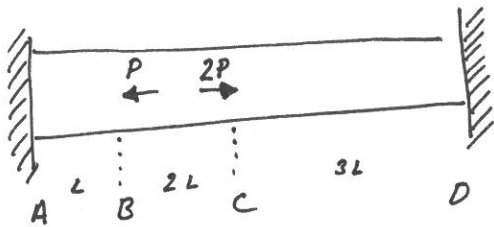


# 2.1.31 Givet Stång

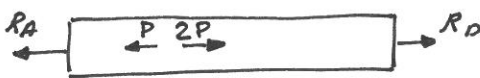


- x Stela väggar
- x Tvärsnittsarea A
- x Lm. el. mtrl (E)

Sökt Normalspänningar  $\sigma_{AB}$   $\sigma_{BC}$   $\sigma_{CD}$

## Lösning

### 1. Frilägg

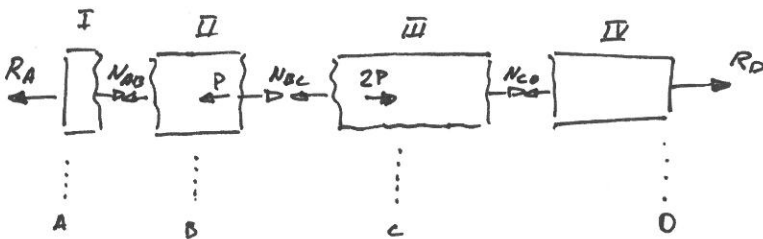


### 2. Jmv

$$\rightarrow \downarrow: -R_A - P + 2P + R_D = 0$$

$$\Leftrightarrow R_A = P + R_D$$

### 3. Snitta



### 4. Jmv

$$\rightarrow \downarrow \text{ I: } -R_A + N_{AB} = 0 \Rightarrow N_{AB} = R_A$$

$$\rightarrow \downarrow \text{ II: } -N_{AB} - P + N_{BC} = 0 \Rightarrow N_{BC} = N_{AB} + P$$

$$\rightarrow \downarrow \text{ III: } -N_{BC} + 2P + N_{CD} = 0 \Rightarrow N_{CD} = N_{BC} - 2P$$

$$\rightarrow \downarrow \text{ IV: } -N_{CD} + R_D = 0 \Rightarrow N_{CD} = R_D$$

5 kända, 4 unika ekvationer  
 $\Rightarrow$  statiskt obestämt!

### 5. Normalspänningar

$$\sigma_{AB} = \frac{N_{AB}}{A}$$

$$\sigma_{BC} = \frac{N_{BC}}{A}$$

$$\sigma_{CD} = \frac{N_{CD}}{A}$$

### 6. Konstitutivt samband

$$\left[ \delta = \frac{FL}{EA} \right]$$

$$\delta_{AB} = \frac{N_{AB} \cdot L}{EA}$$

$$\delta_{BC} = \frac{2N_{BC} \cdot L}{EA}$$

$$\delta_{CD} = \frac{3N_{CD} \cdot L}{EA}$$

### 7. Kompatibilitet

$$\delta_{AB} + \delta_{BC} + \delta_{CD} = 0 \text{ ty stela väggar}$$

$$\Leftrightarrow \frac{N_{AB} \cdot L}{EA} + \frac{2N_{BC} \cdot L}{EA} + \frac{3N_{CD} \cdot L}{EA} = 0$$

$$\Leftrightarrow N_{AB} + 2N_{BC} + 3N_{CD} = 0$$

"5:e unika ekvationen"

$$\Rightarrow (\text{jmv-ekv}) \quad R_D = N_{CD} = N_{BC} - 2P = N_{AB} + P - 2P = R_A - P$$

$$R_A + 2 \cdot (R_A + P) + 3 \cdot (R_A - P) = 0 \Leftrightarrow R_A + 2R_A + 2P + 3R_A - 3P = 0 \Leftrightarrow R_A = \frac{P}{6}$$

$$R_D = -\frac{5P}{6}$$

$$\therefore \sigma_{AB} = \frac{P}{6A} \quad \sigma_{BC} = \frac{7P}{6A} \quad \sigma_{CD} = -\frac{5P}{6A}$$