DESIGN AND STRUCTURAL ANALYSIS OF SOLAR GRASS CUTTER USING CAE TOOLS

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Abstract: A Solar grass cutter is a machine that uses roller blades to cut a lawn at a faster rate. Solar grass cutter can operate manually and motor driven. This is one of sophisticated device in a field. Power consumption becomes essential for future. Solar grass cutter is a very useful device which is very simple in construction. It is used to maintain and upkeep lawns in gardens, schools, college's etc. Our aim is to analyze on the blade by using different materials like Steel and Iron for the grass cutter. .Even unskilled person can operate easily and maintain the lawn very fine and uniform surface look. In our project, solar grass cutter is used to cut the different grasses for the different application. The solid model of cutter machine and blade is developed in Catia. Tetrahedral mesh is generated for the model using Ansys. Static, Eigen and frequency responses analysis of both body and steel blades are carried out. Inter laminar shear stresses are calculated for composite propeller by varying the number of layers. The present thesis deals with modeling and analyzing the cutter blades of a grass cutter machine for their strength. A propeller is a complex geometry which requires high end modeling software.

I.INTRODUCTION:

A Grass crusher provides for pulverization of Grass to a yield size of 2" or less. Recycling operations may range from simple, manually-fed, self-contained machines to extravagant Cutting systems complete with screens, conveyors, crushers and separators. All non-Grass contaminants must generally be removed from the Grass prior to recycling. The processes used in Grass Cutting for recycling involves the same methods used by the aggregate industry for Cutting into small pieces of Grass (Grass crusher).

Technology is changing people's labor patterns, in the s a me way, the Grass Cutting process is also changing all the time. The traditional Grass Cutting production process has been far from meeting requirements of the people. Only advanced new type Grass crusher and its intelligent process can meet the development of the industry.

Zambia is rapidly pushing on the national infrastructure, which not only requires a lot of building materials, but also needs a lot of Grass. As we all know, Grass used in Crushers Grinding Mills all aspects of our lives, not only have the function of function, but also have decorative effect. After large-scale urban infrastructure and demolition, the remaining Grass mostly become was trend also occupy large space, the most important thing is that it easily causes injury or death if we misplace the Grass. In addition, a t the same time, we need a lot of Grass productions. So it is very important and urgent that how do we can turn was Grass into treasure, save resources and a lot of urban construction funds.

Most conventional Grass machines crush Grass only into cullet. The resulting cullet is used for making Grass again if it is transparent, and other cullet is mixed in secondary products, asphalt and blocks. The cullet, however, is low-value-added products, and its use in business is limited. On the other hand, produced

by the Waste-Grass Recycling Plant, has a wide range of application, such as a light embanking material in civil engineering, a culture medium or an inorganic soil amendment in horticulture and agriculture, a purification material in water purification and an insulator in architecture. It is now used in various areas for various purposes.

However, modern Grass Cutting process has been far different from the traditional method, which adopts the system of float Grass Cutting production. The system is mainly composed of fall of plate, plate and crusher machine. The equipment conveys the unqualified Grass fall in the assembly line directly to roller crusher Cutting floor warehouse for secondary Cutting and mashing, so it falls an angle through the fall plate, then connect plate roller cohesion, unqualified Grass been transported to the Automatic Grass Cutterry, there is a cone Cutting warehouse below plate and crusher, the bottom of the Cutting warehouse install secondary crusher, the crushed class after secondary Cutting been into circulation over belt system, Board roller Grass and crusher are openly install on the floor, dust with entry and exit of crusher all can fly out and then touches the roller conveyer equipment and the transferring qualified Grass surface, the second Cutting is also like this.

These are the new flow of modern Grass Cutting process which compared with the traditional Cutting method is method more safe and efficient, it is also very helpful for enterprise's long-term investment interests. Ti me in constant progress, The New Type of Grass Crusher has some technical updates every yea r, for time is money in the market competition, which can make the biggest production efficiency in the shortest time will win the advantage in the market.

II - LITERATURE REVIEW

Srishti Jain, Amar Khalore and Shashikant Patil et al. according to the author a solar powered vision based robotic lawn mower which provides automatic lawn mower that will helps the user the independence to cut the grass with less effort. Unlike other robotic lawn mowers, this design requires no perimeter wires to maintain the robot within the lawn and also with less human effort in the manual mode operation. Through an array of sensors safety takes major consideration in the device, this robot will not only stay on the lawn, it will avoid and detect objects and humans. Here they used a 12v 310mA solar panel in their project. Each contributing to 0.5v each. They could attach a battery but as the lead acid rechargeable battery used is rated 12v 1.2Ah, it won't be overcharged due to the small output of solar panel. To detect the obstacles, they used IR sensors. There are two sensors, one on each side. This is because in case the obstacle is on the left then it will move in right direction and if the right sensor detects the obstacle then it goes towards the left. But disadvantage is that sometimes response of the system is too slow so in real time high end DSP processors is recommended that can process much faster.

Ms. Rutuja A. Yadav, Ms. Nayana V. Chavan, Ms. Monika B. Patil, Prof. V .A. Mane et al. according to the author a daily purpose robot which is able to cut the grass in the lawn. The system will have some automation work for guidance and other obstacle detection and the power source that is battery and a

solar panel will be attached on the top of the robot because of this reduces the power problem. Automated solar grass cutter are increasingly sophisticated, are self –docking and some contain rain sensors if necessary, nearly eliminating human interaction. The system is switched to automatic mode in which the robot's infrared sensors make a comparison between, cut and uncut the grass. The mower continues this process until it completes the job. The system uses 12v batteries to power the vehicle movement motors as well as the grass cutter motor. They also use a solar panel to charge the battery so that there is no need of charging it externally. The grass cutter and vehicle motors are interfaced to an 8051 family microcontroller that controls the working of all the motors. It is also interfaced to an ultrasonic sensor for object detection. The microcontroller moves the vehicle motors in the forward direction in case no obstacle is detected. If in case obstacle is detected by the sensor then the microcontroller stops the grass cutter motor so as to avoid any damage to the object/human/animal coming.

Ms. Bhagyashri R. Patil, Mr. Sagar S. Patil et al. according to the author, human enlargement in many countries there are studies and trials going on the solar energy and the wind energy, so they made their new concept solar power Automatic Grass Cutter. In this concept they cut the grass on the agricultural land or small plants in lawns and gardens. The design of solar powered agricultural equipment will include direct current (DC) motor, a rechargeable battery, solar panel, a stainless steel blade and control switch. The

Automatic Grass Cutter is going to perform the grass cutting operation by its own which means no manpower is essential. The purpose of the project here is to design and build a remote controlled grass cutter. The device consists of linear blades and it does not affected by climatic conditions. They have used many components for preparing grass cutter like DC Motor (3) for rotating the wheels and blade, wheels (4), battery, Solar panel, IR sensor, Collapsible blade. There are two main components such as transmitter and receiver. Transmitter continuously transmits the rays if any obstacle come in front of grass cutter then the rays are reflected back towards the receiver. The receiver receives the signal in the serial form from encoder but microcontroller requires parallel data for communication so receiver sends data to decoder to convert data in the parallel form and then it is passed to microcontroller.

Vicky Jain et al. proposed a wireless grass cutter that uses solar panels for extracting photovoltaic energy. Hence batteries don't have to be externally charged or replaced. The battery is continuously charged at constant voltage even when the grass cutter is working. It is a remote-controlled device. It makes use of two DC motors and hence both forward and backward motion of grass cutter is simultaneously possible.

Ashish Kumar et al. discusses an experimental study of Solar Power Grass Cutter Robot. In this paper, the author explained how the solar plate placed above the grass cutter generates solar energy and uses the obtained energy for the functioning of the grass cutter. For preventing the battery from overcharging and over

discharging, a voltage regulator or a charge controller is placed into the system which must be placed in a series. It specifies extensions to a simple model under the paper's discussion such as using a driver circuit for controlling the speed of the motor as per the requirement. Other extensions can be the usage of LCD screens for status and energy generation monitoring purposes, provision of power banks to charge the machine instantly when there is a scarcity of solar energy such as during rainy seasons.

Pratik Patel, Ashwini Bhosale et al. in their paper outlines non-solar energy based automated grass cutter. Automation is achieved through the use of different sensors. The feature that stands out in their model is the use of an LCD Screen and keypad system to allow users to provide input regarding the area to be cut in terms of X and Y axis. This allows for customizing the cutting patterns, for instance cutting the lawn area in shapes of letters or words.

T. Karthick, S et al. in his paper fabricated Automatic Grass Cutter with rotary blades by using solar energy. The photovoltaic energy based system uses linear or rotary blades that slide linearly to cut the grass. The level at which the grass must be cut can be adjusted by considering ground clearance. The fabricated machine is more oriented towards providing a low cost and environment-friendly solution that can be used even by unskilled operators. It does not put forward automation and sets up a manually operated system.

III - WORKING METHODOLOGY

3.1 Automatic Grass Cutter

Grass Crusher Machine is to use the high rotation speed hammers to crush the waste Grass coming into the Cutting chamber of the Grass crusher machine.

The principle of small Grass crusher machine is as follows:

In the Cutting chamber of the Grass crusher machine, there are many hammers which are installed on the center shaft t. The motor make the center shaft rotate in high speed. Thus, the hammers on the center shaft also rotate in high speed.

The waste Grass goes into the Cutting chamber through the feed inlet, and then it is crushed by the high speed hammers into small pieces.

On the bottom of the Grass crusher machine, there is half-round sieve, and on the sieve there are many holes. Only the small Grass pieces can go through the sieve, the big size Grass pieces will be crushed again by the hammers.

3.2 Working Principle of Crusher:

The structure of crusher: main frame, eccentric shaft, a large belt pulley, fly wheel, swing , side guard plate, toggle plate, Rear bracket, adjust gap screw, reset spring, and fixed and swing board etc., and the toggle plate also plays a role of protection.

The motor transmits power through belt and belt pulley, drives the swing surround the eccentric shaft do periodic motion. The angle between toggle plate and swing increases when swing moves up., which makes the moving get, closes to the fixed.

At the same time the material is squeezed, rubbing, grinding and other multiple broken. The angle of Crusher between toggle plate and swing decreases when swing moves down, the moving of Crusher moves away from fixed by the pulling of rod and

spring, the products after Cutting will be discharged from the outlet of Crusher.

IV - DESIGN METHODLOGY OF AUTOMATIC GRASS CUTTER

4.1 Introduction to CATIA

CATIA (Computer Aided Three-dimensional Interactive Application) is a multi-platform CAD/CAM/CAE commercial software suite developed by the French company Dassault Systems. Written in the C++ programming language, CATIA is the cornerstone of the Dassault Systems product lifecycle management software suite. CATIA competes in the high-end CAD/CAM/CAE market with Cero Elements/Pro and NX (Unigraphics).

The 3D CAD system CATIA V5 was introduced in 1999 by Dassault Systems. Replacing CATIA V4, it represented a completely new design tool showing fundamental differences to its predecessor. The user interface, now featuring MS Windows layout, allows for the easy integration of common software packages such as MS Off Grass, several graphic programs or SAPR3 products (depending on the IT environment).

The concept of CATIA V5 is to digitally include the complete process of product development, comprising the first draft, the Design, the layout and at last the production and the assembly. The workbench Mechanical Design is to be addressed in the Context of this CAE training course.
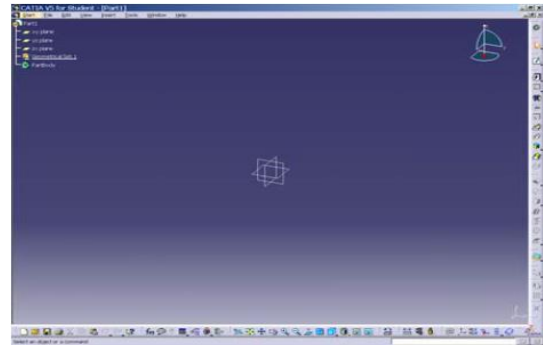
Fig: 4: Home Page of CatiaV5

CATIA enables the creation of 3D parts, from 3D sketches, sheet metal, composites, and molded, forged or tooling parts up to the definition of mechanical assemblies. It provides tools to complete product definition, including functional tolerances, as well as kinematics definition. CATIA facilitates the design of electronic, electrical as well as distributed systems such as fluid and HVAC systems, all the way to the production of documentation

Modeling of Automatic Grass Cutter

This Automatic Grass Cutter is designed using CATIA V5 software. This software used in automobile, aerospace, consumer goods, heavy engineering etc. it is very powerful software for designing complicated 3d models, applications of CATIA Version 5 like part design, assembly design. The same CATIA V5 R20 3d model and 2d drawing model is shown below for reference. Dimensions are taken from. The design of 3d model is done in CATIA V5 software, and then to do test we are using below mentioned software's.
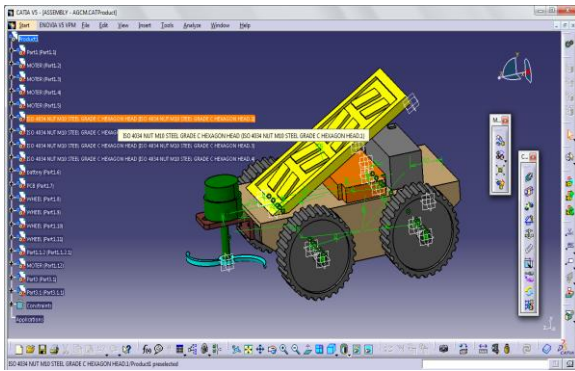
Fig: 13: Model design of AGCM in CATIA-V5

V - ANALYSIS OF AUTOMATIC GRASS CUTTING VEHICLE

5.1 Procedure for FE Analysis Using ANSYS:

The analysis of the Crusher blade, bushes, Tubs, & shafts are done using ANSYS. For compete assembly is not required, motor and attached pulley system is to carried out by applying moments at the rotation location along which axis we need to mention. Fixing location is bottom legs of rod assembly machine.

5.2 Preprocessor

In this stage the following steps were executed:

- Import file in ANSYS window

- File Menu > Import> STEP > Click ok for the popped up dialog box > Click

- Browse" and choose the file saved from CATIAV5R20 > Click ok to import the file
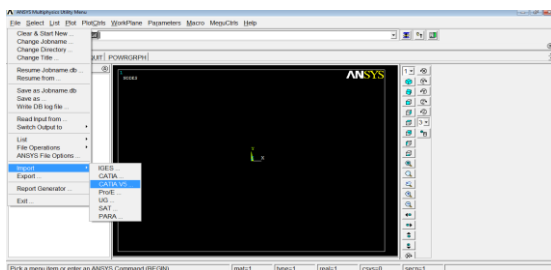
Fig.34: Import panel in Ansys.

5.2.1 Meshing:

Mesh generation is the Grass of generating a polygonal or polyhedral mesh that approximates a geometric domain. The term "grid generation" is often used interchangeably. Typical uses are for rendering to a computer screen as finite element analysis or computational fluid dynamics. The input model form can vary greatly but common sources are CAD, NURBS, B-rep and STL (file format). The field is highly interdisciplinary, with contributions found in mathematics, computer science, and engineering. Three-dimensional meshes created for finite element analysis need to consist of tetrahedral, pyramids, prisms or hexahedra. Those used for the finite volume method can consist of arbitrary polyhedral. Those used for finite difference methods usually need to consist of piecewise structured arrays of hexahedra known as multi-block structured meshes.

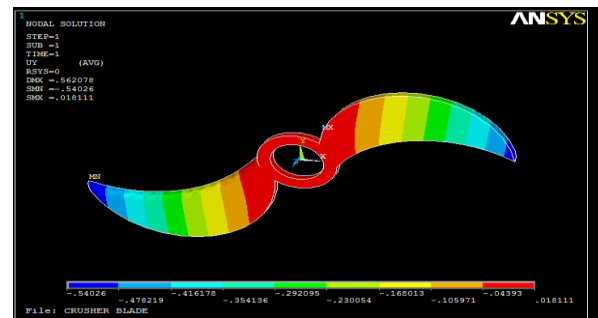## VI - DISCUSSION ON ANALYSYS RESULT

6.1 Results of Displacement analysis:
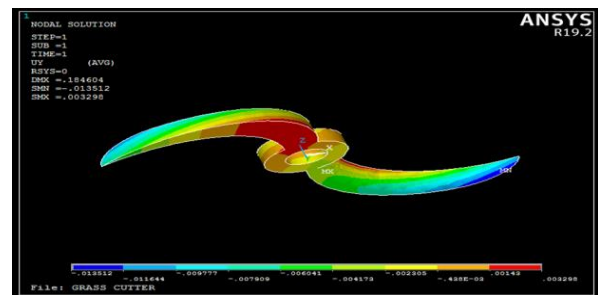

Fig: Displacement of Crusher Blade – Iron

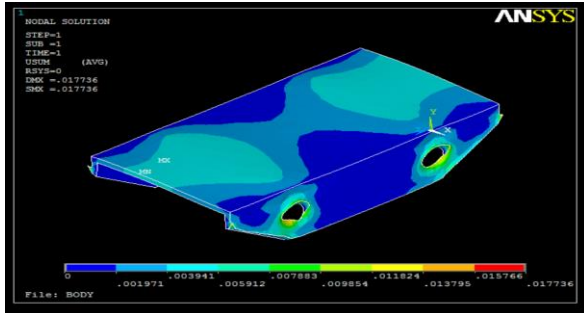**Fig: 54.2: Displacement of Crusher Blade – Steel**

Fig: Displacement of Body

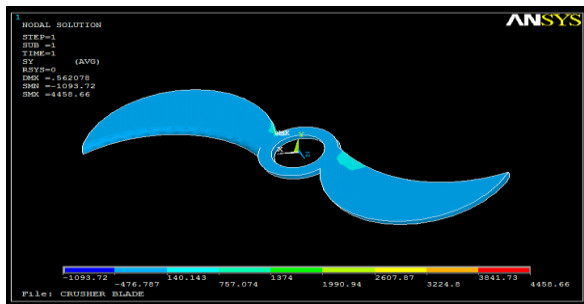**6.2 Results of Stress analysis:**

Fig: Stress Analysis of Crusher Blade – Iron
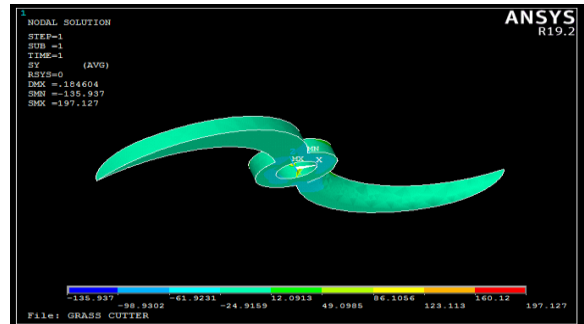

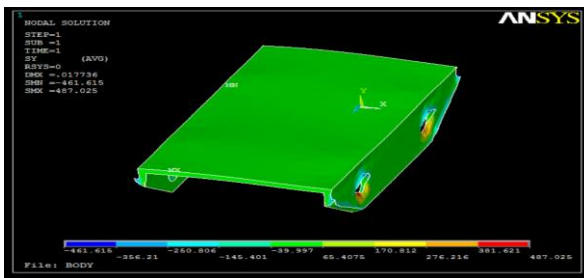**Fig: Stress Analysis of Crusher Blade – Steel**

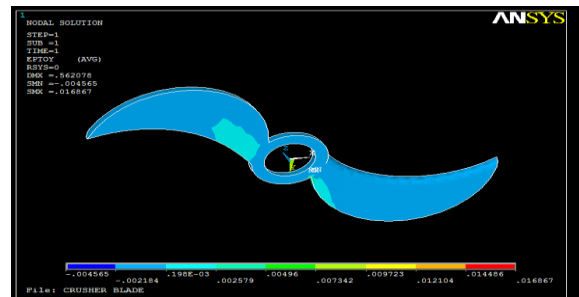**Fig: Stress Analysis of Body**

6.3 Results of Strain analysis:

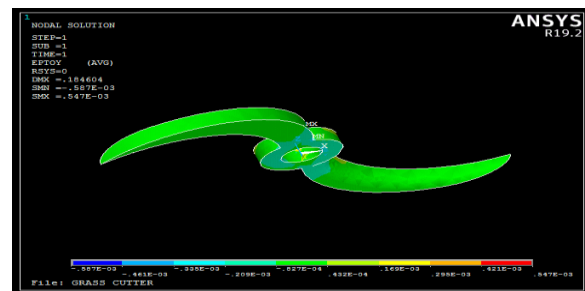**Fig: Strain Analysis of Crusher Blade – Iron**

Fig: Strain Analysis of Crusher Blade – Steel
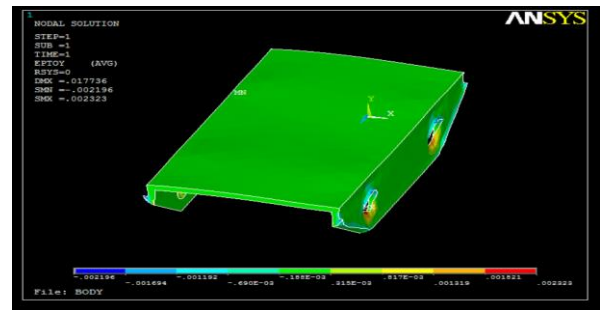

Fig: Strain Analysis of Body

VII - CONCLUSION

Most conventional Grass Cutting Vehicles cut Grass and resulting cullet is used for making Grass again if it is transparent. As shown above figures the displacement, stresses and strains of the complete assembly is meshed and solved using Ansys and displacement is very less. This is showing us that clearly each component in gear assembly is having minor displacement. Stress is at the fixing location (Minimum Stress which is acceptable). The value is which is very less compared to this is below the yield

point as given in the analysis results. The maximum stress is coming, this solution solving with the help of Ansys software so that the maximum stress is less. So we can conclude that the steel has adopted better results that Iron for cutter blade as per our design parameters which are approximately correct.

The final result positive manner .There is no problems while the design of the machine. Final assembly is designed and it can go without failure. For proving that above analysis is carried out. Grass Cutter has a wide range of application, such as a light embanking material in civil engineering, a culture medium or an inorganic soil amendment in horticulture and agriculture, a purification material in water purification and an insulator in architecture. It is now used in various areas for various purposes. The stresses obtained are well within the limit of good Cutting and hard elastic property of the materials. The results were compared with failure theory and found they were within the safe limits.

VIII.REFERENCES

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