NEW VIEW is a pavilion structure that explores how a swarm-driven and form-found tectonic system, applied to a non-uniform parametric reciprocal frame structure, can be combined with material properties, vernacular and fabrication techniques in order to design and construct novel spatial structures through a material swarm articulation.

The project explores a form finding computational framework of tension structures with integrated, curved plywood panels, based on their material properties and force distribution. The generated structures, in equilibrium, are analyzed further according to environmental parameters, and a bottom-up approach is integrated for enhancing the permeability and environmentally generative articulation of the structure. It is a study that builds upon research that focuses on the architectural transfer of agent-based design systems by means of novel computational design and simulation methods, along with computer-controlled manufacturing methods for further building implementation.
METHOD-OBJECTIVE

The aim is to develop a materially aware and fabrication oriented design approach that is able to generate a range of different geometries with common topological features. A custom design workflow has been implemented that allows the control of form and forces by prescribing any combination of force densities, forces, stiffness or lengths to the spline and cable-net elements. The resulting equilibrium shapes are analyzed and evaluated upon their performance (structural, light) and fabrication feasibility.

The shape-defining possibilities of reciprocal structural systems, as well as their combination with curved surface elements in tension structures, are demonstrated through a series of design studies with various boundary conditions, spline configurations and programmatic configurations. Here, the realized NEW VIEW Pavilion is presented as designed, analyzed and constructed in Athens, Greece, where the pavilion was assembled on the roof of a cultural center to provide shelter from the sun and to host social events.

CONTRIBUTION

This research explores a design approach that unfolds morphological complexity and performative capacity from material parameters without differentiating between formation and the materialization processes. It draws inspiration from vernacular building techniques and local material traditions and matches them with contemporary computational tools. It focuses on combining and assembling short structural elements in intricate ways in order to achieve spans longer than the elements. It provides a straightforward method and intuitive method for the design of hybrid structural systems, and, therefore, facilitates further exploration of the generative capacity of multi-agent systems for design and that of the reciprocal frame as a structural and tectonic system.
6  Perspective View of the Structure on the Rooftop

7  Top View of Sun Radiation Analysis for the Canopy Structure

8  Curvature/Stress Analysis and Force Diagram for the Generated Surface
IMAGE CREDITS

All images: Evangelos Pantazis with Dr. David Jason Gerber as Thesis Chair and Faculty Advisor

DAVID GERBER is an Assistant Professor of Architecture and Engineering at the University of Southern California. At USC Dr. Gerber leads a team of design researchers focused on the intersection of design, science, computing, and technology. Professionally, Dr. Gerber has worked in architectural practice in the United States, Europe, India and Asia including for Zaha Hadid Architects; for Gehry Technologies in Los Angeles; for Moshe Safdie Architects in Massachusetts, and The Steinberg Group Architects in California. Dr. Gerber has been a board level advisor, and an executive officer for a number of design technology startup companies and was a Vice President for Gehry Technologies.

IASON PANTAZIS is a founding principal of Topotheque Design Office. He is a registered architect in Greece and has taught architecture at Columbia University as teaching assistant. Iason's previous personal and collaborative work, ranging from architecture to art and installations, has been exhibited and performed at the Center of Architecture in New York, the State Museum of Modern Art in Thessaloniki and the Byzantine Museum in Athens. Iason holds a Master of Science Degree in Advanced Architectural Design from Columbia University and a Diploma of Architecture from Aristotle University of Greece. As a visiting student, he attended Master Program in Architecture at Delft Technical University and Master Program Media Architecture at Bauhaus University Weimar.

EVANGELOS PANTAZIS is a PhD student at the University of Southern California, pursuing PhD research in the field of design and computation across the disciplines of computer science, engineering, and architecture as part of Dr. Gerber’s funded research lab. Evangelos holds a Master of Advanced studies, on the field of Computer Aided Architectural Design, from the university of ETH in Zurich since 2013. He obtained his Diploma in Architecture from Aristotle’s University of Thessaloniki in 2010. After gaining professional experience in international offices like Graft Architects in Berlin and Studio Pei Zhu in Beijing he co-founded Topotheque design office, a studio that engages with design in its various expressions, including Architecture and Industrial design as well as graphic and plastic arts.