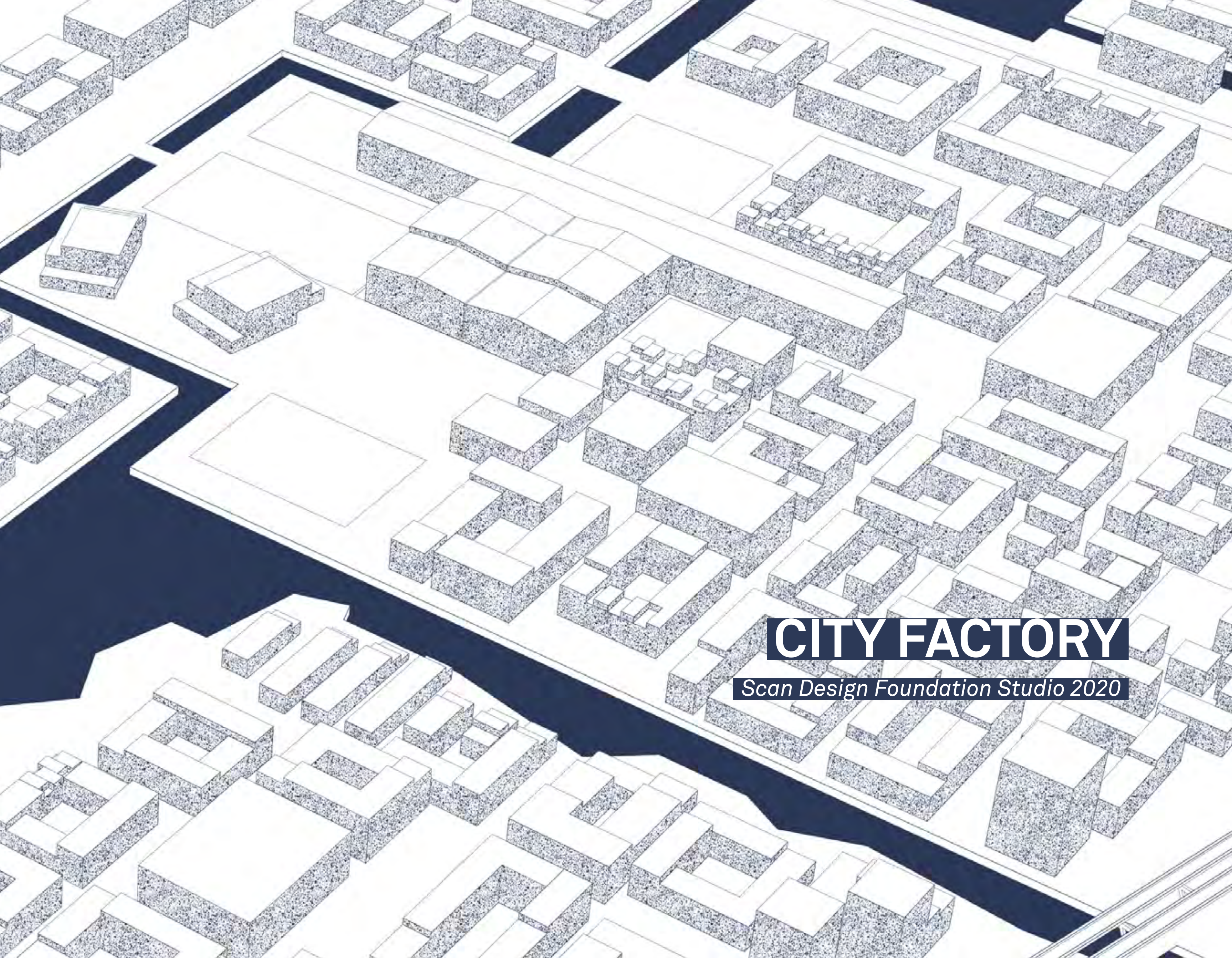


# CITY FACTORY

*Scan Design Foundation Studio 2020*

## INTRODUCTION

During the autumn of 2020, Dan Stubbergaard, founder and creative director of COBE Architects in Copenhagen, was the Scan Design Foundation Distinguished Visiting Professor at the University of Washington in Seattle. In that role Stubbergaard taught a graduate-level master studio in the Department of Architecture with Associate Professor Peter Cohan.

The topic of the studio, CITY FACTORY, asked the students to design a production facility for the fabrication and assembly of large scale building components for Nordhavn, a new neighborhood for 40,000 inhabitants being developed at the site of an old maritime industrial harbor. The project proposes that the factory will locally produce components for the future development of Nordhavn. When the neighborhood is fully built out the factory will either be repurposed for another use or disassembled for re-use elsewhere. The students were asked to address both possibilities in developing their design proposals. In addition, the factory was to be built primarily of wood and have a carbon-neutral footprint. The project site is in a green post-industrial landscape adjacent to Tunnelfabrikken, a former factory that once produced pre-cast concrete parts for the tunnel to Sweden and is now being converted into a new cultural hub for Copenhagen.

The studio began with extensive research into wood construction, carbon-neutral materials, the circular economy and design for disassembly. Following this phase, groups of students conducted site/program analysis and developed a number of different site strategies for the project. During the remainder of the quarter, students worked individually or in pairs to further develop their design proposals for the City Factory.

## PARTICIPANTS

Connor Beck
Bryce Boho
Qutaiba Buyabes
Zining Cheng
Emily Crichlow
Cody Edmonds
Skyler Johnson
Stephanie Lam
Halina Murphy
Siobhan Schramm
Connor Stein
Claire Sullivan

## DAN STUBBERGAARD | COBE

Dan Stubbergaard graduated from the Royal Danish Academy of Fine Arts in Copenhagen in 2002. After working as an architect in the Netherlands and Denmark, he founded Cobe in 2005. Today, Cobe employs some 100 architects, urban planners, and landscape architects. Since its founding, Cobe has created a number of high-profile, award-winning projects in Denmark and abroad, including urban master plans, public spaces, and buildings. Among Cobe's most important projects are Nordhavn - the masterplan development of the north harbor area in Copenhagen, the Nørreport Train Station - Copenhagen's busiest station, and the Silo - the transformation of a 17-storey former grain silo in Nordhavn into apartments.

All of Cobe's projects emphasize that architecture is not a matter of a certain style or form. More important is its adaptability to context, society and the life of its users. Cobe's mission is to create cities, public spaces and buildings that work as social engines and are intuitively understood by the people who experience them.

Cobe has been recognized numerous times for its accomplishments, including receiving the Golden Lion Award at the 10th International Venice Biennale of Architecture in 2006, Nykredit's Architecture Prize in 2012, the MIPIM Award for Best Residential Development in 2015 and the C.F. Hansen Royal Medal from the Danish Academy in 2020.

In addition to his practice, Dan Stubbergaard taught at The Royal Danish Academy of Fine Arts from 2004 to 2008 and was also the Scan Design Foundation Visiting Professor at the University of Washington in 2015 and 2018.

Stubbergaard/COBE Studio 2020

1


2


3


4


5


6


## WORKS | COBE

1. Nørreport Station (2015)
2. Frederiksvej Kindergarten (2015)
3. Ultra-Fast Charging Stations for Electric Cars (2019)
4. Krøyer Plads (2016)
5. Tingbjerg Library (2018)
6. The Silo (2017)

# 40%

Is the share of total greenhouse gas emissions from our buildings worldwide. Half of the emissions are due to cooling and heating of buildings. The other half come from material manufacturing, construction processes and maintenance.

How can we transform our buildings so they become a *resource*?

# CITY FACTORY

"Our current levels of consumption of raw materials, energy, water, food and land use are not sustainable: we need to change how we treat nature, how we produce and consume, live and work, eat and heat, travel and transport.

We need to give our systemic change its own distinct aesthetic – to match style with sustainability.

Construction is an area that needs to be made more sustainable, with buildings currently generating 40 per cent of emissions globally. We need to make buildings more sustainable.

Can we turn the construction sector from a carbon source into a carbon sink? We can if organic building materials, like wood, and circularity become the main design parameters in how we give form and apply materials to architecture in the future.

Our buildings, public spaces and cities need to become less wasteful, less expensive and more sustainable."

- Dan Stubbergaard / COBE

## THE ASSIGNMENT: **CITY FACTORY**

The City Factory will be a $CO_2$ neutral facility for the production of prefabricated wood products.

Design constraints:

*the structure will be built primarily out of wood*
*the enclosure will be built using $CO_2$-friendly materials*
*the production hall will be daylit in order to more easily accommodate a second-life function*
*the structure and enclosure will be designed for disassembly*

The factory will be located in the Nordhavn neighborhood of Copenhagen, which is being transformed into a new urban neighborhood capable of housing 40,000 people and supporting 40,000 jobs. It will be linked to the rest of Copenhagen by a new Metro line. This new neighborhood, whose master plan was designed by Cobe Architects, is in the tenth year of a projected twenty-five year development plan.

The idea of a city factory is to reduce costs associated with transportation by manufacturing building products as close as possible to the place where they will be used. During this period of tremendous growth for Nordhavn, the facility will produce prefabricated building elements for residential and commercial buildings in the neighborhood. When construction tapers off toward the end of the development period it will be disassembled and either re-built elsewhere or its constituent parts will be re-used in another way.

The City Factory will be composed of the following program elements:

| | |
|---|---|
| *production hall* | *3,000 m2* |
| *office/meeting rooms* | *400 m2* |
| *employee facilities (wc, changing room etc.)* | *150 m2* |
| *canteen* | *150 m2* |
| *external exhibition space* | *100 m2* |
| *outside area (hard surfaces and landscape* | *1,000 m2* |



## NORDHAVN
*from industry to livable city*

Nordhavn as it looked before the transformation began in 2008.

Nordhavn as it will look when fully completed.

Islets and Canals

The Harbor and Cultural Heritage

Five Minute City

## THE SUSTAINABLE CITY OF THE FUTURE

The original development plan for Nordhavn began in 2009 and was based on ***six key themes:***

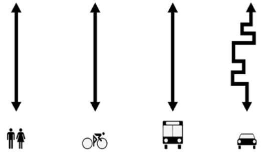
**Islets and Canals**
Splitting the site into islets creates distinct neighborhoods and facilititates a flexible planning strategy.

**Identity and History**
New development integrates with the existing buildings and industrial grid.

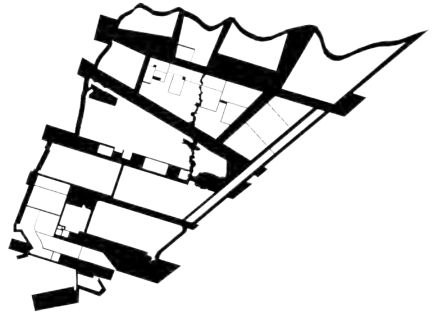
**Five-Minute City**
The green metro and bike loop allows for every area of Nordhavn to be less than a five-minute walk away. The planned infrastructure encourages the use of public transportation over the car.

**Blue and Green City**
Close proximity to green and blue space is a priority to enhance the city's public life.

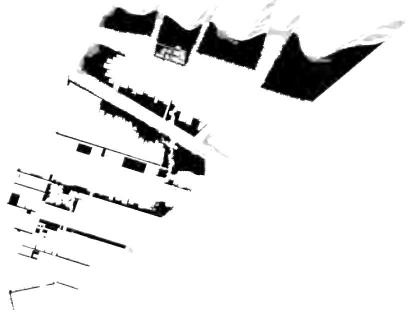
**CO2 Friendly City**
Minimial energy consumption standards are set for a urban development of this scale.



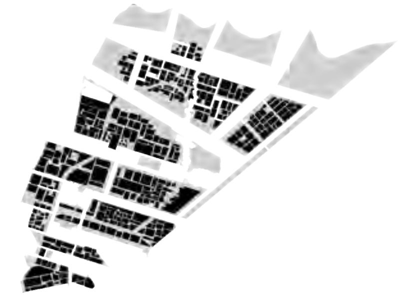
**Intelligent Grid**
Nordhavn will have multiple mixed functions combined within any given area. Controlled flexibility creates a grid that can adapt to changes over time.



The City on the Water



The Urban Green



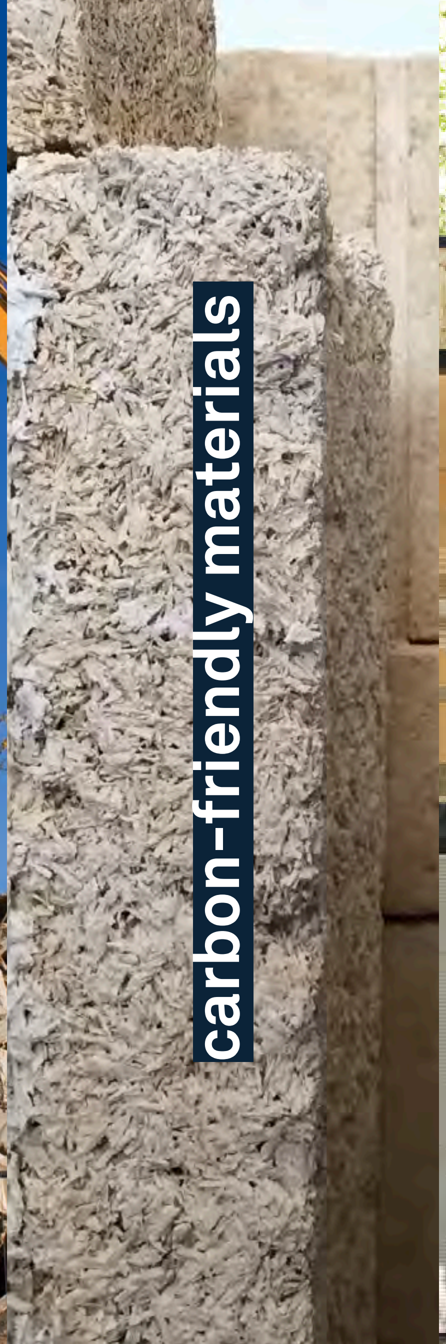
The Intelligent Grid

Stubbergaard/COBE Studio 2020

PHASE 1: **RESEARCH**

The first two weeks of the quarter involved an intensive research phase that addressed the fundamental questions related to the City Factory. The four categories of research were: wood construction innovation, upcycling and the circular economy, carbon-friendly materials and design for dis-assembly. The information gathered was combined into a resource document for use by the students during the design phase of the project.

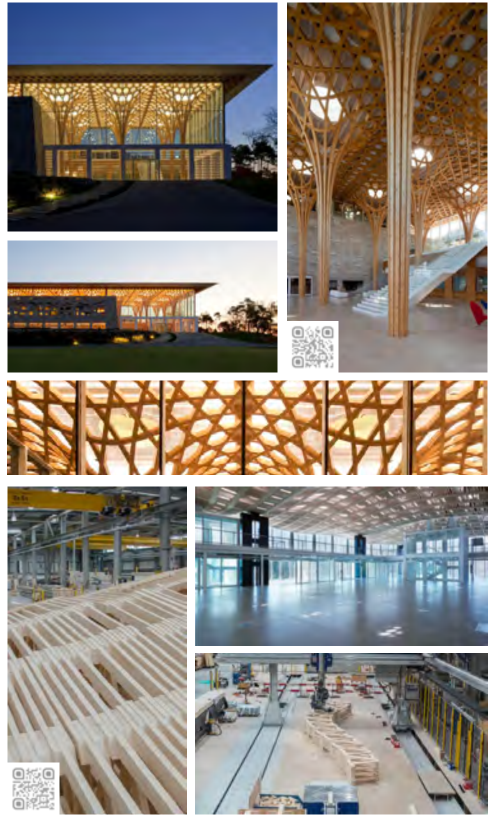





# WOOD INNOVATION

## Poplar in CLT

Fast growth rate at two meters per year, makes poplar a renewable resource. Poplar is also easy to maintain and is a compatible material for CLT (cross-laminated timber). Sourcing poplar from nearby locations can also minimize transportation, and associated CO2 emissions.



1-3: Nine Bridges Country Club, Shigeru Ban Architects.
4-7: Wood Innovation Design Centre, Michael Green Architecture.

## Parametric Design

Parametric design can be utilized to help determine final geometries of a design, or verify structural integrity. It also allows for a higher complexity in geometries. Parametric design is achieved through digital models, paired with computational algorithms, such as through grasshopper.

## Pre-Fabrication

Prefabrication can vary from single elements to a composite element. Prefabricated single elements include mass timber, such as CLT (cross-laminated timber) panels or glulam (glue-laminated) beams. Composite elements may be a wall construction that includes structure, insulation, cladding, and attachments for plumbing. Many prefabricated elements also integrate connections into the unit to further decrease construction time once it arrives on site. In all cases, the elements reduce overall time to complete a construction on-time. For example, the LifeCycle One Tower completed construction of seven floors in seven days.

1-2: LifeCycle Tower ONE, CREE.
3-5: Wood Innovation Design Centre, Michael Green Architecture.
6-7: Kendeda Building, Miller Hull Architects.

## Innovative Truss

There is a large variety in wood truss construction. Of note, is the use of small dimensional lumber to create large spans of open space. Small dimensional lumber is readily available and has a large opportunity for upcycling. This material may be prefabricated off-site, like the structure for the Richmond Olympic Oval. They may also be assembled on-site with low-tech assembly of nuts and bolts, like the Archery Hall and Boxing Club projects.

1-2: Archery Hall, FT Architects.
3-4: Richmond Olympic Oval, Cannon Design.

1,4: Timber Pavilion of the Vidy-Lausanne Theatre, Yves Weinand Architectes sàrl + Atelier Cube.
2-3, 5-6: WikiHouse, Open Systems Lab.

## CNC Milled Components

CNC milled components consist of wood panels that are cut to create nail-free and glue-free connections. All that is needed is a local CnC machine. The computational files for the CnC machine may be open-source, and do not require a factory to produce the components. Therefore, this approach is both cost-effective, and accessible to the public at-large.

## Robotic Arm

Wood construction with robotic arms is currently in its infancy. However, it has made great strides with built projects, such as the Future Tree by Gramazio Kohler. This approach allows a higher flexibility and complexity of form, in comparison to traditional construction methods. Computational methods, such as parametric design, provide information to the robotic arm for assembly. The use of the robotic arm is also faster than traditional construction. Strides are being made to improve sensors to increase accuracy. Currently, sensors from cameras are used to check for accuracy.

1-3: Future Tree, Gramazio Kohler.
4: Robotic Arm
5-6: Nail Laminated Pavilion, Perkins and Will Building Technology Lab.

## Carbon in the Built Environment


### BUILDING AND CONSTRUCTION IMPACTS

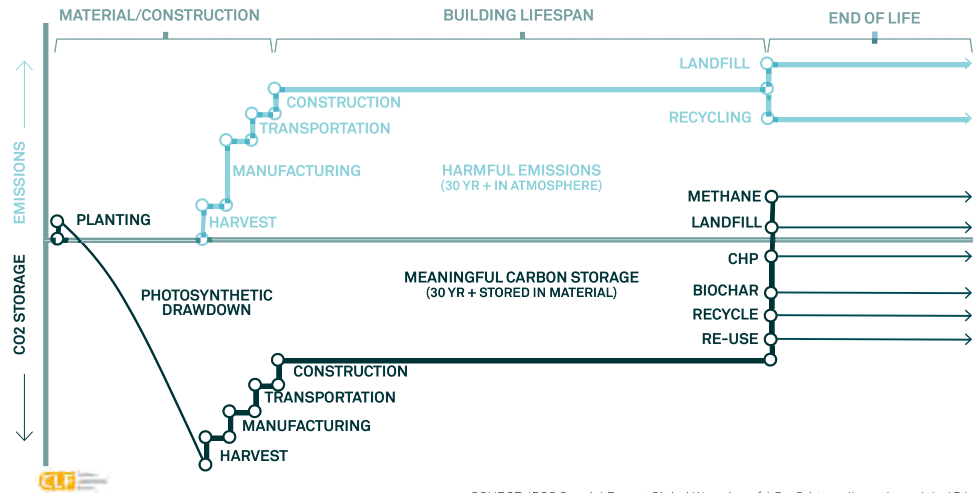
Building operations, materials and construction make up roughly **40% of global CO2 emissions** today. This is broken down into two major categories:

**embodied carbon**
the carbon emitted during the construction process. This includes everything from resource extraction, sourcing, manufacturing, transportation, and building. Something we cannot see when experiencing the building, but this is where the most carbon is emitted in building and construction.

**operational**
the carbon emitted when the building is running. This includes lights, combustion gasses, etc. It is already more readily addressed in many existing examples and more heavily controlled by code standards.

The building and construction industry needs to address embodied carbon as global floor area ratio is projected to nearly double in the next 25 years.

### WHAT BUILDING CARBON STORAGE LOOKS LIKE LONG TERM:




SOURCE: IPCC Special Report Global Warming of 1.5 o C, https://www.ipcc.ch/sr15/

### CASE STUDIES OF BUILDINGS USING CARBON-FRIENDLY MATERIALS

bio-concrete design // studied at Universitat Politecnica de Catalunya

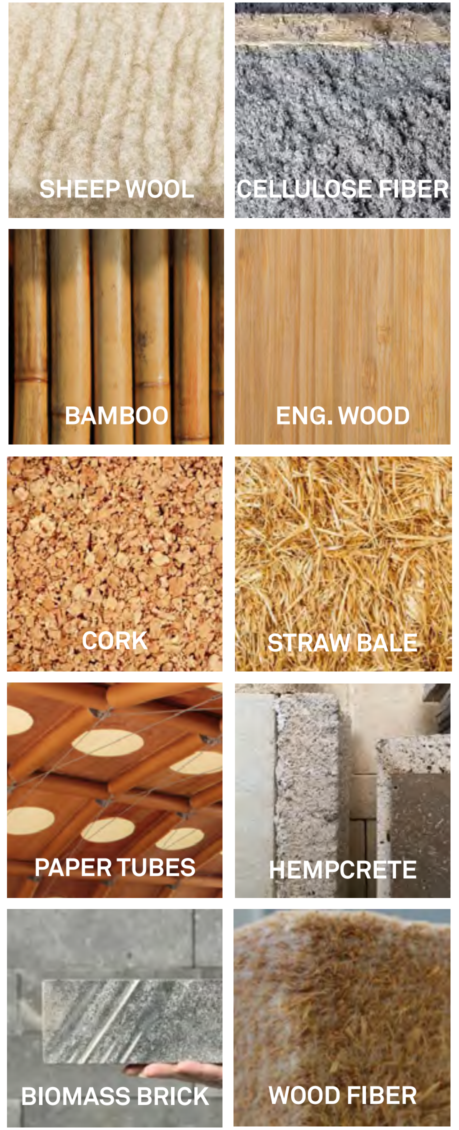
Green Design Center // BAMB

### CARBON-NEUTRAL BUILDING MATERIALS

The most impactful way to reduce embodied carbon in the built environment is through **materials**.

Using carbon friendly materials means using materials that help sequester carbon or emit little to no carbon when produced. Mass timber, like CLT and other engineered wood, is the most widely accepted and readily available for both structural and interior building purposes. It embodies the carbon it has stored over its lifetime, making it a neutral building material with durable integrity.

Some structural examples include hempcrete, a mixture of hemp and lime, bamboo, one of the fastest growing renewable resources and cork, which is derived from oak trees. Interior materials for insulation including straw, sheep wool and bioplastics, are important material innovations because they can be made of fibers from a wide variety of materials.




Examples of innovative and carbon-sequestering materials

For every use of concrete, steel and aluminum there is a direct consequence that impacts our environment.

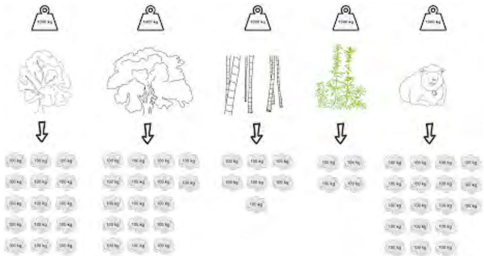
1 ton of concrete is equivalent to 159 kg of CO2 into the atmosphere

1 ton of steel is equivalent to 1.24 tons = 1124 kg of CO2 into the atmosphere

1 ton of aluminum is equivalent to 1.7 tons = 1542 kg of CO2 into the atmosphere

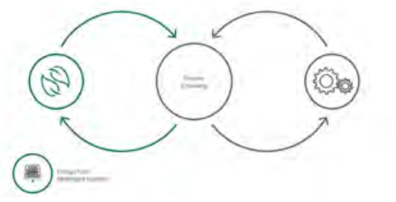

Below are some examples of carbon friendly materials, instead of emitting carbon dioxide these materials help to absorb co2 from the atmosphere.

Each of these shows for 1000kg of each material how much carbon is sequestered.



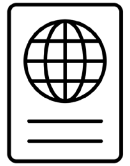
## RE-USE
Design for Dissembly





How do we transform our economy from a linear one to a circular one? With unsustainable consumption and global temperatures ever on the rise, the pressure to live within our means has become more consequential. The above two diagrams attempt to illustrate a broad overview, wherein a new economic paradigm pivots away from take-make-dispose process to one that reduces-reuses-recycles-upcycles materials, products and buildings. While the topic of Re-reuse in reference to circular economy is complex, there are three main gravitational focal points. All three of these topics must be present for a circular economy to function. The topics are: Material Passport, Circular Economy, and Design for Disassembly.

## Material Passport

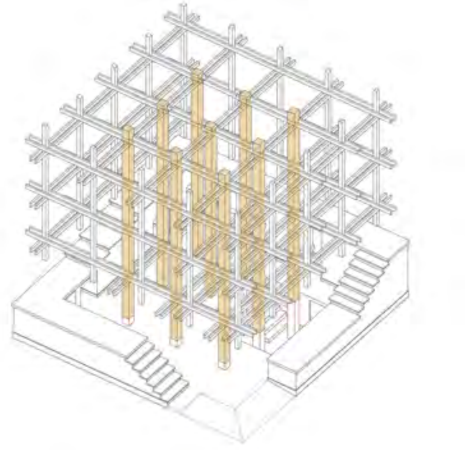


The Material Passport is simple in concept, but powerful in implementation. When a material has been numerically matched from the real world to a BIM model it allows the designer to store much more detail than basic physical attributes. The framework allows for granular information (Environmental Product Declaration) about carbon dioxide impacts (and other greenhouse gases) to be aggregated for detailed calculations. In a way this granular information encompasses the origin of materials. More importantly, the building model provides a catalog of the materi-als for future use. This means that when the building reaches end-of-life, it's pieces can easily be reused in a new design or dismantled and re-cycled for a different use. Material Passports can be viewed as a value add from the perspective of the building owner because they convert a source of waste into an asset that can be sold on the secondary market.



Amsterdam Airport Schiphol, contracted with Phillips for its lighting needs

Venlo City Hall, all building materials have a passport





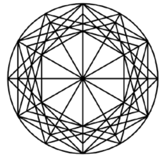




## Circular Economy

From new business models (business as a service) to maintaining material integrity (through biological and technical cycles), the future of any object will need to start with the premise of circularity. If humanity is to live within the resource bounds of this magnificent earth then we will need to learn how to consume responsibly by redistributing, repairing and recycling as de rigueur.

An interesting early case study of Business-as-a-service is Phillips partnership with Amsterdam Airport Schiphol. Phillips offered lighting as a service, which means that Amsterdam Airport Schiphol only paid for the lighting it used, and Phillips owned the apparatus and responsibility for maintaining and end-of-life recy-cling. By creating a business-as-a-service contract, the client can find new synergies with other businesses to make services last longer and align motivations. If clients only have to pay for the services they use, they are able to reduce unnecessary run time and thus reduce cost. Businesses have a strong incentives to build the longest lasting, lowest maintenance product during the term of the contract, and create profit that can be reinvested.

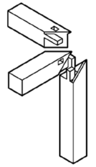


Bosch Siemens Headquarters

## Design for Disassembly

Kengo Kuma, Nest We Grow

Design simply; design fashioners and joints to be disassembled; design with materials that can be reused easily. These are a few ideas to keep in mind when designing for disassembly. Kengo Kuma is notorious for producing simple yet elegant buildings that look complex but follow the logic of a honest joint. This can be seen in the Nest We Grow Building, which uses effortless tectonics that focus on the joint. Similar to the infographic representing this section, the cuts used to make an easy-to-construct joint might look complex on their own, but a strong joint is achieved without adhesives, allowing for decreased labor costs when it comes time to deconstruct and re-imagine the space. This benefit is even more apparent when designers use digital fabrication techniques to produce the elements that make up the joint. If materials can't be disassembled from their building whole, then material passports can't turn a depreciating asset into a re-usable or recyclable component, and humanity's consumption patterns will remain linear instead of circular, ultimately denying billions of humans a good standard of living.



## PHASE 2: **SITE/PROGRAM ANALYSIS**

Following the research phase of the project the students gathered information about the following aspects of the site and program:

*Circulation*
how materials arrive on the site
how the building components go out
how people come and go to the site, including factory workers, park visitors and future users of the building's second life

*Environment*
how the sun and wind affect the site
the summer and winter climate conditions

*Scale*
the size of the site and how it compares it graphically to familiar spaces of a similar size

*Site and Building Program*

the size of the various city factory program elements
park uses and amenities that might be appropriate for this site - in summer and winter
potential relationships of the factory and the park to Tunnelfabrikken, to the water and to the surrounding housing

*Factories*
case studies of similar factories to determine possible bay widths, heights, flow of materials-to-products

*Re-use strategies*
second-life program elements that might fit into the building and onto the site



## CIRCULATION
Research and Site Analysis


Nordhavn as it looked before the extension began in 2008.


Nordhavn as it will look when fully expanded.


Connected to the public transportation loop is a green corridor for bikes, which connects Nordhavn to the larger biking network of the city.

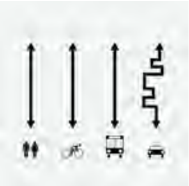

An extra loop on the Metro city ring will connect Nordhavn with the city centre.


(1) Shipping access


(2) Metro access


(3) Pedestrian Access

In Nordhavn, it is easier to walk, cycle or use public transport than travelling by car.



**(1) The city on the water** - Along with the green strips, new canals will be dug to enhance access and proximity to the water. The planning of blue and green city qualities precedes the planning of buildings.

**(2) The urban green** - Strips of green spaces run from east to west. Moving through these sections is experienced as a diverse and varied journey. The public spaces vary from "urban green" in the south to "natural green" in the north.

**(3) The green loop** – Transport is addressed as a clearly visible and distinctive element as well as a recreational space. The green Metro and bicycle loop connects the islets and makes for an integrated city. Every corner of the island is envisioned to have less than a five-minute walk to public transportation.

**(4) The intelligent grid** - The intelligent grid makes room for multiple mixed functions within a given area. The grid can adapt to changes over time and gives the plan a great deal of controlled flexibility. The variation of lots makes for a diverse city.

## CIRCULATION STRATEGIES


THE CITY ON THE WATER

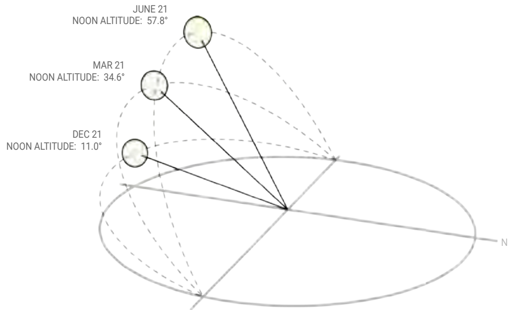

THE URBAN GREEN


THE GREEN LOOP

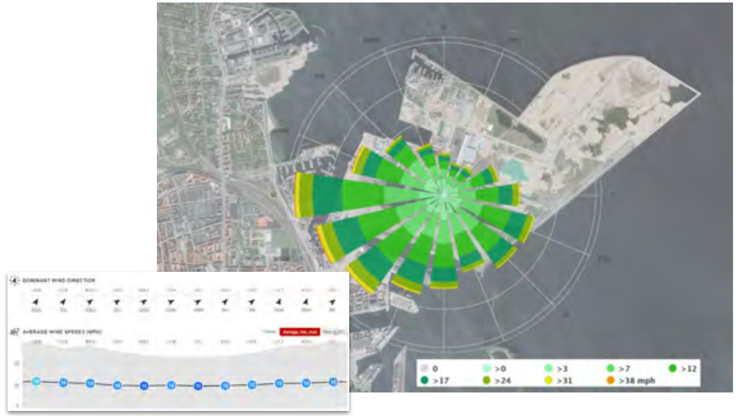

THE INTELLIGENT GRID

## ENVIRONMENT

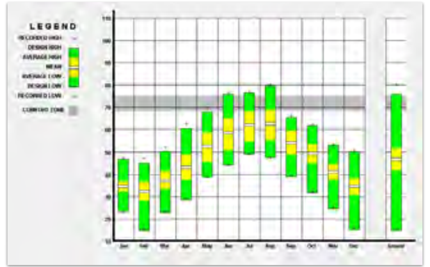
### SUN ANGLE



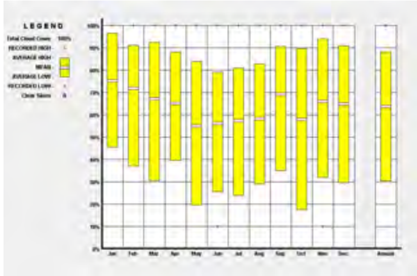

### WIND



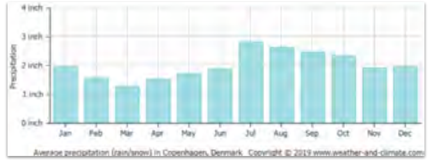
### TEMPERATURE



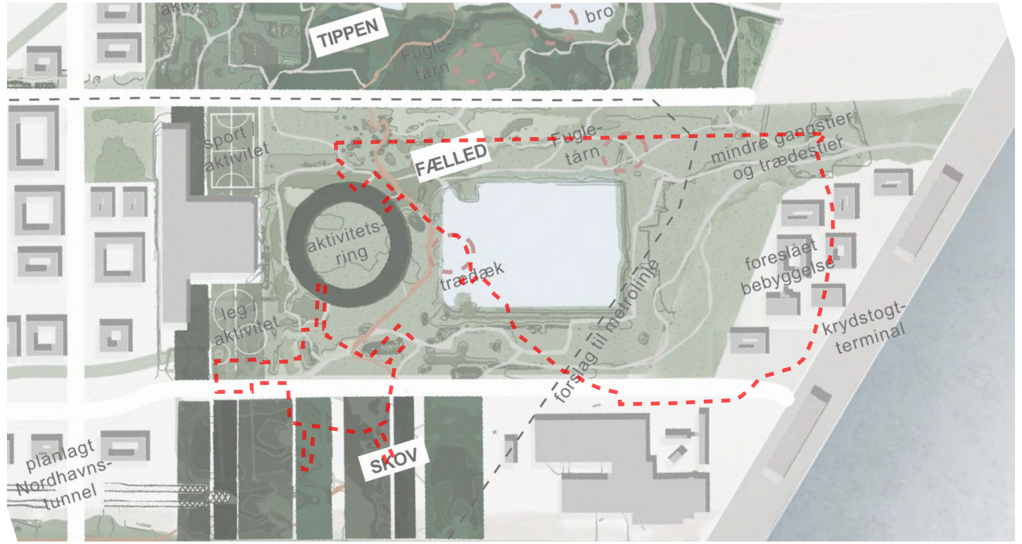
### CLOUD COVER



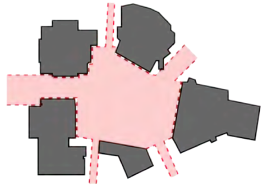
### PRECIPITATION

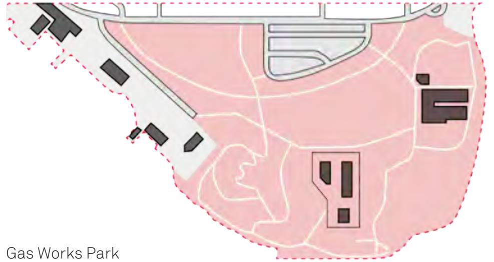


## SCALE
Research and Site Analysis



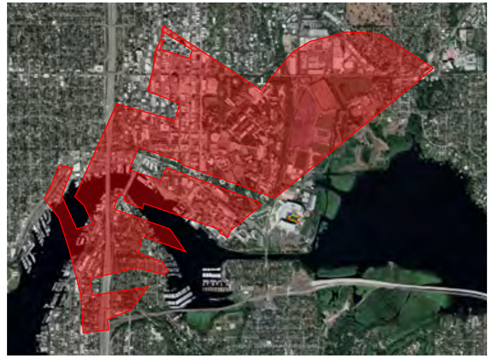
Nordhavn Site


UW - Red Square


Gas Works Park


Nordhavn Neighborhood


Downtown Seattle


University of Washington Campus

Stubbergaard/COBE Studio 2020

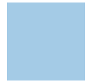
## SITE AND BUILDING PROGRAM

### Summer Park Uses

### Winter Park Uses

### Program Element Scale // 1" = 50M


Production Hall
3000 M ²


Offices
400 M ²


Employee Facilities
150 M ²


Canteen
150 M ²


External Exhibition
100 M ²


Landscaping
1000 M ²

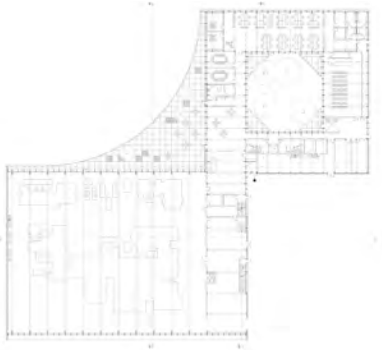
## FACTORIES

### BC Passive House Factory

Area: 1,500 m2
Bay Width: 16.855 m
Bay Length: 6 m
Height: 8.711 m
Primary Function: Light Timber Panels

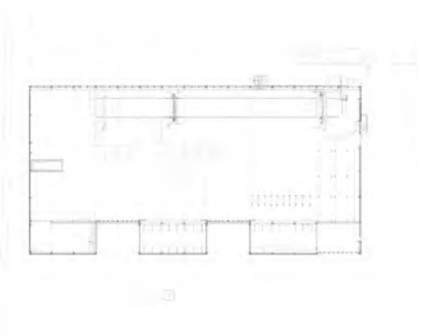
### Trumpf Smart Factory

Area: 5,295 m2
Bay Width: 5 m
Bay Length: 45 m
Height: 4 m up to 13 m
Primary Function: Light Timber Panels



### Walter Kung AG Production Hall

Area: 2,535 m2
Bay Width: 30.25 m
Bay Length: 78 m
Height: 14.3 m
Primary Function: Holzpur (diagonally-crossed DLT)



## RE-USE STRATEGIES

Second Life Typologies

**Fab Lab Barcelona**
Fab Labs
*MAKER'S SPACE*

**The Gantry**
Hawkins/Brown
*OFFICE*

**Learning Barge**
Crisman Petrus Architects
*URBAN FARM*

**Allez UP Rock Climbing**
Smith Vigeant Architects
*RECREATION*

**Wooden Nursery**
Djuric Tardio Architects
*EDUCATION*

**4-Generation Tokyo Home**
Tomomi Kito
*MULTI-GENERATION LIVING*

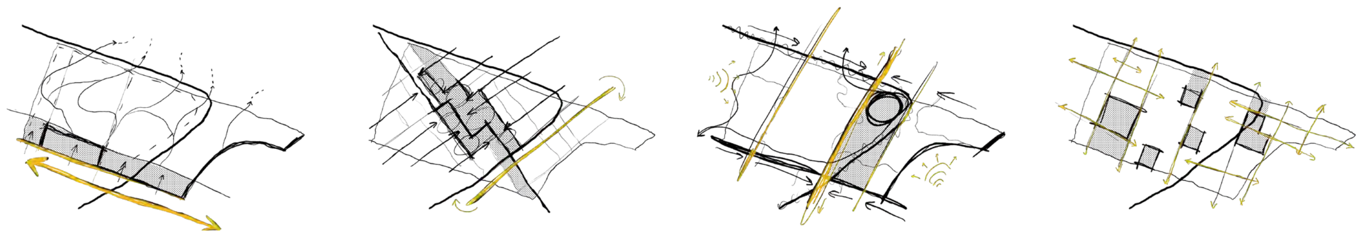
**Launchlabs**
Stereo Architektur
*EVENT SPACE*

**FRAC Dunkerque**
Hawkins/Brown
*GALLERY/MUSEUM*

## PHASE 3: **SITE SCHEMING**

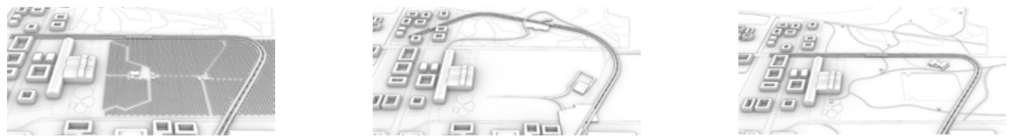
Once the studio had gathered sufficient information about the site and program, the students worked in three teams to develop multiple site schemes for the project. The teams were asked to consider site circulation, park uses (winter and summer) and future transformations of both the building and the site. Using a combination of diagrams, site models and perspective collages they depicted the life of the park and its relationship to the city factory, both in its first life as well as in future ones.

### SITE SCHEMING: **TEAM A**



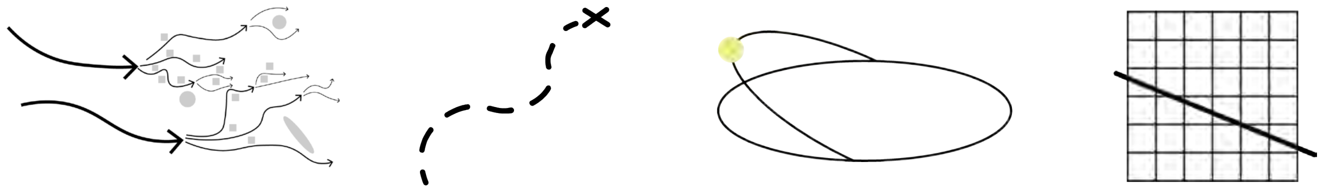
Bryce Boho, Qutaiba Buyabes, Stephanie Lam, Halina Murphy

### SITE SCHEMING: **TEAM B**



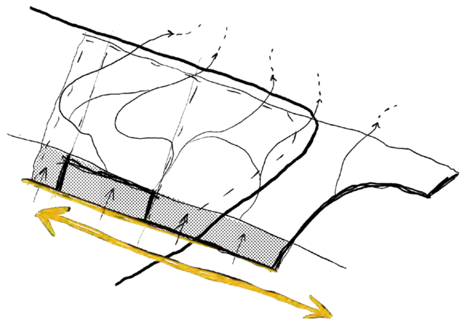
Connor Beck, Zining Cheng, Skyler Johnson, Claire Sullivan

### SITE SCHEMING: **TEAM C**



Emily Crichlow, Cody Edmonds, Siobhan Schramm, Connor Stein

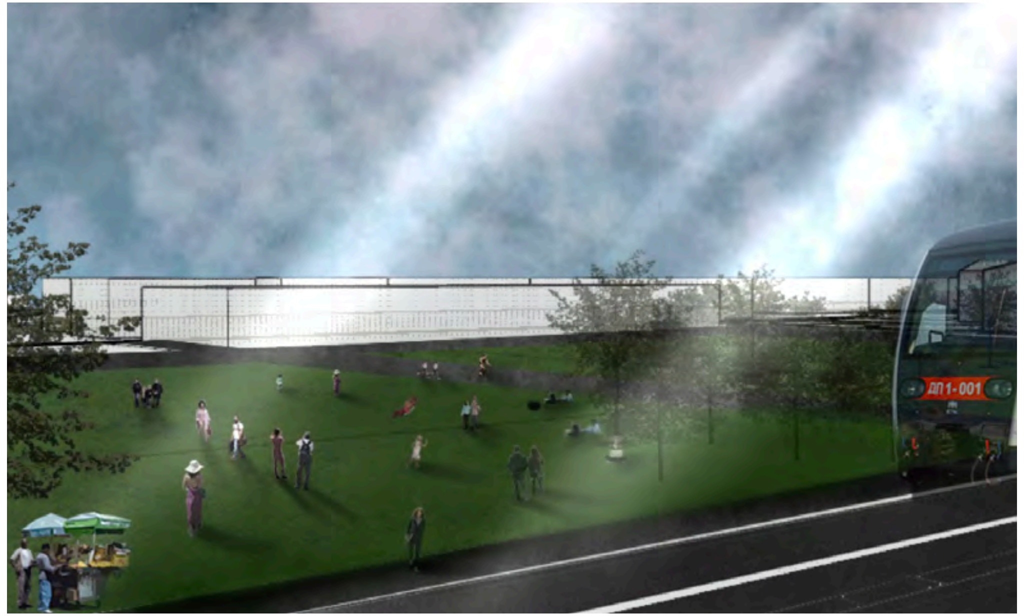
## FRINGE



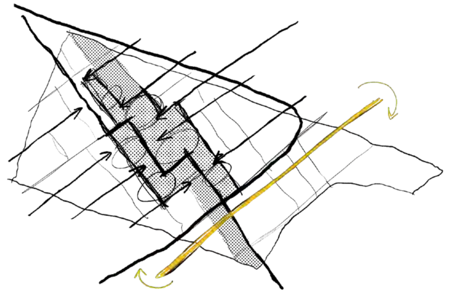
Conceptual Strategy

Life 01

Life 02



## DEFRAMED TRACES

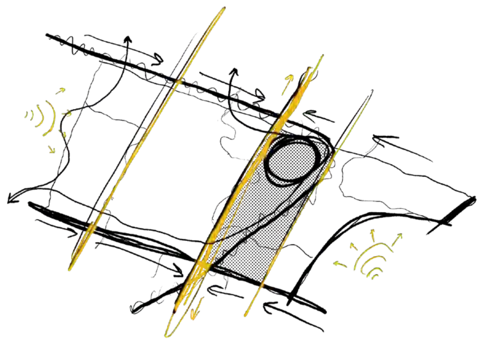


Conceptual Strategy

Life 01

Life 02

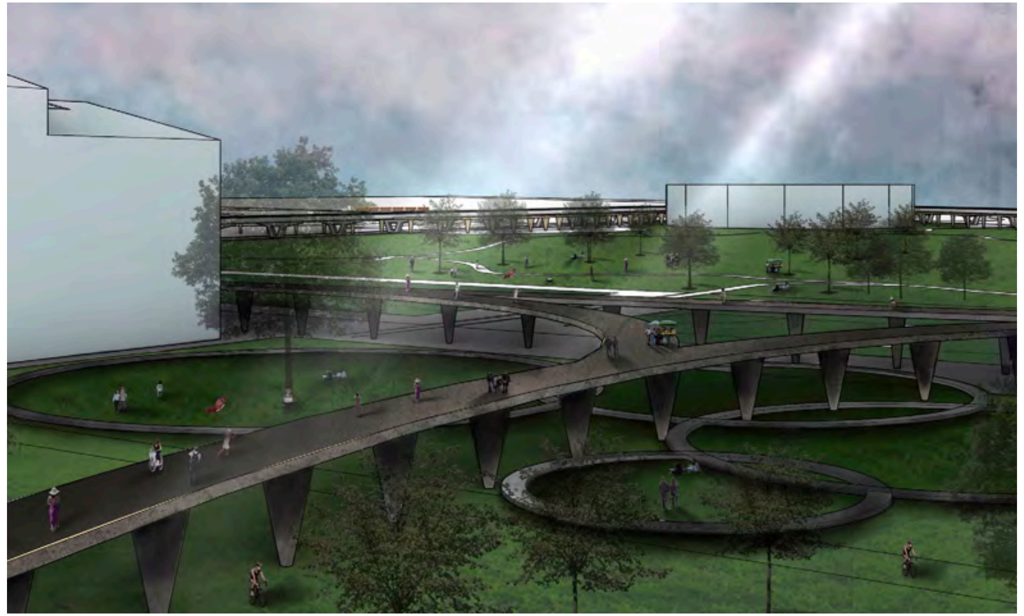
## COIL + STRAND



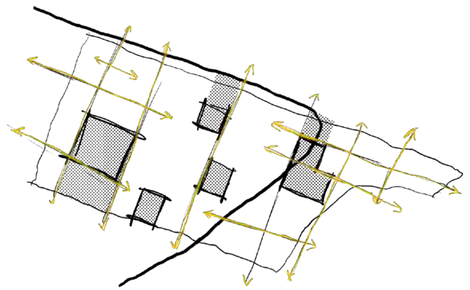
Conceptual Strategy

Life 01

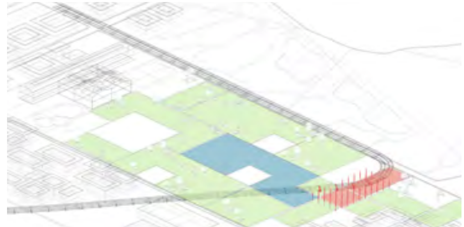
Life 02



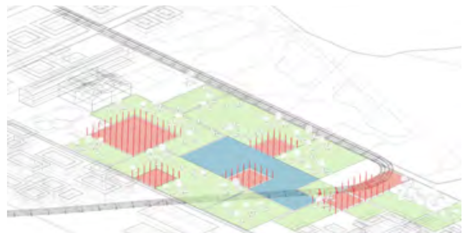
## GRITTY



Conceptual Strategy

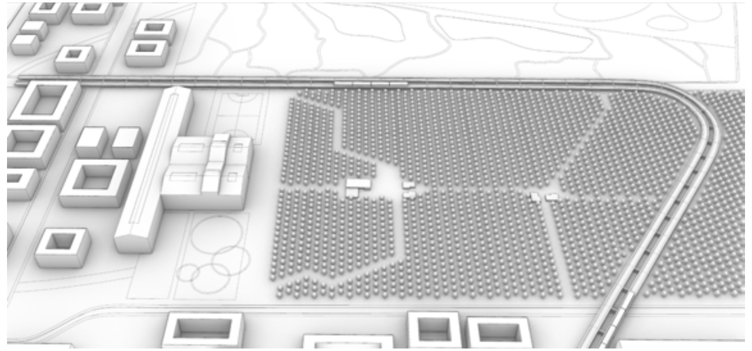


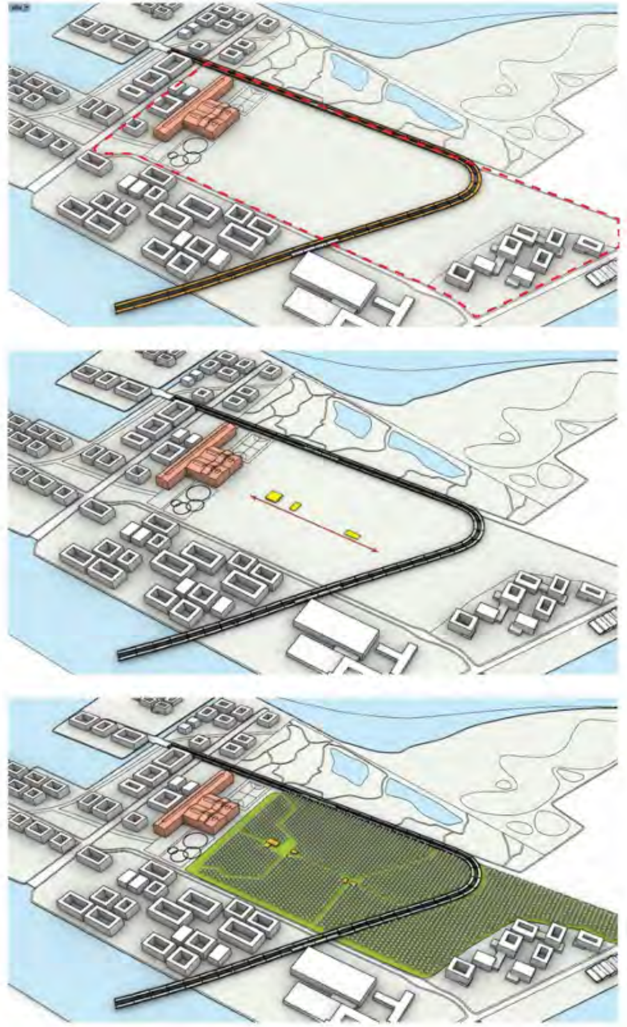
Life 01

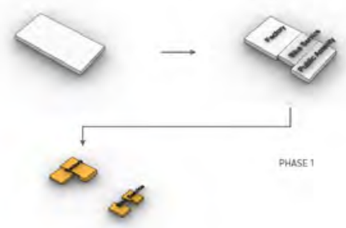


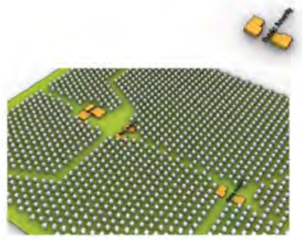
Life 02

## TREE FARM
PHASE 1

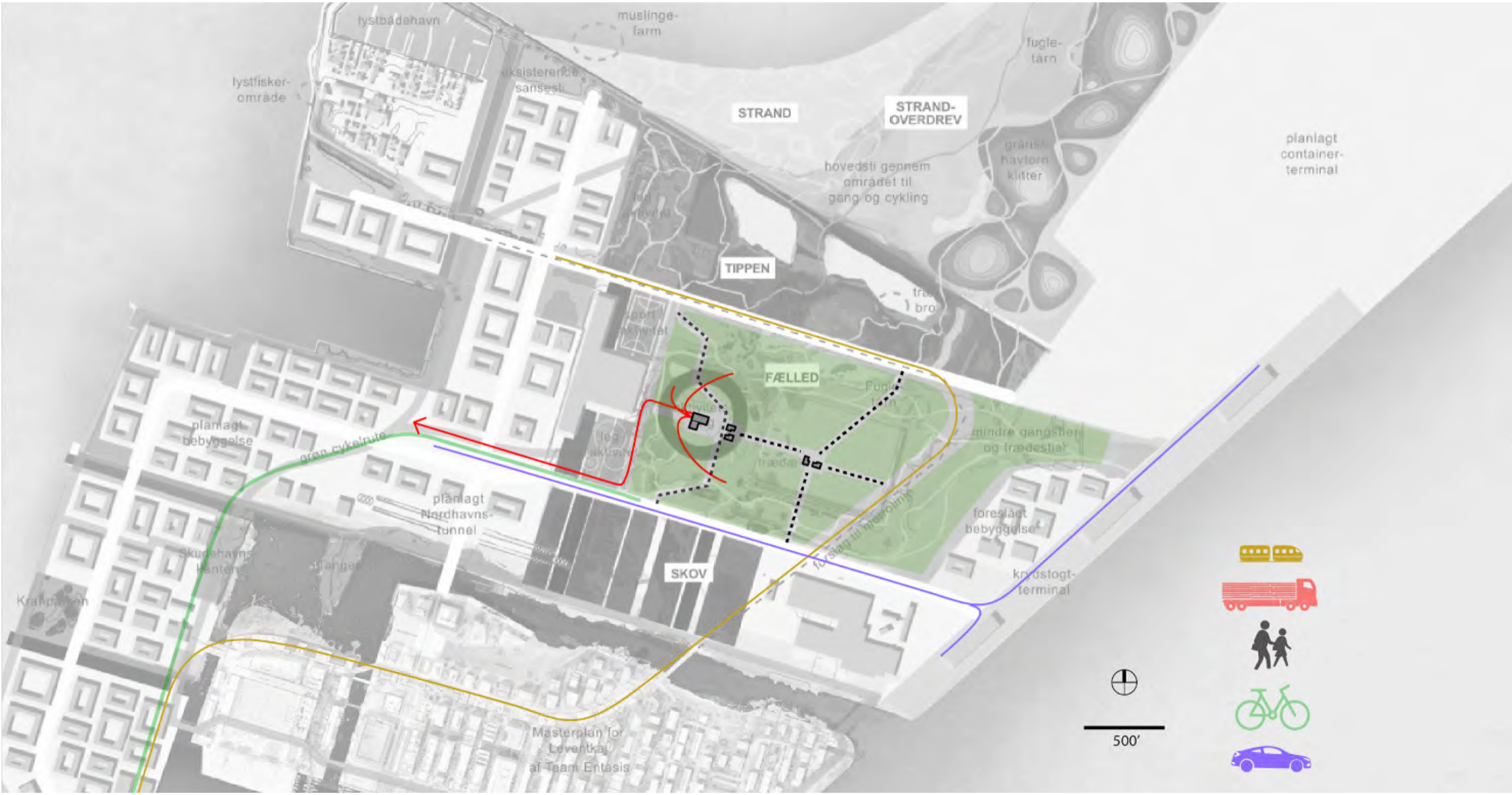




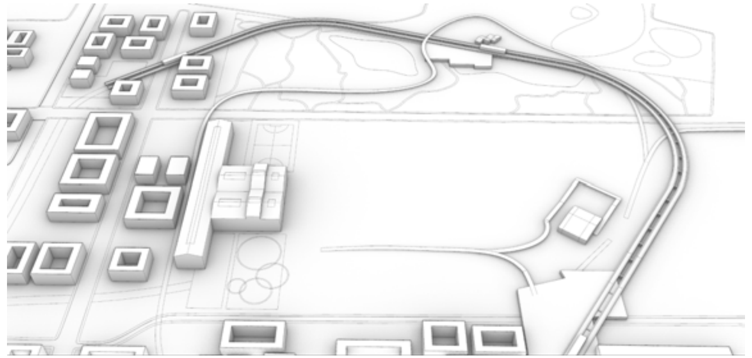


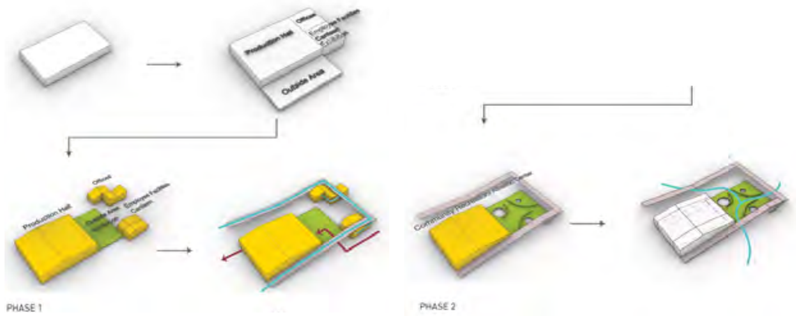



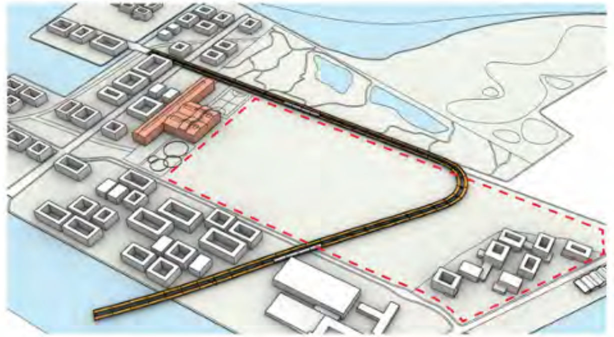
## TREE FARM

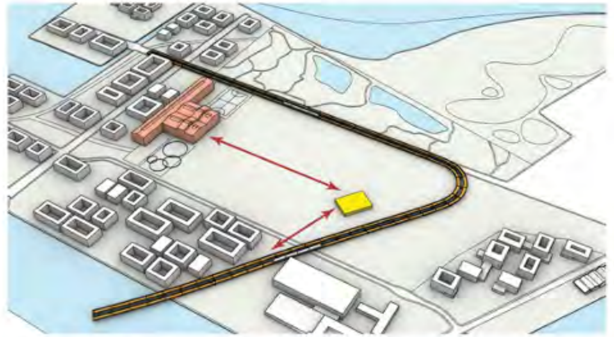


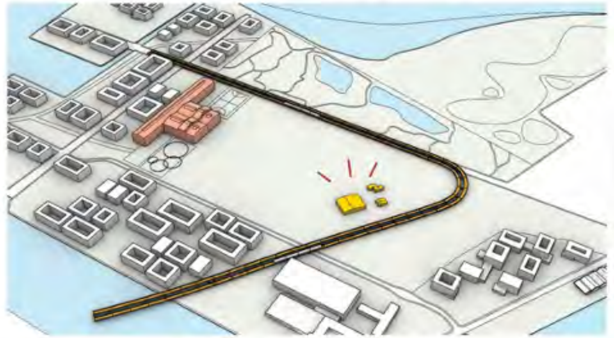
## LINK




PHASE 1
PHASE 2



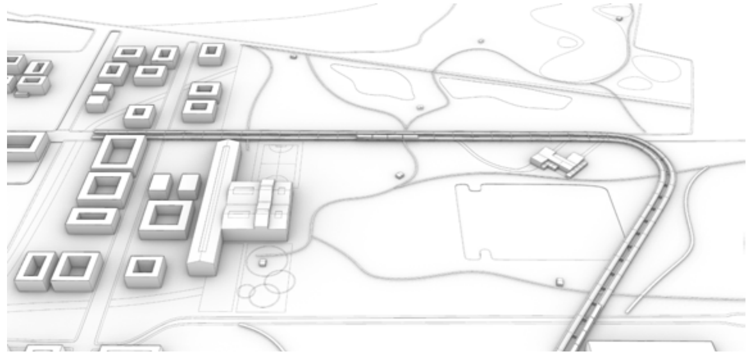


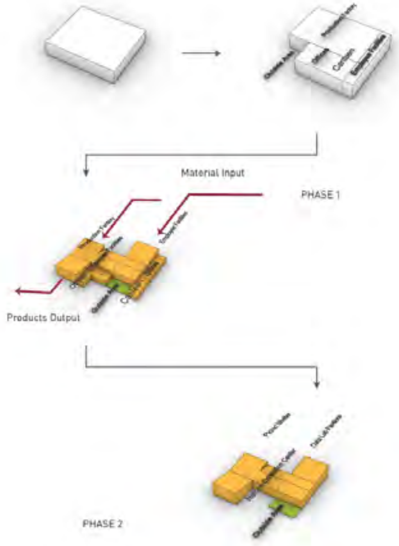


## LINK

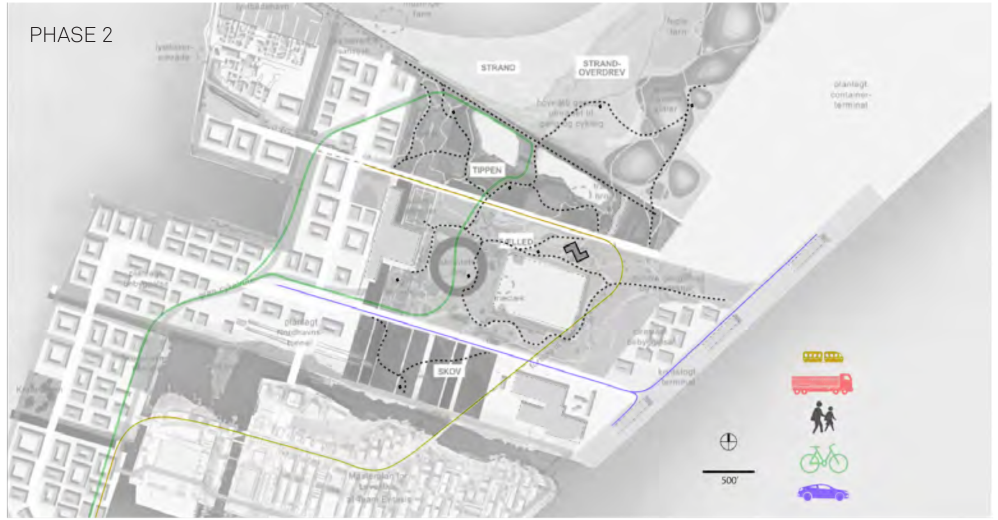

lystbådehavn
muslinge-
farm
lystfisker-
område
eksisterende
sansesti
STRAND
STRAND-
OVERDREV
TIPPEN
FÆLLED
aktivitets-
ring
Fugle-
tårn
planlagt
bebyggelse
grøn cykelrute
planlagt
Nordhavns-
tunnel
mindre gangstier
og trædestier
foreslået
bebyggelse
krydstogt-
terminal
SKOV
Kranparken
Masterplan for
Leventkaj
af Team Entasis
500'

# DISPERSAL

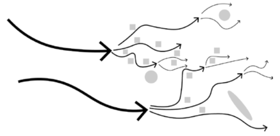





# DISPERSAL

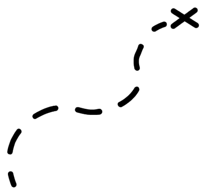




## WARRENS AND DENS
WIND

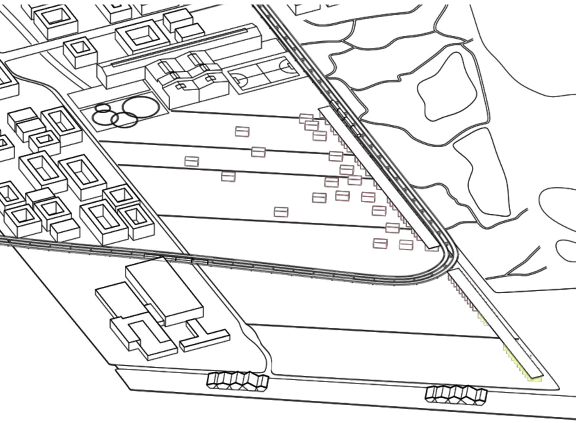


Subtle topographic folds fan outward from the southeast corner of the site, producing microclimates shielded from prevailing winds. The City Factory is tucked into a large mound adjacent to the Tunnelfabrikken. The resulting basins mitigate the effects of cloudburst flooding in warmer months, while freezing over in the winter to function as an ice skating path. On closer inspection, some of the mounds reveal themselves to be lightweight structures, housing cafes and greenhouses. The social nature of the park transitions to permaculture habitat, providing grounds for foraging. After its first life, the City Factory transitions into a greenhouse to continue providing a climate-conscious source of healthy food for the neighborhood.

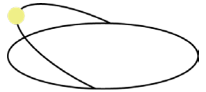
## ANGLED BAR
CIRCULATION



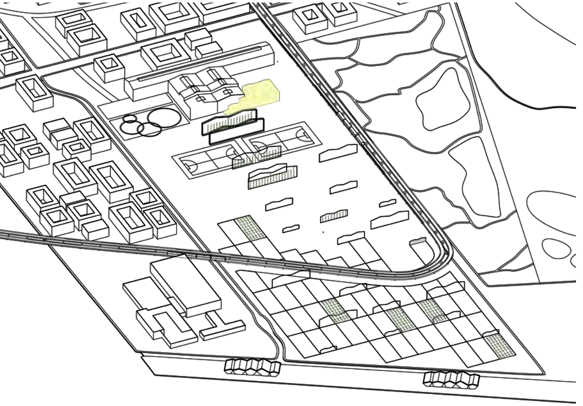
The City Factory forms a strong edge in the northeast corner of the site, situating it to both easily receive materials from the container terminal while also functioning as a threshold between the site and the adjacent parks to the north. The angled bar is characterized by a continuous roof line infilled with volumetric modules rotated at a slight angle. These modules dissipate outward from the bar, providing spaces for warming huts or acting as urban furniture. After its first life, the City Factory transitions into a recycling sorting center on view to the public.



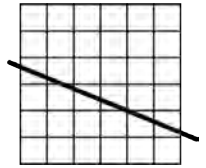
## PARASITES OF SHADE AND SUN
SUN



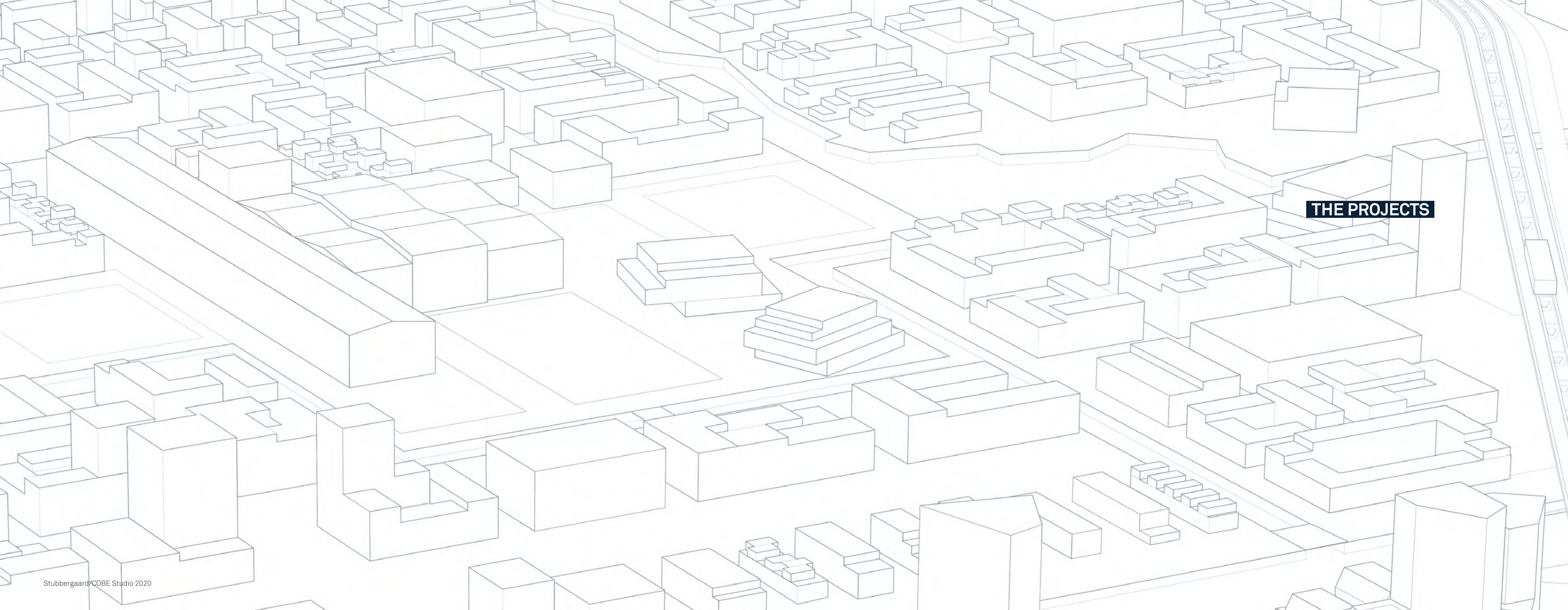
In order to maximize daylight to the site, the City Factory is parasitically located in the shadow of the Tunnelfabrikken. Alternatively, a series of large-scale trellises which mimic the profile of the Tunnelfabrikken parasitically latch onto sunny spaces throughout the site and become overgrown with vegetation. These plant "walls" form outdoor rooms in the park, producing a variety of space for visitors to occupy depending on the weather. From west to east, the site transitions to a bio-based building material farm for crops such as hemp. After its first life, the City Factory transitions into housing for the elderly to age in-place in dialoge with the proposed student housing of the Tunnelfabrikken.



## SKEWED PROCESSION
GRID



The City Factory and the Tunnelfabrikken join into dialogue in a skewed yet classical composition. The villa-like form of the Tunnelfabrikken sits prominently at the end of a long tree-lined axis through the site. A slightly skewed allee of trees cuts through the primary axis toward the container terminal. The intersection of these axes frames four large quadrants of park space for recreational or festival uses. After its first life, the City Factory is hollowed out and converted into housing. The park itself is slowly developed into a typically dense urban neighborhood with pockets of trees dispersed throughout to mitigate heat island effect. The formely monumental factory building becomes part of the fabric of everyday life.




Stubbergaard/COBE Studio 2020

CONNOR BECK
## PLANTAGERFABRIKKEN

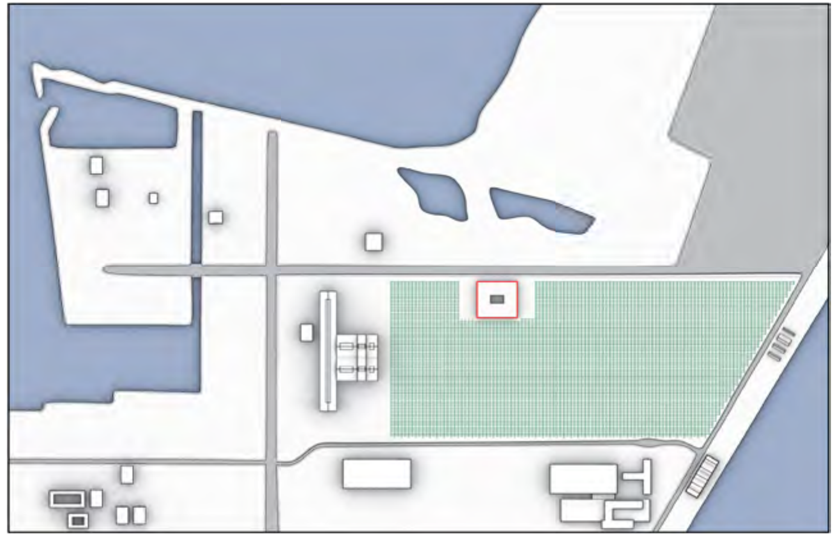
The Plantation Factory will manufacture building components for Copenhagen's North Harbor. The goal is to produce a sustainable supply of lumber for Nordhavn's ongoing development.

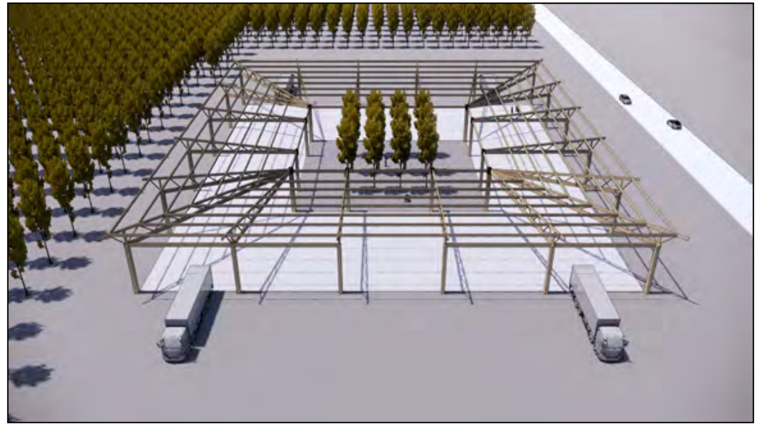
Phase I will involve milling and manufacturing building components with local poplar being the primary ingredient. Poplar trees are categorized as "fast growing trees." Growth rate is 2m per year allowing for a fast rotation compared to other tree species.

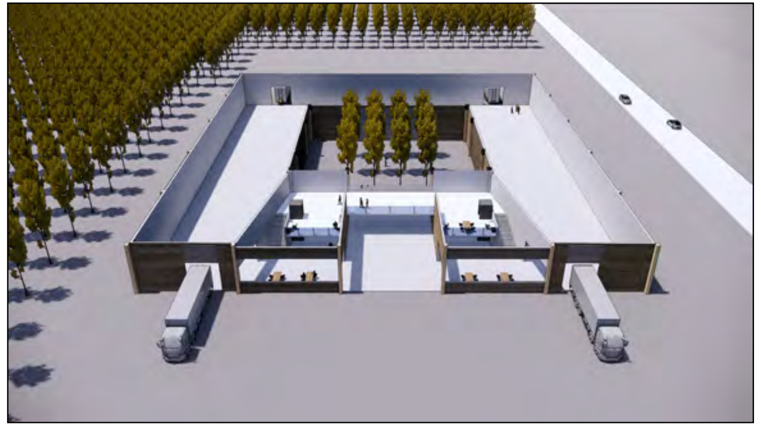
Phase II assumes the plantation becomes the new city of Nordhavn in the form of lumber. The factory itself will transform into its second life while serving as tribute to the original poplar plantation. Twelve poplar trees will remain in the courtyard, reaching full height in 40 years.

Phase I

The initial concept involves planting a grid of poplar trees on the Nordhavn site. The factory is positioned next to an existing road to minimize the cost of infrastructure.

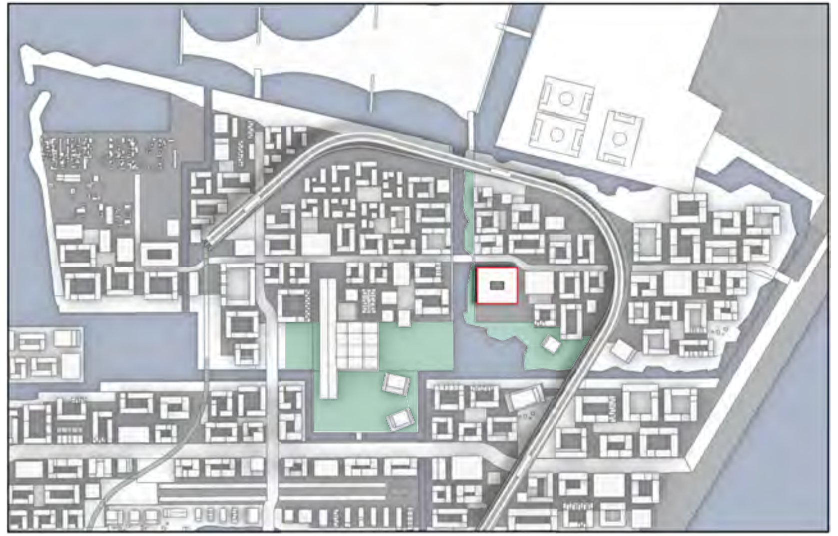


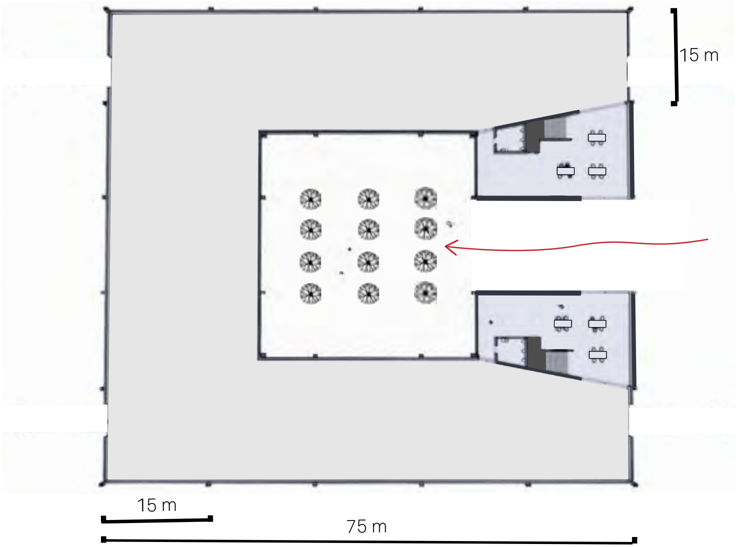




Phase II

As the site fully develops into an urban city, the factory's original location integrates within the future grid of Nordhavn






Aerial View

Inner edges of the roof angle toward the courtyard with a minimum height of 10m. Outer roof perimeter has an additional height of 3m for the glass clear story.

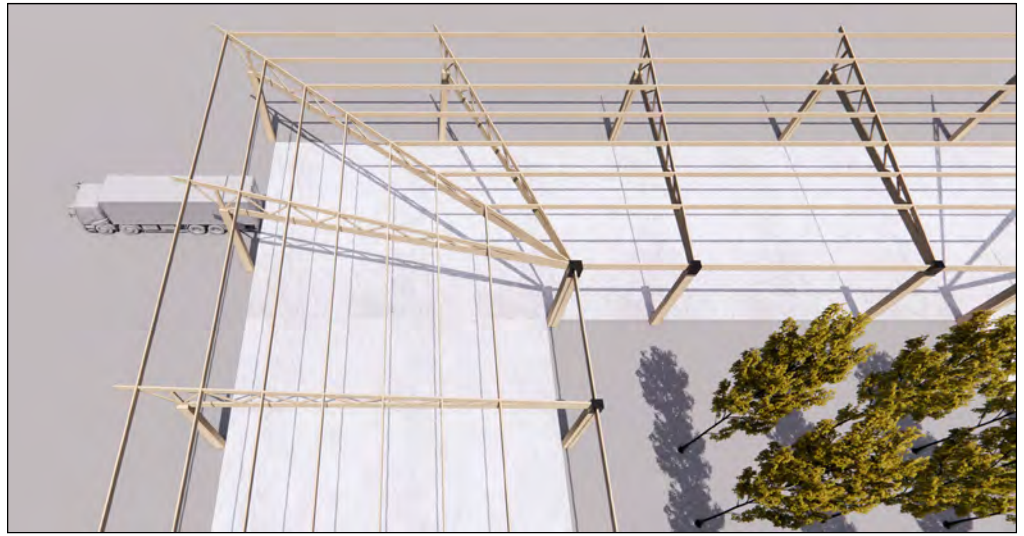
PV panels are installed onto the roof, directly over the primary members. Skylights are positioned in between secondary roof members.

View From Production Hall

Primary structural members are exposed with a perimeter clear story. Minimum operational ceiling and wall height is 10m.

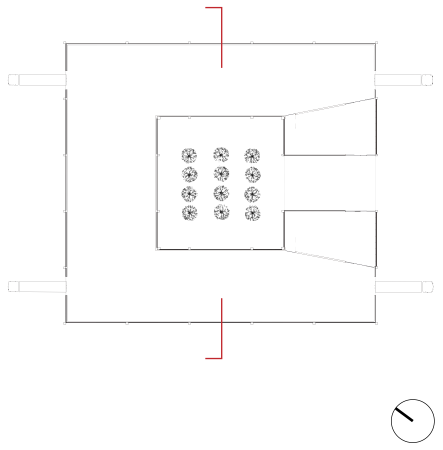
View From Courtyard

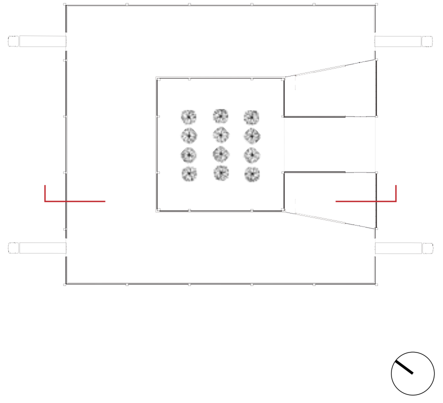
Trees in the courtyard provide share and protection against wind from the bay. A bridge over the corridor separates pedestrian traffic from office areas on the 2nd level.



Structural View

Rotating three trusses at each corner of the building suggests "turning the corner" through production halls. Secondary beams lie directly on top of the truss webbing.





Phase I

The original building is constructed with wood materials and components in order to minimize its carbon footprint. The cladding, furnishings, and secondary members are made of poplar CLT panels. Primary long span members are produced as poplar/spruce hybrid CLT panels to increase strength as needed.

Phase II

Building operations shift from wood manufacturing to a second use. Considering the unique character of factories (long spans, high ceilings, large overall footprint, this creates an opportunity to consider how future-use buildings with similar physical requirements could fit into the existing floor plan of a factory.

At 10m high, the original structure could be re-used as an athletic facility to accommodate the future neighborhood. The factory's original support functions could be salvages and re-used for materials in a new facility.

Trees in the courtyard are a relic of the original plantation. With proper maintenance, a poplar tree will last 50 years. When the Nordhavn master plan is complete, the trees will reach full height.

BRYCE BOHO
**BYFABRIKKEN**

### Local Construction Solutions For A Sustainable Future

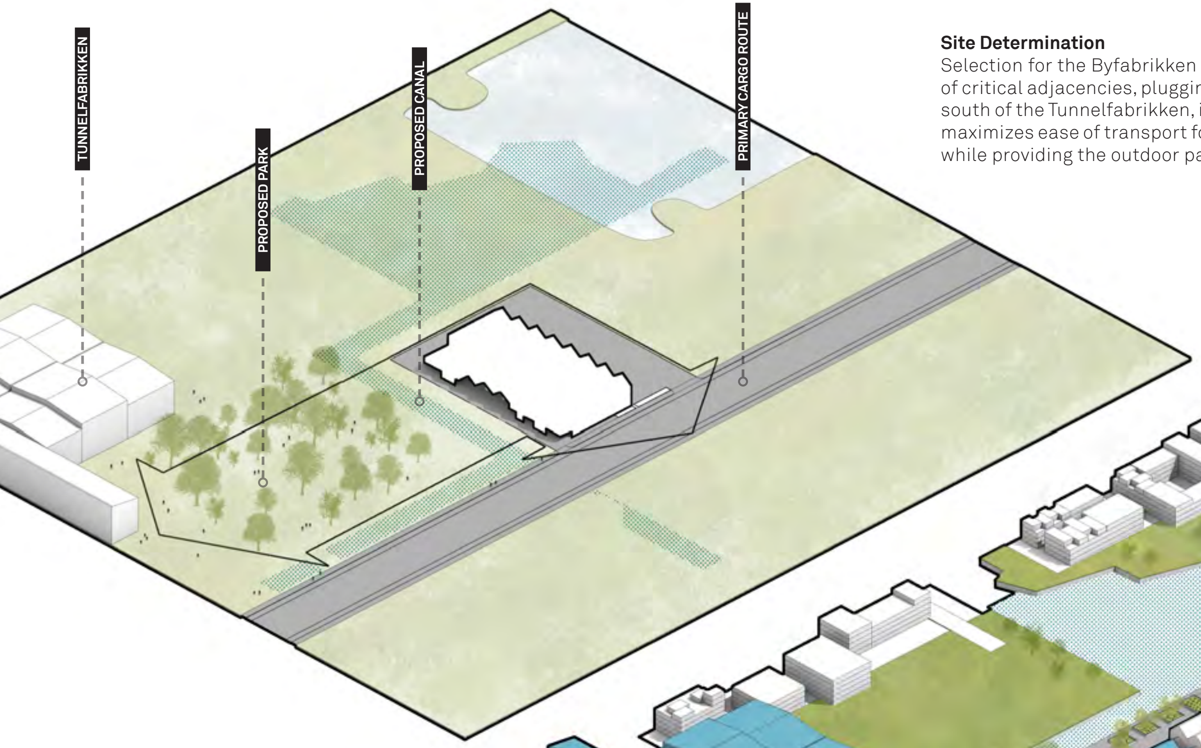
Within the Nordhavn neighborhood, Byfabrikken City Factory will be a key player in the development and construction of its own context. A focus of the future neighborhood is to spearhead the Danish circular sustainability movement, in which materials flow from cradle the cradle, **emphasizing the economics of both high efficiency construction and deconstruction.** The Byfabrikken's role within Nordhavn is to act as a point of genesis for the community, a building capable of **streamlining construction techniques which will be utilized in the building of buildings across Nordhavn.**

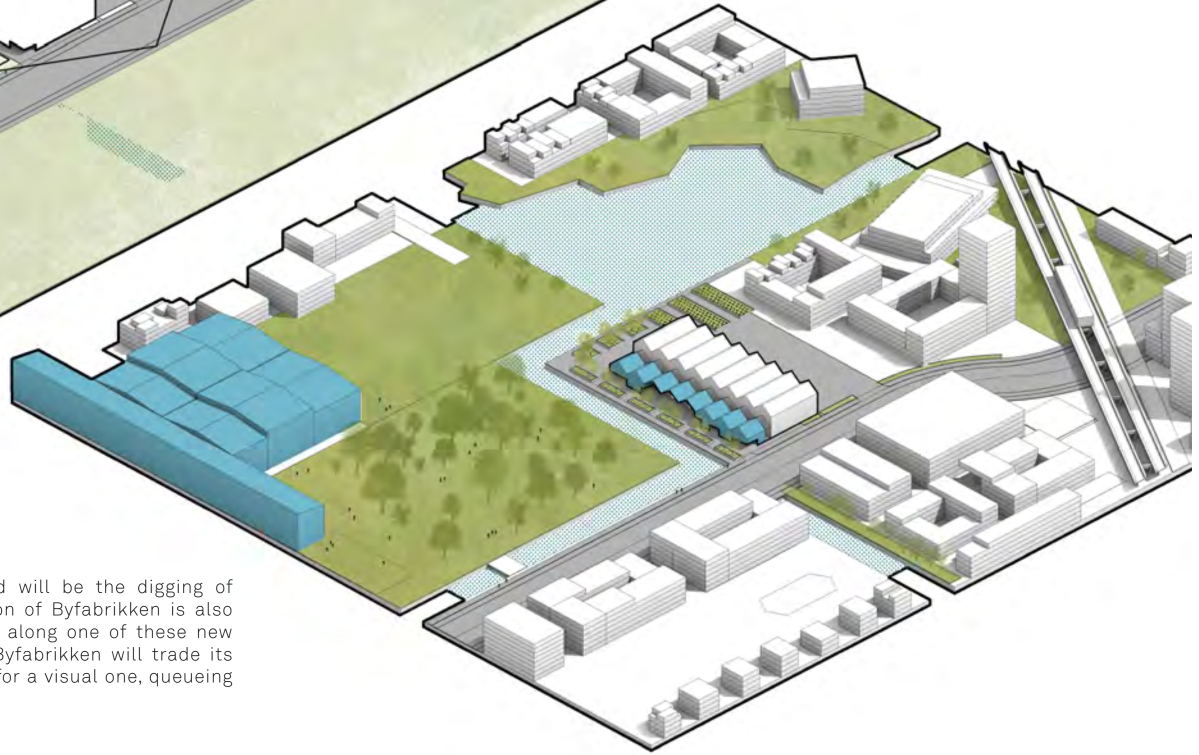
A building designed to maintain its utility throughout multiple programmatic lives, Byfabrikken building **components are designed for disassembly and reconstruction** at an entirely new site. Careful consideration was applied to the selection of each implemented material, affording **endless possibilities for reuse or recycle.**

Keying into development themes of the Nordhavn master plan, **Byfabrikken picks up on traces of history and culture through its formal language,** referential of the adjacent Tunnelfabrikken, a future cultural genesis point and hub. Byfabrikken also **ties into concepts of the future healthy-and-active district,** encouraging outdoor activity along the adjacent canal and housing an urban garden at the site's northern edge.

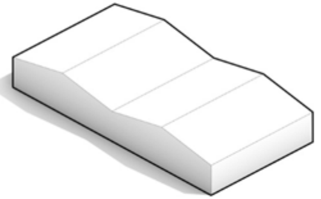
Stubbergaard/COBE Studio 2020

**Site Determination**
Selection for the Byfabrikken site was determined through careful assessment of critical adjacencies, plugging into key assets such as a developing park space south of the Tunnelfabrikken, in addition to Nordhavn's primary cargo route. This maximizes ease of transport for material delivery and shipment from the factory while providing the outdoor park with a spatial enclosure.

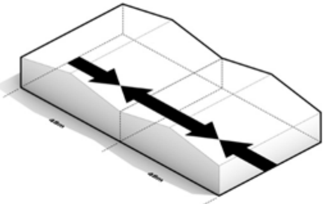


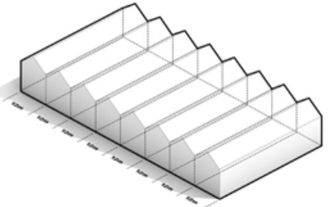
**Evolving Nordhavn**
A new feature of the Nordhavn neighborhood will be the digging of canals across its masterplan, the site selection of Byfabrikken is also characterized by its future context as located along one of these new canals. Once the canal has been completed, Byfabrikken will trade its physical relationship with the Tunnelfabrikken for a visual one, queueing into its color pallet to maintain their connection.



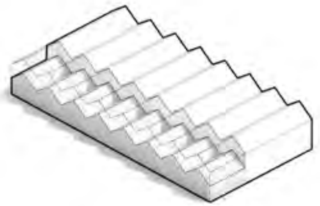
**Tunnelfabrikken**
Directly west of the Byfabrikken site, Tunnelfabrikken is in the process of conversion into a cultural hub. This is one of few buildings already plugged into the Nordhavn masterplan and serves as a referential geometric base for the Byfabrikken.



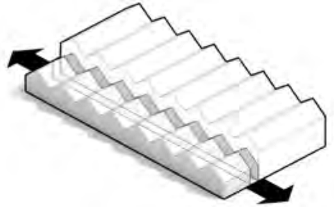
**Split and Press**
Composed of a light gauge steel superstructure, Tunnelfabrikken is a building of both efficiency and utility, notable in its 48m spans made possible through its gabled roof. Although a 48m bay width is feasible, the timber Byfabrikken building modifies this span dimension to maximize material efficiency.



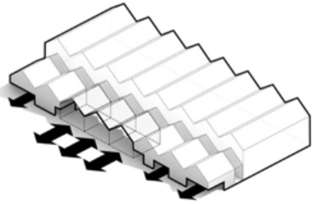
**Contextual Reference**
Byfabrikken is an anomalous typology, a building which builds buildings. As such, its formal language and scale was found in its built context. A survey of 40+ buildings within Copenhagen, helped determine an appropriate bay / volume width of 12m, breaking up the volume while allowing for each gable to contribute structurally.



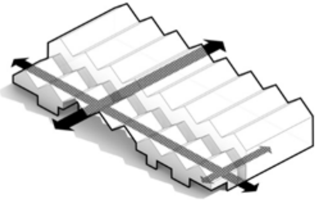
**Dissolving to Human Scale**
Programmatic requirements of the Byfabrikken include a need for human scaled spaces to occupy a section of the floorplan. Dissolving 12m of depth from the volume allows the form to better relate to its occupants and site, both internally and externally.



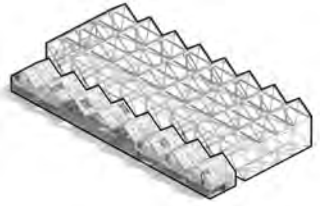
**Buffer the In-between**
Dividing the factory and office spaces, a glass buffer zone slices the lower volume, providing the Byfabrikken a central axis and opportunity to segment the building with a ribbon of glass, an articulated material severance between each program volume.



**Person Scale Erosion**
Tying Byfabrikken to its activated edge, a series of cut voids meet ground level circulation zones with transparency. Larger voided volumes additionally permit direct connection to building internals, locking Byfabrikken into its site.

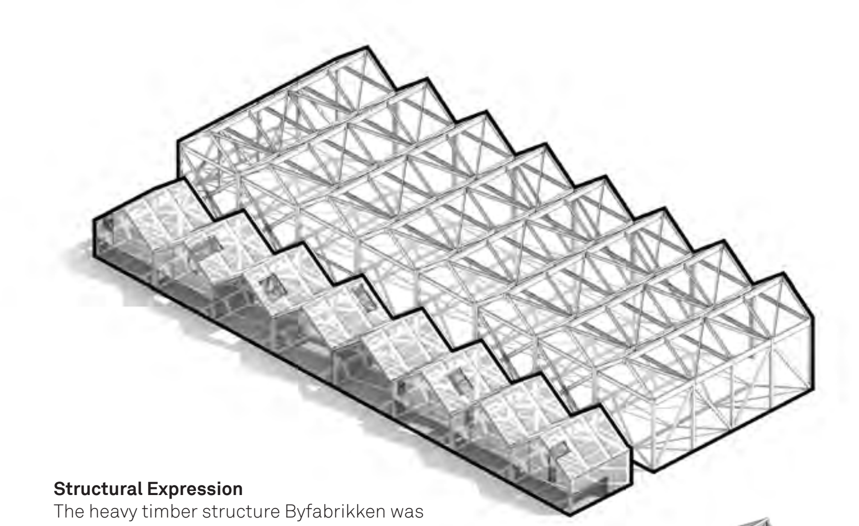


**Circulation Hierarchy**
Primary circulation zones key into a need for the Byfabrikken to facilitate the flow of both persons and material components. Following its glass ribbon, Byfabrikken's primary circulation corridor is bisected by secondary passageways scaled to its occupants and construction components.

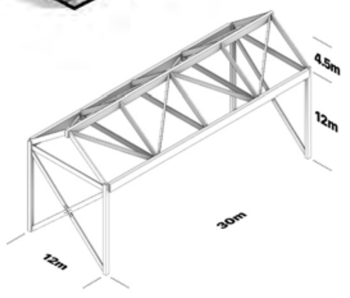


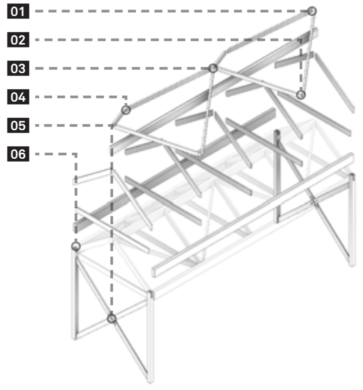
**Structural Systems**
Both the large span factory and smaller office spaces are similarly heavy timber framed. Providing lateral stability to the factory, timber members span diagonally across each face. Adapting this frame, the office volume utilizes SIP panels to provide lateral stability.

**Material Quality**
Seen from Byfabrikken's point of entry, materiality is utilized in the reinforcement of programmatic nature. Cladding the offices, an upcycled wood plank is dyed to articulate its relationship with the cerulean Tunnelfabrikken. A recycled polycarbonate clads the factory volume, proclaiming its nature as an industrial "other" in relation to the developing context.

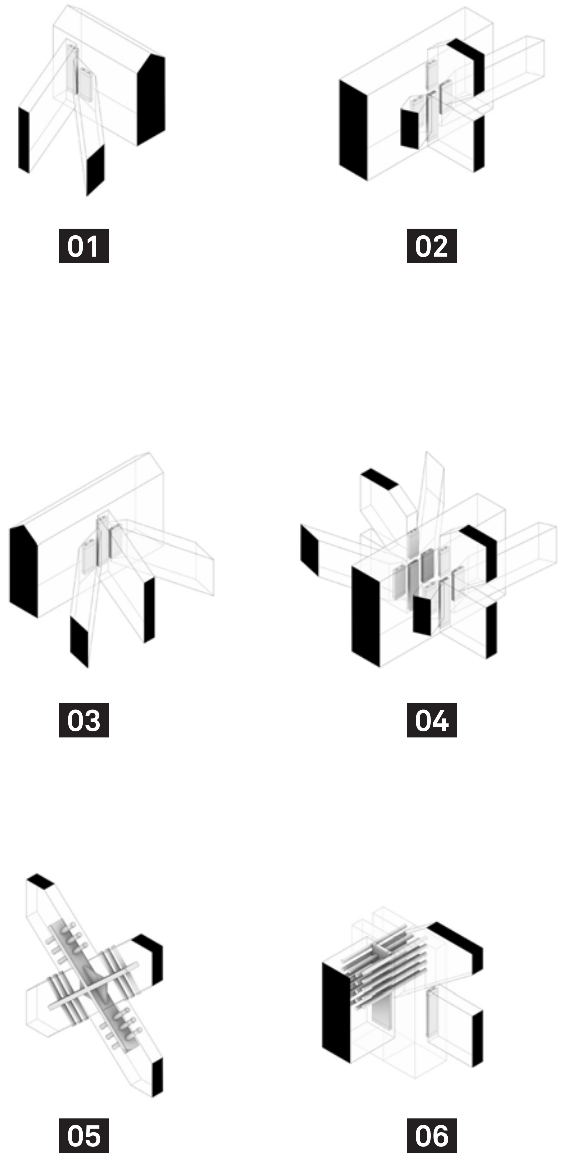


**Structural Expression**
The heavy timber structure Byfabrikken was subjected to a number of material efficiency studies to reduce the building's net timber usage per cubic foot. This final scheme utilizes the long span gable depth similarly to a tower crane arm, triangulating its load across three primary girders. Coupled with the building's embedded slot joint system, interior spaces are characterized by the wood finish, in which structure plays a dual role by defining interior expression.



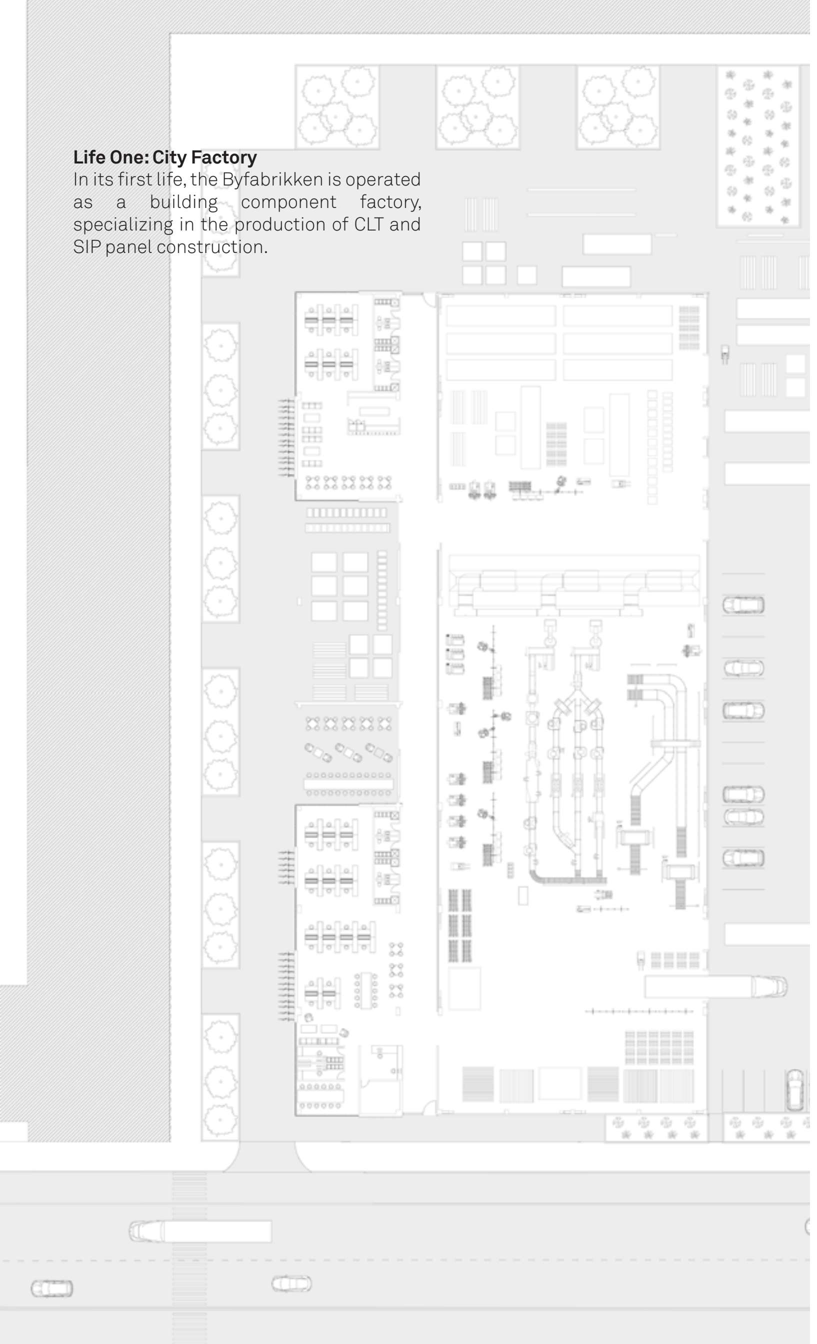



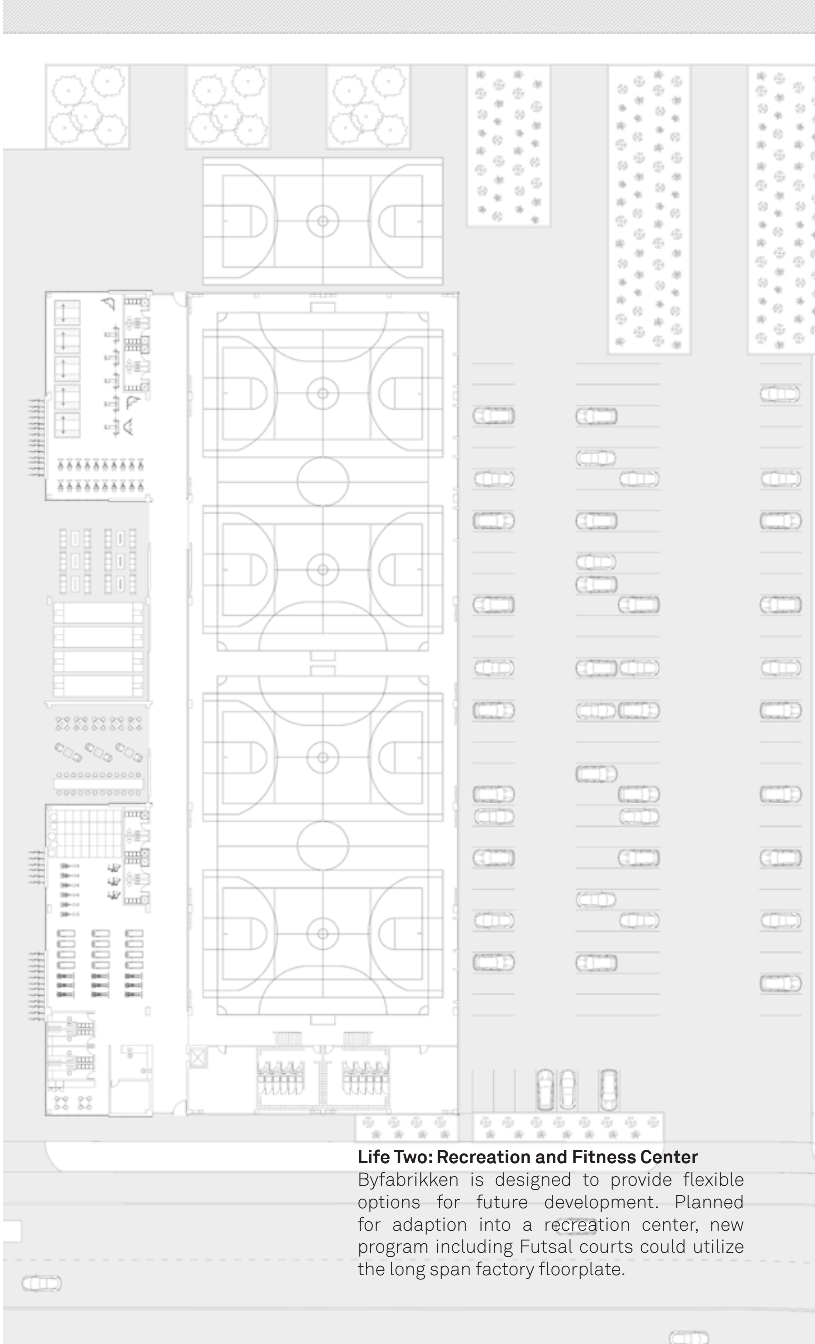

**Standard Bay Isolation**
In satisfying a desire to maximize simplicity and repetition throughout the Byfabrikken construction, structural building components were designed in a series of isolations. This allowed for careful consideration of construction/deconstruction ease and order, through which primary structural glulam members are joined by a slotted Knapp Connectors joint system. Variants of the Megant product line can be seen in isolation of building joints, determined through an assessment of design-for-disassembly component options.



**Multi Use Exterior Zones**
Along the Byfabrikken's office volume, void spaces serve multiple purposes designed for future adaption. During the city factory lifespan, these spaces facilitate program including exterior gathering and casual meeting, in addition to large building component storage, both open to the Byfabrikken's canal corridor.

**Life One: City Factory**
In its first life, the Byfabrikken is operated as a building component factory, specializing in the production of CLT and SIP panel construction.





**Life Two: Recreation and Fitness Center**
Byfabrikken is designed to provide flexible options for future development. Planned for adaption into a recreation center, new program including Futsal courts could utilize the long span factory floorplate.

**Factory Adaption**
Requiring a clear height of no less than 9m, the factory volume is well equipped to house large machinery in addition to future program requiring its long span. Within this flexible volume, additional construction may also be possible, such as the mezzanine and locker rooms as seen below.

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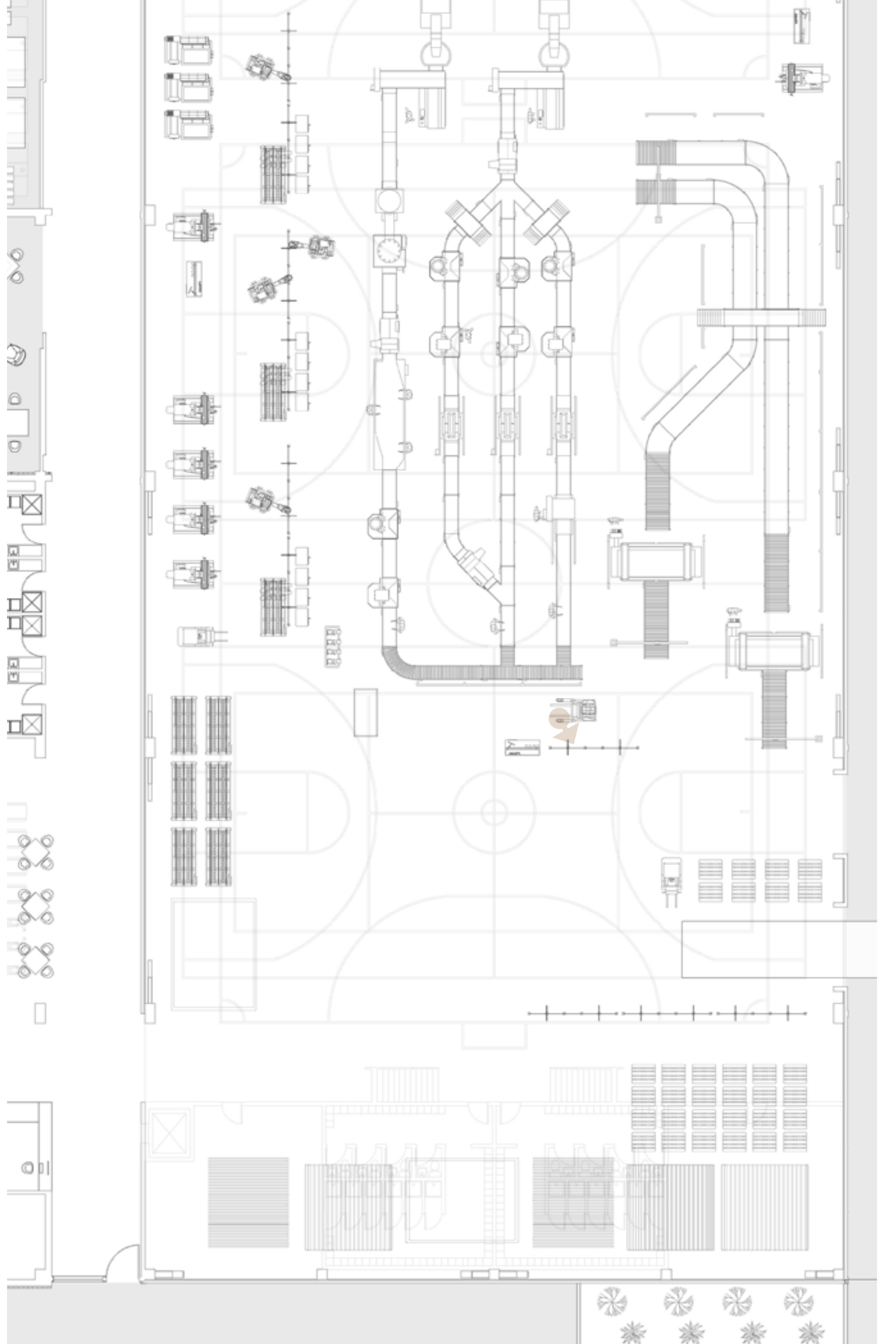
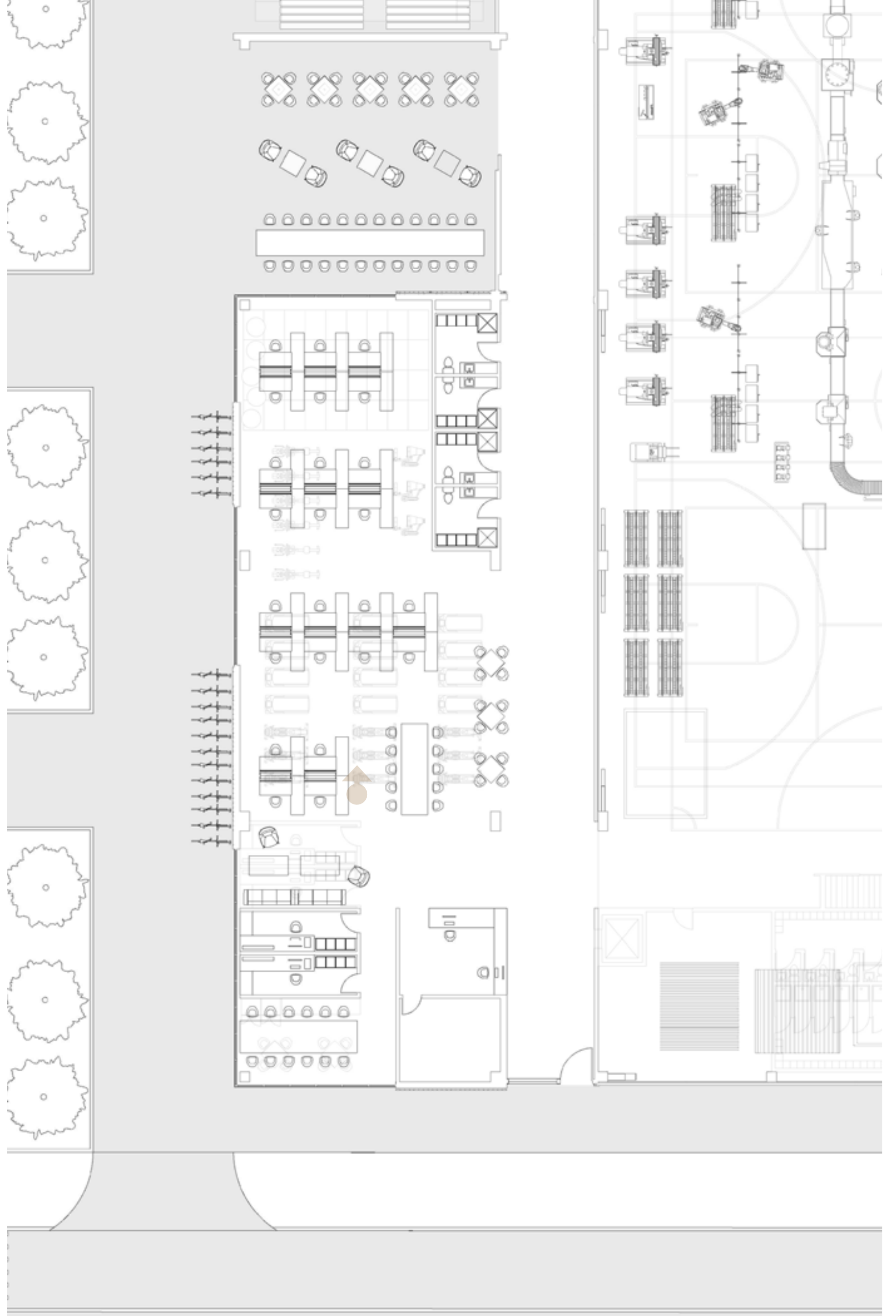


**Office Adaptation**
Open plan office spaces, serving the city factory lifespan, can be easily adapted for future use as a recreation and fitness center. Clerestory windows, skylights, and ground level glazing allows these spaces to be naturally daylit during key hours of operation.

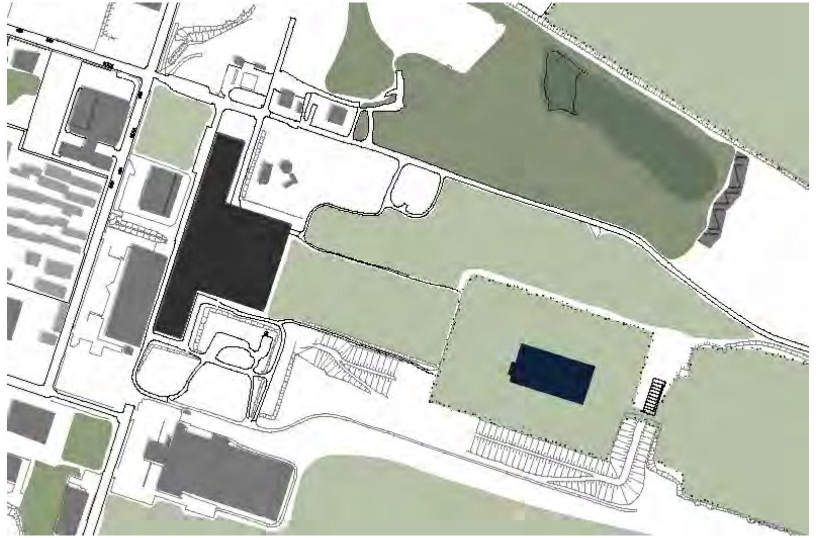


# QUTAIBA BUYABES | ZINING CHENG
## SKAL FABRIK

Skal Fabrik's (Shell Factory) driving concept is to keep Nordhavn alive and growing, so that no matter what, the main function of the building is its necessity to serve Nordhavn. Skal Fabrik is placed in parallel to the original Tunnel Factory's location, creating a relationship between old and new. Through the parallel relationship, there are new discoveries of ways to respond to the people, the water, and the context. The water becomes the connector and there are new strategies that arise for circulation, accessibility, and landscape.

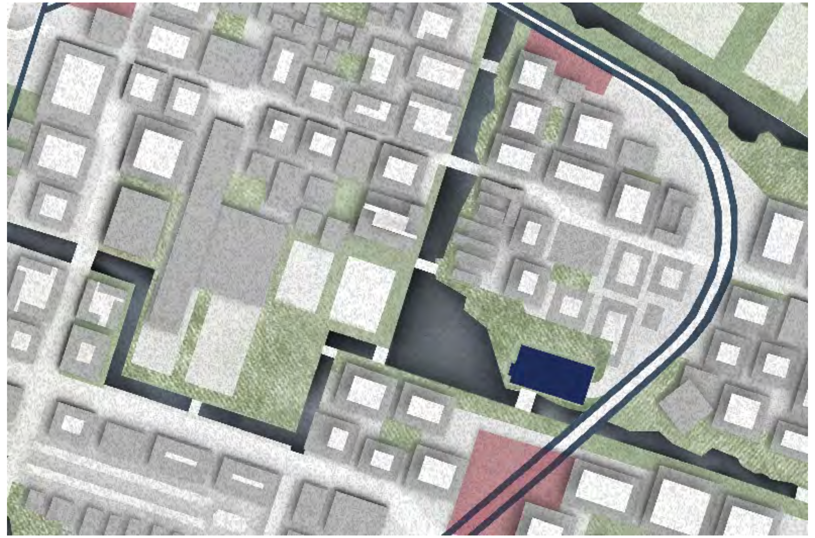
The site's placement is in close proximity to the metro station stop so factory workers are led to the main entrance of the city factory. There are walking paths connected between both the old Tunnel Factory and the new City Factory. From the City Factory, there is a strong visual connection to the Tunnel Factory. And the continuous bike path established in COBE's masterplan aligns with the back of our building. New opportunities for these modes of circulation come into play from this parallel relationship. The repetition seen in the form of building's design serves to bring in as much daylight in as possible, extending the sunlight into the universal space during working hours.

These strategies served a helping hand in having us focus architecturally on designing a large universal space that can be defined and redefined into something else in its other lives. Everything that is programmed (employee and administration facilities) is fit right into the support functions box at the front of the building and the production hall itself becomes that universal and flexible space that can be redefined into a potential performance center, recreation center, or pavilion / food production hall in its subsequent lives. In that sense, the architecture defines the program instead of letting the program define the architecture. Skal Fabrik is a flexible shell right next to the water, identifying itself as the new city factory in parallel to the old Tunnel Factory.



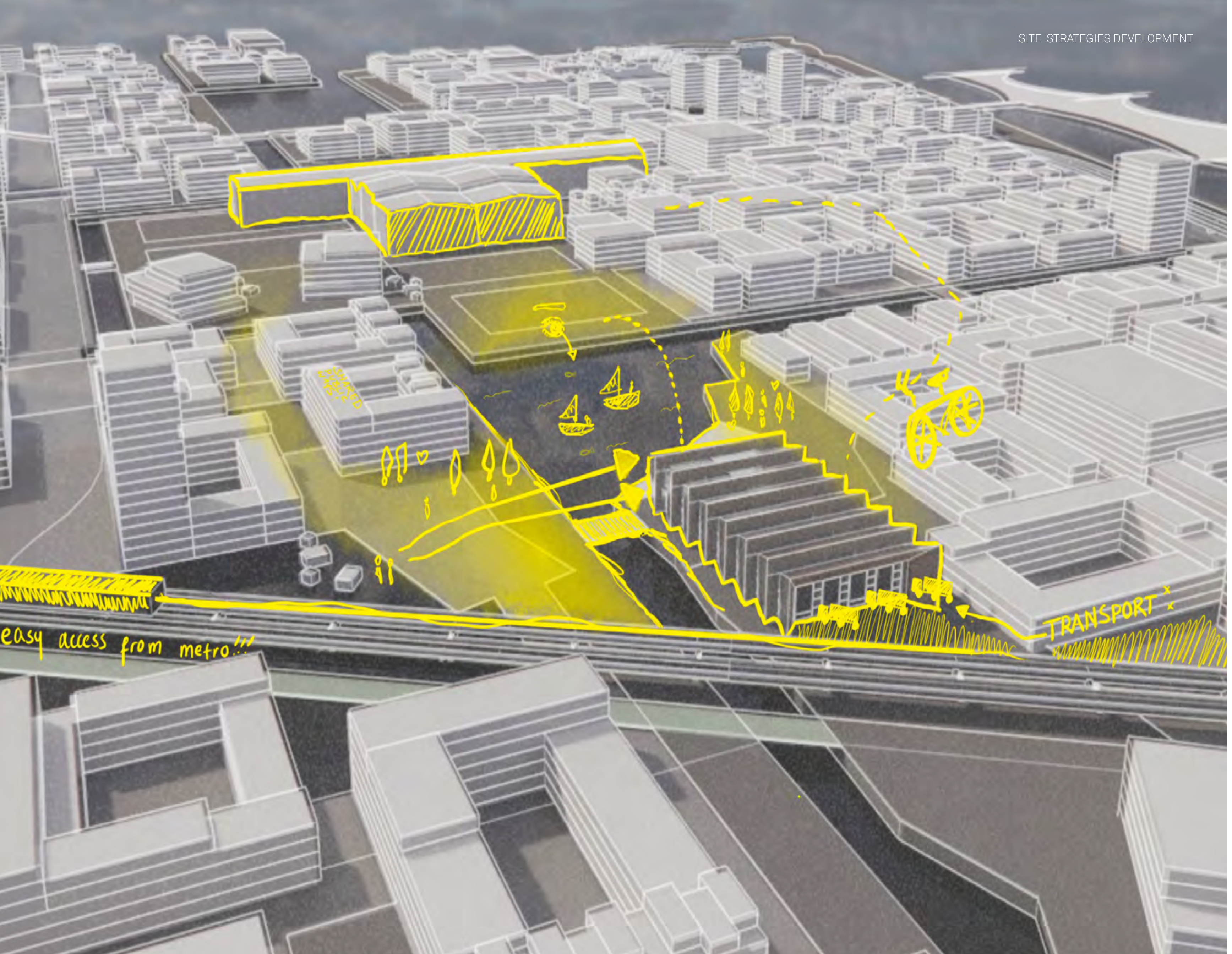
**(1)** NORDHAVN - CITY FACTORY / EXISTING CONDITIONS

**(3)** SITE PERSPECTIVE - (L): TUNNEL FACTORY / (R): CITY FACTORY

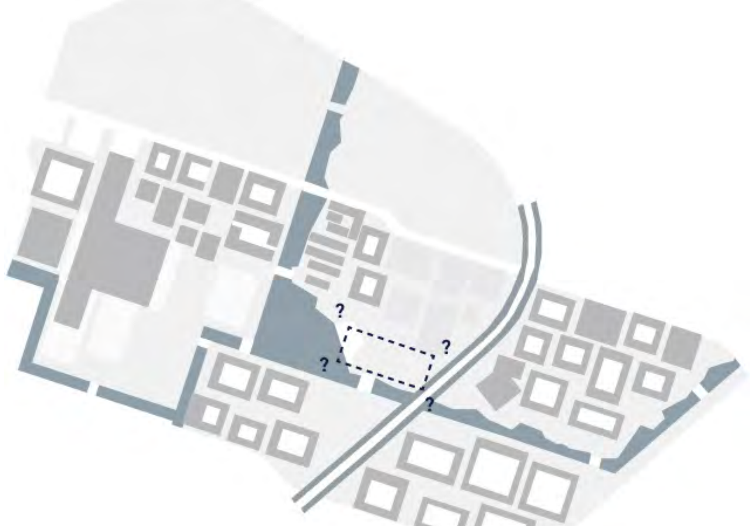


**(2)** NORDHAVN - CITY FACTORY / LIFE 1

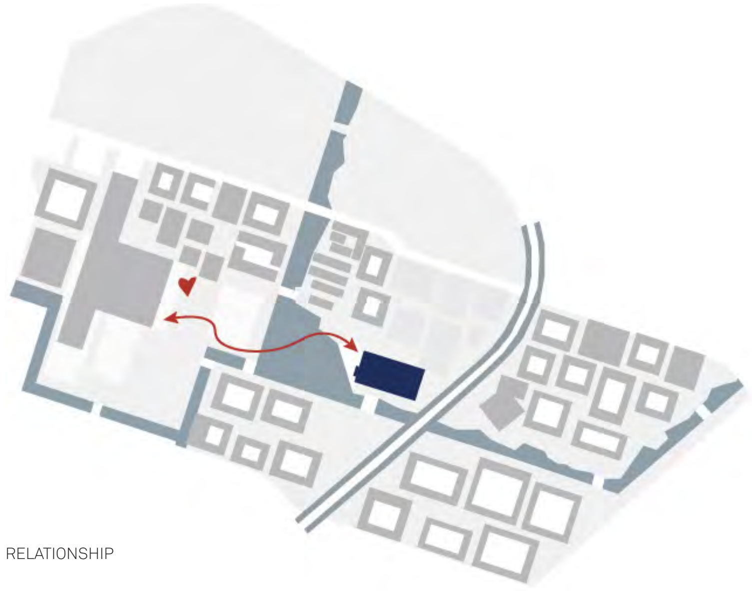
(3)





SITE

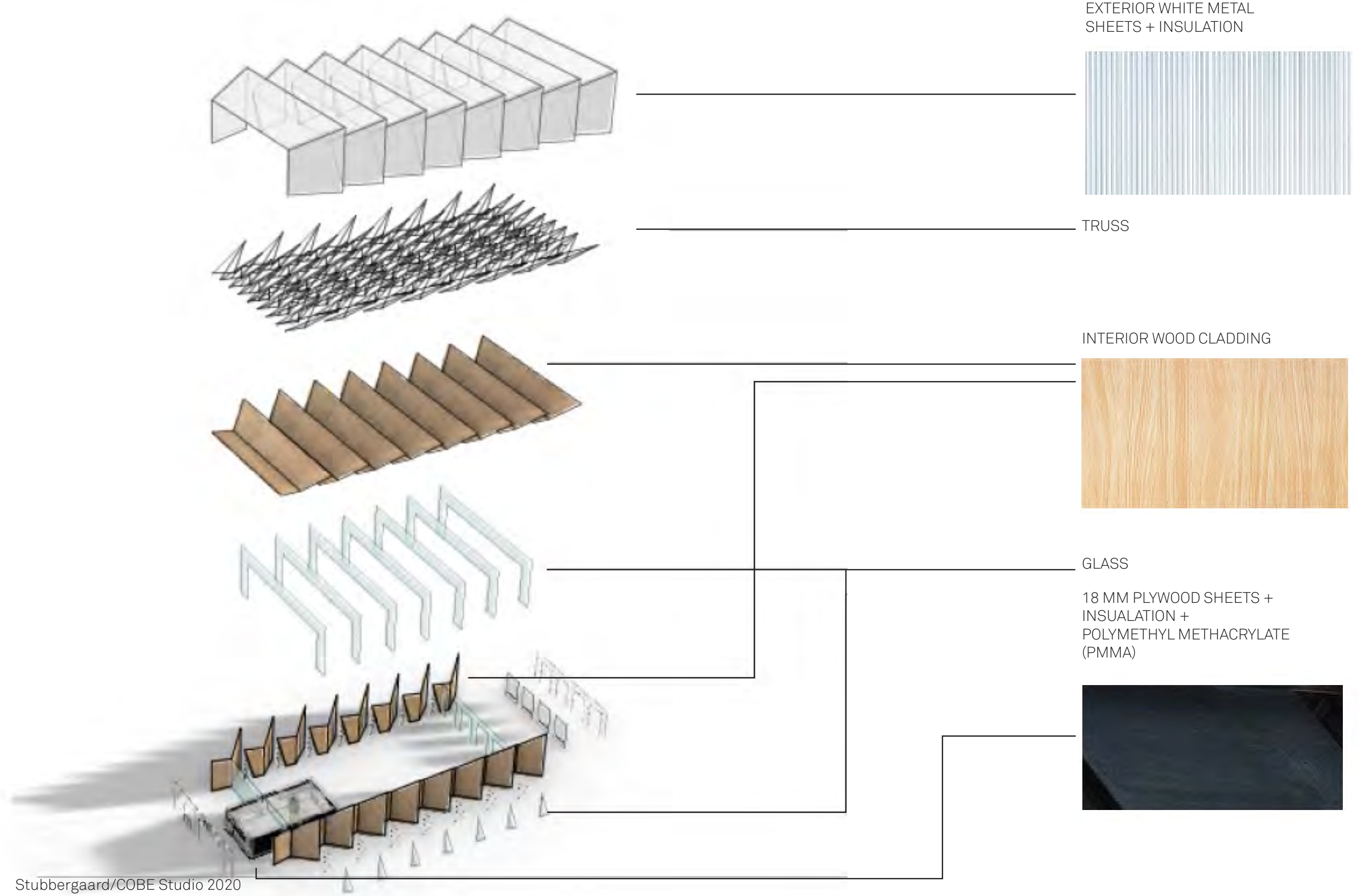


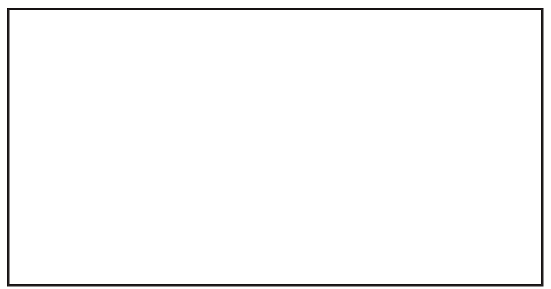
RELATIONSHIP

CIRCULATION

LANDSCAPE

Qutaiba Buyabes | Zining Cheng

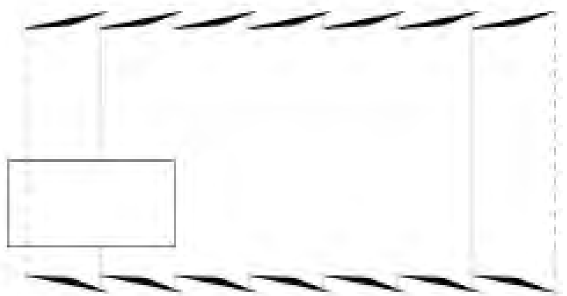



**FILL**

The architecture is meant to define the program. In its subsequent lives, we want the original locations of the program in its first life to serve the purpose of the building in its redefined lives. As we are designing a universal space that can be reused for the other lives, we started a rectangular shape to fill in with possible program locations.

**POSITIVE / NEGATIVE**

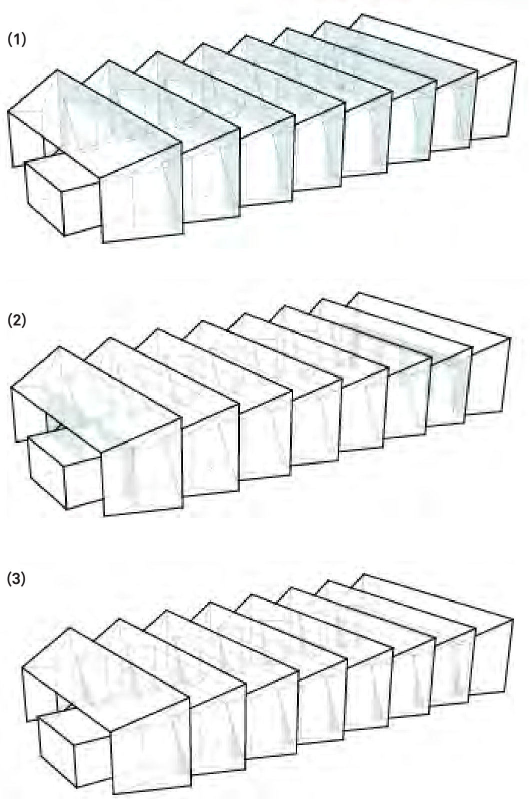
The next step was to finalize the locations of the support functions box and the production hall, the two primary elements of our program that will be repurposed in the next lives. The support functions will house the employee facilities and administration offices, putting it front and center facing the water. The production hall becomes one large space connected to the support functions box. The negative space (white) forms the access points of the building.



**FORM**

Bringing program, access, and positive and negative together allowed us to next determine the form of the building. This is where we focused on the other aspects of the building and these aspects that determined our form are laid out in the concept diagrams on the previous page.

**ENCLOSURES**



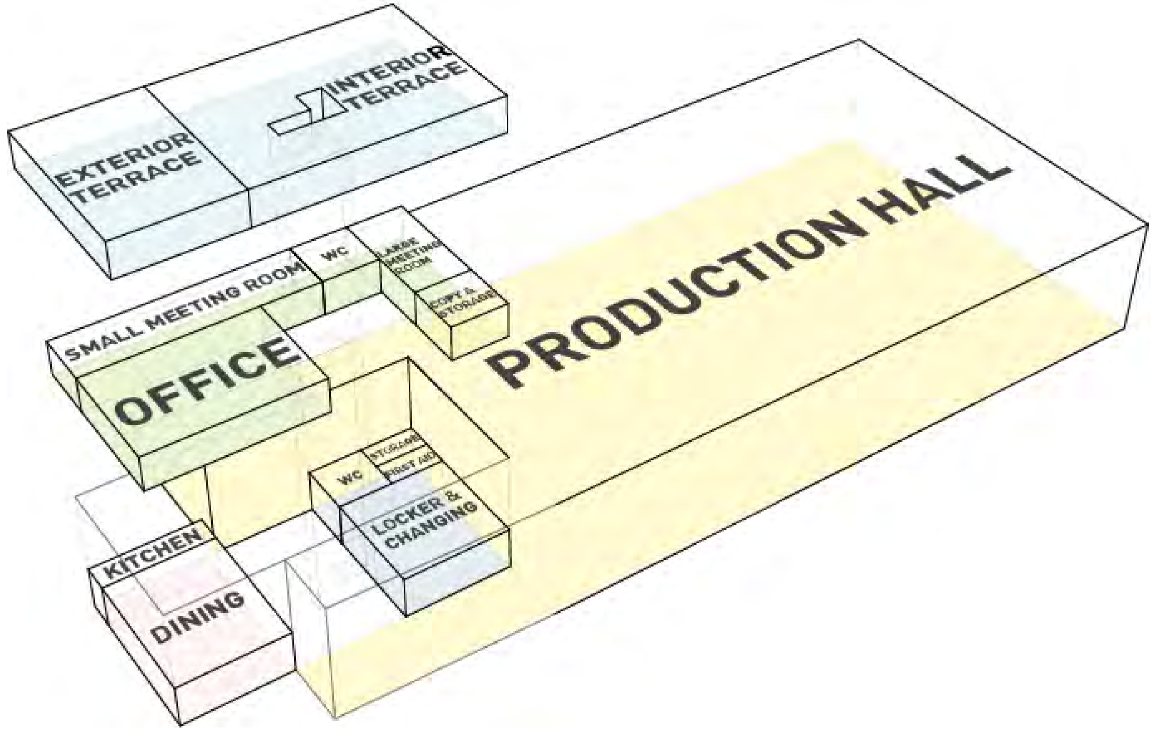

(1) Glass enclosure allowing daylight to come in through skylights. The skylights element is repeated throughout the shells, radiating light into the city factory during working hours.

(2) Thin glass membranes on the front and back of the City Factory. The glass membrane at the front is used as the main access point into the building, directly bringing in factory workers into the production hall. The rear entrance is used primarily for materials and transportation with four garage doors that open up in the back.

(3) The semitriangular glass membranes are used as transparent elements that serve to support the secondary structural system of the building.

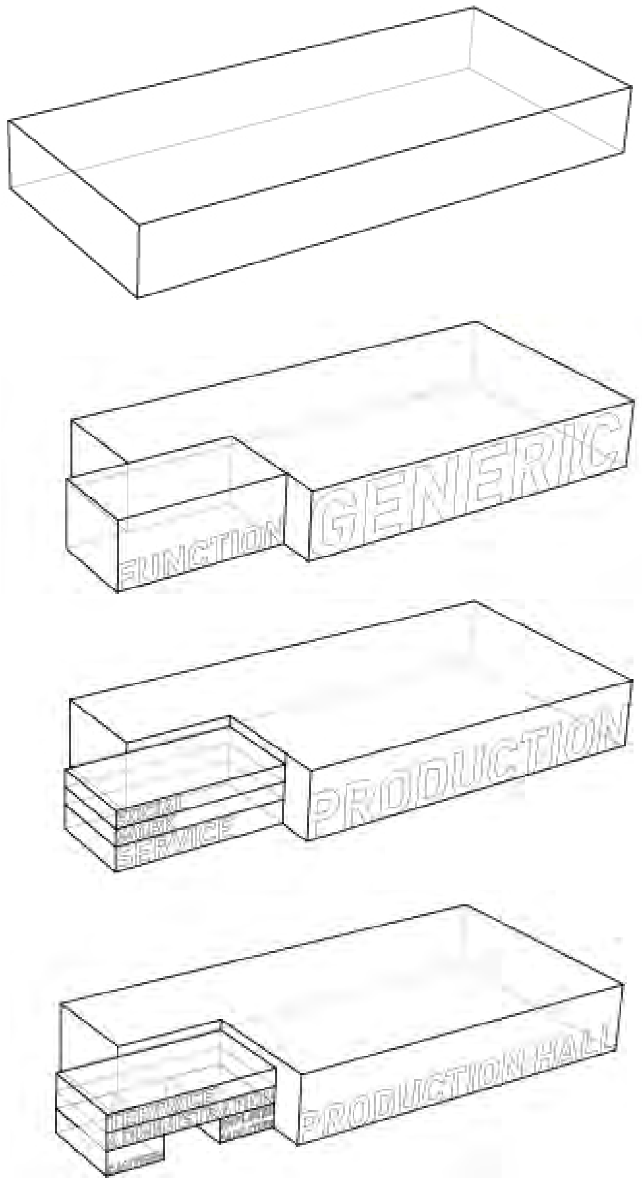
**PROGRAM AXONOMETRIC**

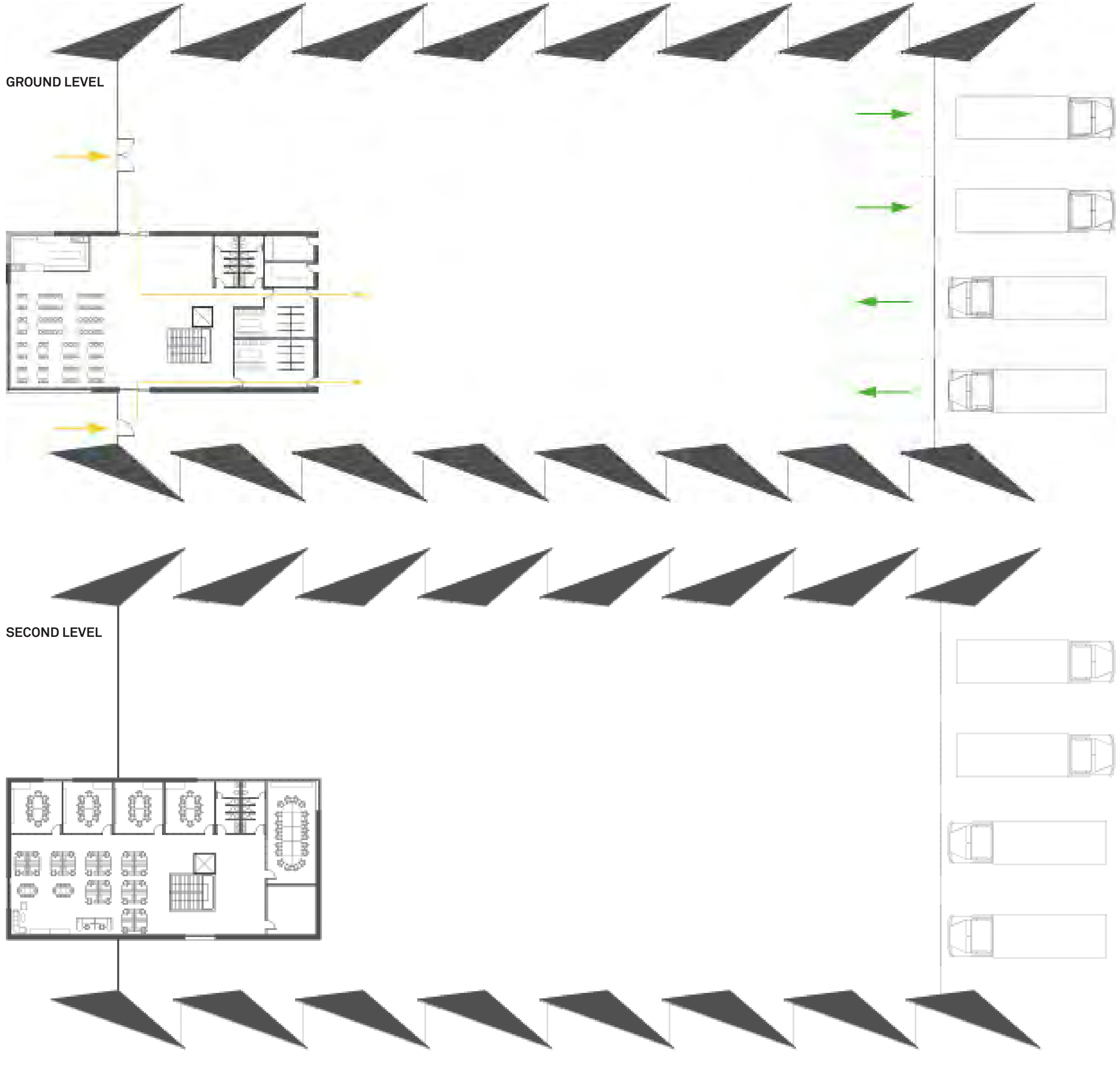
The program axon below illustrates the two focus elements of the City Factory, the production hall and the support functions box. The support functions box houses the employees facilities and adminstration, with an indoor / outdoor terrace that oversees the hall from inside and the water and the old Tunnel Factory from outside.




**PROGRAM FORMATION**

The program formation shows how the two main functional elements of the program were designed so that they can be universally and flexibly adapted into a performance center or a sports center in the second life, and an open pavilion / food production hall in its third and final life. The main functions of the support box will remain as being dedicated to the service of the building in the next lives, and the production of the building will remain as the production space for the next lives, so the building does not lose its essence.

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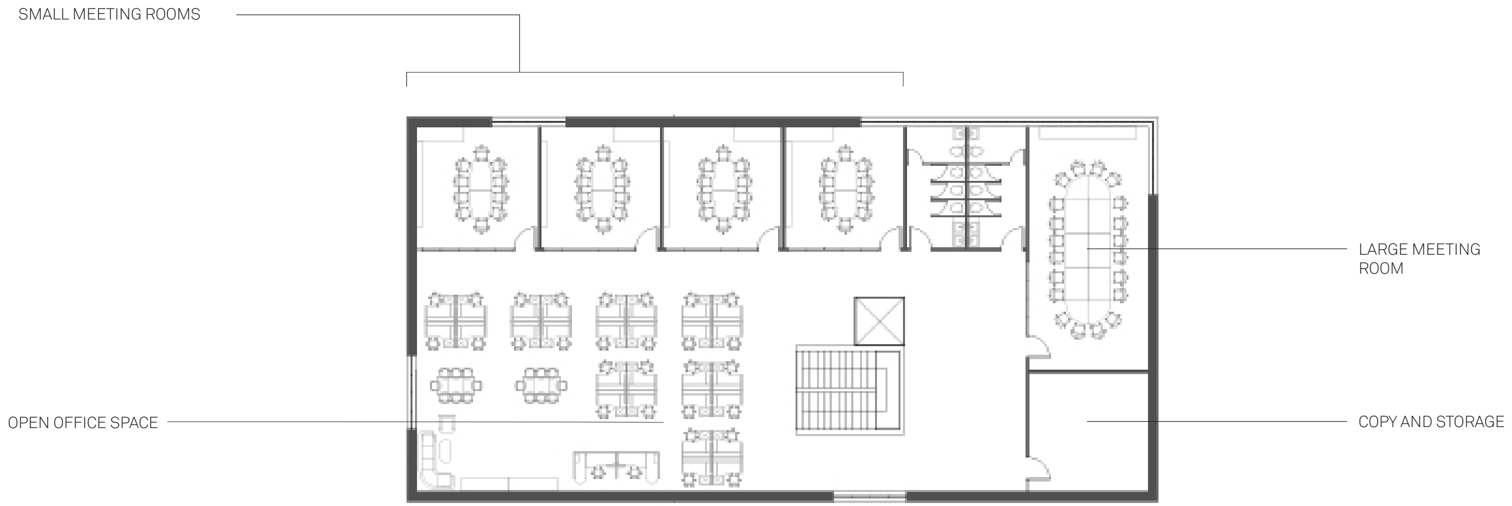


**SECOND LEVEL**


**GROUND LEVEL**

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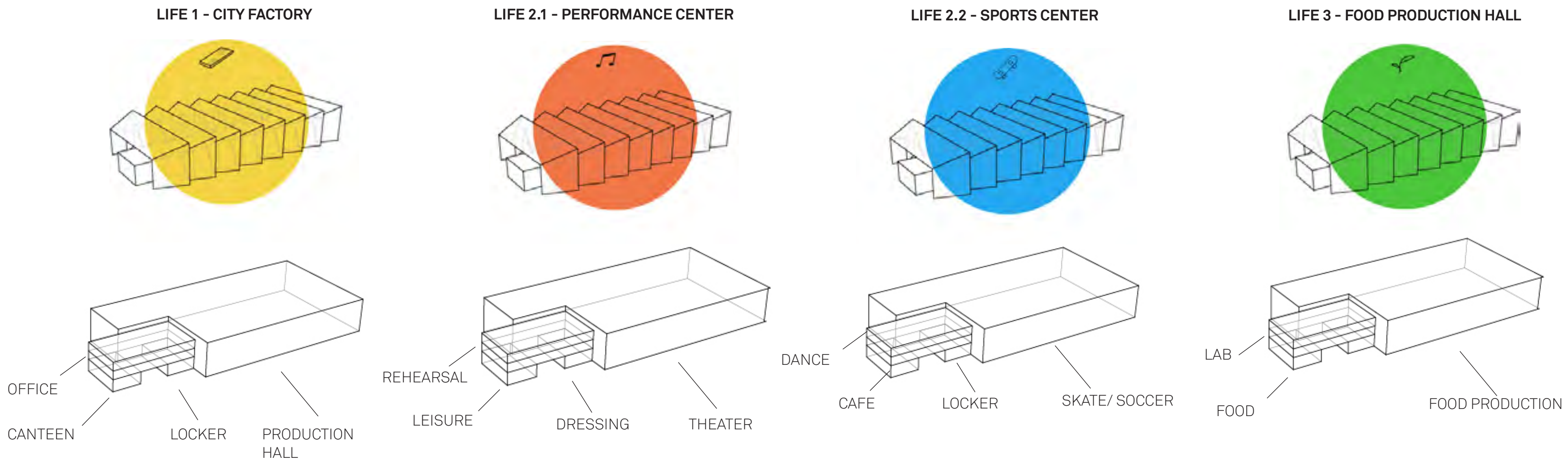
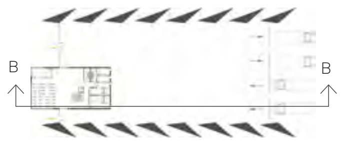
**LIFELINES**

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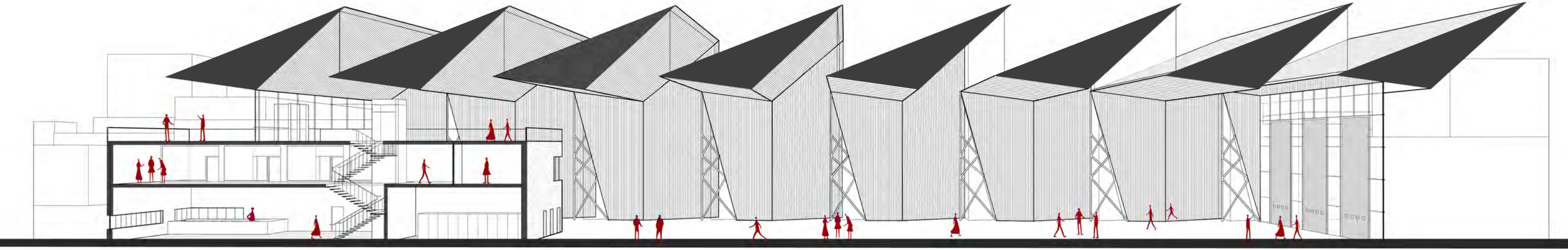


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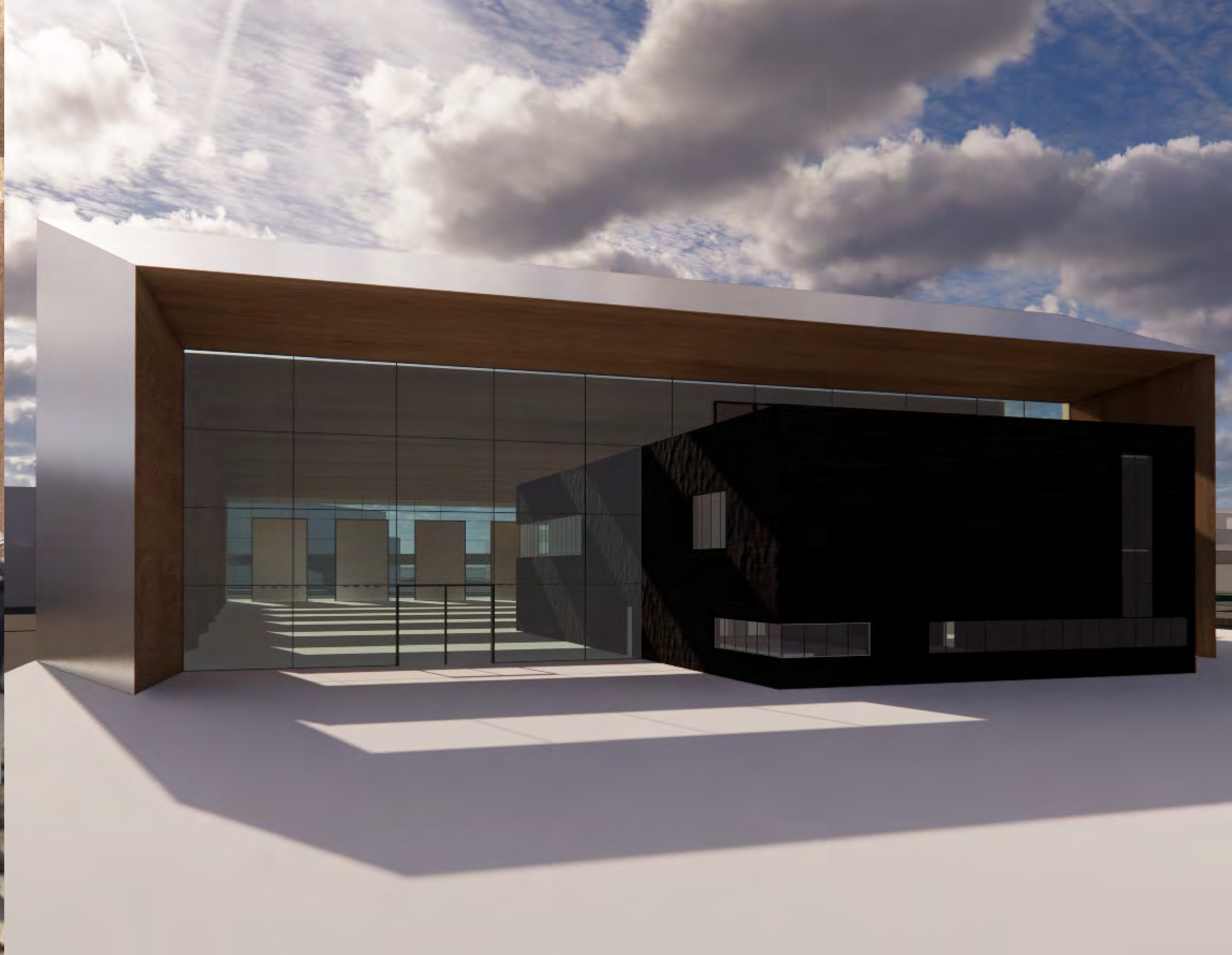


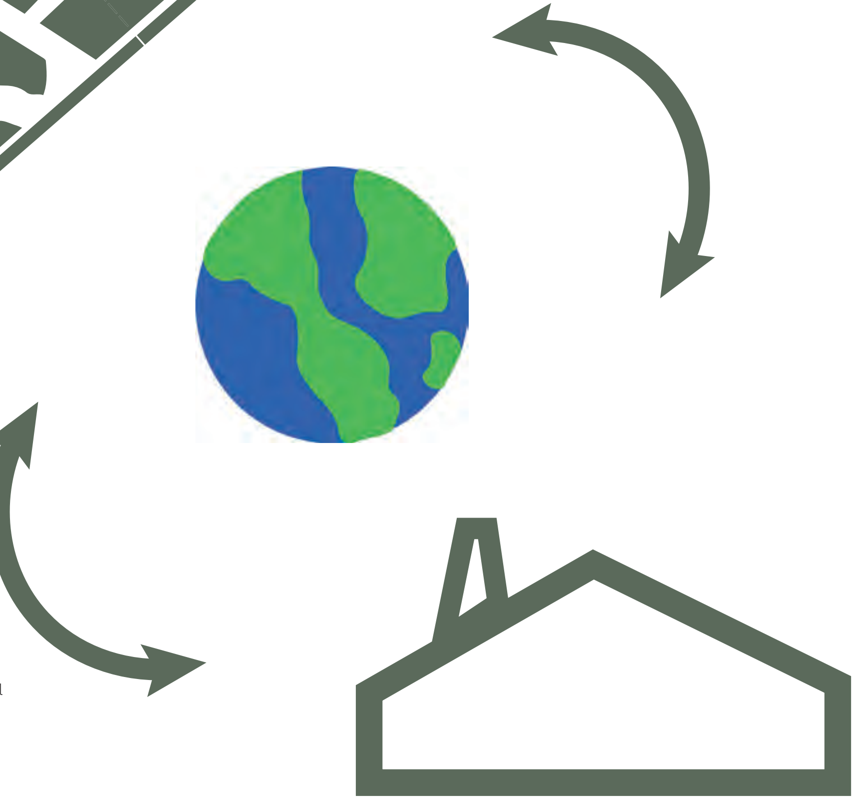
EMILY CRICHLOW | CLAIRE SULLIVAN

**HAVNEFABRIK**

The idea of this city factory is to locate the facility on upcycled barges on the water. Havnefabrik, or “port factory” is inspired by the industrial port heritage of Nordhavn where movements of imports, exports, commercial activity, and cruise ships define the site. With the factory situated on a barge, it can be sited in many locations and responsive to the ongoing developments in Nordhavn. In 20-30 years when the city factory is no longer needed in Nordhavn, it can be moved to another city development in Copenhagen.

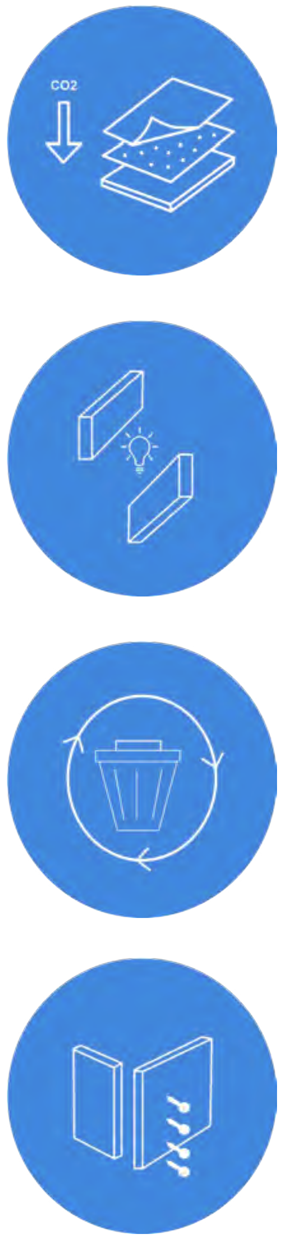
This factory’s strengths are its hyper-modularity and hyper-flexibility. The entire structure is made of modular units (20mx10m) rotated and repeated. Every element of construction can be prefabricated and all joinery is mechanically connected for ease of disassembly to form new roof structure options. Interior modules are built inside the factory for support space and are designed to be rearranged for the program that is needed at the time.

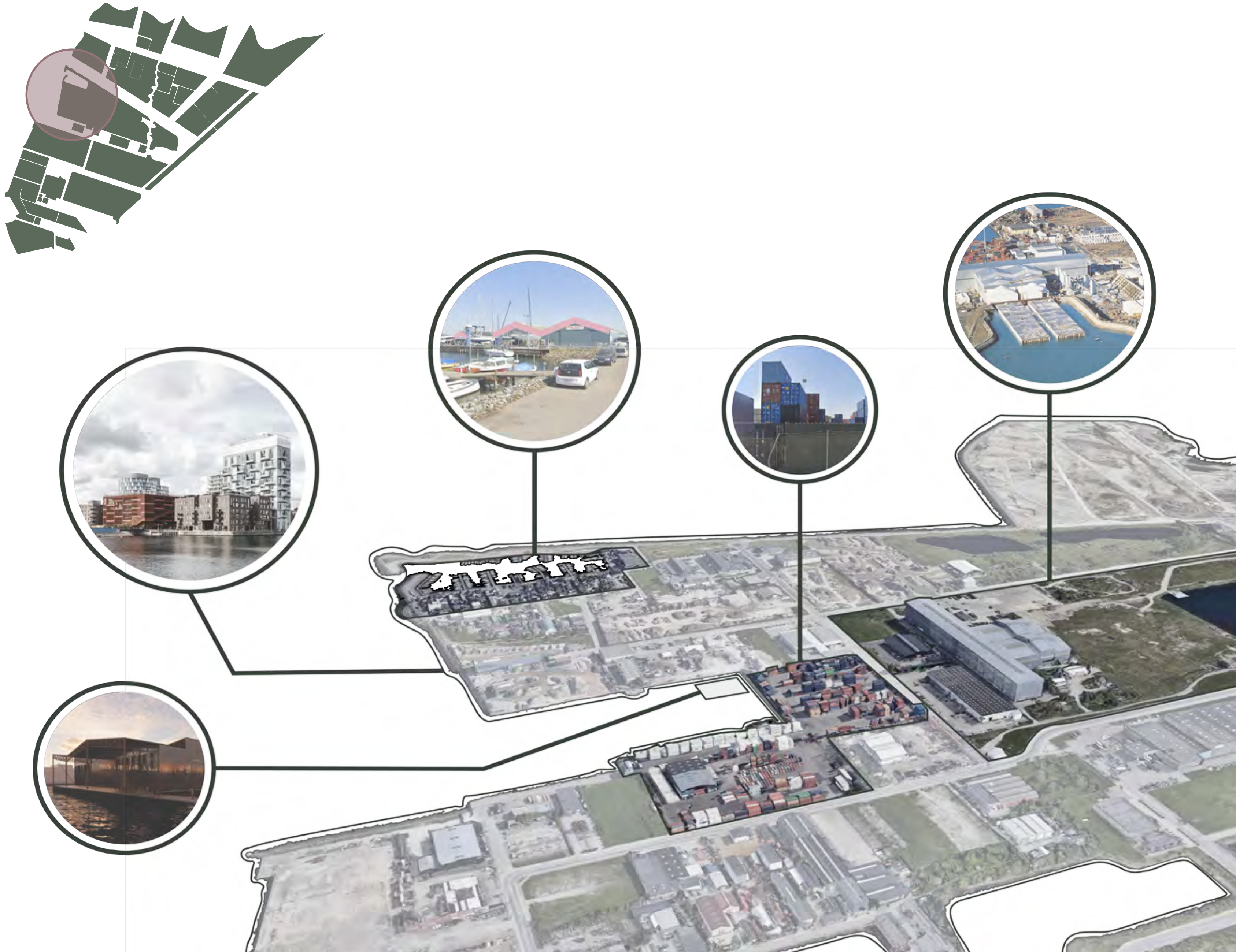
In designing for a carbon-neutral future, Havnefabrik considers everything from materials to life beyond a factory.



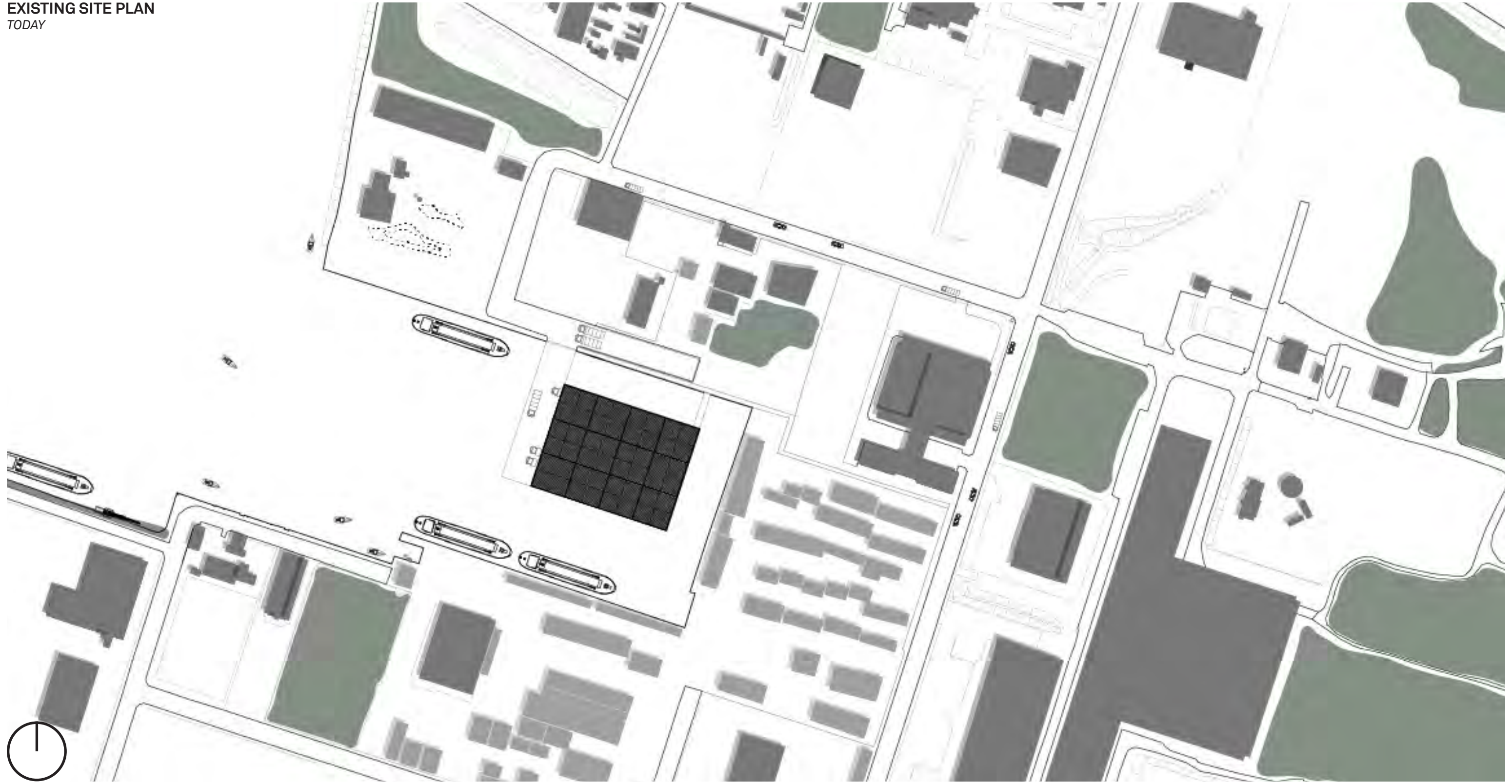
## ECOLOGICAL IMPERATIVE

The earth is experiencing detrimental damage due to climate change. And the building industry is greatly contributing to that damage with construction accounting for 40% of the world's energy and material consumption. The approach of this design seeks to re-envision the typical factory model to make it more sustainable and adaptable.



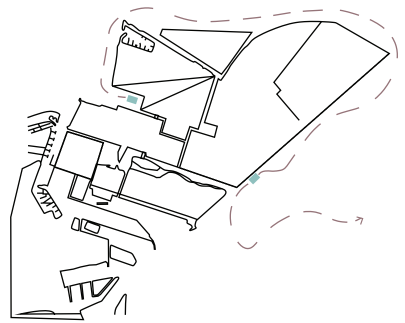
EXISTING SITE PLAN
*TODAY*



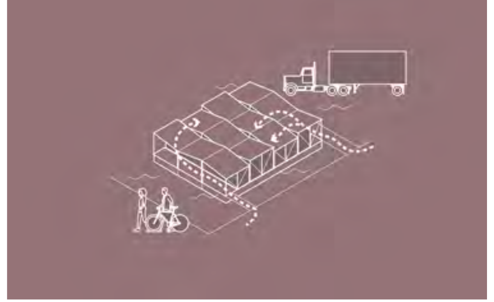
DEVELOPED SITE PLAN
*20-30 YEARS*

**DESIGN PARAMETERS**

In the beginning phases of design this project developed a set of guiding design parameters. First and foremost, the factory would be located on a barge to remain flexible throughout its lifetime. In addition, this factory would encourage circulation of workers and visitors on one end and vehicular and construction circulation on the other. With a large open floor plan the factory also needs to have daylighting opportunities from all sides no matter where the barge is located. Finally, it was important that the factory structure and bay spacing allow for even distribution of programming between support spaces and factory work space.

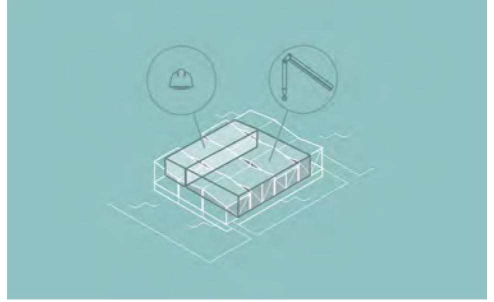


CIRCULATION

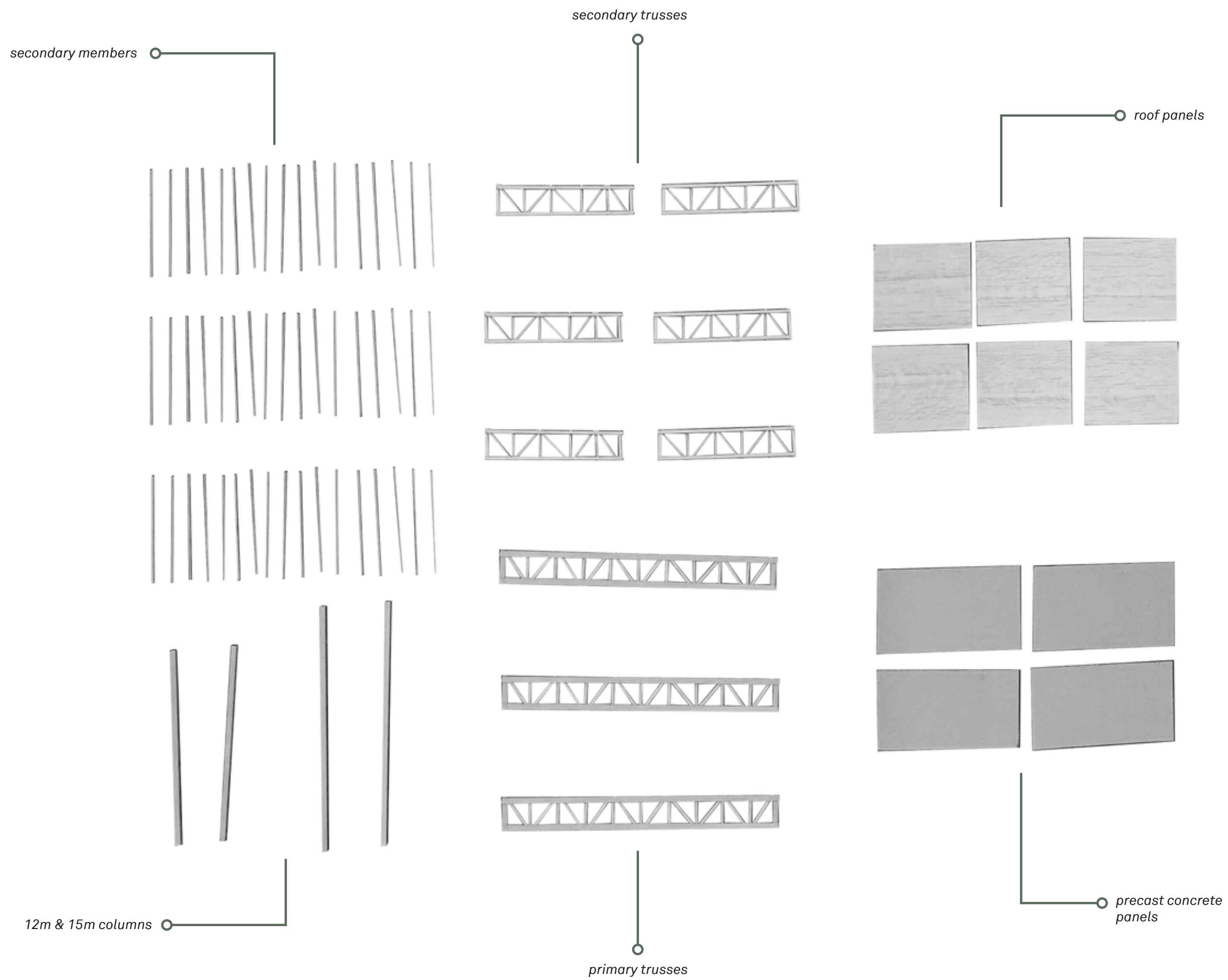


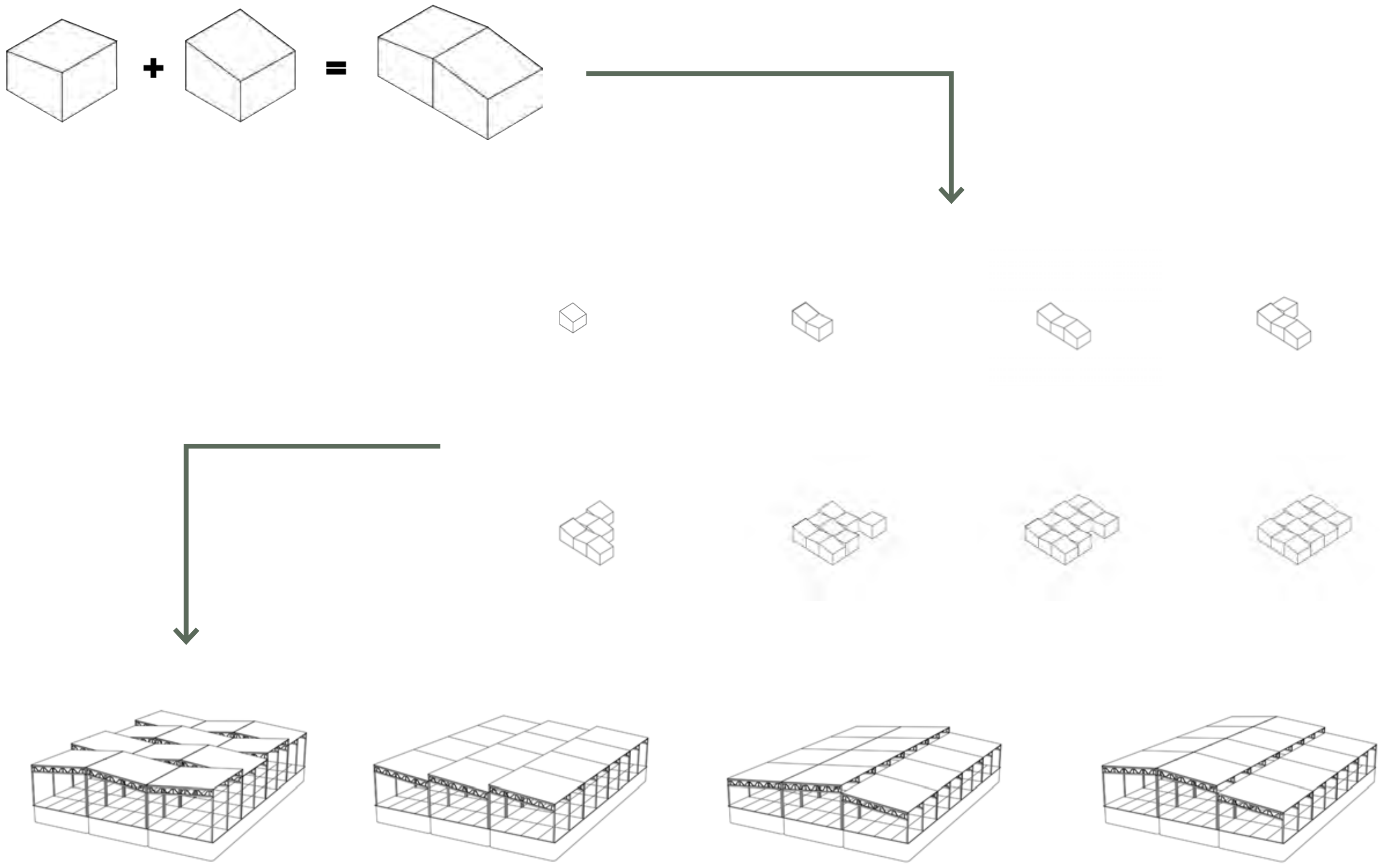
DAYLIGHTING

PROGRAMMING



## STRUCTURE OF MODULES



## STRUCTURAL OPTIONS

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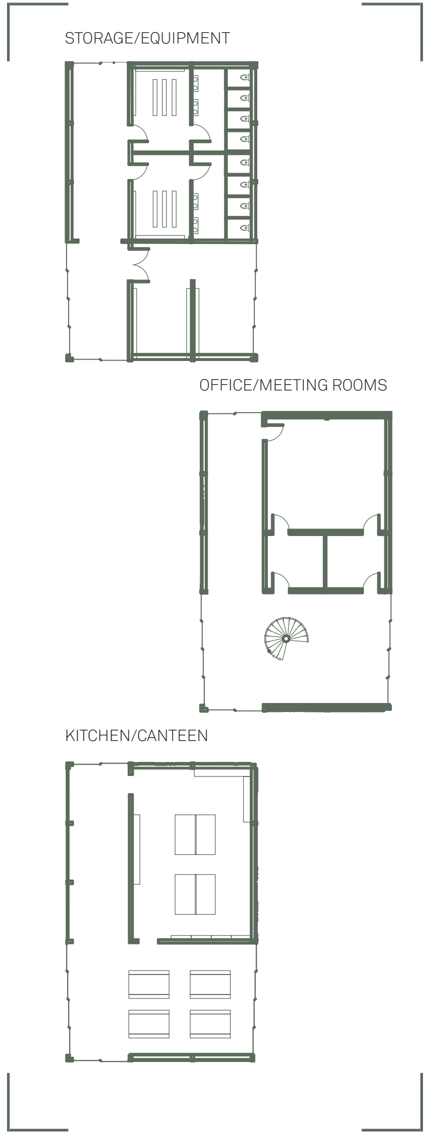
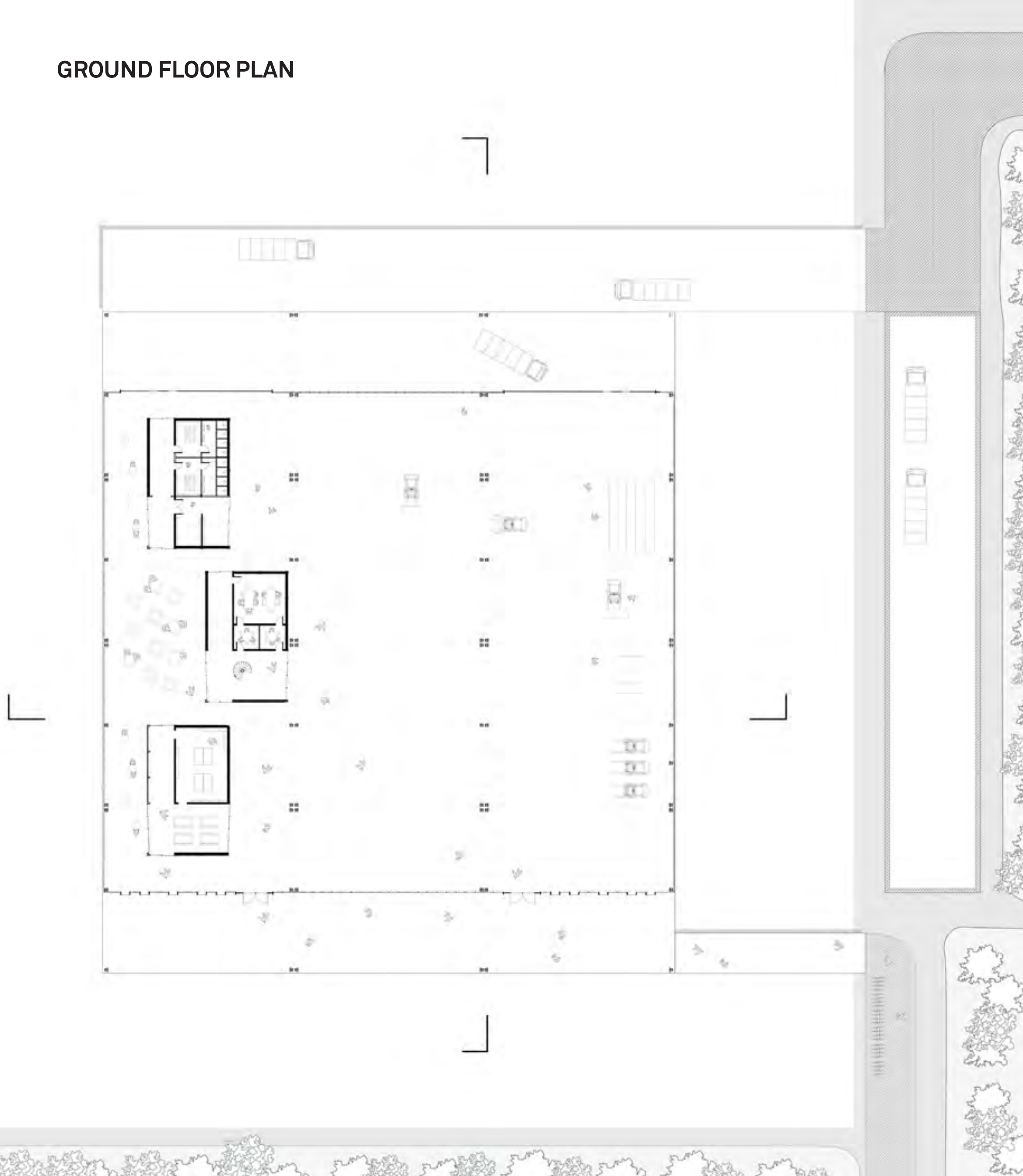
## INTERIOR MODULES

Each interior module unit is the same and meant to be repeated and translated depending on its intended uses.

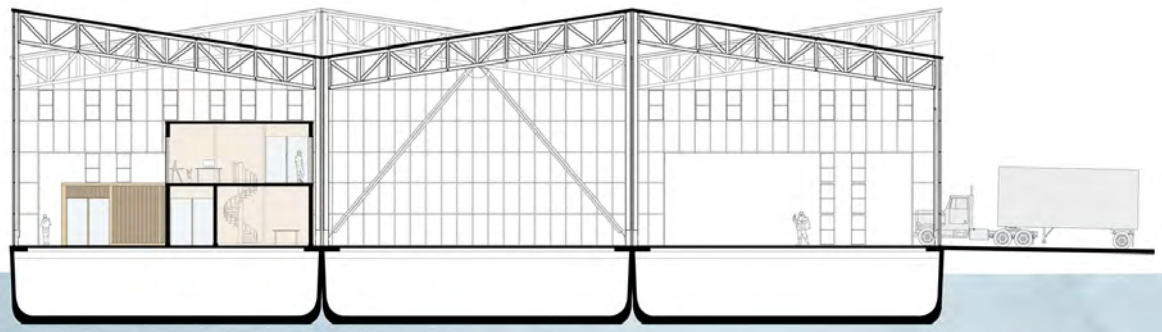
## INTERIOR PLANS



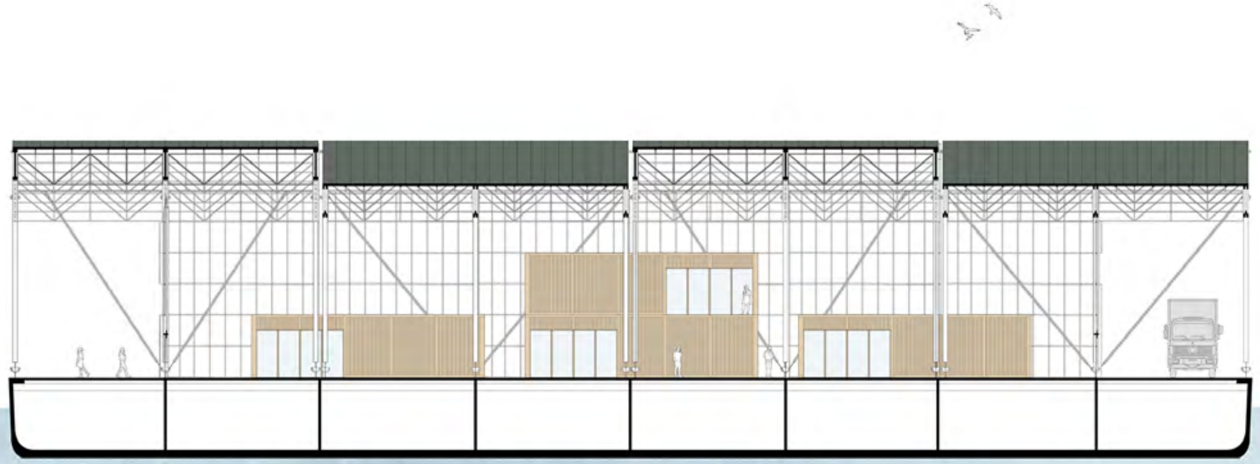

## GROUND FLOOR PLAN



Emily Crichlow | Claire Sullivan



TRANSVERSE SECTION

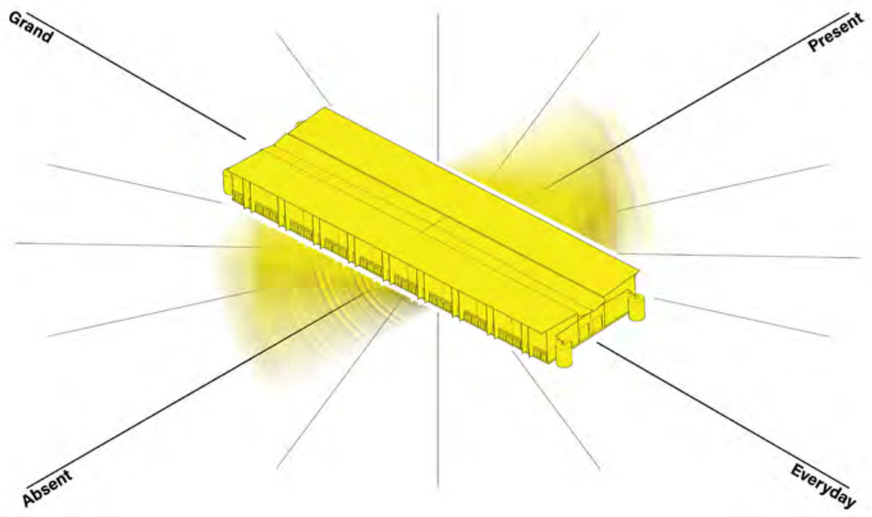


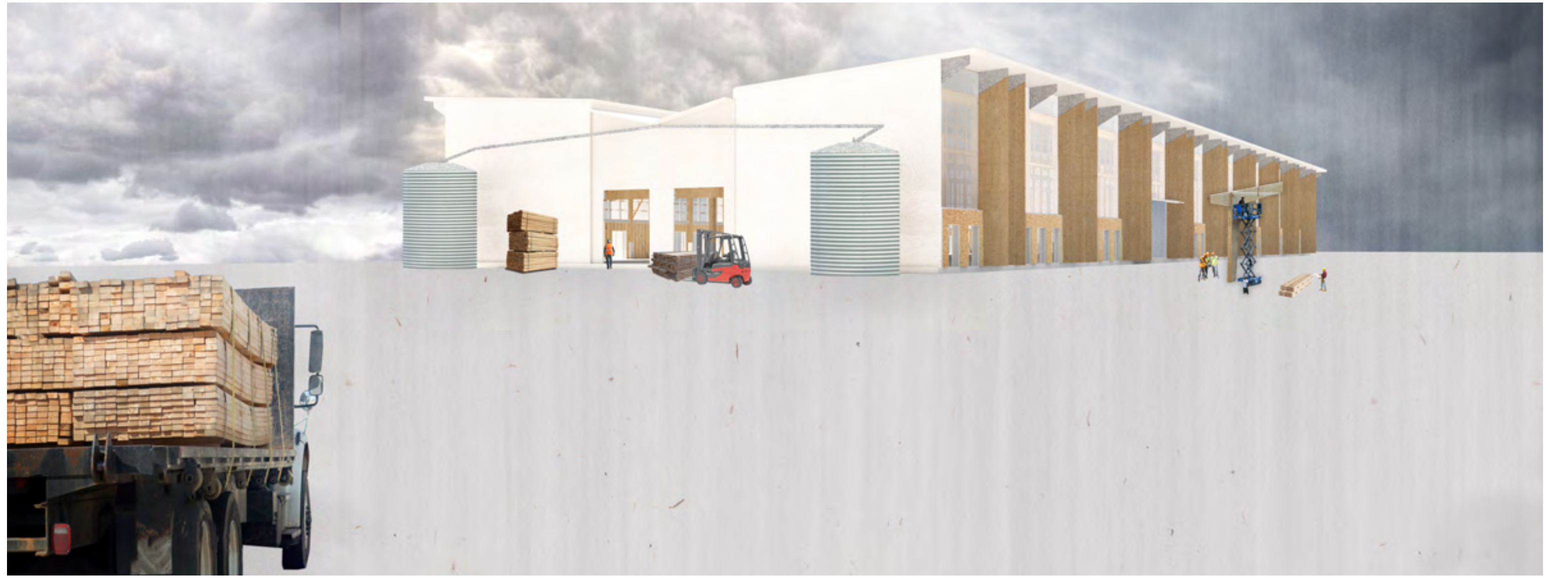
LONGITUDINAL SECTION

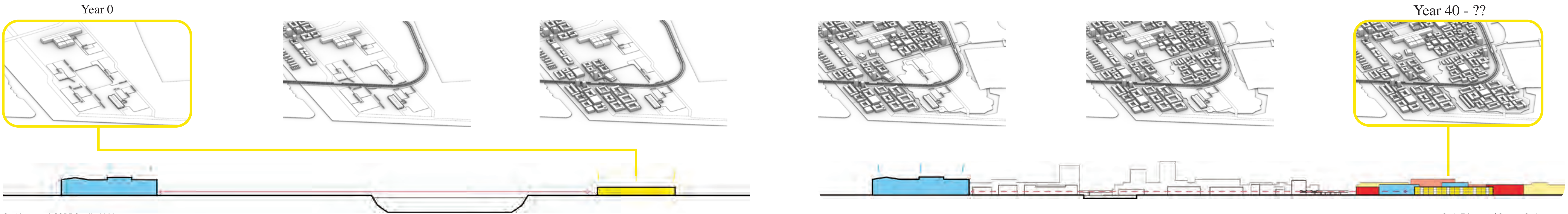

NATIONAL CRANE

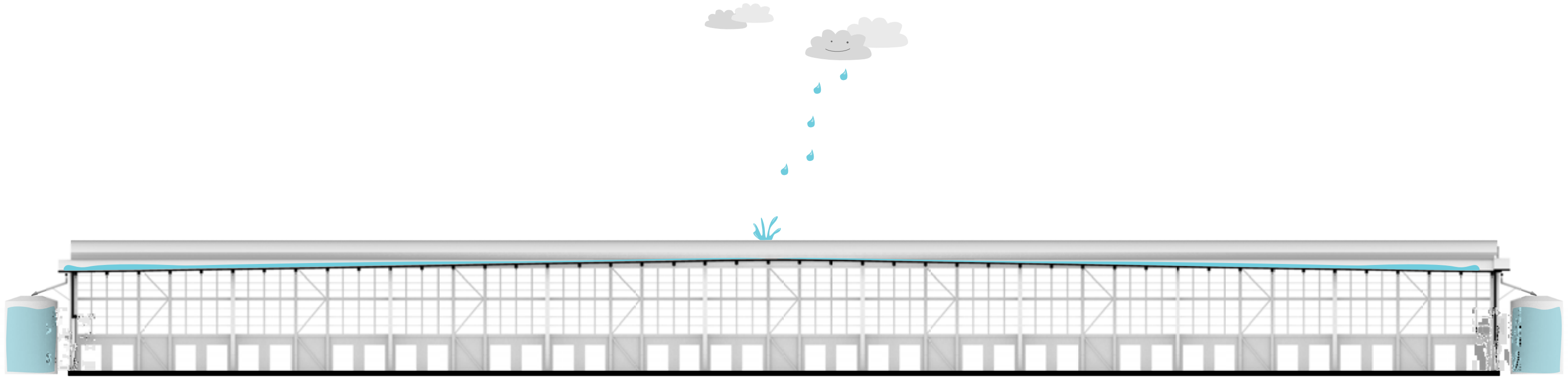
CODY EDMONDS |
CONNOR STEIN

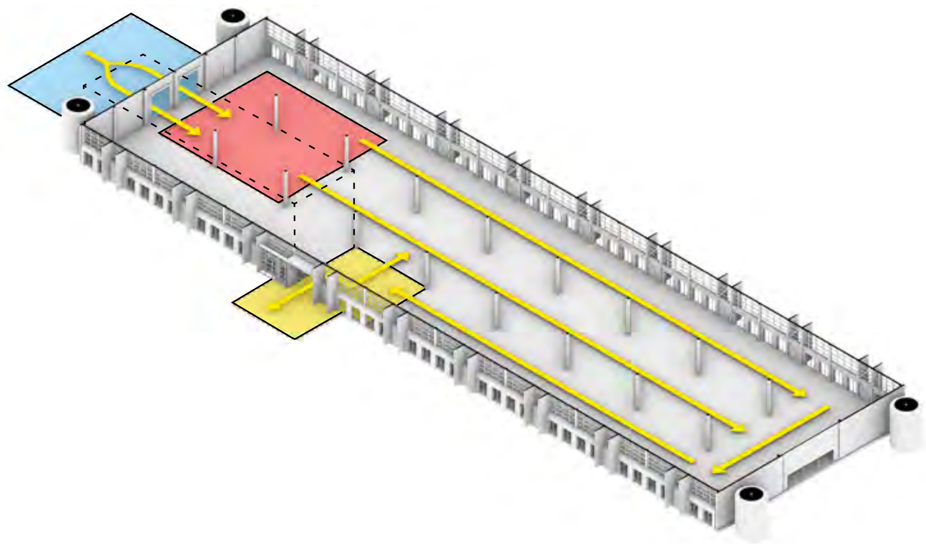
The brief for a factory initially lends itself to a heroic structural expression or articulation of the skin as a means of communication. Locating the factory in a developing urban neighborhood pushes the project in another direction. A modest form, driven by an economy derived from the factory floor organization and the watershed of the massive roof, brings the factory into a conversation with the current open context of the field and the future dense context of the Nordhavn neighborhood. Planning for a second life as generously sized urban housing units, the City Factory transitions from a monumental object in the landscape to a piece of urban fabric, exhibiting an everydayness that becomes a backdrop to countless lives.

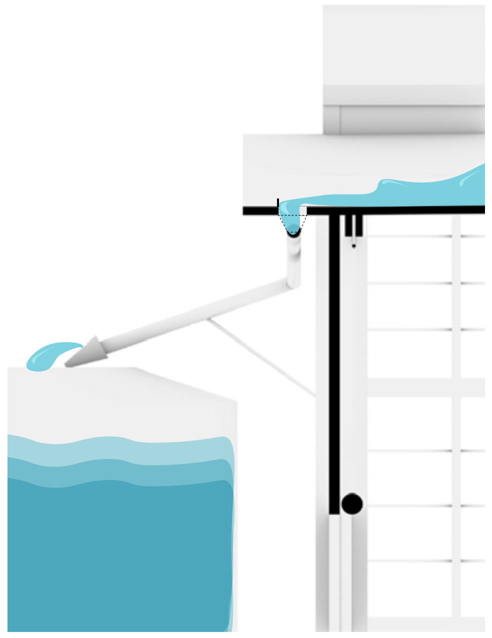


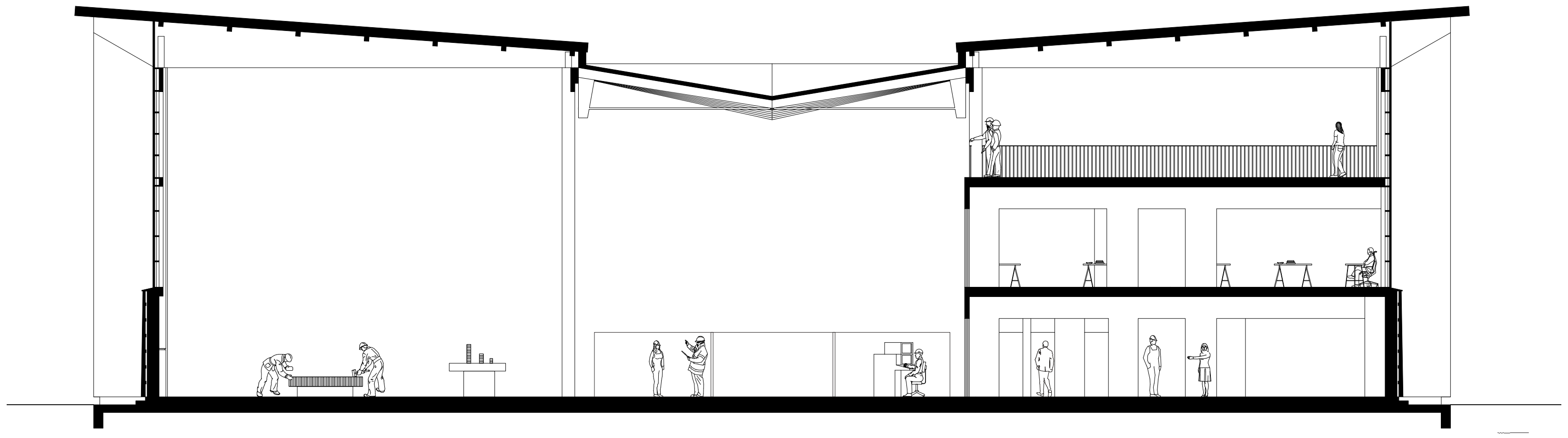



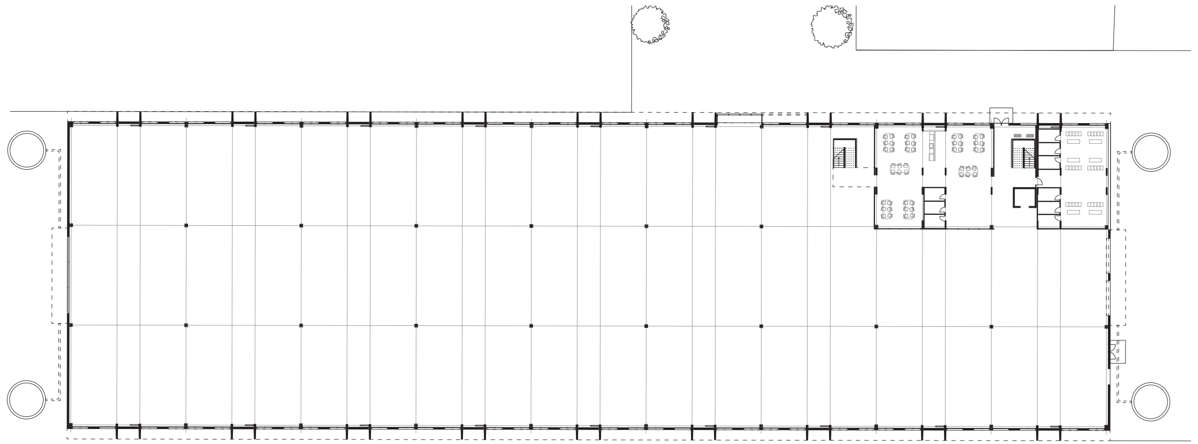


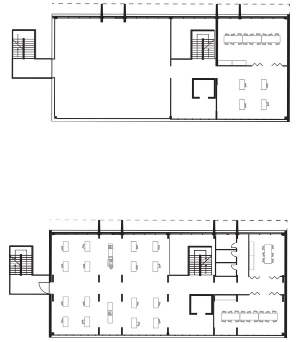


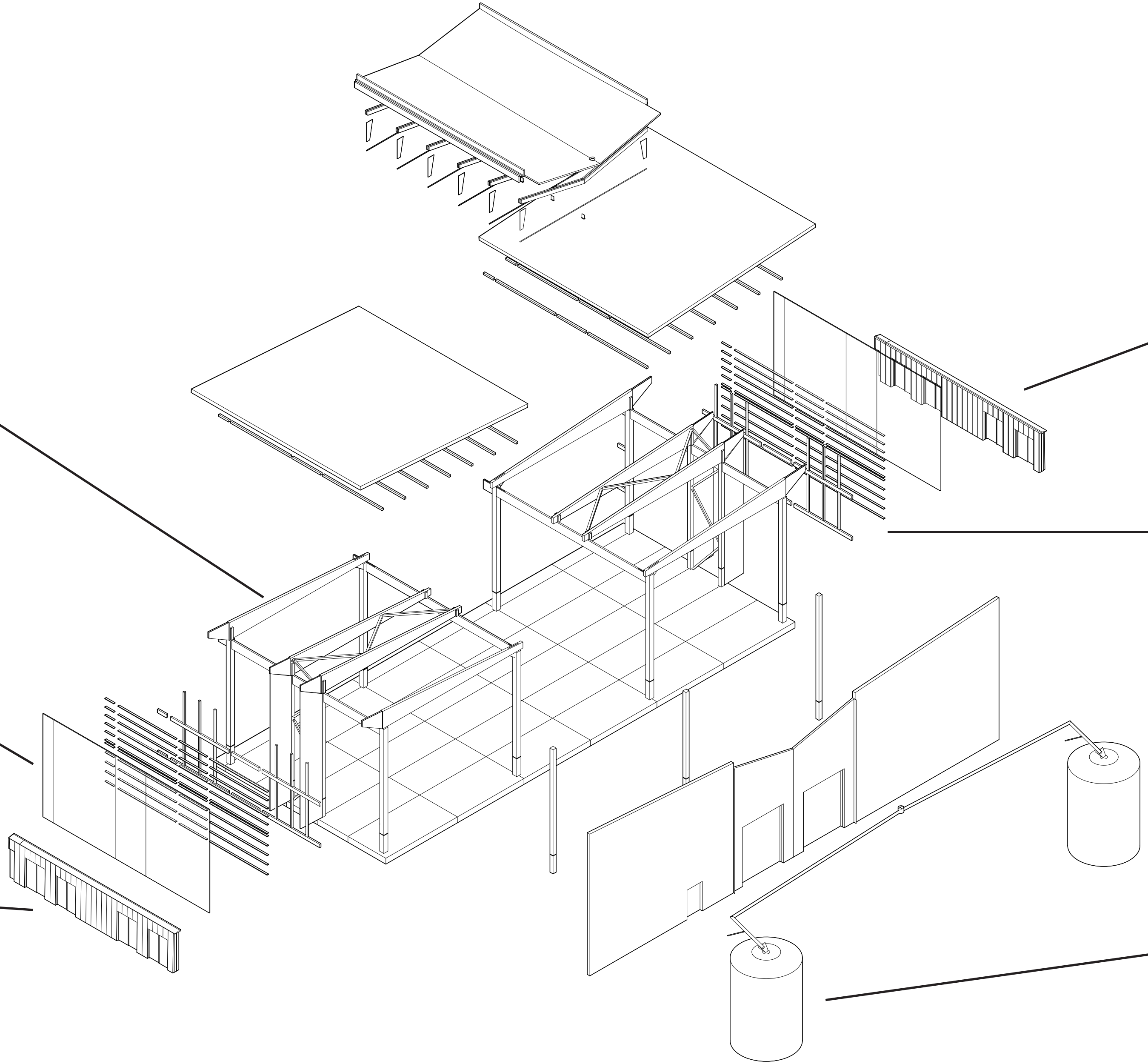












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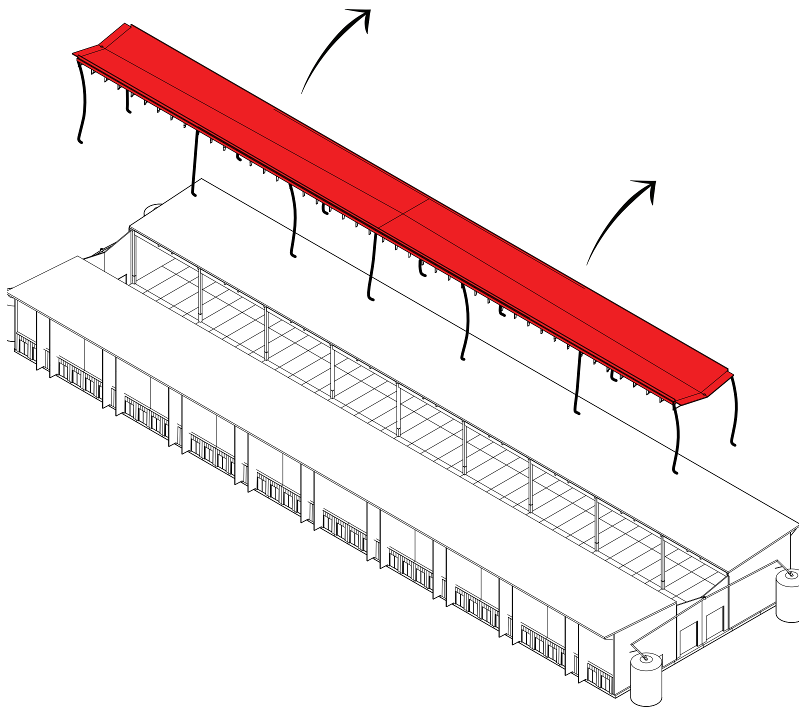
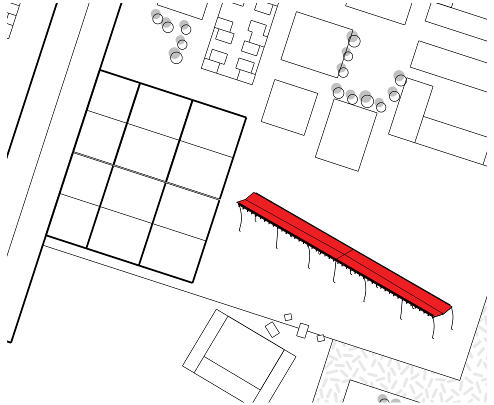
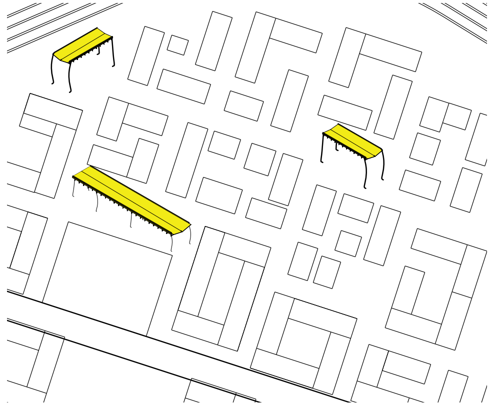
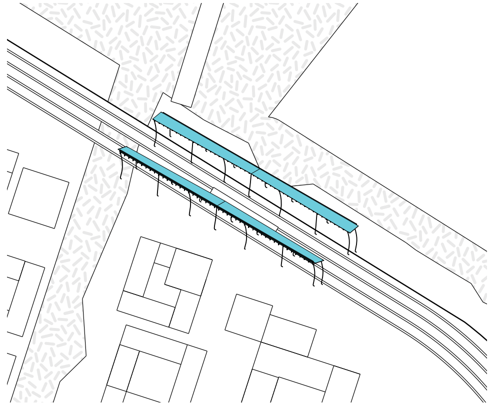
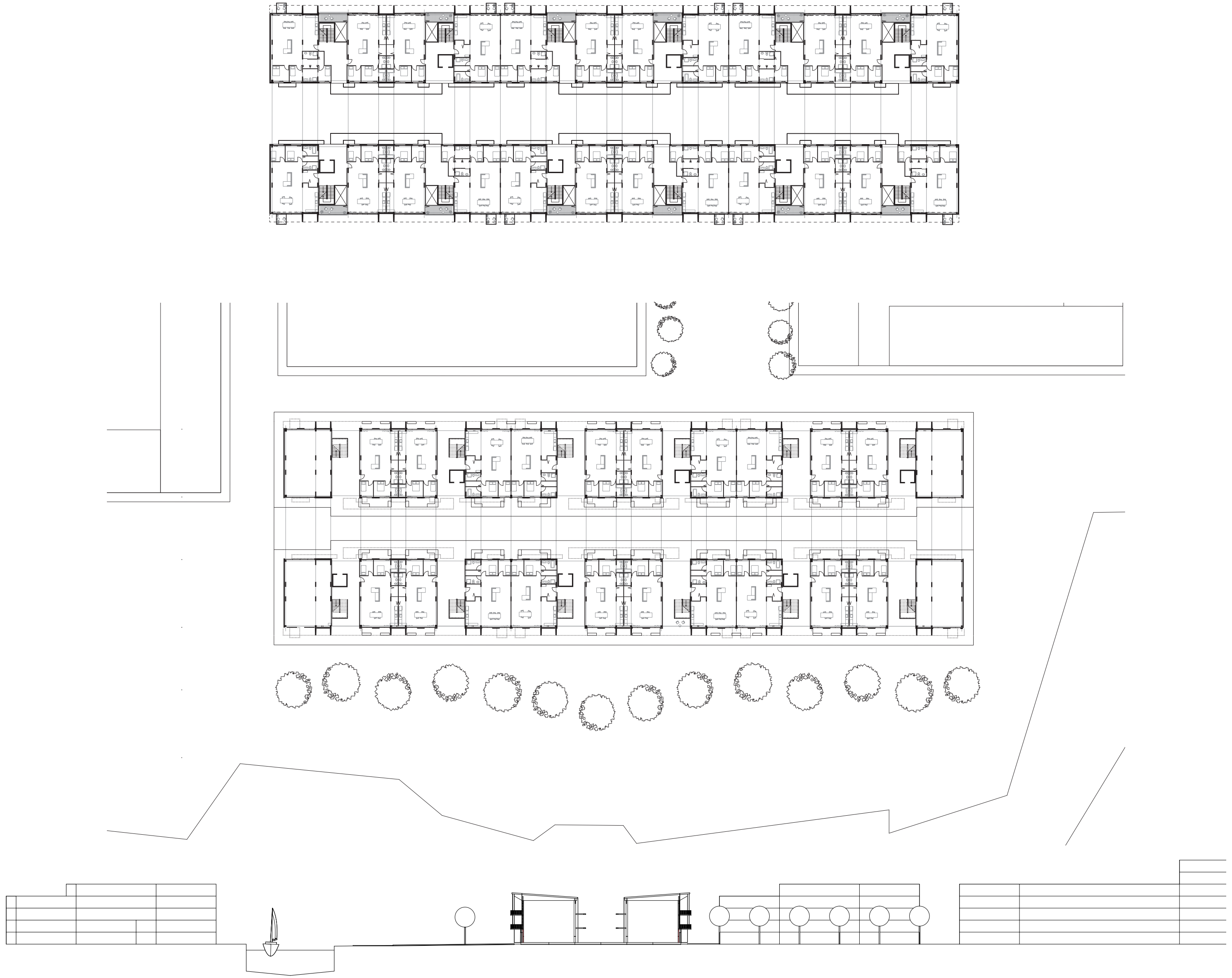
Cody Edmonds | Connor Stein











SKYLER JOHNSON

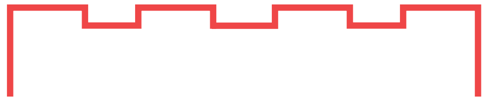
## MARCHING AHEAD

The CityFactory is within Copenhagen's industrious Nordhavn neighborhood, for which a new masterplan is now being developed and implemented to transform it into a lively urban district housing more than 40,000 workers and residents over a 25-year period. Sited adjacent to the footprint of the prominent Tunnelfabrikken's water basin, previously used in the process of creating tunnel components for the Øresund tunnel, the City Factory echo's the manufacturing / production line essence.

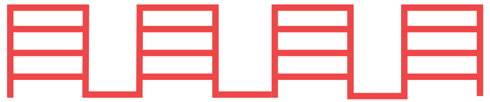
The built environment of Nordhavn will be comprised of prefabricated timber components manufactured locally on site at the CityFactory during its first life, maintaining identity. Workers and future occupants will have convenient access to bicycle and light rail transit corridors near the site. Carried by soaring timber trusses, the building incorporates 10' tall monitor clerestory lights allowing light to flood the production hall.

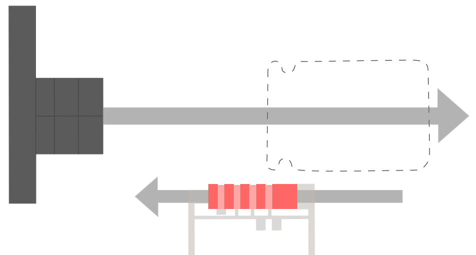
Following completion of the district, the CityFactory will transform into its second life where the provisional glazed bays are disassembled and removed. The spaces between the primary structural shells will open through to the canals, seamlessly transitioning into a new contextual urban identity established in the masterplan and emphasizing a pedestrian friendly smart grid. The final move as a factory will be to fabricate the components that will be used to infill the structural shells, transforming the use to residential or mixed-use program.

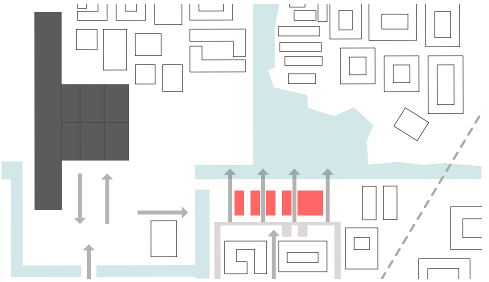

First Life: Factory

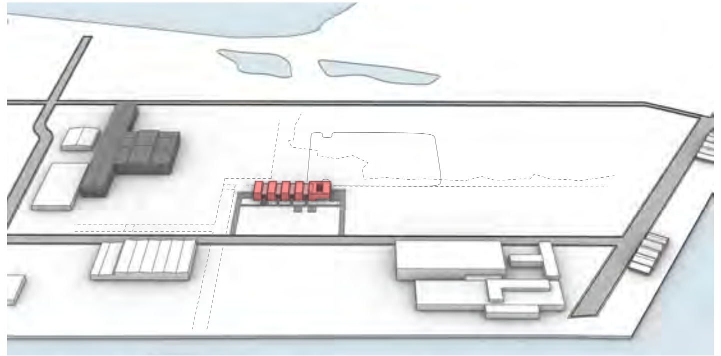


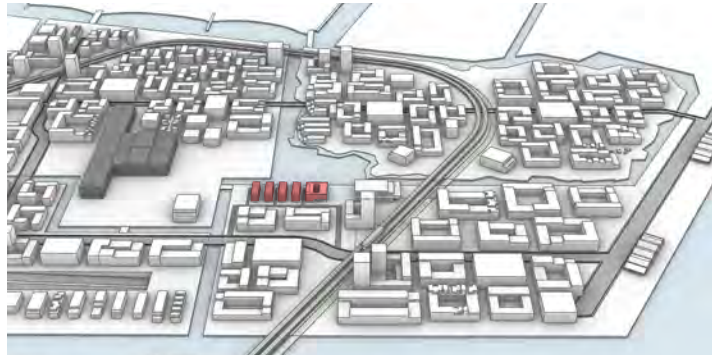
Second Life: Housing / Office

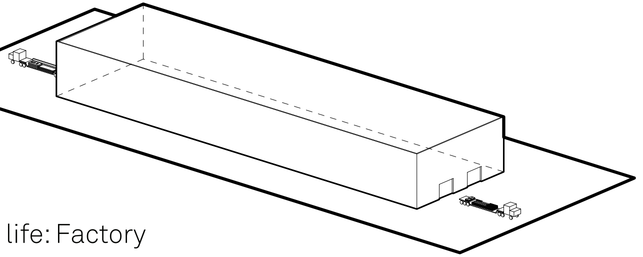




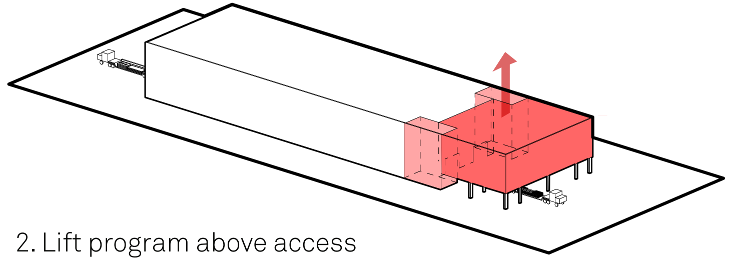




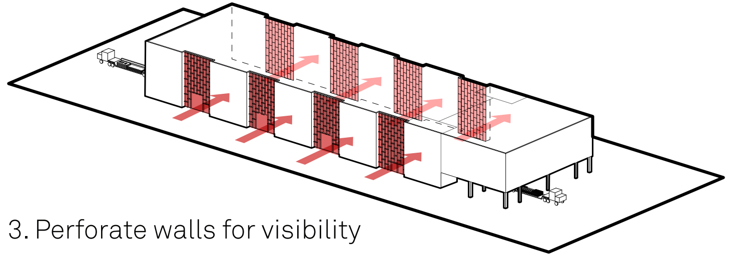




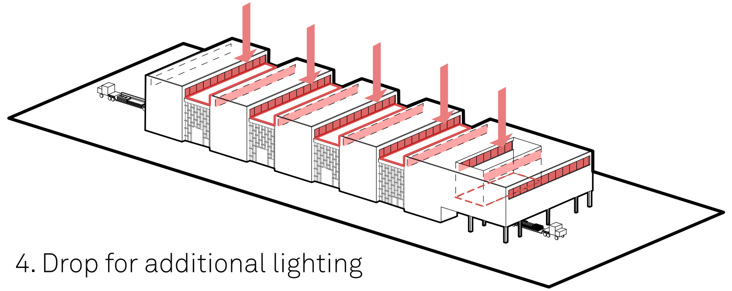
1. First life: Factory



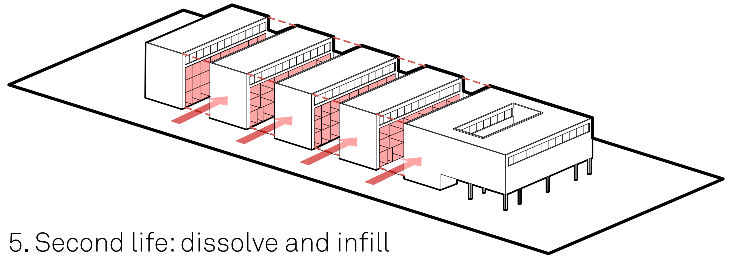
2. Lift program above access



3. Perforate walls for visibility



4. Drop for additional lighting



5. Second life: dissolve and infill

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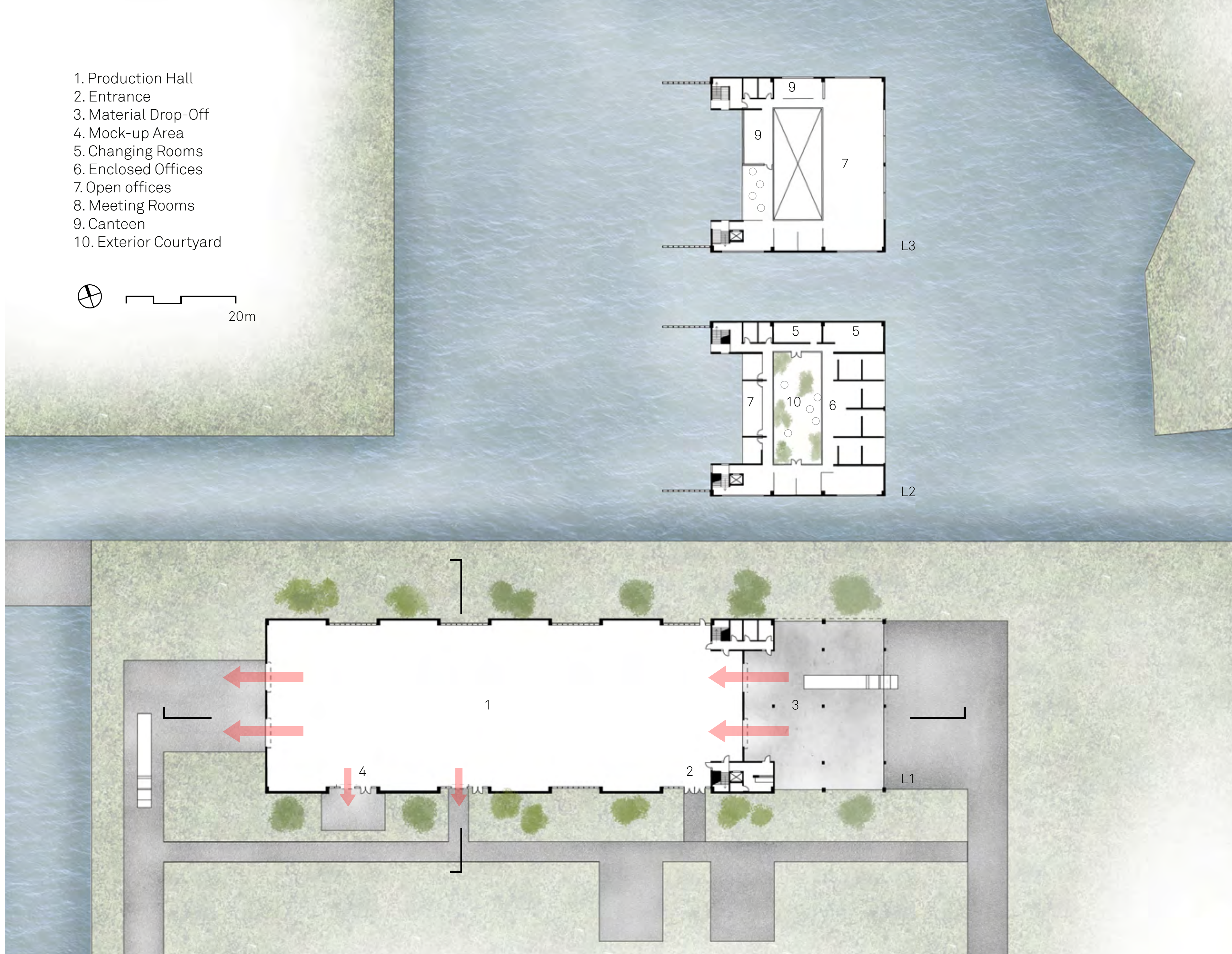
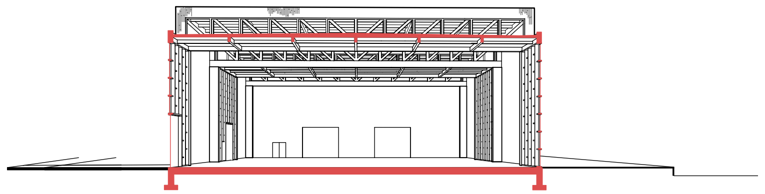


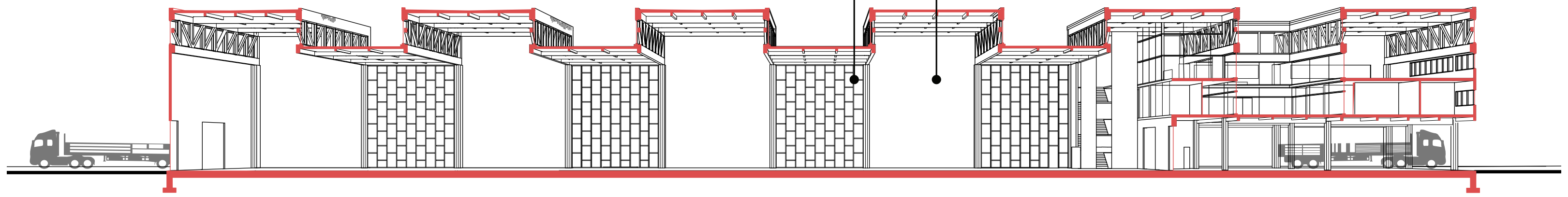
To allow for complete disassembly at the building's eventual end of life, dry mechanical connections are used throughout the structural and non-structural systems.

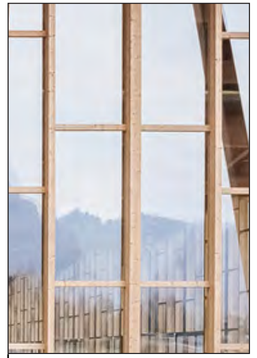
Intermittent bays are designed to have window walls with a timber framing (a), using a semi-translucent system on the south side to mitigate glare. The alternating bays are lifted by 10' tall glulam trusses (b) spanning the factory's width, allowing for expansive light monitors to be integrated into the building's passive design strategies. Cross-laminated timber (c) sheer walls enclose the shell structures, leaving the lower bays to have a transparent quality through to the waterfront. The building façade is cladded using reclaimed lumber (d) and allow for easy replacement when the building begins a second life.

## Transverse Section



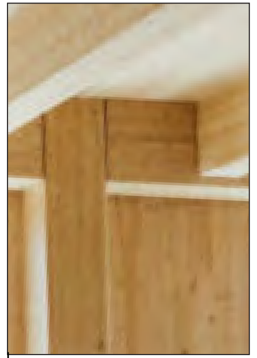
## Longitudinal Section





a

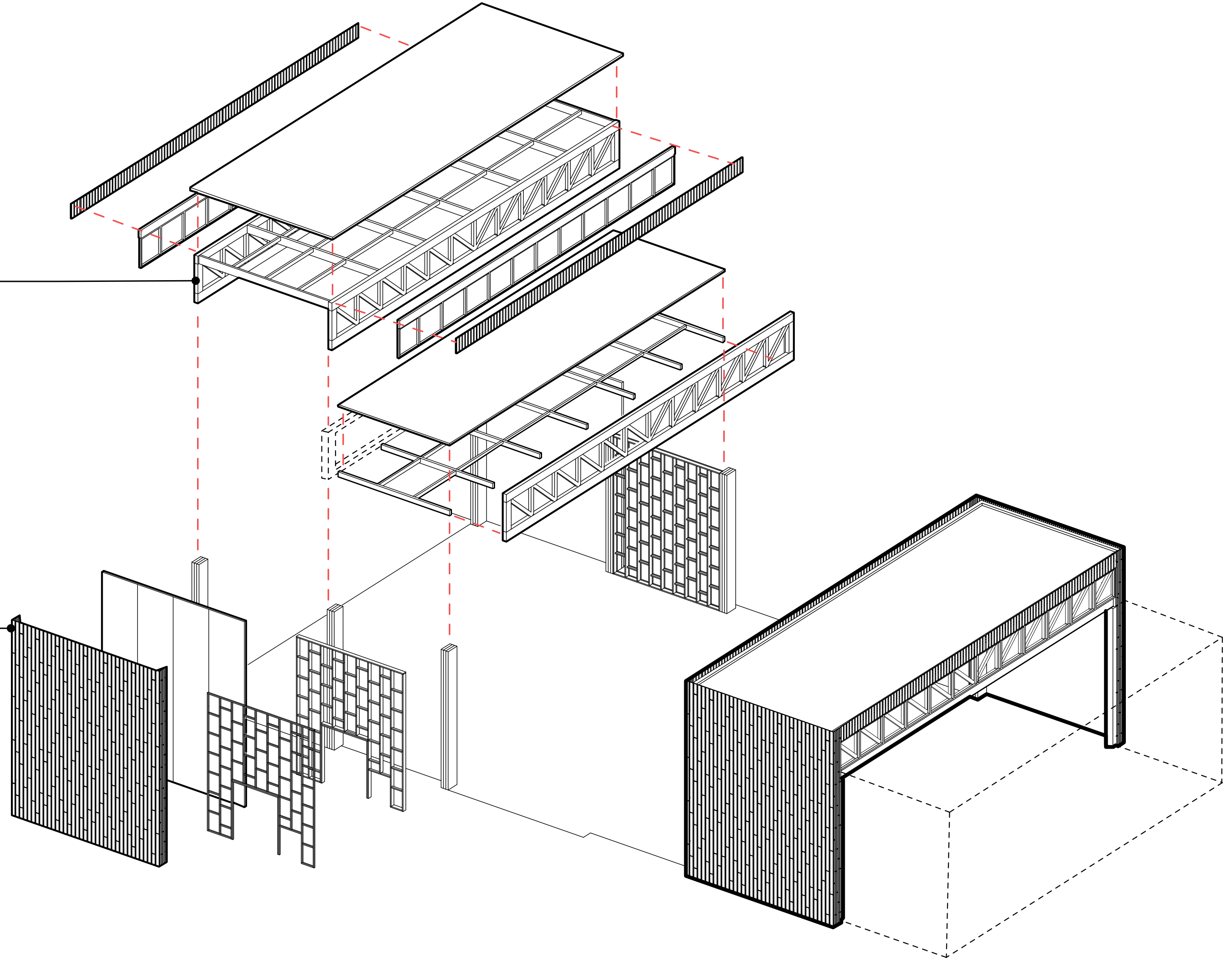
b



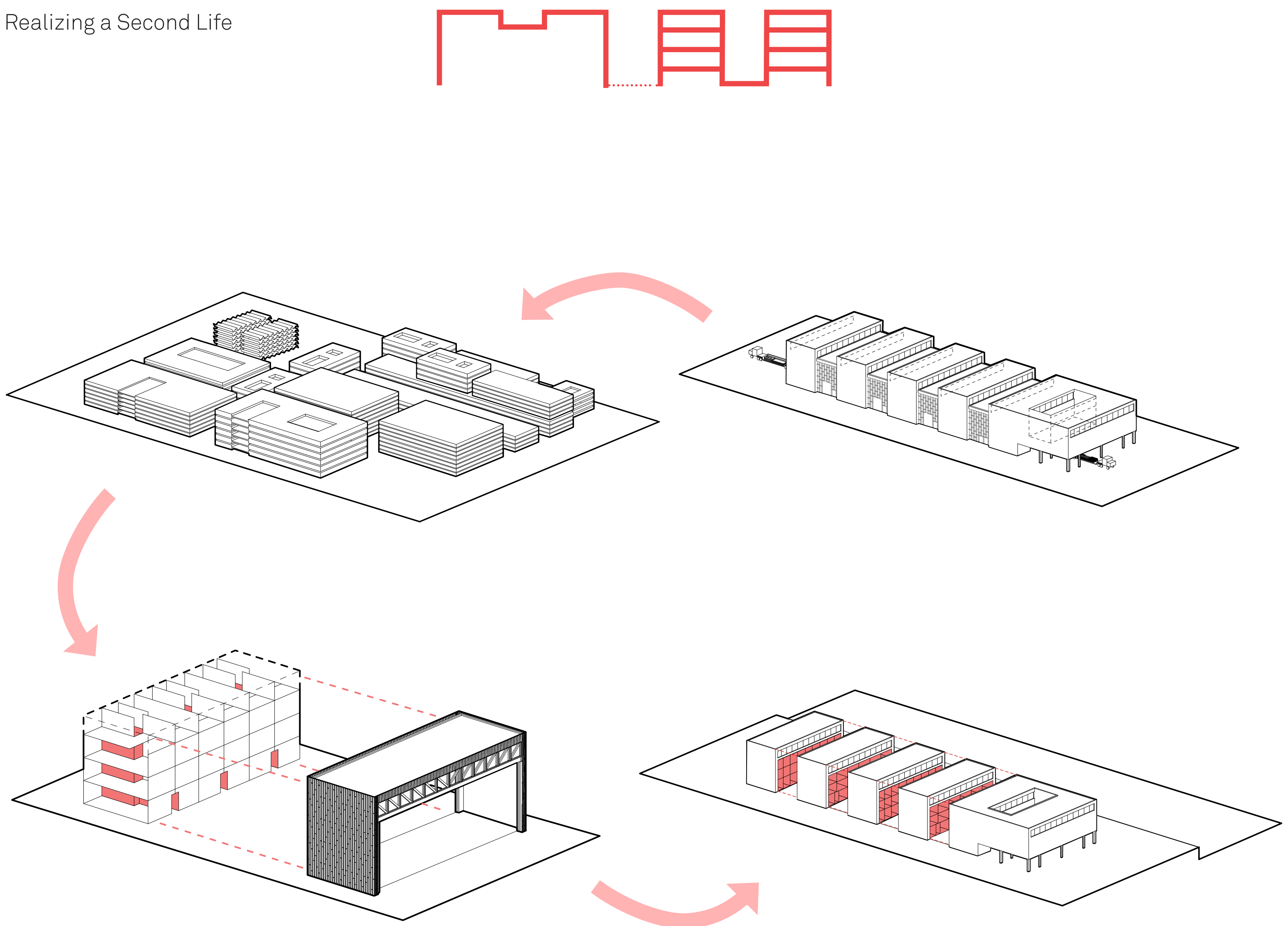
c

d

## Materials & (dis)assembly



Realizing a Second Life



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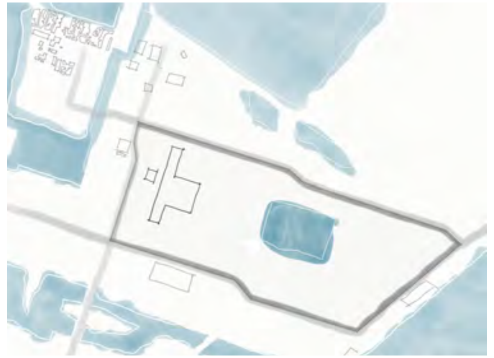
# STEPHANIE LAM | SIOBHAN SCHRAMM

## WEAVING IN NATURE



Existing Site

Connecting Nature

CityFactory Builds Nordhavn

Second Life:Market and Urban Farm

Disassembly

The site of the CityFactory is located on a brownfield within the historically industrial harbor of Nordhavn. COBE's Nordhavn City Masterplan intends to transform the harbor into a lively urban area. One of the masterplan's themes is the blue and green city; blue for water and green for nature. The proposed design for the CityFactory site hones into these themes.

First, nature transforms the brownfield. New pathways surrounded by topography and softscape connect existing and projected green spaces. The added topography prevents strong winds from the sea during its first life, and while sunken areas allow for spaces of flooding to occur due to anticipated global warming. The sunken areas also create biofiltration opportunities to clean runoff water before it returns to the sea. Next, nature "weaves" into the anticipated intelligent grid, extending outwards from the green pathways into the urban fabric.

The CityFactory is sited as a transition between nature and city- There is a natural park just south of the building and the north end is met by the city. Starting from the north, the scale of the urban fabric breaks down as it moves towards nature and allows the people to stroll by or stay a while.

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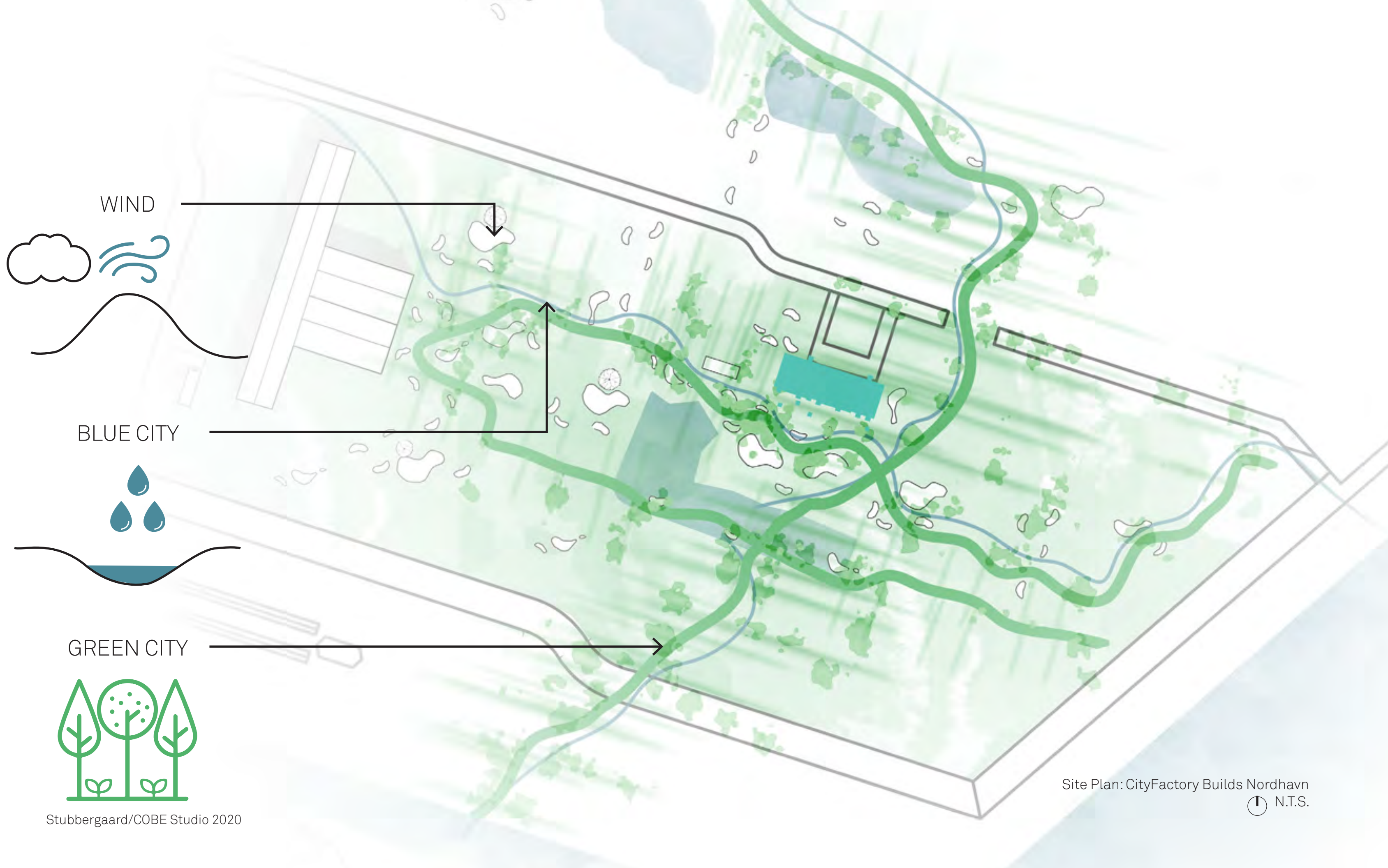
**WEAVING IN NATURE**

The CityFactory Builds Nordhavn




Site Plan: CityFactory Builds Nordhavn
N.T.S.

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# WEAVING IN NATURE

The CityFactory and the City


Site Plan: CityFactory + Developed Nordhavn
N.T.S.

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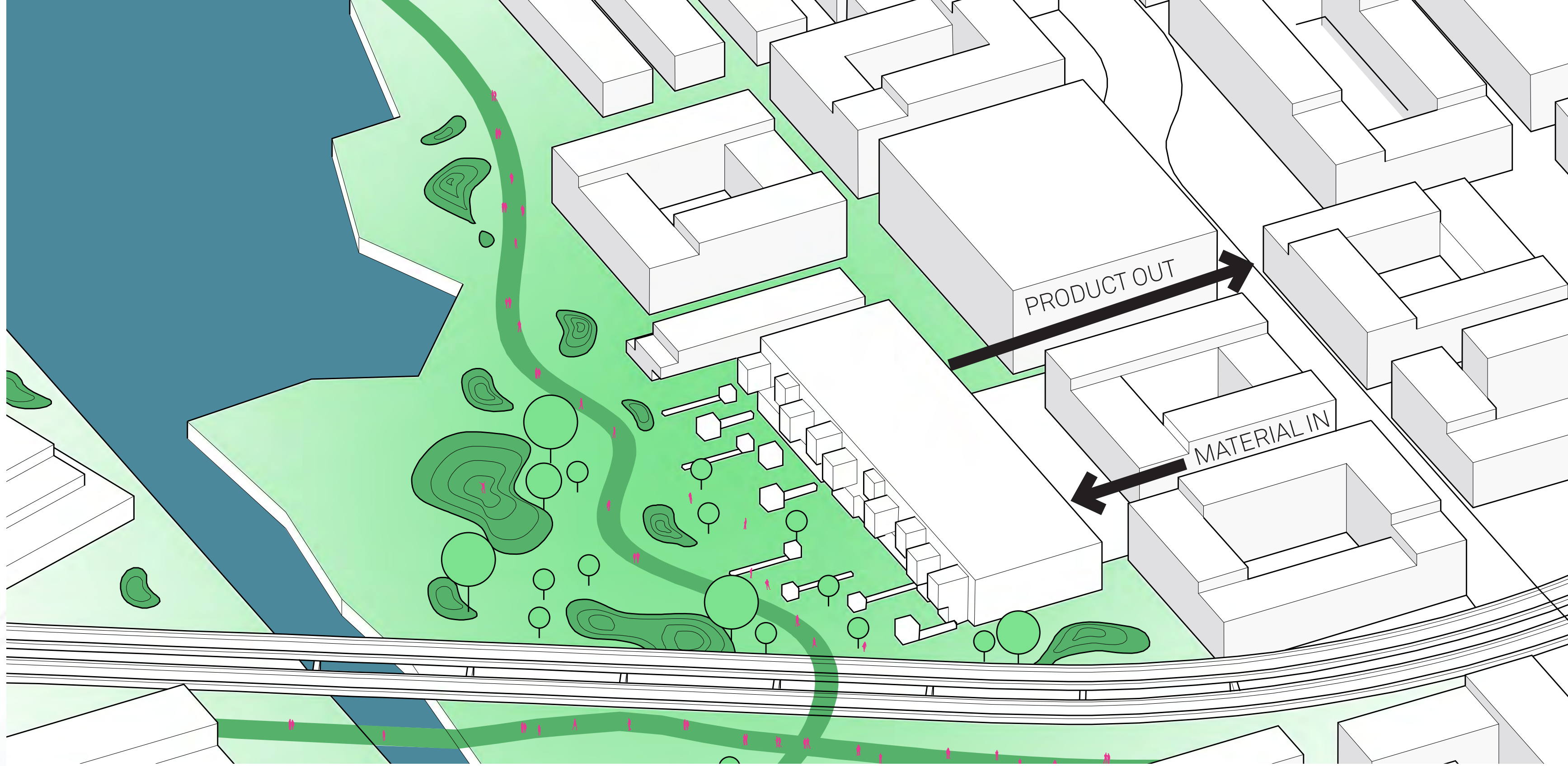
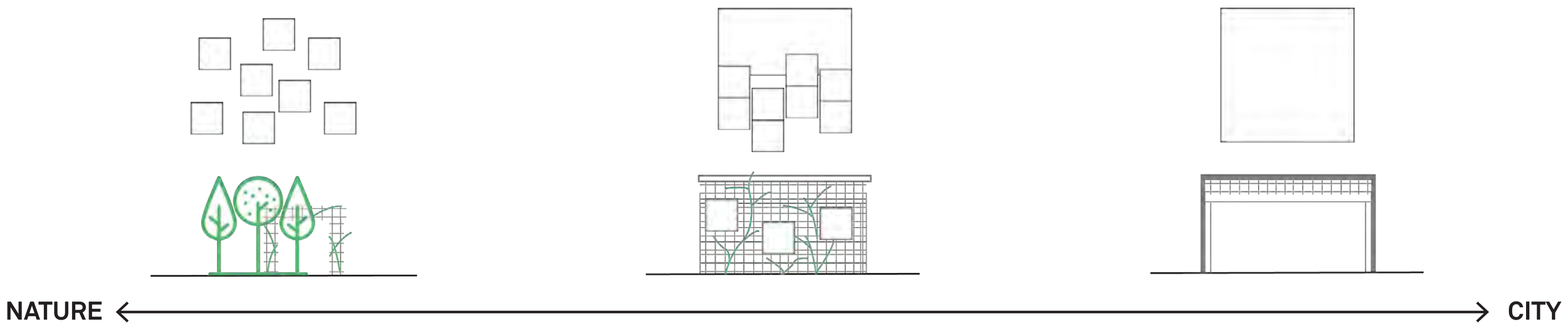
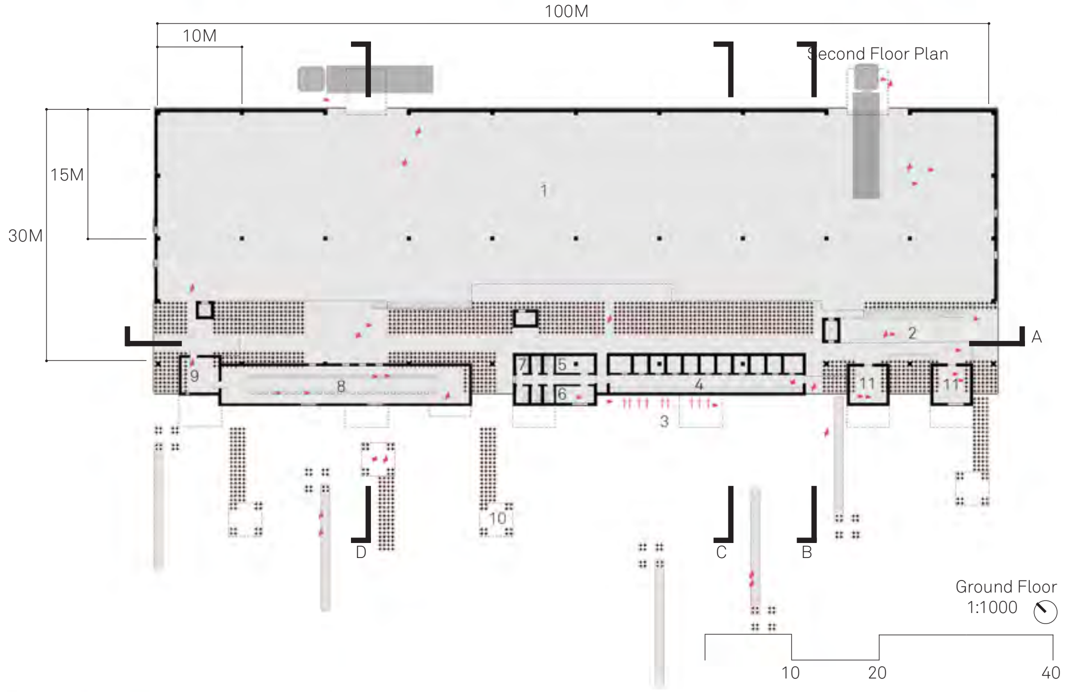



Stephanie Lam | Siobhan Schramm

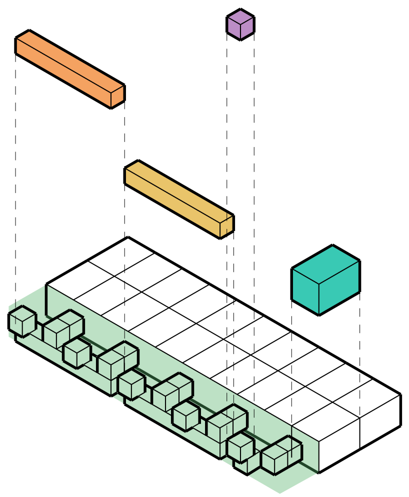
1. Production Hall
2. Entry
3. Bike Parking
4. Lockers and Showers
5. Storage
6. First Aid
7. Restrooms
8. Canteen
9. Kitchen
10. Exterior Pavilion
11. Meeting
12. Offices
13. Copy and Storage


First Floor



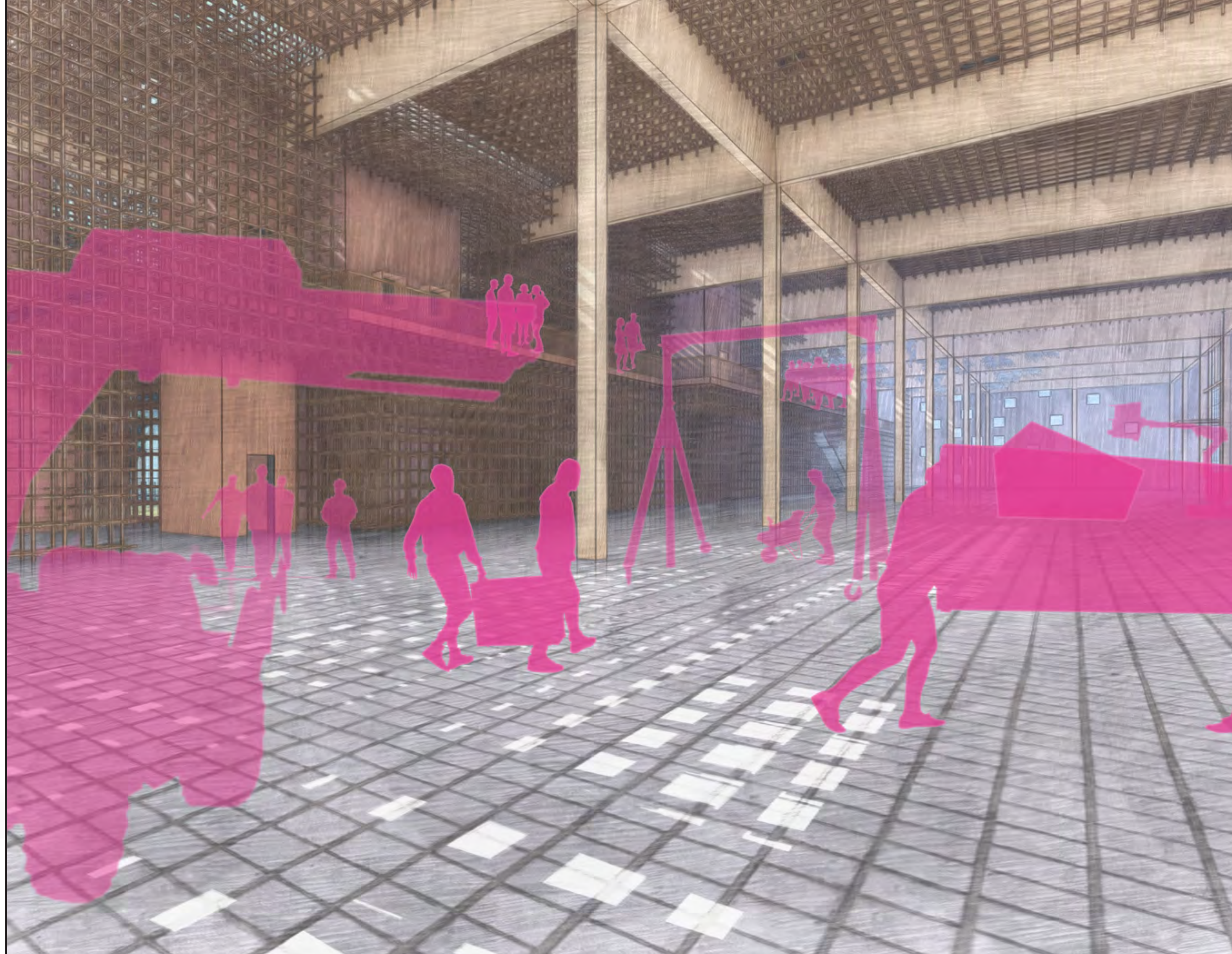

Ground Floor
1:1000

OFFICE
CANTEEN
FACILITIES
PRODUCTION BAY



CityFactory Program

Longitudinal Section A



Cross Section D
1:750

Cross Section C
1:750

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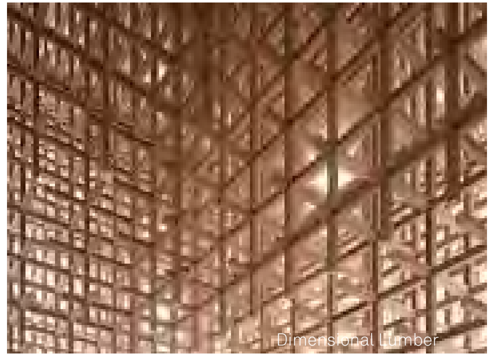
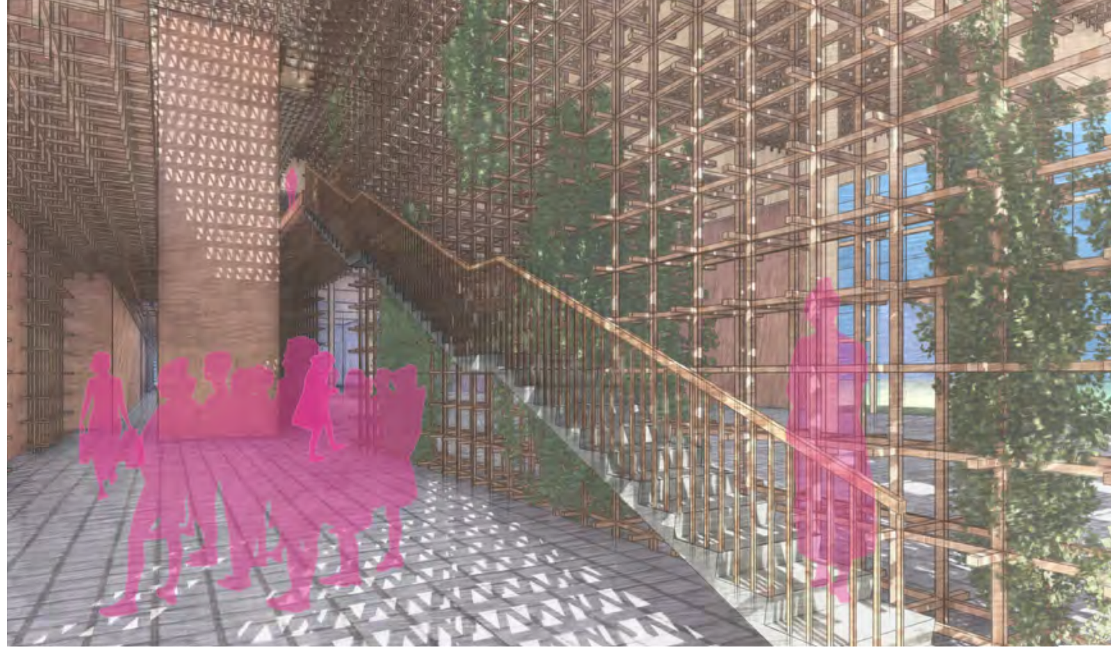
Cross Section B
1:750

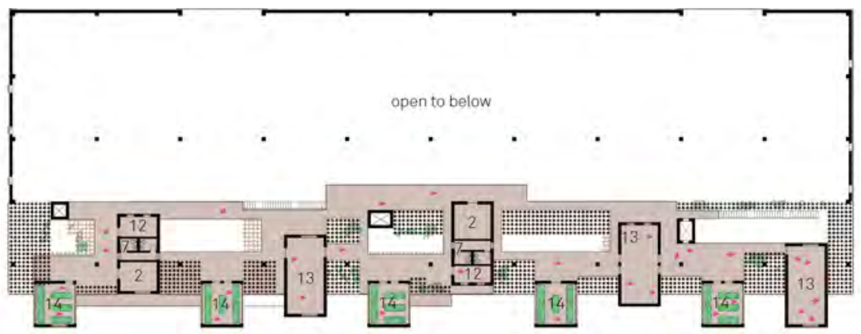
Plywood and CLT panels

Recycled Polygal Cladding

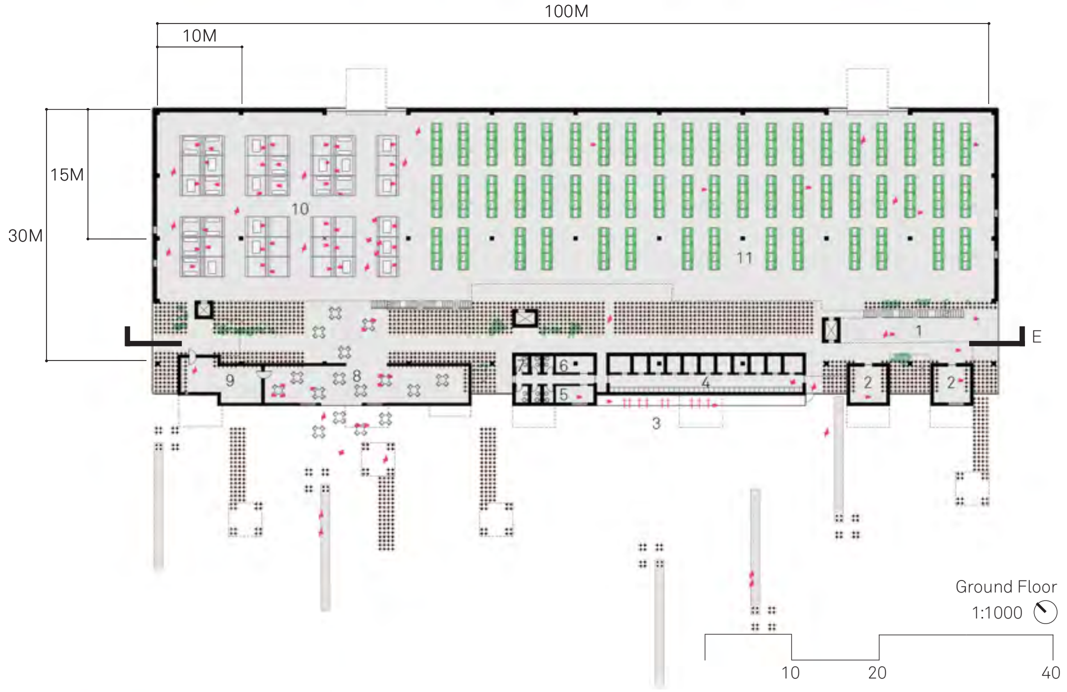


Dimensional Lumber






First Floor



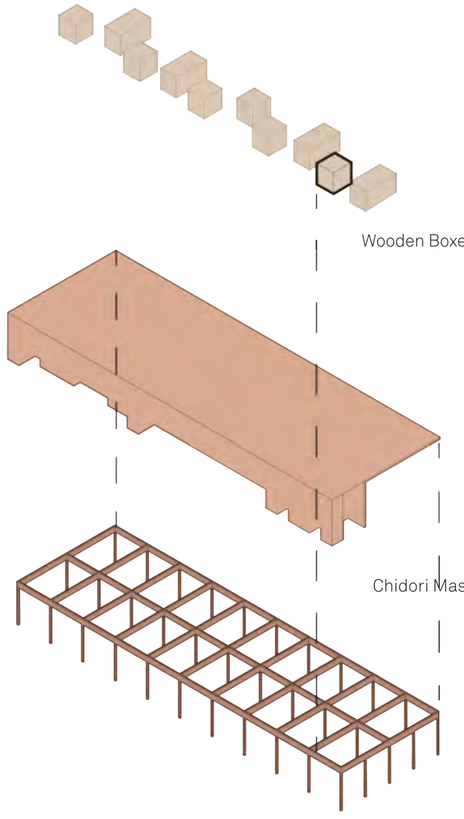

Ground Floor
1:1000

1. Entry
2. Urban Farm Storage
3. Bike Parking
4. Lockers and Showers
5. Storage
6. First Aid
7. Restrooms
8. Cafe
9. Kitchen
10. Market
11. Urban Farm
12. Manager Offices
13. Storefront
14. Community Allotments

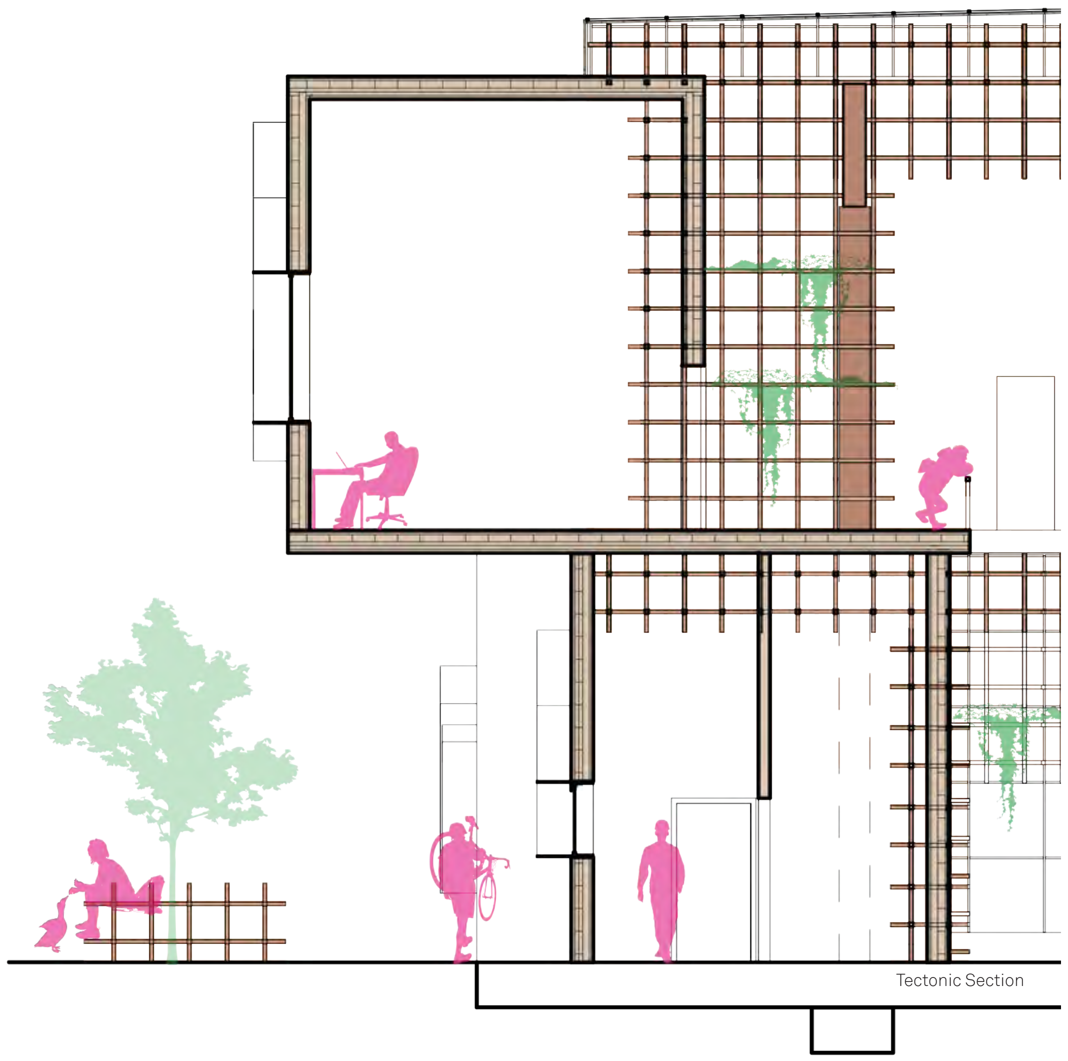
Longitudinal Section E

# WEAVING IN NATURE

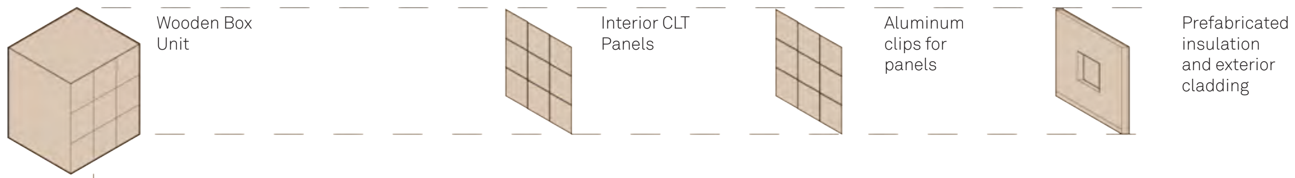
Disassembly

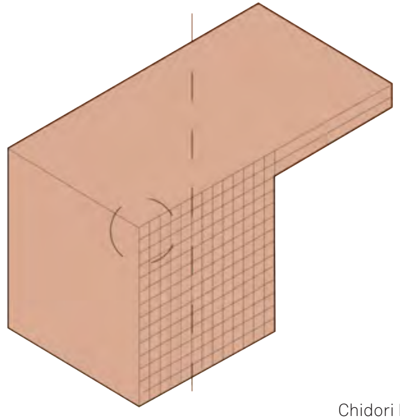



Post + Beam Production Hall



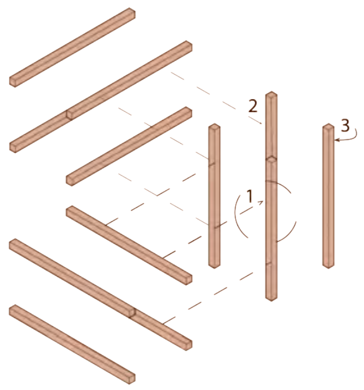
Tectonic Section



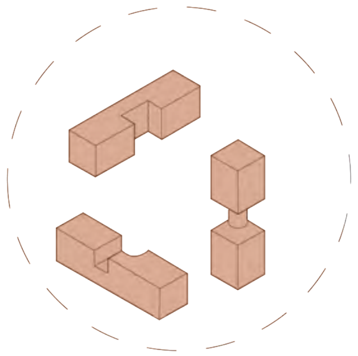



Chidori Mass Bay

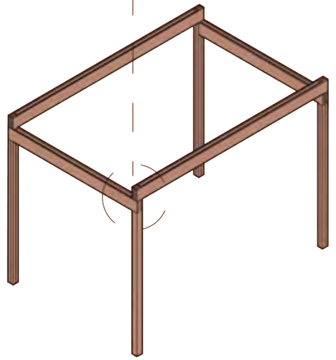
Chidori Unit



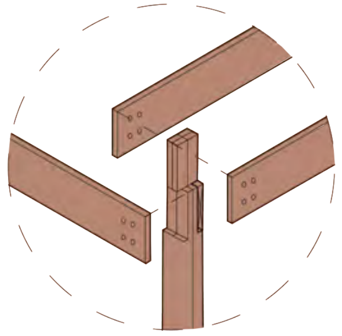

Chidori Disassembled



Chidori Joinery

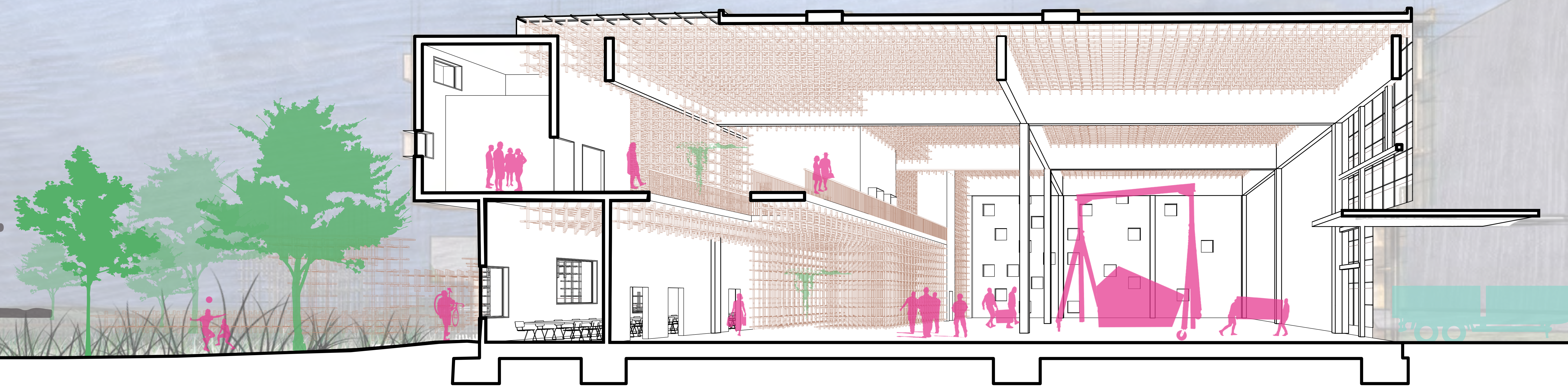


Post + Beam Unit



Post + Beam Connection


Post + Beam Disassembled



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HALINA MURPHY
**LEVENDEFABRIK**

The Levende Fabrik in Nordhavn is adjacent to the Tunnelfabrikken, once a production facility for tunnel elements now being redesigned as a cultural facility. A close relationship to the Tunnelfabrikken creates programmed outdoor space to act as a focal point for the neighborhood. The Levende Fabrik establishes a strong street edge that allows for a low building height compared to surrounding development, limiting the amount of shade to the north.

The Levende Fabrik expands on Cobe's Master Plan goal to promote sustainable mobility and encourage an active lifestyle. Thus, the Levende Fabrik is an active building that changes form seasonally. Utilizing kinetic building systems allows the factory to open in the summer and button up in the winter. The Levende Fabrik's changing form also foreshadows its future disassembly; in using operable systems, the building is partially disassembled and reassembled seasonally before its final disassembly.

The Levende Fabrik has a double-skin facade. The outermost layer's primary use is ventilation control and is comprised of polycarbonate louvers that operate seasonally. Supported by a timber truss system, it is separated from the innermost layer of low-E glass that primarily acts as a thermal envelope. These two systems act in unison.

The Levende Fabrik program, in its current state, is programmed in large bays that allow for free flow of materials. This organization works with its proposed second life as an athletic and aquatics facility. This use will closely relate to the future neighboring canal for leisurely use in the summer and allow for indoor activity in the winter before it is ultimately disassembled.

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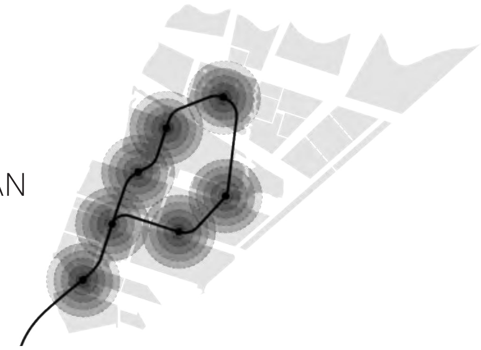
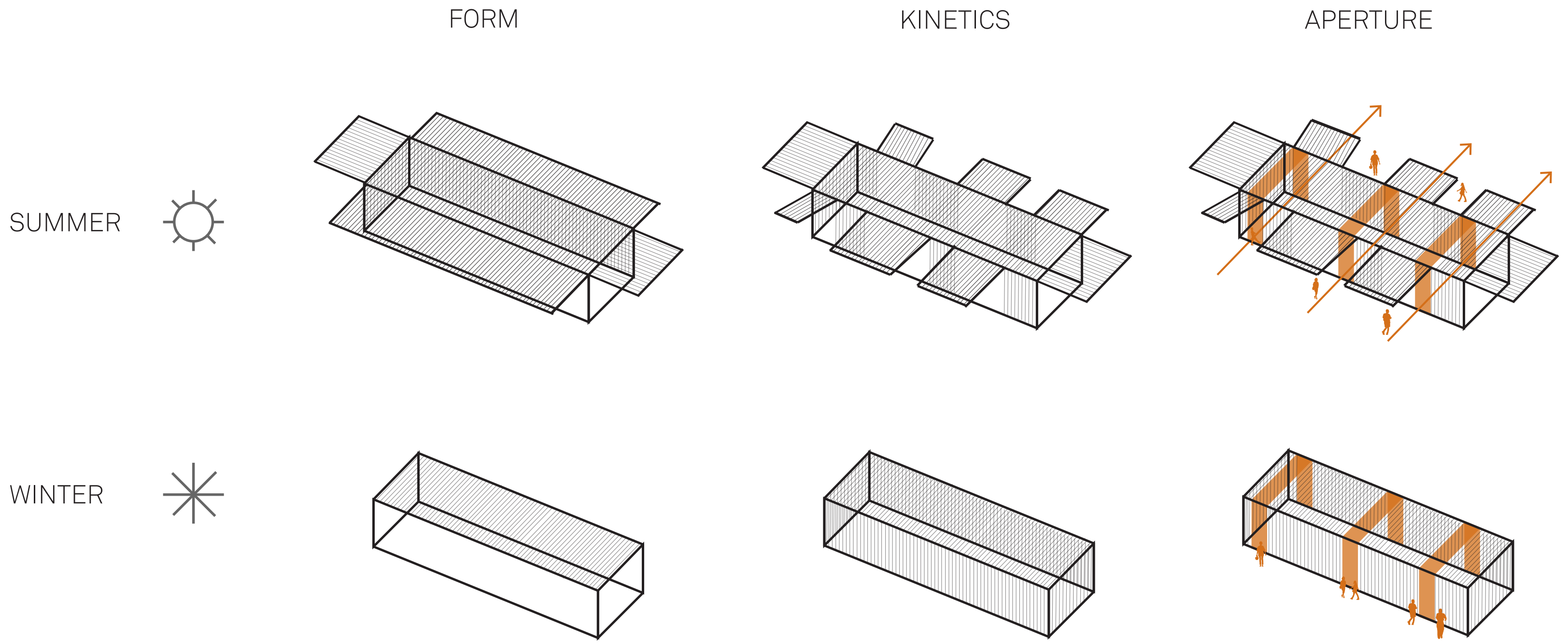
## NORDHAVN MASTER PLAN
Five-Minute City



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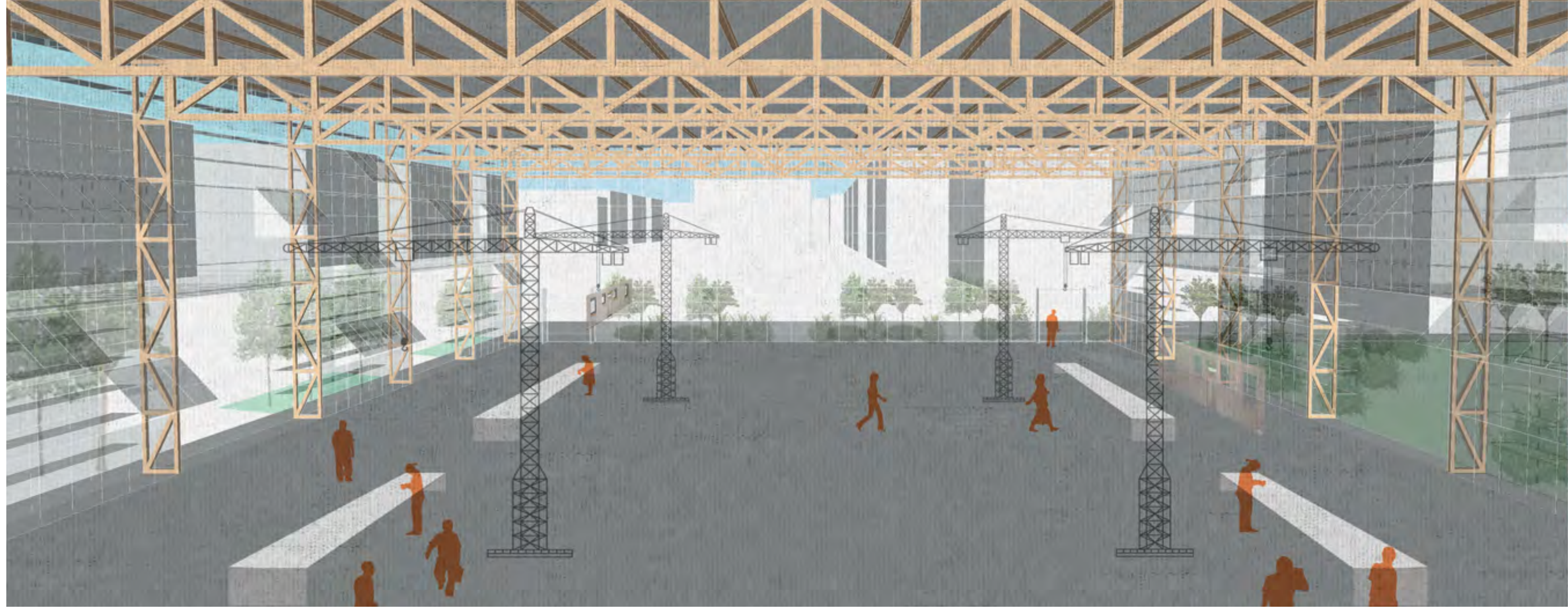
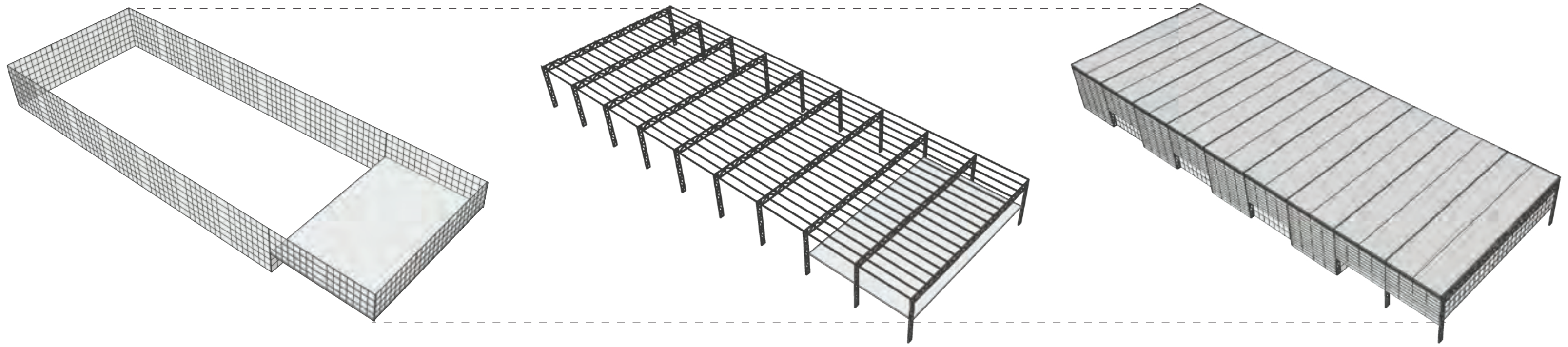


## LAYERED ASSEMBLY

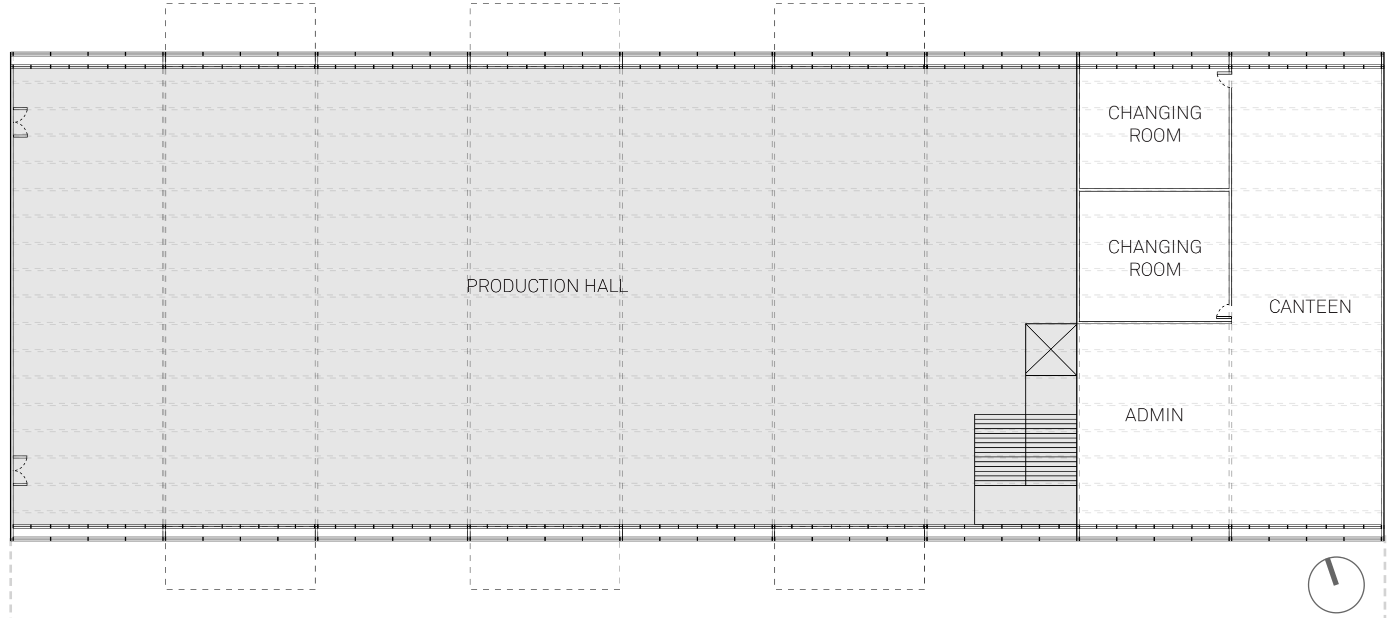


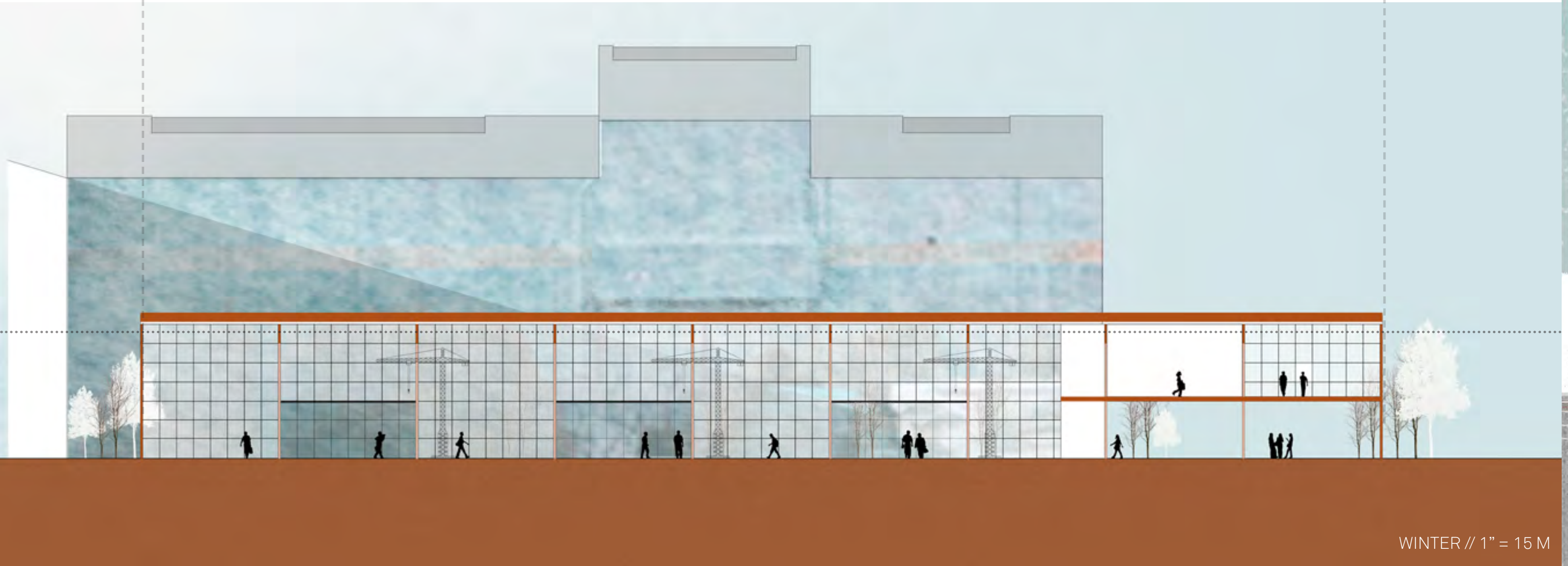
Innermost: low-E glass

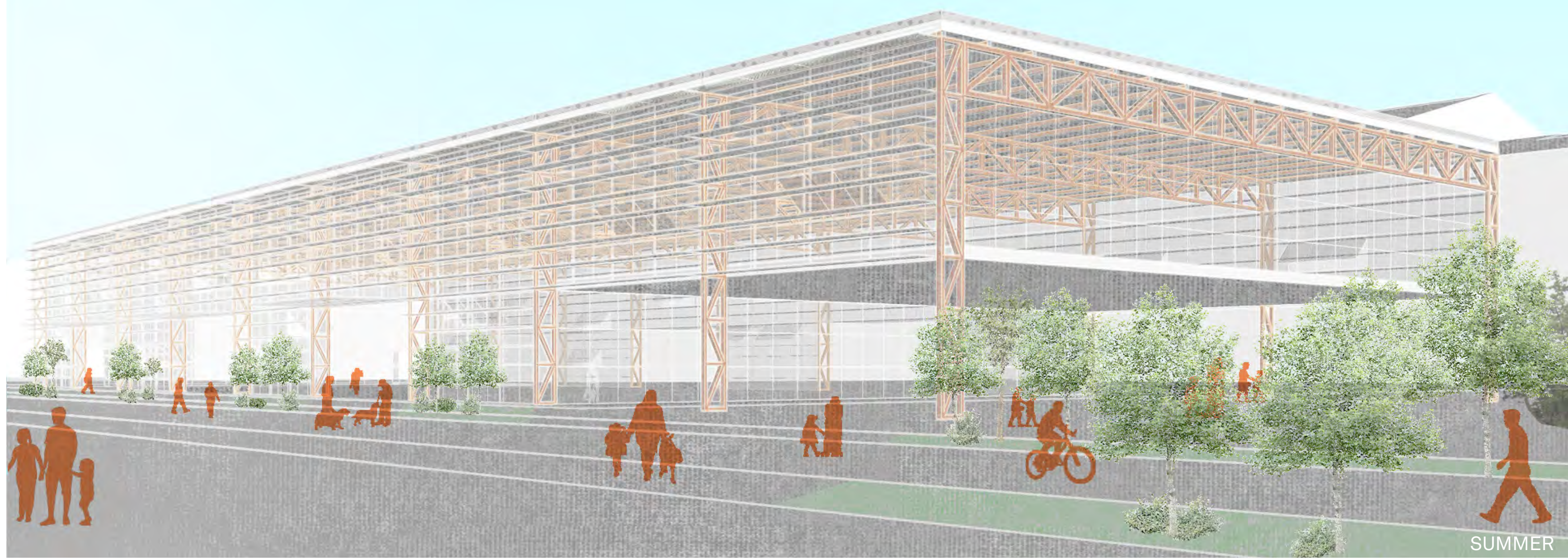
Structure: timber truss + framing

Outermost: polycarbonate louvers

Halina Murphy



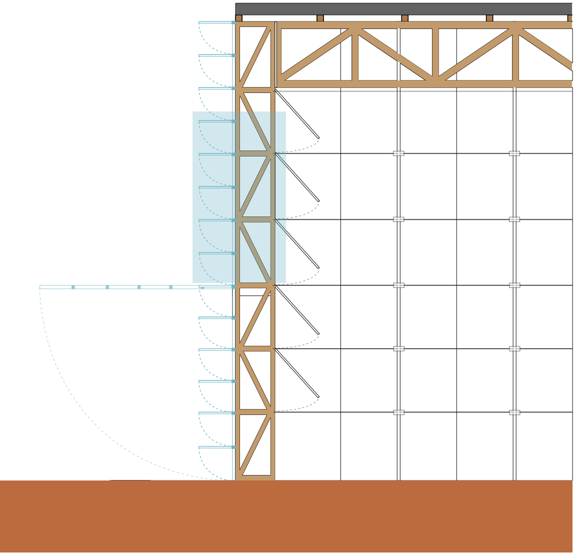


SUMMER

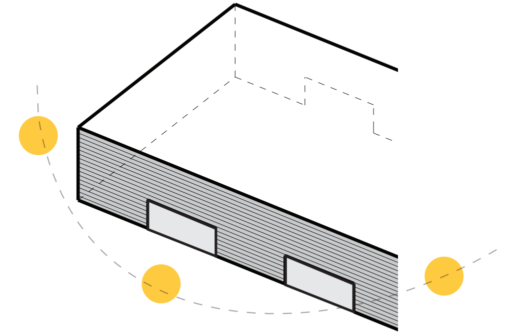
WINTER // 1" = 15 M

WINTER

# KINETICS + TECTONICS
Outer Layer

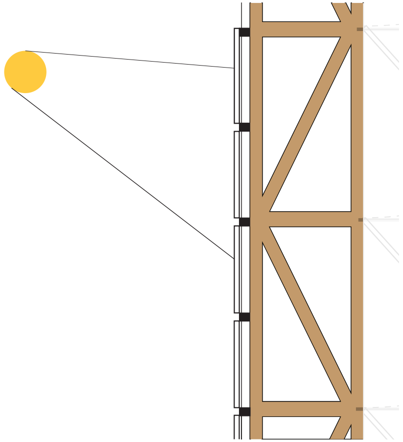


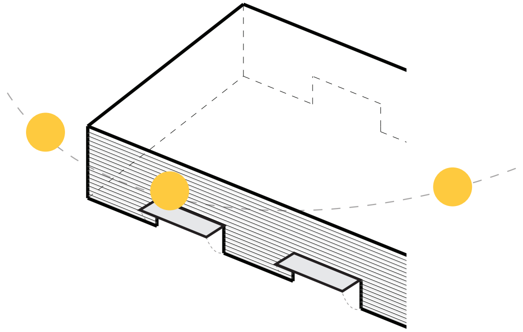
Use: ventilation
Material: polycarobonate



WINTER

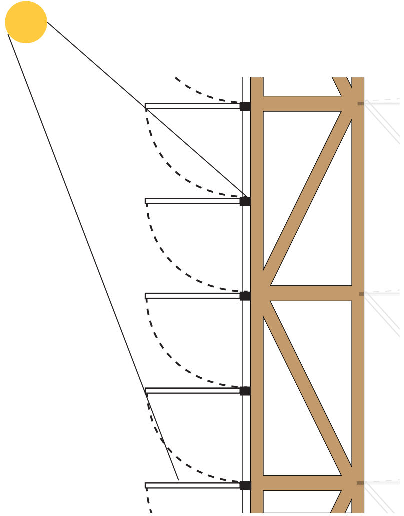
-Louvers not in operation
-Polycarbonate reduces glare





SUMMER

-Louvers in operation dependent on sun angle



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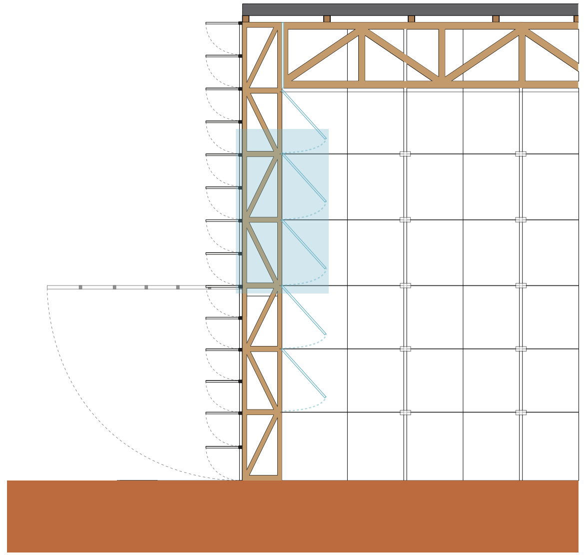
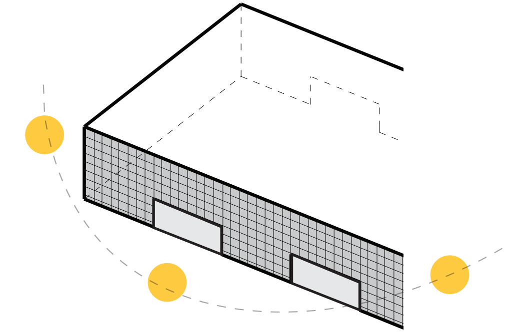
# KINETICS + TECTONICS
Inner Layer

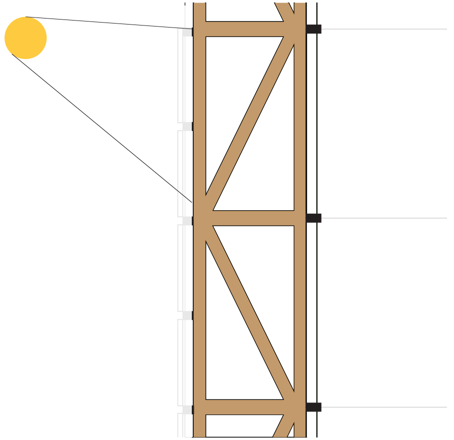


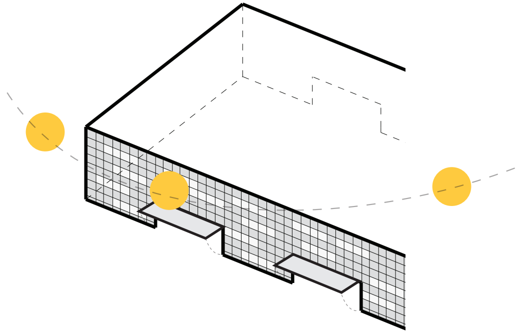
Use: thermal envelope
Material: low-E glass



WINTER

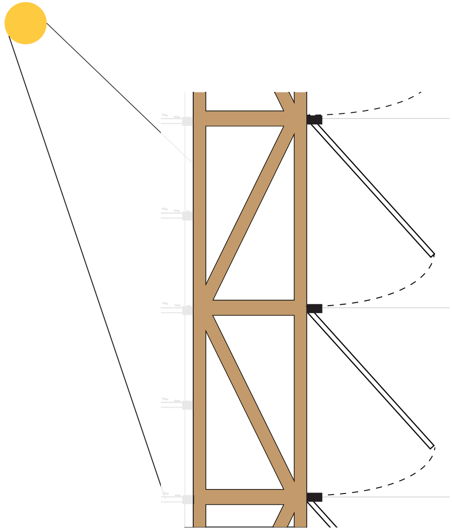
-Louvers not in operation
-Low-E glass reduces glare





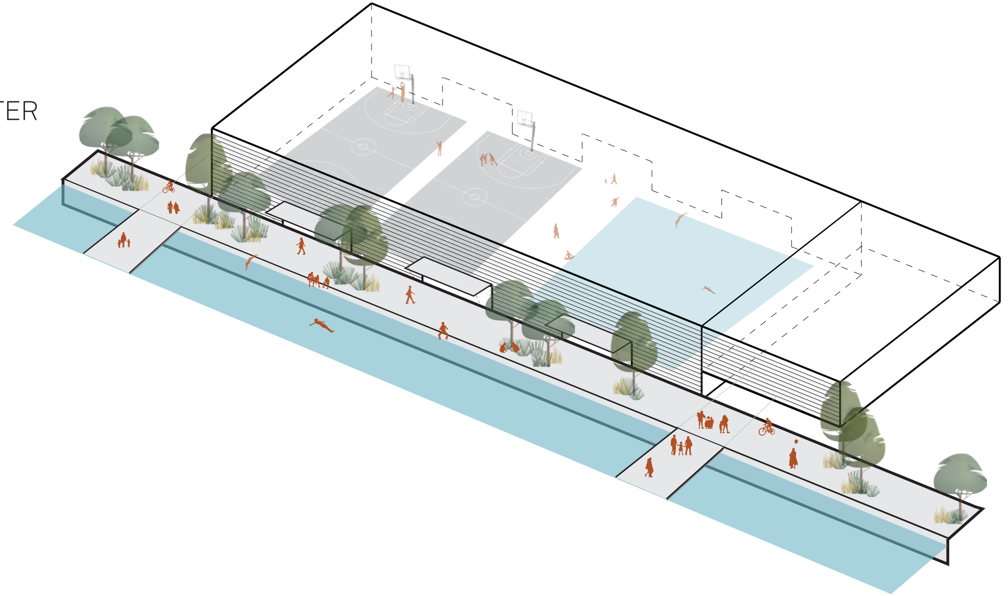
SUMMER

-Louvers in operation dependent on sun angle

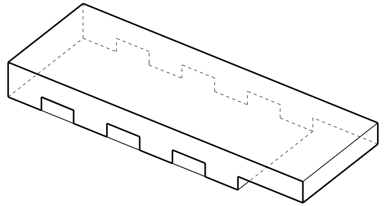


Halina Murphy

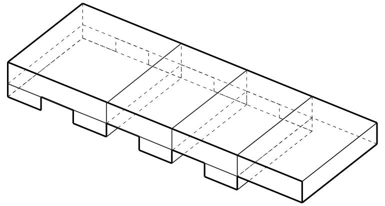
## SECOND LIFE
ATHLETIC + AQUATIC CENTER



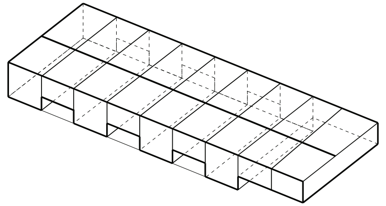
## ALTERNATIVE USES



Museum/Exhibition

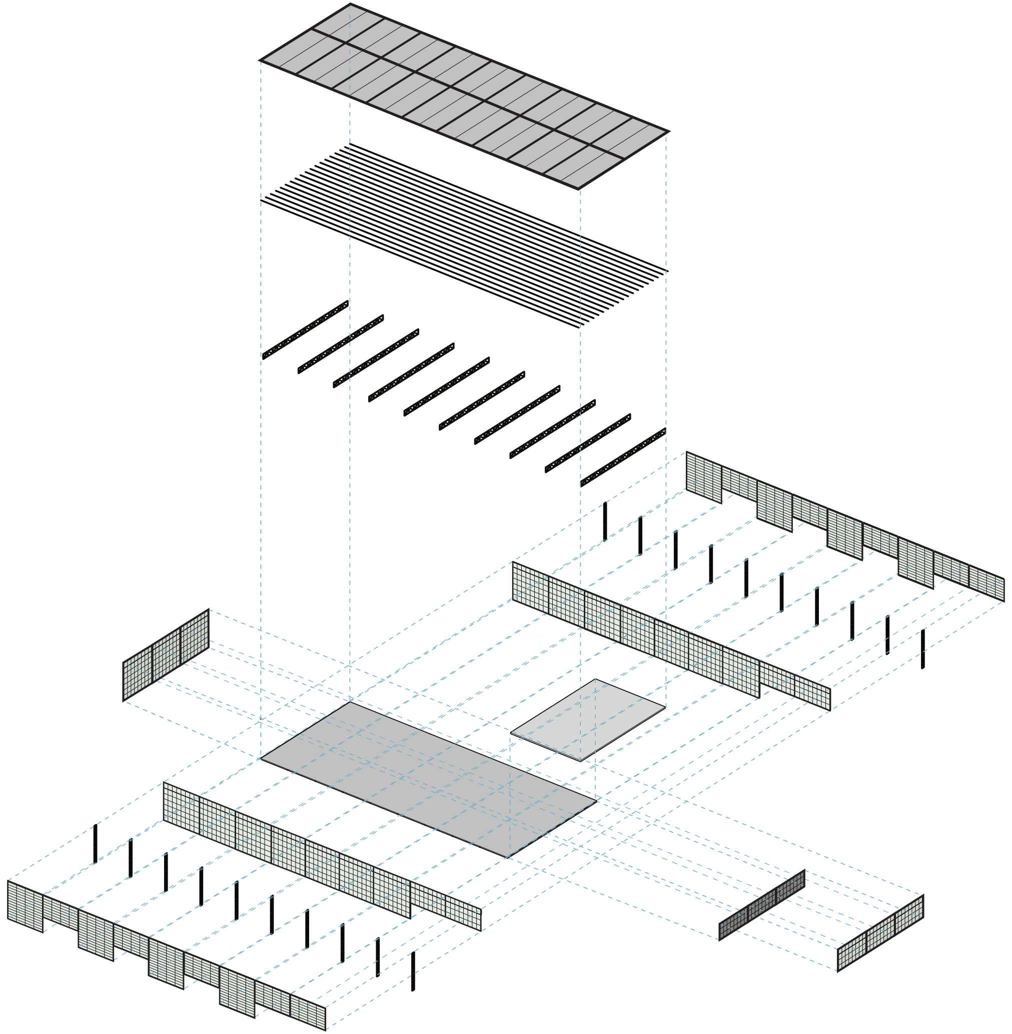


Offices

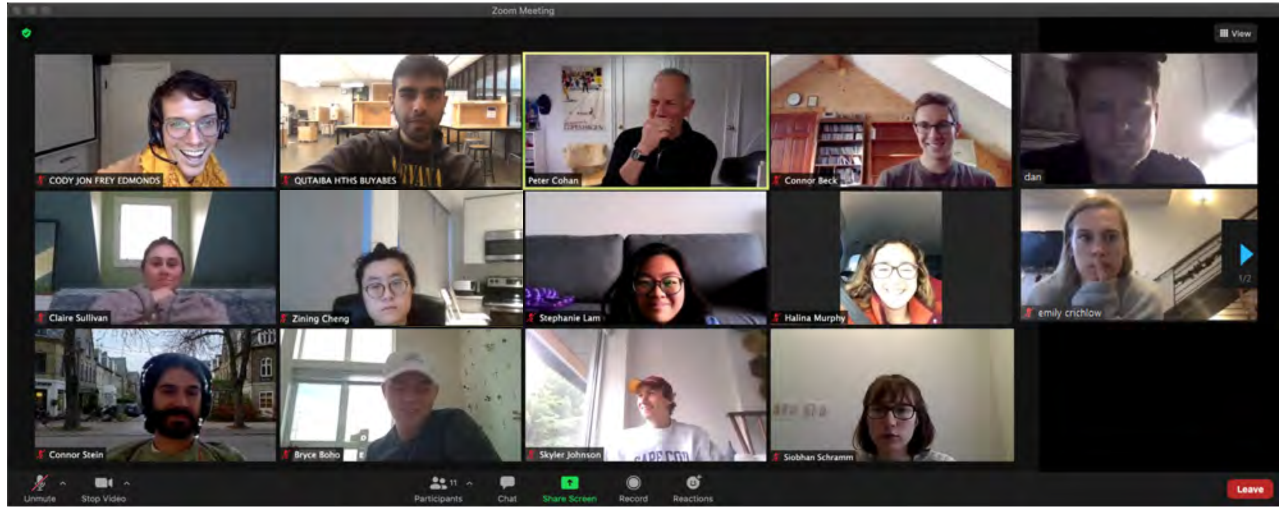


Housing

## DESIGN FOR DISASSEMBLY



Halina Murphy




## TAK

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