



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

TECHNOLOGY OF PATTERNMAKING

Pattern types and Allowances

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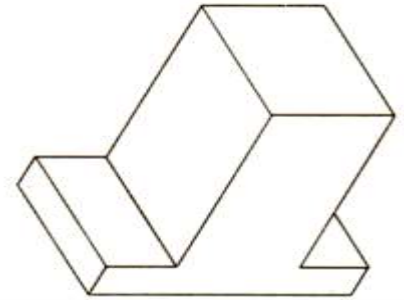
TYPES OF PATTERN

- Single Piece Pattern
- Split Pattern or Two Piece Pattern
- Gated Pattern
- Cope and Drag Pattern
- Match Plate pattern
- Loose Piece pattern
- Follow Board pattern
- Sweep Pattern
- Skeleton Pattern

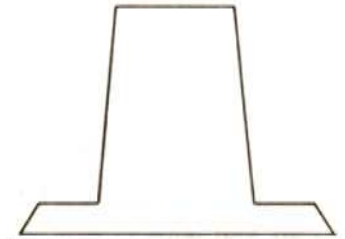


SINGLE PIECE OR SOLID PATTERN

- Simplest and least inexpensive to make.
- They are made of a single piece.
- It is used for relatively simple shapes, very small scale production, in prototype development.
- This pattern should be entirely in the drag.
- To avoid withdrawal problem, one of the surfaces should be flat so that it can be used as parting plane.



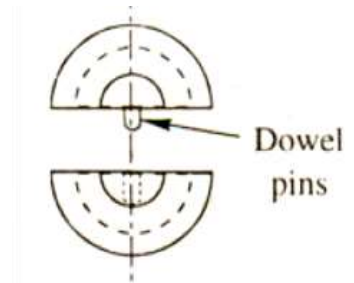
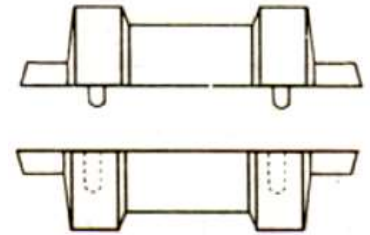
Casting



Pattern

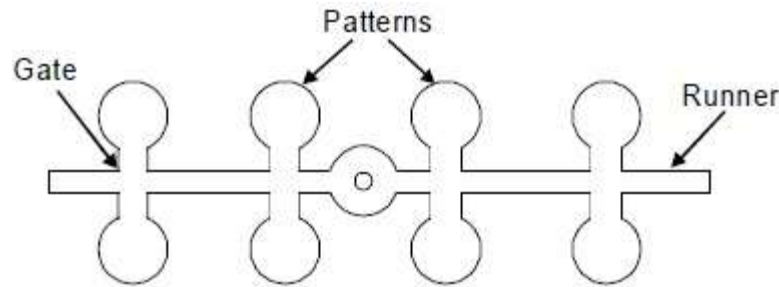
SPLIT OR TWO PIECE PATTERN

- When contour of the casting makes its withdrawal from the mold difficult or when the depth of the casting is too high, pattern is spit into two parts.
- Used for intricate castings.
- Split surface of the pattern is same as the parting plane of the mold.
- Dowel pins are used to align two halves.



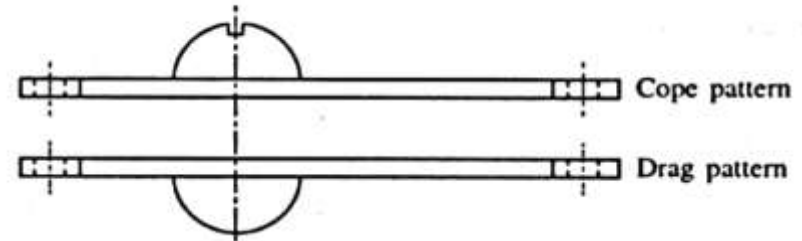
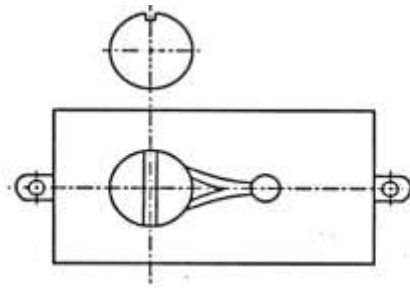
GATED PATTEN

- This is an Improvement Over the Simple Pattern where the Gating and Runner System are Integral Part of the Pattern.
- This Eliminates the Hand Cutting of the Runners and Gates and help in Improving the Productivity of a Molder.



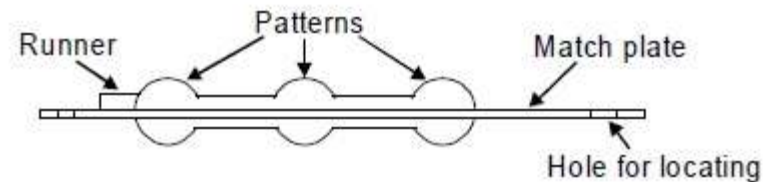
COPE AND DRAG PATTERN

- This is similar to split patterns.
- When large quantities are to be produced, cope and drag halves of split patterns are attached to separate metal or wooden plates and aligned to produce cope-and-drag patterns.
- Large molds can be handled more easily in separate segments.
- These types of patterns are used for heavy castings which are inconvenient for handling as also for continuous production.



MATCH PLATE PATTERN

- In match plate pattern, cope and drag patterns along with the gating and the risering are mounted on a single plate.
- On one side of the match plate the cope flask is prepared and on the other side drag flask. After molding when match plate is removed, a complete mold with gating is obtained by joining the cope and the drag together.
- The complete pattern with match plate is entirely made of metal, usually aluminum.
- Several patterns may be fixed to a single match plate.
- Generally used for small castings with higher dimensional accuracy and large production.

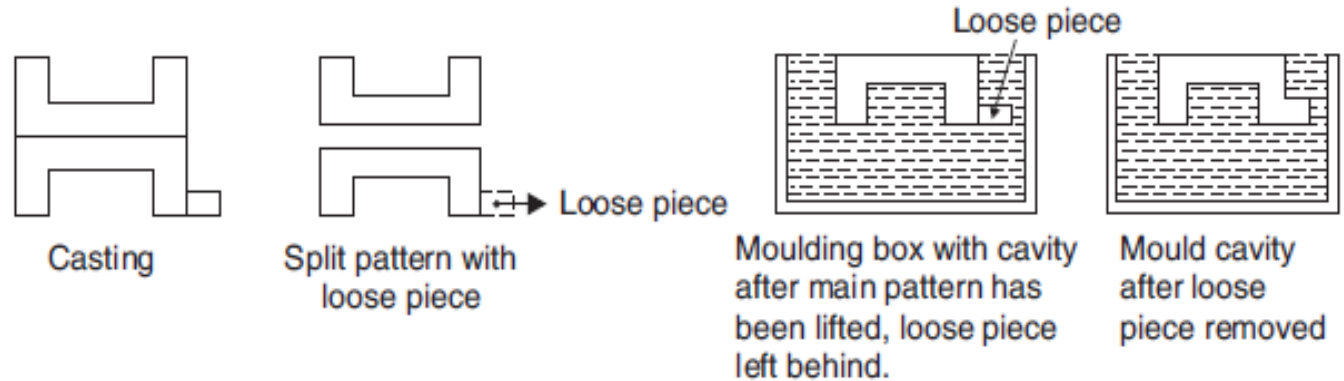


LOOSE PIECE PATTERN

- When the product has protruding sections arranged such that a one-piece or split pattern could not be removed from the mold, a loose-piece pattern can be used.
- Loose pieces are held to the primary segment of the pattern by beveled grooves or pins.
- After molding, the primary segment of the pattern is removed by direct withdrawal. The hole that is created permits the remaining segments to be moved in the direction necessary for their extraction.
- Loose piece patterns are expensive, they require careful maintenance, slow the molding process, and increase molding costs, their need should be eliminated through design changes

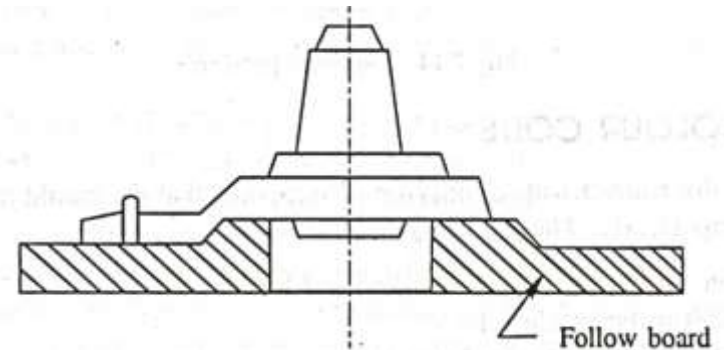


- But they enable the sand casting of complex shapes that would otherwise require the full-mold or investment processes.
- Loose piece pattern for molding a large worm. After sufficient sand is packed around the pattern halves to hold the pieces in position, wooden pins are withdrawn. The mold is completed and pieces of the pattern are removed in sequence.



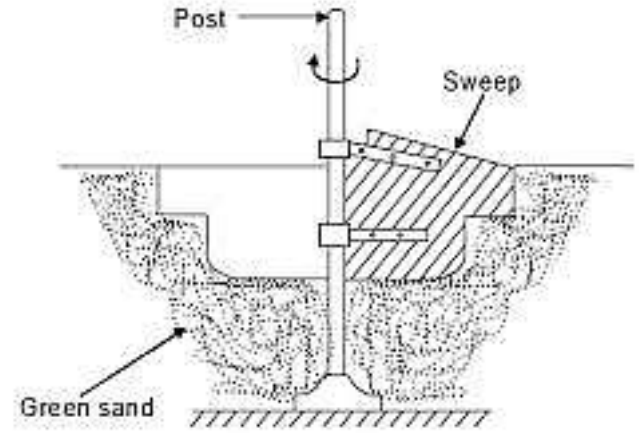
FOLLOW BOARD PATTERN

- This type of pattern is adopted for the castings having some structurally weak portions which if not supported properly, are likely to break under the force of ramming.
- The bottom board is modified as a follow board to closely fit the contour of the weak pattern and thus support it during the ramming of the drag.
- During the preparation of the cope, no follow board is necessary because the sand which is compacted in the drag will support the fragile pattern.



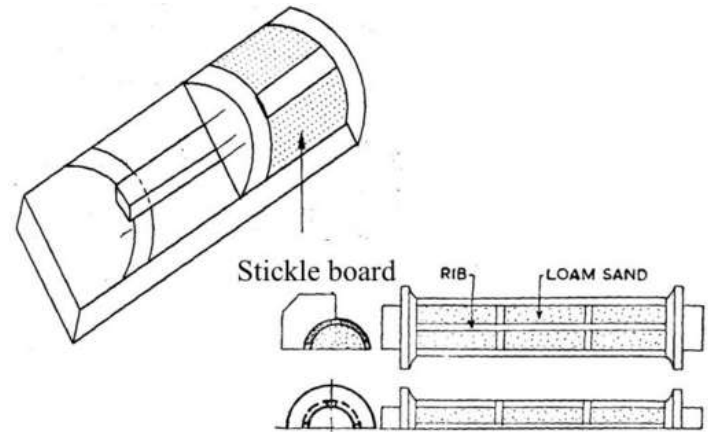
SWEEP PATTERN

- It is used to sweep the complete casting by means of a plane sweep.
- Sweep pattern is used for generating large axi-symmetric or prismatic shapes such as bell shaped or cylindrical shape.
- It avoids the cost of a three dimensional pattern.
- Sweep pattern is particularly suitable for very large castings such as the bells for ornamental purposes which are generally cast in pit molds.



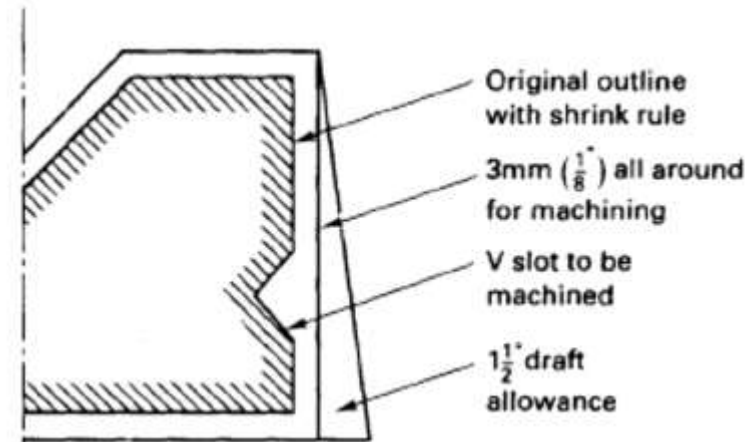
SKELETON PATTERN

- A skeleton of the pattern made of strips of wood is used for building the final pattern by packing sand around the skeleton.
- After packing the sand, desired form is obtained with the help of a strickle.
- Type of skeleton to be made is dependent upon the geometry of the workpiece.
- Skeleton pattern is generally useful for very large castings, required in small quantities where large expense on complete wooden pattern is not justified.



PATTERN ALLOWANCES

- The dimensions of the pattern are slightly different from the final dimensions of the casting.
- The modifications that are incorporated into a pattern are called pattern allowances which are of following five types:
- **Shrinkage allowance:** To compensate for solid cooling (i.e. Cooling from freezing temperature or range to room temperature)
- **Draft and shake allowance:** To facilitate easy withdrawal of pattern from mold
- **Machining or finish allowance:** Extra amount of material to be provided on the casting so as to impart better finish to it
- **Distortion allowance:** To compensate for distortion of weaker sections of the casting



SHRINKAGE OR CONTRACTION ALLOWANCE

- Most metals and alloys undergo noticeable contraction once they are poured in the mold cavity and begin to cool. There are three principal stages of shrinkage:

PHASE-1: Shrinkage of liquid melt (liquid cooling) from pouring to freezing temp

PHASE-2: Solidification shrinkage due to phase change at freezing temperature (metals) or range (alloys)

Phase-3: Shrinkage of solidified casting (solid cooling) due to cooling from freezing to room temperature

- Shrinkage due to phase-1 and 2 are taken care of by using risers while shrinkage allowance takes care of shrinkage due to phase-3



SHRINKAGE OR CONTRACTION ALLOWANCE

- To produce the desired final dimensions, the external dimensions of the pattern must be made slightly larger than the casting. The exact amount of this compensation depends on the metal that is being cast
- If a core is to be used to form a hole or interior cavity, it also must be made oversized to compensate for shrinkage.



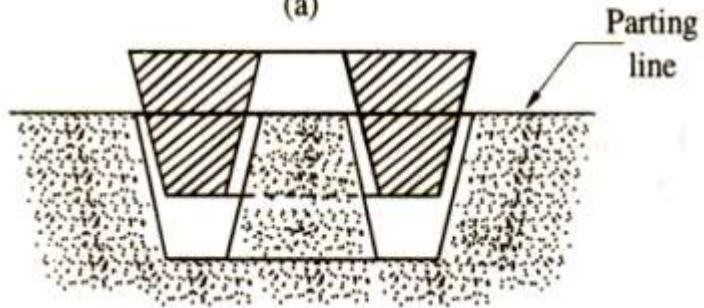
DRAFT ALLOWANCE

- To facilitate pattern removal
- If the pattern contains surfaces that are perpendicular to the parting line or parallel to the direction of pattern withdrawal, the friction between the pattern and the mold, or any horizontal movement of the pattern during extraction may damage the mold.
- This damage is particularly severe at the corners where the mold cavity intersects the parting surface.
- By incorporating a slight taper, or draft, on all surfaces parallel to the direction of withdrawal, this difficulty can be minimized.





(a)



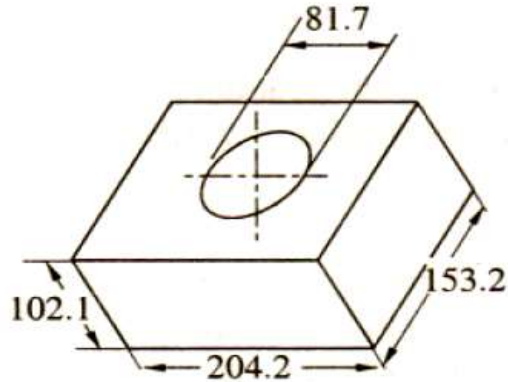
(b)

- Amount of draft is determined by the
 - ❖ Size and shape of the pattern
 - ❖ Depth of the cavity
 - ❖ Method used to withdraw the pattern
 - ❖ Pattern material
 - ❖ Mold material
 - ❖ Molding procedure

- Draft allowance varies with the complexity of the casting
 - ❖ Inner surfaces of the pattern require higher draft than outer surfaces.
 - ❖ More draft should be provided for hand molding compared to machine molding.



PROBLEM BASED ON DRAFT ALLOWANCE



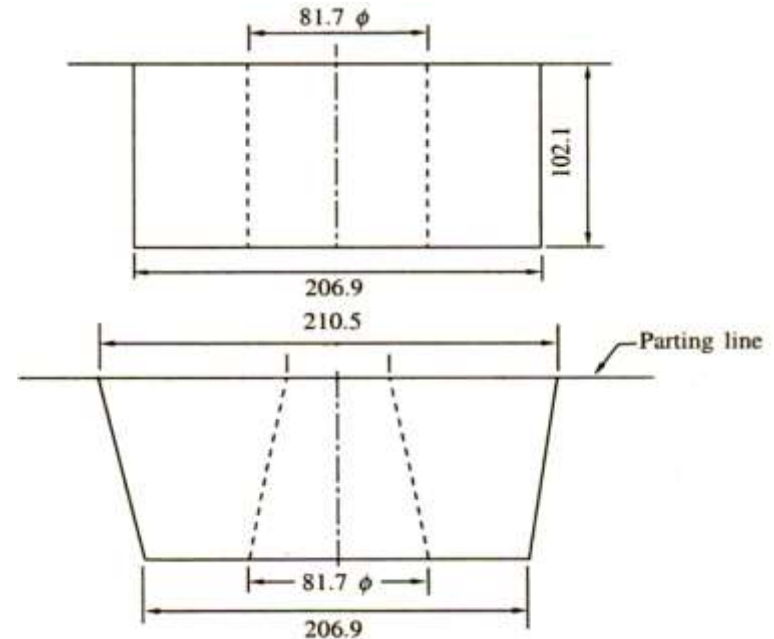
For 102.1 size, the taper required is

→ For external dimensions

$$102.1 \times \tan (1.00) = 1.78675 \sim 1.8$$

→ For internal dimensions

$$102.1 \times \tan (3.00) = 5.35 \sim 5.40$$



Pattern With Draft Allowance

SHAKE ALLOWANCE

- In some casting processes (such as sand casting), before withdrawing the pattern from the mold, the pattern is rapped or shaken all around the vertical faces to enlarge the mould cavity slightly to facilitate its removal. The original pattern dimensions have to be reduced to account for this increase in dimension.
- It is a negative allowance and is to be applied only to those dimensions which are parallel to the parting plane (i.e. Width or thickness and not to height).
- Shake allowance is highly dependent on the foundry personnel and practices involved.



MACHINING OR FINISH ALLOWANCE

- If a casting has machinable surfaces, it is necessary to provide a machining allowance, or finish allowance on the pattern.
- Ordinary sand castings have rougher surfaces than those of shell-mold castings. Die castings are sufficiently smooth so that very little or no metal has to be removed, and investment castings frequently require no additional machining.



- Ferrous materials would have scales on the skin which are to be removed by cleaning. Hence extra material is provided which is to be subsequently removed by machining or cleaning process, called machining allowance.

- Machining allowance provided depend on the
 - ❖ Metal cast
 - ❖ Type of molding used
 - ❖ Class of accuracy required on the surface
 - ❖ Complexity of surface details

- One way of reducing the machining allowance is to keep entire casting in the drag flask such that dimensional variation and other defects due to the parting plane are reduced to minimum.

Machining allowance on patterns for sand casting

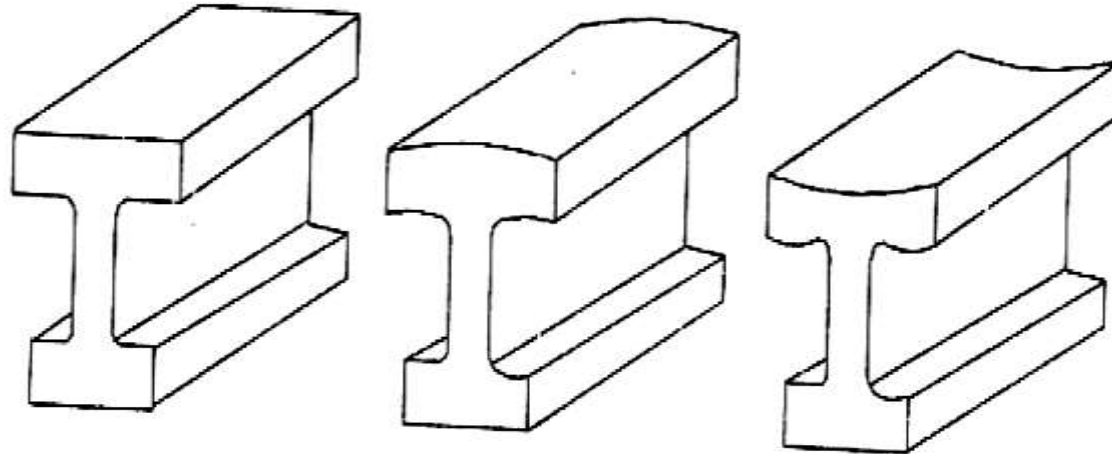
<i>Dimension, mm</i>	<i>Allowance, mm</i>		
	<i>Bore</i>	<i>Surface</i>	<i>Cope side</i>
<i>Cast iron</i>			
up to 300	3.0	3.0	5.5
301 to 500	5.0	4.0	6.0
501 to 900	6.0	5.0	6.0
<i>Cast steel</i>			
up to 150	3.0	3.0	6.0
151 to 500	6.0	5.5	7.0
501 to 900	7.0	6.0	9.0
<i>Non ferrous</i>			
up to 200	2.0	1.5	2.0
201 to 300	2.5	1.5	3.0
301 to 900	3.0	2.5	3.0

DISTORTION ALLOWANCE

- A metal when just solidified, is very weak and therefore is likely to be distortion prone. Long flat portions of V-, U-, H or I-section which may have thin and long sections, connected to thick sections.
- Long horizontal sections tend to sag in the center unless adequate support is provided by suitable ribbing.



- Distortion depends greatly on particular configuration of casting
- Shape of pattern is given a distortion (camber) of equal amount in the opposite direction of the likely distortion direction.



➤ Required Casting Distorted Casting Cambered Pattern

THANKS

