

Cont. Sp. Cutting Parameters

\* Sp. Cutting Force      Dimensions      Units (SI)

$$f_c = \frac{F_c}{C.S.A_c}$$

$$= \frac{F_c}{f_c \cdot l_c}$$

$$= \frac{F_c}{\omega t_0}$$

force / area      [kN/m<sup>2</sup>]  
 or [kPa]  
 or [N/mm<sup>2</sup>]  
 or [MPa]

\* Sp. Cutting Work/Energy      Energy / Vol.      [kJ/m<sup>3</sup>]  
 [J/mm<sup>3</sup>]

$$W_c = f_c \cdot l_c$$

$$sp. work = \frac{f_c \cdot l_c}{\omega t_0 l_c} = \frac{f_c}{\omega t_0} = f_c$$

\* Sp. Cutting Power      power / MRR      [W / (mm<sup>3</sup>/s)]  
 = [W·s / mm<sup>3</sup>]

$$U_t = f_c \cdot V$$

$$U_t = \frac{f_c \cdot V}{\omega t_0 V} = f_c$$

\* Summary: *is equivalent to*

Sp. force (f<sub>c</sub>)      =      Sp. work/energy      =      Sp. power (U<sub>t</sub>)

$$\frac{f_c}{\omega t_0} = \frac{f_c \cdot l_c}{\omega t_0 l_c} = \frac{f_c \cdot V}{\omega t_0 V}$$

\* How to find cutting force  $F_c$   
( $P_s$ )

① Direct Measurement

a) force transducer: sensor

b) dynamometer:  
like spring scale  
(mechanical)  
unit of force (US system)

c) load cell:  
uses electrical strain gage

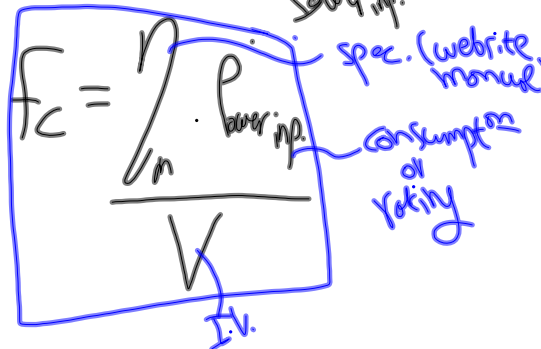
② Using Power Consumption

"eta"  $\eta$

$$\eta = \frac{\text{Power}_c}{\text{Power}_{\text{inp.}}} = \frac{P_s}{U_t}$$

mechanical motor ( $\leq \frac{1}{2}$ )

$$\eta = \frac{F_c \cdot V}{\text{Power}_{\text{inp.}}}$$



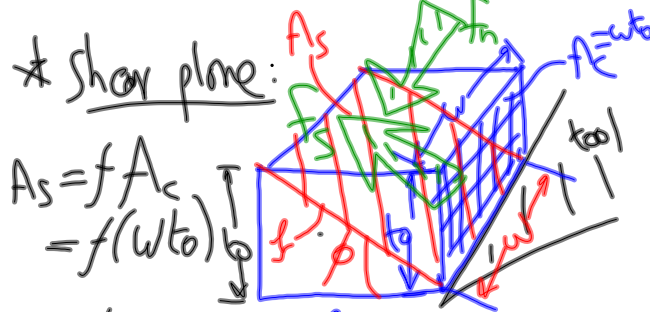
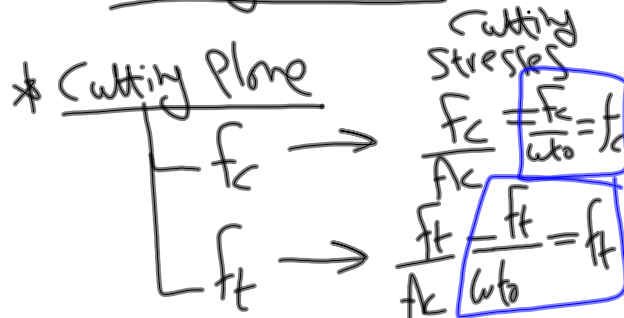
③ sp. energy tables

eg Mg alloy 0.3-0.6 W.s/mm<sup>3</sup>  
 $u_t = 0.45 \text{ W.s/mm}^3$

$$u_t = \frac{F_c \cdot V}{\omega \cdot t \cdot V} = \frac{F_c}{\omega \cdot t}$$

$$\Rightarrow F_c = u_t \cdot (\omega t)$$

# Cutting Stress



$$\sin \phi = \frac{t_0}{l_s} \Rightarrow l_s = \frac{t_0}{\sin \phi}$$

$$A_s = w l_s = \frac{wt_0}{\sin \phi} = \frac{A_c}{\sin \phi}$$

shear stress due to  $f_s$ :

$$\tau_s = \frac{F_s}{A_s} = \frac{F_s}{\frac{wt_0}{\sin \phi}} = \frac{F_s \sin \phi}{wt_0}$$

$$F_n: \sigma_n = \frac{F_n}{A_s} = \frac{F_n \sin \phi}{wt_0}$$

\* friction (tool chip) plane:

rate force

$$F: \tau = \frac{F}{c \cdot SA_{fric}} = \frac{F}{wt_c}$$

$$N: \sigma = \frac{N}{c \cdot SA_{fric}} = \frac{N}{wt_c}$$