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LOAD TEST PERFORMANCE ON EXCAVATOR BUCKET TO UNDERSTAND THE RANGE OF DEFORMATION AND STRESSES INDUCED BY USING CAE TOOL

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Abstract

Excavator Bucket always undergoes the heavy loading conditions. Hence the life of bucket is less than the designed life span. It all happened only due to the vibrations and the heavy loading conditions. Deformation and stresses induced in bucket structure must be studied well so that the life of bucket can be improved. It can be done by conducting Load test by using CAE software. Now a day's CAE softwares are more reliable and giving more approximate results.

In this paper the load test on the excavator bucket is performed by using CAE tool to study the range of deformation and stresses. CAD model is developed for this purpose and imported into CAE tool i.e. ANSYS software. Further loading conditions are given and deformation and stresses are obtained.

Keywords : CAE Software, CAD Mdel, ANSYS, Loading Condition, etc.

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1. INTRODUCTION

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.

1.1 Loads on excavator bucket

There are several types of loads which are directly or indirectly applied on bucket. Some of them are listed below.

i) Impact load on teeth and bucket.
ii) Vibrations due to sudden impact.
iii) Self weight
iv) Load applied by hydraulics to perform movement.
v) Loads applied while working.

1.2 Material and its Strength

Material used for the construction of excavator bucket is though and having maximum stiffness to withstand for maximum loading condition. Usually stainless steel, High Carbon steel or heavy graded steel is used to construct excavator bucket.

Strength of Metal: A metal used for construction of excavator bucket are having maximum strength. It is only because of nature of working. Excavator works in worst environmental conditions. Hence to withstand in this condition metals with better strength are required.

1.3 Load Test Importance

As we know that the excavator buckets are used to work in heavy duty type of work. Hence to study stability and performance of excavator bucket, load test is important. We

can perform load test by using CAE tools effectively. Following are the merits due to which we perform load test.

i) Study of dynamic stability in different loading condition.
ii) To identify stress concentration and maximum deformation range.
iii) Shape optimisation and material optimisation.
iv) To improve life of excavator bucket

1.4 Life span of excavator bucket

of the cases excavator bucket fails before its designed life. Normally the bucket is designed for 7 years working. But due to heavy loading Excavator bucket works in extreme conditions, hence in most and continuous impact of forces bucket fails. By improving stiffness with addition on material at the stress concentrating areas, we can improve the life of bucket.

2.LITERATURE SURVEY

There are several research papers are available regarding stress analysis and maximum deformation of excavator bucket. Some of them are focusing on the stability of bucket and others are focusing on dynamic balancing, vibrations, loading conditions and performance characteristics

2.1 Outcome from Literature Study

- Research on load test performance of excavator bucket is needed more concentration.
- There is a large scope to improve the stability and stiffness of bucket.
- Loading conditions should include the frequency generation during working of excavator bucket.

2.2 Aims and Objectives of study

- Static load analysis for excavator bucket performance
- Total Deformation a stress concentration areas.
- Life improvement of Excavator bucket
- Excavator bucket reconstruction support.

3 ANSYS as a CAE Tool

3.1 CAD model preparation:

To prepare CAD model we have used small excavator bucket which is shown in Figure 3.1. This bucket is small in size and general bucket which is used in most of the operations.

Figure 3.1: Excavator Bucket

Figure 3.2 shows the CAD model of excavator bucket which is developed by using CAD tool. Several commands are used to develop it like extrude, pocket, fillet, chamfer etc.

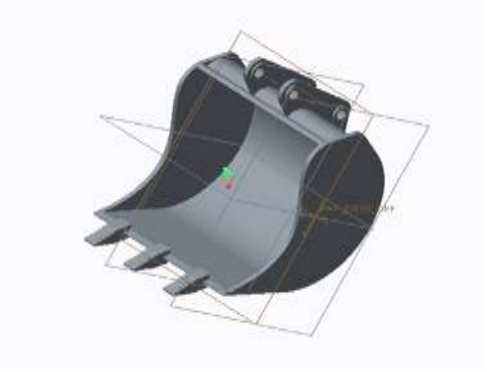

Figure 3.2: Excavator Bucket CAD model.

3.2 Conversion of CAD file

IGES (Integrated graphics exchange system) is the neutral file format used for conversion and importing of CAD file into CAE tool.

3.3 ANYSIS as a CAE Tool

ANSYS software is used to design products and semiconductors, as well as to create simulations that test a product's durability, temperature distribution, fluid movements, and electromagnetic properties

3.4 Required Material Properties

Following are the properties required for the vibration analysis.

Table 3.1: Properties of Stainless Steel(SAE 1020) for Vibration Analysis.

Property	Value
Young's Modulus (E)	2.2e5 MPA
Poisson's Ratio	0.3
Density	7850 kg/m^3
Load	7380 N

3.5 Meshing Process.

Following digram shows the meshed view of excavator bucket which is generated in ANSYS software.

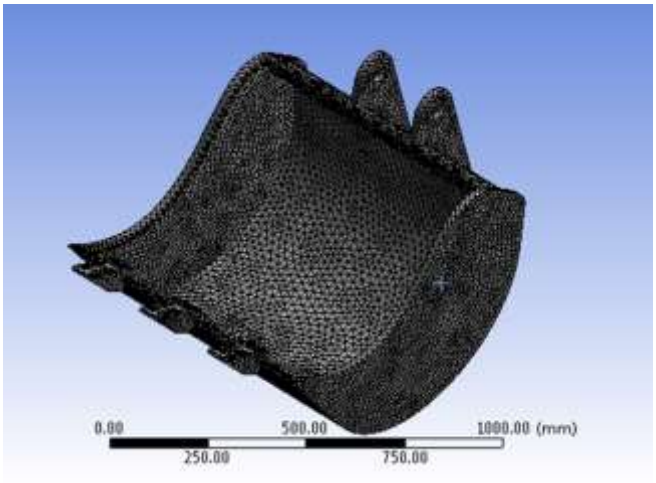

Figure 3.3: Meshed view of Excavator Bucket

The details of nodes and elements formed along with type of element are given in Table 3.2.

Table 3.2: Number of Nodes and Elements

Types of element	3DTetragonal, 3D Hexagonal
No. of elements	39285
No. of nodes	76693

4. Results Obtained in CAE Tool

By performing structural Analysis with the help of ANSYS software, we have obtained following results. This results are regarding max. deformation, normal stress, shear stress, equivalent stress etc.

Sr. no.	Result	Value
1	Total Deformation	1.84 mm
2	Normal Stress	18.413 MPA
3	Shear Stress	18.717 MPA
4	Equivalent Sress	47.116 Mpa

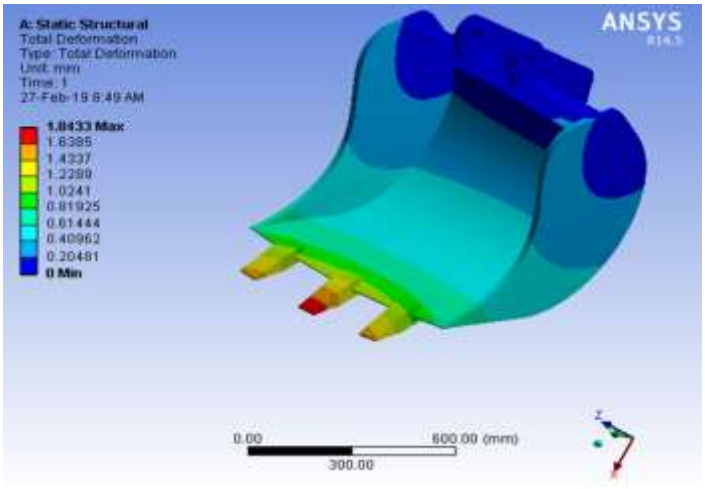

Figure 4.1: Total Deformation for applied load.

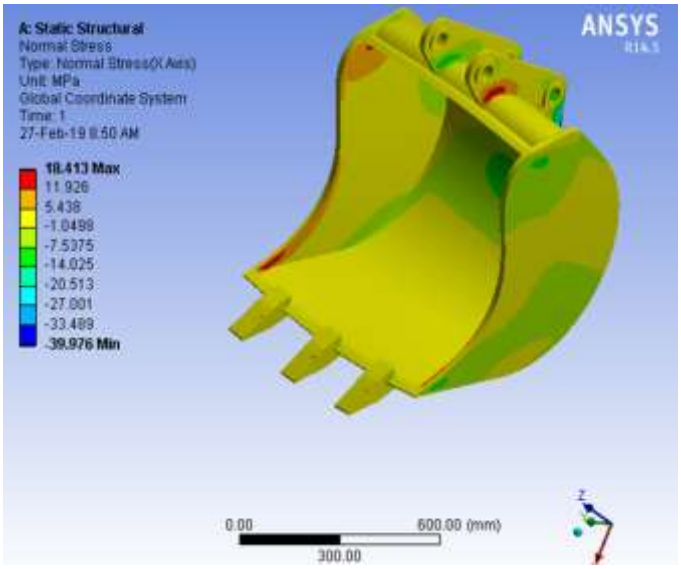

Figure 4.2: Normal Stress concentration at the fix collars.

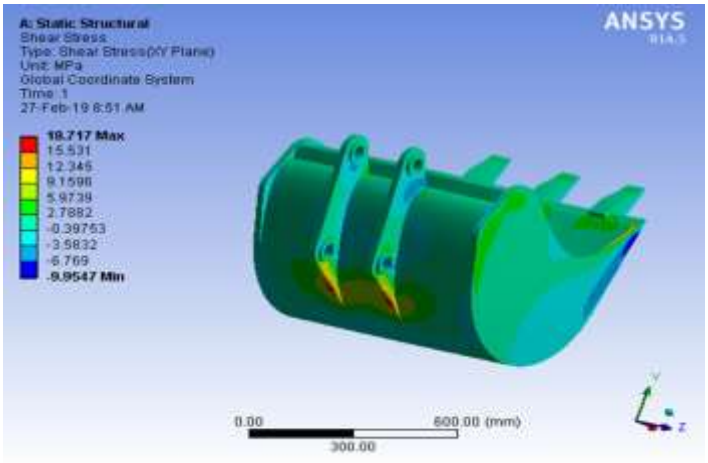

Figure 4.3: Shear Stress concentration at the fix collars.

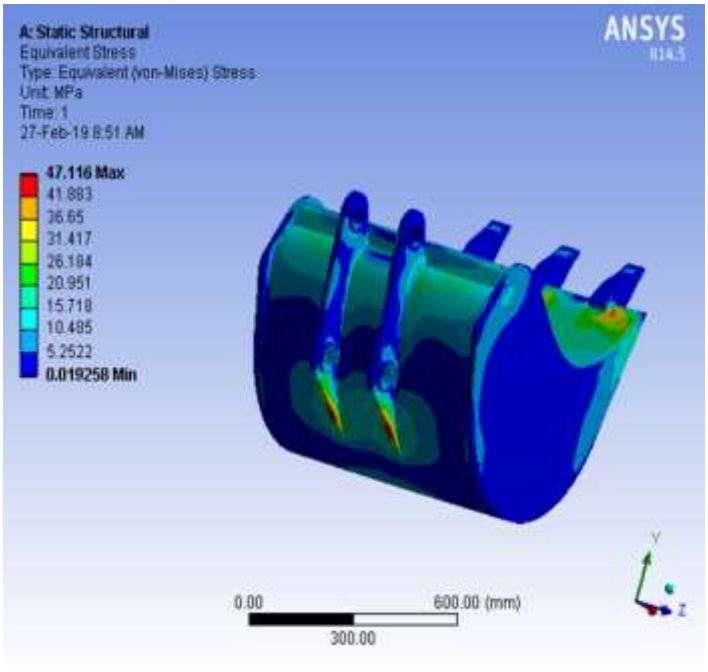

Figure 4.4: Equivalent Stress concentration at the fix collars.

5. Conclusion

Deformation and stresses induced are in acceptable range. But continuous impact of such loads affect the dynamic stability and hence the performance of Excavator Bucket. To avoid failure extra material can be added to improve stiffness and to reduce stresses

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