PRODUCTION PROCESS - II

SEM 4 (CBCGS - DEC - 2019)

BRANCH - MECHANICAL ENGINEERING

Q1 - Attempt any four (5 marks each) **20**

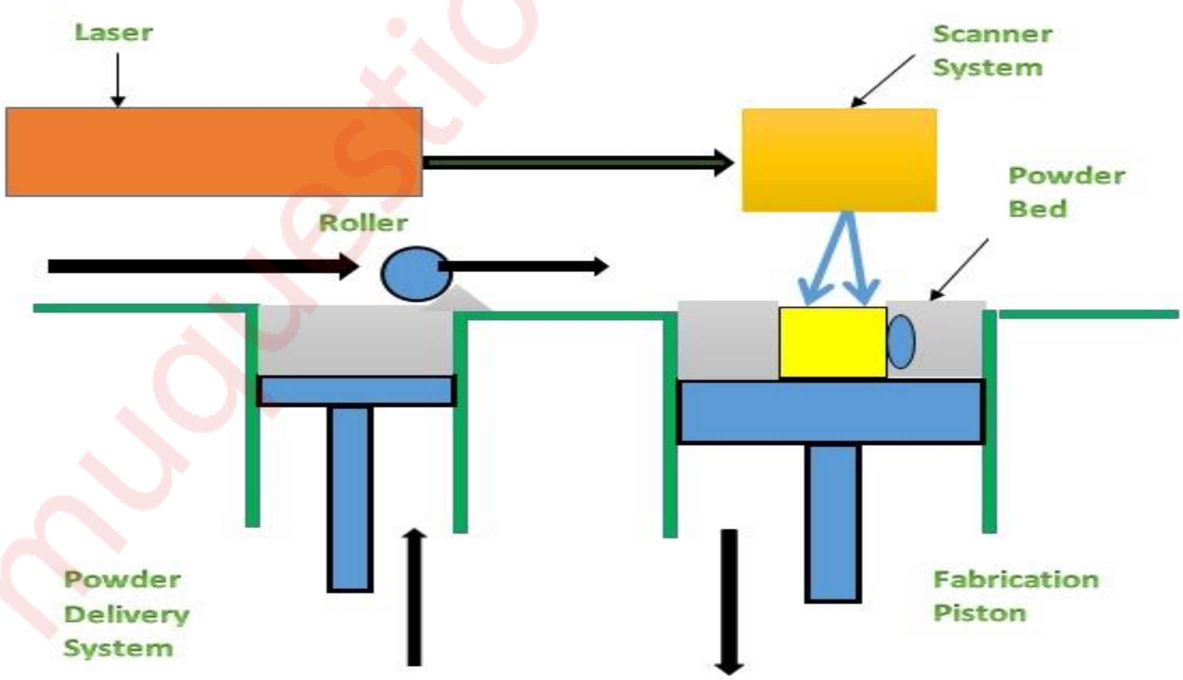
a. Describe one RP process with neat sketch.

ANS :-

There are various Rapid prototyping process which are as follows

a. Stereo Lithography (SLA).
b. Fused Deposition Modeling (FDM).
c. Laminated Object Manufacturing (LOM).
d. Selective Laser Sintering (SLS).
e. Three Dimensional Printing (3DP)

Selective Laser Sintering (SLS)



Principle and Process

- In this process a high power laser beam selectively melts and fuses powdered material spread on a layer.
- The powder is metered in precise amounts and is spread by a counter-rotating roller on the table.
- A laser beam is used to fuse the powder within the section boundary through a cross-hatching motion.
- The table is lowered through a distance corresponding to the layer thickness (usually 0.01 mm) before the roller spreads the next layer of powder on the previously built layer.
- The un-sintered powder serves as the support for overhanging portions, if any in the subsequent layers.

Advantages

- The main advantage is that the fabricated prototypes are porous (typically 60% of the density of molded parts), thus impairing their strength and surface finish.
- Variety of materials.
- No post curing required.
- Fast build times.
- Limited use of support structures.
- Mechanical properties of Nylon & Polycarbonate parts.

Limitations

- Rough surface finish.
- Mechanical properties below those achieved in injection molding process for same material.
- Many build variables, complex operation.
- Material changeover difficult compared to FDM & SLA.
- Some post-processing / finishing required.

b. Describe the factors affecting MRR in AJM

ANS:

- Process Parameters of Abrasive Jet Machining process parameters of Abrasive Jet Machining (AJM) are factors that influence its Metal Removal Rate (MRR).
- In a machining process, Metal Removal Rate (MRR) is the volume of metal removed from a given workpiece in unit time.
- The following are some of the important process parameters of abrasive jet machining:
    - ✓ Abrasive mass flow rate
    - ✓ Nozzle tip distance
    - ✓ Gas Pressure
    - ✓ Velocity of abrasive particles
    - ✓ Mixing ratio

- ✓ Abrasive grain size

Abrasive mass flow rate:

- Mass flow rate of the abrasive particles is a major process parameter that influences the metal removal rate in abrasive jet machining.
- In AJM, mass flow rate of the gas (or air) in abrasive jet is inversely proportional to the mass flow rate of the abrasive particles.
- Due to this fact, when continuously increasing the abrasive mass flow rate, Metal Removal Rate (MRR) first increases to an optimum value (because of increase in number of abrasive particles hitting the workpiece) and then decreases.
- However, if the mixing ratio is kept constant, Metal Removal Rate (MRR) uniformly increases with increase in abrasive mass flow rate.

Nozzle tip distance:

- Nozzle Tip Distance (NTD) is the gap provided between the nozzle tip and the workpiece.
- Upto a certain limit, Metal Removal Rate (MRR) increases with increase in nozzle tip distance.
- After that limit, MRR remains constant to some extent and then decreases.
- In addition to metal removal rate, nozzle tip distance influences the shape and diameter of cut.
- For optimal performance, a nozzle tip distance of 0.25 to 0.75 mm is provided.

Gas pressure:

- Air or gas pressure has a direct impact on metal removal rate.
- In abrasive jet machining, metal removal rate is directly proportional to air or gas pressure.

Velocity of abrasive particles:

- Whenever the velocity of abrasive particles is increased, the speed at which the abrasive particles hit the workpiece is increased.
- Because of this reason, in abrasive jet machining, metal removal rate increases with increase in velocity of abrasive particles.

Mixing ratio:

- Mixing ratio is a ratio that determines the quality of the air-abrasive mixture in Abrasive Jet Machining (AJM).
- It is the ratio between the mass flow rate of abrasive particles and the mass flow rate of air (or gas).
- When mixing ratio is increased continuously, metal removal rate first increases to some extent and then decreases.

Abrasive grain size:

- Size of the abrasive particle determines the speed at which metal is removed.

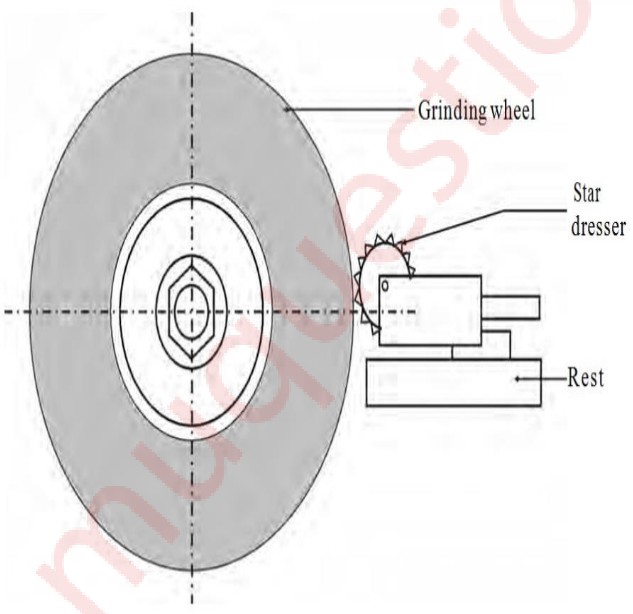
- If smooth and fine surface finish is to be obtained, abrasive particle with small grain size is used.
- If metal has to be removed rapidly, abrasive particle with large grain size is used.

c. What is meant by dressing, trueing and balancing of grinding wheel

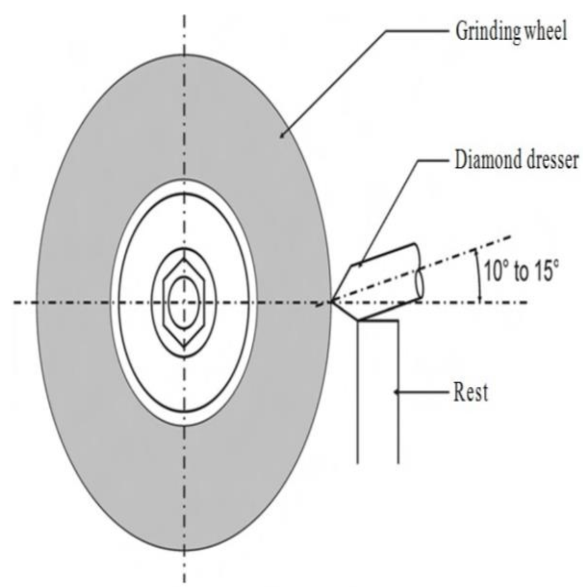
Ans:

Dressing :

- If the grinding wheels are loaded or gone out of shape, they can be corrected by dressing or truing of the wheels.
- Dressing is the process of breaking away the glazed surface so that sharp particles are again presented to the work. The common types of wheel dressers known as "Star" - dressers or diamond tool dressers are used for this purpose.
- A star dresser consists of a number of hardened steel wheels on its periphery.
- The dresser is held against the face of the revolving wheel and moved across the face to dress the wheel surface.
- This type of dresser is used particularly for coarse and rough grinding wheels.
- For precision and high finish grinding, small industrial diamonds known as 'bort' are used.
- The diamonds are mounted in a holder.
- The diamond should be kept pointed down at an angle of 15° and a good amount of coolant is applied while dressing.
- Very light cuts only may be taken with diamond tools.



Dressing of a Grinding Wheel (Star wheel method)



Dressing of a Grinding Wheel (Diamond Dresser Method)

Truing

- The grinding wheel becomes worn from its original shape because of breaking away of the abrasive and bond.
- Sometimes the shape of the wheel is required to be changed for form grinding.
- For these purposes the shape of the wheel is corrected by means of diamond tool dressers.
- This is done to make the wheel true and concentric with the bore or to change the face contour of the wheel. This is known as truing of grinding wheels.
- Diamond tool dreesers are set on the wheels at 15° and moved across with a feed rate of less than 0.02mm. A good amount of coolant is applied during truing.

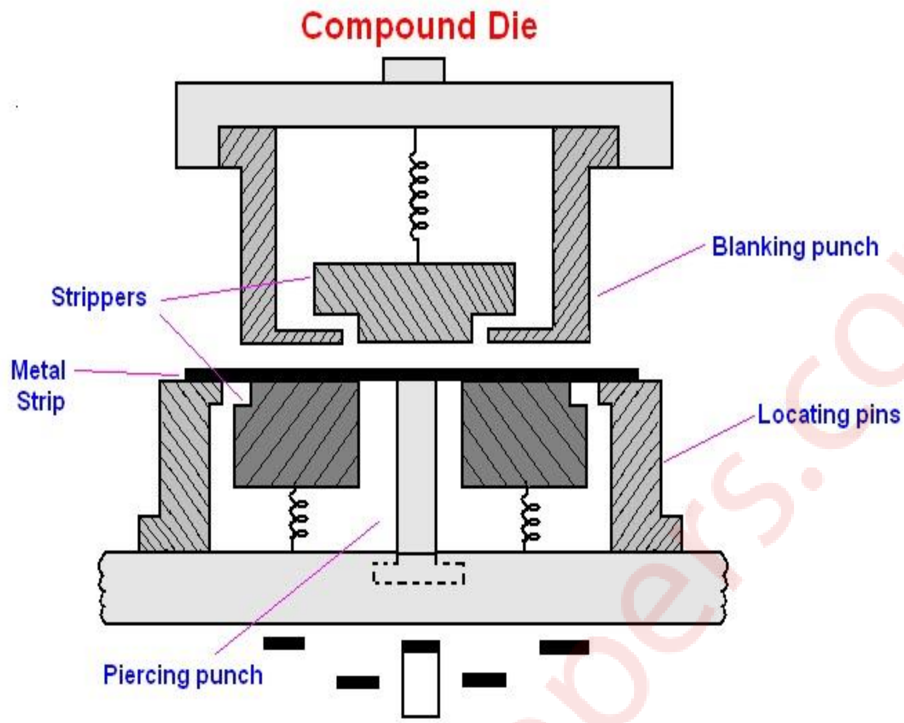
Balancing

- A grinding wheel is a delicate and fragile tool. Unless it is used properly, it may not give optimum service or may even result in accidents.
- In this respect correct mounting and balancing is of utmost importance.
- Balancing is needed as wheels revolve at many thousand r.p.m. and any unbalanced centrifugal forces may crack the wheel or spoil the bearing

d. Describe feature and mechanism of compound die ?

Ans:

- In these dies, two or more operations may be performed at one station.
- Such dies are considered as cutting tools since, only cutting operations are carried out.
- Figure shows a simple compound die in which a washer is made by one stroke of the press.
- The washer is produced by simulation blanking and piercing operations.
- Compound dies are more accurate and economical in production as compared to single operation dies.
- The features of compound blanking operation are -
    - ✓ It is possible to reduce the number of processing steps;
    - ✓ Since the accuracy of the relationship between outer shape and holes is determined by the die, the accuracy of the product becomes better;
    - ✓ The flatness is good because the work is done while keeping the material pressed by the knock outs and the punches;
    - ✓ The directions of the burrs of holes and outer shape are the same, etc.



e. What are the condition under which different types of chips are formed in metal cutting?

Ans:

The most favorable conditions of forming continuous chips are

1. Material should be ductile in nature
2. Rake angle and cutting speed should be high
3. Friction should be minimum
4. Deft of cut should be small
5. Use of efficient cutting lubricants
6. Tool material should have low-coefficient of friction
7. Proper use of coolant and lubricant

The favorable conditions of forming Discontinuous chips are

1. The work piece should have brittle in nature.
2. Slow speed of cutting
3. Small rack angle of tool
4. Depth of cut should large

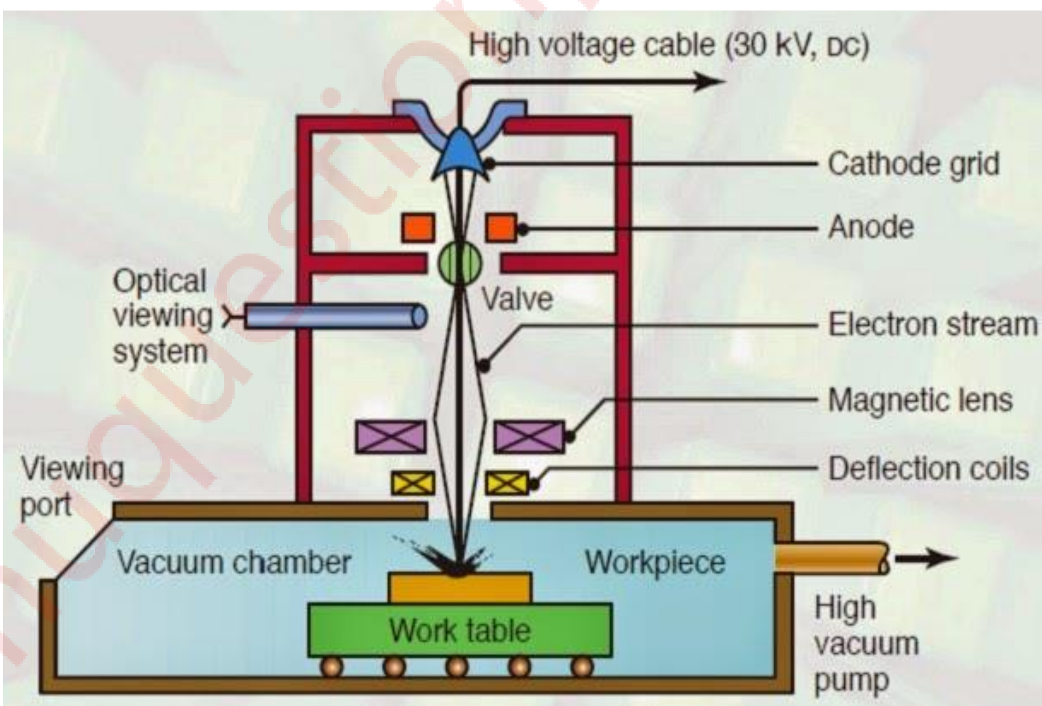
Q2.

a. What are the factors determining MRR in EBM ? (10)

Ans:

Electron Beam Machining (EBM)

- Electron Beam Machining (EBM) is a thermal process. Here a steam of high speed electrons impinges on the work surface so that the kinetic energy of electrons is transferred to work producing intense heating.
- Depending upon the intensity of heating the workpiece can melt and vaporize.
- The process of heating by electron beam is used for annealing, welding or metal removal.
- During EBM process very high velocities can be obtained by using enough voltage of 1,50,000 V can produce velocity of 228,478 km/sec and it is focused on 10 – 200 µM diameter. Power density can go up to 6500 billion W/sq.mm.
- Such a power density can vaporize any substance immediately.
- Complex contours can be easily machined by maneuvering the electron beam using magnetic deflection coils.
- To avoid a collision of the accelerating electrons with the air molecules, the process has to be conducted in vacuum. So EBM is not suitable for large work pieces.
- Process is accomplished with vacuum so no possibility of contamination.
- No effects on work piece because about 25-50 µm away from machining spot remains at room temperature and so no effects of high temperature on work.



***MRR in EBM*:**

Q = area of slot or hole × speed of cutting = A×V

Where power for 'Q' MRR is P = C.Q

Where,

C = Specific power consumption

Thermal velocity acquired by an electron of the work material due to electron beam is

$$v_{th} = \sqrt{\frac{2\, k_b\, T}{m}}$$

Where, k_b = Boltzmann constant

m = mass of one atom of work.

T = rise in temperature

Advantages:

- ✓ Very small size holes can be produced.
- ✓ Surface finish produced is good.
- ✓ Highly reactive metals like Al and Mg can be machined very easily.

Limitations:

- ✓ Material removal rate is very low compared to other unconventional machining processes.
- ✓ Maintaining perfect vacuum is very difficult.
- ✓ The machining process can't be seen by operator.
- ✓ Workpiece material should be electrically conducting.

Applications:

- ✓ Used for producing very small size holes like holes in diesel injection nozzles, Air brakes etc.
- ✓ Used only for circular holes.

b. Describe chip formation in orthogonal cutting process ? (10)

Ans:

Mechanics of the orthogonal cutting process:

For the purpose of the analysis presented below following Idealized conditions are assumed to exist during cutting:

- The tool is perfectly sharp and there is no contact along the flank face.

- The shear surface is a thin plane extending upward front the cutting edge.
- The cutting edge is a straight line perpendicular to the motion and generates a plane surface as the work moves past it.
- Width of tool is greater than width of work piece
- Continuous type of chips are produced without build up edge.
- There is no side movement of the chip in either direction.
- The work piece moves with a uniform velocity related to the tool.
- The stresses on the shear plane are uniformly distributed.

Chip Thickness Ratio:

- The ratio of the thickness of the chip before removal to the thickness after removal is termed as chip thickness ratio, chip thickness coefficient or cutting ratio.
- The reciprocal of this ratio is known as "Chip compression factor"

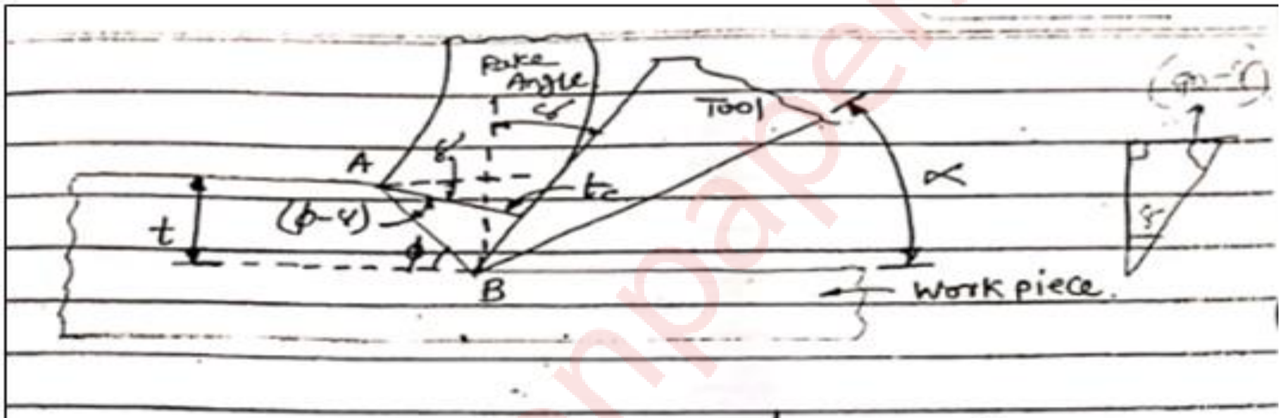


Figure :- Geometry of chip formation.

From Figure,

$$\text{chip thickness Ratio } = r_c = \frac{t}{t_c}$$

$$= \frac{AB \cdot \sin \emptyset}{AB \cdot \cos(\emptyset - \gamma)}$$

$$= \frac{\sin \emptyset}{\cos(\emptyset - \gamma)}$$

$$\text{NOTE} : \cos(A - B) = \cos A \cdot \cos B + \sin A \cdot \sin B = \cos \emptyset \cdot \cos \gamma + \sin \emptyset \cdot \sin \gamma$$

$$= \frac{1}{\cos \emptyset \cdot \cos \gamma + \sin \gamma}$$

$$\cot \emptyset \cdot \cos \gamma = \frac{1 - r_c \sin \gamma}{r_c}$$

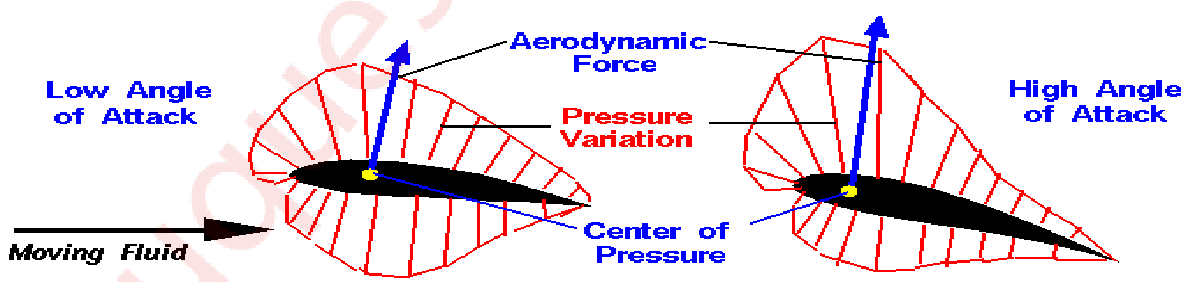
$$\therefore \tan \emptyset = \frac{r_c \cos \gamma}{1 - r_c \cdot \sin \gamma}$$

Q3.

a. Describe the process of finding center of pressure ? (10)

Ans:

- As an object moves through a fluid, the velocity of the fluid varies around the surface of the object.
- The variation of velocity produces a variation of pressure on the surface of the object as shown by the the thin red lines on the figure.
- Integrating the pressure times the surface area around the body determines the aerodynamic force on the object.
- We can consider this single force to act through the average location of the pressure on the surface of the object.
- We call the average location of the pressure variation the center of pressure in the same way that we call the average location of the weight of an object the center of gravity.
- The aerodynamic force can then be resolved into two components, lift and drag, which act through the center of pressure in flight.
- Determining the center of pressure is very important for any flying object.
- To trim an airplane, or to provide stability for a model rocket or a kite, it is necessary to know the location of the center of pressure of the entire aircraft
- In general, determining the center of pressure (cp) is a very complicated procedure because the pressure changes around the object.
- Determining the center of pressure requires the use of calculus and a knowledge of the pressure distribution around the body.
- We can characterize the pressure variation around the surface as a function p(x) which indicates that the pressure depends on the distance x from a reference line usually taken as the leading edge of the object.
- If we can determine the form of the function, there are methods to perform a calculus integration of the equation.



Center of Pressure is the average location of the pressure.
Pressure varies around the surface of an object. $P = P(x)$

$$cp = \frac{\int x\ p(x)\ dx}{\int p(x)\ dx}$$

Aerodynamic force acts through the center of pressure.
Center of pressure moves with angle of attack.

b. State the principle of location w.r.t. jigs and fixtures ? (10)

Ans:

Principles or rules of locating in jigs and fixtures

- For accurate machining, the workpiece is to be placed and held in correct position and orientation in the fixture (or jig) which is again appropriately located and fixed with respect to the cutting tool and the machine tool.
- It has to be assured that the blank, once fixed or clamped, does not move at all.
- Any solid body may have maximum twelve degrees of freedom as indicated in Fig. 8.1.4. By properly locating, supporting and clamping the blank its all degrees of freedom are to be arrested as typically shown in Fig. 8.1.5.

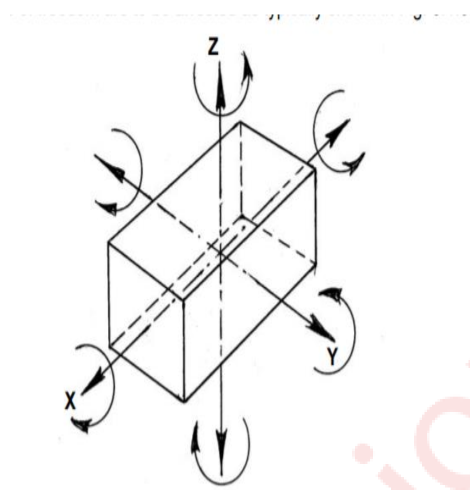


Fig. 8.1.4 Possible degrees of freedom of a solid body.

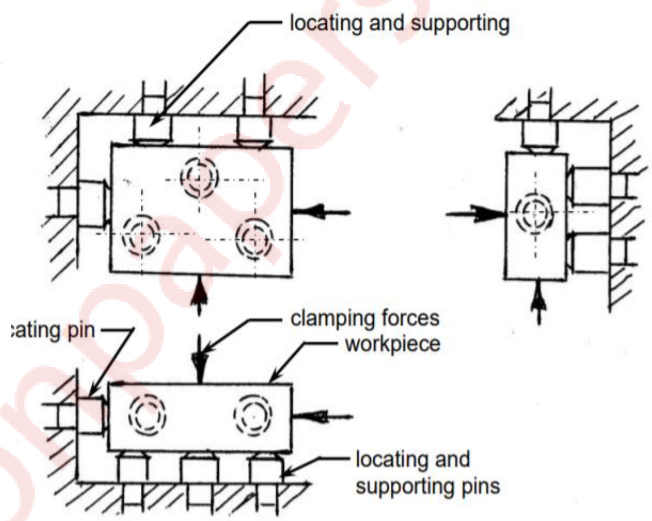


Fig. 8.1.5 Arresting all degrees of freedom of a blank in a fixture.

- The three adjacent locating surfaces of the blank (workpiece) are resting against 3, 2 and 1 pins respectively, which prevent 9 degrees of freedom.
- The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping.
- Some of such forces may be attained by friction.
- Some basic principles or rules need to be followed while planning for locating blanks in fixtures, such as;
  - ✓ One or more surfaces (preferably machined) and / or drilled / bored hole(s) are to be taken for reference
  - ✓ The reference surfaces should be significant and important feature(s) based on which most of the dimensions are laid down
  - ✓ Locating should be easy, quick and accurate
  - ✓ In case of locating by pin, the pins and their mounting and contact points should be strong, rigid and hard

- ✓ A minimum of three point must be used to locate a horizontal flat surface
- ✓ The locating pins should be as far apart as feasible
- ✓ Vee block and cones should be used for self-locating solid and hollow cylindrical jobs as typically shown in Fig. 8.1.6
- ✓ Sight location is applicable to first – operation location of blank with irregular surfaces produced by casting, forging etc. as indicated in Fig. 8.1.7 when the bracket is first located on two edges to machine the bottom surface which will be used for subsequent locating.

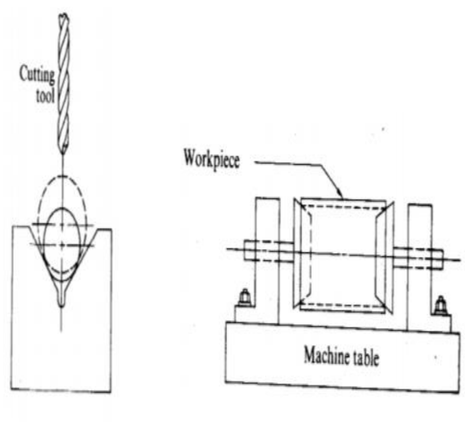


Fig. 8.1.6 Locating by Vee block and cone.

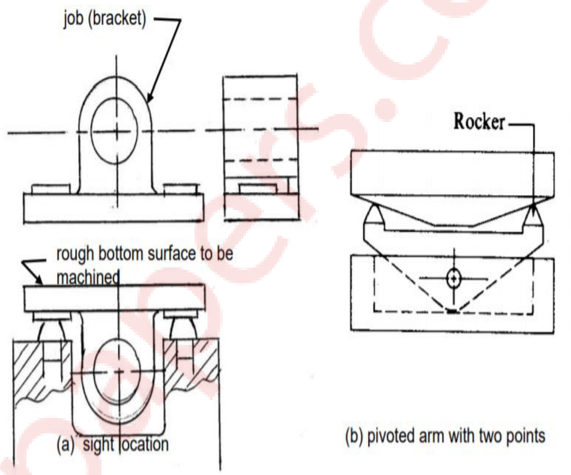


Fig. 8.1.7 (a) Sight location and (b) location by pivoted points (equalizer)

Q4.

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a. What is he nomenclature for expressing the cutting tool signature in MRS. Draw a sketch also. (10)

Ans :

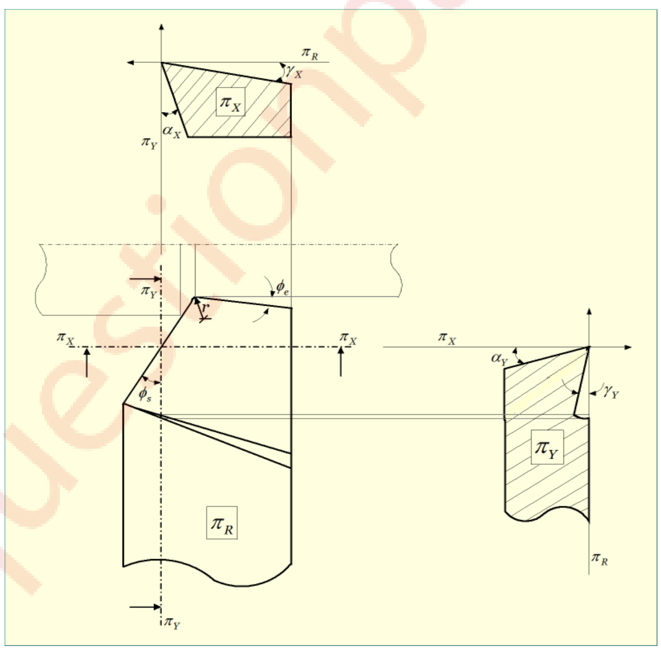
- Various features of a cutting tool including rake angles, clearance angles, cutting angles and nose radius can be displayed in a specific manner in the tool signature.
- Tool designation systems basically specify the manner of displaying a tool signature.
- There exist quite a few tool designation systems as enlisted below.
- Maximum Rake System (MRS) in one of such tool designation systems, which offers many advantages over other systems of specifying tool signature.
  - ✓ Tool In Hand system
  - ✓ American Standards Association (ASA) system
  - ✓ Orthogonal Rake System (ORS) or ISO Old System
  - ✓ Normal Rake System (NRS) or ISO New System
  - ✓ Maximum Rake System (MRS)

Tool In Hand system of tool designation

- Tool designation by Tool-In-Hand system basically refers to the identification of few useful salient features just by observing the cutting tool in bare eyes.
- Usually, it does not fetch any quantitative value (like value of principal cutting edge angle is 60º); rather it gives apparent and generalized information of the tool.
- Such views are immensely helpful in selecting a particular tool prior to operation.
- For example, the Tool-In-Hand system for turning tool can provide following information relevant to the cutter.

ASA system of tool designation

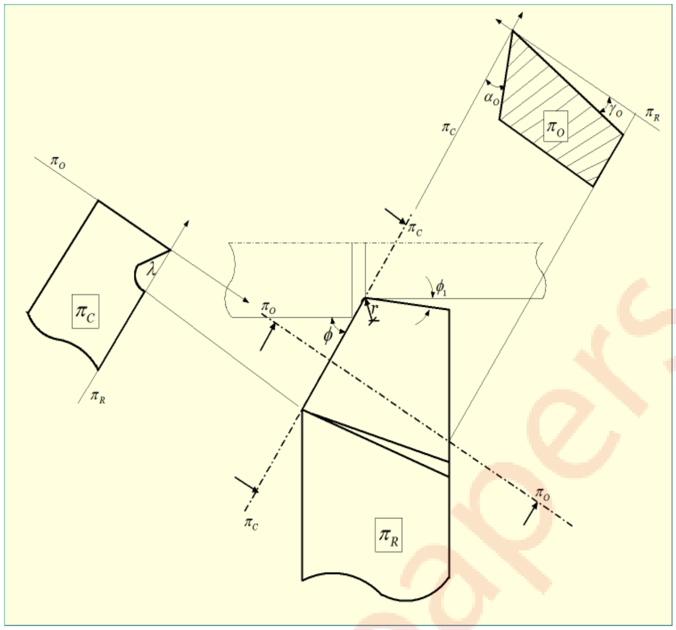
- In American Standards Association (ASA) system, turning tool angles are designated based on machine longitudinal plane and machine transverse plane along with reference plane.
- It consists of two rake angles, two clearance angles, two cutting angles and the nose radius of the turning tool. The nose radius value is expresses in inch.
- There exists a specific pattern for designation of turning tool by ASA system as provided below.
- It is to be noted that ASA system does not portray any information about the auxiliary cutting plane of the turning tool. Learn more about American Standards Association (ASA) system.



ORS system of tool designation

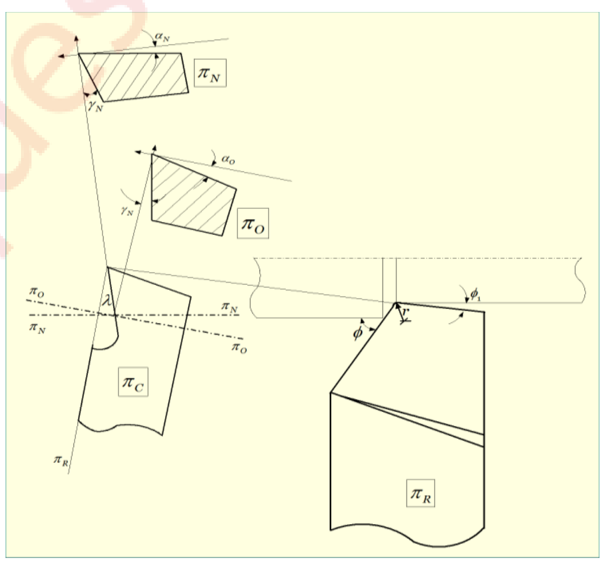
- In Orthogonal Rake System (ORS), also called ISO Old System, orthogonal plane and cutting plane along with reference plane are utilized for designation of turning tool geometry.

- The ORS system displays two rake angles−two clearance angles two cutting angles and the nose radius (value in mm).
- Unlike ASA system, ORS system provides some information regarding the orientation of auxiliary cutting plane of an SPTT



NRS system of tool designation

- In Normal Rake System (NRS), also called ISO New System, normal plane and cutting plane along with reference plane are utilized for designation of turning tool geometry. NRS system displays two rake angles, two clearance angles, two cutting angles and the nose radius value in mm.
- Unlike ASA system, NRS system also provides some information regarding the orientation of auxiliary cutting plane of the SPTT



MRS system of tool designation

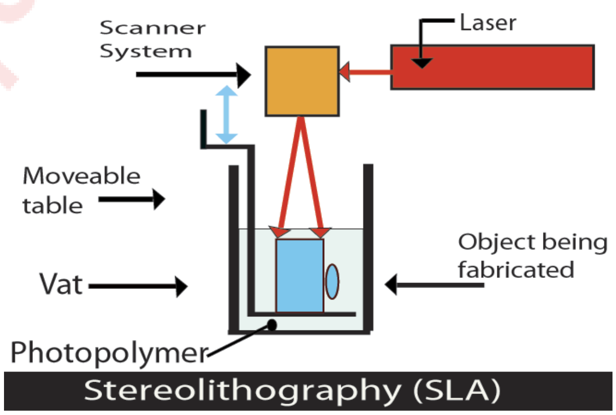
- Maximum Rake System (MRS) of tool designation, also called British System, uses maximum rake angle and minimum clearance angle to describe a tool.
- Compared to other standard designation systems, MRS system offers certain advantages during setting the tool in vice for grinding or sharpening operation.
- In either of the above three systems (ASA, ORS and NRS), at least three angles are required to set for grinding of each face of the tool; whereas, MRS needs setting of only two angles for each surface. So instead of using 3-D vice, a 2-D vice will be sufficient.
- This reduces difficulty and saves time for re-sharpening uncoated tools.

b. Describe the process of photo polymerization with neat sketch (10)

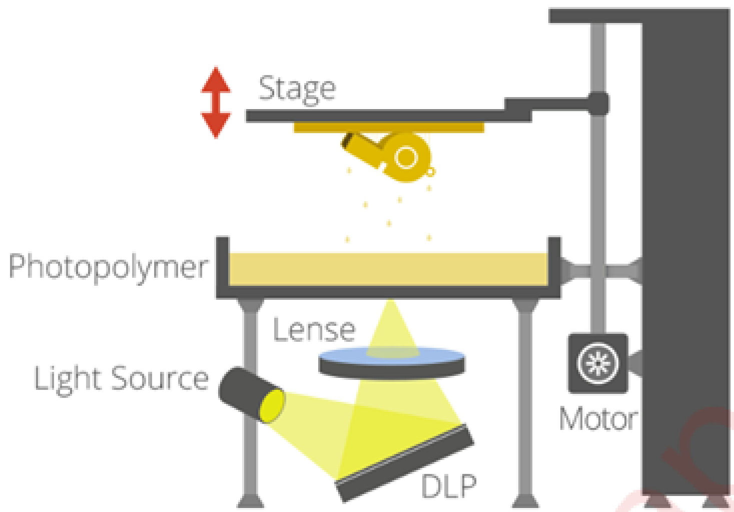
Ans:

- Photopolymerization 3D printing technology encompasses several different process that rely on the same basic strategy: a liquid photopolymer contained in a vat (or tank) is selectively cured by a heat source. Layer by layer, a 3D physical object is built until completion.
- There are multiple types of curing devices in addition to the oldest technique, which is based on lasers.
- Digital Light Processing projectors and even LCD screens are now a popular way of photopolymerizing materials given their low cost and very high resolution.
- One of the advantages of these two techniques compared to lasers is their ability to simultaneously cure a full layer of resin, whereas the laser needs to progressively illuminate the whole surface by drawing it.
- The most popular vat photopolymerization 3D printing technologies include the following:

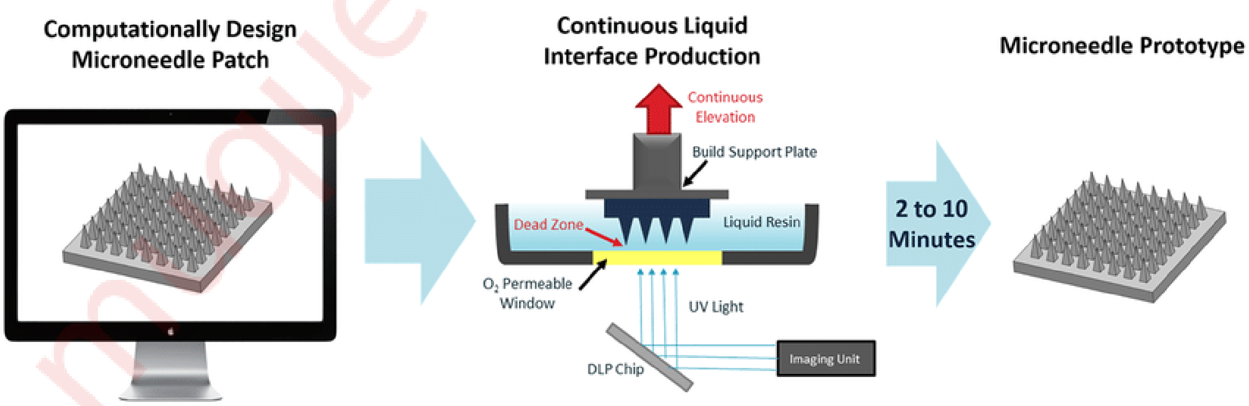
<u>StereoLithogrAphy (SLA):</u> SLA is also known as SL, optical fabrication, photo-solidification, or resin printing. During the SL manufacturing process, a concentrated beam of ultraviolet light or a laser is focused onto the surface of a vat filled with a liquid photopolymer. The beam or laser is focused, creating each layer of the desired 3D object by means of cross-linking or degrading a polymer.



Digital Light Processing (DLP) : For DLP 3D printing process, a digital projector screen is used to flash a single image of each layer across the entire platform at once. Because the projector is a digital screen, the image of each layer is composed of square pixels, resulting in a layer formed from small rectangular bricks called voxels. DLP can achieve faster print times for some parts, as each entire layer is exposed all at once, rather than drawn out with a laser.



Continuous Liquid Interface Production (CLIP): by Carbon The CLIP vat photopolymerization technique uses a tank of resin as base material. Part of the vat bottom is transparent to ultraviolet light, and therefore called the window. An ultraviolet light beam shines through the window, illuminating the precise cross-section of the object. The light causes the resin to solidify (photopolymerize). The object rises slowly enough to allow resin to flow under and maintain contact with the bottom of the object. An oxygen-permeable membrane lies below the resin, which creates a dead zone. This persistent liquid interface prevents the resin from attaching to the window, which means the photopolymerization is inhibited between the window and the polymerizer. Unlike standard SLA, the 3D printing process is continuous and claims to be up to 100 times faster than commercial 3D printing methods.



Daylight Polymer Printing (DPP): by Photocentric Instead of using a laser or a projector to cure the polymer, the DPP manufacturing process uses a LCD (Liquid Crystal Display). This technique, also called LCD 3D printing, uses unmodified LCD screens and a specially formulated Daylight polymer. The company Photocentric has been able to make this work by developing one of the world's most sensitive daylight resins.

Q5.

a. In an orthogonal cutting operation, the rake angle is 5^0, chip thickness before the cut = 0.2mm, and width of cut = 4mm. The chip thickness ratio is 0.4. (10)

i. determine the chip thickness after the cut

ii. determine shear angle

iii. determine friction angle

iv. determine coeeficient of friction

v. determine shear strain

Ans:

Given:

Rake angle $\alpha = 5^0$

Chip thickness before the cut t_1 = 0.2mm

Width of cut (b) = 4mm

Chip thickness ratio r_t= 0.4

To find :

i. determine the chip thickness after the cut t_2 = ?
ii. determine shear angle $\emptyset$ = ?
iii. determine friction angle $\beta = ?$
iv. determine coeeficient of friction $\mu = ?$
v. determine shear strain γ = ?

Chip thickness after the cut

$$r_t = \frac{t_1}{t_2}$$

$$0.4 = \frac{0.2}{t_2}$$

$$t_2 = 0.5\text{mm}$$

Shear angle

$\tan \emptyset = \frac{r_t \times \cos \alpha}{1 - r_t \times \sin \alpha} = \frac{0.4 \times \cos 5}{1 - 0.4 \times \sin 5} = 22.43^0$

Friction angle

$$\boldsymbol{\beta = 2\,(45) + \alpha - 2 \times \emptyset}$$

$$\boldsymbol{\beta = 90 + 5 - 2\,(22.43)}$$

$$\boldsymbol{\beta = 50.14^0}$$

Coefficient of friction

$$\boldsymbol{\mu = \tan \beta}$$

$$\mu = \tan 50.14$$

$$\mu = 1.197$$

Shear strain

$$\gamma = \tan(\emptyset - \alpha) + \cot \emptyset$$

$$\gamma = \tan(22.43 - 5) + \cot 22.43$$

$$\gamma = 0.3139 + \frac{1}{\tan 22.43}$$

$$\gamma = 0.3139 + 2.4225$$

$$\gamma = 2.7364$$

b. Determine the percentage change in cutting speed required to give 50% reduction in tool life. Take n = 0.2 (10)

Ans:

Given -

Tool life in 1st case = 1

Tool life in 2nd case = $\frac{1}{5}$

n = 0.2

To find:

Percentage change in cutting speed.

Formula used:

Taylor's tool life equation VT^n= C

where, V= Cutting speed (m/min)

T= Tool life (min)

C = Machining constant

n = Exponent

Procedure:

Using the Taylor's tool life equation $VT^n = C$

$$V_1 \, T^n{}_1 = V_2 \, T^n{}_2$$

$$\frac{V_2}{V_1} = (\frac{T_1}{T_2})^n$$

$$(\frac{1}{\frac{1}{5}})^{0.2} = 1.38$$

$$\frac{V_2}{1} = 1.38 \qquad \text{(as } V_1 = 1\text{)}$$

$$V_2 = 1.38$$

$$\%\ Increase\ in\ V_2 = (1.38 - 1) \times 100\%$$

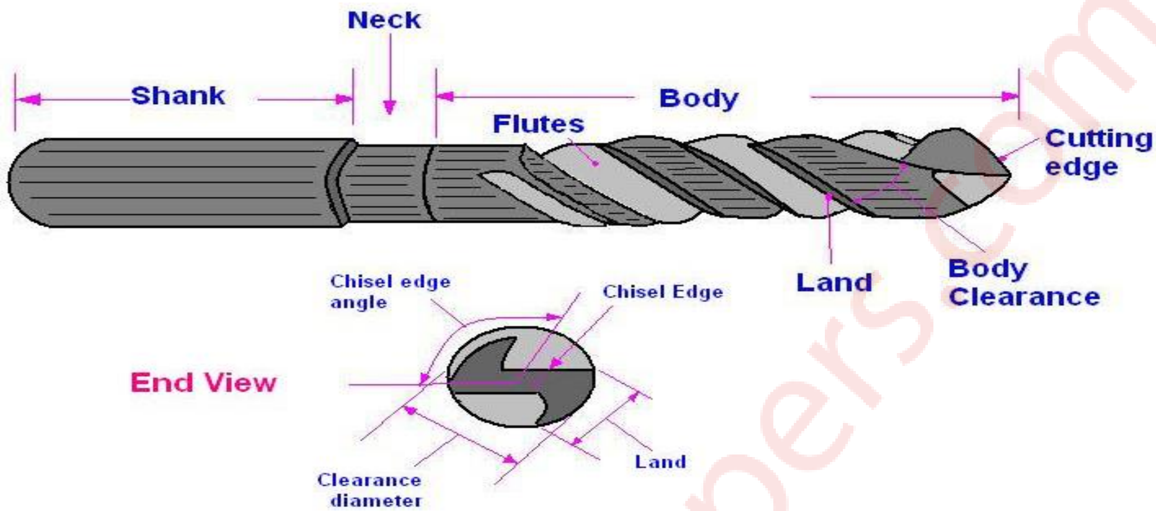
$$= 38\%$$

The percentage increase in cutting speed is 38% by doing half tool life.

Q6. Attempt all the following question (5 marks each) (20)

a. Draw neat labelled sketch of typical twist drill

ans:



b. Difference between transfer and non transfer plasma arc machining process

Ans:

Sr no	Transfer plasma	Non transfer plasma
1	Arc is established between electrode and WP	Arc is established between electrode and nozzle
2	The WP is a part of electrical circuit and heat is obtained from the anode spot and the plasma jet. therefore higher amount of energy is transferred to work.	The WP is not part of electrical circuit and heat is obatained from plasma jet. therefore less energy is transferred to work
3	Higher penetration is obtained so thicker sheets can be welded	Less penetration is obtained so thicker sheets can be welded
4	Higher process efficiency	Less process efficiency

c. Describe dynamometer used in Milling Machine

Ans :

Milling dynamometer

- Since the cutting or loading point is not fixed w.r.t. the job and the dynamometer, the job platform rests on four symmetrically located supports in the form of four O-rings.
- The forces on each O-ring are monitored and summed up correspondingly for getting the total magnitude of all the three forces in X, Y and Z direction respectively.
- Fig. 10.13 shows schematically the principle of using O-ring for measuring two forces by mounting strain gauges, 4 for radial force and 4 for transverse force.
- Fig.typically shows configuration of a strain gauge type 3 – D milling dynamometer having 4 octagonal rings.
- Piezoelectric type 3 – D dynamometers are also available and used for measuring the cutting forces in milling (lain, end p and face)

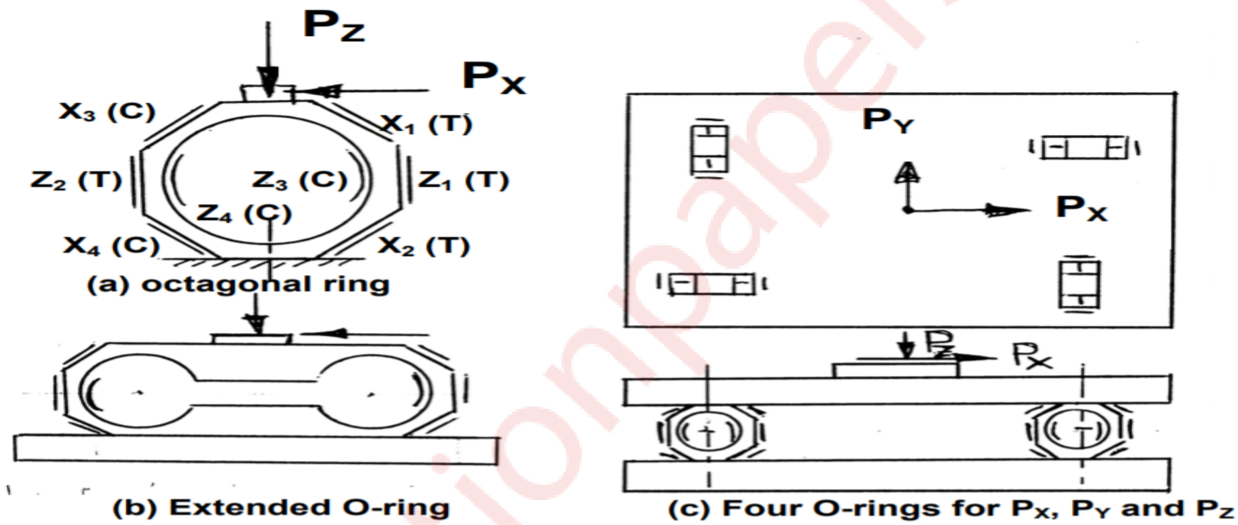


Fig. 10.13 Scheme of strain gauge type 3 — D milling dynamometer

d. Classify various locators used in jigs and fixtures

Ans:

- There are different methods used for location of a work.
- The locating arrangement should be decided after studying the type of work, type of operation, degree of accuracy required.
- Volume of mass production to be done also mattes a lot.
- Different locating methods are described below.

1. **Flat Locator**
2. **Cylindrical Locators**
3. **Conical Locator**
4. **Jack Pin Locator**

5. **Drill Bush Locator**
6. **Vee Locators**

Flat Locator

Flat locators are used for location of flat machined surfaces of the component. Three different examples which can be served as a general principle of location are described here for flat locators. These examples are illustrated in Figure 4.3. A flat surface locator can be used as shown in first figure. In this case an undercut is provided at the bottom where two perpendicular surfaces intersect each other. This is made for swarf clearance. The middle figure shows flat headed button type locator. There is no need to made undercut for swarf clearance. The button can be adjusted to decide very fine location of the workpiece. There can be a vertical button support as shown in third figure, which is a better arrangement due to its capacity to bear end load and there is a provision for swarf clearance automatically.

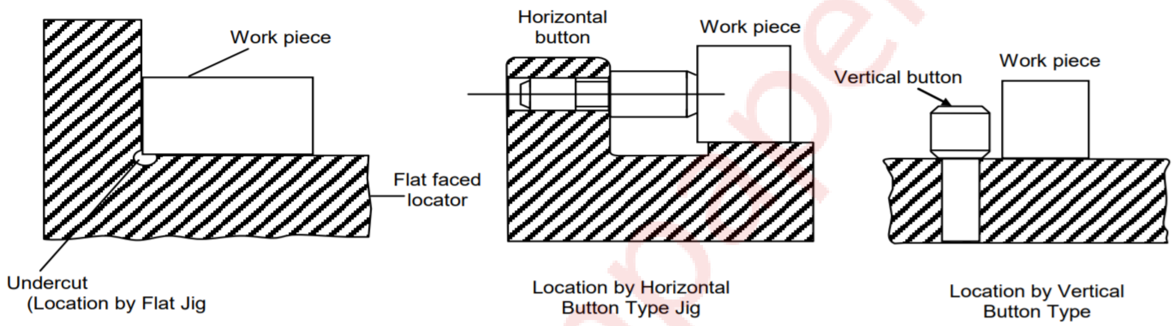


Figure 4.3 : Method of Locating using Flat Locators

e. How does a welding fixture differ from machining fixture

Ans:

JIGS :

- It holds and locates the work as well as guides the tool
- these are lighter in construction and clamping with the table is often unnecessary
- used for holding the work and guiding the tool in drilling, reaming or tapping operation
- gauge blocks are not necessary
- the cost is more
- their designing is complex

FIXTURE:

- it holds and llocates the work but does not guide the tool
- these are heavier in construction and bolted rigidly on the machine table
- used for holding the work in milling, grinding, turning and planning operation
- gauge blocks may be provided for effective handling
- the cost is less as compared with the jigs
- their designing is simple as compare to jigs