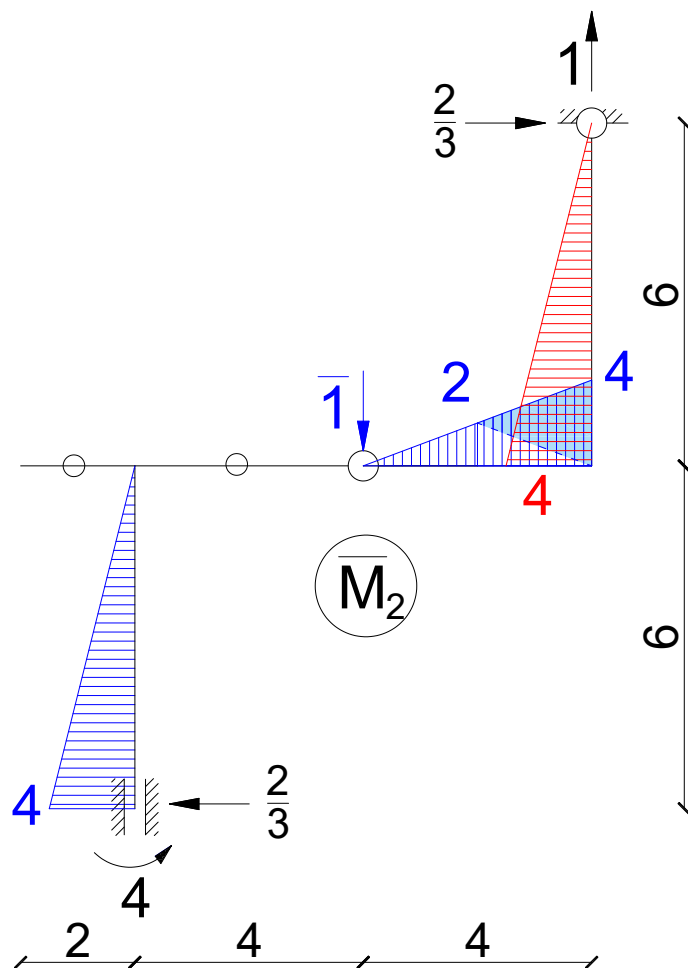
Wyznaczenie przemieszczeń z zasady prac wirtualnych:



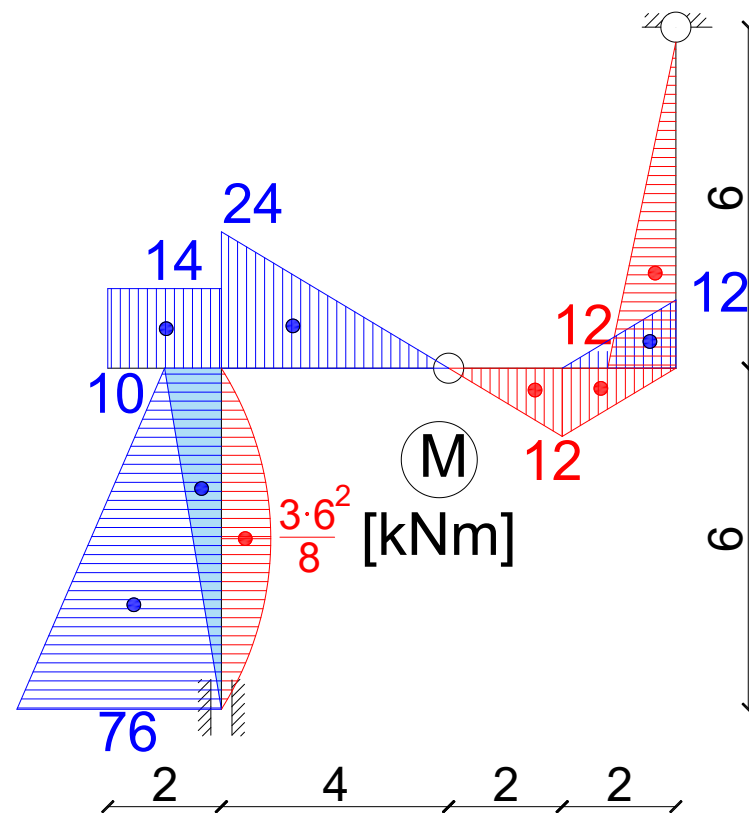
$$u_D = \frac{405}{EI}$$



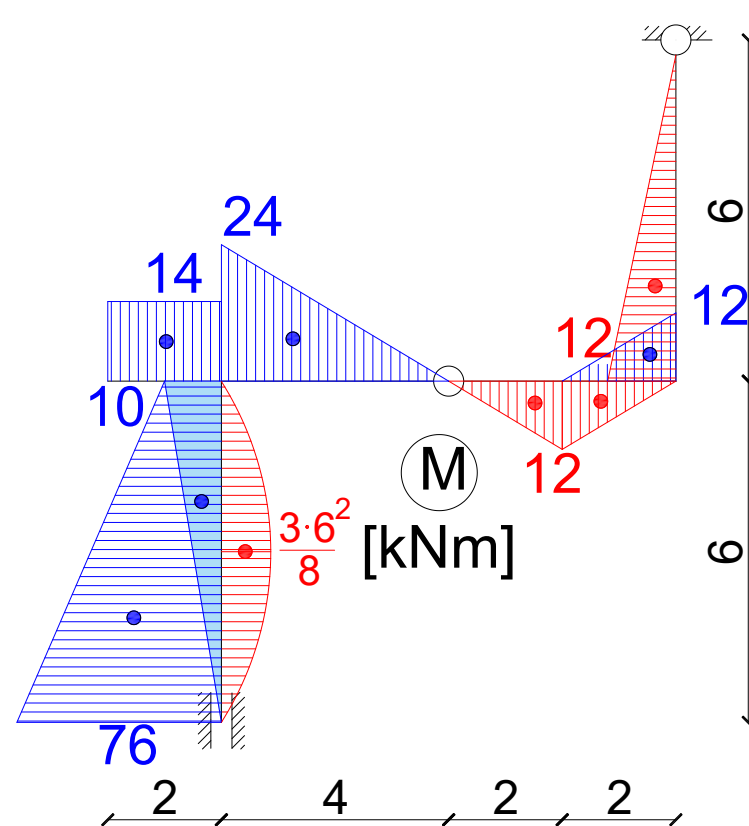
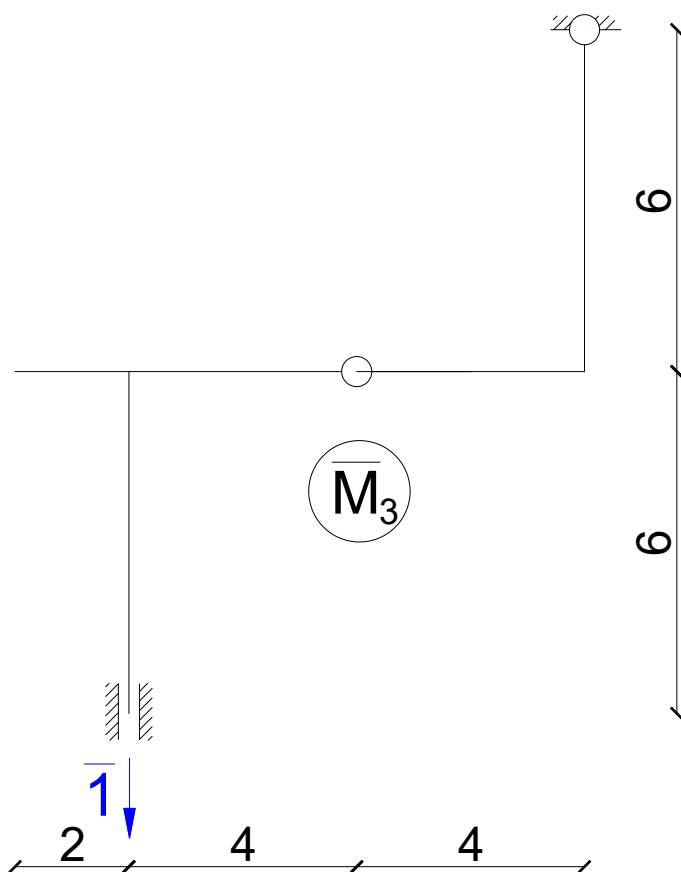
Wyznaczenie przemieszczeń z zasady prac wirtualnych:



$$v_C = \frac{358}{EI}$$

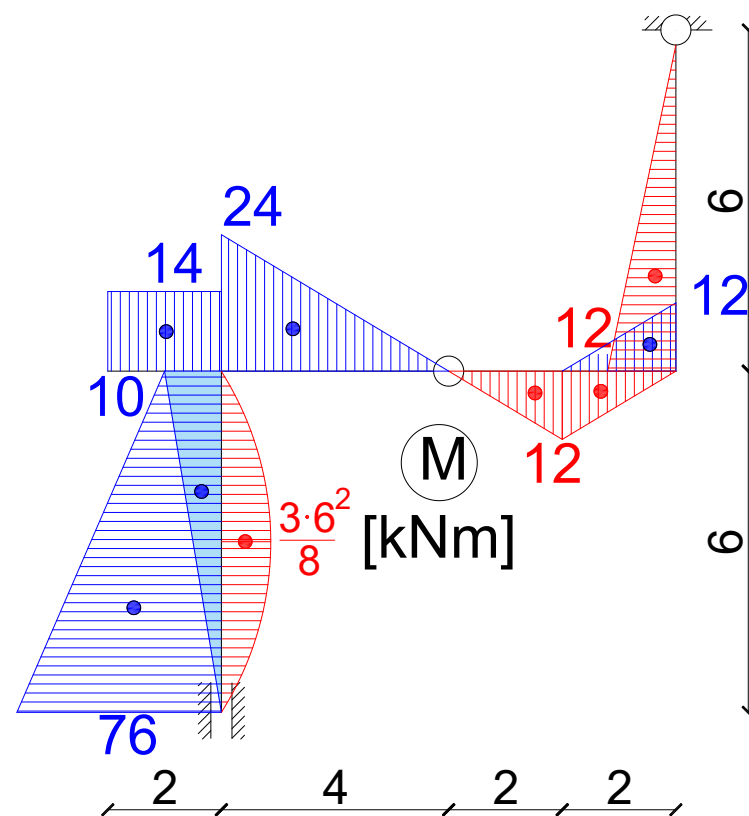
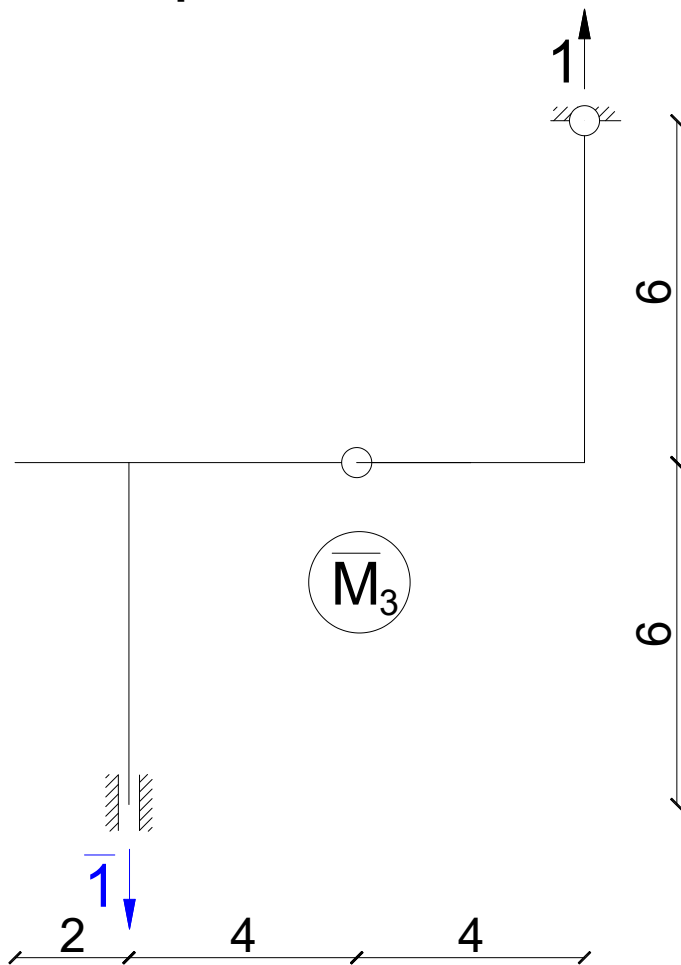


Wyznaczenie przemieszczeń z zasady prac wirtualnych:



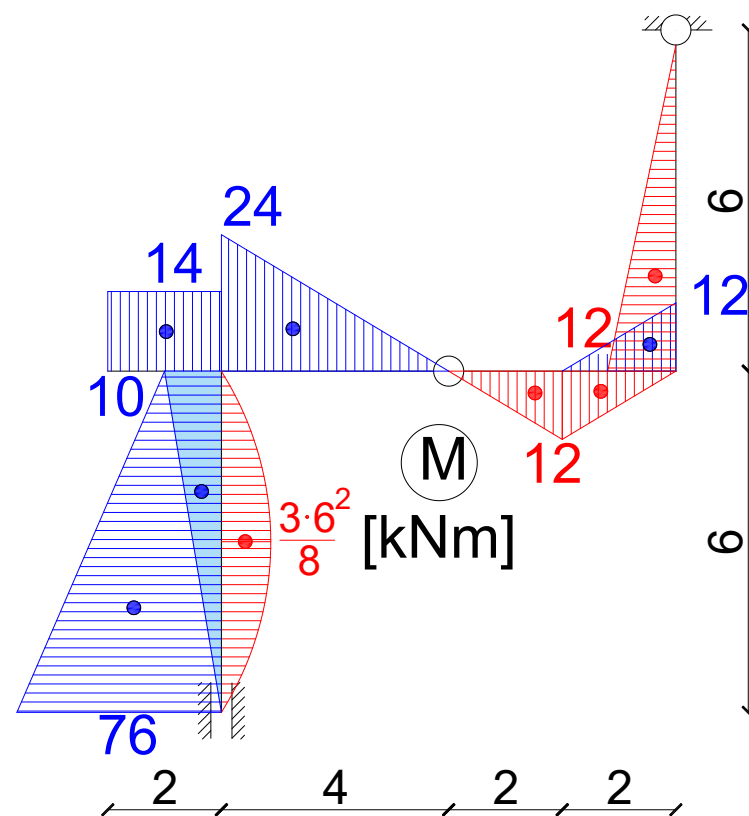
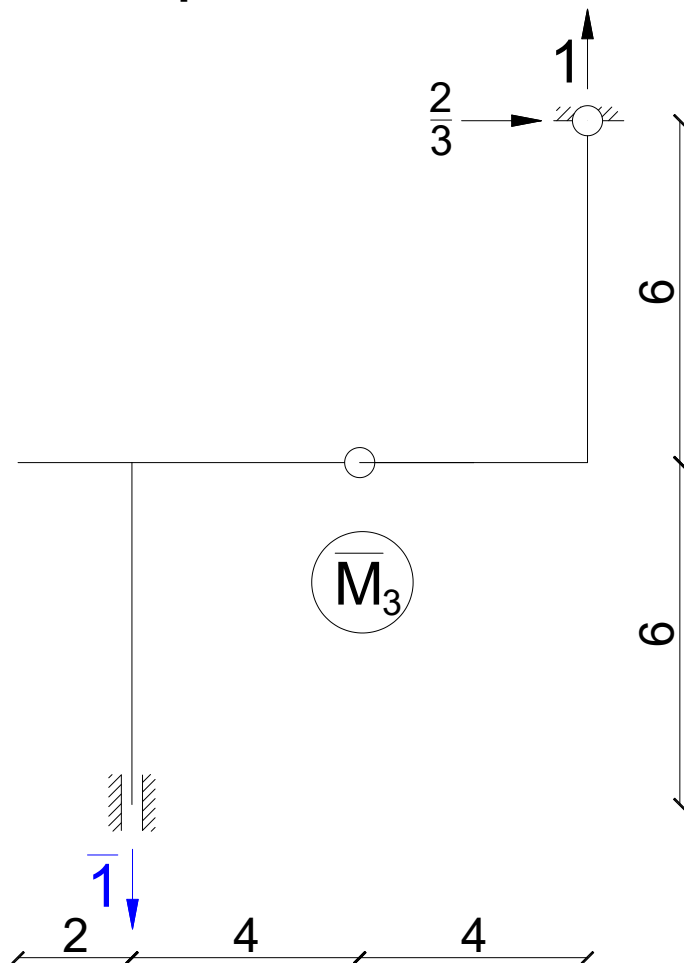
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



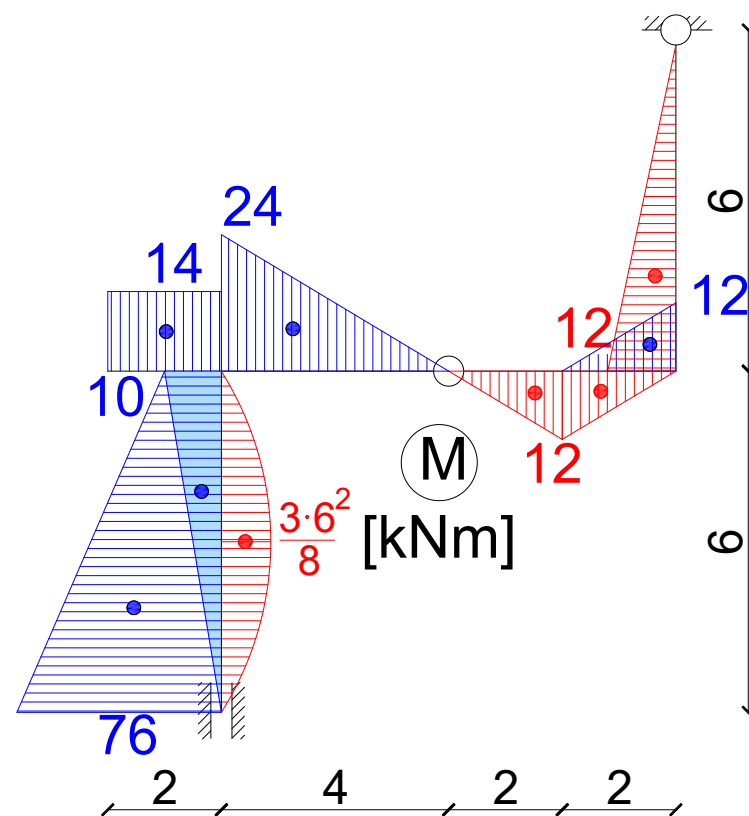
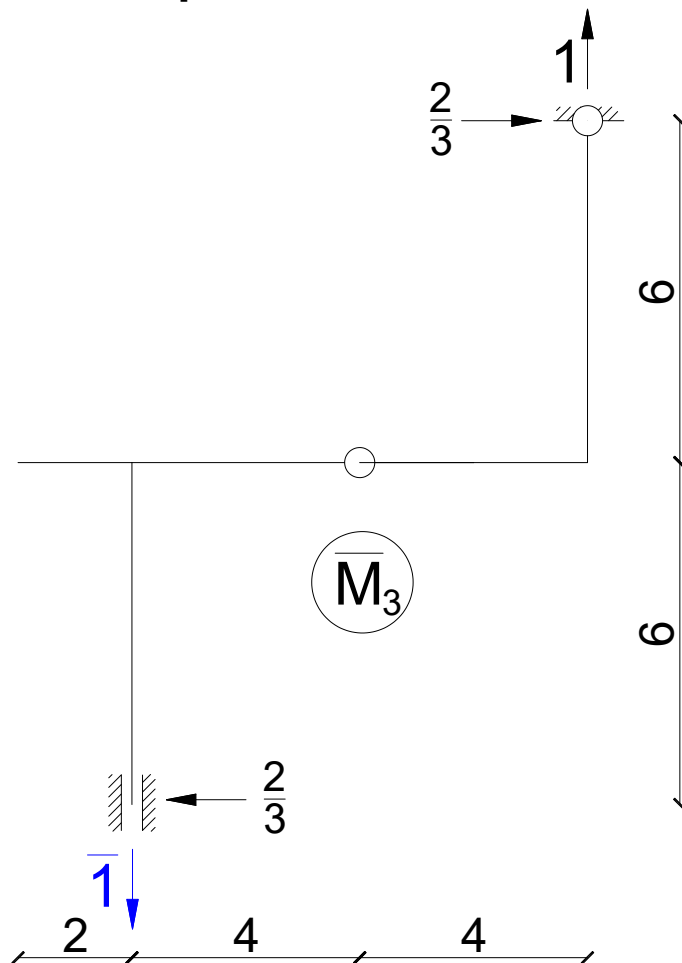
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



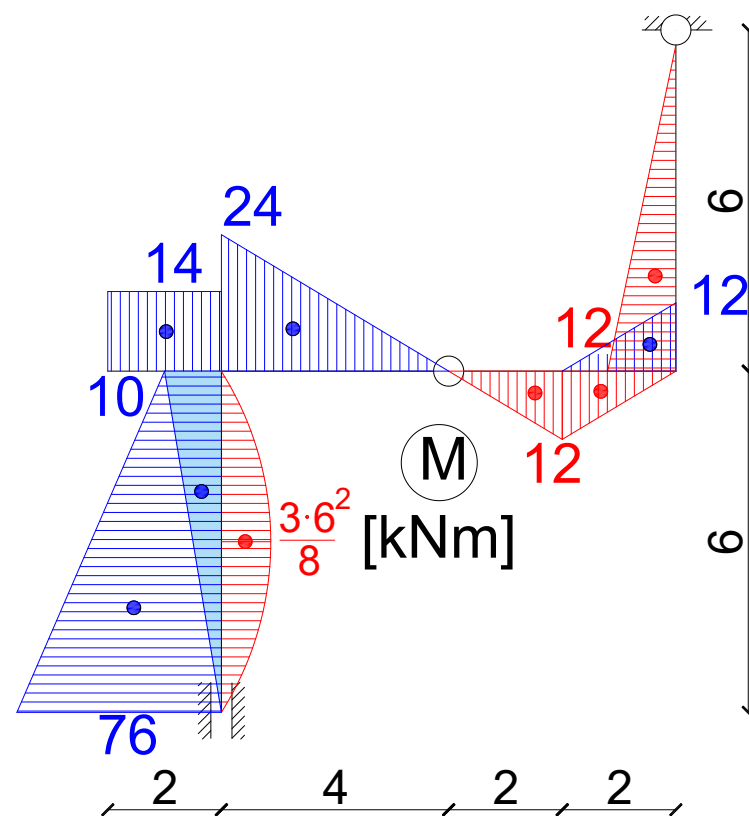
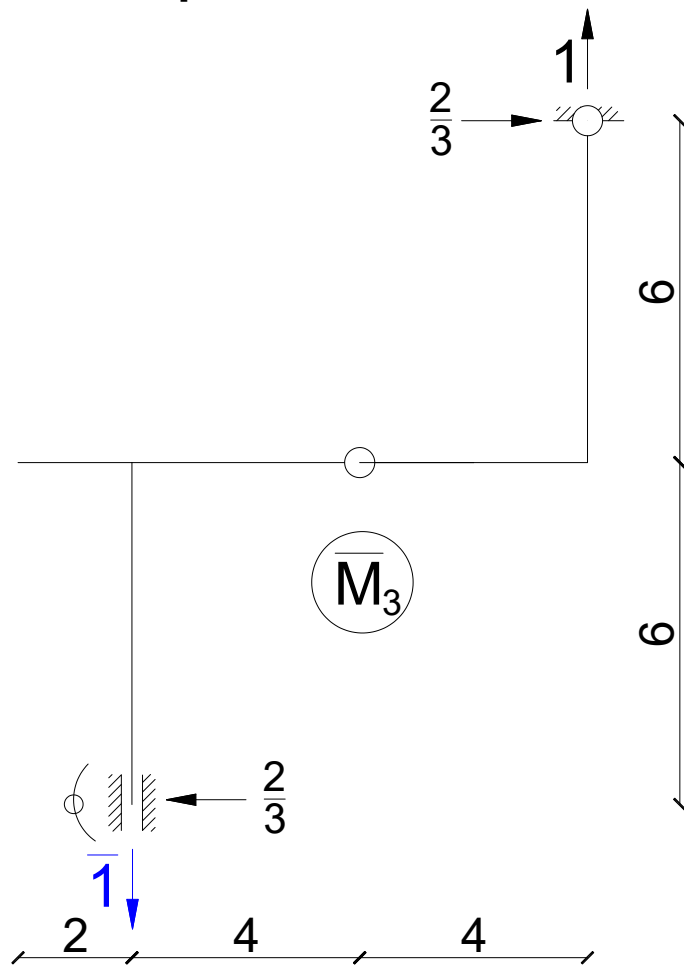
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



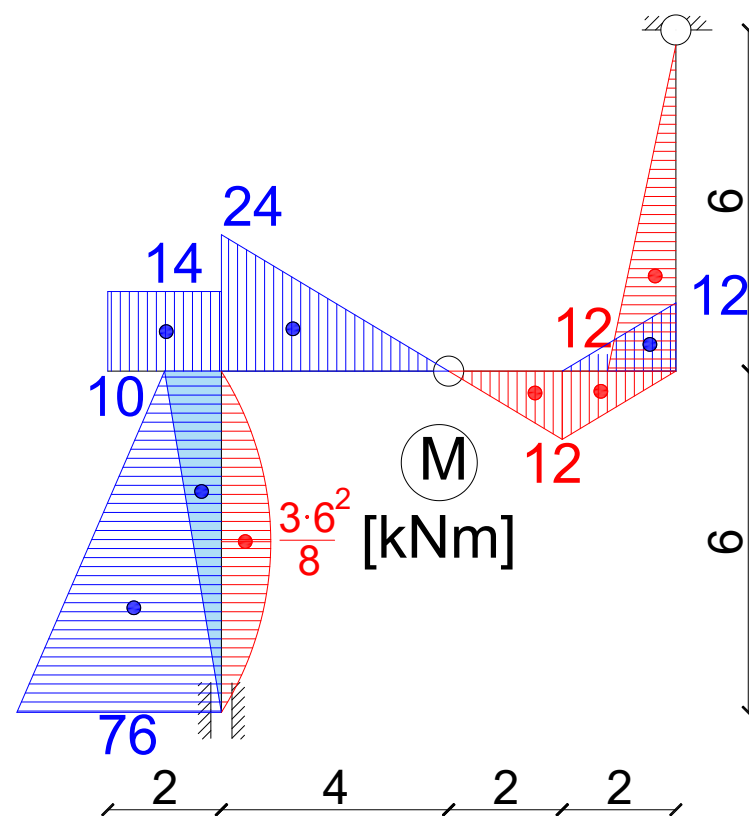
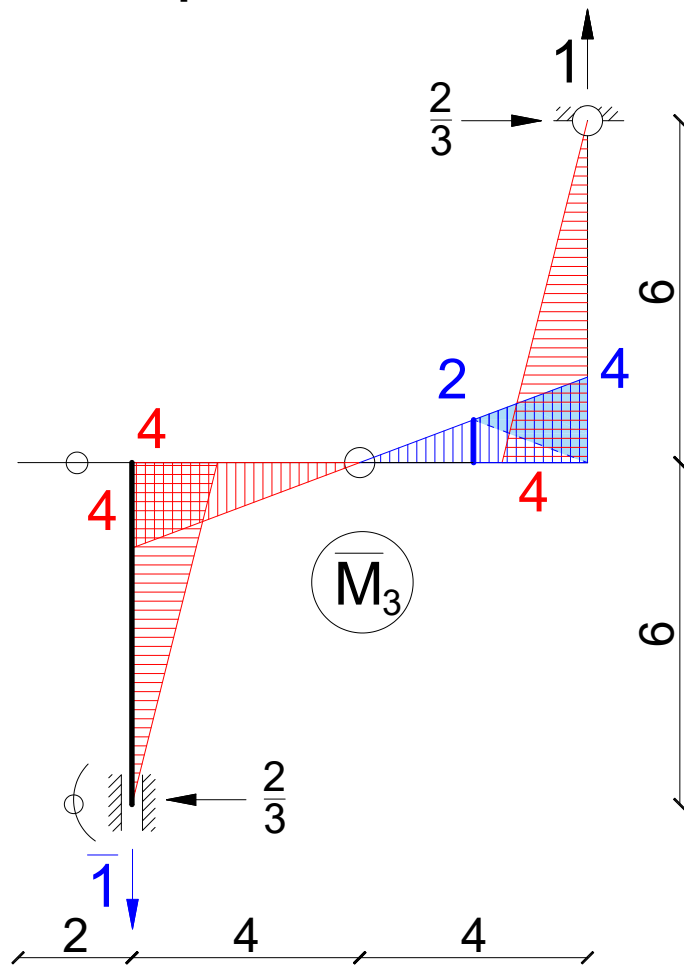
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



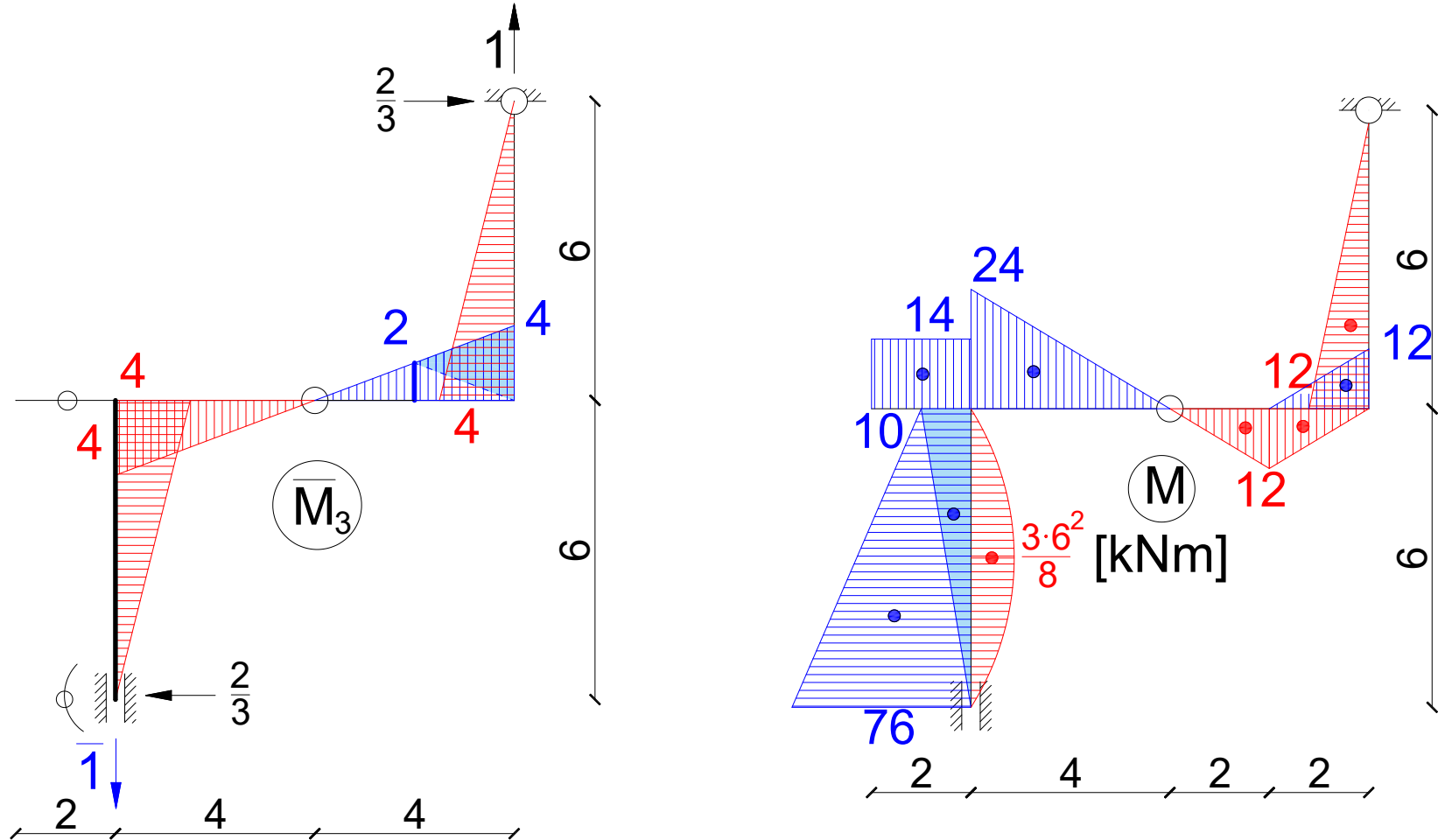
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



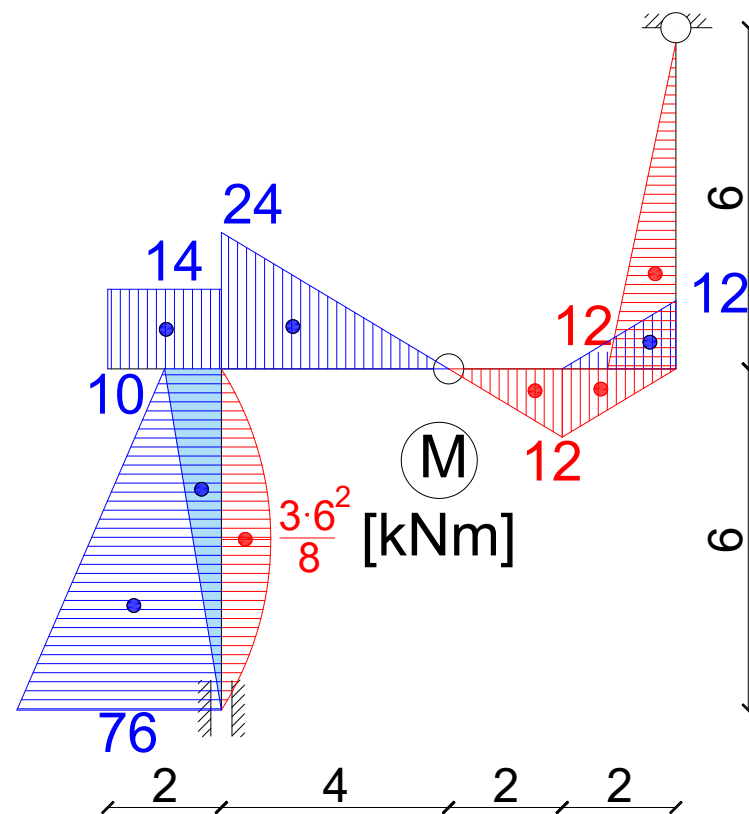
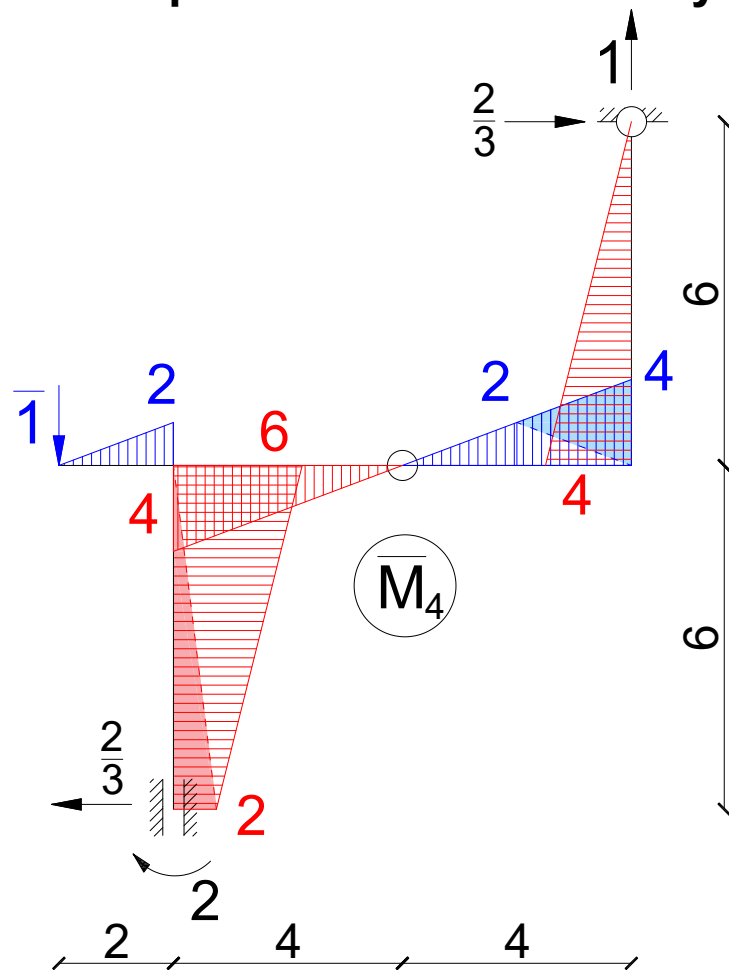
$$v_A = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



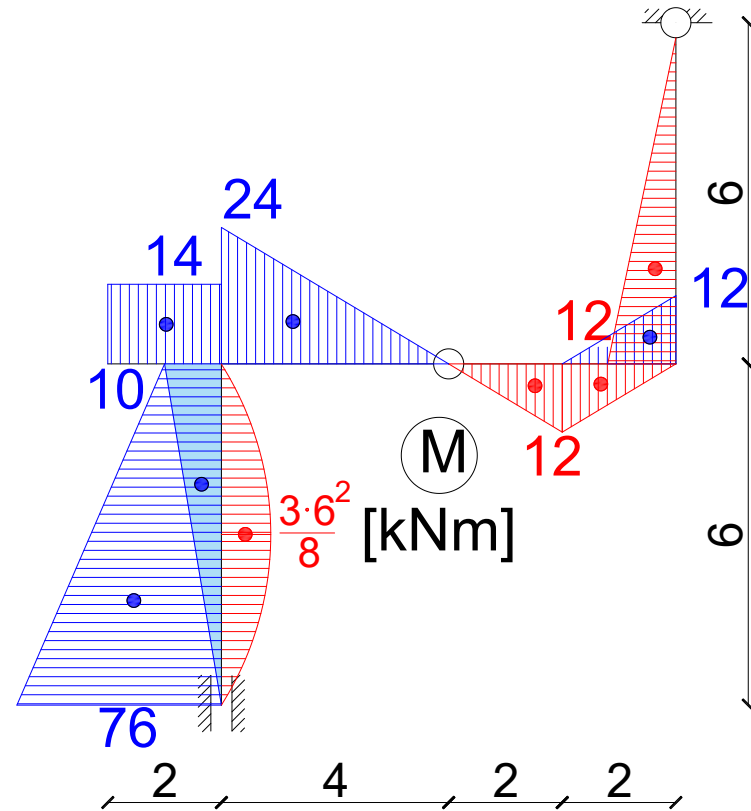
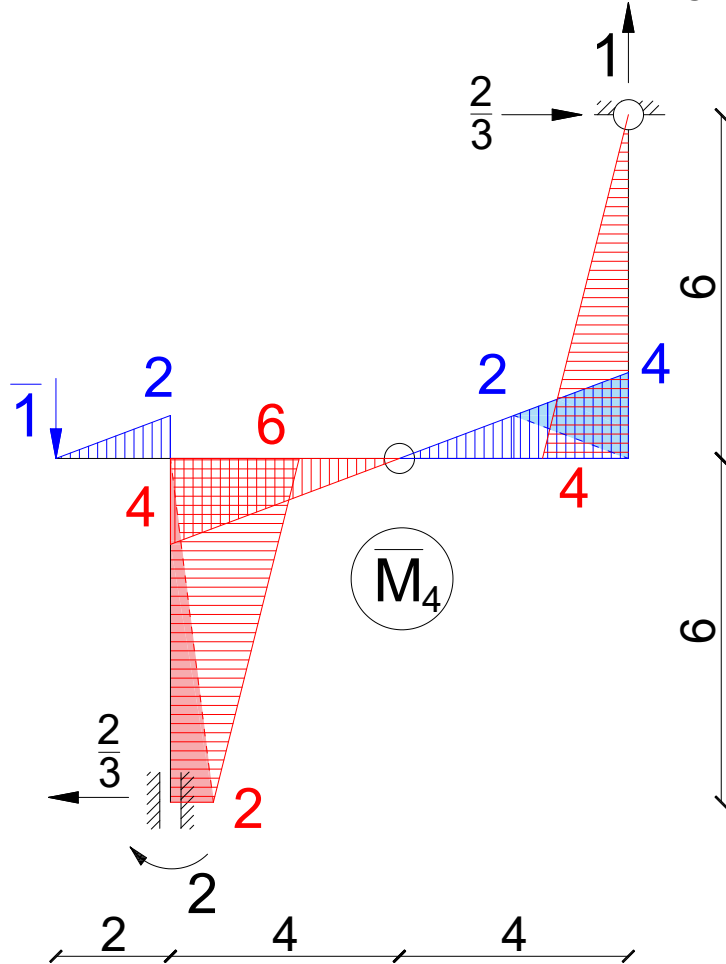
$$v_A = \frac{1}{2EI} \left(-\frac{1}{2} \cdot 4 \cdot 6 \cdot \left(\frac{2}{3} \cdot 10 + \frac{1}{3} \cdot 76 \right) + \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot \frac{1}{2} \cdot 4 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 24 \cdot 4 \cdot \frac{2}{3} \cdot 4 \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 6 \cdot \frac{2}{3} \cdot 4 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \frac{2}{3} \cdot 2 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \left(\frac{2}{3} \cdot 2 + \frac{1}{3} \cdot 4 \right) \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \left(\frac{1}{3} \cdot 2 + \frac{2}{3} \cdot 4 \right) \right) = \frac{-178}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



$$v_D = ?$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:

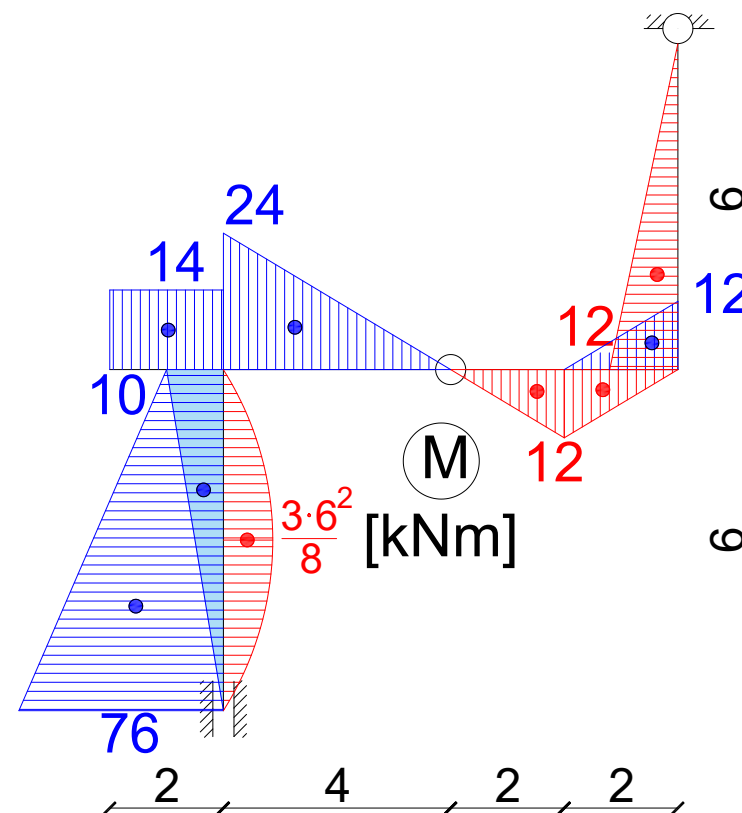
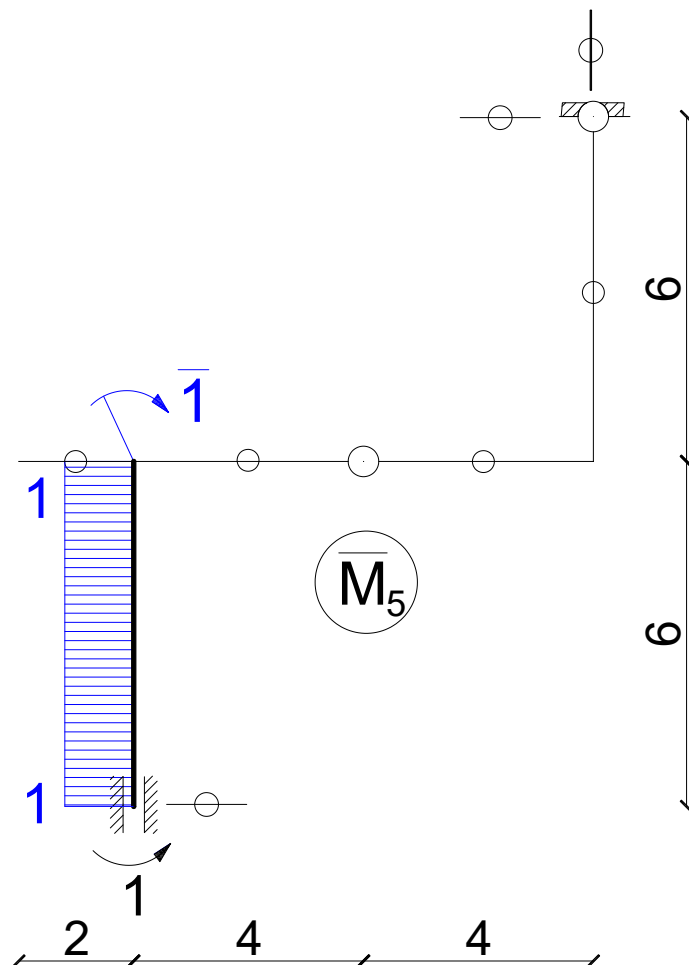


$$v_D = \frac{1}{2EI} \left(-\frac{1}{2} \cdot 76 \cdot 6 \cdot \left(\frac{2}{3} \cdot 2 + \frac{1}{3} \cdot 6 \right) - \frac{1}{2} \cdot 10 \cdot 6 \cdot \left(\frac{1}{3} \cdot 2 + \frac{2}{3} \cdot 6 \right) + \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot \left(\frac{1}{2} \cdot 2 + \frac{1}{2} \cdot 6 \right) \right) + \frac{1}{EI} \left(14 \cdot 2 \cdot \frac{1}{2} \cdot 2 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 24 \cdot 4 \cdot \frac{2}{3} \cdot 4 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \frac{2}{3} \cdot 2 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \left(\frac{2}{3} \cdot 2 + \frac{1}{3} \cdot 4 \right) \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot \left(\frac{1}{3} \cdot 2 + \frac{2}{3} \cdot 4 \right) \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 6 \cdot \frac{2}{3} \cdot 4 \right) = \frac{-354}{EI}$$

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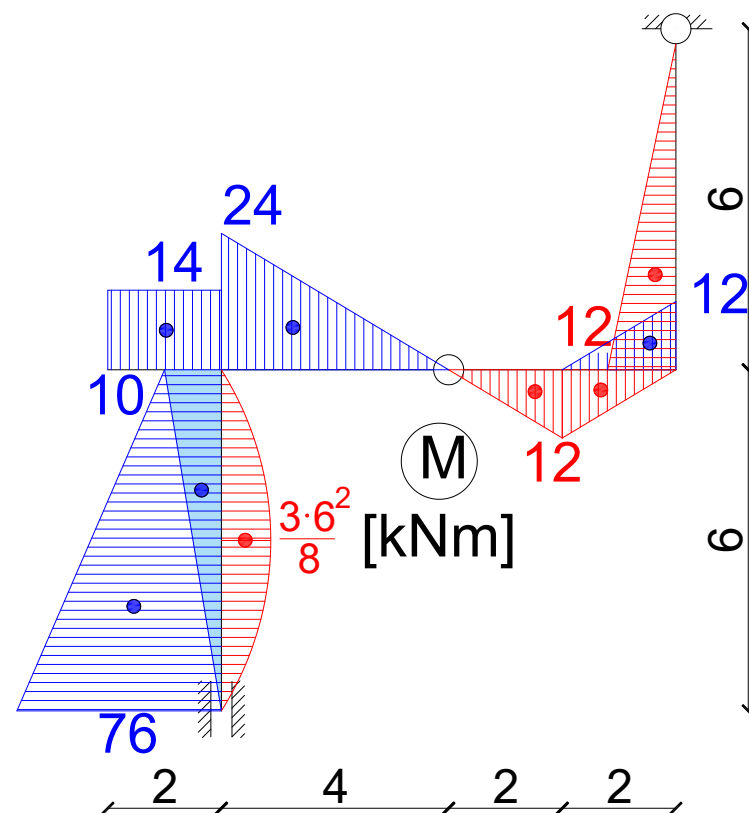
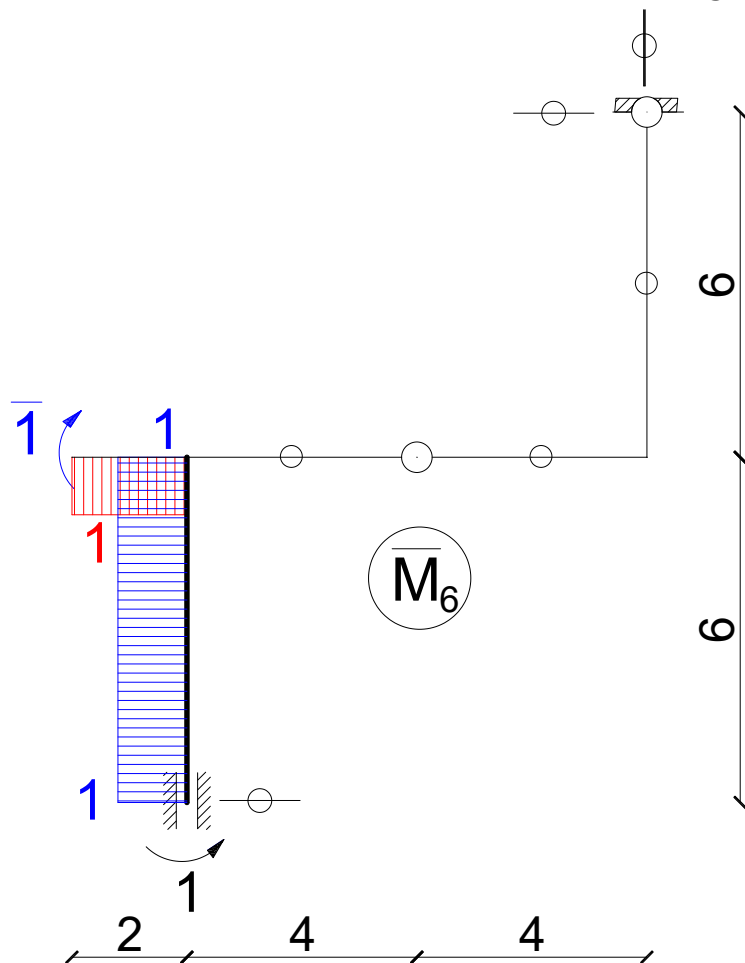
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Wyznaczenie przemieszczeń z zasady prac wirtualnych:



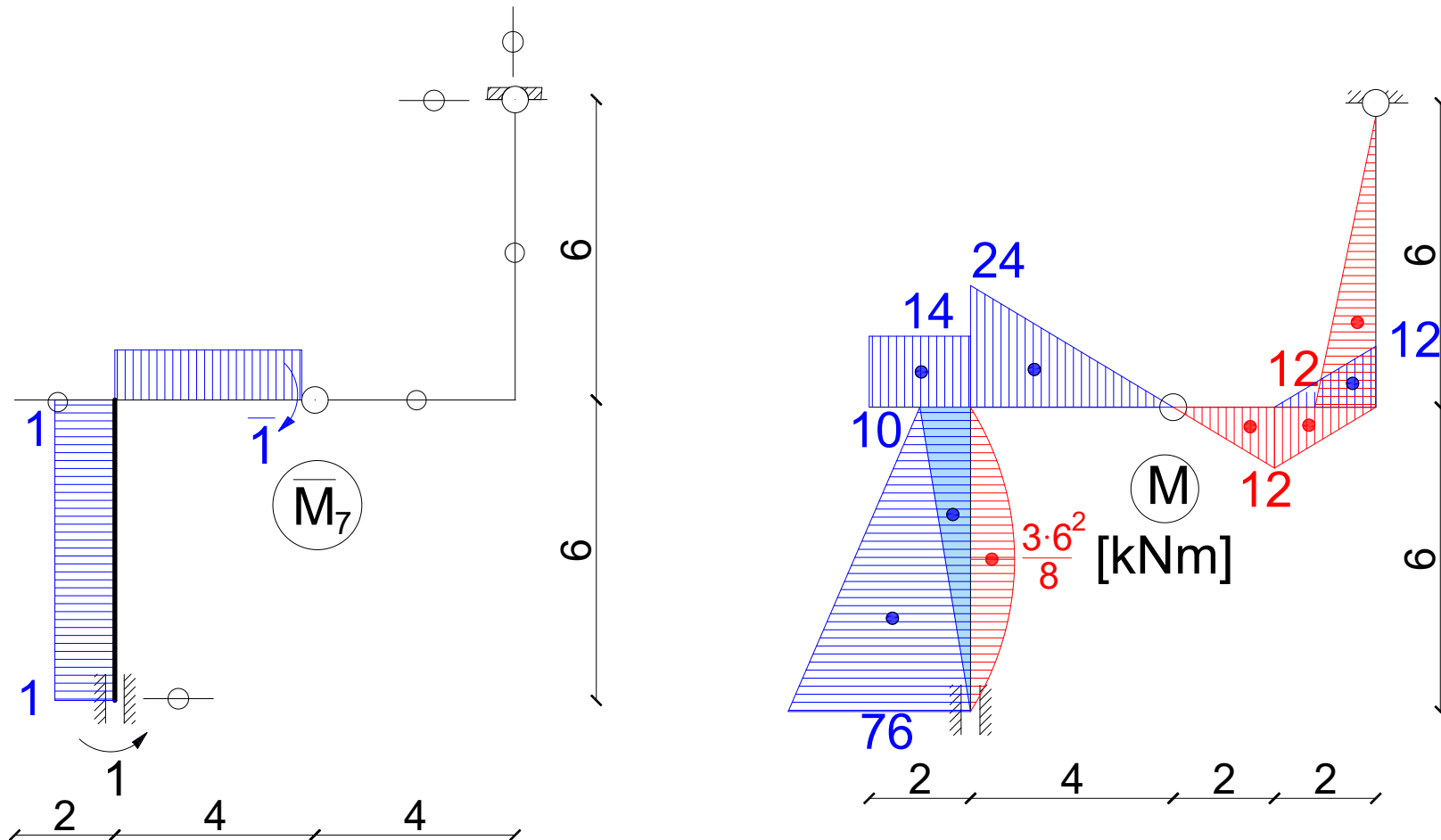
$$\varphi_E = \frac{1}{2EI} \left(\frac{1}{2} \cdot 76 \cdot 6 \cdot 1 + \frac{1}{2} \cdot 10 \cdot 6 \cdot 1 - \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot 1 \right) = \frac{102}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



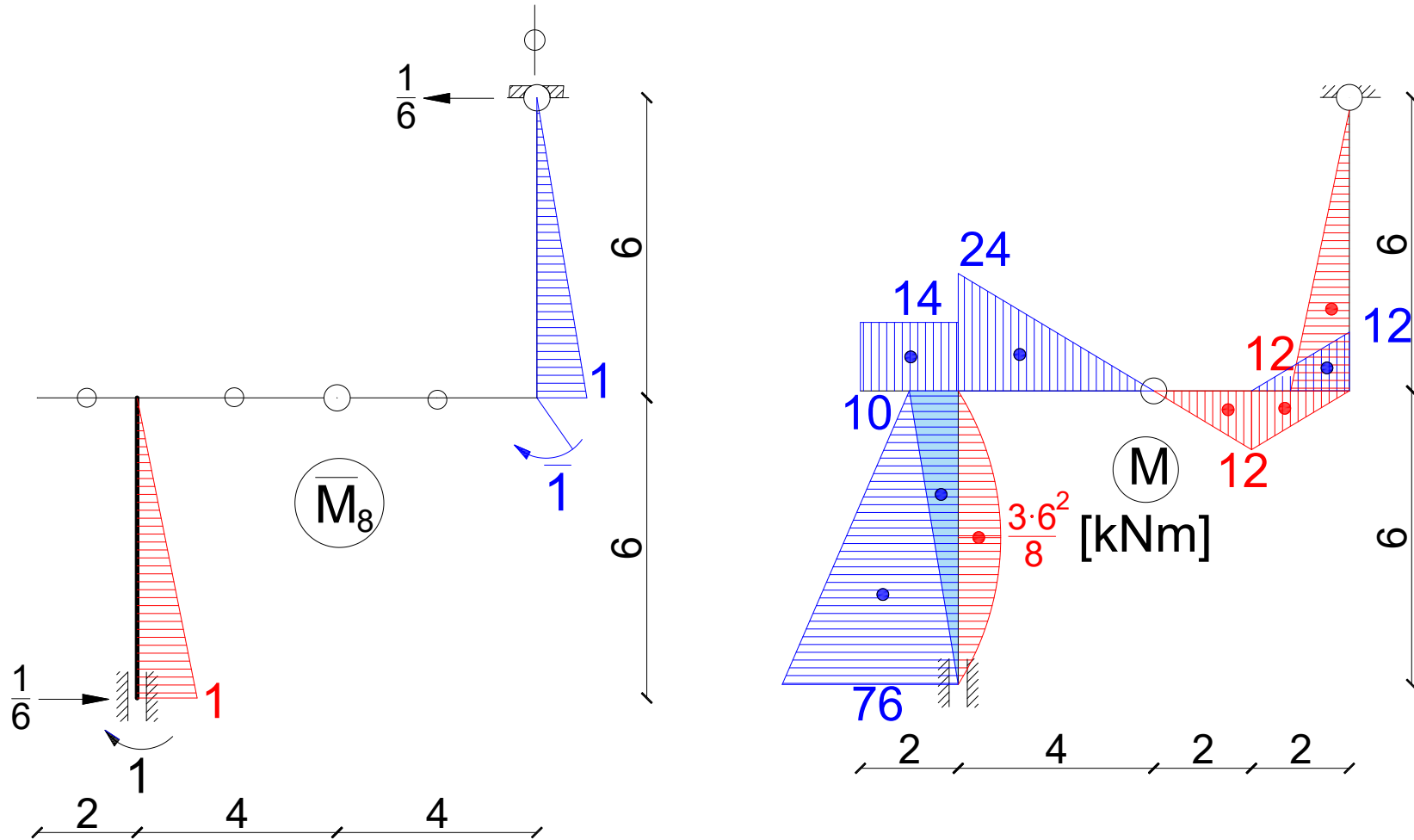
$$\varphi_D = \frac{1}{2EI} \left(\frac{1}{2} \cdot 76 \cdot 6 \cdot 1 + \frac{1}{2} \cdot 10 \cdot 6 \cdot 1 - \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot 1 \right) - \frac{1}{EI} (14 \cdot 2 \cdot 1) = \frac{74}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



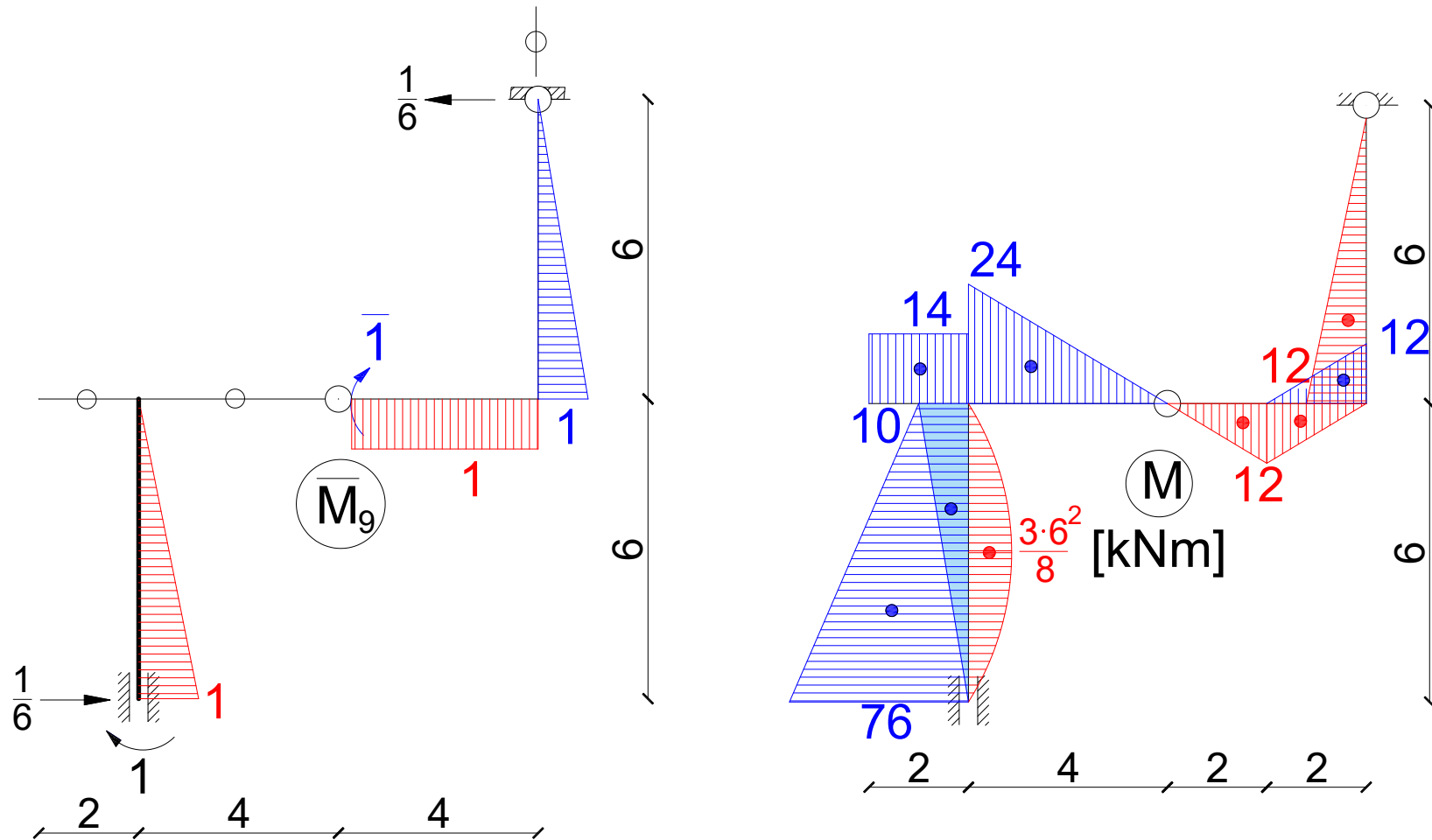
$$\varphi_C^L = \frac{1}{2EI} \left(\frac{1}{2} \cdot 76 \cdot 6 \cdot 1 + \frac{1}{2} \cdot 10 \cdot 6 \cdot 1 - \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot 1 \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 24 \cdot 4 \cdot 1 \right) = \frac{150}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



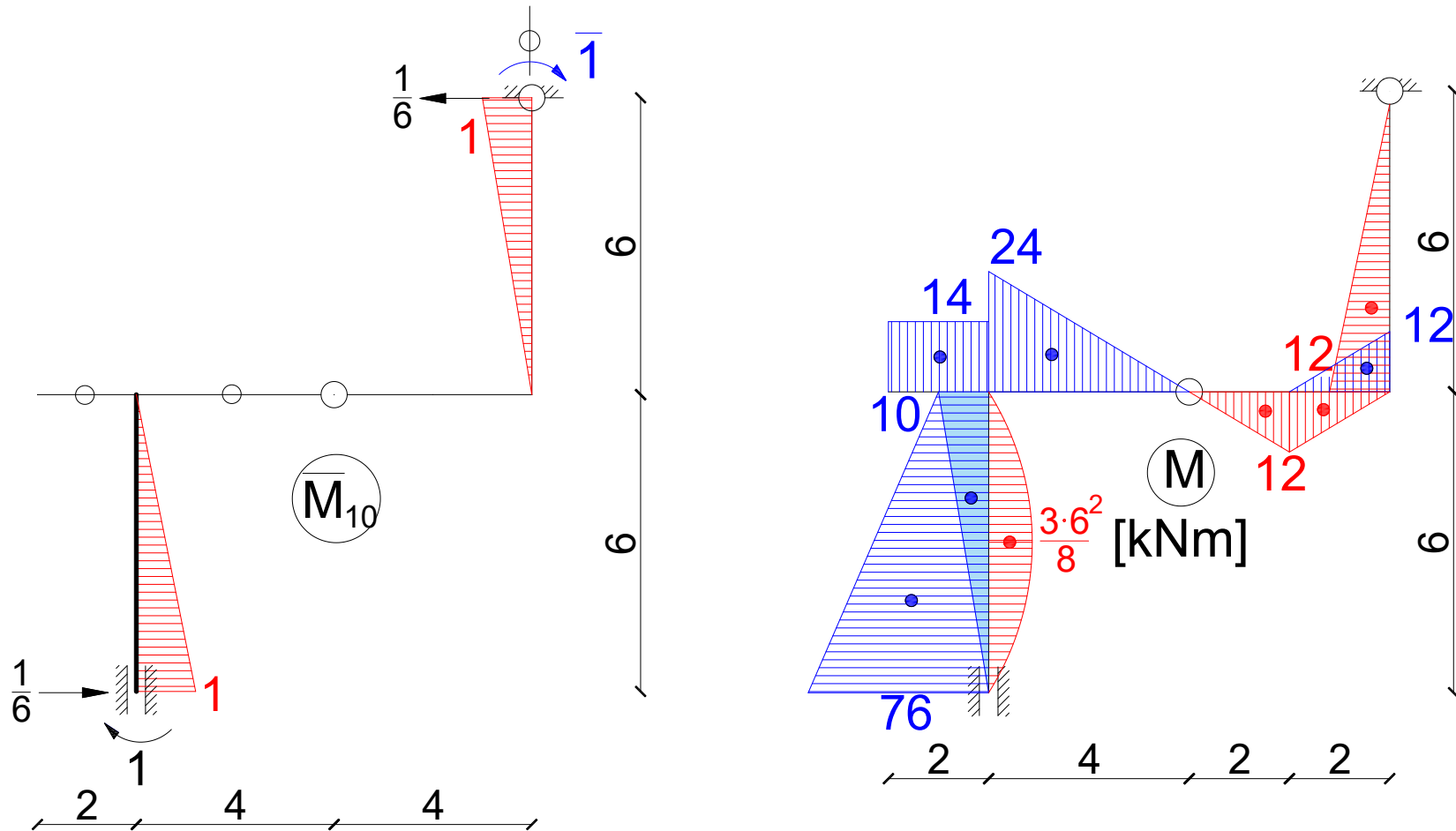
$$\varphi_F = \frac{1}{2EI} \left(-\frac{1}{2} \cdot 76 \cdot 6 \cdot \frac{2}{3} \cdot 1 - \frac{1}{2} \cdot 10 \cdot 6 \cdot \frac{1}{3} \cdot 1 + \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot \frac{1}{2} \cdot 2 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 6 \cdot \frac{2}{3} \cdot 1 \right) = -\frac{183}{2EI} = -\frac{91,5}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



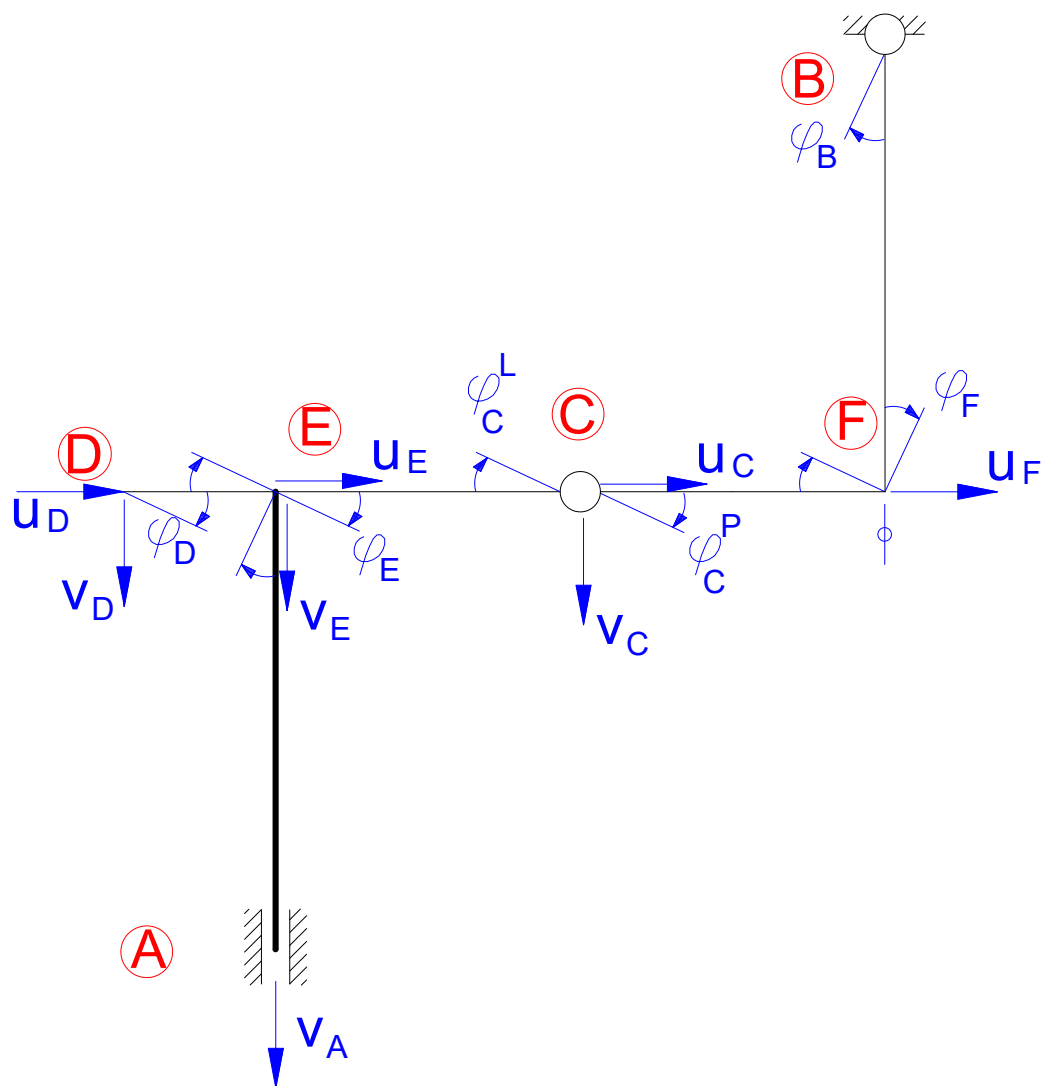
$$\varphi_c^P = \frac{1}{2EI} \left(-\frac{1}{2} \cdot 76 \cdot 6 \cdot \frac{2}{3} \cdot 1 - \frac{1}{2} \cdot 10 \cdot 6 \cdot \frac{1}{3} \cdot 1 + \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot \frac{1}{2} \cdot 2 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 6 \cdot \frac{2}{3} \cdot 1 \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot 1 \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot 1 \right) - \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 2 \cdot 1 \right) = -\frac{159}{2EI} = -\frac{79,5}{EI}$$

Wyznaczenie przemieszczeń z zasady prac wirtualnych:



$$\varphi_B = \frac{1}{2EI} \left(-\frac{1}{2} \cdot 76 \cdot 6 \cdot \frac{2}{3} \cdot 1 - \frac{1}{2} \cdot 10 \cdot 6 \cdot \frac{1}{3} \cdot 1 + \frac{2}{3} \cdot \frac{3 \cdot 6^2}{8} \cdot 6 \cdot \frac{1}{2} \cdot 2 \right) + \frac{1}{EI} \left(\frac{1}{2} \cdot 12 \cdot 6 \cdot \frac{1}{3} \cdot 1 \right) = -\frac{111}{2EI} = -\frac{55,5}{EI}$$

Wyznaczenie przemieszczeń w węzłach:



$$u_D = \frac{405}{EI}$$

$$v_C = \frac{358}{EI}$$

$$v_A = \frac{-178}{EI}$$

$$v_D = \frac{-354}{EI}$$

$$\phi_E = \frac{102}{EI}$$

$$\phi_D = \frac{74}{EI}$$

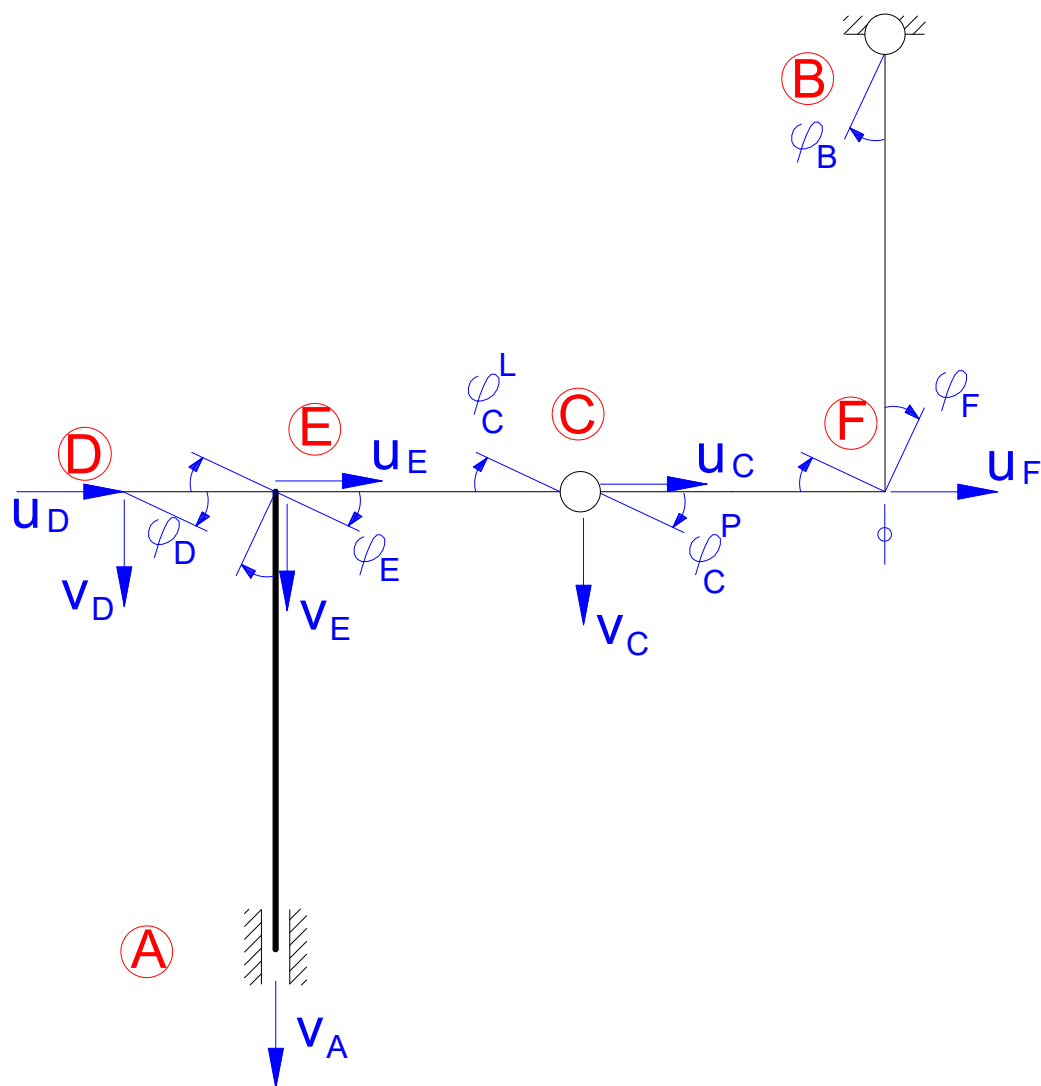
$$\phi_C^L = \frac{150}{EI}$$

$$\phi_F = -\frac{91,5}{EI}$$

$$\phi_C^P = -\frac{79,5}{EI}$$

$$\phi_B = -\frac{55,5}{EI}$$

Wyznaczenie przemieszczeń w węzłach:



Założenie $1/EI=a \rightarrow$

$$u_D = \frac{405}{EI}$$

$$v_C = \frac{358}{EI}$$

$$v_A = \frac{-178}{EI}$$

$$v_D = \frac{-354}{EI}$$

$$\varphi_E = \frac{102}{EI}$$

$$\varphi_D = \frac{74}{EI}$$

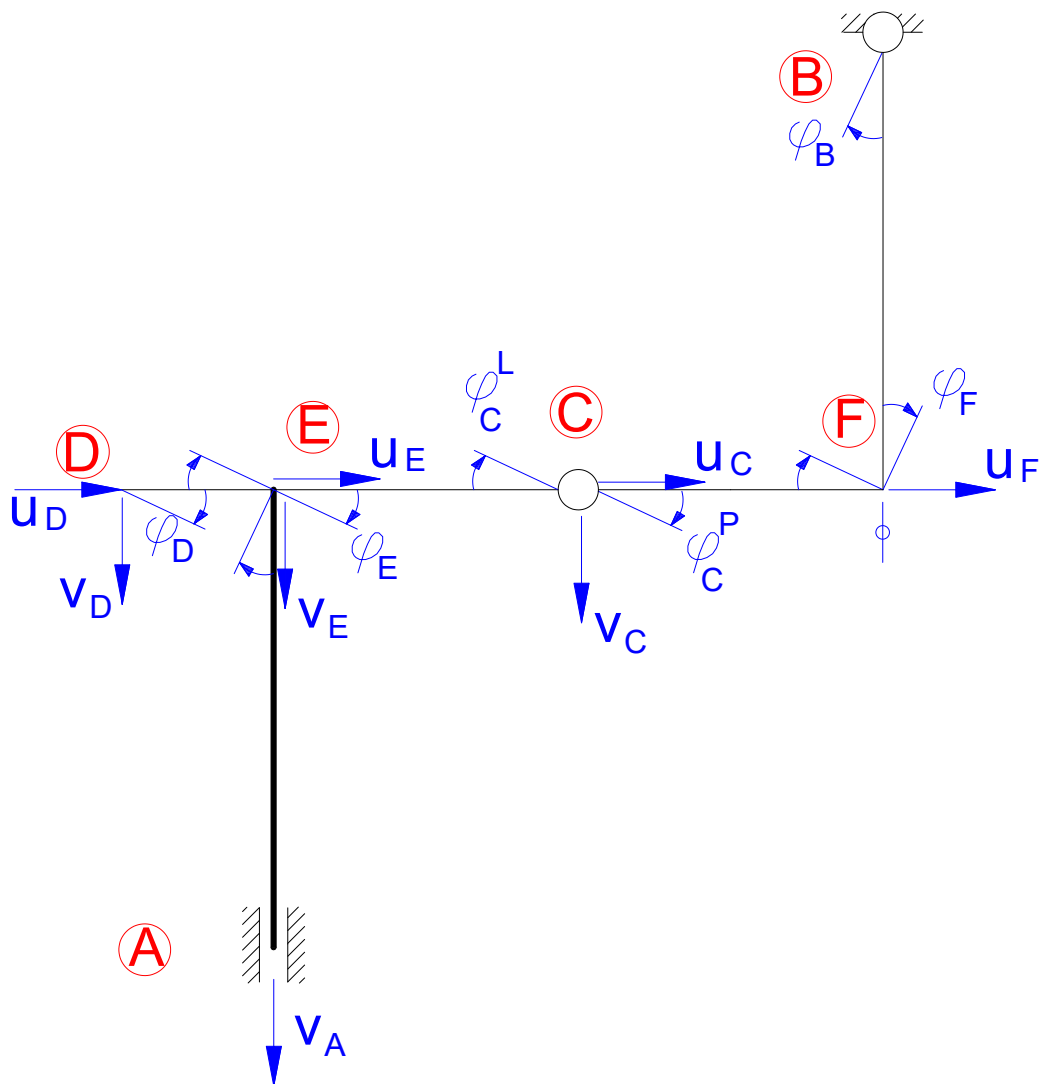
$$\varphi_C^L = \frac{150}{EI}$$

$$\varphi_F = -\frac{91,5}{EI}$$

$$\varphi_C^P = -\frac{79,5}{EI}$$

$$\varphi_B = -\frac{55,5}{EI}$$

Wyznaczenie przemieszczeń w węzłach:



Założenie $1/EI=a \rightarrow$

$$u_D = \frac{405}{EI} \rightarrow 405 a$$

$$v_C = \frac{358}{EI} \rightarrow 358 a$$

$$v_A = \frac{-178}{EI} \rightarrow -178 a$$

$$v_D = \frac{-354}{EI} \rightarrow -354 \text{ a}$$

$$\varphi_E = \frac{102}{EI} \rightarrow 102 \text{ } a$$

$$\varphi_D = \frac{74}{EI} \rightarrow 74 a$$

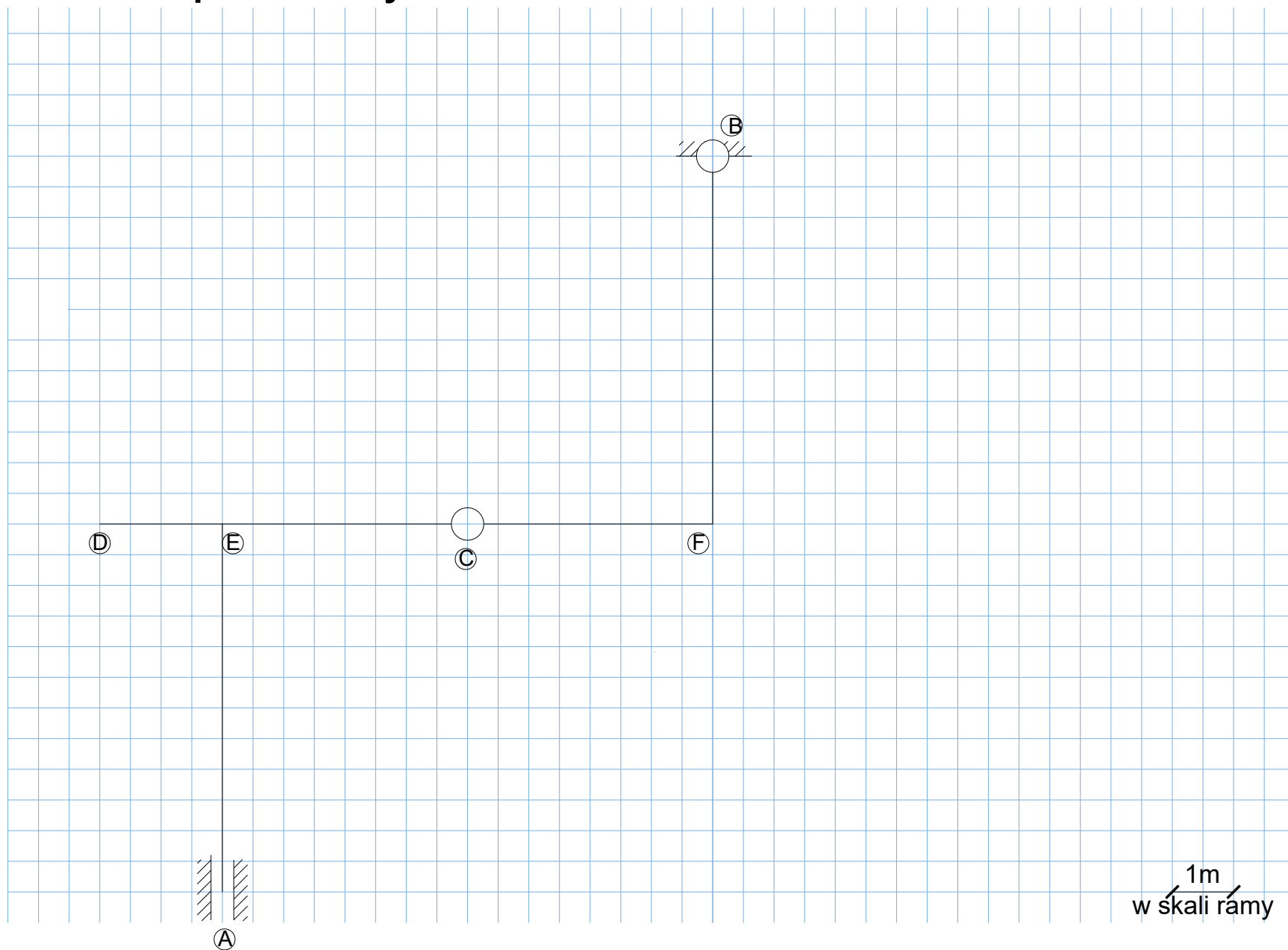
$$\varphi_C^L = \frac{150}{EI} \rightarrow 150 \text{ a}$$

$$\varphi_F = -\frac{91,5}{EI} \rightarrow -91,5a$$

$$\varphi_c^P = -\frac{79,5}{EI} \rightarrow -79,5a$$

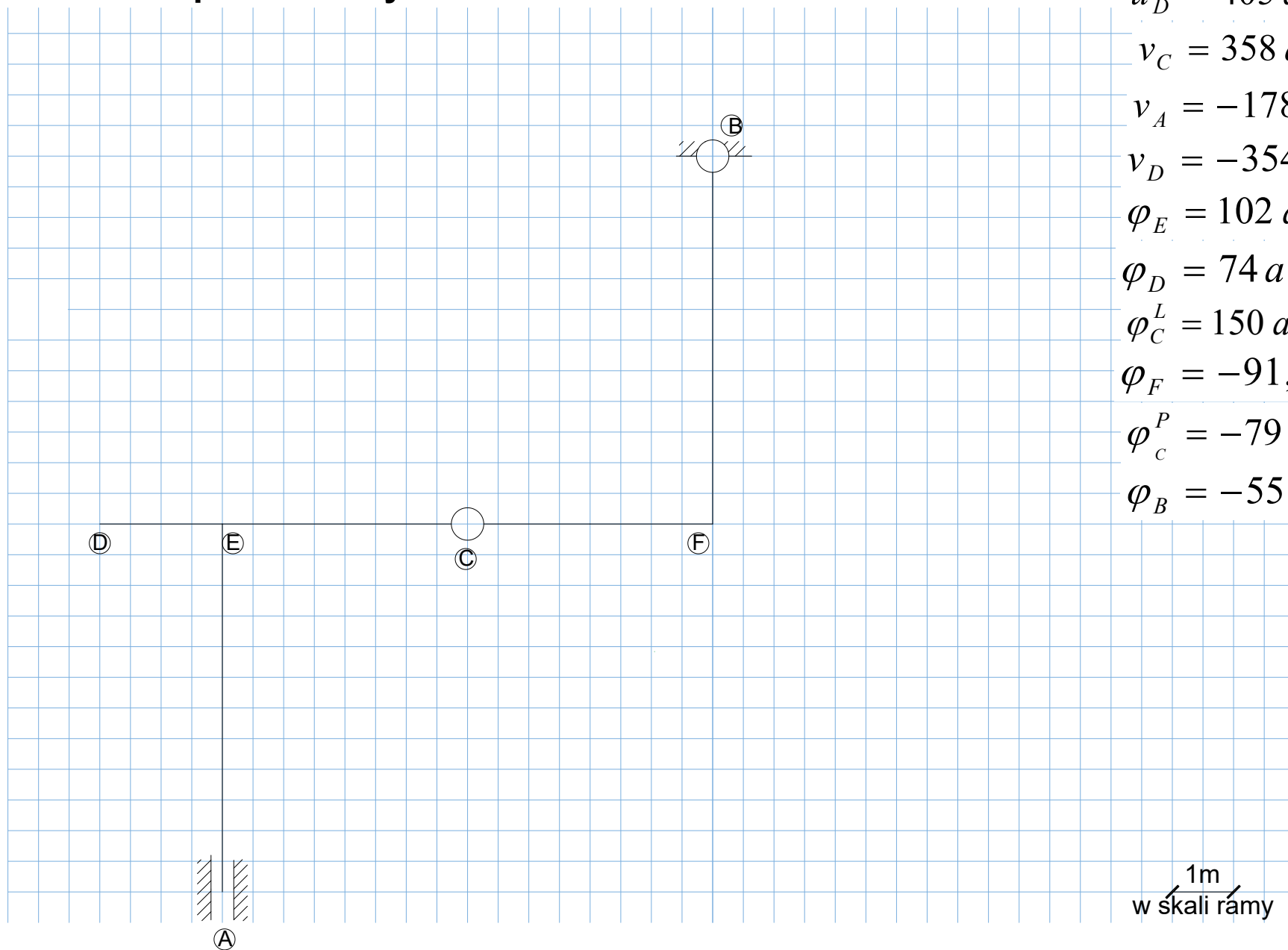
$$\varphi_B = -\frac{55,5}{EI} \rightarrow -55,5a$$

Odkształcona postać ramy:



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Odształcona postać ramy:



$$u_D = 405 a$$

$$v_C = 358 a$$

$$v_A = -178 a$$

$$v_D = -354 a$$

$$\varphi_E = 102 a$$

$$\varphi_D = 74 a$$

$$\varphi_C^L = 150 a$$

$$\varphi_F = -91,5 a$$

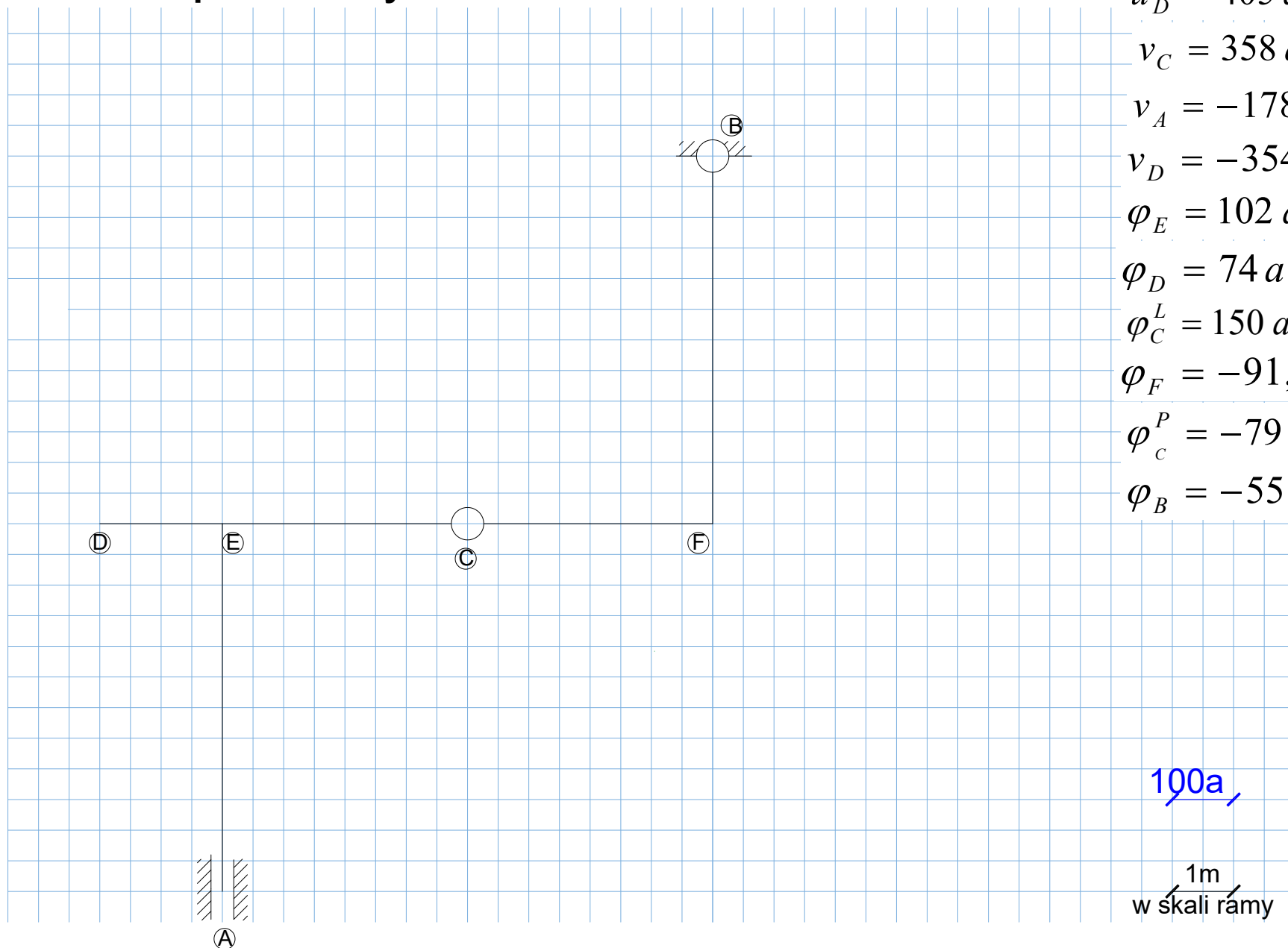
$$\varphi_C^P = -79,5 a$$

$$\varphi_B = -55,5 a$$

1m
w skali rąmy

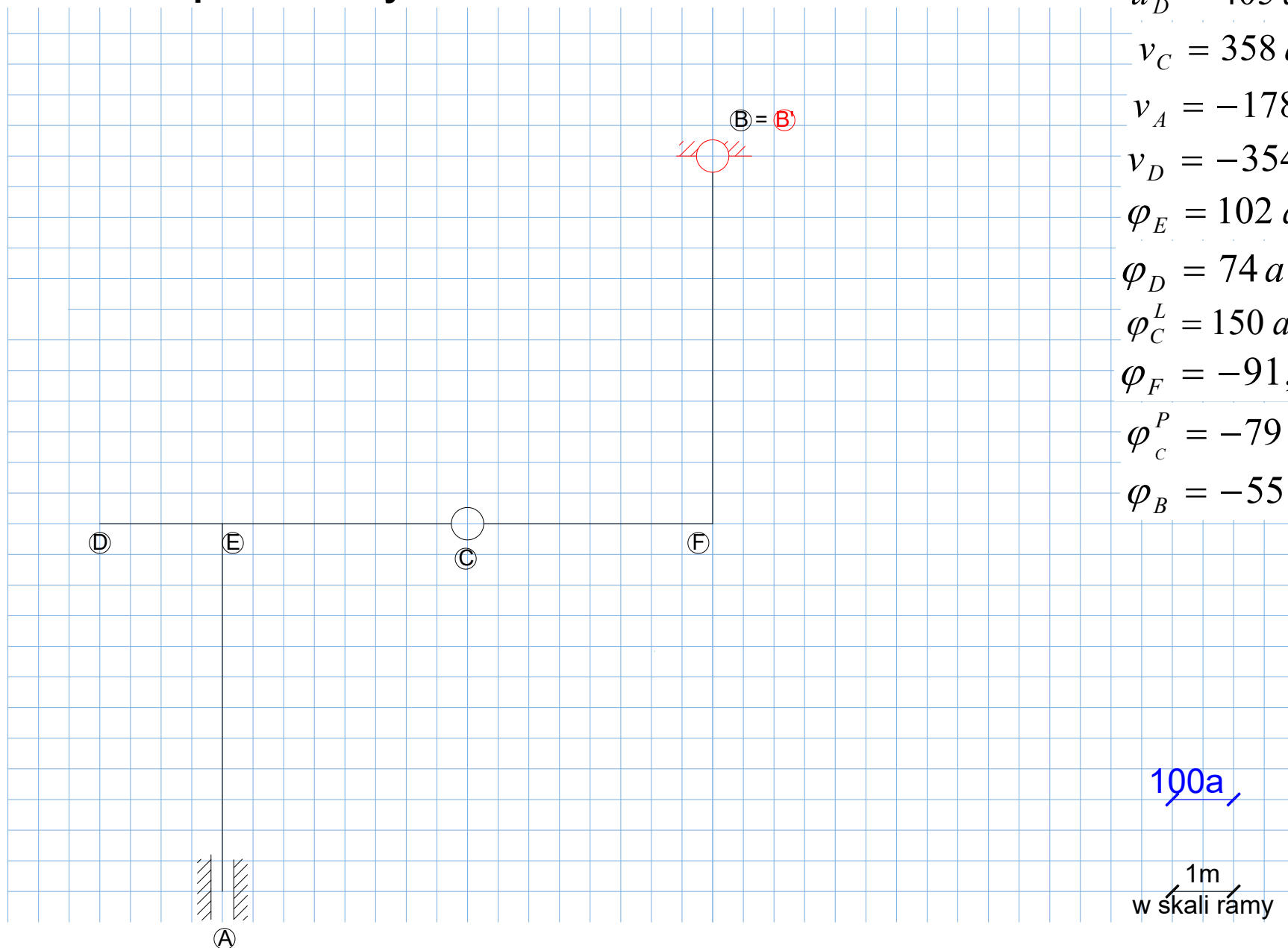
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Odkształcona postać rąmy:



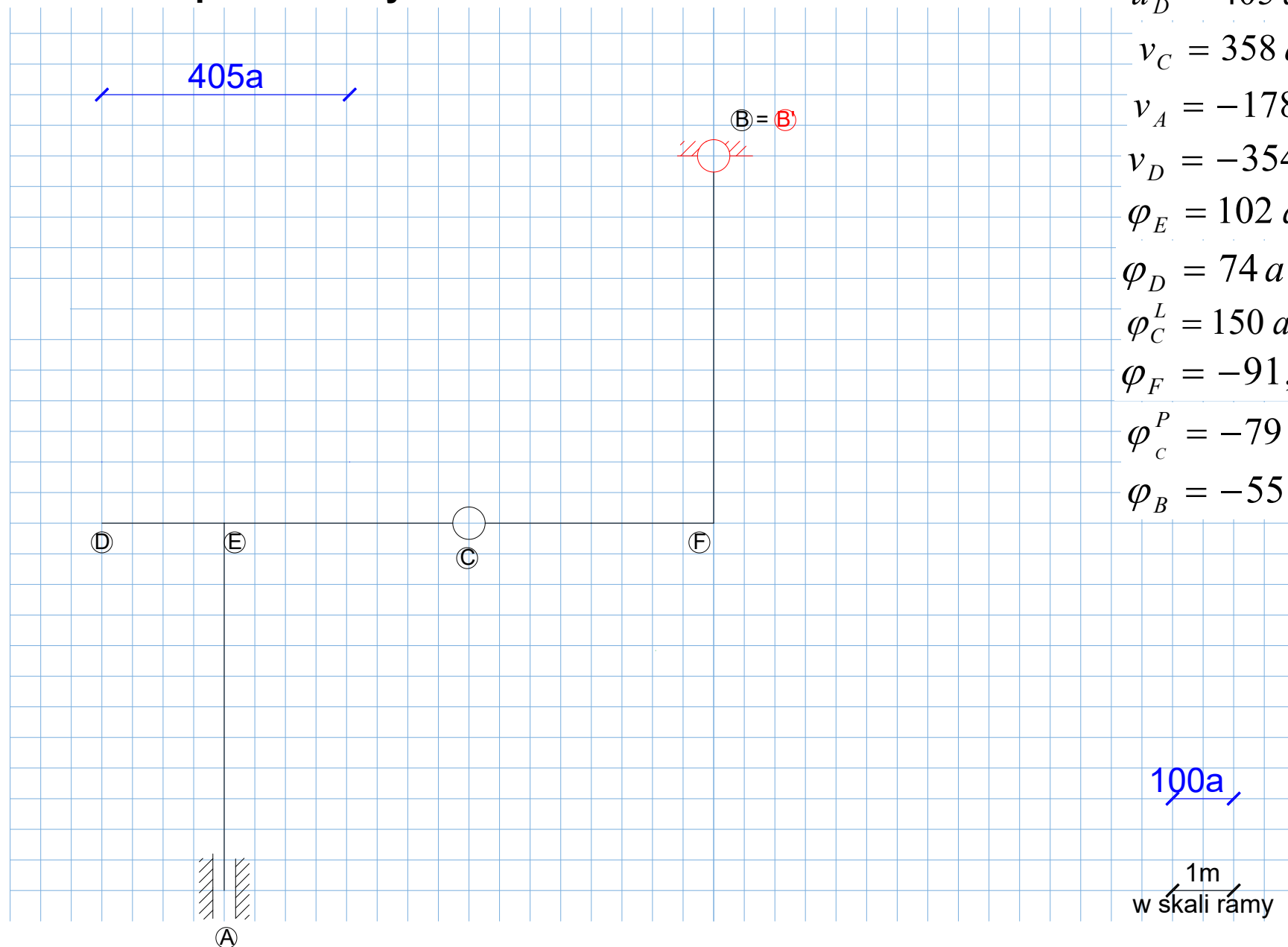
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać rąmy:



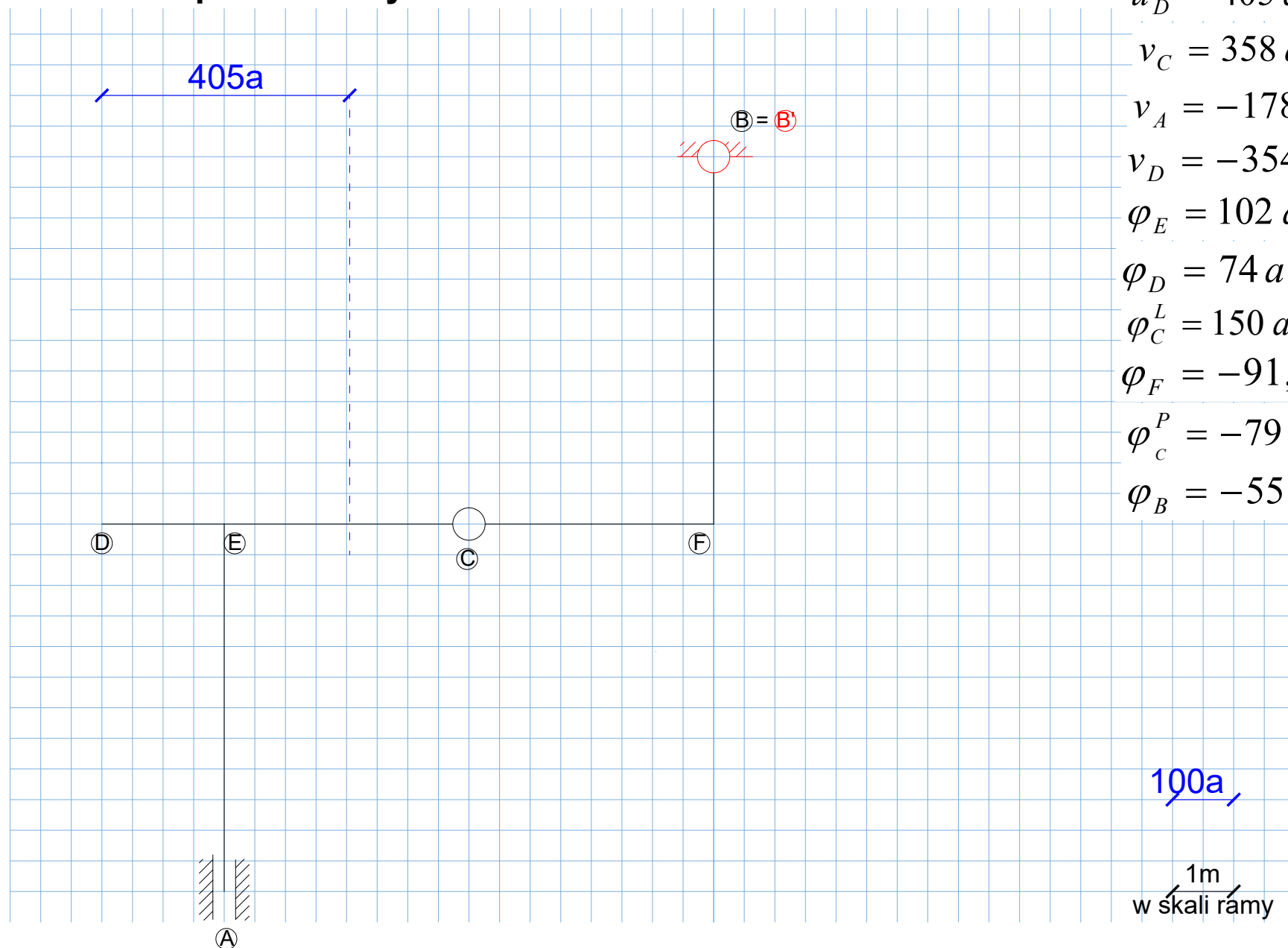
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać rąmy:



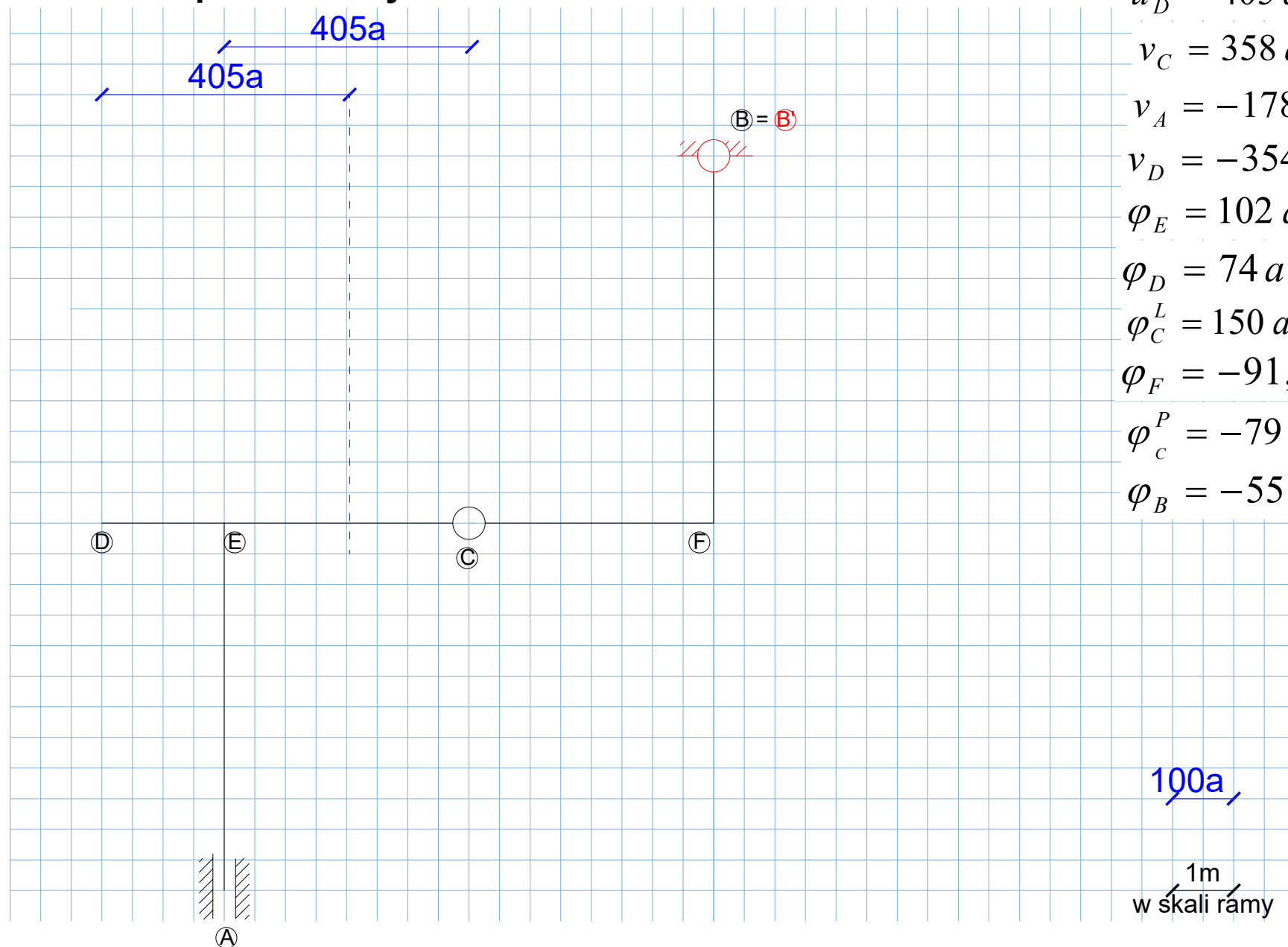
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać rąmy:



$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:

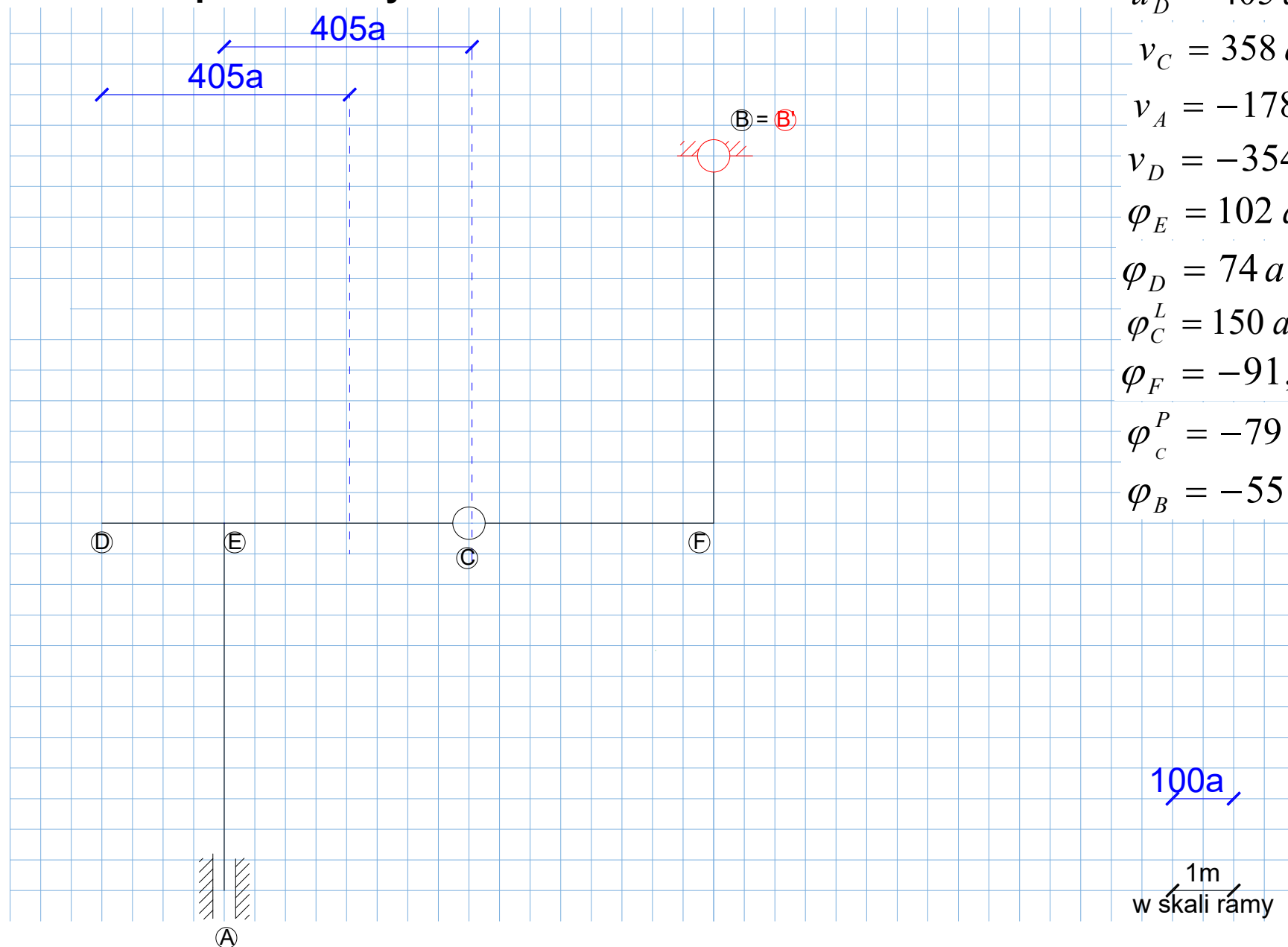


$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

$100a$

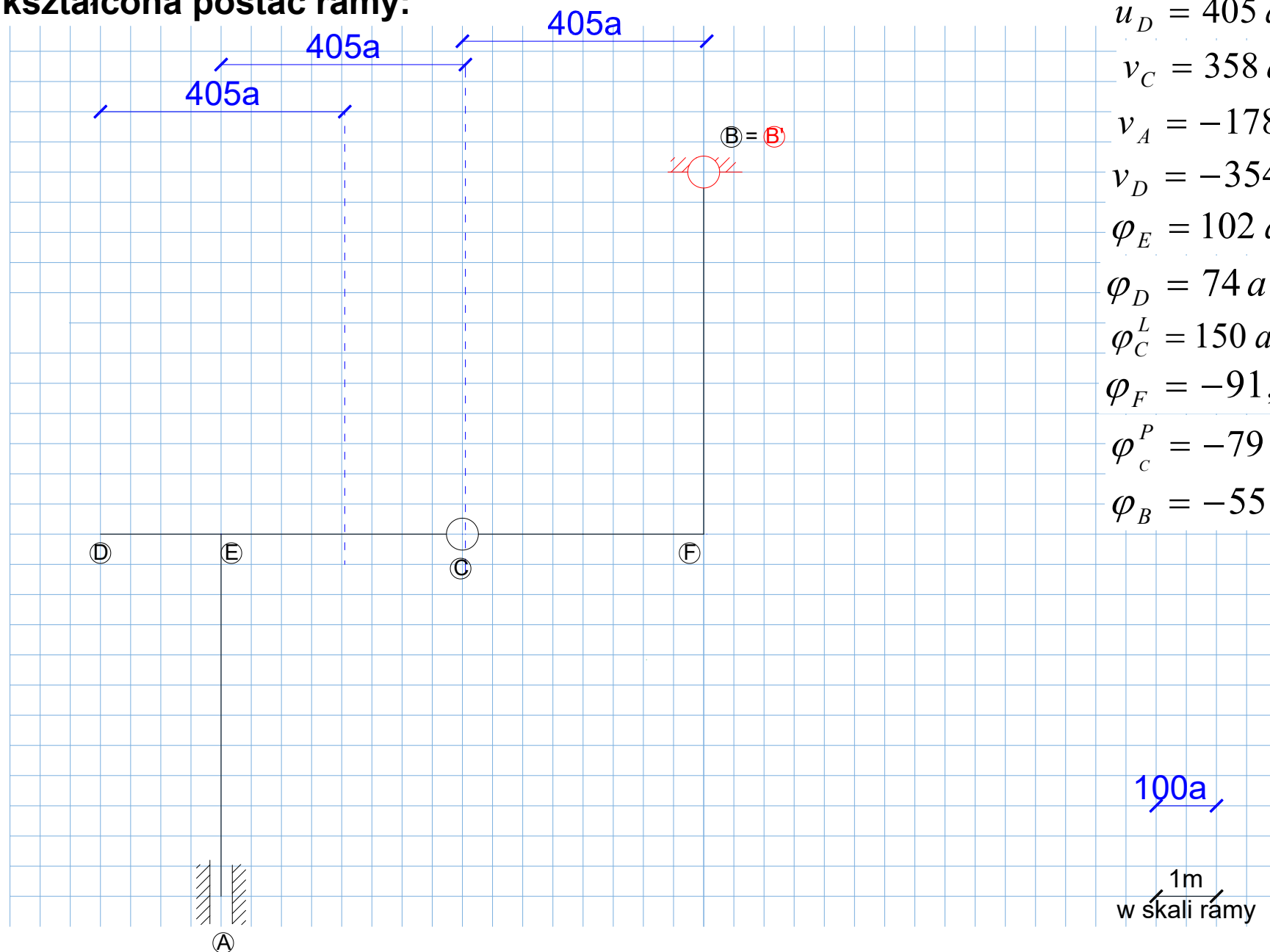
$1m$
w skali rąmy

Odkształcona postać ramy:



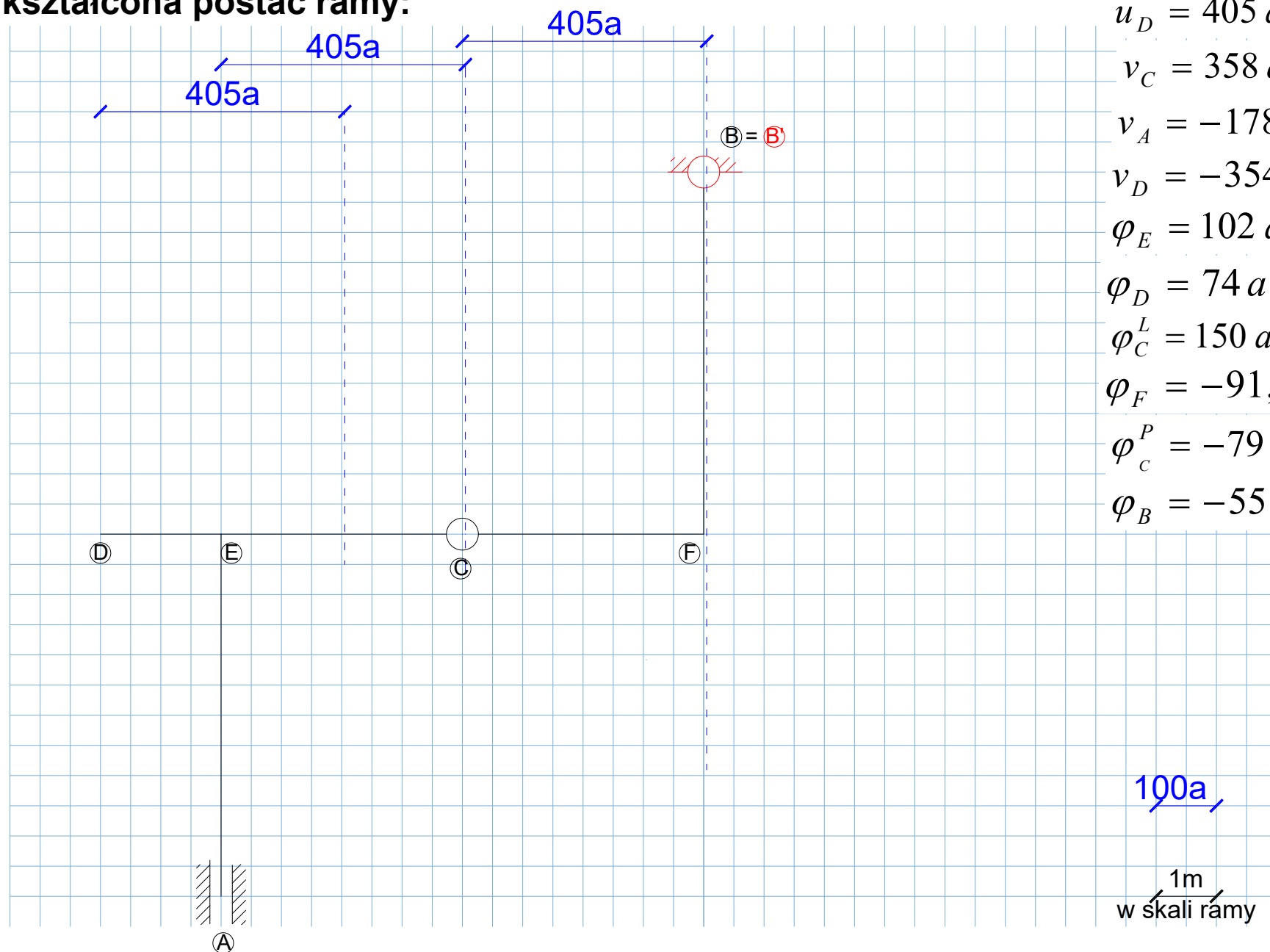
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:



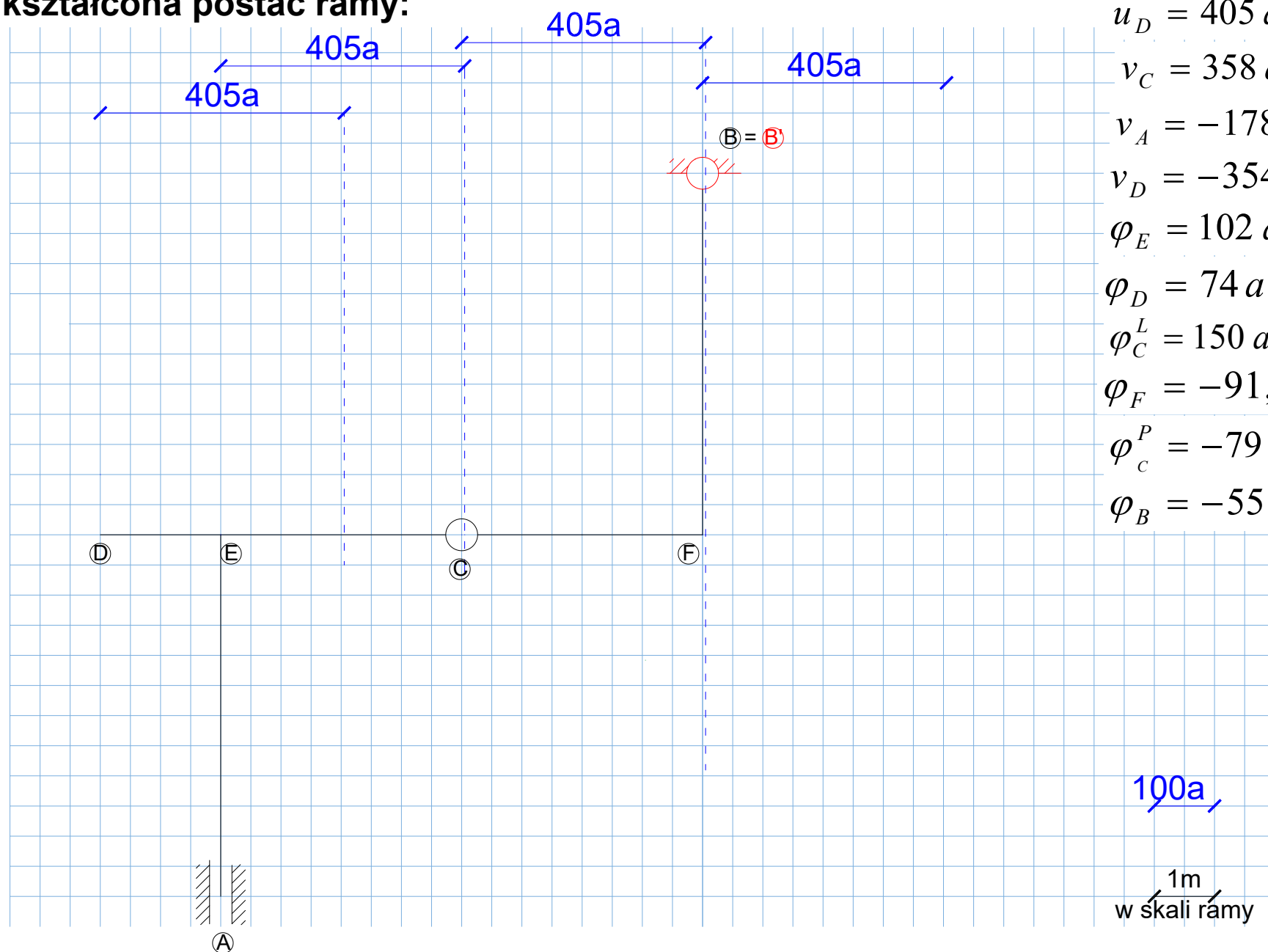
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:



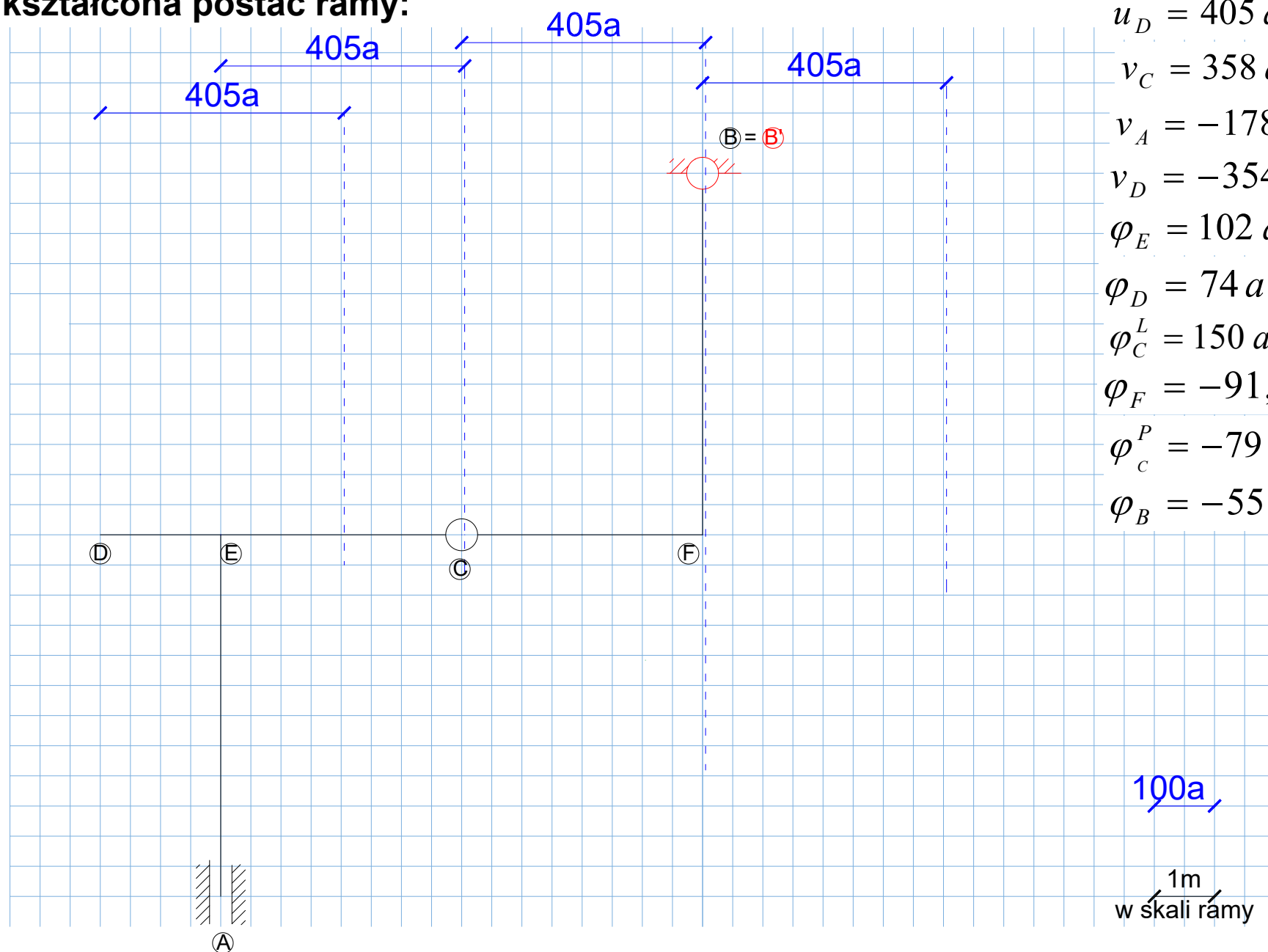
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:



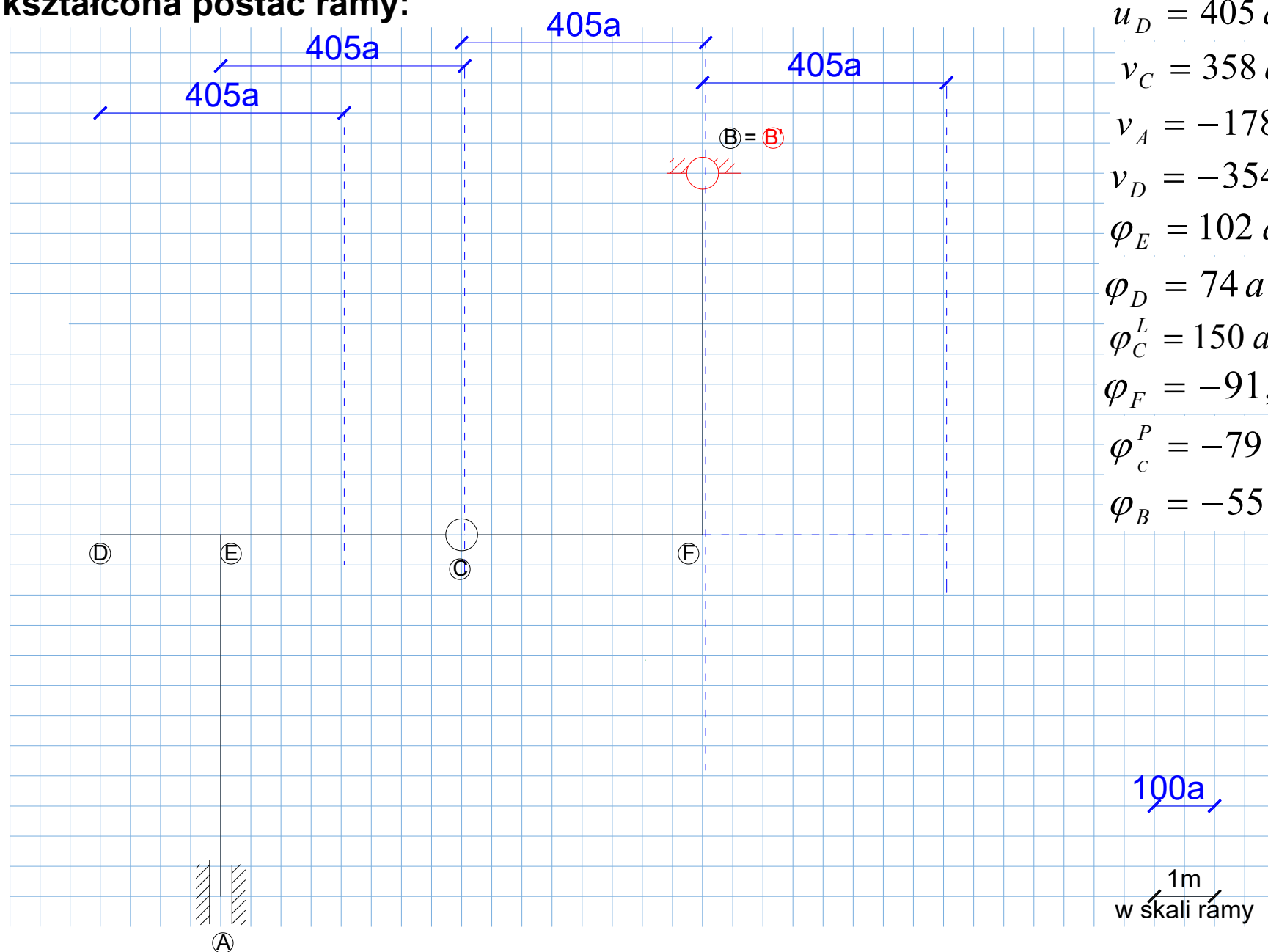
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:



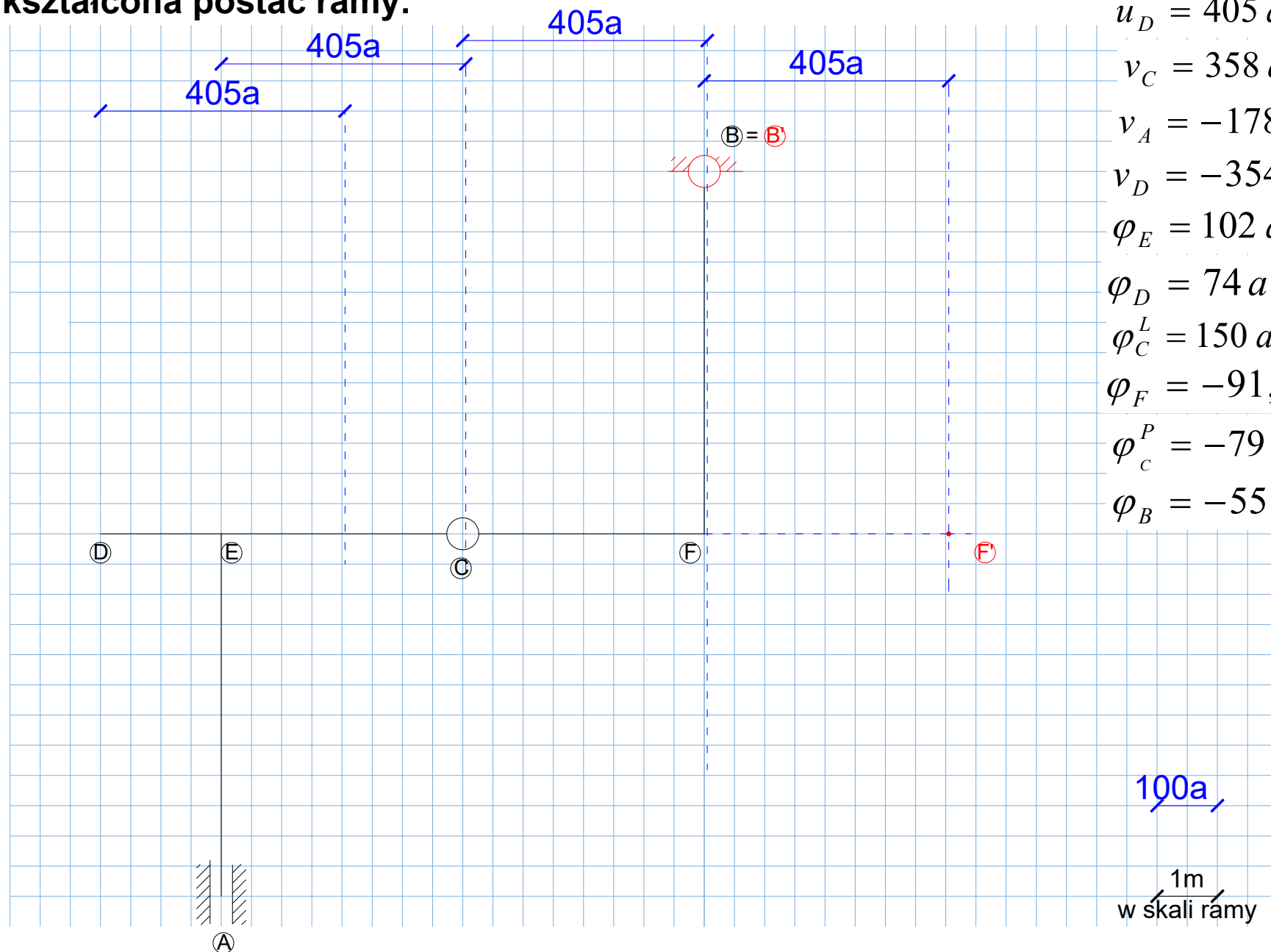
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:



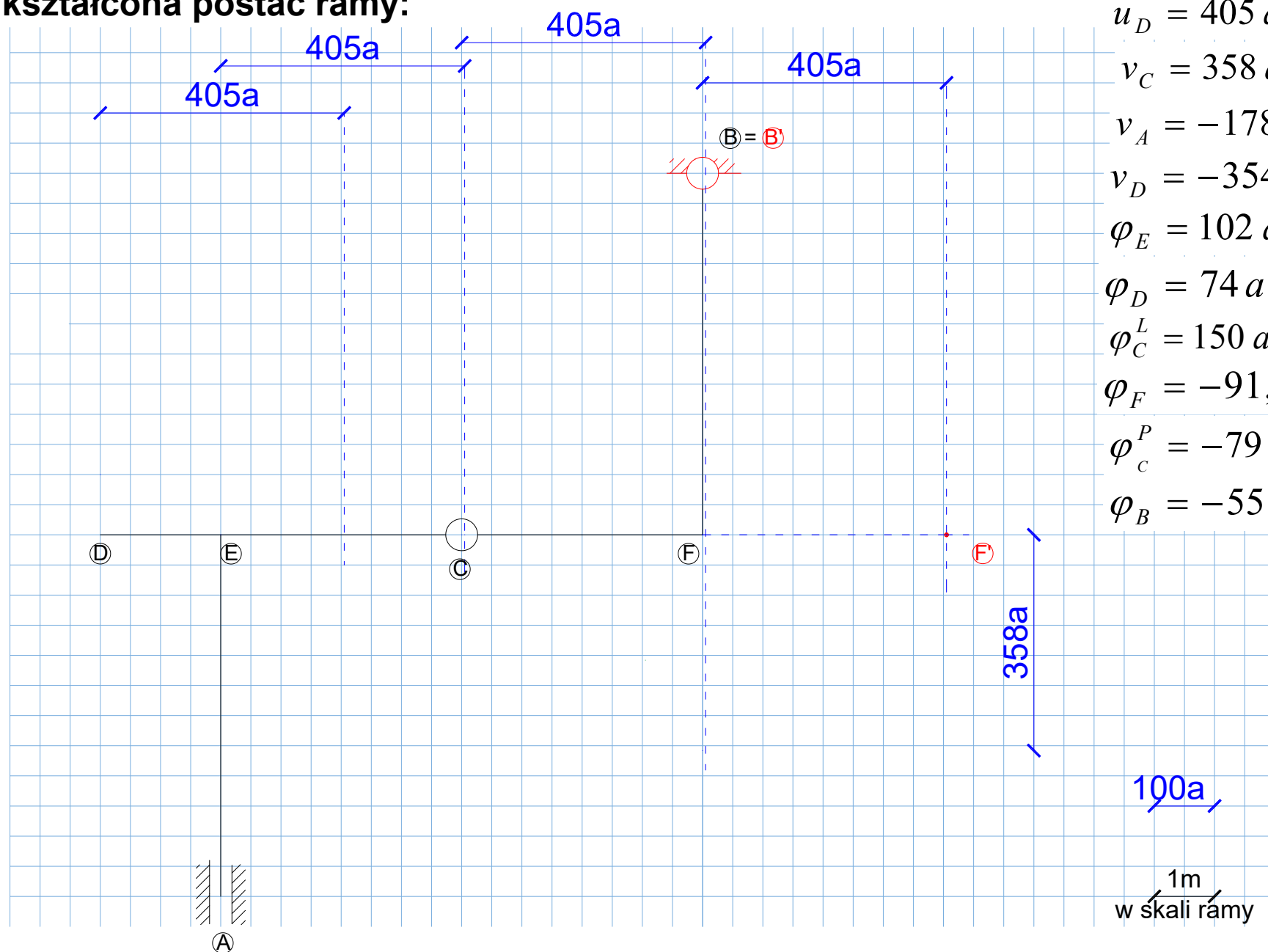
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:

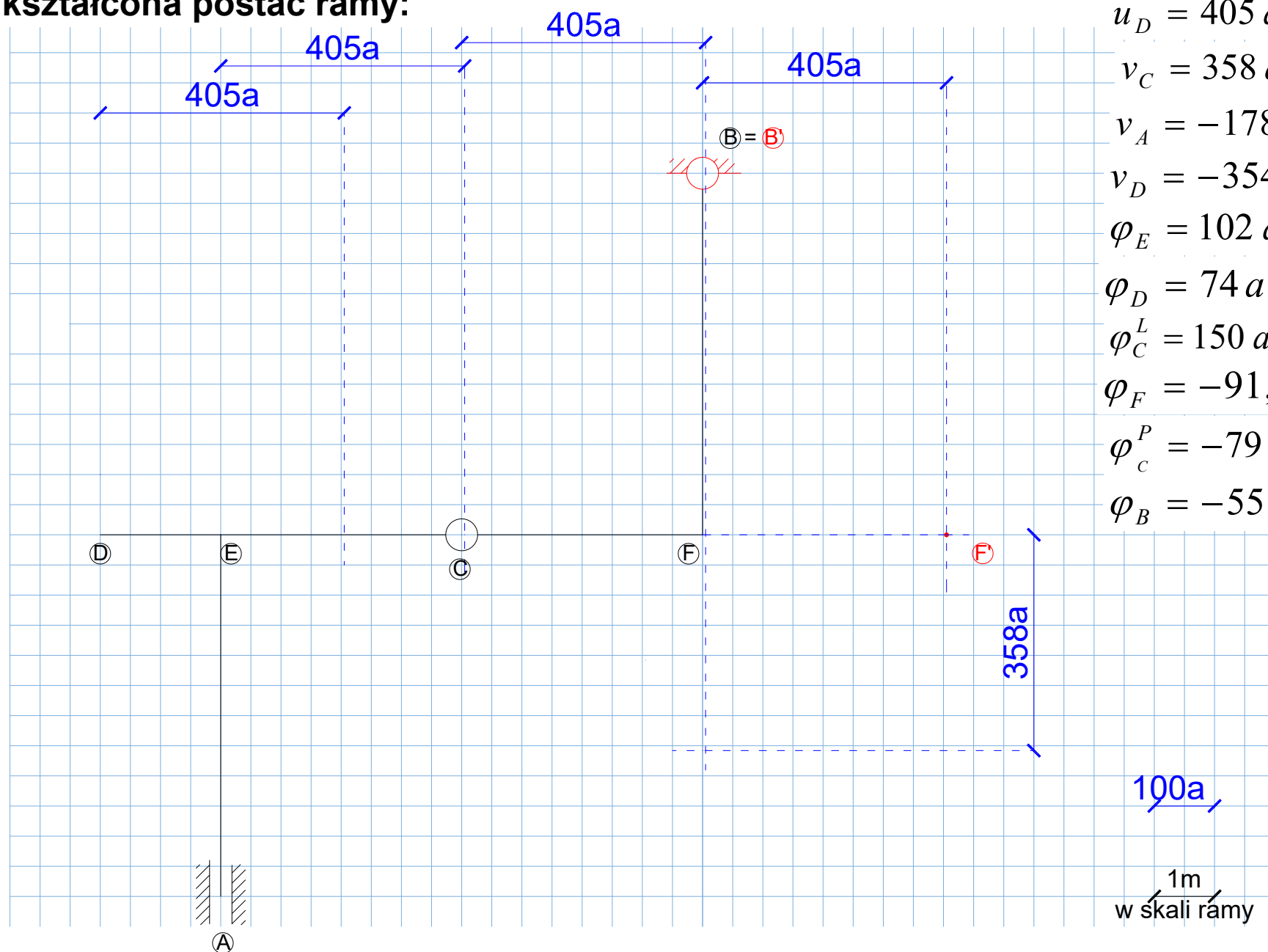


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Odkształcona postać ramy:

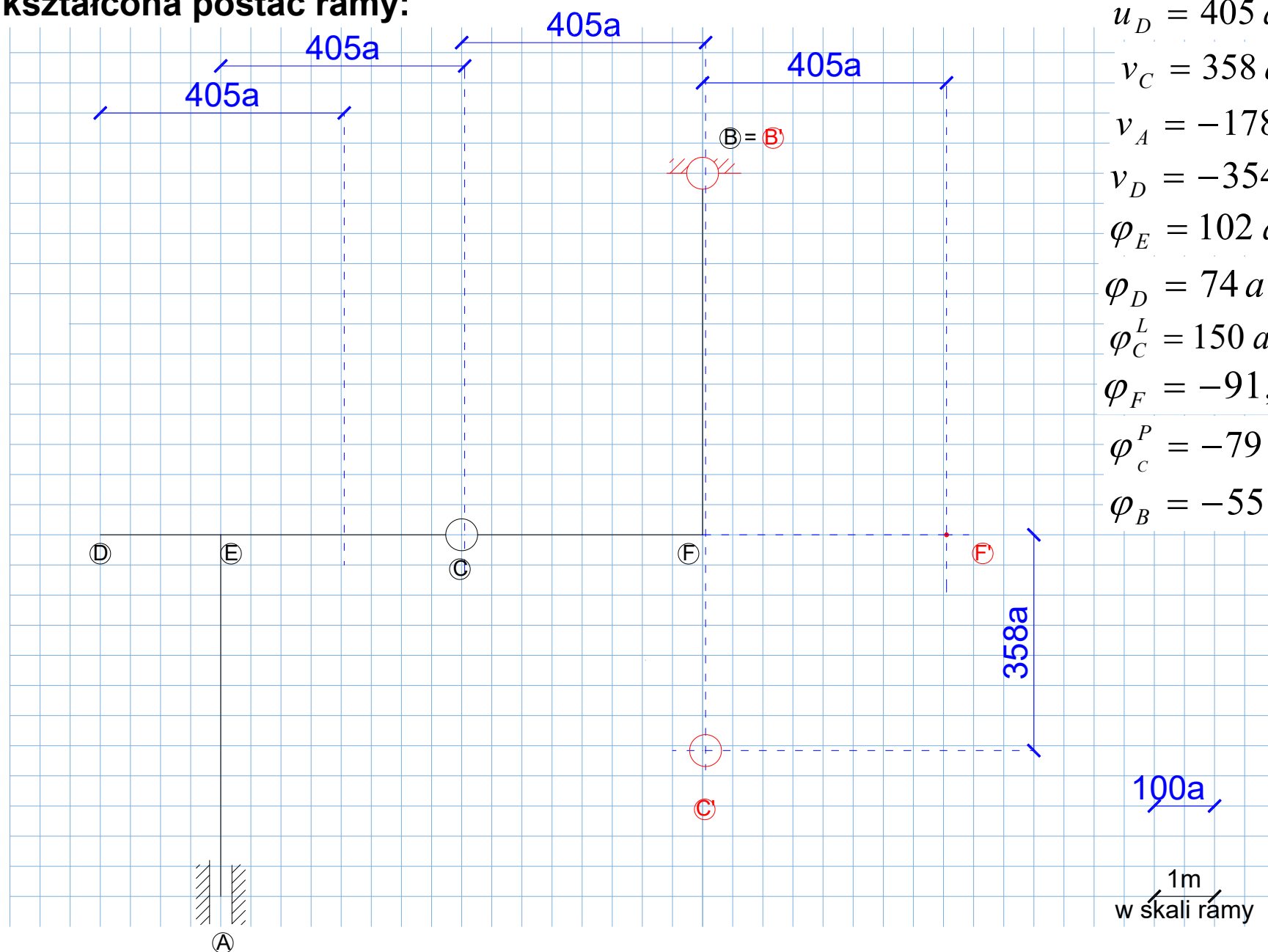


Odkształcona postać ramy:

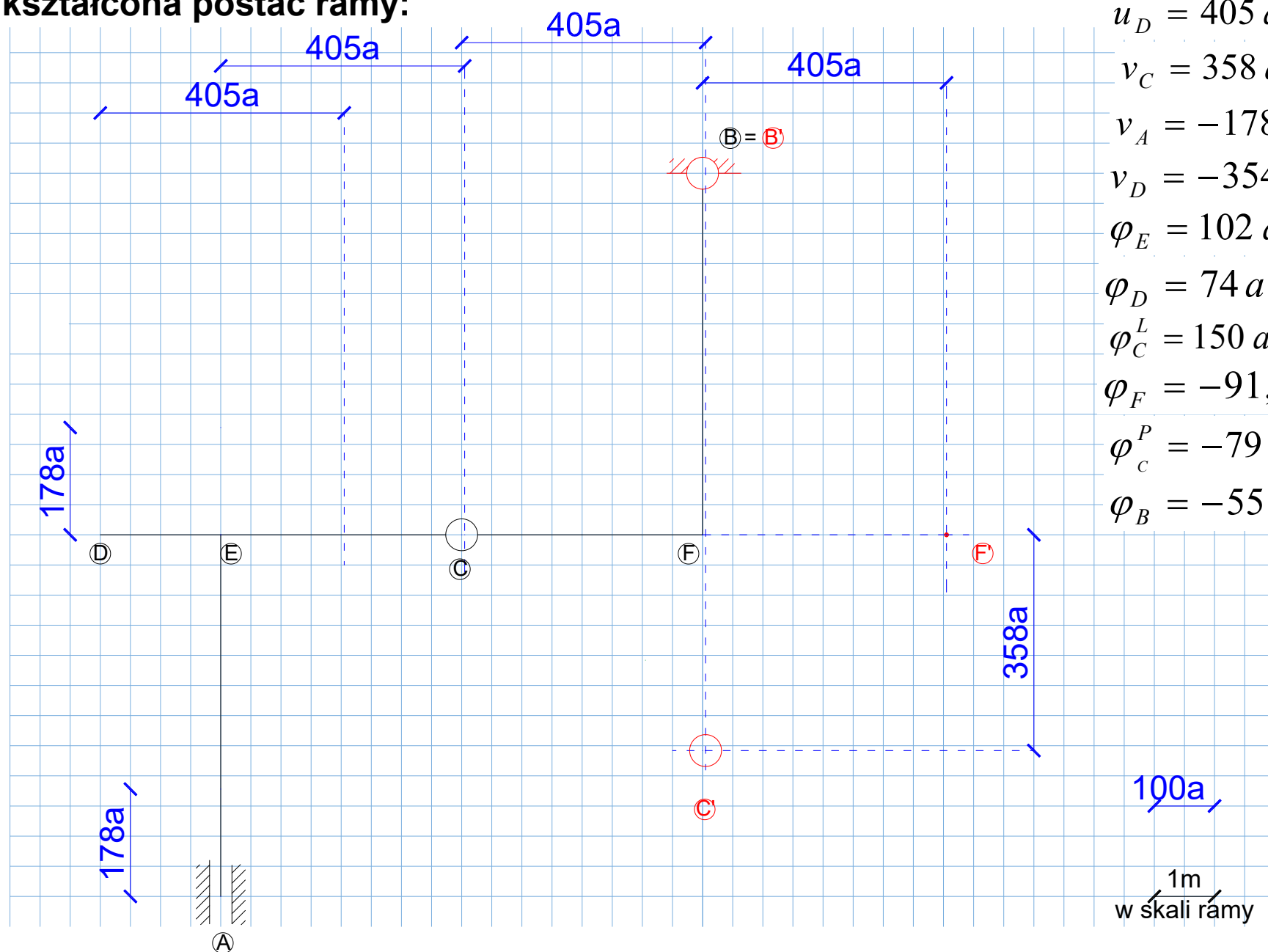


$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_c^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:

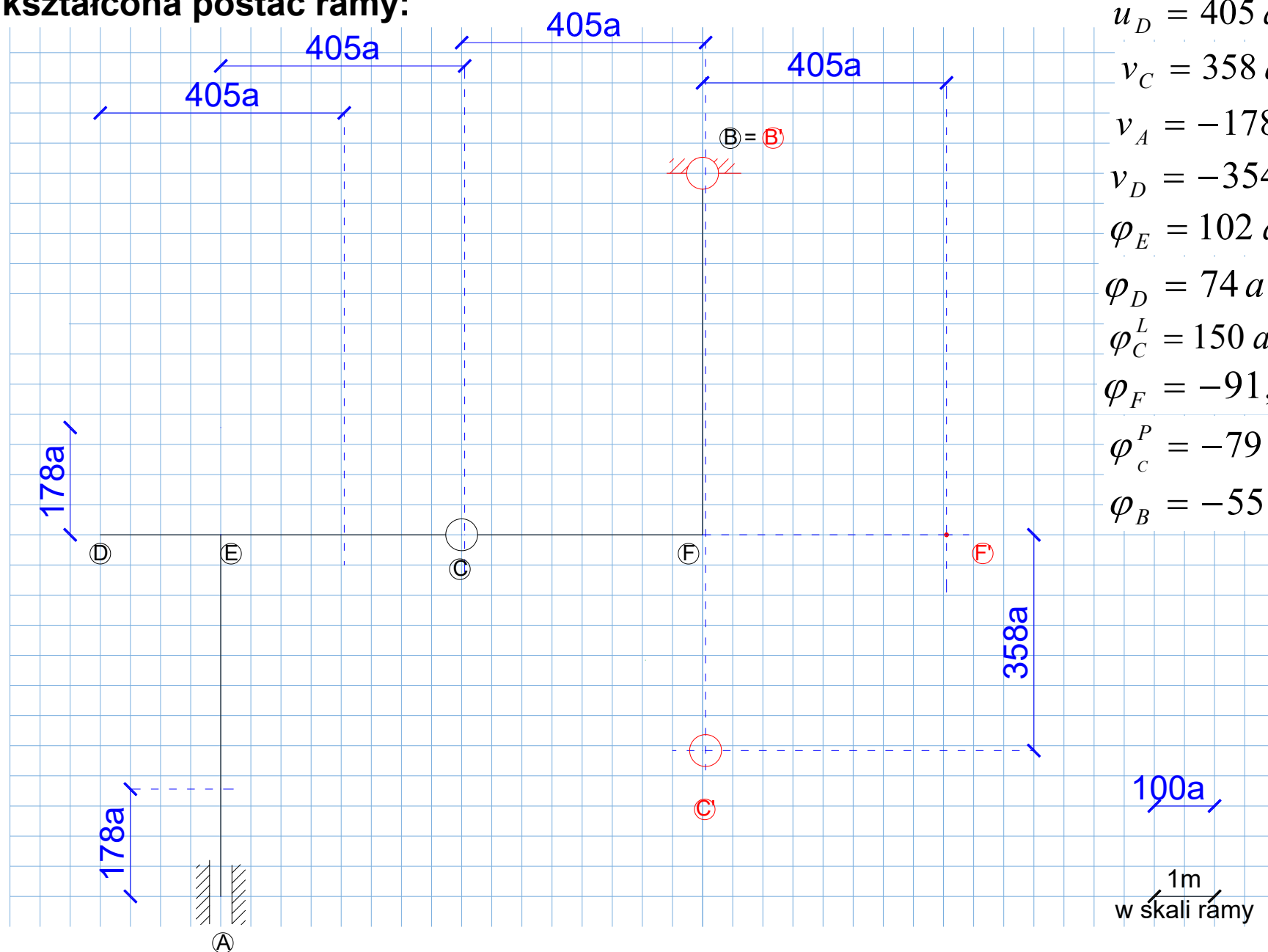


Odkształcona postać ramy:



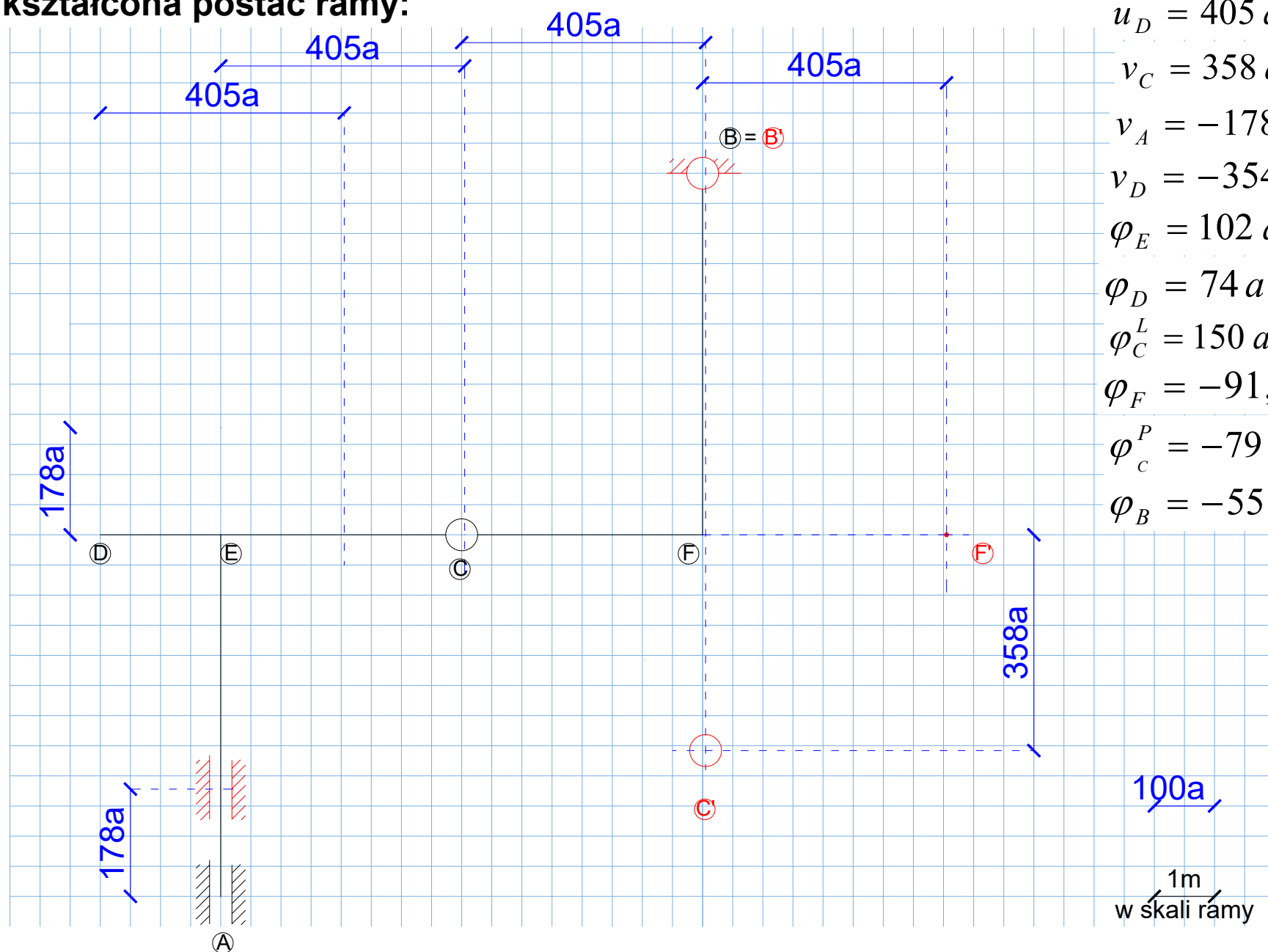
$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

Odkształcona postać ramy:



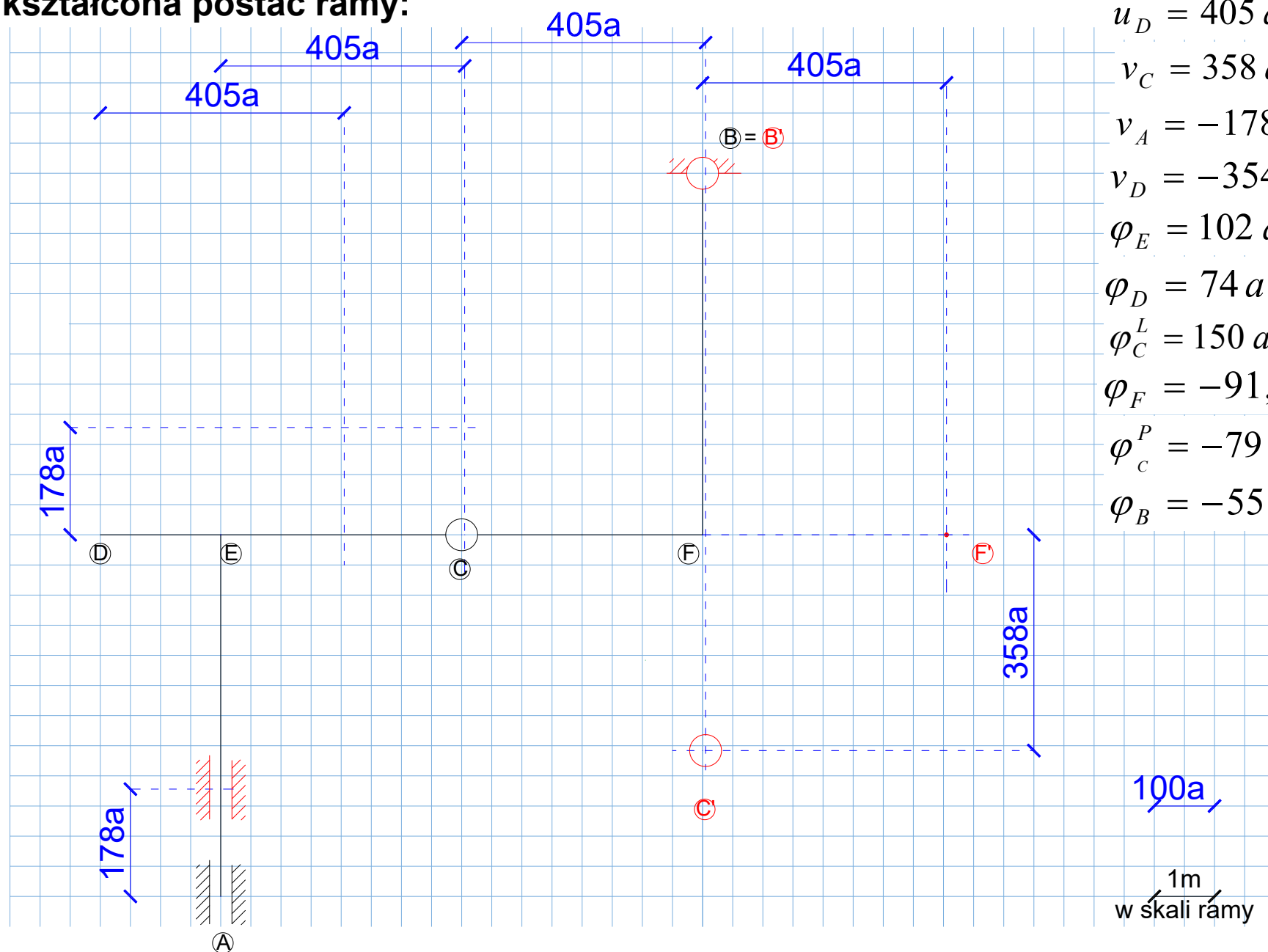
$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

Odkształcona postać ramy:



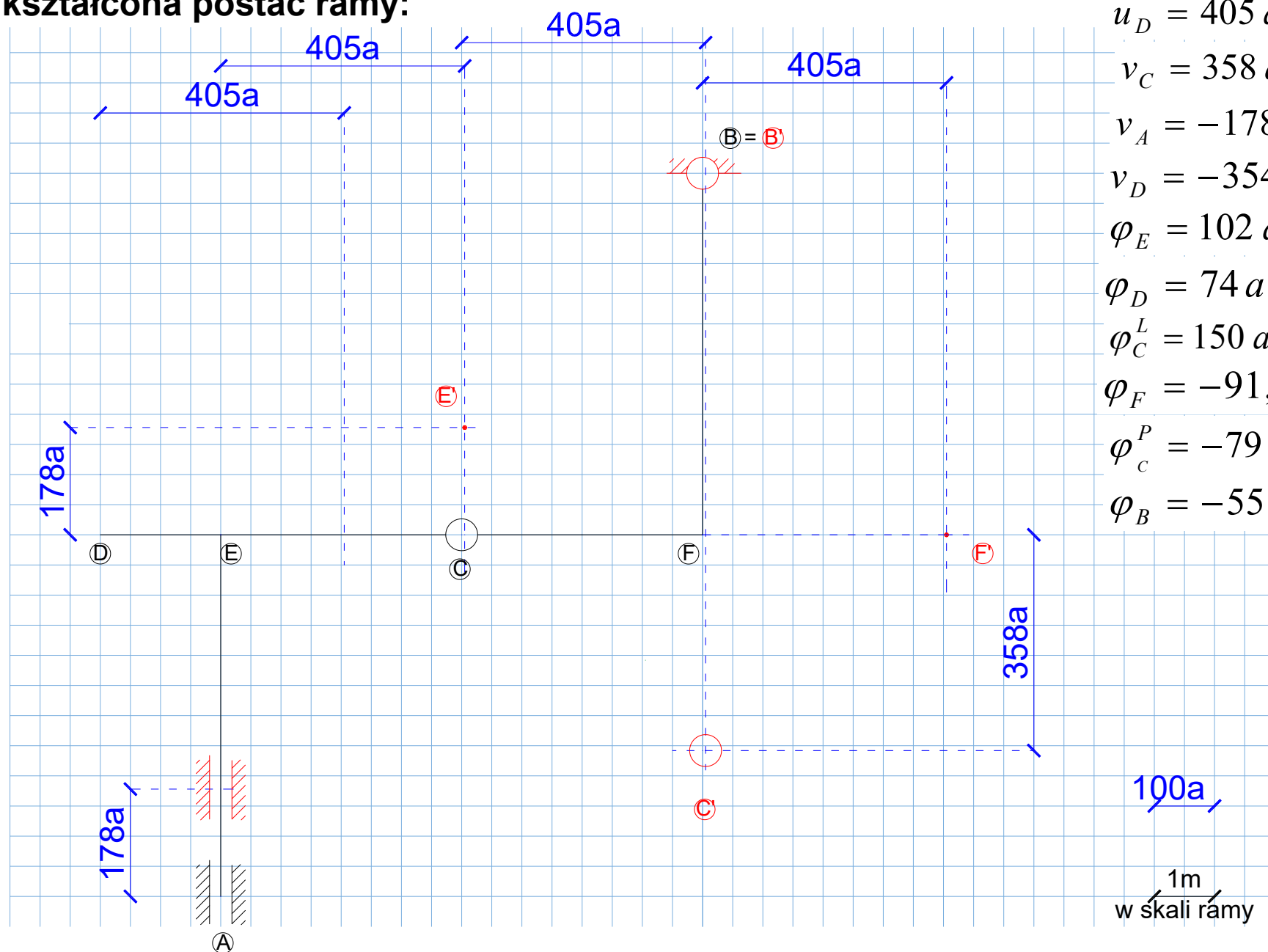
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Odkształcona postać ramy:



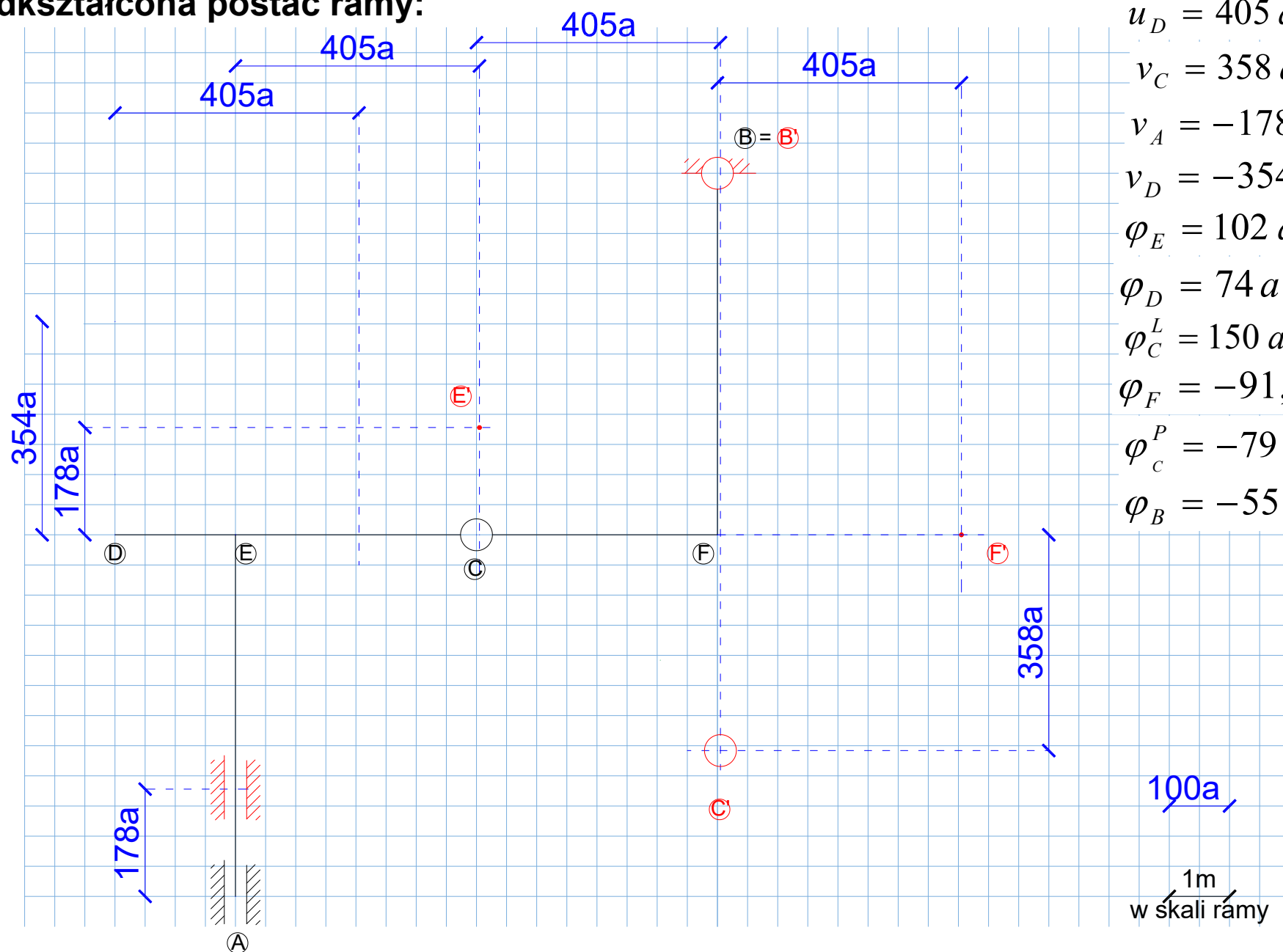
$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

Odkształcona postać ramy:

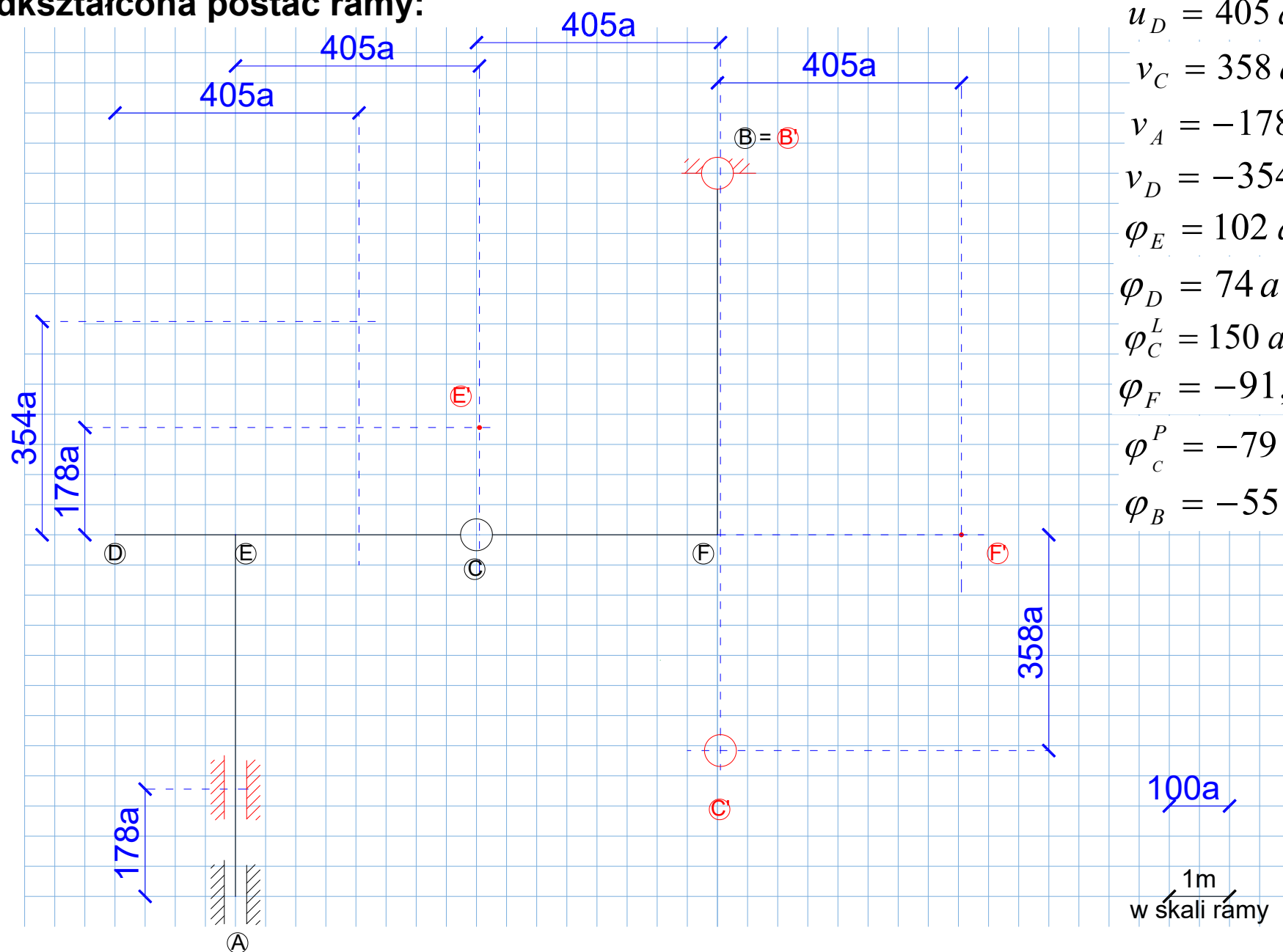


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:

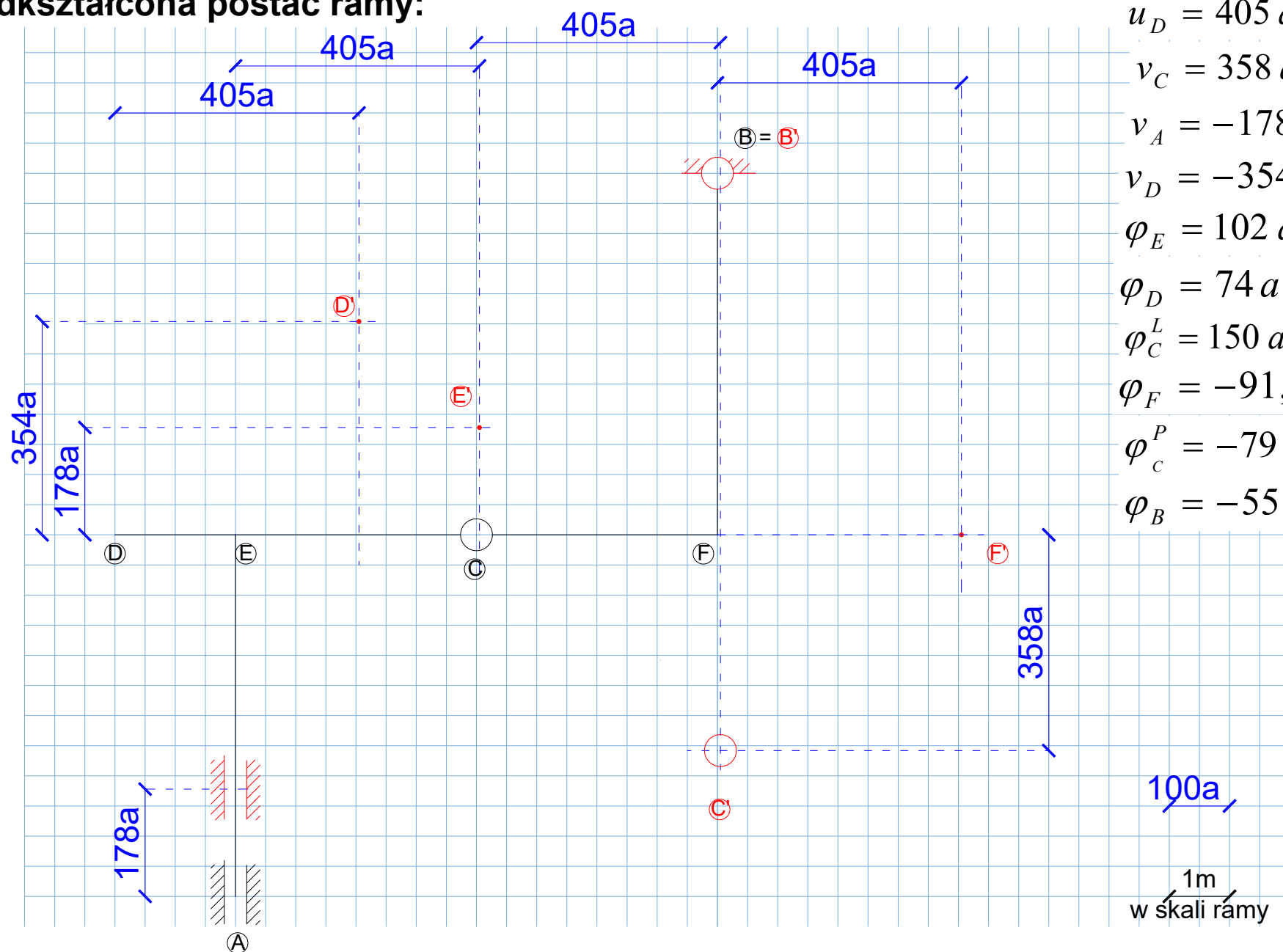


Odkształcona postać ramy:



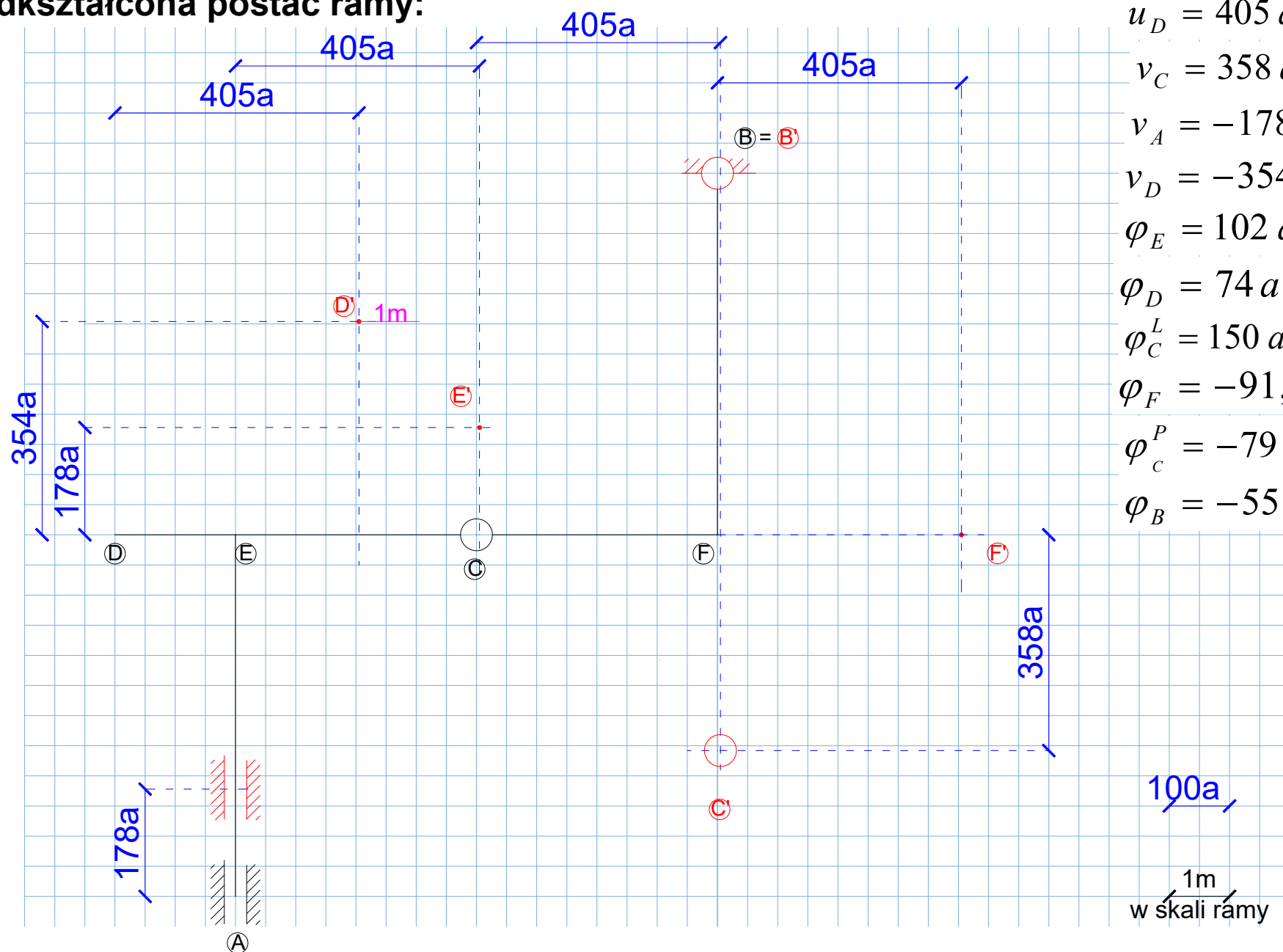
$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

Odkształcona postać ramy:



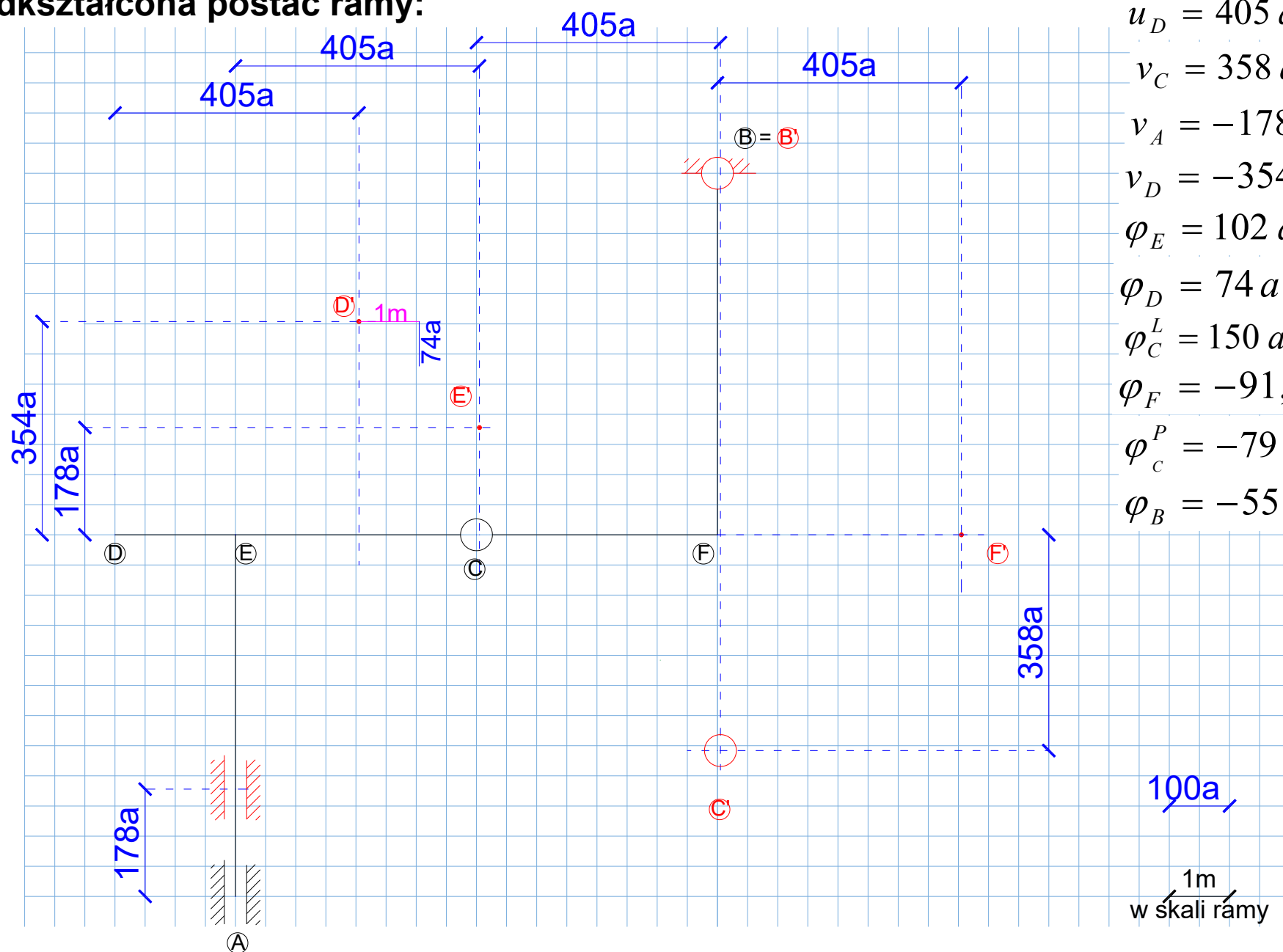
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:



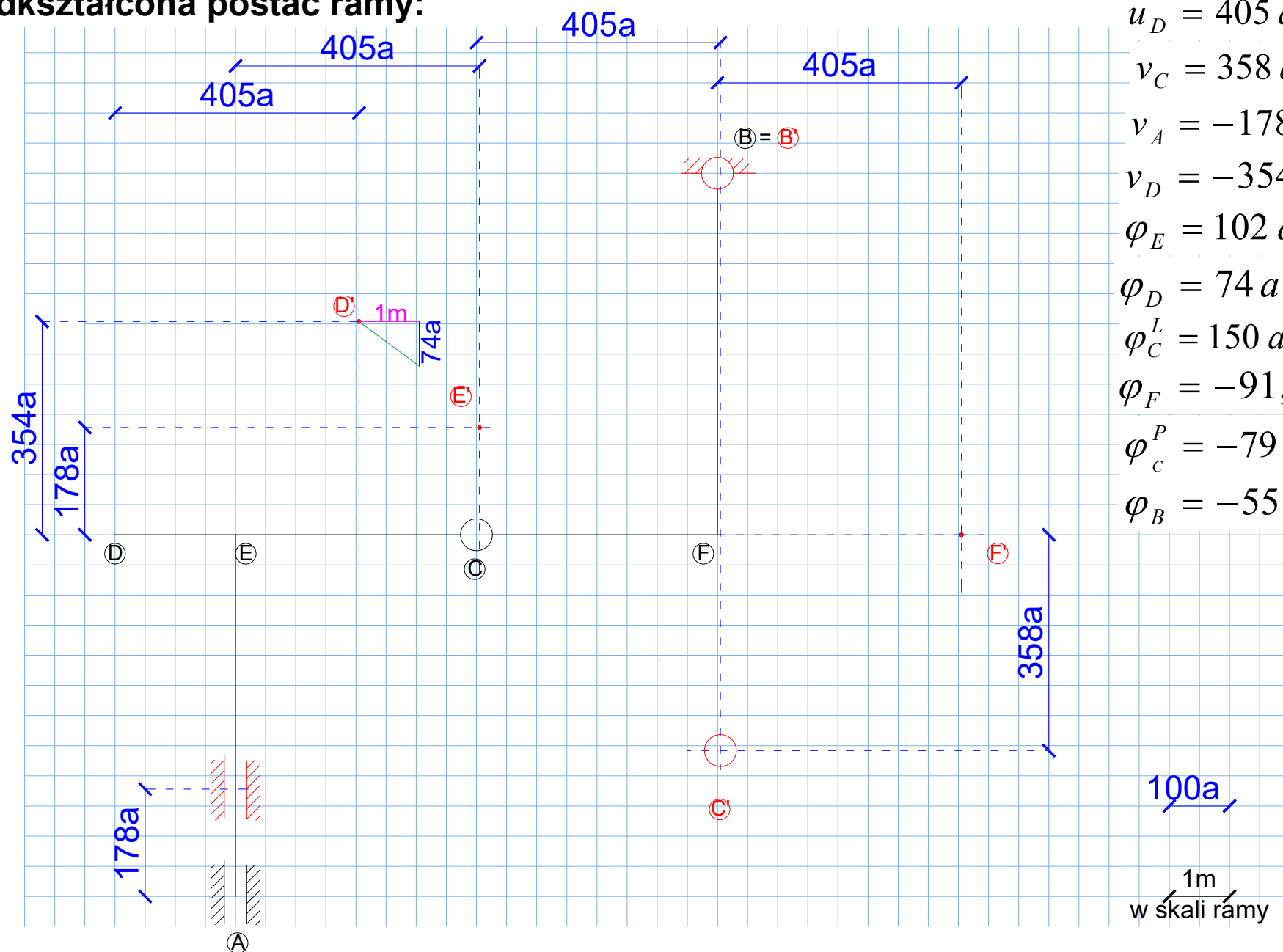
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:



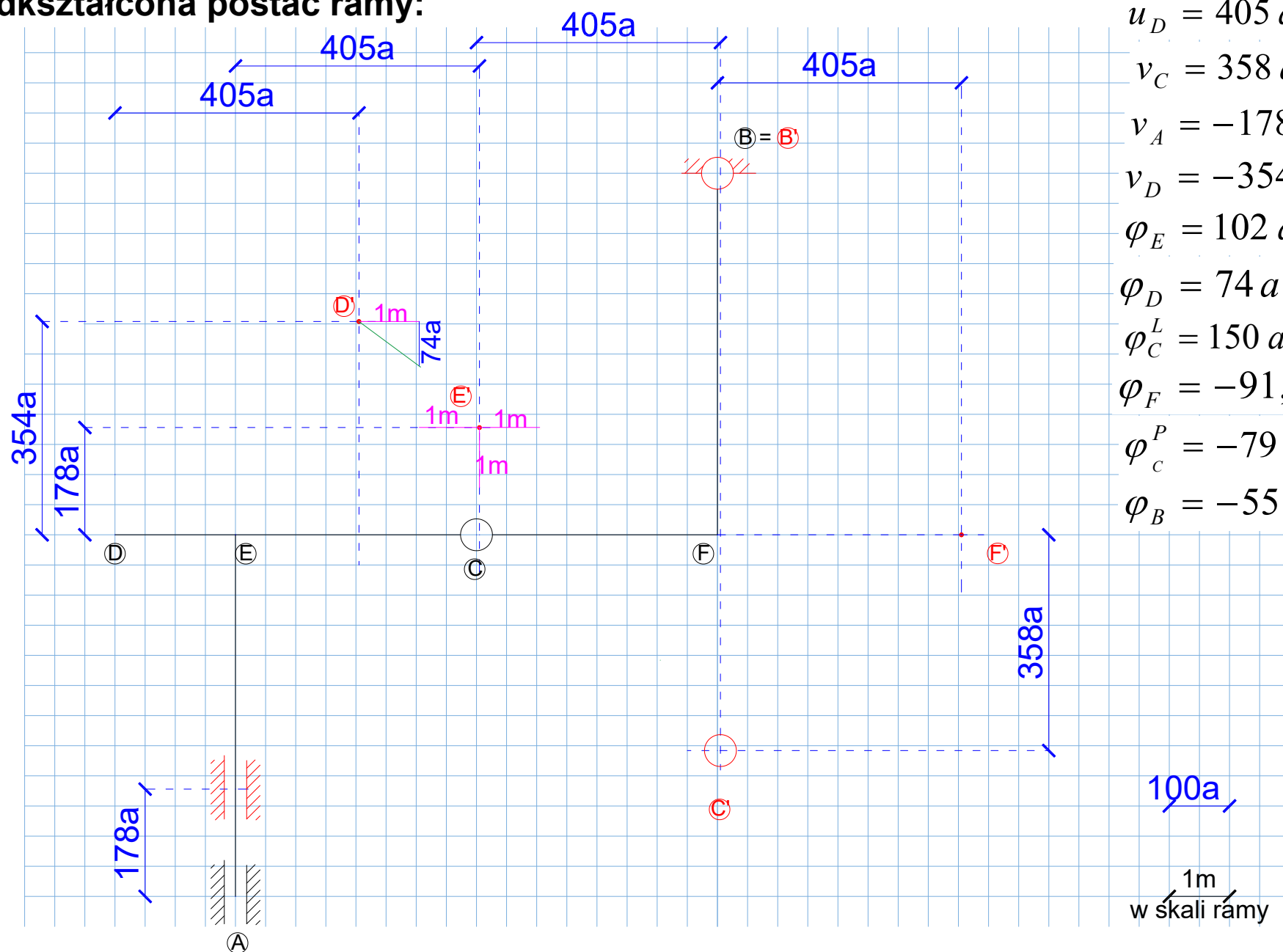
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:



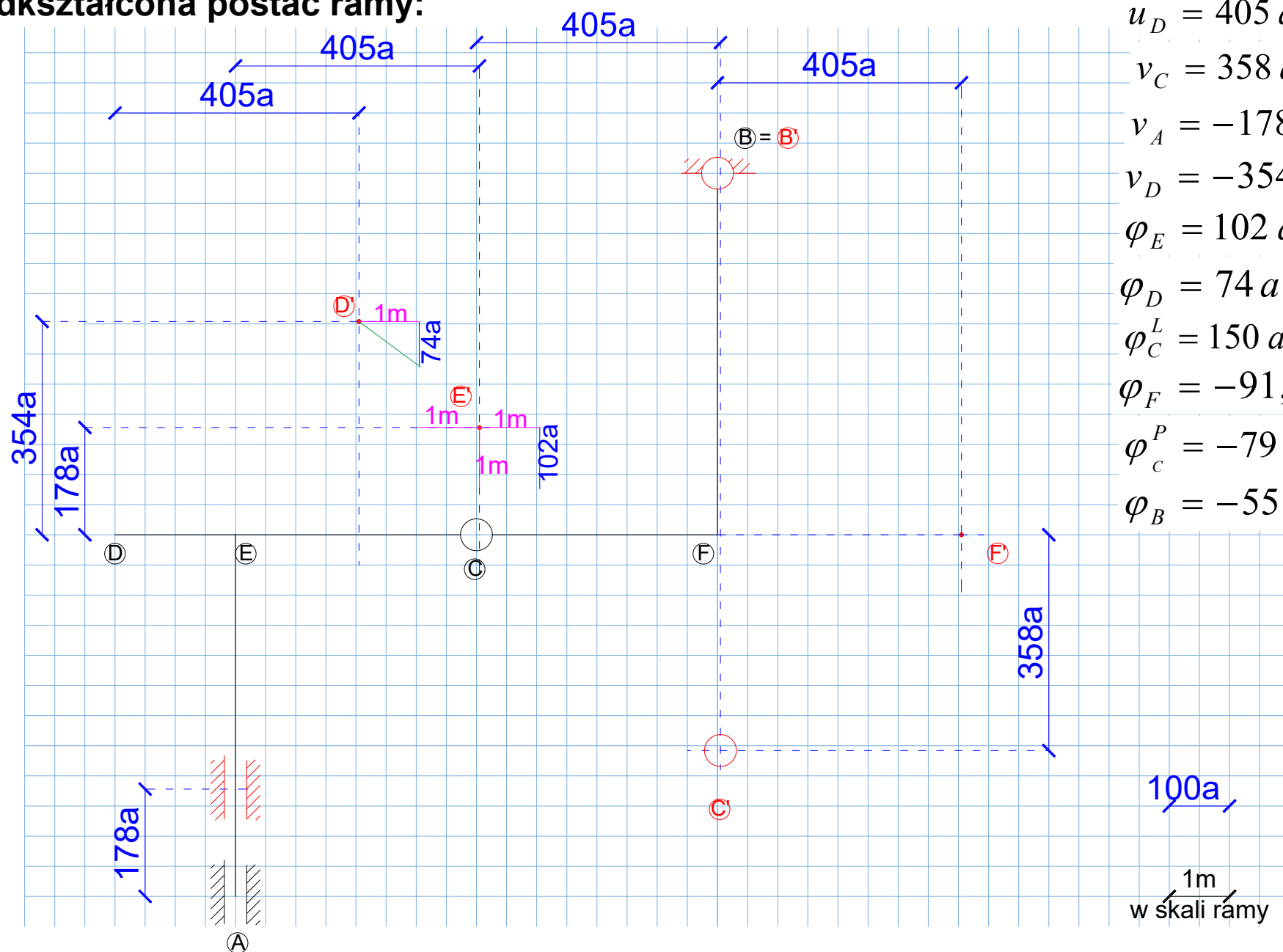
$$\begin{aligned} u_D &= 405a \\ v_C &= 358a \\ v_A &= -178a \\ v_D &= -354a \\ \varphi_E &= 102a \\ \varphi_D &= 74a \\ \varphi_C^L &= 150a \\ \varphi_F &= -91,5a \\ \varphi_C^P &= -79,5a \\ \varphi_B &= -55,5a \end{aligned}$$

Odkształcona postać ramy:



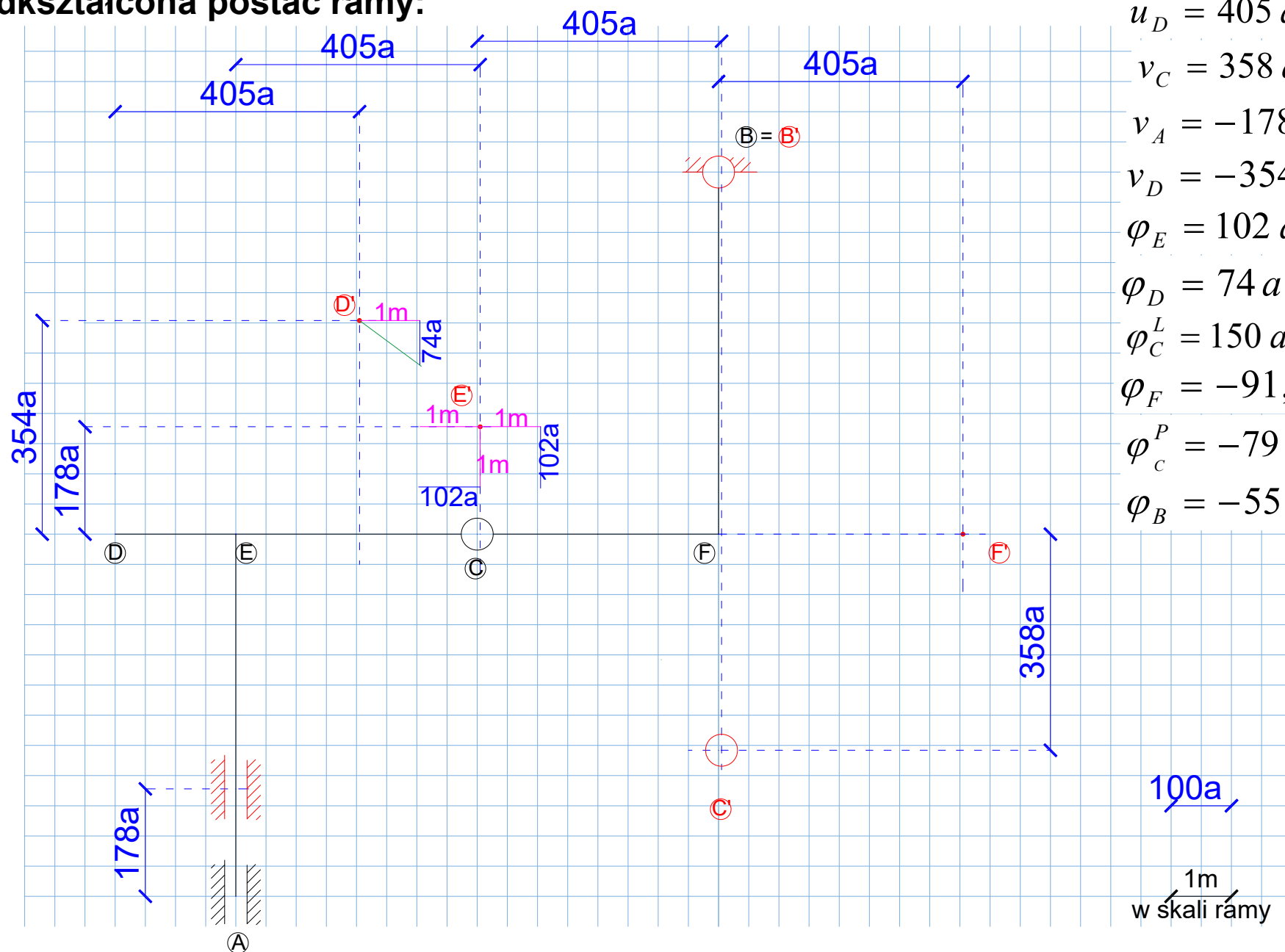
$$\begin{aligned} u_D &= 405a \\ v_C &= 358a \\ v_A &= -178a \\ v_D &= -354a \\ \varphi_E &= 102a \\ \varphi_D &= 74a \\ \varphi_C^L &= 150a \\ \varphi_F &= -91,5a \\ \varphi_C^P &= -79,5a \\ \varphi_B &= -55,5a \end{aligned}$$

Odkształcona postać ramy:



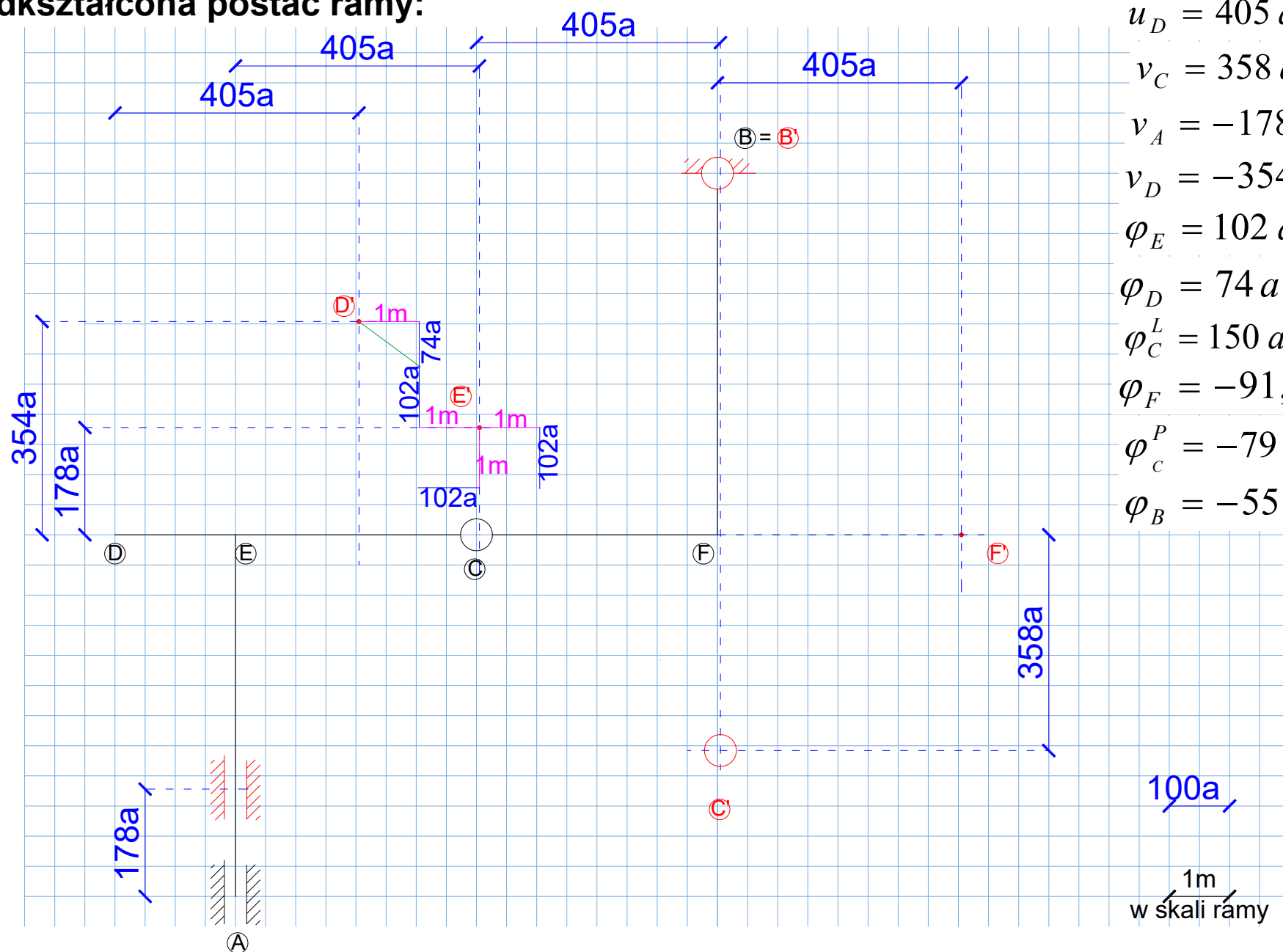
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:



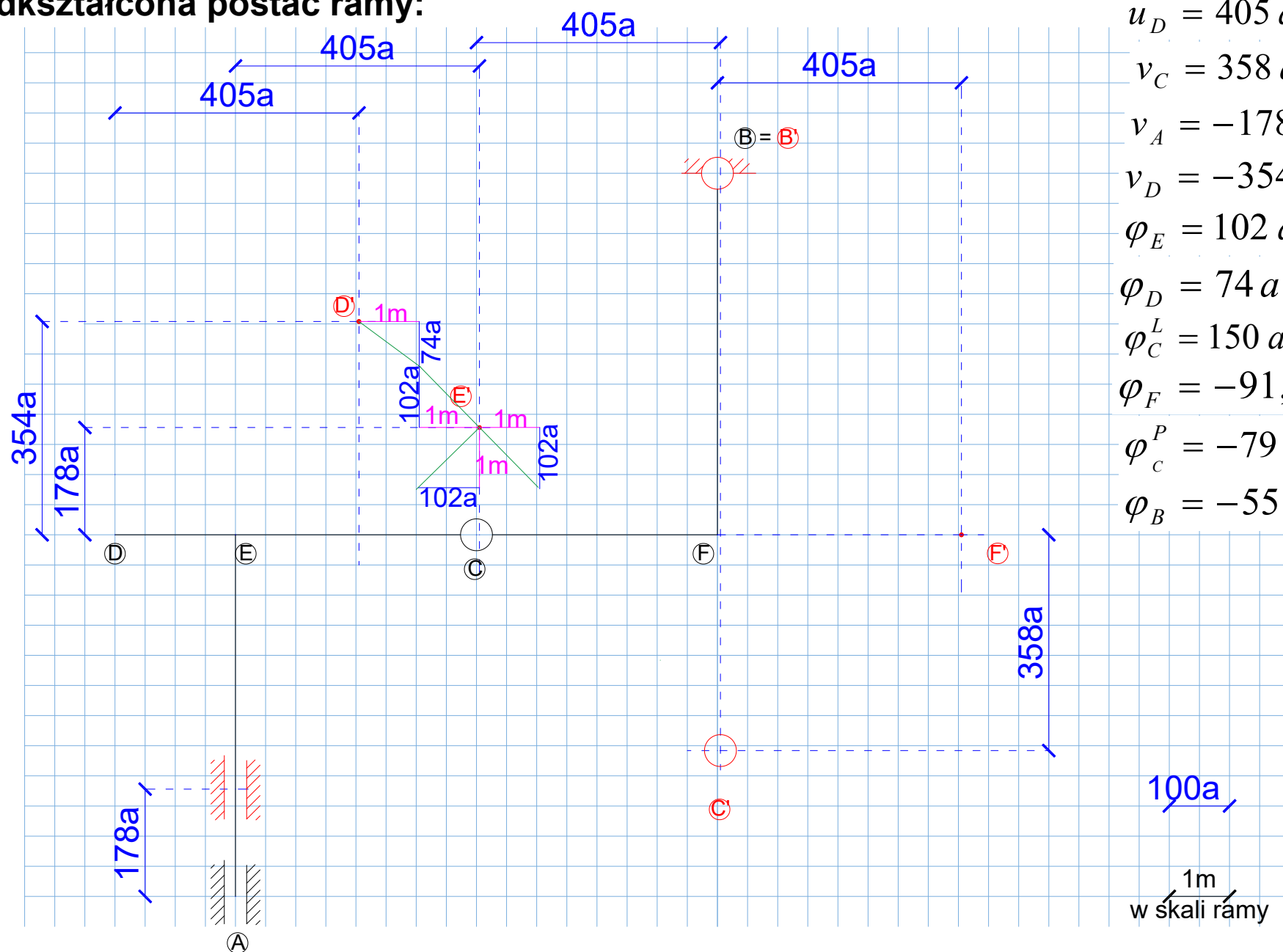
$$\begin{aligned} u_D &= 405 a \\ v_C &= 358 a \\ v_A &= -178 a \\ v_D &= -354 a \\ \varphi_E &= 102 a \\ \varphi_D &= 74 a \\ \varphi_C^L &= 150 a \\ \varphi_F &= -91,5 a \\ \varphi_C^P &= -79,5 a \\ \varphi_B &= -55,5 a \end{aligned}$$

Odkształcona postać ramy:



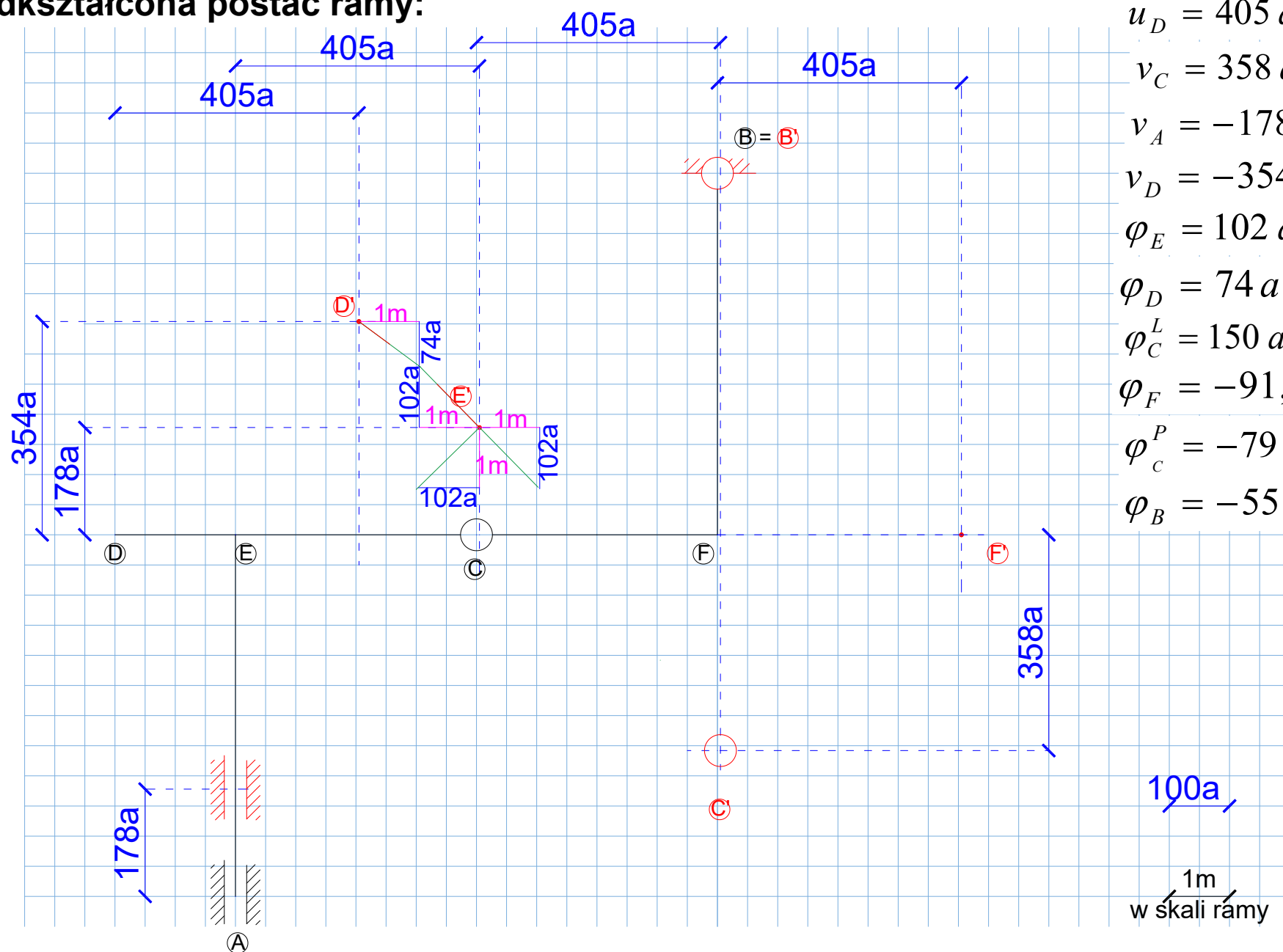
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

Odkształcona postać ramy:

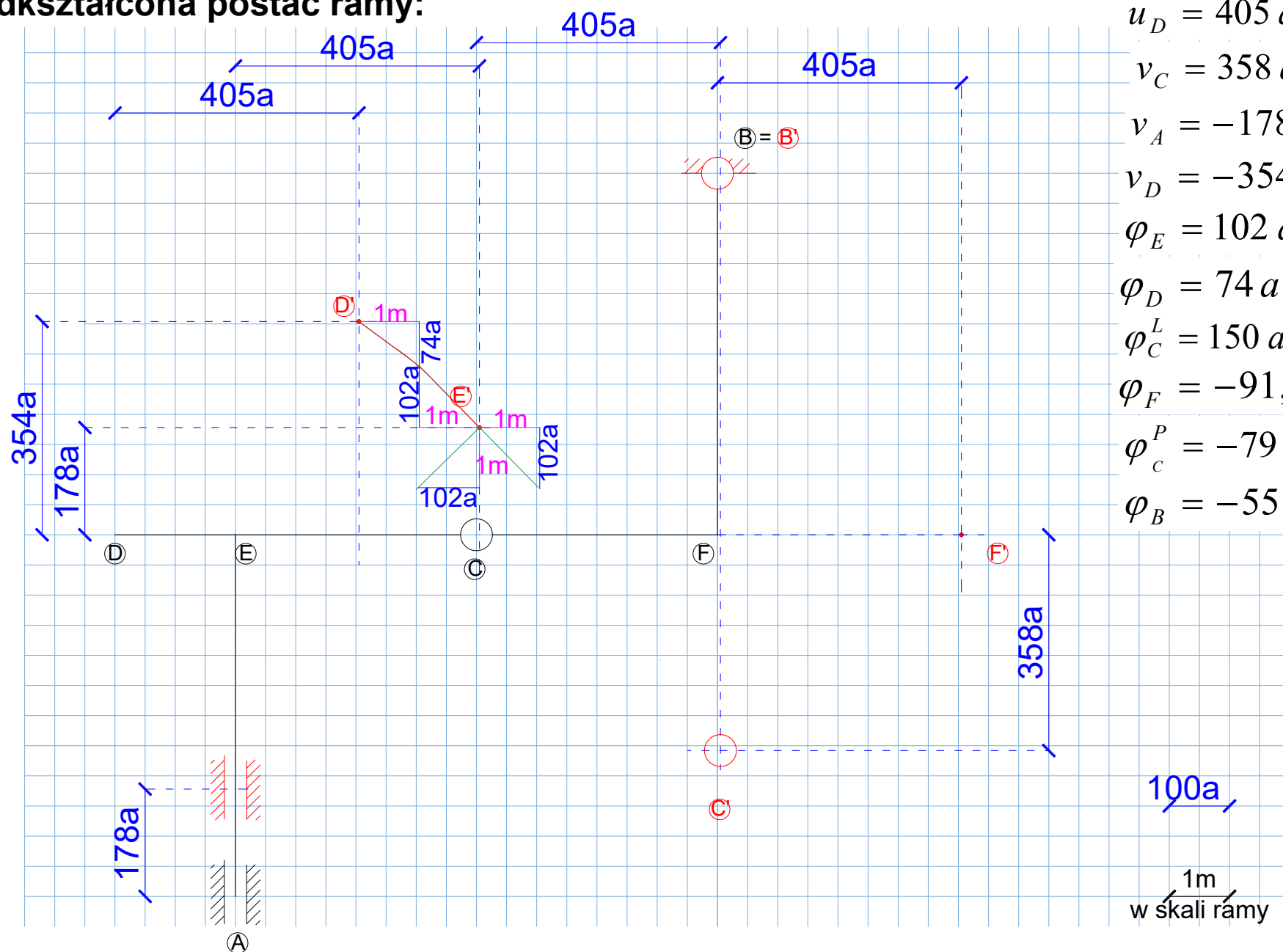


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

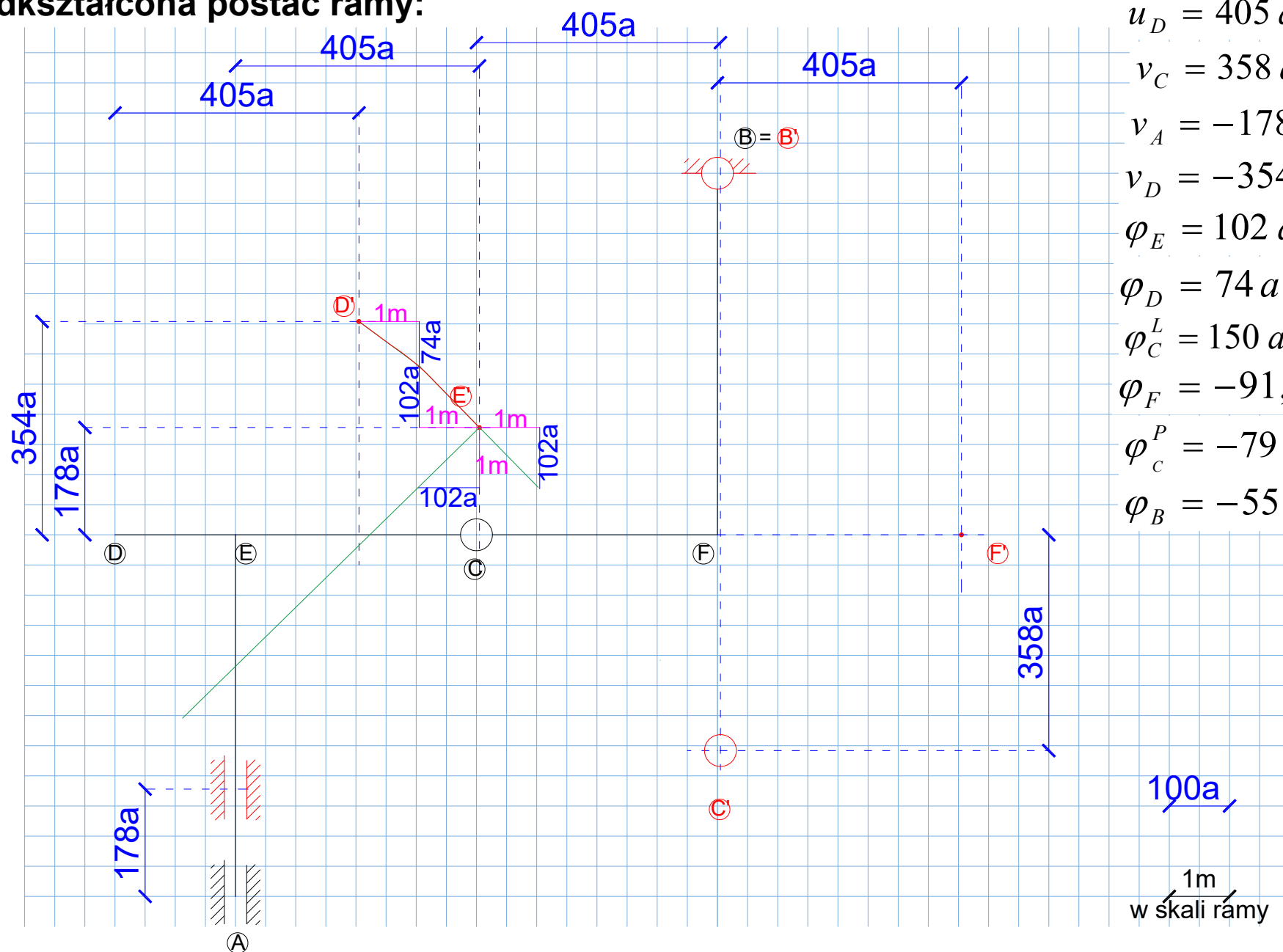
Odształcona postać ramy:



Odkształcona postać ramy:



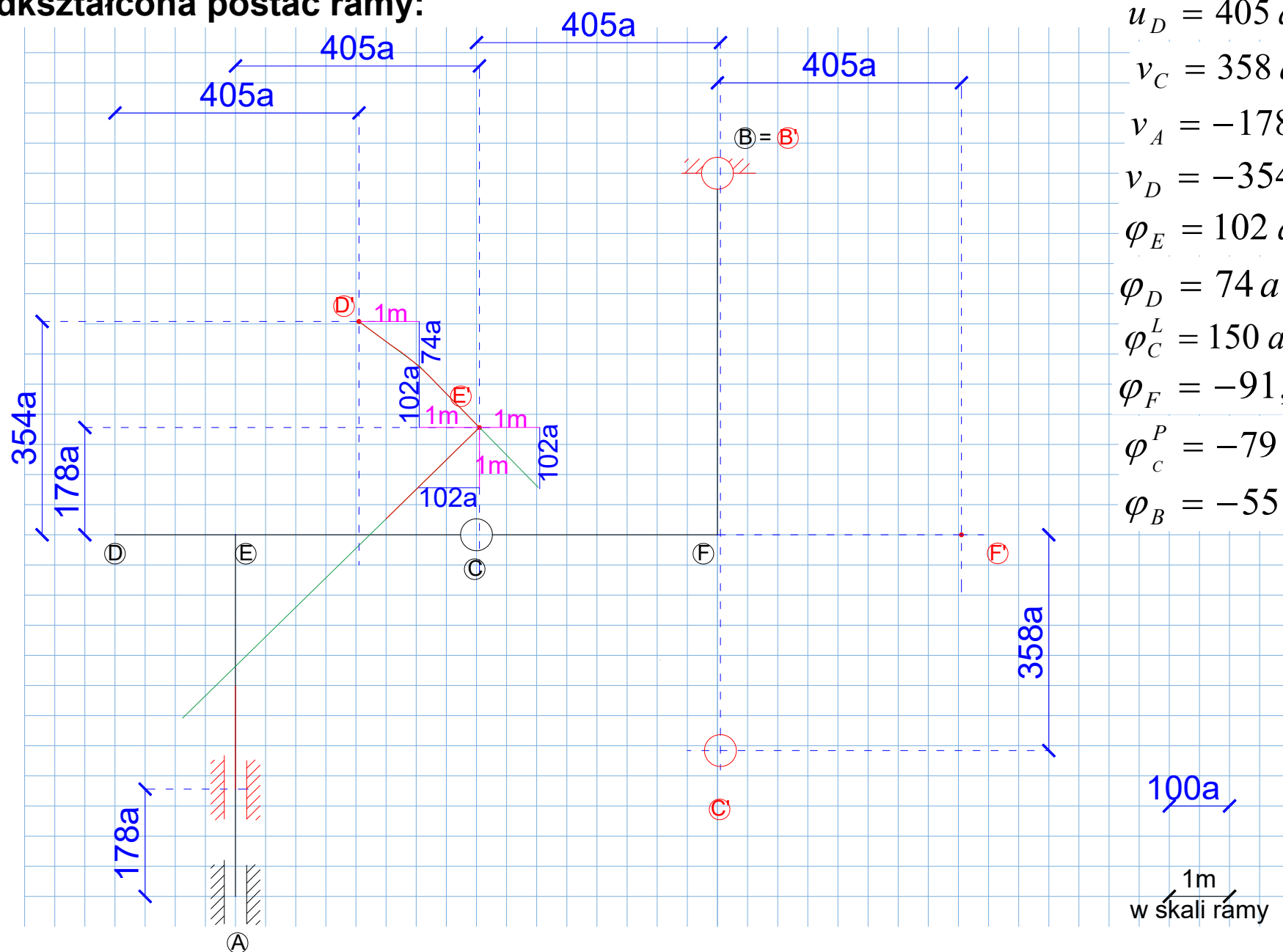
Odkształcona postać ramy:



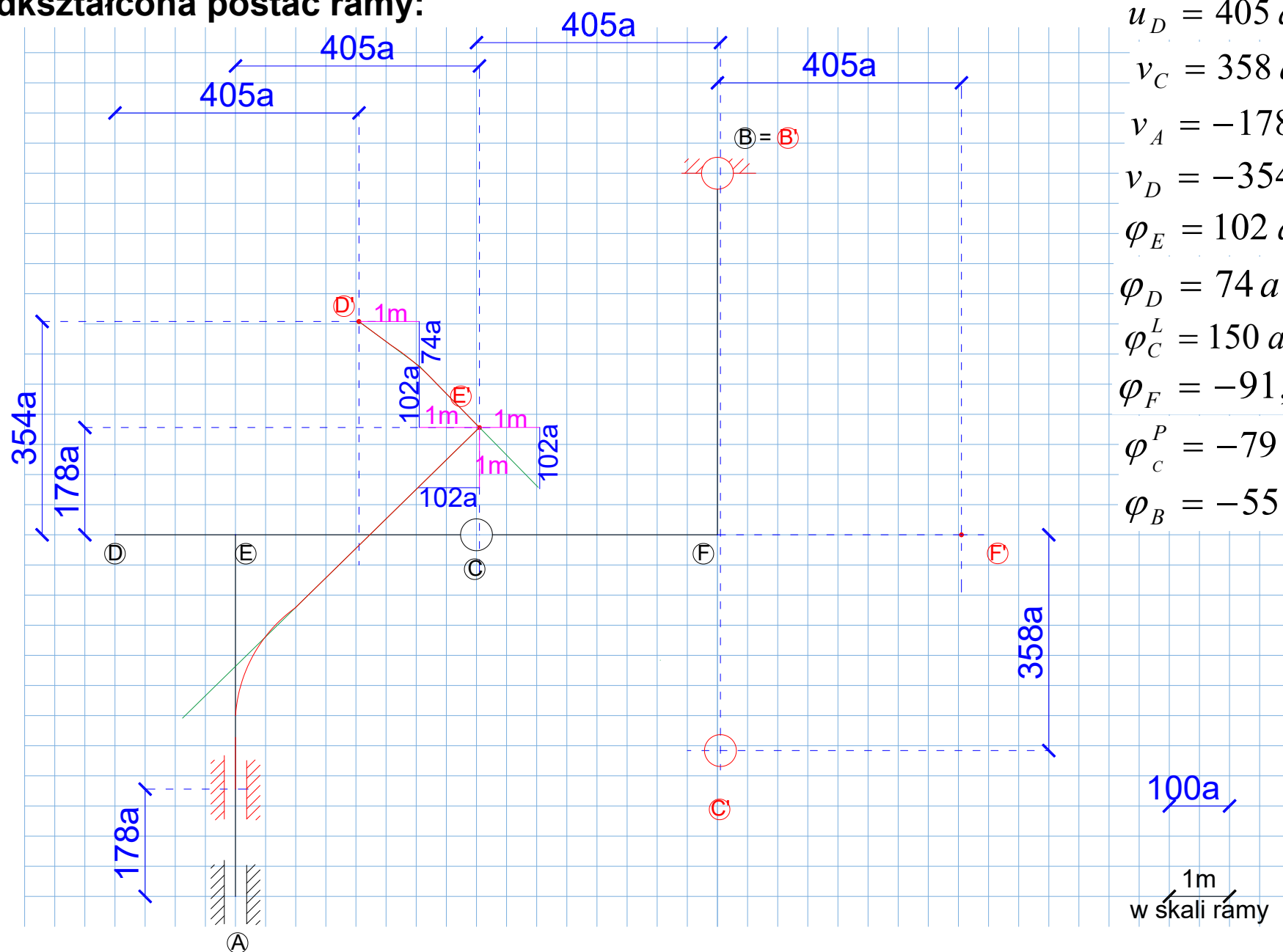
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

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Odkształcona postać ramy:

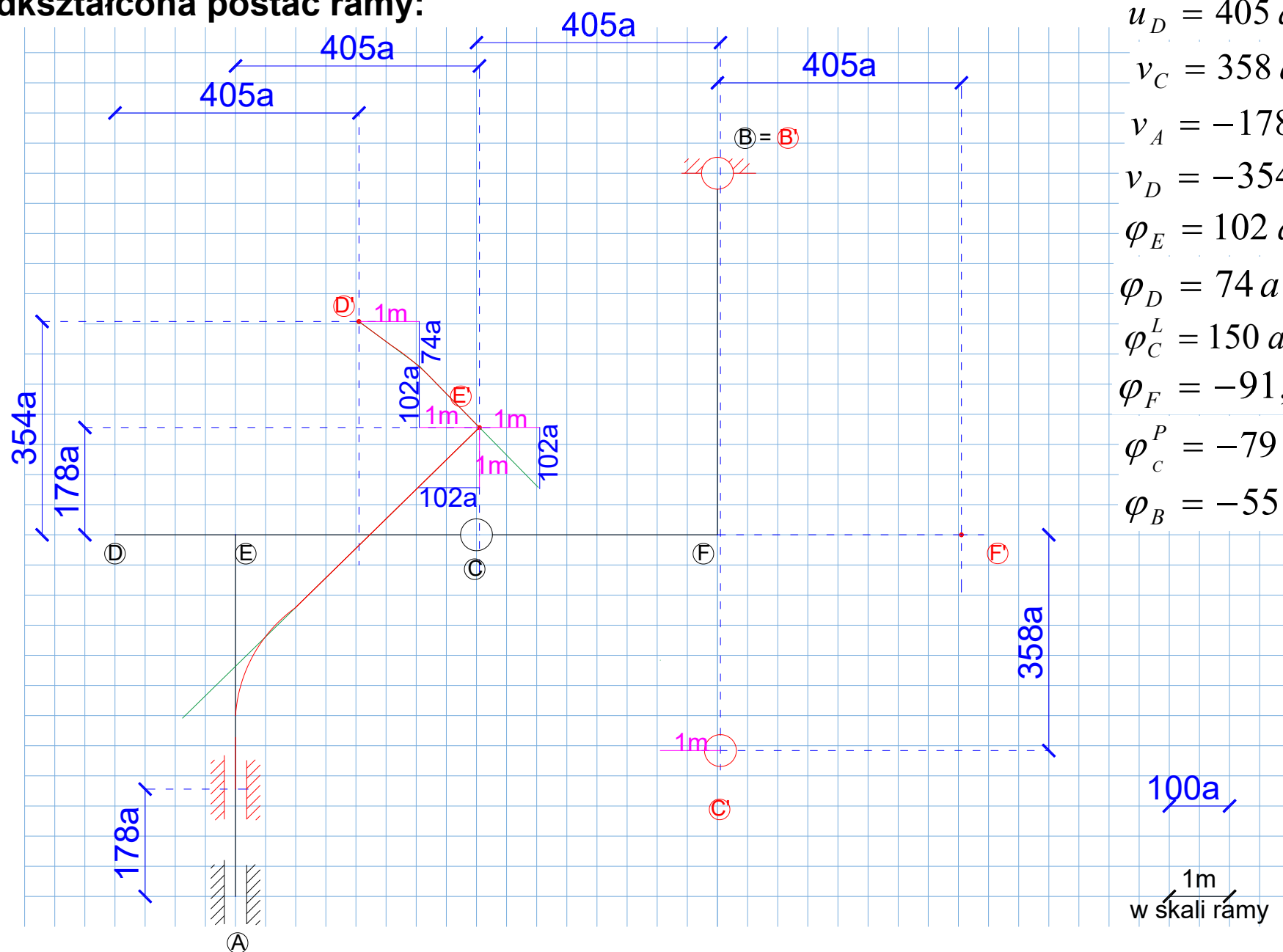


Odształcona postać ramy:

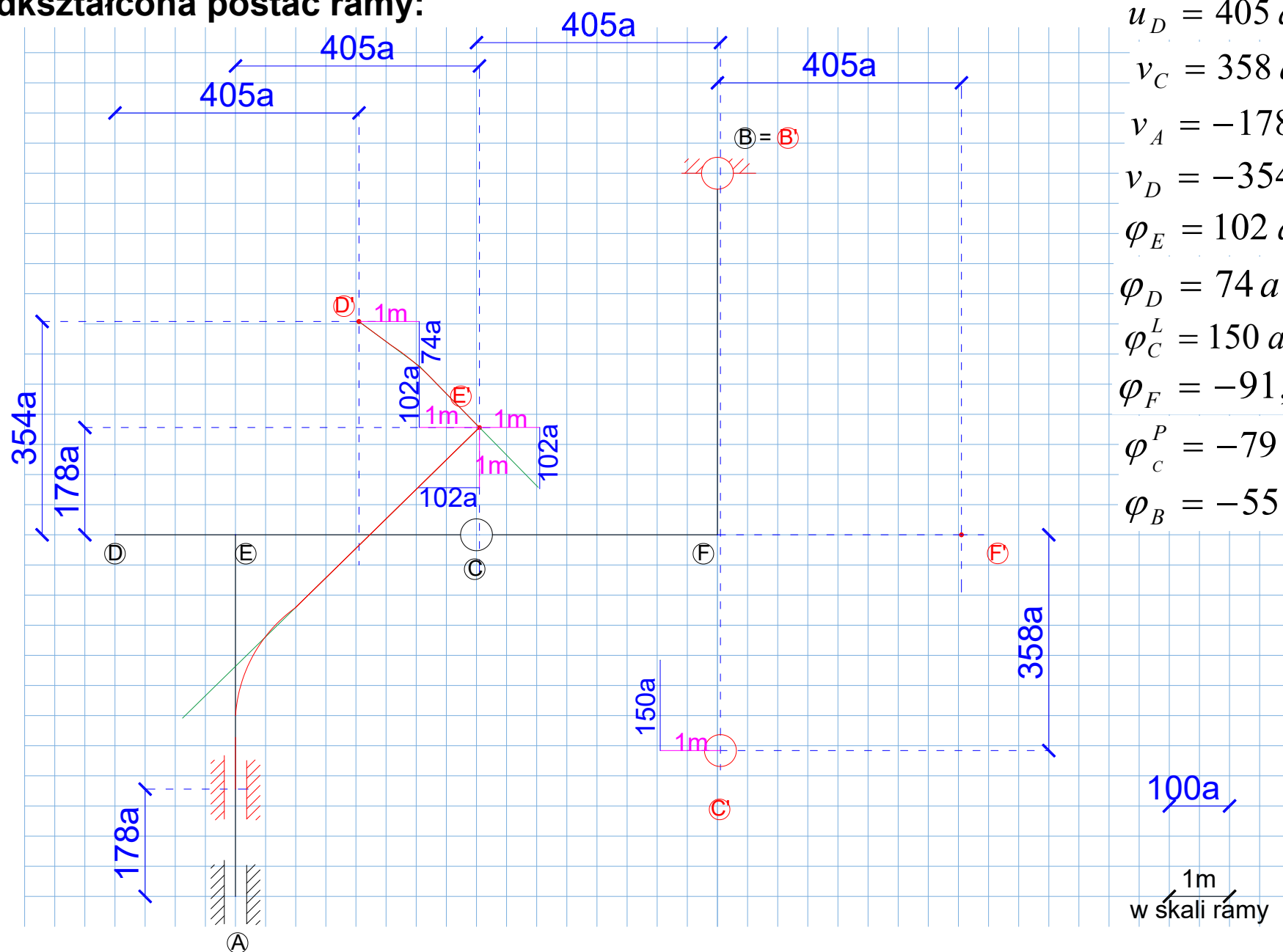


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

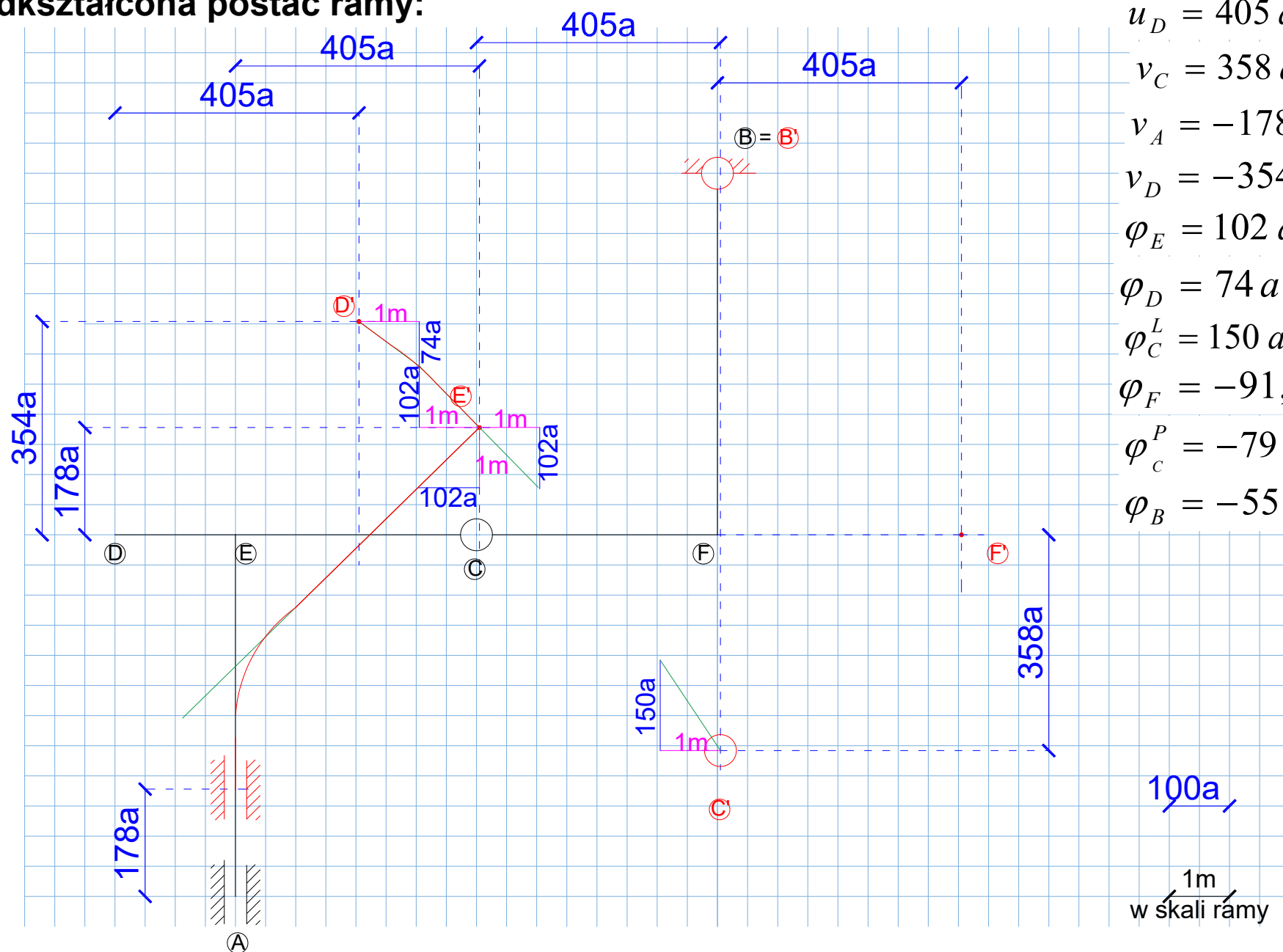
Odkształcona postać ramy:



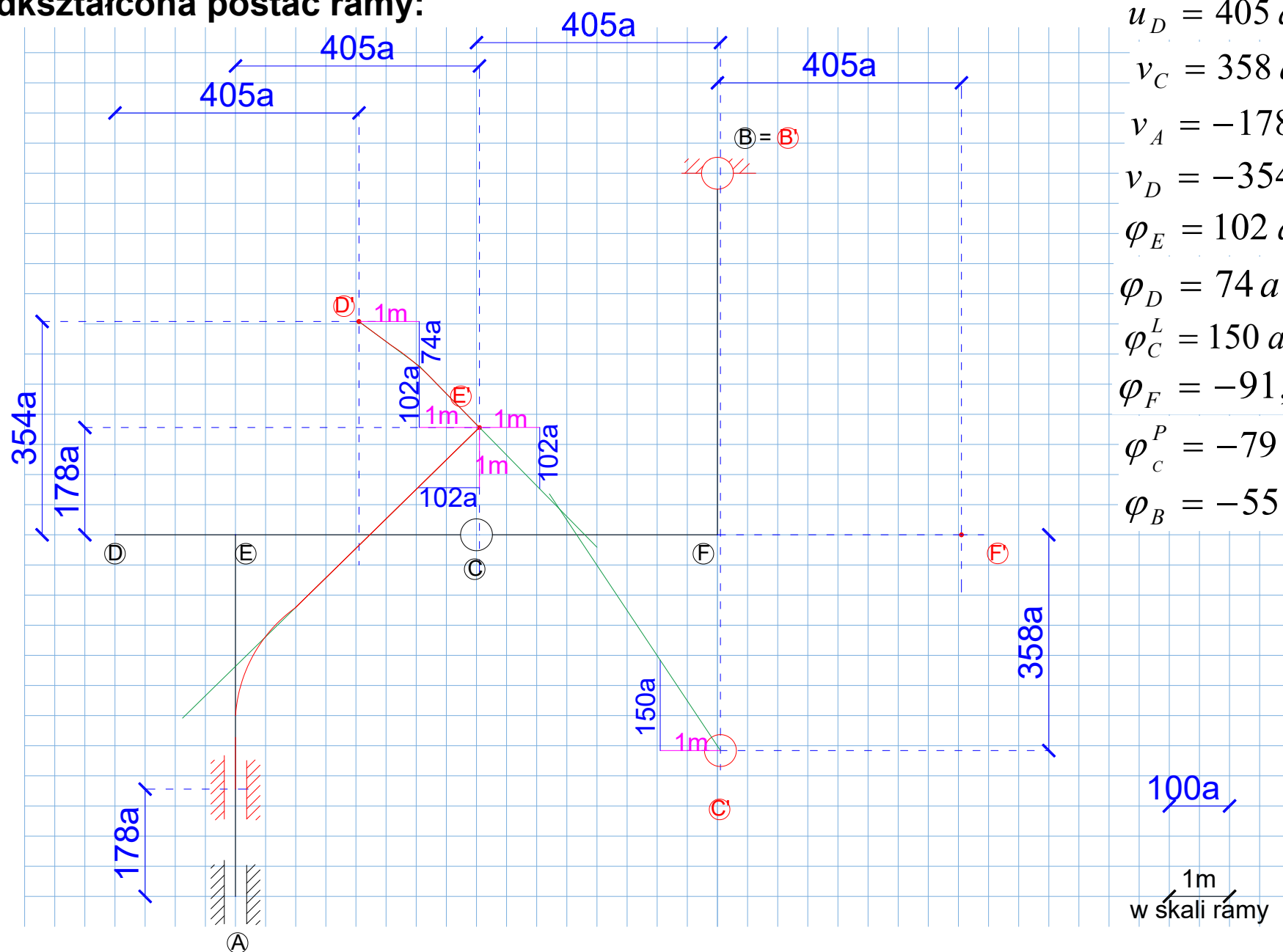
Odkształcona postać ramy:



Odształcona postać ramy:

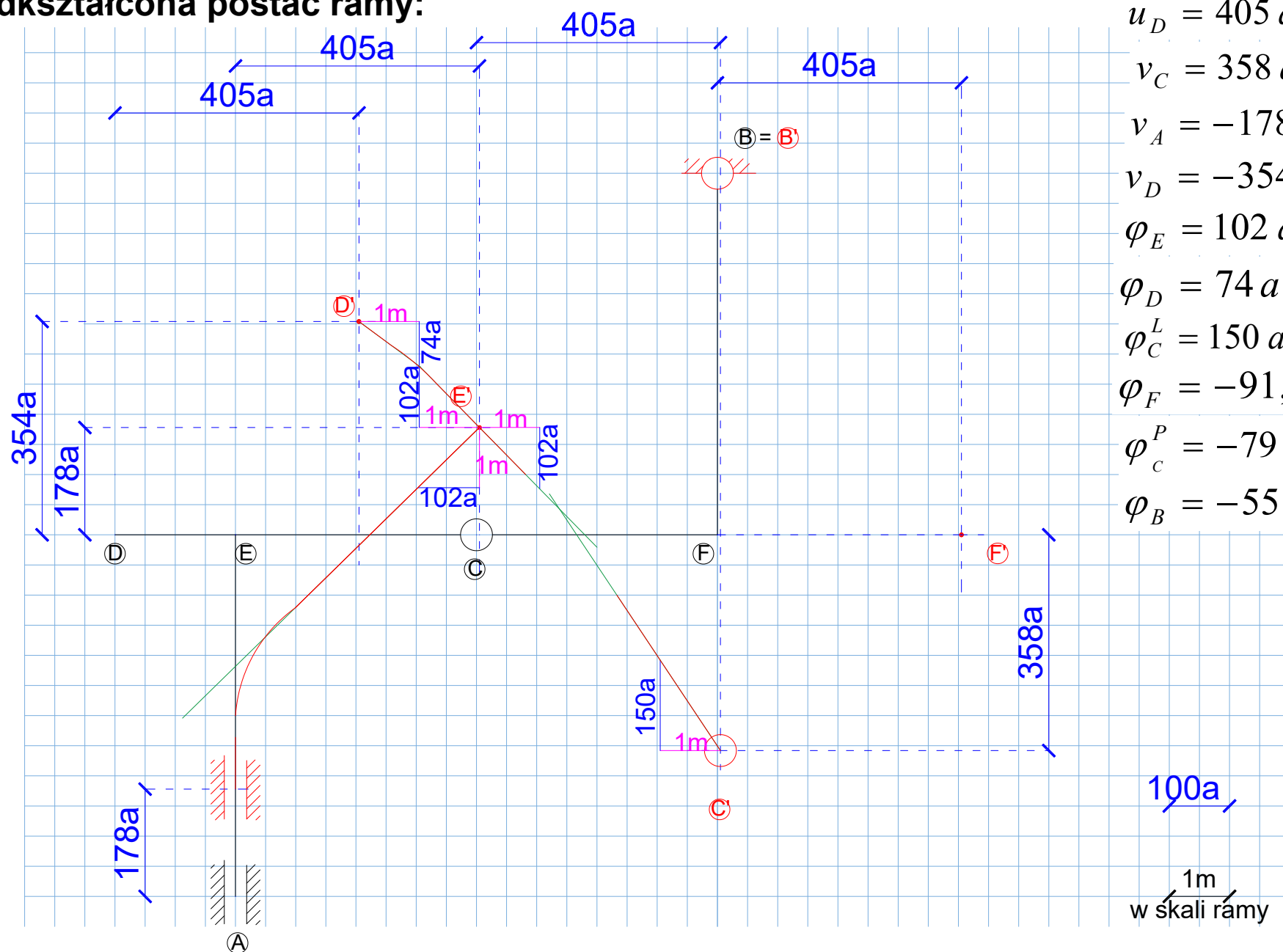


Odształcona postać ramy:

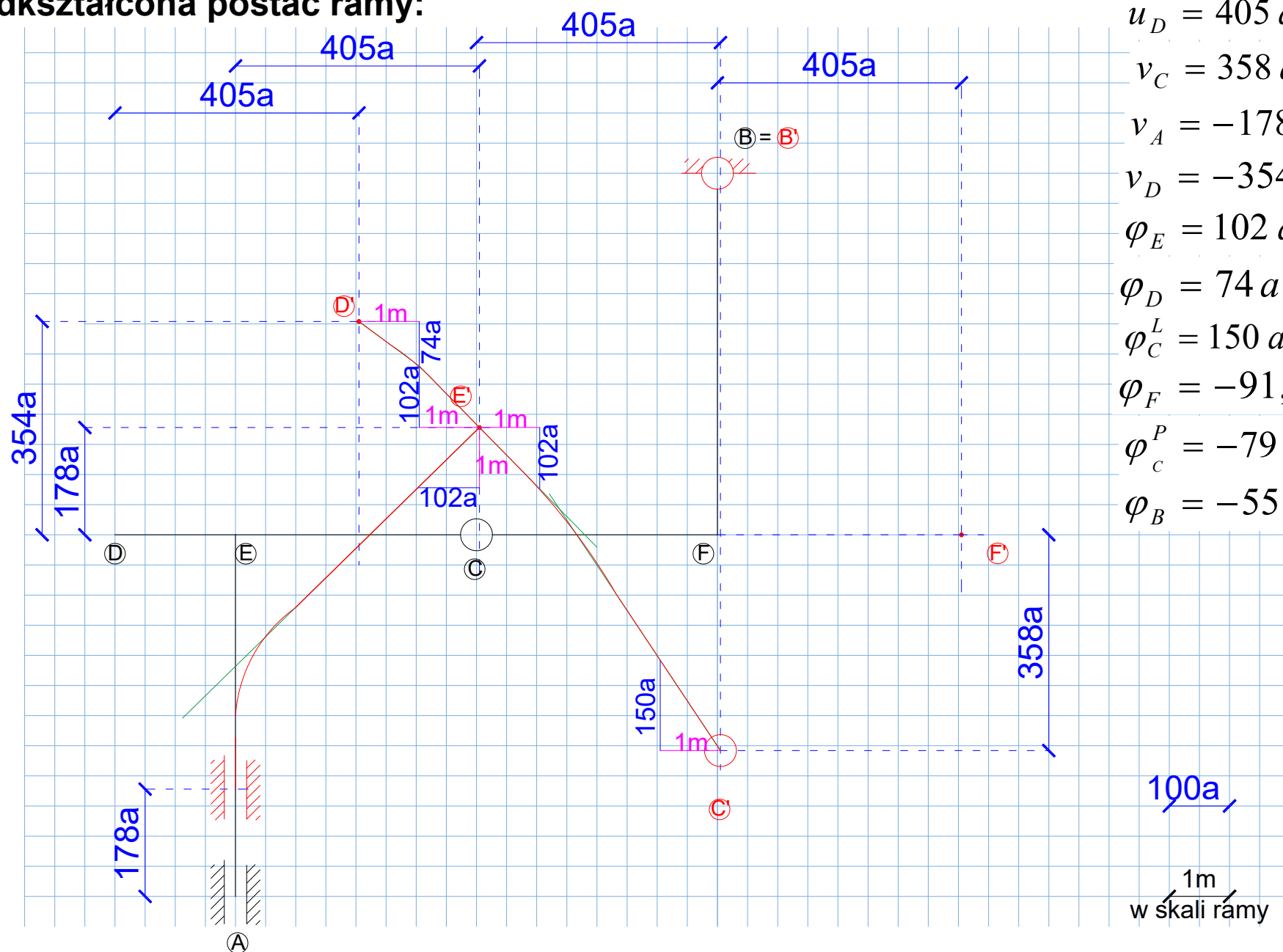


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

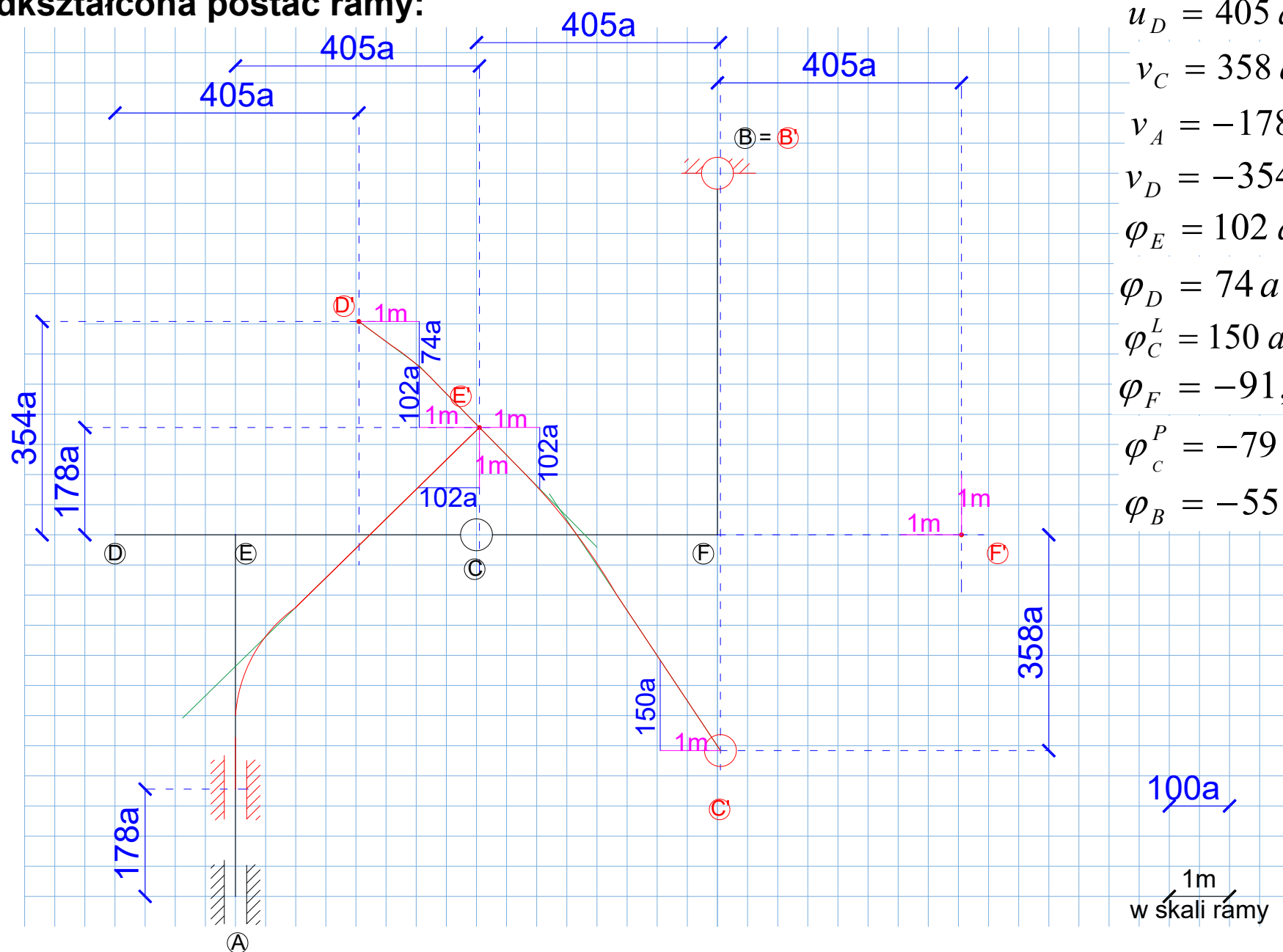
Odształcona postać ramy:



Odkształcona postać ramy:

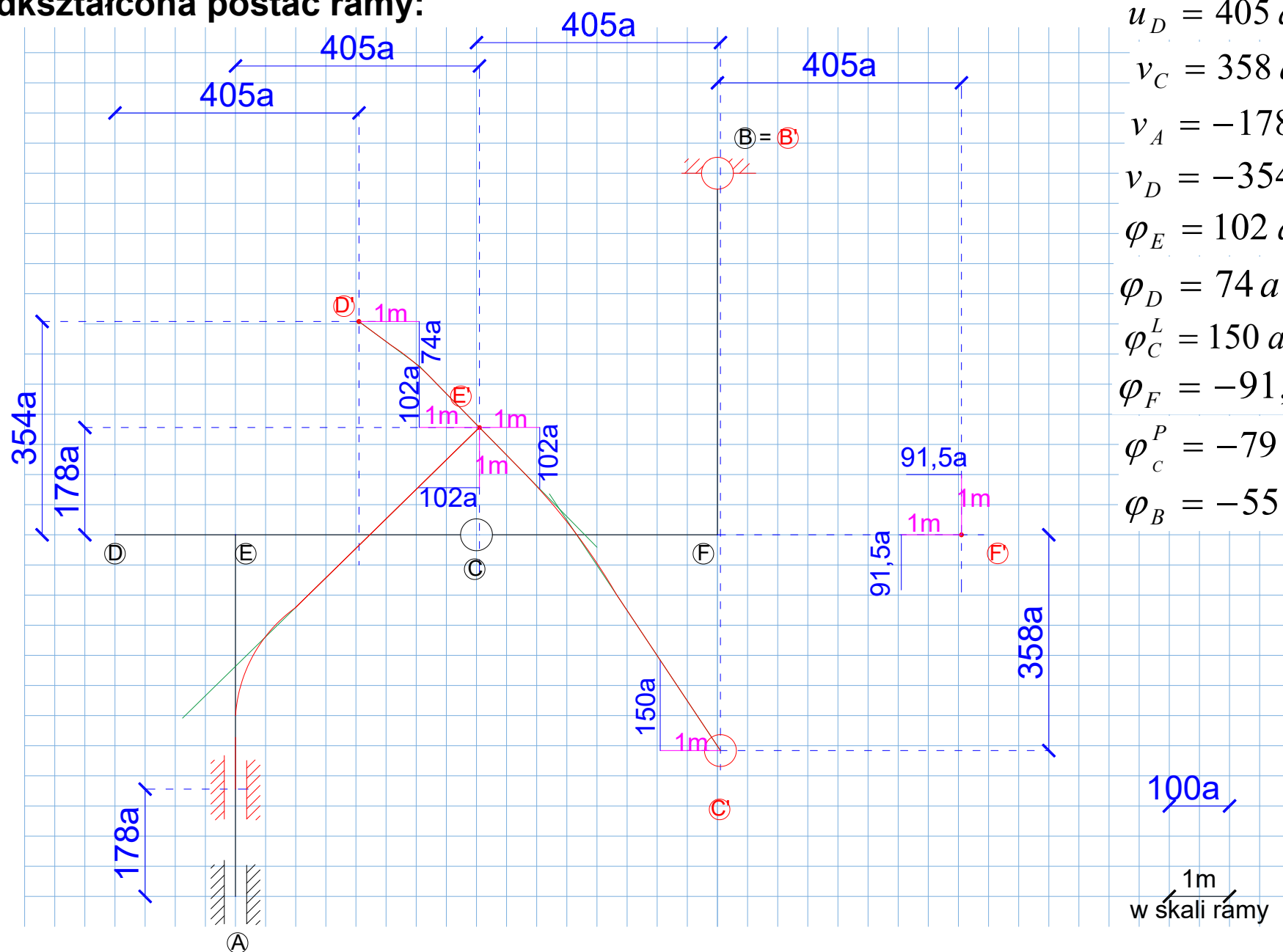


Odształcona postać ramy:

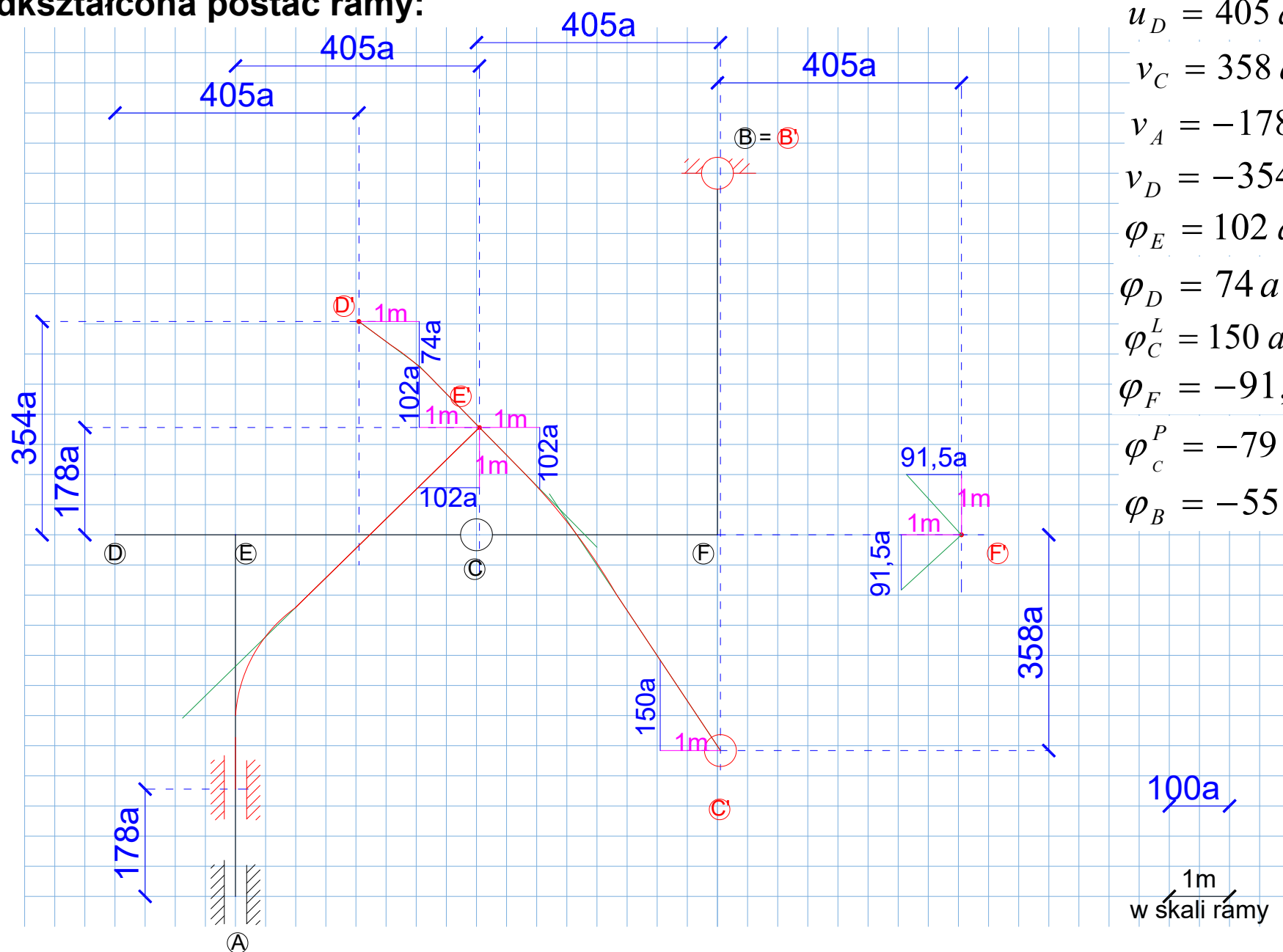


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

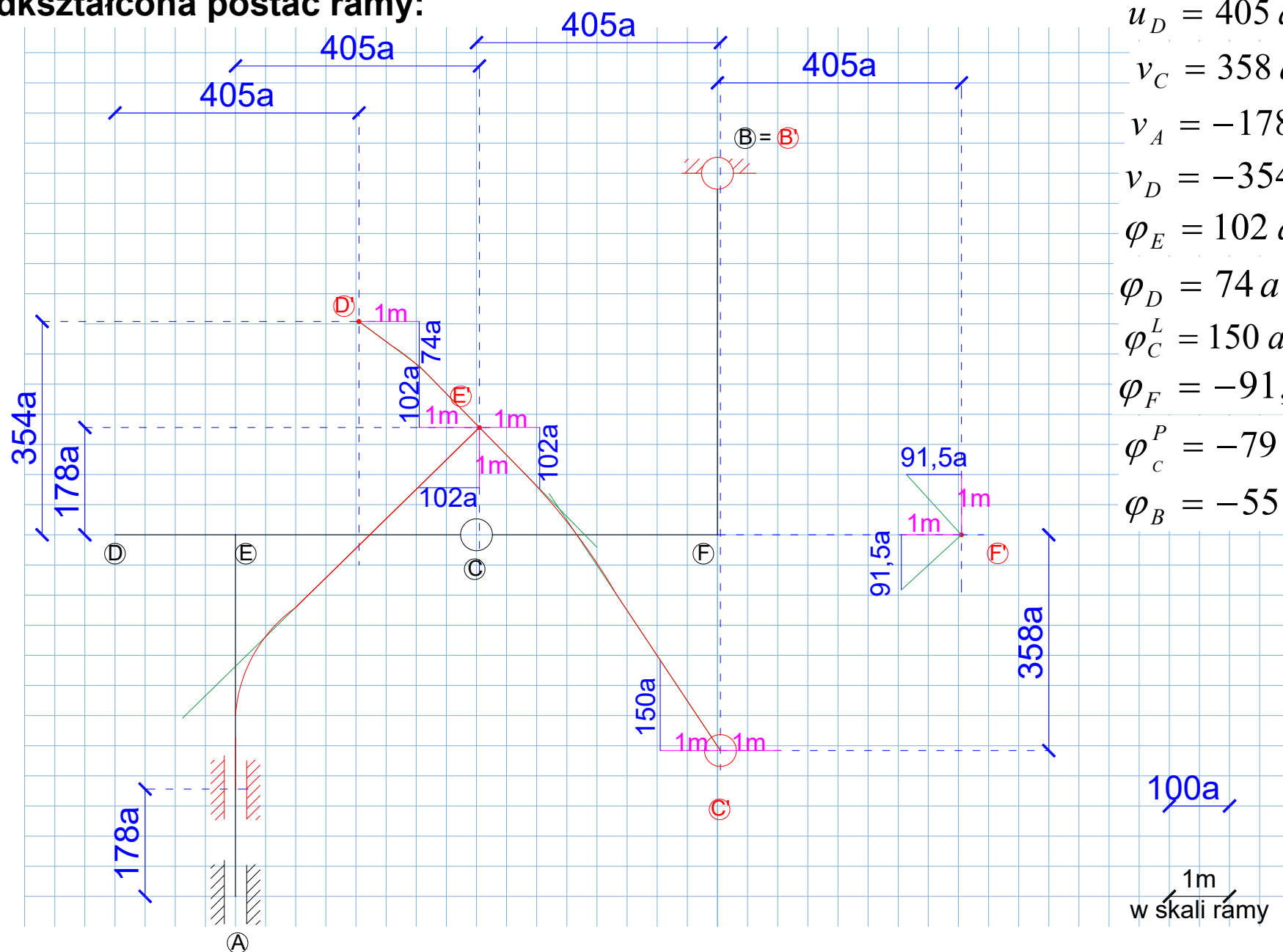
Odształcona postać ramy:



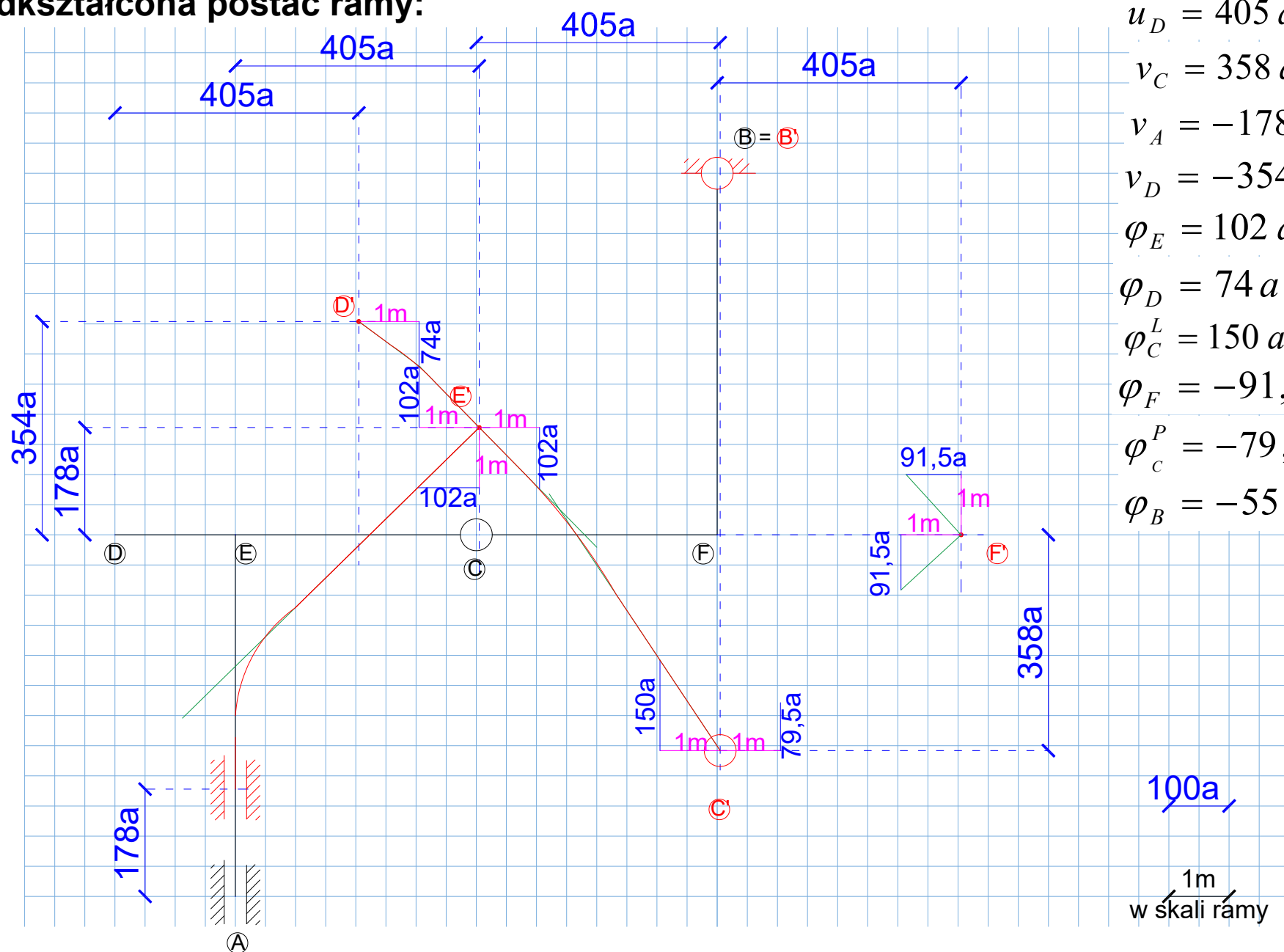
Odształcona postać ramy:



Odkształcona postać ramy:

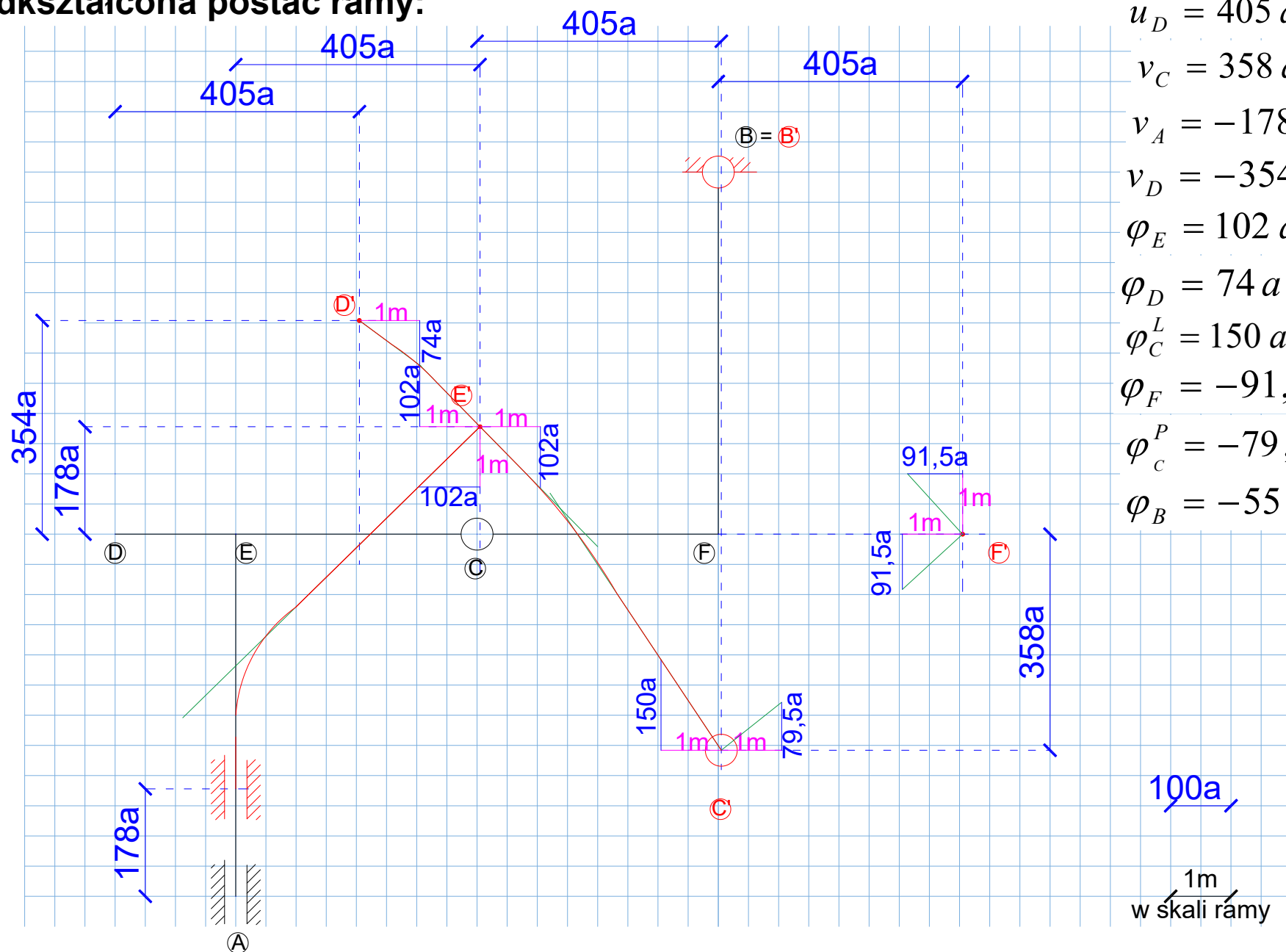


Odształcona postać ramy:

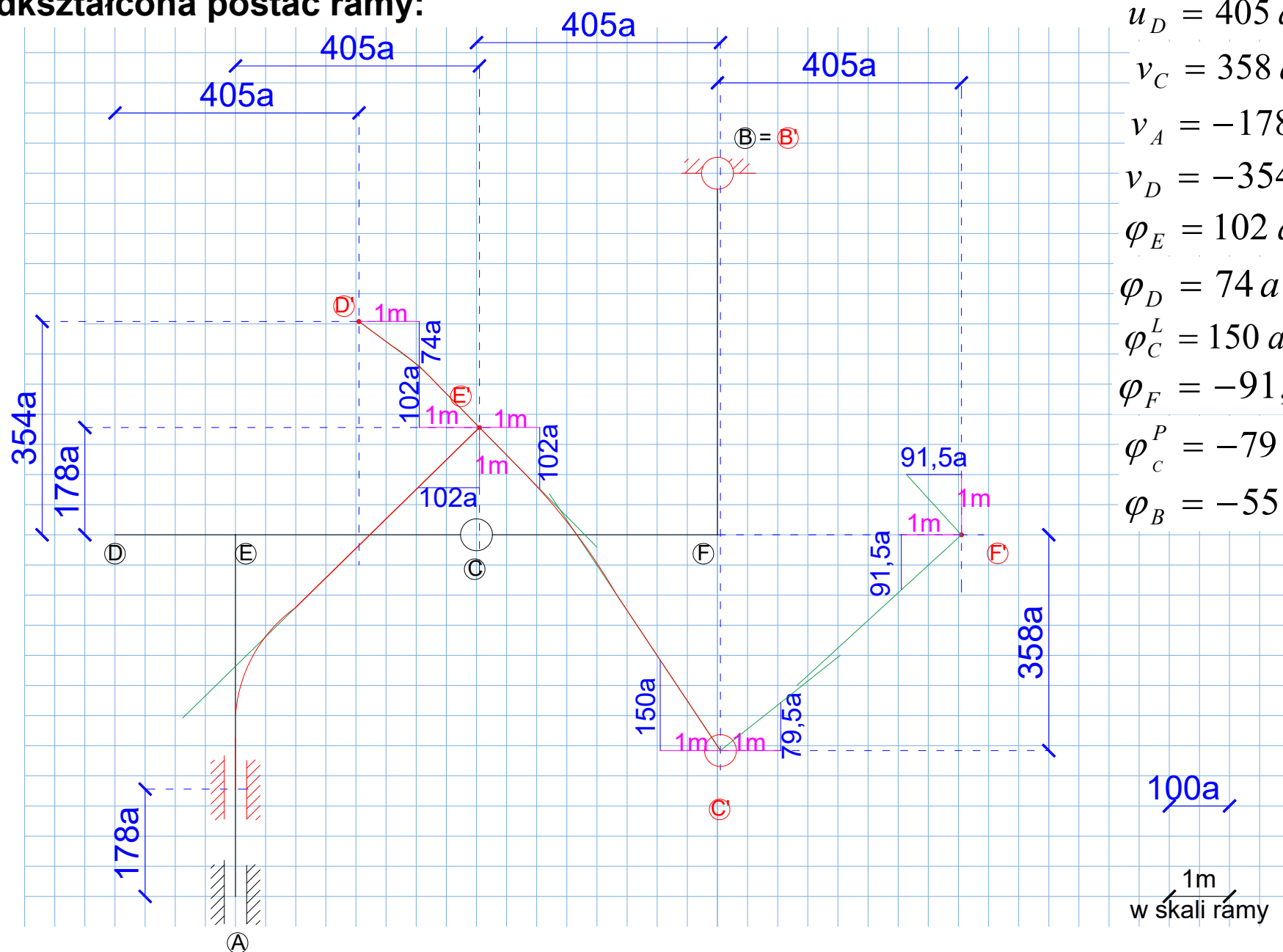


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91.5a \\
 \varphi_C^P &= -79.5a \\
 \varphi_B &= -55.5a
 \end{aligned}$$

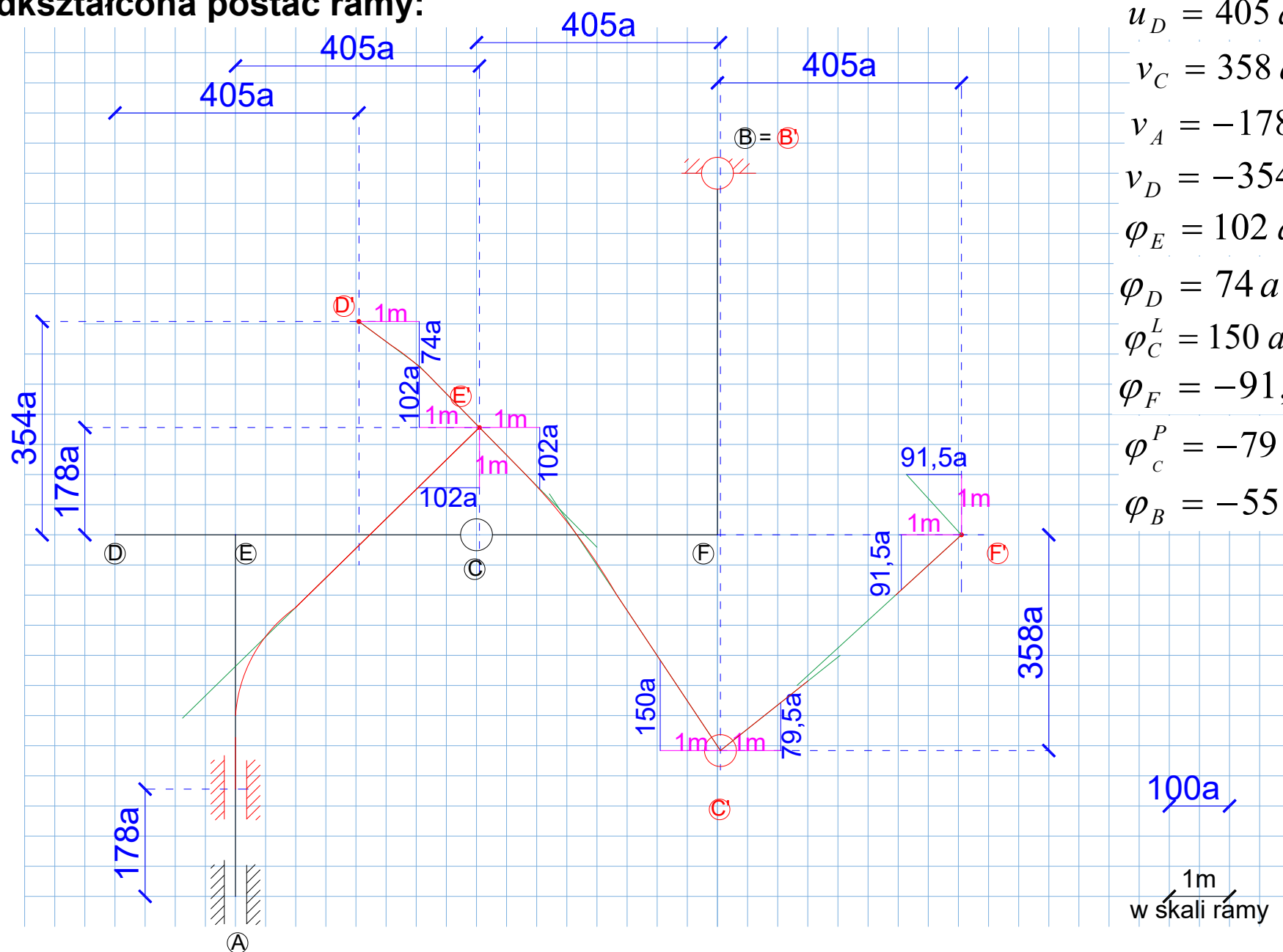
Odształcona postać ramy:



Odkształcona postać ramy:

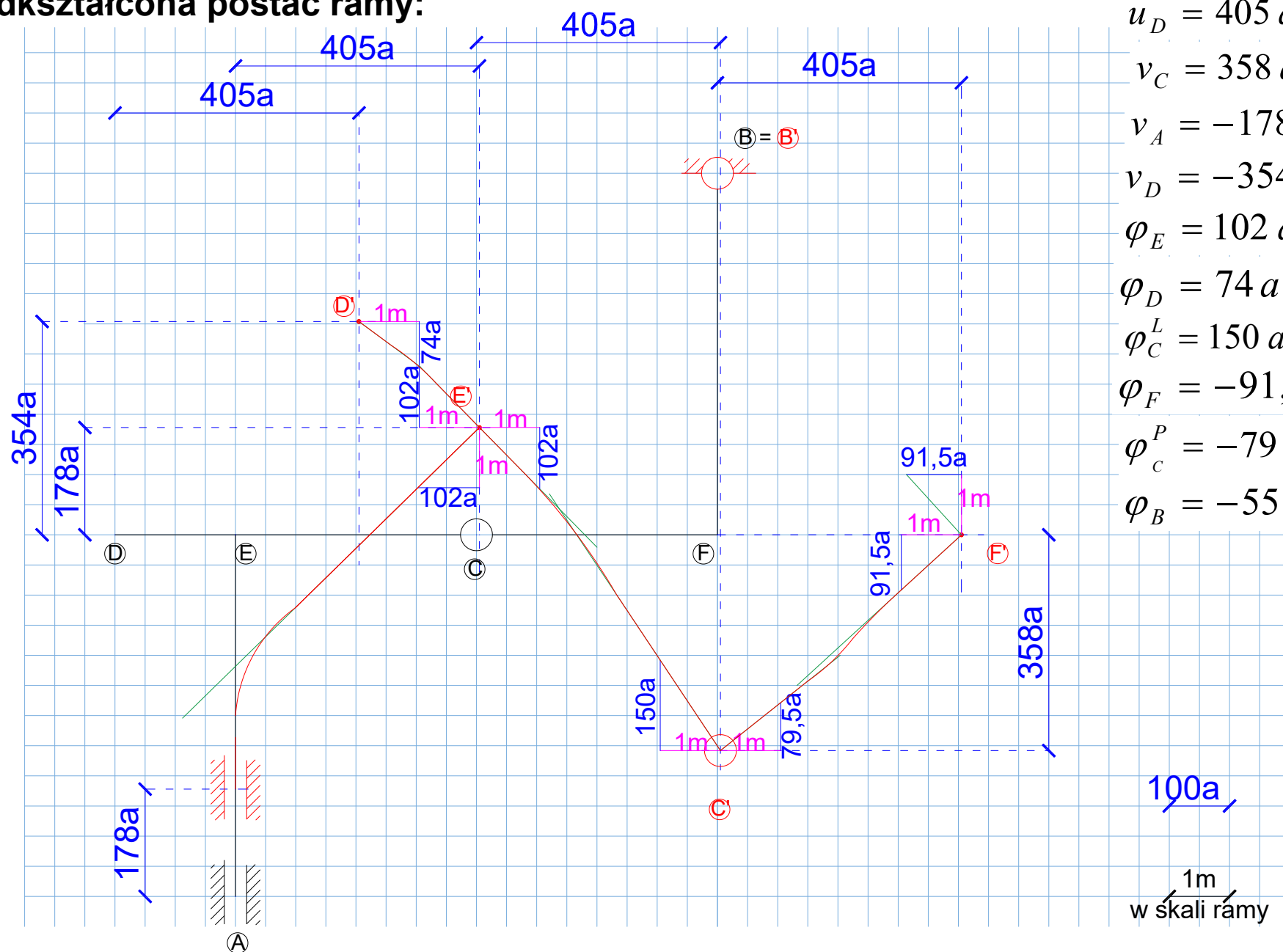


Odształcona postać ramy:

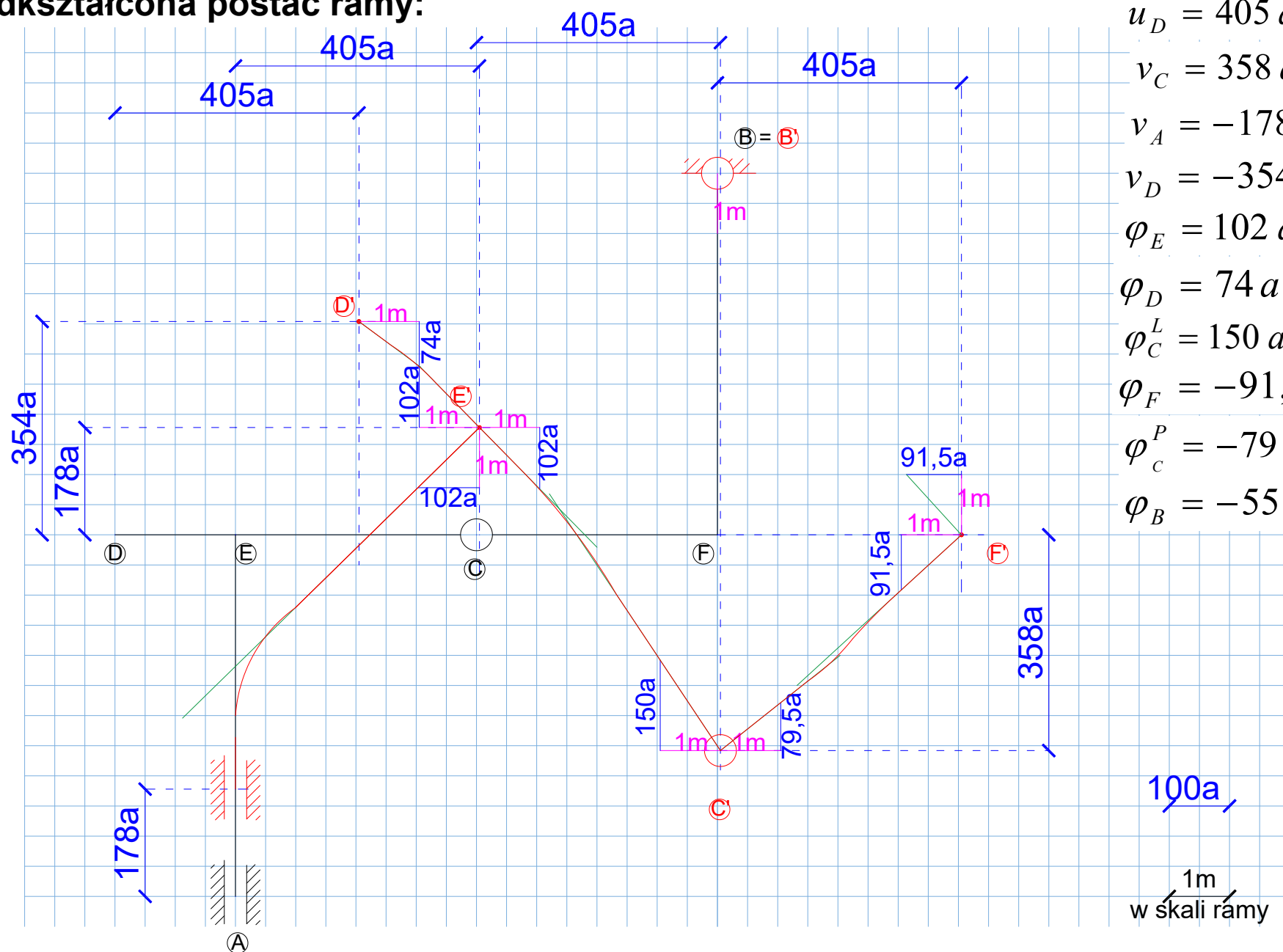


$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odkształcona postać ramy:

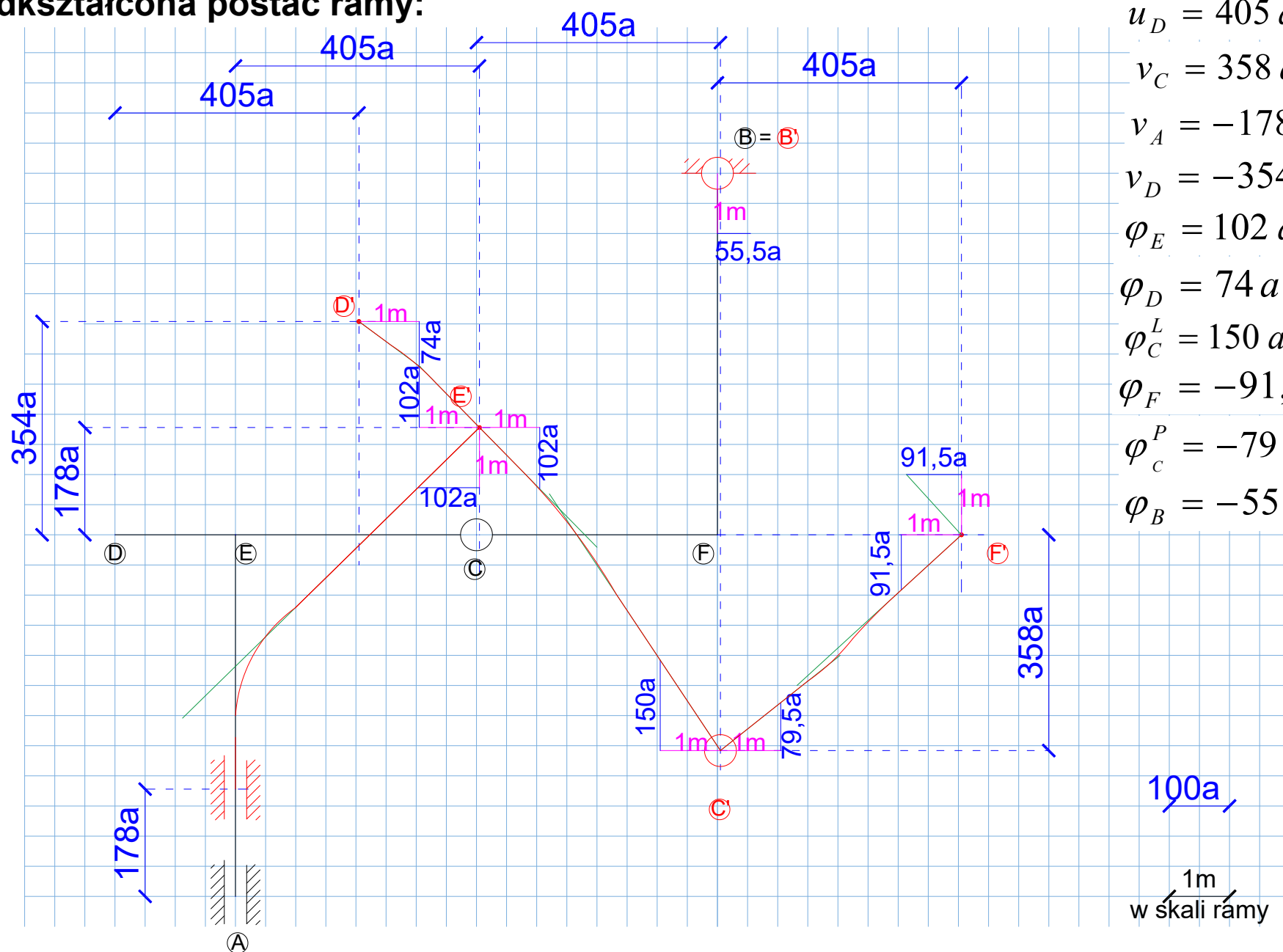


Odształcona postać ramy:

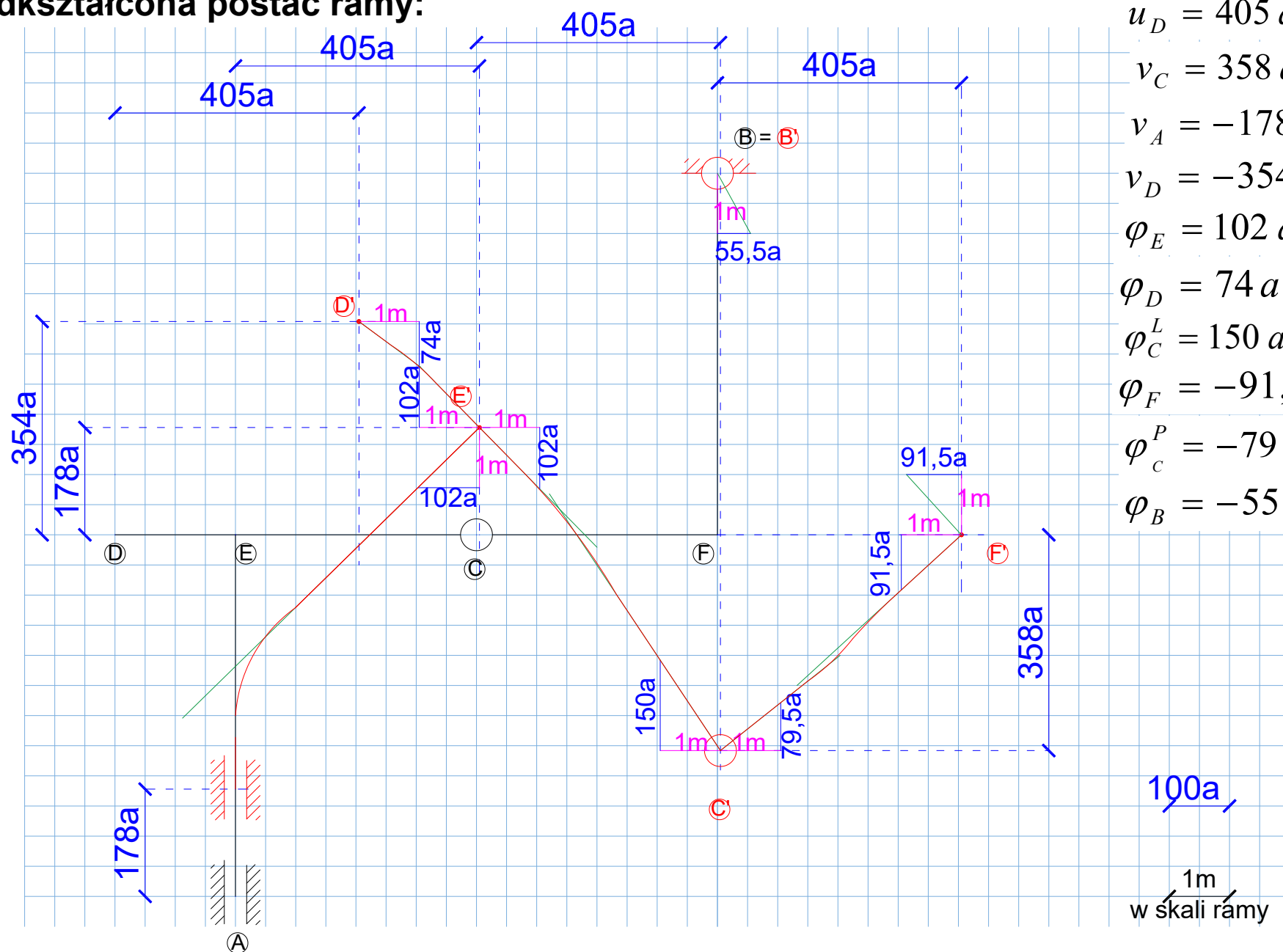


$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
 \end{aligned}$$

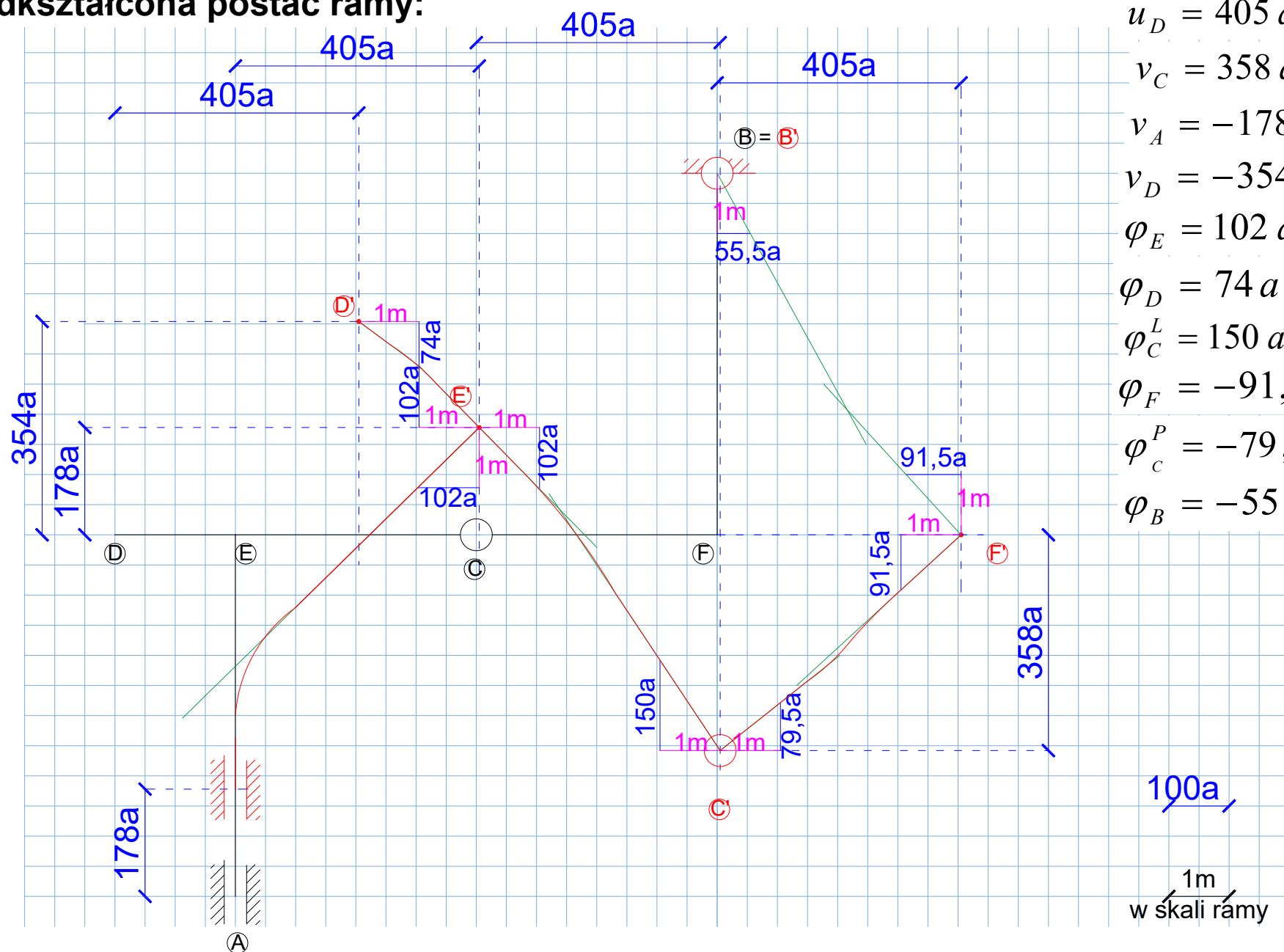
Odształcona postać ramy:



Odształcona postać ramy:

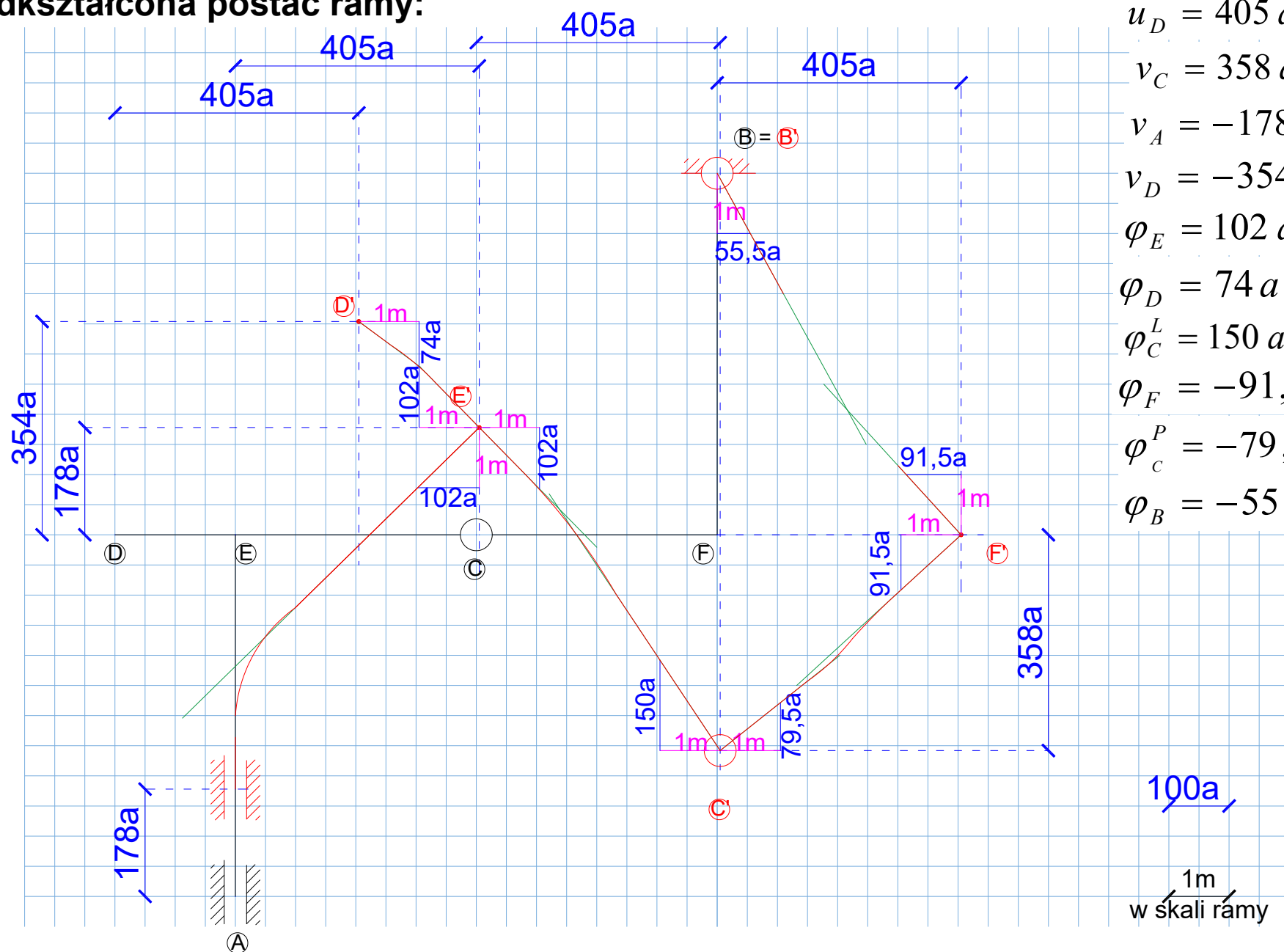


Odształcona postać ramy:



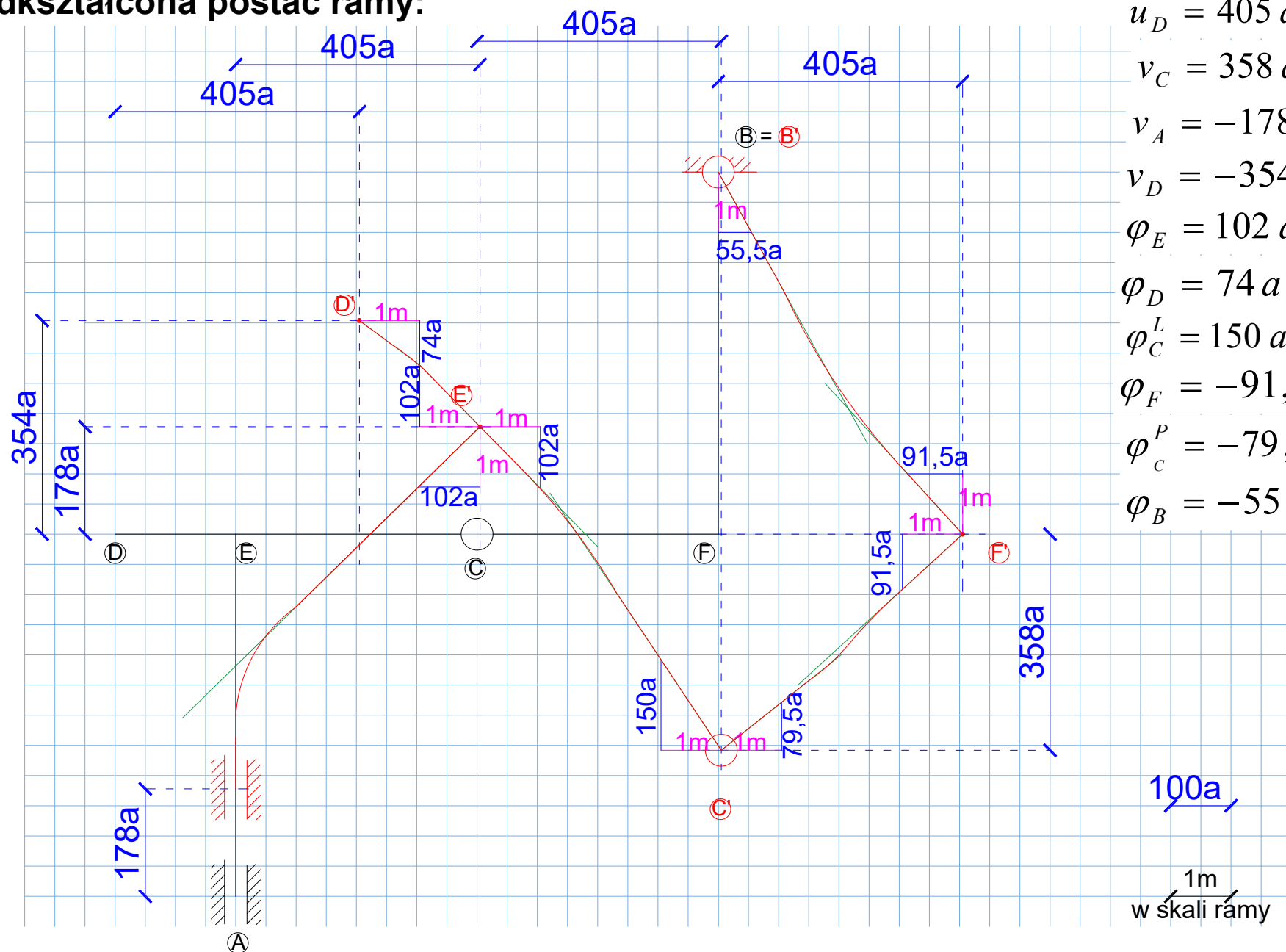
$$\begin{aligned}
 u_D &= 405 a \\
 v_C &= 358 a \\
 v_A &= -178 a \\
 v_D &= -354 a \\
 \varphi_E &= 102 a \\
 \varphi_D &= 74 a \\
 \varphi_C^L &= 150 a \\
 \varphi_F &= -91,5 a \\
 \varphi_C^P &= -79,5 a \\
 \varphi_B &= -55,5 a
 \end{aligned}$$

Odształcona postać ramy:



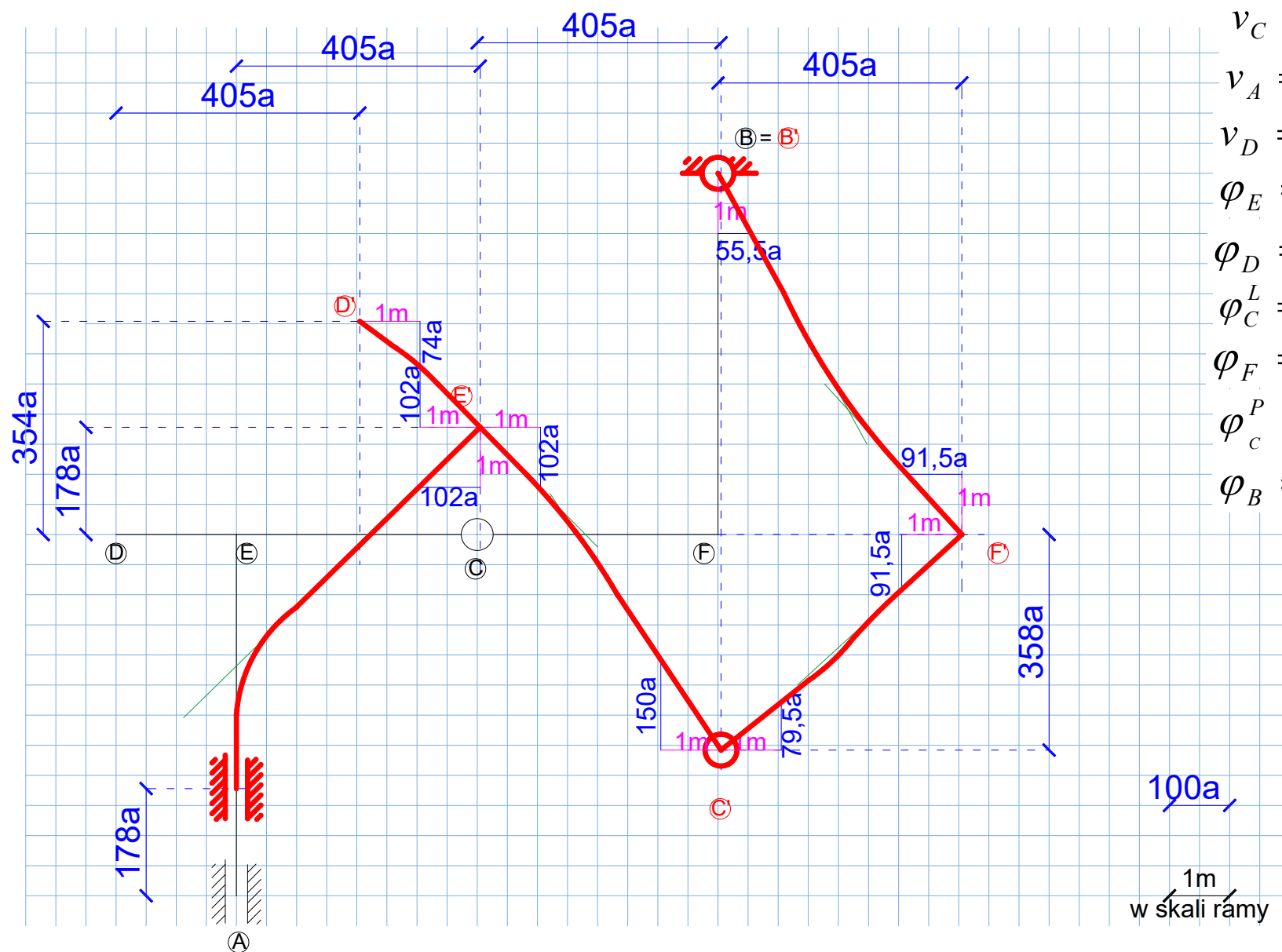
$$\begin{aligned}
 u_D &= 405a \\
 v_C &= 358a \\
 v_A &= -178a \\
 v_D &= -354a \\
 \varphi_E &= 102a \\
 \varphi_D &= 74a \\
 \varphi_C^L &= 150a \\
 \varphi_F &= -91,5a \\
 \varphi_C^P &= -79,5a \\
 \varphi_B &= -55,5a
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