DESIGN AND FABRICATION OF ARECA BUNCH SEPARATOR

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Abstract: The people in rural areas of south India like Karnataka and Kerala mainly depend on agriculture for their livelihood. The main crops grown are Areca nut and coconut. Agriculture is now one of the most important sectors in the Indian economy. Labor Problems in every sector is leading to mechanization of processes. Agricultural sector is also facing such problem due to which most of the farmers tend to give up the practice. Areca nut cultivation is a long process involving harvesting, separating the fruitsfrom bunches, moving the areca nut to ground, drying, de-husking, separating, bagging. Several machines are being developed to help farmers to aid the mentioned processes. "In manual process lifting the bunch of arecas and beating each areca bunch on a solid surface several times and collection of stripped Arecanut from ground level is usually performed which leads to high demands of energy expenditure and develops high work stress and risk in the majority of the Arecanut plantation workers. Areca nut Separating from the bunch is one among them. This paper explains regarding reduction of labour efforts and ease of Arecanuts for further process from the separation.

Key words: *Areca bunch separator, Rotary blades,*

I. INTRODUCTION

Areca nut is an important commercial crop in India. An Areca nut is the seed of the Areca nut palm. It plays a prominent role in the social, cultural functions, religious and economic life of people in India. The income produce is the fruit called "betel nut" and is used mainly for masticatory purposes. Areca Nut more commonly known as Betel Nut is a very important commercial crop in India. It is commercially available in dried, cured, and fresh forms. It takes approximately five years for an area nut palm to mature and bear fruit. Each areca palm is harvested once a year up to fifty years. The cultivation of Arecanut can be traced back to Vedic periods. Arecanut was even used in Ayurvedic and Ethane veterinary medicines. [1][2]

Areca dehusking machine is made major role in this cultivation. But still there is no machinery for separating the areca from the bunch. The machine is intended to separate areca nuts from bunch, after segregating it only feed the nuts to dehusking machine for remove the over covering the areca. The machine is operated by single person so that farmer himself can use it.

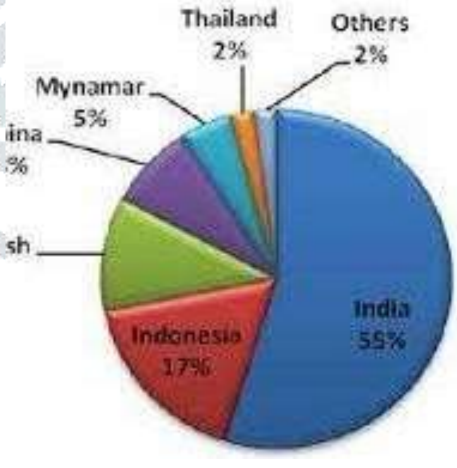

Figure.1 World Scenario of Arecanut.

. The above Fig 1Areca Nut production is the largest in India according to FAO statistics.According to this in 2019, Indian production of Areca Nut counts for 55% of the total world production. In India, Karnataka has the highest production percentage of 62.69%.[3]

1.1 PROBLAM DEFINATION

The removing of husk from areca nut is the concentrated process for the labors. In most of thevillages the ladies and children are working for segregating the areca nut. By hand it is very difficult to peel the areca nut. They use Solid Material for beating the Bunches for segregating.By this method, the production rate is low and time consumption is more. The production rateis 500kg/hr. being done through manually.[4]

Figure.2 Segregating Areca by manual process.

And normally one will do about 5000 kg in a day. This work is done by skilled rate is 500kg/hr.being done through manually as shown in Figure.2. And normally one will do about 5000kg in a day. This work is done by skilled rate is 3kg/hr [5]. being done through manually. And normallyone will do about 5000 kg in a day. This work is done by skilled season. It is necessary to develop a machine which is upgrade the rate of production. Now a day's there are more varietytypes of machines are available in the market. These existing machines are more costly and arecomplex in design. The main problem is that they are heavy and not portable. Some machinesmay cause damage to the Areca nut and not easy to operate. "In manual process lifting the bunch of arecas and beating each areca bunch on a solid surface several times and collection of stripped Arecanut from ground level is usually performed which leads to high demands of energy expenditure and develops high work stress and risk in the majority of the Arecanut plantation workers. This result causes musculoskeletal disorders, such as upper limb disorders,lower limb disorders and less job satisfaction. Our project is based on reduction of these issuesto improve efficiency and production".[6]

II. Components of product

Table No.1 Component Used

Sl. No	COMPONENTS
1	MS PIPE
2	GM PIPE SHAFT
3	SHEET METAL
4	BALL BEARING
5	MS BLADES
6	ELECTRIC MOTOR
7	PULLYS
8	BELT DRIVEN
9	RUBBER BUSH

Above table No 1 denotes the list of components used in the assembly of the prototype of ArecaBunch separator. Each component is linked to their parts with various Means of joining process.

III. METHODOLOGY

The methodology of fabrication and working of Areca bunchseparator as follows.[7] [8]

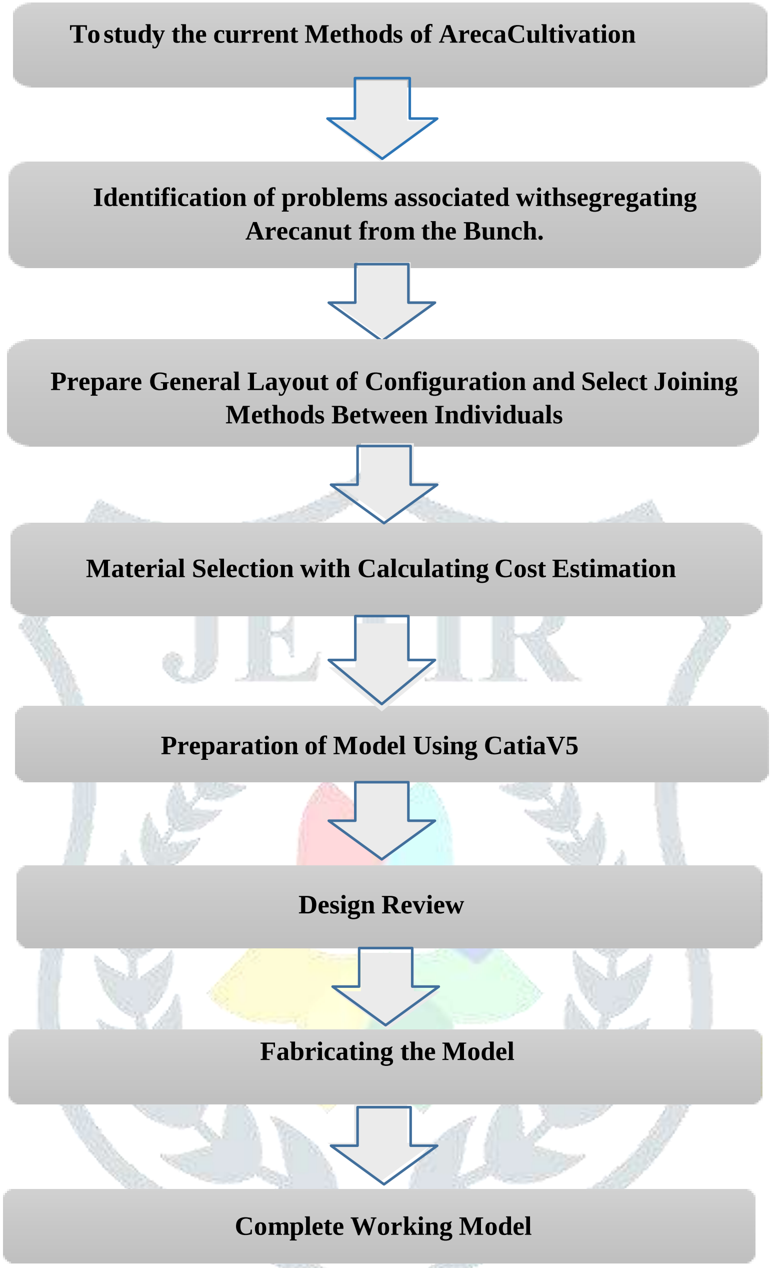

Figure.3 Methodology

IV. RESULTS & DISCUSSIONS:

4.1 DESIGN CALCULATION FOR ELECTRIC MOTOR [9]

Given:

Horsepower of the motor=1hpRpm
of the Motor=1440rpm
Voltage=220V
Service factor of 1hp motor = 1.25

To find:
Power, Current, Torque, Force

Sol'n:

Power = Horsepower * 746
=1hp*746
= 746w
=746/220
=3.4amp;

Torque = (Motor Horsepower*63025*Service factor)/rpm
= 1hp*63025*1.25/1400
=56.27 N-m

Force = Torque*[Length*sin (90)]
= 56.25 *[.05m*1]
=28.135 N

So, from table, referred from K. Lingaiah Design Data book

4.2 DESIGN CALCULATION FOR BLADE AND SHAFT [10][11]

TORTIONAL MOMENT

Torsion is the twisting of a beam under the action of a torque (twisting moment). It is systematically applied to screws, nuts, axles, drive shafts etc, and is also generated more randomlyunder service conditions in car bodies, boat hulls, aircraft fuselages, bridges, springs and many other structures and components.

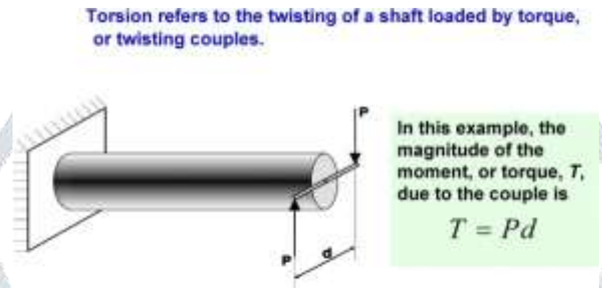

Figure.4 Tortional Moment of the Shaft.

Mt/J=G*θ/L=Z/R **MT=**9550*N/m;
MT=9550*0.754/1460
MT=4930N-M

Outer Width, H=20mm;Inner Width h=16;
Therefore,
J=4930*80/79.30*1000
J=11.5

MB/I=SIGMA/C
I=B/12(H^3-h^3)
I=80/12(20^3-16^3)
I=26026.66mm^4

So, from table, referred from K. Lingaiah Design Data book

4.3 CALCULATION OF HALLOW SQARE PIPE [12]

TENSILE STRESS

Tensile stress can be defined as the magnitude of force applied along an elastic rod, which is divided by the cross-sectional area of the rod in a direction perpendicular to the appliedforce. Tensile means the material is under tension and that there are forces acting on it trying to stretch the material.

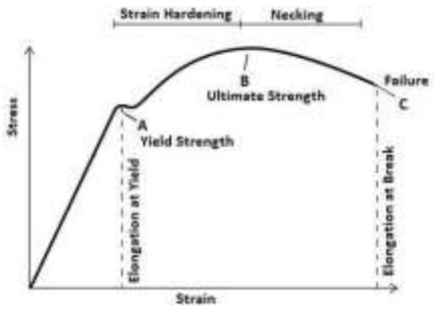

Figure.5 Stress vs Strain curve.

Mb/I=σd/C

To find;σd=?

Sol'n;

F=10kg

F=10*9.81=**98.1**

Mb=F*L;

=98.1*80*10^2;(APPLIED LOAD=F)

=80*10^4mm;

I=80/12(20^3-16^3)

I=26026.66mm^4**;**

C=H/2;

=20/2; =**10mm;**

σd =10*80*10^4/26026.66

σd =307.37N/mm^2

So, from table, referred from K. Lingaiah Design Data book

4.4 BUCKLING EFFECT

In structural engineering, buckling is the sudden change in shape (deformation) of a structural component under load, such as the bowing of a column under compression or the wrinkling of a plate under shear.

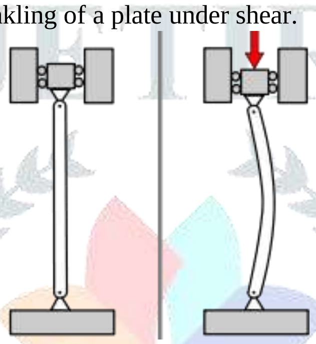

Figure.6 Buckling Effect.

Pcr=Eπ^2*I/L^2

Given;

E=101*10^3 N/mm^2

I=20626.66mm^4

L=860mm

To find;Pcr=?

Sol'n;

Pr=E*PI*I/L^2;

Pcr=101*10^3*π^2*26026.66/860^2 =305.78N

Pr<σd Hence,

So, from table, referred from K. Lingaiah Design Data book

Design is safe;

4.5 CALCULATION FOR BASE FRAME UPPER SECTION SIMPLY SUPPORTED BEAM STRUCTURE

Calculations for static response of simply supported beams under various loading scenarios.

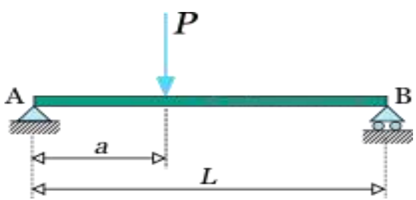

Figure.7 Simply supported Beam.

The formulas describing the static response of the simple beam under a concentrated point force **P** , imposed at a random distance **a** from the left end, are presented.

Given;

P=F*g
P=20*9.81=196.2KN
a=0.25m
b=0.33m
L=0.58m
E=215Gpa
$I=a^4/12$
$=0.2^4/12=.000033m^4$
x=0

To find;

Reactions,Bending moment, Transverse shear forces, Deflections and Slopes

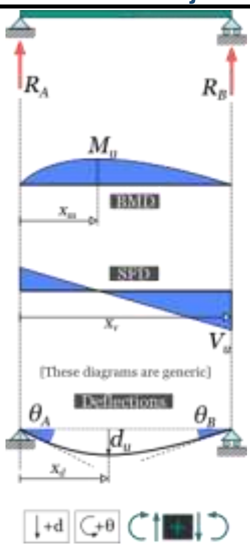

Figure.8 Simply supported Beam graph.

Sol'n;

Reaction time ;

R_A=Pb/L
=98.1*0.33/0.58
=55.81kN;

R_B=Pa/L
=98.1*0.25/0.58
=42.854kN;

Ultimate bending Moment;

M_U=Pab/L
=98.1*0.25*0.33/0.58
=13.9539kNm;
X_m=0.25m;

End slopes;

$\theta_A= -Pb(L^2-b^2)/6EIL$
$= -98.1*0.33(.058^2-0.33^2)/6*2Gpa*0.33*10^{-4}*0.58$
= -0.0169deg;

$\theta_B= -Pa(L^2-a^2)/6EIL$
$= 98.1*0.25(.058^2-0.25^2)/6*2Gpa*0.33*10^{-4}*0.58$
= 0.015deg;

Deflection;

$D_U= \sqrt{3}Pa(L^2-b^2)^{3/2}/27EIL$
$= \sqrt{3}*98.1*0.25(.058^2-0.25^2)^{3/2}/27*215Gpa*.33*10^{-4}*0.58$
$= 5.43*10^{-5}m;$
x_d=0.2778m;

Bending moment at x;

M(x)= Pbx/L
=98.1*0.33*0/0.58
=0kNm;

Shear force at x;

V(x)=Pb/L
=55.81kN;

Deflection at (x);

$d(x)= - \theta_A x-(R_A x^3/6EI)$

$= -7.54*0-(55.81*0^3/6*2Gpa*0.33*10^{-4})$

= -0.0169deg;

Diagrams;

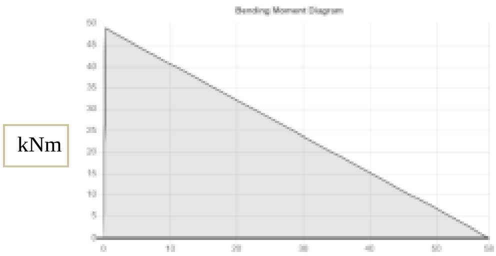

Figure.9 Bending moment Diagram of the beam.

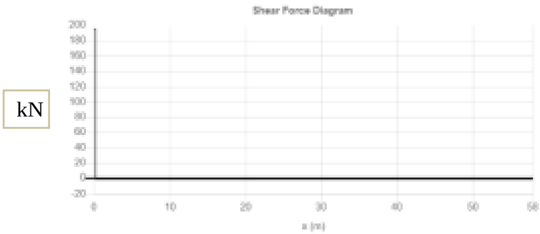

Figure.10 Shear force Diagram of the beam.

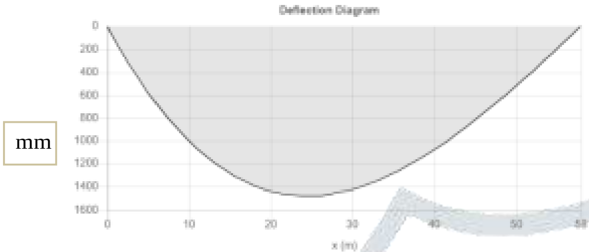

Figure.11 Deflection Diagram of the beam.

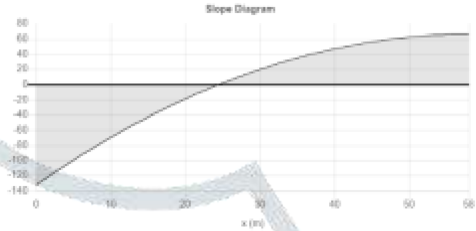

Figure12 Slope Diagram of the beam.

4.6 DESIGNED ARECA BUNCH SEPARATOR PRODUCT

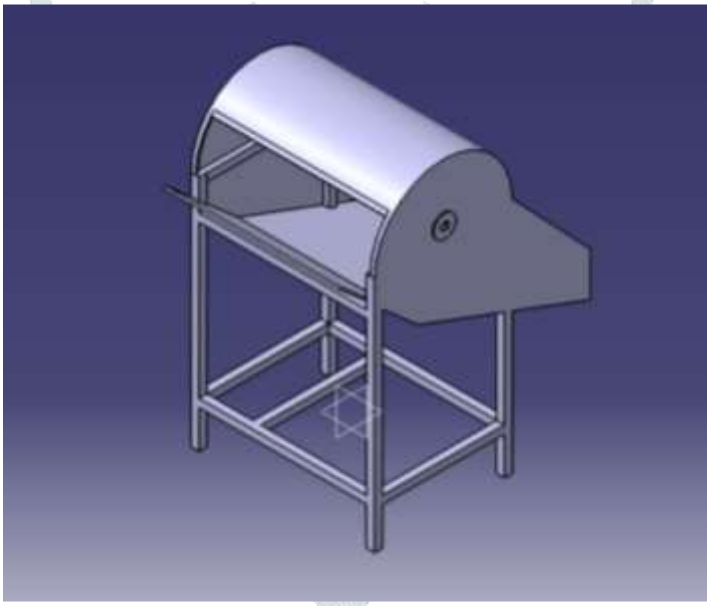

Figure.13 Assembled Product.

The above figure.13 Shows the complete assembled product of Areca bunch separator. Based on the design revive calculation Designed Areca Bunch separator machine. It consists of following below…

- Shaft
- Bearing
- Rotary Blades
- Base Frame
- Electric Motor

4.7 DRAFTING WITH DIMENTION

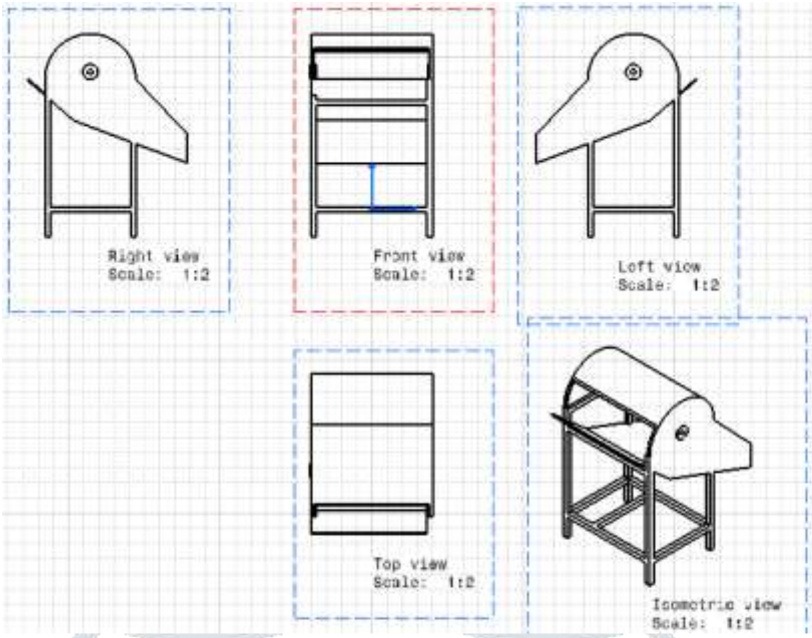

Figure.14 Draft Copy of Assembled product.

The Above Figure.14 Shows the Draft copy Of the Product of Areca Bunch Separator. It includesLeft Side view, Front view, Right Side view, Top view and Isometric view.

4.8 ADVANTAGES, LIMITATIONS AND APPLICATIONS

ADVANTAGES

- Reduce Human effort.
- Production rate increases.
- Time Consumption Reduces.
- More Efficiency.
- Portable.

LIMITATIONS

- Must need Electricity.
- Need one person for operating.
- Semi-Automated

APPLICATIONS

- Segregating the Areca from Bunches.
- Cleaning the Dust arrive from the nuts.
- It can portably use for segregating the pepper seeds.

5 CONCLUSION

The Arecanut Bunch Beater is developed and tested successfully. This machine is compact in design, making it portable. This machine is economical compared to the other existing machines. It can be operated by semiskilled personnel also. Hence this machine has overcome the problems associated with the existing machines. After performing the experiments, it can be concluded that the machine has an efficiency of 80%.

In Manual Areca bunch separation result. Consider one acre of areca land. It contains approximately 650 Areca trees. Each Tree have 4-6 Bunches. And each Bunch weighs approximately 10kg of Nuts. So total weight of Nuts is 25 Quintals. Segregating of Areca from the bunches required 150minutes per person(without rest) for 10 Quintals. So the total time for entire Bunches approximately 11hrs. And the labour cost of that person is approximately 500₹ for 5 Quintals. So total cost expenditure of the entire work is 8000₹. It leads lot of fatigue effect on Human beings.

But in Machine Areca bunch separation results. Segregating of Areca from the bunches required 60min for 10 Quintals. So, the total time for entire Bunches approximately 5hrs. And the labour cost of that person is approximately 500₹ for 5hrs. So total cost expenditure of the entire work is 5000₹ Include Electricity and maintenance charges. It does not fatigue effect on the Human beings.

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