



Analysis of Rake Angle Effect to Stress Distribution on Excavator Bucket Teeth Using Finite Element Method

S. Hadi Suryo ^{a*}, A. P. Bayuseno ^a, J. Jamari ^a, A. Imam Wahyudi ^a

^a Department of Mechanical Engineering, University of Diponegoro, Semarang, Indonesia.

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Abstract

Excavator is mostly used for mining and construction. This heavy equipment, widely known as a backhoe, is a digging machine commonly used for dredging the mining materials, digging and leveling the soil, dredging the river, removing the road and demolition. Excavator has bucket teeth, component that frequently undergoes a change. The replacement of bucket teeth is performed due to its low usage time and many failure experiences such as wear, bend, crack and fracture during the use. To prevent the occurrence of the failures, a structural analysis on bucket teeth is necessarily conducted. The analysis was conducted to find the stress distribution on bucket teeth from the rake angle effect during the excavation. The analysis was performed using finite element method by static loading and two-dimensional modeling to determine digging and resistive force in bucket teeth. Based on the analysis, it was obtained the stress distribution and maximum value of von mises occurring in the bucket teeth from the rake angle effect. The maximum stress, obtained from the analysis results, was then compared to the allowable stress of the bucket teeth material. The results showed that the materials used were in safe limits and had small potential for experiencing failure as well.

Keywords: Bucket Teeth; Excavator; Failure; Rake Angle.

1. Introduction

In mining industry, heavy equipment is familiar thing to hear and see. The equipment is used to support the mining process starting from opening a new mine, road construction, excavation and transporting the mining material to the next process. The types of heavy equipment are also variously based on its application, for example transporting and digging the mining materials and so on. Although this heavy equipment is mostly known in mining industry, however, it is not only used by mining industry. Construction, forestry, landscaping and some other applications also use this heavy equipment for daily activities. One type of heavy equipment that is mostly used for this activity is excavator. This heavy equipment, widely known as a backhoe, is a digging machine commonly used for dredging the mining materials, digging and leveling the soil, dredging the river, removing the road and demolition. Excavator has a part used as a tool for digging and loading the material that is called an excavator bucket. Excavator bucket is generally equipped protruding gear on its point that is called bucket teeth.

Bucket teeth (the gear or mostly called as the nail of the bucket) are parts of the bucket that easily experience failure when the excavator is being operated because this part will be in direct contact with the medium under work by the excavator. The bucket teeth must have appropriate geometrical design to the need so that the usage time can be prolonged and the cost can be reduced [1]. Excavator bucket teeth have several types, whose function is based on the shape. The examples are: Standard Long Teeth commonly used for the excavators working on various types of surfaces; Extra Teeth commonly used for rock and abrasive surface; Rock Chisel Teeth commonly used for rock or hard soil; Tiger Teeth

* Corresponding author: mr.sumarhadi@gmail.com

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