



First stage

First semester

Workshops

Metal casting processes

Lecture: 4

Dr. Saleh Al-Absi

Pattern materials

- Patterns for sand castings are subjected to considerable wear and tear due to ramming action that is required and the abrasive action of the sand
- Should be impervious to moisture because of changing surroundings
- Made of: wood, metal, plastics, plaster and synthetic materials
- Woods => white pine, sugar pine; The wood should be straight grain, light, easy to work, little tendency to develop crack and warp.
- More durable: Mahogany
- For large castings: metal such as cast iron or aluminium
- When metal pattern are cast from the wooden master pattern, double shrinkage must be provided on the wooden master pattern
- Assume metal pattern is made of aluminium and castings are made of CI, the shrinkage allowance for the wooden master pattern is:

$5/32$ inch per foot for Al+ $1/8$ inch per foot CI = $9/32$ inch per foot

Solid shrinkage for cast metals

Material	Dimension	Shrinkage allowance (inch/ft)
Grey Cast Iron	Up to 2 feet	0.125
	2 feet to 4 feet	0.105
	over 4 feet	0.083
Cast Steel	Up to 2 feet	0.251
	2 feet to 6 feet	0.191
	over 6 feet	0.155
Aluminum	Up to 4 feet	0.155
	4 feet to 6 feet	0.143
	over 6 feet	0.125
Magnesium	Up to 4 feet	0.173
	Over 4 feet	0.155

5. Draft allowance:

All the surfaces parallel to the direction in which the pattern will be removed are tapered slightly inward to facilitate safe removal of the pattern. This is called '**draft allowance**'.

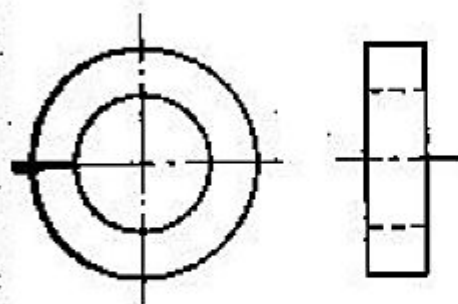
General usage:

External surfaces ; Internal surfaces, holes, pockets

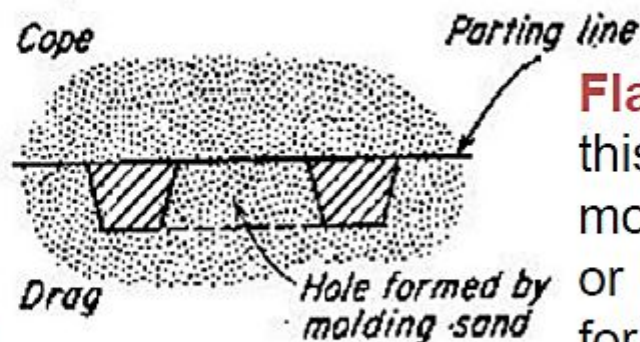
Typical Draft Allowances

Pattern material	Height of the given surface (inch)	Draft angle (External surface)	Draft angle (Internal surface)
Wood	1	3.00	3.00
	1 to 2	1.50	2.50
	2 to 4	1.00	1.50
	4 to 8	0.75	1.00
	8 to 32	0.50	1.00
Metal and plastic	1	1.50	3.00
	1 to 2	1.00	2.00
	2 to 4	0.75	1.00
	4 to 8	0.50	1.00
	8 to 32	0.50	0.75

Different ways for making a casting mold



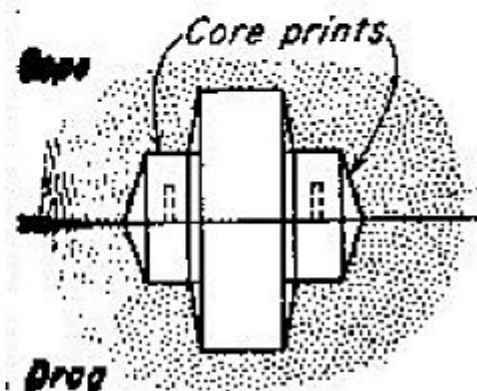
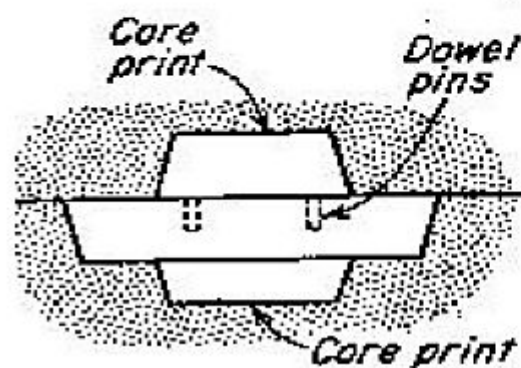
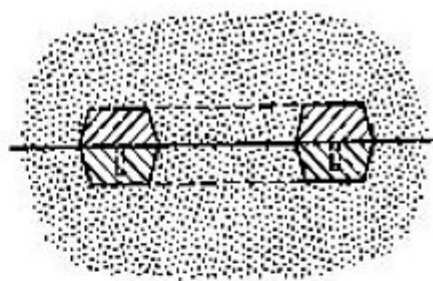
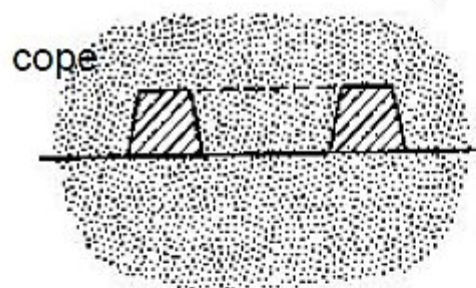
Simple bushing:
Sand casting to be molded



Flat back pattern can be used for this. In this after completing, the mold cavity is either in the drag side or in cope side or in both. The hole is formed by the molding sand.

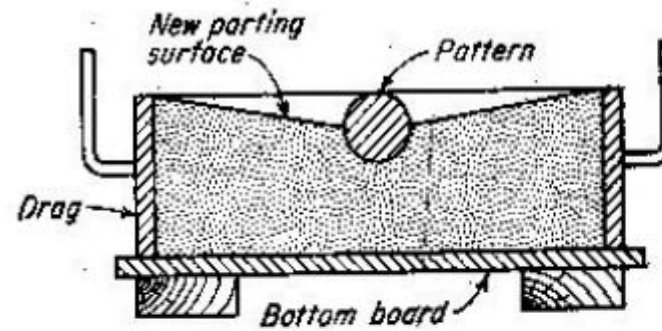
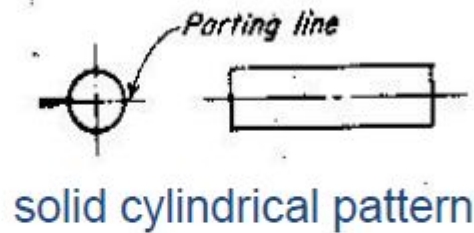
The outside edge around the flat back is the parting line and it is the starting place for draft.

This is the simplest and easiest method.



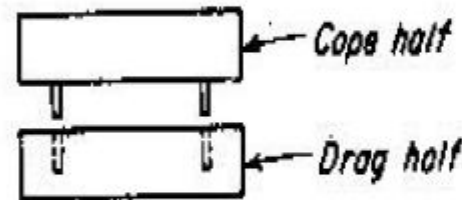
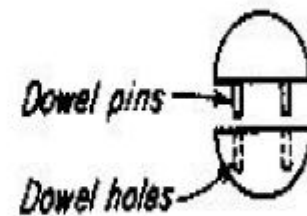
Using a dry sand core to obtain the core and this is split pattern. The axis of the hole (and core print) is vertical in first case.

The second case is same as first, except that the hole axis is horizontal.



Consider a solid cylindrical pattern as shown above. The pattern is placed on the molding board, rammed and rolled over. In order to withdraw the pattern from the sand, some of the sand is removed and smoothed as shown. This creates a new parting surface. Thus a parting line is made which joins parting line around the pattern. The operation of removing the sand and making a new parting surface is called 'Coping down'.

The mold is completed by ramming up the cope in a usual manner.

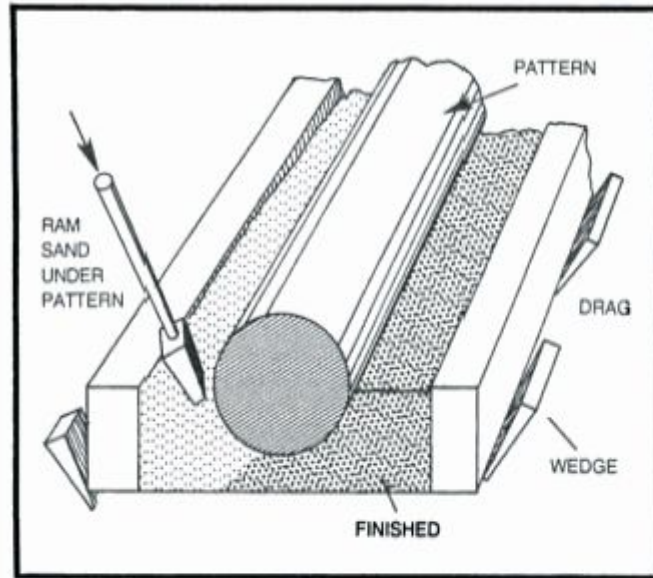


Split pattern for molding cylindrical casting

Other methods:

- cylindrical pattern standing on the end, if it were not too long
- cylindrical pattern can be molded using split pattern/mold also as shown in above figure.

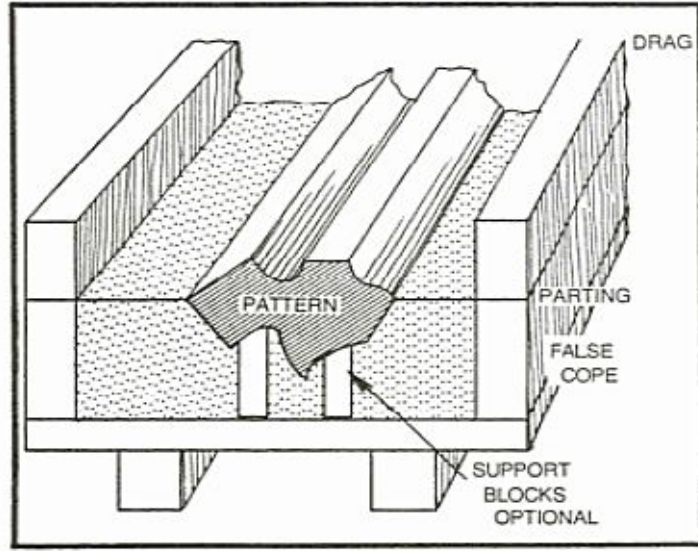
Bedding-in method



A complete handbook of sand casting, C.W. Ammen

- The solid cylindrical pattern can also be molded using 'bedding-in method'.
- In this method, first the drag is partially filled with molding sand and rammed.
- After sufficient ramming, the pattern is pressed into the sand. In this, to have proper ramming of sand, the sand close to the pattern is tucked and rammed tightly.
- Sometimes, the pattern is removed and the sand is surface tested for soft spots. In case of soft spots, ramming is continued with additional sand till the sand is packed tightly.

- The pattern is again pressed downwards to have a properly rammed mold cavity.
- Bedding-in is done so that the parting line is about level with the surrounding flat sand surface.
- Whenever a pattern is bedded-in, the drag need not be rolled over.
- Bedding-in can be employed for making larger molds using pit molding



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False cope (sometimes called 'odd side')

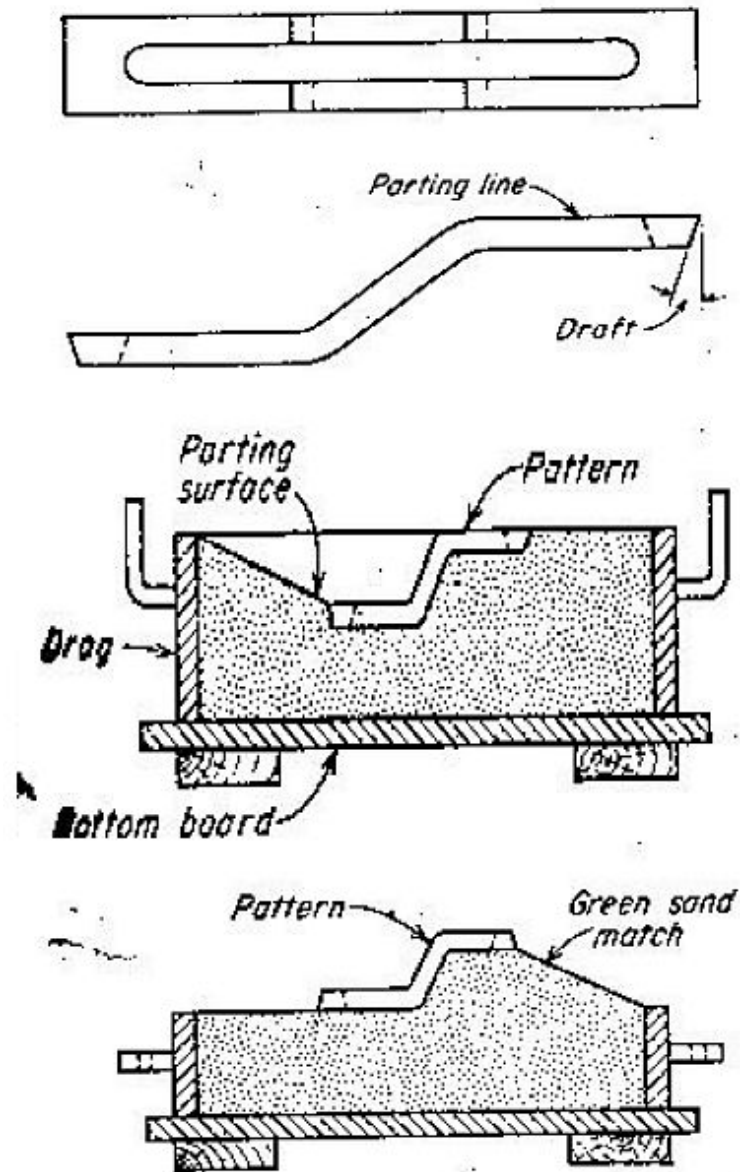
False cope technique is another method of molding the solid cylindrical pattern. This is similar to bedding-in method, except that it is not required to ram the sand tightly under the pattern, or the pattern shape is such that it is not possible to ram the sand tightly. The pattern is first bedded into the cope without giving importance to the ramming of sand beneath the pattern and a smooth parting surface is made.

The cope and pattern is then dusted with parting sand and drag part of flask is placed on top of the cope. Ramming is then completed in a usual manner.

The entire assembly is clamped and rolled over on a sand bed. The clamps are removed and the cope, cope bottom board are removed and destroyed.

The empty cope is then placed on the drag and usual ramming is performed. It should be observed that the cope, first used, is a dummy block for creating the drag correctly. This is called 'FALSE COPE'.

Green sand match



Green sand match ready for further drag making

The main reason for making a green sand match is that the coping down operations can be reduced to a greater extent, reducing the costs and time.

Take an example like a pattern with a parting line not lying in one plane (shown in first figure).

This pattern should be supported on a moldboard at the elevated end by a wood piece.

Once the ramming, rolling over and coping down are completed, the drag will look like as shown in second figure.

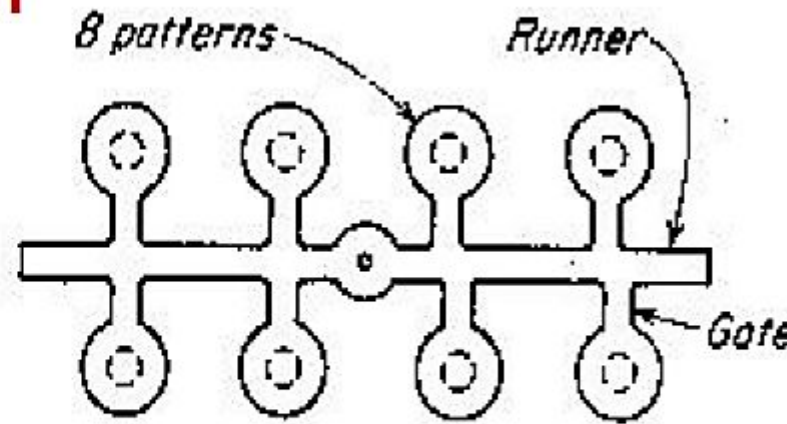
On top of this drag, a green sand match may be rammed up extra hard without sprue and riser pins.

The completed **green sand match** with pattern in place is shown in last figure.

The sand match is now retained with the uneven parting surface to support pattern and for further making of rammed drags.

Also called hard sand match, POP match, cement match

Gated pattern



Gated pattern for making eight small patterns

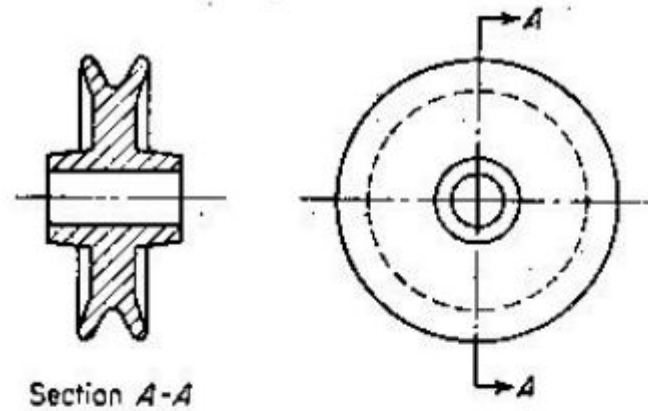
In this, the gate is made part of the pattern.

In general, a gated pattern consists of many small patterns fastened together through gating.

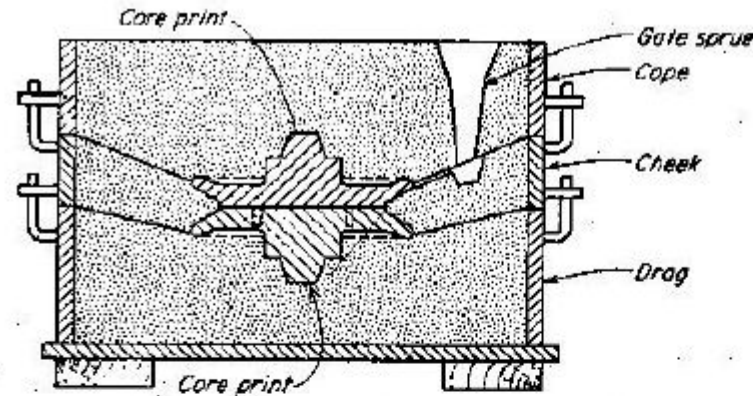
Since gates, runners are part of the pattern, time and cost are not spent in making them separately.

A number of patterns are rapped and drawn from the mold at the same time, saving additional time.

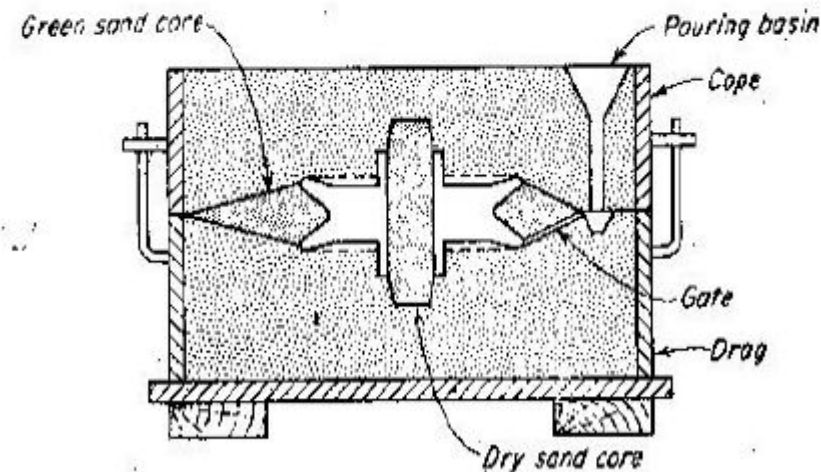
Patterns requiring two or more parting surfaces



Sheave wheel to be molded



Three part mold for sheave wheel casting



Using green sand core for making sheave wheel casting

- First method of making a sheave wheel mold is through three part flask, having a middle flask region called '**cheek**'.
- another way is by using **special green sand core**.