Thermally Responsive Materials

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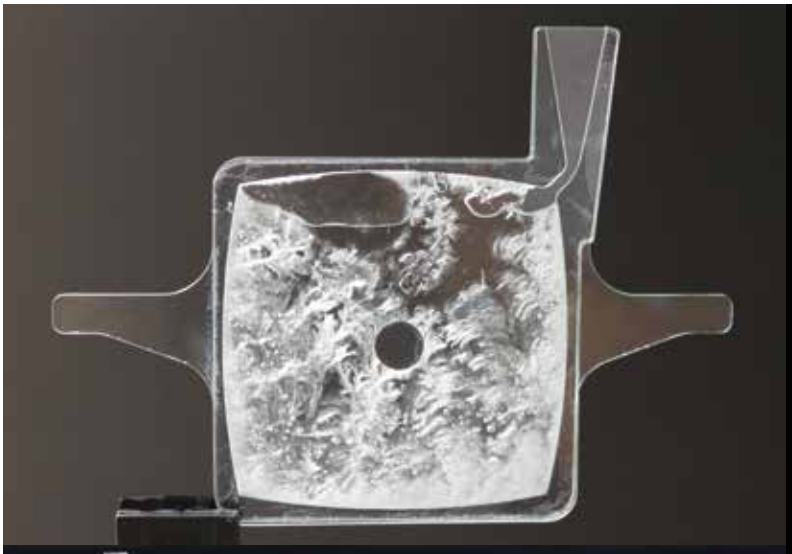
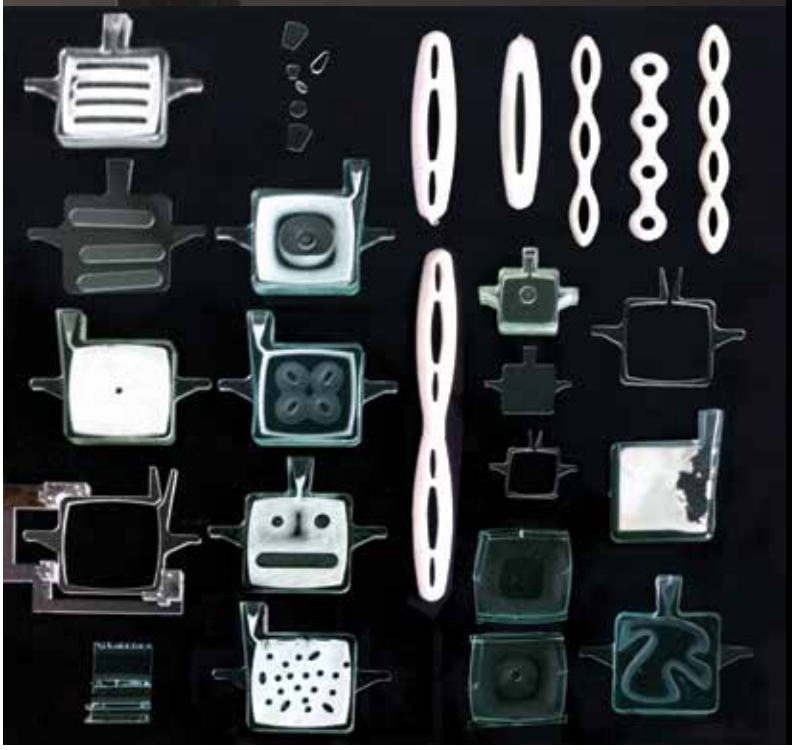
Presented are a series of design experiments that demonstrate the potential to make architecture more responsive to local temperature variation. Design examples are given of recent work with an emerging class of organic phase change materials (PCMs). PCMs are substances with a high heat of fusion and are capable of storing and releasing large amounts of latent heat. Two novel temperature stabilization devices are presented that address the problem of low thermal conductivity of organic PCMs and render the material more effective at thermal transfer. Each is designed to visually convey their operation and modulate temperature swings in interior environments. The devices are stand-alone systems for retrofit scenarios or for new construction. Implicit in each project is the visual demonstration of thermodynamic material properties that can make buildings more communicative of their operation and to building occupants. The application presented is a collaborative effort between architects, materials consultants, and engineers to help meet the energy petal of the Living Building Challenge for the Frick Environmental Center in Pittsburgh, PA.

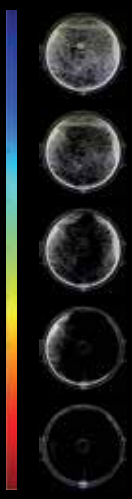
Broader questions are raised concerning the reinvention of our relationship with the natural world through the filter of architecture, materials and technology. The project speculates on the visual properties of responsive architectural systems and the ability of visualization to influence human behavior in response to awareness of local environmental change and energy usage.

Keywords: Phase Change Materials, Responsive Architecture, Thermal Transfer

The work is situated within an environmental center and designed to artfully engage children, inspire wonder, and get them to ask questions about the sustainable technology. On a personal scale, the thermal tiles are designed to be touched, the tiles register, and hold, the heat of the hand.







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Responsive Thermal Tiles

Faculty Advisors

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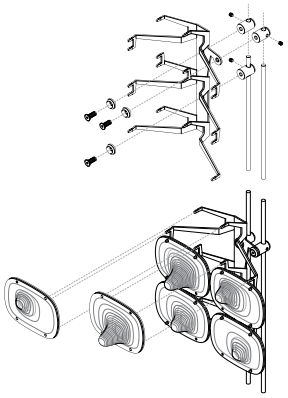
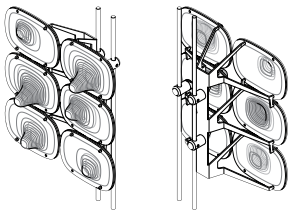
Our team introduced phase change materials (PCMs) to help meet the Living Building Challenge for the Frick Park Environmental Center in Pittsburgh, PA by Bohlin Cywinski Jackson. Our innovation is the design and engineering of a thermal battery system that lowers reliance on mechanical conditioning and provides a visual translation of thermal cycles to building occupants. By packaging PCM in thin transparent containers the Thermal Tiles optimize heat transfer between the material and the surrounding environment. As important, our work is situated within an environmental center and designed to artfully engage children, inspire wonder, and get them to ask questions about the sustainable technology. On a personal scale, the thermal tiles are designed to be touched, the tiles register, and hold, the heat of the hand. On the building scale, the tiles absorb solar energy during the day and release it in the evening.

The intent of the project is to visually augment our 'tactile' mode of thermal sensing and reopen pathways between people and the environment through heightened awareness of variation. The Thermal Tiles express naturally occurring material properties that contribute to lowering building energy consumption and occupant behavior. We've found that phase change materials exhibit crystalline patterns are similar to those found in snowflakes.

Most recent iterations were designed and fabricated by faculty and students of architecture at Cal Poly, San Luis Obispo



B1
MODULE
CONNECTIONS



B2
MODULE
ASSEMBLED