

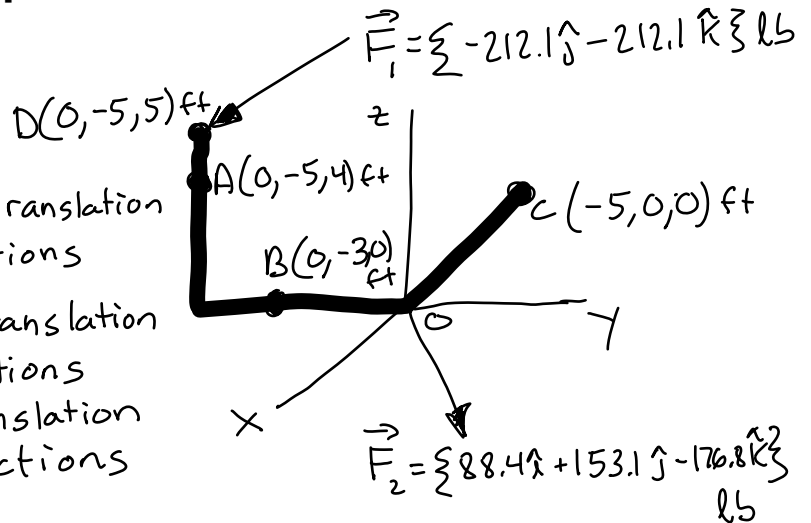
Support Reactions

Problem Statement: Determine the support reactions.

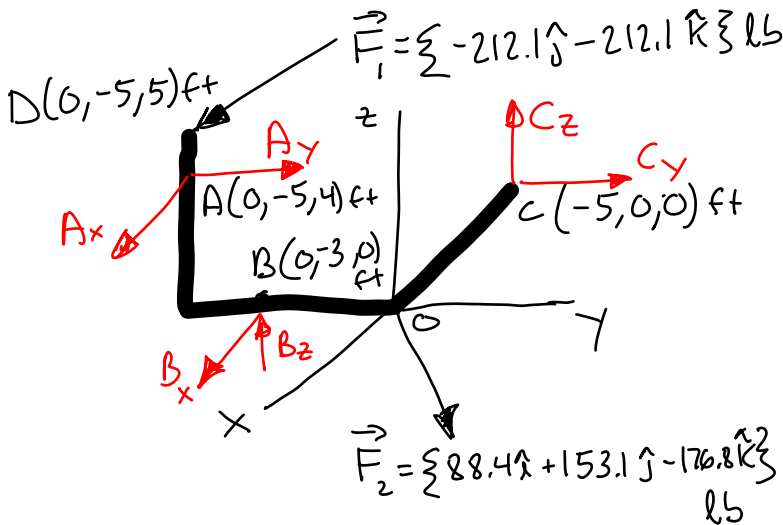
Point A: Restrained against translation in the x and y directions

Point B: Restrained against translation in the x and z directions

Point C: Restrained against translation in the y and z directions



1.) Draw the FBD.



2.) Enforce equilibrium.

$$\sum F_x = 0 \Rightarrow A_x + B_x + 88.4 \text{ lb} = 0$$

$$\sum F_y = 0 \Rightarrow A_y - 212.1 \text{ lb} + 153.1 \text{ lb} + C_y = 0$$

$$\sum F_z = 0 \Rightarrow -212.1 \text{ lb} + B_z - 176.8 \text{ lb} + C_z = 0$$

$$\sum \vec{M}_O = 0 = (\vec{r}_{OD} \times \vec{F}_1) + (\vec{r}_{OA} \times \vec{A}) + (\vec{r}_{OB} \times \vec{B}) + (\vec{r}_{OC} \times \vec{C})$$

$$\vec{r}_{OD} \times \vec{F}_1 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -5 & 5 \\ 0 & -212.1 & -212.1 \end{vmatrix} = \{ [(-5)(-212.1) - (5)(-212.1)]\hat{i} - 0\hat{j} + 0\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$= \boxed{\{2121\hat{i}\} \text{ lb}\cdot\text{ft}}$$

$$\vec{r}_{OA} \times \vec{A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -5 & 4 \\ A_x & A_y & 0 \end{vmatrix} = \{ [0 - 4A_y]\hat{i} - [0 - 4A_x]\hat{j} + [0 - (-5A_x)]\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$= \boxed{\{ -4A_y\hat{i} + 4A_x\hat{j} + 5A_x\hat{k} \} \text{ lb}\cdot\text{ft}}$$

$$\vec{r}_{OB} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -3 & 0 \\ B_x & 0 & B_z \end{vmatrix} = \{ [-3B_z - 0]\hat{i} - 0\hat{j} + [0 - (-3B_x)]\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$= \{ -3B_z\hat{i} + 0\hat{j} + 3B_x\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$\vec{r}_{OC} \times \vec{C} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -5 & 0 & 0 \\ 0 & C_y & C_z \end{vmatrix} = \{ 0\hat{i} - [-5C_z - 0]\hat{j} + [(-5C_y) - 0]\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$= \{ 0\hat{i} + 5C_z\hat{j} - 5C_y\hat{k} \} \text{ lb}\cdot\text{ft}$$

$$(\sum M_O)_x = 0 \Rightarrow 2121 \text{ lb}\cdot\text{ft} - 4A_y - 3B_z = 0$$

$$(\sum M_O)_y = 0 \Rightarrow 4A_x + 5C_z = 0$$

$$(\sum M_O)_z = 0 \Rightarrow 5A_x + 3B_x - 5C_y = 0$$

Six Equations, Six Unknowns

$$\begin{aligned} A_x &= 632.7 \text{ lb} \\ A_y &= -141 \text{ lb} \\ B_x &= -721 \text{ lb} \\ B_z &= 895 \text{ lb} \\ C_y &= 200 \text{ lb} \\ C_z &= -506.1 \text{ lb} \end{aligned}$$