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Design Analysis and Weight Optimization of Top Beam Up-packing 15 BPH Bale Press Machine

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Design Analysis and Weight Optimization of Top Beam Up-packing 15 BPH Bale Press Machine

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Abstract. In the Ginning industry, the process of removing seeds from the cotton fibres and after that seedless cotton is compress to make a lint bale is carried out. The pressing of seedlesscotton is compress to make a lint bale. The pressing of seedless cotton is the last process at the ginnery. The cotton bailing press is taken under consideration, a product of Bajaj Steel Industry. It is important to modify the structure and check for suitability to improve the efficiency. Top beam modeling is done in solid edge. The static structural analysis is performed of top beam of bailing press in order to check the sustainability. ANSYS software was used to carried out the static structural analysis. The results obtained like maximum Von- mises stress and maximum deformation are used for improving design modification. Also adopting a technique of optimization it helps in provide a better outcome.

Keywords - Solid edge, ANSYS, Optimization, Cotton bailing machine.

1.Introduction

Ginning is the process of separating cotton fibres from seed in its most actual meaning. The fundamental role of a cotton ginnery is to turn a field crop into a marketable product. Current ginneriesmust clean seed cotton, divide rivers from seed, clean and position the fibres, and arrange them in a commercially acceptable container to turn seed cotton into final result. Cotton gins produce the fibres and place them in goods with a profit margin. As a result, ginning serves as a link between the production of cotton and the production of cotton. Cotton lint's bulk demands compression to make a bale in order to save money on shipping and storage. The final stage of cotton processing at theginnery is pressing (baling). Indian cotton bales are currently compressed to a high density of 500kg/m3 to 650kg/m3 (30 to 40 lb/ft3). Of course, this has a benefit in terms of volume per unit weight, given the size is lower. High-density bales, on the other hand, are more difficult to open, and a significant amount of energy is expended at the balepress and in the break to restore fluffinessacceptable for spinning.The International Cotton Advisory Committee has also underlined the necessity for a common cotton bale and processing standard. As a result, India should pursue the development of a universal density bale press, which will protect fibre quality, increase spinning capacity, and fulfill worldwide manufacturing sector demands. It is necessary to have an understandingof cotton bale standardization for enhancing efficiency in transportation, mechanical handling ofcotton bales.

1.1 Working of Cotton Uppacking Bale press machine

A framework, two hydraulic cylinders, a door less cylinder, a pusher assembly, chambers, and other components make up the cotton balepress machine. The basic function of the press machine is to compress seedless cotton into little bales. The press machine's frame structure is a critical element. It is made up of a bottom frame and a top frame that are joined by two tie bars. Cotton enters one box chamber thanks to the pusher assembly. With the use of a movement disc, the box chamber is then rotated 360 degrees. As a result, the cotton-filled box chamber is inserted into the frame construction, leaving an unfilled box chamber to be filled. There are two cylinders in the bottom frame of the press machine that are hydraulically controlled in an upward orientation. Second element is a doorless cylinder that travels downward through the top frame. The pressing procedure is then done. The pressed cotton, also known as a size bale, is removed from the machine. The bale size becomes more reliable and simple for long-distance transportation and handling.

Figure 1. 15BPH Uppacking Bale press machine

2. Literature Review

The researcher of this report discusses how globalization of cotton ginning is likely if press machines are inexpensive. The process of compressing cotton lint from a bale is a complex phenomena caused by nature's basic cotton elements, such as quality, strong point, maturity, and so on. On this press machine, a wide-ranging model of machine research and testing time and motion study was carried out for squeezing bale from the fresh lint cotton for a decentralized compostie ginnery. The framework was designed to resist the compressive load applied on the bottom most and sides of the structure's box during bale compression. The method concluded that using the main conceptual cotton press machine will significantly cut the price and space needed for a composite cotton ginnery [1].

In their research, the authors had found the lot of barriers to the implementation of advanced methods of cotton handling and processing practices, especially those related to packaging. Improvements tothe ginnery are only feasible if the intial costs of the press and cotton handling equipment areparticularly in comparison to get a complete overview about the design concepts. Using CAD softwarelike CATIA and ANSYS, design and analysis is carried out [2].

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3. Problem Identification

- The Bajaj Steel Industry has manufactured cotton pressing machine for that there requirement is to improve previous design.
- The cost of machine is much higher than the other industry machine
- Plant needs to reduce machines cost.
- Changing the geometric structure and material optimization.

4. Objectives

1) Design and analysis of top beam of balepress machine for reduction of weight and cost.

2) To investigate the machine performance, stability risk analysis under the specific load condition.

5. Material Specification

Different metals are used for different applications. Materials are selected scientifically for required properties. Steels are iron and carbon alloys that are widely used in construction and other systems due to their higher quality and low cost. The mild steel used for the frame was chosen because it is soft and ductile, making it easy to weld and machine for construction purpose. Following are the mechanical properties of the material used for the analysis.

Density = 7850 kg/m^3
Yield Strength = 410 x 10^6 N/mm^2
Poisons Ratio = 0.3
Young’s Modulus = 2.1 x 10^5 N/mm^2
Factor of safety = 1.25

6. Methodology

Table 1. Methodology

Detailed study of problem definition
Detailed study of existing system of present cotton bailing press machine at Bajaj Steel Industry PVT.LMT
Designing of conceptual CAD model of proposed design
Taking detailed dimension from company to develop work cell of existing system in cotton bailing press machine
Design of top beam
FEA optimization process
Analysis and testing of new improved design
Result

7. Procedure of design and analysis

The first stage is to research the design of the existing press, it has been discovered that the product based of the present press is insufficient. The cost prohibitively expensive for the average person.

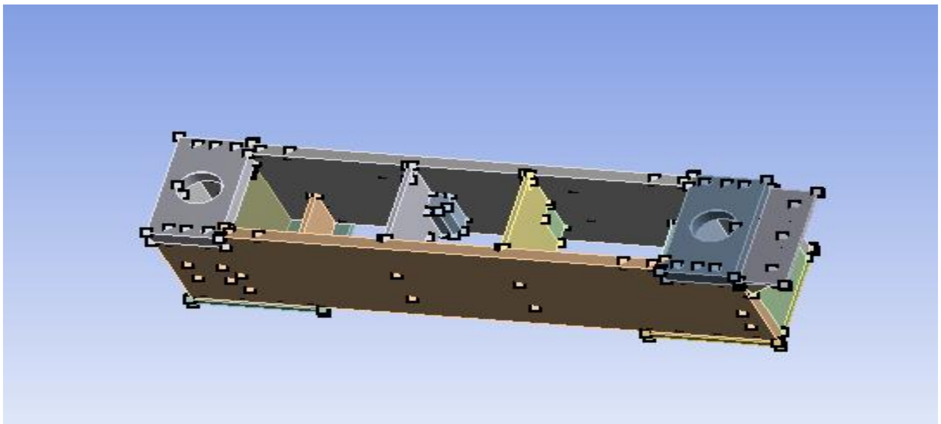

Figure 2. Frame of Top frame of machine

The outcome of the original press for maximum stress and total deformation is displayed in the diagram below.. The blue colour represents the safe region, While the red colour represents the critical region. The total deformation is 0.344 mm and the maximum stress is 539.24 Mpa.

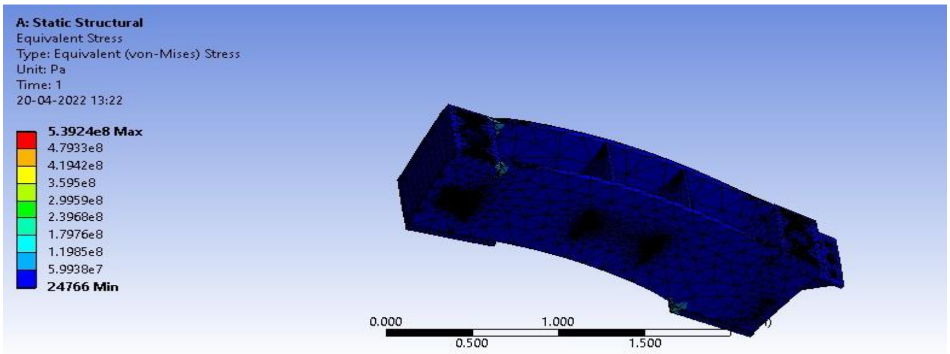

Figure 3. Maximum stress for Existing Top beam of machine

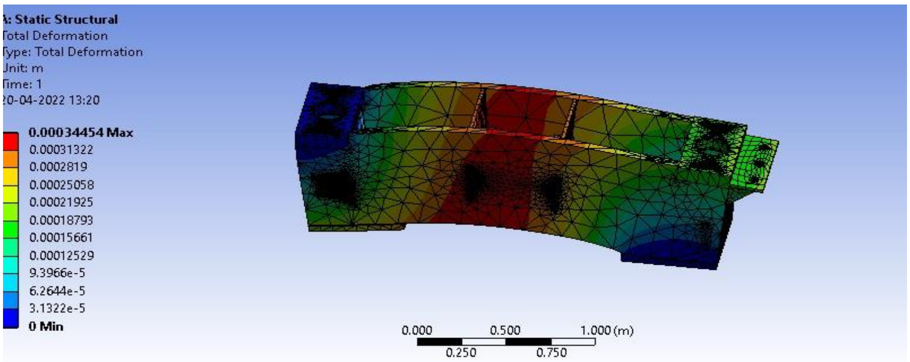

Figure 4. Total deformation of Existing Top beam of machine

The thickness of parts is reduced in the design of the balepress machine's top beam in good enough condition to optimise the weight of the top beam.

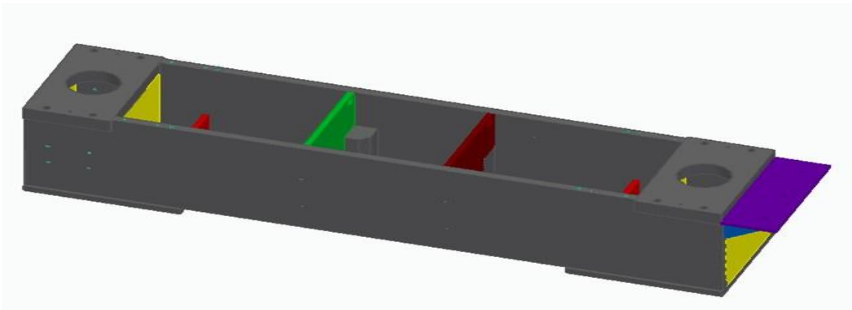

Figure 5. Frame of New top beam of machine

The analysis results for Total Deformation is 0.46mm and the Maximum stress is 776.9Mpa is obtained after doing the modification in existing top beam.

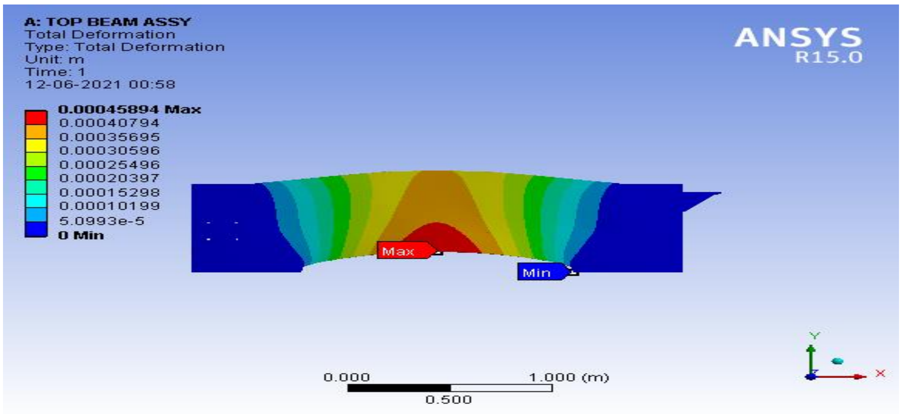

Figure 6. Total deformation for new top beam

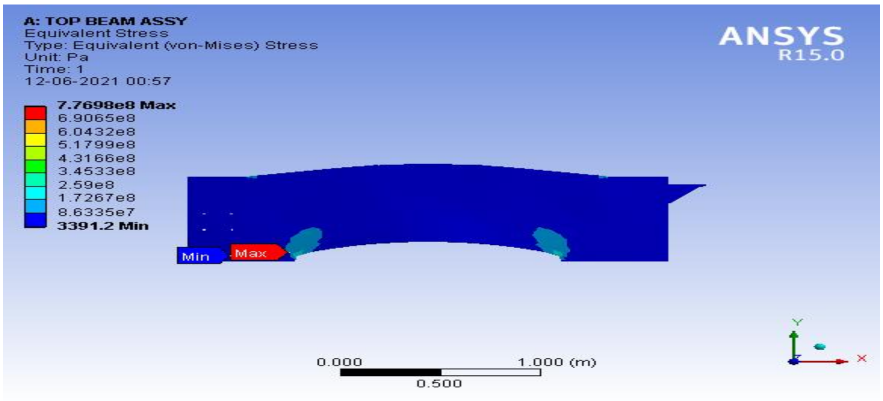

Figure 7. Maximum stress for new top beam

7.1 Result comparison

Table 2. Comparison of weight of top frame

Component	Previous weight	Optimized weight	Reduction
Top beam	2107.798 KG	1448.96KG	658.838KG

Table 3. Analysis result of existing and current top frame

Top beam	Total deformation	Maximum stress
Existing frame	0.344mm	539.24 MPa
Current frame	0.46mm	776.9MPa

8. Calculation of cost reduction for new top beam of bale press machine

Before optimization
Cost of material per kg = Rs.55
Cost of fabrication per kg = Rs.25
Cost of material 2107.798 kg = Rs.115928.8
Cost of fabrication for 2107.798 kg = Rs. 52694.9
Total Cost = Rs.168623.7

[II]
After optimization
Cost of material per kg = Rs.55
Cost of fabrication per kg = Rs.25
Cost of material1448.96kg = Rs.79692.8
Cost of fabrication for 1448.96 kg = Rs.36224
Total Cost = Rs.115916.8

[III]
Cost decreased of top beam
(Total cost before optimization) - (Total cost after optimization)/ Total cost before optimization
= (168623.7 - 115916.8)/ 168623.7
= 0.31257 x 100
= 31.25%
Reduction in cost up to 31.25%

9. Conclusion

After modification, the conclusion is that the stresses and deformation are well within the limit, implying that the change is safe to apply. The revision shows that the loading condition has no effecton the frame structure due to the decrease in thickness. Changing the thickness of the top beam provides the better answer, according to the FEA analysis. Proposed design process of analysis and optimization is successfully incorporate for minimization of weight for frame structure of hydraulic press. As a result, in attempt to correct and save the material and the machining time and cost required can be reduced. The cost reduction upto 31.25% after optimising the weight of the top beam of bale press machine.

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