Numerical Analysis: The Effect of Composite Material on Insole Sport Shoe on Foot Pattern

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Abstract— Different type of foot pattern can deliver various impact to shoes. The composite material which constructive the insole shoe with specifically in basketball shoe will be tested with the different kinds foot patterns in terms of durability. The selected material that has been used is basically made from synthetic material such as polyethylene. The simulation of insole shoe will be compare to three different kinds of foot patterns to analyze the durability. All of these will be tested in the simulation to determine the impact to that insole shoe.

1. Introduction

A sport shoe is a footwear design to comfort and protect athlete’s foot while doing various activities [1]. However, the insole shoe has a huge impact for people footwear. Typical material like synthetic material is selected to give a suitable place for foot in the insole shoe. Different shoe has different type of materials for insole. For example, in sports game, insole shoe is created base on particularly sport that people do such as basketball, football, running, and so on. In basketball, insole shoe is made by using synthetic materials [1]. Viscoelastic materials are often characterized in the literature by an engineering measurement which is the ratio of the viscosity of material to its elasticity [2]. Thermoplastic materials are the material which can become ductile when the particle heated and will remain to the same configuration when cooled [2]. This why polyethylene thermoplastics are one of the most commonly used in insole basketball shoe because it designed to deliver comfortable to the people’s foot and hold to the position where the weight and forces are being applied to the insole [3]. In insole design, they are divided into flat and heel cup insoles. In particular basketball insole design, heel cup is normally being used. There is a purpose of designing heel cup to basketball insoles because they provides a protection to ankle and reduce the forces during the impact loads that applied to the insole during walking and jumping. The heel cup insole is taken in order to investigate by using the Nike zoom basketball from Kobe Bryant. Figure 1. is the sample which taken from the right and the top view.

Figure 1. Original Basketball Shoe and Shoe Ins

In addition, the component that needs to evaluate to suit the insole shoe is by looking for the types of foot pattern. Foot pattern is divided by three pattern: normal/neutral foot, high arch/supination foot, and flat foot/pronation foot.

The three patterns of foot will be evaluated and make the accuracy for athletes so that it can fit to the foot. All of this will be tested of their durability.

2. Methodology and Experimental Work

2.1. Shoe Insole Modeling & Foot Pattern

The material for the shoe insole will be selected properly due to simulation later after the modeling. Polyethylene is chosen due to the configuration of stability and possesses adequate flexibility and strength [3]. The basketball insole will be modeled with 7.5 cm length. This modeling is done by solidworks software.

Figure 2. Foot Patterns: (a) neutral; (b) flat ; (c) High-arc

Foot patterns are studied and tested to identify the different pressure at the insole to produce results in stress, displacement, and deformation. First, the experiment was started with taking three sample feet to wet and stick their foot to A4 paper as called foot printing. After three sample of foot printing are collected then the simulation will be run.

Figure 3. (a) Top View Model of Shoe Insole ; (b) Side View of Shoe Insole
2.2 Durability

Sport shoes should provide durability during the support phase of a lateral maneuver because of the large forces transmitted to the ground as player transition from lateral jump vertical to the ground [4]. The purpose is to investigate the barefoot pattern as perform the vertical jumping for evaluating lateral durability of insole shoe.

3. Results and Discussion

The results of the insole in the simulation will be resulted when the external loads were applied to the insole. For example, The external load/pressure is taken which applied to the insole is 20 N/m². This pressure will applied to each surface of the insole.

After the load was being applied, the insole will deform and results the stress, displacement, and deformation. Figure 6 is the statistic of the stress to the Shoe Insole and the displacement:

In stress, maximum stress is shown in red color with 82.2 N/m² and minimum stress is 0.2 N/m². In addition, the deformation is decompressed to 1.455 (10)⁻⁷ mm. It caused of the movement of the foot that contact to the insole shoe which can deform slowly. In displacement, the maximum displacement happened in the middle of insole with 1.45 (10)⁻⁷ mm and then slowly decreasing along the foot movement to the side part.

5. Conclusion

Shoe insole will affect by human foot based on the weight supply which will create pressure to the insole to analyze the durability. All in all, the testing in the simulation delivers the different pressure that result in stress, deformation, and displacement due to foot contact to the insole.

Acknowledgment

I personally would like to thank especially to my supervisor and friends who give support and motivation for my final year project

References