Q:Name three reasons why we need machining?

1. To achieve Closer dimensional accuracy may be required than can be achieved by metalworking or casting processes alone (first we cast or metal work to close dimension then machining is done).

2. Some geometric features, such as sharp corners and internal threads, that cannot be produced by other processes.

3. After heat treatment which causes dimensional distortion we need finishing operations.

4. Special surface characteristics or textures for example copper mirrors with very high reflectivity are typically made by machining with a diamond cutting tool.

5. It may be more economical to machine the part than to make it by other processes, particularly if the number of parts required is relatively small.

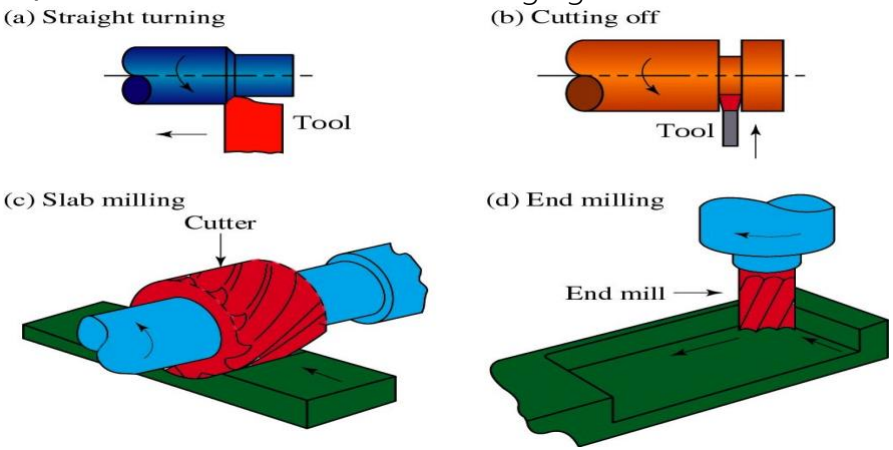
Q:Name one limitation or disadvantage of machining?

1. Machining processes inevitably waste material and generally require more energy and labor than other metalworking operations.

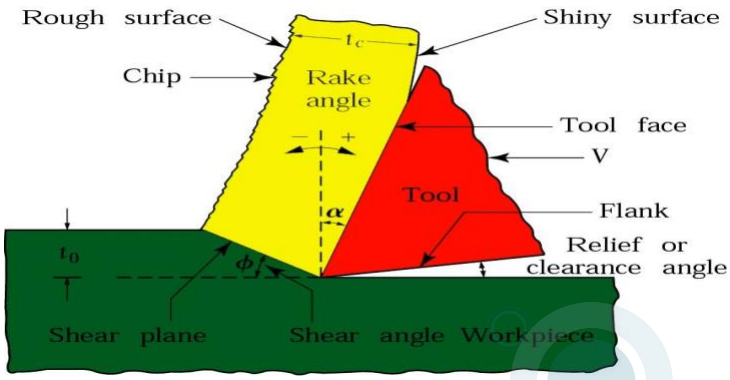
2. Removing a volume of material from a workpiece generally takes more time than other processes.

3. Material-removal processes can have adverse effects on the surface integrity of the product, including its fatigue life.

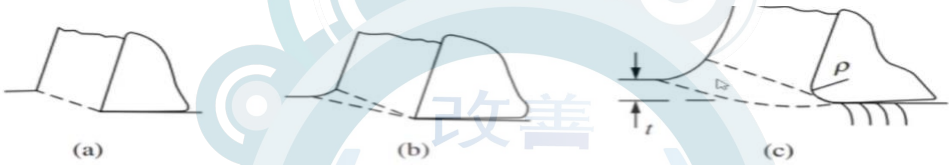
Q:Name the Process in the following figures?



Q:Draw a schematic of orthogonal cutting with names of angles ?



Q:Illustrate with a figure the extensive shear zone case and explain the effect of the nose radios?



All steady state chips do not behave in accordance with the model of Fig a. If the work is relatively soft and not pre strain hardened before cutting, chip formation will involve a pie shaped zone (Fig b) and an even more extensive shear zone if the radius at the tool tip (ρ) is significant relative to the un deformed chip thickness, t.

?Questions: Discuss the effect of low shear angle on shear strain?

Lower the shear angel higher the shear strain

Q:Name the different types of chip Morphology in machining?

1-Continuous chips 2-BUE chips 3-Serrated chips (saw shape) 4-Discontinuous chips

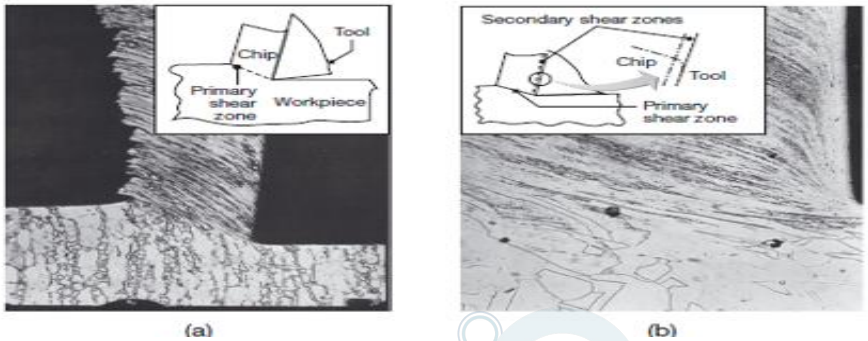
Q:Why do we need chip breakers?

If chips tend to become tangled around the tool

?Q:Why do secondary shear zones occur?

In case of high friction

Q:Illustrate with a schematic figure the primary secondary shear zone?



Q:Why does built up edges lead to low integrity in machining And bad surface finish?

because it changes the geometry of cutting, and Leads to rough surface finish
Because of work hardening and deposition of successive layers of material

+?As it grows larger, the BUE becomes unstable and eventually breaks up; the upper portion of the BUE is carried away on the tool side of the chip and the lower portion is deposited randomly on the machined surface.

Q: Name three factors that affect the formation of BUE?

(a) adhesion of the workpiece material to the rake face of the tool and the strength of the interfacial bond. Ceramic cutting tools for example, have much lower affinity to form BUE than do tool steels

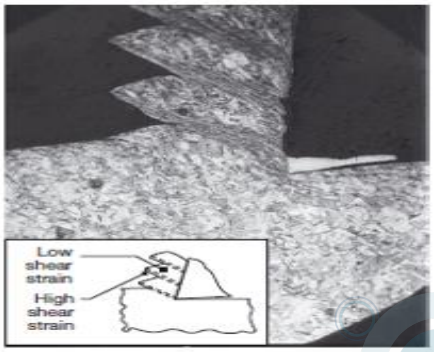
(b) growth of the successive layers of adhered metal on the tool;

(c) tendency of the workpiece material for strain hardening; the higher the strain-hardening exponent, n, the higher the probability for BUE formation.

Q:What is the effect of the following process parameters on BUE

a) Cutting speed : as the cutting speed, V, increases , BUE decreases
b) Depth of cut : as depth of cut, to, decreases, BUE decreases
c) Rack angle: as rake angle, α, increases; , BUE decreases
d) Tip radius : as tip radius of the tool decreases; , BUE decreases

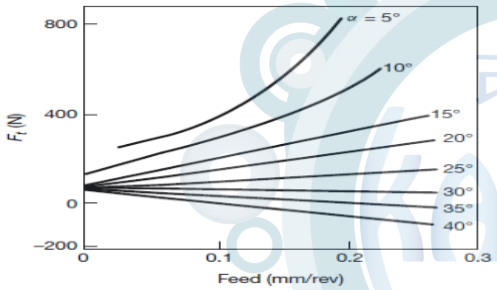
Q:Illustrate the condition for serrated chips and discontinuous chips?



Q:How can we solve the problem of chip curl and long continuous chips?

By using chip breakers

Q:Illustrate with a schematic figure the effect of feed and rake angle on thrust forces?



Q:Illustrate with a figure the effect of rake angle and shear stress area on shear force and normal force?

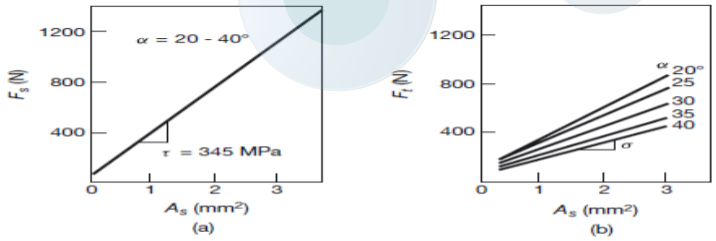


FIGURE 8.13 (a) Shear force and (b) normal force as a function of the area of the shear plane and the rake angle for 85–15 brass. Note that the shear stress in the shear plane is constant, regardless of the magnitude of the normal stress, indicating that the normal stress has no effect on the shear flow stress of the material. *Source:* After S. Kobayashi and E.G. Thomsen.

*note:The depth of cut has an important influence; as to increases, R must also increase and thus, Fc will increase as well.

Q:Name three reasons why we need to analyze and monitor temperature in metal cutting?

• High temperatures can adversely affect the strength, hardness, and

wear resistance of the cutting tool

• Control of tolerances can be made difficult by dimensional changes in

the workpiece

• The machined surface can encounter thermal damage, adversely

affecting its properties and service life.

Q:What are the two principal sources of heat generation in metal cutting?

(a) primary shear zone and

(b) friction at the tool-chip interface. (worn or dull tool tip rubbing increases heat)

Q:What do you expect the effect of temperature as we increase the following factors

(c) V , T increases

(d) T0 ,T increases

(e) Flow stress, T increases

(f) K(thermal diffusity) , T decreases

(g) volumetric specific heat, T decreases

Q:Illustrate with a schematic figure the effect distance from the tool chip and velocity of cutting on flank surface temperature and tool chip interface

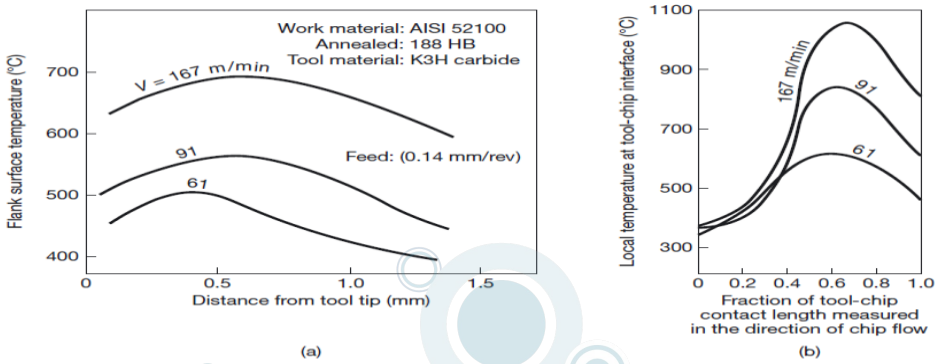
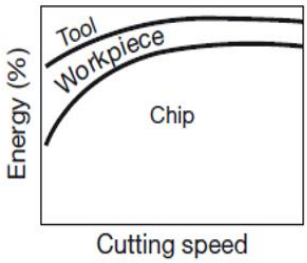


FIGURE 8.17 Temperature distribution in turning as a function of cutting speed: (a) flank temperature; (b) temperature along the tool-chip interface. Note that the rake-face temperature is higher than that at the flank surface. *Source:* After B.T. Chao and K.J. Trigger.

Q:What is the main reason why we get this figure results?



As we increase the cutting speed there will be less time for the heat to move to the tool and the wokpiece from the chips thus more percentage of the heat will be in the chips

Q:Name two methods to measure temperature in metal cutting?

(a) Using thermocouples, embedded in small holes in the tool or in the workpiece

(b) Measuring thermal emf (electromotive force) at the tool-chip interface,

(c) Using a radiation pyrometer, monitoring the infrared radiation from the cutting zone;

Q:Name the four types of tool wear and failure?

as flank wear (GRADUAL)/ crater wear (GRADUAL)/ nose wear (GRADUAL)/ and chipping of the cutting Edge (catastrophic failure).

* tool life curves slide 83

?Q:Name two reasons that affect flank wear in addition to cutting speed and material Type?

1. Adhesive and/or abrasive wear due to Sliding of the tool on machined surface

2. Temperature rise, which affects tool material.

Q:Name two main reasons in addition to speed and tool material that affect the crater wear?

1-temperature (can reach up to 1100 ^{o}C)

2-level ofchemical affinity between the tool and the workpiece materials.

?Q:Provide a proof that the temperature has definite effect on crater wear?
The location of crater wear is at max temp

?Q:Give a simple method to identify the temperature profile in cutting and where to expect the biggest wear?

discoloration

Q:What is chipping and what the main reasons for it?

a)Definition: sudden breaking away of a piece from the cutting edge of the tool.

b)Two main causes of chipping are

Mechanical shock and thermal fatigue

Q:Why do we need tool condition monitoring?

to avoid extensive tool wear and improve the surface of the machined part and accuracy.

Q:Differentiate between direct and indirect tool condition monitoring?

The direct method involves optical measurement of wear, by periodically observing changes in the profile of the tool. (disadvantage: Periodic)

Indirect methods: by correlating the tool wear to continuously measured variables:

1- Cutting variables: force, power, temperature rise, surface finish,

and vibration and chatter. (example: continually monitor such parameters as spindle torque and

cutting-tool forces)

2-The acoustic emission measures accostic wave stress and relates it to wear. By.

This technique is particularly effective in precision machining operations with little forces and low depth of cut.

Q:name three main metal cutting factors that affect the surface finish?

1)Built-up edge

2)depth of cut

3)A dull cutting tool

Q: Explain why the radius of cutting tool should be less than depth of cut?/ Depth of cut should be greater that nose radius explain why?
To avoid rubbing and friction heat that will induce surface residual stresses , and causing surface damage, such as tearing and cracking.

Q: Explain why in low depth cut (specific to finishing) a dull tool may have high adverse effect on the surface?

at small depths of cut, the rake angle of an otherwise positive-rake tool can effectively become negative; the tool may simply ride over the workpiece surface and not remove any material.

Q: Name the four measures for the machinability of a material?

(a) surface finish and integrity of the machined part;
(b) tool life
(c) force and power requirements
(d) chip control.

Q: Name two reasons why lead improves the machinability of steel?
1-During machining, the lead particles are sheared and act as a solid lubricant
2-lead lowers the shear stress in the primary shear zone, thus reducing cutting forces and power consumption

Q: Name two alternatives to Lead to improve the machinability of steel?

bismuth and tin (lead-free steels).

Q : How does sulfur and phosphorous Improve the Machinability Of steel?
Why is sulfur added?
act as stress raisers in the primary shear zone; as a result, the chips produced are small and they break up easily, thus improving machinability.
Why is phosphorus added?
Increasing the hardness of steels and producing less continuous chips.

Q: Explain why aluminum and silicon impair(weakens\is harmful to) the machinability of steels?
, because these elements combine with oxygen to form aluminum oxide and silicates,which are hard and abrasive

Q: What is the effect of increasing carbon content or alloying elements such as chrominum and nickel on the machinability of steels?
As the carbon content increases, machinability decreases
++Carbon and manganese have various effects on the machinability of steels, depending on their composition. As the carbon content increases, machinability decreases, although plain low carbon steels (less than 0.15% C) can produce poor surface finish due to forming a built-up edge. Alloying elements,

such as nickel, chromium,molybdenum, and vanadium (which improve the properties of steels) generally reduce machinability.

Q: Why may softer metals(like AL) have lower machinability?

softer grades tend to form built-up edge ,and thus, poor surface finish.

++High cutting speeds, rake angles, and relief angles are recommended

Q: Why is the high silicon content(&cast alloys) in aluminum reduces machinability?

silicon content and cast alloys may be abrasive, thus requiring harder tool materials.

++Dimensional control may be a challenge in machining aluminum, because of its low elastic modulus and Relatively high thermal coefficient of expansion.

Q: What type of tool may be suitable for machining gray cast iron and cobalt base alloys? Why?

requiring tools with high toughness .

Nodular and malleable irons are machinable , using hard tool material

Gray cast irons are generally machinable , although they are abrasive

Free carbides in castings reduce machinability and cause tool chipping and fracture, thus

Q: Why does molybdenum and tantalum has poor machinabilty?

They are ductile ,work hardening, and soft; which produces a poor surface finish and so tool wear is high

Q: Why does titanium has poor machinabilty?

and its alloys have poor thermal conductivity (the lowest of all metals; see the inside front cover), causing significant localized temperature rise and the formation of BUE

Q : Why Reinforced plastics More difficult to machine than thermoplastics?

Reinforced are generally very abrasive(kasht), depending on the type of fiber, and are difficult to machine; fiber tearing and pullout is a significant problem. There are also environmental considerations, as machining these materials requires proper removal of machining debris to avoid human contact with and inhalation of loose fibers.

Q: Name the four Properties important for cutting tool materials?
1-Hardness
2-Toughness
3-wear resistance
4-chemical stability

Q: Compare ceramics carbide , high speed steel and Carbon tool steels in terms of hot hardness?
From slide & graph
Endure temp without decrease in hardness
Ceramics>carbides*>cast alloys>HSS*>carbon tool steels

Q: Explain why carbon and medium alloy steels are limited to low speed machining operations and woodworking?
these steels do not have sufficient hot hardness and wear resistance for machining at high cutting speeds, where temperature rise is significant.

Q: What are conditions that HSS is especially suitable for?
1- high positive rake angle tools
2-interrupted cuts
3- use on machine that are subject to vibration and
chatter.

Q: What are the most suitable tool material for machining operations that require complex tool shapes such as drills reamers taps and gear cutters?
HSS

Q: What are the characteristics that makes HSS tool very versatile?
high toughness and resistance to chipping and fracture

Q: Name the types of HSS and the main differences between them?

Mseries Tseries

From slides

Q: Name the two categories for carbides and their compositions?

1. Tungsten carbide

. consisting of tungsten carbide particles bonded together in a cobalt matrix. Tungsten carbide tools are generally used for machining steels, cast irons , and abrasive nonferrous materials.

2. Titanium carbide.

Titanium carbide TiC) has higher wear resistance than tungsten carbide, but it is not as tough. With a nickel molybdenum alloy as the matrix, TiC is suitable for machining hard materials , mainly steels and cast irons, and for machining at speeds higher than those for tungsten carbide.

Q: Why is inserts the most suitable shape for carbides?

No need to be reground when the tool become dull it has multiple edges

A square insert, for example, has eight cutting edges, and atriangular insert has six.

Q: Why titanium nitride coating improves machinability?

It has low coefficient of friction, high hardness,good high temperature properties, and good adhesion to the substrate.Titanium nitride coated tools perform well at higher cutting speeds and feeds; they do not perform as well as uncoated tools at low speeds, because the coating is susceptible to chip adhesion.

Q: Why titanium carbide coating improves machinability?

TiC coatings over tungsten carbide inserts have high resistance to flank wear , especially in machining abrasive materials.

?Q: Why coating is especially effective for cutting stainless steel?

Coated carbide tools are available with two or three layers of such coatings, and are particularly effective in machining cast irons

Q: What is the main advantage for alumina based ceramics tools?
They have very high abrasion resistance and hot Hardness.Lower tendency to form a built up edge. Consequently , good surface finish is obtained , particularly in machining cast irons and steels.

Q: What is Alumina base ceramic tools disadvantage?
ceramics lack toughness, which can result in premature tool failure by chipping or fracture. (negative rake angles preferred to avoid chipping)

Q: Why is the cubic boron nitride suitable for machining iron and nickel?
Has very high wear resistance and cutting edge strength.
Chemically inert to iron and nickel and
its resistance to oxidation is high; it is therefore particularly suitable for machining hardened ferrous and high temperature alloys.

Q: What is the main disadvantage of cubic boron nitride tool?
Susceptible to vibration and chatter because it is brittle (needs machine dampers).

Q: Which tool is recommended for cast iron and nickel based superalloys?
Silicon Nitride Base Ceramics SiN

Q: Why is diamond tool more suitable for abrasive nonmetallic materials and soft nonferrous alloys?
It is the hardest material, it has low tool chip friction, high wear resistance, and thus the ability to maintain a sharp cutting edge. Diamond is used where very fine surface finish and dimensional accuracy are required,
?Q: What are the recommended geometry for diamond tool and why?
Diamonds brittle, and tool shape and sharpness are thus important; low rake angles and large included angles are normally used for a strong cutting edge .

Q: Why is the diamond not suitable for plain carbon steels , titanium and nickel?
Because of its strong chemical affinity

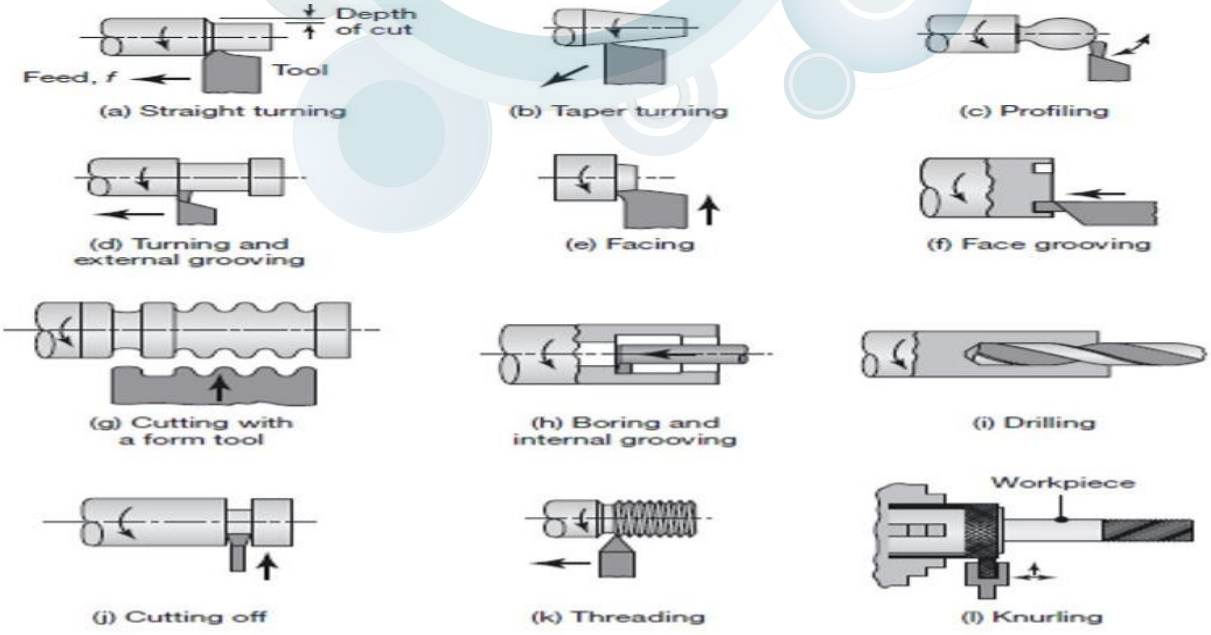
Q: What are the five reasons for the use of cutting fluids?
1-Cool the cutting zone, thus reducing workpiece temperature and distortion, and improving tool life
2-Reduce friction and wear, thus improving tool life and surface finish
3-Reduce forces and energy consumption;
4-Wash away chips
5-Protect the newly machined surfaces from environmental attack

Q: Name the three types of cutting fluids?
oils, emulsions, semi synthetics

Q:Name six machining processes?

1-Turning 2-boring 3-drilling 4-milling 5-planing 6-shaping 7-broaching 8-sawing

Q:Name the process in the figure?

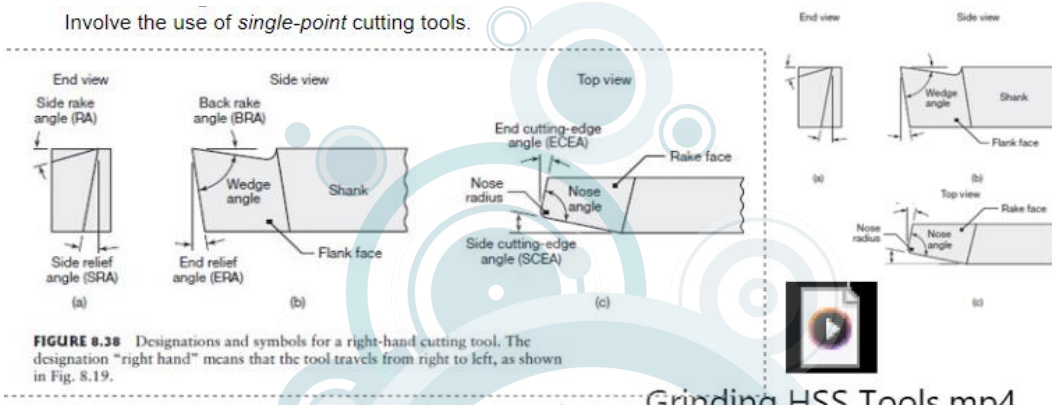


Q:In terms of depth of cut and feed between roughing and finishing?

Roughing cuts depths of cut greater than 0.5 mm and feeds on the order of 0.2–2 mm/rev.

Finishing cuts usually involve smaller depths of cut and feed

Q:Name the diff angles in the following fig



Grinding HSS Tools.mp4

Q:What is the main effect of

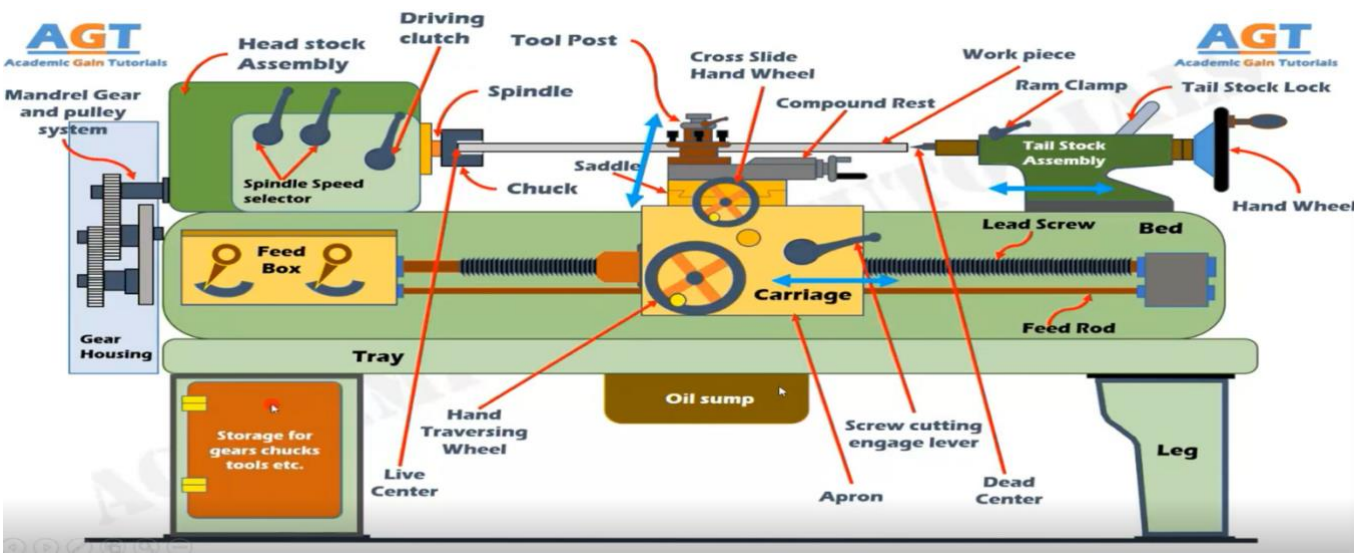
a)Rake angle :Chip flow, reduce force and temperature

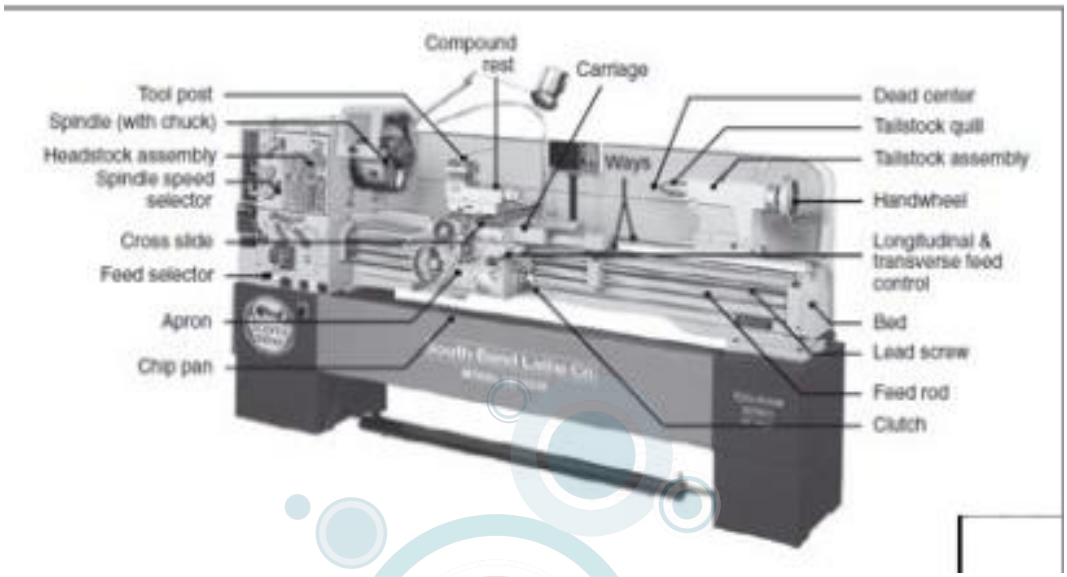
b)Relief angle: Affects rubbing and flank wear, chip off

c)Cutting edge angle: Chip formation, tool strength, forces

E)Nose radius: Surface finish, tool strength, chatter

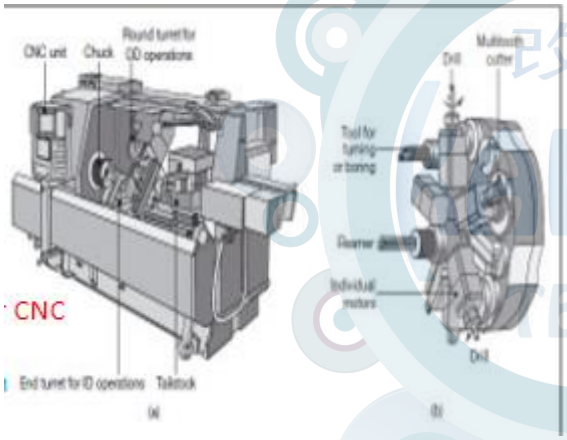
Q:Name the different components in turning machine?





Q:Name the following machines in the figure?

CNC Lathe



Q:What are the main reasons for CNC Lathes?

Repetitive operations and high dimensional accuracy

Q:What is cutting tool in ultra-precision machining?

Single crystal diamond

Q:How can you explain continuous chips in ultra-precision machining of brittle materials?

Ductile regime cutting

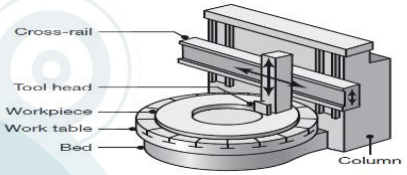
Q:Range of tolerance for ultra-precision machining?

0.001 mico meters (1 nano)

Q:What is hard turning?

Turning hard heat-treated steel to replace grinding and produces good dimensional accuracy and surface finish

Q:Identify the machine in the following figure?

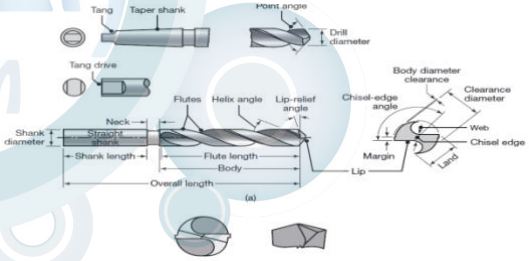


A vertical boring mill.

Q:What do we use boring machine?

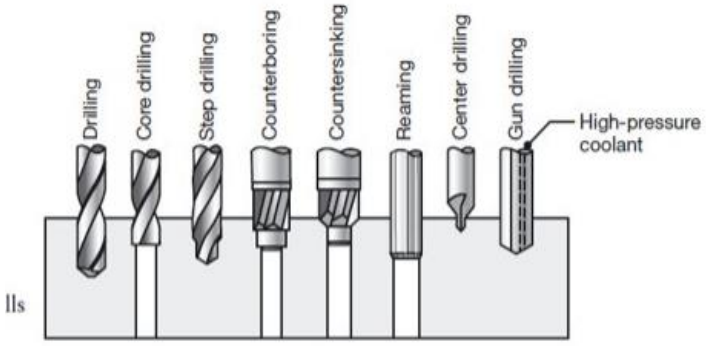
Same as turning but for large pieces

Q:Identify the tool in the following figure?



Twist drill

Q:Name the missing drilling operation for the following?



Q:What is reaming?

Drilling with multiple cutting tools

Q:Which drilling operation is the finishing one with highest accuracy?

Reaming

Q:Identify the sequence of drilling operations to produce the best accuracy?

Centering> drilling>boring> and reaming

?Q:Name the basic types of milling operations

1- slab milling

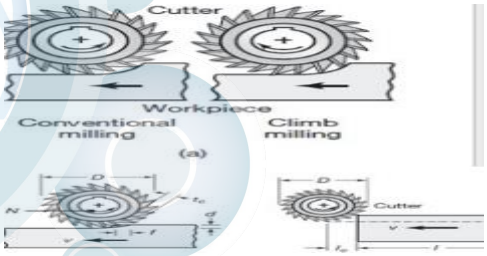
2-face milling

3-end milling

4-tool headers

5- profile

Q:Name the operation in the following figure?



Slab milling (peripheral milling)

Identify the main difference between up and down milling?

1-direction of tool rotation

2-high impact forces in down milling

3-up milling more subject to chatter

4-surface integrity better in down milling

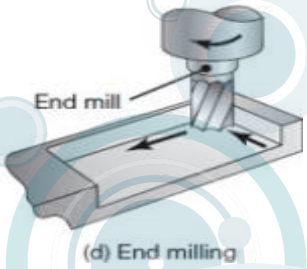
?Q:What is the effect on lead angle in milling on

1- MRR: stays the same

2-Chips: as the lead angle (positive, as shown in the figure) increases the undeformed chip thickness (thus also the thickness of the actual chip) decreases

??3-Forces: I guess increases since more contact length

Q:Name the operation?



End milling

Q:Name the following tools?

?Q:Name the pieces in the following figure?

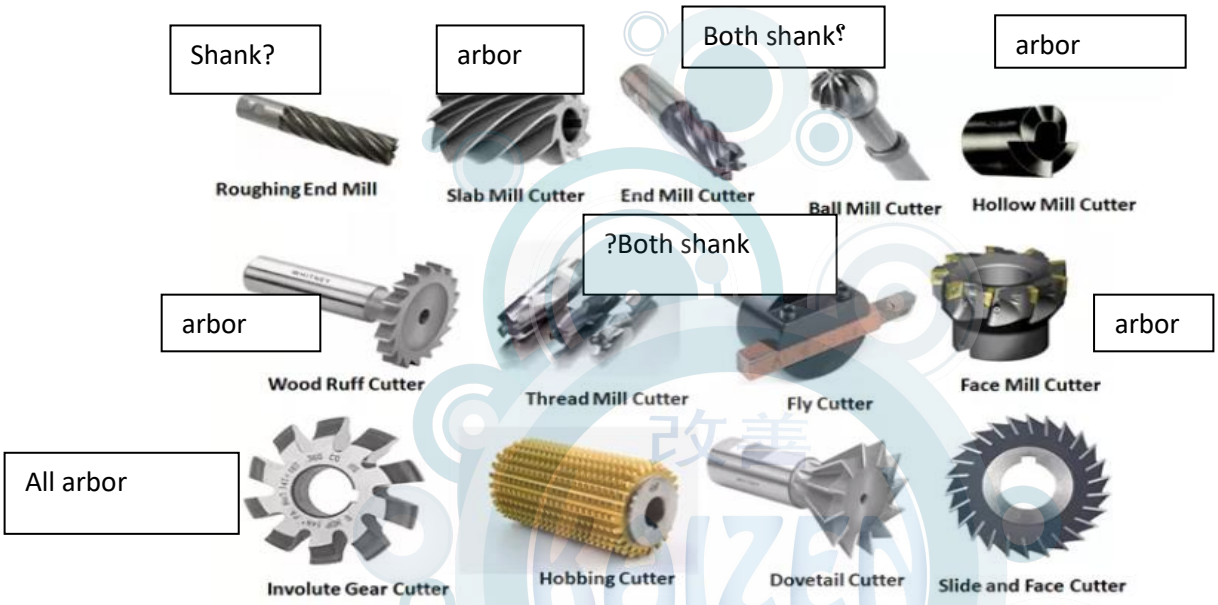
collets

Slide 165

Q: Name 5 types of milling machines?

1-Column-and-kness /2-bed type /3-planner/4-shaper/5-Rotary table/6-Profile /7-dublicating

?Q:Which tools are arber type and which are shank type in the following figure?



Q:What is main characteristics for workpieces that we use planner type machines?

Heavy workpieces

Q:What is the main use of rotary milling machines?

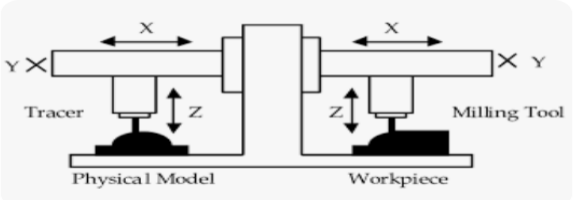
Face milling

Q:What is the usual number of axis in profile milling?

5

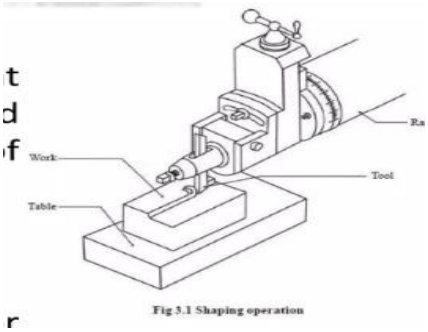
?Q:What is the CNC milling machine alternative machine to make complicated profiles by tracing a physical model?

Q:Name the following machine



duplicating machines

Q:What is the name of the machine In the following figure



shaper

Q:What are the main difference between Planer and shaper machines?

3,5,9

DIFFERENCES B/W SHAPER & PLANER

SHAPER	PLANER
1. These are light in construction	1. Large & heavy
2. Requires less floor space area	2. More floor area
3. Tool reciprocate, the workpiece is stationary	3. Tool stationary, workpiece move
4. Shaper tools are simple	4. quite massive
5. Only one tool use	5. More than one tool can be use
6. Perfect accuracy is not obtain	6. Maximum accuracy obtained
7. Adopted for small work	7. It is adopted for large work
8. Used for batch or job shop production	8. Used for mass production
9. Cost of machine is less	9. Cost of machine is high

改善
KAIZEN
TEAM