EasyChair Preprint

№ 5802

Design and Analysis of of Drainage Cleaning System

Yashwant Chapake, Pratik Borade, Anand Danai, Sanket Harak and Adesh Kurhade

June 15, 2021

DESIGN AND ANALYSIS OF OF DRAINAGE CLEANING SYSTEM

Yashwant Chapake[1], Pratik Borade[2], Anand Danai[2], Sanket Harak[2], Adesh Kurhade[2]
AssistantProfessor , Student

Sinhgad Academy of Engineering Kondhwa, Pune 411048, India.

ABSTRACT

Now-a-days even though mechanical drainage plays a vital role in all domestic and industrial applications in the proper disposal of sewages from domestic, industries and commercials are still a challenging task. Drainage pipes are using for the disposal and unfortunately sometimes there could also be loss of human life while cleaning the blockages within the system. The proposed research work is to replace the manual work in gutter cleaning by Automated drainage cleaning system. The Automated drainage Cleaning system is a machine which helps to protect the environment from different kinds of environmental hazards through the promotion waste management by the removal of garbage from the drainage system. These wastes when not removed find yourself settling in residential places where these wastes are burnt thereby causing global climate change otherwise these wastes block the drainage systems thereby causing flooding. In this project the proposal concept is to exchange the manual add drainage cleaning by automated system. We know that water features a great importance in person life, the water flow in drain filled with wastes like polythene, bottles etc. The gutters get blocked due to these wastes in water. To overcome this problem and to save lots of human life we implement a design "Automated Drainage Cleaning system" and that we have designed our project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages.

Keywords: Drainage, waste, cleaning.

INTRODUCTION

Water is being used very fast in today. The significance of water is especially used for cooking, cleaning and drinking in our lifestyle. The water utilized in the factory and therefore the house comes from the drains and reaches within the rivers, within the ponds and within the oceans. In which more solid ingredients (polythene, bottles etc.) along with water also reaches. We have built Automated drain cleaning machine with the main purpose of removing these solid materials from drains. This machine are often established at any point of drain very easily. It has been designed in such a way that its lets water flow through it but collects all the solid substances and gives a group in the dustbin. This machine is able to do cleaning and moving processtogetheronthedrains/gutters.

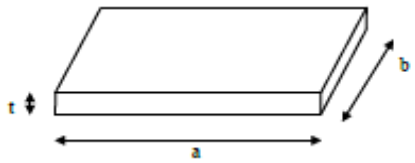
The Drainage water cleaner system are wont to clean wastes from water like polythene, bottles etc. present in water. This can be used to overcome the problem of filtration of wastes from water and it save the time and cost that spend on cleaning the drainage. As the industry setup increase in the environment the water coming from industries are full of wastes like polythene, bottles, and other materials and that water mix with the other water that are used by people and we know that that water is not good for the for health of people. So, to overcome from these problems we can filter the water drainage water before it mixes with other water. This

type of filtration of water is called primary filtration. In this project we use DC or AC motor to run the system when power supply is available& the Equipment, we used are motor, chain, driver, bucket, frame, wheel, sprocket gear, solid shaft etc. Water may be a basic necessity of human and every one living beings. There is a many water on earth that's not suitable for human use. The impurities present in water can cause hazardous diseases. Waste water is defined because the flow of used water from homes, business industries, commercial activities and institutions which are subjected to the treatment plants by a carefully designed and engineered network of pipes. The biggest impact of cleaning the chemical wastes can cause respiratory diseases and it plays a challenging issue for the municipality officers. Water damage is assessed as three sorts of contaminated water. They are clean water, gray water and black water.

EXPERIMENTAL DESIGN

CALCULATIONS

Design calculations are as follows,

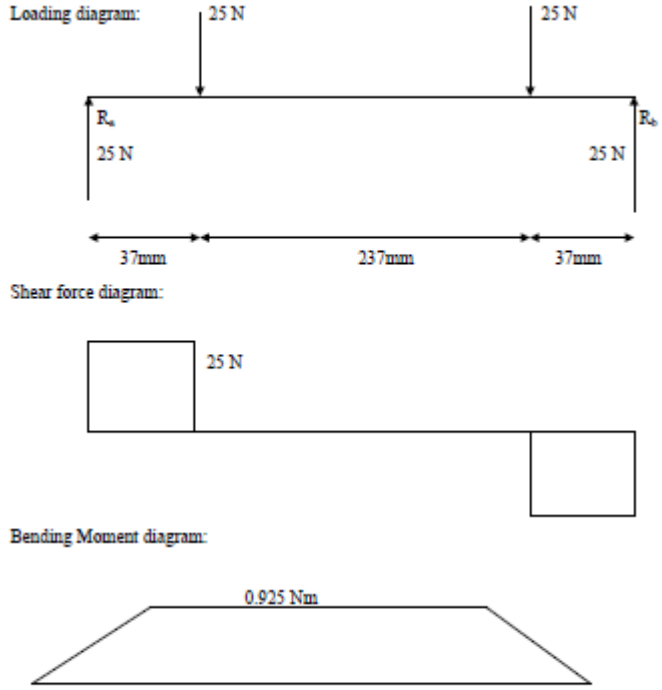


a = 250mm Material assumed: Stainless steel (SS316)
b = 100mm Density(ρ): 7930 kg/m^2
c = 10mm Youngs Modulus (E): 190 GPa
Mass of waste = 3kg Poisson's ratio: 0.265
Weight of waste = Load(w) = 3 * g = 30 N ……. (g = 10 m/s^2)
We need to check whether these dimensions assumed are safe.
UDL applied on plate(W) = w / (a) = 30/0.25 = 120 N/m

Find Maximum Deflection:
Deflection = $\frac{5\,WL^4}{384\,E\,I}$ ……. (1)
I = $bt^3 / 12$ = 100 * 10^3 / 12 = 8333.33 mm^4 = 0.83 * 10^{-8} m^4
Putting all values in (1)
We get **Deflection = 3.87 * 10^{-3} mm**
This deflection is very negligible considering our system. So, it is assumed that Design of Lifter is safe.
Weight of plate = Volume * ρ
= 0.25*0.1*0.01 * 7930
= 1.98 ≈ 2 kg

Design of Shaft
Material: Mild steel (AISI 1018) Motor RPM = 30
E = 210 GPA Motor torque = 1.25 Nm
Yield Strength = 370MPA
Let FOS be 4

Allowable stress = yield strength / FOS = 370 / 4 = 92.5 N/mm2



For Loading diagram:
$\Sigma F_y = 0$
$R_a + R_b = 50$
$\Sigma M_A = 0$
25 *37 +25*274 = Rb * 311
$R_a = 25$
$R_b = 25$
For SFD BMD:
M = W*a
] = 25*37
= 925 N mm
M = 0.925 N m
$M_e = 1.24$ Nm
$\sigma_b = 32 * M_e / \pi * d_3$
$d3 = 32 * 1.24 / \pi * 92.5 * 10^6$
d = 5.15 mm
next standard size = 6mm
So, for safety we should take minimum diameter of shaft as 6 mm
In design we have taken it as 20 mm
3.2.3 Design of Chain and sprocket assembly:
Step:1
Type of Chain: Roller Chain is selected for the application
Step:2
Determination of Transmission Ratio
Calculate transmission ratio (i) from PSG Design Data Book P. No: 7.74
i= Z2 / Z1
We need i = 1
Pinion: 1 Wheel: 2 we have Z1 =Z2
Select the Preferred transmission ratio from PSG Design Data Book P. No: 7.74 based on the calculated (i) value
Step:3

Standard Number of Teeth on Pinion Sprocket (Z1)
For the preferred transmission ratio (i) from PSG Design Data Book P. No: 7.74 select recommend number of teeth on sprocket (Z1)
Choose odd number of teeth
Recommended Z1 = 27 to 30
Selected **Z1 = 29**
Step:4
Standard Number of Teeth on Wheel Sprocket (Z2)
So, from i we have **Z2 = 29**
Step:5
Selection of standard pitch (p)
Using the formula of optimum centre distance in PSG. Design Data Book P. No. 7.74 and calculate pitch value (p)
So, pitch selected is p = 15.875
Centre distance a = (30 to 50) p
a = 30p = 476.25 mm
a = 50p = 793.75mm so selected is a= 770 mm (as per requirement)
Step:6
Calculation of Breaking Load (Q)
Rearrange the formula for Power Transmitted in PSG Design Data Book P. No: 7.77 and calculate breaking load in kgf

$$\text{Power (in Kw)} = \frac{Q * v}{102 * n}$$

Calculate speed "v" using formula
V = z1*n1*p / 60 * 1000
v =29*30*15.875 / 60*1000 = 0.23 m/s

Q = 102 *n* p / v =4434.78 kgF

Step:7
Selection of Chain

Chain No. ISO/DIN	Rolon	Pitch P mm	Roller dia max D_r mm	Width between Inner Plates min W mm	Pin Body dia max D_p mm	Plate Depth max G mm	Transverse pitch P_t mm	Overall over joint max A_1, A_2 A_3 mm	Bearing Area cm^2	Weight per Meter kgf	Breaking Load min kgf
08B-2	DR1278	12.7	8.51	8.00	4.45	11.70	13.92	34.40	1.00	1.32	3180
08B-3	TR1278	12.7	8.51	8.00	4.45	11.70	13.92	48.30	1.50	1.95	4540
	R1278H	12.7	8.51	8.00	4.45	11.70	—	22.50	0.54	0.75	2100
	R1548	15.875	7.75	4.90	3.68	9.90	—	12.80	0.26	0.29	820
	R1564	15.875	10.16	6.65	5.08	14.30	—	20.10	0.51	0.80	2270
10A-1	R50	15.875	10.16	9.55	5.08	15.05	—	25.90	0.70	1.01	2220
10A-2	DR50	15.875	10.16	9.55	5.08	15.05	18.11	44.00	1.40	1.78	4440
10A-3	TR50	15.875	10.16	9.55	5.08	15.05	18.11	62.00	2.10	3.02	6660
10B-1	R1595	15.875	10.16	9.85	5.08	14.30	—	23.50	0.67	0.91	2270
10B-2	DR1595	15.875	10.16	9.85	5.08	14.30	16.59	39.90	1.34	1.82	4540

Based on the calculated breaking load and pitch value select the Roller chain from PSG Design Data Book P. No: 7.71 to 7.73
Step:8
Check for bearing stress
Calculate value of Service factor Ks
Ks = k1*k2*k3*k4*k5*k6

K1 = 1.25
K2 = 1.25
k3 = 1
k4 = 1.25
k5 = 1.5
k6 = 1.5
Ks = k1*k2*k3*k4*k5*k6 = 4.39
Using the formula of power transmitted in PSG Design Data Book P. No: 7.77 calculate bearing stress
Power in kw = bearing stress * A * V / 102 *Ks
Bearing stress = 1.854 kgF / mm^3
Select the allowable bearing stress from PSG Design Data Book P. No: 7.77 based on speed of small sprocket and pitch value
Allowable bearing stress = 3.5 kgF / mm^3
If the calculated bearing stress is less than allowable bearing stress, then the design is safe
Hence design is safe.
Step:9
Calculation of actual length of chain
Using the formula in PSG Design Data Book P. No: 7.75 calculate actual length of chain
Lp = approx. number of links
Ap = a/p = 770/15.875 = 47.24
Lp = 2 ap + (z1+z2 / 2) + $(z1 - z2)^2$ = 123.48 = 124
Length of chain = lp * p = 1968.5 mm
Step:10
Calculation of pitch diameter of sprockets
PCD of sprocket = p / sin (180/z1) =146.82 mm
Using the formula in PSG Design Data Book P. No: 7.78 calculate pitch diameter of sprockets
3.2.4 Selection of bearing
P = XVFr + YFa
Where,
P = equivalent dynamic load (N)
Fr = radial load (N)
Fa = axial or thrust load (N)
Fa = 0
V = race-rotation factor
X and Y are radial and thrust factors respectively
When the bearing is subjected to pure radial
load Fr,
P = Fr = 25 N
Expected life in hour = L_{10h} = 10,000 hrs
L_{10} = 60 * rpm * L_{10h} / 10^6
L_{10} = 18 million revolution
C = P $(L_{10})^{1/3}$ = 65.51
So, selection of bearing is done of basis of C and P for required diameter.

RESULTS- MODELLING AND ANALYSIS

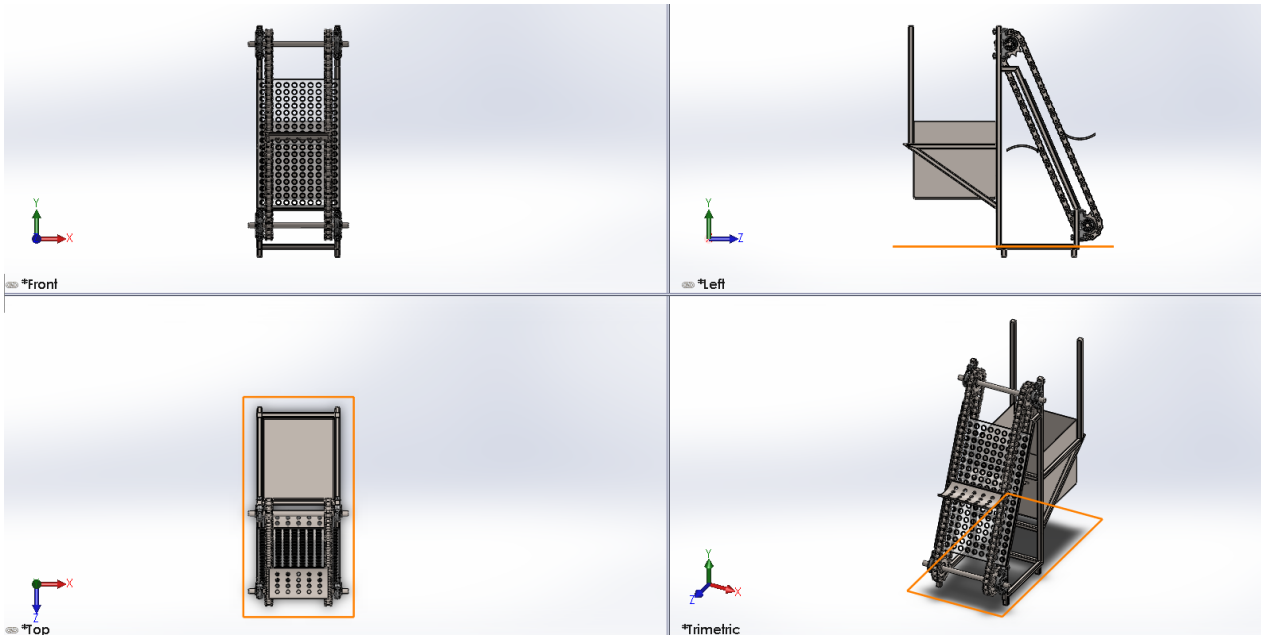


Fig No. Modelling of Drainage Cleaning System

ANALYSIS

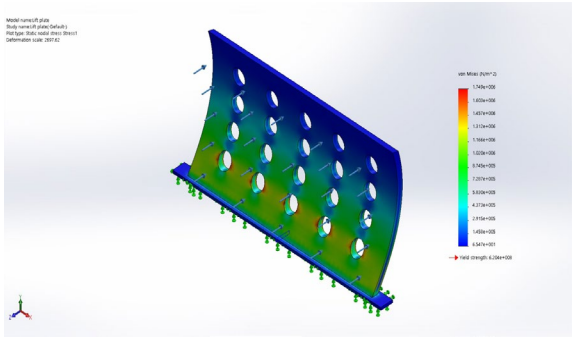


Fig No. Stress Analysis of lifter

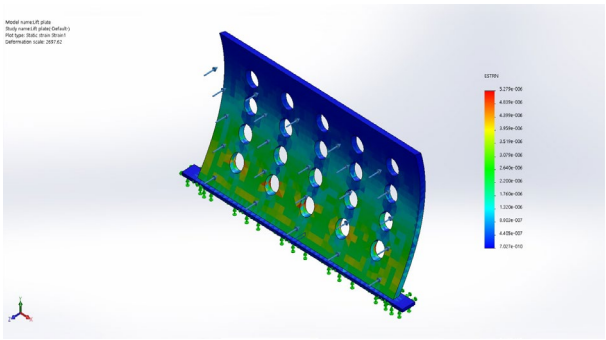


Fig No. Strain Analysis of lifter

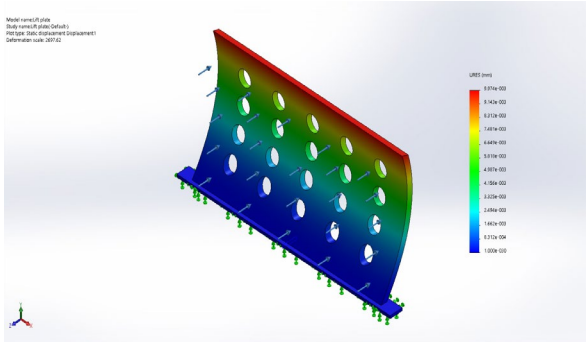


Fig No. Displacement Analysis of lifter

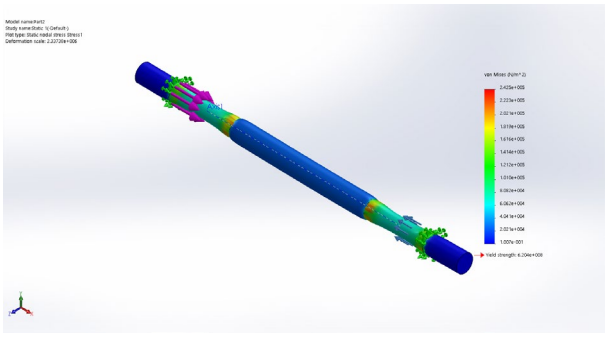


Fig No. Stress Analysis of shaft

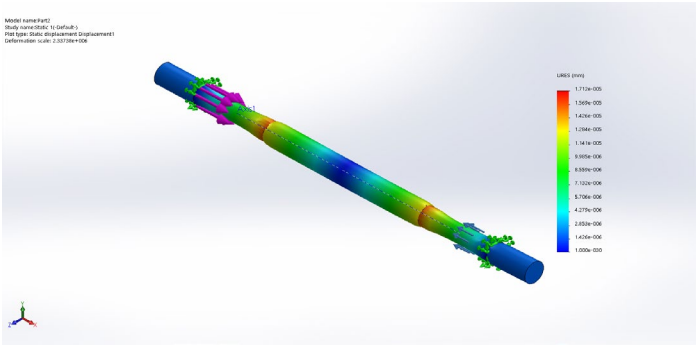


Fig No. Displacement Analysis for shaft

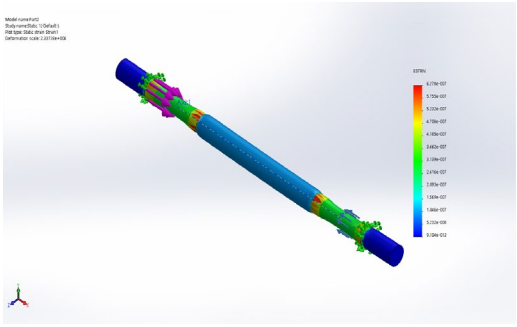


Fig No. Strain Analysis for shaft

CONCLUSION

In the treatment system of drainage, waste water control by the machine and the collecting bin to achieve automatic control of waste water treatment. Drainage from domestic and industries is treated through this project to meet the national emission standards, with stable operation, low cost and good effect. The cleaner functions more effectively during the heavier rains which has more volume of running water with garbage and high velocity. Risk of Labors catching infections or poisoning due to large amounts of waste and chemicals will be reduced. This system is used To Operate Automated Gutter Cleaning System. This project may be developed with the full utilization of men, machines, and materials and money. This Research work made economical and efficient with available resources. This system is Designed, Fabricated successfully and also tested. It works satisfactorily. We hope that this will be done among the most versatile and interchangeable one even in future. Thus we can able to obtain following through Automated Gutter Cleaning system

REFERENCES

[1.] IJRET : International journal of research in engineering and technology eISSN 2319-1163 | pISSN: 2321-7308.

[2.] International journal of science and technology management and research volume 2 issue 2 febraury 2017.

[3.] Internatinal conference on exploration and innovation in engineering and technology.

[4.] International journal of engineering science and computing may 2017 vol. 7 issue no.

[5.] https://en.wikipedia.org/wiki/Drainage_system

[6.] Theory of machines –S S Rattan Department of Mechanical Engineering Regional Engineering College Kurukshetra (2004). Publication: Tata McGraw-Hill Publishing company Limited.

[7.] PSG design data book