

DATE

Experiment - 1.

SHEET NO. 1.

AIM: To study the mechanism and morphology of chip formation under different machining (turning) conditions.

Process: straight turning

Work material: C60 steel

Cutting tool: grade P30

SPUN Carbide inserts.

THEORY: Morphology and mode of formation of chips are quite important indices to judge machinability characteristics of any work-tool combination under given machining conditions. All the parameters involved in machining play significant roles on such machinability characteristics.

Morphology of chips include the following properties:

(a) Colour (b) Thickness (c) length

→ Colour of chips :

Metallic

Yellow

Blue

Dark blue

Increasing temperature of machining

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PROCEDURE -

- 1) The work piece diameter was noted along with the available speed-feed combination.
- 2) The appropriate RPM for the spindle was calculated and set using variable spindle drive.
- 3) The chips formed were collected after a few seconds of machining.
- 4) The colour and form of the chips were noted down.
- 5) The average thickness of the chips was measured and noted down.
- 6) The values of chip reduction coefficient (C_r) and shear angle (ϕ) were calculated for all machining conditions.

FORMULAE -

$$C_r = \frac{a_2}{a_1} \quad a_1 = s \sin \phi$$

$$\tan \phi = \frac{\cos \gamma_0}{C_r - \sin \gamma_0}$$

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PROCESS PARAMETERS:

Cutting velocity (V_c) : 60 to 120 m/min
(steps of 20 are chosen).

Feed (s) : 0.08, 0.12, 0.16 and 0.20 mm/rev

Depth of cut (t) : 2 mm

Environments : Dry and soluble oil

→ chip reduction coefficient

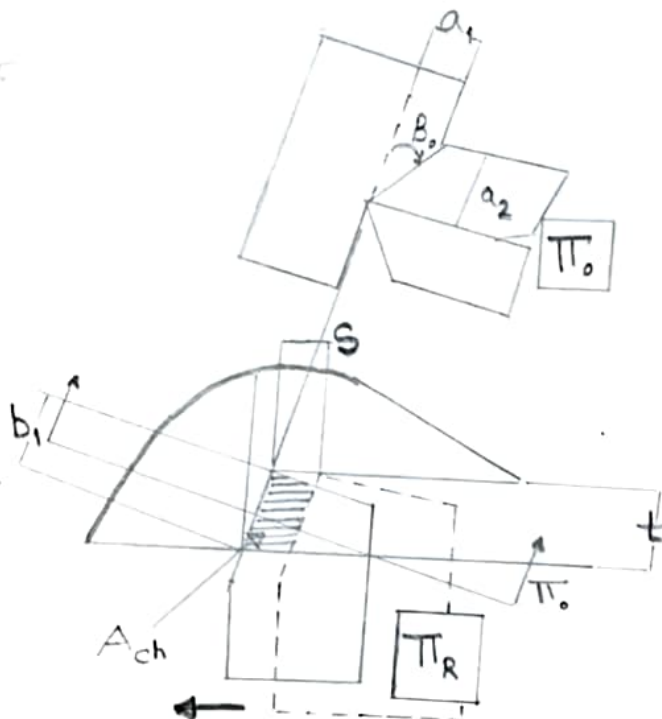
$$\zeta = \frac{a_2}{a_1} ; a_1 = S \sin \phi$$

$$\tan \beta_0 = \frac{\cos \gamma_0}{\zeta - \sin \gamma_0}$$

$\gamma_0 = 0$ and $\phi = 90^\circ$ (in this experiment).

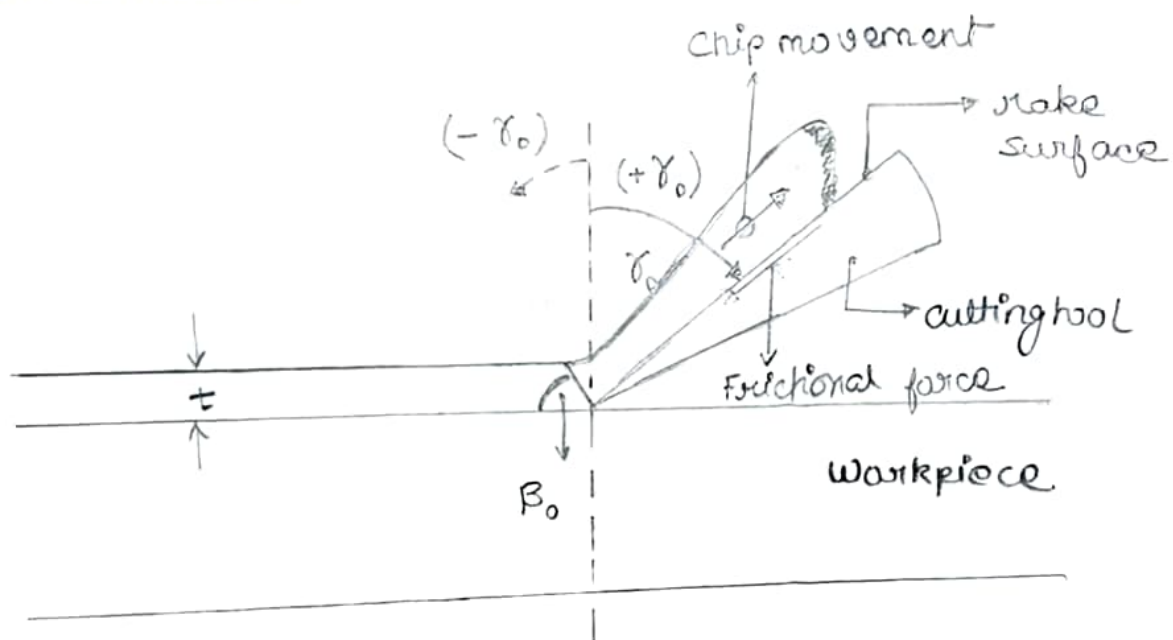
$$\Rightarrow \tan \beta_0 = \frac{1}{\zeta}$$

→ shear angle



Morphology of chips depends on the following parameters :

- (a) Workpiece material
- (b) Geometry of cutting (rake angle, depth of cut etc.)
- (c) Extent of machining
- (d) Environment.



$\beta_0 \rightarrow$ shear angle

$\gamma_0 \rightarrow$ make angle

$t \rightarrow$ depth of cut

OBSERVATION TABLE

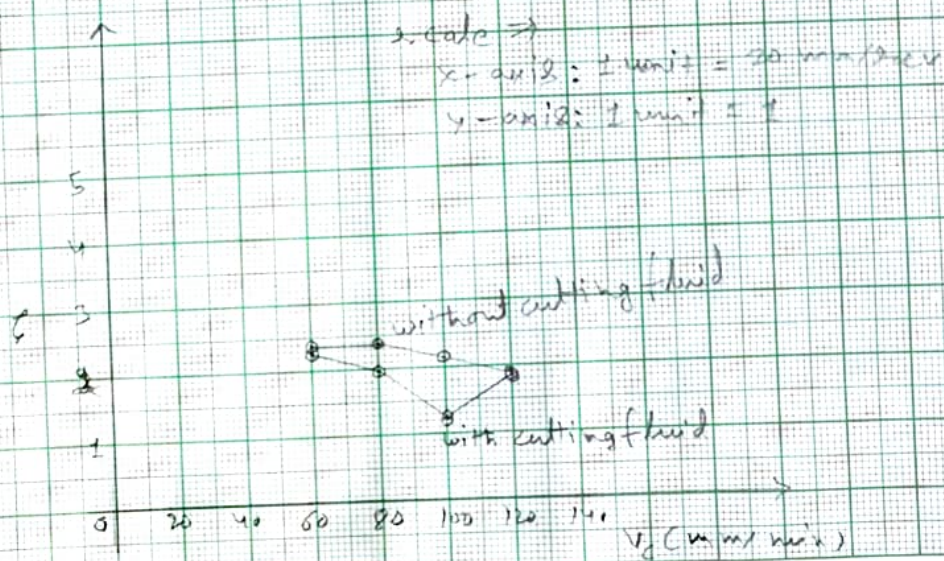
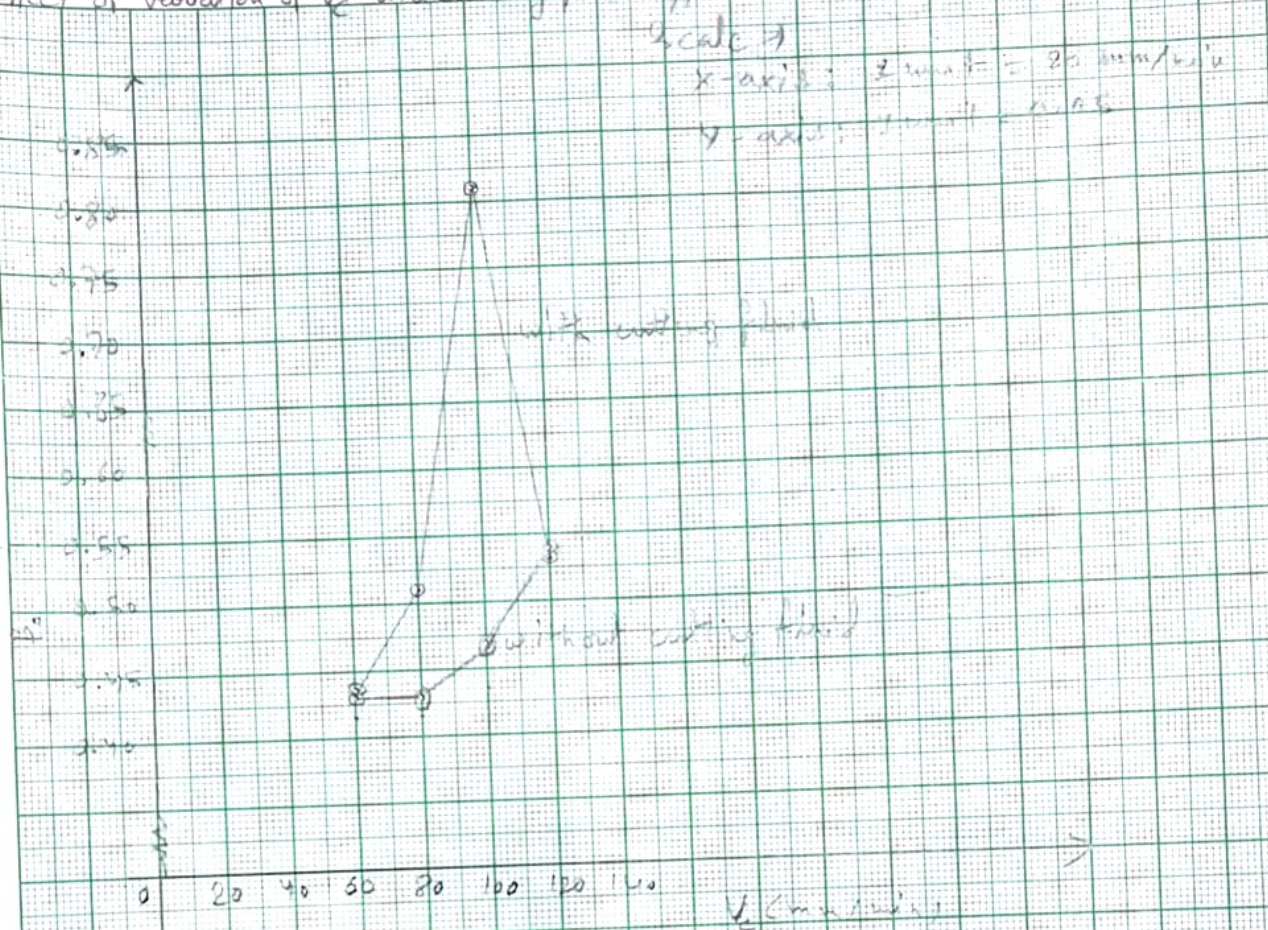
① Without Coolant

#	V_c m/min	RPM	S mm/rev	Chips		a_2 (mm)	f	β_0
				Colour	Form			
1	60	95.5	0.16	Light blue	Discontinuous	0.373	2.33	0.43
2	80	127.3		Light blue	Discontinuous	0.376	2.35	0.43
3	100	159.2		Dark blue	Discontinuous	0.340	2.12	0.47
4	120	191		Dark blue	Discontinuous	0.296	1.85	0.54
5	100	159.2	0.08	V. Light blue	Discontinuous	0.186	2.32	0.43
6			0.12	Light blue	Discontinuous	0.240	2.00	0.50
7			0.16	Dark blue	Discontinuous	0.340	2.12	0.47
8			0.20	Dark blue	Discontinuous	0.370	1.85	0.54

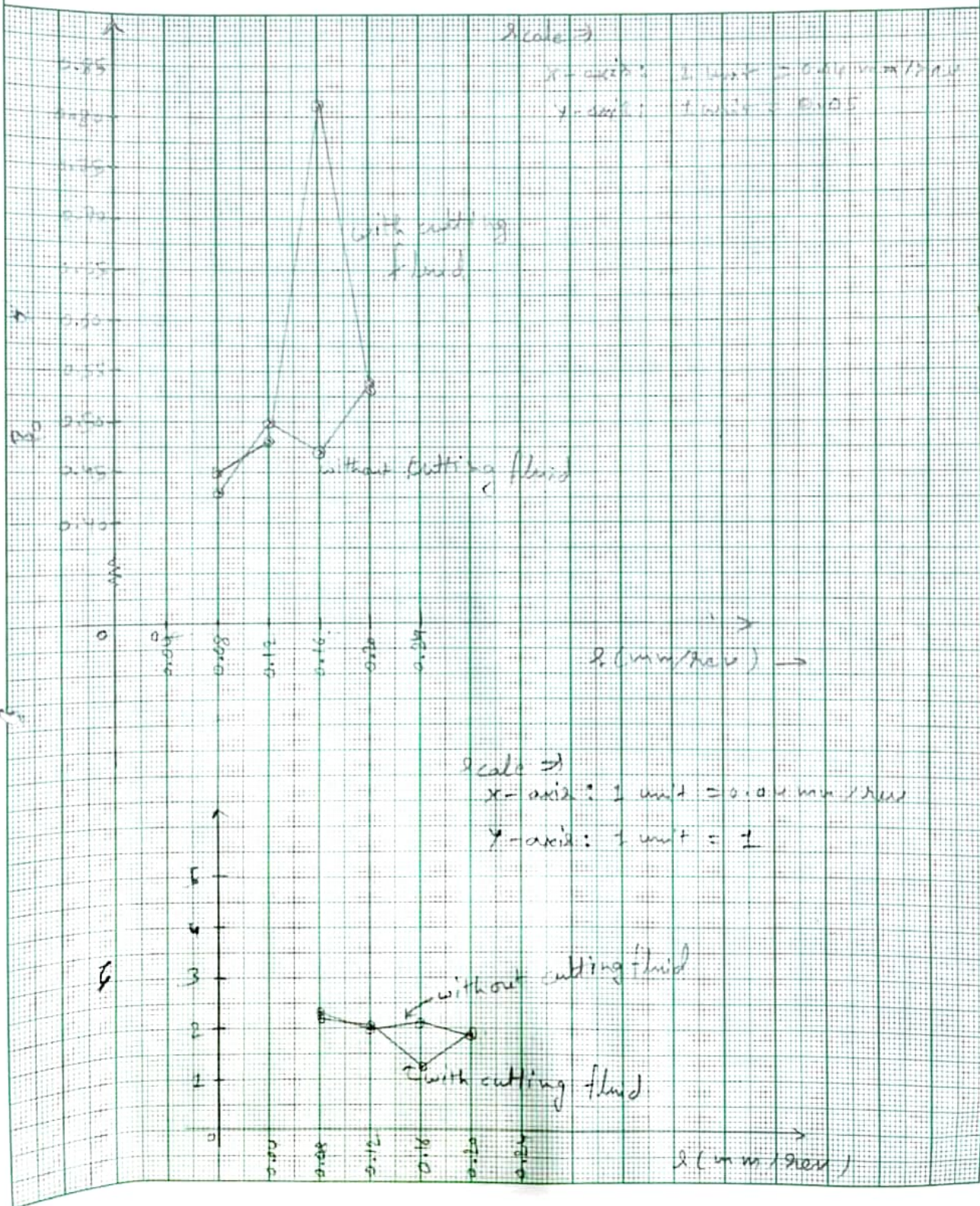
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Effect of variation of V_c and cutting fluid application on value of C_1 & B_0 .



Effect of variation of λ & cutting fluid application on value of β_0 & ζ .



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DISCUSSION

1. Value of chip reduction coefficient (ζ) is low for all velocities in case of straight turning with lubricating fluid. as compared to the case in which lubricant was not used.
2. Shear angle is more for all velocities in case of straight turning with lubricating fluid as compared to the case in which fluid was not used.
3. For all values of s , the chip reduction coefficient (ζ) is low for the case with lubricant as compared to one without lubricant.
4. Shear angle is more with fluid than without fluid for all values of s .
5. Colour of the chips are principally blue and form discontinuous for cutting without fluid due to higher heat and temperature, whereas on using fluid, the color is principally metallic and continuous form at lower temperatures.

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OBSERVATION TABLE

(With Coolant)

#	V _c m/min	RPM	S mm/rev	Chips		a ₂ mm	ζ	β_0
				Colour	Form			
1	60	95.5	0.16	Silver	Discontinuous	0.366	2.2835	0.437
2	80	127.3	0.16	Gray	Discontinuous	0.313	1.956	0.511
3	100	159.2	0.16	Gray	Segmented	0.197	1.231	0.812
4	120	191	0.16	Gray	Segmented	0.300	1.875	0.533
5	100	159.2	0.08	Gray	Continuous	0.177	2.245	0.457
6	100	159.2	0.12	Gray	Continuous	0.250	2.083	0.480
7	100	159.2	0.16	Gray	Segmented	0.197	1.231	0.812
8	100	159.2	0.20	Silver	Discontinuous	0.377	1.885	0.530