



Investigation and Redesign of the Modern Lacrosse Stick Head



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Introduction

The modern lacrosse stick head has evolved greatly from its earliest curved wooden ancestors of the Cherokee Native Americans. However, perfection has not yet been reached. The frequency in which lacrosse stick heads fail is the fuel behind the research and design in this project. The purpose is to reduce the stress experienced in the sidewall section of the head under impact loading conditions in order to reduce the incidence of failure. The focus of this project will be on the Warrior Revolution lacrosse stick head.

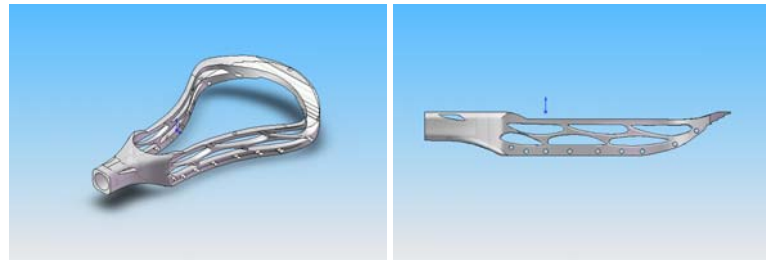
Motivation

The motivation behind this project is that broken lacrosse stick heads are commonplace among all levels of play. Leading companies offer little to no warranties for their products and expect athletes to repeat buy when their sticks fail. The main area of failure for most lacrosse sticks is the sidewall region.



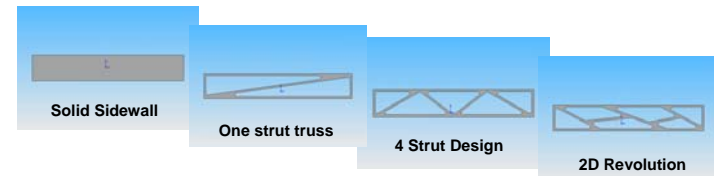
3D Model

A computer generated model of the existing Warrior Revolution Stick was created using SolidWorks design program. The stick was used to compare against a new and improved design.



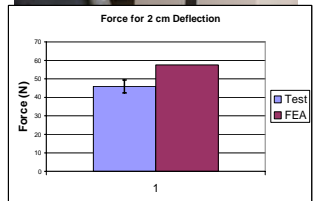
2D Optimization

In order to simplify the design, the sidewall section is idealized into a 2D rectangular section of dimensions 18.5 X 2.79 centimeters. A design matrix is set up to minimize the von mises stresses under a nominal loading condition and one end fixed. The optimum design is chosen based on stress and weight.

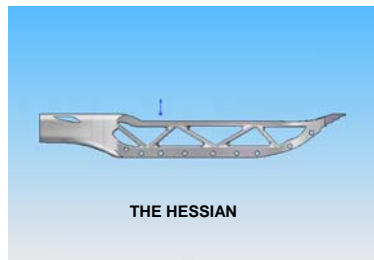


Validate Model

To ensure that the 3D model is representative of the existing stick, it must be verified using a force-displacement test. The experiment for the actual stick is shown to the right.



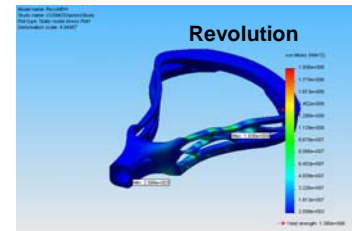
3D Implementation



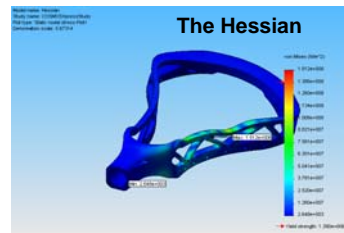
The 2D optimum was transferred into the 3D model in place of the existing truss network. Additional optimization was necessary to account for the thickness. The 3D design is then analyzed using finite element analysis to determine the max stress.

Results

A loading condition is applied to both models to mimic the impact of a ball on the sidewall.



0.214 kg Max Stress: 194 MPa



0.211 kg (> 1% reduction)

Max Stress: 151 MPa (22% Reduction)

Conclusions

The project produced a new lacrosse stick head design coined "The Hessian" that has lowered the maximum stress in the sidewall region to 151 MPa. It more than satisfies the weight constraint of the existing Revolution design. The Hessian was compared to the computer model of the Revolution, which was validated to the actual stick within 25%. The Hessian design is a five strut truss structure with filleted corners and edges to minimize wasted material.