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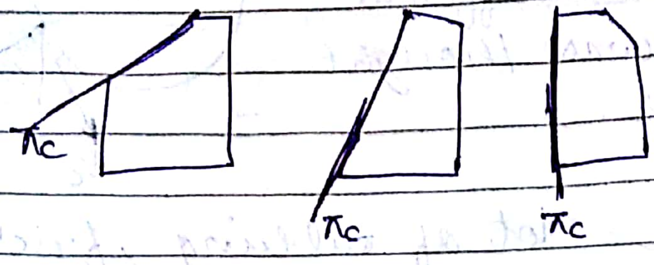
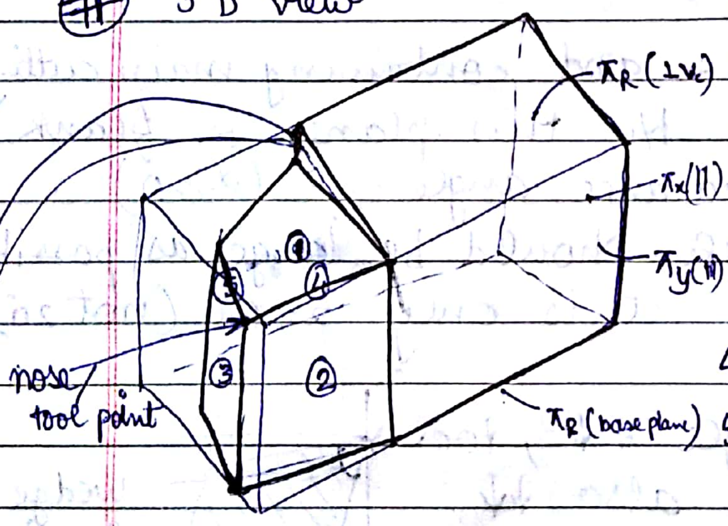
is +ve clearance angle. If opp. then -ve.
We always want α to be +ve to avoid interference of tool with the w/p.

⇒ Machine Transverse plane (π_y)
Plane ⊥ to spindle axis (machine axis) (⊥ to both π_R & π_x) taken in direction of cross feed.



⇒ M/c longitidunal plane (π_x)
Plane || to m/c axis. (plane ⊥ to π_R and taken in direction of assumed longitudinal feed)
→ π_C → Plane ⊥ to π_R containing main cutting edge

3 D view

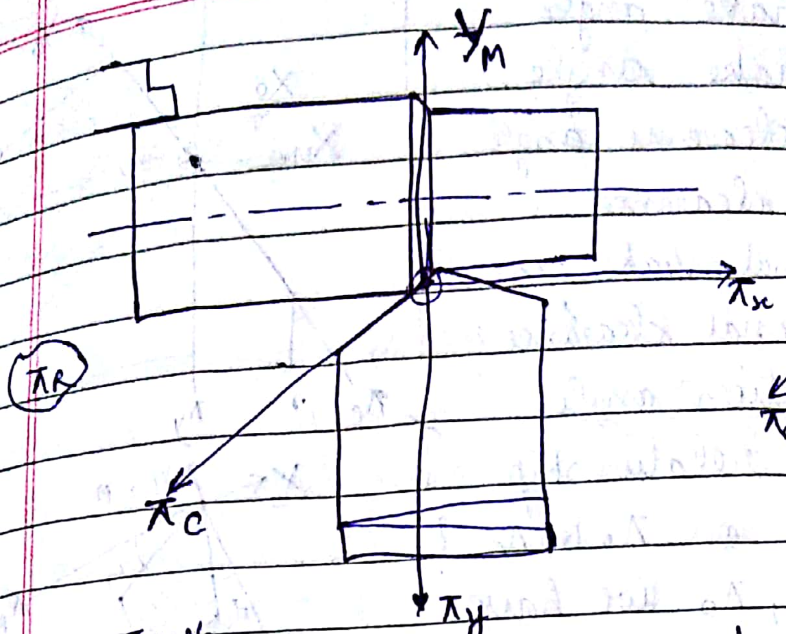


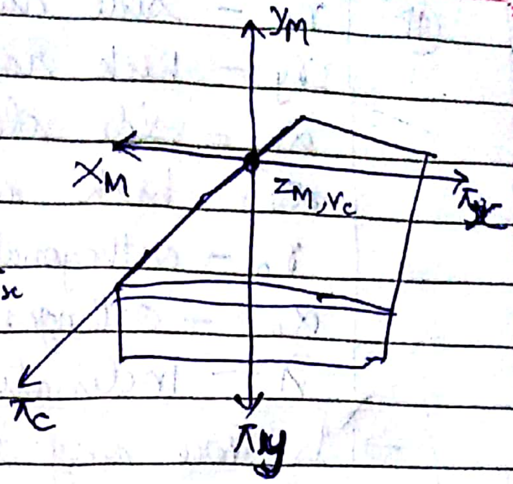
1 - rake surface
2 - principal clearance/ flank surface
3 - auxiallary flank/ clearance surface
4 - PCE / main cutting edge
5 - Aux CE / minor/ End cutting edge

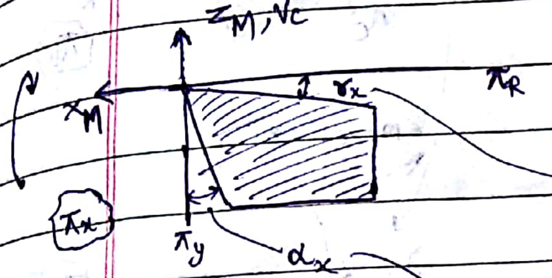
π_R - plane ⊥ to V_c passing through tool tip

→ height of rake surface is somewhat different from the top surface.

→ intermediate surface generated during grinding of C/T







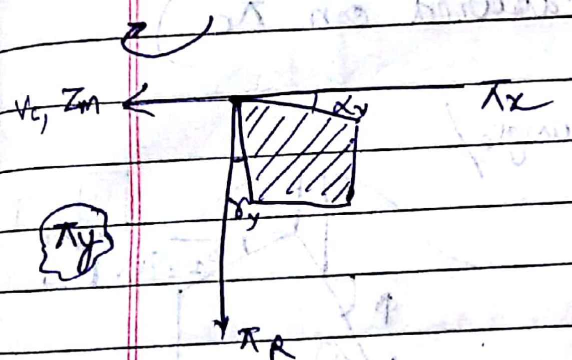
Z_m is intersec^n of π_y & π_c also of π_x & π_y.

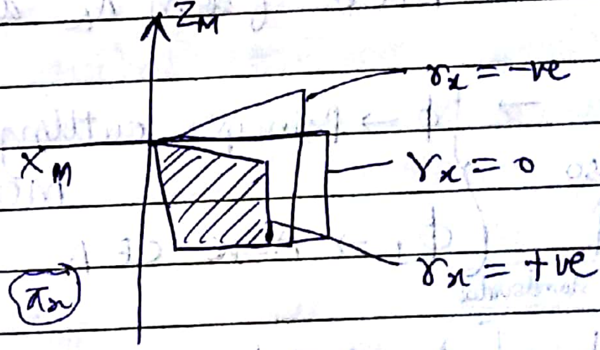
→ Rake angle in π_x plane (visualised in π_x plane)

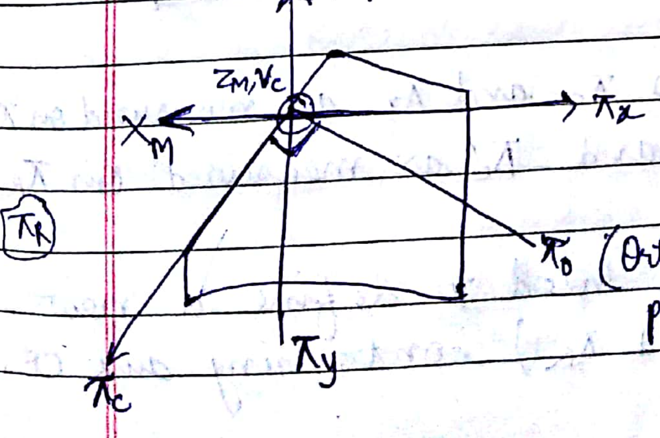
→ clearance angle visualised in π_x

→ For defining clearance angle, we need π_c

∴ Z_m line is also reminent of π_c.







π_o (Orthogonal plane)

π_o → plane ⊥ to π_R and π_c going through tool tip.

↓

analyzed at mid-section of width of cut

↳ not particularly at tool tip.

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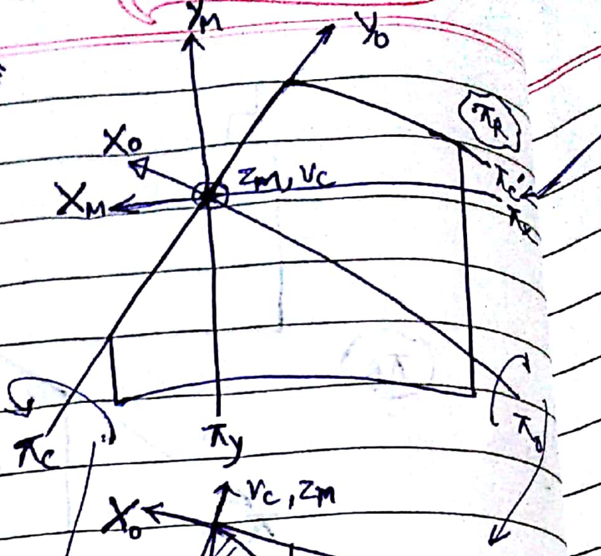
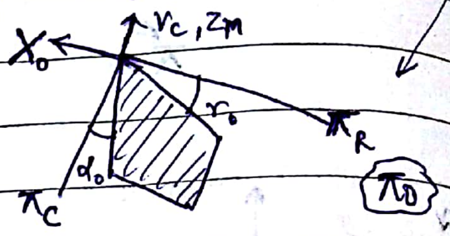
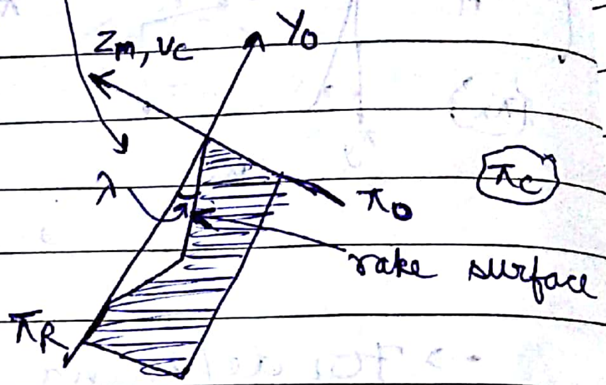
\# γ_x – side rake angle
γ_y – back rake angle
α_x – side clearance angle
α_y – back clearance "
γ_o – Orthogonal rake "
α_o – orthogonal clearance "
λ – Inclination angle



→ Is there any relationship b/w π_x & π_y or π_o & π_c ?
→ On π_x, π_y, π_o we have defined rake angle.



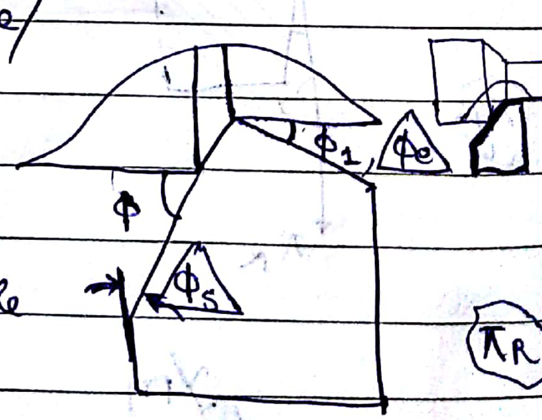
→ It is also rake angle
Angle b/w π_R & Rake surface measured on π_C
(Instead of γ_C we call it inclination angle) (Inclination of MCE from π_R as measured on π_C).



Iso ↑ → { ϕ → Principle cutting edge angle / MCEA
ϕ_1 → Aux CEA

Diff. Standards

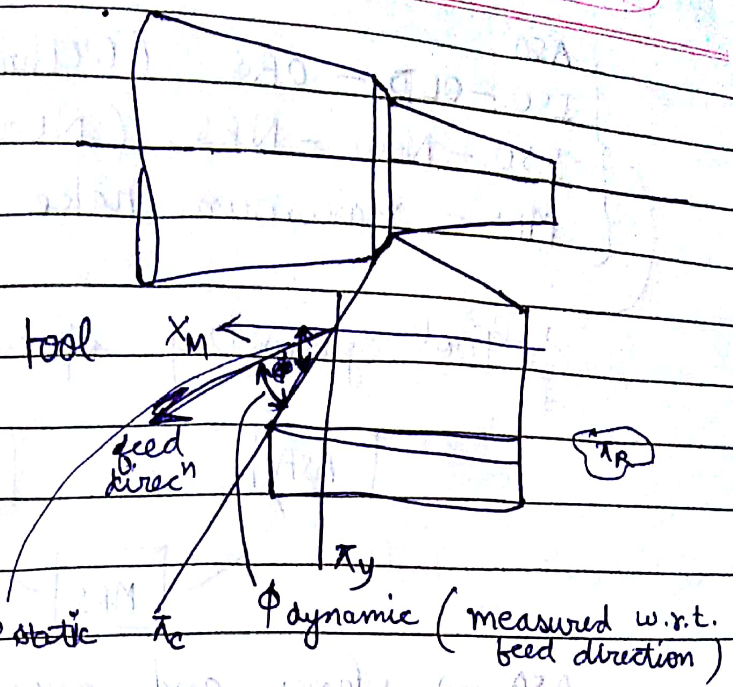
↓ ASA { ϕ_s → Side CEA / Approach angle
ϕ_e → End CEA



($\phi_s = 90 - \phi$) ϕ – Angle b/w π_c and π_x as measured on
ϕ_e, ϕ_1 – Angle b/w π_x and π_c' as measured on π_r

For defining ϕ_1 we need to define a new

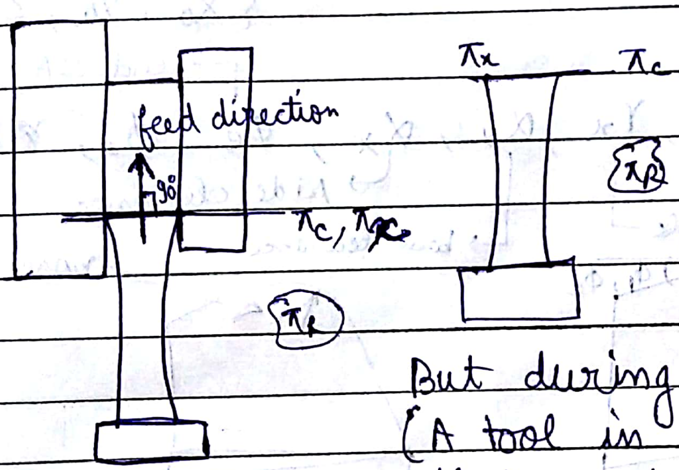
Aux. cutting plane
$\pi_c' \perp \pi_R$
containing aux. CE



dynamic angle → employ tool during machining

ϕ_{dyn} → Angle b/w feed direc^n & π_c as measured on π_R plane

→ By default, we assume feed to be in X_M but in taper turning this is not true.



$\phi_{dynamic} = 90°$

$\phi = 0$ ← for tool in hand (this is what we think

But during operation, $\phi = 90°$
(A tool in hand is quite diff than a tool in operation)

→ Can π_x & π_o coincide?
If $\phi = 90$ or π_c and π_y coincide. ⇒ $\lambda = \gamma_y$
↳ $\phi_s = 0°$

If π_x & π_o coincide ⇒ $\gamma_x = \gamma_o$

Masterline → obtained at the intersection of the relevant surface and plane || to π_R or base plane (π_b)

- rake surface
- principal flank
- Auxiallary flank

→ 3 angles required ~~do no~~ to define a plane

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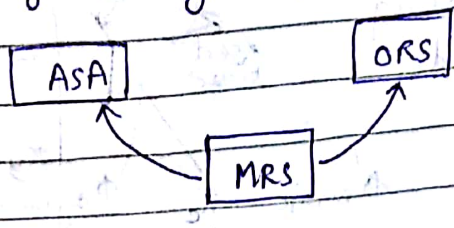
- ASA
- ISO – OLD – ORS (Orthogonal Rake system)
- ISO – New – NRS (Normal Rake system)
- MRS – maximum rake system

→ Tool geometry specification systems

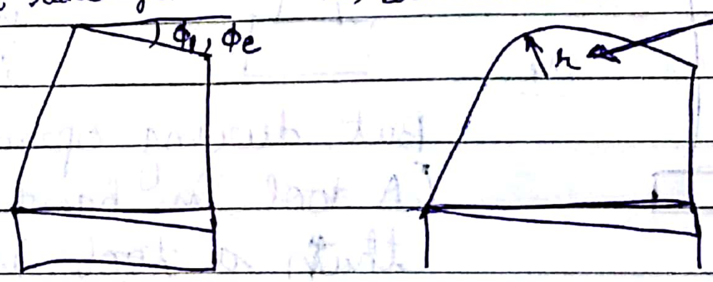


ASA → planes and axes → $\pi_x, \pi_y, \pi_R, \pi_B, \pi_C$
$\{X_M, Y_M, Z_M, V_C\}$

ORS → planes and axes → $\pi_o, \pi_C, \pi_R, \pi_B, \pi_C', \pi_o'$
$\{X_o, Y_o, Z_o, V_c\}$

ASA → $\gamma_y, \gamma_x, \alpha_y, \alpha_x, \phi_e, \phi_s, r$

- γ_y → back rake
- γ_x → side rake angle
- α_y → back clearance
- α_x → side clearance
- ϕ_e → end CEA
- ϕ_s → Side CEA
- r → nose radius (in inch)



If you have nose radius, surface roughness will decrease drastically. All single point C/T have nose radius. (We want surface → smooth)

→ A single point C/T has many surfaces. With ASA parameters, we can completely define the C/T i.e. its surfaces (with help of various angles)

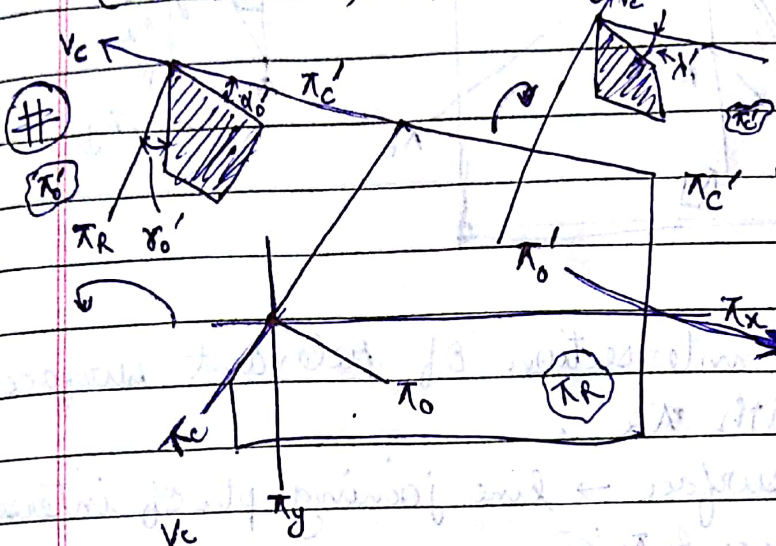
ORS → λ γ_o α_o α_o' ϕ_1 ϕ r (mm)

- λ → Inclination angle
- γ_o → orthogonal Rake
- α_o → orthogonal
- α_o' → auxiallary clearance of aux. flank
- ϕ_1 → ACEA
- ϕ → PCEA / MCEA

→ α_o' → It cannot be 0. If it = 0, even on auxiallary flank → rubbing on w/p.

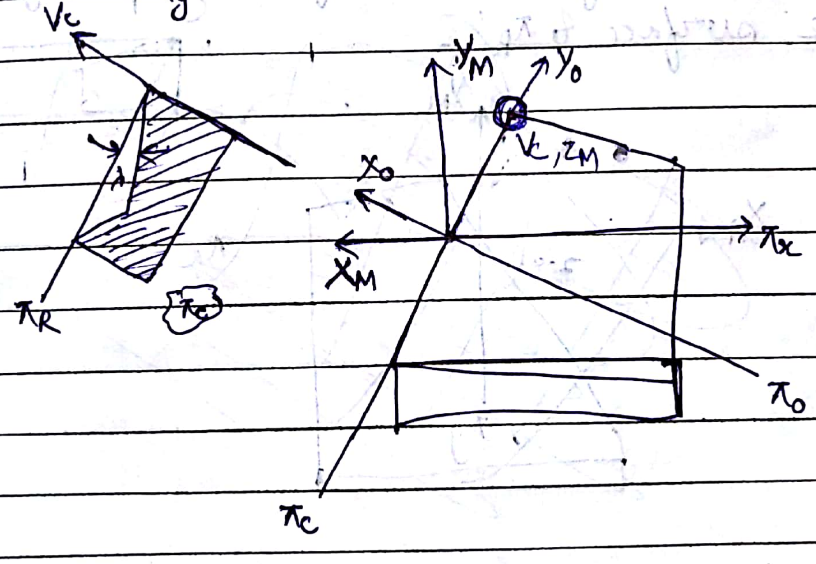
→ ASA → r (in inch) → ORS → r (in mm)

→ ASA does not cover α_o' (ASA doesn't has orthogonal)
(In Book, ASA designaⁿ is given wrong).

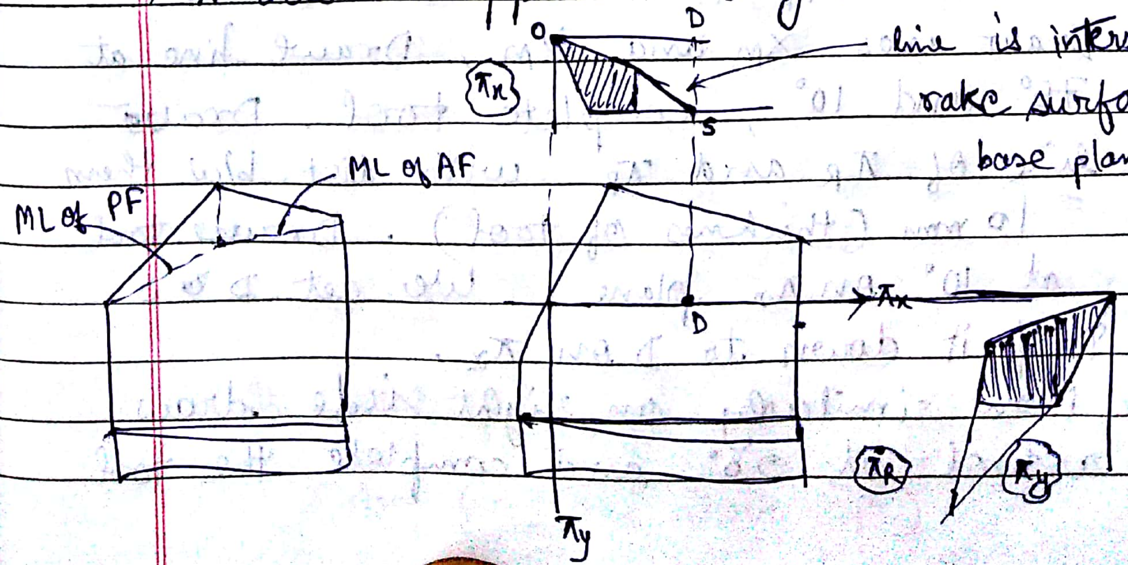


π_c' {⊥ π_R containing ACE}
aux cutting plane

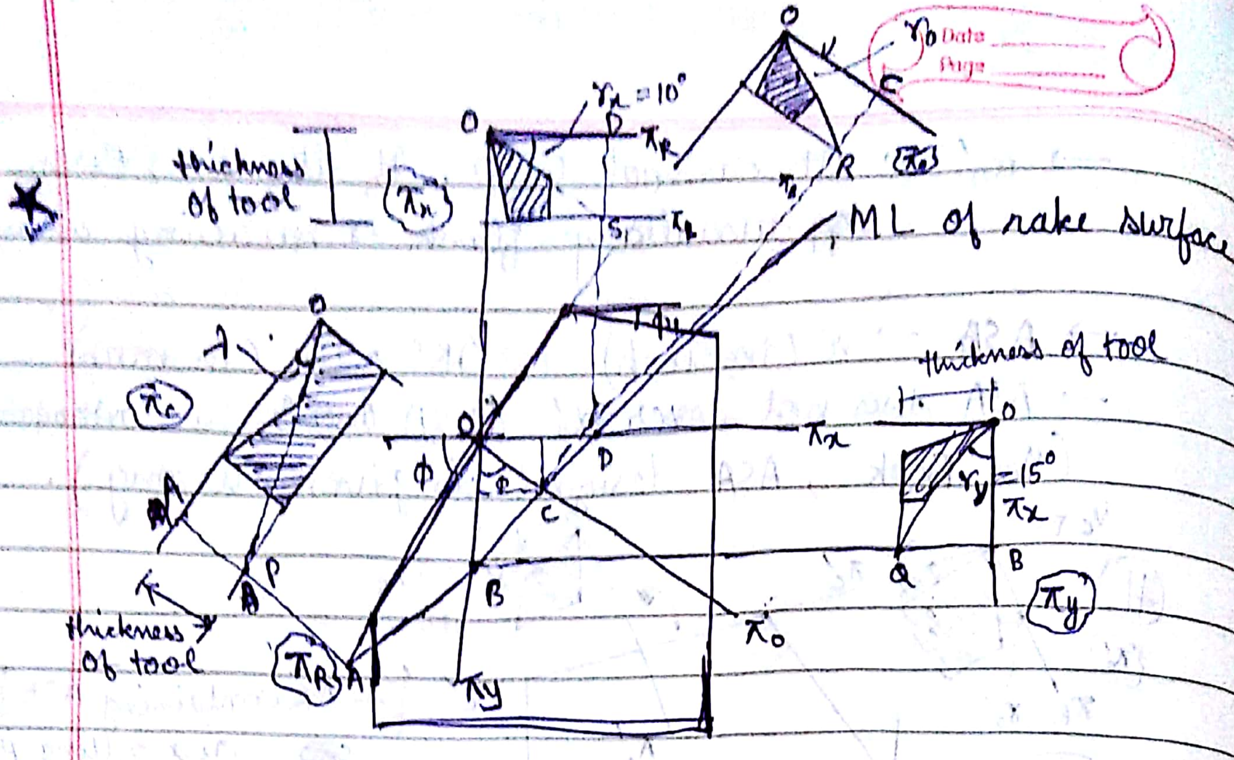
π_x {⊥ π_R and π_c'}
aux orthogonal plane



→ λ' does not appear in any standard

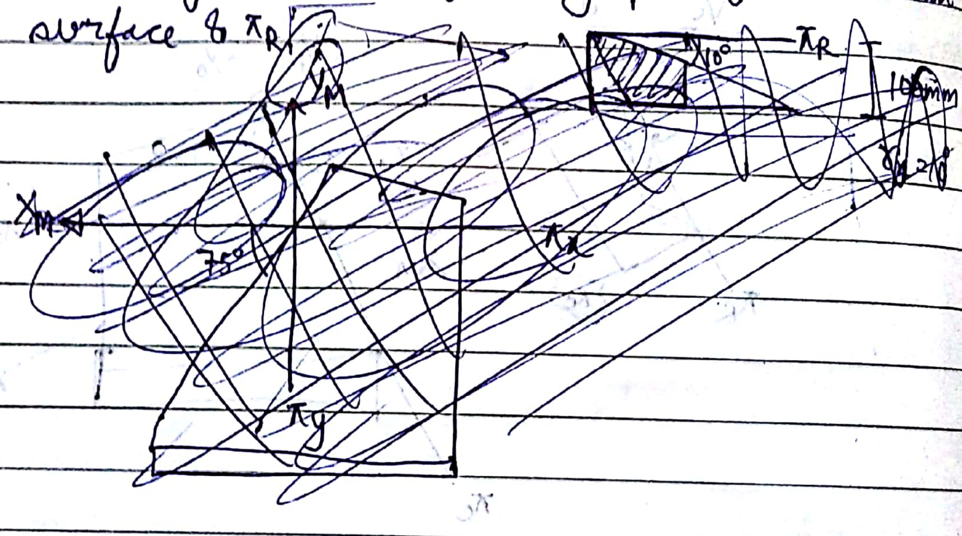


P.T.O.



Master line → intersection of relevant surface with π_R.

ML of rake surface → line joining pt. of intersection of rake surface & π_R



→ $\phi = 75°$ $\phi_1 = 10°$ $\gamma_x = 10°$ $\gamma_y = 20°$

→ Draw axes X_M and Y_M, Drawl line at 75° and 10°, complete tool. Draw line of π_R and π_B with dist. b/w them = 10 mm (thicknes of tool). Draw tool at 10° on π_x plane. We get D & S. Drop it down to D on π_x.

Now similarly on right side draw a tool at 20° and complete the tool

Get the points Q & B and project B on tool at π_y plane. Now joint B & D. This is ML of rake surface. Intersecⁿ with π_o gives C and with π_c gives A.
Now project C and A and join O P
Inclinaⁿ of O P with OA gives λ.

→ Interretations b/w ASA and ORS :

$$\tan \gamma_x = \frac{SD}{OD} = \frac{T}{OD} = \frac{1}{OD} \quad \text{if } T=1$$

Thickness of tool

$$\tan \gamma_y = \frac{QB}{OB} = \frac{T}{OB} = \frac{1}{OB} \quad \text{if } T=1$$

$$\tan \gamma_o = \frac{RC}{OC} = \frac{T}{OC} = \frac{1}{OC} \quad \text{if } T=1$$

$$\tan \lambda = \frac{AP}{OA} = \frac{T}{OA} = \frac{1}{OA} \quad \text{if } T=1$$

$$\rightarrow \underset{\downarrow\, OC}{\gamma_o} = f(\underset{\downarrow\, OD}{\gamma_x}, \underset{\downarrow\, OB}{\gamma_y})$$

$$\Delta OBD = \Delta OCB + \Delta OCD$$

$$\frac{1}{2} OB \cdot OD = \frac{1}{2} OB \times OC \sin\phi + \frac{1}{2} OD \times OC \cos\phi$$

Divide by ½ OB · OD · OC

$$\Rightarrow \frac{1}{OC} = \frac{\sin\phi}{OD} + \frac{\cos\phi}{OB}$$

$$\Rightarrow \boxed{\tan\gamma_o = \tan\gamma_x \sin\phi + \tan\gamma_y \cos\phi}$$

If $\phi = 90° \rightarrow \pi_x$ & π_o coincide ⇒ γ_x & γ_o will be same

(also from the above eqⁿ)

$$\lambda = f(\gamma_x, \gamma_y)$$

($\lambda \to OA$, $\gamma_x \to OD$, $\gamma_y \to OB$)

$$\Delta OAD = \Delta OAB + \Delta OBD$$

$$\frac{1}{2} OD \times OA \sin\phi = \frac{1}{2} OA \times OB \cos\phi + \frac{1}{2} OB \times OD$$

$$\Rightarrow \frac{\sin\phi}{OB} = \frac{\cos\phi}{OD} + \frac{1}{OA}$$

$$\Rightarrow \tan\gamma_y \sin\phi = \tan\gamma_x \cos\phi + \tan\lambda$$

$$\Rightarrow \boxed{\tan\lambda = \tan\gamma_y \sin\phi - \tan\gamma_x \cos\phi}$$

if $\phi = 90^\circ \Rightarrow \lambda = \gamma_y$

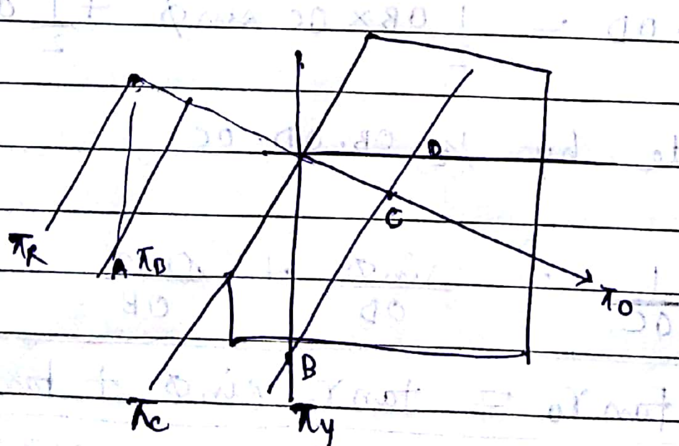
$$\rightarrow \begin{bmatrix} \tan\gamma_o \\ \tan\lambda \end{bmatrix} = \begin{bmatrix} \sin\phi & \cos\phi \\ -\cos\phi & \sin\phi \end{bmatrix} \begin{bmatrix} \tan\gamma_x \\ \tan\gamma_y \end{bmatrix}$$

$$\hookrightarrow \begin{bmatrix} \tan\gamma_x \\ \tan\gamma_y \end{bmatrix} = \begin{bmatrix} \sin\phi & -\cos\phi \\ \cos\phi & \sin\phi \end{bmatrix} \begin{bmatrix} \tan\gamma_o \\ \tan\lambda \end{bmatrix}$$

Det. of this matrix = 1.

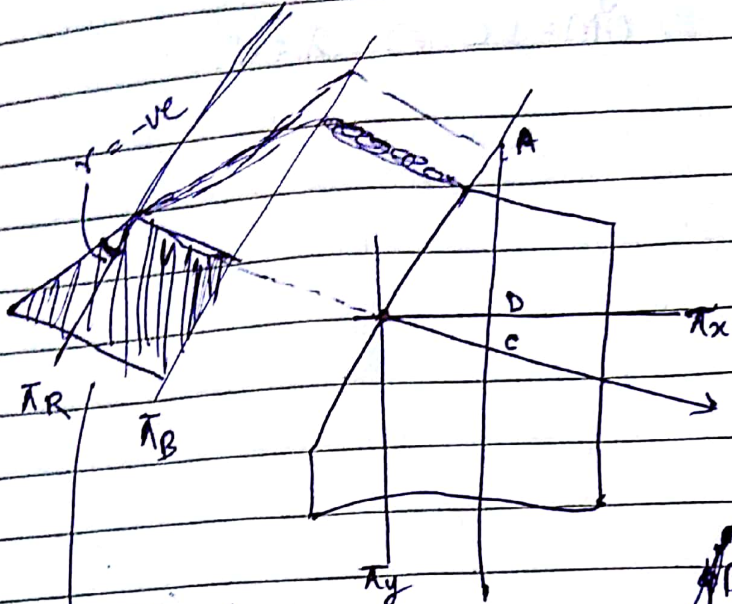
$$\rightarrow \left.\begin{aligned} \gamma_x &= f(\gamma_o, \lambda) \\ \gamma_y &= f(\gamma_o, \lambda) \end{aligned}\right\} \text{H.W.: Derive them!}$$

#



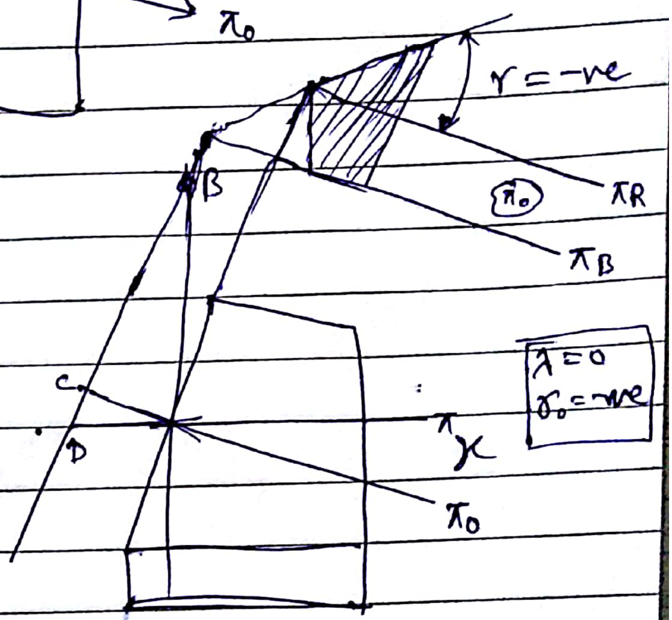
ML if || to a particular plane $\Rightarrow$ Rake angle measured on that plane $= 0^\circ$

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



tool tip towards the operator

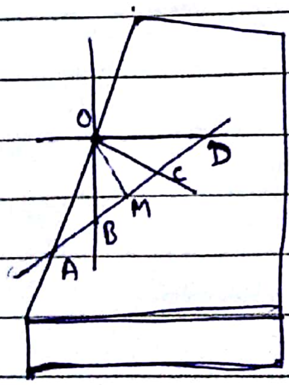
$\gamma_y = 0$
$\lambda = -ve$



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

→ 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



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

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

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

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

$\because$ OM is least

$\therefore$ γ_M is max among all