MODELING AND ANALYSIS OF CHISEL PLOUGH

V.Madhava[1]*, D.Mohana Krishnudu[2], P.Hussain[3], Dr.S.Sudhakar Babu[4]

***Corresponding Author:**
1. V.Madhava, AVR&SVR Engg College, Kurnool
2. D Mohana Krishnudu, Associate professor, AVR&SVR Engg College, Kurnool
3. P Hussain, Associate Professor & HOD, AVR&SVR Engg College, Kurnool
4. Dr.S.Sudhakar Babu, Professor & principal of AVR&SVR Engg College, Kurnool
Mail:*madhava.mech09@gmail.com*

ABSTRACT

The chisel plough is considered as a farm minimum tillage tool for leaving mulch remaining on the soil surface. The quantity of carbon dioxide that gets lost during tillage depends on the used implement; the disk harrow causes bigger loss than the chisel plough. The chisel plough has been introduced in Venezuela since 1973. The efficient performance of the chisel plough is function of the position of the bodies in the frame. The specific objectives consisted on relating the number, distances and position of the shank with the bulk density, water content, porosity, efficiency, field capacity, working depth, draft requirement, weed control and clod size. An 82 kW John Deere 4240 tractor was used, and a mounted chisel plough Bon ford Super flow standard model of 7 mobile chisel with a maximum working width of 2.44 m. A blocks design at random was used with eight treatments that consisted of varying the number, position and distance of the shanks with five repetitions. A conventional variance analysis was carried out among the eight treatments and the differences among them were detected by means of the Minimum Significant Difference Test with ($p \leq 0.05$). It was obtained, the apparent density between 1.49 and 1.63 kg m^3, the porosity between 32.59 and 37.78%; the depth between 24.86 and 28.80 cm, soil humidity between 10.63 and 14.58 cm3, the best weed control was for the position in V of five bodies, with 25 cm among bodies. On concluded, recommending the appropriate positional order of the bodies for the studied parameters, including weed residuals.

Key words: Chisel plough, shank position and number, performance, savannah soil, Model Ansysis V11

1. INTRODUCTION

Agriculture is an important sector of the economy, In order to produce food takes a lot of processes using dedicated machines. One such machine is the plough. Its construction has changed over the centuries. Many research centers and companies conduct continuing studies to improve the construction of ploughs. It is important to reduce the cost of fuel during plowing .One of the important parts of the plow is a mould board. One of the important parts of the plow is mold board. Its shape and tri biological properties have a great influence on the work of the plough. In this paper the influence of pressure directed at the working surfaces of the plough body to the stresses inside the structure was analyzed. The analysis was performed using Finite Element Analysis (FEA) in Auto Desk Inventor Professional 2015. FEA analysis allows pre-testing of the properties of the part before manufacturing. Creating a model and adding forces and pressures to it allows for huge savings for companies. It is possible to find weaknesses in designed products before they cause problems. Characteristics of the materials that make up the individual parts correspond to the materials used for the production in the AGRO-MASZ company after suitable heat treatment.

The primary purpose of plugging is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. As the plough is drawn through the soil it creates long trenches of fertile soil called furrows. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting. Plowing and cultivating a soil homogenizes and modifies the upper 12 to 25 cm of the soil to form a plow layer. In many soils, the majority of fine plant feeder roots can be found in the topsoil or plow layer.

Ploughs were initially human powered, but the process became considerably more efficient once animals were pressed into service. The first animal powered ploughs were undoubtedly pulled by oxen, and later in many areas by horses (generally draft horses) and mules, although various other animals have been used for this purpose. In industrialized countries, the first mechanical means of pulling a plough were steam powered (plugging engines or steam tractors), but these were gradually superseded by internal combustion powered tractors. Modern competitions take place for plugging enthusiasts like the National Plugging Championships in Ireland. Use of the plough has decreased in some areas, often those significantly threatened by soil damage and erosion, in favor of shallower plugging and other less invasive conservation tillage techniques.

Natural farming methods are emerging that do not involve any plugging at all, unless an initial plugging is necessary to break up hardpan on a new plot to be cultivated, so that the newly introduced soil life can penetrate and develop more quickly and deeply. By not plugging, beneficial fungi and microbial life can develop that will eventually bring air into the soil, retain water and build up nutrients. A healthy soil full of active fungi and microbial life, combined with a diverse crop (making use of companion planting), suppresses weeds and pests naturally and retains rainwater. Thus the intensive use of water, oil and energy hungry irrigation, fertilizers and herbicides are avoided. Cultivated land becomes more fertile and productive over time, while tilled land tends to go down in productivity over time due to erosion and the removal of nutrients with every harvest. Proponents of perm culture claim that it is the only way of farming that can be maintained when fossil fuel runs out. On the other hand, the advantage of agricultural methods that require repeated plugging are those they allow mono cropping on a large scale at remote locations, using industrial machinery rather than human labor.

Parts of the Chisel Plough

The basic parts of the modern plough, Beam, Hitch (Brit: hake), Vertical regulator, Coulter (knife coulter pictured, but disk coulter common), Chisel (foreshore), Share (main share), Moldboard

Other parts not shown or labeled include the frog (or frame), runner, landside, shin, trash board, and stilts (handles). On modern ploughs and some older ploughs, the moldboard is separate from the share and runner, so these parts can be replaced without replacing the moldboard. Abrasion eventually destroys all parts of a plough that come into contact with the soil.

1.1 History of Plough

1.1.1 Hoeing

When agriculture was first developed, simple handhold digging sticks and hoes were used in highly fertile areas, such as the banks of the Nile where the annual flood rejuvenates the soil, to create drills (furrows) to plant seeds in. Digging sticks, hoes, and mattocks were not invented in any one place, and hoe cultivation must have been common everywhere agriculture was practiced. Hoe farming is the traditional tillage method in tropical or subtropical regions, which are characterized by stony soils, steep slope gradients, predominant root crops, and coarse grains grown at wide distances apart. While hoe agriculture is best suited to these regions, it is used in some fashion everywhere. Instead of hoeing, some cultures use pigs to trample the soil and grub the earth.

1.1.2 Ard

Some ancient hoes, like the Egyptian *mr*, were pointed and strong enough to clear rocky soil and make seed drills, which is why they are called *hand ards*. However, the domestication of oxen in Mesopotamia and the Indus valley civilization, perhaps as early as the 6th millennium B.C., provided mankind with the draft power necessary to develop the larger, animal drawn true ard (or scratch plough). The earliest was the *bow ard*, which consists of a *draft pole* (or *beam*) pierced by a thinner vertical pointed stick called the *head* (or *body*), with one end being the *stilt* (handle) and the other a *share* (cutting blade) that was dragged through the topsoil to cut a shallow furrow ideal for most cereal crops. The ard does not clear new land well, so hoes or mattocks must be used to pull up grass and undergrowth, and a handheld, coulter like *ristle* could be used to cut deeper furrows ahead of the share. Because the ard leaves a strip of undisturbed earth between the furrows, the fields are often cross ploughed lengthwise and across, and this tends to form squares fields (Celtic fields).[5] The ard is best suited to loamy or sandy soils that are naturally fertilized by annual flooding, as in the Nile Delta and Fertile Crescent, and to a lesser extent any other cereal growing region with light or thin soil. By the late Iron Age, ards in Europe were commonly fitted with coulters.

1.2 Heavy ploughs

In the basic mould board plough the depth of the cut is adjusted by lifting against the runner in the furrow, which limited the weight of the plough to what the ploughman could easily lift. This limited the construction to a small amount of wood (although metal edges were possible). These ploughs were fairly fragile, and were not suitable for breaking up the heavier soils of northern Europe. The introduction of wheels to replace the runner allowed the weight of the plough to increase, and in turn allowed the use of a much larger mould board faced in metal. These *heavy ploughs* led to greater food production and eventually a significant population increase around 600 AD.

1.3 Turn wrest plough

The turn wrest plough allows plugging to be done to either side. The mould board is removable, turning to the right for one furrow, and then being moved to the other side of the plough to turn to the left (the coulter and ploughshare are fixed). In this way adjacent furrows can be ploughed in opposite directions, allowing plugging to proceed continuously along the field and thus avoiding the ridge and furrow topography.

1.4 Reversible plough

The reversible plough has two mould board ploughs mounted back to back, one turning to the right, the other to the left. While one is working the land, the other is carried upside down in the air. At the end of each row, the paired ploughs are turned over, so the other can be used. This returns along the next furrow, again working the field in a consistent direction.

1.5 Specialist ploughs

1.5.1 Chisel plough:

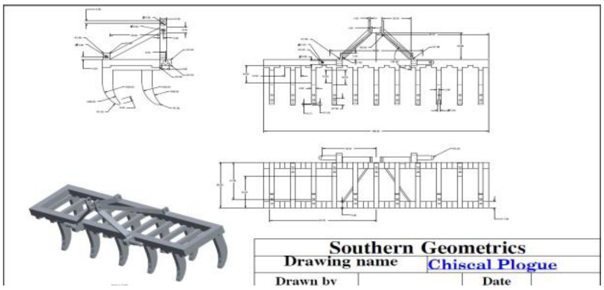
The *chisel plough* is a common tool to get deep tillage (prepared land) with limited soil disruption. The main function of this plough is to loosen and aerate the soils while leaving crop residue at the top of the soil. This plough can be used to reduce the effects of compaction and to help break up ploughman and hardpan. Unlike many other ploughs the chisel will not invert or turn the soil. This characteristic has made it a useful addition to no tilland low till farming practices that attempt to maximize the erosion prevention benefits of keeping organic matter and farming residues present on the soil surface through the year. Because of these attributes, the use of a chisel plough is considered by some to be more sustainable than other types of plough, such as the mould board plough. The chisel plough is typically set to run up to a depth of eight to twelve inches (200 to 300 mm). However some models may run much deeper. Each of the individual ploughs, or shanks, are typically set from nine inches (229 mm) to twelve inches (305 mm) apart. Such a plough can encounter significant soil drag consequently a tractor of sufficient power and good traction is required. When planning to plough with a chisel plough it is important to bear in mind that 10 to 15 HP (7 to 11 kW) per shank will be required. Cultivators are often similar in form to chisel ploughs, but their goals are different. Cultivator teeth work near the surface, usually for weed control, whereas chisel plough shanks work deep beneath the surface. Consequently, cultivating also takes much less power per shank than does chisel plugging

1.6 Types of Chisel Plows

Animal Drawn Moldboard, Melur, Improved Iron, Animal Drawn Bose, Khargaon, Debra, Rau, Chisel, MP Iron Wedge, Birsa Animal Drawn Ridger, Kapas Ridger, Bullock Drawn Ridger, Bullock Drawn Disc Harrow, Disc Harrow, Blade Harrow, Bullock Drawn Puddler, Animal Drawn Puddler, Animal Drawn Helical Blade Puddler, Bullock Drawn Land Leveler, Bullock Drawn Cultivator, Tractor Mounted Moldboard, Tractor Drawn Disc.

These are the various types of Chisel Plows used in agriculture field for different types of soils.

2. Model criteria by pro-E



Specification of the model

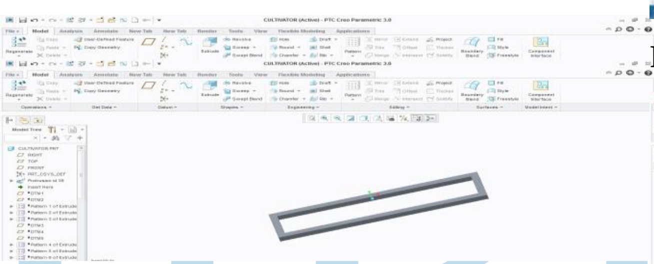


Fig. Step 1

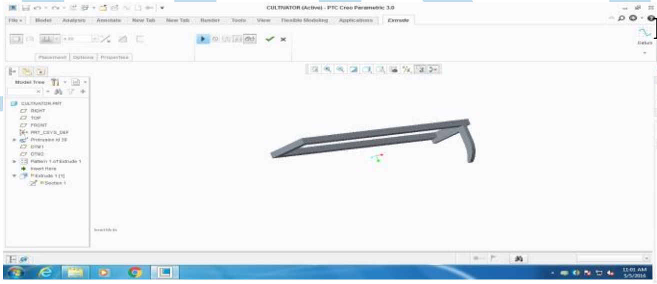


Fig. Step 2

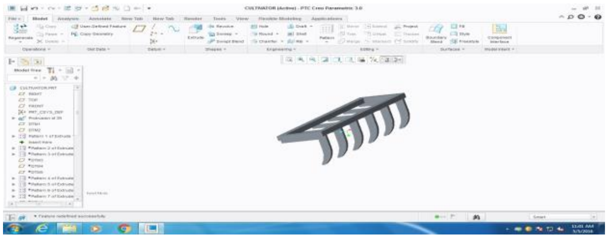


Fig. Step 3

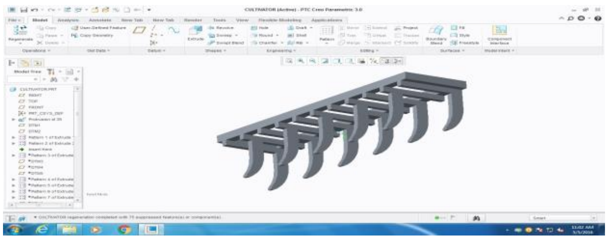


Fig. Step 4

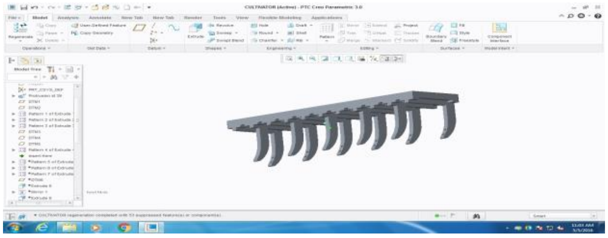


Fig. Step 5

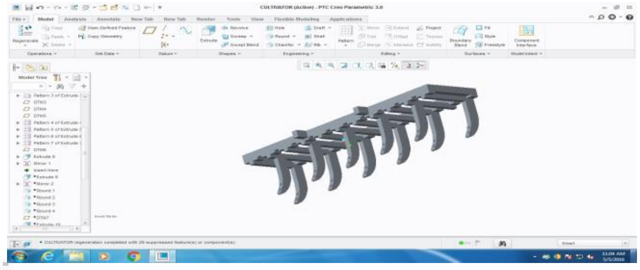


Fig. Step 6

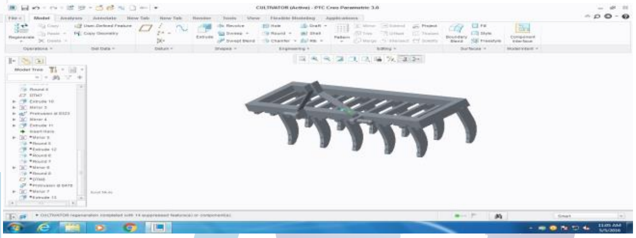


Fig. Step 7

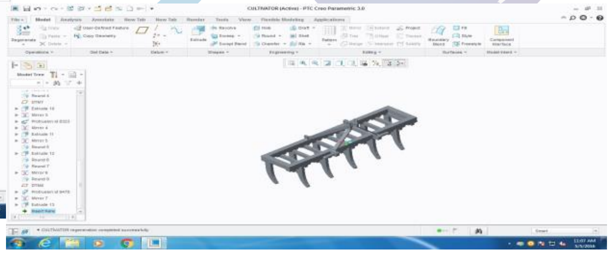


Fig. Step 8

3: Finite Element Method / Analysis

The finite element method is a numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. Because of its diversity and flexibility as an analysis tool, it is receiving much attention in almost every industry

3.1: Need of the finite element method:

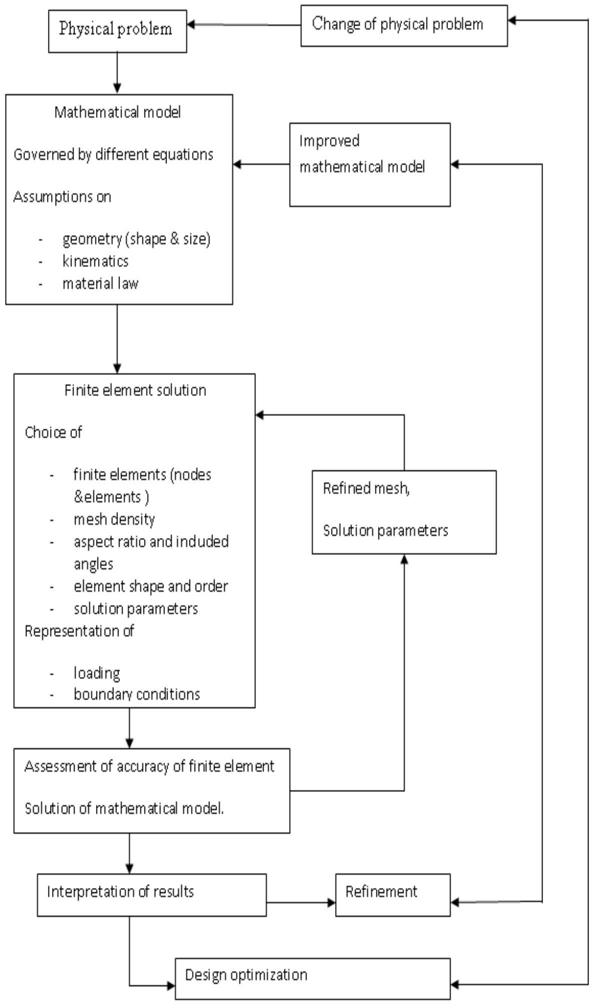
To predict the behaviour of structure the designer adopts three tools such as analytical, Experimental and Numerical methods. The analytical method is used for the regular sections of known geometric entities or primitives where the component geometry is expressed mathematically

The solution obtained is exact by the time consumed to find the result and during preparation of specimens also more. There are many numerical schemes such as Finite difference methods, Finite Element Method, Boundary element and volume method, Finite strip and volume method and Boundary integral methods etc., are used to estimate the approximate solutions of acceptably tolerance. The Finite Element Method is so popular because of it's favourably towards use of digital computers. The Finite Element Method predicts the component behaviour at desired accuracy of any complex and irregular geometry at least price.

3.2:Design considerations:

Engineering Design is the process of designing a system component or process to meet desired needs. It is the decision-making process (often iterative) in which the basic sciences, mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, syntheses, analysis, construction, testing and evaluation.

3.3: The Process of Finite Element Method:



The Finite Element Method is used to solve physical problems in engineering analysis and design. Flow chart summarizes the process of Finite Element Analysis. The physical problem typically involves an actual structure or structural component subjected to certain loads. The idealization of the physical problem to a mathematical model requires certain assumptions that together lead to differential equations governing the mathematical model. The Finite Element Analysis solves the Mathematical model, which describes the physical problem. The FEM is a numerical procedure; it is necessary to assess the solution accuracy. If the accuracy criteria are not met, the numerical solutions have to be repeated with refined solution parameters until a sufficient accuracy is reached.

3.4PROCEDURE:

3.4.1 Importing the Pro.EModel:

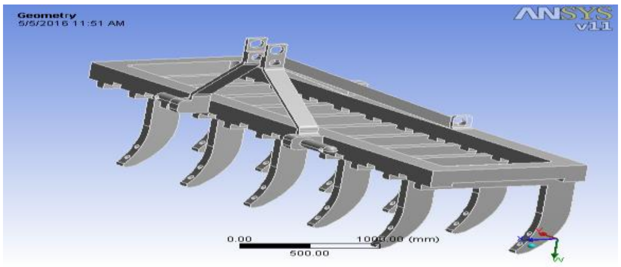


Fig: imported geometry

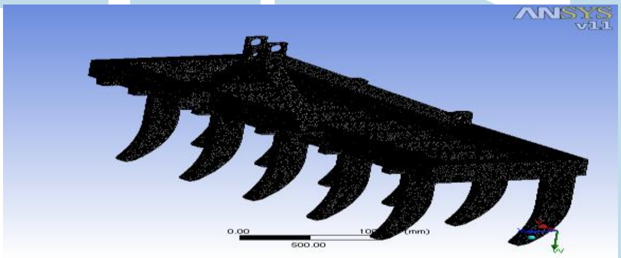


Fig: Messing Modal

Material: Structural steel

Structural Steel	
Structural	Add/Remove Properties
Young's Modulus	2.e+005 MPa
Poisson's Ratio	0.3
Density	7.85e-006 kg/
Thermal Expansion	1.2e-005 1/°C
Alternating Stress	
Strain-Life Parameters	
Tensile Yield Strength	250. MPa
Compressive Yield Strength	250. MPa
Tensile Ultimate Strength	460. MPa
Compressive Ultimate Strength	0. MPa
Thermal	Add/Remove Properties
Thermal Conductivity	6.05e-002 W/mm·°C
Specific Heat	434. J/kg·°C
Electromagnetics	Add/Remove Properties
Relative Permeability	10000
Resistivity	1.7e-004 Ohm·mm

Fig: SS Material Properties

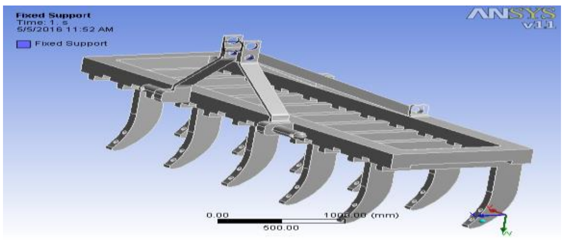


Fig: Fixe Supports

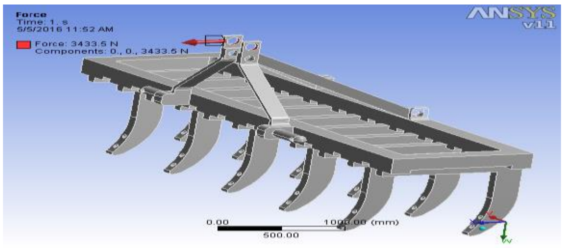


Fig: Force Applied in forward direction

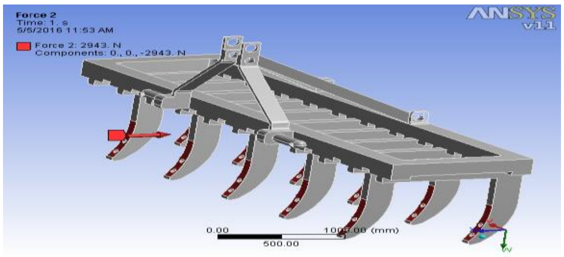


Fig: Force Applied on reverse direction

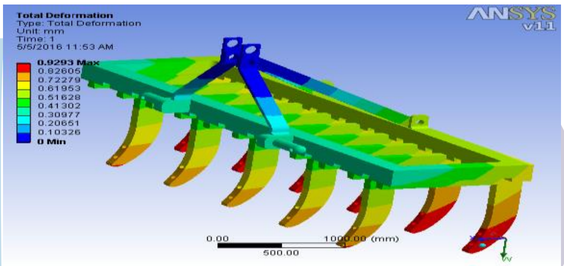


Fig: Total Deformation

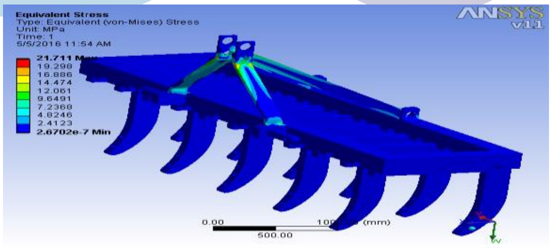


Fig: Equivalent Stress

3.4.2 Modal Analysis Results for Structural steel

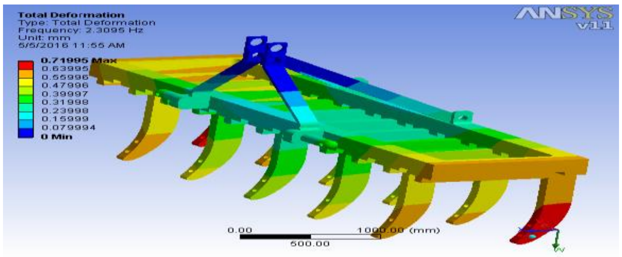


Fig: Mode 1

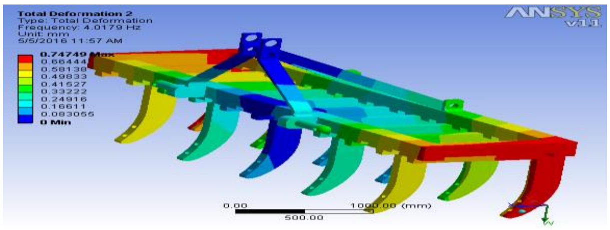


Fig: Mode 2

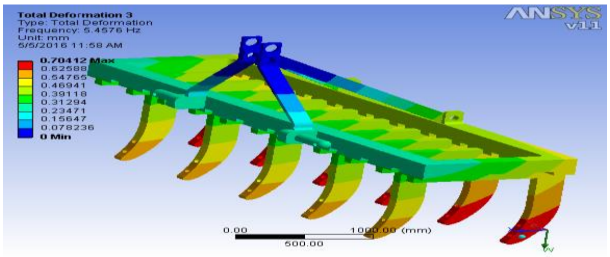


Fig: Mode 3

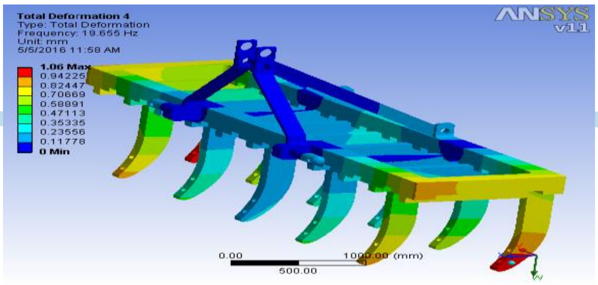


Fig:Model 5

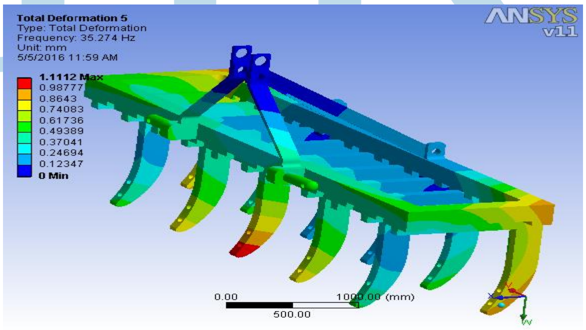


Fig:Model 6

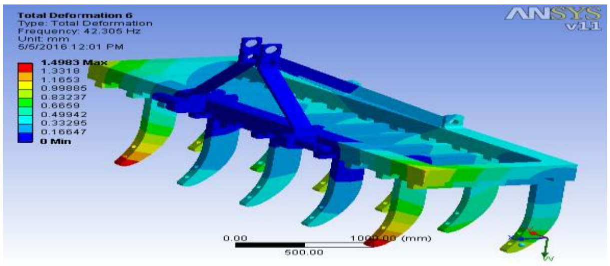
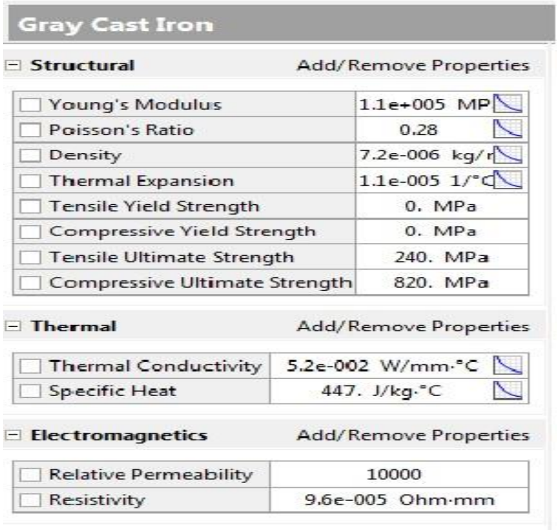


Fig: Mode 4

Material: Gray cast Iron



Gray Cast Iron

Structural	Add/Remove Properties
Young's Modulus	1.1e+005 MP
Poisson's Ratio	0.28
Density	7.2e-006 kg/
Thermal Expansion	1.1e-005 1/°C
Tensile Yield Strength	0. MPa
Compressive Yield Strength	0. MPa
Tensile Ultimate Strength	240. MPa
Compressive Ultimate Strength	820. MPa
Thermal	Add/Remove Properties
Thermal Conductivity	5.2e-002 W/mm·°C
Specific Heat	447. J/kg·°C
Electromagnetics	Add/Remove Properties
Relative Permeability	10000
Resistivity	9.6e-005 Ohm·mm

Fig: Gray Cast iron Properties

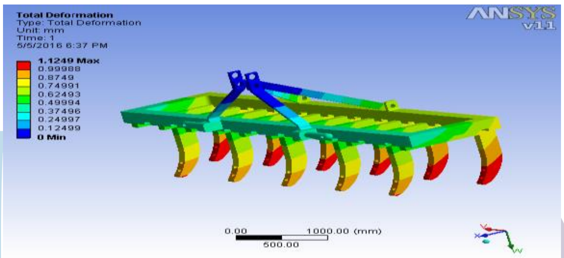


Fig: Total Deformation

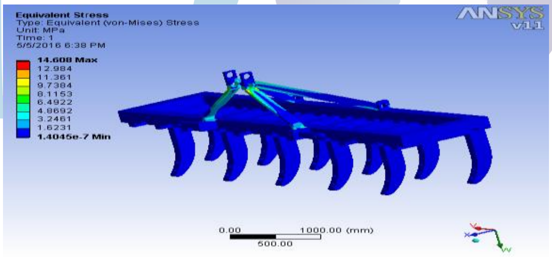


Fig:Equalent strees

3.4.3 Modal Analysis Results for Gray cast iron

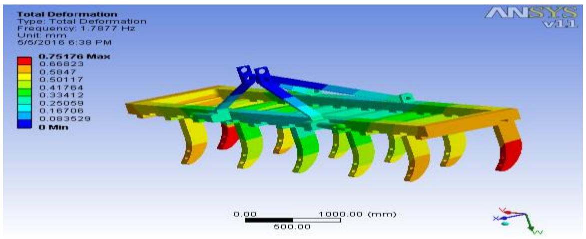


Fig:Mode 1

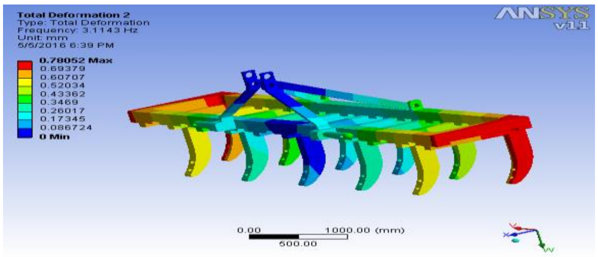


Fig: Model 2

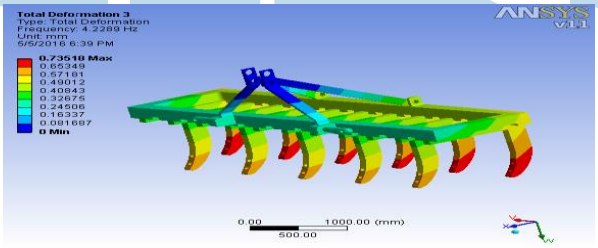


Fig: Model 3

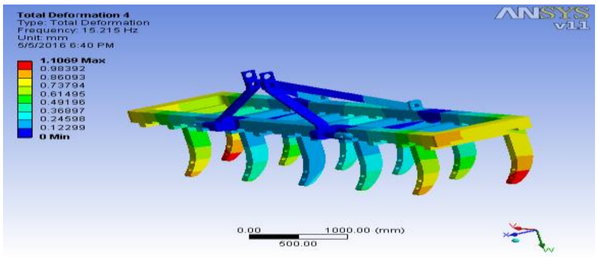


Fig:Model 4

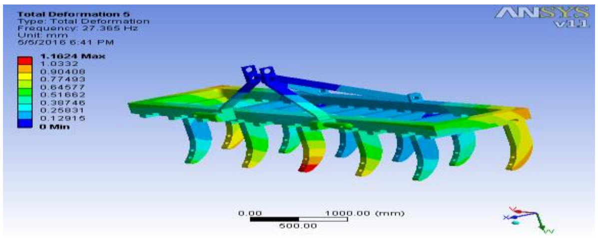


Fig:Model 5

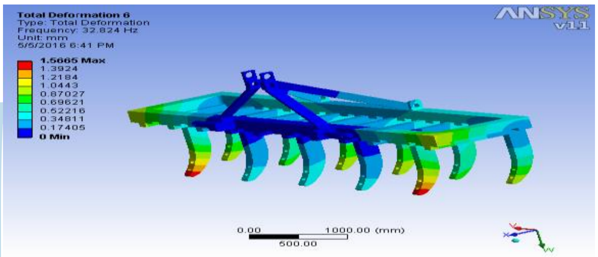


Fig: Model 6

4. RESULTS

Materials	Total Deformation (mm)		Equivalent Stress (Mpa)		Ultimate tensile strength(Mpa)
	Minimum	Maximum	Minimum	Maximum	
Stainless Steel	0	0.9293	2.6702e-7	21.711	460
Gray Cast iron	0	1.1249	1.4045e-7	14.608	240

Material	Mode1		Mode2		Mode3		Mode 4		Mode 5		Mode 6	
	TD	FZ	TD	FZ	TD	FZ	TD	FZ	TD	FZ	TD	FZ
SS	0.71995	2.3095	0.74749	4.0179	0.70412	5.4576	1.06	19.655	1.1112	35.274	1.4983	42.305
GCI	0.75176	1.7877	0.78052	3.1143	0.73518	4.2289	1.1069	15.215	1.1624	27.365	1.5665	32.824

5. CONCLUSION

It has been observe that for smaller agriculture works C.I plough is the best suitable material because of brittleness material because of brittle, But heavily tillage agriculture work stainless steel predoriment results,These two materials are obtained negligible deformation and minimum stresses which are in prescribed limits based on the applied pressure or load depending on the soil surface.

6. REFERENCE

1. Sahu and Raheman (2006) reported that the draft of the tillage implements was significantly affected by depth and speed of operation and with increase in depth and speed of operation, the draft of the tillage implements increased. This was because of the higher soil resistance and more volume of soil handled with increase in depth and higher force required accomplishing the soil acceleration with increase in speed of operation.

2. Boydas and Turgut (2007) found that soil physical properties are extremely vital to plant growth. The influence of tillage implements on soil physical properties is significant.

3. Boulal et al. (2011) mentioned that the water storage capacity of the soil surface depends almost exclusively on the surface roughness. Alvarez-Mozos et al. (2011) showed that different tillage tools have different impacts on the translocation of the soil surface. The water storage capacity of the soil surface depends almost exclusively on the surface roughness.

4. Julieta et al. (2012) mentioned that the method of soil preparation affected of the soil surface roughness indices significantly, demonstrating the importance of soil tillage for the physical conditions on the soil surface. Reported also before tillage the soil surface roughness ranged from 3.89 to 5.99 cm and before tillage soil surface roughness values did not differ significantly and that an average of these values can be considered.