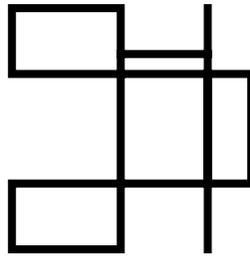


Morphological Translation of Mondrian's Neo-plastic Compositions into Three-dimensional Embodiments using Shape Grammar

This document explores morphological translation of Piet Mondrian's Neo-plastic compositions into three-dimensional embodiments. The principle of sub-dividing a canvas with lines and selecting few of the sub-divided pieces for colouring is applied in 3D by sub-dividing input 3D primitives with planes and selecting few of the sub-divided geometries for presence or absence.

Content

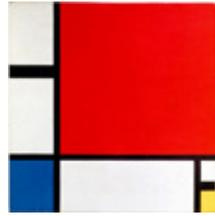
	○	Empirical observation	04
	○	Shape grammar rule-set	05
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3D	○	3D Translation	09
	○	Shape grammar rule-set	10
	○	Generative process	12
	○	Elevations	13
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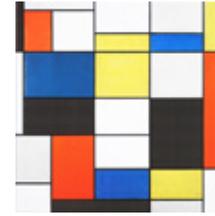
Morphology of Mondrian's Neo-plastic Compositions

Piet Mondrian's Neo-plastic compositions can be appropriated by sequentially sub-dividing a canvas with lines in x and y directions, and selecting few of the sub-divisions for colouring. Such a procedural method captures the morphological ethos of the compositions and can be applied to three-dimensions with the same ethos.

2D | Empirical Observation



Composition 2, 1929



Composition A, 1923

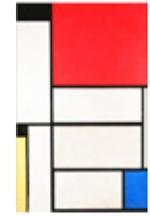


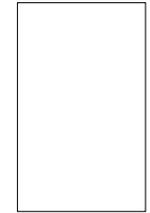
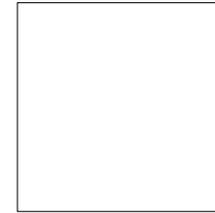
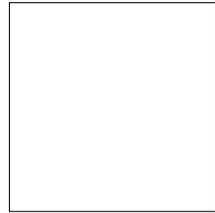
Tableau I, 1921

Empirical analysis of Mondrian's 45 Neo-plastic compositions leads to the following observations –

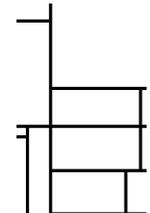
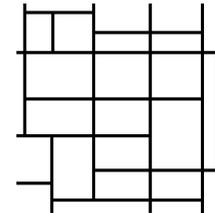
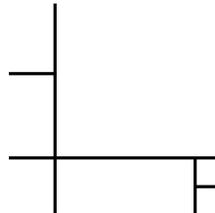
1. Canvases are rectangles of varying aspect ratio,
2. Canvases are sub-divided with two kinds of vertical (continuous and split) and two kinds of horizontal (continuous and split) lines, and
3. Few of the sub-divisions are selected for colouring with four colours.

To appropriate the compositions, shape grammar is used on an orthogonal grid with 4 rules to sequentially sub-divide the canvas with corresponding line types.

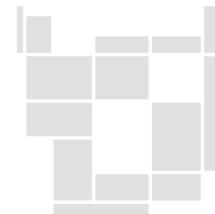
Canvas Proportion



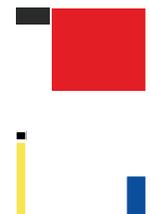
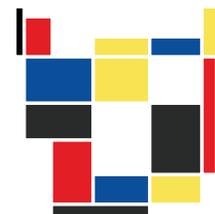
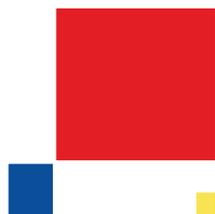
Sub-dividing Lines



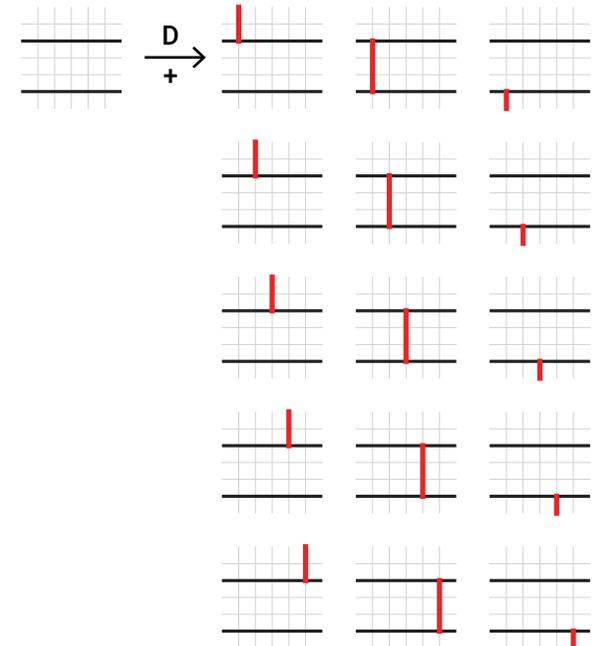
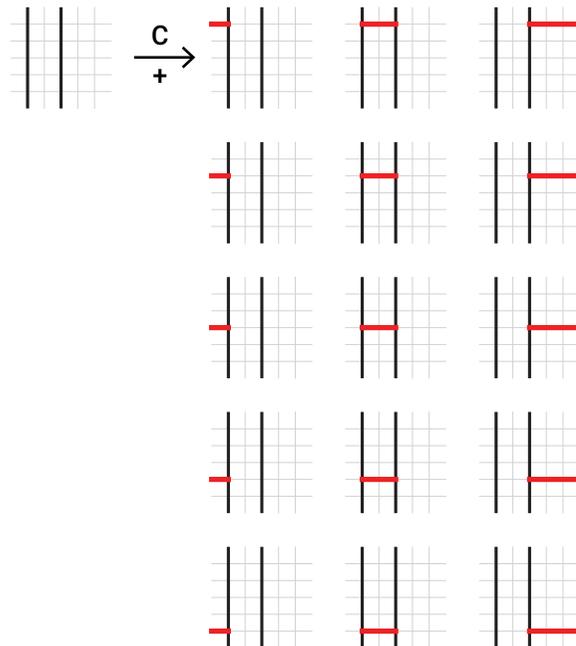
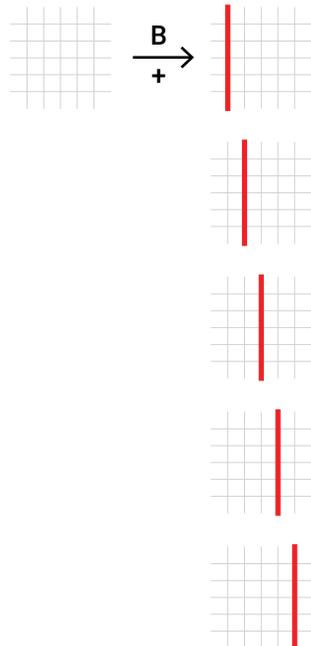
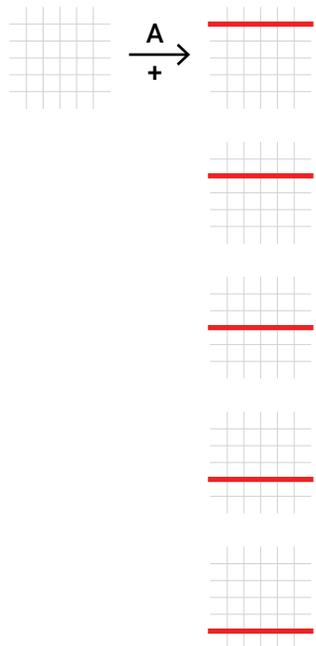
Selected Sub-divisions



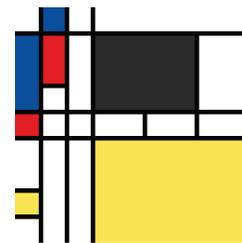
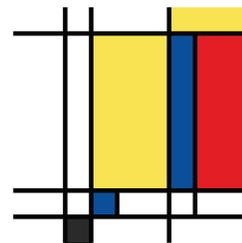
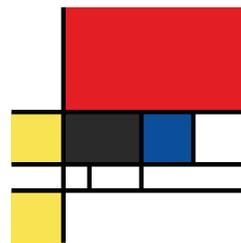
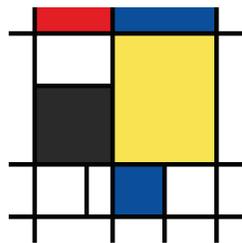
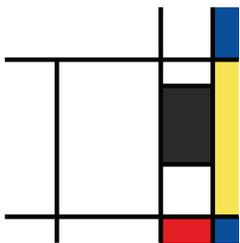
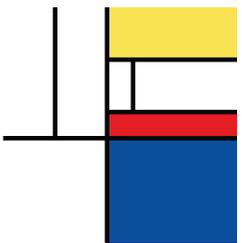
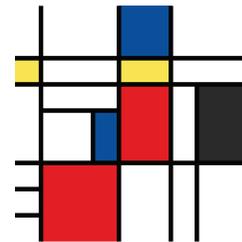
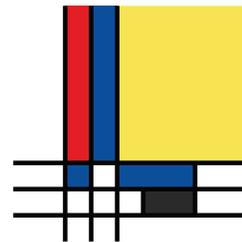
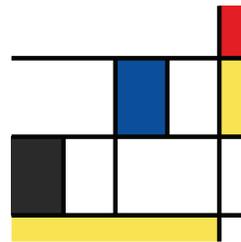
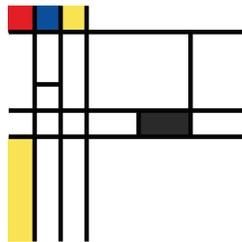
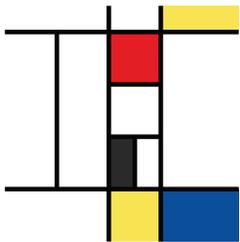
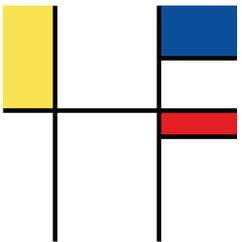
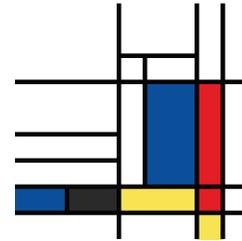
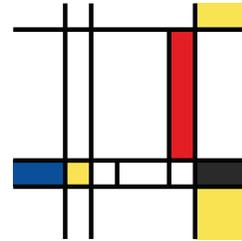
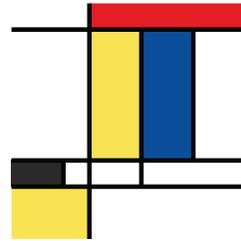
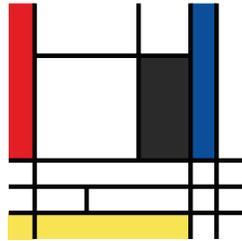
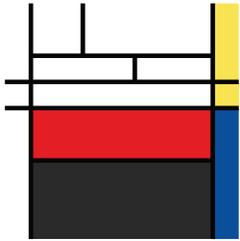
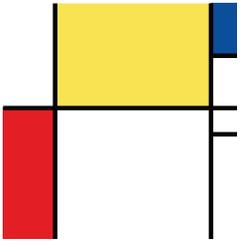
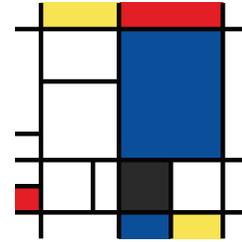
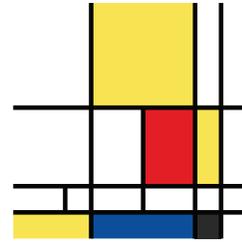
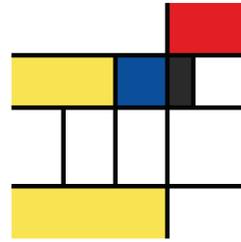
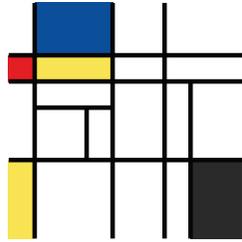
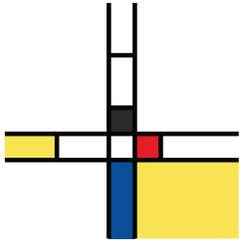
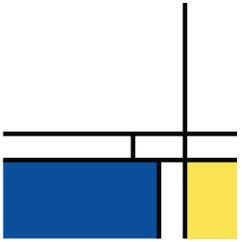
Coloured Sub-divisions

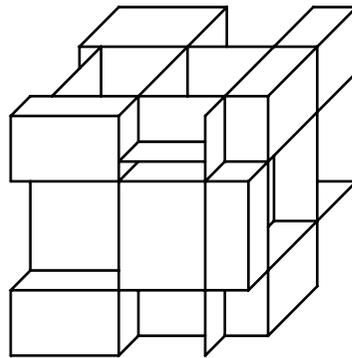


2D | Shape Grammar Rule-set



2D | Output Variations



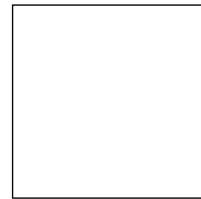


Three-dimensional Embodiments

The embodiments show similarity to lines and overhanging planes of the Prairie style. The flattened elevations appropriate the ethos of the Neo-plastic compositions. The operative rule-set of the compositions can be extended to deconstruct any architectural typology to generate infinite variations. These can act as the starting point for finer articulation of the geometry in design development phase.

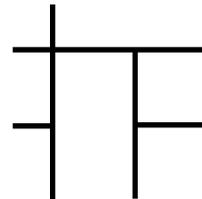
3D | 3D Translation

The initial geometry changes from canvas (2D) to various input primitives (3D), the sub-dividing agents change from lines (1D) to planes (2D), and sub-divided components change from rectangles to cuboids. Colouring of the selected sub-divisions is skipped in 3D to keep the tone neutral.



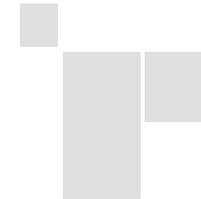
Canvas

2D to 3D



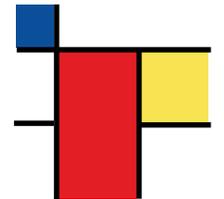
Sub-dividing Lines

Lines to Planes



Selected Sub-divisions

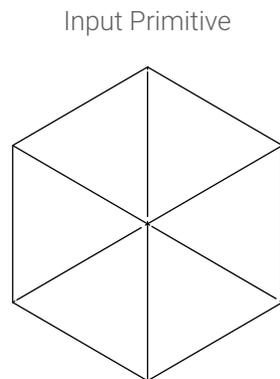
Rectangles to Cuboids



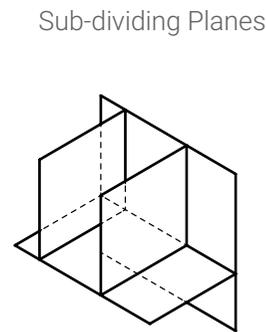
2D Composition



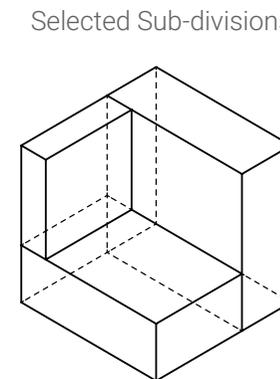
Similar to the 2D compositions, shape grammar is used for sequential sub-division of the input primitive. A, B and C rules add a continuous plane in the xy, yz and zx planes respectively, and D, E and F rules add a split plane in the xy, yz and zx planes respectively.



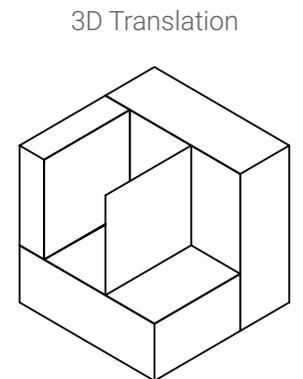
Input Primitive



Sub-dividing Planes

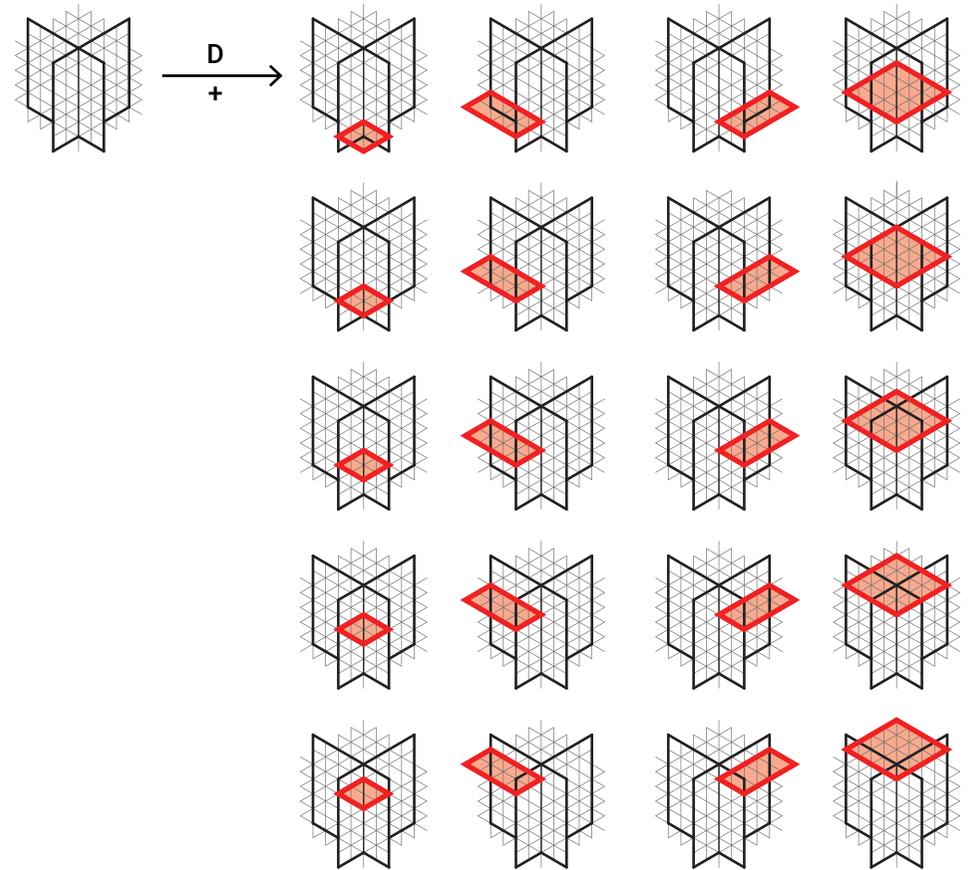
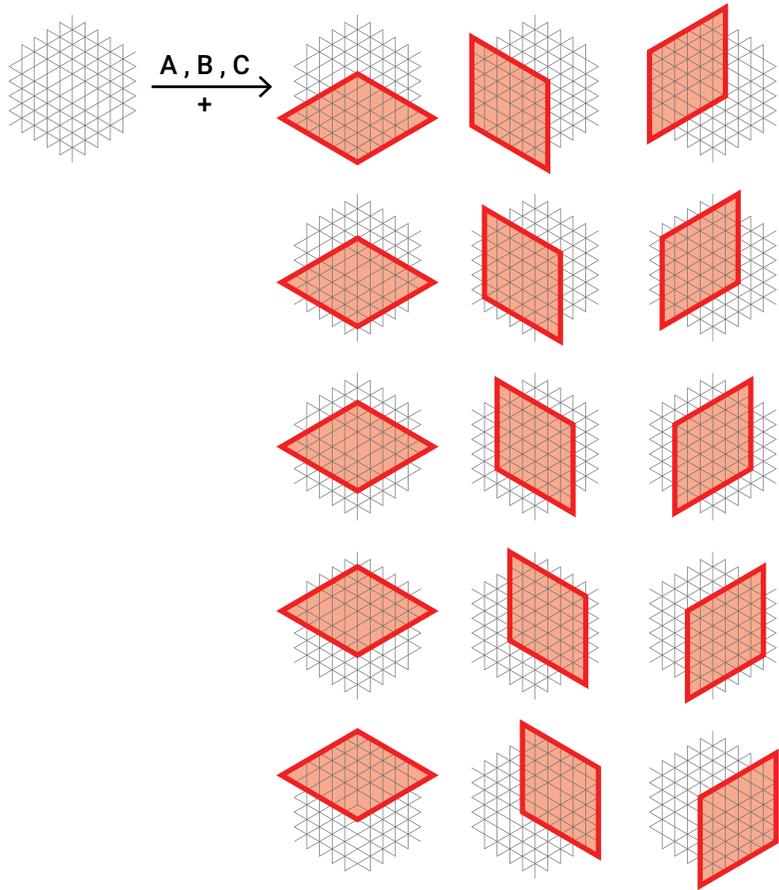


Selected Sub-divisions

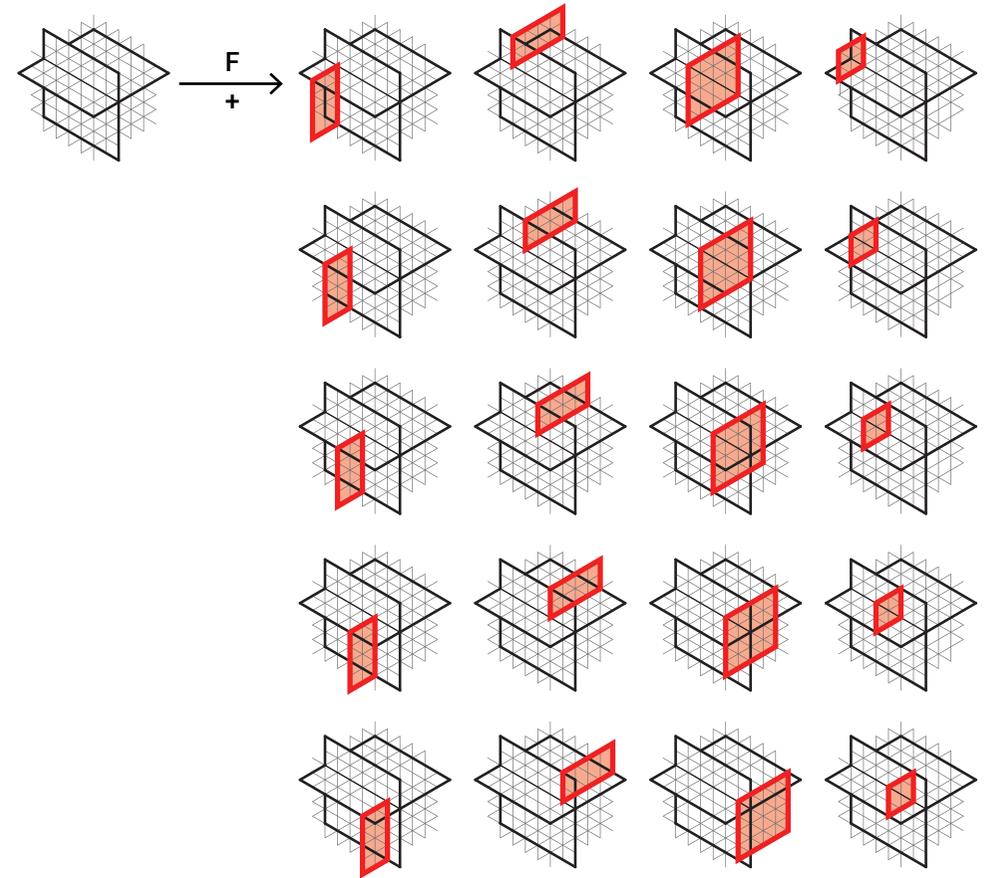
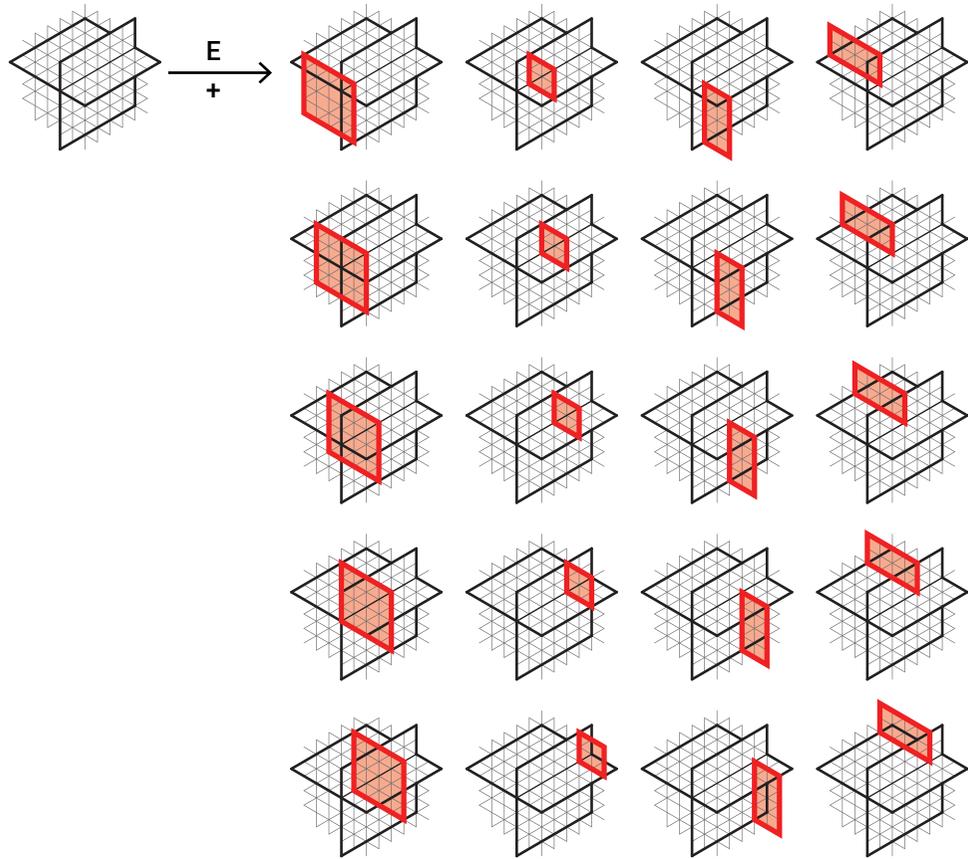


3D Translation

3D | Shape Grammar Rule-set



3D | Shape Grammar Rule-set

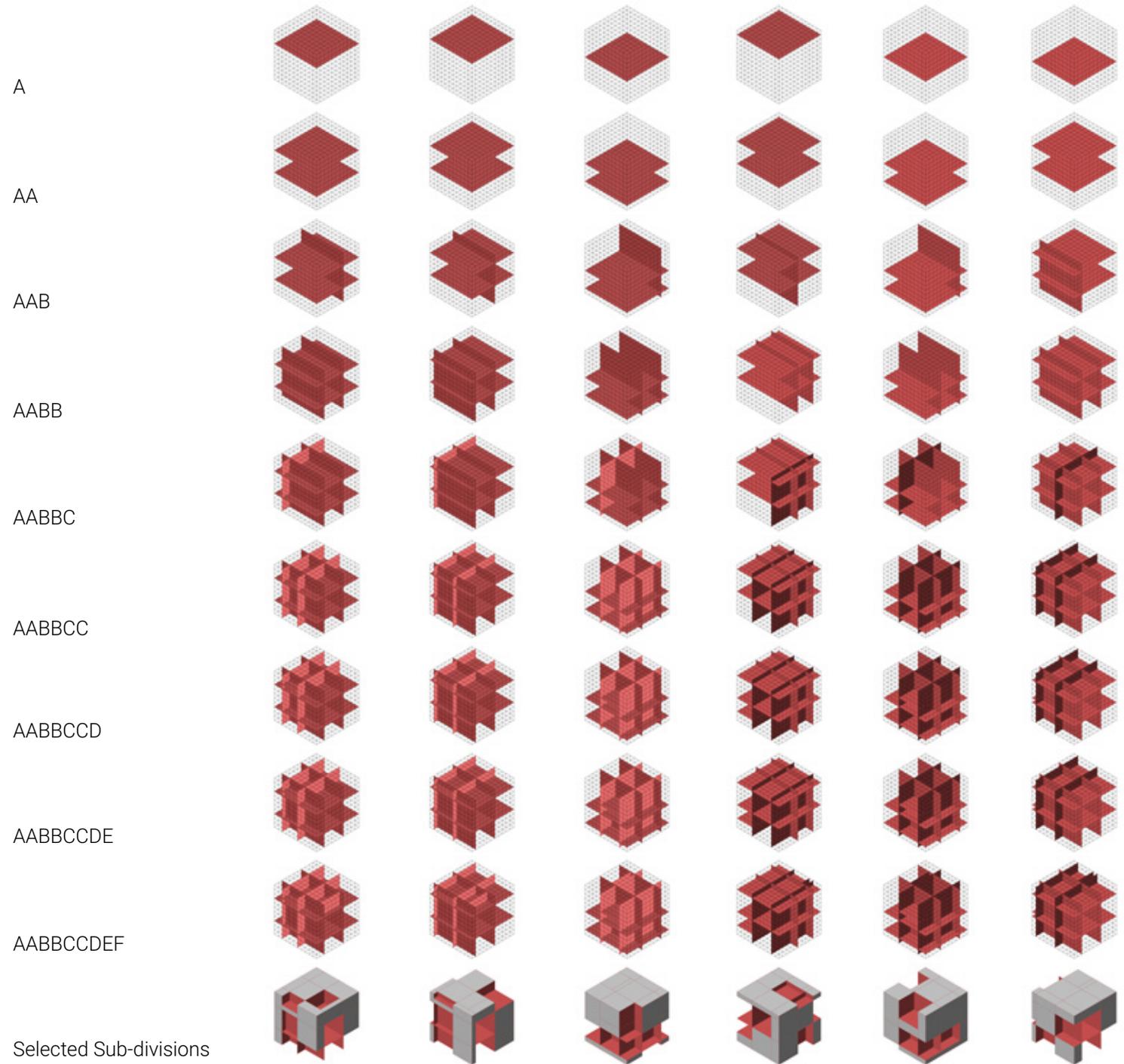


3D | Generative Process

As shown in the diagram, a cube is sequentially sub-divided by two kinds of planes (continuous - A/B/C and split - D/E/F) in xy, yz and zx planes according to the shape grammar string. Subsequently, 60% of the sub-divisions are selected for retention.

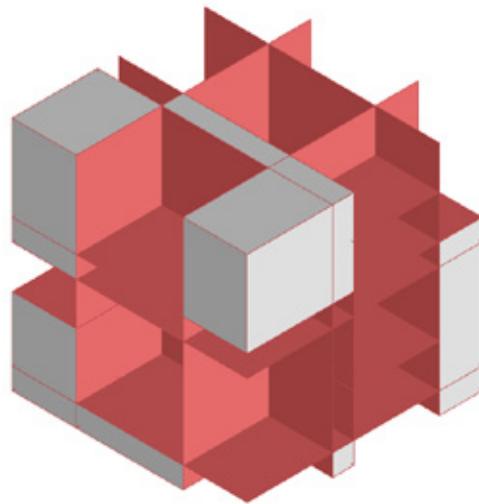
The variables in the algorithm are as following -

1. Input primitive shape,
2. Number of candidate planes in xy, yz and zx planes,
3. Shape grammar string,
4. Order of selection of candidate planes according to (3),
5. Percentage of sub-divisions to be retained, and
6. Order of selection of sub-divisions for retention.

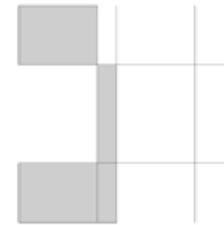


3D | Elevations

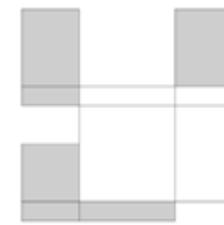
The embodiments show similarity to lines and overhanging planes of the Prairie style. The flattened elevations appropriate the ethos of the Neo-plastic compositions. The operative rule-set of the compositions can be extended to deconstruct any architectural typology to generate infinite variations. These can act as the starting point for finer articulation of the geometry in design development phase.



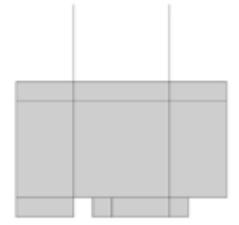
3D



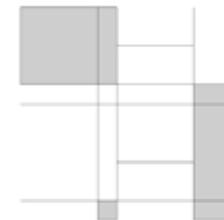
Top



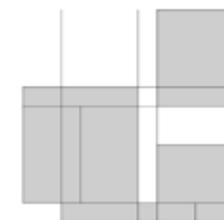
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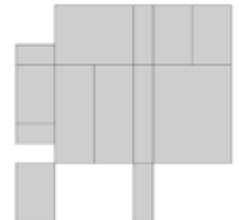
Right



Front

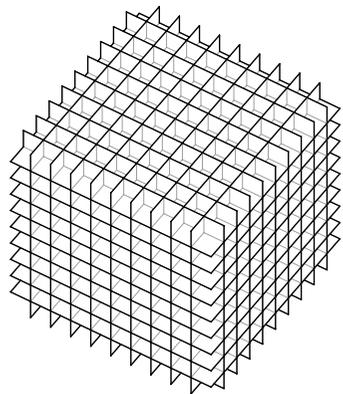
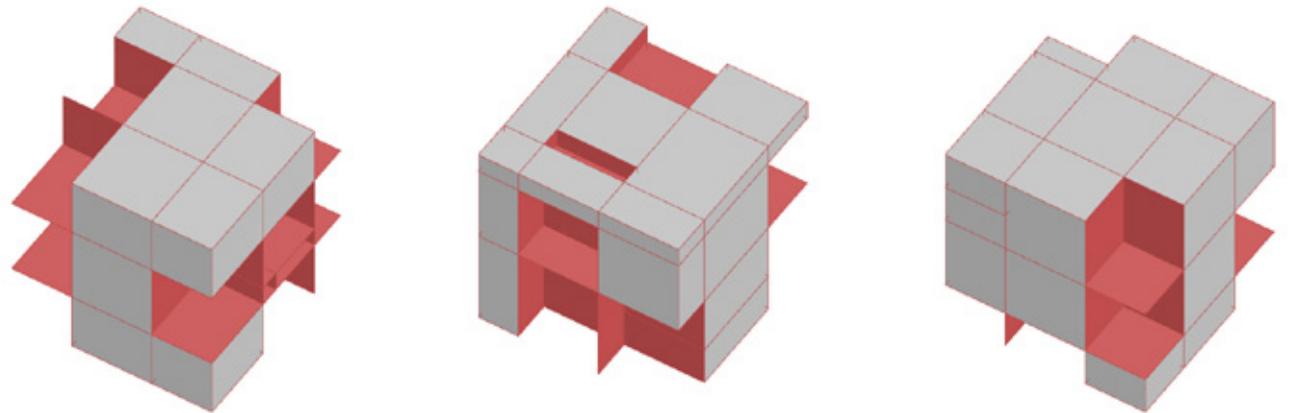
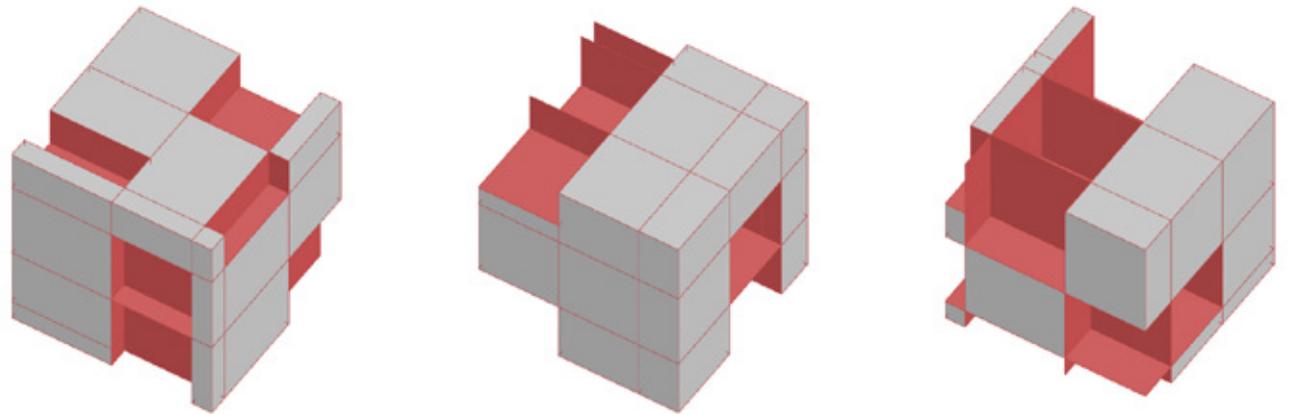
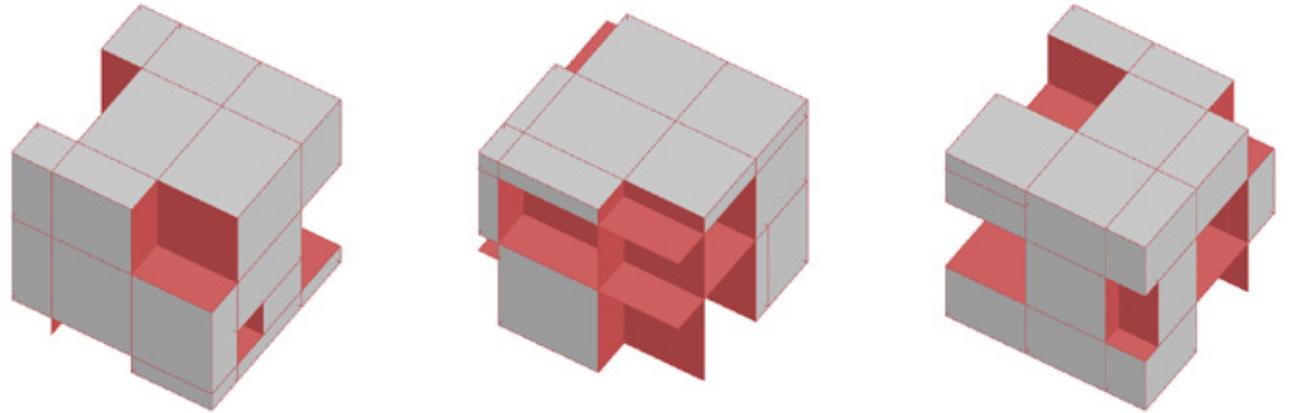


Back

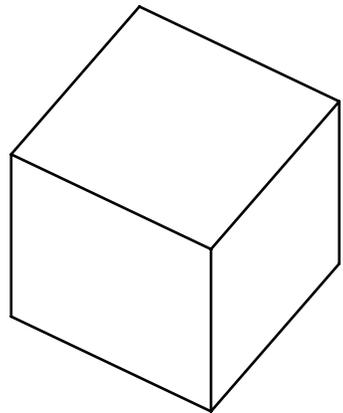


Bottom

3D | Output Variations



Sub-dividing Candidate Planes

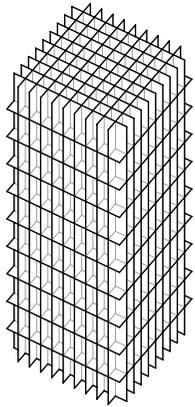


Cube

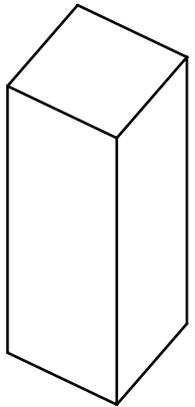
Input Primitive

Output Variations

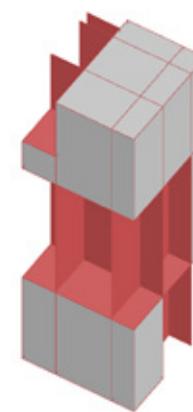
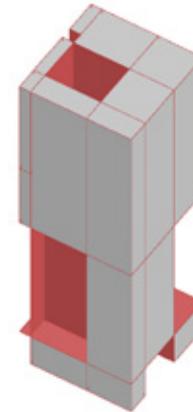
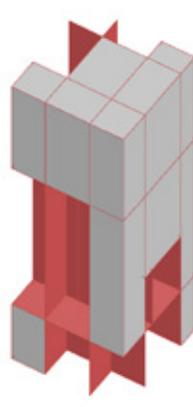
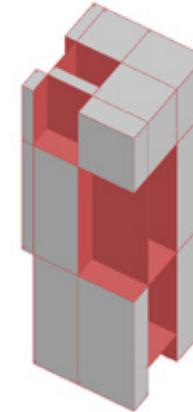
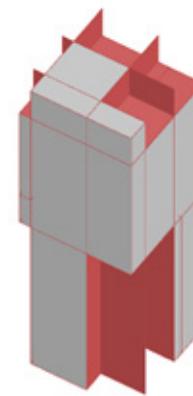
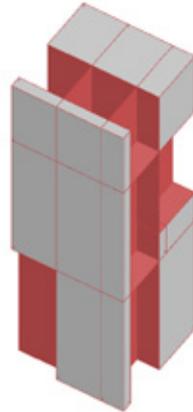
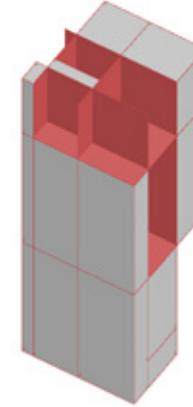
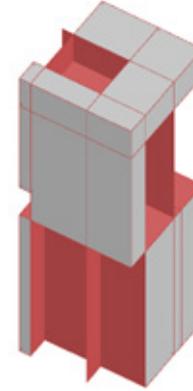
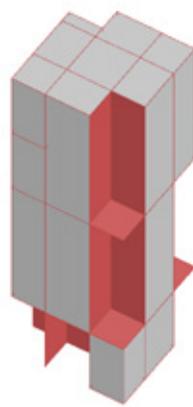
3D | Output Variations



Sub-dividing Candidate Planes

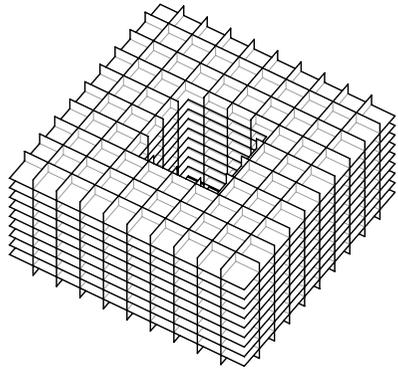


Cuboid Vertical
Input Primitive

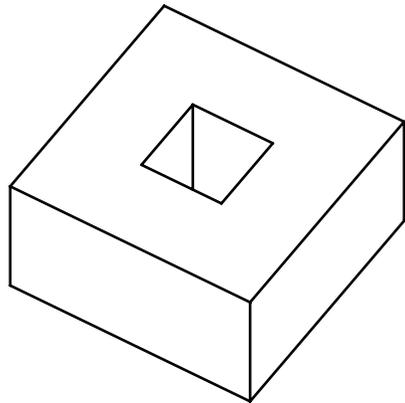


Output Variations

3D | Output Variations

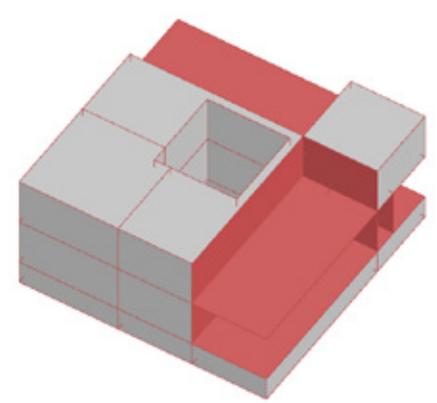
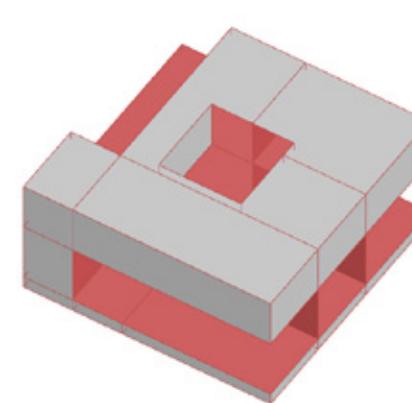
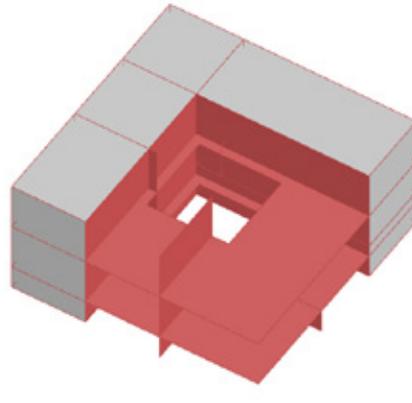
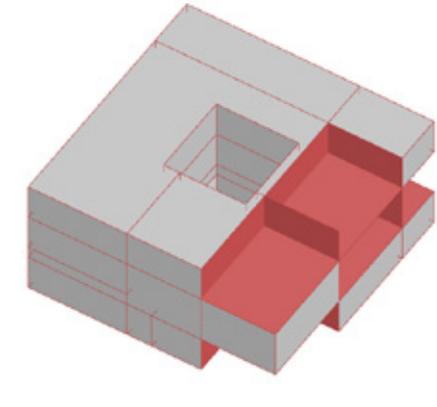
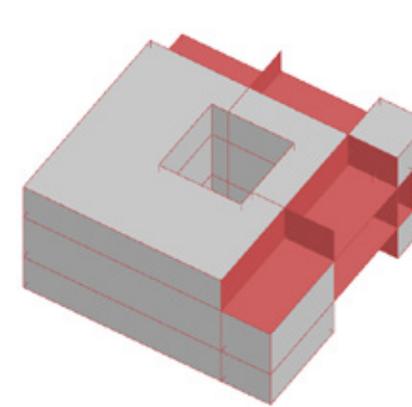
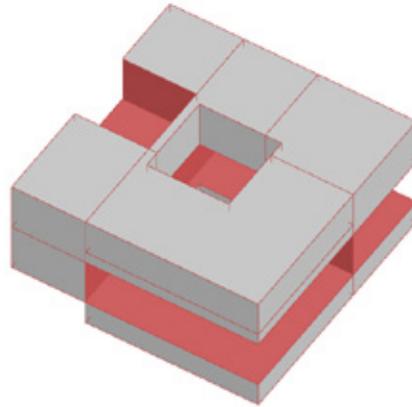
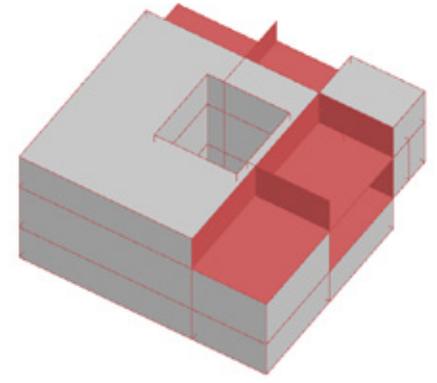
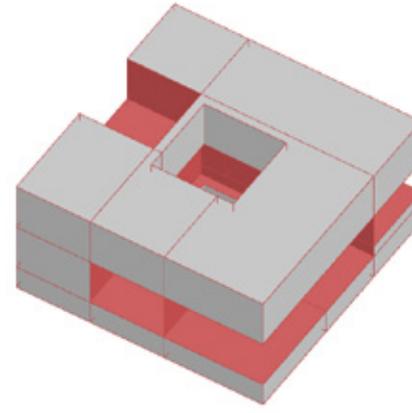
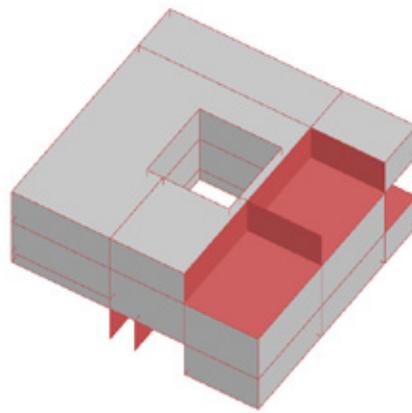


Sub-dividing Candidate Planes



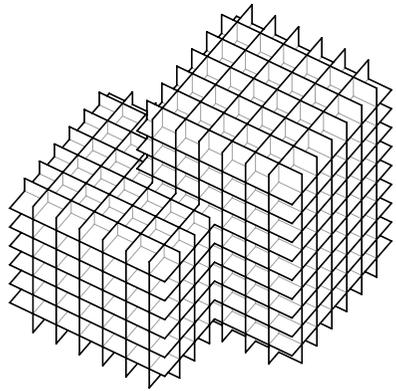
Cuboid with Courtyard

Input Primitive

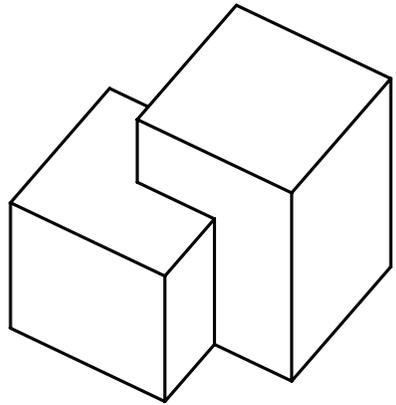


Output Variations

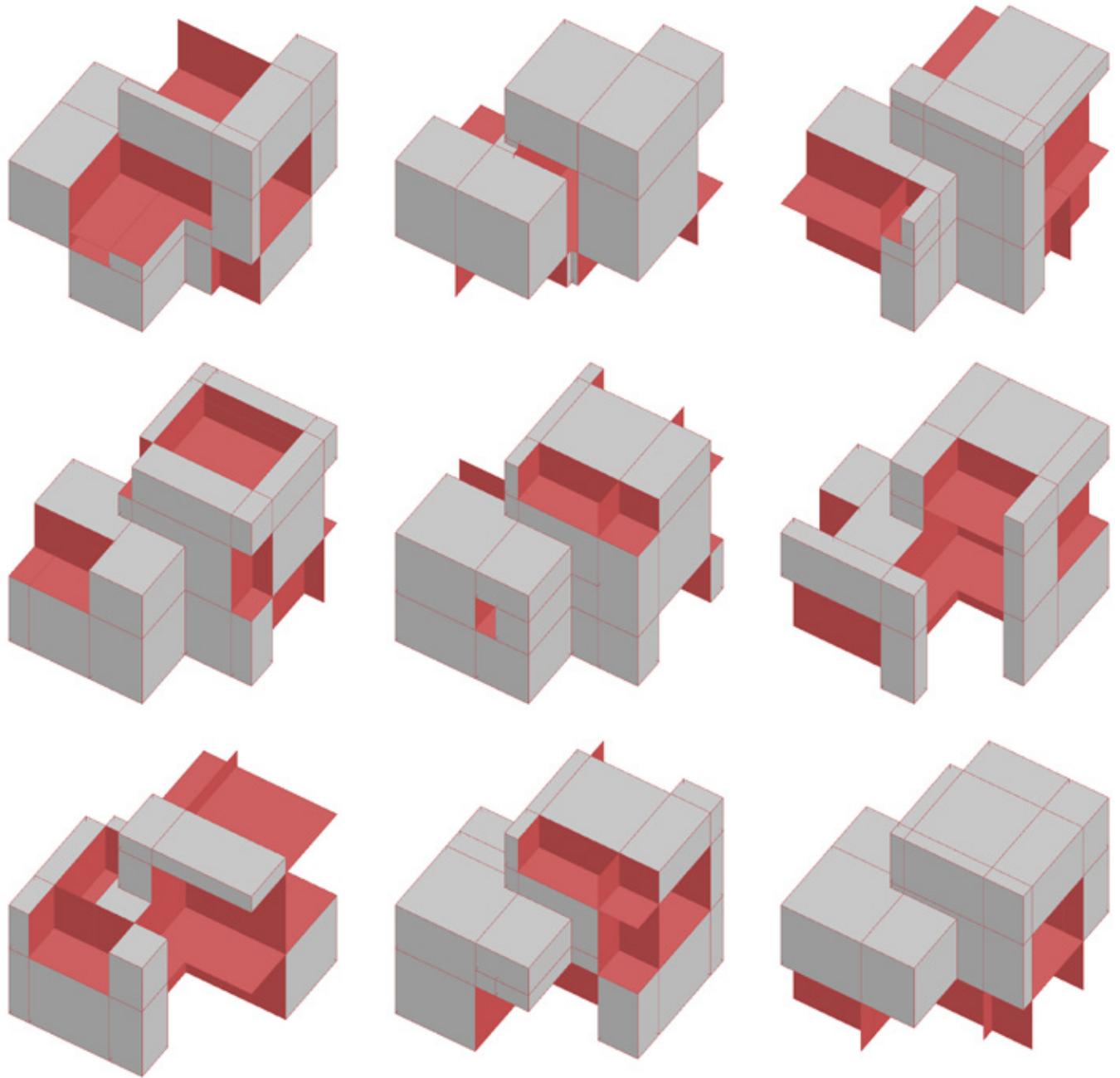
3D | Output Variations



Sub-dividing Candidate Planes

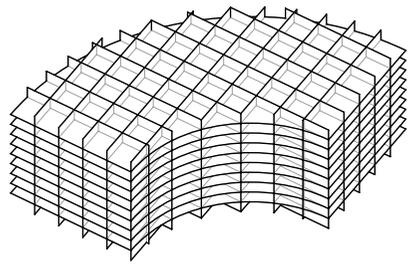
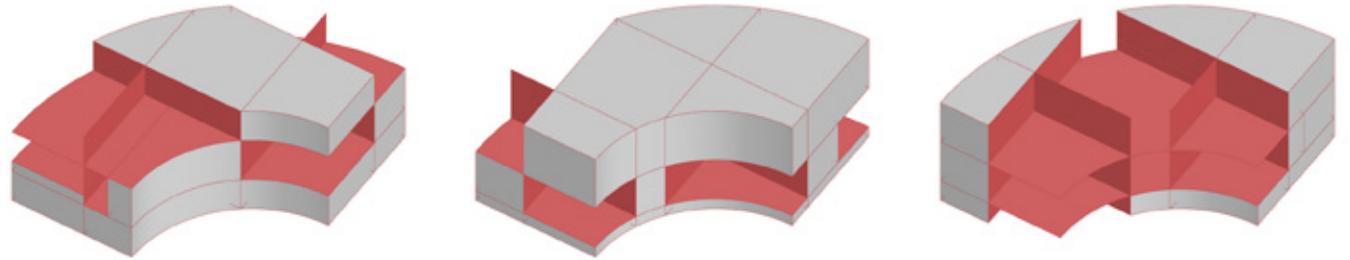


Cuboid Union
Input Primitive

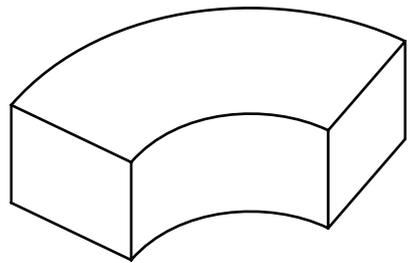
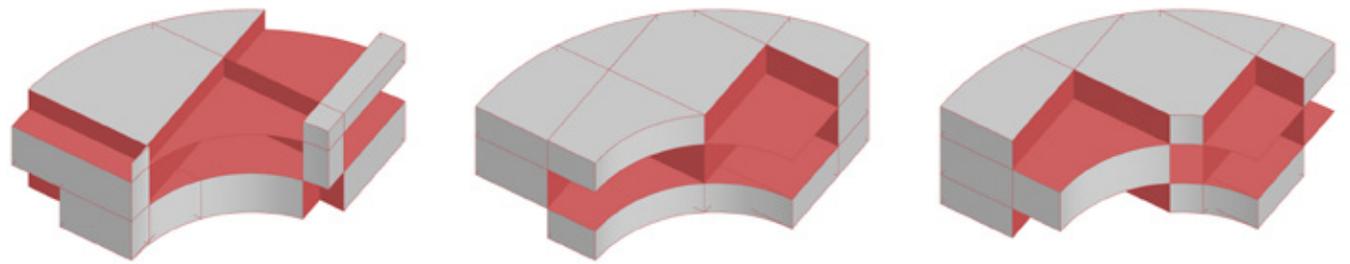


Output Variations

3D | Output Variations

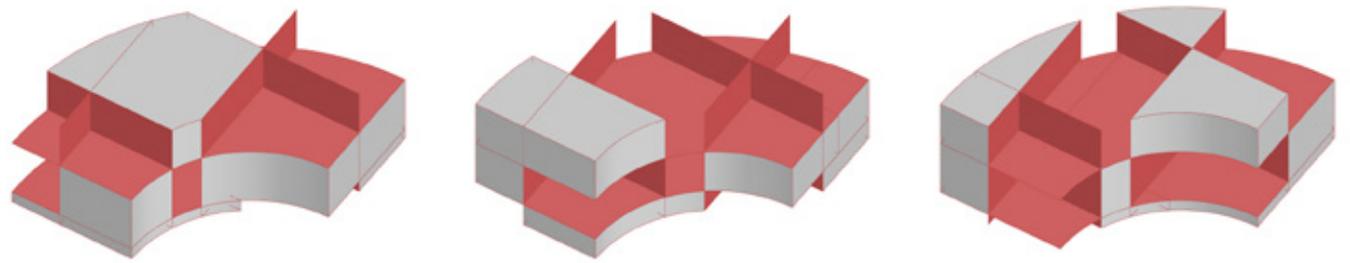


Sub-dividing Candidate Planes



Hollow Cylinder Quadrant

Input Primitive



Output Variations

