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Finite Element Analysis Approach on 3D Modeling of Archery Bow Design

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Abstract

This paper presented the simulation analysis of 3D modeling of the archery bow design using finite element analysis. The objective of this study is to develop and optimized new design of bow based on the current design used in the competition. It leads to the comparison of the previous and the optimized designs have been developed. The bow was simulated under static and maximum condition of bow using finite element analysis software. During shooting an arrow, full draw stage is the most critical point of shooting and sustains the maximum load applied on the bow. In this analysis, the maximum draw length was considered is 660 mm and 710 mm which exerted in two different forces behaviour. Modelling software was performed 3D image archery bow before analyzing in commercial finite element software. Aluminium alloy 6061 T6 was applied for the material properties similar to the current bow, in order to optimise the designs that have been proposed in the first place. Furthermore, isotropic material and the tetrahedral meshing element were selected for acceptable results. The results reveal that the current design can sustain both set of forces with maximal deflection of 0.29 mm with factor of safety (FOS) is 10.6. Hence, to optimize the design, the material was removed about 16% from the total mass to get the final weight approximately 0.92 kg. However, this method will increase the maximum deflection and reduced the FOS to the optimum number. Then, the optimum design was fabricated using 3-axis CNC machining to compared with the previous design. This approach considered the basic method of design to reduce the time and cost taken in fabricating products. It is beneficial for the manufacturer and engineer to enhance the sports equipment capability to the limit especially in Archery.

Keywords: Finite Element Analysis, Bow, Archery.

1. Background/ Objectives and Goals

Archery is a well-known sport and even played in Olympics. There are many of types of Archery bows available in the market but among them, the only Recurve bow is permitted in the Olympics for the time being [1]. Basically, the main parts of bow anatomy are riser and limb. However, the riser are considered to be the heart of the recurve bow since it is the major contributor of mass and stability when shooting [2]. The physics is archery which is the interaction between the bow and the arrow have become a scientific research as it lost its importance as a weapon in hunting and war [3]. According to Leroyer, Hoecke and Helal, good skills in propelling arrows refers to the ability to shoot at the given target with good accuracy [4]. In competition level, metallic alloy risers are being widely used due to its stiffness and ability to resist creep. However, Haidn and Weineck as cited in [5], a good riser should be low