

# CASTING (FOUNDRY)



# What is casting process ?

- **Casting** is also known as foundering and it is one of the oldest manufacturing process
- **Casting** is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting product, which is ejected or broken out of the mold to complete the process
- All casting used a mould ,either permanent or temporary, which is a negative of the desired shape. Once the metal is poured and solidifies ,it forms the positive shape of the desired product.
- Successful casting operation needs a knowledge in the following areas
  - (i) Preparation of moulds and patterns.
  - (ii) Melting of metal and pouring of the melted metal.
  - (iii) Solidification and further cooling to room temperature.
  - (iv) Defects and inspection.

## Advantages of casting process

- **complex shape** can be easily produced.
- Practically **mostly material can be casted**.
- **Any size** of casting can be **produced up to 200 tons**.
- Casting is the **often cheapest** and most direct way of producing a shape with certain desired mechanical properties.
- Certain metals and alloys cannot be worked mechanically and can be cast only.
- The casting process is used to produce components such as pistons, mill rolls, wheels, cylinder blocks, liners, machine tool beds.

## Limitations of casting process

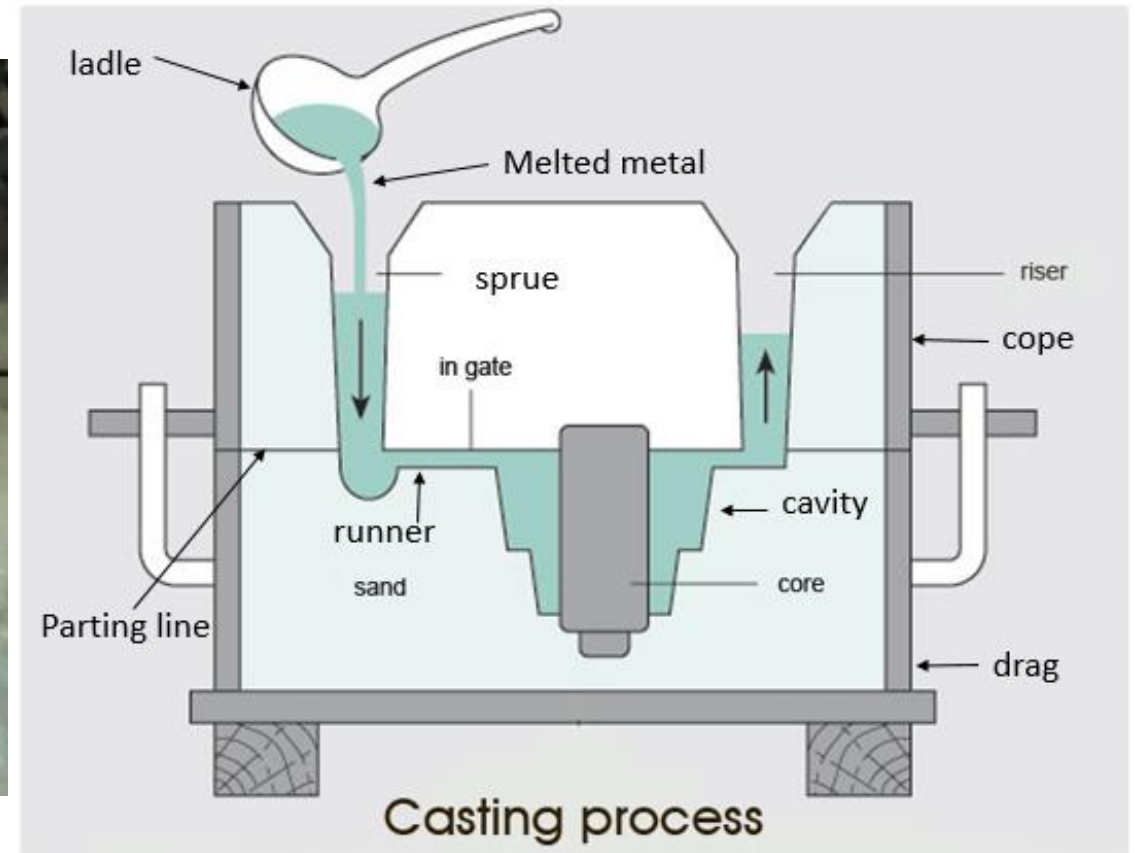
- With normal sand casting process, **the dimensional accuracies and surface finish is less**.
- **Defects are unavoidable**.
- **Sand casting is labour intensive**.

## Terms associated with casting :

- (a) Flask :** (i) A moulding flask is one which holds the sand mould.  
(ii) A flask has only sides and no top or bottom .  
(iii) The shape of a flask may be square ,rectangular, round or any convenient shape.



Flask



**(b) Pouring basin :** A small funnel shaped cavity at top of the mould into which the molten metal is poured.

**(c) Sprue:** The passage through which the molten metal from the pouring basing reaches the mould cavity.  
in many cases it control the flow of metal into the mould.

**(d) Runner :** The passage ways in the parting plane through which molten metal flow is regulated before they reach the mould cavity.

**(e) Gate:** The actual entry point through which molten metal enters the mould cavity.

**(f) Riser:** It is a reservoir of molten metal in the casting so that hot metal can flow back into the mould cavity when there is a reduction in volume of metal due to solidification.

**(g) Core:** It is used for making hollow cavities in casting.

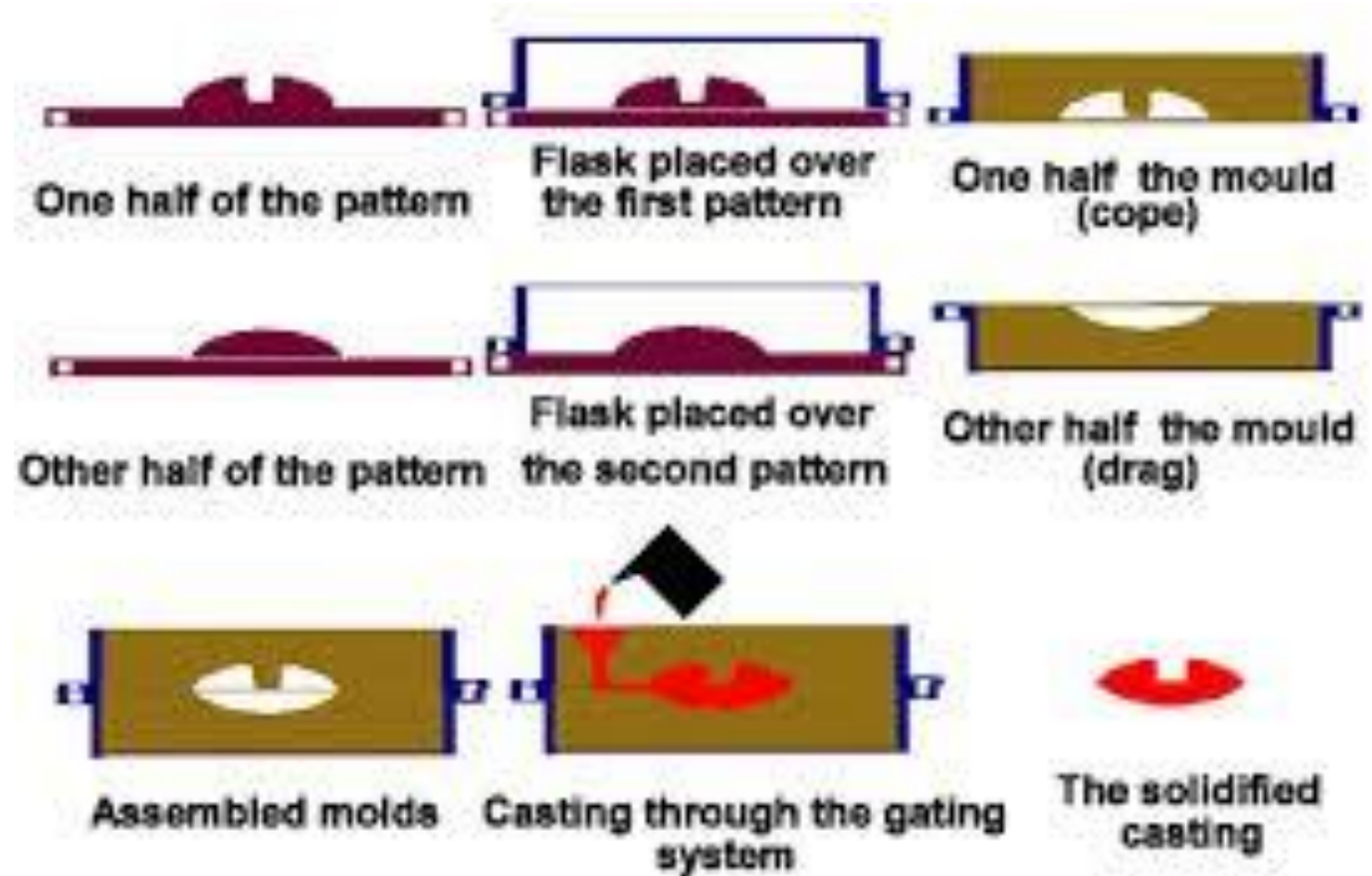
**(h) Chaplet :** chaplet are used to support cores inside the mould cavity to take care of its own weight.



# Sand casting:

- Traditional method of casting is sand casting. Sand casting is used to make large parts of different metals and alloys such as iron ,bronze , brass , aluminium etc.
- there are six basic steps in making sand casting which are given below.

- Pattern making
- Core making
- Moulding
- Melting and pouring
- Cooling and solidification
- cleaning



# Pattern materials

- **Pattern is a replica of the object** to be cast used to prepare the cavity into which molten material will be poured during the casting process.
- Pattern used in sand casting may be made of wood , metal ,plastic or other materials.

The common type of pattern material are **wood ,metal , plastics, wax, plaster of paris.**

## (1) Wood

it is used for pattern making because of following advantages

- It is cheap and easily available
- Can be easily shaped
- Light in weight

However it has certain disadvantages

- Due to low resistance to sand abrasion ,it wear out quickly
- It is affected by moisture which results in splitting.
- Life is less



## (2) Metals:

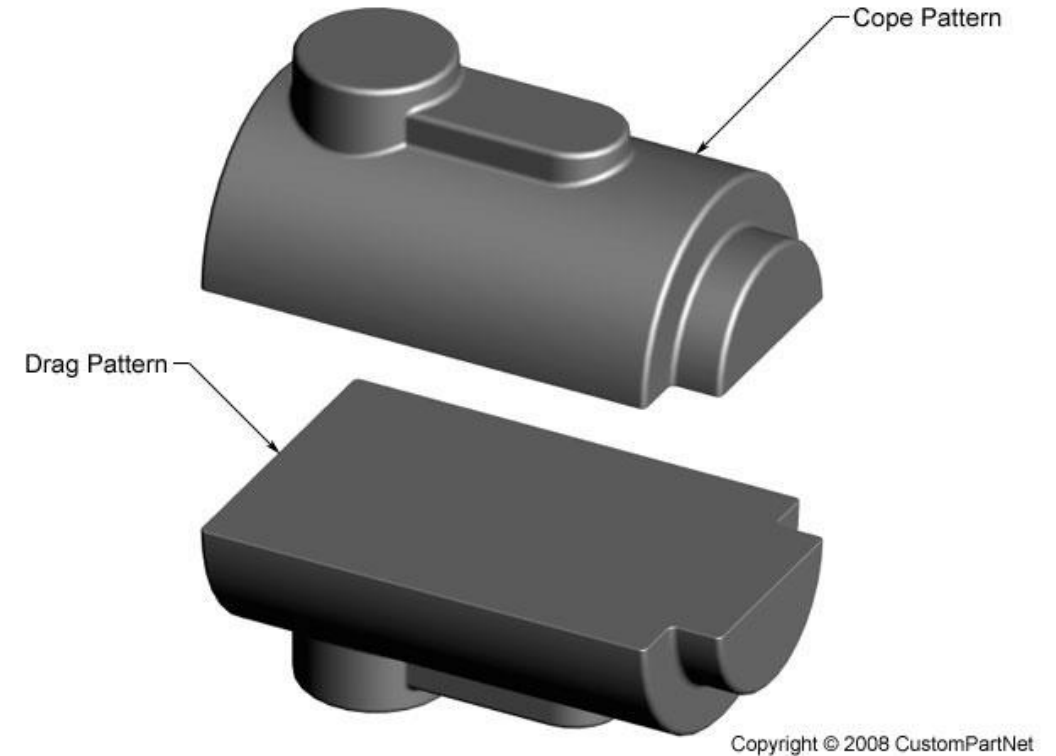
Though many materials such as cast iron ,brass etc are used as pattern materials but aluminium and white metal (tin, lead, zinc etc ) are the most commonly used .because of they are light in weight ,easily worked and corrosion resistant.

It is used because of following advantages

- They have much longer life than wooden pattern.
- Strong and durable
- Have good surface finish

But metal patterns have following disadvantages

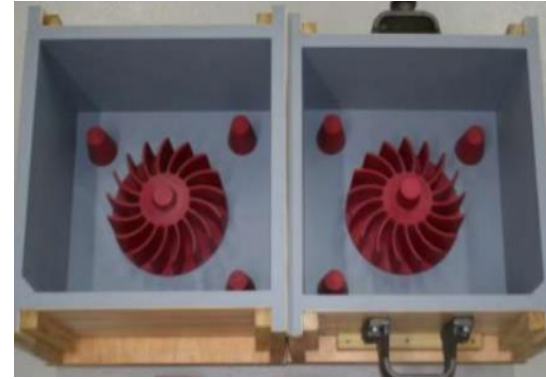
- Costly than wood
- Most of them are heavy in weight
- Have a tendency to get rusted.





### (3) Plastic

- It is used because of low weight high resistance to wear ,smooth surface ,durability and lower cost.
- The plastics used as pattern materials are **thermosets, phenolic plastic** have the desired properties of a pattern material.



### (4) Plaster of Paris

Gypsum cement known as plaster of Paris is used for making pattern material since it can be easily cast into complex shapes.

It has higher compressive strength. It is used making small patterns .



## (5) Wax

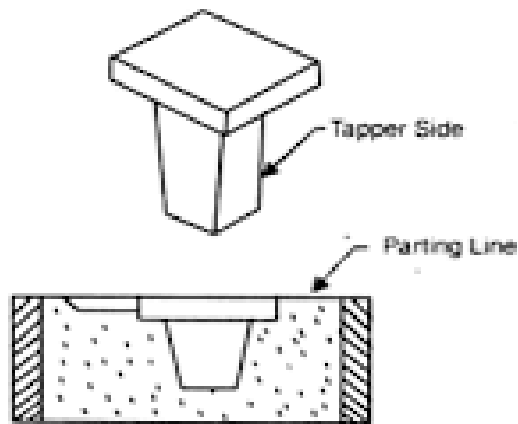
- Pattern made from wax have high degree of surface finish and close dimensional tolerances.
- After being moulded ,wax pattern is not taken out of the mould but the mould is inverted and heated to remove the wax in molten form.
- Commonly used wax are paraffin wax , bees wax , shellac wax etc.



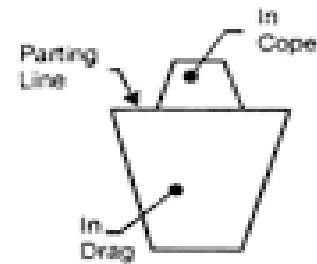
## TYPES OF PATTERNS

### (1) Solid or single piece pattern

- A solid pattern is made in one piece without any joints.
- They are generally used for simpler shapes and low quantity production.
- Solid pattern are generally made of wood and are inexpensive materials.



(a) Solid piece pattern.

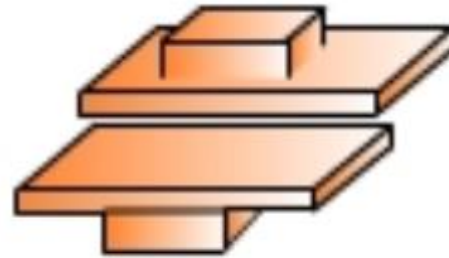


(b) Solid pattern in cope and drag.

Fig. 3.1. Solid or single piece pattern.

## (2) Split pattern

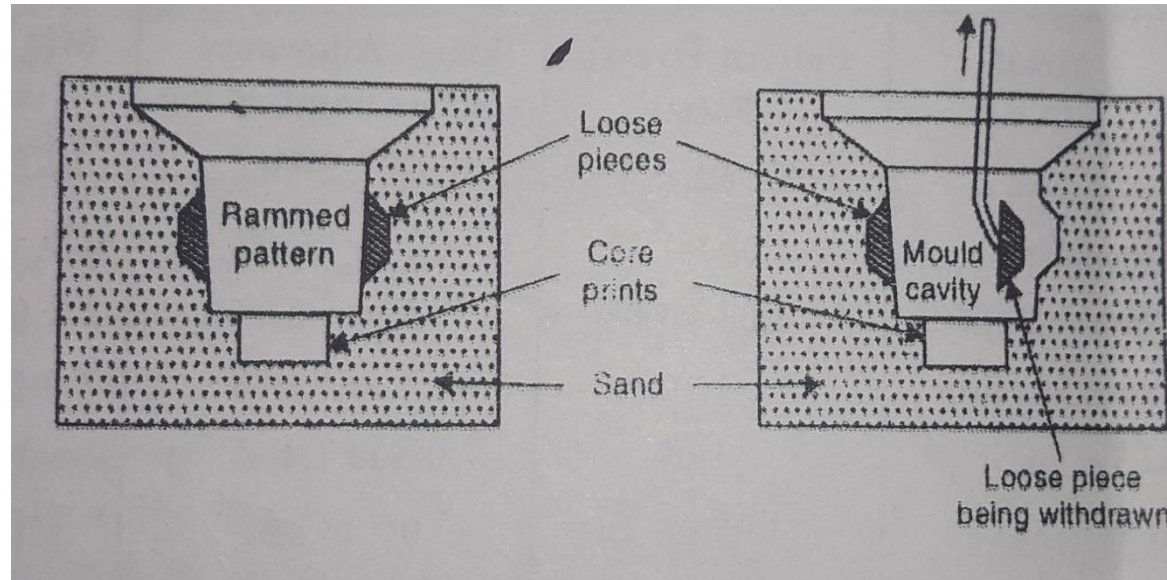
All pattern cannot be made of a single piece because of the difficulty in moulding .To eliminate the difficulty the patterns are made split, half rests in lower part of the mould and half in upper part.



Split pattern

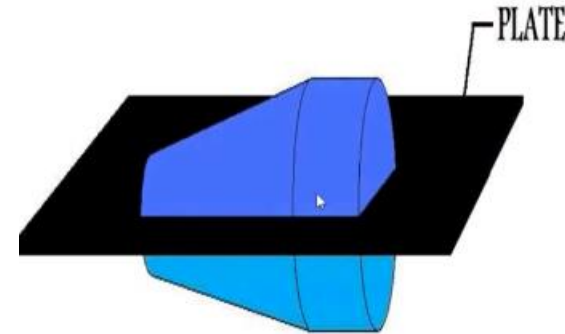
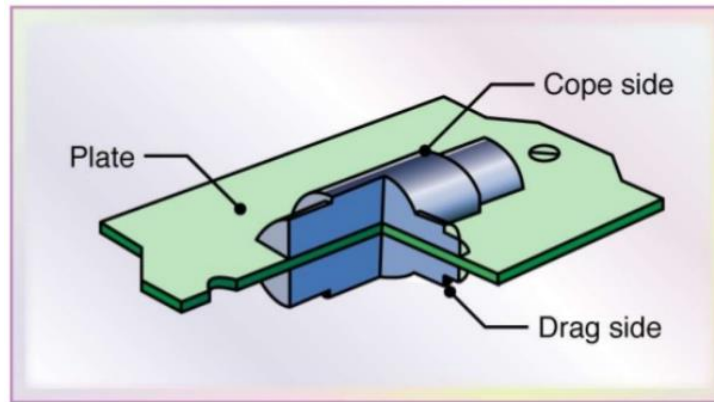
## (3) Loose piece pattern

It consists of loose pieces, which are necessary to facilitate withdrawing it from the mould.



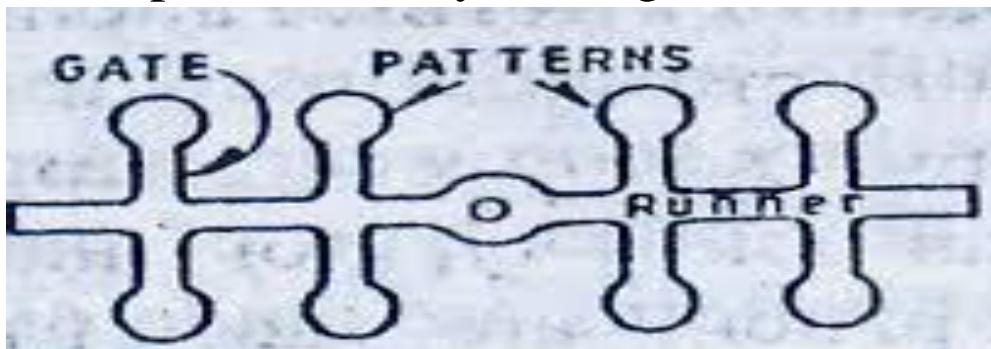
#### (4) Match plates pattern

- Patterns are made in two pieces one piece mounted on one side and the other on other side of plate called match plate.
- Plate may carry one or group of patterns mounted on match plate.



#### (5) Gated pattern

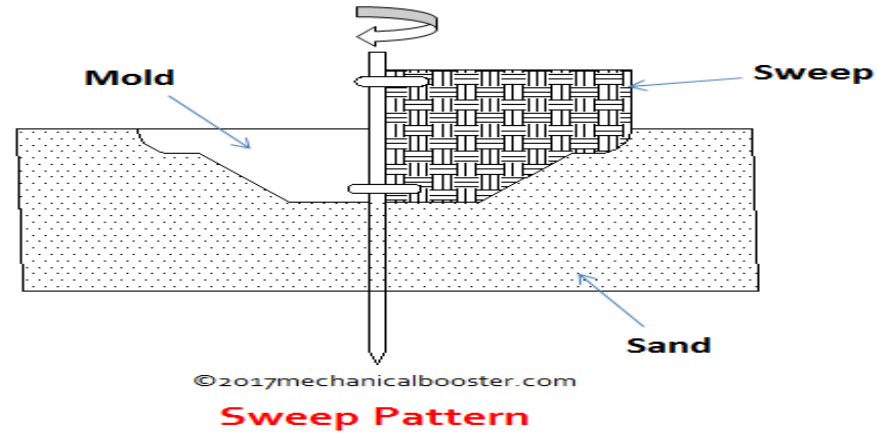
- In this the pattern are usually made of metals.
- In this **multi-cavity** moulds are produced & the sections connecting different pattern serves as gate and runner. This facilitates filling the mold in better manner.
- Can produce many castings at one time and hence saves time as well as cost.



## (6) Sweep pattern

These are used where the shape to be moulded can be formed by the rotation of a curved line element about an axis.

This type of casting is generally suitable for very large castings such as **bells of temples**, **cone** etc. In this ,pattern will be swept inside the mould cavity by  $360^\circ$  By fixing one of its end.



## (7) Skeleton pattern

- Skeleton is made from **wooden strips** and is filled with sand and rammed. Extra sand is remove.
- Applicable for large castings and is very economical as less material costs.
- It is used for casting of **Large castings such as turbines, water pipes, L bends etc.**
- **Cores are required if necessary.**

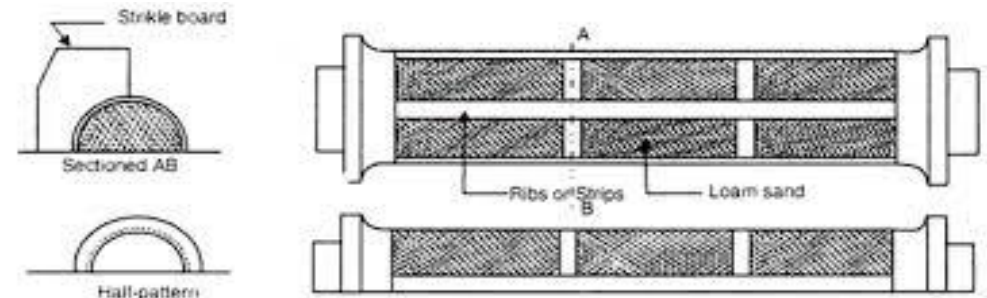
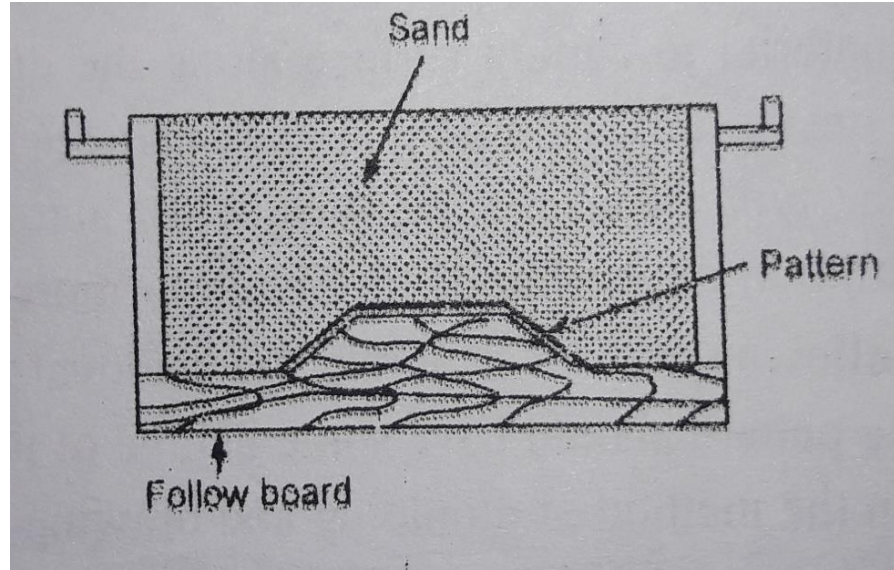


Fig. 3.7. Skeleton Pattern.



## (8) Follow board pattern

These are used for those casting where there are some portions which are structurally weak and if not supported properly are likely to break under the force of ramming. Thus bottom board is modified as a follow board to closely fit the contour of the weak pattern and provide support to it during ramming of the drag.



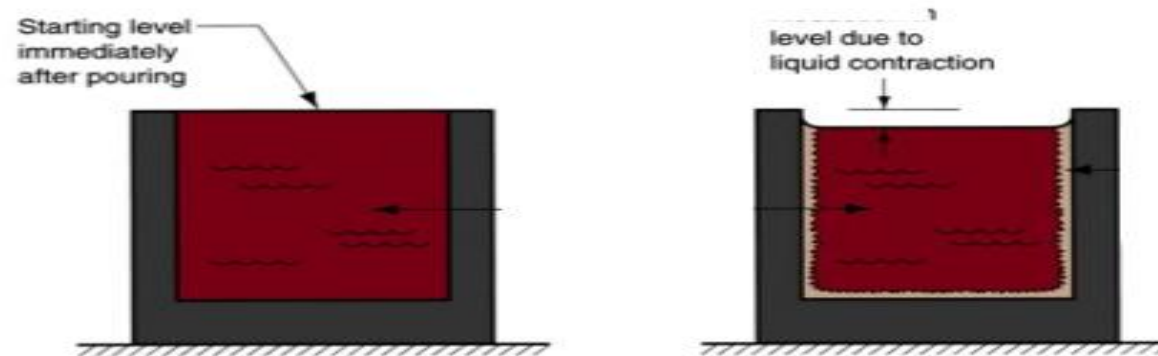


# Pattern allowances

- To compensate for any dimension and structural changes which will happen during the casting process, allowances are usually made in the pattern.
- Modification incorporated in pattern are allowance or pattern allowance
- Allowances are added to the pattern and mould cavity is larger than final Casting.
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## Types of Pattern Allowances

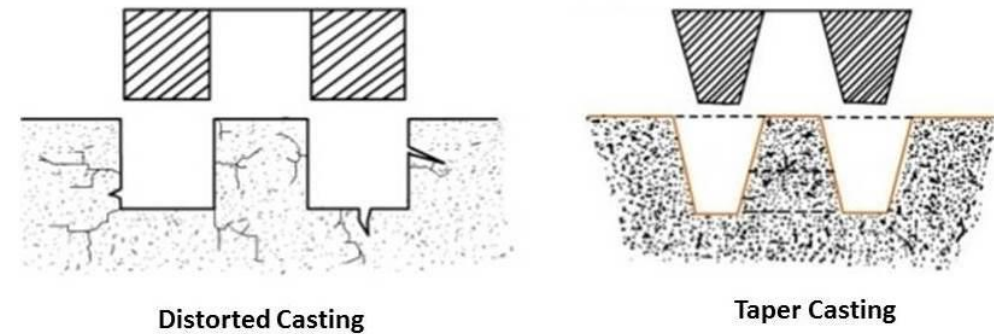
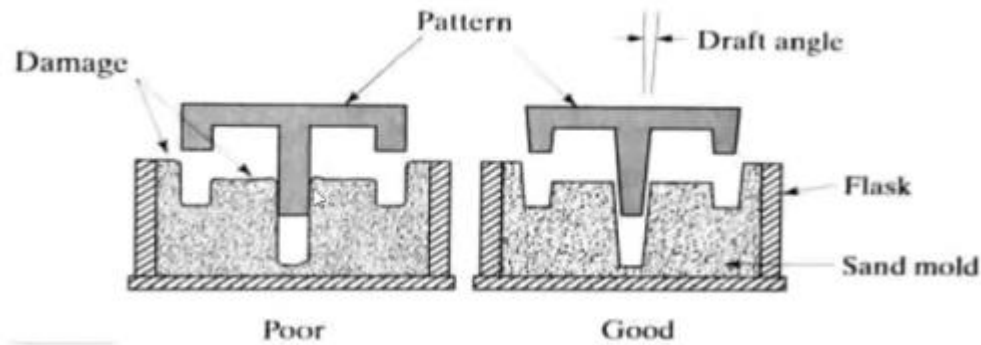
(1) **Shrinkage or contraction allowance:** To compensate the solid phase contraction of the casting ,the pattern dimensions are increased by certain amount depending on cast metal.



(2) **Draft or taper allowances:**

- Draft allowance is given so that the pattern can be easily removed from the molding material tightly packed around it with out damaging the mould cavity.

- To facilitate the removal of the pattern from the weak and brittle moulding sand, the pattern should have some degree of taper called draft



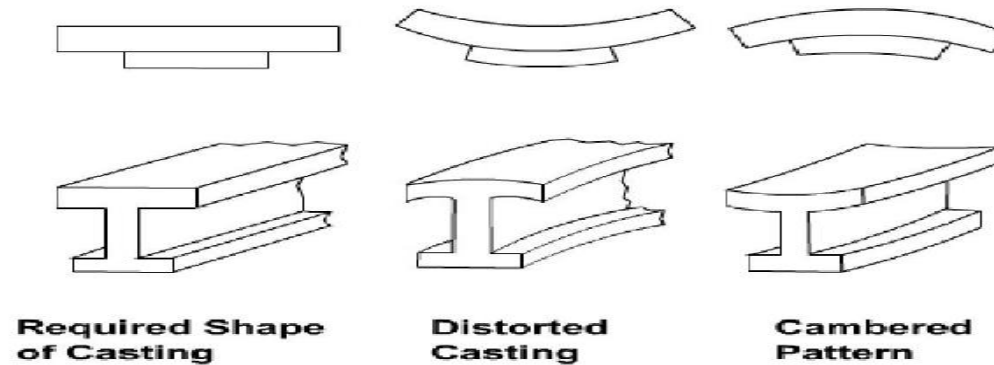
### Draft Allowance

**(3) Machining or finish allowance:** It is required because of following reason-

- Casting produces poor surface finish and tolerance so some margin is given to the pattern for machining part to produce after solidification.
- Castings get oxidized in the mold and during heat treatment; scales etc., thus formed need to be removed.
- It is the intended to remove surface roughness and other imperfections from the castings.
- It is required to achieve exact casting dimensions.
- Surface finish is required on the casting

#### (4) Distortion or chamber allowance

When casting of very thin surfaces like V Shape, U shape etc. it will **distort** or damage during pattern removal or during casting. To avoid this problem, a chamber is provided on pattern to compensate **distortion** during pattern removal.



#### (5) Shake allowance

- A patten is shaken or rapped by striking the pattern with a wooden piece from side to side. This is done so that the pattern a little is loosened in the mold cavity and can be easily removed.
- In turn, therefore ,rapping enlarges the mould cavity which results in a bigger sized casting.
- allowance is provided on the pattern i.e., the pattern dimensions are kept smaller in order to compensate the enlargement of mould cavity due to rapping.