

A Review Paper on Design, Modelling and Analysis of Shaft of Two Furrow Reversible Plough

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Abstract— In the field of agriculture there is a remarkable development, the farmers are using plough, harvester, tractors and advance farm equipment's. Plough is one of the very important agricultural equipment and thus the various parts of plough such as frame, shaft, tilting mechanism, mould board should be reliable and strong. In this paper, various parameters are identified for optimum design of shaft of two furrow plough. That can be useful for further analysis and optimum designing of plough.

Key words: Plough, Furrow Reversible Plough

I. INTRODUCTION

In last few decades we all are witnessing the development in each and every field of life. In the field of agricultural also we had seen remarkable development, farmers of developed nations are now a day's using harvester, tractor, advance machine tools and advance farm equipment's but country like India most of the farmers are still using traditional method of farming may be because of poor financial conditions or unavailability of cheap and reliable farm equipments. Farmers are facing the various problems with the agricultural equipments viz. High cost, heavier in weight, less reliable, etc., it's also observed that the agricultural equipments are mostly manufactured by local manufacturing companies and they do not having any R & D facilities also they manufactured the equipments without applying any type of scientific tools, techniques and methods. Therefore there is a need of improved agricultural tools so that it does not get failed at the time of uses.

II. PLOUGH

Plough is used to turn the heavy growth of green manure to help proper decay and addition of humus to soil. It is generally done to create a favorable condition for seed placement and plant growth. It is the mechanical manipulation of soil which is used to maintain, modify or promote changes in soil environment for plant growth. The mould board plough is one of the oldest of all agricultural implements. In general, this plough is used in the areas where there is sufficient rainfall to produce a good crop. Of all the types of mould board plough, the one with single bottom and animal drawn and walking type is the most common among the farmers. However, some farmers who own tractors drawn multi bottom mould board plough. They are classified further as-

A. Types of Plough

1) Reversible type of Plough:

The reversible plough has two mouldboard ploughs mounted back-to-back, one turning to the right and 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 the

next furrow, again working the field in a consistent direction.

A reversible plough can be turned over by the tractor's hydraulics or manually at the end of the furrow and the next pass made against the previous strip. The ploughman drives backwards and forwards across the field until all is done.

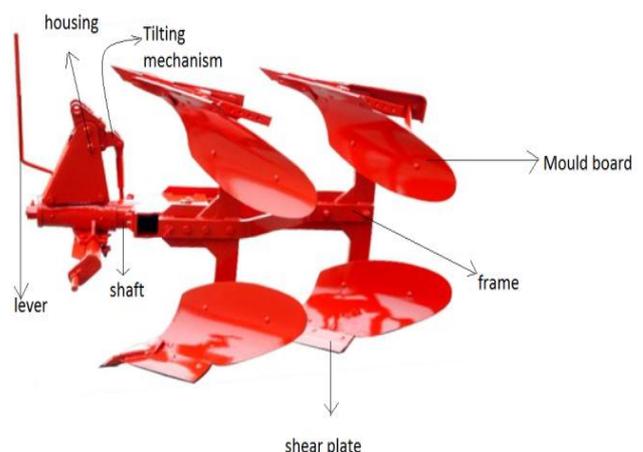
2) Non Reversible Type of Plough:

Non reversible plough can only turn the soil one way. If the ploughman were to run back alongside the previous furrow the soil would pile up in the middle. Instead the field is divided into lands. A land is an arbitrary area around which the ploughman drives in an elongated spiral. All the soil is turned the same way and there is only one slight ridge in the middle where the soil was turned together. As each land is finished and the next started there is a shallow trench left between the adjacent lands.

B. Functions of Plough:

- 1) To obtain a seedbed of good tilth.
- 2) To add humus and fertility to the soil by covering vegetation and manure.
- 3) To destroy the weeds and prevent their growth.
- 4) To leave the soil in condition to retain the moisture from rain.
- 5) Precision leveling of land for irrigation and other operations.
- 6) For circulation of air freely.

III. VARIOUS COMPONENTS OF PLOUGH AND THEIR DESCRIPTION



The various component of two furrow reversible plough are given as –

A. Main Frame:

The frame is important component on which shaft is fitted with the help of bolt and mould board is also attached to frame. The frame is reversed by connecting rod which is attached to mechanism.

B. Shaft:

The shaft rotates with help of mechanism which is useful for reversing the frame with the help of two bearing at its front inside housing.

C. Tilting Mechanism:

This is the mechanism used for reversing the frame. It is operated with the help of lever. It may be operated manually or hydraulically.

D. Housing:

The housing consists of the front end of shaft and the shaft is fixed to it by spring washer and hexagonal nut. The tilting mechanism is also attached to housing.

E. Plough Bottom:

It consists of mould board, share bar and landslide bolted and welded to the frog.

F. Bearings:

Two bearings are mounted on the shaft at its front end which is useful for its rotation and supporting during the operation.

It has been observed that there are different types of failure occurred in mould board plough like failure of tilting mechanism, failure of mould board, bending of shaft.

In this paper we are analyzing the shaft of two furrow reversible plough.

IV. LITERATURE REVIEW

The literature review has been carried out for finding various important parameters which are required to be considered while optimum designing. By field survey and literature review it has been observed that following are the failures generally occurs in the shaft –

- Bending of shaft
- Breakage of shaft

According to V. Jankauskas et al. (2008) the welding of different parts of plough is very important for reliable application of plough. Anil R. Sahu et al. (2011) has focused on tilting mechanism of plough and they identified the proper spring diameter and weld thickness is important parameter for reliable reversible mechanism. Sneha S. Wasu et al. (2015) has done design and modeling of two furrow reversible plough and they identified that shear plate is important component of reversible plough and they suggested that the boron steel is suitable material for shear plate. PoojaM. Raut et al. (2014) has done FEM analysis of nine type duty cultivator and they optimize the life of shovel and they have changed the material of shovel to boron steel.

From the above literature review it has been observed that most of the authors optimize the design of different components of mould board like shovel, shear plate, tilting mechanism and welding of different components. But nobody has done the optimization of shaft. Therefore in this paper we are suggesting the various important parameters which have to be considered while designing shaft so that the reversible plough work efficiently without fail at the time of use.

V. MODELLING

Modeling is a process of generating three dimensional objects of the real world for the purpose of designing,

analyzing, drafting and manufacturing. Modeling creates a data base in the computer which represents the object generated. The various types are -

A. Geometric Modeling

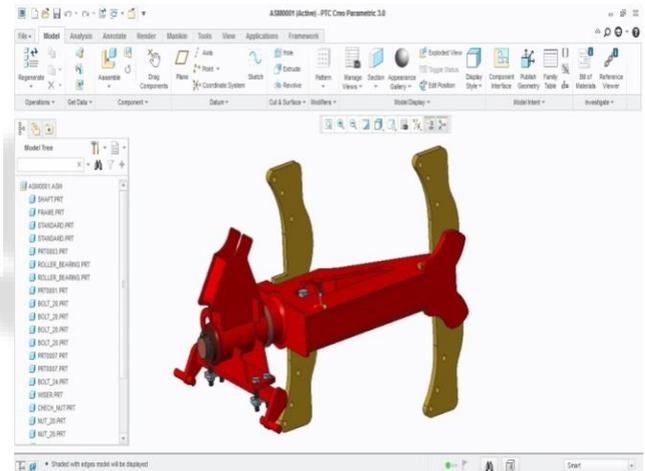
It involves the use of a CAD system to develop a mathematical description of the geometry of an object. The mathematical description, called a geometric model, is contained in computer memory. This permits the user of the CAD system to display an image of the model on a graphics terminal and to perform certain operations on the model. It has various capabilities which permit the user to develop the existing model as well as modify it.

B. Wire Frame Modeling

It uses interconnecting lines (straight line segments) to depict the object. Wire-frame models of complicated geometries can become somewhat confusing because all of the lines depicting the shape of the object are usually shown.

C. Solid Modeling

In solid modeling, an object is modeled in solid three dimensions, providing the user with a vision of the object very much like it would be seen in real life. The object is modeled as seen in real life.



VI. FOLLOWING ARE IMPORTANT PARAMETERS TO BE CONSIDERED FOR DESIGNING OF SHAFT

- 1) Forces acting
- 2) Diameter of shaft
- 3) length of shaft
- 4) Stresses
- 5) Self-weight
- 6) Shaft material
- 7) Pulling force
- 8) Soil condition
- 9) Velocity of ploughing
- 10) Tractor's power
- 11) Operating conditions

VII. DESIGNING OF SHAFT

In this paper the author has designed the shaft of two furrow reversible plough which is used in black cotton soil.

A. Forces Acting

In two furrow reversible plough following forces are acting –
– Draft force

– Pulling force

1) *Draft Force*

It increases with increase in speed, due to rapid acceleration of any soil. It is given as-

a) Draft,

$$D_s = D_o + K S^2$$

(Reference –Elements of agricultural Engineering by Dr. Jagdishwarsahay P -237)

Where,

D_s = draft at speed S

D_o = static component of draft independent of speed

S = forward speed

K = constant, depending upon type of implement and soil condition

2) *Soil Friction,*

$$\mu = \frac{F}{N} = \tan\theta$$

(Reference – Elements of agricultural Engineering by Dr. Jagdishwarsahay P -237)

Where,

μ = coefficient of friction

F = frictional force, tangent to surface

N = normal force

θ = angle of friction

3) *Pulling Force,*

$$Pull = \frac{Draft}{\cos\theta}$$

(Reference – Elements of agricultural Engineering by Dr. Jagdishwarsahay)

Where,

θ = angle of pull

B. *Self Weight*

$$W = mg$$

Where,

m = mass

g = gravity

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VIII. CONCLUSION

While optimum designing of the shaft the forces acting on it, soil condition and tractor's pulling force are the important parameters that should be considered for reliable operation of mould board plough so that the shaft will not get bend of failed at the time of uses.

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