

DESIGN AND DEVELOPMENT OF SEWAGE CLEANING MACHINE

Submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Mechanical Department.

By

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**DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **Mohamed Thanveer H (37150121), Mugesh P (37150123)** who have done the project work as a team who carried out the project entitled “**DESIGN AND DEVELOPMENT OF SEWAGE CLEANING MACHINE**” under our supervision from **October 2020 to March 2021**.

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Submitted for Viva voce Examination held on 17.04.2021

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DECLARATION

We, **Mohamed Thanveer H (37150121)** and **Mugesh P (37150123)** hereby declare that the Project Report entitled “**Design and Development of Sewage Cleaning Machine**” done by us under the guidance of **Mr.J. Jeya Jeevahan** Department of Mechanical Engineering is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

DATE:12.04.2021

PLACE: CHENNAI

1.

2.

SIGNATURE OF THE CANDIDATE

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ABSTRACT

The first method of sewage purification was manual scavenging, in which workers put sediment into barrows and were then pushed down the sewer and lifted from manholes by buckets. Not only is the job dirty, unpleasant, and dangerous. The welfare of manual scavenging workers is a major concern, and cleaning is often performed by humans for financial purposes. Despite the fact that automation is becoming more prevalent in all manufacturing applications, proper sewage disposal from factories and advertisements remains a difficult task. To address real-time issues, a sewage cleaning system has been proposed. A sewage cleaning system has been proposed to fix real-time problems. Our aim with this project is to eliminate manual sewer cleaning by introducing a system that manages waste disposal efficiently and filters waste on a regular basis. In our model, a screw conveyor is connected to a motor underneath the tank and plays a significant role. The helical blade rotates in a clockwise direction when the motor is turned on, sucking solid waste from the sewage into the tank. Finally, our goal is to create a machine that is both cost effective and easy to operate.

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CHAPTER 1

INTRODUCTION

Water is used at an alarming pace in today's world. Since it is used for cooking, washing, and drinking, water is extremely significant in our everyday lives. The factory's and, by implication, the house's water comes from drains and ultimately ends up in rivers, ponds, and oceans. This area receives more solid ingredients (polythene, bottles, etc.) as well as water. Manual scavenging is the most revolting activity; for some, it is the only means of survival. More than half a million manual scavengers clean, bear, and dispose of human excreta across the world, from drains and sewers to septic tanks and railway tracks. They push their way into clogged sewers and septic tanks, where they linger for hours, scooping filth with their bare hands and smelling like sewage. Hundreds of manual scavengers die every year as a result of poisonous gases. The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993, made manual scavenging illegal 25 years ago, but it is still practiced today. There are also structural issues that require people to use septic tanks. "Septic tanks are poorly built. They have engineering flaws, which means a computer can't clean them after a certain point," said A Narayanan, director of Change India in Chennai. The fact that many cities do not have sewerage that covers the whole city adds to the issue. Sewage lines are often attached to storm drains, which get clogged and require human intervention. Open drains, on the other hand, are poorly built and allow people to spill solid waste into them, exacerbating the problem. Drains are clogged by improper disposal of plastic bags and bottles, napkins, and other items. Few people take on this menial role, unaware that human feces and urine contain a wide range of diseases. Hepatitis A, E. coli, Rotavirus, Nor virus, and pinworms are all possible carriers. Coming into contact with two of these wastes puts the population at risk of infection. That explains why sewer workers can die as young as 40, succumbing to a variety of illnesses such as cholera, hepatitis, meningitis, typhoid, and cardiovascular issues. In reality, unprotected handling of human excreta causes

respiratory and skin diseases, as well as anemia, jaundice, trachoma, and carbon monoxide poisoning. We will not be able to remove manual scavenging until we implement the necessary technologies.



Figure 1.1 Manual Scavenging

India is a large country with a rapidly increasing population; as a result, we have proposed a new design approach for drainage cleaners, keeping this in mind. Uncovered manholes and open drains are a common occurrence on Indian highways. Neither large metropolitan cities nor small towns and villages are exempt. While the growing number of fatal accidents caused by these open drains has become a major source of concern for pedestrians and residents, city officials remain unconcerned. Despite several accidents, the government has declined to learn from its mistakes and has taken no preventative steps. As a result, the drains remain open, and innocent lives are lost. These open drains and manholes require a large team of cleaners and sweepers to clean. They get into manholes and drainage systems. Accidents happen to cleaners all the time. A similar accident occurred in Chandigarh's Sector 47. The accident resulted in the deaths of three workers. The workers entered a clogged drain that was full of waste. They perished as a result of suffocation. If the drain had been washed on a regular basis, the

amount of waste that needed to be collected by the worker would have been less. According to the police report, the drain was overflowing with waste. The most common cause of an accident is ignorance. The Indian metropolis had witnessed this and other accidents. In today's fast-paced world, technology is infiltrating rural areas through the use of various computers, mobile communication, and other means. It could be transformative if this technical penetration is rendered into the municipal cleaning department. This project, which is a motorized drainage cleaner, is an example of such an attempt. A sewage cleaner device is used in sewage systems to remove solid waste material that flows with water and clogs the sewage system further. The power for these devices comes from a DC motor.



Figure 1.2 Deposition of solid waste

1.1. PREAMBLE

People have been migrating from rural and semi-urban areas to cities and towns in large numbers over the years. From 27.8 percent in 2001 to 31.80 percent in 2011, the proportion of people living in cities has risen. From 5,161 in 2001 to 7,935 in 2011, the number of towns has risen. Many Indian cities lack infrastructural facilities such as water

supply, sewerage, stormwater drainage, and solid waste management as a result of unchecked urbanization.

The majority of slum areas in the country are plagued by severe sewage disposal issues. Sewage and its management have become a tenacious issue as a result of insufficient efforts by town/city authorities, despite the fact that it receives a substantial portion of municipal expenditure. It is not unusual to find that a significant portion of the money is spent by Urban Local Bodies (ULBs) on manning sewerage systems for service and maintenance. Despite this, the quality of services in terms of collection, transportation, treatment, and proper disposal of treated waste, as well as steps to protect public health, sanitation, and the environment, has steadily declined. In many cities and towns across the world, a large amount of sewage goes untreated, resulting in unsanitary conditions in densely populated slums, which leads to an increase in morbidity, particularly due to pathogens, parasitic infections, and infestations in all segments of the population, particularly among urban slum dwellers.

Sewerage and sewage treatment are part of public health and sanitation, and they are covered by the State List in the Indian Constitution. The responsibility for delivering the services falls under the public domain since it is non-exclusive and necessary. The activity is delegated to the ULBs, who are responsible for delivering sewerage and sewage treatment services with their staff, facilities, and funds. Part of the job is contracted out to private companies in a few instances.

Cities and towns with sewerage and sewage treatment facilities are unable to meet the increased strain of supplying such facilities at the required degree of efficiency. Issues and limitations that ULBs responsible for supplying sewerage and sanitation services face are exacerbated for a variety of reasons. The accidental discharge of untreated, partially processed, and non-point sources of sewage are the primary cause of water contamination, and its effect on human health and the environment is even more important

Although traditional sewerage is an efficient method for sewage collection, transportation, and treatment, it is also a resource-inefficient technology. As a result, the system's high capital cost and ongoing substantial operating and maintenance costs prevent its widespread implementation in all sizes of urban areas across the world.

There has been no significant effort to raise community awareness about the potential dangers of inadequate sewage management or the easy steps that every resident can take to help reduce sewage generation and encourage efficient sewage management and treatment. The level of public knowledge and community sensitization is low. At the household level, there is no method for separating black water (from toilets) and greywater (from other liquid wastes). The majority of cities and towns lack adequate service connections for toilets that link to the sewage collection system.

1.2. NEED FOR SAFE SANITATION SYSTEM

Sanitation refers to the environments and processes that affect people's health, especially the systems that provide water and dispose of human waste. Other issues covered by such a mission would logically include solid waste, industrial, and other special/hazardous wastes, as well as stormwater drainage. Sewage, on the other hand, is the most potent of these contaminants.

As untreated sewage builds up and becomes septic, the decomposition of the organic matter causes a slew of problems, including the creation of foul-smelling gases. Furthermore, the untreated waste contains a variety of bacteria that live in the human intestine. Sewage can also contain harmful compounds or compounds that are potentially mutagenic or carcinogenic, which may promote the growth of aquatic plants. To protect public health and the environment, sewage must be removed from its sources of generation as soon as possible and without causing any inconvenience, then treated, reused, or dispersed into the environment in an environmentally friendly manner.

1.3. PRESENT SCENARIO OF URBAN SANITATION IN INDIA

Because of the increased congestion and density in towns, the sanitation problem has become even worse. Indeed, the environmental and health consequences of appalling sanitation are a major source of concern. According to a report by the World Bank's Water and Sanitation Program (WSP), when mortality effects are taken into account, the economic impact on the poorest 20% of households is the greatest. The National Urban Sanitation Policy (NUSP) of 2008 established a system for resolving citysanitation issues. The Policy stresses the importance of raising sanitation awareness through a city-wide approach that includes assigning institutional roles and taking into account demand and supply considerations, with a particular emphasis on the urban poor.

According to the 2011 Census, 81.4 percent of households have a latrine on the property, including 72.6 percent with a water closet, 7.1 percent with a pit latrine, and 1.70 percent with other latrines (connected to open drains, night soil removed by human, etc., which are unsafe). Water closets with piped drainage systems are located in 32.70 percent of households, septic tanks in 38.20 percent of households, and pit latrines (ventilated enhanced pit/open pit, etc.) in 1.70 percent of households. The remaining 18.60 percent of households use public latrines (6%) and defecate in the open (12.60 percent)

Treatment plant capacity is also woefully inadequate due to a variety of factors, including ULBs' poor planning and implementation of sewerage and sewage treatment plants, as well as other appropriate sanitation facilities, due to a lack of adequate financial resources and ULB capacity in the nation. In cities and towns, sewer networks for collecting and transporting sewage from every household are insufficient to convey sewage to treatment plants

1.4. BASIC PHILOSOPHY OF SEWAGE TREATMENT

When sewage is collected from towns, it resembles a "water conveyor belt." Its handling can be thought of as "unloading the conveyor belt" in order to make it usable once more. Water on the conveyor belt is a major problem. As a result, treated waste must eventually return to receiving water sources or property, or it can be reused for specific purposes after undergoing the appropriate treatment. The difficult question that design and practicing engineers must address is: What levels of treatment must be accomplished in a given form of treatment – beyond those required by discharge requirements – to ensure community and environmental protection? Detail assessments of local requirements and needs, application of scientific expertise and engineering judgment based on previous experience, and consideration of federal, state, and local regulations are all required to address this question. In some cases, a thorough examination is needed. For certain ULBs, sludge reuse and disposal are vexing issues that need careful consideration.

1.5. SEWERAGE AND SEWAGE TREATMENT TECHNOLOGY

Sewerage and sewage treatment technology is a branch of environmental engineering in which basic engineering principles are used to solve collection problems, biochemistry principles are used to treat sewage, and environmental concerns are addressed in the disposal and reuse of treated sewage. The ultimate aim is to safeguard public health while taking into account environmental, economic, social, and political considerations. Awareness of the following topics is needed to protect public health and the environment

- sewage constituents of interest
- when the sewage is dispersed into the atmosphere, the effects of these constituents
- the transformation of these voters in treatment processes and their long-term fate

CHAPTER 2

LITERATURE SURVEY

Prabhushankar N et al. designed a machine that used a reciprocating pump as the main component instead of a centrifugal pump for dewatering of drainages. Since centrifugal pumps were more expensive and ineffective at completely removing suspended and heavy solids. For a reciprocating cylinder, they used a pneumatic and spring system. Using compressed airpower, a pneumatic cylinder was used to achieve linear motion with reciprocation. One of the pneumatic drainage system's components was the spring return pneumatic cylinder. One downside was that it was inefficient because some of the cylinder's force was lost when it tried to push against the spring.

T Duricic et al. studied the electrocoagulation process for removing phosphate from synthetic wastewater. Although phosphate is an important nutrient, too much of it causes eutrophication. The findings revealed that as the initial phosphate concentration increased, the rate of phosphate removal decreased, while the rate of phosphate removal increased as the electrolysis time increased. Experiments revealed that an aluminum electrode had a higher removal efficiency (98.9%) than an iron electrode (93.5%) after 40 minutes of treatment (International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137).

Nithyavathy N et al. modified the "Drainage Cleaning Machine" with the help of his group members. They paid close attention to the welfare of employees of the municipal corporation. "Remote Control Sewage Cleaning Machine," they suggested. RF transmitters and receivers, as well as a 9-volt battery and a four-channel relay board, were used. Previously, when municipal corporation members had to clean water, they had to dump it into a drainage system; however, in the modified version, they can

control the machine's speed and direction using a remote control. A worker with less experience could easily operate the computer.

Vetrivel S et al. suggested a method for creating a sewer robot capable of cleaning blockages in sewer pipes with diameters ranging from 80 to 100mm without the use of humans. When moving vertically, a caterpillar-style wheel system was used to maximize cleaning.

The entire system was designed at a low cost, and pipe inspection was made simple with the aid of a "Sewer Robot using the principle of Sensor Locomotives." The entire structure was based on the instruction. It used a four-bar chain system to extend and contract their wheel suspensions in tandem with their movement. They could easily do inspection and cleaning actions where the human hand could not easily reach by combining some sensors and processors with a locomotive.

Ganesh U L showed how to use a mechanical drainage cleaner to avoid having to sweep drains manually. The drain pipes must be washed because they are filthy. When a water supply has to be cleaned, it can be hazardous to humans. They solved the problem by installing a mechanical semi-automated drainage water cleaner, which ensures that the water flow is efficient thanks to the project's frequent waste filtration. With the aid of a drainage system unit, various types of environmental hazards can be minimized.

G. E. Jhonson and James C. Conwell suggested the design and development of a modern test machine configuration that provides the same benefits as the traditional one. During normal operation, the new machine and associated instrumentation allow link tension and roller sprocket impact monitoring, as well as more realistic chain loading. The use of an idle sprocket allows for separate length and preload adjustments.

S D Rahul Bharadwaj, Proposed the automatic cleaning of wastewater in order to prevent global warming and melting of glaciers. The findings highlight the importance of wastewater treatment plants, which treat water until it is suspended in rivers. The

first step is to produce electricity, which is then used to power the wastewater treatment process.

Balachandraetal, Reviewing drainage cleaning to replace manual work with an automated system because manual cleaning is hazardous to human life and wastes time, they created a concept called "Automated drainage water pump monitoring and control system using PLC and SCADA" to solve this issue. PLC and SCADA systems were developed. In this project, the aim is to use an effective method to manage waste disposal on a regular basis, as well as to handle waste disposal in various ways for toxic and nontoxic gases. To achieve Automated control of sewage wastewater treatment, Siemens PLC controllers were used in the treatment system of drainage wastewater control by the stepper motor, compressor, gas exhauster, pressure valve, and liquid level, flow, and other analog variables.

Nitin Sall explained the flow of used water from homes, business industries, commercial activities is called wastewater. Every day, each person generates between 200 and 500 liters of wastewater. So, instead of destroying a pollutant in a sewage system, wastewater technology removes it.

Ndubuisi.C.Daniels demonstrated a drainage system cleaner machine that automatically removes waste and sewage, thus protecting the environment from various types of environmental hazards. The drainage system cleaner's efficient operation is made up of three main components: the Propeller, Cleaner, and Pan.

Dr.K.kumaresan explained manual work converted to an automated system. Drainage pipe using for disposal and it may be a loss for human life while cleaning the blockage in the drainage pipes. They introduced an "Automated Sewage Cleaning System" to solve the problem. They planned their project in such a way that the clearance of gaseous substances is handled separately, allowing for effective water flow. This project could be completed with the full use of men, equipment, supplies, and funds. With the resources they had, they were able to make their project cost-effective and successful. They used automation technology to manage and monitor output, which included mechanical, electronic, and computer-based systems.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1. AIM:

The project's main goal is to provide assistance to sewage cleaning workers in overcoming the major challenges they face in their daily lives. As a result, we thought that this project would provide a solution to these people with a very efficient design.

This project aims to design a sewage cleaning machine that has features such as,

- low cost
- covering more area in the manhole
- To minimize or overcome the problem which can face in the manual machine.
- easy to operate and less time-consuming.

3.2. SCOPE OF THE PRESENT INVESTIGATION:

- This project fabricates the prototype of a sewage cleaning machine. The mechanical parts are not in their original sizes. Otherwise, the shape and design of each part are similar to the original design. Since we only fabricate the prototypes, during the test section, the maximum load is lower than what we expect for the exact design.

- This new design of sewage cleaning machine can reach up to a certain depth. The parameters and design of each part depend on these scopes. A mechanism that clearly can reach this scope level is select and chosen.
- This new design of sewage cleaning machine mechanism is for heavy-duty work. The design and selection of material elements and parameters depend on this scope which can undergo heavy-duty work. The cost and processing time can be due to this scope.

3.3. PRESENT INVESTIGATION:

- Nowadays, when workers are cleaning in a manhole, many accidents occur. There is a lot of toxic gas inside the manhole that emanates from plastic waste. It's very damaging to humans. This project, therefore, aims to develop and develop a new, stable, safe, and non-inside manhole sewage cleaning system. In order to ensure that an accident is not a concern.
- In our field research, we discovered that many workers still engage in manual scavenging in urban areas, with rural areas being the most common. Despite the fact that the Indian government outlawed this practice in 2013. Some people continue to do so for financial reasons.
- We interviewed some of the sewage cleaning workers that includes both manual scavengers and semi-automated workers.

Person 1: Name – Balaji (Manual Scavenging worker)

Age – 38

Place – Cuddalore.

- I clean three to five days a week.

- Every day, I am terrified to death. It's difficult, but I have no choice but to help my family. I'm obligated to complete this mission.
- Doing this work makes me feel terrible. I don't have a choice; I have to work to make a living. I'm still nervous about opening the sewer because I'm not sure how bad it'll be.
- I make a pittance. With the money I earn, I can only help myself and my children. Protective gear is out of reach.
- The scent, poisonous gas, and difficulty breathing are the main challenges I face when cleaning manholes. There are also occasions when I step on glasses.

Person 2: Name – Sankar (Automated worker)

Age – 52

Place – Nungambakkam, Chennai.

- I clean around 15 to 20 times in a week.
- With the help of this machine it is easier and more time efficient.
- I simply put on a pair of gloves and operate the unit from the outside.
- We use a water truck to force water into the sewage pipe at a high pressure to clear the blockage. Later, we use this unit to extract waste from the next manole.
- This is due to the fact that this is a city. This equipment and truck were funded by the government. If you're in a rural area, it's a different storey.



Fig 3.1



Fig 3.2



Fig 3.3



Fig 3.4

AUTOMATED MACHINE

CHAPTER 4

MATERIAL AND METHODS ALGORITHMS

4.1. EXPERIMENTAL OF PROTOTYPE MODEL

- As there is a responsibility to safeguard human from toxic gas who are cleaning the manhole of sewer, we are adopting the sewage cleaning machine to certain depths without entering.
- There aren't many sewage cleanings machines that are designed and fabricated, we are implementing very less and effective operating mechanism to transfer the mud waste to the tank.
- Finally, we are going to fabricate a sewage cleaning machine which performs more functions than the other sewage cleaning machine's available in the market.
- The main asset of this project is Screw Conveyor. The system comprises of spur gear, metal sheets, mesh container, rack & pinion, DC motor, motor shaft coupling, bearings, helical screw thread, etc.
- This is very compact in size and efficient.
- This possesses simple structure



Figure 4.1 PROTOTYPE

4.2. WORKING METHODOLOGY

- Initially, the device is installed inside the manhole to allow muds to flow through lower grids.
- Solid waste in the drain, a screw conveyor lifts them to the tank, which is connected to the tank.
- screw conveyor is driven by the motor.

- The mesh container will filter the water from the solid waste.
- This disc is attached to the tank by a gear-driven motor, allowing the device to move in a linear and 360-degree motion with the help of a rack and pinion mechanism, allowing it to cover a larger area.
- When the motor is turned on, the helical blade (screw conveyor) begins to circulate, causing the waste to lift up. The waste is lifted up and stored in the tank.

4.3. DESIGN SPECIFICATIONS

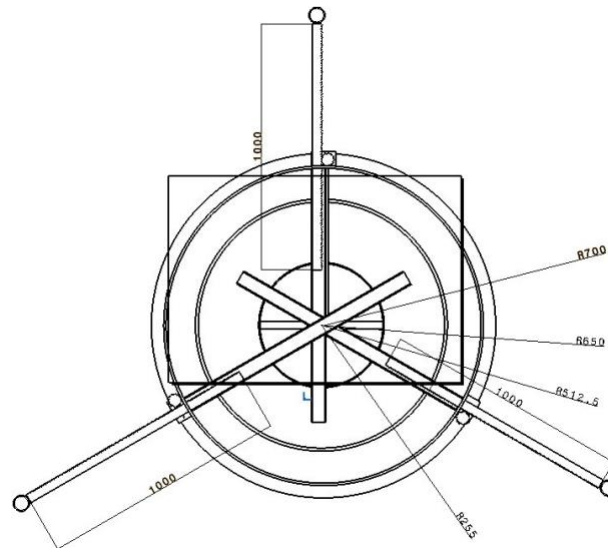


Fig 4.1 Top Specification

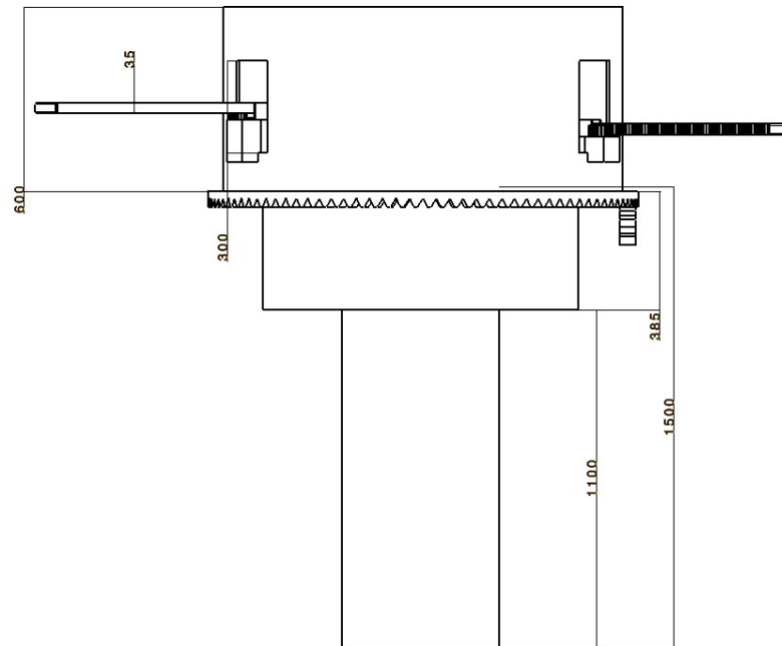


Fig 4.2 Side Specification

Table 4.1 Screw Conveyor Parameters

PARAMETER	VARIABLES	VALUES
Inner Diameter	di	81mm
Outer Diameter	do	176mm
Pitch	P	100mm
Screw Length	L	1100mm
Height	H	170mm

4.4. MATERIALS USED

Spur Gear

Screw Conveyor

Mesh Container

DC Motor

Motor Shaft Coupling

Bearings

4.4.1 Spur Gear

Spur gears are the most well-known common gears used to transmit motion between two parallel shafts. Because of their shape, they are classified as a type of cylindrical gear. Since the tooth surfaces of the gears are parallel to the axes of the mounted shafts, no thrust force is generated in the axial direction. Due to their ease of manufacture, these gears can also be made to a high degree of precision. Spur gears, on the other hand, have the disadvantage of being noisy. The gear with the most teeth is called the "gear," and the gear with the fewest teeth is called the "pinion," when two spur gears mesh.

Spur gears shift motion and power from one shaft to another through a set of mated gears and are used in mechanical applications to multiply torque or increase or decrease the speed of a machine. Spur gears are used in this experiment to improve performance.



Fig 4.3 Spur Gear

A spur gear's design and construction have a major impact on its performance. To perform their functions effectively and efficiently, they must be made of high-quality materials and to specific measurements. The dimensions of each feature are critical to the operation of a particular gear.

Some of the typical **industrial applications** include:

1. Transmissions
2. Conveyor systems
3. Speed reducers
4. Engines and mechanical transportation systems
5. Gear pumps and motors
6. Machining tools

Spur gears have a number of advantages in industrial applications and systems, including the following:

1. Simplicity
2. Constant speed drives
3. Reliability
4. Cost effectiveness
5. Efficiency

4.4.2. Screw Conveyor

Archimedes screw

The Archimedes screw is said to be one of the first hydraulic engines. It is made up of a helical arrangement of plain blades wrapped around a central cylinder, almost like a woodscrew. This screw is held in place by a fixed trough. There is a slight distance between the trough and the screw, enabling the screw to rotate easily while allowing only a small amount of water to spill past the blade tips. The Archimedes screw is said to have been invented by Archimedes of Syracuse a Greek astronomer, mathematician, and inventor. However, evidence suggests that screw technology was

invented and used more than three centuries before Archimedes, during King Sennacherib's reign in the Assyrian Empire in the 7th century BCE..

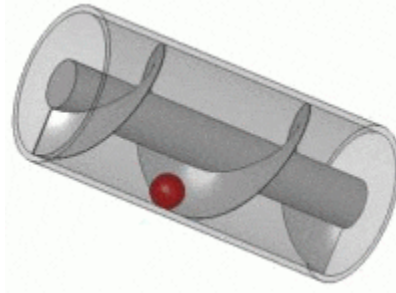


Figure 4.4 Archimedes Screw

Archimedes' screw, also known as the Egyptian screw, is a pump that transports water from a low-lying body of water into irrigation ditches. The rotation of a screw-shaped surface inside a vessel is used to pump water. Powders and seeds are also transported using Archimedes screws. Furthermore, instead of lifting fluid, Archimedes screws could produce power if they were driven by flowing fluid. (Archimedes screw turbines/generators).

Positive displacement pumps have been around for a long time, with the screw pump being the first. The first mention of a water screw, also known as a screw pump, dates from before the 3rd century BC in Hellenistic Egypt. The screw pump was later imported to Greece from Egypt. During Archimedes' visit to Egypt in 234 BC, he mentioned it. This tradition may simply reflect the Greeks' lack of familiarity with the apparatus.

A screw conveyor, also known as an auger conveyor, pushes liquid or granular materials through a tube by spinning a helical screw blade known as a "war." They're used in a lot of industries that deal with bulk materials. Screw conveyors are commonly

used in modern industry to transport semi-solid materials such as food waste, wood chips, aggregates, cereal grains, animal feed, boiler ash, beef, and bone meal, municipal solid waste, and many others horizontally or at a slight incline. The Archimedes screw was the first screw conveyor, and it has long been used to pump irrigation water.

It's popular to use a trough or tube with a spiral blade coiled around a shaft that's driven at one end and held at the other, or a "shaft less spiral" that's driven at one end and free at the other. The speed of volume transfer is determined by the shaft's rotational speed. The system is often used as a variable rate feeder in industrial control applications, changing the shaft's rotation rate to deliver a measured rate or quantity of material into a process.

For material flow that is inclining upward, screw conveyors can be used. As long as space allows, this is a very cost-effective way of elevating and conveying. As the angle of inclination increases, the capability of a given unit rapidly decreases.

Materials may be transported horizontally, vertically, or on an incline using screw conveyors. They may be heated or cooled when being used to feed, sell, store, or mix goods. With the right cover and gasketing, they can easily be rendered dust or weather tight and rodent proof. Their clean, lightweight design saves space so there is no need for a return run. Screw Conveyors are compact, simple to support and instal, and less expensive than most other types of conveyors.

The time-tested formula Screw Conveyor Corporation is a company that manufactures screw conveyors. Screw Conveyors are built tough and precisely to ensure complete dependability as well as the versatility needed to handle a variety of tasks. Screw Conveyors are used in a variety of industries, and custom designs are being developed for use as parts of machinery and equipment.



Fig 4.5. Screw conveyor

4.4.3. Mesh Container

Wire mesh containers from Direct Metals are designed and made to last a long time, making them suitable for material handling. Industrial wire baskets come in a wide range of sizes and capacities. Our galvanized wire mesh containers are stackable, collapsible, and rust-resistant, as well as being sturdy, compact, self-cleaning, and shippable.

Features of Wire Mesh Containers:

- Clear view of product inside container
- Open wire mesh construction
- Long service life
- Recyclable
- Stackable & collapsible for space saving
- Multiple package dividers
- Optional protection lid for goods in storage or transit
- Optional casters



Fig 4.6. Mesh Container

4.4.4 Dc Motor

Any of a group of rotary electrical machines that transform direct current electrical energy into mechanical energy is known as a DC motor.

The most popular forms depend on magnetic fields to generate forces.

Almost all DC motors have an internal mechanism, either electromechanical or electronic, that changes the direction of current flow in a portion of the motor on a regular basis.

Since they could be operated by existing direct-current lighting power distribution systems, DC motors were the first type of motor to become widely used.

The speed of a DC motor can be varied over a wide range by varying the supply voltage or adjusting the current intensity in the field windings.

Tools, toys, and appliances all use small DC motors.

The universal motor is a lightweight brushed motor that can run on direct current and is used in portable power tools and appliances.

Larger DC motors are currently used in electric vehicle propulsion, elevator and hoist drives, and steel rolling mill drives.

With the advent of power electronics, it is now possible to replace DC motors with AC motors in a variety of applications.

They offer higher starting torque & increased speed control over a wide range. They are ideal for low-cost operation & are devoid of the Harmonic Effect. They give you quick control over the motors & offer improved speed regulation. The Electronics and Rectification are minimal.

Here, in this project we used box type high torque geared DC motors.



Fig 4.7 DC MOTOR

4.4.5 Motor Shaft Coupling

- These are used as intermediate element between the arms and the motor as well as to hold the pinion gear on its turned part on one side. Grub screw is fitted into the threading to arrest the movement of this shaft on motor shaft and fit tightly, so movement is provided for the end parts such as arms & gear.



FIG 4.8 Motor shaft coupling

4.4.6 Bearings

A bearing is a machine component that restricts relative motion to only the desired motion and reduces friction between moving parts. The bearing's design can, for example, allow for free linear movement of the moving part or free rotation around a fixed axis, or it may prevent motion by regulating the vectors of normal forces that bear on the moving

parts. Most bearings make the desired motion easier by reducing friction. Bearings are broadly defined based on the type of action, the motions permitted, or the directions of the loads (forces) applied to the pieces.

There are many types of bearings

1. Ball bearing
2. Jewel bearing
3. Fluid bearing
4. Magnetic bearing



Fig 4.9. Bearings

Rotary bearings are mechanical structures that carry rotating components such as shafts or axles within mechanical systems and move axial and radial loads from the source of the load to the structure that supports it. The plain bearing is the most basic type of bearing, consisting of a shaft revolving in a socket. To minimize friction, lubrication is used. In ball bearings and roller bearings, rolling components with a circular cross-section are mounted between the races or journals of the bearing assembly to reduce sliding friction. There are several bearing designs to choose from to meet the application's needs for maximum strength, reliability, durability, and efficiency.

The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part.

4.4.7 Fabrication Of Main Frame

- It acts as the chassis for the system.
- All the loads applied are distributed over the frame.
- Components and attachments are affixed to the main frame for support and balance.
- The material used is M.S Flat Plate of 300*305*2.5 mm.



FIG 4.15 CUTTING THE MAIN FRAME FROM RAW MATERIAL

4.4.8 Motor Support Plates

- It is a plate that supports the motors with the help of screw fittings. They are welded to Main frame using one of its bases.



FIG 4.10 MARKING OF DIMENSIONS ON MOTOR SUPPORT PLATE

4.5 CALCULATIONS

4.5.1 DESIGN CALCULATION FOR SCREW

This is the design calculation for making of the screw

Diameter of the shaft (d)= 75mm

Height (h) = 170mm

Pitch =100mm

TO FIND THE INNER DIAMETER OF THE RING

$$\begin{aligned}
 \text{Inner diameter } d_i &= \sqrt{(\text{dia of shaft} \times \pi)^2 + \text{pitch}^2} \\
 &= \sqrt{(75 \times 3.1416)^2 + 100^2} \\
 &= \sqrt{55516.313 + 10000} \\
 &= \sqrt{65516.313} \quad \text{-----equation 1}
 \end{aligned}$$

Equation 1 ÷ π

$$\begin{aligned}
 &= \sqrt{65516.313} / 3.1416 \\
 &= 255.961 / 3.1416
 \end{aligned}$$

Inner Diameter of Ring= 81 mm.

Outer Diameter d_o = height – shaft diameter

$$= 170 - 75$$

$$= 95 \text{ mm}$$

-----equation2

Equation2+ Inner Diameter of Ring

Outer diameter of ring= 176 mm.

HELICAL ANGLE:

$$\begin{aligned}\alpha &= height \left(\frac{2\pi}{pitch} \right) \\ &= 170 \left(\frac{2 \times 3.1416}{100} \right) \\ &= 10.68\end{aligned}$$

4.5.2 Calculations for screw conveyor

Capacity in kg per hour (Q) for horizontal transport*

$$Q \text{ (kg/u)} = 47.1 \times (d_i - d_o) \times s \times n \times i \times sw$$

d_i = screw outside diameter in dm

d_o = screw inside diameter in

dms = pitch in dm

n = rotations per minute

i = degree of trough filling (eg. 10%: $i = 0,1$)

sw = specific weight of the material (see table)

$$\begin{aligned}Q &= 47.1 \times (d_i - d_o) \times s \times n \times i \times Sw \\ &= 47.1 \times (0.095 - 0.081) \times 0.05 \times 0.1 \times 0.1 \times 7850\end{aligned}$$

$$Q = 2.588$$

Power in Kw (P)

$$P = (Q \times L \times K)$$

P = power in Kw

Q = capacity in kg per hour

L = conveyor screw length (m)

K = friction coefficient

$$P = 2.588 \times 1.1 \times 0.42$$

$$P = 1.1956 \text{ KW}$$

4.5.3 Spur Gear Design calculations

Item	Symbol	Formula	Example
Pinion Gear 1 Module	m		3
Pressure Angle	α	20°	3
Number of Teeth	z_1, z_2	12	
Center Distance	a	$(z_1 + z_2)m / 2$	54.000 5
Pitch Diameter	d	zm	36.000 72.000 6
Base Diameter	d_b	$d \cos \alpha$	33.829 67.658 7
Addendum	h_a	$1.00m$	3.000 8
dedendum	h_f	$1.25m$	3.750 9
Outside Diameter	d_a	$d + 2m$	42.000 78.000 10
Root Diameter	d_f	$d - 2.5m$	28.500 64.500

CHAPTER 5

RESULT AND DISCUSSION

5.1 INTRODUCTION TO CAD

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the application of computer technology to the design and documentation of a product. The method of drafting with a computer is referred to as computer assisted drafting. CADD applications, also known as environments, gives users input-tools to help them streamline design, drafting, documentation, and manufacturing processes. The output of CADD is often in the form of electronic files for printing or machining. Industry-based software (construction, manufacturing, etc.) usually uses vector-based (linear) environments, while graphic-based software uses raster-based (pixilated) environments.

5.2 CATIA

CATIA is a Para surface-based modeler, and uses a parametric element based way to deal with make models and congregations. Boundaries allude to limitations whose qualities decide the shape or math of the model or get together. Boundaries can be either numeric boundaries, for example, line lengths or circle distances across, or mathematical boundaries, for example, digression, equal, concentric, flat or vertical, and so on. Numeric boundaries can be related with one another using relations, which permits them to catch plan goal.

Plan aim is the way the maker of the part needs it to react to changes and updates. For instance, you would need the gap at the head of a helmet can to remain at the top surface, paying little mind to the tallness or size of the can. CATIA permits the client to indicate that the gap is an element on the top surface, and will at that point honor their plan goal regardless of what stature they later allocate to the can.

Highlights allude to the structure squares of the part. They are the shapes and tasks that

develop the part. Shape-based highlights regularly start with a 2D or 3D sketch of shapes, for example, managers, openings, spaces, and so forth. This shape is then expelled or sliced to include or eliminate material from the part. Activity based highlights are not sketch-based, and incorporate highlights, for example, fillets, chamfer, shells, applying draft to the essences of a section, and so forth.

Building a model in CATIA as a rule begins with a splines sketch (in spite of the fact that 3D portrays are accessible for power clients). The sketch comprises of math, for example, focuses, lines, curves, conics (aside from the hyperbola), and splines. Measurements are added to the sketch to characterize the size and area of the calculation. Relations are utilized to characterize ascribes, for example, juncture, parallelism, oppositeness, and concentric section

The parametric idea of CATIA implies that the measurements and relations drive the calculation, not the reverse way around. The measurements in the sketch can be controlled freely, or by connections to different boundaries inside or outside of the sketch

For fabricating this machine, we made a CATIA design which helped us to fabricate the sewage cleaning machine with a little ease. This CATIA design helped us place the spur gears.

These figures are Computer-Aided- Three-Dimensional Interactive Application (CATIA) design for sewage cleaning machine.

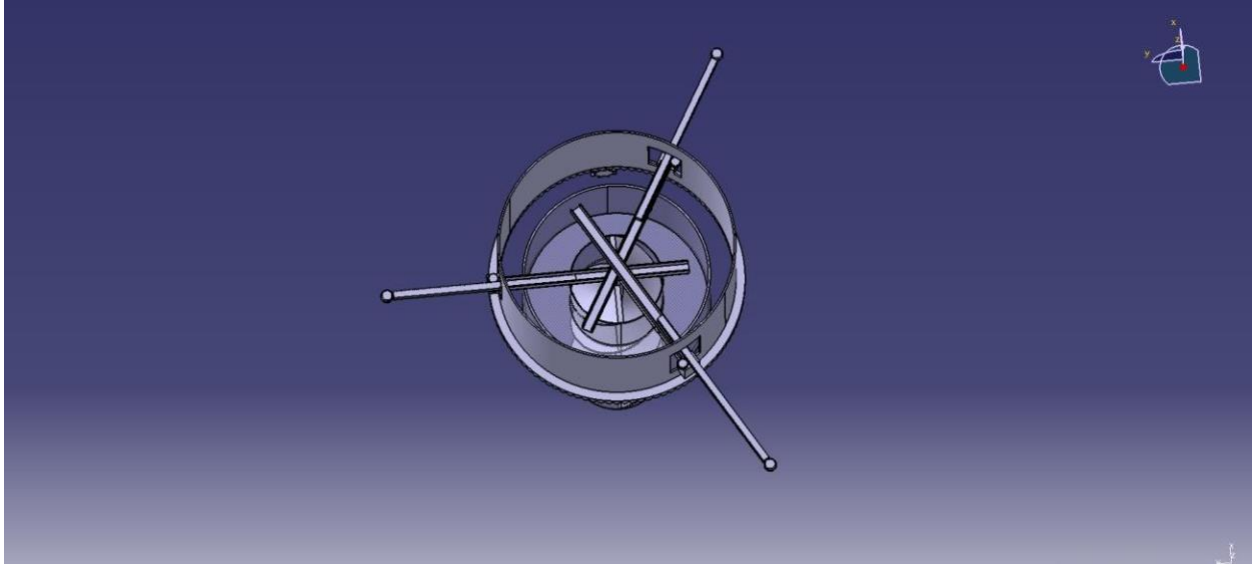


FIG 5.1 Top View

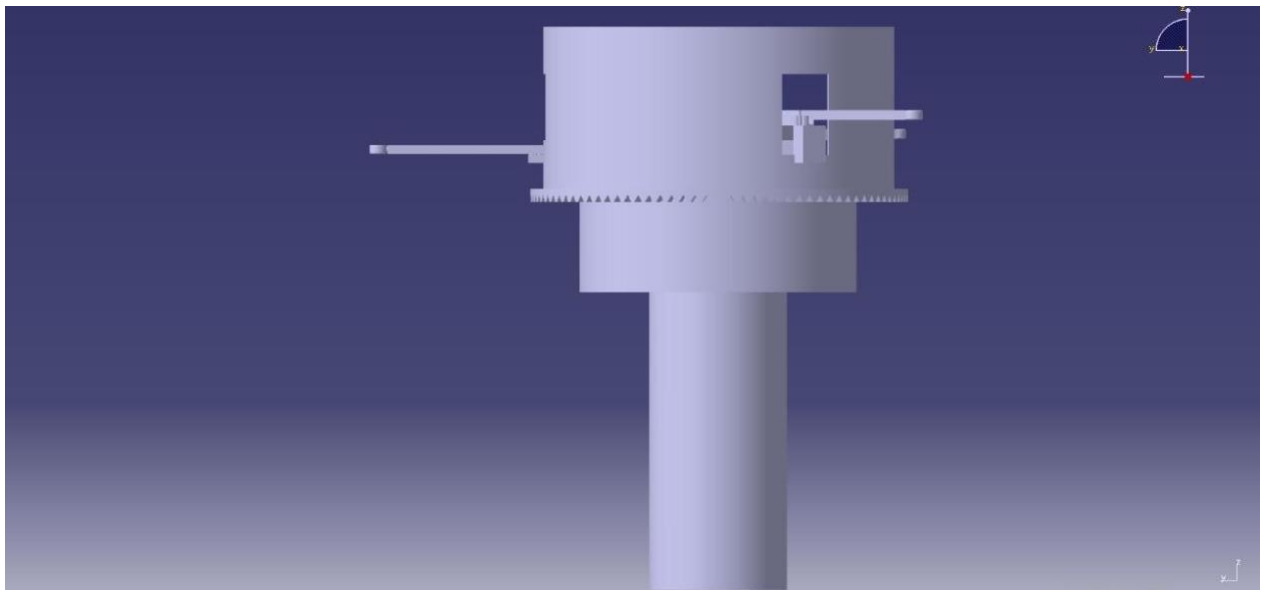


Fig 5.2 Side View

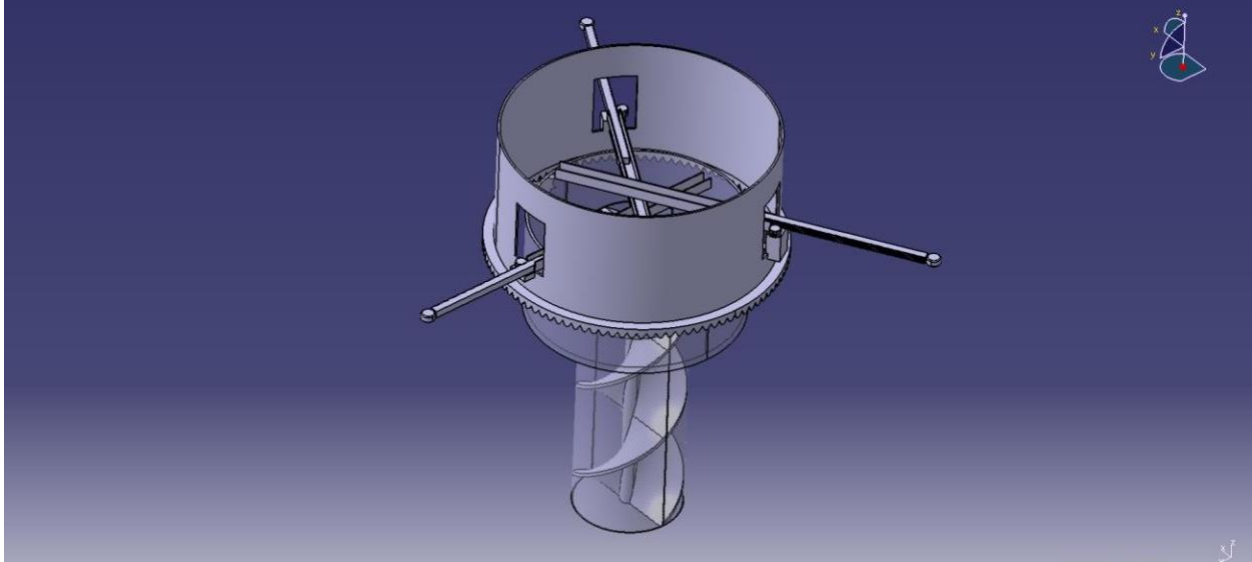


Fig 5.3 Isometrical View

5.3 ANSYS

Ansys is a company that creates and sells engineering modelling software for use during the product life cycle. For evaluating resilience, durability, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes, mechanical finite element analysis software is used to simulate computer models of structures, electronics, or system components. Ansys is used to assess how a product can perform under various conditions without having to create test products or conduct crash tests. Ansys software, for example, can simulate how a bridge would hold up after years of use, how to process salmon in a cannery to minimise waste, or how to build a slide that uses less material without compromising protection.

The Ansys Workbench method, which is one of the company's key products, is used for the majority of the company's simulations. Larger structures are typically broken down into small components that are each modelled and evaluated separately in Ansys.

A user may start by defining the dimensions of an object, and then adding weight, pressure, temperature and other physical properties. Finally, over time, the Ansys programme simulates and analyses movement, fatigue, fractures, fluid flow, temperature distribution, electromagnetic performance, and other effects.

➤ **Meshing**

Complex geometries are decomposed into basic elements that can be used as discrete local approximations of the larger domain in simulation. The mesh has an effect on the simulation's precision, convergence, and pace.

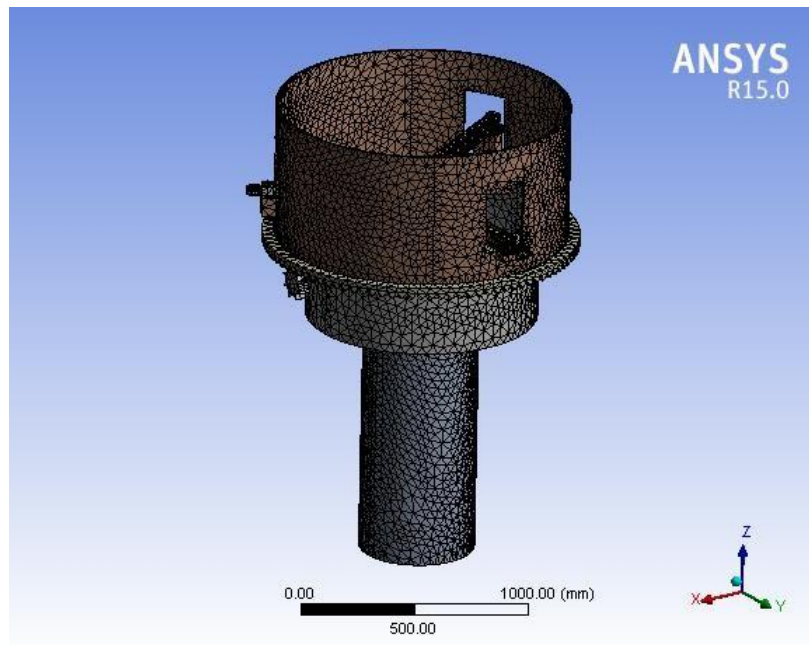


Fig 5.4 Meshing view

➤ **Static structural**

The measurement of displacements, stresses, strains, and pressures in structures or components caused by loads with minimal inertia and damping effects.

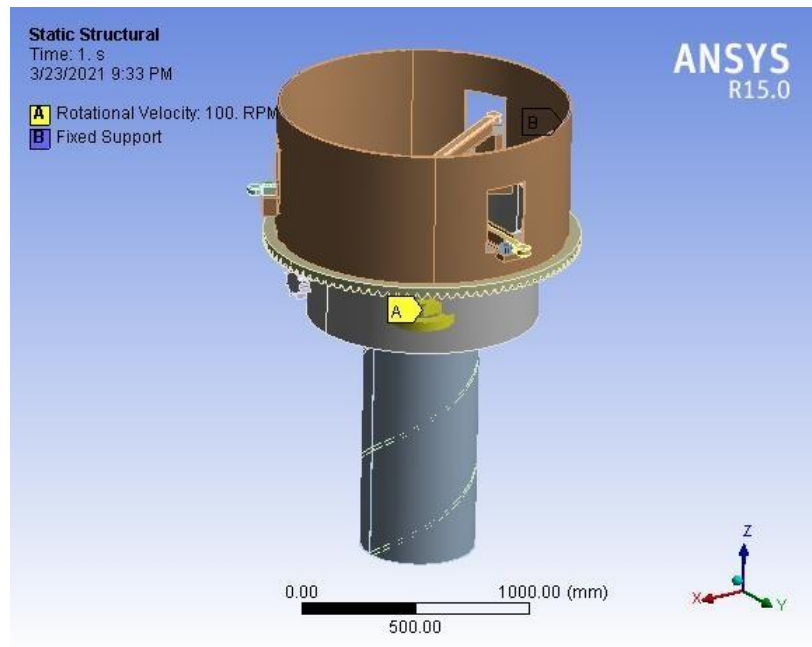
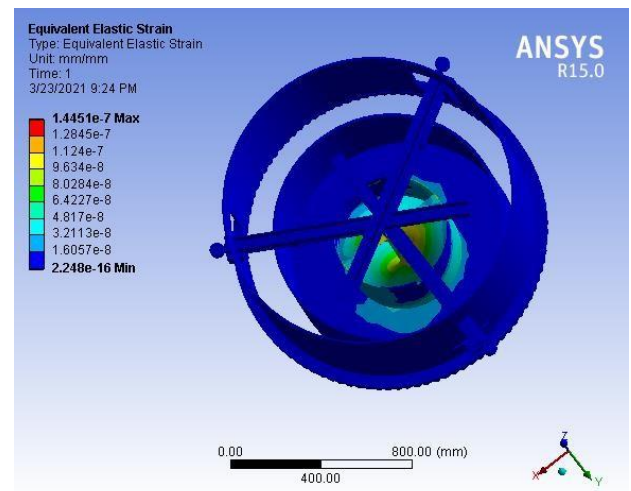
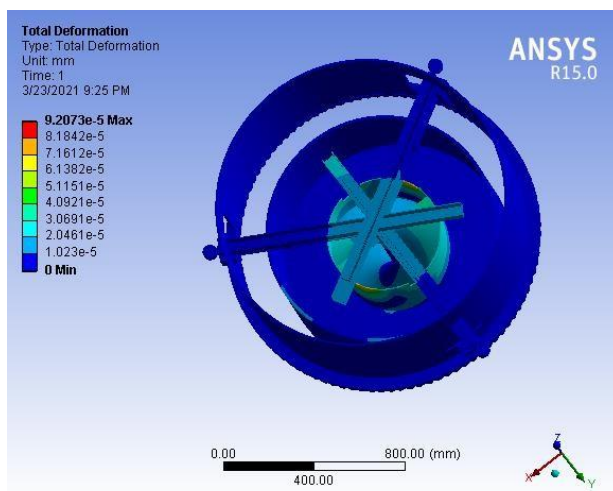


Fig 5.5 Static Structural

➤ **Stainless Steel**



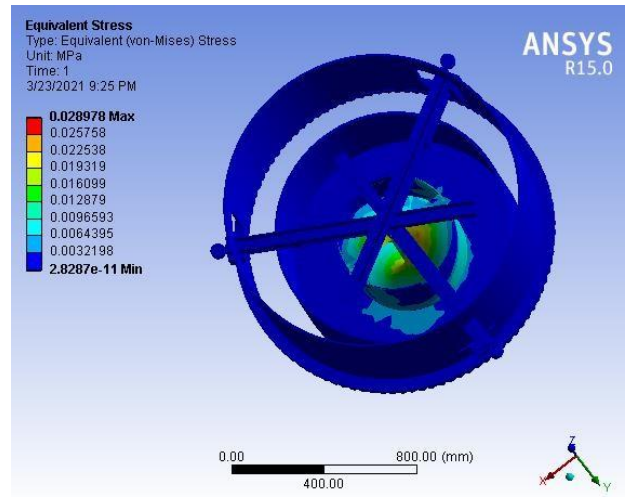
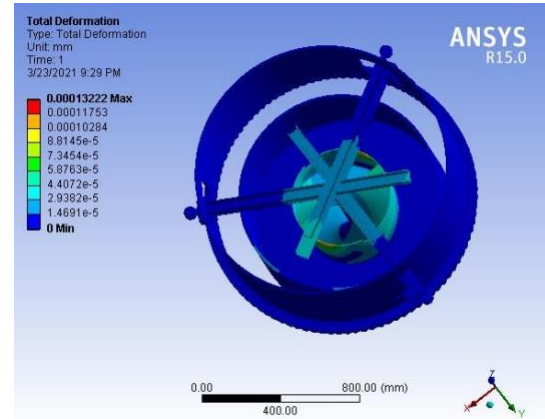
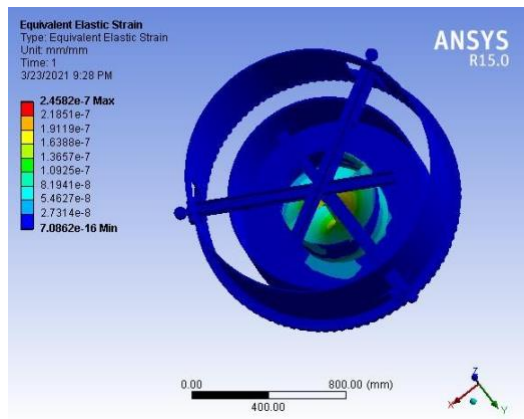


FIG 5.6 Stainless Steel

➤ **Structural Steel**



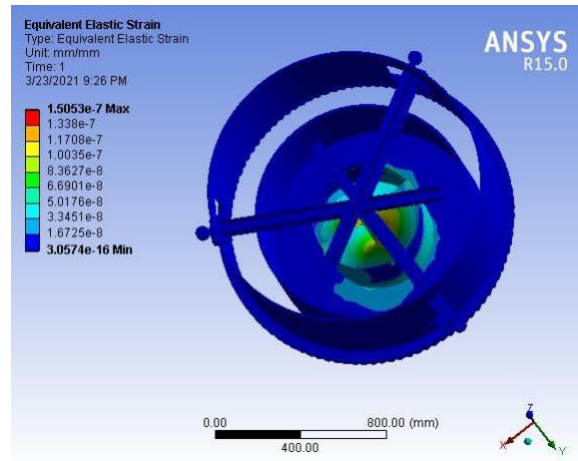
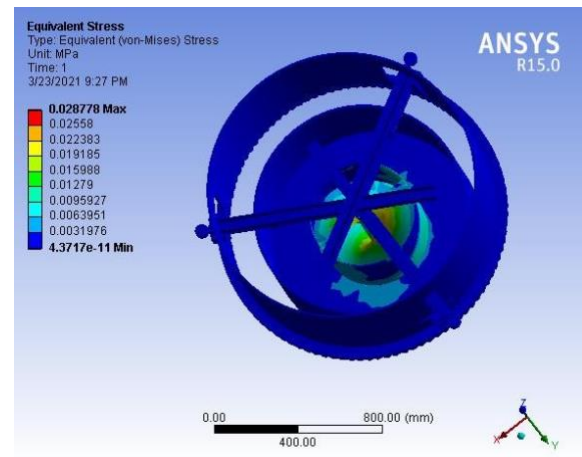
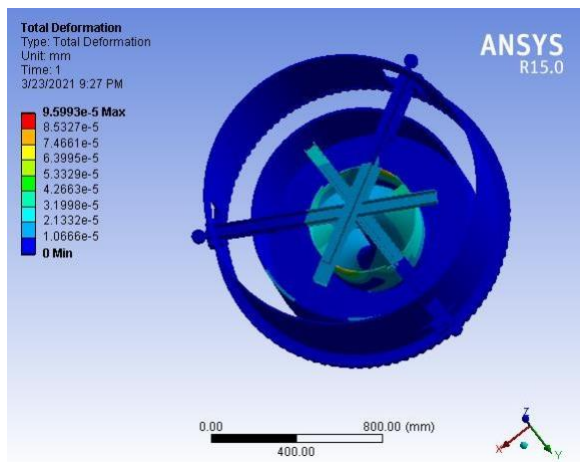


FIG 5.7 Structural Steel

➤ **Cast Iron**



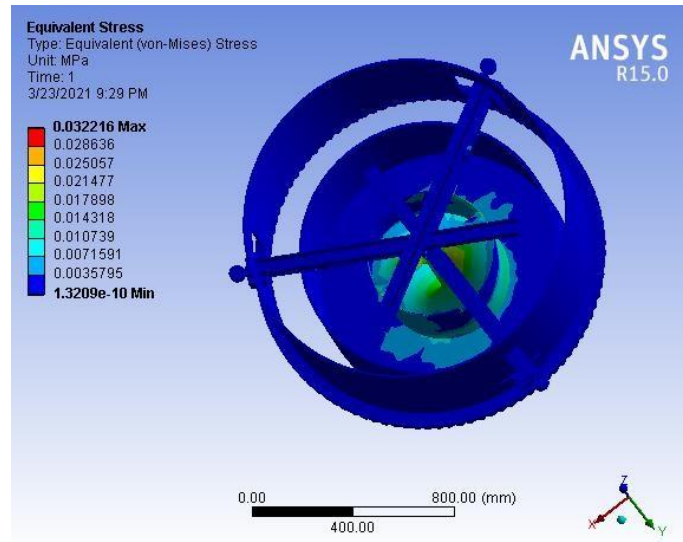
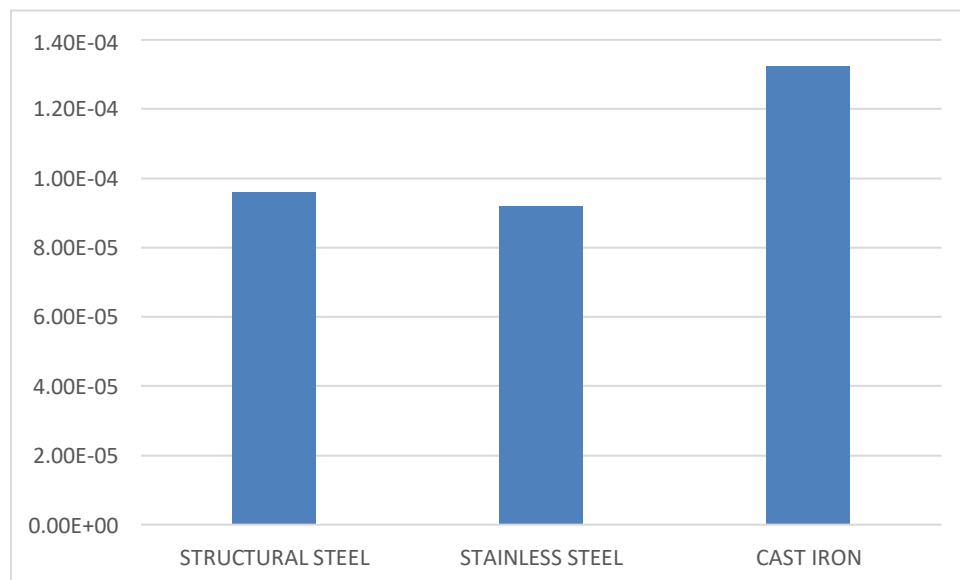


FIG 5.8 Cast Iron

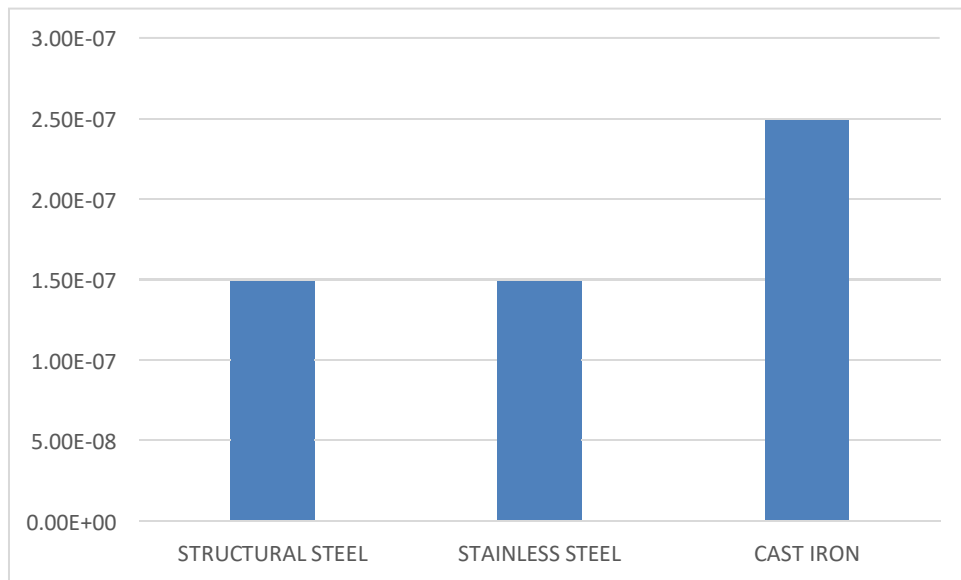
➤ **Total deformation**

Directional deformation can be put as the displacement of the system in a particular axis or user defined direction. Total deformation is the vector sum all directional displacements of the systems.

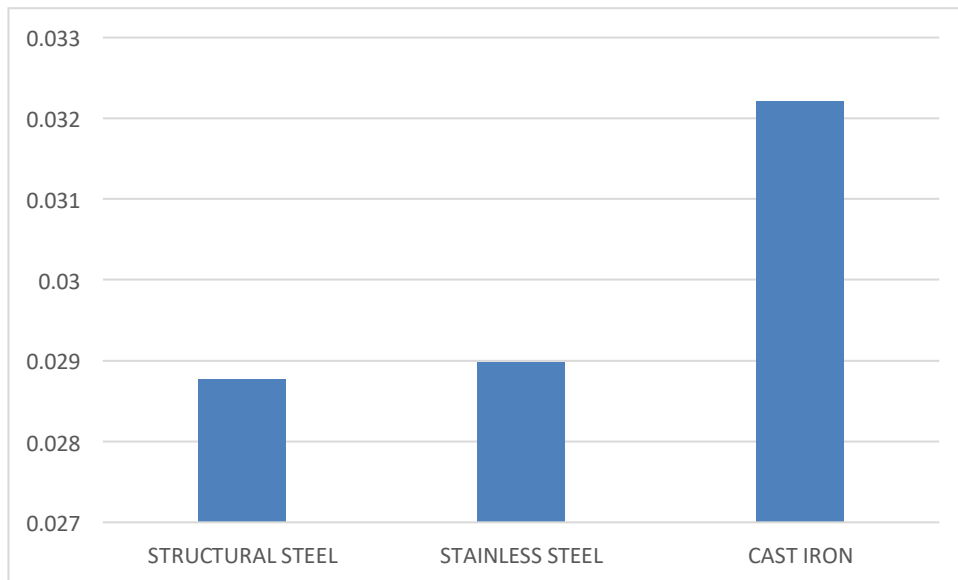
Total Deformation



Strain



Stress



STANDARD GRAPH OF TOTAL DEFORMATION

➤ **Material Properties**

Table 5.1 Material Properties

	DENSITY	YOUNG'S MODULUS	POISSON'S RATIO
STRUCTURAL STEEL	7850	200	0.28
STAINLESS STEEL	7600	210	0.28
CAST IRON	7700	120	0.3

CHAPTER 6

SUMMARY & CONCLUSION

The Project outcome of the new innovative sewage cleaning machine is invented for maximum drainage cleaning using fully automated cleaning system, rolling expandable gear setup is implemented for this design, the screw conveyor plays the major role in this project, so screw conveyor material selection is done by ANSYS Structural Analysis and final prototype model is prepared.

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