9.3.1.3 Bevel Gears **using Mott*

For bevel gears, you will likely encounter a set of straight bevel gears in a question. In such a question, you will be given the following:

- Diametral Pitch (P_d)
- Number of Teeth in pinion and gear (N_P and N_G)
- Pressure Angle (ϕ)

In return, you will need to provide the following geometric features:

- Gear Ratio (m_G)
- Pitch Diameter for gear and pinion (D and d)
- Pitch Cone angles for pinion and gear (γ and Γ)
- Outer Cone Distance (A_O))
- Face Width[51] (F)
- Mean Cone Distance (A_m)
- Mean Circular Pitch (p_m)
- Mean Working Depth (h)
- Clearance (c)
- Mean Whole Depth (h_m)
- Mean Addendum Factor (c_1)
- Gear Mean Addendum (a_G)
- Pinion Mean Addendum (a_P)
- Gear Mean Dedendum (b_G)
- Pinion Mean Dedendum (b_P)
- Gear Dedendum Angle (δ_G)
- Pinion Dedendum Angle (δ_P)
- Gear Outer Addendum (a_{OG})
- Pinion Outer Addendum (a_{OP})
- Gear Outside Diameter (D_O)

[51] Usually a range rather than a discrete value

- Pinion Outside Diameter (d_O)

As you can see, there is an absolute shit ton of things to calculate. Luckily, the calculator does all of this immediately, so don't be a dummy and use it. I will provide the different equations below, but will not present these as proper steps. It is easier for both of us that way.
*All units are in inches, and angles are in degrees.

1. **Start off by gathering everything that is given and calculating the gear ratio and pitch diameters.**

$$m_G = \frac{N_G}{N_P}$$

$$D = \frac{N_G}{P_d}$$

$$d = \frac{N_P}{P_d}$$

2. **Next, calculate Pitch Cone angles.**

$$\gamma = tan^{-1}(\frac{N_P}{N_G})$$
$$\Gamma = tan^{-1}(\frac{N_G}{N_P})$$

3. **Find outer cone distance.**

$$A_O = \frac{0.5D}{sin(\Gamma)}$$

4. **Determine the face width. Find F_{nom}, then F_{max} using both equations, and choose something (preferably a whole number within the range.**[52]

$$F_{nom} = 0.3A_O$$
$$F_{max} = A_O/3$$
$$F_{max} = 10/P_d$$

**Check both F_{max} equations!*

Then,

$$F_{nom} \leq F \leq F_{max}$$

[52]For the Matlab code, I use the midpoint between the nominal and the max, but you are better off just taking a whole number if applicable

5. **Find the Mean Cone Distance and Mean Working Depth.**

$$A_m = A_O - 0.5F$$
$$p_m = (\frac{\pi}{P_d})(\frac{A_m}{A_O})$$

6. **Calculate Mean Working Depth, Clearance, and Mean Whole Depth.**

$$h = (\frac{2}{P_d})(\frac{A_m}{A_O})$$
$$c = 0.125h$$
$$h_m = h + c$$

7. **Calculate the Mean Addendum and Dedendum for the Gear and Pinion.**

$$c_1 = 0.21 + \frac{0.29}{(m_g)^2}$$
$$a_G = c_1 h$$
$$a_P = h - a_G$$
$$b_G = h_m - a_G$$
$$b_P = h_m - a_P$$

8. **Find the Dedendum Angles for the Gear and Pinion**

$$\delta_G = tan^{-1}(\frac{b_G}{A_m})$$
$$\delta_P = tan^{-1}(\frac{b_P}{A_m})$$

9. **Find the Outer Dedendums for the Gear and Pinion**

$$a_{OG} = a_G + 0.5F\ tan(\delta_P)$$
$$a_{OP} = a_P + 0.5F\ tan(\delta_G)$$

10. **Find Outside Diameters for Gear and Pinion**

$$D_O = D + 2a_{OG}\ cos(\Gamma)$$
$$d_O = d + 2a_{OP}\ cos(\gamma)$$

That's basically it! Good job!