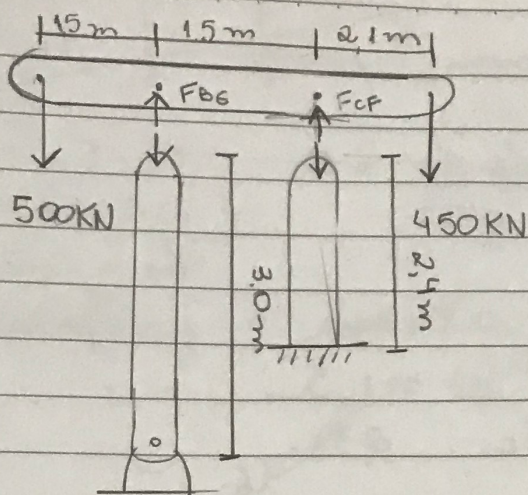




a) $\sum M_B = 0$

$$-500(1,5) - F_{CF}(1,5) + 450(3,6) = 0$$

$$-750 - F_{CF}(1,5) + 1620 = 0$$

$$+ F_{CF}(1,5) = 870$$

$$F_{CF} = 580 \text{ KN}$$

$$\sum F_y = 0$$

$$-500 + 580 + F_{CF} - 450 = 0$$

$$580 - 950 + F_{CF} = 0$$

$$F_{CF} = 370 \text{ KN}$$

Tensão

$$\sigma = \frac{F}{A}$$

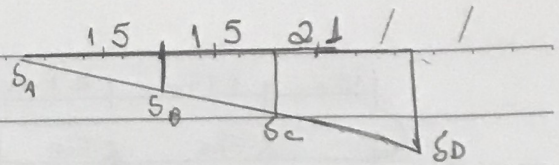
$$\sigma_{BG} = \frac{(-370 \cdot 10^3)}{(11 \cdot 10 \cdot 10^{-6})} = -33,33 \text{ GPa}$$

$$\sigma_{CF} = \frac{(-580 \cdot 10^3)}{(9,28 \cdot 10^{-6})} = -62,5 \text{ GPa}$$

$$b) \delta_{BG} = \frac{(-370 \cdot 10^3) \cdot 3}{(11 \cdot 10 \cdot 10^{-6}) (200 \cdot 10^9)} = -0,5 \text{ m}$$

$$\delta_{CF} = \frac{(-580 \cdot 10^3) \cdot 2,4}{(9,28 \cdot 10^{-6}) (200 \cdot 10^9)} = -0,75 \text{ m}$$

$$b'_c - b'_B = 0,75 - 0,5 = 0,25 \text{ m}$$



$$\frac{b_D - b_A}{b_c - b_B} = \frac{1,5}{1,5}$$

$$\frac{b_B - b_A}{0,25} = 1$$

$$b_B - b_A = 0,25$$

$$0,5 - b_A = 0,25$$

$$b_A = 0,25 \text{ m}$$

para baixo

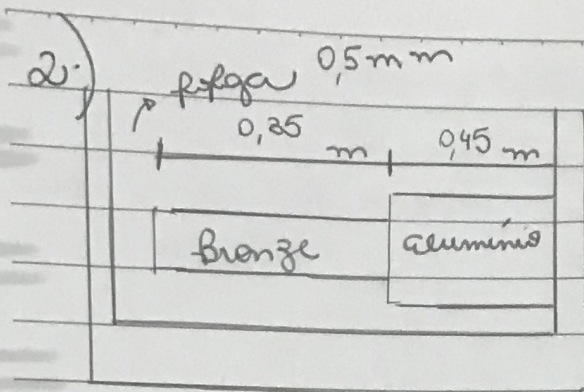
$$\frac{b_c - b_B}{b_D - b_c} = \frac{1,5}{2,1}$$

$$\frac{0,25}{b_D - b_c} = \frac{1,5}{2,1}$$

$$b_D - b_c = 0,35$$

$$b_D - 0,75 = 0,35$$

$$b_D = 1,1 \text{ m}, \text{ para baixo}$$



$$A_{Br} = 1500 \text{ mm}^2; \alpha_{Br} = 20,6 \times 10^{-6} / ^\circ\text{C}$$

$$E_{Br} = 115 \text{ GPa}$$

$$A_{AL} = 1800 \text{ mm}^2; \alpha_{AL} = 28,2 \times 10^{-6} / ^\circ\text{C}$$

$$E_{AL} = 78 \text{ GPa}$$

a.) $\delta_{\text{polga}} = 1,3$

$$\delta_T = \alpha (\Delta T) L$$

$$\delta_T = (\alpha_{Br} (\Delta T) L_{Br}) + (\alpha_{AL} (\Delta T) L_{AL})$$

$$\delta_T = \Delta T ((\alpha_{Br} L_{Br}) + (\alpha_{AL} L_{AL}))$$

$$\delta_T \Delta T$$

$$-0,8 \cdot 10^{-3} = \Delta T ((20,6 \times 10^{-6}) (0,35) + (28,2 \times 10^{-6}) (0,45))$$

$$\Delta T = \frac{-0,8 \cdot 10^{-3}}{1,99 \times 10^{-5}}$$

$$\Delta T = -40,20^\circ\text{C}$$

$$\Delta T = T_F - T_i \rightarrow -40,2 = T_F - 15$$

$$-40,2 + 15 = T_F \rightarrow T_F = -25,2^\circ\text{C}$$

b.)

$$0,5 \cdot 10^{-3} = \Delta T ((20,6 \times 10^{-6}) (0,35) + (28,2 \times 10^{-6}) (0,45))$$

$$\Delta T = \frac{0,5 \cdot 10^{-3}}{1,99 \times 10^{-5}}$$

$$\Delta T = 25,13^\circ\text{C}$$

$$\Delta T = T_F - T_i$$

$$25,13 = T_F - 15$$

$$T_F = 40,13^\circ\text{C}$$

c.)

$$\sigma_{Br} = 50 \text{ MPa}$$

$$\sigma_{Br} = \frac{F_{Br}}{A_{Br}} = \frac{50 \cdot 10^6}{1500 \cdot 10^{-6}} = F_{Br} = 75.000 \text{ N} \text{ ou } 75 \text{ kN}$$

$$\delta_P = \left(\frac{P L_{Br}}{A_{Br} E_{Br}} \right) + \left(\frac{P L_{Al}}{A_{Al} E_{Al}} \right)$$

$$\delta_P = \frac{((75 \cdot 10^3) \cdot (0,35))}{((1500 \cdot 10^{-6}) (115 \cdot 10^9))} + \frac{((75 \cdot 10^3) \cdot (0,45))}{((1800 \cdot 10^{-6}) (78 \cdot 10^9))}$$

$$\delta_P = 3,92 \cdot 10^{-4} \text{ m} \text{ ou } 0,392 \text{ mm}$$

$$l_T = 0,5 + 0,392$$

$$l_T = 0,892 \text{ mm}$$

$$\delta_T = \Delta T ((20,6 \cdot 10^{-6}) (0,35)) + ((28,2 \cdot 10^{-6}) (0,45))$$

$$0,892 \cdot 10^{-3} = \Delta T \cdot 1,99 \cdot 10^{-5}$$

$$\Delta T = 44,82^\circ \text{C}$$

$$\Delta T = T_F - T_i$$

$$44,82 = T_F - 15$$

$$T_F = 59,82^\circ \text{C} //$$