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# Design and Analysis of Unloading and Handling Mechanism of Heavy Bags for Small-Scale Industries

**Kamalkumar Patel[1], Himanshu Patel[2], Darshan Jotva[3], Vishal Pandya[4]**

*[1,2,3] Student, Department of mechanical engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*
*[4]Professor, Department of mechanical engineering, Birla Vishwakarma Mahavidyalaya, Gujarat, India*

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**Abstract -** *The material of LLDPE (Linear low-density polyethylene) and LDPE (low-density polyethylene) baggage largely imported from Kuwait, Kingdom of Saudi Arabia and Qatar thanks to its law price camper to the Indian manufacturer. The foreign material comes in LD (linear density) plastic that has low elastic properties. In small-scale industries, throughout handling method of LD baggage like loading and unloading, the engrossing force of employee could cause tearing and manufacture holes. The adverse result of those holes creates several issues. To catch up on those issues, we have a tendency to introduce the new conception of material handling. Our principal objective is to handle baggage safely and quickly. After lots of brainstorming, we have developed a mechanism to attain our goal. The principle within the base of the mechanism is to convert the rotary motion into linear motion. The LD baggage is hanging on L-sections and it gets the motion through the screw. The mechanism is intended in such some way that it may be simply assembled and dismantle as per user's requirement.*

***Key Words***: material handling, plastic bags, small-scale industry

## 1. INTRODUCTION

Linear low-density polyethylene (LLDPE) is a linear polymer (polyethylene), with significant numbers of short branches, commonly made by copolymerization of ethylene with longer-chain olefins. Linear low-density polyethylene differs structurally from conventional low-density polyethylene (LDPE) because of the absence of long chain branching. The linearity of LLDPE results from the different manufacturing processes of LLDPE and LDPE.

We have visited a small-scale industry, named Priya plastics, Vadodara. The raw material for that industry comes from overseas. Yes, there are many Indian manufacturers, that makes raw material of LLDPE and LDPE. Those manufacturers are Reliance, Gail and many more. They have higher price rate and due to that, dealer order goods from other companies like Sabic. But, the carrier LD plastic granules has less mechanical properties. The gripping force of workers may cause many problems.


**Fig - 1:** LD bag, SABIC, Saudi Arabia and snap of bag which has a hole

- **How it affects cost?**

In labor cost, per labor has distributed 100 Rs/tone. In addition to that, when labor carries L.D. bags sometimes it creates a hole. Approximately 40 bags have 1 or 2 bags are defect generated and it has around 2-3 kg weight loss. Here the cost of 1 kg is 103 Rs. When a hole is generated in L.D. bags, moisture content is entered in those L.D. bags. The effect of moisture defects product, it generates a bubble in the final product. The loss due to the bubble is higher than the material loss caused by the hole.

To remove moisture, they have to apply drying process on raw material and its also costly process.

- **How does it affect in time consideration?**

After a number of visit and reading, we found that total time required for a worker to unload 1 ton (40 bags) raw material from truck to storeroom (around 6 meters) is 17 minutes (it is the average value of the number of reading). Here, the material handling time is very high and we know that the time value of money.

After studying all the problems, we decide the aim and objective of our area of concentration.

### 1.1 Aim and Objectives

- Quick unloading process.
- Reduce un-necessary cost of material handling.
- Prevent the breakage of LLDPE/LDPE bags due to the uneven force applied during unloading.
- Prevent Wastage of material due to the hole.
- Improve the unloading process.
- Produce better quality of the product by eliminating moisture problem.

On the basis of aim and objective, we design a new mechanism for material handling. The configuration of a mechanism such that it satisfies all requirement which solves most of the problems of small companies.

The CAD modeling of the mechanism

3D solid modelling was performed in CREO 3.0 CAD software. The main reasons behind selecting CREO is it offers users heightened speed and efficiency during the design process. Key benefits include: Faster, more flexible part and assembling modeling. Increased efficiency through an intuitive interface and unrestricted simplification and editing of geometry.

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### List of Components involved in the mechanism are,

1. Large pitch screw
2. Bearing seat
3. Ceiling Support
4. L section
5. Hook
6. Lever

### 2.1 The construction of mechanism contains the following points

The system is completely mechanical system and it operates by man power. The main reason behind manpower is a small-scale industry. We focused small-scale industry, where cost is a most crucial factor. We can provide automatic drive like motor but it may increase the base price of the mechanism. In the mechanism, one worker is already required for loading and unloading, so the motor can be compensated by human effort. The design of mechanism or say the beauty of mechanism is that, worker have to apply only 30 kg of effort on the lever to carried out satisfactory work from the mechanism.

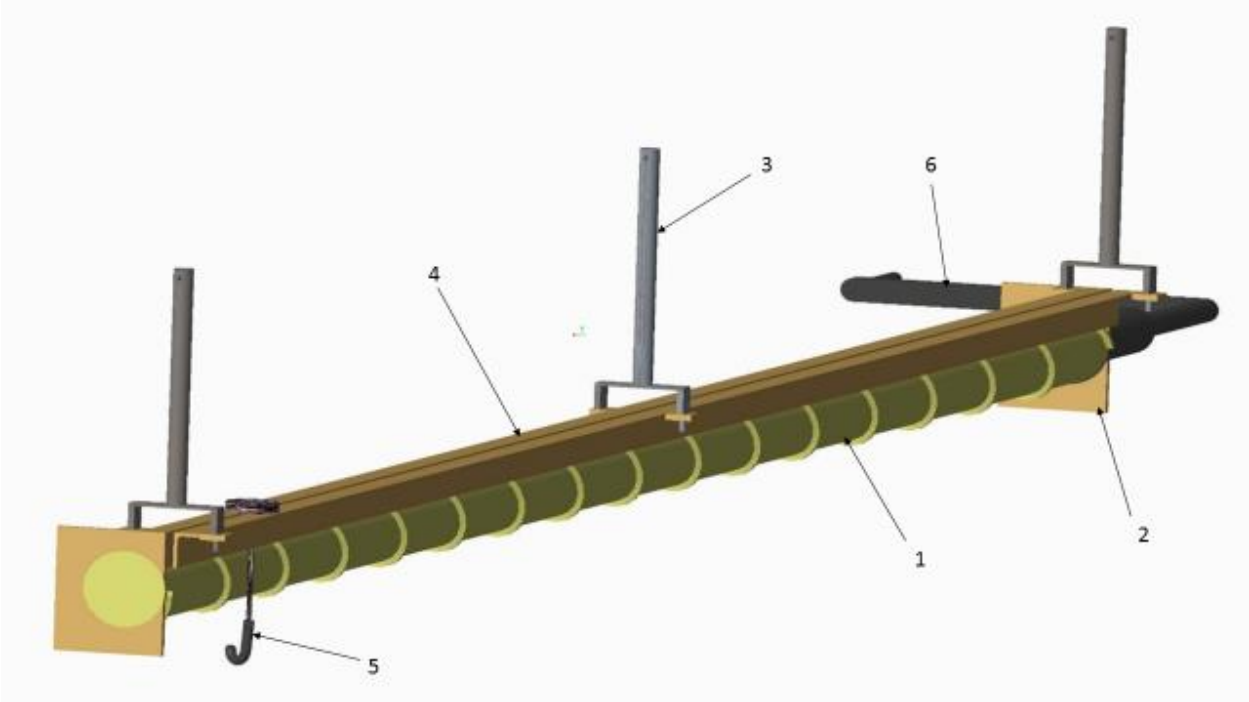


**Fig - 2:** final assembly of the material handling mechanism

The most important component in the mechanism is a screw. The outer diameter of the screw is 145mm (very large diameter) and 4000mm in length. It mandatory to select large screw diameter to reduce human power up to 30 kg. There might be a question in mind that screw has 4000 mm length, so it may bend due to its own weight. But it doesn't. Screw only bear axial load created by a hook which is sliding on L-section. That axial load is bared by bearings which are mounted at the end of the screw. The total axial load on the screw is very low (around 2400 Newton, it is multiple of 8×300 where 8 is a number of hook and 300N is applied Force to move hook) and that's why stress produces in the hook is also less or we can say that negligible. Due to low magnitude stress (around 1.2 $N/mm^2$), the required thickness of screw is very low about 3 to 4 mm, which occupy very low mass, so the question of bending got an answer.

Apart from this, the screw has large pitch around 250mm and that large pitch in a pipe of 145 mm diameter is a very difficult manufacturing process. The easiest way to manufacture this is to make a thread in the form of spring and then weld it with a pipe. The cross section of that spiral thread is a most important thing because it has to transport the material, we want to move hook properly and for that thread must have higher depth compare to hook diameter.

The function, of the screen w, is to overcome the sliding friction between hook the and L-section and, move the hook. The weight of the raw material is transfer to only L-section, which ultimately transfer it in ceiling via ceiling support. There are total 2 L-section we have used and the gap between that L-section plays a vital role. The hook has a certain diameter as per loading condition and it has to transfer through L-section. The gap between n L-section such that it provides ease to move hook, only 2 to 3mm higher than hook diameter gap provided. Support play a considerable role to maintain that gap, the design of it had been done in such a way that it holds L-section tightly and accurately in its proper position.

Besides that, we provide ceiling support. Mostly small scale industry phase space problem and if we locate this mechanism at the ground which requires very large space. To avoid this problem, we have designed it as overhead. Apart from that, we divide support in a two-part the upper one and the lower one. The main reason for that is to easiness in assembly and disassembly of mechanism as per application. For that, we provide a dowel pin between that two partitions. As per the user's requirement, he can use the pin for engagement and disengagement. On the other hand, in hook assembly there is also a pin is provided. During material handling of LD bags, there might be chances of fluctuation in thrust which leads to the oscillating motion of hook and bag also. In the solution of that, we provide a pin in between hook and hook rod. Due to pin, the center of gravity of LD bags can maintain, it can adjust the angle between hook and hook rod as per center of gravity. Ultimately it nullifies oscillating motion of hook. To provide rotary motion to screw, a high strength Lever is used which is situated front end of the mechanism.

## 2.2 Working or path to take advantage of the mechanism

To transport a whopping number of bags, considerably large manpower required if it was done by manually. But, in this mechanism, only two workers are required, at extreme points. First of all, a worker takes a big, high capacity bag which can sustain the 100kg of the load. Then it put 4 LD bags into the bigger one and then hooked up it in the hook of the mechanism. After putting the bag into hook, worker rotates the lever twice in a counter clockwise direction which leads to linear motion of hook assembly over L-section. The motion caused by relative contact between the screw thread and hook rod. The hook travel around 500mm (as per pitch of screw). Then again the same worker mounts another hook and again perform the same procedure such that after some time total 8 hooks sliding on L-section with 100kg each. Likewise, worker1 load hook and on the other hand, a certain distance far from its second worker unload hook in the storage room. The worker2 takes hook assembly out of mechanism and locate raw material properly in proper place. He collects a number of hooks say 15 then simultaneously give it back to the starting point.

The question may arise in mind that there are many unloading and handling system or mechanism is available in the market so why this?

Reasons for selecting such a solution are,

- Due to a larger pitch of screw motion become faster, so unloading process becomes quick.
- These bags are highly sensitive about shear if more force applied by man hand then there might be a chance of failure and it results in scattering of material and if holes are produced by hand grip then moisture enters in bags, it affects in mounding process and also moisture removal cost is high
- Also by using other equipment, there is a possibility of excessive force on bags so due to this forces, low-density bags may damage.
- Cost of other equipment is high which is very difficult to buy for small-scale industry.
- L-section has highest structure rigidity over other sections.
- By using more numbers of hooks between predefined distance more bags can be transmitted so, the process becomes faster.

This system adjusts the center of gravity automatically during the transmission of bags because hook with a hinge is used.

## 3. Design and Analysis

The first step in designing any component is a preliminary design. Preliminary design starts with an assumption which is the backbone of design. Then, by Appling basic fundamental concept of mechanics, one can get basic dimensions of the component.

The assumption in Preliminary Design

- The Material for all component is "C15Mn75", which is the most widely used material for the general purpose.
- The maximum load acting on L section in 2m of a span is 5000 N.
- Only static a load is acting on L section.
- The value of the coefficient of friction between the L section and hook remain constant.
- There is no any adverse effect of deflection on transmitting a load.
- According to the parameter factor of safety is considered 2.

After getting dimension, we have done an analysis of all individual components. The analysis was carried out by us in ANSYS software which is very reliable in the result. During analysis, we provide appropriate constrain and load to all component. Images of analysis are following.

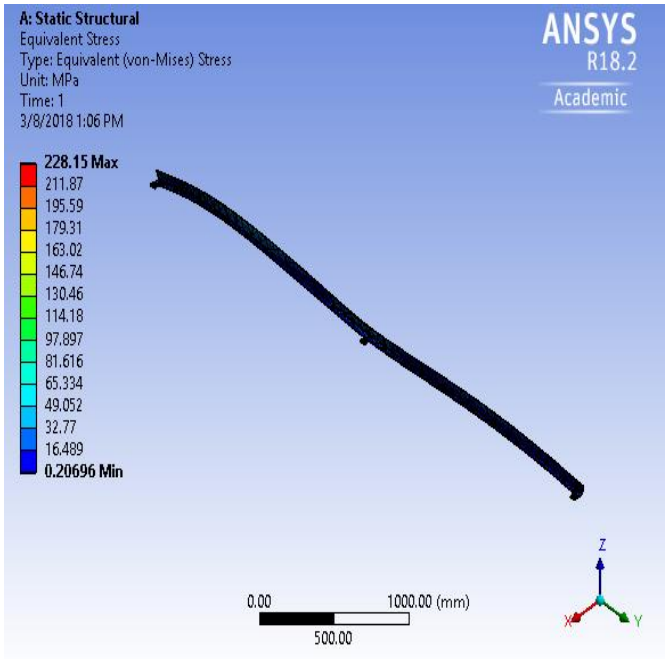


**Fig - 3:** ANSYS analysis of L-section

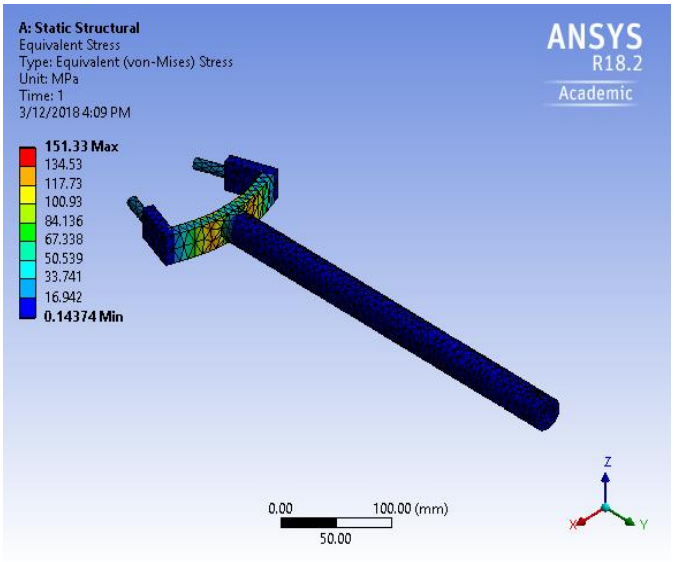


**Fig - 4:** ANSYS analysis of support

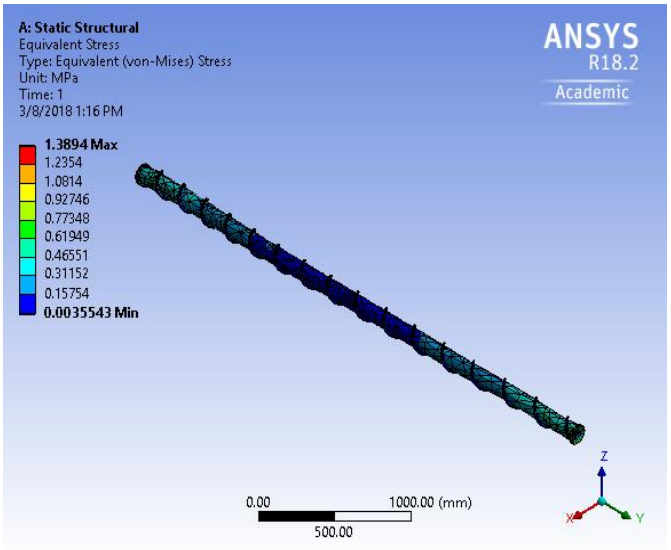


**Fig - 5:** ANSYS analysis of large pitch screw

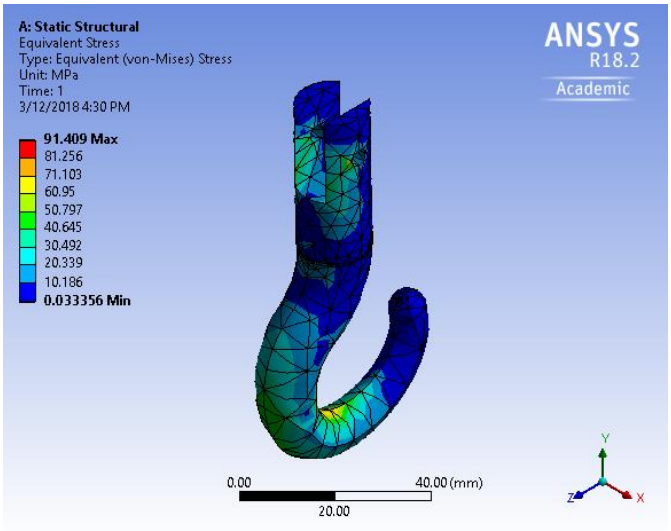


**Fig - 6** ANSYS analysis of hook

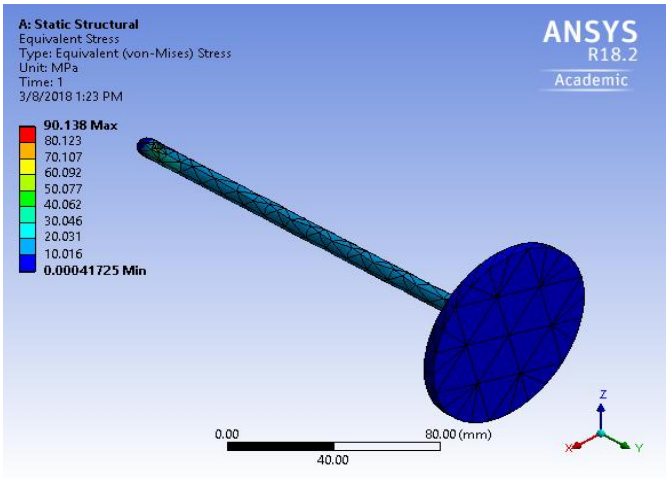


**Fig - 7:** ANSYS analysis of hook rod

The outcome of ANSYS analysis was the design is safe.

Our concept is a hypothetical or imaginary concept. In imaginary, suppose we develop new working mechanism but in actual, there are many factors which affect it. To ensure that we have manufactured actual modal in scale size. In the prototype, we did some changes as per convenience in manufacturing and using the function. We provide ground support to modal rather than ceiling support because we just ensure that does the function satisfied or not? And in the end, we can able to achieve our goal.

## 4. CONCLUSION AND RECOMMENDATION

During working under the project, we have learned so many things. The gurney of concept development to manufacturing of prototype had many challenges and that challenges help us to enhance our knowledge. Overall, the mechanism is cheap and very simple in operation. It can save considerable time for material handling. Due to its benefits, we recommend the mechanism to a different industry. It might be a most acceptable mechanism in future of material handling system.

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