INTRODUCTION TO METAL CUTTING

BASIC METAL CUTTING THEORY

The usual conception of cutting suggests clearing the substance apart with a thin knife or wedge. When metal is cut the action is rather different and although the tool will always be wedge shaped in the cutting area and the cutting edge should always be sharp the wedge angle will be far too great for it to be considered knife shaped. Consequently a shearing action takes place when the work moves

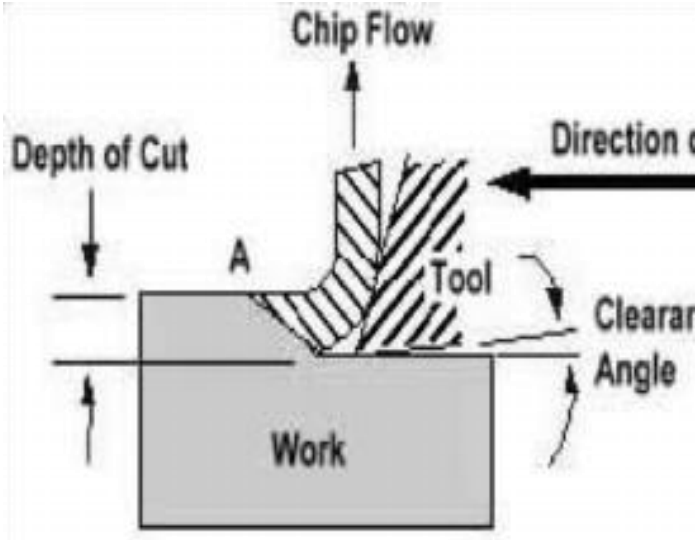
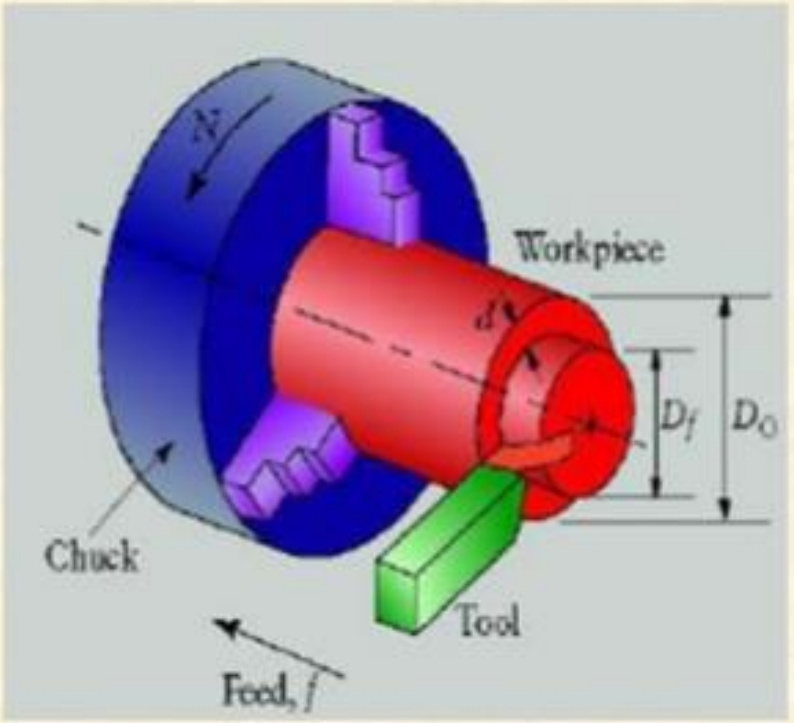
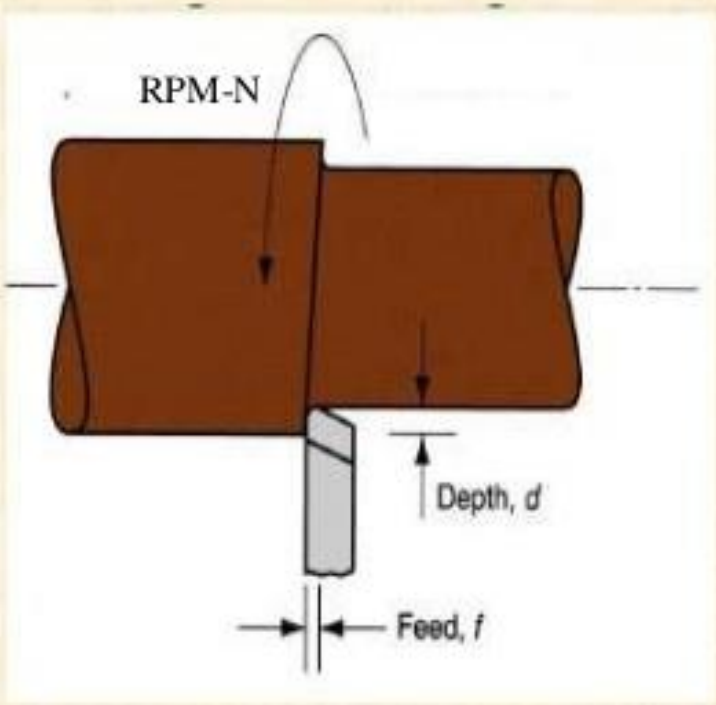


Figure above shows a tool being moved against a fixed work piece. When the cut is in progress the chip presses heavily on the top face of the tool and continuous shearing takes place across the shear plane AB. Although the Figure shows a tool working in the horizontal plane with the work piece stationary, the same action takes place with the work piece revolving and the tool stationary.

Cutting Parameters





Cutting Parameters

Cutting speed (V) is the largest of the relative velocities of cutting tool or workpiece. In turning, it is the speed of the workpiece while in drilling and milling, it is the speed of the cutting tool.

Cutting speed is the distance traveled by the work surface in unit time with reference to the cutting edge of the tool.

Cutting speed of a cutting tool can be defined as the rate at which its cutting edge passes over the surface of the workpiece in unit time.

It is normally expressed in terms of surface speed, referred to as speed(v) and expressed in meters per minute (m/min)

In turning, it is given by the surface speed of the workpiece

$V = r\omega = r \cdot (2\pi N)/60 = \pi DN/1000$ m/min D in mm, N in rpm

D= Dia. of w/p
N=rpm of spindle

V=linear velocity
ω = angular velocity = rad/sec

Feed: The feed is the distance advanced by the tool into or along the workpiece each time the tool point passes a certain position in its travel over the surface.
In case of turning, feed is the distance that the tool advances in one revolution of the workpiece.

Feed **f** is usually expressed in mm/rev.
Feed in mm/min = Feed in mm/rev x N

Depth of cut : It is the distance through which the cutting tool is plunged into the workpiece surface.

Thus it is the distance measured perpendicularly between the machined surface and the unmachined (uncut) surface or the previously machined surface of the workpiece.

The depth of cut ***d*** is expressed in mm.=(d1-d2)/2 for turning

MACHINE TOOL :

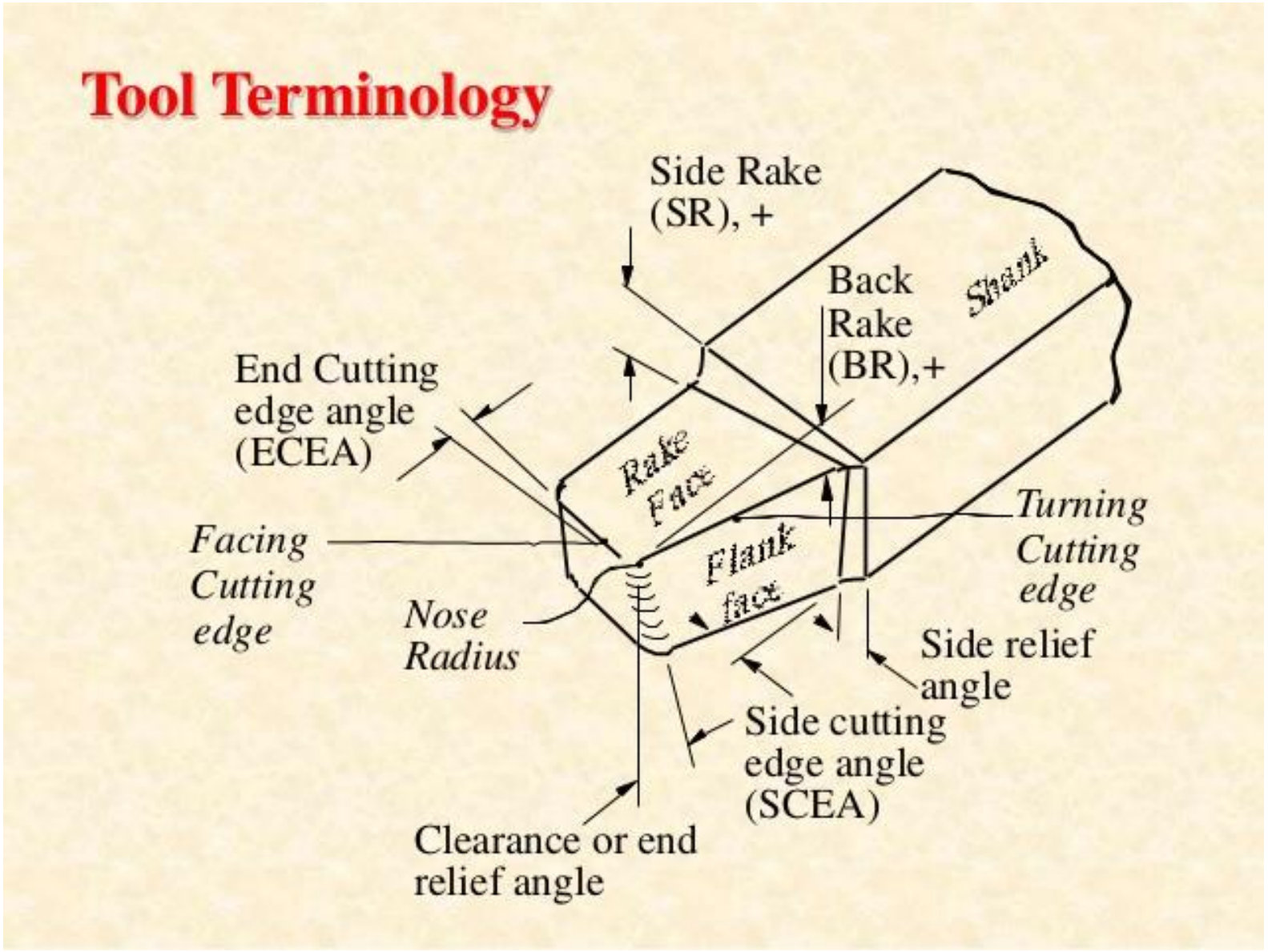
A machine tool may be defined as a power driven machine which accomplishes the cutting or machining operations on it. The fundamental machine tools that are used for most of the machining processes are lathe, drilling, tapping, shaping, milling and grinding machines.

CUTTING TOOLS :

There are basically two types of cutting tools:

- Single point (e.g. turning tools).
- Multiple point (e.g. milling tools).

Following figure shows the terminology of **single point cutting tool.**



- **Shank:** The shank is the portion of the tool bit which is not ground to form cutting edges and is rectangular in cross-section**.**
- **Face:** The face of the cutting tool is that surface against which the chip slides upward**.**
- **Flank:** The lank of a cutting tool is that surface which face the work piece.
- **Heel:** The heel of a single point tool is the lowest portion of the side cutting edges.
- **Nose:** The nose of a tool is the conjunction of the side-and end-cutting edges. A nose radius increases the tool life and improves surface finish.
- **Base:** The base of a tool is the underside of the shank.
- **Rake:** The rake is the slope of the top away from the cutting edge. The larger the rake angle, the larger the shear angle and subsequently the cutting force and power reduce.
- **End cutting edge angle:** It is the angle between face of the tool and a plane perpendicular to the side of the shank. It varies from 5 to l5 degrees.

Rake Angle

Rake angle is the angle between the top face of the tool and the normal to the work surface at the cutting edge. In general, the larger the rake angle, the smaller the cutting force on the tool. A large rake angle will improve cutting action, but would lead to early tool failure, since the tool wedge angle is relatively weak. A compromise must therefore be made between adequate strength and good cutting action.

Clearance Angle

Clearance angle is the angle between the flank or front face of the tool and a tangent to the work surface originating at the cutting edge. All cutting tools must have clearance to allow cutting to take place. Clearance should be kept to a minimum, as excessive clearance angle will not improve cutting efficiency and will merely weaken the tool. Typical value for front clearance angle is 6° in external turning.

TOOL MATERIALS IN COMMON USE :-

The different materials used for cutting tools are:

1. High carbon steel
2. Alloy steels
3. High speed steel
4. Stellites
5. Cemented carbides
6. Ceramics
7. Diamonds
8. Abrasives

LATHE

INTRODUCTION

Lathe is one of the most versatile and widely used machine tools all over the world. It is commonly known as the mother of all other machine tool. The main function of a lathe is to remove metal from a job to give it the required shape and size. The job is securely and rigidly held in the chuck or in between centers on the lathe machine and then turn it against a single point cutting tool which will remove metal from the job in the form of chips.

TYPES OF LATHE

Lathes are manufactured in a variety of types and sizes, from very small bench lathes used for precision work to huge lathes used for turning large steel shafts. But the principle ofoperation and function of all types of lathes are same. The different types of lathes are:

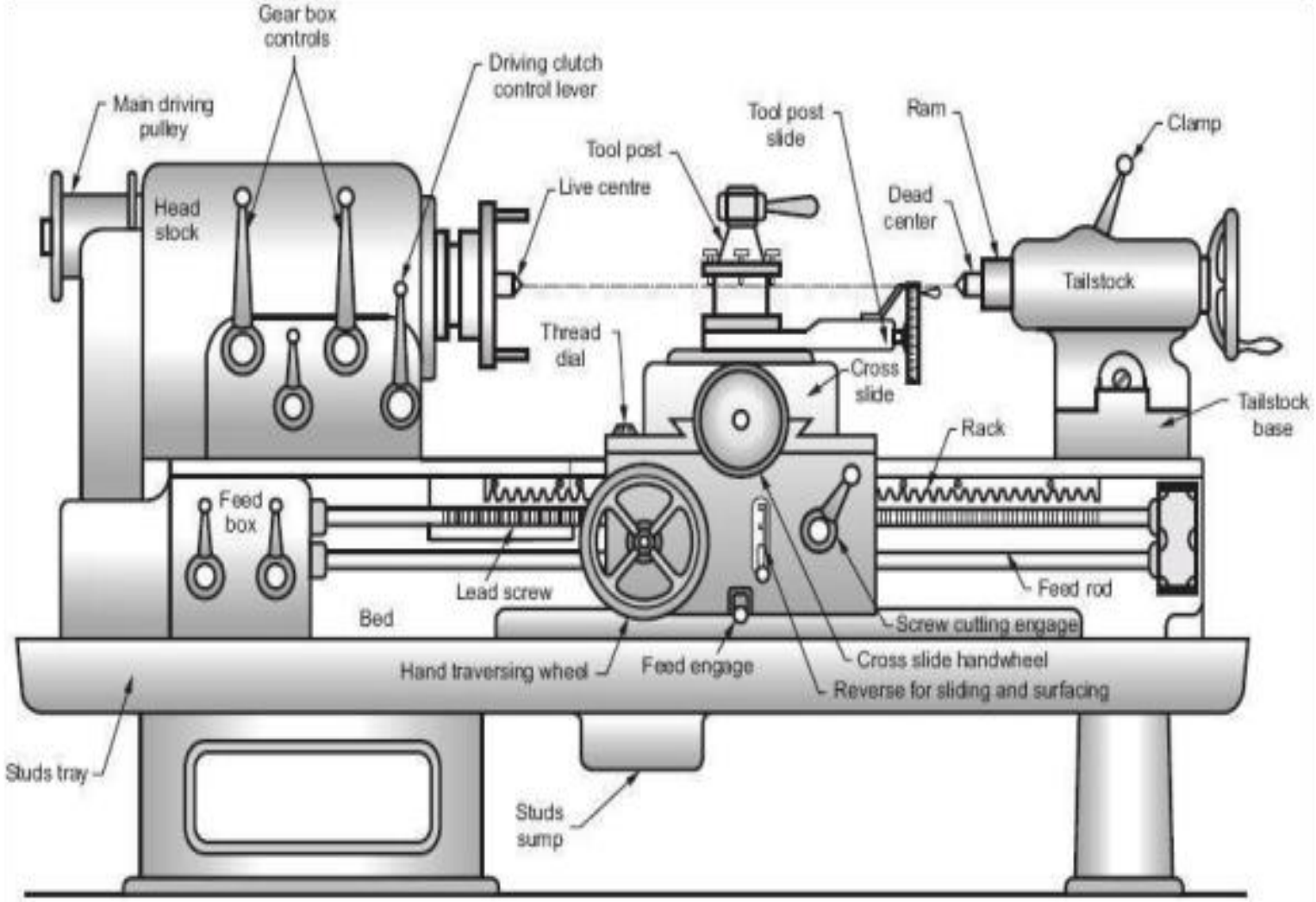
1. Speed lathe
2. Centre or Engine lathe
3. Bench lathe
4. Tool Room Lathe
5. Capstan and Turret lathe
6. Special purpose lathe
7. Automatic lathe

PRINCIPLE PARTS OF LATHE

A simple lathe comprises of a bed made of grey cast iron on which headstock, tailstock, carriage and other components of lathe are mounted. Following figure shows the different parts of engine lathe or central lathe.

The major parts of lathe machine are given as under:

1. Bed
2. Head stock
3. Tailstock
4. Carriage
5. Feed mechanism


Gear box controls
Driving clutch control lever
Main driving pulley
Tool post slide
Ram
Clamp
Tool post
Live centre
Dead center
Head stock
Tailstock
Thread dial
Cross slide
Tailstock base
Rack
Feed box
Lead screw
Feed rod
Bed
Screw cutting engage
Hand traversing wheel
Feed engage
Cross slide handwheel
Reverse for sliding and surfacing
Studs tray
Studs sump

LATHE OPERATIONS

- Straight turning
- Taper turning
- Facing
- Chamfering
- Thread cutting
- Grooving
- knurling
- Under cutting
- Filing
- Spinning
- Forming
- Polishing
- Solder turning
- Spring winding
- Boring
- drilling

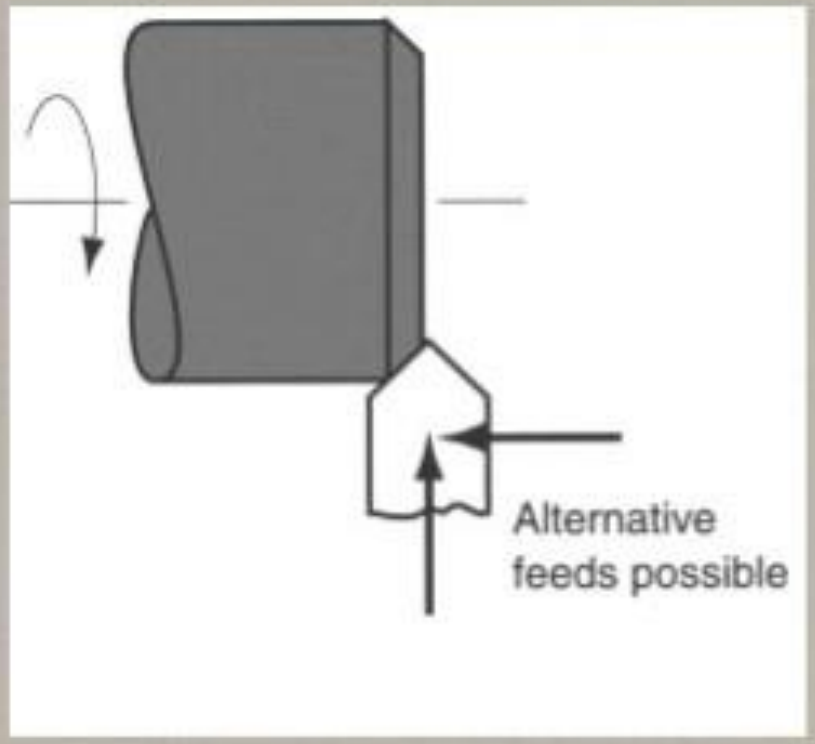
STRAIGHT TURNING

- Work piece become cylindrical.
- Motion of tool is parallel to the work piece surface.

FACING

- To make side surface perpendicular via cutting tool
- Motion of tool is perpendicular to the work piece surface.

CHAMFERING



- Cutting edge cuts an angle on the corner of the cylinder, forming a "chamfer"