

Design and Fabrication of Portable Crop Harvesting Machine

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Abstract— Today agriculture is especially in India need to concentrate in some aspect such as how to increase the productivity and profit, how to reduce the cost and how to solve the problem comes from worker. Currently in India farmer used conventional method for crop cutting as manually cutting using labour but this method is lengthy and time consuming. To overcome thus, a new solar operated cutter is fabricated for cutting various crop like wheat, rice etc. during the time of harvesting and name as a “Portable Crop Harvesting Machine”. This project aims to design and analysis of small field crop cutter for small height crop. The machine consist of electric motor to operate cutting blade. We can cut crop in any height by this machine. When we compared to manual crop cutting by hand this machine has a capacity to cut the crop faster.

Keywords: Portable Crop Harvesting Machine, Solar Panel, DC Motor

I. INTRODUCTION

Harvesting of crops in India is still done using human labour. However in, some parts of country, harvesting of rice and wheat is carried out using engine power. Rice and wheat are the two most important staple food for the people in Asian countries. Harvesting is one of the major field operations for food grain crops and consumes as much as 20-30% of manual labour requirement the harvesting process begins when a crop is physiologically matured, to get maximum recovery of the grain harvesting should be grate at appropriate space to minimize the loses, and to increase the yield. In agricultural field or in nursery or even in house hold grass, grass is commonly found problem. Removal of the grass is also a tedious job involving lot of human efforts. In the modern world as time carrying out many things has reduced drastically so as to be done the removal of grass involving use of a machine. This machine can be railed as multipurpose agriculture cutter which is mostly depends on the type of blade that we use to cut the crops.

It is simple in construction where a very high speed motor and cutting blade is connected to an end of arm that is held with hand through the handle. The blade rotate with high speed with help of motor. The rotation given to the cutter through the pulley and belt arrangement. The motor is run by the electric battery. The arm can be move up and down along with the vertical column for height adjustment. The vertical column provided with number of holes for height adjustment for cutting. The speed of motor can be controlled by control unit. The whole components are placed on the wagon.

A. Objectives:

The main objective is to design and fabrication of portable crop harvesting machine working on solar energy, cost effectiveness and fabrication by using easily available component.

II. CONSTRUCTION AND WORKING

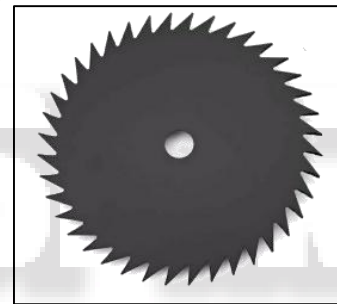
A. Component:

- Cutting blade
- Chain drive
- DC motor
- Solar panel
- Frame

1) Cutting Blade:

The cutter blade as shown in above figure. These blade are made of hardened steel. Used for the cutting of wheat and rice.it should have high quality and weather resistance. It is available in 255mm in diameter, 2.5mm in thickness. It has 40 number of teeth.

The blade are mounted on rotating shaft which is driven by electric motor with the help of belt derive. It cut the crop by rotary motion.



2) Chain Drive:

Chain drive is a way of transmitting mechanical power from one place to another place. The power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear meshing with the holes in the link of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

A sprocket or sprocket wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material the name sprocket applies generally to any wheel upon which radial projection engage a chain passing over it. It is distinguished from a gear in that sprocket are never meshed together directly, and differs from a pulley in that sprocket have teeth and pulley are smooth.



3) DC Motor:

A motor (DC) is main component of crop cutting machine, which is operated on battery. A DC motor is any of a class of rotary electric machine that convert direct current electrical energy into mechanical energy. We used the 50watt, 3000rpm

DC motor for crop cutting machine. The mechanical energy (rotary motion) of motor is transferred to the cutter blade of crop cutting machine by using belt pulley arrangement.

4) Battery and Solar Panel:

An electrical battery is a device consisting of one or more electrical cell with external connection provided to power electrical device such as motor. It is main component of system on which motor is run.

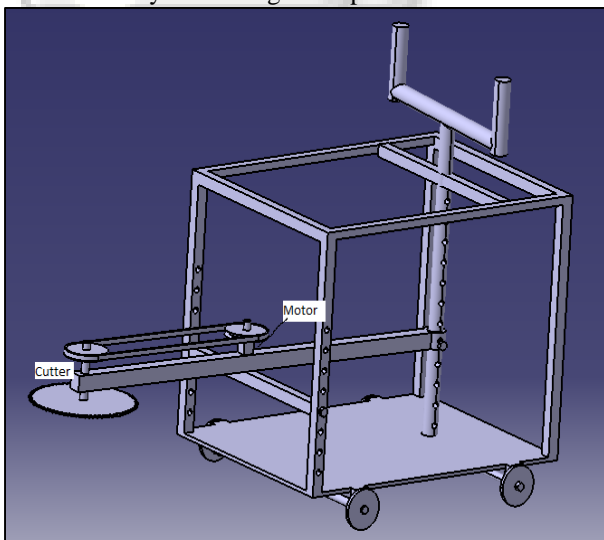
- Type –sealed lead – acid type
- Current rating -4 Amp
- Voltage rating – 12Volt
- Rechargeable

Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generate and supplies solar electricity in commercial and residential application.

B. Working:

Construction of crop harvesting machine shows in above fig. it consist of one wagon which carry all component of machine. Machine have one horizontal arm attached to the handle. Handle give the motion to the cutter blade for cutting of crop. Motor is mount on the horizontal arm and also cutter is mounted at the end of arm. DC power supply is connected to motor (i.e. Battery) and battery is charge by using solar panel.

- Power is given to motor with the help of battery.
- Battery is charged by solar plate.
- In solar plate solar energy is directly converted into electrical energy with the help of photovoltaic cell.
- Power from motor is transmitted to cutter with the help of belt derive.
- And cutter is start rotating.
- Hence ready for cutting of crop.



III. DESIGN AND DEVELOPMENT

A. Selection of Motor

For selection of motor, motor power is to be determined.

We take following parameter for design purpose:

Diameter of cutter = 255mm, Radius = 127.5mm

Cutting force required to cut wheat and rice crop = 13N⁷¹

So, Torque = 127.5*13 = 1657.5 N. mm =1.5675 N.m

N= 2500 rpm (assumed initially)

P= 433.85 w =0.04338 kw

Power in Hp is 0.58 Hp

Type- DC motor

B. Selection of Chain Drive:

- Pitch circle diameter of sprocket = 76mm
- Chain pitch =7mm
- Roller diameter = 5mm
- Number of links in chain = 152
- Centre distance between sprockets = 410mm

C. Diameter of Shaft:

Determine the shaft diameter by ASME code

$$T_e = \sqrt{(K_b * M)^2 + (K_t * T)^2}$$

$$T_e = \sqrt{(1.5 * 8951.31)^2 + (1 * 1567.5)^2}$$

$$T_e = 13518.15 \text{ N.mm}$$

$$\tau_{max} = \frac{16 * T_e}{\pi * d^3}$$

d = 10.74 mm (We take standard diameter for safety d = 20mm)

D. Selection of Bearing:

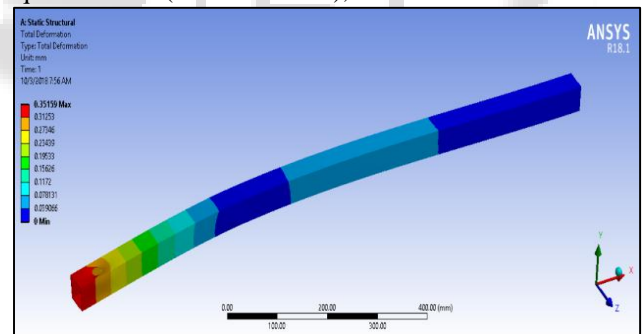
From Manufacturing Catalogue we select bearing, No. 61804

IV. ANALYSIS OF ARM

We design the arm with different cross-section like Square, C-section, and Rectangle in ANSYS software.

A. Analysis of Hollow Square Section

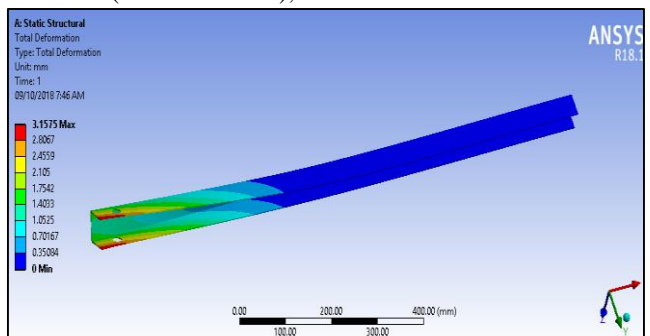
Square section (40*40*1150*2), Material- MS



Total deformation of Arm (Square Section)

B. Analysis of C-Section

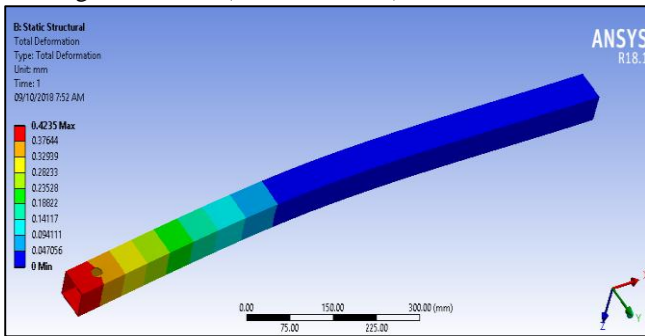
C-section (40*40*1150*2), Material-MS



Total deformation of Arm (C-section)

C. Analysis of Rectangular Section

Rectangular Section (50*40*1150*2)



Total deformation of Arm (Rectangular Section)

From above three analysis of Square section, C-Section and Rectangular Section, We conclude that the total deformation and equivalent stresses in C-Section and Rectangular Section is more than Square Section. So, we take Square section for fabrication.

V. ADVANTAGES

- 1) Simple in construction.
- 2) It is battery operated, hence it can be used anywhere in the farm.
- 3) Machine can be operated on AC or DC supply.
- 4) Battery can be solar operated.
- 5) Less vibration to the operator as compare to other equipment.
- 6) Cutting speed can be varied.
- 7) Easy to operate.
- 8) Less maintenance required.

VI. DISADVANTAGE

- 1) Cutting is limited for small crop.
- 2) Battery should be handle carefully.

VII. APPLICATION

Portable crop harvesting machine is used for cutting and harvesting the crop like wheat, rice, etc.

VIII. CONCLUSION

We design and fabricate portable crop harvesting machine. This machine useful for small farmer. This machine can cut wheat, crop and other plant small than wheat. The machine can cut crop in variable height and also this machine can operate in variable speed. The machine operated on battery which charge by solar panel.

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