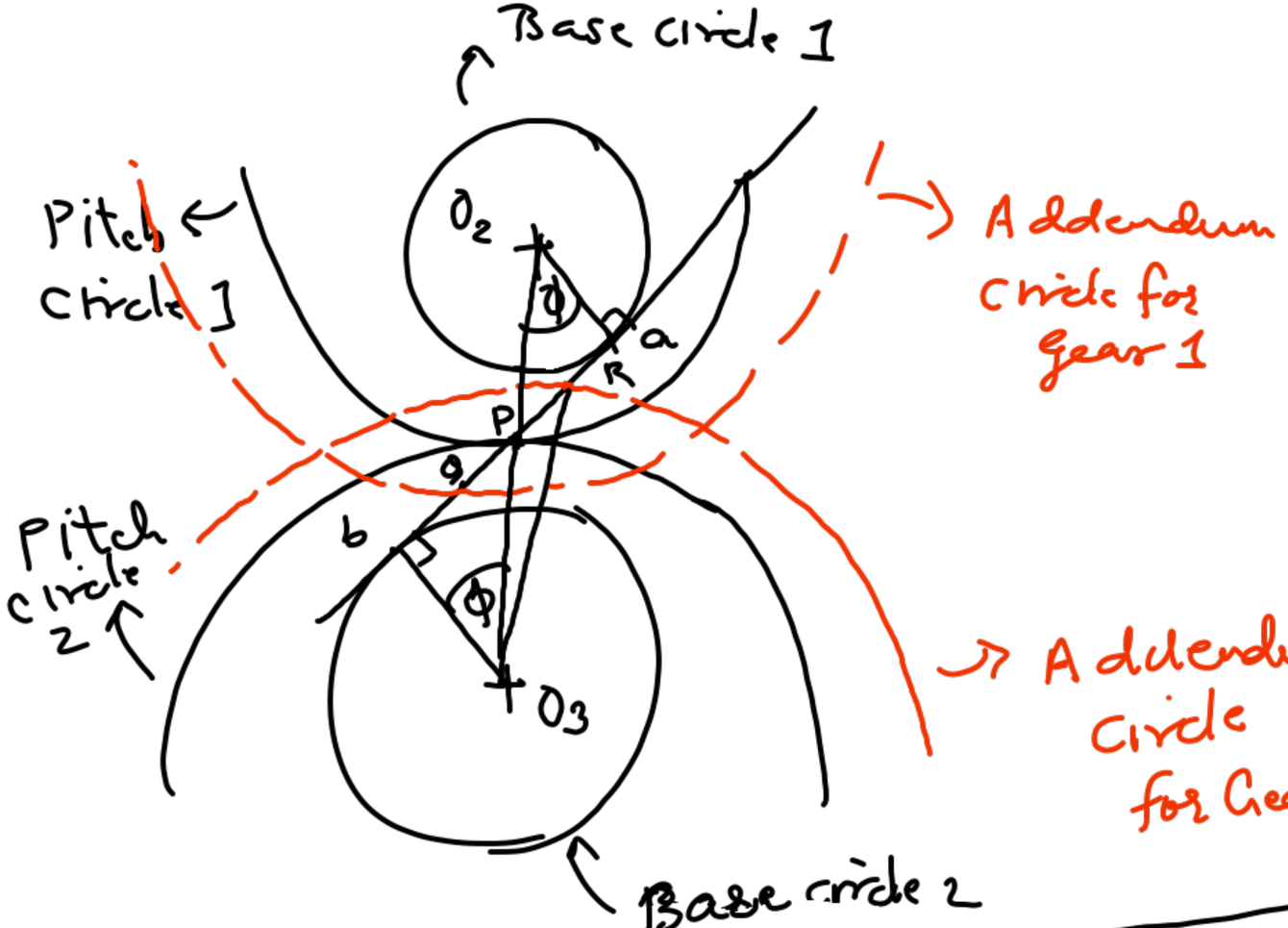
Length of action Z



$$Pb = O_3P \sin\phi = r_g \sin\phi$$

$$Pa = (O_2P \sin\phi) = r_p \sin\phi$$

Intersection of common tangent with the addendum circles leads to the length of action.

$$Z = RQ$$

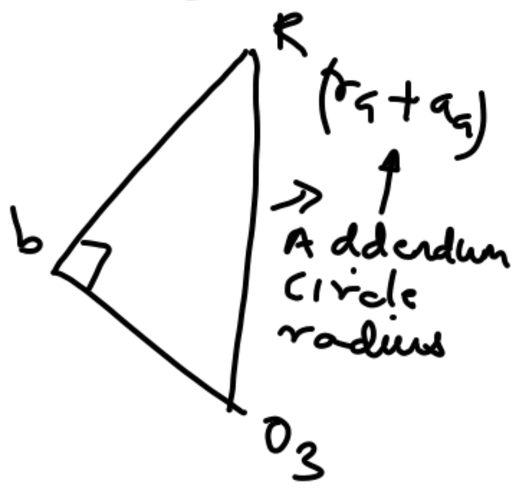
$$= RP + PQ$$

$$= (Rb - Pb) + (Qa - Pa)$$

$$= (Rb + Qa) - (Pb + Pa)$$

Consider

$\Delta O_3 b R$



$$Rb = \sqrt{(O_3R)^2 - (O_3b)^2}$$

$$= \sqrt{(r_G + a_G)^2 - (r_G \cos\phi)^2}$$

Same exercise for $\Delta O_2 Q a$

$$Qa = \sqrt{(r_p + a_p)^2 - (r_p \cos\phi)^2}$$

$$(Pb + Pa) = r_G \cancel{\cos\phi}\ \text{sin(phi)} + r_p \cancel{\cos\phi}\ \text{sin(phi)}$$

$$= (r_G + r_p) \cancel{\cos\phi}\ \text{sin(phi)}$$

$$Z = \sqrt{(r_b + a_G)^2 - r_G^2 \cos^2\phi} + \sqrt{(r_p + a_p)^2 - r_p^2 \cos^2\phi} - (r_G + r_p) \cancel{\cos\phi}\ \text{sin(phi)}$$