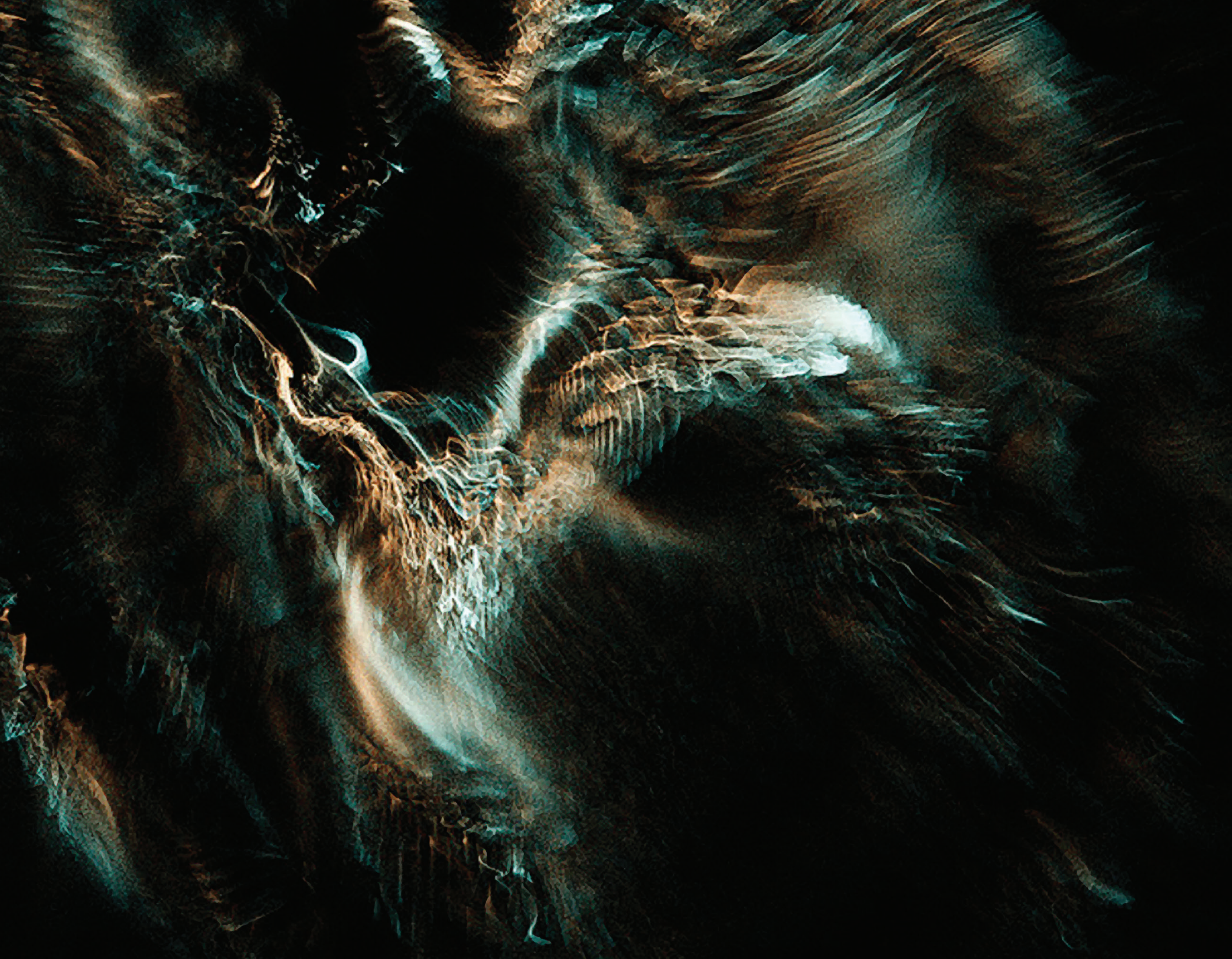

ACADIA // 2016

POSTHUMAN FRONTIERS: DATA, DESIGNERS, AND COGNITIVE MACHINES

Projects Catalog of the 36th Annual Conference of the Association for Computer Aided Design in Architecture

University of Michigan Taubman College of Architecture and Urban Planning, Ann Arbor

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Edited by Kathy Velikov, Sandra Manninger, Matias del Campo, Sean Ahlquist, Geoffrey Thün

TAUBMAN COLLEGE
architecture + urban planning
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PROJECTS

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Microtherme

Brandon Clifford
MIT / Matter Design

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Matter Design

1 Interior of *Microtherme* (Clifford, 2015, © Matter Design).

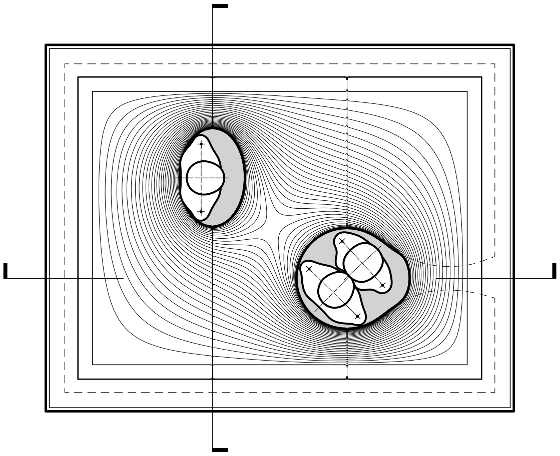
Architecture exists at the confluence of form, material, environment, and structure. While this odd set of bedfellows informs architecture, this overlay produces an experience for the occupant. *Microtherme* is a condensation of thermal and sensorial experiences that produces contradictions of conventional notions of comfort. Sitting adjacent to a burning fire on a cold night is a known comfortable experience, yet it does not fall within the ASHRAE standards of the 'Thermal Comfort Zone' (ASHRAE 2016)—a rather narrow definition that assumes continuity over difference. As described by Lisa Heschong, the human body is capable of, if not excited by, thermal extremities (Heschong 1979). In the conception of the Roman bath complex, occupants move from extremity (caldarium) to extremity (frigidarium), managing their own thermal delight. As opposed to a liquid bath, *Microtherme* is a radiant one that co-mingles extremities into singular thermal contradictions. It frames the occupants' experiences—from the act of rolling under a monolithic object to standing up inside the bath, the occupant is confronted with another world inside, thus producing the illusion and thermal experience of wading in a bath of voluptuous concrete. The experience of *Microtherme* is simultaneously a spatial and thermal set of contradictions.

PRODUCTION NOTES

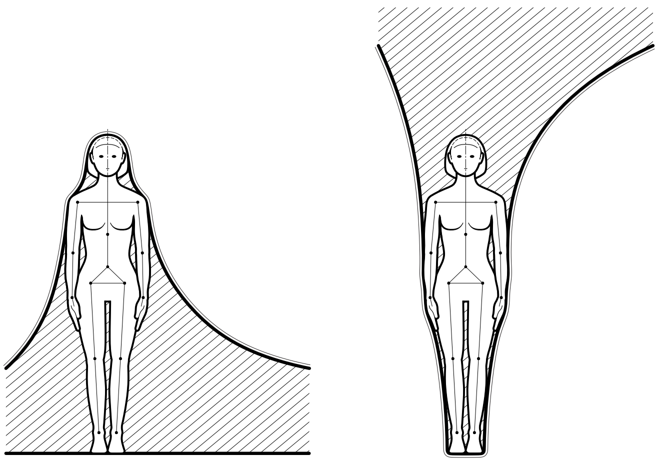
Architect:	Matter Design
Year:	2015
Site:	Boston, MA
Location:	BSA Space
Exhibition:	Bigger Than A Breadbox
Size:	7' X 8' X 8'
Materials:	GFRC, Birch Plywood

Spatial contradictions

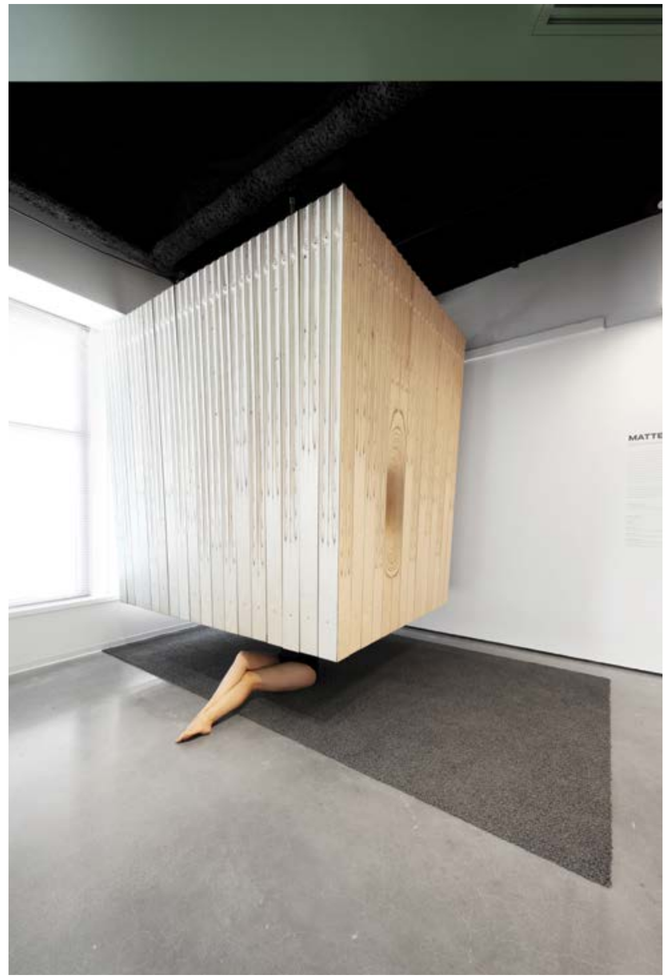
Upon approach, the visitor is confronted by a hovering wooden mass, punctured by a singular and limited port, enticing curiosity about the interior. This port is five inches wide; too small to enter, but large enough to peer inside and fit one arm into the interior to blindly feel around, experience



2 Plan (Clifford, 2015, © Matter Design).



3 Perceptual Rhetoric Diagram (Clifford, 2015, © Matter Design).



4 Exterior of *Microtherme* (Clifford, 2015, © Matter Design).

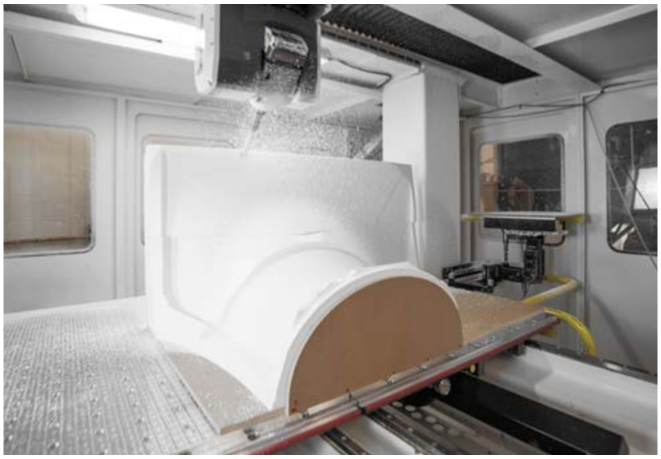
the temperature, and innocently grope other visitors. The visitor then rolls under the mass on a bed of carpet to experience a new materialization of a concrete mass rendered elastically. The mass is seventeen inches above the ground; the lowest dimension one can expect a person to roll under. From this vantage point, other people occupying the space appear to be draped in a concrete fabric, producing the illusion that the people themselves are supporting this engulfing mass. From this vantage, the visitor sees two possible standing locations. The first is a twenty-one inch diameter space at the waist, and the second is an ellipse; twenty-one by fourteen inches. The first larger space is large enough for a single person to stand inside, turn around, and share with another person. The second is large enough for a single person to stand within, but not to rotate. Each is relative to different manhole typologies. The previous dimensions are pulled from the work of Niels Diffrient and Alvin Tilley of Henry Dreyfuss Associates, which is commonly used in Architectural Graphic Standards (Ramsey 2000). Once standing inside one of these vertical spaces, the rhetoric of the human holding the concrete up is inverted. The form of the shell is a negotiation between accessibility of threshold and the ratio and distance of concrete to human skin.

Similar to Sigfried Giedion's three spatial concepts (Giedion 1971), the visitor transitions from an object to a canopy hypostyle and finally into a single enclosed space. By transitioning the visitor through these varieties of spatial conceptions, a game of perceptual inversion is played. This spatial experience is further compounded with radiant thermal conditions.

Thermal contradictions

Microtherme is plumbed (see fabrication) as an experiment to test thermal radiant comfort. It is thereby able to alter the surface temperatures between warm and cold. The geometries of the surfaces are created to average and maximize the surface area ratio for these different scenarios so an occupant is receiving equal parts hot and cold radiant temperatures. Regardless of the configuration, the air temperature is a constant room

5 Interior view of the upper space shared with another visitor (Clifford, 2015, © Matter Design).



6 5-Axis milling of the foam molds (McGee, 2015, © Matter Design).

7 View of the shell back side before cladding (Clifford, 2015, © Matter Design).

8 Detail of the assembly flanges (Clifford, 2015, © Matter Design).

temperature of 72 degrees Fahrenheit. The hot and cold radiant temperatures span the range of 120 degrees to 48 degrees, producing an average of 72 degrees. While these temperatures are quickly understood through touch, it takes about twenty seconds to receive that feedback with radiant temperature, producing an interesting lag in thermal experience. One scenario that was tested is to have all the upper surfaces cool and the lower surfaces warm. If below the concrete, one gets the experience of sun bathing, as almost all of the radiant surface percentage is warm. It is not until the visitor stands to receive the cool temperatures and balance the thermal range. This produces a theoretical average of 72 degrees, though the lower body is warm while the upper is cool; like bathing in a warm pool in the winter. Some people are less likely to stand, working under the common assumption that heat rises. The brave few that do are delighted with a thermal surprise. Another interesting configuration heats and cools from left to right instead of top to bottom. If in the small space, the visitor's back will begin to roast while the front will cool. Like being next to a fireplace, the occupant wants to rotate in order to roast another portion of their body—though physically impossible in this space. A negotiation occurs with the other occupant to exchange spaces. This thermal experience ultimately encourages a dynamic relationship between the occupant and the space. As with the roman bath complex, it requires motion in order to maintain comfort.

Fabrication

Microtherme is fabricated from an expanded polystyrene (EPS) foam mold that is coated in water-based surfacing compound. The mold is rough cut from a blank with a custom seven-axis robotic hot-wire, and then finish machined on an Onsrud five-axis mill. The mold is cast by spraying glass fiber reinforced concrete (GFRC) to a thickness of a half-inch. Copper tubing lines the backside of this GFRC shell and is encapsulated in more GFRC to transfer the temperature to the surface as warm and cold water passes through the tubing. The panels are discretized from the larger form; determined by weight, shipping volume, and the reach of the fabrication process. Around the perimeter

9 Interior view of the lower space shared with another visitor in the small vertical space (Clifford, 2015, © Matter Design).

of each panel, a four-inch flange serves to connect panels to each other. The global structure is hung from the gallery ceiling, with a compression beam above. This beam supports the load down through the wooden enclosure to grab a hold of the GFRC shell from the bottom. The upper perimeter of the geometry is not supported by the structure, rather serves as a lighting cove for the continuous lighting effect.

ACKNOWLEDGEMENTS

Microtherme is designed and fabricated by the authors (www.matterdesignstudio.com) with structural engineering by *Simpson Gumpertz & Heger* (www.sgh.com), lighting by Etta Dannemann, and environmental concept by Christoph Reinhart. Fabrication support by the *University of Michigan TCAUP FABLab* and the *MIT Rapid Prototyping Lab*. This project is funded in part by the *MIT Department of Architecture*, the *University of Michigan TCAUP FABLab*, the *Boston Society of Architects*, *Matter Design*, and the *SUTD-MIT International Design Centre (IDC)*. The project was exhibited in the *Bigger than a Breadbox Exhibition*. The surface relaxation computation employs Kangaroo (www.grasshopper3d.com/group/kangaroo) as the physics engine solver for the particle-spring system developed by Daniel Piker to work inside Grasshopper (www.grasshopper3d.com), a plugin developed by David Rutten for Rhinoceros (www.rhino3d.com), a program developed by Robert McNeil. The surface was generated through T-Splines (www.tsplines.com). The project team includes Myung Duk Chung, Cody Glen, Asa Peller, Maya Shopova, Tyler Swingle, and Luisel Zayas.

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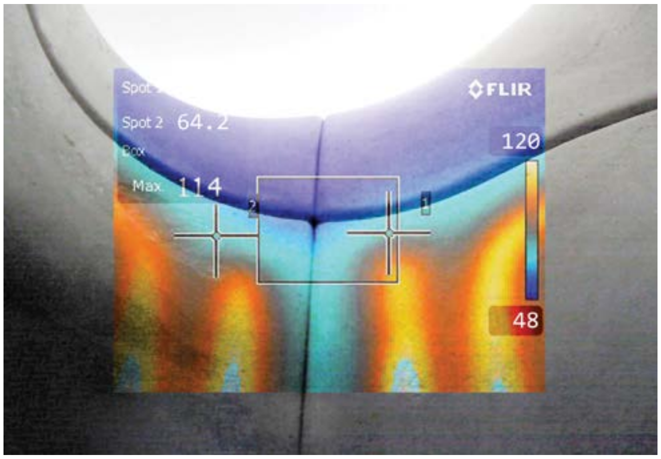
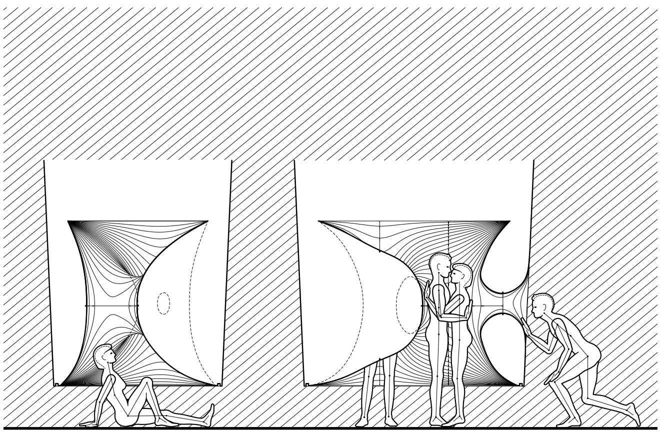


10 Thermal imaging exposing the temperature (Clifford, 2015, © Matter Design).



11 Sections (Clifford, 2015, © Matter Design).

12 Interior detail exposing the hand port (Clifford, 2015, © Matter Design).

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Brandon Clifford is an Assistant Professor at the Massachusetts Institute of Technology and Principal at Matter Design. Brandon received his Master of Architecture from Princeton University in 2011 and Bachelor of Science in Architecture from Georgia Tech in 2006. He worked as project manager at Office dA from 2006–09, LeFevre Fellow at OSU from 2011–12, and Belluschi Lecturer at MIT from 2012–16. Brandon has been awarded the Design Biennial Boston Award, the Architectural League Prize, as well as the prestigious SOM Prize. Brandon’s translation of past knowledge into contemporary practice continues to provoke new directions for digital design.

Wes McGee is an Assistant Professor in Architecture and the Director of the FABLab at the University of Michigan Taubman College of Architecture and Urban Planning. His work revolves around the interrogation of machinic craft and material performance, with a research and teaching agenda focused on developing new connections between design, engineering, materials, and process through the creation of customized software and hardware tools. As a founding partner and senior designer in the studio Matter Design, his work spans a broad range of scales and materials, always dedicated to re-imagining the role of the designer in the digital era. In 2012 Matter Design was awarded the Architectural League Prize.