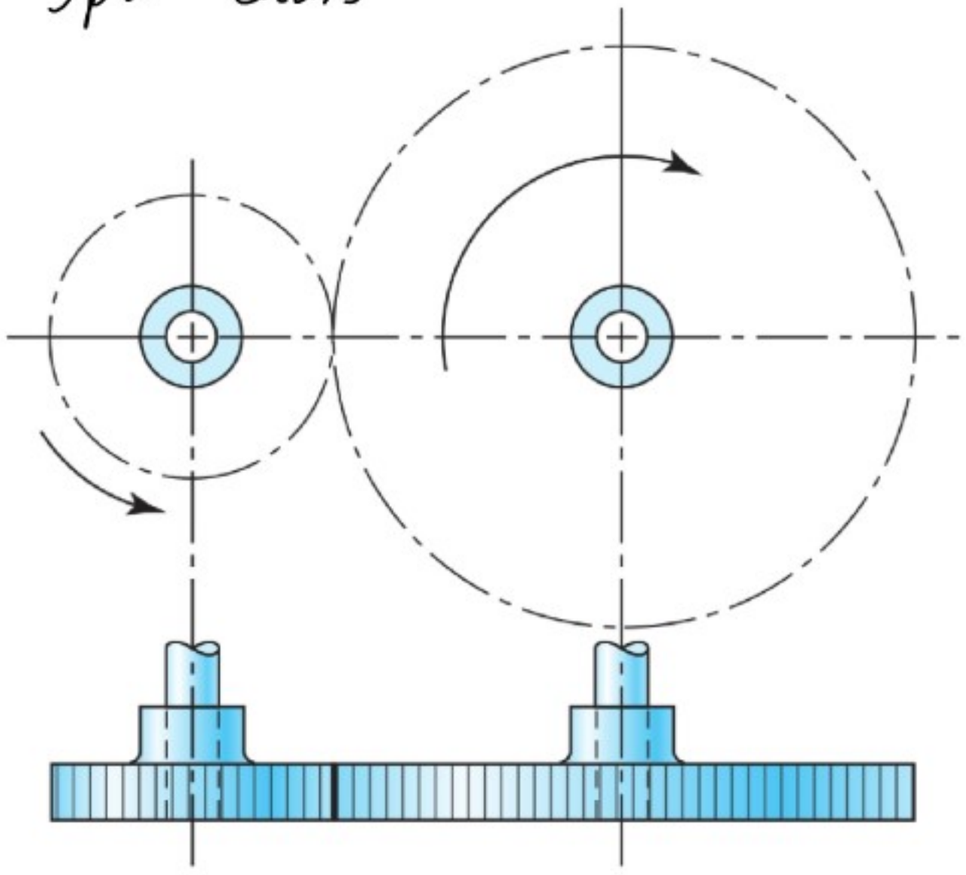
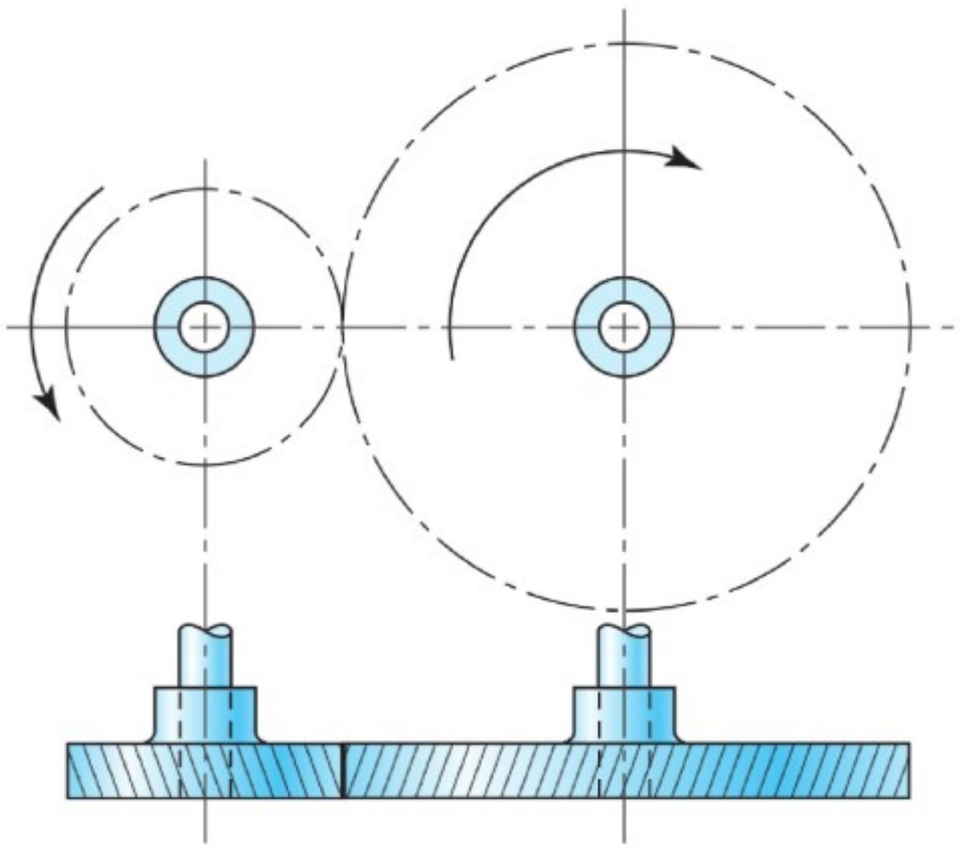
Gears

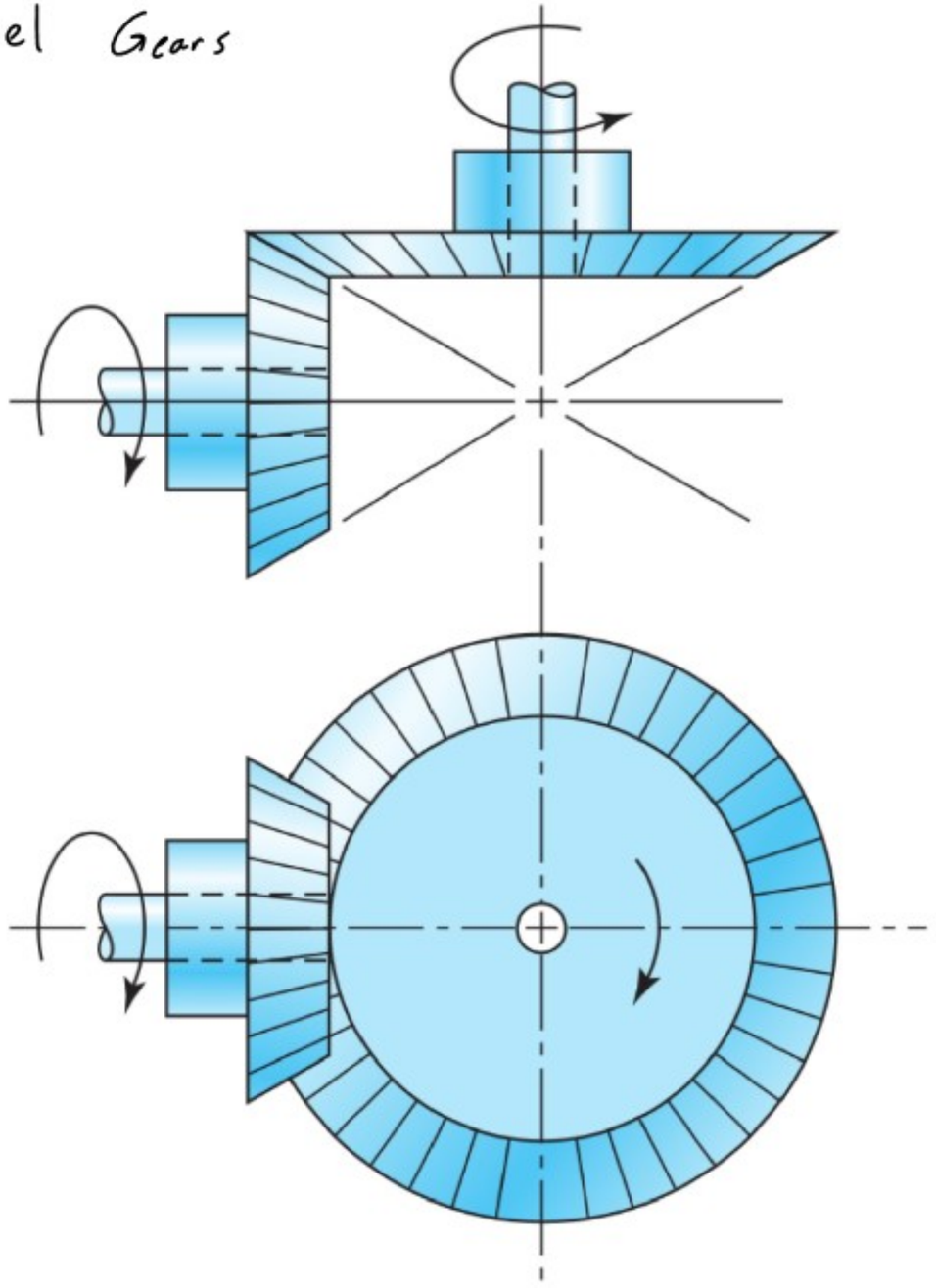
Spur Gears



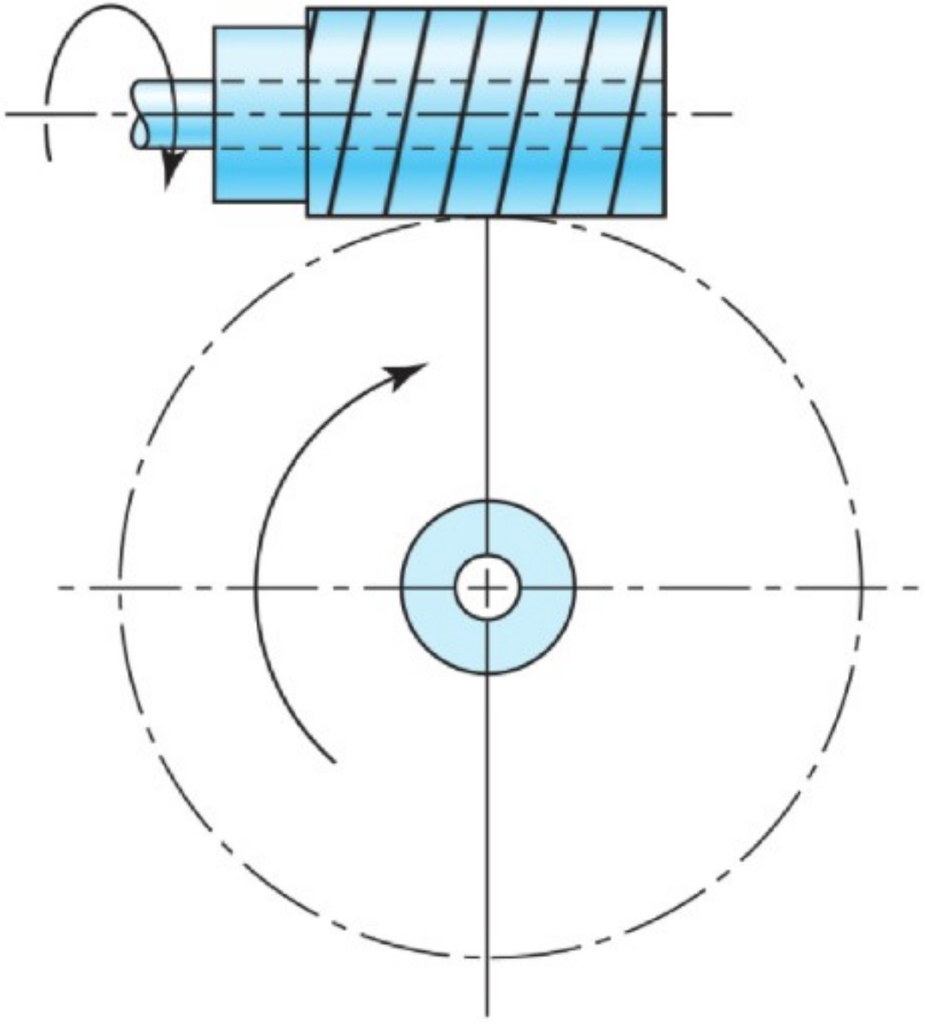
Helical Gears



Bevel Gears

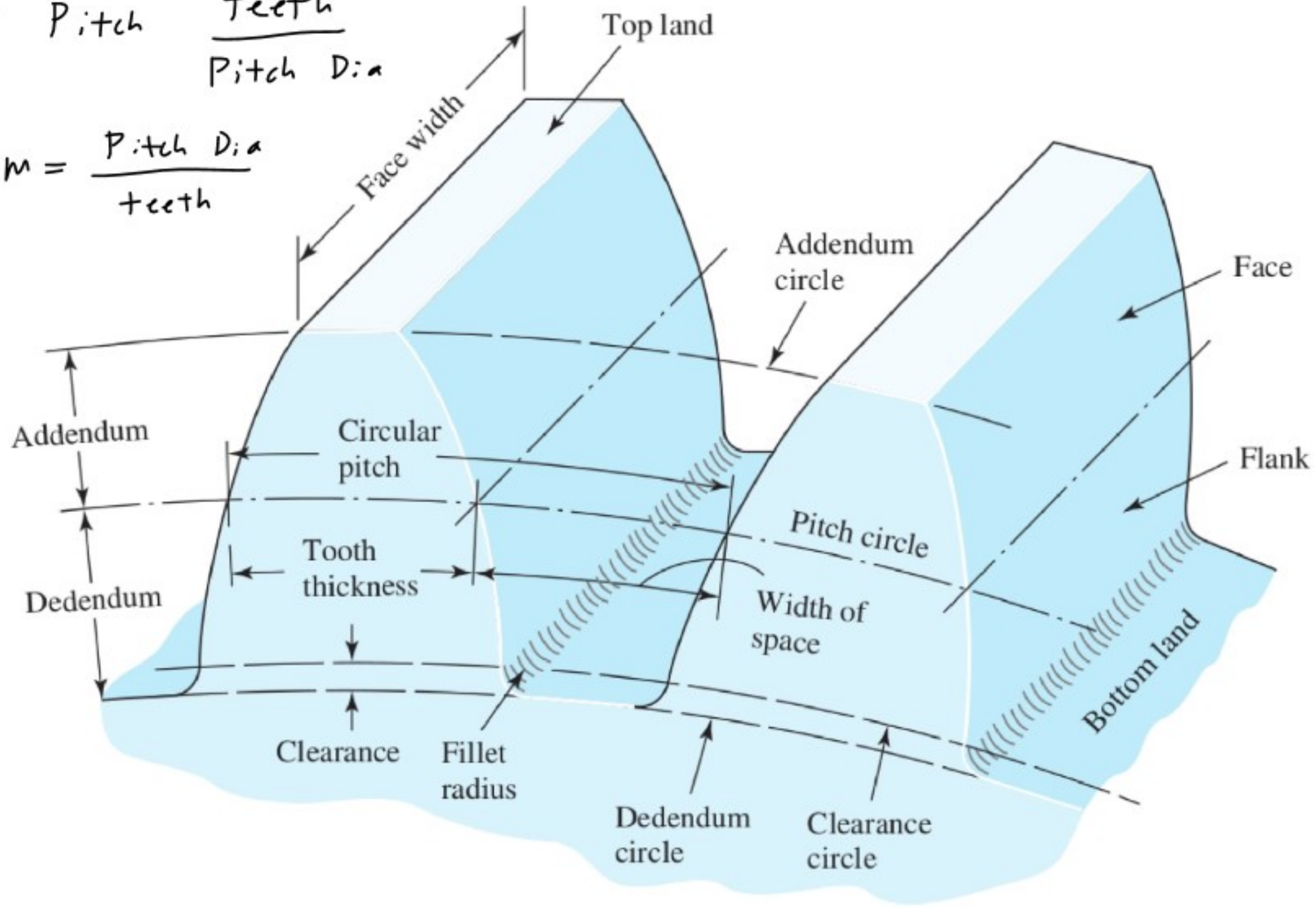


Worm Gear



Diametral Pitch $\frac{\text{teeth}}{\text{Pitch Dia}}$

Module $m = \frac{\text{Pitch Dia}}{\text{teeth}}$



$$P = \frac{N}{d}$$

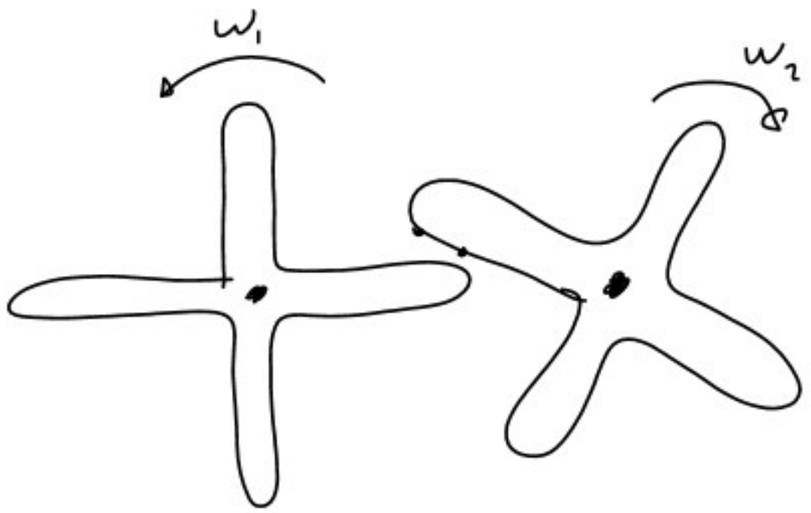
$$m = \frac{d}{N}$$

$$p = \frac{\pi d}{N} = \pi m$$

$$p P = \pi$$

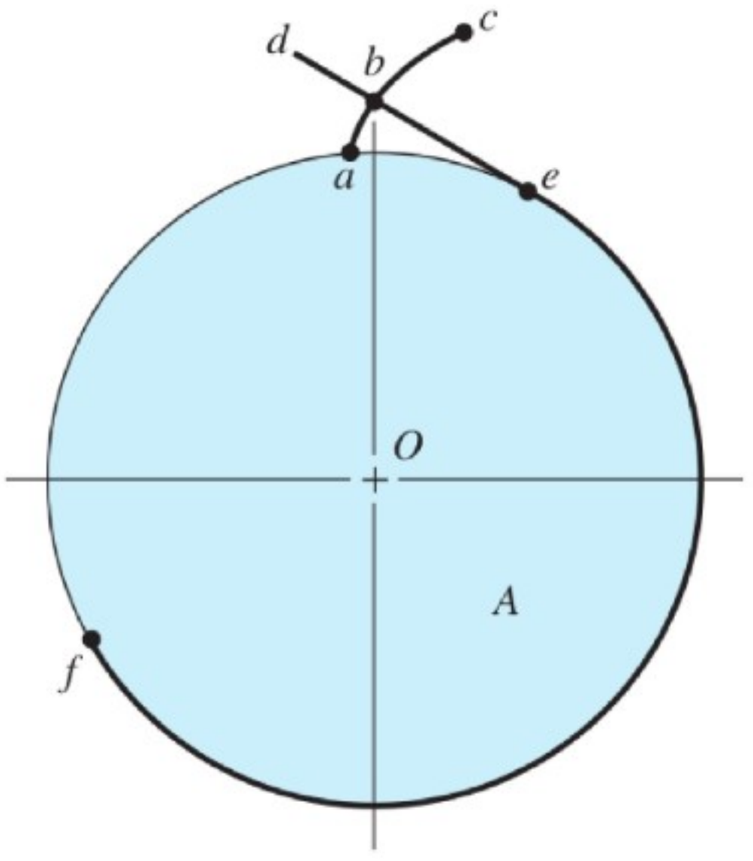
P	diametral pitch
N	number of teeth
d	pitch dia
m	module
p	circular pitch

Conjugate Action

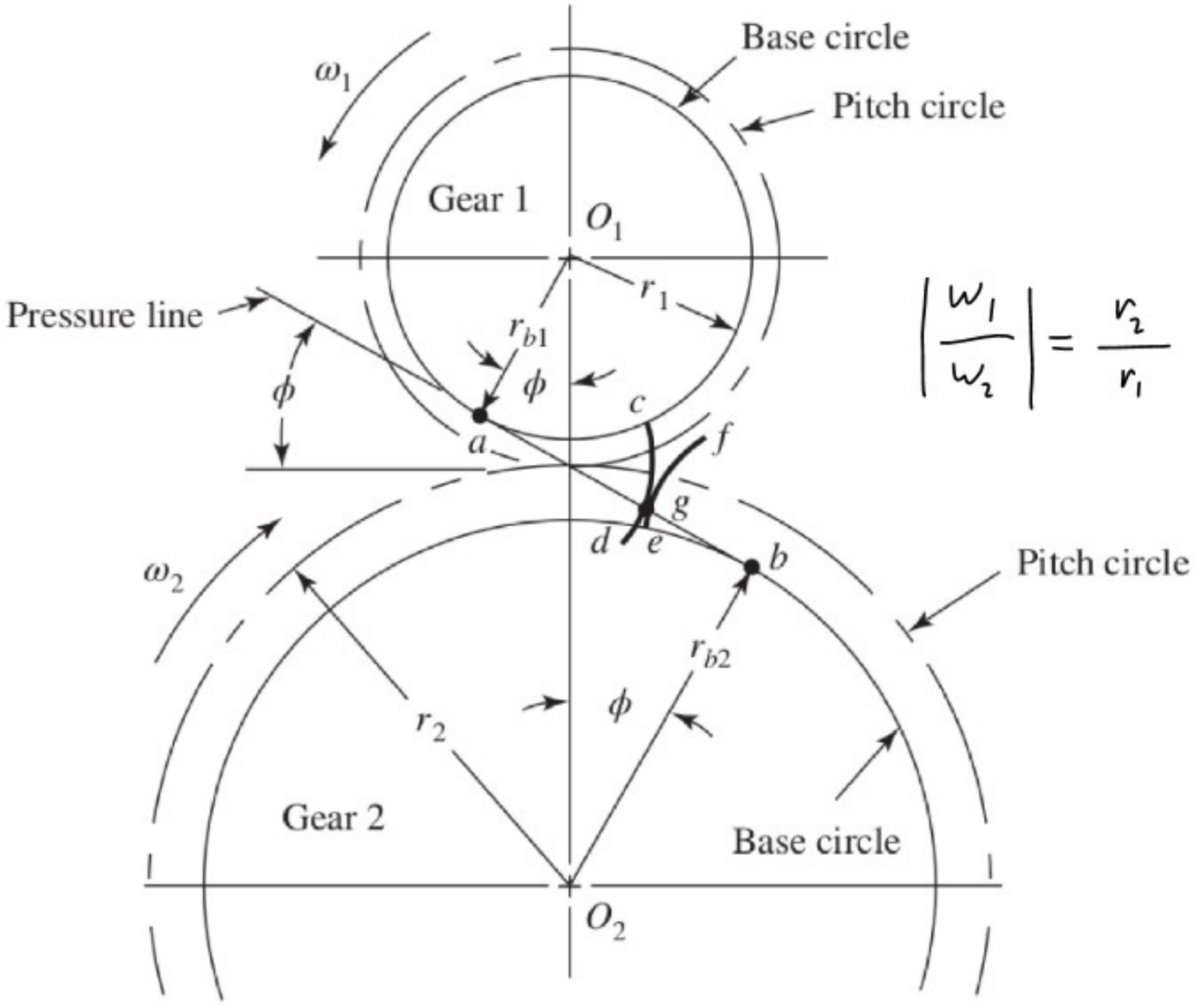


$\frac{\omega_1}{\omega_2}$ non constant

Involute Profile $\frac{\omega_1}{\omega_2}$ constant



$r_{bi} = r_i \cos\phi$



$$\left|\frac{\omega_1}{\omega_2}\right| = \frac{r_2}{r_1}$$

Contact Ratio

Average Number of teeth in contact

$$m_c = \frac{L_{ab}}{p\cos\phi}$$

Minimum Gear Teeth

for 1:1 ratio

$$N_p = \frac{2k}{3\sin^2\phi}\left(1+\sqrt{1+3\sin^2\phi}\right)$$

for ratio $m = N_G/N_p$

$$N_p = \frac{2k}{(1+2m)\sin^2\phi}\left(m+\sqrt{m^2+(1+2m)\sin^2\phi}\right)$$

$K = 1$ full depth teeth

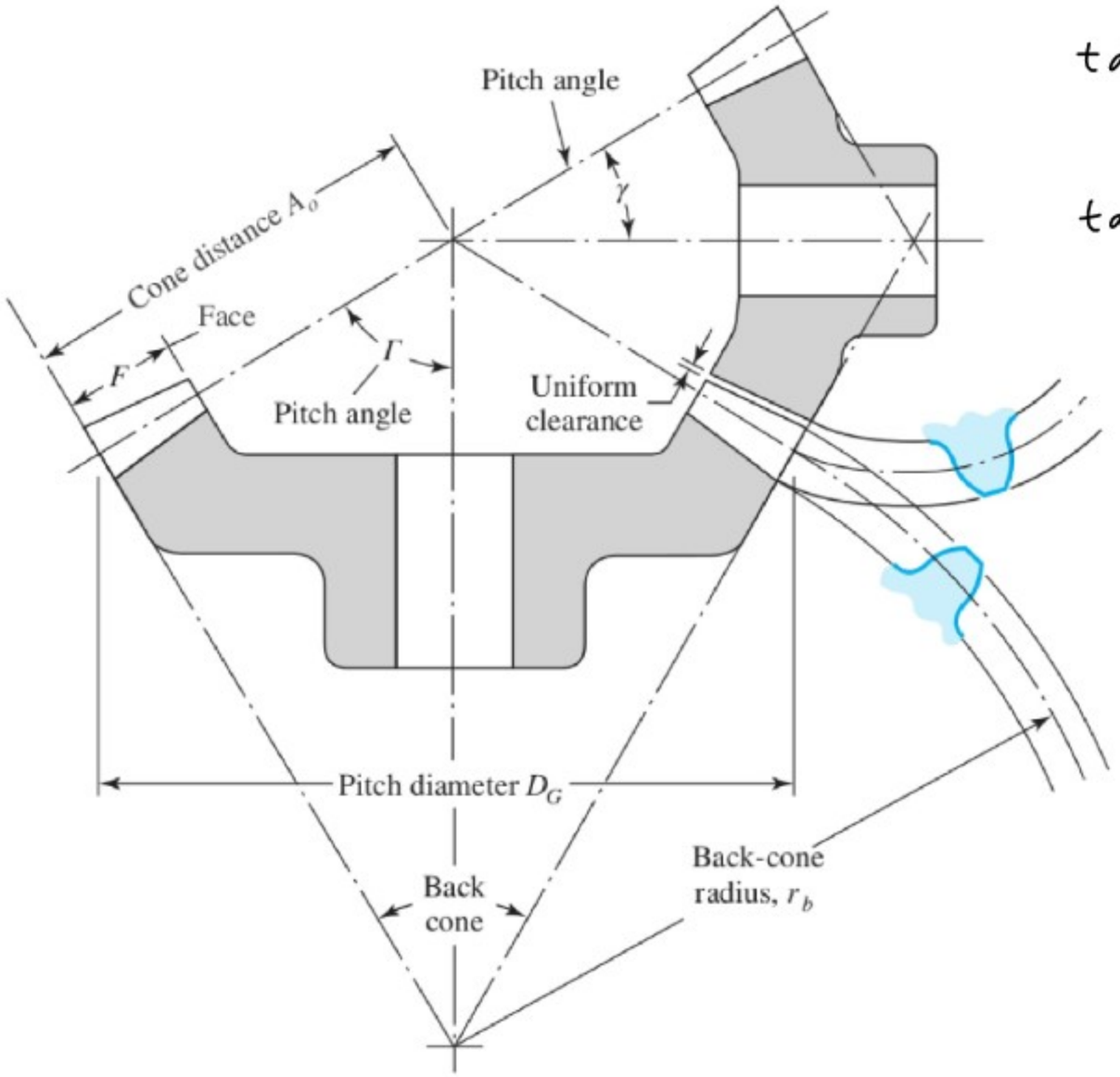
$K = 0.8$ Stub teeth

N_p number of pinion teeth

N_G number of gear teeth

$N_p < N_G$

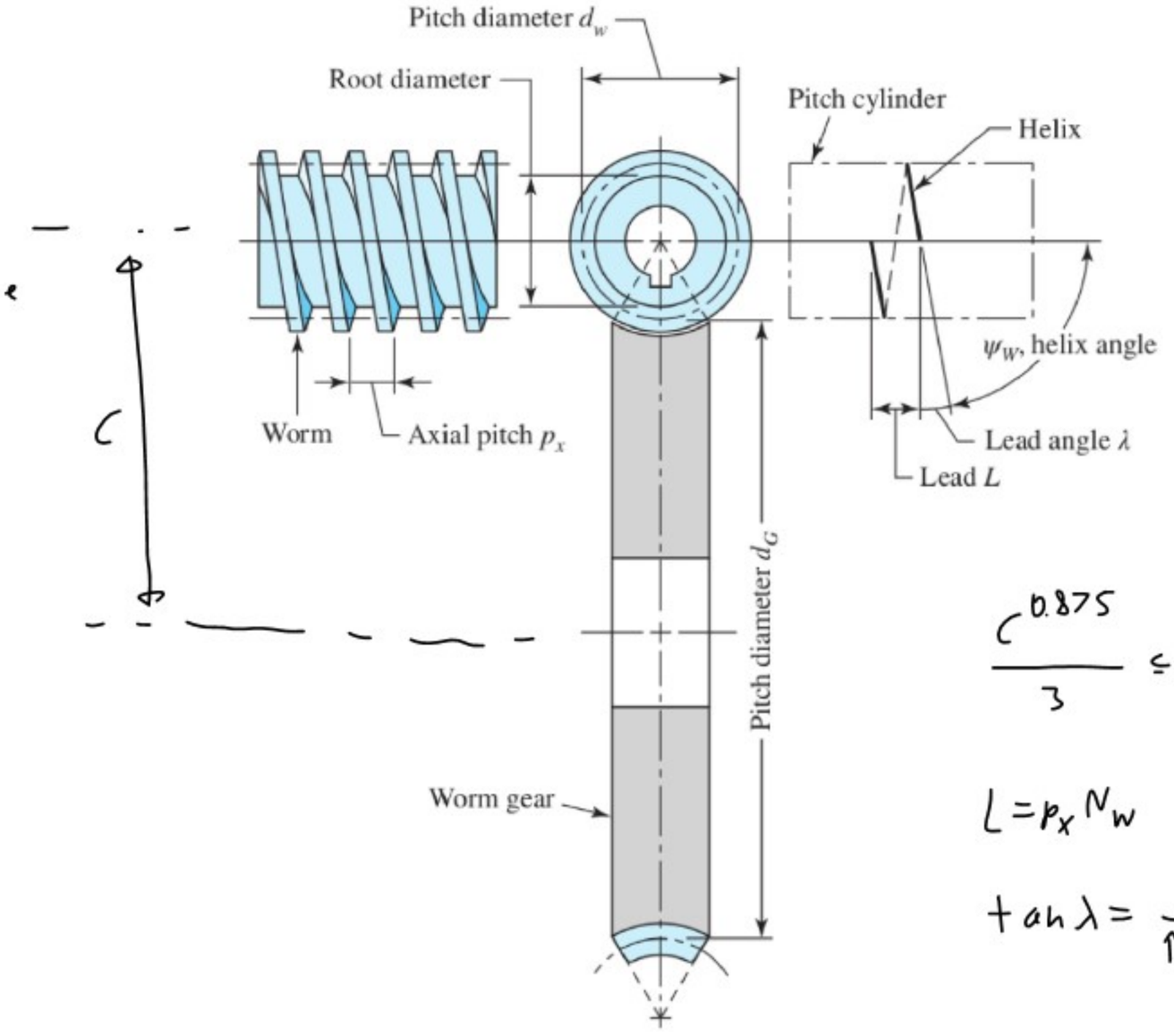
Bevel Gears



$$\tan\gamma = \frac{N_p}{N_G}$$

$$\tan\Gamma = \frac{N_G}{N_p}$$

Worm Gears



C center distance

N_w number of worm teeth

$$d_G = \frac{N_G p_t}{\pi}$$

$p_t = p_x$ if angle $= 90°$

N_G number of teeth on worm gear

$$\frac{C^{0.875}}{3} \le d_w \le \frac{C^{0.875}}{1.7}$$

$$L = p_x N_w$$

$$\tan\lambda = \frac{L}{\pi d_w}$$

13-1

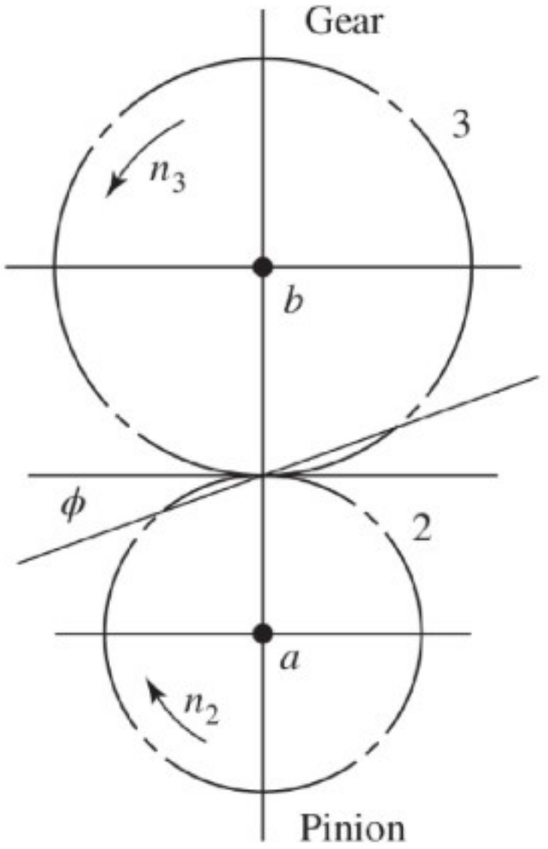
Tooth System	Pressure Angle ϕ, deg	Addendum a	Dedendum b
Full depth	20	$1/P$ or m	$1.25/P$ or $1.25m$ $1.35/P$ or $1.35m$
	$22\frac{1}{2}$	$1/P$ or m	$1.25/P$ or $1.25m$ $1.35/P$ or $1.35m$
	25	$1/P$ or m	$1.25/P$ or $1.25m$ $1.35/P$ or $1.35m$
Stub	20	$0.8/P$ or $0.8m$	$1/P$ or m

13-2

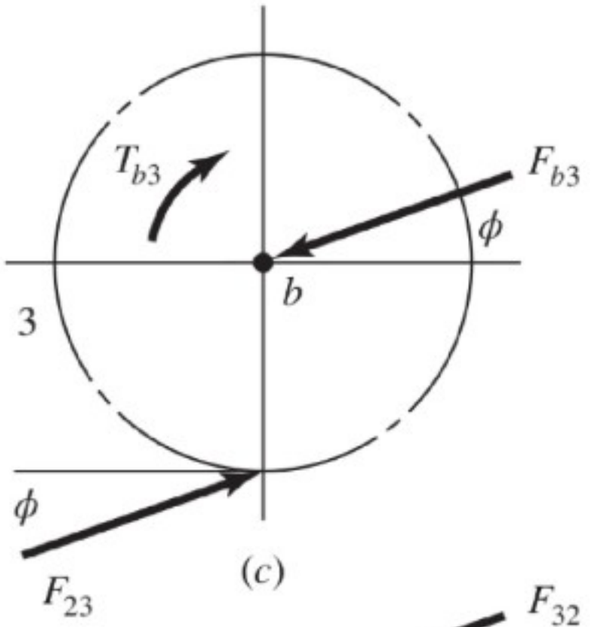
Diametral Pitch P (teeth/in)	
Coarse	2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, 4, 6, 8, 10, 12, 16
Fine	20, 24, 32, 40, 48, 64, 80, 96, 120, 150, 200

Module m (mm/tooth)	
Preferred	1, 1.25, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50
Next Choice	1.125, 1.375, 1.75, 2.25, 2.75, 3.5, 4.5, 5.5, 7, 9, 11, 14, 18, 22, 28, 36, 45

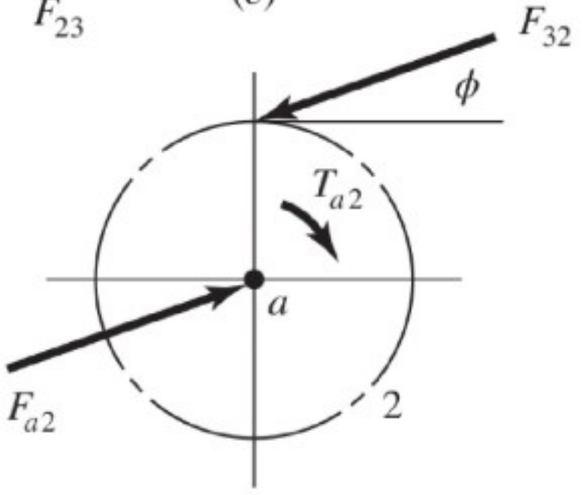
Forces


Gear
3
n_3
b
ϕ
2
a
n_2
Pinion

(a)


T_{b3}
F_{b3}
ϕ
b
3
ϕ
F_{23}

(c)


F_{32}
ϕ
T_{a2}
a
F_{a2}
2

(b)

A spur gearset has a module of 6 mm and a velocity ratio of 4. The pinion has 16 teeth. Find the number of teeth on the driven gear, the pitch diameters, and the theoretical center-to-center distance.

$$m = \frac{d_p}{N_p} \Rightarrow m N_p = d_p$$

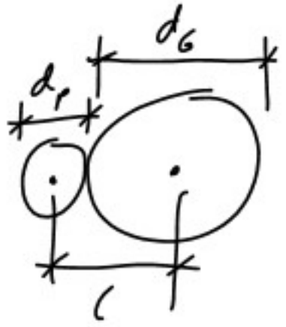
$$6\text{ mm}\ 16 = 96\text{ mm} = d_p$$

$$\left|\frac{\omega_1}{\omega_2}\right| = \frac{r_2}{r_1}$$

$$q = \frac{d_2}{d_1} \Rightarrow q d_p = d_G$$

$$4 \cdot 96\text{ mm} = 384\text{ mm} = d_G$$

$$N_G = \frac{d_G}{m} = \frac{384\text{ mm}}{6\text{ mm}} = 64 = N_G$$



$$C = r_p + r_G = \frac{d_p + d_G}{2} = \frac{96 + 384}{2} = 240\text{ mm}$$

A 17-tooth spur pinion has a diametral pitch of 8 teeth/in, runs at 1120 rev/min, and drives a gear at a speed of 544 rev/min. Find the number of teeth on the gear and the theoretical center-to-center distance.

$$\left|\frac{\omega_P}{\omega_G}\right| = \frac{r_G}{r_P} = \frac{N_G}{N_P}$$

$$\frac{1120}{544} = \frac{N_G}{17} \quad \Rightarrow \quad 17\,\frac{1120}{544} = 35 = N_G$$

$$P = \frac{N}{d} \quad \Rightarrow \quad d = \frac{N}{P}$$

$$d_P = \frac{17}{8} = 2.125 \text{ in} \qquad d_G = \frac{35}{8} = 4.375 \text{ in}$$

$$C = r_P + r_G = \frac{d_P + d_G}{2} = \frac{2.125 + 4.375}{2} = 3.25 \text{ in}$$