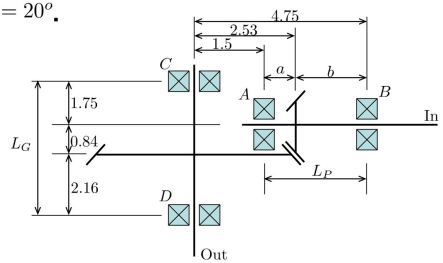
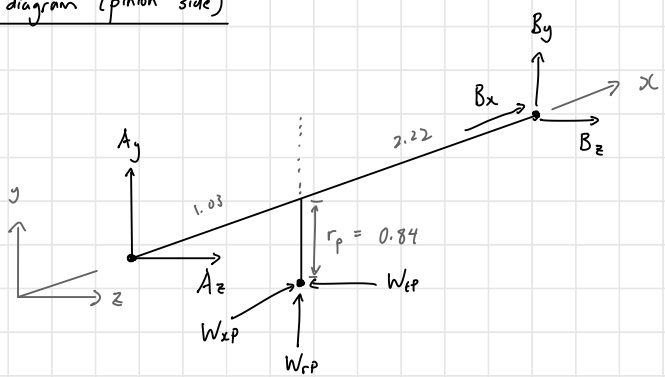
Ex 7)

- **Determine forces on the pinion shaft and bearings (A, B). Assume the axial load is supported only by B. Input shaft speed=600 m^{-1}, and power $P = 2.5$ hp. The pitch radius $r_P = 0.84$ in and the pinion pitch cone angle $\gamma = 18.43^o$. Use $\phi = 20^o$.**



$n_{in} = 600$ rpm

Free-body diagram (pinion side)



$P_{in} = 2.5 \times 550 = 1375$ lb·ft/s

$n_{in} = 600 \times \frac{2\pi}{60} = 62.83$ rad/s

$T_p = \frac{P_{in}}{n_{in}} = \frac{1375}{62.83} = 21.88$ lb.ft

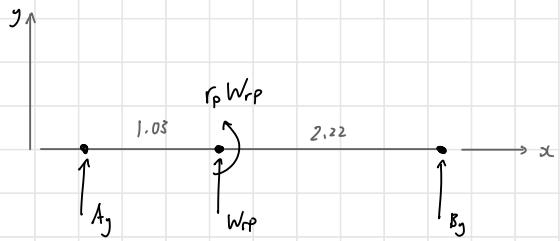
$W_{tP} = \frac{T_p}{r_p} = \frac{21.88}{0.84/12} = 313$ lb

$W_{rP} = W_{tP} \cos\gamma = 313 \times \tan 20^\circ = 108$ lb

$W_{xP} = W_{tP} \tan\gamma \sin\gamma = 36$ lb

Beam loads :

x-y plane



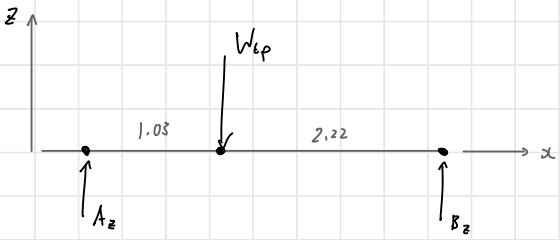
$\Sigma F_y = A_y + W_{rp} + B_y = 0$

$\Sigma M_p = r_p W_{xp} + 2.22 B_y - 1.03 A_y = 0$

$\Rightarrow A_y = -64.5$ lb

$B_y = -43.5$ lb

y-z plane



$\Sigma F_z = A_z + B_z - W_{tp}$

$\Sigma M_p = 2.22 B_z - 1.03 A_z = 0$

$\Rightarrow A_z = 215$ lb

$B_z = 98.9$ lb

$F_{rA} = \sqrt{A_y^2 + A_z^2} = 222.6$ lb

$F_{rB} = 108.04$ lb

Plus torsion on section b with $T_p = r_p W_{tp} = 21.84$ lb·ft (or 262 lb·in)

Plus the axial force at bearing B

$F_{aB} = B_x = W_{xp} = 36$ lb