

Pb 2-21

$$\sum F_y = 0 \quad F_A \sin 20^\circ = F_B \sin \theta \quad (1)$$

$$\sum F_x = 950 \quad F_A \cos 20^\circ + F_B \cos \theta = 950 \quad (2)$$

From (1):  $F_A = \frac{F_B \sin \theta}{\sin 20^\circ}$

replace in (2)  $\frac{F_B \sin \theta \cos 20^\circ}{\sin 20^\circ} + F_B \cos \theta = 950$

$$F_B (\sin \theta \cot 20^\circ + \cos \theta) = 950$$
$$F_B = \frac{950}{\sin \theta \cot 20^\circ + \cos \theta}$$

$$\frac{dF_B}{d\theta} = 0 \quad (\text{condition for min.})$$

$$\Rightarrow \frac{-(\cos \theta \cot 20^\circ - \sin \theta) 950}{(\sin \theta \cot 20^\circ + \cos \theta)^2} = 0$$

$$\Rightarrow \cos \theta \cot 20^\circ = \sin \theta$$
$$\cot 20^\circ = \tan \theta \quad \theta = 70^\circ$$

Solving (1) & (2) for  $F_A$  and  $F_B$ :

$$F_A = 892.708 \text{ N}$$

$$F_B = 324.919 \text{ N}$$

Pb 2-103

$$\vec{DA} (x, -4, z) \quad \vec{DB} (-3, -4, 2) \quad \vec{DC} (0, -4, -3)$$
$$DA = \sqrt{x^2 + 16 + z^2} \quad DB = \sqrt{29} \quad DC = 5$$

$$\sum F_x = 0 \quad 300 \times \frac{x}{\sqrt{x^2 + z^2 + 16}} = \frac{3}{\sqrt{29}} \times 250$$

$$\sum F_z = 0 \quad 300 \times \frac{z}{\sqrt{x^2 + z^2 + 16}} + \frac{2}{\sqrt{29}} \times 250 - \frac{3}{\sqrt{29}} \times 350 = 0$$

2 eq. with 2 unknowns  $x$  &  $z$

$$300x^2 = 19396.55(x^2 + z^2 + 16)$$

$$300z^2 = 10431.03(x^2 + z^2 + 16)$$

$$x^2 = 5.1576$$

$$z^2 = 2.77$$

$$x = 2.27 \text{ m}$$

$$z = 1.66 \text{ m}$$

Pb 2-133

$$\vec{F} (-100 \cos 10, 0, 100 \sin 10)$$
$$\vec{AB} (-0.5, 0.2, 0.2)$$

$$F = 100$$

$$AB = \sqrt{0.5^2 + 0.2^2 + 0.2^2} = 0.574$$

$$\cos \theta = \frac{\vec{F} \cdot \vec{AB}}{F \cdot AB} = \frac{-100 \cos 10 (-0.5) + 0 \times 0.2 + 100 \sin 10 \times 0.2}{100 \times 0.574}$$

$$\theta = 23.4^\circ$$

4-50

$$M_x = 75 \sin \theta \times 1.5$$

$$M_y = 75 \sin \theta \times 2$$

$$M_z = 75 \cos \theta \times 2$$

$$M_A = \sqrt{112.5^2 \sin^2 \theta + 150^2 \sin^2 \theta + 150^2 \cos^2 \theta}$$
$$= \sqrt{112.5^2 \sin^2 \theta + 150^2}$$

$$\frac{dM_A}{d\theta} = \frac{2 \times 112.5^2 \cos \theta \sin \theta}{2 \sqrt{112.5^2 \sin^2 \theta + 150^2}} = 0$$

$$\cos \theta = 0 \quad \text{or} \quad \sin \theta = 0$$
$$\theta = 0, 180^\circ \text{ min} \quad \theta = 90^\circ \text{ max}$$

4-67

$$M_x = F_x (200 \sin 45 + 150 \cos 45)$$
$$= 60 \times (200 \sin 45 + 150 \cos 45)$$
$$= 14849.2 \text{ N}\cdot\text{mm}$$
$$= 14.85 \text{ N}\cdot\text{m}$$