DRILLING PROBLEMS

Problem 1

In a drilling operation:

Hole diameter =30 mm
Hole depth = 100mm
Cutting speed = 300 r.p.m
Feed =0.25 mm/rev
Specific cutting resistance = 2000 N/mm^2

Calculate:

a- The chip area.
b- The main cutting force.
c- Machining time.
d- Material removal rate.

$D = 30\,mm,\ L = 100\,mm,\ N = 300\,rpm$

$S = 0.25\ mm/rev,\ K_s = 2000\ N/mm^2$

$A = ?\quad P_s = ?\quad T_m = ?\quad Q = ?$

$$A = \frac{D \times S}{4} = \frac{30 \times 0.25}{4} = 1.87\ mm^2$$

$$F_c = K_s \times A = 2000 \times 1.87 = 3750\ N$$

$$T_m = \frac{L + (D/4)}{S \times N} = \frac{100 + (30/4)}{0.25 \times 300} = 1.43 \text{ min}$$

$$Q = \pi \frac{D^2 S \times N}{4} = 53014.4 \text{ mm}^3/\text{min}$$

$$= \frac{53014.4}{1000} \text{ cm}^3/\text{min}$$

$$= 53 \text{ cm}^3/\text{min}$$

Problem 2

In a drilling operation using a twist drill, the lip angle is 120 degree (standard), the spindle speed is 300 rpm, the feed is 0.2 mm/rev and the drill diameter is 10 mm. Calculate:

a - the machining time to drill a through hole 30 mm long.
b - the drill torque in [N-m] assuming that specific cutting resistance for the work. material is 200 Kg/mm^2.
c - the amount of material removed at the first 10 sec after full engagement of drill.
d - the cutting power if cutting force is 2000 N.

$N = 300$ rpm, $S = 0.2$ mm/rev, $D = 10$ mm, $L = 30$ mm

(a) $\because T_m = \dfrac{L + D/4}{S \times N} = \dfrac{30 + 10/4}{0.2 \times 300} = 0.54$ min

(b) $K_s = 200$ kg/mm^2 $= 200 \times 9.81$ N/mm^2

$= 1960$ N/mm^2

$\because M = K_s \times \dfrac{D^2 \times S}{8} = 1960 \times \dfrac{10^2 \times 0.2}{8} = 4900$ N.mm

$= 4.9$ N.m

(C) Let's first find MRR

$MRR = V \times \dfrac{S \times D}{4} = \pi D N \times \dfrac{0.2 \times 10}{4}$

$= 3.14 \times 10 \times 300 \times \dfrac{0.2 \times 10}{4}$

$MRR = 4712$ mm^3/min

or $MRR = 4712/60$ mm^3/sec

Now Material removed in 10 sec $= \dfrac{4712}{60} \times 10$

$= 785.33$ mm^3

(d) $P_m = P_s \times V$

$= 2000 \times \left(\pi \times \frac{10}{1000} \times 300/60\right)$

$P_m = 314.15$ watts

Problem 3

A gun drilling operation is used to drill a 7/16 in.- diameter hole to a certain depth. It takes 4.5 min to perform the drilling operation using high-pressure fluid delivery of coolant to the drill point. The cutting conditions are N = 300 rev/min at a feed = 0.001 in./rev. To improve the surface finish in the hole, it has been decided to increase the speed by 20% and decrease the feed by 25%. How long will it take to perform the operation at the new cutting conditions?

$D = 7/16$ in

$T_{m_1} = 4.5$ min, $N_1 = 300$ rev/min, $S_1 = 0.001$ in/rev

$N_2 = 1.2 \times 300 = 360$ rev/min

$S_2 = 0.75 \times 0.001$ in/rev $= 0.00075$ in/rev

$$T_{m_2} = \frac{L + D/4}{S_2 N_2} \quad \text{——— (1)}$$

$\because$ $$T_{m_1} = \frac{L + D/4}{S N}$$

$$4.5 = \frac{L + (7/16 \times 4)}{0.001 \times 300}$$

$\Rightarrow L = 1.24$ in

put $L = 1.24$ in in eq-(1)

$$T_{m_2} = \frac{1.24 \times (7/16 \times 4)}{0.00075 \times 360} = 4.99 \text{ min}$$