Design and Fabrication of Multipurpose Seed Sowing Machine

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Abstract: Agriculture is the science and art of cultivating the soil, producing crops, and raising livestock. It is the backbone of the economy. Cultivation of any crop involves a sequence of classified steps like plowing, sowing, irrigation, and harvesting. The agricultural equipment available is extremely costly and proves to be impractical for these small-scale farmers. Thus, demand has been noticed for low-cost equipment and hence a concept is been developed to investigate if multiple small machines could be integrated and made more efficient than traditional large tractors and human forces with cost factors in mind. The main objective of our project is to combine all the individual tools and develop a modular design that provides farmers with an equipment-loaded vehicle that can be used for multiple purposes. The secondary objective of the design includes a vehicle that is small, compact in size, and is easily accessible and controlled by an individual. At the same time to make use of green energy and provide a cleaner environment.

Keywords: Seed Sowing Machine, Agriculture, Cultivating Soil.

I. INTRODUCTION

Agriculture has been the backbone of the Indian economic system and it'll maintain to stay so for a long time. a person without meals for three days will quarrel, for a week will fight and for a month or so will die. Agriculture is a department of applied science technology. Agriculture is the pure science technology and artwork of farming such as cultivating the soil, generating plants, and elevating farm animals. it is the maximum important corporation within the globe. over time, agricultural practices have been finished through small-holders cultivating among 2 to a few hectares, using human labour and conventional equipment consisting of the wood plowyoke, leveller, harrow, mallet, spade, huge sickle, etc. those equipment are used in land instruction, for sowing of seeds, weeding, and harvesting.

Modem agricultural techniques and gadgets aren't used by small landholders because these gadgets are too pricey and tough to collect. with the aid of adopting medical farming methods, we can get maximum yield and right first-class vegetation that can store a farmer from going bankrupt but the majority of farmers nevertheless make use of primitive approach of farming techniques because of lack of awareness or loss of investment for using the contemporary system.

the use of hand tools for land cultivation remains major in India due to the fact tractors require sources that many Indian farmers do now not have clean get entry to. The want for agricultural mechanization in India must consequently be assessed with the deeper expertise of the smallholder farmers' activities. there's a large gap in era adoption and put in force used with small and marginal farmers.

Sustainable development in the livelihoods of terrible farmers in growing nations depends in large part on the adoption of improved aid retaining cropping systems. at the same time as the maximum of the necessary additives already exist, information on the availability and performance of the system is lacking and powerful verbal exchange between farmers and agricultural studies and improvement branch is unsuccessful.

II. LITERATURE SURVEY

Thorat Swapnil V et al., have made a sowing machine that is operated manually but reduces the efforts of farmers thus increasing the efficiency of planting also reduces the problem encountered in manual planting. For this machine, we can plant different types and different sizes of seeds also we can vary the space between two seeds while planting. This also increased the planting efficiency and accuracy. Also, its adjusting and maintenance method is simplified.

Pavan T V et al. reported that the automation and robotics application in the branch of agriculture is at the booming stage when compared to its wide range of applications in other sectors. The robot developed is capable of making a hole in the soil up to a certain depth, placing the seed accurately in the same hole, and closing the mud. The process is controlled by a microcontroller. The robot developed overcomes the drawbacks in the traditional method of seeding which includes wastage of seeds, high labour wage, lower utilization of land, etc.

Ramesh et al., reported in this this paper provides brief information about the various types of innovations done in seed sowing equipment. The different types of seeding equipment are studied.

III. PROBLEM FORMULATION

The machine which was designed before can perform 1 operation at time, now able to perform 2-3 operation at a time. (I.e. weed removing, cutting, cultivation).

- The Problems which we have overcome in sowing methods are as follows:
    - No control over the depth of seed placement.
    - No uniformity in the distribution of seed placement.
    - Loss of seeds.
    - No proper germination of seeds.
    - During sowing, Placement of seeds at uneven depth may result in poor emergence
    - because subsequent rains bring additional soil cover over the seed and affect plant emergence.
    - More labor requirement.
    - Time required for sowing is more.

IV. METHODOLOGY

1. Planning.
2. Designing of Model.
3. Selection of Components.
4. Fabrication of Model.
5. Execution.

PLANNING.

The basic aim of this project is to develop a multipurpose machine, which is used for digging the soil, seed sowing, and leveler to close the mud and water sprayer to spray water with least changes in accessories with minimum cost. This whole system of the vehicle works with the battery and solar power. The Automated seed sowing technology is a method design in order to reduce human efforts as it requires less amount of manmade Labour and can be handle efficiently without a skilled operator. Seeding manually requires lots of time, therefore this technology develops which eradicated much amount of time with proper efficiency, less time consuming, accuracy in sowing seed at a specific distance

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The base frame is made for the vehicle with 4 wheels connected and driven the rear wheel is a DC motor. At one end of the frame, the cultivator is fitted which is also driven by a DC motor, and the design is made to dig the soil.

DESIGNING OF MODEL USING SOLIDEDGE V19

Assembly modeling is a technology and method used by computer-aided design and product visualization computer software systems to handle multiple files that represent components within a product. The components within an assembly are represented as solid or surface models.

The designer generally has access to models that others are working on concurrently. For example, several people may be designing one machine that has many parts. New parts are added to an assembly model as they are created. Each designer has access to the assembly model, while a work in progress, and while working in their own parts. The design evolution is visible to everyone involved. Depending on the system, it might be necessary for the users to acquire the latest versions saved of each individual component to update the assembly.

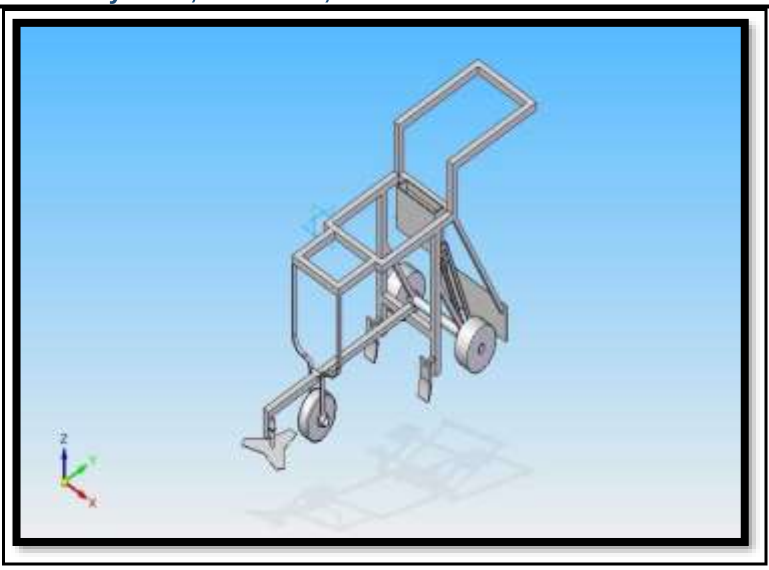

Fig 1. Assembled and Modelled in Solid Edge V19

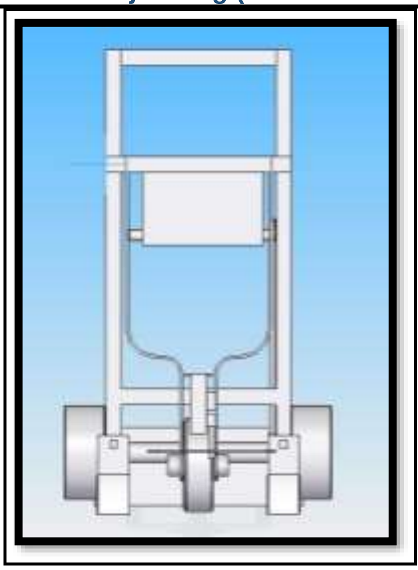

Fig 2. Front view

MESHED 3D MODEL FOR ANALYSIS IN ANSYS 18.1 WORKBENCH

Meshing is defined as the process of dividing the whole component into a number of elements so that whenever the load is applied to the component it distributes the load uniformly called meshing. A component is analyzed in two ways. One is with Meshing and the other is without meshing. ANSYS Meshing. ANSYS Meshing is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient metaphysics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model.

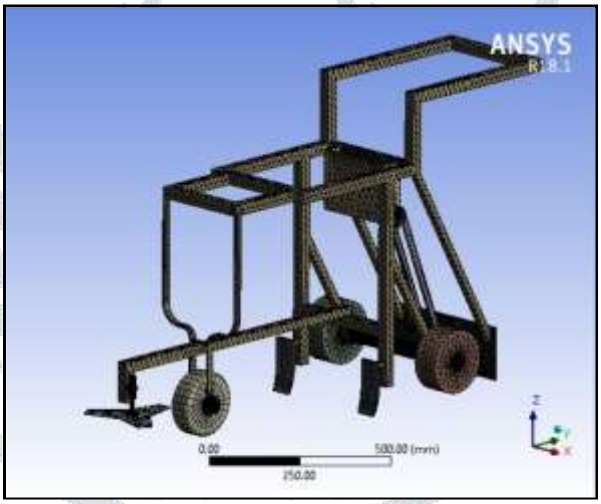

Fig 3. Meshed model in Ansys 18.1

- Mesh Details :

Statistics	
Bodies	10
Active Bodies	10
Nodes	22500
Elements	88180
Mesh Metric	Tetrahedral Quality
Min	7.19632415686877E-03
Max	0.996480279426868

V.CONDUCTING STATIC STRUCTURAL ANALYSIS USING ANSYS 18.1 SOFTWARE

STATIC STRUCTURAL ANALYSIS:

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. A static structural load can be performed using the ANSYS, or ABAQUS solver.

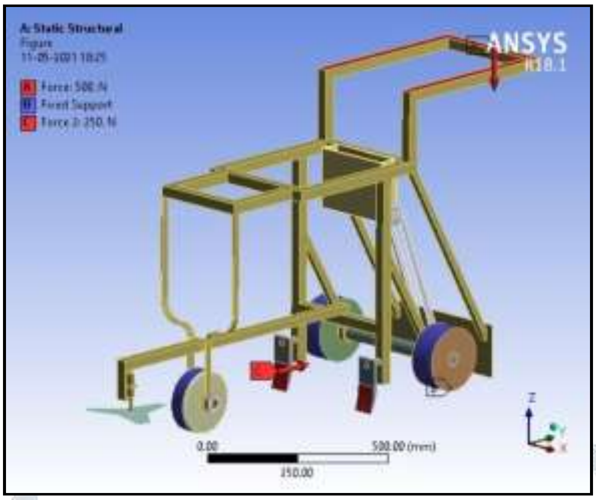

Fig 4. Applying boundary condition on the vehicle

The Three wheels are To be fixed, the load of 500N (52Kg) is applied on the Handle surface of the Vehicle Considering the surrounding temperature to be 22°C.

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
22	1.93e+011	0.31	1.693e+011	7.3664e+010

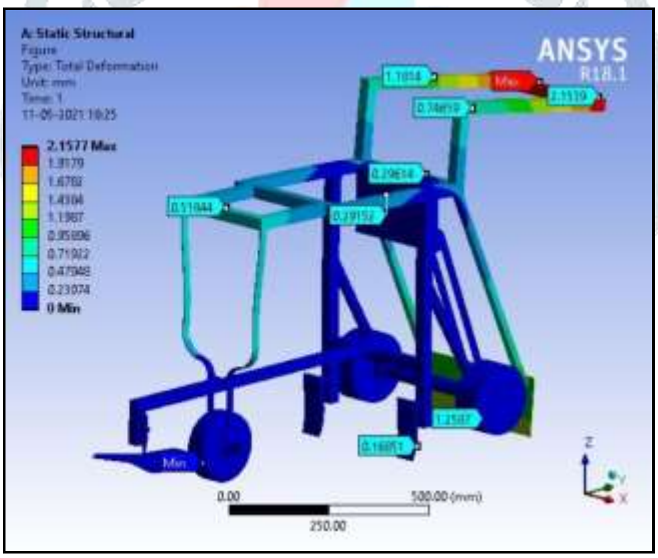

Fig 5. Total Deformation when subjected to load

Total Deformation result:

From Fig 5 the Total deformation along X-axis, Y-axis & Z-axis the max. deflection created is 2.1577e-005 mm and minimum deflection X-axis-axis & Z-axis is given as 0.23974e-005 mm that is the static structural deformation result on X-axis, Y-axis & Z-axis for 500N (52Kg) under time interval of 15 seconds

Fig 6. Von- Mises stress Acting on the body

Von- Mises stress result:

From Fig 6. the von- mises stress acting on the Vehicle max. The Stress created is 45 Mpa and min. von- mises stress Created 1.3485e-014 Mpa that is the static structural Stress result on X-axis, Y-axis & Z-axis for 500N (52Kg) under time interval of 15 seconds.

- **Types of Cyclic Loading**

1. Fully Reversed
2. Zero Based
3. Ratio
4. History Data

Fully Reversed cycle loading: One cycle of this type of loading occurs when a tensile stress of some value is applied to an unloaded part and then released, then compressive stress of the same value is applied and released. A rotating shaft with a bending load applied to it is a good example of fully reversing load.

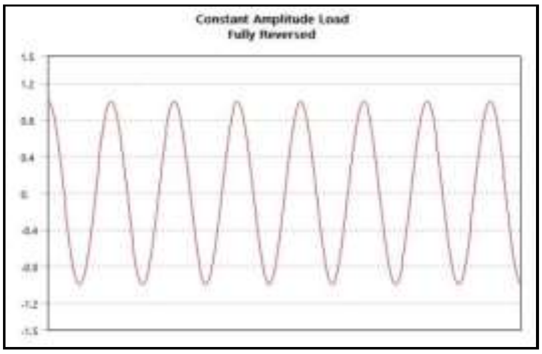

Fig 7. Constant amplitude cycle graph

Mean Stress Correction: The alternating stress amplitude for a stress cycle is computed as half the stress range in the cycle. The amount of damage caused by a stress cycle depends not only on the alternating stress but also on the mean stress. The effect of mean stresses on the cycles to failure is illustrated by the following diagram, called the Haigh diagram.

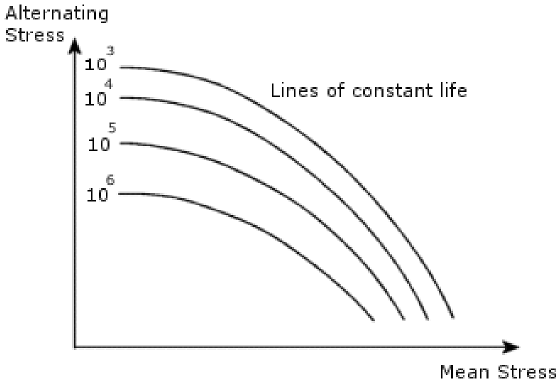

Fig 8.Haigh diagram

The mean stress is zero only when the load is fully reversible. The most straightforward case is when an S-N curve with the same R-ratio as the loading is provided. In this case, the S-N curve is directly used since no correction is needed. If you define S-N curves with different R-ratios, the software accounts for the mean stress by linear interpolation between the curves. If only one S-N curve with an R-ratio that is different from the R-ratio of the loading is provided, a correction is needed.

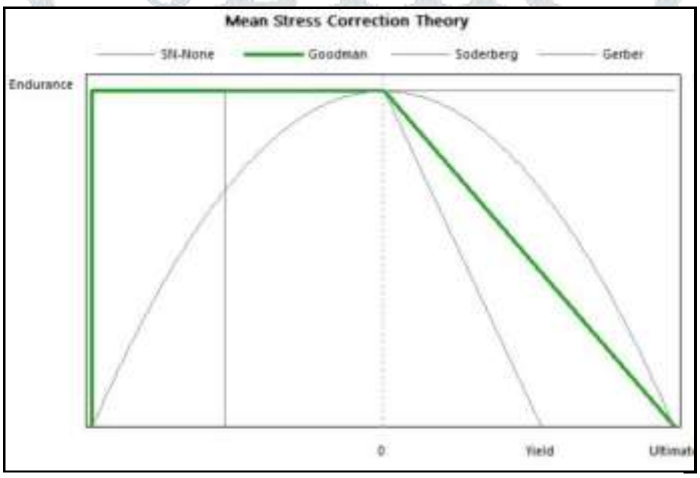

Fig 9. Mean stress correction graph of analyzed vehicle

VI.RENDERED 3D MODEL OF THE PROTOTYPE

Rendering or image synthesis is the process of generating a photorealistic or non-photorealistic image from a 2D or 3D model by means of a computer program. The resulting image is referred to as the render. The term "rendering" is analogous to the concept of an artist's impression of a scene.

Fig 10. Assembled And Rendered Modeled (Iso-metric view)

VII. CALCULATION

The calculation for rpm and shaft radius of the motor from motor power:

Assuming the force required for plowing of the field is around **300 N**

If we use a motor of **1 HP** the following calculations can be made-

1 HP = 746 Watts

Power Input, P_{in} = **746 Watts**

Power output, P_{out} = **P_{in} x Efficiency**

The efficiency of an electric motor to convert electrical energy to mechanical work done is assumed to be as **10%.**

At 10 % efficiency

Power output, P_{out} = **746 x 0.1 = 74.6 Watts**

As we know that,

Power = Torque x angular velocity = T x ω

Power = Force x shaft radius x angular velocity

74.6 = 300 x r x ω

r x ω = **0.25 m/sec** --------------- Equation 1

ω = **2 x π x n/ 60**

Using above equation, equation 1 can be written as,

r x n = **(0.25 x 60)/2 x π**

r x n = **2.42 m-rev per minute** -------------------Equation 2

At n=60 Rpm	At n=100 Rpm
Substituting n value in equation 2 **r = 40.33 mm** The moving speed of the vehicle at this rpm can be calculated as Velocity = angular velocity x radius of the front wheel **Velocity = 2 x π x 60 x 0.12 / 60 = 0.75 m/sec = 2.7143 km/hr**. The velocity of the vehicle obtained at 60 rpm is obtained as **2.7143 km/hr** which is less than the average walking speed of humans i.e., **5km/hr.** At this speed, the area that can be covered is given by: Area covered = Speed of the vehicle x space between 2 rows of plowing blade x 2 **Area covered = 2.7143 x 1000 x 0.20 x 2 = 1085.72 m^2/hr.** This means on 1 acre (**4046.86 m^2**) land, the seeds can be sown in **3 hours 45 minutes**.	Substituting n value in equation 2 **r = 24.2 mm** The moving speed of the vehicle at this rpm can be calculated as Velocity = angular velocity x radius of the front wheel Velocity = **2 x π x 100 x 0.12 / 60 = 1.2566 m/sec = 4.52km/hr.** The velocity of the vehicle obtained at 100 rpm is obtained as **4.5239 km/hr** which is less than the average walking speed of humans i.e., **5km/hr**. But at this speed, there will be difficulty in sowing seeds. At this speed, the area that can be covered is given by: Area covered = Speed of the vehicle x space between 2 rows of plowing blade x 2 **Area covered = 4.5239 x 1000 x 0.20 x 2 = 1809.56 m^2/hr.** This means on 1 acre **(4046.86 m^2**) land, the seeds can be sown in **2 hours 15 minutes**.

VIII. FABRICATION AND ASSEMBLY OF THE MODEL

Fig 11. Cutting Operation performed on Square pipe

Fig 12. Cutting Operation performed on sheet metal

Fig 13. Welding performed on the frame

Fig 14. Welding Operation Performed on wheels

Fig 15. Front View Of Vehicle

Fig 16. Completely assembled multipurpose seed sowing machine

IX. RESULTS AND CONCLUSION

Practically our multipurpose agricultural equipment can be used for tilling, sowing, leveling and also used for weed removal purposes. All the parts are connected in such a way that in every stage of agriculture the equipment can be rearranged or easily assembled with fasteners to the required length and specifications of field operation. A multipurpose sowing machine is designed for small farmers to improve their productivity.

The existing sowing machine had an individual storage place and separate seed metering mechanism which leads to more cost. The drawbacks in the existing sowing machine are rectified successfully in our machine. It will be more useful for small farmers and the agricultural society. Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labor effort and expenses. The whole idea of multipurpose equipment is a good concept and can be successfully implemented in real-life situations.

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