

# Design and Development of Dry Coconut Cutting Machine.

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**Abstract** - The purpose of the project is to design a machine that will split coconuts into 2 equal halves. The machine will consist of a feed mechanism which will feed the coconuts to the cutting chamber. The cutting chamber will consist of a cutting wheel that will cut the coconut. The cutting wheel will be driven by a prime mover (mostly an electric motor). The coconuts will be first fed in from a bucket/hopper to the chamber where the complete process thereafter will be automated. The main aim after the design and development of such a machine is to automate the process of coconut splitting wherein the process will be time saving, include less efforts and will help prevent any probable accidents.

**Key Words:** Feed Mechanism, Automated, Development, Prime Mover, Less Efforts

## 1. INTRODUCTION

Coconut production play a very important role within the financial set-up of Bharat. Coconuts are known for its skillfulness as seen in several uses of its totally different components. It additionally has cultural and religious significance in several societies. Coconut meat is that the dried meat or kernel of the coconut. Traditionally coconut shell is operated manually to urge coconut meat out. However it consumes longer and additional exercise of employees, therefore the main objective is to cut back time consumption and exercise by introducing a machine to interrupt coconut shell. It ought to be to operate with less wastage of coconut meat. This machine is scale back the accidents which will happen during deshelling manually. Coconut de-husking and de-shelling being exhausted villages so it must not be of electrical power consumption sort. To lower down the accidents which occur during the operation of ongoing machines in market as well as making availability of machines easy with low transportation costs and low maintenance costs.

### 1.2 Design Methodology :

Dry coconut with ovoid shape with length of 210-270 mm, Diameter of 160-206 mm, Weight of 0.62-125 kg, Shell diameter 80-120 mm, thickness is 62 at pedicel end, thickness is 34mm at apex end, thickness is 32 mm from 1/4<sup>th</sup> distance from pedicel end, thickness is 24 mm from half distance from pedicel end and thickness is 28 mm from 3/4<sup>th</sup> distance from pedicel end. The methodology to design of coconut shearing machine based on the quality function deployment (QFD) method, which the basis for determining the parameters needed to design accordance with the coconut farmer's community needs. Figure illustrated the

methodology flowchart for the intended process to do survey collection of the data and development of House Of Quality (HOQ) for shearing machine design. The survey design for capturing the coconut farmer's community requirements was consisted of identify population and sample, choose survey method, design questionnaire and carry out survey.

### 1.2 Manufacturing Methodology:

The development process of the House of Quality (HOQ) consisted of several processes, such as by distributing questionnaires to coconut farmer's community who serve as the respondents. Then, collecting and analyzing of data, subsequence that was performed the validity and reliability tests of the results of obtained questionnaires. The results of validity and reliability tests were incorporated into the matrix of the House Of Quality to obtain the required attributes for design of coconut de-husking machine based method of the Quality Function Deployment (QFD). The development processing of the matrix of the House Of Quality. The materials and components selection of the coconut shearing machine were as following: Steel plate, L profile of steel for the machine frame, Cutting blade, Connecting shaft for transmission, Connecting shaft as the gear sprocket, Selection of bearing, Selection of gear, Selection of motor, Selection of reducer, Selection of coupling. The design result of priority ranking of the HOQ was determined by the highest value to lowest value of coconut farmer's requirements. The highest value of ranking would be a top priority in the design of coconut de-husking machine. Accordance the ranking result of the design of coconut de-husking machine was awarded by ergonomic design became the main priorities, followed by the dimensions of the machine, the materials and selection of components machine. The ergonomic design of coconut de-husking machine was required a safety and comfortable to use, easy to operate or user friendly, a quicker in process and portable product (easy to carry or moveable). Selection of proper specified component for coconut de-husking machine. There are various components used in the coconut de-husking machine. Such as gears, shafts, bearings, frame, drum, spikes, motor, cutter, metal sheet and hopper. Different factors are to be considered while selecting the components of machine, viz., material properties, factor of safety, speed, torque, different types of loads, capacity to sustain the load. For designing the gear, the factors are to be considered such as speed reduction ratio, module, diameter, number of teeth, etc. Various loads are acting on the shaft, so by considering these loads shafts and bearings to be

selected. For proper mounting of bearing, the pedestal bearing is preferred. Motor is selected on the basis of speed, torque, load, capacity and working hours. On the basis of material to be used spikes are designed and the number of spikes considered according to drum length. The coconut de-shelling machine was developed based on the following consideration: The availability of materials locally to reduce cost of production and maintenance of the machine. The de-shelling rod was Introduced in between and near to disc cutter without touching the disc cutter and smoothly conducts the operation. It is desired that the coconut fruits should be well de-shelled without nut breakage and also that cobra extracted should not be distorted, thus pulleys were carefully designed/selected to meet the required synchronized speeds of the de-shelling.

**2. Design Methodology:**

The frame structure was decided to be a box frame using L angle bars. Design process was validated by support of CAE Results. The Frame was created in a CAD software SOLIDWORKS and constraints were applied in order to produce the results.

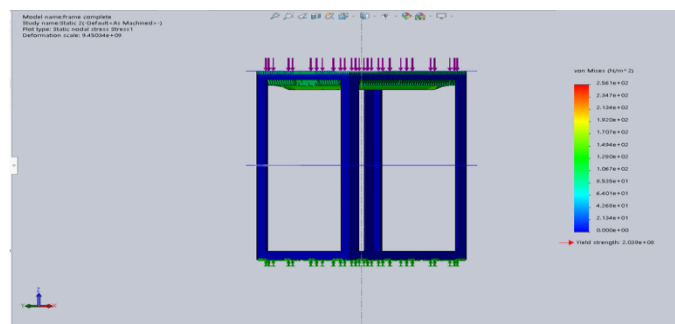


Figure-1: Stresses induced in frame

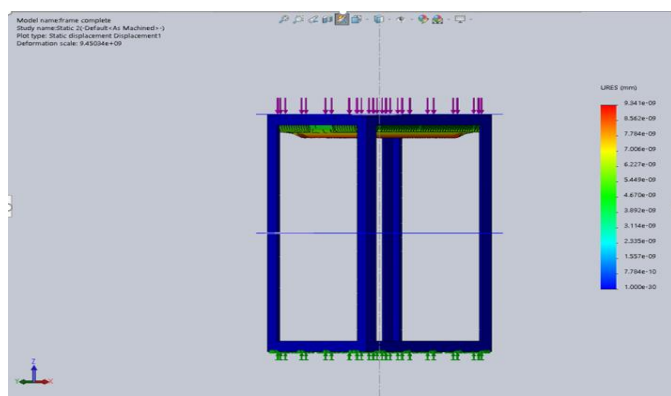


Figure-2: Deformation in frame

**2.1 Selection of the Cutter by calculating the cutting force for Coconut :**

¼th of blade thickness, Thickness of the coconut shell considered to be 8 to 10 mm. Considering Factor of Safety to be 2.

$$F = 18.606 \text{ kN}$$

Optimum force required to break the coconut

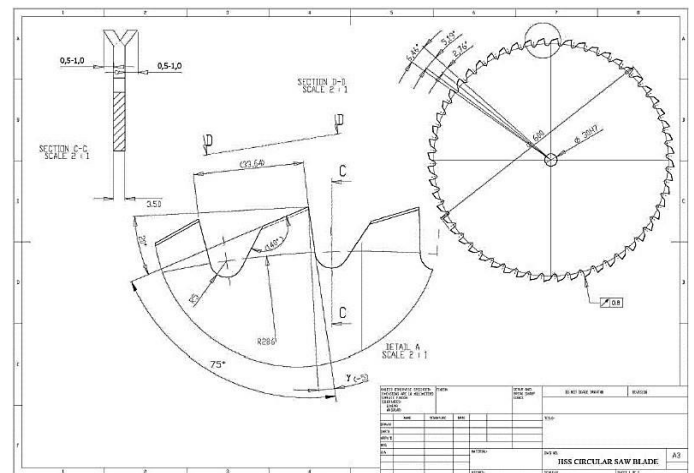


Figure 3: Drawing Sheet of HSS Circular Saw blade for 12' diameter

**2.2 Selection of the Bearing from selection of shaft:**

Since the shaft diameter is calculated and obtained as 35mm and the load acting is only radial the decision is made to use Deep Groove Ball Bearing (DGGB).

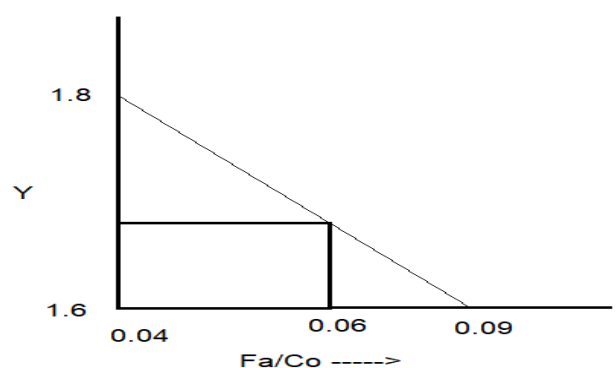


Figure-4: Graph of Loading factor vs ThrusFactor

**2.3 Gearbox Specification:**

Product Description-Premium Transmission Ltd-"ALM Series" Altra Worm Gearbox Ratio range from 5:1 up to 1600:1

Range: Power range from 0.06 kW up to 7.5 kW.

Sizes: Centre distance from 30mm to 130 mm

Type Worm: available in foot and flange mounted versions

Applications: Conveyors, Packing, Loading, and Automation

Key Features: Robust construction, High efficiency, Hardened steel alloy used. The cost of project on the basis of research was estimated to be around 30,000 to 35,000 INR. Many different models were studied providing alternatives which has the points like performance, maintenance, aesthetic and cost effectiveness. Machines available in the market have additional features which increase the cost to around 50 thousand to 60 thousand rupees.

### 3. CONCLUSIONS

Operation of machine requires 250v ac 60hz. In this working of machine on feed wheel the coconuts are loaded as per requirement. Considerable low rpm of the feed wheel gives time to the operator to take time while loading and also the cutting of the outer shell of coconut also occurs with the smoothness however, the rpm if the feed wheel are reduced with the help of the gear reducer mechanism hence after complete cutting of the coconut two equal parts fall apart and the remaining coconut water is collected for external uses without any impurities. The entire structure of the frame is so made to sustain the vibrations occurred during the operation. The developed model is easy, efficient, needs less time and price effective compared to the present on the market model. Importance is given towards user friendly operational and principally safety. The primary objective of being able to cut coconut in a much safer and a hassle free way is achieved. Other objectives like the aesthetic and accessories like water collection unit are to be worked upon yet. By examination with many varieties of existing ways, includes traditional, and automatic, it will be complete that this machine need less human effort and therefore the check results substantiate the above. The rotating parts like belt, block and gears area unit provided with safety cowl. The general performance of coconut braking machine is satisfactory by braking coconut effectively and economically.

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