न हि ज्ञानेन सदृशं पवित्रमिह विद्यते।

Smt. S. R. PATEL ENGINEERING COLLEGE

Gujarat Technical University

S.R.P.E.C

DESIGN AND DEVELOPMENT OF TRUE CENTRIFUGAL CASTING MACHINE

Project:- UDP

Group No :-028 Team ID:- 55396

Guided By :-

Prof. M. D. Patel

(Department of Mechanical)

Prepared By :-

Soni Amit V. (12me45)

Patel Viral M. (12me61)

Chaudhari Ankit R. (12me66)

Chaudhari Mayur R. (12me67)

CONTENTS

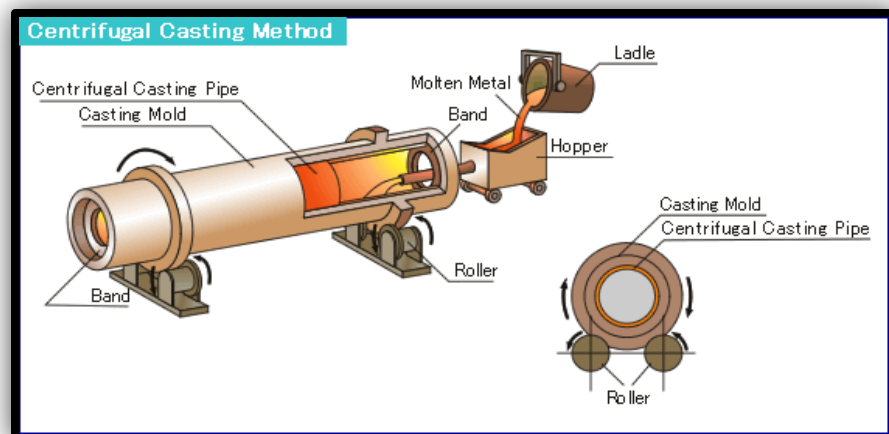
ABSTRACT:-

- The aim of the project is design and development of centrifugal casting machine. This machine produce hollow cylindrical parts. The casting part reduce porosity and make a sound casting part.
- The operation of the machine is based on the principle of centrifugal force. Suitable design theory and calculation were adopted carried out in the course of the work. The mold is bolted to the base plate which can rotate at moderate speeds thereby forcing the molten metal against the inner walls of the mold. This machine could be used to cast small engineering components in small industries and for practical purpose in workshop.

INTRODUCTION

CASTING : It is the manufacturing process in which molten metal is pored into mould cavity, after solidification of metal desired shape of part achieved.

CENTRIFUGAL CASTING : This is a process where the mould is rotated with predetermined speed about its central axis as the molten metal is pored into it. A molten metal is centrifugally thrown towards the inside metal wall, where it solidifies after cooling.



Centrifugal force is acted for making a sound casting in two way :

(1) Centrifugal force is utilised to distribute liquid metal over the outer surface of cast part, so hollow cylinder and other annular shape are formed.

(2) Centrifugal force tends to pored metal and freezing metal to fly outward to centre and this tendency creates high pressure on the metal which minimise porosity and holes in cast part.

There are three main types of centrifugal casting process :

(1) True centrifugal casting

(2) Semi centrifugal casting

(3) Centrifuge casting

There are basic two types of centrifugal casting machine

(1) Horizontal centrifugal casting

The method casting involves rotating the mould in a horizontal axis. A typical horizontal centrifugal casting machine is shown in Fig. Horizontal centrifugal casting preferred for the tube geometry.

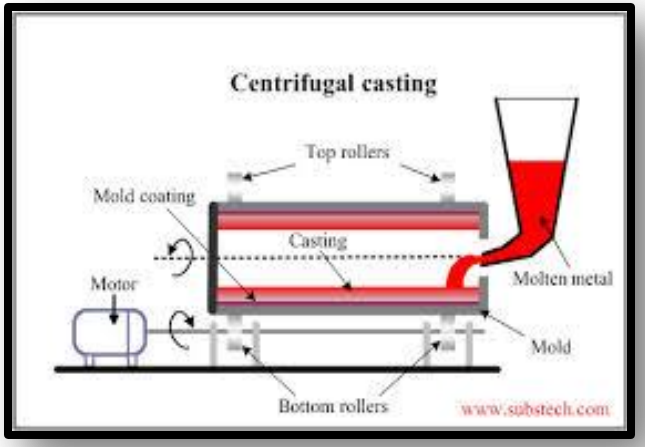


fig : Horizontal centrifugal casting machine[11]

(2) Vertical centrifugal casting

This type of casting is followed for cylinder type bodies having ring geometry. In this method the mould is rotated in a vertically axis. A typical vertical centrifugal casting machine is shown in Fig.

fig : Vertical centrifugal casting machine[11]

OBJECTIVES:-

- Design of true centrifugal casting machine.
- Fabrication of true centrifugal casting machine.
- By using centrifugal force Produce a small hollow cylindrical parts.
- Practical purpose for junior students in college workshop

Methodology

- Problem identification
- Analysis of process parameter
- Design calculations
- Prepare a design setup of true centrifugal casting machine
- Fabrication of true centrifugal casting machine

Literature Review

Sr.	Title	Investigator	Remarks
1	Properties of Centrifugal Casting at Different Rotational Speeds of the Die (January 2013)	Madhusudhan, Narendranath S, G C Mohan Kumar	•Study of rate of solidification of centrifugal casting is highly impossible by direct measurement, based on grain size the solidification rate can be easily determined. •. The slow rate of solidification gives coarse grains and faster rate of solidification gives fine equi-axed grains.

Sr.	Title	Investigator	Remarks
2	Cilinder liners in aluminium matrix composite by centrifugal casting (June 2004)	F. Bonollo, A. Moret, S. Gallo, C. Mus	The aim of this work is to analyze centrifugal casting process parameters in order to optimize the reinforcement distribution at the inner surface of the liner.

Sr.	Title	Investigator	Remarks
3	Process Capability Analysis of a Centrifugal Casting Process (2010)	S C Mondal	• The quality of the cast product depends on the rate of solidification, pouring time, pouring temperature, ladle preheat temperature and rpm of the mould. In centrifugal casting, the mechanical properties of material are considered as more critical than the dimensional characteristics (having a wide range of specification).

Sr.	Title	Investigator	Remarks
4	Experimental investigation on centrifugal casting of 5500 alloy: A Taguchi approach (November 2012)	P. Shailesh, B. Praveen Kumar, S. Sundarrajan and M. Komariahia	• Decrease in pouring temperature leads to increases in all the mechanical properties due to fine grains in matrix formed during the process. • Increase in Die-speed increases ultimate tensile strength due to the effect of centrifugal force acting on the metal.

Sr.	Title	Investigator	Remarks
5	Determination of the Solidification Time of Al-7%Si Alloy during Centrifugal Casting (February 2014)	P.Shaliesh, B. Praveen Kumar, K Vijaya Kumar and A Nagendra	• Freezing time of molten metal in centrifugal casting is a strong function of mould temperature as well as the pouring temperature. • The freezing time is completely independent of the rotational speed of the mould in the range considered in the present investigation.

DESIGN CALCULATIONS

❖ ***Determination of the Speed of Driven Pulley***

The speed of the driven pulley is determined by

$$N_2 = \frac{N_1 \times d_1}{d_2} \qquad \text{.....(1)}$$

Where:

N1 = Speed of the motor pulley (rpm);

N2 = Speed of the driven pulley (rpm);

d1 = Sheave diameter of motor pulley (mm);

d2 = Sheave diameter of driven pulley (mm).

The speed of the driven pulley is determined from Eq. (1) to be 510 rpm

❖ ***Determination of the belt speed***

The speed of the belt is determined by the relation

$$V = \frac{\pi \times d_1 \times N_2}{1000} \qquad \text{.....(2)}$$

Where:

V = Speed of belt.

The speed of the belt is determined using Eq. (2) to be 94.98 m/min

❖ ***Determination of belt Length***

The length of the belt of the centrifugal casting machine is determined by

$$L = 2C + \frac{\pi}{2}(d_2 + d_1) + \frac{(d_2 - d_1)^2}{4c} \qquad \text{..... (3)}$$

Where:

L = effective outside length (mm);

C = Distance between the two pulleys (mm).

The length of the belt is determined from Eq. (3) to be 1164 mm

❖ ***Determination of the centrifugal force on the machine***

The centrifugal force on the machine is given

$$F = M \times r \times \omega^2 \qquad \text{..... (6)}$$

Where:

F = Centrifugal force on the machine (N);

M = Total mass of the rotating disc (kg);

r = Radius of the disc (m);

ω = angular speed of rotating disc (rad/sec)

The centrifugal force of the machine is determined from Eq. (6) to be 1424.71 N

❖ ***Determination of the torque generated by the machine***

The torque generated by the machine is determined by

$$T = F \times r_D \qquad \text{..... (7)}$$

Where:

T = Torque generated (Nm);

r_D = Radius of rotating disc (m).

Using Eq. (7) above, the torque generated by the machine is determined to be 99.7 Nm

❖ *Determination of the required power by the machine*

The required power by the centrifugal machine is determined by the relation

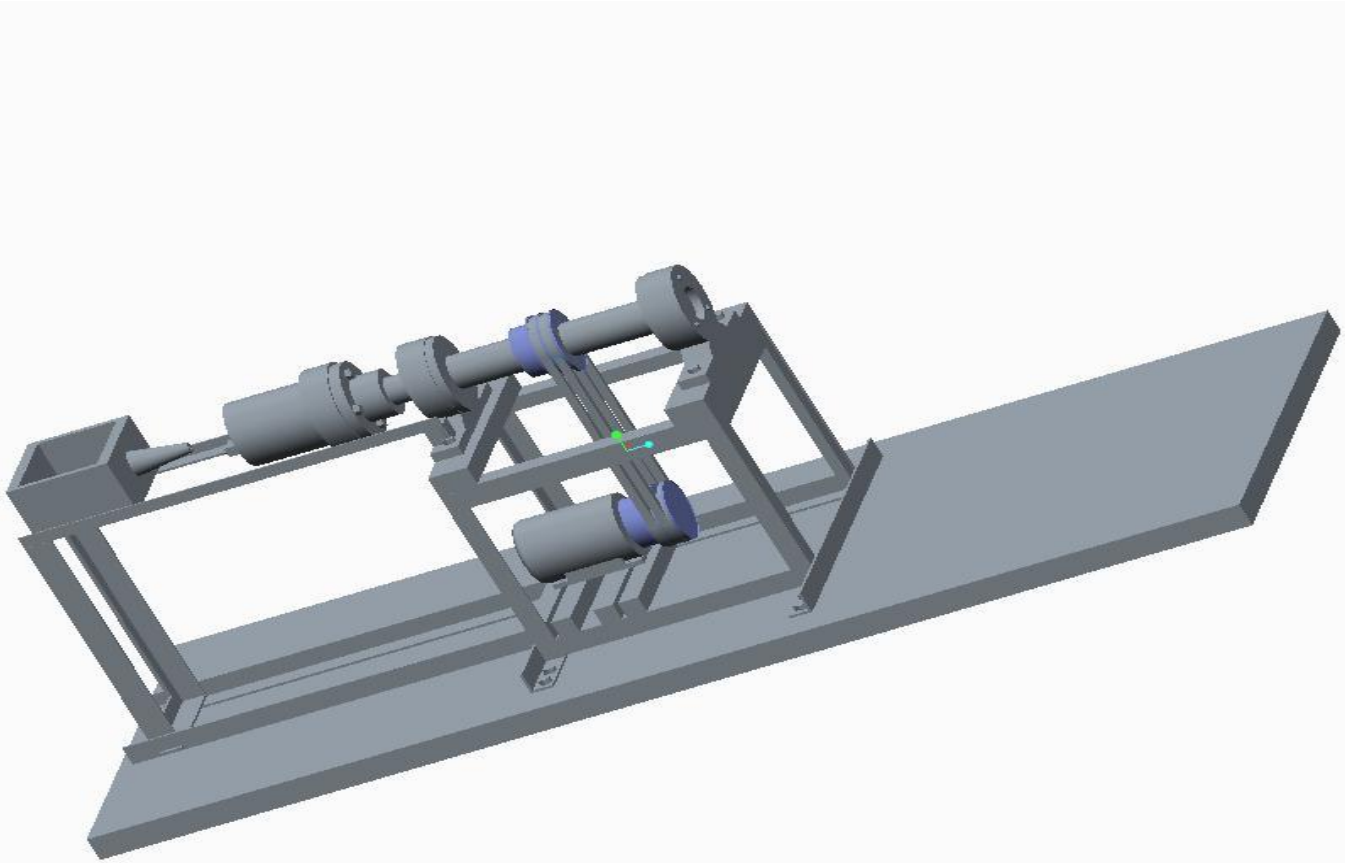
$$P = \frac{2 \times \pi \times T \times N_2}{60} \qquad \text{..... (8)}$$

Where:

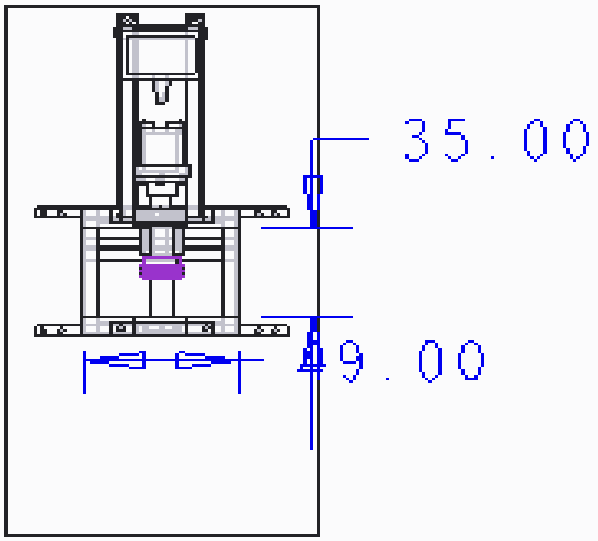
P = the required power (W)

From Eq. (8), the required power by the machine is determined to be 1.08 kW

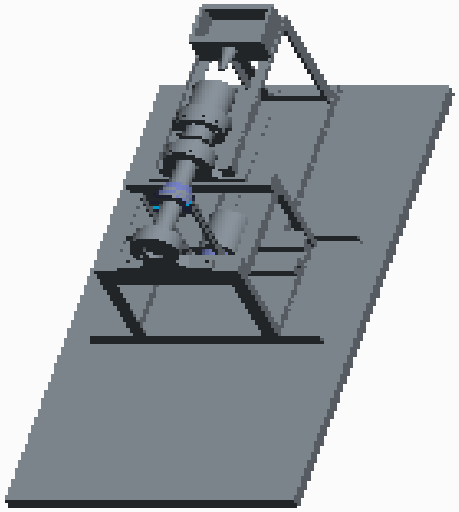
Machine setup



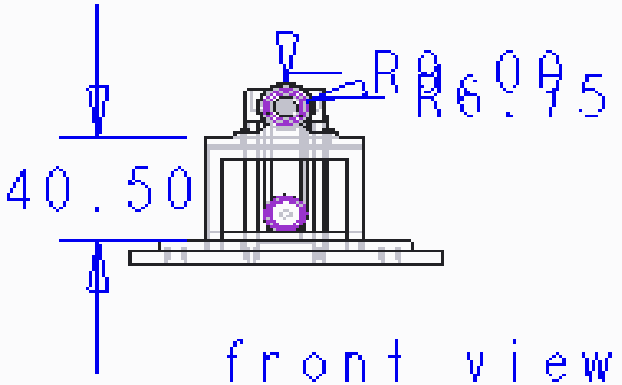
Design setup



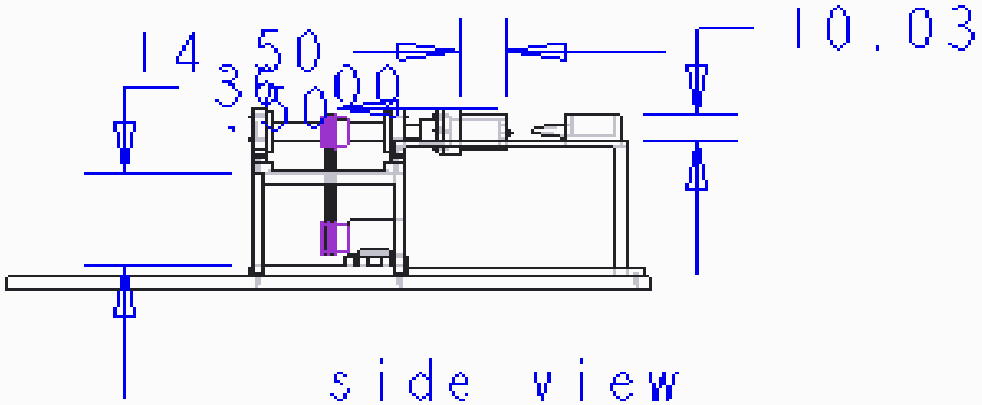
Top View



3D view



front view



side view

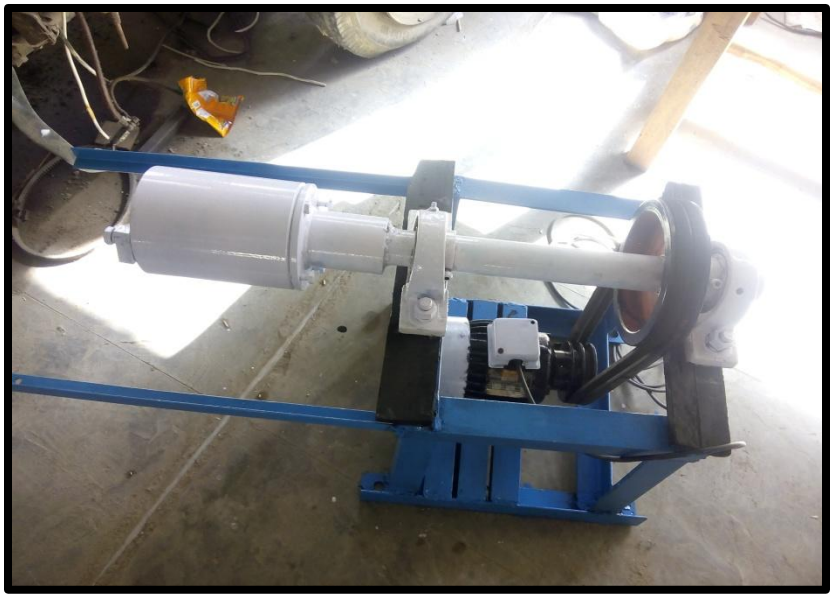
Stand

Shaft & bearing

Bearing

3-phase induction motor

Development of centrifugal casting machine



working of centrifugal casting machine

Casting part:-

Conclusion:-

- This project led to the design and construction of true centrifugal casting machine which is made of mould, shaft, belt & pulley, bearing, motor.
- It is basically used for casting small hollow cylindrical components.
- The mould spinning speed depends on the casting desired.
- The design setup is reduce the construction cost of machine.
- This process is minimise porosity and holes in cast part.
- A Sound casting parts are generate by using centrifugal force.

Progress Report

Sr. No	*Topic*	*Jan-2016*				*Fabru-16*				*March-15*			
		W-1	*W-2*	*W-3*	*W-4*	*W-1*	*W-2*	*W-3*	*W-4*	*W-1*	*W-2*	*W-3*	*W-4*
(1)	*Gathering information about the components*												
(2)	*Collect the parts*												
(3)	*Machining process*												
(4)	*Assembly of machine components*												

Sr. No	Topic	April-16				May-16
		W-1	W-2	W-3	W-4	W-1
(4).	Assembly of machine components					
(5).	Practical perform on centrifugal casting machine					
(6)	Presentation and Report					

References

- (1)Madhusudhan, Narendranath S, G C Mohan Kumar, “Properties of Centrifugal Casting at Different Rotational Speeds of the Die”, Volume 3, Issue 1, January 2013), Website: www.ijetae.com (ISSN 2250-2459).
- (2)Adedipe Oyewole and Abolarin Matthew Sunday, “DESIGN AND FABRICATION OF A CENTRIFUGAL CASTING MACHINE”, Vol. 3 No.11 November 2
- (3) Mahendra Kumar Gupta, Soniya Nayak, Amit Ku. Kachhawaha, “Analysis of centrifugal casting on their manufacturing parameter”, 2015,www.johronline.com
- (4)Nagesh Jamulwar, Kedar Chimote,Ashtashil Bhambulkar, “Design and Implementation Of Centrifugal Casting Locking Plate”, Volume 2, Issue 2, April 2012 ISSN 2249-6343

- (5) Sagar Kadam, Girish Deshpande, “A Review on Design Analysis and Optimization of Centrifugal Casting Machine Shaft”, Vol. 5,Iss. 5, May 2015 www.ijmer.com
- (6)Aakanksha Suryawanshi, Chandra.H, Shiena Shekhar, “OPTIMIZATION TO IMPROVE THE QUALITY OF CENTRIFUGAL CASTING BY GREY FUZZY METHOD”, *Jan.-March,2015,*
- (7) P.Shaliesh, B. Praveen Kumar, K Vijaya Kumar and A Nagendra, *“*Determination of the Solidification Time of Al-7%Si Alloy during Centrifugal Casting”, *Special Issue-2 (Feb 2014)*
- (8)A Review of Various Methodologies Used for Shaft Failure Analysis(2012) V. S. Khangar and Dr. S. B. Jaju .
- (9) G. Chirita,I. Stefanescu,J. Barbosa,H. Puga,D. Soares and F. S. Silva, “On assessment of processing variables in vertical centrifugal casting technique” 2009 VOL 22 NO 5
- (10)Nan nan Song, Shi ping Wu, Xiu hong Kang,c Dian zhong Li, “Hydraulic experiments of mold filling process in horizontal centrifugal Casting”, *2010/Oct/27* www.ttp.net.
- *(11)F. Bonollo, A. Moret, S. Gallo*,“Cilinder liners in aluminium matrix composite by centrifugal casting”, 6/2004

- (12)R. Nowosielski, R. Babilas, “Fabrication of bulk metallic glasses by centrifugal casting method”, VOLUME 20 ISSUES 1-2 January-February 2007
- (13) Process Capability Analysis of a Centrifugal Casting Process (2010) S C Mondal.
- (14) Fu Hanguang , Cheng Xiaole , Du Zhongze , Lei Yingping , and Feng Zhenjun, “Effect of quenching temperature on structure and properties of centrifugal casting high speed steel roll”. Received: 2008-10-10; Accepted: 2009-01-05
- (15) Shivaji V. Gawali, Vinod B. Tungikar, “STUDY OF BEHAVIORAL PATTERN IN WEAR APPLICATIONS COMPOSITE IN PRESENCE OF DIFFERENT GEOMETRIC SHAPES”, Volume 12, Issue 1, April 2013
- (16) S C Mondal, “Process Capability Analysis of a Centrifugal Casting Process”. *January 9 – 10 2010*

- (17) P. Shailesh, B. Praveen Kumar, S. Sundarrajan and M. Komariahia, “Experimental investigation on centrifugal casting of 5500 alloy: A Taguchi approach”, 12 November, 2012,http://www.academicjournals.org.
- (18)Charanjeet Singh Yunis Ahmad Dar “Study of Centrifugal Casting of Cast Iron Rolls and its Problem Formulation at India Factory, Malerkotla”, Volume : 4 | Issue : 6 | June 2014 | ISSN – 2249,

Thanks……