MILLING PROBLEMS

Problem 1

A slab milling operation is performed to finish the top surface of a steel rectangular workpiece 250 mm long by 75 mm wide. The helical milling cutter, which is 65 mm in diameter and has eight teeth, is set up to overhang the width of the part on both sides. Cutting conditions are v=35 m/min, f = 0.225 mm/tooth, and d = 0.250 in.

Determine:

(a) the time to make one pass across the surface

(b) the metal removal rate during the cut.

$\ell = 250\,mm$, $b = 75$, $V = 35\,m/min$, $S_z = 0.225\,mm/tooth$

$D = 65\,mm$, $z = 8$, $b = 120\,mm$

$e = 0.25\,in = 0.25 \times 25.4 = 6.35\,mm$

$T_m = ?$ $\quad MRR = ?$

① Let's find "L"

(10% of tool diameter)

$$L = 2\sqrt{e(D-e)} + 2C + \ell$$

$$= 2\sqrt{6.35(65-6.35)} + 2(0.1\times 65) + 250$$

$$= 295.1\,mm$$

Also $\quad S_z = \dfrac{U}{n \times Z} \Rightarrow U = S_z \times n \times Z$

$$\because V = \pi D n \Rightarrow n = \frac{V}{\pi D} = \frac{35}{3.14 \times 65/1000} = 171.4\,rev/min$$

Now $\quad U = 0.225 \times 171.4 \times 8$

$$U = 308.5\,mm/min$$

Now $\quad T_m = L/U = 295.1/308.5 = 0.95\,min$

(2) $$MRR = \frac{l \times b \times e}{T_m} = \frac{250 \times 75 \times 6.35}{0.95}$$

$$= 125328.9 \ mm^3/min$$

$$= 125.3 \ cm^3/min$$

Problem 3

In horizontal milling, the following conditions exist:
Work (mild steel with specific cutting energy 3200 N/mm^2); Cutter (No. of teeth 12, tool diameter 120 mm, tool width 30 mm); Machining parameters (cutting velocity 45 m/min, feed velocity 360 mm/min, depth of cut 2.5 mm).

Calculate:

(a) Maximum chip thickness.
(b) Maximum tangential force/tooth.
(c) Machining time for one travel, if work length is 450 mm.
(d) Machining power

$K_s = 3200\ N/mm^2$

$Z = 12,\ D = 120\,mm,\ b = 30\,mm$

$V = 45\ m/min,\ U = 360\ mm/min,\ e = 2.5\,mm$

$h_e = ?,\ P_{s\,max} = ?\quad N_s = ? = P_m = ?$ (Same)

$T_m = ?$ if $l = 450\,mm$.

$$h_e = \frac{U}{n \times Z} \times 2\sqrt{e/D} \qquad \left(\because n = \frac{V}{\pi D} = \frac{45}{\frac{3.14 \times 120}{1000}} = 119.4\ rev/min\right)$$

$$h_e = \frac{360}{119.4 \times 12} \times 2 \times \sqrt{\frac{2.5}{120}} = 0.07\ mm$$

$$P_{s\,max} = K_s \times b \times h_e = 3200 \times 30 \times 0.07 = 6720\ N$$

$$T_m = \frac{L}{U} = \frac{2\sqrt{e(D-e)} + 2C + l}{U}$$

$$= \frac{2\sqrt{2.5(120-2.5)} + 2(0.1 \times 120) + 450}{360} = 1.4\ min$$

$$\text{Power} = P_{s\,(total)mean} \times V$$

$$= K_s \times \frac{U \times e \times b}{\cancel{V}} \times \cancel{V}$$

$$= \frac{3200 \times 360 \times 2.5 \times 30}{1000 \times 60} = 1440 \text{ watts.}$$