

3. Loose piece pattern:

- Certain patterns cannot be withdrawn once they are embedded in the molding sand. Such patterns are usually made with one or more loose pieces for facilitating from the molding 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 molding box and thereafter as soon as the loose parts are removed, the result is the mold cavity.

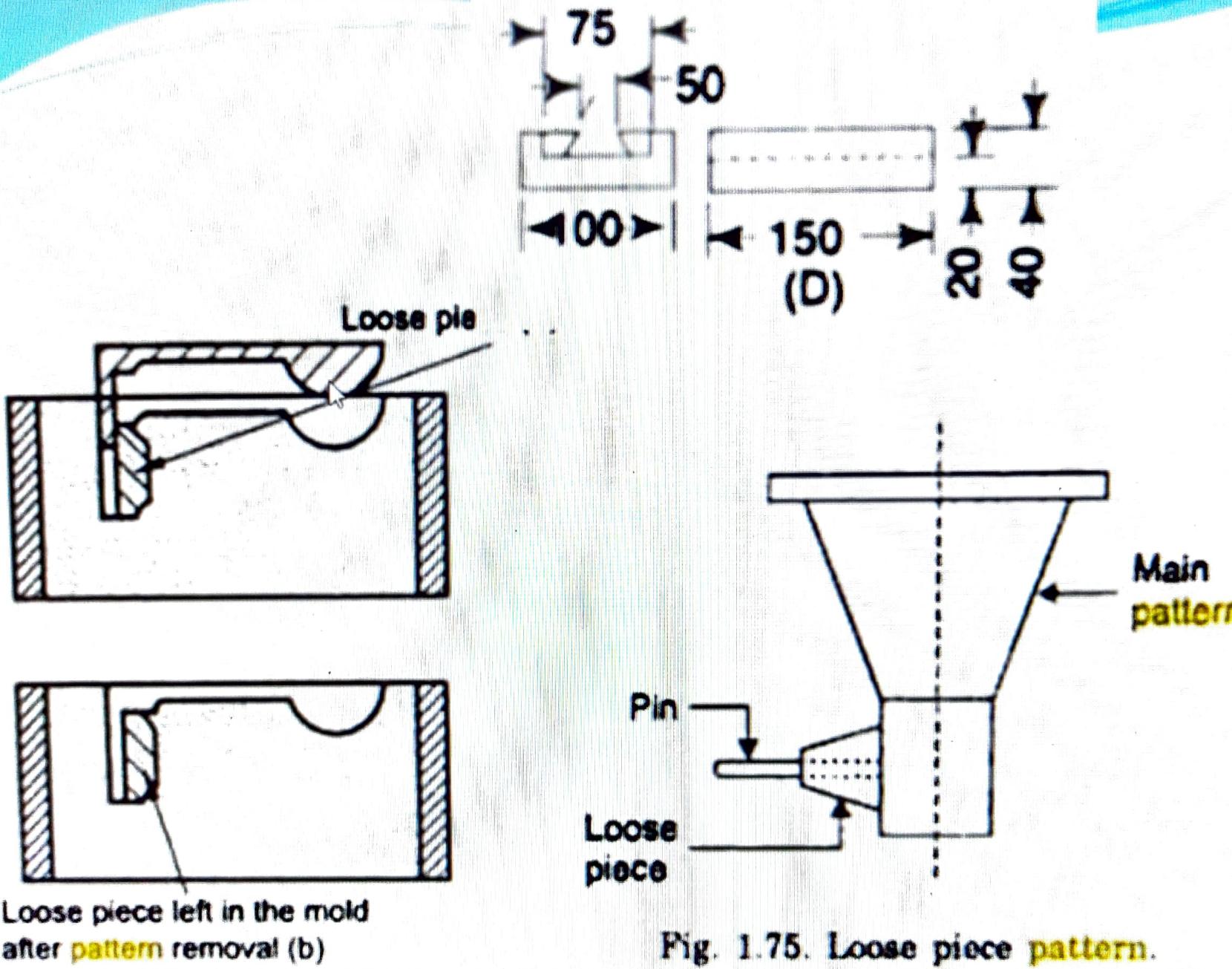
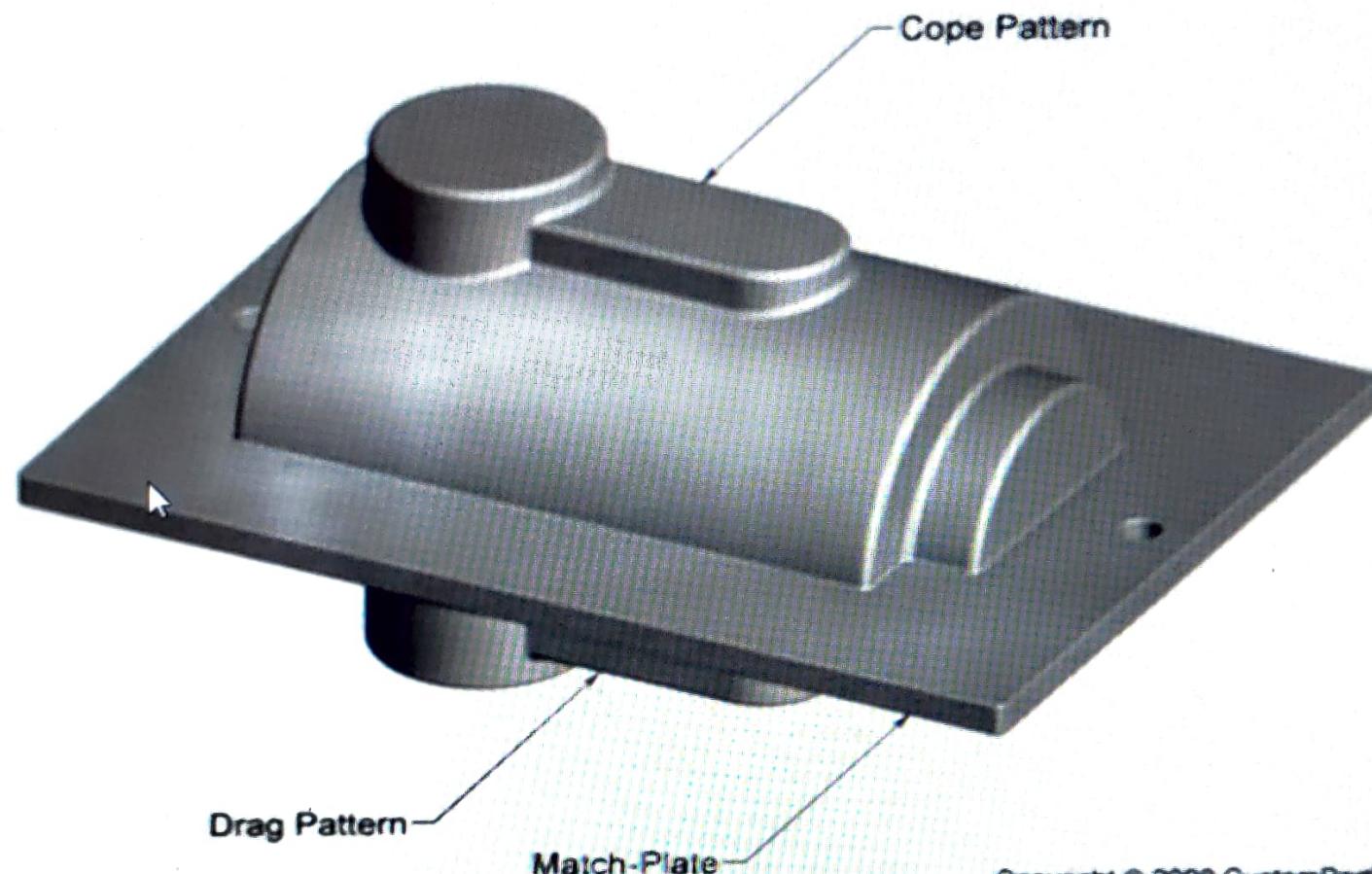


Fig. 1.75. Loose piece pattern.

4. Match plate pattern:

- It consists of a match plate, on either side of which each half of split patterns is fastened.
- A no. of different sized and shaped patterns may be mounted on one match plate.
- The match plate with the help of locator holes can be clamped with the drag.
- After the cope and drag have been rammed with the molding sand, the match plate pattern is removed from in between the cope and drag.
- Match plate patterns are normally used in machine molding.
- By using this we can eliminate mismatch of cope and drag cavities.



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Fig: Match plate pattern

5. Sweep pattern:

- A sweep pattern is just a form made on a wooden board which sweeps the shape of the casting into the sand all around the circumference. The sweep pattern rotates about the post.
- Once the mold is ready, Sweep pattern and the post can be removed.
- Sweep pattern avoids the necessity of making a full, large circular and costly three-dimensional pattern.
- Making a sweep pattern saves a lot of time and labour as compared to making a full pattern.
- A sweep pattern is preferred for producing large casting of circular sections and symmetrical shapes.

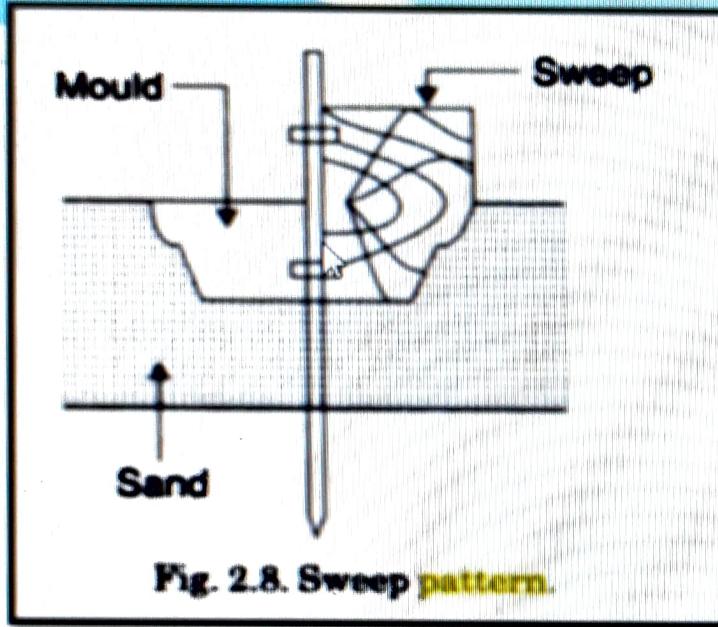
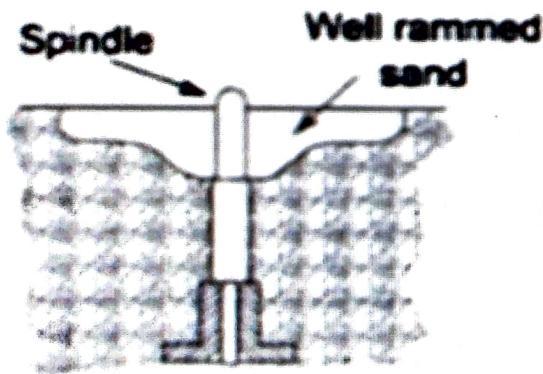
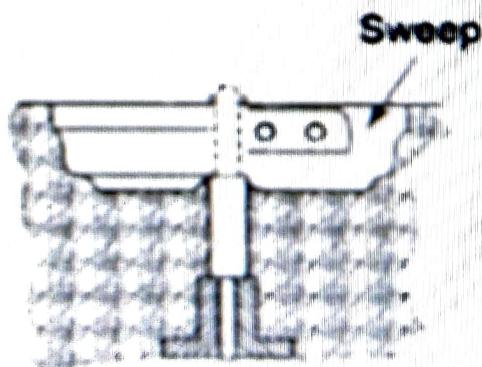


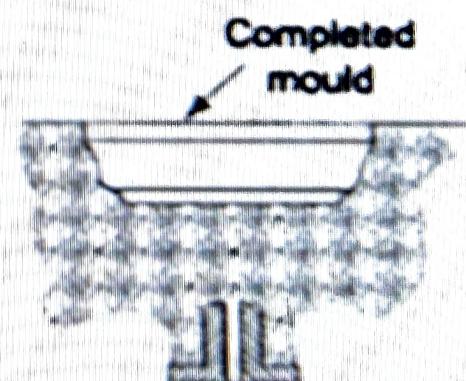
Fig. 2.8. Sweep pattern.



(a)



(b)



(c)

Fig. 3.15 Sweep pattern



6. Gated pattern:

- The sections connecting different patterns serve as runner and gates.
- This facilitates filling of the mould with molten metal in a better manner and at the same time eliminates the time and labour otherwise consumed in cutting runners and gates.
- A gated pattern can manufacture many casting at one time and thus it is used in mass production systems.
- Gated patterns are employed for producing small castings.

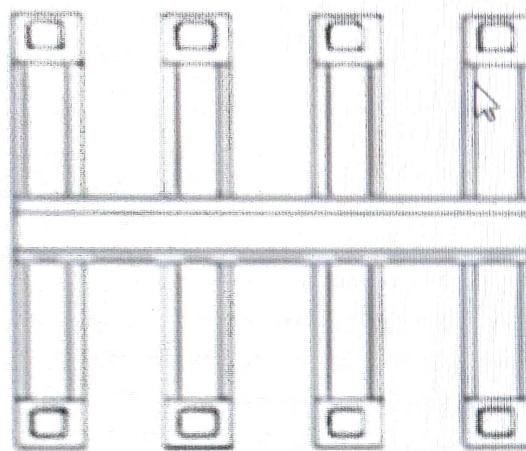
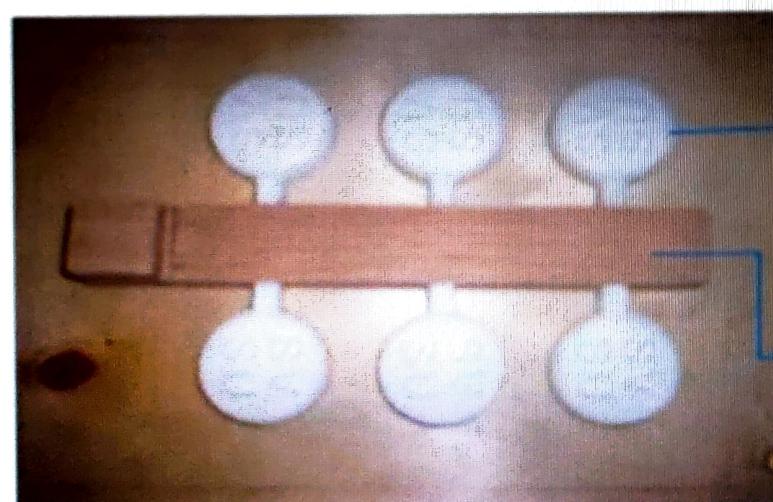
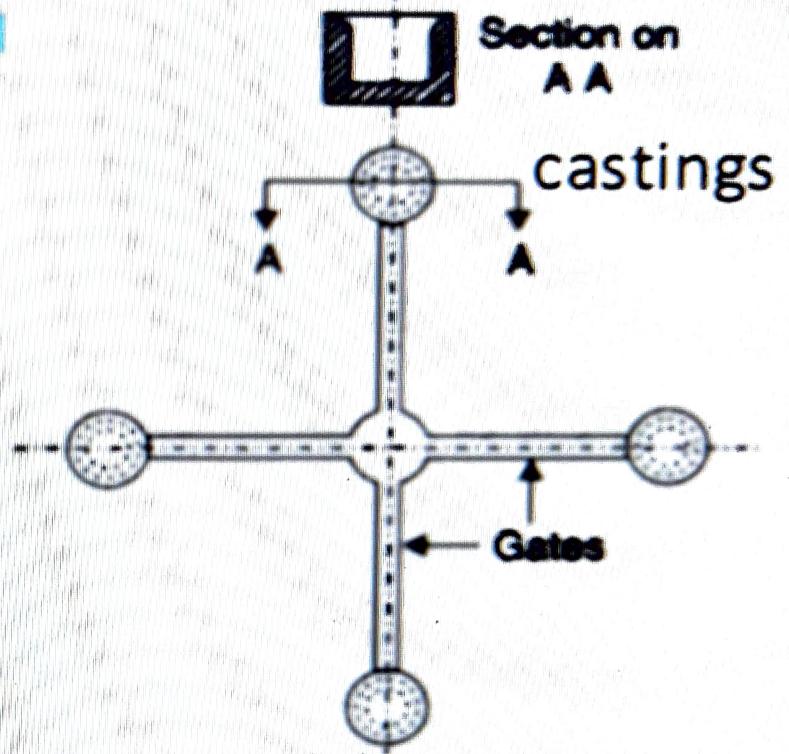


Fig. 1.10 Gated pattern



• Gating system

7. Skeleton pattern:

- A skeleton pattern is the skeleton of a desired shape which may be S-bend pipe or a chute or something else. The skeleton frame is mounted on a metal base
- The skeleton is made from wooden strips, and is thus a wooden work.
- The skeleton pattern is filled with sand and is rammed.
- A strickle (board)  assists in giving the desired shape to the sand and removes extra sand.
- Skeleton patterns are employed for producing a few large castings.
- A skeleton pattern is very economical, because it involves less material costs.

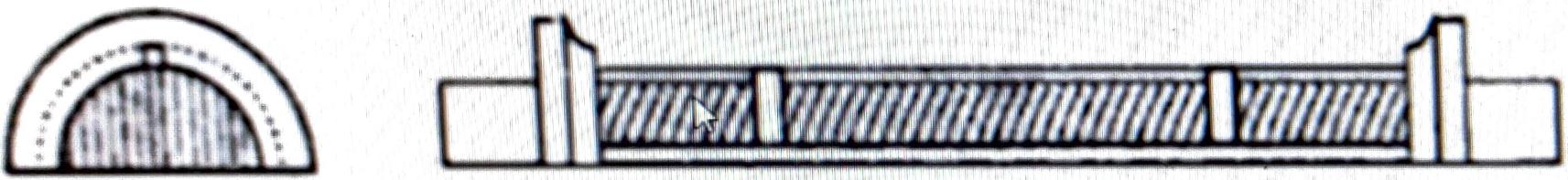


Fig. 1.78. A skeleton pattern for a flanged pipe.

8. 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 way and collapse under pressure when the sand above the pattern is being rammed.
- With the follow board support under the weak pattern, the drag is rammed, and then the fallow board is with drawn, The rammed drag is inverted, cope is mounted on it and rammed.
- During this operation pattern remains over the inverted drag and get support from the rammed sand of the drag under it.
- Follow boards are also used for casting master patterns for many applications.

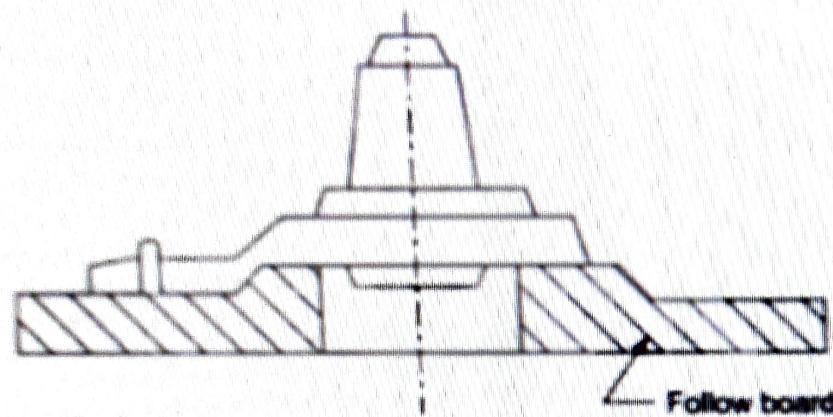
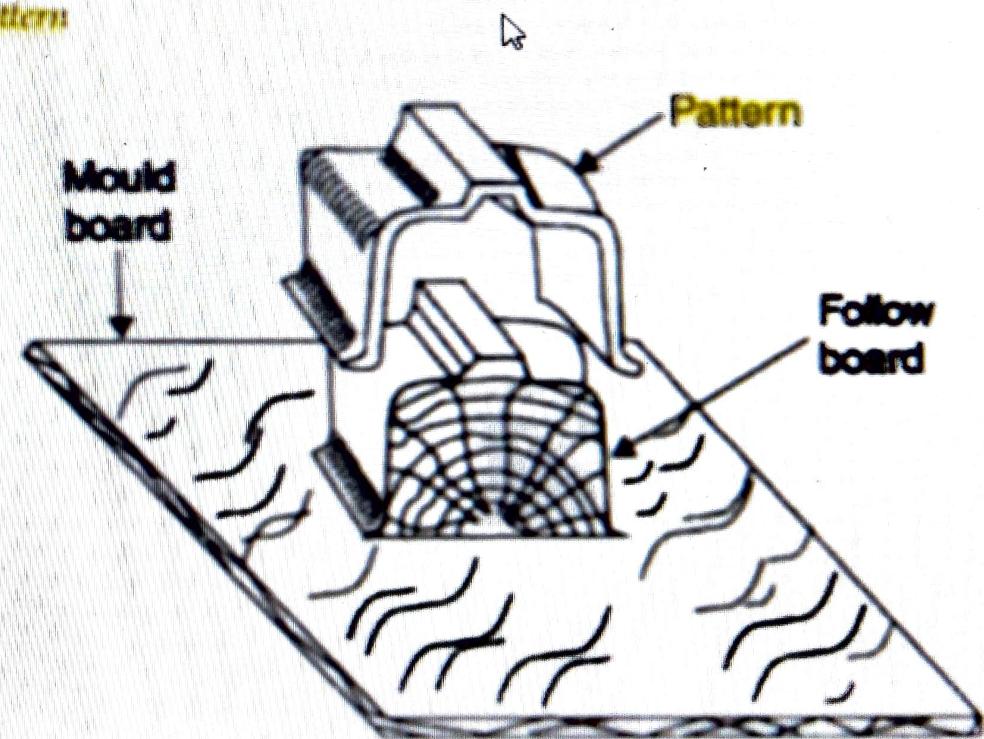
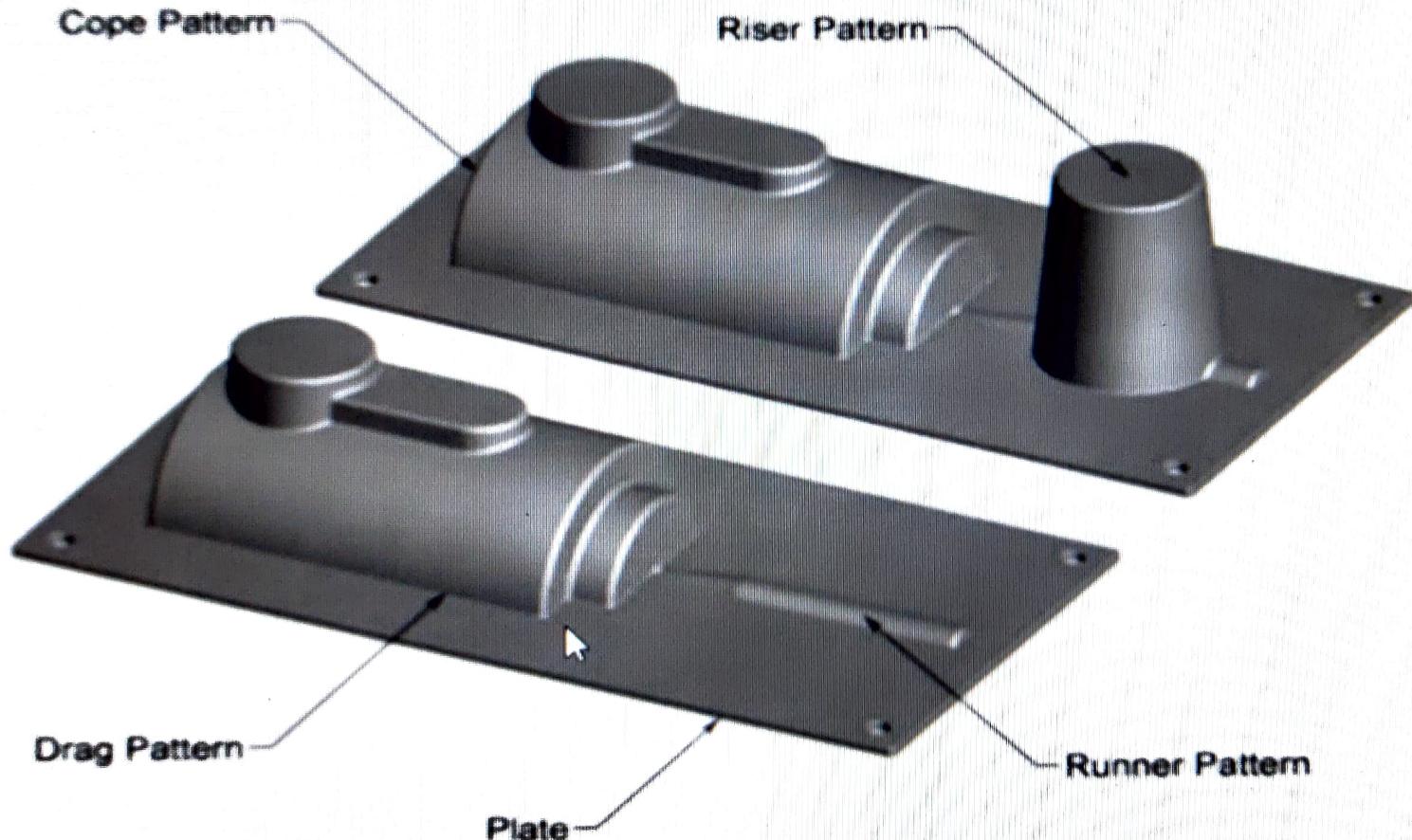


Fig. 3.14 Follow board pattern



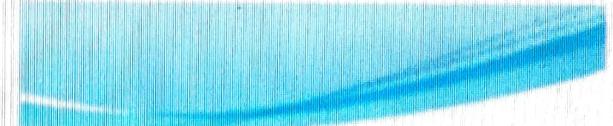
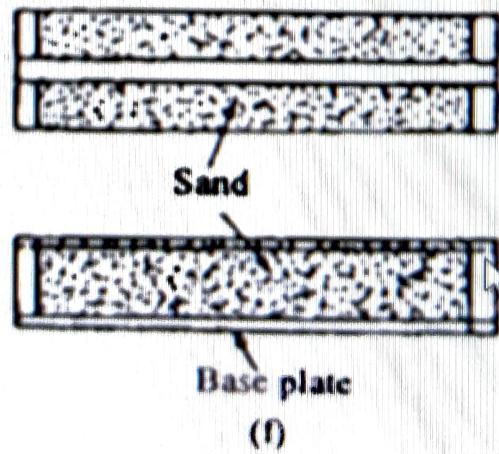
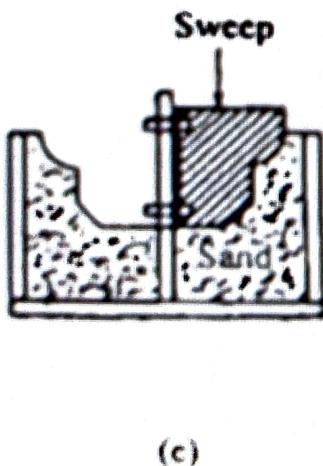
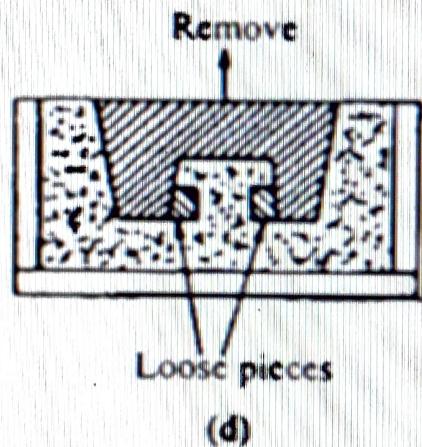
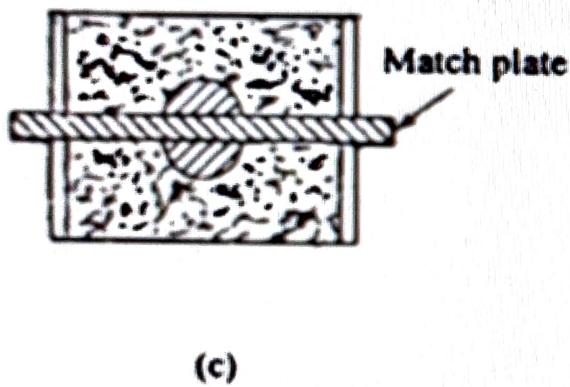
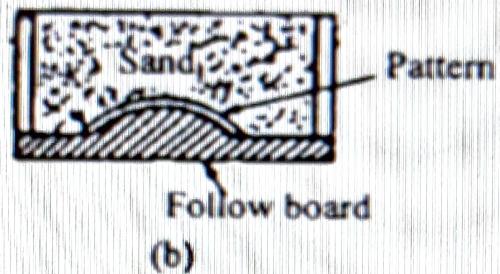
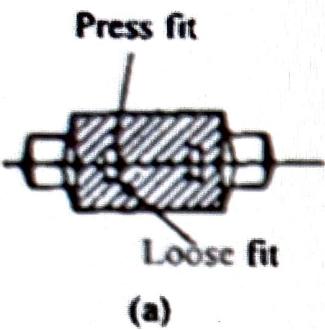
9. Cope and Drag patterns:

- A cope and drag pattern is another form of split pattern.
- Each half of the pattern is fixed to a separate metal/wood plate.
- Each half of the pattern(along the plate) is molded separately in a separate molding box by an independent molder or moulders.
- 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.



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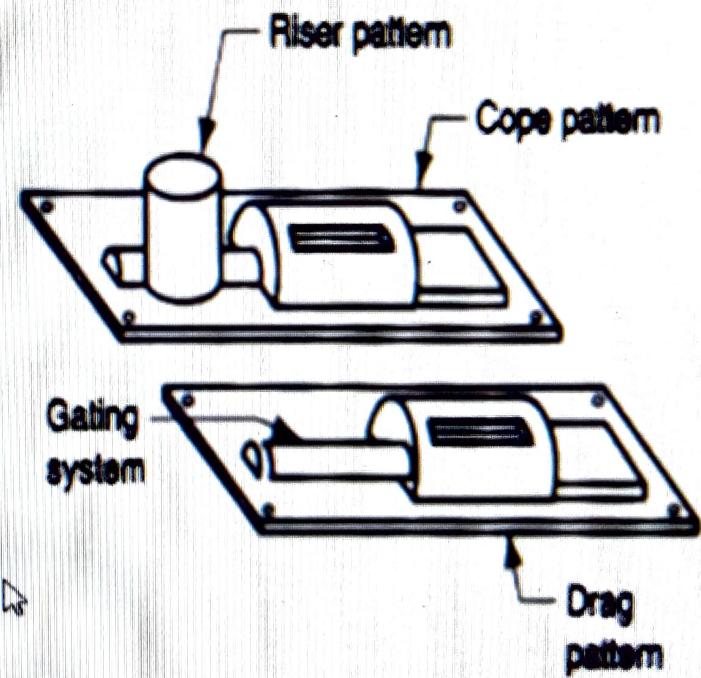
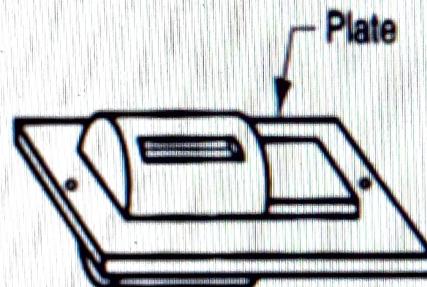
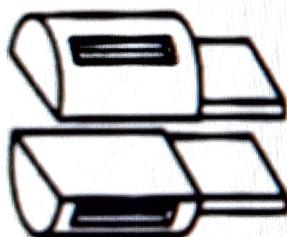
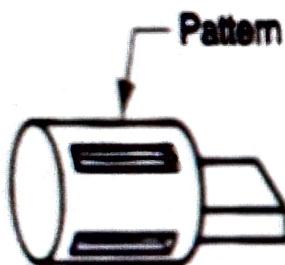
Fig: Cope and drag pattern



- (a) Split pattern
- (b) Follow-board
- (c) Match Plate
- (d) Loose-piece
- (e) Sweep
- (f) Skeleton pattern



Types of patterns used in sand casting: (a) solid pattern, (b) split pattern, (c) match-plate pattern, and (d) cope-and-drag pattern.



(a)

(b)

(c)

(d)



PATTERN ALLOWANCES

Pattern Allowances:

A pattern is larger in size as compared to the final casting, because it carries certain allowances due to metallurgical and mechanical reasons for example, shrinkage allowance is the result of metallurgical phenomenon where as machining, draft, distortion, shake and other allowances are provided on the patterns because of mechanical reasons.



Types of Pattern Allowances:

The various pattern allowances are:

1. shrinkage or contraction allowance.
2. Machining or finish allowance.
3. Draft of tapper allowances.
4. Distortion or chamber allowance.
5. Shake or rapping allowance.
6. Heat treatment Allowance

1. Shrinkage Allowance:

All most all cast metals shrink or contract volumetrically on cooling.

The metal shrinkage is of two types:

1. Liquid Shrinkage:

it refers to the reduction in volume when the metal changes from liquid state to solid state at the solidus temperature. To account for this shrinkage; riser, which feed the liquid metal to the casting, are provided in the mold.

2. Solid Shrinkage:

it refers to the reduction in volume caused when metal loses temperature in solid state. To account for this, shrinkage allowance is provided on the patterns.

- Almost all cast metals shrink or contract volumetrically after solidification and therefore the pattern to obtain a particular sized casting is made oversize by an amount equal to that of shrinkage or contraction.
- Different metals shrink at different rates because shrinkage is the property of the cast metal/alloy.
- *The metal shrinkage depends upon:*
 1. The cast metal or alloy.
 2. Pouring temp. of the metal/alloy.
 3. Casted dimensions(size).
 4. Casting design aspects.
 5. Molding conditions(i.e., mould materials and molding methods employed)

Table 3. Contraction Allowance for Different Metals

S. No.	Metals / Alloys	Contraction allowance mm / metre
1.	Grey cast iron	7 to 10.5
2.	White cast iron	21
3.	Malleable iron	15
4.	Steel	20
5.	Copper	16
6.	Brass	16
7.	Bronze	10.5 to 21
8.	Zinc	24
9.	Lead	24
10.	Aluminium	16
11.	Magnesium	18

The contraction of metals/alloys is always volumetric, but the contraction allowances are always expressed in linear measures.

2. Machining Allowance:

A Casting is given an allowance for machining, because:

- i.** Castings get oxidized in the mold and during heat treatment; scales etc., thus formed need to be removed.
- ii.** It is intended to remove surface roughness and other imperfections from the castings. ↗
- iii.** It is required to achieve exact casting dimensions.
- iv.** Surface finish is required on the casting.

How much extra metal or how much machining allowance should be provided, depends on the factors listed below:

- i. Nature of metals.
- ii. Size and shape of casting.
- iii. The type of machining operations to be employed for cleaning the casting.
- iv. Casting conditions.
- v. Molding process employed

Machining Allowances of Various Metals:

Table 2.3

Material	Dimensions (in mm)	Machining allowance (in mm)
Cast Iron	Up to 300	2.5
	300 to 600	4.0
Aluminium	Up to 300	1.5
	300 to 600	3.0
Cast Steel	Up to 300	3.0
	300 to 600	4.5

3. Draft or Taper Allowance:

- It is given to all surfaces perpendicular to parting line.
- Draft allowance is given so that the pattern can be easily removed from the molding material tightly packed around it without damaging the mould cavity.
- The amount of taper depends upon:
 - i. Shape and size of pattern in the depth direction in contact with the mould cavity.
 - ii. Moulding methods.
 - iii. Mould materials.
 - iv. Draft allowance is imparted on internal as well as external surfaces; of course it is more on internal surfaces.

The taper provided by the pattern maker on all vertical surfaces of the pattern so that it can be removed from the sand without tearing away the sides of the sand mold and without excessive rapping by the molder. **Figure 3 (a)** shows a pattern having no draft allowance being removed from the pattern. In this case, till the pattern is completely lifted out, its sides will remain in contact with the walls of the mold, thus tending to break it.



Figure 3 (a) Pattern Having No Draft on Vertical Edges

Figure 3 (b) is an illustration of a pattern having proper draft allowance. Here, the moment the pattern lifting commences, all of its surfaces are well away from the sand surface. Thus the pattern can be removed without damaging the mold cavity.

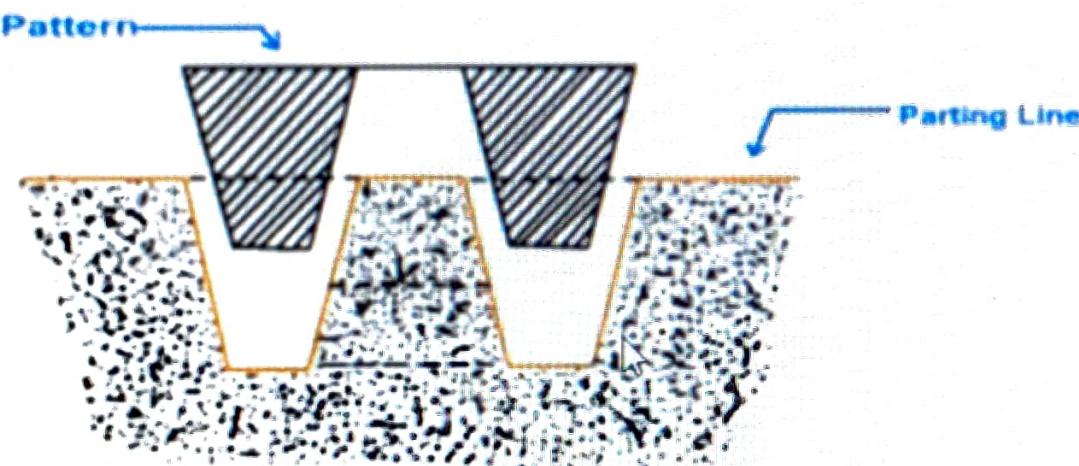


Table 7.2 Suggested draft values for patterns

<i>Pattern material</i>	<i>Heights of the given surface, mm</i>	<i>Draft angle of surfaces, degrees</i>	
		<i>External surface</i>	<i>Internal surface</i>
Wood	upto 20	3.00	3.00
	21 to 50	1.50	2.50
	51 to 100	1.00	1.50
	101 to 200	0.75	1.00
	201 to 300	0.50	1.00
	301 to 800	0.50	0.75
	801 to 2000	0.35	0.50
	over 2000	—	0.25
Metal and plastic	20	1.50	3.00
	21 to 50	1.00	2.00
	51 to 100	0.75	1.00
	101 to 200	0.50	0.75
	201 to 300	0.50	0.75
	301 to 800	0.35	0.50

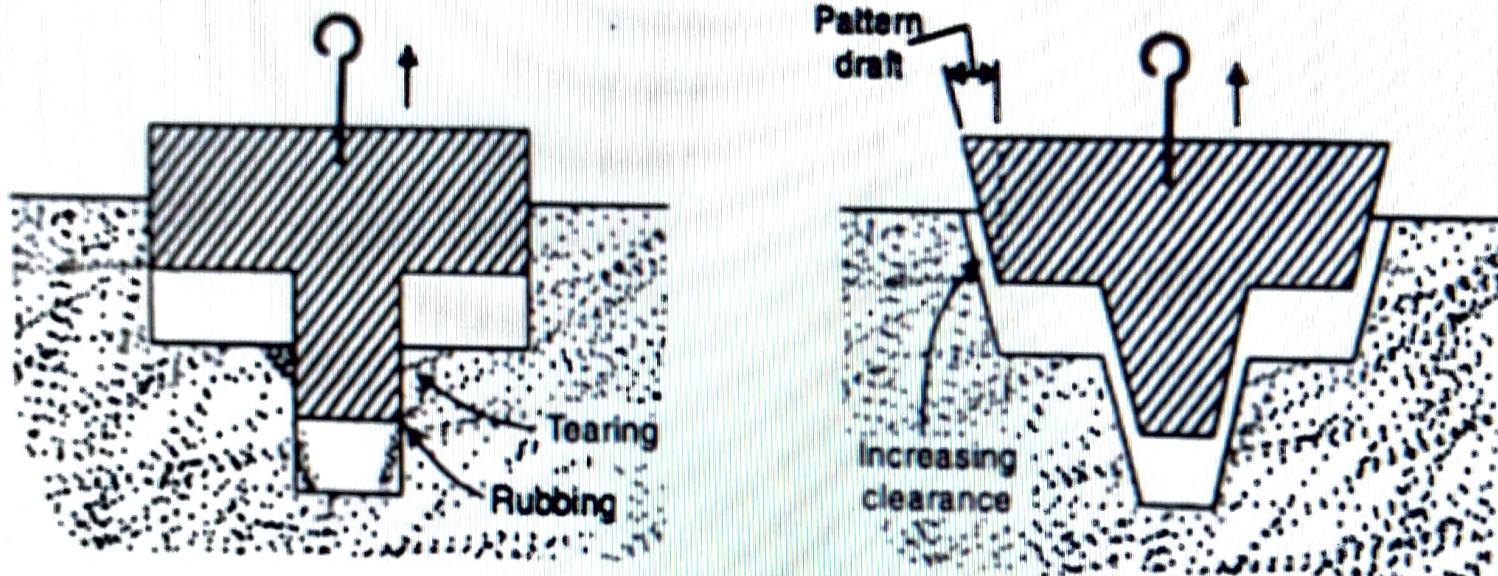


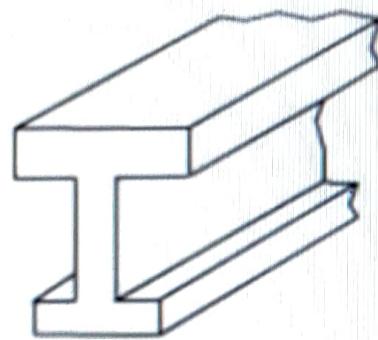
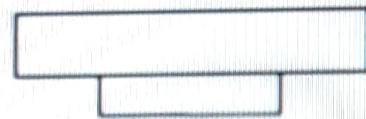
Fig. 2.9 Draft Allowance.

Fig: taper in design

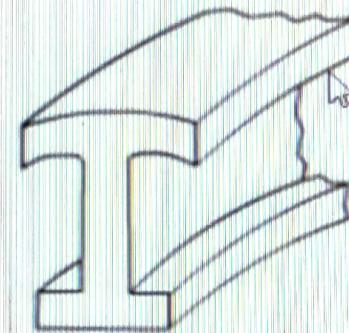
4. Distortion or cambered allowance:

A casting will distort or wrap if :

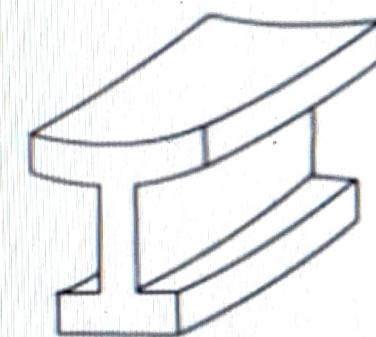
- i. It is of irregular shape,
- ii. All its parts do not shrink uniformly i.e., some parts shrink while others are restricted from doing so,
- iii. It is u or v-shape,
- iv. The arms possess unequal thickness,
- v. It has long, rangy arms as those of propeller strut for the ship,
- vi. It is a long flat casting,
- vii. One portion of the casting cools at a faster rate as compared to the other.



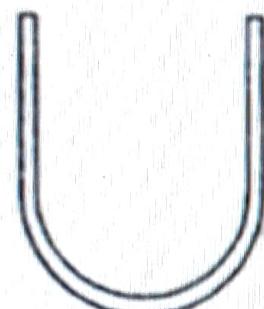
**Required Shape
of Casting**



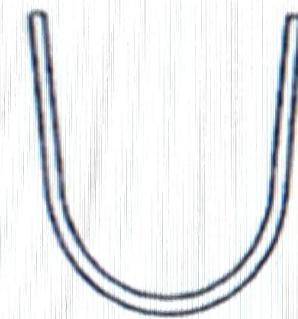
**Distorted
Casting**



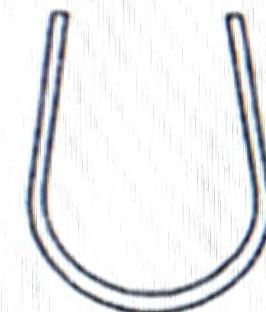
**Cambered
Pattern**



(I)



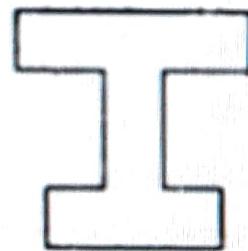
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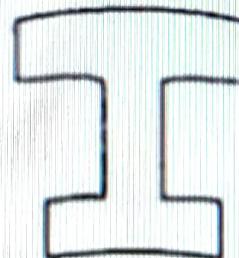
(III)

(a) U-shaped Casting

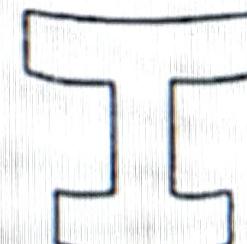
- (I) Required shape of casting
- (II) Casting produced with **distortion**
- (III) Pattern provided with **Camber allowance**



(I)



(II)



(III)

(b) I-section Casting

5. Shake allowance:

- A pattern is shaken or rapped by striking the same 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.
- Hence, a -ve 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.
- The magnitude of shake allowance can be reduced by increasing the tapper.

PATTERN LAYOUT AND PATTERN CONSTRUCTION



Pattern Layout:

Steps involved:

- Get the working drawing of the part for which the pattern is to be made.
- Make two views of the part drawing on a sheet, using a *shrink rule*. A shrink rule is modified form of an ordinary scale which has already taken care of shrinkage allowance for a particular metal to be cast.
- Add machining allowances as per the requirements.
- Depending upon the method of molding, provide the draft allowance.