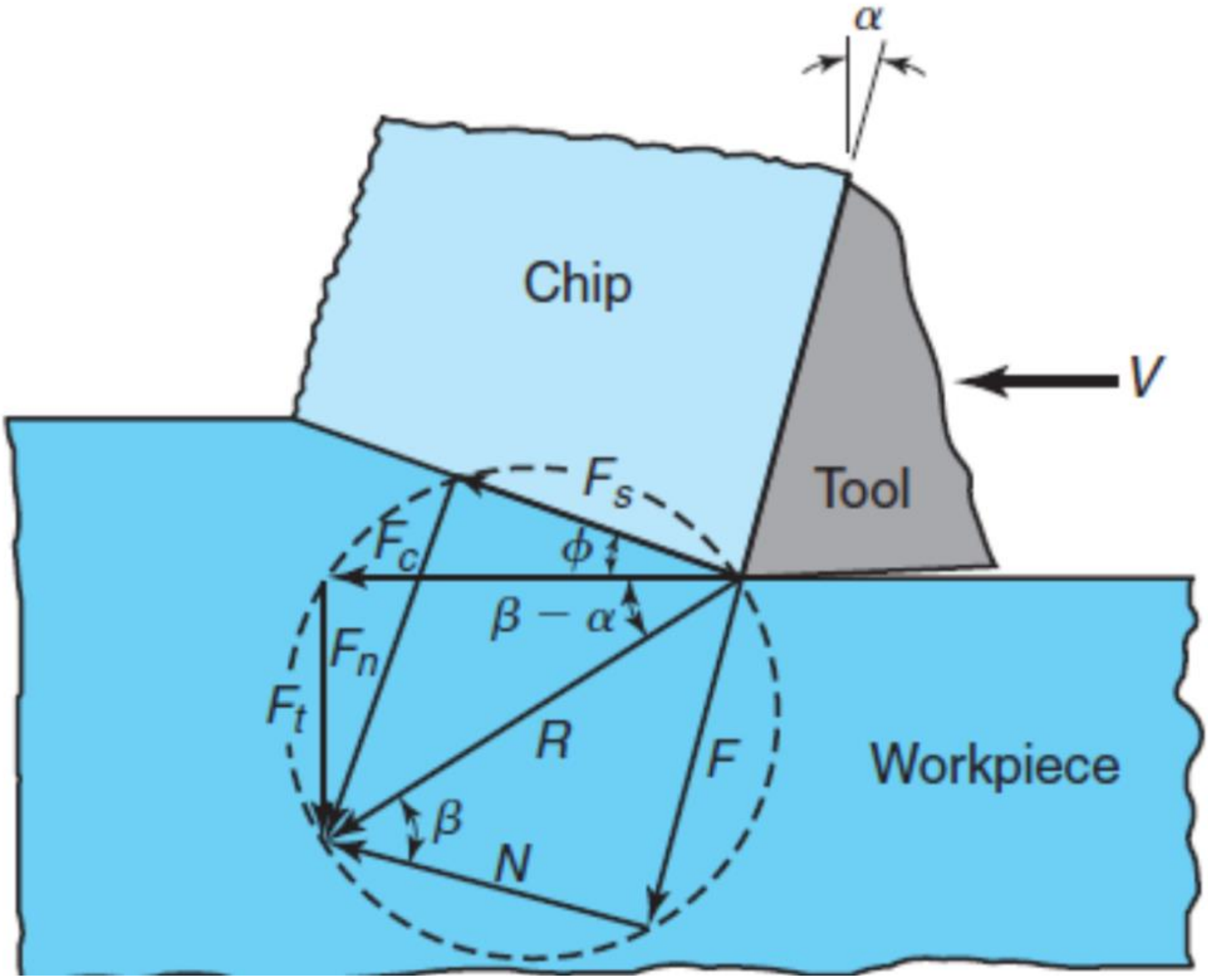
α
Chip
V
Tool
F_s
F_c
ϕ
$\beta - \alpha$
F_n
F_t
R
F
Workpiece
β
N

	Cutting	Shear	Friction
lengths	t_o, w (I.V.)	$\gamma = f(\alpha, \phi)$	t_c (can measure)
angles	α (I.V.)	$\phi = f(t_o, t_c, \alpha)$ ($r = t_o/t_c$)	β ($\tan\beta = \mu$) lookup
speeds	V (I.V.), f (I.V.)	$V_s = f(V, \alpha, \phi)$	V_c chip ($V_c = V \frac{t_o}{t_c}$)
Forces	$\vec{F_c} \perp \vec{F_t}$ (cutting)	$\vec{F_s} \perp \vec{F_n}$	$\vec{F} \perp \vec{N}$
	⇓ R	⇓ $\vec{R}$	⇓ $\vec{R}$

measure using device (eg dynamometer)

$(R = \sqrt{F_c^2 + F_t^2})$

$(R = \sqrt{F_s^2 + F_n^2})$

$(R = \sqrt{F^2 + N^2})$

$F_s = f(F_c, F_t, \phi)$

$F_n = f(F_c, F_t, \phi)$

$F = f(F_c, F_t, \alpha)$

$N = f(F_c, F_t, \alpha)$

$F_c \leftrightarrow P_s$

$F_t \leftrightarrow P_t$

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power: $U_t = F_c . V$ $\quad U_s = F_s . V_s$ $\quad U_f = F . V_c$

$$U_t = U_s + U_f$$

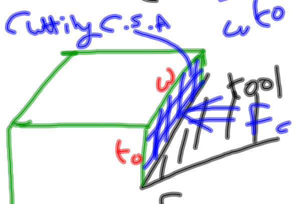
sp. power:

$u_t = \frac{U_t}{MRR} = \frac{F_c . V}{w t_o V}$

$u_s = \frac{U_s}{MRR} = \frac{F_s . V_s}{w t_o V}$

$u_f = \frac{U_f}{MRR} = \frac{F . V_c}{w t_o V} = \frac{F r}{w t_o}$

$f_c = \frac{F_c}{w t_o}$



$f_c = \frac{F_c}{w t_o}$ (universal cutting equation)

$$u_t = u_s + u_f$$

$$\frac{F_c}{w t_o} = \frac{F_s . V_s}{w t_o V} + \frac{F r}{w t_o}$$