Design and Fabrication of Industrial Sand Screening Machine for Green Sand

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***Abstract*: For the casting process, it requires sand as an important ingredient. Sand is used in green sand casting process for mold, core, runner and riser etc. in cope and drag. The sand screening machine is a machine that is used for sorting/ screening/separation of sand. The machine is work on the principle of rotary motion is responsible for the agitation (shaking) of the sand leading to separation of coarse particle from the required particle (fine and clean sand). The machine fabricated for casting process where the quality of sand increases the quality and finishing of the work.**

Sand is use in construction, manufacturing and many industries. Sand needs to be filtered and separated from unneeded particle, stones and other large particles before it are put to use. Our system puts forward a fully automated sand filtering and separator system that automatically filters sand poured on it. Here we use motorized shafts that are mounted horizontally using mounts. The shafts are connected to the filter frame with mesh below and enclosing frame on the side. We now have a rod connected from the shaft to the filter frame in a way such as to achieve best horizontal motion at the same time. ON switching on the motor using our motor controller circuit, the system allows to operate the motor. This allows us to operate the sand filter motion for appropriate sand filtering needs.

A sand scanning device for separating wanted element from unwanted material or for characterizing the particle size distribution of a sample, typically using a woven screen such as a mesh or net. This project focuses in design, fabrication of the mechanical part of machine and the system of the sieve machine. To achieve this project objective, this sieve machine body structure and mechanical system needs to concern some other criteria such as strength, safety and ergonomic design.

***Keywords*: Casting process, Design and fabrication, Ergonomic design, Filtering, Scanning machine, Rotary motion.**

1. Introduction

A sand sieving machine is designed to separate the particle according to their mesh size. In many industries for Example the pharmaceutical, mining, food, etc. it is often desirable to communicate particulate matter. Sieves are Used for sifting flour has very small holes. Depending upon the types of particles to be separated, sieves with different Types of holes are used. Sieves are also used to separate stones from the stand. A number used to designate the size of a sieve, usually the approximate number of openings per inch. The size of openings between crosses wires of a testing sieve.

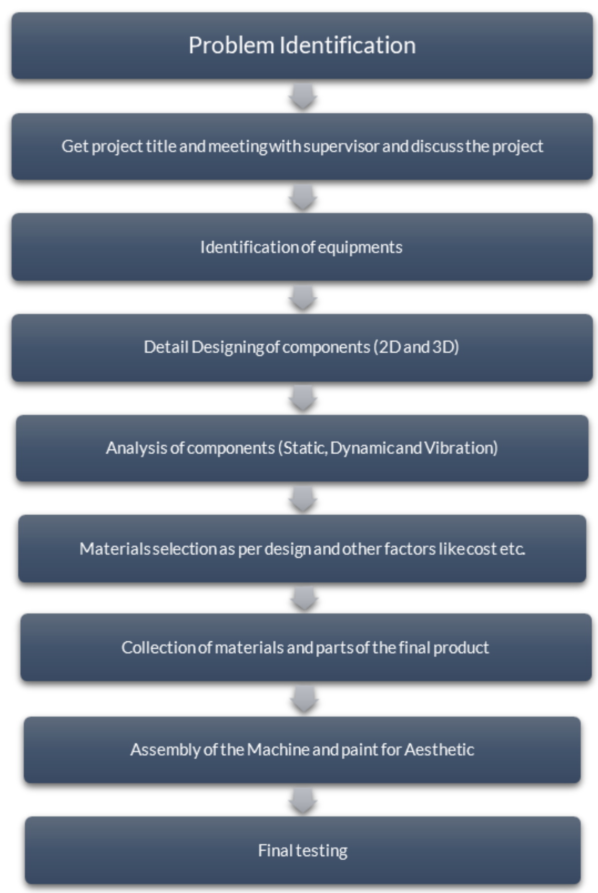

Fig. 1. Methodology

The sand sieving machine is handily to construct and can be operated easily. This fabricated with the help of parts like a handle, crank and slotted link mechanism, bearing, rail track, sieving box and a collecting box.

The horizontal sieving machine is worked by eccentric pendulum mechanism. The rail track is attached to the base in which the collecting box moves in it. The collecting box is fixed with the shaft to move when the shaft is reciprocated. The sieving box is placed inside the collecting box, and the machine is started. When the collecting box moves in the reciprocating motion, the sieving process is performed.

The various size of coal, coffee powder, sand is separated by eccentric pendulum operated two-level screening machine. The component which is greater in size they stay on the top layer of vibrating screen. The little components fall on the second screen and lesser size of components obtained in the tray. Thus the different sizes of components are separated with the help of screens.

2. Design Calculation

A. *Design of Powder*

Weight = 2.5kg
Crank radius = 55mm
Connecting rod = 310mm
Work = Force * Distance
= 2.5*9.81*55*2
= 2697.75N-mm
= 2.6N-mm
Speed = 30rpm
1rev = 1stroke = 2l = 110mm
30*110 = 3300mm/min
= 3.3m/min
Velocity, v = 0.055m/s
Power, p = Force*Velocity
P = 2.5*9.8*0.055 = 1.34W

B. *Design of power by dynamics principal*

Acceleration=m w r (sin0+sin20/n)
=0.431m/s^2
Force = mass * acceleration
= 2.5*0.431
=1.07N
Power = Velocity*Force
= 0.055*1.07
P = 0.058W

C. *Design of Bearing*

Diameter of the shaft = 15mm
Speed of the shaft = 30rpm
Radius load, F_r =3000N
Trust load, F_s = 1000N
Life of the bearing expected, L_a = 500hrs.
Since,
$F_a/F_r < 0.7$, a single row deep ball bearing may be suitable.
For the given diameter of the shaft = 15mm

From PSG.DDB
Corresponding to F_a/C_o=0.29
E = 0.27 (by interpolation)
=0.33>e.

Radial load, F_t = 3000N
Thrust load, F_a = 1000N
Life of the bearing expected, L_a = 500hrs.

Since,

$F_a/F_t < 0.7$, a single a row deep groove ball bearing may be suitable,
For the given diameter of the shaft=15mm

From DDB

Election SKF6202 bearing
Static load rating, C_o = 3350N
Dynamic load rating, C = 6100N
F_a/C_o = 1000/3350 = 0.298w

From DDB

Corresponding to F_a/C_v =0.29
e = 0.27 (by interpolation)
Since, F_a/C_v =1000/3000 = 0.33 > e

From DDB

Corresponding to 30rpm and 500rpm
Loading ratio/P = 1.24
C = 1.24*4020 = 4984.8N

Since the dynamic load of the SKF6202 bearing is more than the required dynamic load capacity, the selected bearing is suitable.

The calculated dynamic load< Standard dynamic load.

4984.8N < 6100N

So, "*design is safe*".

3. Working Principle

The sand screening machine is very easy to construct and can be operated easily. It is very economic among this kind of machines. This project is fabricated with the help of parts like a V- Belt, pulley, cam plate, sand siever. Sand sieving machine works on the principle of reciprocation motion is responsible for sand leading to separation of stone particles from the required fine and clean particles. When the A.C. supply is switch ON the motors starts to rotate with the required rpm. The V-Belt pulley connected on the motor shaft power transmission one shaft to another shaft. Connecting rod attached with cam plate and sand sieve or mesh. Cam provides sand sieve rotary motion into reciprocation motion, then sand put on the sand sieve and reciprocates and sand clean particles collect on the container (sand collecting box) and according to need it's used it.

4. Selection of Components

Table 1
Selection of material

S. No.	Component name	Suitable engineering material	Criteria	Material selected
1	Engine base	Mild steel, HSS	Strength, Cost	Mild steel
2	Mesh Frames	Stainless steel, Al	Corrosion resistance	Stainless steel
3	Clamps with screw	Stainless & mild steel	Lightness	Stainless steel
4	Bearing	Pillow & thrust	Axial and radial load	Pillow
5	Sieve member	Mild steel Stainless steel	Strength	Stainless steel
6	Feeding inlet & shield	Stainless steel, Al	Workability	Stainless steel

5. Components Name

Table 2
Detail component name

S. No.	Name of Components
1	AC single phase induction motor(2HP)
2	Pulley -1
3	Pulley-2
4	V-belt
5	Plummer block
6	Frame support 2*2 angle and net mechanism
7	Clamps with nut and bolt
8	Control switch
9	Centre rod
10	Screening Net
11	Hopper and material collector
12	Base plate
13	Red oxide and paint
14	Motor and hopper mounting
15	Motor cover
16	Wheel and mounting (rubber wheel)
17	Shafts which washer
18	Handle and dead weight

6. Criteria

The design should have:

1) High life expectancy
2) Ease of maintenance
3) Low transmitted force
4) Low power consumption
5) Standard parts
6) Low maintained cost

The criteria that must be considered the Sand Screening Machine,

1) Durability: Machine must be durable when it's working
2) Material: The material must be suitable to fabricate the screenings machine and easy to get.
3) Cost: It depends on material and, manufacturing processes. It should reduce the cost to the minimum.

7. Project Scope

From the title that has been given, the development of this project must include how to design the mechanical part of machine using materials like mild steel, stainless steel and how to fabrication the system of this mechanical part.

8. Dimension of Sand Screening Machine

Table 3
Dimension of components

S. No.	Component Name	Dimension (mm)
1	Rod	1200
2	Right side frame	900
3	Lift side frame	880
4	Pedestal shafts	200
5	hopper	200*300
6	Side hopper	400*600
7	Motor cover	200*400
8	Clamp plate	50*20
9	V-Belt	100
10	Pedestal bearing	40
11	Rubber wheel	60
12	Wheel plate	100*200

9. Design in PTC Creo

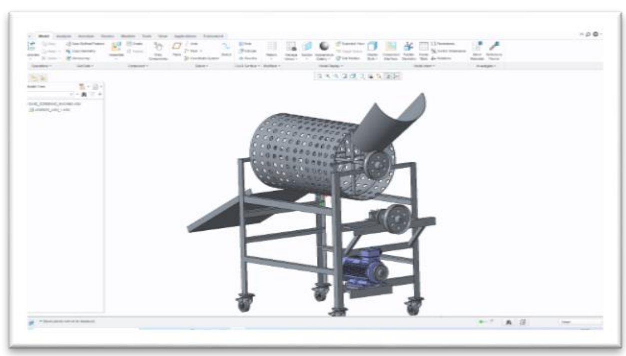

Fig. 1. 3D diagram of sand screening machine

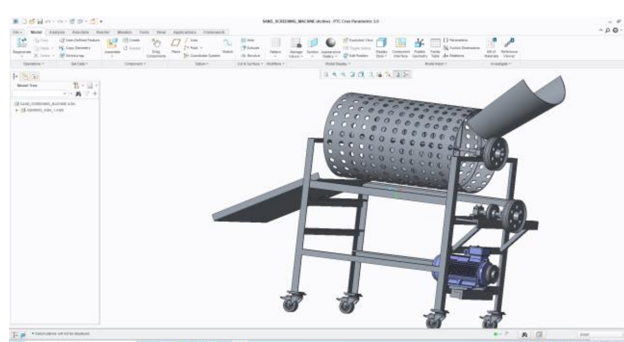

Fig. 2. 3D diagram of sand screening machine view

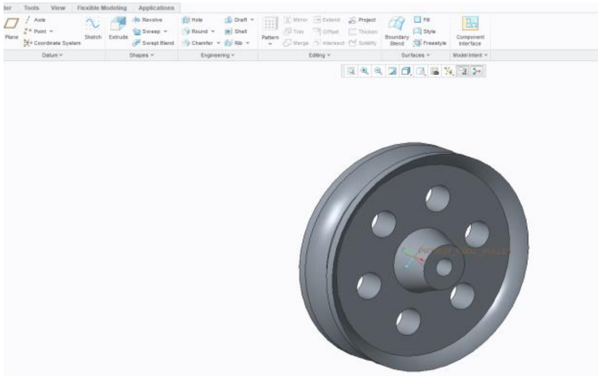

Fig. 3. 3D diagram of pulley

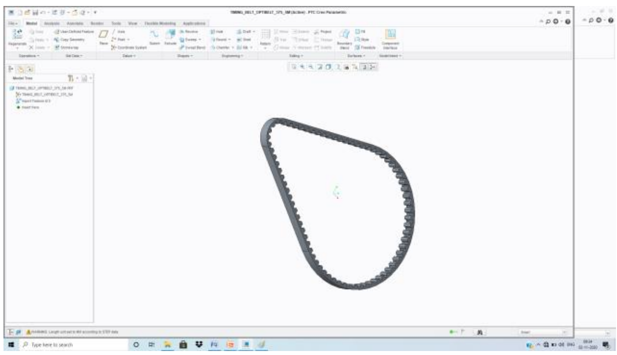

Fig. 4. 3D diagram of Belt

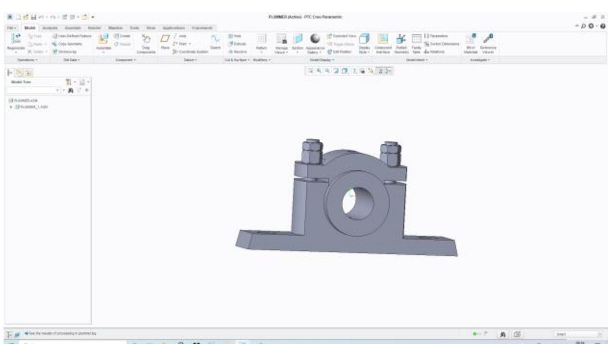

Fig. 5. 3D diagram of pedestal bearing

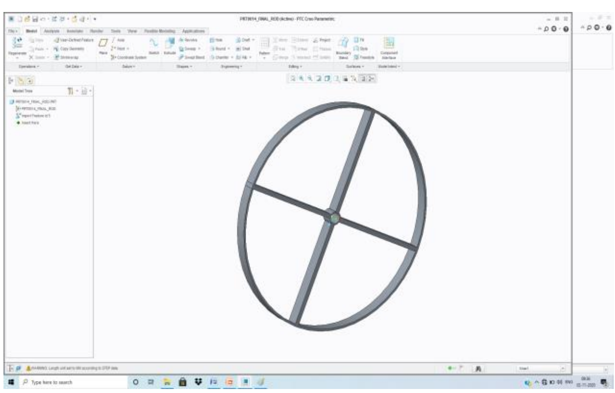

Fig. 6. 3D diagram of Net support

10. Ansys Result

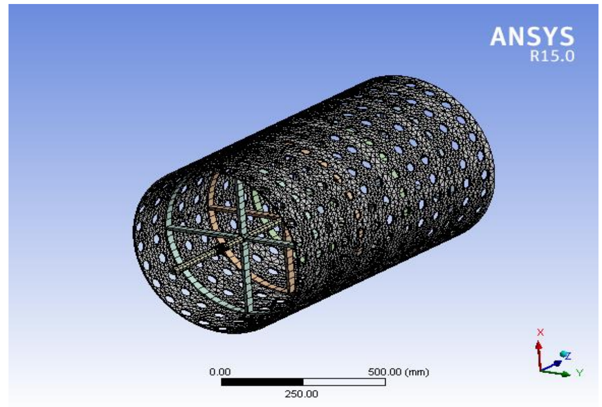

Fig. 7. Meshing

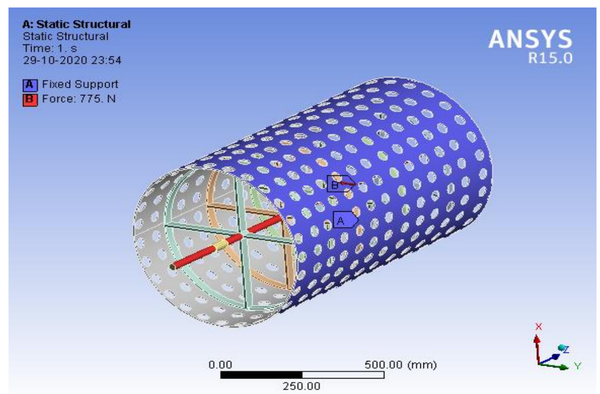

Fig. 8. Static Structural

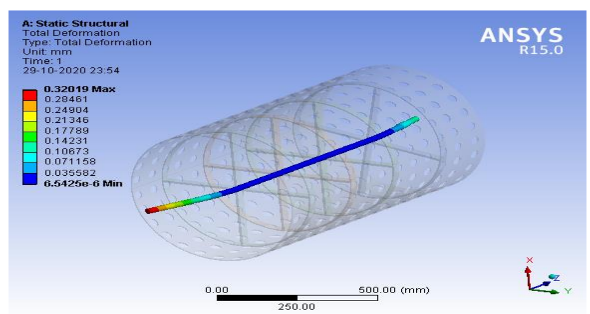

Fig. 9. Total deformation (at rod)

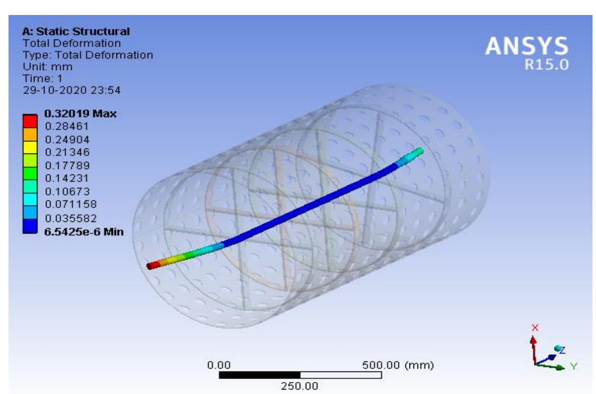

Fig. 10. Total deformation

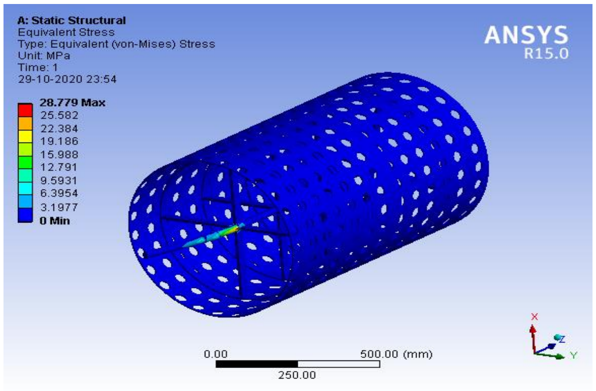

Fig. 11. Equivalent stress

Table 4
Static structure

Object Name	Static Structural (A5)
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

Table 5
Parameter for Ansys

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

11. Fabrication Process

The fabrication process encompasses cutting, welding (assembly) and covering.


Fig. 12. Angle raw material


Fig. 13. Assembly


Fig. 14. Power supply system


Fig. 15. Pedestal bearing


Fig. 16. Wheel


Fig. 17. Net

Fig. 18. Hopper arrangements

Fig. 19. Motor mounting

12. Result

1) The machine is faster and portable, hence, it reduces labor compare to manual screening.
2) The adjustable of the machine was really effective and well satisfactory.
3) By observation for screening 10kg sand required 1min (60 sec).
4) By using these machine material handlings reduce.

13. Conclusion

It is possible to conceptualize, design and execute a locally sand screening machine at casting industries for increasing production.

Finally, these projects should be place regularly on service so as to enhance its workability and durability.

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