

Outreach Activity – James Dyson Bursary

Design using Natural Materials

Project title - Natural and Carbon Fibre Composites for Automotive Applications

By Kate Bassil

kjb83@cam.ac.uk

Introduction

My project focussed on natural fibre composites as a replacement for carbon fibre in automotive applications. I completed mechanical analysis and a Life Cycle Assessment.

The outreach activity focussed on the mechanical behaviour of natural, renewable, and sustainable materials. The main task of the session was to build a tower, out of paper, which could support the weight of a 500ml bottle of water. The winning group was the one with the tallest tower that could support the water bottle. As this task was about sustainable materials, recycled paper was used.

My session consisted of a short introduction to building with natural materials and a description of the task, followed by the building activity itself, and then the judging (towers measured by the teacher) and finally a round up session where the winning team explained their design choices and I answered remaining questions.

The activity was run remotely over Zoom, with all of the students present together in the classroom, allowing them to work in groups of three.

Equipment List

A4 paper

Scissors

Masking tape

Pencils

500ml bottle of water

Due to COVID 19, most of the materials used were provided by the school or sent from CUED in advance. Therefore, the minimal equipment required for this task was an advantage.

Overview of the session (45 minutes)

1. Introduction to building materials and sustainable materials (5 minutes)

In this short introduction, I asked the students to list the materials they recognised as being used in buildings, with prompts about what their own houses are made of, and what skyscrapers might be made of.



Figure 1 - Image prompts for materials)

2. Short discussion of natural fibres (5 minutes)

I also included a brief introduction to natural fibres, as this is the material my project focused on. I used F1 vehicle and sports car parts as examples of possible applications.



Figure 2 - Image prompts for natural fibres

3. Description of the task (5 minutes)

I explained the task, to build the highest tower from paper (and masking tape) which could support a 500ml bottle of water. I then talked through some good approaches, for example cylindrical and triangular structures, as well as a wide base. I showed a number of examples of structures and discussed the advantages and disadvantages of each.



Figure 3 - Example structures

4. Planning (5 minutes)

I got the students to form groups of three and then gave them 5 minutes to plan their structures before they were allowed to start building.

5. Building (15 minutes)

The time allocated to building was 15 minutes. The teacher went around the room to look at the progress, but the students worked essentially independently in their groups of three. I used a countdown clock on the board to indicate the time remaining, and all teams managed to produce a final structure within the time (with one falling over just as the time ran out)

6. Judging and feedback (5 minutes)

The students then moved away from their towers and the teacher measured each tower. The tallest was 670mm (the fallen tower would have been 1000mm). This tower used cylinders in each layer and had a wide base, two of the key structural design choices we had discussed. All groups had taken some of the recommendations on board. There were several questions about how towers could have been improved and what the best designs are, showing that the group had engaged really well.

7. Clear up (5 minutes)

A few minutes were required at the end to dismantle the towers and recycle the paper.

Reflection on activity

This activity was adapted to be delivered remotely, hence the focus on group work which required minimal interaction with the students during the task. The introduction was carried out with the class all in their seats and was short enough to avoid the students getting distracted. The group listened to the instructions well and produced a range of successful towers which all demonstrated elements of the design ideas we discussed in the introduction. They appeared to be enjoying the building element of the session, and were very focussed on the task, due to the 15 minutes time constrain. It was hard to get the group to settle back down after such an interactive task, particularly when trying to communicate with them through a screen. The class teacher helped to get the group back to their seats and once settled they asked several good questions which related to both the building task and the introduction about sustainable materials, again suggesting that they had engaged well with the session. I enjoyed running the class and hope that the students enjoyed participating.

Health and Safety

There are some (low) risks associated with the activity. Scissors should be school/safety scissors and should be used carefully. The object placed on the top of the towers could fall, and therefore a relatively light object has been chosen.