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Semi-Automatic Chapati Roller Machine

Khairulnizam Othman[1]*, Emir Danial[1], Ashraffi Adli[1]

[1]Department of Mechanical Engineering, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), Pagoh Education Hub, KM 1, Jalan Panchor, 84600 Panchor, Johor, MALAYSIA

*Corresponding Author Designation

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Abstract : Semi-automatic Chapati Roller Machine is the machine that gives a solution for the user to press the dough to be exact chapati thickness in a short time. Other machines in the market are industrial types which are heavy, complex, and high cost. This research is aimed at smaller industrial or home-based businesses which are just started into this industry to have a machine that makes their products faster and bigger with low-cost modal and maintenance. Along with the development of a small industrial market, these two classes either high or mid-class, the field on running the Chapati's market has already been in high demand. The Chapati Roller machine must be a long-lasting product and can mass-produce chapati in a short time. In Malaysia, this 4machine is not popular as in India because the small businesses still use the old traditional method. The problem is the supply cannot overtake the demands. Many small businesses in Chapati making are still using a traditional method such as using rolling pins. They just can make 200 to 400 pcs of chapatis per day. This phase cannot keep its demand. So, the solution is to build a low-cost semi-automatic Chapati roller machine. We study materials to realize why they carry on the way they do so we may utilize that information to settle on great designing choices in picking the correct materials for the work thus that we may, if important, search out techniques for making materials that will serve our requirements best.

Keywords: Chapati, Chapati Roller, Roller Machine

1. Introduction

Semi-automatic Chapati Roller Machine is the machine that gives a solution for the user to press the dough to be exact chapati thickness in a short time. Other machines in the market are industrial types which are heavy, complex, and high cost. This research is aims for smaller industrial or home-based businesses which is just started into this industry to have a machine that makes their products faster and bigger with low-cost modal and maintenance.

Indian cuisine in Malaysia is well-known to people as they become daily-basis food such as Roti Canai and Curry dishes. Chapatti is also are a portion of food that Malaysian People's favorite. In the

*Corresponding author: nizam@uthm.edu.my

local market, Chapati's making industrial is still building its market even though the demands keep rising. The problem is the supply cannot overtake the demands. Many small businesses in Chapati making are still using a traditional method such as using rolling pins. They just can make 200 to 400 pcs of chapatis per day. This phase cannot keep its demand. So, the solution is to build a low-cost semi-automatic Chapati roller machine.

To design an innovative Semi-Automatic Chapati Roller Machine. Along with the development of a small industrial market, these two classes either high or mid-class, the field on running the Chapati's market has already been in high demand. The Chapati Roller machine must be a long-lasting product and can mass-produce chapati in a short time. In Malaysia, this machine is not popular as in India because small businesses still use the old traditional method.

1.1 Design of Semi-Automatic Chapati Roller Machine by using AutoCAD software

AutoCAD is a computer-aided design (CAD) program that architects, engineers, and building professionals rely on to deliver detailed 2D and 3D drawings. For architecture, mechanical engineering, electrical design, and more, AutoCAD provides industry-specific features and intelligent objects. designing a semi-automatic Chapati Roller system to assist small businesses in mass-producing their products with low-cost machines. Animate the drawing by using Fusion CAD software to simulate the movement of the mechanism. Fusion Cad is computer-aided design software that animates the simulation for the drawings project. Use this software to examine the design using a variety of tests, including the Stress Test and the Safety Factor Stress.

1.2 Significant of The Study

Investigate materials to understand why they behave the way they do so that design can use that information to make good design decisions in selecting the right materials for the job and, if necessary, seek out techniques for making materials that will best serve our needs.

The problem that could occur in the event if skip the studies.

- Some parts of this machine will be broken due to the unsuitable product's material.
- This machine could not last long in near future.
- The production of the Semi-Automatic chapati roller machine could cost a lot and exceeded the targeted budget.

2. Materials and Methods

In this study, the materials and methods used to build and simulate each component are examined in order to construct a flawless Semi-Automatic Chapati Roller Machine.

2.1 Components Material and Design

Design analysis is the systematic phase of design creation, including all exploration, preparation, and communication of knowledge. In this project, analyzing the best design for each part is one of the most important steps.

The cover's function is to cover the chassis, motor, gear, and shaft. Aside from that, the purpose is to keep the user from accidentally touching the gear and shaft. As a precaution, the designs [1], [2], and [3] have been taken into account. The cover (as in **Figure 1**) is made from stainless steel. We use stainless steel because stainless steel is stainless. Our machine water and flour.

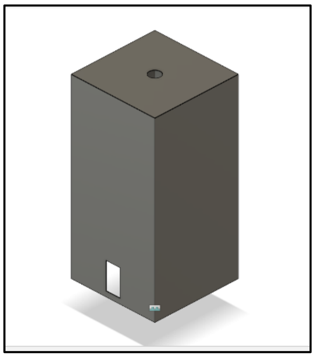

Figure 1: The Cover

Chassis (as in **Figure 2**) is where we put motor, gear, and shaft. Chassis is made from carbon steel because mild steel is strong and lightweight. Chassis is part we put heavy components. So, we must use strong steel but at the same time, it is lightweight.

Figure 2: The Chassis

An electric motor (as in **Figure 3**) is a mechanism that converts electrical energy into mechanical energy. Many electric motors create power in the form of torque imparted to the shaft of the motor by interacting between the magnetic field of the motor and the electrical current in a wire winding. We are spinning the gear and shaft with an electric motor.

Figure 3: Electric Motor

The role of the shaft (as in **Figure 4**) is to collect energy from the gear and rotate the plate while the plate is where the chapatti is placed. This is due to the fact that chapati is spherical. This cerate diameter of the plate is 8cm. So, the result of chapati will be like the original chapati. Our plate is made of stainless steel, which was chosen for its durability.

Figure 4: Plate and Shaft

This mechanism is designed to give pressure to the roller (as in **Figure 5**) to give form and to make the chapati thin in an even field. This component is made of mild steel. High carbon steel properties include extremely high strength, extreme hardness and wear resistance, and mild ductility, an indicator of the material's ability to withstand deformation without cracking.

Figure 5: Pressure Roller Mechanism

A roller is to give pressure to the dough and the dough will be shaped like a plate's shape as in **Figure 6**. Moreover, the roller will make the dough thickness the same and even around the area. The roller is made from stainless steel.

Figure 6: The Roller

Spring is split into two parts. First, it functions as a mechanism to return the roller to its original position. Second, provide the proper location for the rollers to press the dough by achieving the desired thickness.

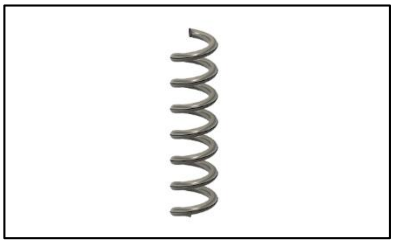

Figure 7: The Spring

2.2 Methods

This chapter presents the methodology, flowchart, mechanical parts, the operation of the device, bill of material, component, and design software. The project is deriving by combining the several aspects contained in mechanical engineering such as material selection, material engineering, engineering design and mostly manufacturing process. To help more in setting up this final year project, the rules that are applied in making this prototype are cutting, designing, and drilling, to meet the desired characteristic of the project, the material that is used for this project is measured of material and by comparing to others material. To operate producing the product, a various process needs to be done according to the proper procedure to ensure that the process does not have any problem.

2.2.1 Flowchart of Methodology

The flowchart is a graphic image of the flow for the project method. It is used to show the steps from start to end about the methods etc. It is not in detail and does not have an exact timeline on the activities and is just a simple guideline.

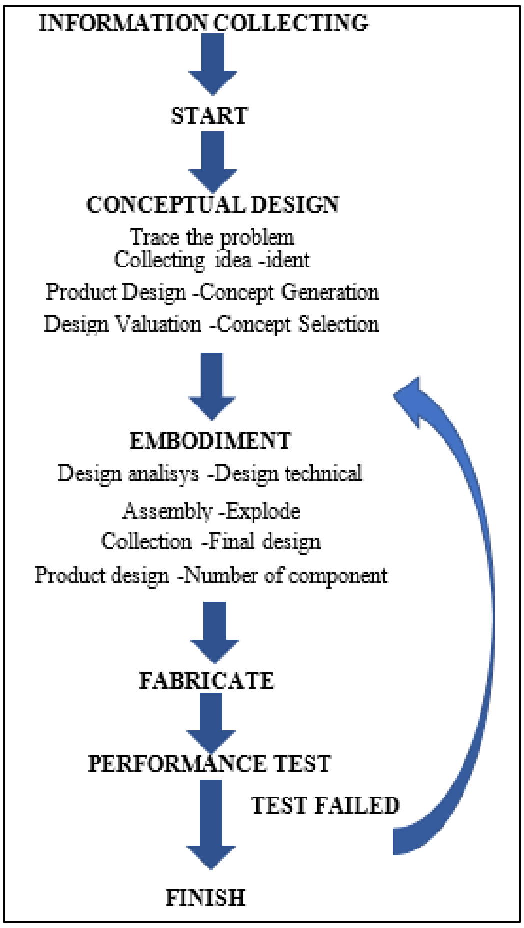

Figure 8: Flowchart

Based on this project, this chapati roller machine must have:

- The dough can be pressed.
- The targeted number of chapati that can be pressed in one hour is 400 pcs.
- The tray can rotate perfectly.
- The arm of the roller can function well.
- Rust-resistant

2.3 Equations Yield Stress

This connection is only valid in areas where Hooke's Law applies. According to Hooke's Law, the strength of the recovery in an elastic material is proportional to the distance the material is stretched. The limit of the elastic range is marked by the resultant tension, which is the point at which plastic deformation occurs. Use this equation to calculate the yield pressure.

$$\sigma = E \times \epsilon \qquad \textbf{Eq. 1}$$

The balancing approach applies to stresses that occur along a single axis, but some applications need a formula that can manage two axes. Use von Mises criteria to solve this problem:

$$(\sigma_1 - \sigma_2)^2 + \sigma_1 + \sigma_2 = 2\sigma(y) \qquad \textbf{Eq. 2}$$

Safety is critical while developing an engineering product or component. To guarantee the safety of such things, each component is built to withstand a load that is greater than the actual working load. As a result, there will always be a little margin or bearing in comparison to its operating capabilities. This may be achieved at the design stage by considering the necessary safety elements. The safety factor is defined as the ratio of a component material's principal stress to its working pressure. This denotes the component's increased strength over and above the necessary strength.

3. Result and Discussion

3.1 Result for Material Selection for the Chassis

This project was analyzed completely in terms of selecting the best material for the machine chassis. Two suitable materials met the requirement for this part and that is stainless steel 304 as referring to **Table 1** and mild steel as referring to **Table 2**. But this project needs to use only one material. The material selected must have an outstanding mechanical property. Below is the table for each material selected and its comparison.

Table 1: Shows the mechanical properties of Stainless Steel 304

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (MPa) min	Elongation (% in 50mm) min	Hardness	
				Rockwell B (HR B) max	Brinell (HB) max
304	515	205	40	92	201
304L	485	170	40	92	201
304H	515	205	40	92	201
304H also has a requirement for a grain size of ASTM No 7 or coarser.					

In summary, the mechanical properties of stainless steel are shown in the **Table 2** of mild steel is the tensile strength of 440 MPa (min), a hardness of 71 HRB Rockwell B and 126 HB Brinell. Therefore, it is clearly stated that mild steel is the most suitable material for the engine chassis due to its sufficient high tensile strength and hardness. The chassis must be stiff for the electric motor to be mounted. If the material selected is brittle and fragile, the possibility for an engine to collapse is high. Meanwhile, mild steel also is cheaper than stainless steel.

Table 2: The mechanical properties of Mild Steel

Mechanical Properties	Metric	Imperial
Hardness, Brinell	126	126
Hardness, Knoop (Converted from Brinell hardness)	145	145
Hardness, Rockwell B (Converted from Brinell hardness)	71	71
Hardness, Vickers (Converted from Brinell hardness)	131	131
Tensile Strength, Ultimate	440 MPa	63800 psi
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)	15.0 %	15.0 %
Reduction of Area	40.0 %	40.0 %
Modulus of Elasticity (Typical for steel)	205 GPa	29700 ksi
Bulk Modulus (Typical for steel)	140 GPa	20300 ksi
Poissons Ratio (Typical For Steel)	0.290	0.290
Machinability (Based on AISI 1212 steel. as 100% machinability)	70 %	70 %
Shear Modulus (Typical for steel)	80.0 GPa	11600 ksi

3.2 Component Simulation

Simulations are applied to our important parts for searching for any weakness in our design. Several simulations such as safety factor test and stress test. are applied using Autodesk Fusion CAD software to several important parts.

3.2.1 Chassis

The design of this chassis is simple but strongly structural for this project. The chassis has run several tests to prove its design is strong. The tests that we run are the stress test and safety factor test.

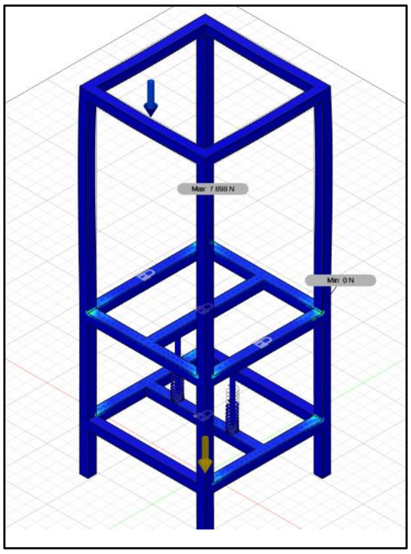

Figure 9: Stress Test

Table 3: Stress Test Result

	Stress Test	
	Min	Max
Von Mises	1.257E-05 MPa	1.524 Mpa
1st Principal	-0.3462 Mpa	1.226 Mpa
3rd Principal	-1.523 Mpa	0.1121 Mpa
Normal XX	-0.5458 Mpa	0.5445 Mpa

The value of load forces that we use is 50N for the chassis that directly forcing from the top to bottom of the chassis. This will simulate the force from the pressure roller, electric motor, and gravity. The stress test applied for the chassis can be shown in **Figure 9**. Based on the stress test result shown in **Table 3**, the maximum pressure this chassis can handle is 1.524 Mpa which is a proved these chassis are strong.

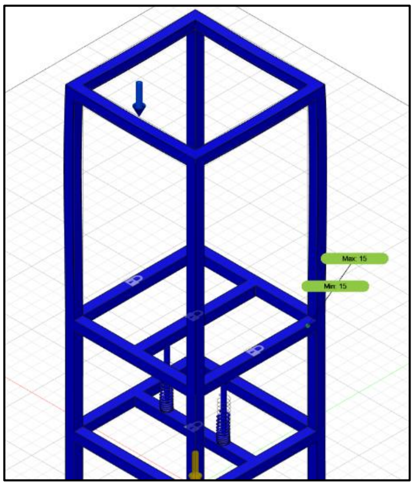

Figure 10: The Safety Factor Test

Table 4: Safety Factor Test Result

Safety Factor		
Safety Factor (Per Body)	15	15

The Safety Factor test is essential for evaluating the safety points in this chassis design. **Table 4** displays the results of the test once it has been completed, as illustrated in **Figure 10**. The outcome indicates that the safety factor for this chassis is 15. Finally, this chassis is suitable for usage in a real product.

3.2.2 The Roller Arm Mechanism

The design of this roller arm mechanism is simple but it has many moving connection points that can cause several weak points. For instance, both tests are applied to the design. A roller arm is, in essence, a type of lever [4]. By sandwiching the rocker arm between them, the same effect as increasing the height of the ridge can be obtained as opposed to the cam ridge pushing down the valve directly. It is also possible to obtain a reduction effect. To reduce mechanical loss, many designs in recent years have used a roller as the contact part and contact it as a rolling bearing [5]. Since it is a lever, it can be divided into a swing arm type and a seesaw type according to the positional relationship of the fulcrum/force point/action point. The former has a layout of "fulcrum/force point/action point" and corresponds to the second type lever. When applied to an engine, a lash adjuster is placed at the fulcrum, and the point of the effort is to receive input from the cam ridge with the roller in the middle part, and the point of action is to drive the valve at the end [6]. This is the majority of the arms.

Rotary indexing tables are widely used in automated assembly machinery, and choosing the right mechanism is critical for both optimising performance and lowering the cost of this critical component [7]. This how-to will look at two common devices that may be used for rotary indexing and provide advise on how to choose the right one. Cam indexing drives and motor rotary tables are three leading types of equipment. Cam indexers are a typical device used in rotary tables for many decades. They are an excellent choice for applications that demand high-precision positioning at a low cost and always index at the same angle.

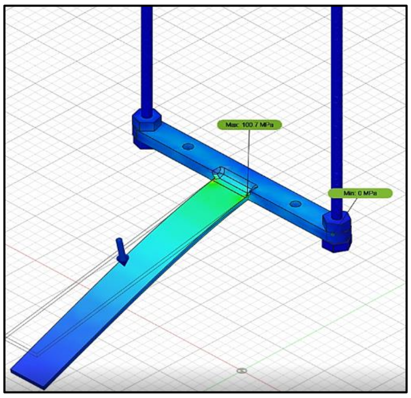

Figure 11: Stress Test

Table 5: The Stress Test Result

	Stress Test	
	Min	Max
Von Mises	0 MPa	116.1 MPa
1st Principal	-7.921 MPa	136.9 MPa
3rd Principal	-83.82 MPa	21.04 MPa
Normal XX	-33.17 MPa	40.23 MPa
Normal YY	-65.43 MPa	115.6 MPa
Normal ZZ	-31.1 MPa	44.03 MPa

The stress test, as shown in **Figure 11**, reveals that the foot stepper is more important than the other parts when subjected to 50N of force loads from the top to the bottom. The results of the stress test are shown in **Table 5**, where it is stated that the highest pressure point value is at 116.1 Mpa, which is located at the connection point between the foot stepper and the arm.

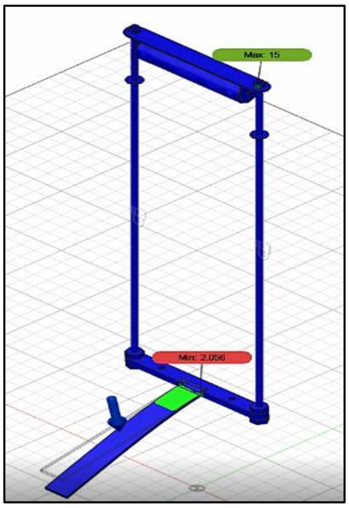

Figure 12: The Safety Factor Test

Table 6: Safety Factor Test Result

Safety Factor		
Safety Factor (Per Body)	1.783	15

The results of the safety factor tests are similar to the results of the stress test. As illustrated in **Figure 12**, the connection between the foot stepper and the roller's arm is more important than the other parts. **Table 6** results, for example, show that the crucial part safety factor is 1.783. This demonstrates the need for the foot stepper to be redesigned for safety precautions and durability in the final product.

3.2.3 Plate shaft

Plate shafts are the important parts that transmit kinetic power to the plate from the electric motor. To simulate the force during operation, stress tests are applied with rotational force load as the shaft spins with pressure on it [8].

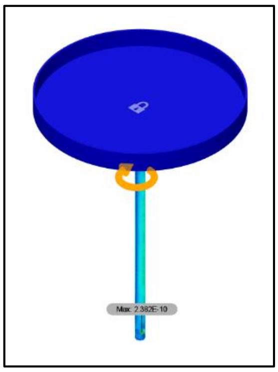

Figure 13: Stress Test

Table 7: The Stress Test Result

	Stress Test Min	Max
Von Mises	0 MPa	1.253E-04 MPa
Normal XX	-5.663E-05 MPa	5.409E-05 MPa
Normal YY	-6.906E-05 MPa	6.927E-05 MPa
Normal ZZ	-4.389E-05 MPa	5.593E-05 MPa
Shear XY	-6.102E-05 MPa	2.602E-05 MPa
Shear YZ	-1.616E-05 MPa	1.553E-05 MPa
Shear ZX	-2.491E-05 MPa	1.877E-05 MPa

The stress test that was applied to the plate shaft design, as shown in **Figure 13,** gave the results as shown in **Table 7.** According to the results, the plate shaft design is extremely strong and adequate for the Chapati Roller machine. The maximum value of pressure is 1.253 MPa while the minimum pressure is 0 MPa.

4. Conclusion

In a nutshell, each project has its own goal and focus. This proposal for a semiautomatic chapati roller machine is no exception. Even if there are several limitations [9] in terms of fabrication and designing, the goal is still accomplished. Based on the findings and discussion, it is evident that the experiments conducted were all successful. Aside from that, the development of semi-automatic chapati roller machines is weak in Malaysia, and most chapati machine enthusiasts do not attempt to create their own. The main goal of this project is to combine all the information gathered and, eventually, to create a simulation of a prototype semiautomatic chapati roller machine. This simulation is based on the prototype that we have designed.

After analyzing every part of the product, this project is considered a success. Below are some suggestions for further research related to the prototype of the Semi-Automatic Chapati Roller Machine. The design should have a safe design such as a smooth and curve edge. Foot stepper mechanism also must be improved to make it more durable against heavy force.

Acknowledgement

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