International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 847-852 www.ijaem.net ISSN: 2395-5252

Design and Analysis of Rotavator Blades by Using Ansys Software

Prof.K.R.Sontakke[1], Mr.Prashant R. Ubarhande[2]
[1](Associate Professor, Dept. of Mechanical Engineering, Pankai Laddhad Institute of Technology,Buldana(MS), India)
[2](P.G. Student, Dept. of Mechanical Engineering, Pankai Laddhad Institute of Technology,Buldana(MS), India) ,(MS), India)

Date of Submission: 22-06-2020 Date of Acceptance: 10-07-2020

ABSTRACT

In this research paper Design and analysis of Rotavator blade on the basis of simulation and finite element method is done by using ANSYS software. In India farming the preparation of seedbed for deep tillage using additional machinery and tillage tool are increased. Rotavator or Rotavator tiller is one of the tilling machines most suitable for seedbed preparation. In a rotary tillage machine most important and critical part are blade which are engaged with soil to prepare the land and to mix the fertilizer. These blades interact with the soil in a different way. Which are subjected to impact that creates cyclic force which results in fatigue failure of the blade. Therefore it is necessary to design and develop of blade. The proposed work result are identifying sufficient tolerance in changing the material such as EN24 steel and EN8 steel and the dimension of Rotavator blade also changes for reliable strength. The present geometry working model with tillage blade is analysis to new design change for maximum weed removal capacity. Then better design will be compared by comparing the result

Keywords: Rotary tillage tool, Simulation, FEM design analysis.

I. INTRODUCTION

Rotavator is a tractor drive rotary tillage implementation this is also called as tillage machine this rotary tillage machine is used in soil bed preparation and also weeds control in arable field and fruit gardening. Rotavator has huge capacity of mixing to topsoil preparing the seedbed directly. And also it has more mixing capacity seven times than the plough. Its component work under miscellaneous force because of power, vibration, pointless impact effect of soil part as after reaching to higher side. The design optimization error and manufacturing error can be minimized by its component design analysis and optimization.

The most important and critical part of the Rotavator is blade. Especially blade and transmission element other component of Rotavator have to be reliable in field the performance against to operating force. The design optimization of tillage tool is obtained by reducing its cost, weight and by improving field performance to higher weed removal effiency. The analysis has been prepared a three dimensional solid modeling and application of finite element analysis method are getting so widespread in the industry.

The undesired stress distribution component, it cannot compensate to the operating force in the field of environment and result in breakdown and failure due to higher stress and deformation. The proposed work has developed a computer aided experimental system for design testing and valuation of agricultural tools and equipments. The selected physical model of Rotavator has been measured with accurate dimensions and 3D solid model is prepared in CAD-software such as ANSYS, CATIA, Pro/E, SOLID WORKS etc.

1.1Rotavator/Rotary tiller

Rotavator is mainly used in agriculture which is used in soil-bed preparation and fruit gardening agriculture. It has huge capacity for cutting it has higher soil mixing capacity to topsoil preparing the seedbed direct. Rotavator saved 30-35% of time & 20-25% in cost of operation as compared to tillage by cultivator. It gives 25-30% quality of work than tillage by cultivator.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 847-852 www.ijaem.net ISSN: 2395-5252

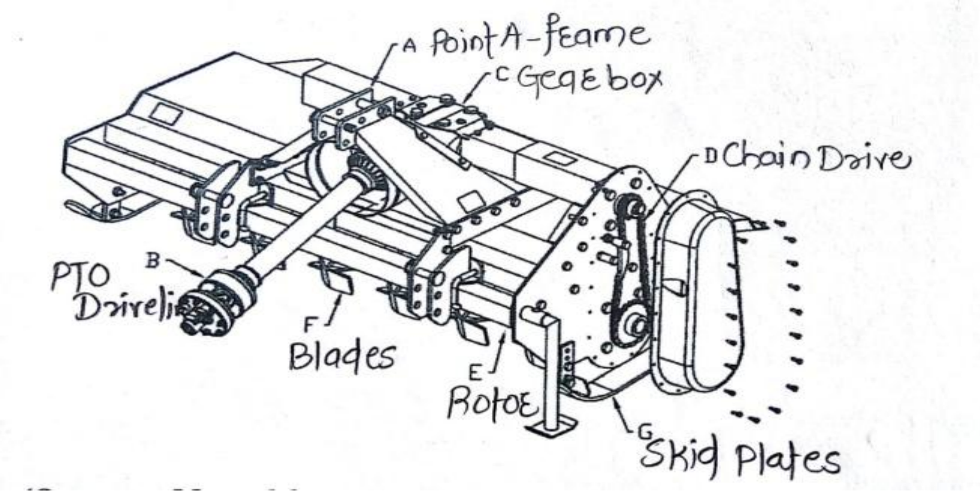


Fig 1.1. Rotary tillage tool component

II. TYPES OF BLADE

Rotavator blades are mounted on a flange, this flange are attach to the shaft of Rotavator. This is driven by power-take-off-shaft. There are three main types of Rotavator blades. 'L 'blade, 'C blade & 'J' blade. L blades are used for general work. And C blade is used when working in heavy and pluggy clay soil.

- L blade
- C blade
- J blade

1 'L' blade. This type of blade having a long shank blade as the name implies, than the standard power blade. This allows the greater clearance between the rotor and blade. And due to this the greater depth of cultivation is obtained.

2 'C' blades. This blade is more efficient self cleaning action less use of power and produced a coarser finish than the other blades.

Fig 2.1 'L' 'C' 'J' Type blade.

After reviewing of research of past studies some general conclusion are drawn.

- L-shaped blades are better than the C or J type blade in trashy condition
- The Rotavator tiller has a huge cutting capacity, mixing to topsoil preparing the seedbed directly. And also it has seven times more mixing capacity than plough.
- Normally the average service life time of Rotavator blade is 20-200 hours.

III. RESEARCH OBJECTIVES

1. To find out Deformation analysis.
2. To evaluate model analysis.
3. To compare existing design with new modified design and identify the scope in design modification.
4. With the rotor blades cutting upward, the tilled soil was scattered out of the seeding furrow and a seedbed was not formed. A down-cut process is therefore necessary for effective seedbed preparation.

IV. METHODOLOGY

The proposed work results in identifying sufficient tolerance in changing the material; (EN8 steel & EN24 steel). It is expressed in following methodology as,

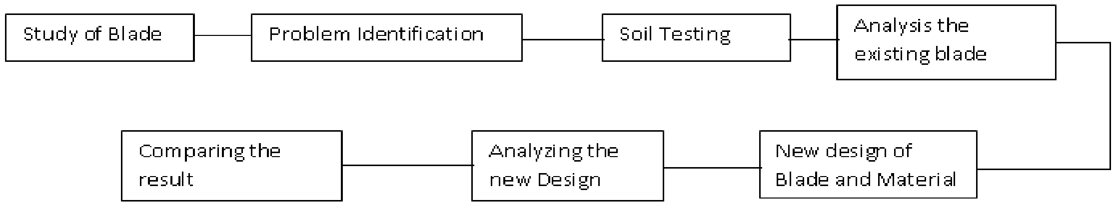


Fig 4.1. Methodology

V. PROBLEM IDENTIFICATION

The problem is that existing design cannot withstand the given load condition cause this that Rotavator blades get break while cultivation and also identified the working hour for blades is maximum up to 20-200hr, but cultivation time is more and hence it is not suitable for the farmer to use it hence we need to design new blade which withstand higher load condition and working for longer hours.

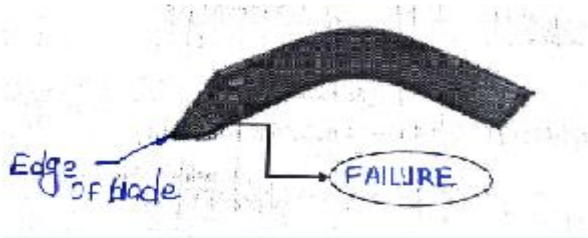


Fig. 5.1 Failure in Blade (Mild Steel)

VI. MODELING AND ANALYSIS

It is very difficult to find the best design. For Rotavator blades, there are still research are being carried out to find out the best best design of Rotavator blade, to find out the behavior of blade during agriculture application. There is always a need of some assumption to made any complex geometry.

The assumption which are made while modeling the process are given below,

- The domain is considered as axis-symmetric.
- The blade material is considered as isentropic and homogeneous.
- Inertia and body force effect are negligible during the analysis.
- The analysis is based on pure force loading and displacement and thus only stress level due to the above said is done. The analysis will determine the life of the blade.

VII. SOIL TEST USING CORE CUTTER

The core cutter is device which is used for testing the soil in agriculture. By using core cutter. Test the impact load on the soil by using core box is able to find the density.

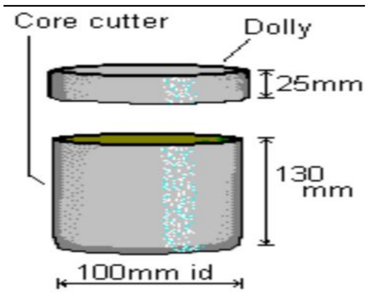


Fig 7.1 Core cutter

The dimensions of core cutter which is used for testing.

Diameter of core cutter	100mm
Height of core cutter	130mm
Diameter of Steel dolly	100mm
Height of steel dolly	25mm
Weight of steel rammer	9kg

Volume =Area * Height

=

$=10201017.612\ mm^3$

$=0.00102\ m^3$

Procedure for using core cutter

Expose a small area about 300mm sq. of the soil to be tested and level it place steel dolly on the top of the cutter. Apply pressure by using hammer up to which the cutter get embedded in the soil and the soil layer until the top edge of the cutter is a few millimeter below the soil surface. Dig out the core sample; trim the top end and bottom end of the core cutter with the end of cutter and steel straight edge. Reject those that are not

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 847-852 www.ijaem.net ISSN: 2395-5252

completely filled with soil if the core are satisfactory pack them in other container.

7.1 Type of soil to be tested

- Red soil
- Red soil with clay

7.1.1 Red soil with clay mix

Density =mass of the soil / volume of core cutter

= 2.190/ 0.00102

= 2147.05 kg/ m^3

Load acting on blade area = 600N

7.1.2 Red soil

Density =mass of the soil / volume of core cutter

= 2.060/ 0.00102

= 2019.60 kg/ m^3

Load acting on the blade area =563 N

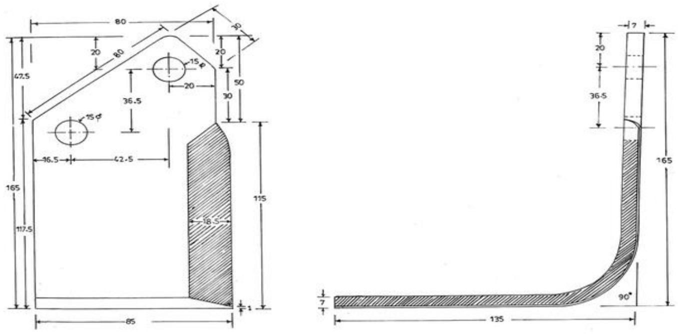
8 MATERIALS

Generally mild steel is used for manufacturing Rotavator blade. But it produced more stress. From the analysis of Rotavator blade. It is observed that the stress value of material has been reduced by applying the design change and changing the material as,

Sr No.	Material Name	Material Properties		
		Elastic Modulus (N/ mm^2)	Poisson Ratio	Density (Tone/ mm^3)
1	Mild Steel	2.10 X 10^{11}	0.3	7.89 X 10^{-9}
2	High Carbon Steel	1.97 X 10^{11}	0.29	7.48 X 10^{-9}
3	Cast Iron	1.20 X 10^{5}	0.28	7.20 X 10^{-9}

9 BLADE DIAMENSION

OLD DIAMENSION



Modeling is created by means of a Pro/E Creo Software, Dimensions of new blade is given below,

For radius 34

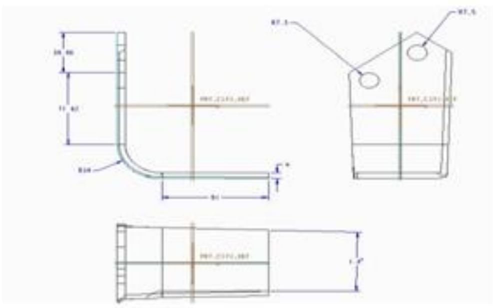


Fig.9.1. Radius 34

For radius 38

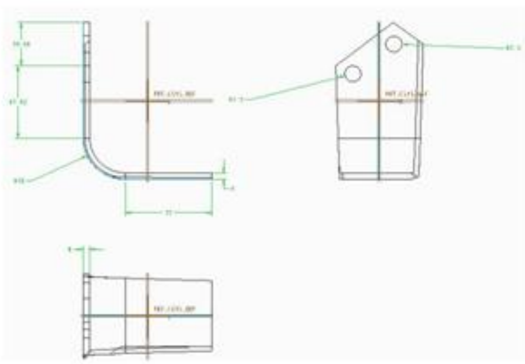


Fig.9.2 Radius 38

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 847-852 www.ijaem.net ISSN: 2395-5252

VIII. RESULT AND DISCUSSION

The Stress Strain value for different material in different soil are obtained from the analysis and result are discussed as follows

For radius 34

Sr No.	Material	Stress		Strain	
		Red soil with clay.	Red soil.	Red soil with clay.	Red soil.
1	Mild steel	50479	53796	0.25617	0.24037
2	EN 24 steel	49050	52273	0.25253	0.23696

The Stress and strain is analyzed in ANSYS as shown below,

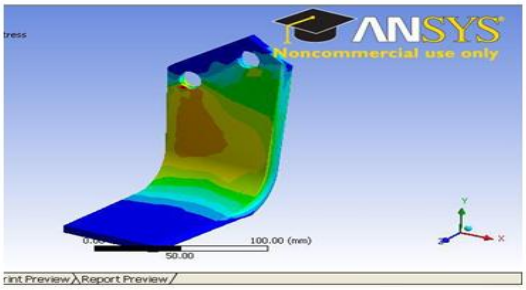


Fig 9.3 Stress Diagram

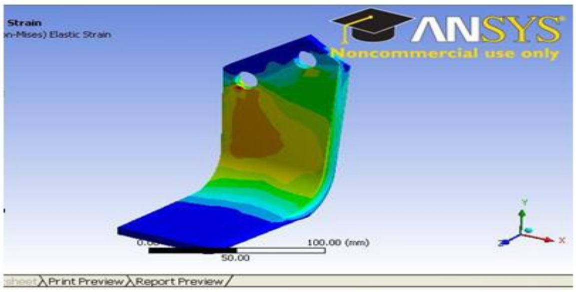


Fig 9.4 Strain Diagram

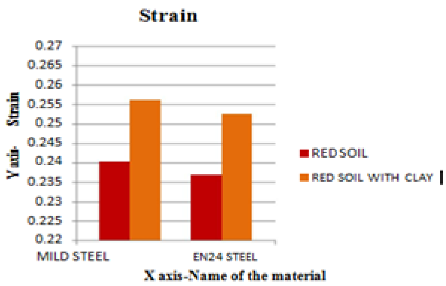


Fig.9.5. Strain

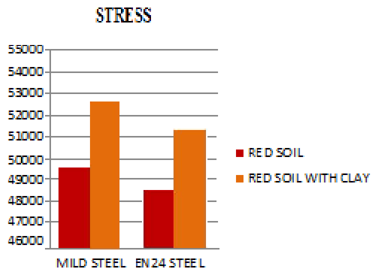


Fig.9.6. Stress

For radius 38

Sr No.	Material	Stress		Strain	
		Red soil with clay.	Red soil.	Red soil with clay.	Red soil.
1	Mild steel	53796	50479	0.25617	0.24037
2	EN 24 steel	52273	49050	0.25253	0.23696

The Stress and strain is analyzed in ANSYS as shown below,

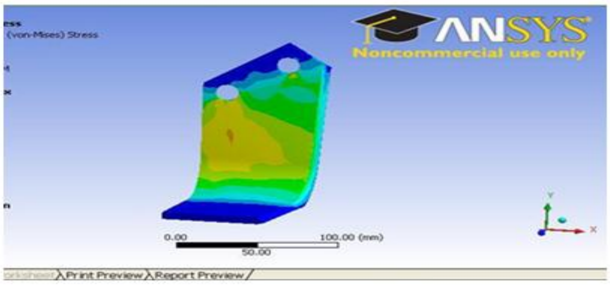


Fig.9.7. Stress Diagram

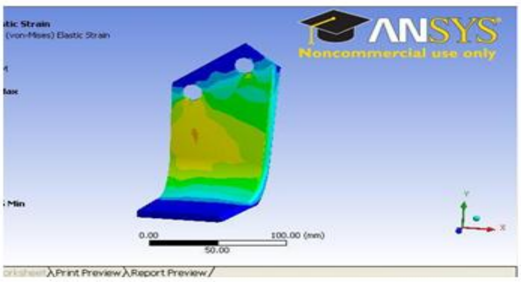


Fig.9.8. Strain Diagram

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 847-852 www.ijaem.net ISSN: 2395-5252

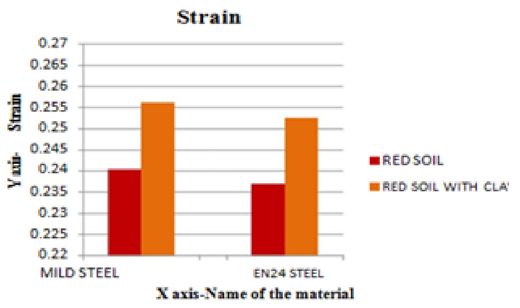


Fig.9.9. Strain

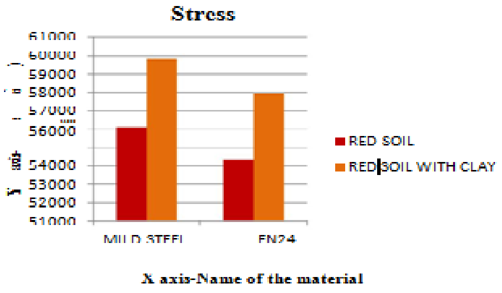


Fig.9.10. Stress

IX. CONCLUSION

The problem is that the blade get bend at the edge during cultivation. To avoid this problem we design the new blade with new dimensions.

And also changes the material from mild steel to EN24 steel these materials produced less stress as compared to mild steel. We analyses the blade and find the stress strain value for new dimension of blade. The geometry of the new, structure analysis for old and new blade is done by ANSYS software.

By this, we can increase the working hour of the blade and by using different material we can increased the wear resistance of the blade.

REFERENCES

[1]. Akinci, I., D. Yilmaz, and M. Canakci. Failure of a Rotary Tiller Spur Gear. Engineering failure analysis, 12(3): 400-404. (2005).

[2]. Altair Engineering. Inc, “Hypermesh Users Guide”, 2003

[3]. Anonymous, (1971). Design data book. PSG college of Tech. Kalaikathir Publications, Coimbatore.

[4]. Ansys Inc, “ANSYS 8.1 Documentation, Structural Analysis Guide”,

[5]. Swansos Analysis System, United state, 2004

[6]. Bechly, M. E., and P. D. Clausent. (1997). “Structural Design of a Composite wind turbine blade using Finite Element Analysis”. Computers & Structures Vol. 63. No. 3, pp. 639-616.

[7]. Beeny, J. M., and D. C. Khoo. (1970). “Preliminary investigations in to the performance of different shaped blades for the rotary tillage of wet rice soil”. J. Agric. Engg. Res, 15 (1):27-33.

[8]. Ben Yahia, Logue, and M. Khelifi. (1999). “Optimum settings for rotary tools used for on-the-row mechanical cultivation in corn”. Transactions of ASAE, 15(6): 615-619.

International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 02 Issue: 01 DOI: 10.35629/5252