International Journal of Future Generation Communication and Networking
Vol. 13, No. 2s, (2020), pp. 802–808

Design And Analysis Of Crop Reaper Machine

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Abstract:

This project is to help small-scale farmers to meet an increased demand for local grains, by designing a reaper machine to harvest grains more efficiently. Our study will focusing on ease of harvesting operation to the small land holders for harvesting varieties of crop in less time and at low cost by considering different factors as power requirement, cost of equipment, ease of operation, field condition, time of operation and climatologically conditions. The operating, adjusting and maintaining principle are made simple for effective handling by unskilled operators. The 3D model will be drawn with the help of CATIA software. All the components required for the project are collected and assembled. After making the parts assembly was done and after that the result and conclusion was carried out.

***Keywords*:** *Scissoring motion, scotch yoke mechanism, collecting mechanism.*

I. INTRODUCTION

A reaper is a farm implement or person that reaps (cuts) crops at harvest when they are ripe. Usually the crop involved is a cereal grass. The first documented reaping machines were Gallic reaper that was used in modern day France during Roman times. The Gallic reaper involved a comb which collected the heads, with an operator knocking the grain into a box for later threshing. These reapers are costly and only available of very large-scale farming. However, agriculture groups make these available for rent on an hourly basis. But the small holding farm owners generally do not require the full-featured combine harvesters. Also, these combine harvesters are not available in all parts of rural India due to financial or transportation reasons. Thus, there is a need for a smaller and efficient combine reaper which would be more accessible and also considerably cheaper. Farming is most widely followed profession in India. Agricultural products contribute a major portion to our economy. Engineering science has brought tremendous changes in traditional methods of agriculture viz. sowing, planting, irrigation, fertilizer spraying, harvesting, etc. However, to increase our economic condition, we must increase the productivity and quality of our farming activities. Nowadays very few skilled labors are available for agriculture. Because of this shortage the farmers prefer to use reaper harvesters.

The mission is to create a portable, user-friendly and low-cost mini harvester taking into account the requirements of current situation; the idea was created to prepare a machine which is cheap and will reduce the labor required to cut crops. This machine has the capability and the economic value for fulfilling the needs of farmers having small land holdings. This machine is cost effective and easy to maintain and repair for the farmers. The machine model is designed based on the demand for a compact and economical reaper. This demand is taken into consideration by consulting farmers in person, for their problems and requirements. Taking into account the present scenario of sugarcane harvesting we decided to prepare a model of sugarcane reaper with compact construction which will be mostly suitable for farmers having small and for agriculture. The machine prototype will be economical and most convenient for cutting corn stalks and other similar plants having same or less shear strength than corn.

ISSN: 2233-7857 IJFGCN

Harvesting is the process of gathering a ripe crop from the fields. Reaping is the cutting of grain or pulse for harvest, typically using a scythe, sickle, or reaper. Process automation has increased the efficiency of both the seeding and harvesting process.

II. METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are
relevant to this topic. After going through this paper, we learnt about crop reaper.
Step 2: - After that the components which are required for our project are decided.
Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of CATIA software.
Step 4: - Purchasing the components and then assembling them together.
Step 5: - The experimental observations will be taken, calculations will be done and then the result will be concluded.

III. DESIGN

A. Material Selection

Table 1. Selection of material for Semi-Automatic Crop Reaper

SR no.	Components	Materials
1	Engine	-
2	Shaft	Mild steel
3	Bevel gear	Cast iron
4	Belt	Rubber
5	Pulley	Cast iron
6	Bearing	Cast iron housing, Chrome steel bearing
7	Blades	High steel
8	Frame	Mild steel
9	Scotch yoke mechanism	Mild steel

B. Design Specification of a reaper

Table 2. Specification of semi-automatic crop reaper

Sr No.	Component	Parameter	Values
1.	Engine	Power	5Hp, 3.73Kw (Petrol)
2.	Frame	Length Width Height	1100mm 640mm 760mm

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3.	Shafts	Ground wheel shaft Rotating disc shaft Rotating Pulley shaft	20mm
4.	Belt	Type	A-Section
5.	Pulley	Diameter (D,d)	(150mm, 75mm)
6.	Bevel Gear	No. of teeth (Pinion, Gear)	(12, 24)
7.	Blade	Type (Length*Height)	Trapezoidal (75mm*80mm)
8.	Scotch Yoke Mechanism	Type Diameter of crank Length of slotted bar	Standard 200mm 155mm
9.	Cutting stroke	Length Force Speed	200mm 95.4N 0.4m/min

C. Cad model

1. Engine:

An engine or motor is a machine designed to convert one form of energy into mechanical energy. Heat engines, like the internal combustion engine, burn a fuel to create heat which is then used to do work.

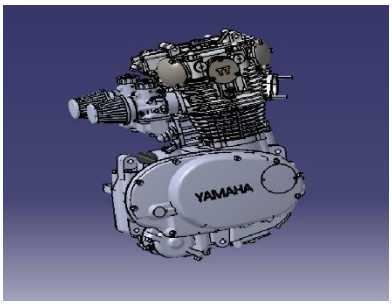

Fig.1: Engine

2. Frame

It is nothing but the body of structure on which the all components are mounted. Here the frame is used to support mechanical equipment and provide rigid platforms for attachment.

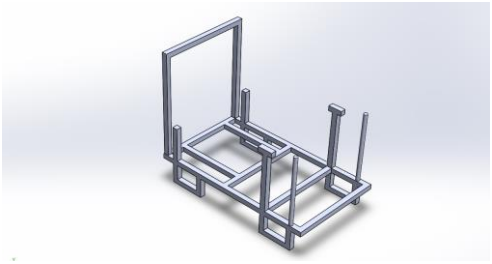

Fig.2: Frame

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3. Bevel gear:

Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone.

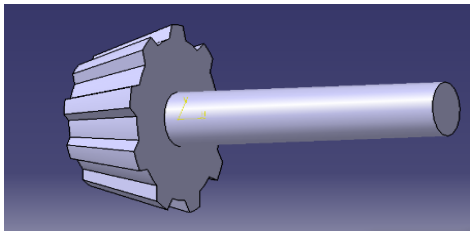

Fig.3: Bevel gear

4. Shaft

A shaft is a rotating or stationary component which is normally circular in section. A shaft is normally designed to transfer torque from a driving device to a driven device.

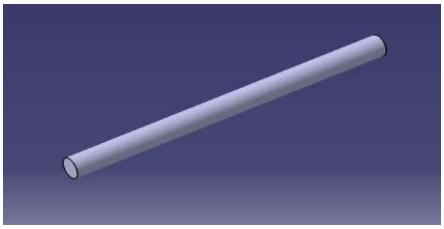

Fig.4: Shaft

5. Belt & pulley:

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

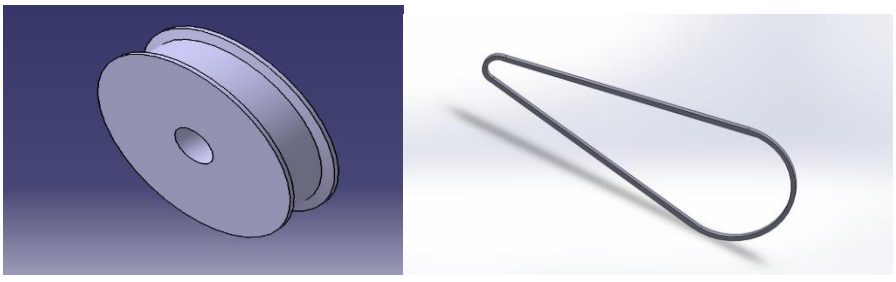

Fig.5: Belt and Pulley

6. Bearing:

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for

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example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may *prevent* a motion by controlling the vectors of normal forces that bear on the moving parts.

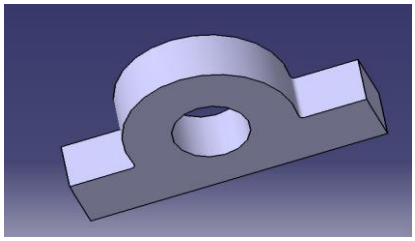

Fig.6: Bearing

7. Scotch yoke mechanism:

The Scotch yoke (also known as slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion, or vice versa.

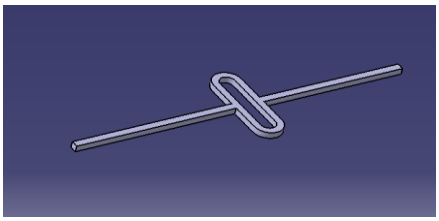

Fig.7: Scotch Yoke Mechanism

D. Analysis of component

1. Total deformation

Directional deformation can be put as the displacement of the system in a particular axis or user defined direction. Total deformation is the vector sum all directional displacements of the systems.

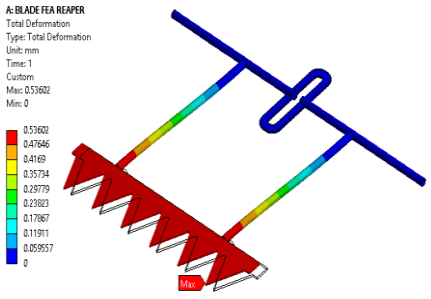

Fig.8: Total Deformation of Blade

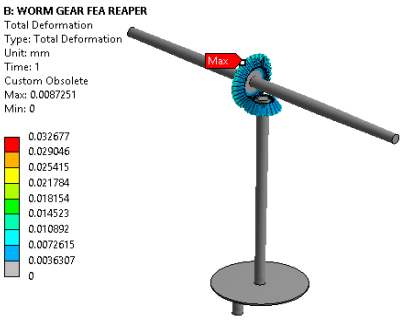

Fig.9: Total deformation of bevel gear

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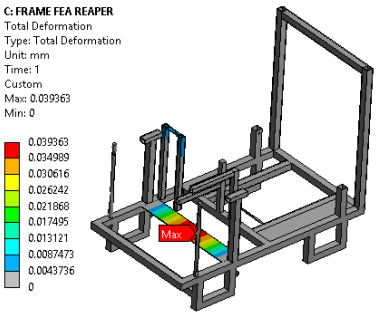

Fig.10: Total Deformation of Frame

2. Equivalent Stress

Equivalent stress is often used in design work because it allows any arbitrary three-dimensional stress state to be represented as a single positive stress value. Equivalent stress is part of the maximum equivalent stress failure theory used to predict yielding in a ductile material.

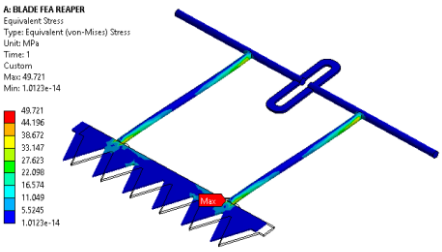

Fig.11: Equivalent Stress of Blade

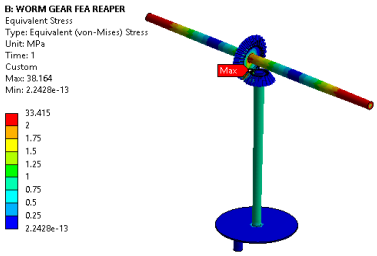

Fig.12: Equivalent Stress of Bevel gear

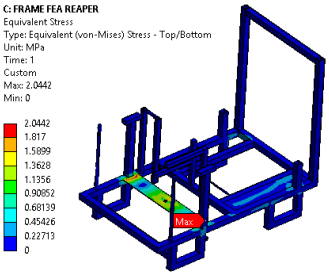

Fig.13: Equivalent Stress of Frame

IV. CONCLUSION

The crop reaper machine is used to cut the crops. This machine is developed so that the efforts of human are decreased. We have produced this machine which is helpful for the farmers which is available in cheap cost. The design can be carried out with affordable capacity

ISSN: 2233-7857 IJFGCN

and better-quality product is manufactured. From the analysis result, it is seen that the maximum stress obtained value is less than that of the yield strength of the material.

V. ACKNOWLEDGMENT

It is my great pleasure to acknowledge sense of gratitude to all, who have made it possible for us to complete this project with success. It gives me great pleasure to express my deep gratitude to my project guide ***Prof. S.P Bansode*** for his support and help from time to time during seminar work. It is my pleasure to acknowledge sense of gratitude to ***Prof. N.P Sherje*** our Head of Department, and Principal Dr. A.P Deshpande for their great support and encouragement in project work.

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