Since the introduction of non-standard design to the field of architecture, we have seen a diminishing interest in the work of serialized units as a design strategy. On the contrary, every building block has become different as enabled by digital fabrication technologies and CNC manufacturing. In the advent of the current energy crisis, and technologies of distribution that allow crowd-sourcing as a design strategy, the Polyomino project attempts to re-consider serial repetition through a framework of combinatorics and graph theory, one in which we consider geometry as a data structure for a plethora of design variations.

PAPER VOXEL / 3D DOMINO
As a starting point of the research project, it was decided to work with perfect packing polyhedra; a unit that could define a three-dimensional array without any gaps. From the different options available, the truncated octahedron was selected due to its number of neighbours in a voxel configuration and the ability to transfer vertical loads between units.
The truncated octahedron became the initial condition for topology studies; in a similar way in which a ‘domino’ block uses dot patterns to describe possible connectivity between units, dots located in the faces of and edges of the truncated octahedron units would start breaking the symmetry of the voxel allowing for only specific orientations to have synergy with each other.

The exploration of this diagrammatic rule set would become the basis for the design of an actual geometry, one that would understand the rules of topology and its potential combinations.

DEFINITION OF GEOMETRY

The design of the geometry would focus on the use of tangent curvatures that allow to blur the definition of one tile, and define assemblies as molecules that could be re-purposed as a higher order of structure.

While our current design tools are well implemented to work with parametric models, we currently don’t have good tools to work with a combinatorial paradigm. The research unit desired to use Unity3D, a game engine with a strong geometric API, to allow user interaction with a geometric rule set.

Under the described set of constraints for connectivity of units and rules of propagation, the Polyomino project can be classified as a combinatorial system; one that does not describe a holistic output, but rather an open-ended tile set. The project was further implemented to describe architectural assemblies that would operate as a structural envelope dealing with shading and structure.
4 Small Aggregation

5 Final Geometry defined by the tangency connection

6 3D-Printed Prototype
The system, being based on a voxel, can grow from linear aggregations to surface-like two-dimensional arrays, and finally three-dimensional volumetric configurations that would require the redundancy of units to produce higher order and organization.

The implications of re-considering a serialized mass production of units that operate under combinatorics are not only formal, but socio-economical. On the one hand, the product, as described as a non-holistic design system, relies on new content generated by the user. The crowd source potential for designs insists that the final product is open-ended and engineered as a speculative building set.

In the Polyomino project, the search for patterns would become a fundamental design strategy to generate larger configurations. The units are considered the fundamental letters of the alphabet, but soon a community of users could describe a whole alphabet of words, sentences and paragraphs.1

NOTES
1. This is an analogy that Alexander uses in his article “Systems generating systems.”

IMAGE CREDITS
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