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Design & Development of Road Side Cleaning Machine

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Abstract – *Our study shows that dirt besides the road causes uncleanness and accident problems. We had developed a semiautomatic road side cleaning machine that insures that dust and dirt in sides of road should be clean. Our design proposes and successfully implemented the use of scrubber and brush that will remove the dust and collect it into the storage box in which the scrubber is driven by engine which removes the dust and throws it into the path of brush. This brush is driven by speed amplification mechanism which consist of chain and gear drive separately. The motion of brush allow to push the removed dust into the storage box.*

Key Words: **Scrubber, Brush, Speed amplification and Storage box**

1.INTRODUCTION

Environment is a place where humans as well as plants and animals live. Keeping it clean and neat is our responsibility. It is necessary to keep our environment clean because we get fresh air, reduce pollution etc. An unclean environment leads to a bad condition of a society, arrival of diseases and many more. In recent years cleanliness is becoming an important factor for the betterment of the nation and so, to support the cause we have conducted a study, prepared a design and working of a Semiautomatic Road Cleaning Machine. The cleaning machine is an approach to deliver easy and time efficient cleaning of roads, by reducing human efforts. There are in numerous functions of the road cleaning machine mainly,

1) Remove the dust from road by the use of scrubber which is operated by using engine.
2) Cleaning of dust and dirt by use of brush.
3) Collecting the dust into the collector tank

This cleanliness can be achieved by utilizing all the functions of the road cleaner to the optimum level. The basic idea is to generate a machine which works on basic principles of physics, using mechanical, automobile components and devices. Making an assembly of the components and ultimately creating a machine which can be the answer to various cleaning issues in a single unit.

2. PROBLEM STATMENT

Now, workers are hired to do this stuff but it is impossible to work continuously for workers. So this is time consuming and also costly process because of workers salary. The important factor is eliminating traffic problem because of less manpower as well as accident

The running cost of machine is low and initial cost of machine is covered by saving of workers salary. It can be recovered within in one or one and half year. The divider side cleaner requires only one worker for handling and it will be efficient for this work..

3. COMPONENT

3.1 Brush

Fig. Brush

The cleaning brush is located at outside of the machine and it is mounted on the shaft which is rotated with the help of chain and sprocket unit. The main work of the brush is to push the Garbage into storage tank.

3.2 Scrubber

Fig. Srubber

Scrubber is important component of our cleaning machine and it is rotated by the engine shaft and it is directly attached on engine shaft by Allen screws. The engine is running at 700rpm so also Scrubber is rotated at same rpm or speed. The scrubber is actually in contact with dust, dirt beside the road divider.

3.3 Chain drive

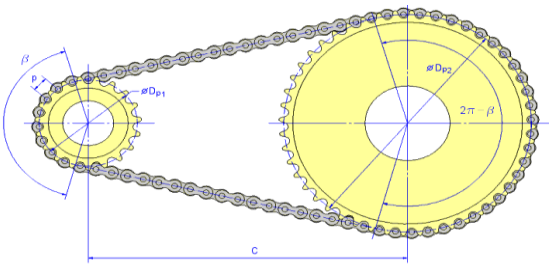


Fig. Chain drive

The chains are made up of rigid links which are hinged together in order to provide the necessity flexibility for wrapping around the driving and driven wheel. The wheels have projecting teeth and fit into corresponding recesses. The wheels and the chains are thus constrained to move together without slipping and ensure the perfect velocity ratio. The toothed wheels are known as sprocket wheel.

3.4 Gear pair

Fig. Gear drive

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radically. Though the teeth are not straight-sided the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts.

4. MECHANISMS

4.1 Speed Amplification Mechanism

Fig. Speed amplification mechanism

Practically near about 40 to 50 RPM speed is required for brush to collect or push the dust which is removed by the scrubber into the dust storage box and hence it is essential to rotate the brush at this speed. It is possible to get this speed. If we go with the only arrangement of pair of gear but it requires larger size of gear and pinion which may lead to weight of setup hence we decided to rotate this brush into two stages.

4.2 Steering mechanism

This steering mechanism can steer the front wheels up to 60 degrees with the vertical and for doing this small amount of force is required. This mechanism is based on the lever principle in which input force is amplified to provide maximum output. When driver

rotates the handle anticlockwise the arms moves to left side which moves z strips and finally wheel gets turn to left side and vice versa.

Fig. Steering mechanism

5. DESIGNED PARTS

5.1 Design of brush shafts

The brush shaft is subjected to torsion as well as bending force hence it is necessary to design brush shaft on torshional rigidity basis'

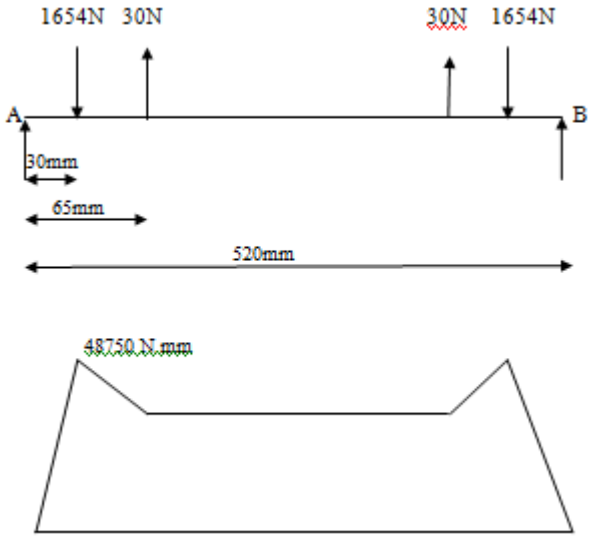
Given Data-

Material = mild steel (45C8), S_{yt} = 380 N/mm^2

τ_{max}= 0.5*380 = 190 N/mm^2

step 1] Bending and torshional moment

- Vertical plane



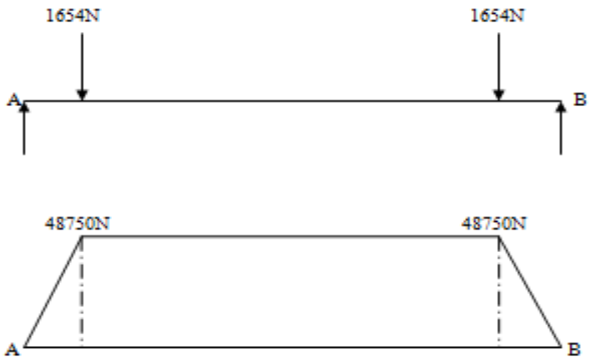
Calculation of support reaction,

For vertical reaction,

$R_A = 16.54*\frac{490}{520} - 30*\frac{425}{520} - 30*\frac{95}{520} - 16.54*\frac{30}{520}$

R_A = 1624 N

- Horizontal reaction



R_B = 1624 N.

$(B.M)_C$ =1624*30 = 48720 N.mm

$(B.M)_D$ =1624*95 = 46770 N.mm

For horizontal reaction,

R_A = 1654 N.

R_B = 1654 N.

$(B.M)_C$ =1654*30 = 49620 N.mm.

The forces B.M. is act C,F as loading diagram is symmetrical .the resultant bending moment at C is given by,

$M_b = \sqrt{48720^2 + 49620^2}$

M_b = 69539.79 N.mm

Torshional moment,

M_t = 1654*42.5 =70295 N.mm

Assuming K_b =1.5 K_t =2

Step 2]

Shaft diameter,

$d^3 = \frac{16}{\pi*\tau} * \sqrt{(Kb * Mb)^2 + (Kt * Mt)^2}$

$d^3 = \frac{16}{\pi*190} * \sqrt{(1.5 * 69539.79)^2 + (2 * 70295)^2}$

d = 16.74 mm

selecting standard size,

d = 20mm

5.2 Design of driving shaft

Design Driving shaft on torshional rigidity basis'

Given Data-

Material = mild steel (45C8)

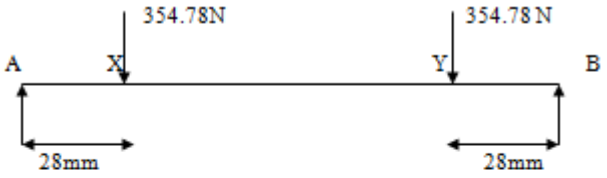
S_{yt} = 380 N/mm^2

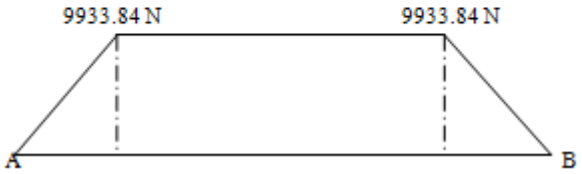
τ_{max}= 0.5*380 = 190 N/mm^2

step 1]

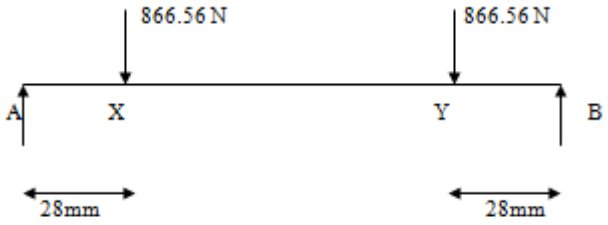
Bending and torshional moment

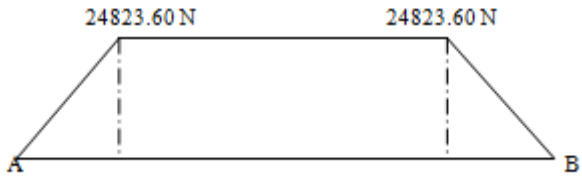
- **Vertical plane**





- **Horizontal plane**





Calculation of support reaction,

For vertical reaction,

Symmetrical about vertical axis,

R_A = 354.78 N.

R_B = 354.78 N.

$(B.M)_X = (B.M)_Y$ = 354.78*28 = 9933.84 N.mm

For horizontal reaction,

R_A = 886.54 N.

R_B = 886.54 N.

$(B.M)_X = (B.M)_Y$ = 886.56*28= 24823.60 N.mm

The forces B.M. is act X as loading diagram is symmetrical .the resultant bending moment at C is given by,

$M_b = \sqrt{9933.84^2 + 24823.68^2}$

M_b = 26737.54 N.mm

Torshional moment,

M_t = 886.56*95= 84223 N.mm

Assuming K_b =1.5 K_t =2

Step 2]

Shaft diameter,

$d^3 = \frac{16}{\pi * \tau} * \sqrt{(Kb * Mb)^2 + (Kt * Mt)^2}$

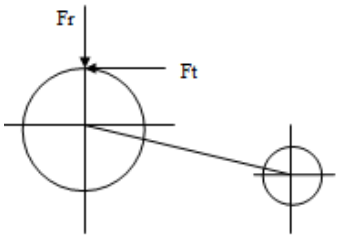
$d^3 = \frac{16}{\pi * 190} * \sqrt{(1.5 * 26737.54)^2 + (2 * 84223)^2}$

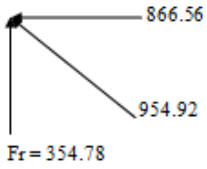
d = 16.68 mm

Selecting standard size,

d = 20mm

5.3 Design of bearing



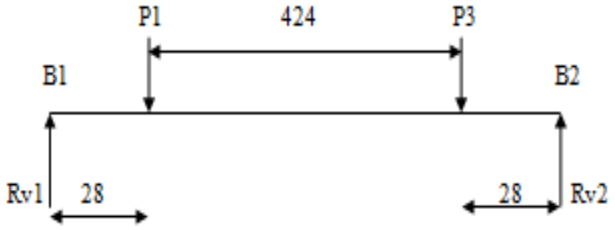


tan θ = 25/10

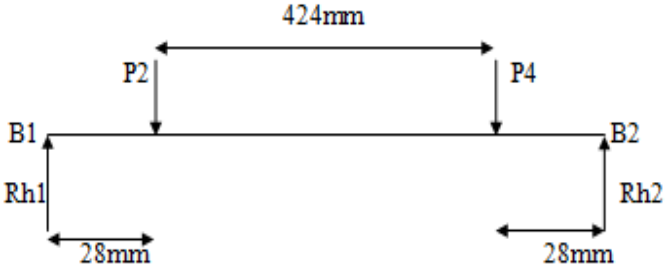
θ = 68.19

load factor for chain drive = 1.5

- **Vertical plane**



- **Horizontal plane**



Taking vertical forces and beam at B1

P1*28 + P3*452 – Rv2*480 = 0

Rv2 = 354.78 N.

As loading diagram is symmetrical, hence reaction also same.

Rv1 = 354.78 N.

Rh1 = Rh2 = 886.36 N,

Reaction at two bearing,

$R2 = R1 = \sqrt{(Rv1)(Rv1) + (Rh1)(Rh1)}$

$R2 = R1 = \sqrt{(354.88)(354.88) + (886.56)((886.56))}$

R2 = R1 = 954.91 N

Fr1 = R1 = 954.91 N. Fr2 = R2 = 954.91 N.

There is no axial thurst,

Fa1 = Fa2 = 0

Consider load factor,

$C1 = P1*(L10)^{1/3}$*load factor

C1 = 954.91*(50)1/3*1.5

C1 = 5276.87 N

C2 = 5276.87 N

Hence for 20 mm shaft bearing No. 6004 selected from below table

Bearing selection table (From design data book)

Principal Dimensions (mm)			Basic Load Rating(N)		Designation
D	D	B	C	Co	
20	32	7	2700	1500	61804
	42	8	7020	3400	16404
	42	12	9360	4500	6004
	47	14	12700	6200	6204
	52	15	15900	7800	6304

6. CONSTRUCTION AND WORKING

Fig. Road side cleaning machine

Above fig. shows the road side cleaning machine in which scrubber is mounted at the middle and the brush along with the storage box is located behind the rear axle. The drive to scrubber is given with the help of engine. As the engine stars it rotate the scrubber in contact with the road, this makes dust which is stick to the road is removed and then it passes in the path of brush. As soon as the rear axle rotates it actuates the speed amplification mechanism which rotates the brush. Due to rotary motion of brush the dust is pushes into the storage box. The storage box can be easily removed and remounted.

7. METHDOLOGY

1. Literature survey.
2. Study of road cleaning machines, road cleaning trucks and other devices.
3. Study of mechanical drives for power transmission by using chain drive and gear drive.
4. Study and application of steering system.
5. Selection of material for different parts of the system.
6. Design of frame and different components of the system.
7. Manufacturing of model
8. Assembly of model.
9. Testing of the model.

7. CONCLUSION

From this project, we can conclude that, when engine starts rotating scrubber also rotates at that speed and it scrubs the road dust and dirt besides the road divider. Scrubbed dust and dirt throws towards the brush because of scrubber force and brush collects it into storage box.

Our cleaning machine is safe, efficient and cheaper than the work done by cleaners. The cleaning machine is easy to handle for one worker so it will reduce cost of cleaning.

8. REFERANCES

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