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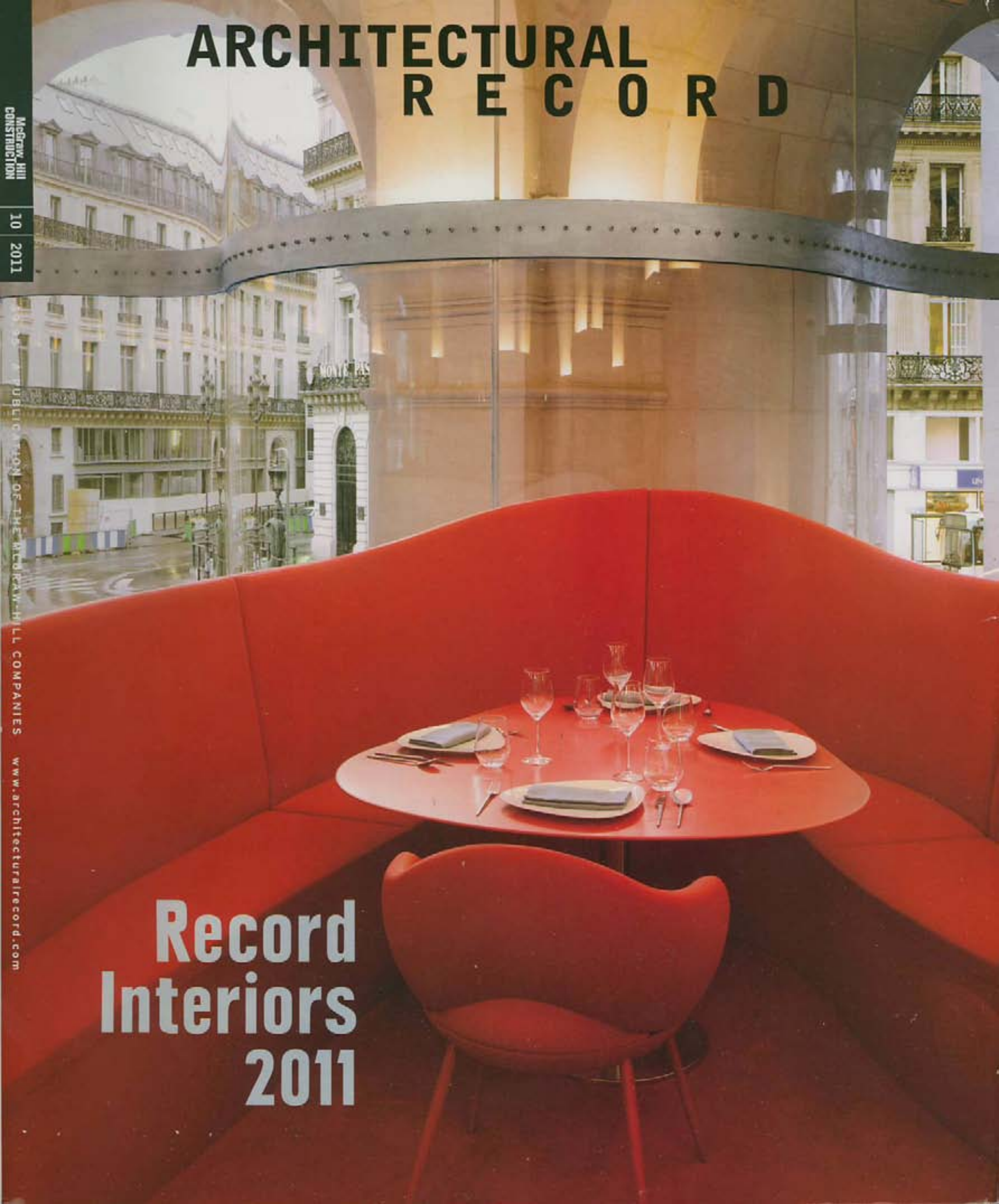


Record Interiors 2011

A FETISH FOR FABRICATION

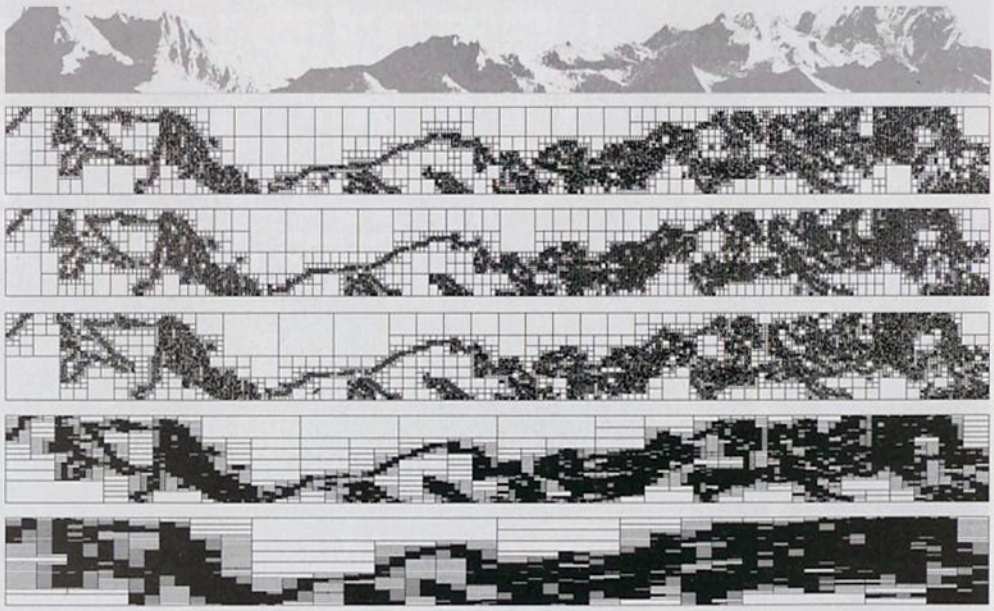
In digitally sophisticated Los Angeles, the Southern California Institute of Architecture's new Robot House ups the ante. By Russell Fortmeyer

THE ARCHITECTS PETER TESTA and Devyn Weiser like to point out that the robotic Stäubli instruments installed last spring in the new Robot House at the Southern California Institute of Architecture (SCI-Arc), in Los Angeles, are not people. For that matter, the Robot House is not a house, but rather a converted double-height space at the south end of SCI-Arc's main building. The room has two glass walls and a catwalk overhead, which allow students to view the robots in action.

Testa and Weiser, partners in the firm Testa/Weiser and faculty members at SCI-Arc, initiated the school's partnership with Stäubli and oversaw the Robot House's design and construction. The five robots in the facility, along with a sixth, much smaller one in an adjacent classroom, range in weight from 60 to 550 pounds and can handle loads of up to 75 pounds, moving as fast as 35 feet per second. They might not be people, but they may well populate the next frontier of digital design.

Similar models of robots build cars, process pharmaceuticals, and perform surgery, guaranteeing precision and consistency. In architecture, robots have mostly been used individually to "pick and place" materials, such as bricks. But with multiple robots, designers can investigate movement, choreography, and collaboration, providing an alternative to the typical linear sequence of design and programming, followed by fabrication and construction. "We consider the robots a real-time design and construction platform," explains Testa. Robots offer a way of getting beyond the computer screen, which doesn't account for gravity or material properties. "We wanted to move on to something more tangible and interactive," he says. Robots could also enable free-form fabrication, minimizing or eliminating the use of molds. This summer, Weiser taught the first seminar using the robots, called Robotic Confections and Confabulations, or RoCoCo, while Testa's earlier XLab studios at SCI-Arc had speculated on their potential use.

Contractors and other schools have robots as part of fabrication shops. Machineous, a Los Angeles–based fabricator, has a six-axis robot in its stable of equipment that was used to cut the tri-lobe-shaped plastic "bricks" for architect Greg Lynn's Blobwall for Panelite in 2007.



For the eatery Earl's Gourmet Grub, FreelandBuck created a mural made of white maple veneer laminated onto standard sheets of medium-density fiberboard. To develop the mural's low relief, the architects digitally translated a photograph of an Alpine landscape into a gridlike pattern. They then worked with fabricator Joe Cooper to set the tool path for the CNC machine. They programmed it to make cuts in the direction of the grain first, to avoid chipping or splintering the veneer.

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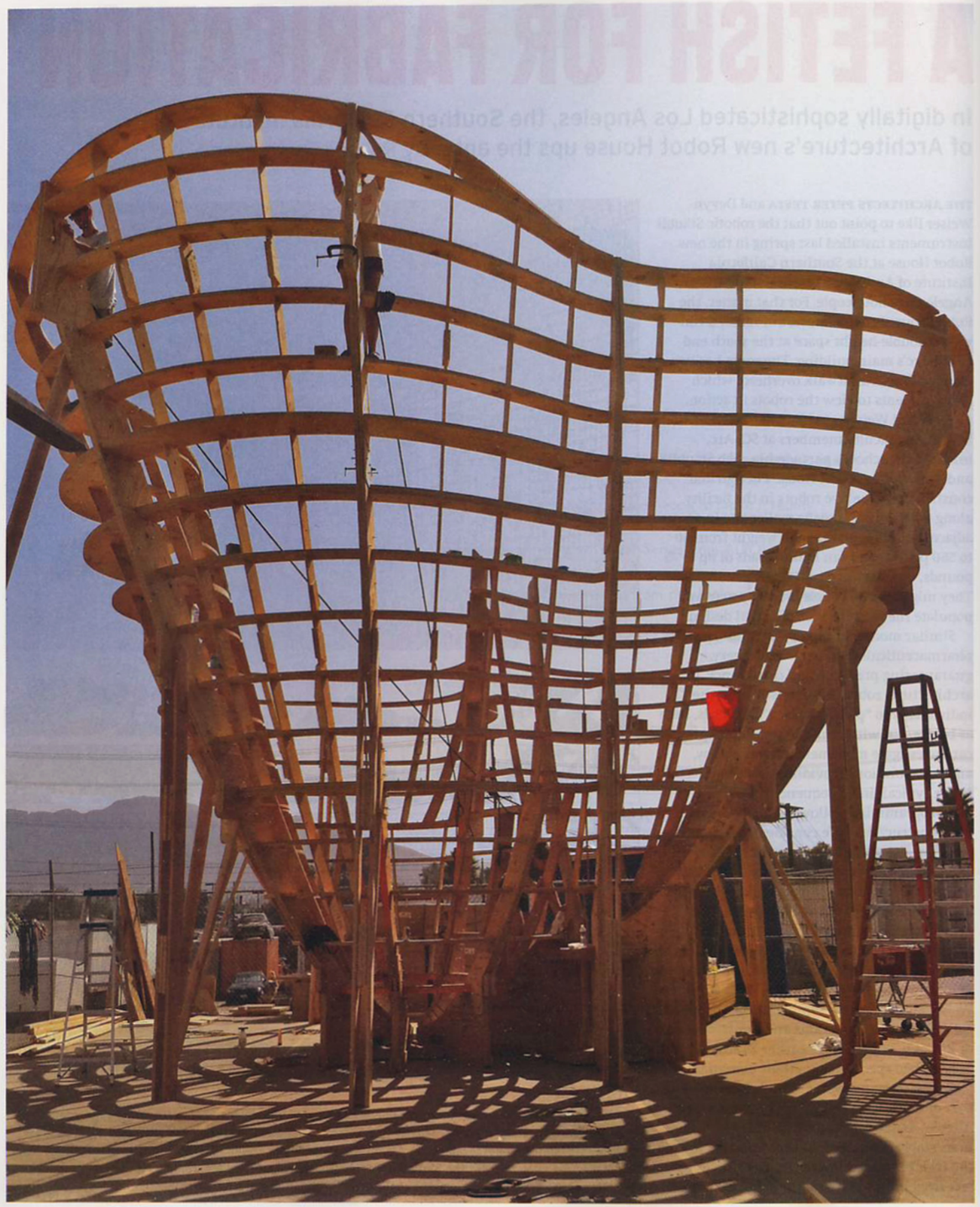


PHOTOGRAPHY: © LAWRENCE ANDERSON

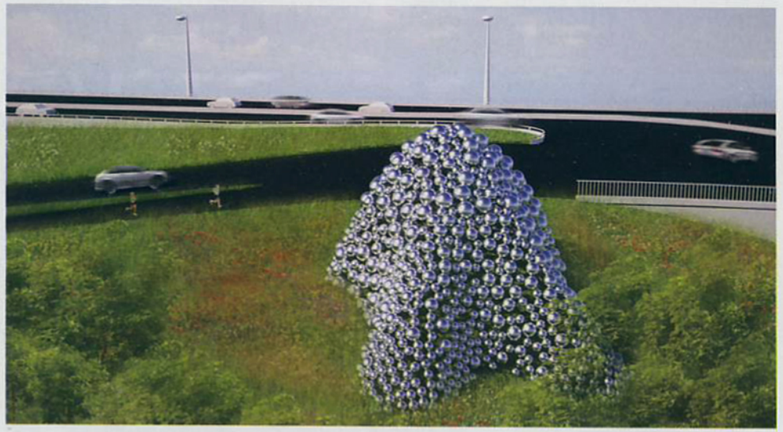
RENDERINGS: COURTESY BALL-NOGUES

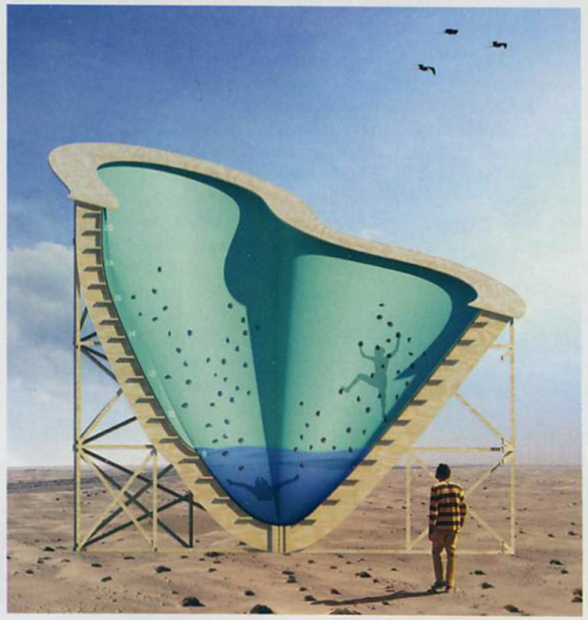
A six-axis robot can move in the typical X-Y-Z planes but also rotate 360 degrees around an object. If robots are not new, they represent the next phase in the fascination with digital design and fabrication that has defined some of Los Angeles' most progressive architectural practices. Twenty years ago, computer numerical control (CNC) milling machines, which typically consist of large beds with a vertical spindle that can cut material based on programming input, were not common in architecture schools, let alone in commercial practice. High-profile local projects such as Gehry Partners' Walt Disney Concert Hall, which opened in 2003, helped change the situation. The approximately 8,000 wood panels and components inside the hall were fabricated using a CNC mill with digital files created by the architects.

Although some architecture offices have their own CNC equipment, most work with a fabrication shop. The Los Angeles– and New York–based practice FreelandBuck collaborated with Los Angeles fabricator Joe Cooper for a mural installed in Earl's Gourmet Grub on Venice Boulevard (see story, page 88). Cooper's first step with any project is to clean up architectural CAD files, connecting lines or deleting offsets, as mills require exact instructions. He then converts them into a Mastercam file, which he uses to produce the so-called "G code" that runs the mill's controller. "There's no room for mistakes," Cooper says. "Whatever I program is exactly what it will do." He then sets up a tool path that directs where and how fast the mill will cut.

For Earl's, FreelandBuck created the design for the mural, which consists of maple veneer laminated onto standard sheets of medium-density fiberboard, based on a photograph the client had provided showing a mountain landscape. With the software Maya, the architects translated the image into a grid that resembled a topographic map, with darker tones indicating a denser grid. They then translated this into a Rhino file to send to Cooper. The architects worked with Cooper to set the tool path, programming the mill to make cuts in the direction of the veneer's grain first in order to minimize chipping or splintering. It took less than four days to mill the 60-foot-long mural.

If FreelandBuck's work in digitized architectural surfaces represents one mode of practice in Los Angeles, the art installations of the Ball-Nogues Studio represent another. Architects Benjamin Ball and Gaston Nogues, two SCI-Arc graduates, started working together in 2004. Ball had worked for Gehry before pursuing set design for film productions, while Nogues had spent much of his career working in digital design for Gehry. (Ball says "everyone in L.A. is standing on





Ball-Nogues Studio is building a CNC-milled plywood frame (opposite) that will mold 2,000 stainless steel spheres into Talus Dome—a public art piece for the City of Edmonton, Alberta (above). After the dome's fabrication, the studio plans to install the frame at a site near Yucca Valley and convert it into an elevated "crater" filled with water (left).

Continuing Education

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Learning Objectives

1 Identify methods for digital form finding and fabrication.

2 Outline fabricators' processes for working with architects' digital files.

3 Discuss applications for robotics in architectural design and fabrication.

4 Identify some of the programming languages that support robotic fabrication.

AIA/CES Course #K1110A

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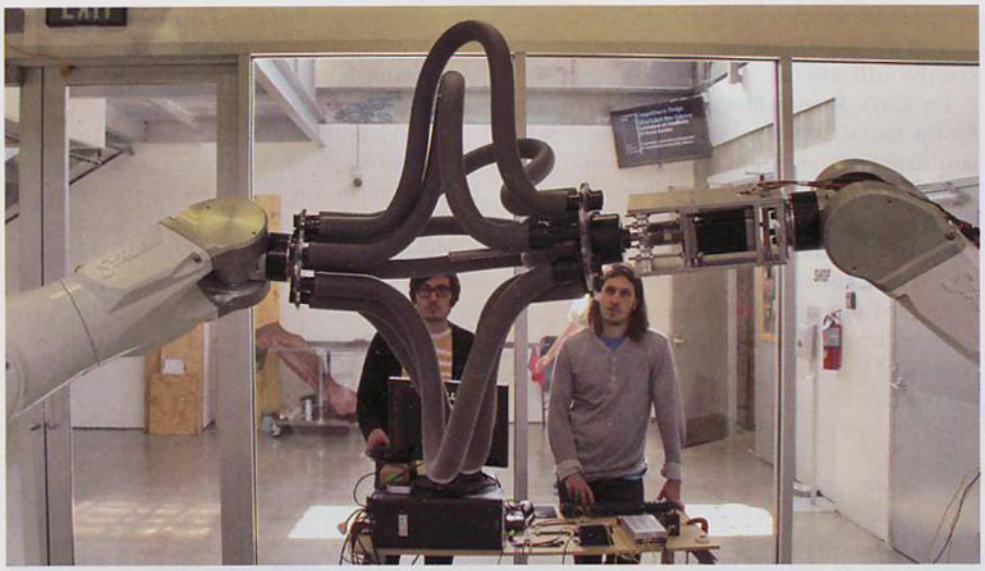

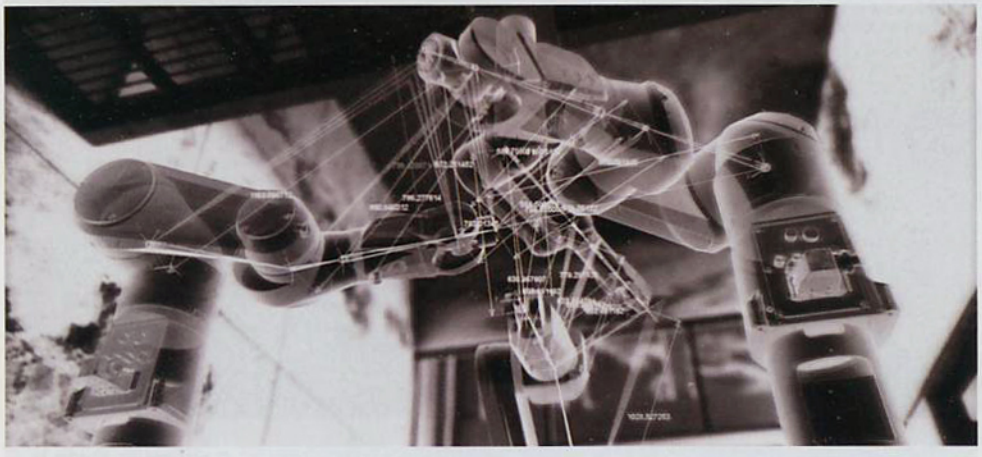

In a seminar held this past summer in SCI-Arc's Robot House (above), students conducted various activities with robots, including deforming materials (above, left). In preparation for one final group demonstration, they created an algorithm that calculates the distance between the robots' arms, helping coordinate movement (left).

Gehry's shoulders.") The architects are fabricating a public art piece they will install in Edmonton, Alberta, later this year. Called Talus Dome, the installation consists of approximately 2,000 stainless steel spheres that range from 8 to 30 inches in diameter and are interconnected and self-supported in place.

Ball and Nogues used their own CNC mill to fabricate the timber frame that will serve as the dome's mold. If all goes as planned, the freestanding, self-supported 30-foot-tall mold will then be reused as an elevated aquatic basin for a proposed project called Yucca Crater to be installed near Yucca Valley, California, for the nonprofit arts group High Desert Test Sites.

To create the dome—which Ball describes as a happy medium between a pile of sand and a parabolic sphere—the architects are lining the frame with thin plywood and stacking the spheres along the interior surface. "We have not been able to find a piece of software to predict with any accuracy how these spheres will stack," says Nogues. Steel connector plates, bent into U-shapes on molds cut out by the CNC mill, will then be welded to adjacent spheres to hold them in place. The dome will be fabricated in sections to allow it to be transported to Canada and assembled on-site, with no internal support mechanisms. Next year, Ball and Nogues are scheduled to undertake an installation at SCI-Arc using the Robot House. Ball has jokingly suggested that the robots be fitted with chain saws.

There were no chain saws in Weiser's summer seminar. In fact, there were few physical objects created. Instead, the students used the robots to explore synchronous movement, projection, sonic environments, weaving, and material deformation. "The Robot House is not an extension of the shop," explains Testa. "It is a design environment."

One of the key achievements of the seminar and the prior SCI-Arc studios was the creation of an interface between the VAL-3 programming language that controls robots and the architectural modeling software Maya. As part of their final presentation, M.Arch students Brandon Kruysman, Jonathan Proto, and Curime Batliner used this software platform to produce a choreographed demonstration with three synchronously moving robots, attempting to coordinate movement, sound, and other variables. Two robots held projectors displaying video on the walls, while the third robot filmed the event. The students created an algorithm-based program that determined the distance between the two projection robots to modulate the tone and frequency of an ambient sound track. Each student manually controlled the preprogrammed sequence of an individual robot, resulting in a few near-collisions.

Testa expects that the tools will eventually be sophisticated enough to enable designers to tightly control the work spheres of multiple robots in complex spatial conditions. This would set the stage for robots moving out of the factory and onto the construction site, ultimately allowing a much more adaptive and responsive design environment, where both architect and client can evaluate outcomes in real time. ■

PHOTOGRAPHY: COURTESY SCI-ARC