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Modelling and 3D Printing of Jcb Bucket

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ABSTRACT

A JCB bucket is a piece of heavy equipment that is commonly used in construction work. Mining work and work that requires lifting can be too heavy for humans. JCB is a vehicle that is engineered and consists of things that can be used as a bucket which can have different components is backhoe acts as a control for the JCB bucket and the shape of the bucket carries the materials and teeth leads to damage to the ground engaging tools i.e. bucket teeth. The teeth of the JCB are the main contacting part of it which comes first in contact with soil while doing the excavation at various sides. In this project, we created an optimal model using 3D modeling software i.e. Solidworks. Then the model JCB bucket is exported to Solidwork for prototype fabrication by using Flash Forge Creator Pro model of the bucket is a Digging bucket

Keywords: JCB bucket, modeling, 3d printing, rapid prototyping.

INTRODUCTION

Excavator buckets, essential attachments fixed to the excavator's arms, facilitate digging in various terrains and tasks like trenching, geotechnical investigations, and loading dump trucks. Their versatility extends to applications in construction, urban infrastructure projects, waste management, and even mining and demolition in India. These machines feature hydraulic systems for precise control during operations, with cylinders applying forces to manipulate the bucket, arm, and boom. While boom cylinders mainly adjust bucket position, arm, and bucket cylinders primarily handle excavation tasks, each contributing to the overall digging force. Excavators play a pivotal role in earthworks, offering efficiency and power for diverse heavy-duty tasks across different industries and projects.

Fig.1.1 JCB bucket

LITERATURE REVIEW

1. MilošTanasijević discusses about Cycle of bucket wheel excavators which is analyzed in his study. He has concentrated on quality of service characteristics. He has 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 considered as a measure of quality of service.
2. Nedeljko Vukojević and Fuad Hadžikadunić have discussed SH630 Excavators which are specially used in mines. According to his stress analysis results, the main body of the bucket remains undeformed in normal working conditions. The actual part that comes under stress is the joints and corners where the stress value is slightly less than allowable stresses. Dynamic stress changes take place around a relatively low

medium stress with a small stress amplitude, which is desirable from the standpoint of strength. The stress change character fully agrees with the expected changes caused by normal operating excavator operations.

3. Santosh Gudagunti has studied the reduction of cycle time for the manufacturing of buckets, this will also reduce the rejection rate and increase the throughput by applying the lean principles and lean, tools time study is carried out for all the processes in the manufacturing of excavator bucket. The process improvement is done for the process which has a high cycle time. Along with savings in time the research also helped in saving in labour. The lean principles are followed in his study to eliminate the waste in an industry.
4. Janmit Raj and Gaurav Saxena in their review have reported studies in the field of FEA (Finite Element Analysis) consisting of the design of the boom, structural analysis, fatigue analysis, modal analysis, shape optimization, and CAD/CAE system integration with the required software for carrying out the analysis work with an emphasis on the publication in the last 13 years (2002-2015)
5. Vishwajeet A. Patil and 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 method gives the force calculation and further it is used for carrying out the fatigue analysis to calculate the fatigue life of the bucket and its failure. Further, the work regarding the optimization of the bucket to give maximum fatigue life for the digging at the desired force conditions. An analytical approach was provided for static force analysis of the excavator bucket.

METHODOLOG

The methodology behind JCB buckets encompasses meticulous engineering focused on design, construction, and functionality for optimal performance in construction and earthmoving tasks. Factors like material strength, durability, and shape are meticulously considered to ensure efficient digging, lifting, and loading operations. High-quality materials, including hardened steel, enhance resistance to wear and tear, while bucket geometry is tailored to maximize digging force and material retention while minimizing fuel consumption. Attachment mechanisms are crucial for secure connection to JCB machines. Overall, JCB buckets are crafted to be robust, efficient, and versatile tools, enhancing the overall performance of JCB construction equipment across various construction and excavation applications.

MODELING

In SolidWorks, start by creating a new part file and setting up appropriate units and dimensions. Begin by sketching the profile of the JCB digging bucket's cross-section on the top plane, including the bucket's shape and curvature. Use features like extrude and cut to give depth to the bucket's profile and hollow out the interior. Incorporate details such as reinforcing ribs, tooth pockets, and wear plates using additional sketches and features. Utilize the shell feature to create the thickness of the bucket walls, ensuring structural integrity while minimizing material usage. Include the attachment mechanism, such as mounting holes or pins, using sketches and features to accurately represent how the bucket connects to the JCB equipment. Apply appropriate material properties to the model, considering factors like hardness, toughness, and wear resistance, typically using hardened steel for durability. Create assembly mates to simulate the bucket's connection to the JCB equipment within an assembly file. Document the design by creating detailed drawings with dimensions, annotations, and a Bill of Materials (BOM) for manufacturing guidance. Validate the design through prototyping and testing, making adjustments as necessary based on feedback. Ensure that the final model adheres to manufacturing standards and specifications for quality control. By following these steps in SolidWorks, you can efficiently model a JCB digging bucket that meets the demands of construction and excavation applications.

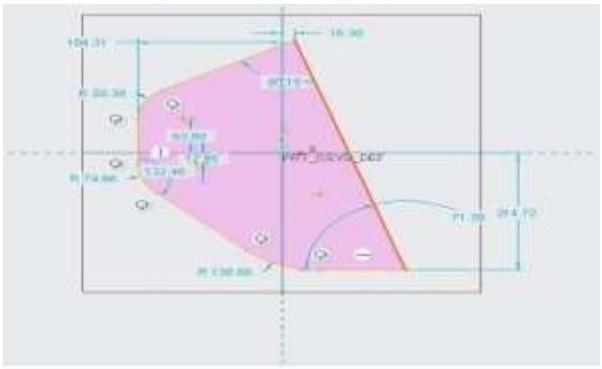

Fig:1 Dimensions of JCB Bucket

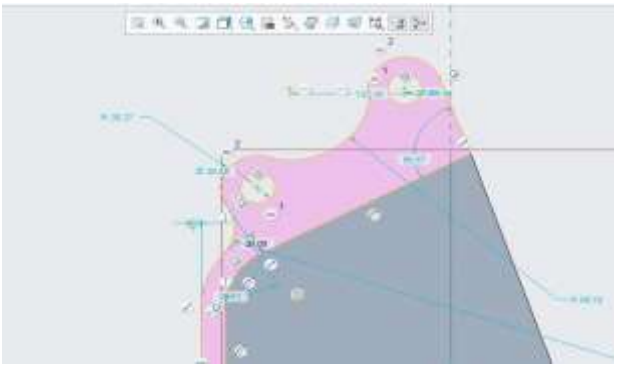

Fig:2 Designing of Backhoe

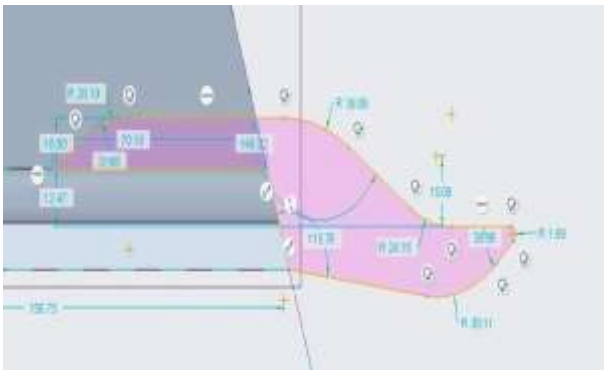

Fig:3 Design of Teeth

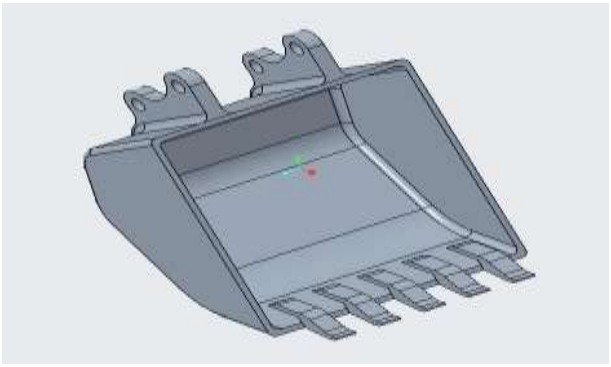

Fig:4 Fixing the teeth to bucket

3D PRINTING

The 3D printing process involves converting a digital design into a physical form by adding layers of print material. Steps include CAD file development, conversion to specific formats like STL, and manipulation of the STL file to set orientation and size. Preparing the printer involves installing necessary materials like polymers and binders. The printing process begins, building the object layer by layer, with patience required due to the time it takes. For printing a JCB bucket, the model is added to the software, repaired if necessary, and transformed as needed. The model is then sliced into g-code for printing, with settings adjusted and the printing process initiated either directly or by exporting the g-code file. Finally, the printer is prepared, temperatures are checked and adjusted, bed preparation is done, and printing is initiated.

Fig.6.3.1 3D Printing Machine

Fig.6.3.2 Digital Display Of The 3D Printer

RESULTS

In this project, we learned the digging bucket of one of the JCB machine vehicles that was engineered. This digital 3d model is converted into a set of instructions for the 3d printer which is called the slicing process. Then the 3d printer will take the input and it will build the required JCB bucket. A simple model of a JCB bucket is designed which is very stable and can take enough load on uneven surfaces and somewhat inclination is also allowed. This jcb bucket model is properly designed in the designing software i.e., Solid Works and perfectly printed by the 3d Printer

CONCLUSION

The prototype of the JCB bucket is designed in Solid Works software and then it is printed using 3d printer. The proposed has reduced weight by changing the manufacturability. Designing this new bucket reduces the number of parts simplifying the assembly process.

The ability to create intricate and tailored designs using 3D printing technology provides a level of flexibility previously unseen in traditional manufacturing processes. This adaptability allows for the optimization of JCB bucket specifications to meet specific project requirements, ultimately improving performance and productivity on construction sites.

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