Dyson Bursary Project - Outreach Activity

CAN BAMBOO REPLACE WILLOW IN CRICKET BATS?

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Introduction

This project focused around using material testing to determine whether or not bamboo could replace willow in cricket bats. Bamboo was chosen as the material of choice as it has a much lower carbon footprint as well as having some similar properties during early research.

The material used for the blade of a cricket bat should be as stiff as possible, with a handle with a lower stiffness. This will allow the highest energy transfer from the player's hands to the bat. At the same time the material should be lightweight, so that the player can control its movement easily. However, there is the trade-off between weight and strength as a thinner bat will be easier to control but transfer less energy to the ball and be more likely to break. Historically Salix Alba, a light coloured willow, has been used for cricket bats as it is lightweight with high stiffness and surface hardness. In this project laminated Moso Bamboo (Phyllostachys edulis) was compared with the willow currently used for bat manufacture to determine whether it has the correct properties for use as a cricket bat.

Activity aims

Introduce students to material selection for an application through investigating different properties of the materials. The activity could be made more or less challenging based on the ability of the students and their ages. For example, students in lower years can focus on weight and material properties while older students could look at costs and operational parameters.

Hopefully these activities would show students that engineering is not just about theory but also the real world application of testing and processing. It should interest not just those interested in science but also, for older children, those with interests in economics, management or finance. Most school curricula focus on individual subjects without showing all the cross-links between them so this activity should broaden their horizons and help them to consider a wider range of factors involved in decision making.

Potential activity

The overall aim of the project is for the children to determine which material is best for use as a cricket bat out of: willow, laminated bamboo, steel and PVC. We would start with a brief introduction to what properties a cricket bat should have: lightweight, high stiffness, relatively cheap material and high Coefficient of Restitution (CoR). More experienced groups can include frequency analysis, surface hardness and fracture toughness.

The activity I would have liked to run would involve several smaller groups working on different aspects of the material selection process before changing round so everyone can explore all areas. Depending on the numbers the groups can be larger or smaller to fit but these are the basic activities which would be carried out.

1. Finding the weight or density (ability dependent) of samples using weighing scales and measurement equipment for the volume.
2. Dropping a ball onto a samples to find an approximate estimate for the CoR by seeing how high it bounces. Extension activity is comparing different heights, analogous to speeds, and trying to find a pattern in that.
3. Performing a 3 point bend test at low strains to find the stiffness of the material.

If the students are of a higher level or there is time permitting then the following experiments could also be carried out:

1. Frequency analysis using Python script and microphone, as seen in *Figure 1.*
2. Attempting to create their own processing pathway for manufacture of a bat.
3. Using the Hardness-Vickers testing in the Materials Laboratory to understan more about the surface hardness.

After all the groups have completed each activity we would have a discussion about which material would be most suited for use in a cricket bat. Hopefully, the steel would be discounted due to its high density/weight and the PVC would be discounted due to its low stiffness. Ideally, they would find it difficult to chose between willow and laminated bamboo but say that the laminated bamboo has a higher density/weight so stay with willow.

After this willow and laminated bamboo cricket bats, seen in *Figure 2*, could be passed around for students to see the difference. They should be able to tell, just by picking up the bat, that the laminated bamboo bat is much heavier than the willow bat. The best students would identify that the bamboo bat could be improved by making it thinner.

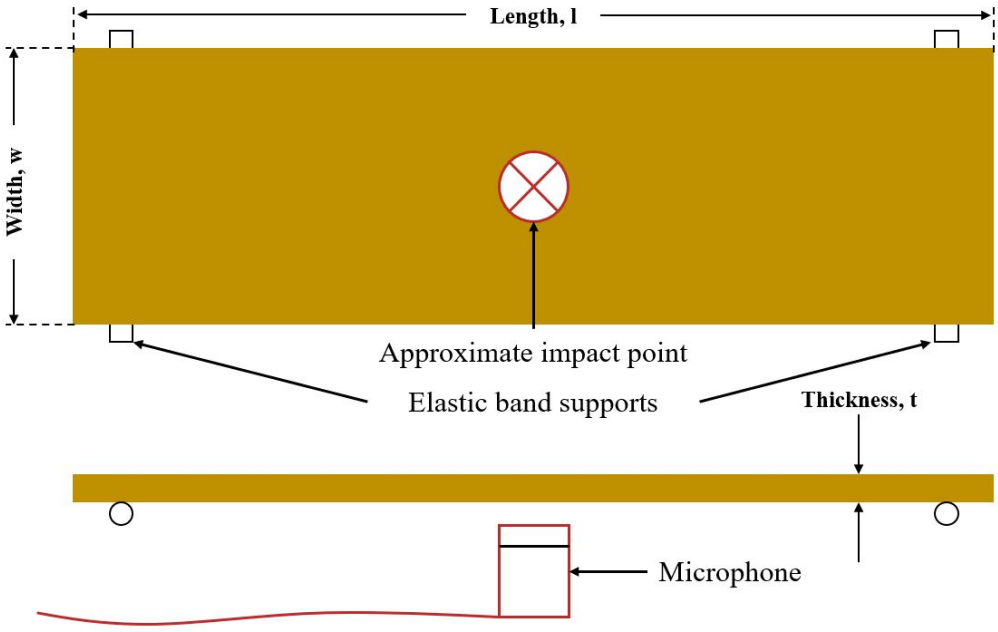

Figure 1: Set-up of frequency analysis experiment

Figure 2: Bamboo and willow bats for use in comparison.

Risk assessment

The experiments undertaken have low risk as the weights used would be low and the samples can be manufactured to have rounded corners, reducing the likelihood of injury. For the 3-point bend test this will be directly supervised and small samples used at low strains, so there should not be failure or if there is the failure is not explosive.