

**FABRICATION AND DESIGN OF CLEANING RICKSHAW MECHANICALLY COUPLED
WITH FIBRED BRUSH DUST COLLECTOR**

Devesh Kumar Mishra
Assistant Professor,
Rewa Engineering College, Rewa, M.P, India

Pradhumn Tiwari
Assistant Professor,
Rewa Engineering College, Rewa, M.P, India

Abstract

Cleaning has become a basic need for all human beings and it is unavoidable daily routine process. The conventional road cleaning machine is most widely used in railway stations, airports, hospitals, Bus stands, etc. needs electrical energy for its operation. It is not user friendly as well as eco-friendly. In summer time there is power crisis and most of the roads cleaning machines are not used effectively due to this problem particularly. In our project we are using manual power operated machine with low cost. It is the better alternative for conventional machine.

The conventional floor cleaning machines is most widely used in airport platforms, railway platforms, hospitals, bus stands, malls and in many other commercial places. These devices need an electrical energy for its operation and not user friendly. In India, especially in summer, there is power crisis and most of the floor cleaning machine is not used effectively due to this problem, particularly in bus stands. Hence it is a need to develop low cost, user friendly floor cleaning machine. In this project, an effort has been made to develop a manually operated floor cleaning machine so that it can be an alternative for conventional floor cleaning machines. In this work, modeling and analysis of the floor cleaning machine was done using suitable commercially available software. The conventionally used materials were considered for the components of floor cleaning machine. From the finite element analysis, we observe that the stress level in the manually operated floor cleaning machine is within the safe limit.

I. INTRODUCTION

Effective cleaning and sanitizing helps and protect the health of the human beings directly and Indirectly. Also, cleaning and sanitizing prevents the pest infestations by reducing residues that can attract and support bees, pests etc. It also improves the shelf life of the floor, walls etc. due to regular cleaning and maintenance. In recent years, most of the people prefer to use trains or buses for commuting and hence these places are littered with biscuits covers, cold drink bottles etc. Hence, it is necessary to clean the bus stands and railways stations at regular interval. There is no one single cleaning method that is suitable for all locations and occasions and effective cleaning

depends upon type of cleaning device, cleaning technique and also the equipment should be user friendly. Cleaning work can be physically demanding and a need has been identified to developed methods for systematic ergonomic evaluation of new products.

In recent years, floor cleaning robots are getting more popular for busy and aging populations due to lack of workers. However in India, unemployment is more and hence there is a need to develop less labor oriented cleaning machine. Hence, the present work is aimed to design, development and evaluation of a manually operated road cleaning machine. "" Liu et al carried out a technical analysis of residential floor cleaning robots based on US granted patents. They observed that the macroscopic analysis of patents and patent bibliometrics or patent maps, is useful tools to make an overview for designated technical topics and they observed that the Samsung is the top one patentee in cleaning robot after macroscopic of view. Imaekhai Lawrence et al evaluation has shown how the use of multiple assessment techniques can provide a comprehensive appraisal of the design, usability and musculoskeletal loading upon the operator. They suggested that the trials with a larger number of subjects would certainly strengthen the conclusions.

We find that the most significant cause of road dust to the total suspended particulate burden is vehicle traveling on paved and unpaved' surfaces. Consequently data directly relating dust to road accidents are rare, but in a study if dust is the cause of 10% of these accidents casualties then the cost could amount to as much as 0.02% of GDP in some developing countries and total about \$800 million annually. The present state of the road cleaning process is described below. There are two ways for road cleaning:

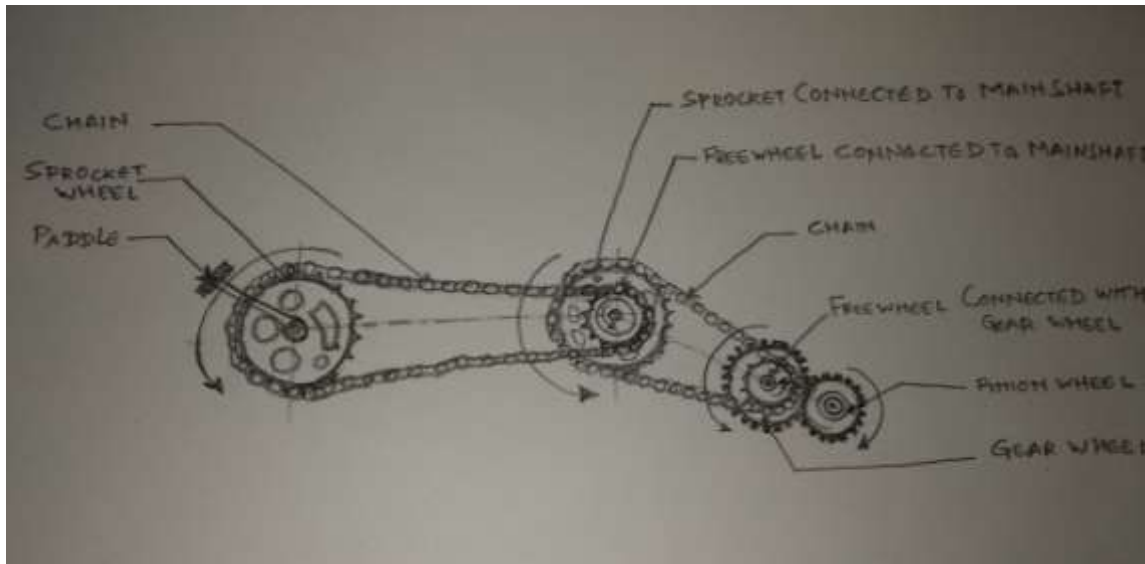
- 1) Manual process
- 2) Machinated process.

MANUAL PROCESS:- In manual process, the road cleaning is done with the help of and shovel to clean off the debris, waste etc. hand to clean the road by spreading the dust all over in the air.

MACHINATED PROCESS:- While in the Machinated process, a vehicle containing broom at bottom continuously rotating, clean the road as well as sucks the dust spread by rotating broom.

II. WORKING PRINCIPLE

This model works on the principle of converting rotary motion into rotary & translatory motion. Which explains that," when paddling is provided to tricycle, the gear and chain arrangement convert this motion to rotary motion of back wheel and shaft, an another sprocket and chain drive provide power for a gear arrangement. The gear drive converts this motion into rotary motion of sweeping brush or bloom & translator motion of tricycle."



III. TECHNICAL DISCRIPTION

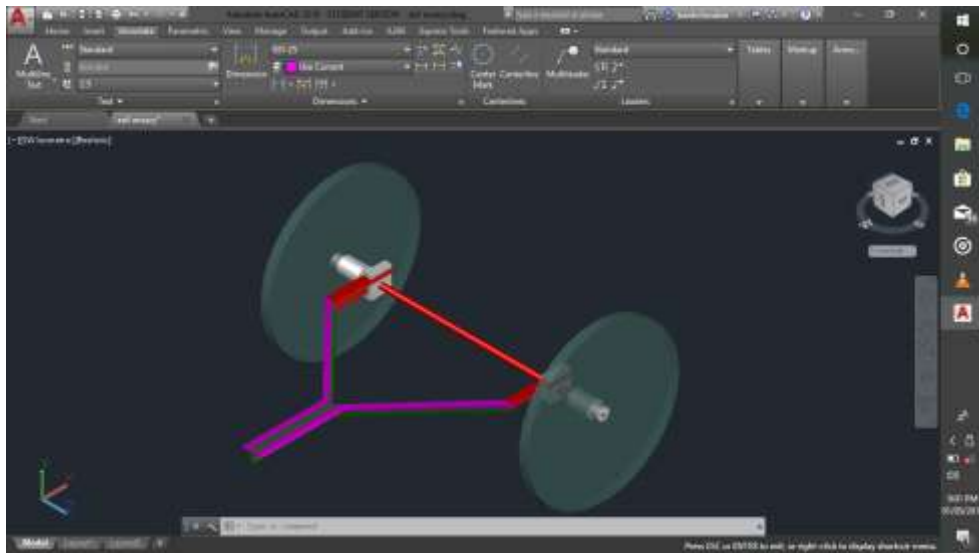
The machine is joined with a Rickshaw. It consists of a rotary brush which rotates with a chain and gear drive. When we drive the rickshaw the shaft with back wheel rotates, we have provided two sprockets near both the back wheel which is fixed with rotary shaft. And a sprocket and gear, welded together, is provided in between the rotary brush shaft and rickshaw shaft. A smaller gear is attached with shaft of rotary brush which rotates the shaft. When we drive the rickshaw the shaft with wheel rotates, as sprocket is fixed with shaft, it also rotates, which drive the sprocket and gear arrangements in same direction, the gear is mesh with smaller gear of bloom shaft which rotates the bloom in opposite direction. The brush is in touch with ground .the brush rotates and dust and waste is collected in dustbin attached in front of rotary brush. Dustbin is a hopper like arrangement which is fixed below rickshaw shaft and open towards the brush. One end is slightly above the ground and other is above the brush, the dust is collected when brush rotates and forwards the dust.

COMPONENTS USED IN ROAD CLEANER

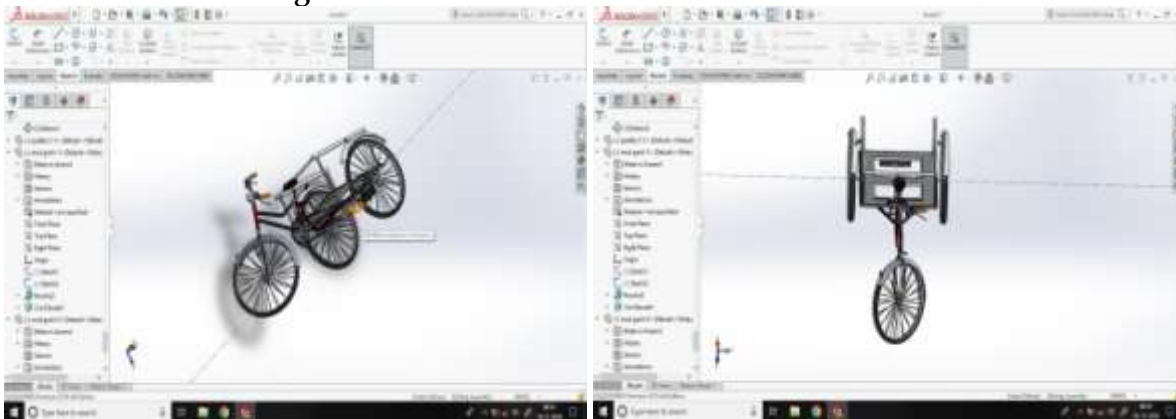
- A tricycle (rickshaw)
- Gears
- Sprocket wheels
- Freewheels
- Chains
- Roller brush
- Hopper as dustbin
- Frame

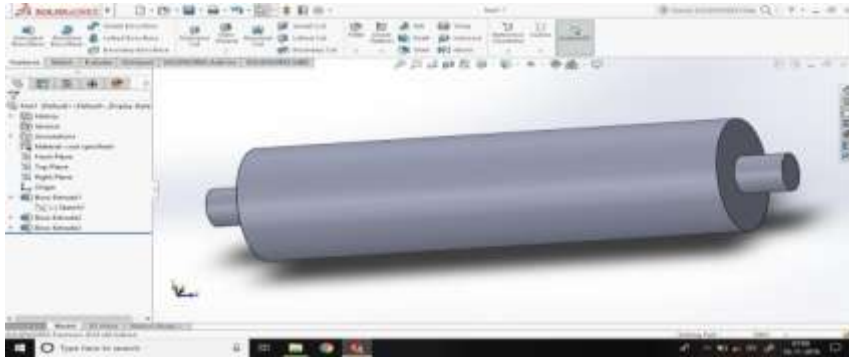
CAD Modelling

In analysis of manually operated eco-friendly road cleaner was carried out by using Auto CAD software. Analysis was used to find the deflection and stress on frame, brushes and wheels. The maximum deflection & stress were checked and maintained with in the allowable limits for the materials of construction. Dead load is the self weight of the structure which is acting on it. Load is the dead load applied on the machine. Figure shows the dead load acting. The 3D model was developed and then it was meshed using the Auto CAD tool. Finite element model is made using beam elements, shell element and mass element & MPC element (Multi point constraint). Figure shows the model of the floor cleaning machine on the model at the specified points. The required boundary conditions are applied on the model and then the model was checked for maximum deflections and maximum stresses using the software.



Solid Works Modeling :





IV. SPECIFICATION OF COMPONENTS

Components	Materials	Dimensions
Driving Sprocket	Cast Iron(FG260)	Dia-16cm Teeth-44
Driven Sprocket	Cast Iron(FG260)	Dia-8cm Teeth-22
Driving Spur Gear	Cast Iron	Dia-10cm Teeth-48
Driven Spur Gear	Cast Iron	Dia-5cm Teeth-24
Broom	Hard Plastic	Dia-45cm
Shaft	Mild Steel	Dia-2cm
Frame	Soft iron	-
Supporting Tyres	Cast Iron(FG260)	Dia-6cm

V. DESIGN & RESULTS

Material – Cast Iron

Ultimate Tensile Strength – 200 N/mm²

No. of teeth :

- Gear = 48
- Pinion = 26

Diameter:

- Gear = 10 cm
- Pinion = 5 cm

According to standards for tooth of 26, Lewis form factor = 0.337

$$\begin{aligned} \text{Therefore force } S_b &= m \cdot b \cdot \sigma \cdot Y \\ &= 4.8 \cdot 48 \cdot (200/2) \cdot 0.337 \\ &= 7764 \text{ N} \end{aligned}$$

Now tangential force due to rated torque

$$M_t = 60 * \frac{10^6}{2 * \pi * 200}$$

$$= 47746 \text{ N-mm}$$

$$P_t = \frac{2 * M_t}{d_p}$$

$$= 1909 \text{ N}$$

Effective Load

$$V = \frac{\pi * d_p * n_p}{60 * 10^3}$$

$$= 0.5 \text{ m/s}$$

$$C_v = \frac{3}{3 + v}$$

$$= 0.85$$

Taking Service factor $C_s = 1.5$

$$P_{eff} = \frac{C_s}{C_v} * P_t$$

$$= 3340 \text{ N}$$

$$\text{Factor of Safety} = \frac{S_b}{P_{eff}}$$

$$= \frac{7764}{3340}$$

$$= 2.32$$

Design Analysis of Chain Drive

p - Pitch length

T - No. of teeth

From calculation, we know pitch = 12.7 mm

$$\text{Diameter of bigger sprocket} = \frac{p}{\sin\left(\frac{180}{T_1}\right)} = 16 \text{ cm}$$

$$\text{Diameter of bigger sprocket} = \frac{p}{\sin\left(\frac{180}{T_2}\right)} = 8 \text{ cm}$$

From standard for pitch of 12.7 mm and rpm = 50

$$\text{Braking Force} = 17800$$

$$\text{Braking Power} = 280$$

$$V = T_1 * p * \frac{n}{60 * 10^3} = 0.5 \text{ m/s}$$

$$\text{Tension in chain} = \frac{P}{V} = 560 \text{ N}$$

$$\text{Factor of Safety} = \frac{17800}{560} = 32$$

$$\text{Total length of chain} = 50 * p = 635 \text{ mm}$$

VI. CONCLUSION

The manually operated eco-friendly road cleaner is successfully designed, analyzed and fabricated. This project works implements the manually operated ecofriendly road cleaner for road cleaning that reducing the cost, human efforts as well as time. It is the best alternative for automated road cleaning machine during power crisis and rural and small towns. It is found that the existing road cleaning machines uses petrol and diesel. It can cause pollution and also the vibration produced in the machine causes noise pollution. While manual cleaning may cause

healthy problem as the person directly comes in contact with dust. Also, the shoulder problem due to continuously sweeping occurs. A manually operated eco-friendly road cleaner is an alternative concept for avoiding such problems. The manually operated eco-friendly road cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the road seems to be very rough and damaged. It can provide job to the uneducated person who is in need for such jobs as human energy is needed to drive the machine.

Manually operated floor cleaning machine is an alternative for an automated floor cleaning machines during power crisis. Body is pedal operated to achieve dry and wet cleaning simultaneously. Its design was carried out by using Auto CAD tool 3D meshed model is developed according to the required dimensions. Using Auto CAD tool, 3D model is checked for Deflection, Stresses.

1) Maximum deflection and stresses in the frame (dry cleaner) i.e. for total load (dead load and live load), dead load is the self weight of the body and live load is the rider weight over the body. For total load, induced deflection and induced stress were found and these values are small and negligible.

2) For Maximum total load on the beam induced stress and induced deflection were found and these values were small and negligible.

From the above two FEA results induced stress is lesser than
The allowable stress therefore design is safe.

REFERENCES

- [1] Praveen H et.al, IJRASET, Volume 6 Issue V, May 2018
- [2] DHIRAJ M. BANKAR et.al, IJERT, VOLUME 4, ISSUE 3, Mar.-2017
- [3] Aman khan et.al, IRJET, Volume: 04 Issue: 02, Feb -2017
- [4] Pravesh Kumar Singh et.al, IJARIT, Volume3, Issue3
- [5] Muhammad KashifShaikh Ghaffar et.al, IJAERD, Volume 5, Special Issue 06, April-2018
- [6] SANDEEP J. MESHRAM et.al, JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN MECHANICAL ENGINEERING, Volume 4, ISSUE 1, NOV 15 TO OCT
- [7] Imaekhai Lawrence et.al, IISTE, Vol 3, No 4, 2012
- [8] Mohsen Azadbakht, Ali Kiapey, Ali Jafari- "Design and Fabrication of a tractor powered leaves collector equipped with suction blower system" - September, 2014
- [9] Agric Eng Int: CIGR Journal Open access at <http://www.cigrjournal.org> Vol. 16, No.3.
- [10] M. Ranjith Kumar, N. Kapilan- "Design and Analysis of Manually Operated Floor Cleaning Machine" - International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERT IS040912 [www.ijert.org] Vol. 4 Issue 04, April-2015.
- [11] Sandeep. J. Meshram, Dr. G.D. Mehta - "Design and Development of Tricycle Operated Street Cleaning Machine" - Journal of Information, Knowledge And Research In Mechanical Engineering ISSN 0975 - 668X | Nov 15 To Oct 16 | Volume- 04, Issue- 01.

- [12] Liu, Kuotsan, Wang Chulun - "A Technical Analysis of Autonomous Floor Cleaning Robots Based on US Granted Patents" - European International Journal of Science and Technology Vol. 2 No. 7 September 2013, 199216.
- [13] Imaekhai Lawrence - "Evaluating Single Disc Floor Cleaners" - An Engineering Evaluation, Innovative Systems Design and Engineering, Vol 3, No 4, 2012, 41-44.
- [14] Abhishek Chakraborty, Ashutosh Bansal - "Design of Dust Collector for Rear Wheel of Four-Wheeler" - International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 7, July 2013, 199216.
- [15] Jialei Cheng, Jens-Steffen Gutmann, Kristen Culp, Mario E. Munich and Paolo Pirjanian - "The Social Impact of a Systematic Floor Cleaner". - In IEEE international workshop on advance robotics an its social impacts , Technische University munchen, Germany May 21-23,2012
- [16] Renaekuehl, Ernesto Gambao, Miguel Hernando and Dragoljub Surdilovic - "Development of a SemiAutomated Cost- Effective Facade Cleaning System", Robotics and Automation in Construction".
- [17] P.U. Asnani, Rajath S, Yashas R N, Bhardwaj M Pothins , Darshan Gowda R, Vanishree T S, July 2015. Journal paper on "Design and fabrication of feet dust removal and deodorizing machine" Vol.2, Issue 11, ISSN: 2347- 1697.
- [18] Vinod Kumar M V, Prem kumar Naik, Prasad B G, Syed Razequlla - " Design and Fabrication of Automated Glass Curtain Cleaning Machine" - International Journal