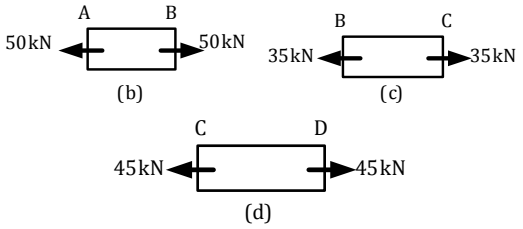
SOLUTION

1. Sol. **(a Z 1.21 *mm*)**

For the above composite steel bar,



Force in $AB \Rightarrow F_{AB} = 50\,kN = P_1$

Force in $BC \Rightarrow F_{BC} = 50 - 15 = 35\,kN = P_2$

Force in $CD \Rightarrow F_{CD} = 50 - 15 + 10 = 45\,kN = P_3$

$\therefore$ From principal of superposition,

$$\Delta = \Delta_1 + \Delta_2 + \Delta_3 = \frac{1}{AE}\left(P_1 l_1 + P_2 l_2 + P_3 l_3\right)$$

Putting the values we get, $\Delta = 1.21\,mm$ **Ans.**

2. Sol.

Let F_s and F_a be the two reactions acting in the same directions as shown.

From statics,

$F_s + F_a = 300\,kN$ ...(i)

Also,

Extension in steel = Compression in aluminium

$$\frac{F_s \times L_s}{A_s \times E_s} = \frac{F_a \times L_a}{A_a \times E_a}$$

Or, $\dfrac{F_s \times 500}{1250 \times 210000} = \dfrac{F_a \times 250}{2500 \times 70000}$

Or, $F_s = 0.75 F_a$ ...(ii)

For equation (i) and (ii)

$F_s = 171.4\,kN$

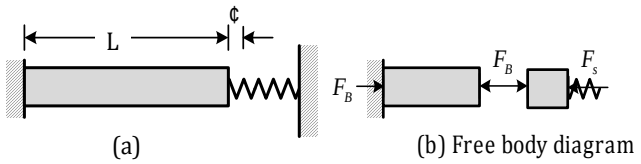
And $F_a = 128.6\,kN$

Stress in steel, $\pm_s = 102.88\,MPa$ (Tension)

Stress in aluminium, $\pm_a = 68.56\,MPa$ (Compression)

3. Sol.

Equlibrium equation: From free body diagram



(a) (b) Free body diagram

Figure 1.1 |

$F_{bar} = F_{spring}$

Or, $\pm \times A = k \times ¢$ ...(i)

Compatibility condition:

Total strain = Temperature strain-strain relieved

$$\frac{\pm}{E} = \frac{\sim L\Delta t}{L} - \frac{¢}{L}$$ ...(ii)

From equation (i) and (ii)

$$\pm = \frac{E \sim \Delta t}{1 + \dfrac{EA}{kL}}$$

4. [R_1 Z $\frac{Pb}{L}$, R_2 Z $\frac{Pa}{L}$, a$_1$ Z $\frac{Pab}{LAE}$]

5. [0.2219 mm]

6. [a Z $\frac{¥ L^2}{6E}$]

7. [Eff. mod. = $\frac{E(1-«)}{(1-2«)(1+«)}$ Poisson's ratio =0]

8. [Ans. 1/2400 (increase)]

9. [Ans. 0.00016]

10.[¢V Z 250 mm^3 , P Z 6000 kN]

11. [¢$_B$ Z $\frac{PH}{2EA\cos^3}$]

12. [P Z 1.26 kN]

13. [R_A = 1.545 P Ê í Ë , F_S = 1.818 P, F_B = 0.727 P]

14. [p_1 Z 0.15 p , p_2 Z 0.2 p , p_3 Z 0.65 p]

15.[(a) 0.00249% (b) 321 mm^3]