Analysis of the Mechanical Properties of Modified Cricket Bat Handles in Comparison to Referenced Handle

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Abstract- In this study an analysis had been done to assess the mechanical properties of Modified Handles in comparison to Referenced Handle. All the parameter had been already quantified and assumptions were made that, all the materials (same type of cane wood, rubber, twine, adhesive and joint assembly) and manufacturing process are equivalent, or at least do confer any performance benefited, if altered. In order to test the mechanical properties on prepared prototype laminated cane handles, in which thirty six (36) handles, were tested. The key parameters associated with the performance of Referenced and Modified Handle had been accessed through three (03) different types of experiments, i.e. bend, tensile and torsion test were performed consecutively. As per the experimental results, it was concluded that the performance of Modified Handles' was not found satisfactorily in comparison to the referenced handle.

Keywords – Cricket bat handle modified handle, referenced handle, joint assembly.

I. INTRODUCTION

The problem originally sourced and selected from previously published one of the patents no. (993/DEL/2014 A, 2014) [1], and with due permission of the patentee, the researcher conducted this study; experimentally on cricket bat handle as per the recent advancement in technological development into materials that have motivated a number of changes in cricket bat design and its specification, that may be guaranteed as some industrial application, compilations of the same work with correct interpretation [2].

In this study an approach was used to predict the performance of Modified Handles in respect to a Referenced Handle. Experiments had been carried on two major types of specimens; first was a Referenced Handle a conventional handle and the other was Modified Handle in which joint assembly was installed on three locations. The specimens used in this study were made up of laminated cane wood of constraint measurements on selected geometrical parameters, which were more similar to a traditional design.

Various modifications and designs have been developed using wood, aluminium and composite materials to improve the performance of baseball and cricket bats [3], [4], [5], [6], [7]. An alternate approach had been carried out to modify the handle of the bat, and then to a prototype Modified Handle was developed by Ali, & Murtaza [1], in which a joint assembly was used for attaching and detaching the handle having its distinct length, made up of brass materials mounted on to bottom portion of the handle [8].

Now a days, any equipment which comes out, and permitted to use into the games fairly, is often available after or with a lab test that simulate game conditions and incorporate the use of two objects; the object being evaluated and the object that it impacts in the course of its use. Aiming to that this work provides a working framework and to further improve upon and modify into the invention this work had been carried out.

And, the sole intension of conducting this type of work was to test the invention [1], technically and experimentally to make this invention industrially applicable and to ensure that the design and its implementation is in line with the international manufacturing standards of Cricket bats as well as conforming the rules of the sport. In order to make wide use of this invention as per the new Law 5 of MCC, 2017 [9], various tests were carried out on the innovative bat in the light of the MCC laws to reach a conclusion whether the design and the properties of the said bat handle confirm the rules of MCC or not.

II. METHODOLOGY AND PROCEDURES

In this study, various types of materials and methods were employed for the designing, production and manufacturing of the required specimen in which Referenced Handle and Joint Assembly and Parts thereof for Modified Handle. Various methods were used to test the prototypes have either been designed and/or purchased to meet as per the requirements of this study.

2.1 Handle models and Materials: A referenced handle had been constructed and produced having constraint measurements as per selected geometrical parameters, which was more similar to a traditional design made up of laminated cane wood [10], [11].

2.2 Selection of Sample Size for each type of Handles: All together total thirty six (36) handles was used, out of that nine (09) were referenced handle in which a set of three (03) handles were used for each type of mechanical test. And, rest of twenty seven (27) were modified handles in which a set of three (03) handles each a joint assembly was installed on to three (03) different locations, were also tested on each type of mechanical test [12], [13].

2.3 Preparation of Specimens: The dimensions of the specimens were kept constraint before performing the test [11]. All the specimens were prepared in a manner that the procedure does not harm the specimen's characteristics, and the specimen does not lose its originality, acts accordingly as it works, and looks in the normal shape and size. In order to test the mechanical properties on laminated cane handle; four major types of handles were produced [12], [13].

1) Referenced Handle

i) Handle as shown in fig. 1(a) has a more usual referenced handle, particularly used into cricket bat.

2) Modified Handle

ii) In Handle as shown in fig. 1(b), the assembly was located on to top part of handle,

iii) In Handle as shown in fig. 1 (c), the assembly was located on to middle part of handle and

iv) In Handle as shown in fig. 1(d), the assembly was located on to bottom part of handle part.

(a)

(b)

Figure 1

(c)

(d)

Therefore, all the parameter quantified and assumptions were made that, all the materials (same type of cane wood, rubber, twine, adhesive and joint assembly) and manufacturing process are equivalent.

2.4 Performance Analysis: The performance of handles is accessed by static test conducted by the means of dynamic machines, which are to be used for testing mechanical properties of materials. All the tests were destructive in nature.

Three different experiments were performed to study the mechanical properties of Referenced handle in comparison of a Modified Handles; a bend test by using simple supported beam as shown in figure (2), a tensile test as shown in figure (3) and a torsion test as shown in figure (4), were performed consecutively, on the samples prepared for testing purpose as shown in figure (5).

Fig. (2): Bend test

Fig. (3): Tensile test

Fig. (4): Torsion test

Fig. (5) : Modified Specimen used for testing

Only those Modified Handles were taken for further testing process, in which Joint Assembly were made-up of Metal Alloys materials i.e. Brass and Aluminium Alloy and rest of them were failed during the manufacturing process i.e. Polymer Mix Composite (PMC) and Fibre Reinforced Polymer (FRP), therefore they were put away from testing procedure.

Finally six (06) Modified Handles were tested against a set of Referenced Handle. The Referenced Handle was coded as H_1 Ref, and rest of Modified Handles were coded as H_2 Mod BT, H_3 Mod BM, H_4 Mod BL and H_5 Mod AT, H_6 Mod AM, H_7 Mod AL, Therefore, altogether in this study we measured and compared the performance of seven (07) different prototypes of cricket bat handles [2].

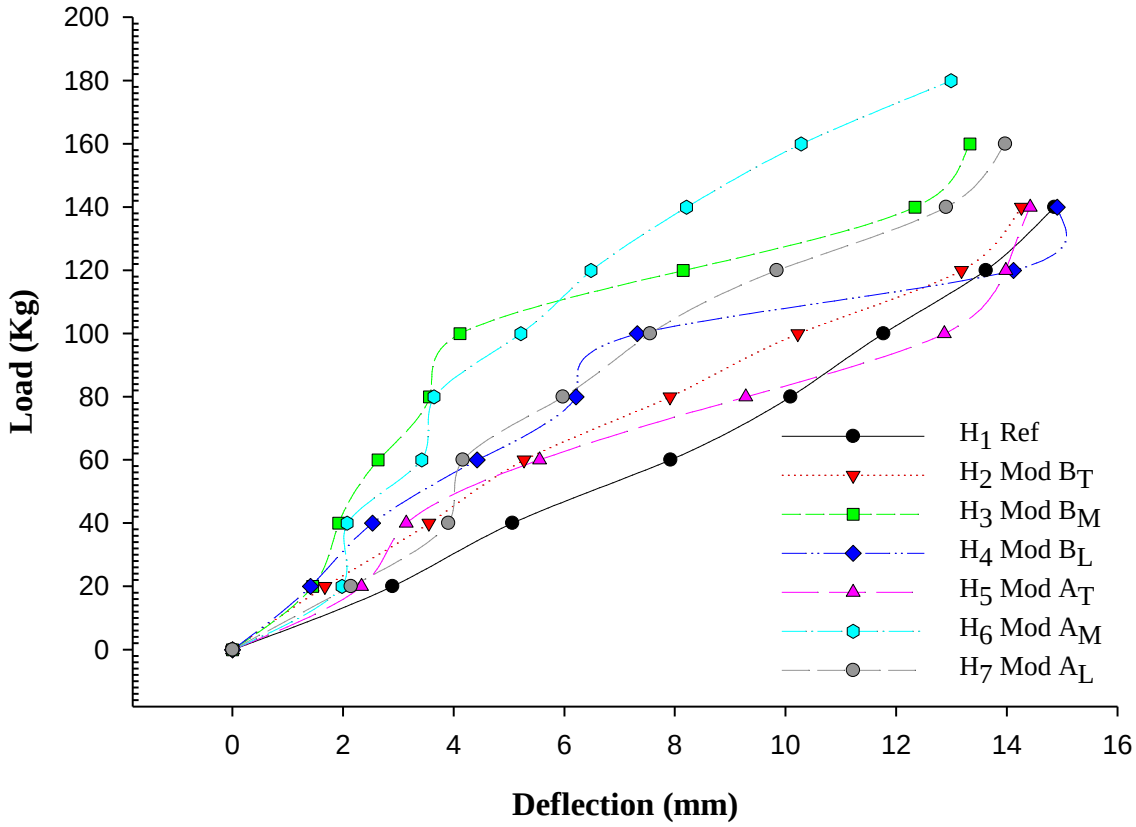
III. FINDINGS AND INTERPRETATION OF THE RESULTS OF MECHANICAL TESTING

With the help of the experimental data collected from the experiment, graphs were prepared for each and every case and all those graphs are mentioned and discussed below:

3.1 Findings and Interpretation of Results from Bend Test: In the first experiment, bend test had been performed on selected specimens' of the handles to check the relationship between applied loads and deflections, during the test deflection were recorded at various points of loads.

From the experimental data, a graph was plotted by taking flexural loads along the vertical axis (y-axis), and deflections resulting from these loads are plotted along the horizontal axis (x-axis) for each type of handles as shown in figure (6), during the initial phase of loading which is from 0 to 20 Kg does not show much difference in deflection but as the graph moves from 20 to 100 kg load the deflection of Modified handles increase much more rapidly than that of the Referenced Handle.

Fig. (6) Graph Plot of Load Vs. Deflection for Referenced and Modified Handle



The performance of modified handles in which joint assembly was made up of aluminum alloy showed better results than those handles in which joint assembly was made up of brass material. Because the deflection against given load was more than that of the brass, that shows the aluminum alloy is more ductile than brass alloy.

The referenced handle elastically deforms with the maximum deflection but the modified handles get deformed plastically with minimum deflection in all the handles. And the values of the deflection for the same load were accessed lesser in modified handle than to reference handle. Due to that a liner relationship between loads vs. deflection was present only in referenced handle and it was absent in all the modified handles.

As per the analysis of results, the deflection of handle does depend upon the use of various types of materials and their placement. Comparison between referenced and modified handles shows that the modified handles has much more resistance against deflection as compared to referenced handle and comparison between the placements of joint assembly on different location of handle show that, the top placed joint assembly had less deflection than other modified handles.

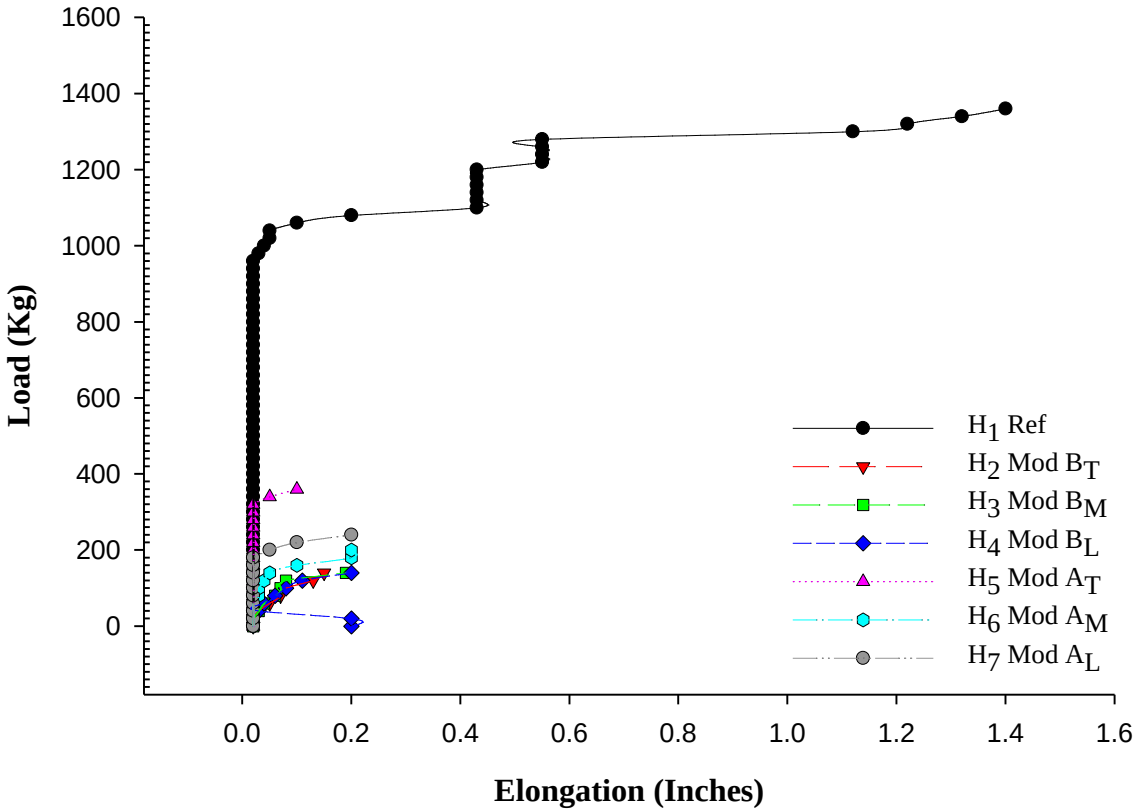
This much variation was accessed due to the use of different type of material for joint assembly and also due to the placement of joint assembly on different locations of handles, which makes the handles more rigid than to referenced handle. So, from the results and graph it was accessed that the deflection of Modified Handles is less than that of Referenced Handle.

3.2 Findings and interpretation of results from tensile test: In the second experiment, tensile test had been performed on selected specimens of handles to check the relationship between applied loads and elongation. During the test elongation was recorded at various points of loads.

From the experimental data, Load vs. elongation graph was plotted for each type of handles. The load was plotted along the vertical axis (y-axis), and elongation resulting from those loads was plotted along the horizontal axis (x-axis) as shown in figure (7). During the initial loading which is from 0 to 20 Kg does not show any changes

in the original length of any handle but as the graph moves from 20 to 100 kg load the Modified Handles get deformed and increase much more rapidly than that of the Referenced Handle.

Fig. (7) Graph Plot of Load vs. Elongation for Referenced and Modified Handle



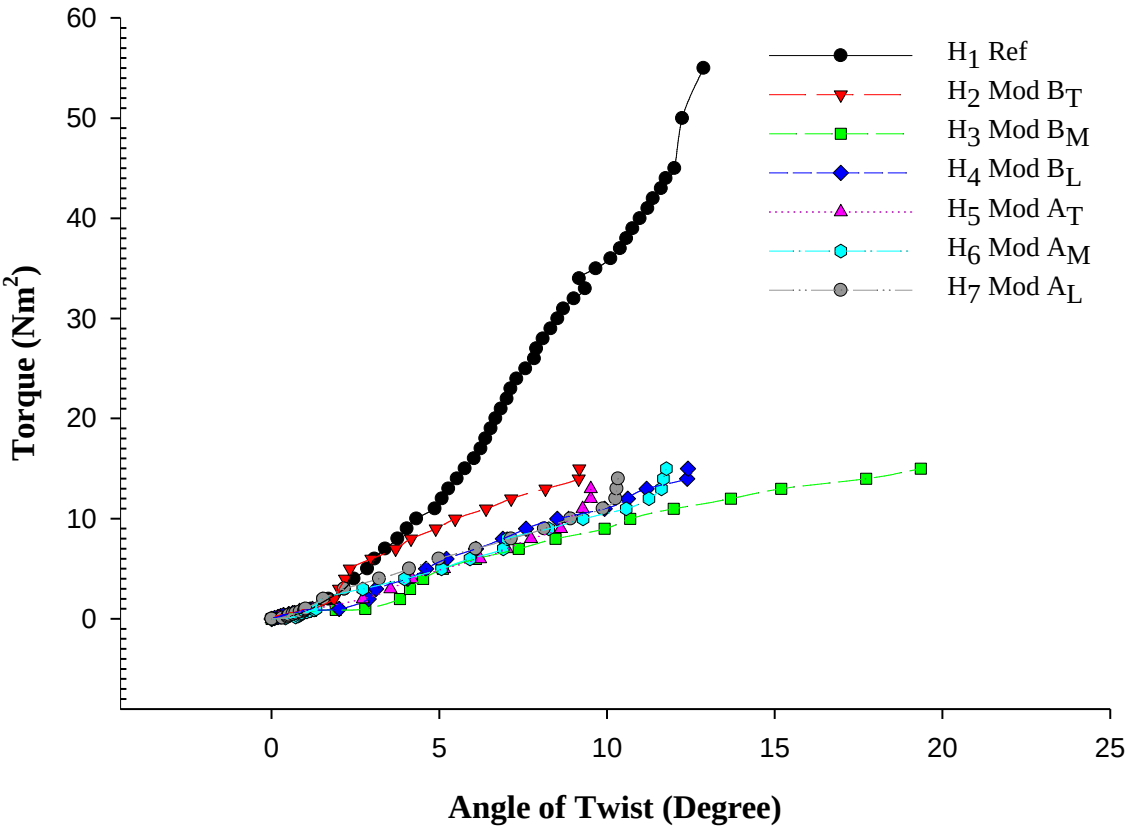
The change in original length for the same load were accessed greater in modified handle than to referenced handle due to that a liner relationship between load and deflection was present only in referenced handle (i.e. H1 Ref), and in modified handle, it was absent.

From the result it was concluded that all modified handles, within each group, showed statistically significant differences with their respective group. This was found that the elastic properties did vary from sample to sample due to the placement of joint assembly into different locations and use of different material of the assembly used in handle. The Referenced Handle had a much higher tensile strength and modulus of elasticity than the Modified Handles. In case of modified handles, a sudden failure takes place, as the curve is linear until it breaks with no bending of the curve at high loads. Consequently, in reference handle there is no permanent deformation during this test, which shows elastic behavior of handle.

3.3 Findings and Interpretation of Results from Torsion Test: The third experiment, torsion test had been performed to check the relationship between applied torque and angular displacement. During the test angular displacements were recorded as per the torque applied. The experimental data of torsion test were plotted on to the graph by using torque against the corresponding angle of twist as shown in figure (8).

By manipulating the torque angular displacement relationship in torsion, it was found that there was very less deviation into the torque approximately 1.18 Nm to 2.79 Nm up to 1o degrees of angle of twist in all the specimens. The linear trend of the curve was increased in a progressive manner as torque increased; the angle of twist also increased. And this linear trend was present only in referenced handle, due to that the referenced handle had the good capacity to absorb the torsional load caused by the twisting force.

Fig. (k) Graph Plot of Torque vs. Angle of twist for Referenced and Modified Handle



The results also show that all modified handles, within each group, showed statistically significant differences with their respective group. This shows that the torsional properties vary from sample to sample due to the placement of joint assembly into different locations and use of different material into handle.

IV. CONCLUSION

From the experimental results, it was founded that the mechanical properties of joint assembly of different types of materials having high values than the cane wood; due to that, all the modified handles get rigid in which joint assembly was mounted on the top, bottom & middle locations, the transverse load bearing capacity also get effected and lost, withstand the process the weight of the handle get increased. In other hand, the manufacturing process of modified handles was itself so tedious, in which the handle and joint assembly were designed and manufactured separately, then after they were get assembled. The whole process requires more time, care and manpower to align all the parts with low production rate and on high cost. The modified handles were not proved so sustainable to provide economic feasibility and reliability than the referenced handle. And the performance of modified handles was not so precise, and fit for the purpose for that they were invented. The referenced handle is the only the reliable and performance oriented material which showed good agreement between the key parameters associated to the overall performance of the handle and bat. At last, finally it was concluded that the performance of modified handles' in which joint assemblies made up of different materials were used to find out most reliable material of joint assembly but none of the selected materials withstand with the durability and performance of referenced handle's materials [2], [14].

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