Bearings

What if an engineer requires more reliability than 90% in the bearings that he or she is specifying? How can the engineer ensure that the reliability is 96% or 98% instead? Keep in mind the vendor is going to publish data for a 90% reliability only.

How do we take our application's critical information and translate it into information that the vendor needs?

$$C_{10} = F_D \left[\frac{x_D}{x_0 + (q - x_0)(1 - R_D)^{1/b}} \right]^{\frac{1}{a}}$$

a = 3 for ball bearings, 10/3 for roller bearings
x_o, b, and θ are determined statistically from a distribution called a **Weibull Distribution** (unlike the normal distribution, which is symmetric about a mean, the Weibull Distribution is skewed about the mean. The parameters, xo, θ, and b determine the degree of skewedness). The Weibull parameters we will use are based on data collected on testing of ball and roller bearings and are related to bearing life.

R_D is the designer's required reliability

xo = 0.02
(θ-xo) = 4.439
b=1.483

$$C_{10} = F_D \left[\frac{x_D}{.02 + 4.439(1 - R_D)^{1/1.483}} \right]^{\frac{1}{a}}$$

xD is the ratio of the Designer's life requirements to the vendor's published bearing life (assuming a 90% reliability by the vendor)

$$x_D = \frac{60 L_D n_D}{60 L_r n_r} = \frac{60 L_D n_D}{E6}$$

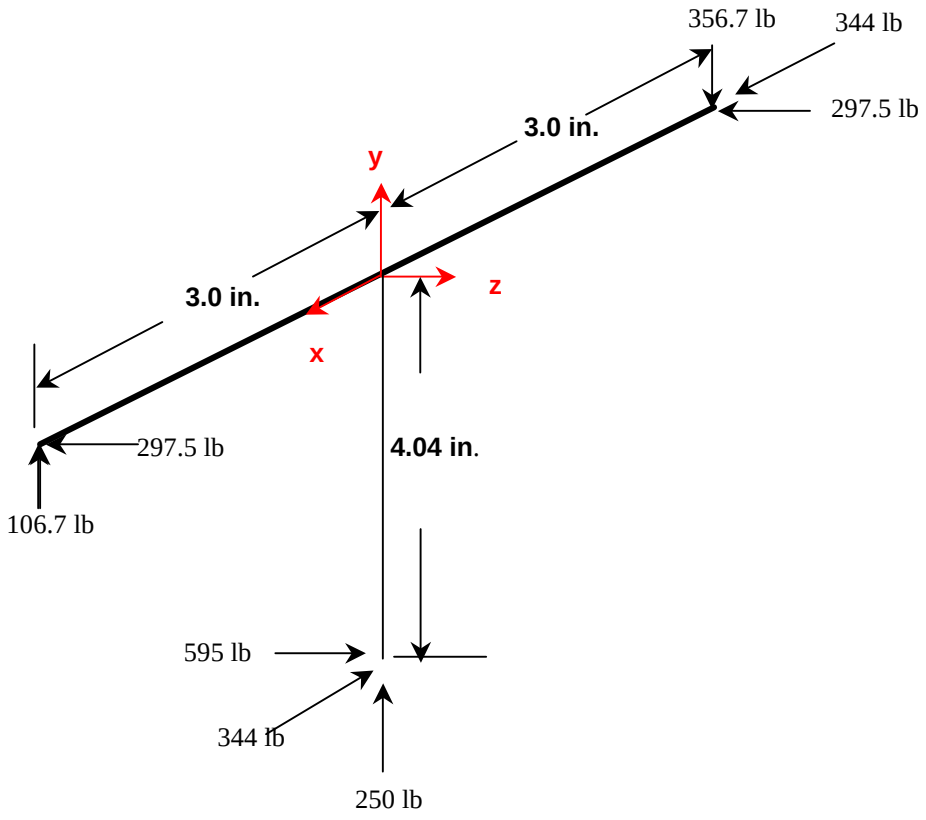
Example:

An engineer has determined that the load on a ball bearing will be 413 lb and an application factor of 1.2 is warranted. (An application factor is somewhat like a factor of safety--it encompasses uncertainties in loading, operating conditions, etc.) The speed of the shaft will be 300 r/min and the service life of the bearing needs to be at least 30 kh with 99% reliability. The engineer does not expect large axial loads, so she has decided to look for a deep grooved ball bearing. What bearing will she choose?

(Use the vendor information I provided in class).

Example--how to handle combinations of radial and thrust loadings

The second shaft on a parallel-shaft i25 hp crane speed reducer is loaded as shown in the following schematic.



An engineer is required to specify bearings for the left and right ends of the 6.0" shaft.

You are to select a roller bearing for the left end of the shaft and an angular contact bearing for the right end (why these particular choices for these ends?)

The life requirement for this application is 10 kh and the reliability for the 4 bearings must be at least 96%.