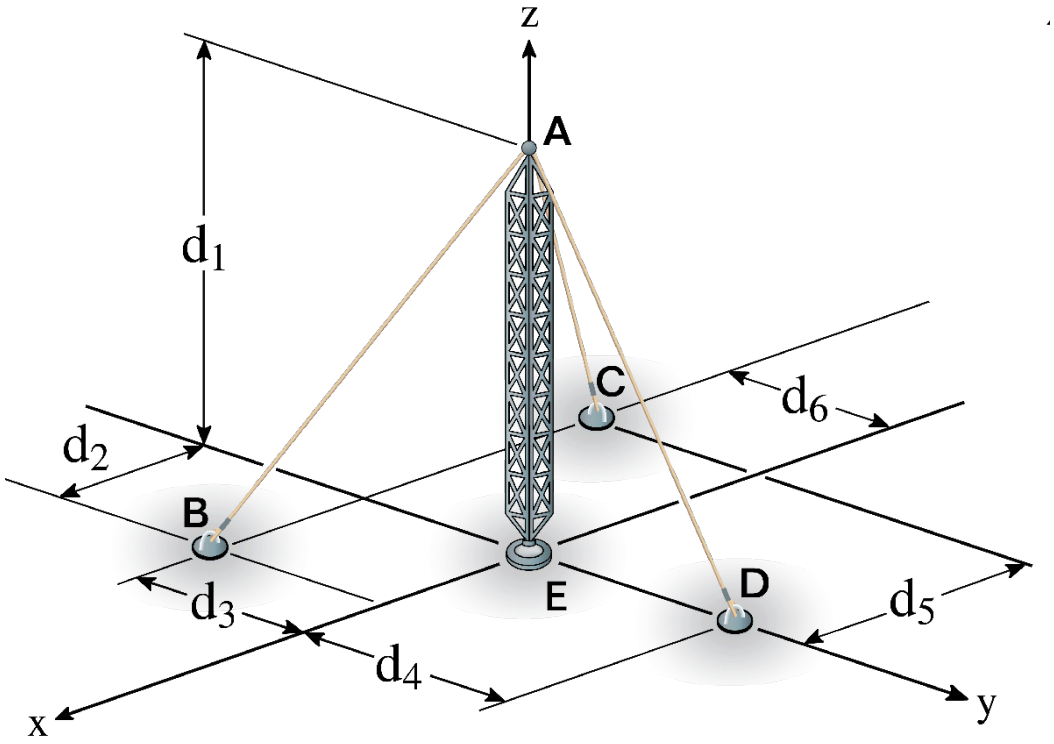

Three ropes are attached to a tower as shown above. In order for the tower to remain upright, the ropes must exert forces such that there is static equilibrium. If the maximum allowable tension in all ropes is F_{max}, find the maximum forces exerted by all ropes.

Which rope will have the largest tension / will reach its maximum tension?

$$||\overrightarrow{AB}|| = \sqrt{{d_1}^2 + {d_2}^2 + {d_3}^2}$$

$$||\overrightarrow{AC}|| = \sqrt{{d_1}^2 + {d_5}^2 + {d_6}^2}$$

$$||\overrightarrow{AB}|| = \sqrt{{d_1}^2 + {d_4}^2}$$

$$\Sigma F_x = 0 \rightarrow \frac{d_2}{||\overrightarrow{AB}||} F_{AB} - \frac{d_5}{||\overrightarrow{AC}||} F_{AC} = 0$$

$$\Sigma F_y = 0 \rightarrow \frac{d_4}{||\overrightarrow{AD}||} F_{AD} - \frac{d_3}{||\overrightarrow{AB}||} F_{AB} - \frac{d_6}{||\overrightarrow{AC}||} F_{AC} = 0$$

$$BC_{ratio} = \frac{F_{AB}}{F_{AC}} = \frac{d_5||\overrightarrow{AB}||}{d_2||\overrightarrow{AC}||}$$

$$CD_{ratio} = \frac{F_{AC}}{F_{AD}} = \frac{d_2 d_4||\overrightarrow{AC}||}{(d_3 d_5 + d_2 d_6)||\overrightarrow{AD}||}$$

$$DB_{ratio} = \frac{F_{AD}}{F_{AB}} = \frac{(d_3 d_5 + d_2 d_6)||\overrightarrow{AD}||}{d_4 d_5||\overrightarrow{AB}||}$$

If $BC_{ratio} > 1$ and $DB_{ratio} < 1$, then rope AB is the tightest rope.

$$F_{AB} = F_{max}$$

$$F_{AC} = \frac{F_{AB}}{BC_{ratio}}$$

$$F_{AD} = F_{AB} DB_{ratio}$$

If $CD_{ratio} > 1$ and $BC_{ratio} < 1$, then rope AC is the tightest rope.

$$F_{AC} = F_{max}$$

$$F_{AD} = \frac{F_{AC}}{CD_{ratio}}$$

$$F_{AB} = F_{AC} BC_{ratio}$$

If $DB_{ratio} > 1$ and $CD_{ratio} < 1$, then rope AD is the tightest rope.

$$F_{AD} = F_{max}$$

$$F_{AB} = \frac{F_{AD}}{DB_{ratio}}$$

$$F_{AC} = F_{AD} CD_{ratio}$$