A digital design process for freeform shell structures

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Abstract

Over the last few decades, the design of freeform structures has undergone a radical change: powerful computational tools within parametric environment associated with digital fabrication techniques are pushing the boundaries of architecture towards bold solutions. The digital process can be defined, from concept to fabrication, to optimize the design taking into account structural and fabrication requirements. In this context, the optimization of processes can assure good structural behavior while minimizing amount of material, and allow a time-effective fabrication.

The present work proposes a digital workflow for a shell in compression. The design process starts with the form-finding phase, which generates a hanging model. Through the interoperability of digital tools within parametric environment, optimization of the shape and structural analysis were carried out in order to investigate its behavior. The resulting surface is subject to tessellation, planarization of its cells, in order to fulfill fabrication constrains, and the 3D generation of panels composing the thickness of the structure. In order to accomplish an easier assembly process a hypothesis of a puzzle-like connection system is developed.

The whole process provides a guidance for the design of freeform shell by the creation of a "customized" digital workflow implemented by digital fabrication techniques for the realization phase.

References

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