



A STUDY ON DESIGN AND ANALYSIS OF PROSTHETIC RUNNING BLADE

Engineering

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ABSTRACT

Prosthetic running blade (PRB) used in competitive and recreational running in able-bodied athletes involves a hopping motion to achieve forward motion. The muscles and joints of the lower-limb absorb energy during the initial contact of stance phase, and then provide propulsion upwards and forwards during the latter part of stance phase. PRB are constructed of various types of composite material, shaped into a continuous J-like shape without an articulating joint analogous to the ankle.

It is not yet formally recognized how lower limb prosthesis should be assessed for their performance. To assist in this process, experiments are undertaken to investigate the linearity, stiffness and assessment of foot-based energy return prosthesis technology typically used for elite level high speed running. Through initial investigations, it is concluded that static load testing would not be recommended to specify or regulate energy return prosthesis for athletes with a lower limb amputation.

KEYWORDS

Composite material, Solidworks software, Kevlar fibre, Ansys workbench software.

INTRODUCTION:

Prosthetic running blade is energy returns technology when loaded under dynamic conditions demonstrates changes in mechanical stiffness due to bending and elective blade length variation during motion. Such radical changes of boundary condition due to loading suggest that any assessment of lower limb prosthesis technology in the future should use methods that do not assume linear mechanical for the design of the project, various designing software's are used such as AutoCAD, Solidworks, Pro-E, Catia etc. In our project we have selected Solidworks software for designing of various parts i.e. Socket and Foot of prosthetic running blade. Solidworks is modeling software which could be a Para solid-based solid creator and utilizes a constant feature-based approach to form models and assemblies.

METHODOLOGY:

- 1) **Design of the project:** it is fully based on solid work and Ansys. Which help us to get the result.
- 2) **Analysing project:** This is the process where we determine the stresses acting on the blade by applying boundary conditions such as the weight of the amputee and the ground reaction. The analysis of the prosthetic running blade can be done by using the Ansys Workbench software.
- 3) **Result obtained after analysing:** This is the process in which the results obtained are observed by the deflection or due to high stresses where it tends to fail i.e. break depending on the boundary conditions applied.

TABLE 1: Material Specification We have selected Kevlar Fibre material for this experiment.

Properties	Polypropylene (For socket)	Stainless Steel (For screw)	Titanium	Kevlar Fibre
Youngs modulus (Mpa)	1800	180000	114000	30000
Density (Kg/m ³)	920	7750	4500	1400
Poisson's Ratio	0.42	0.31	0.32	0.35

BASIC PROSTHETIC RUNNING BLADE:

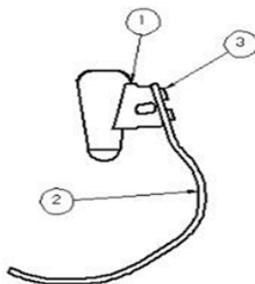


FIGURE 1: Basic PRB

Hence as shown in the above figure 1 the main parts required for the assembly of prosthetic running blade are as follows:

- 1) Socket & Bracket.
- 2) Blade
- 3) Screw

PROBLEM DEFINITION:

Material with low weight and high strength is required. The presently available material for prosthetic running blade is of high cost, which can't be affordable by many people. Design is slightly complicated, hence manufacturing costs increases.

DESIGN OF SOCKET WITH BRACKET:

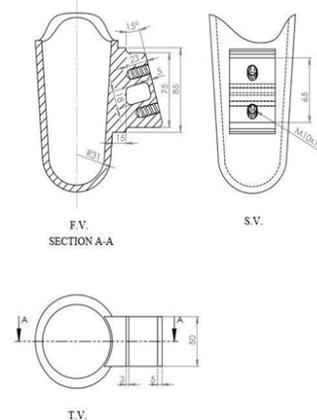


FIGURE 2: Projected view of socket and bracket

VARYING THICKNESS BLADE:

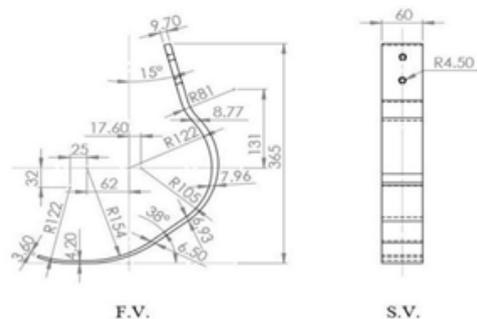


FIGURE 2: varying thickness

PROJECTED VIEW WITH HOLES ON BLADE TO REDUCE WEIGHT:

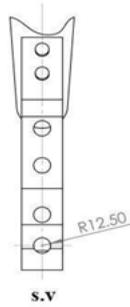


FIGURE 3: blade with holes

SAME THICKNESS BLADE:

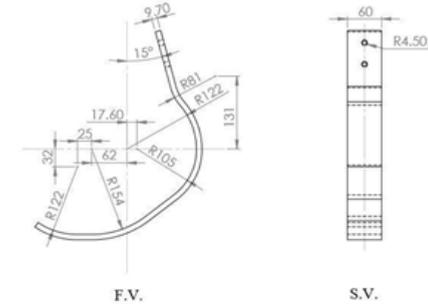
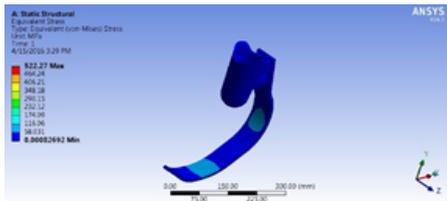


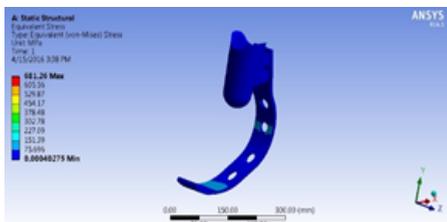
FIGURE 4: same thickness

ANALYSIS:

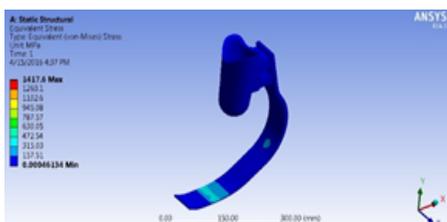
CASE 1: same thickness blade



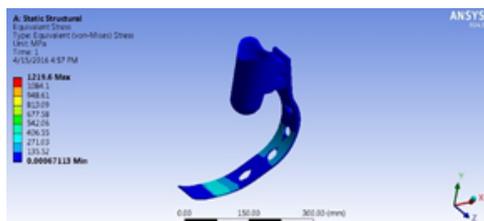
CASE 2: same thickness blade with holes



Case 3: Varying thickness blade



Case 4: Varying thickness blade with holes



STRESS RESULTS:

	Case 1	Case 2	Case 3	Case 4
Stress (Mpa)	522.27	681.26	1417.6	1219

CONCLUSION: We have considered same thickness and varying thickness type of blade while designing thus for reducing weight we have made changes in design that is by making some hole on blade. we can conclude that Kevlar fiber is a good replacement for carbon fiber.

REFERENCE:

- 1) <http://www.wikipedia.org/>
- 2) <http://www.ansys.com/>
- 3) Brian S. Baum, April 2013, "Running mechanics in amputees", National Institute of Advanced Industrial Science.
- 4) Quebec, Canada, 2008, "Energy storage and return (ESAR) foot-ankle prosthesis"
- 5) Richard R. Neptune, USA, 2006, "ASME International Mechanical Engineering Congress and Exposition", Department of Mechanical Engineering, University of Texas, Volume 10.
- 6) Siamak Noroozi and Bryce Dyer, School of Design, Engineering and Computing, Bournemouth University, Poole House P124, Talbot Campus, Fern Barrow, Poole, Bournemouth BH12 5BB, UK.