

Adapting Mass Manufacturing Methods to Develop Living Hinges for Foldable Robotics

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Background

- Foldable robots are robots that are created using a folding process and that leverage their folds to attain a wide range of robot morphologies.
- Flat sheet are cut and laminated to form multi-material composites.
- This gives the designer a high degree of control to differentiate between the “link” and “hinge” characteristics of the

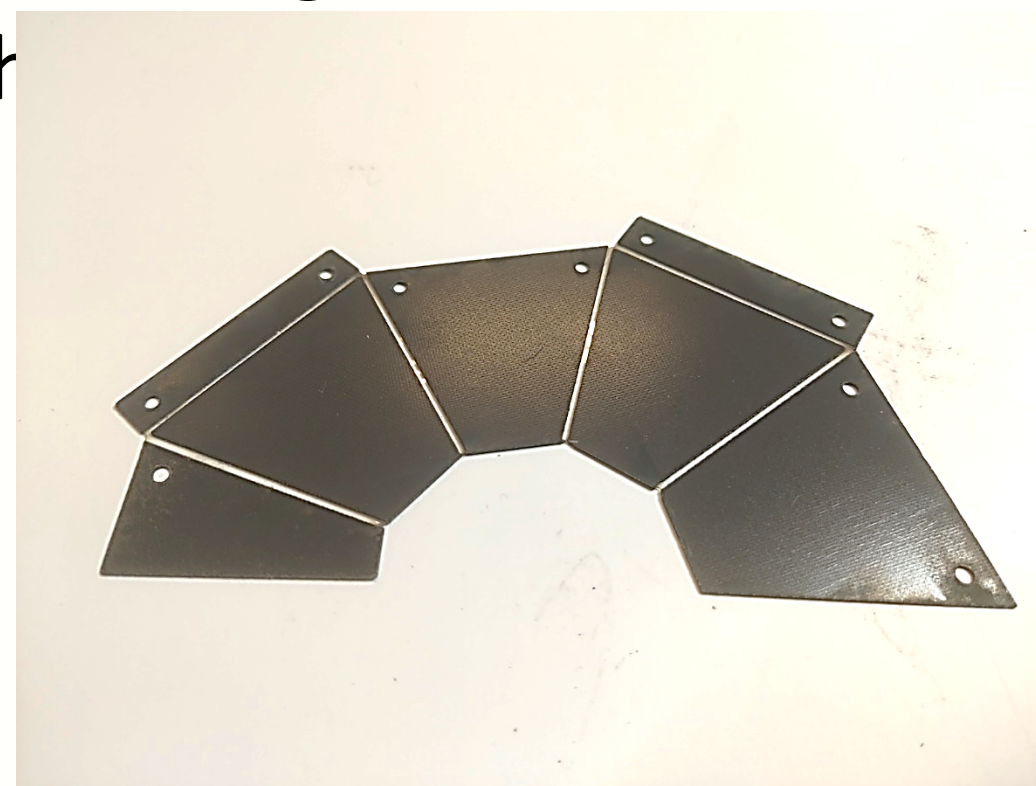


Fig 1- Fiberglass and plastic laminate structure

- The cost, accessibility to materials and hazardous nature of certain materials serves as a point of friction for the field of foldable robotics

Research question

- The goal of the project is to explore cost effective methods of manufacturing flexible robotics structures while keeping the design process relatively simple and using only one material.
- The second goal is to identify approaches to, fabricating equivalent designs using simple tools like exacto knives, instead of the industrial machines like laser cutters.

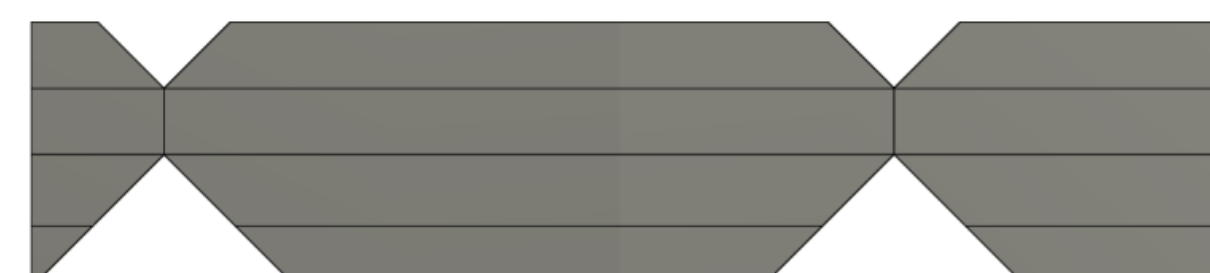


Fig 2- flat view of the PP test structure

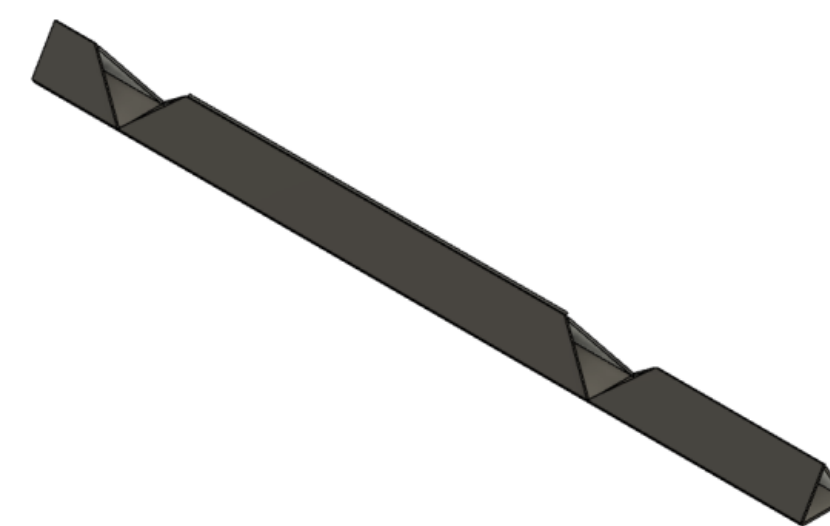


Fig 3- PP test structure final form

Methodology

- Various materials were considered and iterated; Polypropene was selected due as it struck the perfect balance between rigidity and flexibility
- The challenge lied in the hinge as hinge relied more on the material properties
- To add rigidity to the ‘link’ section of the structure a triangular cross-section was adopted
- As shown in fig 2 and fig 4, the sheet was creased and folded together
- For the hinge different methods of creasing were explored and tested
 - Cut creases (exacto knives)
 - Heat creases (laser cutter)
- The hinges were tested in a testing rig to the point of failure.

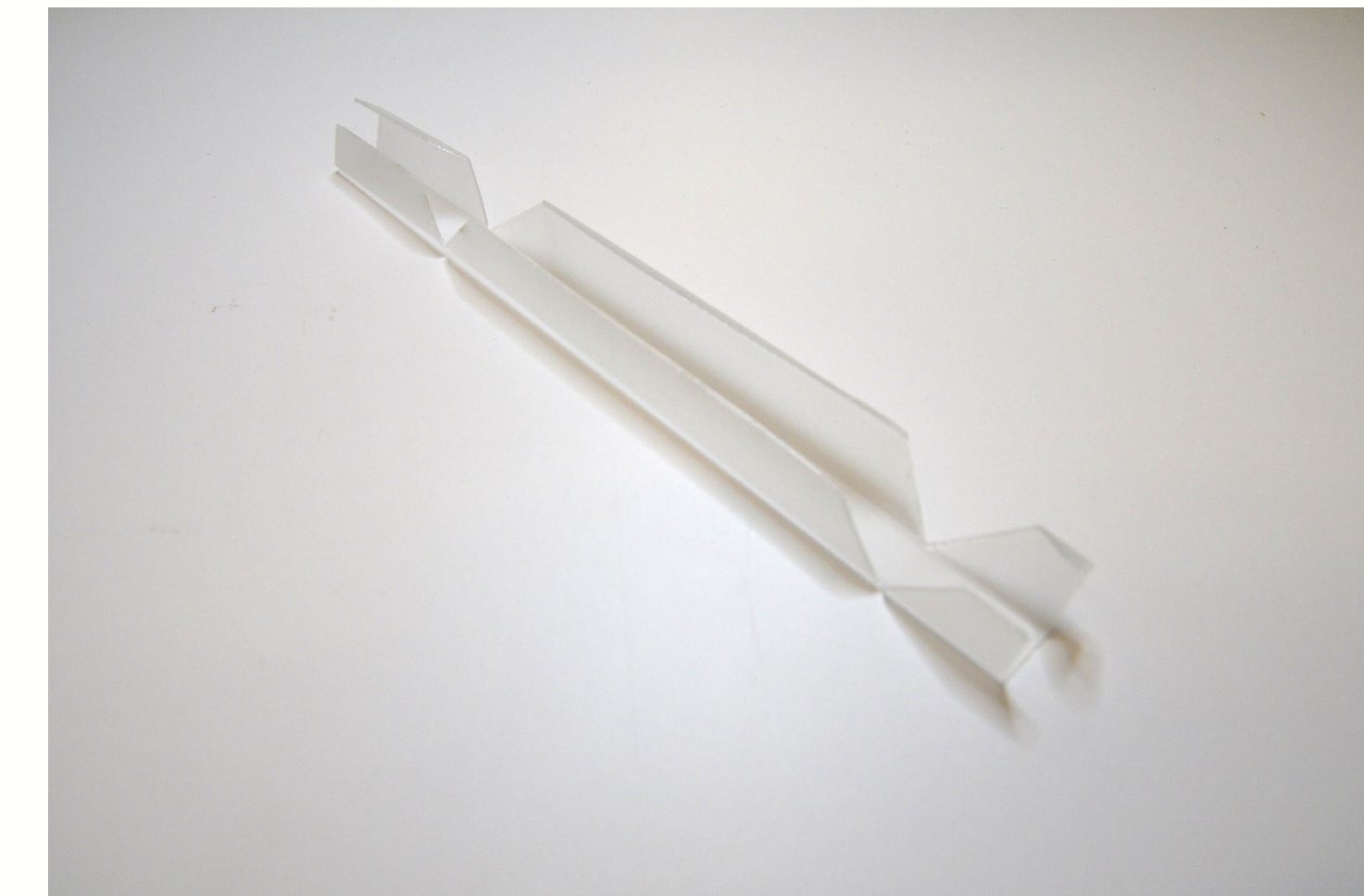


Fig 4- PP sheet after being creased and folded

Inferences

- Polypropene sheets in the range 0.4-0.6mm are optimum.
- The hinges are quite robust (4000+ cycles) but loose their stiffness progressively

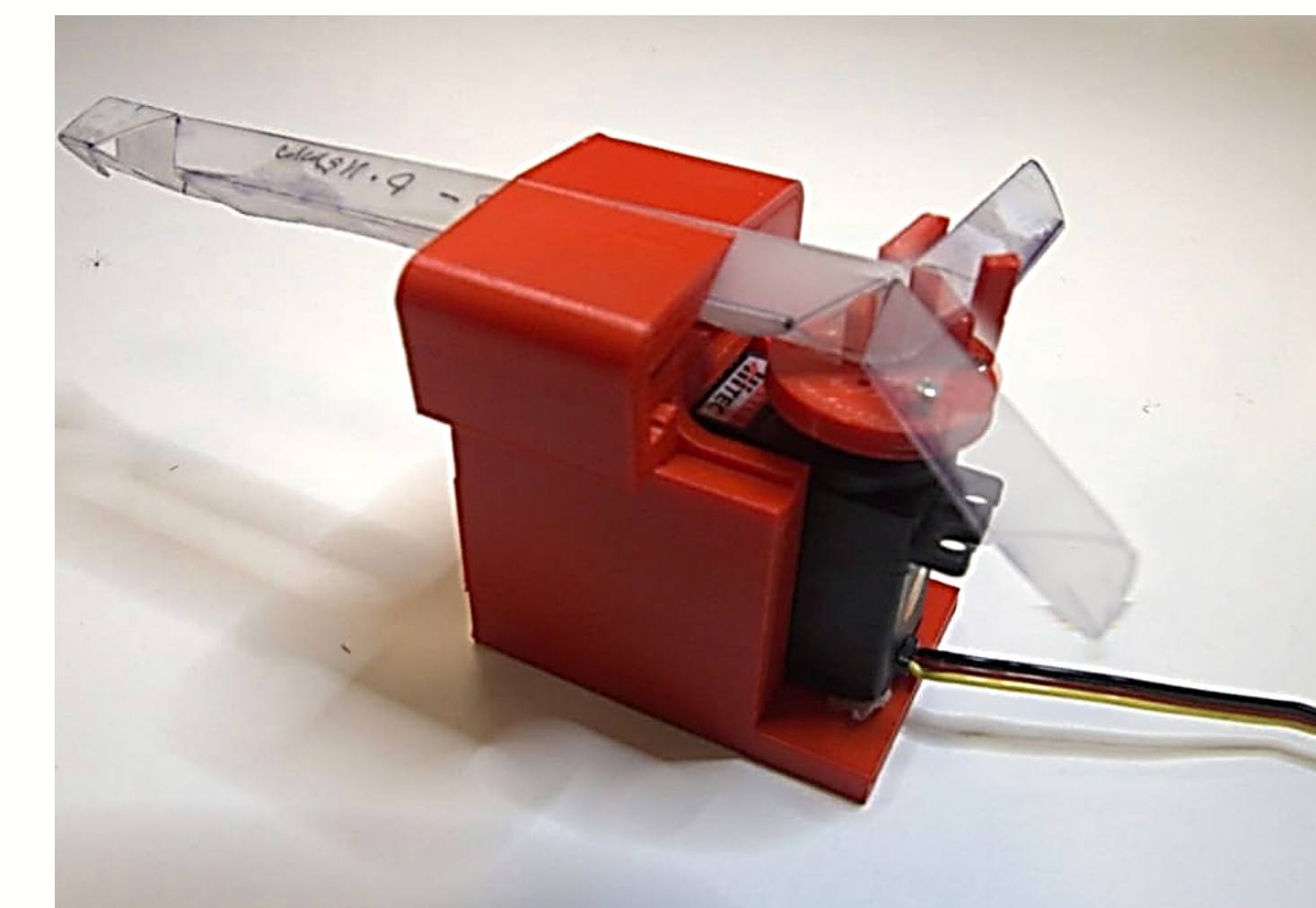


Fig 5- hinge testing rig