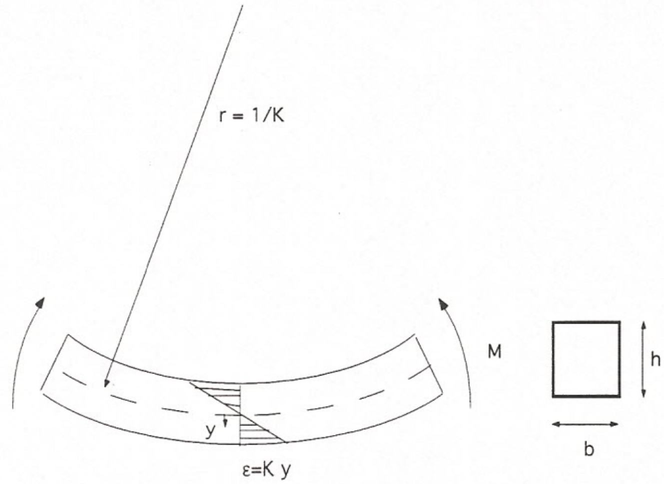
Derivation of the Bending Stiffness of a Rectangular Beam



$\varepsilon(y) = Ky$

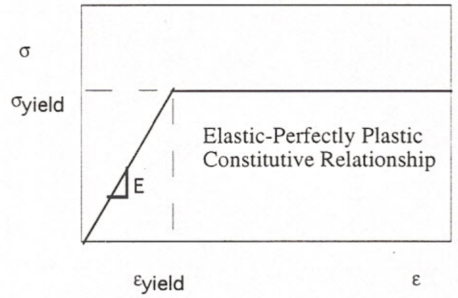
$\sigma = E\varepsilon = E\,K\,y$ (for elastic beam only)

$$M = 2\int_0^{h/2} \sigma\, b\, y\, dy$$

$$= 2b \int_0^{h/2} E\,K\,y^2\, dy$$

$$= \frac{2}{3} b\,E\,K\,(h/2)^3$$

$$= E\,\frac{1}{12} b\,h^3\ K$$



Moment of inertia for a rectangular section

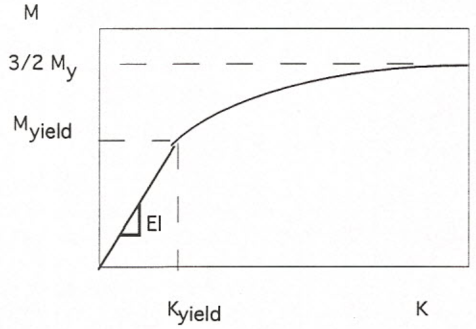
$$I = \frac{1}{12} b\,h^3$$

Therefore for the elastic region (when $K < K_{yield}$):

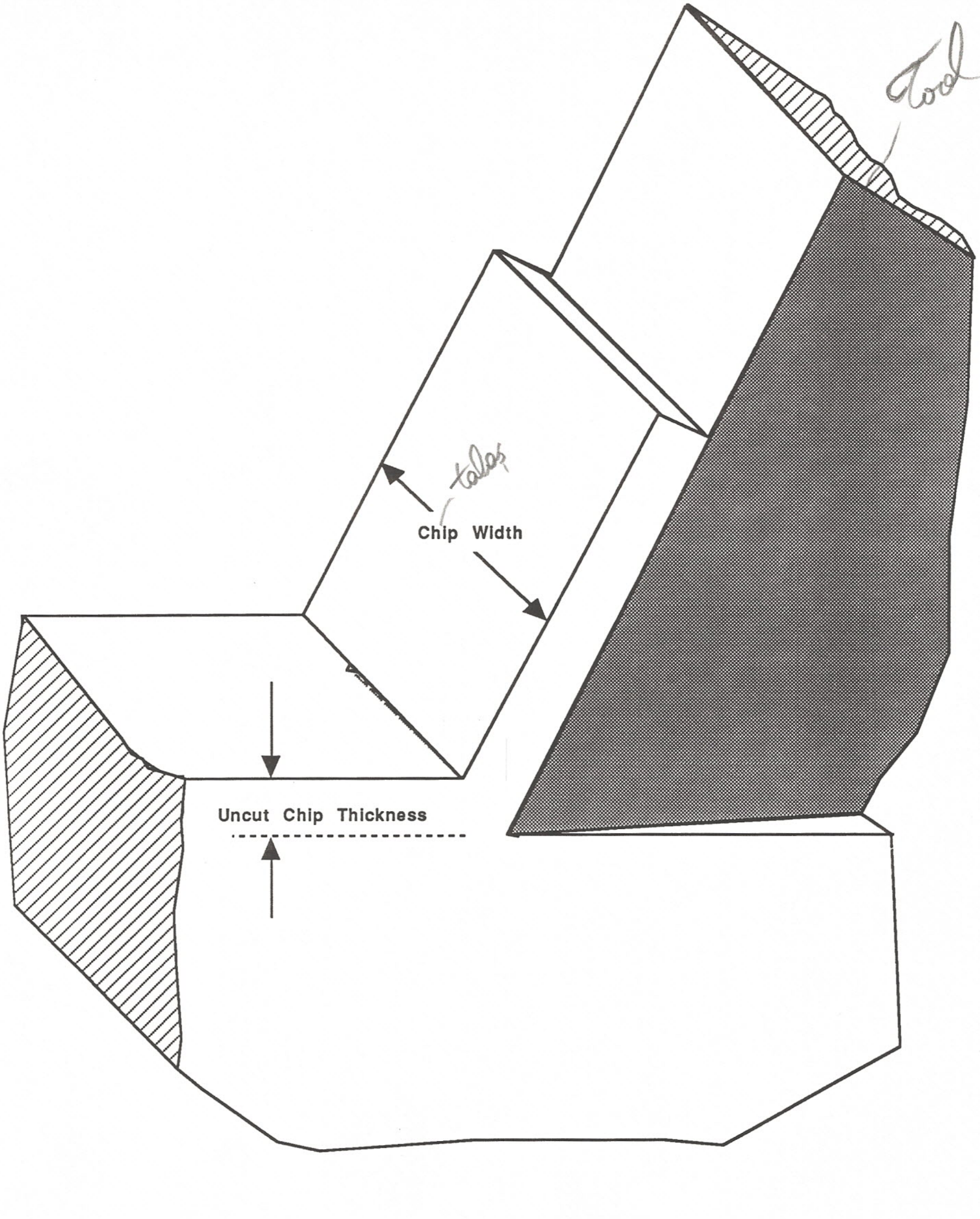
$$M = EI\ K$$

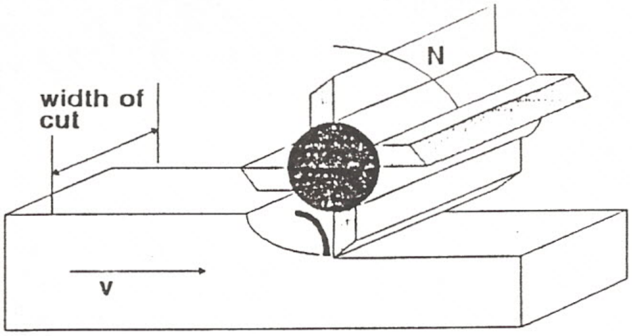
A similar derivation for the elastic - plastic region, assuming that $\sigma = \sigma_{yield}$ for $\varepsilon > \varepsilon_{yield}$ leads to the expression for the moment curvature relationship for a rectangular beam for $K > K_{yield}$:

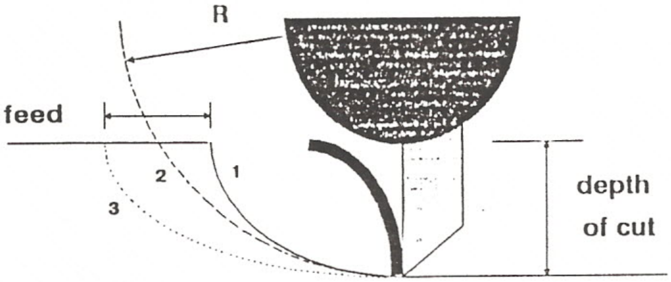
$$M = \frac{3}{2} M_{yield}\left(1 - \frac{1}{3}\left(\frac{K_{yield}}{K}\right)^2\right)$$



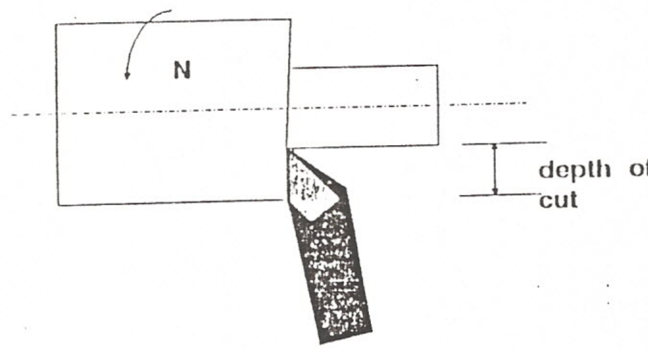
Resulting Moment Curvature Diagram for a Rectangular Beam

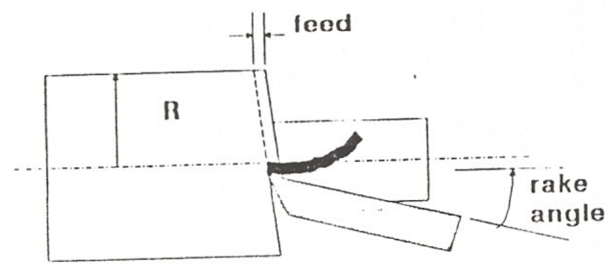

Chip Width
Uncut Chip Thickness





1. Previous Cutter Path
2. Tool Radius (path with zero feed)
3. Cutter path with finite feed





Simple Turning Geometry

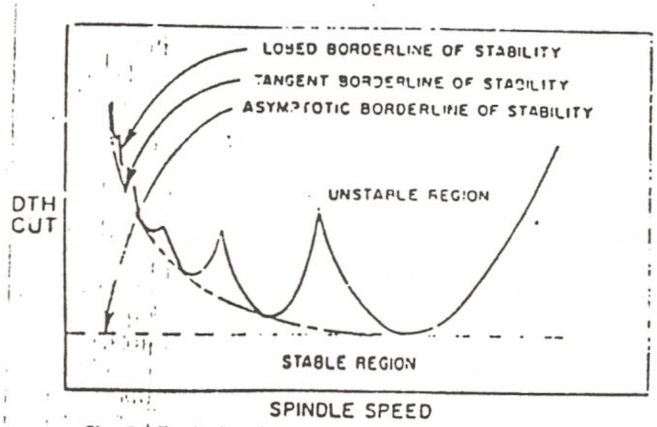


Fig. 1 Typical stability chart for a machine tool

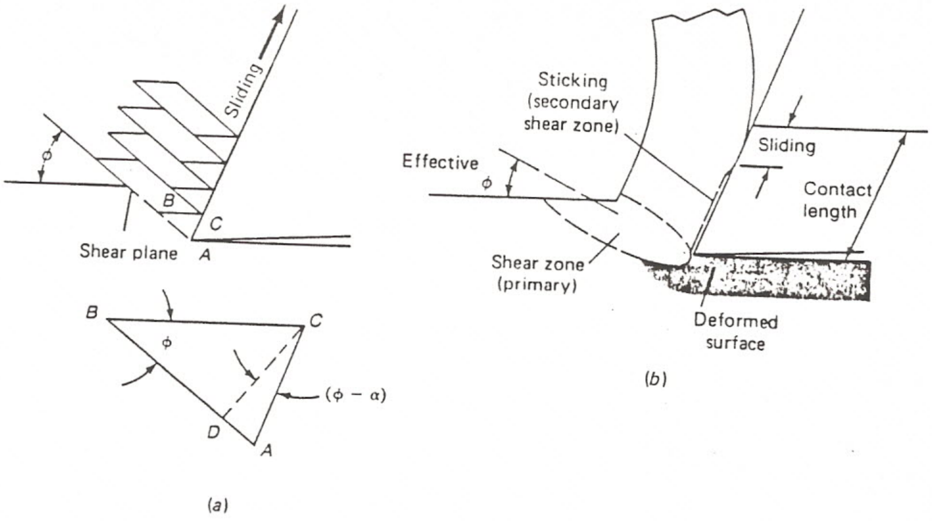


FIGURE 8-2 Chip formation may be visualized as (*a*) simple shearing but is (*b*) more complex in reality.

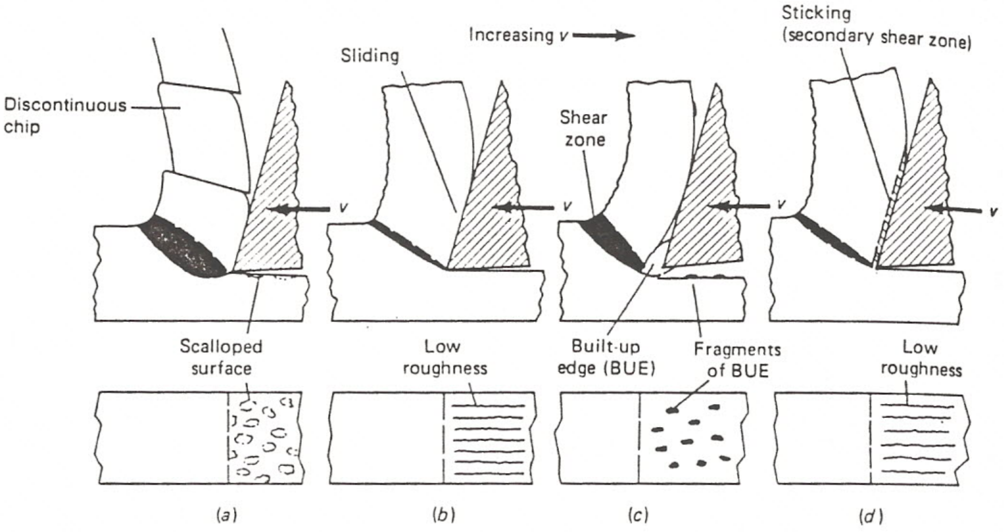


FIGURE 8-4 The process of chip formation changes with cutting speed. When cutting steel, the chip (*a*) is discontinuous at speeds below 2 m / min, (*b*) is continuous and slides on the rake face at 7 m / min, (*c*) forms with a built-up edge at 20 m / min, and (*d*) develops a secondary shear zone at 40 m / min. (*After M. C. Shaw, in Machinability, Spec. Rep. 94, The Iron and Steel Institute, London, 1967, pp. 1–9.*)

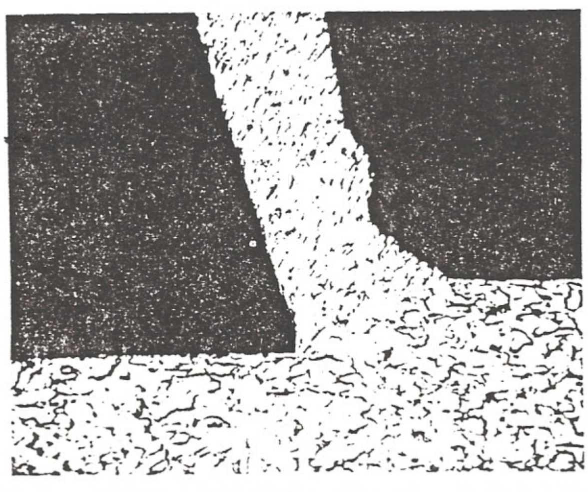


Figure 16-5 Photomicrograph of the formation of a continuous chip. (Courtesy Cincinnati Milacron, Inc.)