The "Angewandte 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 ("Die Angewandte").

The "Robotic Infiltrations" workshop is a collaboration between the University of Innsbruck’s REX|LAB and the Institute of Architecture at the University of Applied Arts Vienna and represents a continuation of research that explores the potential of additive digital production through the use of robotically controlled placement of phase-change polymers in the production of full scale structures.
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 HAL and KARAMBA platforms. The handling of virtual simulation methods and the engineering of full-scale structures using robotic manufacturing were a primary focus of the workshop. Three ABB industrial robots from REX|LAB were used for on-site fabrication. The workshop was taught by Andrei Gheorghe (Die Angewandte Vienna) along with Georg Grasser, Kadri Tamre, Thibault Schwartz (TU Innsbruck) and guest experts: Clemens Preisinger, Moritz Heimrath, Robert Vierlinger, Arne Hoffmann (Bollinger+Grohmann Engineers). Participating students included: Lu Jiaxing, Rhina Portillo, Matthias Urschler, Maria Valente, Yi Lin Vincent and Matea Ban.

STRUCTURAL PERFORMANCE

Structural testing of PU foam mockups revealed a strong tension ability of the expanded material. Supporting points on the floor and suspension point on a moveable rack were defined locally taking into account the architectural site context. Possible connection lines between these points were optimized for internal bending moments using the structural plugin Karamba in combination with the genetic algorithm Galapagos.
INTRINSIC MATERIAL QUALITIES
The geometrically accurately defined design strategy reacts with loosely defined material behavior. The precise abilities of the robots correlate with the very uncertain geometrical condition entailing from the foam expansion process. This intuitive material behavior enriches the digital precision resulting in artifacts of one-time unique aesthetic design results. The experimental and final production of the structure, then merge in one single fabrication process.

FABRICATION PROCESS
A Grasshopper Definition was developed to extract four-point nodes and two-point connections from the final design network. HAL was used to compute specific tool paths for the three robots. A specific material mixture (PU foam, gypsum, water and hardener) developed at TU Innsbruck combined with precise time management was required to produce the structural nodes.

IMAGE CREDITS
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ANDREI GHEORGHE is an architect currently teaching as Assistant Professor at the Institute of Architecture/University of Applied Arts in Vienna at the interface of design & technology in architecture, structures and digital media. He studied at the Academy of Fine Arts Vienna and Harvard University, after being awarded the Fulbright Scholarship, 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 and Harvard Graduate School of Design (Career Discovery Program). Previously, he worked as an architect for international offices such as Jakob + MacFarlane, dEcoi and Foreign Office Architects.