# Intertransformability

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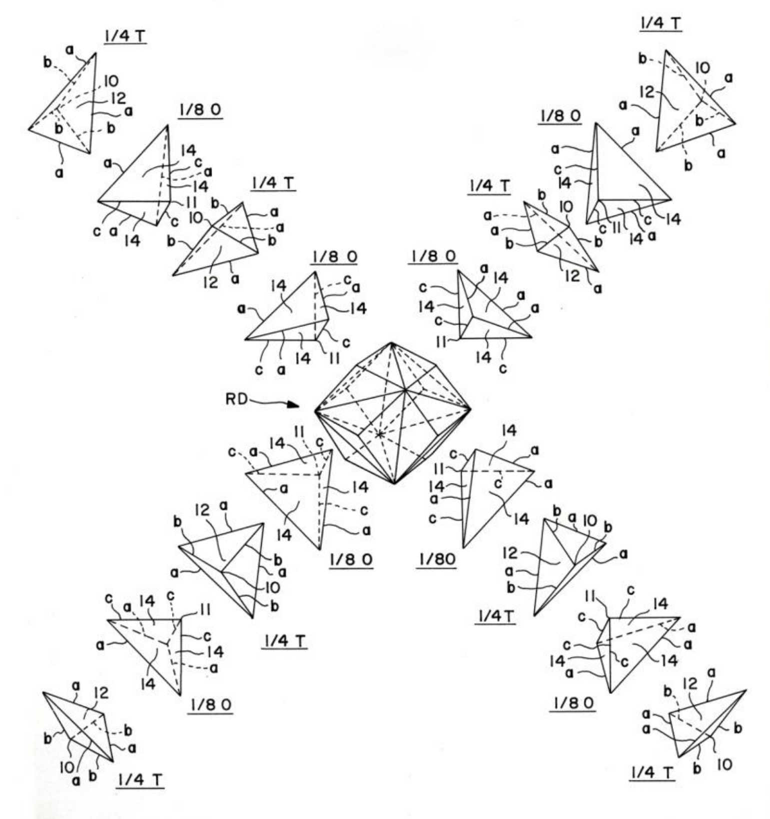
## Abstract

Following is a brief description of a single transformation of structural forms into other forms that are possible with a building block system described in a United States Patent granted October 5, 1993:

**GEOMETRIC BUILDING BLOCK SYSTEM EMPLOYING SIXTEEN BLOCKS, EIGHT EACH OF ONLY TWO TETRAHEDRAL SHAPES, FOR CONSTRUCTING A REGULAR RHOMBIC DODECAHEDRON.**

A geometric block system for constructing a regular rhombic dodecahedron having twelve identical rhombic faces, the system consisting of eight identical first blocks each being one-quarter of a regular tetrahedron and eight identical second blocks each being one-eighth of a regular octahedron, as illustrated below in the first drawing for USPTO Patent # 5, 249,966.



## The Transformations

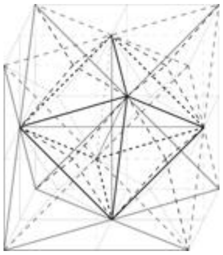


**Figure I:** *Duo-tetrahedron*

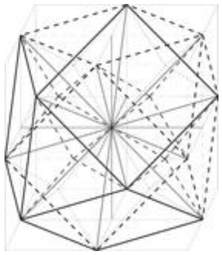


**Figure II:** *Cuboctahedron*

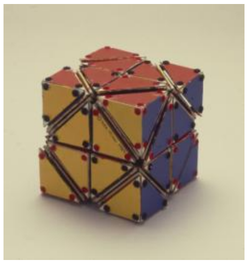


**Figure III:** *Cuboctahedron*

**Figure:** *Duo-tetrahedron*

Two blocks in four sets of sixteen blocks in each set, thus consisting of thirty-two ¼ T blocks and thirty-two 1/8 O blocks may be used to create two basic forms: in the first state (State "A"), the result is a "duo-tetrahedron" formed from an octahedron surrounded by eight tetrahedra (as shown in **FIG. I**). In the second state (State "B"), the result is a cube octahedron (please see **Fig. II**). Note that these two States A and B are freely interconvertible. In a variant on the transformation process involving the "duo-tetrahedron" shown in **FIG. I**, the complex cube shown in **FIG. IV** can be broken down into the "duo-tetrahedron" shown in **FIG. I** plus three octahedra. In a parallel transformation, the complex cube of **FIG. III** breaks down into the cuboctahedron of **FIG. II**, with a remaining octahedron. We can in fact divide the cube in either phase into two halves by separating along any one of three orthogonal planes. After the two halves have been separated, each half is rotated 180 degrees around a vertical axis, and the two halves are brought back together to reveal the other phase. That is, the duo-tetrahedron of "State A" freely may be converted into the cube octahedron of "State B" and vice versa. This phenomenon of "intertransformability" is the direct result of the subdivision of the tetrahedron into fourths and the octahedron into eights. Further subdivision and additional transformations are possible. In addition to the transformations described above these respective geometric State A and State B configurations can be converted into:

(a) eight tetrahedra plus four octahedra;
(b) a cuboctahedron plus one octahedron;
(c) a double tetrahedron plus three octahedra;
(d) four isosceles dodecahedra and four octahedra;
(e) eight cubes each formed from a tetrahedron consisting of four ¼ T blocks surrounded by four 1/8 O blocks;
(f) four rhombic dodecahedra;
(g) two complex tetrahedra, each made of four tetrahedra, each of which is formed from four ¼ T blocks, surrounding an octahedron formed with eight 1/8 O blocks, with two remaining octahedra.