

DESIGN AND FABRICATION OF FLEXIBLE ROLLER CONVEYOR SYSTEM

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Abstract:

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. 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 make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries. A flexible roller conveyor is one of the accommodations used to move goods from one place to another. The working scope of transporting goods from one place to another is a must for those whom work in a retailer store. However, most of the small company are having limitation of space. Therefore, they created a storage at an upper space of the store. Due to the limitation of the storage space, the employees are having health issues such as back pain, neck strains, wrist sprain and etc. Therefore, most of the employees did not working with this company for a long time as the working environment is uncomfortable for them. Our objective is to ease the work of the employees as well as to save energy and time of employees. We surveyed a few of retailer store owner and discussing on producing a new product which to help them ease the work of their employees. We also conducted a market survey to know our target market opinion on this product. We discussing and brainstorming the ideas in order to enhance our product to achieve our customer's expectation. Therefore, we come out with the idea of producing a flexible roller

conveyor which can be used to transport the goods from one place to a higher place. An additional feature was added as it can be used to move goods to a higher place where the height of the conveyor can be adjusted.

Keywords: Flexible roller conveyor, efficient transportation, adjustable height.

Introduction:

Known for proficient and reliable mechanism, flexible motorized roller conveyor can be installed easily. With its low-cost maintenance, the product is expandable and adjustable to support various operations. The enhanced durability and sustainability of products used in manufacturing make the roller conveyor resistant against different types of loading, wears and impacts but more costly. The performance of sorting process within factory increases with the advanced features of flexible motorized roller conveyor.

Conveyor system have been used for decades to transport heavy and bulk loads. They proved their worth everywhere. A conveyor system is a common piece of mechanical handling equipment for transporting one point to another point.

A conveyor system is a technique of transporting products, packages, supplies, equipment, and parts for use in manufacturing, relocation, or transportation. Conveying systems come in a variety of configurations, including pneumatic, belt, screw, and roller. Individual systems are built depending on the resources to

be moved, including their size, weight, and transportability. Conveying systems are vital for material handling and production, but they are also utilized in other manufacturing applications such as sintering, part washing, and part and assembly finishing. They are usually automated, but unautomated variants with chutes and rollers are used in material handling, retail, and shipping applications.

Types of Conveyor Systems

- Gravity Conveyor systems
- Powered Belt Conveyor systems
- Pneumatic conveyor systems
- Vibrating conveyor systems
- Flexible conveyor systems
- Vertical conveyor systems and spiral conveyors
- Live Roller Conveyor systems

Problem Definition:

The aim of this project is to redesign existing gravity roller conveyor system by designing the critical parts (Roller, Shaft, Bearing and Frame), to minimize the overall weight of the assembly and to save considerable amount of material.

Objectives:

- To move items from one point to another point with relatively less effort, quickly and reliably.
- To allow objects to skate across its surface.
- To reduce the manpower.
- Optimize use of space.
- Enhance product quality

Scope of Project:

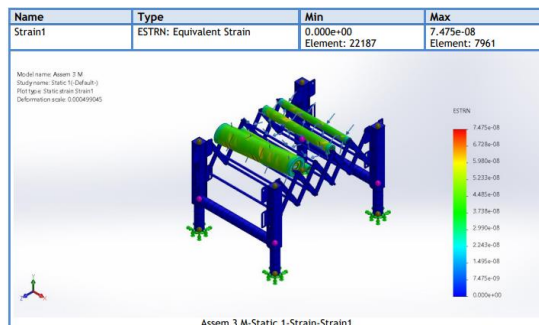
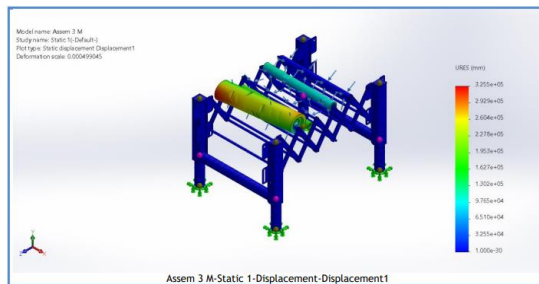
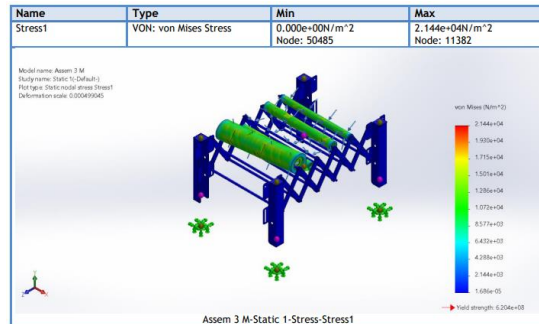
- The roller conveyor has changed the face of the industrial economy around the world. Today, it has applicable uses in countless industries, such as transportation and food services.
- According to the survey performed 85% industrial units face difficulties in manually handling bulk material packaging.
- Conventional ways are responsible for material wasting, time wasting & above all a poor managing issue. In this project our focus is to take out the manual material handling ways and saving a good amount of time.

Need of the Project:

- Flexible conveyors are a kind of temporary conveyors that have the ability to stretched and shortened, are very fast and flexible, and can move products easily and efficiently.
- They are compact in structure and occupy a small space.
- In some situations that are not suitable for fixed conveyors, such as when trucks need to load and unload goods at different locations, these locations are not designed as long-term fixed loading and unloading points, so they will not be equipped with fixed conveyor lines.
- At this time, flexibility is very suitable for this situation, and even flexible conveyors can become conventional equipment on trucks, following the truck in different locations to efficiently complete loading and unloading operations.

Design and Analysis:

CAD Model-



Calculations:

Design of Roller:

Material is MS (Mild Steel)

E = 2.10*10⁵ MPa

P = 7860kg/m³

S_{yt} = 590 MPa

Consider uniformly distributed load and factor of safety=2

$$\begin{aligned} \text{Allowable stress} &= S_{yt}/FOS \\ &= 590/2 \\ &= 295\text{MPa} \end{aligned}$$

Maximum stress calculation

$$W = 60/3$$

$$= 20 \text{ kg (load on 3 rollers on at a time)}$$

D₁ = outer diameter of roller

$$= 24 \text{ mm}$$

D₂ = inner diameter of roller

$$= 20 \text{ mm}$$

W = width of roller

$$= 300 \text{ mm}$$

Y = Distance from neutral axis

$$= 0.024/2$$

$$= 0.012$$

Consider uniform load

Maximum Moment = $WL^2/8$

$$= 20 * 9.8(0.3)^2/8$$

$$= 2.2\text{Nm}$$

$$\begin{aligned} \text{Moment Of inertia} &= \pi((0.024)^4 - (0.02)^4)/64 \\ &= 0.027 * 10^{-7} \end{aligned}$$

Maximum bending moment stress = 104MPa

$$\begin{aligned} \text{Checking factor of safety} &= \sigma_{all}/\sigma_b \\ &= 295/9.8 \\ &= 30.1 \end{aligned}$$

Calculated FOS > Assumed FOS selection of material

Hence, design is safe.

Maximum deflection:

$$Y_{max} = 5 * W * L^3 / 384EI$$

$$\begin{aligned} &= 5 * 20 * 9.8 * (0.3)^3 / 384 * 2.10 * 10^{11} * 0.027 * 10^{-7} \\ &= 1.2165 * 10^{-4} \\ &= 0.12165\text{mm} \end{aligned}$$

0.12165mm as compare to 500 mm is negligible

Here selected channel can be considered safe

$$\begin{aligned} \text{Weight of Roller} &= \text{Cross section} * \text{Width} * \text{Density} * \text{No. of roller} \\ &= \pi * ((0.024)^2 - (0.02)^2) * 0.3 * 7860 * 11/3 \\ &= 4.73 \text{ kg} \end{aligned}$$

Selection of shaft:

$$\begin{aligned} E &= 2 * 10^5 \text{ MPa} \\ P &= 7860 \text{ kg/m}^3 \\ S_{yt} &= 560 \text{ MPa} \\ \text{FOS} &= 2 \\ \text{Allowable stress} &= S_{yt} / \text{FOS} \\ &= 560 / 2 \\ &= 280 \text{ MPa} \end{aligned}$$

Design Of shaft:

$$\begin{aligned} W &= 60/3 \\ &= 20 \text{ kg (load at on 3 rollers on at time)} \\ D &= 20 \text{ mm} \\ W &= \text{width of roller} \\ &= 560 \text{ mm} \\ Y &= 0.02/2 \\ &= 0.01 \\ \text{Maximum Moment} &= WL^2/8 \\ &= 20 * 9.81 * 0.562/8 \\ &= 7.69 \text{ Nm} \\ \text{Moment of inertia} &= 7.8540 * 10^{-4} \text{ m}^4 \\ \text{Maximum bending stress} &= \text{Moment} * Y/I \\ &= 9.79 \text{ MPa} \end{aligned}$$

Checking FOS for design:

$$\begin{aligned} \text{FOS} &= \sigma_{all} / \sigma_b \\ &= 780 / 9.79 \\ &= 28.6 \end{aligned}$$

Calculated FOS > Assumed FOS

Hence, selected material can be considered as safe.

Advantages:

- Longer Life
- Can be used with different shapes and sizes.
- 24 Hour Operations
- Staff Safety
- Roller conveyors are efficient, and cost little to run.
- Light weight and easy to carry along with the material
- Portable
- Compact and space saving
- Low maintenance

Disadvantages:

- Speed cannot be controlled manually.
- Chances of product being damaged when moved by gravity.

Expected Outcome:

- Improved Efficiency: Flexible roller conveyors are designed to move products smoothly and efficiently, which can help increase the overall productivity of a manufacturing facility. This can lead to faster turnaround times and increased throughput.
- Reduced Labor Costs: Using a flexible roller conveyor system can help reduce the need for manual labor in the handling and movement of products, resulting in reduced labor costs for the manufacturing facility.
- Increased Safety: Flexible roller conveyors are designed to transport products safely and smoothly, reducing the risk of injuries to workers and damage to products.
- Improved Quality Control: A flexible roller conveyor system can help ensure consistent and accurate movement of products

throughout the manufacturing process, which can lead to improved quality control and a reduction in defects.

- Space Optimization: Flexible roller conveyors are designed to be compact and space-saving, which can help optimize the use of available space in a manufacturing facility. This can lead to a more efficient use of space and reduced overhead costs.

Conclusion:

The load can be transferred from one point to another with minimal manpower with the help of gravity. It should also be able to lift the load and push it from its one end to another.

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