Variables: Cutting

* Angles: α, ϕ, β
* Coefficient of friction: μ — static μ_s > dynamic μ_k
* Cutting ratio: $r = \frac{t_0}{t_c} = f(\alpha, \phi)$ 0.5–2
* Shear strain: $\gamma = \frac{\overline{AB}}{\overline{OC}} = \frac{\text{shear length}}{\text{dist. bet } \perp \text{ planes (d)}}$ (reference)

Note: Variables ↑ are unitless
adv.: makes calculation easier

relations bet. variables:

* $\underline{\alpha, \phi, \beta}$:

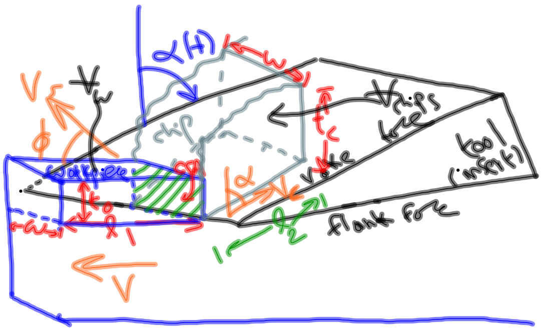
as $\alpha \downarrow \Rightarrow \phi \downarrow$ } $\Rightarrow$ chip thick (t_c) $\uparrow$
as $\beta(\mu) \uparrow \Rightarrow \phi \downarrow$ }

$\phi \downarrow \Rightarrow \sigma \uparrow$ ($\because \overline{AB} \uparrow$)

$\Rightarrow$ more energy / power loss (ie. more consumption $\Rightarrow$ \$ $\uparrow$)

Also $\Rightarrow$ temp, heat $\uparrow$
$\Rightarrow$ tool wear $\uparrow$

Conc. : choose carefully parameters of cutting : $\Rightarrow \alpha$
$\hookrightarrow$ tool material proper for workpiece material



Conserv^on of Volume

workpiece mat cut → chips

$$\forall_{mat} = \forall_{chips}$$

$$(C.S.A)_{mat}\, l_{mat} = (C.S.A)_{chip}\, l_{chip}$$

$$w\, t_o\, l_1 = w\, t_c\, l_2$$

include time (divide by t):

$$MRR = \frac{w t_o l_1}{t} = \frac{w t_c l_2}{t}$$

MRR = mat. removal rate; $\frac{l_1}{t} \to V$, $\frac{l_2}{t} \to V_c$

$$\cancel{w}\, t_o V = \cancel{w}\, t_c V_c$$

$$t_o V = t_c V_c$$

$$r = \frac{t_o}{t_c} = \frac{V_c}{V} = \frac{\sin\phi}{\cos(\phi - \alpha)}$$

∴ Cons. of mass/Volume ⇒ relation:

angles, lengths, speeds

$$r = f_1(\alpha, \phi),\ f_2(t_o, t_c),\ f_3(V, V_c)$$

BONUS

1. Slide 13:
Show relations in both triangles are equivalent < ΔABV, ΔVV_cV_s
(show all angles)

2. Slide 15.
Show 2 relations (left & right) are the same equivalent (r, ϕ)

3. Slide 17.
a) Show that the two relations for γ are equivalent
b) show that as $\alpha \downarrow \Rightarrow \gamma \uparrow$

4. Show relations bet. V, V_c, V_s
Slide 19