Problems for milling

Problem 1

A slab milling operation is performed to finish the top surface of a steel rectangular workpiece 250 mm long by 65 mm wide. The helical milling cutter, which is 75 mm in diameter and has eight teeth, is set up to overhang the width of the part on both sides. Cutting conditions are cutting speed = 35 m/min, feed rate = 0.225 mm/tooth, and depth of cut = 6.35 mm.

Determine:

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

(b) the metal removal rate during the cut.

Problem 2

A peripheral milling operation is performed on the top surface of a rectangular workpart that is 300 mm long by 100 mm wide. The milling cutter, which is 75 mm in diameter and has four teeth, overhangs the width of the part on both sides. Cutting conditions are cutting speed = 80 m/min, feed rate = 0.2 mm/tooth, and depth of cut = 7.0 mm.

Determine:

(a) the time to make one pass across the surface
(b) the material removal rate during the cut.

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 rate = 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 consumed during the process
(e) Motor power if machine efficiency is 85%

Prob. 1 milling

$L = 250$ mm, width of workpiece $= 65$ mm $= w$

This is a Slab milling operation

$D = 75$ mm, $Z = 8$

$V = 35$ m/min, $f = 0.225$ mm/tooth

$d = 6.35$ mm

(i) $T_m = ?$ (ii) $MRR = ?$

DLC 1.1.

$$\because T_m = \frac{L + A}{f_r}$$

$$A = \sqrt{d(D-d)}$$

$$= \sqrt{6.35(75-6.35)}$$

$$= 20.87 \text{ mm}$$

Also

$$f = \frac{f_r}{N \times Z}$$

$$\because V = \pi D N$$

$$\Rightarrow N = \frac{V}{\pi D} = \frac{35}{\frac{3.14 \times 75}{1000}} = 148 \text{ rev/min}$$

Now $f_r = f \times N \times Z$

$$= 0.225 \times 148 \times 8$$

$$f_r = 266.4 \text{ mm/min}$$

Now

$$T_m = \frac{250 + 20.87}{266.4}$$

$$T_m = 1.02 \text{ min}$$

$$MRR = \frac{L \times d \times f}{T_m}$$

$$= \frac{250 \times 6.35 \times 0.225}{1.02}$$

$$= 3502 \text{ mm}^3/\text{min}$$

Prob 3 milling

$K_s = U_t = 3200\ N/mm^2$, $L = 450\ mm$

$z = 12$, $D = 120\ mm$, Tool width $= 30\ mm$ (w)

$V = 45\ m/min$, $f_r = 360\ mm/min$

$d = 2.5\ mm$

(i) $t_c = ?$ (ii) $P_{s\,max} = ?$ (iii) $T_m = ?$

(iv) Machining Power $= ?$ (V) Motor Power $= ?$

$\eta = 0.85$

(i) $t_c = \dfrac{2 f_r}{N \times Z}\sqrt{d/D}$

$\therefore N = \dfrac{V}{\pi D} = \dfrac{45}{3.14 \times \frac{120}{1000}} = 119.36\ rpm$

$t_c = \dfrac{2 \times 360}{119.36 \times 12}\sqrt{\dfrac{2.5}{120}} = 0.073\ mm$

(ii) $P_{s\,max} = K_s \times w \times t_c = 3200 \times 30 \times 0.073$

$P_{s\,max} = 7008\ N$

(iii) $T_m = \dfrac{L + A}{f_r}$ $\therefore A = \sqrt{d(D-d)}$

$A = \sqrt{2.5(120-2.5)} = 17.14\ mm$

$T_m = \dfrac{450 + 17.14}{360} = 1.29\ min$

(iv) $\therefore$ Maching Power $= P_{s(total)\,mean} \times V$

Also $P_{s(total)\,mean} = \dfrac{f_r \times d \times w}{\pi \times D \times N} \times K_s$

$= 1920.1\ N$

$\therefore Power_{machining} = 1920.1 \times \dfrac{45}{60}$

$Power_{machining} = 1440\ Watts$

(V) $P_{ower\ motor} = P_{s\,max} \times V \times \dfrac{1}{\eta}$

$= \left(7008 \times \dfrac{45}{60}\right) \times \dfrac{1}{0.85}$

$= 6183.5\ Watts$