DIPLOMA IN MECHANICAL ENGINEERING

(C09)

WORK SHOP PRACTICE-II

LAB MANUAL

P. BALAKRISHNA
ASST. PROFESSOR
MECHANICAL DEPARTMENT

SANKETIKA POLYTECHNIC COLLEGE

AFFILIATED TO STATE BOARD OF TECHNICAL EDUCATION AND TRAINING,

HYDERABAD

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PREFACE

Industrial Revolution has given man a lot many luxuries, and these are generally in the form of Mechanical Machines. The manufacturing of their parts is not a simple task and requires a lot of accuracy many times. This is not obtainable by any of the direct methods from the molten metal. Hence metal is obtained in a basic shape and size which is then machined to the exact required size. The Study of these metal removing operations is done under MACHINE TOOLS. The lab sessions are intended to make the students understand the different operations in machines such as Lathe, Drilling Machine, Milling Machine, Grinding Machine etc. The student will be provided with a raw metal piece along with the dimensions of the required work piece. The Laboratory for MACHINE TOOLS complements the learning experience of the lecture. Laboratory exercises provide opportunities for direct study of the Machines and their operation. The laboratory must be used as a chance to enhance understanding of the Machining & chip formation. The following Learning Objectives for the laboratory will guide you in taking an active role in your education.

1. Gain familiarity with physical use of Machines.

You will perform operations to obtain Metal pieces in various shapes: Step, Tapered, Drilled

etc. A student is required to observe the different characteristics of the tool such as: a. Rake.

b. The effect of the speed, feed & depth of cut on type of chip formation.

These experiments give a first hand experience with Machining Operations. As a result of performing these experiments one should be able to understand the difficulties faced in obtaining the desired shape and reduce the errors if there are any to a maximumextent possible. Also one should follow all the instructions carefully and take all the precautions so none’s life is put under danger.

2. Develop and reinforce measurements skills.

A student should know how to read the different scales with Vernier or Thimble scales for smaller readings. He must be able to find the Least count & error in the given scale and use the information to obtain the correct angle or measurement for the given work piece.

3. Develop and reinforce skills in documenting observations.

You should develop good habits in the organization and recording of raw data in a notebook, and take care to document the data such that it can be analyzed at a later time. You should sketch the physical apparatus used in the experiment. In doing so, pay special attention to the specific mechanical and operational details that enable the apparatus to achieve the purpose for which it was designed. You should be able to list and describe the steps used to obtain the desired measurements. You should be able to identify whether any actions were taken to improve the outcome of the experiment. Likewise, you should be able to identify any actions that may have contributed to undesirable outcomes.

4. Develop skills at writing laboratory reports.

You will create reports to document your measurements in the laboratory. You will use a writing style and format that is common to technical documentation used in Civil and Mechanical Engineering. Your reports should be complete, yet concise. By writing the report, you should develop a clear understanding of the laboratory exercise, and communicate that understanding in your written words.

RIGHT HAND SCREW THREAD CUTTING AND KNURLING OPERATION

Aim:

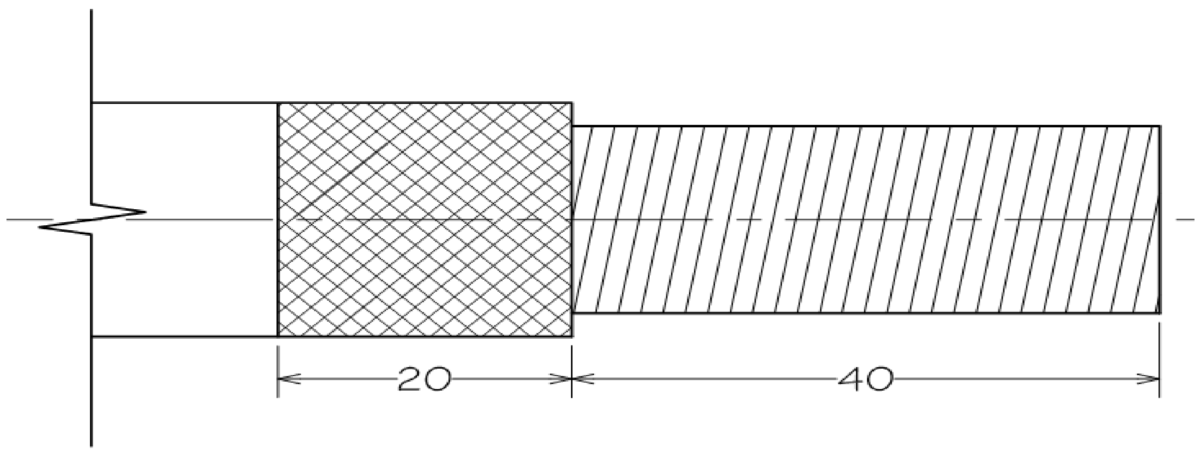
To obtain a Right Hand Screw threaded work piece of given dimensions.

Apparatus:

1. Lathe with standard accessories.
2. Work piece

Material:

Mild Steel round rod of diameter 20 mm



Procedure:

The given work piece is fixed tightly in the 3 jaw chuck. Facing and turning operations are done to make the diameter equal to the major diameter of the screw thread. According to the given Pitch, the necessary gearing ratio is calculated. The feed selection lever that unlocks the half-nut lever for use, is set on the carriage apron for cutting metric threads, the included angle of the cutting edge should be ground exactly 60O , the thread cutting tool is fixed in the tool post so that the tip of the tool coincides with the axis of the work piece the lathe spindle speed is reduced by on half, on forth of the speed required for turning by back gear mechanism or quick change levers. The half nut lever engaged at the end of the cut, the spirit nut lever disengages the carriage and the tool is withdrawn to its position sufficient depth is given for each cut using the cross slide the process is repeated till the required dimensions are obtained.

Precautions:

1. For cutting right threads the change gears should be so arranged that the direction of the lead screw is in same direction as that of the rotation of spindle.

2. The work piece should be fixed tight in the jaw.

3. The power supply switched off before measuring diameters.

Result:

Right Hand thread with required pitch is produced on the given work piece.

STEP TURNING OPERATION

Aim:

To perform a step turning operation on the given cylindrical work piece

Apparatus:

1. Lathe with standard accessories.
2. Work piece

Principle:

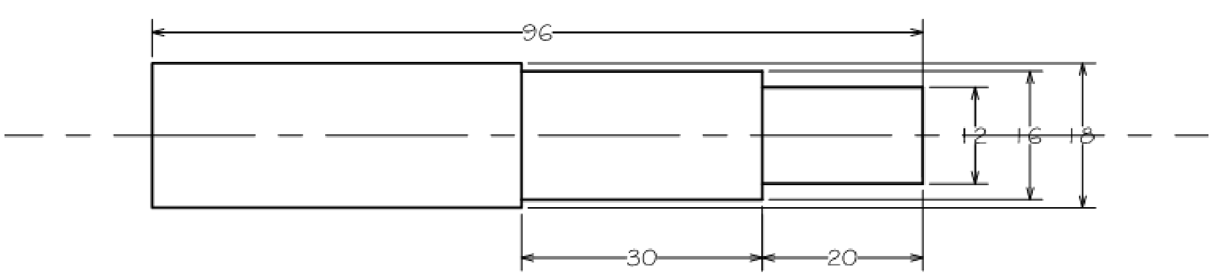
Turning is a lathe operation in which an external cylindrical surface is produced by generating.

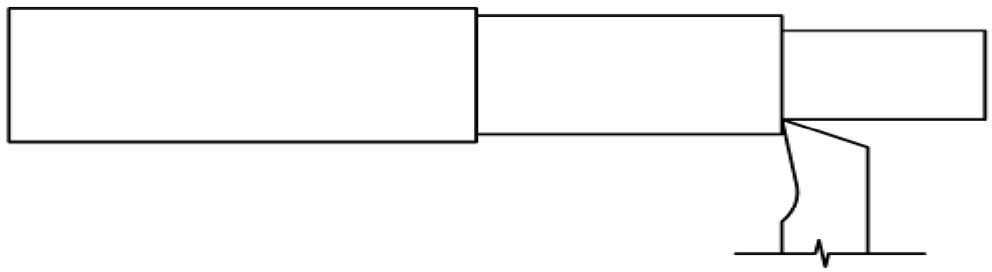
The cutting Tool is first adjusted for the desired depth of cut, using the cross slide. Then as the work piece rotates, the cutting tool is advanced relatively slowly I a direction parallel to the rotational axis of the spindle. The motion is known as the feed. These combined motions cause the work piece by adjusting the feed so that the helical path of the tool tips overlaps and generates a cylindrical surface on the work piece. A spindle rpm which gives a desired cutting speed at the circumference of the cylindrical surfaces should be reflected.

This may be calculated using the following formula:

$$\text{Spindle speed, rpm} = \frac{\pi \times d^2}{4}$$

Feed is measured as advance of the cutting tool per revolution of the work piece.





Tools:

Steel rule, outside callipers, tool holder with key, chuck key, HSS cutting Tool bit.

Material:

Mild Steel round rod of diameter 20 mm

Procedure:

Initially the given work piece is fitted the chuck using a chuck key. The high speed tool bit is positioned in the tool cutting is kept at an angle to the axis of the given work piece. During this Process positioned in the tool holder, the speed of the lathe is high.

After this operation, the diameter of the work piece is to be reduced according to the given dimensions by turning process. While doing the work piece one end of the work piece is reduced to the required diameter and after this, chamfering. Process if performed by burning the tool but at 45O inclination and by bringing the tool in contact with the edge of the job, this process removes all sharp edges of the component.

Precautions:

1. The chuck key must be removed immediately after the use.
2. The power supply switched off before measuring diameter.
3. Before performing facing they must be in same line.

Result:

The required steps are made on the work piece for the given dimensions.

TAPER TURNING OPERATION

Aim:

Test Procedure to perform Taper turning operation by Compound Rest Swivelling method on

The given cylindrical work piece.

Apparatus:

1. Lathe with standard accessories.
2. Work piece

Principle:

Cutting Tapers on a lathe is common application. A number of methods are available for cutting tapers on a lathe.

They are:

1. Compound rest Swivelling Method.
2. Using form tools.
3. Tail stock offset method.
4. Taper attachment method.

These methods are used for turning steep and short tapers. There is a circular base graduated in degrees which can be swivelled at any angle from the centre line of the lathe centres.

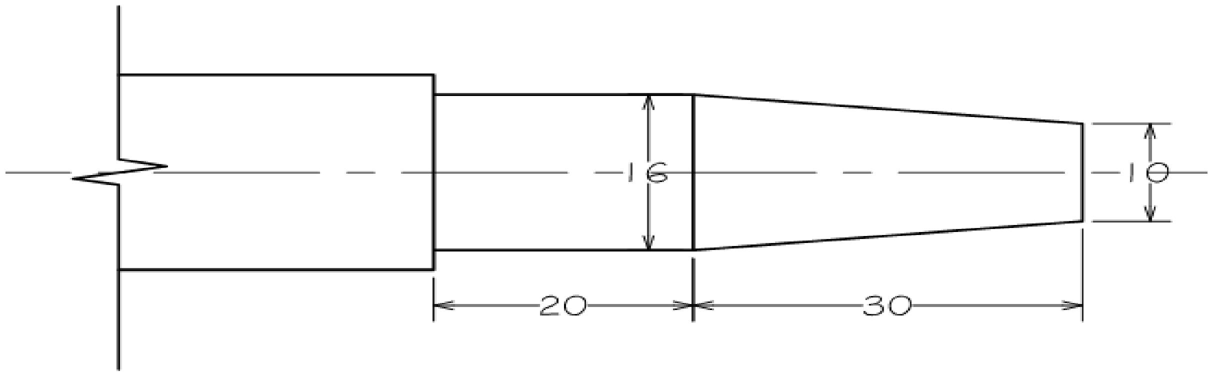
The amount of taper in a work piece is usually specified by the ratio of the difference in diameters of the taper to its length. This is termed as conicity and is designated by the letter K.

$$\text{Conicity } K = (D-d)/(2xl)$$

Referring to the above figure BC draw parallel to the axis and in the right angle Triangle ABC.

Tools:

Chuck key, high speed Steel (HSS) cutting tool bit, outside callipers, Tool Holder with key, Spanner etc.



$$\tan \alpha = \frac{D-d}{2L}$$

Material:

Mild Steel round rod of diameter 20 mm

Procedure:

The work piece is fixed in the tool post tightly and the centre of head stock and tail stock is coincided with the centres of head stock and tail stock. Facing and plain turning operations are performed to get the required diameter on the work piece.

The compound rest is set on the required half taper angle and is locked by the cutting rod is adjusted to a fixed position for the best possible to the open hand wheel and cross feed. Then the carriage is locked and first cut is made at the end of the cut, the tool is again cross fed is given for the next cut. Cuts are repeated piece is then removed from the chuck and dimensions obtained are noted.

Precautions:

1. The work piece should be fixed tight in the jaw.
2. The power supply switched off before measuring diameters.

Result:

The required steps are made on the work piece for the given dimensions.

TUNGSTEN INERT GAS WELDING

Tungsten inert gas (TIG) welding or gas tungsten arc welding (GTAW) is an inert gas shielded arc welding process using non#consumable electrode. The electrodes may also contain 1 to 2 % thoria (thorium oxide) mixed along with the core tungsten or tungsten with 0.15 to 0.40 % zirconia (zirconium oxide).the pure tungsten electrodes are less expensive but will carry less current . The thoriated tungsten electrodes carry high currents and are more desirable because they can strike and maintain a stable arc with relative ease. The zirconia added tungsten electrodes are better than pure tungsten but inferior to thoriated tungsten electrodes. A Typical tungsten inert gas welding setup is shown in fig. it consists of a welding torch at the centre of which is the tungsten electrode. The inert gas is supplied to the welding zone through the annular path surrounding the tungsten electrode to effectively displace the atmosphere around the weld puddle. The smaller weld torches may not be provided with circulating cooling water.

The TIG welding process can be used for the joining of a number of materials though the most common ones are aluminium, magnesium and stainless steel. The typical combination of TIG setups to be used with these and other metals are presented in table.

Material	Electrodes	Power supply used	preferred shielding gas
Stainless steel	thoriated tungsten	DCEN	Argon
Aluminium	Alltypes	AC	Argon
Magnesium	Tungsten	AC	Argon
DeoxidisedCopper			
Monel	Thoriated tungsten	DCEN	Argon
High carbon steel	Thoriated tungsten	AC or DCEN	Argon

POWER SOURCE

The power sources used are always the constant current type. Both direct current (DC) and alternating current (AC) power supplies can be used for TIG welding. When DC is used, the electrode can be negative (DCEN) or positive (DCEP). With DCEN more heat is generated near the work piece and consequently the electrode does not get heated to a great extent. But when DCEP is used, a large amount of heat is liberated at the electrode itself thereby limiting the maximum current that can be carried by an electrode. Roughly, the current carrying capacity of a DCEN electrode is about 10 times as high as that of a DCEP electrode. The DCEP is sometimes utilized to break down the oxides on the surface of the metals such as aluminium. The electrons from the oxide layer move towards the positive electrode weakening the surface layer. The positively charged ions from the electrode would then be able to easily break the surface layer and thus would help in obtaining the fusion. Similarly, when AC is used, the half cycle during which the electrode is positive, the electrons from the oxide layer would be moving towards the electrode, whereas in the other half the electrons from the electrode would be able to easily break the oxide layer on the work piece surface. Thus, an AC arc welding is likely to give rise to a higher penetration than that of DCEP. Hence,DCEP is normally used for welding thin metals whereas for deep penetration welds DCEN is used. DCEP also causes larger heat affected zones and more weld distortion than DCEN.

The DC power supply used for TIG can be either a steady one or more often a step pulsed one. In the case of the step pulsed current machine, the current level is maintained at two levels , as shown in fig. the low level is called background currents which is used for cooling the weld metal. The other is the peak current used when the actual melting (welding) takes place. During the background current period the arc is maintained but very small heat input goes to the weld and, as a result, the arc crater cools. This type of step pulsed DC source is, particularly, useful for welding in out of positions (other than flat position) since it allows for the controlled heating and cooling. Otherwise, the electrode is to be flipped away slightly from the arc crater to allow for the cooling of the puddle before it is moved forward again. But the pulsed DC arc welding provides for proper solidification during the background current period when the torch is moved forward for forming the next spot (bead).

When the alternating current (AC) is used for TIG welding, the current continuously changes its direction. It changes its direction 50 times every second (in 50Hz power supply) such that half the time it is operating as DCEN and rest, as DCEP. A typical AC wave form. which is termed as balanced wave since the positive side and the negative side are identical in magnitude. But the TIG welding machine would not behave as normal AC. During the period when the electrode is positive, the electron move from flat work piece surface to the small sized tip of the electrode which restricts the flow of electrons. This is termed as 'Rectification' and is responsible for the reduced current flow during DCEP portion of the AC wave as shown in fig. This is known as unbalanced wave. This rectification is an AC cycle during the time when the electrode becomes positive will make the AC arc, a highly unstable one. To maintain a steady arc in an un balanced AC welding machine, a very high voltage, very high frequency and low current power supply is superimposed on the unbalanced wave. This maintains the shielding gas ionized during the period, when the electrode is positive and thus maintains the arc continuously. There are quite a few advantages of an un balanced AC arc welding machine compared to a balanced wave machine. It is less expensive. Since less current flows when the electrode is positive, less heat is liberated near the electrode. This permits a higher current carrying capacity for the electrodes, which results in better penetration.

It is possible to provide a balanced wave as shown in fig. by incorporating a large number of capacitors in series to provide the necessary current discharges during the time when the electrode is positive. These capacitors get charged during the time when the electrode is negative. A balanced wave maintains a steady arc and therefore is preferred for better removal of the oxide layer is possible. However, these machines are more expensive compared to the un balanced type.

ELECTRODES:

The tungsten electrodes used for the welding should be clean and completely free from any kind of contamination such as molten filler metal. If the arc is started by first touching the base metal and withdrawn, the electrode tip may pick up the base metal which causes the subsequent sputtering and loss of metal in the electrode tip.Also, the electrode may get consumed quickly if it is allowed to be oxidized, since tungsten oxide has a lower melting temperature. The oxidation occurs when the electrode is allowed to cool in the atmosphere after welding. Hence, the shielding gas flow should be maintained for some time after extinguishing the arc so that the electrode gets sufficiently cooled in a protective atmosphere rather than in the oxidizing normal atmosphere. The tungsten electrode tip should be prepared for proper weld penetration. The typical shapes that can be used are shown in fig. Though it is possible to use these electrodes without any tip preparation, it would be better to prepare the tip since it enhances the weld quality. For AC welding with high frequency (AC-HF) un balanced machines ,the tip should be pencil#pointed as shown in fig. so that the HF current gets concentrated and the arc is easily initiated (high frequency current tend to flow through the surface). Also, once the arc is formed which reduces the effect of current rectification and thus, stabilises the AC arc.

With DCEN, the electrode would be made conical as in fig. while grinding ,the tip concentricity should be maintained , otherwise the gas flow would become uneven making some part of the puddle not properly shielded and thereby, causing contamination of the weld joint in that portion. Pure tungsten electrodes are never made into conical point since the end is likely to melt and contaminate the weld metal. Instead, it is better to make full round ball at the tip

WELDING TECHNIQUE:

The welding technique used for TIG is essentially similar to that of the gas welding. The edge preparation is also similar to that of gas welding. Backing of the joint is sometimes preferable, to provide good performance and uniformity of the weld. The metallic backing plates used are provided with a small groove of a depth of the order of 0.4 mm near the root, with the width being about 3 to 4 times the depth. The backing plate is removed after the welding is over. The current setting to be used depends on the type of power supply and the electrode used. The typical ranges of these values used for various electrode sizes are presented in table.

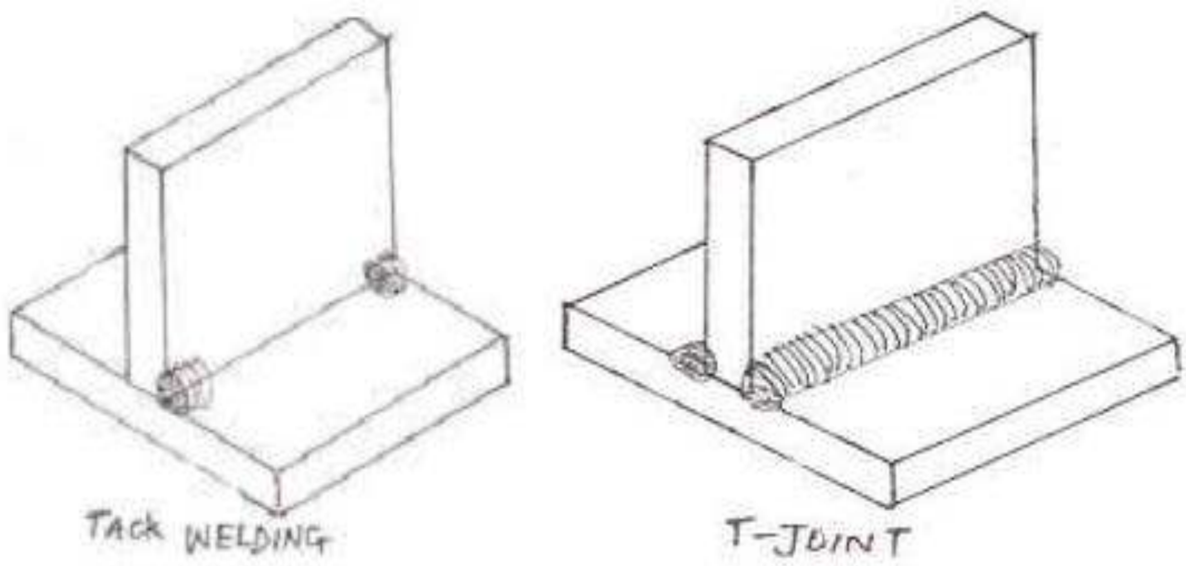
Electrode diameter	Pure tungsten		2% thoriated tungsten			Zirconium tungsten
Mm	AC-HF	DCEN	AC-HF	AC	DCEN	AC-HF
1.0	10-60	15-80	20-80	20-60	25-85	20-80
2.5	100-160	125-225	130-250	100-180	135-235	130-250
3.15	150-210	225-360	225-360	160-250	250-400	225-360
4.0	200-275	360-450	300-450	200-320	400-500	300-450
5.0	250-350	450-720	400-550	290-390	750-980	600-800
6.3	325-450	720-950	600-800	340-525	750-980	600-800

Sometimes filler metals may have to be used depending on the base metal. The filler metal for TIG (GTAW) welding is generally a bare wire. The size of the filler metal depends on the base metal thickness. The sizes of the filler rods are shown in table, for various metal thicknesses for aluminium welding. The nozzle or shield size (the diameter of the opening of the electrode to be chosen depends on the shape of the groove to be welded as well as the required gas flow rate). The gas flow rate depends on the position of the weld as well as its size. All the parameters for the TIG welding of aluminium are summarised in table .too high gas consumption would give rise to turbulence of the weld metal pool and consequently porous welds. Because of the use of shielding gases no fluxes are required to be used in inert gas shielded arc welding. However for thicker sections, it may be desirable to protect the root side of the joint by providing a flux or preferably a shroud of inert gas.

T-JOINT

AIM: preparation of T-joint as shown in figure using shielded metal arc welding process.

MATERIAL REQUIRED: two mild steel flats of given size.



TOOLS REQUIRED: welding transformer, connecting cables, electrode holder, ground clamp,
electrodes, chipping hammer, welding shield, wire brush etc.

THEORY: Arc welding is a fusion welding process. Arc welding is the process of joining two
metallic pieces by the application of heat, where heat is obtained from the electric arc.

In this process the two metallic pieces will act as base metal or parent metal. Electrode will act as filler metal. The electrode is coated with flux, which prevents oxidation of parent metal.

T -JOINT: joint are used to weld two plates or sections whose surfaces are at approximately right angles to each other. Plates or surfaces should have good fit up in order to ensure uniform penetration and fusion. Edge preparation of vertical member is come as that of the butt joint.

PROCEDURE:

1. Required edge preparation is made over the given metallic pieces.
2. The work pieces are cleaned properly from rust, grease, oil etc.
3. Place the electrode in the holder and ensure that all connections are given properly or not.
4. Assemble the given work pieces as shown in fig. T-JOINT: joint are used to weld two plates or sections whose surfaces are at approximately
5. Switch on the power supply and initiate the arc.
6. first tack welding is done.
7. now full welding is carried after one pass, slag is removed from the weld bed by using chipping hammer and wire brush.
8. then second, third passes will be carried until to get the desired height of weld.

PRECATIONS:

1. To protect the welder make use of welding shield, goggles, gloves, apron etc.
2. Maintain uniform arc length to have uniform weld bed.

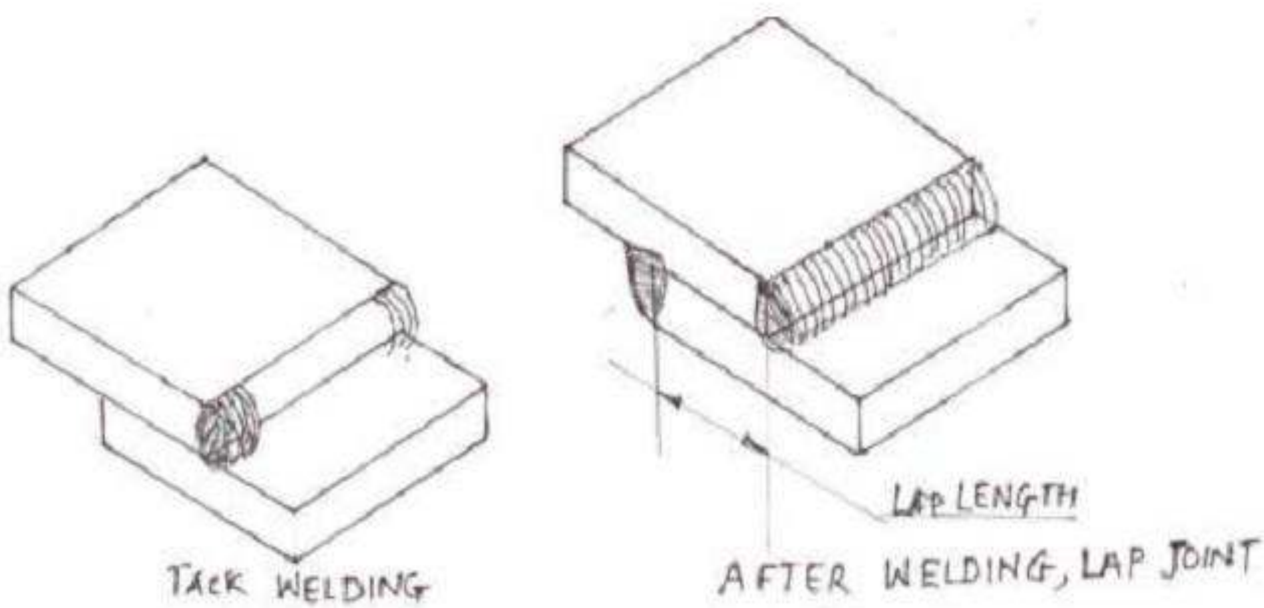
RESULT: T-joint is prepared as shown in fig by using by shielded metal arc welding process.

LAP JOINT

AIM: Preparation of double welded lap joint as shown in fig using shielded metal arc welding.

MATERIAL REQUIRED: 2 M.S. flat of given size.

TOOLS REQUIRED: Welding transformer, connecting cables, electrode holder, ground clamp, electrodes, chipping hammer, welding shield etc.



THEORY: Arc welding is fusion welding process. Arc welding is a process of joining two metallic pieces by the application of heat is obtained from the electric arc between two electrodes. In this process two metallic pieces will act as base metal or parent metal and electrode will act as filler metal. The electrode is coated with flux which prevents oxidation of parent metals.

LAP JOINT: The lap joint is used in joining two overlapping plates so that edge of each plate is welded to the surface of the other. The overlapping portion is called lap. The width of lap may be 3 to 5 times the thickness of the plates to be welded. Welds usually run each side of the lap. No edge preparation is required for a lap joint.

PROCEDURE:

1. The given metallic pieces are prepared to given sizes by filling.
2. The metallic pieces are thoroughly cleaned from rest, grease, oil etc.
3. Now given metallic pieces were assembled as shown in fig. select the electrodes, based on thickness of metal piece and hold it in the electrode holder.
4. Switch on the supply and initiate the arc by either striking arc method or drag.
5. Tack welding to be done before full welding.
6. The full welding process is carried after completion of one pass slag is removed from the full weld bed with help of chipping hammer and metallic wire brush.
7. Then the above process is repeated until to reach desired height of the weld.

PRECAUTIONS:

1. Use goggles, gloves in order to protect the human being.
2. Maintain constant arc length to have uniform weld bead.

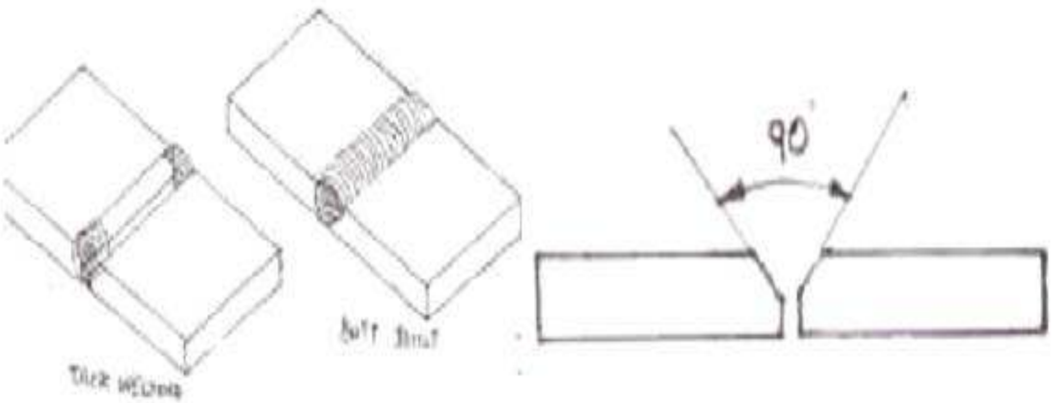
RESULT: Lap joint is prepared as shown in fig by using arc welding process.

BUTT JOINT

AIM: preparation of butt joint as shown in figure using shielded metal arc welding process.

MATERIAL REQUIRED: 2M.S Flat pieces of given size.

TOOLS REQUIRED: welding transformer, connecting cables, electrode holder, ground clamp, electrodes, hipping hammer, welding shield etc.



THEORY: Arc welding is a fusion welding process. Arc welding is the process of joining two metallic pieces by the application of heat, where heat is obtained from the electric arc between two electrodes. In this process two metallic pieces will act as base metal or parent metal and electrode will act filler metal. The electrode is coated with flux which prevents oxidation of parent metals.

BUTT JOINT: the butt joint is join the ends or edges of plates or surfaces located approximately in the same plate with each other. Preparation of edge varies according to the thickness of the material and welding process used. Light gauge section requires only 90 sheared edges with no spacing between them. Materials ranging from 9 to 13mm thick that can be welded only from one side should be reduced either as a single V or single U. However thicker plates are prepared from both sides.

The U shaped type of joint is more satisfactory and requires less filler material than V type groove. How ever it is more expensive to prepare U shape.

PROCEDURE:

1. The given metallic pieces filled to the desired size.

2. On both pieces bevelled in order to have V groove.

3. The metallic pieces are thoroughly cleaned from rust grease, oil, etc.

4. The metallic pieces are connected to terminals of Trans former.

5. Select electrode dia based on thickness of work piece and hold it on the electrode holder.

Select suitable range of current for selected dia.

6. Switch on the power supply and initiates the arc by either striking arc method or touch and drag method.

7. Take welding to be done before full welding.

8. In full welding process after completion one part before going to second part. Slag is removed from the weld bed. With the metal wire brush or chipping hammer.

9. Then the above process will be repeated until to fill the groove with weld bed or weld metal.

PRECAUTIONS:

1. Use goggles, gloves in order to protect the human body.

2. Maintain the constant arc length.

RESULT: butt joint is prepared as shown in figure by using arc welding process.

MOULDING MATERAILS

A large variety of moulding materials are used in foundries fro manufacturing moulds and cores.

They are:

Moulding sand,

System sand (backing sand),

Rebounded sand,

Facing sand,

Parting sand and

Core sand.

The properties that are generally required in Moulding materials are

Refractoriness: It is the ability of the moulding material to with stand the high temperatures of

The molten metal so that is does not cause fusion. Properties of Some refractory materials are

Material	Melting point, ^0C	Coefficient of linear expansion, X $10^6/^0C$
Silica(SiO)	1710	16.2
Alumina(Al_2O_3)	2020	8
Magnesia(MgO)	2800	13.5
Thoria(ThO_2)	3050	9.5
Ziroconia(ZrO_2)	2700	6.5
Zircon($ZrO_2.SiO_2$)	2650	4.5
Silicon Carbide(SiC)	˜ 2700	3.5
Graphite	˜4200	---

Green strength: The moulding sand that contains moisture is termed as green sand. The green sand should have enough strength so that the constructed mould retains its shape.

Dry strength: When the moisture in the moulding sand is completely expelled, it is called dry sand. When molten metal is poured into a mould, the sand around the mould cavity is quickly converted into dry sand as the moisture in the sand immediately evaporates due to the heat in themolten metal. At this stage, it should retain the mould cavity and at the same time withstand the metallostatic forces.

Hot strength: After all the moisture is eliminated, the sand would reach a high temperature when the metal in the mould is still in the liquid state. The strength of the sand that is required to hold the shape of the mould cavity then is called hot strength.

Permeability: During the solidification of a casting, large amounts of gases are to be expelled from the mould. The gases are those which have been absorbed by the metal in the furnace, air absorbed from the atmosphere and steam and other gases that are generated by the moulding and core sands. If these gases are not allowed to escape from the mould, they would be trapped inside the casting and cause defects. The moulding sand should be sufficiently porous so that the gases are allowed to escape from the mould. This gas evolution capability of the moulding sand is termed as permeability. Besides these specific properties, the moulding sand should also have collapsibility so that during the contraction of the solidified casting, it does not provide any resistance which may result in cracks in the casting; they should be reusable and should have good thermal conductivity so that heat from the casting is quickly transferred.

MOULDING SAND COMPOSITION:

The main ingredients of any moulding sand are:

The silica grains (SiO_2),

The clay as binder, and

Moisture to activate the clay and provide plasticity

SILICA SAND: The sand which forms the major portion of the moulding sand (up to 96%) is essentially silica grains, the rest being the other oxides such as alumina, sodium (Na_2O+K_2O) and magnesium oxide ($MgO+CaO$). These impurities should be minimized to about 2% since they affect the fusion point of the silica sands. The main source is the river sand which is used with or without washing. Ideally the fusion point of sand s should be about 14500C for cast irons and about 15500C for steels. In the river sand, all sizes and shapes of grains are mixed. The sand grains may vary in size from a few micrometers to a few millimeters. Shape of the grains may beaffect the properties of the moulding sands.

Zircon sand is basically a zirconium silicate ($ZrSiO_4$). The typical composition is ZrO_2-66.25%, SiO_2-30.96%, Al_2O_3-1.92%, Fe_2O_3-0.74% and traces of other oxides. It is very expensive. In India it is available in the quilon beach of Kerala. It has a fusion point of about 24000 C and also a low coefficient of thermal expansion. It is generally used to manufacture precision steel castings requiring better surface finish and for precision investment casting

Chromite sand is crushed from the chrome ore whose typical composition is Cr_2O_3-44%, Fe_2O_3-28%, SiO_2-2.5%, CaO-0.5%, and Al_2O_3+MgO—25%. The fusion point is about 18000 C. it also used to manufacture heavy steel castings requiring better surface finish. It is best suited to austenitic manganese steel castings.

Olivine sand contains the minerals fosterite (Mg_2SiO_4) and fayalite (Fe_2SiO_4). It is very

versatile sand and the same mixture can be used for a range of steels.

Clay: clays are the most generally used binding agents mixed with the moulding sands to provide the strength, because of their low cost and wider utility. The most popular clay types used are

Kaolinite or Fire clay (Al2O32 SiO22H2O)

Bentonite (Al2O34 SiO2H2OnH2O)

Kaolinite or Fire clay has a melting point of 1750-17870 C

and Bentonite has a melting temperature range of 1250-13000C. Of the two, bentonite can absorb more water which increases its bonding power. The clays besides these basic constituents may also contain some mixtures of lime, alkalies and other oxides which tend to reduce their refractoriness. There are basically two types of bentonites, one with sodium as adsorbed ion which is often called western bentonite and the other with calcium ion called southern bentonite. Sodium bentonites produce better swelling properties-volume increases some 10-20 times, high dry strength and high resistance but higher green strength. It is possible to improve the properties of calcium bentonite by treating it chemically with soda ash (sodium carbonate)

Water: clay is activated by water so that it develops the necessary plasticity and strength. The amount of water used should be properly controlled. This is because a part of the waterabsorbed by clay helps in bonding while the remainder up to a limit helps in improving the plasticity but more than that would decrease the strength and formability. The normal percentages of water used are from 2-8.

TESTING SAND PROPERTIES:

Sand preparation: tests are conducted on a sample of the standard sand. The moulding sand should be prepared exactly as is done in the shop on the standard equipment and then carefully enclosed in a closed container to safeguard its moisture content.

Moisture content: moisture is an important element of the moulding sand as it affects many properties. To test the moisture of a moulding sand a carefully weighted test sample of 50g is dried at a temperature of 1050C to 1100C for 2 hours by which time all the moisture in the sand would have been evaporated.

The sample is then weighted. The weight difference in grams when multiplied by 2 would give the percentage of moisture contained in the moulding sand. Alternatively a moisture teller can also be used for measuring the moisture content. In this the sand is dried by suspending the sample on a fine metallic screen and allowing hot air to flow through the sample. This method of drying completes the removal of moisture in a matter of minutes compared to 2 hours as in the earlier method. Another moisture teller utilizes calcium carbide to measure the moisture content. A measured amount of carbide in a container along with a separate cap consisting of measured quantity of moulding sand is kept in the moisture teller care has to be taken before closing the apparatus that carbide and sand do not come into contact. The apparatus is then shaken vigorously such that the following reaction takes place.

CaC2+2H2O→C2H2+Ca (OH) 2

The acetylene (C2H2) coming out will be collected in the space above the sand raising the pressure. A pressure gauge connected to the apparatus would give directly the amount ofacetylene generated which is proportional to the moisture present. It is possible to calibrate the pressure gauge to directly read the amount of moisture.

Clay content: the clay content of moulding sand is determined by dissolving of washing it off the sand. To determine the clay percentage a 50g sample is dried at 105 to 1100C and the dried sample is taken in a one litre glass flask and added with 475 ml of distilled water and 25ml of a one percent solution of caustic soda (NaOH 25g per litre). This sample is thoroughly stirred. After the stirring, for a period of five minutes the sample is diluted with fresh water up to a 150mm graduation mark and the sample is left undisturbed for 10 minutes to settle. The sand settles at the bottom and the clay particles washed from the sand would be floating in the water. 125mm of this water is siphoned off the flask and it is again topped to the same level and allowed to settle for five minutes. The above operation is repeated till the water above the sand becomes clear, which is an indication that all the clay in the moulding sand has been removed. Now the sand is removed from the flask and dried by heating. The difference in weight of the dried sand and 50g when multiplied by two gives the clay percentage in the moulding sand.

Sand grain size: To find out the sand grain size, a sand sample which is devoid of moisture and clay such as the one obtained after the previous testing is to be used. The dried clay-free sand grains are placed on the top sieve of a sieve shaker which contains a series of sieves one upon the other with gradually decreasing mesh sizes. The sieves are shakencontinuously for a period of 15min. After this shaking operation, the sieves are taken apart and the sand left over on each of the sieve is carefully weighed. The sand retained on each of the sieve expressed as a percentage of the total mass can be plotted against the sieve number as in figure. To obtain the grain distribution. But more important is the Grain Fineness Number (GFN) which is a quantitative indication of the grain distribution. To calculate the grain fineness, each sieve has been given a weight age factor as shown in table. The amount retained on each sieve is multiplied by the respective weight age factor, summed up, and then divided by the total mass of sample, which gives the grain fineness number. The same can be expressed as

$GFN=\Sigma M_i f_i/\Sigma f_i$

M_i =Multiplying factor for the i thsieve, f_i=amount of sand retained onthe ith sieve.

Permeability: the rate of flow of air passing through a standard specimen under a standard pressure is termed as permeability number. The standard permeability test is to measure time taken by a 2000cm3of air at a pressure typically of 980 pa to pass through a standard sand specimen confined in a specimen tube. The standard specimen size is 50.8mm in diameter and a length of 50.8mm. then the permeability number P is obtained by

$P=VH/pAT$

Where V= volume of air=2000cm3

H= height of the sand specimen=5.08cm

P= air pressure, g/cm2

A= C/S area of sand specimen=20.268cm2

T= time in minutes for the complete air to pass through the gaps

Inserting the above standard values in to the expression, we get P=501.28/Pt

Specimen preparation: since the permeability of sand is dependent to a great extent, on thedegree of ramming, it is necessary that the specimen be prepared under standard conditions. To get reproducible ramming conditions, a laboratory sand rammer is used along with a specimen tube. The measured amount of sand is filled in the specimentube, and a fixed weight of 6.35-7.25kg is allowed to fall on the sand threetimes from a height of 50.8-0.8mm. to produce this size of specimen usually sand of 145 to 175g would be required.

After preparing a test sample of sand as described, 2000cm3 of air are passed through the sample and the time taken by it to completely pass through the specimen is noted. Then from the above equation the permeability number can be calculated.

Strength: measurement of strength of moulding sands can be carried out on the universal sand strength testing machine. The strength can be measured in compression, shear and tension. The sands that could be tested are green sand. Dry sand of core sand. The compression and shear test involve the standard cylindrical specimen that was used for the permeability test. Green compression strength: green compression strength or simply green strength generally refers to the stress required to rupture the sand specimen under compressive loading. The sand specimen is taken out of the specimen tube and is immediately (any delay causes the drying of the sample which increases the strength) put on the strength testing machine and the force required to cause the compression failure is determined. The green strength of sands is generally in the range of 30 to 190kPa.

Green shear strength: with a sand sample similar to the above test, a different adapter is fitted in the universal machine so that the loading now be made for the shearing of the sand sample. The stress required to shear the specimen along the axis is then represented as the green shear strength. The green shear strengths may vary from 10 to 50 kPa.

Dry strength: the tests similar to the above can also be carried with the standard specimens dried between 105 and 1100C for 2 hours. Since the strength greatly increases with drying, it may be necessary to apply larger stresses than the previous tests. The range of dry compression strengths found in moulding sands is from 140 to 1800 kPa, depending on the sandsample. Mould hardness: the mould hardness is measured by a method similar to the Brinell hardness test A spring loaded steel ball with a mass of 0.9kg is indented into the standard sand specimen prepared.

The depth of indentation can be directly measured on the scale which shows units 0 to 100. When no penetration occurs, then it is a mould hardness of 100 and when it sinks completely, the reading is zero indicating a very soft mould. Besides these, there are other tests to determine such properties as deformation, green tensile strength, hot strength, expansion, etc

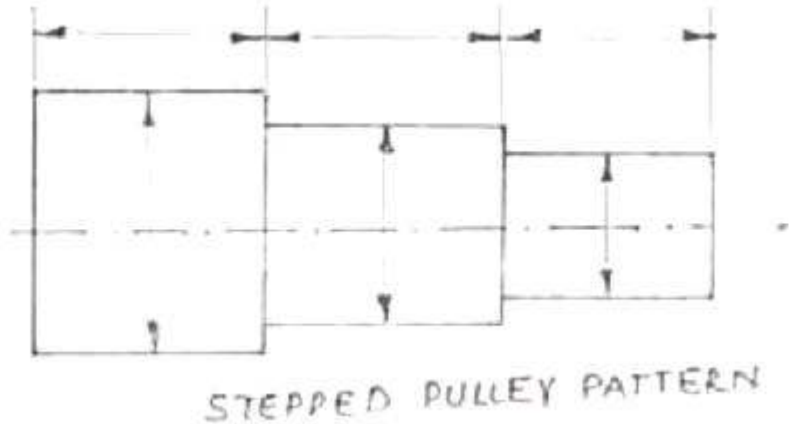
MOULDING AND CORE MAKING

The moulding is a process of making a cavity out of sand by means of pattern. The molten metal is poured into the moulds to produce castings. Sometimes a casting is to be made hallow cavities with in it. Such type of castings required the use of core. A core is defined as a sand shape which is exactly similar to the cavities or holes to be provided in the casting. The cores are generally made separately i.e. they are not moulded with the pattern the process of making core is called as core making.

PREPARATION OF STEPPED PULLEY PATTERN

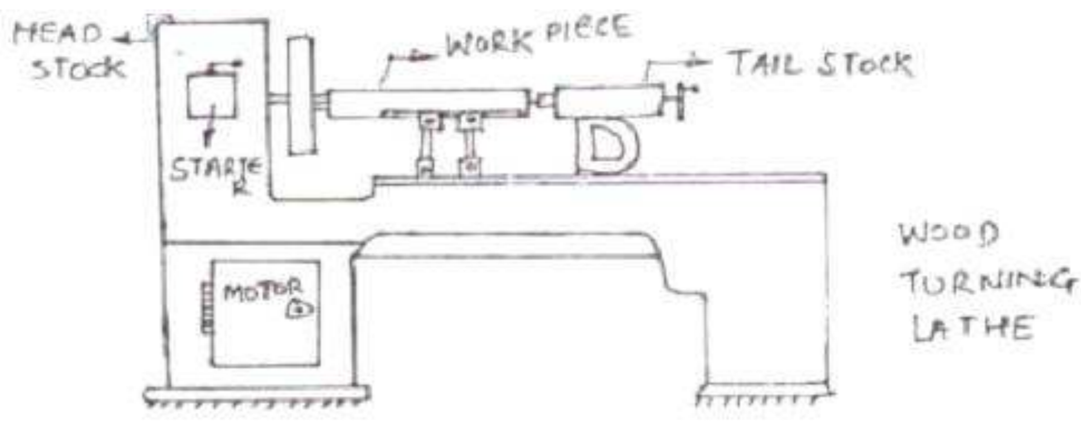
AIM: Prepare a stepped pulley pattern of given dimensions as shown in fig. using wood turn

lathe.



TOOLS REQUIRED: Gauge, skew chisel, parting tool, scraping tools.

DESCRIPTION OF LATHE:



Wood turning lathe is also called lathe. It is simple in construction having three basic parts bed,head stock and tail stock. The head stock is permanently fixed on the left side of the bed. On thetop of the bed guide way tail stock is mounted and it is free to slide and it can be clamped in anyposition. The work piece is held between centers (head stock and tail stock) and revolved on itsown axis. The tool is fed manually to remove UN wanted material from rotating work piece. From this machine any axis symmetric component can be produced.

PROCEDURE:

1. Take the work piece of required length and size.
2. Check the end faces weather they are perpendicular or not with the rectangular faces.
3. Mark the centers on both end faces.
4. Fix the work piece between centers. That is live center and dead center.
5. Rotate the work piece in anti clock wise direction.
6. Feed the tools manually to get the desired shape.

PRECAUTIONS: Use goggles to protect the eyes from dust.

RESULT: Required green sand mould for given stepped pattern pulley is prepared

RESULT: Required green sand mould for given single piece pattern is prepared

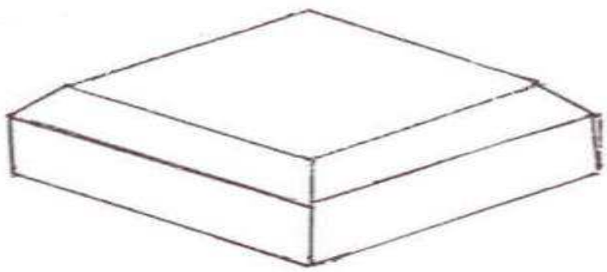
PREPERATION OF GREEN SAND MOULD USING SINGLE PIECE PATTERN

AIM: Preparation of green sand mould for given single piece pattern.

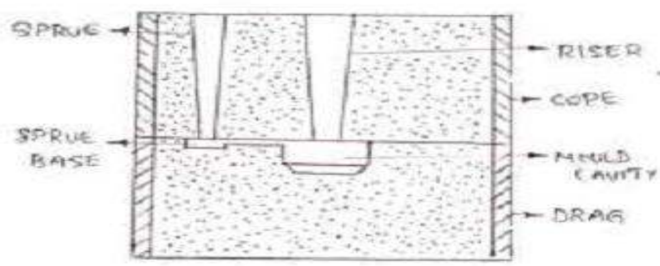
MATERIAL REQUIRED: Green moulding sand, pattern, moulding boxes.

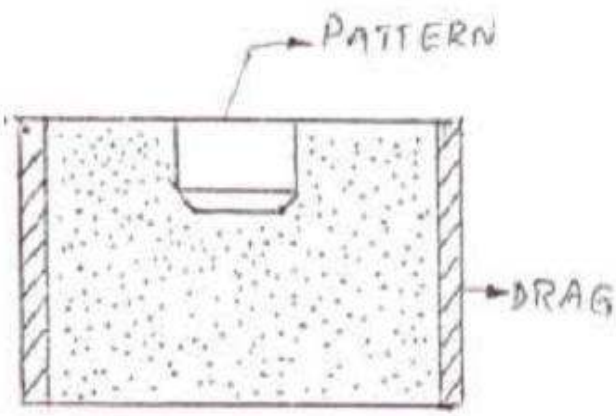
TOOLS REQUIRED: Rammers, slicks, strike of bar, riddle, shovel, riser, sprue pin etc.

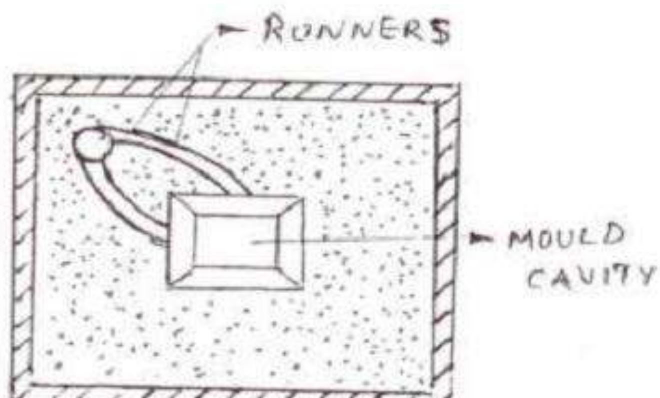
DESCRIPTION: A mould can be described as a cavity created in compact sand mass which when filled with molten metal will produce a casting. Obviously it is the impression left behind by a pattern after withdrawing the pattern. The cavity obtained will exactly resemble with the external shape and size of pattern. The process of producing this cavity is called moulding technique.



PATTERN







SECTIONAL VIEW AT PARTING

PROCEDURE:

1. First of all a suitable flask is selected. Large enough to accommodate the pattern and also allow some space around it for ramming.

2. Sprinkle the parting sand on the floor for partly removal of pattern. The drag part is placed upside down on the floor.

3. The pattern is placed on the floor inside the flask centrally.

4. Moulding sand is filled all along the pattern surface and fill up to the level flank rammed properly. Hold the pattern and ram the sand around it. Again fill the sand up to the level of flask and ram it.

5. The excess sand is removed by using strike off bar.

6. A small amount of dry loose sand is sprinkled over the top surface and the drag is turned upside down.

7. The cope is placed over the drag and parting sand is sprinkled on the top surface.

8. Runners, riser is put in positions and supported vertically by taking small amount of moulding sand around them.

9. The sand is filled in the flask and rammed it. Excess sand is removed and vent hole are made, parting sand is sprinkled around the top surface.

10. Then remove the cope and drag flask gently and carefully without spoiling the mould.

11. Remove the pattern from the flask by slightly shaking pattern in horizontal position along x and y direction.

12. Repairs are then made in the cavity and gates are cut.

13. The cope and drag flasks are assembled together and mould is ready for pouring of molten metal.

PRECAUTIONS:

1. Ramming to be done uniformly.
2. Moulding flask (cope and drag) is to be assembled with guide pins.

RESULT: Required green sand mould for given single piece pattern is prepared

PREPERATION OF GREEN SAND MOULD FOR CONNECTING ROD

AIM: To prepare a green sand mould for the split pin pattern as shown in figure.

MATERIAL REQUIRED: Green molding sand, pattern, molding boxes, parting sand.

TOOLS REQUIRED: Rammers, slicks, strike of bar, riddle, shovel, riser, sprue pin etc.

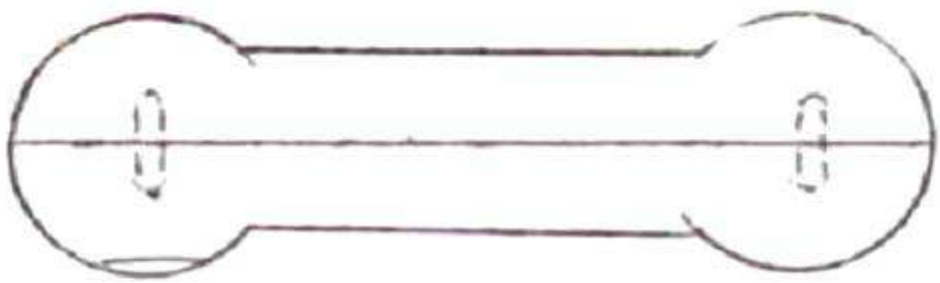
DESCRIPTION: A mould can be described as a cavity created in compact sand mass which

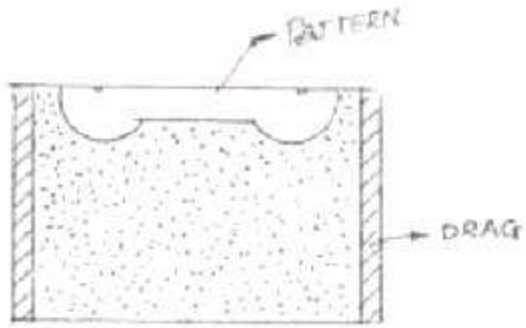
when filled with molten metal will produce a casting. Obviously it is the impression left behind

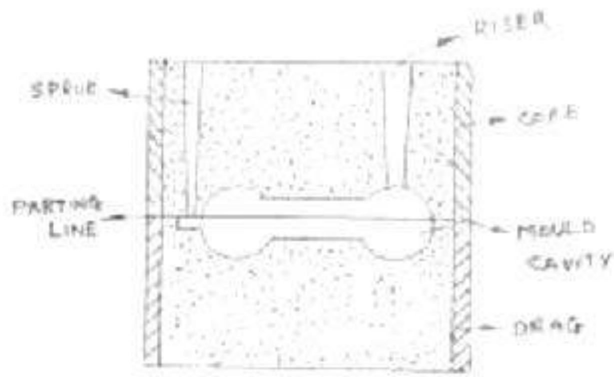
by a pattern after with drawing the pattern. The cavity obtained will exactly resemble with the

external shape and size of pattern. The process of producing this cavity is called molding

technique.







PROCEDURE:

1. First of all a suitable flask is selected. Large enough to accommodate the pattern and also allow some space around it for ramming.
2. Sprinkle the parting sand on the floor for easy removal after ramming. The drag part is placed upside down on the floor.
3. The pattern which comes into the drag part, is placed such that parting surface matching with floor.
4. Moulding sand is filled all along the pattern surface and fill up to the level flank rammed properly. Hold the pattern and ram the sand around it. Again fill the sand up to the level of flask and ram it.
5. The excess sand is removed by using strike off bar.
6. A small amount of dry loose sand is sprinkled over the top surface and the drag is turned upside down.
7. The cope portion pattern is assembled drag pattern with the help of dowel pins. Assemble the cope flask.
8. Runners, riser is put in positions and supported vertically by taking small amount of moulding sand around them.
9. The sand is filled in the flask and rammed it. Excess sand is removed and vent hole are made, parting sand is sprinkled around the top surface.
10. Then remove the cope and drag flask gently and carefully without spoiling the mould.
11. Remove the pattern from the flask by slightly shaking pattern in horizontal position along x and y direction.
12. Repairs are then made in the cavity and gates are cut.
13. The cope and drag flasks are assembled together and mould is ready for pouring of molten metal.

PRECAUTIONS:

1. Ramming to be done uniformly.

2. Moulding flask (cope and drag) is to be assembled with guide pins.

RESULT: Required pattern is prepared