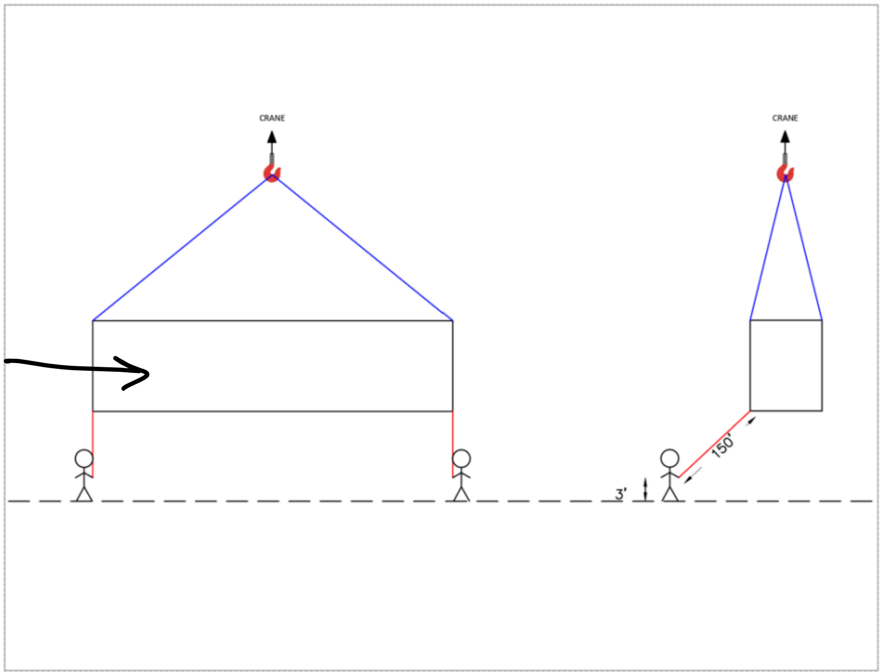
1. A crane is lifting a 40′ shipping container with a mass of 4,000 kg until the bottom of the container is 100′ in the air. The remaining dimensions of the container are 8′ wide and 10′ tall. The load is exposed to wind gusts of 25 mph, broadside, on the largest face of the container. If there are two taglines attached to the load as shown below (not to scale), what maximum possible tension is expected in the taglines during a gust? Assume sea level dry air density and the worst-case loading scenario. Ignore the very thin rigging.

Largest face of container



We can find the tension in each tagline if we find the torque on the tagline.

$$\tau = F \times d$$

d = height of the bottom of container − height of container

$= 100\,ft - 10\,ft = 90\,ft$

Convert to SI units, m

$90\,ft = 27.432\,m$

Next, we need to find F

In this case F will be the wind force

The force for wind is: $F_{wind} = \frac{1}{2}\rho v^2 A$

$\rho = 1.225\ Kg/m^3$ (sea level dry air density)

$v \Rightarrow$ wind velocity $= 25$ mph $= 11.176$ m/s

$A =$ area of face of container which is blown by wind

$= (10\ ft)(40\ ft) = 400\ ft^2$

$= 37.1612\ m^2$

$$F_{wind} = \frac{1}{2}(1.225\ Kg/m^3)(11.176\ m/s)^2(37.1612\ m^2)$$

$$F_{wind} = 2842.95\ N$$

$$\tau = F_{wind} \times d = (2842.95\ N)(27.432\ m)$$

$$\tau = 77987.8044\ Nm$$

$$T = \frac{\tau}{\text{moment arm}} = \frac{77987.8044\ Nm}{6.096\ m} = 12997.97\ N$$

half of container length $= 20$ ft $= 6.096$ m