Minimal Surface tensegrity networks: The case of an enneper surface pavilion structure

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Abstract

Minimal surface tensegrity networks constitute a new typology of double layer tensegrity structures that can be formed from the assembly of tensegrity units of square base. The geometric investigation of these networks has led to a design method that takes into both the constraints determined by the space packing geometry of prismatic tensegrity units as well as the geometric properties of minimal surfaces. Accordingly algorithmic processes that permit the exploration of three different types of minimal surfaces, namely of helical, catenoid and enneper have been developed [1], [2]. All three surface geometries are considered for the form exploration of a tensegrity pavilion structure. Finally enneper geometry has been chosen as the preferred one for further exploration.

A morphological investigation of various configurations of double layer-tensegrity networks of Enneper shape has been conducted. In this study the user's spatial and visual experience, as well as options for membrane surface integration, have been given priority.

Once the final shape is decided, the developed algorithm is also used to determine the dimensions of all members, the overlapping cable lengths of all adjacent units of the structure, as well as the sizes of the surface elements to be added to the structure after its completion. For the realization of the pavilion, a method that permits the construction of double layer tensegrity structures from the assembly of collapsible tensegrity units will be used. The application of the method facilitates the packaging and transportation of the structure as well as its on-site assembly and erection,

Test model structures have been constructed, pre-assembled and tested at the University of Patras, Greece. Aluminum tubular pipes, metal wire mesh and wire rope are used. Special attention is placed to the design and fabrication of the nodes, as they should allow for unit prestress and, at the same time, facilitate the connection of one unit to another.

It is expected that the pavilion will serve as a convincing argument that the embedded mathematical processes combined with technological innovation account for the structure's controlled complexity and rigorous form.

References

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