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Design And Fabrication Of Rice Harvesting Machine

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Abstract

Rice is one of the most important grain in India. It is the staple food of the people in the eastern and southern parts of the country.Currently in India small scale farmers still used conventional method for rice haevesting. We designed the machine such that all three important process in rice harvesting are integrated in a single machine. This machine is more dedicated to the small scale farmers who have the land less than 2-3 acres. Cutting process is carried out by the trimmer like cutter which is operated on scotch yoke mechanism. All the cutter,conveyor,and thresher are motor operated & motor is driven by battery. This harvestor is that automates the harvesting process reduces the harvesting time & maximizes the efficiency also the labour problem is reduced largly.
Keywords: Crop cutting, threshing, harvesting, harvestor.

I. INTRODUCTION

Rice dehusking is a process of removing the husk and grain from the paddy rice and producing head white rice grains that are sufficiently milled, free from impurities and contains minimum number of broken grains. First process is of harvesting. It is a process of cutting and gathering of ripened rice crops. The rice crops are generally cut with the help of sickles and are then stacked at one place so as to allow them to dry in the sun for some days. The next step is separating the grains from the stock(culm). This process is called as Threshing. Threshing is done by beating the crop with the sticks so as to separate the grains from their stock or the straw. In big fields, it is done with the help of threshers. The above explained is a conventional manual process.

Fig.1:Manual crop cutting process

In India agriculture has facing serious challenges like scarcity of agricultural labour, in peak working seasons but also in normal time. This is mainly for increased nonfarm job

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opportunities having higher wage, migration of labour force to cities and low status of agricultural labours in the society. So this shifted farmers to use harvestors. All available harvestors are too coastly small scale farmers cannot aford it. Also they do not require full featured big haevstors.Thus there is need of compact, efficient, & cheaper harvestors. The idea was to create harvestor to solve all above discussed problems which is faced by small scale farmers in current situation. The machine fulfills the need of farmers having small land holdings less than 2-3 acres. The machine is cost effective and also easy to maintain.

II. PROBLEM STATEMENT

By using conventional rice harvesting process following are some problems associated with it,

- Labour shortage.
- Time consuming.
- Less efficient.
- Coastly.

As present harvestors are coastly so small scale farmers cannot afford it.
Due to improper roads in rural areas so that problem occurs to take big harvestors on field easily.

III.OBJECTIVES

Our designed prototype achieves the following objectives,

- Design is ‘Simple’ to operate and ‘Safe’.
- It have ‘Low Cost of Maintenance’.
- Harvesting requires Less Man Power.
- The design is Reliable.
- The design contains a threshing unit.

IV. METHODOLOGY

Rice is one of the most important grain in India also the demand is increasing, the aim was to design and fabricate a prototype of inexpensive rice harvesting machine which helps the small scale farmers whoholds the land less than 2-3 acres. For the fulfilment of the aim we decided to follow the following steps:

1. Discussion with the small scale farmers who have the land holdings less than 2-3 acres.
2. Study of big harvesting machines i.e, what mechanisms used in it.
3. Study of International papers to see till date what work is been done on rice harvesting machines which targets small scale farmers.
4. Brainstorming is conducted within all group members.
5. Design of small, compact, cheaper rice harvesting machine.

V. DESIGN CALCULATIONS

- **Design of Frame**

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Taking, b=25mm d=25mm & l=450mm.

For design to be safe, $\sigma_{bending} < \sigma_{allowable}$
By Bending equation,

$$\frac{M}{I} = \frac{\sigma}{Y}$$

Bending Moment,
M = Force * Perpendicular Distance
= 50 kg * 9.81 * 450
= 220725 Nmm
Now, Moment of Inertia,

$$I = \frac{BD^3 - bd^3}{12}$$
$$= \frac{25 * 25^3 - 19 * 19^3}{12}$$
$$= 21692\ mm^4,$$

$$Y = \frac{d}{2} = \frac{25}{2} = 12.5\ mm,$$

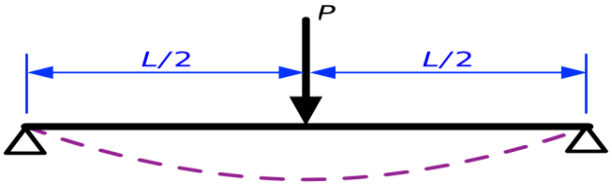
$$\sigma_{bending} = \frac{MY}{I}$$
$$= \frac{220725 * 12.5}{21692}$$
$$= 127.19\ {}^{N}/_{mm^4}$$

Properties of Mild steel,
Yield strength Syt = 275 ${}^{N}/_{mm^4}$
Assuming FOS = 2
(Ref. Page 19 From design Data Book)

$$\sigma_{allowable} = \frac{Syt}{FOS} = \frac{275}{2} = 137.5\ mm$$

$\sigma_{bending} < \sigma_{allowable}$
$127.19 < 137.5$
$\therefore Design\ is\ Safe.$

- **Design of Shaft:**



Maximum Bending Moment = $\frac{WL}{4} = \frac{40 * 9.81 * 200}{4}$
= 19620 Nmm.
Shaft is subjected bending,

$$\sigma_{bending} = \frac{MY}{I} = \frac{32 * M}{\pi d^3}$$

$$127.19 = \frac{32 * 19620}{\pi d^3}$$

$$d = 11.62\ mm$$

d = 12 mm is selected as standard size.

- **For Motor (diameter of motor shaft)**

n = 30 rpm
v = 12v
I = 1.5A

Power = V * I
= 12 * 1.5
Power = 18 watt

$$Power = \frac{2\Pi NT}{60}$$

$$18 = \frac{2\Pi * 30 * T}{60}$$

T = 5.7295 Nm

Motor diameter

For ductile material,
According to maximum shear stress theory,
Sys = 0.5*Syt
Sys = 137.5

Now,

$$\tau = \frac{Sys}{2} = \frac{137.5}{2}$$

$$\tau = 68.75\ {}^{N}/_{mm^4}$$

$$\tau = \frac{16T}{\Pi d^3}$$

$$68.75 = \frac{16 * 5.7295 * 1000}{\pi d^3}$$

$d^3 = 424.4378$
d = 7.515 mm

d = 8 mm

- **Bearing Selection**

Considering deep groove ball bearing,
d = 12
Race rotation factor,
V=1 inner race factor,
V=1.2 outer race factor.
X=1
Y=0

$$(\frac{Fa}{Fv}) \leq e$$

P = X.Fr + Y.Fa

P = equivalent dynamic load
X = Radial load constant
Fr = Radial load
Y = Axial load constant
Fa = Axial load

In our case,

Radial load,
Fr = 490.5 N

Fa = 0

P = 1*490.5 N

$L_{10} = (\frac{C}{P})^n$

Considering 4000 working hour,
Where, n = No. of revolution/min
L = Length on m
H = Depth in m

$L = \frac{60*n*4000}{100}$
L = 240 mrev
$240 = (\frac{C}{490.5})^3$
C = 3.048 KN

Principle Dimensions		Basic Load Rating		Destination
d	D	B	C_o	
12	28	8	5070	6001

VI. ADVANTAGES

Our machine consists of following advantages,

- Machine is compact operator can easily handel & operate the machine.
- Cost efficient then conventional harvestors.
- Highly efficient & time saving then mannual harvesting process.
- Affordable by farmers holding land less than 2-3 acres.

VII. CONCLUSION

This paper concludes that rice harvesting machine (prototype) made by us is meeting the requirements of farmers holding land less than 2-3 acres. Most of population of our country lives in villages & their main occupation is agriculture. Moreever, the farmers have small land holdings & their financial status is also poor. Hence they cannot buy available harvestors, so they opt manual harvesting. Our machine helps them. Also it is cheap, efficient, compact & can be operated by single labour. This machine reduces the labour problem largely in peak sessions of crop cutting period. This is only prototype and can be use more effectively and efficiently by using IC engine as a prime mover.

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