Adda247

WELCOME

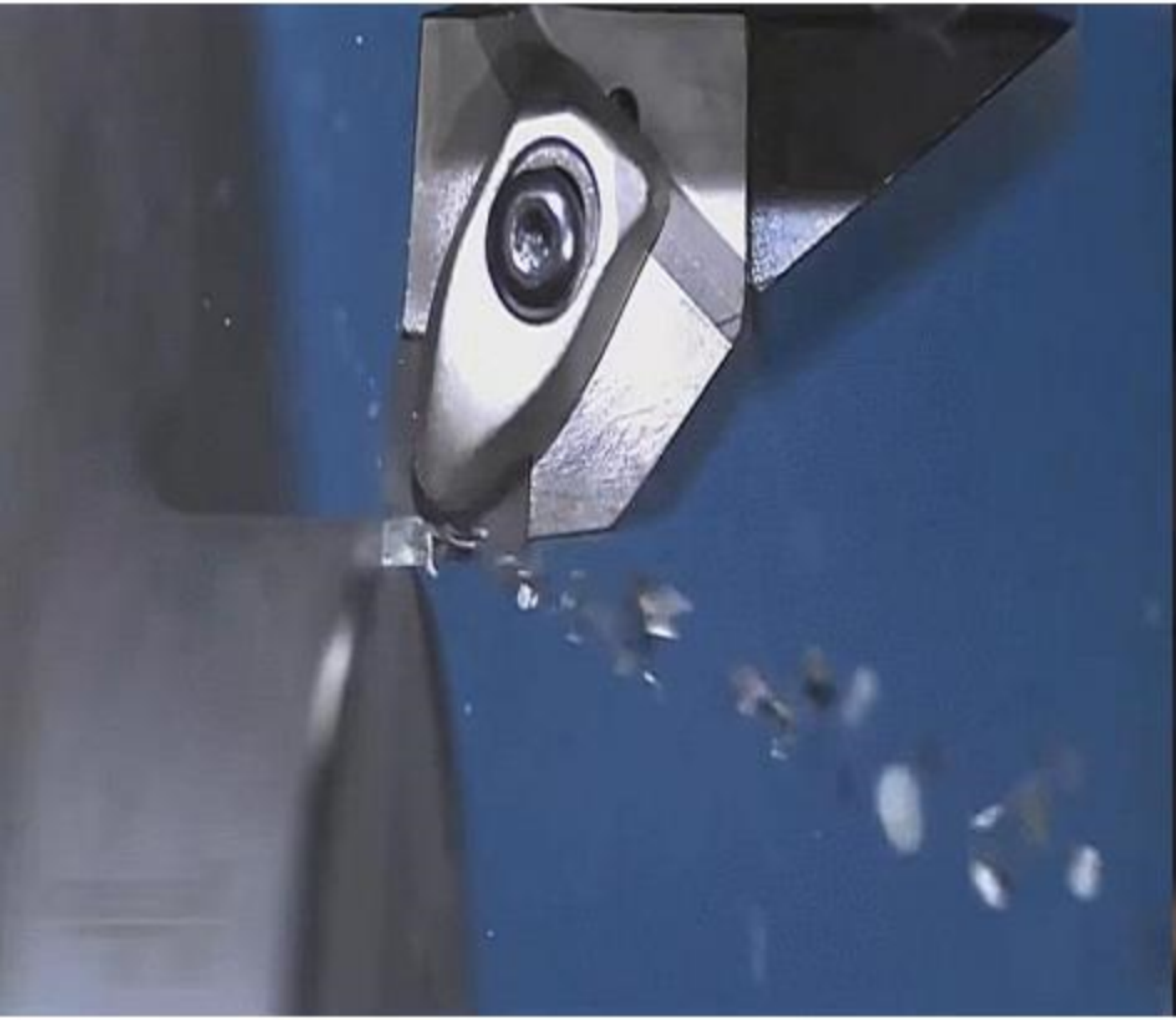
TO Adda247

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


GATE 2024
GATE
प्रचण्ड Batch
PRODUCTION
METAL CUTTING
LEC-4
Mechanical Engineering


GATE 2024
GATE
प्रचण्ड
Batch
MECHANICAL ENGINEERING
MON/ TUE/ WED- 9PM
THEORY OF MACHINE (TOM)
THUR/ FRI/ SAT- 6PM
PRODUCTION ENGINEERING

METAL CUTTING



1.Itroduction to Metal cutting

2.Machining operation

3.Turning operation And analysis

4 .Orthogonal Machining Analysis

1.System of Description of Tool Geometry

2.Orthogonal And Oblique cutting

3.Tool Signature

Orthogonal And Oblique Cutting

Orthogonal cutting is a type of cutting in which the cutting tool is perpendicular to the direction of tool motion. In this cutting, the flow of chip is perpendicular to cutting edge. The tool has lesser cutting life in this type of cutting.

* cutting Edge is ⊥ to the cutting velocity Vector

⇓

* cutting Force (F_c) :→ Acting ⊥ to the cutting edge.
* Thrust Force (F_t) :→ Acting ∥ to the cutting Edge.

1. Orthogonal Machining is 2-Dimensional Machining Operation

↓↓

* F_c
* F_t

2. Orthogonal Machining :→

→ Turning

→ Broaching

→ Sawing

Oblique cutting is a type of cutting in which cutting tool is at an oblique angle to the direction of tool motion. In this cutting, the flow of chip is not perpendicular to cutting edge. The tool has greater cutting life as compared to orthogonal cutting.

* Cutting Edge is oblique OR not ⊥ to the cutting velocity Vector.

* Forces acting on oblique cutting operation: →

* F_c

* F_t → F_a → Axial force; F_r → Radial force

oblique cutting is 3-Dimensional cutting operation

↓

* F_c
* F_t → F_a, F_r

* For the easy of Simplicity the Analysis of 3-D operation becomes Difficult

⇓

For All oblique Machining (3-D) operation Converted int orthogonal operation (2D)

3D —conversion→ 2D operation

3D operation ⟶ 2 D operation

⇓

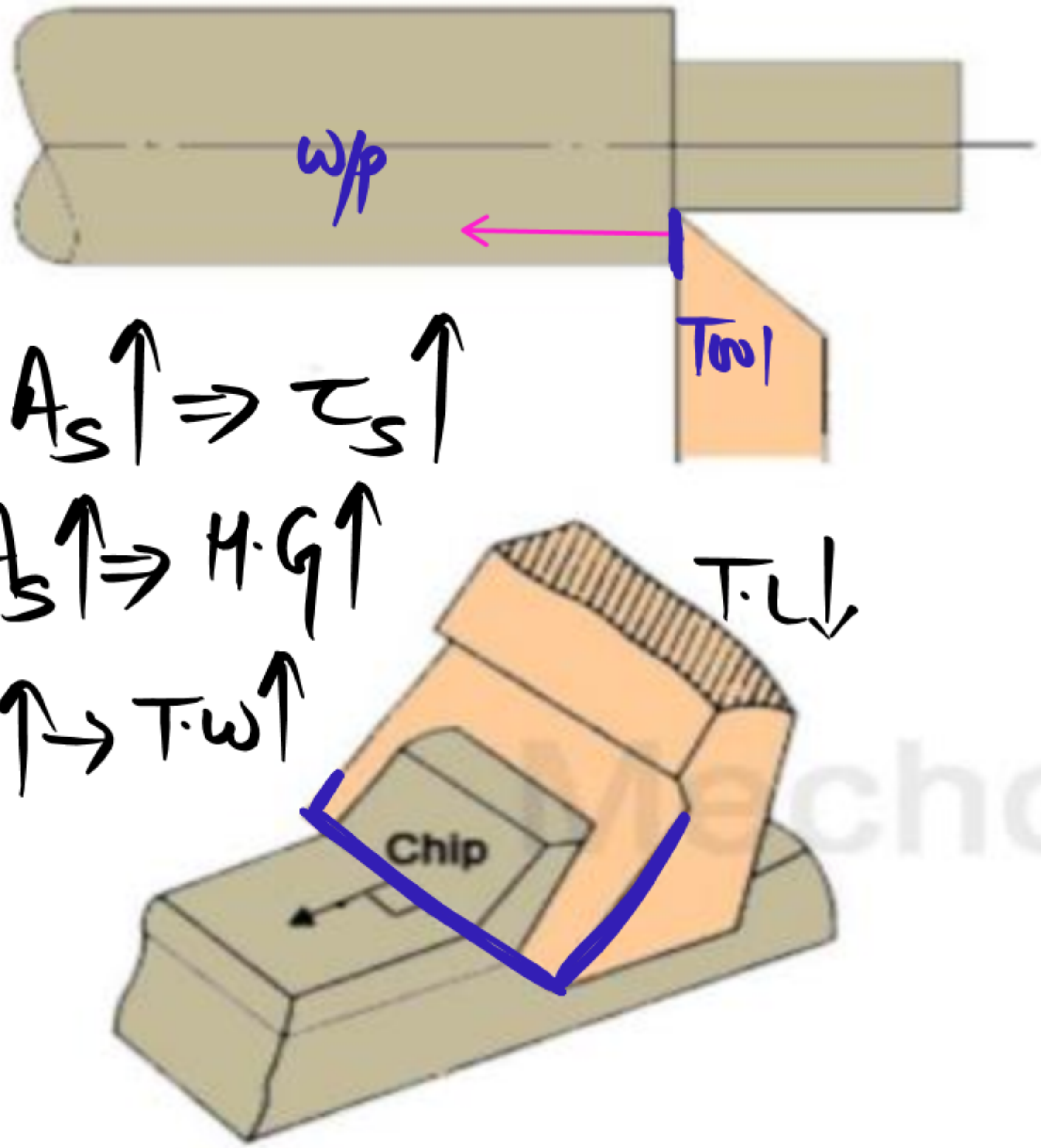
* Force conversion
* corresponding Area conversion

* 3-D operation ⟶ 2-D operation

* F_c — * F_c

* F_t → F_a, F_r — * F_t

Orthogonal cutting

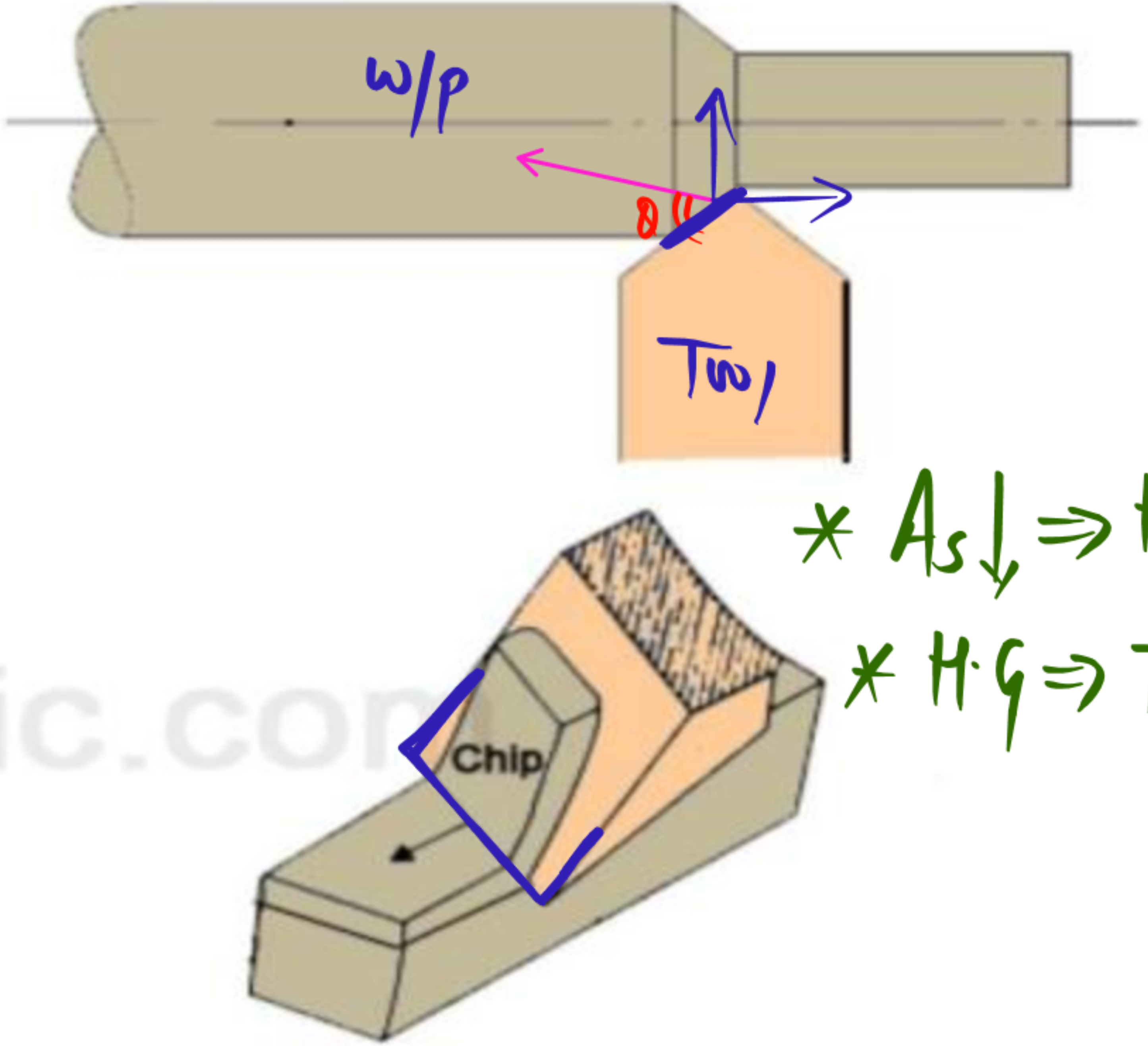


① $A_s \uparrow \Rightarrow \tau_s \uparrow$

② $A_s \uparrow \Rightarrow$ H.G ↑

* H.G ↑ → T.W ↑

Oblique cutting



* $A_s \downarrow \Rightarrow$ H.G ↓

* H.G ⇒ T.L ↑

Oblique operation :→ Milling, Drilling, Grinding, Shaping- - - - .

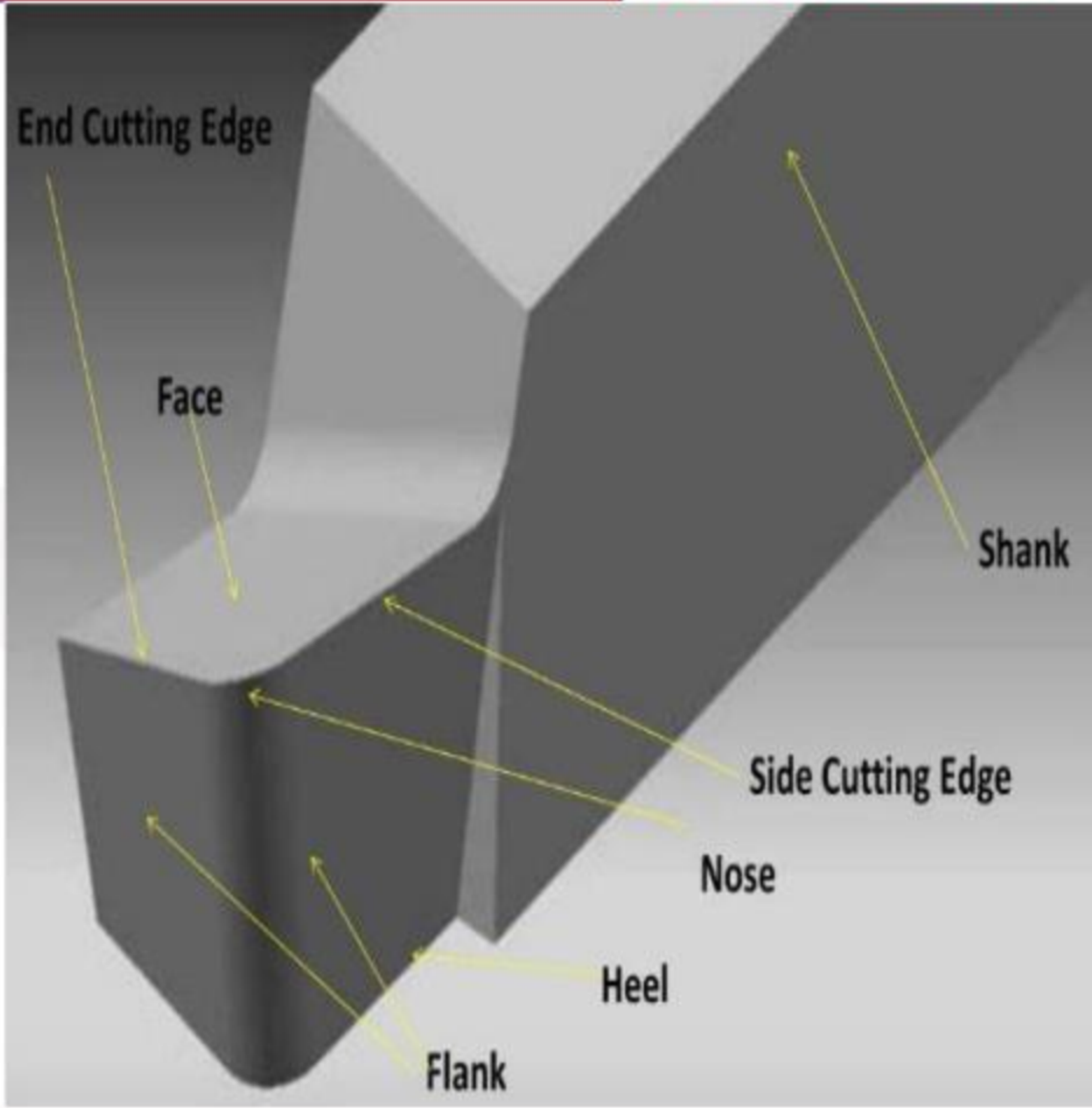
S.No	Orthogonal Cutting	Oblique Cutting
1	The cutting angle of tool make right angle to the direction of motion ($\theta = 90°$)	The cutting angle of tool does not make right angle to the direction of motion ($\theta \neq 90°$)
2	The flow of chip is perpendicular to cutting edge.	The flow of chip is not perpendicular to cutting edge.
3	The tool has lesser cutting life.	The tool has higher cutting life.
4	The shear force per unit area is high which increases the heat per unit area.	The shear force per unit area is low which decrease heat per unit area .
5	In this cutting, chip flow over the tool.	In this cutting, chip flow along the sideways.
6	In orthogonal cutting, surface fiish is poor.	In oblique cutting surface finish is good.
7	Cutting edge is longer than edge of cut.	Cutting may or may not be longer than edge of cut.
8	Two mutually perpendicular cutting force act on the workpiece	Three mutually perpendicular forces are involved .

System of Description of Tool Geometry

1. Machine Reference System

2. Tool Reference System

3. Work Reference System



Tool Designation Or Tool Signature

∴ → 7 Parameters
* 6 → Angles
+
* 1 → Nose Radius

1.Machine Reference System (ASA)

$\alpha_b \quad \alpha_s \quad \gamma_e \quad \gamma_s \quad C_e \quad C_s \quad R$

If 6th digit i.e

$C_s \leq 30^\circ$ → only when system will be in "ASA" otherwise Not.

"ORS"

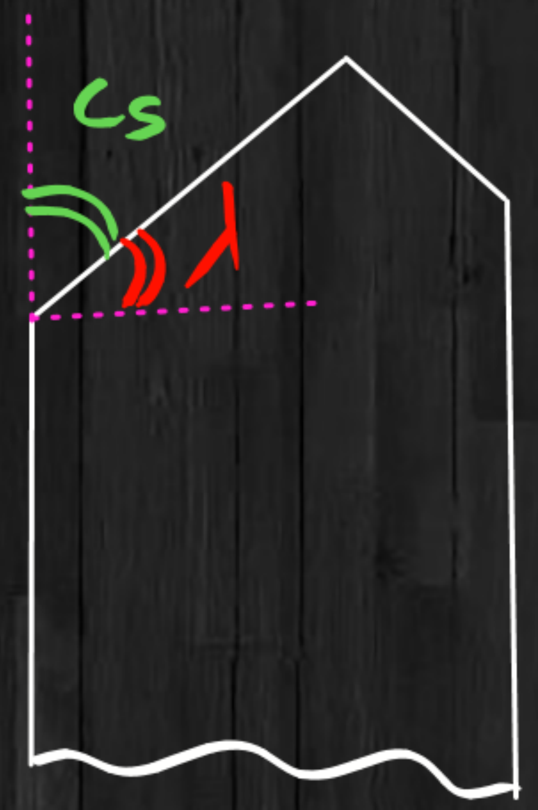
2.Tool Reference System (ORS)

i	α	γ_s	γ_e	C_e	λ	R

- $i \rightarrow$ Inclination Angle
- $\alpha \rightarrow$ orthogonal Rake Angle
- $\lambda \rightarrow$ Principle cutting Edge Angle OR Approach Angle
- $R \rightarrow$ Nose Radius
- $i = 0 \Rightarrow$ orthogonal cutting
- $i \neq 0 \Rightarrow$ oblique cutting

* $\lambda + C_s = 90^0$

* $\lambda = 90 - C_s$



	i	α	γ_s	γ_e	C_e	λ	R	
Q ①	6^0	12^0	21^0	24^0	32^0	75^0	21 mm	→ ORS

ⓐ $24^0 \longrightarrow \gamma_e$

ⓑ $32^0 \longrightarrow C_e$

	α_b	α_s	γ_e	γ_s	C_e	C_s	R	
②	4^0	12^0	21^0	28^0	20^0	30^0	75 mm	→ ASA

ⓐ $12^0 \longrightarrow \alpha_s$

ⓑ $28^0 \longrightarrow \gamma_s$

3.Work Reference System

Interconversion between ASA and ORS

$i \to$ ORS

$\alpha \to$ ORS

$\lambda \to$ ORS

$\alpha_b, \alpha_s \to$ ASA

$$\begin{bmatrix} \tan i \\ \tan \alpha \end{bmatrix} = \begin{bmatrix} \sin\lambda & -\cos\lambda \\ \cos\lambda & \sin\lambda \end{bmatrix} \begin{bmatrix} \tan\alpha_b \\ \tan\alpha_s \end{bmatrix}$$

* $\tan i = \tan\alpha_b \cdot \sin\lambda - \tan\alpha_s \cdot \cos\lambda$

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* $\tan\alpha = \tan\alpha_b \cdot \cos\lambda + \tan\alpha_s \cdot \sin\lambda$

$$\begin{bmatrix} \tan\alpha_b \\ \tan\alpha_s \end{bmatrix} = \begin{bmatrix} \sin\lambda & \cos\lambda \\ -\cos\lambda & \sin\lambda \end{bmatrix} \begin{bmatrix} \tan i \\ \tan\alpha \end{bmatrix}$$

* $\tan\alpha_b = \tan i \cdot \sin\lambda + \tan\alpha \cdot \cos\lambda$

* $\tan\alpha_s = -\tan i \cdot \cos\lambda + \tan\alpha \cdot \sin\lambda$

$$* \tan\alpha = \tan\alpha_s \cdot \sin\lambda + \tan\alpha_b \cdot \cos\lambda$$