B.E.

Fourth Semester Examination, May-2008

# Manufacturing Technology (ME-202-E)

**Note :** Attempt any five questions. All questions carry equal marks.

**Q. 1. (a) What is the function of additives in moulding sands ? Explain the effects of various additives used in moulding sand.** **12**

**Ans.** The main function of additives is that it is capable of adhering to the surfaces of other materials, it is entirely due to this property that the heavy sand mass is successfully held in a moulding flask and manipulated as desired without any danger of its falling down.

The effects of various additives used in moulding sand as given below :

Additives are those materials which are added to the moulding sand to improve upon some of its existing properties or to impart certain new properties to it. The commonly used additives are :

**(i) Cood dust :** It is mainly used in the sand used for grey iron and malleable ion castings. Its main purpose is to react chemically with the oxygen present in the sand pores and thus, produce a reducing atmosphere at mould-metal interface and prevent oxidation of the metal.

**(ii) Sea Coal :** It is a finely ground soft coal and is vastly used in sands used for grey and malleable iron castings, it restricts the mould wall movement and improves surface finish, it reduces permeability and hot strength of the mould and requires a higher % of water in the sand.

**(iii) Cereals or Cornflour :** It promotes mould wall movement by being volatized by heat, reduces expansion defects, improves strength, toughness and collapsibility of the sand and decreases permeability and flowability.

**(iv) Silica Flour :** It increases hot strength, decreases metal penetration into the mould, reduces expansion defects and improves surface finish, it may be added up to 35%.

**(v) Wood Flour :** It promotes mould wall movement, reduces expansion defects, increases collapsibility improves surface finish and thermal stability of the mould. It may be added from 0.5 to 2 percent or even more.

**(vi) Pitch :** It improves hot strength and surface finish an ferrous castings it an be advantageously added up to 2% .

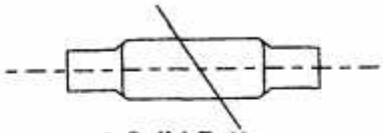
**(ix) Dextrin and Mollases :** Their addition increases the dry strength of the sand. In other respects they behave more or less like cornflour.

**(viii) Fuel Oil :** Its addition is sometimes done in order to reduce the requirement of free water in the sand.

**Q. 1. (b) How are the pattern classified ? Describe them with neat sketches and state the uses each of them.** **8**

**Ans.** The types of pattern to be used for a particular casting depends upon many facters like the bulk of casting, type of moulding process, number of casting required and the anticipated difficulty of moulding on account of the typical shape or design of casting. The following types of patterns are commonly used :

**(i) Solid or Single Piece Pattern :** A typical form of solid /single piece pattern as shown in figure is made in one piece and carries no joint, partition or loose pieces. Depending upon the shape it can be moulded in one or two boxes.



**A Solid Pattern**

**(ii) Two Piece or Split Pattern :** They are made in two parts which are joined at parting line by means of dowels, while moulding, one part of the pattern is contained by the drag and the other by the cope. Many times the design of casting offers difficulty in mould making and withdrawal of pattern, if a solid pattern is used for such casting, split or two piece patterns are employed.

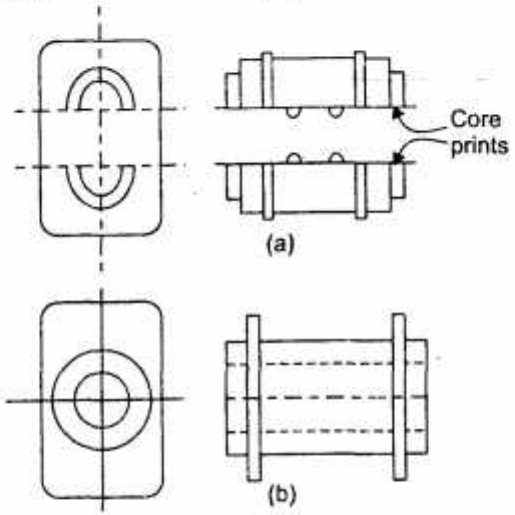
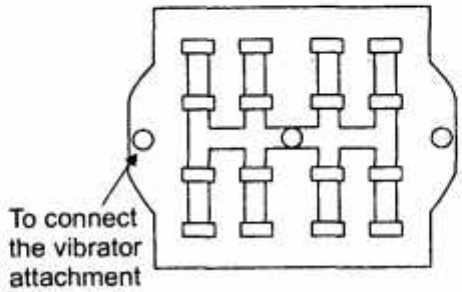


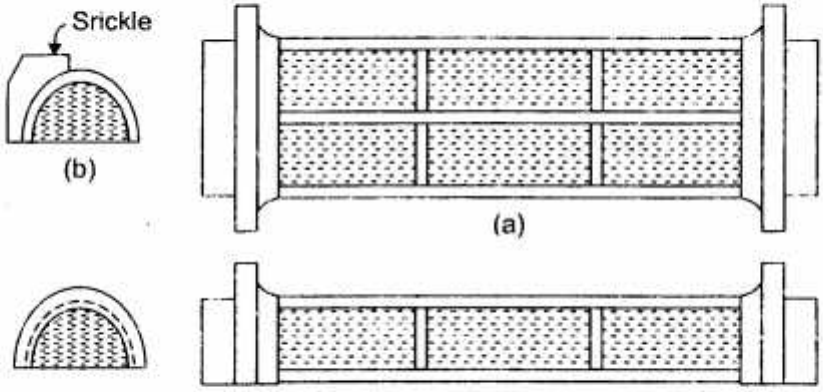

**Fig. A split pattern**
**(a) Two halves of pattern (b) Prepared casting**

**(iii) Match Plate Patterns :** Those patterns are used where a rapid production of small and accurate castings is desired on a large scale. These patterns are made in two pieces, one piece mounted on one side and other on the other side of the plate called match plate, the plate may carry only one pattern or a group of patterns mounted in the same way on its two sides. Gates and runners are also attached to the plate alongwith the pattern as shown in figure.




**Match Plate Patterns**

**(iv) Skeleton Pattern :** A pattern consisting of a wooden frame and strip is made called skeleton pattern. It is filled with loam sand and rammed It is used when the size of the casting is very large but easy to shape and only a few numbers are to be made, it is ineconomical to make a large solid pattern of that size. In such cases skeleton pattern is used.

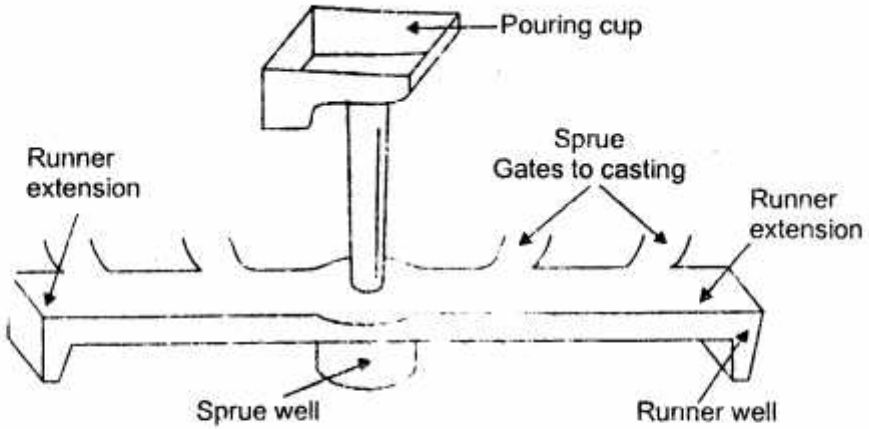



A skeleton pattern for a flanged pipe

**Q. 2. (a) What do you understand by the term gating system ? State the main requirements expected of an ideal gating. How a gate is designated ?** **12**

**Ans.** The passage way for bringing the molten metal from ladle to mould cavity is called gatting system. Gating system includes :

(i) Pouring Basin, (ii) Sprue (iii) Runner, (iv) Gate (v) Riser




Elements of Gating System

Molten metal is poured into pouring basin, the metal travels down through sprue, then along horizontal channels called runner and finally through gates reaches to mould cavity. Gating system is illustrated with the help of diagram as shown in above For idle gating system the main requirement are as follow :

(i) The metal should enter the mould cavity with a little turbulence.

(ii) The metal should enter the mould cavity at optimum flow rate.

(iii) Unwanted materials like sand particles, slag and dross should not be allowed to enter the mould cavity.

(iv) Molten metal flow through gating system should be properly controlled in such a way that absorption of gases and atmospheric air is prevented.

(v) The gating system chosen should be economical, easy to operate and removable after solidification.

The gates are designed depending upon the applications and specific requirements there are various types of gates they are :

**(i) Parting Gate :** Parting gate is most common gate used in sand casting, as name suggests metal enters the mould cavity at the parting plane separating cope and drag.

**(ii) Bottom Gate :** Bottom gates are used to overcome the difficulty of mould erosion in deep moulds. Here the metal enters of the mould cavity at the bottom of the mould.

**(iii) Top Gate :** In this case all metal enters the mould cavity from top of the mould cavity. Since the metal which enters first reaches at the bottom and hotter metal is at the top and a favourable temperature gradient is created, also the mould is filled very quickly.

**(iv) Step Gate :** The step gate ensures gradual filling of mould without mould erosion and produces good quality castings. Step gates are used for deep, heavy and large castings. The molten metal enters the mould cavity through a number of side gates.

**Q. 2. (b) State the methods of cleaning castings. What is ?** **8**

**(i) Snagging (ii) Pickling**

**Ans.** Cleaning of castings generally refers to all operations involved in the removal of adhering sand, gates, risers or other metal not a part of the casting for this there are various methods are used as follows :

**(a) Rough Cleaning :** It is that part of cleaning operations which includes removal of gates and risers and removing fins and unwanted projections on casting surfaces this process is also called as a fettling.

**(b) Surface Cleaning :**

**Tumbling :** The sand, scale and some fins and wires may removed by tumbling in a barrel-like machine called as tumbling mill.

**Blasting :** The blasting is the most rapid means of removing sand and scale. The abrasives employed are sand, metal grit and metal shot.

The other methods such as wire brushing, buffing, pickling and various polishing procedures may be used to aid in the surface cleaning.

Chipping and grinding processes is also used for removing the fins, gates and riser pad, wires etc.

**(i) Snagging :**The rough grinding or snagging of castings is used to remove excess metal. It may be done by portable grinders stand grinder and swing frame grinders. For snagging abrasive belt machines is also used from this can achieve a good rate of stock removal it consists of two metal rollers over which runs an endless abrasive belt.

**(ii) Pickling :** Pickling is a chemical cleaning in which dilute acids is used for removing sand from the surfaces and inaccessible pockets of the castings. Pickling involves immersing the casting in acid (Kept in acid proof tank) for quite long time then the casting is taken out and the acid on it is neutralised by dipping the casting in lime water the casting is finally rinsed in water.

**Q. 3. Describe the steps necessary for a product in impression die forging. What material is used to make forging dies and what physical properties they must possess ?** **20**

**Ans.** Important steps for a impression die forging to produces the particular complex shape product are as follow

(i) The first Performing step is blank is placed on the lower and as the upper die begins to descend, the blank's shape graduallly changas by forging forces.

(ii) The next perform processes is fullering in fullerming material is distributed away from an area and distribute the material into various regions of the blank much as they are in shaping dough to make pastry.

**(iii) Edging :** In this step material is gathered into a localized area and redistributes the metal.

**(iv) Blocking :** The part is then formed into the rough shape of a desired product by process called blocking, using blocker dies.

**(v) Finishing and Trimming Operations :** The final operation is the finishing of the forging in impression dies that give the forging its final shape, the flash is removed usually by a trimming operations.

Selection of proper die materials depends on such factors as the die size, the composition and the properties of the workpiece, the complexity of the shape, the forging temperature, the type of forging operation, the cost of the die materials, and the number of forging required.

The common die materials are tool and die steels containing chromium, nickel, molybdenum and vanadium. Dies are made from die blocks, which themselves are forged from castings and then machined and finished to the desired shape and surface finish.

The general physical properties for die materials are :

(i) Strength and toughers at elevated temperature.

(ii) Hardenability and ability to harden uniformly.

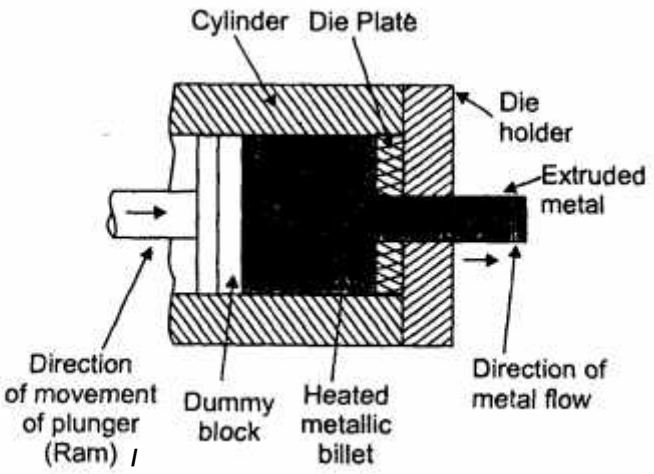
(iii) Resistance to mechanical and thermal shock and

(iv) Wear resistance, particularly resistance to abrasive wear because of the presence of scale in hot forging.

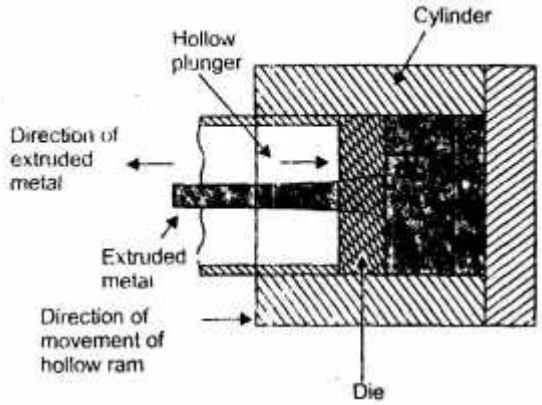
**4. (a) Explain briefly with neat sketches different processes of extrusion. Discuss their relative merits and demerits.** **10**

**Ans.** Extrusion is the process of confining the metal in closed cavity and then forcing it to flow from one opening (die) so that metal will take the shape of the opening the operation of extrusion is similar to the squeezing of tooth paste out of tooth paste tube. There are two types of extrusion processes i.e., (i) Forward (Direct) extrusion and (ii) Backward extrusion (Indirect) as shown in figure :

**Forward Extrusion** : In this case the flow of metal is in the direction of movement of ram or plunger.



**Backward Extrusion** : In the case A hollow plunger compresses the metal against container forcing, it to flow backward through the die in hollow plunger less force is required.




The limitations of the process in case backward extrusion are the weakening of ram because it is hollow and difficulty of providing proper support for the extruded metal and in case of forward extrusion the problem of friction is predominant because of relative motion between heated metallic billet and cylindrical walls to reduce friction lubrication are used but at high temperature the lubricants get compound.

**Advantages :**

(i) Extrusion is a single pass process unlike rolling.

(ii) Dies are easy to manufacture.

(iii) Variety of shapes of high strength, good accurary and surface finish can be obtained.

(iv) High production rate with relatively low die cost.

**Q. 4. (b) What are the forms steel goes when rolled into structural shapes?**

**Ans.** There are various shapes or forms steel goes when rolled into structural shapes are as follow :

**(i) Ingot :** It is raw material used in rolling. This is obtained by pouring molten into ingot mould having standard dimension.

**(ii) Slab :** The standard dimensions of slab are 50 to 150mm thickness and 600 to 1500 mm width.

**(iii) Bloom :** Blooms have square cross-section with minimum 150×150mm. Blooms are further rolled in structural shapes such as 'I' beam, rail road rail etc.

**(iv) Billet :** Billet have square cross-section and are small than bloom they can have any cross-section. They are further rolled into shapes such as rounds rods or bars.

**(v) Plate Sheets and Strips :** Plate, sheets and strips are obtained by further rolling the slab with flat rolls.

For rolling flat products, plain cylindrical rolls are used but to obtain different cross section (like 'I' section 'T' section. or ('[') channel section and 'L' section etc.)

**Q. 5. (a) How do you compare ac & dc for arc welding?** **7**

**Ans. Comparison Between A.C. & D.C. Arc Welding :**

| | A.C. Arc welding | D.Cc Arc welding |
|---|---|---|
| (i) | An AC arc welding transformer is cheaper and simpler in operation | A DC generator set is costlier and more cumbersome in operation. |
| (ii) | It is less suitable for use at low current with small dia. electrodes. | It is better suited for use at low amperages with small dia electrodes. |
| (iii) | Bare electrodes cannot be used in AC only specifically designed coated electrodes with coverings containing stabilizers can be used. | Both bare and coated electrodes can be used. |
| (vi) | It is generally not preferred for welding of sheet metal due to difficulty in starting the arc. | It is more preferred because starting of arc is easier and the arc remains steady. |
| (v) | Different fixed polarities are not available. Hence it is not suitable for welding all metals, particularly non-ferrous ones. | Distinct fixed polarities can be used for welding almost all metals and different thickness. |

**Q. 5. (b) What are the advantages of each of the several sources of current for arc welding? 7**

**Ans.** In electric arc welding the sources of current may be alternating current or direct current. The advantages are as follow :

(i) In A.C. arc welding can be used only when AC mains supply is available but in D.C. arc welding an engine driven D.C. generator set can be used even in absence of A.C. mains supply.

(ii) In A.C. arc welding there is hardly any problem of arc blow and maintenance of an A.C. transformer is easier and more economical since it has no moving parts.

(iii) In D.C. arc welding maintenance of short arc is easier, starting of arc is easier and the arc remains steady. Distinct fixed polarities can be used for welding almost all metals and different thicknesses.

(iv) In A.C. welding the metal can be welded at very large distances from the power supply, because voltage drop in long leads is much less and it can be used for welding positions.

**Q. 5. (c) What do you understand by the term polarity and what is the advantage/disadvantage of having different polarities ? 6**

**Ans.** These is no fixed polarity at the terminals when using A.C. and they interchange in every cycle. Polarity is a very significant factor in all D.C. welding works. This polarity can be of two types :

**(i) Straight Polarity :** In this, the electrode forms the negative terminal and the workpiece positive.

**(ii) Reverse Polarity :** In this, the electrode forms the positive terminal and the workpiece negative.

These two polarities are known as electrode negative and electrode positive respectively.

**Advantages/Disadvantage of the Different Polarities :**

(i) For thinner materials reverse polarity is used and thicker materials straight polarity is used because straight polarity gives move heat as compared to reverse polarity.

(ii) The penetration obtained in straight polarity is large. In reverse polarity penetration is small.

(iii) By using these polarities almost all the metals can be welded by using D.C. as many metals require more heat to acquire the fusion state than the electrode used, for example, copper, and it is possible only through different polarities to have more heat on the job and less on the electrode.

**Q. 6. Describe and explain : 20**

**(i) hard facing**

**(ii) brazing**

**(iii) soldering, stating the principal difference between them. Also state their specific applications.**

**Ans. Hard Facing/Hard Soldering :** A method of joining metals, particularly when they are in the form of sheet. By using another metal or alloy which has a fairly low melting point as compared to the metals to be joined. The metal or alloy used for this purpose is called as a solder. A soft solder is primarily an alloy of lead and tin, and hard solder is an alloy of copper and zinc to which silver is also added sometimes. German silver, used as a hard solder for steel, is an alloy of copper, zinc and nickel. The hard solder metls above 600°C. The operations performed by using hard solder is called as hard soldering.

**(ii) Brazing :** It is the process through which metal pieces are joined by means of a hard solder. Brass is usually the main constituent of this solder. the brazing solder used in modern practice. In brazing the joint is obtained by means of filler material whose melting point 450°C and less than the melting temperature of base metal. The filler metals from brazing can join dissimilar metals which are insoluble in each other. Brazing is used for joining electrical parts, joining carbide tips to tools, heat exchangers, radiators etc.

**(iii)**

| | **Soldering** | **Brazing** |
|---|---|---|
| (i) | In soldering joint is obtained by means of filler material whose melting point is less than 450°C and less than the melting point of base metal. | In brazing the joint is obtained by means of filler material whose melting point is above the 450°C and less than the melting temperature of base metal. |
| (ii) | The filler metal is essentially used because joint is made by filler material only, filler metals are alloys of lead and tin. | The filler metal are alloy of copper (e.g., copper zinc and copper silver alloys). |
| (iii) | The soldered joints are weakest among the soldering, welding and brazing. | The brazed joints are stranger than soldered joint but weaker than welded joints. |
| | **Applications :** Soldering is widely used in joining small assemblies, electric and electronics parts. | **Applications :** Brazing is used for joining electrical parts, joining carbide tips tools, heat exchangers, radiators etc. |

**Q. 7. (a) What is the principle of thermit welding ? What can it do better than other processes ?**

**Ans.** The thermit welding consists of a cone shaped vessel carrying fire brick lining inside. A mixture of powdered aluminium and iron oxide is placed inside the vessel. This mixture is ignited by heating to about 1550°C and chemical action takes place due to which aluminium is converted into aluminium oxide and iron is melted the reaction is :

$$8Al + 3Fe_3O_4 \rightarrow 9Fe + 4Al_2O_3 + Heat$$

Usually barium peroxide powder is used for igniting the thermit mixture. Due to the chemical action, a bright white heat is produced inside and the iron melted. The molten iron is tapped from the vessel and made to run in the cavity of the joint.

Thermit welding is a very useful method and is particularly adopted where neither electrical power nor the supply of gases is available. The complete unit is a very compact and is of portable type. The process of thermit welding is very quick and economical. It does not require very expensive apparatus and it is reckoned that the welds produced by this process are stronger than those produced by electric welding.

**Q. 7. (b) What is Ultrasonic welding ?** **5**

**Ans. Ultrasonic Weldng :** Ultrasonic welding is a solid state welding processes where in coalesence is produced by the local application of high frequency vibratory energy to the workpiece as they are held together under pressure.

Actually, the workpieces are clamped together under a modest static force normal to thier interface and oscillating shear stresses of ultrasonic frequencies are applied approximately parallel to the plane of interface for about one second but usually less. The bonding of the workpiece is not dependent upon melting of their surfaces, nor does it involve high pressures and large deformations. Rather, the bonding is accomplished in the solid state, without applying external heat, filler rod or high pressures.

**Q. 7. (c) What is electron beam welding ?** **5**

**Ans. Electron Beam Welding :** Electron beam welding is defined as a fusion welding process where in coalescence is produced by the heat obtained from a concentrated beam composed primarily of high velocity electrons.

As the high velocity electrons strike the surfaces to be joined, their kinetic energy changes to thermal energy thereby causing the workpiece metal to melt and fuse.

Electron beam welding is not used to weld titanium, tungsten molybdenum : Stainless steel, aluminium and many of more refractory metal.

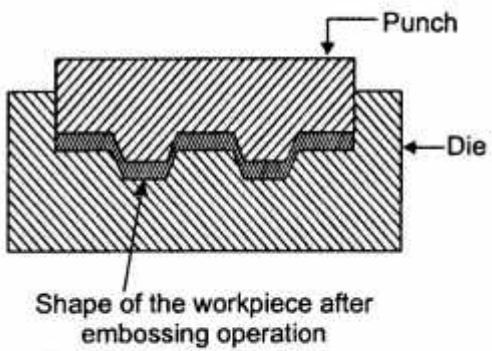
**Q. 8. Write short notes on following :** **20**

**(i) Embossing & Coining**

**(ii) Electro slag welding**

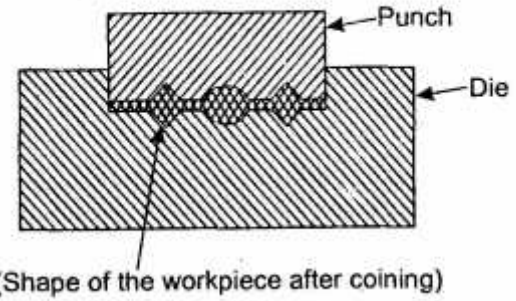
**(iii) Continuous casting**

**Ans. (i) Emobssing :** In which projected or raised figures are made on sheet metals with corresponding relief on the other side. There may be the negligible change in the thickness of the metal.




Embossing is used for providing rigidity to sheet metals and for decorative sheet work used in houses and other religious places.

**Coining :** Coining is basically cold forging operation. The process is used to produce coins, meals and similar products where exact size and fine details are required. The coining die consists of punch and die which are engraved with necessary details required on the both sides of final product.




**(ii) Electro Slag Welding :** It is initiated by starting an arc between the filler metal/electrode and the work, this arc heats the flux and melts it to form the slag, the arc is then extinguished and the (conductive) slag is maintained in molten condition by its resistance to the flow of electric current between the electrode and the work. Molten slag remains between the electrode and the work. The molten pool remains shielded by the molten slag which moves along the full cross-section of the joint as the welding progresses.

Plates of 25 mm or more can be joined without costly multiple posses and without special joint preparations.

**Continuous Costing :** Continuous costing is accomplished by pouring molten metal into (one end of) a metal mold open at both ends and by keeping it filled at all times. The metal at the lower end of the mould is cooled so that it solidifies and solid product thus formed is extracted in a continuous length from the lower end.

Round ingots, slabs, square billets and sheets can be cast by a continuous processes directly from molten metal.