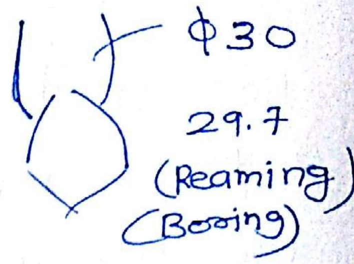
Drilling :-

It is a process of creating hole.



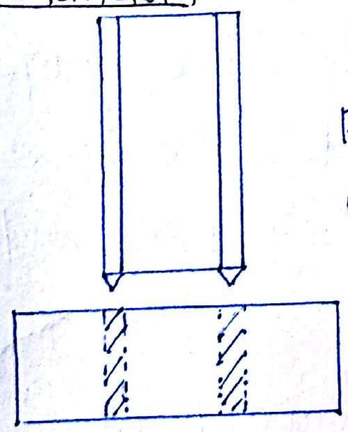
⇒ Hole produced by any drill will be slightly smaller than size some margin is kept for Reaming operation.

⇒ **Reaming** :- is a process of exacting the hole

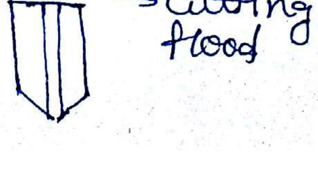
⇒ In twist drill there will be some unbalance masses due to which it's body may rub the finish part. To avoid this rubbing drill body is slightly tappered

Boring :- It is the process enlarging the hole primarily by single point cutting tool. Multiple cutting point tools are also available.

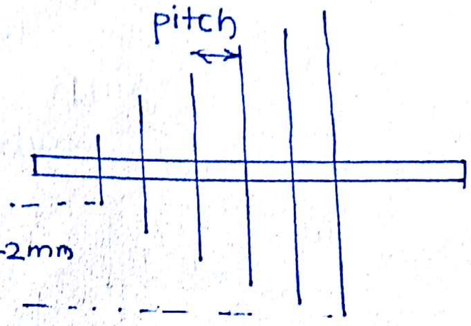
Trepanning :- & Gundrill

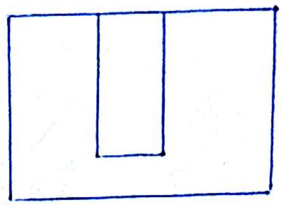


In trepanning process material is removed only from the peripheri and the central portion rises inside the tube it is ment to produce large diameter hole. very deep hole are produced by Gun drills. There is hole at Centre through which we pumping cutting Flood in machining area. It not only take heat from machining area but also helps the chip to flow in backward direction



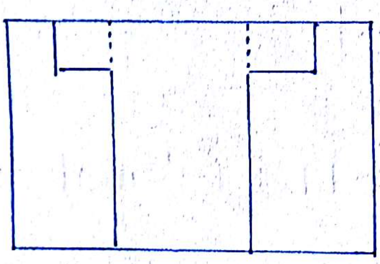
Broaching:- Broach is a multipoint cutting tool in which cutting edge are increasing in diameter. When the broach pulled through a hole we get mirror like surface finish.
(used for super finishing)



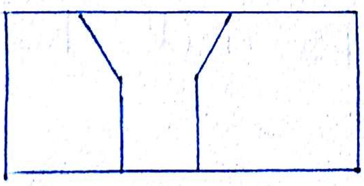


Blind hole.

Counter ~~milling~~ Boring: It's a process of increasing the diameter of hole by end milling process and it is a ~~sitting~~ Seating place for bolts and nuts



Counter Sinking:- It's a process of making the hole slightly tapper at the entry by sinking tool or tool of slightly larger in diameter the purpose it is ~~sitting~~ Seating place screw heads.



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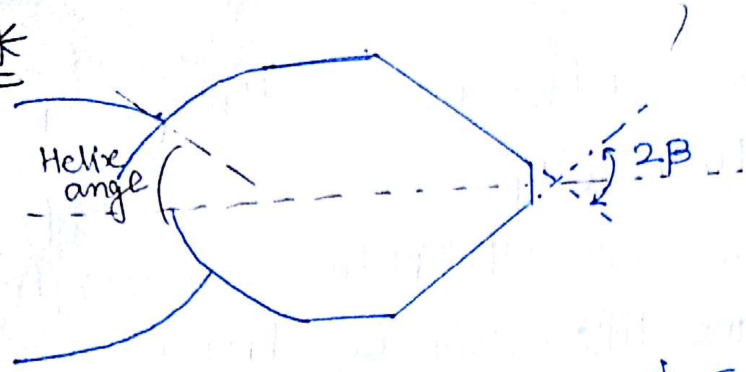
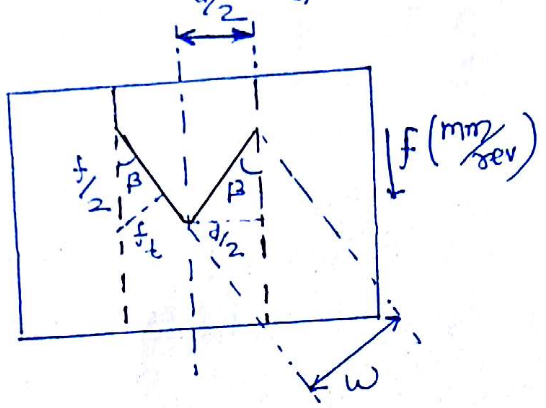


β - point angle.

d = depth of cut

drilling

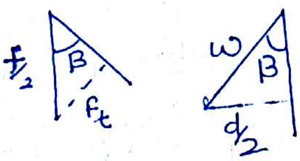


$$\frac{d/2}{w} = \sin\beta$$

$$w = \frac{d/2}{\sin\beta}$$ → width of chip

$$\frac{f_t}{f/2} = \sin\beta \Rightarrow f_1 = t_1 = \frac{f}{2}\sin\beta$$

↳ uncut chip thickness



$\frac{f}{2}$ = effective feed

Point angle in the drill is having effect similar to SCEA in single point cutting tool.

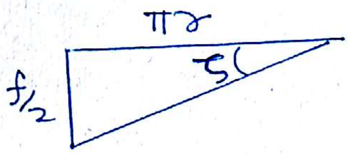
As it can be seen in the analysis that smaller is the point angle chips will be thiner and wider.

→ while machining Ductile material since it produce continuous chip, if the chips are thick it will accumulate in helix due to work hardening. So for machining ductile material we use smaller point angle because thiner chip will easily come out through helix.

Helix Angle

* At the centre of drill since cutting edge murge to the chiesel edge rake angle will be zero. As we are moving towards ~~pberi~~ peripheri rake angle will gradualy increase and after ~~pbes~~ peripheri since cutting edge murge into helix so rake angle will exactly equal to helix angle.

Feed Angle (τ)



$$\tan \tau = \frac{f}{2\pi r}$$

Clearance Angle

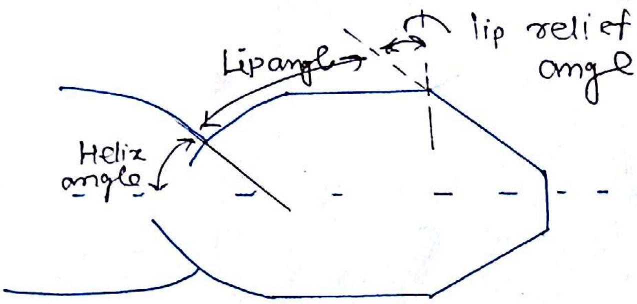
	Ductile	Brittle
Clearance	8-12	6-9
Point angle	118°	135°

Flute:- through which Chips goieng out

Feed Angle:-
Work piece material that is going from the back side of cutting edge form an angle with the horizontal plane called feed angle.
This material will be removed by the next cutting edge in next half revolution.
Due to this feed angle work material will

try to hit the cutting edge and try to break it. So clearance is provided on the tool to avoid this rubbing.

For machining ductile material since there will be elastic recovery so large clearance has to be provide to the tool.



Helix angle + lip Angle + lip relief angle = 90°

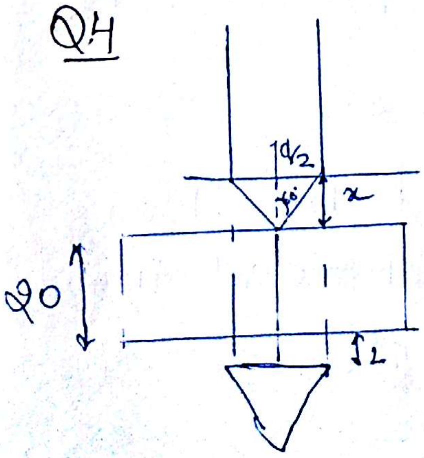
CHAP-6

work book

Q.3 $f = 3.9$ m/min $\quad V = \frac{3900}{6} = 650$ rpm

$P = 6$ mm

Q4



$\frac{d/2}{x} = \tan 60° \Rightarrow x = \frac{5}{\tan 60°} = 2.8$

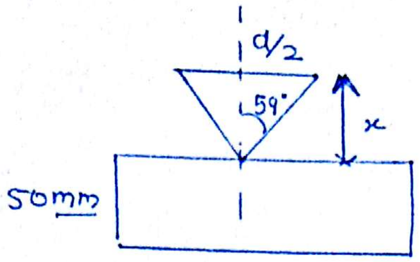
$l = x + 20 + 2$

$l = 22 + 2.8 = 24.8$ mm

No. of rev. $= \frac{l}{feed} = \frac{24.8}{0.2}$ rev

$time = \frac{24.8 \times 60}{0.2 \times 300} = 25$ sec.

Q.13



$$\frac{d/2}{x} = \tan 59°$$

$$x = \frac{7.5}{\tan 59°} = 4.500 \text{ mm}$$

$$l = 4.50 + 50 + 2 + 2 = 58.50 \text{ mm}$$

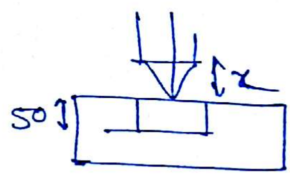
$$\text{No. of rev.} = \frac{l}{f} = \frac{58.50}{0.2} = 292.53 \text{ rev.}$$

$$T = \frac{278.3 \times 60}{500} = ~~33.39 \text{ sec.}~~ \; 35.10 \text{ secs}$$

* if point angle Not give.

1. Calculate without Considering x
2. or Consider $x = 0.3d$ and Calculate

Q.19



$$L = 50 + \frac{5}{\tan 60°} = 52.88 \text{ mm}$$

$$\text{No. of rev.} = \frac{52.88}{0.2} = 264.433$$

$$\text{time} = \frac{264.433}{600} = 0.4407 \text{ min}$$

Q.20

Half the daimeter is depth of cut

$$d/2 = 10 \text{ mm}$$

Q.21

$L = 45\,mm$ $\quad d = 15\,mm$

$V = 20\,m/min$

for 1 hole

$V = \pi D N$ $\quad 20 = \pi \times 15 \times N$

$N = 424.62\,rpm$

$T_1 = \frac{45}{0.2 \times 424.62} = 0.529\,min$

T_1 - machining for 1 hole

(i) $\eta = \frac{\text{tool life}}{T_1} = \frac{100}{0.529} = 189$ Ans

(ii) ~~Production~~ = $\frac{1}{(T_1 + \text{idle time})}$

$P.R. = \frac{1}{T_1 + \text{idle time}} = \frac{1}{0.853} = 1.16$

Production time $= T_1 + \text{idle time}$

$= 0.529 + \frac{20}{60}$

$= 0.853\,min$ Ans

Q.22

$L = 30 + 3 + 2 + \frac{10}{\tan 60^\circ} = 40.77\,mm$

$\frac{f}{2} = 0.01\,mm/re \quad f = 0.02\,mm/re$

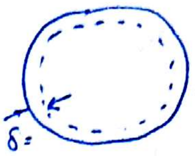
No. of rev. $= \frac{40.77}{0.02} = 2038.5$

So $T = \frac{2038.5 \times 60}{500} = 244.62\,sec$

Chap 09

Q. 14

$$G.R. = \frac{\text{W.P. material} \searrow}{\text{tool material wear} \searrow}$$



$\delta = \pi D \times t \times w_1$

$$G.R. = \frac{2.5 \times 200 \times 5}{\pi (300)(20 \times 10^{-3})(25)} = 5.30$$

Q. 15

Specific energy × MRR = Energy ($F_c V$)

$$\frac{40 \times 22 \times 0.04 \times 1180}{60} = F_c V = F_c \times \frac{\pi \times 220}{60} \times \frac{3600}{\cancel{180}}$$

$F_c = 16.7$ N

CHAP 4 ①

$d_1 = 6.25$ mm $\qquad V = 18$ m/min

$d_2 = 25$ mm

$V_i = \pi d_1 N_1 \qquad N_1 = \frac{18000}{6.25 \times \pi}$

$V_o = \pi d_2 N_2 \qquad N_2 = \frac{18000}{25 \times \pi}$

$$\gamma = \left(\frac{N_2}{N_1}\right)^{1/5} = \left(\frac{25}{6.25}\right)^{1/5} = 1.319$$

③

$L \sin(\alpha/2)$

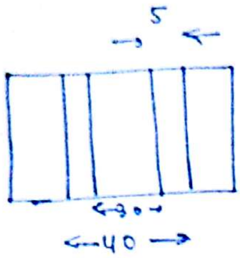
$= 400 \sin 2°$

Q.4

$d_1 = 30$ mm $V = 30$ m/min $N = \frac{3000\,V}{\pi D}$

$d_2 = 40$ mm $f = 0.01$ cm/rev

$f = 0.1$ mm/re



① $d_1 = 2$ mm

30 → 34 $d_m = 32$ mm $N_1 = \frac{30000}{3.14 \times 32}$

$l = 100$ mm

No. of rev $= \frac{100}{0.1} = 1000$ rev. $N_1 = 298.85$ rpm

$T_1 = \frac{1000}{298.85} = 3.350$ min

② $d_2 = 2$ mm

34 − 38 $d_m = 36$ mm $N_2 = \frac{30000}{3.14 \times 36}$

$T_2 = \frac{1000}{26.53}$ $N_2 = 26.53$

$T_2 = 37.69$

③ $d_3 = 1$ mm

38 − 40 $d_m = 39$ mm

$N_3 = \frac{30000}{3.14 \times 39}$

$N_3 = 244.977$

$T_3 = \frac{1000}{244.977} = 4.082$

$T = 3.35 + 3.76 + 4.08$

$= 11.19$

Q.5

$d = 10$ mm, 20 mm $V = 10$ m/min

Dia of Hole = 20 mm $f = 0.2$ mm/rev.

① No. of rev $= \frac{50}{0.2} = 250$ rev

$N_1 = \frac{10,000}{3.14 \times 100} = 318.47$ rpm

$T_1 = \frac{250}{318.47} = 0.785$ min

② $N_2 = \frac{10,000}{3.14 \times 20} = 159.235$

$T_2 = \frac{250}{159.235} = 1.56$

$T = 1.56 + 0.785$

$T = 2.4$ min

Q.6 $a = 100$ m $N = 500$ rpm

No. of chatter $= \frac{360}{30} = 12$ chatter.

$P = \frac{500}{60} \times 12 = 100$ Hz

Q.8 $v = 50$ m/min

$f = 0.8$ mm/rev.

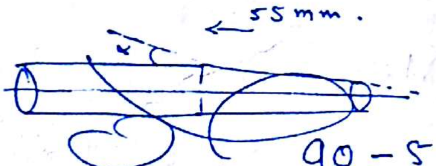
$d = 1.5$ mm

MRR $= f d v$

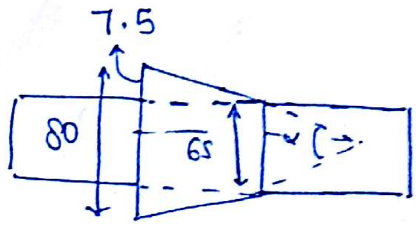
$= 50 \times 10^3 \times 1.5 \times 0.8$ mm³/min

MRR $= 60000$ mm³/min

Q.7



$\tan\alpha = \frac{90-55}{40}$



$\tan\frac{\alpha}{2} = \frac{7.5}{55}$ ⇒ $\alpha = 7.76$

$2\alpha = 15.53°$

Offset $= L \sin\frac{\alpha}{2} = 90 \sin 7.76$

$= 12.16$ mm

Q.8 double start $= 2 \times 2$

$= 4$ mm/rev

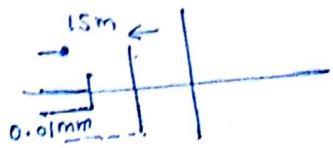
Q.10

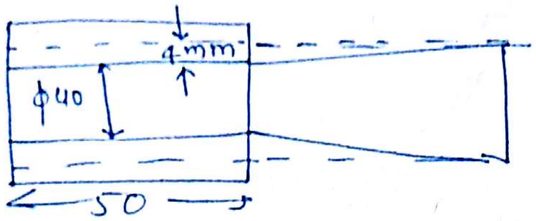
P = 10 KW   d = 40 mm

V = 0.35 m/min   L = 50 mm

f_z = 0.01 mm/tooth

φ 40 → φ 48   Broach





No. of Cutting = $\frac{4}{0.01}$ = 400

So L = 50 + 15 (399)

T = $\frac{6035}{0.135 \times 1000}$ = 0.172 min

Q.12 d = 3 cm
No. of thre = 3/cm
= 45 thm

L = 15 + 0.5 + 0.5 = 16 cm

1 rev → 3 cm
16 cm → 48 rev
tm = $\frac{48}{88}$ × 7

Q.11

V = 20 m/min
f = 1.2 mm/rev.

60 mm → 42 mm

① ~~60~~ d_1 = 3 mm
60 → 54 d_m = 57 mm

$N_1 = \frac{20,000}{3.14 \times 57}$ rpm

N_1 = 111.687 rpm

~~T = 111.68 min~~

L = $\frac{215}{1.2}$ = 179.166

T_1 = 1.604 min

② d_1 = 3 mm
54 − 48
d_m = 51 mm

$N_2 = \frac{20,000}{3.14 \times 51}$

N_2 = 124.827 rpm

$T_2 = \frac{115}{1.2 \times 124.827}$

T_2 = 0.767 min

③ d_3 = 3 m
48 − 42
d_m = 45 mm

$N_3 = \frac{20000}{3.14 \times 45}$

N_3 = 141.47 rpm

$T_3 = \frac{115}{1.2 \times 141.47}$

T_3 = 0.677

T = 3.048 min

Q.13 4 cm → 3.5 cm $V = 30\,m/min$

$f = 0.4\,mm$ $d_m = 3.75\,cm$

$d_m = 37.5\,mm$ $N = \frac{30,000}{37.5 \times 3.14}$

$N = 254.647\,rpm$

$L = 15\,cm$

$L = 150\,mm$

$\text{No. of rev} = \frac{150}{0.4} = 375\,rev.$

$T = \frac{375}{254.647} = 1.472\,min$

Q14 ϕ = 50 mm − 42 mm

① $d_1 = 3\,mm$

50 − 44

$d_m = 47\,mm$

$N = 450\,rpm$

$\text{No. of rev} = \frac{50+3}{0.2} = 265\,mm$

$t_1 = \frac{265}{450} = 0.588$

② $d_1 = 1$

44 → 42

$d_m = 41\,mm$

$N = 450$

$\text{No. of re} = \frac{53}{0.2} = 265$

$t_2 = \frac{265}{450} = 0.588$

$T = 1.176$

Q.15 52 → 44 mm

① $d_1 = 3\,mm$

52 − 46

$d_m = 49\,mm$

$N = \frac{35000}{\pi \times 49} = 227.364\,rpm$

$L = 200\,mm$

$\text{No. of rev} = \frac{200}{0.3} = 666.67\,re$

$T = \frac{666.67}{227.364} = 2.932\,min$

② $d = 1mm$

$46 \rightarrow 44$

$d_m = 45$ mm

$N_2 = \frac{50000}{\pi \times 45}$

$N_2 = 353.67$

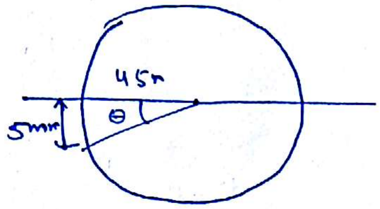
$L = \frac{200}{0.1} = 2000$

$T_2 = \frac{2000}{353.67}$

$T_2 = 5.654$

$T = 8.58$ min

Q.16



$\tan\theta = \frac{5}{45}$

$\theta = 6.340°$

Bake rake angle $= 10 - 6.340 = 3.66°$ for

Clearance $= ~~10~~\ 5 + 6.34 = ~~16.34°~~\ 11.34$

Q.17

$d = 4.5$ mm

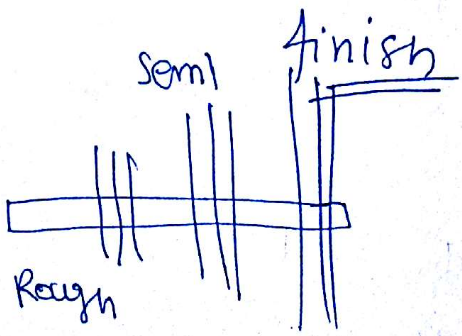
Rise $= 0.0125 \times 8 = 0.1$ mm.

Rise needed $= 4.5 - 0.1 = 4.4$

no. of rough teeth $= \frac{4.4}{0.1} = 44$

length $= (22 \times 43) + (8 \times 20) + (4 \times 20)$

$L = 1186.0$



Chap 5

Q.3 Double stroke mean backward & forward 30 per min

one double stroke = 2 sec.

t_1 = forward time

t_2 = return time

$$t_2 < t_1$$

$$\frac{t_2}{t_1} = 0.6 \qquad L = 250\ mm$$

$$t_1 + t_2 = 2\ sec$$

$$1.6\, t_1 = 2$$

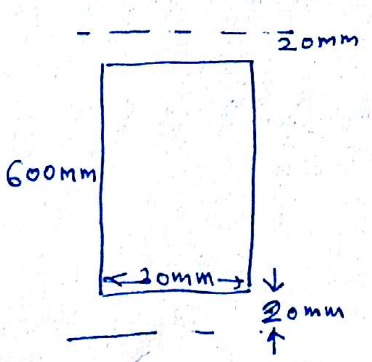
$$t_1 = \frac{2}{1.6} = 1.25\ sec.$$

$$t_2 = 0.75\ sec.$$

$$V = \frac{L}{t_1}$$

$$\text{Cutter velocity} = \frac{250 \times 10^{-3} \times 60}{1.25 \times 60} = 12\ m/min$$

Q.4



$$V = 8\ m/min \qquad f = 0.3\ mm/stroke$$

$$\frac{t_1}{t_2} = \frac{1}{2}$$

$$\text{No of stroke} = \frac{30}{0.3} = 100$$

$$l = 640\ mm$$

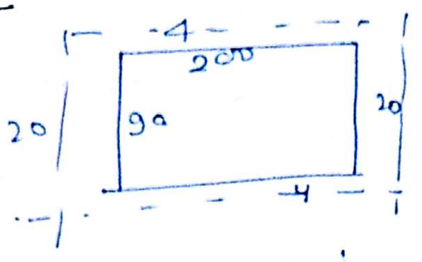
$$t_1 = \frac{l}{V} = \frac{640}{8 \times 1000} = 0.08\ min$$

$$t_2 = 0.04\ min$$

$$t = 0.12\ min \text{ for 1 stroke}$$

$$\text{for 100 stroke} = 100 \times 12 = 12\ min$$

Q.6



$Q = 240$

$V = 13.5$ m/min

No. of stroke = $\frac{98}{0.57}$

$f = 0.57$ mm/d.s

$t_2/t_1 = 0.83$

$t_2 = \frac{98 \times \frac{240}{0.57}}{13.5 \times 1000}$

~~$t_2 = 5.59$ mins~~ $t_2 = 3.056$

$t = t_1 + t_2$

~~$t_2 = 240$~~

$t = 1.83\, t_1$

$t = 1.83 \times 3.056$

$t = 5.593$ mins

Q.7

Power ~~Sp. energy~~ $= 1.49\ J/mm^3 \times MRR$

Power ~~spec~~ $= 1.49 \times 200 \times 4 \times 0.25$

$= 298$ watt

Q.8

$t_1/t_2 = 3/2$

$L = 200$ mm

$V = 18$ m/min

$t_1 = \frac{200 \times 60}{18000} = 2/3$ sec.

$t_2 = \frac{2/3}{3/2} = 4/9$ sec

$t = t_1 + t_2 = 2/3 + 4/9 = \frac{10}{9} = \frac{10}{9 \times 60} = \frac{1}{54}$ min

rpm = 54 rpm

Q.9 $f = 0.001$ mm

$\frac{t_1}{t_2} = \frac{2}{1}$ ~~$t_1 + t_2 = 40$~~ ~~$t_1 = \frac{20}{3}$ min~~

$$t_1 = \frac{0.150 \times}{V} = \frac{20}{3} \times 60$$

$$\frac{150,000}{V} = \frac{20 \times 60}{3}$$

~~V =~~

$$t = \frac{10 \times 60}{10^5}$$ no. of stroke $= \frac{100}{0.001} = 10^5$

$$t = t_1 + t_2$$

$$\frac{10 \times 60}{10^5} = \frac{0.15}{V} + \frac{0.15}{2V}$$

$$V = 37.5 \text{ m/se}$$

Shaping & Planing: (single point Cutting tool)

Shaping & planing is a machining operation for Generating Flat surface.

Shaping - work piece is stationary & cutting tool is given a reciprocating motion

Planing :- it is similar to shaping & diff is that workpiece is reciprocating instead of Cutting tool.

* In shaping time for forward stroke is more because in forward motion we require more force to remove material so it is a slow stroke in backward stroke no force require so it is fase

$$\boxed{t_1 > t_2}$$

Plane stress $k' = \frac{\sigma_0}{2}$

Plane strain → $\dot{\epsilon}_z = 0$ ⇒ $k' = \frac{\sigma}{\sqrt{3}}$

↳ No metal flow during forging

eg. forging of cylinderical billet stress

$\sigma_1 - \sigma_2 = 2k'$

Q.2 Book P.g. 339

Brittle material

↓

Fracture mechanism

$k_c = y\sigma\sqrt{\pi a}$

k_c - Fracture toughness

y - material.

σ - strength

a - max' crack size

Surface crack a → a/2

$\sigma = 300$ MPa

$k_c = 3.6$ MPa $\sqrt{m}$

$y = 1$

$a = ?$

Q.10

P.g. 20

$L = 200mm$

$t = 2$ sec.

$t_2/t_1 = 2/3$

$t_1 + t_2 = 2$

$t_1 + \frac{2}{3} t_1 = 2 \Rightarrow \frac{5t_1}{3} = 2 \Rightarrow t_1 = \frac{6}{5}$ sec

$V = \frac{L}{t_1} = \frac{200 \text{ mm} \times 5 \times 60}{6 \times 1000} = 10$ m/min

Q11

$L = 750$ mm

$t_2/t_1 = 1/4$

$f = 3$ mm

$V_1 = 9$ m/min

No. of stroke $= \frac{90}{3} = 30$ stroke.

$V_1 = \frac{L}{t_1}$ for 1 stroke

for 30 stroke $t_1 = \frac{750}{9000} \times 30 \Rightarrow t_1 = 2.5$

$t_2 = 0.625$

$t = 3.125$ min

Q.12

$L = 2000mm$

$w = 310$ mm

no. of stroke = 310

$t_1 = \frac{2}{1} = 2$ sec.

$t_2 = 1$ sec.

$t = 3$ sec.

total time = 930 sec

total time = 930 sec.

for one work $= \frac{930}{2}$

$= 465$ sec.

~~Q.SP3~~

Q. 13

$b = \quad L = 150\ mm$

$\frac{t_2}{t_1} = 0.7$

$V_1 = 20\ m/min$

$f = 0.3\ mm/stroke.$

No. of stroke $= \frac{1000}{0.3} =$ ~~500 stroke~~ 333.33 str

$V_1 = \frac{L}{t_1}$

$\Rightarrow 20 \times 1000 = \frac{150}{t_1} \times$ ~~500~~ 333.33

~~$t_1 = \frac{20,000}{50000} = \frac{2}{5}$ min~~

$t_2 = t_1 = \frac{5}{2}$

$t_2 = 1.75$

$t_1 + t_2 = 4.25$ min

$MRR = A_c \times f \times d$