Design of Vertical Gravity Die Casting Machine

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Abstract— In today's competitive world of castings, foundry has made significant advancements in the production, sale, storage methods .in production technology advancements using technology, technology plays a significant role to meet the demands and fulfill the challenges of production. Casting methods also have undergone various changes to make the process easier, faster and economical. Out of many processes of casting, there is a process called as Gravity Die Casting .It uses the principle that the molten metal flows under action of gravity due to its self weight so as to fill the die. The earlier method of production using Horizontal Gravity Die Casting method faced many problems like shrinkage, porosity, blowholes, turbulence .The main cause of it was faulty pouring method. This pouring method contains the pouring of molten metal directly into the die by using manual labour. This project aims at reducing rejection of finished product by increasing precision, accuracy. This can be achieved by changing the pouring method by tilting the die. This project briefs on design, analysis and production of Vertical tilting Gravity Die Casting machine. It is nothing but a machine which will tilt the die and cause the pouring of molten metal in the die by semiautomatic method and eliminating manual pouring in the die.

Key words: Gravity Die Casting, Pouring Method, Vertical Tilting

I. INTRODUCTION

A. *Gravity Die Casting Machine:*

The operation of vertical Gravity Die Casting machine starts with pouring of molten metal (which is at 1200^0 C) into the pouring pan which would make the whole process semi-automatic. And thus, the conventional method of manual pouring directly into die ends here. After the pouring of molten metal into the pouring pan which is attached to the die, the operation of tilting starts and thus, the metal starts flowing into the die with uniform speed. After 15 seconds, the casting solidifies with reduced losses. Finally, the casting is removed and then the die is cleaned with the pressurized air. Then the machine is brought to original position for further manufacturing of casting products.

B. *Design Approach:*

The approach of designing deals with the materials readily available in the market, space available

As we know that the operation of tilting the machine has to be carried out. There was need of cylinder to sustain the weight of machine under pressure. The number of cylinders selected was based on symmetry of machine so that proper tilting operation of machine would carry out throughout the process. As hydraulic cylinders were selected the other parts automatically came into picture of complete design of Vertical Gravity Die Casting tilting machine.

List of parts which we have designed are :-

- Top cylinder
- Bottom cylinder
- Hinged (tilt) shaft
- Bottom cylinder rod end
- Fulcrum pin
- Piston rod pillar
- Bottom cylinder fulcrum
- Selection of ball bearing

1) *Design of Shaft:*

a) *Material Selection:*

Ref :- (PSG 1.10, 1.12 & 1.17)

DESIGNATION	TENSILE STRENGTH N/mm^2	YEILD STRENGTH N/mm^2
EN 24	800	680

Centre hinge shaft is subjected to direct shear failure under weight of the structure and frame which is assumed to be 1000 kg , as two shafts on either side carry this load , load on each shaft is 500kg = 5000N

Now;

$$\text{Shear stress} = \frac{\text{Shear force}}{\text{Shear area}}$$

$$\sigma_{s(act)} = f_s \div (\Pi/4 \times d^2)$$

Shaft diameter = 60 mm

$$\sigma_{s(act)} = \frac{5000}{\Pi/4 \times 60^2}$$

$$\sigma_{s(act)} = 1.768 \text{ N/mm}^2$$

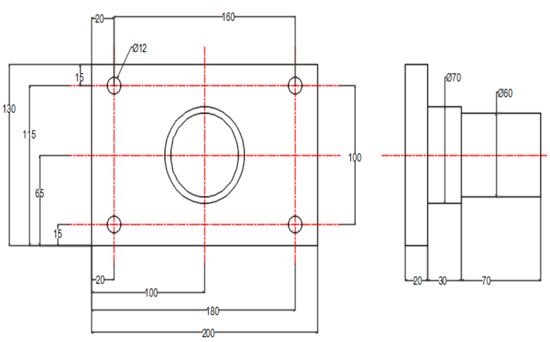
$$\sigma_{s(all)} = S_{ut} \div fos$$

$$= \frac{800}{2}$$

$$= 400 \text{ N/mm}^2$$

As; $\sigma_{s(act)} < \sigma_{s(all)}$ shaft is safe under shear load.

TILT SHAFT



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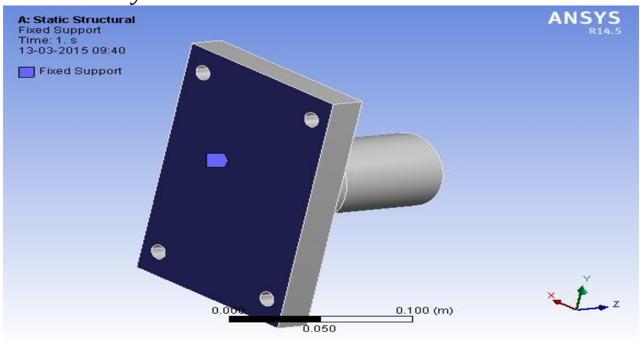
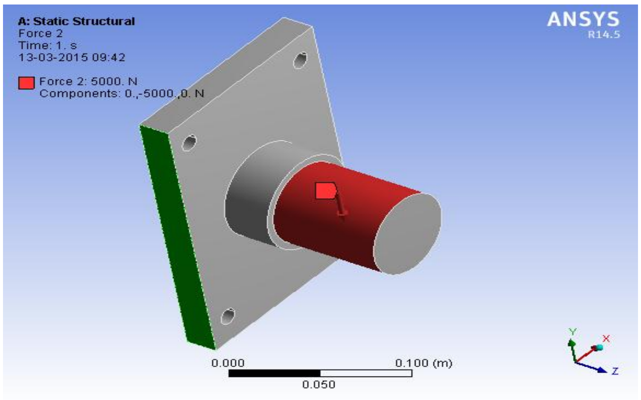
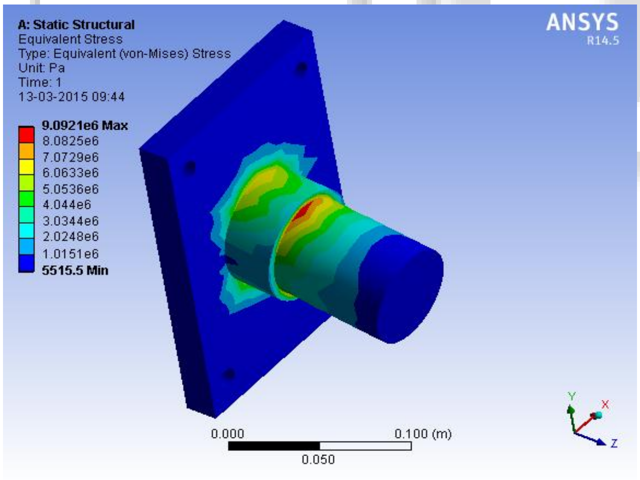
II. ANSYS ANALYSIS

A. Boundary Condition:





B. Result:



As the maximum stress induced 9.90 < 200 N./mm2 the shaft is safe in shear failure

III. CONCLUSION

Due to tilting of machine, we achieved the uniform speed of molten metal poured into the die, which eliminated the turbulence, (air trapped in molten metal) thus, resulting the reduced losses such as shrinkage, porosity, blow holes, dragging significantly.

The time for machining of product (the taking of molten metal from furnace into ladle upto removal of casted product after solidification) is reduced significantly. From the graph of production rate, we can conclude that the rate of production is increased slightly from the month of December.

We could achieve the high precision and accuracy of the products by reducing the effect of turbulence. Thus, increasing the rate of production.

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