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"AUTOMATIC ROTARY SAND SCREENING MACHINE"

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Abstract - In construction business, Traditional methods are used for screening the sand. Its rate of screening is very low and it is time consuming. It also has great limitation for wet sand & requires more man power. Scarcity of labor is one of the biggest problems in construction business. Because of above limitation of traditional method we were inspired to manufacture a machine which will solve above limitation. The machine which we have manufactured for screening the sand is known as "Rotary Sand Screening Machine" Sand screening machine mainly consists of a fabricated divergent drum type structure on which a screening mesh has wound. This structure is mounted over a central shaft with the help of square bar spokes. This shaft is supported by the pedestal bearing on the two ends which are mounted on the M.S. angle structure. A hopper mounted on same structure feed sand in the small opening of rotating drum. This drum is driven by an electric motor, through worm & worm wheel. As sand flows from small opening to big opening it gets screened & unscreened sand eliminated out from big end & can be collected separately.

1.INTRODUCTION

In the todays advanced technological world construction work is tremendously increased. It needs all the works involved in has to carry out by machine automatically. The sand screening is one of the processes which are being carried out by the conventional means till today. It is carried out by rectangular frame holding screen in it & keeping inclined to the ground & with the help of man power. Its rate of screening is very low & time consuming. It also has great limitation for wet sand. It also requires very much man power. In most of the large & medium construction work, lot of sand has to be use after screening & the conventional devices are insufficient uneconomical to serve their purposes. It requires lot of time because a worker has to pour sand slowly on the inclined screen by providing reciprocating motion to his hand. Also perfect (100%) screening is not obtained i.e. a large amount of useful sand goes waste through unscreened sand. So it also requires a double or triple screening depending on the conditions. The screen also gets damaged after a short period of use, so it fails to serve purpose of screening. Also it has great problems for wet sand. To overcome all the problems, we thought to provide such a machine which is free from any limitation and also consume less power. & this is the reason why we get attracted towards this sand screening machine.

SAND SCREENING MACHINE- It mainly consists of a fabricated divergent drum type structure on which a screening mesh has wound. This structure is mounted over a central shaft with the help of square bar spokes. This shaft is supported in the roller bearing on the two ends which are mounted on the M.S. angle structure. A hopper mounted on same structure feed sand in the small opening of rotating drum. This drum is driven by an electric motor, through worm & worm wheel. As sand flows from small opening to big opening it gets screened & unscreened sand comes out from big end, & can be collected separately.

2. Design and Development Phase

The meaning of design is the creation of new and better machines which are more economical in the overall cost of production and operation. From the study of exiting ideas, a new idea has to be conceived. The idea is then studied keeping in mind its commercial success & given shape & form in the form of drawings. In the preparation of these drawings care must take of the availability of resources in money, in men & materials required for the successful completion of the new idea in to an actual reality. In design there must be satisfaction of human needs. In the previous chapter, the need for developing sand screening machine has been clearly stated. & here onwards, starts the actual design & development phase.

There are no unique dimensions for any component. It is meaning less to request the correct answer to design problem, because there is none. But design is a way to approach the reliable dimensions. No matter what words are used to describe the design function, in engineering it is till the process in which scientific principles & tools of engineering are used to produce a plant or a system which when carried out, will satisfy a human need.

3. WHAT IS THE SCREENING MACHINE?

A fabricated taper drum shaped structure made from MS strips it has an increasing cross-sectional area throughout this length .It is mounted on a central hollow shaft, with the help of MS square bar spokes. This is to assure firmly holding the drum on shaft screening mesh is wound on the drum & clamped.

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To support this shaft & revolving drum, a MS angle structure is used. The two ball bearings are set into the pedestals on the base structure in the alignment. Shaft is extended from one bearing away from the drum to mount a worm wheel to which the power is given by an electric motor fixed on base structure through a worm mounted on a shaft extending from motor shaft. The shaft is also slight extended from other end to hold the handle through bearing. In power cut-off conditions one can rotate the drum with the help of handle by disengaging the gear.

The square pyramid frustum shaped MS sheet hopper is mounted above small of the drum by giving it supports from base structure. Its opening is inserted in a small end of drum.

4. DIFFERENT COMPONENTS OF SAND SCREENING MACHINE-

1) Base Structure
2) Drum
3) Mesh
4) Shaft
5) Bearing Pedestals
6) Electric Motor
7) Worm & Worm wheel gear box
8) Handle
9) Hopper
10) Gear box housing

SELECTION OF MATERIAL:

Mild Steel is the most commonly available of the cold-rolled steels. It is generally available in round rod, square bar, and rectangle bar, steel angles. It has a good combination of all of the typical traits of steel - strength, some ductility, and comparative ease of machining; it has very good fabrication properties. Chemically, it is very similar to A36 Hot Rolled steel, but the cold rolling process creates a better surface finish and better properties.

1) BASE STRUCTURE-

Base structure is a fabricated structure of MS 2" &1 ½" angles it gives rigid support to revolving drum & a fixed hopper .The height of base structure is so maintained that the height of hopper is obtained for easy working of average height person, for its ergonomics operation. The height of base structure is also accommodating maximum amount of sand underneath it. This height also facilitates the eliminating of dust particles with natural wind flow.

Considering above factors it is selected that the height of 100cm .for the base structure in the base width should be such that, it could not be unbalance during working. It should be slightly greater than the larger diameter of drum for its aesthetic view. Considering, these two things it is selected that the base width of structure as 70cm. Two MS channels (3") are provided at the two ends of apex of structure, to provide the base for pedestals. Length of these channels i.e. top width of structure is selected as 42cms to accommodate pedestals easily. The length of this base structure should be sufficient to accommodate length of drum keeping clearances of 15cms on both sides of drum. So the length of base structure is selected as 135cms to give more rigidity.

All DIMENSIONS ARE IN CM

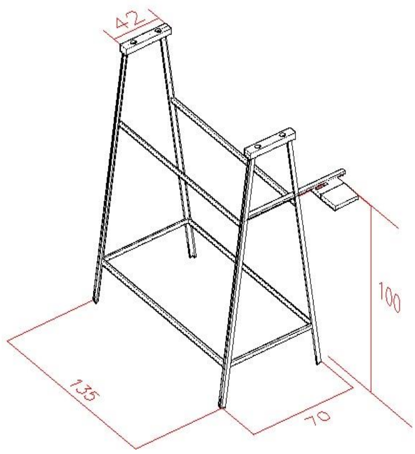


FIG 2: BASE STRUCTURE

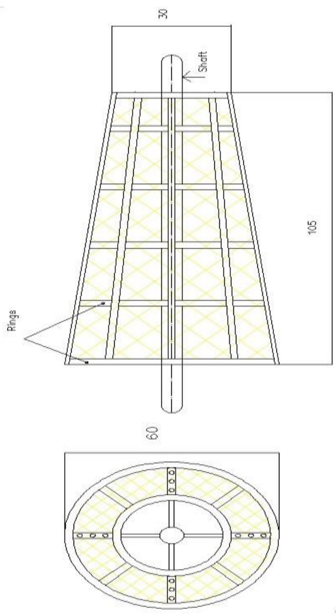
2) DRUM-

For perfect screening sand must slowly slide over the mesh. To serve this purpose the cylindrical drum should be inclined up to 10 degrees to axis of drum. But mounting of inclined drum on bearings is quite difficult to maintain alignment. It also gives axial thrust on the bearings. So we decided to prepare a divergent c/s drum (taper drum), whose axis (shaft) remains parallel to ground. Due to tapered shape its capacity also gets increased & it serves the purpose of sliding the sand over mesh from inlet to outlet in very fine manner.

The dimension chosen for drum are follows

1) Inlet diameter is selected as 30cm
2) Outlet diameter is selected as 60 cm
3) Length of drum is selected as 105cm

These dimensions are chosen such that its inlet can accommodate mouth of hopper easily through which proper amount of sand can be feeded to drum. It also gives the inclination of approximately 10 degrees, to flow sand on the mesh for perfect screening. Maximum amount of surface area of mesh should be in contact with the sand to increase the rate of screening.



ALL DIMENSIONS ARE IN CM

FIG 3: DRUM

3) DESIGN OF SPOKES-

To mount this drum on a central shaft spokes are necessary. To manufacture these spokes a 10mm square bar of M.S. is selected. The length of spokes goes increasing from inlet to the outlet of drum.

MATERIAL FOR MANUFACTURING DRUM-

1. M.S. strips
   Width =20mm
   Thickness=3mm

2. M.S. square bar
   Size=10*10mm

3. Mesh
   Area = 4'*8'
   Size =for both coarse & fine sands.

4) DESIGN OF SHAFT-

A shaft is rotating machine element which is used to transmit the power from one place to another. We have decided to select a hollow shaft for the purpose of weight reduction & to provide maximum area to fix the spokes. It is also considered that the length of shaft between bearings is more.

Material selected for shaft is Mild steel.

Therefore Maximum allowable stresses
In Tension = 112 N/mm^2
In Shear = 56 N/mm^2

We assume,
Weight of stand in the drum is 30 kg (300N)
The average radius of drum

$$\theta = \tan^{-1}\frac{(D-d)}{2l}$$

$$\theta = \tan^{-1}\frac{(60-30)}{2*105}$$

Θ= 8.13^0

$$\tan\theta = \frac{X}{52.5}$$

X= 75 mm

Average radius =75+150mm
=225mm

Maximum torque required to be transmitted is
T=300*225
T=67500 N mm
T=67.5 Nm

Calculating maximum bending moment

We assume,

Weight of shaft + Weight of sand + Weight of drum= **600N**

At that two ends we have fitted bearing so that maximum bending moment occurs at center.

BM max=675*600

M=405000Nmm

Equivalent torque

$$T_e = \sqrt{T^2 + M^2}$$

$$T_e = \sqrt{67500T^2 + 405000^2}$$

T_e = 410586 N mm

But we know that,

$$T_e = \frac{\pi}{16} * \tau * do^3(1-k^4)$$

Where,

k= (di/do) = 0.8

410586= $\frac{\pi}{16} * 56 * do^3(1-0.8^4)$

do = 39.84 mm =**40 mm**

di = 0.8*40

=32 mm

Calculating length of shaft,

$$\frac{T}{J} = \frac{G\theta}{l}$$

T= Torque =67500 N mm

J= $\frac{\pi}{32}(do^4 - di^4)$

J= 148.31*10³ mm

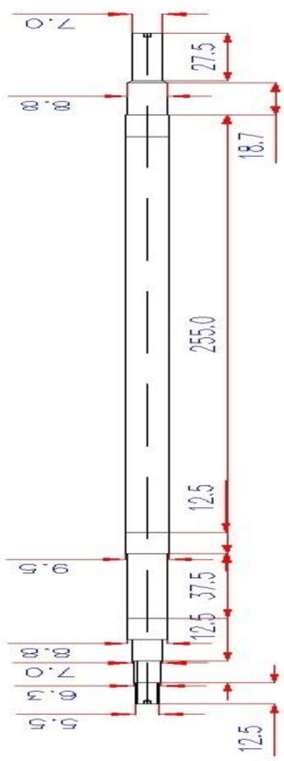
$\theta = 0.25^o = 4.3611 * 10^{(-3)}$ rad

G=200*10³ N/mm²

l=2000mm

We have selected **length of shaft=1775mm**

As the length of our drum is 1335mm, we have extended shaft from right side to accommodate worm wheel & we have extended shaft from left side to accommodate handle.



All DIMENSIONS ARE IN MM (SCALE 1:4)

5) DESIGN OF BEARING-

While selecting the bearing for this machine the major problem in front of us is maintaining perfect alignment of such long shaft along the axis of two bearing, we have selected self-alignment ball bearing with taper bore and split sleeve

Suppose machine is in 8hr service, which is fully utilized.

Life of bearing is 40000 to 60000 hrs.

We have selected bearing life in hrs.

L_{10}h=50000 hrs. (Approximately)

Speed N=25hrs

Life of bearing in million revolutions

$$L_{10} = \frac{(60 * n * L_{10})}{10^6}$$

L_{10} = 75 million revolution

Calculating equivalent dynamic load

$P_e = XV * F_r + YF_a$

Pr = Equivalent dynamic load

V= Race revolution factor=1

Fr = Radial load =600N

Fa = Axial load =0

Consider,

$$\frac{Fa}{Fr} > e$$

X=0.56

Pe = 0.56*1*600

=336 N

Dynamic capacity

$$C = L_{10}^{(\frac{1}{k})} * P_e$$

=336*75^113

=1417 N

From design data book for self-aligning double ball bearing

As this bearing is very small as compared to design shaft we have to select randomly a self-aligning ball bearing. We can select self-aligning with taper bore having internal diameter 35 mm & I.S. No=2307K

As the cost of bearing and bearing housing is very high, we have taken **pedestal bearing** while manufacturing of the machine. The bearing pedestal, we have taken is capable to sustain weight upto1 tone.

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