

Design and Analysis of Manual Grass Cutter

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Abstract

Now a days grass cutters are important stage in agriculture field. Currently in India farmers used conventional method for the grass cutting purpose. i.e manually cutting using labor but this method is lengthy and time consuming. This project aim is to design and analysis of these small field grass cutter machine for small height grass. This project is to analysis cutting roller and horizontal cutting blade by using ANSYS software. The machine consists of horizontal cutting blade to operate cutting roller. This manual grass cutting machine has a capacity to cut the grass in faster and economically low of cost. This machine is helpful for both the small farm as well as gardens.

Keywords: conventional method, economically, gardens.

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I. INTRODUCTION

Agriculture is the backbone of India. 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 opportunities having higher wage, migration of labour force to cities and low status of agricultural labours in the society. In India two type of grass cutting like as manual method (conventional method) and mechanized type of grass cutter. The grass cutting is important stage in agriculture field. Currently Indian farmer used conventional method for grass cutting i.e. cutting grass manually using labour but this method is very lengthy and time consuming. To design and analysis the grass cutter machine which is help to the Indian farmer which is in rural side and small farm. It will reduce the cost of grass cutting in field. It will help to increase economical standard in Indian farmer. The design of the grass cutting machine will be presented by using CATIA drawing software. The force analysis on the cutter blade, the force analysis on the roller cutter blade by using ANSYS 18.0 software. This rendered the cutter safe from the cutting forces.

1.1 METHODOLOGY

This stage of project is done to minimize the likelihood of error, management cost, assess risk, and evaluate the potential success of the intended project. in any event, once an engineering issue or problem is defined, potential solutions must be identified. Detailed survey on scholarly sources and reviewing on specific topics or other similar models or projects to identify relevant theories, methods and gaps in existing research and focusing on how to make it simple and relevance to the project title. Conceptual design sketching several type of design based on concept that is being selected and stating the dimension for all part. The finalization of the design is done as per the required dimensions and sketch. The selection of material is done based on model design and criteria which includes light weight, easy to weld or join and easy to manufacture and for assemble. The model is designed in the software and the cutting blade is statically and dynamically analyzed using the analysis software.

1.2 MATERIAL SELECTION

The choice of material for the design of the reel lawn mower was aimed at achieving high efficiency. This was achieved by selecting the appropriate materials with adequate working condition and stability of the component. The following table shows the materials used and their properties.

Table 1: Materials used and its parts

PARTS	MATERIALS USED
1.The Frames	Mild Steel of 1mm square pipe of 18mm gauge
2.Gears	Mild steel
3.Spiders	Mild steel of 4mm thickness
4.The blades	Mild steel
5.Handle	Mild steel
6.Shaft	Mild steel
7. Roller	Mild steel with rubber tapped

1.3 ANALYSIS OF MODEL

FEA is the basis of modern software simulation software, with the results usually shown on a computer-generated colour scale. While some theories state that FEA has its roots in the 16th century work of Euler, the earliest mathematical papers directly detailing the technique date back to Schellbach’s work of 1851. FEA was developed further by engineers from different industries around the world in order to solve a large number of structural mechanics problems, primarily in civil engineering and aerospace. The first development of FEA for real world applications began in the mid-1950s and was further developed over the next few decades.

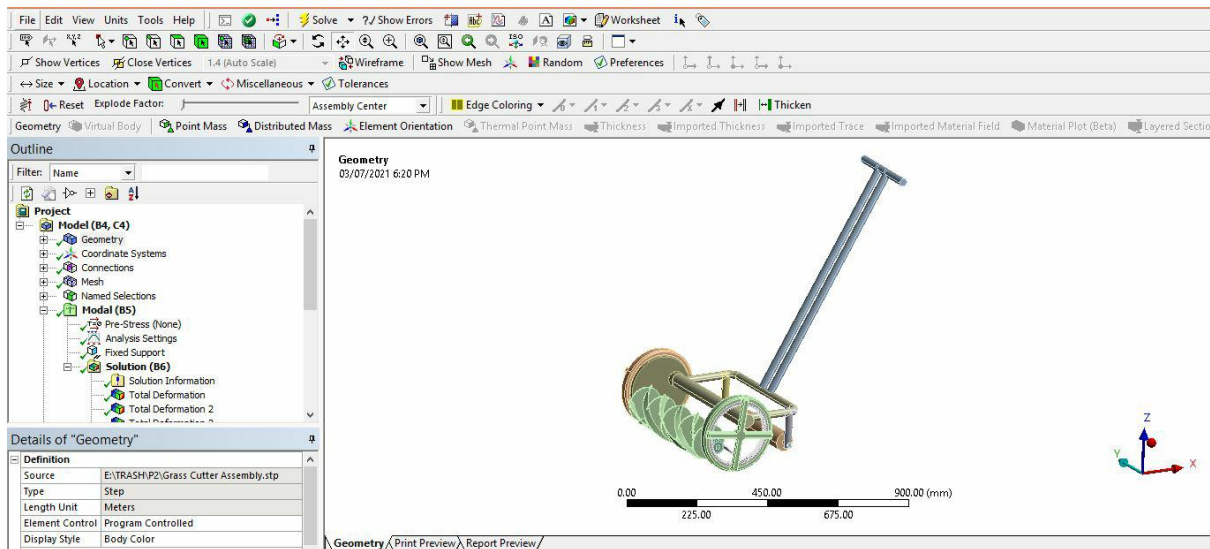


Figure 1: Geometry of Grass cutter (Assembly)

Material Data

The material used for the analysis of the Grass cutter assembly is **Structural steel**.

Table 2: material Data

Material Data	
Density	7.85e-006 kg mm ⁻³
Coefficient of Thermal Expansion	1.2e-005 C ⁻¹
Specific Heat	4.34e+005 mJ kg ⁻¹ C ⁻¹
Thermal Conductivity	6.05e-002 W mm ⁻¹ C ⁻¹
Resistivity	1.7e-004 ohm mm
Young's Modulus MPa	2.00E+05
Poisson's Ratio	0.3

Bulk Modulus MPa	1.67E+05
Shear Modulus MPa	76923
Yield Strength MPa	2.50E+02

1.4 Meshing

Grass cutter geometry model is meshed effectively. The mesh is mix of triangle and quadrilateral elements, which is said to be a good mesh. Which effectively absorbs the stress and strain produced in the geometry model upon subjected to load. Meshed model are shown in figure below.

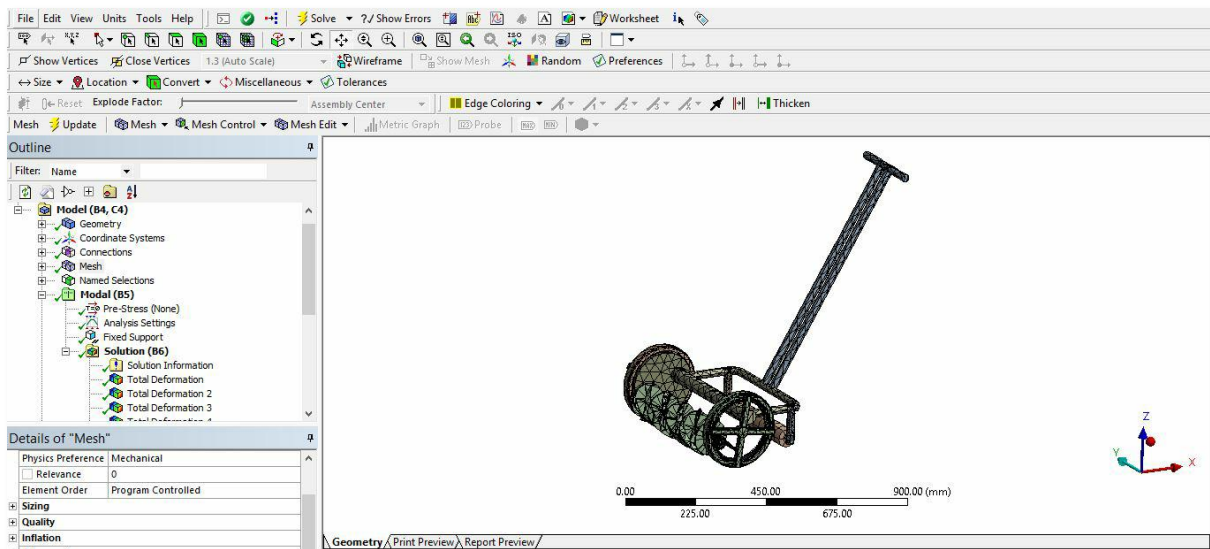


Figure 2: Meshed model

1.5 Boundary conditions

After the meshing is done, the model is provided with its boundary conditions. The boundary conditions include fixed supports, Forces, Gravity load will be applied. The grass cutter is applied with possible boundary conditions as shown in the fig shown below.

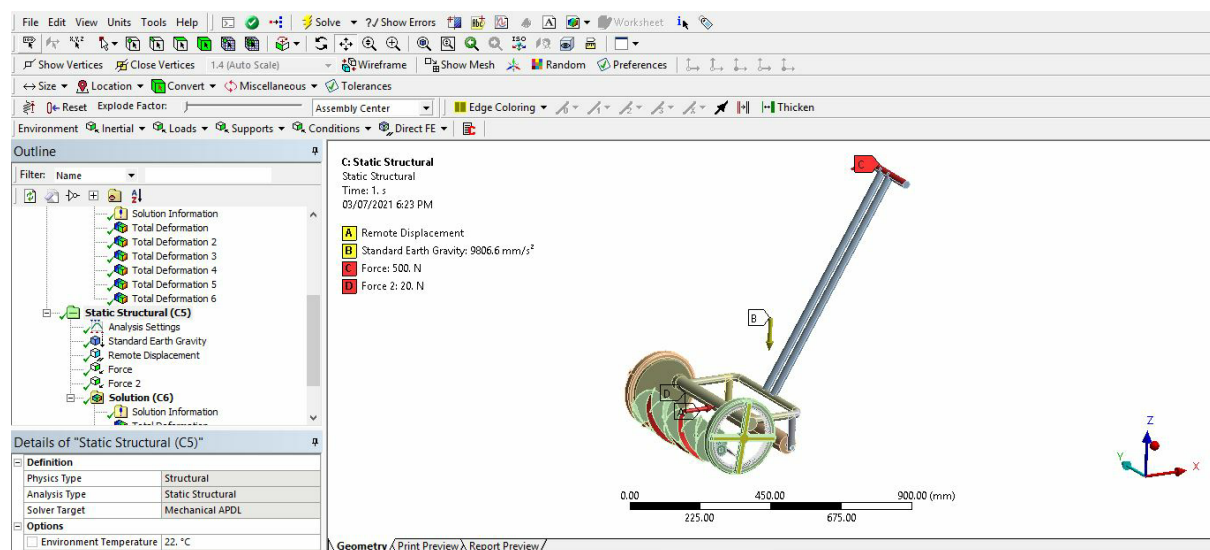


Figure 3: boundary conditions

II. RESULT AND DISCUSSION

2.1 WORKING MECHANISM

The mechanism of a manual grass cutter is quite simple. There is cylinder drum that has several helical blades that are welded for the circular plate called as spider. The shaft of the cylindrical drum is connected to the pinion, which further connected with the internal spur gear that is mounted with the wheel. In the working, human force is applied for the movement of the wheels through handles that are connected to the covering plate. As soon as the wheel moves forward the internal spur gear which is intern connected on the either of the wheel transmits rotation to the pinion gear and the generated torsional motion transmits to the shaft of the circular drum. As drum rotates the blades, which are connected starts to rotate and cutting action is activated when grass meshes between the rotating blade and stationary that is connected just below the helical blades get cuts. To put it in easier terms, the working of a grass cutter is akin to a pair of paper scissors.

2.2 Finite element analysis

The analysis of manually operated grass cutter structure is done with the help of FEA commercial software ANSYS workbench. First stage prepares the CAD model of Go-kart using SOLIDWORKS Software & model importing into the geometry in ANSYS workbench. Further that the material selection is done from in engineering data sheet of FEA package software. Meshing or discretization done as tetra mesh a solid element is generated is to required small pieces. Static structural analysis Grass cutter model weight is distributed in equilibrium condition. Stress analysis model is assumed as stationary and constrained as show in figure. And assumed pushing load as 500N to the handle and force over the cutting blade and gravity is applied to the overall structure. However stress and displacement is within the limit thus structure is safe.

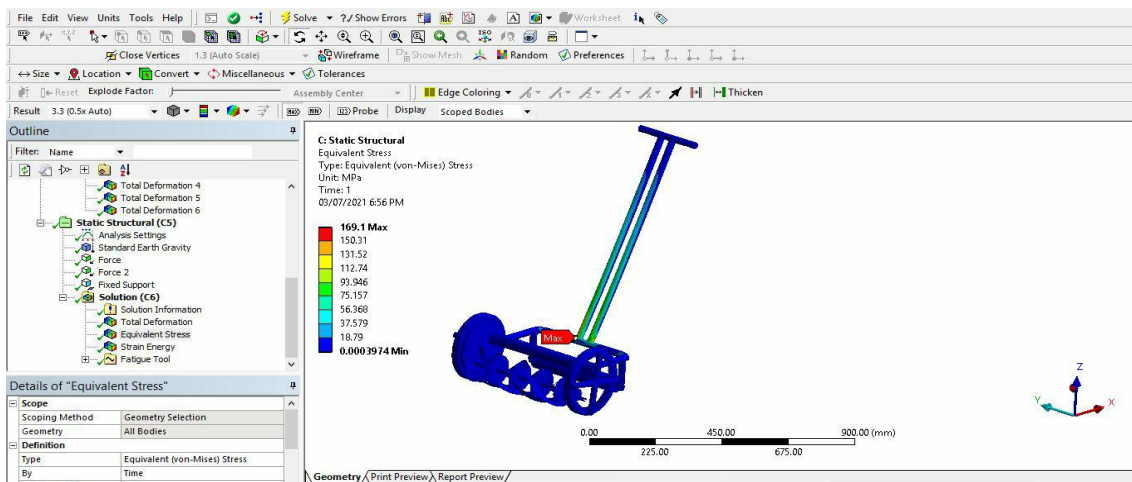


Figure 4: stress distribution

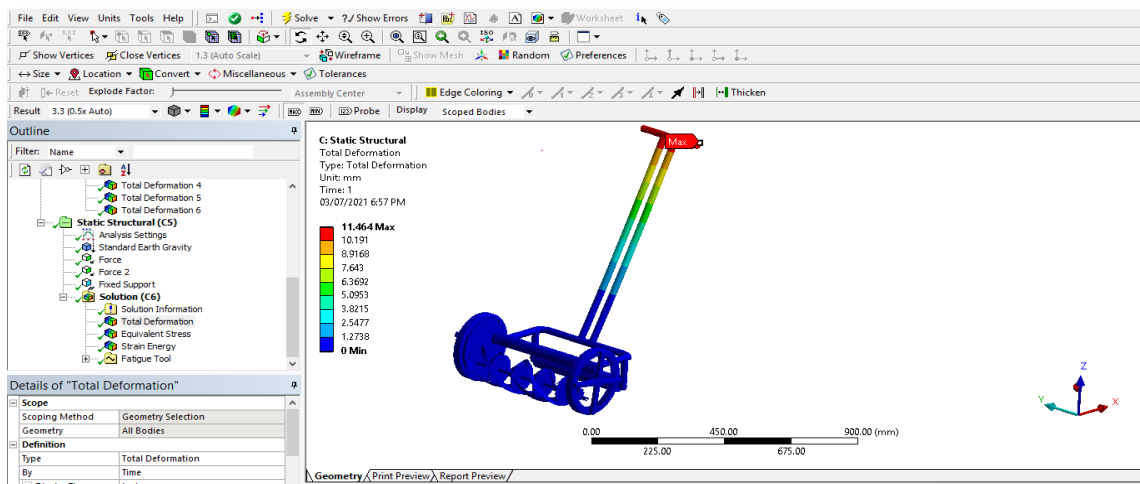


Figure 5: displacement plot

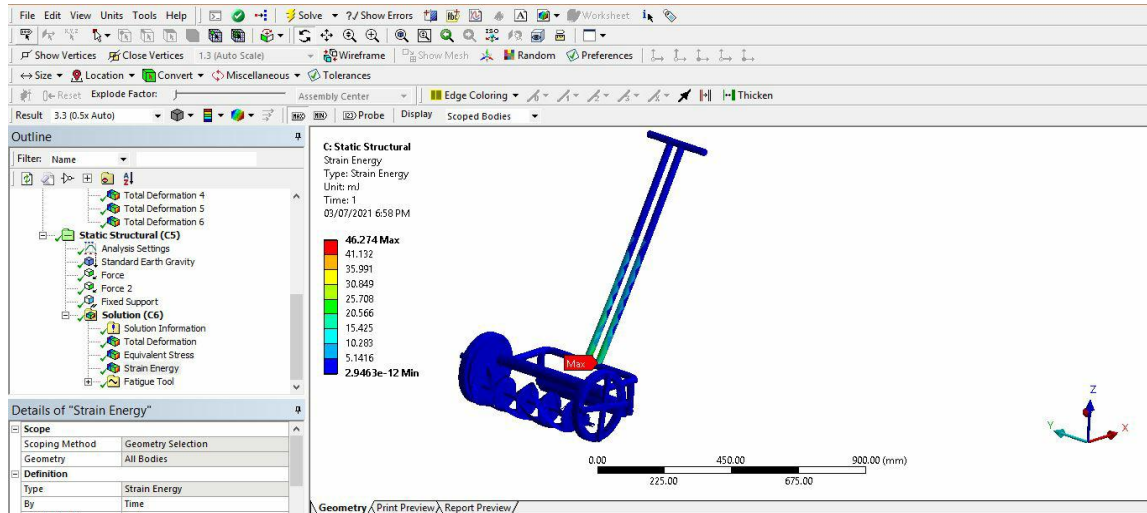


Figure 6: strain energy

From the given data and boundary conditions applied we get the following results as tabulated below.

Table 3: results

Static structural Analysis of structure	
Total Deformation (mm)	11.46
Von Mises stress (Mpa)	169.1
Strain Energy (mJ)	46.2

The table above shows the comparative study of Strain Energy, stress, Deformation during analysis in structural steel and results were summarized. Stress induced in material 169.1 MPa which is lower than the yield stress. It was probably due to high specific strength of material and its ability to get denser. The deformation was 11.46 mm and the strain energy stored by the system is found to be 46.2 mj.

III. CONCLUSION

Here by overall conclusion of this project is that the Analysis has been carried out to know the details that to be done in the project. We had done the conceptual design of manually operated grass cutter and we had gathered some of the inputs by literature survey, books for the design aspects. We have done the actual design of the manually operated grass cutter; we have selected materials for the project components. The design of the actual appearance of the grass cutter has been done taking some of the input from the literature survey work and reference. Analysis for the model as per the required dimensions using suitable materials are carried out in this project.

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