



WELCOME  
TO Adda247

*"There is  
nothing  
impossible to  
they who will  
try."*

# GATE 2024



**प्रचण्ड** Batch

**PRODUCTION**

**METAL CUTTING**

**LEC-2**

**Mechanical Engineering**



**GATE 2024**



GATE

**प्रत्न** Batch

**MECHANICAL ENGINEERING**



**MON/ TUE/ WED- 9PM**

**THEORY OF MACHINE (TOM)**



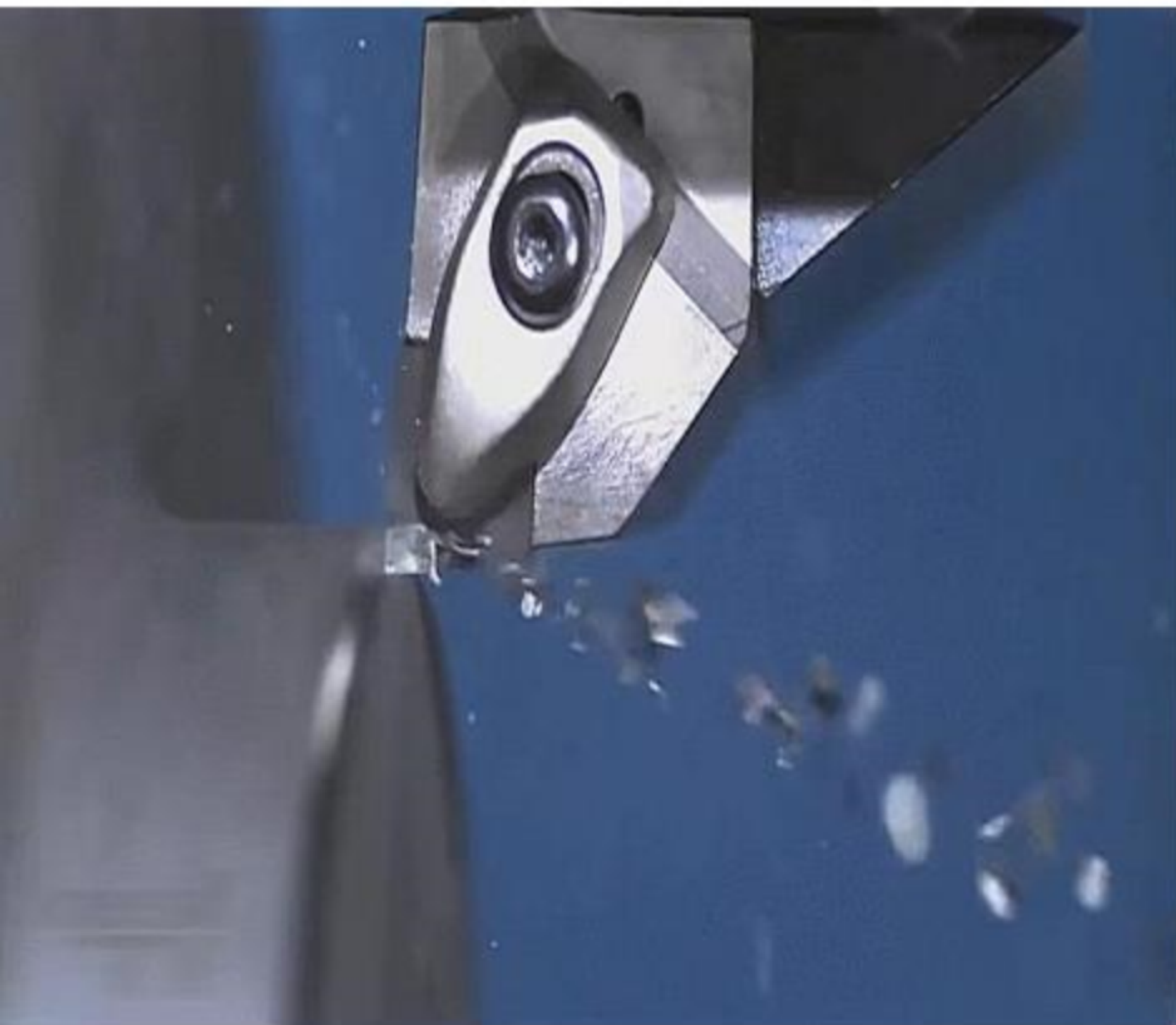
**THUR/ FRI/ SAT- 6PM**

**PRODUCTION ENGINEERING**

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## METAL CUTTING





1. Introduction to Metal cutting

2. Machining operation

3. Turning operation And analysis





today's  
topic

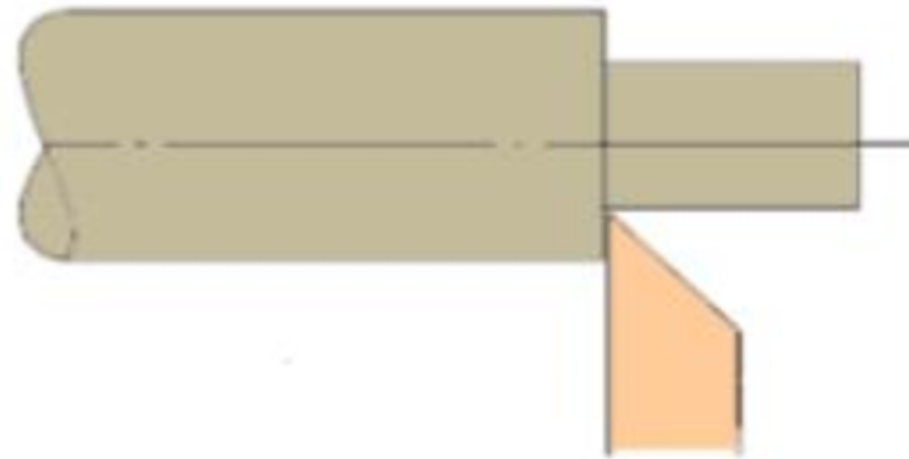
- ✓ 1. Orthogonal Machining And Analysis
- 2. Machine Tool And Cutting Tool
- 3. SPCT AND MPCT



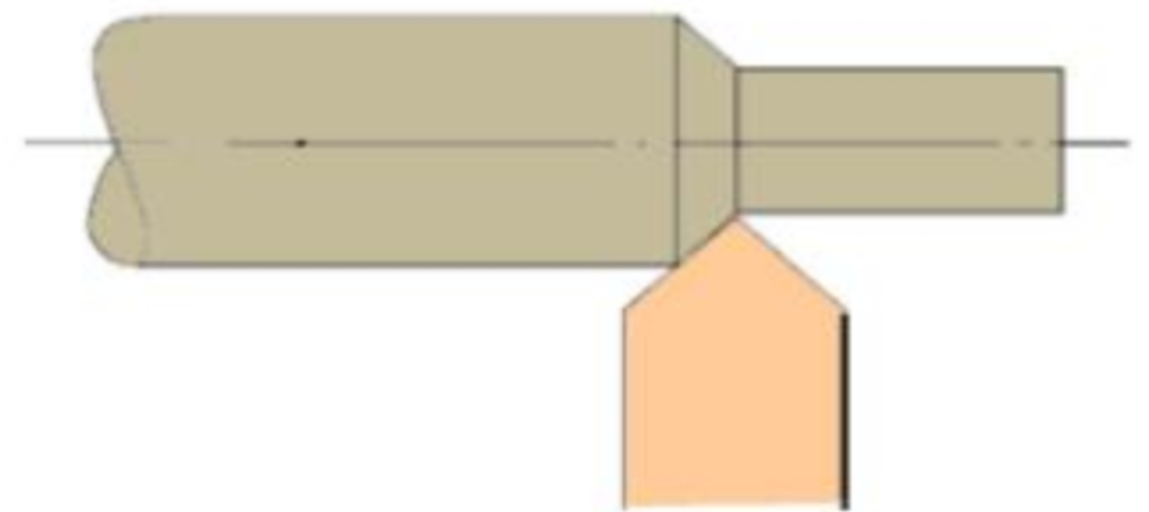
## Machining

1. Orthogonal Machining

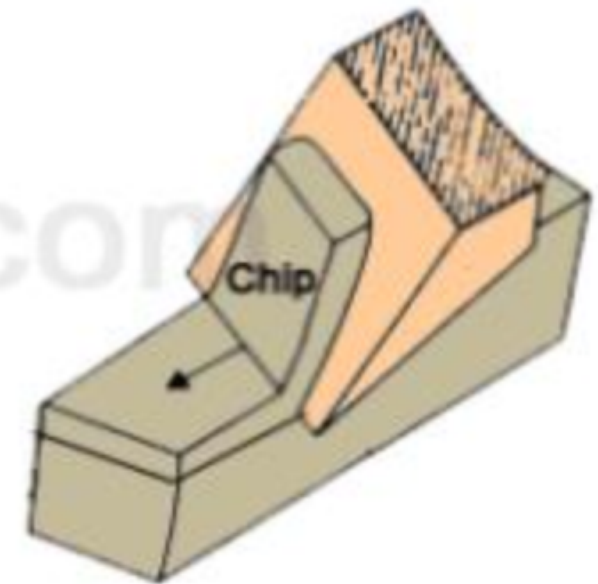
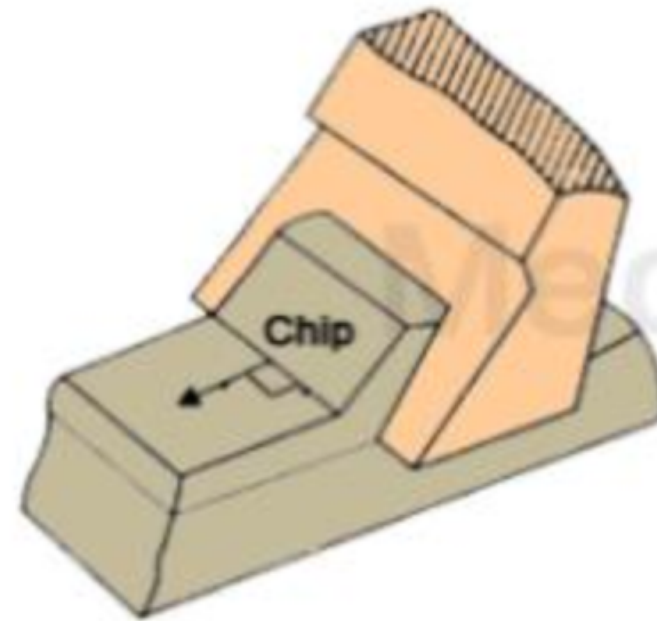
Orthogonal cutting



Oblique cutting



2. Oblique Machining

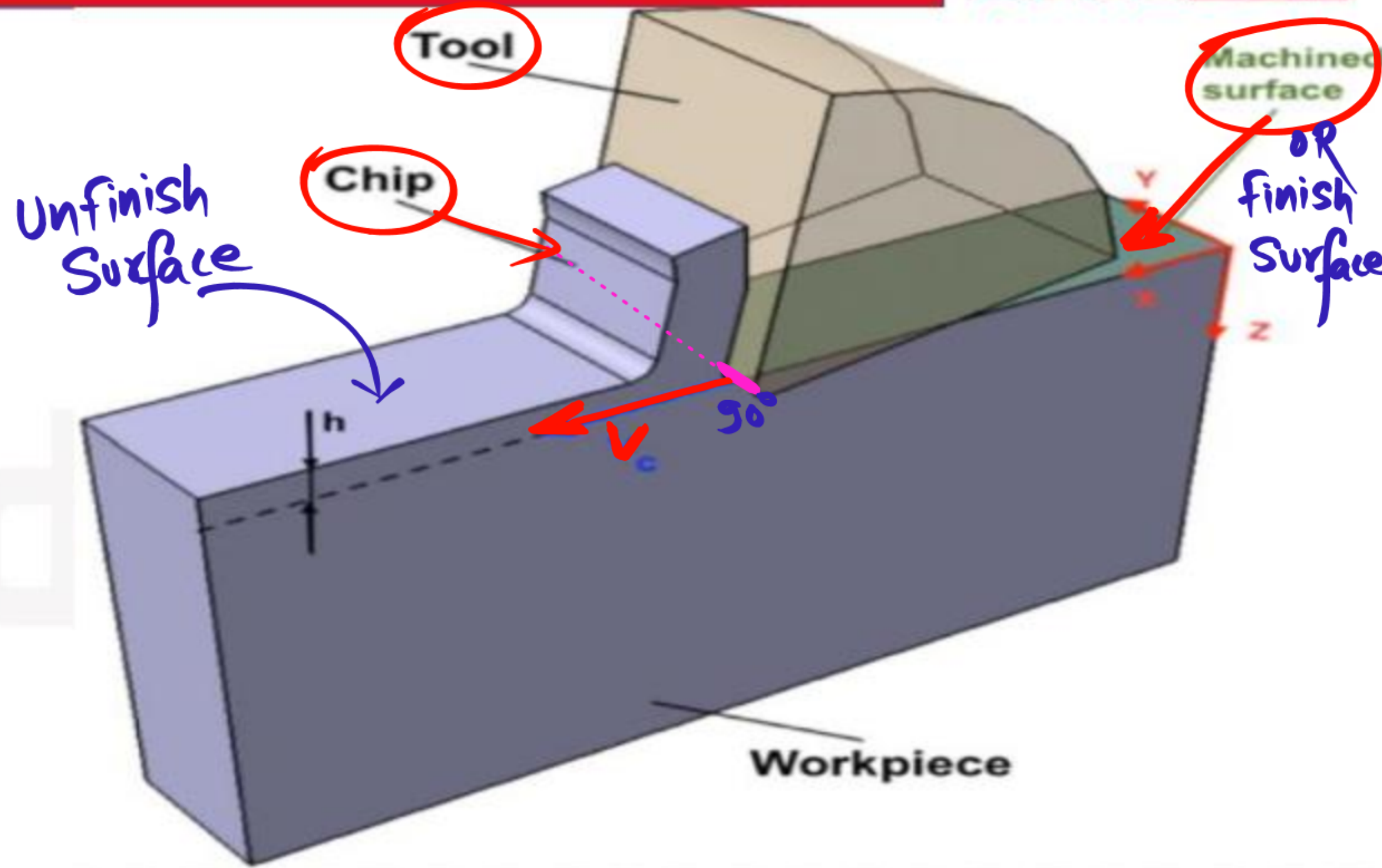




# Orthogonal Machining



\* Cutting Edge of the Tool is  $\perp$  to the Velocity Vector.

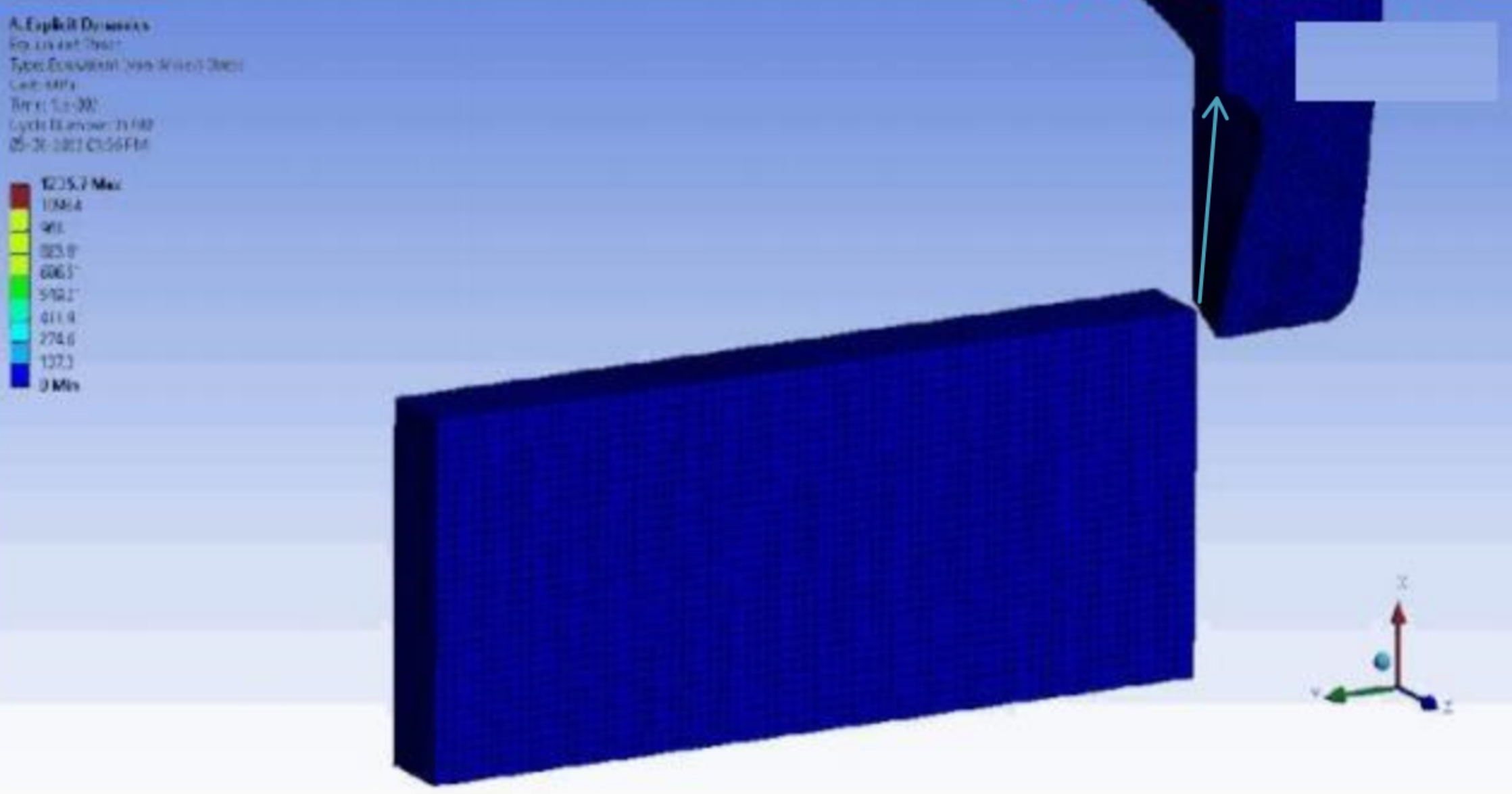
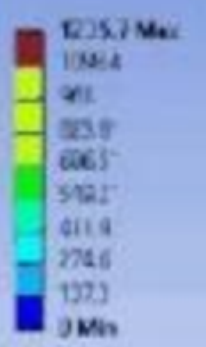


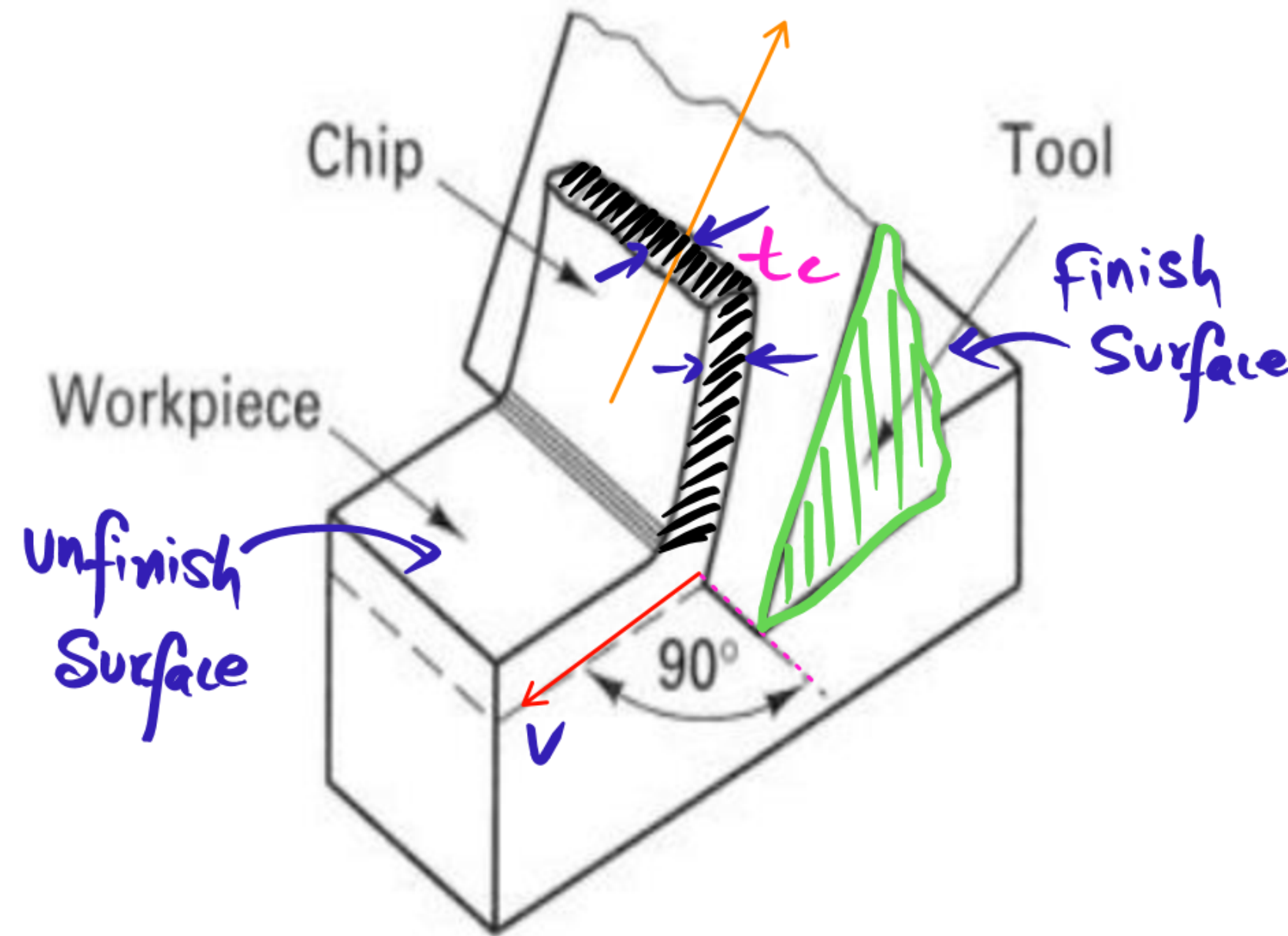
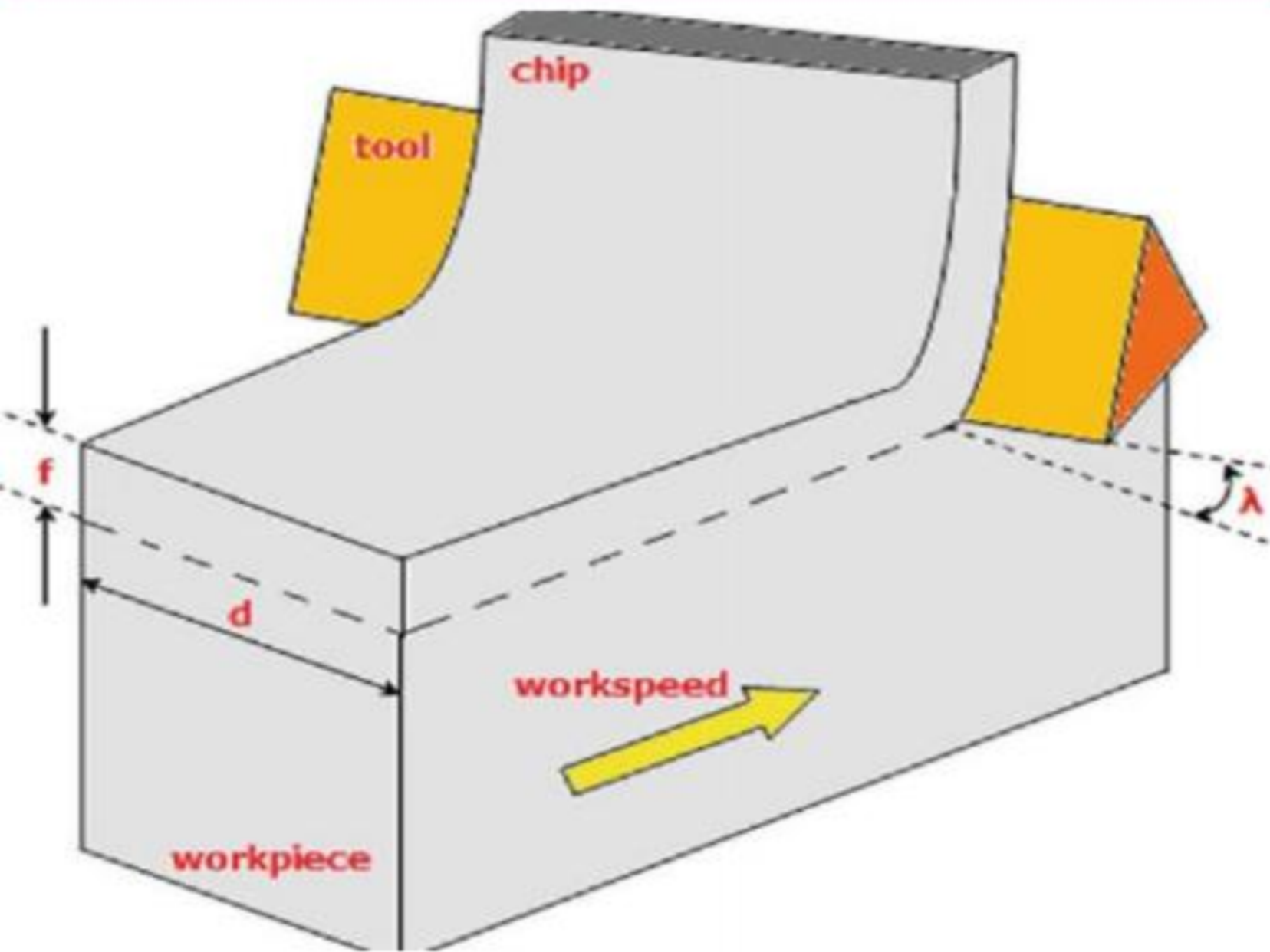
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A, Explicit Dynamics  
Eq. Solver: Explicit  
Type: Equivalent (non-linear) Shell  
Units: MPa  
Time: 1.1-001  
Cycle Elapsed: 21.000  
05-20-2023 01:56 PM





# Orthogonal Machining

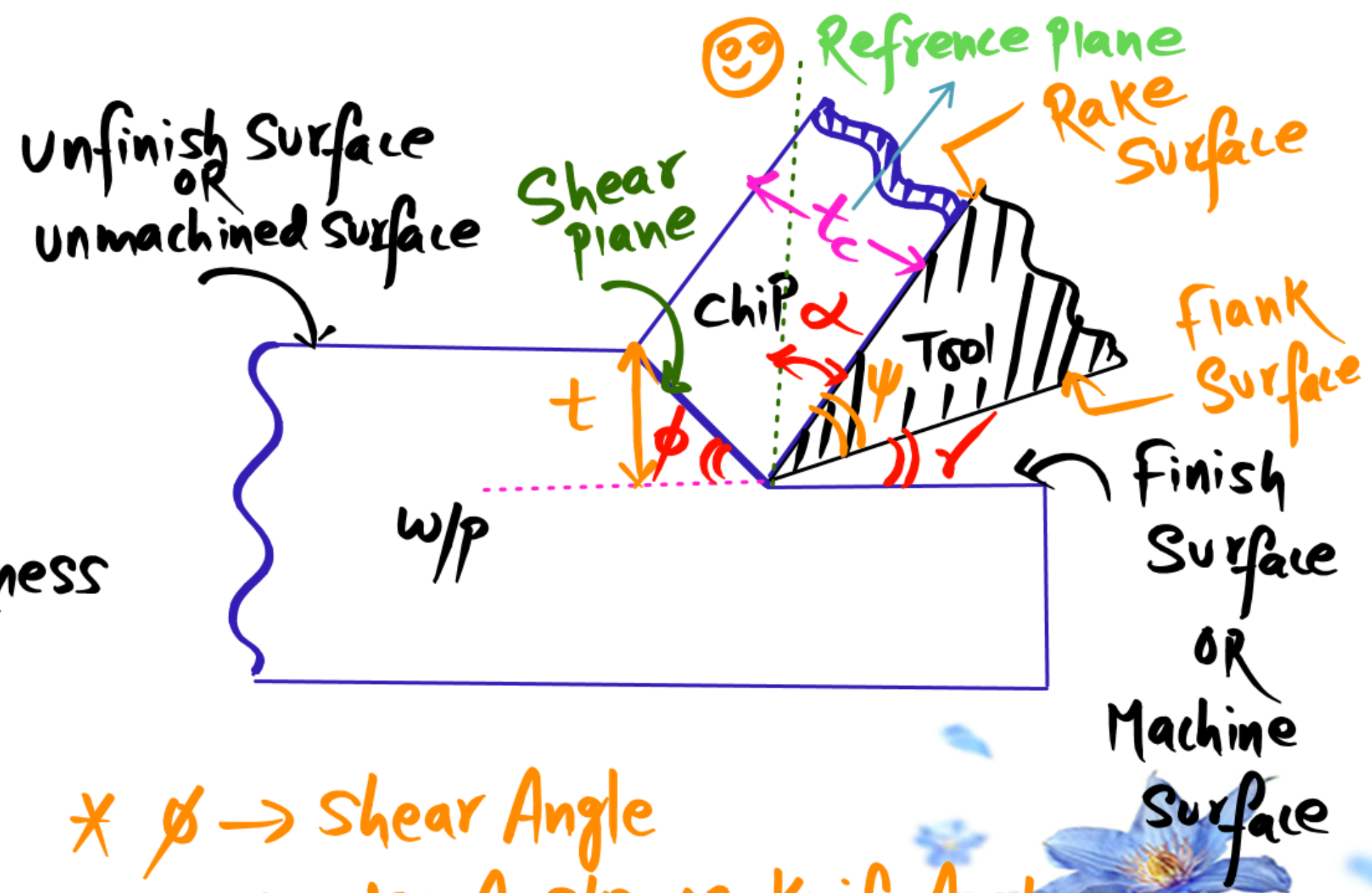
- \*  $t_c \rightarrow$  chip Thickness
- \*  $t \rightarrow$  uncut chip thickness  
OR  
Undeformed chip Thickness

\*  $\alpha \rightarrow$  Rake Angle

\*  $\gamma \rightarrow$  Clearance Angle  
OR  
Relief Angle

\*  $\phi \rightarrow$  Shear Angle

\*  $\psi \rightarrow$  Wedge Angle OR Knife Angle  
OR  
Lip Angle OR cutting Angle



# Chip Thickness Ratio ( $\gamma$ )



$$* \gamma = \frac{t}{t_c}$$

# chip Reduction factor ( $h$ )



$$* h = \frac{1}{\gamma}$$

$$* h > 1$$



$$* t_c > t$$

- ①
- ②

Due to Plastic Deformation (Shear Strain)  
Due to Thermal Expansion



$$* \gamma < 1$$



\*  $t = \text{Depth of cut}$  (only orthogonal cutting)

\*  $t = f \cdot \sin \lambda$  (for Turning)

↙  
feed  
(mm/rev)

↘  
Principle cutting  
Edge Angle



# Reference plane



Plane which is Normal to Finish Surface.

# Rake surface



The surface Along which chip moves upward called as Rake Surface.

# Flank OR Relief surface



The other surface which is relief to avoid rubbing with the machined surface called as Relief OR Flank surface.



☺ \*  $\alpha + \psi + \gamma = 90^\circ$

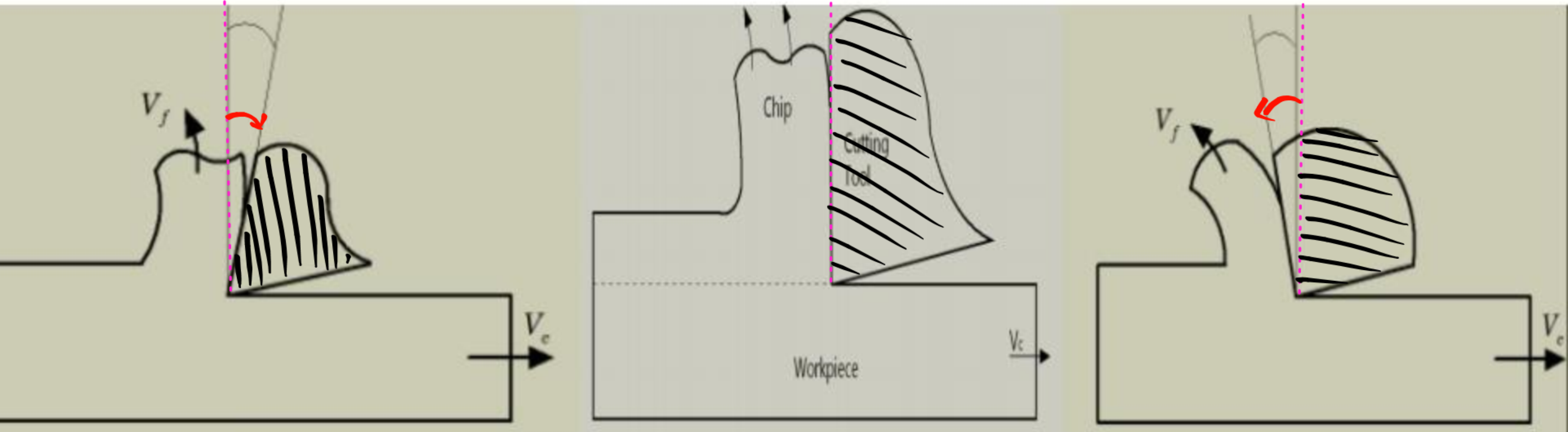
\*  $\alpha + \psi + \gamma = \text{constant}$





Discussion on Rake Angle

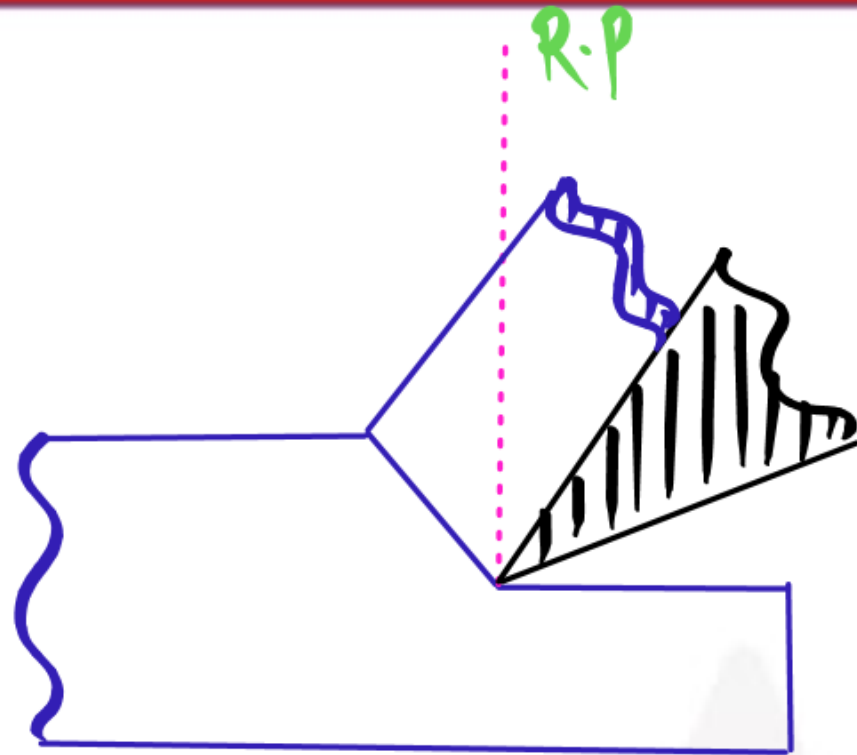
Reference Plane



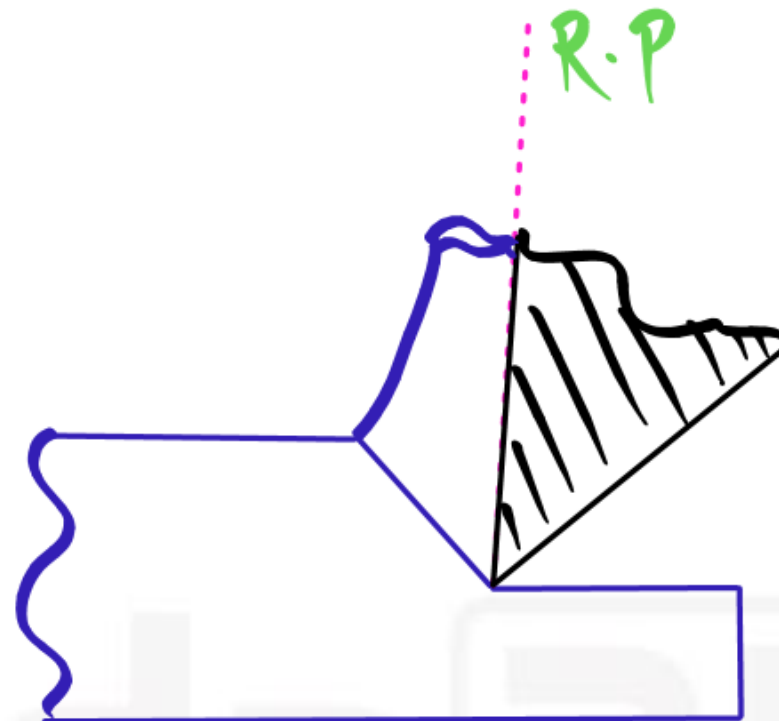
\*  $\alpha = +ve$

\*  $\alpha = 0$

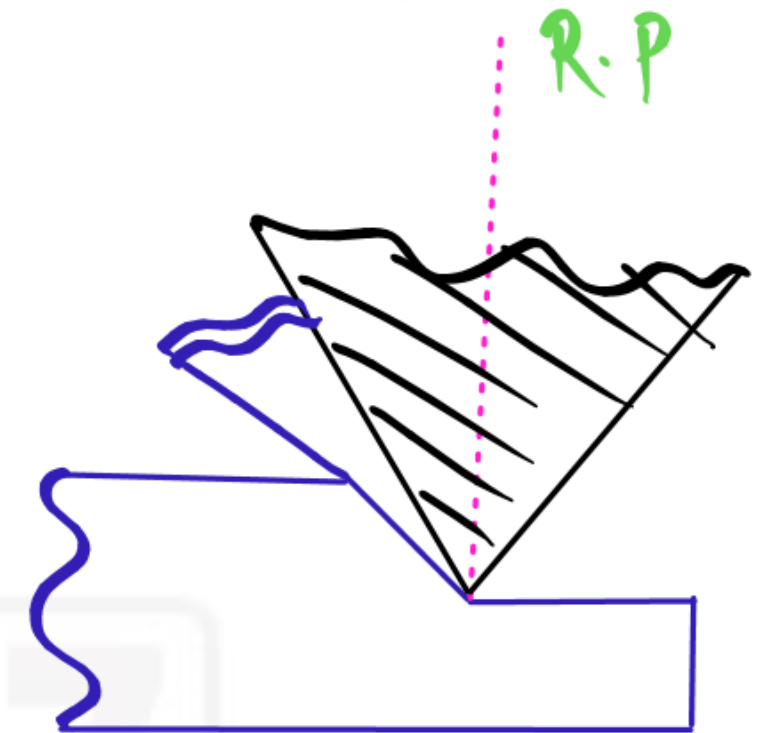
\*  $\alpha = -ve$



\*  $\alpha \rightarrow +ve$



\*  $\alpha \rightarrow \text{zero}$



\*  $\alpha \rightarrow -ve$

## # +ve Rake Angle

\* Machining of Low Strength Material.

\* Low Power machine

\* Low cutting Speed

\* Do not Required Rigid Setup

\* Low cutting force

\* Cutting Tool Material: HSS

High Speed Steel

😊 \* HSS → 30m/min

\* HSS → 18:4:1  
(W:Cr:V)

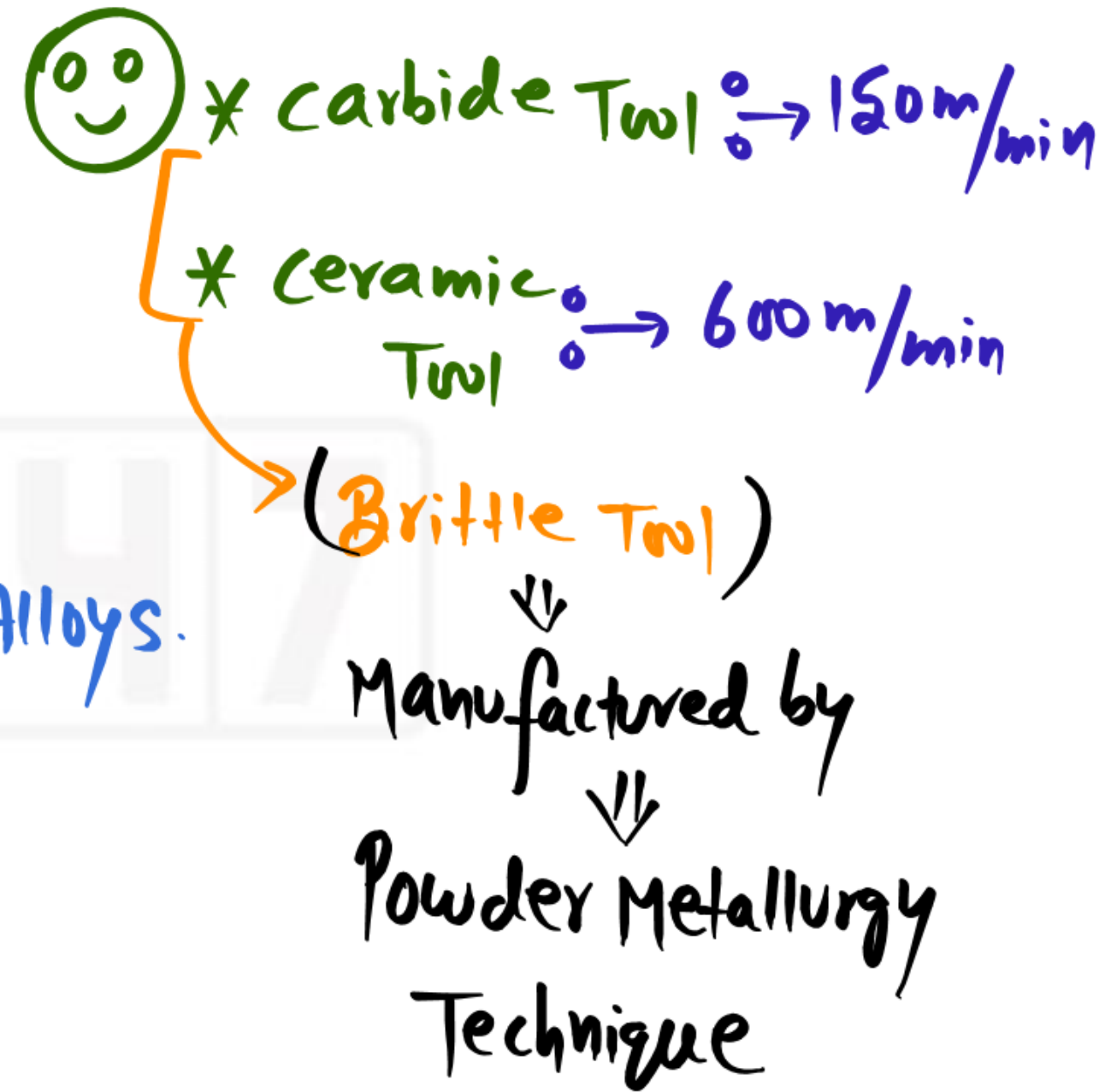
😊 \* Steel + W → Hot Hardness Temp ↑

\* Steel + Cr → Corrosive Resistance ↑

\* Steel + V → Wear Resistance ↑

## # -ve Rake Angle

- \* Required more force/power consumption
- \* Required High cutting Speed
- \* Increase Tool Life
- \* for Machining of High Strength material/Alloys.
- \* Required Rigid Setup.
- \* Cutting Tool Material : Carbide, Ceramic



## Machine Tool And Cutting Tool

### 1. Machine Tool

A machine tool is an assembly of several different elements, mechanisms, prime mover as well as CPU/microprocessor.

Which holds both workpiece and cutting tool in an appropriate position and brings the required relative moments between the workpiece and cutting tool.

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## Cutting Tool

Cutting tool is the one which comes in direct contact of workpiece to deform it plastically .

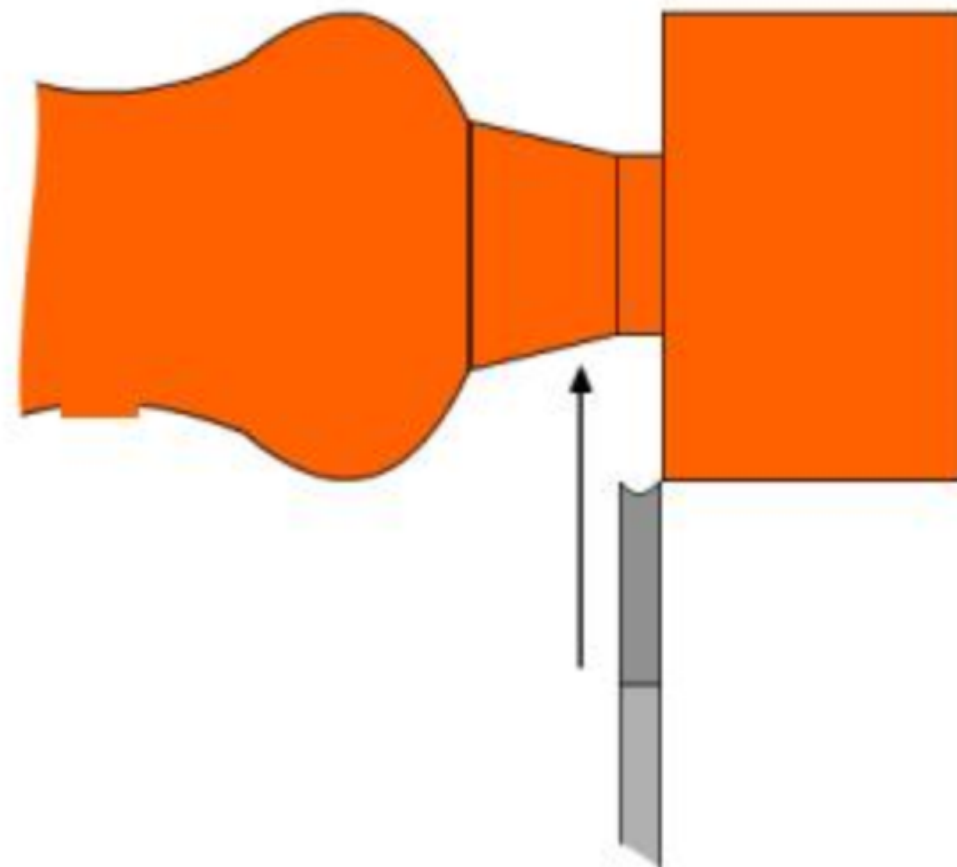
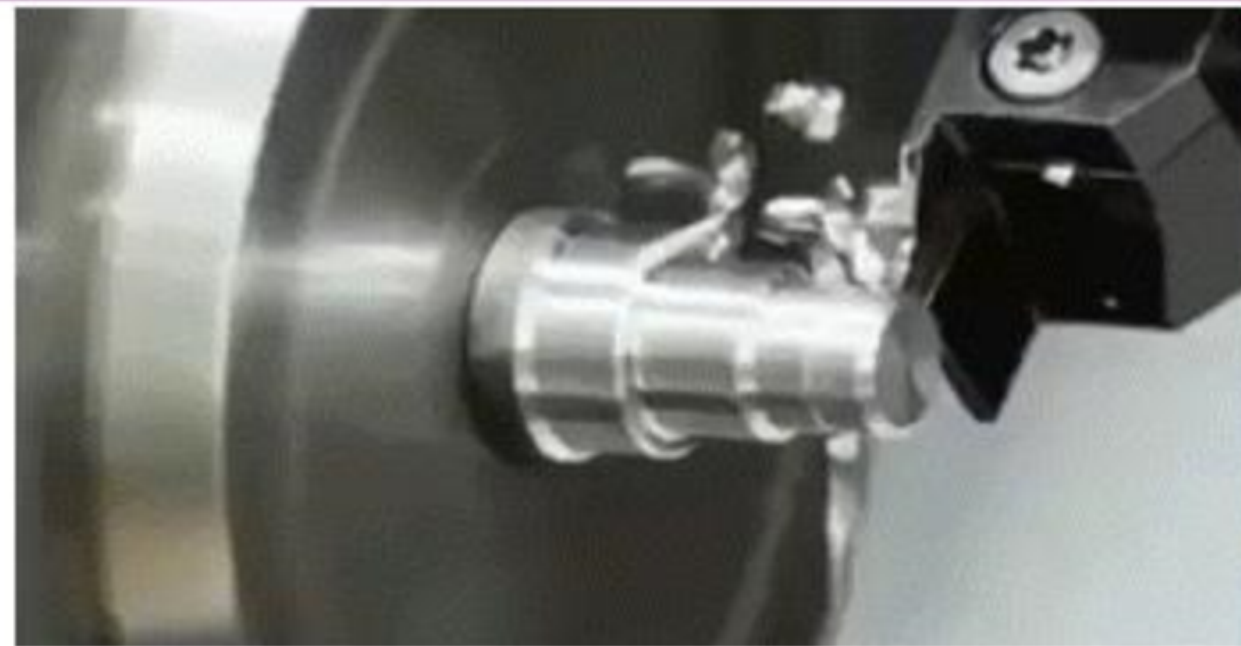
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MACHINE TOOL	CUTTING TOOL
It is an assembly of mechanisms that are clustered to perform certain operations by utilizing electrical , mechanical ,etc energy.	It is service having one or more wedge shape and sharp cutting edges to facilitate shearing during metal cutting.
It provides necessary motions to accomplish <u>cutting action</u> .	It does not provide any motion.
It supports and hold the <u>work-piece</u> and other necessary elements.	It generally hold the <u>Inserts</u> by clamping screw.
It transmits the vibrations to ground , hence foundation is necessary.	As it does not transmit any vibration to ground no foundation is needed.
Machines are difficult to move as they are large in size and heavier.	Cutting tools are easier to move from one place to another.
Cost is higher then cutting tool.	Cheaper than machine tool.
Example:- Lathe machine , Milling machine , etc.	Example:-Single point cutting tool, etc.

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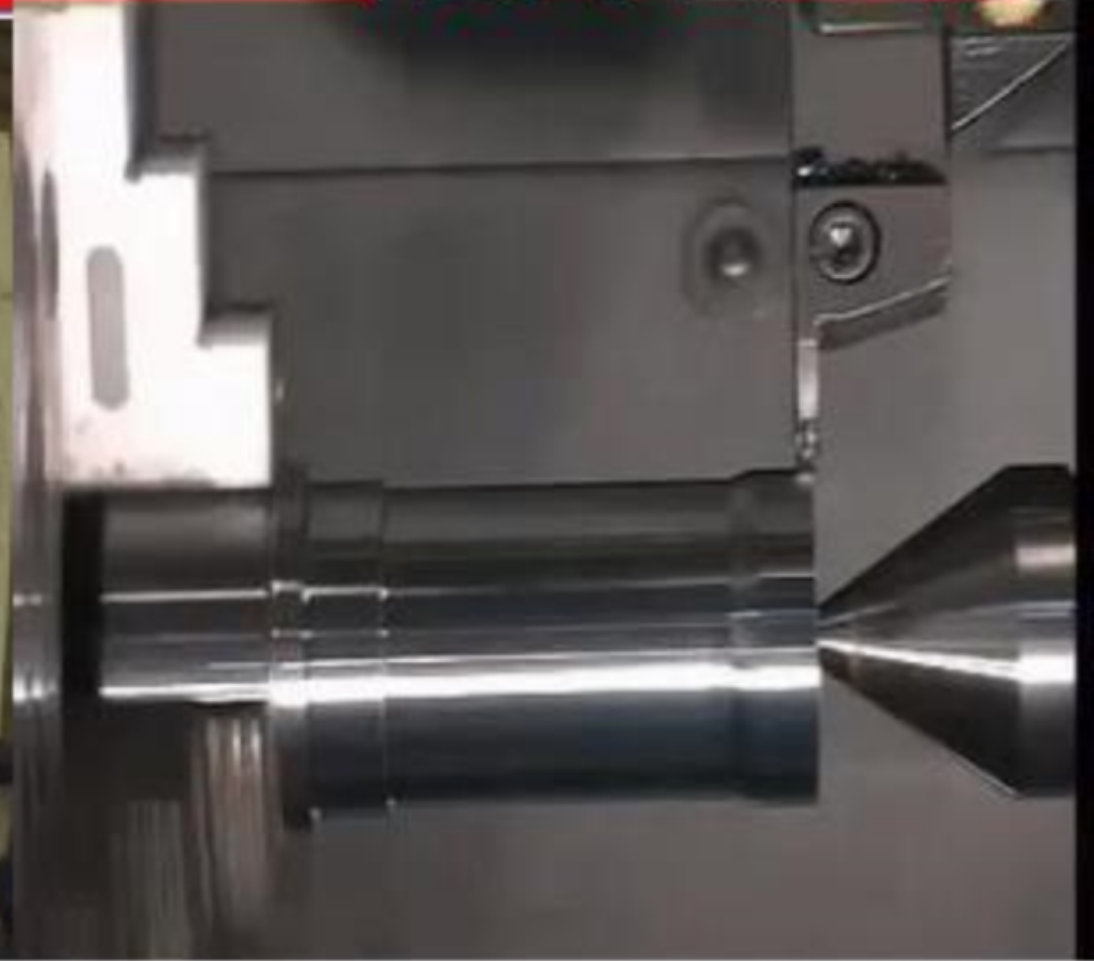
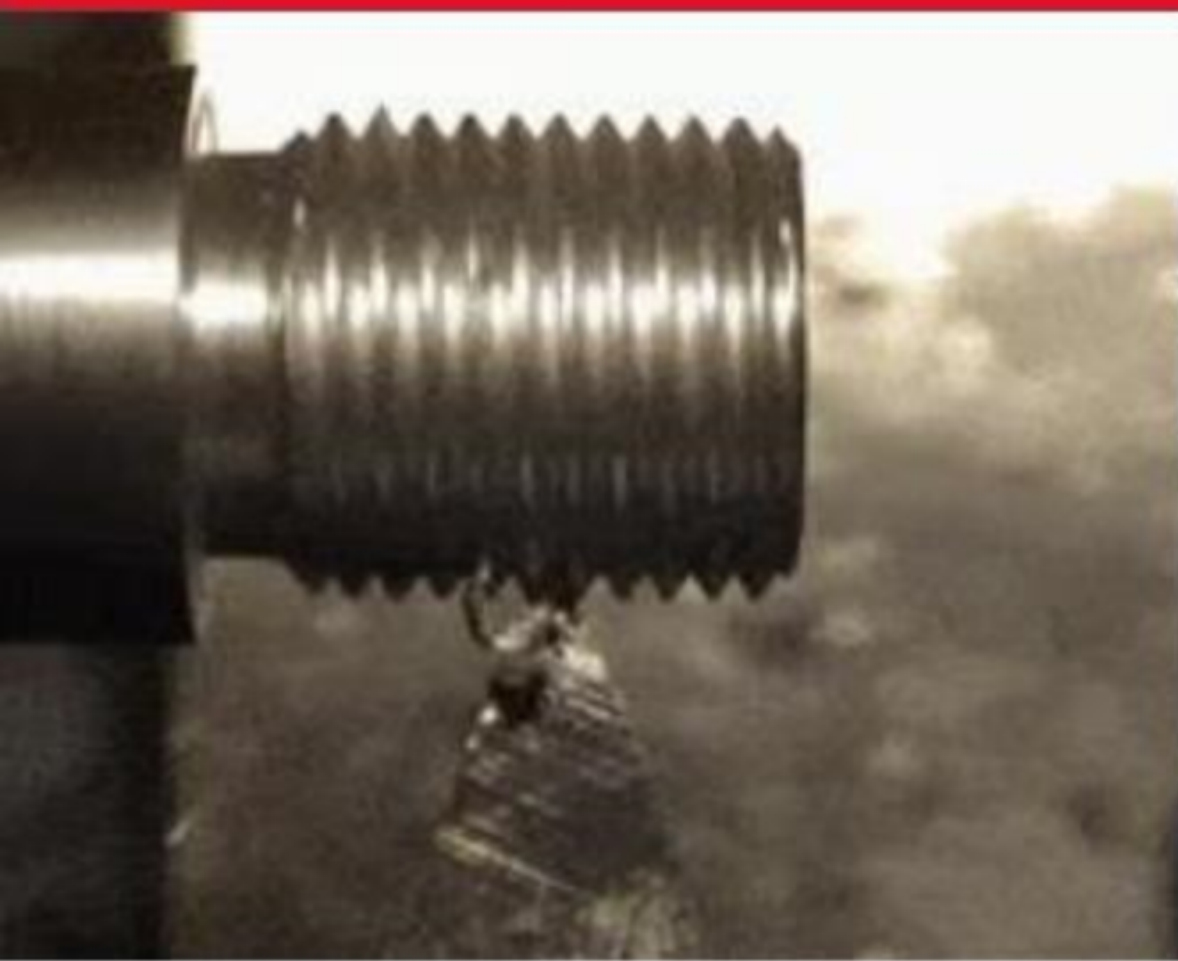
Single point cutting Tool





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Multipoint cutting Tool

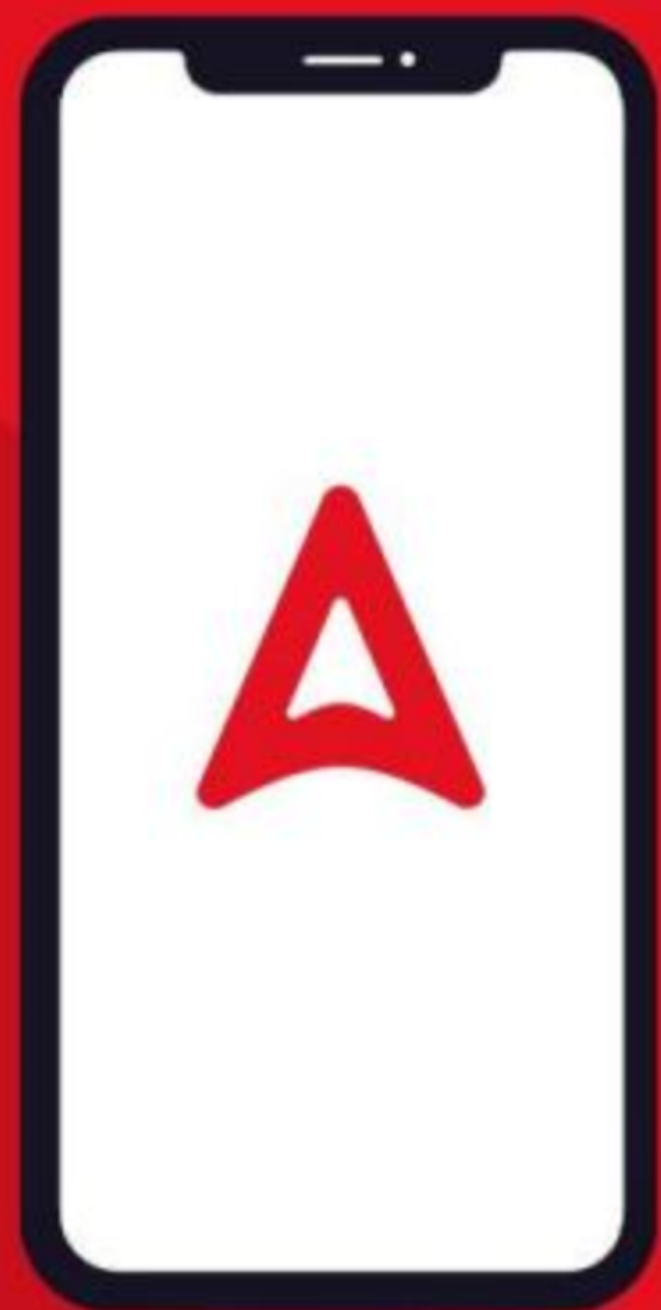


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