

**Primjer F: Deformacije ravnog nosača metodom analogne grede**

Zadano:  $F, a, M = F \cdot a, EI_y = \text{konst.}$

F)

Reakcije u obojnicima:

- $\sum F_z \rightarrow 0 \quad F + F_A + F_B = 0$
- $\sum M_A \rightarrow 0 \quad F \cdot 2a - F_B \cdot 2a + U - U = 0 \quad /: 2a$

$$F_B = \frac{F}{2}, \quad F_A = -F_B - F = -\frac{3}{2}F$$

$$M_A = -Fa, \quad M_{D,L} = -F \cdot 2a + F_A \cdot a = -\frac{1}{2}Fa$$

$$M_{D,D} = M_{D,L} + U = -\frac{1}{2}Fa + Fa = \frac{1}{2}Fa$$

$$M_B = M_E = U = Fa, \quad M_C = 0$$

Opterećenje analogne grede:

$$F_1^* = \frac{1}{2} \cdot \frac{Fa^2}{EI_y} = F_3^* = F_4^*, \quad F_2^* = F_5^* = \frac{1}{4} \cdot \frac{Fa^2}{EI_y}, \quad F_6^* = \frac{Fa^2}{EI_y}$$

Reakcije analogne grede:

$$\overline{AB}^*: \quad F_A^* = F_B^* = (F_2^* \cdot \frac{4}{3}a + F_3^* \cdot 0) \cdot \frac{1}{2a} = \frac{5}{12} \cdot \frac{Fa^2}{EI_y}$$

$$\overline{AC}^*: \quad F_C^* = F_1^* + F_A^* = \frac{Fa^2}{EI_y} \left( \frac{1}{2} + \frac{5}{12} \right) = \frac{11}{12} \cdot \frac{Fa^2}{EI_y}$$

$$M_C^* = F_1^* \cdot \frac{2}{3}a + F_A^* \cdot a = \frac{Fa^3}{EI_y} \left( \frac{1}{2} \cdot \frac{2}{3} + \frac{5}{12} \cdot 1 \right) = \frac{9}{12} \cdot \frac{Fa^3}{EI_y}$$

$$\overline{BE}^*: \quad F_E^* = F_B^* + F_6^* = \frac{Fa^2}{EI_y} \left( \frac{5}{12} + 1 \right) = \frac{17}{12} \cdot \frac{Fa^2}{EI_y}$$

$$M_E^* = -F_B^* \cdot a - F_6^* \cdot \frac{a}{2} = -\frac{Fa^3}{EI_y} \left( \frac{5}{12} \cdot 1 + 1 \cdot \frac{1}{2} \right) = -\frac{11}{12} \cdot \frac{Fa^3}{EI_y}$$

Nađimo tangente na elastičnu liniju grede:

$$\alpha_A = -\alpha_B^* = F_A^* = \frac{5}{12} \cdot \frac{Fa^2}{EI_y}, \quad \alpha_B = -\alpha_B^* = F_B^* = \frac{5}{12} \cdot \frac{Fa^2}{EI_y}, \quad \alpha_C = -\alpha_C^* = F_C^* = \frac{11}{12} \cdot \frac{Fa^2}{EI_y}, \quad \alpha_E = -\alpha_E^* = F_E^* = \frac{17}{12} \cdot \frac{Fa^2}{EI_y}$$

Brojevi:  $0,41667, 0,41667, 0,91667, 1,41667$

$$\alpha_D = -\alpha_D^* = F_A^* \cdot \frac{1}{2} - F_2^* \cdot \frac{1}{4} - F_3^* \cdot \frac{1}{4} = \frac{Fa^2}{EI_y} \left( \frac{5}{12} - \frac{1}{4} - \frac{1}{4} \right) = -\frac{4}{12} \cdot \frac{Fa^2}{EI_y}$$

Brojevi:  $-0,33333$

Prognosti grede:  $w_A = w_B = 0$

$$w_C = M_C^* = \frac{9}{12} \cdot \frac{Fa^3}{EI_y}, \quad w_E = M_E^* = -\frac{11}{12} \cdot \frac{Fa^3}{EI_y}, \quad w_D = M_D^* = -F_A^* \cdot a + F_2^* \cdot \frac{2}{3}a + F_3^* \cdot \frac{a}{2} = \frac{Fa^3}{EI_y} \left( -\frac{5}{12} \cdot 1 + \frac{1}{4} \cdot \frac{2}{3} + \frac{1}{2} \cdot \frac{1}{2} \right)$$

Brojevi:  $0,75, -0,91667$

$$x_{m1} = 1,4725 \cdot a \rightarrow w(x_{m1}) = 0,094038 \cdot \frac{Fa^3}{EI_y}$$

$$x_{m2} = 2,5275 \cdot a \rightarrow w(x_{m2}) = 0,094038 \cdot \frac{Fa^3}{EI_y}$$

(U skorijoj budućnosti, svi primjeri analognih greda bit će iscrtani i ispisani uobičajenom tehnikom, a sada se ovdje daju skenirani iz radnog materijala!).