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Review on Problem Identification in Rotor Pipe (Shaft) 5-feet Raj Rotavator

Shubham S. Awachat[1], Shrikant M. Fulmali[2], Ujwal D.Gulhane[3]
[1, 2, 3]*Department of Mechanical Engineering, Bapurao Deshmukh College of Engineering Sevagram*

Abstract: ***The intent of the paper is to study the various problem in the rotor shaft assembly of 5- the feet raj rotavator. These rotavators mainly have the progressive cutting sequence which was considered for analysis. The study was carried out on different papers and identifies the various forces acting on a Rotor shaft of a rotavator that can cause the failure in the rotor shaft of a rotavator. This paper mainly presents the various problem that were identified in an existing rotor shaft of a raj rotavator that lead to its failure. And the proposed methodology is suggested to execute the prevention of the problem identified in the rotor shaft of the rotavator.***

Keywords: Rotavator, Rotor Shaft Flange, Rotor Shaft assembly, Rotavator Blades.

I. INTRODUCTION

Automation in the industry gains great value and popularity as it helps reduce costs and time with increased productivity and quality, automation is becoming increasingly popular in the agricultural sector. This has led to the provision of world-class resources for agricultural crops from planting to harvesting to storage. The individual farmland is small which does not allow for the use of labor costs. However, over the past two decades with the development of small-scale agricultural machinery the economic costs are also being achieved by small independent builders.

Farmers usually take two or more crops a year. In a subsequent planting process, a seed bed is needed to prepare for the next harvest. Rotavator as it has been very popular since only a decade and some of the designs were adopted overseas, its changes were made to its features.

Rotavator is a special tractor-operated tool that uses the rotating power of the soil (i.e., plowing the soil), to produce a good crop bed. While the Rotavator destroys weeds, paddy kernels, and sugarcane completely. The cultivation process increases the Porosity and air permeability that promotes plant growth. One of the additional advantages of using a rotavator is that it provides forward motion thus reducing the need for tractor towing [1]. Compared to a standard plow the amount of power required is low. It is the most effective way to transfer engine power directly to the ground compared to the normal operation of ground tillage [2]. Compared to the rotavator plow type, the rotating type consumes less than 25% power [3]. Normally the engine power is supplied to the rotavator using a PTO shaft tractor. Rotary movement and transmission to rotor via gearbox and transmission system. Flanges are attached to the rotor where the cutting blades are inserted.

A. Parts of Rotavator

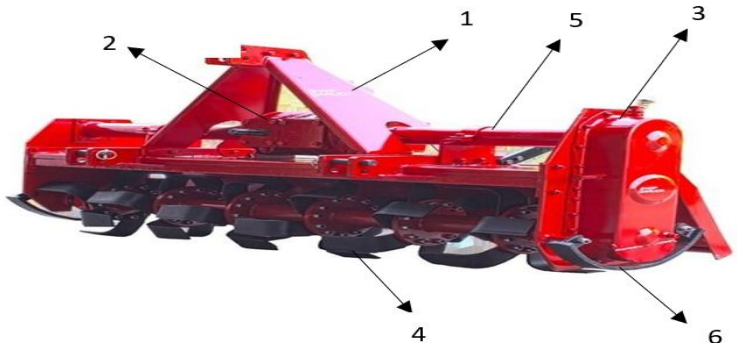

Fig. 1 Raj 5-feet rotavator

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The following are different parts of the rotavator:

1) *Independent topmast:* Used to attach the rotavator and tractor tightly. The attachment is done by attaching the top of the tractor link to the top of the rotavator topmast.
2) *Primary multi-speed gearbox:* The rotor shaft must operate at the right speed to perform the desired function but requires lowering the average PTO rpm speed from 540 to 210 rpm and in this case, a gearbox with bevel gears , shaft main, pinion. on the shaft, roller bearings are used. It allows the rotor shaft to rotate in the direction of rotation which helps to dislodge the material behind the rotavator, which helps prevent rotavator blockage. The first gearbox assembly has bevel gears, a main shaft, a pinion shaft, and a heavy-duty roller bear. It is used to reduce the transfer of P.T.O rpm from tractor to rotavator.
3) *Second gearbox:* Has 3 gears fixed internally which reduces future rpm when inserting the rotor shaft assembly.
4) Rotor shaft assembly: Inside the rotor shaft assembly blades are attached to the flange and flanges are inserted into the rotor shaft.
5) *Flange shaft:* flange shaft is used to transfer power from the main gearbox to the second gearbox.
6) *Adjustable depth skids:* Planting area is essential for seed bed preparation and is placed on a flexible frame to adjust the distance between the feather contact. Depth of tillage can be controlled using adjustable dept skids.
7) *Offset Flexible Framework:* The Offset Flexible Framework is a strong fixed support on the side parts attached to the shaft.
8) *Frame and cover:* By adjusting the back cover area, the level of soil compaction will be controlled. If the cover is to be kept wide open, the clouds are thrown away from the rotor.

B. Rotor Shaft Assembly of Rotavator

In the rotavator, the main work of tillage of soil is done by rotor shaft assembly. Rotor shaft assembly consists of three parts i.e. rotor pipe (shaft), flange, and blades. Flanges are attached to the rotor shaft and blades are attached with nuts and bolts on flanges.

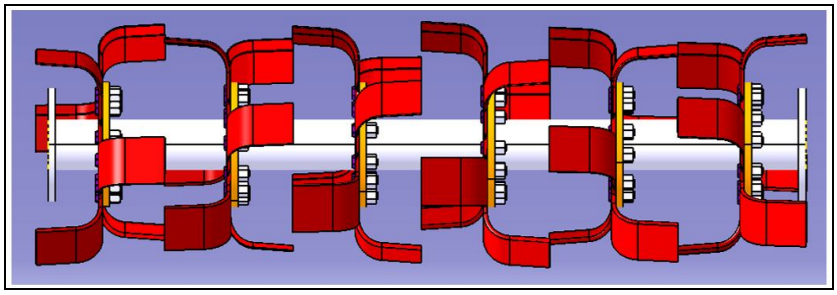

Fig. 2 Rotor shaft assembly of rotavator

II. LITERATURE REVIEW

Extensive literature has been made to find previous work done by different researchers or manufacturers related to design modification and failure analysis of different rotavator components or in the same domain.

A. Study of Torsional Response on the Rotor shaft of a Rotavator Under Transient Load Conditions.

In this paper, author Vignesh. M, et. al, (2015) have studied the flexible rotor shaft response of a normal rotavator under temporary loading by considering the twist angle and the corresponding pressure on the rotor shaft and found that due to shear pressure and twist angle. , cycle variability occurs. The cutting sequence influences the rotor tensile response. Analyze, the sequence of cuts has little effect on the same stress. The cutting edge of the conventional rotavator cutting blade is not arranged in the best possible sequence and the twist angle can be reduced by the proper selection of the cutting sequence. The torsional strength of the shaft can be increased by choosing the right cutting sequence

B. Computer-Aided Design and Analysis of Rotor Shaft of Rotavator

In this paper, Mr. S. A. Mishra, et. Al, (2015) conducted research on flanges attached to the rotor shaft. In this study, various factors were identified and the existing rotor integration was analyzed by modeling and performing ANSYS analysis. Within the study, a large number were made on the flange and after analysis, it was concluded that the flange material was not suitable for withstanding the different types of power generated on it. Therefore, a new EN 19 property (oil Extinguished and extracted) has been proposed.

C. Design and Development of Rotavator

In this paper, Prof. Shinde B. V. et al. At-studied the parameters of the L-shape blade of the rotavator and ries to reduce the power up to the blade, found that blade life is an important factor and depends on the strength of the blade and the strength and geometry of the blade straightforward. relationships with each other. He suggests that in order to prolong the life of the blade, the force it reaches must be reduced. In order to prolong the life time of the blade coming in it should be reduced. For this reason you are preparing a mathematical model and analysis of the new model and the previous model is done using the application SolidWorks software application, a method of analyzing limited objects on the basis of deviation and stress caused by the blade after power consumption. So he got a little deviation and a little pressure created on the new model by comparison.

D. Preliminary Design of a Power Transmission Shaft under Fatigue Loading Using ASME Code

In this paper, Mr. Stephen K. Armah, (2018) conducted a study of energy transfer shafts under the load of fatigue using the ASME code. In their study, they introduced a comprehensive approach to fatigue analysis to determine the initial size of the energy transfer hole under fatigue load based on the American Society of Mechanical Engineers (ASME) Standard B106.1M: 1985. Also separate analysis of pressure in potentially critical areas is performed to determine shaft sizes. Sizes from these areas are then used to measure sizes in low-pressure areas. With the help of this, the countershaft is a counter-mounted design. And to visualize the future CAD model is designed.

E. Design & Development of Rotavator blade: Interrogation of CAD Method

In this paper, Ms. Subrata Kr. Mandal (2013) also conducted research on the rotavator blade. The aim of the study is to develop a healthy rotavator blade. In Rotavator, Blades are important parts that meet the ground to prepare the soil bed. These blades interact with the ground differently than plows with a common impact and high collisions resulting in uneven and uneven strength causing blade aging. This shortens the service life of the blade. Therefore, it is necessary to design and develop a suitable blade in order to improve personal health. His research also took the form of computer-aid design (CAD) into a blade design and development account.

F. Modification and Analysis of Rotavator Blade

In this paper, author Jeevarathinam. A, et al performed Element's limited analysis of the Blade-induced stress study and found that aging and stress were less of an improved L-type blade, and found that visual pressure was reduced by application. design change and changing building materials. The most common materials used for the blade are cast iron and produce high pressure, different material sizes and sizes are taken for analysis and load condition is used for existing and modified design blades. Then the best combination of materials and sizes were suggested. By changing the design of the rotavator blade they increase the working hours of the blades and by using various materials increase the wear resistance of the blades.

III.FORMULATION OF PROBLEM

A. Research Gap

After conducting a detailed literature review it is observed that so many authors studied the rotavator for optimal designing of it. Mainly they had done analysis on other components of rotor shaft assembly such as flanges and blades. Within that they had considered the effect of depth of cut, rotational speed, forward speed, and width of cut on the torque requirement, arrangement of blades, etc., but least consideration is given to torsional response on the rotor shaft of rotavator under impact load conditions.

B. Problem Identify

It is observed that there are frequent failures of parts of the rotavator, but it is important to note that the other parts of the rotavator are easily available and it is easy and convenient to repair or replace them but if there is any failure in the rotor shaft the owner has to replace the entire rotor shaft which is much costlier and time-consuming to both rotavator owner and manufacturer. It is observed that in normal conditions there is no failure in the rotavator, but when the speed of the tractor is increased or some obstacles such as roots of plants, hard stone, etc. come in the path of the rotavator while working, more torque is required to overcome those obstacles and due to that, there are the chances of failure of the rotor shaft. Generally the material is not having the allowable strength to sustain that impact torque that why the failure mainly occurs.

Fig. 3 Breakdown of rotor shaft

IV. PROPOSED METHODOLOGY

Methodology refers to the discussion regarding the specific method chosen and used in a research paper. In other words, the methodology represents the technical steps involved in conducting the research.

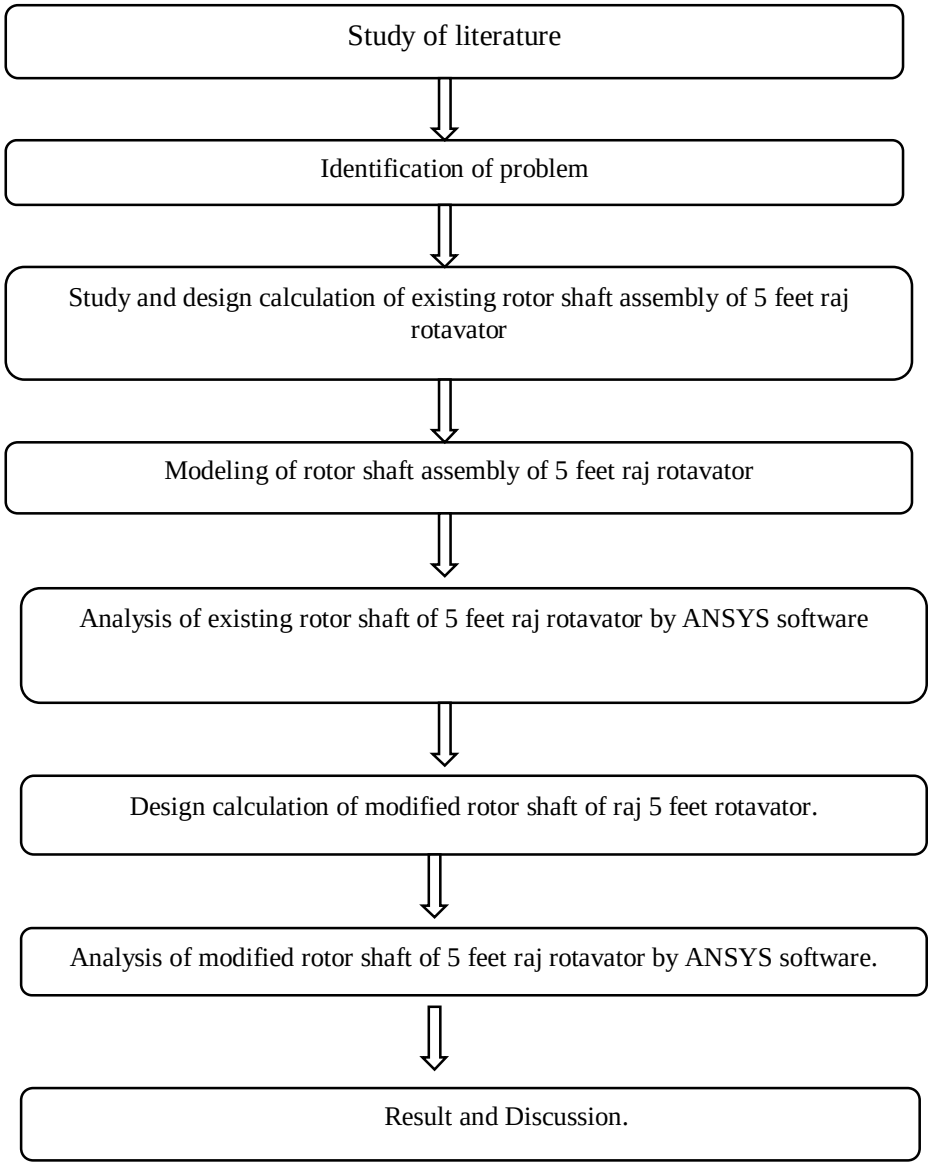

Fig. 4 Methodology chart

A. Study of Literature Review

This help to select the direction of work. The researchers who have already worked on the rotavator and rotor shaft assembly parts will be studied and from their reference, further work will be carried forward.

B. Identification of Problem

No mechanism or no system is ideal. Every system consists of some problem. Therefore to make the system more economic and useful, identification of problems must be done. Once the problem in the system is identified it can be solved by properly studying it and giving the best possible solution.

C. Study and Design Calculation of Existing rotor shaft Assembly of 5 Feet raj Rotavator

Within this, the overall rotor shaft assembly is been study including the forces acting on the various parts of the rotor shaft assembly, the material used, and other general specifications of the rotavator.

For designing any component the forces and stress must be known. And this will be found by using conventional design. So by using convention design, the forces and stress acting on the rotor shaft will be found.

D. Modeling of the Rotor Shaft Assembly

Once the conventional design is over, prepare the CAD model of the existing rotor shaft assembly of the rotavator. For modeling purposes, CATIA OR CREO can be used.

E. Analysis of Existing rotor shaft of 5 feet raj Rotavator by ANSYS Software

After modeling the rotor shaft it is necessary to analyze for sustainable condition and this analysis will be done by using ANSYS WORKBENCH and generated results will be compared.

F. Design Calculation of modified rotor shaft of raj 5 feet Rotavator.

Within these some new material is been selected that is eligible for shaft manufacturing and by considering their material properties and specification again design calculations are being made. After comparing all the new materials in terms of all the convention design values, force and stress act on the shaft

G. Analysis of Modified rotor shaft of 5 feet raj Rotavator by ANSYS Software

After modeling the modified rotor shaft it is necessary to analyze for sustainable condition and this analysis will be done by using ANSYS WORKBENCH and generated results will be compared.

H. Result

Compare the new modified design with an existing model with the various design parameters.

V. CONCLUSIONS

After conducting a detailed literature review it is observed that so many authors studied the rotavator for optimal designing of it. they had considered the effect of depth of cut, rotational speed, forward speed, and width of cut on the torque requirement, arrangement of blades, etc, but least consideration is given to torsional response& The various forces acting on the rotor shaft of rotavator under impact loading conditions. Within this paper, the problem in the rotor shaft assembly is been identified due to which the failure occurs in the rotor shaft. The proposed methodology has been suggested for the prevention of failure in the rotor shaft. Therefore this paper will be of great use to the designers and also for design optimization

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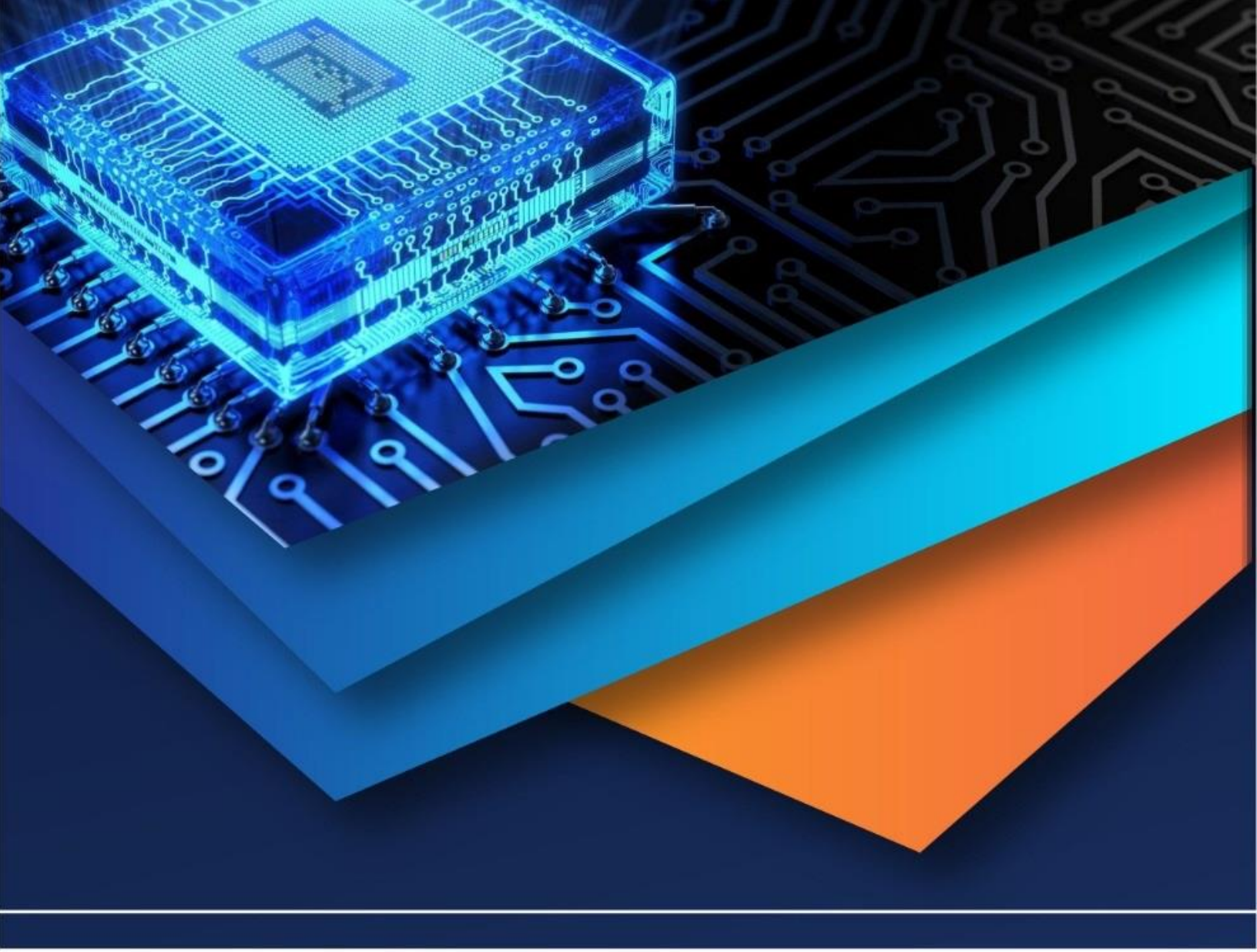

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