

# International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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## Design and Fabrication of Shoe Sole Cleaning Machine

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**ABSTRACT:** Cleaning has become a basic need of all the human beings. Throughout the world many researchers are conducting experiments to eradicate and solve the dust removing process. There should be improvisation with innovative ideas and techniques which may ensure good health. If an equipment is developed it should be ecofriendly with its usage. In this work, it is proposed to design a shoe sole cleaning machine. As all the employees, faculty etc. required to wear clean shoes before entering their laboratories, as these laboratories have highly précised instruments, sensors etc. and the air inside should be very clean. Thus, shoe sole cleaner is designed, considering all the parameters with respect to customer need in terms portability and economically available to them, thus providing dust & dirt-free environment. Because of shoe sole cleaning machine, the sole of the shoe is cleaned within the second of time. Which keeps shoes sole clean regularly without any human effort & dirt is not carried from one place to another place. This dirt is stored at one place & can be deposited.

**KEYWORDS:** shoe cleaning machine, machine design,

### I. INTRODUCTION

In this work, it is proposed to design a shoe sole cleaning machine . As all the employees, faculty are required to wear clean shoes before entering into their laboratories, as these laboratories have highly précised instruments, sensors etc. and the air inside should be very clean. Thus shoe sole cleaner is designed, considering all the parameters with respect to customer need in terms portability and also economically available to them, thus providing clean environment . The high speed rotation of the brush helps in cleaning the sole of the shoe effectively . Hence the shoe sole cleaners are extremely useful in places where the dust due to the footwear is a major problem. The shoe sole cleaning machine is a complete set up produced for cleaning the shoe in order to maintain dust free environment . Thus we can conclude from the above that the usage of shoe sole cleaning is a must for all the industries (chemical, food processing etc) and institutions where cleanliness and dust free environment is a primary requirement.

### II. DESIGN AND CALCULATION

#### II.I Calculations

**1) Selection of power sources :-** We are going to select power on the basis of loads acting on the machine. In this load include self load and foot load. Total load acting on shaft due to brush, self load of shaft and foot load =  $14.71+9.81+29.43 = 53.95 \sim 54 \text{ N}$  at the centre.

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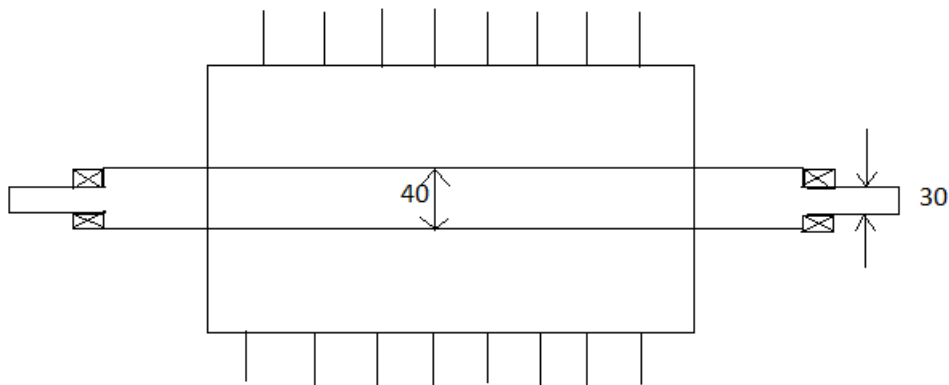


Fig 4.1.1- various load acting on shaft

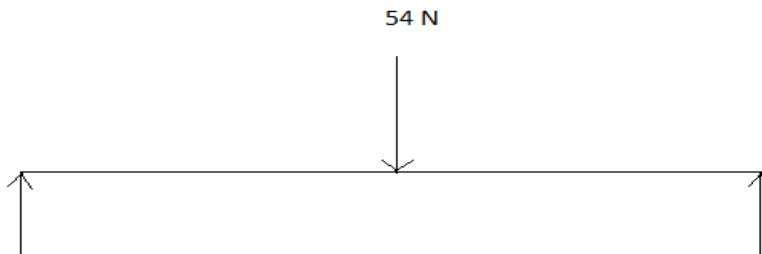


Fig 4.1.2- load acting on shaft

(i) Torque=Force\*Radius

Force=54N [1], Radius=110mm

$$T = 54 * 110$$

$$T = 5940 \text{ N-mm}$$

N = 70rpm

(ii) Power=  $2\pi NT/60 * 10^6$

$$= 2\pi * 70 * 5940 / 60 * 10^6$$

$$= 0.0435 \text{ KW}$$

Factor of safety = 3

Therefore,  $P = 0.0435 * 3$

$$= 0.1305 \text{ KW}$$

$$P = 0.1305 \text{ KW}$$

But due to unavailability of power source of 0.1305 kw. We have selected the power source of 0.373Kw ( i.e. 0.5 HP)

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### 2) Design of belt :-

#### Belt tensions :-

$$(T_1 - T_2) / 1000 * V = P$$

$$P = 0.373 \text{ KW}$$

$$V = \pi dN / 60 * 10^3$$

$$= \pi * 75 * 70 / 60 * 10^3$$

$$V = 0.2749 \text{ m/s}$$

$$(T_1 - T_2) = P * 1000 / V$$

$$= 0.37 * 1000 / 0.2749$$

$$(T_1 - T_2) = 1345.94 \text{ N}$$

$$T_1 / T_2 = e^{\mu \Theta} \quad (\mu = 0.25, \Theta = 180)$$

$$T_1 / T_2 = e^{(\mu * 180 / 180)}$$

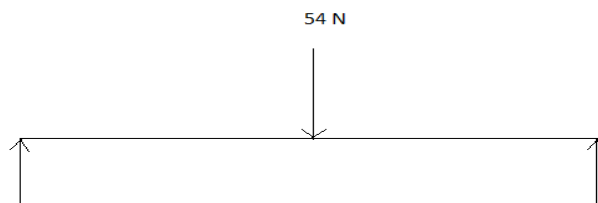
$$T_1 / T_2 = 2.1933$$

$$T_1 = 2.1933 T_2$$

$$2.1933 T_2 - T_2 = 1345.94$$

$$T_2 = 1169.81 \text{ N}, T_1 = 2565.75 \text{ N}$$

### 3) Design Of Shaft :-



**Fig 4.3.1- load acting on shaft**

Material for shaft = Plain carbon steel

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

$$F.O.S = 3$$

$$\mu = 0.25$$

$$\Theta = 180^\circ$$

Permissible shear stress:-

$$\tau = S_{sy} / F.S. = 0.5 S_{yt} / 3 = 0.5 * 400 / 3 = 66.67 \text{ N/mm}^2$$

$$T_1 = 2565.75 \text{ N}$$

$$T_2 = 1169.81 \text{ N}$$

Torque supplied to the shaft :-

$$M_t = (T_1 - T_2) * R$$

$$= (2565.75 - 1169.81) * 37.5$$

$$M_t = 52347.75 \text{ N-mm}$$

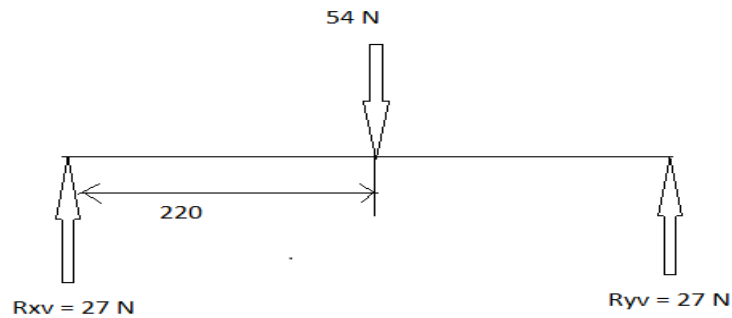
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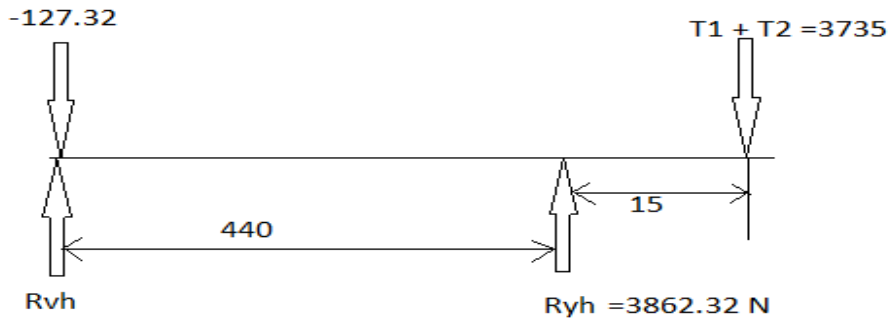
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(i) For vertical reaction,



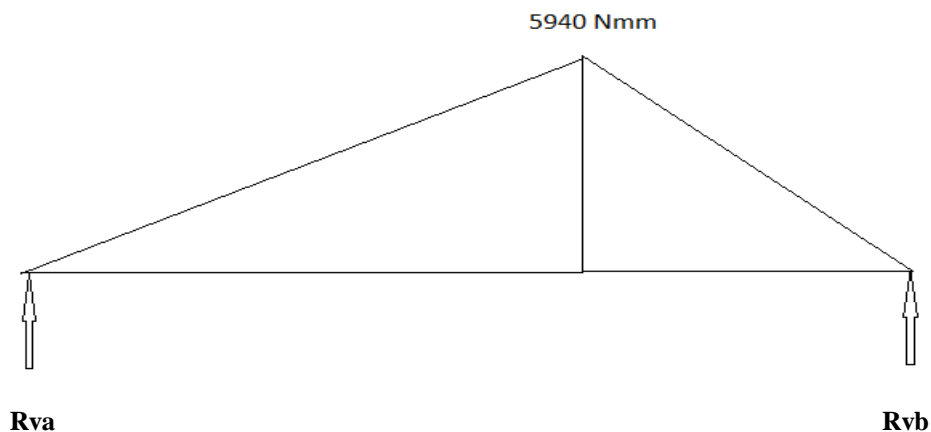
**Fig 4.3.2 -Vertical load acting on shaft**

(ii) For horizontal reaction,



**Fig 4.3 - Horizontal load acting on shaft**

Bending moment for vertical reaction,



**Fig 4.3.4 - Bending moment for vertical reaction**

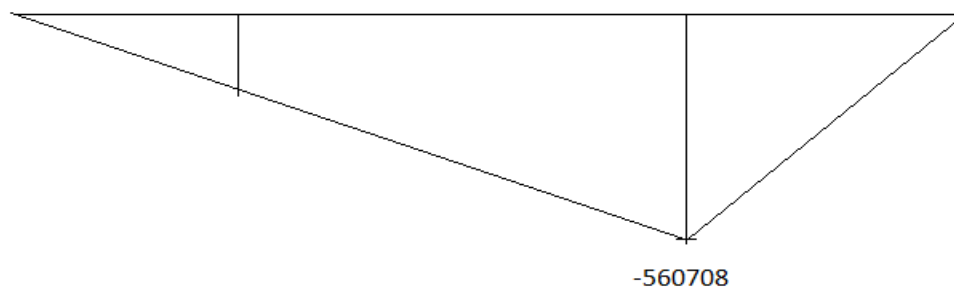
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Bending moment for horizontal reaction,



**Fig 4.3.5 - Bending moment for horizontal reaction**

$M_B$  at B = 5940

$M_B$  at C = -560208 Nmm

Therefore, Max at C,

$M_B = 560208$  N-mm ( Downward direction)

**Shaft Diameter :-**

$$\tau_{max} = \frac{16}{\pi d^3} [(K_b M_b)^2 + (K_t M_t)^2]$$

$$d^3 = \frac{16}{\pi \tau_{max}} 1.5 * 560282 + 1 * 59402$$

$$d^3 = \frac{16}{\pi \tau_{max}} * 840332.99$$

**d = 40mm**

Therefore we selected diameter of shaft is suitable and protecting.

#### 4) Selection of bearing for shaft :-

Shaft Diameter for Bearing = 30mm

Type of Bearing = Single Row deep groove ball bearing

Belt Tension,

$$T_1 = 1169.81 \text{ N}$$

$$T_2 = 2565.75 \text{ N}$$

$$T_1 + T_2 = 3735.56 \text{ N}$$

N = 70 RPM....speed of shaft

Machine used for continuous operation (4-8 hrs per day)

Therefore,  $L_{10h} = 50000$  hrs

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

$$L_{10} = \frac{(60 * 70 * 50000)}{10^6}$$

**$L_{10} = 210$  million rev.**

Now,

$$C = P(L_{10})^{1/3}$$

$$P = F_r = 3735.56 \text{ N}$$

$$C = 3735.56 (210)^{1/3}$$

$$C = 22203.88 \text{ N}$$

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Principal dimensions (mm)			Basic load rating (N)		Designation
D	D	B	C	C0	
30	42	7	3120	2080	61806
	55	9	11200	5850	16006
	55	13	13300	6800	6006
	62	16	19500	10000	6206
	<b>72</b>	<b>19</b>	<b>28100</b>	<b>14600</b>	<b>6306</b>

Table 4.4.1 -Five different bearings are available for shaft diameter 30mm

We select Bearing Having capacity greater than 22203.88N, From table it is 28100N.  
Bearing No is **6306**. (from SKF Catalogue)  
Inner Diameter=30mm  
Outer Diameter=72mm  
Axial width of bearing=19mm  
Dynamic load capacity=28100N

Part Name	Material
Shaft	Plain carbon steel
Bearing	Stainless steel
v-belt pulley	Cast Iron
Handle	Galvanised steel bar
Brush	Nylon

Table 4.4.2 - Material

## II.II Design

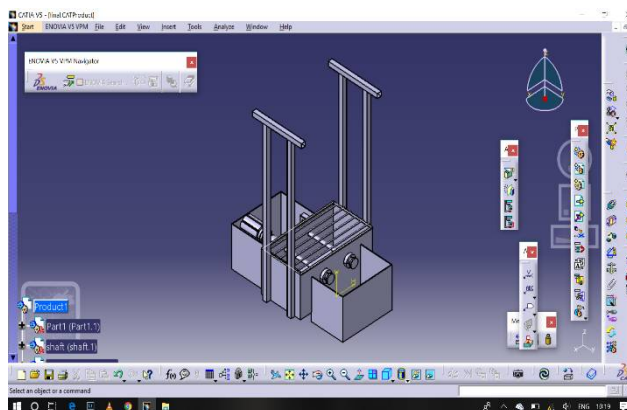


Fig 1:

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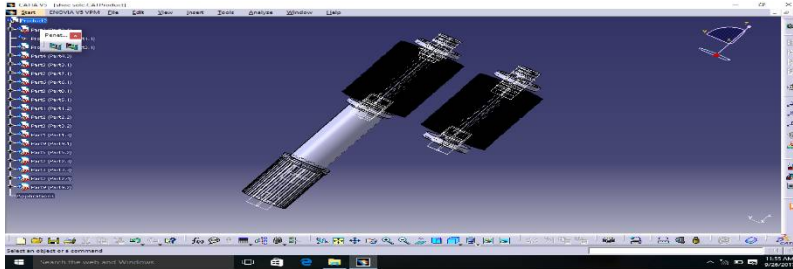


Fig 2:

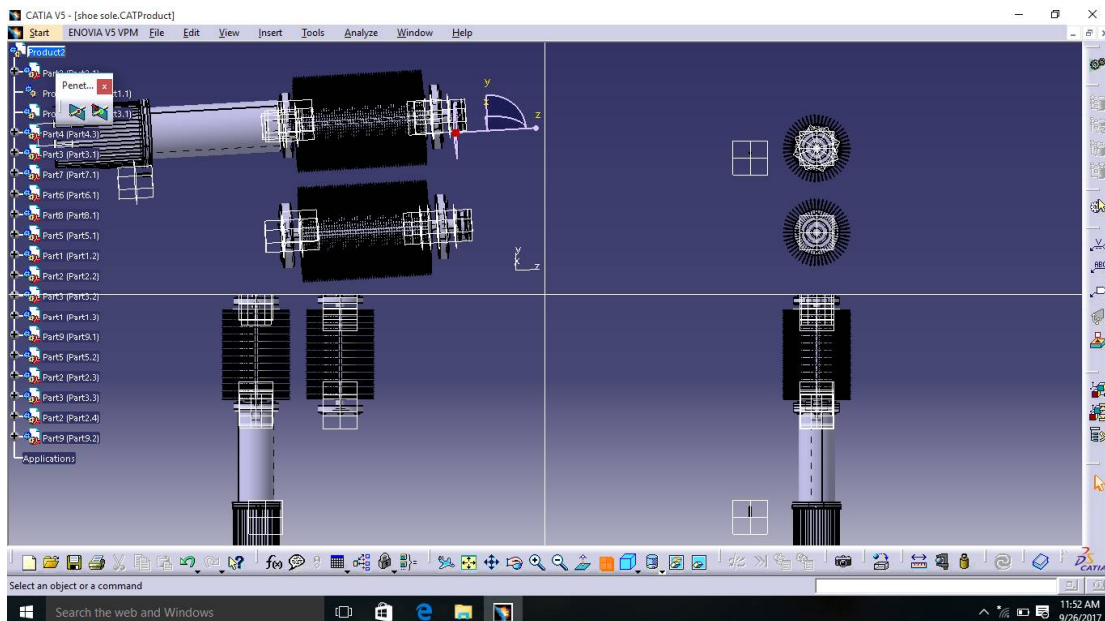


Fig 3:

### III. CONCLUSION

Upto this stage of project, we got idea about design as well as procedure for different parts of mechanical component. Also we got the knowledge about CATIA software. We learn how to work in group and how the team management is done. We got the idea about the management of project work. Also we got Knowledge about industrial problem solving.



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