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Continuing the 'Continua' II: Application of thin plywood in construction through biologically inspired approach

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CONTINUING THE 'CONTINUA' II

Application of thin plywood in construction through biologically inspired approach

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1. Introduction

This paper investigates a possibility of application of thin (ca. 5 mm) plywood as structural material. It takes departure from the Erwin Hauer's 'Continua' series (figure 1), and proposes how it could be developed with the contemporary digital tools and by following the biological paradigm. The objective is to minimise wastage as well as to test how the resulting structure would perform structurally and as a light-controlling device.

2. Biological paradigm

The re-design of the 'Continua' series takes inspiration from the biomimetic approach. Biological systems utilise information -- stored in the genetic code -- rather than energy in order to solve technical problems (Vincent et al., 2006) and self-assemble structures that unlike the engineered solutions are hierarchical. Energy is used sparingly, single material often serves both structural and protective purposes, the distinction between material and structure is blurred. Today's environmental concerns and depleting resources invoke interest in the efficient and rational biological systems.

3. 'Continua' worth continuing

Erwin Hauer (b.1926) is an Austrian-American sculptor, known for repetitive screen-wall systems based on modular elements cast from moulds in concrete, gypsum or acrylic resin or later CNC-milled in MDF and

limestone (Hauer, 2004). These are time and energy consuming and produce waste. ‘Design 3’ (1952) from the ‘Continua’ series would be applicable for external light-breaking building envelopes (Kłaczyńska, 2013).

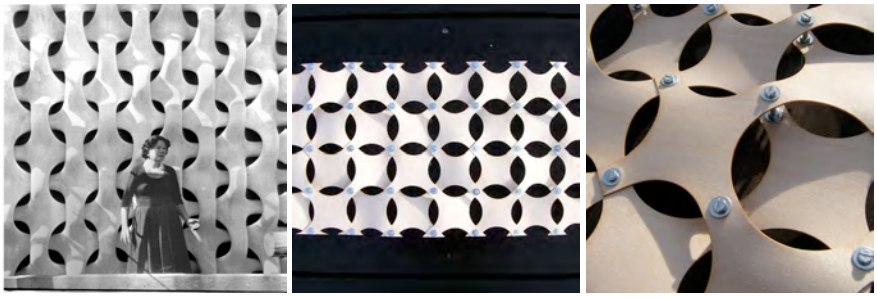

Figure 1 - Erwin Hauer’s ‘Design 3’. Figure 2 and 3 - proposed solution.

4. Proposed approach

The proposed solution (figure 2 and 3) is based on sheet material bent to form and thus achieving strength. Thin plywood is lightweight, durable, flexible and based on a renewable resource. Tension in bending is induced by threaded bars. The cross shape of the panels provides for achieving double curvature. The distribution of convex vs. concave panels regulates the overall stiffness. CNC laser cutter enables variation without extra production time. The system uses the method of parametric design, where sizes of the openings and amplitudes of the wave are variable. That allows for changing the geometry in response to the geometrical, structural and environmental factors. Hierarchically, global form is controlled locally at a level of a single unit, that being dependent on the combination of material properties and geometry. By doing so much less material, energy and time are used to produce a final piece. This solution required reconfiguration of the modules, but the geometrical features of the original ‘Design 3‘ are sustained. Further development of the system includes providing for self-support through the overall geometry, e.g. shells, as well as adding material criteria as a variable parameter by varying the number of plies in response to the curvature.

References

Hauer, E: 2004, *Erwin Hauer: continua : architectural screens and walls,* Princeton Architectural Press, New York.

Kłaczyńska, S: 'Transition Zone' jako opozycja dla ściany. *In:* T Wagner, ed. *Modernity in Architecture. Integration - Identification - Innovation*, 2013. Gliwice: Wydział Architektury Politechniki Śląskiej w Gliwicach, pp. 107-122.

Vincent, JFV, Bogatyreva, OA, Bogatyrev, NR, Bowyer, A and Pahl, A-K: 2006, Biomimetics: its practice and theory, *Journal of The Royal Society Interface,* 3(9)**,** pp. 471-482.