

# Design, Analysis and Fabrication of Manhole Cleaning System

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**Abstract**—In this research paper the proposed concept is to use mechanical manhole cleaner that replace the manual work with manhole cleaning system. Now-a-days even mechanical drainage plays an important role in every industrial application in the proper disposal of waste from industries and commercials are still a challenging task. Drainage pipes are using for the disposal and unfortunately sometimes there may be loss of human life while cleaning the blockages in the drainage system. In order to solve this problem and to save human life we have implement a design “Manhole Cleaning System” and thus designed this project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages. Our concept is to use this in efficient way to removal of solid wastages from water. This System helps to protect the environment from different kinds of harmful waste through the promotion waste management by the removal of garbage, plastic and solid waste from the drainage system. These wastes when not removed they get settling in residential places and these wastes are burnt by causing climate change or else these wastes block the drainage systems which causing flooding. Dozens of millions of tons of plastics and other debris end up floating in water bodies around the world. Waste like plastic bottles, cans, bio-debris etc. are lifted up by using buckets which are fitted with projecting teeth.

**Keywords**—Sewer line, Manhole cleaning, chain bucket conveyor

## I. INTRODUCTION

As long as the draining system is considered the function of the main drainage system is to collect, transport and dispose of the water through an outfall or outlet. Impurities in drainage water can be like empty bottles, polythene bags, papers, etc. Waste water is the flow of used water activities from homes, industries, commercial and institutions, businesses, which are subjected to the treatment plants by an exactly designed and engineered network of pipes. There are large number of machines used for removing out the wastes from drains. Mechanical control techniques include: gathering, destroying, cutting, rototilling, rotating, binding and lifting. Sewers provide a myriad of dangers for those who work within them. Toxic gases resulting from cleaning fluids and excrement may build up in areas of the sewer, rising to levels that pose severe risks to those breathing them. The septic environment poses severe risk of infection should the worker have any open cuts. This risk of infection is more considerable when taking into account the potential for open cuts occurring while within the sewer. Of particular concern when a person is alone in the sewer is the “sewer gas” present. This gas is a complex combination of various organic and inorganic compounds, the levels of which can vary greatly. The most abundant gas, hydrogen sulphide, is the result of the breakdown of human waste in the absence of oxygen. As such it is difficult to judge where this gas may be present without first testing oxygen levels within the sewer. Hydrogen sulphide toxicity poses a particular danger to those operating in the sewer alone.

## II. LITERATURE REVIEW

Various parameters used for design of drainage cleaning system has been studied. Brief summary about each considered parameter is explained for design, selection and fabrication purpose.

**Ganesh U L, et.al.** [1], said that the usage of mechanical drainage system cleaner to replace the manual work required for drainage cleaning system. Drainage pipes are very dirty. Sometimes it is harmful for human life while it is need for cleaning drainage system. To overcomes this problem, they implemented a mechanical semi – automated drainage water cleaner and so the water flow efficient because the regular filtration of wastage with help of that project.

**Nithyavathy N et al.** [2] modified the “Drainage Cleaning Machine” with the help of his group members. They kept their attention towards the health of municipal corporation workers. They proposed, “Remote control sewage cleaning machine”. They used RF transmitters and receivers, 9-volt battery and four channel relay board.

**Varun, et.al.** [3] This paper presents a concept of implementing an Intelligent System for detection of proportion of different components present in manhole gas mixture. The determination of proportion of components in manhole gas mixture is important because the manhole gas mixture contains many poisonous gases namely hydrogen sulphide, ammonia, methane, carbon dioxide, nitrogen oxide and carbon monoxide. Even these gases are harmful for the components of the machine as they can cause reactions when in contact with metals and may degrade the components.

**Jack Warner, et. al** [4] In this paper we have studied the advantages and disadvantages of Chain drives and Belt drives.

## III. DESIGN CALCULATIONS

### Manhole:

Manhole dimensions were selected according to Pune Municipal Corporation guidelines with manhole diameter=75cm

$$UTS = 4.074 \text{ MN/m}^2$$

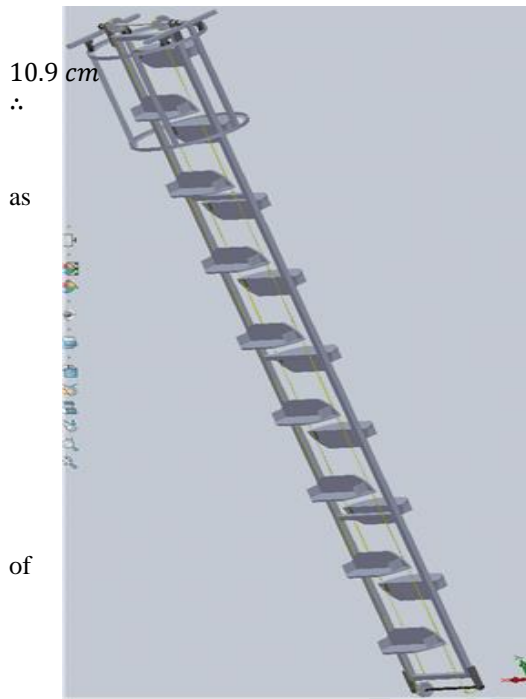
**Chain and Pulley:**

Material selected of chain is stainless steel  
Standard chain-Pulley was selected with 1000kg capacity  
Chain length = 11m

Material selected for pulley is CA104 aluminium bronze  
Number of teeth of hand chain pulley  $N = 8$   
Pulley diameter is given by (PD),  
Pitch of pulley is taken as 4.15cm,

$$\therefore PD = \{pitch \div [\sin\left(\frac{180}{N}\right)]\}$$

$$PD = 4.15 \div [\sin(180/8)]$$



calculated are  
Solid shaft

$$\begin{aligned} \{(32 \text{ M}) \div (\pi d^3)\} &\leq \sigma_{all} \{(32 * 250) \div (\pi d^3)\} \\ &= 190 * 10^6 \text{ N/mm}^2 \\ d^3 &= 2.37 * 10^{-2} \\ \therefore d &= 25\text{mm} \end{aligned}$$

Ultimate tensile strength UTS,

Let us consider maximum load to be 2000 N

$$UTS = (\text{maximum load}) \div (\text{cross sectional area})$$

$$UTS = 2000 \div 4.9 * 10^{-4}$$

**Frame:**

Material selected for frame is aluminum

$$\text{Density } \rho = 2705 \text{ Kg/m}^3$$

$$\text{volume} = \text{cross sectional area} * \text{length}$$

$$= 700\text{mm}^2 * 650\text{mm}$$

$$\therefore \text{Total mass} = \text{density} * \text{volume} = 30\text{Kg}$$

**Bucket:**

Material selected for frame is aluminum

$$\text{Density } \rho = 2705 \text{ Kg/m}^3$$

$$\text{volume} = \text{cross sectional area} * \text{thickness}$$

$$= 500\text{mm} * 200\text{mm} * 20\text{mm}$$

$$\therefore \text{Total mass} = \text{density} * \text{volume} = 22\text{Kg}$$

$$PD =$$

Pitch  
diameter is  
calculated  
10.9 cm

**IV. MODELING OF DESIGNED MANHOLE**

Modeling of manhole is done using Solidworks Software.

**Shaft design:**

Material selected for shaft is mild steel  
Uniformly distributed load is to be considered 1KN across the shaft,  
The reaction forces

Fig.1 Support assembly

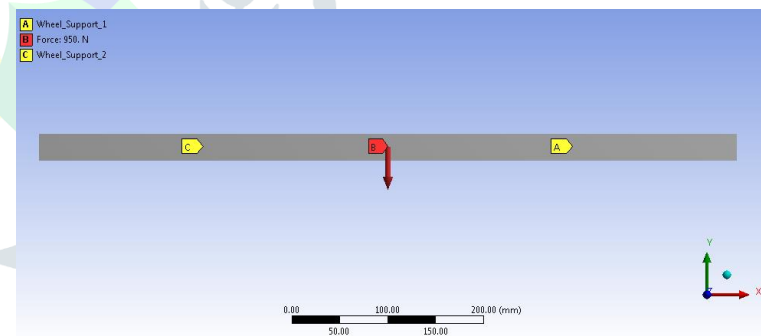


Fig.4 Load distribution

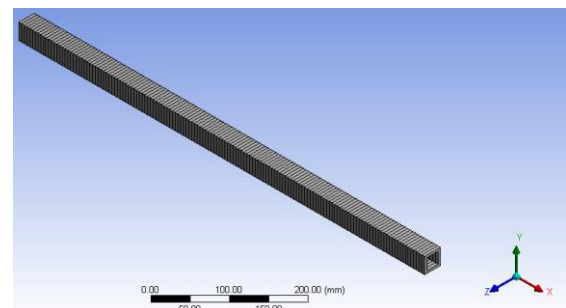
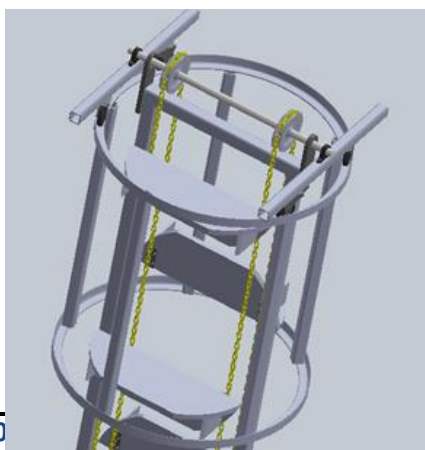
**V. THEORETICAL ANALYSIS OF WHEEL SUPPORT**

Fig.3 frame mesh



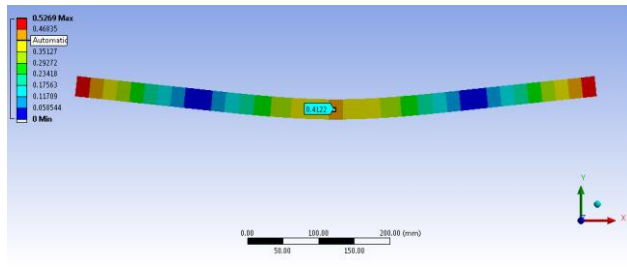


Fig.5 Deformation

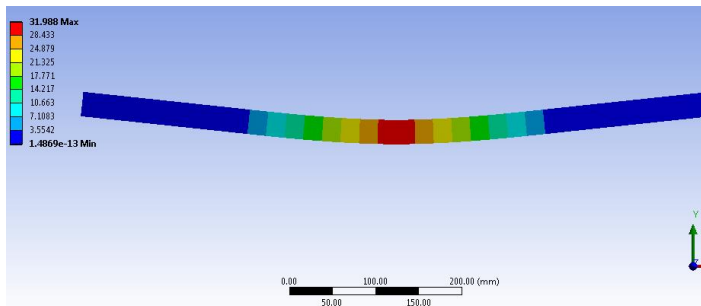


Fig.6 Bending Stress Distribution

## VI. CONCLUSIONS

1. This machine has greater efficiency than the presently working machines.
2. Risky manual job is replaced by this machine.
3. It is cost effective than the presently working machines.
4. Machine can increase the employability and job recruitment for illiterates.

## VII. FUTURE WORK

Future work of the project includes replacement of hand chain pulley with sprocket. Addition of electronic devices like sensors, display etc. and some other mechanical accessories can be assembled. Improvisation in materials of different components and making it cost efficient.

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