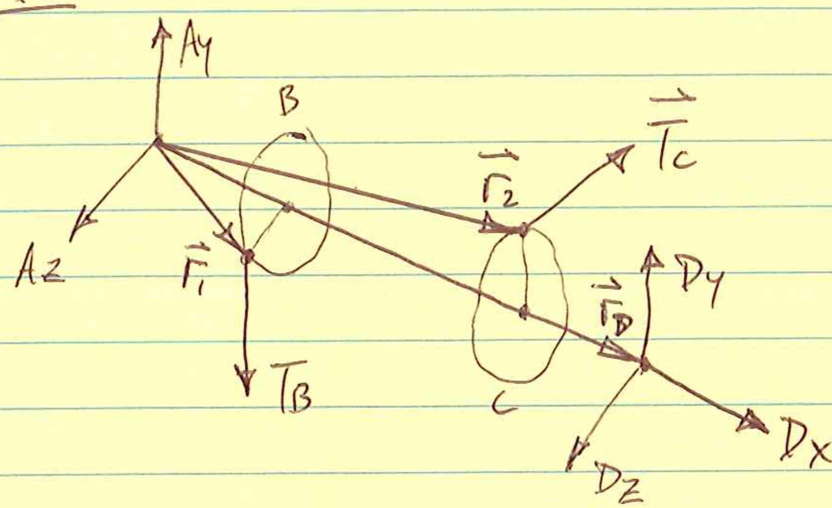
PROB. 4.91

$R_B = 30^{mm}$, $R_C = 40^{mm}$, $T_B = 80^N$, FIND

$\vec{A}$ AND $\vec{D}$. ASSUME $A_x = 0$.

FBD



EQUILIBRIUM EQNS.: $\sum \vec{F} = 0$, $\sum \vec{M}_A = 0$

LOCATE POINTS: POINT 1: $(90, 0, 30)^{mm}$,

POINT 2: $(210, 40, 0)^{mm}$, POINT D: $(300, 0, 0)^{mm}$

$\vec{r}_1 = (90)\hat{i} + (30)\hat{k}$ mm

$\vec{r}_2 = (210)\hat{i} + (40)\hat{j}$ mm, $\vec{r}_D = (300)\hat{i}$ mm

$\vec{T}_B = (-80)\hat{j}^N$, $\vec{T}_C = (-T_C)\hat{k}^N$

PROB. 4.91 CONT.

$$\vec{A} = (A_y)\hat{j} + (A_z)\hat{k} \ ^{N}$$

$$\vec{D} = (D_x)\hat{i} + (D_y)\hat{j} + (D_z)\hat{k} \ ^{N}$$

$$\Sigma F_x = 0: \quad D_x = 0 \qquad (1)$$

$$\Sigma F_y = 0: \quad -80 + A_y + D_y = 0 \Rightarrow A_y = 80 - D_y \qquad (2)$$

$$\Sigma F_z = 0: \quad -T_c + A_z + D_z = 0 \Rightarrow A_z = -D_z + T_c \qquad (3)$$

$$\Sigma \vec{M}_A = 0: \quad \vec{M}_1 + \vec{M}_2 + \vec{M}_3 = 0$$

$$\vec{r}_1 \times \vec{T}_B + \vec{r}_2 \times \vec{T}_c + \vec{r}_D \times \vec{D} = 0$$

$$\vec{M}_1 = \vec{r}_1 \times \vec{T}_B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 90 & 0 & 30 \\ 0 & -80 & 0 \end{vmatrix}$$

$$\vec{M}_1 = [0 - (30)(-80)]\hat{i} - (0)\hat{j} + [(90)(-80) - 0]\hat{k}$$

$$\vec{M}_1 = (2400)\hat{i} + (-7200)\hat{k} \ ^{N \cdot mm}$$

$$\vec{M}_2 = \vec{r}_2 \times \vec{T}_c = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 210 & 40 & 0 \\ 0 & 0 & -T_c \end{vmatrix}$$

PROB. 4.91 CONT.

$$\vec{M}_2 = [(40)(-T_c) - 0]\hat{i} - [(210)(-T_c) - 0]\hat{j} + (0)\hat{k}$$

$$\vec{M}_2 = (-40T_c)\hat{i} + (210T_c)\hat{j} \quad N\cdot mm$$

$$\vec{M}_3 = \vec{r}_D \times \vec{D} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 300 & 0 & 0 \\ 0 & D_y & D_z \end{vmatrix}$$

$$\vec{M}_3 = (0)\hat{i} - [(300)D_z - 0]\hat{j} + [(300)D_y - 0]\hat{k}$$

$$\vec{M}_3 = (-300D_z)\hat{j} + (300D_y)\hat{k} \quad N\cdot mm$$

$$\Sigma M_x = 0: \quad 2400 - 40T_c = 0 \Rightarrow T_c = 60^N \qquad (4)$$

$$\Sigma M_y = 0: \quad 210T_c - 300D_z = 0$$

$$\underline{D_z} = 0.7T_c = 0.7(60) = \underline{42^N} \qquad (5)$$

$$\Sigma M_z = 0: \quad -7200 + 300D_y = 0 \Rightarrow \underline{D_y = 24^N} \qquad (6)$$

$$(2): \quad \underline{A_y} = 80 - D_y = 80 - 24 = \underline{56^N}$$

$$(3): \quad \underline{A_z} = -D_z + T_c = -(42) + (60) = \underline{18^N}$$

$$\underline{\vec{A} = (56)\hat{i} + (18)\hat{k}^N, \quad \vec{D} = (24)\hat{j} + (42)\hat{k}^N}$$