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Example 1: Tool Geometry

What roles do rake and relief angles play in cutting tools?

Example 1: Cutting forces and Power

In orthogonal machining the tool has rake angle 10°, chip thickness before cut is t_o = 0.02 in, and chip thickness after cut is t_c = 0.045 in. The cutting and thrust forces are measured to be F_c = 350 lb and F_t = 285 lb while at a cutting speed of 200 ft/min. Determine the machining shear strain, shear stress, and cutting horsepower.

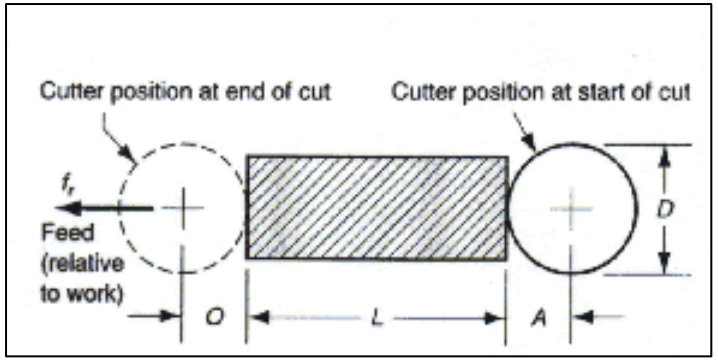
Example 2: Time Analysis for Milling

A face milling operation is performed to finish the top surface of a steel rectangular workpiece 12 in. long by 2 in. wide. The milling cutter has 4 teeth (cemented carbide inserts) and is 3 in. in diameter. Cutting conditions are 500 rpm, f = 0.01 in./tooth, and d = 0.150 in. Determine the time to make one pass across the surface and the metal removal rate during the cut.

Solution:

Allow for over-travel O where A = O:

Full face A = O = D/2



Example 3: Tool Life

The n and C values in accompanied table are based on a feed rate of 0.01 in./rev and a depth of cut of 0.10 in. Determine and compare the cubic inches of steel removed for each of the following tool materials if a 15 minute tool life is required in each case: a) HSS b) ceramic

Solution:

Tool Material	n	C ft/min	C (m/min)
Plain carbon tool steel			
Nonsteel cutting	0.1	200	(70)
Steel cutting	0.1	60	(20)
High-speed steel			
Nonsteel cutting	0.125	350	(120)
Steel cutting	0.125	200	(70)
Cemented carbide			
Nonsteel cutting	0.25	2700	(900)
Steel cutting	0.25	1500	(500)
Cermet			
Steel cutting	0.25	2000	(600)
Coated carbide			
Steel cutting	0.25	2200	(700)
Ceramic			
Steel cutting	0.6	10000	(3000)

For turning at feed = 0.01"/rev. and depth = 0.100 "

Example 4: Cutting Temperature

Consider a turning operation performed on steel whose hardness = 225 HB at a speed = 3.0 m/s, feed = 0.25 mm, and depth = 4.0 mm. Compute an estimate of cutting temperature using the Cook's equation. Assume ambient temperature = 20°C.

Solution:

$$\Delta T = \frac{0.4U}{\rho_C}\left(\frac{vt_o}{K}\right)^{0.333}$$

Example 5: Orthogonal Cutting

Assume that in orthogonal cutting, the rake angle is 15° and the coefficient of friction is 0.25 determine the percentage change in chip thickness when the friction is doubled.

Example 6: Drilling

A hole is being drilled in a block of magnesium alloy with a 10 mm drill at a feed of 0.1 mm/rev. The spindle is running at 800 rpm. Calculate the material removal rate, and estimate the torque on the drill (*Hint: The unit power for Mg-alloys is about 0.5 W.s/mm^3).*

Next Lecture:

Friction and Lubrication