

{2.9~11절}

2.59 [질점의 평형 문제]

$$\beta = 5^\circ, \quad W = 12 \text{ kN}$$

<방법 1 : 직각 성분>

$$\Sigma F_x = T_{CB} \cos \alpha - T_{CA} \sin \beta = 0 \quad \dots \textcircled{1}$$

$$\Sigma F_y = -T_{CB} \sin \alpha + T_{CA} \cos \beta - W = 0 \quad \dots \textcircled{2}$$

(a) ①×cosβ + ②×sinβ

$$(\cos \alpha \cos \beta - \sin \alpha \sin \beta) T_{CB} - W \sin \beta = 0$$

$$\Rightarrow T_{CB} = W \frac{\sin \beta}{\cos(\alpha + \beta)}$$

$$T_{CB} \text{ is minimum} \Rightarrow \cos(\alpha + \beta) \text{ is maximum} \Rightarrow \cos(\alpha + \beta) = 1$$

$$\Rightarrow \alpha + \beta = 0^\circ \Rightarrow \alpha = -\beta = -5.00^\circ \Rightarrow \alpha = \sphericalangle 5.00^\circ$$

(b) $T_{CB} = W \sin \beta = (12 \text{ kN}) \sin 5^\circ = 1.0458 \text{ kN} \Rightarrow T_{CB} = 1.046 \text{ kN}$

<방법 2 : 힘 삼각형>

(a) T_{CB} is minimum $\Rightarrow \theta = 90^\circ$

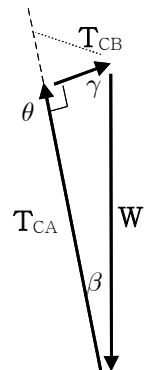
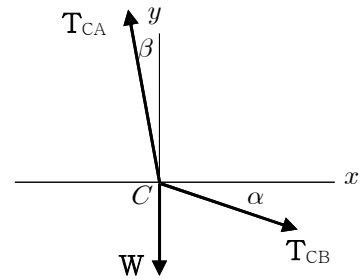
$$\gamma = 90^\circ - \beta = 90^\circ - 5^\circ = 85^\circ$$

$$\alpha' = 90^\circ - \gamma = 90^\circ - 85^\circ = 5.00^\circ \Rightarrow \alpha = \sphericalangle 5.00^\circ$$

(b) $T_{CB} = W \sin \beta = (12 \text{ kN}) \sin 5^\circ = 1.0458 \text{ kN}$

$$\Rightarrow T_{CB} = 1.046 \text{ kN}$$

자유물체도



2.64 [질점의 평형 문제]

$$W = 200 \text{ N}, \quad P = 192 \text{ N}, \quad h = 400 \text{ mm}$$

도르래 B에서 $T_B = W = 200 \text{ N}$

장력 $T_A = T_B = 200 \text{ N}$

자유물체도

<방법 1 : 직각 성분>

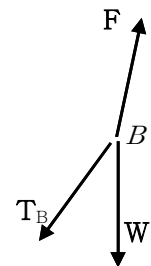
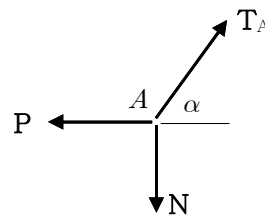
$$\Sigma F_x = T \cos \alpha - P = 0$$

$$\Rightarrow \cos \alpha = \frac{P}{T} = \frac{192 \text{ N}}{200 \text{ N}} = 0.960$$

$$\Rightarrow \cos \alpha = \frac{x}{\sqrt{x^2 + h^2}} \Rightarrow \cos^2 \alpha (x^2 + h^2) = x^2 \Rightarrow x^2 = \frac{\cos^2 \alpha}{1 - \cos^2 \alpha} h^2$$

$$\Rightarrow x = \sqrt{\frac{\cos^2 \alpha}{1 - \cos^2 \alpha}} h = \sqrt{\frac{0.960^2}{1 - 0.960^2}} (400 \text{ mm}) = 1,371.4 \text{ mm}$$

$$\Rightarrow x = 1,371 \text{ mm}$$



<방법 2 : 힘 삼각형>

$$P^2 + N^2 = T_A^2$$

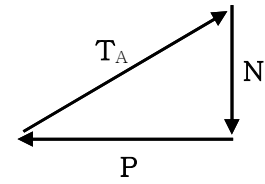
$$\Rightarrow N = \sqrt{T_A^2 - P^2}$$

$$= \sqrt{(200 \text{ N})^2 - (192 \text{ N})^2} = 56 \text{ N}$$

$$\frac{x}{h} = \frac{P}{N}$$

$$\Rightarrow x = \frac{P}{N} h = \frac{192 \text{ N}}{56 \text{ N}} (400 \text{ mm}) = 1,371.4 \text{ mm}$$

$$\Rightarrow x = 1,371 \text{ mm}$$



2.68 [도르래, 질점의 평형 문제]

$$W = 6 \text{ kN}$$

F.B.D.

(b) 도르래에서 $\Sigma F_y = 0 ; 2T - F_1 = 0$

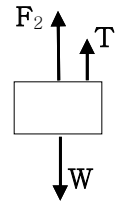
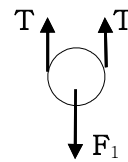
$$\Rightarrow F_1 = 2T$$

줄의 장력 $F_2 = F_1 = 2T$

상자에서 $\Sigma F_y = 0 ; T + F_2 - W = 0$

$$\Rightarrow T + 2T = W$$

$$\Rightarrow T = \frac{1}{3} W = \frac{1}{3} (6 \text{ kN}) = 2 \text{ kN} \quad \Rightarrow \quad T = 2.00 \text{ kN}$$



(d) 도르래에서 $\Sigma F_y = 0 ; 3T - F_1 = 0$

$$\Rightarrow F_1 = 3T$$

줄의 장력 $F_2 = F_1 = 3T$

상자에서 $\Sigma F_y = 0 ; T + F_2 - W = 0$

$$\Rightarrow T + 3T = W$$

$$\Rightarrow T = \frac{1}{4} W = \frac{1}{4} (6 \text{ kN}) = 1.5 \text{ kN} \quad \Rightarrow \quad T = 1.500 \text{ kN}$$

