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Design and Development of Road Bed Cleaner Machine

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ABSTRACT-

Development of a country depends on the connectivity of various places with adequate road network. Roads are the major channel of transportation for carrying goods and passengers. They play a significant role in improving the socio-economic standards of a region. Roads constitute the most important mode of communication in areas where railways have not developed much and form the basic infra-structure for the development and economic growth of the country. The benefits from the investment in road sector are indirect, long-term and not immediately visible. Roads are important assets for any nation. Thus for the construction of roads there is the need of the more efficient and cost effective machine so that the total cost of the road will be minimised. So there is the need of machine which will be less costly and easy to maintain. In India road construction is very important for the development of the country and also the budget of any developing country is also a subject of concern thus we need to made machines which will be of less cost and can reduce the human effort.

Keywords-Road Bed, Road cleaner, cleaner m/c

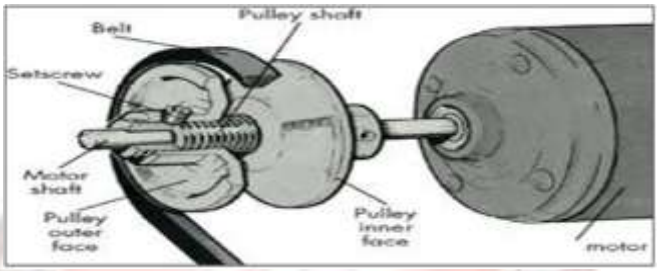
I.INTRODUCTION

In the construction work there are many machines used such as road rollers, tar laying machines and carriers for brining the raw materials, cement mixers for cement road etc. In India there is not much development about the construction process and still we do most of the work manually means with the help of labour and when human comes in to the play there are always many factors comes into the action. Worst thing is that the time consumption, human cannot does work for long hours as machines can do and also the most important is that the time taken to do work or simply the speed of working is far less than the machines. Thus there should be maximum work should be done with the help of machines.

One of the important works in the road construction is that the cleaning of the bed of the road that means the surface on which the road has to be made or where the tar or cement has to be put. Mostly there is the use of labours for this work and they sweep the road to ensure that there should be minimum dust or dirt on the surface. But the problem is that the time taken for labours is very large and many times the whole construction work has to halt. Another problem is that sweeping the surface with in sitting down position is vey tedious work and one cannot simply bend on his legs for the long time. So there is the need of the machine which will overcome from this tedious work and also do it in the less time and the Road Bed Cleaner Machine will do this job for us.

II. WORKING PRINCIPLE OF ROAD BED CLEANER MACHINE

It is based on synchronous ac motor by which shaft of the brush is moving with the help of belt and other end remains fixed by bearing. The shaft of the ac motor give motion to shaft of brush and brush remain revolving with the help of belt. The another side of belt is connected to the shaft with the help of pulley. The shaft holds the brush which is for the removing the dust and dirt form the surface that is road bed. As the motor started the brush starts revolving and when the operator of the machine moves the machine forward the brush cleans the surface along with it. There is an arrangement for the surface which are either deeper than the road bed surface or at the higher elevation. When there deeper surface comes in front then lead screw is use the up and down the motor and shaft assembly. The Motor and the shaft are mounted on the same assembly and this assembly is supported with the help of lead screw. As the bolt of the lead screw has adjusted then the whole assembly which supports the motor and shaft has changed its elevation from the ground.



In modern scenario, in road construction, when we lay the pavement some adverse soil and tiny particles remains laid on road. Tiny particles which effect the pavement, weaken road life.

For this many worker sweep the road to remove the tiny particle and gravel to make it fit for pavement so, we design a road sweeper machine in order to avoid this problems. Conventionally named Road Bed Cleaner Machine which is fit for road which is under construction.

III. ESTIMATION OF POWER REQUIREMENT OF ROAD BED CLEANER MACHINE

The estimation of power requirement of the machine is done with the help experimental data. There are two motors are used for it, 0.5 hp with maximum speed 1000 rpm and another 0.25 Hp with maximum speed 750 rpm. Two roller brush are used with 30 mm and 40 mm diameter. Tachometer is used for the measurement of the speed of motor. The distance covered by the dust at the particular rpm is as shown in the tables.

Table: 7.1 Power Requirement Estimation (Table 1)

Sr. no	Diameter (mm)	RPM	Torque (N-m)	Distance covered by Dust (m)
1	30	100	17.80	0.10
2	30	200	8.90	0.17
3	30	250	7.12	0.20
4	30	300	5.93	0.27
5	30	400	4.45	0.35

Contact angle of brush with ground, θ=40°

Performing with motor, P=0.25Hp, Max speed=750rpm

Table: 7.2 Power Requirement Estimation (Table 2)

Sr. no	Diameter (mm)	RPM	Torque (N-m)	Distance covered by Dust (m)
1	30	150	23.74	0.15
2	30	200	17.80	0.19
3	30	250	14.24	0.24
4	30	300	11.87	0.28
5	30	350	10.95	0.30

Contact angle of brush with ground, θ=40°

Performing with motor, P=0.5Hp Max speed=1000rpm

Table: 7.3 Power Requirement Estimation (Table 3)

Sr. no	Diameter (mm)	RPM	Torque (N-m)	Distance covered by Dust (m)
1	40	150	23.74	0.48
2	40	200	17.80	0.50
3	40	250	14.24	0.57
4	**40**	**300**	**11.87**	**0.65**
5	40	325	10.95	0.67

Contact angle of brush with ground, θ=45°

Performing with motor=0.5Hp, Max speed=1000rpm

From the above experimental result, the dust is sweep to the distance of 0.65 m by the 0.5 Hp motor at 300 rpm which is the desired for the collection of dust in the collecting arrangement.

IV.DESIGN CALCULATIONS

Design of V-Belt drive

P_R=0.5Hp

P_D=P_RxK_lxK_Θ

=0.5x0.746x1.15x2

P_D =857watt

N1=1000rpm

D1=40mm

D2=115mm

Cross Section area A= 480〖mm〗^2

N_1 D_2=N_2 D_2

N_2=347.8rpm

Sinα=(115-40)/2x450

α = 〖4.78〗^°

We know that angle of contact

Θ=〖180〗^°-2α

=180-2(4.78)

Θ=〖170.44〗^°

Assume groove angle β=〖17.5〗^°

2.3log (T_1/T_2) =uΘ cosec β

T_1/T_2 =13.42

Velocity of Belt

V_p=(πD_(1) N_1)/60

V_p=2.09m/s

Mass of belt per meter length

m =A x l x ϱ

=0.48 kg/m^3

Therefore, centrifugal tension in the belt

T_c=mv^2

T_c=0.48 x 〖2.09〗^2

T_c=2.096 N

And maximum tension in the belt

T= stress x area

=2 x 480

T=960 mPa

T_1=T-T_c

=960-2.096

T_1=957.904 N

T_2= 957.904/13.42

T_2=71.37 N

Power Transmitted per belt

(T_1-T_2) v =(95709-71.37) x 2.09

=1852.84 watt

No of belts = P_d / power per belt

857/1852.84

=0.46≈1

Therefore the number of belts will be 1.

Pitch length of belt:

L= π(r_2-r_1) +2x+〖〖(r)〗_2-r_1)〗^2/x

= π+(57+20)+2x450+〖57-20)〗^2/450

L= 1144.94mm

2. Design of Shaft

W_B=T_1+T_2

T_1=957.904 N

T_2= 71.37 N

Vertical load on B= W_B= T_1+T_2

=957.904+71.37

=1029.274 N

Vertical load on shaft at C= 2 N

Torque acting on pulley

T=(T_1-T_2)R_B

= (957.904 – 71.37) x 0.115

T = 101.95 N-m

(T_3-T_4) x R_C= T

(T_3-T_4) x 60 x 〖10〗^(-3)= 101.95……..(1)

T_1/T_1 =T_3/T_4

(957.904)/(71.37)=T_3/T_4 ……(2)

By solving (1) and (2)

We get,

T_3=136.80 N-m

T_4=10.19 N-m

W_C=T_3+T_4+35

(Force to sweep the dust= 35 N)

= 136.80+10.19+35

W_C=185 N-m

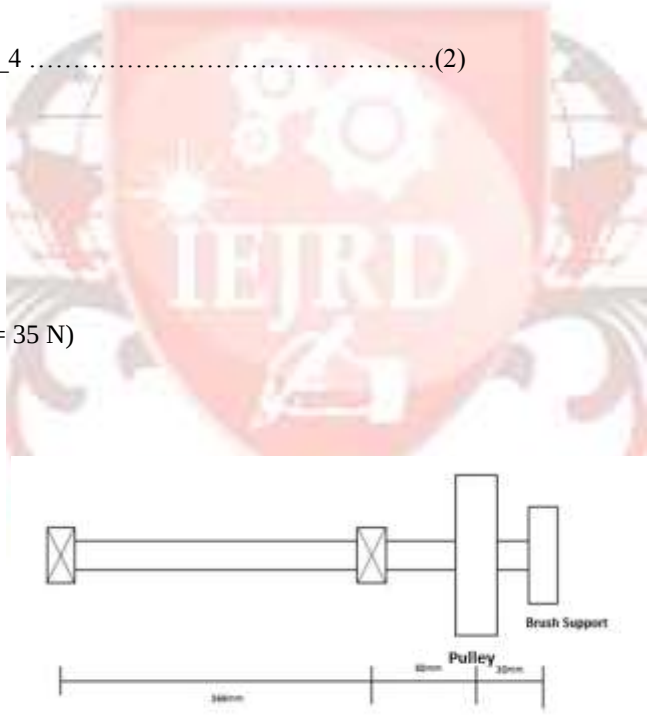


Fig:8.1 Road bed cleaner machine shaft

Vertical Reaction at fixed support

R_BV=-1029.274 N

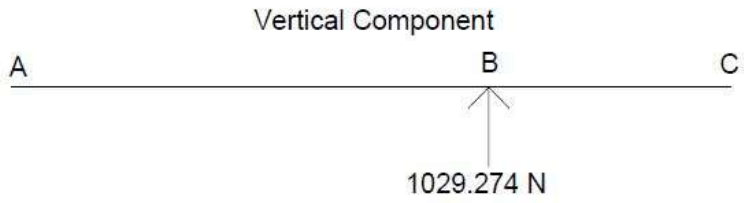


Fig: 8.2Vertical Reaction at fix support B

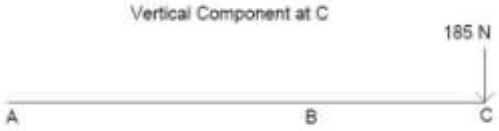


Fig: 8.3 Vertical Reaction at fix support C

Bending moment:

For Vertical component:

M_BV=-51.46 N-m

M_CV= -1029.274 X 0.03

M_CV=-30.87 N-m

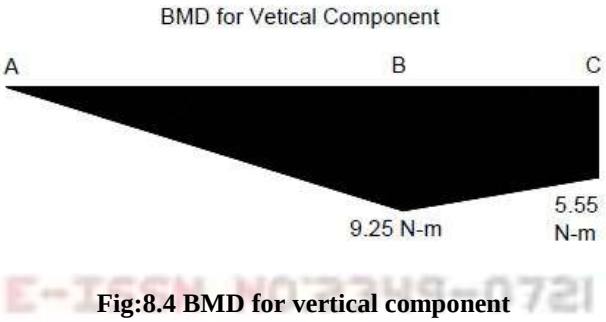


Fig:8.4 BMD for vertical component

For Horizontal component:

R_A=185 N

M_B=185 x 0.05

M_B=9.25 N-m

M_C=185 x 0.03

M_C= 5.55 N-m

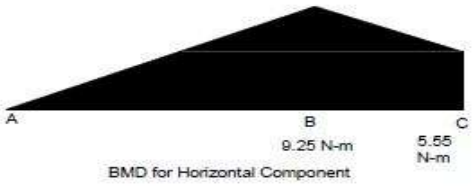


Fig: 8.5 BMD for Horizontal Component

Resultant Bending Moment of B and C:

M_B= √(〖(M_BV)〗^2+〖(M_BH)〗^2)

= √(〖(-51.46)〗^2+〖(9.25)〗^2)

M_B=52 N-m

M_C= √(〖(M_CV)〗^2+〖(M_CH)〗^2)

= √(〖(-30.87)〗^2+〖(5.55)〗^2)

M_C= 31.192 N-m

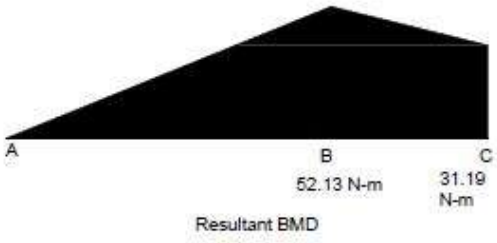


Fig:8.6 Resultant BMD

Maximum Bending moment

M= M_B=52 N-m

Let,

d=diameter of shaft

T_e=√(M^2+T^2)

=√(〖52〗^2+〖101.95〗^2)

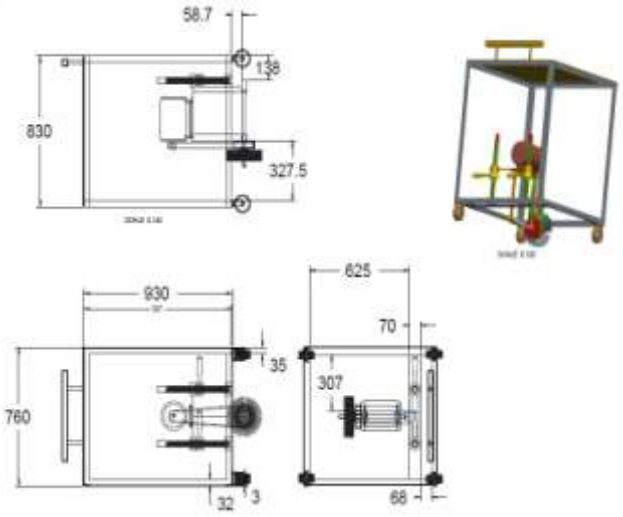
T_e = 114.44 N-m

T_e=π/16 τ x d^3

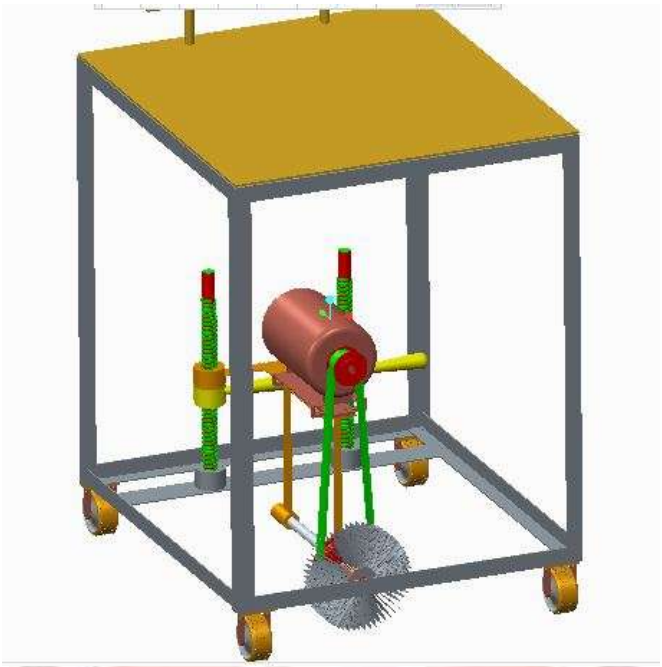
114.44 x 〖10〗^3=π/16 x 45 x d^3

d=18.75 mm

IV.MODELING AND FABRICATION



Assembly Drawing of Road Bed Cleaner Machine



Isometric View of Road Bed Cleaner Machine

Road Bed Cleaner Machine-Cleaner Mechanism

Road Bed Cleaner Machine

V.CONCLUSION

The research work deals with the use of an electric vehicle for road bed cleaning purposes. An electric vehicle has the dual advantage of both being relatively eco-friendly as well as much more cost efficient. Instead of individual systems for the sweeper and cleaner using electric systems and operating the vehicle on combustion engine, the system's use of pure electric propulsion means the unit can be designed as a whole. The entire vehicle can be modified and redesigned as needed for operation. The vehicle can save costs on fuel in the long run as well as the fact that electricity remains the only future resource for mankind. This vehicle can also reduce road pollution and thereby help reduce the amount of accidents that occur due to improper road maintenance.

VI.FUTURE SCOPE OF THE PROJECT

We can improve the machine for operation on different surfaces.As it reduces overall handling time therefore it can be used for various mounting purpose.Since no pollution take place during operation therefore it also helps to maintain pollution free environment.Because of more reliability it can be used for various types of particles easily sweep like as street cleaning simulator storm drains now removal road debris

As it reduces overall handling time therefore it can be used for various purposes

VII.ACKNOWLEDGEMENTS

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