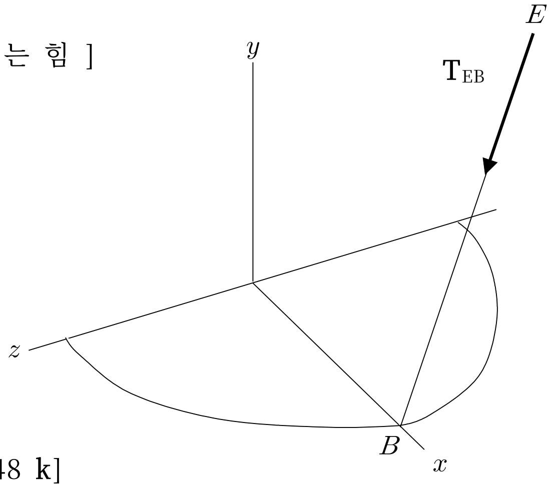
{2.12~14절}

2.88 [힘의 작용선 상의 두 점과 힘 크기에 의해 정의되는 힘]



R = 36 cm, 힘의 크기 T_{EB} = 60 N

d_x = R = 36 cm, d_y = -45 cm, d_z = 48 cm

$d = \sqrt{d_x^2 + d_y^2 + d_z^2}$

$= \sqrt{(36\text{ cm})^2 + (-45\text{ cm})^2 + (48\text{ cm})^2} = 75$ cm

$\lambda = \frac{1}{d}$ (d_x **i** + d_y **j** + d_z **k**)

$= \frac{1}{75}$ [36 **i** + (-45) **j** + 48 **k**]

$\mathbf{T}_{DB}$ = T_{DB} λ = (60 N) $\frac{1}{75}$ [36 **i** + (-45) **j** + 48 **k**]

= (28.8 N) **i** - (36.0 N) **j** + (38.4 N) **k**

$(\mathbf{T}_{DB})_x$ = (28.8 N) **i** , $(\mathbf{T}_{DB})_y$ = (-36.0 N) **j** , $(\mathbf{T}_{DB})_z$ = (38.4 N) **k**

2.94 [공간에서 힘의 직각성분 합성]

P = 6 kN, Q = 7 kN

P_y = -P sin30°, P_h = P cos30°

P_x = P_h sin20°, P_z = P_h cos20°

P = -P sin30° **j** + P cos30° (sin20° **i** + cos20° **k**)

= -(6 kN) (0.5) **j** + (6 kN) (0.866) (0.342 **i** + 0.940 **k**)

= -3.0 **j** + 1.777 **i** + 4.884 **k** (kN)

Q_y = Q sin45°, Q_h = Q cos45°

Q_x = -Q_h sin15°, Q_z = -Q_h cos15°

Q = Q sin45° **j** + Q cos45° (-sin15° **i** - cos15° **k**)

= (7 kN) (0.707) **j** + (7 kN) (0.707) (-0.259 **i** - 0.966 **k**)

= 4.949 **j** - 1.282 **i** - 4.781 **k** (kN)

R = **P** + **Q**

= (1.777 **i** - 3.0 **j** + 4.884 **k**) + (- 1.282 **i** + 4.949 **j** - 4.781 **k**) (kN)

= 0.495 **i** + 1.949 **j** + 0.103 **k** (kN)

magnitude

$R = \sqrt{R_x^2 + R_y^2 + R_z^2} = \sqrt{(0.495)^2 + (1.949)^2 + (0.103)^2}$ (kN) = 2.013 (kN)

⇒ R = 2.01 kN

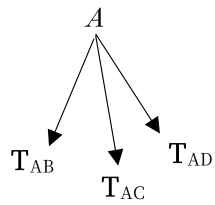
direction

$\cos\theta_x = \frac{R_x}{R} = \frac{0.495}{2.013} = 0.2459$ ⇒ $\theta_x = \cos^{-1}(0.2459) = 75.7°$

$\cos\theta_y = \frac{R_y}{R} = \frac{1.949}{2.013} = 0.9682$ ⇒ $\theta_y = \cos^{-1}(0.9682) = 14.5°$

$\cos\theta_z = \frac{R_z}{R} = \frac{0.103}{2.013} = 0.0512$ ⇒ $\theta_x = \cos^{-1}(0.0512) = 87.1°$

2.100 [공간에서 힘의 직각성분 합성]



T_{AC} = 1770 N, R = R_y j, R_x = 0, R_z = 0

$(d_{AB})_x$ = -4 m, $(d_{AB})_y$ = -20 m, $(d_{AB})_z$ = 5 m

$d_{AB} = \sqrt{(d_{AB})_x^2 + (d_{AB})_y^2 + (d_{AB})_z^2} = \sqrt{(-4\,\mathrm{m})^2 + (-20\,\mathrm{m})^2 + (5\,\mathrm{m})^2}$ = 21 m

$\lambda_{AB} = \frac{1}{d_{AB}}$ $[(d_{AB})_x$ **i** + $(d_{AB})_y$ **j** + $(d_{AB})_z$ **k**] = $\frac{1}{21}$ [(-4) **i** +(-20) **j** + 5 **k**]

$\mathbf{T}_{AB}$ = T_{AB} λ_{AB} = T_{AB} $\frac{1}{21}$ [(-4) **i** +(-20) **j** + 5 **k**]

$(d_{AC})_x$ = 12 m, $(d_{AC})_y$ = -20 m, $(d_{AC})_z$ = 3.6 m

$d_{AC} = \sqrt{(d_{AC})_x^2 + (d_{AC})_y^2 + (d_{AC})_z^2} = \sqrt{(12\,\mathrm{m})^2 + (-20\,\mathrm{m})^2 + (3.6\,\mathrm{m})^2}$ = 23.6 m

$\lambda_{AC} = \frac{1}{d_{AC}}$ $[(d_{AC})_x$ **i** + $(d_{AC})_y$ **j** + $(d_{AC})_z$ **k**] = $\frac{1}{23.6}$ [12 **i** + (-20) **j** + 3.6 **k**]

$\mathbf{T}_{AC}$ = T_{AC} λ_{AC} = (1770 N) $\frac{1}{23.6}$ [12 **i** + (-20) **j** + 3.6 **k**]

= (900 N) **i** - (1500 N) **j** + (270 N) **k**

$(d_{AD})_x$ = -4 m, $(d_{AD})_y$ = -20 m, $(d_{AD})_z$ = -14.8 m

$d_{AD} = \sqrt{(d_{AD})_x^2 + (d_{AD})_y^2 + (d_{AD})_z^2} = \sqrt{(-4\,\mathrm{m})^2 + (-20\,\mathrm{m})^2 + (-14.8\,\mathrm{m})^2}$ = 25.2 m

$\lambda_{AD} = \frac{1}{d_{AD}}$ $[(d_{AD})_x$ **i** +$(d_{AD})_y$ **j** +$(d_{AD})_z$ **k**] = $\frac{1}{25.2}$ [(-4) **i** +(-20) **j** + (-14.8) **k**]

$\mathbf{T}_{AD}$ = T_{AD} λ_{AD} = T_{AD} $\frac{1}{25.2}$ [(-4) **i** +(-20) **j** + (-14.8) **k**]

R = $\mathbf{T}_{AB}$ + $\mathbf{T}_{AC}$ + $\mathbf{T}_{AD}$

= T_{AB} $\frac{1}{21}$ [(-4) **i** +(-20) **j** + 5 **k**]

+ (900 N) **i** - (1500 N) **j** + (270 N) **k**

+ T_{AD} $\frac{1}{25.2}$ [(-4) **i** +(-20) **j** + (-14.8) **k**]

$R_x = \Sigma F_x = -\frac{4}{21} T_{AB} + (900\text{ N}) - \frac{4}{25.2} T_{AD} = 0$ ⋯ ①

$R_z = \Sigma F_z = \frac{5}{21} T_{AB} + (270\text{ N}) - \frac{14.8}{25.2} T_{AD} = 0$ ⋯ ②

①×14.8 - ②×4

$[-\frac{4}{21}(14.8) - \frac{5}{21}(4)]\ T_{AB} + (900\text{ N})(14.8) - (270\text{ N})(4) = 0$

⇒ $T_{AB} = \frac{12240\text{ N}}{3.771}$ = 3245 N = 3.245 kN ⇒ T_{AB} = 3.25 kN

①×5 + ②×4

$(900\text{ N})(5) + (270\text{ N})(4) + [-\frac{4}{25.2}(5) - \frac{14.8}{25.2}(4)]\ T_{AD} = 0$

⇒ $T_{AD} = \frac{5580\text{ N}}{3.143}$ = 1775.4 N = 1.775 kN ⇒ T_{AD} = 1.775 kN