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Design & Development of Conveyor Belt Roller

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Abstract:-

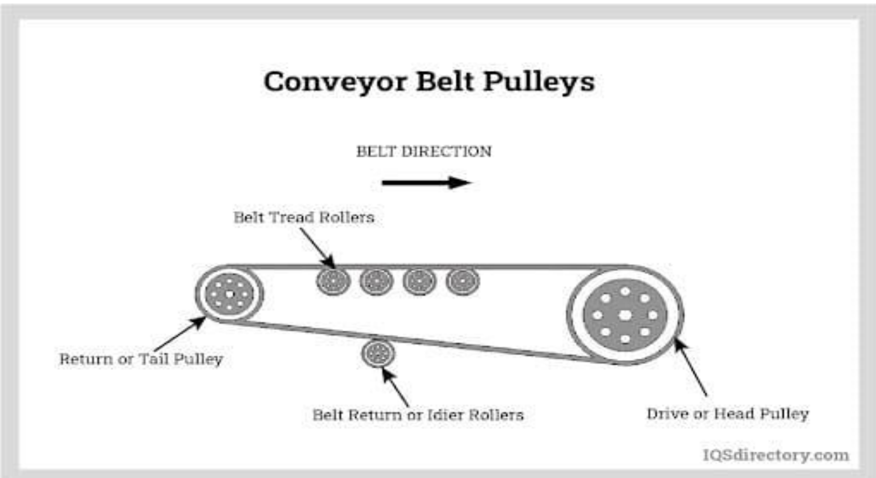
With the fast development in continuous conveyor technology, the belt conveyor to be more widely applied, the belt conveyor technology is gradually refined, and has made a number of achievements. A model of this conveyor was developed using Dassault Systems' SOLIDWORKS 2022 3D CAD software. Selection of main elements, drive units and accompanying mechanisms was performed. Dimensions and parameters of the most important elements of the design (rollers, frames and drive arrangement) were determined based on calculation. The primary objective is to design and optimize the conveyor which it carries 1 tons of load to the supplier. So, the study a shape optimization process is used for the design of roller chain link for minimization of failure modes.

Introduction:-

In the current scenario, Material handling equipment plays an important role in many industries, construction sites, and storage units. Proper attention should be paid while designing the roller conveyor system for a particular application. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which makes them very popular in the material handling and packaging industries.

Many factors are important in the accurate selection of a conveyor system. It is important to know how the conveyor system will be used beforehand. Some individual areas that are helpful to consider are the required conveyor operations, such as transportation, accumulation and sorting, the material sizes, weights, and shapes

Working:-



Conveyor systems consist of a belt stretched across two or more pulleys. The belt forms a closed loop around the pulleys so it can continually rotate. One pulley, known as the drive pulley, drives or tows the belt, moving items from one location to another.

When power is applied to a conveyor, the belt starts rotating. As the pulley moves, the belt begins to travel in a forward direction, because of its close contact with the pulley. Snubber idlers also help in maintaining close contact between the pulley and belt.

The material (to be transported) is loaded on the center of the belt with the help of a hopper. The material travels along the belt. The belt moves forward on troughing idlers. This permits the belt to carry more material per linear meter without spillage. The amount of feed delivered depends on the width and speed of the belt. At the discharge end, the material may be unloaded manually or mechanically. Once the material is unloaded, the belt returns on lighter non-troughing rolls to the point of feeding.

Designed Components and Calculation

1. **Electric Motor**: The motor is the one of the important parts of a conveyor since it is used to drive the belt. As this is a fixed or constant speed application, AC motors & gear motors are well suited. An AC induction motor is used in an application where the conveyor motor needs to operate continuously in one direction. They are very durable and require little maintenance because of a lack of brushes. Therefore, they are perfect for slow-moving, continuous applications.

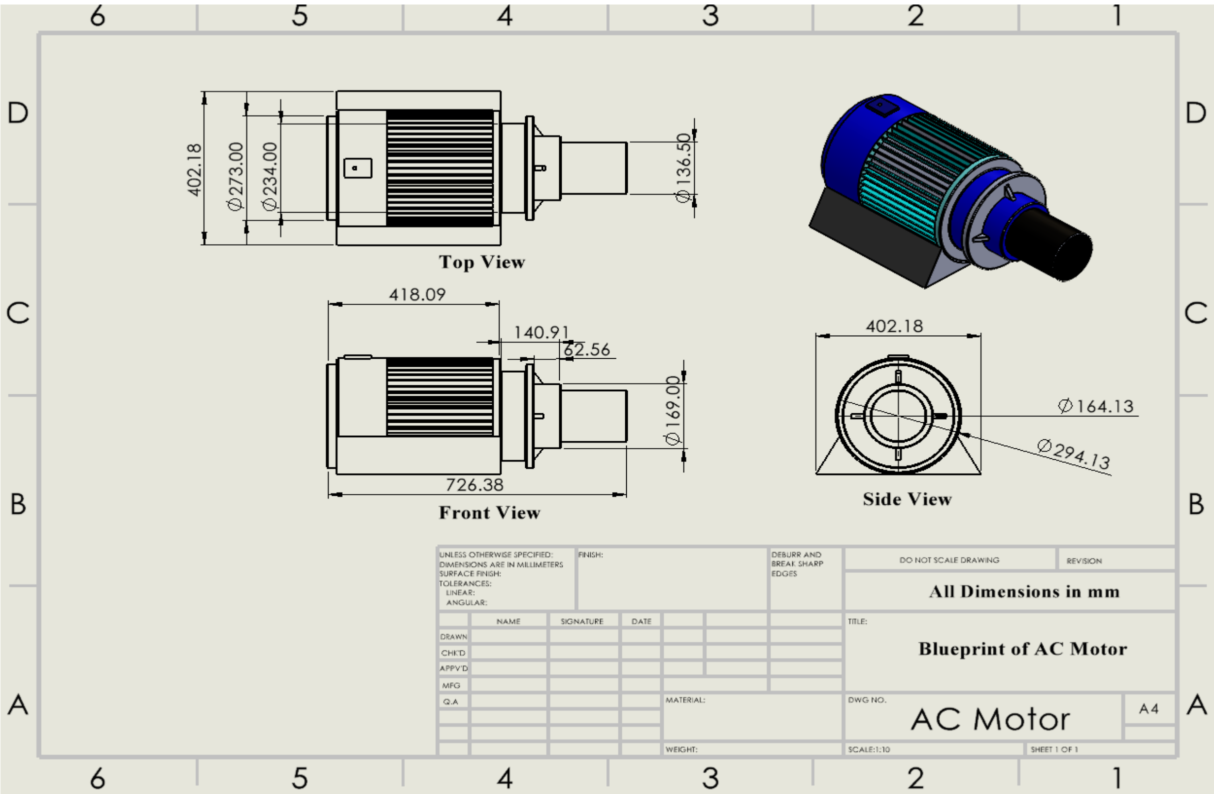


Fig1: Design texture of AC Motor

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Motor Power Calculations:-

The resistance to motion of all pieces of load on the conveyor is

W=m.g. *zo[(2. f/D* +□□ d/D)cos□□□□□sin□□□ *mv..g.z.*□□□ d/D

Where,

m –load unit mass=1000 kg

z_o – number of loads moving simultaneously on the conveyor=1

f – rolling friction factor= 0.005

D – roller diameter=0.15m

d – roller journal diameter=0.1m

m_v – roller mass=348.63 kg

□ – roller journal coefficient of friction=0.64

z – number of rollers=19

□ – inclination angle=0

g –acceleration of gravity= 9.81 m/s^2

Therefore we get W=7721.873

The electric motor power for conveyor drive is:

P = W. *v*/□

Where,

v – velocity of the load=0.833 m/s

□ – total efficiency of the drive mechanism=90%

Calculating we get the required power

= **6684.24 Watts**

2. **Belt:** In a belt-driven system friction forces are put to use for transferring power from one pulley to another pulley. For this application we are using a flat belt. A flat belt is a belt with a flat surface, usually evenly textured on both sides, used in a pulley system. They are commonly seen in use as conveyor belts or parts of belt arrays, where the flat surface makes it easy to move products along the top of the belt.
3.

An important reason to choose flat belt was they are very easy to replace.

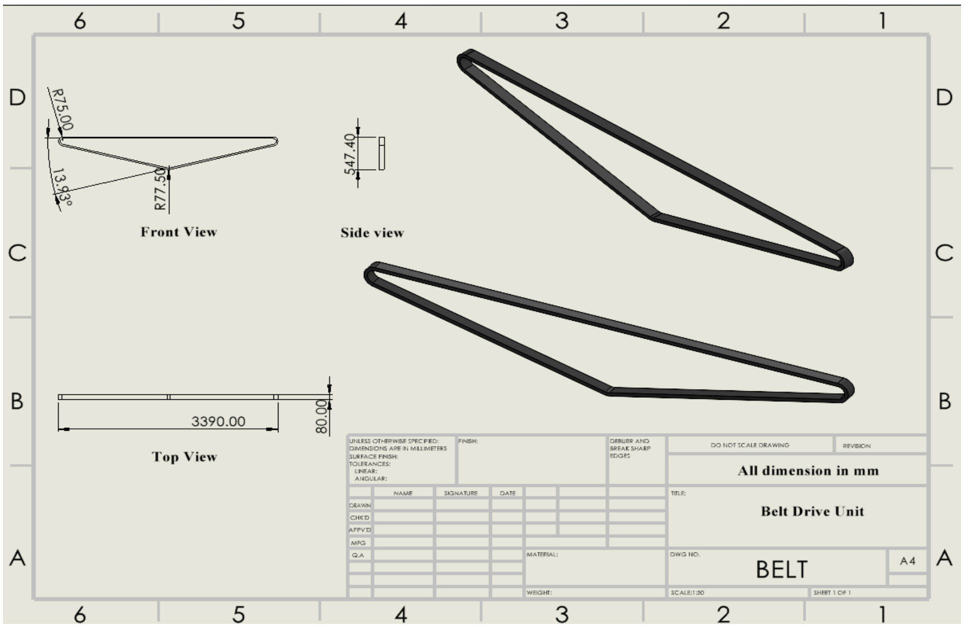


Fig2: Design texture of Belt

3. **Pulley:** It is attached to the motor shaft and spins when we supply power to the motor. The type of pulley that we have used is a flat belt pulley.

Some reasons for choosing the flat belt pulley where flat belts are thinner by 25% or more, which allows flat belt pulleys to be smaller than V-belt pulleys. Flat belts are also less expensive than belts used in a serpentine belt pulley. flat belts are thinner by 25% or more, which allows flat belt pulleys to be smaller than V-belt pulleys. Flat belts are also less expensive than belts used in a serpentine belt pulley.

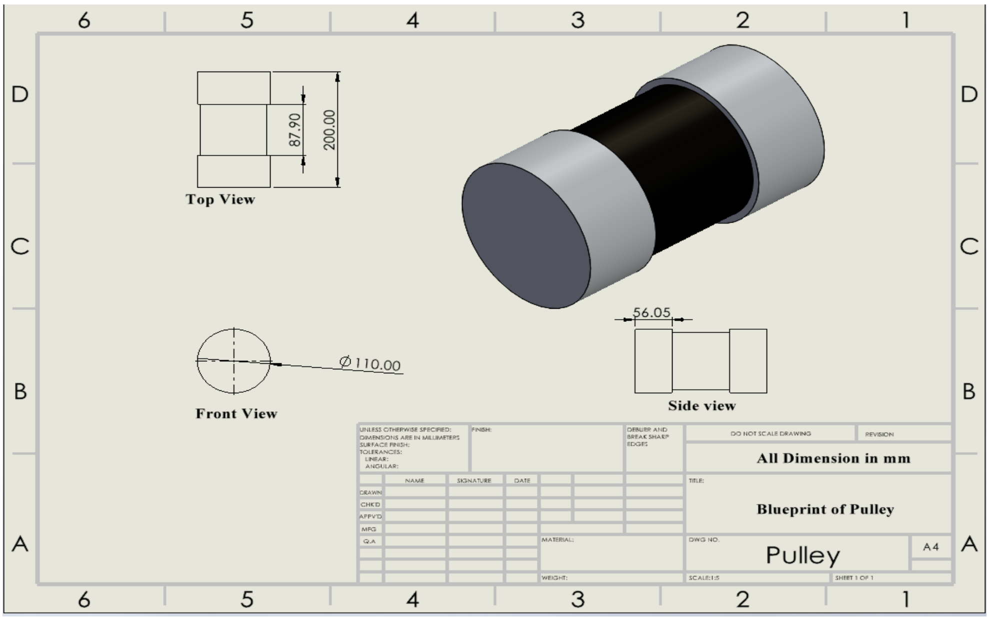


Fig3: Design texture of Pulley

Calculations for Pulley rpm:-

Diameter of rotating pulley=108mm=0.108m
Circumference of pulley= 0.33 m

$$RPM = \frac{required\ linear\ velocity\ of\ object\ * 60}{circumference\ of\ driving\ pulley}$$

Calculating we get,
Pulley rpm = 152

4. **Rollers:** For our application we have decided to go for aluminum rollers as it is a lightweight metal and reducing weight is important to keep the motor power at minimum. Rollers form an important part of the assembly as they are in direct contact with the load and affect its behavior.

We have decided to go with 19 rollers for this purpose to keep the load at each roller at a minimum which in turn increases service life.

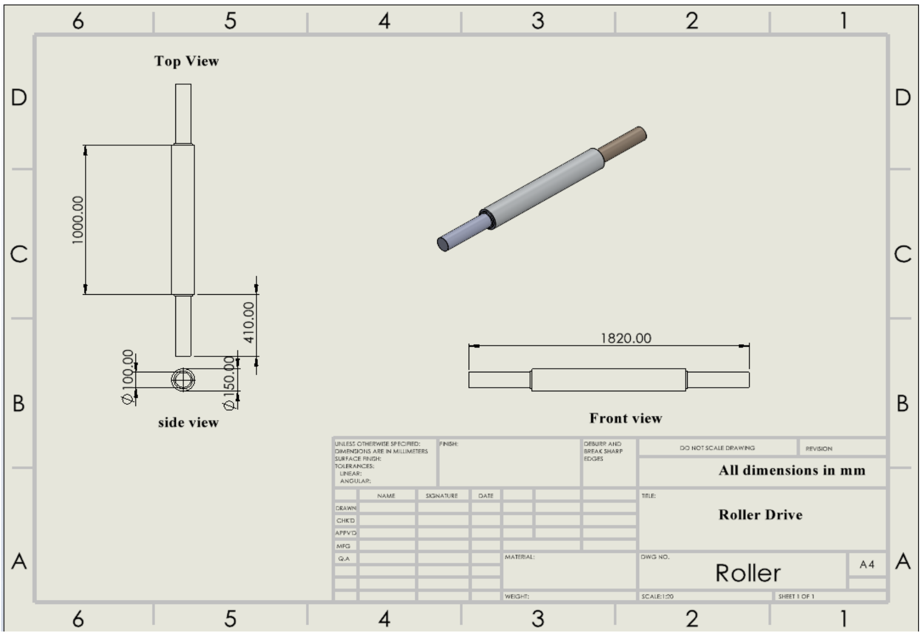


Fig4: Design texture of Roller

Calculations for roller rpm:-

N1=Pulley Rpm=152

N2=Roller Rpm=?

D1=Pulley Diameter= 108mm

D2= Roller journal Diameter = 100mm

We know,

N1.D1=N2.D2

Therefore, **N2= 165 rpm**

5. **Body/ Frame:** It is the final part of the assembly forms its base. All the other components our mounted on it including the rollers, pulleys and belts etc. only the motor is mounted separately. Usually the frame is made of structural steel due to its high tensile strength and ability handle such loading conditions. The frame has to deal with static and dynamic loads, without undue deflection or distortion.

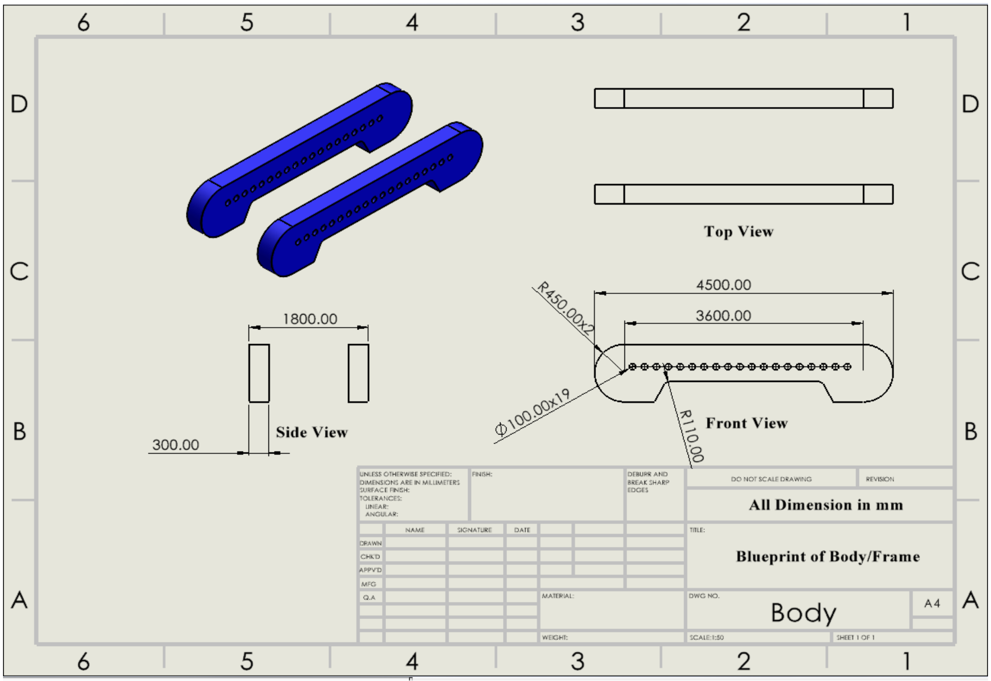
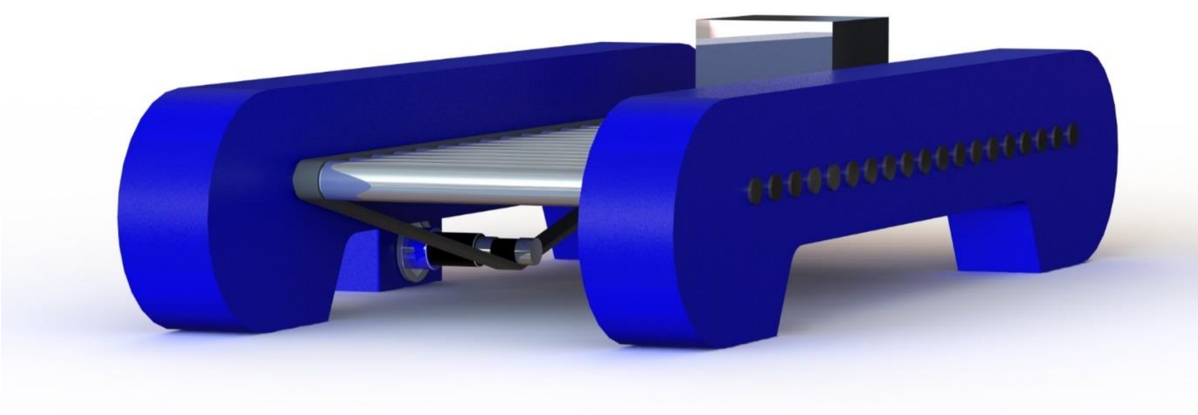
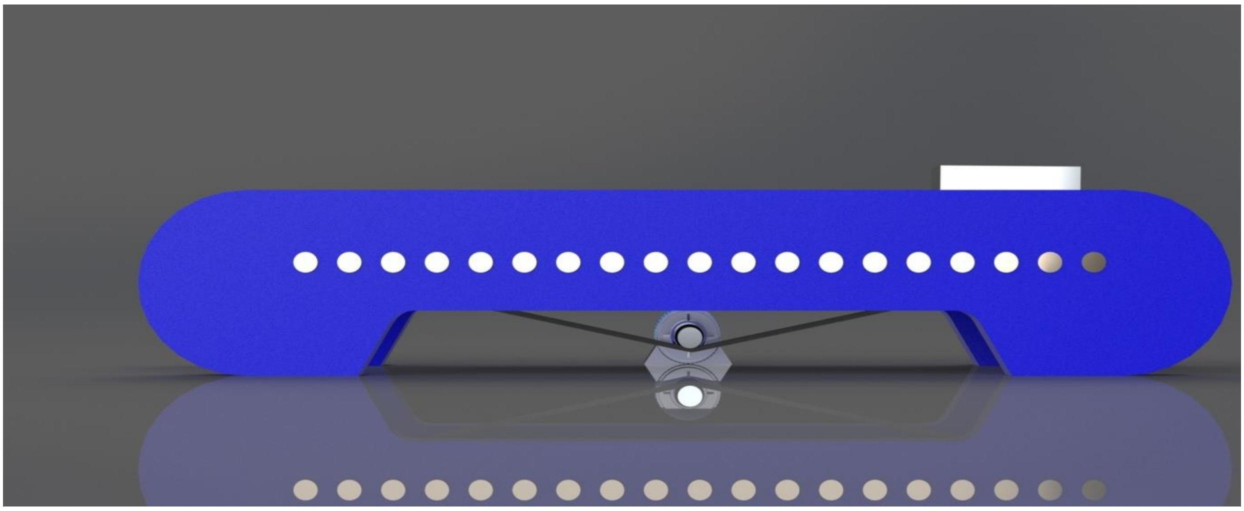
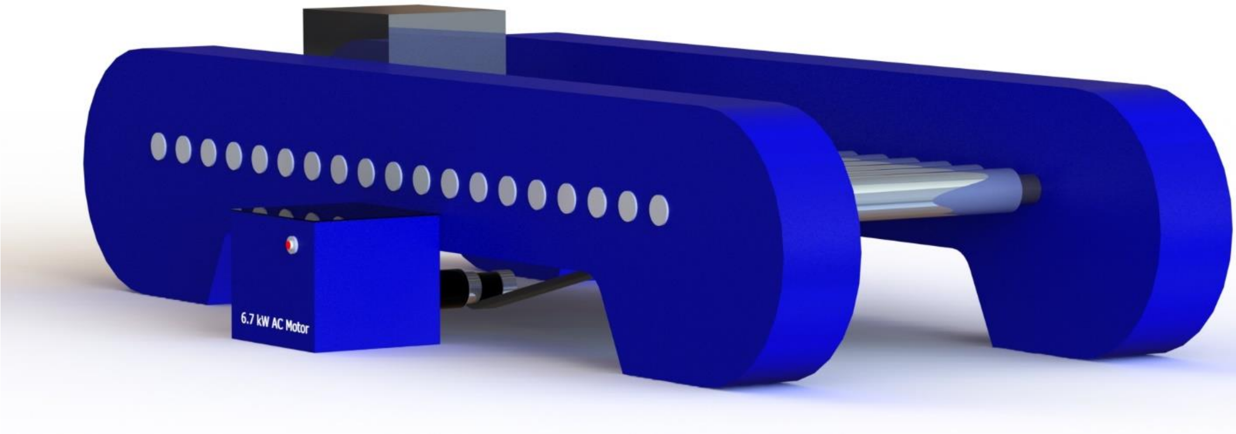


Fig5: Design texture of Frame/Body

6. **Final Design/Concept**






6.7 kW AC Motor

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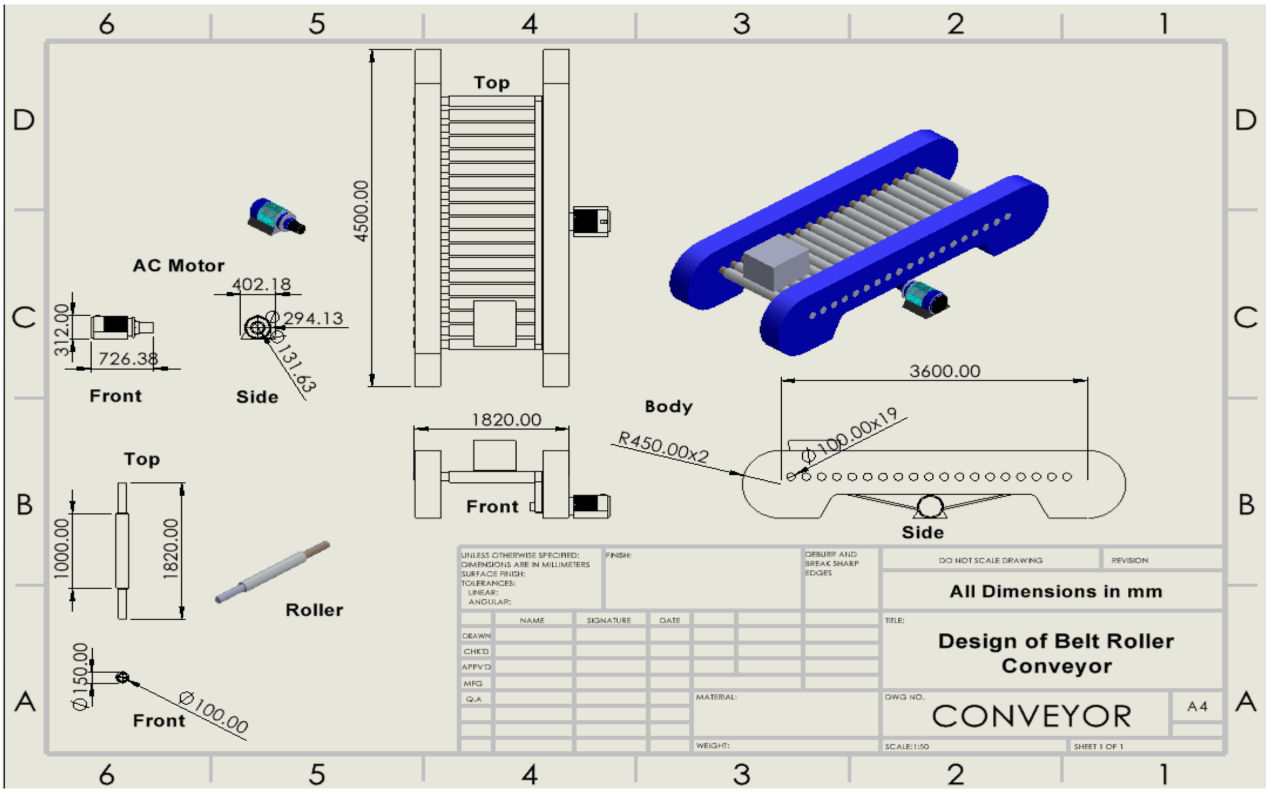
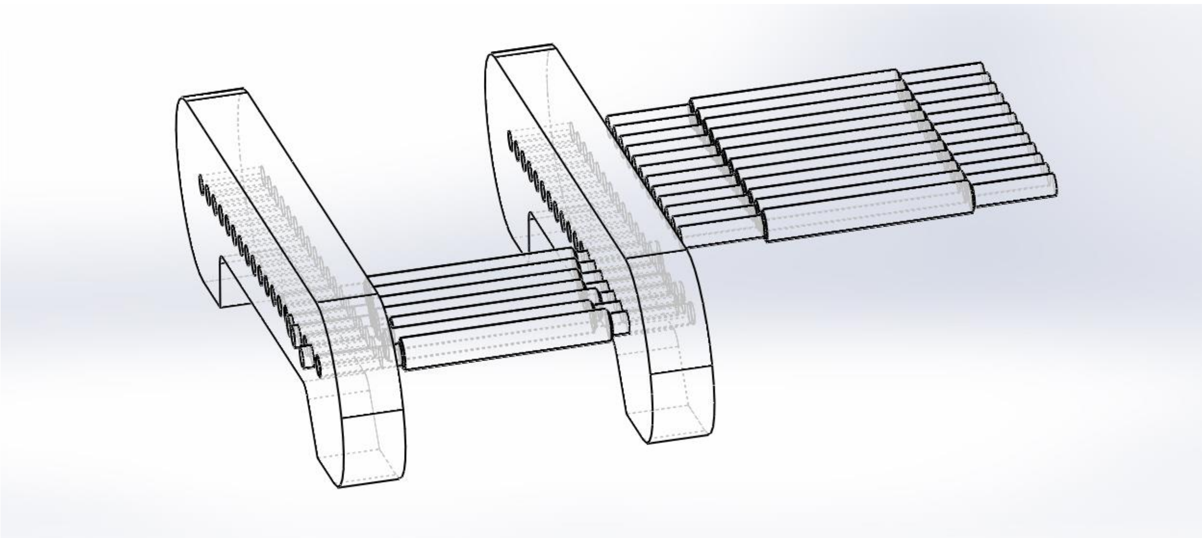


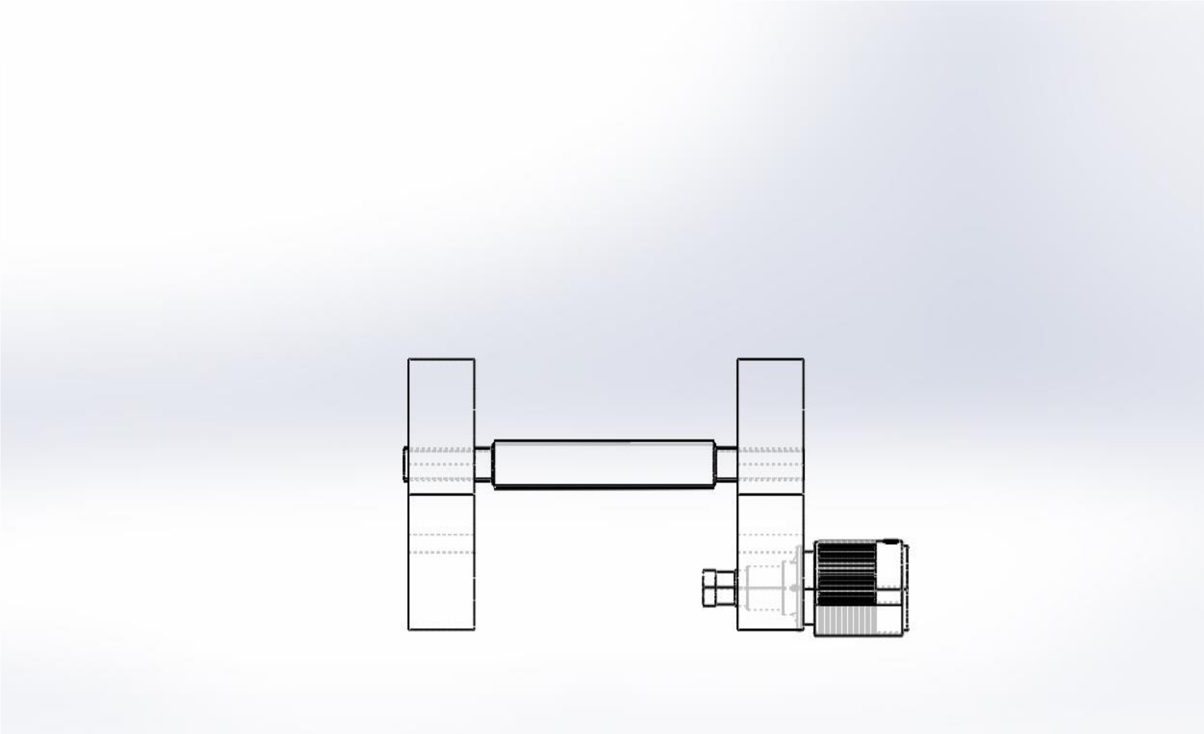
Fig6: Design texture Assembly of working

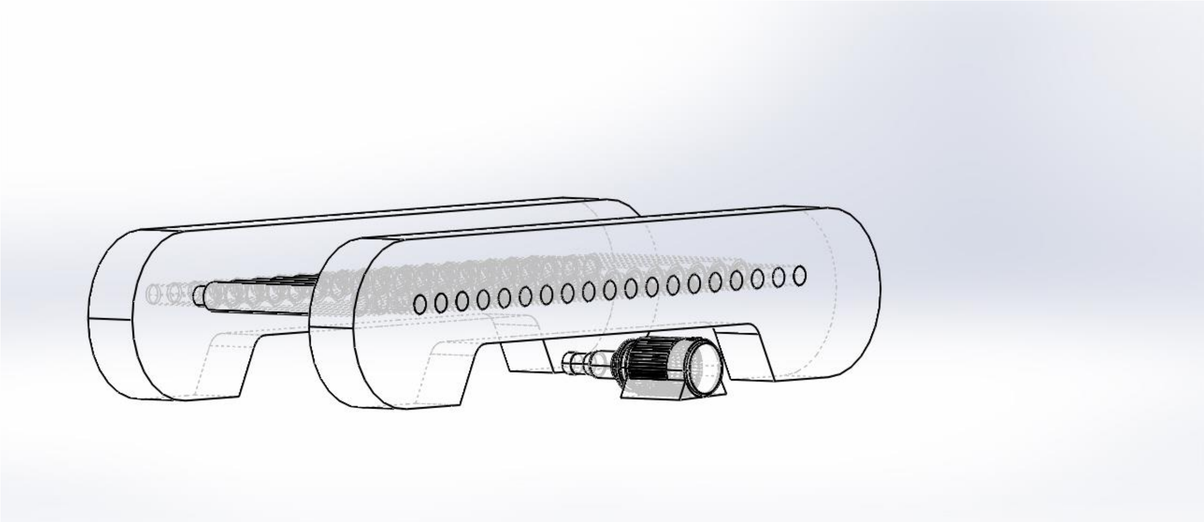
Arrangement of Assembly Setup:

a. Attaching the rollers to the frame:

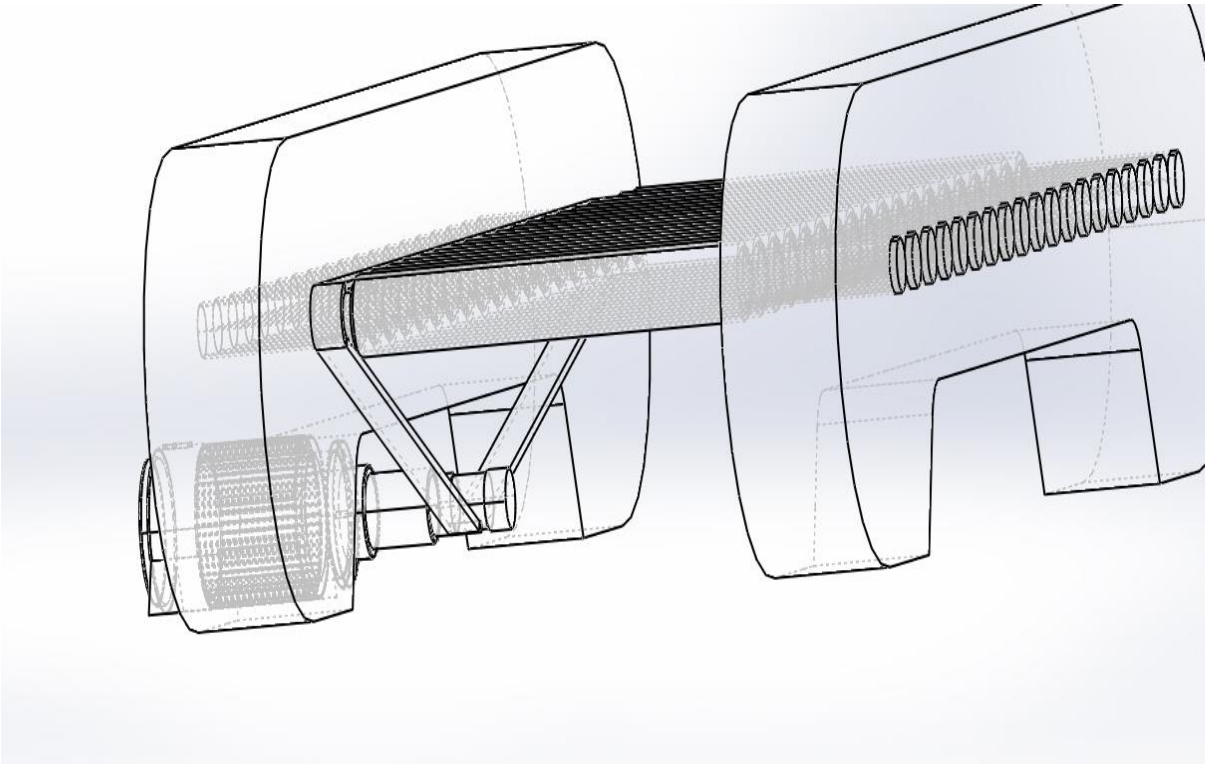


b. Attaching the motor and driving pulley in parallel with rollers





c. Attaching the belt over the driving and driven pulley (gradual rollers)



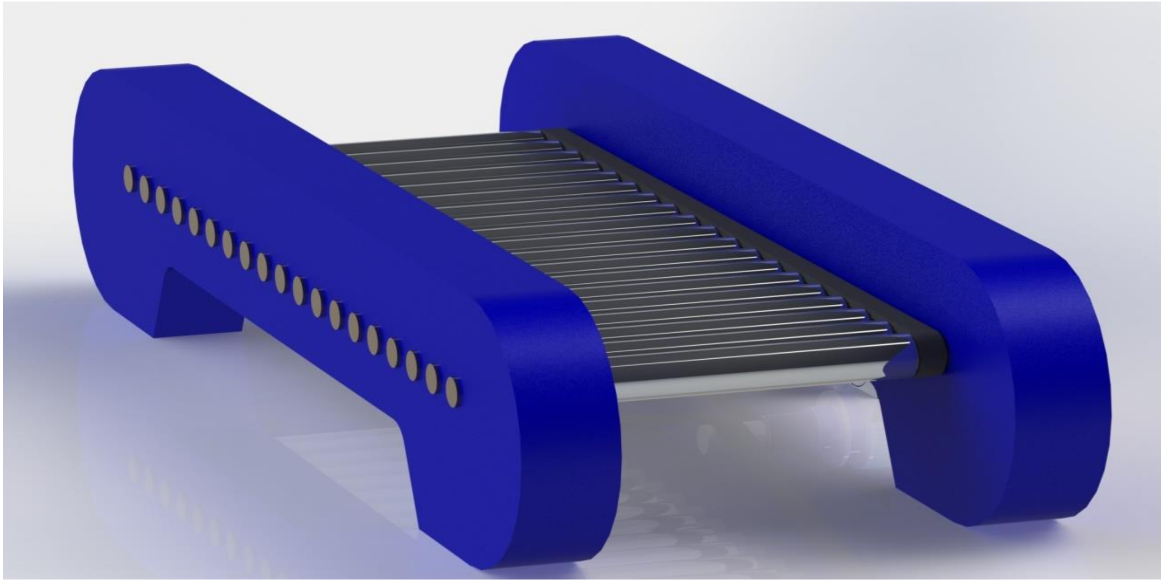
Proof of Documentation Work

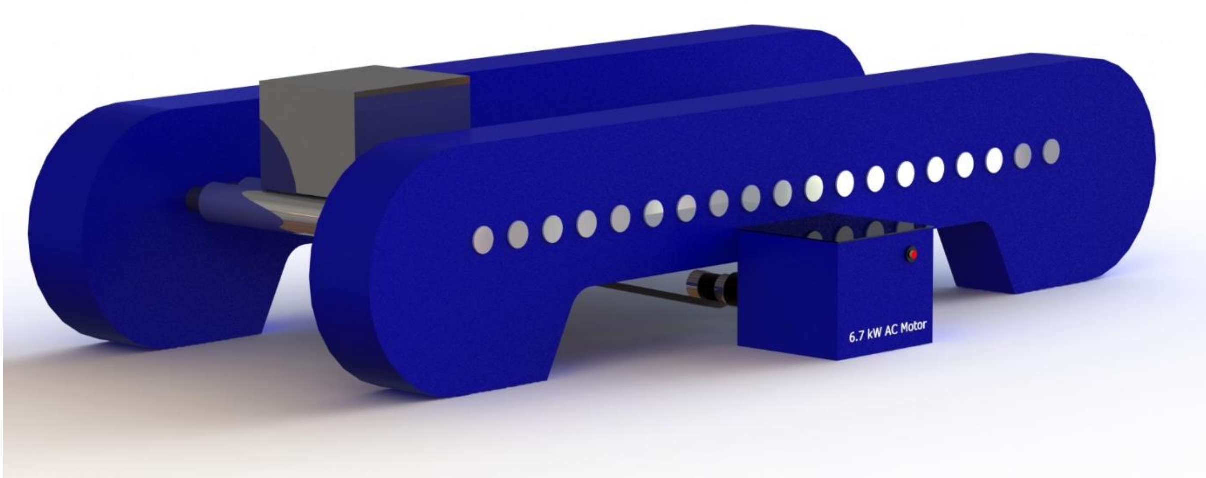
GrabCAD : *https://grabcad.com/raj.vigneshwar.r-1*

Google Drive: *Working Demonstration Roller Belt conveyor*

Result

A classical model was designed with a load of 1 ton, to study the effect of varying the loads below and above the rated speed of the electric motor. Equations were developed using some notations to represent the operating parameters of a conveyor belt manufacturing system. For the selected machine works by the power consumption of 6.7kW of 220 V. This proves that the design is suitable when an optimal time for a conveyor speed is required to be selected. Most focus has been on increasing the efficiency of the conveyor belt system.




6.7 kW AC Motor