RAEL SAN FRATELLO
2200 Adeline Street, Suite 340
Oakland, CA 94607
+1 510 207 8620

www.rael-sanfratello.com
www.emergingobjects.com

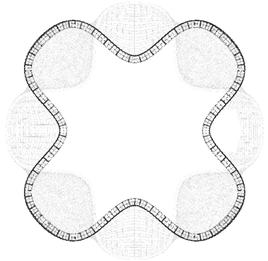
BLOOM: 3D Printed Room

Project Date: 2015
Project Team: Ronald Rael, Virginia San Fratello, Kent Wilson, Alex Schofield, Sofia Anastasiou, Stephan Adams, Yina Dong, Ari Oppenheimer

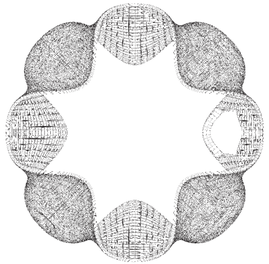
The Bloom Room is the first powder based 3D printed cement architecture in the world.

Bloom is a 9 foot tall freestanding pavilion with a footprint that measures approximately 12 feet by 12 feet. It is composed of 840 customized blocks that were 3-D-printed using an iron oxide-free Portland cement polymer formulation. The pavilion represents a new paradigm in building construction methods. Each of the 3D printed blocks is enumerated for easy assembly and is structural, supporting the weight of the pavillion.

Fabricated using a farm of 11 3D printers, the completed structure has a variegated pattern that allows for varying amounts of light to pass through creating a distinct figural pattern, reminiscent in pattern and form of the traditional Tiebele mud houses of Ghana.



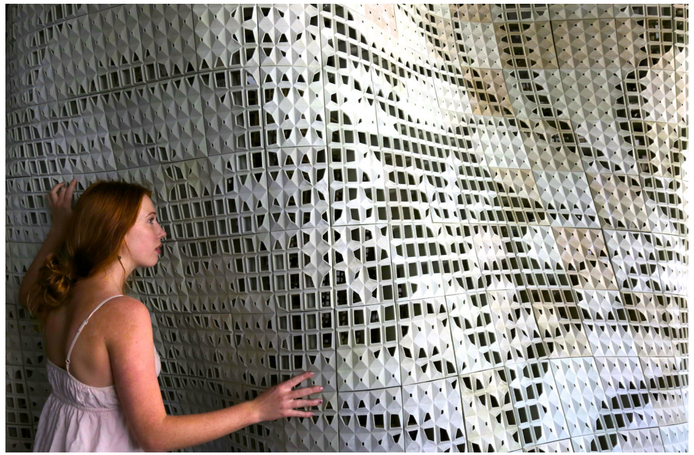
Floor Plan



Roof Plan

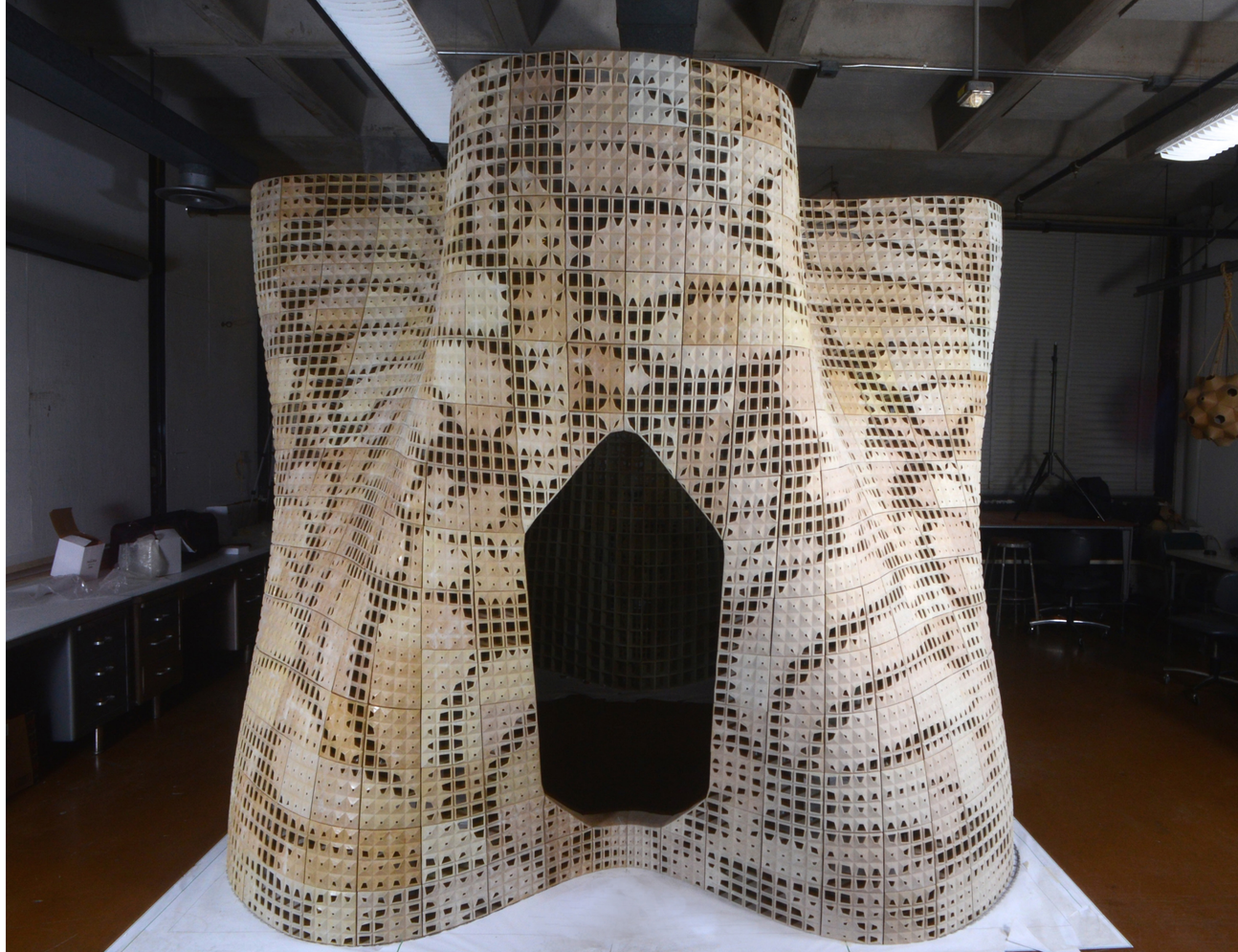
Tiebélé Building

Bloom at night



Black and White motif

3D Printed cement blocks



SALTYGLOO

Project Date: 2013
Project Team: Ronald Rael, Virginia San Fratello, Seong Koo Lee, Eleftheria Stavridi

The Saltygloo is an experiment in 3-D printing using locally harvested salt from the San Francisco Bay to produce a large-scale, lightweight, additive manufactured structures.

The Saltygloo takes its clues from the Inuit Igloo, both in form and concept. In the landscape of the San Francisco Bay Area natural power from the sun and wind, produce 500000 tonnes of sea salt each year. The salt is harvested from 109-year-old salt crystallization ponds in Redwood City. These ponds are the final stop in a five-year salt-making process that involves moving bay water through a series of evaporation ponds. In these ponds the highly saline water completes evaporation, leaving 8-12 inches of solid crystallized salt that is then harvested for industrial use. From this landscape, Rael and San Fratello theorize a new kind of architecture created through the lens of 3D printing and computer-aided design. The Saltygloo is made of a combination of salt harvested from the San Francisco Bay and glue, a “salty glue”, which makes an ideal 3D printing material, one that is strong, lightweight, translucent and inexpensive.

To build the Saltygloo, 336 translucent panels were 3D printed using this unique material invention. Each panel recalls the crystalline form of salt and is randomly rotated and aggregated to create a larger structure where all tiles in the structure are unique. The form of the Saltygloo is drawn from the forms found in the Inuit Igloos, but also the shapes and forms of tools and equipment found in the ancient process of boiling brine.

The panels are connected together to form a rigid shell that is further supported with lightweight aluminum rods flexed in tension, making the structure extremely lightweight and able to be easily transported assembled in only a few hours.

The translucent qualities of the material, a product of the fabrication process and the natural properties of salt, allow for natural light to permeate the space and highlight the assembly and structure and reveal the unique qualities of one of humankind’s most essential minerals.

The Saltygloo is on display at the Museum of Craft and Design in San Francisco as part of the New West Coast Design Exhibit.

boiling brine

crystallizer in Redwood City

SALT-Y-GLOO under construction

Construction in the studio

Single tile

Interior view

Interior

Single salt tile

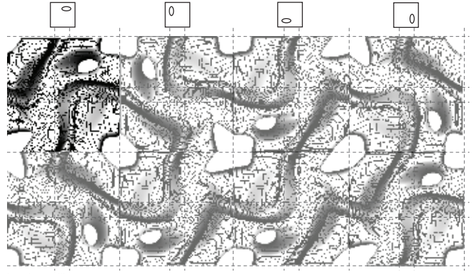
SALT-Y-GLOO at the Museum of Craft and Design

SEAT SLUG:
Developing 3D printing for the rapid manufacture of structural cement-polymer building components

Project Date: 2010
Project Team: Ronald Rael, Virginia San Fratello, Kent Wilson, NIck Buccelli, Emily Licht

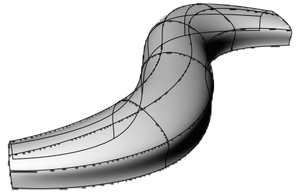
RSF has developed a cement-based polymer and a new process that,for the first time, employs conventional rapid prototyping hardware to produce strong and durable building components that cost far less than conventional rapid prototyping materials—up to 90% less than comparable powder printing materials. The material can also reach strengths of up to 4,700psi in compression. This advancement in material output from digital modeling software ushers in a new era in building materials, and a new synthesis of design and production.

The SeatSlug, a biomorphic interpretation of a bench, demonstrates how this new digital output process generates end-product structural building components directly from 3D software models. The design is inspired by flabellina goddardi, the newest species of sea slugs discovered in California in 2010, and by the infinite tessellations of Japanese karakusa patterns. It is constructed of 230 unique rapid-manufactured components.The sinuous form, subtle translucency and glossy finish engage viewers with a memorable aesthetic experience—a tactile personal encounter with a technological breakthrough.



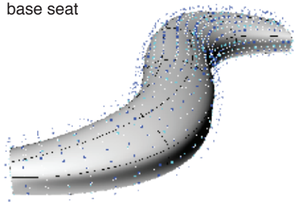
karakusa tiling pattern

offset point distribution

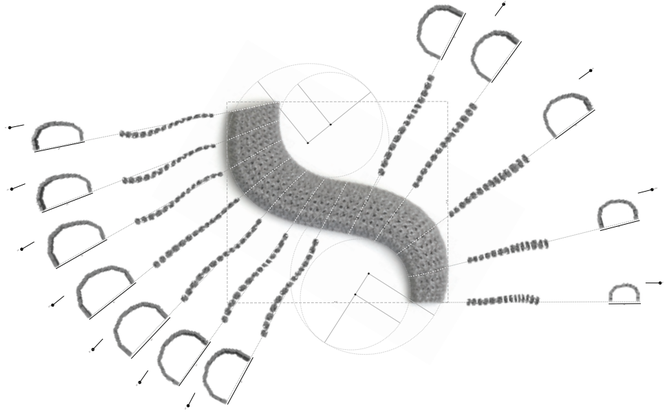


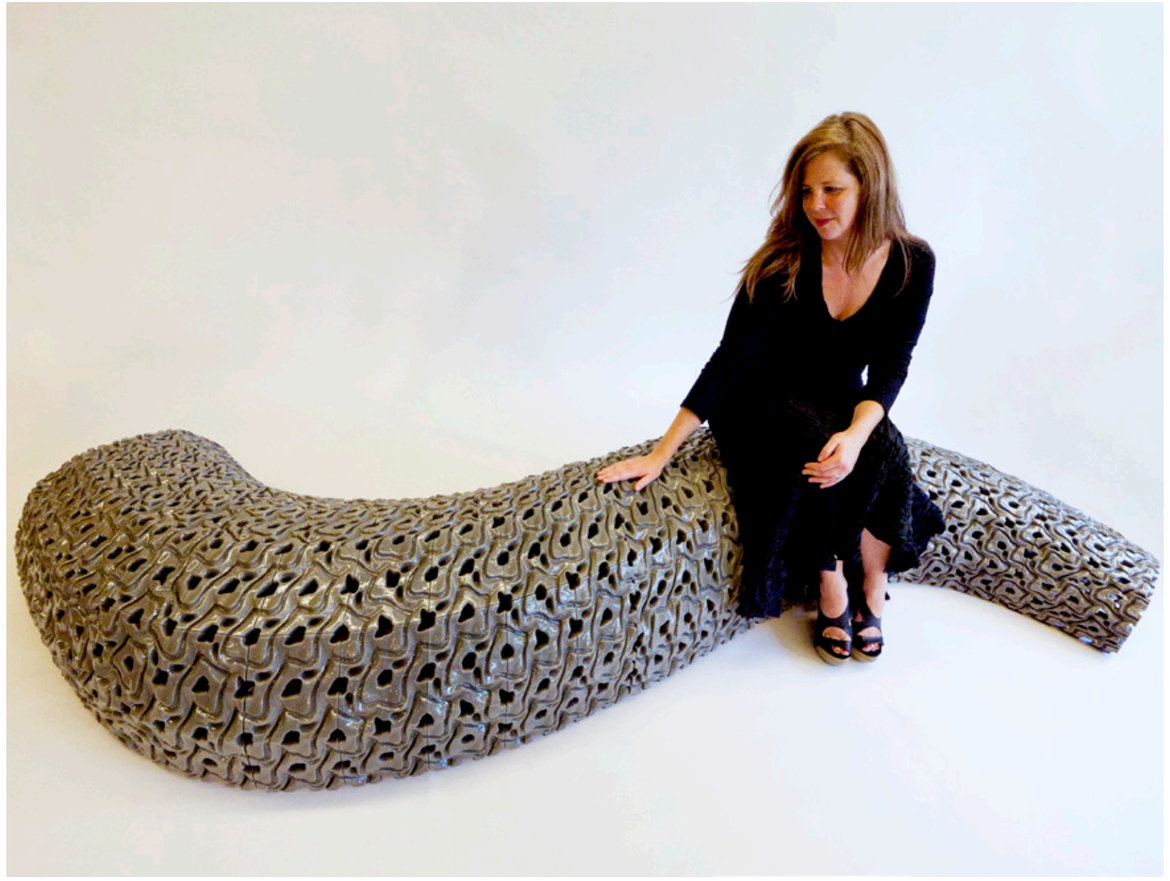
base seat

point distribution



base seat + point distribution for tiling





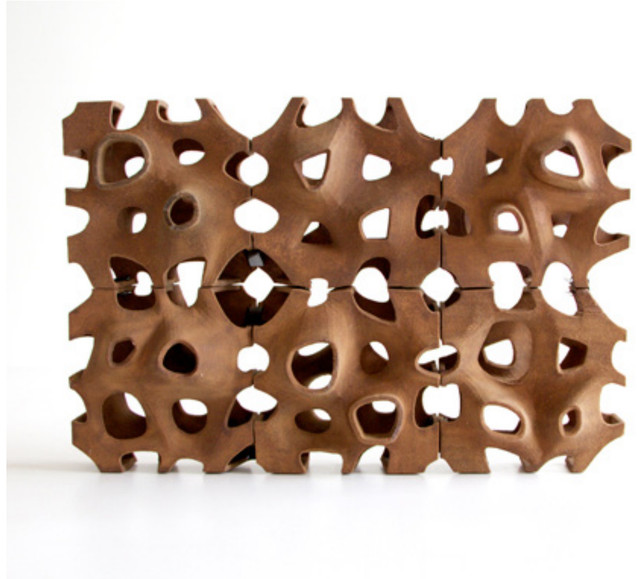
SAWDUST SCREEN

Project Date: FALL. 2013 / SPRING 2014
Project Team: Ronald Rael, Virginia San Fratello, Molly Wagner, Victoria Leroux

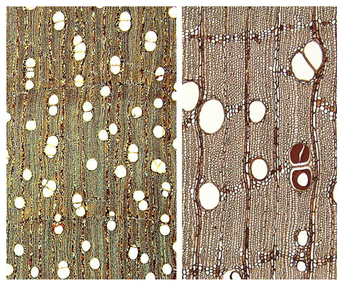
The Sawdust Screen is the outcome of research into the development of curtain wall and free standing structural wall systems using additive manufacturing technologies and wood-based materials. The Sawdust Screen is fabricated from 3D printed walnut and the surface retains the layering effect from the additive manufacturing process, which simulates natural wood grain. The screen is comprised of individual 3D printed wood components which are affixed together to form a variably dimensional enclosure and surface.

The Sawdust Screen is inspired by the vessels found in the microscopic analysis of wood anatomy in hardwoods. When viewed from the endgrain, vessels simply appear to be holes in the wood—what are commonly referred to as pores. In a live tree, vessels serve as the pipelines within the trunk, transporting sap within the tree.

In the Sawdust Screen, the vessels serve as an opportunity for visual porosity. The subtle curvature of each vessel accentuates the openings as convex or concave aperatures making the screen both a visual and haptic experience.

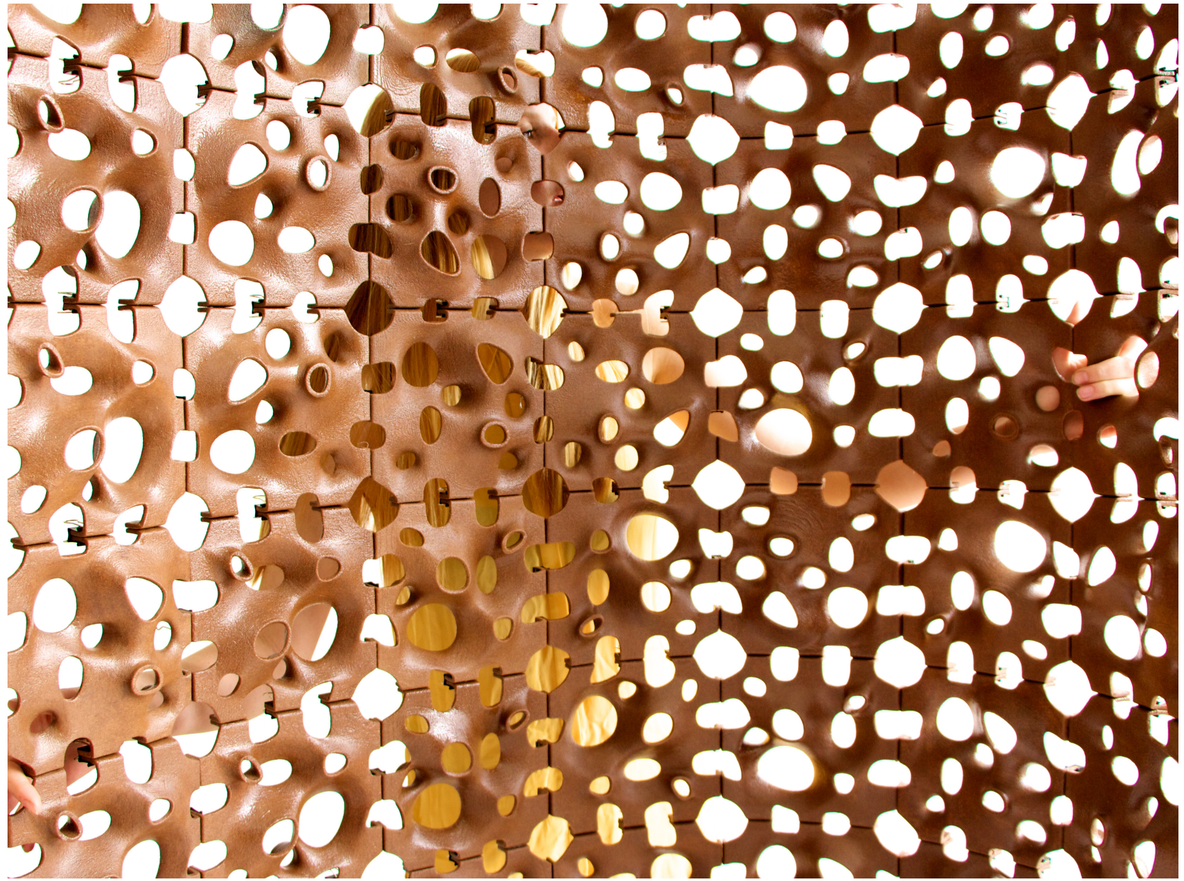


a double sided version of the screen



Pterocarpus santalinus. L Cross Section

close up showing scale of openings



PICOROCO WALL IN ORANGE

Project Date: Nov. 2014

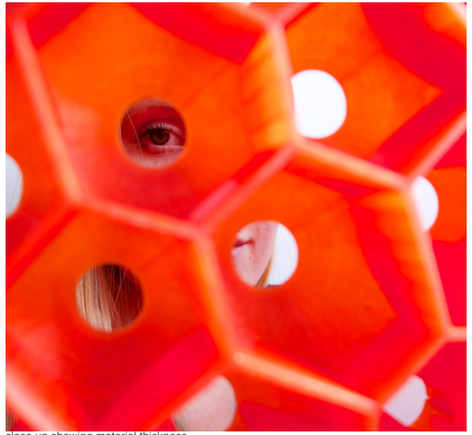
Project Team: Ronald Rael, Virginia San Fratello. Seong Koo Lee

The Picoroco Wall is constructed using the Picoroco Block™, a modular 3D printed building block for wall fabrication printed in PLA. PLA, or polyactic acid, is a thermoplastic aliphatic polyester derived from renewable resources. The wall is comprised of blocks with a dimension of 5.75″X5.75″X5.75″. Three different blocks are used in the construction of the wall—a 2, 3 and 4 hole block. Each block can be randomly rotated to create the variable pattern found in the wall.

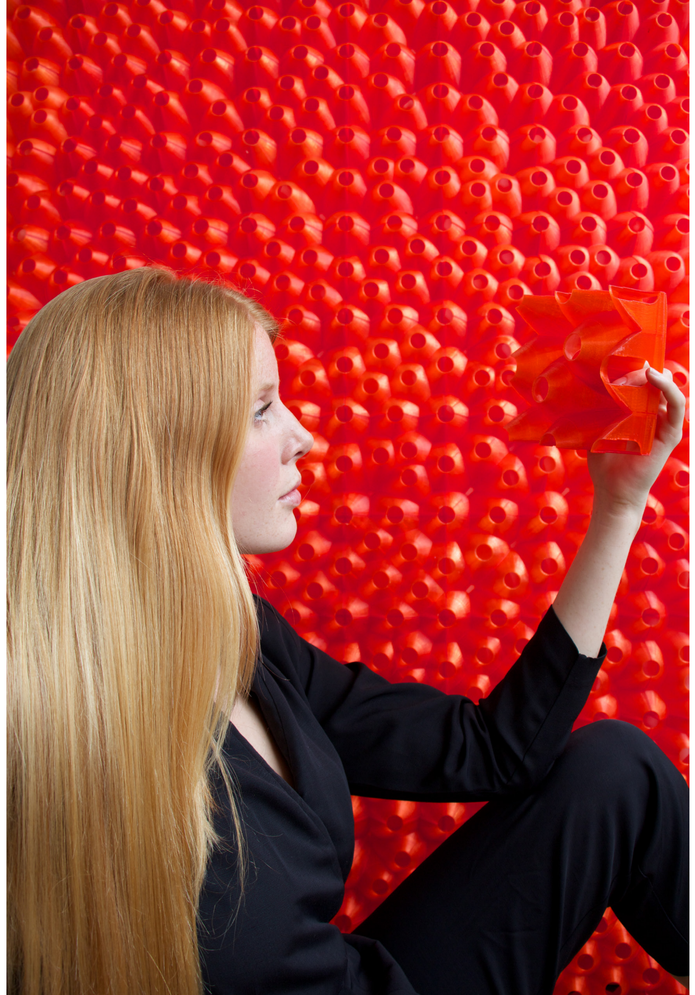
The transparency of the material creates different layers of visual porosity. Figures moving behind the wall are revealed within the cellular geometry of the blocks.

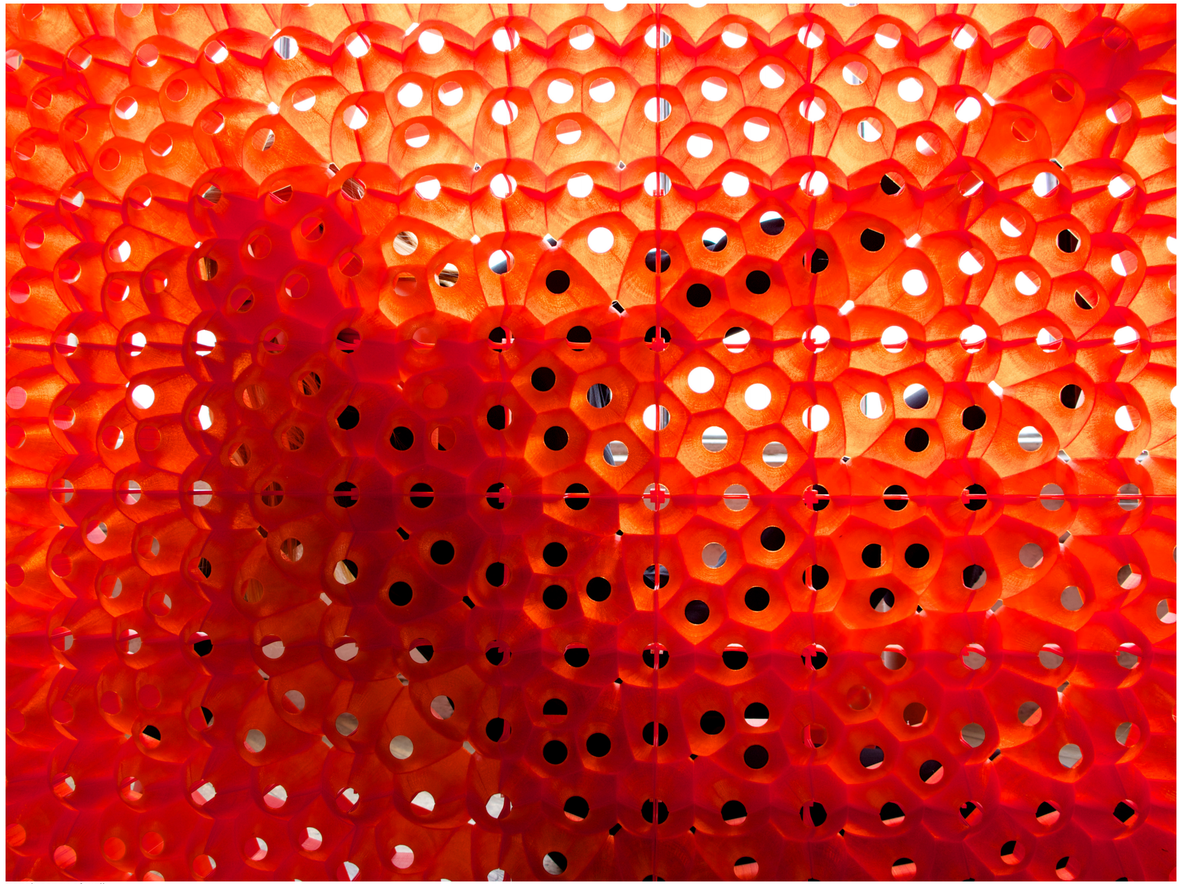
The opposing side of the wall reveals the bumpy surface's underlying geometry—a series of interconnected pentagons, hexagons and quadrilateral shapes whose terminus is a circle. Each block is connect by 3D printed clips of the same material that bind the corners of each block together making the wall easy to assemble and disassemble.

The variegated pattern allows for views to pass through in some areas of the wall, but not in others. The quality of light and shadow constantly changes across the surface with the passing of the day.



close up showing material thickness





translucency of wall

EMERGING OBJECTS

Project Date: 2010 -ongoing
Project Team: Ronald Rael, Virginia San Fratello, Emily Licht, Kent Wilson, Nick Buccelli, Bryan Allen

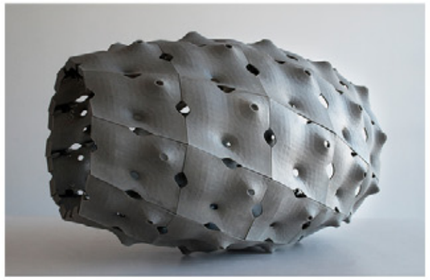
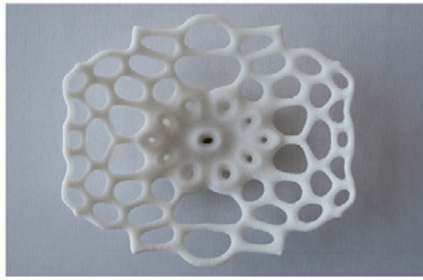
MISSION
Emerging Objects is a pioneering design and research company that specializes in designing and 3D printing objects for the built environment.

ABOUT
Our research and designs focus on the development of innovative 3D printed objects that serve the fields of architecture, interior design, furniture design and product design. Our design research has served as the foundation for our consulting projects and we work with a range of industrial partners, nonprofit foundations and creative practices.

VISION
Emerging Objects is interested in the creation of 3D printed buildings, building components and interior accessories that can be seen as sustainable, inexpensive, stronger, smarter, recyclable, customizable and perhaps even reparable to the environment. We want to 3D print long-lasting performance-based designs for the built environment using raw materials that have strength, tactility, cultural associations, relevance and beauty.

Because the inherent nature of 3D printing opens new possibilities for shaping materials, this process will reshape the way we as a society think about manufacturing and construction. Though rapid manufacturing, geometries can be created that would be impossible to create by hand or require expensive machinery to produce or reproduce. Because additive manufacturing requires no dies or molds, products can be mass-customized, employing the flexibility of computer-aided manufacturing systems, rather than mass- produced, allowing design parameters to be quick. 3D printing is also a fabrication method that minimizes waste which makes it an environmentally conscious method of manufacturing.

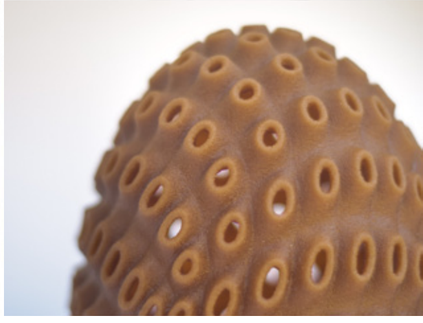










3D Printed items in cement polymer, nylon, salt, wood and sand

EARTHSCRAPER:
Developing 3D printing for the rapid manufacture of sand-based building components

Project Date: 2010
Project Team: Ronald Rael, Virginia San Fratello, John Faichney, Maricela Chan, Chris DeHenzel, Emily Licht

SUMMARY

The creation of building components that can be seen as sustainable, inexpensive, stronger, recyclable, customizable and perhaps even reparable to the environment is an urgent, and critical focus of architectural research. In the U.S. alone, the construction industry produced 143.5 million tons of building-related construction and demolition debris in 2008, and buildings, in their consumption of energy produce more greenhouse gasses than automobiles or industry.

Because the inherent nature of 3D printing opens new possibilities for shaping materials, the process will reshape the way we think about architectural building components. Digital materiality, a term coined by Italian and Swiss architects Fabio Gramazio and Matthias Kohler, describes materiality increasingly enriched with digital characteristics where data, material, programming and construction are interwoven. The research aspires towards this classification through the use of parametric modeling tools, analytic software and quantitative and qualitative analysis.

Rapid Prototyping, which is the automatic construction of physical objects using additive manufacturing technology, typically employs materials intended for the immediate analysis of form, scale, and tactility. Rarely do the materials used in this process have any long-term value nor does the process, except in rare cases with expensive metal prototyping, have the ability to create actual and sustainable working products.

3D printed sand display table

This research intends to alter this state of affairs by developing methods for 3D printing using concrete for the production of long-lasting performance-based components.

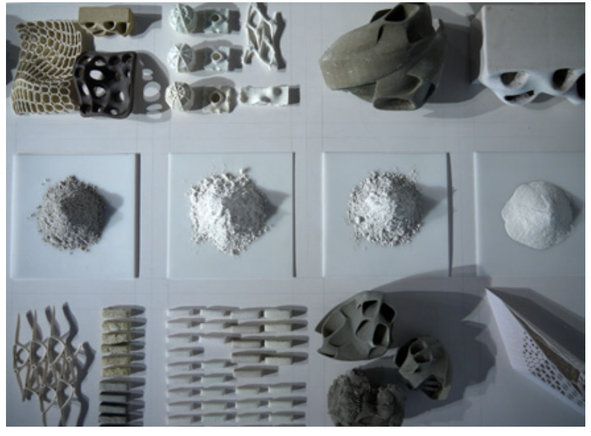
MATERIAL INFORMATION

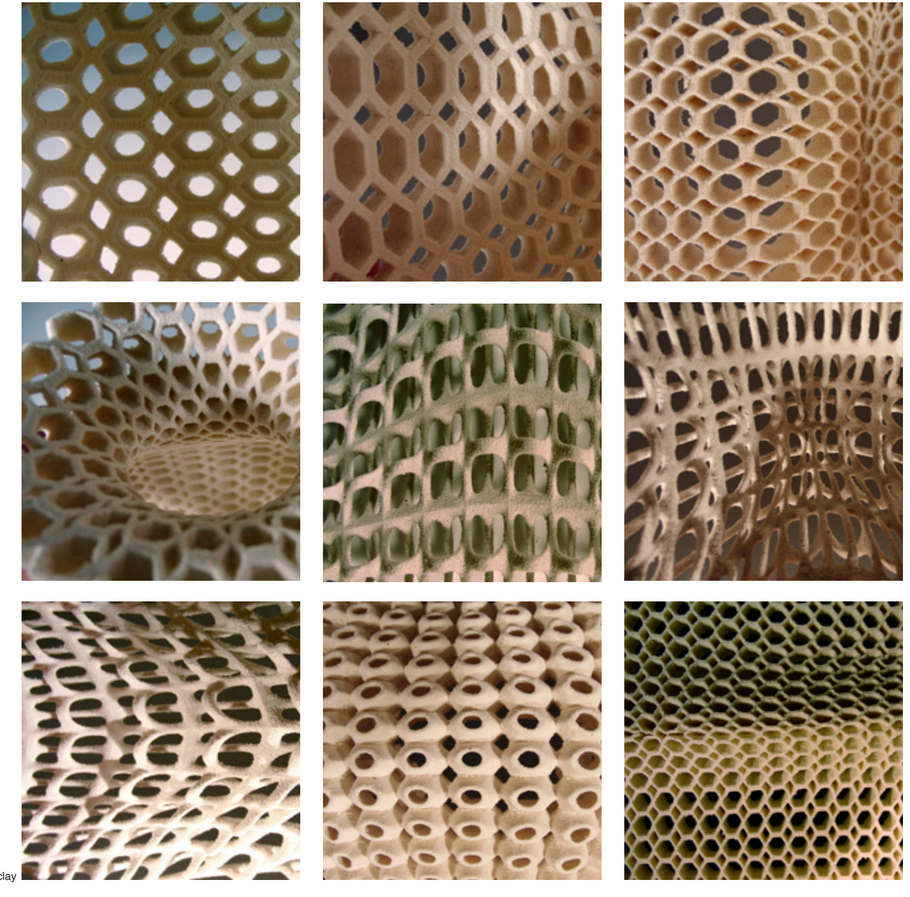
The word concrete comes from the Latin word “concretus” (meaning compact or condensed), the perfect passive participle of “concresco”, from “com-” (together) and “cresco” (to grow). The development of concrete has evolved for over two thousand years. The Romans used quicklime, pozzolana and aggregate or rubble to build concrete structures such as the Pantheon and the Baths at Caracalla. In 1756 John Smeaton rediscovered concrete by mixing hydraulic lime and powdered brick as aggregate. These mixtures produced concrete with a comprehensive strength comparable to the mixes that we use today. The mixes that we most frequently use today include:

Portland cement: which consists of a mixture of oxides of calcium, silicon and aluminium. Portland cement and similar materials are made by heating limestone (a source of calcium) with clay, and grinding this product (called clinker) with a source of sulfate (most commonly gypsum).

Water: Combining water with a cementitious material forms a cement paste by the process of hydration.

Aggregates: Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel and crushed stone are mainly used for this purpose. Recycled aggregates (from construction, demolition and excavation waste) are increasingly used as partial replacements of natural aggregates, while a number of manufactured aggregates, including air-cooled blast furnace slag and bottom ash are also permitted.





right: studies of 3D printed porcelain and ball clay

When initially mixed together, Portland cement and water rapidly form a gel, formed of tangled chains of interlocking crystals. These continue to react over time, with the initially fluid gel often aiding in placement by improving workability. As the concrete sets, the chains of crystals join up, and form a rigid structure, gluing the aggregate particles in place. During curing, more of the cement reacts with the residual water (hydration).

Concrete is inherently weak in tension as the cement holding the aggregate can crack. The addition of steel reinforcement to concrete in the 19th century solved this problem. In addition to adding steel reinforcing bars, we now add steel fibers, glass fiber, or plastic fiber to carry tensile loads. Thereafter the concrete is reinforced to withstand the tensile loads upon it.

The mix for use in the 3d printer is similar to yet varies in composition from the traditional mixes used. The traditional processes used vary dramatically, from hand tools to heavy industry, but result in the concrete being placed in a formwork where it cures into a final form. In the case of 3d printing concrete there is no form work or mould. There is however, the constraint that all binding particles used in the concrete mix must fit through a 35 picoliter print head and all cement, aggregate and reinforcement must be smaller than 0.010”. The mix that is used in the 3D printer is made of:

Portland cement
Finely graded sand
Powdered sugar
Maltodextrin
Rice wine
Nylon fibers

below: 3D printed sand structure
right: Tower printed in 4 pieces and stacked together at interlocking sections

The Portland cement serves the same purpose as it does in a traditional mix. The finely graded sand, sugar and maltodextrin act as the aggregates. The rice wine is composed of 80% water and acts as the binder, although a slurry is not formed, and the nylon fibers serve as reinforcement.

HOW IT WORKS

The 3D printer lays down a thin layer of the dry, powdered concrete mix, then using an ink jet sprays the image of one ‘slice’ of the 3D object or in this case CMU (concrete masonry unit) onto the dry mix. The wet parts of each layer hydrate into rock-hard concrete, and the rest remains in a powder form which can be brushed off later. Because concrete cures via a chemical reaction – hydration- no air is required for curing, so the next layer can be deposited immediately.

The cycle of laying down concrete and binder with the rice wine is repeated over and over, stacking layer upon layer, building up a solid object inside the pile of dry, powdered concrete mix. The dry concrete mix acts as a support structure during the printing process, so objects may have undercuts which is unseen in traditional concrete casting.

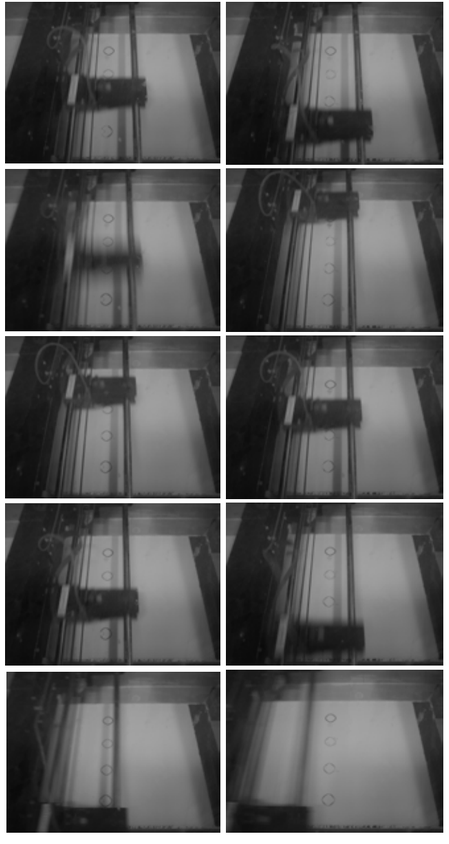
Once the concrete cures enough to handle, which typically takes about 12 hours, the finished object can be lifted out of the powder bed. The dry mix used to support the concrete object during printing can be recycled. Printing an intricate and unique concrete part would only consume a few dollars worth of material, would incur no cost for formwork and very little labor costs. Additionally compared to printing with z corps proprietary blend, the costs are considerably lower. The Z corp polymer / plaster powder, at it’s cheapest, is $3 a cubic inch and the 3D printed concrete costs mere cents per cubic inch.

Concrete Media:

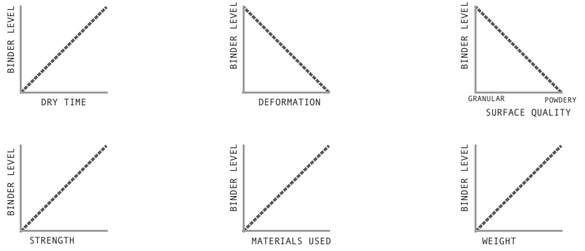
The initial impetus to work with concrete as a 3D printed material was driven by an installation we designed called Earthscapers. Earthscrapers imagines the potential of employing Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) processes in the construction of a proto-architectural landscape—one where the building material source and the building itself are seamless. The project also imagines a future scenario for the material and the process as a scalable technology—one that also dissolves the role of the architect and builder. We imagined printing full scale buildings with in situ aggregates in a world where designer and geomorphologist merge.

The capability to 3D print at the scale of the building is gaining momentum and is certain to occur. Currently the largest 3D printer in the world is a 10’ x 10’ x 10’ 3-D stereolithic printer that creates models entirely out of artificial sandstone using CAD-CAE modeling technologies and CAD-CAM software to control the plotter. The printing proceeds in 5-10mm layer segments and, in the end, produces a structure that has strength characteristics reminiscent of standard Portland Cement. This printer can print a low resolution room.

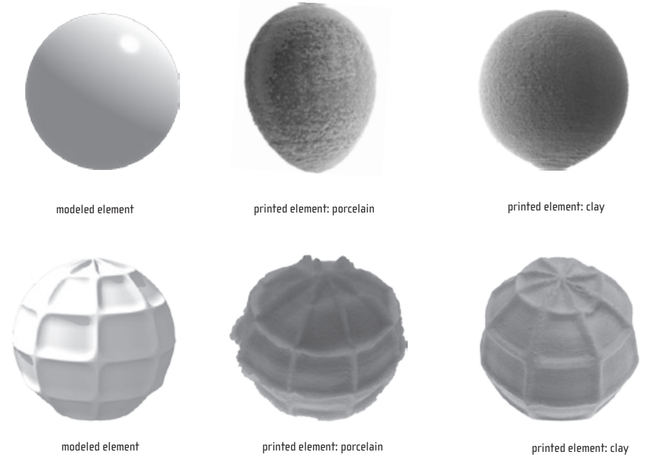
Dr. Behrokh Khoshnevis, of the University of Southern California has developed a different printing technique called Contour Crafting (CC). Contour crafting is a layered fabrication technology that has potential for automating the construction of whole structures as well as sub-components. Using this process, a single house or a colony of houses, each with possibly a different design, may be automatically constructed in a single run, embedded in each house all the conduits for electrical, plumbing and air-conditioning. They have recently collaborated with Catepillar to fabricate a 6 foot wall.



EFFECTS OF BINDER LEVELS:

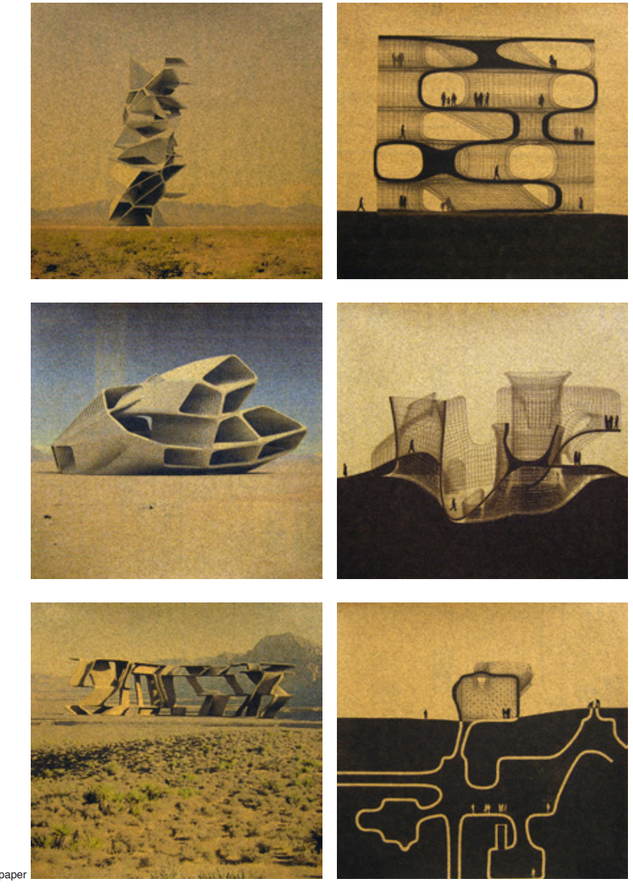


MATERIAL DEFORMATION



For the Earthscrapers exhibit we were uniquely interested in connecting the 3D printed material to the landscape therefore we started by printing various materials including clays, sands and ashes. Ultimately we decided to print a small amount of portland cement mixed with a large portion of sand. The resulting concrete prints proved to be very stable, strong and have the effect of looking like earth due to the amount of natural aggregate within the mix.

The plastic nature of both concrete and 3D printing offer up a powerful material solution to recent generative design processes in architecture, which often feature organic, doubly curved surfaces and complex ornamentation. The Earthscrapers exhibit explored a range of complexly curved forms. It also explored thinness and attempts to push the limits in terms of extracting thin surfaces and thin structural elements from the printer bed. Several of the complexly curved, fiber reinforced concrete prints were easily 1/16” of an inch thick which would be very difficult, if not impossible, to cast using traditional methods of mould making. Making the 3D printed models and objects that were on display in the Earthscraper exhibit was an active process where software, geometry, material, fabrication and production were simultaneously linked. The complexity of form was limited by thinness and slump. If the form was not allowed to cure in the bed for at least 12 hours the concrete object would fail. The success of the mix depended on the amount of binder being laid down at each successive interval. For example, if the binder was sprayed at full capacity the concrete print would slump therefore the binder level should be set at .75.



Drawings printed on sand paper

PLANTER BRICK WALL:
Developing 3D printing for the rapid manufacture of clay building components

Project Date: 2011
Project Team: Ronald Rael, Virginia San Fratello, Molly Reichert

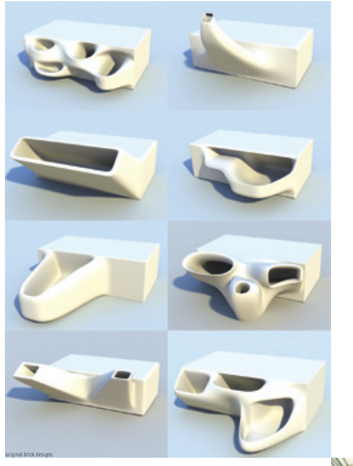
The planter brick wall is designed to be a combination of traditional masonry units combined with units that can hold plants and vegetation. Most plants do not need much, if any, soil but they do need water and nutrients. The plants held in the planter bricks will be fed water and nutrients through drip irrigation lines that are built into the cavity of the masonry wall.

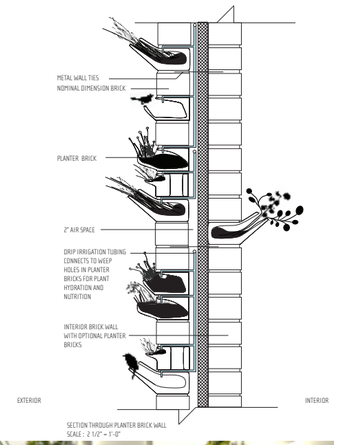
The planter bricks have the potential to counter the heat island effect in big cities through evapotranspiration and pollution conversion and by the light, reflective color of the bricks. Additionally, edible plants such as rosemary and other fragrant herbs with shallow root systems may be planted in the bricks and accessed through openings in the wall. The plants in the bricks will help mediate the temperature of the microclimate surrounding the building, buffer sound and filter the air.

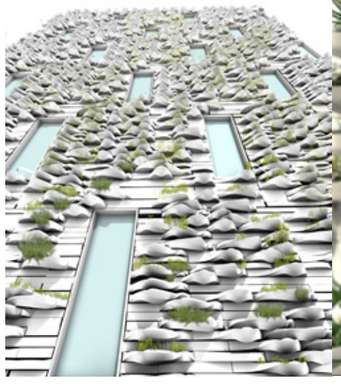
The planter bricks are made by direct digital manufacturing and rapid prototyping technology. Ceramic particles are printed and held together unsing an organic binder and then fired in a kilm just like traditional bricks. The bricks may be assembled in a load bearing cavity wall condition or installed as a traditional masonry curtain wall would be on a steel or concrete frame building and can be installed new or retrofitted.

The planter bricks shown here have all been 3D printed using direct digital manufacturing . The bricks are modeled in a 3D software application and the digital file is sent directly to the 3D printer for manufacture. This means a very diverse and infinitely unique selection of bricks can be manufactured based on the clients or designers desires for a particular application.

The bricks are manufactured with clay instead of more ephemeral powders that are typically used for rapid prototyping. The 3d clay prints are then bisque fired at cone 5 and glazed to make them waterproof.







3D printed clay wall assembly

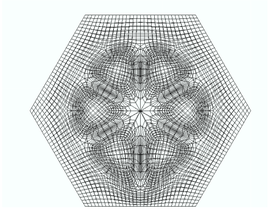
3D printed clay brick glazed white

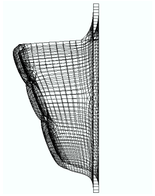
PLANTER TILES

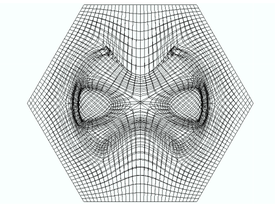
Project Date: May. 2014

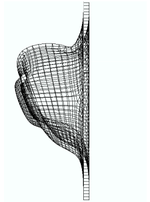
Project Team: Ronald Rael, Virginia San Fratello

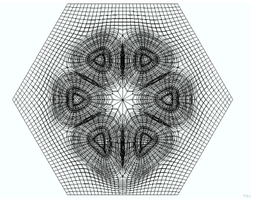
The Planter tiles are 3D printed cement hexagonal tiles that close pack together. The overall pattern is composed of 6 different tile patterns, 4 of which have the capacity to hold plant life. The petal motif on the tiles themselves ties together the planter tiles and non planter tiles through the use of a 3 dimensional graphic. The planter tiles are one of the first commercial applications of the 3D printed cement.

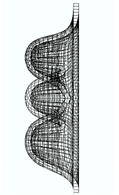












Front View of Tiles

Side View of Tiles

STARLIGHT

Project Date: Nov. 2014

Project Team: Ronald Rael, Virginia San Fratello

The Digital Dandelion rings inspired this series of light fixtures which are made using similar modeling techniques. In order to print at larger scales the lamps must be divided up into 3D printable parts that can be assembled. The parts are then modified with flanges and holes for mechanical fastening. The orange and white lamps are fabricated out of bio-plastic using an FDM printer (fused deposition modeler) and the large grey floor lamp is 3D printed out of white cement .

Starlight MINI

Starlight MEGA being assembled

Starlight MEGA

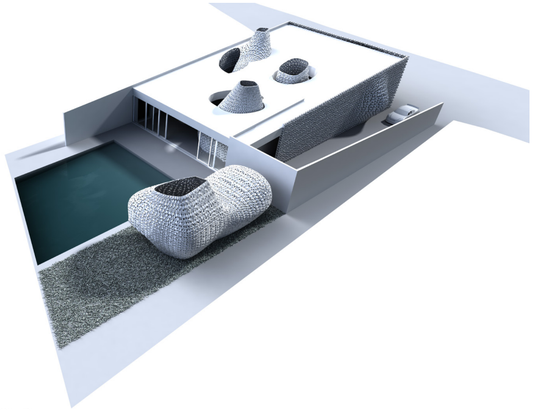
YINSHUA DASHA / 3-D PRINTED HOUSE

Project Date: May 2013-October 2013
Project Team: Ronald Rael, Virginia San Fratello, Seong Koo Lee, Eleftheria Stavridi

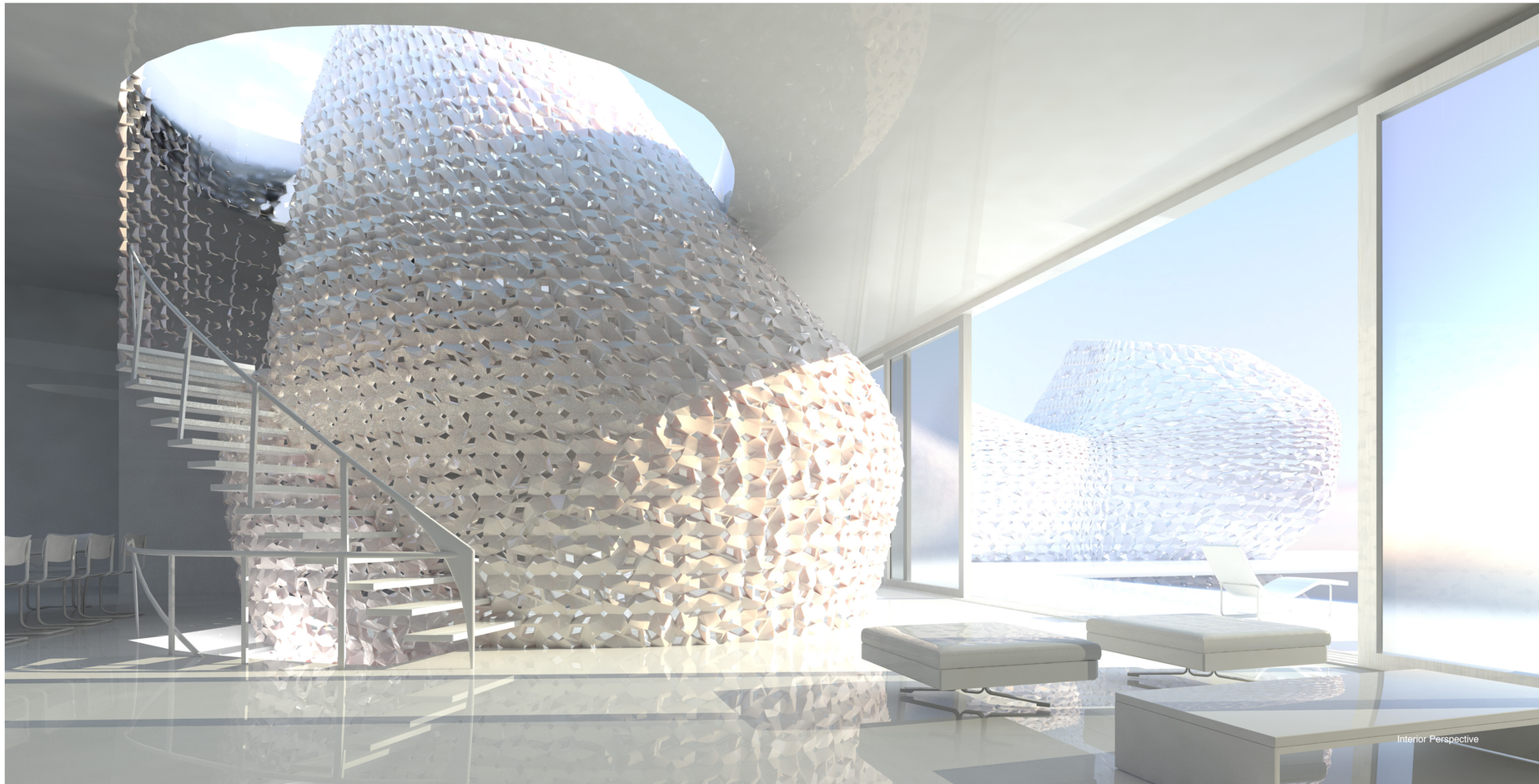
The Yinshua Dàshà is a case study in 3D printing major components of a house. The exterior walls of the Yinshua Dàshà will be constructed of concrete, pastered white, with portions of the exterior cladding that are 3D printed using a black foundry sand. Inside, the private spaces of the house—the bedrooms, bathrooms and family dining room are housed in translucent 3D printed double hieght and two story tall vessels constructed of salt. Outside, adjacent to the pool, is a free standing 3D printed pool cabana.

The house explores justopositions between traditional construction methods and 3D printed manufacturing. It also explores relationships between public and private within the organization of the program of the house.

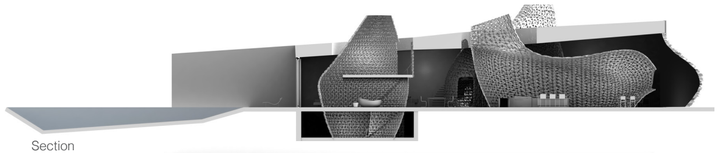
Tranlucency, porosity and openness are all tested in the different material conditions and inform the optics, lighting, views and thresholds between adjacent spaces.



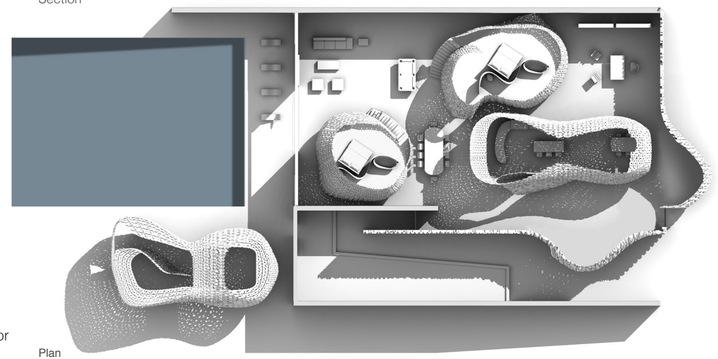
Site Plan



Interior Perspective

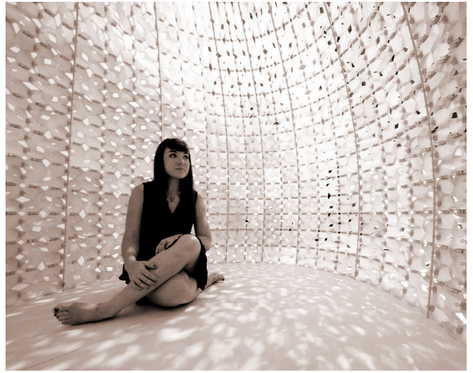


Section

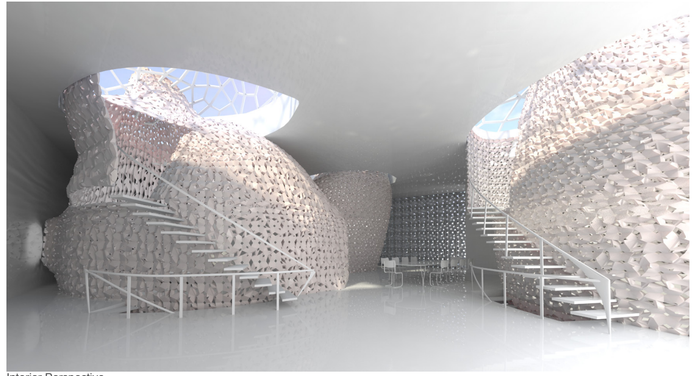


Plan

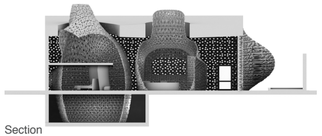
The Salt-Y-Gloo acts as a prototype for the interior volumes within the 3D printed house. Material development, manufacturing techniques, fabrication assemblies and material effects have been explored through the prototype and found to have desirable results for use in the interior of the house.



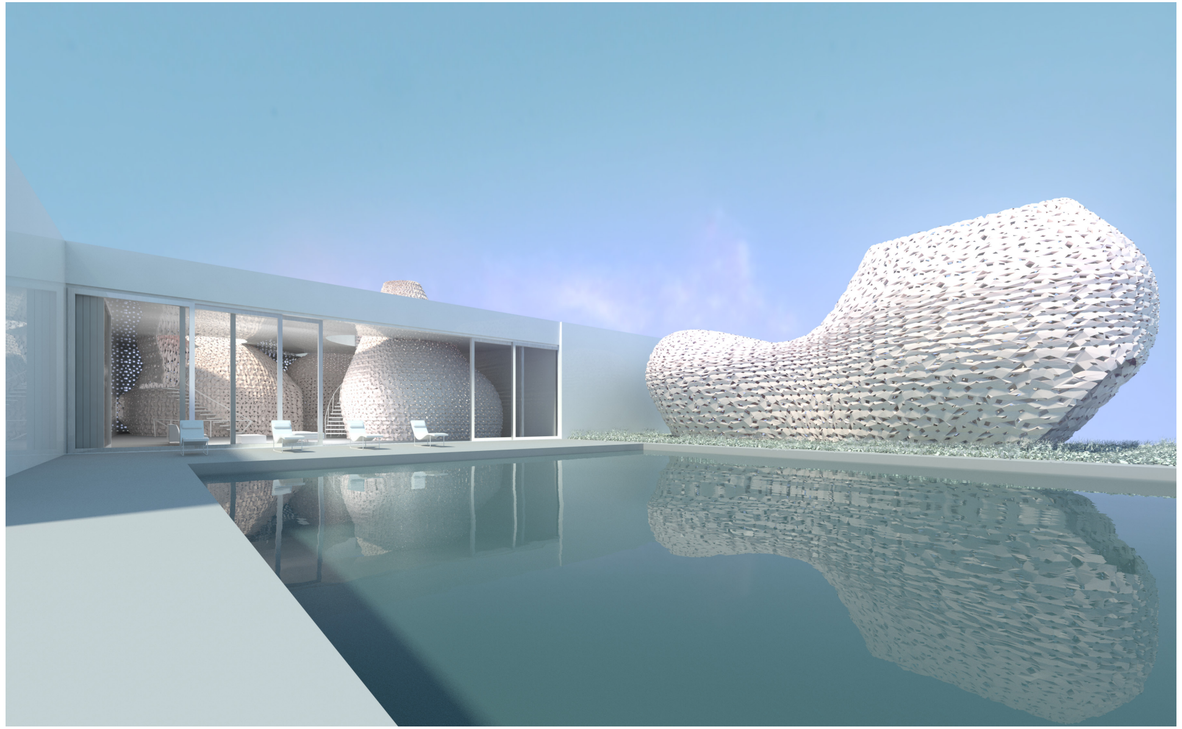
Photograph of 3D printed interior



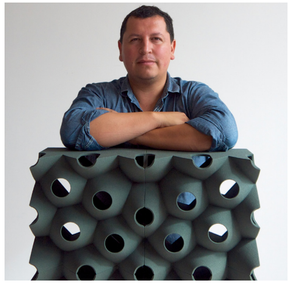
Interior Perspective

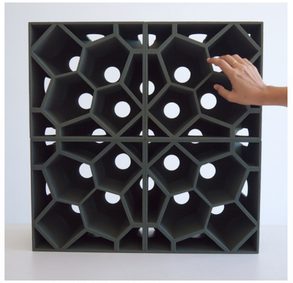


Section



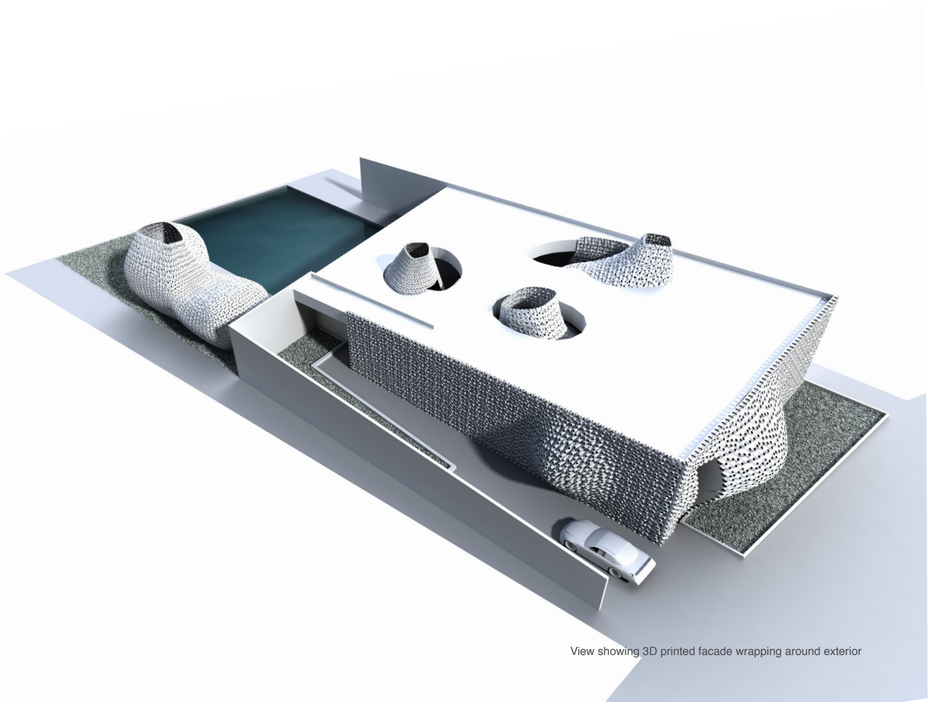
Exterior View





Interior side of 3D printed block

Close-up of PicoRoco Block used on exterior cladding



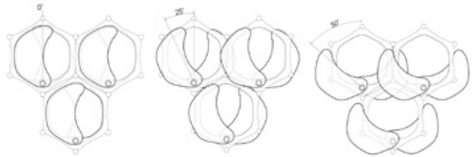
View showing 3D printed facade wrapping around exterior

3D printed prototype of building facade

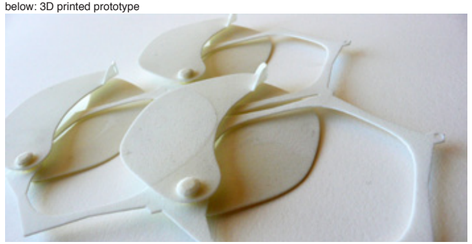
HEX CURTAIN:
Developing 3D printing for the rapid manufacture of facade elements

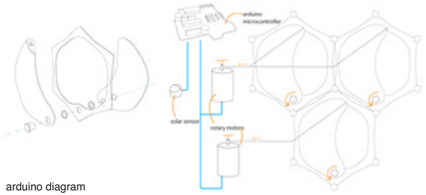
Project Date: 2011
Project Team: Ronald Rael, Virginia San Fratello, Chase Lunt

The HEX curtain is designed to open and close automatically in response to natural daylighting conditions. Each row of the HEX curtain is composed of hexagonal shaped apertures that are covered by 2 operable shields. Ids have the ability to pivot open and closed. The shields are hinged at the bottom and threaded at the top. The top thread connects each shield to the one next to it. At the end of each row a rotary motor pulls the thread and slowly opens or closes the shields in tandem. motor is driven by an arduino microcontroller connected to a solar sensor so on a sunny summer day the shields remain closed and on a sunny winter day the sheilds are automatically opened to allow sun to enter the interior and warm the space. The HEX curtain is constructed of laser sintered nylon and is 3D printed in 27" x 22" panels.

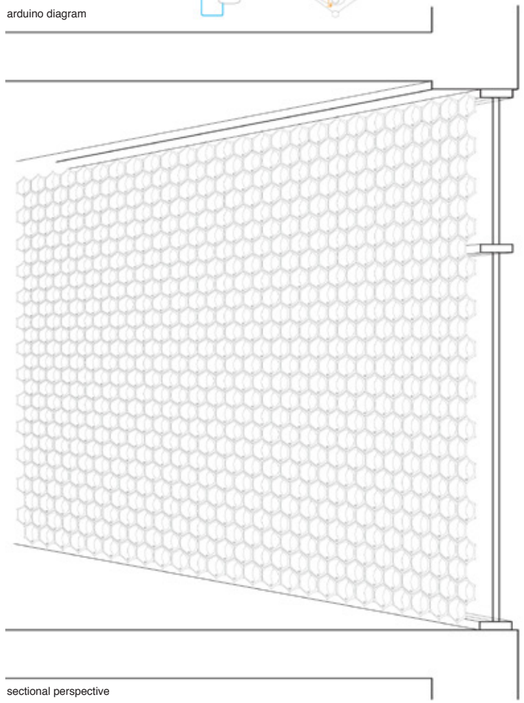


above: opening and closing sequence
below: 3D printed prototype

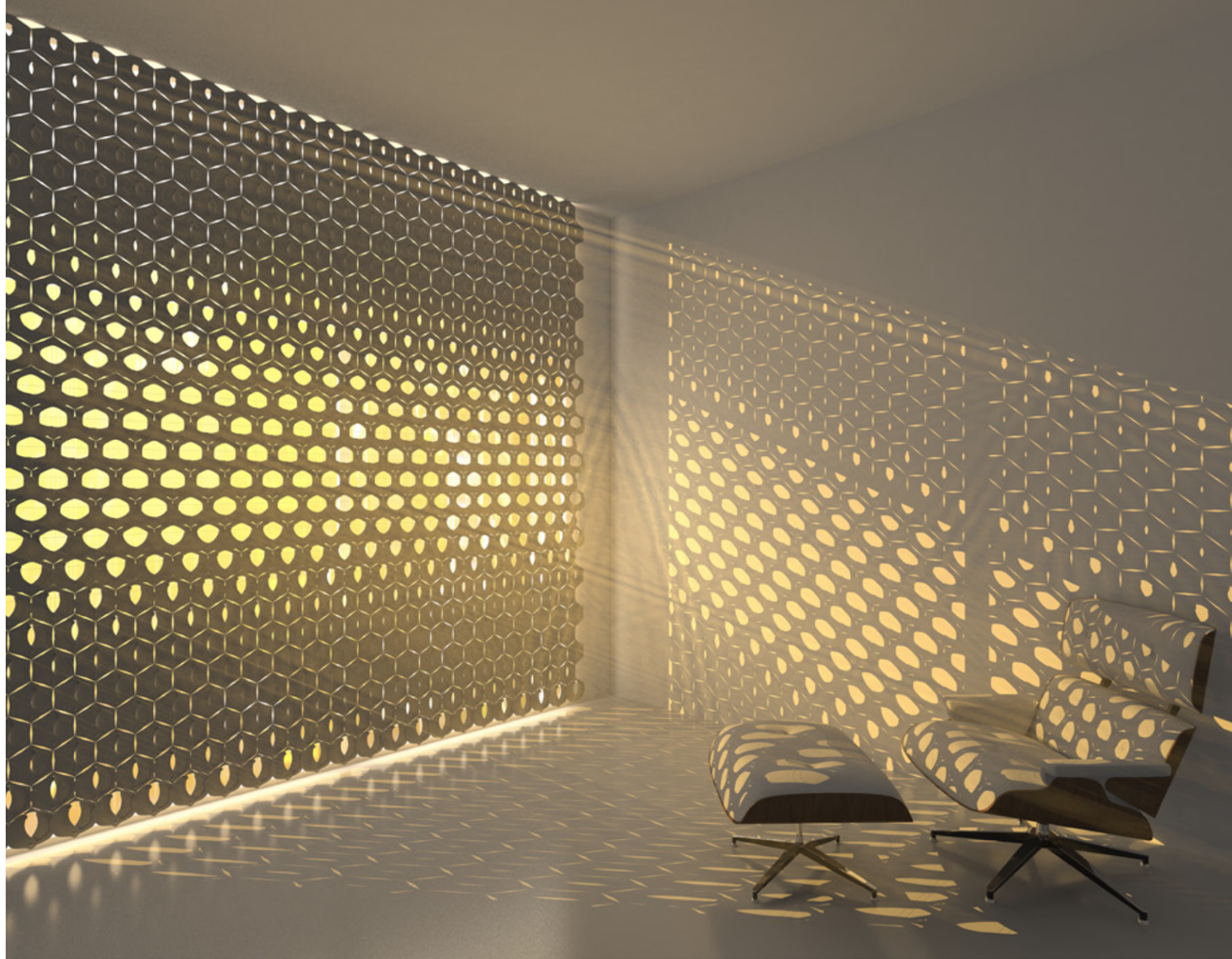




arduino diagram



sectional perspective



SOL GROTTO

Project Date: 2012
Project Team: Ronald Rael, Virginia San Fratello, Bryan Allen, Chase Lunt, Dustin Moon, Kent Wilson, Bridget Basham

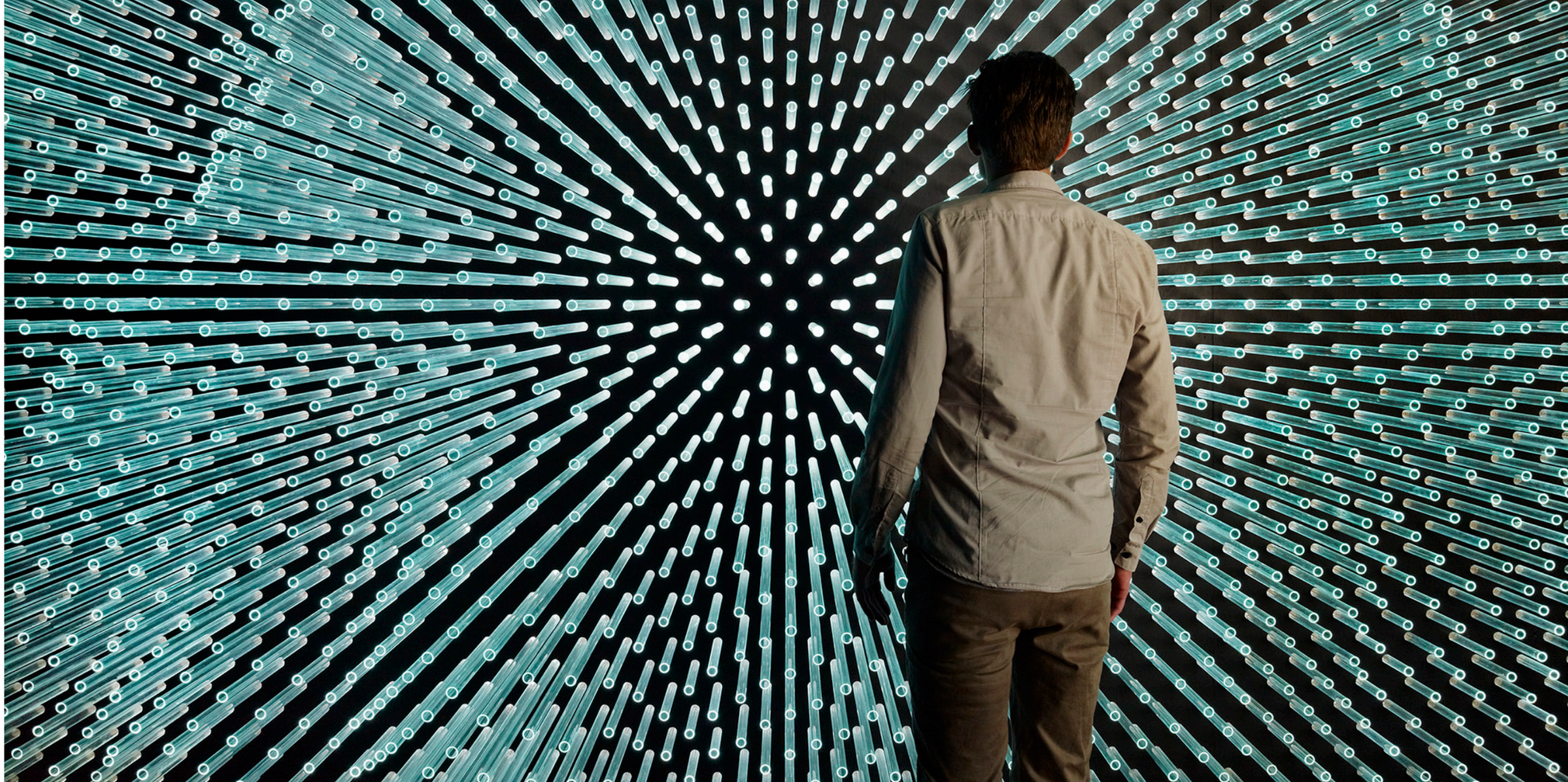
SOL Grotto is a spartan retreat—a space of solitude and close to nature where one is presented with a mediated experience of water, coolness and light . The SOL Grotto also explores Solyndra's role as a company Sh*t Out of Luck. 1,368 of the 24 million high tech glass tubes destined to be destroyed as a casualty of their bankruptcy, are used in the installation.

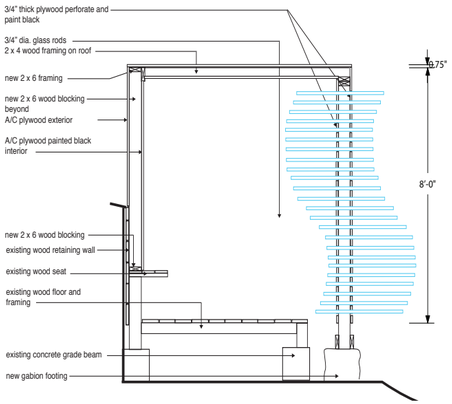
The project is located in the Berkeley Botanical Garden alongside Strawberry Creek in the California Native section as part of the exhibit Natural Discourse, which is a collaborative project between The University of California Botanical Garden at Berkeley and a multi-disciplinary group of artists, writers, architects and researchers who have been invited to spend time in the Garden's extraordinary collection of plants, engage with the horticulturists and develop new site specific work.

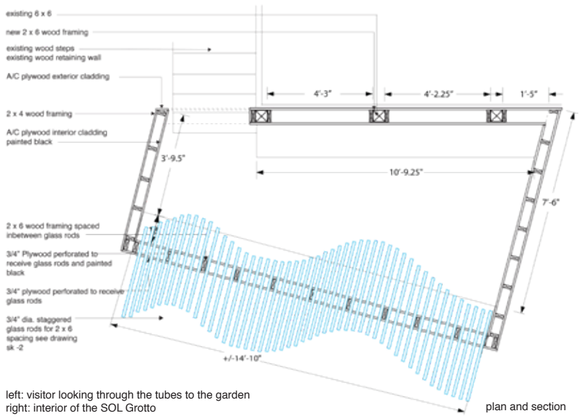
The tube's original role as a light concentrating element is extended to transmit cool air into the space via the Venturi effect, to amplify sounds from the adjacent waterfall via the vibrations of the tubes cantilevering over the creek, and to create distorted views of the garden.

The glass tubes are illuminated electric-blue naturally from the direct and ambient light that is conducted through the glass causing each tube to change in intensity throughout the day. Collectively, the tubes take on the form of a cave wall or a waterfall, evoking Plato's Allegory of the Cave where shadows, light and sounds call reality into question. The view through the rods is simultaneously kaleidoscopic and mesmeric and has become home to several insects found in the garden. The sound of a waterfall is present inside The SOL Grotto and the combination of sound, light, views and coolness filtering through the cracks in the flooring creates a highly sensorial space.

right: elevational view of SOLYNDRA tubes

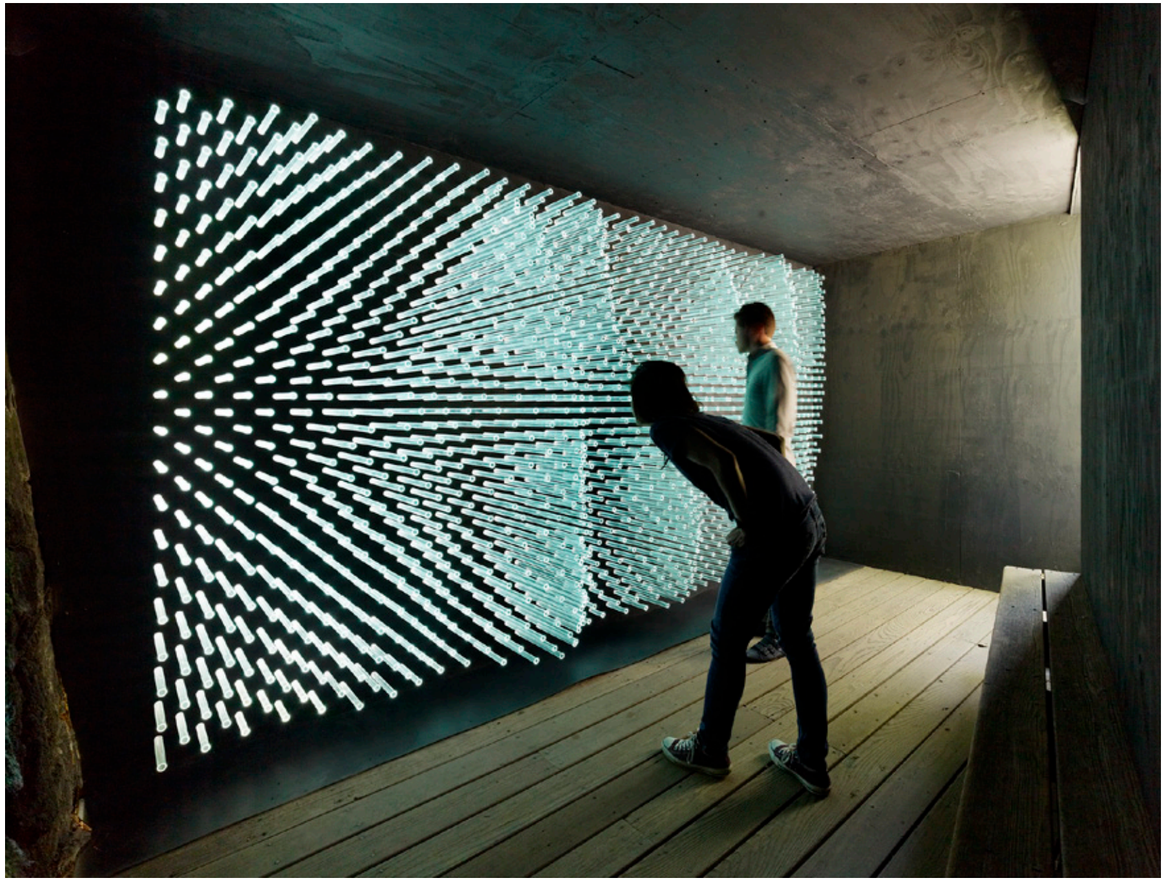


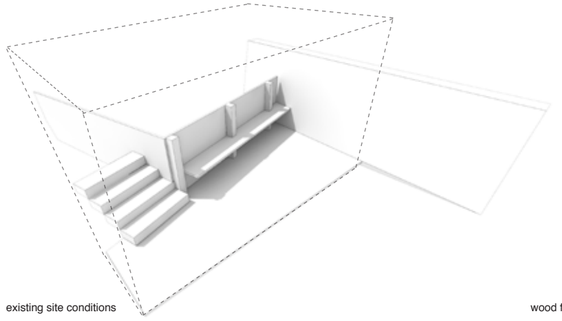




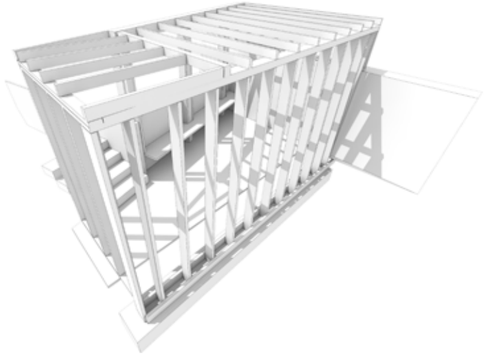
left: visitor looking through the tubes to the garden
right: interior of the SOL Grotto

plan and section

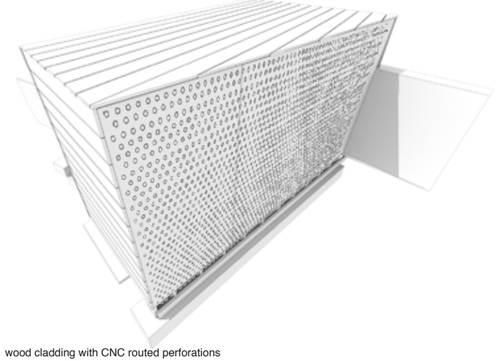




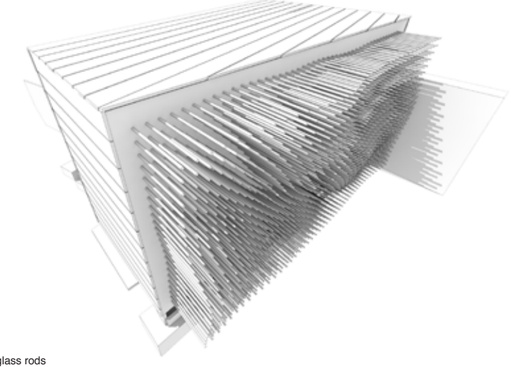
existing site conditions



wood frame

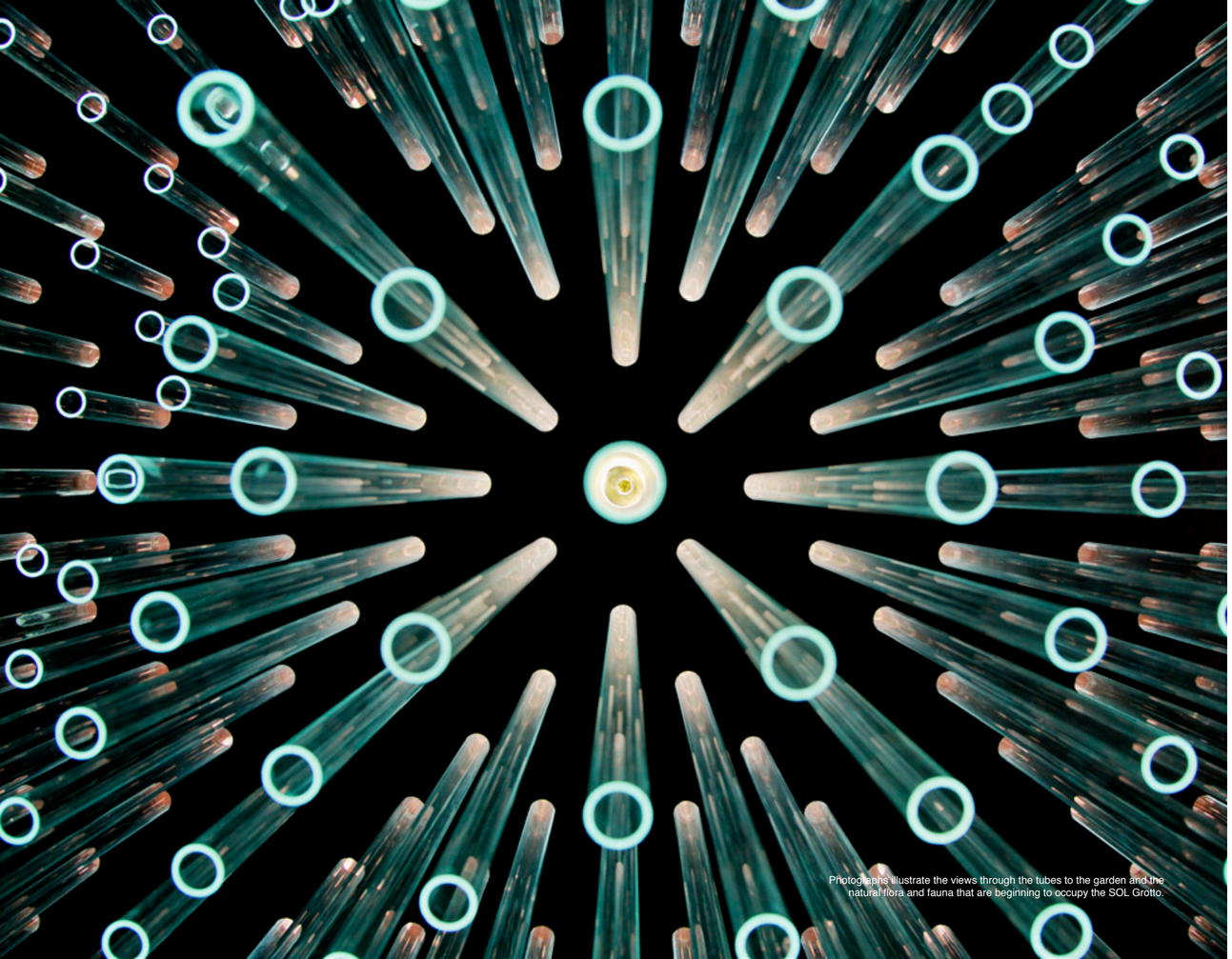


wood cladding with CNC routed perforations

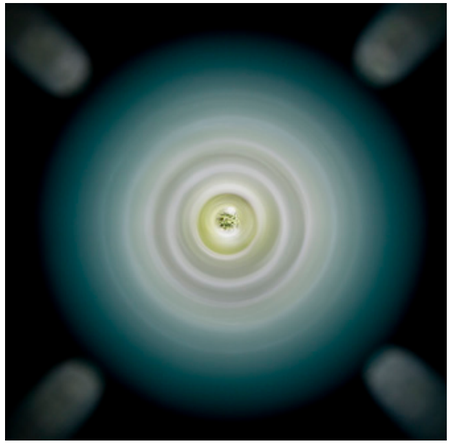


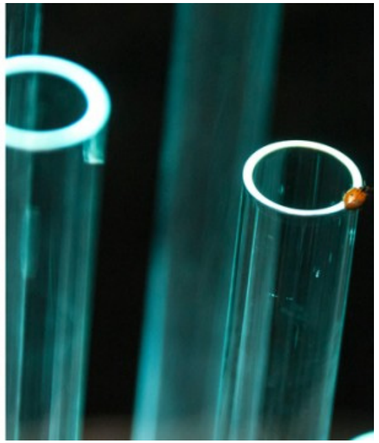
SOLYNDRA glass rods

right: SOL Grotto in the Botanical Gardens at dusk



Photographs illustrate the views through the tubes to the garden and the natural flora and fauna that are beginning to occupy the SOL Grotto.





STRAW GALLERY

Project Date: 2011
Project Team: Ronald Rael, Virginia San Fratello

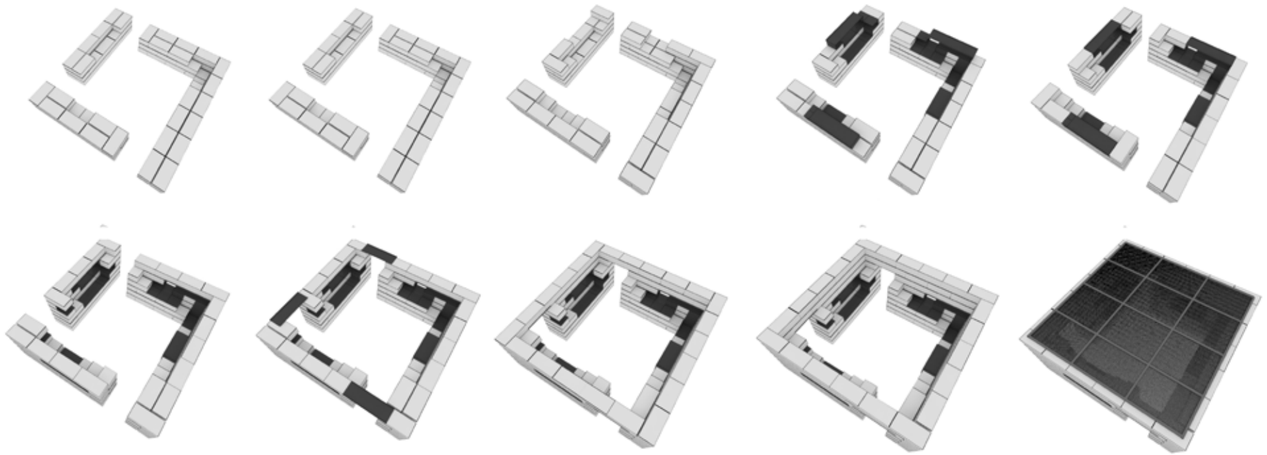
The Straw Gallery was designed for HEDGE Gallery for the 4th annual sf20/21 San Francisco Art and Design Show held at the Festival Pavillion, Fort Mason Center. The temporary gallery was on display from September 15th through 18th opening with a benefit for the San Francisco Museum of Modern Art's educational programs.

The gallery is an aromatic, enveloping, and raw space in contrast to the refined and modern elements that are displayed within. The gallery consists of three unfinished, blackened steel display niches interwoven within the walls of straw bales. Each niche is an excavation that is filled with HEDGE's highly edited visions of 20th and 21st century design, art and craft, presented at different levels relative to the eye and the hand of the visitor.

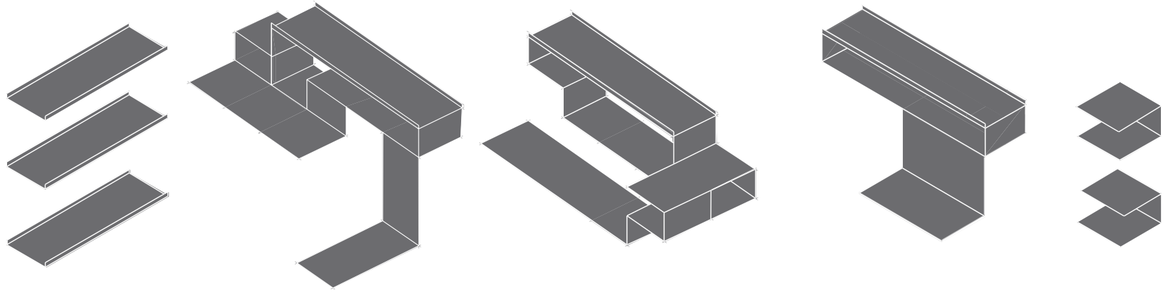
The juxtaposition of the two materials, steel and straw—one industrial and the other representing a storied agrarian history—heightens the tactile sensibilities as one navigates between the richness of the hay and the clean surfaces of the steel compartments. Straw is an incredibly effective acoustic buffer and the walls are in most places two bales thick and placed strategically to block views to the exterior as you enter the space. The experience within Straw Gallery is one of quiet, calm and focused observation in contrast to a busy exterior.

The several hundred wheat straw bales, an agricultural by-product used for bedding, roughage and fuel, used to construct the gallery were returned to the feed store. The steel shelves were recycled and will be used to construct furniture and shelving in San Francisco.

above: ceiling perspective and floorplan right: view from the exterior



above: stacking sequence
right: elevational view of straw gallery in site



above:steel shelves
below: details of steel inserted into the straw
right: view of the interior showing the display of objects on straw and steel shelves

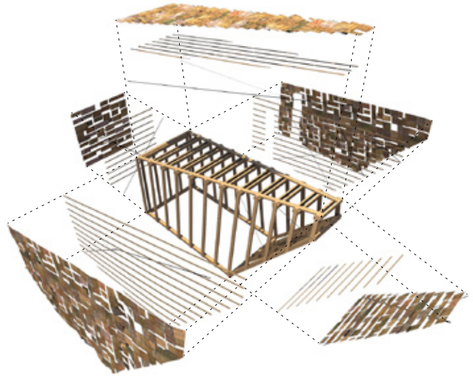
HOMELESS HOUSE: Sukkah of the Signs

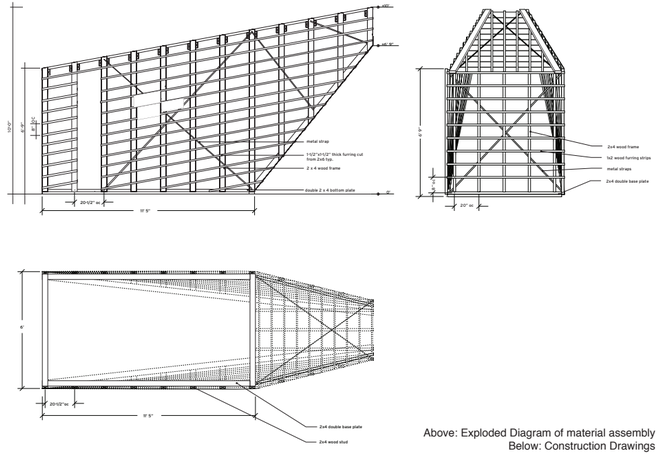
Project Date: 2010
Project Team: Ronald Rael, Virginia San Fratello,
Maricela Chan, Emily Licht

Ten years ago, architects Ronald Rael and Virginia San Fratello started buying cardboard signs off homeless people in and around their Oakland-based firm. The idea was to exhibit the signs as works of art, then sell them to raise money for charities that benefit the homeless. But the project stalled, leaving Rael and San Fratello waiting for an opportunity to resurrect them from storage. That came this year, with the announcement of Sukkah City: NYC 2010, a new, international design competition challenging architects to re-imagine the ephemeral, elemental shelter known as the sukkah.

Sukkah City is the brainchild of Joshua Foer, a journalist, author and member of Reboot, a New York-based nonprofit that encourages creative Jews to “reboot” Jewish traditions and make them relevant again in modern life. Reboot co-founder Roger Bennett was Foer’s partner in this endeavor. The project also received support from the Union Square Partnership, an organization that works to enhance the atmosphere of New York City’s Union Square. “We wanted architects to think about the sukkah in a way that was experimental and contemporary,” Foer said, “and show what kind of creative possibilities can lie within the constraints of Jewish law.”

The contest attracted nearly 600 entries from 43 different countries, including Kazakhstan, Bulgaria, Thailand and Paraguay. Rael and San Fratello, whose East Bay firm combines architecture, art, culture and environment, created the “Sukkah of the Signs,” a wooden structure clad with signs — some as small as a sheet of paper, some large enough to be a makeshift bed — made by the homeless and destitute.





Above: Exploded Diagram of material assembly
Below: Construction Drawings

“This project reinforced something for us as architects,” said Rael, a professor at U.C. Berkeley. “Our designs can send a social and political message, which is often hard to deliver. Clients don’t hire you to make social commentary, but we had the chance to express that through our work.” Inspired by a mosque made entirely of cardboard that Rael and San Fratello discovered in a Yemenite refugee camp a few years ago, the “Sukkah of the Signs” boasted roughly 280 signs, covering a 10-foot wooden structure of lumber pieces. The signs came from throughout the Bay Area, mostly in San Francisco. Rael and San Fratello drove down Van Ness, stopped at freeway exits and wandered through the Haight District. Sign bearers led them to others in Golden Gate Park. Rael even put an ad on Craigslist to get more.

“You see these guys on the streets all the time brandishing these signs,” Rael said. “We thought they were amazing and beautiful works of art.” Convincing the homeless of that took some time. Rael remembered how awkward it was initially approaching their subjects to ask for their signs — in many cases, it was all they had. He gradually learned that listening to their stories, coupled with an offer to buy the sign for a couple bucks, usually translated to success. Rael met people of all ages, races and religious backgrounds. They clutched signs that were humorous, serious, thought provoking and strange. One woman held a sign that said: “Need money for a new pair of shoes.” She didn’t have legs.

He approached people who couldn’t talk or write, grasping signs that made no sense as an act of desperation. In the bowels of

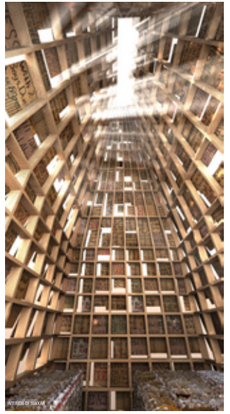
Examples of signs collected from San Francisco, Oakland, San Jose, San Diego, Los Angles, Venice, Las Vegas and Denver

Above: People who contributed their sign to the project
Below: Homeless man in Union Square Park in front of Sukkah of the Signs

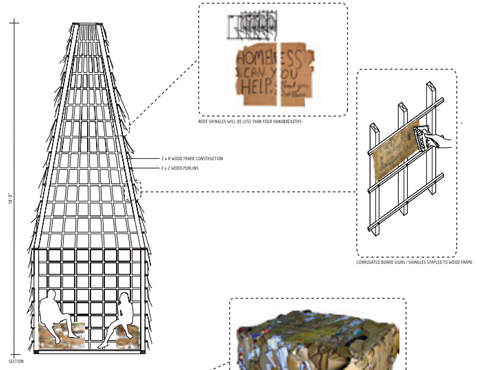
Golden Gate Park, he talked to individuals who lost their jobs and couldn't make rent, stuck in a vicious cycle they could not escape. "I was already empathetic toward people on the streets," Rael said. "To a greater extent, I understand the reasons of why they are there. Some accuse [the homeless] of being lazy or wanting to be on the streets, but so many have no choice."

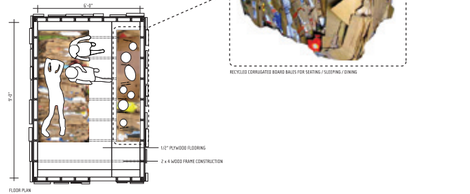
Creating the "Sukkah of the Signs" inspired Rael and San Fratello to start the Homeless House Project, whose aim is to bring attention to homelessness in America. Rael hopes to publish a book with images of the signs used in the sukkah. "When we learned about the concept of the sukkah, it was a nice way to think about the contemporary issues of homelessness in the U.S. and the interesting stigmas that arise," Rael said. "In a sense we were waiting for a project like Sukkah City. We had the signs and it was a good opportunity to marry the two projects."

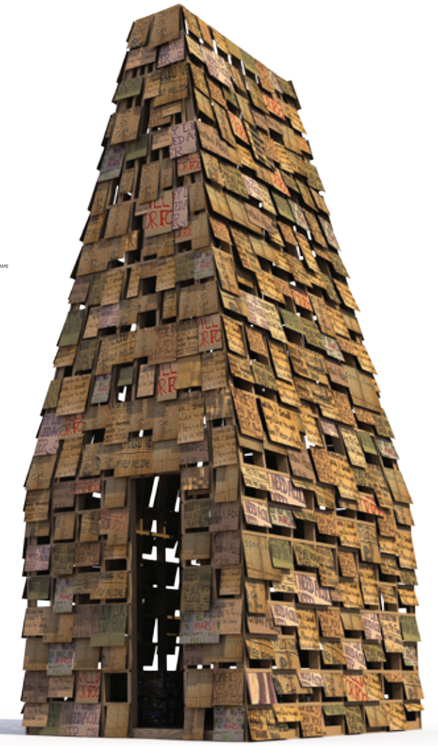
Erected for one week each fall during the festival of Sukkot, the sukkah is traditionally a space for sharing meals, entertaining, sleeping and rejoicing. Its construction must adhere to precise parameters: the structure must be temporary, have at least two and a half walls, be big enough to fit a table, and have a roof made of shade-providing organic material through which one can gaze at the stars. "We've inherited this tradition of sukkah building, but very few of us know the real rules or even build them anymore," said Reboot Executive Director Lou Cove. "For those who do it's very nice, but it's not a widely shared creative enterprise. The idea of making the sukkah an architectural piece was a way of reinvigorating that tradition." While the sukkah's religious function is to commemorate the temporary structures



INTERIOR OF A CARDBOARD MOSQUE AT A SOMALIAN REFUGEE CAMP IN YEMEN







CONCEPT:

Just as the sukkah commemorates shelter provided during the forty desert-wandering years of Exodus, the design for our sukkah brings attention to the contemporary state of homelessness and wandering within the United States and is clad with signs made by the homeless and destitute. By purchasing homeless signs, from the individuals who made them, we are also contributing to a meal for someone who might not otherwise be able to eat today. In honor of the primary and traditional role of sukkah, which is a feast of bounty, of hospitality, and of welcoming strangers. Additionally the corrugated board shingles are made of the fibers of hardwood trees, therefore one could equate them to the historical use of branches on the sukkah roofs. The frame of our sukkah tapers as it moves up toward the sky to draw the eye up and also to provide a smaller framework for the shingles that are less than 4 handbreadths—relating directly to the presence and scale of the hand in each of the handmade signs. This sukkah, if built for Sukkah City, will be auctioned and the funds donated to a homeless shelter in New York city.

STATISTICS:

—It is estimated that between 40% and 50% of homeless single adults residing in the municipal shelter system have a chronic mental illness.
—Approximately 90% of homeless New Yorkers are black or Latino, although only 53% percent of New York City's total population is black or Latino.
—Almost 17% of residents of the single adult shelter system are employed.

Coalition for the Homeless, Updated May 2003
New York Times, 2002
Hunger Action Network of NYS, 1999
NY Coalition Against Hunger, 1998
http://www.ysiop.org/statistics.htm

—Each year 100,000 New Yorkers experience homelessness.
—Each night, over 38,000 homeless individuals sleep in the New York City shelter system. This includes more than 16,000 children and 8,000 single adults.
—Nearly 1-in-20 New York City residents have experienced homelessness.
—There are over 1,000 soup kitchens & food pantries in NYC and 2,730 in NY State serving 2 million New Yorkers annually. They will serve 60 million meals this year to hungry men, women & children.
—Families make up 78% of New York City's homeless shelter population.
—More than one-in-four children in NYC live in poverty. A typical homeless child is under 5 years old.
—Over half of homeless mothers in New York City have a history of domestic violence.
—Nearly one-in-five homeless parents were in foster care as a child.

WHO IS HOMELESS RIGHT NOW?

Daily Census for July 29, 2010

—8,087	Families With Children
—1,310	Adult Families
—7,776	Single Adults
—35,148	Total Individuals are homeless in NYC today

http://www.nyc.gov/html/dhs/html/home/home.shtml

SUKKAH

in which the Israelites dwelled during their exodus from Egypt, it is also a symbol of the transience of life as expressed in architecture.

Contestants did not have to be Jewish. The teams behind the 12 finalists received guidance from Judaic experts on how to craft a kosher sukkah. Neither Rael nor San Fratello are Jewish, but that didn't matter. "At this point, I think I'm much more familiar with the rules of constructing a sukkah than a lot of Jews," Rael said with a laugh. "Learning about lesser-known traditions of Judaism was really interesting." From dawn until dusk Sept. 19 to 20, nearly 200,000 passers-by wandered through Sukkah City in Union Square Park to marvel the sukkahs. "It turns out that architects viewed Jewish law in a way we could not anticipate," Foer said. "Working with the design constraints handed down for thousands of years was inspiring. They immediately understood how many levels of residence there are in the sukkah — what it means to be impermanent or homeless, to the role it plays in reconnecting Jews with their agricultural past. "All that is bound up with esoteric rules, some of which are playful," he continued, noting that a sukkah may be built out of an elephant's skeleton but no other animal's. "If that's not an invitation to do something weird, then I don't know what is."

Exerpted fro the article, "A booth with a view: Oakland architects build sukkah using signs from the homeless" by Amanda Pazornik. J! Weekly, Thursday, September 23, 2010.

Photo: Nate Levy
Sukkah City, NY

NOWHERE

Project Date: 2013
Project Team: Ronald Rael, Virginia San Fratello

The Museum of Nowhere is a remote frontier for art, design, craft and architecture. NOWHERE's aim is to recognize that in a century where greater than 50% of the population of the planet is migrating to cities, a rural community can also be a SOMEWHERE of rich cultural, geographic, historic and aesthetic importance. NOWHERE (or NOW HERE as the locals like to say) demonstrates this by combining the work of internationally recognized artists with local artists in the small town of Antonito, Colorado (pop. 779).

The museum is located in an abandoned building that was previously the town drugstore. Rael San Fratello purchased the building, demolished the interior and completely transformed the space into a typical modern gallery interior. A director was installed during the summer of 2013 who curated bi-weekly performance pieces, a museum shop and gave tours. NOWHERE asks the question, "Can art be a seed for economic development in a small town?"

Nowhere sign by Golden West Sign Arts


Performance piece by Chloe Rossetti

Interior: installations by Ehren Toole, Elmgreen + Dragset, Future Farmers and Stephanie Syjuco among others


Local visitor examining ceramic cups by Ehren Toole

THE MUD HOUSE

Project Date: 2008
Project Team: Ronald Rael, Virginia San Fratello,
Jeremey Chinnis, Natalie Gambill

The Mud House is located in in the high West Texas desert in the town of Marfa, TX. The house is inspired by the landscape, traditional building practices and the contributions of Donald Judd and is situated in a landscape of ocotillo, mesquite, yucca and sotol with a view to the Davis Mountains in the distance.

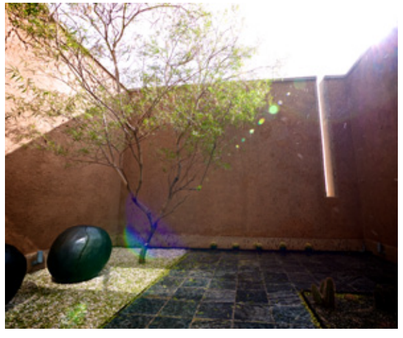
The Mud House is a large earthen box, designed to be easily constructed of mud brick and plastered with local soils mixed with cactus mucilage, horse manure and straw on the interior and exterior, and contains a smaller box inside that houses the major utilities of the housew.

Radiant heating in the floors warms the body in the cool winters and the massive earthen walls store the heat minimizing energy costs. The sun also enters the space in the winter months through a courtyard that connects the house to the sky and outdoors directly from the living area. The contrast between the thick, earthen walls and the concrete lintels that interpenetrate the façade to create openings, as well as the use of stainless steel in contrast with the earth, create a tension between old and new, rough and smooth, and the industrial and non-industrial.

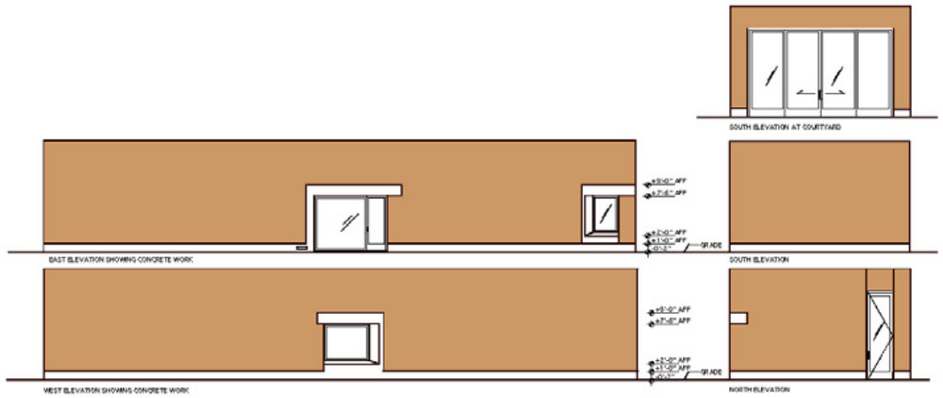
In the summer months, a subtle overhang over the courtyard entrance prevents direct sunlight from entering the house and the mud walls and high ceilings keep the interior cool. The clients, who are art lovers, selected works that are complimented by the earthen walls such as Kiki Smith and Susan York.

The entrance to the Mud House is through a slit in the earthen wall adjacent to a concrete pool that fills with water from the desert rains that is filled via the large scupper extending from the roof.

view of the big window



Inside, a large courtyard opens to the interior and to the sky, bringing in vast quantities of light, while shielding the desert sun.



Donald Judd aluminum box

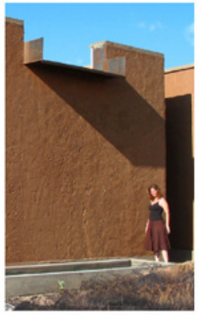
Interior perspective showing aluminum box and ceiling and changing reflections and light

View of Haystack Mountain from big window

right: view of the mud plastered interior and big window

Two types of mud bricks, or adobes, were used in the construction. The lower portion has adobes made in New Mexico that posses a higher compressive strength and resistance to water. Towards the top of the wall, adobes made in nearby Ojinaga, Mexico were used that are lighter in both weight and color. The mud used in the plaster is from Van Horn and has a beautful reddish tint.

this page: concrete lintel and window in the bedroom



right: north wall with scupper

PRADA MARFA

Project Date: 2008
Project Team: Ronald Rael, Virginia San Fratello

On July 13, 2005, 22 miles north of the U.S./Mexico border, patrol agents from the Marfa Sector of the United States Border Patrol surrounded five people traveling through the Chihuahua Desert in West Texas. Suspecting illegal activity, the agents had been informed that illegal immigrants were detected by the tethered aerostat radar system hovering overhead that provides counter-narcotics and border crossing surveillance and can distinguish targets down to a meter across at ground level.

It is not uncommon that coyotes, smugglers involved in the profession of human trafficking, drive the desolate roads searching for “wets”, the derogatory term for illegal immigrants, in the vast desert expanse surrounding Marfa. When the five suspects were questioned on the nature of their business the answer was not so clearly comprehended by the Border Patrol. The suspects were a gallery curator, a photographer, an artist, and two architects who were discussing the selection of the future building site of Prada Marfa, a minimalist sculpture that replicates the luxury boutique where the Fall 2005 line of Prada shoes and bags were to be displayed.

The juxtapositions between the United States and Mexico, or between wealth and poverty, that are clearly evident in the Big Bend region of Texas define a landscape charged with contrasting conditions in which Prada Marfa is built. The immense ranches that comprise the area, each several thousand acres or larger, often appearto be abandoned, but are owned by many of the wealthiest people in the United States. Most of the ranch owners have ties to oil, and more recently, dot com wealth, including a ranch owned by Amazon.com CEO and founder Jeff Bezos, where he has announced plans to construct a spaceport just down the road from Prada Marfa. Just as each of these polarities are somehow equally at home and “foreign” to this environment, so to is Prada Marfa, with it’s delicate interiors and massive walls, schizophrenically positioned in the geo-political and cultural framework in which it is built. In fact, the process of building the project is as simultaneously contextually grounded and extrinsic as the work itself.

The primary building material used to construct Prada Marfa is dirt. While it may seem odd to construct a building with soil, particularly one with the associated title Prada, building with earth is actually quite common. It is estimated that currently 1/2 of the world’s population, more than 3 billion people on 6 continents, lives, works, or worships in buildings constructed of raw earth. This makes fragmental soil, not to be confused with other materials that come from the ground, such as stone, cement, or metals derived from ore, the most ubiquitous building material on the planet. Earth buildings can also be found in almost every climatic zone on the planet, from the deserts of Africa, Australia and the Americas to England, Denmark, China and the Himalayas.

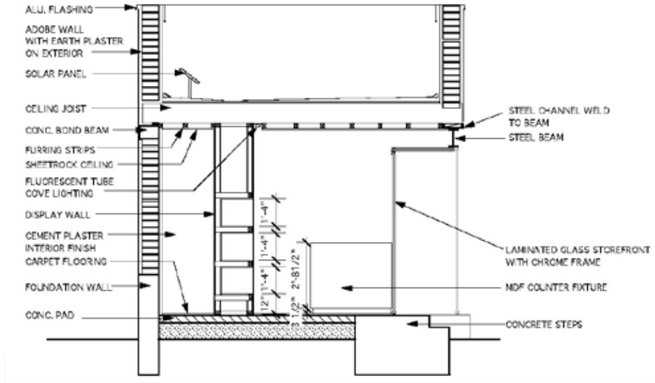
Whereas earth is a material that westerners commonly perceive to be reserved for the small, humble structures of developing countries, there are earth buildings of almost every architectural type in use by every economic and social class. Examples of churches, hospitals, museums, embassies, and even an airport demonstrate the wealth of earth building types found throughout the world. Typically, earth is also considered to be a building material only used in rural environments, but earth architecture can be found just as easily in contemporary urban environments. The world’s first skyscrapers, 11 story buildings first constructed over 500 years ago, continue to be constructed entirely from mud in the dense cities of Yemen. Perceived as a material of low quality, earth buildings also represent the oldest extant buildings

right: Prada Marfa at dusk

on the planet. Using approximately 7,000,000 mud bricks, the Ziggurat at Ur dates back to 4000 B.C. Taos Pueblo constructed between 1000 and 1450 A.D., in New Mexico is the oldest continuously occupied dwelling in North America and was also constructed from raw earth.

While earthen architecture is often considered the building material of the very poor , many wealthy residents inhabit the vast mud brick suburbs of Santa Fe, New Mexico. Ronald Reagan's former Ranch House (also known as "The Western White House") in California, Saddam Hussein's childhood home in Iraq, and Chairman Mao's childhood home in China were all constructed of mud brick, which speaks to the great breadth of ideological extremes represented by this omnipresent material. Now we can add Prada Marfa to this "A-List" of earthen architecture – the first Prada related building constructed of mud.

A large percentage of buildings in the region surrounding Prada Marfa, are also traditionally constructed of mud brick. Often made directly from soil excavated from the build site, mud brick, called adobe in Texas, is a brick made from soil mixed with water and straw and left to dry and harden in the sun. Historically, this was the traditional construction method used by the Mexican and Mexican American population. In the case of Prada Marfa, the 2,500 mud bricks used to construct the building were made by machine and express shipped to the site from a mud brick yard in Alcalde, New Mexico, over 500 miles away. Not unlike the luxury goods that fill the faux-boutique, the mud bricks arriving from this adobe yard are primarily manufactured to supply a growing population of southwestern affluence enamored with the romantic notion of living in a house constructed of earth. Increasingly, the demands made by wealthy interstate immigrants longing for mud brick residences have had a dramatic effect on the cultural and built landscape.



left: adobe bricks and concrete mortar walls
right: 2005 collection of Prada shoes and purses

At one time, buildings made of earth were looked down upon, and ultimately made illegal to construct for several decades. Today, however, mud brick's increasing popularity has created a demand for the material that has transformed it into a status symbol in the southwestern United States. The humble earthen houses that comprise Marfa's residential district now fetch several hundred thousand dollars from New Yorkers, Houstonians and Los Angelenos. Thus, what was once a vernacular tradition has transformed into a capitalist driven process that often leaves the traditional descendants of earth dwellers unable to afford mud, forcing them to switch to an ironically more affordable consumption of prefabricated mobile homes and concrete-block houses. Much like the knockoffs of Prada bags that are a consequence of the high price tag of authentic Prada merchandise, adobe knockoffs, faux-adobes, are the preferred style of manufactured southwestern homes.

Unlike traditional mud brick buildings, whose bricks are laid in an earthen mortar, the mud bricks used to build Prada Marfa were set in a cement mortar. The juxtaposition between the industrial material of cement and the traditional mud brick could be read as a nod to Donald Judd, but the combination also represents the bipolar nature of the context in which it is built. In Marfa the use of industrially produced cement, introduced by the U.S. military

– each leaving built traces in the landscape that are evident today. By crossing a border between art as commodity and commodity as art, Prada Marfa offers a conceptual interpretation of the latest wave of occupation in the region - Judd and the gentry of gallery owners, artists and art lovers who are his followers. It also raises questions regarding the consequences of this history.

While Prada Marfa was not constructed with illegal labor, mud brick construction is labor intensive and labor provided by illegal aliens is cheap. The demand for inexpensive labor in America coupled with a search by immigrants for higher paying jobs work hand in hand to prompt people to cross the desert by foot. Although it is difficult to know exactly how many immigrants cross the border in the Marfa sector each year, in 2005 there were 10,536 illegal border-crossing apprehensions and approximately 12 migrant border-crossing deaths. Most of these deaths are attributed to heat stroke or hypothermia. From a distance, illegal aliens walking through the desert at night
might perceive the illuminated building to be a possible source of water or shelter. However, upon closer inspection, Prada Marfa reveals an irony that connects the history of the region while also offering a prognostication. It is not uncommon for one's shoes to wear out during the arduous journey across the desert. In a desperate attempt to protect tired feet from the rough terrain, immigrants are known to try to fashion shoes from the only material available – the yucca plants that dot the landscape. The contrastingly opulent presentation of meticulously organized shoes and bags housed within the familiarity of mud brick walls also foretells the future – a growing socio-economic polarity at a local and, indeed, global level. – From the essay "House of Prada / House of Mud", Prada Marfa Catalog, Ronald Raelimmigrants for higher paying jobs work hand in hand to prompt people to cross the desert by foot. Although it is difficult to know exactly how many immigrants cross the border in the Marfa sector each year, in 2005 there were 10,536 illegal border-crossing apprehensions and approximately 12 migrant border-crossing deaths. Most of these deaths are attributed to heat stroke or hypothermia. From a distance, illegal aliens walking through the desert at night might perceive the illuminated building to be a possible source of water or shelter. However, upon closer inspection, Prada Marfa reveals an irony that connects the history of the region while also offering a prognostication. It is not uncommon for one's shoes to wear out during the arduous journey across the desert. In a desperate attempt to protect tired feet from the rough terrain, immigrants are known to try to fashion shoes from the only material available – the yucca plants that dot the landscape. The contrastingly opulent presentation of meticulously organized shoes and bags housed within the familiarity of mud brick walls also foretells the future – a growing socio-economic polarity at a local and, indeed, global level. – From the essay "House of Prada / House of Mud", Prada Marfa Catalog, Ronald Rael

left: Boyd Elder visiting Prada Marfa

BORDERWALL: ARCHITECTURE, INFRASTRUCTURE AND SOUVENIRS

Project Date: 2009-2013
Project Team: Ronald Rael, Virginia San Fratello, Brian Grieb, Nicholas Karklins, Emily Licht, Plamena Milusheva, Colleen Paz, Molly Reichert, Aine Coughlan, Kent Wilson

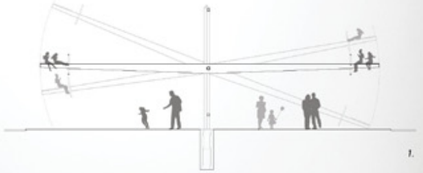
Recuerdos (Souvenirs) is a journey documenting a series of scenarios, real and imagined, along the U.S.-Mexico Border Wall. It is a story that must be told, for it is an account of the largest construction project in 21st century Usonia. Almost exactly the distance of the Grand Tour, the migratory route for upper-class European men that went from London to Rome, this journey stretches along the southern border for 1,931 miles. This Nuevo Grand Tour traces the consequences of a security infrastructure that stands both conceptually and physically perpendicular to human migration. Whereas the artifacts Grand Tourists would return with (art, books, pictures, sculpture) became symbols of wealth and freedom, the border wall is a preventative measure against Grand Tourists from the south.

On this journey, the collected experiences are accounted for in the form of stories, drawings, images, postcards, key chains and snow globes: souvenirs, or recuerdos—a Spanish term that defines both the trinkets one might purchase at tourist shops, and memories—in this case declarative memory that is both semantic (independent of context) and episodic (particular to context). The recuerdos gathered are tragic, sublime and absurd, occasionally hyperbolized, but in all cases based on real experiences and events existing in the liminal space that defines the southern boundary of the United States.

RECUERDOS, *{Souvenirs}*

Ronald Rael & Virginia San Fratello
RAEL SAN FRATELLO ARCHITECTS

But when one draws a boundary it may be for various kinds of reasons. If I surround an area with a fence or a line or otherwise, the purpose may be to prevent someone from getting in or out; but may also be part of a game and the players be supposed, say, to jump over the boundary; or it may show where the property of one man ends and that of another begins; and so on. So if I draw a boundary line that is not yet to say what I am drawing it for. — Wittgenstein[1]



1.

2.

3.

Fig 1. Teeter Totter Wall Section

Fig 2. The trade and labor relationships between the U.S. and Mexico are in a delicate balance, as witnessed in the Teeter Totter Wall

Fig 3. Cross-border volleyball game at Friendship Park, CA and Tijuana, MX

RECUERDOS, *{Souvenirs}*

On this journey along the border, a series of souvenirs, or *recuerdos*, a word which has the dual meaning describing both the tangible objects and the images we store in our memory, are collected. The liminal spaces that forged these moments along the wall were created by The US Secure Fence Act of 2006, which funded the single largest domestic building project of the twenty-first century. It financed approximately 800 miles of fortification dividing the US from Mexico at a cost of up to $16 million dollars per mile.[2] The construction of this wall has transformed large cities, small towns, and a multitude of cultural and ecological biomes along its path. The wall was envisioned for a *tabula rasa* defined by former Department of Homeland Security Secretary Michael Chertoff who was given the unprecedented power by President George W. Bush to waive any and all laws to expedite the wall's construction.[3] Ultimately, 30 laws were waived or suspended for the construction of the wall, including important environmental, wildlife, and Native American heritage protections. Ignoring the diverse contexts found along the border raises critical questions of ecology, politics, economics, archaeology, urbanism, and eminent domain, and radically redefines the territories of the *frontera*.

4.

5.

Published by U.S. Border Patrol

Una biblioteca binacional, construida en la línea divisoria, transforma el muro fronterizo en un lugar donde las ideas pueden cambiar.

6.

7.

Fig 4.,5. In 1891, prior to the construction of the wall, a boundary commission was created to assume the task of re-marking the border with a series of monuments. Border Monument Keychains, for which there is no key, were collected along the journey.

Fig 6. Excerpt from the postcard series

Fig 7. Map of existing fence types along the U.S. - Mexico Border

TYPOLOGIES

The over 800 miles of U.S. - Mexico border wall is organized in single, double, triple or more layers depending on the topography, incidence of crossings and available patrol resources. The wall is fabricated from steel, wire mesh, concrete and older sections are constructed of re-purposed Vietnam-era Air Force landing strips. It makes use of high-tech surveillance systems—aerostat blimps, subterranean probes, and heat sensors. Walls can be defined by the following typologies:

PEDESTRIAN [pedestre]
Constructed to prevent pedestrian crossing and often has a high transparency for surveillance.

VEHICULAR [vehicular]
Designed to withstand the impact of a large vehicle, often with a heavy concrete base.

HYBRID [híbrido]
Contains features of both pedestrian and vehicle walls.

LEVEE [dique]
Used along rivers to control flooding and prevent illegal crossings.

NATURAL [natural]
Rivers, deserts, temperature extremes, rough terrain are all considered natural barriers.

VIRTUAL [virtual]
Employ technologies such as motion detection, radar, sonar, infrared, wifi and photography.

Fig 8. Typical wall types along the U.S. - Mexico Border

Fig 9. "Federation Walls" divide families, communities and social networks

Fig 10. Porosity and transparency are common characteristics of the barrier

The concept of "national security" governs and militates construction and design of the wall as the success of the wall has been measured in the numbers of intercepted illegal crossings. However, the wall, at such prices, should be thought of not only as security, but also as product: ive infrastructure—as the very backbone of a borderland economy and ecosystem. Coupling the wall with viable infrastructure, focusing on water, solar energy, and urban social infrastructure, is a pathway to security and safety in border communities and the nations beyond them. This proposition is for a wide array of retrofits and new typologies for the US-Mexico border wall that build on existing conditions and seek to ameliorate problems created by the physical divider.

OBSERVATIONS

On this journey along the wall, it is discovered that the wall is fraught with a wide range of uses beyond a security infrastructure because:

The Wall is a common wall like those where special laws govern walls shared by neighboring properties. When a neighbor alters the common wall if it is likely to affect the property on the other side. Although each wall has two sides, altering a wall on one side will affect the wall and the space on the other side.

The Wall is an attractor. The current border wall is meant to keep people out and away, but instead, it serves as an attractor that engage both sides in a common dialogue.

The Wall is temporary and is constructed with the consideration that it will eventually be removed or reconsidered—creating a post-border wall condition that must reconcile the liminal space it once defined.

Over 700 miles of barrier have been constructed since 2006 at a cost of $3.4 billion. Additionally, the new wall has already been breached over 3,000 times, incurring $4.4 million in repairs. The construction and maintenance costs are estimated to exceed $49 billion over the next 25 years and there are several hundred more miles of wall construction recently proposed.[4] While recent statistics show a 50 percent drop over the past two years in the number of people caught illegally entering the United States from Mexico, human rights groups put the number of deaths during attempted crossings at its highest since 2006—almost 6,000 deaths have occurred since 1994.[5]

Fig 11. The construction of the fence dividing the Tohono O'odham Nation unearthed remains from a Native American burial site.

Fig 12. Families embrace through the barrier. Photo courtesy of Sandy Huffaker

DESIGN

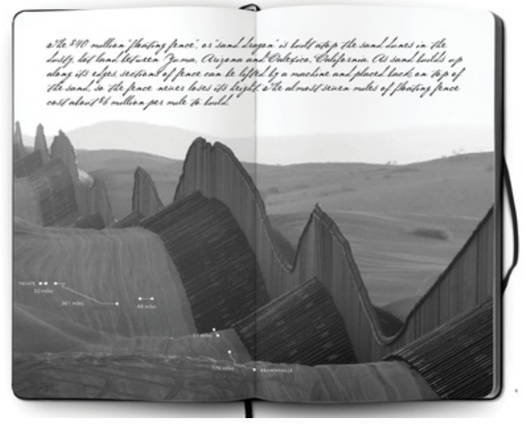
For the most part, architects and designers have stayed away from the border security issue. Ricardo Scofidio said about architects involvement in a border fence project, "It's a silly thing to design, a conundrum. You might as well leave it to security and engineers."[6] Rem Koolhaas, who studied the Berlin Wall, made the following observation:

"the Wall was not really a single object but a system ...it was one wall that always assumed a different condition."[7]

This is also true for the US-Mexico wall. It has created a paradoxical territory of horror, transformation, and flux, but at a much larger scale. It divides rivers, farms, homes, public lands, cultural sites, wildlife reserves, and migration routes, and was planned to cut through a university.

While the wall is always constructed on US soil, in many places it is constructed as far as two miles away from the actual territorial border. Removed from the market economy, this land in between the political boundary of the United States and the security barrier loses its productive value. Estimates suggest that there are approximately 40,000 acres of US land that will lie on the Mexican side of the border wall—an area equal to twice the size of Manhattan. To counter this economically neutralized land, the security infrastructure must be put to work through contextual engagement and investment.

Fig 13. Sister Cities along the border drawn as contiguous megacity



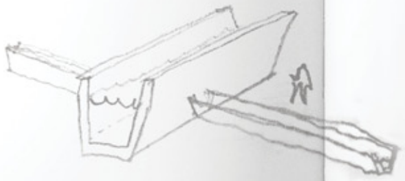
"The $90 million "floating fence," as sand troops" is built atop the sand dunes in the dusty, dry land between Yuma, Arizona and Andrade, California. All sand builds up along its edges as part of fence can be lifted by a machine and placed back on top of the sand. So the fence never loses its height. The almost seven miles of floating fence cost about $8 million per mile to build."

WATER INFRASTRUCTURE

The border wall has already proven to be an effective, if accidental, water collection system. Water from desert rains typically drain across the border—yet in areas such as the port of entry at Sonoyta and Organ Pipe Cactus National Monument, or in the Ambos Nogales, the fence acts as a dam, causing flooding and environmental damage. Border walls also block animals from food and water sources, which leaves them especially vulnerable in times of drought. When water collection is considered proactively, it can become a system with transformative consequences for the desert communities along the border.

14.

15.



16.

17.

Fig 14, 15. Trough Wall and Aqueduct sketches

Fig 16. Deer are blocked from their natural migration routes in search of water near Arizona's Riparian National Conservation Area

Fig 17. Flooding in Nogales, AZ and Heroica Nogales, MX

WATER TREATMENT: CALEXICO, CA - MEXICALI, MX

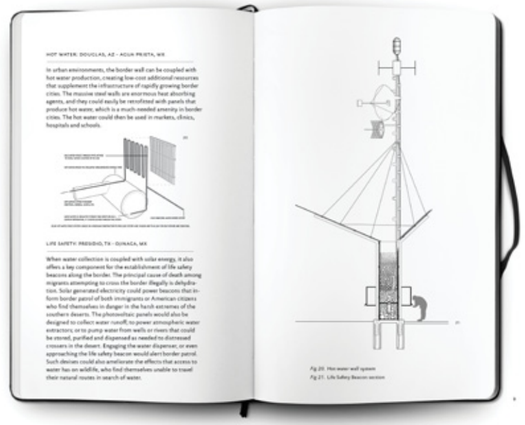
The New River is considered the most polluted river in the United States.[1] It flows north from Mexicali and crosses the border at Calexico. New River toxicity is comprised of chemical runoff; pathogens like tuberculosis, hepatitis, and cholera; and fecal coliform bacteria, which at the border checkpoint far exceeds US-Mexico treaty limits. The New River then flows through the Imperial Valley, which is a major source of winter fruits and vegetables, cotton, and grain. While the Secure Fence Act of 2006 was enacted, according to President Bush, to "help protect the American people" from illegal immigration, drug smuggling, and terrorism, the New River represents a far more dangerous flow north from Mexico in need of containment.[2]

A wastewater treatment wall located in the two-mile-long wasteland that buffers Mexicali from the Imperial Valley is a solution to the "illegal entry" of toxins to the US.

The pollution problem is expected to worsen as Mexicali's population, already at 1.3 million, continues to expand without adequate infrastructure. For $33 million, the same cost as the wall that divides Calexico and Mexicali, it is possible to construct a wastewater treatment facility with the capacity to handle 20 million gallons per day of effluent from the New River. This proposed facility is composed of a linear pond filtration and purification system, creating a secure border infrastructure. The by-product of the wastewater treatment facility would include methane and water, a combination that could power a series of lit, green corridors, creating a healthy, social infrastructure that could join these growing border cities.

Fig 18. Wastewater treatment plant cleans toxins from the New River

Fig 19. Wastewater treatment plant section



HOT WATER: DOUGLAS, AZ - AGUA PRIETA, MX

In urban environments, the border wall can be coupled with hot water production, creating low-cost additional resources that supplement the infrastructure of rapidly growing border cities. The massive steel walls are enormous heat absorbing agents, and they could easily be retrofitted with panels that produce hot water, which is a much-needed amenity in border cities. The hot water could then be used in markets, clinics, hospitals and schools.

LIFE SAFETY: PRESIDIO, TX - OJINAGA, MX

When water collection is coupled with solar energy, it also offers a key component for the establishment of life safety beacons along the border. The principal cause of death among migrants attempting to cross the border illegally is dehydration. Solar-generated electricity could power beacons that inform border patrol of both immigrants or American citizens who find themselves in danger in the harsh extremes of the southern deserts. The photovoltaic panels would also be designed to collect water runoff, to power atmospheric water extractors, or to pump water from wells or rivers that could be stored, purified and dispensed as needed to distressed crossers in the desert. Engaging the water dispenser, or even approaching the life safety beacon would alert border patrol. Such devices could also ameliorate the effects that access to water has on wildlife, who find themselves unable to travel their natural routes in search of water.

Fig 20. Hot water wall system

Fig 21. Life Safety Beacon section

SOLAR INFRASTRUCTURE

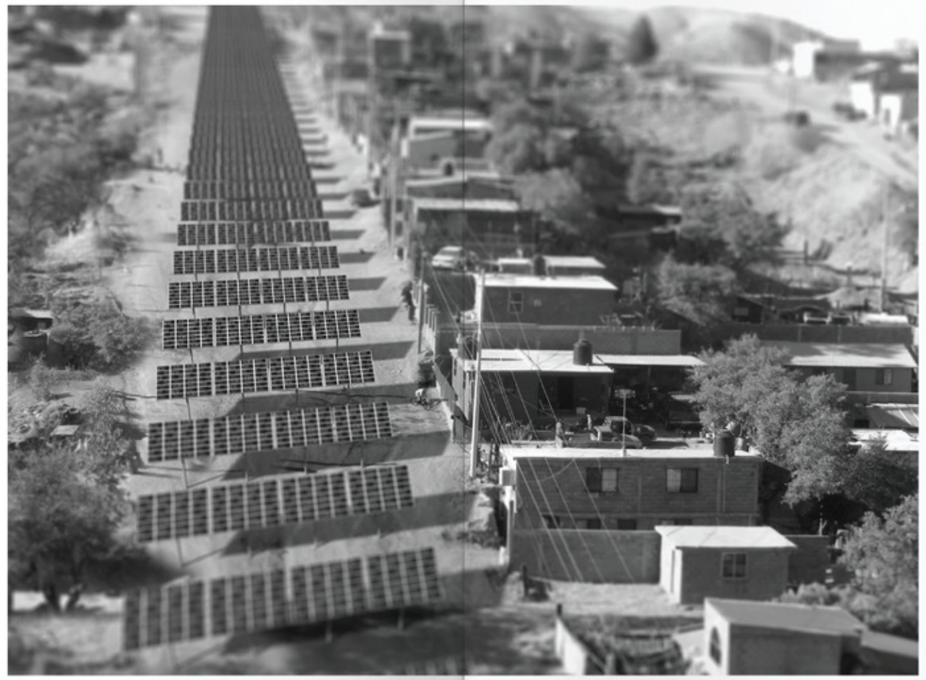
Building upon the installation of photovoltaics along the border, it is important to note that the most untapped potential for solar development in the United States lies along the US-Mexico border. Solar farms, in turn, are highly secure installations. Re-allocating funds used to construct and maintain the border wall for the construction of energy infrastructure along the border creates scenarios that, in many instances, are more secure than the existing wall, and simultaneously provide solar energy to the Southwest. The stretch between Nogales and Douglas see 87 miles of border wall construction at a cost of $333.5 million, while the largest solar farm in the world, the Olmedilla Photovoltaic Park in Spain, cost $330 million. For $333.5 million, 54 miles of profit-generating solar farm could be constructed at 40 feet wide, powering 40,000 households.

Fig 22. Solar potential map

Fig 23. Border Solar Park section

Fig 24. Nogales Fence, 1939

Fig 25. Nogales Solar Wall today



According to the U.S. Dept. of Energy, One square foot of land along the U.S-Mexico border can generate up to 260 kilowatts of electricity in one year - enough to power a household dishwasher for a year.

SOCIAL INFRASTRUCTURE

While most of this journey has been focused on public utility-style resources, the importance of social improvements along the border should be stressed. Exercise and eating, for example, are social activities where networks between people with common interests are formed. Social capital, a concept that refers to the value of social relations and the role of cooperation and confidence to achieve collective or economic results, can be produced by such networks and is a core element in the fabric of communities. social capital can produce safety and security, friendship and community, civic identity and economic value. Over time, social capital builds "social infrastructure," in the form of parks and other civic amenities—a key element in the health of communities. One of the most devastating consequences of border wall security is the division of communities, cities, neighborhoods, and families—the erosion of social infrastructure. Despite this, sports have served as a way to cope with the realities of the wall.

CLIMBING WALL: OTAY MESA, CA | TIJUANA, MX

"Show me a 50-foot wall and I'll show you a 51-foot ladder.."– Janet Napolitano

This comment has become a mantra for describing the fence's inadequacies as various techniques are used to surmount the wall. Artist Judi Werthein has created special shoes called Brincos (jumpers) - "crossing trainers" – designed to help illegal immigrants negotiate the sometimes deadly terrain they encounter when crossing the border from Mexico to the U.S. Various makeshift platforms/ ramps have also been erected to allow cars to drive over the border fence. With the Climbing Wall, the act of climbing the fence becomes not more difficult, but more challenging, as it employs rock climbing wall profiles with various routes and grading.

Fig 26. The Climbing Wall creates challenges on both sides for surmounting the barrier

Fig 27. Since its construction, the wall has been breached over 5000 times

Fig 28. Brincos: shoes designed for traversing the border

TORTILLA WALL: FRIENDSHIP PARK, CA | TIJUANA, MX

Casual exchange is not uncommon across the border wall. Friendship Park was one of the few places on the border where people from Mexico and the U.S. could meet and talk across the frontier. Families would set up beach chairs on both sides of the fence for picnics, lovers would clasp fingers through the mesh and embraces from family and friends through holes in the fencing could occur. Commercial exchanges also took place, albeit illegally, even between thirsty and overheated U.S. Border Patrol agents and humble tejocate salesmen on the other side. The Tortilla Wall is the name given to the 14 mile section of wall between the Otay Mesa Border Crossing and the Pacific Ocean. Sections of this wall accommodate food carts built into the wall. The proximity to the wall and the security overhang create shade. Seating is built into the wall and food, conversation or a bi-national meals can occur across the border.

Fig 29. A piece of tortilla is passed through the fence

Fig 30. Tortilla Wall section

Fig 31. The wall becomes a point of exchange for cross-border dialogue

Fig 32. Bulk or food carts on the Tortilla Wall

LINEAR PARK: CALEXICO, CA | MEXICALI, MX

Using the border as an armature for a linear urban park through certain urban geographies could offer pedestrian and bicycle routes through the city. The linear park, in turn, could increase adjacent property values and the quality of life on both sides of the border while providing an important green corridor through the city. Border towns lack the infrastructure that allows them to be sustainable, healthy cities and a border wall that integrates pedestrian transportation networks within the city, while promoting border security and decreasing automobile emissions. Trails support an active lifestyle that improves health. Physical activity helps prevent heart disease, diabetes, osteoporosis, obesity, colon cancer and depression. An increase in physical activity can save millions in health care spending. Tourism and recreation-related spending on items such as bicycles and in-line skates are just a few of the ways a bicycle path wall can positively impact community economies. Several of the social infrastructure proposals presented thus far could also be organized along this park.

Fig 33. Bicycle/Pedestrian Wall in Calexico, CA and Mexicali, MX

Fig 34. Jogging, riding and dog-walking along the security barrier

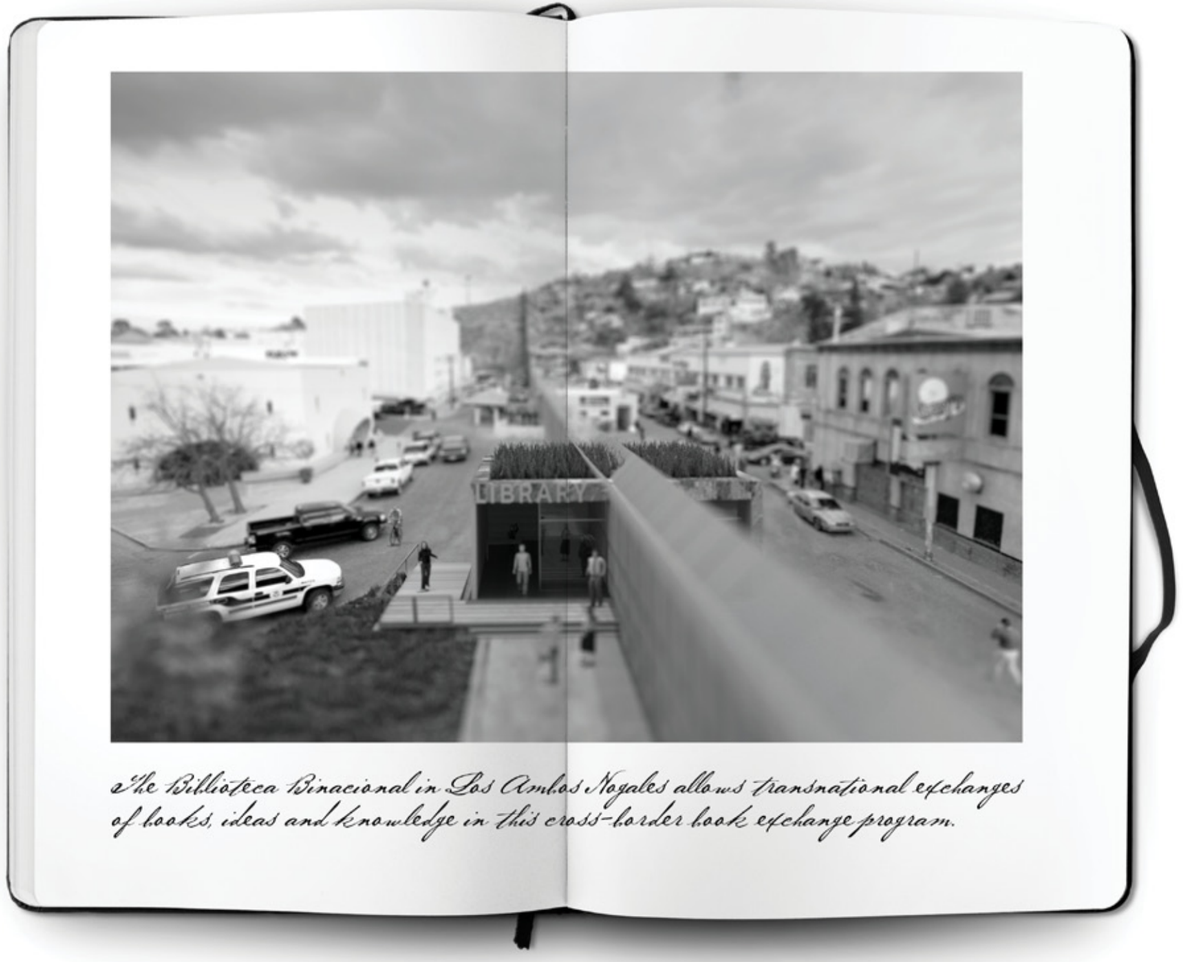
Fig 35. Linear Park with access to green corridors in the outer cities

SWING WALL: CHAMIZAL NATIONAL MEMORIAL, TX

The Treaty of 1884 went on to maintain that alterations to the border had to result from gradual natural causes. This provision followed the long-established doctrine of international law that when changes in the course of a boundary river are caused by a deposit of alluvium, the boundary changes with the river, but when changes are due to avulsion, the old channel remains the boundary. The river continually shifted south between 1852 and 1868, with the most radical shift in the river occurring after a flood in 1864. By 1873 the river had moved approximately 600 acres, cutting off land that was in effect made United States territory. The newly exposed land came to be known as El Chamizal, and eventually the land was settled and incorporated as part of El Paso. Both Mexico and the United States claimed the land. In 1895, Mexican citizens filed suit in the Juárez Primary Court of Claims to reclaim the land. The Swing Wall allows participants riding on the swing to cross back and fourth across the border without leaving their home country.

Fig 34. The Swing Wall allows riders to traverse back and forth across the border without leaving their home country

Fig 35. Swing Wall section



The Biblioteca Binacional in Los Amlos Nogales allows transnational exchanges of books, ideas and knowledge in this cross-border book exchange program.

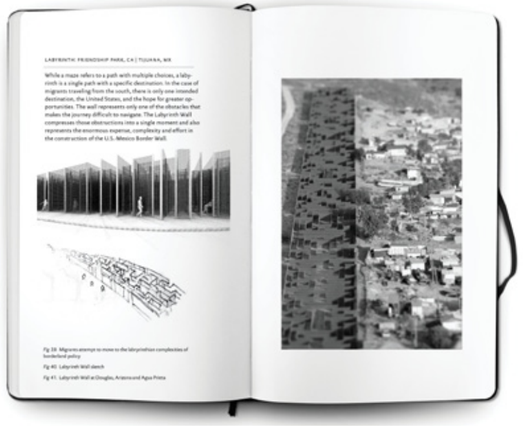
CONFESSIONAL: FRIENDSHIP PARK, CA | TIJUANA, MX

The division created by the wall often heightens border exchanges. In Friendship Park, a beach park that spans both San Diego, CA and Tijuana, Mexico, intimate exchanges are common. Each Sunday afternoon Holy Communion is offered through the fence -increasingly as an act of civil disobedience. Here the fence serves as an opportunity for confession, with both confessor and priest-most ask that his trespasses be forgiven as they must transcend the border to perform the rite.

Fig 36. Confessional Wall detail sketch

Fig 37. Confessors stand in line to confess their crossing of the border illegally

Fig 38. Both confessor and priest transgress the border in the Confessional Wall



LABYRINTH: FRIENDSHIP PARK, CA | TIJUANA, MX

While a maze refers to a path with multiple choices, a labyrinth is a single path with a specific destination. In the case of migrants traveling from the south, there is only one intended destination, the United States, and the hope for greater opportunities. The wall represents only one of the obstacles that makes the journey difficult to navigate. The Labyrinth Wall compresses those obstructions into a single moment and also represents the enormous expense, complexity and effort in the construction of the U.S.-Mexico Border Wall.

Fig 39. Migrants attempt to move to the labyrinthian complexities of borderland policy

Fig 40. Labyrinth Wall sketch

Fig 41. Labyrinth Wall at Douglas, Arizona and Agua Prieta

SWING WALL: CHAMIZAL NATIONAL MEMORIAL, TX

The Treaty of 1884 went on to maintain that alterations to the border had to result from gradual natural causes. This provision followed the long-established doctrine of international law that when changes in the course of a boundary river are caused by a deposit of alluvium, the boundary changes with the river, but when changes are due to avulsion, the old channel remains the boundary. The river continually shifted south between 1852 and 1868, with the most radical shift in the river occurring after a flood in 1864. By 1873 the river had moved approximately 600 acres, cutting off land that was in effect made United States territory. The newly exposed land came to be known as El Chamizal, and eventually the land was settled and incorporated as part of El Paso. Both Mexico and the United States claimed the land. In 1893, Mexican citizens filed suit in the Juárez Primary Court of Claims to reclaim the land. The Swing Wall allows participants riding on the swing to cross back and fourth across the border, but at all times remain securely on their respective sides.

Fig 34. The Swing Wall allows riders to traverse back and forth across the border without leaving their home country

Fig 35. Swing Wall section

"What I seek to convey is the historic truth that the United States as a nation has at all times maintained opposition—clear, definite opposition—to any attempt to lock us in behind an ancient Chinese wall." (Jan 6., 1941) – Roosevelt[13]

reTHINK BAY BRIDGE

Design Team: Ronald Rael, Virginia San Fratello, Frederick Schwartz, Marc L'Italian

On Monday, September 2, 2013 the new eastern span of the Bay Bridge opened to vehicular traffic, thus ending the 240,000 cars per day load to the historic, James "Sunny Jim" Rolph Bridge, east of Yerba Buena Island. In 2009, in anticipation of the new bridge, we proposed to repurpose, rather than destroy, the then to be abandoned bridge and imagined The Bay Line— an aerial garden, which would include housing, recreational and cultural facilities connected to a continuous, lushly planted, green strip, floating above the water as the region's newest park through which you could walk and wander and enjoy the most spectacular views of the bay.

Today the new bridge lies in the shadow of the abandoned span and new questions arise. Metropolitan Transportation Commission spokesman John Goodwin said the current cost forecast for the demolition project is $233.7 million and will take about three years. Previous predictions of the cost of the bay bridge project were unpredictable, resulting in the bridge being several billion dollars over budget and many years behind schedule, so there is good reason to at least imagine what other possibilities might exist for the abandoned structure.

If we compare the $233.7 million for the demolition to the cost of perhaps the most famous infrastructural reuse project, The High Line, the total cost of Section 1 and 2 of The High Line was $152.3 million. The design and construction of the currently opened area cost $86.2 million. Funding for the project came from multiple sources: $112.2 million from the City, $20.3 million from the Federal Government, $400,000 from the State, $44 million raised by the Friends of the High Line.

Does the possible investment in social infrastructure outweigh the cost associated with demolishing the bridge?