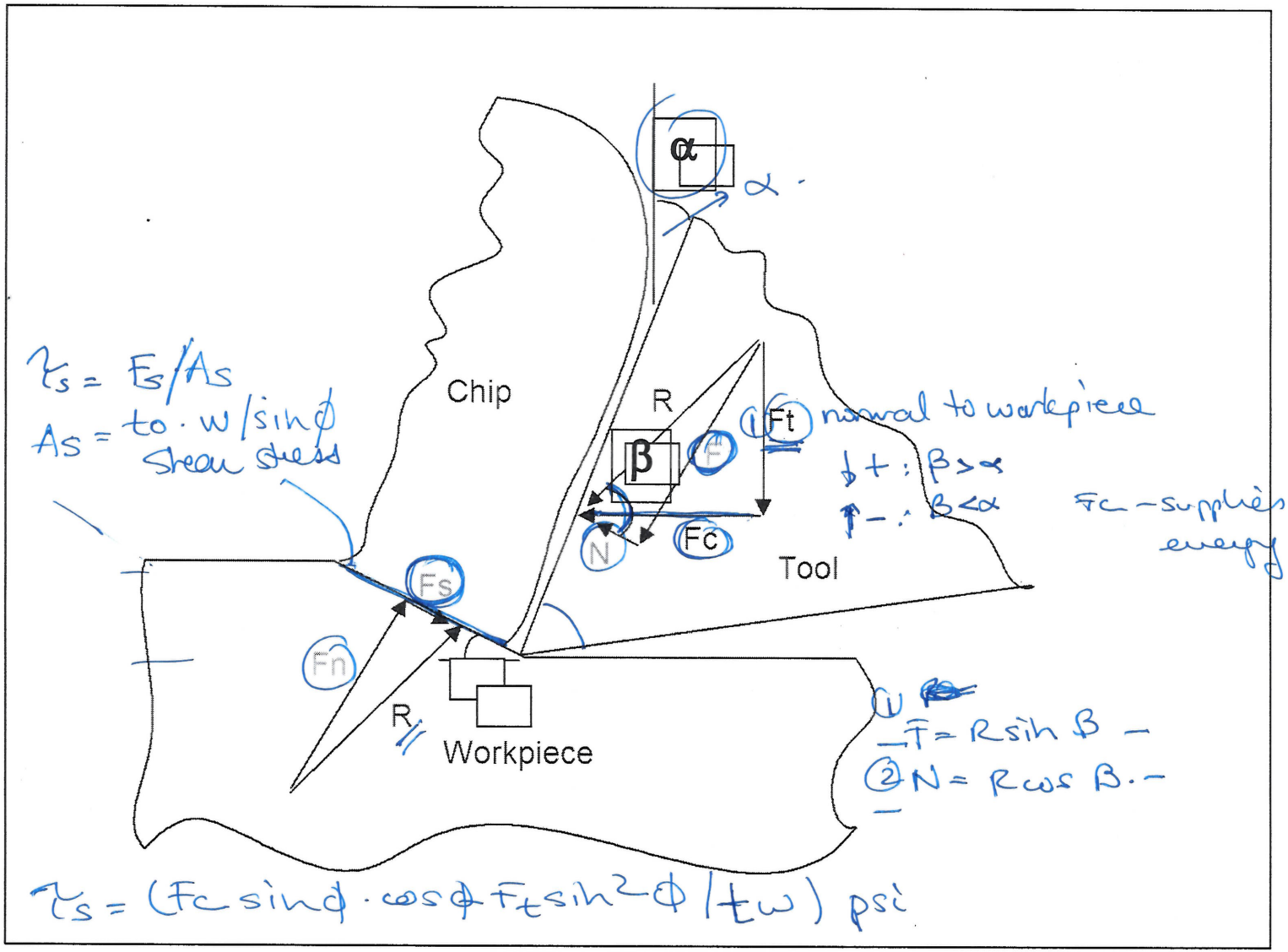
Cutting Forces and Power



$\tau_s = F_s / A_s$

$A_s = t_o \cdot w / \sin\phi$

shear stress

① Ft normal to workpiece

↓ + : $\beta > \alpha$

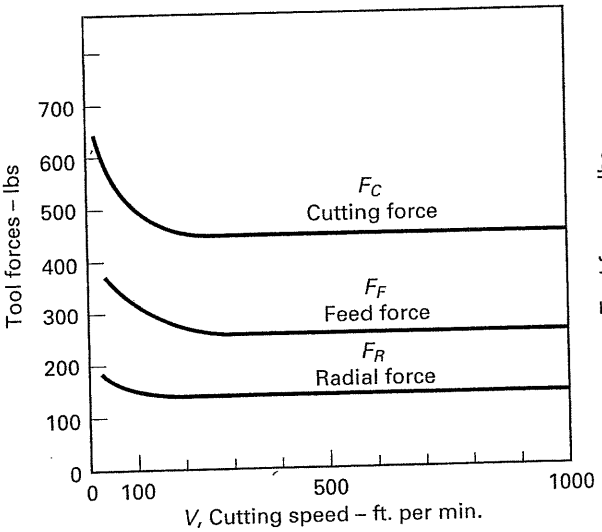
↑ − : $\beta < \alpha$

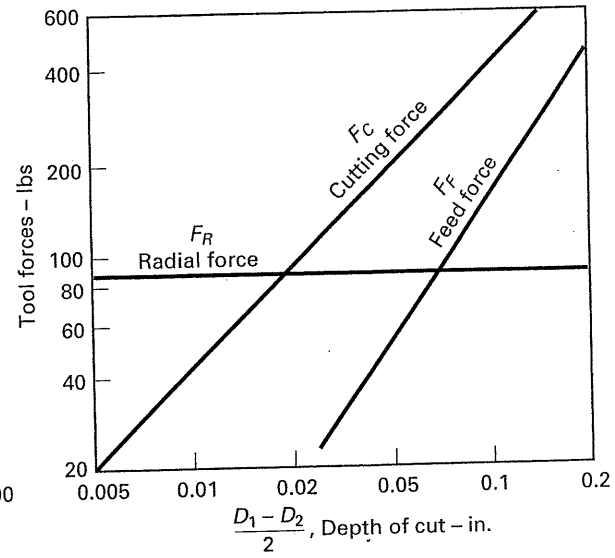
Fc − supplies your energy

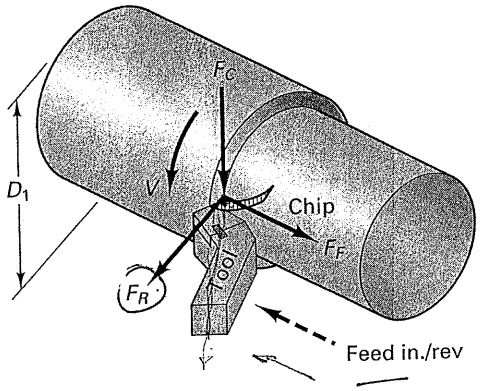
① $F = R \sin\beta$

② $N = R \cos\beta$

$\tau_s = (F_c \sin\phi \cdot \cos\phi + F_t \sin^2\phi / t_o w)$ psi







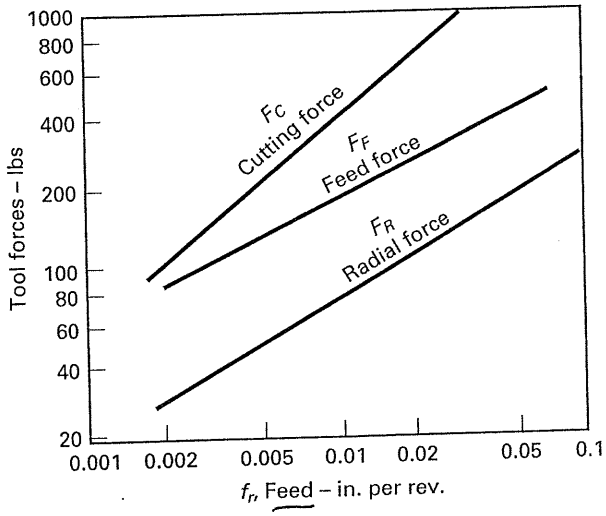


FIGURE 21-11 Oblique machining has three measurable components of forces acting on the tool. The forces vary with speed, depth of cut, and feed.

3 Force

F_C = Cutting force (vertical)

F_R = Radial force (thrust)

F_F = Feed force

The power required for cutting is

$$P = F_c V (\text{ft-lb/min})$$

The horsepower at the spindle of the machine is therefore

$$\text{hp} = \frac{F_c V}{33{,}000}$$

In metal cutting a very useful parameter is called the unit, or specific, horsepow which is defined as

$$\text{HP}_s = \frac{\text{hp}}{\text{MRR}} (\text{hp/in}^3/\text{min})$$

In turning, for example, where $\text{MRR} \cong 12 V f_r d$, then

$$\text{HP}_s = \frac{F_c}{396{,}000 f_r d}$$