Leibniz-Institut für Polymerforschung Dresden

HOCHSCHULE FÜR TECHNIK UND WIRTSCHAFT DRESDEN UNIVERSITY OF APPLIED SCIENCES

DRESDEN concept

Leibniz Gemeinschaft

APPLICATION OF A VARIABLE-AXIAL FIBER DESIGN

Lightweight Stool L1

A curvilinear or variable-axial fiber design can help exploit the full potential of reinforcement fibers and anisotropic material behavior in terms of strength and stiffness. The ability to place fibers in arbitrary directions is challenging for composite engineers as special design strategies are required.

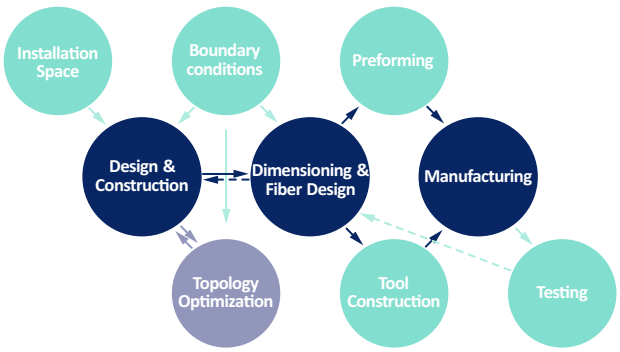
The lightweight stool *L1* made of carbon fiber reinforced thermoset shows appropriate technologies.

Development Process

The stool development process is based on the following steps:

- design and construction
- dimensioning and fiber design
- final manufacturing

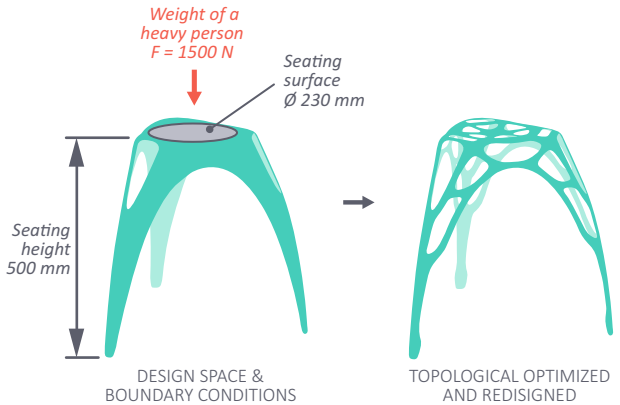
At an early stage of the design process, a topology optimization of the initially given installation space has been carried out. Subsequently, the shape of the resulting component was adjusted to aesthetic criteria.

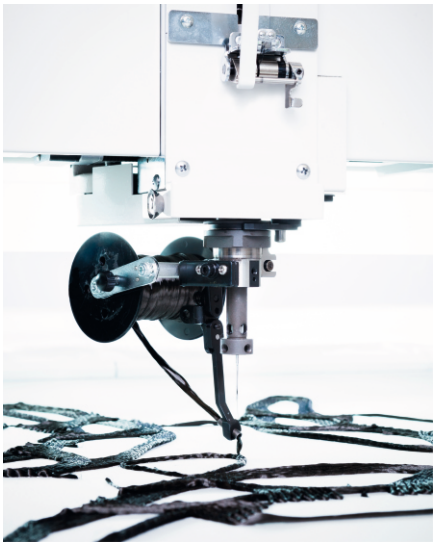


Idea and Design

The decision choosing a three-legged stool as a demonstrator was based, on the one hand, on the three-dimensional shape of the original design space and, on the other hand, on the easy-to-apply load cases.

The initial design approach is based on a three-dimensional topology optimization where isotropic material properties are applied to the given design space. These results and the initial shape have been taken into account when students from the HTW Dresden – University of Applied Sciences, Faculty of Design, created the final design.



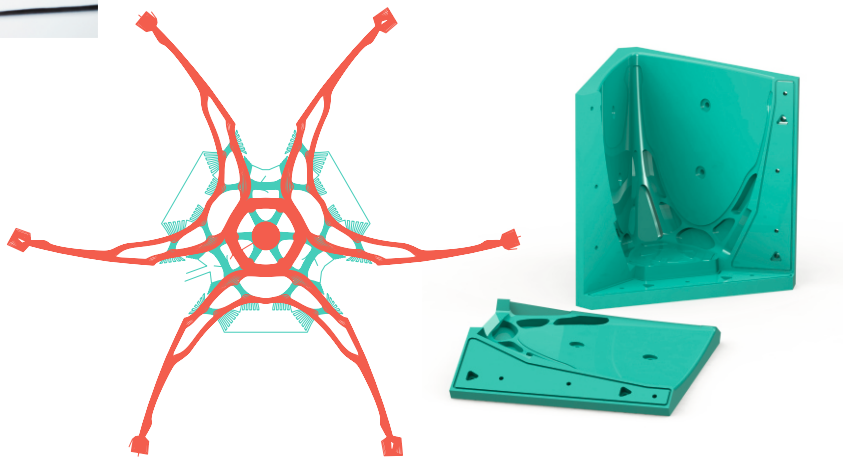


Manufacturing

The lightweight stool L1 was manufactured by using Tailored Fiber Placement Technology. Using this embroidery-based process (left), fibers can be placed and fixed in arbitrary angles on an in-plane movable base material. Textile preforms with a complex curvilinear fiber pattern can thus be manufactured, enabling even very small radii of the fiber paths below ten millimeters.

The fiber pattern is oriented along the resulting truss-like structure and the component properties can be adjusted by the selection of fiber material and the number of rovings placed along the fiber pattern.

The three-dimensional shape is created by draping the textile preform into a negative mold and a final resin infusion process.



Testing

The stool was loaded by stacking of eight bags each weighing 25 kg. After a total load of 200 kg without stool failure, the test was terminated. The mass of the carbon fiber preform is about 300 g and the total mass of the stool is slightly less than 700 g.

Contact

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state as of: May 2021