

Clarification of Design Principle of Testcian Primeval Planktons and Its Engineering Application to Design of Space Structures

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<http://plankton.random-walk.org/>

We considered design principles of testacian primeval planktons in order to obtain guidelines for designing space structures. In design of space satellites and constructs, we have much degree of freedom compared with that of constructs on earth because we can neglect gravity and air force. In astronomic space in which no supported point exists, shapes which keeps static equilibrium such as symmetric shape is required.

Planktons are almost free with gravity so that much of symmetric shape are observed. They also considered to be minimized their weights by balancing tensile and compressive members from a viewpoint of metabolic cost. Radiolaria and foraminifera consist of silica and calcium carbonate frames respectively as compressive members. Shapes of plankton's frames can be considered to have some mechanical rationalities because they have to keep their tensile members such as membranes and fibers. For this reason, it is one of effective means to discover the rationalities in order to find a new shape of space structures. We discussed how planktons, which have simple shapes, optimize their frames in this study.

We constructed a model of chamber formation of foraminifera. We tried to describe locations using a few parameters by approximating chamber to sphere. Using appropriated parameter values, we found some patterns similar to real foraminifera. Figure shows an example of results. We also constructed a model of frame formation of spherical radiolaria by approximating the frame to convex polytope. The polytope is constructed by another polytypes, so-called dual polytypes, whose vertices are corresponds to faces of original polytopes. By changing the face vectors in order to maximize a volume of the frame, we obtained some frames similar to radiolaria's one. These results indicate a possibility of existence of the mechanical rationalities.

