9.3.2 Gear Forces (Not Force Analysis)

This section will cover the forces induced by gears **but does not include the stress calculations, which is instead covered in the next section**. You may need to calculate these forces for these gears before beginning with some foul stress calculations.

9.3.2.1 Spur Gears **using Mott*

We will obviously start with spur gears. These formulas, especially for the tangential force, will translate into the other gears too, so you will probably use one of these formulas no matter the type of gear.

The Torque and the Tangential force:

$$T = \frac{63000P}{n} = \frac{W_t D}{2} \tag{1}$$

$$W_t = \frac{33000P}{\nu_t} = \frac{126000P}{nD}$$

The Radial and Normal forces now:

$$W_r = W_t \tan(\phi)$$

$$W_n = \frac{W_t}{\cos(\phi)} = \sqrt{W_t^2 + W_r^2}$$

9.3.2.2 Helical Gears **using Mott*

Now for helical gears we use the same Torque formula above in Equation (1).

The pitch line speed, which you will need for the tangential force, is given by:

$$\nu_t = \frac{\pi D n}{12}$$

Now, we find the tangential, radial, and the axial forces:

$$W_t = \frac{33000P}{\nu_t} = \frac{126000P}{nD}$$

$$W_r = W_t \tan(\phi_t)$$

$$W_x = W_t \tan(\psi)$$

9.3.2.3 Bevel Gears **using Mott*

Bevel gears will use the pitch cone angles for the pinion and gear (γ & Γ) and will also use the mean radius r_m

$$\nu_t = \frac{\pi D_G n_G}{12} = \frac{\pi D_P n_P}{12}$$

$$W_t = \frac{33000P}{\nu_t} = \frac{126000P}{nD}$$

$$r_m = \frac{d}{2} - \frac{F}{2}\sin(\gamma)$$

$$R_m = \frac{D}{2} - \frac{F}{2}\sin(\Gamma)$$

Now we can find our transmitted (W_t), radial (W_r), and axial (W_x) loads:

$$W_t = \frac{T_P}{r_m} = \frac{T_G}{R_m}$$

$$W_t = \frac{63,000P}{r_{m,p} n_p}\,(\text{lbf})$$

$$W_r = W_t \tan(\phi)\cos(\Gamma) = W_t \tan(\phi)\cos(\gamma)$$

$$W_x = W_t \tan(\phi)\sin(\Gamma) = W_t \tan(\phi)\sin(\gamma)$$

Note that there are two formulas for transmitted force loads which are different from each other. Just use the second one to be honest.