JURNAL

Design & Development Of Maize Thresher Machine Using 3D Design Software

Diajukan Sebagai Salah Satu Syarat Untuk Memperoleh Gelar Sarjana Teknik Pada Program Studi Teknik Mesin Fakultas Teknik Universitas Muhammadiyah Sumatera Barat

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PROGRAM STUDI TEKNIK MESIN

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Abstract. Maize (Zea mays) is one of the important cereal crops that has grains commonly consumed as a staple food in various countries including Indonesia. Maize plants can grow well in various types of soil and climatic conditions, making it a popular crop in Indonesia. Maize production in Indonesia is quite high and has become one of the main agricultural commodities. Maize is grown in various regions in Indonesia, especially in Java, Sumatra, and Sulawesi. A corn thresher is a mechanical device designed to separate corn kernels from the cob efficiently. This study aims to assess the performance of corn thresher machines in increasing agricultural productivity. The results of this study show that corn thresher machines can improve the efficiency and quality of corn threshing compared to the manual method. The use of maize thresher machines can save farmers' time and labor, and increase agricultural productivity. In addition, the development of maize thresher technology continues to improve the performance and durability of the machine.

Keywords::maize thresher, efficiency, agricultural industry, processing technology, productivity

1. INTRODUCTION

Indonesia is an archipelago located in the tropics and has favorable agro-climatic conditions that make Indonesia an opportunity to become the largest supplier of agricultural products in the world. One of these agricultural products is corn. Indonesia produced 48.8 million tons of maize in the last 4 years, making it the 7th largest maize producing country in the world, using animal power or mechanical threshing machines. Threshing maize is easy to do when the maize is dry, because in this state the maize is easily separated from the cobs and in addition, damage to the maize kernels can be minimized. Threshing corn in the household or small industry is mostly done in the traditional way. It is labor-intensive, time-consuming and the production rate is low, making the traditional threshing method inefficient. Taking into account the above conditions, it is necessary to make efforts to change the way corn post-harvest handling becomes faster and more efficient. One method that can overcome the above problems is the need to design an appropriate technology machine that can increase the production rate and the selling price of the machine that can be affordable by the corn farming community. With the increase in the post-harvest production rate of corn, the income of corn farmers will certainly increase, so that it also has an impact on welfare

2. LITERATURE REVIEW

1.1 maize thresher machine

This literature review aims to provide an overview of previous research that is relevant to the development of corn thresher machine designers by increasing efficiency, productivity, and quality in the process of corn from the cob and to avoid damage, loss, and facilitate transportation and further processing.

2.2 Mechanical Design and Efficiency

Mechanical shelling is done by using a corn sheller machine. The advantage of using a machine is that the shelling capacity is greater than the manual method. However, if the operation is not correct and the moisture content of the corn is not appropriate, it will affect the viability of the seeds. Many corn sheller machines have been produced and are well known to the public, but many produce pipil corn for feed and food raw materials. Mechanical shelling is generally carried out by farmers in corn production centers, by renting the sheller machine.(Kahar et al., n.d.)

2.3 material selection

The frame functions as a holder of a tool. so that the frame is safe to use, a calculation must be made of the load that will be imposed on the frame. .(Prasetyo et al., 2020)

The process of selecting the frame material also affects the strength of the frame. The wrong calculation process and material will result in the frame not being able to withstand the existing load. existing corn thresher machines require a strong and sturdy frame. has a frame that is safe to use(BUDIPRASETYO.I8109008(1),n.d.)

Each material has its own characteristics that influence the selection for various applications. It is important to consider these factors, such as strength, durability, cost, and environmental impact, in exploring material options for construction or manufacturing,projects..(Umardani&RizalNurferdian,2009)

2.4. Maintenance

Good design can improve operator comfort and productivity, and can also reduce the risk of long-term injuries associated with non-ergonomic working positions. It's an important investment for well-being and efficiency in the work environment. (FitrahAdry&Zetli,2022)
The needs of employees at work will be driven by the need for a safe, comfortable and serene work environment in order to achieve maximum productivity..(FitrahAdryZetli,2022)

2.5.Performance Evaluation and Prototype Development

Based on previous research (Razak, Arthur halik Rasyid, syaharuddin sujaya, eko sibian bimantara mattalitti, ryo ayatullah atmojo, Ragil tri, 2021).
Concluded that good design can improve the operational efficiency of corn threshers, such as more efficient energy use and a faster and more accurate threshing process. For example, the design of mechanical systems with minimal friction or the use of components with precise tolerances can reduce wasted energy and improve power conversion efficiency.(Razaketal.,n.d.)

3. RESEARCH METHODS

This research aims to design and analyze the framework that will be applied to the corn erontok machine. The research method used includes several stages, namely data collection, design and calculation. The following are the detailed stages of the research method that will be carried out:

3.1 Tools and Materials

In this design the tools used are as follows :

1. Laptop Hp
   The laptop used is an Asus Laptop with the Asus M409DA series with an AMD Athlon Silver 3050U Processor and 12 GB of ram..
2. Software Solidworks 2022
   SolidWorks 2022 is a CAD (Computer-Aided Design) design software put forward by Dassault Systèmes SolidWorks Corporation. SolidWorks 2022 offers significant performance improvements, including more responsive loading times, more efficient response times, and smoother general performance. This allows users to work with more complex designs without experiencing performance degradation.

3.2.*Materials*

Gray cast iron, or often referred to as gray cast iron, is a type of cast iron that has unique characteristics in the form of graphite flakes in the material matrix. Here is a further explanation of gray cast iron: (Umardani & Rizal Nurferdian, 2009)

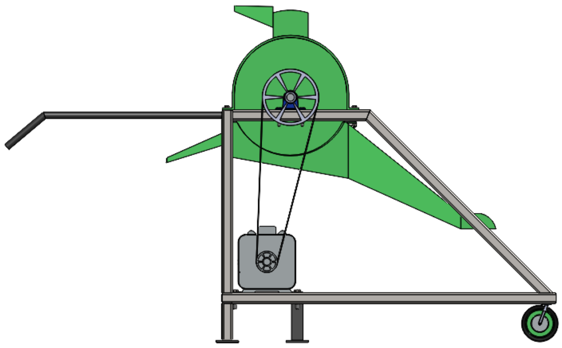
Composition: Gray cast iron generally contains about 2.5-4% carbon and 1-3% silicon, plus small amounts of sulfur, manganese, and phosphorus. Graphite flakes are scattered throughout the iron matrix.

Microstructure: The microstructure of gray cast iron consists of graphite flakes embedded in a matrix of ferrite and pearlite. These graphite flakes are what give it its distinctive gray color when it breaks

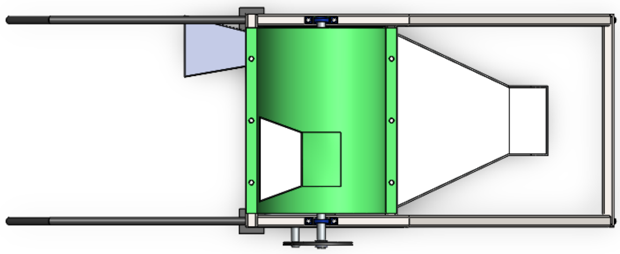
Property	*Grey iron*	*CGI*	*Ductile Iron*
Tensile strength (MPa)	*250*	*450*	*750*
Elastic Modulus (GPa)	*105*	*150*	*160*
Elongation (%)	*0*	*1.5*	*2.5*
Endurance Ratios			
- Rotating Bending	*0.35-0.50*	*0.45-0.50*	*0.45-0.50*
- Three Point Bending	*0.55-0.65*	*0.60-0.70*	*0.65-0.75*
- Tension Compression	*0.20-.030*	*0.25-.0.35*	*0.65-0.75*
Thermal Conductivity (W/m-K)	*48*	*38*	*32*

3.2 Design

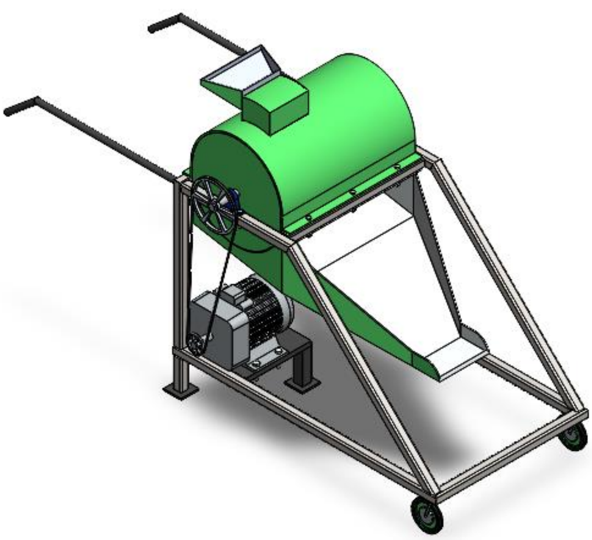
1. Front Viuw



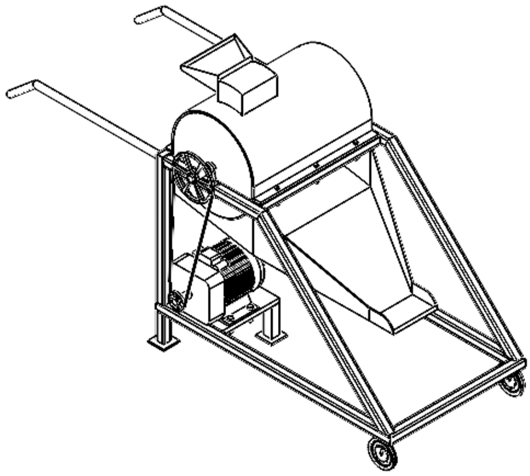
2. Top Viuw



3. Isometri Viuw



4. 3D Dimensions



3.5 Manual Calculation

According to (Lestari & Kurniawan, 2021), practical shrinkage (TP) and piping capacity are calculated based on the following formula:

$$TP\frac{BI-(B2+B3+B4)}{B2}$$

Description :
B1 : initial weight of corn
B2 : the weight of the flat corn inside the tarpaulin mat measuring 5 m x 5m
B3 : weight of the corn cob after shucking
B4 : weight of flakes produced during the flaking process

$$KP\frac{m}{t}$$

Description :
KP : pipetting capacity (kg/h) ;
m : input weight (kg)
t : pipetting time (h)

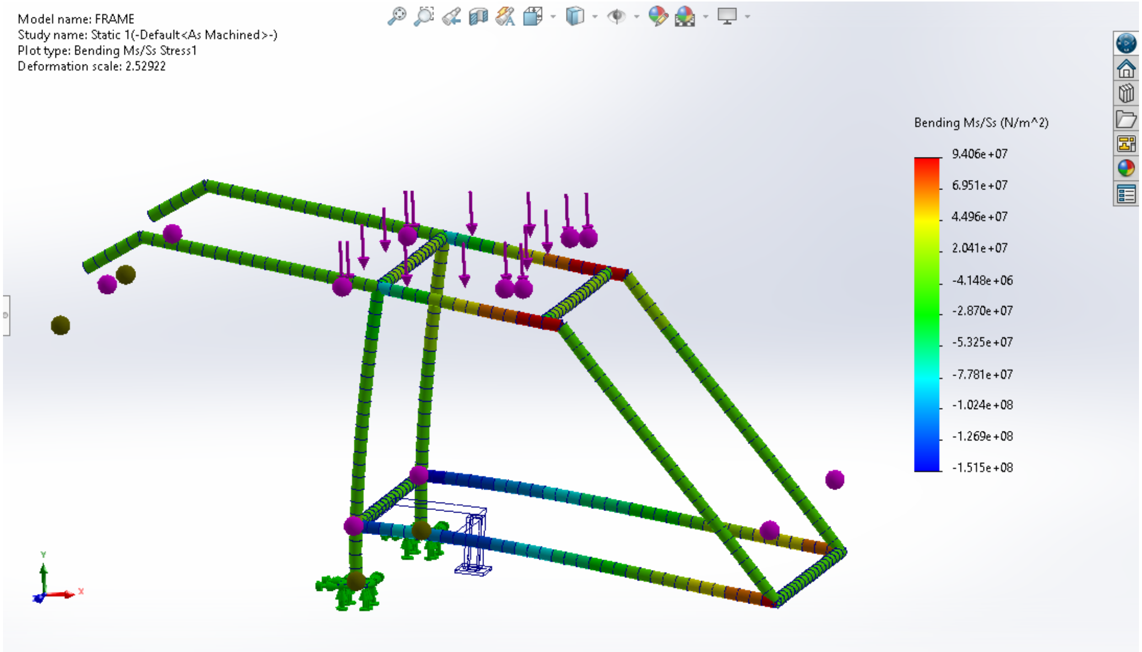
$$ST1 = T1/J \times 100\%; T2/J \times 100\%; ST3/J100\%$$
$$J = T + T1 + T2 + T3$$

ST1 : Scattered shrinkage 1 (%)
T1 : Scattered 1(%)
ST2 : shrinkage scattered 2 (%)
T2 : cattered shrinkage 2 (%)
ST3 : Scattered shrinkage 3 (%)
T3 : Scattered 3 (%)
T : Amount of corn shelled (%)
J : total number of corn kernels (%)

4. RESULTS AND DISCUSSION

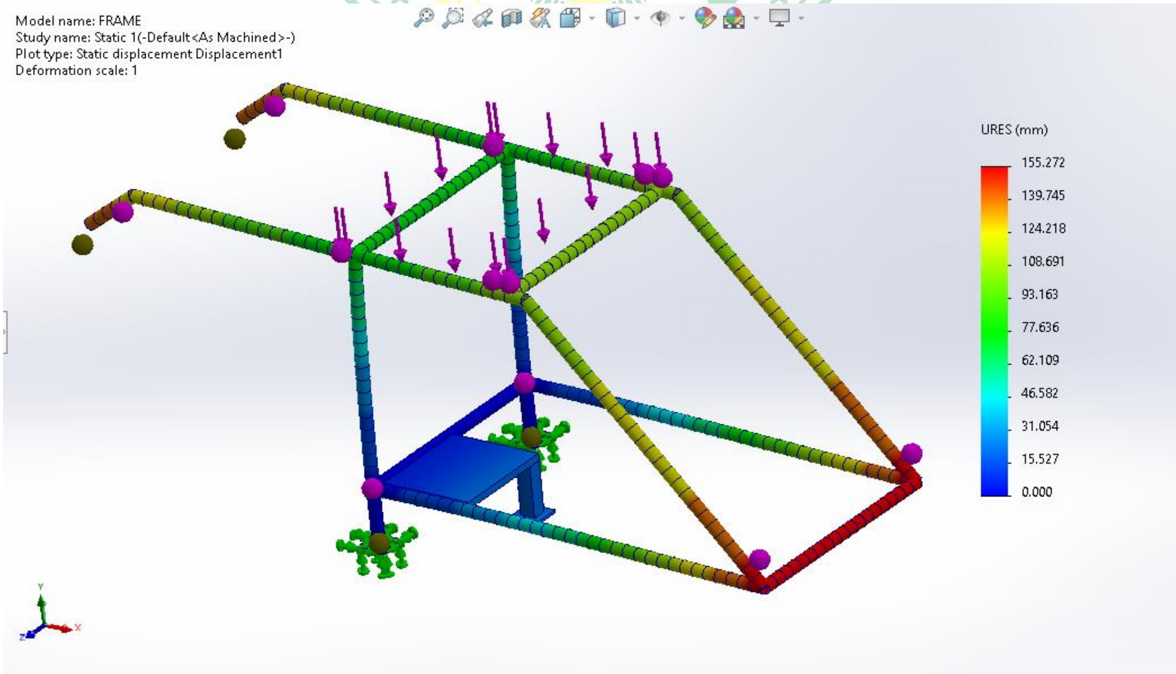
To analyze the corn thresher machine frame using the FEA (Finite Element Analysis) method, the results obtained in the study using FEA simulations on Solidworks 2022 software with the object analyzed by the Corn Thresher Machine Framework as follows:

4.1 Upper Bound Bending In Dir 1



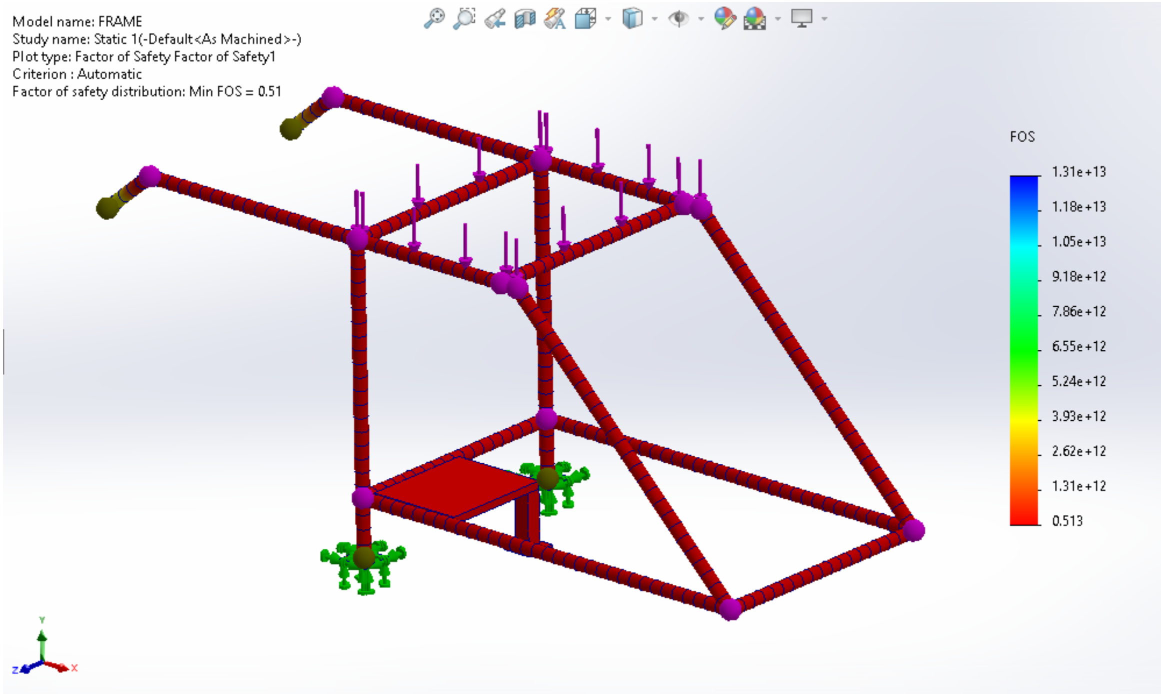
From the results of the stress analysis simulation by giving a loading of 10,000N (1000Kg) on the structure, the bending stress results were obtained. In the figure above, the largest von misses stress value is 940.6 N/mm2, while the smallest upper bound axial and bending stress value is 15.1 N/mm2.

4.2 Total deformation



Based on the figure above, the total deformation simulation results on the frame show that the largest displacement that occurs is 155.272 mm while the smallest displacement value is 15.527 mm.

4.3 Safety Factors



For the distribution of the minimum safety factor value that occurs in the frame of the corn thresher machine, it is shown in the figure above and the value obtained is 0.51.

CONCLUSION

This study successfully designed and analyzed a frame on a corn thresher machine using SolidWorks software. Structural analysis and kinematic simulations show that the designed corn thresher machine frame is able to withstand loads up to 10,000N (1000Kg). The frame can be said to be safe because the stress value does not exceed the yield strength value of the material.

Designing a corn thresher machine using SolidWorks proved to be effective in visualizing, analyzing, and optimizing the design before the fabrication stage. Proper material selection is also an important factor to improve strength, corrosion resistance, and minimize the total weight of the system..

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