

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

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

G)

Reakcije u zglobovima:

$$1. \sum F_z = 0 \quad F_A + F_B + 2F = 0$$

$$2. \sum M_A = 0 \quad -M - 2F \cdot e - M - F_B \cdot 2e = 0 \quad /: 2e$$

$$F_B = \frac{F}{2}(-2-2) = -2F, \quad F_A = -2F - F_B = 0$$

$M_C = M_A = M_D = M = Fe, \quad M_E = 0, \quad M_B = -M = -Fe$

Opterećenje analogne grede:

$$F_1^* = F_2^* = \frac{Fe^2}{EI_y}; \quad F_3^* = F_4^* = \frac{1}{4} \cdot \frac{Fe^2}{EI_y}$$

Reakcije analogne grede:

AB\*:  $1. \sum F_z^* = 0 \quad -F_A^* - F_B^* + F_2^* = 0$

$$2. \sum M_A^* = 0 \quad F_B^* \cdot 2e = F_2^* \cdot \frac{a}{2} - F_3^* \cdot \frac{2}{3}e \quad /: 2e$$

$$F_B^* = \frac{Fe^2}{2EI_y} \left( 1 \cdot \frac{1}{2} - \frac{1}{4} \cdot \frac{2}{3} \right) = \frac{1}{6} \cdot \frac{Fe^2}{EI_y}$$

$$F_A^* = F_2^* - F_B^* = \frac{Fe^2}{EI_y} \left( 1 - \frac{1}{6} \right) = \frac{5}{6} \cdot \frac{Fe^2}{EI_y}$$

AC\*:  $F_C^* = F_1^* + F_A^* = \frac{Fe^2}{EI_y} \left( 1 + \frac{5}{6} \right) = \frac{11}{6} \cdot \frac{Fe^2}{EI_y}$

$$M_C^* = -(F_1^* \cdot \frac{a}{2} + F_A^* \cdot a) = -\frac{Fe^3}{EI_y} \left( 1 \cdot \frac{1}{2} + \frac{5}{6} \cdot 1 \right) = -\frac{8}{6} \cdot \frac{Fe^3}{EI_y}$$

BE\*:  $F_E^* = F_B^* = \frac{1}{6} \cdot \frac{Fe^2}{EI_y}$

$$M_E^* = -F_B^* \cdot e = -\frac{1}{6} \cdot \frac{Fe^3}{EI_y}$$

Negativne tangente na elastičnu liniju grede:

$$\alpha_A = -\alpha_A^* = -F_A^* = -\frac{5}{6} \cdot \frac{Fe^2}{EI_y} \quad \alpha_B = -\alpha_B^* = F_B^* = \frac{1}{6} \cdot \frac{Fe^2}{EI_y} \quad \alpha_C = -\alpha_C^* = -F_C^* = -\frac{11}{6} \cdot \frac{Fe^2}{EI_y}$$

$$\alpha_D = -\alpha_D^* = -F_A^* + F_2^* = \frac{Fe^2}{EI_y} \left( -\frac{5}{6} + 1 \right) = \frac{1}{6} \cdot \frac{Fe^2}{EI_y} \quad \alpha_E = -\alpha_E^* = F_E^* = \frac{1}{6} \cdot \frac{Fe^2}{EI_y}$$

Prigibi grede:  $w_A = w_B = 0$

$$w_C = M_C^* = -\frac{4}{3} \cdot \frac{Fe^3}{EI_y} \quad w_D = M_D^* = F_A^* \cdot a - F_2^* \cdot \frac{a}{2} = \frac{Fe^3}{EI_y} \left( \frac{5}{6} \cdot 1 - 1 \cdot \frac{1}{2} \right) = \frac{1}{3} \cdot \frac{Fe^3}{EI_y} \quad w_E = M_E^* = -\frac{1}{6} \cdot \frac{Fe^3}{EI_y}$$

Mjesto maksimalnog prigiba:

$$Q(x'_m) = 0 = F_A^* - F^* - F_1^* = \frac{Fe^2}{EI_y} x'_m = \frac{Fe^2}{EI_y} \cdot \frac{5}{6} \rightarrow x'_m = \frac{5}{6} a \approx 0,8333 \cdot a, \quad F^* = \frac{5}{6} \cdot \frac{Fe^2}{EI_y}$$

$$w(x'_m) = F_A^* \cdot x'_m - F^* \cdot \frac{x'_m}{2} = \frac{5}{6} \cdot \frac{Fe^2}{EI_y} \cdot \frac{1}{2} \cdot \frac{5}{6} \cdot a = \frac{25}{72} \cdot \frac{Fe^3}{EI_y} \approx 0,34722 \cdot \frac{Fe^3}{EI_y}$$

$$x_m = a + x'_m = 1,8333 \cdot a$$

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