Designing and Analysis of Excavator Bucket

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***Abstract-** A Excavator bucket plays a afflictive role in mining industries. Mostly excavator bucket was made of steel alloys mixtures. It is one of the most important component As the failure of excavator bucket causes the loss of production In this paper, we present a comprehensive study on the design and analysis of an excavator bucket using SolidWorks and ANSYS Workbench. The design process involves creating a 3D model of the excavator bucket using SolidWorks, followed by structural analysis using ANSYS to ensure its structural integrity and performance. The analysis includes finite element analysis (FEA) to evaluate the Life, Deformation, Damage and Equivalent altering stress of the bucket under different loading conditions. The results obtained from the analysis are used to optimize the design of the excavator bucket, ensuring its safety and reliability in operation*

***Keywords:** Excavator bucket, SolidWorks, ANSYS, Design, Finite Element Analysis (FEA).*

1. INTRODUCTION

Excavator buckets are critical components of excavators used in construction and mining industries for various material handling tasks. The design and analysis of excavator buckets are crucial to ensure their structural integrity, performance, and reliability under heavy loads and harsh working conditions. SolidWorks and ANSYS Workbench are widely used software tools for 3D modelling and finite element analysis(FEA), respectively, and offer powerful capabilities for designing and analysing excavator buckets.

Here we designed the bucket with DOMEX STEEL ALLOY. Domex cold forming steels are thermo-mechanically rolled in modern plants where the heating, rolling and cooling processes are carefully controlled. The chemical analysis, consisting of low levels of carbon and manganese has precise addition of grain refiners such as niobium, titanium or vanadium. This together with a clean structure, makes Domex Steels the most competitive alternative for cold formed and welded products.

which is very strong and have all mechanical properties where the excavator bucket needed, and also Bendability and weldability properties which gives more advantage to bucket manufacturing. The design process involves creating a 3D model of the excavator bucket using SolidWorks, followed by finite element analysis (FEA) using ANSYS Workbench to evaluate its structural integrity and performance. The analysis includes stress analysis, deformation analysis, and optimization to ensure that the excavator bucket is safe and reliable under different loading conditions. Verification and validation of the model and results are also conducted to ensure accuracy and reliability. The design and analysis of excavator buckets are crucial in ensuring their optimal performance, durability, and safety. With advancements in computer-aided design (CAD) and finite element analysis (FEA) software, such as SolidWorks and ANSYS Workbench, engineers can create and simulate excavator bucket designs to evaluate their structural integrity, performance, and reliability. Material selection, geometry optimization, structural analysis, and optimization techniques are key aspects of excavator bucket design and analysis, aiming to achieve optimal performance with minimal weight and material usage.

Excavator buckets play a significant role in construction and mining operations, and their design and analysis have been the subject of extensive research and development. The literature review on

this topic provides an overview of the existing knowledge and research related to excavator bucket design and analysis, including studies on material selection, geometry optimization, structural analysis, optimization techniques, and verification and validation of the design. Understanding the state of the art in excavator bucket design and analysis is crucial for engineers and researchers to further improve and optimize the performance of these critical components in construction and mining machinery.
In this paper, we will present a comprehensive study on the design and analysis of an excavator bucket using SolidWorks and ANSYS Workbench software. We will discuss the design process, finite element analysis, optimization, verification, and validation of the excavator bucket model, utilizing the capabilities of SolidWorks and ANSYS Workbench to ensure a robust design that meets the requirements of the intended application. The findings of this study can contribute to the development of optimized excavator buckets that are safe, efficient, and reliable in construction and mining operations

2.LITERATURE REVIEW

In this case, the literature review will focus on the design and analysis of excavator buckets using SolidWorks and ANSYS Workbench software.
Design of excavator buckets has been a subject of extensive research and development due to their critical role in construction and mining operations. Various studies have explored different aspects of excavator bucket design, including material selection, geometry optimization, and structural analysis. Additionally, the use of CAD and FEA software, such as SolidWorks and ANSYS Workbench, has become prevalent in excavator bucket design and analysis, offering advanced tools and capabilities for engineers to create optimized and reliable designs.
One important aspect of excavator bucket design is material selection. The choice of material for the bucket affects its performance, durability, and weight. Researchers have investigated different materials, such as steel alloys, wear-resistant steels, and composite materials, for excavator bucket design. For instance, a study by He et al. (2016) explored the use of high-strength steel alloy for excavator bucket design, considering factors such as yield strength, tensile strength, and toughness. The study concluded that the selected steel alloy showed superior mechanical properties and could be a viable option for excavator bucket design.
Finite element analysis (FEA) using software such as ANSYS Workbench has become a widely used technique for the structural analysis of excavator buckets. FEA allows engineers to evaluate the structural integrity and performance of excavator buckets under various loading conditions, such as static loads, dynamic loads, and impact loads. Several studies have employed FEA to investigate the stress distribution, deformation, and failure modes of excavator buckets. For example, a study by Liu et al. (2017) conducted a static stress analysis of an excavator bucket using ANSYS Workbench, and identified the critical stress areas and potential failure modes. Another study by Wang et al. (2018) performed a dynamic simulation of an excavator bucket using FEA to evaluate its fatigue life and identified the fatigue-prone areas.
Verification and validation of the excavator bucket model and results are also crucial in ensuring the accuracy and reliability of the design. Several studies have employed experimental testing and field validation to validate the performance of the excavator bucket design.

3. MODELLING

Following are the dimensions of Excavator Bucket.

S.No	Dimensional parameters	Dimensions(mm)
1.	Overall length of bucket	5130
2.	Width of bucket	3810
3.	Length of teeth	220
4.	Volume of Bucket	2.3379e+007
5.	Mass	18405 kgs

3.1. Excavator Bucket dimensions

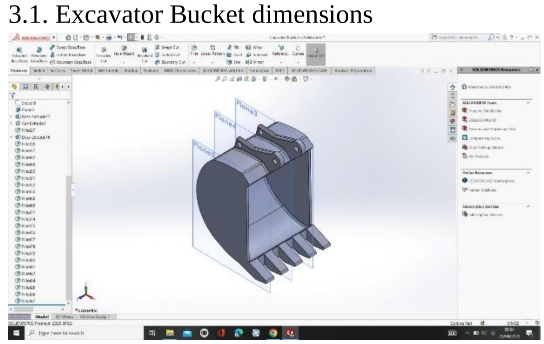


Fig.1. Solid works model of Bucket

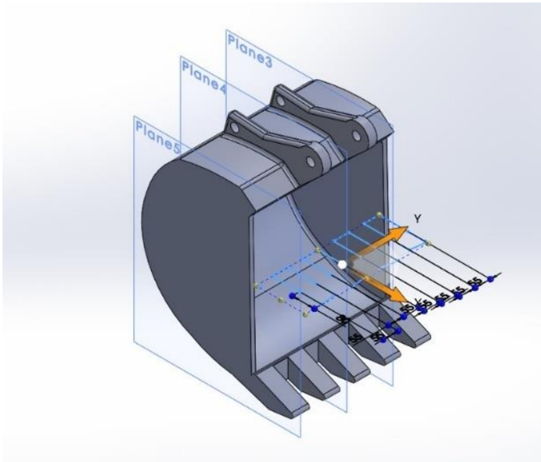


Fig.2. Front view of excavator bucket

4. SIMULATION

In this project we used designed the Excavator Bucket in solid works software. And done analysis on Ansys Workbench. we are going to find the life, damage and equivalent altering stress. In Ansys the designed excavator bucket is dumbed and done Static Analysis

- Meshing the CAD model in software and then applying the boundary conditions.
- Solve for solution of meshed model using the ANSYS. • Modification in CAD model for optimization using application.
- Carrying out different iteration by removing material or changing conditions based on ANSYS results.
- Checking of deformation and checking the maximum stress, life and damage ensuring it is well within the safe region

MECHANICAL PROPERTIES OF DOMEX ALLOY:

Property	Values
Yield strength	240-960 MPa
Tensile strength	310-1000 MPa
Hardness (HB	240-600
Elongation	14-25%
Density	7890 kgm*3

CHEMICAL PROPERTIES OF DOMEX STEEL

Material	Percentage max
Carbon (C)	0.05-0.20%
Sulphur (S)	0.01%
Silicon (Si)	0.1-0.50%
Nickel (Ni)	1.00%
Phosphorus (P)	0.025%
Chromium (Cr)	1.40%
Manganese (Mn)	1.0-1.60%

Other alloying elements may be present in smaller amounts, such as molybdenum, and vanadium.

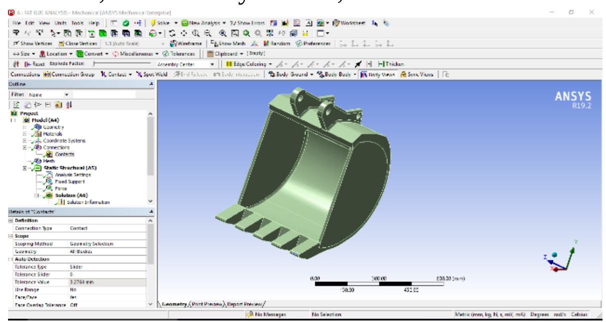
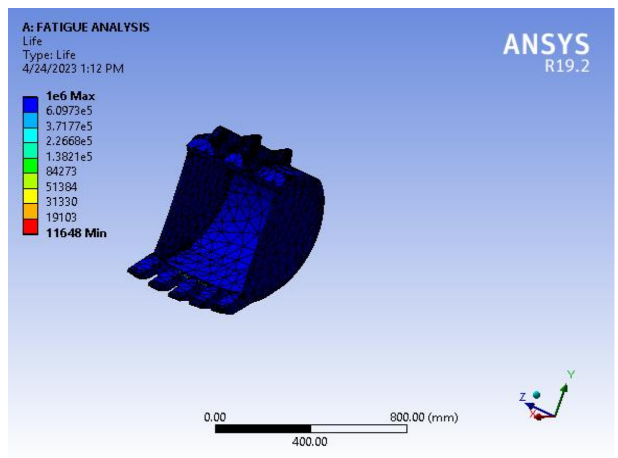


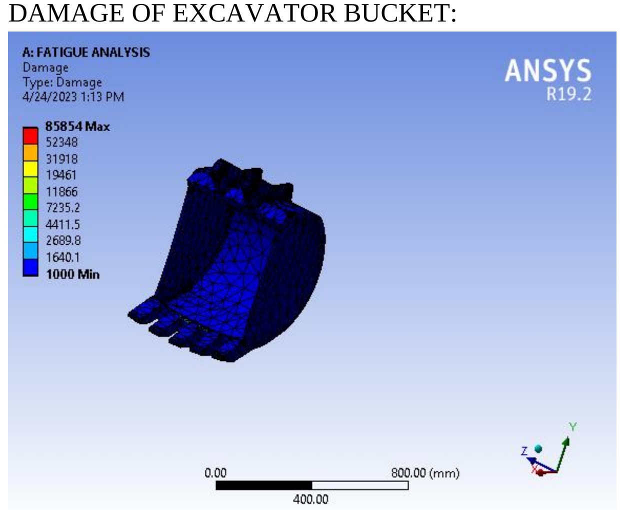
Fig-1: Geometric image of Excavator Bucket

5.RESULTS

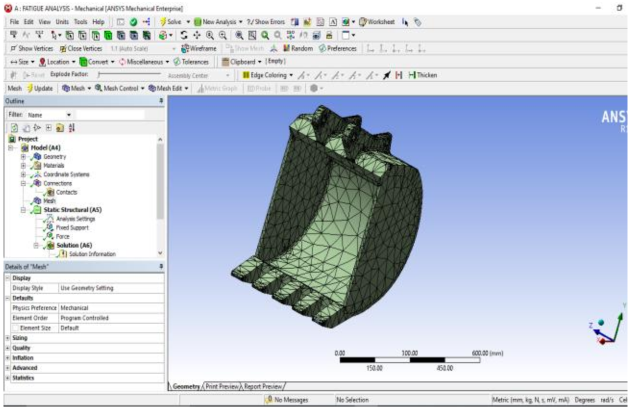
LIFE OF EXCAVATOR BUCKET:



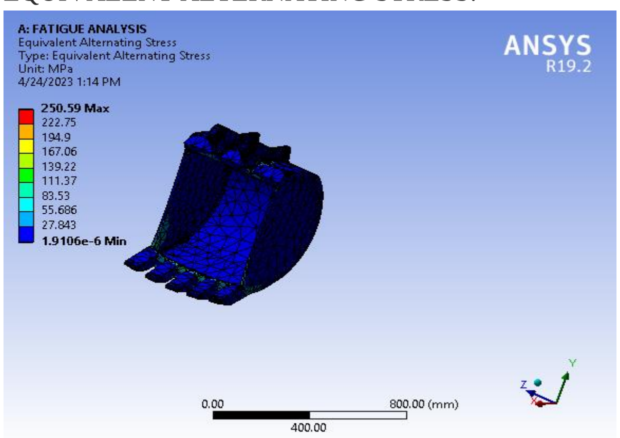
DAMAGE OF EXCAVATOR BUCKET:



MESHING OF EXCAVATOR BUCKET:



EQUIVALENT ALTERNATING STRESS:



6. CONCLUSION

Thus the design and analysis of Excavator Bucket is done and has the following conclusions. The design and fatigue analysis of the excavator bucket using SolidWorks software proved to be effective in ensuring the bucket's durability and safety. The results of the fatigue analysis demonstrated that the bucket could withstand repeated loading cycles without experiencing fatigue failure. The design can be modified to meet specific requirements or to optimize performance based on the intended use

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