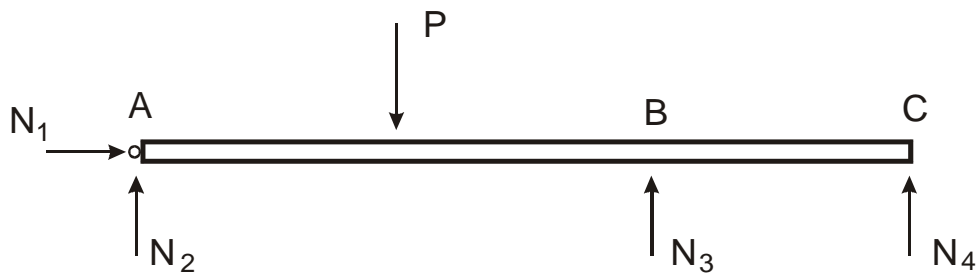


Equações de Equilíbrio



$$\sum X = 0 \quad N_1 = 0$$

$$\sum Y = 0 \quad N_2 + N_3 + N_4 = P \quad \text{I}$$

$$\sum M_A = 0 \quad -Pl + N_3 \cdot 2l + N_4 \cdot 2l = 0 \quad \text{II}$$

Variações de comprimentos das barras

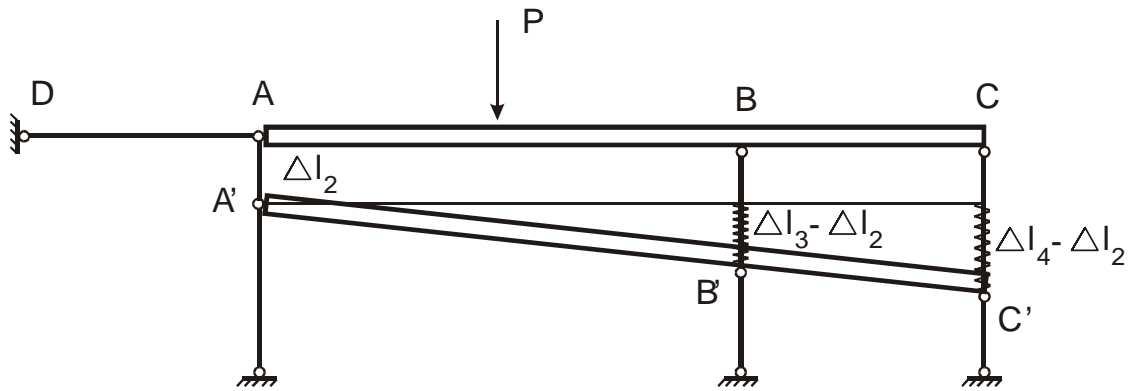
$$\Delta l_1 = 0$$

$$\Delta l_2 = \frac{N_2 \ell}{EA}$$

$$\Delta l_3 = \frac{N_3 \ell}{2EA}$$

$$\Delta l_4 = \frac{N_4 \ell}{EA}$$

Equação de compatibilidade de deslocamentos



$$\frac{\Delta l_3 - \Delta l_2}{2\ell} = \frac{\Delta l_4 - \Delta l_2}{3\ell}$$

$$\frac{\frac{N_3 \ell}{2EA} - \frac{N_2 \ell}{EA}}{2} = \frac{\frac{N_4 \ell}{EA} - \frac{N_2 \ell}{EA}}{3}$$

$$3\left(\frac{N_3}{2} - N_2\right) = 2(N_4 - N_2)$$

$$3\left(\frac{N_3 - 2N_2}{2}\right) = 2(N_4 - N_2)$$

$$3(N_3 - 2N_2) = 4(N_4 - N_2)$$

$$3N_3 - 6N_2 = 4N_4 - 4N_2$$

$$3N_3 - 2N_2 - 4N_4 = 0 \quad \text{III}$$

As equações I, II e III permitem a determinação de N_2 , N_3 e N_4 :

$$N_2 + N_3 + N_4 = P$$

$$2N_3 + 3N_4 = P$$

$$3N_3 - 2N_2 - 4N_4 = 0$$

$$N_2 = P - N_3 - N_4$$

$$3N_3 - 2(P - N_3 - N_4) - 4N_4 = 0$$

$$3N_3 - 2P + 2N_3 + 2N_4 - 4N_4 = 0$$

$$5N_3 - 2N_4 = 2P$$

$$10N_3 - 4N_4 = 4P$$

$$10N_3 + 15N_4 = 5P$$

$$10N_3 - 4N_4 = 4P$$

$$\underline{-10N_3 - 15N_4 = 5P}$$

$$-19N_4 = -P$$

$$N_4 = \frac{P}{19}$$

$$2N_3 + 3N_4 = P$$

$$2N_3 = P - 3N_4 = P - \frac{3P}{19} = \frac{19-3}{19}P$$

$$2N_3 = \frac{16P}{19}$$

$$N_3 = \frac{8P}{19}$$

$$N_2 = P - N_3 - N_4 = P - \frac{8P}{19} - \frac{P}{19} = \frac{19-8-1}{19}P = \frac{10}{19}P$$

$$N_2 = \frac{10}{19}P$$

$$N_1 = 0$$

$$N_2 = \frac{10}{19}P \quad (\text{compress\~{a}o})$$

$$N_3 = \frac{8}{19}P \quad (\text{compress\~{a}o})$$

$$N_4 = \frac{P}{19} \quad (\text{compress\~{a}o})$$

Deslocamentos:

$$u_A = 0$$

$$v_A = |\Delta\ell_2| = \frac{10}{19}P \frac{\ell}{EA} = \frac{10P\ell}{19EA}$$

$$u_B = 0$$

$$v_B = |\Delta\ell_3| = \frac{8}{19}P \frac{\ell}{2EA} = \frac{4P\ell}{19EA}$$

$$u_C = 0$$

$$v_C = |\Delta\ell_4| = \frac{P}{19} \frac{\ell}{EA} = \frac{P\ell}{19EA}$$

Equa\~{c}o'es de equil\~{b}rio 1,0

Equa\~{c}o'es de compatibilidade de deslocamentos 1,5

$$N_1 = 0,25$$

$$N_2 = 0,25$$

$$N_3 = 0,25$$

$$N_4 = 0,25$$

$$\text{Deslocamento de A} = 0,5$$

$$\text{Deslocamento de B} = 0,5$$

$$\text{Deslocamento de C} = 0,5$$