Computer aided casting design and simulation of bracket component

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ABSTRACT

Abstact : Casting is the process of manufacturing the desired shape of components. This is the basic process for the components for many years and has got importance even today in the 21st century. The earlier this process is used for making golden idols. In present situation the application of casting process spread widely in automotive components and domestic components and especially in spacecraft components, industrial components like valves etc. the principle of casting process that involves creating a cavity inside a sand mould and then molten metal is pouring directly into the mould. it is a versatile process and can be used in mass production. The component produced by this process has sizes vary from very large size to very small depends on design

INTRODUCTION

The casting process has several steps to finish, in that molding and melting are important stages. Many of the components produced by this process has defective casting, this is due to the improper control over these steps. The result will be poor productivity of foundry industry. Today the foundry facing problems majorly poor quality and productivity, due to large number of process parameters and shortage of skilled workers compared to other industries. Today we all see anywhere there is a competition so global buyers demand defect free casting and in-time delivery plan, which foundries are finding it very difficult to meet. It is important to correctly identify the defect symptoms prior to assigning the cause to the problem.

False remedies not only fail to solve the problem, they can confuse the issues and make it more difficult to cure the defect. The defect should be diagnosed correctly for appropriate defect measures otherwise new defect may be introduced. But the fact is it is not a easy task, since casting process involving complex interaction among various parameters and operation related to method design molding, pouring, melting, machining. The proper classification and identification of particular defect is

need to correct and control the casting quality .the gating system plays an important role in casting process to produce high quality casting. Generally the casting defects occurs due to poor design of gating system. The mould filling process occurs in process is controlled by gating system. The main function of gating system is to lead clean molten metal from ladle to the casting cavity ensuring smooth, uniform and complete filling. To design good gating system we should know the behavior of fluid flow during mould filling process. The mould filling is a complex phenomenon that influences both internal and external quality of component. The molten metal flows which is after being poured is a transient phenomena accompanied by turbulence, simultaneous heat transfer during the flow and onset of solidification. And melting properties like viscosity, surface-tension and density are continuously changing during flow. All these processes together makes filling analysis complex. An optimized gating design which fulfills the entire requirement is obtained by experimentation through trial and error methods for given casting geometry. The research work gives information that purpose of optimizing gating system is to maximize the casting yield, minimizing the wastage, minimizing the ingate velocity of molten metal and optimizing ingate location. No need of focusing maximizing the filling rate of molten metal.

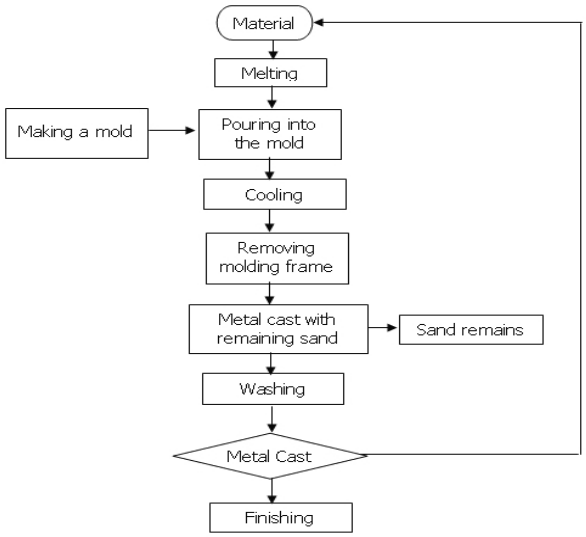

Fig. no. 1.5 Flow chart of casting process

Advantage of casting process:

- The process is easy to understand and any complex shape can be produced.
- The casting properties are same due to low cooling rate from all direction
- It is cheapest and direct method of producing desired shapes.
- The maximum size of casting can be produced i.e. above 150 tones
- It is best method for composite components to be cast which requires different properties in different directions.

Dis- advantages of casting process:

- The process takes much time to complete.
- Difficult to make thin sections.
- The investment cost is much and it is labor intensive.
- It is not suitable for mass productions.

1.2 Basic steps involved in casting process

There are two basic steps involved in the casting process, they are explained as follows

1.2.1 Obtaining the casting geometry:

The traditional method of obtaining the casting geometry is by sending the blue print drawings to the foundry. The customer will provide the required drawing to be cast.

1.2.2 Sand casting:

Sand casting is a process by which the molten metal is poured in sand mold to produce the desired casting parts. The process has following steps which are as follows.

- **Pattern making :**

  It may be defined as a replica of the object to be cast, used to prepare the cavity into which molten material will be poured during the casting process**.** When the pattern is withdrawn its replica leaves the mold cavity that is ultimately filled with metal to become casting.

Fig no. 1.6 Engine block pattern

- **Core making:**

  In core making cores are formed usually made of sand which is placed in the mold cavity to form Interior surfaces of casting.

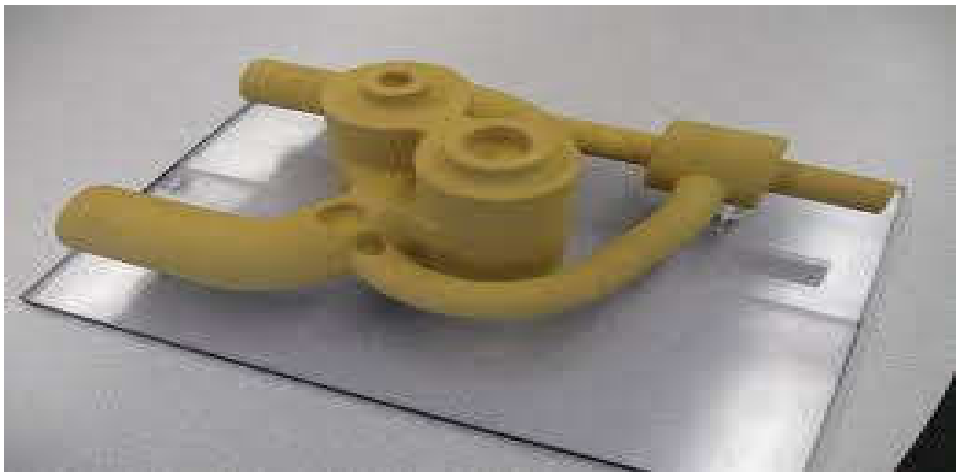

Fig no. 1.7 Core used in casting

- **Molding :**

  It is a process that consists of different operations essential to develop a mold for receiving molten metal. Molding process involves placing a molding aggregate around a pattern held with supporting frame.

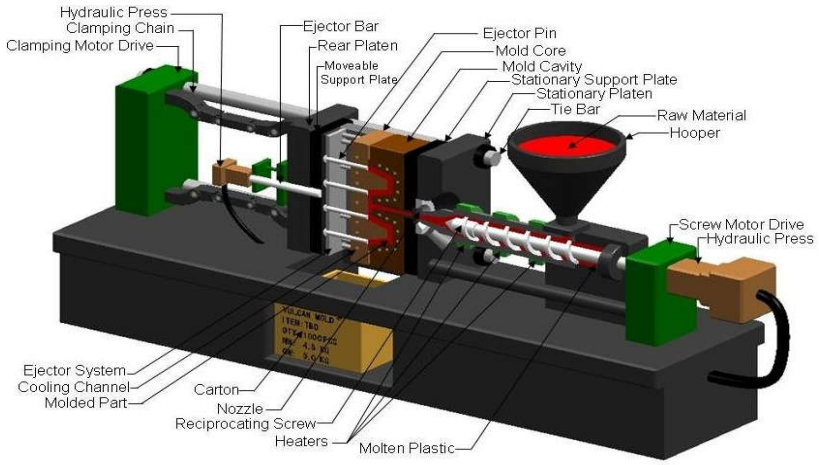

Fig. no. 1.8 Injection molding process

- **Melting and pouring:**

  Melting is a process of conversion of solid to molten state of the material for casting. It is generally done in specifically designated parts of foundry. Pouring is the process in which the molten metal is transported to the area where the molds are filled.

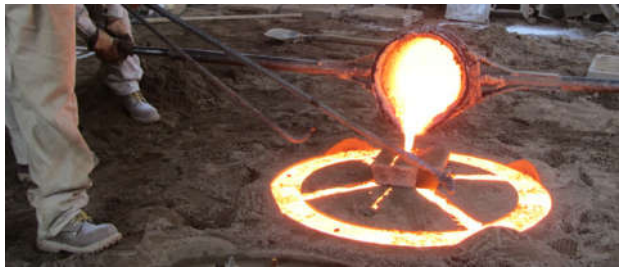

Fig. no. 1.9 Melting and pouring process

- **Cleaning :**

  It is the process in which after solidification of molten metal forms the casting and is separated from the mold and transported to cleaning department. The excess materials are removed like runner, gates, wire, line fins. then final testing and inspection is carried out for any casting defects.

Fig. no. 1.10 Finishing

Types of Gating system :

There are mainly two types of gating system which are as follows.

- **Horizontal gating system.**
- **Vertical gating system.**

1.7.1 Horizontal gating system: In this gating system the parting plane is in horizontal position and this gate contains runner and in gates in horizontal position. The element sprue is vertical in position and right angle to parting plane this kind of gating system is generally used for flat castings which are filled under gravity like in green sand casting and gravity die casting.

1.7.2 Vertical gating system: In this gating system as its name the parting plane is vertical in position and having runner and in gates in same position. The element sprue is vertical for gravity filling process and is along the parting plane for pressure die casting process. This type system is good for very height castings.

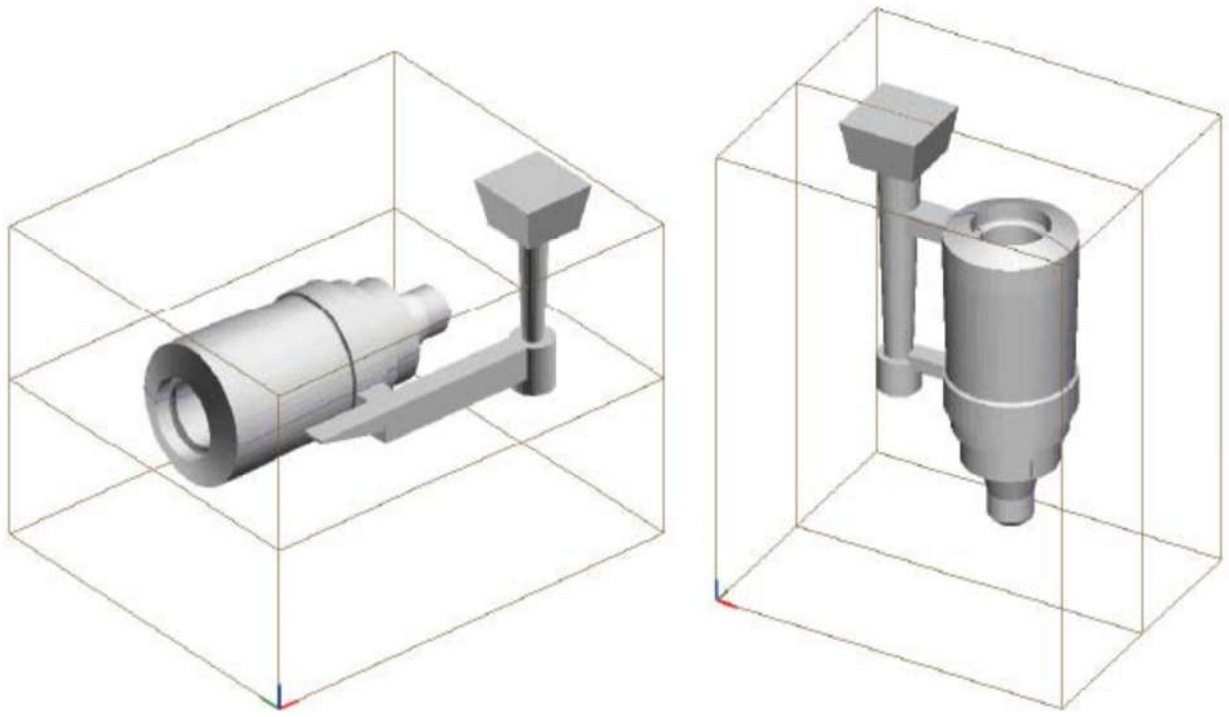

Figure. 1.13 a) and b) Classification of gating system based on parting plane orientation.

Now the other type of gating system depending upon the position of in gates the horizontal gating system further classified as .

a) Top gating system.
b) Bottom gating system.
c) Parting line gating system.
d) Step gating system.

a) **Top gating system :**

This is the type of gating system in which the molten metal from pouring basin enters directly to mould cavity which is in top position. The important thing of this gating system is to promote the directional solidification from bottom to top of casting cavity. In this gating the velocity of molten metal is remain constant from starting point to end point of filling at in gates hence the top gating system offers fast filling process than other gating system. it is only for ferrous alloys.

b) **Bottom gating system** :

The gating system in which molten metal from basin directly enters the mould cavity which is in bottom position with minimum disturbance and this system takes much time to fill the mould cavity. Generally this is used for deep mould and the mould erosion would not cause in this type.

c) Parting line gating system:

In sand casting process this type of gating system is widely used the name itself indicates when the molten metal enters the mould cavity at the parting plane in which half of casting part in the cope and half of casting is in drag. This type of gating is best compared to top and bottom gating system. Among all gates this is easy and most economical

d) **Step gating system:**

For heavy and large casting this type of gating system is preferred. in this gating the molten metal flows through the number of in gates which are arranged in vertical step and then finally enters mould cavity. The size of in gates are slightly lesser than size of runner. The type of gating system gives gradual filling of mould without any mould erosion.

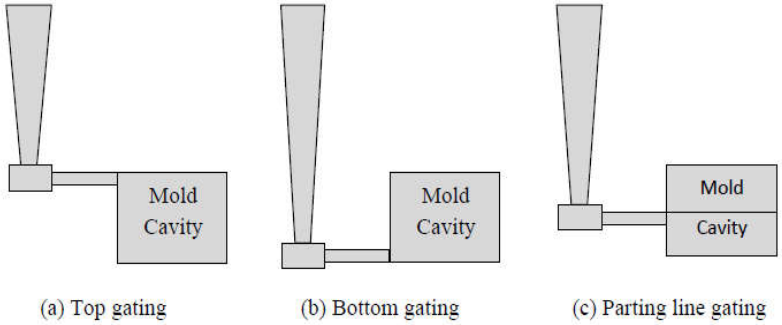

Figure. 1.13 c) Classification of gating system based on parting plane orientation.

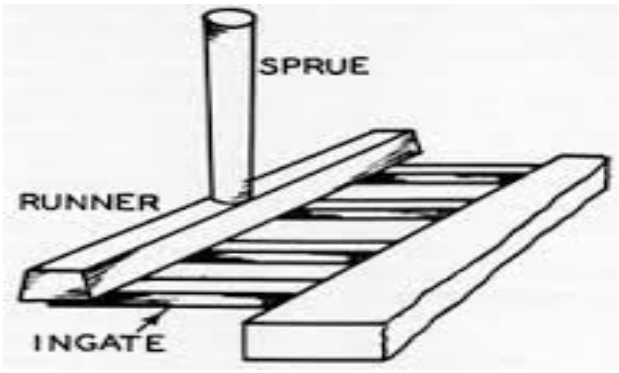

Figure. 1.13 Classification of gating system based on parting plane orientation. (d) Step gate

1.8 Filling related defects:

There are three types of casting defects filling process, they are

a) Incomplete filling.
b) Solid inclusion.
c) Gaseous entrapments.

a) Incomplete filling : when two stream of molten metal flowing in opposite direction and meet but not merge each other fully that results in cold shut or misrun this is due to poor fluidity of molten metal and this occurs when molten metal does not fill at thin or end section of component.

b) Solid inclusion: during filling of molten metal because of the high turbulence this defect is occurred in the form of sand inclusion and slag inclusion. The type of defect occurs due to bulk turbulence occurs in the gating that result in the erosion of sand from the mould wall.

c) Gaseous entrapments: The type of defect appears in the form of blow hole. When the hot gas which is inside the mold cavity is impossible to escape from sand and get into trapped in the final casting

component. The reason for this defect is rate of solidification is fast, generation of gas is high and poor venting.

1.8 The defects related to poor gating system design:

- Poor design allows metallic oxide and slag to enter the cavity of the casting.
- Produces gas-holes at surface.
- C + Mo = CO +M
- If temperature of pouring metal is low then problem arises

Fig no 1.14 Defects due to gas entrapment

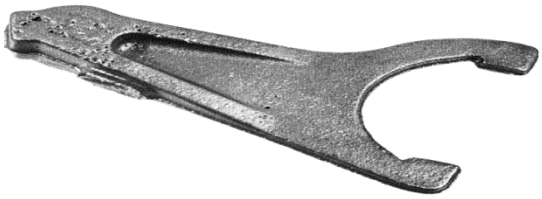

Fig. no. 1.14 Defects due to poor gating

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