Environmental Material Performance of Solid Wood:

pareSITE: The Environmental Summer Pavilion

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Abstract:

The research on performative wood is held with great results at RCAT, Oslo School of Architecture and Design and ICD, Universitey of Stuttgart. Our project focused on the material performance of solid wood cut in tangential section with the use of graphical algoritm editor Grasshopper for Rhino and digital fabrication techniques as the design tools. PareSITE: The Environmental Summer Pavilion serves as a prototype to further research on material-environmental interaction of industrialy produced performative screens.

The pavilion designed for reSITE festival, is a möbius shaped structure, built from torsed pine wood planks in triangular grid with half cm thin pine wood triangular sheets that provide shadow and evaporate moisture in dry weather. The sheets, cut in a tangential section, interact with humidity by warping themselves, allowing air circulation for the evaporation in arid conditions.

*pareSITE (*Wágnerová *2013)*

This interdisciplinary project involved students from the Architectural Institute in Prague (ARCHIP) and the students of the Faculty of Forestry and Wood Sciences at the Czech University of Life Sciences Prague (FLD CZU).

The concept of evaporating moisture and thus humidifying the air is well developed in oriental countries on their wooden ornamental screens so called 'mashrabīyas'. Today also European cities suffer with arid conditions during the summer seasons. The principle of wooden 'mashrabīyas' operates on hygroscopity of the material and its environmental conditions. At night, when the relative humidity is high, the wood absorbs moisture which is evaporated during the day. The performance of those systems was studied by Michael Hensel. Hensel writes:

'Mashrabīyas are multi-functional elements that control light penetration, airflow, privacy and views, while operating on a synergetic relation between ornamental pattern and material distribution.' (Hensel 2011)

Our project is using warping of wood in tangential section for supporting the circulation of humid air. This warping generates so called 'cup' across the fiber. (Knight, 1961) The triangular panelling thus bends outwards in dry weather, while inwards in the humid one, closing the structure. The sheets are 5 mm thick. These triangles were made using HOMAG Venture 06S 3-axis milling machine.

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The application of warping of wood in tangential section is common from traditional Norwegian panelling and was described by Larsen and Marstein:

'The boards are nailed towards the upper edge, just below the joint where they overlap. In dry weather, the lower board ends bend outwards, allowing dry air into construction. In wet weather the boards close again.' (Larsen and Marstein 2000)

The contemporary research on performative wood, led by Michael Hensel at RCAT, Oslo School of Architecture and Achim Menges with Steffen Reichert at ICT, University of Stuttgart, is mainly focused on laminated veneers, which we find to fragile for industrial solutions.

The project was designed in Rhino in combination with Grasshopper for Rhino. The triangulation

was generated in LunchBox plug-in from the author Nathan Miller. The plug-in contained algorithmic geometry, panelling tools, structure and powerful utilities.

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The form of pavilion does not allow subdivision into planar surfaces, but anisotropic properties of the material support torsion. Several prototypes of the triangles with different plank thicknesses and moisture content were sampled. The angles of cuts hold the boards' torsion together in the joint. The strength in the torsion of the planks has been tested. Because of its ability to bend, it was agreed to use green wood for the structure. The experiment had therefore to deal with twisted planks which introduced new set of forces into the structure. Due to rather unpredictable and complex nature of these forces, decision was made to encapsulate these into triangular particles, preventing unwanted accumulation and interactions. Planks were cut by Hundegger Speed-Cut 3 cnc saw. Each particle consisting of three twisted pine 20mmX150mm planks was connected by 0,6 mm metal sheet overlay on whole length of connecting edge tightened by screws. These particles were afterwards connected with each other by 4 m8 bolts and large washers, hiding the metal overlay.

Conclusion:

The pavilion generated plesant environment for its visitors during the hot days of the festival.
The LunchBox plug-in became the main tool to finish and create better workflow for the final definition.
The structure from the torsed planks proved to be rigid enough to sustain 200 kg weight on the highest not directly supported point.

Participation:

The project was accomplished with the kind support of Skanska, Eurodach, Lesy České republiky, reSITE, Faculty of Forestry and Wood Sciences at the Czech University of Life Sciences Prague, ARCHIP, Collaborative Collective and Oximoron.

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Martin Šichman/ Oximoron – structure

Literature:

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