GATING SYSTEM

Gating system means all the passages through which the molten metal enters the mould cavity.

i.e. it includes the

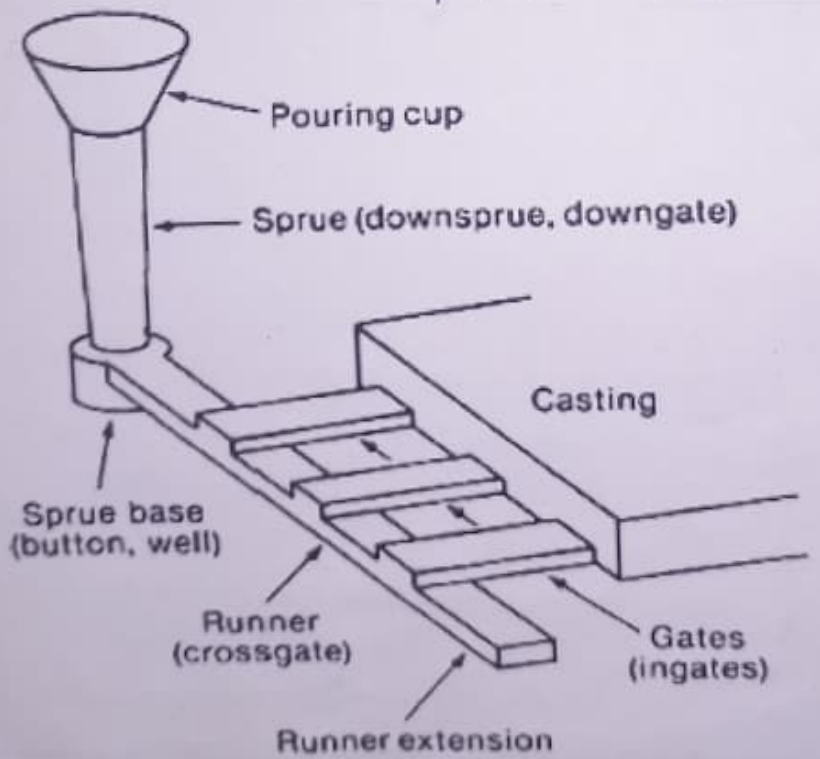
Pouring basin → Strainer → Sprue → Sprue base well → Runner → Skim bob → Gate → Casting.

Objectives of Gating Design

- Design the gating elements such that liquid metal can enter into the cavity with optimum velocity within a given time without causing turbulance, splashing and mould erosion.
- Design the gating elements such that pure metal can be entered into the cavity without air aspiration effect.
- Produce the gating elements to get maximum yield.

$$\text{Casting Yield} = \frac{V_c}{V_c + V_g}$$

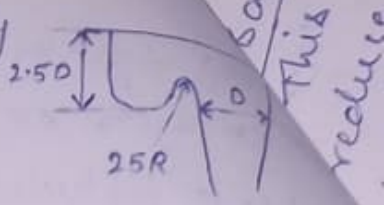
[V_c = Vol^m of Casting. V_g = Vol^m of gating system]



* Splash Core: provided at the bottom of the sprue to avoid the sand erosion from the bottom of the sprue.

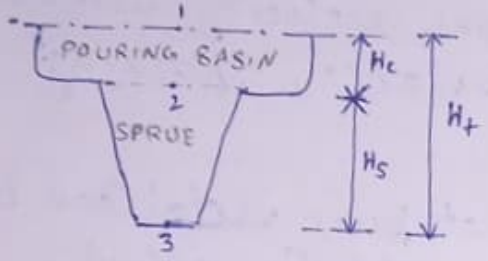
Pouring Basin:

- Pouring basin is designed to reduce the velocity of the molten metal which is entering into the sprue.
- It minimize the errosion.



Sprue:

- It is a tapered cylindrical section through which molten metal flow down.
- Velocity of molten metal increases due to tapered.
- This is made tapered to reduce air aspiration effect.



Due to continuity Eqn

$\rho AV = \text{Constant}$

In the mould we take ρ = constant.

$AV = \text{Constant}$

$\hookrightarrow A_2V_2 = A_3V_3$

$$\frac{A_2}{A_3} = \frac{V_3}{V_2} = \frac{\sqrt{2gH_t}}{\sqrt{2gH_c}} = \sqrt{\frac{H_t}{H_c}}$$

A = Area

V = Velocity.

$$\therefore \boxed{\frac{H_t}{H_c} = \left(\frac{A_2}{A_3}\right)^2}$$

* AIR ASPIRATION EFFECT:

During pouring of molten metal into the casting cavity, somewhere along the gating system, if the pressure falls below atmospheric pressure then pressure difference exists between outside and inside of the gating system. Due to this pressure difference, air starts flowing from outside to inside of gating system through permeability property of mould sand and form gas defects. This defect is called as Air Aspiration effect or inhalation effect or breathing effect.

To avoid air aspiration effect, the ideal shape of sprue is parabola. To reduce manufacturing difficulty, shape of sprue is considered as tapered cylinder.

Batch Time: _____ Roll Number: _____

Date: _____ Name of Candidate: _____

Base Well:

This is a reservoir for metal at the bottom of the sprue to reduce the ~~tigated jet and sprue~~ ~~wat~~ momentum of the molten metal.

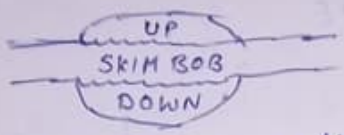
It prevent splashing and mould erosion.

Runner:

- It is a trapezoidal in shape.
- It has slope of 1mm inclination per 100mm of length [1:100]
- It regulates the flow of molten metal in the mould.
- It is a common passage for ~~reach~~ molten metal to reach the all. gates of cavity.

Skim bomb:

- It separates the small size impurities from the mould.



- The low density gases are collected in the upper portion which are ejected through vent holes.
- The high density [impurities] dross settled down in downward portion of skim bob.

Runner Extension

- This extension is provided to trap the slag from the molten metal.

Gates

- Tiny openings through which the molten metal enters the mould cavity.
- Cross sectional area of gates are smaller than runner, for increasing the velocity of molten metal and filling the cavity completely.

Riser

A Riser, feeder, is a reservoir of molten metal used to provide material when volumetric shrinkage arises during solidification.

* Strainer → device having holes punched in it or mode of crossed wires for separating solid matter from a liquid.
* Dross → foreign matters, dregs, Mineral waste in particular scum formed on the surface of molten metal.

GATE (Ingates):

- The openings through which the molten metal enters the mould cavity.
- It also have horizontal and uniform cross-section.

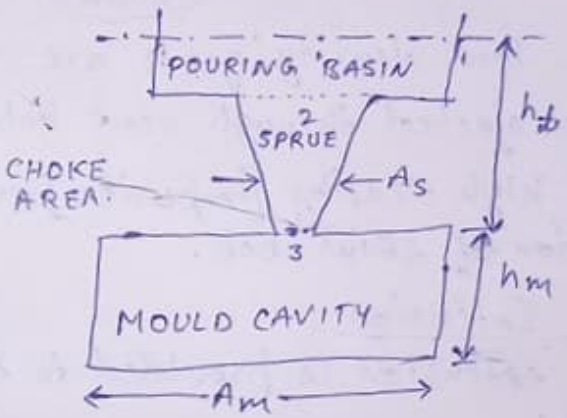
Classification of Gating System

1. Based on position of Ingate.
   - (a) Top gating system
   - (b) Bottom gating system
   - (c) Parting gating system.
   - (d) Step gating system.
2. Based on pressure above the molten metal in pouring basin.
   - (a) Pressurised gating system.
   - (b) Non-pressurised gating system.

(1) BASED ON POSITION OF INGATE

(a) Top gate

- Liquid metal will directly entered into the cavity from bottom of the sprue at atmospheric pressure.



A_m = Mould cross sectional area (cm^2)
A_s = Gate " " "
h_m = Height of mould (cm)
h_t = filling (pouring) height (cm)

Velocity of liquid metal at gate $(V_g) = \sqrt{2gh_t}$

$$\text{Pouring time} = \frac{\text{Volume of mould}}{\text{Gate cross-sectional area} \times \text{Velocity of melt at gate.}}$$

$$= \frac{A_m h_m}{A_s \times V_g} \text{ seconds.}$$

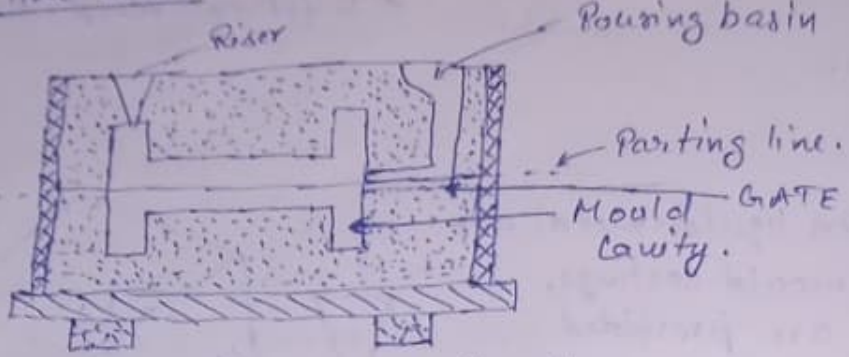
Roll Number: _____

Disadvantages

* Turbulence and erosion is caused in case of large castings.
* Can be used where moulds are erosion resistant.

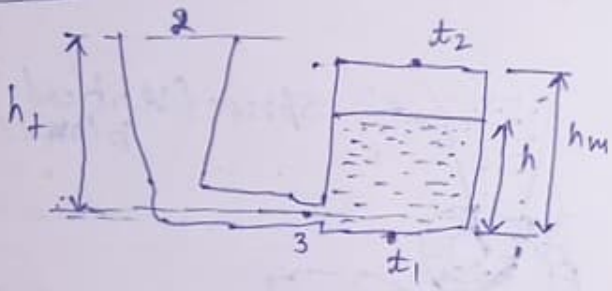
...ntages
Simple design.
Used of ferrous material.

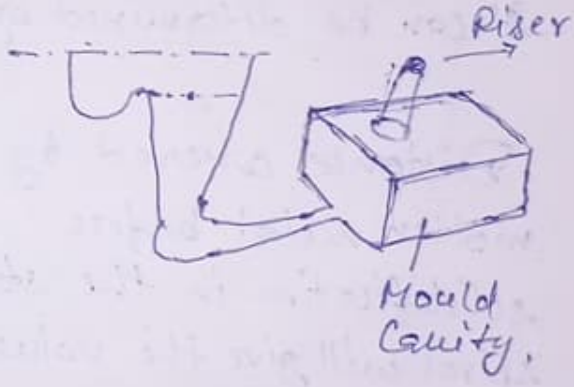
Parting line Gate:



* Gate is provided along the parting line.
* Below the parting line, cavity can be filled by assuming ~~bottom~~ gate
  above " " " , " " " " " bottom ".
  To get advantage of both top & bottom gate, it is commonly used.
* Liquid metal can filled in the cavity within a given time without causing turbulence.

Bottom gate:





* CHOKE AREA: The smallest area that occurs at the bottom of the sprue is known as "Choke area."
  Choke area is designed based on Bernoulli's theorem.

* Gate is provided at the bottom of the cavity.
* Velocity of the liquid metal negligible.

Advantages

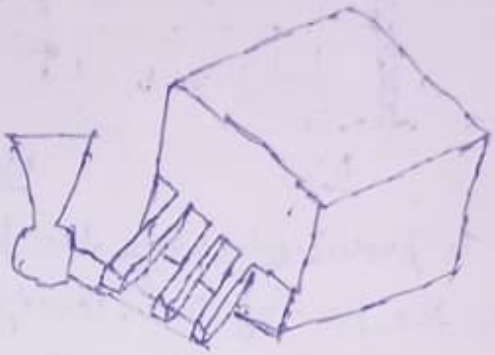
* No turbulence & Splashing.
* Used for casting of Non-ferrous material.
* Minimum erosion.

Disadvantage.

* riser solidify before the casting.
* Different temp. arises.

(4) Step Gate :

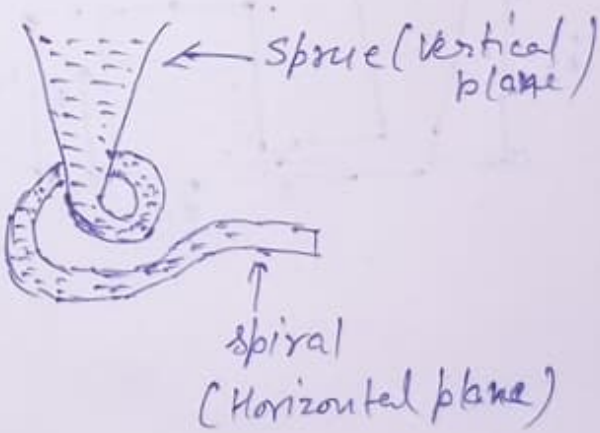
* To fill the molten liquid metal into very large sized mould castings,
* number of gates are provided such that liquid metal can be filled within given time.
* Min. Splashing & turbulance.



FLUIDITY

Ability of the liquid metal to flow into the cavity is called fluidity. It is the property of the liquid metal. It can be determined by conducting spiral test.

Distance covered by the molten metal before solidification in the standard spiral will give the value of fluidity.



d on pressure above the molten metal in pouring basin.

(a) Pressurized Gating System

* Choke area is at the gate.
* Velocity of the liquid metal which is entering into the cavity is very high
* Possibility of turbulence & splashing.
* Used for ferrous materials.
* No chance of air aspiration.
* Casting yield is more.

(b) Non-Pressurized Gating System:

* Choke area is at the bottom of the sprue.
* Velocity of the liquid metal which is entering into the cavity is less.
* No turbulence & splashing.
* Used for Non-ferrous material.
* ~~No~~ chance of air aspiration.
* Casting yield will be less.

Materials	Pressurized	Non-Pressurized Grating System.
	$A_C : A_R : A_G$	$A_C : A_R : A_G$
Gray Cast Iron →	1 : 1.3 : 1.1	1 : 4 : 4
Aluminium	1 : 2 : 1	1 : 3 : 3
Steel	1 : 2 : 1.5	1 : 3 : 3

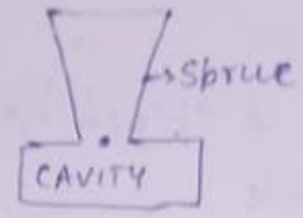
A_C = Cross-sectional area of choke or sprue.

A_R = " " " " Runner

A_G = " " " " Gate./

/Total cross-sectional area of the all gates.

Types of Grate

	Basis	Top Grate.	Bottom Grate.
1)	Shape.		
2)	Choke area	On the end point of sprue	Gate.
3)	Casting / Mould cavity size	Small	Large.
4)	Turbulance & Splashing	High (Max.)	Low (Minimum)
5)	Casting Materials	Ferrous	Non-ferrous.

	Properties of Liquid Metal		Fluidity
1.)	Pouring Temp.	↑	↑
2.)	Viscosity	↑	↓
3.)	Density	↑	↓
4.)	Surface finish of Cavity	↑	↑
5.)	% of water in Sand	↑	↓

Riser

* A riser is a reservoir of molten metal used to provide material when volumetric shrinkage arises in the casting during Solidification.

* Types

(i) Open riser

* Top surface of this riser is exposed to atmosphere.

(ii) Blind riser

It is a mould cavity formed either on the top or side of a casting and is surrounded from all sides by the moulding sand.