

THE ECONOMICS OF SPACE & TIME: TOWARD A TRUE MIXED-USE

A Thesis Submitted to the Department of Architecture
Harvard University Graduate School of Design, by

GEORGE H. ZHANG

In Partial Fulfillment of the Requirements for the Degree of
[Master of Architecture]

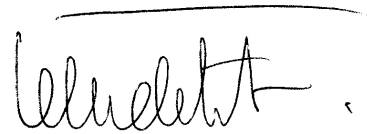
DECEMBER 2020

(Month and Year Thesis Submitted)

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George H. Zhang



Belinda Tato
Thesis Advisor

T H E
E C O N O M I C S
O F
S P A C E
A N D
T I M E

Toward a True Mixed-Use

Master of Architecture Thesis
By George H. Zhang

Advisor: Prof. Belinda Tato

Harvard University
Graduate School of Design

Fall 2020

PREFACE



As the world's population continues to gravitate towards cities (at the rate of 1 million per 5-6 days), perennial challenges in today's cities - congestion, density, and high costs of living - will only exacerbate as this trend continues. On the other hand, buildings in cities have yet reached their potentials. According to U.S. Energy Information Administration (USEIA), in 2018, residential and commercial buildings accounted for about 40% of total U.S. energy consumption, but buildings are often designed only to be used for a third of a day's time at any given point.

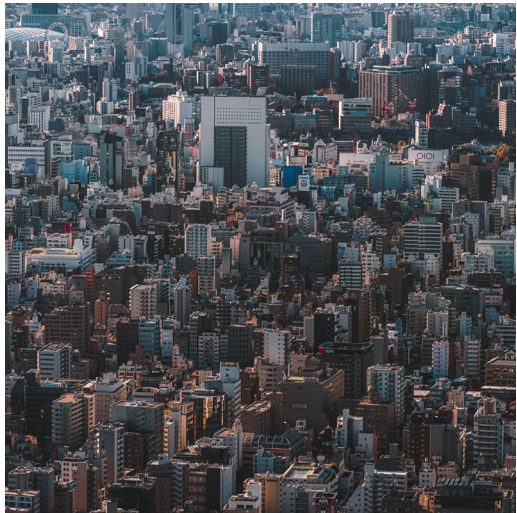
With the rise of the sharing economy, we have seen more flexible models of space and property use, where individuals can lend out their underused rooms or spaces (Airbnb), and different people can share a working space traditionally lent to larger groups (WeWork). This is known as the arbitrage of space, where opportunities are created between different values and modes of space use. This could well extend to "time gaps" within physical environment where flexible design can accommodate for a space that is activated through 24 hours - as an office during the day, as a restaurant during the evening, as a bedroom at night, and as an athletic court on the weekends. The possibilities are endless...

FORCES AT PLAY

“95% OF THE WORLD POPULATION
LIVES ON 10% OF THE LAND”

1,000,000

Additional people move into cities
every five to six days



POPULATION GROWTH

“Virtually all population growth between now and the end of the century will be in cities. It boils down to more than one million additional people living in cities every five to six days from now until 2100.”

- Joel Cohen, Laboratory of Populations at Rockefeller University and Columbia University

89.4 hrs

Spent in congestion by the
average New Yorker



COMMUTE CHALLENGES

Americans spent an average of 54.2 minutes commuting daily in 2018. Commute times have been rising for decades, and big job markets in high-cost and high-commute metropolitan areas like New York or the San Francisco Bay Area aren't helping to bring those averages down.

[Source: CNN]

\$115,000 (2x)

Amount of annual income needed to
afford a one-bedroom in Manhattan



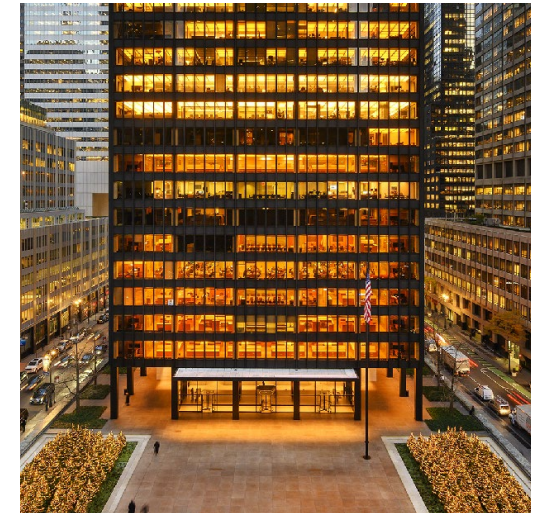
LACK OF AFFORDABILITY

“We produced less than half the number of units of new housing starts for the last 25 years than we used to produce every year for 50 years.”

Governor Charlie Baker
September 9, 2019

40%

of Total U.S. Energy Consumption
comes from buildings

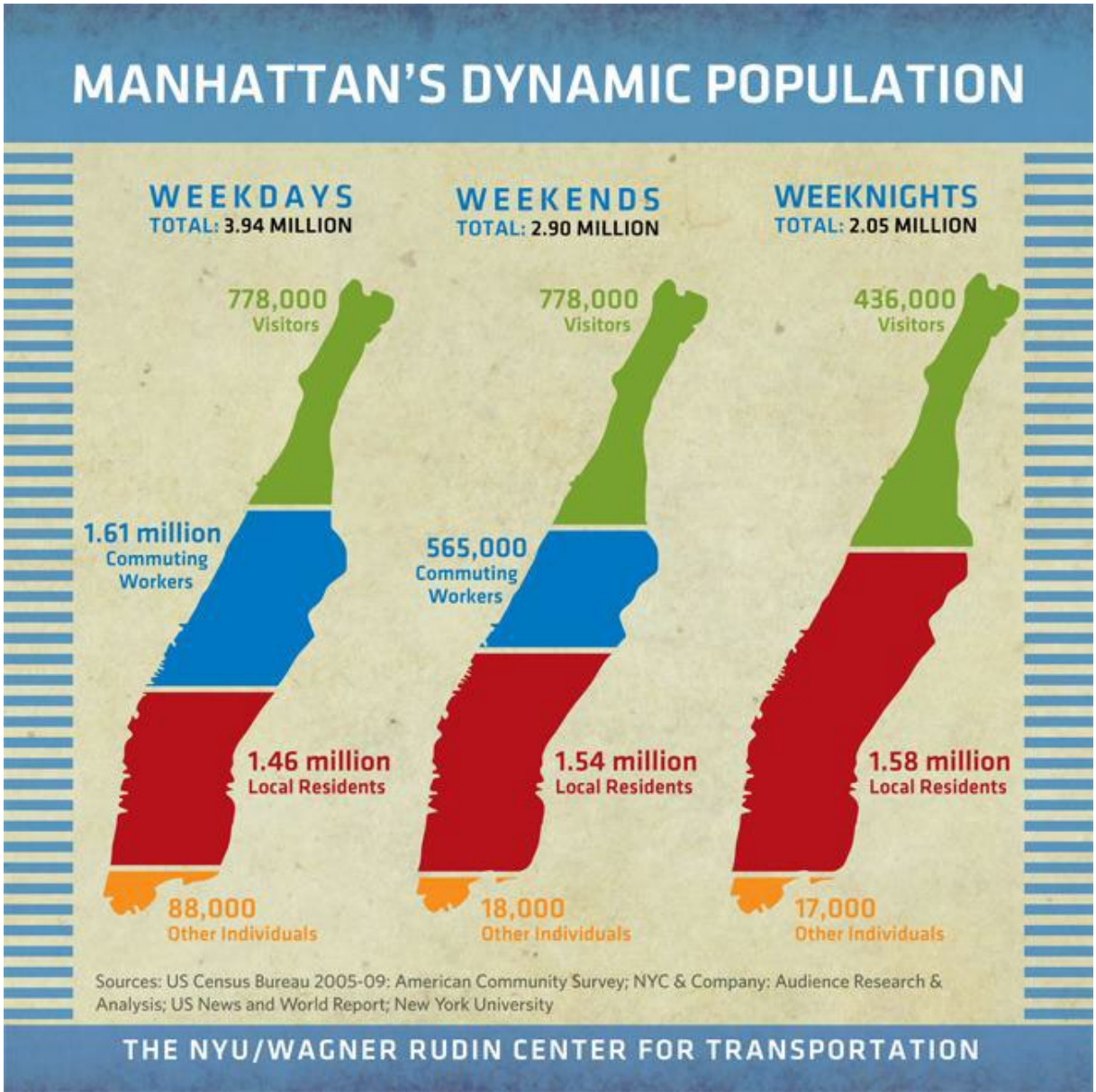


ENERGY CONSUMPTION

According to the U.S. Energy Information Administration (USEIA), in 2018, residential and commercial buildings accounted for about 40% of total U.S. energy consumption, but buildings are often designed only to be used for a third of a day's time at any given point.

TIDAL POPULATION

AN AVERAGE OF 1.61 MILLION PEOPLE COMMUTE TO
MANHATTAN ON A DAILY BASIS



THAT'S A POPULATION GAP OF NEARLY 1-2 MILLION
BETWEEN WEEKDAYS AND WEEKNIGHTS + WEEKENDS

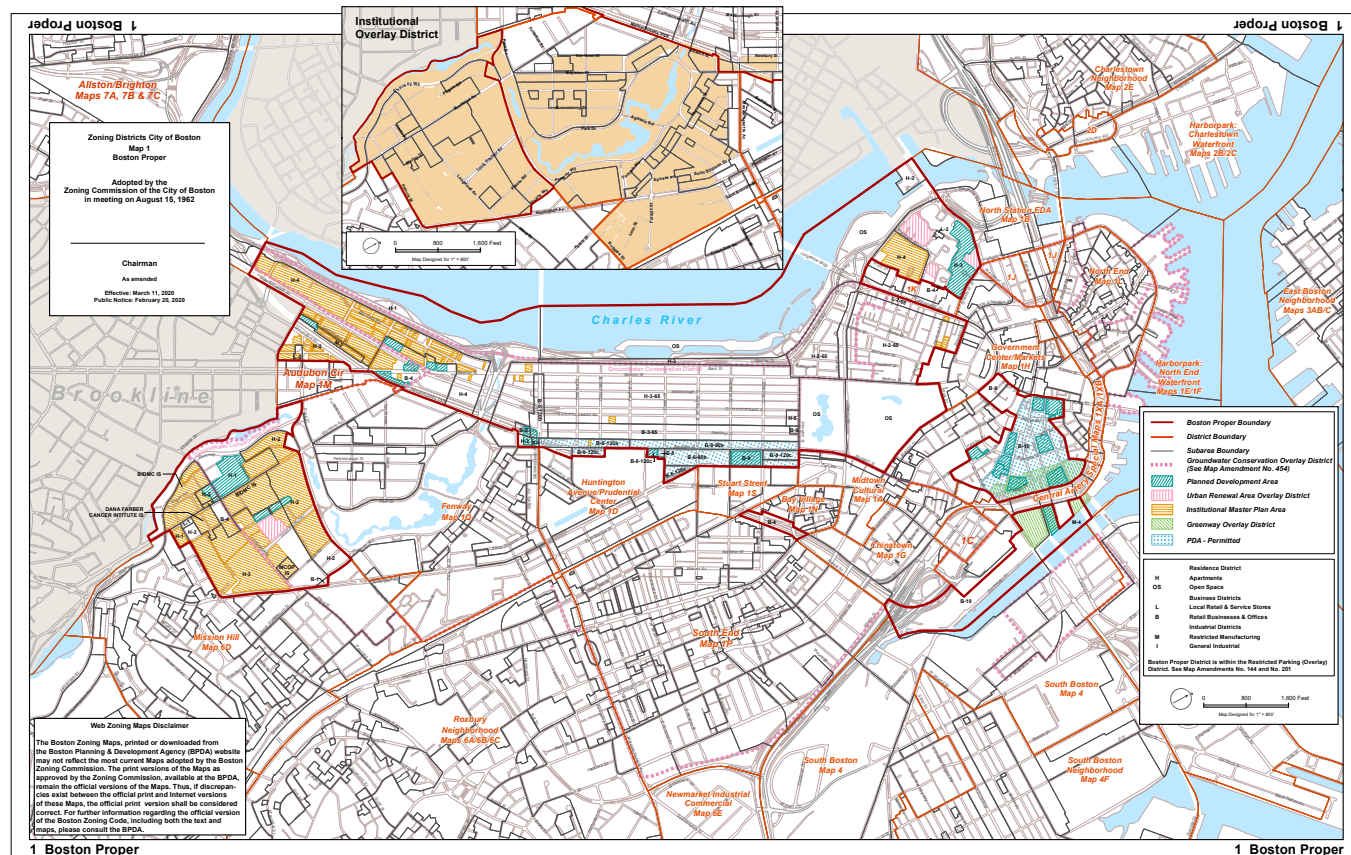
CITIES ARE “LESS FUN”...



...BECAUSE THERE IS LESS SERENDIPITY

BEYOND ZONING

ZONING POLICIES ARE SET IN PLACE TO ENSURE SENSIBLE AND SUSTAINABLE URBAN GROWTH, BUT THE BOUNDARIES ARE INCREASINGLY BLURRED...



ZONING MAP
City of Boston



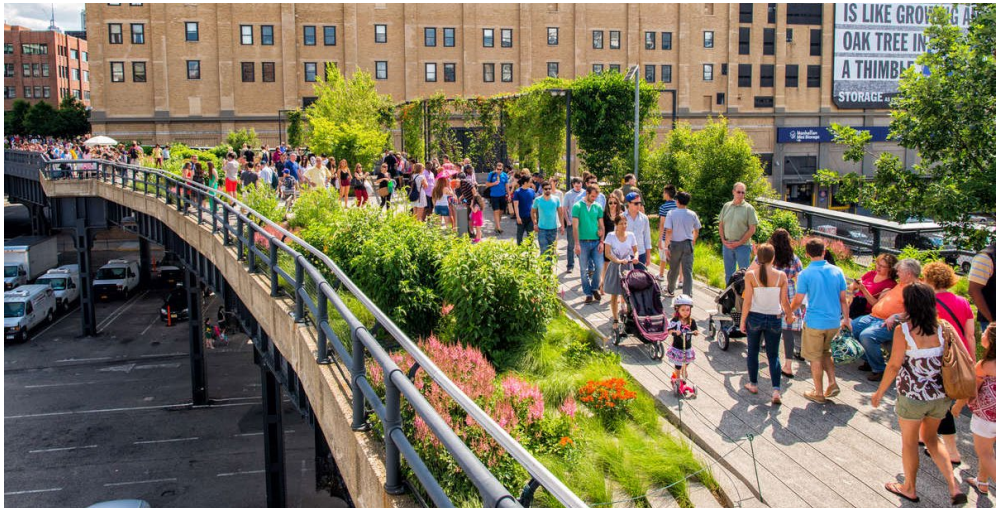
WORKING FROM HOME = RESIDENTIAL + OFFICE

SHOPPING ONLINE = COMMERCIAL + RESIDENTIAL

ONLINE CLASSES = RESIDENTIAL + INSTITUTIONAL

MAKER SPACE = COMMERCIAL + INDUSTRIAL

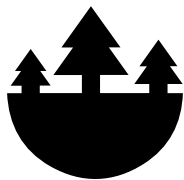
TIMES ARE TOUGH FOR CITIES...



SOCIAL



ECONOMIC



ENVIRONMENTAL

...BUT THESE TRENDS ARE HERE TO STAY

IS OWNERSHIP STILL RELEVANT?

Uber



BLUEbikes



wework



SHARING OF TRANSPORTATION

SHARING OF SPACES

PROVOCATION

LIVE



EAT



WORK



PLAY

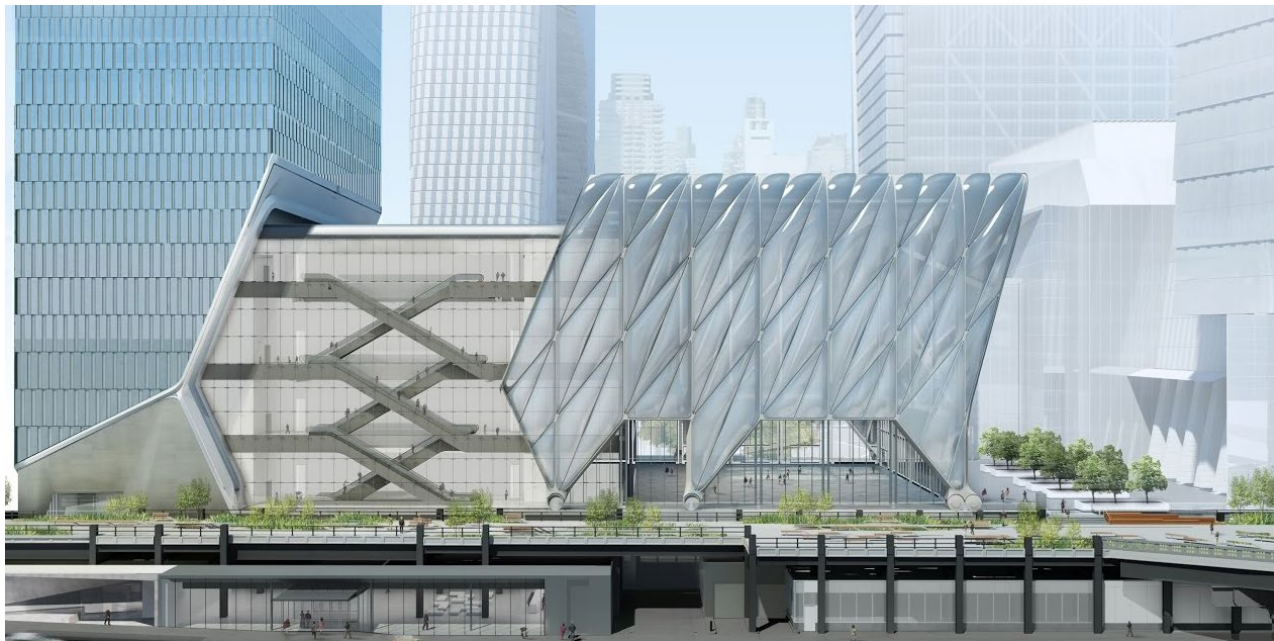


A 24 HOUR CITY NEEDS A 24 HOUR BUILDING

SAVING SPACE, TIME, ENERGY ALL WHILE CREATING VALUE

TRUE MIXED-USE

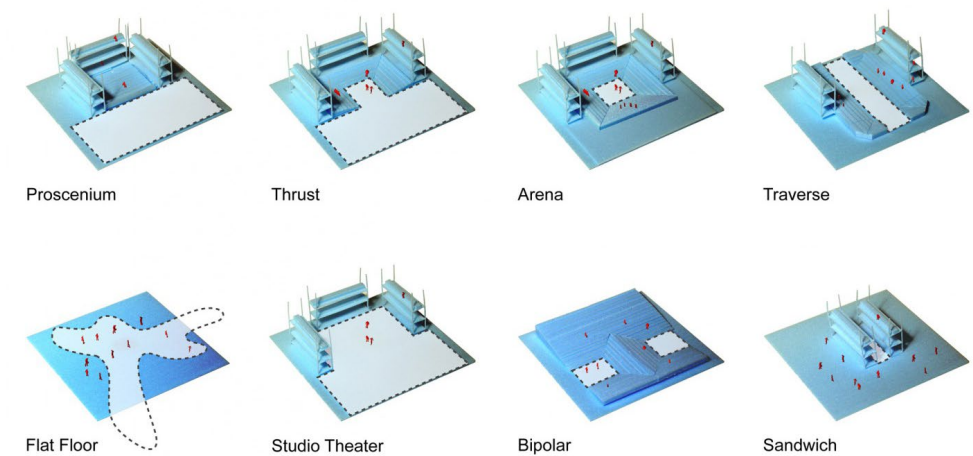
SPATIAL PRECEDENTS



THE SHED @ HUDSON YARDS

DS+R & Rockwell Group

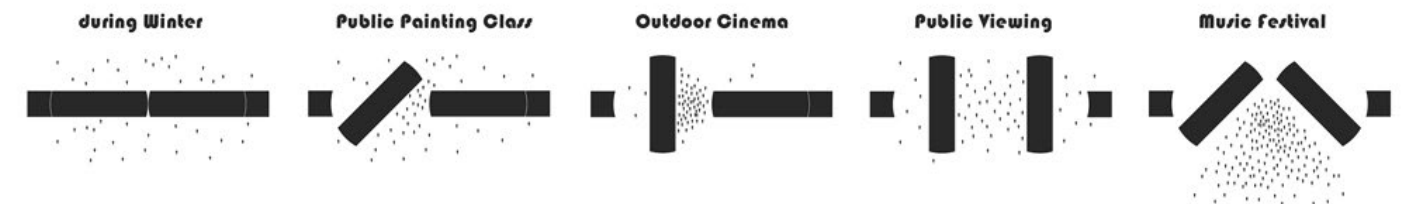
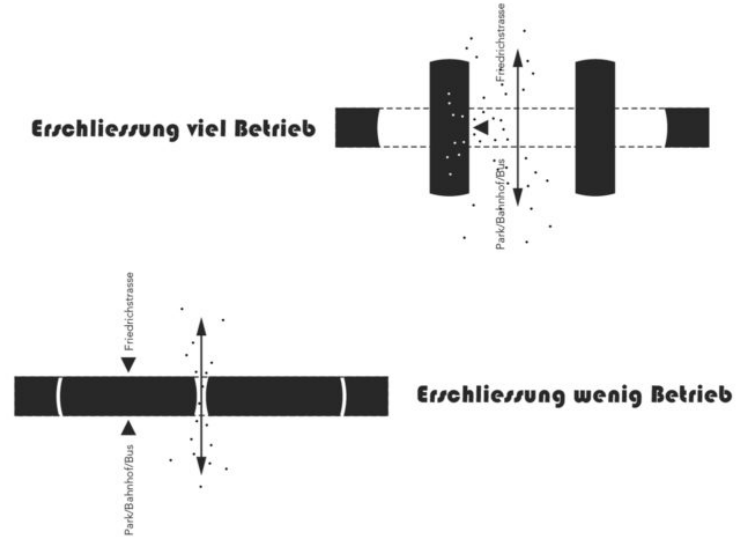
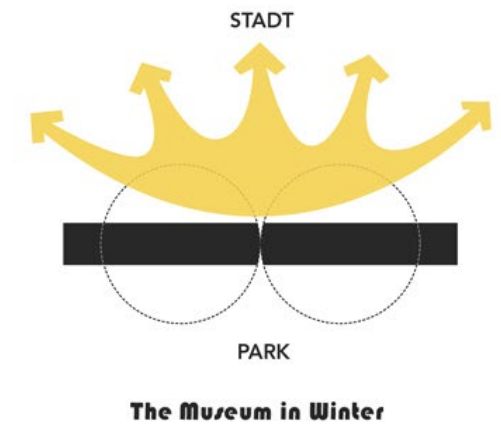
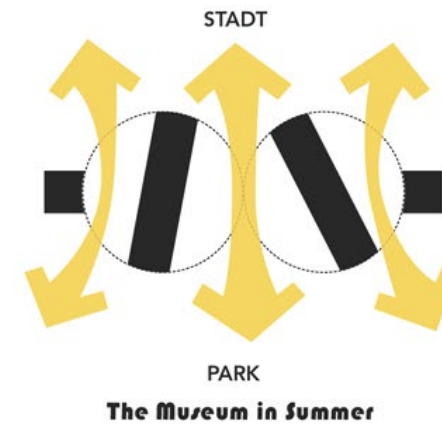
Designed with adaptability in mind, the Shed at Hudson Yards is a cultural center that features a wide range of activities in “performing arts, visual arts, and culture.” Its iconic 16,000 sf telescoping shell allows the space to expand and contract to accommodate many events and audiences.



DEE AND CHARLES WYLY THEATRE

OMA + REX

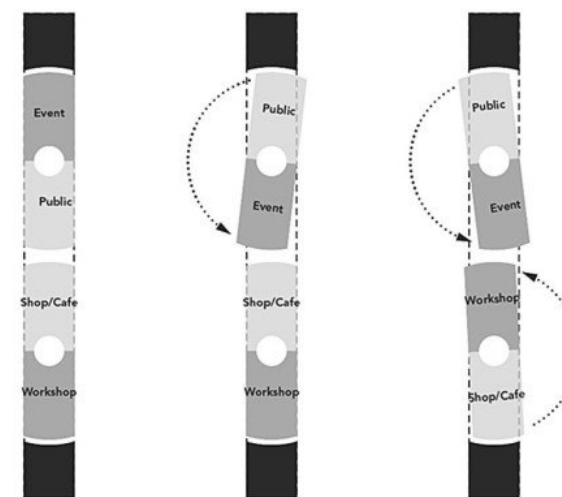
Aimed at revolutionizing the traditional “front of house” and “back of house” model, the Dee and Charles Wyly Theatre features an innovative vertical design (at 12 stories) that allows for a compact design while providing adaptability and flexibility in its setup.

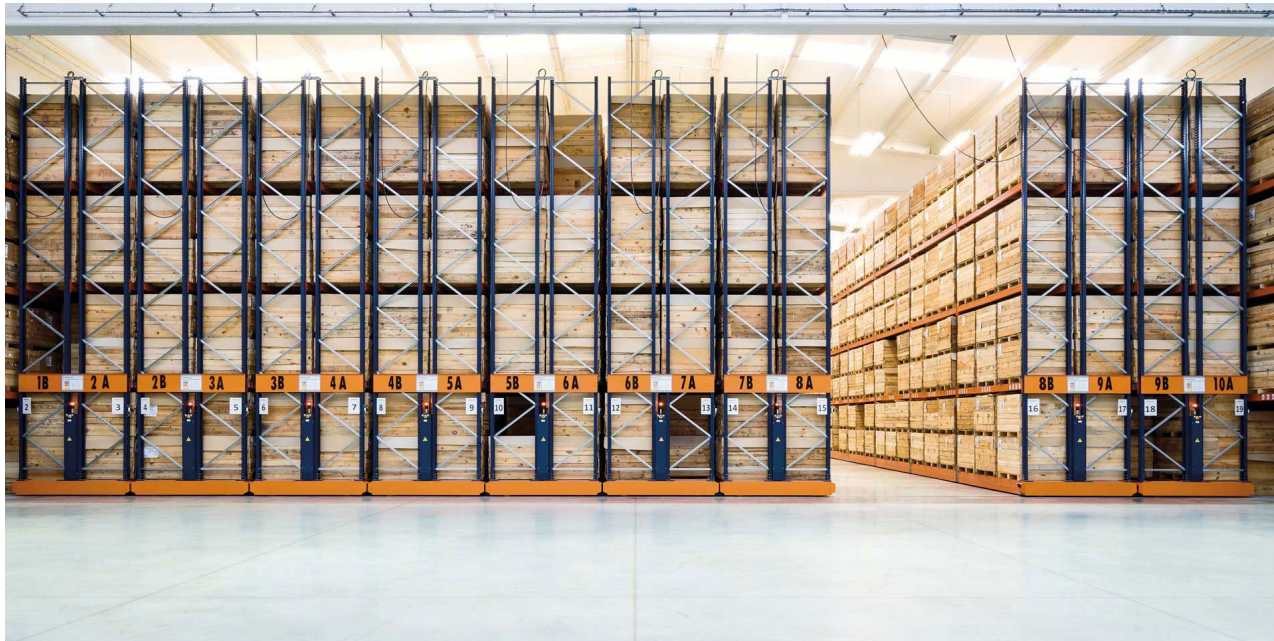


BAUHAUS MUSEUM PROPOSAL

Penda Architects

Penda's proposal boasts a transformable design that serves as an "extension of the city on one hand and as a connector to the surrounding park on the other." The design features two rotating platforms that can open and close at different times of the day to modulate connection to the sculpture park.

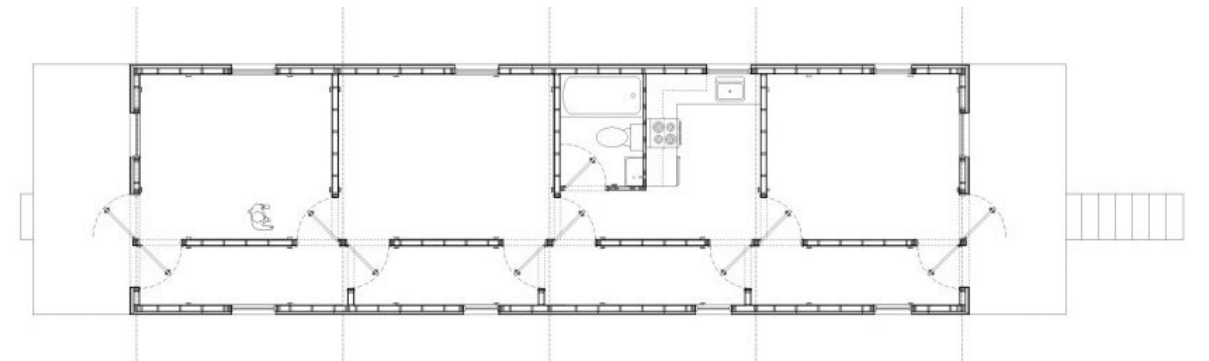




MOBILE SHELVING SYSTEMS

Warehouses & Libraries

In order to minimize spatial inefficiencies caused by corridor spaces, many libraries and warehouses adopt a movable shelving system whereby shelves operate on a sliding mechanism and will collapse together when not in use.



DUCHAMP DOOR MODEL

First Office

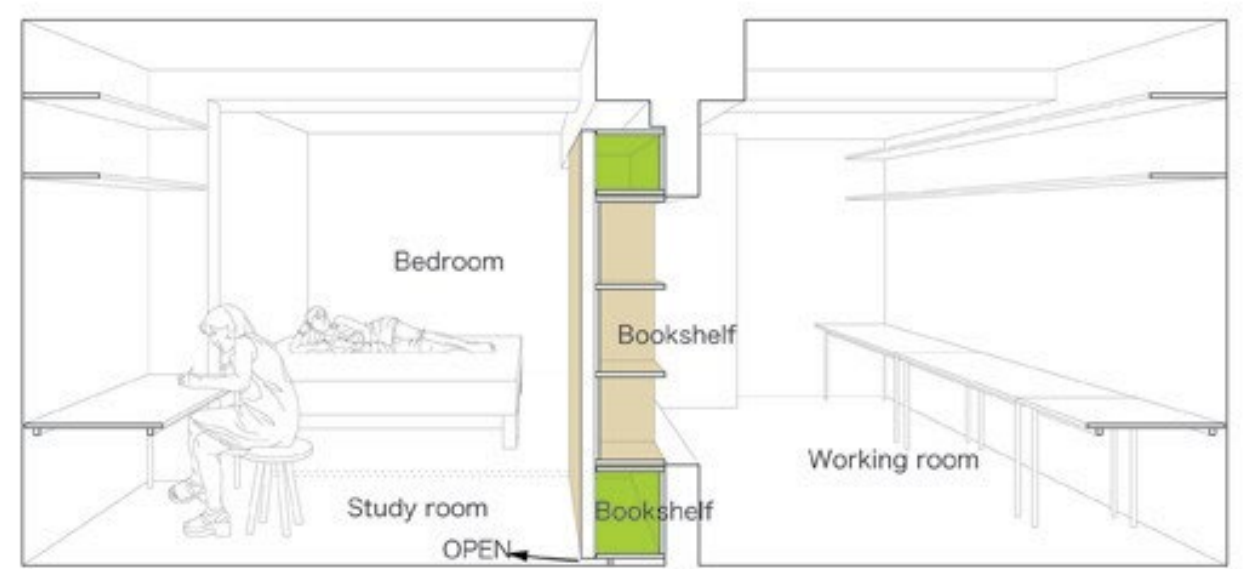
Inspired by Duchamp's original double-door installation, this 2011 adaptation by First Office extends it into the context of a shotgun house and explores the potentials and implications of creating flexibility within the structure with a seemingly commonplace domestic element.



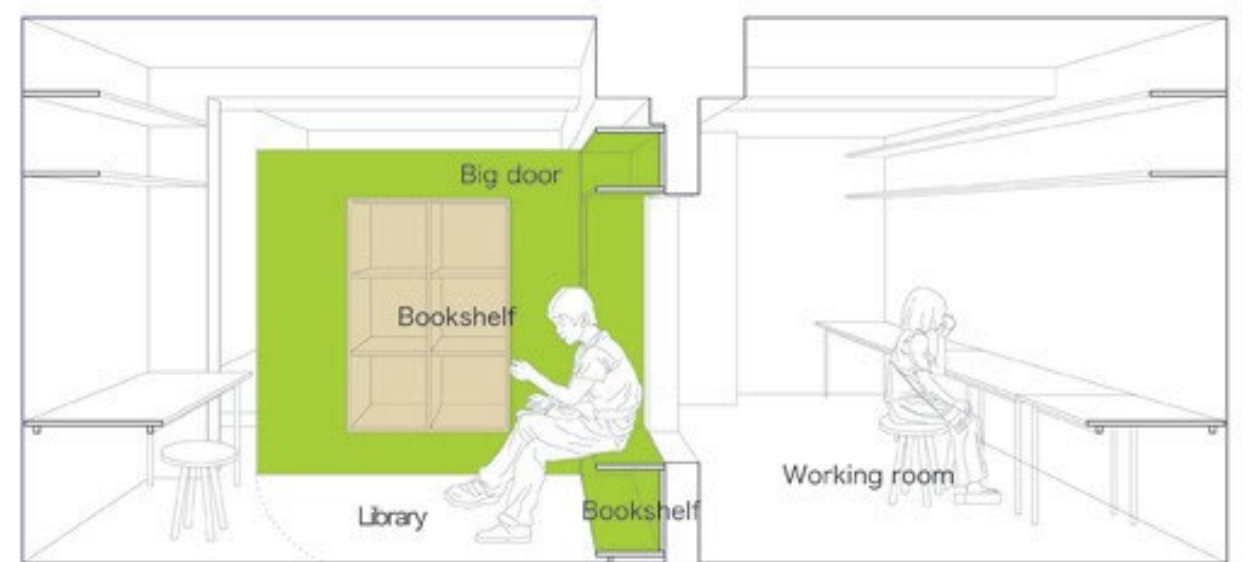
SWITCH

Yuko Shibata Office

Originally intended as a residential space, the design intervention allows greater clarity and separation between its living and office program and sections. By introducing a wall-like hinging partition, the space is modulated by the adaptability of the mechanism as well as the iconic color.



HOME(pm 10:00~am 9:00)



OFFICE(am 9:00~pm 10:00)

OPERATIONAL PRECEDENTS



wework

WEWORK
Co-Working

Founded in 2010 in response to the growing demand for work spaces by digital nomads and young creative professionals, WeWork has grown to a major real estate company that provides flexible shared working spaces with over 800 locations across the world.



SPACIOUS

SPACIOUS
Co-Working

Now acquired by WeWork, Spacious was a New York-based company that aims to take advantage of under-utilized urban spaces, such as “abandoned retails stores and empty restaurants” during off-hours into co-working spaces. The company had since converted dozens of restaurants in NYC and SF into weekday work spaces.



whyhotel

SONDER



SHORT-TERM RENTALS

Various companies

Over the years, short-term rental platforms such as Airbnb, Mint House, WhyHotel, and Sonder have emerged to allow homeowners and landlords to rent out their homes on a more flexible basis, offering flexibility in contract and usage compared to traditional models of hotels and rentals.

TIMESHARE APARTMENTS

Various locations

A timeshare (sometimes called vacation ownership) is a property with a divided form of ownership or use rights. These properties are typically units in which multiple parties hold rights to use the property, and each owner of the same accommodation is allotted their period of time. (Source: Wikipedia)



McREFUGEES

SOCIAL PHONOMENA

As many McDonalds locations in major cities are now open 24 hours, they have become a place of stay at late nights for the homeless population who cannot afford to rent, raising controversies around public and private space, housing affordability, income equality, etc.



NET CAFE REFUGEES

SOCIAL PHONOMENA

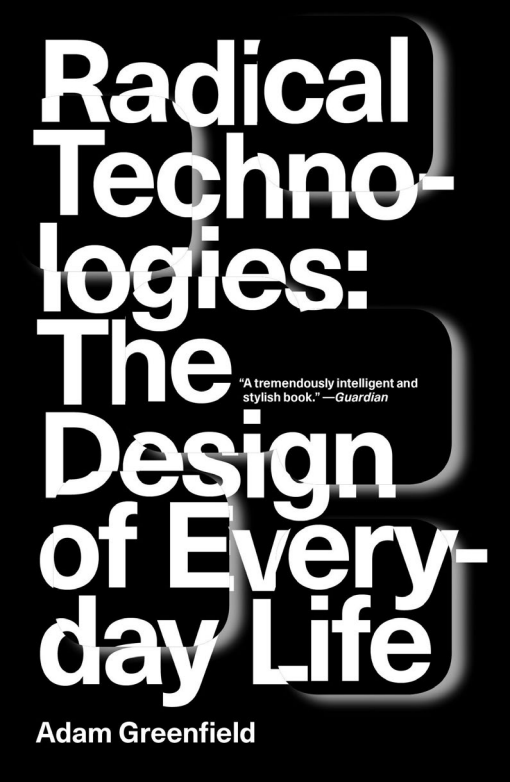
Net café refugees, also known as cyber-homeless, are a class of homeless people in Japan who do not own or rent a residence (thus having no permanent address) and sleep in 24-hour Internet cafés or manga cafés, as the cost is often cheaper than that associated with renting. [Source: Wikipedia]

LITERATURE



MADE IN TOKYO
Atelier Bow-Wow

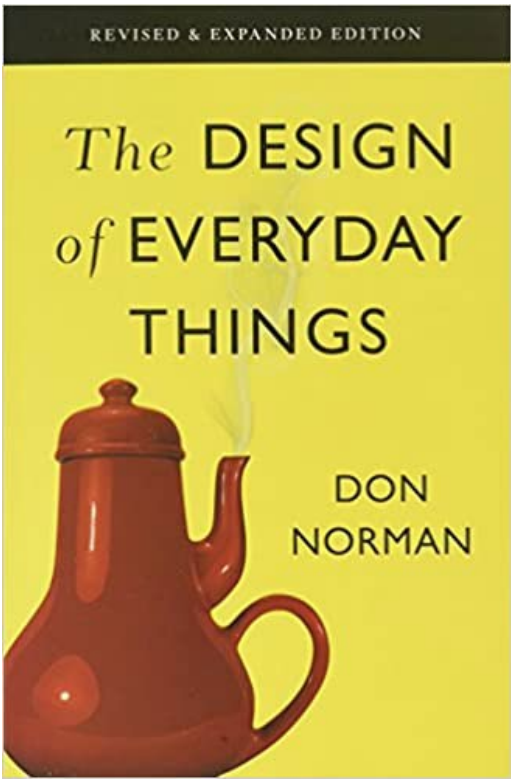
A catalog of many of the idiosyncratic program adjacencies in Tokyo, *Made in Tokyo* documents that “the unique modernity of Tokyo’s urban space through the architecture that architects would like to forget.”



RADICAL TECHNOLOGIES
Adam Greenfield

“Everywhere we turn, a startling new device promises to transfigure our lives. But at what cost?”

In this investigation into the implications of the latest and greatest in technology, Greenfield dissects what it means to have our lives tied to the novelties and conveniences offered by technology.



THE DESIGN OF EVERYDAY THINGS
Don Norman

By looking at the design behind our everyday objects - and why some are more user-friendly than others, Norman’s book reminds us that successful products relies not just on the physical design itself but also how well they address the needs of users and the principles of cognitive psychology.

RESEARCH + ANALYSIS

OPPORTUNITY ANALYSIS - BY TYPE

- SEASONAL
- TIMES OF WEEK
- TIMES OF DAY

LAND

SPACE

TIME



GOLF COURSE



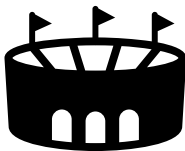
OIL + GAS MINE



PARKING LOT



FIELDS



STADIUMS



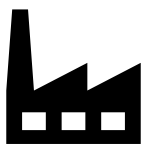
PARKS



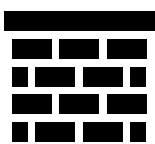
AGRICULTURAL



BUILDING



INDUSTRIAL



PARKING



OFFICE



SCHOOL



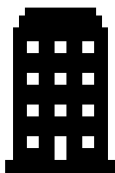
RETAIL



HOME



AIR



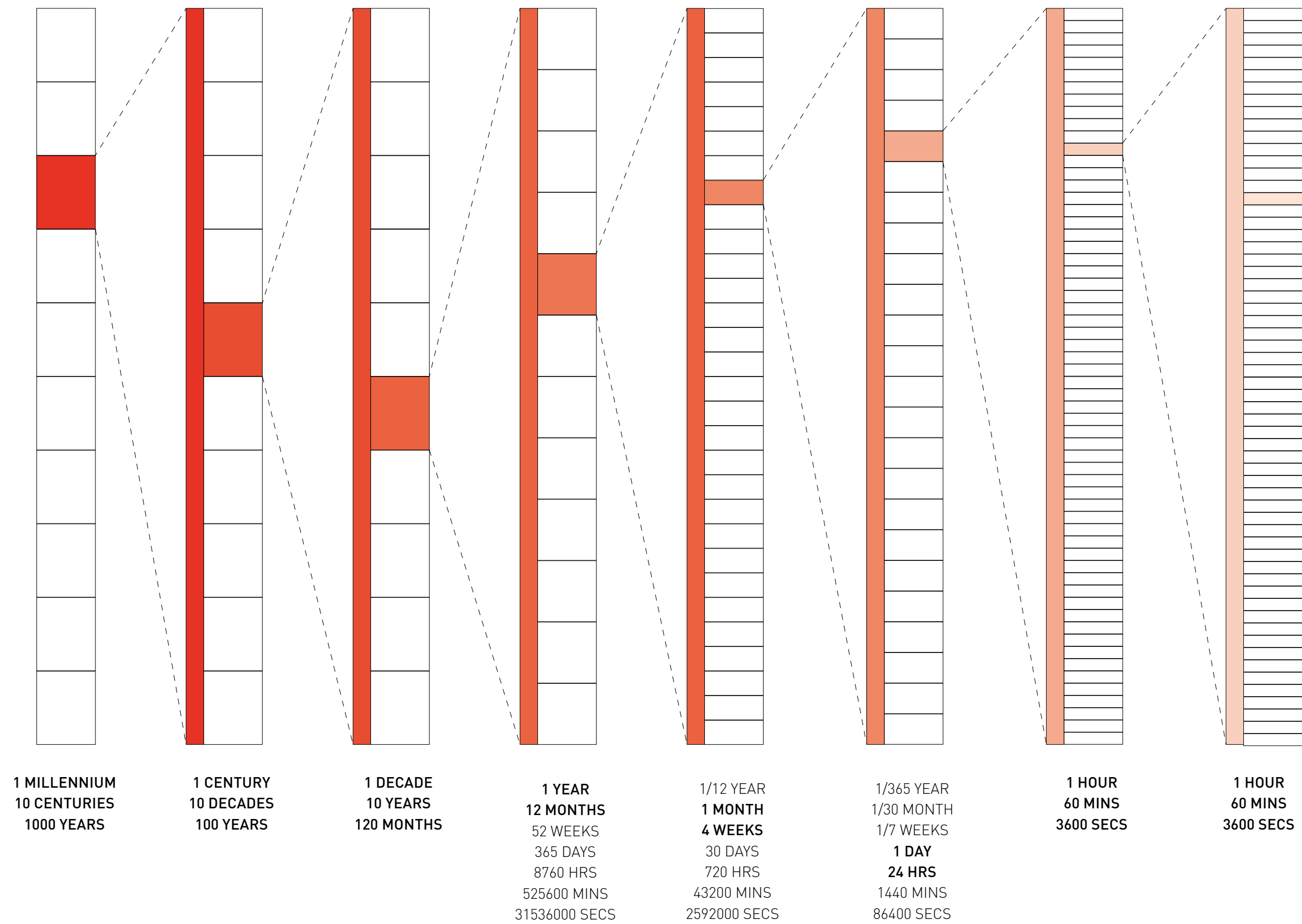
AIR RIGHTS



FAA AIRSPACE

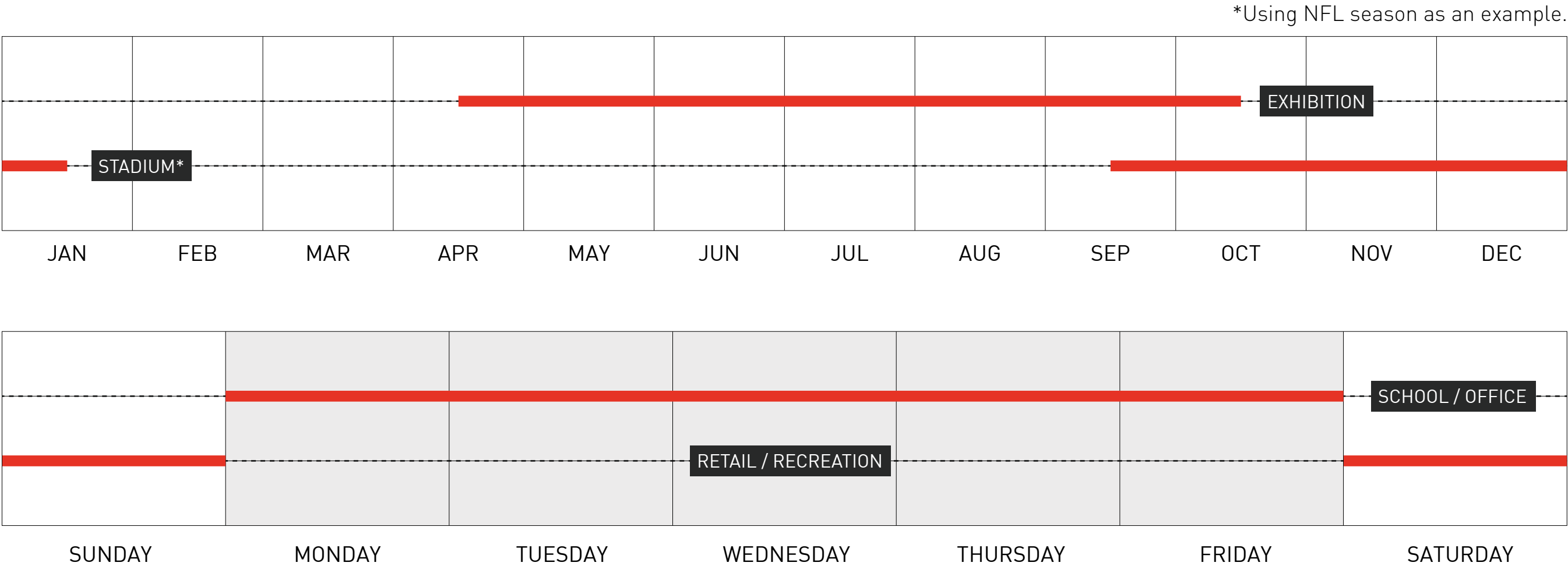


SCALE OF TIME



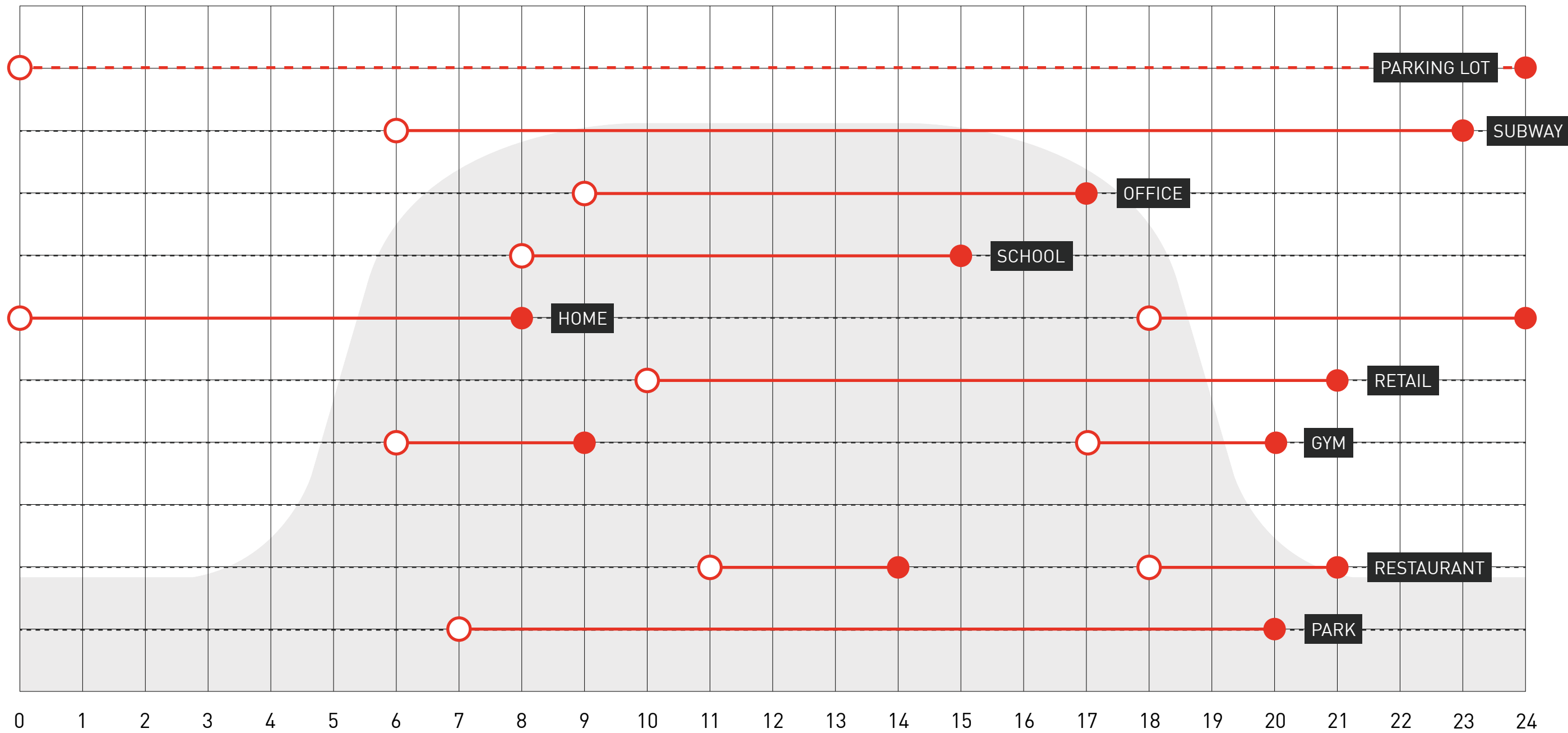
OPPORTUNITY ANALYSIS

INEFFICIENT OCCUPANCY ON A SEASONAL + WEEKLY SCALE



OPPORTUNITY ANALYSIS

INEFFICIENT OCCUPANY ON A DAILY SCALE



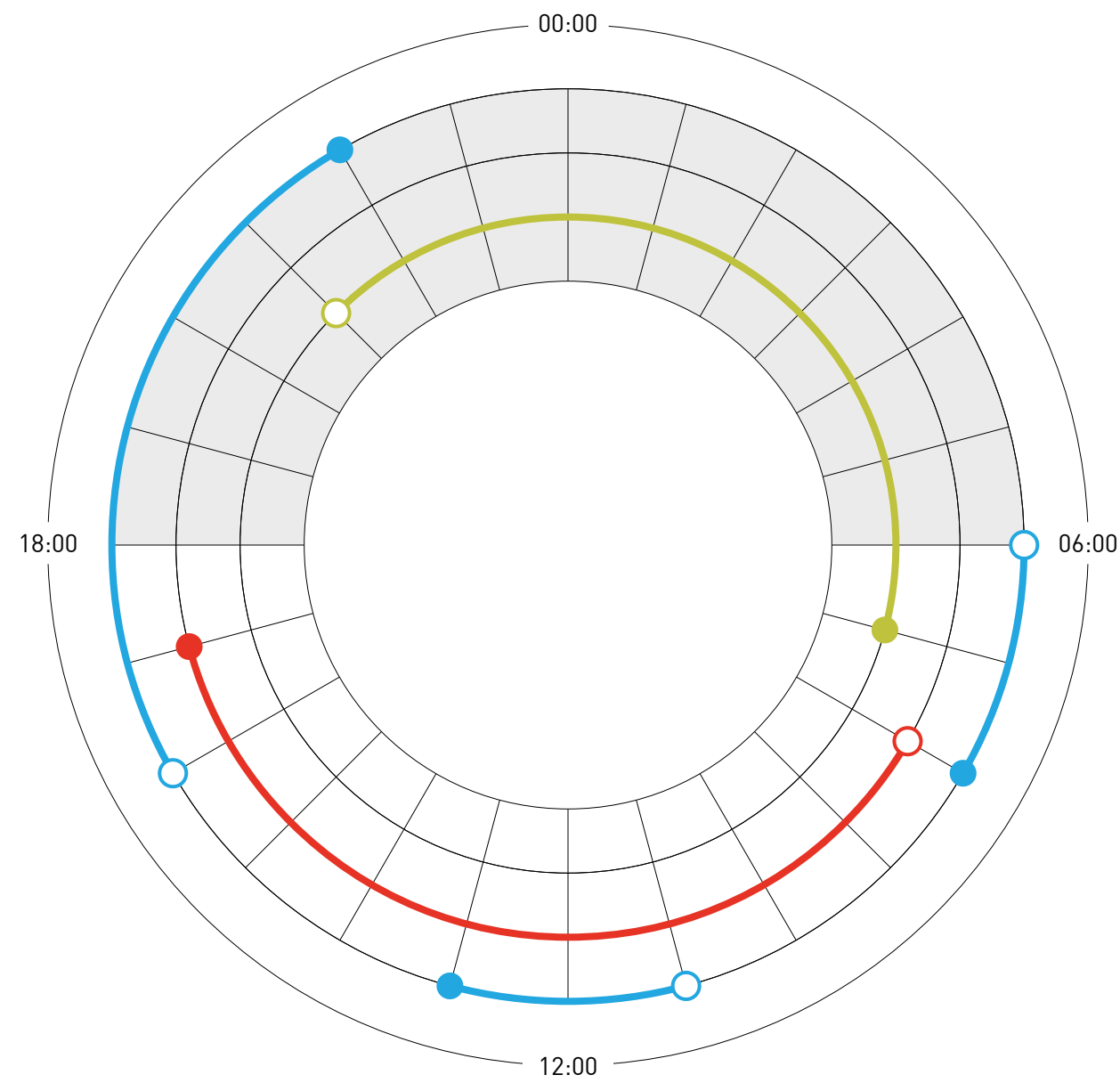
PROGRAMMATIC UNDERSTANDING

“WHAT DO PEOPLE NEED
OUT OF A SPACE?”



Some programs have clear overlaps...

OWNERSHIP BY TIME



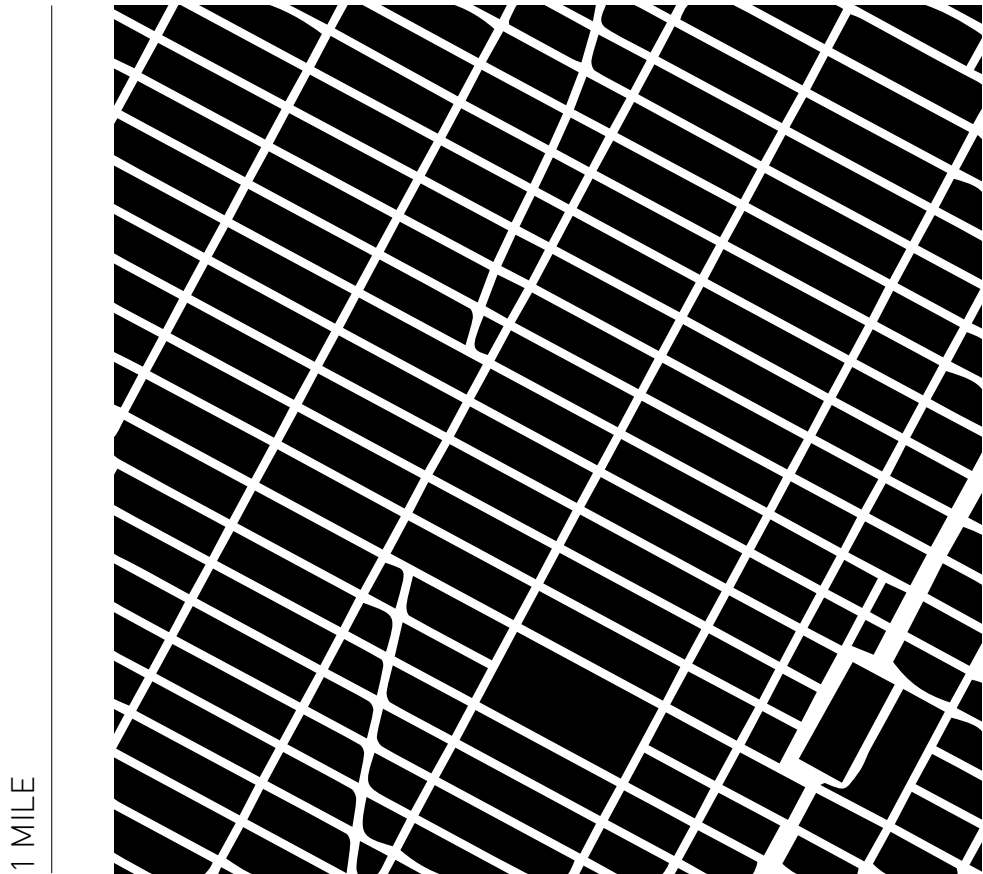
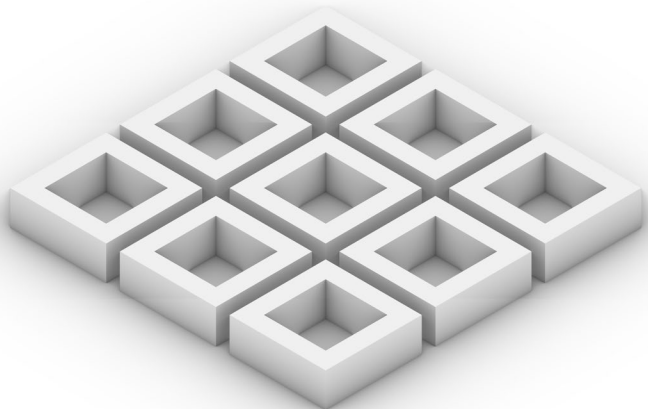
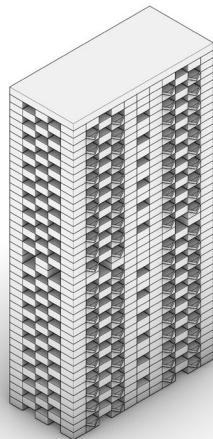
As opposed to the traditional model of singular programmatic use, the new paradigm encourages a mix of uses around the clock, so that the physical space - a precious resource in many cities - can be used to its maximum and allow for economic, environmental, and social benefits.

POSSIBLE COMBINATONS ARE INFINITE...



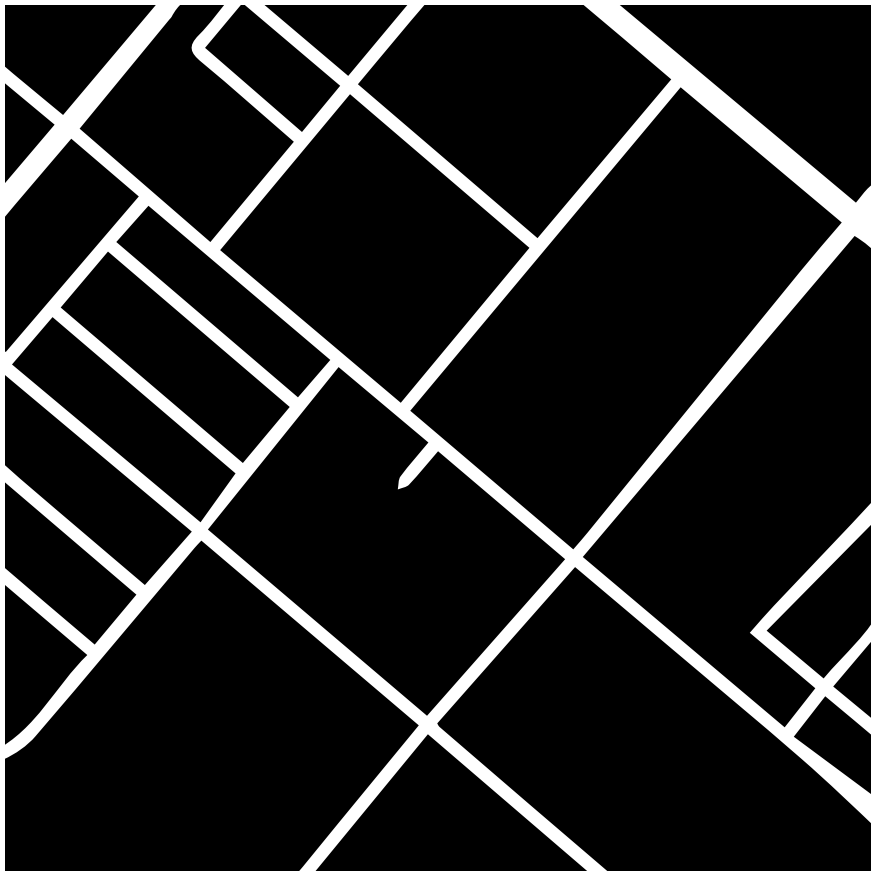
While traditional programmatic design dictates a particular use for a given space around the clock, the new flex model will allow for cross-programmatic breeding that transforms the space into different uses to fit different needs and demands throughout the day.

TYPOLOGICAL ADAPTATIONS



1 MILE

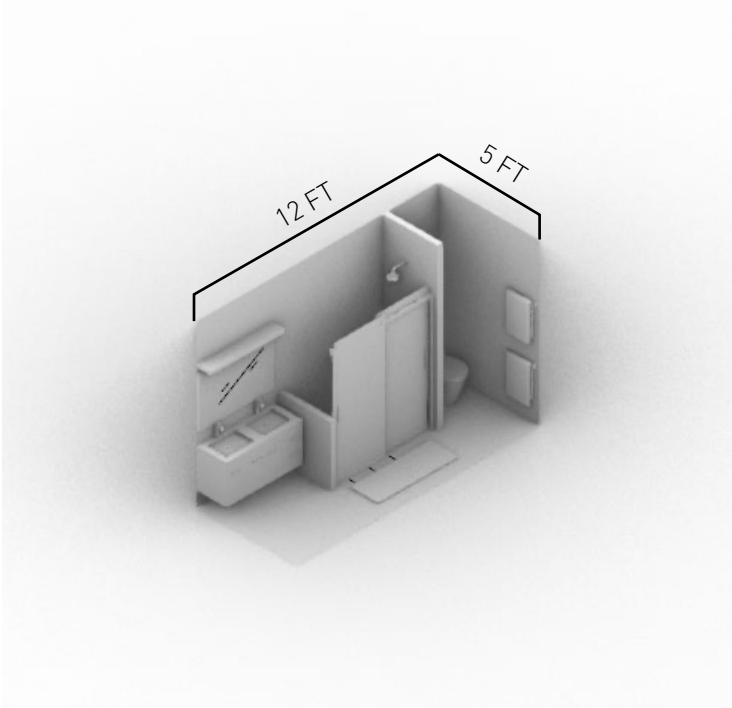
MANHATTAN, NEW YORK CITY, NY
POPULATION / SQ MI: 66,940
HIGH DENSITY APPLICATION



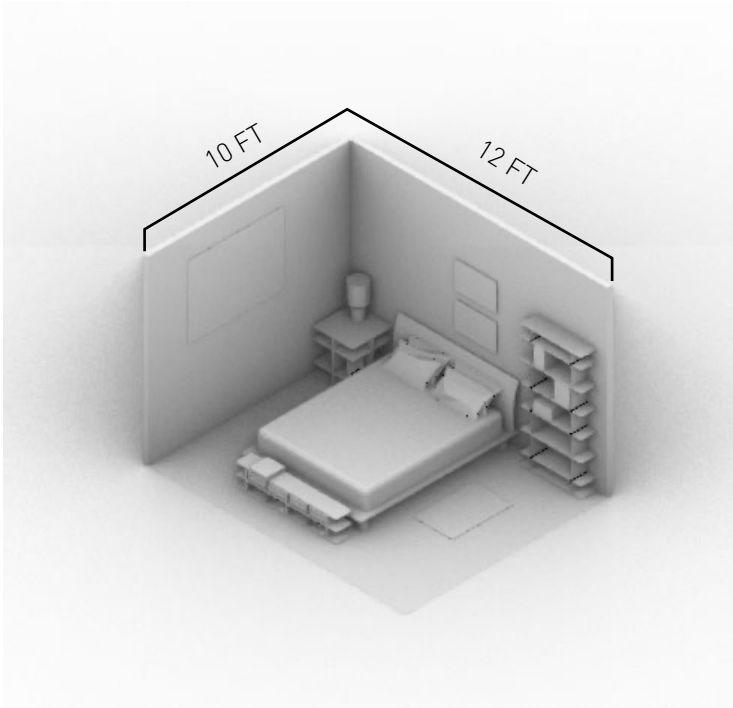
1 MILE

LOS ANGELES, CA
POPULATION / SQ MI: 8,484
LOW DENSITY APPLICATION

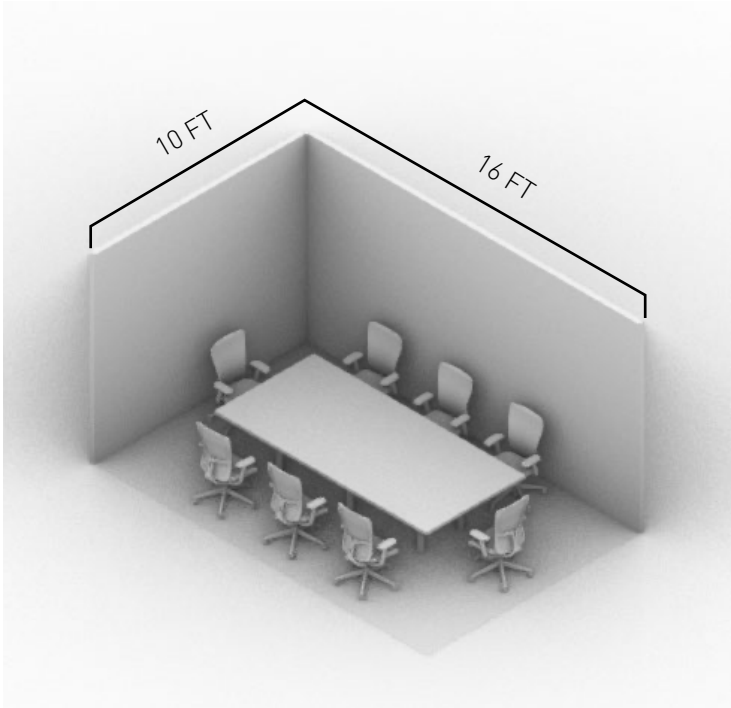
UNDERSTANDING SCALE



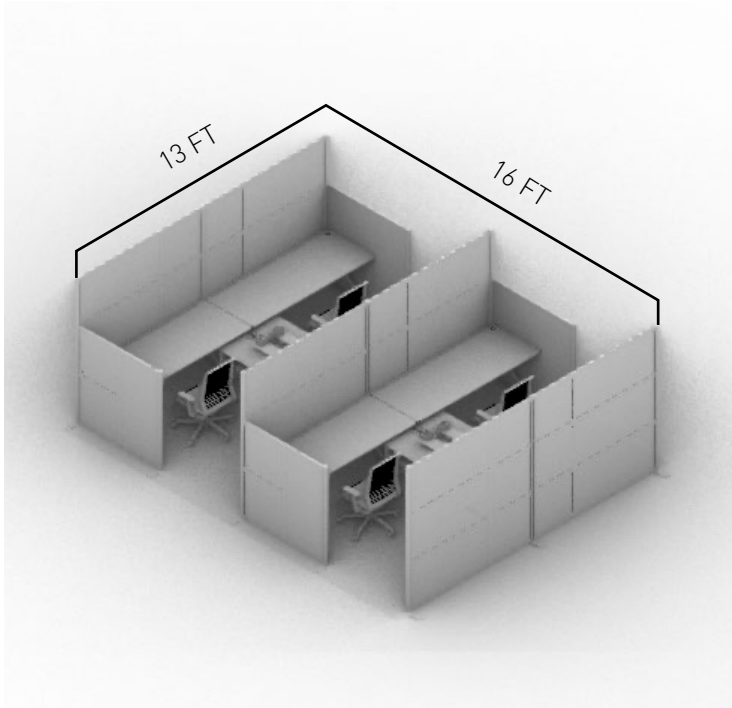
BATHROOM
60 SQFT



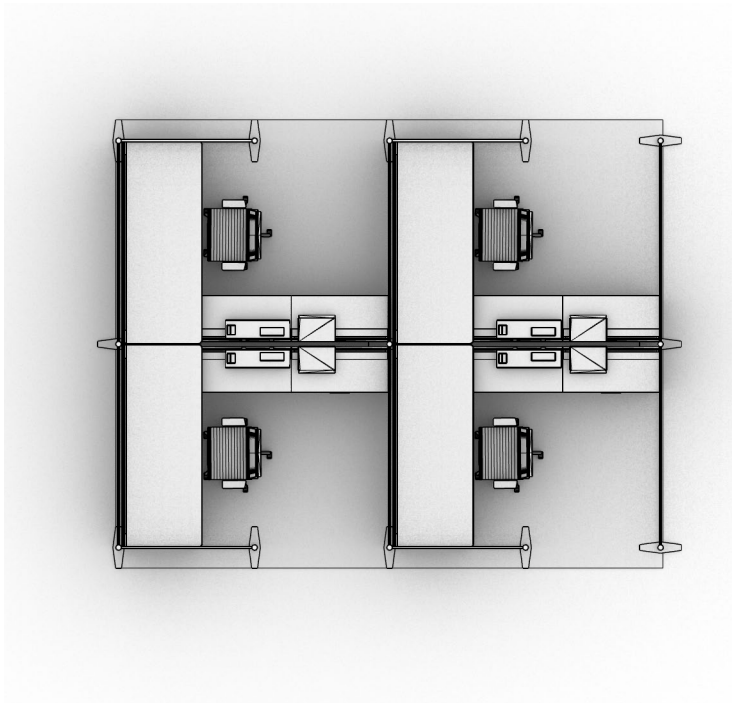
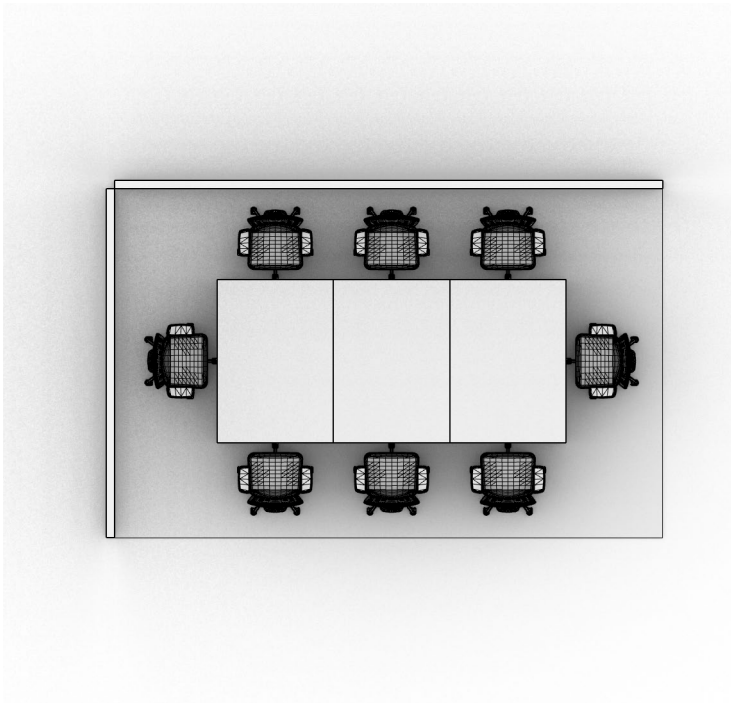
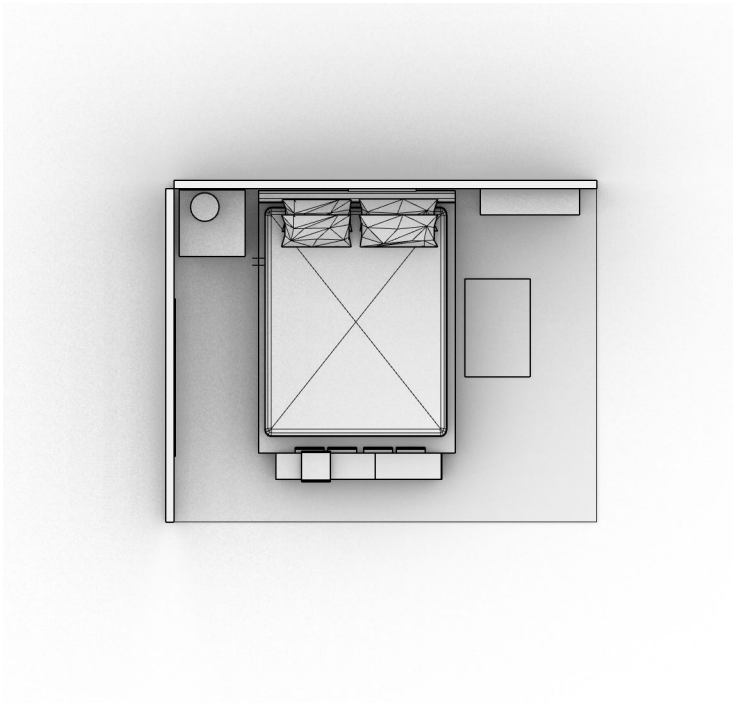
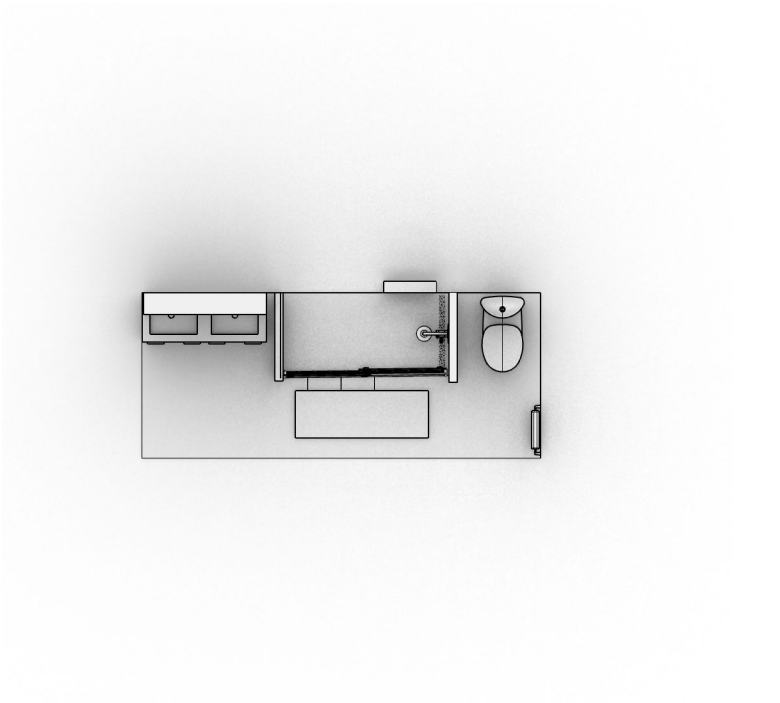
BEDROOM
128 SQFT



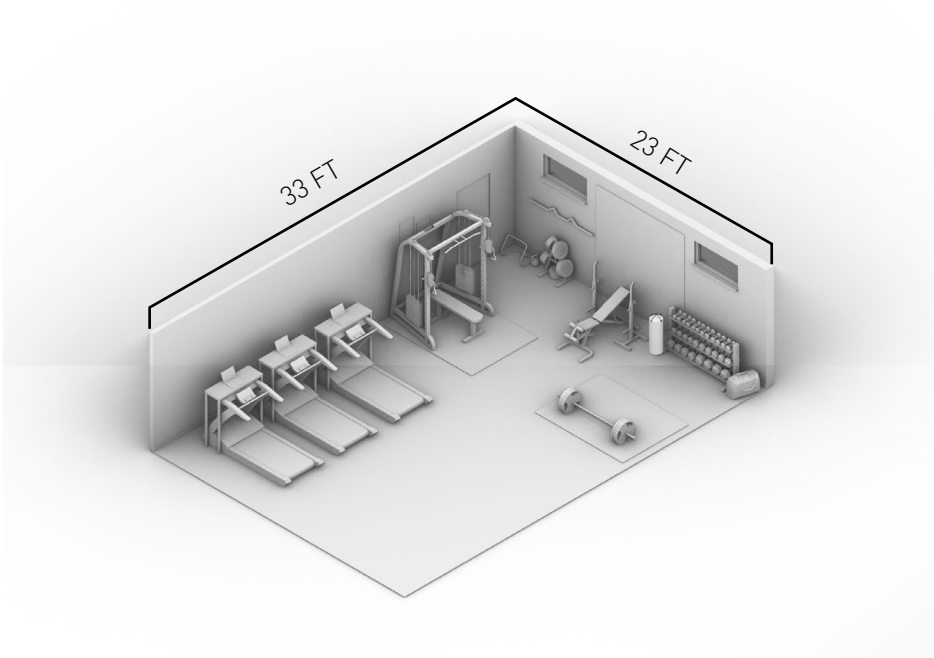
MEETING ROOM (8)
174 SQFT



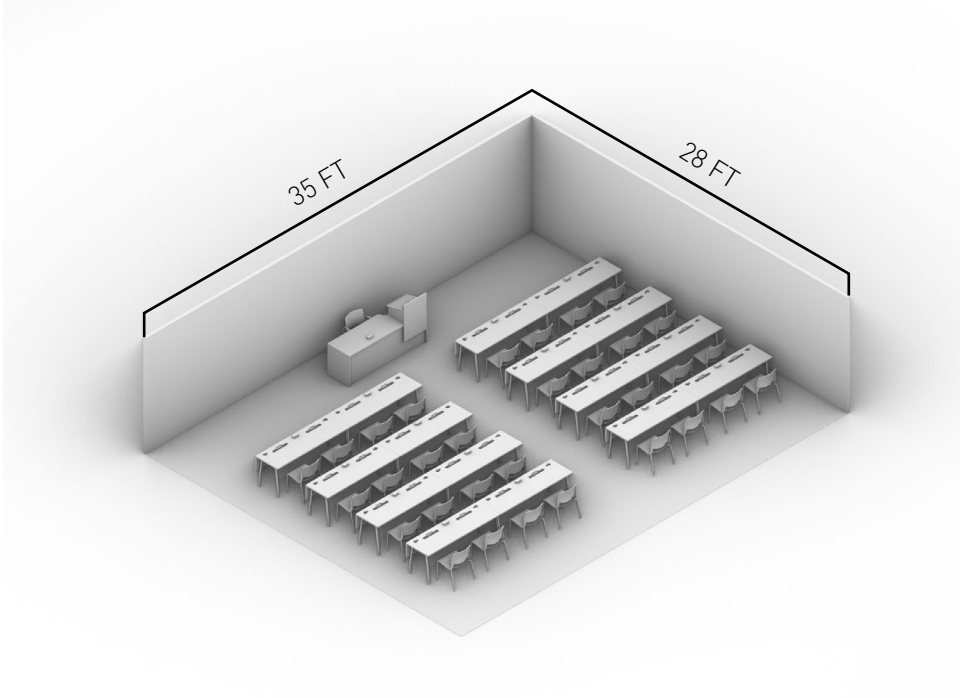
OFFICE CUBICLES (4)
222 SQFT



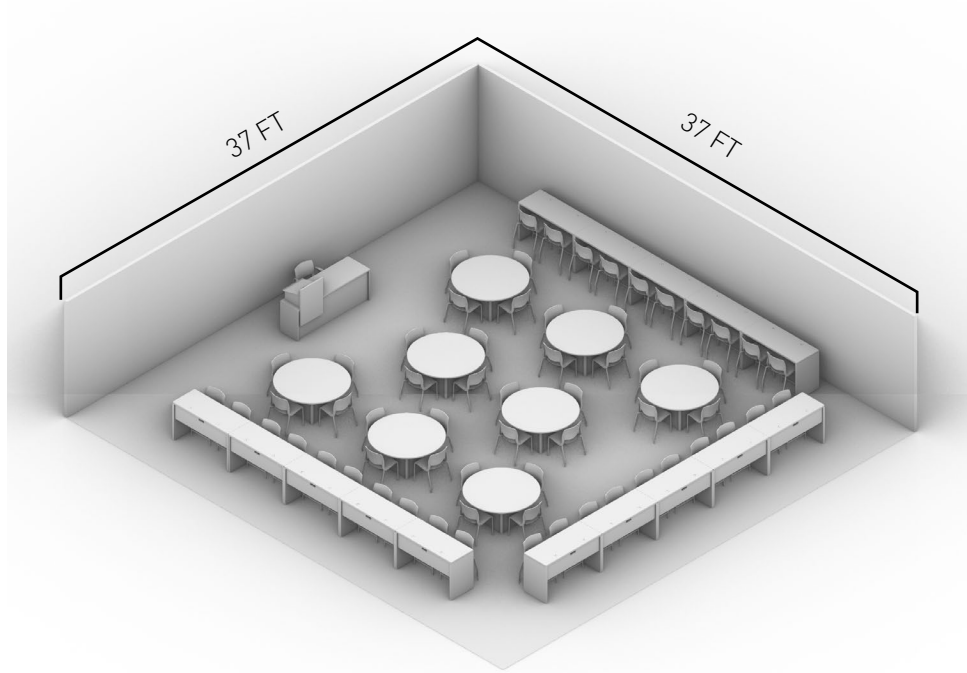
UNDERSTANDING SCALE



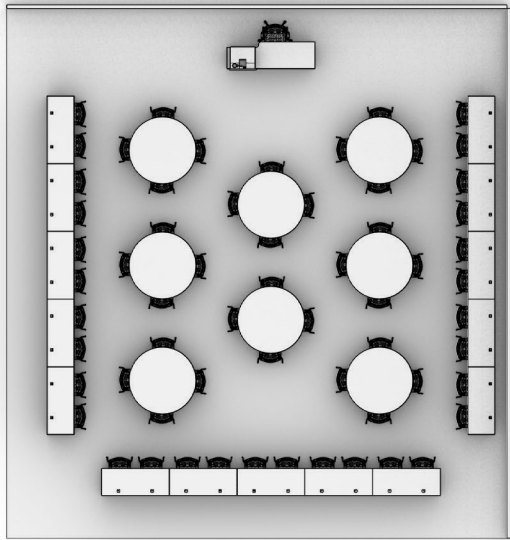
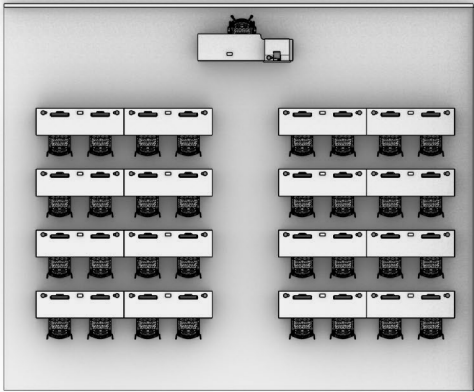
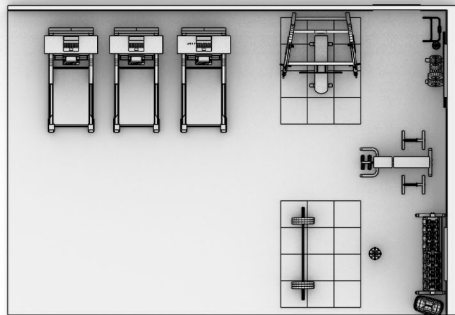
SMALL GYM
726 SQFT



CLASSROOM
979 SQFT



MULTIPURPOSE ROOM
1440 SQFT



PROTOTYPE



0 500 ft 1500 ft 3000 ft

CENTRAL PARK

ROCK CENTER

TIMES SQUARE

562 FIFTH AVE

HUDSON YARDS

GRAND CENTRAL

PENN STATION

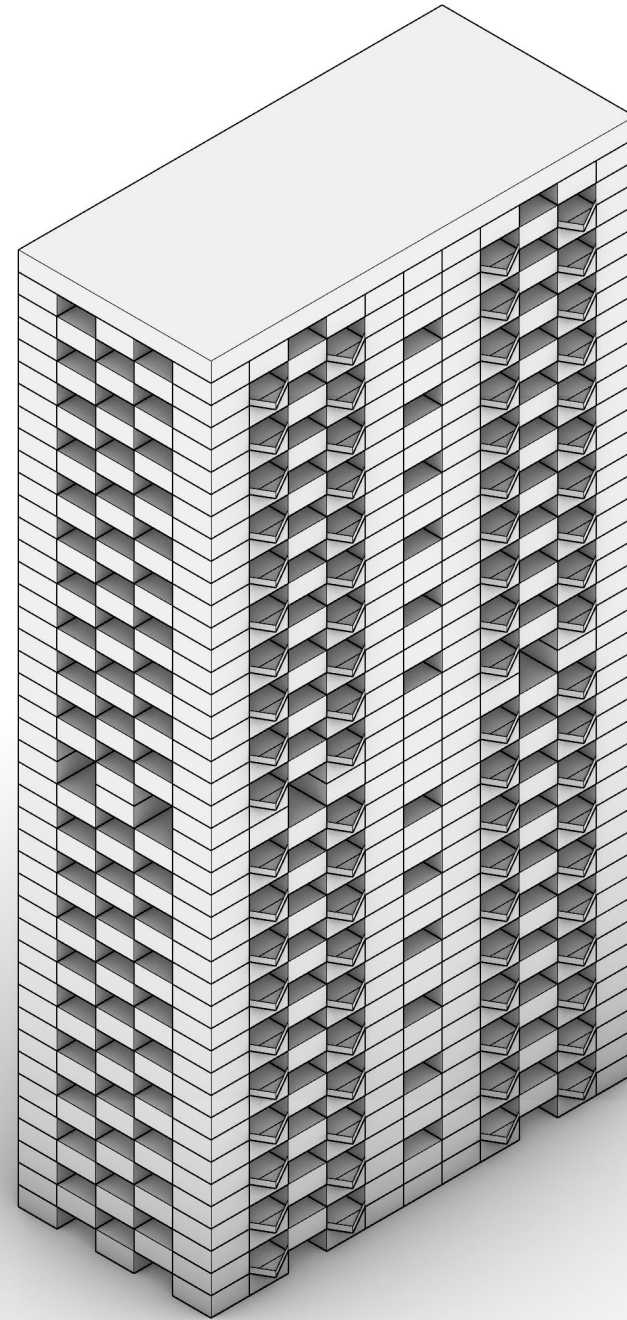


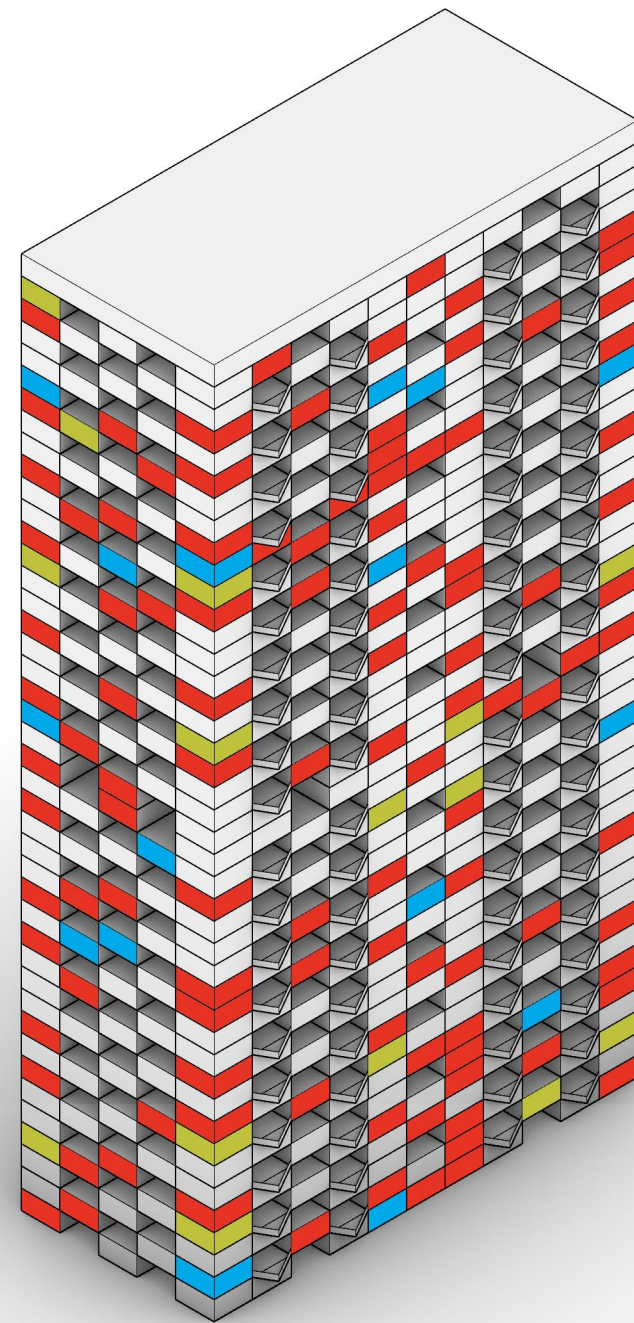
PROTOTYPICAL SITE

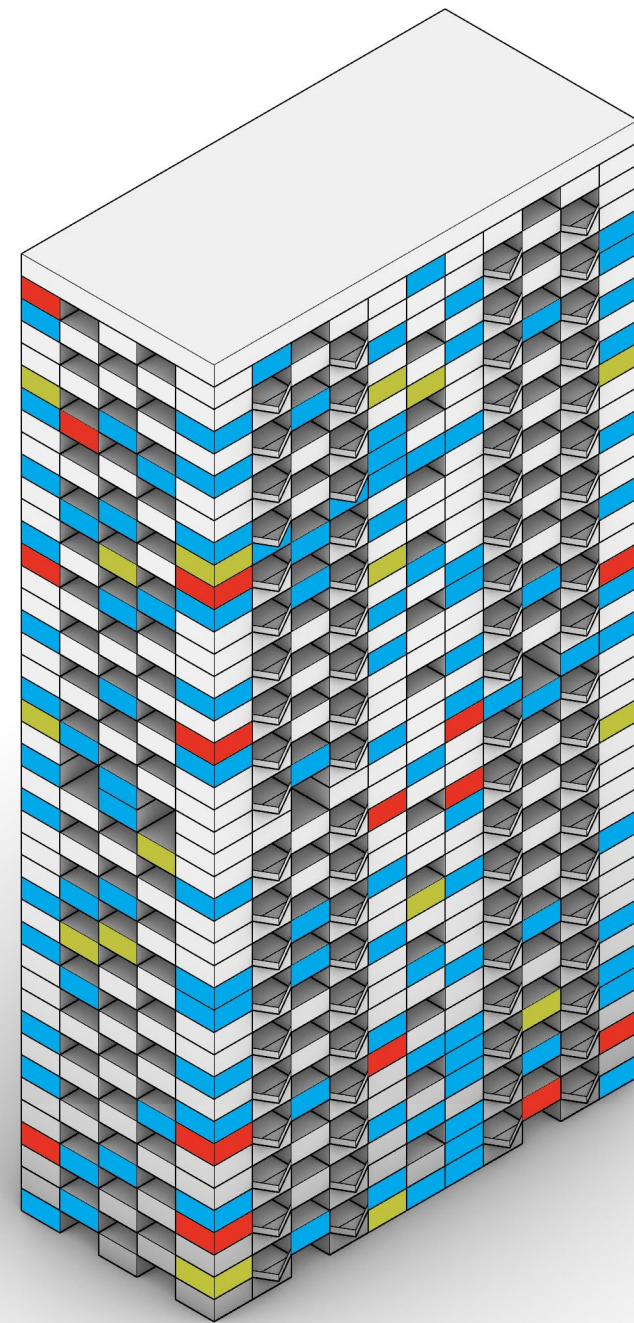
562 FIFTH AVE

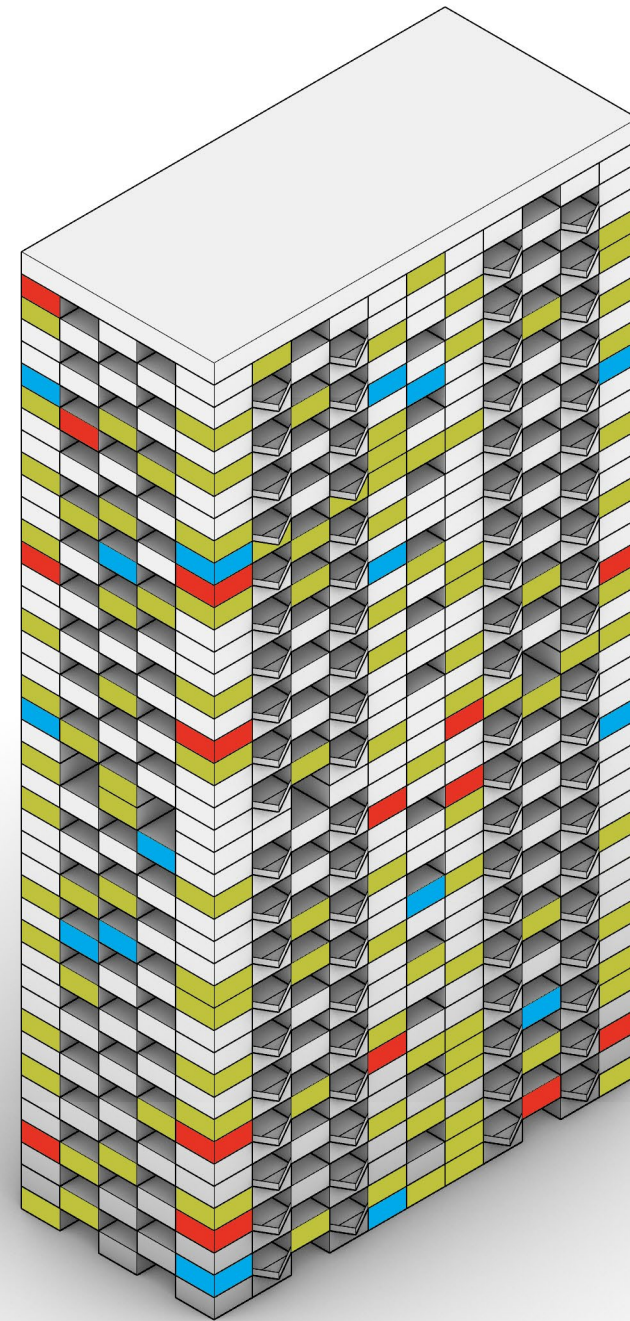
RUBIK'S CUBE TOWER
MIDTOWN, NEW YORK CITY

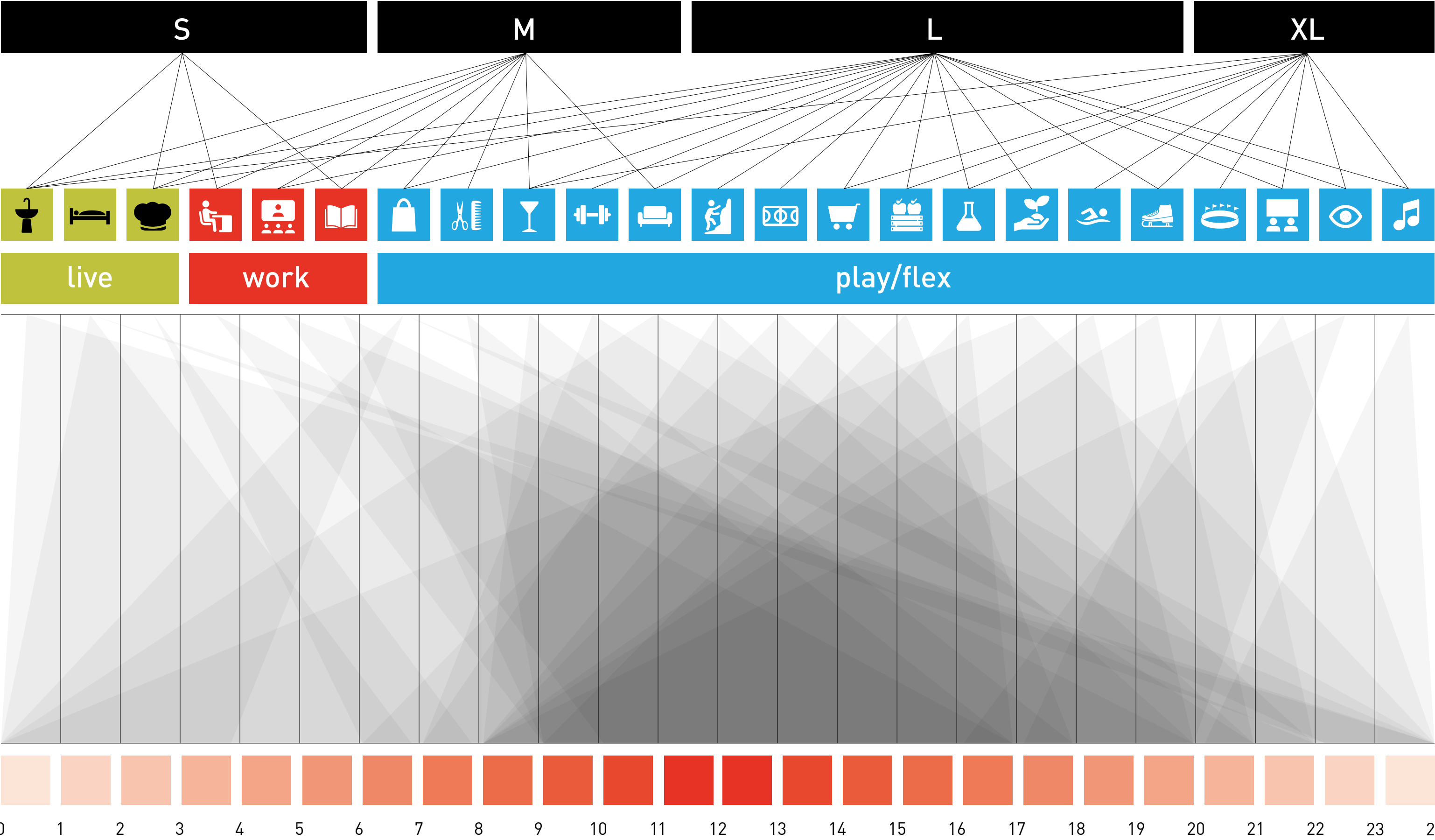




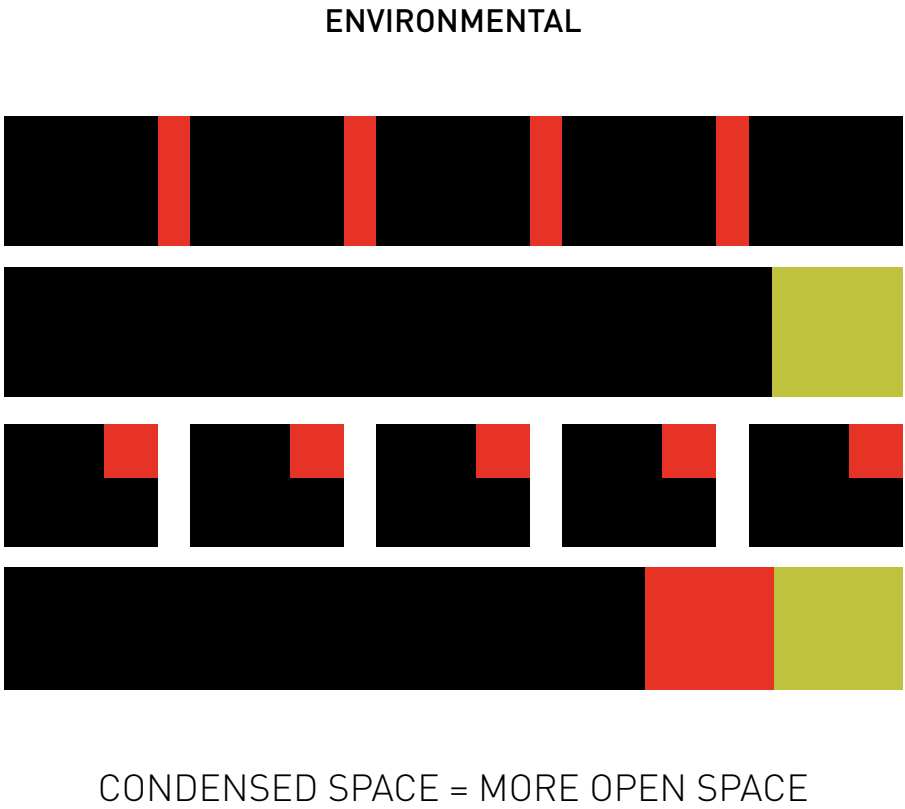
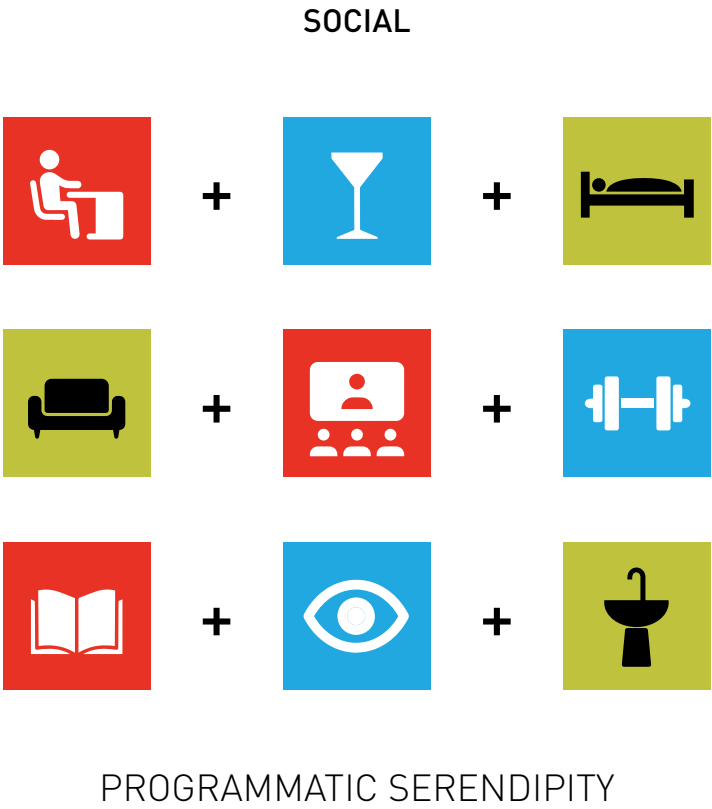
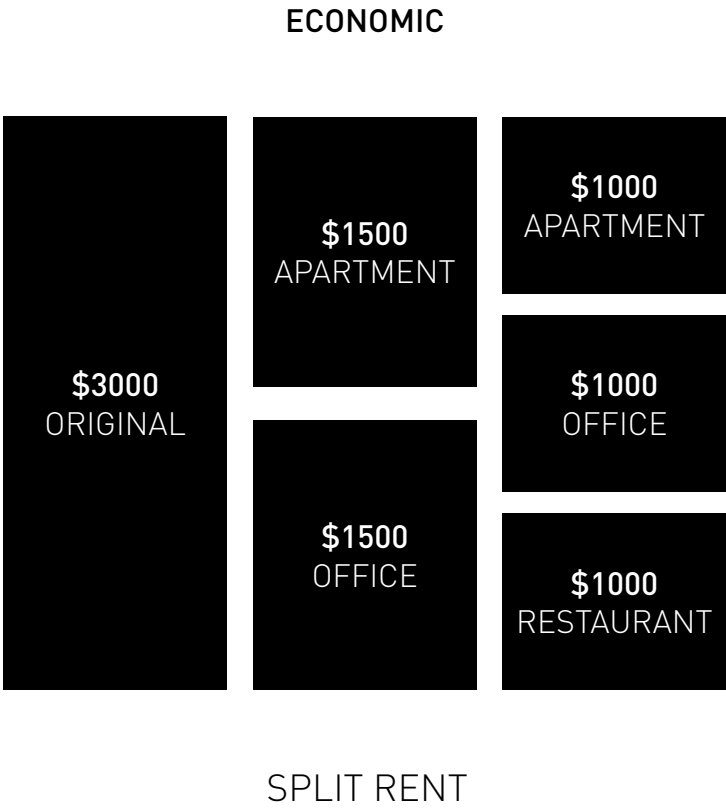




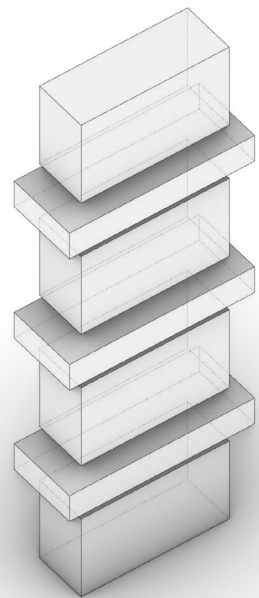




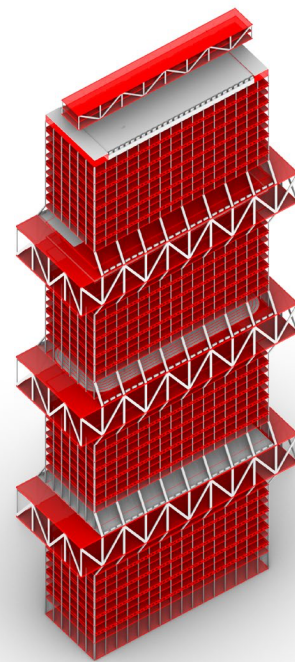
EFFICIENCY LEADING TO SYNERGY



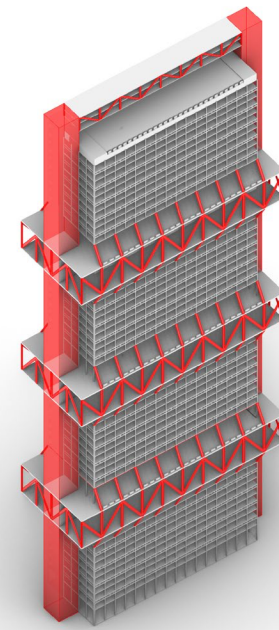
ARCHITECTURAL STRATEGY



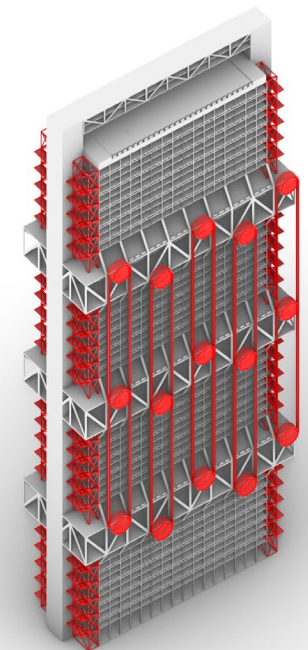
1. SCALE-BASED VOLUMES



2. FLOOR PLATES

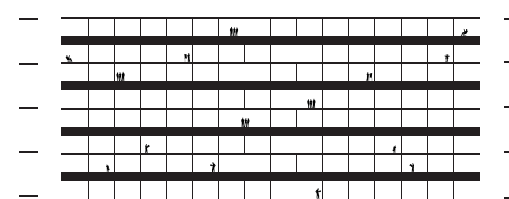
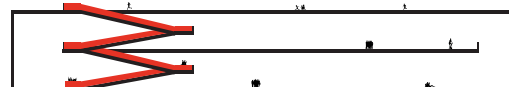
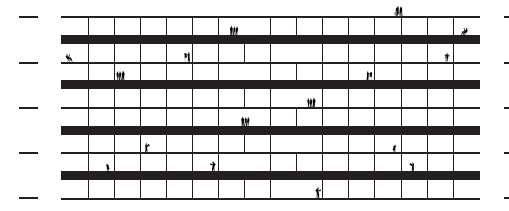
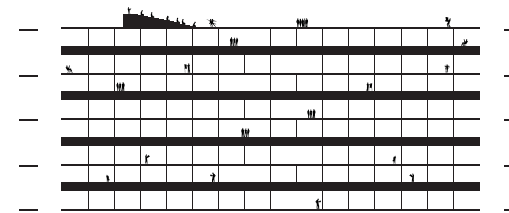
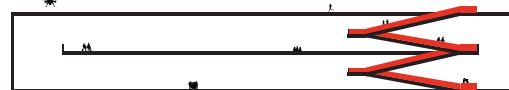
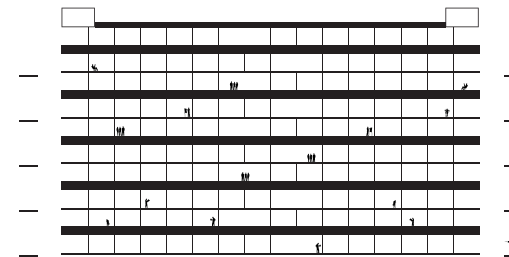


3. STRUCTURE



4. INFRASTRUCTURE

PROGRAMMATIC STRATEGY



LARGE

DAY: CONFERENCE / EVENT / GALLERY...
NIGHT: CONCERT / THEATER...



MEDIUM

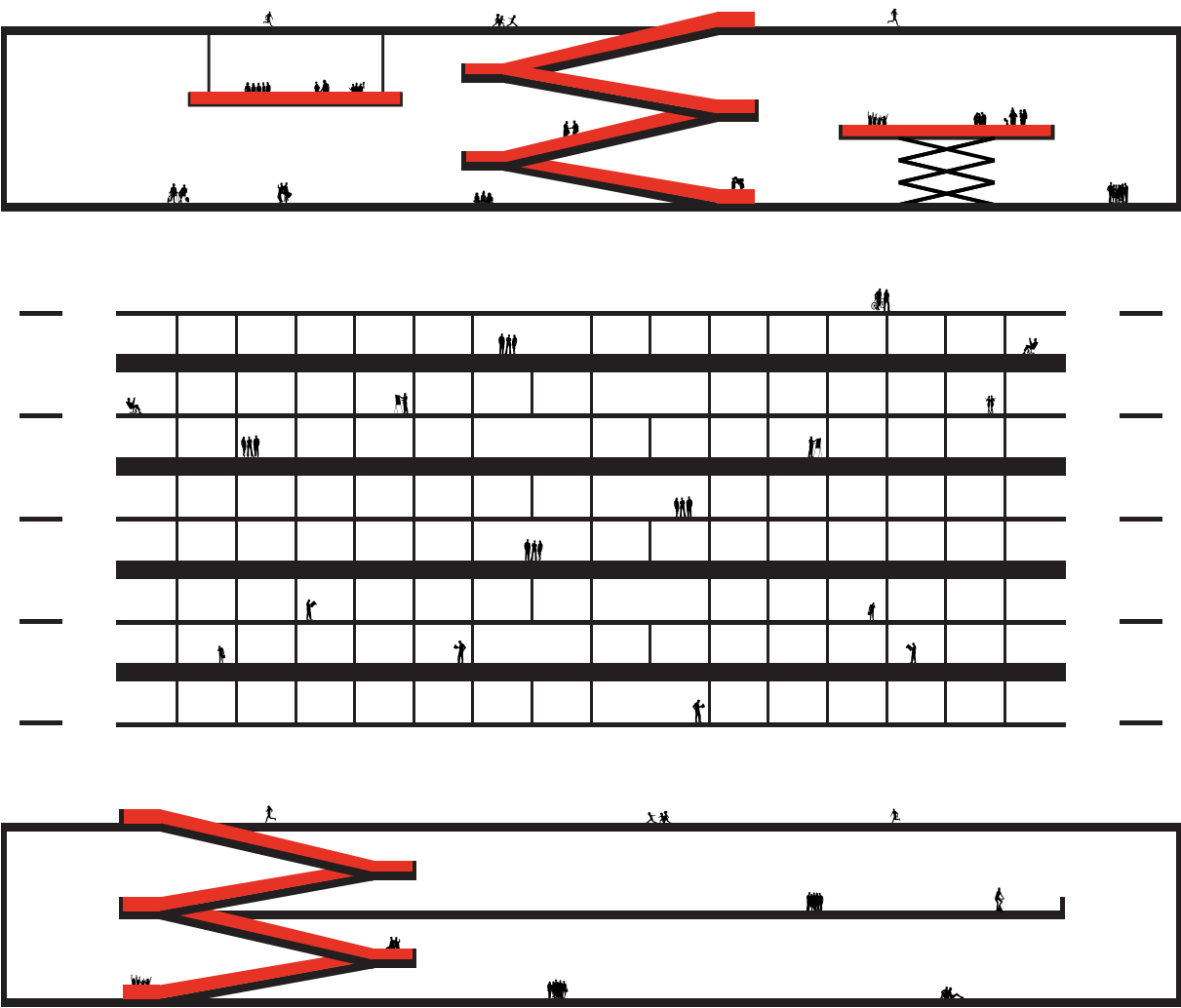
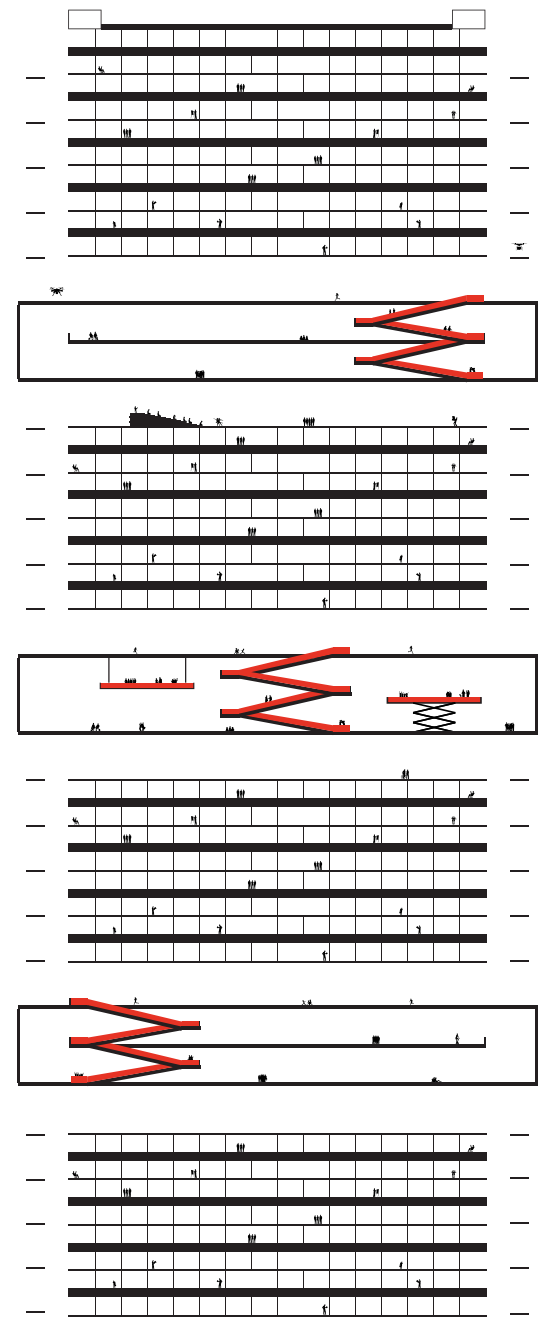
24' HEIGHT FLEX SPACES
DAY: FIELD / TRACK / PARK...



SMALL

DAY: OFFICE / SHOP / STUDIO...
NIGHT: BEDROOM / SPEAKEASY...

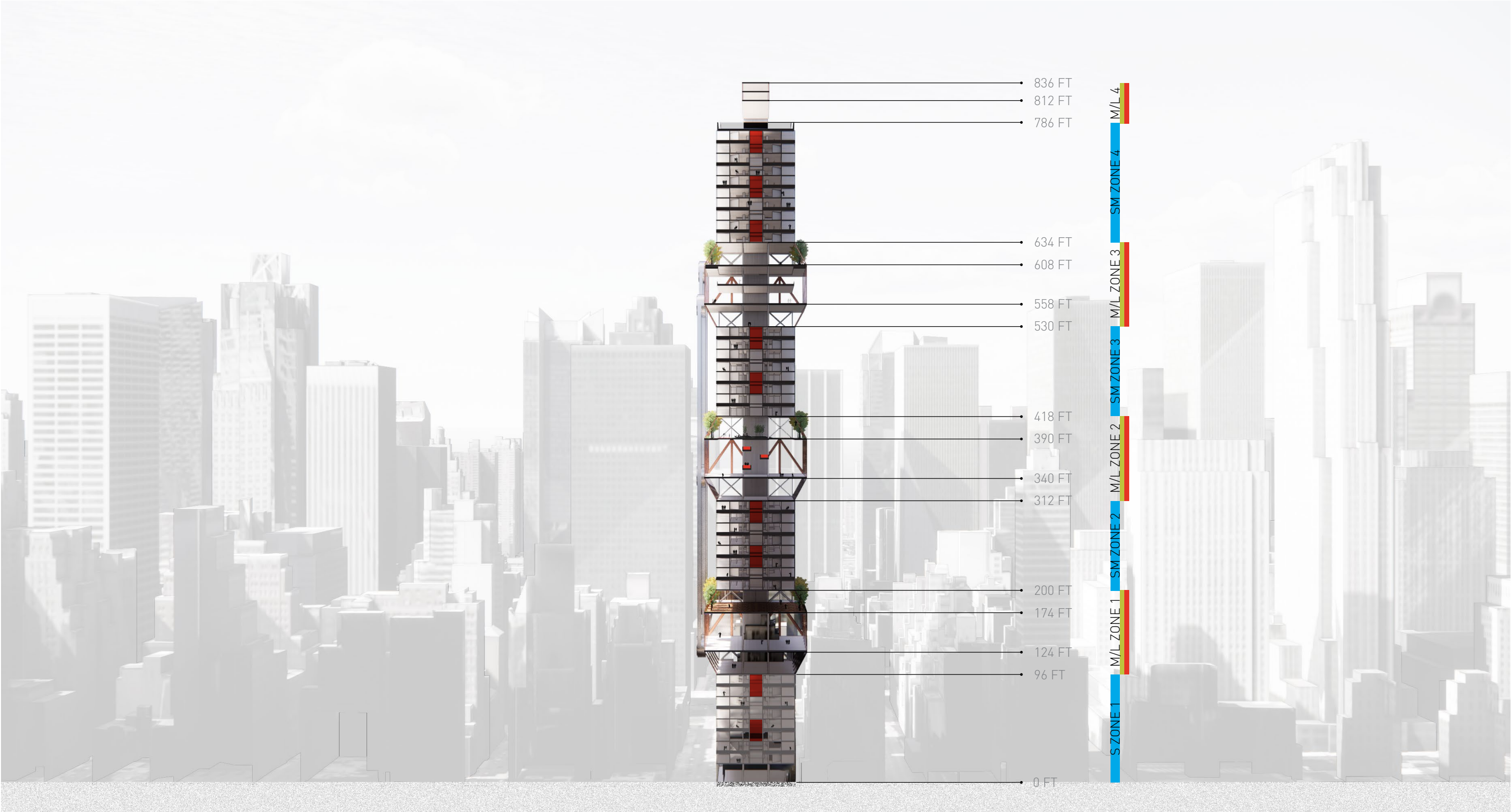
PROGRAMMATIC STRATEGY



PROGRAMMATIC STRATEGY



SECTION 2



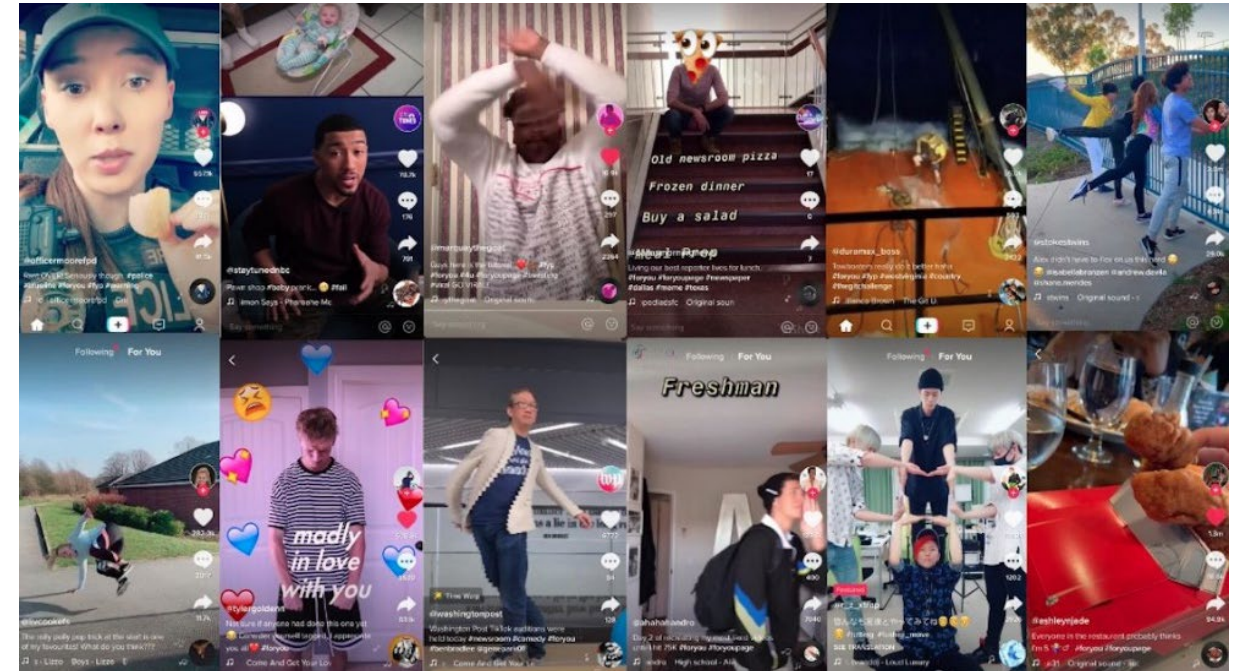
Democratizing expression in the digital age

TOP DOWN



Prudential Center

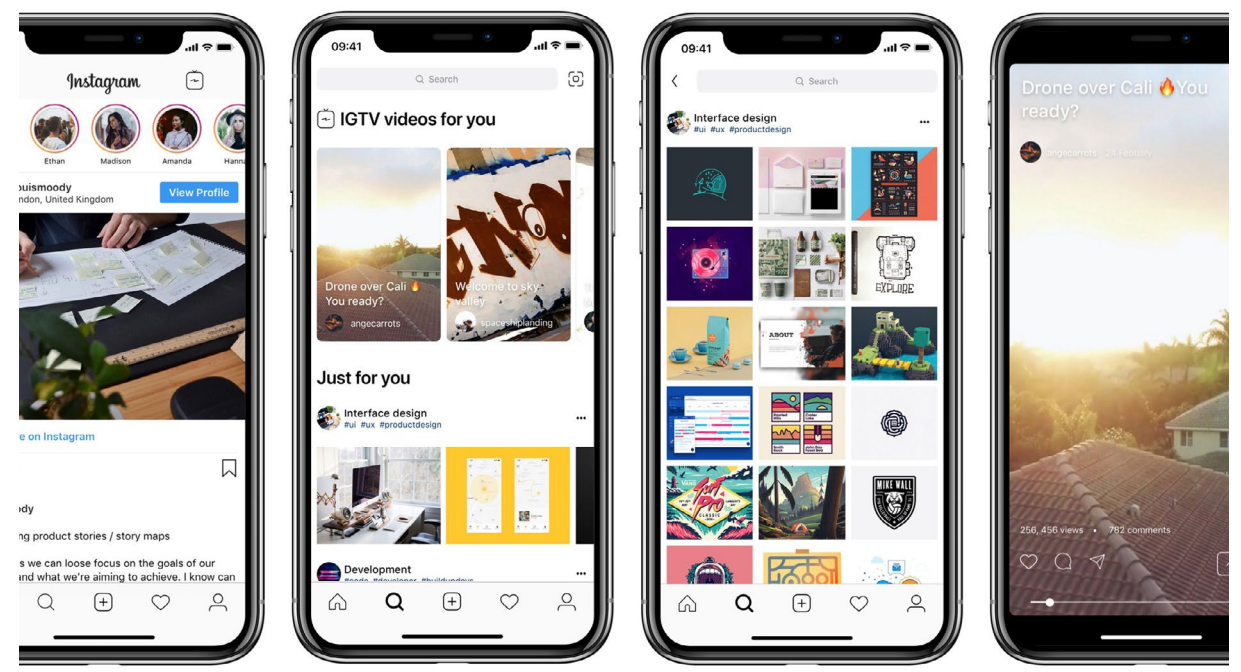
BOTTOM UP



TikTok



Times Square



Instagram

ELEVATION DAY VS. EVENING VS. NIGHT



ELEVATION DAY VS. EVENING VS. NIGHT

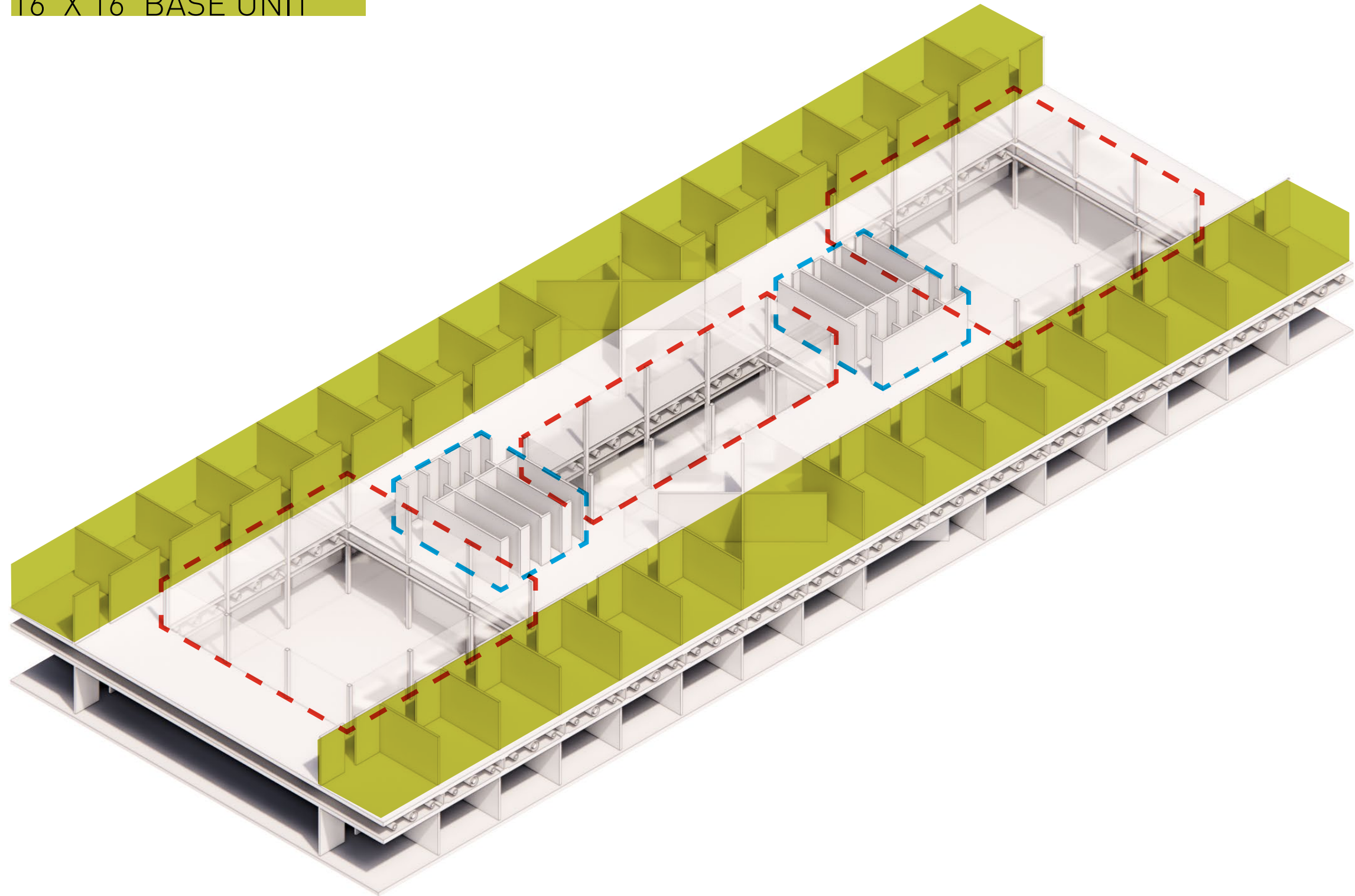


ELEVATION DAY VS. EVENING VS. NIGHT

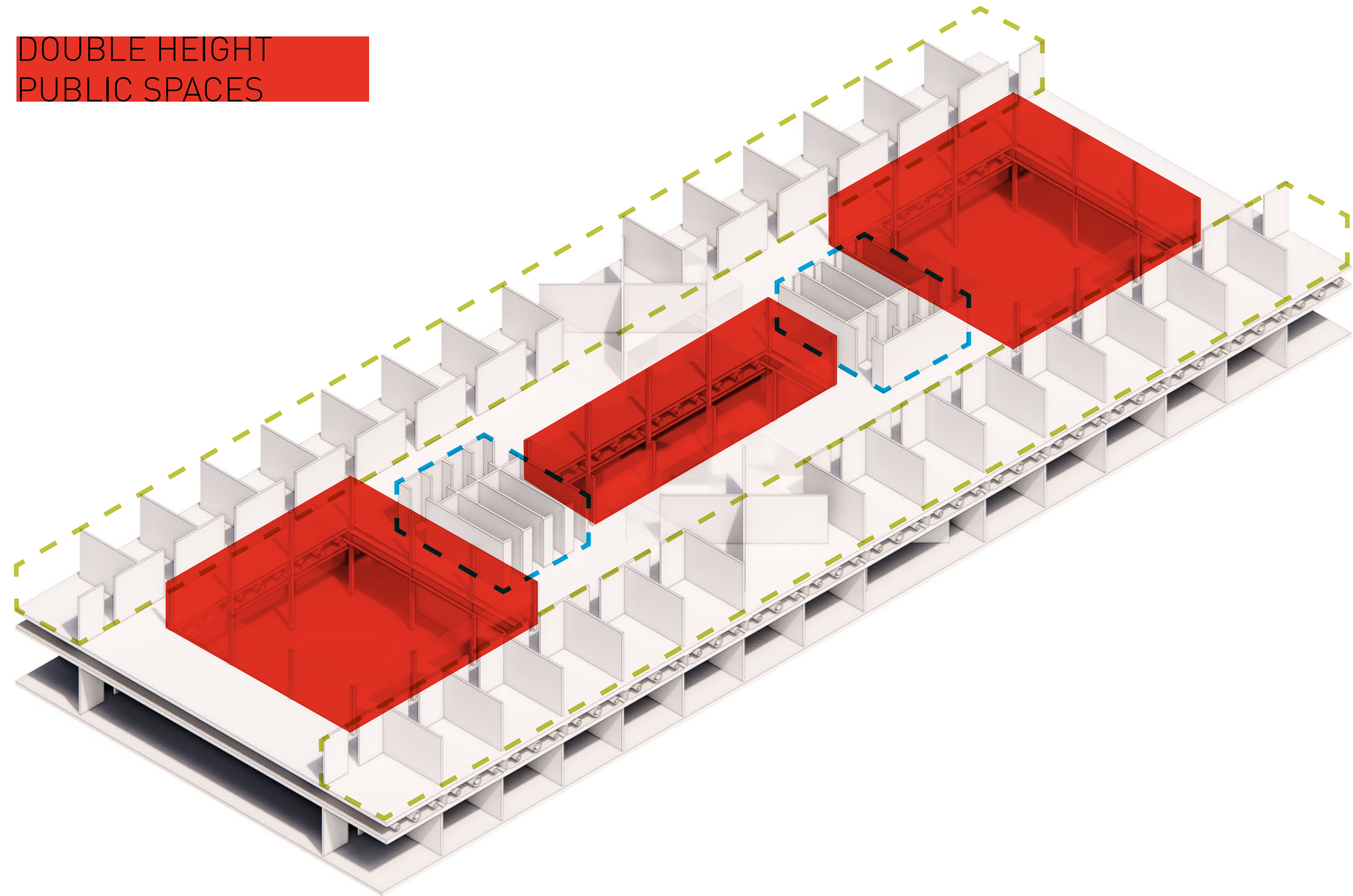


A VERTICAL COMMUNITY

16' X 16' BASE UNIT

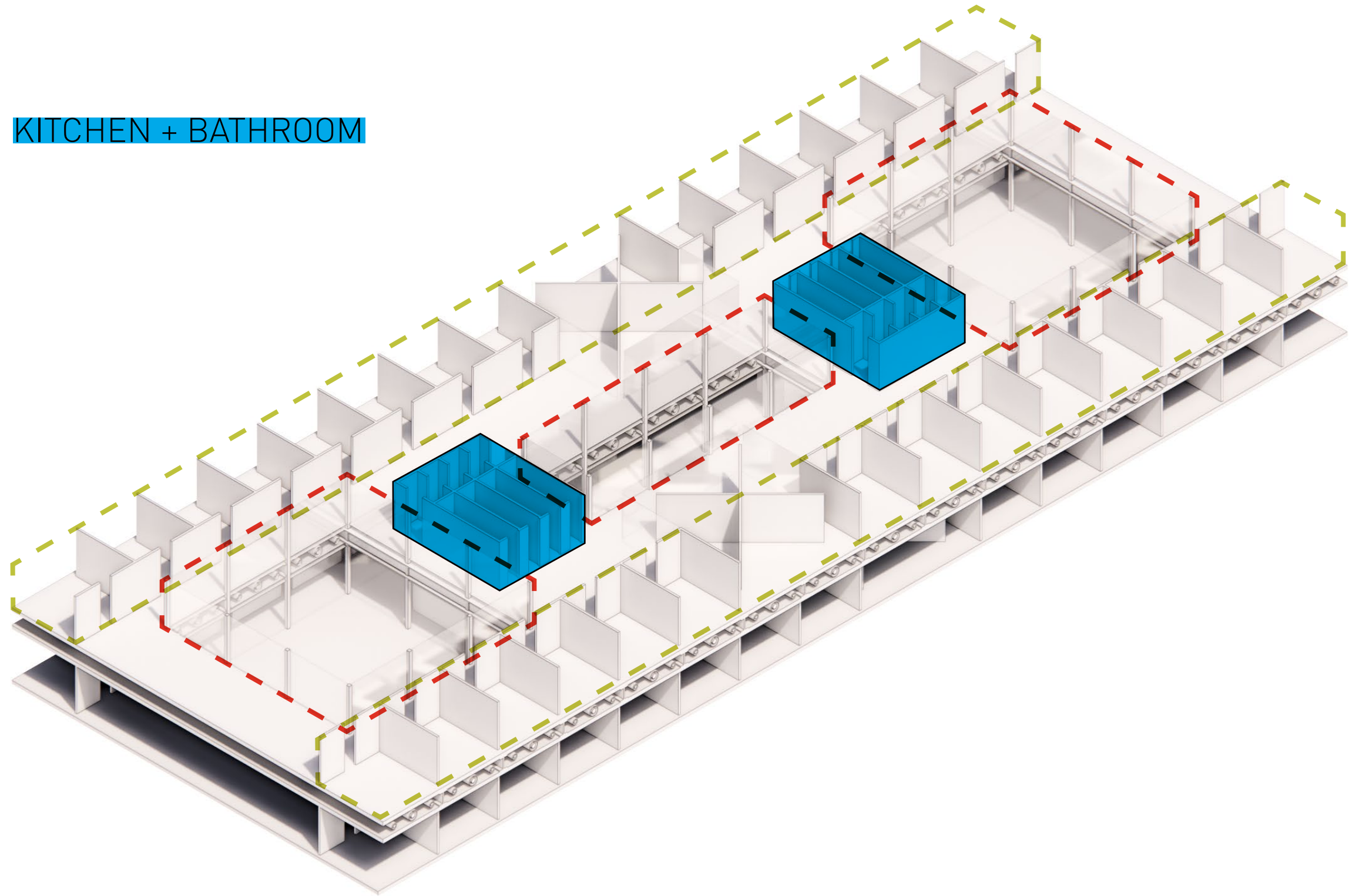


FLOOR PLAN AXON - A VERTICAL COMMUNITY



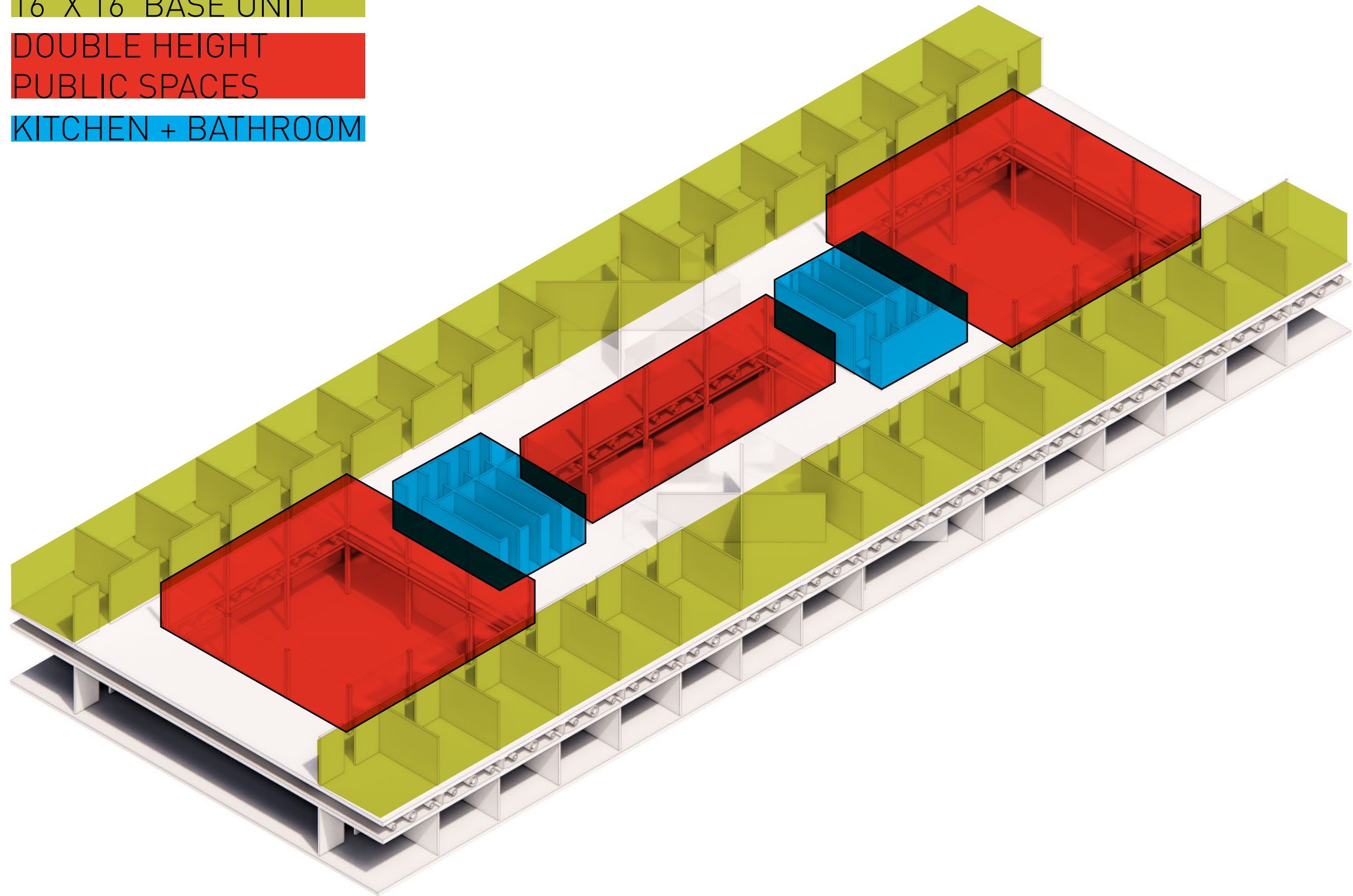
FLOOR PLAN AXON - A VERTICAL COMMUNITY

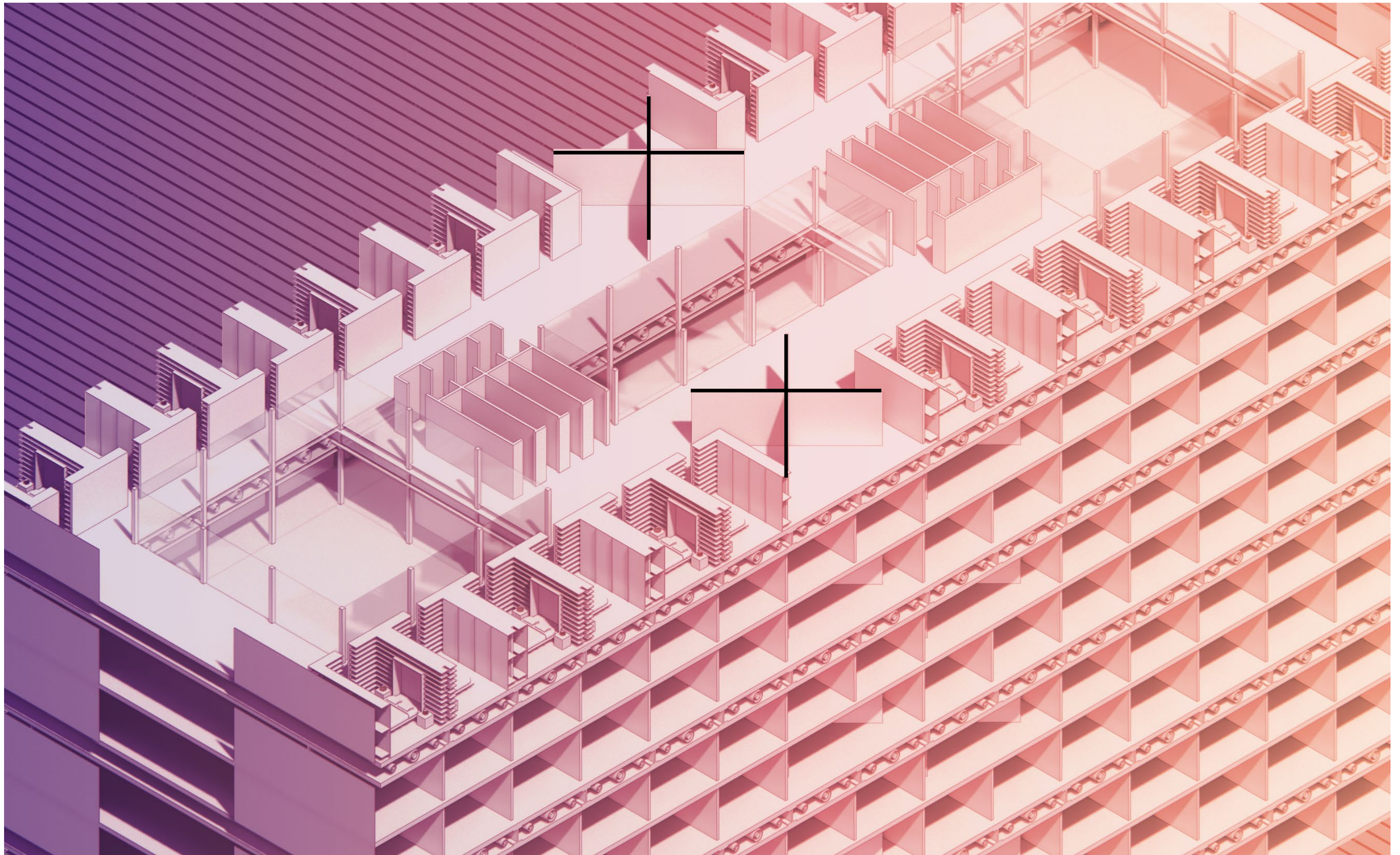
KITCHEN + BATHROOM

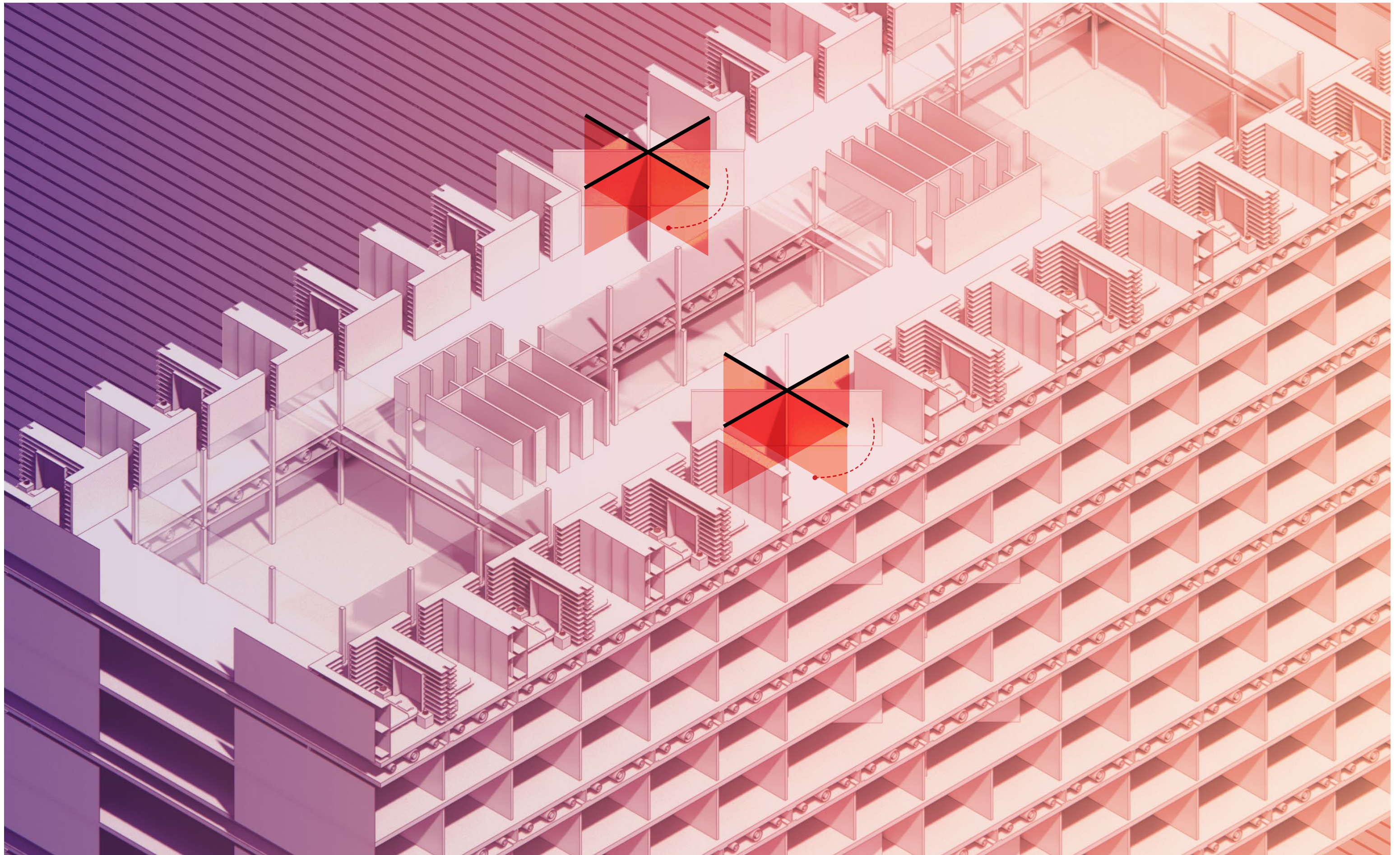


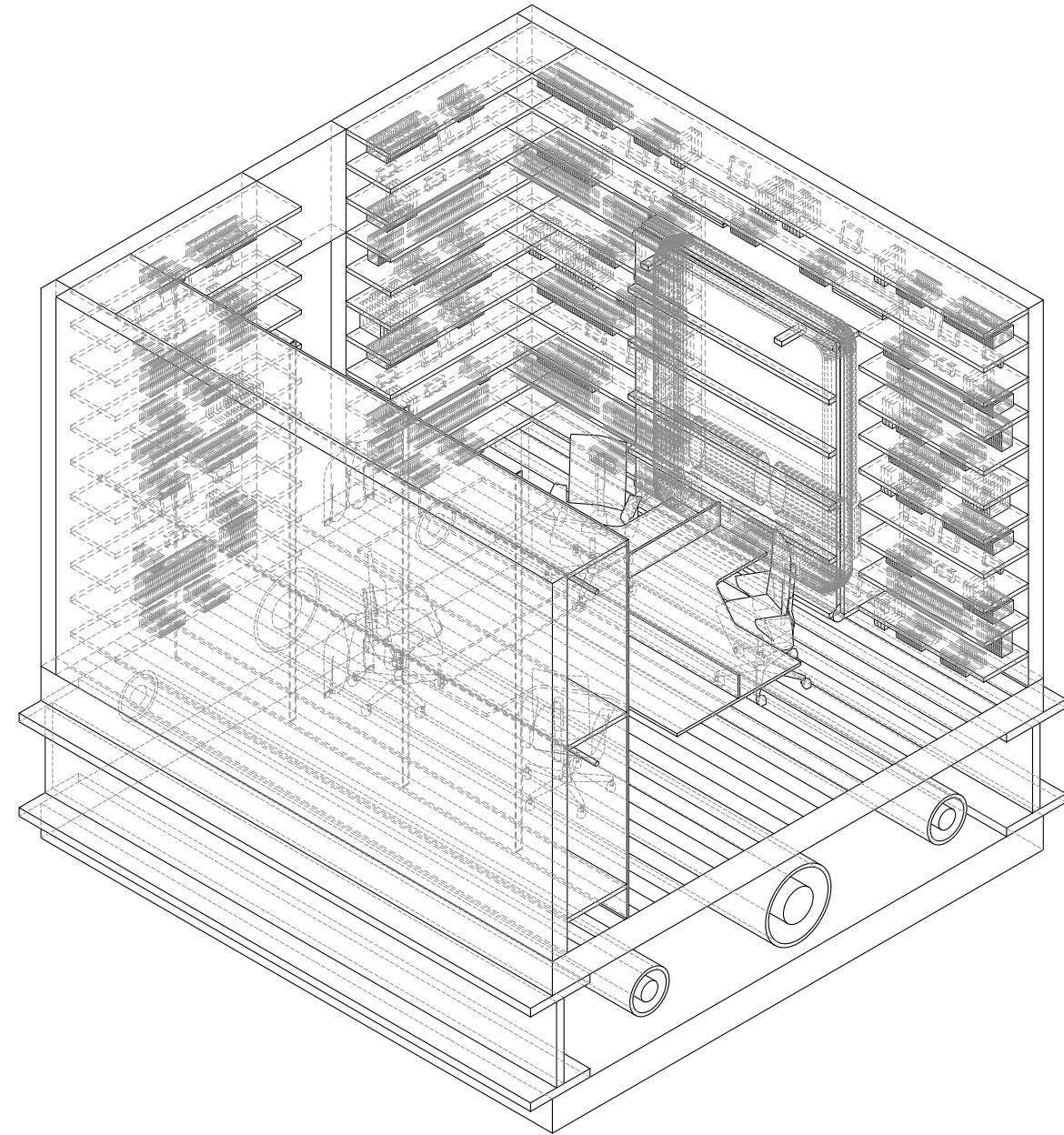
FLOOR PLAN AXON - A VERTICAL COMMUNITY

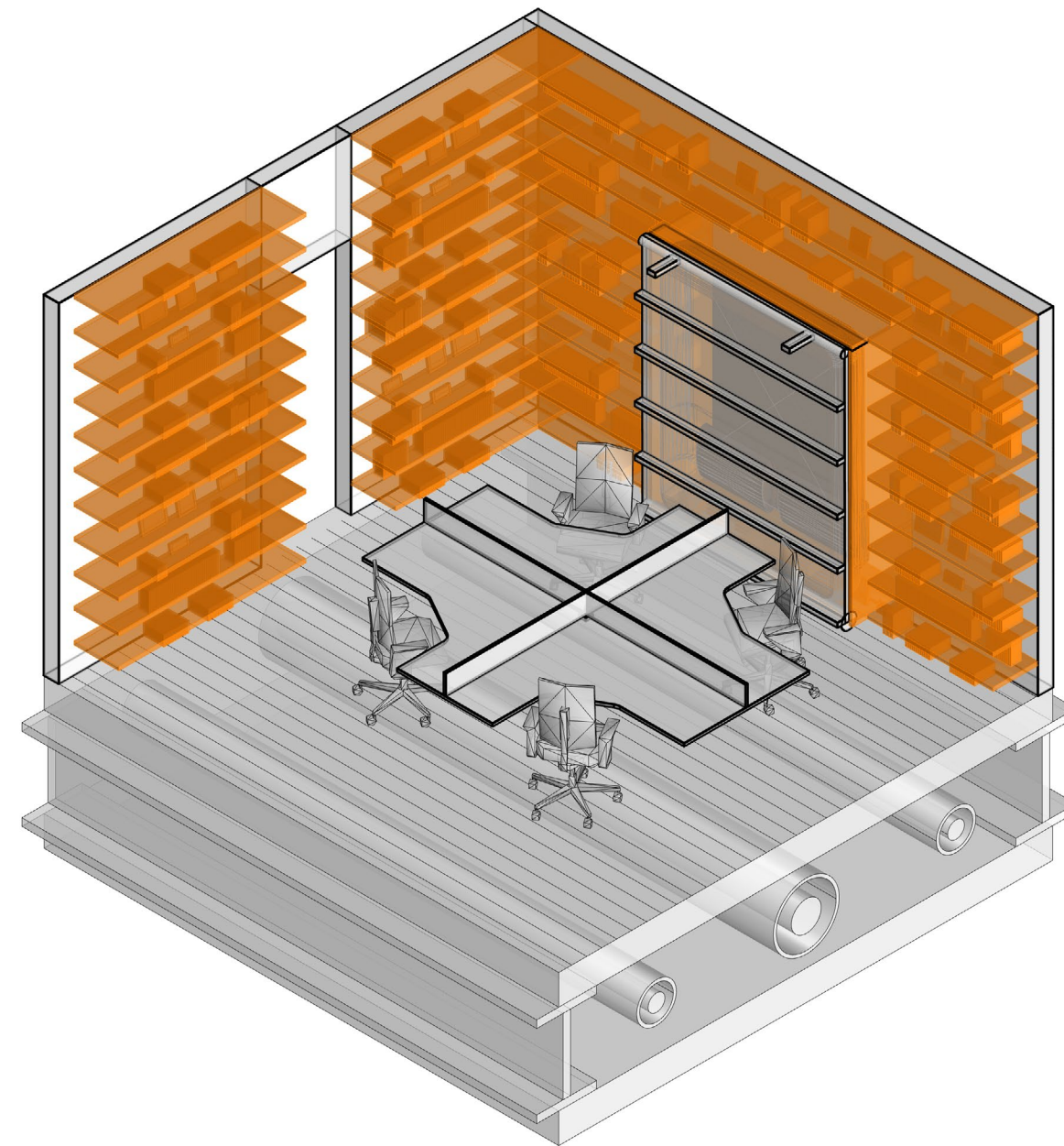
16' X 16' BASE UNIT
DOUBLE HEIGHT
PUBLIC SPACES
KITCHEN + BATHROOM

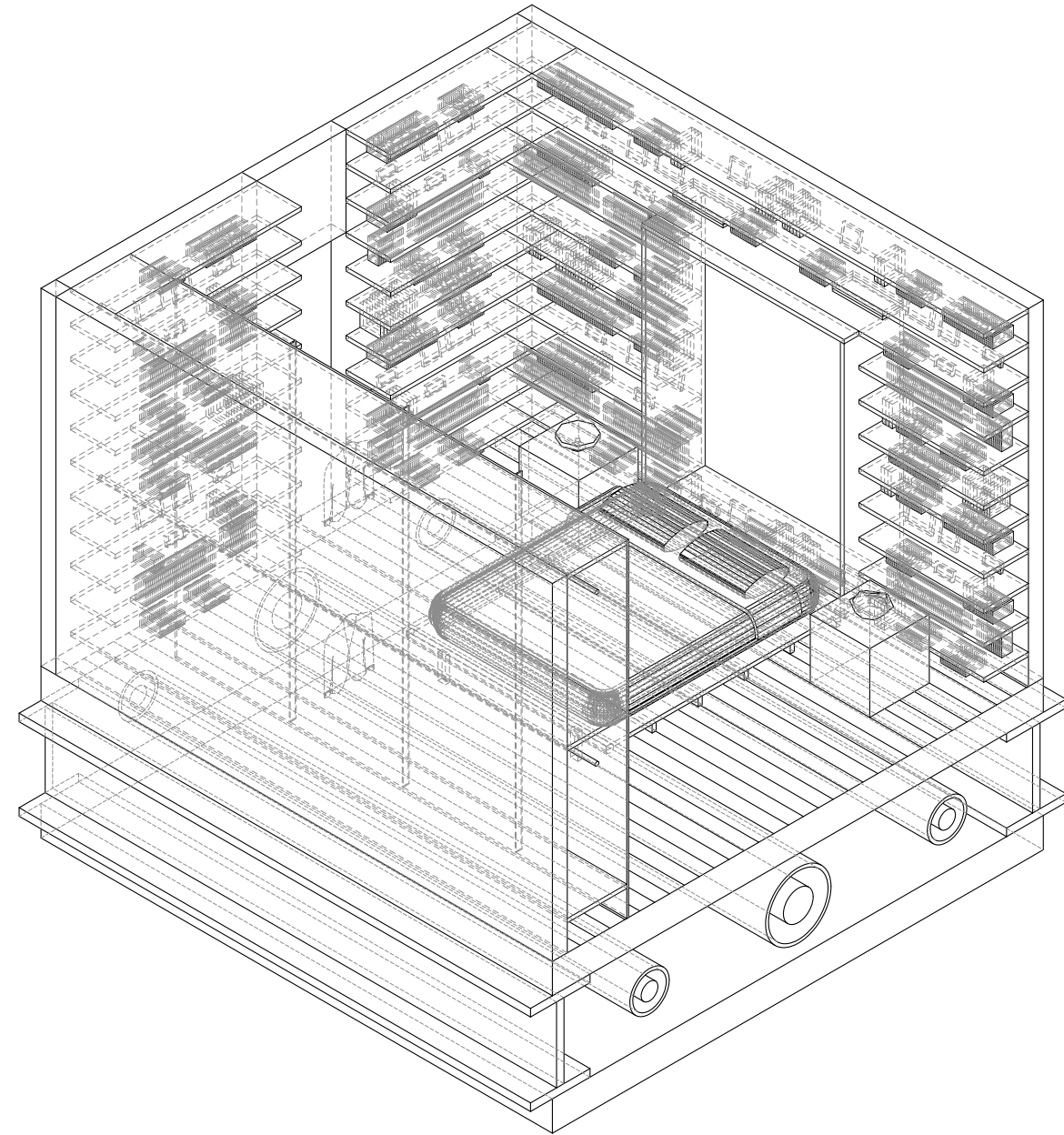


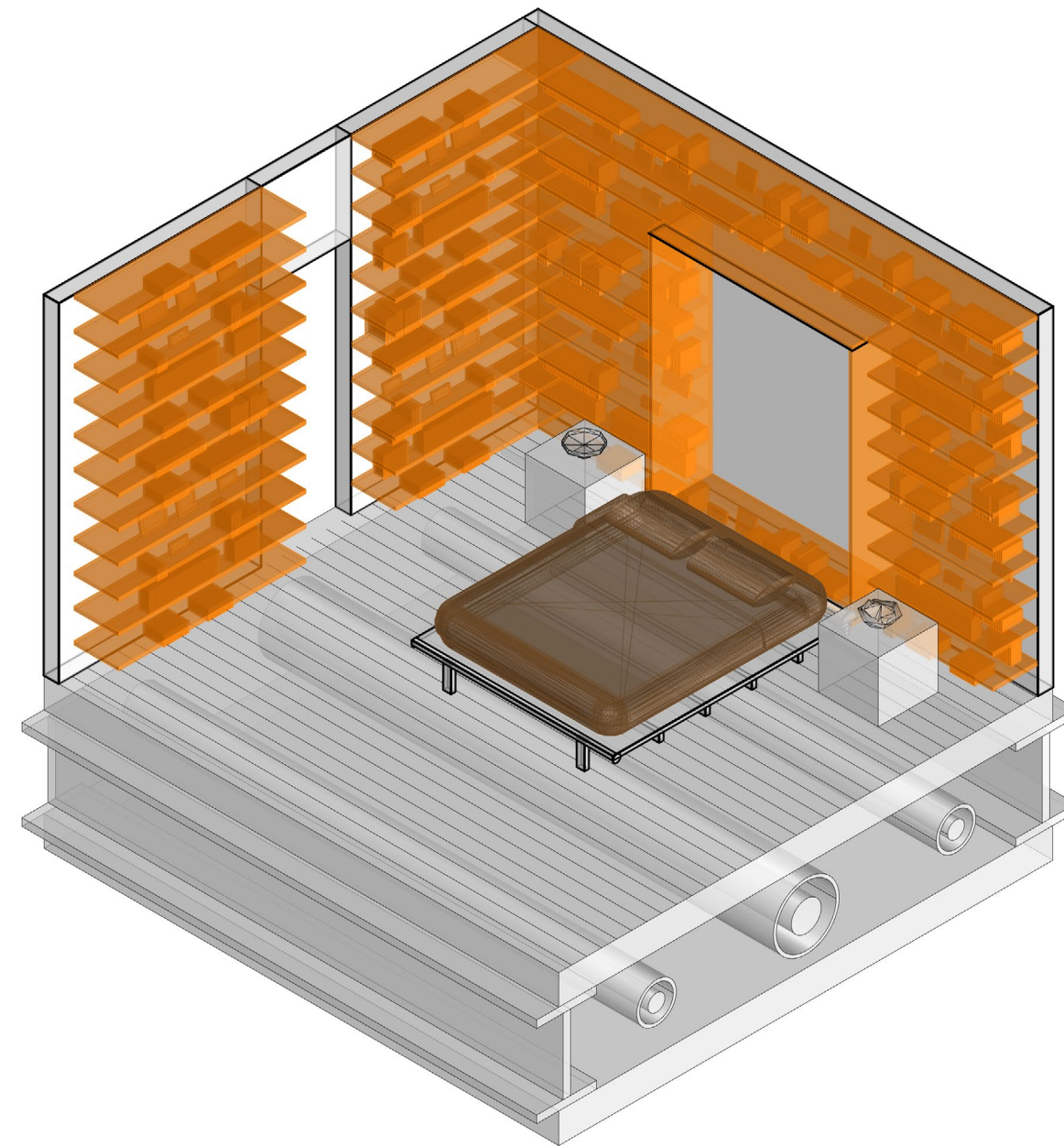


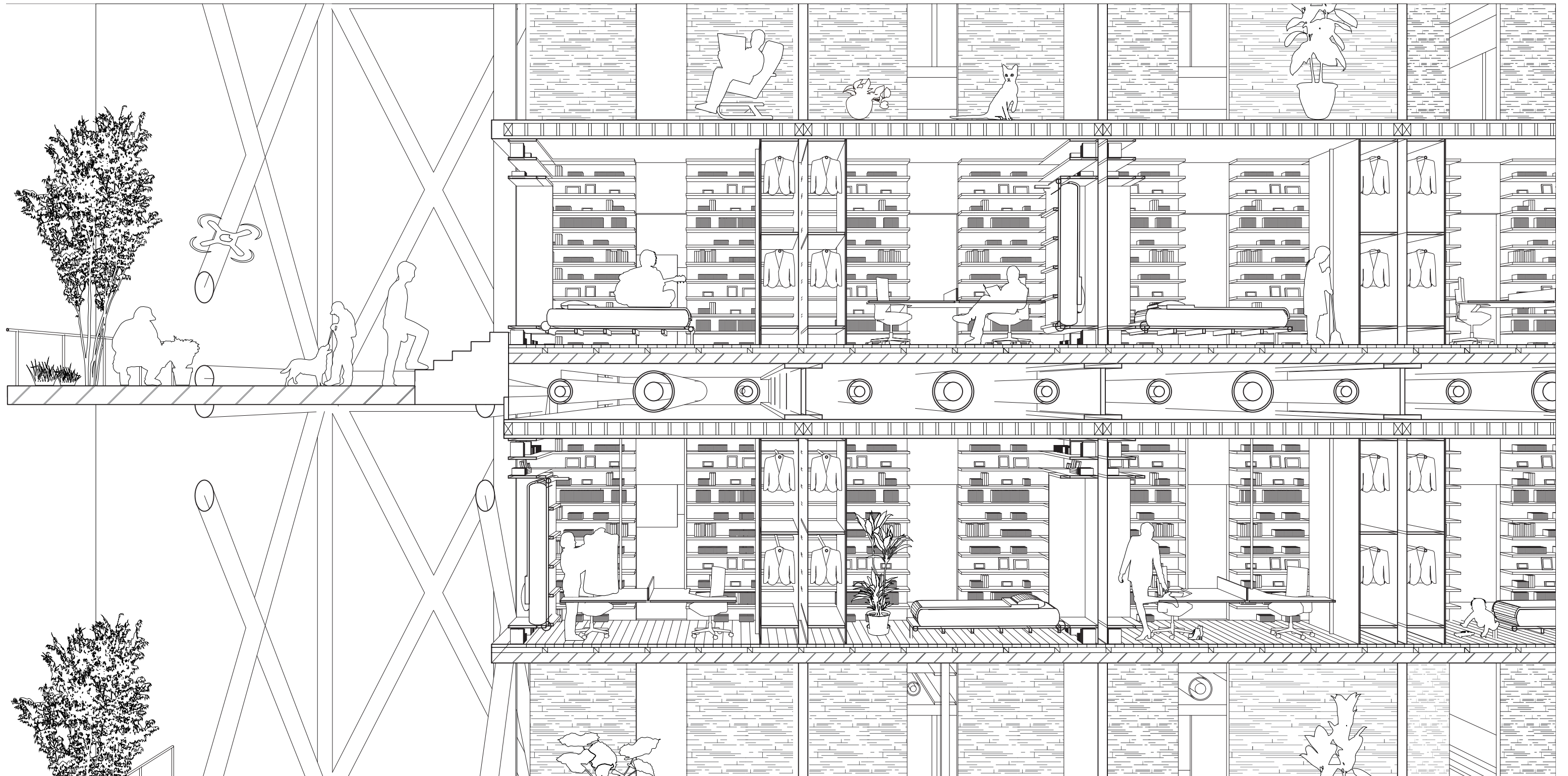


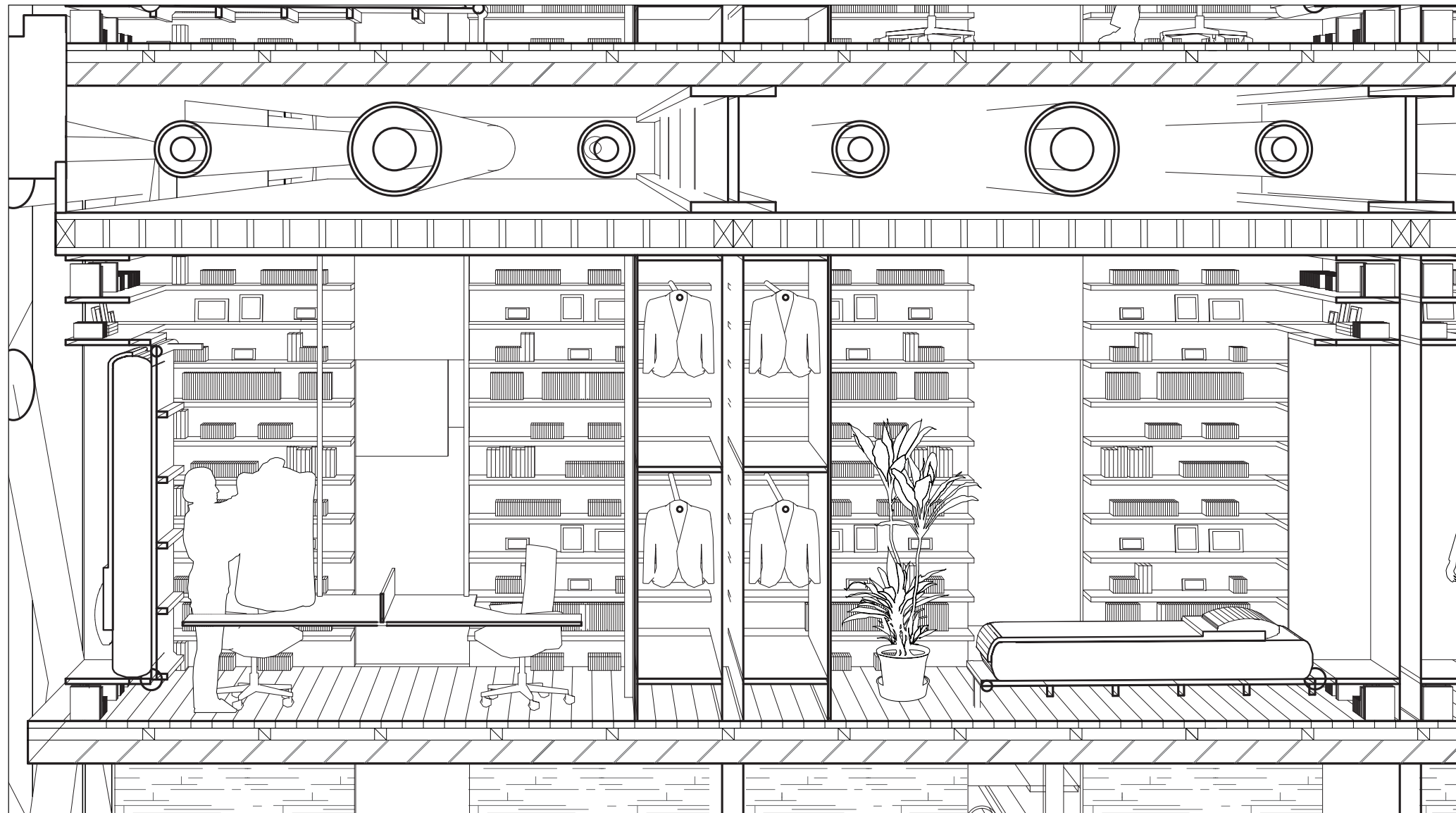






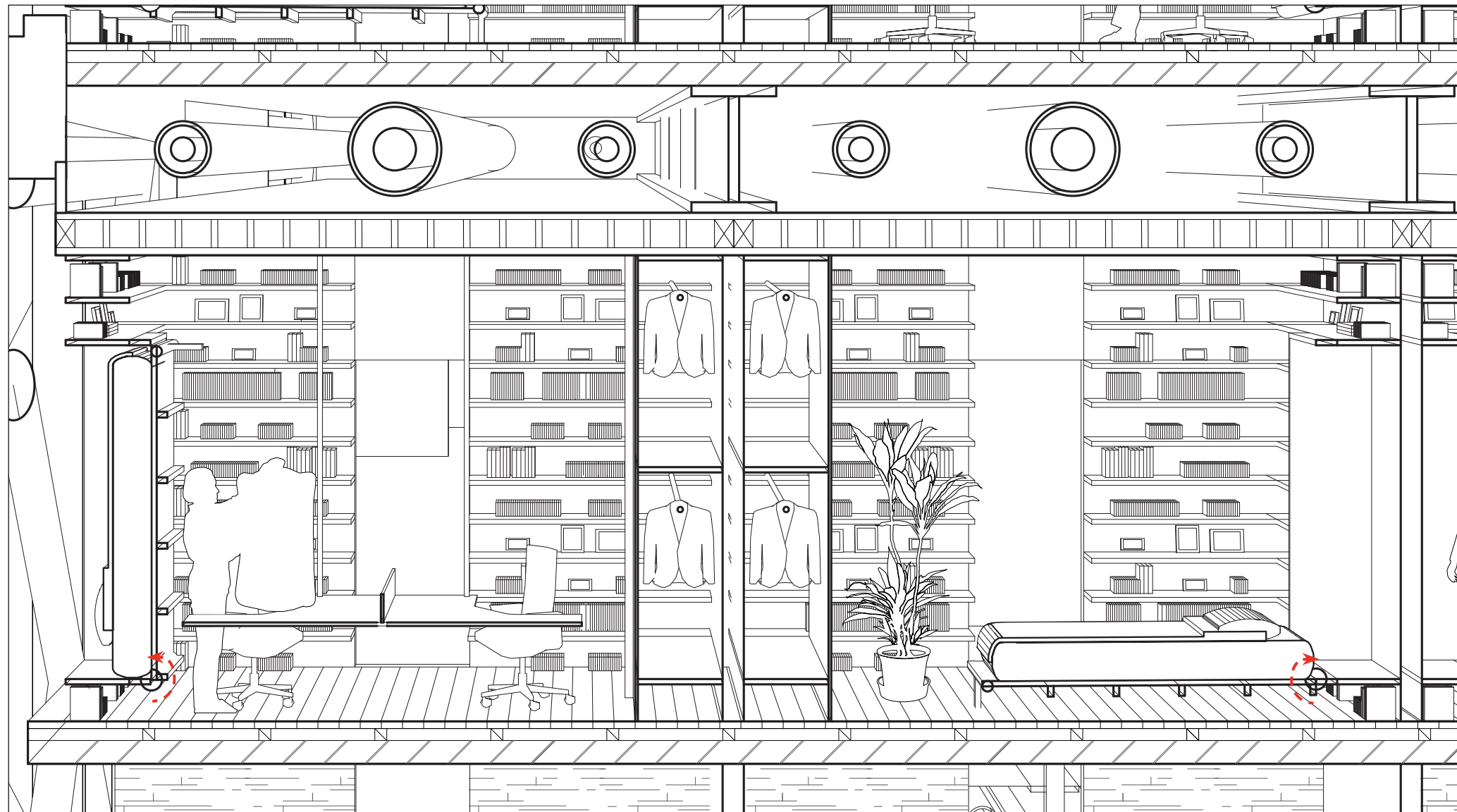






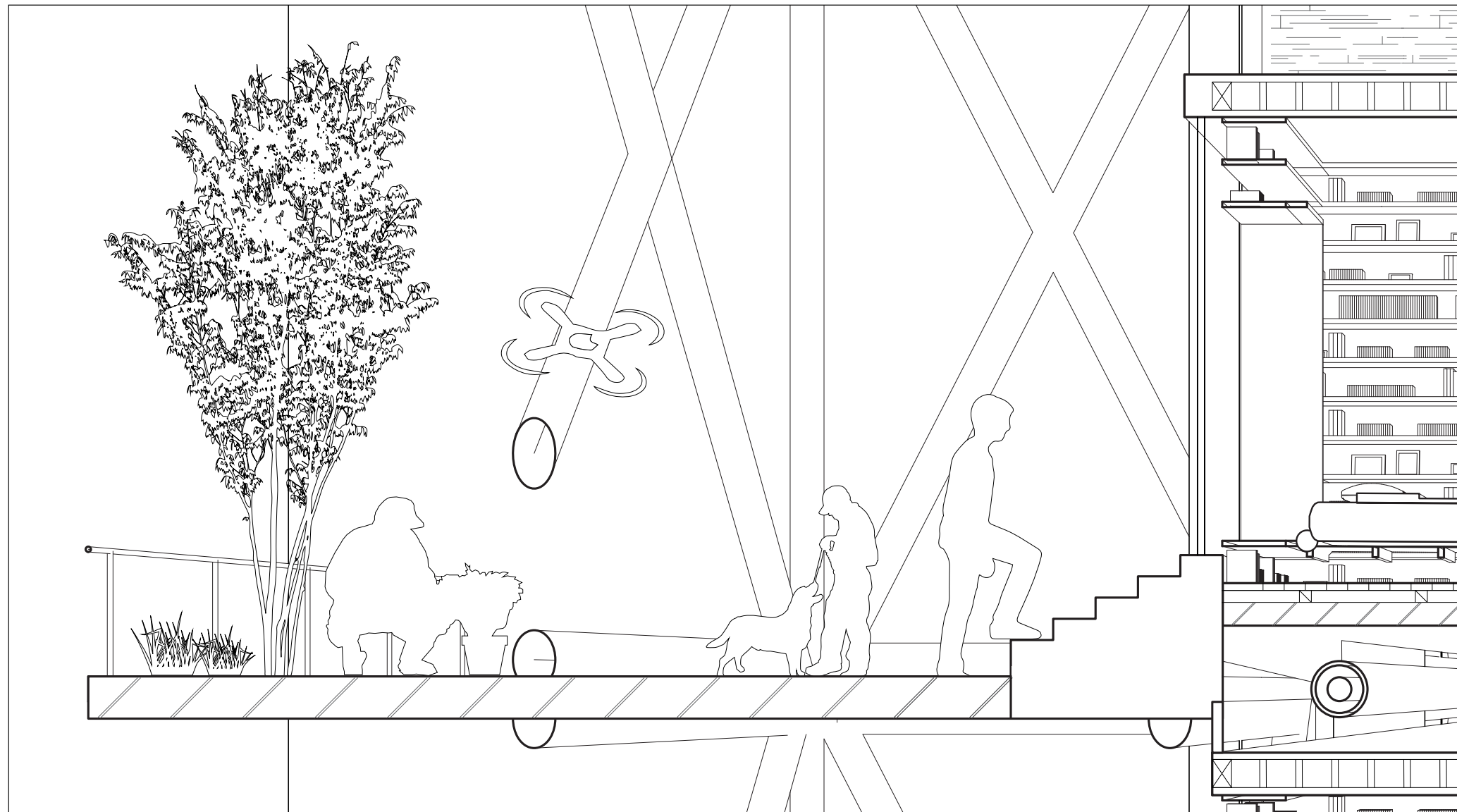
OFFICE BY DAY

APARTMENT BY NIGHT

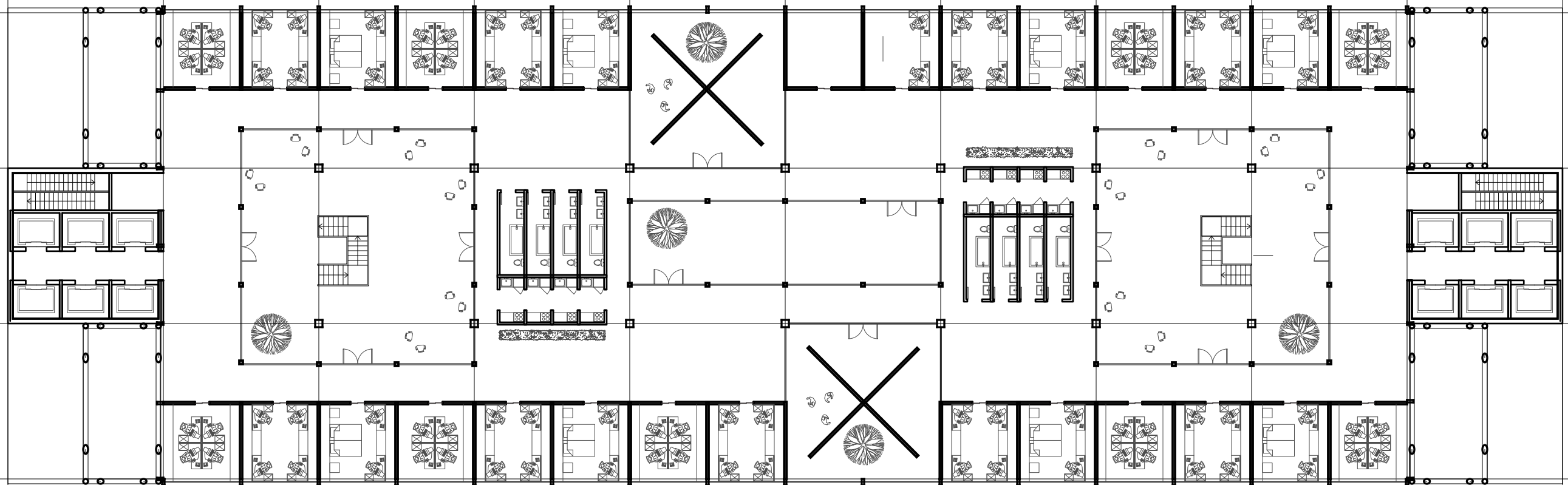


OFFICE BY DAY

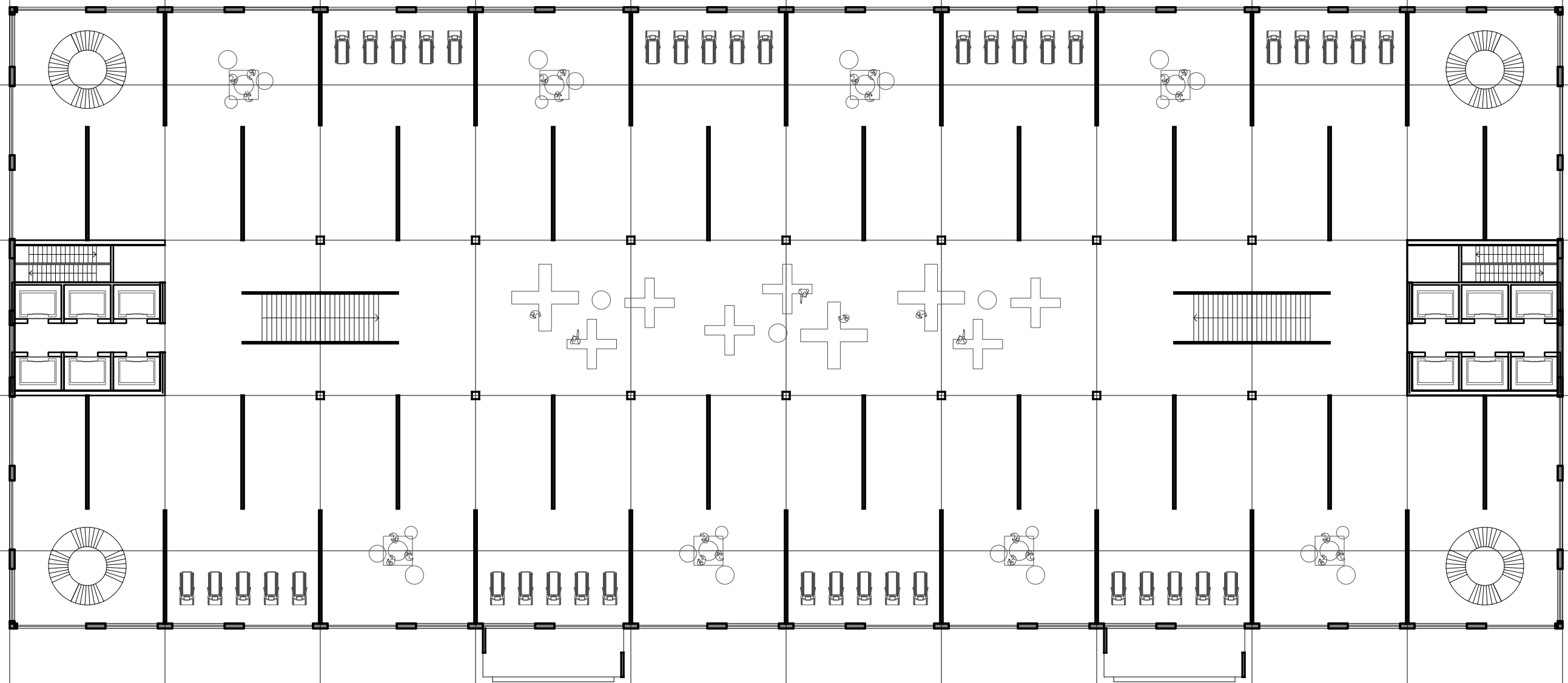
APARTMENT BY NIGHT



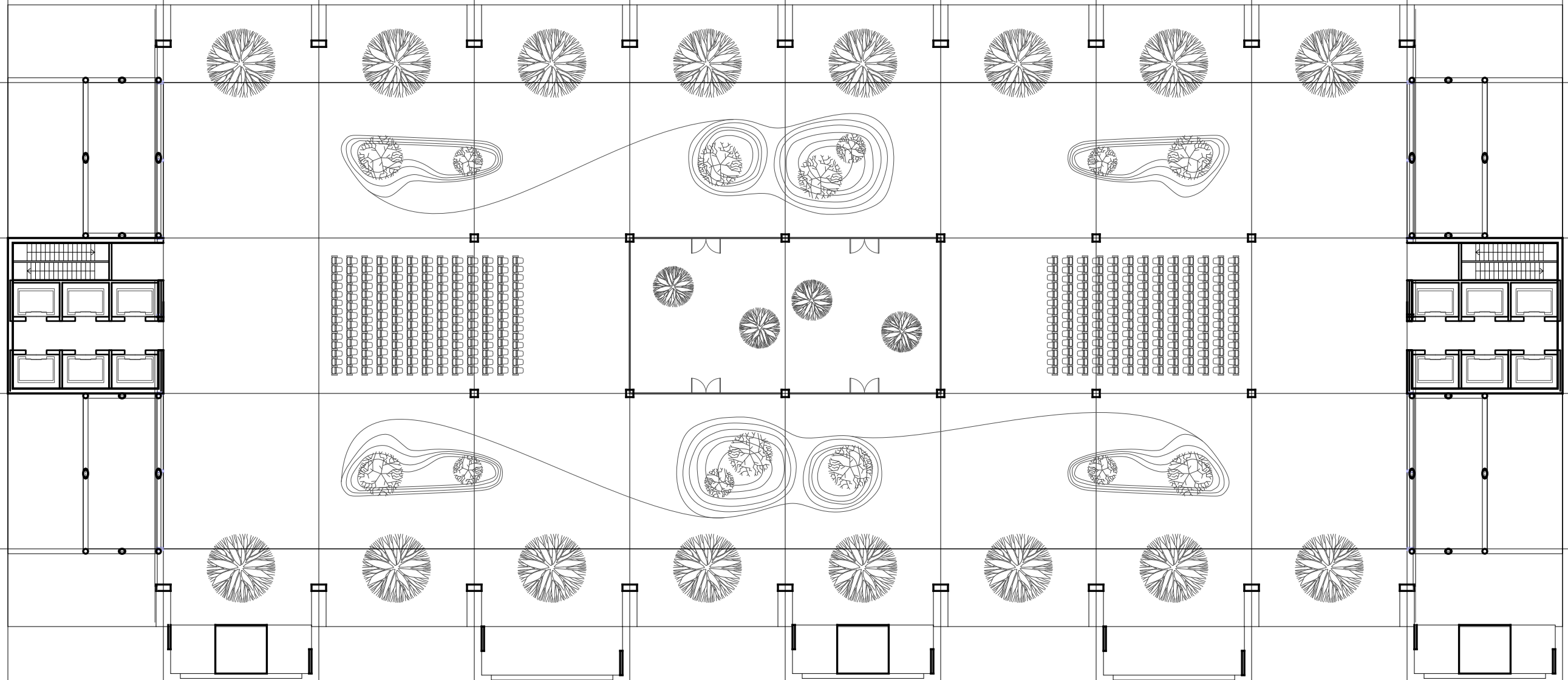
OUTDOOR PATIO +
DRONE DELIVERY PORT



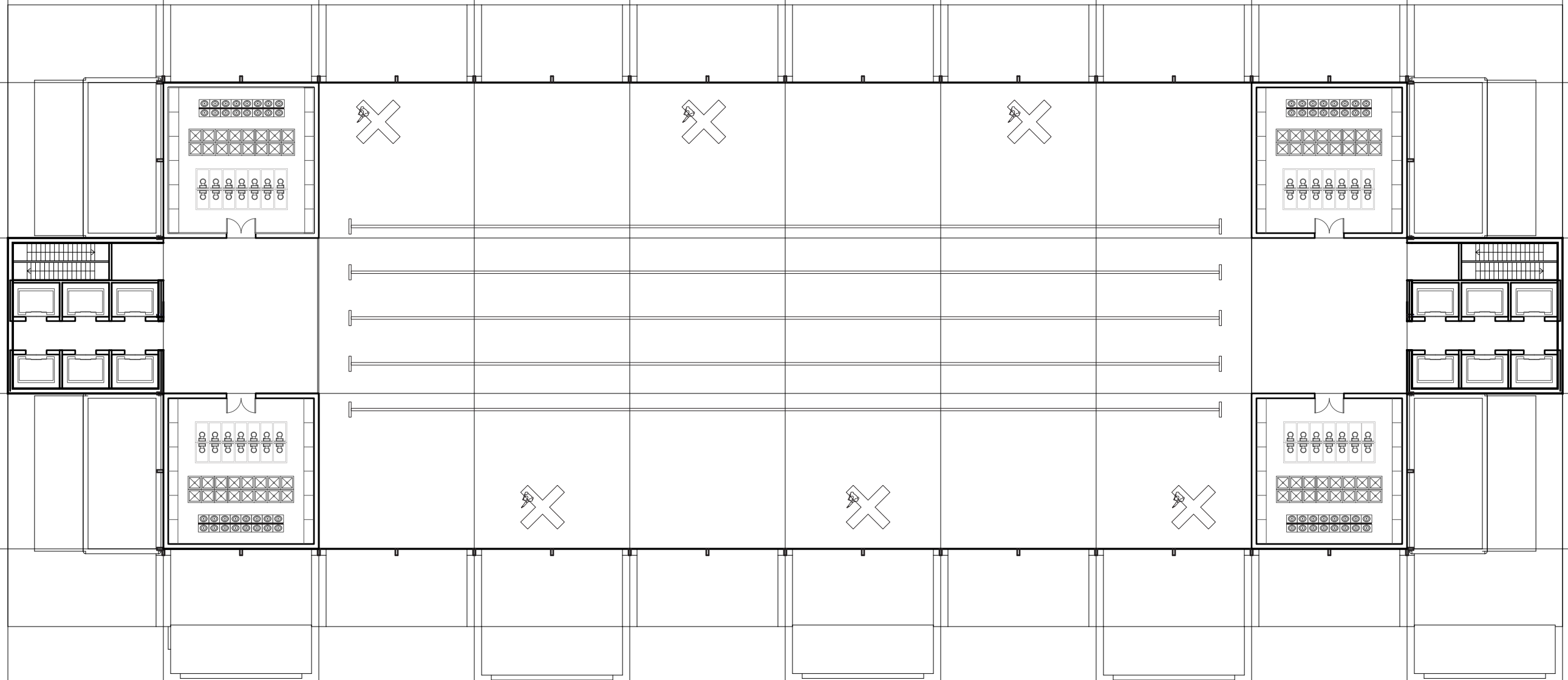
TYPICAL FLOOR PLAN
 $1/24" = 1'-0"$



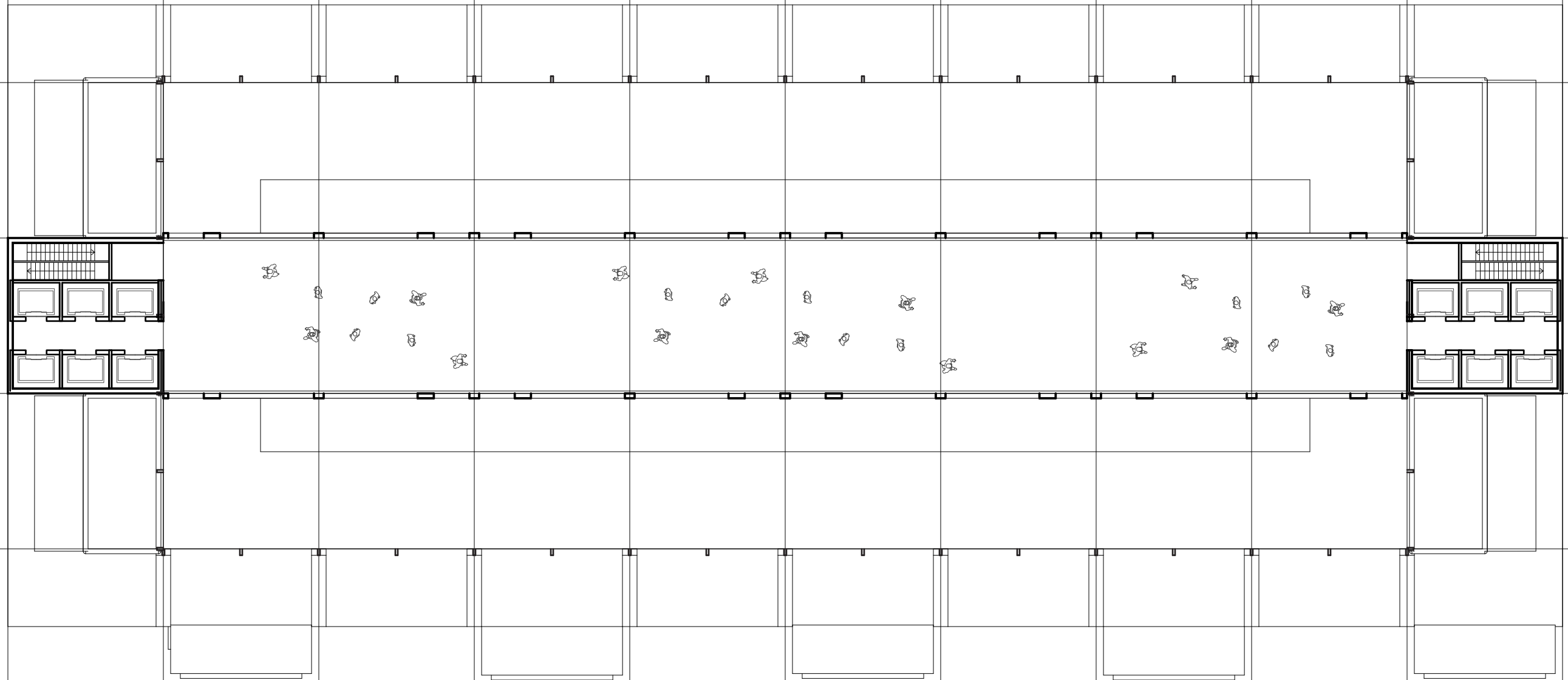
INDOOR PUBLIC FLOOR PLAN
 1/24" = 1'-0"



OUTDOOR PUBLIC FLOOR PLAN
1/24" = 1'-0"



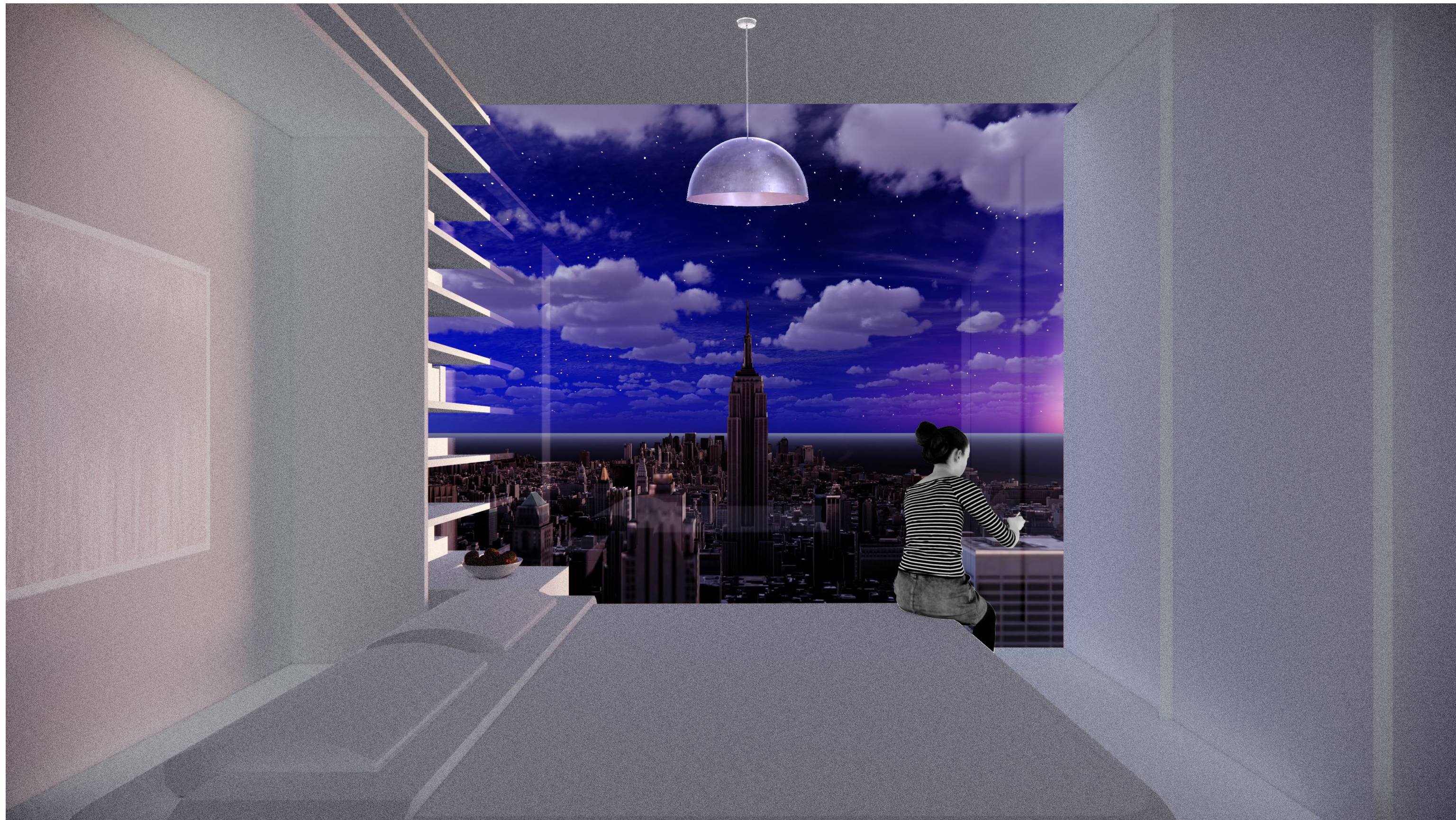
ROOFTOP FLOOR PLAN
1/24" = 1'-0"



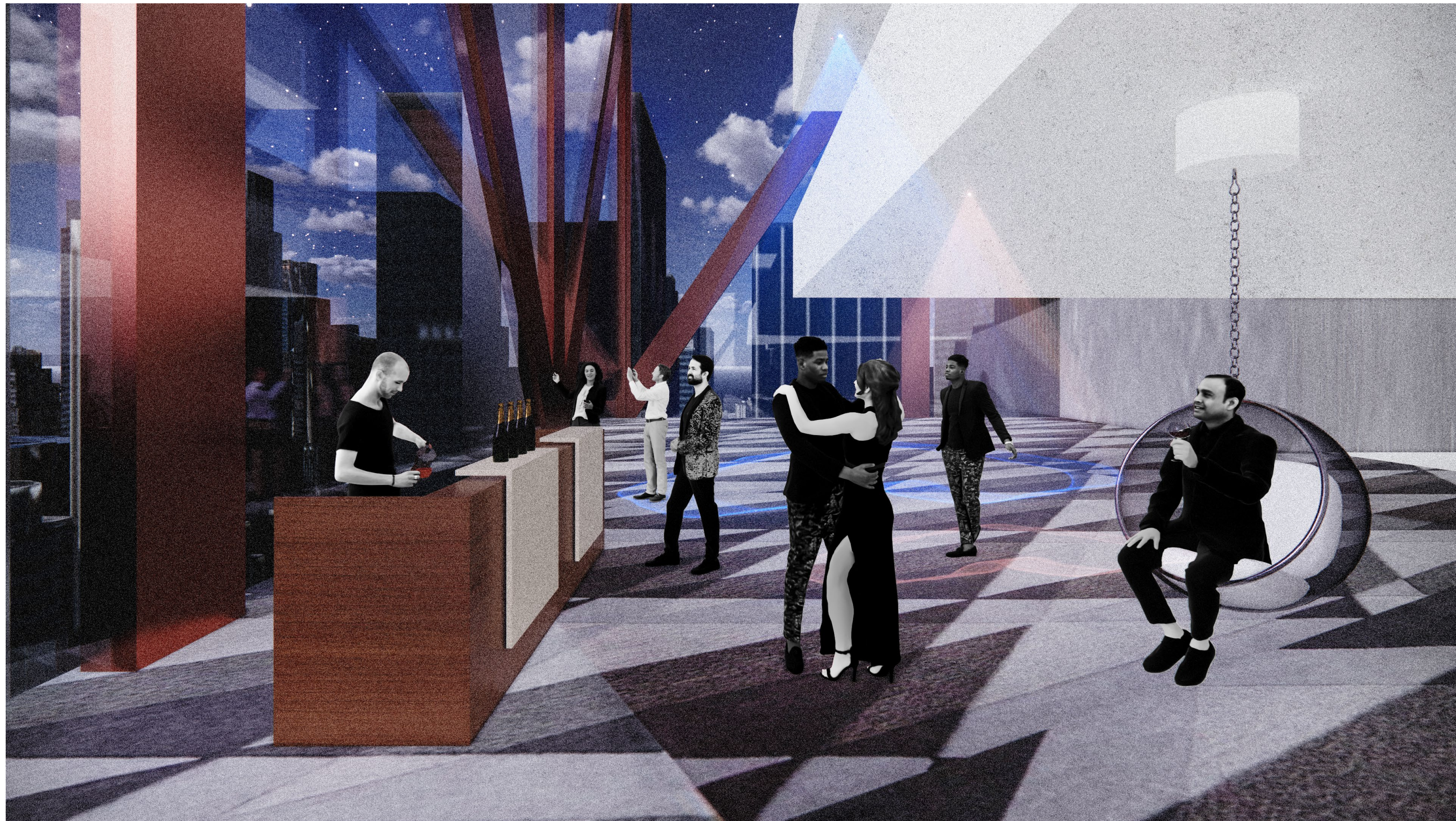
SKYWALK FLOOR PLAN
1/24" = 1'-0"

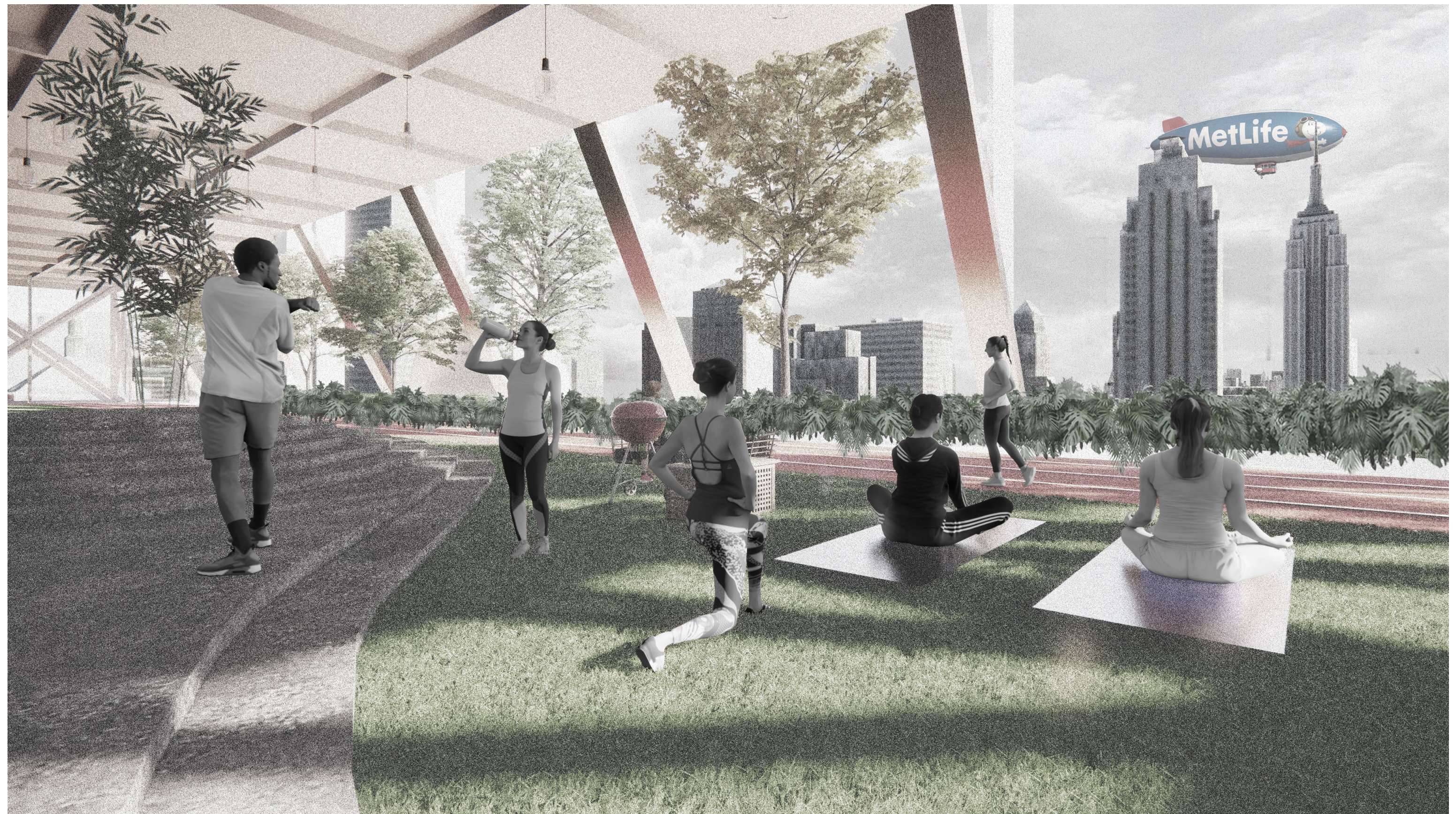


















THANK YOU!

The Economics of Space & Time: Toward True Mixed-Use
Master of Architecture Thesis

By George H. Zhang
Advisor: Prof. Belinda Tato

Fall 2020

Harvard University
Graduate School of Design

CREDITS & ATTRIBUTIONS

Page 5

More than one million additional people living in cities every five to six days from now until 2100.

Nuwer, Rachel. "Is the World Running out of Space?," September 1, 2015.
<https://www.bbc.com/future/article/20150901-is-the-world-running-out-of-space>.

In 2018, residential and commercial buildings accounted for about 40% of total U.S. energy consumption.

"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis," June 18, 2020. <https://www.eia.gov/energyexplained/use-of-energy/>.

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"Virtually all population growth between now and the end of the century will be in cities. It boils down to more than one million additional people living in cities every five to six days from now until 2100."

Nuwer, Rachel. "Is the World Running out of Space?," September 1, 2015.
<https://www.bbc.com/future/article/20150901-is-the-world-running-out-of-space>.

Americans spent an average of 54.2 minutes commuting daily in 2018. Commute times have been rising for decades, and big job markets in high-cost and high-commute metropolitan areas like New York or the San Francisco Bay Area aren't helping to bring those averages down.

Tappe, Anneken. "Americans Are Saving More than Just Money by Not Commuting." CNN. Cable News Network, September 1, 2020.
<https://www.cnn.com/2020/09/01/economy/commuting-coronavirus-money-saved/index.html>.

We produced less than half the number of units of new housing starts for the last 25 years than we used to produce every year for 50 years.

Baker, Charlie. September 9, 2019.

According to the U.S. Energy Information Administration (USEIA), in 2018, residential and commercial buildings accounted for about 40% of total U.S. energy consumption, but buildings are often designed only to be used for a third of a day's time at any given point.

“U.S. Energy Information Administration - EIA - Independent Statistics and Analysis,” June 18, 2020. <https://www.eia.gov/energyexplained/use-of-energy/>.

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Manhattan's Dynamic Population

Moss, Mitchell L., and Carson Qing. Rep. *The Dynamic Population of Manhattan*. New York, NY, 2012.