Casting

Pattern materials

Wood

1. Most widely used
2. Easily available
3. Low weight
4. Problem of moisture absorption causing dimensional inaccuracy over time
5. Low durability due to wear
6. Pine, mahogany, teak, walnut, deodar trees are commonly used

Metal

1. Durable, dimensionally accurate, better surface finish
2. Extensively used for large production quantity
3. Aluminium and white metal are mostly used due to low weight, easily workable, corrosion resistance.
4. Low shrinkage allowance is needed for metal patterns.

Plastic

1. Low weight, easy formability, durability, smooth surface finish
2. Dimensionally stable
3. Corrosion resistant, does not absorb moisture like wood
4. Epoxy resins are commonly used

Types of Moulding Sand

1. **Green moulding sand:** Freshly prepared mixture of silica, clay and moisture.
2. **Backing/system sand:** Reconditioned foundry sand (burnt sand) used in bulk of the mould.
3. **Facing sand:** mixture of system sand with finely powdered sea coal or bituminous coal (2% - 3%) to obtain better surface finish and to prevent sand fusion by avoiding mould-metal interaction.
4. **Parting sand:** Applied on parting plane and pattern surface for easy removal of pattern and easy separation of cope and drag flasks at parting plane. Composition is washed silica sand.
5. **Mould wash:** Finely powdered sea coal, graphite or some proprietary material is mixed with alcohol and applied on mould cavity by spraying/painting. Purpose is same as that of facing sand.

Properties of Moulding Sand

1. **Refractoriness:** Ability of moulding material to withstand high temperature of molten metal so that the sand does not fuse.

Material	Melting point (^{O}C)	Coeff. Of linear expansion x 10^{6}
Silica (SiO2)	1710	16.2
Alumina (Al2O3)	2020	8.0
Zircon (ZrO2 + SiO2)	2650	4.5

2. Green strength: Strength of the moulding sand in moist condition to retain the shape and size of the mould cavity.

3. Dry Strength: Strength of the moulding sand to retain the shape and size of the mould cavity when molten metal is poured and the mould becomes dry.

Properties of Moulding Sand

4. Hot strength: Strength of the moulding sand to retain the shape and size of the mould cavity when the mould becomes hot due to the presence of hot metal.

5. Permeability: Ability of the moulding sand to expel various gases through the mould during casting.

6. Collapsibility: During solidification of the molten metal, the moulding sand should not resist the shrinkage of the casting. This property is called collapsibility.

7. Thermal conductivity: This should be high for better heat removal from the casting.

Effects of different variables on moulding sand properties

1. **Shape and size of sand grains:** Coarse grains increase permeability and refractoriness, but deteriorates green strength and surface finish. Widely distribution of grain size increases permeability. Round grains decrease permeability.
2. **Clay and Water:** Strength of moulding sand increases with increase in clay content. For a certain amount of clay, an optimum amount of water should be used to obtain maximum strength.
3. **Moulding procedure:** Increased ramming increases bulk density and mould strength, but reduces permeability.

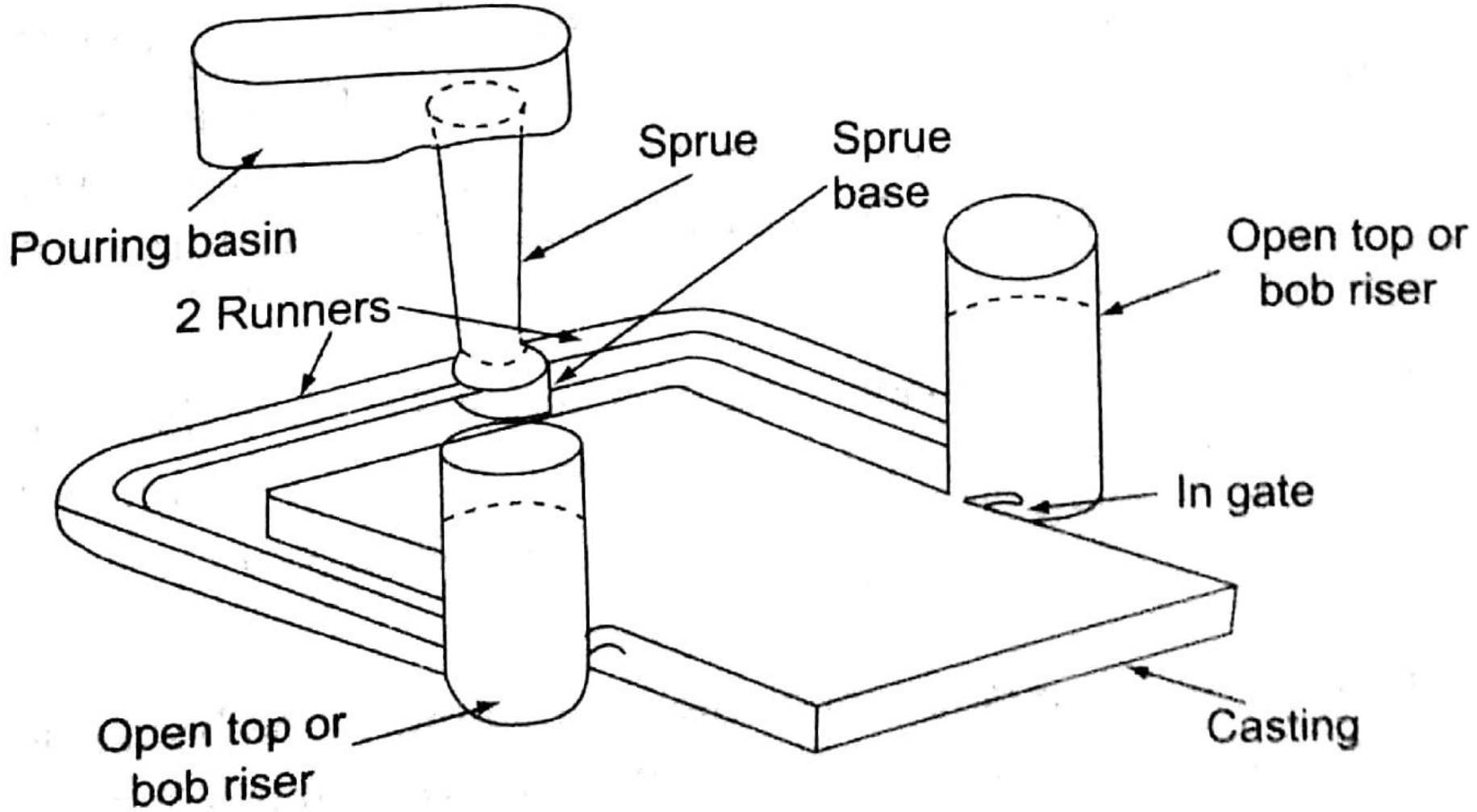
Properties of a good quality mould:

1. Strong enough to withstand the temperature and weight of molten metal.
2. Resistance to erosive action of erosive hot metal.
3. Gas generation should be minimum.
4. Good venting capacity.

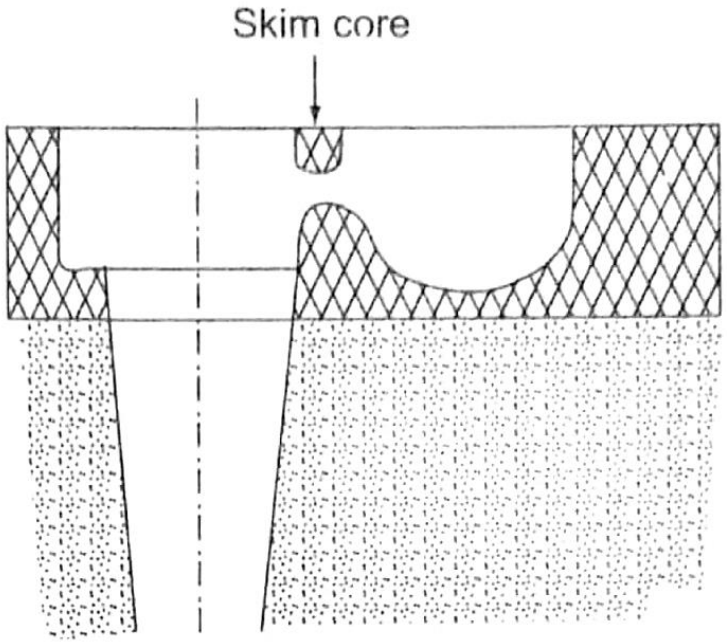
Types of sand mould

1. **Green-sand mould:** Most commonly used and least expensive. Metal is poured immediately and casting is taken out. Require less floor space and no storage of the mould is done. Mould erosion is common problem.
2. **Dry-sand mould:** Green sand moulds dried at 150 to 350 C in an oven for 8 to 48 hours. Higher strength than green-sand mould. Used for medium to large castings. Better surface finish and dimensional accuracy. Mould may be distorted during baking. Production cycle is longer. Costlier than green-sand mould.
3. **Skin-dried mould:** Skin of the mould is dried by a torch to a depth of 15 – 25 mm, instead of drying the complete mould.

Elements of a gating system



Pouring Basin

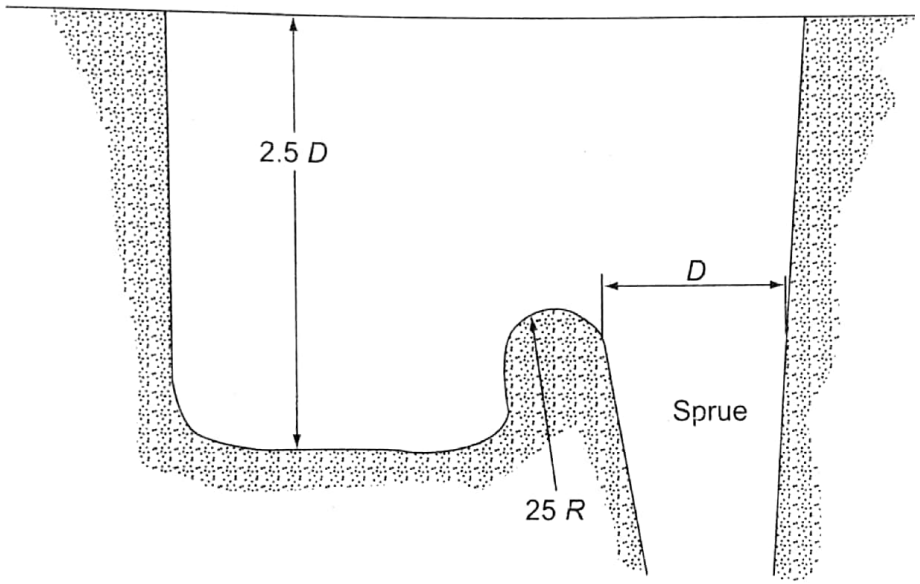


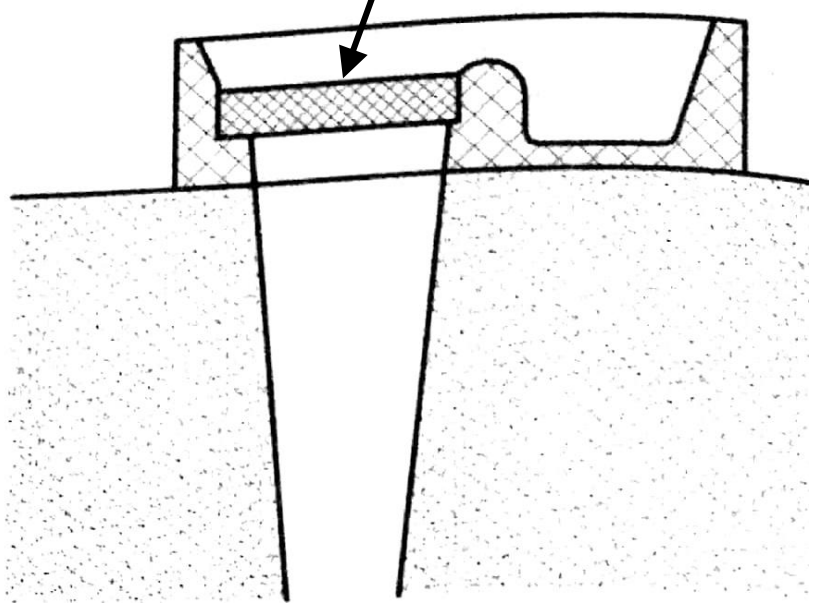
Main function: It reduces the momentum of liquid metal flowing into the mould cavity.

It should always be full to avoid air flow to the mould cavity.

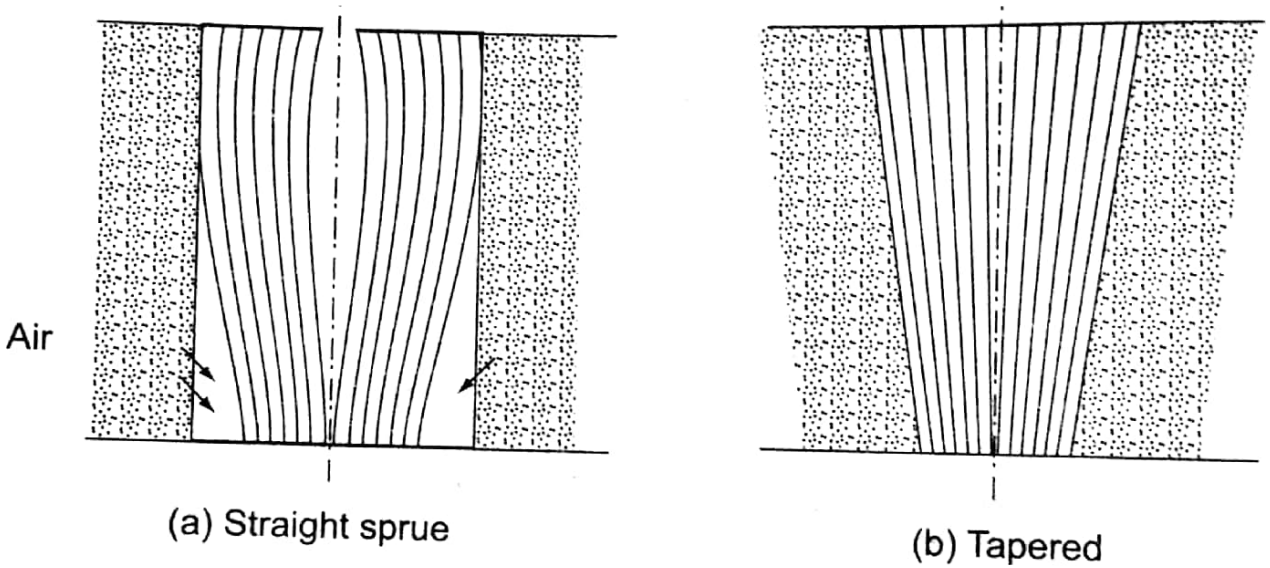
Skim core/Skimmer: Separates the slag from the molten metal.

Ceramic Filter: Removes slag and creates smooth flow in the sprue





Sprue It is the channel through which molten metal comes from the pouring basin to the parting plane.



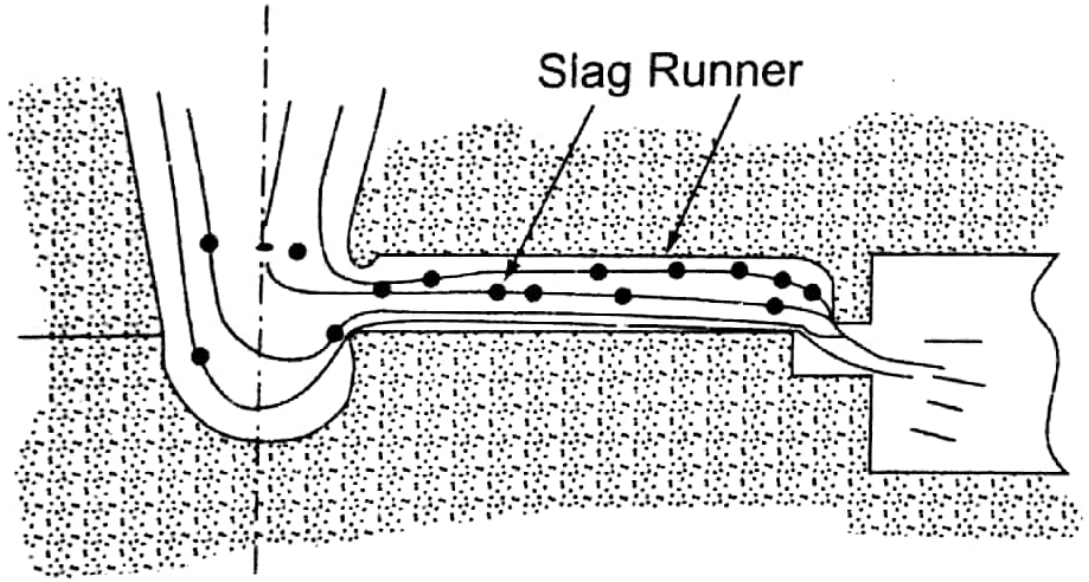
Straight cylindrical sprue: Low pressure zone is created around the metal flow, causing air flow from the atmosphere to the mould cavity.

Tapered cylindrical sprue: Sprue is always full of metal, hence no air flow from the atmosphere to the mould cavity.

Sprue base well: Molten metal reservoir at sprue bottom. It reduces the momentum of liquid metal, thus reduces mould erosion.

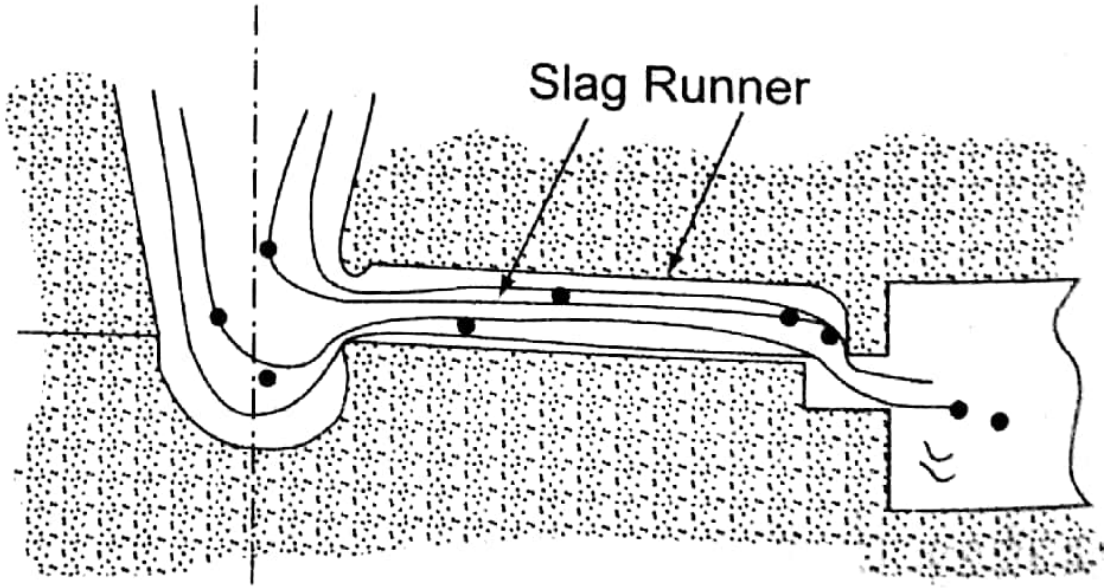
Generally, Sprue base well area is 5 times that of the sprue bottom (choke) area, and well depth approximately equal to that of the runner.

Runner It is the channel at the parting plane that allows metal flow from the sprue base well to the gate.



(a) Runner full

No slag flow into the mould cavity.



(b) Runner partially full

Slag flow into the mould cavity. Also, air inclusion may occur.

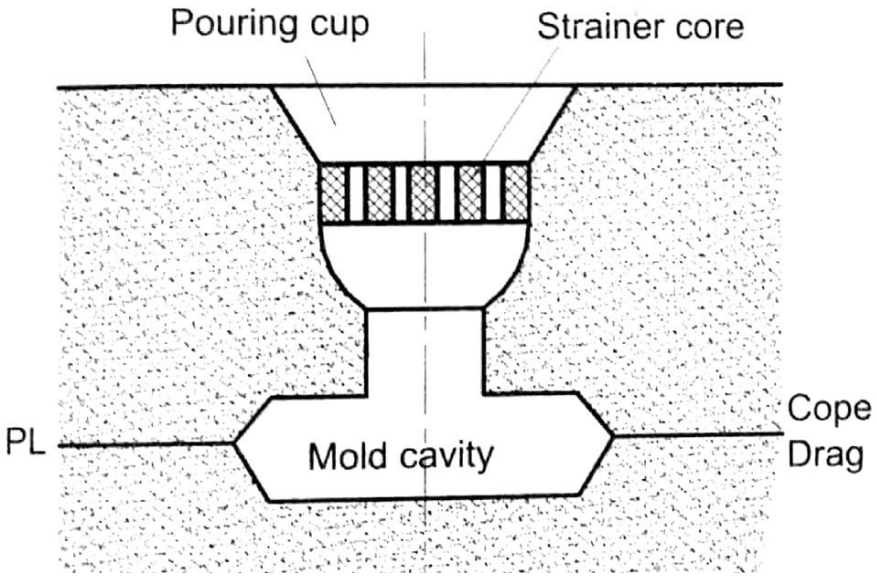
Runner extension: Runner is extended beyond the gate for slag trapping.

Gate/In-gate Opening through which molten metal enters the mould cavity from the runner.

Types of gate:

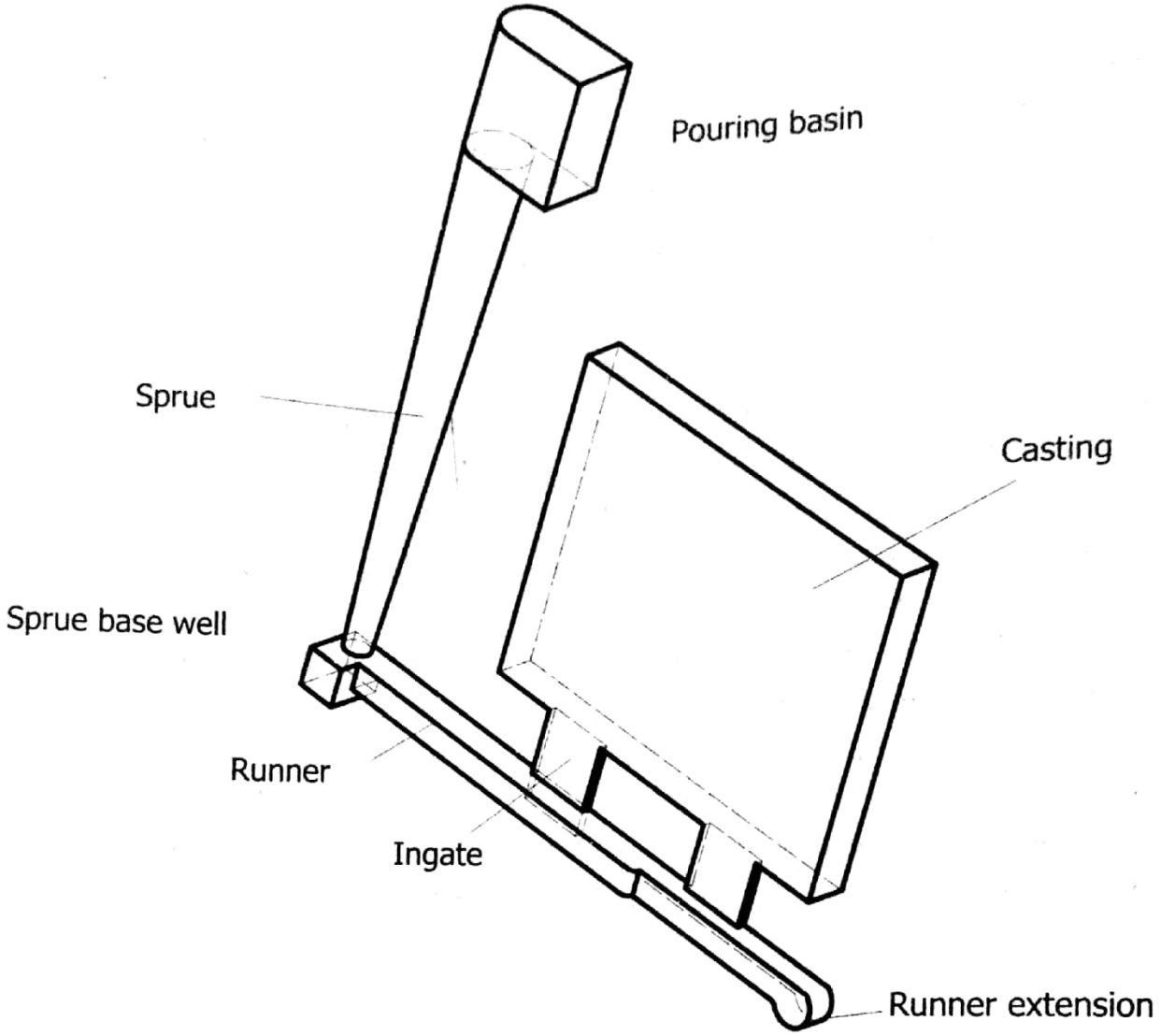
1. Top gate
2. Bottom gate
3. Parting gate
4. Step gate

Top Gate



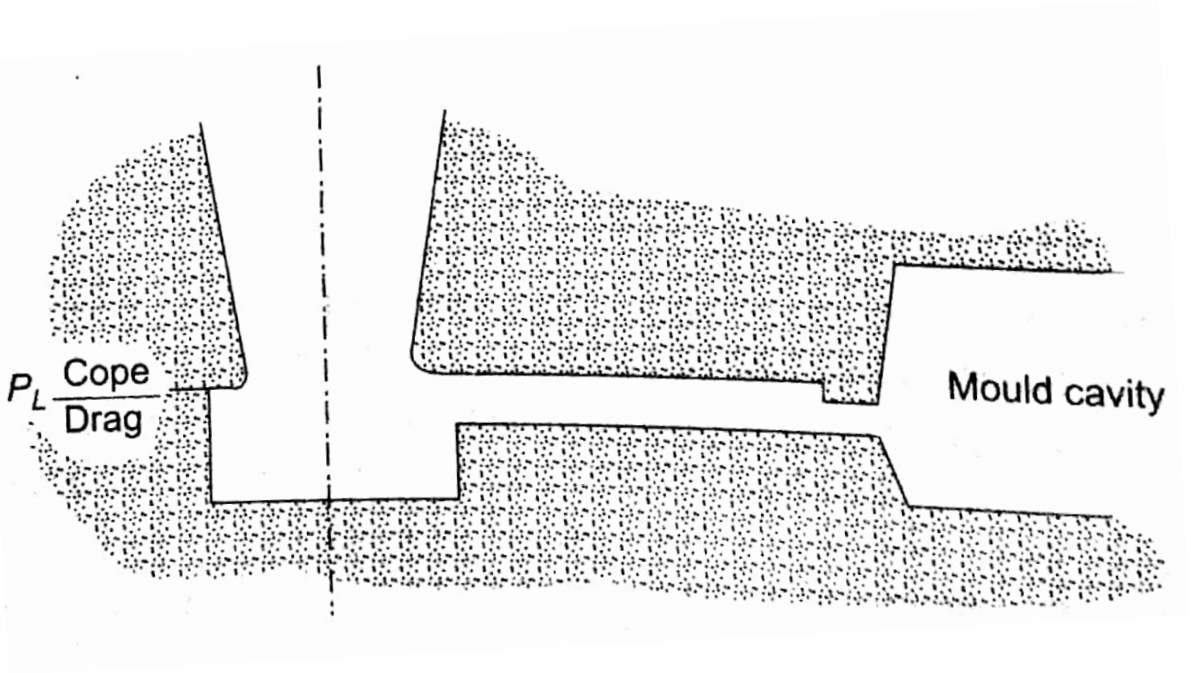
- Mould cavity filled very quickly.
- Favourable temperature gradient.
- No riser required.
- Causes mould erosion.
- Causes turbulence, thus producing dross.
- Suitable for simple, low-depth casting.
- Unsuitable for non-ferrous casting.
- High casting yield.

Bottom Gate



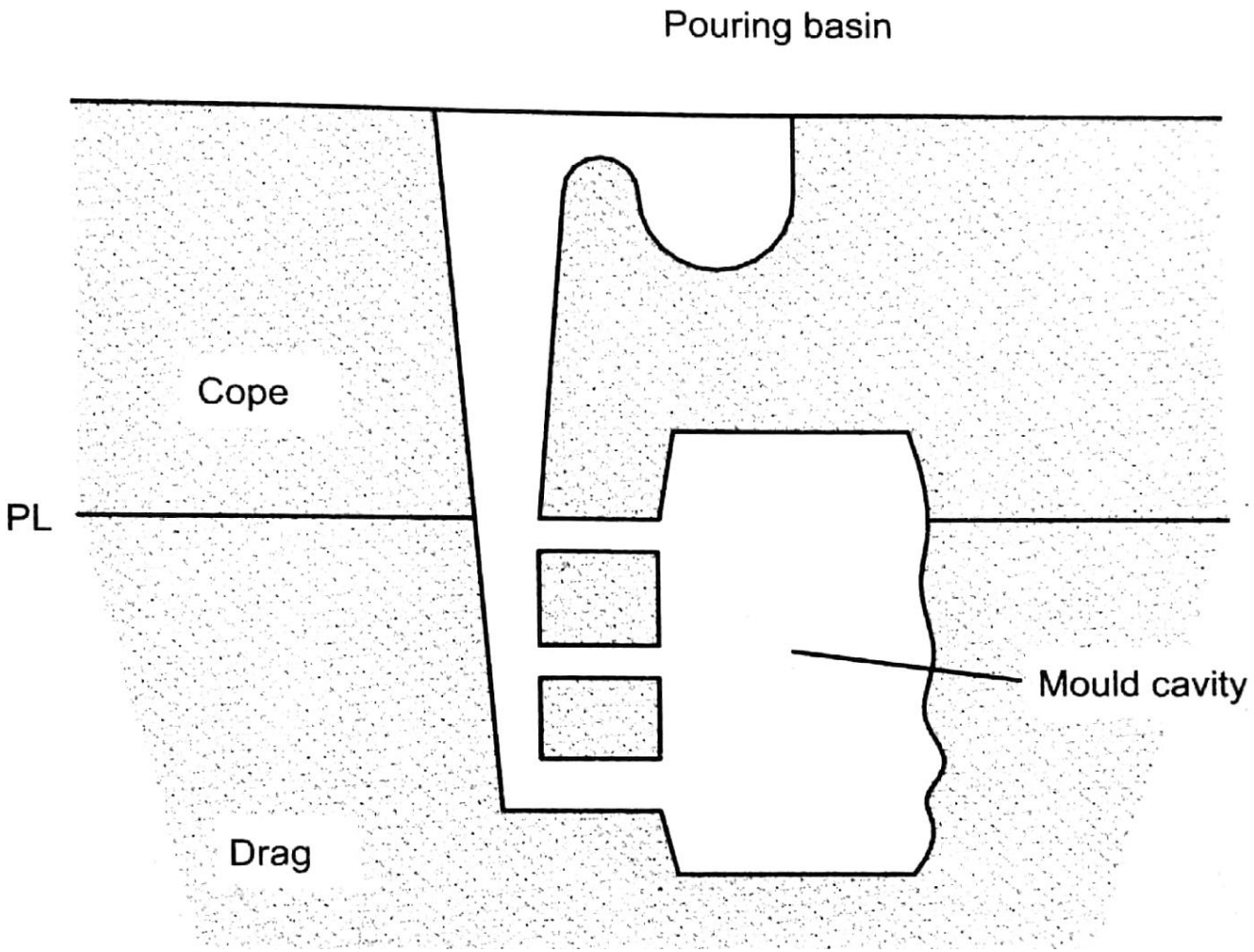
- Suitable for deep casting.
- No turbulence and mould erosion.
- Longer pouring time.
- Unfavourable temperature gradient.
- Large riser required.
- Lower casting yield.

Parting Gate



- Most widely used gate.
- Acts as top gate for the mould cavity in drag and as bottom gate for the mould cavity in cope.
- Deeper mould cavity in drag may cause mould erosion, dross formation, and air inclusion.

Step Gate



- Used for heavy and large castings.
- Molten metal enters the mould cavity via a number of gates arranged vertically.
- Size of the gates increase with depth.