ENGINEERING MECHANICS: STATICS

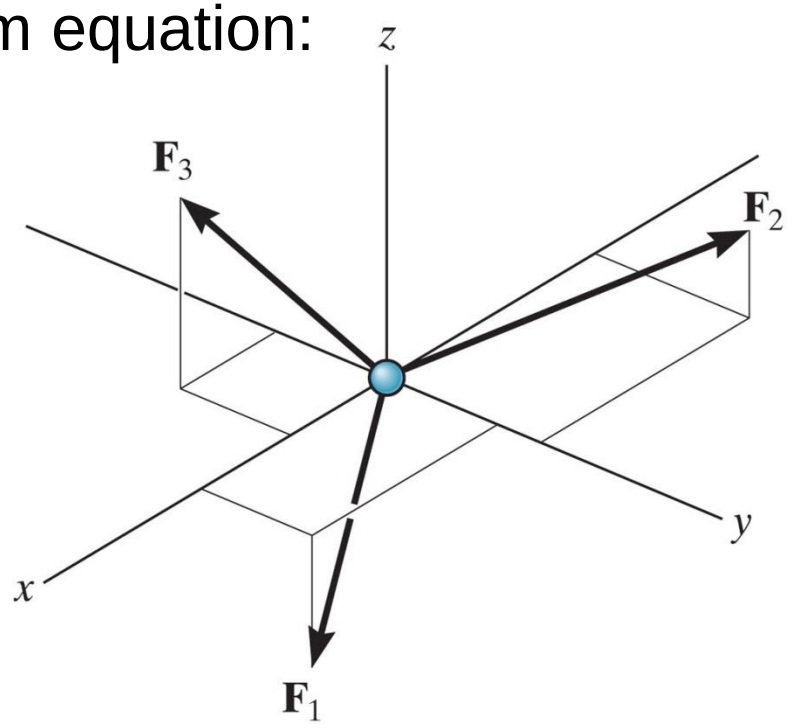
COLLEGE OF
ENGINEERING, ARCHITECTURE AND TECHNOLOGY

西南交通大學
Southwest Jiaotong University

3.4: Three Dimensional Force Systems

General form of the equilibrium equation:

$$\sum F = 0$$

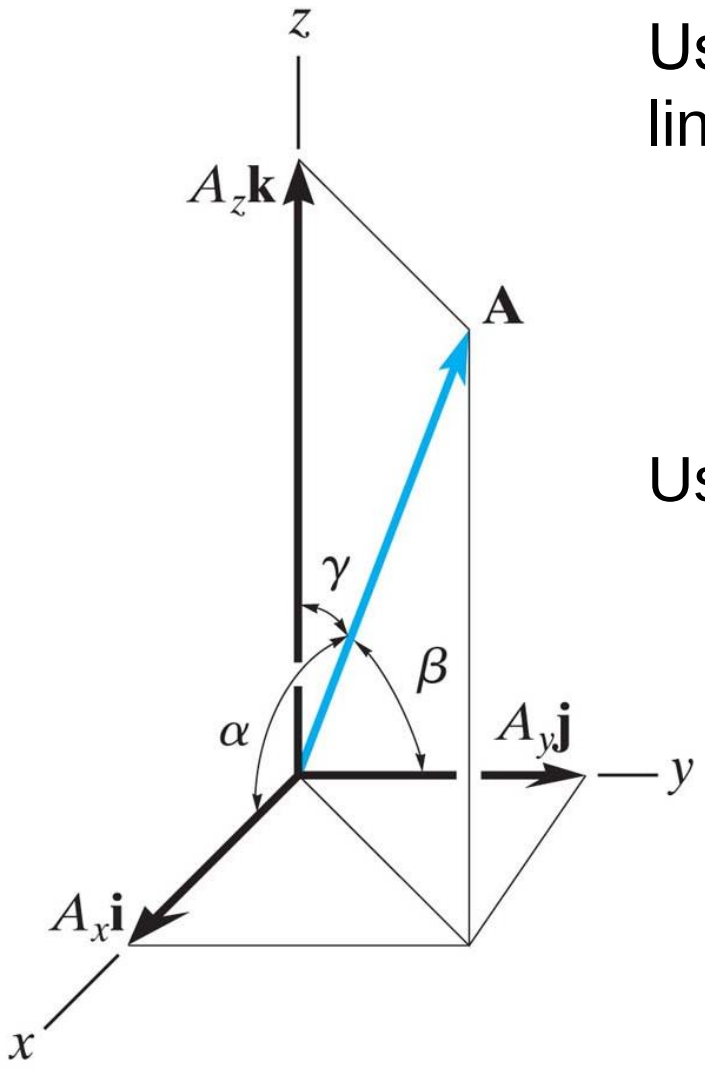


Three equilibrium eqns exist:

$$\sum F_x = 0$$
$$\sum F_y = 0$$
$$\sum F_z = 0$$

Note: When working on 3-D problems, placing the equations in Cartesian Vector form will greatly simplify the process

Recall from Chapter 2,
To write a force in Cartesian form,

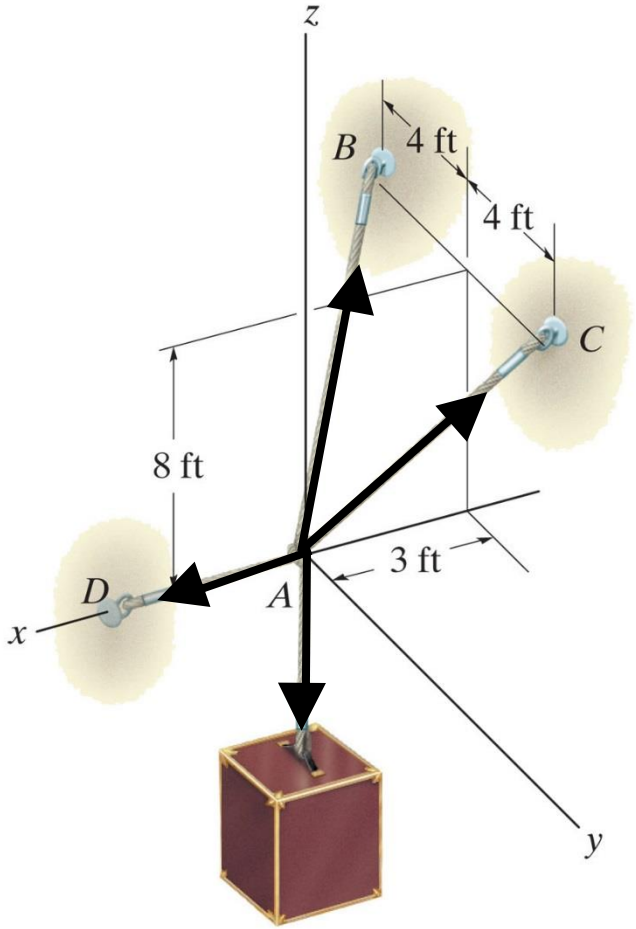


Using the unit vector of the force's line of action:

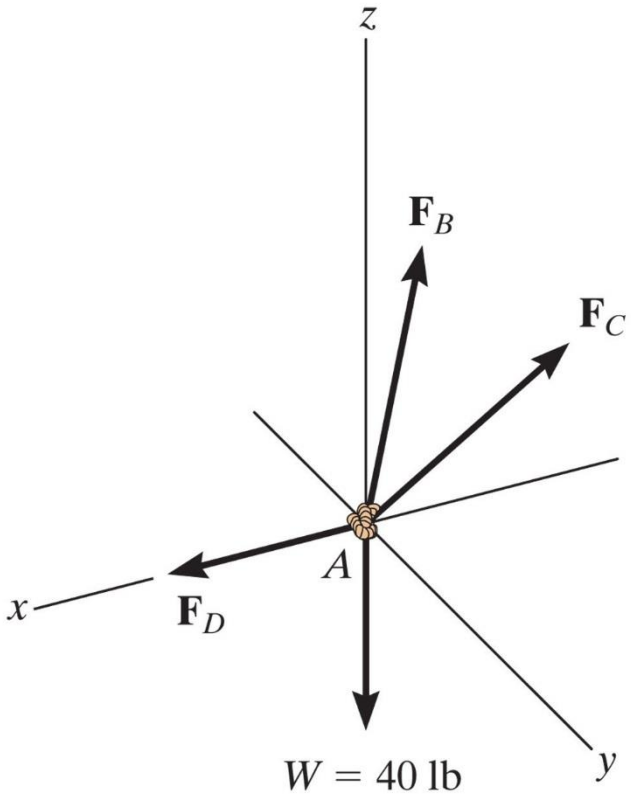
$$\bar{A} = |A|\bar{u}$$

Using the direction cosines:

Consider the 3-D cable system below,

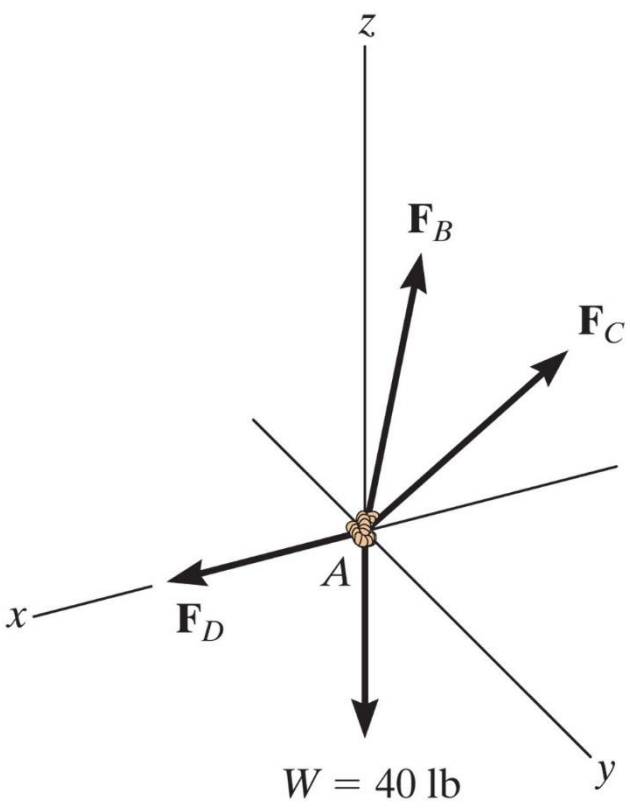


Original System



FBD of System

Cartesian Form,



FBD of System

F_D and W are already in Cartesian Form:

$$\overline{F_D} = F_D\hat{\imath}\ \text{lb}$$

$$\overline{W} = 40\hat{k}\ \text{lb}$$

Unit vectors are utilized to place F_B and F_C in Cartesian Form:

$$\overline{F_B} = |F_B|\frac{\overline{r_B}}{|r_B|} = F_B\hat{\imath} + F_B\hat{\jmath} + F_B\hat{k}\ \text{lb}$$

$$\overline{F_C} = |F_C|\frac{\overline{r_C}}{|r_C|} = F_C\hat{\imath} + F_C\hat{\jmath} + F_C\hat{k}\ \text{lb}$$

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