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Name. Akash Parmar Faculty No..... Class. B.E. IST Batch. A2

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VISION OF DEPARTMENT ⟶

To provide quality treatment compatible with global standard in fluid of mechanical engineering who can Contribute to Societys through innovation, enterpreneur ship and sustainable development.

MISSION OF DEPARTMENT ⟶

To impart highest quality in fundamentals, technical knowledge and scientific education to the learner to make them globally competitive mechanical engineers.

To promote vision with world class industries and educational industries for excellence in teaching reason and Consulting practices.

To make students life-long learners, ethically and technically capable to build their Carrier in terms of professional personality.

Laboratory Course objective: ⟶

To understand different manufacturing processes (forging, welding and foundry) and use of different tools and equipment in these processes.

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SAFETY PRECAUTIONS OF FOUNDRY ⟶

1. Do not permit water to collect on the floor around the furnance.
2. Do not throw damp or wet metal in the furnace crucible or ladle of molten metal.
3. Store crucible in a warm dry place.
4. Before using crucible check them for flaws.
5. Do not wedge piece of metal into a crucible when charging it.
6. Preheat the crucible before placing it in a heated furnace.
7. ladles should be thoroughly dry and warm before metal is poured into them.
8. Use properly fitted tongs and shanks when handling crucible of molten metal.
9. Grasp a ladle firmly and be sure it is well balanced when transporting molten metal.
10. Do not walk backward when carrying a lade of molten metal. Never run.
11. Do not place your face directly over riser.
12. Keep a clear space around the pouring area.
13. Wear safety goggles when tapping a furnace.

(14) Wear gloves when chipping cold slag from furnace lining.

(15) Wear safety goggles or a face shield when pouring molten metal.

(16) legging should be worn to protect leg and feet from splashes of molten metal.

(17) Do not wear gauntlet gloves while pouring metal.

(18) Hot metals should be stored where there is no danger of body Contact by any person, Mark hot pieces withchalk.

(19) Preheat any tool on solid metal which is to come in Contact into molten metal and a Cold piece of metal that is Suddenly thrust into molten-metal may Cause the molten-metal to Splitter because of moisture-Condensation.

(20) Heat and glare of molten-metal during pouring may have bed effects on eyes and skin. for this thick protective clothing and safety glasses should be used.

MOULDING :-

Moulding is a process of manufacturing mould, a cavity by shaping liquid or pliable raw material using a rigid frame called mould or matrix into which liquid, plastic metal glass ceramic is filled depending upon the moulding process. Materials used pouring method, it is classified into following:-

① Sand moulding:-

Moulding sand is used containing sand, silica, clay, water and other additives in small quantity when mould is used in moist condition it is called green sand mould but the castings produced by this method have some surface defects dry sand moulding is practised to remove the defects in green sand moulds are partly dried on their inner walls just before passing molten metal. it is further classified into various types:-

(a) Bench moulding :-

Moulds are prepared on bench and suitable for small size. Castings in small number usually of light metal and alloys such

metal moulds are easily handed by hand.

(b) Floor moulding :— For medium and large sized castings mould are prepared on foundry floors acting as drag part into which mould cavity is dry and Cope is placed over it and Molten metal is a poured.

(c) Pit moulding :— Casting of several tons are made by digging pits into floor acting as drag for moulds to withstand high hydrostatic pressure walk are lined with bricks and Concrete Cope in form of Corner is placed over it.

(d) Machine moulding :— Moulding machine are used for pouring and rimming of sand eg: galt- Squeeze. or jet- Squeeze roll over machines.

(2) Plastic moulding :—

Plastic a synthetic material Can easily moulded into desired shape and Caube reformed if necessary so not the basis of different shapes and size it is also classified into various

types:-

(a) Injection moulding:→

it creates high quality 3-D objects. It begins by melting plastics in happens which is injected into tightly closed chilled mould. The plastic takes required shape of mould. The mould can be generally used for many times before replacing.

(b) Blow moulding plastic manufacturing:→

The plastic takes required shape of mould. The mould can be generally used for many times before replacing. The mould has a tube set within it which has particulants shape when in infeated. During this air is blown into the tube initially and plastic has formed around tubing & removed after cooling.

(c) Compression moulding:→

for this molten place poured into moulded then a second mould is praised into it. this squeeze the plastic into desired shape

before it is removed after cooling.

(d) Rotational moulding → in this liquid plastic forms each object and is added to mould from inside. Two mechanical arms constantly rotate the mould at same level, when molten is inside in it. As mould turns plastic coats the inside of mould and creates a hollow plastic object.

PATTERNS:→

it is replica of an object to be cast used to prepare cavity into which molten material is poured. The selection of pattern materials depends primarily on the following factors:—

(1) Service requirements, e.g. quantity, quality and intricacy of casting i.e. minimum thickness desired, degree of accuracy and finish required.

(2) Type of production of castings and the type of moulding process.

(3) Possibility of design changes.

(4) Number of castings to be produced i.e. possibility of repeat orders.

To be good of its kind, pattern material should be:-

(1) easily worked, shaped and joined;

(2) light in weight;

(3) strong, hard and durable, so that it may be resistant to wear and abrasion, to corrosion, and to chemical action;

(4) dimensionally stable in all situation;

(5) easily available at low cost;

(6) repairable and reused;

(7) able to take good surface finish;

The wide variety of pattern materials which meet these characteristics are wood and

wood products; metal and alloys; plasters; plastics and rubbers; and waxes.

WOOD:- Wood is the most common material for pattern as it satisfies many of the aforesaid requirements. it is easy to work and readily available. Wood can be cut and fabricated into numerous forms by glueing, bending and curving. it is easily sanded to a smooth surface, and may be preserved with shellac, which is the most commonly used finishing material for wooden pattern. wood has its disadvantage as a pattern material. it is readily affected by moisture: it changes its shape when the moisture dries outof it, and when it picks up moisture from the damp moulding sand. it wears out quickly as a result of sand abrasion, and, if not stored properly, it may warp badly. owing to these reasons wooden patterns do not last long, and they are generally used when a small number of castings are to be produced.

Exa:- woods of teak, pine, mahagony, deodar, sheesham are commonly used.

Metals →

Metal is used when a large number of Casting are desired from a pattern or when Conditions are too Severe for wooden pattern. Metal patterns do not change their shape when Subjected to moist Conditions. Another advantage of a metal pattern is freedom from warping in storage. Metal patterns are very useful in freedom from warping in storage. Metal patterns are very useful in freedom from because of their accuracy, dulability and strength. Commonly, a metal pattern is itself cast from a wooden pattern called master pattern. when metal patterns are to be cast from master patterns, double shrinkage must be allowed. for example if the metal pattern is to be made of brass and the castings are to be of cast iron, the shrinkage allowed on the wood master pattern will have to be 14 mm per metre for brass, plus 10 mm per metre for cast iron, making a total of 24 mm per metre. Metals used for patterns include Cast iron, steel brass, aluminium and white metal.

Cast iron → it is used for some highly specialised types of patterns. it is strong, gives a good smooth mould surface with sharp edges and is resistant to the abrasive action of the sand. But cast iron patterns are heavy and are easily broken. Iron patterns rust too much and require a dry storage area.

Brass:— it is used in patterns, particularly when metal patterns are small, it is strong, does not rust, takes a better surface finish than cast iron, and is able to withstand the wear to the moulding sand. But brass patterns are heavier than cast iron. This is why they are restricted to small size patterns.

Aluminium:→

It is probably the best all round metal because it melts at a relatively low temperature, is soft and easy to work, light in weight, and resistant to corrosion. Aluminium, being rather soft, is liable to the be damaged by rough usage.

WHITE METAL— It is not much used for patterns but is the best material that can be used for making intricate and fine shapes. These alloys are used in most die-casting production and therefore, are often called die-casting alloys. They have a low melting point, about 200°C. and have little appreciable shrinkage. A comparative evaluation of these metals is given as Table

PLASTICS:→ Plastics are now finding their place as a modern pattern material because they do not absorb moisture, are strong and dimensionally stable, resistant to wear, have a very smooth and glossy surface, and are light in weight. Because of its glossy surface it can be withdrawn from the mould very easily without injuring the mould, and no dry or liquid parting compound is necessary. Furthermore, the plastic material has a very low solid shrinkage.

Two types of plastic materials are used in pattern shops, namely thermosetting and thermoplastic. In the thermosetting varieties, epoxy resin has become very popular because of its good

production qualities. of the thermoplastic varieties which tend to become soft and subsequently gasify on heating, the most common is polystyrene foam. The material is available in different densities in foamed or expanded form. It can be easily shaped, machined and fabricated by glueing to form the pattern.

Rubbers:→ Certain types of rubbers, such as silicon rubber, are favoured for forming a very intricate type of die for investment casting. This material like epoxy resin, is available in two parts, binder and hardener. When the two parts, originally in liquid form, are mixed together, poured over a master pattern or into a die and cured, a solid shape, a pattern, is produced.

Plasters:→ Gypsum pattern cement as plaster of peris is also used for making patterns and core boxes. It has a high compressive strength, up to 300 kg/cm^2, and it can be readily worked with wood tools. When talc and cement are mixed with water, it forms a plastic mass capable of being cast into a mould.

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WAXES:→ Wax patterns are excellent for investment casting process. The materials generally used are blends of several types of waxes, and other additives which act as polymerising agents, stabilisers etc. The waxes commonly chosen are paraffin wax, shellac wax, bees-wax, Cerasin-wax, and micro-crystalline wax. The properties desired in a good wax pattern include low ash content (upto 0.05%), resistant to the primary coat material used for investment, high tensile strength and hardness and substantial weld strength.

Comparative Evaluation of metals for patterns —

S.NO.	Factors	Castiron	steel	Aluminium	Brass
1.	Availability	Good	Good	Good	Good
2.	Castability	Good	Difficult	Less difficult	Good
3.	Machinability	Good	Good	very good	very good
4.	Surface finish	Good	Good	very good	very good
5.	Lending to modification	Good	Good	Good	very Good
6.	weight	very heavy	very heavy	very light	heavy
7.	Brittleness	High	Low	Low	Low
8.	Tendancy to oxidation	Yes	Yes	No	No
9.	Requiring machining	Yes	Less	Not much	Not much
10.	Cost	Low	low	Medium	high

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Pattern making tools :→

The pattern maker is basically a wood worker. The tools employed in making patterns, therefore do not differ from those used by a wood worker, excepting the special tools that the particular needs of the trade have developed.

In addition to those used by a wood worker or Carpenter, there is one tool in the equipment the Contraction rule, which is a measuring tool typical of the pattern maker's trade. All castings Contract in cooling from the molten state, and patterns have to be made Correspondingly larger than the required casting in order to Compensate for the loss in size due to this Contraction.

Different metals and alloys have different Contractions The allowance of shrinkage, therefore, varies with different metals and also according to particular casting conditions and it increases in proportion to the size of the pattern.

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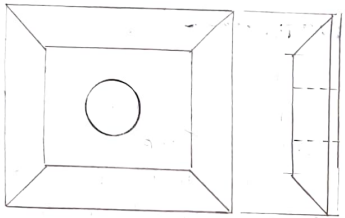
TYPES OF PATTERN :→

The type of pattern selected for a particular casting will depend upon several conditions. Among these, one is the anticipated ease or difficulty of the moulding operation to come. others are whether a small or large number of castings is wanted, the type of moulding process and other factors which may enter the situation because of characteristics peculiar to the casting. Several of the more commonly used types of pattern are listed and described below :—

1. Single-piece pattern
2. Split pattern
3. Match plate pattern
4. Cope and drag pattern
5. Gated pattern
6. Loose-piece pattern
7. Sweep pattern
8. Skeleton pattern
9. Segmental pattern
10. Shell pattern
11. Built-up pattern
12. Boxed-up pattern
13. Lagged-up pattern
14. Left-and right hand pattern



① SOLID PATTERN

② TWO-PIECE SPLIT PATTERN

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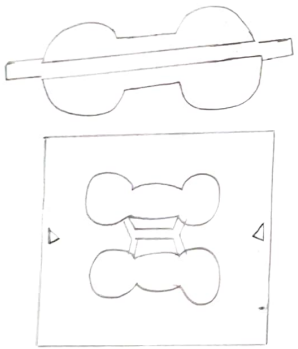
① **Single-piece or Solid pattern :→**

A patten that is made without joints, partings or any loose pieces in its construction is called a single-piece or solid pattern. A single-piece pattern is not attached to a frome or plate and is, therefore, sometimes known as a loose pattern. These patterns are cheaper. when using such patterns, the moulder has to cut his own runners and feeding gates and risers. This operation takes more time, and they are not recommended except for limited production. Single-piece patterns are usually used for large castings of simple shapes.

② **Split pattern :→**

Many patterns cannot be made in a single piece because of the difficulties encountered in moulding them. To eliminate this difficulty and for castings of intricate design or unusual shape, split patterns are employed to form the mould. These patterns are usually made in two parts, as shown in figure ② so that one part will produce the lower half of the

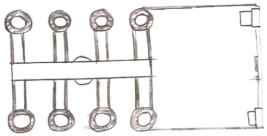


③ Match plate Pattern

mould, and the other, the upper half. The two parts, which may or may not be of the same size and shape, are held in their proper relative positions by means of the dowel-pins fastened in one-piece and fitting holes bored in the other. The surface formed at the line of separation of the two parts, usually at the centreline of the pattern, is called the parting surface or parting line. it will also be the parting surface of the mould.

③ Match plate pattern :→

When split patterns are mounted with one half on one side of a plate and the other half directly opposite on the other side of the plate, the pattern is called a match plate pattern. A single pattern or a number of patterns may be mounted on a match plate. The pattern is made of metal, and the plate which makes the parting line may be either wood or metal. Aluminium is commonly used for metal match plates. Pattern for gates and runners are fastened to the drag side of the plate in their correct positions to from the complete match plate.



⑤ Gated pattern

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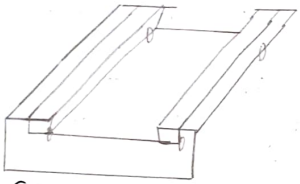
④ Cope and drag pattern :→

In the production of large castings, the complete moulds are too heavy to be handled by a single operator. Therefore, cope and drag patterns are used to ease this problem to efficient operation. The patterns are made in halves, split on a convenient joint line, and separate cope and drag patterns are built and mounte on individual plates or boards. This arrangement permits one operator or group of operators to prepare the cope half of the mould while another operator or group worked on the drag hal This planned distribution of labour increases producti appreciably.

⑤ Gated Pattern :→ To produce good casting, it i necessary to ensure that full suppy of molten me flows into every part of the mould. provision f easy passage of the flowing metal into the mould is called gating which cannot be ma by hand operations for volume high production particularly because of the time involved. In production, a number of castings are produce



⑥ LOOSE - PIECE PATTERN

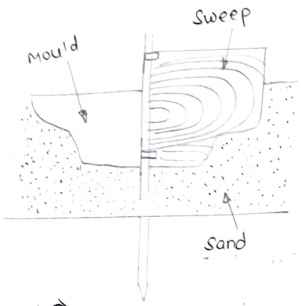
a single multicavity mould by joining a group of patterns, and the gates or runners for the molten metal are formed by the connecting parts between the individual patterns.

⑥ LOOSE PIECE PATTERN :→

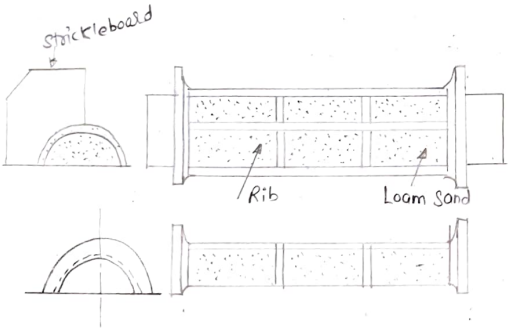
Some patterns are produced as assemblies of loose component pieces. The loose-piece patterns are needed when the part is such that the pattern cannot be removed as one piece, even though it is split and the line is made on more than one plane. In this case, the main pattern is usually removed first. Then the separate pieces, which may have to be turned or moved before they can be taken out as removed. Completed patterns of this type usually require more maintenance and are slower to mould. Fig. 6 show a loose piece pattern.

⑦ SWEEP PATTERN :→

Symmetrical moulds and cores, particularly in l
sizes, are sometimes shaped by means of
sweep patterns. The sweep pattern consis



⑦ SWEEP PATTERN



⑧ SKELETON PATTERN

of a board having a shape corresponding to the shape of the desired casting and arranged to rotate about a central axis as illustrated in the figure. ⑦ The sand is rammed in the place and the sweep board is moved around its axis of rotation to give the moulding sand and the desired shape. Sweep patterns are employed for moulding part having circular sections. The curved sweep might be used to form part of the mould for a large cast-iron kettle and the straight sweep for any shape of groove or ridges. The principal advantages of his pattern is that it eliminates expensive pattern construction.

⑧ SKELETON PATTERN :→

Patterns for very large castings would require a tremendous amount of timber for a full pattern. In such cases a skeleton pattern as in fig. ⑧ may be employed to give the general contours and size of the desired casting. This is a ribbed construction of the large numbers of square or rectangular openings btw the ribs which form a

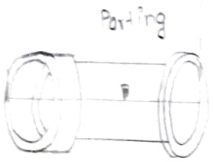
⑨ Segmental pattern

skeleton outline of the pattern to be made. The framework is filled and rammed with clays, sand or loam, and a strike-off board known as a strickle board is used to scrape the excess sand out of the spaces btw the ribs so that the surface is even with the outside of the pattern. it is usually built in two parts : one for cope and the other for the drag.

Exa:→ Soil and water pipes, pipe bends, valve bodies and boxes are few examples of castings which are made by making skeleton patterns.

⑨ SEGMENTAL PATTERN:→

Segmental patterns or part patterns are generally applied to circular work as rings, wheel rims, gears etc. They are sections of a pattern so arranged as to form a complete mould by being moved to form each section of the mould. when making a mould using this pattern, a vertical spindle is firmly fixed in the centre of drag flask. The bottom of the mould is rammed and swept level. Then the segmental pattern is fastened to the spindle. Moulding sand is



(10) Shell pattern

rammed between the outside of the pattern and the flask, and in the outside, but not at the ends of the pattern. After ramming one section it goes forward to the next section for ramming; and so on, until the entire mould perimeter has been completed.

(10) SHELL PATTERN :→

The shell pattern is used largely for drainage fittings and pipe work. A typical example is shown at fig. (10) the pattern is usually made of metal, mounted on a plate and parted along the centre line, the two sections being accurately doweled together. These short bends are usually moulded and cast in pairs. The shell pattern is a hollow construction like a shell and the outside shape is used as a pattern to make the mould, while the inside is used as a core-box for making cores.

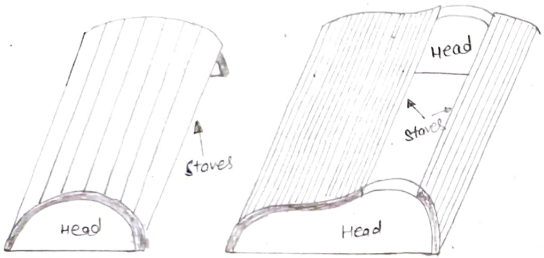
Sometimes, a pattern of the entire shape of the casting is termed a shell pattern, and a pattern that is of the required shape outside, but having the inside cored out is termed a block pattern.

(11) BUILT UP PATTERN →

As the name implies, built-up patterns or parted patterns are composed of two or more pieces. Patterns for special pulleys are built-up segments of wooden strips. These segments are made by cutting strips of wood to the curvature required, and the thickness desired is built up by glueing them in layers. Flanges are also made similarly. The building up is sometimes necessary because it is difficult to make an intricate shape on a block of wood for constructing a pattern, but it is easier to build up the shape by glueing or joining number of segmental pieces together.

(12) BOXED-UP PATTERN: →

In a boxed-up pattern the planks or strips of wood are so joined together either by glue, nails or screws that a pattern is made like a box. Not only this method economises wood for large patterns but makes them lighter on weight. The box construction is employed in making many patterns specially for a



(13) Lagged up pattern

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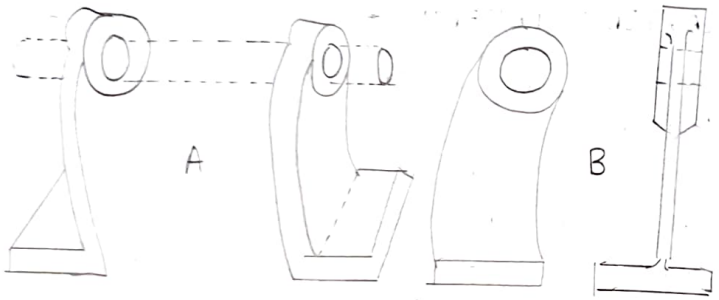
Casting having a regular outline and rectangular form.

(13) **LAGGED UP PATTERN** → Cylindrical works such as Cylinders pipes or Columns are built up with lag or stave construction which ensures permanence of form. "Lags" or "Staves" are longitudinal strips of wood which are bevelled on each side to make the joints tight outside, and glued and nailed or screwed to the end pieces of wood called "heads". The illustration of figure. shows the staves fastened to heads that are half a regular polygen, the object being to make a cylinder or barrel that is to be parted longitudinally through the centre. Such a construction gives the maximum amount of strength and permits building close to the finished outline of the pattern so that there is comparatively little excess stock to be removed to bring it to the required form.



(14) Left and right hand pattern

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(14) Left and right hand patterns:→

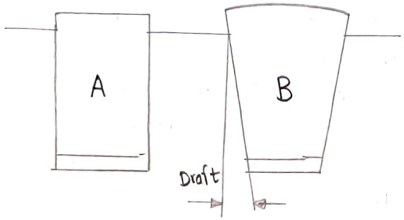
Many patterns are required to be made in pairs and when their form is such that they cannot be reversed and they have the centres of hubs, bosses etc. opposite and in line, they must be made right and left hand. 'T' hangers for overhead shaft line, legs for wood-turning lathe, or garden bench or for paddle type sewing machine, and brackets for luggage racks in the railway carriages are few examples where a pair of right-and left-hand patterns are required. In such instances, on many occasions, pattern makers are supplied with drawings which show either a right-or left hand casting. from this he is requested to make pattern equipment for both the right and left hands. This often presents considerable difficulties especially on the more complicated drawings as to what constitutes the difference between left-and right hand patterns.

Metal patterns :—

Metal patterns are used for large scale production of castings and they are rarely required as loose patterns. As the patterns are cast, there is no need to make joints or segments. However, the method of manufacture is intricate and requires immense skill. The patternmaker must be practised in metal cutting, finishing and fabrication methods in addition to inspection technique. Metal patterns, when used are normally mounted on one or both sides of a pattern plate. when patterns are small, several patterns can be mounted on the same plate.

PATTERN MAKING ALLOWANCES →

Patterns are not made the exact same size as the desired casting for several reasons. Such a pattern would produce castings which are undersize. Allowance must therefore be allowed for shrinkage, draft, finish, distortion and rapping.



② Draft Allowance

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① SHRINKAGE ALLOWANCE →

As metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a pattern is made larger than the finished casting by means of a shrinkage or contraction allowance. In laying measurements for the pattern the patternmaker allows for this by using shrink or contraction rule which is slightly longer than the ordinary rule of the same length. for example, when constructing a pattern for cast iron, the patternmaker uses a shrink rule measuring about 10mm longer per metre than the conventional rule since cast iron shrinks 10 mm per metre.

② DRAFT ALLOWANCE →

When a pattern is drawn from a mould, there is always some possibility of injuring the edges of the mould. This danger is greatly decreased if the vertical surfaces of a pattern are tapered inward slightly. This slight taper inward on the vertical surfaces of a pattern is known as the draft. Draft may be expressed in millimeter per metre on a side, or in degrees, and the

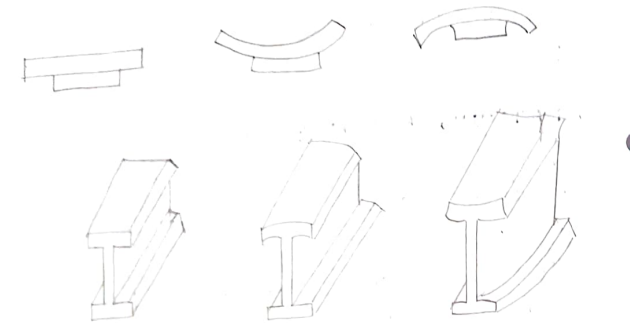
amount needed in each case depends upon (1) length of the vertical side, (2) intricacy of the pattern and (3) the method of moulding.

(3) MACHINING ALLOWANCE →

Rough surfaces of castings that have to be machined are made to dimensions somewhat over those indicated on the finished working drawings. The extra amount of metal provided on the surfaces to be machined is called machine finish allowance and the edges of these surfaces are indicated by a finish mark V or f. The amount that is to be added to the pattern depends upon (1) the kind of metal to be used (2) the size and shape of the casting and (3) methods of moulding.

(4) Distortion or camber allowance :→

Some castings, because of their size, shape and type of metal, tend to warp or distort during the cooling period. This is a result of uneven shrinkage and is due to uneven metal thickness or to one surface being more

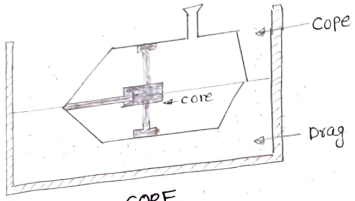


④ Distortion in Casting

exposed than another, causing it to cool more rapidly. The shape of the pattern is thus bent in the opposite direction to overcome this distortion. This feature is called distortion or camber allowance. As an example, a casting shaped like the letter U will be distorted with the legs diverging, instead of parallel. To compensate for this condition, the pattern is made in such a manner that the legs converge but as the casting cools after its removal from the mould, the legs straighten and remain parallel.

⑤ Rapping allowance :→

When a pattern is rapped in the mould before it is withdrawn, the cavity in the mould is slightly increased. In every cases where castings must be uniform and true to pattern, rapping or shake allowance is provided for by making the pattern slightly smaller than the actual size to compensate for the rapping of the mould.



CORE

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Core:— Core is a device used in Casting and moulding process to produce interval cavities requirement angle. it is a disposable item that is displayed to get it out of piece.

Materials for Core making:—

① Core Sand ② Bentonite clay

③ Pulverised Coal ④ Resin oil

Why Core is used ?

They are seven requirement for Core.

(i) **GREEN STRENGTH:→** Requirements for core is green Condition there must be adequate strength for handling.

(ii) In the hardened state, it must be strong enough to handle forces of Casting.

(iii) The Compression Strength should be 100-200 must be very high to allow for escape of gases.

(iv) **Friability →** As the Casting or moulding tools

the Curve must be weak enough to break down as the material should shrink. they must be easy to remove during shake out.

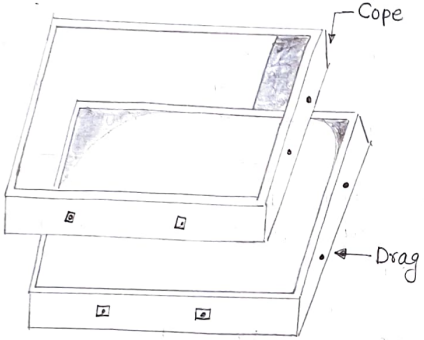
(V) Good refractoriness is necessary to withstand high temp. which is associated with thermal stability.

(VI) A smooth surface finish.

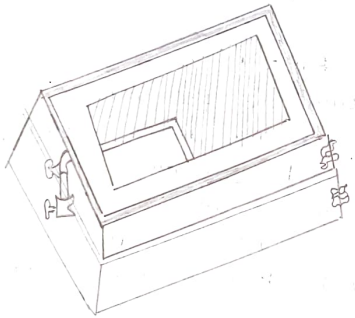
(VII) Minimum generation of gases during metal pouring.

MOULDING BOX →

Sand mould are prepared in specially constructed boxes called flask used to impart rigidity and strength to sand in moulding. These are either made of steel or wood. They are usually made in two parts :- Core and drag. flask of metal are used to when production is large, but when only a few casting are needed.



① Box-type of flask



② Snap type moulding box

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There are different designs of moulding box types are:-

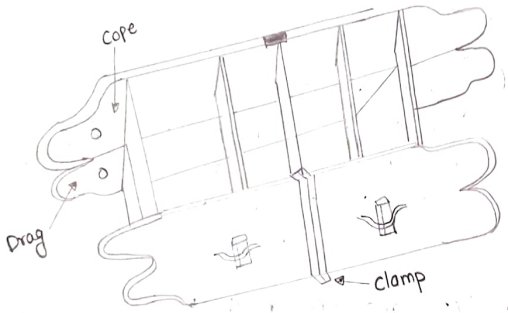
① **Box type moulding flask →**

It is a permanent flask as the flask should not be recovered till the pouring of molten metal is completed. These boxes are generally made of steel and used for small and medium sized storage. They may be of rectangular or circular shape. The two parts of box type moulding are:-

→ Upper part is known as Cope.

→ Lower as the drag.

② **Snap type moulding box:→** These boxes are fitted which a hinge at one corner and a fastner as diagonally opposite corner. After the mould has been made. it is moved in position where it is to be cast. These boxes are used for mass production of small casting and in machine moulding.



③ wooden moulding Box

③ wooden moulding box :→

These are used for Producing large sized Castings. on the ends wooden handles are used for any handling of flask. The sides of flask are hold together by cross-boards to prevent leakage of moulding sand. The upper part cope has cross wooden position but not drag which support sand when cope is lifted. for accuration placing of cope and drag. Steels degs are provided The clamps and wedge are used for holding the leg at their position.

Moulding Sand :→

It is principle material used in foundry shop for moulding sand in a cavity into which molten material is poured to produce Casting. The main integrediants of moulding sand are— Sillica and graine, clay, moisture and other materials moulding sand consists of 80-90% Sillica, 5-20% clay and 2-8% moisture and rest Compasition is of miscellaneous material.

Type of moulding Sand according to different uses :→

(1) **GREEN SAND →** The Sand in natural or moist State is Called green Sand (tempered Sand). it is the moisture of 20-30% clay & 6-8% moisture. It is fine, soft, light and porous. Being damped it reaches, retains any shape. Green and moulds prepared are used for Small size Casting of ferrous and non-ferrous metal.

(2) **Dry Sand →** Green Sand when backed or dried before pouring molten metal is Called dry Sand. The dry Sand moulds have greater strength, rigidity and thermal stability and are used for large and heavy Casting.

(3) **Loam Sand →**

A mixture of 50% Sand grains and 50% clay is called loam Sand. it is used for beam moulds of large grey iron Casting. it becomes hard after drying.

(4) **Parting Sand** →
A Sand used on the focus of pattern before moulding is called parting sand, without sticking. it consist of dry silica sand, sea sand or burnt sand which allows parting surface of cope and drag to separate without clinging.

(5) **Facing Sand** →
it is used before powing molten metal on the surface directly next to surface of pattern and comes in contact with molten metal when powed it has high strength and refractoriness it is made of sillica, clay, They are Sometime mixed with 6-15 times as much fine moulding sand to make facing.

(6) **Backing Sand** →
it is used to back up the facing sand and not used next to pattern to full whole volume of flasks. it is also called black and due to it's colour.

(7) **Core Sand** → To form hollow sections or cavities in mould of desired shape, size. it is Sillica

Sand mixed with Linseed oil or any other oil.

Properties of moulding sand →

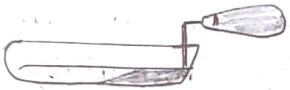
① Porosity / Permability →
it is property of sand which permits steam and other gases to pass through sand mould steam and other gases to pass through sand mould. it depends on grain size, shape, moisture and clay content of sand. if sand is too fine porosity is low.

② Flow ability → This is property of sand due to which it flows to all portions of box and take up required shape High flow-ability and uniform density provides good shape.

③ Adhesiveness → it allow to adhere or ling to side of moulding box.

④ Cohesiveness (Strength) →
It allows sand grains to sticks together during ramming. insufficient strength may lead to collapse in mould, but it should take the

① SHOVEL



Finishing trowel

Square trowel

② TROWEL

desired shape even after hot metal is poured.

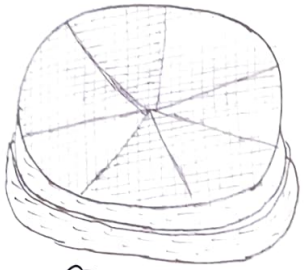
⑤ Refractoriness → it allow sand to resist to high temperature of molten metal without breaking or fusing. it should be high.

FOUNDRY SHOP HAND TOOLS →

foundry shop is the place where metal casting is prepared by melting and pouring molten metal into metals moulds, some of commonly used tools for this are shovel, trowel, riddle, vent wire, rammers etc.

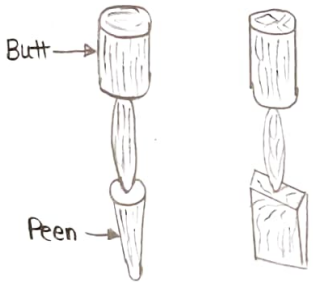
① SHOVEL → it consist of an iron pan with a wooden handle. it can be used for mixing and conditioning the sand and for moving the sand pile into flask.

② TROWEL → A trowel consists of a metal blade fitted with a wooden handle. Trowels are employed in order to smooth or sleek over the surfaces of moulds. A moulder also uses them in repairing the damaged portions of a mould.



③ RIDDLE

④ LIFTER



⑤ RAMMER

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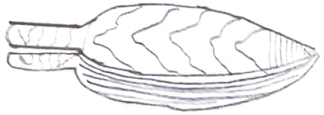
③ **RIDDLE** →

A riddle, sometimes called a screen, consists of a circular or square wooden frame fitted with a standard wire mesh at the bottom as shown in fig. ③. it is used for removing foreign materials such as nails, shot metal, splinters of wood, from the moulding sand.

④ **LIFTER** → Lifters are made of thin sections of steel of various widths and lengths with one end bent at right angles as shown in fig. ④. They are used to clean and finish the bottom and sides of deep, narrow openings in moulds.

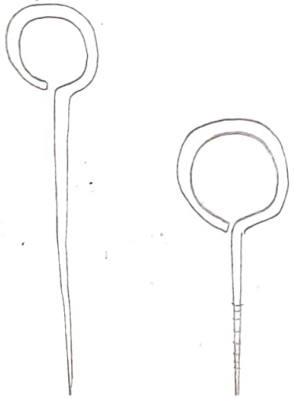
⑤ **RAMMER** → A hand rammer is a wooden tool used for packing or ramming the sand into the mould, one end, called the peen, is wedge shaped and the opposite end, called the butt, has a flat surface. Floor rammers are similar in construction but have long handles.



⑥ BELLOW

⑦ SWAB

⑧ VENT WIRE



⑨ DRAW SPIKE

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⑥ **Bellow** → Bellows are used to blow loose particles of sand from the pattern and the mould cavity. A hand blower is shown in fig. ⑥ moulding machines are also provided with a compressed air jet to perform this operation.

⑦ **SWAB** → A simple swab is a small brush having long hemp fibres a bulb swab has a rubber bulb to hold the water and a soft hair brush at the open end. Swabs are used for moistening the sand around a pattern or for applying paint.

⑧ **vent wire** → A vent wire is used to make a series of small holes to permit gases to escape while the molten metal is being poured.

⑨ **DRAW SPIKE** →

The draw spike is a pointed steel rod, with a loop at one end. it is used to rap and draw patterns from the sand. The draw spike is threaded on the end to engage metal patterns.

(10) STRIKE-OFF BAR

(11) SPRUE PIN

(12) SLICK

(10) **STRIKE-OFF BAR** → The strike-off bar is a piece of metal or wood with a straight edge. it is used to strickle or strike-off excess sand from the mould after ramming to provide a level surface.

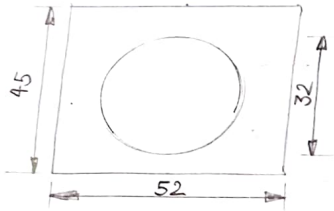
(11) **SPRUE PIN** → A sprue is a tapered peg pushed through the cope to the joint of the mould. As the peg is withdrawn it removes the sand, leaving an opening for the metal.

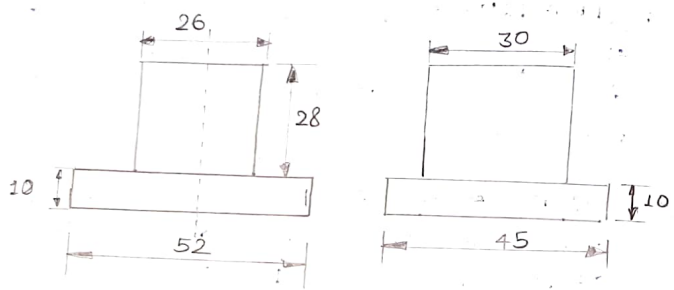
(12) **SLICK** → it is a small double-ended tool having a flat on one end. and a spoon on the other end. Slicks are used for repairing and finishing small surfaces of the mould.

All dimensions are in mm.

① Actual dimensions are given

② Pattern is made using Construction allowance.





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OBJECT → To prepare a mold of given split pattern

Metal required → Moulding sand, parting sand etc.

Tools and equipments requirements →

① Moulder's hand tool set
② Moulding Box
③ Bench rammer
④ Sprue & risers pin
⑤ Bellow
⑥ Shovel

Procedure for Casting →

Except the pattern is in two parts therefore:—

① When we fill the sand in join the 2nd part of pattern.

② withdraw the two parts of patterns from drag and cope separately.

PROCEDURE →

① Select a moulding box which can accomodate mold cavity and gatting system.

(a) Place the pattern on moulding bench, even surface of pattern should be in Contact with bench surface.

(b) In case of split pattern place half part of pattern on the moulding bench.

(2) Sprinkle parting sand over and around this pattern.
(3) Invert the drag and place it on the bench keeping the pattern in centre.
(4) Fill the drag with loose moulding sand.
(5) Ram the sand uniformly in moulding box all around the pattern.
(6) Fill the drag again of necessary and ram it.
(7) Strike off the excess sand over the flask height. This complete the operation for the drag.
(8) Sprinkle parting sand over the top of drag and roll over the drag.
(9) Using trowel given finish to the mould near edge of pattern.
(10) (a) In case of self core pattern some suitable nails in the core.
(b) in case of split pattern join other half part of pattern to the first half.
(11) Sprinkle parting sand on drag and pattern.
(12) Lace cope over the rammed drag.
(13) place sprue and riser pins at proper place at from suitable sized cavities for pouring metal.
(14) Fill the cope with moulding sand and ram it.
(15) Strike off the excess sand from top of cope.
(16) Remover the sprue and riser plants and vent the cope with a vent wire.
(17) Sprinkle parting sand over the top of cope surface.

18. All over the Cope on the bench.

19. Apply little moisture near the edges of pattern with a swab.

20. loose and remove the pattern from drag, using spike and rapping bar. repair the mold if necessary incase of split pattern remove other half of pattern from cope also

21. out the gates to connect to mold cavity with sprue hole and riser hole.

22. Allow the mold to dry in shade for a week. Blow out loose sand from mold cavity by bellow and clean and the mold.

23. Close the mold by investing the cope over the drag forming the mould assembly.

24. Keep the assembly on pouring floor, clamp cope with drag or place suitable weights on Cope. The mold is now ready for pouring metal.