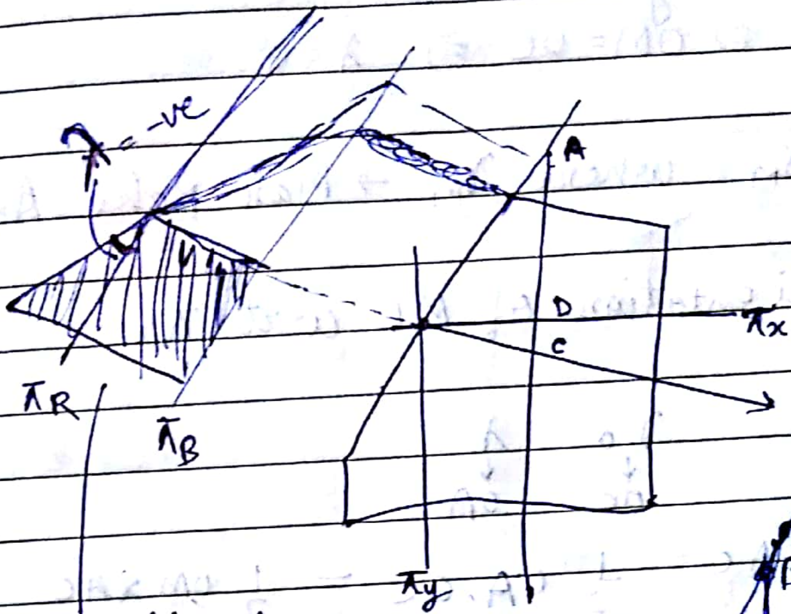
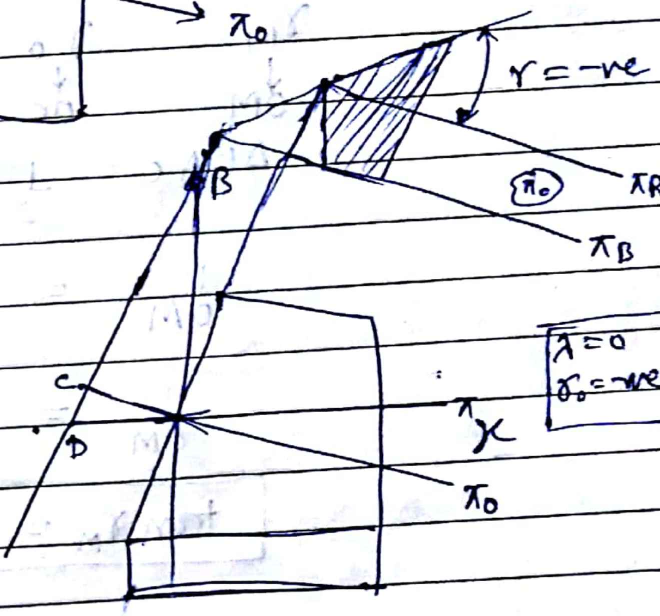
$\tan\lambda = \frac{1}{OA}$ $(OA \to \infty \Rightarrow \lambda = 0^\circ)$



$\gamma_y = 0$
$\lambda = -ve$

tool tip towards the operator

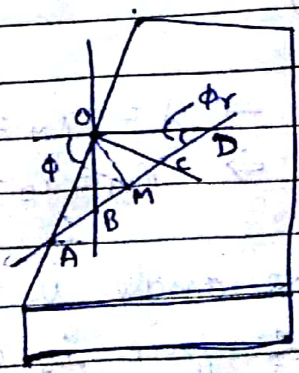


$\lambda = 0$
$\gamma_o = -ve$

→ If ML doesn't exist, rake angle & clearance angle are 0 irrespective of ϕ

→ ML for clearance faces will always exist while for rake surface it may not

#



$\frac{1}{OD} = \tan\gamma_x$ $\frac{1}{OM} = \tan\gamma_M^*$

$\frac{1}{OC} = \tan\gamma_o$

$\frac{1}{OB} = \tan\gamma_y$

$\frac{1}{OA} = \tan\lambda$

∵ OM is least

∴ γ_M is max among all

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→ OM is smaller of all as it is ⊥ to AD. Hence γ_* will be highest.

→ If $\gamma_M = \gamma_o \Rightarrow OM = OC \Rightarrow \lambda = 0^\circ$

$$\frac{1}{OM} = \tan\gamma_M \quad \text{where } \gamma_M \rightarrow \text{Max. Rake Angle}$$

ϕ_γ – orientation of ML wrt π_x

$$\begin{array}{ccc} \gamma_M & \gamma_o & \lambda \\ \downarrow & \downarrow & \downarrow \\ OM & OC & OA \end{array}$$

$$\Delta OAC = \frac{1}{2} OA . OC = \frac{1}{2} OM \times AC$$

$$\frac{1}{OM} = \frac{AC}{OA.OC} = \frac{\sqrt{OA^2 + OC^2}}{OA.OC}$$

$$\frac{1}{OM} = \sqrt{\frac{1}{OC^2} + \frac{1}{OA^2}}$$

$$\boxed{\tan\gamma_M = \sqrt{\tan^2\gamma_o + \tan^2\lambda}}$$

$$\tan\angle OAC = \frac{OC}{OA} = \frac{1/OA}{1/OC}$$

$$\boxed{\tan(\phi - \phi_\gamma) = \frac{\tan\lambda}{\tan\gamma_o}}$$

If $\phi = \phi_\gamma$ → What are the implications?

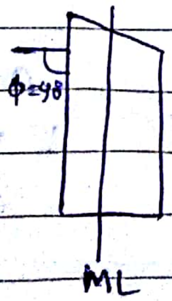
→ $ML \parallel \pi_c \rightarrow \lambda = 0$

→ $\gamma_M = \gamma_o \quad (OM = OC)$

→ if ML is also $\parallel \pi_y$

↳ $\pi_c \equiv \pi_y \Rightarrow \lambda = \gamma_y = 0^\circ$

↳ $\pi_o = \pi_x \Rightarrow \gamma_M = \gamma_o = \gamma_x$



→ Orthogonal Rake angle is +ve
(∵ Rake surface is drooping away)

$\gamma_M \quad \gamma_x \quad \gamma_y$
$\downarrow \quad \downarrow \quad \downarrow$
$OM \quad OD \quad OB$

$$\Delta OBD = \frac{1}{2} OB \cdot OD = \frac{1}{2} OM \cdot BD$$

$$\frac{1}{OM} = \frac{BD}{OB \cdot BD} = \sqrt{\frac{OB^2 + OD^2}{OB^2 \cdot OD^2}}$$

$$\boxed{\tan \gamma_M = \sqrt{\tan^2 \gamma_x + \tan^2 \gamma_y}}$$

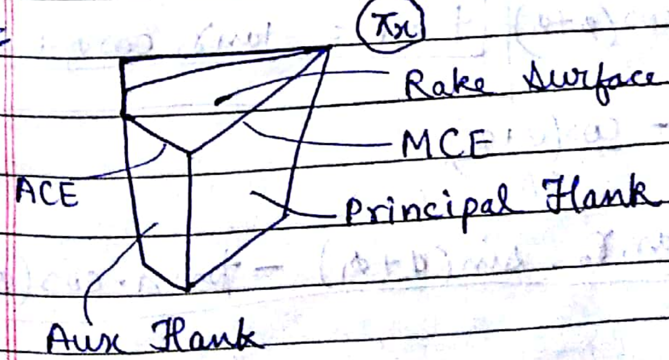
further $\tan \angle ODB = \tan \phi_\gamma = \frac{OB}{OD} = \frac{1/OD}{1/OB}$

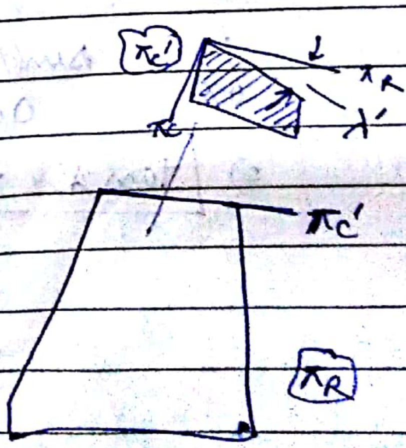
$$\boxed{\tan \phi_\gamma = \frac{\tan \gamma_x}{\tan \gamma_y}}$$

→ If $ML \parallel \pi_C$, $\boxed{\tan \phi = \frac{\tan \gamma_x}{\tan \gamma_y} \; \{ML \parallel \pi_C)}$

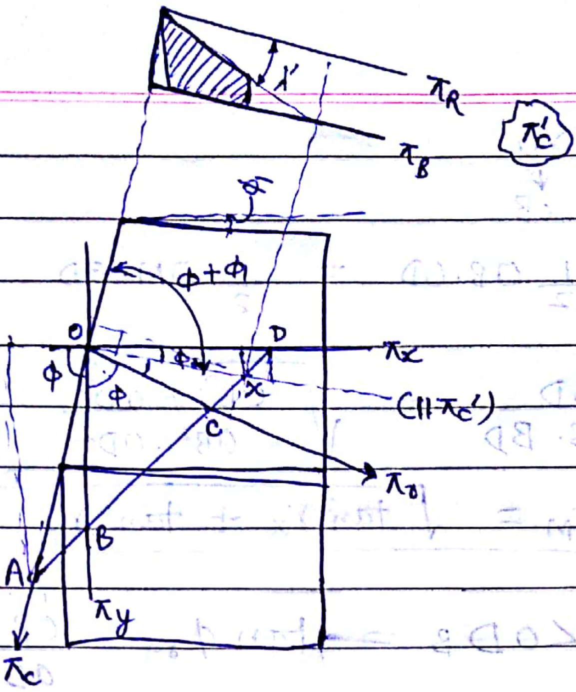
→ Use of ML is during grinding of tool. Once tool becomes blunt, it has to be regrinded for that tool needs to be oriented in a particular way; so tool grinding needs to be done in Master Rake System (MRS).

#





$\lambda' \rightarrow$ inclination of aux CE from π_R as measured on π_C'.



$$\frac{1}{OD} = \tan\gamma_x$$

$$\frac{1}{OC} = \tan\gamma_0$$

$$\frac{1}{OB} = \tan\gamma_y$$

$$\frac{1}{OA} = \tan\lambda$$

$$\frac{1}{OX} = \tan\lambda'$$

→ λ' doesn't appear in any of ASA or ORS ; ∴ some relation needs to be there for connecting it with known angles.

ORS

$\lambda' \to OX$, $\lambda \to OA$, $\gamma_0 \to OC$

~~$\Delta OXA = \Delta OAC + \Delta OCX$~~

~~$\frac{1}{2} OA.$~~

$$\Delta OAC = \Delta OAX - \Delta OCX$$

$$\frac{1}{2} OA.OC = \frac{1}{2} OA.OX.\sin(\phi+\phi_1) - \frac{1}{2} OC.OX\cos(\phi+\phi_1)$$

$$\frac{1}{OX} = \frac{\sin(\phi+\phi_1)}{OC} - \frac{\cos(\phi+\phi_1)}{OA}$$

$$\Rightarrow \boxed{\tan\lambda' = \tan\gamma_0 . \sin(\phi+\phi_1) - \tan\lambda . \cos(\phi+\phi_1)}$$

MRS

$\lambda' \to OX$, $\gamma_x \to OD$, $\gamma_y \to OB$

$$\Delta OBD = \Delta OBX + \Delta OXD$$

$$\frac{1}{2} OB.OD = \frac{1}{2} OB.OX\cos\phi_1 + \frac{1}{2} OD.OX\sin\phi_1$$

$$\frac{1}{OX} = \frac{\cos\phi_1}{OD} + \frac{\sin\phi_1}{OB}$$

$$\boxed{\tan\lambda' = \tan\gamma_x \cos\phi_1 + \tan\gamma_y \sin\phi_1}$$

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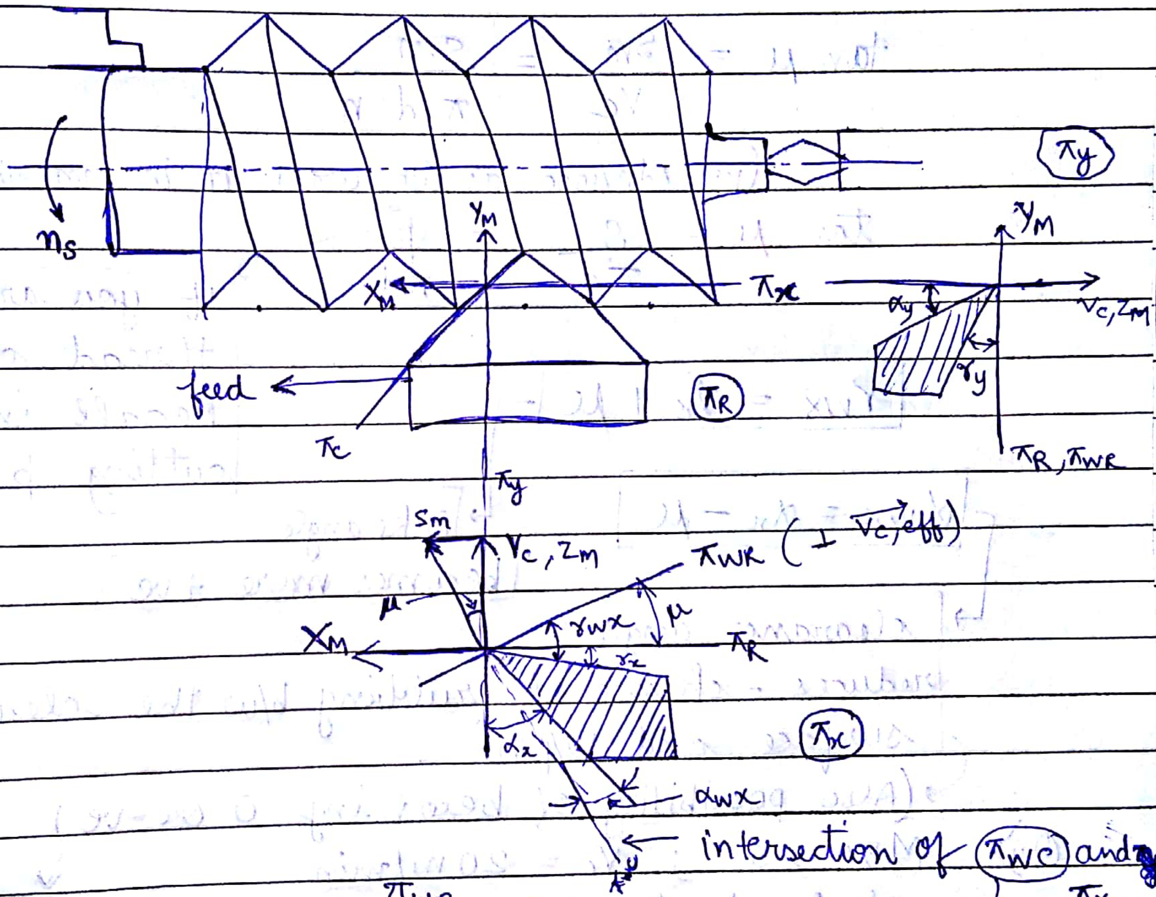
Work Reference System (WRS)

→ change in tool geometry due to use of the tool during machining operation

- (i) for the effect of feed
- (ii) for improper tool setting.



π_{WC} → plane $\perp$ to π_{WR} and containing main cutting edge.

$$\overrightarrow{V_{c,eff}} = \overrightarrow{V_c} + \overrightarrow{S_m} = \overrightarrow{V_{WC}}$$

V_{WC} → cutting speed in WRS

S_m → feed rate

$V_{c,eff}$ → effective cutting speed

→ No effect of feed on back rake angle & clearance ∠.

→ more (P.T.O.)

$\pi_{WR} \perp \overrightarrow{V_{c,eff}}$ or $\overrightarrow{V_{wc}}$

↳ Reference plane in WRS

$\gamma_{wx} \rightarrow$ Side Rake angle in WRS due to change in orientation of $\pi_R \rightarrow \pi_{WR}$

$\alpha_{wx} \rightarrow$ Side Clearance angle in WRS.

$$\tan\mu = \frac{S_m}{V_c} = \frac{s.n}{\pi.d.n}$$

(not $\pi dn/1000$ as we want it in mm/min)

$$\tan\mu = \frac{s}{\pi d} = \frac{p}{\pi d}$$

if you are doing thread cutting. Recall in thread cutting $p = s$.

$$\boxed{\gamma_{wx} = \gamma_x + \mu}$$

Rake angle becomes more +ve

$$\boxed{\alpha_{wx} = \alpha_x - \mu}$$

clearance angle reduces - chance of rubbing b/w the clearance surface and W/p ↑↑

(Also possibility of becoming 0 or -ve)

Use to find max. pitch of thread that can be machined such that α_{wx} doesn't become 0°

Qu) M50 × 5 ; V_c = 20 m/min

0° 0° 10° 10° 60° 60° 0.4 mm (ORS)

Calculate γ_x

M50*5 meaning? Other cases?

Metric thread with d_p = 50 mm

pitch = 5

$$\tan\mu = \frac{p}{\pi d} = \frac{5}{\pi \times 50} = 0.0318$$

$\mu = 1.8231°$

$\phi = 60°$ $\gamma_o = 0°$ $\lambda = 0°$

$\tan\gamma_x = \sin\phi \tan\gamma_o - \cos\phi \tan\lambda$

$\tan\gamma_x = \sin 60 \cdot \tan 0^\circ - \cos 60 \cdot \tan 0$

$\gamma_x = 0^\circ$

$\therefore \gamma_{wx} = 0 + 1.823 = \underline{1.823^\circ}$

(In this problem rake surface $\parallel$ to π_R $(\lambda = 0^\circ)$ and $\therefore$ ML of rake surface doesn't exist)

→ In exam Only Type of Thread will be specified you need to learn diff type of thread and their included angles.

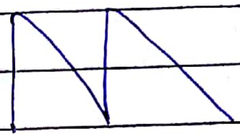
→ Effect of transverse feed on Rake & clearance angles could be understood by grooving or parting operation :→

Qu.) 0   10°   10°   10°   30°   90°   0.3 mm

$p = 10$ mm

$n = 100$ rpm

$v_c = 10$ m/min



find out α_{wx} and γ_{wx}

$\mu = \tan^{-1}\left[\frac{10 \times 100 \times /1000}{10}\right] = \underline{5.71^\circ}$

$\gamma_o = 10^\circ \quad \lambda = 0^\circ \quad \phi = 90^\circ$

$\tan\gamma_x = \sin 90 \tan 10^\circ - \cos 90 \tan 0^\circ$

$\Rightarrow \gamma_x = 10^\circ$

$\therefore \gamma_{wx} = 10 + 5.71^\circ$

$= \underline{15.71^\circ}$

$\phi = 90^\circ \Rightarrow \pi_x$ & π_o will coincide

$\Rightarrow \alpha_x$ & α_o will be same $= 10^\circ$

$\therefore \alpha_{wx} = 10 - 5.71 = \underline{\underline{4.29^\circ}}$