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# STUDY OF EXCAVATOR BUCKET PERFORMANCE AND ITS LIFE SYNTHESIS FOR RECONSTRUCTION OF BUCKET BASED ON RESEARCH REVIEW.

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## Abstract

*Excavator bucket life is the very important issue, because it fails to complete its designed life. The major reason behind this failure is its working environment and modes of operations. Excavator buckets are designed to work in worst conditions, situations for long duration of time. During its working bucket undergoes with great amount of stresses, loads, jerks, deformations and it would be very difficult to withstand in such situations.*

*Hence the excavator bucket material is tough. However this selection is not sufficient for designed bucket life. In bucket observations, we found cracks and tear areas on buckets which failed during working. In this paper research done to improve bucket life is discussed along with step by step life journey. Important conclusions were drawn from this study.*

***Keywords:*** *Excavator Bucket, Strength, cracks and tear.*

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## 1. Introduction to Excavator Bucket and Its Life.

A bucket (also called a scoop to qualify shallower designs of tools) is a specialized container attached to a machine, as compared to a bucket adapted for manual use by a human being. It is a bulk material handling component. The bucket has an inner volume as compared to other types of machine attachments like blades or shovels.

The bucket could be attached to the lifting hook of a crane, at the end of the arm of an excavating machine, to the wires of a dragline excavator, to the arms of a power shovel or a tractor equipped with a backhoe loader or to a loader, or to a dredge.

Excavator bucket is the important part which is responsible for work. It is used for digging, trolley felling, Heavy duty work etc. Some of the applications are listed below.

- Digging of trenches, holes, foundations
- Material handling
- Brush cutting with hydraulic saw and mower attachments
- Forestry work
- Forestry mulching
- Construction
- Demolition with hydraulic claw, cutter and breaker attachments
- General grading/landscaping
- Mining, especially, but not only open-pit mining
- River dredging
- Driving piles, in conjunction with a pile driver
- Drilling shafts for footings and rock blasting, by use of an auger or hydraulic drill attachment
- Snow removal with snowplow and snow blower attachments

From above applications it is clear that this part is very important to perform any type of work with excavator machine. Figure 1.1 shows the general excavator bucket. It consist of main body, collar and four teethes at the end.

**Fig 1.1:** Excavator Bucket

### 1.1 Types of Buckets

Following are the types of bucket.

1) Digging Buckets
2) Ditch Cleaning Buckets.
3) Grading Buckets
4) Heavy Duty Buckets
5) Heavy Duty Rock Buckets

6) Tilting Ditch Cleaning Buckets.

**1.2 Life of Excavator Bucket**

Excavator bucket is designed for at least 7 years duration by considering normal working conditions. But it fails within 5 years of service. There are several reasons are there due to which the bucket get failed. But the stresses developed during working and the frequency developed beyond the natural frequency of bucket are the major reasons for the failure.

If we go through the entire life of bucket then we will come to know with following facts.

- Load applied by the bucket is greater than the designed loading condition.
- Continuous application of heavy loads on bucket.
- Sudden collusion with heavy objects, rocks, mud etc.
- Thermal Loading on bucket during hazarders operation.
- Less maintenance.

**2. LITERATURE SURVEY.**

Till date research shows us that the design of excavator bucket is improved and brought to withstand heavy duty work. But till it fails to do so, just because of beyond capacity loading conditions. To avoid this the proper capacity buckets are to be utilized. Further research about bucket dynamics, stability, design and optimal working conditions is discussed as follows.

**2.1 Literature Review.**

Miloš Tanasijević is discussed about Life-cycle of bucket wheel excavators which is analyzed in his study. He have concentrated on quality of service characteristics. He have also concentrated on a model for quality of service evaluation which is based on fuzzy sets theory. In his study Evidential reasoning is developed by using quality of service evaluation and dependability performance is co nsidered as a measure for quality of service. [1]

Nedeljko Vukojević, Fuad Hadžikadunić have discussed about SH630 Excavator which are specially used in mines. According to his stress analysis results, the main body of bucket remains undeformed in normal working condition. Actual part which comes under stresses is the joints and corners where the stress value slightly less than allowable stresses. Dynamic stress changes taking place around a relatively low medium stress with small stress amplitude, which is desirable from the standpoint of strength. Stress change character fully agrees with the expected changes caused by normal operating excavator operations. [2]

Santosh Gudagunti have studied for the reduction of cycle time for the manufacturing of bucket, this will also reduce the rejection rate and to increase the throughput by applying the lean principles and lean, tools time study is carried out for all the process in manufacturing of excavator bucket. The process improvement is done for the process which has the high cycle time. Along with savings in time the research also helped in saving in labors. The lean principles are followed in his study to eliminate the waste in an industry. [3]

Janmit Raj1 and Gaurav Saxena2 in their review they have reported studies in the field of FEA (Finite Element Analysis) consisting the design of the boom, structural analysis, fatigue analysis, modal analysis, shape optimization and CAD/CAE system integration with the required softwares for carrying out the analysis work with an emphasis on the publication in the last 13 years (2002-2015). This literature have progressively discussed about the softwares, research methodology and the outcome of the discussed researches and is intended to give the readers a brief variety of the researches carried out on the excavator boom. [4] Vishwajeet A. Patil, M.R.Khodake have studied that there is rapid growth in the earth moving machine industries as the construction work is rapidly growing is assured through the high performance of construction machines. This study focuses on the evaluation method of digging forces required to dig the terrene for light duty construction work. This methods gives the force calculation and further it is used for the carrying out the fatigue analysis to calculate fatigue life of bucket and its failure. Further the work regarding the optimization of bucket to give maximum fatigue life for the digging at the desired force conditions. An analytical approach provided for static force analysis of excavator bucket. [5]

Bhavesh kumar P. PATEL have focuses on the evaluation method of bucket capacity and digging forces required to dig the terrain for light duty construction work. This method provides the prediction of digging forces and can be applied for autonomous operation of excavation task. The evaluated digging forces can be used as boundary condition and loading

conditions to carry out Finite Element Analysis of the backhoe mechanism for strength and stress analysis. A generalized breakout force and digging force model also developed using the fundamentals of kinematics of backhoe mechanism in context of robotics. An analytical approach provided for static force analysis of mini hydraulic backhoe excavator attachment. [6]

Mr. Mundane Sagar R. have focuses on study of actual productivity against the theoretical productivity to demonstrate the loss of productivity. This real time monitoring of the heavy equipment can help practitioners improve machine intensive and cyclic earthmoving operations. [7]

Dhaval Kumar A Patel have discussed about kinematics of excavator machine which is helpful to doing the kinematic modelling of the excavator machine. Kinematic modelling is helpful for understanding behavior and improving the operating performance of the hydraulic excavator machine. [8]

Neeraj Chandrakar, Shadab Imam have aimed their study on the influence of Boron carbide and chromium variations on analysis of Bucket Teeth. FEM analysis are carried out and it is observed that best results are found by adding coating of Chromium and boron carbide of coating 2mm. the excavator bucket teeth which fail due to abrasive wear and impact load is protected against abrasive wear by using four different types of hard facing materials using manual metal arc welding process. They have used Excavator bucket teeth using finite element method (FEM). FEM is selected as the component size is complicated and the process is an all-position process, highly versatile and user friendly. The

Result of Boron carbide and chromium steel having almost same result on Equivalent stress and deformation.

The Result of the same is having higher Than High tensile steel by almost 0-1%. The Process of FEM is being used for Coating and without Coating of Excavator Bucket teeth. [9]

**2.2 Outcomes from Literature Survey:**

- Most of the researchers have focused on CAE softwares.
- Stresses induced in Bucket are more at the joints.
- Vibrations are also responsible for failure.

**3. Conclusion**

In the view of structural failure of the excavator bucket it is found that the life of bucket can be improved by reconstruction of bucket. A thru study of static dynamic analysis is required and with addition of material strips the life and performance of bucket can be improved.

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