Hinge design
Innovative designs

General introduction

Hinges are another type of interlocking part that can be printed as a single assembly. Here, too, there must be sufficient space around the interconnecting pieces to prevent them from fusing together. There are several different kinds of hinges, and because of the space required around the different pieces, different types of hinge designs will be more wobbly than others.

Scaling

These two hinges are very similar; they both have two pieces that connect to an object on the left, and a middle piece that connects to an object on the right. They both have a rod that goes through the centers of the hinge pieces and gaps each end.

However, for the one on the left, the middle piece rotates around the rod, as do the pieces connecting to the left. For the hinge on the right, the rod and middle piece are one solid piece, so it is only the top and bottom parts of the hinge that rotate around the rod.

This second hinge wobbles less because there does not need to be any space between the middle piece and the rod. They are one piece.

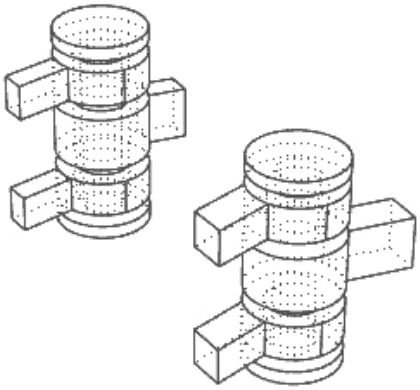

Figure 1: Examples of hinge design strategies

Examples

Figure 2: This intricate egg features a tiny hinge connecting its two halves.

Figure 3: Another type of hinge uses cones that fit into matching divets. These modules by can snap apart and back together.

Living hinges

Basics

It is possible to print a finitely flexible part with HP 3D HR PA 12 by adjusting its wall thickness and geometric structure. A thin and folded section performs like a living hinge, and it allows 3D printed parts to be collapsible and expandable to a certain degree.

To design and print flexible parts successfully, it is important to have an appropriate wall thickness; to maintain the curves and angles of folded hinges when converting the model to mesh; and to specify the print orientation.

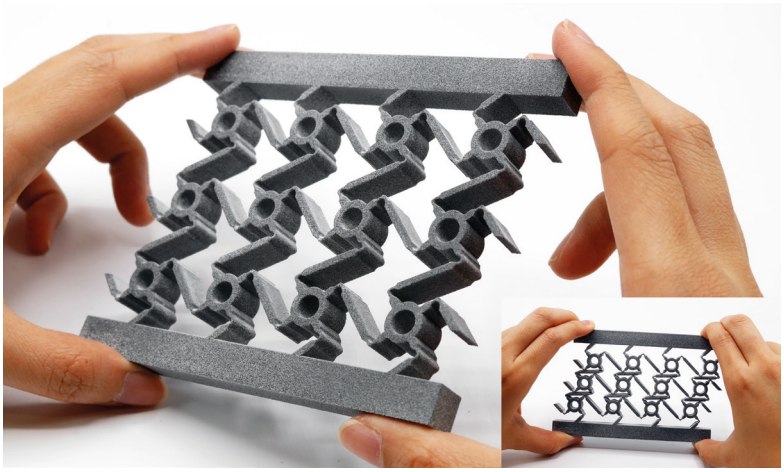

Figure 4: An array of living hinges, collapsible by hand

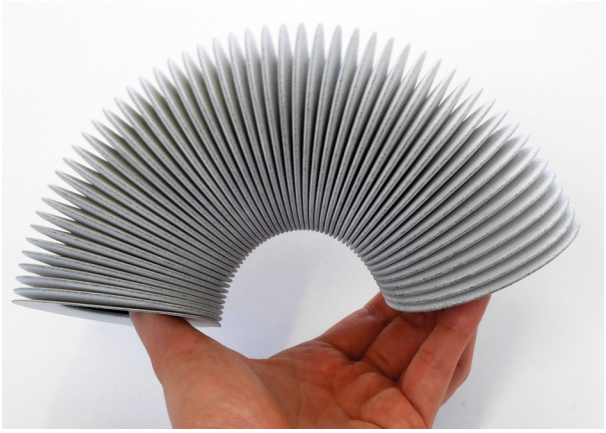

Figure 5: Tube with cosine-curve shaped walls

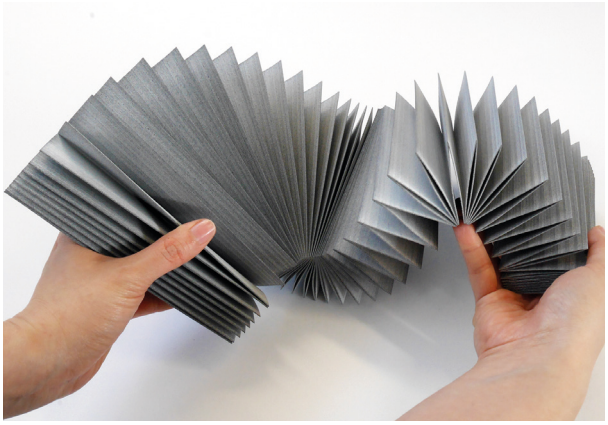

Figure 6: Accordion structure composed of a number of connected plates

Wall thickness

Even a difference in wall thickness of 0.1 mm has a great impact on the degree of the part's flexibility, and if walls are too thin, the part will not survive cleaning and sandblasting. It is recommended to experiment with varied and controlled wall thicknesses to find the suitable resilience and robustness for a part's purpose.

Geometry of structures

A part's structural geometry controls its mechanical behavior when outside force is applied. Different folding designs can be applied to create specific effects, such as springy tension and smooth motion. The shape and tightness of the folding has a direct impact on a part's movement. Make the apex of the fold hinge slightly rounded to avoid the risk of being snapped when the printed part is stretched or pressed.

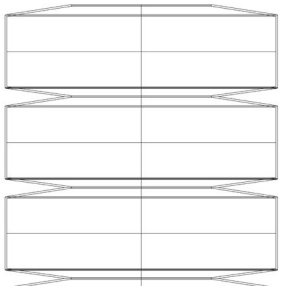

Figure 7: V-shaped connectors create springy tension in the folds.

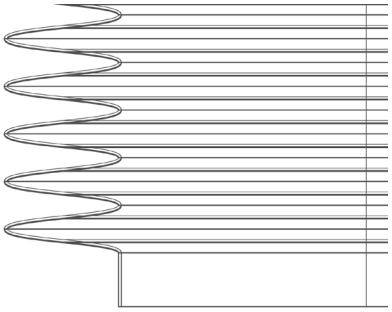

Figure 8: Cosine curve shapes create smooth motion.

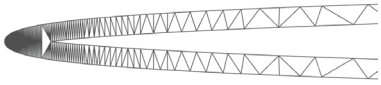

Figure 9: The highly dense mesh applied to the accordion structure maintains the folds' roundness.

Print orientation

To maximize the durability of the thin structure, it is recommended to print the part in an orientation such that its thin planes are approximately parallel with the X/Y plane. Specific print modes, such as mechanical mode and fast cooling, can be used to maximize elongation at the break point of the part if necessary.

There are some exceptions where thin parts benefit from being printed at an angle, such as the tambourine shown under "Designing for Sound."

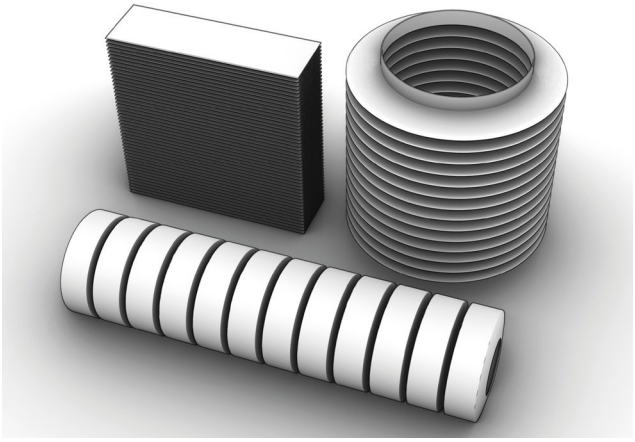

Figure 10: Recommended print orientation for sample designs

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