

## Architecture Challenge 2014 Team



Andrei Gheorghe

Andrei is currently teaching as an Assistant Professor at the Institute of Architecture / University of Applied Arts in Vienna. Previously he was Assistant Professor at Portland State University USA, where he developed pedagogy and research in digital media and fabrication. He studied at the Academy of Fine Arts Vienna and after being awarded the Fulbright Scholarship at Harvard University, where he graduated with distinction and received the Harvard GSD Digital Design Prize. Andrei has taught at various institutions such as Academy of Fine Arts Vienna, SCI-ARC Los Angeles and Harvard Graduate School of Design (Career Discovery Program). Previously, he worked as an architect for international offices such as Jakob + MacFarlane, dEcoi Paris and Foreign Office Architects (FOA) London.



Robert Thum

Professor - Computational Design in Architecture at University of Applied Sciences - Trier, between 2006 - 2013 Head of Diploma, and Diploma Unit Master, School of Architecture and Visual Arts, University of East London, between 2003-2010 Visiting Lecturer at Institute of Building Studies, Technical University Vienna



Peter Ortner

Frederick Peter Ortner is an architect based in Geneva and an instructor and researcher with the Media and Design Lab at the Ecole Polytechnique Fédérale de Lausanne. His teaching and research has focused on parametric architecture and urbanism. Peter studied architecture at Yale University where he received an undergraduate degree in architecture with distinction, and at Harvard University where he received the Faculty Design Award with his masters degree. He has worked as an architect in the US and Europe for offices such as SOM, SsD, and Convergeo.



Wieland Becker

Professor in Wood Technology at Hochschule Trier, research focus in development of hybrid construction methods, composite materials and wood/concrete, wood/steel, wood/glass, wood/textile applications.



Robert Vierlinger

Robert is a researching engineer and interdisciplinary consultant. Working on his PhD at the University of Applied Arts Vienna, he investigates on digital representations and evolutionary design strategies. Robert develops the plug-ins octopus and octopus.e for Grasshopper, further he is involved in the development of karamba. Parametric engineering and optimizations for international competition- and construction-projects are the basis of his consultancy at Bollinger-Grohmann engineers. He studied structural design at TU Delft and TU Vienna, studied at Studio Hani Rashid Vienna, led workshops in Germany, England, Denmark, Hongkong and Austria, and teaches at Studio Zaha Hadid Vienna.



Eirik Kjolsrud

Degree in computer science Norway, 2000. Software developer 2000 - 2005, Bachelor in Architecture 2005 - 2007 at University of Newcastle, Australia. Worked for Polaris Architects, Luxembourg 2008 - 2010. Master in Architecture 2010 - 2013 at Hochschule Trier, Masterthesis: „Digitaler Entwurfsprozess in der Nachverdichtung - algorithmische Grundrissgenerierung und Optimierung“, currently Research Assistant at Hochschule Trier



Jakub Havik



Eleonore Audi



Lukas Gschwilt



Onur Koklu



Vlad Popa



Sorana Chiris



Marc Winkhofer



Anna Varakli



Alexander Walzer



Juan Sepulveda



Madalin Gheorghe



Tal Friedman



Amine Khouni



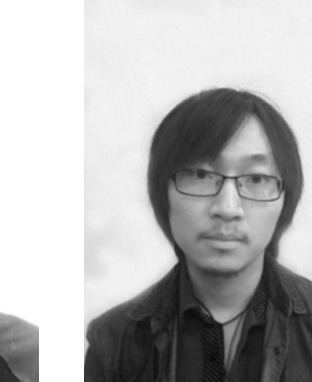
Anah Ashour



Lidia Ratoi



Julia Vishchanenko



Marin Katusic



Lu Jiaxing



Kevin Mazanek

## Project Description

### Polymer Folding Scapes

The project represents a continuation of research that explores the potential of polymer concrete applications and wood/concrete composites in the production of full scale structures. It is a collaboration between the Institute of Architecture at the University of Applied Arts Vienna and the Hochschule Trier.

The "ARCHITECTURE CHALLENGE" program is an international design workshop series in collaboration with international experts and institutions. It is intended for architecture students interested in exploring integrated digital design and fabrication while simultaneously designing a full-scale built project within the teaching environment of the Institute of Architecture at the University of Applied Arts in Vienna. Architectural Design at "Die Angewandte" is taught as an integrated, multidisciplinary process. Following this tradition, the design process in the workshop was enriched with robotic design strategies combining Grasshopper plugins such as the OCTOPUS and KARAMBA platforms. The workshop was taught by Andrei Gheorghe from Die Angewandte, Eirik Kjolsrud, Robert Thum and Wieland Becker from HS Trier, Robert Vierlinger from Bollinger + Grohmann Engineers and invited guest experts Peter Ortner and Lu Jiaxing. The handling of virtual simulation methods and the engineering of full-scale structures using robotic manufacturing were a primary focus of the project. The polymer concrete material testing and application has been made possible through the support of the RAMPF Group in Germany.

### Structural Performance

Structural testing of joints in wood/polymer concrete composites revealed a strong tension and bending ability of the cured material. Using this method, stiff connection points between wood members could be achieved without the inlay of metal sheets. A hyperboloid surface was designed in Rhino Grasshopper and optimized using Karamba and multicriteria optimization in Octopus taking into account the architectural site context, structural behavior, assembly and construction limits.

### Intrinsic Material Qualities

The precisely defined design strategy reacts with loosely defined material behavior. The formwork was unfolded from the 3D model and laser cut on polystyrol sheets. The wood members were fit at the joints in the formwork and the polymer concrete was cast. After the curing process, a stiff wooden joint consisting of direct adhesion of wood and concrete was achieved. The overall geometry emerged through the precise folding process of the cast nodes.

The precise, optimized overall geometry correlate with the very differentiated aesthetic quality of the cast polymer concrete joints. This intuitive material behavior enriches the digital precision resulting in artifacts of one-time unique aesthetic design results. Material experiment and final production of the structure merge in one single fabrication process.

### Fabrication Process

A Grasshopper definition was developed to extract two types of nodes, the cast 3-points polymer concrete nodes and wood - wood connection joints between the 3-points modules. Grasshopper was used to compute the wood - wood joints at a right angle to allow for easy assembly and fixation while erecting the final structure. A specific material mixture of the polymer concrete components combined with precise time management was required to produce the structural stiff nodes.

### Future Application

Digital Design and Fabrication processes will have increasing importance in future architecture production. The project researches an alternative way of construction. The high strength polymer concrete is applied for the first time in a new way in this project to achieve structurally stiff wood/concrete composites without any metal inlays. The research project attempts to develop strategies of building full-scale architectural structures. In future, this technology can be refined to be used in fully functional small and large-scale construction.



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