Design of Semi-Automated Cotton & Mirchi Packaging Machine

A PROJECT REPORT SUBMITTED

In partial fulfillment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

MECHANICAL ENGINEERING

SUBMITTED BY

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CERTIFICATE

This is to certify that the **Minor project Report** entitled **"Design Semi Automating Cotton & Mirchi Packaging Machine"** has been carried out at VNRVJIET, Hyderabad and submitted by the following Students.

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In partial fulfillment of the requirements for the award of the bachelor of Technology in Mechanical Engineering to Jawaharlal Nehru Technological University Hyderabad at **VNR Vignana Jyothi Institute of Engineering & Technology** during the period of 2018 – 2022 is a bonafide of the work carried out by them under the guidance and supervision of the under signed. The results embodied in this project report have not been submitted to any other University for the award of any Degree.

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APPROVAL CERTIFICATION

Viva-Voice examination conducted for the dissertation work entitled "**Design of Semi Automating Cotton & Mirchi Packaging Machine"** is conducted on Product Development and the work is approved for the award of **Degree of Bachelor of Technology in Mechanical Engineering.**

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We, the undersigned declare that the project report entitled **"Design of Semi Automating Cotton & Mirchi Packaging Machine"** has been carried out and submitted in partial fulfillment of the requirements for the Award of the Bachelor of Technology in Mechanical Engineering at VNR Vignana Jyothi Institute of Engineering & Technology, affiliated to Jawaharlal Nehru Technological University, Hyderabad is an authentic work and has not been submitted to any other university.

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ABSTRACT

The problem we have identified is in the agriculture sector. For the farmers to sell the cotton and Mirchi in the government markets, cotton and Mirchi must be packed tightly in the gunny bags. The process of packing Cotton and Mirchi in gunny bags is labor intensive, time taking and costly. Our solution is a semi-automated machine which produces a smaller shape and size packages, that reduces the cost and time, and makes it less labor intensive and also makes the transportation more economical by stacking multiple packages on a truck. The machine is powered by using the hydraulic pump of the tractor. The running cost of the Machine is 200 per hour. The estimated cost of the machine is 25000, which is affordable by the farmers. The machine uses hydraulic cylinders to compress the cotton and mirchi, and then packed into the bag.

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CHAPTER 1

INTRODUCTION

1.1 Objective

The objective of this project is to find a solution to the existing problem in the agriculture sector which is making it difficult for the farmers to attain profits. The problem we have identified is the painful and inefficient process of packing cotton and mirchi in the gunny bags by the farmers.

1.2 Motivation

The motivation for doing this project is the fact that the process of packing cotton and Mirchi into gunny bags is costly, time taking and a physically painful process. The process is easily automatable. From the survey it is observed that the cost of packing Mirchi of 25 tons is 7500 and time taken is 7 hours. And the process causes a lot of physical pain and burning sensation. By the presented solution the time is reduced to 1 hour, the cost is reduced to 3500, and the physical pain is reduced too. This increases the income to the farmer and makes cultivating the cotton and mirchi easy for the farmers.

1.3 Scope for the Work

- In this project we are going to present the problem faced by the farmers in the process of packing cotton and mirchi into gunny bags.
- A potential approach is mentioned in the solution.
- The entire cost analysis of the solution was presented in this report.
- A design model of the solution is developed using CATIA V5 software.

1.4 Data from Survey

The survey has been conducted to understand the requirements of the farmer.

1. Average price per Acer-7500/-
2. Average time – 7 hours
3. Number of people - 6
4. Number of sucks - 70
5. Average Tons produced in one acer – 25 tons

1.5 Pain Points

1. Burning sensation on hands, legs, and nose.
2. Body pains.
3. Shortage of labor.
4. High Transportation and storage Costs.
5. Time taking.

1.6 User Needs

User needs are the requirements that add value to a product, service or environment for a user. Capturing user needs is the process of engaging users to understand their problems, processes, goals and preferences. So, we have collected a few of them, to understand our user in a better way.

- **Primary Needs**
  1. Automating the compressing process.
  2. Reducing the count of workers.
- **Secondary Needs**
  1. Automating the cotton & mirchi loading process.
  2. To reduce the cost of processing.
- **Latent Needs**
  1. Automated stitching process of the stack.

1.7 Initial Survey results

A	B	C	D	E	F	G	H	I	J
amount(tons)	pricing for packing	number of bags	Number of people	Time taken	SUCK PRICE		PRICE PER TON	PRICE FOR ACER	TIME FOR ACER
30	5000	75	5	9	3750		162.3076923		
30	5000	80	6	9	4000				
25	4000	70	5	7	3500		293.3333333	7333.333333	7HOUR,5PEOPLE
30	5500	82	6	10	4100				
15	1600	40	6	5	2000				
20	2800	55	6	6	2750				

Figure 1.1. Data from the Survey

CHAPTER 2

LITERATURE REVIEW

A. G. Naik, et.al[1] - They have done research on the FEA implementation in analysis and optimization of top and bottom frame for hydraulic cotton lint baling press where from this paper we have learnt about FEA implementation for analysis and optimization of top and bottom frame for hydraulic cotton lint baling press. And ensured manufacturability is structurally optimized.

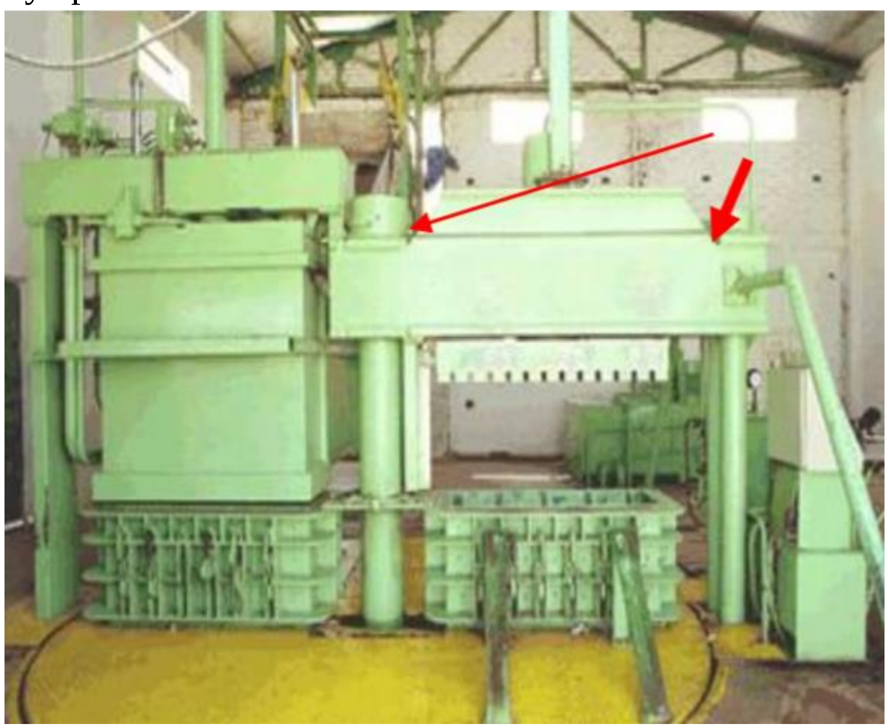

Figure2.1. Hydraulic press, Arrows indicating most frequently failure parts

Luigi Solazzi, et.al[2]– He clearly explained that the telescopic hydraulic cylinder is made up of composite material instead of steel geometry of the cylinder, and stress analysis at different positions of composite telescopic hydraulic cylinder and buckling analysis.

Abdul Talib Din, et.al[3] - He presents the design and development of a mathematical model of dynamic motion of pneumatic telescopic cylinders. Learned about how to develop a telescopic pneumatic system that can handle variable load at constant forward and retracting speed.

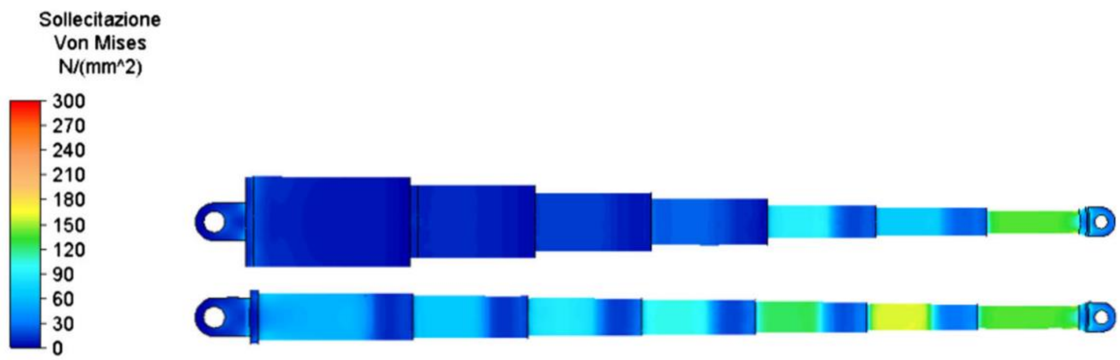

Figure 2.2 Stress state [MPa] in the hydraulic cylinder made of steel and composite material

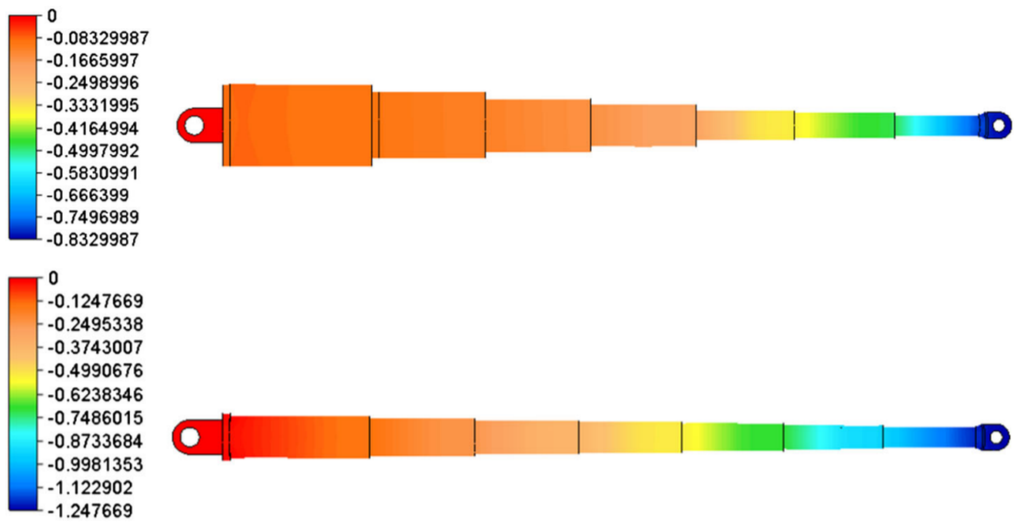

Figure 2.3 Axial displacement [mm] in the hydraulic cylinder made of steel and composite material

Sattar Ramazanovich Alikulov, et.al[4]- The article presents materials on the analysis of the process of cotton compaction in containers with a flexible shell, taking into account vertical pressures and friction forces using approximating functions and nonlinear differential equations.

S Baragetti,et.al[6]- This paper analyses the bending behavior of hydraulic piston-type actuators using analytical models, able to take into account friction, rectilinear imperfections and the actual geometric configuration of piston-type actuators. The reliability of these analytical models was confirmed by means of experimental tests carried out on full-scale equipment.

Bloye, et.al [7]- In this paper double acting double ends hydraulic cylinder was designed and analyzed. Relevant standards and codes were used in the material selection process and choosing of seals also follows. This designed double acting double end hydraulic cylinder can be effective employed when manufactured for industrial automation such as hydraulics system for cutting and crimping of hydraulics pipe hoses, power steering for earth moving vehicles among others industrial applications.

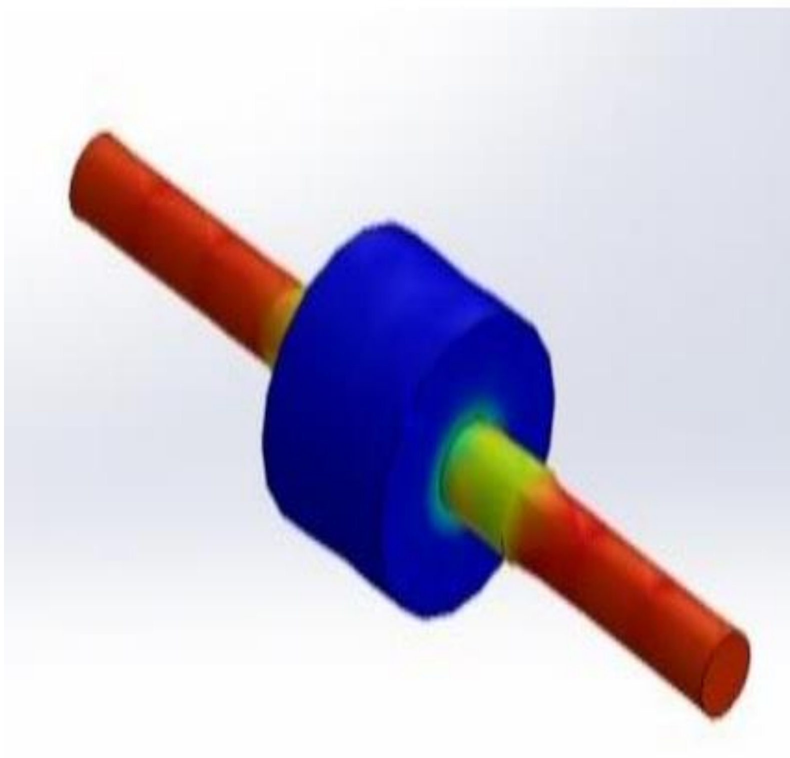

Figure 2.4 Stress analysis of double acting piston [7]

Husin .et.al[8]-The results of this research If high-density compression begins to be used during harvesting to provide more efficient field packages for transport to the gin, seed cotton moisture contents will become even more critical to minimize seed damage. The maximum safe seed moisture content for storage is 12%. Furthermore, high storage time at high density and moisture content could pose problems as well. The most striking result suggests that compression density should not exceed 24 lb ft-3to avoid significant damage to the cottonseed.

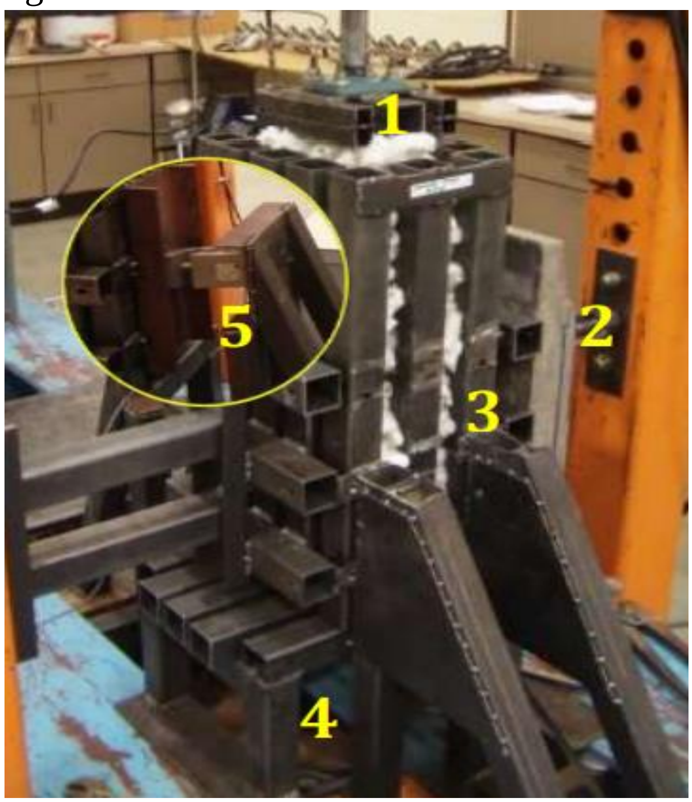

Figure 2.5 Miniature bale press showing the parts. Tramper foot (1), truck scale (2), bale chamber (3) and chamber stand (4). The inset in the circle shows the S-load cell at the back side of the chamber (5) [8]

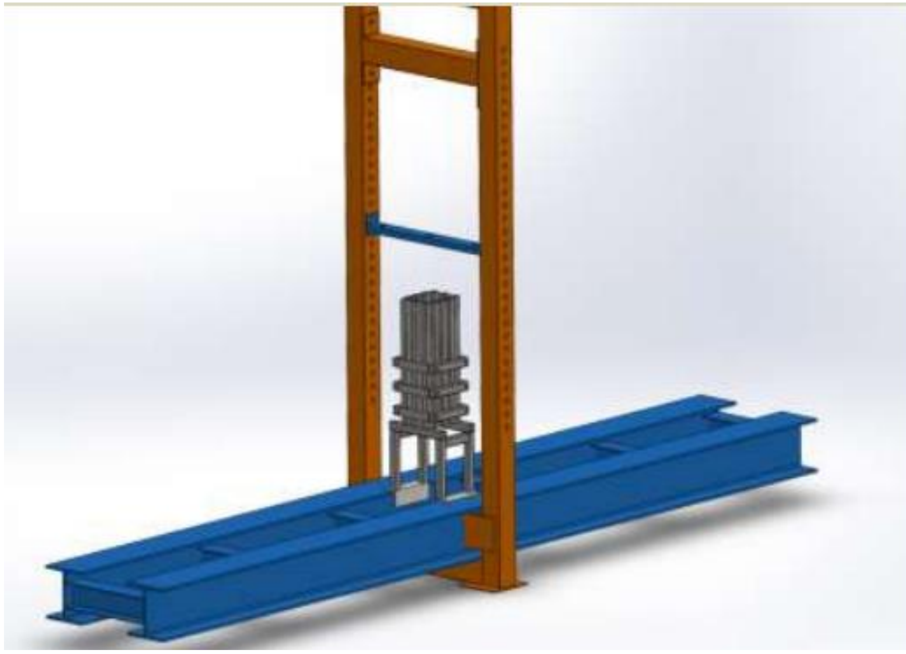

Figure 2.6 Solid works drawing of bale press

Figure 2.7 Enlarged pictures of the cracked seeds.

Satish B. Mariyappagoudar et.al[9]-This paper presented the Design and Analysis of Hydraulic Press using ANSYS.

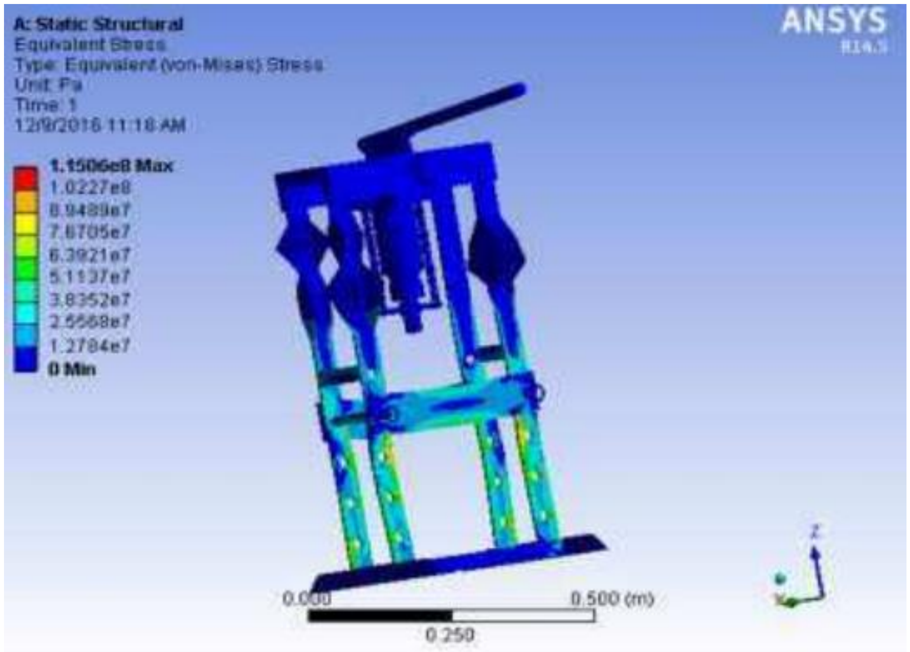

Figure 2.8 Von-mises stress

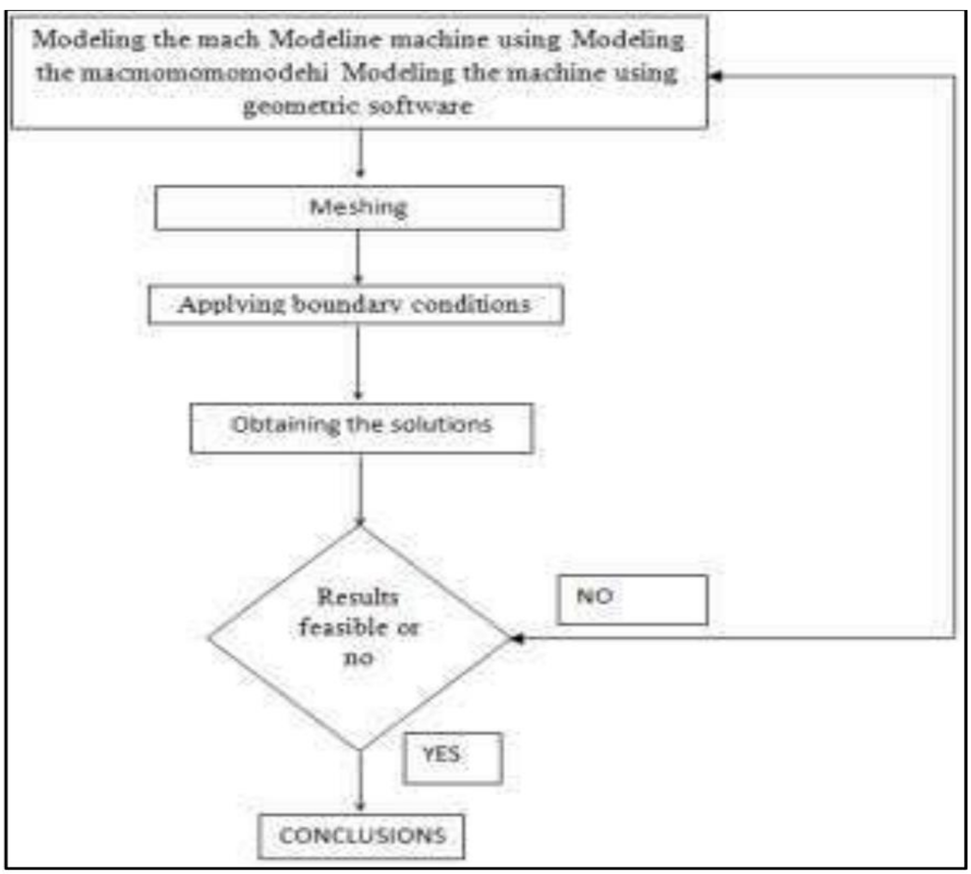

Figure 2.9 Flow Chart Indicating Stage of the Methodology

CHAPTER - 03

WORK METHODOLOGY

3.1 Understanding the problem

The primary needs and requirements of the users are collected.

3.2 Literature Survey

Information from all similar problems and applicable solutions has been gathered and evaluated.

3.3 Selection of solution mechanism

From the literature survey all the possible solutions are examined and based on the user requirements and feasibility most optimal solution has been selected.

3.4 Design of solution

Based on the requirements the solution is designed in the 3D Design software such as CATIA. The design is changed based on the feasibility, easy to use. This is an iterative process.

3.5 Result

Optimal designed machine which can be implemented is produced. The benefits of using this machine are noted in comparison with the present packing process.

CHAPTER - 04

Design of Semi-Automating Cotton & Mirchi packing process

4.1 Design considerations

The following are the design requirements of the solutions, so that the present solution meets the requirements of farmers.

1. It has to be economically viable for the framer to use.
2. As most of the agriculture machines are powered and carried by tractor. So, the present solution has to work and be carried by the tractor.
3. It has to automate the harder compression process.

4.2 Design parameters

1. The gunny bag dimensions are height = 111cm, radius = 21 cm.
2. The capacity of the gunny bag is 50kg.

These values are taken for Food corporation of India report [5].

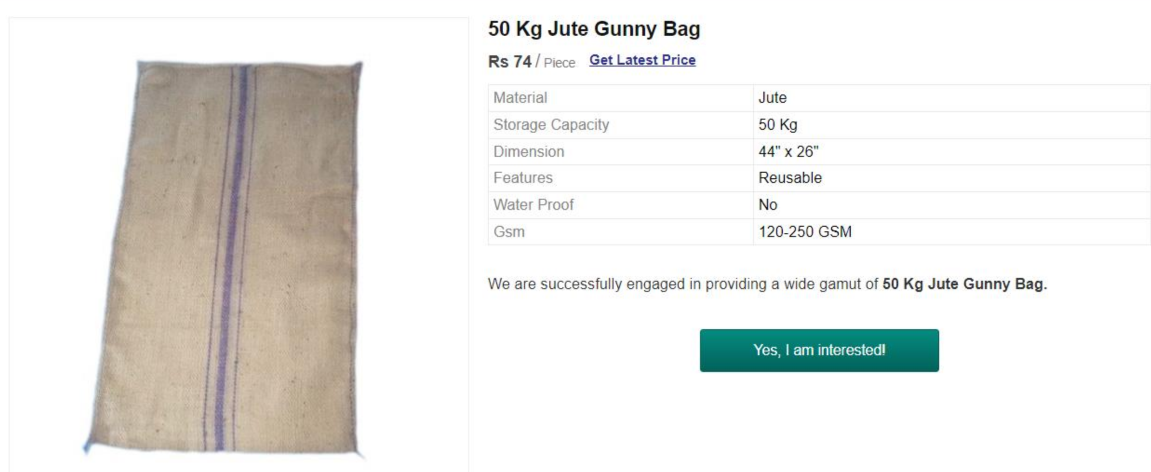

Figure 4.1 Gunny bag

4.3 Mechanism selection

Most commonly used compression technique is hydraulic piston and also tractor has inbuilt hydraulic pump which can be used to power the hydraulic piston. Pneumatic can also be used but it can't be powered by the tractor, which is an important factor.

So, a hydraulic piston has been selected. As the piston has to return to its original position after the compression action, a double action piston has been selected.

MODEL 1

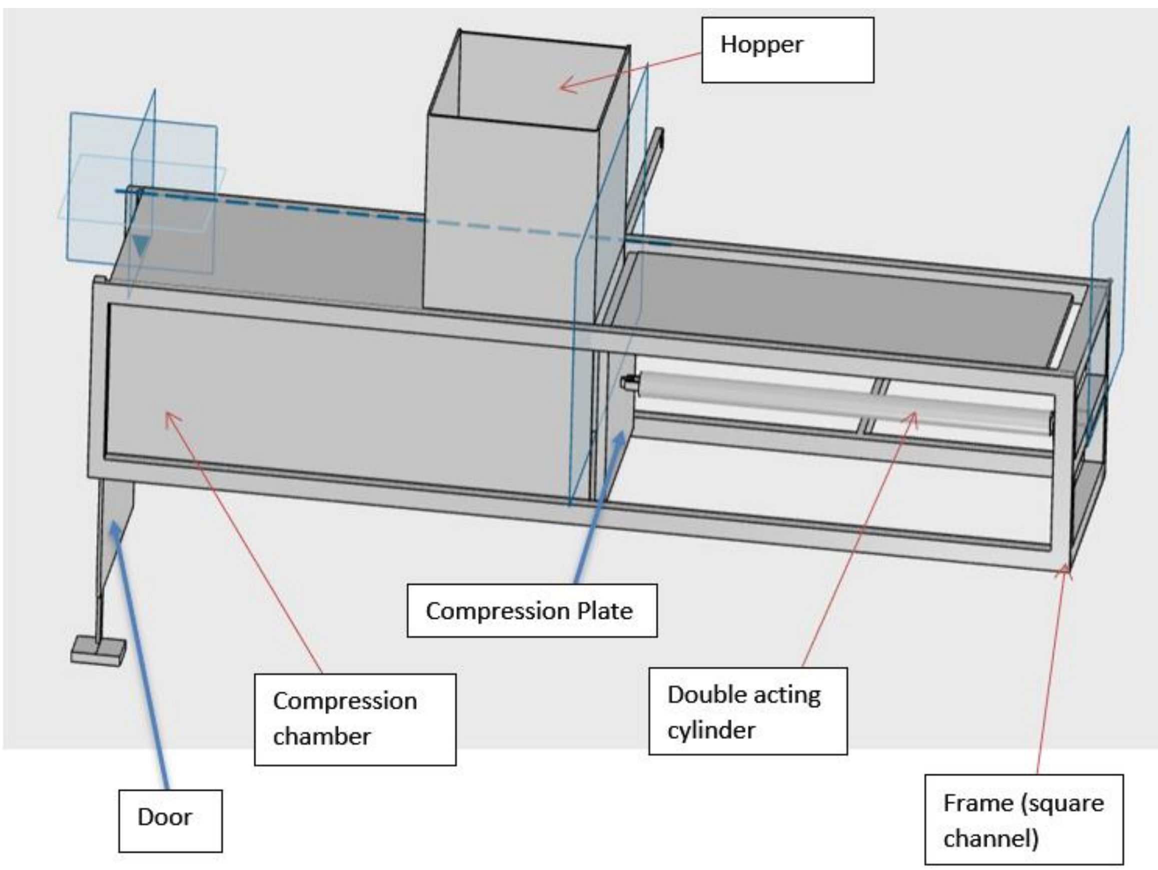

Figure.4.2 3D Model 1

Problems with this design model are as follows

1. Length of the piston required is high.

2. Door mechanism is complex.
3. Commonly used gunny bags can't be used while using this machine.

MODEL 2

Problem with this design model are as follows

1. Length of the piston required is high.
2. Door mechanism is complex.

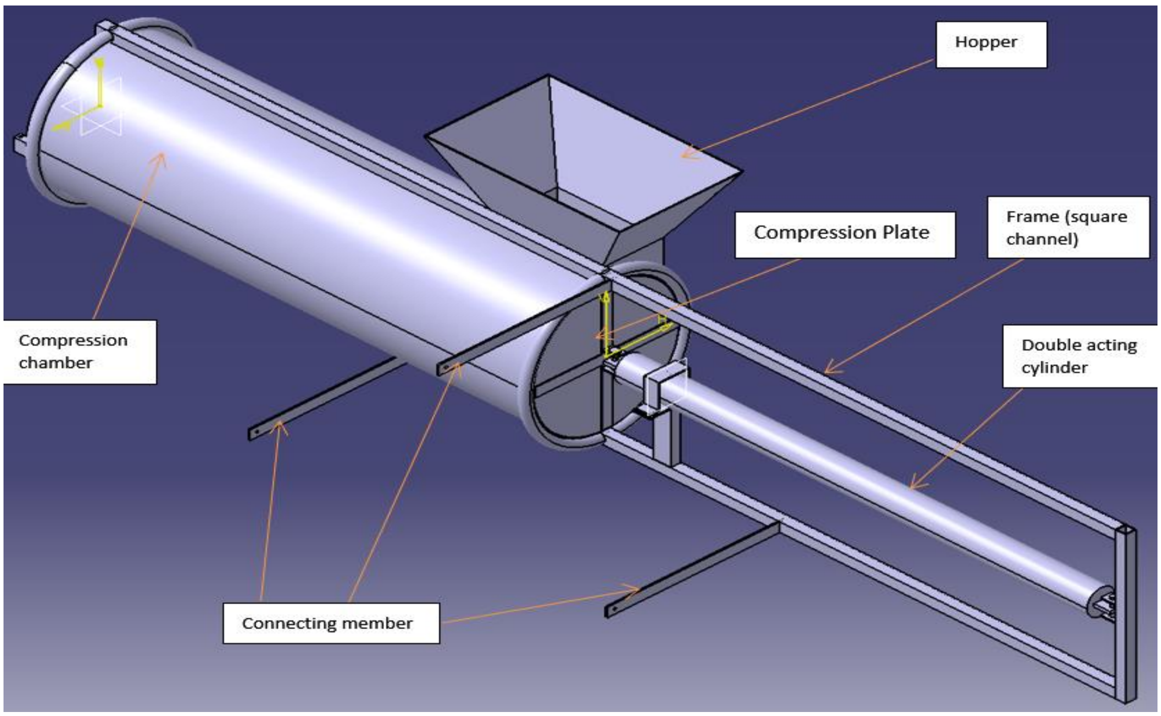

Figure.4.3 3D Model 2

Model 3

Advantages of this design are

1. Length of the piston is reduced.
2. There is no need for a compression chamber.
3. There is no need for any door mechanism.
4. This design is simpler and cost effective than the previous design.

Based on the advantages the model 3 has been selected.

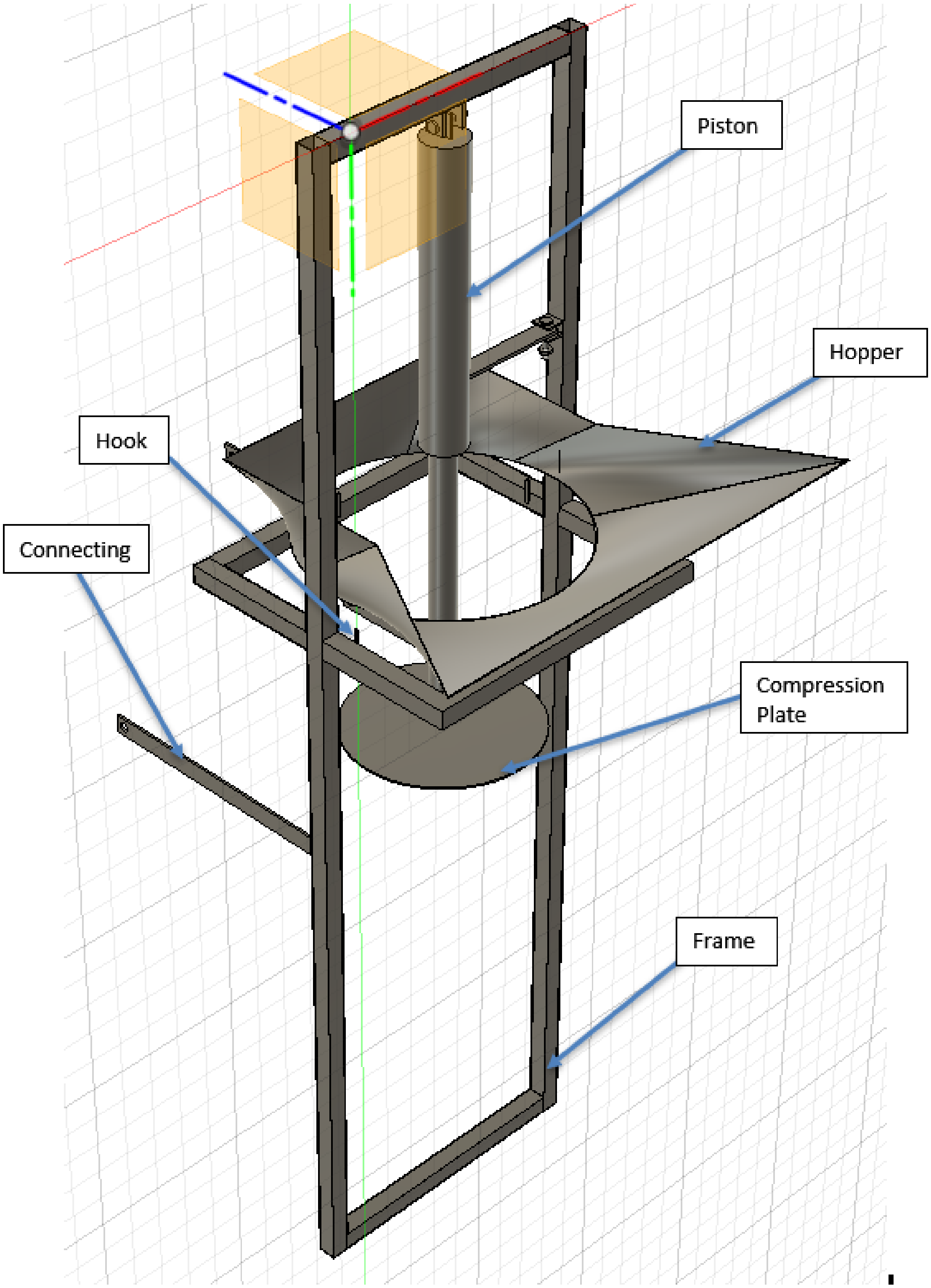

Figure 4.4 3D Model 3

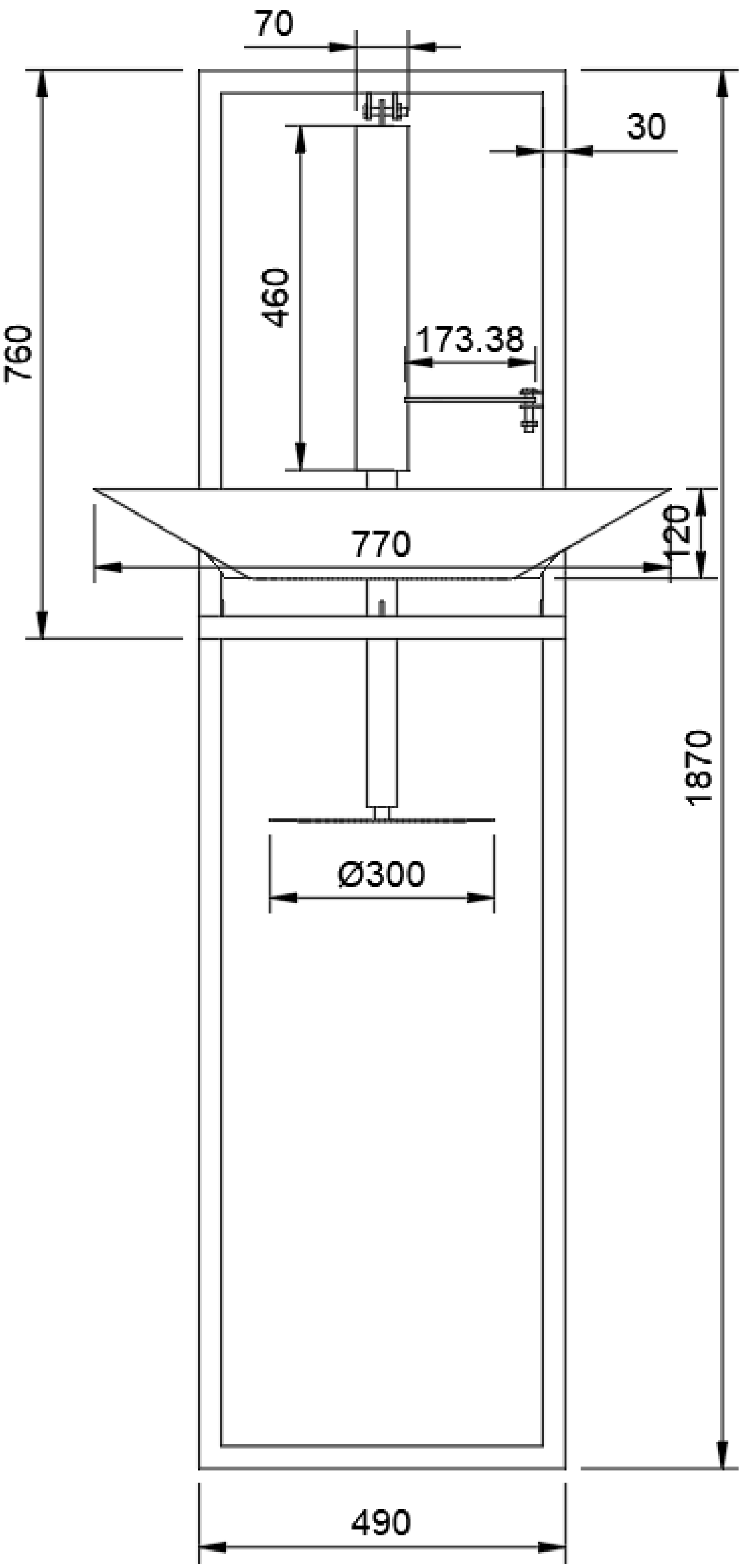

Figure.4.5 Front View

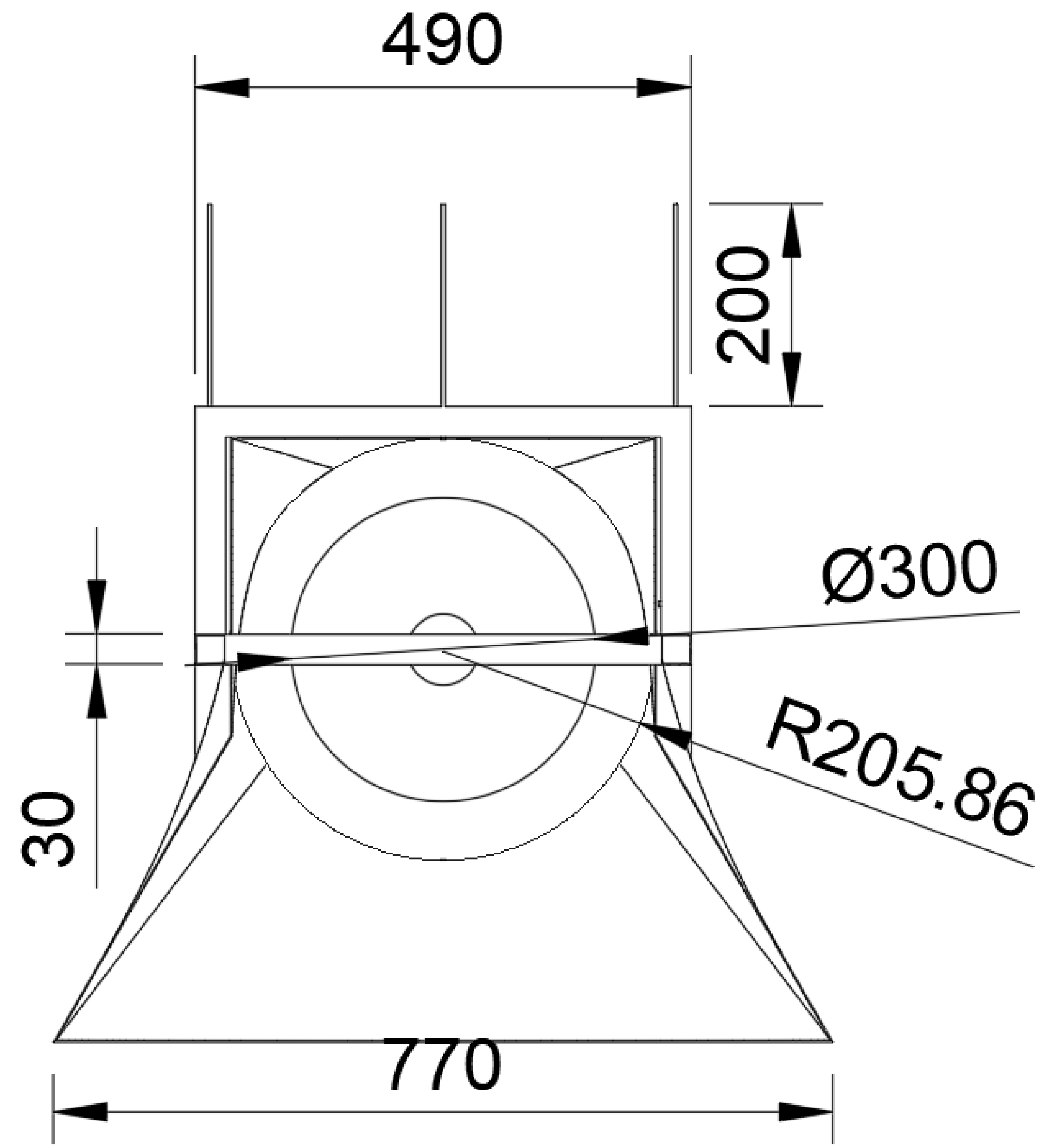

Figure.4.6 Top View

4.3.1 Hydraulic piston parameters

Length of the double acting piston depends upon the length of the gunny bag and size of the hopper.

Length of the gunny bag = 111 cm
Size of the hopper

Requirements are easy to load the material. The volume of cotton that a human can pick up and load in one-go. This has been collected by the farmer to be $16000cm^3$.
So, a hopper of volume is $26262cm^3$,high is 15cm, is selected considering the size constraints and easy to load the material.

If the length of the piston is too high, then the time of packing gunny will be high, and this also increase the cost of the overall machine and if the length of the piston is smaller than that does take more time for packing gunny bag. So, optimal length must be selected.
So, the length of the piston can be in a range of 50 – 65 cm.
Taking into consideration the availability and price 55 cm length Double acting piston has been selected by referring to resources like Indian Mart.

Figure.4.7 Double acting piston

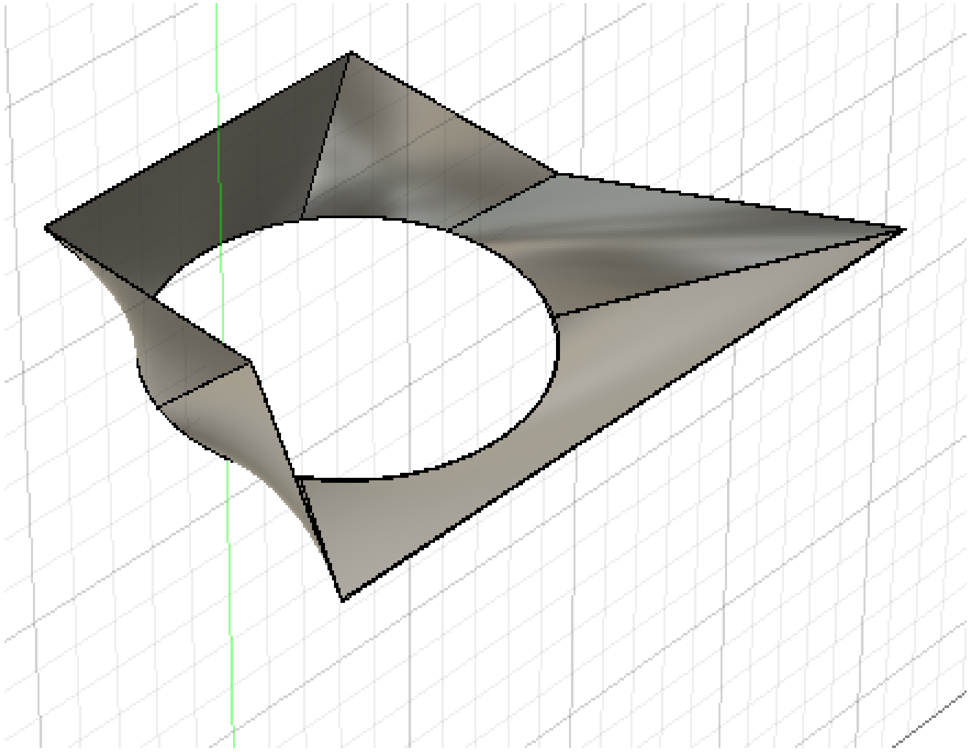

Fig 4.8 Hopper

4.3.2 Structural members

Requirements are this must bear the load acting on the machine, as well must be easily available, easy to build. Rectangular hollow tubes have been selected. Material selected is mild steel as it has lower price and high strength.

Length of the side structure member = length of the gunny bag+ length of the hopper+ length of the piston.

Length of the structural member =111+15+55 = 181 cm.

4.3.3 Connecting members

Proper mechanical connection between the tractor and the machine is must as the machine is carried by the tractor while travelling and the force is acted on the connecting member.

Length of the connecting member = 50 cm.

Cross section = 2× 0.3 cm.

4.3.4 Auxiliary Valve

Figure: 4.9 Auxiliary Valve Kit for tractors

The auxiliary valve is already present in all the tractors that are releasing now a days. But some old model tractors don't have auxiliary valve, but this can be added.

4.3.5 Hose pipe

Hose pipe is used to connect the piston and the auxiliary valve ports. This hose pipes are already present with the auxiliary valve.

Figure.4.10 Hose pipe

4.3.6 Relief Valve

A relief valve, also known as a pressure relief valve, is a device that lowers the pressure to prevent damage to the system. Their function is to protect pressure sensitive equipment from damage caused by overpressure. They are critical in a pressure system to ensure that system failures are avoided. To prevent system failure the pressure must be kept below a predetermined design limit. Each relief valve has a set point at which it starts to open and starts to prevent overpressure**.**

4.11 Relief Valve

4.4 Calculation

4.4.1 Pressure calculation

At present Cotton and Mirchi is compressed by humans. So their weight and foot area is taken into consideration.

Average weight of an average Indian male =65 kg (Taken from the survey report on the Hindu website)

Foot area =100 cm^2.(This is found by conducting a survey)

Pressure acting = $\frac{F}{A}$ bar

Pressure acting = $\frac{650}{0.01}$ = 0.65 bar.

Taking the atmosphere pressure =1 bar.

Total pressure acting, adding the atmosphere =1.65 bar.

4.4.2 Calculating diameter of piston

Force exerted on the material = $F \times A$ N

Where A is the area of the compression plate = π ×$r^2 m^2$.

=3.14×0.21^2

=0.1385 m^2

P =165 kPa.

F=1.65 × 10^5 × 0.1385 N

F = 22852 N.

Pressure exerted by the hydraulic pump varies from 100bar to 200bar.

Discharge rate of the pump is 50-70 LPH.

Taking the minimum pressure for calculating considering safety.

Area of the piston = $\frac{F}{P}\ cm^2$

Where 'P' is the pressure of the fluid.

'F' is the force exerted.

A = $\frac{22852}{10^7}$ = 2285× $10^{-6}\ m^2$.

R = $\sqrt{\frac{A}{\pi}} = \sqrt{\frac{2285\times10^{-6}}{3.14}}$ = 0.027 m = 2.7 cm.

So, the required double acting should have minimum diameter of 5.4 cm.

Time taken for complete elongation of piston = $\frac{volume\ of\ piston}{flow\ rate\ of\ pump} =$

$\frac{3.14\times2.7^2\times55}{833} = \frac{1258}{833} = 1.5\ min$

4.4.3 Strength calculation and material selection

4.4.3.1 Rectangular channel

Mild Steel Grade S355K2H has been selected for the Square channels. As it is a common available grade and also meets the requirements.
Tensile strength = 470 MPa.
Dimensions are L=3 cm, W = 3 cm, Thickness = 3mm.
Cross section area = 3.24 cm^2

Force acted on the channel is 69 kN. This force is transferred from piston, when compressed material and piston are at equilibrium.

Tensile pressure acting on channel = $\frac{F}{A} = \frac{22852}{3.24\times10^{-4}}$ = 73 Mpa.

Factor of safety = $\frac{Tensile\ strength}{Tensile\ Stress\ acting} = \frac{470}{73}$ = 6.4.

4.4.3.2 Strength analysis using software

Fusion 360 software has been used to analysis the strength of the frame of the machine.
Parameters
Fixed end: Bottom most end
Forced applied: Forced is applied on the top face
Magnitude of force: 22900 N.

Displacement Analysis:
Maximum displacement as accorded at the midpoint on the topmost element.
Value of Maximum displacement =0.1671mm.

Stress Analysis:
Maximum Stress produced = 108 MPa.
Maximum stress location can be seen in the Figure 4.13.

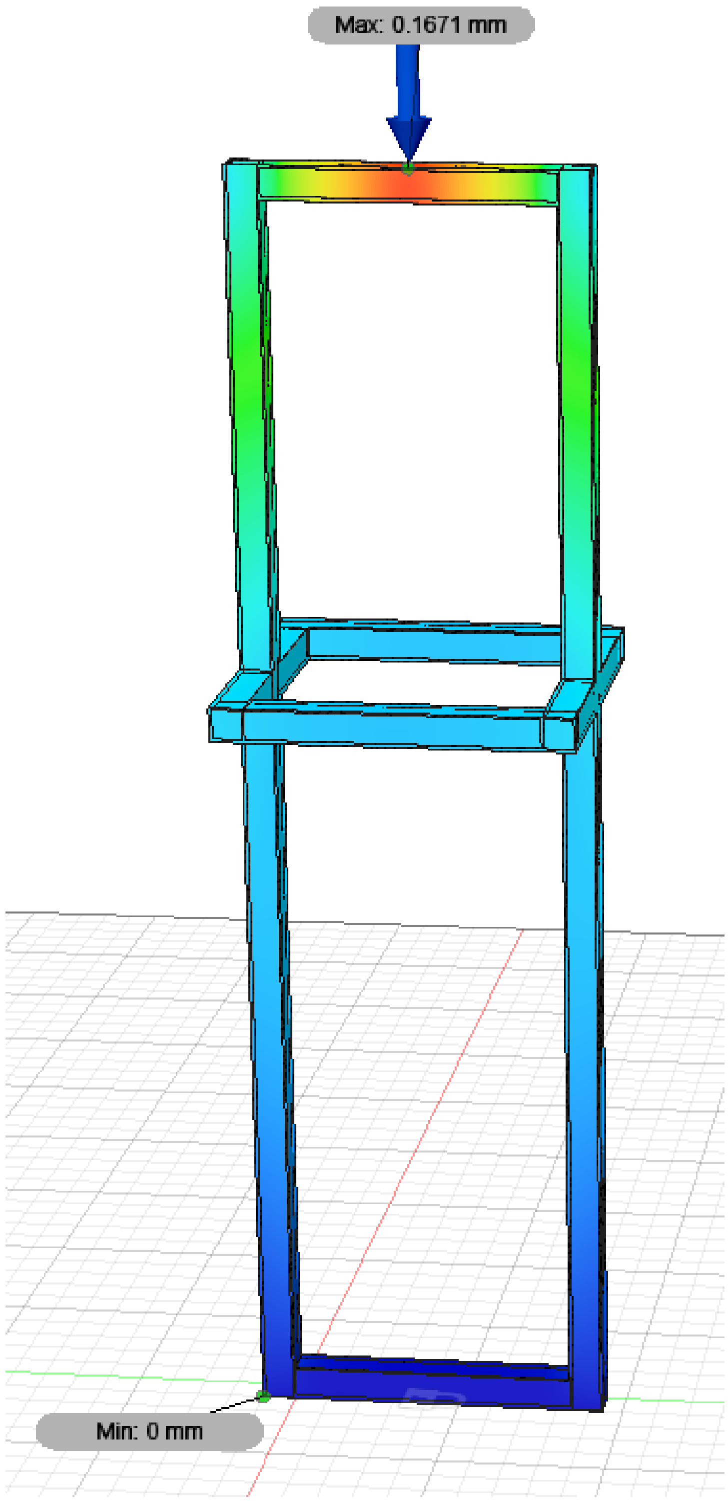

Figure.4.12 Displacement analysis

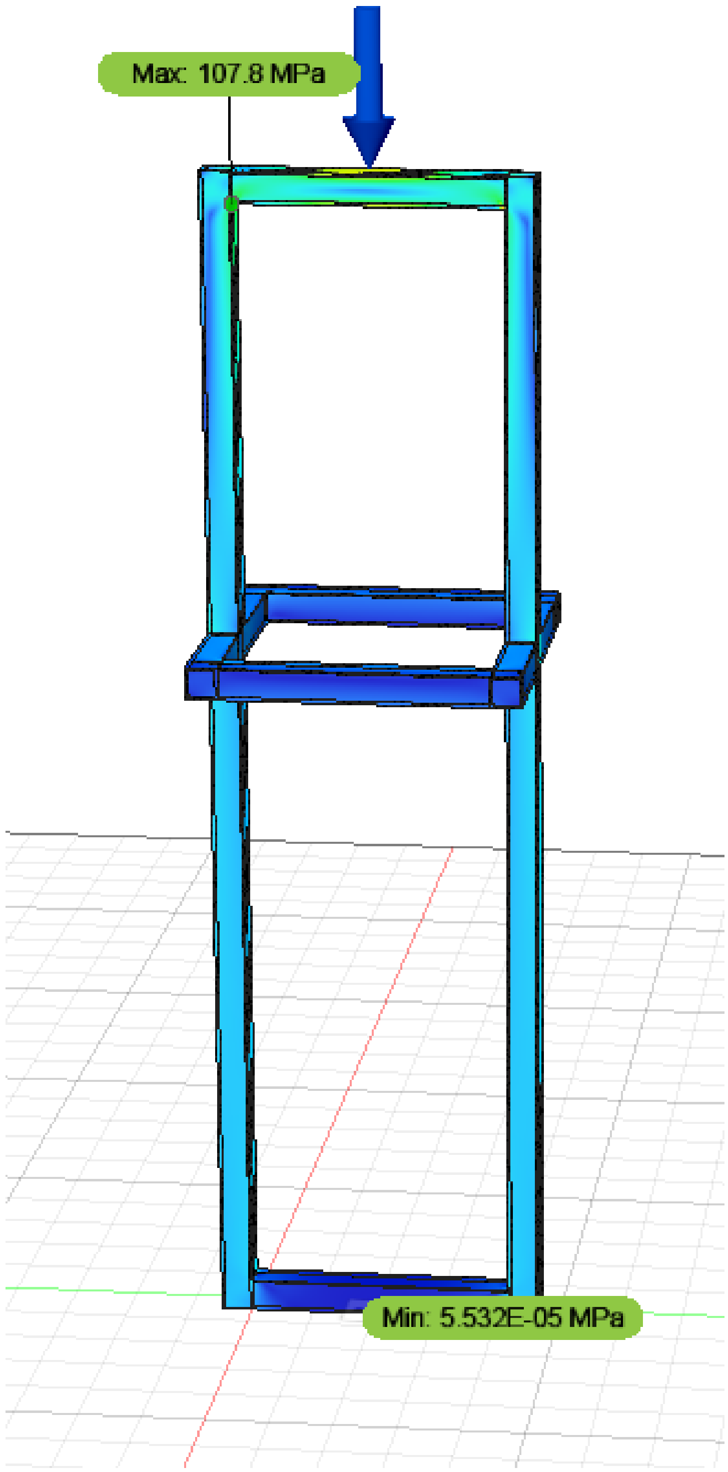

Figure.4.13 Stress analysis

4.4.4 Hydraulic circuit

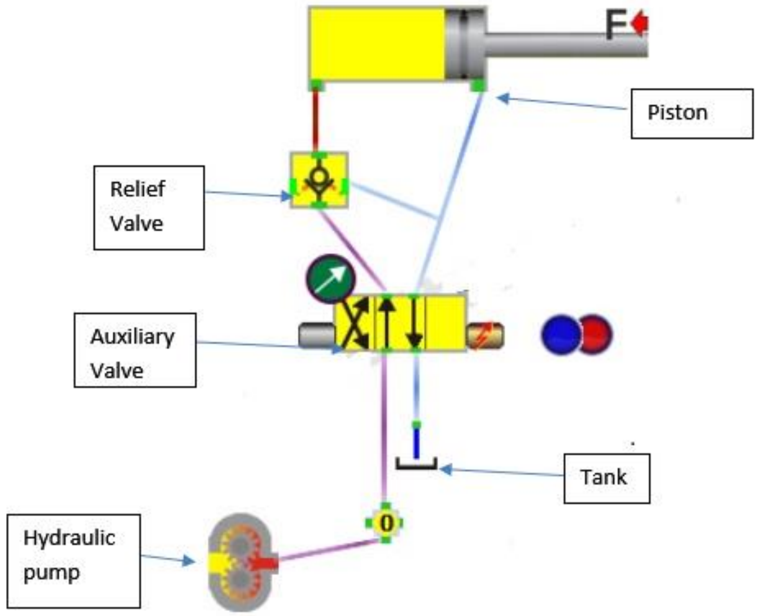

Figure 4.14 Hydraulic circuit

The hydraulic circuit is designed using free hydraulic circuit simulation software platform. This figure makes the understanding of the system simpler. The hydraulic pump is power by the engine of the tractor. Using the auxiliary valve, the position of the compression plate is changed. Relief valve is used to set the pressure such that excess pressure is not applied on the gunny bag.

4.5 Working process

4.5.1 Material loading

The material to compress is loaded into the hopper.

4.5.2 Compressing the material

The compression plate is operated by using an auxiliary valve and the cotton is compressed.

4.5.3 Loading the material

The compressed plate is pulled back by an operating auxiliary valve. And the step 1 and step2 are repeated until the required amount of cotton is compressed.

4.5.4 Sticking the gunny bag

As the cotton expands fast immediately after the gunny bag is full. The gunny bag mount must be sticked.

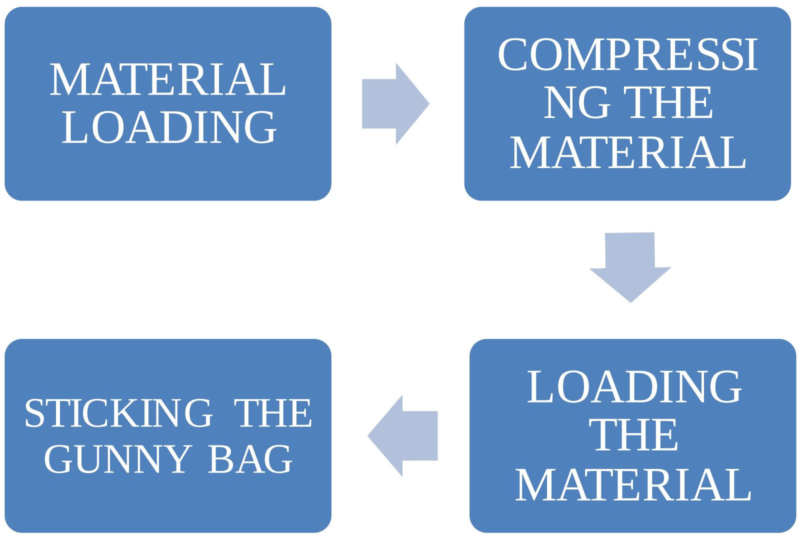

Figure 4.15 Workflow Diagram

4.6 Cost Analysis

The cost of the material and components are taken from the Indian Mart

Components cost:

Double acting piston =4000-6000/-

Square channel:

Length of the Square channel required = 6.26 m.

Area of the cross section = $2.24\times 10^{-4} m^2$

Total volume of material = $6.26\times 2.24\times 10^{-4} = 14\times 10^{-4}\ m^3$.

Density of material = $7850\ {}^{kg}/_{m^3}$

Mass of material required = $7850 \times 14 \times 10^{-4}$ =9.8 kg
Price per kg =60/kg
Total price = 60×9.8 = 588/-

Connecting member:
Length of the member required = 1.5 m
Area of cross section = 0.9 cm^{-2}
Volume of material = $1.5 \times 0.9 \times 10^{-4} = 1.35 \times 10^{-4}\ m^3$.
Density of the material = = 7850 $^{kg}/_{m^3}$
Mass of material required = $7850 \times 1.35 \times 10^{-4}$ =1 kg
Price per kg = 60/kg
Total price = 60/-

Sheet metal required:
Total mass = 3 kg
Price per kg = 60/kg
Total price = 180/-

Pressure Relief Valve:
Price = 600-1000/-

So, the total price for the parts is 5428 – 7828/-
It has to be noted that this price is excluding the assembly cost.

CHAPTER 5

Conclusions and Future Scope

5.1 Conclusion

Semi-automated Mirchi and cotton packaging machines are incorporated to enable an efficient and consumer-centric product to especially small-scale farmers. This product helps the farmers to overcome the transportation charge which shows a significant positive impact on attaining profits. The portability feature which is included in this product helps the farmers to pack the crops at the farm level, which makes the storage and exporting of the crop convenient for the farmers.

This product does not require any external power supply, where it solely runs on the hydraulic power produced by the tractor. The density of cotton packaging by this machine is higher when compared to the manual packaging, this higher density of packaging makes the stacking of these bags efficient, and it also shows a reduction in cost while they are being stored in a cold storage as the farmers are charged according to per bag stored in the cold storage.

Advantages of using Machine

1. As the machine can compress the Cotton and Mirchi to high pressure then human. So, the number of gunny bags required is reduced. As mentioned in the calculation section the machine can compress twice the pressure as human. So, the number of gunny bags can easily reduce to $^{2}/_{3th}$ of the bags used present.
2. Number of humans required is reduced to 3. As 1 human is for operating the valve and 2 are for loading the cotton into the hopper.
3. Time taken is also reduced.

The compression and loading of the material happen parallel. Amount of time taken for loading the material into gunny is 5mins this is collected by the survey. With using the machine, the time taken is reduced to half taking into the fact that number of bags is reduced, and compression and loading can be done parallel.

4. Price is also reduced

In the tradition packing half of the cost is for gunny bags and the remaining half is for human labor.

By using the machine, the labor and number of gunny bags are reduced. But while using the machine the addition cost added is the operation cost of the tractor. Data has been collected and it is noted that operation cost for tractor for 1 hour is 200/-.

Total cost = operational cost of machine + labor cost + gunny bag cost

The calculation is made for 46 gunny bags packing by 3 labors.

Operational cost= $200\times\ number\ of\ hours\ taken = 200\times 4.6 = 920/-$

Based on the survey it is observed labor are pain roughly 200 per 4hour work

Total labor cost = $200\times 3 = 600/-$

Total gunny bag cost = number of gunny bags $\times 50 = 46\times 50 = 2300/-$

Therefore, total cost = 3820/-

5.2 Future scope

Hydraulic compressor unit can be employed instead of tractor. This increases the price of the machine to 32000/-.

But the operation cost is reduced as electric power is cheaper than the diesel.

CHAPTER 6
Result

6.1 Result

Total price for the machine is around 5428 – 7828/-.

Table: Comparing the machine and human process.

	Human	By machine
Time taken	9 hours	4.6 hours
Price	7500/-	3820/-
Number of people	6	3
Number of Gunny bags	70	46

REFERENCES

1. Naik, A. G., and N. K. Mandavgade. "FEA Implementation In Analysis And Optimization Of Top And Bottom Frame For Hydraulic Cotton Lint Bailing Press." International Journal of Scientific & Engineering Research 3.7 (2012): 1-8.
2. Solazzi, Luigi, and Andrea Buffoli. "Telescopic hydraulic cylinder made of composite material." Applied Composite Materials 26.4 (2019): 1189-1206.
3. Din AT, Rahimi RA, Kadir MA. A numerical analysis on double acting pneumatic telescopic cylinder motion characteristics. In 2010 2nd International Conference on Computer Engineering and Technology 2010 Apr 16 (Vol. 5, pp. V5-71). IEEE.
4. Sattar Ramazanovich, and Olim Kholikulovich Eshkobilov. "Analysis of the Conditions of Cotton Packing in Containers with Flexible Casing." Revista Geintec-gestao Inovacao E Tecnologias 11, no. 2 (2021): 871-882.
5. Food Corporation of India "Guidelines for inspection of jute gunny bales" 2018.
6. Baragetti, Sergio, and A. Terranova. "Bending behaviour of double-acting hydraulic actuators." Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science 215, no. 5 (2001): 607-619.
7. Boye, T., O. Adeyemi, and E. Emagbetere. "Design and finite element analysis of double-acting, double-ends hydraulic cylinder for industrial automation application." Am. J. Eng. Res 6 (2017): 131-138.
8. Husin, Nur Azuan Bin. "Impact of Seed Cotton Compression on Cottonseed Quality." PhD diss., 2016.
9. Mariyappagoudar, Satish B., and Vishal S. Patil. "Design and Analysis of Hydraulic Press using ANSYS." IJIRST–International Journal for Innovative Research in Science & Technology 3, no. 07 (2016).