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Design and Development of Manually Operated Fertilizer Spreader

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Abstract: ***In recent days it has been found that farmers are not able to gain more crop production by use of conventional methods. This project is concentrated on manually fertilization process. A method is generated in which fertilizer is spread by means of rotating impeller. The system consist of two wheels which are used to impel fertilizer; a hopper to store fertilizer along with flow control mechanism. Below this system there is an impeller. It is mounted on output shaft; pair of bevel gears which are coupled to the shaft of wheel. The whole design is supported by frame and column.***
Keywords: Fertilizer spreader, hopper, flow control mechanism, impeller, bevel gear, frame.

I. INTRODUCTION

India is agriculture based country. Near about 60% people of our country are farmers. Our economy also gets affected by agricultural products. In recent few decade tremendous changes have occurred in conventional methods of agriculture like irrigation system, speed, plantation, pesticides and spray used. For development of our country and fulfil the needs of growing population it is necessary to increase our agriculture productivity and quality. We are used to do spreading of fertilizer in traditional way which is time consuming as well as does not provide comfort to the labour. Also some tractor operated machine for spreading of fertilizer are available , so what we need is an alternative to the traditional as well as tractor operated fertilizer spreading machine which will fulfil all the requirements and economical for small scale farmers.
So, we are going to design a manually operated machine for fertilizer spreading by taking into consideration the user group and also their needs which helps them to work easy and functional.

II. PROBLEM DEFINITION

In recent days it has been found that farmers are unable to gain more crop production by use of conventional agriculture methods and also each farmer which have less farm area. So there is big need for the development of farming equipments for compensating these drawbacks. It is well known that by using farm equipments farmers yield more crop productions which ultimately have an impact on national economy. It gives prior need of development of agro equipment in field of agriculture.
As we can see today the major problem faced by farmers is shortage of labour and also time required for fertilization is more. In order to solve this problem, it was proposed to manufacture a fertilizer spreader machine which will be more economical than other spreader machines available in market for the large farm owner. So, farmers can work more easy and functional.

A. The fertilizer spreader machine should satisfy following objectives.
1) Less cost.
2) Less time consuming.
3) Less fatigue to operator.
4) Portable.
5) Eco friendly and user friendly.

III.CONSTRUCTION AND WORKING

In the process of spreading of fertilizer, fertilizer is spread over the fallow land by dropping of fertilizer over the impeller disc through the hopper. Impeller disc is rotated by means of bevel gear pair attached to shaft of the wheel which gives rotating motion to the impeller. Project design consist of hopper, impeller, bevel gear pair, wheels and whole design is supported by frame.

A. Components
1) Hopper
a) Hopper is used to stored the fertilizer and to supply fertilizer to rotating impeller disc.
b) In this project, we design the symmetric rectangular shaped hopper having inclined surfaces at it's bottom.

c) For hopper aluminium sheet of thickness 5mm to 10mm is used.
d) Delivery point of hopper is at both ends having elliptical shape hole.
2) Specification: Dimensions and properties of hopper
a) Length = 80 cm
b) Breadth = 56 cm
c) Height =20 cm
d) Density=2800 kg/m^3

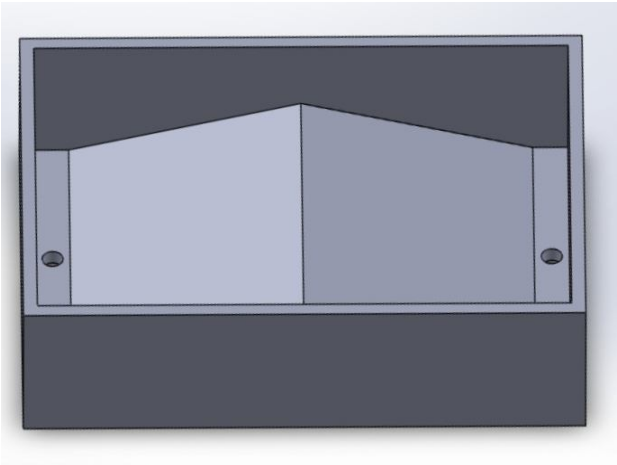


Fig. 1 Hopper

3) Calculations
a) For Weight Of Hopper
i) Hopper is of trapezoidal shape and is is made up of aluminium sheet.
ii) Aluminium sheet thickness is 2mm and Area of aluminium sheet is 1m^2

Weight Of Hopper
=(Volume of aluminium sheet used)x(Density of aluminium sheet)x(Gravitational acceleration)
= (Area x Thickness)x(2800)x(9.81)
= (1 x 2 x $10^{(-3)}$)x2800x9.81
=54.936N

4) Rotating Disc / Impeller
a) Rotating disc is used as impeller to use the rotary motion to spread the fertilizer properly.
b) Disc is made up of aluminium sheet of 1mm thickness.
c) Hopper drop the fertilizer on rotating impeller disc eccentrically and due to centrifugal force, fertilizer is spread properly.

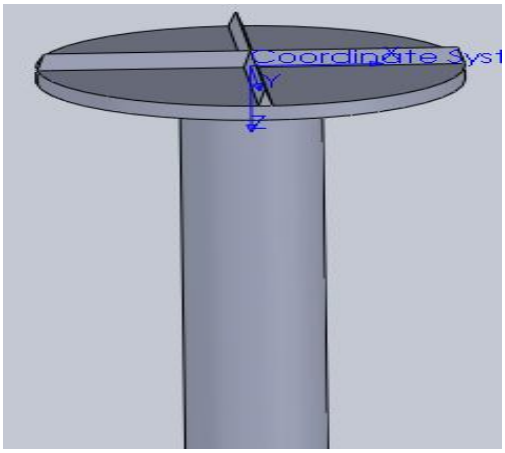


Fig. 2 Rotating Disc

5) Gear pair

1) Bevel gear pair is used in this project.
2) Gear pair is used to transfer the wheel rotation motion to the impeller shaft.
3) Gear pair with gear ratio 6 to 8 is used in this project.
4) Metal gear pair is used on both sides.

6) Wheel

1) The wheels are used to drive the fertilize spreader.
2) The wheels consist of aluminium rim of 18 inch and rubber tyres.
3) Two wheels are used in this project..

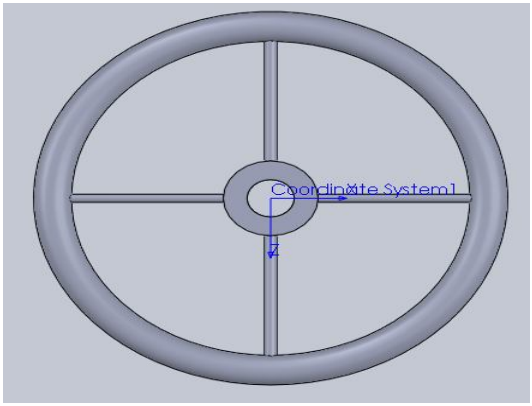


Fig. 3 Wheel

7) Frame

1) In this project frame is used to connect and support the different components of fertilizer.
2) Frame carries the whole weight of machine.
3) Pipes used for manufacturing the frame are of square cross section.
4) Arc welding process is used for joining pipes.
5) At bottom, wheels are attached.
6) Specification
7) Height = 70cm
8) Breadth = 82cm
9) Length = 68cm

Selection of material for frame:-

Selecting mild steel for frame design as it is easily available.

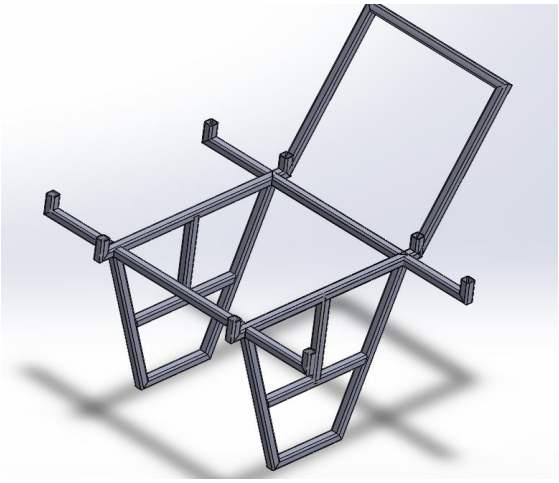


fig. 4 Frame

Checking for frame failure:-

Frame carries the fertilizer and hopper. It is subjected to UDL i.e uniformly distributed load.

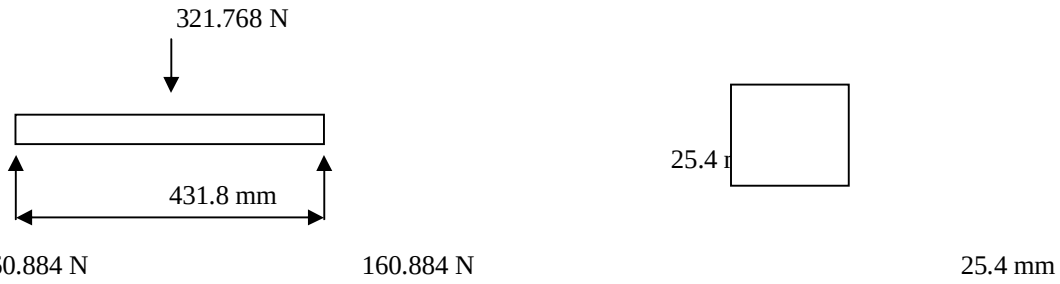
Total load can be calculated by following equation

Total load acting on one beam of frame

= ((1/2)x weight of hopper without fertilizer)+((1/2)x weight of fertilizer)

= (5.6/2)+(60/2)

= 32.8 kg or 321.768 N



10) Maximum bending moment acting on frame

= (Total load x L)/4

= (321.768 x 431.8)/4

= 34734.85 N

11) Moment of inertia about X-X axis

=(1/12) x b x t^3

=34685.95 mm^4

12) Bending stress

=(M/I) x Y

=(34734.85/34685.95) x 12.7

=12.717 N/mm^2

Yield stress=300N/mm^2

Design stress=(Yield stress/F.O.S)

=(300/3)

=100 N/mm^2

13) Design tensile stress=Design bending stress=100 N/mm^2

Design bending stress > induced bending stress

So, Design is safe.

IV. CONCLUSION

A. Our goal is to build a system which efficiently perform manually fertilization process.

B. With future developments, the project is done to fulfill the demand of agricultural application.

C. The main objective of this project is to fulfill the need of farmers suffering from the problem of increasing cost of fertilization, labor cost, availability as it is operated by single person.

D. It has solved the problem of traditional way of fertilization. Since the capital cost is essential factor while selecting equipment for farming. This machine has very less capital cost as compare to other conventional equipment.

E. By undergoing all this discussion and undergoing all the factors associated with fertilization, this machine will be great boon for the Indian agricultural.

V. ACKNOWLEDGMENT

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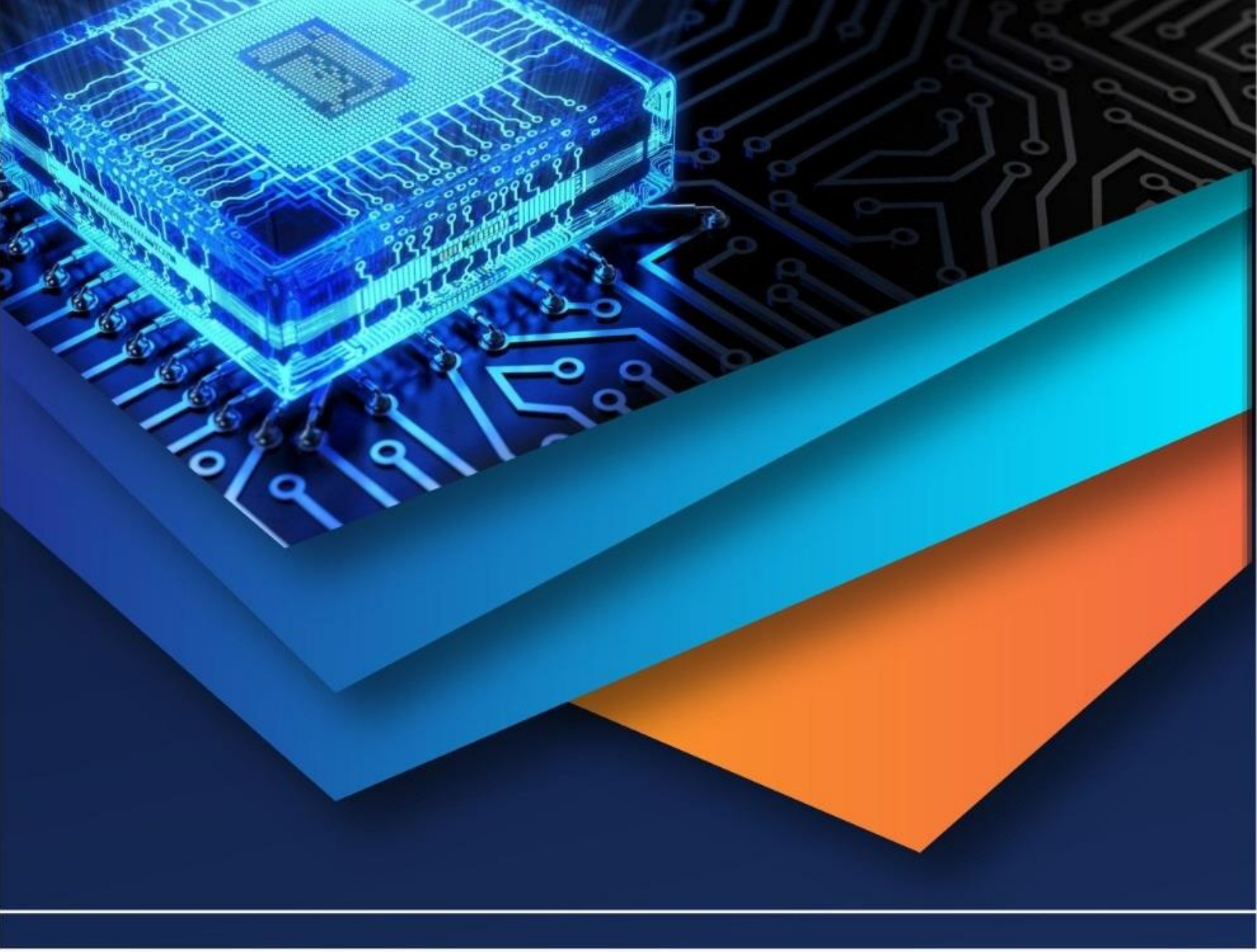

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