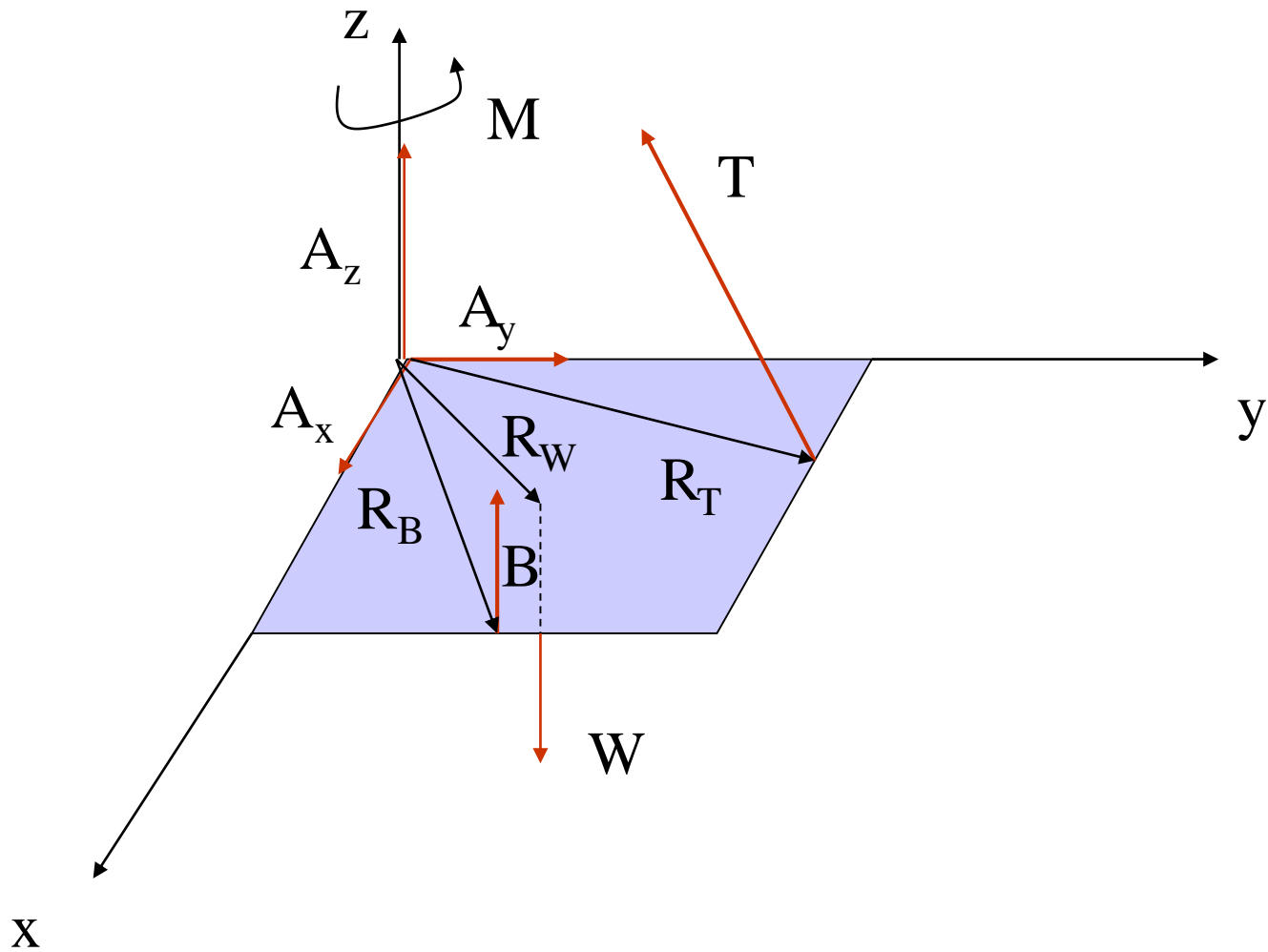


# Equilibrium Problems

- Determine the type of support
- Write forces in  $ijk$  notations
- Write position vectors in  $ijk$
- Do cross product to get Moments in  $ijk$
- Since  $\Sigma \mathbf{F} = 0$  and  $\Sigma \mathbf{M} = 0$  you have 6 equations. Can have at most 6 unknowns
- Convert equations to matrix by writing out unknowns across top line of table. Write coefficients under unknown and constants on RHS.



$$\vec{T} = T \left[ \frac{-3i - 4j + 4k}{\sqrt{3^2 + 4^2 + 4^2}} \right] = -\frac{3T}{\sqrt{41}}i - \frac{4T}{\sqrt{41}}j + \frac{4T}{\sqrt{41}}k$$

$$\vec{A} = A_x i + A_y j + A_z k$$

$$\vec{B} = 0i + 0j + B_z k$$

$$\vec{W} = 0i + 0j - 500k$$

$$\vec{R}_T = 3i + 8j + 0k$$

$$\vec{R}_W = 4i + 4j + 0k$$

$$\vec{R}_B = 8i + 4j + 0k$$

$$\vec{M} = 0i + 0j + Mk$$

$$\vec{M}_T = \vec{R}_T \times \vec{T} = \begin{vmatrix} i & j & k \\ 3 & 8 & 0 \\ \frac{3T}{\sqrt{41}} & -\frac{4T}{\sqrt{41}} & \frac{4T}{\sqrt{41}} \end{vmatrix} = \left( \frac{32T}{\sqrt{41}} \right) i - \left( \frac{12T}{\sqrt{41}} \right) j + \left( \frac{12T}{\sqrt{41}} \right) k$$

$$\vec{M}_B = \vec{R}_B \times \vec{B} = \begin{vmatrix} i & j & k \\ 8 & 4 & 0 \\ 0 & 0 & B_z \end{vmatrix} = 4B_z i - 8B_z j + 0k$$

$$\vec{M}_W = \vec{R}_W \times \vec{W} = \begin{vmatrix} i & j & k \\ 4 & 4 & 0 \\ 0 & 0 & -500 \end{vmatrix} = -2000i + 2000j + 0k$$

# Equations

$$-\frac{3T}{\sqrt{41}} + A_x + 0 + 0 = 0$$

$$0 + \frac{32T}{\sqrt{41}} + 4B_z - 2000 = 0$$

$$-\frac{4T}{\sqrt{41}} + A_y + 0 + 0 = 0$$

$$0 - \frac{12T}{\sqrt{41}} - 8B_z + 2000 = 0$$

$$\frac{4T}{\sqrt{41}} + A_z + B_z - 500 = 0$$

$$M + \frac{12T}{\sqrt{41}} + 0 + 0 = 0$$

Variables:  $M, T, B_z, A_x, A_y, A_z$

# Matrix

M	T	B <sub>z</sub>	A <sub>x</sub>	A <sub>y</sub>	A <sub>z</sub>	
0	$-\frac{3}{\sqrt{41}}$	0	1	0	0	0
0	$-\frac{4}{\sqrt{41}}$	0	0	1	0	0
0	$\frac{4}{\sqrt{41}}$	1	0	0	1	500
0	$\frac{32}{\sqrt{41}}$	4	0	0	0	-2000
0	$-\frac{12}{\sqrt{41}}$	-8	0	0	0	0
1	$\frac{12}{\sqrt{41}}$	0	0	0	0	0