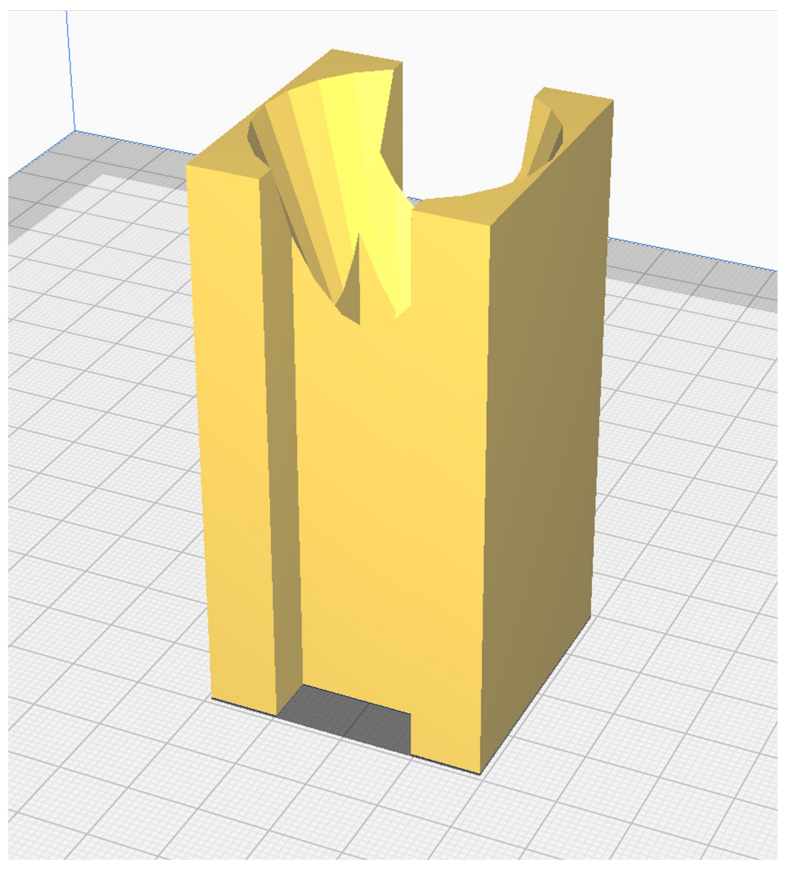
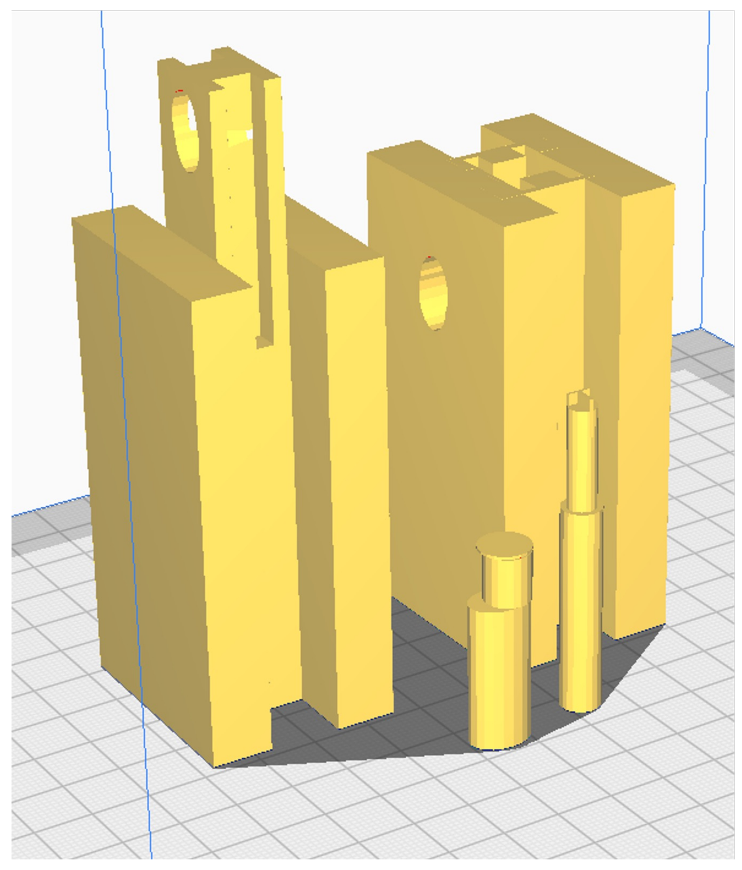
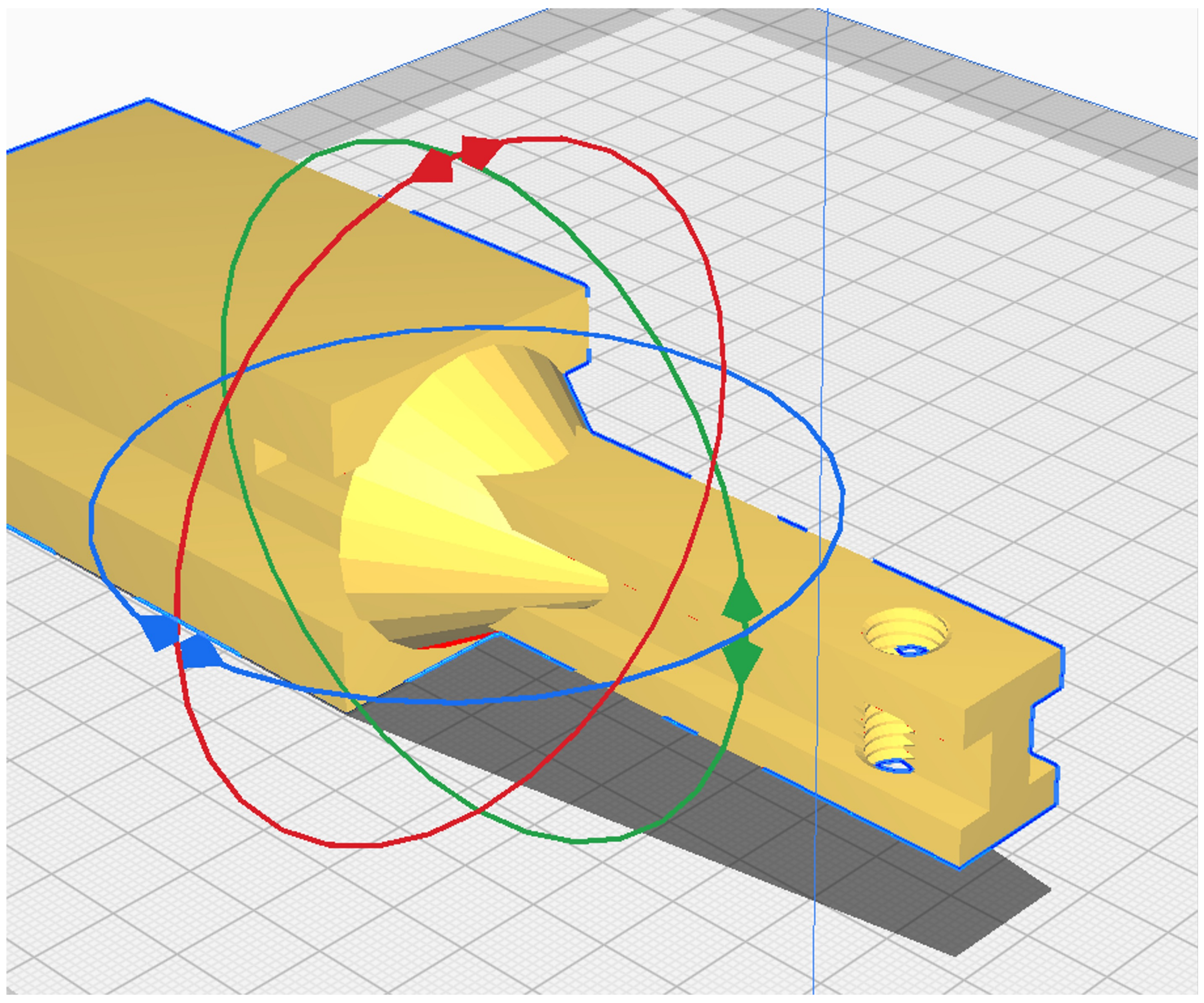
# What parameters need to be considered in composite design for real world cases?

**The Island Free School**
**Gurit**







**Overview:** The project stems from a local community issue where a 'floating bridge' which connects two towns across a river regularly broke down. We wanted to explore the possibility of replacing the inherently unreliable system with a permanent, yet movable bridge built with modern composite materials. With the growing popularity of 3D printing techniques for a range of engineering applications, we aimed to look at all the factors that would need to be considered when building a bridge for a real-world problem.

## Aims

- to make a a stable and reliable bridge that can replace the chain ferry
- to ensure that the structure can bear sufficient load through testing our materials
- to ensure that the bridge design is able to replace traditional materials without adding to the environmental impact

## Background information

PLA (Polylactic Acid) is made from renewable resources such as corn starch or sugar cane. It is a natural polymer designed to substitute widely used petroleum-based plastics like PET (polyethylene terephthalate). We chose this for the material of our bridge as it is readily available, inexpensive and renewable.

## Methodology

The initial task of designing bridge structures was undertaken using free-to-use platform Sketchup. This proved fiddly and time consuming, and so the team moved on to using Tinkercad. The 3D designs are then exported and sliced through Cura. We have used a number of filament types, including TPU, ABS and PLA. We have settled into using a type of black PLA with a working temperature of 185 Celsius which has exceptionally smooth nozzle flow and faithfully replicates each intended design form. Finished models are not brittle, as can be found with some PLA types.
Bridge pieces were then stress tested by our STEM partner Gurit who tested the pieces for Flexural and Tensile strength. We tested for filament type, wall thickness and in-fill structure. The coupons are limited in size and so further structural testing is carried out onsite using load bearing tests.

## Results

Our results conclusively showed that wall thickness plays an important role in flexural and tensile strength, whereas internal fill structure and fill percentage plays an important role in flexural strength. Octet fills were the best load bearing internal structure.

## Conclusion

We concluded that it is possible to build an H-Bar based beam structure and that can perform well in a load bearing environment. Whilst the load bearing capabilities may never exceed that of steal, they are considerably lighter and cheaper and could provide a means for community level projects to cross geographical barriers.

## Evaluation or next steps

We have successfully applied for the extension grant so that we can continue to study optimum build types. We aim to streamline our design process, and with our STEM partner Gurit, will look at the effects of UV light on particle emission from load bearing surfaces, with an aim of reducing plastic pollution from 3D printed structures.

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