

Design of a Peanut Skin Peeling Machine Design Based on Professional Autodesk Inventor Software

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ABSTRACT

In the nut processing industry, such as peanuts, the skin peeling process is an important stage to obtain a quality final product. Manual peeling can be a tiring and time-consuming job, so automating the peeling process using a machine is an efficient solution. The aim of designing a peanut shelling machine is to make it easier for peanut farmers to make the production process more efficient. The design stage of the peanut skin peeling machine design includes analysis of data requirements and obtaining a design that suits the farmer's capacity, design design using Autodesk Inventor Professional Software and design analysis of the peanut skin peeling machine design. The results of the analysis of the peanut shelling machine frame experienced a displacement of 0.00352 – 0.01758 and a safety factor of 15 sf, with stress of -0.886 Mpa to 0.437 Mpa which was experienced at a point below the yield stress of 1.088 Mpa so that the chassis construction was declared safe. to the static load received.

ABSTRAK

Pada industri pengolahan kacang seperti kacang tanah, proses pengupasan kulit merupakan tahap yang penting untuk memperoleh produk akhir yang berkualitas. Manual peeling dapat menjadi pekerjaan yang melelahkan dan memakan waktu, sehingga otomatisasi proses peeling dengan menggunakan mesin menjadi solusi yang efisien. Tujuan perancangan mesin pengupas kulit kacang tanah adalah untuk memudahkan petani kacang tanah dalam proses produksi agar lebih efisien. Tahap perancangan desain mesin pengupas kulit kacang tanah meliputi analisa kebutuhan data dan diperoleh rancang bangun yang sesuai kapasitas peternak, desain rancang bangun menggunakan Software Autodesk Inventor Profesional dan analisis desain rancang bangun mesin pengupas kulit kacang tanah. Hasil analisis rangka mesin pengupas kulit kacang tanah mengalami displacement sebesar 0,00352 – 0,01758 dan safety factor sebesar 15 sf, dengan stress sebesar -0,886 Mpa sampai 0,437 Mpa yang dialami berada pada titik dibawah tegangan luluh sebesar 1,088 Mpa sehingga konstruksi chasis nyatakan aman terhadap pembebanan statik yang diterima.

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INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are cultivated members of the Fabaceae family and are the second most important legume after soybeans. This plant has high economic value and is a tropical plant that grows to a height of between 30-50 cm. Peanuts have small leaves and are leguminous plants, which produce fruit that develops underground (under the ground) (Yang et al., 2020). Peanuts are an agribusiness commodity that has quite high economic value and are a source of protein in the food patterns of the Indonesian population (Bonku & Yu, 2019). The need for peanuts continues to increase from year to year in line with the increasing population, nutritional needs of the community, and the capacity of the feed and food industry in Indonesia (Ozias-Akins & Breiteneder, 2019). Domestic peanut production is not sufficient for Indonesia's needs, which still requires import subsidies from abroad, therefore the government continues to strive to increase production through intensification, expanding planting areas and using appropriate fertilizers (Rahmianna et al., 2020). Peanuts have high economic value and play a big role in meeting the need for nuts. Peanuts contain 25-30% protein, 40-50% fat, 12% carbohydrates and vitamin B1 (Asen et al., 2021). The benefits of peanuts in the industrial sector include making margarine, soap, cooking oil and so on (Toomer, 2020). Peanuts have many health benefits, including reducing the risk of cancer, preventing the formation of gallstones, improving heart health, reducing weight, reducing the risk of heart disease and stroke, reducing cholesterol, and improving bone health (Goncalves et al., 2023). In Indonesia, peanut farmers still have problems related to the peanut processing process. Most farmers immediately sell peanuts in whole form and have not thought about further processing so that the selling price increases and increases the income of peanut farmers. The process of peeling peanuts still uses human power for the peeling process, so it requires more time and energy. Therefore, a peanut peeling machine is needed so that peeling peanut shells is more effective and efficient (Ginting et al., 2019).

Technological advances that can help humans in designing and creating computer-based tools can make human performance more effective and efficient, one of which is the presence of Autodesk Inventor Professional Software. Autodesk Inventor Professional software is a CAD (computer aided design) program with solid three-dimensional modeling capabilities for the process of creating 3D prototype objects visually, simulating and drafting along with data documentation (Rahangmetan et al., 2019). An engineer can make a 2D sketch of a product, model it into 3D to continue with the process of making a visual prototype or even more complex, namely simulation. Measuring power voltage and loading can also be done with the help of an assembly stress analysis environment, apart from that, measurements can be made of the effectiveness, strength and durability of the product that has been designed (de Sousa et al., 2021). As a modeling program specifically for 3D modeling, Autodesk Inventor Professional Software has parametric solid modeling capabilities, namely the ability to design and edit in solid model form with data that has been stored in a data base (Zalilov et al., 2020). With this capability, engineers can revise or modify designs without having to redesign them in part or completely. The modeling stage using the Autodesk Inventor Professional Software program is divided into five parts, namely sketching, 3D modeling, assembling, presenting, and drafting. Each modeling stage has a different file extension, except that the 2D sketching process and 3D modeling of a part are combined in the same extension (Bolo, 2022). Therefore, it is necessary to make an effort to make a peanut shelling tool by relying on technological developments, namely making a design for a peanut shelling machine using Autodesk Inventor Professional Software to make things easier for peanut farmers.

RESEARCH METHODS

The method used in research is research and development (R&D). The research and development method is a research method used to produce certain products and test the effectiveness of these products. Researchers conduct research to collect the necessary data, then carry out product development and carry out testing and evaluation of the products made (Vrontis

& Christofi, 2019). The R&D method has stages that serve as a reference for its design, including designing an efficient chopping machine, namely by utilizing a motor and designing the chopping machine's frame based on Autodesk Inventor software.

The research stages are the steps in conducting research starting from identifying the problems contained in the research object, collecting data and continuing with creating a design using Autodesk Inventor software so that it can be implemented into a design or prototype and finally the conclusion of the research and design which is conducted (Habib et al., 2019). The force applied to the chopping machine knife area is 40 N and the force applied to the driving machine is 70 N.

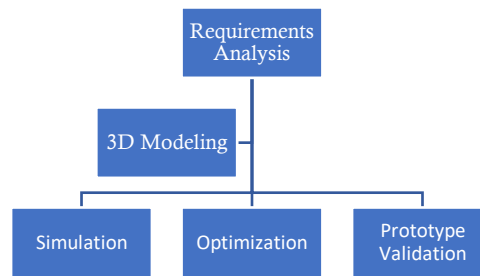


Figure 1. Research Flow

RESULTS AND DISCUSSION

Mesh View

Mesh functions to divide a geometry into small pieces called elements. The corners of each element are vertices and calculations are carried out at the nodes (connection points) so that these elements and vertices form (Naing et al., 2019). In this research, the frame structure of the peanut shelling machine was discretized (meshing) with a total of 7069 nodes and 3005 elements using a triangular mesh. In stress analysis simulations there are provisions for reading the simulation results displayed, namely with provisions for color variants, the color blue indicates the minimum value, while the colors green, yellow and orange indicate the color change from the minimum value to the maximum value, while the color red indicates the maximum value that occurs.

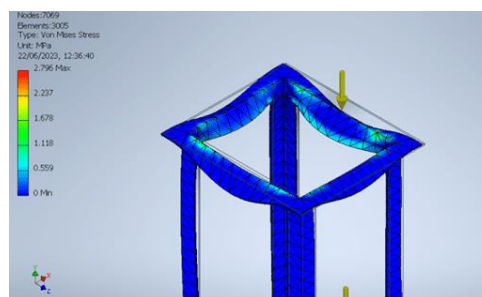


Figure 2. Mesh View of the Knife Support Section

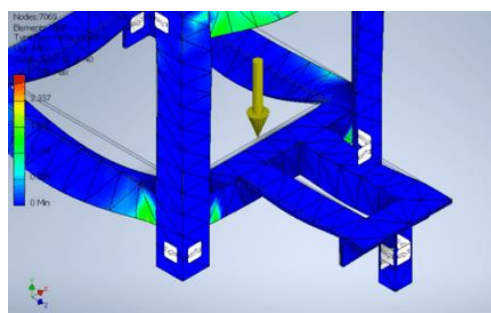


Figure 3. Mesh View of the Driving Machine section

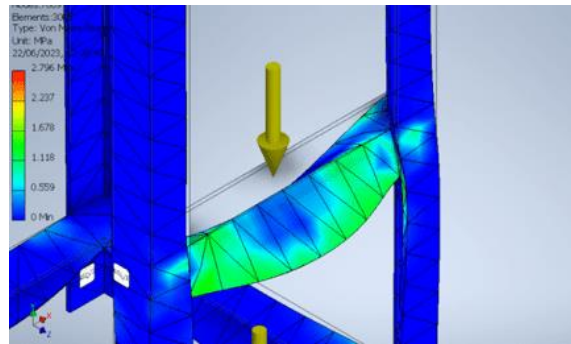


Figure 4. Mesh view of the fan

Stress

Stress or tension in the context of physics is a force that acts on a surface area of one unit. Voltage is a scalar quantity which has units of Pascal (Pa). Stress is a reaction that occurs throughout the specimen in order to withstand the applied load (Adeoye & Kayode, 2019). Stress analysis simulation where the stress analysis that occurs in the chassis construction, the inventor divides the analysis results into several fields, namely fields XX, XY, XZ, YY, YZ, ZZ. The results of this research which are used as a reference are only taken in the YY field. The simulation results show that the maximum stress that occurs in the peeling machine frame is -0.886 Mpa to 0.0437 Mpa, where the stress that occurs is in the YY plane in the chassis component which is the fulcrum for the peeling knife components and the driving machine. The stress that occurs is depicted in yellow in the part where the stress occurs.

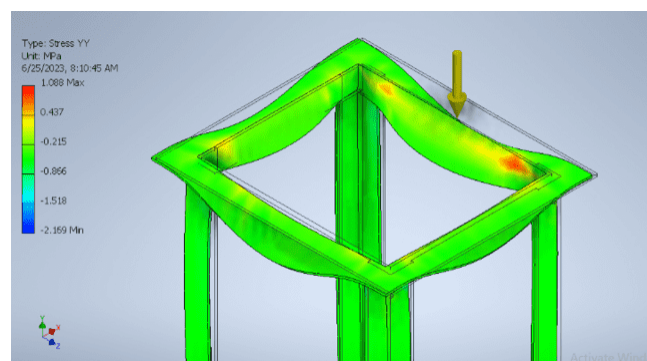


Figure 5. Analysis Results on Stress YY Knife Components

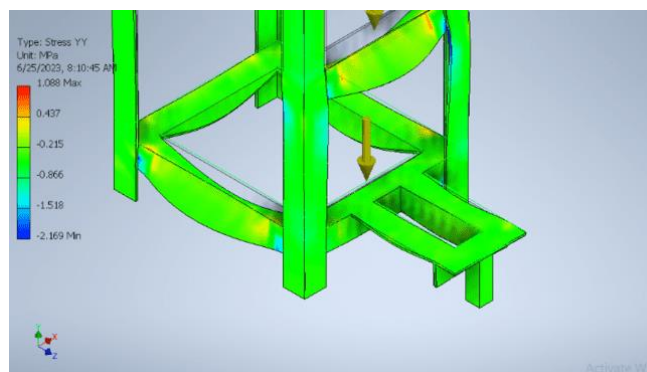


Figure 6. Analysis Results on Stress YY Driving Machine

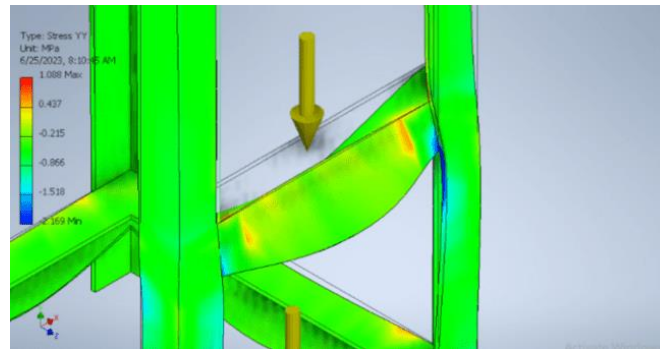


Figure 7. Analysis Results on Fan YY Stress

Strain

Strain is a relative change in size or shape of an object under stress. Strain can be defined as the increase in the length of an object relative to its initial length caused by an external force affecting the object. Strain is a measure of the relative change in size and shape of an object under stress (Lisiak-Myszke et al., 2020). Stress analysis simulation is used to analyze strains that occur in chassis construction. The inventor divides the readings into several fields, namely fields XX, XY, XZ, YY, YZ. In this research, the field that is used as a reference in determining the strain that occurs is the XX field. The strain value that occurs in the frame based on the results of stress analysis simulations carried out is 9.88×10 to 1.35×10^6 . The strains that occur in the chassis components which are the fulcrum of the blade components and the engine driving the strains that occur are depicted with a slight yellow color found in the parts where the strains occur.

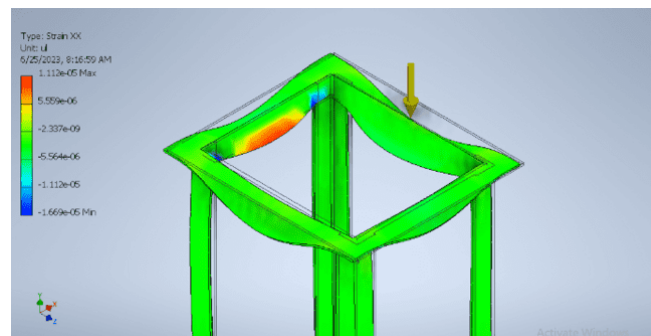


Figure 8. Strain Analysis Stress XX at the Knife Component Support

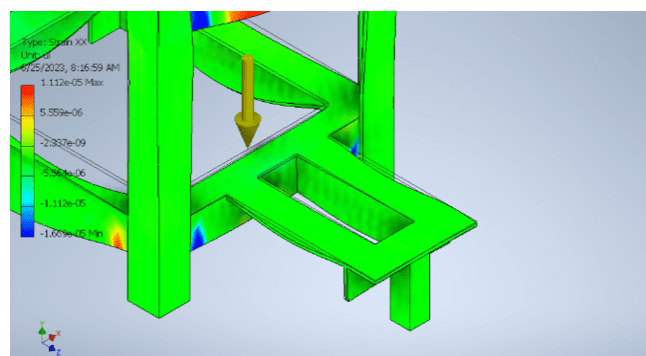


Figure 9. Strain Analysis Stress XX at the Drive Machine Support

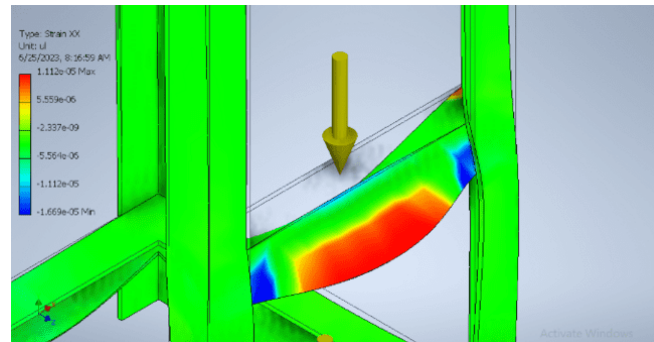


Figure 10. Strain Analysis Stress XX at Fan Support

Displacement

Displacement refers to a displacement vector that shows the amount of displacement or stress that occurs at each point in a structure. In the finite element method, the structure is divided into small elements, and the displacement is calculated for each of them. The displacement vector is used to describe the position of each point in the structure after being loaded (Mengolini et al., 2019). The results of the stress analysis simulation in Autodesk Inventor software show that displacement is described using the X axis, Y axis, Z axis. As a result of this analysis, the displacement value is taken on the X axis due to the depiction of the construction model using the X axis. displacement that occurs on the X axis with a maximum value of 0.00243 mm to 0.01217 mm on the up to 0.01407 mm and support on the fan component occurs at 0.00703 mm to 0.01055 mm where these results can be seen with the orientation of the colors and numbers listed in the application after the simulation process has been carried out.

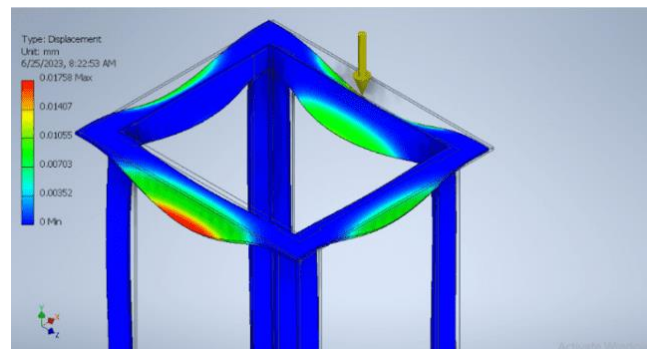


Figure 11. Results of Placement Analysis on Knife Component Supports

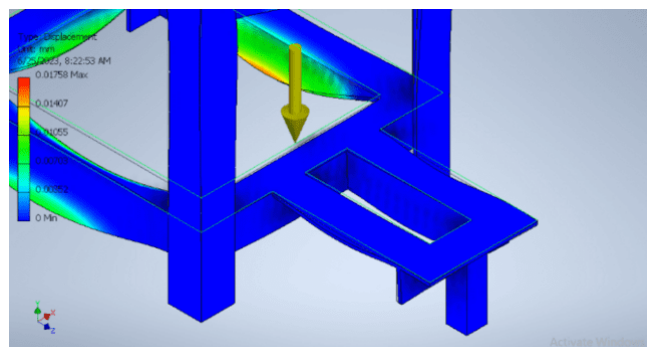


Figure 12. Results of Placement Analysis on Knife Component Supports

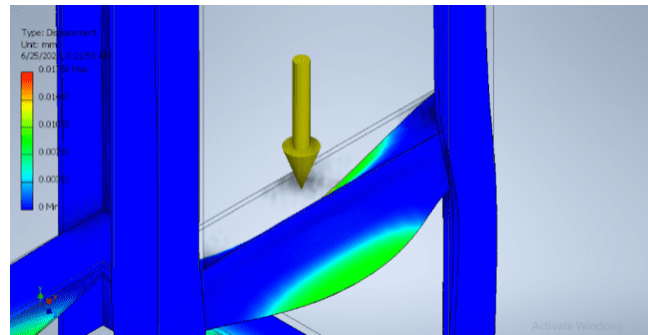


Figure 13. Results of Placement Analysis on Fan Component Supports

Safety Factor

Safety Factor in a frame refers to the factor used to determine the strength and safety of the frame when under load. This Safety Factor is used to ensure that the frame can control the given load without too much force being required to control the load. This safety factor is a factor that can reduce the risk of damage to the frame (Castaldo et al., 2019). The safety factor is calculated with reference to the quotient of the allowable stress divided by the stress that occurs. The results of the simulation carried out show that the safety factor that occurs in the peeling machine frame is 15 safety factors that occur in the angle iron supporting the peeling knife components and the angle iron in the supporting section of the driving machine. The simulation image caption shows the lowest value level for the safety factor shown in blue. The safety factor value that occurs in chassis construction made from angle iron material occupies the maximum value so it is said to be very good.

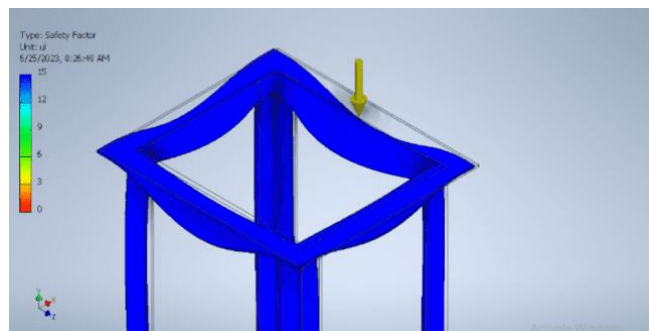


Figure 14. Results of Safety Factor Analysis on Peeling Knife Component Supports

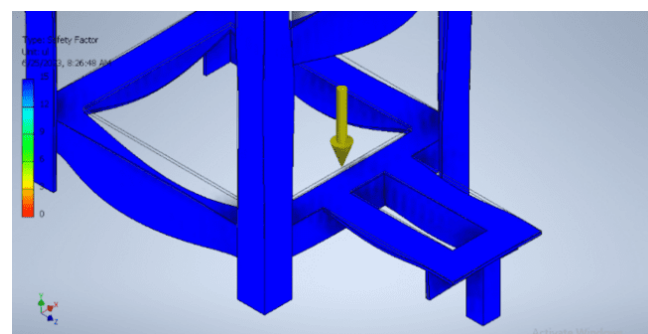


Figure 15. Results of Safety Factor Analysis on Driving Machine Supports

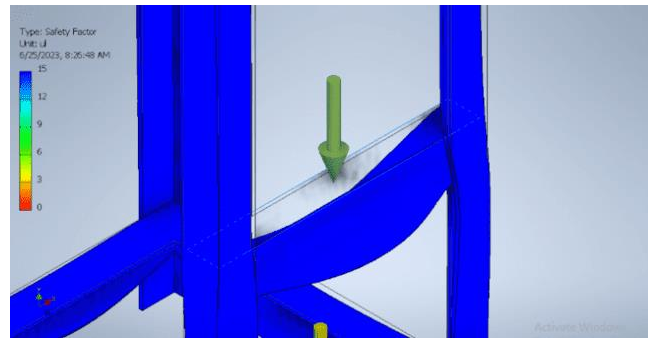


Figure 16. Results of Safety Factor Analysis on Fan Component Supports

Based on the stress analysis simulation data carried out on the peeling machine frame, it was found that the peeling machine frame experienced replacement and was in a good safety factor, with the stress experienced being at a point below the yield strength. So the frame construction using angle iron material with dimensions of 40x40x4 mm is still within safe limits for accepting static loads. The value is still within the safe threshold so the construction is safe, but this loading is a static load so the building only receives loads when it is at rest.

CONCLUSION

From the results of the discussion regarding the explanation of the peanut shelling machine, the author can conclude that the displacement of the X is in the middle bar of the frame which is the load support for the blade component, the support for the driving engine is 0.00352 mm to 0.01407 mm and the support for the fan component is 0.00703 mm to 0.01055mm. Meanwhile, the safety factor that occurs in the shredding machine frame is 15 safety factors that occur in the angle iron supporting the paring knife component, the angle iron supporting the driving machine and the angle iron supporting the fan component. The caption of the simulation image shows that the lowest value level for the safety factor is shown in blue so that the chassis construction is declared safe against the static loading received. The conclusion contains a summary of the results of the discussion and generalization of the results of the research carried out.

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