

Lightweight Cellular Structure: A Formless Fiberglass Buildup Utilize Bending-Active

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Abstract

In this work, the authors aim to contribute to the exploration of the rolling assembly method in lightweight bending-active structures by investigating the design strategy based on a biomimetic investigation of the natural cellular structures, using engineered fiberglass sheet material in mass customization of components. The anatomy and cellular morphology of radiolaria were studied, and the morphological attributes were implemented within the design loop process. Furthermore, the designed lightweight fiberglass structure required no formwork or molding through the employment of the bending-active method. This research utilized a sophisticated, holistic design process integrating digital fabrication capability with formative feedback from structural analysis using finite element analysis (FEA). As a consequence, catenary form strategies were deployed to generate the whole structural surfaces for the bending-active cellular modules, with a particular focus on the computational programming of the cellular distribution in parts of the structure where high stress is evident. The final evaluation of the design and system were validated through the material performance as well as a partial full-scale architectural prototype was constructed.

References

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