Designing New York: Prefabrication in the Public Realm

NYC DESIGN

COLUMBIA GSAPP

Cover Image:
NYC Parks Beach Restoration Modules
Wolfe’s Pond Park, Staten Island, NY
Garrison Architects
Image courtesy of © Andrew Rugge

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This publication is a collaboration of the NYC Public Design Commission (PDC)
and Columbia University’s Graduate School of Architecture, Planning, and Preservation (GSAPP).

Thank you to Columbia University for their generous support toward this publication.

Thank you to the American Institute of Architects New York Technology Committee for their generous support towards furthering this research and facilitating the July 2019 roundtable to discuss these projects.

Contents

Introduction

As part of the NYC Public Design Commission's *Designing New York* series, *Designing New York: Prefabrication in the Public Realm* examines how prefabrication practices can be applied to small-scale urban infrastructure projects to have a large public-realm impact.

As with other densely populated and expanding urban metropolises, New York City is exploring unconventional methods of designing and constructing to meet growing needs for public infrastructure while also addressing pressures to reduce costs. As a result, prefabricated, modular, and flatpack methods of construction are being explored as alternatives to traditional construction methods across the city. Through a research partnership between the NYC Public Design Commission (PDC) and Columbia University's Graduate School of Architecture, Planning, and Preservation (GSAPP), this document presents case studies of current best-practices for prefabrication, and analyzes both technical and logistical nuances of these systems in order to further understand their viability in New York City.

A departure from other discourse on prefabrication that often focuses primarily on cost and time-savings, or on mid- to high-rise housing and hotel typologies, this publication looks to small-scale urban infrastructure and dwelling prototypes that are woven into the public realm. Through this shift towards public-realm focus, the intent is to frame conversations for adaptability and economical design excellence within prefabrication practices both citywide and globally. The long-term goal of this project is to give public agencies, designers, developers, and the community at-large, tools to incorporate and advocate for quality comprehensive approaches to prefabrication across a diverse set of programs and typologies.

This research was originally initiated as a seminar at Columbia University GSAPP entitled *Prefab, Modular, and Flatpack*. The seminar examined the history of exemplary prefabrication processes and projects to-date, and focused specifically on recent developments that have evolved in the last ten years, building upon the 2008 MoMA exhibition and publication *Home Delivery: Fabricating the Modern Dwelling*, curated by Barry Bergdoll and Peter Christensen.

The seminar concluded with a roundtable discussion at the Center for Architecture in July 2019, where a panel of interdisciplinary and cross-sector professionals discussed student findings and further probed issues related to design and procurement, engineering and construction management, and site selection and transport logistics unique to New York City.

Following the seminar and roundtable discussion, research materials and findings were further developed by GSAPP students, and a number of key projects were selected as case studies for inclusion in this document. Amidst the global COVID-19 pandemic, additional public health and pandemic relief projects have also be added.

The goal is that this body of research can be a living document and continue to grow with the ever-evolving conversations surrounding prefabrication practices.

Working Definitions

Prefabricated (Prefab)

Prefabrication, or the abbreviation prefab, is a “general term for the manufacturing of entire buildings or parts of buildings off-site prior to their assembly on-site. Prefabricated buildings include both portable buildings and various types of permanent building systems.” (Smith and Quale 2017, p. 267) The terms prefabrication and prefab are generally used as umbrella terms that include both modular and flatpack systems of construction, and can also be used to describe buildings constructed using hybrid schemes, where portions of the structure are prefabricated while others are constructed with traditional on-site work and assembly. “The building may be delivered in flatpack form with panels lifted up and bolted together, or produced in full volumetric modules that have walls, roofs, and floors.” (Curl and Wilson 2016) The line between a prefabricated and non-prefabricated building is often blurred, as many buildings have some component parts that are prefabricated offsite, such as masonry units, windows, and framing.

There are several benefits of prefabrication including, but not limited to, flexibility in design, reduction in costs through streamlining of component manufacturing, reduced site construction time, safer working conditions in a factory-controlled environment, fewer weather-related construction disruptions, and lower volume of construction waste.

The challenges associated with prefabrication can often include a limited variety and repetitive nature of prefabricated elements, coordination of front-loaded design and engineering decisions to streamline construction process, and transportation and staging logistics.

Modular

Modular construction is a subset of prefabrication, specifically a type of prefabrication where “volumetric building modules form the structure of the building as well as the enclosed useable space.” (Smith and Quale 2017, p. 262) A modular system is characterized by its functional partitioning into discrete three-dimensional standardized modules that can be independently created, assembled, and banked together to create a larger whole.

The umbrella benefits and challenges associated with prefabrication also apply to modular construction. In addition, modular construction faces larger challenges related to transportation logistics, as the size and weight of modules are often regulated by local freight laws and physical limitation of transportation routes, and so moving modules from a factory to the project site requires additional coordination.

Flatpack

Flatpack construction is also a subset of prefabrication, specifically a type of prefabrication where “prefabricated elements or systems are transported to the site as two-dimensional elements, rather than three-dimensional volumetric forms.” (Smith and Quale 2017, p. 256) Flatpack can be used where modular prefabrication is not feasible, or in hybrid approaches, such as the use of flatpack facades on a traditionally or modular constructed building.

Flatpack is considered much more efficient than modular construction since prefabricated flatpack panels can be stacked horizontally on a trailer bed and transported to site more easily than vertically stacked panels or volumetric modules. Flatpack trucking can reduce the bulkiness and cost of shipments significantly, while still providing many of the benefits of prefabricated construction. This method can be very useful in the construction of buildings that do not work neatly as modules.

The working definitions above have been expanded and adapted from *Offsite Architecture: Constructing the Future* and *The Oxford Dictionary of Architecture* by GSAPP students during the *Prefab, Modular, and Flatpack* A4859 Spring 2019 seminar.

Curl, James Stevens; Wilson, Susan. *The Oxford Dictionary of Architecture*. Oxford: Oxford University Press, 2016.
Smith, E. Ryan; Quale, John D. *Offsite Architecture: Constructing the Future*. London: Routledge, Taylor and Francis Group, 2017.

1 New York City
Case Studies

NYC Parks Beach Restoration Modules

Citywide (Staten Island, Brooklyn, Queens)

Modular
New York City

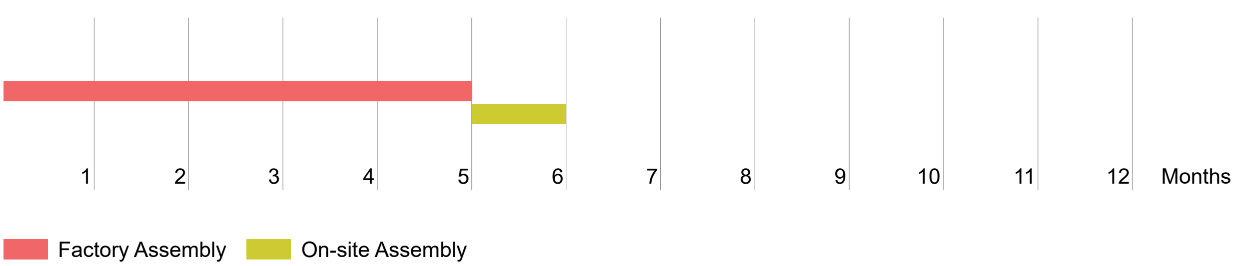
Image courtesy of © Andrew Rugge

Architect	Garrison Architects
Construction Manager	Jacobs Project Management
General Contractor	Triton Structural Concrete
Structural Consultant	Anastos Engineering
Off-site Assembly Time	5 months
On-site Assembly Time	1 month
Year Completed	2013
Site Typology	Infill
Program	Public utility, mixed-use
Stories	1
Gross Square Footage	7,200 SF
Structural Materials	Steel
Facade Materials	Corrugated aluminum, wood
Additional Information	garrisonarchitects.com

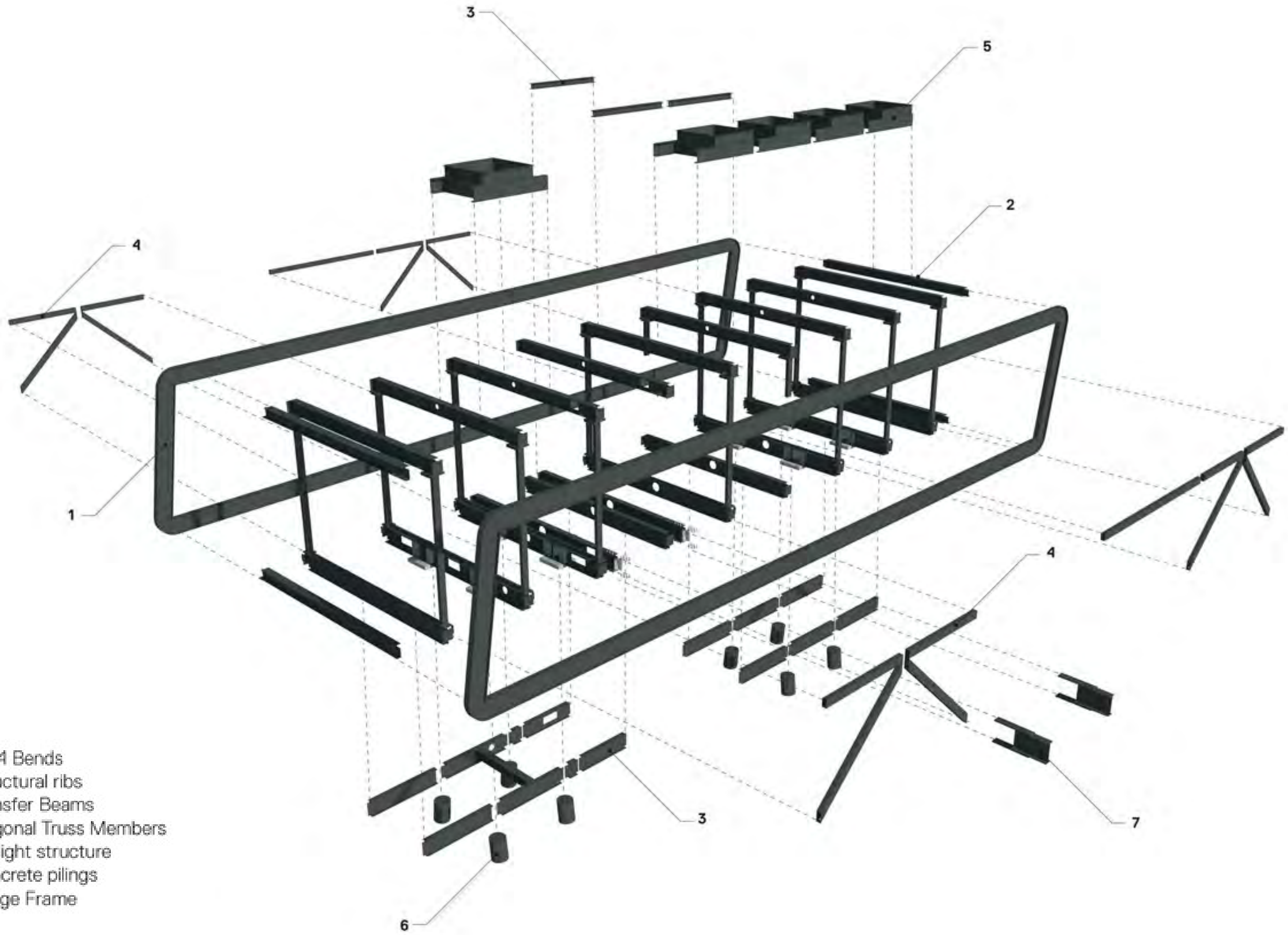
Built and deployed within five months, Garrison Architects designed 37 flood-proof structures that were placed in 15 sites across New York City to replace beach infrastructure damaged by Superstorm Sandy in 2012. In order to minimize disturbance to neighbors, limit site work, and meet a tight schedule, the structures were constructed and assembled in-factory as modules, and then were placed on-site and finished. Through interagency coordination and efficiencies of modular construction, the structures were open and functioning in time for the 2013 summer season.

The modules are flexible and adaptable to different uses and site conditions. Using a common chassis design, the modules were modified for use as comfort stations, lifeguard stations, offices, and public bathrooms. Designed for resiliency, the modules sit on top of concrete legs that raise them above the five hundred-year flood-level, and are accessible by a series of ramps and stairs.

Construction Timeline

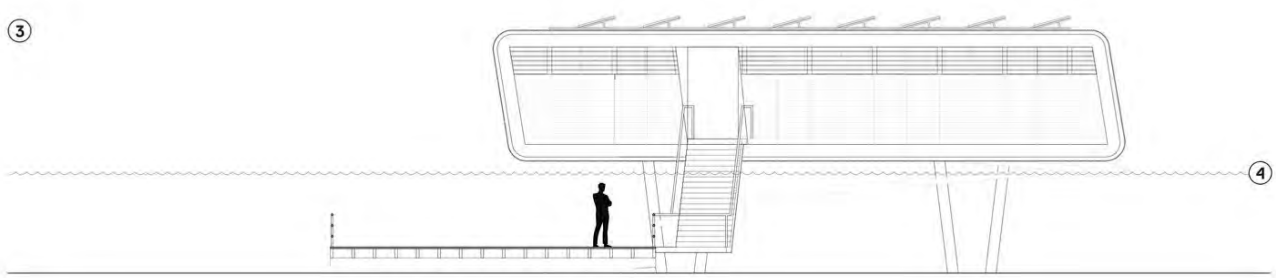


Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Rahul Gupta, GSAPP.



1 W-14 Bends
2 Structural ribs
3 Transfer Beams
4 Diagonal Truss Members
5 Skylight structure
6 Concrete pilings
7 Bridge Frame

Above: Module Components **Below**: Section Drawing



1 Boardwalk Access
2 Beach Access
3 Grade Access
4 Advisory Board Flood Elevation (ABFE)

Images courtesy of © Garrison Architects

Modules at Rockaway Beach, Queens.

Image courtesy of © Andrew Rugge

The Cubes

Socrates Sculpture Park, Queens, New York

Modular
New York City

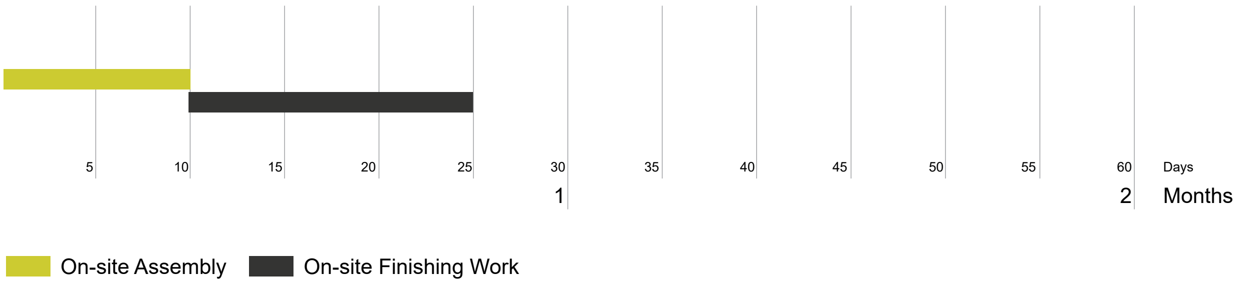
Rendering courtesy of © LO-TEK

Architect	LO-TEK
Year Completed	In progress
On-site Assembly Time	10 days
Site Typology	Infill
Program	Education, administration
Stories	2
Gross Square Footage	2,640 SF
Structural Materials	Steel (shipping containers)
Facade Materials	Corrugated steel, glass
Additional Information	lot-ek.com

When complete, the Cubes at Socrates Sculpture Park will provide a permanent home for the park's administration and education space, including offices and classrooms. Originally installed as a studio in the courtyard of the Breuer Building when it was the Whitney Museum of American Art, the central structure, a prefabricated cube constructed of shipping containers, was donated to the Socrates Sculpture Park for adaptive reuse when the Whitney relocated downtown.

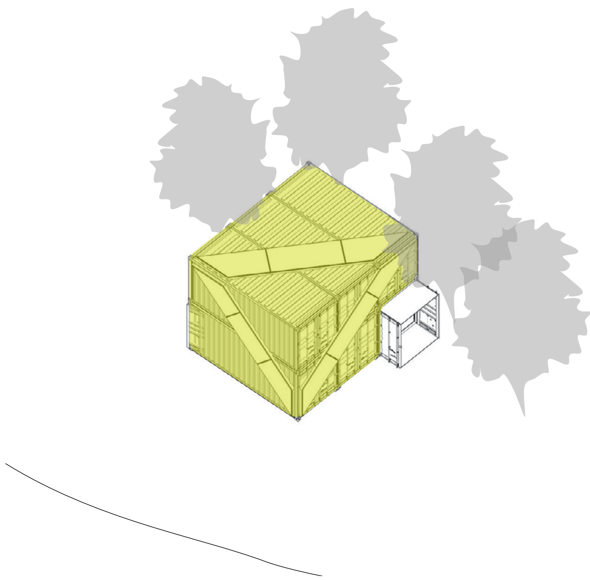
The use of shipping containers not only reduces construction time significantly, but also invokes the park's founding principles, emphasizing reclamation, adaptation, and the neighborhood's industrial roots. The shipping containers have integral structural strength provided by the corrugated steel siding, and the chevron windows add cross-bracing stability while also providing natural light and transparency. The structure at Socrates Sculpture Park will be the result of building upon the existing Whitney studio cube. Two more shipping container cubes will be added to the original cube, plus an open-air "ghosted" cube which will support a shade canopy for outdoor workshops.

Construction Timeline

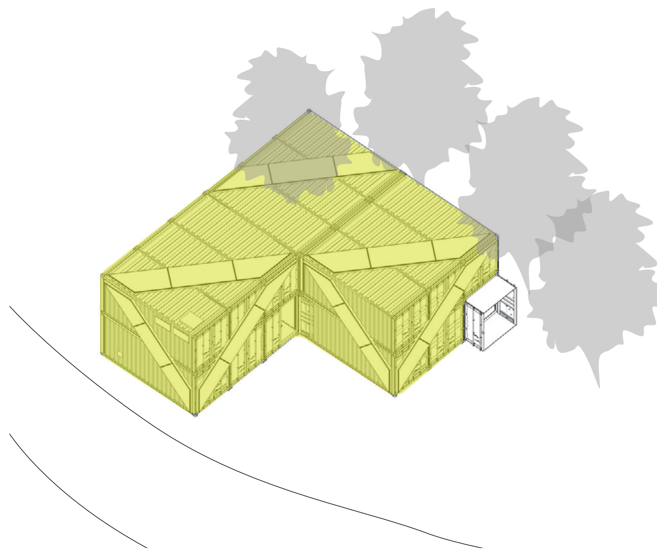


Please note that this project is in development and all project data is estimated. Research by Kuan He, GSAPP.
Project description by Rahul Gupta, GSAPP.

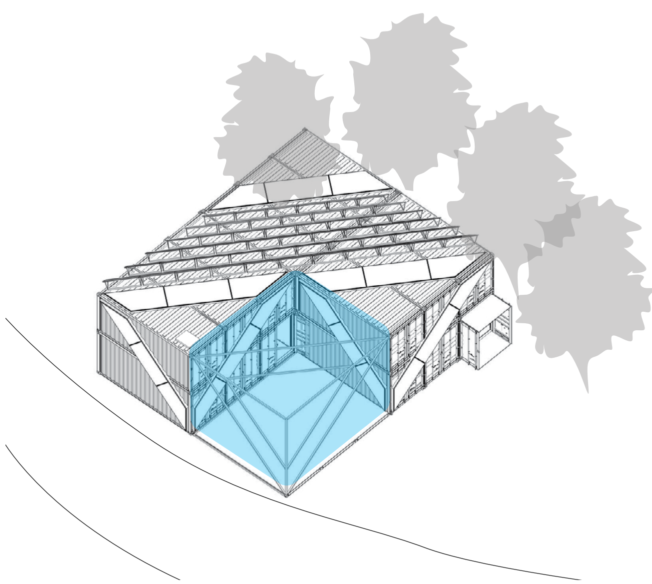
Construction Sequence



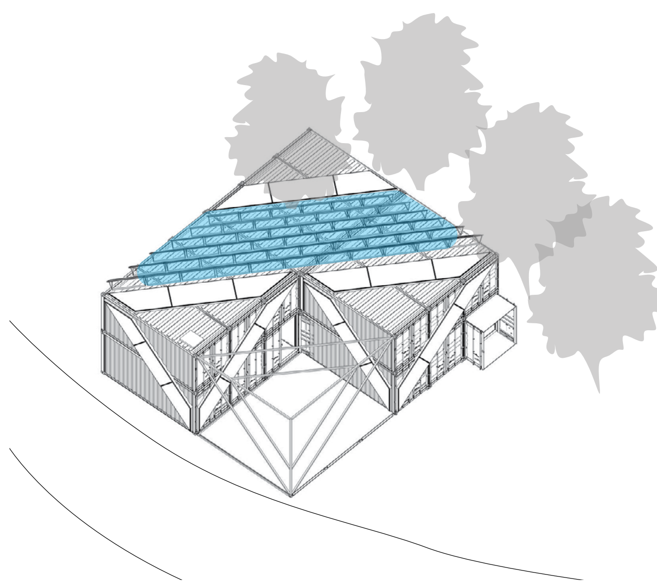
1. The Whitney Studio module.



2. The Whitney Studio module plus two additional modules.



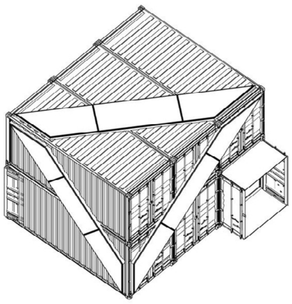
3. The modules plus an open-air enclosure surrounding a 480 SF deck.

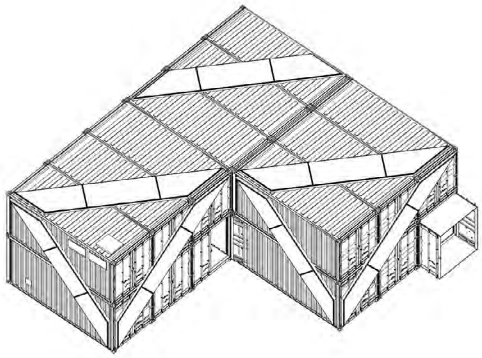


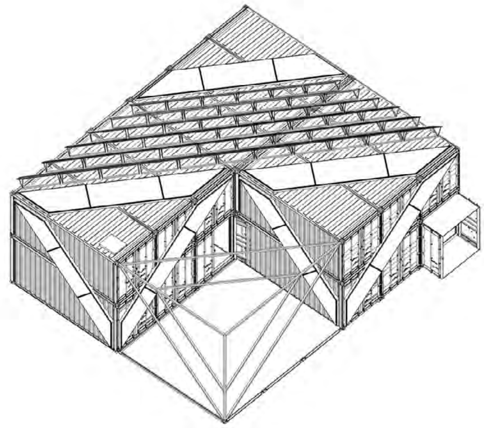
4. A solar-paneled roof will also be added to the structure.

Staging / Containers

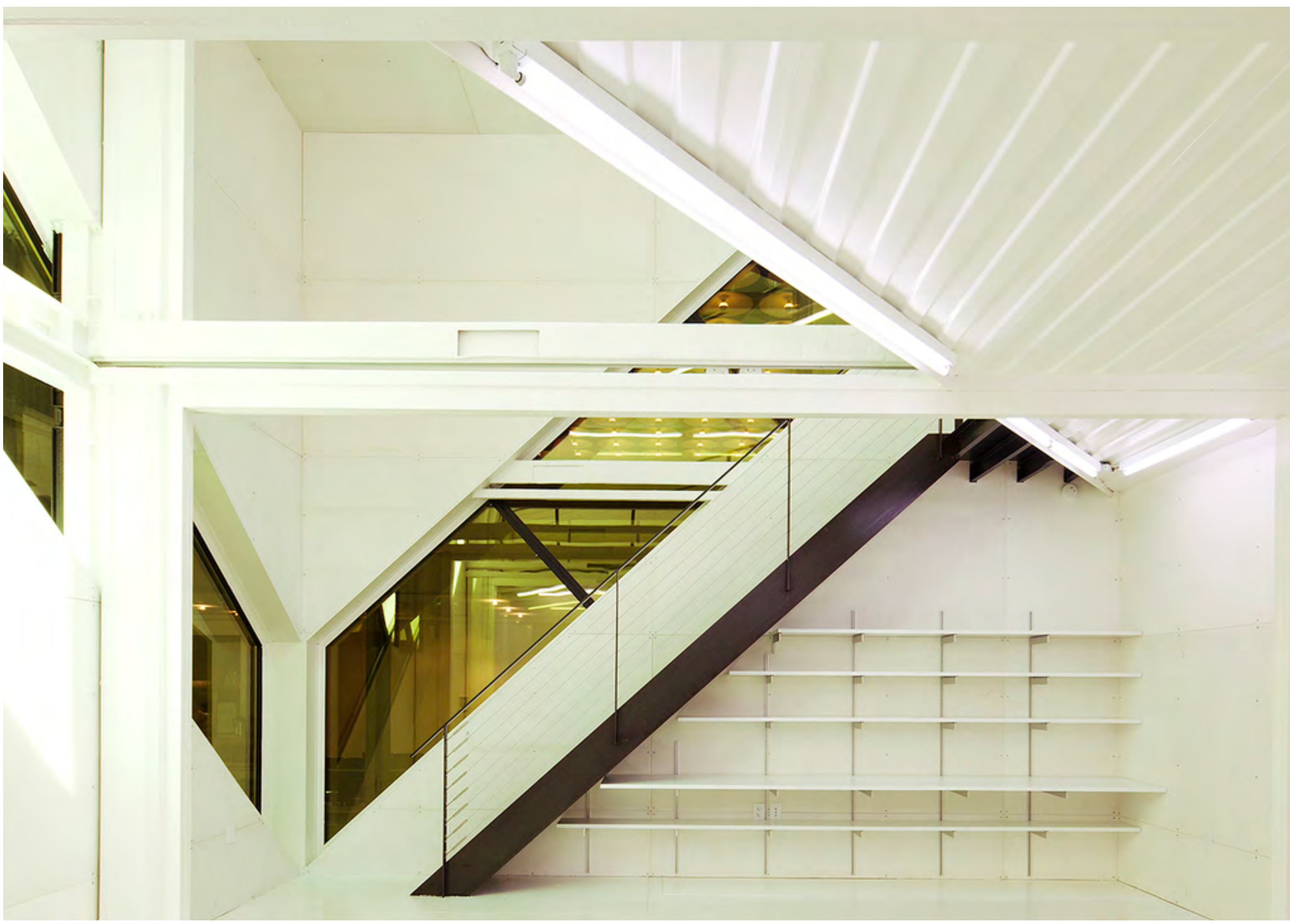
Assembled Components







Above: Module composition of The Cubes. **Below**: Original Whitney Studio module in situ at the Breuer Building.



Images courtesy of © LO-TEK

Renderings courtesy of © LO-TEK

Lady Liberty Charter School

746 Sanford Avenue, Newark, NJ 07106

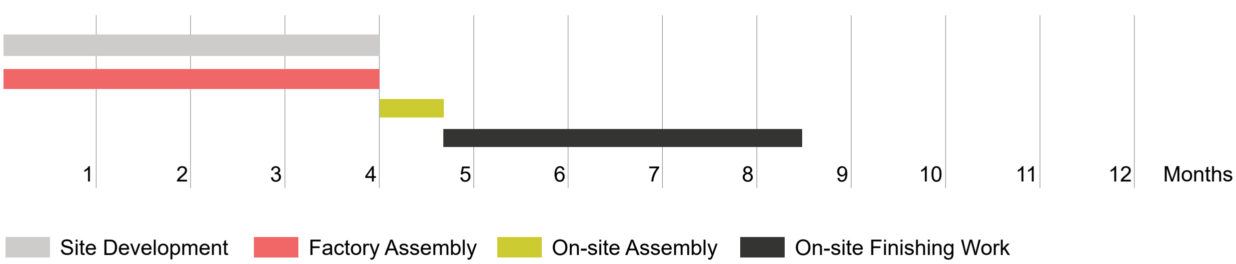
Image courtesy of © GLUCK+

Architect	GLUCK+
Year Completed	2014
Factory Assembly Time	4 months
On-site Assembly Time	3 weeks
Site Typology	Corner
Program	K-8 school
Stories	2
Gross Square Footage	43,400 SF
Structural Materials	Cold rolled steel post and beam, wood infill
Facade Materials	Cement board, aluminum
Additional Information	gluckplus.com

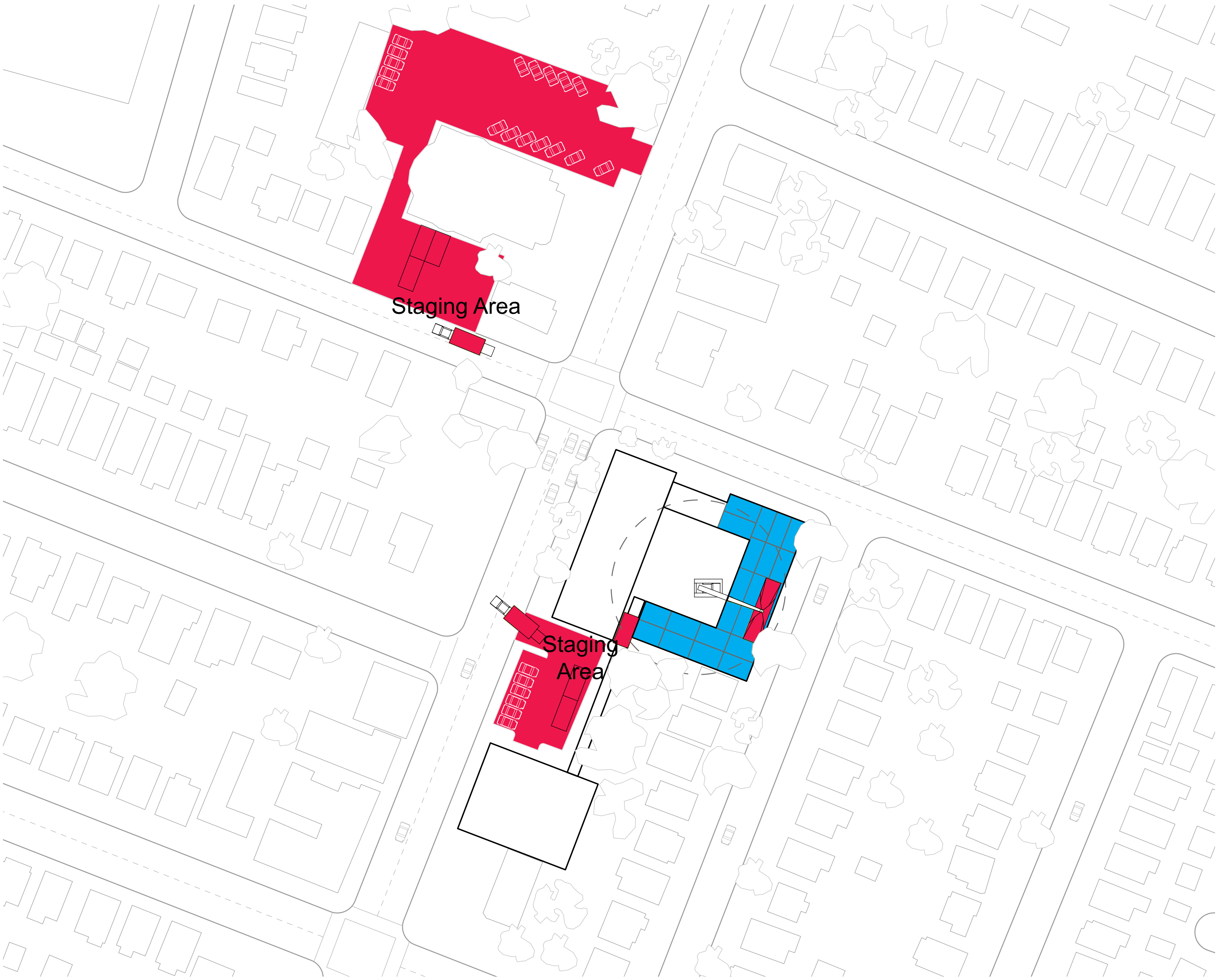
From 2012 to 2019, the Lady Liberty Charter School served over five hundred students in grades K-8. Using both prefabricated and modular methods of construction, a 17,400 SF addition was added to the existing 26,000 SF facility in 2014, creating additional classroom space and a courtyard for recess and recreation.

Given limited funds and a tight construction timeline, modular and prefabricated construction methods were chosen for the build. After excavation, precast concrete retaining walls with insulation and stud walls already attached were placed, rather than poured, on-site to expedite the build of the basement story. Above ground construction was executed using modular prefabricated timber and steel volumes, adding valuable classroom space to the existing facility. The modules were constructed in Pennsylvania and transported via truck to the site. Erection of the modules took ten days on-site, and all the flatpacked cladding and finish work was completed roughly three and a half months later.

Construction Timeline

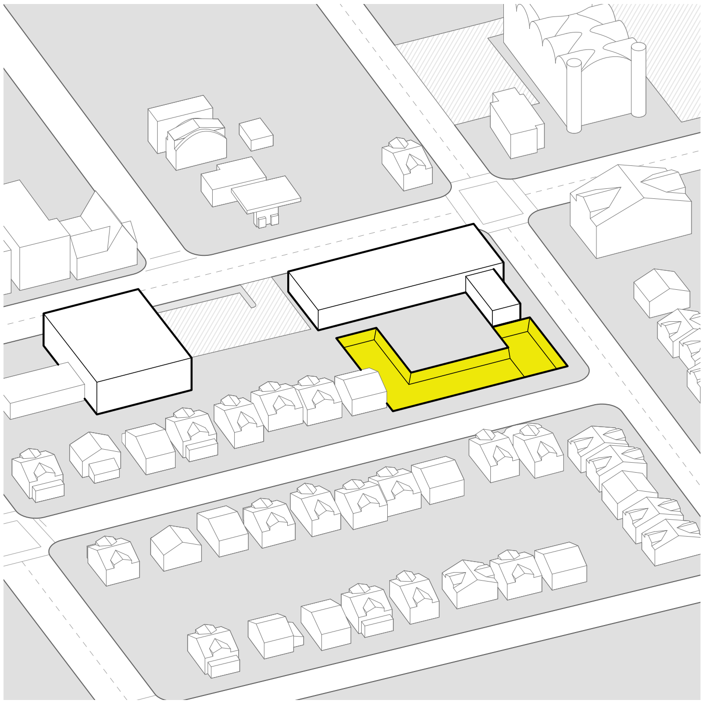


Project data provided by GLUCK+. Research and project description by Jacob Karasik, GSAPP.

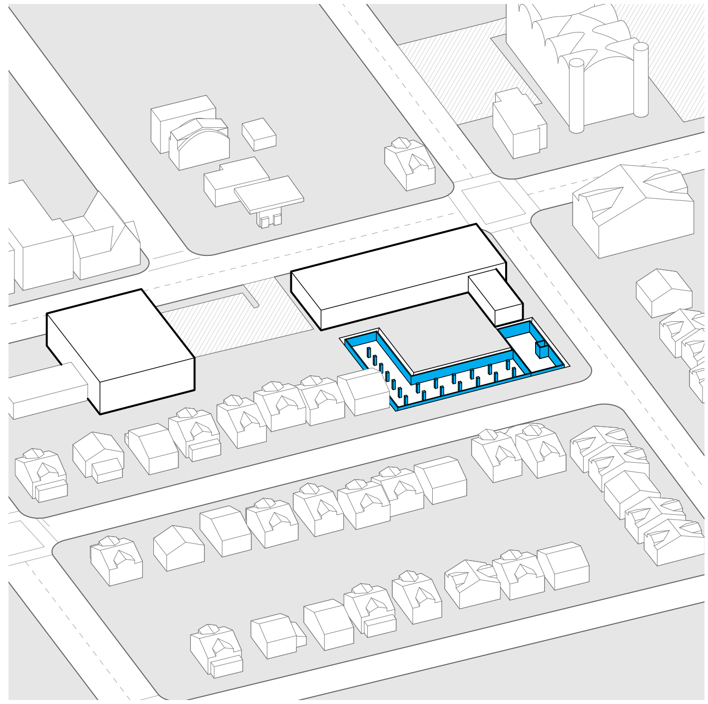


Site Plan and Staging

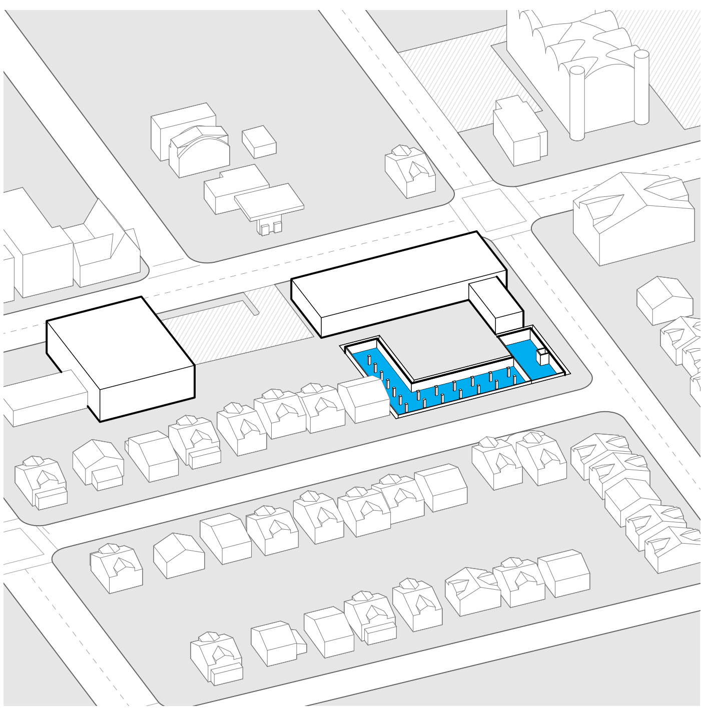
Construction Sequence



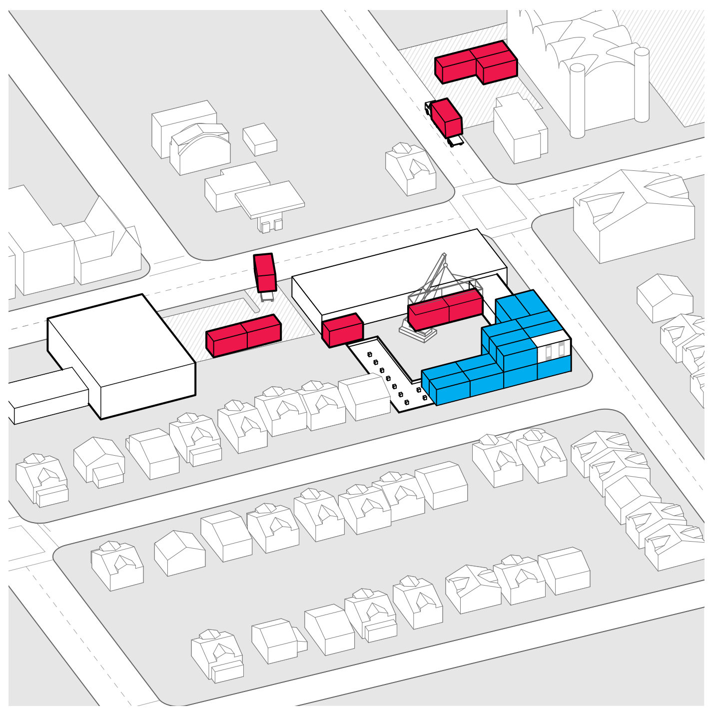
1. Site excavation.



2. Prefabricated concrete walls were placed.



3. Concrete slab was poured.

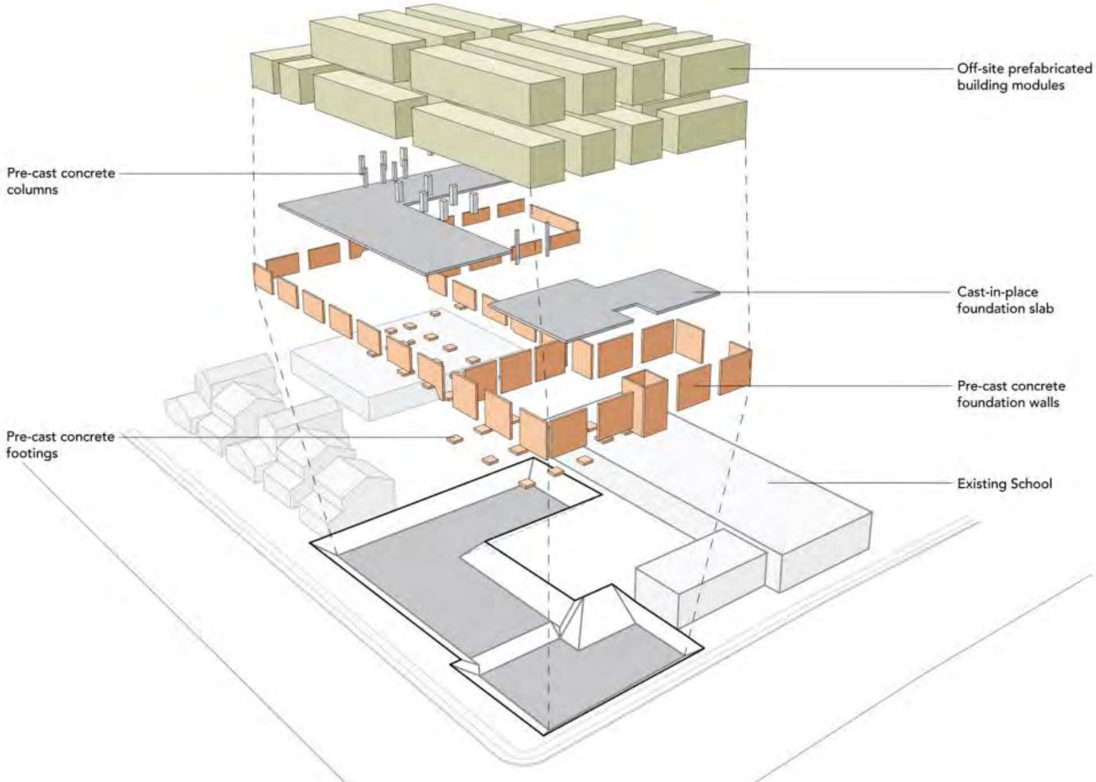


4. Modules were assembled on top of the foundation.

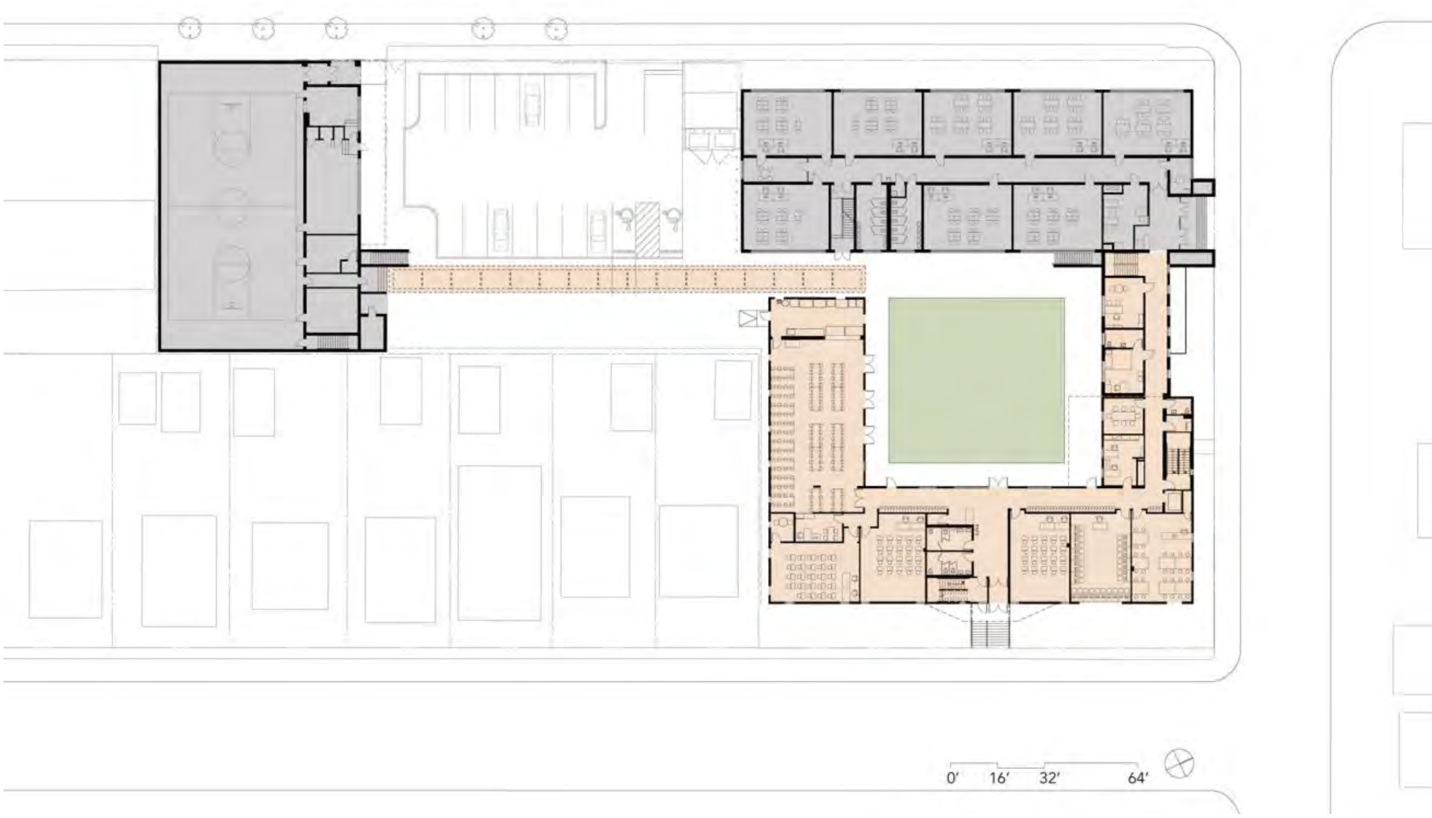
Site Development

Staging / Assembly

Assembled Components



Above: Assembly Axonometric **Below**: Ground Floor Plan



Drawings courtesy of © GLUCK+

Images courtesy of © GLUCK+

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Images courtesy of © GLUCK+

Lady Liberty Charter School

Prefab
New York City

Images courtesy of © GLUCK+

Impact Farm (Harlem Grown)

127 W 127th Street 201, New York, NY 10027

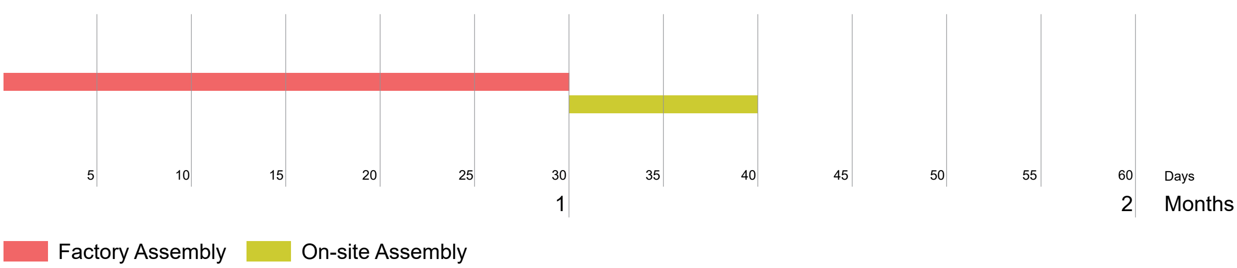
Image courtesy of © Human Habitat

Architect	Human Habitat
Year Completed	2018
Off-site Assembly Time	1 month
On-site Assembly Time	10 days
Site Typology	Infill
Program	Urban agriculture prototype
Stories	2
Gross Square Footage	538 SF
Structural Materials	Timber
Facade Materials	Polycarbonate
Additional Information	humanhabitat.dk harlemgrown.org

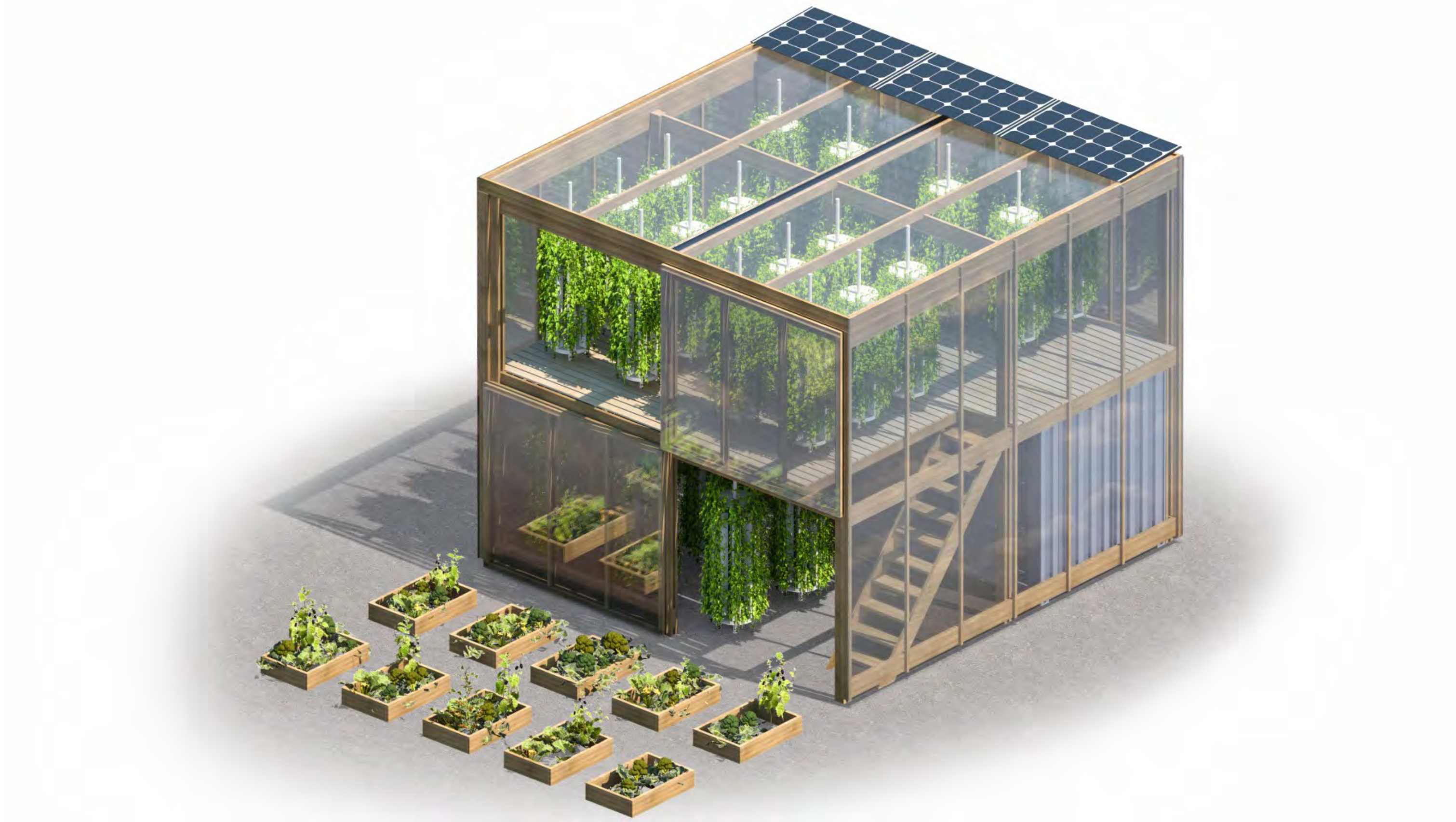
Impact Farm is designed to create an economically sustainable business model that ensures resource-efficient local food production, green jobs, and increased local economic activity. The facility can grow greens, vegetables, herbs, and fruiting plants within its frame. All of the construction components for Impact Farm, along with an instruction booklet, are stored and shipped in a flatpack container. When unpacked, the container includes an assembly kit of pre-made materials that become a two-story vertical, soil-free, hydroponic farm that covers 538 SF.

Construction takes about ten days and the structure can easily be disassembled and moved to various locations. The whole structure and building system is designed to be self-sufficient by harvesting sun and wind and collecting rainwater for internal use. The Impact Farm in Harlem was constructed in the fall of 2018, and since then over 1100 lbs of greens have been harvested from it and distributed to local residents.

Construction Timeline



Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Jacob Karasik, GSAPP.



Above: Module Axonometric **Below**: The original Impact Farm prototype, installed in Copenhagen, Denmark.

Images courtesy of © Human Habitat

NYC Emergency Housing Prototype

Modular
New York City

[165 Cadman Plaza East, Brooklyn, NY 11201]

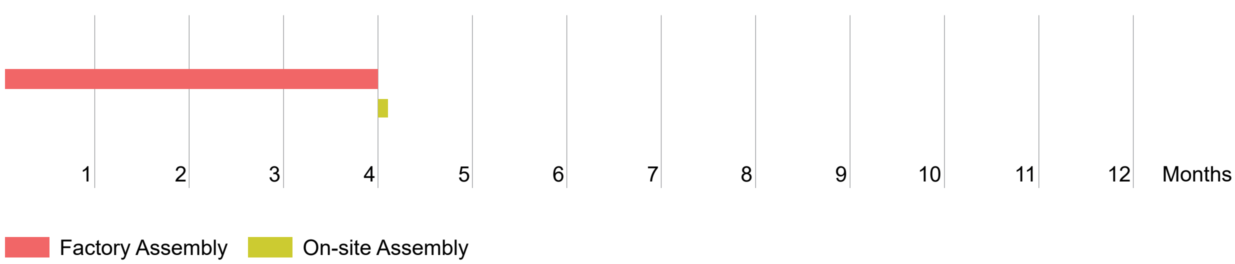
Images courtesy of © Garrison Architects

Architect	Garrison Architects
Fabricator	Mark Line Industries
General Contractor	American Manufactured Structures and Services
Structural Consultant	Anastos Engineering
Civil Engineer	Wohl & O'mara
Factory Assembly Time	4 months
On-site Assembly Time	15 hours
Year Completed	2014
Site Typology	Full block
Program	Interim housing
Stories	3
Gross Square Footage	2,100 SF per module
Structural Materials	Steel
Facade Materials	Corrugated metal
Additional Information	garrisonarchitects.com

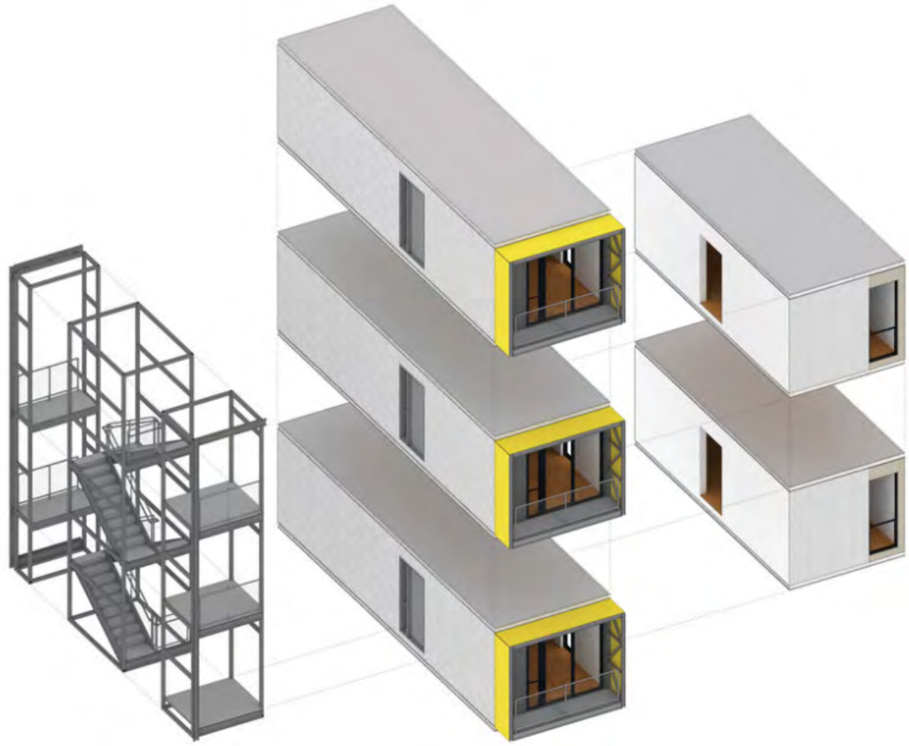
The Emergency Housing Prototype is intended to serve displaced city residents in the event of a natural or man-made disaster while also adhering to strict building requirements regarding safety, sustainability, durability, and universal accessibility. In the months after Superstorm Sandy, a prototype was erected in a parking lot at Cadman Plaza in northern Downtown Brooklyn.

Designed for flexibility and fast deployment, these prefabricated structures can be delivered to site and craned into place within 15 hours, and can also be deployed in various configurations depending on specific urban or site conditions. The flexibility of the unit also allows for its deployment in various settings including vacant lots, private yards, or public spaces. The units can be configured as one- or three-bedroom apartments as needed, and each unit comes equipped with a living area, bathroom, kitchen, and storage space. Additionally, the units are built with recyclable materials including cork floors, double insulated shells, and windows with integrated shading to lower solar heat gain.

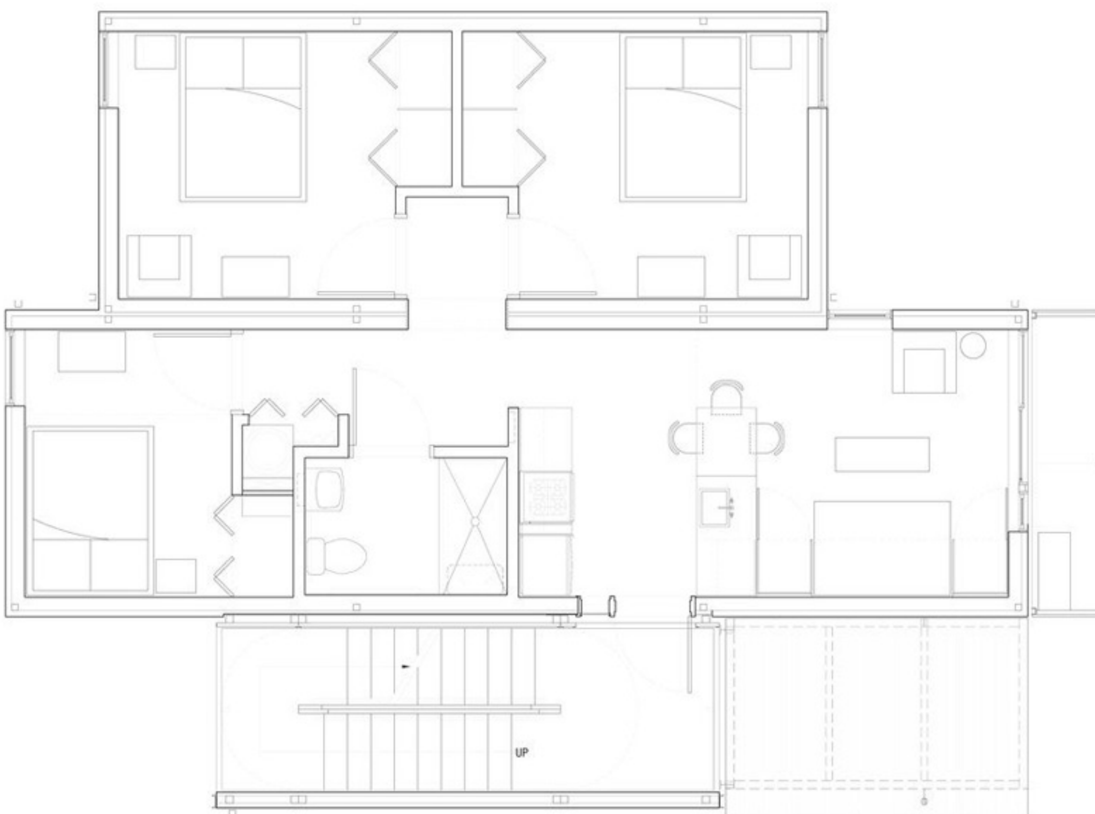
Construction Timeline



Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Rahul Gupta, GSAPP.



Above: Axonometric of Modular Components **Below**: Typical Floor Plan



Images courtesy of © Garrison Architects

Images courtesy of © Andrew Rugge

Images courtesy of © Andrew Rugge

Emergency Housing prototype installed at Camden Plaza, Brooklyn.

Image courtesy of © Andrew Rugge

B2

[Barclays Center, 461 Dean Street, Brooklyn, NY 11217]

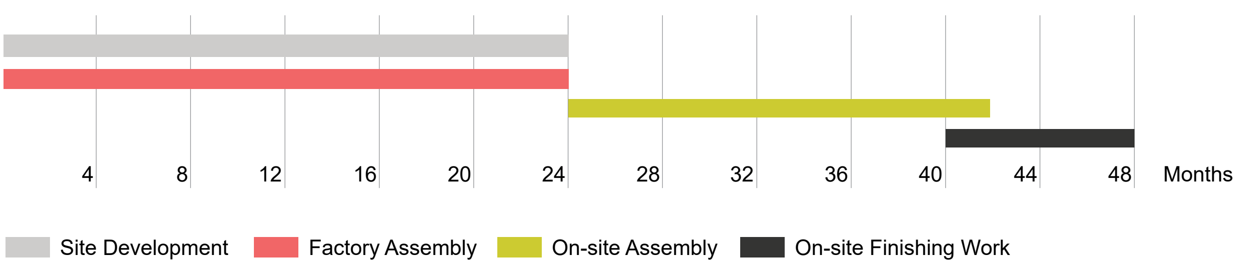
Images courtesy of © SHoP Architects

Architect	SHoP Architects
Fabricator	FullStack Modular
Year Completed	2016
Factory Assembly Time	24 months (6 days per module)
On-site Assembly Time	18 months
Site Typology	Full block
Program	Housing: mixed affordable and market-rate
Stories	32
Gross Square Footage	346,000 SF
Structural Materials	Steel
Facade Materials	Aluminum panels
Additional Information	shoparc.com

Located adjacent to the Barclays Center, the B2 at 461 Dean Street was constructed with 930 modular units comprising 363 apartments, 182 of which are market-rate and 181 of which are affordable. The modules were manufactured by FullStack Modular, a company located in the Brooklyn Navy Yard about two miles from the project site. The proximity of the manufacturer to the project site aided in staging and logistics.

The modules have welded steel frames that were outfitted with wiring and plumbing before arriving on-site. Inspections were done within the modular factory so that the modules could be closed before transport to the building site. Interior partitions of light gauge steel were also preassembled and installed within the frame. The modules were placed on-site by cranes; and the modules fit together like puzzle pieces. Though the modules assembled quickly once on-site, a challenge of the project was the limited on-site storage for the modules awaiting assembly. Due to limited site space and oversized trucking loads, the modules could only get delivered at certain times of day, slowing the otherwise swift assembly. Modules were staged, awaiting transport, at FullStack Modular in the Brooklyn Navy Yard.

Construction Timeline



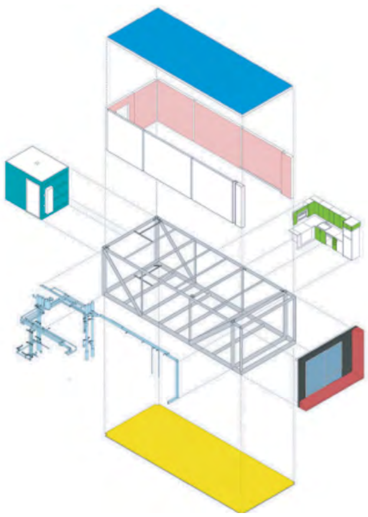
Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Ricky Lo, GSAPP.

Site Plan and Staging

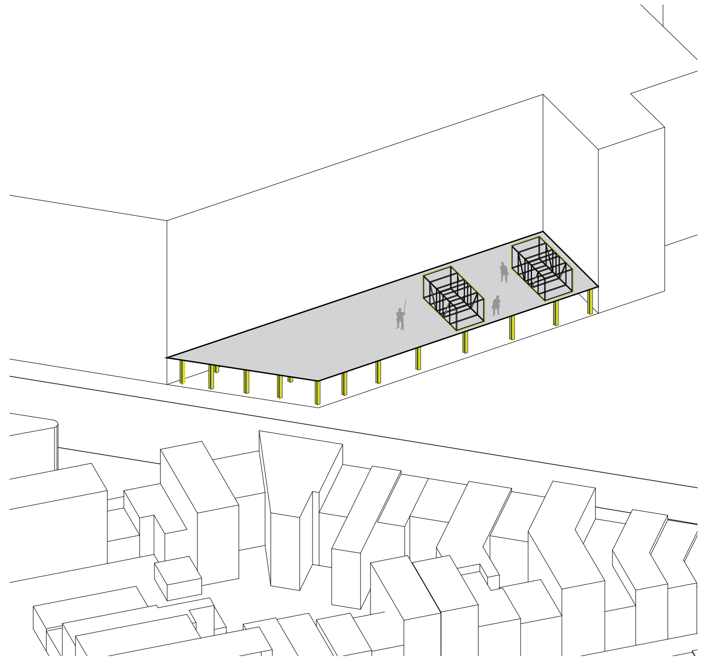
Transportation

Transportation Route (2 miles)

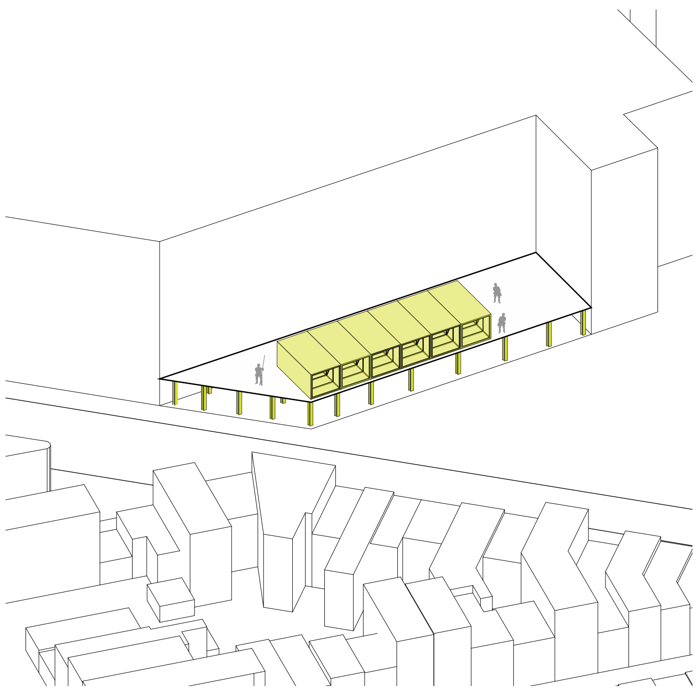
Construction Sequence



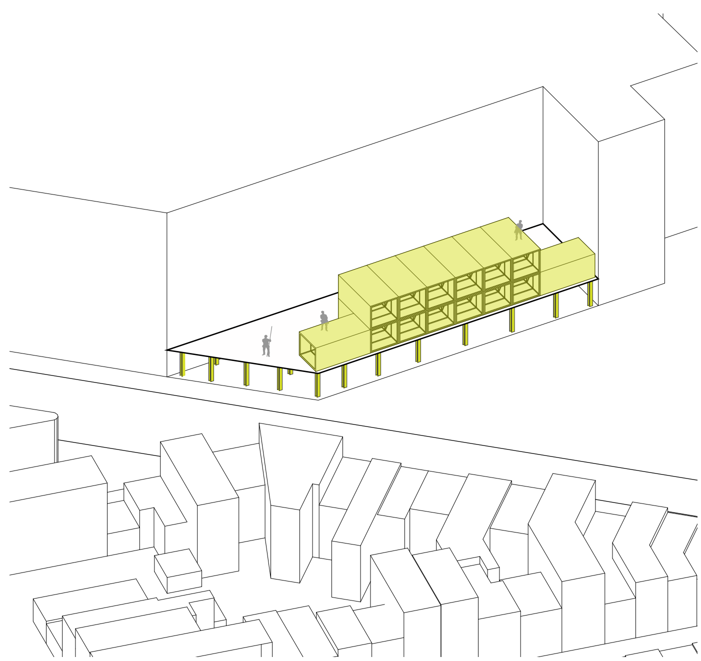
1. Modules prefabricated and assembled in the factory.



2. Concrete foundation and slab were site poured, the podium structure was installed onto the slab, and modules were then delivered via truck and placed on top.



3. Modules were then realigned to ensure structural integrity after staging several modules.



4. Once structural integrity was ensured, the rest of the modules were lifted in place.

Site Development

Staging / Assembly

Drawing by Ricky Lo, GSAPP

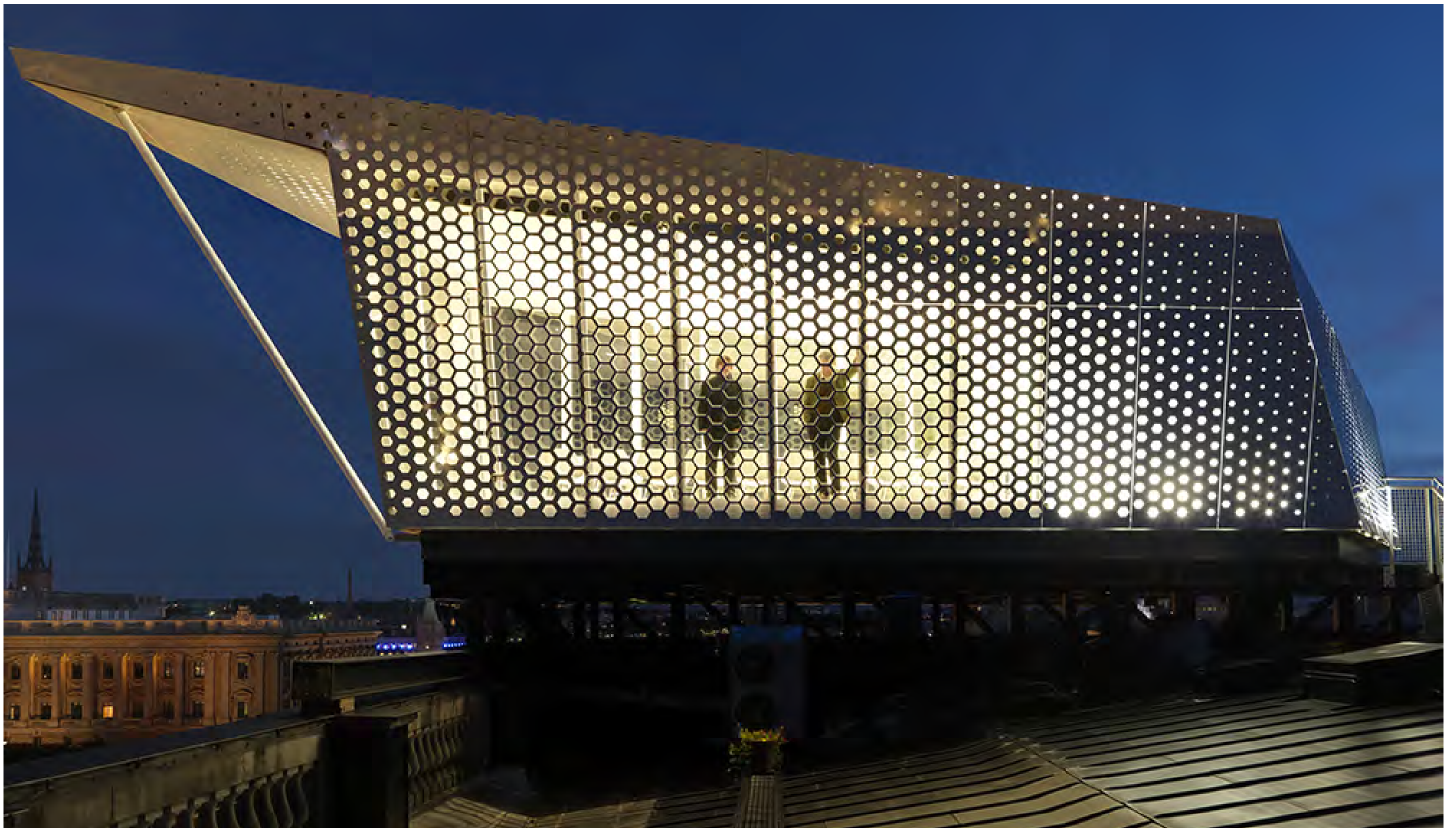
Image courtesy of © SHoP Architects

Image courtesy of © SHoP Architects

2 Global
Case Studies

The Cube

Mobile (Brussels, London, Milan, Stockholm)



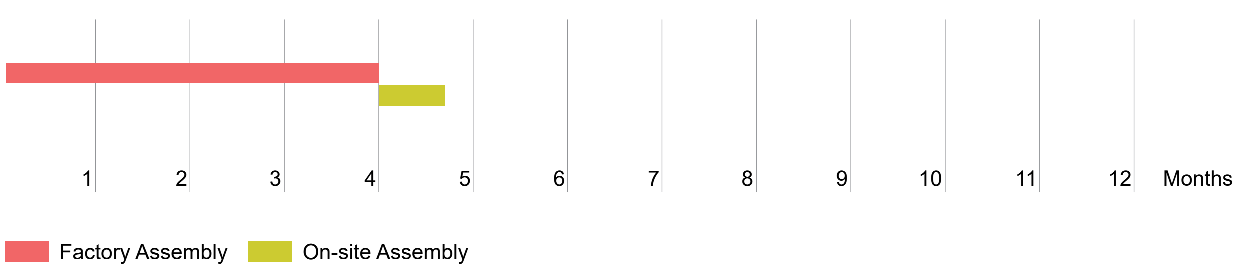
Brussels Installation, 2011. Image courtesy of © Park Associati

Architect	Park Associati
Additional Partners	Electrolux Appliances
Year Completed	2011
Factory Assembly Time	4 months
On-site Assembly Time	20 days
Site Typology	Varies
Program	Restaurant
Stories	1
Gross Square Footage	1,500 SF
Structural Materials	Steel, glass
Facade Materials	Aluminum
Additional Information	parkassociati.com

The CUBE – dining with a view – is a pavilion designed to house a travelling restaurant commissioned by Electrolux. Conceived to be placed in unexpected and dramatic locations, the pavilion traveled through major European Cities between 2011 and 2012, offering lunch and dinner for up to 18 guests at a time.

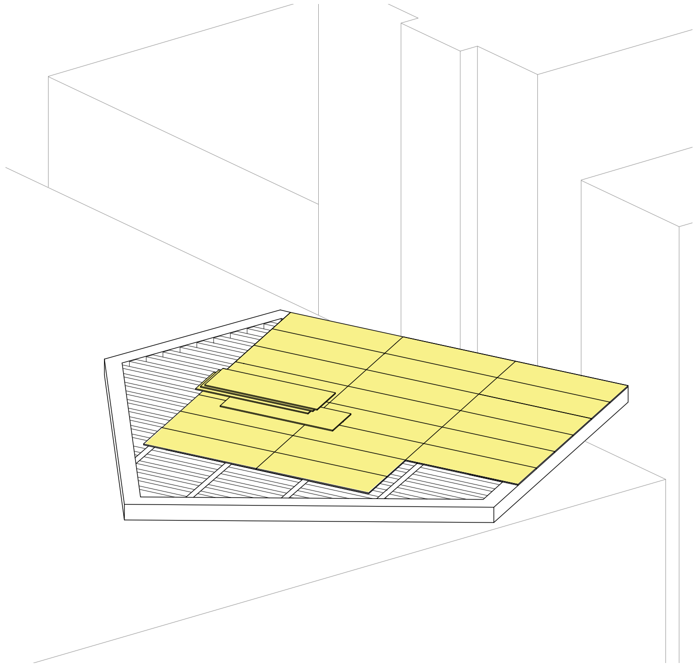
Conceived as a module that can be assembled and disassembled with relative ease, The CUBE was also designed to adapt to a variety of climatic conditions, even the most extreme, while also expressing refined aesthetics and high-quality materials. The pavilion's lightness is accentuated by its exterior white aluminum façade which was laser cut to create a perforated and textured surface.

Construction Timeline

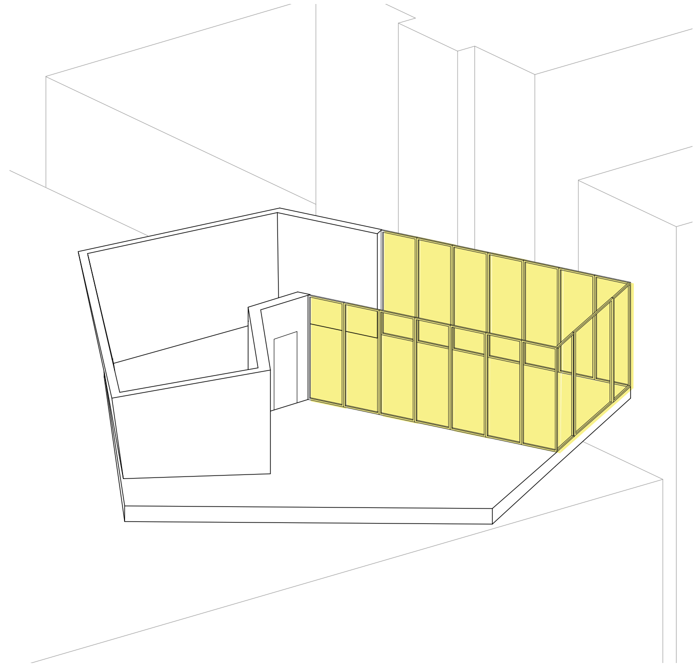


Project data and description provided by Park Associati. Research by Ruxiao Liu, GSAPP.

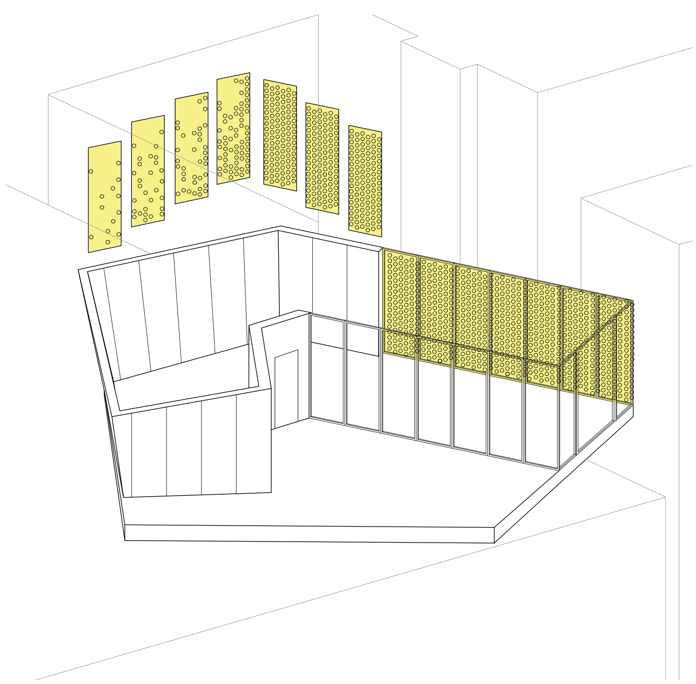
Construction Sequence



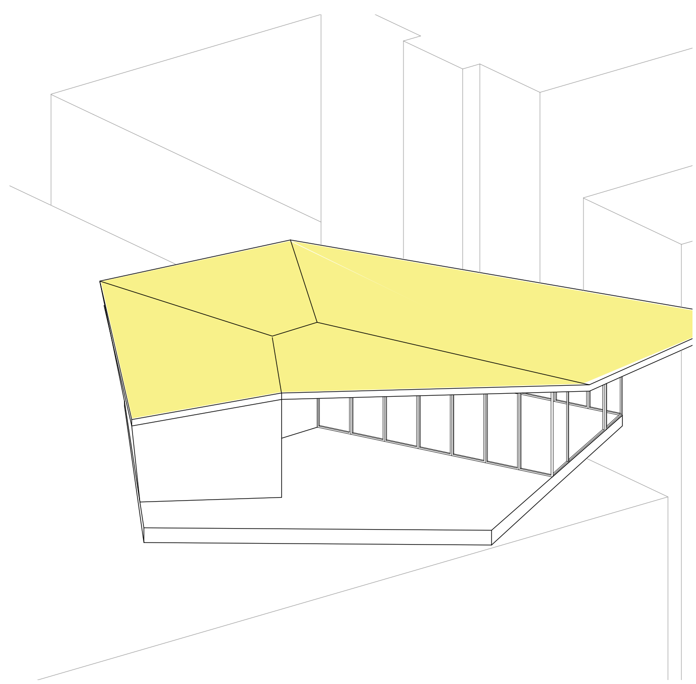
1. Steel foundation and floor panel were site placed.



2. The steel window frame was attached to the floor slab.



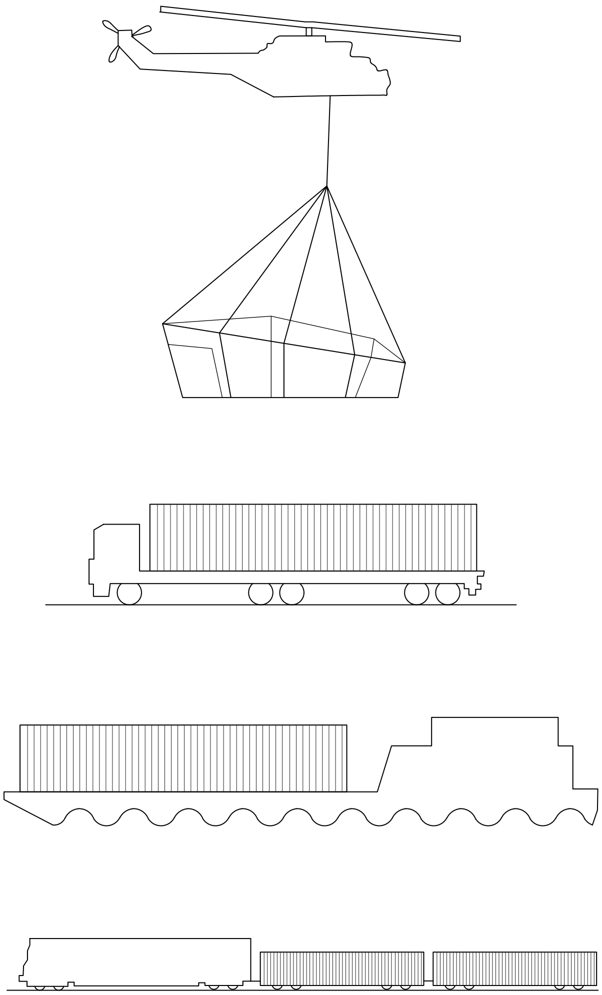
3. The laser cut facade was attached to the steel frame.

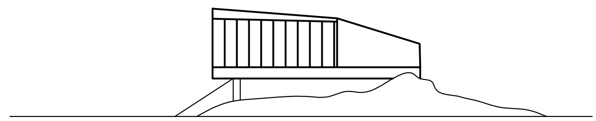


4. The roof was stacked on top of the frame.

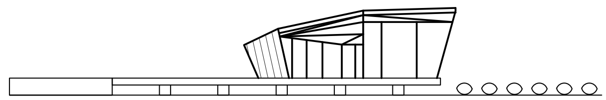
Staging / Assembly

Reuse and Transport



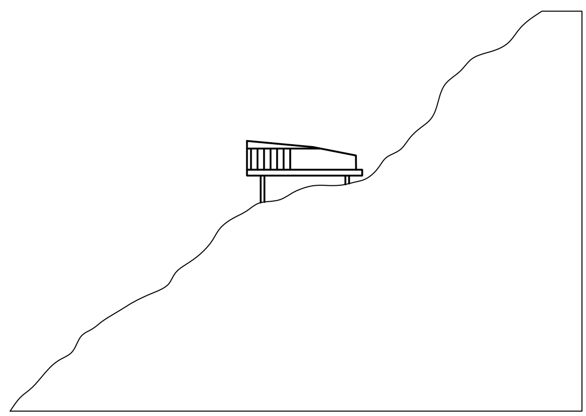


Beach Installation

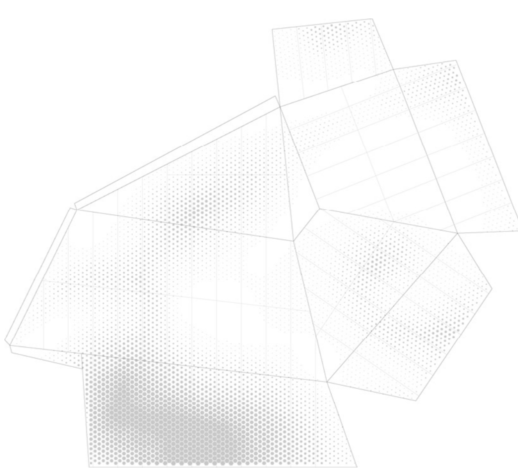


Projection over Waterfront Installation

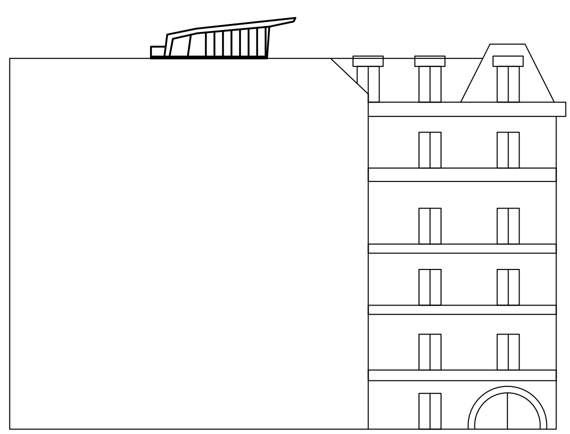
Transportation methods for The Cube



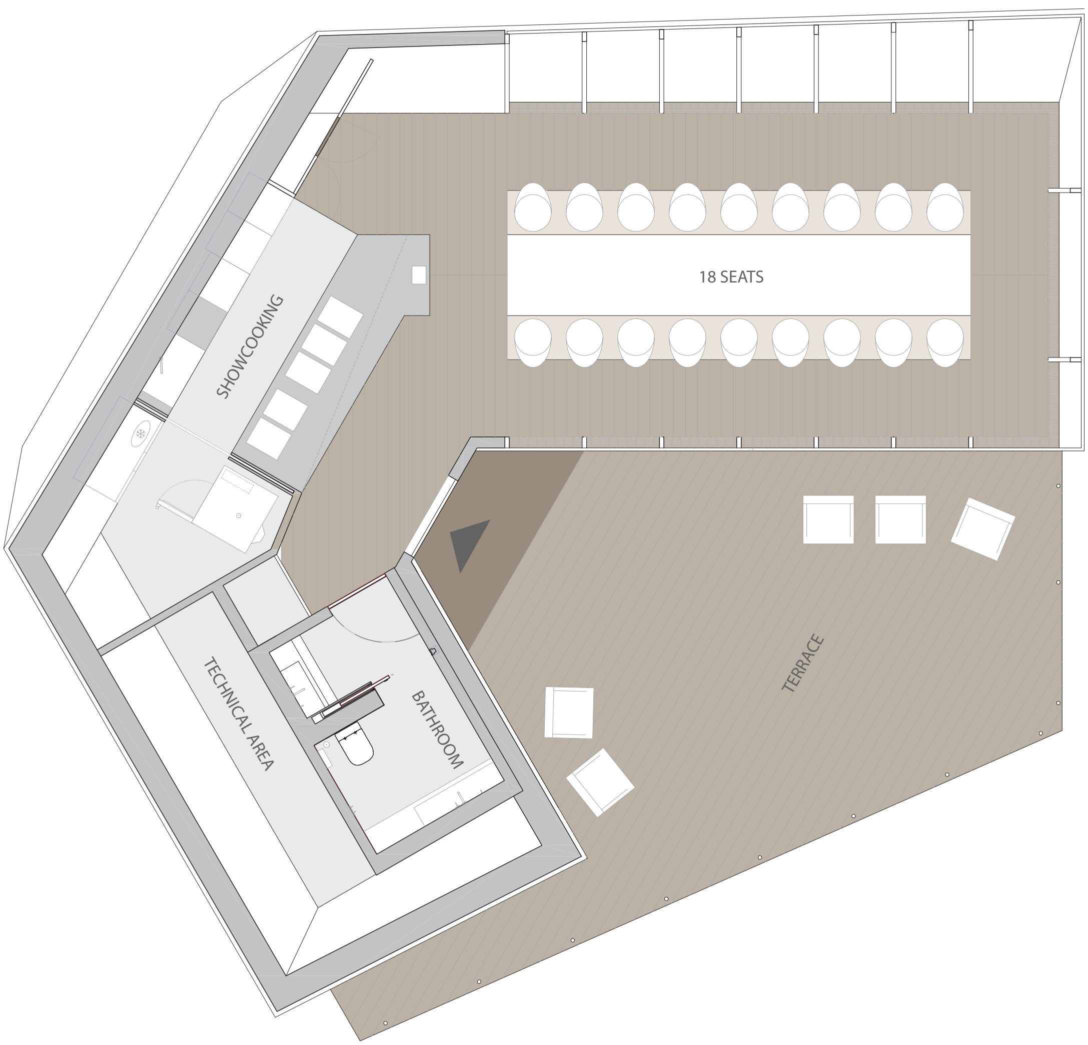
Mountainside Installation



Laser-cut facade unfolding

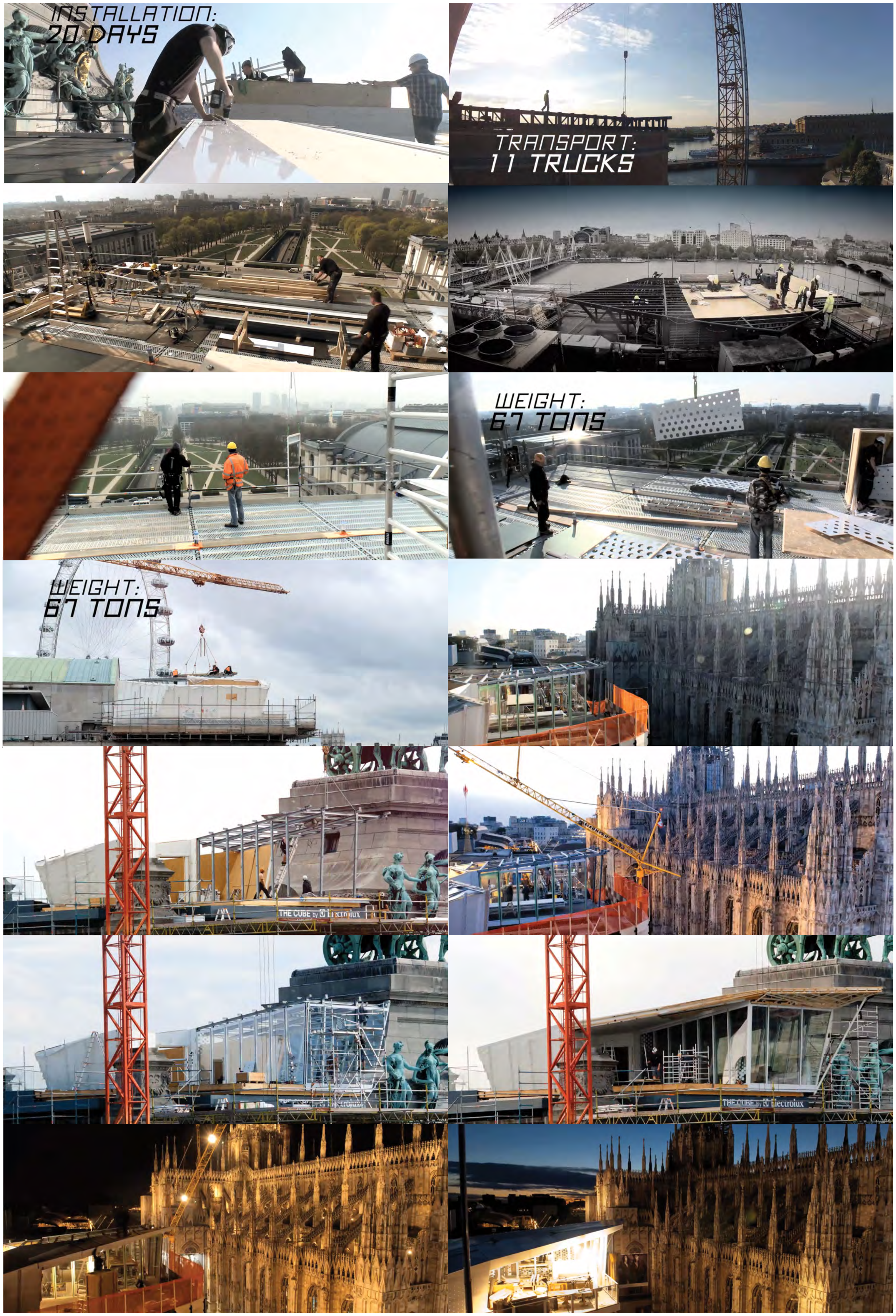


Rooftop Installation



Floor Plan

Images courtesy of © Park Associati



Images courtesy of © Park Associati

The Cube in Brussels, 2011.

Images courtesy of © Park Associati

The Cube in London, 2012.

Images courtesy of © Park Associati

Tomihiro Art Museum

Prefab
Global

[86 Azumachokusagi, Midori, Gunma 376-0302, Japan]

Image courtesy of © Shigeru Ohno

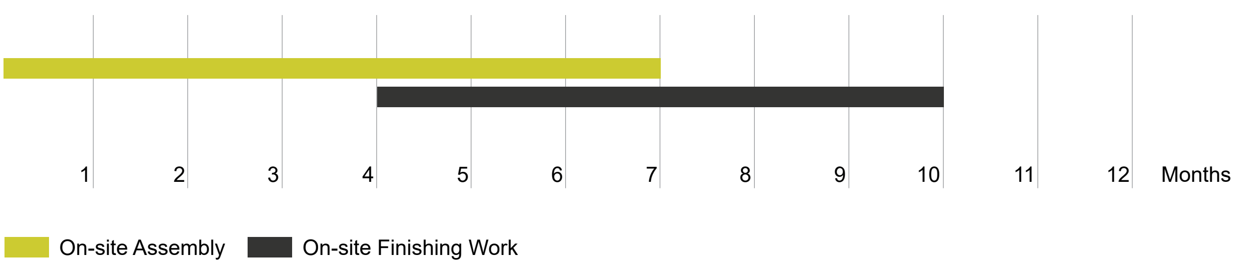
Architect	AAT + Makoto Yokomizo Architects
Structural Engineer	ARUP (Japan)
Year Completed	2005
On-site Assembly Time	7 months
Site Typology	Full block
Program	Art museum
Stories	1
Gross Square Footage	26,517 SF
Structural Materials	Steel, concrete
Facade Materials	Steel, glass
Additional Information	aatplus.com

Located in a mountain village north of Tokyo, the Tomihiro Art Museum is dedicated to the work of local poet and illustrator, Tomihiro Hoshino.

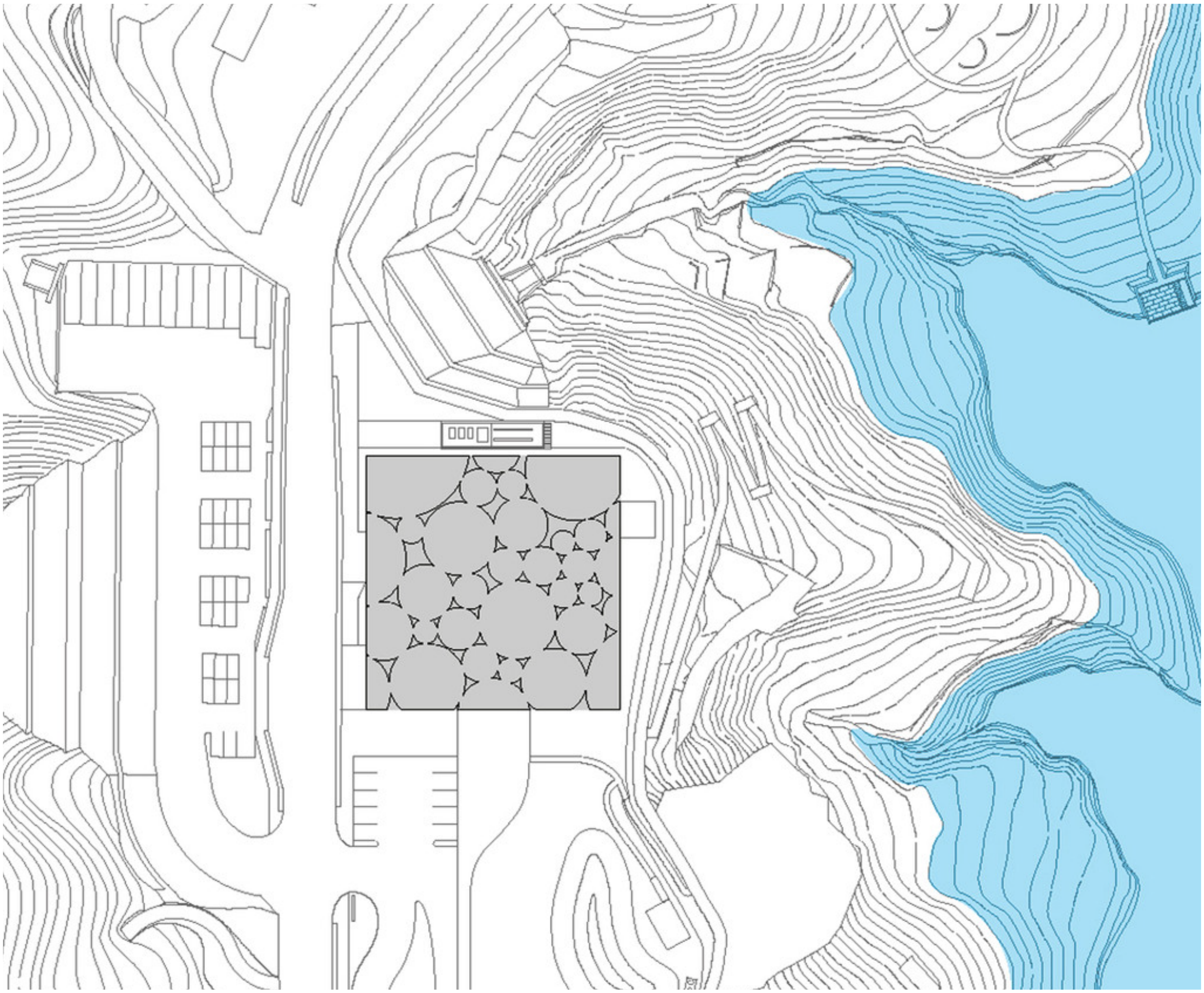
The museum is composed of 33 prefabricated cylinders of varying sizes, set within a 52m square, giving rise to a series of tightly packed circular rooms that form the main areas where the programs of the museum are housed. The scale of the circular modules determine the functional environment of the space within and the interior quality of the spaces, which range from light to dark, and intimate to expansive.

The prefabrication of the cylindrical elements allows the structure to perform highly efficiently in distributing structural loads around the building, and also reduced the construction and assembly time of the project drastically.

Construction Timeline



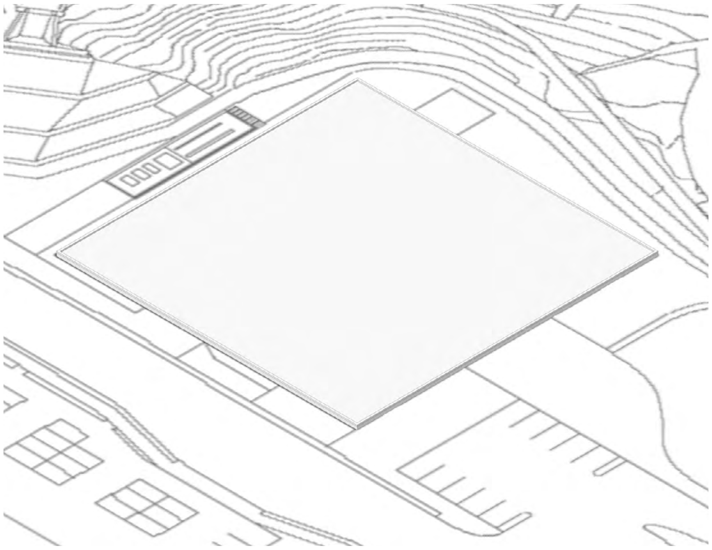
Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Mengxuan Liu, GSAPP.



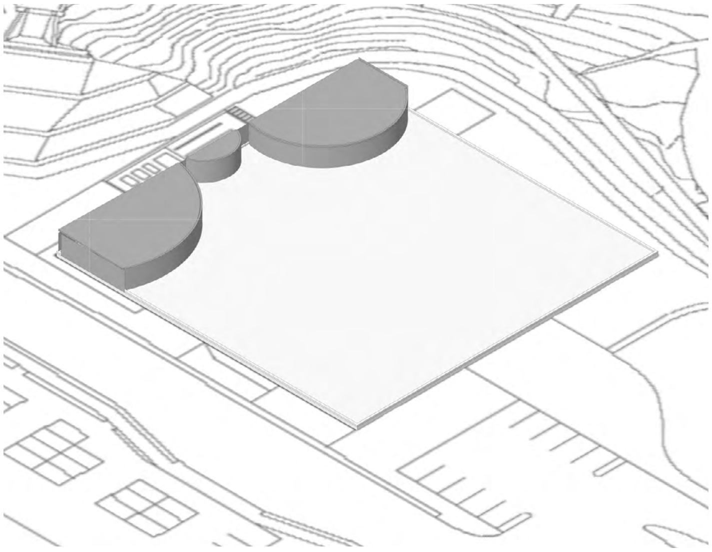
Site Plan

Drawing by Mengxuan Liu, GSAPP

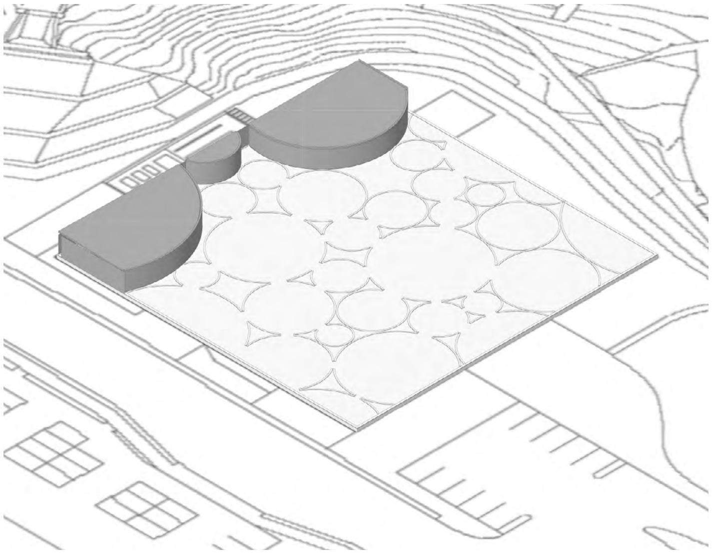
Construction Sequence



1. Concrete foundation and pad were site poured.

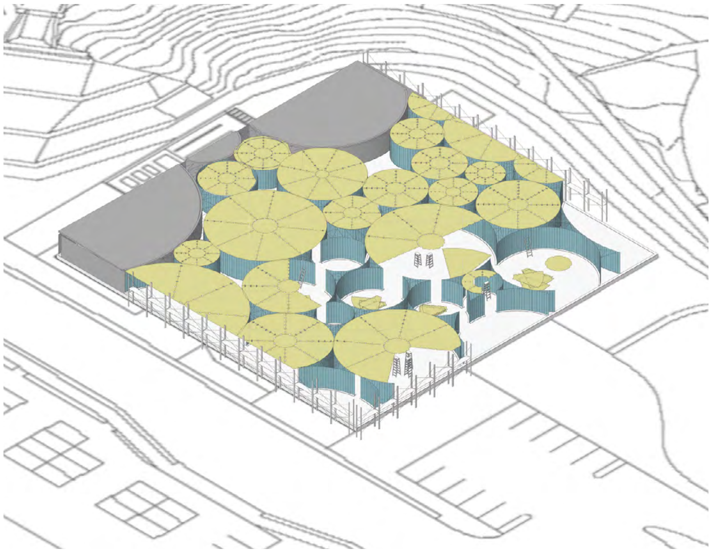


2. Concrete rooms were constructed.

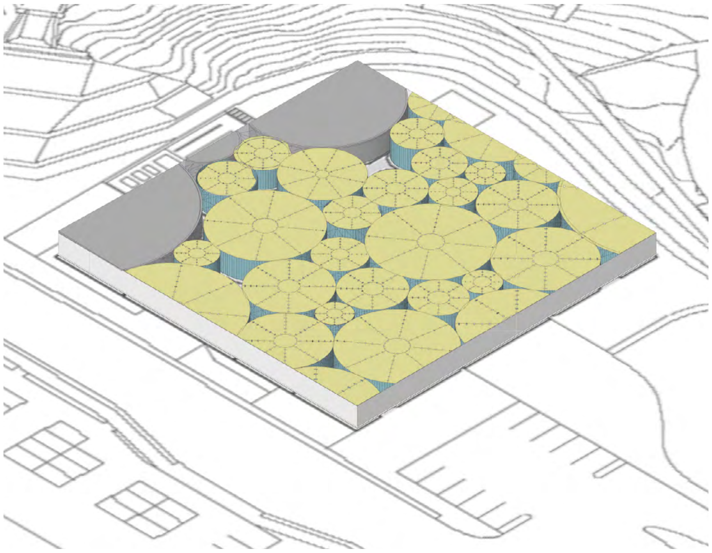


3. Modular steel plates were layed out.

4. Lightweight steel plates were installed.

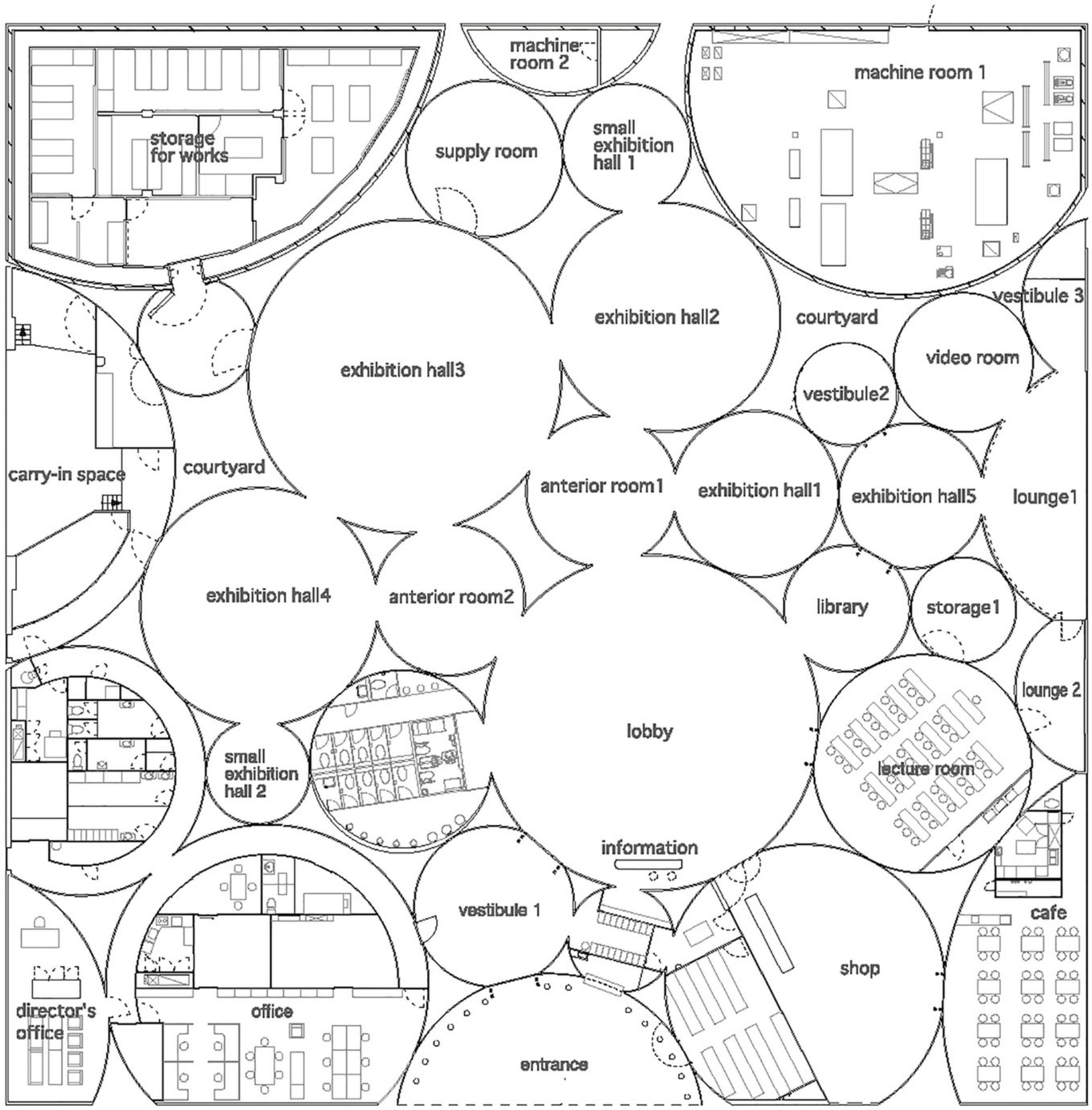


5. Fan shaped pieces were installed.

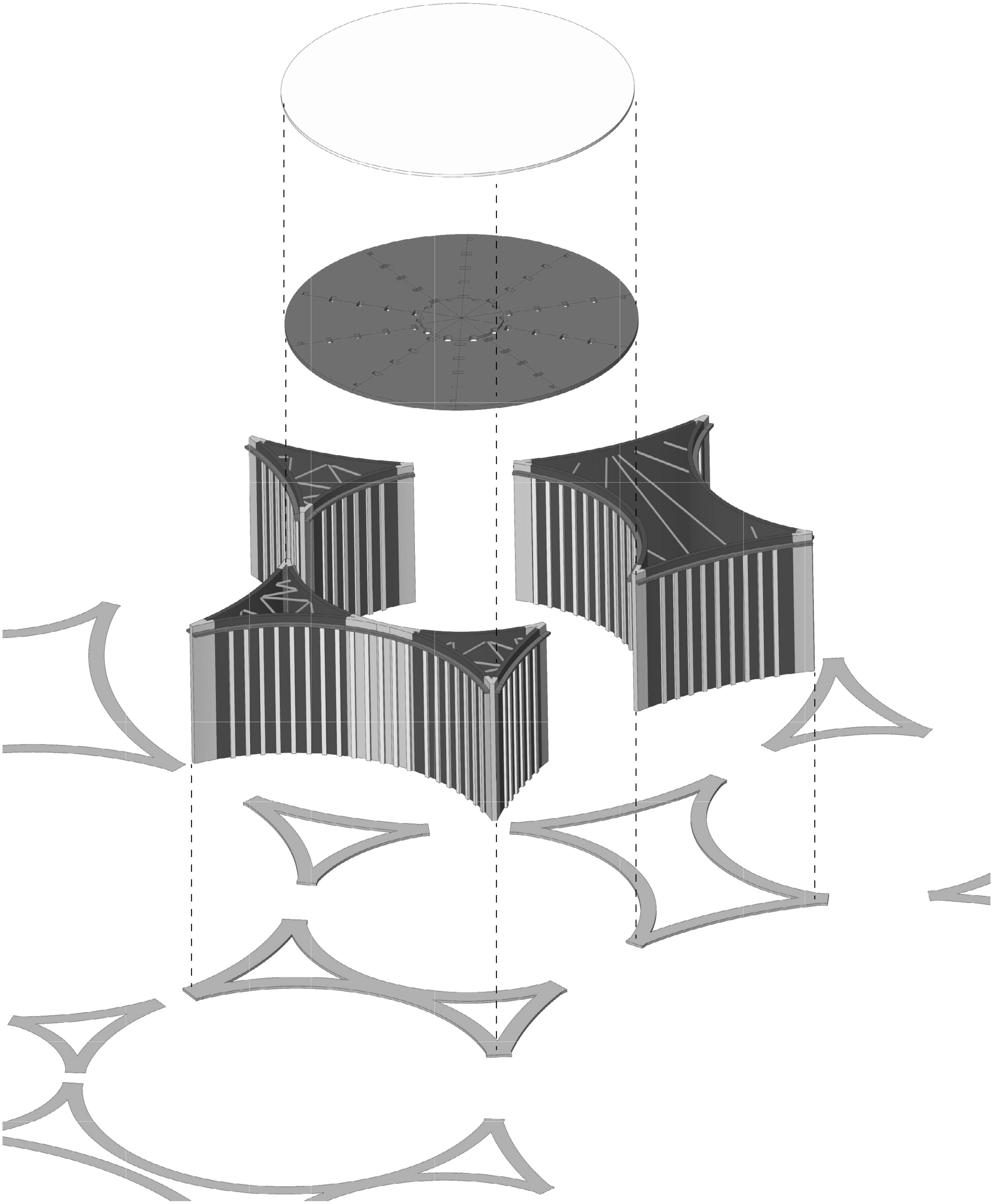


6. Facade was completed.

Drawing by Mengxuan Liu, GSAPP


machine room 2
storage for works
supply room
small exhibition hall 1
machine room 1
exhibition hall2
courtyard
vestibule 3
exhibition hall3
video room
vestibule2
carry-in space
courtyard
anterior room1
exhibition hall1
exhibition hall5
lounge1
exhibition hall4
anterior room2
library
storage1
lounge 2
lobby
small exhibition hall 2
lecture room
information
vestibule 1
cafe
shop
director's office
office
entrance

Floor Plan

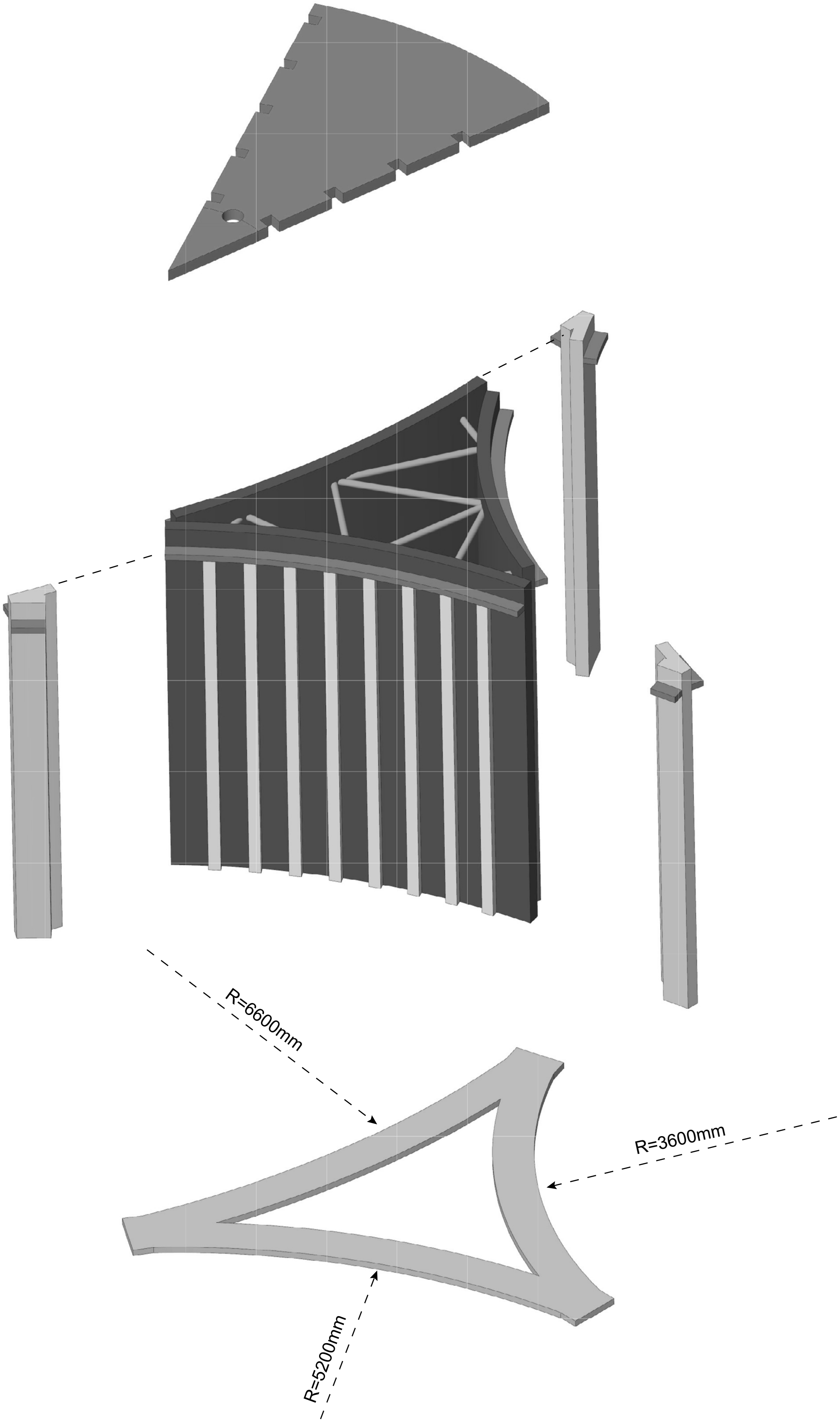


Axonometric of Cylindrical Module

Fan-shaped steel plate

Arc steel plate, thickness is 90mm

Arc steel frame, thickness is 50mm



Axonometric of Modular Components

Images courtesy of © Makoto Yokomizo

Venessla Library and Culture House

[Venneslamoen 19, 4700 Vennesla, Norway]

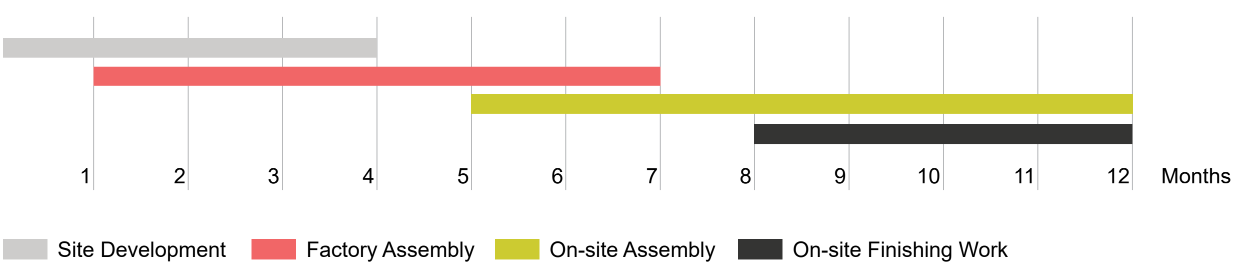
Image courtesy of © Hufton + Crow

Architect	Helen & Hard
Year Completed	2011
Factory Assembly Time	6 months
On-site Assembly Time	7 months
Site Typology	Infill
Program	Library
Stories	3
Gross Square Footage	20,860 GSF
Structural Materials	Glulam wood
Facade Materials	Glulam wood, glass
Additional Information	helenhard.no

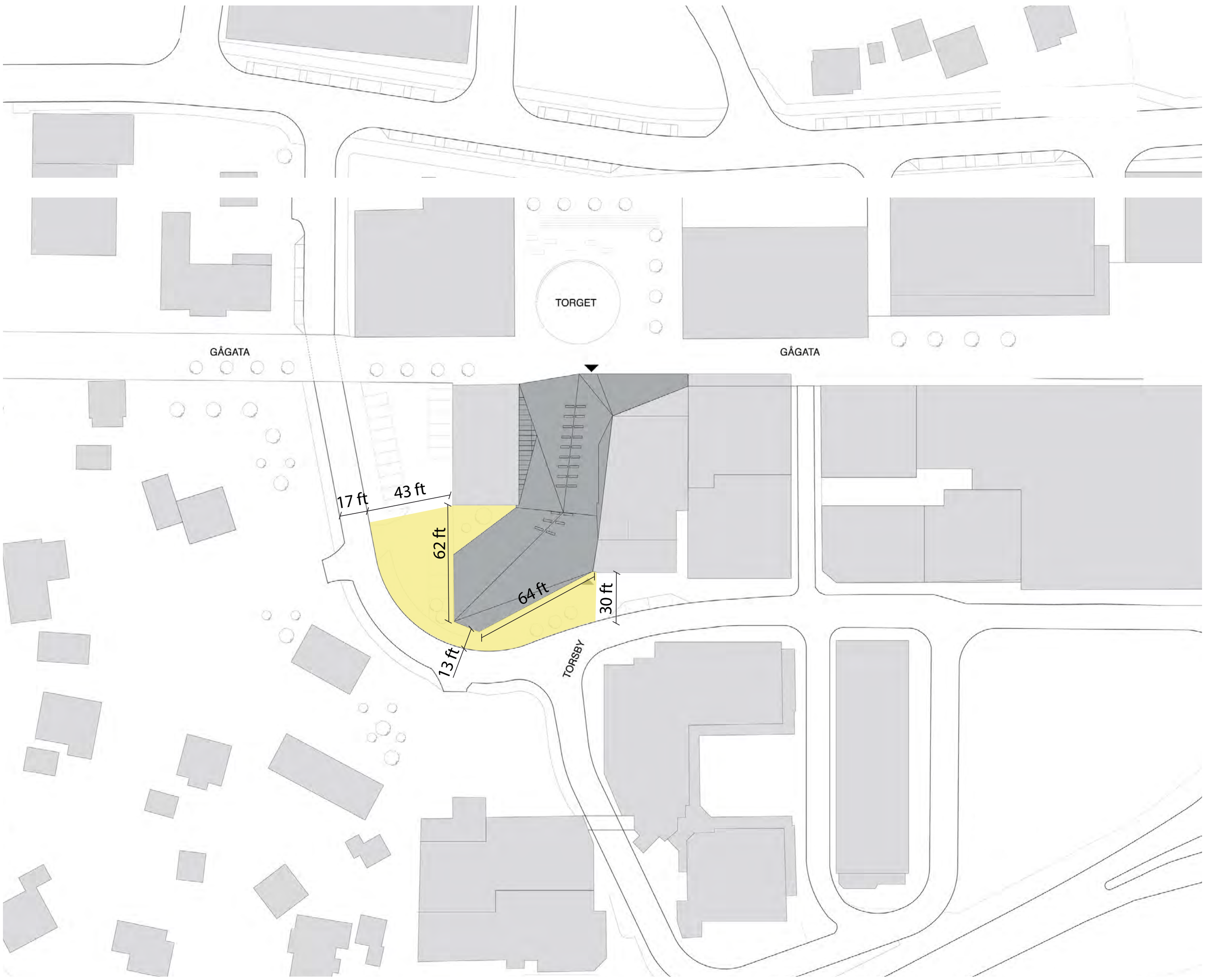
The library in Vennesla comprises a library, a café, meeting places, and administrative areas, and links an existing community house and learning center together. Supporting the idea of an inviting public space, all main public functions have been gathered into one generous space allowing the structure to be combined with furniture and multiple spatial interfaces to be visible in the interior and from the exterior.

Helen & Hard developed a rib concept to create useable hybrid structures that combine a timber construction with integrated services. The whole library consists of 27 ribs made of prefabricated glue-laminated timber elements and CNC-cut plywood boards, with each rib consisting of a glue-laminated timber beam and column, acoustic absorbents which contain the air conditioning ducts, bent glass panes that serve as lighting covers and signs, and integrated reading niches and shelves.

Construction Timeline



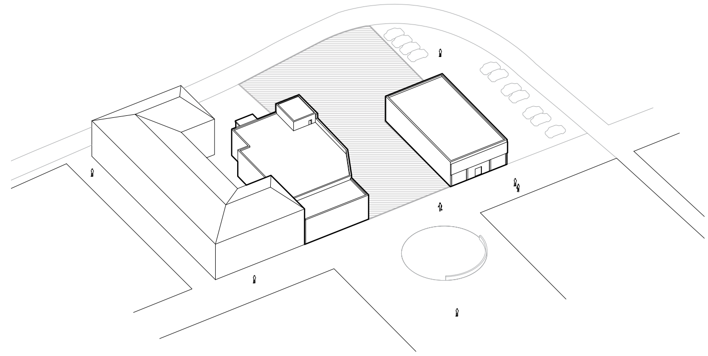
Project data and description provided by Helen & Hard. Research by Leonardo Tamargo, GSAPP.



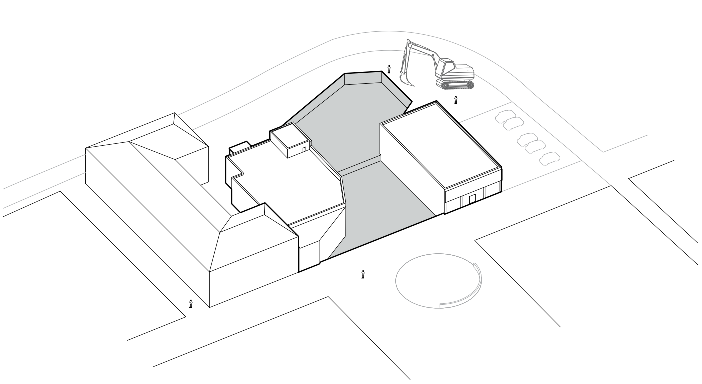
Site Plan and Staging

Construction Sequence

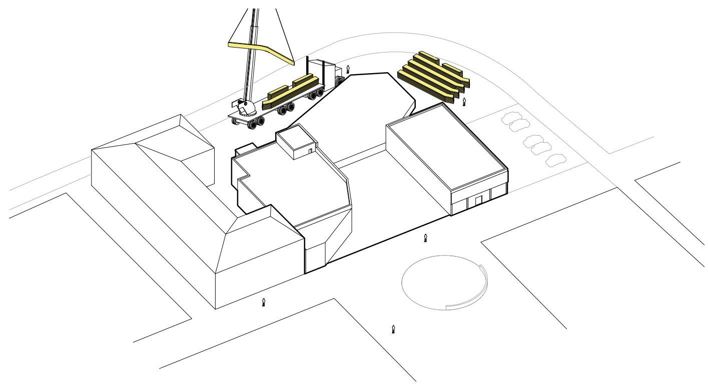
1. Staging area established.



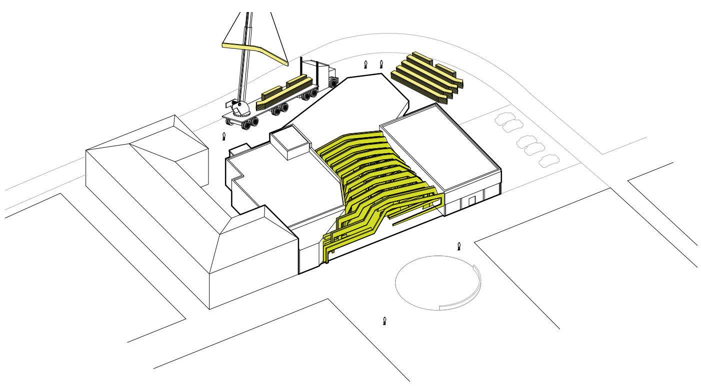
2. Site before construction, including adjacent buildings.



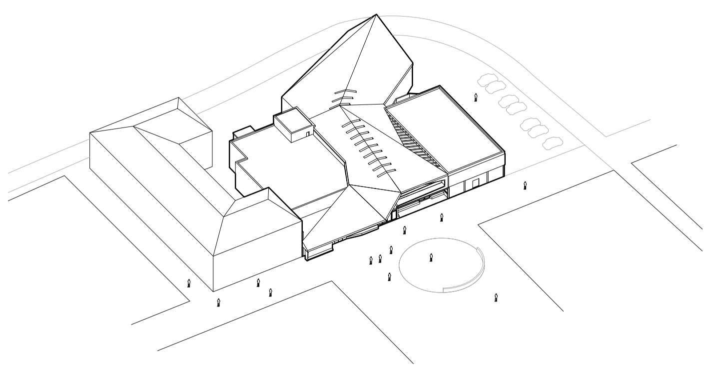
3. Basement was excavated and foundation was poured on site.



4. Concrete cellar was built and wooden members were brought to the staging area.

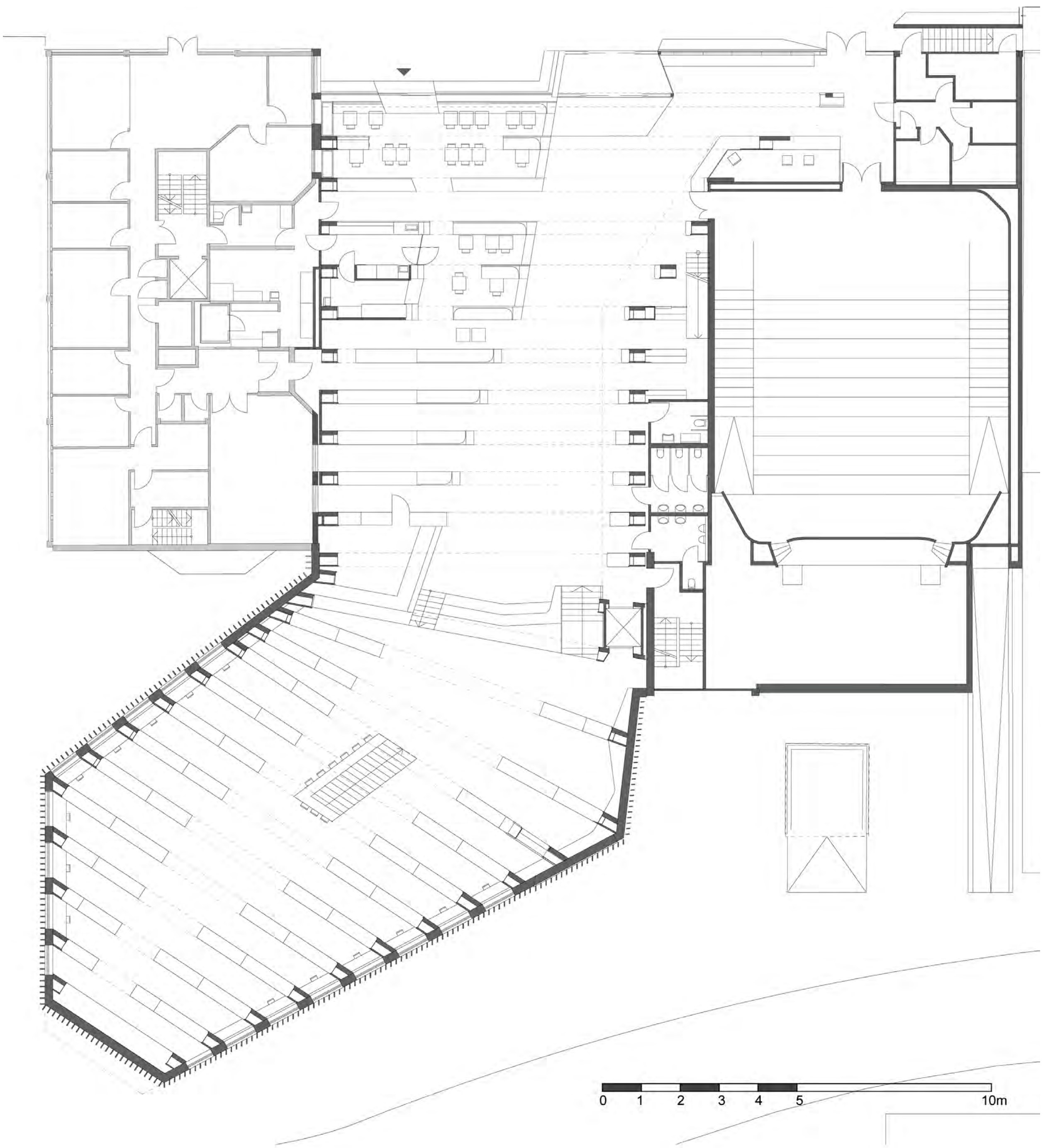


5. Ribs were assembled in addition to the mechanical systems and add-on furniture.

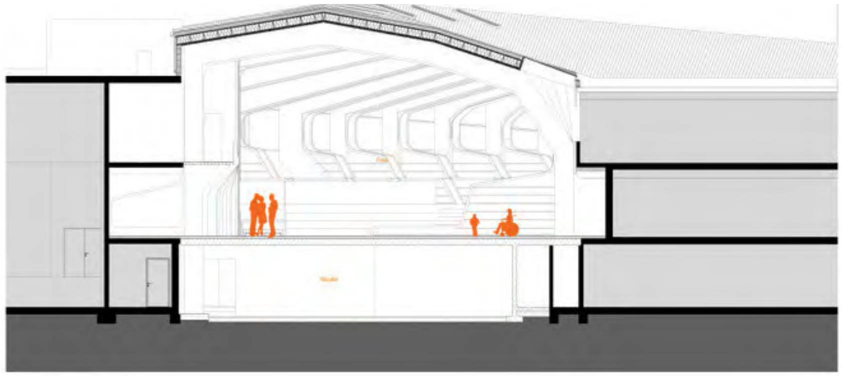


6. Roofing, cladding and finishing work was carried out.

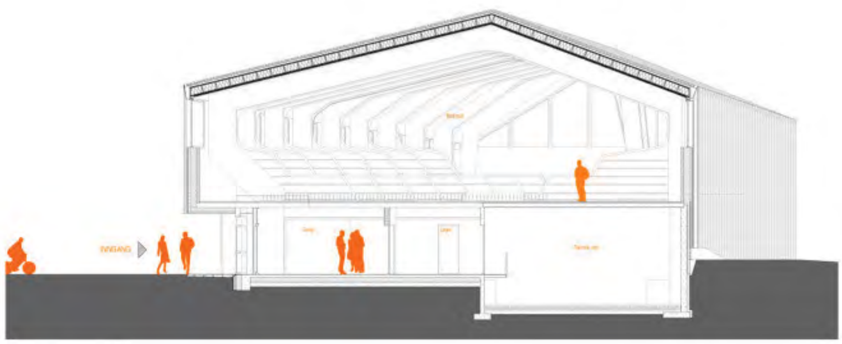
- Site Development
- Staging / Assembly
- Assembled Components



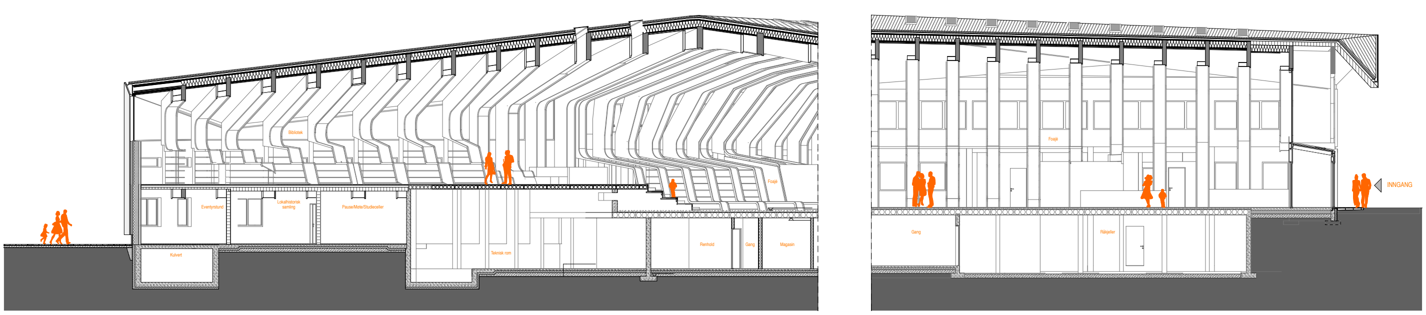
Ground Floor Plan



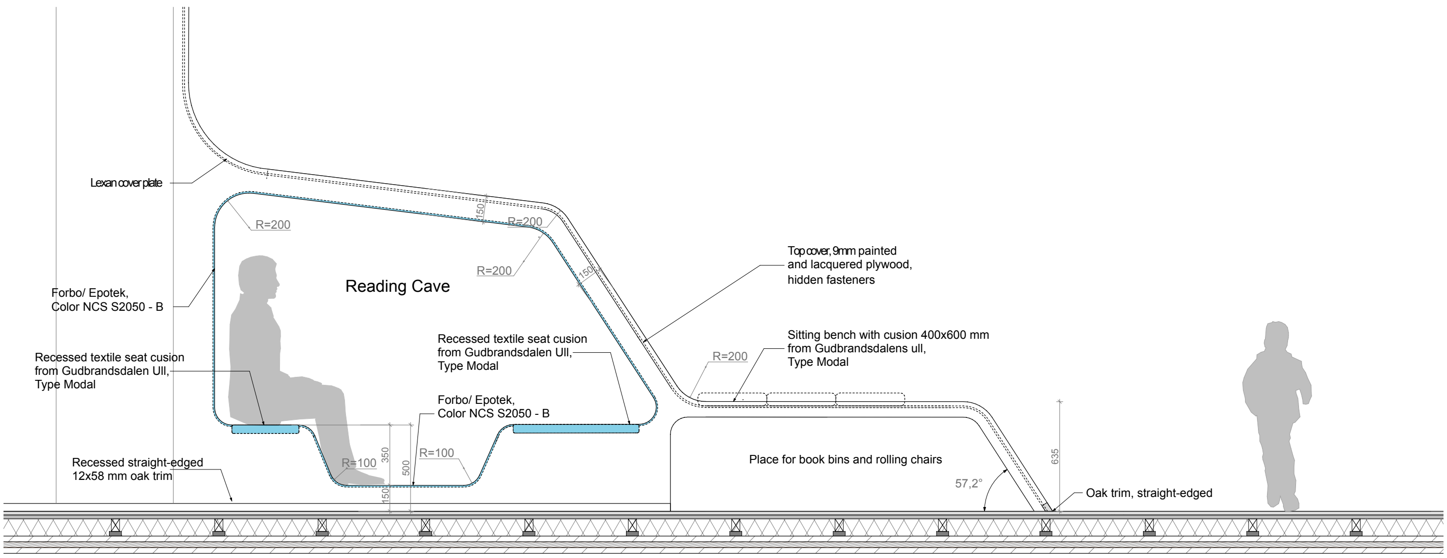
Cross Section 1



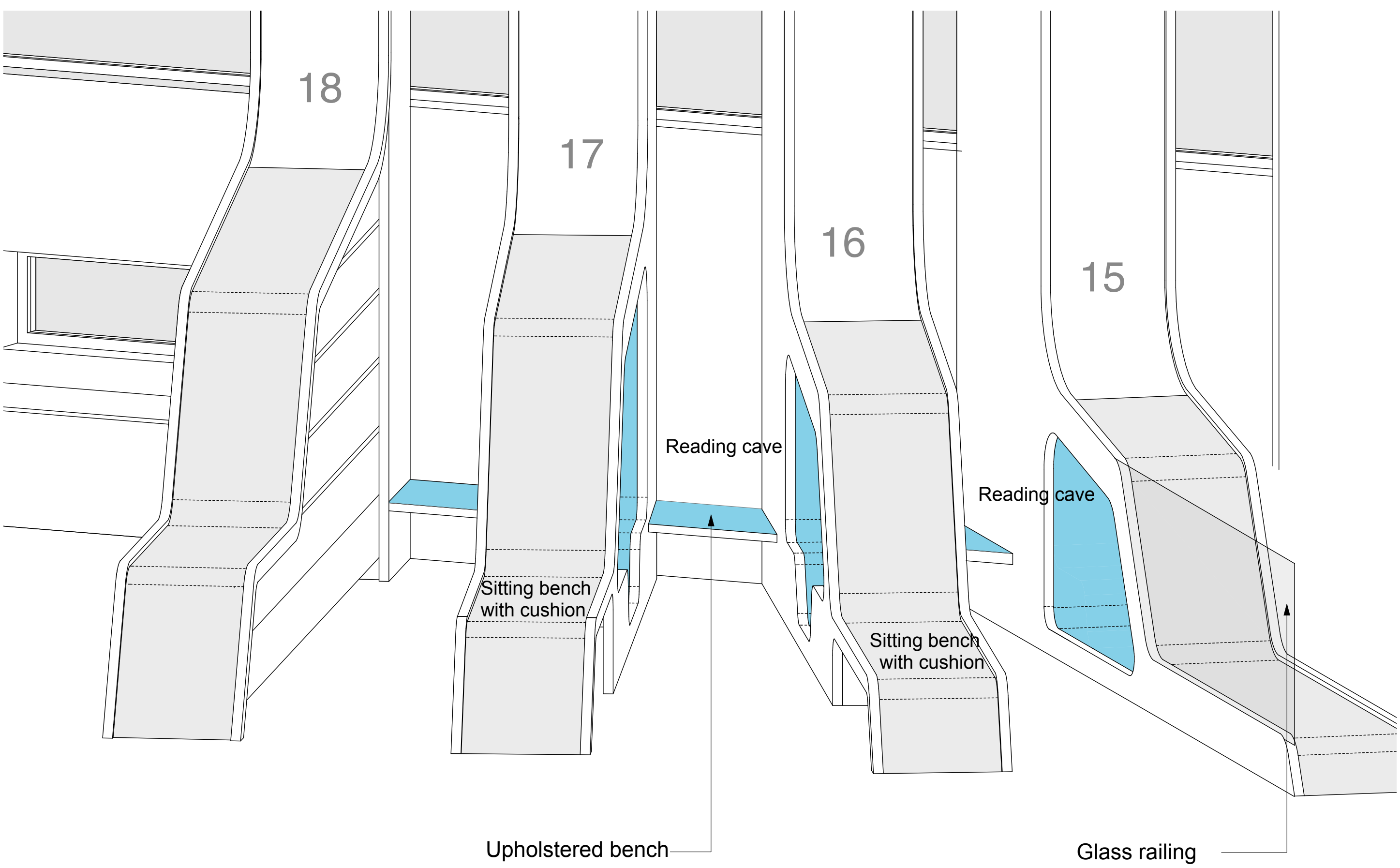
Cross Section 2



Long Section

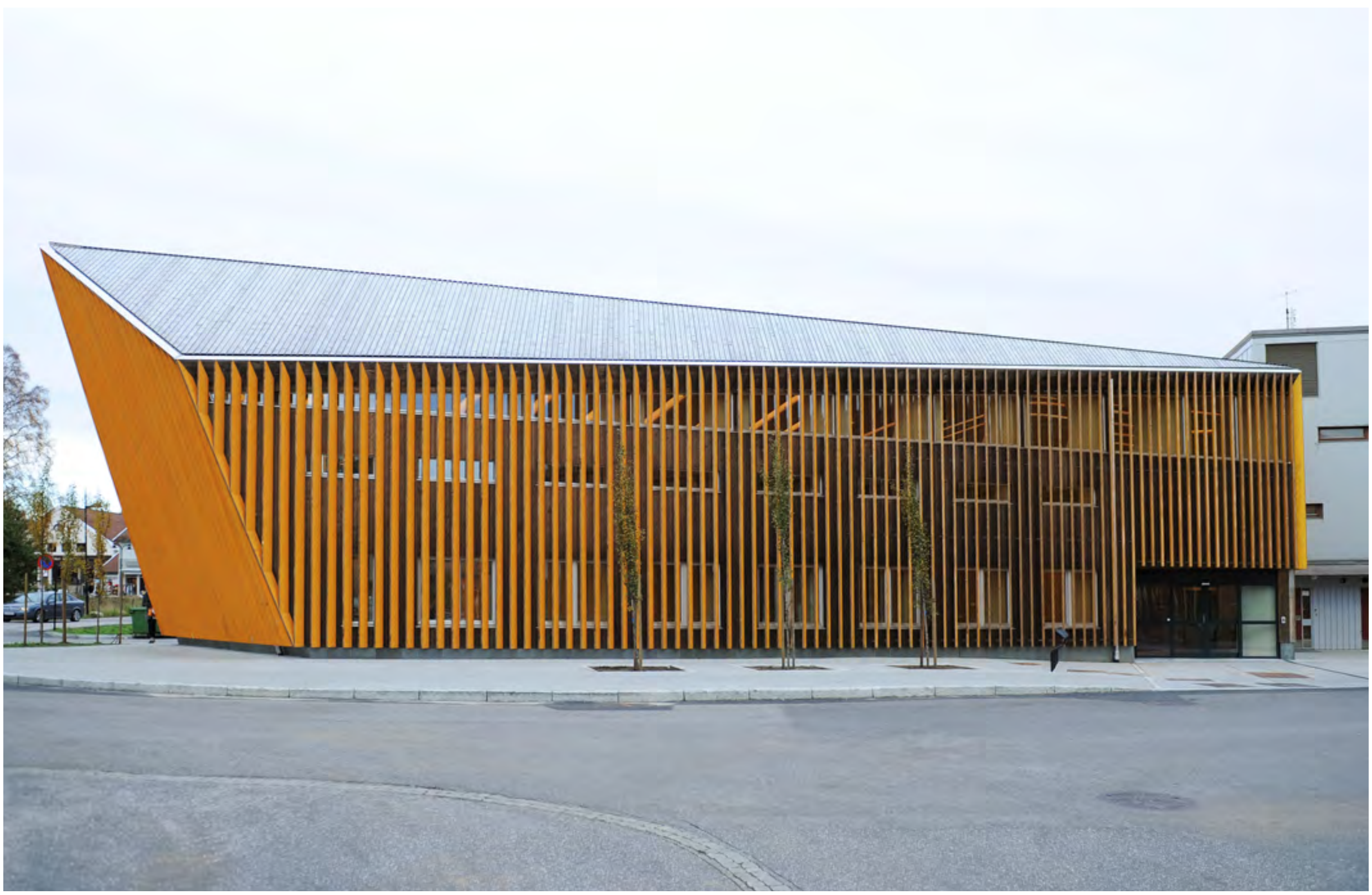


Above: Rib Cross Section **Below**: Rib Axonometric



Images courtesy of © Helen & Hard

Images courtesy of © Erieta Attali



Images courtesy of © Emile Ashley

Power Parasol Lot 59

Arizona State University. Tempe, Pheonix, AZ, USA

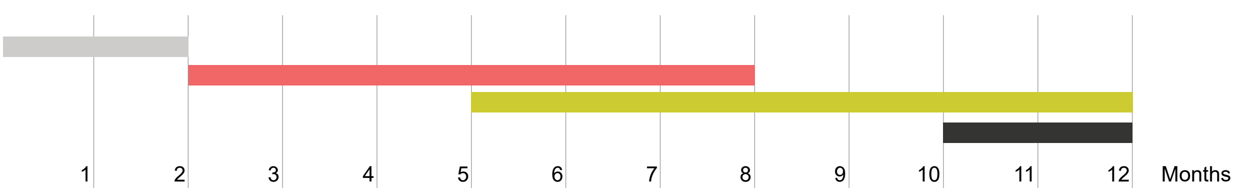
Image courtesy of © Debartolo Architects

Architect	Debartolo Architects
Developer	Strategic Solar Energy
Fabricator	Ironco
Structural Engineer	Rudow + Berry
General Contractor	Hudson/ Downey
Landscape Architect	JJR Floor
Year Completed	2011
Factory Assembly Time	6 months
On-site Assembly Time	7 months
Site Typology	Asphalt surface lot
Program	Utility/ Infrastructure
Stories	1
Gross Square Footage	217,800 GSF
Structural Materials	Galvanized steel
Facade Materials	Dipped galvanized steel
Hard Cost ($)	$40/SF
Total Constuction Cost	$10 Million
Additional Information	debartoloarchitects.com

Part civic shade structure, part energy generator, and part billboard, Power Parasol Lot 59 is a galvanized steel structure of beams and columns, set either on concrete piers or directly buried. The infrastructure is topped by 7,600 photovoltaic panels that covers an existing parking lot for 800 vehicles at Arizona State University in Tempe, Arizona.

The design module was derived from the existing parking stall dimension and the proposed spacing of the solar modules. All of the steel members were locally shop-fabricated and dipped in galvanized dipping vats prior to their arrival on-site, where they were erected and bolted in place. The entire structure is bolted together for efficiency, movability and speed. The patented design for the structure is unique in that it is completely maintained from below and hovers nearly 30 feet above the ground.

Construction Timeline



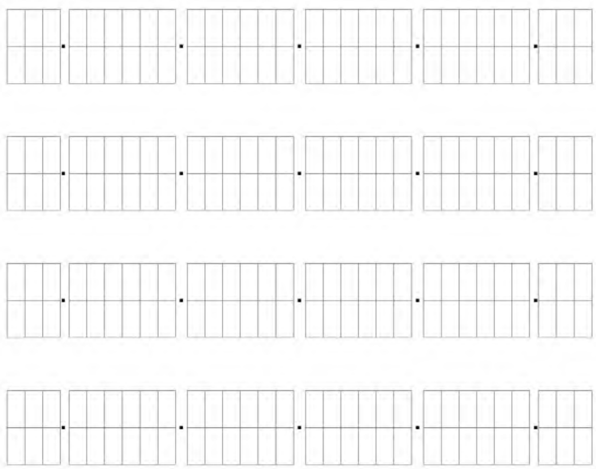
Site Development   Factory Assembly   On-site Assembly   On-site Assembly

Project data and description provided by Debartolo Architects. Research by Korn Suprakorn, GSAPP.

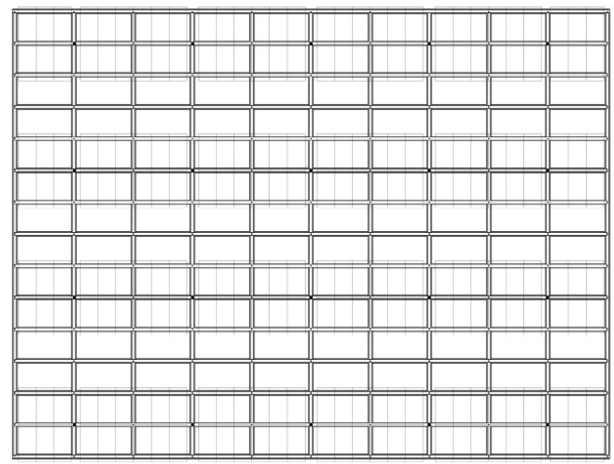
Site Plan

Image via © Google Earth

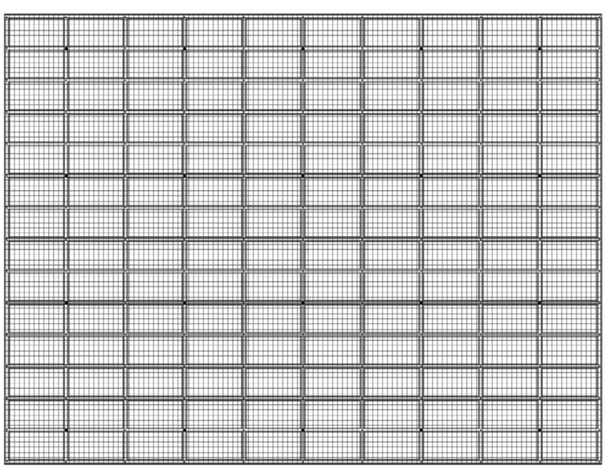
Construction Sequence



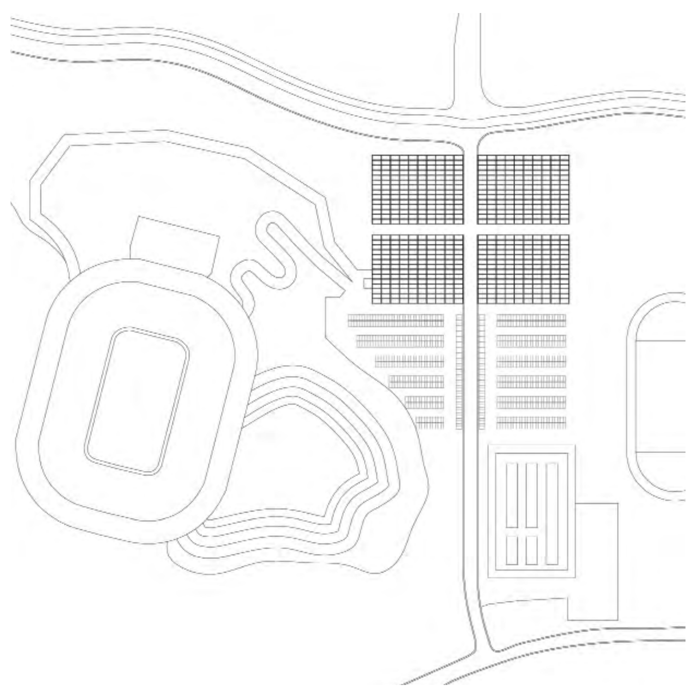
1. Steel columns set the whole layout of the parking lot for 800 vehicles.



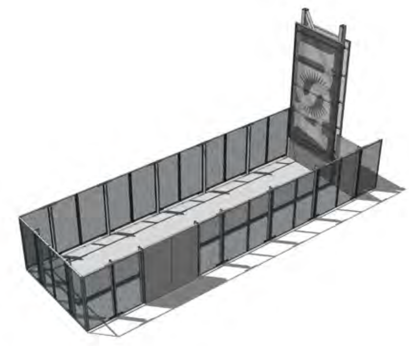
2. The steel columns were topped with galvanized steel I-beams which created a rectangular grid to support the solar panels above.

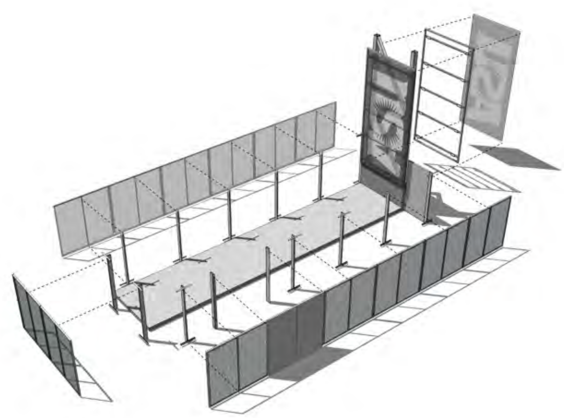


3. The structure was topped with 7,600 photovoltaic panels bringing together shading and power generation under one roof.

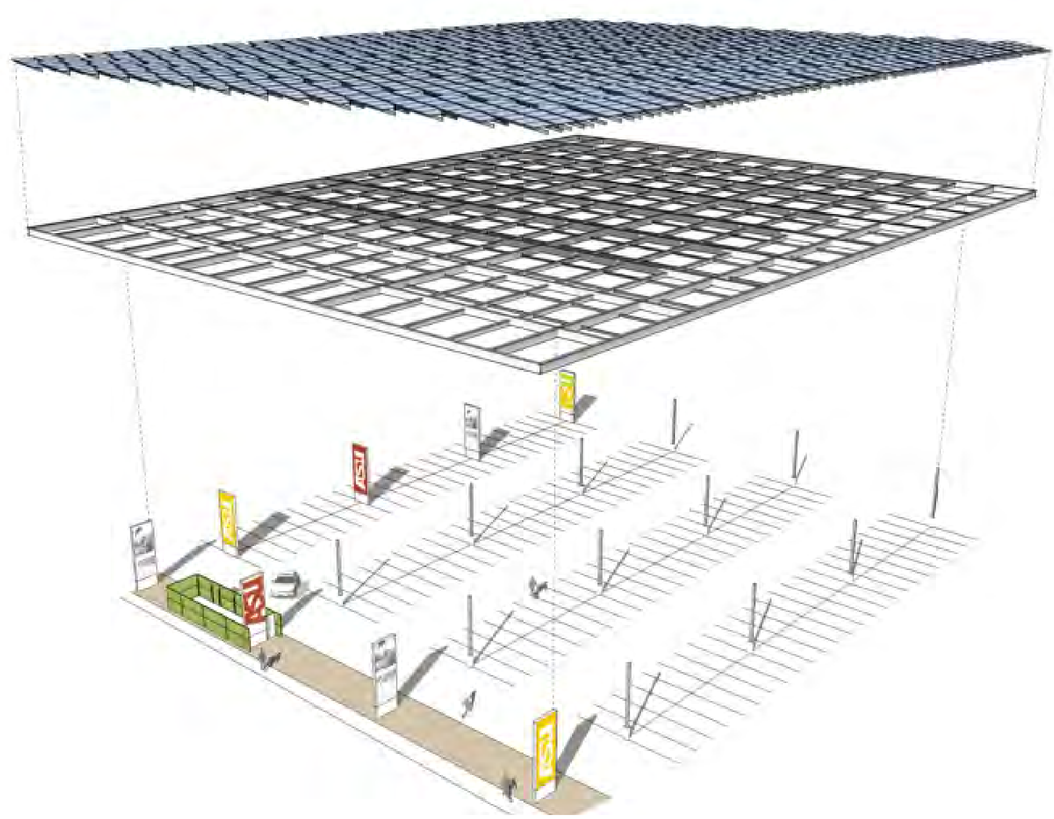


4. Power Parasol Lot 59 is located in the campus area of Arizona State University, right next to the Sun Devil Football Stadium.

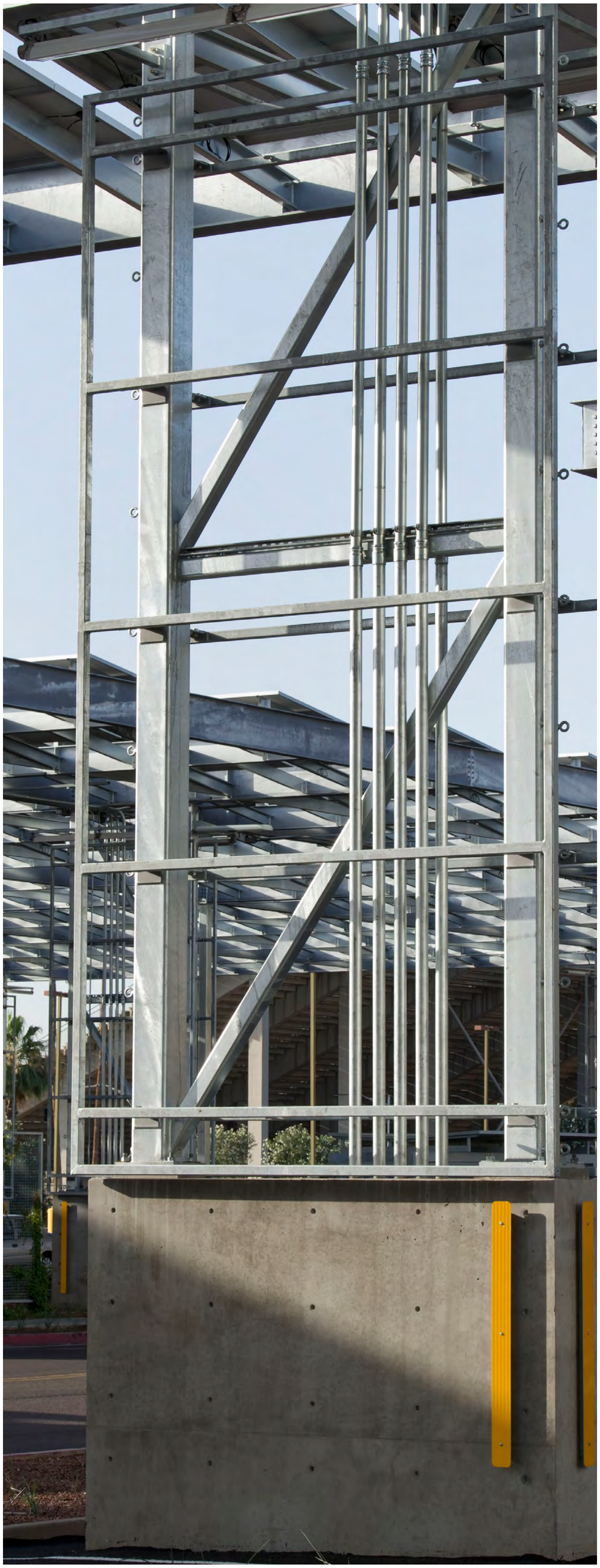


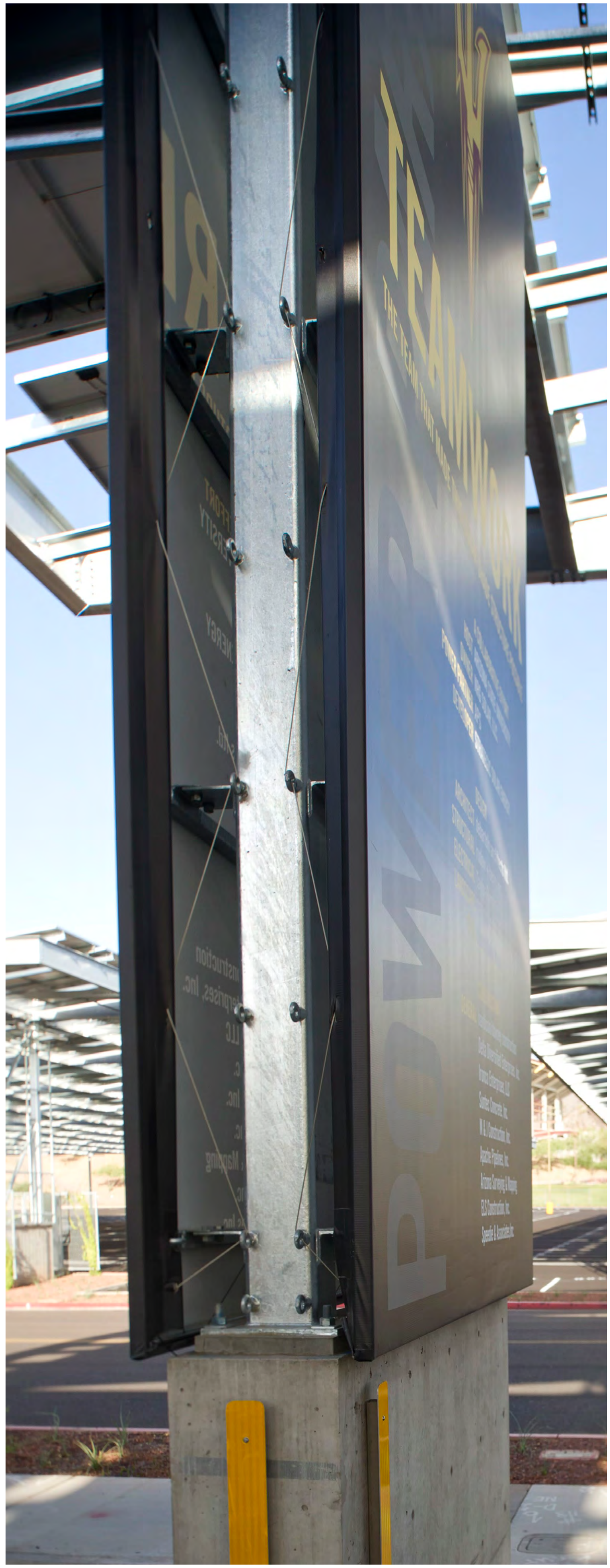


Above: Structural columns for the system serve dual purpose as billboards. **Below**: Axonometric of system components.



Images courtesy of © Debartolo Architects





Images courtesy of © Debartolo Architects

Images courtesy of © Debartolo Architects

L’Aquila Auditorium

Flatpack
Global

Viale delle Medaglie d’Oro, 67100 L’Aquila AQ, Italy

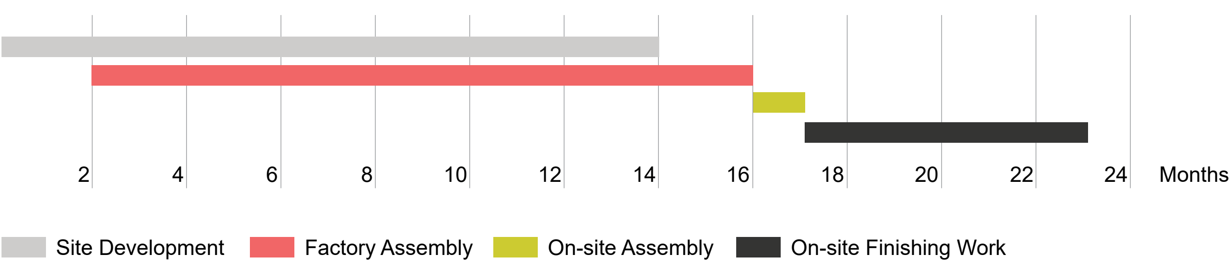
Image courtesy of © Marco Caselli Nirmal

Architect	Renzo Piano Building Workshop
Structural Engineer	Favero & Milan
Acoustic Engineer	Muller BBM
Landscape Architect	Studio Giorgetta
Off-site Assembly Time	14 months
On-site Assembly Time	1 month
Year Completed	2012
Site Typology	Infill
Program	Concert hall
Stories	1
Gross Square Footage	2,500 SF
Structural Materials	Wood
Facade Materials	Larch wood
Additional Information	rpbw.com

The Auditorium in L’Aquila was built as an interim solution to replace the Castello Spagnolo concert hall, which was gravely damaged in a 2009 earthquake. It is an ensemble of three volumes – a trio of cubes set at seemingly random angles, housing the 238-seat concert hall, the foyer, and dressing rooms.

The building was designed entirely as timber construction, including the wood members which were pre-cut and delivered to site via truck as flatpack elements to be assembled in-situ. Wood was chosen for its acoustic properties, but also because it is flexible, more resistant to earthquakes, less invasive, and can be easily prefabricated and quickly assembled.

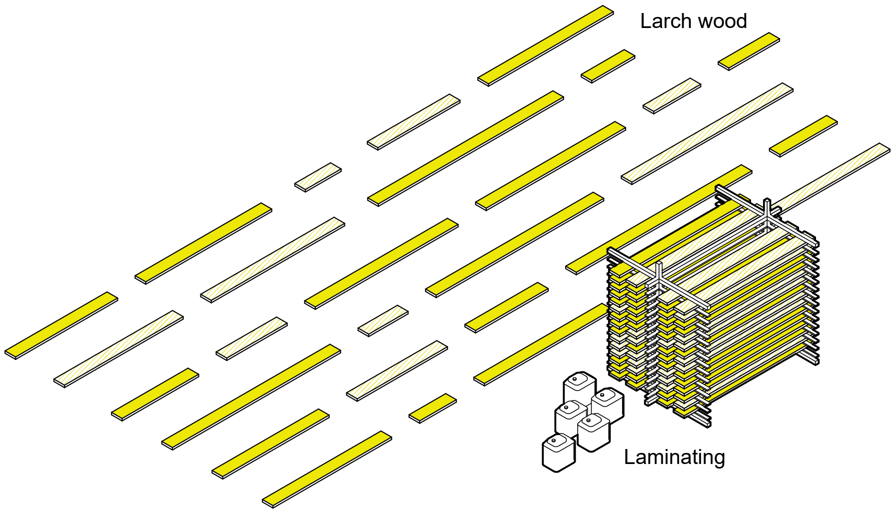
Construction Timeline

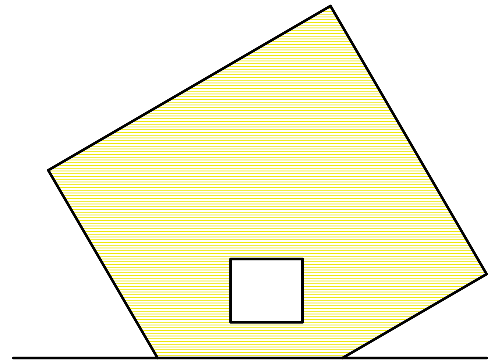


Project data and description provided by Renzo Piano Building Workshop. Research by Jihae Park, GSAPP.

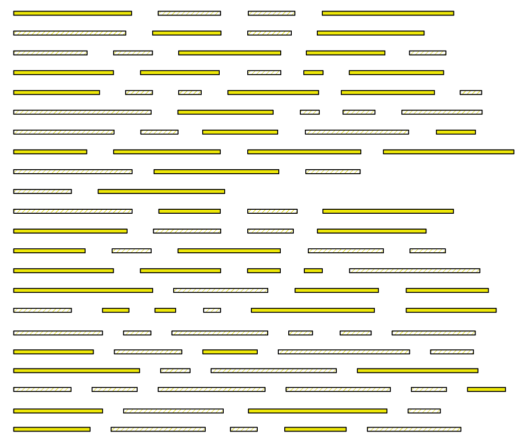
Site Plan

Drawing by Jihae Park, GSAPP



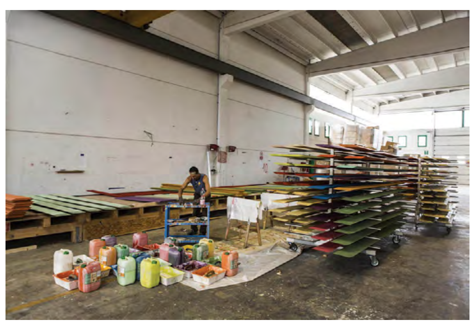


Mapping the laminate wood facade assembly.



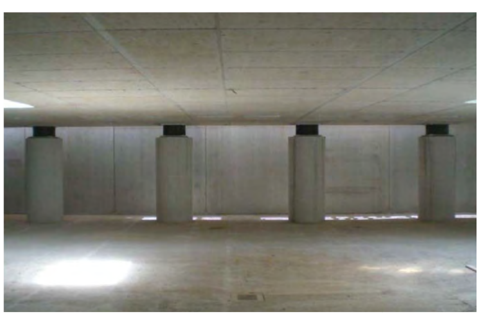
Factory and Site Sequence

Meeting between stakeholders.

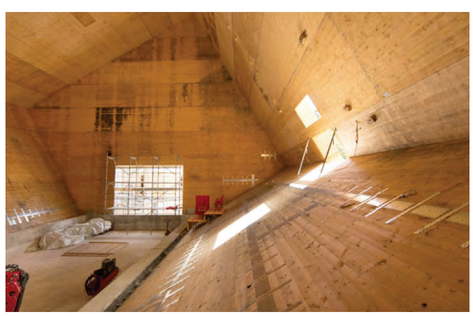


Laminating the wood.

Foundation prototype.



Foundation poured on site.

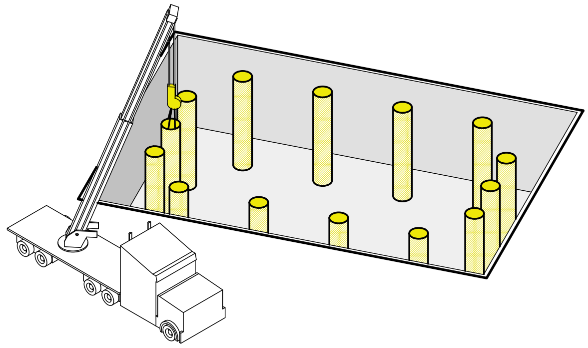


Construction of timber frame.

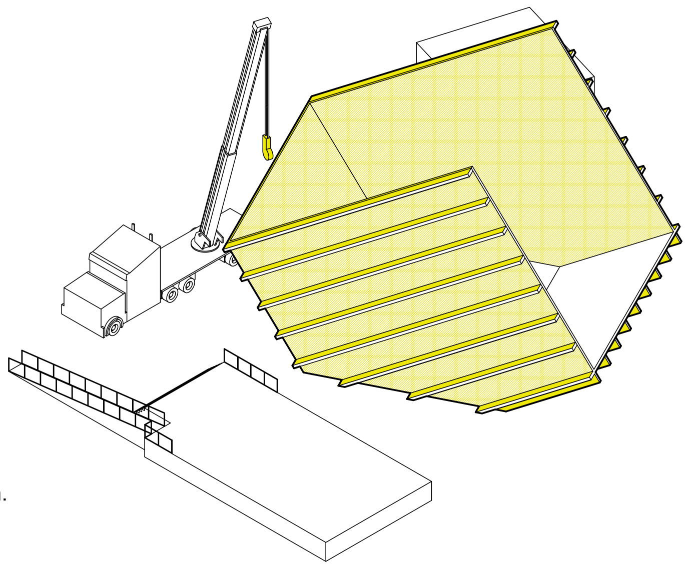
Completed interior.

Drawing by Jihae Park, GSAPP.
Images courtesy of © Renzo Piano Building Workshop

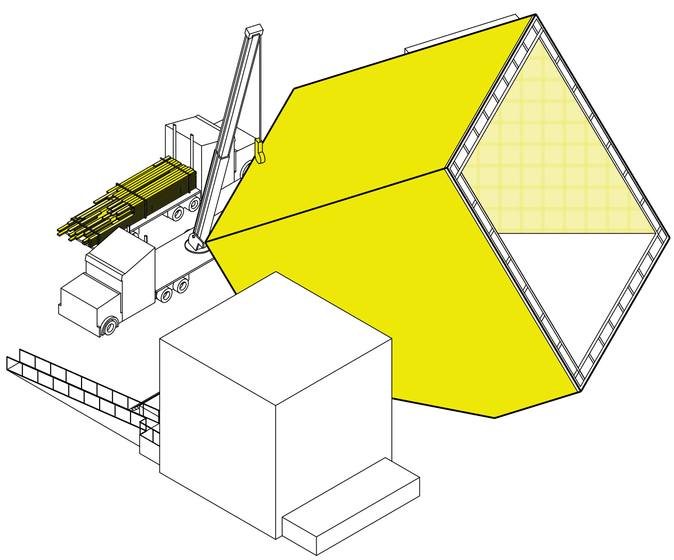
Construction Sequence



1. Concrete foundation was site poured.



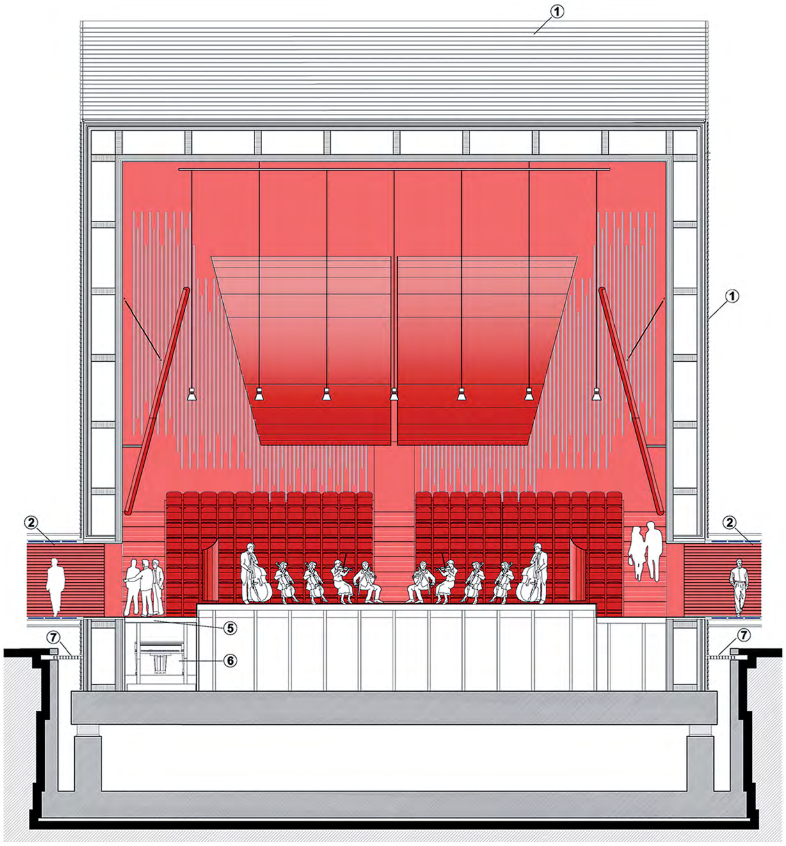
2. Timber frame was placed on foundation.



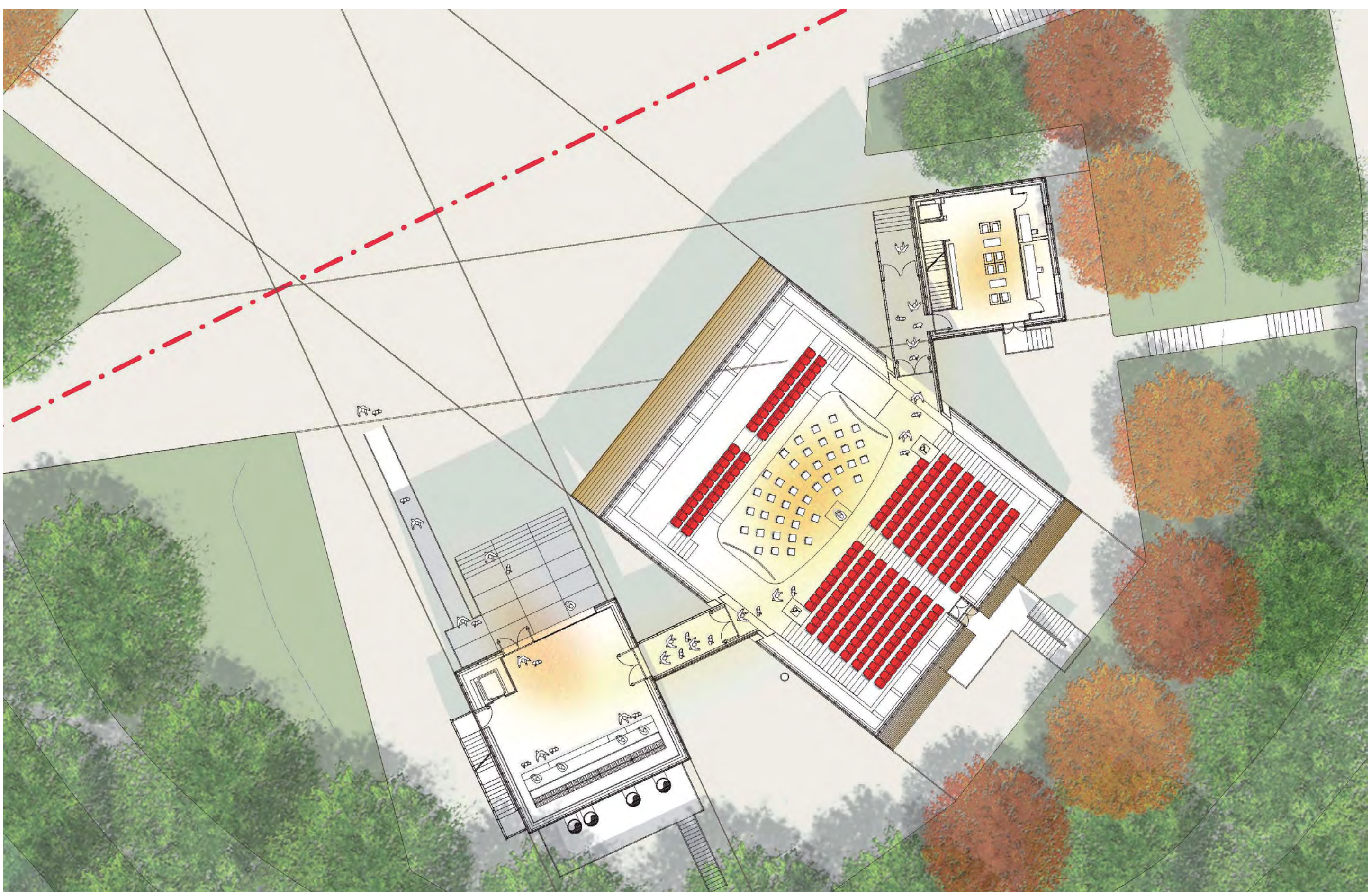
3. Timber frame was cladded and finished.

Site Development

Assembled Components



Above: Cross Section **Below**: Ground Floor Plan



Drawings courtesy of © Renzo Piano Building Workshop

Images courtesy of © Berengo Gardin


SAEZ

Images courtesy of © Marco Caselli Nirmal

Timmerhuis

[Halvemaanpassage 1, 3011 AH Rotterdam, Netherlands]

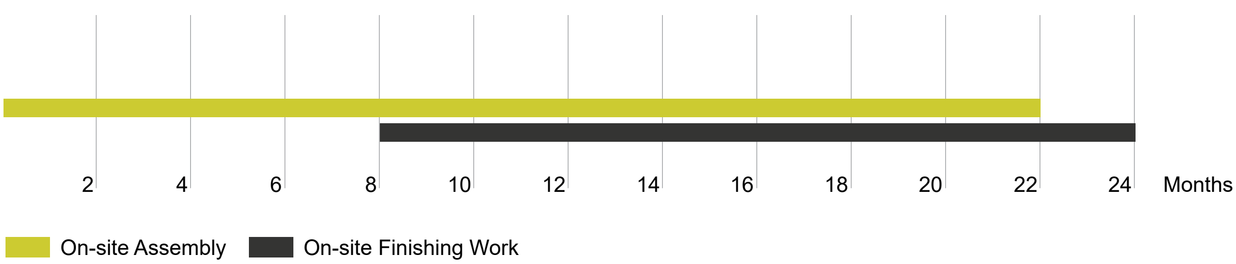
Images courtesy of © OMA

Architect	OMA
Structural Engineer	Pieters Bouwtechniek
Contractor	Heijmans
Year Completed	2015
On-site Assembly Time	22 months
Site Typology	Infill
Project Type	Mixed-use
Stories	14
Gross Square Footage	484,000 SF
Structural Materials	Steel
Facade Materials	Glass
Additional Information	oma.eu

Timmerhuis is a mixed-use building that serves the City of Rotterdam, accommodating municipal services, offices, and residential units. Its form is a compilation of small cubic modules, each measuring 7.2 meters wide, 7.2 meters deep and 3.6 meters high, creating a pixelated appearance, and breaking down the overall scale of the massing.

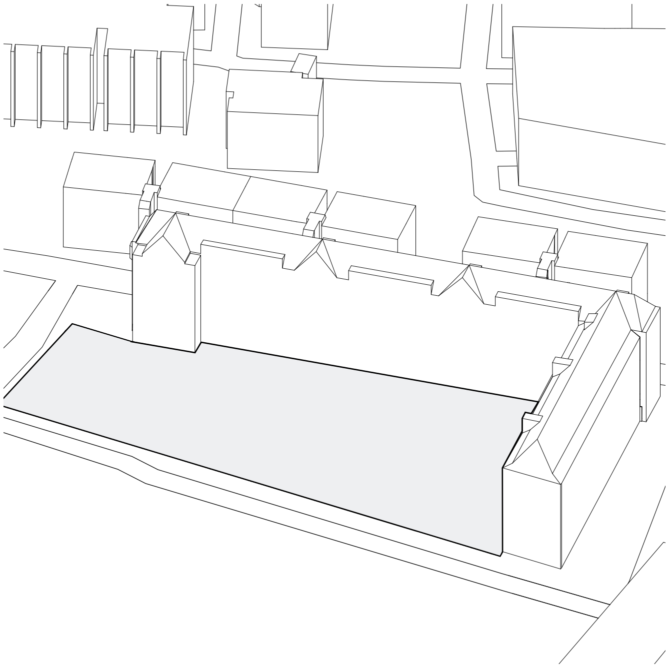
The project uses a prefabricated modular steel structural system, allowing for greater flexibility and versatility in construction, and giving it the ability to adapt to several programs ranging from office spaces, exhibition spaces, housing, and open public space on the ground floor. On the ground floor for instance, the structure allows for generous open space, with modules overhanging rather than encroaching on the street, thus encouraging an active engagement with the city. Further up, the overhang of the modules are used to house a garden for the apartments.

Construction Timeline

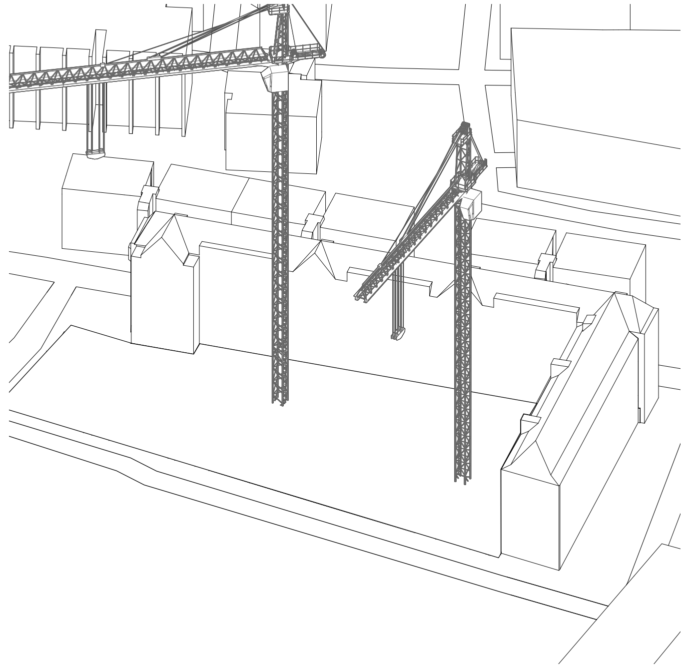


Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Felipe Rocha, GSAPP.

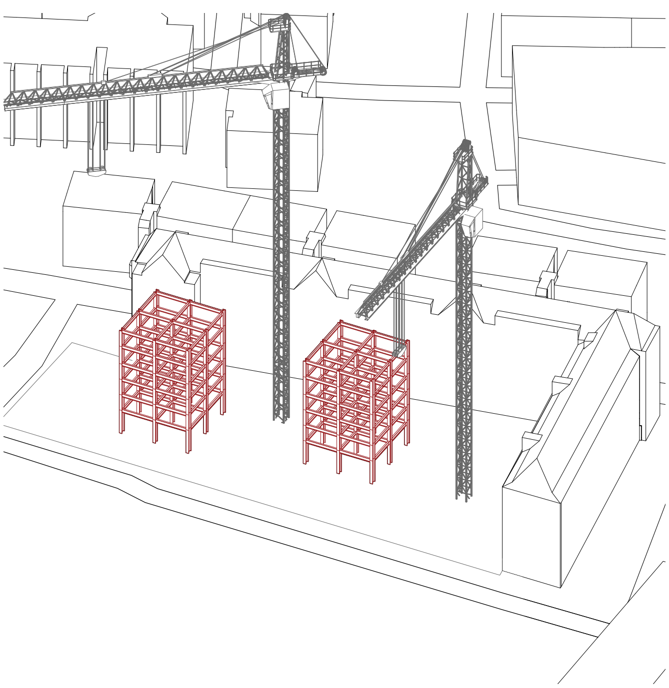
Construction Sequence



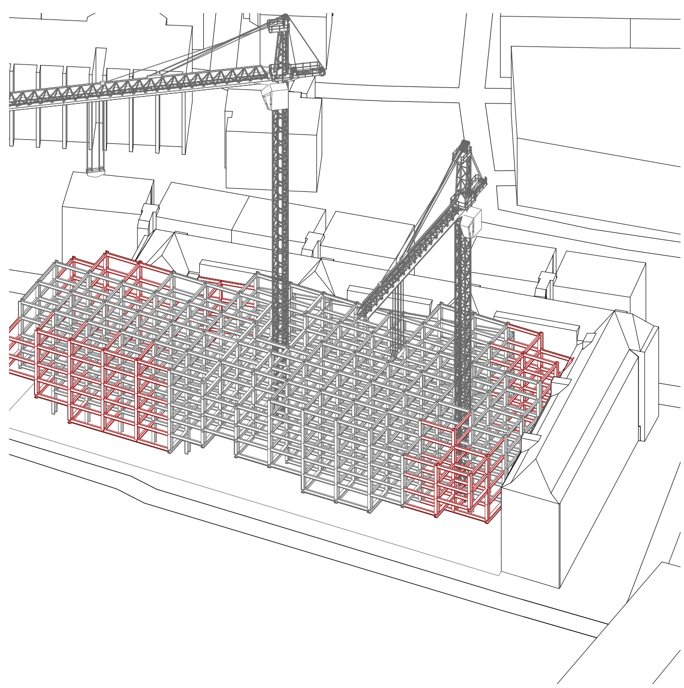
1. Concrete foundation and pad were site poured.



2. Cranes were put in place on site.



3. Structural cores were constructed to attach subsequent phases.

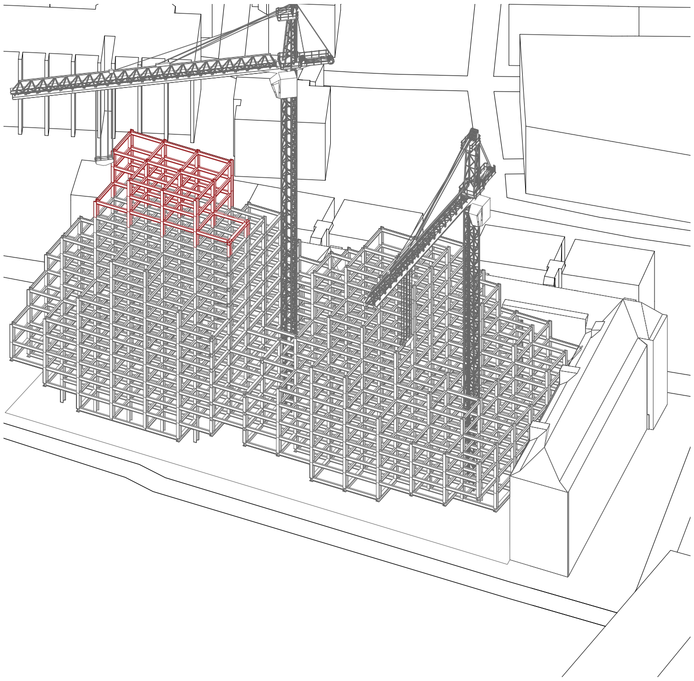


4. Modules were craned into place around the structural cores.

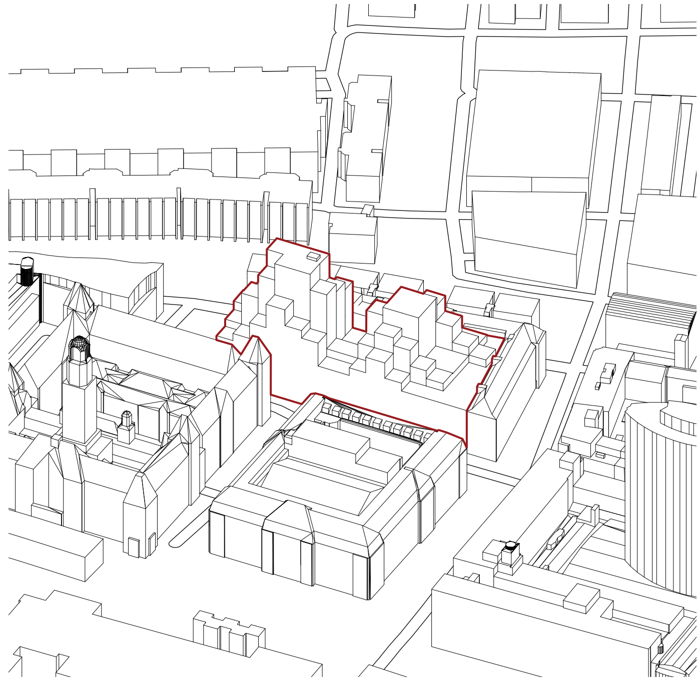
Site Development

Staging / Assembly

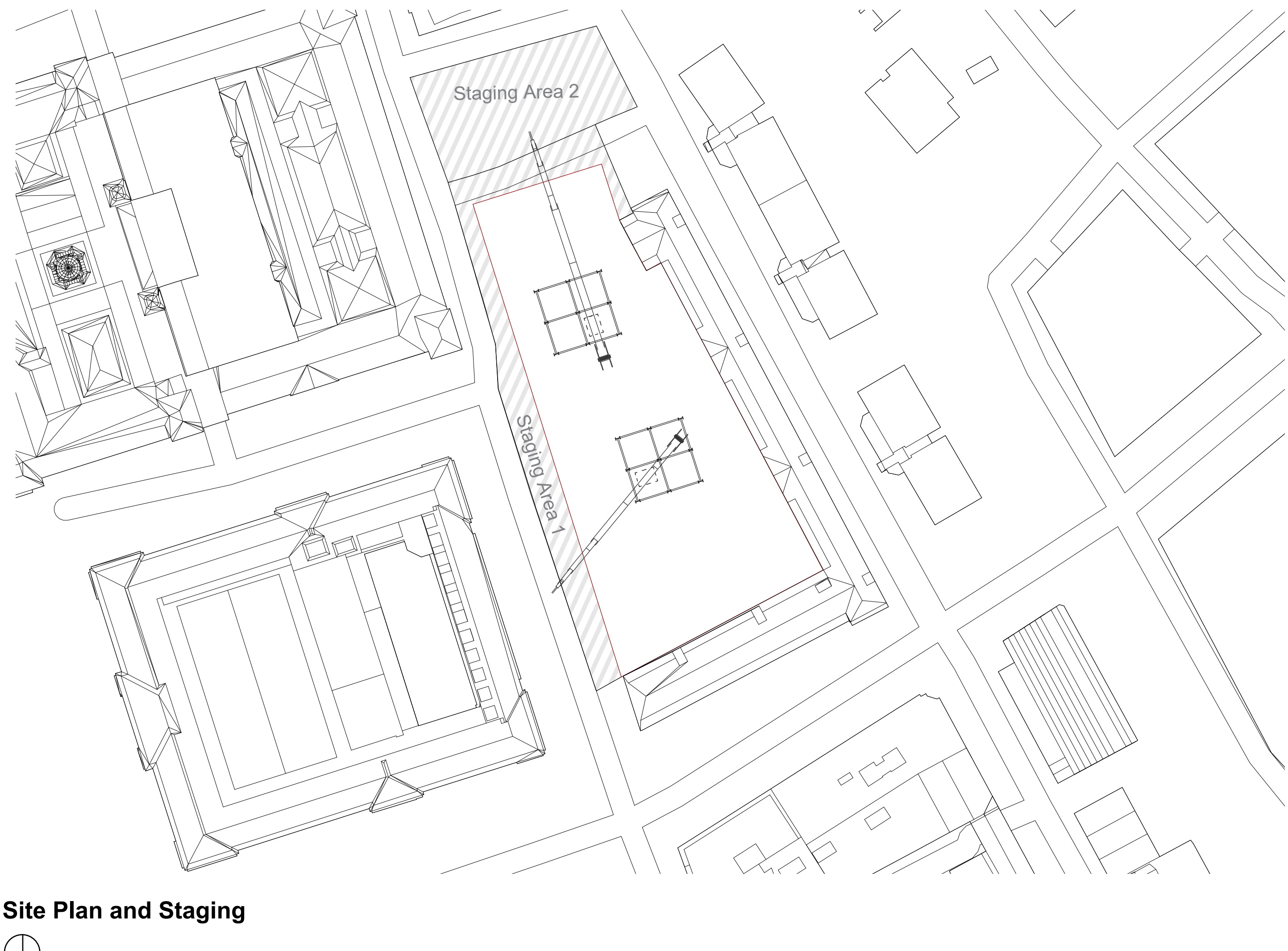
Drawing by Felipe Rocha, GSAPP



5. The remaining modules were craned into place.



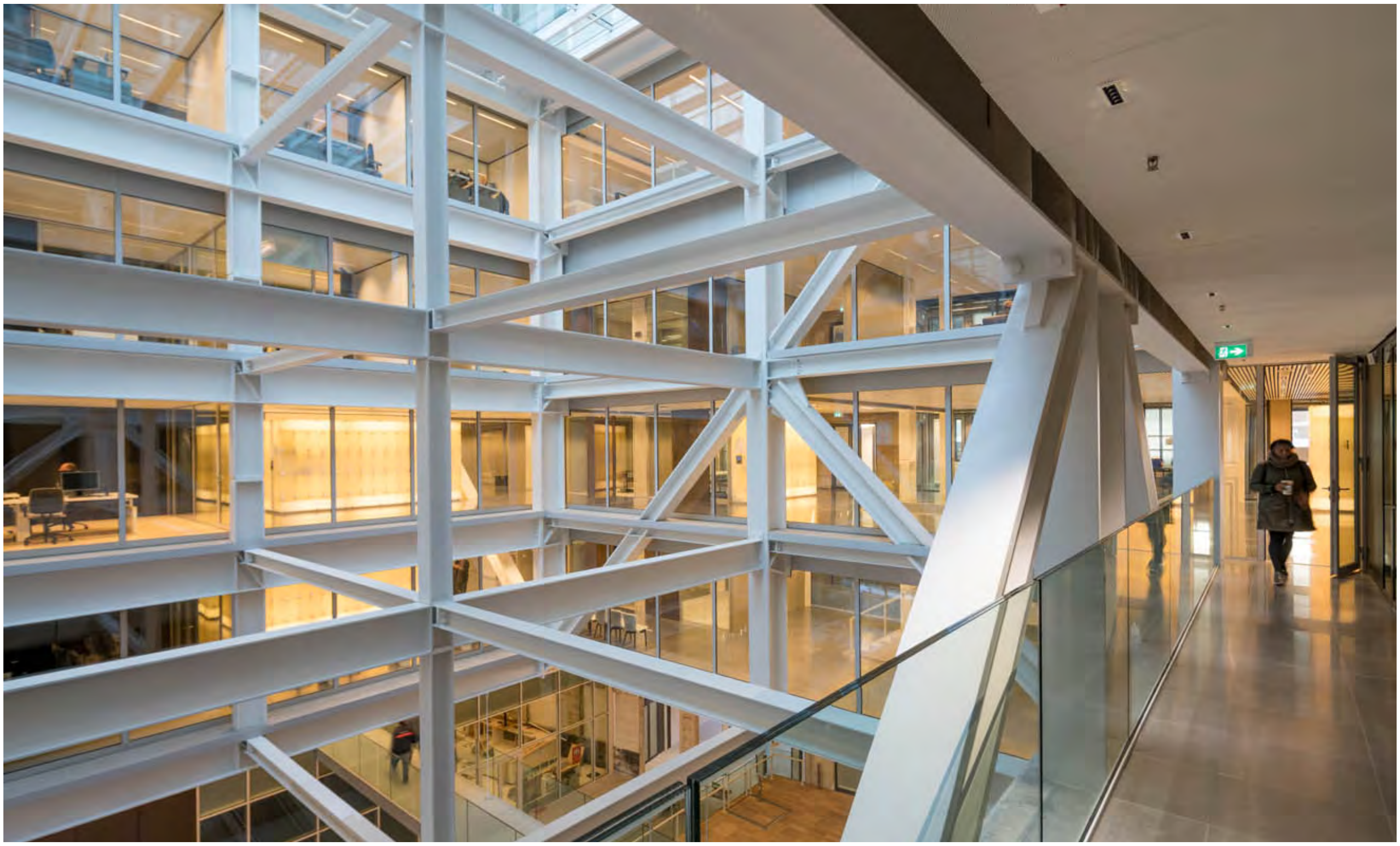
6. Building was cladded and cranes were removed.



Site Plan and Staging

Drawing by Felipe Rocha, GSAPP

Images courtesy of above © Janvan Helleman, below © Sebastian van Damme



Images courtesy of © Sebastian van Damme

Kiosk m Poli

Madrid, Spain

Modular
Global

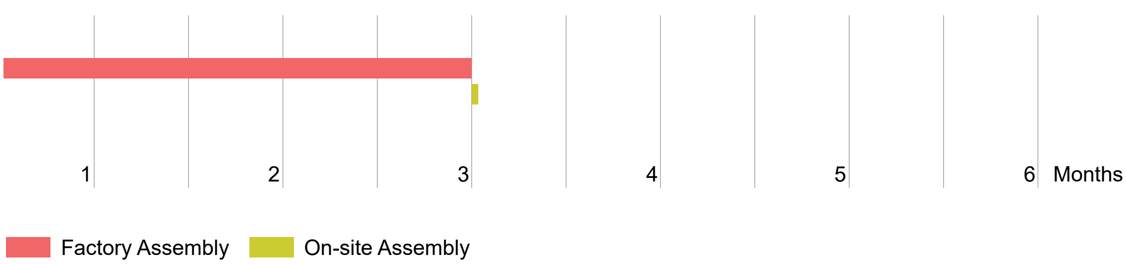
Image courtesy of © Miguel de Guzman

Architect	Brut Deluxe/ Ben Busche
Developer	City of Madrid
Fabricator	Primur SL
Year Completed	2006
Factory Assembly Time	3 months
On-site Assembly Time	1-4 hours
Site Typology	Flexible, public realm
Program	Kiosk, public infrastructure
Stories	1
Gross Square Footage	66 SF
Structural Materials	Steel
Facade Materials	Corten steel
Hard Cost ($)	26,700 € per unit
Total Constuction Cost	73€ million for 275 units
Additional Information	brutdeluxe.com

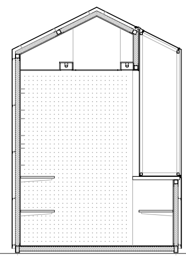
Commissioned by the City of Madrid, the Kiosk m Poli is designed to be a single, streamlined, block design used for temporary street markets and handicraft fairs. The small square footage and simple design enables the kiosk to be transported as one piece and craned into place without the need for assembly or disassembly.

The rotating façade doubles as an advertising board in addition to providing an opening where vendors can serve customers. Available in a variety of finishes, the minimal design of the kiosk allows for it to be placed in practically any part of the city like public squares, gardens, or vacant parking lots, without the need for foundations or any prior preparations on site.

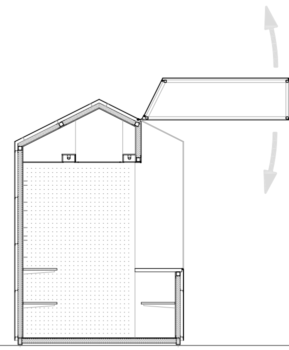
Construction Timeline



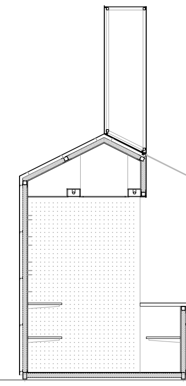
Project data provided by Brut Deluxe. Research and project description by Rahul Gupta, GSAPP.



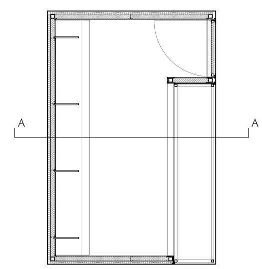
Section/ Closed



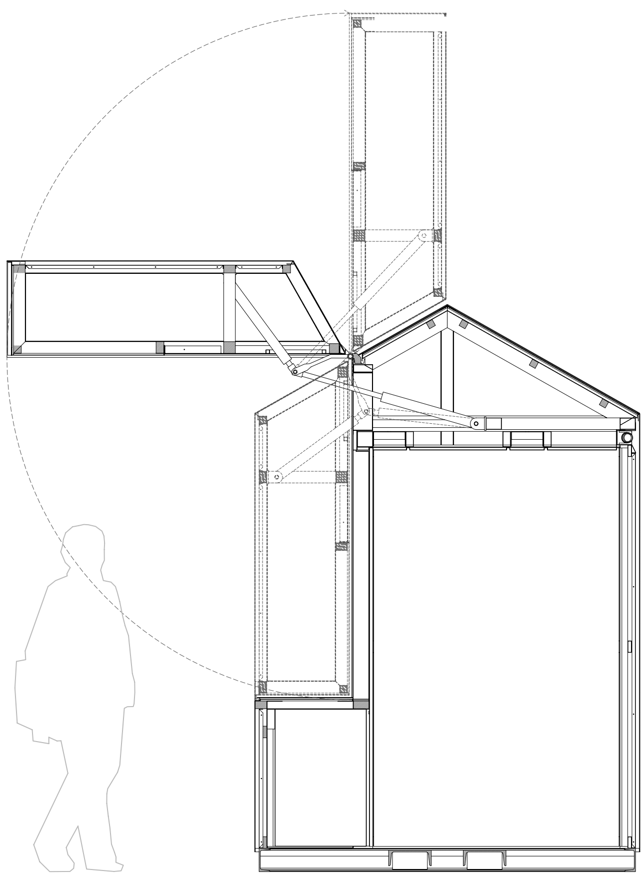
Section/ Semi Open



Section/ Open



Plan



Section

Images courtesy of © Miguel de Guzman

Images courtesy of © Miguel de Guzman

Pagliuca Harvard Life Lab

127 Western Avenue, Allston, MA 02134

Image courtesy of © Shepley Bulfinch Architects

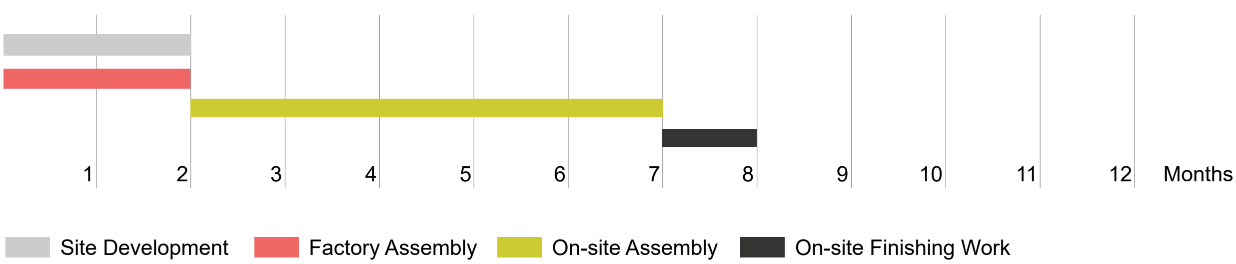
Architect	Shepley Bulfinch
Fabricators	NRB, Triumph Modular
Year Completed	2016
Factory Assembly Time	2 months
On-site Assembly Time	5 months
Site Typology	Infill
Program	Wet laboratory
Stories	2
Gross Square Footage	15,000 SF
Structural Materials	Steel frame, concrete
Facade Materials	Concrete, aluminum
Additional Information	shepleybulfinch.com

The Pagliuca Harvard Life Lab is part of Harvard University's Innovation Labs ecosystem, providing access to a fully equipped wet lab environment. Collaboration and flexibility were the two main drivers in the design and planning of the spaces at the lab. The program of the building is split, with office and collaboration spaces located on the first floor, and wet-lab space located on the second floor.

The 34 prefabricated modules were constructed in a state-of-the-art factory controlled environment in Pennsylvania, transported to the construction site via truck, and installed on a traditional site-poured concrete foundation.

The modules have steel framing with composite concrete decking, which was designed and sized based on shipping limitations on height, width, and weight. The prefabricated modules arrived on-site with substantially complete mechanical, electrical, and plumbing (MEP) systems, millwork, doors, fixtures, exterior cladding, and windows.

Construction Timeline



Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Rahul Gupta, GSAPP.

Images courtesy of © Shepley Bulfinch

ISDSI Campus

[47 Chotana Road, Chiang Mai 50300, Thailand]

Prefab
Global

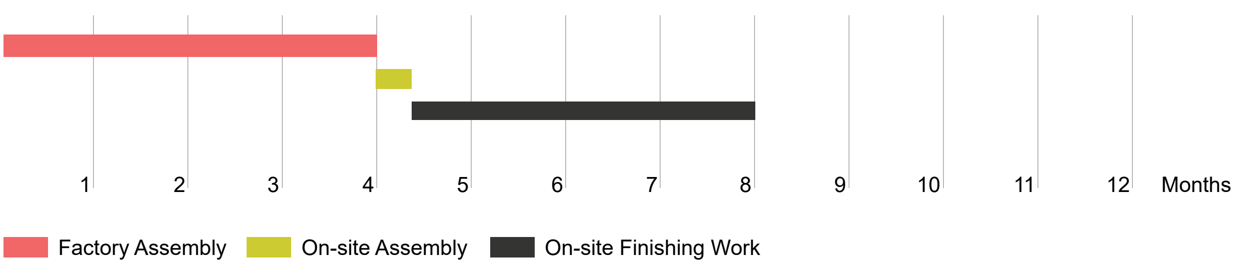
Image courtesy of © ISDSI

Architect	Nattawit Jongprasert
Year Completed	2016
Factory Assembly Time	4 months
On-site Assembly Time	10 days
Site Typology	Infill
Program	School
Stories	3
Gross Square Footage	35,000 SF
Structural Materials	Steel
Facade Materials	Steel, glass
Additional Information	isdsi.org

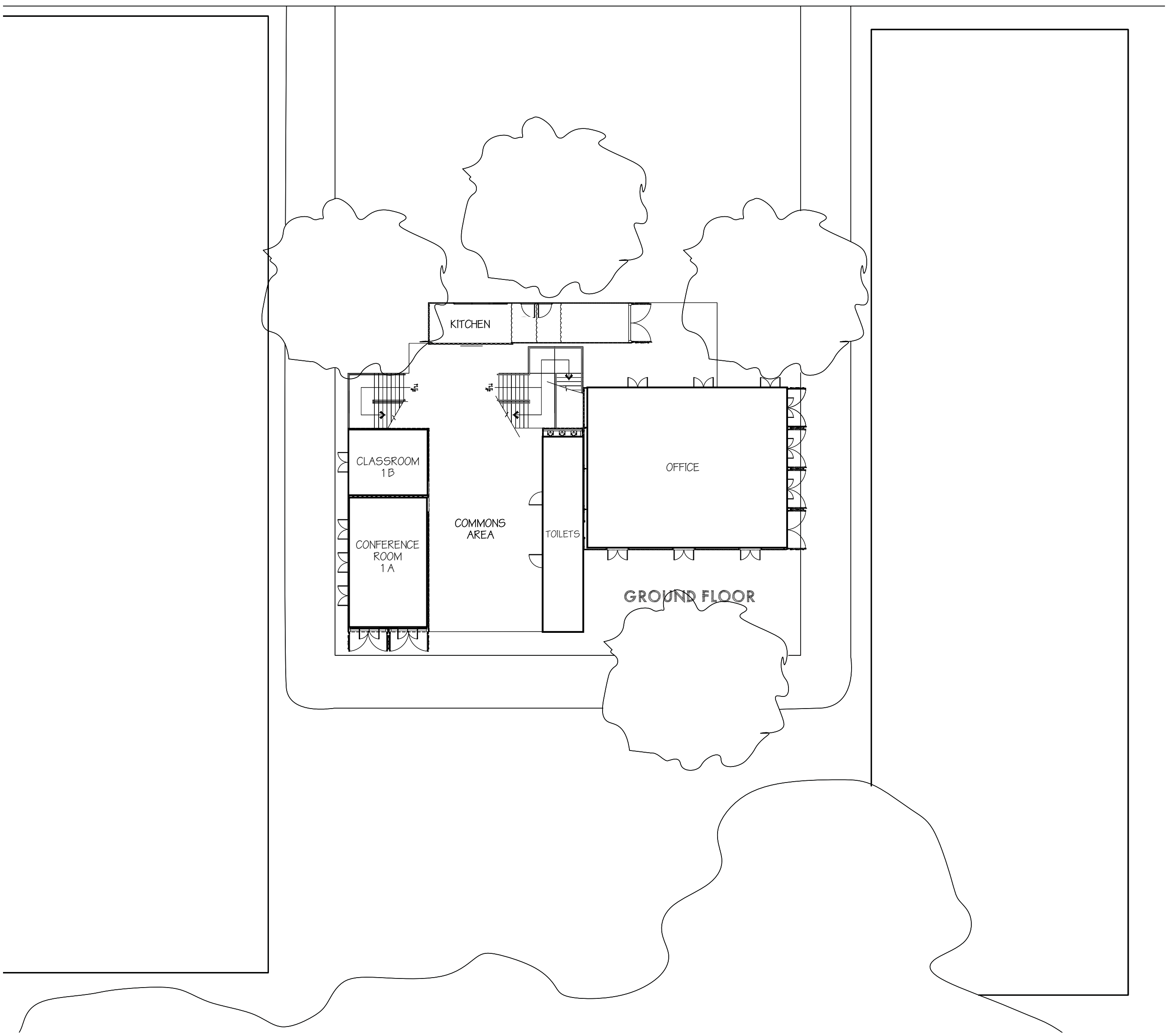
The ISDSI Campus building in Thailand was built using up-cycled steel shipping containers to reduce the carbon footprint of the building. The main structure is built out of 17 'high-cube' shipping containers, which are 9.5' high, one foot taller than a standard shipping container. The extra height of these containers makes the interior space feel much larger, open, and welcoming.

Shipping containers were chosen for the project since they can act as both the primary structure and volumetric component, which maximized efficiency and sustainability. In addition, the containers were built around large, open-air common areas, allowing breeze to constantly flow through the structure, providing passive ventilation in the tropical climate to reduce dependency on air-conditioning systems.

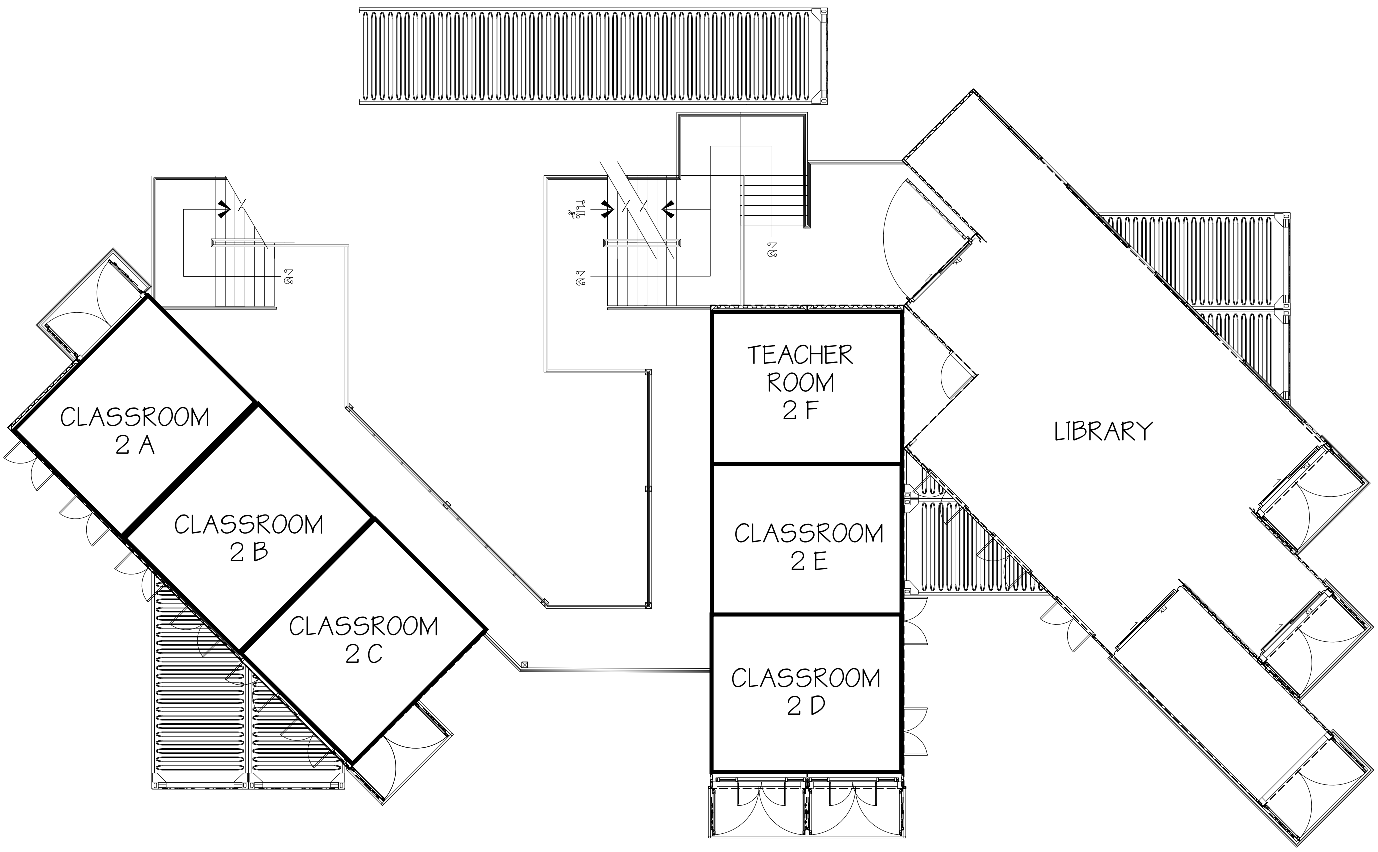
Construction Timeline



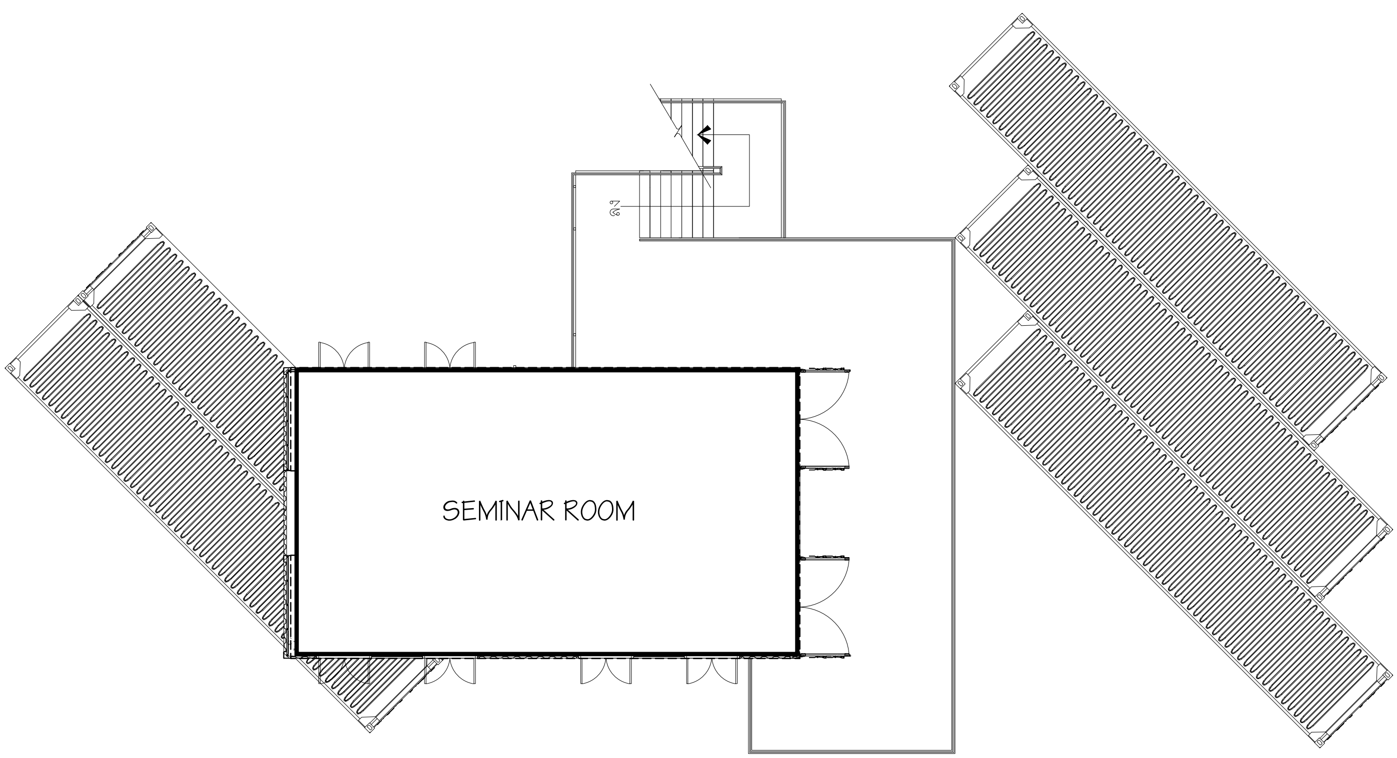
Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Kuan He, GSAPP.



Ground Floor Plan

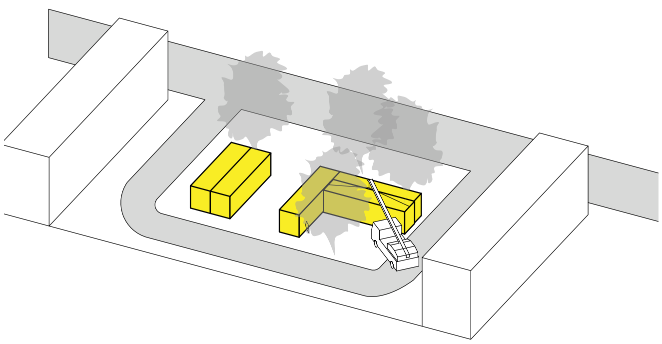


Second Floor Plan

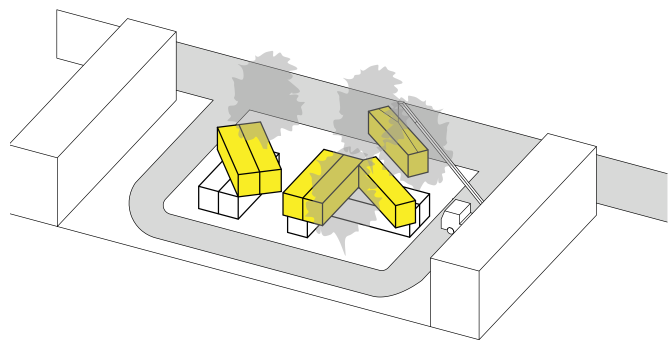


Third Floor Plan

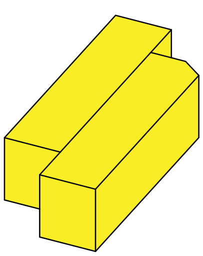
Construction Sequence



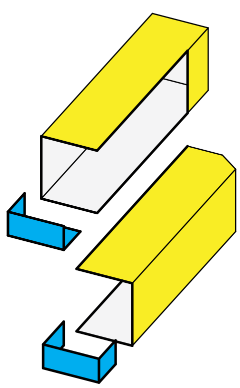
1. The first layer of shipping containers was placed. No on-site construction of foundations were needed.



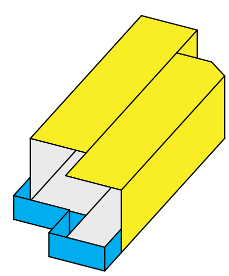
2. The second layer of shipping containers was stacked on top of the first layer.



Initial Shipping Container

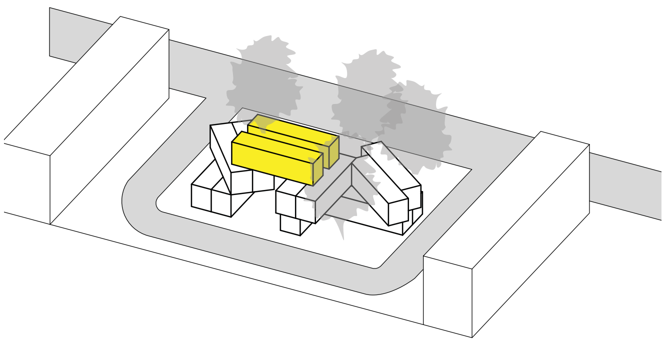


On-site Finishing Work

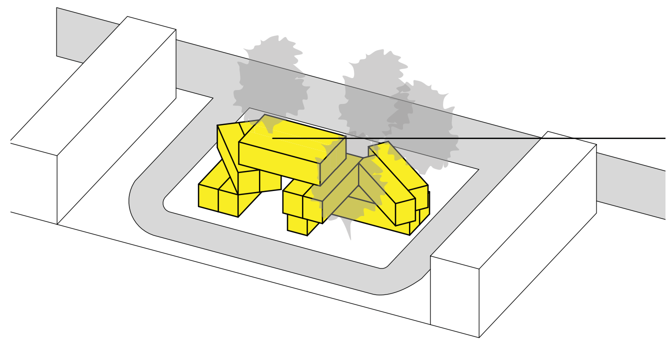


Final Output

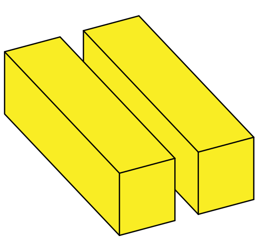
Staging/ containers
Additional components



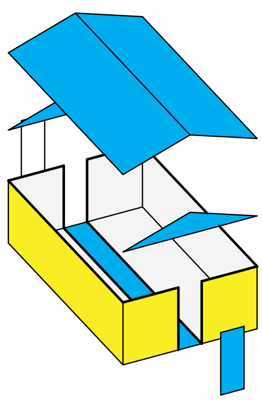
3. The top layer of containers was placed, forming the main office on the third floor.



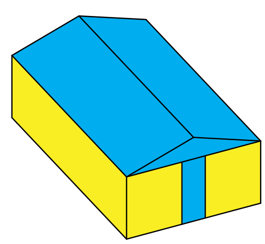
4. Stairs, platforms, and roofs were added to the containers.



Initial Shipping Container



On-site Finishing Work



Final Output

Staging/ containers
Additional components

Drawing by Kuan He, GSAPP

Images courtesy of © ISDSI


TADANO
MAERSK


CHINA SHIPPING
MAERSK

Images courtesy of © ISDSI

Images courtesy of © ISDSI

Living Unit Ljubljana

[Ljubljana Castle, Slovenia](#)

Image courtesy of © OFIS Architects

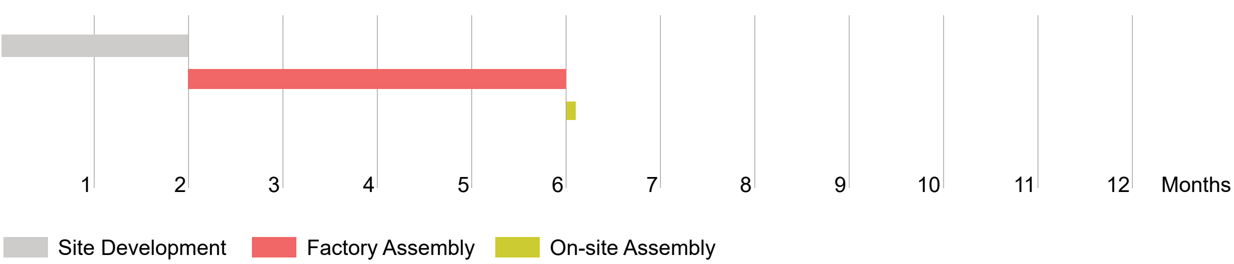
Architect	OFIS Architects, C+C, C28
Structural Engineer	AKT Engineers
Contractor	Permiz
Year Completed	2017
Factory Assembly Time	4 months
On-site Assembly Time	2 days
Site Typology	Infill
Program	Micro-dwelling prototype
Stories	1-3 (varies)
Gross Square Footage	100-400 SF (varies)
Structural Materials	Timber
Facade Materials	Wood, aluminum panels
Additional Information	ofis.si

Living Unit Ljubljana is a wooden shell designed to be adaptable to different locations, climate conditions, and terrains. It can be used as holiday cabin, tourism or micro-dwelling shelter. A prototype was installed on the grounds of the Ljubljana Castle in 2017, but has since been removed.

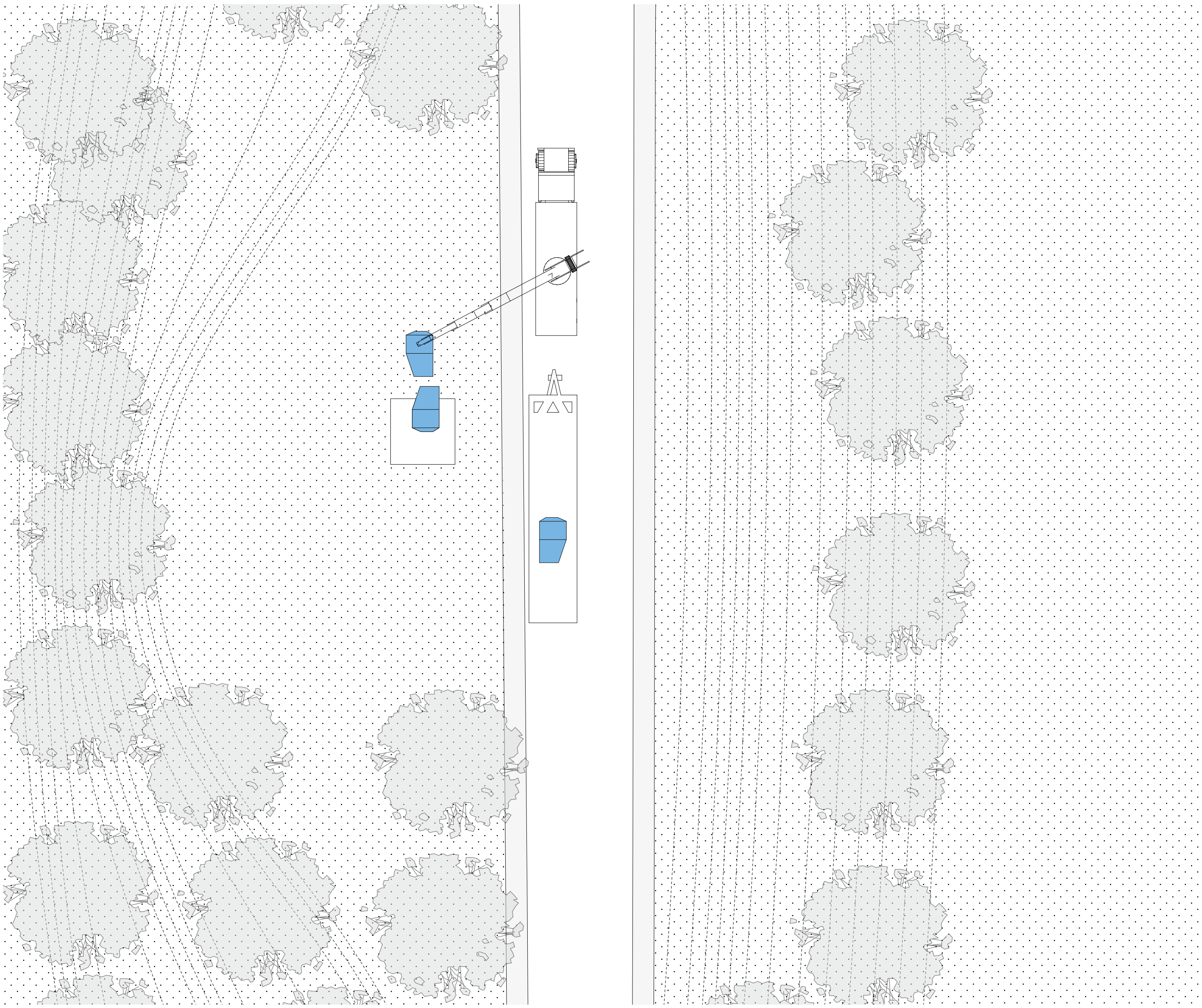
The basic unit's small size (4.50m X 2.50m X 2.70m) allows for easy and different transportation possibilities. The basic unit offers accommodation (with kitchen, bathroom, bed and seats) and joins horizontally or vertically.

The structure is made by prefabricated timber frames which are reinforced by plywood boards on both sides. The cabin can be fixed on the ground by steel anchors or removable concrete cubes. The interior finish is changeable as well.

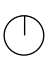
Construction Timeline



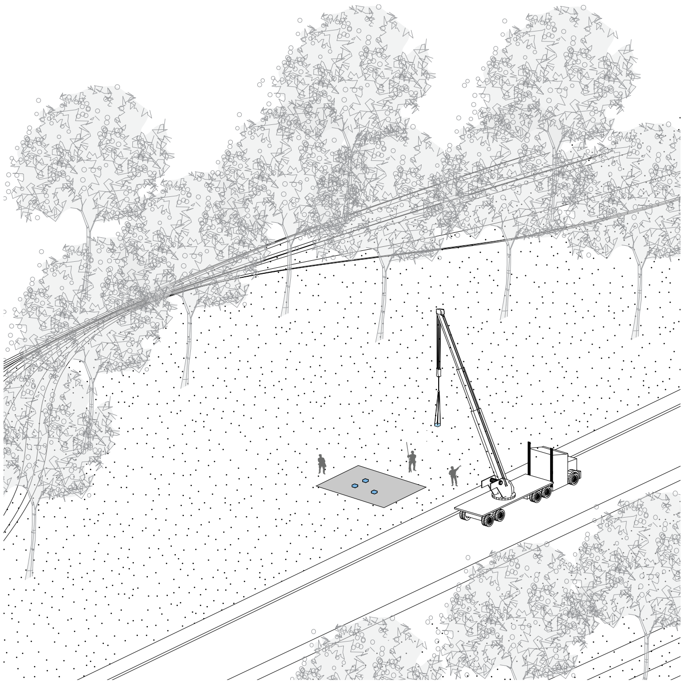
Project data and description provided by OFIS Architects. Research by Oscar DeLeon, GSAPP.



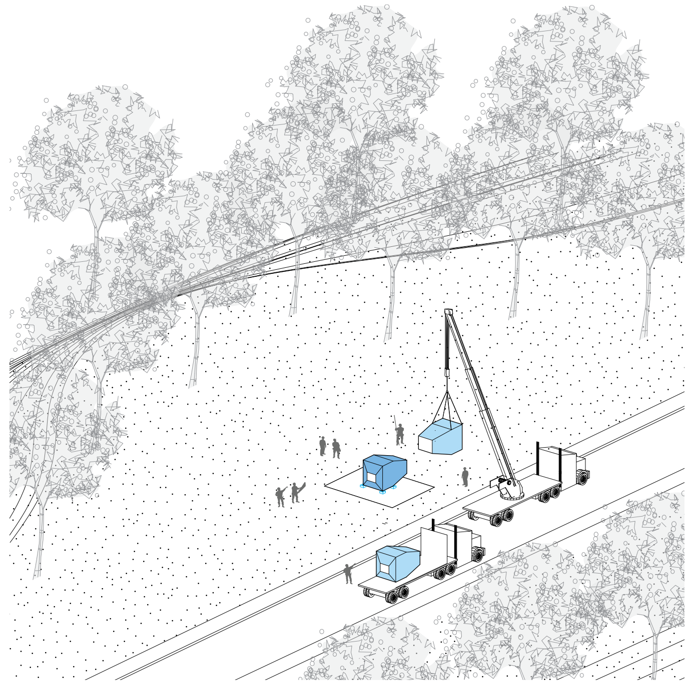
Site Plan



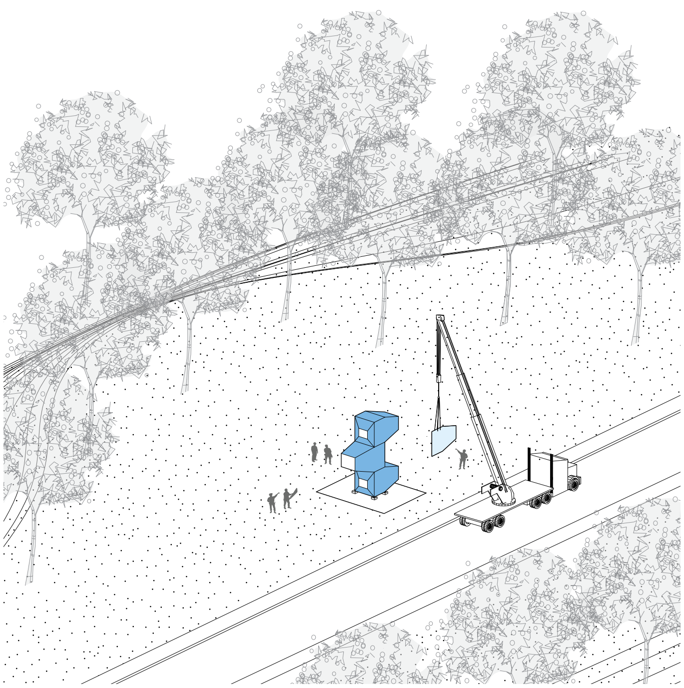
Construction Sequence



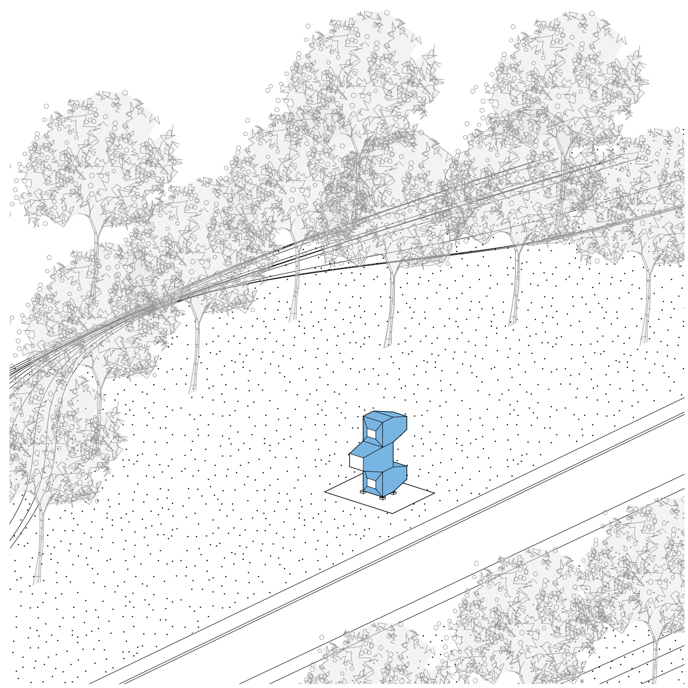
1. Ground was prepared for the foundation.



2. Solid concrete footings were placed.



3. Modules were delivered on site.



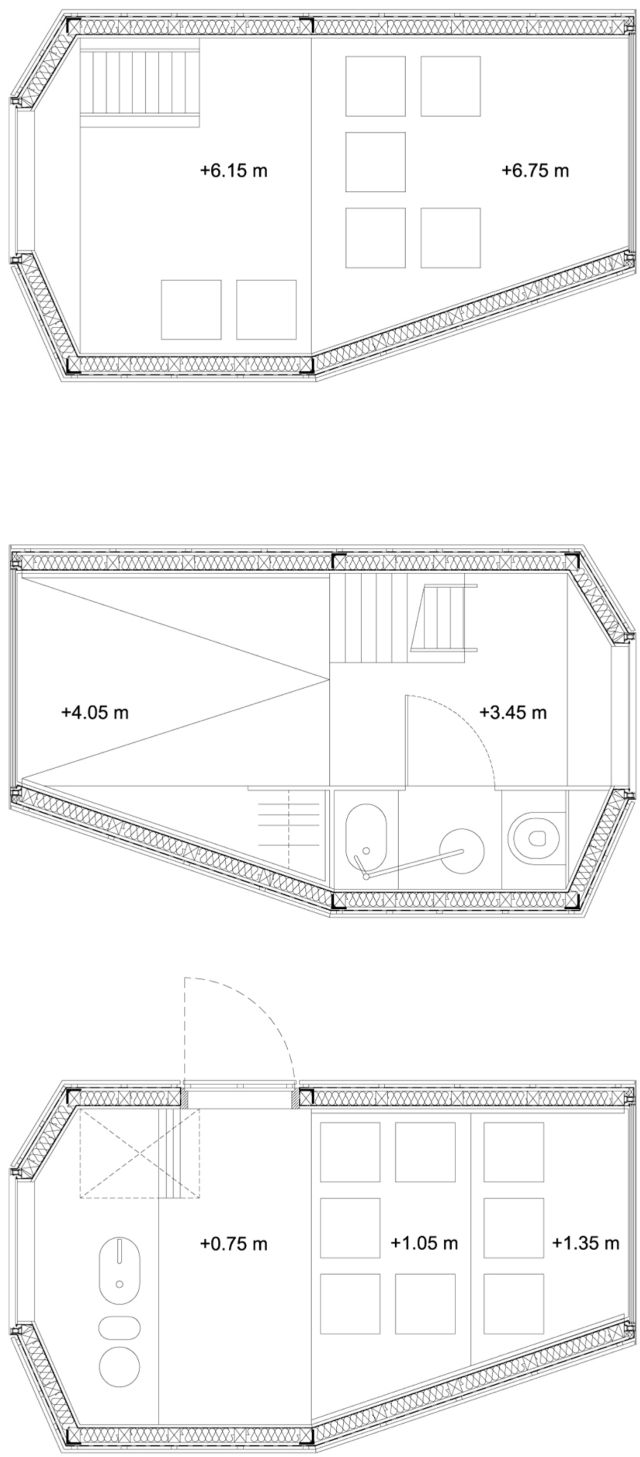
4. Modules were installed and finishing was applied.

Site Development

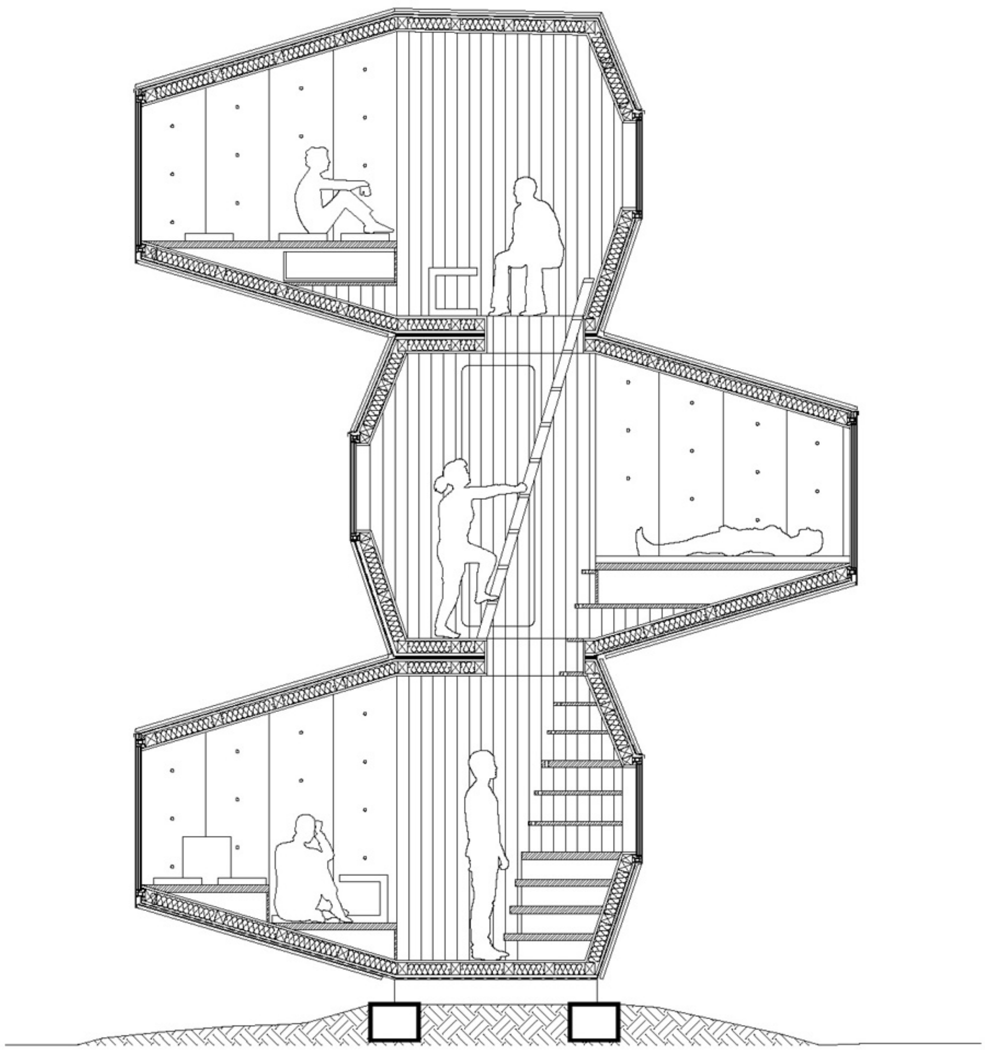
Staging / Assembly

Assembled Components

Drawing by Oscar DeLeon, GSAPP

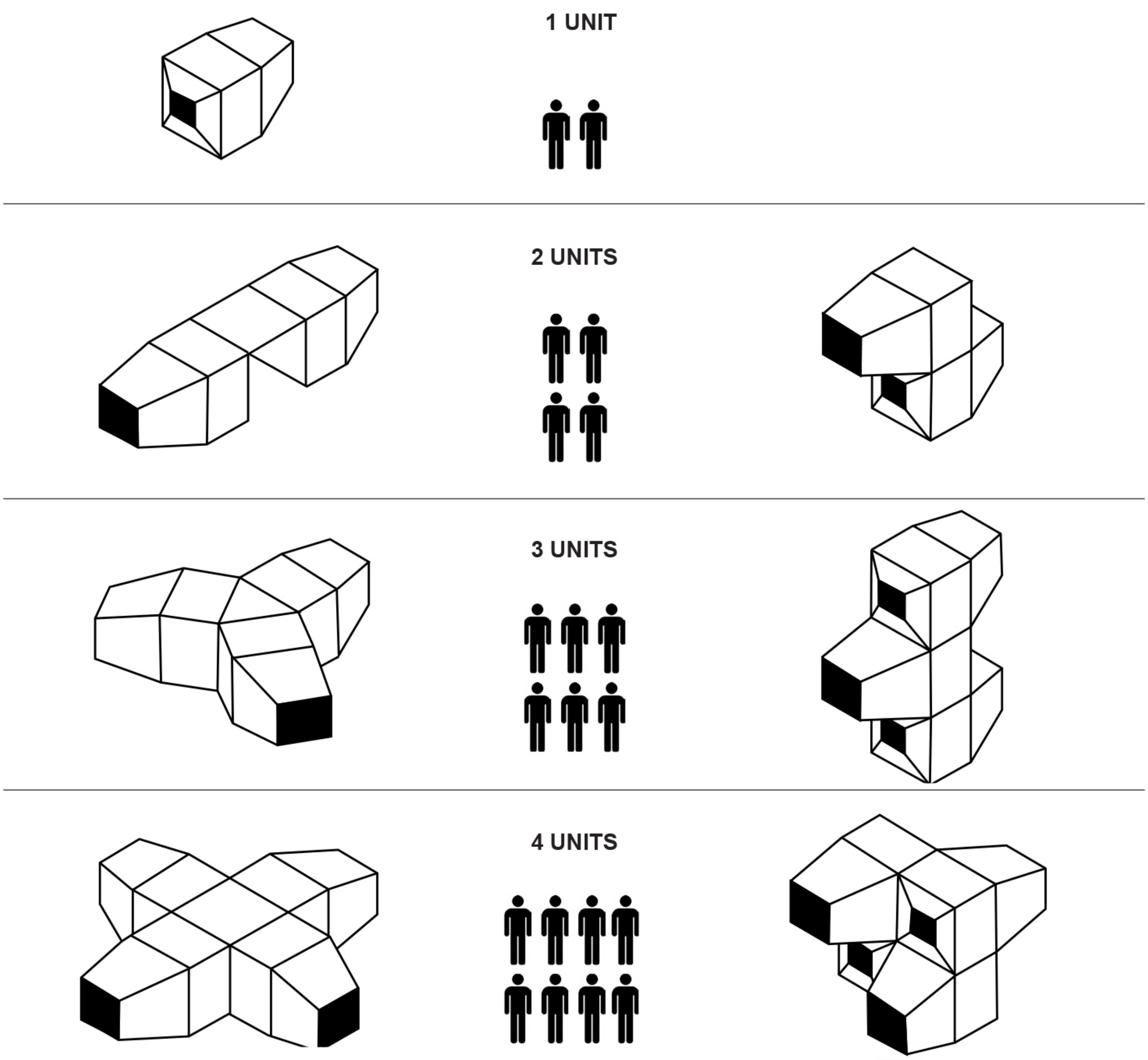


Plans



Section

Image courtesy of © Janez Martincic



Drawing courtesy of © OFIS Architects

Images courtesy of © Janez Martincic

Livingboard

Karnataka, India

Prefab
Global

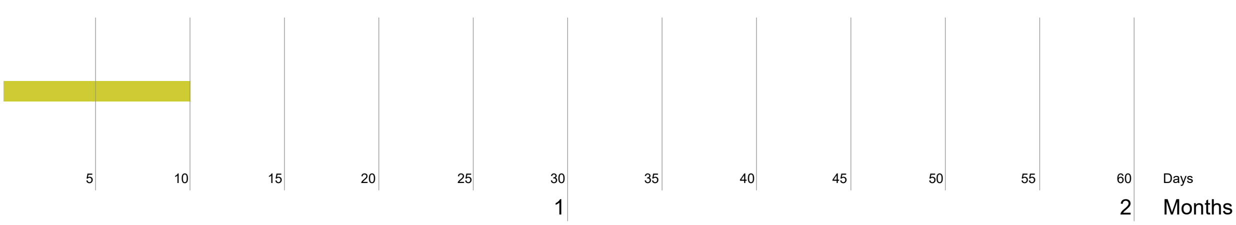
Rendering courtesy of © Carlo Ratti Associati

Architect	Carlo Ratti Associati
Year Completed	In progress
On-site Assembly Time	10 days
Site Typology	Infill
Program	Housing/ infrastructure
Stories	1
Gross Square Footage	130 SF
Structural Materials	Precast concrete
Facade Materials	Rammed earth blocks, bamboo, stone slabs
Additional Information	carloratti.com

Livingboard is a flexible “core” system intended to support the development of housing initiatives in any rural area of the world. The first pilot project is currently under development in India. The Livingboard core must be positioned horizontally, constituting the floor of a 12-square meter room (3x4m). It can provide, depending on the geography and infrastructure of the region in question, water storage and distribution, water treatment through filtration, waste management, heating, batteries to accumulate PV-generated electricity and Wi-Fi connectivity.

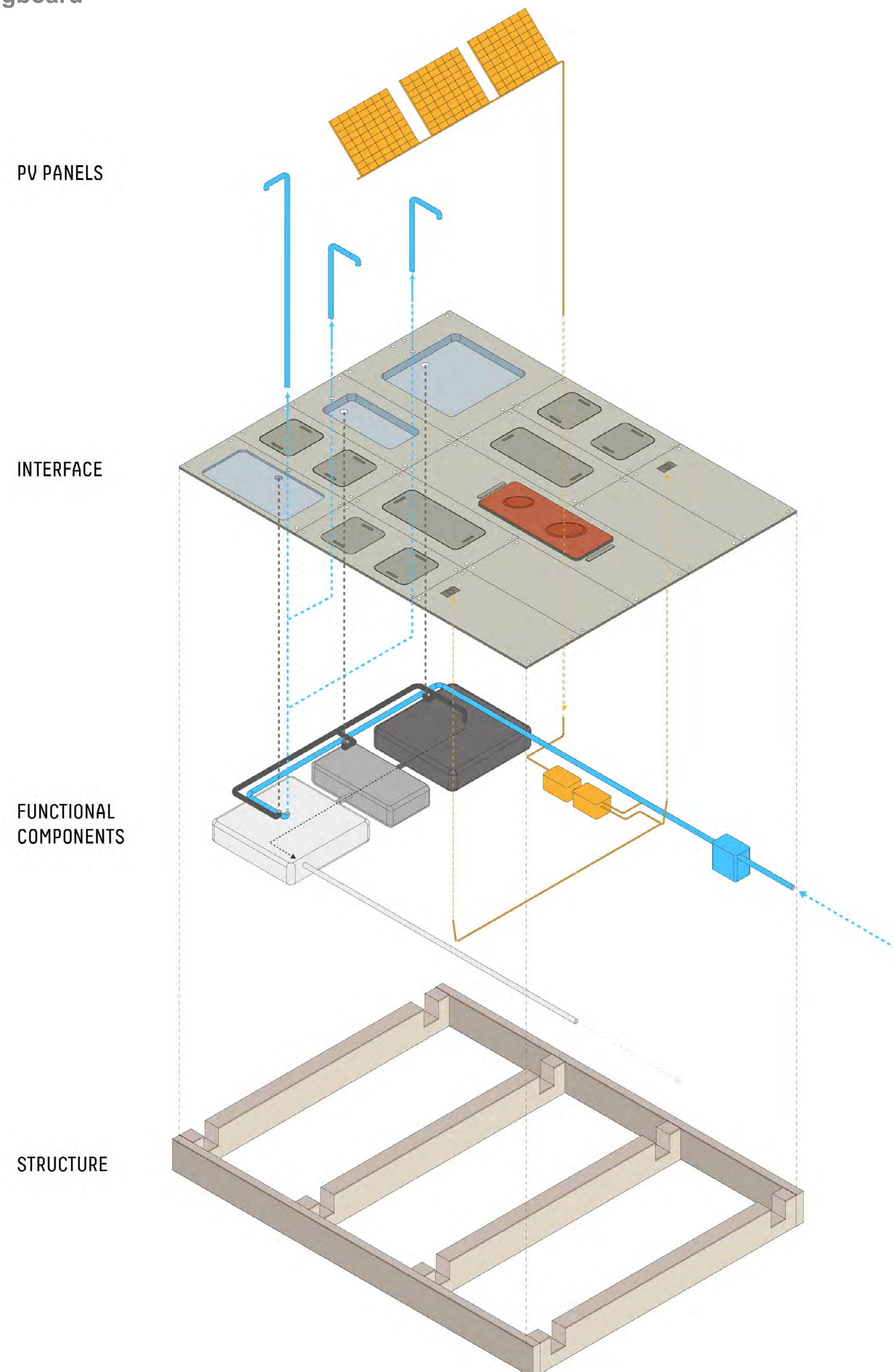
From a structural point of view, the board provides seismic isolation by separating the building’s superstructure from the substructure. Made of low-cost materials that can be flat-packed, Livingboard revolves around the idea that housing should not be a static unit that is packaged and handed over to people, but rather should be conceived of as an ongoing project wherein the residents are co-creators.

Construction Timeline

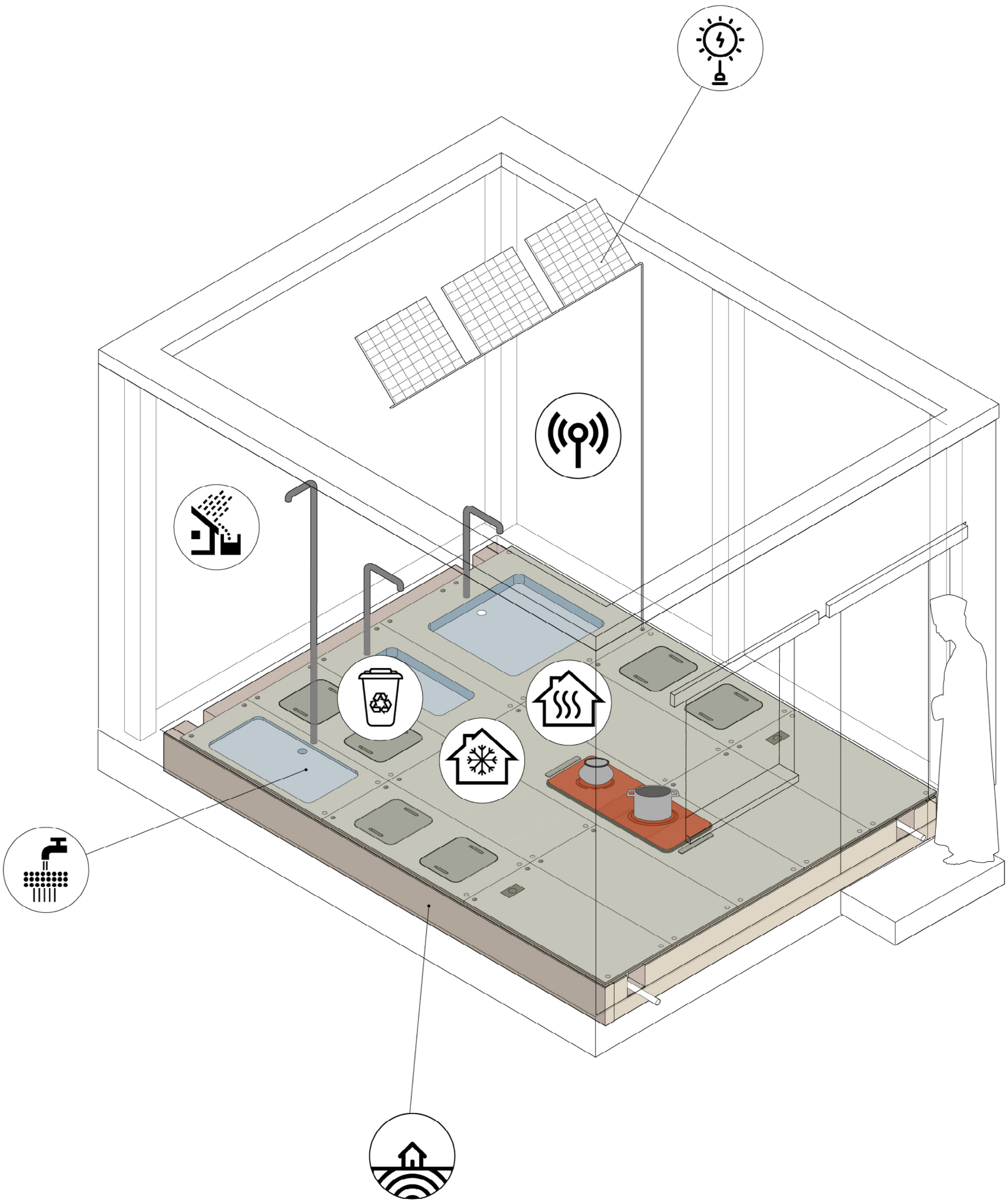


On-site Assembly

Project data and description provided by Carlo Ratti Associati. Please note that this project is in development and all project data is estimated.
Research by Rahul Gupta, GSAPP.



Axonometric of Components



Axonometric of Infrastructural Components

Image courtesy of © Carlo Ratti Associati

Renderings courtesy of © Carlo Ratti Associati

Temporary Housing for Kumamoto Earthquake

Kumamoto, Japan

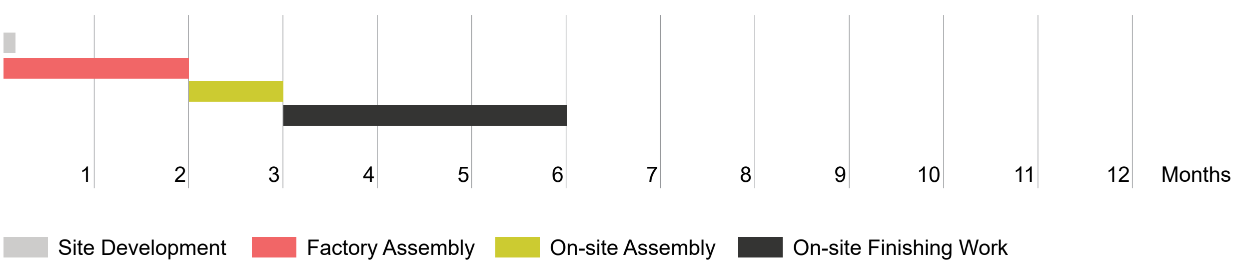
Image courtesy of © JDP

Architect	Shigeru Ban Architects
Additional Partners	Kumamoto University
Year Completed	2016
Off-site Assembly Time	2 months
On-site Assembly Time	1 month
Site Typology	Infill
Program	Interim housing
Stories	1
Gross Square Footage	16,000 SF
Structural Materials	Wood, plywood
Facade Materials	Plywood
Additional Information	shigerubanarchitects.com

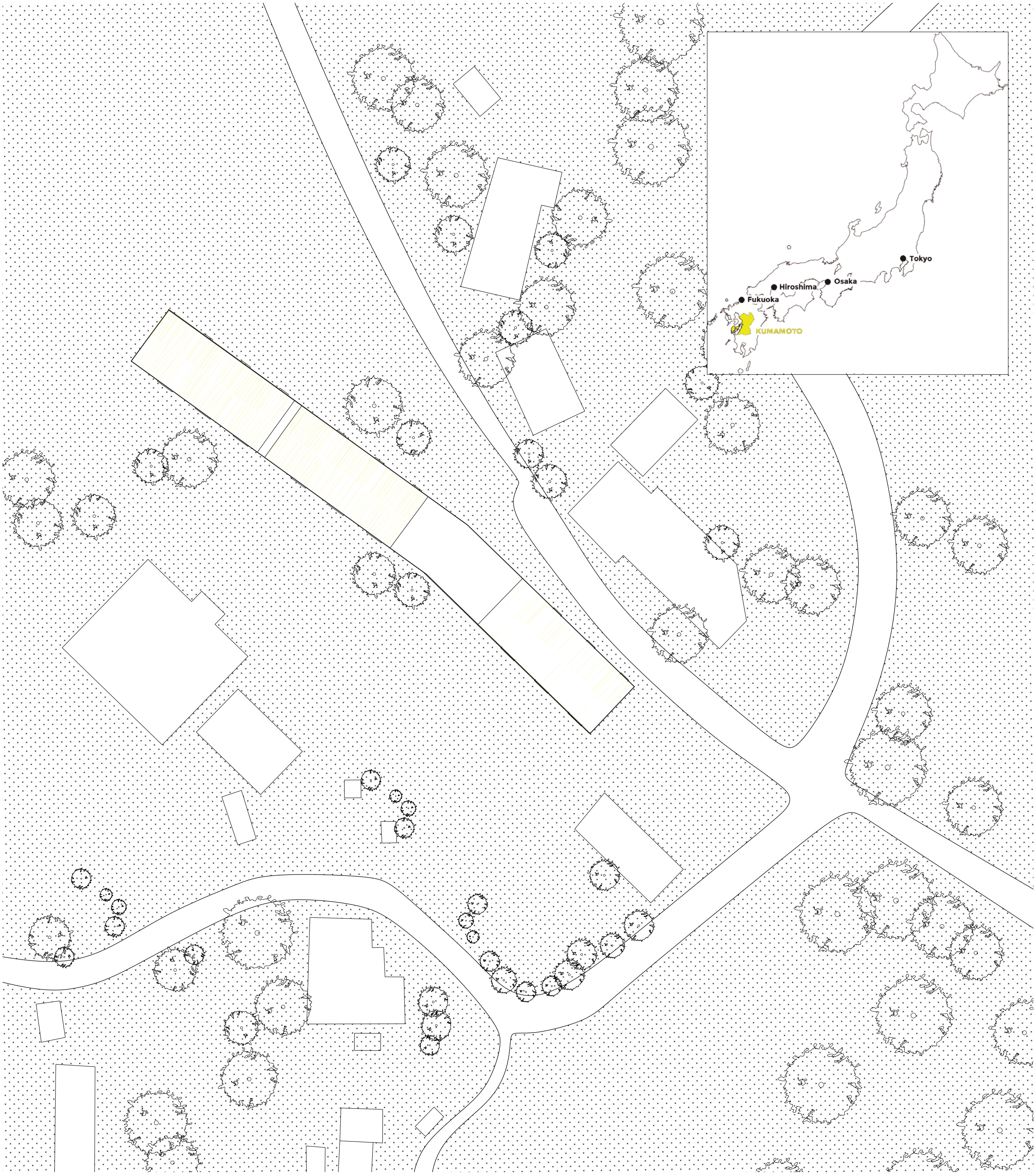
Located in Mifune Town in Kumamoto Prefecture, this project is a housing complex made of three temporary wooden buildings surrounding a central community space, and was designed for ten families who were affected by a massive earthquake in the area in 2016. The project was a collaboration between Shigeru Ban Architects, Voluntary Architects' Network, Keio University SFC Shigeru Ban Lab, and Kumamoto University.

The structure of the temporary house was built from wood and plywood panels. The panels were prefabricated at a factory and then brought to the site, thus shortening the construction period on site, and providing faster relief for the families in distress.

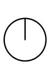
Construction Timeline



Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Pooja Annamaneni, GSAPP.

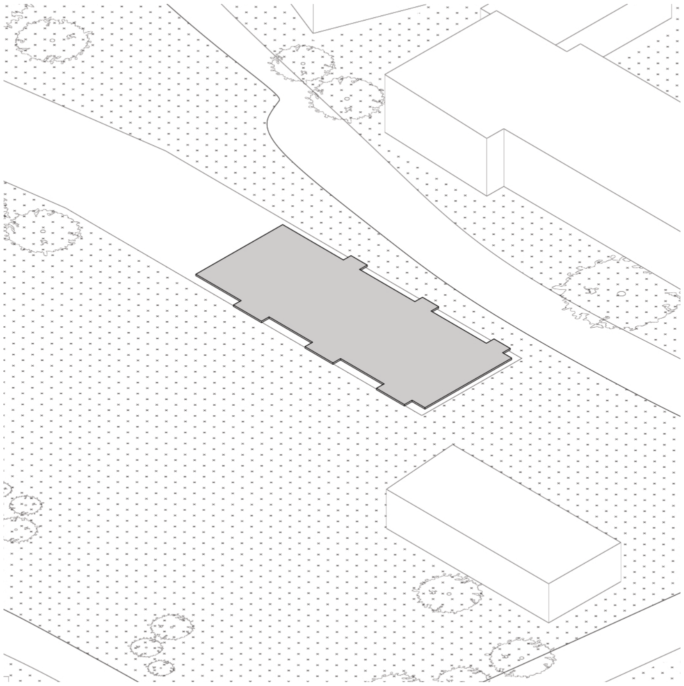


Site Plan

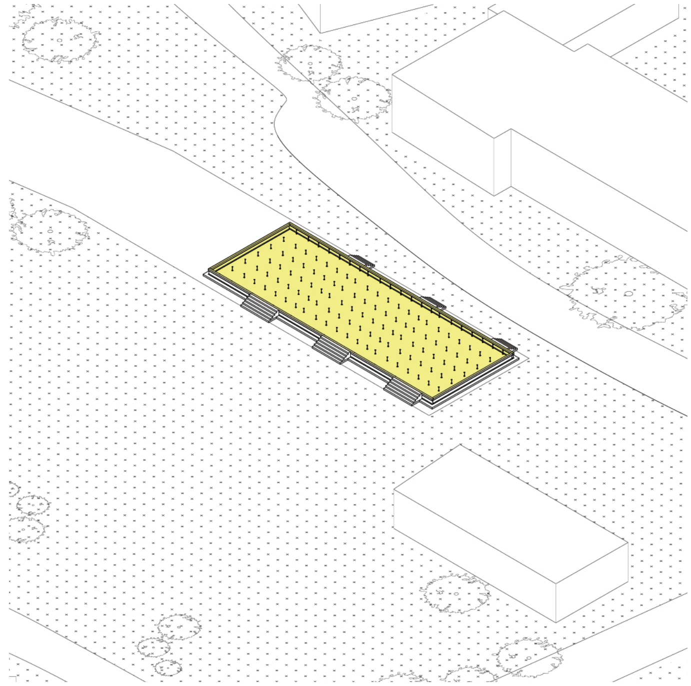


Drawing by Pooja Annamaneni, GSAPP

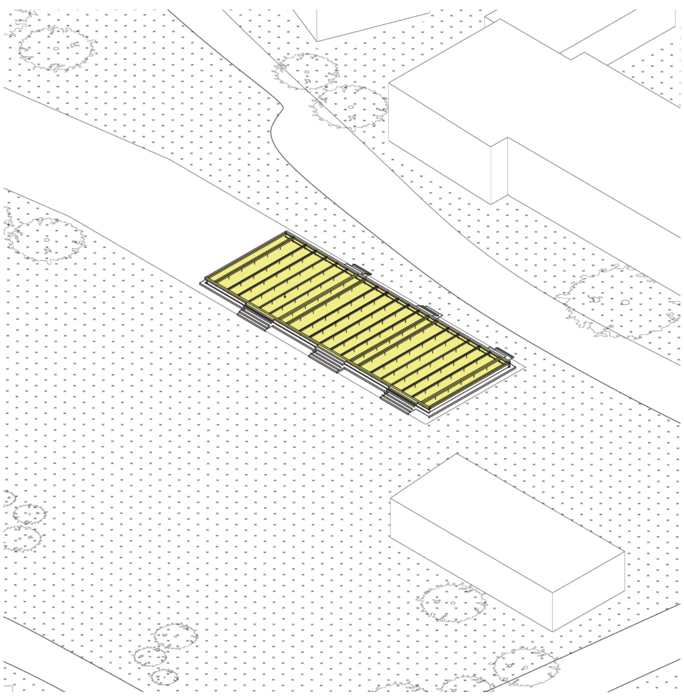
Construction Sequence



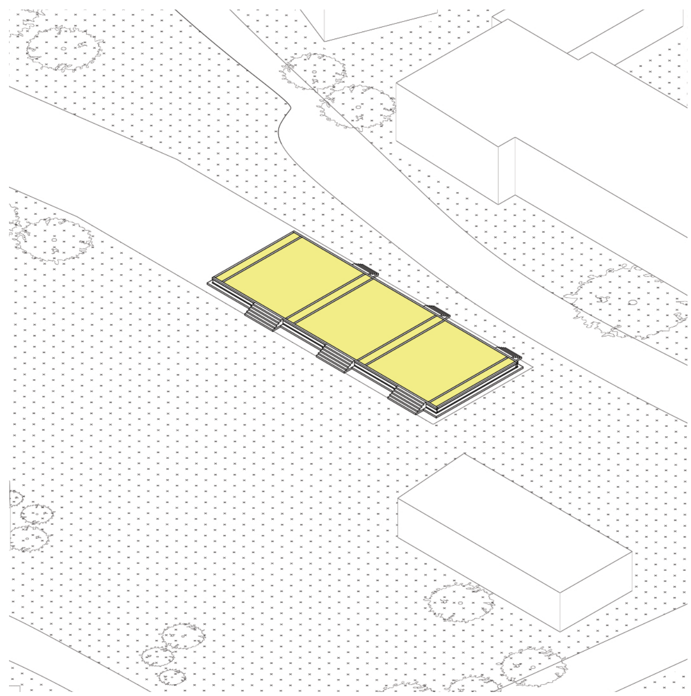
1. Concrete foundation was poured on site.



2. The studs and I-beams were placed in preparation for the wood floor.



3. Wooden floor girders were placed on the studs to span the distance.

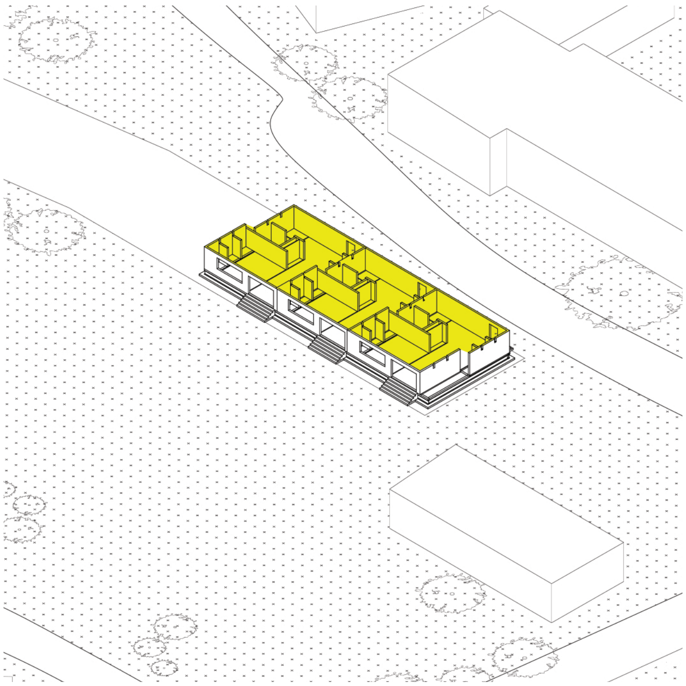


4. Wooden floor was constructed.

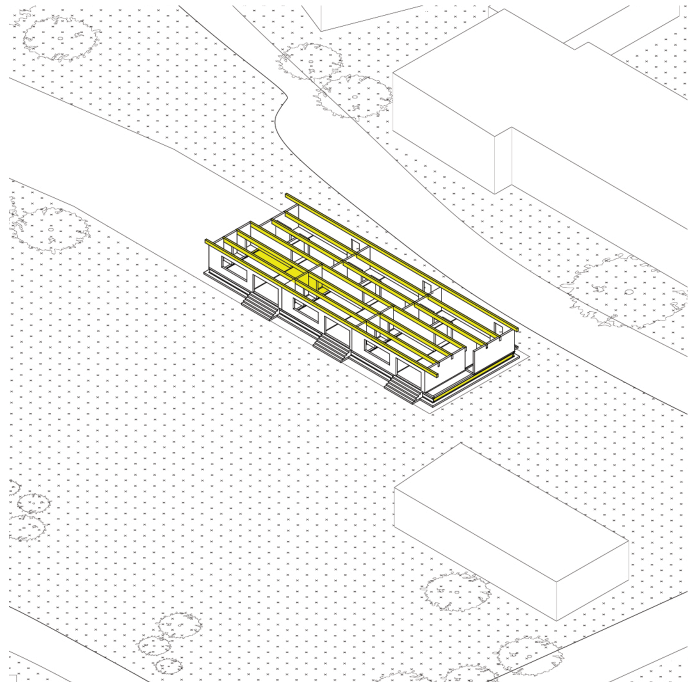
Site Development

Staging / Assembly

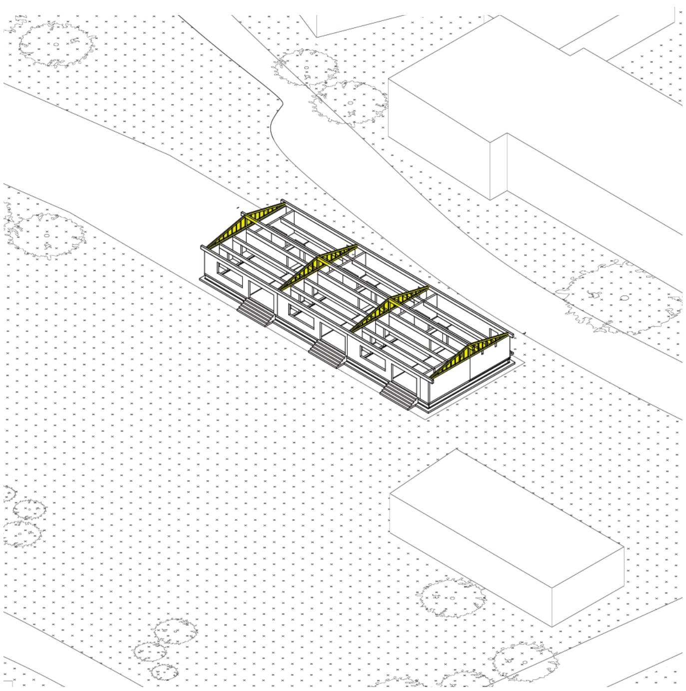
Assembled Components



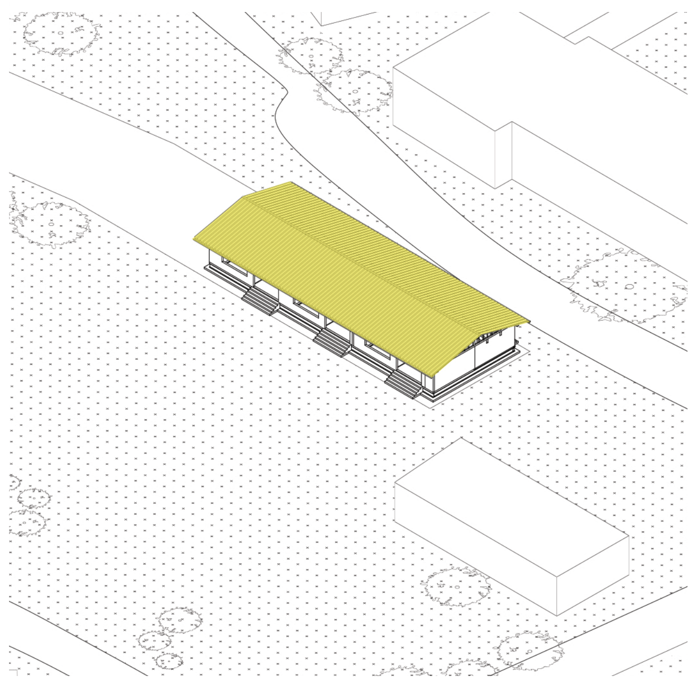
5. Prefabricated walls were placed on the floor.



6. Wooden beams were placed on the walls to support the roof structure.



7. Wooden roof trusses were placed on the beams.



8. Roof was finished with a corrugated metal lining.

Site Development

Staging / Assembly

Assembled Components

Rendered Aerial Plan

Mjørstårnet Tower

Nils Amblis veg 1A, 2380 Brumunddal, Norway

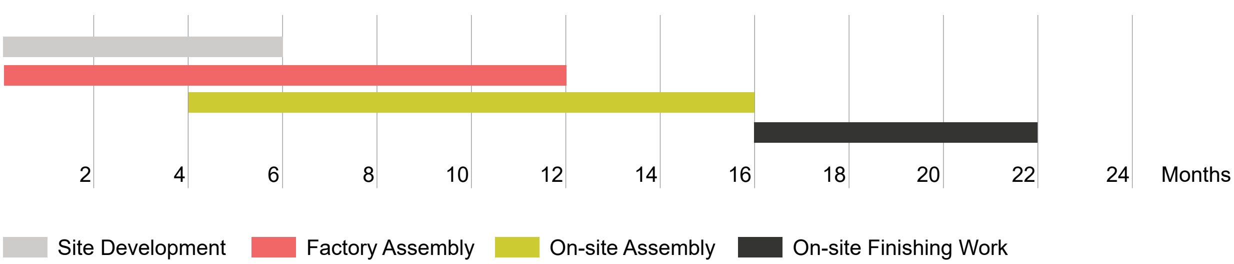
Image courtesy of © Moelven Limitre

Architect	Vol Arkitekter
Fabricator	Moelven Limitre
Off-site Assembly Time	12 months
On-site Assembly Time	12 months
Year Completed	2019
Site Typology	Full block
Program	Mixed-use
Stories	18
Gross Square Footage	120,000 SF
Structural Materials	CLT, glulam, concrete
Facade Materials	Timber, glass
Additional Information	moelven.com

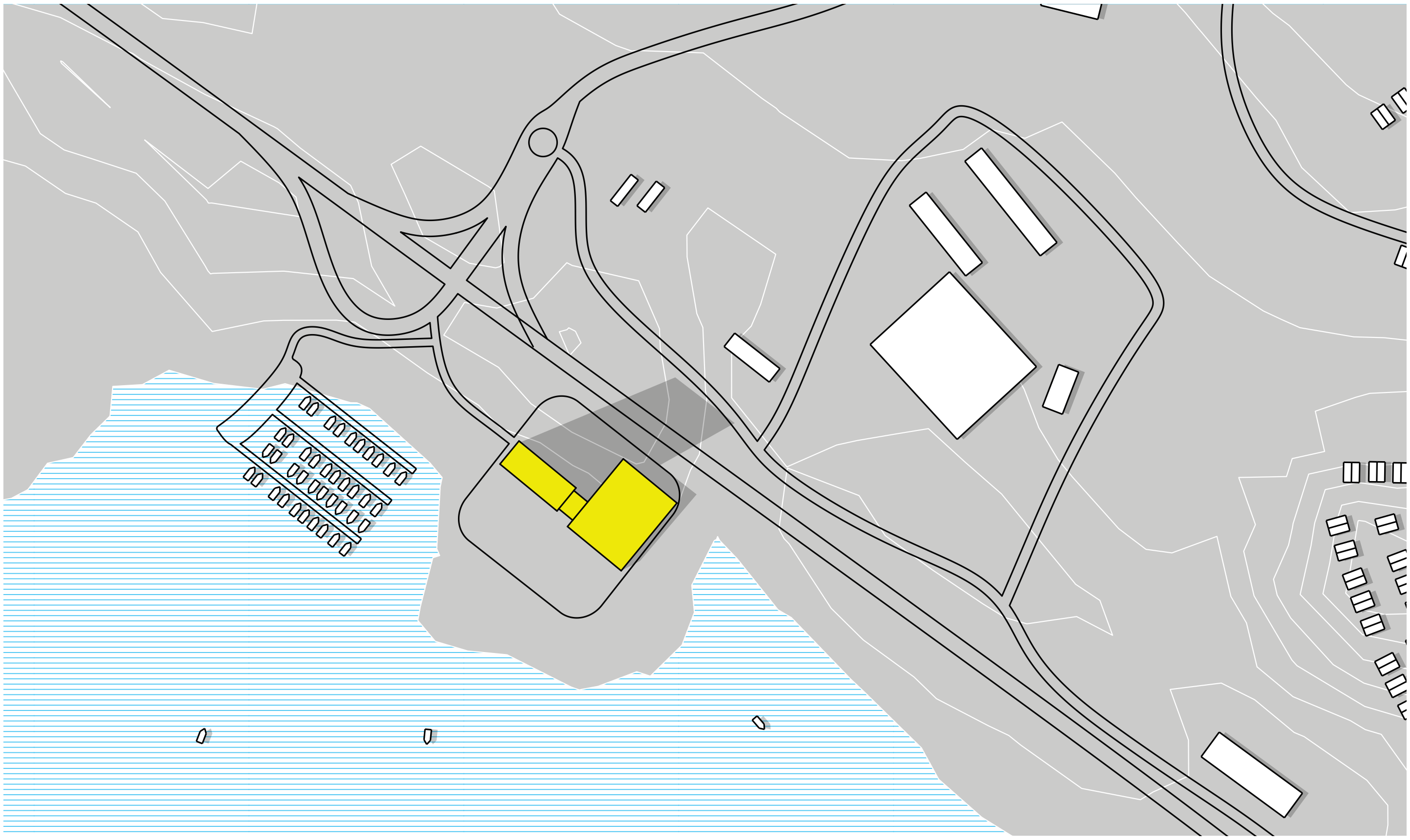
Opened in March 2019, this 85.4m high building is to-date the world's tallest timber building. The mixed-use building has 18 stories that include apartments, a hotel, offices, a restaurant, a rooftop terrace, and common areas. Timber structures, including cross-laminated timber (CLT) and glue-laminated timber (GLT), were prefabricated in a nearby factory and installed by a Norwegian firm Moelven Limitre.

All the wood used for construction came from local sources to support the local forestry and wood processing industry, and also to reduce the carbon footprint of transportation. CLT and GLT were selected as they are strong enough to support large loads and also much more sustainable than conventional construction materials. In both CLT and GLT, the timber acts a carbon sink, permanently locking carbon absorbed from the atmosphere into the structure. To combat the excessive swaying typical of lightweight timber structures, the building has piles running 50m deep and concrete floor slabs on the top seven floors to increase the weight of the structure.

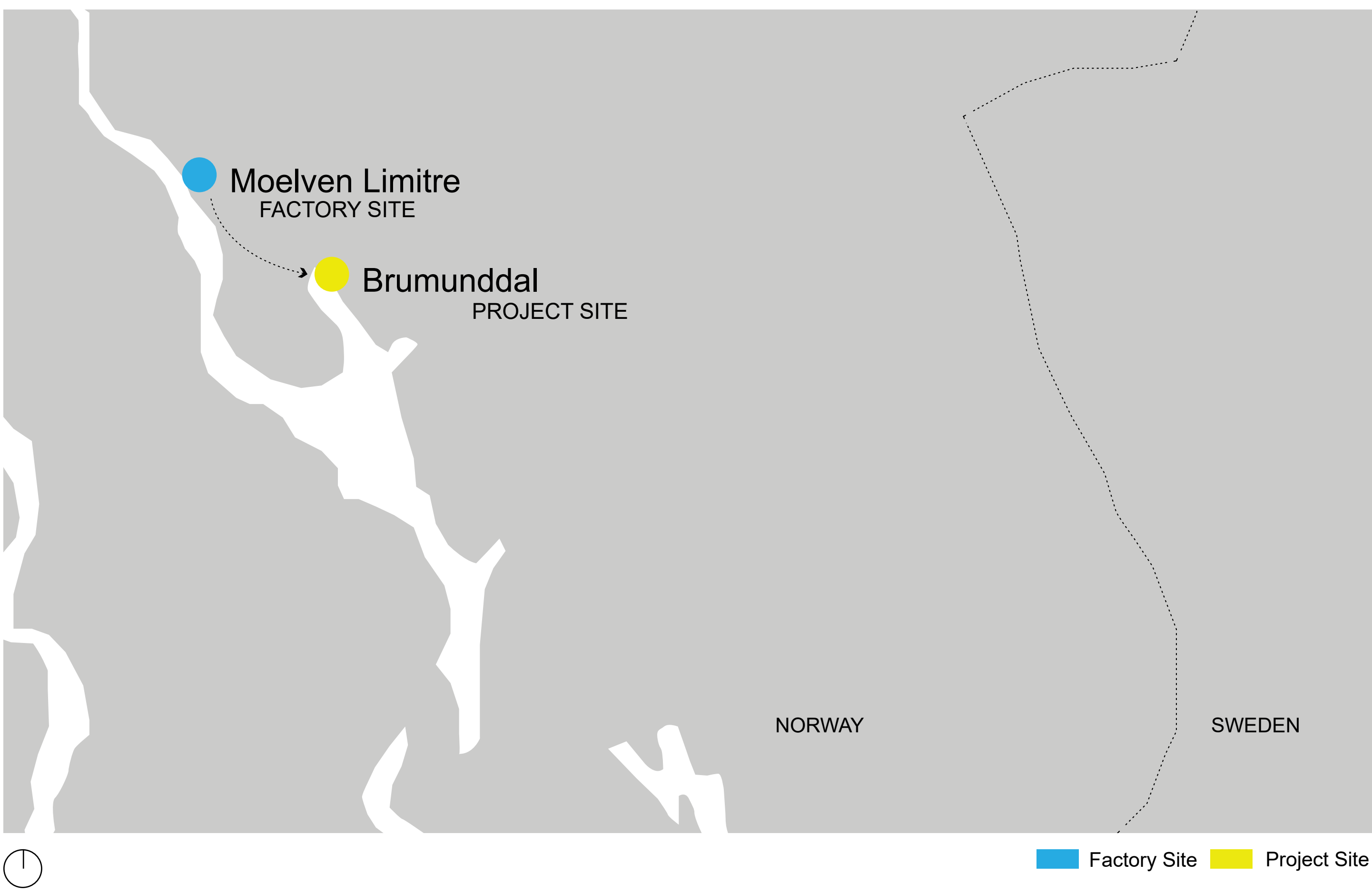
Construction Timeline



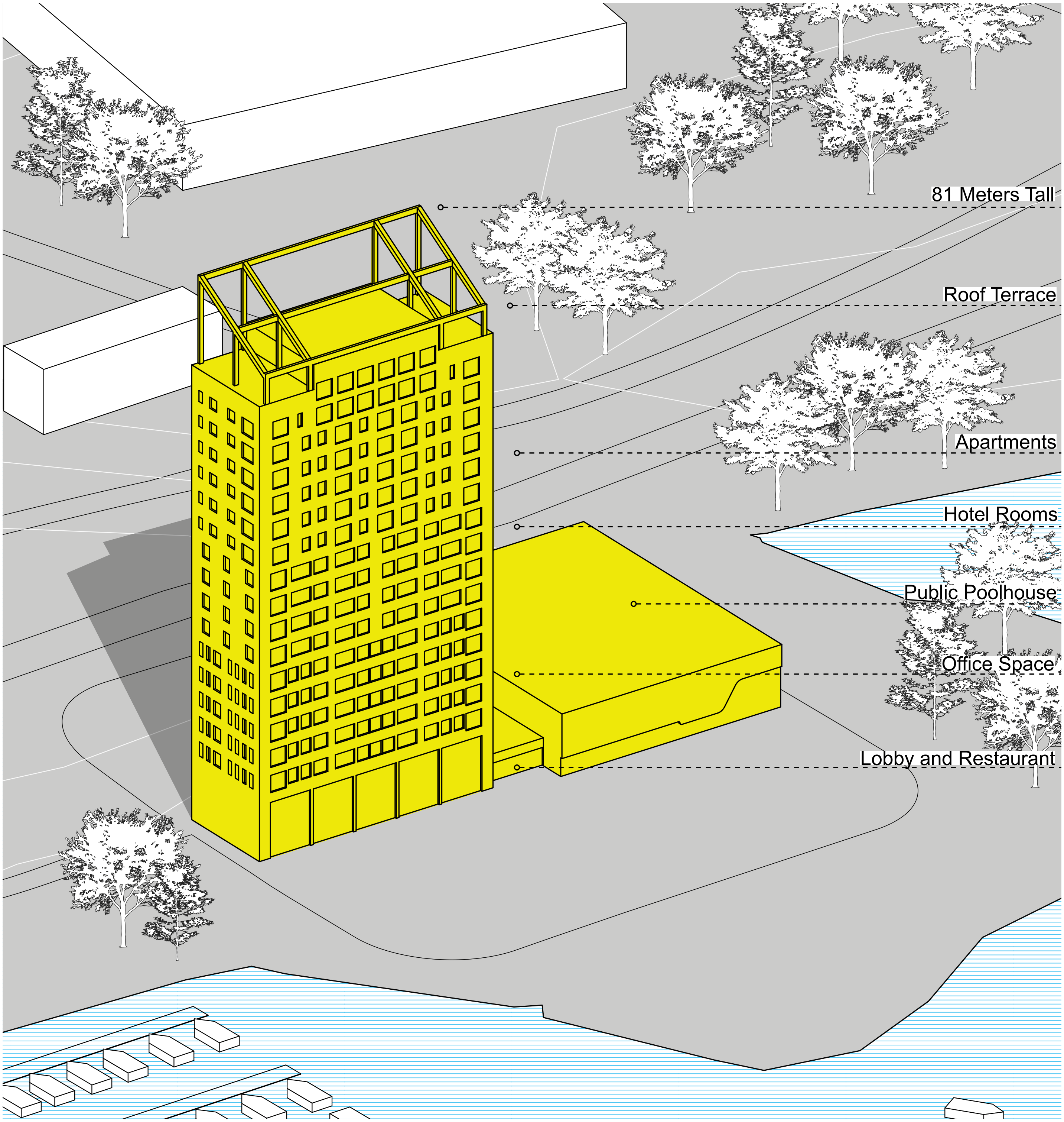
Please note that this project data has been gathered through student research and not verified by the team.
Research and project description by Alek Tomich, GSAPP.



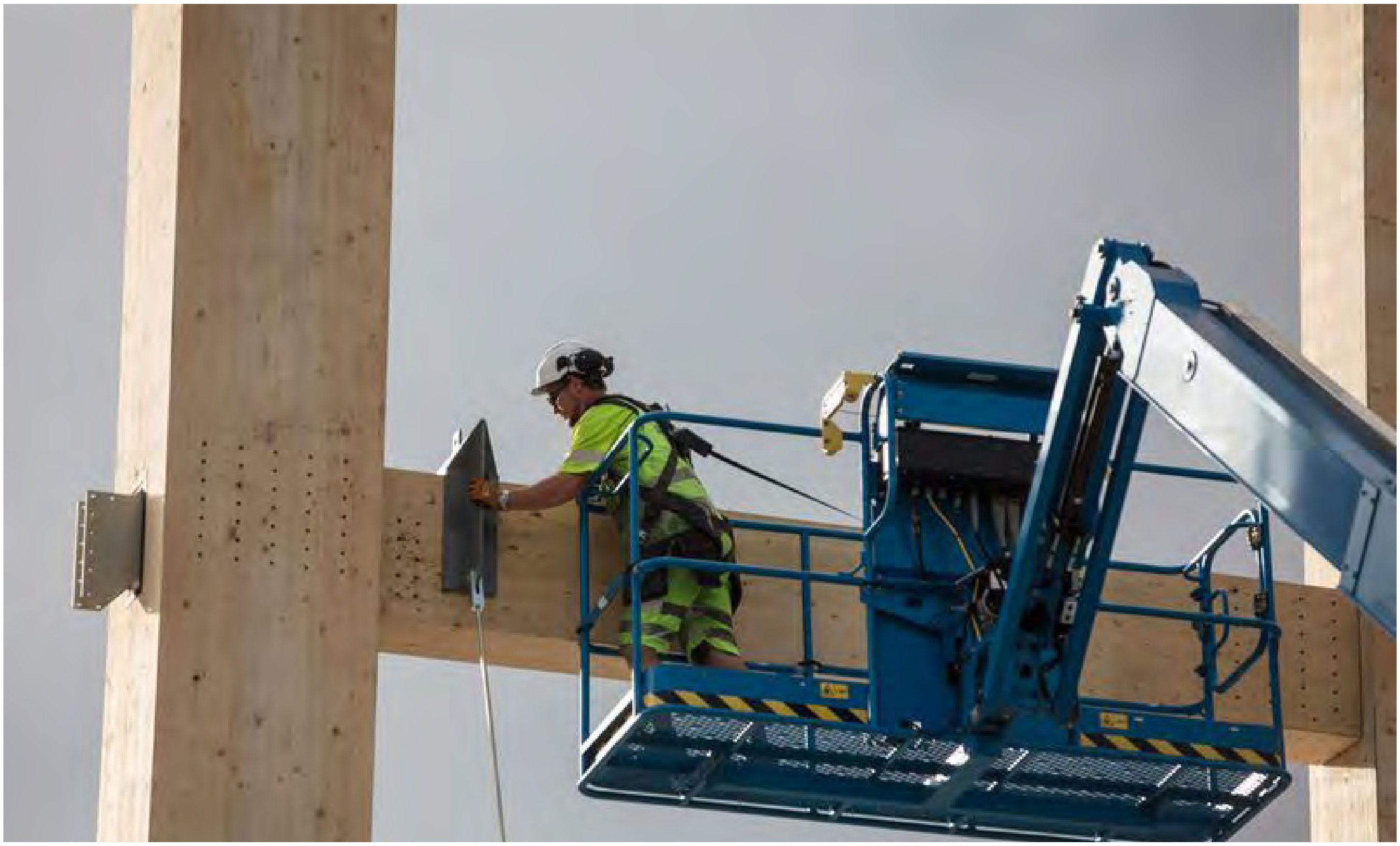
Above: Site Plan **Below**: Transportation



Drawings by Alek Tomich, GSAPP



Program Breakdown



Images courtesy of © Moelven Limitre

Image courtesy of © Moelven Limitre

Mjørstårnet Tower

Flatpack
Global

Image courtesy of © Ricardo Foto

Hemeroscopium House

Prefab
Global

Calle Cabo Candelaria, 9B, 28290 Las Rozas de Madrid, Madrid, Spain

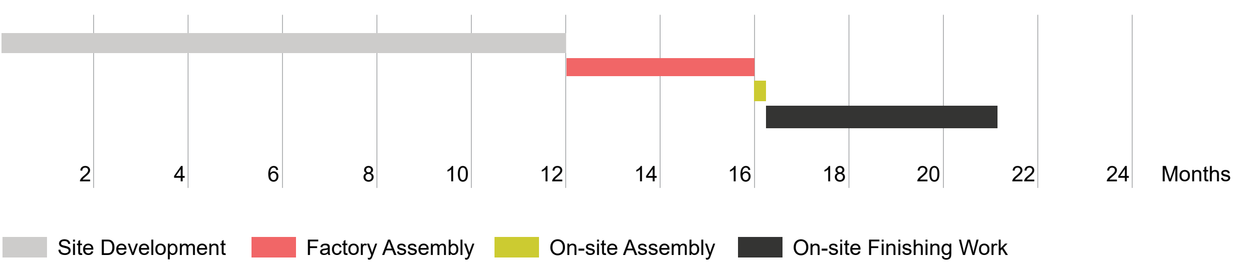
Image courtesy of © Ensamble Studio

Architect	Ensamble Studio
Developer	Hemeroscopium
Construction Company	Materia Inorgánica
Year Completed	2008
Factory Assembly Time	4 months
On-site Assembly Time	1 week
Site Typology	Infill
Program	Housing
Stories	3
Gross Square Footage	4,300 SF
Structural Materials	Precast concrete, steel
Facade Materials	Concrete, glass
Additional Information	ensamble.info

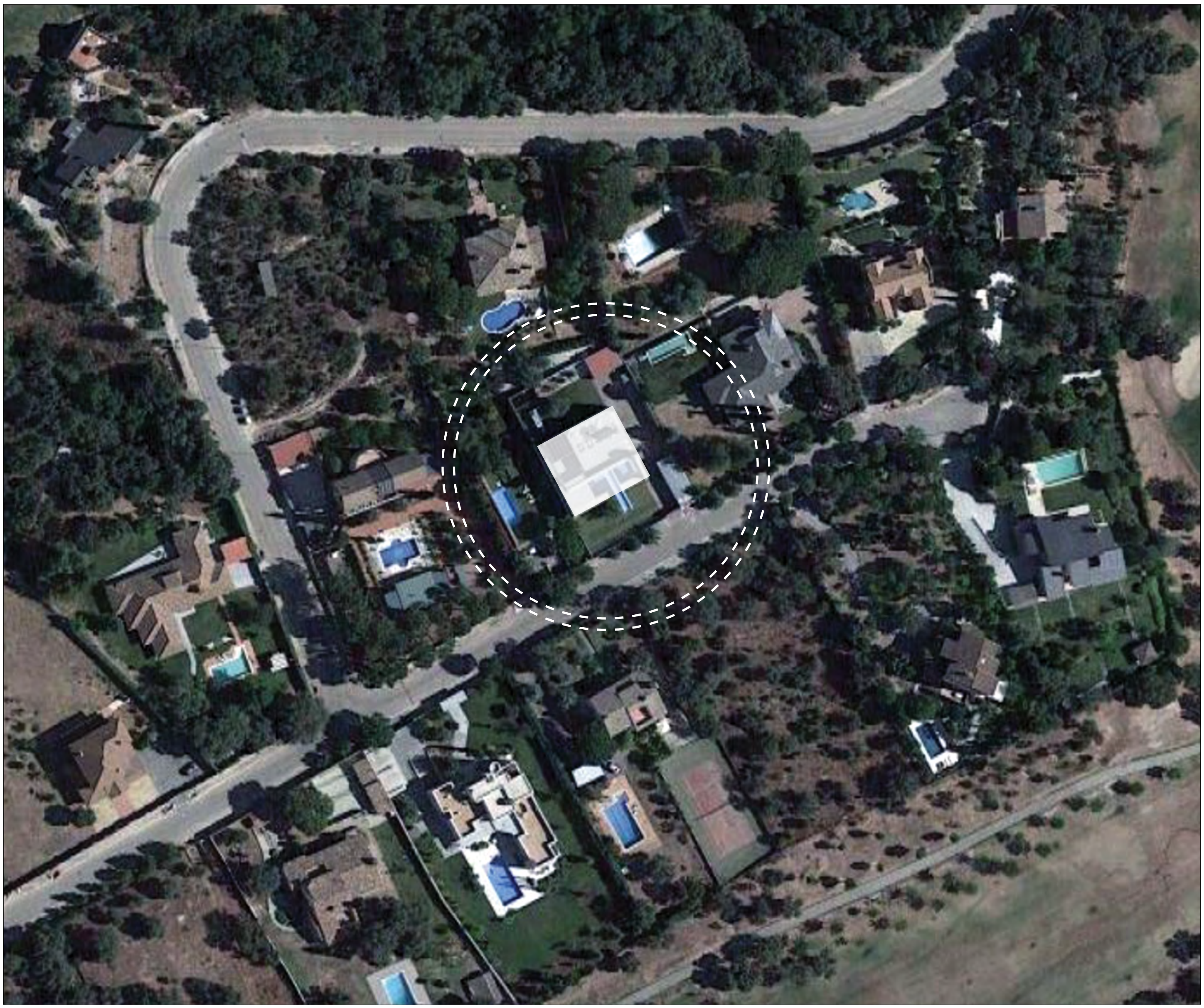
Hemeroscopium House reinterprets the concept of weight and domesticity. Built in just seven days, the project consists of prefabricated elements cast from seven types of typical infrastructure ranging from C-channel concrete segments of an irrigation canal, to pre-stressed concrete I-beams. Together the elements create an architectural space of alternating heaviness and lightness, balance and instability.

The structure encloses the living space and is positioned on the site in a helical sequence that culminates into a single counterweight — a twenty ton block of granite. While the scale and material of the structure marks an imposing presence, the building has a sense of lightness and transparency. Thus, through decontextualizing such large-scale, concrete infrastructure, the project reimagines private and domestic space. A total prefabrication of the different elements and a coordinated rhythm of assembly was key to build the structure in just seven days.

Construction Timeline



Project data and description provided by Ensamble Studio. Research by Cynthia Wang, GSAPP.



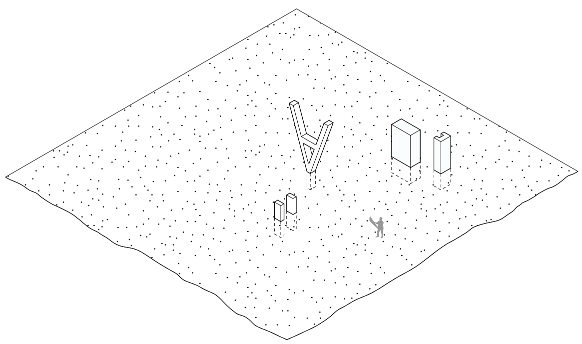
Site Plan

Drawing by Cynthia Wang, GSAPP

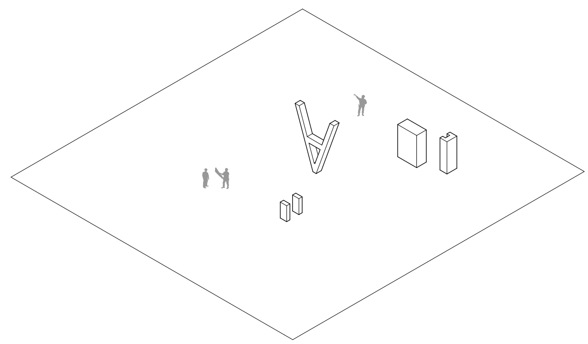
Transportation

Transportation Route

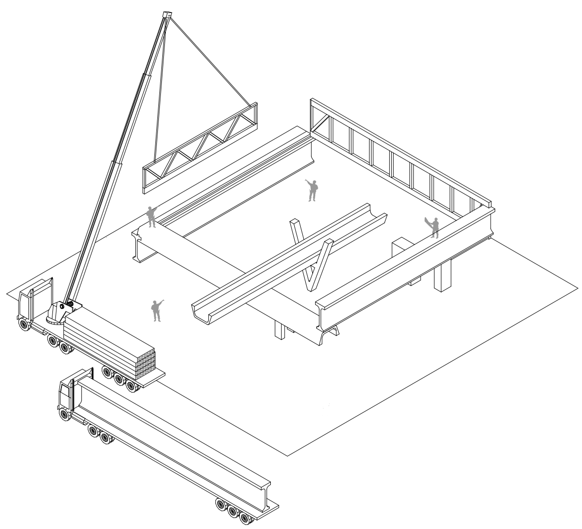
Construction Sequence



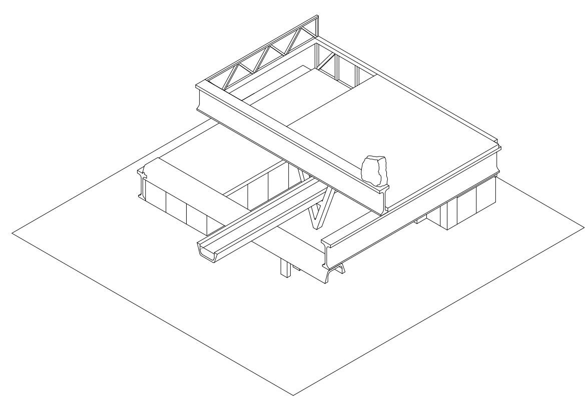
1. Ground was prepared and the structure for the footing was positioned in the soil.



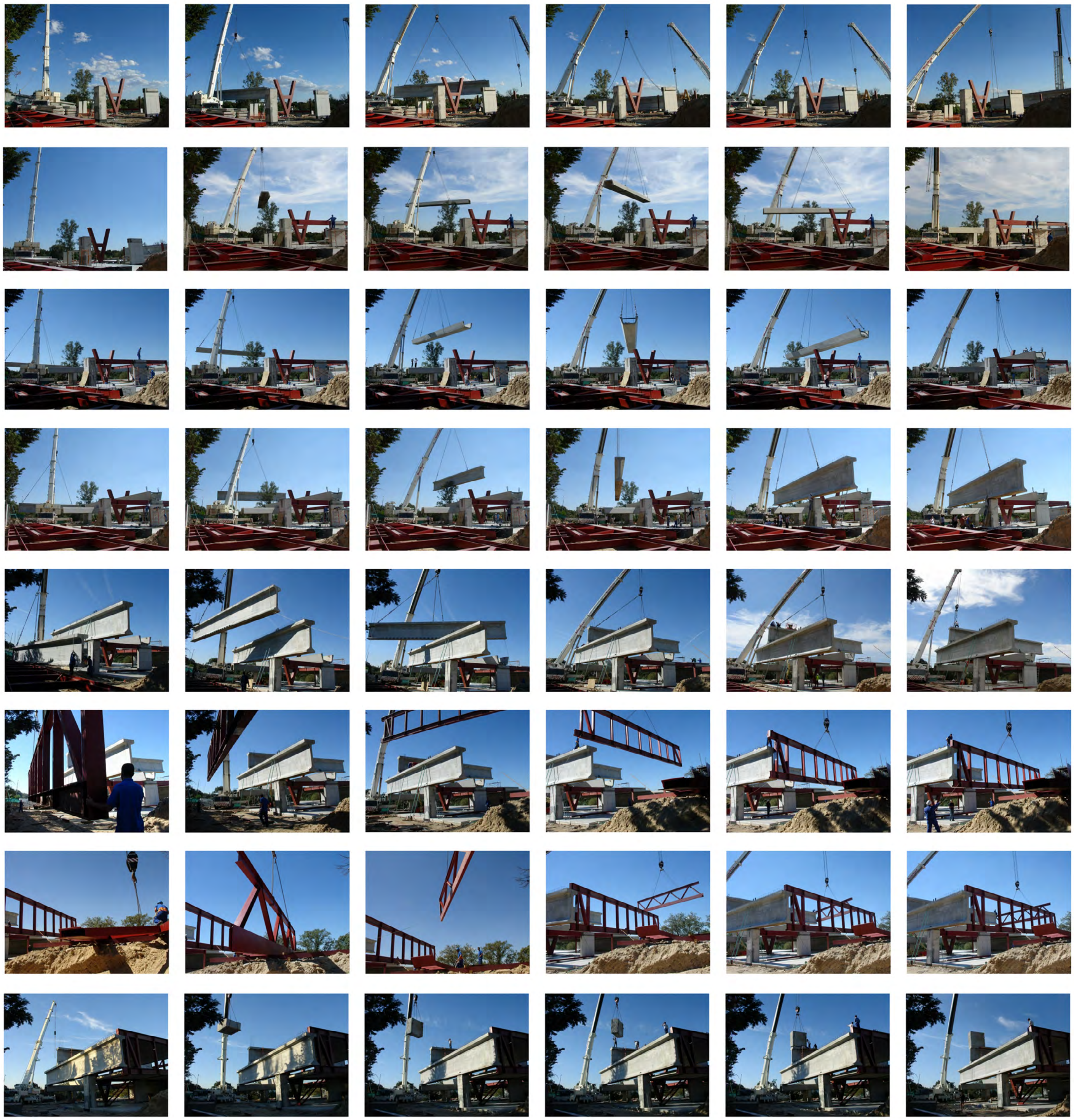
2. Foundation slab was constructed in soil.



3. Seven pre-fabricated structural components (5 prestressed concrete beams and 2 steel trusses) were assembled in a helical sequence.

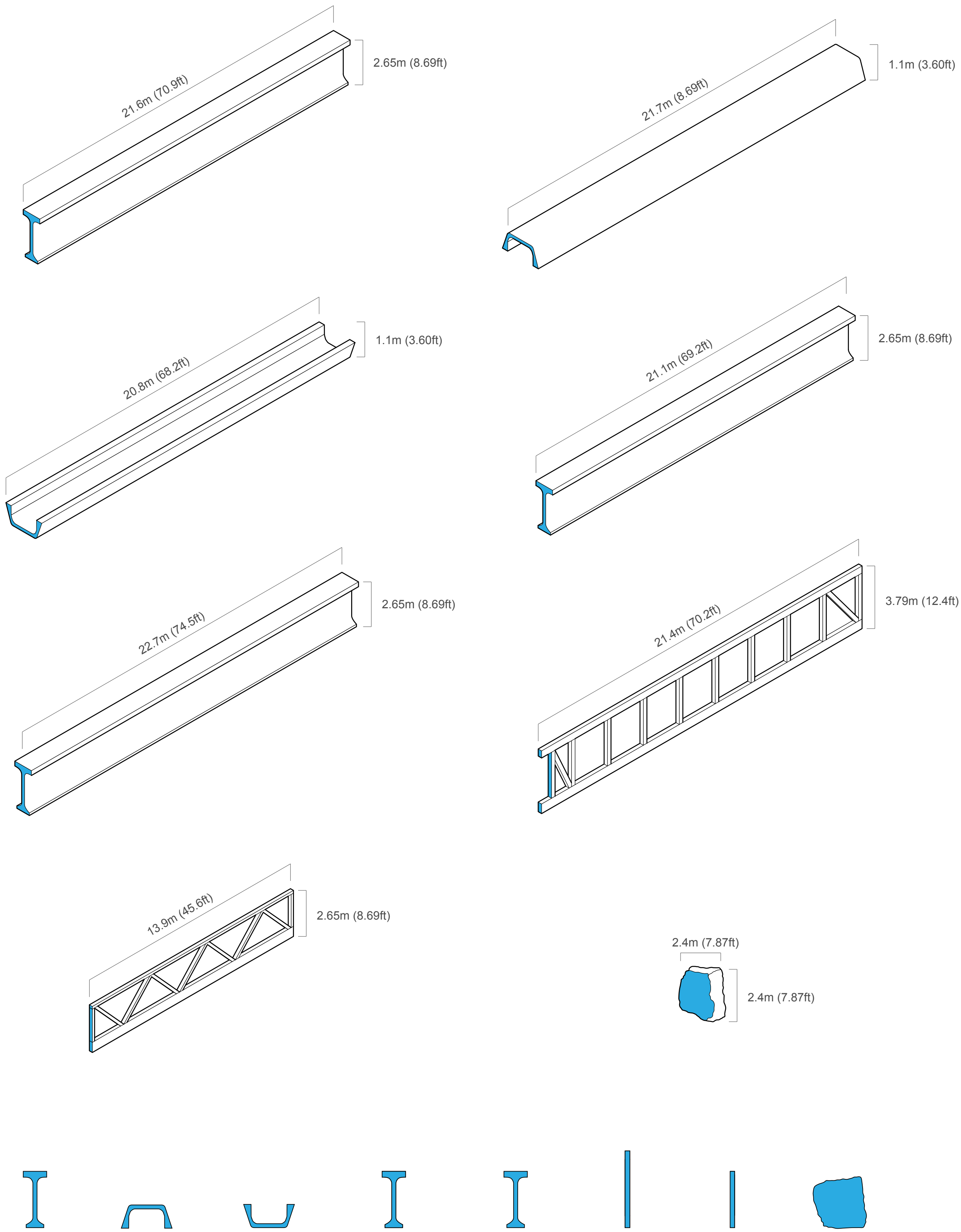


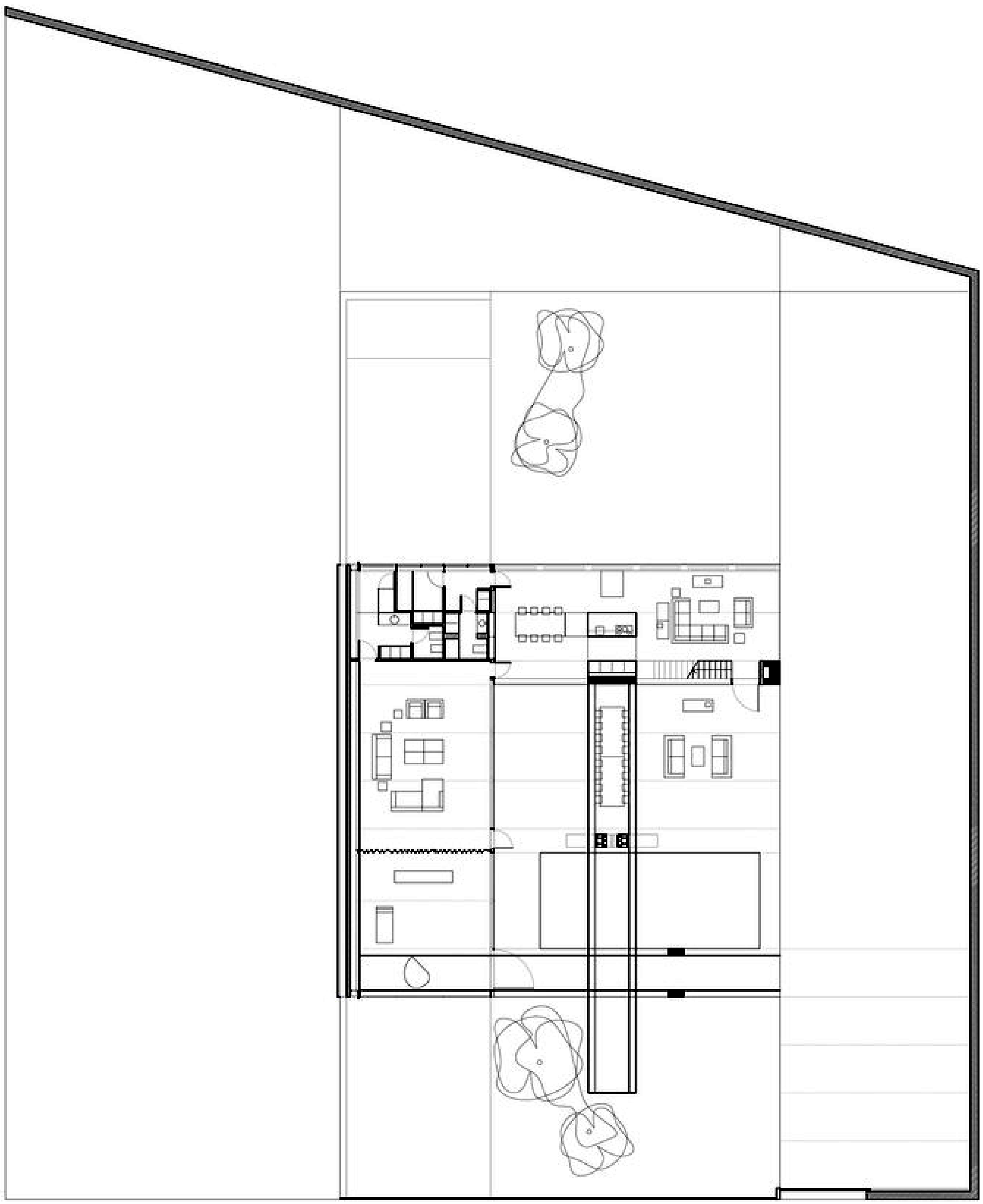
4. Finishing work was done once the structure was in place.



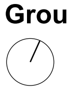
Images courtesy of © Ensamble Studio

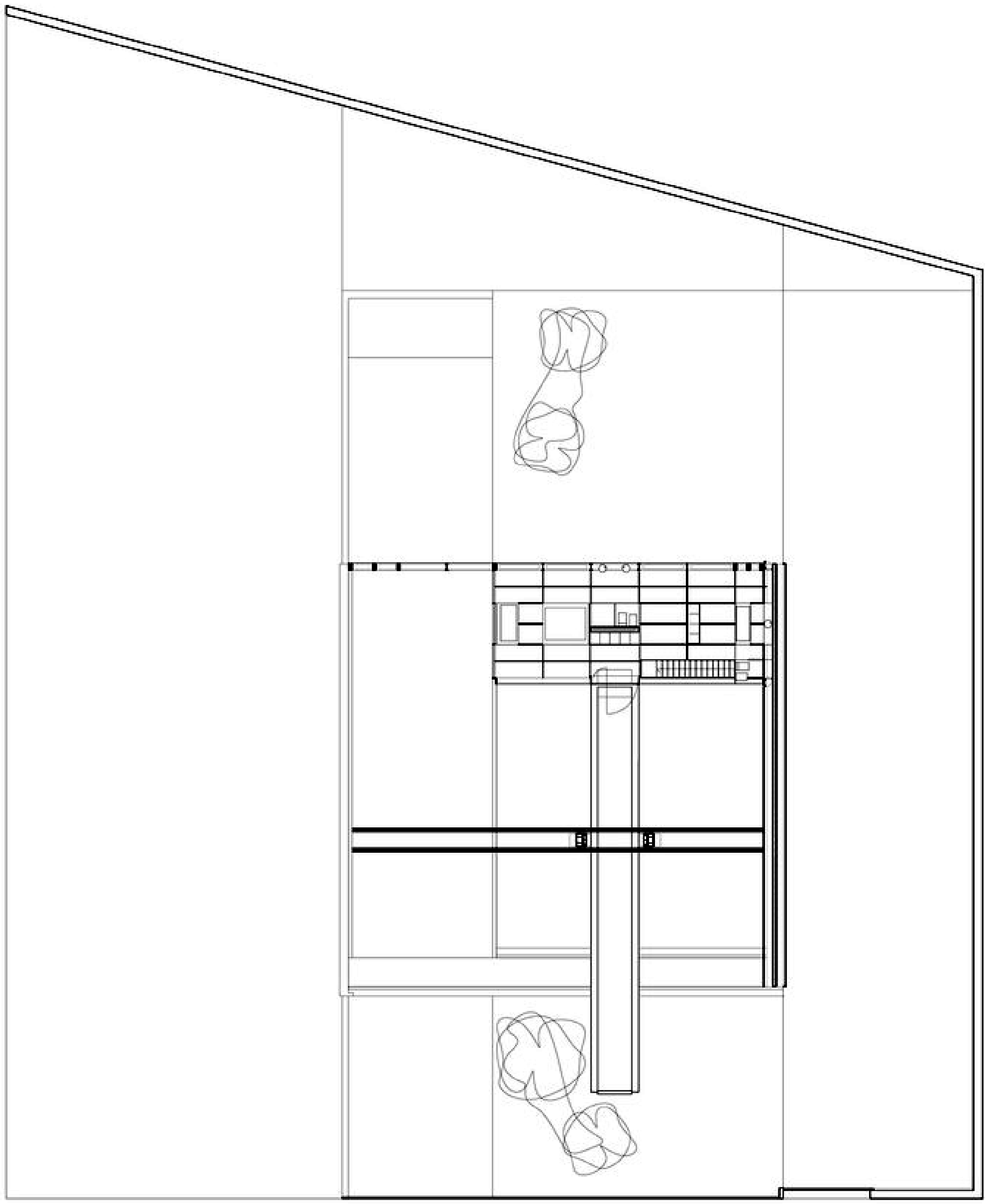
Prefabricated Components



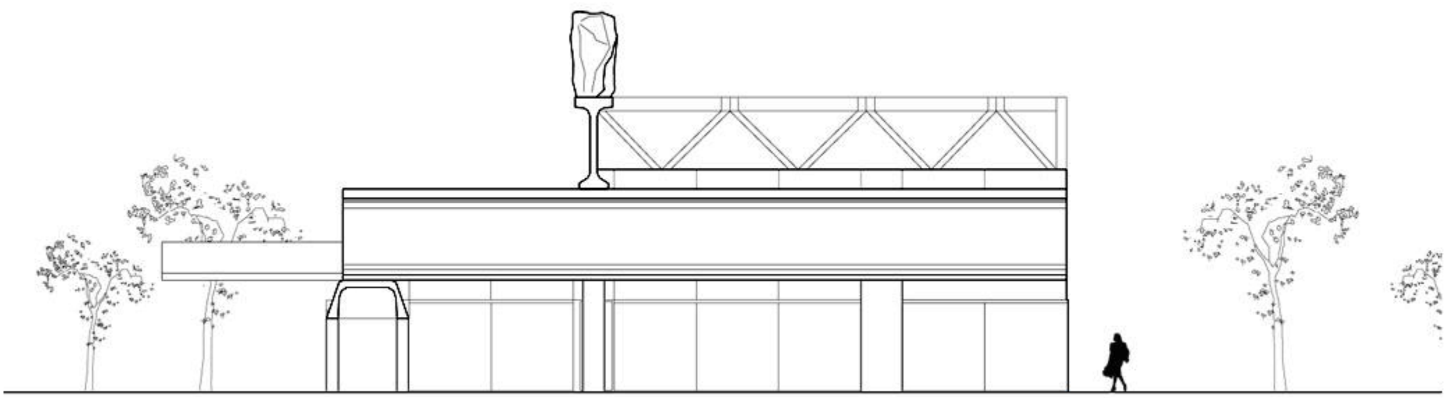


Ground Floor Plan

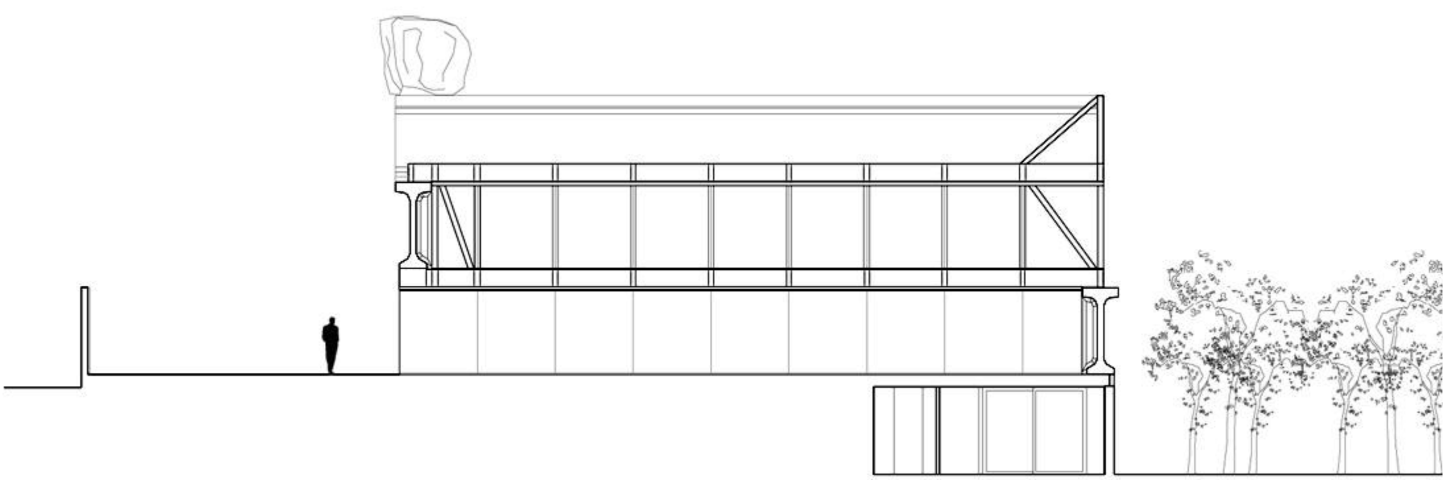




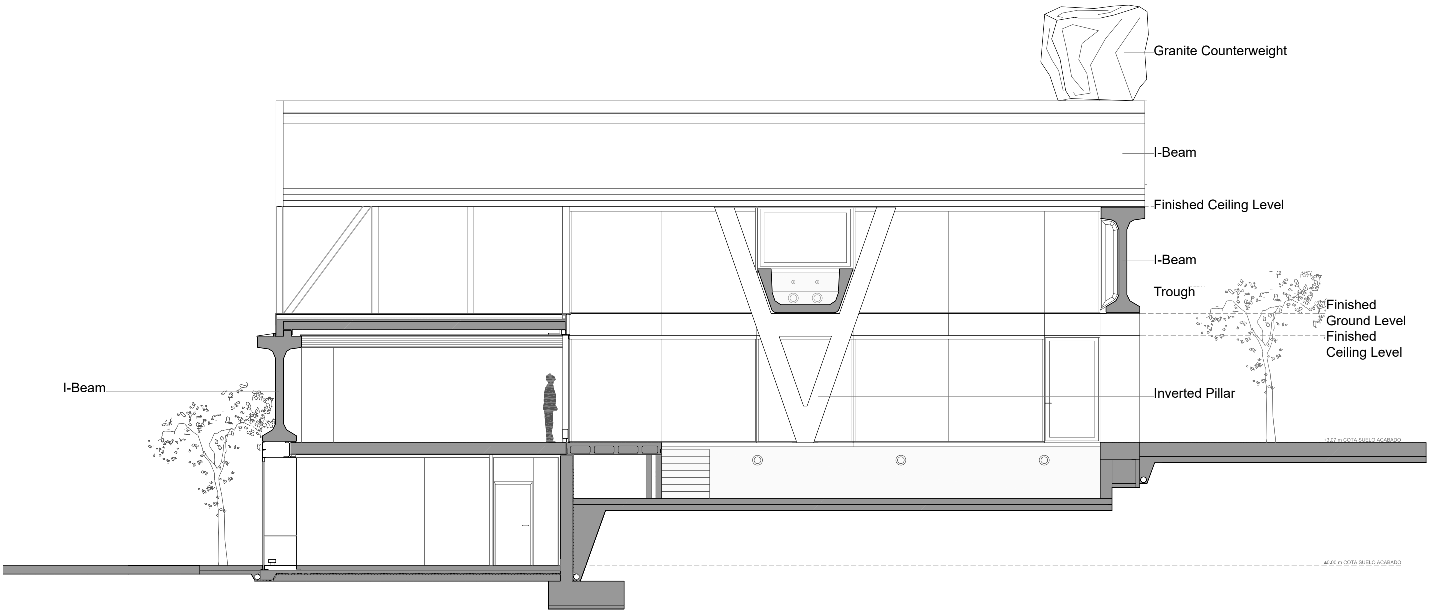
Second Floor Plan



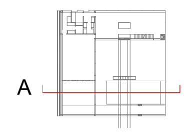
East Elevation

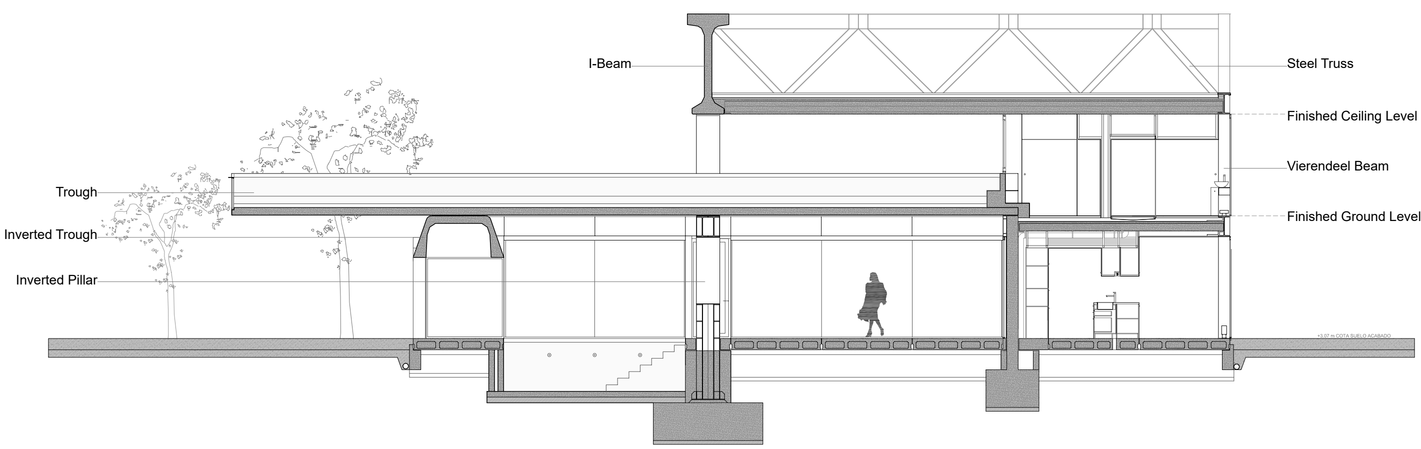


North Elevation

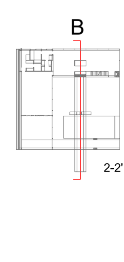


Cross Section A





Cross Section B



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3 Pandemic Response (COVID-19)
Case Studies

CURA

Corso Castelfidardo, 22, 10138 Torino TO, Italy

Prefab
Global

Image courtesy of © Max Tomasinelli

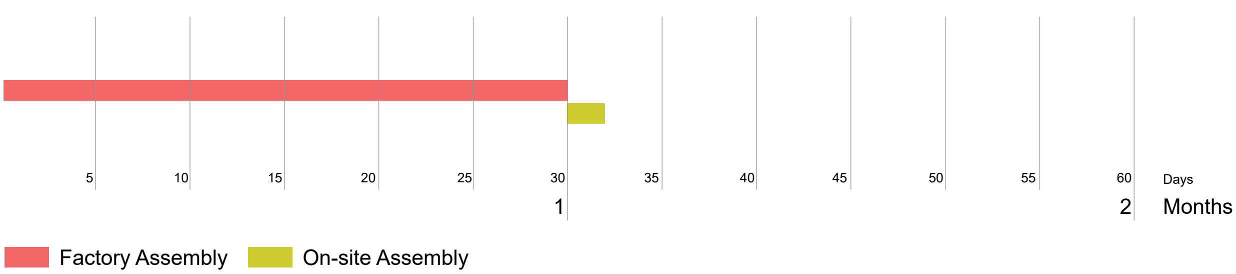
Architect	Carlo Ratti Associati Italo Rota
Engineer	Jacobs
Partners	Phillips, MIT Senseable Lab, IEC Engineering, Projema
Year Completed	In progress
Off-site Assembly Time	1 month
On-site Assembly Time	2 days
Site Typology	Flexible (Temporary relief)
Program	Temporary hospital
Stories	1
Gross Square Footage	160 SF
Structural Materials	Steel containers
Additional Information	carloratti.com curapods.org

CURA (Connected Units for Respiratory Ailments) is a quick-to-deploy emergency facility designed to reduce the pressure from COVID-19 on existing healthcare facilities.

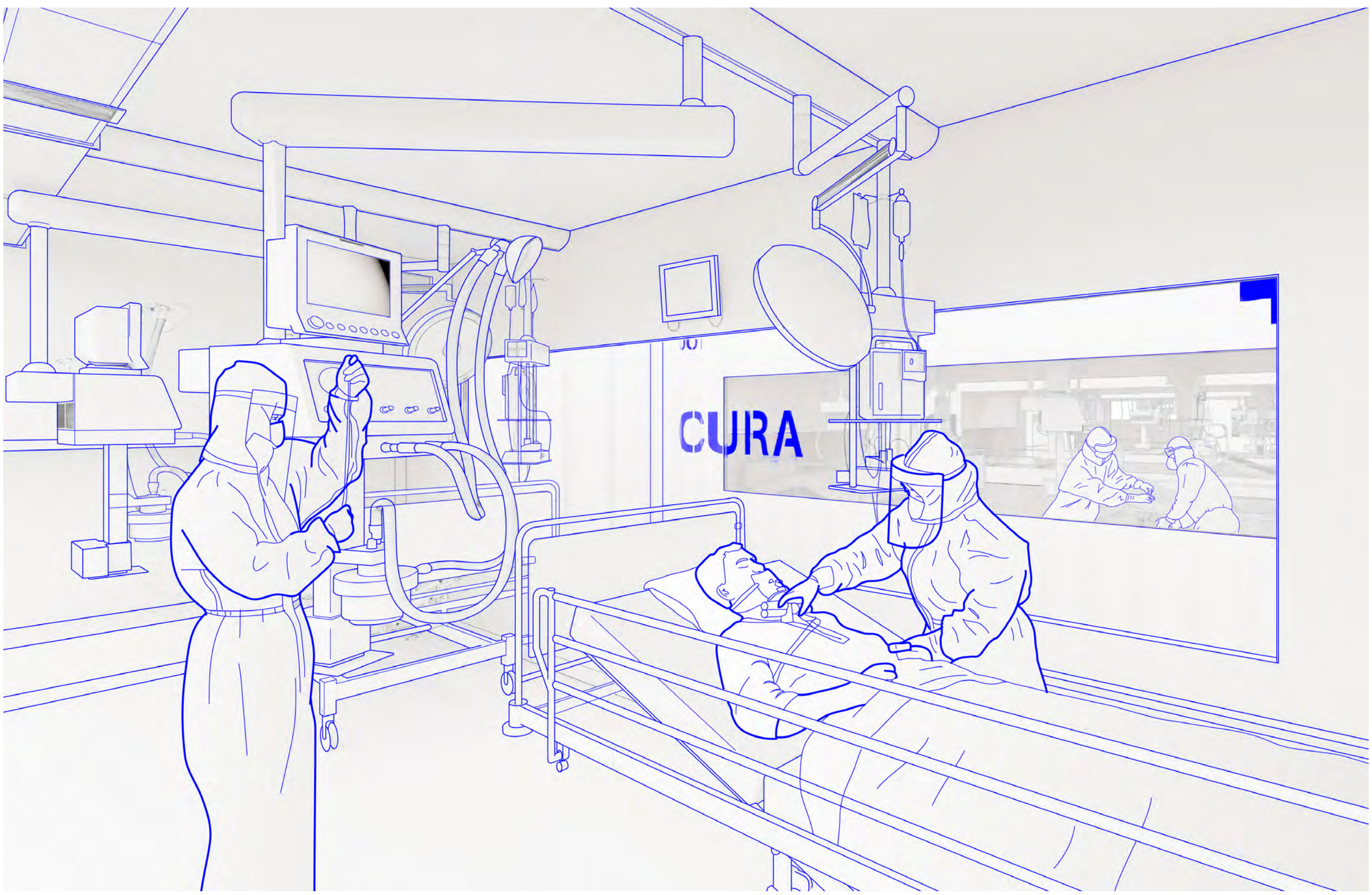
Each unit consists of a twenty foot shipping container, repurposed with bio-containment equipment. The inherent flexibility and adaptability means that each pod can work autonomously and be shipped to any location in the world, adapting to the needs of the local healthcare infrastructure.

An extractor creates indoor negative pressure, complying with the standards of Airborne Infection Isolation Rooms (AIIRs). Windows on either side of the containers provide enhanced monitoring capabilities for doctors and family members without having to step into the isolated ward. The first deployment of CURA is located at a Turin field hospital located within the city's Officine Grandi Riparazioni (OGR), a late 19th century industrial complex.

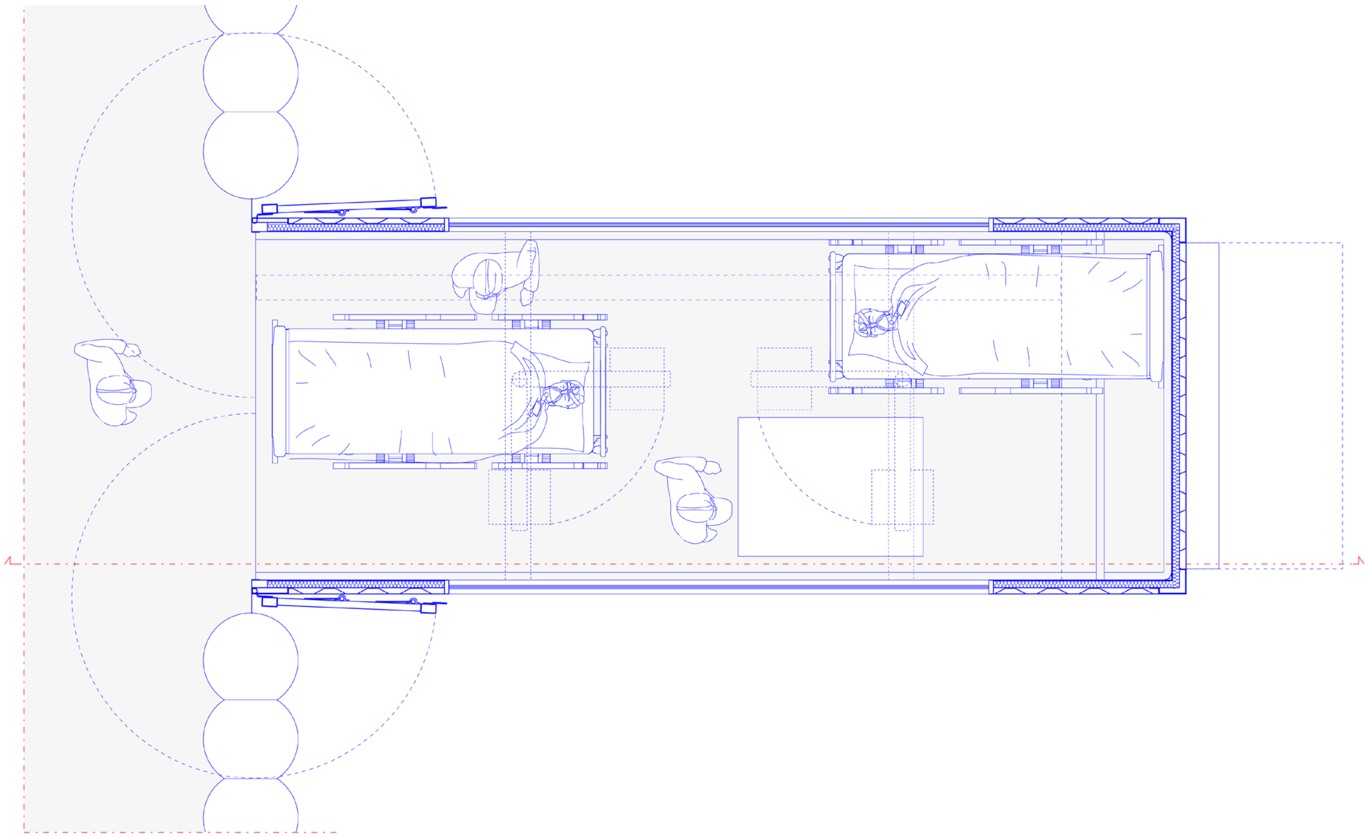
Construction Timeline

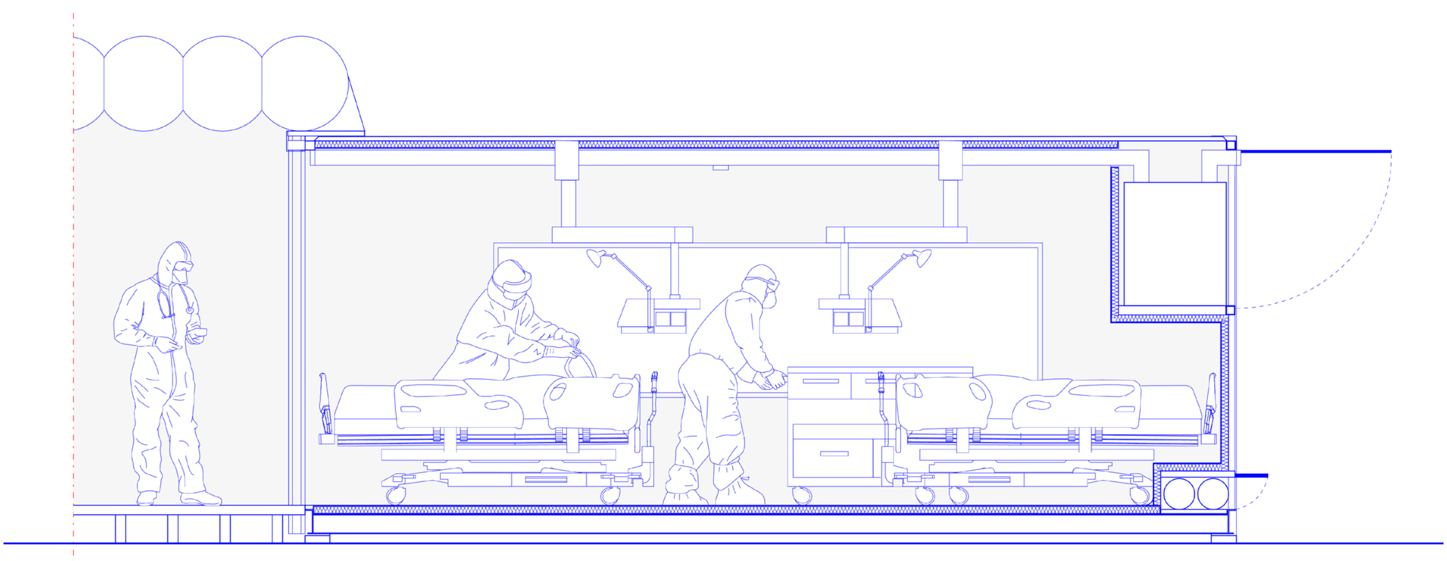


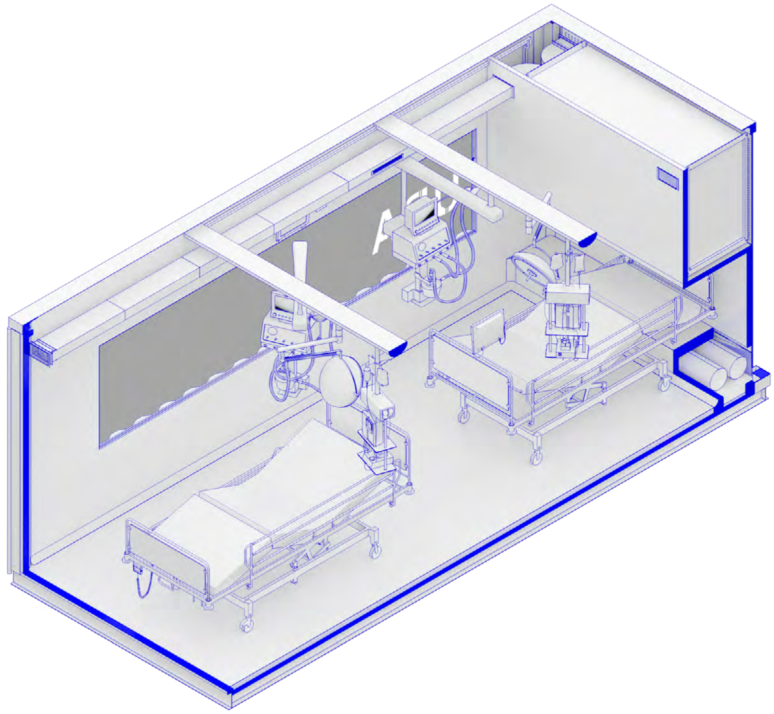
Please note that this project is in development and all project data is estimated. Research and project description by Rahul Gupta, GSAPP.



Drawings courtesy of © CURA



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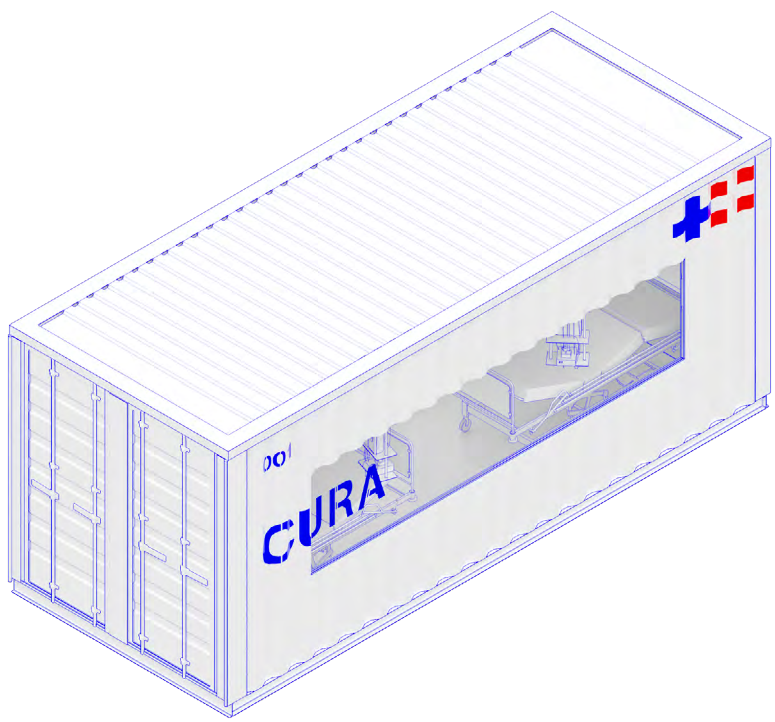

001
CURA

Images courtesy of © Max Tomasinelli

Temporary Shelter for COVID-19 Crisis

Yokohama, Japan

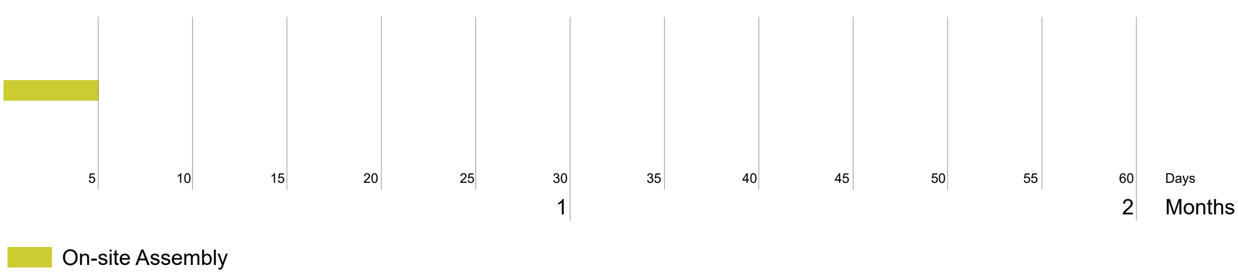
Image courtesy of © AFP

Architect	Shigeru Ban Architects
Year Completed	2020
On-site Assembly Time	5 days
Site Typology	Infill
Program	Flexible (temporary shelter)
Stories	1
Gross Square Footage	36 SF per module
Structural Materials	Cardboard tubes
Siding Materials	Fabric
Additional Information	designboom.com shigerubanarchitects.com

Typically, all-night internet cafes provide shelter for people in the region, offering couches, computers, and showering facilities for people to stay overnight at an affordable price. However, as Japan saw a surge in COVID-19 cases, authorities closed down these cafes, leaving many people homeless.

To aid the "net cafe refugees", Shigeru Ban Architects and his team at Voluntary Architects' Network (VAN) installed these emergency shelters in a martial arts center in Yokohama, Japan, which was converted into a space for these refugees following the closure of an online café in the region due to COVID-19. The design features Shigeru Ban's paper partition system – the same used to help those affected by the Japanese floods in 2018. The system is made using cardboard tubes with fabric sides to provide fast-to-deploy shelter that abide by distancing requirements and also offer a sense of physical privacy.

Construction Timeline



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Resources & Acknowledgements

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Public Design Commission of the City of New York

The Public Design Commission reviews permanent works of architecture, landscape architecture, and art proposed on or over City-owned property. As established by the New York City Charter in 1898, the Commission comprises 11 members, and includes an architect, landscape architect, painter, and sculptor as well as representatives of the Brooklyn Museum, Metropolitan Museum of Art, New York Public Library, and the Mayor. The Commission is an advocate for excellence and innovation in the public realm, ensuring the viability and quality of public programs and services throughout the city for years to come.

Columbia University Graduate School of Architecture, Planning, and Preservation

Among the world's leading research universities, Columbia University in the City of New York continuously seeks to advance knowledge and learning at the highest level. Columbia's Graduate School of Architecture, Planning and Preservation (Columbia GSAPP) develops new forms of pedagogy, research, and practice to engage the crucial issues of our time across all scales of the built environment. The School drives innovation and change through the leadership of its faculty and academic programs—spanning architecture, historic preservation, planning, real estate development, and urban design—as well as the expansion of interdisciplinary research initiatives and timely events,

Architecture A4859 SP2019 Seminar
Prefab, Modular & Flatpack

Instructor: Laurie Hawkinson
Guest Instructor: Rebecca Macklis
Teaching Assistant: Andrea Tonc

Thank you to the students, lecturers, and critics who participated in this research and information exchange during the Spring 2019 seminar at Columbia University.

Students
Pooja Annamaneni, Oscar Deleon, Jacob Gulinson, Rahul Gupta, Kuan He, Fiona Ho, Jacob Karasik, Mengxuan Liu, Ruxiao Liu, Ricky Lo, Leonardo Tamargo Niebla, Jihae Park, Felipe Rocha, Jake Rosenwald, Korn Supsakorn, Alek Tomich, Cynthia Wang

Guest Lecturers & Critics

Jon Cohen
Senior Policy Advisor
Deputy Mayor for Housing and Economic Development

David Farnsworth
Principal and Americas Tall Buildings Business Leader, ARUP

Cristián Fernández
Principal, Cristián Fernández Arquitectos

James Garrison
Principal, Garrison Architects

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Rahul Gupta
M.Arch Candidate '21, Columbia University GSAPP

Designing New York: Prefabrication in the Public Realm Roundtable

Thank you to the participants of the roundtable discussion held at the Center for Architecture, New York City, July 23, 2019.

Thank you to the American Institute of Architects NY Technology Committee for their time and efforts in assisting to facilitate this event and research.

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Senior Policy Advisor to the Deputy Mayor for Housing and Economic Development

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Program Director of the Queens Public Library Program Unit, former Project Executive/Director of Modular Home Design, Department of Design and Construction

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Principal, nArchitects

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Co-founding Principal, LO-TEK

David Farnsworth, PE
Principal and Americas Tall Buildings Business Leader, ARUP

Wolf Manglesdorf
Partner, BuroHappold Engineering

Thank you to the firms and design teams who have generously provided their work and insight to this project.

Brut Deluxe
Carlo Ratti Associati
Debartolo Architects
Ensamle Studio
Garrison Architects
GLUCK+
Helen & Hard
Human Habitat
LOT-EK
OFIS Architects
OMA
Park Associati
Renzo Piano Building Workshop
Shigeru Ban Architects
Shepley Bulfinch Architects
SHoP Architects
Voll Arkitekter

Thank you to Columbia University's Graduate School of Architecture, Planning, and Preservation (GSAPP) for their generous support of this research and document.

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Mayor

Vicki Been
Deputy Mayor for Housing and Economic Development

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Landscape Architect

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Carolina Llano, Project Manager
Mary Beth Betts, Tour Manager
Gail Cornell, Gary Deane, Gail Green, Deirdre LaPorte, and Patricia Orfanos, Docents