8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

SHAPING OF MODULAR TENSEGRITY STRUCTURES

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Key Words: *Bar, Cable, Module, Tensegrity Structure, Topology.*

ABSTRACT

Tensegrity structures were first discovered by Kenneth D. Snelson in 1948 and formally patented by R. Buckminster Fuller in 1962, who coined the word *tensegrity*. It is a neologism that was formed by combining both sounds and meanings from two words: *tensile integrity*. Tensegrity construction is attractive since most building materials are much more efficiently utilized when in tension than when in compression. In tensegrity construction there is a high ratio of tension to compression elements. So we can utilize tensegrity structures to achieve the maximum strength or stiffness with minimum material. The members of tensegrity structure are either always in tension or always in compression, cables or bars respectively. However, the determination of connectivity patterns of the bars and cables which lead to stable tensegrity is challenging. Conventional tensegrity structures, so called 'pure' tensegrity, are complex, which can lead to problems in production.

The goal of the present work is to attempt to surpass those limitations by applying space-filling polyhedra to the problem of form-finding. The sketched results overleaf suggest that geometrical approach may serve as a powerful tool in the design both of stationary and deployable tensegrity structures.

For so many years some researchers have been trying to find the exact definition of tensegrity, which is accepted by the whole scientific community [1-10]. Tensegrity structures can be categorized in several ways. The essential condition for most mentioned definitions of tensegrity structure is a continuous tension network. If it is a three-dimensional structure, in each end of the bar we should have at least three cables attached to the node. Under no circumstances the set of tensioned members is discontinuous. In addition to this observation, the author dares to add another method to create the free-standing and self-stressed tensegrity modules consisting of cables and bars, graphically indicated in Fig.1. Among cable-bar systems also exist tensegrity modules with a discontinuous network of cables. Every one of them possesses a single active cable. This cable operates as a tensioning link. When tensioning links are elongated, all cables are slack and the deployable tensegrity structure collapses into a bundle. The same deployment technique can also make small adjustments for fine tuning of the loaded structure, or adjustment of damaged structure. The bars and the cables can be combined in a variety of ways to form a large number of different designs.

Elemental tensegrity modules can be joined in order to create mast, girder, grid or conglomerate made of the same cells [11-13].

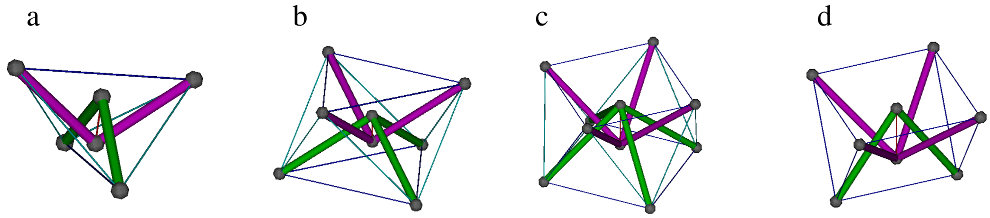

Fig.1 Some examples of the cable-bar modules with the single central cable:
a – segment-based anti-prism (i.e. ordinary tetrahedron), b – triangle-based anti-prism (i.e. ordinary octahedron), c – square-based anti-prism, d – triangle-based prism.

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