Computational Form-Finding and Structural Analysis of a Bending-Active Biotensegrity Textile Hybrid

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Abstract

Employing principles for a bending-active structure with biotensegrity logics, pre-stressed and self-stabilized tetrahedron modules for an ecological farming wall prototype were designed and built using elastically bent glass fiber reinforced plastic rods (GFRP) in combination with flexible and expandable connections. Computational simulations in Kangaroo 2 used in tandem with physical prototyping were adopted in a previous study to define the form of individual tetrahedral modules. Although the previous study revealed continued self-supporting capacity and structural stability within the system's elastic range, its load bearing capacity is limited by its large elastic deformation, which does not meet the loading requirements of the farming wall. In an effort to increase global stiffness, a bending-active biotensegrity textile hybrid was developed that combines bundled GFRP bending active members with pre-stressed CNC knit membrane. The paper details an iterative design process that merges integrated, computational form finding and structural analysis with physical modeling to test for new adaptive and dynamic structural bending-active textile assemblies with biotensegrity logics.

References

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