ARCHITECT

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Diamond Schmitt Architects
Independent Architecture
LEFT Architects

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The Journal of the American
Institute of Architects

R+D Awards

10 Breakthroughs in Building Technology

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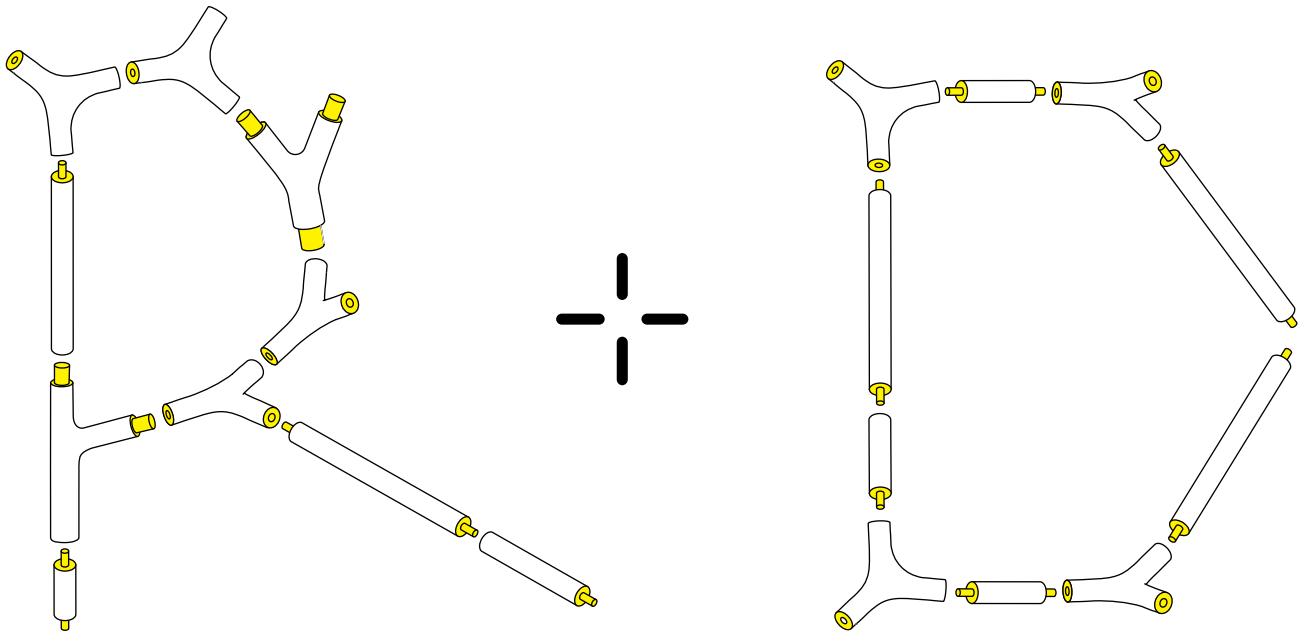
The 12th Annual



JURY

Jackilin Hah Bloom and **Florencia Pita**, founders and partners, Pita & Bloom
Tom Chung, AIA, principal, Leers Weinzapfel Associates
Randy Deutsch, AIA, clinical associate professor and associate director for graduate studies, University of Illinois Urbana-Champaign

AWARDS

EDITED BY WANDA LAU
DESCRIPTIONS BY CLAY RISEN

For this year's R+D Awards jury, it was not enough for prospective winners to ask the right questions, divest their savings, lose sleep, try, fail, and try and fail again in order to finally—finally!—reach a viable solution. Indeed, says juror Randy Deutsch, AIA, "if the result is not beautiful and/or elegant, even if it's really good for the environment and good for people, it hasn't gone quite far enough."

Which is to say that the bar was set extremely high for this year's slate of five citation and five honorable mention recipients. Beyond communicating their purpose and process to near perfection, the multidisciplinary teams tackled a range of topics—from material health to automation and ecology—and showcased, as juror Tom Chung, AIA, put it, "what value architects and designers bring in this world."

This project opens new territory for a material that has connections to art, to architecture, and to the domestic space. This is a novel way of working with felt and it has many applications.

Juror Florencia Pita

This Page: Quilted acoustic panels

Opposite: Robotic head and end effector applying felt in a shiplap technique onto a curved substrate

• CITATION

Robotic Needle Felting

Binding thermoplastic textiles was already familiar territory for **Tsz Yan Ng**, an assistant architecture professor at the University of Michigan, so she turned to the newfound possibilities offered with needle felting, the age-old process whereby a barbed needle pushes through layers of fabric and, as it pulls back, entwines the threads and thus the layers, uniting the plies.

Ng wondered whether she could integrate this low-tech process with robotic manufacturing to create a more efficient way to produce complicated needle felting. But getting the robotics to execute the inherently simple actions was deceptively difficult. "A lot went in to tuning the process, and making the needle bind correctly," she says. "We went through a lot of trial and error."

The result, developed by Ng and her team at the Taubman College of Architecture and Urban Planning's Digital Fabrication Lab, directed by Wesley McGee, is an additive process somewhat analogous to 3D printing: A robotic head equipped with a needle is fed a strip of felt that it then lays out and attaches onto a foam substrate.

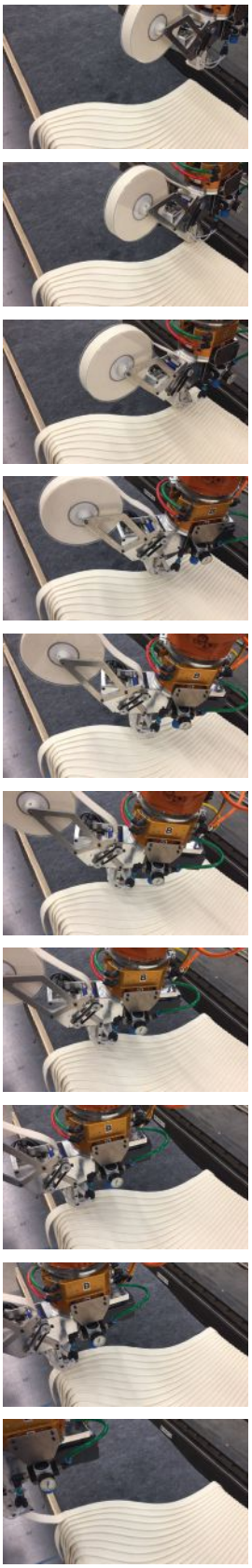
"Integration into a robotic process not only enables precision and speed in manufacturing but also extends needle felting as a 3D process, especially for surfaces with complex geometries," Ng and her team wrote in their submission. Because the robot arm can move in multiple directions and angles, it can create complicated fabric topographies all without thread or glue, making the process environmentally friendly and visually captivating.

Ng focused on three methods of needle felting: quilting, or the binding of two similarly sized felt sections; shiplap, in which entire felt strips successively overlap; and shingling, in which individual felt pieces are laid down, each partially over the previous. Depending on the method deployed, the robot can complete up to several inches a second.

Even without glue or thread, the binding between each layer is incredibly strong. "There are hundreds of fiber interactions per square inch," Ng says.

Possibilities for the technology abound, she adds. "If you look at most acoustic treatments, they're pretty generic," she says. "So there's a lot of potential there." The process can also bind conventional felt over a substrate of insulation, creating a finished insulative surface. A third application would be the incorporation of needle-felted fabrics into furniture or wall treatments.

And Ng is investigating what happens when different types of felt, bound together, are heated. "Once baked, felt creates a different curvature and form with a slight stiffness—and that has all sorts of potential," she says. "Right now, we're testing it to see how far we can push it as a structural element."



TSZ YAN NG

Project Credits

Functional Façade, Emma and Georgina Bloomberg Center, page 100
Client: Cornell University
Design Firm: Morphosis, Culver City, Calif. · Thom Mayne, FAIA (design director); Ung-Joo Scott Lee, AIA (project principal); Luke Yoo (project architect); Nicolas Fayad, Edmund Ming Yip Kwong, Jerry Figurski, Jean Oei (project designers); Chloe Brunner, Debbie Chen, Chris Eskew, Stuart Franks, Farah Harake, Clayton Henry, Ted Kane, Hunter Knight, Ryan Leifield, Simon McGown, Brian Richter, Go-Woon Seo (project team); Cory Brugger, ASSOC. AIA, Kerenza Harris, Stanley Su (advanced technology); Fiorella Barreto, Christopher Battaglia, Marco Beccuci, Paul Cambon, Vivian Chen, Tom Day, Justin Foo, Yong Fei Gu, Yoon Her, Sean Kim, Jognwan Kwon, Matt Lake, Sangyun Lee, Haidi Liu, ASSOC. AIA, Eric Meyer, Nicole Meyer, Jason Minor, Michelle Park, Vincent Parlatore, Conway Pedron, Danny Salamoun, Ben Salance, Suzanne Tanascaux, Matthew Tarpley, Ben Toam (project assistants); Stuart Franks, Jasmine Park, Nathan Skrepcinski, Sam Tannenbaum (visualization)
Façade Construction: A. Zahner Co.
Façade Consultant: Arup
Façade Coating: PPG
Structural Engineer: Arup
M/E/P Engineer: Arup
Fire Protection Consultant: Arup
Sustainability Consultant: Arup
Cost Estimator: Dharam Consulting
Geotechnical Engineer: Mueser Rutledge Consulting Engineers
Lighting Design: Arup
Acoustics: Arup
Audiovisual/IT/Security/Smart Building: Arup
Code Consultant: Code Consultants, Inc.
Specifications: Construction Specifications Institute
Waterproofing Consultant: Henshell & Buccellato
Food Services Consultant: Jacobs Doland Beer
Graphics and Signage: Pentagram
Visualization: Kilograph
Collaborating Artists: Matthew Day Jackson, Michael Riedel, Matthew Ritchie, Alison Elizabeth Taylor
General Contractor: Barr & Barr
Preconstruction Construction Manager: AECOM Tishman
Owner's Representative: Forest City Realty Trust

Buoyant Ecologies Float Lab, page 102
Design Firm: Architectural Ecologies Lab, California College of the Arts, Oakland, Calif. · Adam Marcus, AIA, Margaret Ikeda, Evan Jones, Taylor Metcalf, Georine Pierre, Jared Clifton (project team)
Research Partners: Benthic Lab; Moss Landing Marine Laboratories · John Oliver, Kamille Hammerstrom, Daniel Gossard
Fabricator: Kreysler & Associates
Naval Architecture & Engineering: Tri-Coastal Marine · Andrew Davis
Funding: Miranda Leonard, Kreysler & Associates, Ashland, Autodesk Pier 9 Workshop, Port of Oakland
Special Thanks: Jonathan Massey, AIA, Lisa Findley, Stephen Beal, Tammy Rae Carland, Karen Weber
Size: 120 square feet

The Precautionary List, page 106
Design Firm: Perkins+Will, Dallas · Mary Dickinson, ASSOC. AIA, Monica Kumar, Suzanne Drake, Breeze Glazer, Brodie Stephens, French Clements, Max Richter, Robin Guenther, FAIA, Paula McEvoy, FAIA, Phil Harrison, FAIA, John Haymaker, AIA, Joel Register, Murali Selvaraj, Derek Veren, Tina Lam, Kate Doornbos, Dylan Dechant, Veera Kumar, Andrew Salveson (project team)
Researcher: Melissa Coffin
Research Partner: Healthy Building Network · Michel Dedeo, Jim Vallette, Bill Walsh, Tom Lent
Fabricator: Perkins+Will
Funding: Perkins+Will
Special Thanks: All manufacturers that provide transparent disclosure of their product content, all owners that support product transparency as a part of project goals, the design community, users of Perkins+Will's Transparency website

Here East Gantry, page 108
Design Team: Hawkins\Brown Architects, London · Nick Gaskell, Jack Stewart, Andrew Hills (project team); Architecture 00, London · David Saxby, Ryan Mcloughlin (project team)
Partner: WikiHouse · Clayton Prest
Fabricator: Leisure Technique
Structural Engineer: Momentum
M/E/P Engineer: Cundall
Size: 10,800 square feet

Thinness, page 112
Design Firm: Aptum Architecture, Syracuse, N.Y. · Roger Hubeli, Julie Larsen, ASSOC. AIA (project team)
Industry Partner: Cemex Global R&D · Davide Zampini, Alexandre Guerini, Jeremy Esser, Matthew Meyers (project team)
Research Assistants: Sean Morgan, Ethan Schafer
Fabricator: Cemex Global R&D
Structural Engineer: Sinéad Mac Namar
Size: 100 square feet

Robotic Needle Felting, page 116
Design Team: University of Michigan Taubman College of Architecture and Urban Planning, Ann Arbor, Mich. · Tsz Yan Ng, Wesley McGee, Asa Peller (project team); Rachel Henry (research assistant); Jared Monce, Drew Bradford, Carlos Pompeo (production assistants)
Funding: 2018 Taubman College's Research Through Making grant program, University of Michigan, and the University of Michigan Office of Research's Small Scale and Preliminary Projects grant

Robotic Needle Felting

Limb, page 118
Design Team: Archolab, Ann Arbor, Mich. · Steven Mankouche; University of Michigan Taubman College of Architecture and Urban Planning · Peter von Bülow; Kase Studio, Ann Arbor, Mich. · Kasey Vliet
Research Assistants/Partners: Robert Allsop, Kevin Bukowski, Cody Gilman, Andrew Thompson, Omid Torghabehi, Benjamin Wichman, Shaobo Niu
Funding: University of Michigan Taubman College, University of Michigan Office of Research
Special Thanks: 2017–2018 Taubman College's Research Through Making grant

Social Sensory Architectures, page 122
Designer: University of Michigan Taubman College of Architecture and Urban Planning, Ann Arbor, Mich. · Sean Ahlquist (assistant professor)
Project Team: University of Michigan Medicine Department of Psychiatry · Costanza Colombi; University of Michigan School of Kinesiology· Leah Ketcheson; University of Michigan Taubman College · Oliver Popadich
Research Assistants: Shahida Sharmin, Jordan Turkomani; Roujia Bai, Sommer Cade, Yichen "Janet" Dong, Grace Earl, Teruaki "Aki" Hara, James Hartman, Chang Liu, Giovanni Martinez, Mariana Moreira de Carvalho, John Spellman, Peyton Steurer, Mingyang Xia, Yiwen Yan (architecture students); Erika Goodman, Erin Almony (kinesiology students)
Fabricator: Sean Ahlquist
Yarn Supplier: McMichael Mills
Glass Fiber Reinforced Polymer Material Supplier: Goodwinds
Funding: University of Michigan Taubman College, University of Michigan MCubed Third Century Initiative, Michigan Economic Development Corp., Stoll
Special Thanks: Spectrum Therapy Center · Mary Burke, Tabitha Wisecup; Thinkery · Robin Gose; Str.ucture · Julian Lienhard
Size: 25 to 150 square feet

MineralBuilt, page 124
Design Firm: Gomes + Staub, Austin, Texas · Francisco Gomes, AIA, Dabney Staub
Research Assistants/Partners: Hannah Bacon, Hugo Reynolds, Clare van Montfrans, Ryan McKeeman, Shelley McDavid, AIA
Fabricators: Featherlite Building Products, Dynco Manufacturing, W2 MacFab
Funding: National Science Foundation I-Corps, University of Texas at Austin, Gomes + Staub, MineralBuilt
Structural Engineer: Architectural Engineers Collaborative · Charles Naeve
Intellectual Property Attorney: Meunier Carlin & Curfman · Meredith Struby
Special Thanks: University of Texas at Austin Office of Technology Commercialization · Trevor Hrynyk; Besser, World Center for Concrete Technology

Hydroformed Shading, page 126
Client: Harvard University
Design Firm: Behnisch Architekten, Stuttgart, Germany
Collaborators: Knippers Helbig, Josef Gartner, Edelstahl-Mechanik
Façade Consultant: Knippers Helbig
Façade Contractor: Josef Gartner
Fabricator: Edelstahl-Mechanik
Structural Engineer: BuroHappold Engineering
M/E/P Engineer: van Zelm Heywood & Shadford
Civil Engineer: Nitsch Engineering
Geotechnical Engineer: BuroHappold Engineering
Construction Manager: Turner Construction Co.
General Contractor: Turner Construction Co.
Landscape Architect: Stephen Stimson Associates Landscape Architects
Lighting Designers: Bartenbach, Lam Partners
Interior Designer: Behnisch Architekten