

14

PATTERN MAKING

14.1 Introduction, 14.2 Pattern materials, 14.2.1 Wood, 14.2.2 Metals, 14.2.3 Plasters, 14.2.4 Plastic compounds, 14.2.5 Waxes, 14.3 Pattern making tools, 14.4 Machines used in pattern making, 14.5 Types of patterns, 14.5.1 Solid or single piece pattern, 14.5.2 Split pattern, 14.5.3 Multipiece pattern, 14.5.4 Match plate pattern, 14.5.5 Gated pattern, 14.5.6 Skeleton pattern, 14.5.7 Sweep pattern, 14.5.8 Pattern with loose pieces, 14.5.9 Cope and drag pattern, 14.5.10 Follow board pattern, 14.5.11 Segmental pattern, 14.6 Pattern allowances, 14.6.1 Shrinkage or contraction allowance, 14.6.2 Machining or finish allowance, 14.6.3 Draft or taper allowance, 14.6.4 Distortion or camber allowance, 14.6.5 Shake or rapping allowance, 14.6.6 Mould wall movement allowance, 14.7 Core prints, 14.8 Core boxes, 14.9 Difference between pattern and casting, 14.10 Colour coding for patterns and core boxes, 14.11 Functions of a pattern.

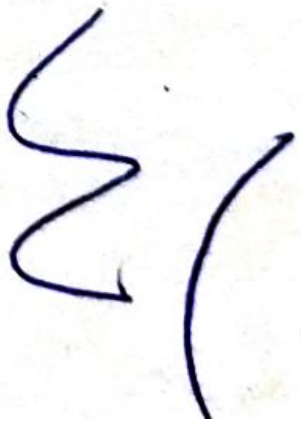
14.1 INTRODUCTION

A pattern may be defined as a model of the desired product (called casting), constructed in such a way that it can be used for forming an impression called mould (cavity) in damp sand. When this mould (cavity) is filled with molten metal, it solidifies and produces a casting (desired product). So the pattern is the replica of the casting.

14.5 TYPES OF PATTERNS

The following types of patterns are commonly used :

- ❖ Solid or single piece pattern
- ❖ Split (Two piece) pattern
- ❖ Multipiece pattern
- ❖ Match plate pattern
- ❖ Gated pattern
- ❖ Skeleton pattern
- ❖ Sweep pattern
- ❖ Pattern with loose pieces
- ❖ Cope and drag pattern
- ❖ Follow board pattern
- ❖ Segmental pattern



14.5.1 Solid or Single Piece Pattern

- ❖ Patterns made without joints, partings or any loose pieces in its construction is called a single piece or solid pattern.
- ❖ This pattern is not attached to a frame or plate so it is also called loose pattern.
- ❖ These are cheaper.
- ❖ Moulder has to cut his own runners, gates and risers so moulding operation takes more time.
- ❖ These are generally used for the large casting of the simple shape.
- ❖ A few example of castings which are made by making solid patterns are soil tamper, stuffing box and gland of steam engines.

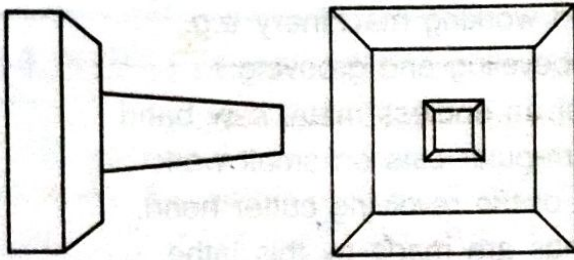


Fig. 14.1. Solid Pattern.

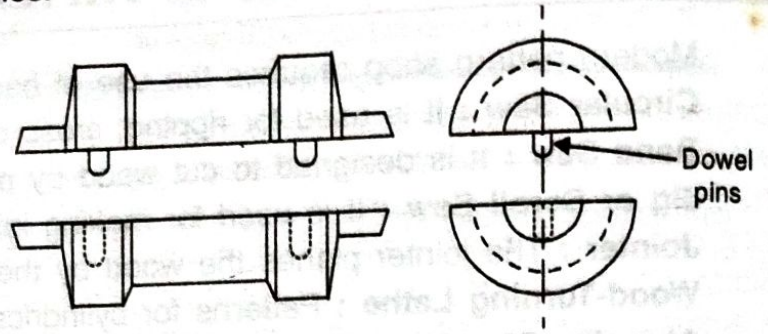


Fig. 14.2. Split Pattern.

14.5.2 Split (Two Piece) Pattern

Sometimes patterns cannot be made in single piece because of the difficulties encountered in moulding or difficulty in withdrawal from the mould. Because of these, patterns are usually made in two pieces called split patterns.

One part will produce the lower half of the mould and the other part will produce the upper half of the mould. These two pieces are held in their proper relative position by means of dowel-pins fastened in one piece and fitting holes bored in the other. The surface which is formed at the line of separation of the two parts, usually at the centre-line of the pattern is called as parting surface or parting line.

Spindles, cylinders, steam valve bodies, water stop cocks and taps are few examples of split patterns.

14.5.3 Multipiece Pattern

Sometimes the patterns are made in more than two parts if the shape is complex. Then these patterns are called multipiece pattern which may consist of 3, 4 or more number of parts depending upon their design.

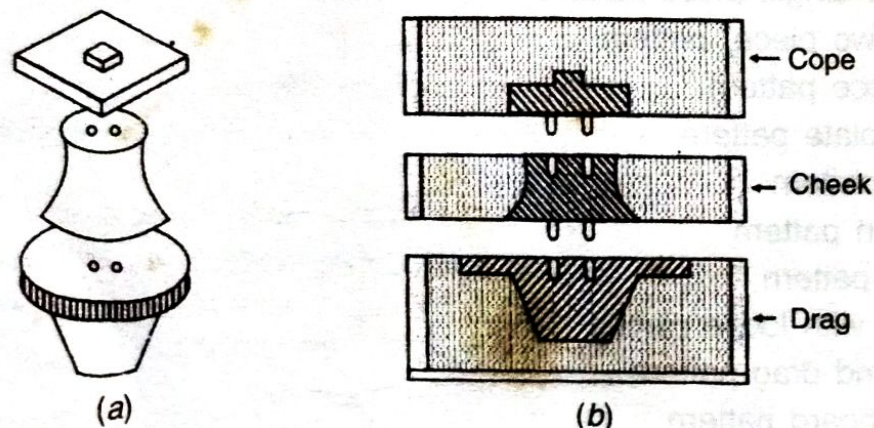


Fig. 14.3. Multipiece Pattern

14.5.4 Match Plate Pattern

When split patterns are mounted with one half on one side of a plate (Match plate) and the other half directly opposite to the other side of the plate, the pattern is called a match plate pattern.

These patterns find a great favour in :

- ❖ Machine moulding.
- ❖ Mass production.
- ❖ Greater dimensional accuracy.
- ❖ Minimum machining requirement.

Because of the above reasons, the high cost of the match plate patterns is justified. A single pattern or a number of patterns may be mounted on a match plate. The match plate may be of wood, steel, magnesium or aluminium. Gates and runners are also attached to the plate along with the pattern. So when the match plate is lifted off the mould, patterns are also withdrawn. The gates and runners are also completed in one operation because patterns for runner and gates are also attached with the match plate along with the patterns of the desired castings. So lot of manual work is reduced.

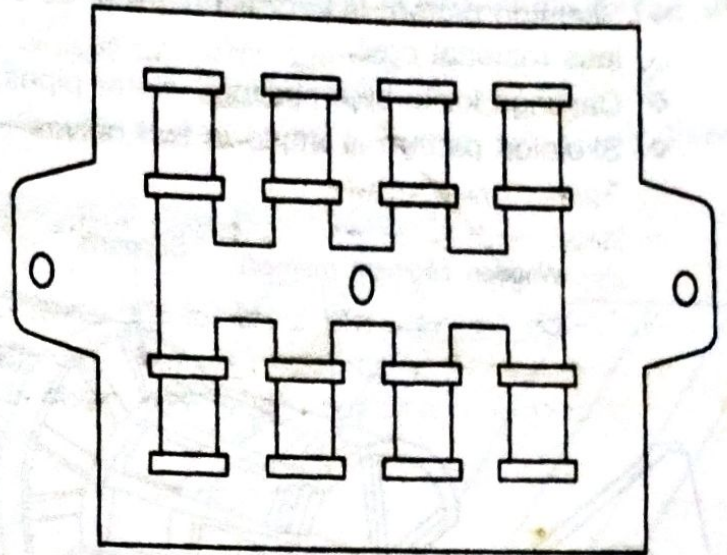


Fig. 14.4. Match Plate Pattern.

14.5.5 Gated Pattern

To produce good casting, it is necessary to ensure that full supply of molten metal flows into every part of the mould. Provision for easy passage of the flowing metal in the mould is called gating and is provided in the gated patterns.

In gated patterns, a single sand mould carries a number of cavities. Patterns for these cavities are connected to each other by means of gate formers which provide suitable channels (path) or gates in sand for feeding the molten metal to these cavities. A single runner can be used for feeding all the cavities. This enables a considerable saving in moulding time and a uniform feeding of molten metal. For small quantities, these patterns may be made of wood, but for large production metallic patterns are preferred.

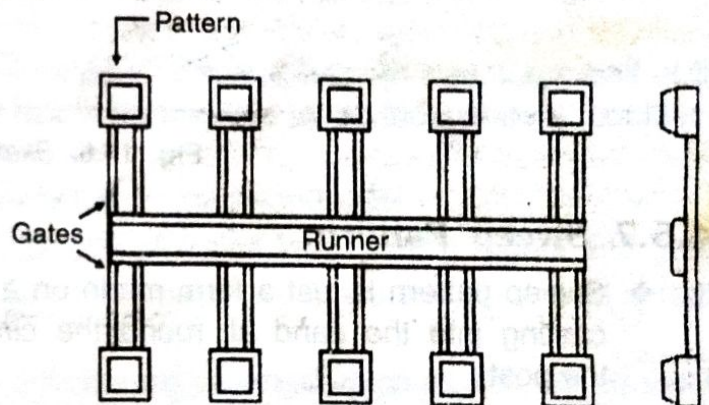


Fig. 14.5. Gated Pattern.

14.5.6 Skeleton Pattern

- ❖ Patterns for very large castings would require a large amount of pattern material. In such cases skeleton patterns are used.
- ❖ Skeleton patterns are hollow patterns and made up of a wooden frame and strips.
- ❖ The frame work is filled and rammed with loam sand and strickle board is used to remove the excess sand. Strickle board is having the same contour as desired so it can remove the extra sand by passing over the skeleton pattern.
- ❖ Cores, if necessary can be produced separately.

- ❖ Skeleton pattern is very economical as compared to a solid pattern, because it involves less material cost.
- ❖ Castings for turbine castings, water pipes, L-bends etc. are made with skeleton pattern.
- ❖ Skeleton pattern is made in two halves—one for cope and other for drag.

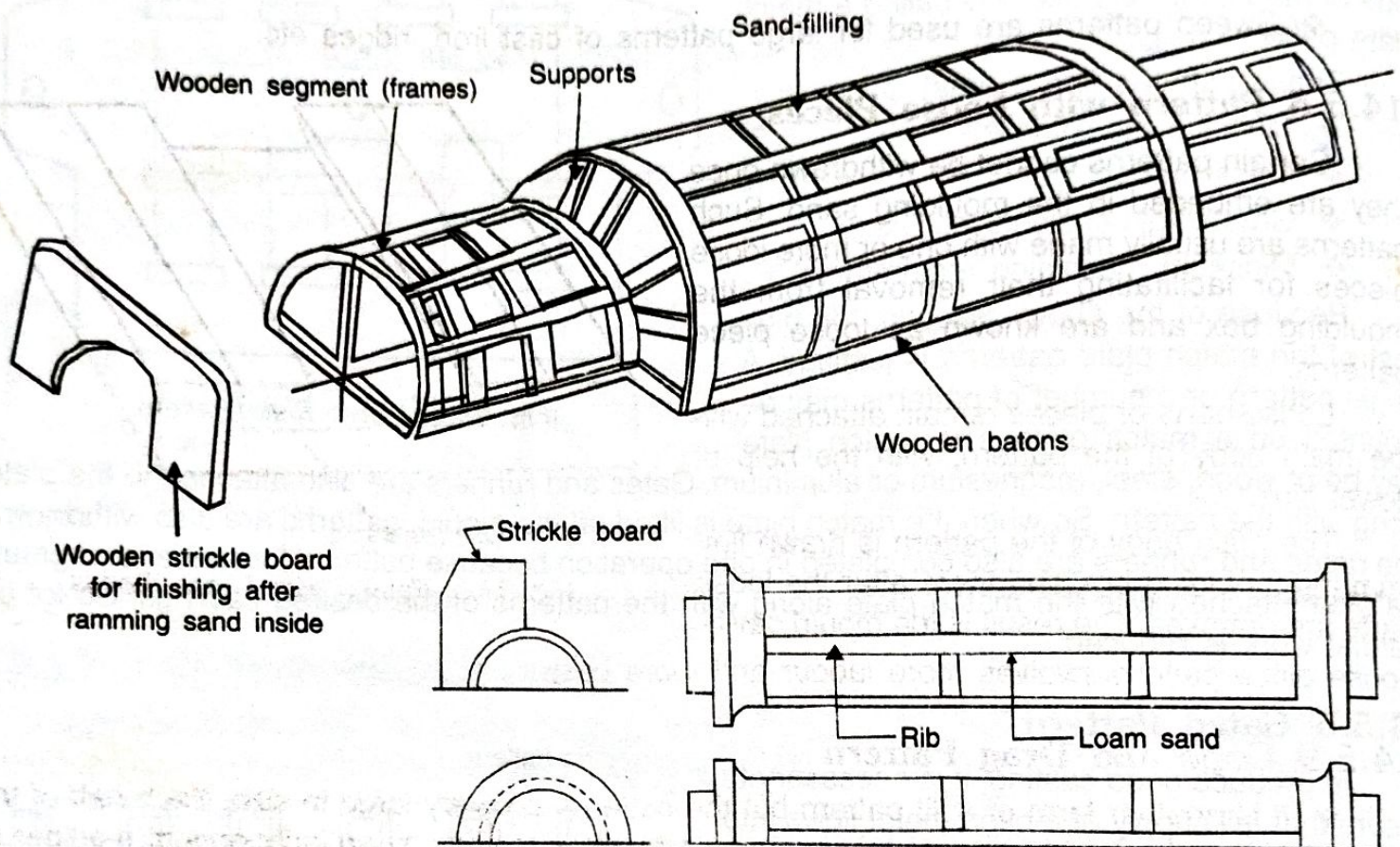
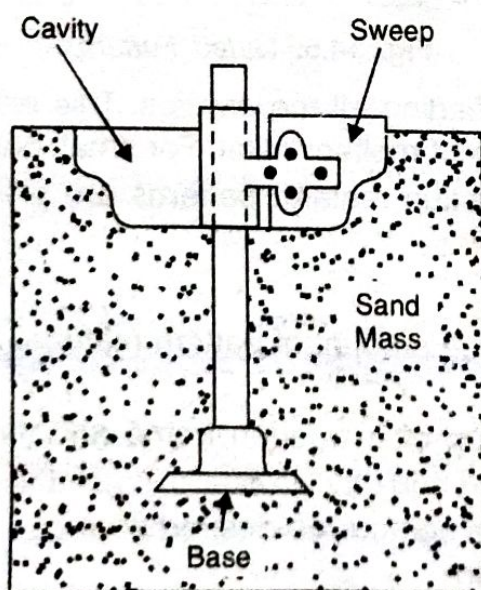


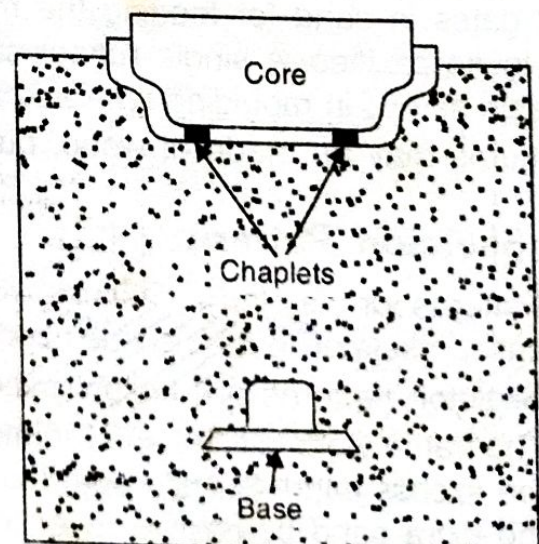
Fig. 14.6. Skeleton Pattern.

14.5.7 Sweep Pattern

- ❖ Sweep pattern is just a form made on a wooden board which sweeps the shape of the casting into the sand all round the circumference. The sweep pattern rotates about the post.



(a) A sweep pattern in action



(b) Mould ready with core in position

Fig. 14.7. Sweep Pattern.

- ❖ The moulds of large size and symmetrical in shape particularly of circular section can be easily prepared by using a sweep instead of a full pattern.
- ❖ Once the mould is ready, sweep pattern and the post (spindle) can be removed.
- ❖ Sweep pattern avoids the necessity of making a full, large circular and costly three-dimensional pattern.
- ❖ Sweep patterns are used for large patterns of cast iron, ridges etc.

14.5.8 Pattern with Loose Pieces

Certain patterns cannot be withdrawn once they are embedded in the moulding sand. Such patterns are usually made with one or more loose pieces for facilitating their removal from the moulding box and are known as loose piece patterns.

Loose parts or pieces remain attached with the main body of the pattern, with the help of dowel pins.

The main body of the pattern is drawn first from the moulding box and there after the loose parts are removed. The result is the mould cavity.

Loose piece pattern involves more labour and more cost.

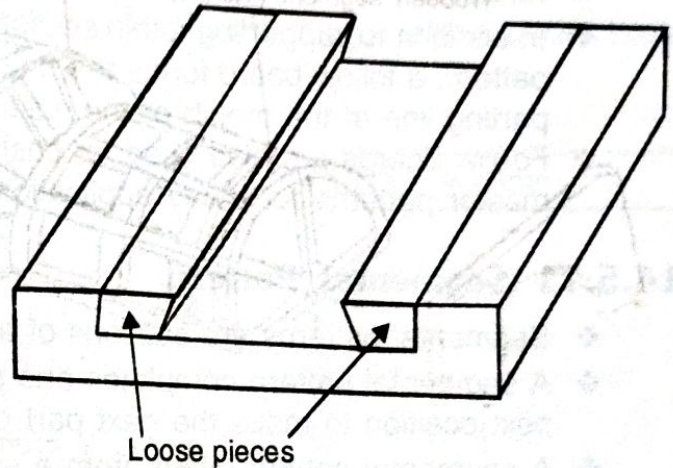


Fig. 14.8. Pattern with Loose Pieces.

14.5.9 Cope and Drag Pattern

- ❖ It is another form of split pattern but the patterns are very large in size. Each half of the pattern is moulded separately in a separate moulding box by an independent moulder or moulders.
- ❖ Each half of the pattern is fixed to a separate metal / wood plate.
- ❖ Each metal plate, besides the pattern, has the provision for moulding runner and gates.
- ❖ The two moulds of each half of the pattern are finally assembled and the mould is ready for pouring.
- ❖ Cope and drag patterns are used for producing big castings which as a whole cannot be conveniently handled by one moulder alone.

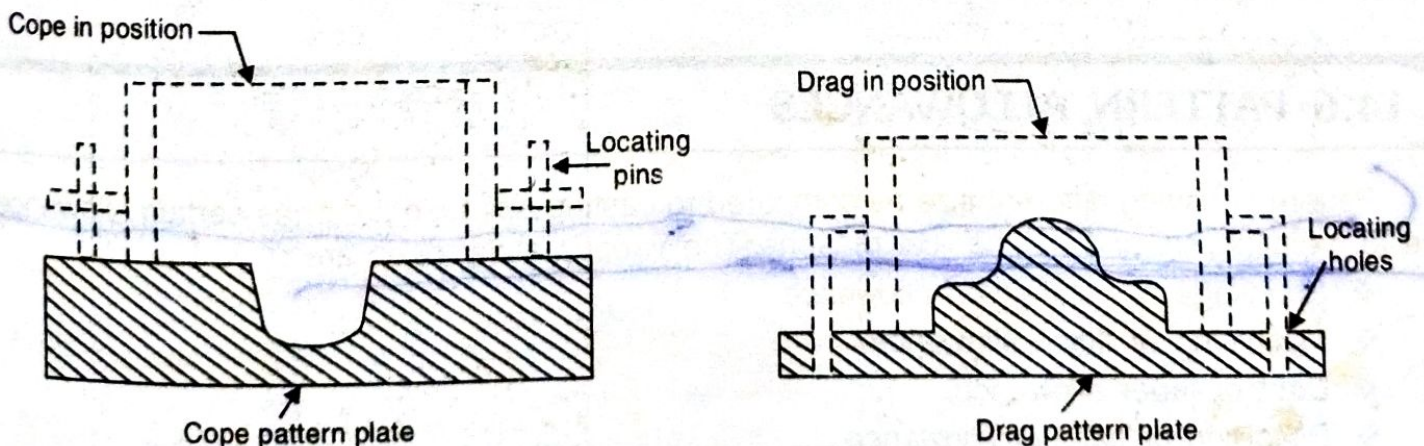


Fig. 14.9. Cope and Drag Pattern.

14.5.10 Follow Board Pattern

- ❖ A follow board is a wooden board and is used for supporting a pattern which is very thin and fragile and which may give away and collapse under the pressure when the sand above the pattern is being rammed.
- ❖ In addition to supporting a thin sectioned pattern, a follow board forms the natural parting line of the mould or the casting.
- ❖ Follow boards are also used for casting master patterns for many applications.

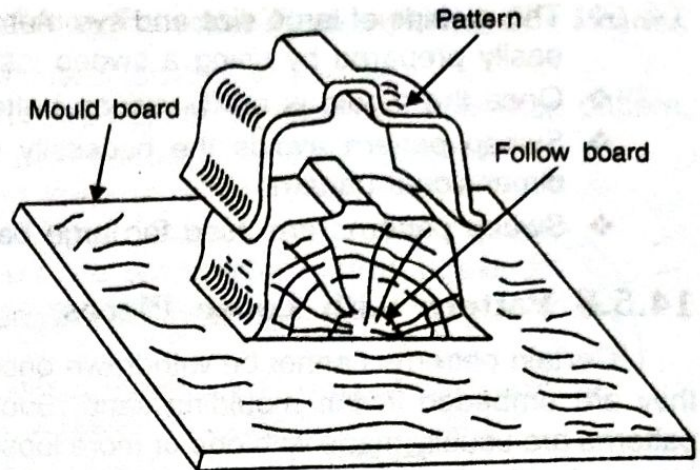


Fig. 14.10. Follow Board Pattern.

14.5.11 Segmental Pattern

- ❖ Segmental patterns are sections of a pattern so arranged as to form a complete mould.
- ❖ A segmental pattern completes one portion (stage) of the mould and then moves to the next position to make the next part of the mould and so on till the mould is completed.
- ❖ A segmental pattern differs from a sweep pattern in the sense that it does not revolve, continuously about the post to make the mould rather it prepares the mould by parts.

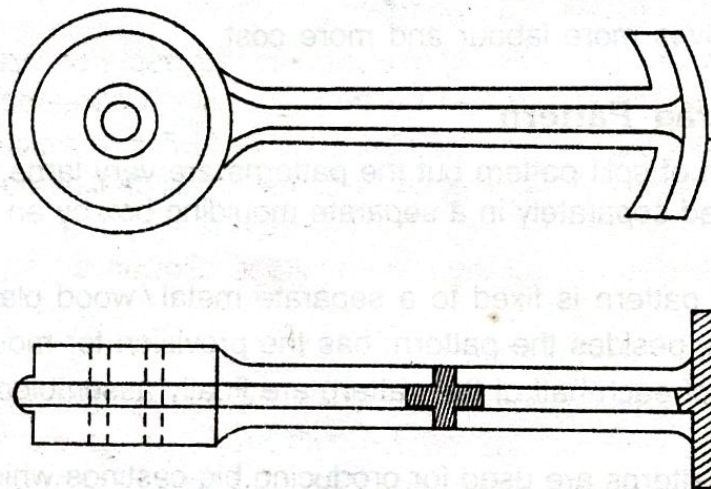


Fig. 14.11. Segmental Pattern.

14.6 PATTERN ALLOWANCES

Pattern is having different size as compared to casting because it carries certain allowances due to metallurgical and mechanical reasons. The various allowances are :

- ❖ Shrinkage or contraction allowance.
- ❖ Machining or finish allowance.
- ❖ Draft or taper allowance.
- ❖ Distortion or camber allowance.
- ❖ Shake or rapping allowance.
- ❖ Mould wall movement allowance.

14.6.1 Shrinkage or Contraction Allowance

- ❖ As metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a pattern is made larger than a finished casting by means of a shrinkage or contraction allowance.
- ❖ Contraction is different for different metals.
- ❖ Wood patterns used to make metallic patterns are given double allowance, one for the shrinkage of the metal of the pattern and the other for that of metal to be cast.
- ❖ The total contraction is volumetric but the shrinkage allowance is added to the linear dimensions.

Shrinkage allowances for various metals :

MATERIAL	SHRINKAGE METALS mm/mm
Grey cast iron	0.0105
White cast iron	0.0160 to 0.0230
Aluminium	0.0130
Brass	0.0155
Copper	0.0160
Lead	0.0260
Magnesium	0.0130

14.6.2 Machining or Finish Allowance

- ❖ For good surface finish, machining of casting is required. For machining, extra metals are needed. This extra metal is called machining or finish allowance.
- ❖ The amount of this allowance varies from 1.6 to 12.5 mm which depends upon the type of casting metal, size and shape of casting, method of casting used, method of machining to be employed and the degree of finish required.
- ❖ This allowance is given in addition to shrinkage allowance.

14.6.3 Draft or Taper Allowance

- ❖ At the time of withdrawing the pattern from the mould, the vertical faces of the pattern are in continual contact with the sand, which may damage the mould cavity. This danger is greatly decreased if the vertical surfaces of a pattern are tapered inward slightly. The slight taper inward on the vertical surface of a pattern is known as the draft.

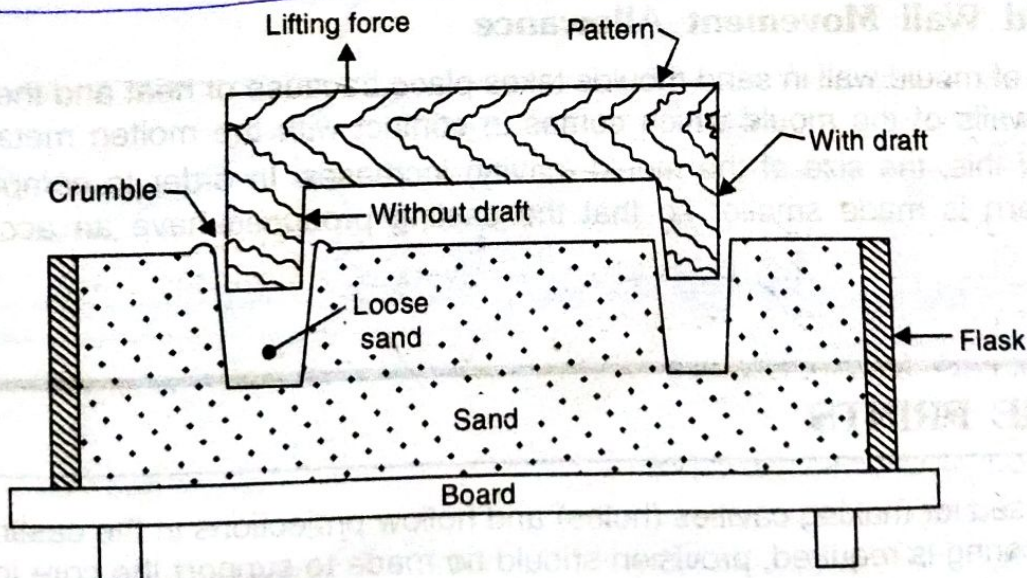


Fig. 14.12. Draft Allowance.

- ❖ It may be expressed in millimeters per metre on a side or in degrees.
- ❖ It depends upon the length of the vertical side, intricacy of the pattern, method of moulding, type of pattern and pattern material.
- ❖ The taper on the inner surfaces must be greater than on the outside surfaces.
- ❖ The amount of taper varies from $\frac{1}{2}$ to $1\frac{1}{2}$ degrees. It may be reduced to less than $\frac{1}{2}$ degree for larger castings.

14.6.4 Distortion or Camber Allowance

If the shape of the casting changes that is called distortion of the casting. A casting will distort or warp, if.

- ❖ It is of irregular shape.
- ❖ All its parts do not shrink uniformly.
- ❖ It has long flat casting.
- ❖ The arms possess unequal thickness.

Distortion can be practically eliminated by providing an allowance and constructing the pattern initially distorted. e.g., For U shape casting, legs will diverge so we make the pattern having legs converging so that after casting, the product is having legs parallel.

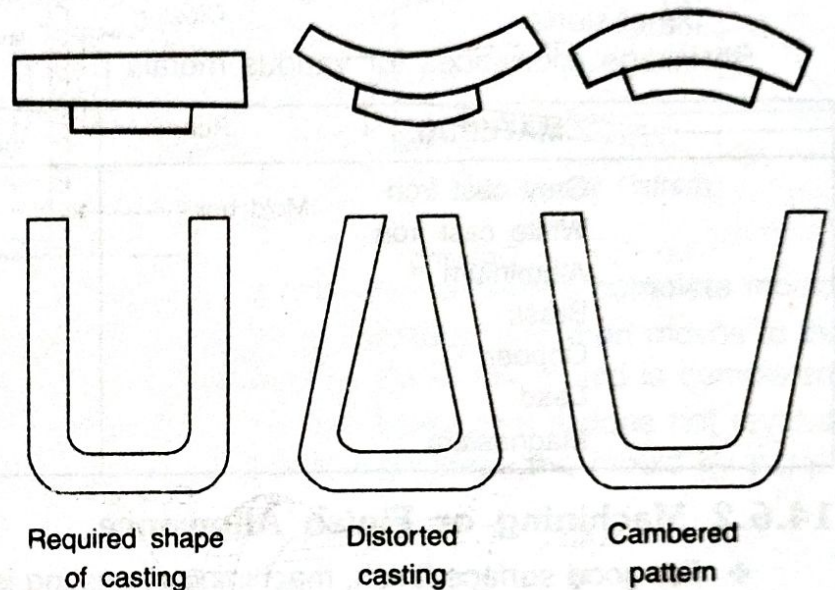


Fig. 14.13. Distortion Allowance.

14.6.5 Shake or Rapping Allowance

- ❖ When a pattern is rapped (shaken) in the mould before it is withdrawn, the cavity in the mould is slightly increased. So in order to compensate this, pattern is made slightly smaller than the actual. This allowance is called shaking or rapping.
- ❖ All allowance except shake or rapping allowance are positive but rapping allowance is negative.
- ❖ The magnitude of shake allowance can be reduced by increasing the taper.

14.6.6 Mould Wall Movement Allowance

Movement of mould wall in sand moulds takes place because of heat and the static pressure exerted on the walls of the mould which comes in contact with the molten metal.

Because of this, the size of the mould (cavity) increases. In order to compensate this, the size of the pattern is made smaller so that the casting produced have an accurate size (i.e., desired size).