Sixty-Eight & Sunny

The Un-modern Architecture of Climate

By Philip Seaton

B.A. Philosophy of Science
New York University, 2005

Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of Master of Architecture at the Massachusetts Institute of Technology

February 2012

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ABSTRACT

Historical control of the thermal environment was a deeply cultural activity: fireplaces distributed throughout buildings needed to be fed to keep burning, drafts needed to be stopped by hanging heavy tapestries. The industrial revolution filled the air with toxic exhaust, but modernist architects promised to seal the building envelope hermetically, keeping dirty air at bay. Thermal control came to depend on the very same centralized technologies responsible for the toxic storm outside. Pumping climates throughout a building from centralized machine rooms turned the modernist building into a human vivarium: a glass box containing a strange, displaced performance of life in some consistently tempered time and place.

Industrialized city-dwellers no longer seek refuge from the outside air, and the vivarium's appetite for energy has proven more than we can sustainably produce. The design project imagines shifts in attitude for architecture after the vivarium. It is a rhetorical project which proposes three main avenues of change from contemporary assumptions. First, it envisions space in which valuable "waste" heat from exhaust, occupants' bodies, and appliances is harvested to provide imperfect and limited thermal control. Secondly, it suggests cultural shifts in clothing, activity levels, and space use that would fluctuate according to season and the availability of thermal controls. Thirdly, it proposes an attitude towards the building skin which eliminates glass in favor of a greyer zone of thermal division between indoors and out. Together these strategies replace centralized and resource-hungry mechanical climate systems with a new kind of cultural acclimatization. The resulting building embraces thermal control as a new kind of luxury good: a problem worthy not only of technical concern, but also of cultural interest.

Thesis Supervisor: Sheila Kennedy, MArch
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THANKS!

Thanks first to my advisory committee for their support and discussions without which the project could not have found its center: Sheila Kennedy, for always challenging me to clarify and root the project historically within the discipline, and for exposing me to the breadth of what architecture can be throughout my time at MIT. Thanks to Mark Jarzombek, for your mischievousness, and for helping me to find the funny in climate control, and to Joel Lamere, whose geometric and fabrication biases will guide my own for long to come.

To my helpers, without whom I would have lost balance in the final weeks: Travis and Flo. A special shout-out to Yan Ping for this above-and-beyond help at the end; the project would be missing several important pages without you.

To Vera, for your support throughout school, even when I'm only half human, and in thesis for your immaculate model making, even at distance.

And to my parents, for their enduring support always.

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Sixty Eight and Sunny

Conceptual Framework

Consider the vivarium: a climactic theater of living activity, displaced from the external environment for the benefit of onlookers. The vivarium removes its contents from the geographic and temporal locale of its surroundings: inside, a rainforest; outside, a desert; in between, a hermetic seal. These environmental differences between inside and out - differences of temperature, light, humidity, pressure, and chemistry - are maintained in a constant state of imbalance through the constant function of mechanical infrastructure.

Jarzombek, Mark. “ARUPtocracy and the Myth of a Sustainable Future.” Thresholds 38 (2010): 66-67.

Rahm, Phillipe. “Architecture as Environmental and Time Displacement.” Breathable. Madrid: Universidad Europea de Madrid, 2009. 284-290, 284.

Le Corbusier envisioned a single type of architectural envelope which would be suited equally for human activity in any climate. This one, perfect typology, implied a human occupant unadapted to his particular climate; all humans, it is implied, function best when the good, ideal climate can be brought to us: sixty-eight degrees, five hundred lumens, forty-five percent relative humidity. The reality of this envelope has come to dominate our space, and the realities of the ever increasing amounts of energy needed to sustain it are reaching global proportions.

Banham, Reyner. The Architecture of the Well-Tempered Environment. 2nd ed. Chicago: University of Chicago Press, 1984, 59.

Modernism is a constitution which hermetically separates technologists from social thinkers. Bruno Latour gives each camp a protagonist: Boyle’s laboratory represents empirically-driven hard scientists; Hobbes’ insistence on the primacy of social contracts makes him the leader of the social thinkers. Together, Hobbes and Boyle “are inventing our modern world, a world in which the representation of things through the intermediary of the laboratory is forever dissociated from the representation of citizens through the intermediary of the social contract.” Latour is critical of this dualistic view, which he sees as putting arbitrary bounds on any single discipline,

Latour, Bruno. We Have Never Been Modern. Cambridge, Mass.: Harvard University Press, 1993, 27 resulting in a comfort with conflicting views between disciplines that don't need to communicate. Writing in Domus, he says "This division between objectivity and subjectivity ensures that one can not simultaneously concentrate on both, the big and the small, the real and the symbolic, the human and nonhuman, the scientific and the 'vécu'. Thus, the traditional optics of our mental camera force us to choose between foreground and background, without ever being able to have the two sharply in focus at the same time."

We live in a modern world: blaming problems on modernism is tautological. But if we take aim at specific problems - such as our unsustainable centralized energy infrastructure, a principal result of the severed connection between technologists and social thinkers - it becomes crucial to understand the modernist history and conceptual bias as we construct and evaluate solutions. For example, "The idea that architecture belongs in one place and technology in another is comparatively new in history." Only as late as the advent of electric lighting and mechanical ventilation, Banham points out, was there even the possibility to separate technology from architecture; prior approaches to ventilation and lighting addressed windows (an integral part of the massive structures that were available) and movable lamps or candlesticks, which were not the architects' business to design. Mumford makes a similar case about technics, which he claims properly "derives from the whole of man in his intercourse with every part of the environment, utilizing every aptitude in himself to make the most of his own biological and ecological potentials."

Banham, Reyner. The Architecture of the Well-Tempered Environment. 2nd ed. Chicago: University of Chicago Press, 1984, 9.

Mumford, Lewis. The Pentagon of Power. 2nd ed. New York: Harcourt Brace Jovanovich, 1970, 309.

Modernist dualities pervade our world, but some important aspects relate specifically to the convergence of social and technical ideas occurring in the built environment. The following five modernist ideas contribute to the maintenance of the social / technical division, and in so doing represent challenges to any architectural project which hopes to bridge the gap:

1. Interiority. The clean separation of inhabitants from their environment, and the attendant notion that space is defined by clear edges and boundaries rather than interwoven zones, depends on the modernist ontological division of subject from object. The most advanced vision of this separation may be the hermetic seal, which allows the interior climate to exist independently of the exterior climate. Le Corbusier provocatively proposed "one single building for all nations and climates, the house with respiration exacte."

quoted in Banham, Reyner. The Architecture of the Well-Tempered Environment. 2nd ed. Chicago: University of Chicago Press, 1984, 159.

2. Centralized Political Power. Lewis Mumford describes the industrialized world as a "megamachine" that parcels work into "orderly, repetitive" tasks in the name of increased efficiency. For Mumford, megamachines represent "the ultimate translation of all organic processes, biological functions, and human aptitudes into an externally controllable mechanical system [characterized by] its concentration upon centralized power and external control." Though the megamachines that Mumford describes begin well before modern times (he cites the building of the pyramids as the first example), the takeover of the modern assembly-line did not occur until the industrial revolution.

Mumford, Lewis. The Pentagon of Power. 2nd ed. New York: Harcourt Brace Jovanovich, 1970, 314.

3. Centralized Energy Infrastructure. Electric power grids made it possible to transmit energy long distances after generation, creating a conceptual and spatial separation of fuel and generated energy (heat, light, motive, or otherwise). Centralized electrical generation also produce large amounts of waste heat in the form of steam; in some large cities this steam is piped underground to large buildings, which use it for heating, adding a second layer to the centralization of energy infrastructure.

4. Atomization of Architectural Elements; Dematerialization. Le Corbusier's elimination of the load bearing wall through the use of piloti enabled structure to be isolated from geometrical form for the first time in history. Simultaneously, other functions of the massive wall - thermal capacity, heat insulation, visual privacy, sound insulation - were decomposed, resulting in the need to "replace additively, element by clip-on element, the performance factors that a massive wall had contained homogeneously and organically." Philippe Rahm describes Le Corbusier's principles as eliminating architecture's slavery to material context. "The idea of eliminating the base comes down to eliminating the gravity of the building that rests on the ground.... The idea of a flat roof rather than a sloping roof is the elimination of the idea that rainwater must flow away and that architecture is therefore subject to climate. Long windows negate the weight of the lintel, the load of which is borne from above, in a diverted way. It is a way of concealing the physical heaviness of materials subject to gravity, and so on."

Banham, Reyner. The Architecture of the Well-Tempered Environment. 2nd ed. Chicago: University of Chicago Press, 1984, 155.

Moreno, Cristina. Interview with Philippe Rahm and Hans Ulrich Obrist. Breathable. Madrid: Universidad Europea de Madrid, 2009. 292-302.

5. Predominance of Vision. According to Liz Diller, "vision dominates our behavior in public space and establishes the basis of social relations. We use vision to assess identity... this visual framework precedes any social interaction." Olafur Eliasson explains that the "artistic agenda has been driven by objecthood and the fetishism connected to that." Eliasson notes how the discussion within the arts has "a parallel life in architecture or even in neurological or cognitive sciences" as he asserts that "the blurring of the visual dominance comes from the idea of deobjectification." Only vision al-

quoted in Moreno, Cristina and Efrén Garcia Grinda . Breathable. Madrid: Universidad Europea de Madrid, 2009,134 lows physical objects their definitive edges, and thus their objecthood. None of the other senses allow us to so easily understand an object, separately from its background, all at once. Touch, smell, hearing, and taste all give partial understandings of objects; while sight may in fact also provide a partial image, the illusion of objecthood can be maintained by the simultaneous vision of all of an object's boundaries.

These five characteristics of modernism each contribute to the manifest separation of architects responsible for the cultural parts of buildings from engineers consulting on the environmental, structural, and mechanical parts. Each of these tenets is potentially objectionable on its own terms: many of the theorists and architects quoted here do, in fact, offer critiques of parts of the modernist constitution as implemented in architecture.

Perhaps the closest we have come to a wholesale departure from the modern constitution takes form in the architecture of atmosphere advanced by projects such as Diller + Scofidio's BLUR and the "physiological architecture" of Décosterd & Rahm. "Atmosphere," as David Toop puts it writing in Breathable, "could be described as a condition between science and art." Art, he suggests, because we experience atmosphere in much the same way that we experience art, and the science "lies in these fugitive conditions - air pressure and temperature, maybe, and the acoustics of a place, plus some sounds at the level of infrasound or ultrasonics that we only sense or physically feel, rather that consciously hear." Juan Elvira sees modernism as even more directly negated by atmospheric projects: "As if it were a perfume, atmospheric architecture negates a complete separation from the user, so we take a part of it with us." He describes these projects as examples

Toop, David. "Background Becoming Foreground." Breathable. Madrid: Universidad Europea de Madrid, 2009, 206.

Elvira, Juan. "Dense Space." Breathable. Madrid: Universidad Europea de Madrid, 2009, 264.

of what he calls “dense” space “where the distinction between the interior and exterior is blurred or irrelevant.... where the distinction between the body and its environment is destabilized.”

The architecture of atmosphere, which re-materializes architecture by embracing all of the senses and rejecting hard-edged geometric conceptions of space, offers us one exciting response to the problems arising from modernist architecture. But to date the narratives and experiences of this new architecture have been focused on the new type of spatial experience as an end in itself. The architecture of atmosphere lacks a specific response to the conceptual chasm that Latour identifies: that between culture and technology.

ibid.

Though Ric Scofidio says of BLUR that “we’re interested in socializing this atmosphere through a technological experiment,” the technological experiment as presented looks inward to the architecture for its raison d’être, not outward towards the bigger problems of technology and culture. The experiment performed is undoubtedly a technical one, but the focus of the project lies clearly in the new social interactions produced by fog, not in the relationship between BLUR’s inhabitants and the technical experiment on display: spray nozzles. Spray nozzles are an unimportant part of the project, except in that they are necessary to produce the social atmosphere of interest. Framed in this way, the spray nozzles in BLUR are just as detached from the social experience of fog as the air conditioning unit found on the roof of any office building is from the social experience of office work.

Décosterd & Rahm’s projects similarly reject many of the dualities of modernist architecture, but focus too purely on the social aspects of the atmosphere while hiding or ignoring the extensively technical means employed to achieve their effects. Aaron Betsky writes, “Décosterd & Rahm attempt something similar [to a tea ritual space] by making us aware of such base activities as breathing (The Hormonorium), sleeping (in the Melatonin Room Project) or, as was the case in the Salle omnisports project, of sweating. The viewer or user must engage in a sequence of actions that range from paying for a ticket to taking off one’s shoes to playing sports in order to engage the architecture.” The strength of this approach lies in the architecture’s capacity to command engagement with its audience in a way that modern architecture, with its clear subject / object divisions, cannot. This is an enormous stride towards an architecture that can help to actively shape public opinion, but missing from Décosterd & Rahm’s projects is an agenda beyond the simple fact of being able to engage the audience through an unprecedented set of physiological stimuli.

Dècosterd, Jean, and Philippe Rahm. Dècosterd & Rahm: Physiological Architecture: published for the exhibition at the Swiss Pavilion as part of the 8th International Architecture Exhibition in Venice 2002. Basel: Birkhauser, 2002, 51.

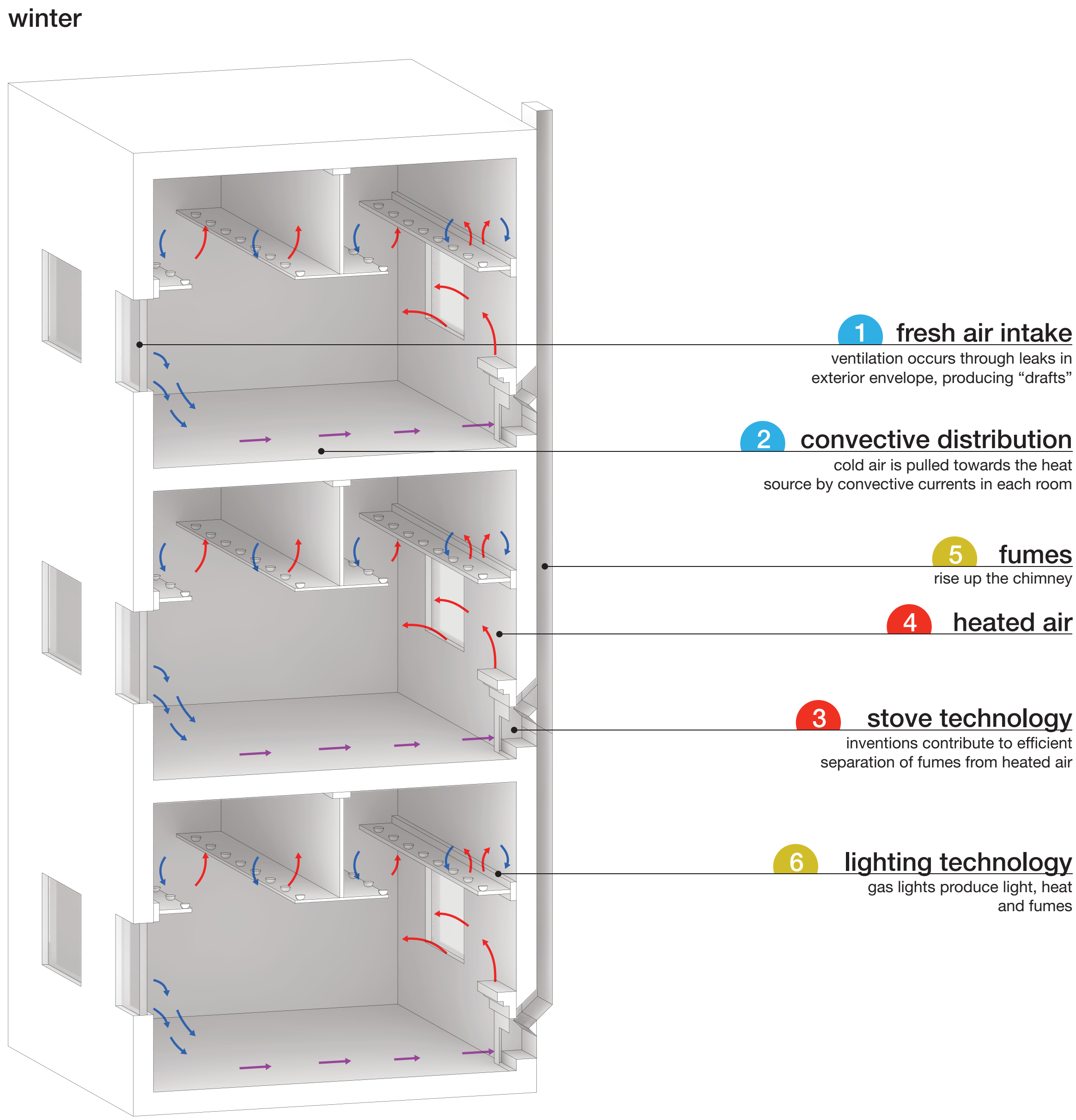
Atmosphere presents an as-yet untapped opportunity to reunite social and technological aspects of architecture; in taking this opportunity we have a chance to bring monumental technological problems, such as modernist energy and power structures, directly into the realm of social experience. We stand to invent an architecture which can answer Latour’s wish: to “simultaneously concentrate on both, the big and the small, the real and the symbolic, the human and nonhuman, the scientific and the ‘vécu’.” Such a project could open the door for a better cultural understanding of energy infrastructure, serving as a stepping stone towards a more sustainable energy future.

Thermal Precedents

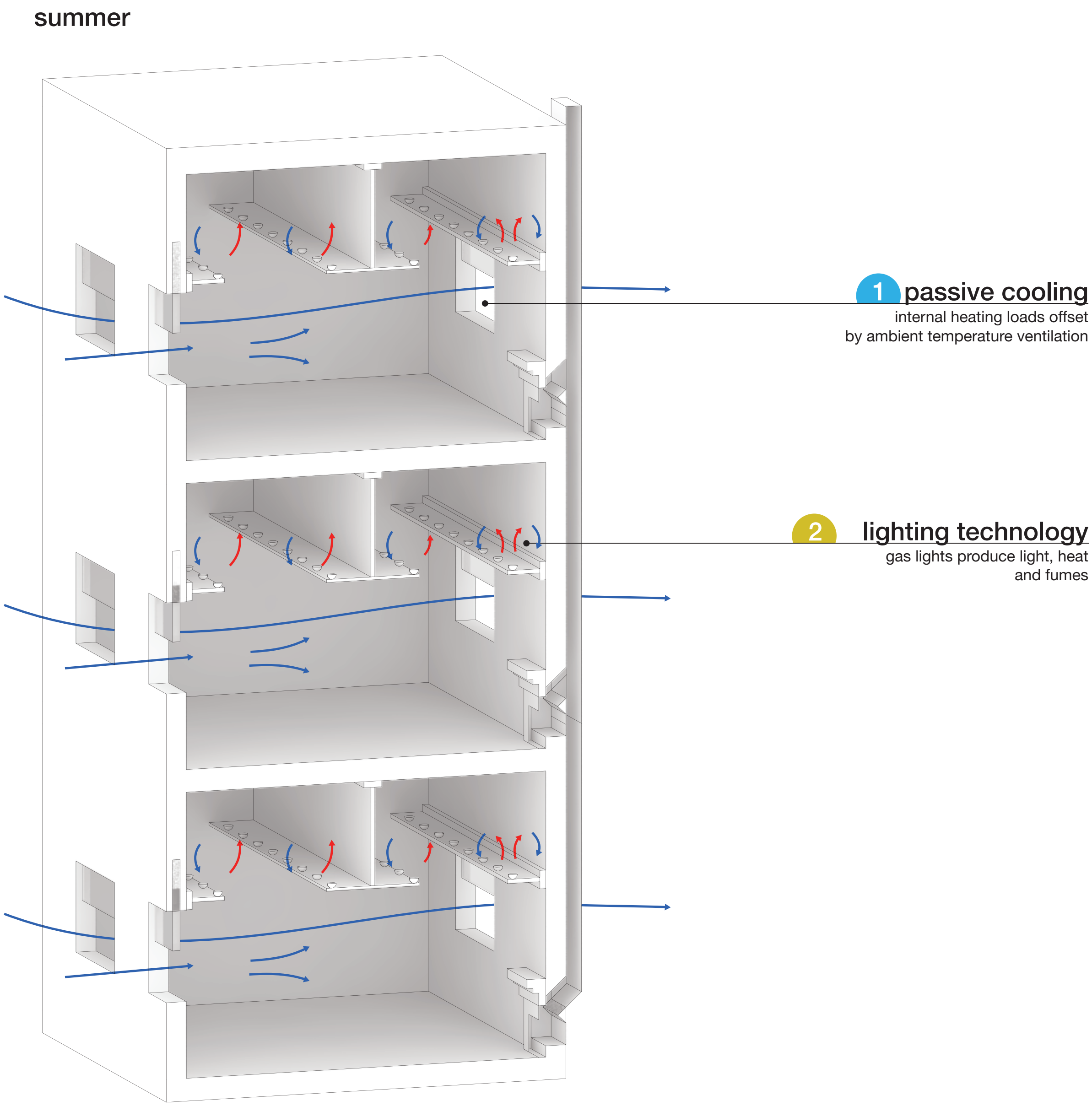
The cultural and historical meaning of the tempered interior

1741
Franklin Stove

Pre-modern heating consisted of distributed infrastructure in which fuel consumption and heat production occur in the same location. Heating of overall buildings thus depended on principles of air flow throughout rooms. Intake of air had not yet entered the equation; instead, cold air entered the space through leaks in the imperfect building envelope. These leaks of cold air were responsible for the "draft" common in buildings at the time.



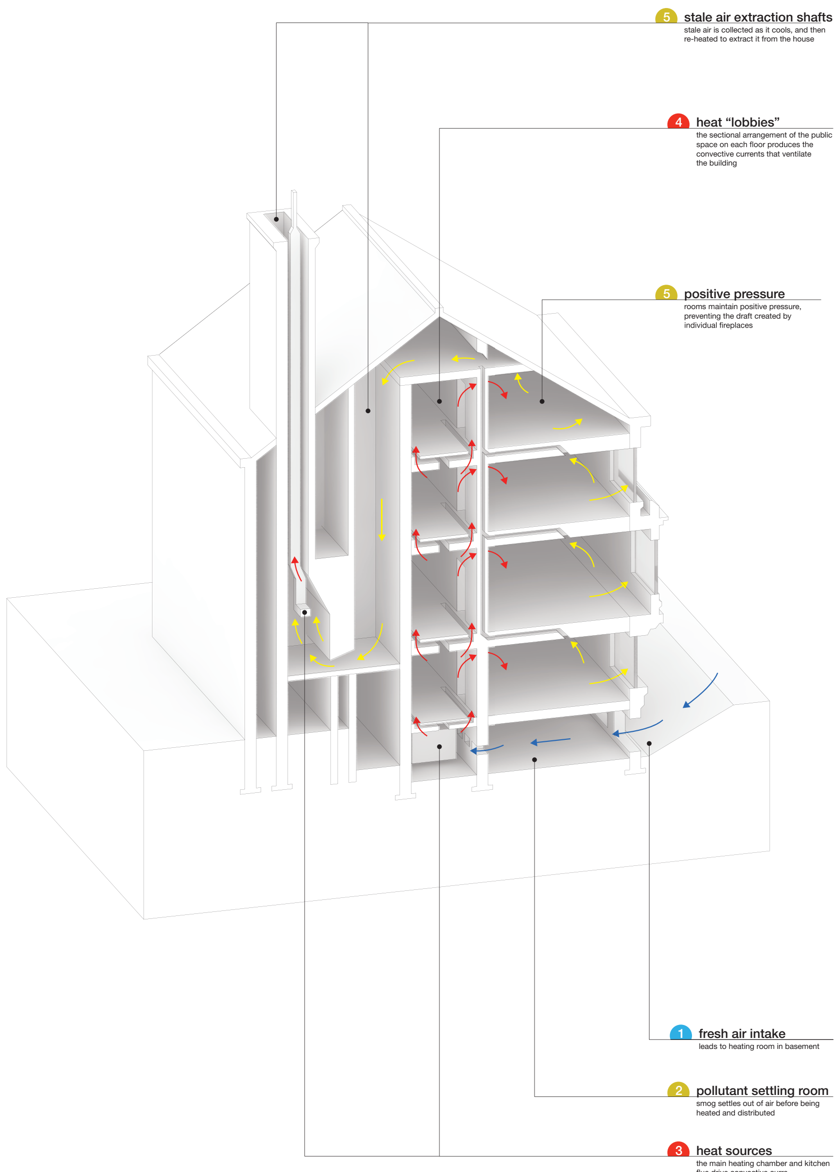
Cooling systems were non-existent for the most part. Though specific rooms used for special purposes were sometimes cooled with ice blocks (indeed we still sometimes use the measure of a "ton" of cooling, which refers to the amount of energy required to melt a ton of ice), ventilation was the primary means of cooling.



1861
Octagon House

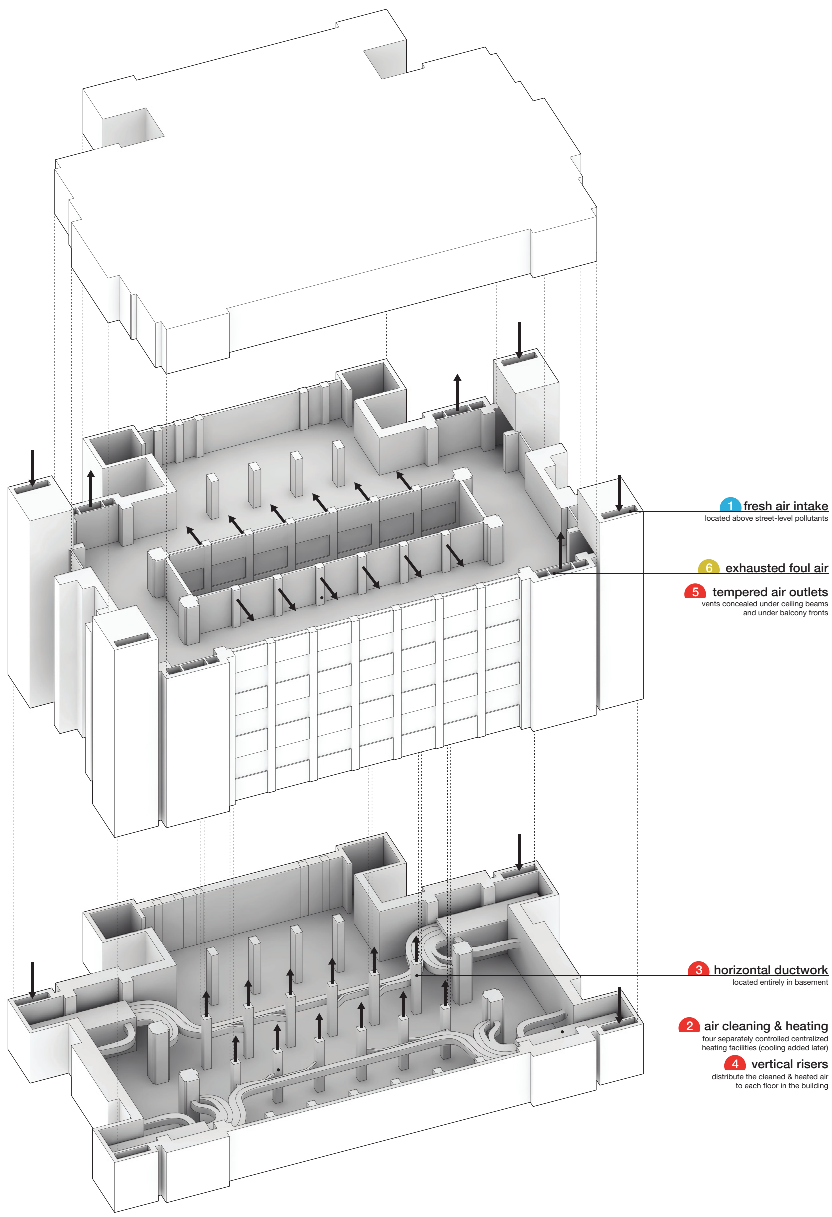
Pre-modern buildings, responding to the beginnings of the dirty external air that would increase as industrialization gathered steam, devised clever, buoyancy-based ventilation strategies as a way to allow particulates to settle out of the air before being circulated through the house.

In the Octagon House, all air intake occured because of negative pressure produced by a centralized heat source in the basement. Though not responsible for the primary heating of the house, this advancement introduce the earliest kind of centralized heating system while employing principles of air flow in the building section.



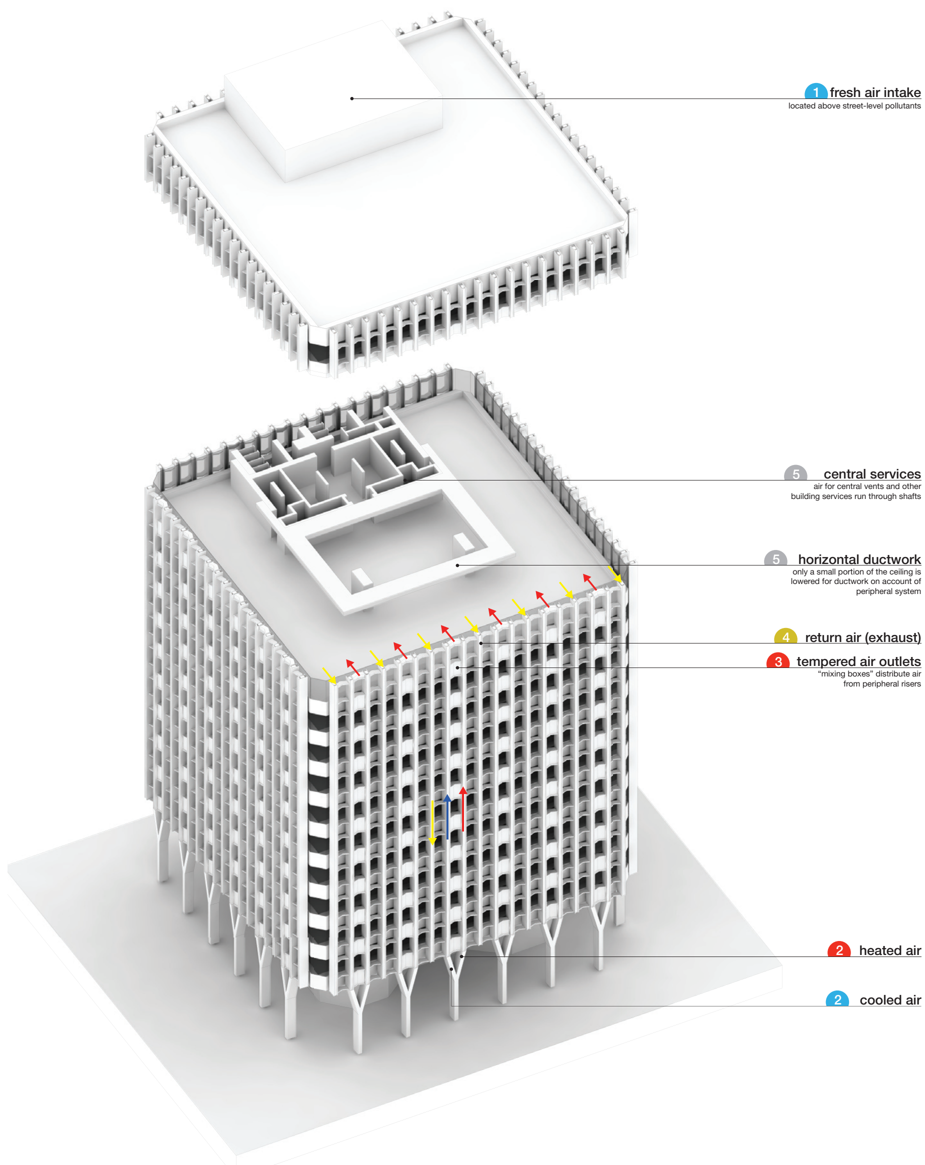
1906
Larkin Administration

Full adoption of centralized heating and, eventually, cooling systems was made possible by the widespread use of the mechanical fan. With the ability to draw air in from above street-level, issues of indoor air quality issues were largely solved; the same fans made it possible for “mechanical” elements to be dislocated from tempered spaces. Centralized heating and cooling facilities eventually became the norm, though their formal expression began to lose any connection to the principles of buoyancy.



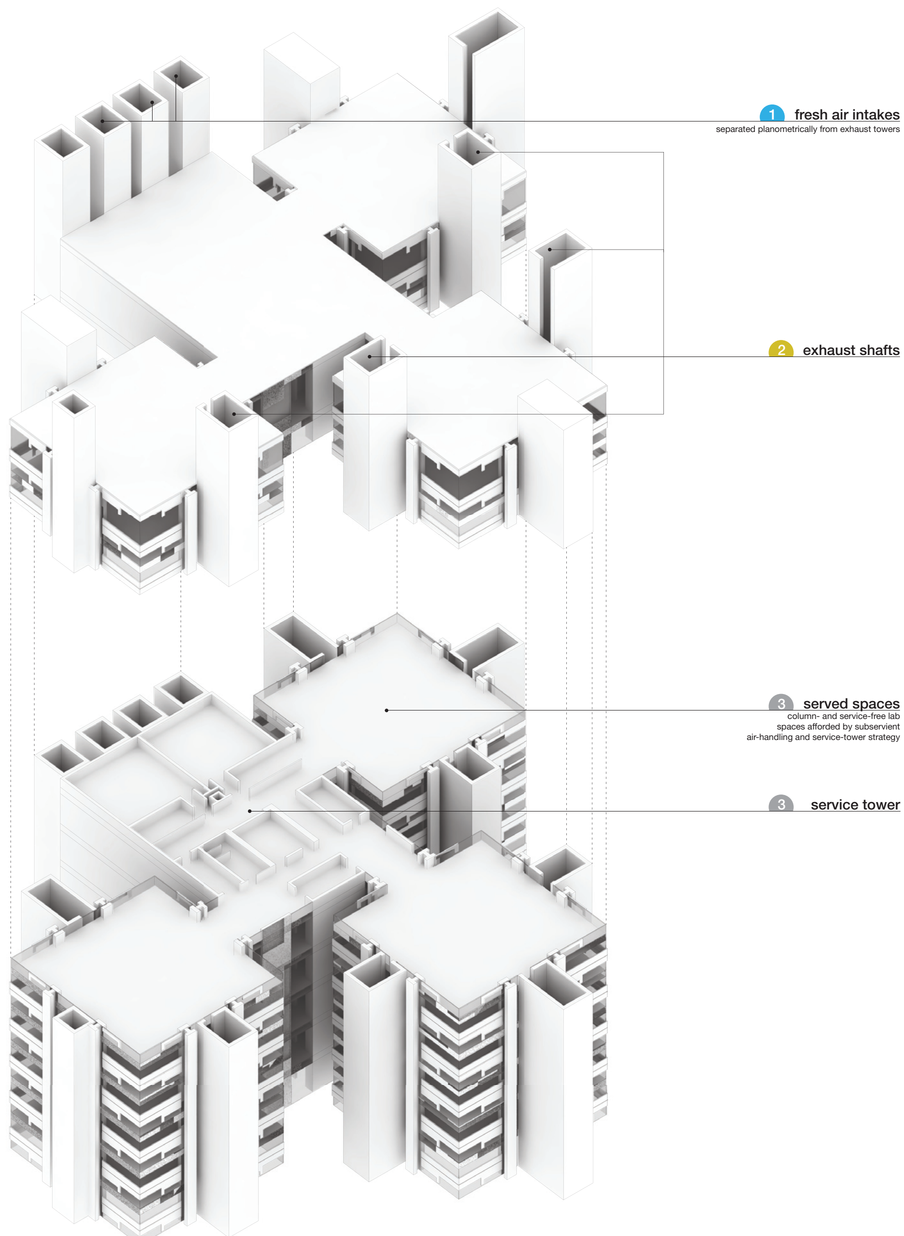
1960
Blue Cross Blue Shield

Well into the modern era, the Blue Cross Blue Shield Building by Paul Rudolph explored infrastructure as a purely peripheral superimposition on the building. By merging structure and air handling, the building exemplified the expanding plasticity of heating and cooling elements.



1960
Richard's Laboratories

Louis Kahn created "servant" spaces and "served" spaces out of the air handling infrastructure in Richard's Laboratories. The complete separation of the air handling infrastructure from the human-occupied parts allowed the parts of the building to begin to take on independent cultural values, with the infrastructural parts taking second shrift to the "more important" parts that they serve.



1960s
Total Environments

Experimental hermetically sealed living environments of the 1960s established a fascination with the mechanically sustained living environment (vivarium) per se. The fascination with the hermetic seal had roots in both the ongoing love affair with machines and the fear of air that began with the industrial revolution and continued into later fears of chemical and biological weapons. By sealing oneself off from the outside, perfect comfort and safety could be achieved. Right?

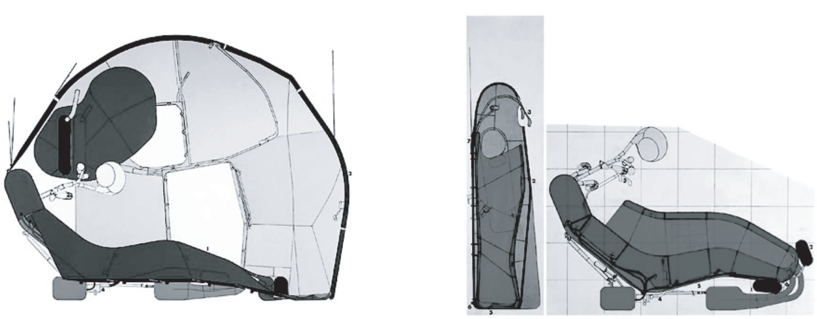
Drawings by their original authors.

1965

The All-American Un-House
Reyner Banham

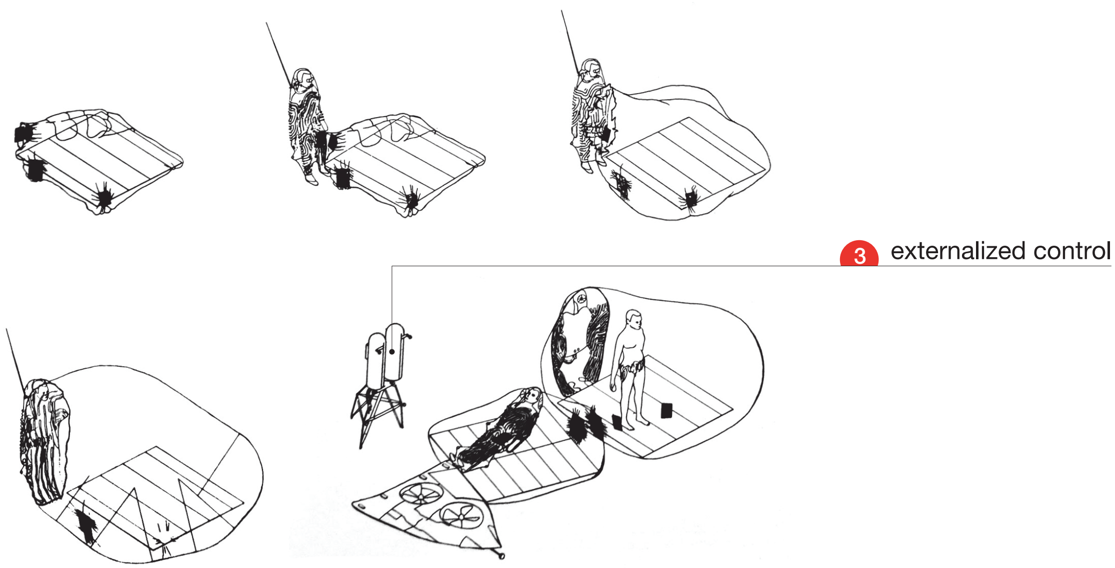
1967

Cushicle
Michael Webb



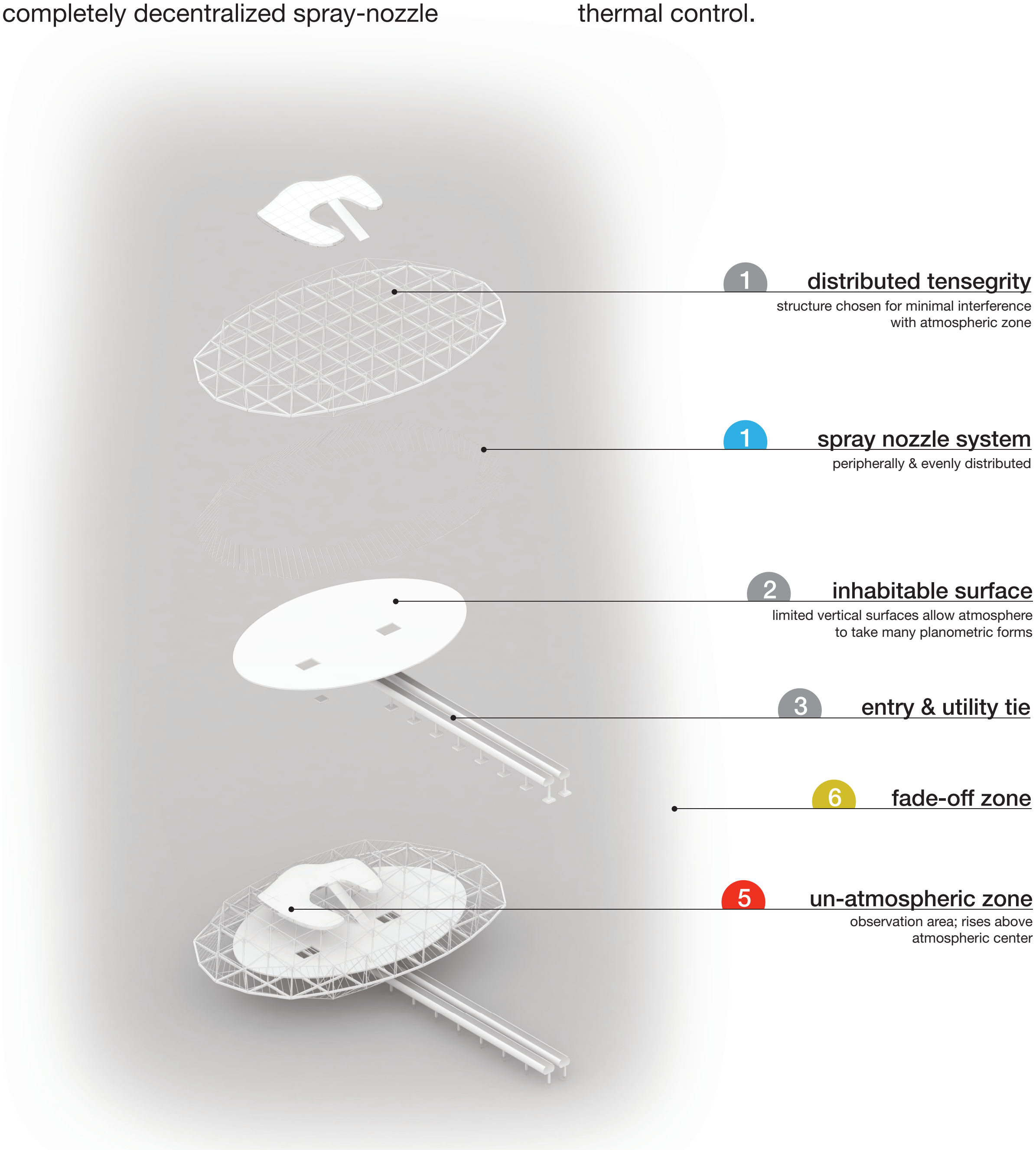
1967

Suitaloon
Michael Webb

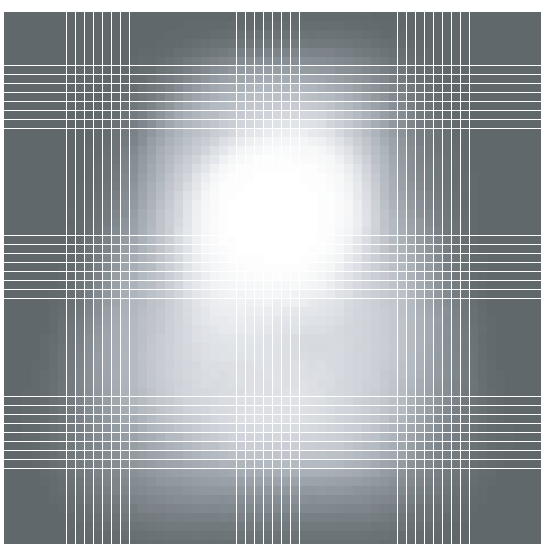


2002
BLUR

Diller & Scofidio's BLUR building explored a new paradigm of architectural atmosphere. Rather than starting with a hard-lined edge or building envelope, BLUR depended on fuzzy "atmospheric zones," produced by completely decentralized spray-nozzle sources. Though the lack of enclosure brings into question whether BLUR is a building at all, the notion of an unsealed envelope and blended interior and exterior has significant implications for the culture of thermal control.



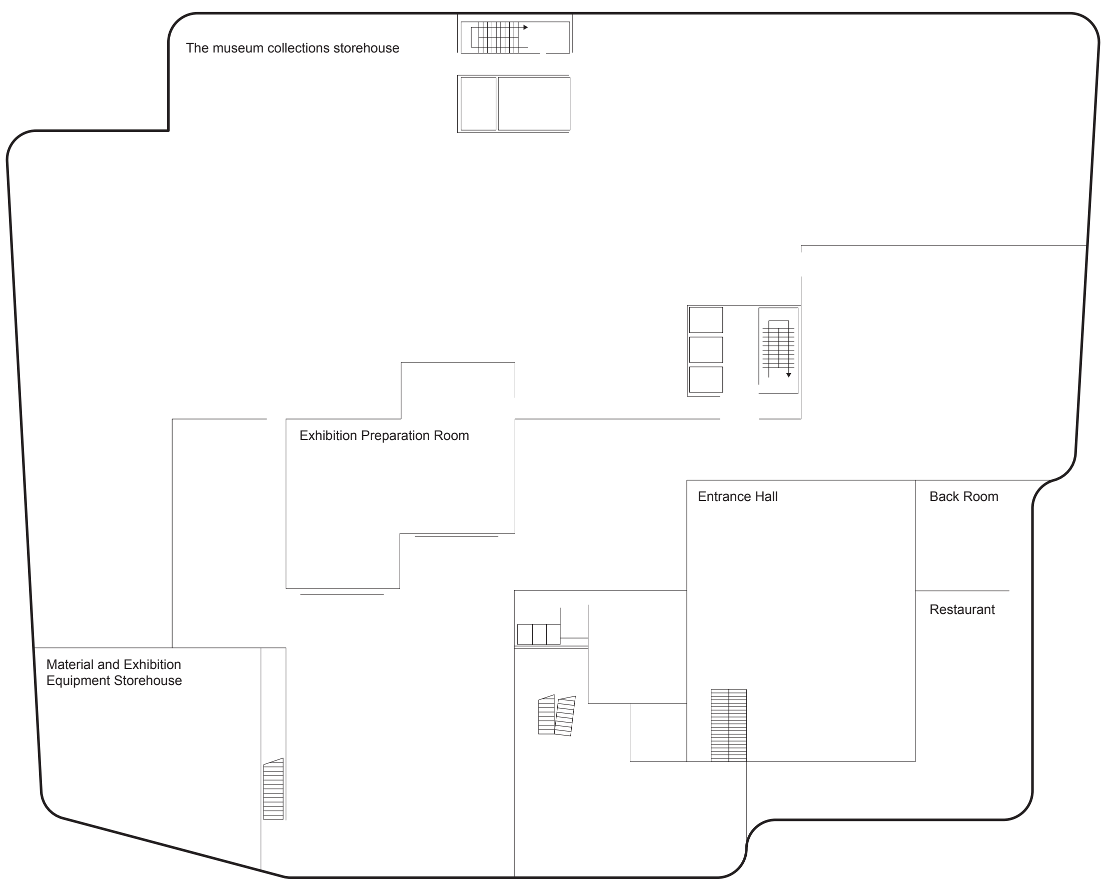
The denial of the linear boundary implied by atmospheric architecture means that the architectural space can have a center, and be of greater concentration in a localized area, but that the building itself is not rigidly contained. For BLUR, Diller & Scofidio had to ensure that the reach of their fog did not cause visibility issues outside a particular urban boundary; therefore they necessarily had to consider wind and weather patterns' effects on the building's position, size, shape, and density.



2008
Convective Museum

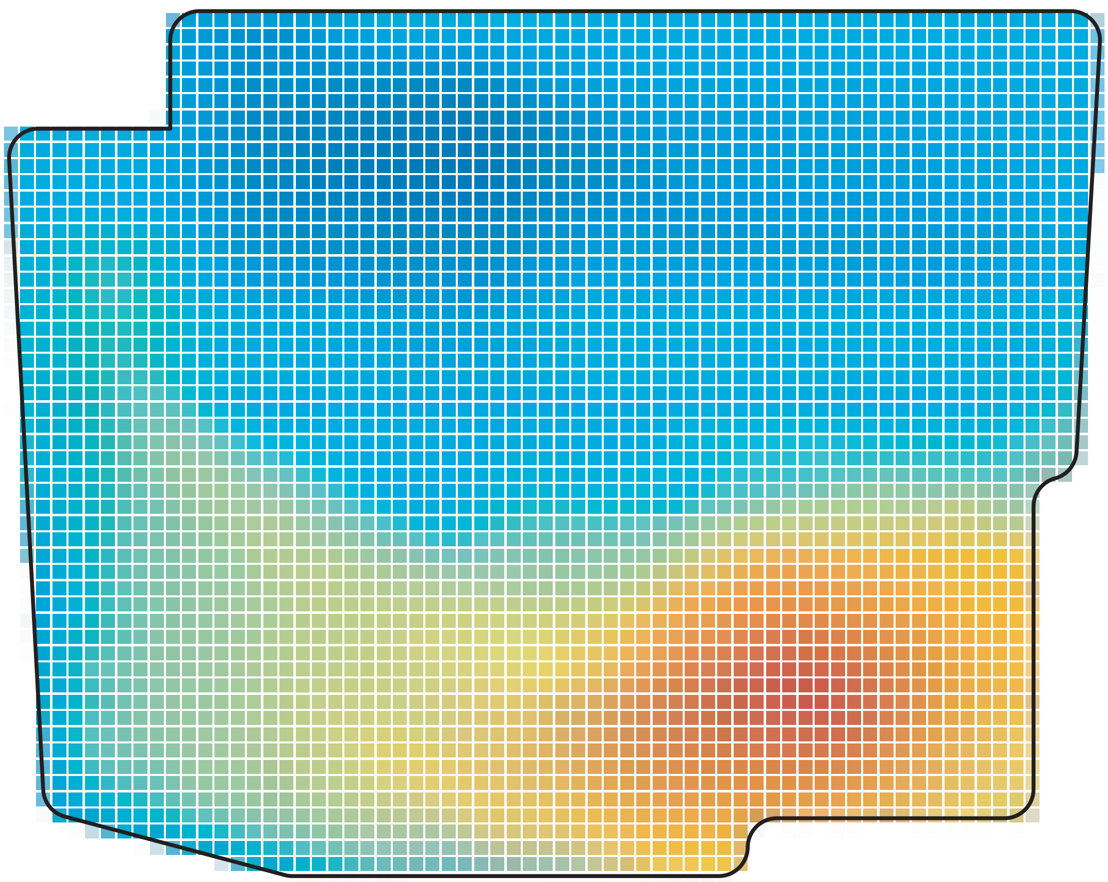
Philippe Rahm's "physiological architecture" redefines space in terms of thermal, barometric, humidity, brightness, and other physiologically perceived properties. The program elements of an art museum are thus arranged according to the archival needs of the art, not only the spatial requirements of people.

The museum consists of a series of borderless "zones" which vary thermally but which lack clearly defined edges, much like BLUR. While closer to being an occupiable 'building' in the sense of providing shelter, Rahm's mechanically-dependent single-line



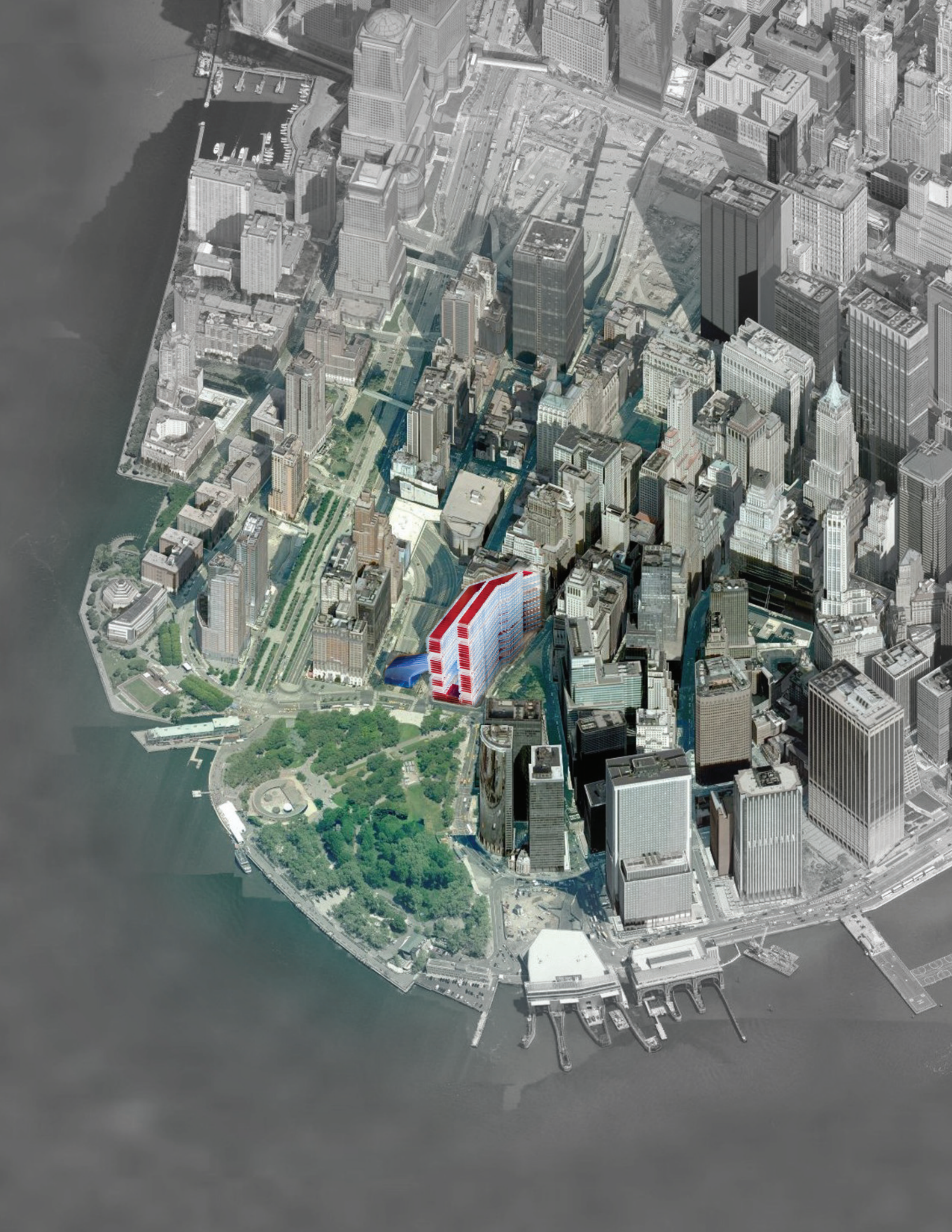
enclosure separating indoors from outdoors reifies the dependence on mechanical systems.

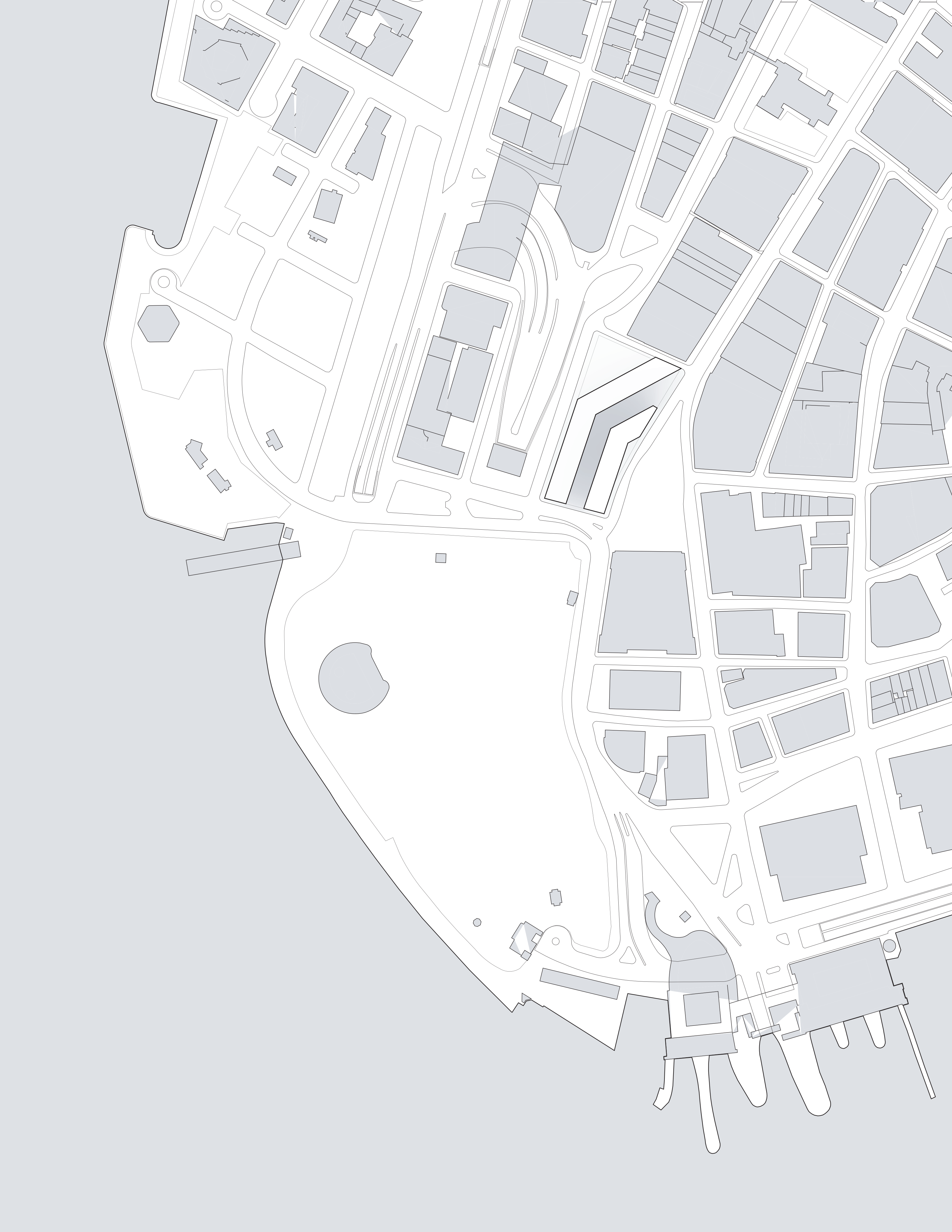
By strengthening this dependence on an efficient building envelope, Rahm's project embraces the notion of "climactic" architecture while actually enhancing its relationship to the vivarium. His concepts of a program organized thermally prove useful as a driver for design decisions, but architecture after the vivarium must attempt to break down the seal, and with it the dependence on external fuel consumption.



Sixty Eight and Sunny

A rhetorical inquiry of architecture after the vivarium



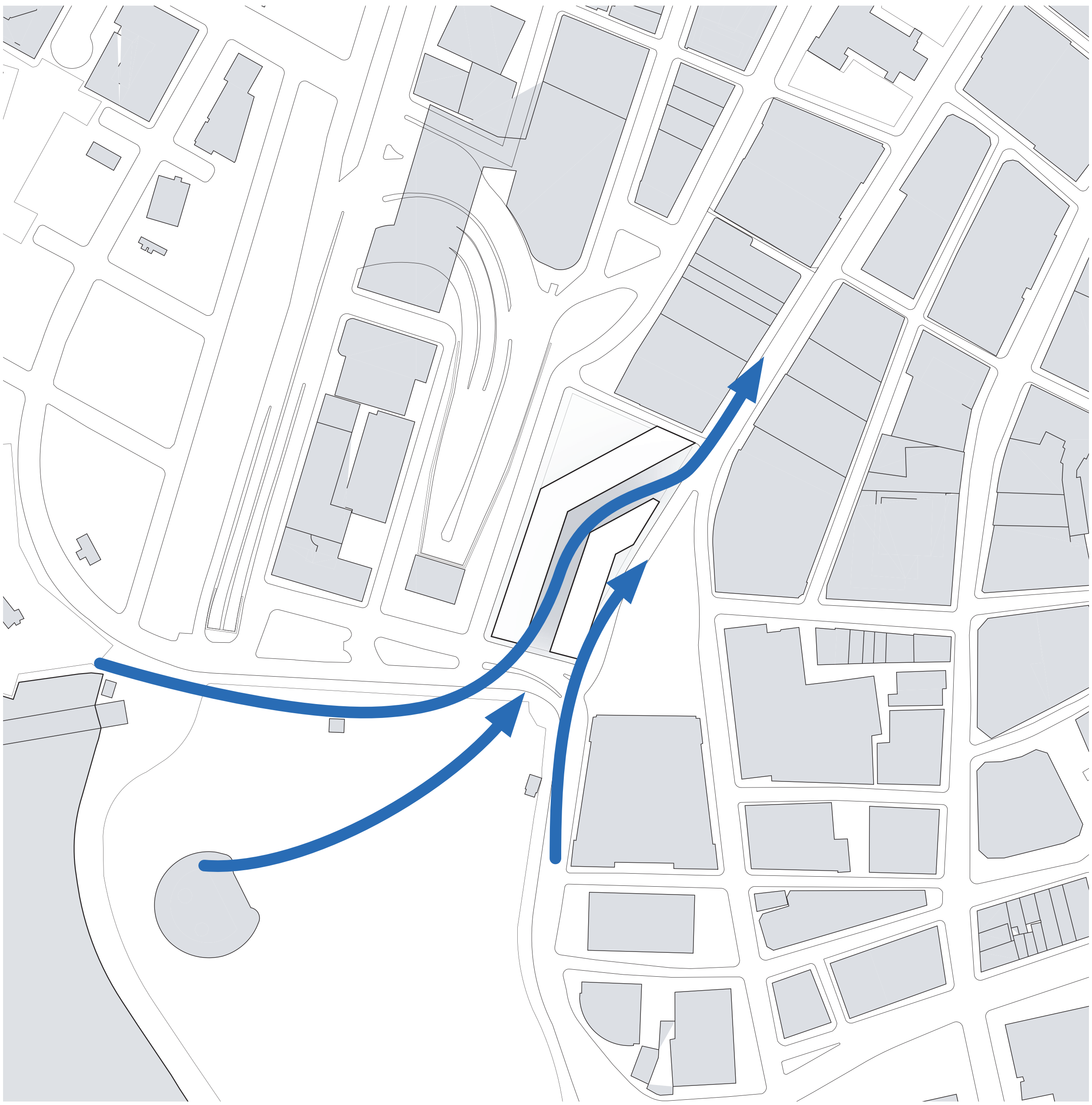


Thermal Urbanism

Site without walls

Unlike the typical modernist building, whose thermal climate is limited to the building's enclosure, Sixty-Eight and Sunny leverages the seasonally-motivated cultural habits of occupants to transform the building seasonally.

In the summer (left), the building's occupants will open up the periphery of the building as much as possible, so as to generate the maximal cooling effect on the interior. This process of "opening", however, has effects beyond the building's "walls". Instead of cooling only the interior, the opening of the periphery makes the



entire building more transparent to wind, allowing the cooling effects of the harbor to reach further inland through the building; the building becomes a kind of “sail” that directs the breeze into the heart of the financial district, where its effects are needed most desperately.

In the winter (right), building occupants stuff their off-season clothes and recyclables into the facade’s metal meshes, insulating themselves while turning the building into a more wind-opaque entity capable of steering unwanted cold wind back out to sea.

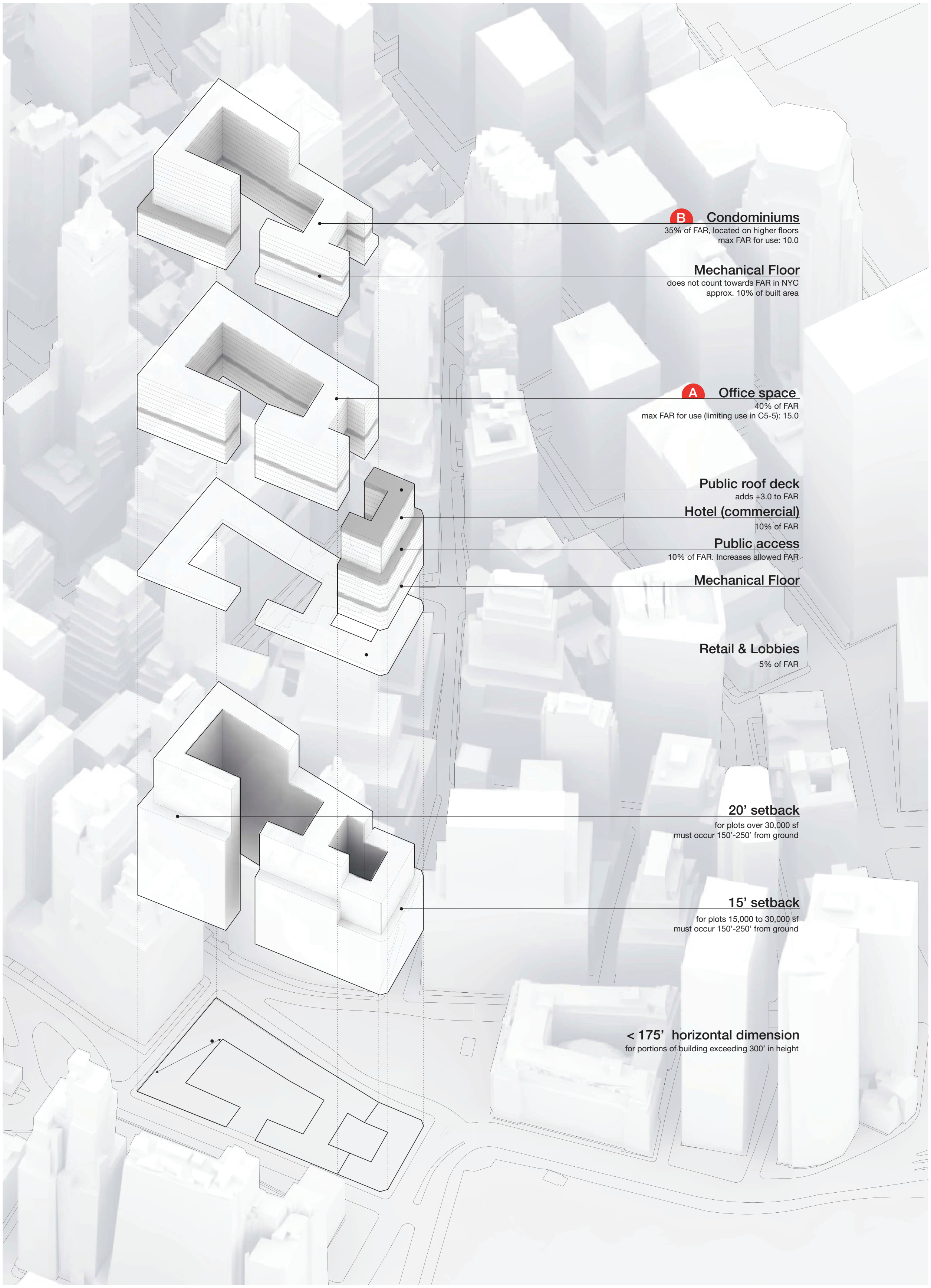
Developer’s Pro-Forma
Deriving FAR & programmatic content

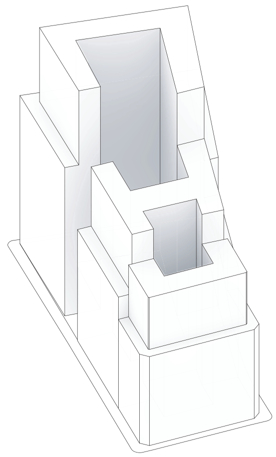
The project proceeds as a conceptual renovation of a completely plausible developer’s solution for the site. Cues from local zoning code, surrounding building heights, programs of surrounding buildings and the relative proportion among uses for mixed-use neighbors are all taken into account as the basis for the programmatic distribution and size of the new building.

Starting with this “pro-forma” building (right), a series of conceptual changes are made to the massing (next page) on an urban scale (see “Thermal Urbanism”). In step six, a breakdown of the masses into “thermal neighborhoods” is introduced. These neighborhoods share common infrastructure, though each neighborhood is fed by its own (mis)balance of heating and cooling sources.

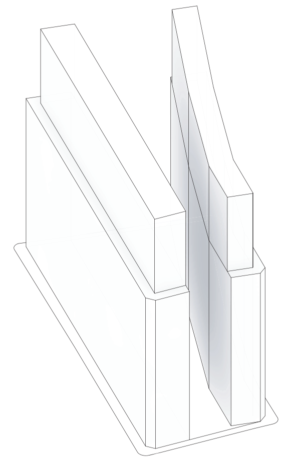
The resulting imperfect balance of available resources for each thermal neighborhood establishes a building whose interior climate and exterior climate mix hazily in a kind of peripheral zone of the building, rather than sharing an edge at a single “building enclosure” edge.

This conceptual renovation stands as the base point in the project from which the thermal explorations occur. Though the project does not insist that the building, as ultimately proposed, would be saleable to a developer’s standard client, it does propose that a new kind of economy might, in the future, evolve around the rethinking of building climates, and the associated luxury of thermal control.

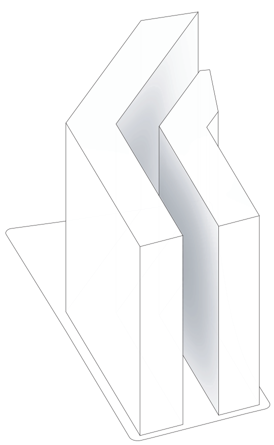

B Condominiums
35% of FAR, located on higher floors
max FAR for use: 10.0
Mechanical Floor
does not count towards FAR in NYC
approx. 10% of built area
A Office space
40% of FAR
max FAR for use (limiting use in C5-5): 15.0
Public roof deck
adds +3.0 to FAR
Hotel (commercial)
10% of FAR
Public access
10% of FAR. Increases allowed FAR
Mechanical Floor
Retail & Lobbies
5% of FAR
20’ setback
for plots over 30,000 sf
must occur 150’-250’ from ground
15’ setback
for plots 15,000 to 30,000 sf
must occur 150’-250’ from ground
< 175’ horizontal dimension
for portions of building exceeding 300’ in height



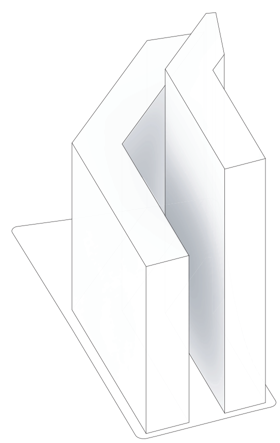
1. Pro forma
Derived from existing buildings
and zoning codes



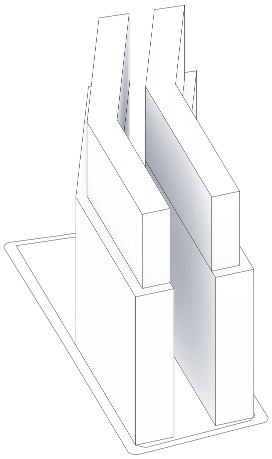
2. Simplification



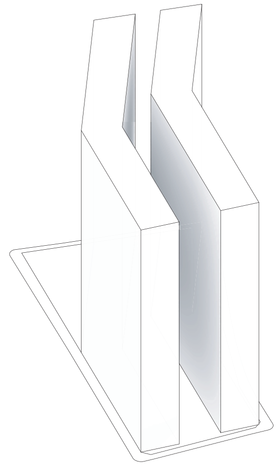
5. Urban connection
By allowing the two towers to stray from their sameness, better connection to Broadway can be achieved.



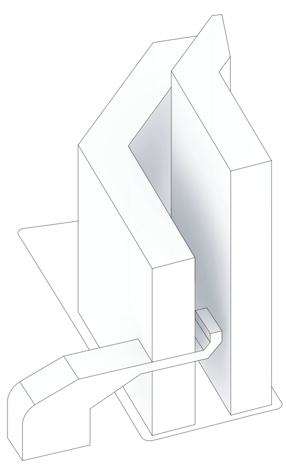
6. Sun allowance
The eastern tower is raised and the western tower lowered to produce more sun-soaked areas.



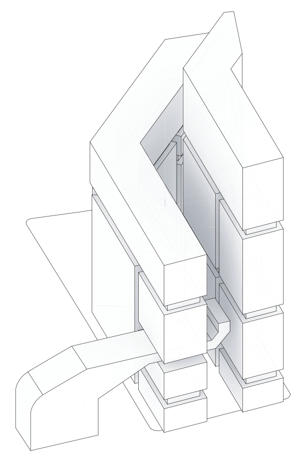
3. Wind Bias
Building is bent to drive air currents up broadway



4. Unification
The existing divide between top and bottom parts of the building is removed.



7. Battery Tunnel allowance
High-velocity cold air from the battery tunnel is piped in between the towers as a source of always-cool air to be harnessed by the buildings



8. Infrastructural Adjacencies
The building's mass is subdivided into various "thermal neighborhoods", each with its own adjacent access to various external, internal, natural, and human-made infrastructural resources.

Profit vs Temperature
The economics of the tempered interior

Two common explanations initially served to justify the sixty-eight degree and five hundred lumen interior environment, when it needed justification at all.

First, it was suggested that productivity was somehow proportional to precise thermal control; ads from the early years of air conditioning show lazy, heat-addled foreign workers napping during the midday heat. By conditioning the interior environment, it was implied, greater worker efficiency would boost profits and, in turn, bring the conditioned inhabitants into a higher class of society, leading to the second justification: comfort.

The comfort argument hinged on the idea that high-class people should not have to endure the discomfort of the unpredictable weather; instead, joining the ranks of “civilized” society implied a comfortable leisure akin to the soft, pale skin once expected of aristocrats. (Ackermann)

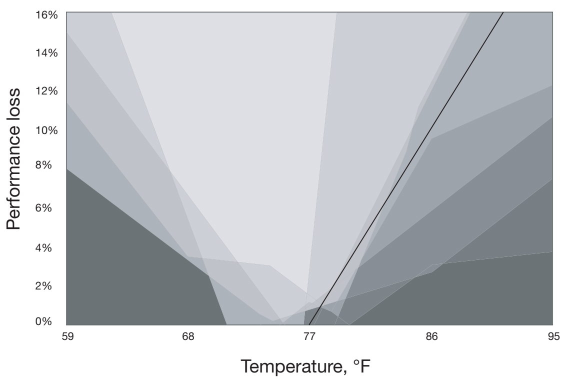
Contemporary research shows, however, that worker performance, while it has upper and lower limits for thermal flexibility, does not suffer at all within a range of at least 65 to 77 degrees. At the same time, the energy required to maintain even one degree closer to 68 can be enormous.

The project proposes that a wider range of acceptable climates should become the norm, both because of the economic argument and because of the cultural and technical ones (see Framework).

Worker Performance

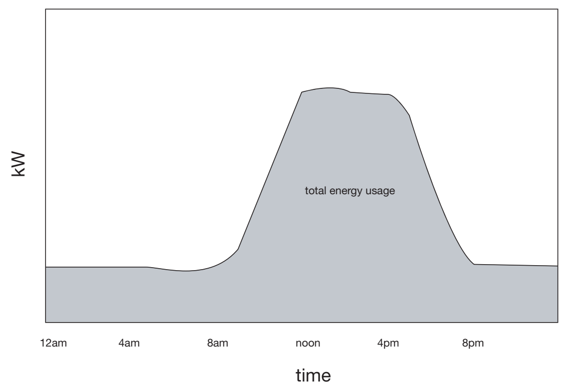
performance loss due to climatic variance
(summary results from numerous studies)

Data as summarized in Seppänen, et. al. Individual studies marked by changing tone; summary results in bold line



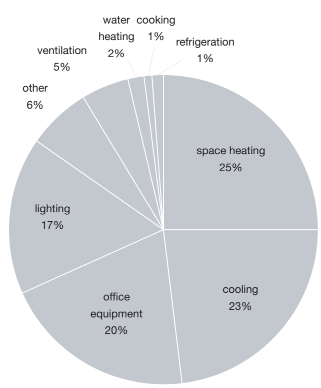
Energy demand

typical daily energy usage
(office buildings)



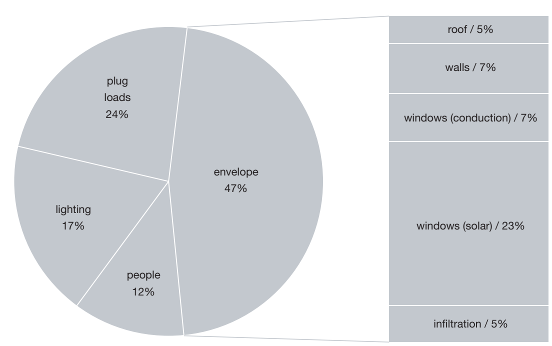
Energy demand

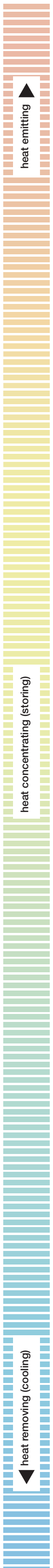
how energy is used in a typical office building

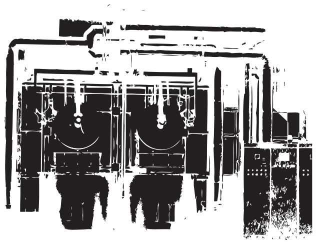


Cooling loads

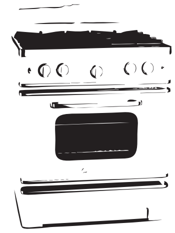
how energy is used in a typical office building







furnace / mechanical



kitchen

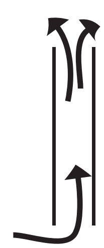
people (exercising)

people (working)

small spaces

plants

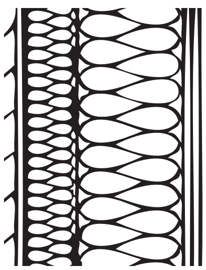
water (chilled)



vertical shaftways

shower

office equipment

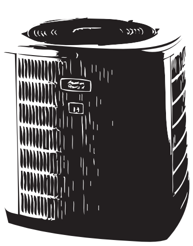


insulation

clothes /
microclimates

masonry

water (aerosol)



air conditioning

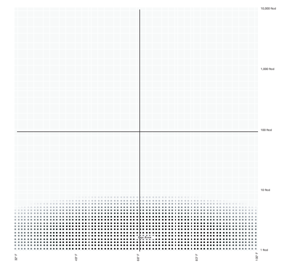
Special Purpose
Thermal Re-Programming

On the vertical axis, light levels. On the horizontal axis, temperature. In the center: sixty-eight and sunny.

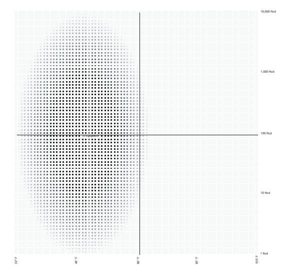
The following graphs identify the ideal thermal situation and likely thermal flexibility of the many program types that might be encountered in a mixed-use office / residential tower in Manhattan.

The use of these types of “zonal” maps for programs suggests organization of the program with reference to the heating, cooling, and lighting sources in the building. IT & server space, for example, could be located in almost any level of brightness, but ideally is situated on the colder side of the building.

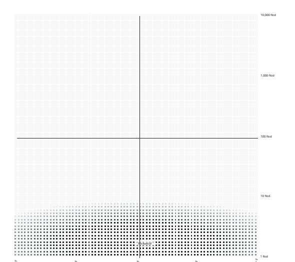
The superimposition of these maps can be used as a diagram for the organization of program within the building.



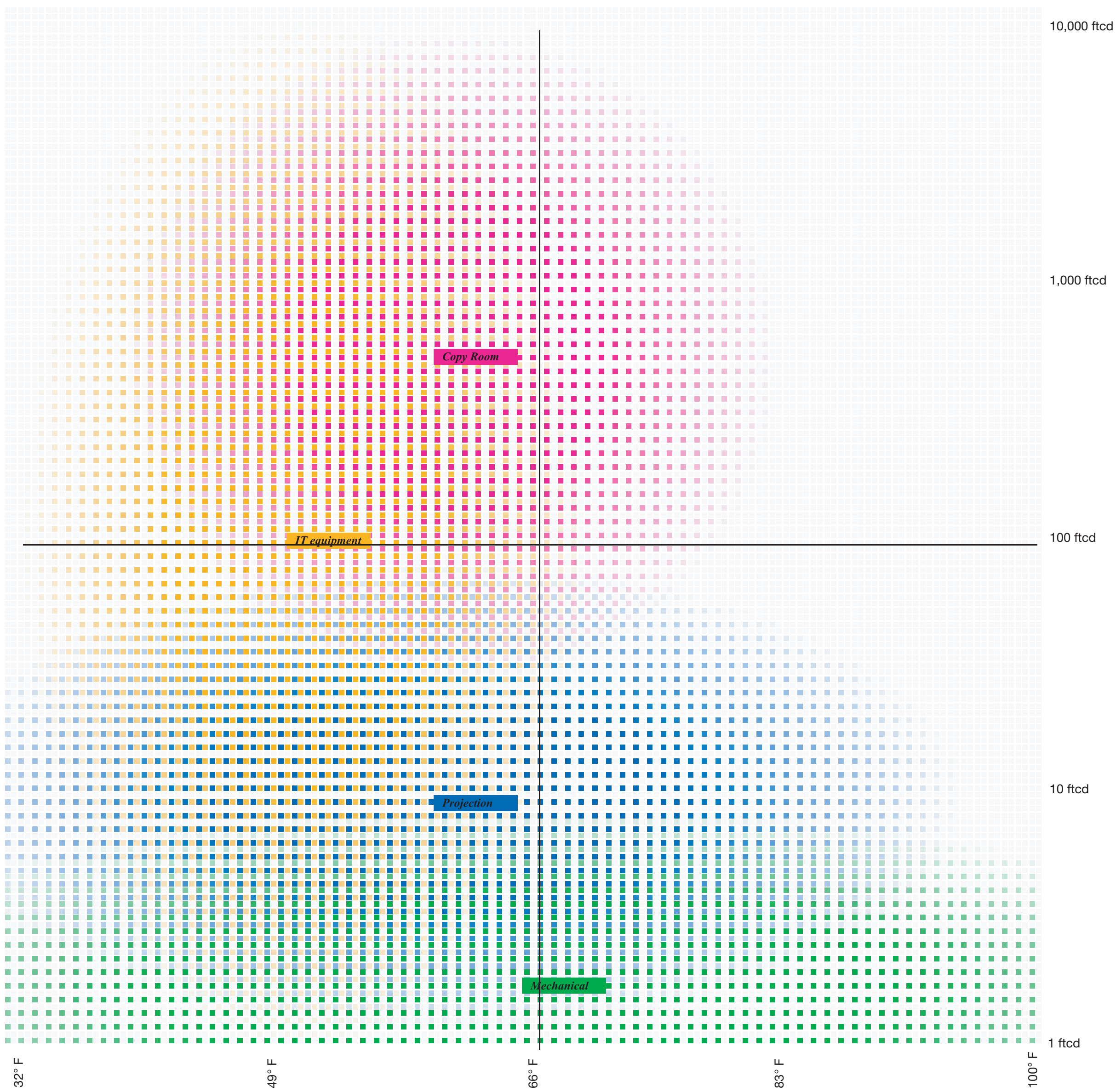
copy rooms



IT space / server rooms

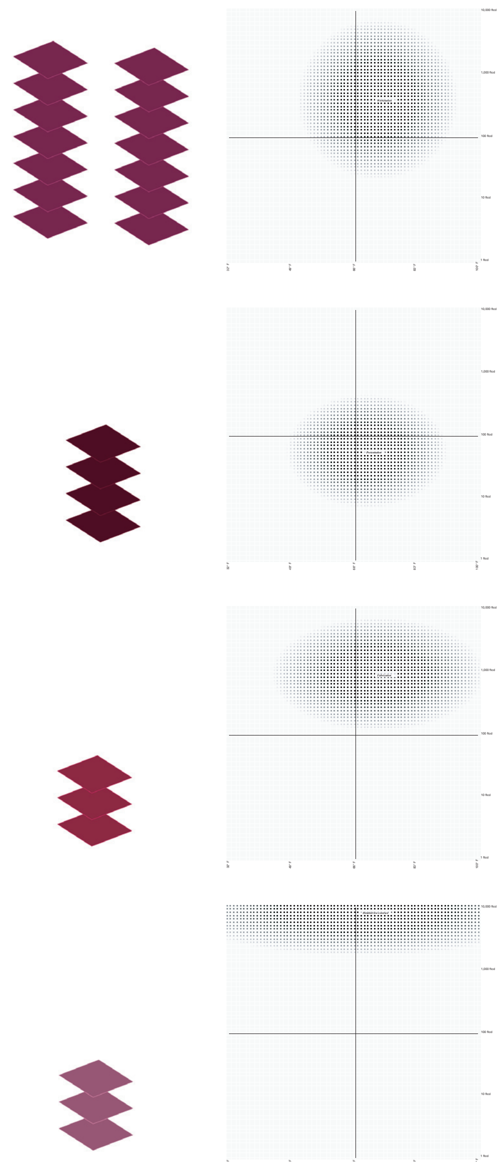


mechanical



10,000 ftcd
1,000 ftcd
100 ftcd
10 ftcd
1 ftcd
Copy Room
IT equipment
Projection
Mechanical
32° F
49° F
66° F
83° F
100° F

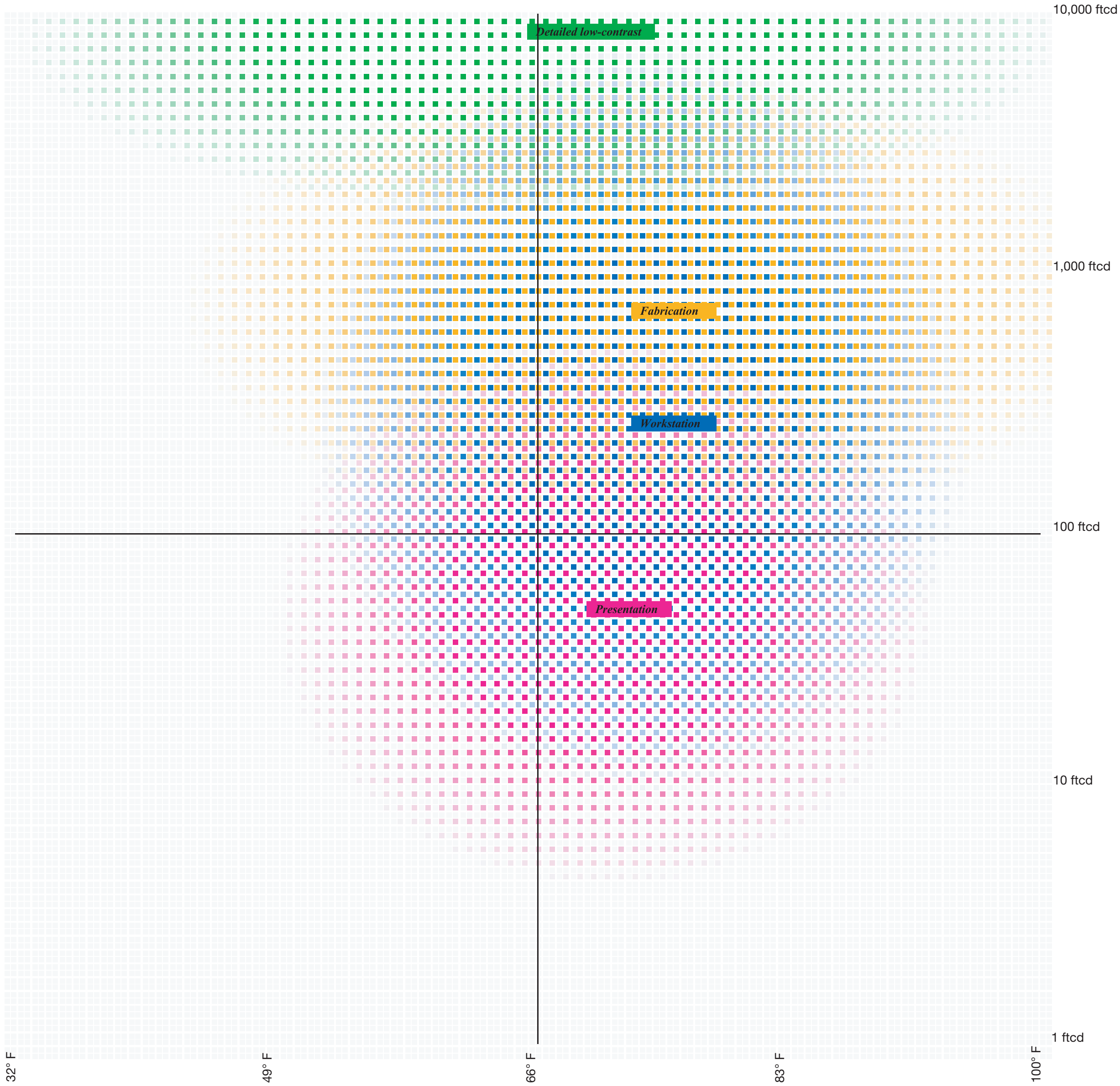
Office Space
Thermal Re-Programming



presentation
(70,000 sf)

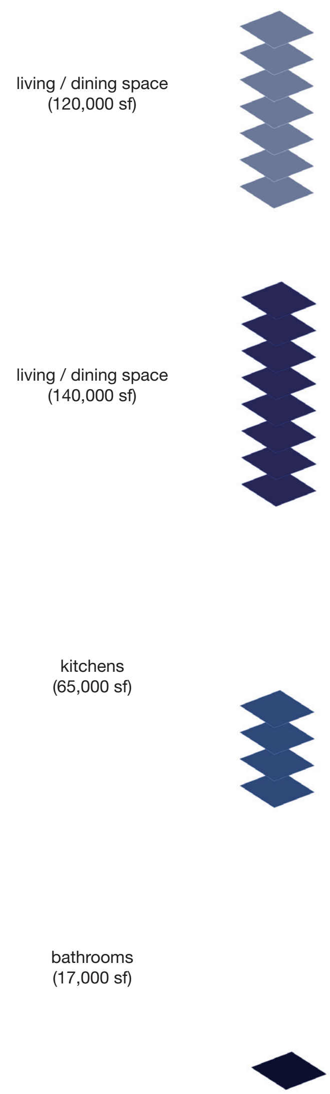
fabrication
(50,000 sf)

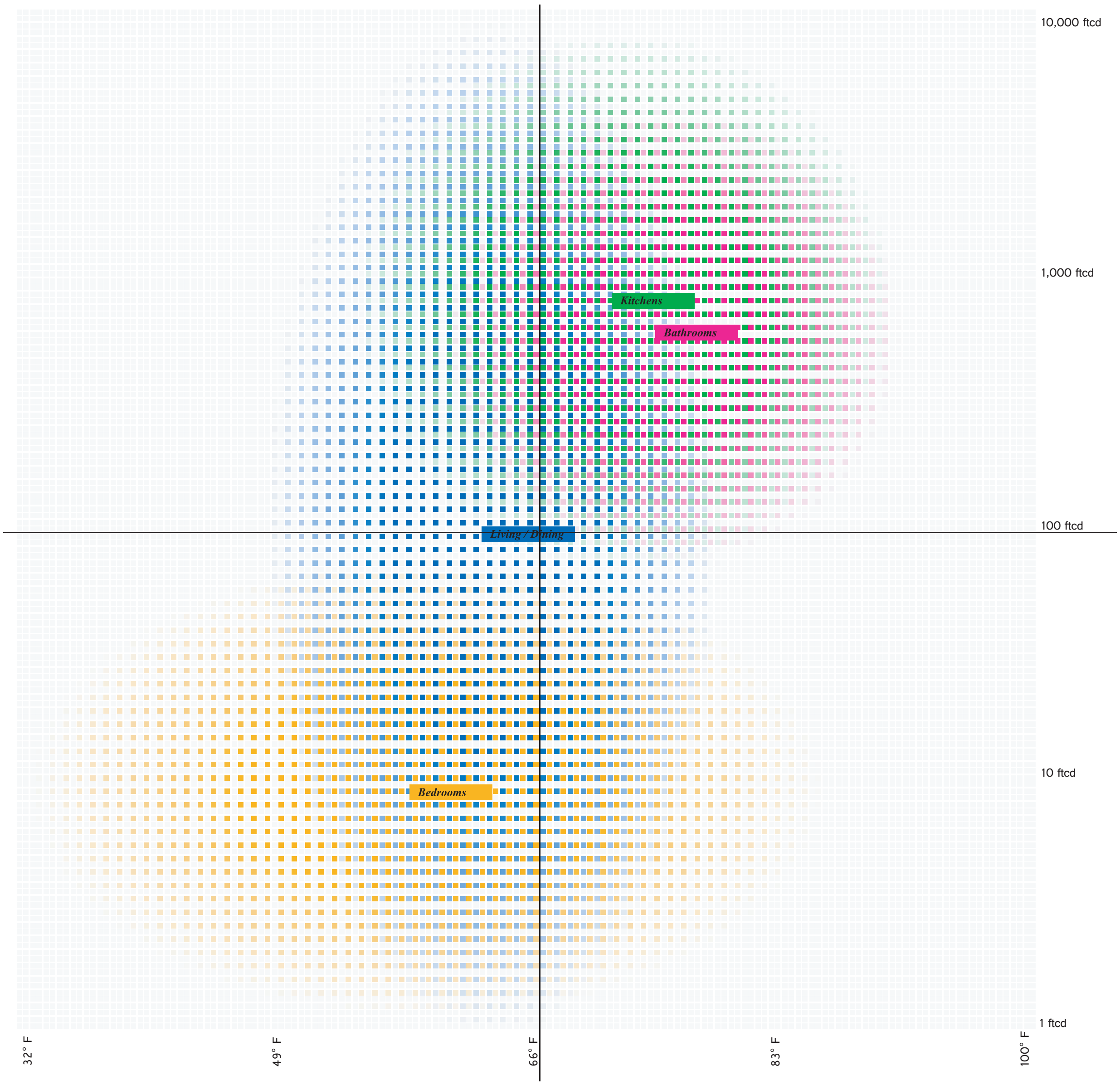
detail work
(50,000 sf)



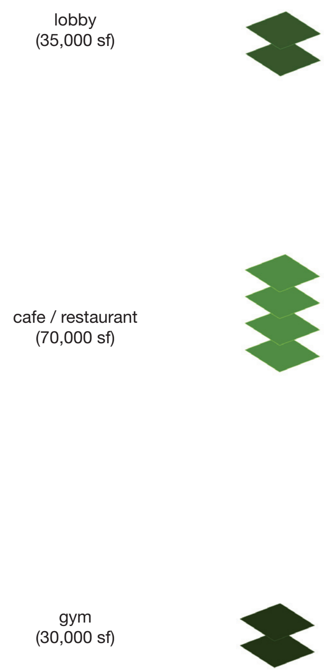
10,000 ftcd
1,000 ftcd
100 ftcd
10 ftcd
1 ftcd
32° F
49° F
66° F
83° F
100° F
Detailed low-contrast
Fabrication
Workstation
Presentation

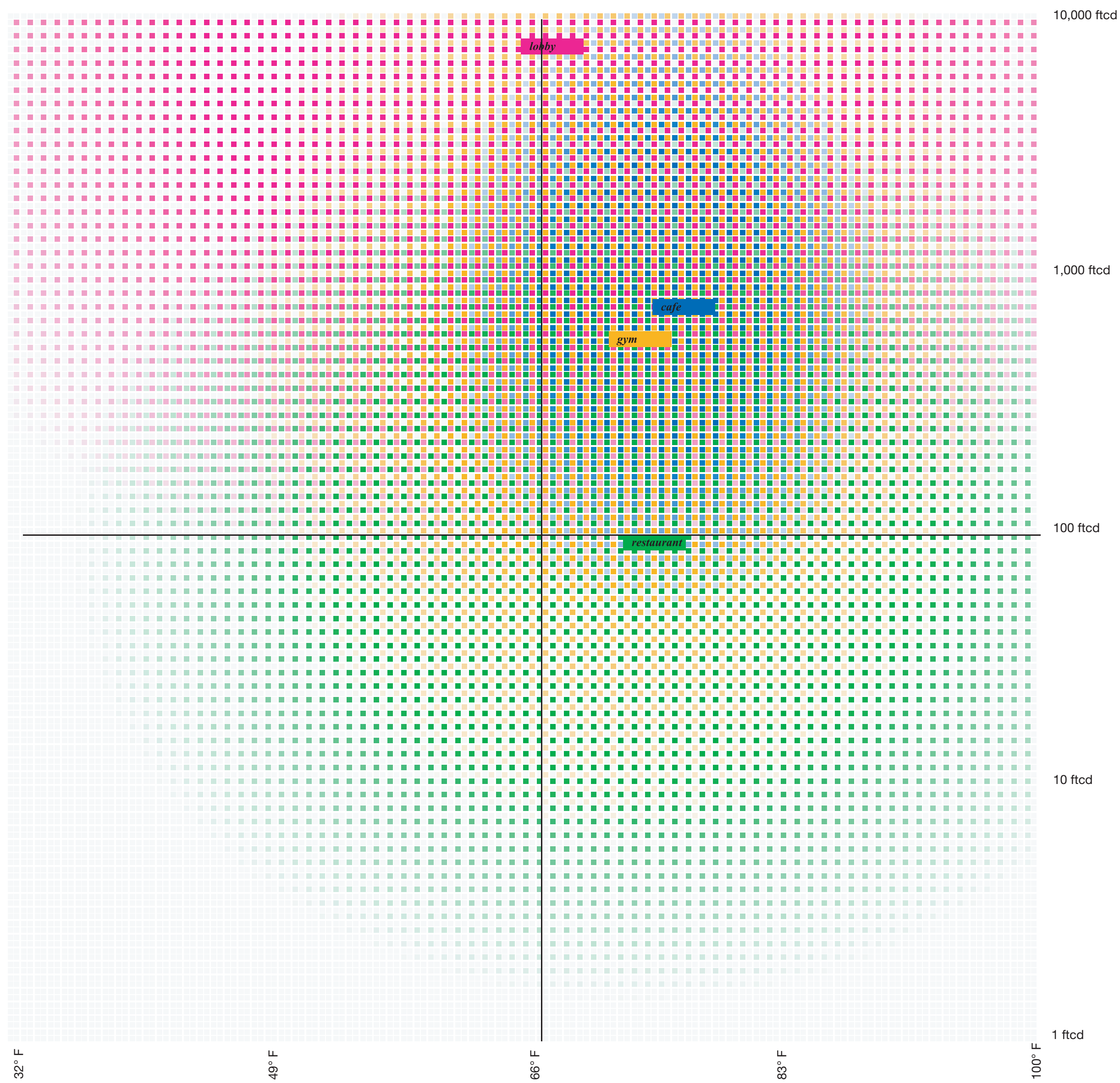
Residential Space
Thermal Re-Programming




10,000 ftcd
1,000 ftcd
Kitchens
Bathrooms
100 ftcd
Living / Dining
10 ftcd
Bedrooms
1 ftcd
32° F
49° F
66° F
83° F
100° F

Public Space
Thermal Re-Programming




10,000 ftcd
1,000 ftcd
100 ftcd
10 ftcd
1 ftcd
lobby
cafe
gym
restaurant
32° F
49° F
66° F
83° F
100° F

Pirated Infrastructures

Only by broadening our conception of resources beyond the typical utility hook-up will it be possible to envision architecture after the vivarium. At this site, at the corner of Broadway and Battery Place, a variety of natural and unnatural resources are available to aid in the building's climate control.

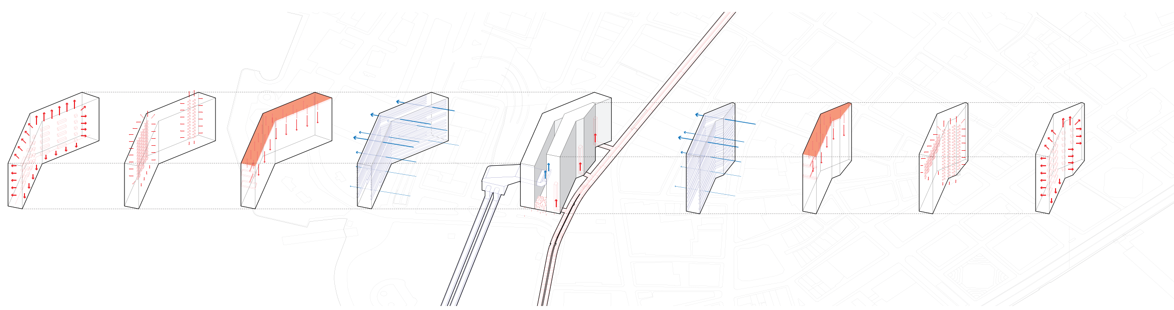
A: Major internal "Heat Positive" Programs elements, such as gyms and server rooms.

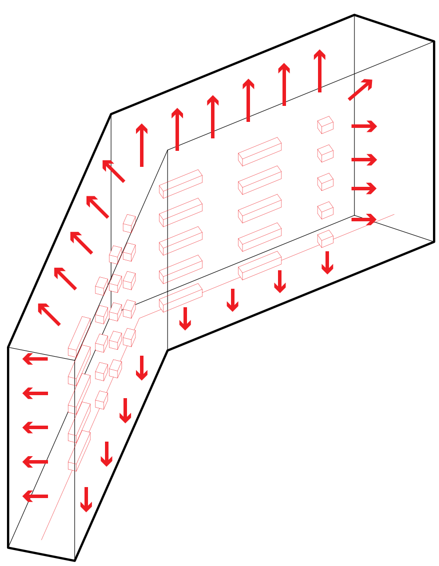
B: Smaller internal heat sources, such as kitchens and bathrooms located in residential units.

C: "Sun-drip" pools, located on the roof, heat water which is then distributed to units on the floors below and adjacent.

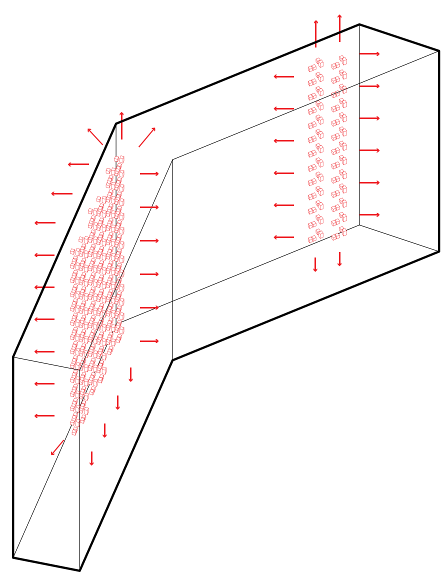
D: Wind, which has a greater cooling effect at higher elevations.

E: Battery tunnel ventilation provides a year-round source of cooling, while the subway shafts provide bursts of forced hot air with each passing train, and retail zones are constructed to maximize the heat-output of pedestrians' bodies by forcing their shopping route to take a long, slanted, vertical route.

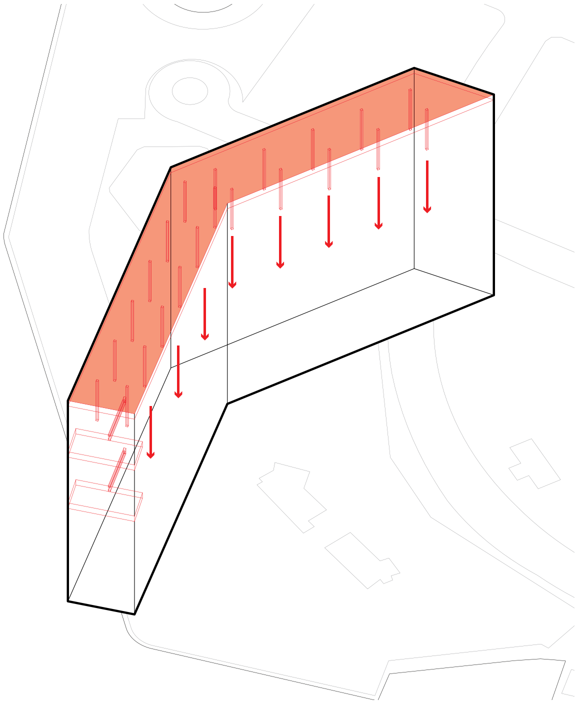




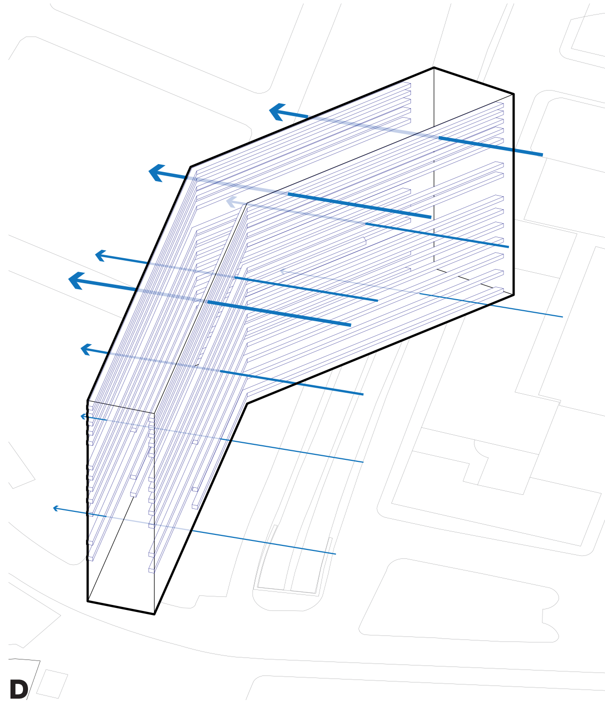
A



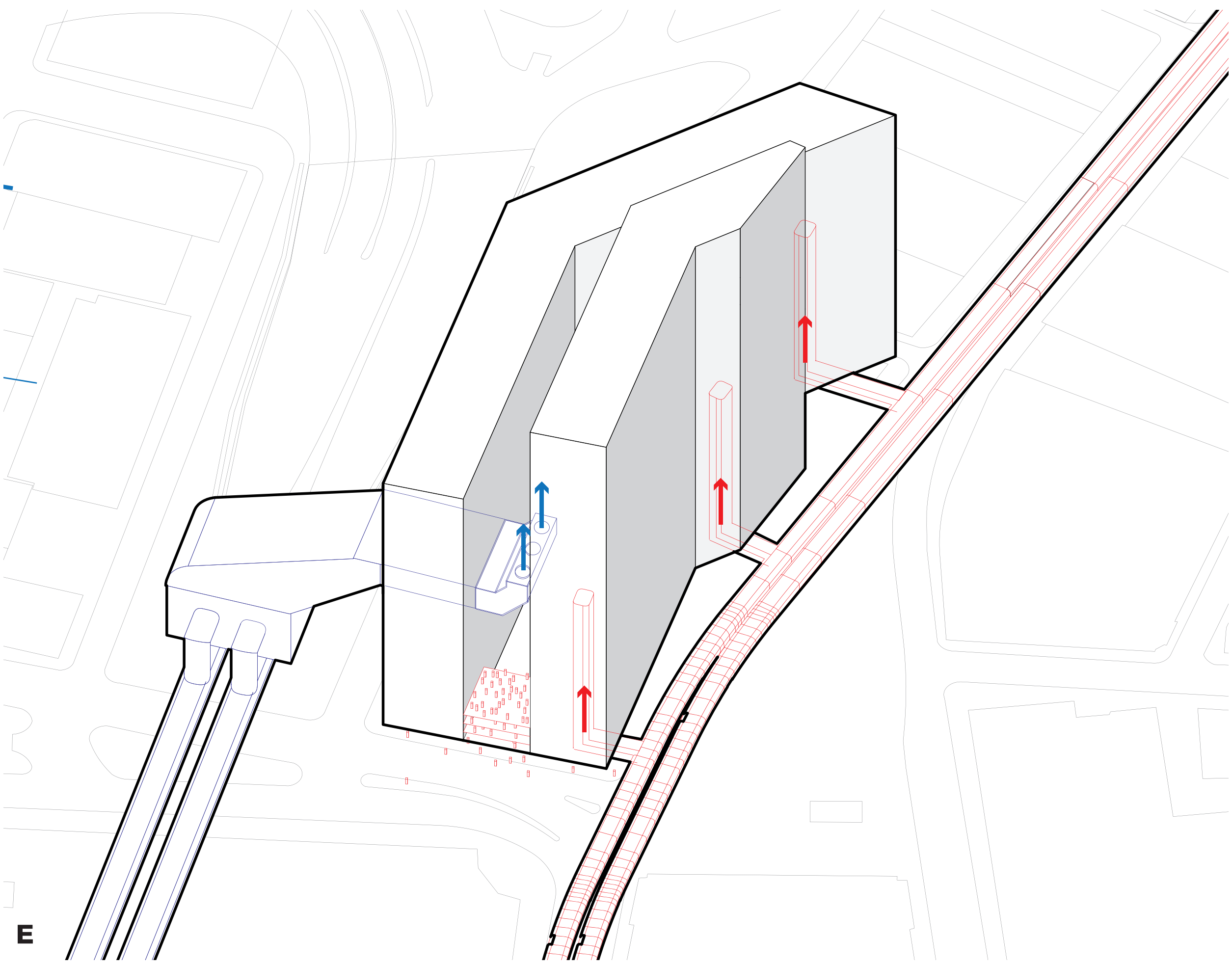
B



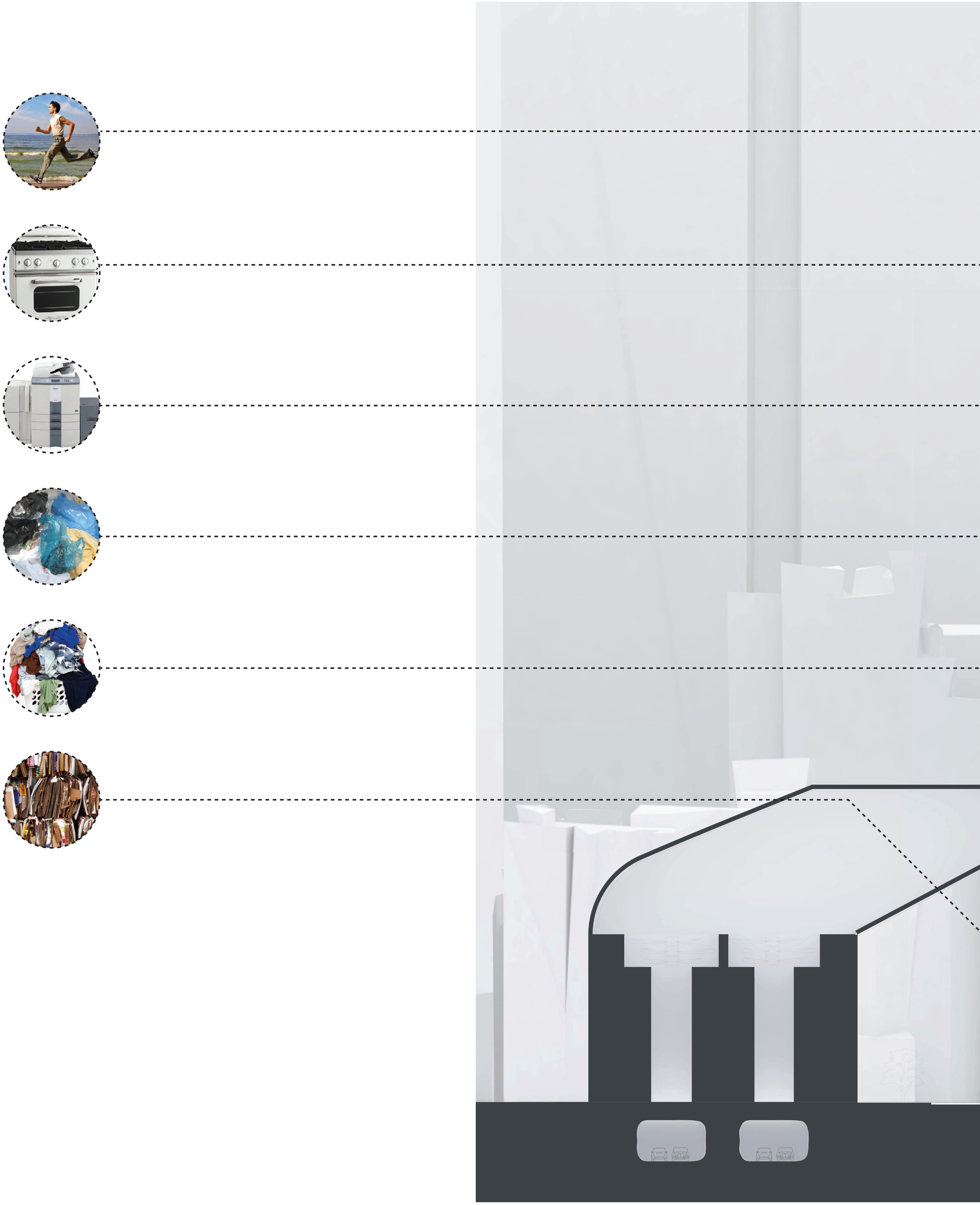
C

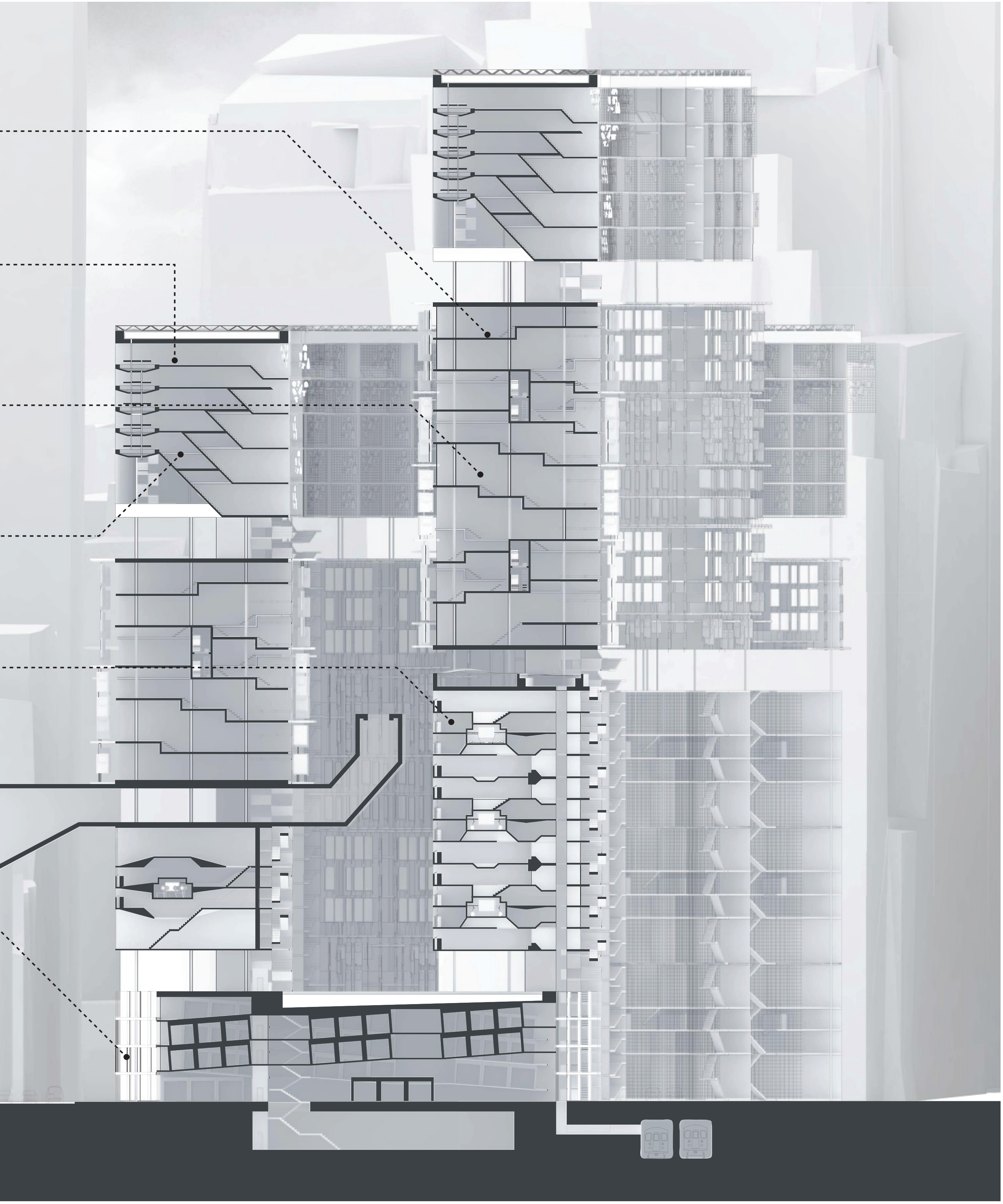


D



E



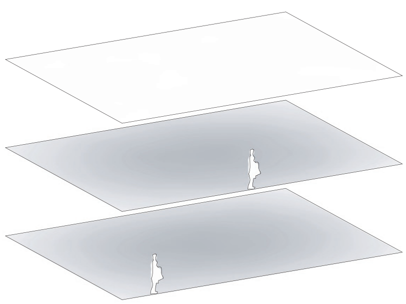


Four Seasons
(Luxury Residential Neighborhood)

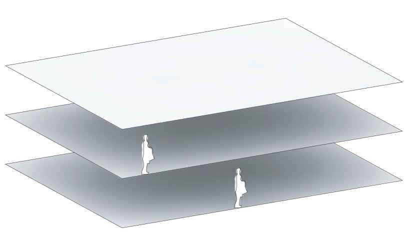
Thoroughly cooled by the strong wind at high elevations, and simultaneously well heated by the sun whose energy is collected in “drip pools” on the roof, this neighborhood represents the height of climatized luxury.

Each unit consists of a “hot side” and a “cool side” with the understanding that activity will move throughout the space seasonally. The hot side’s low ceilings ensure that heat is concentrated right where it’s needed most: at the occupant’s torso heights. The thermal dining table provides a warm pool of water to dip one’s feet in while socializing and eating in the wintertime, and the large vertical separation between hot and cold spaces in each unit guarantees that all available hot air will be keeping you warm right where you are in the winter.

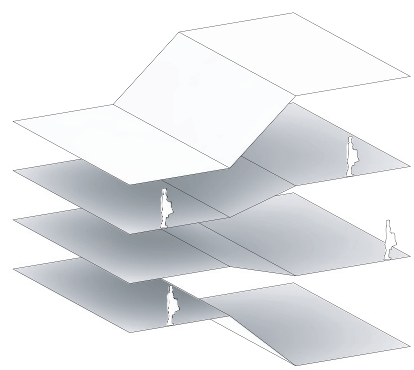
Below the luxury units, a large, year-round garden is watered constantly by the heated water overflow from above, putting to good use the heat harvested by the building.



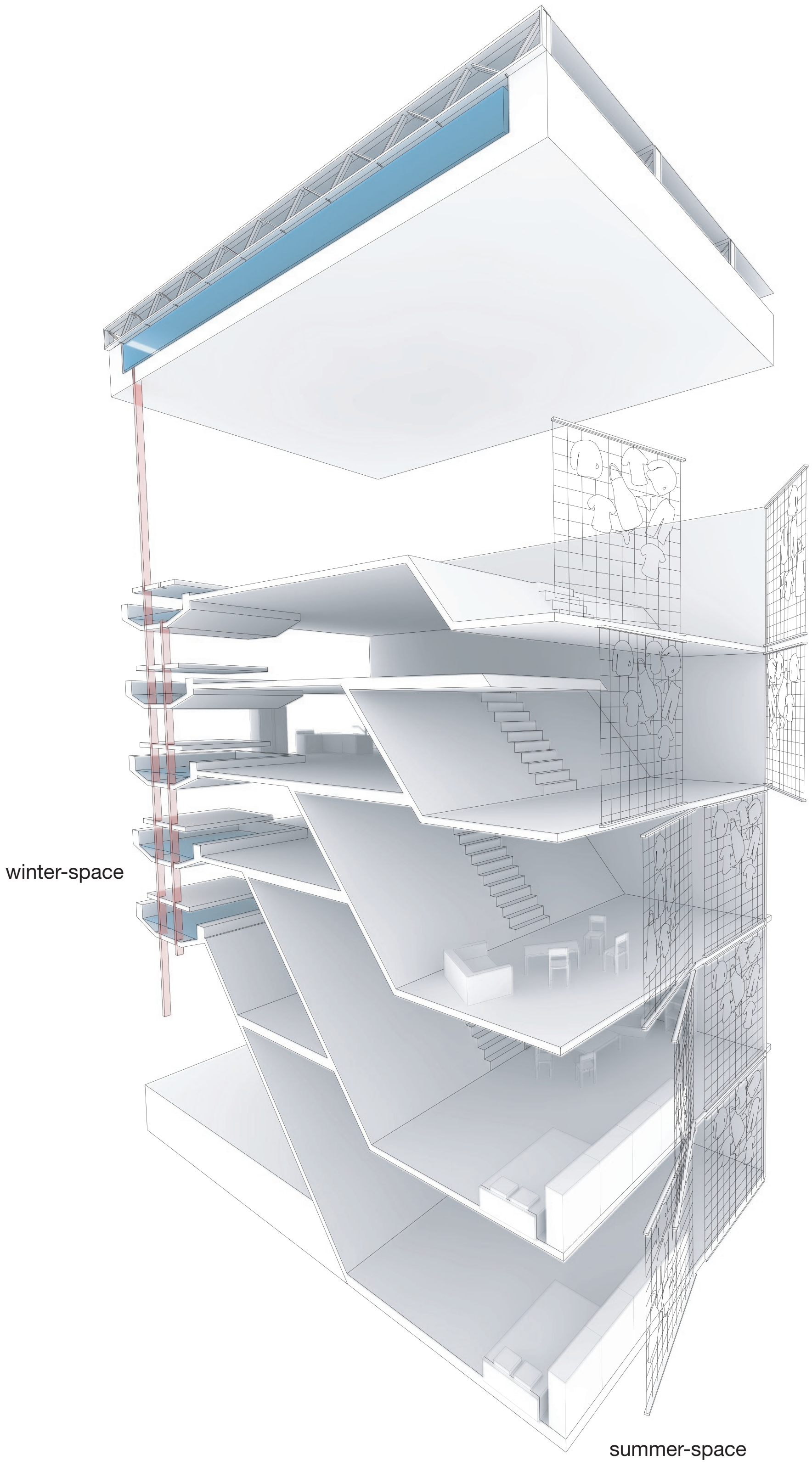
well-ventilated space allows hot air to rise out of the occupiable level and be swept away by directed wind.

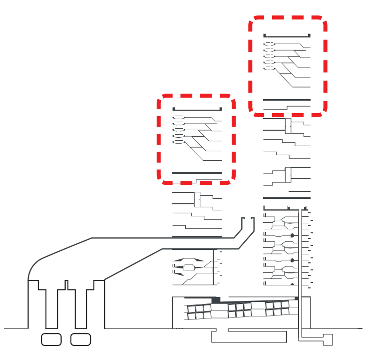


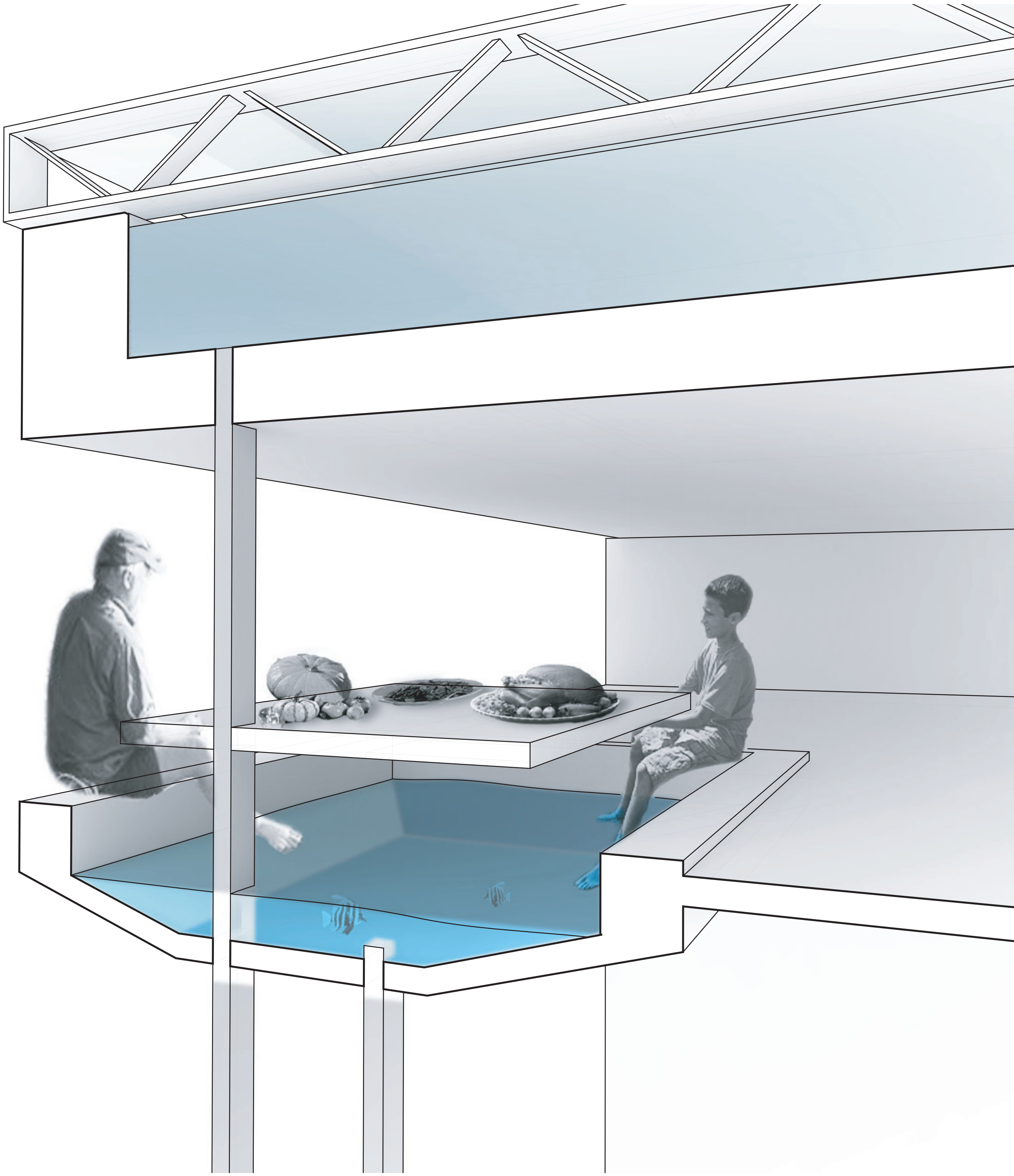
compact space concentrates hot air within occupied zones; this concentrates heat year-round, even when undesirable.



a mixture of floor heights within each unit allows the thermal neighborhood to leverage both its heating and cooling resources.


winter-space
summer-space





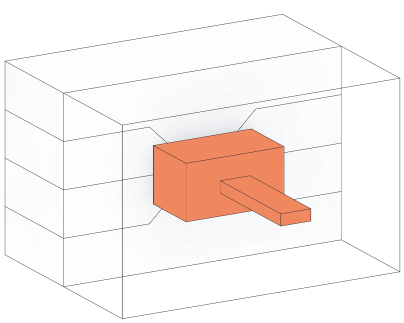
Thermal Dining Experience (Sun-Drip Dining)

Wintertime Pied-à-terre
(Low-cost Residential Neighborhood)

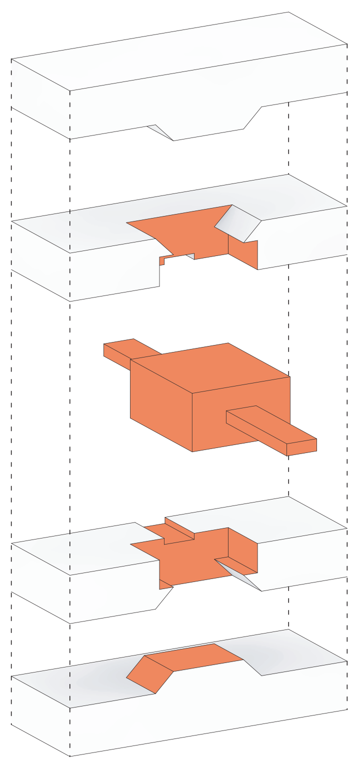
Though thoroughly heated by both the hot air forced upwards from the travel of subway cars below and by the periodic insertion of “heat positive” gym programs, these heat-concentrating low-height residences may be uncomfortably hot in the summer.

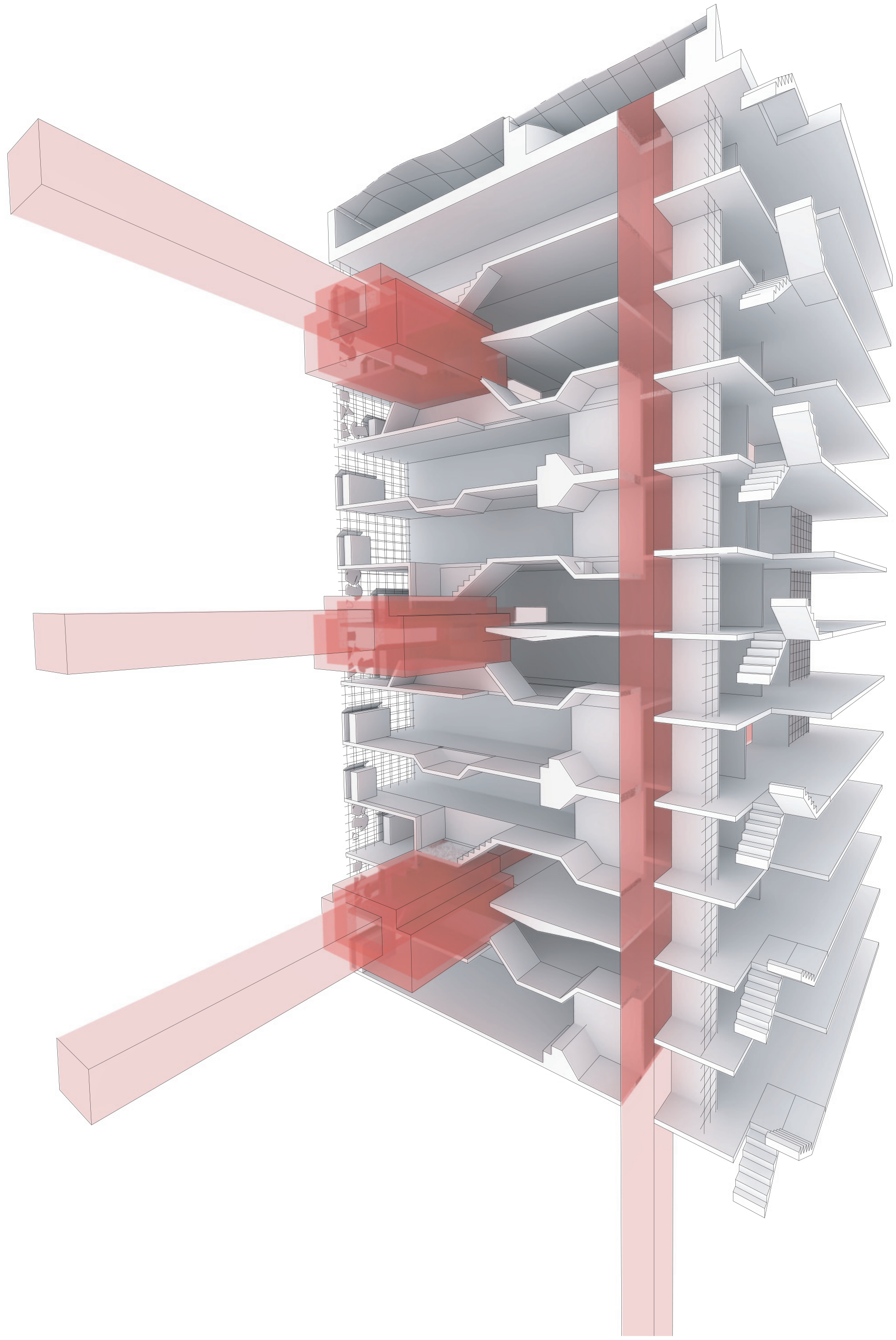
While the heat from the subway may be directed through the main stack at the thermal baths at the neighborhood’s top, there is very little wind available to these low-elevation units, rendering them largely un-cooled, an effect which is compounded by their heat-concentrating section, and off-season clothes facade-closet. For record-breakingly cold days, a gym to keep warm by exercise is never far away.

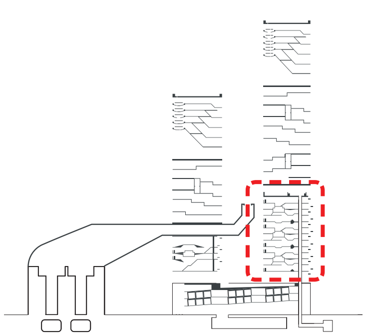
In lieu of an overall cooling effect, the dwellings focus on two centers of activity. A winter “hearth” area around the expanding subway stacks draws people towards the center of the heated space during winter, while the public patios on the wind-exposed (East) side of the building serve as “stoops” for the high-rise tenants to escape from otherwise oppressive heat inside.

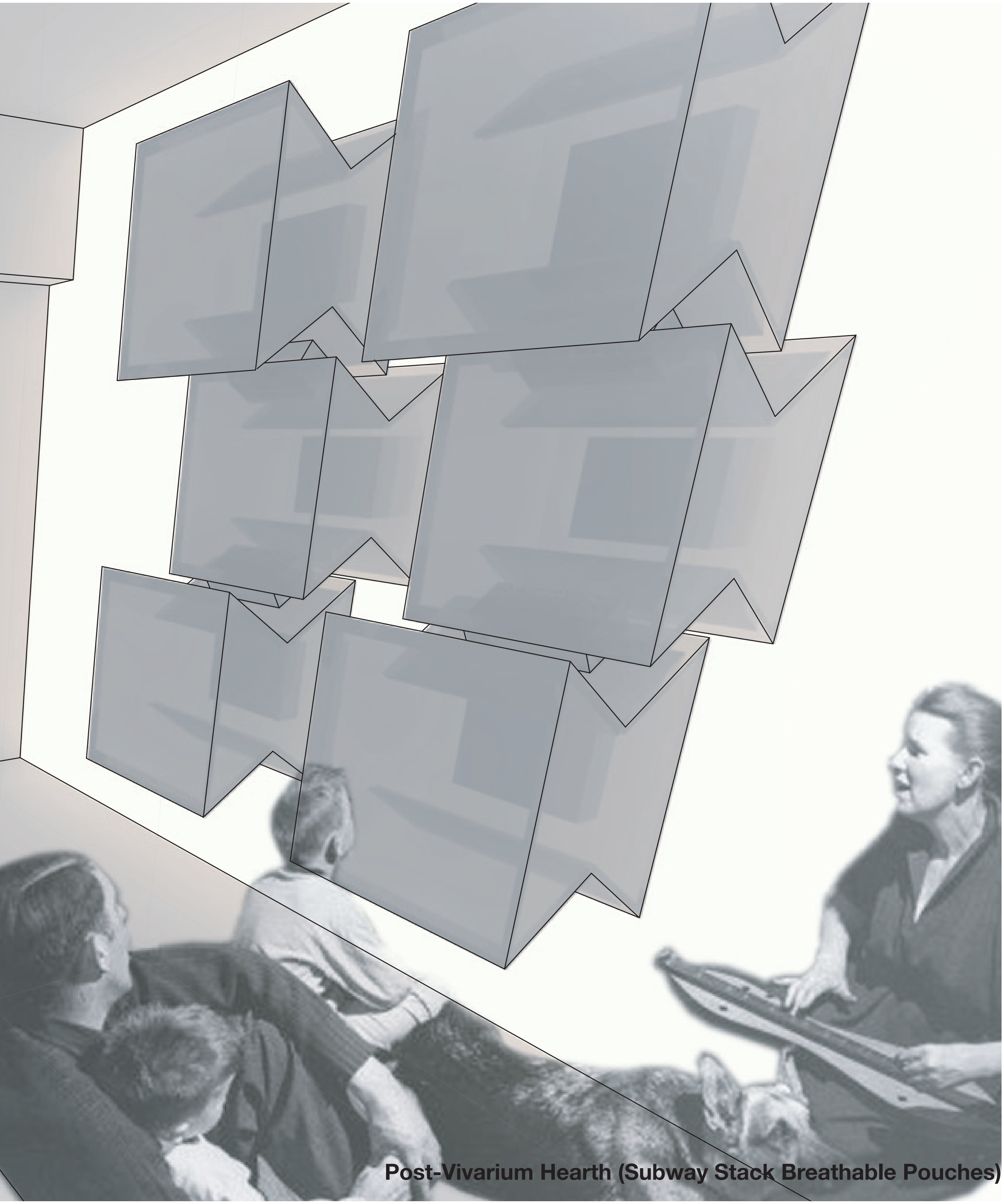


“Heat Positive” gyms are located throughout the neighborhood, shaping forming adjacent units in a way that maximizes surface contact, and thus the conduction of heat.

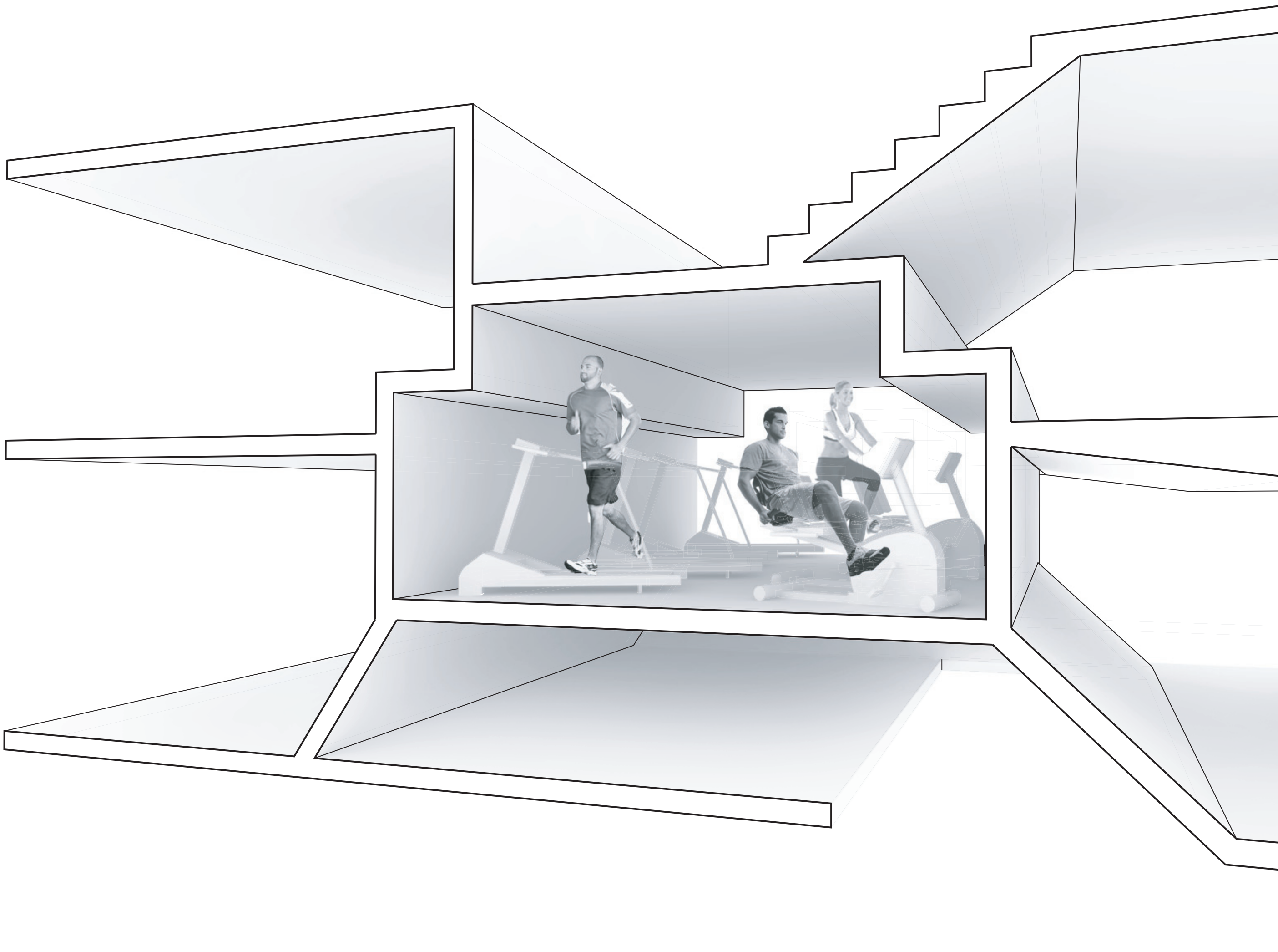


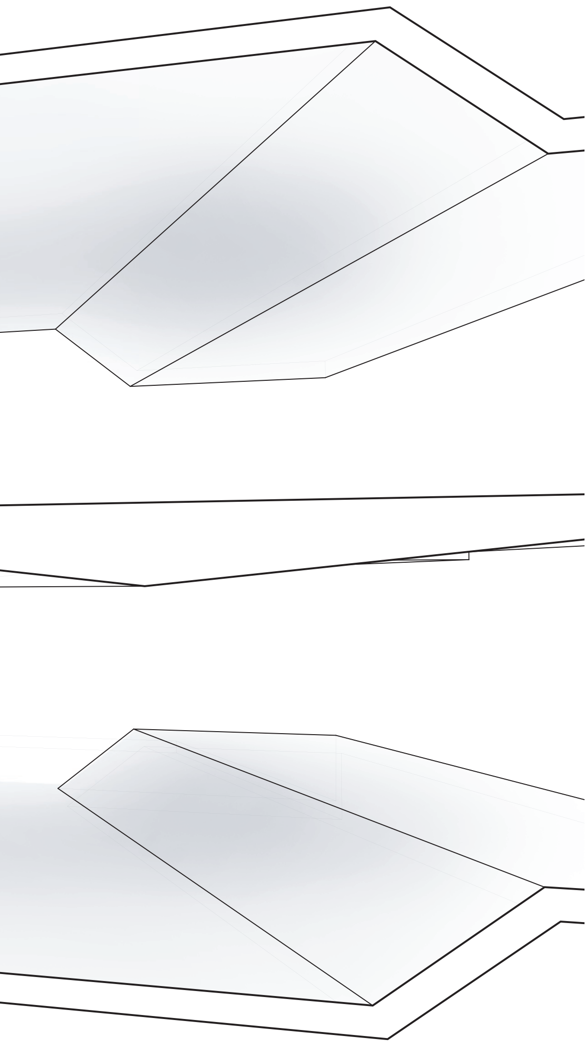




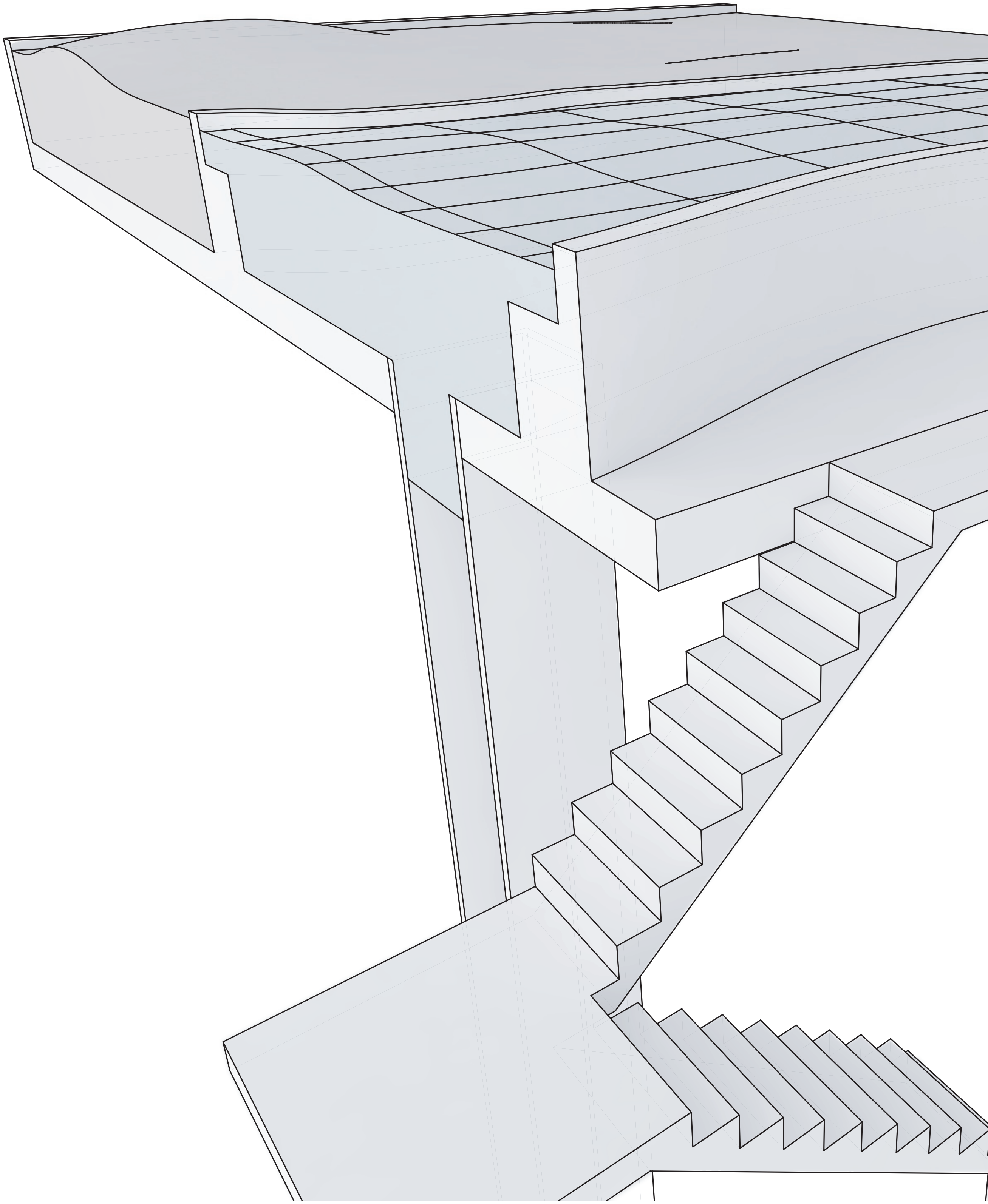


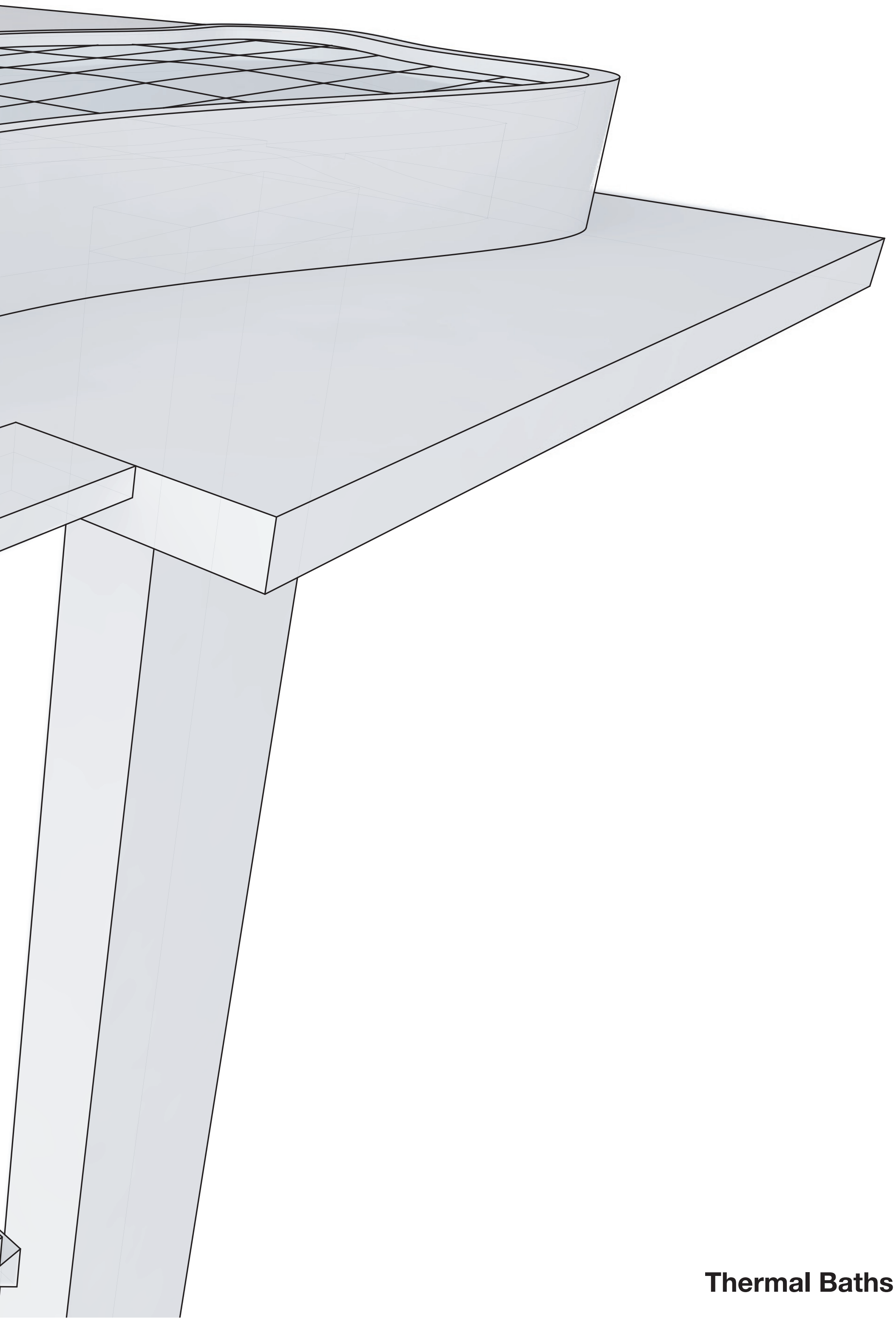
Post-Vivarium Hearth (Subway Stack Breathable Pouches)





Gym (Human-Powered Radiator)





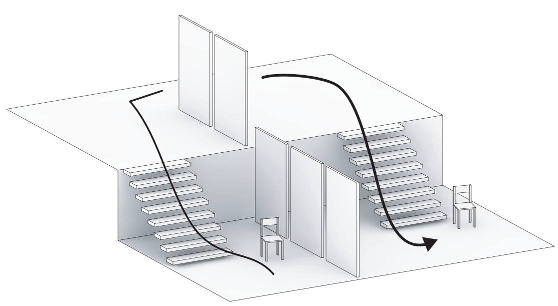
Thermal Baths (Subway Stack Bubbling)

Work(out) Space
(Thermal Neighborhood)

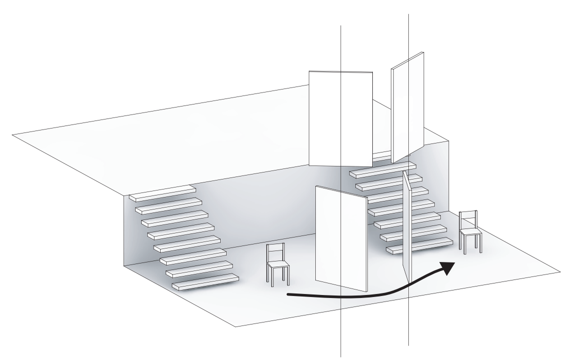
Given the abundance of internal heat sources available in offices, the Work(out) Space leverages the most possible cooling infrastructure from the city: being at a high enough elevation to take full advantage of high wind speeds, and located adjacent to the forced year-round cool-air outlet of the Battery Tunnel ventilation system, it provides comfortable workspace year round.

During the winter, standard partitions are arranged in the workspace to force maximum use of vertical circulation in the space. During the winter deployment of these partitions, workers might have to loop their way up and down several flights of stairs to get to their teammate at the desk next to theirs. Occupants then are cooled in the most local way possible: internally, from their own bodies. On especially cold days, a visit to the warming hut (server room) located on every other floor will serve to provide both socialization and a shot of warmth needed for continual productivity.

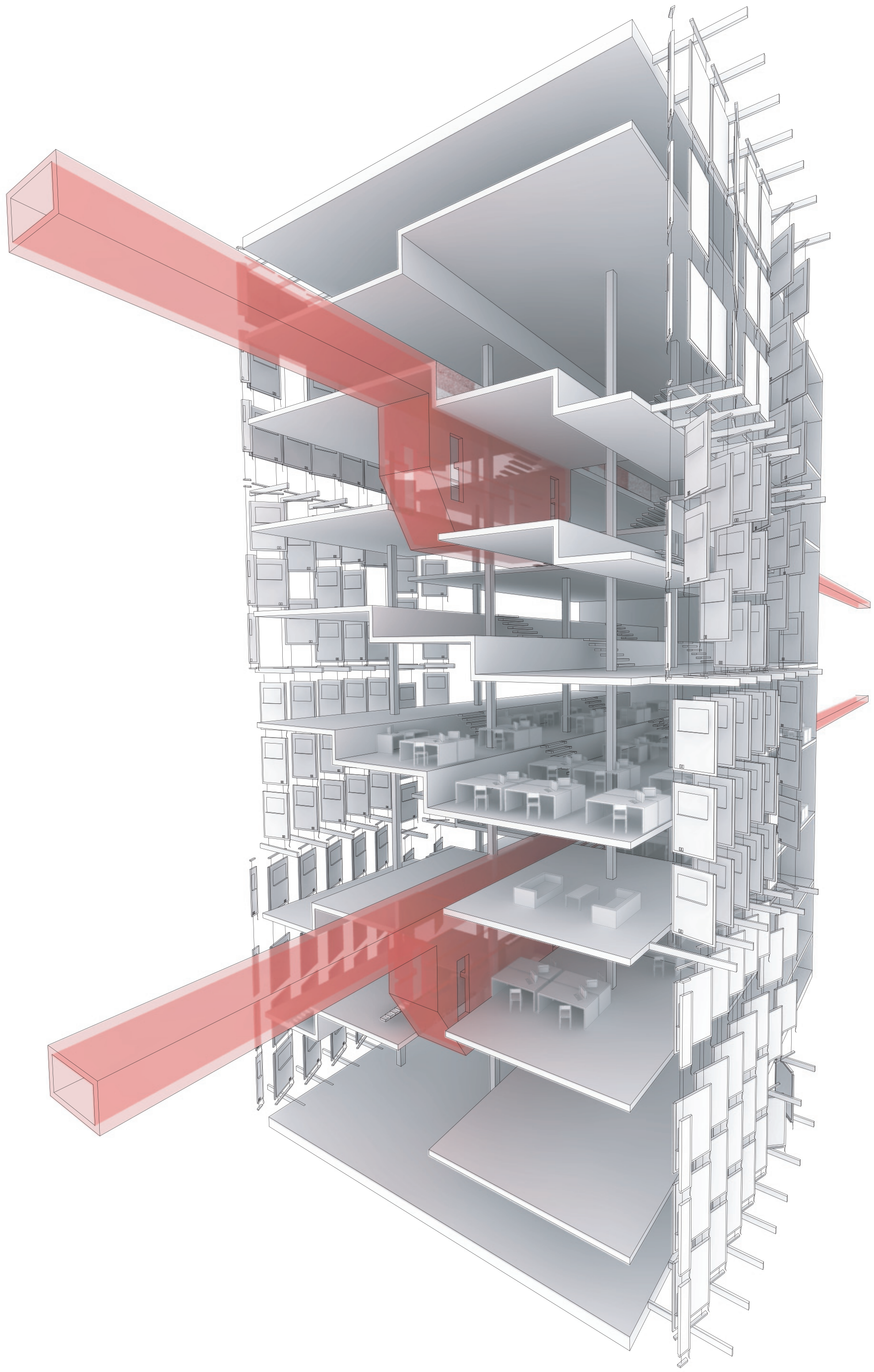
Summer sees the removal of the partition walls to the periphery of the building, where they serve to steer high-velocity and cool wind where it is needed most. By removing these partitions from the workspace, horizontal connections between coworkers are restored, minimizing the exertion necessary to facilitate team function.

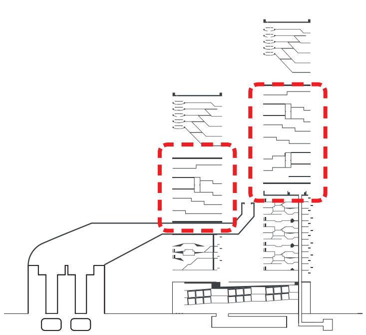


In the winter, partitions force team members to walk up stairs along longer routes, using their own activity to keep them warm.



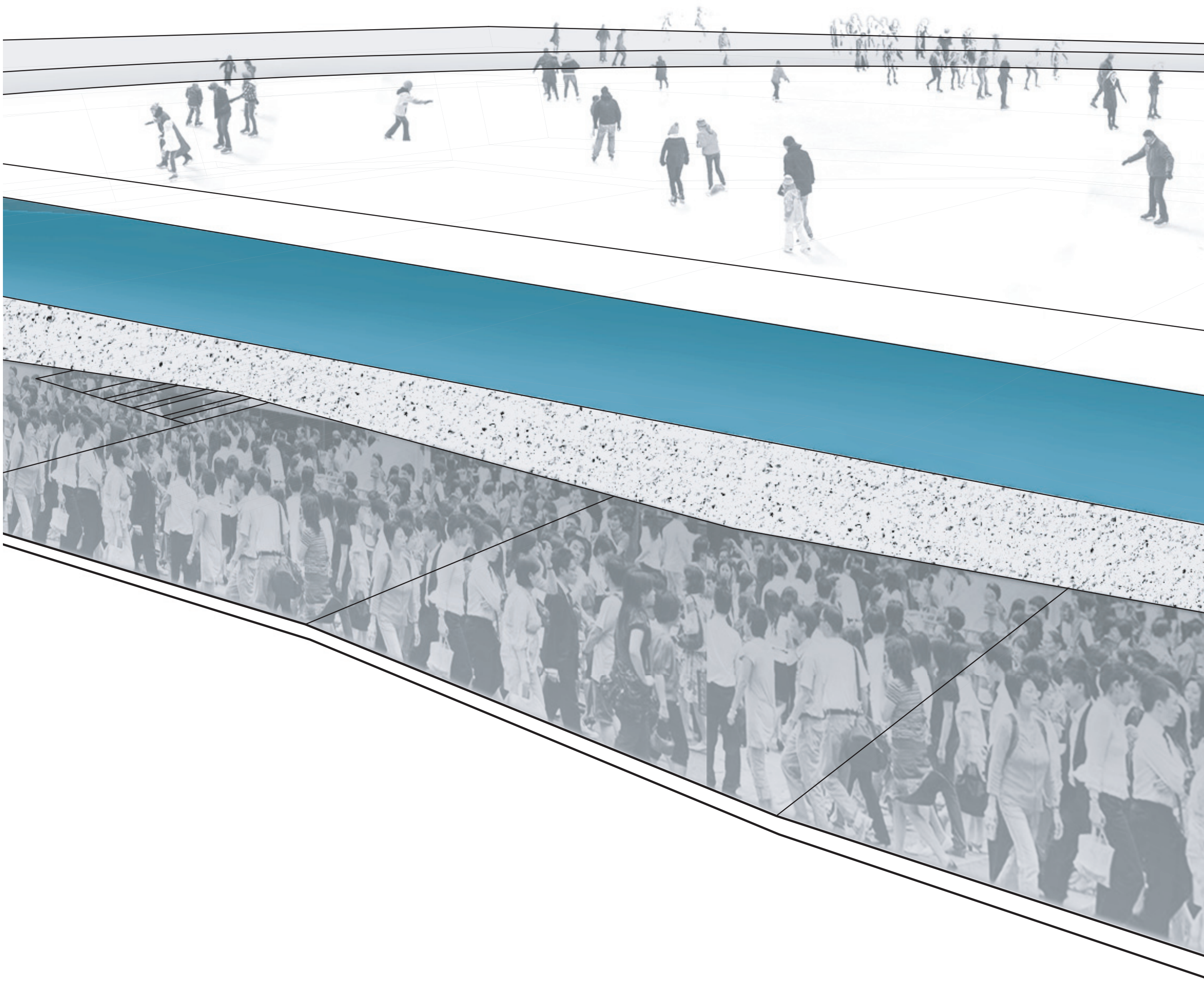
In the summer, the partitions are moved to the periphery of the building, where they serve to direct wind through the space, cooling it as effectively as possible.

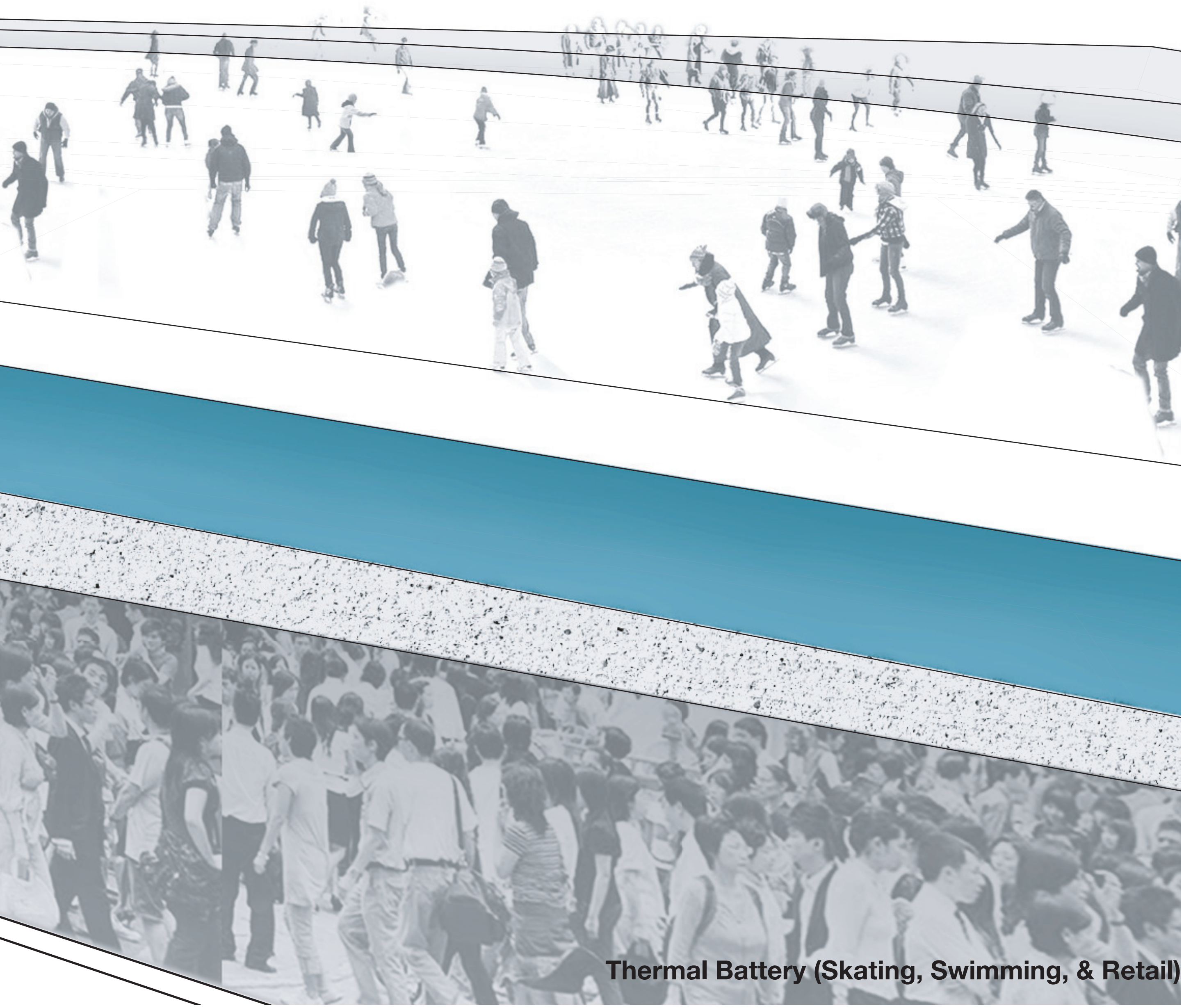


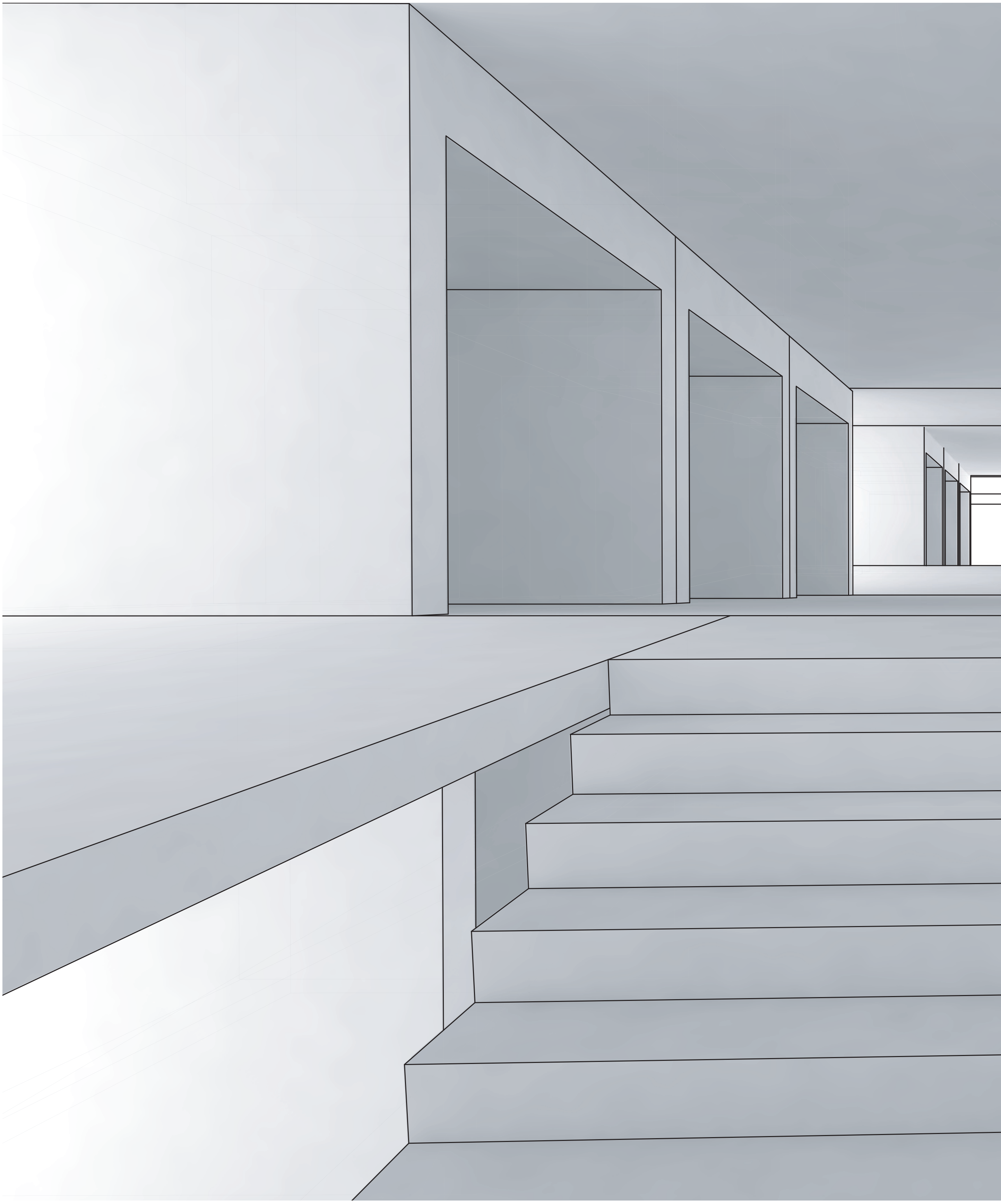


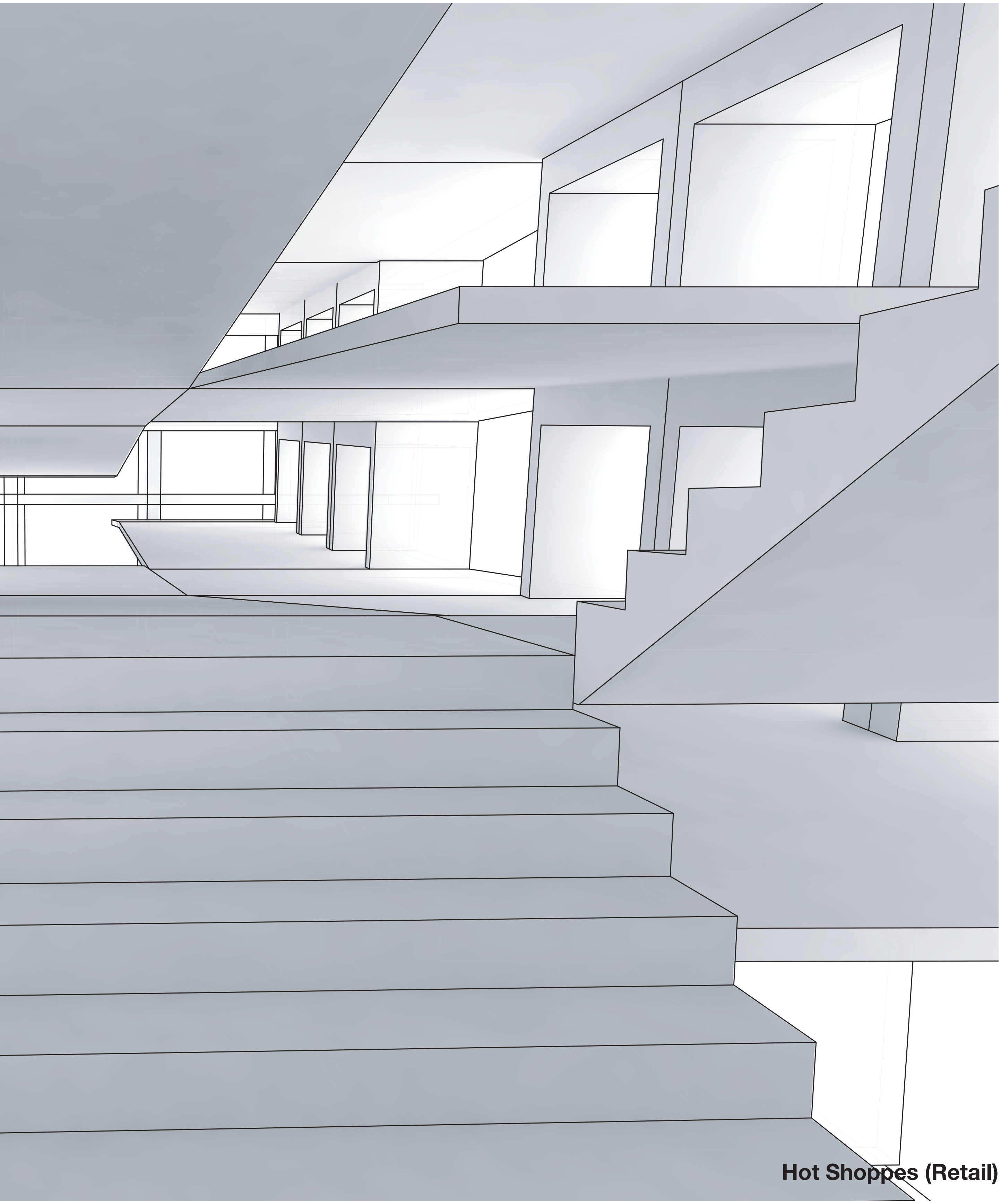
Philip Seaton, Massachusetts Institute of Technology, 2012

Warming Hut (Server Room)




Thermal Battery (Skating, Swimming, & Retail)

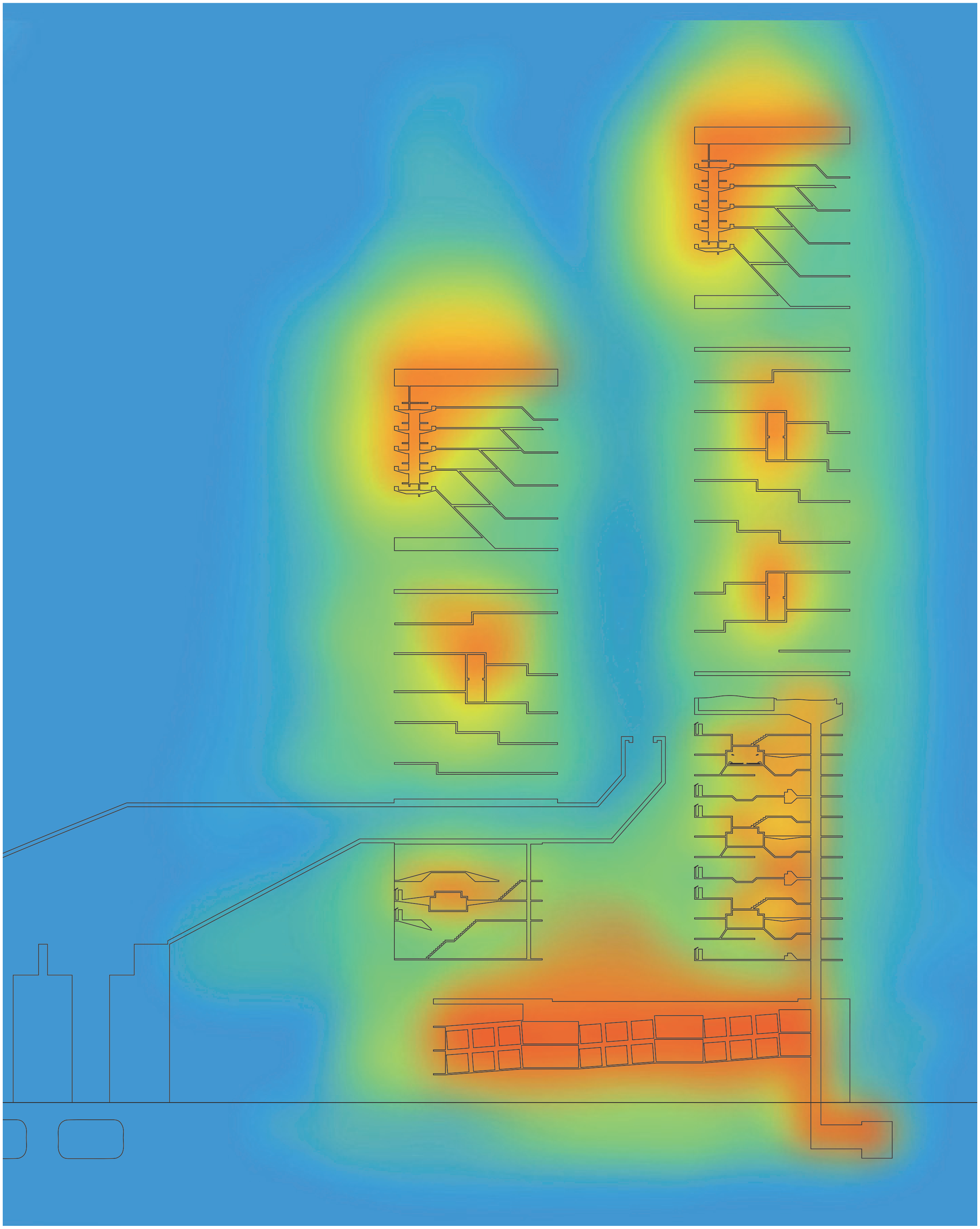




Hot Shoppes (Retail)

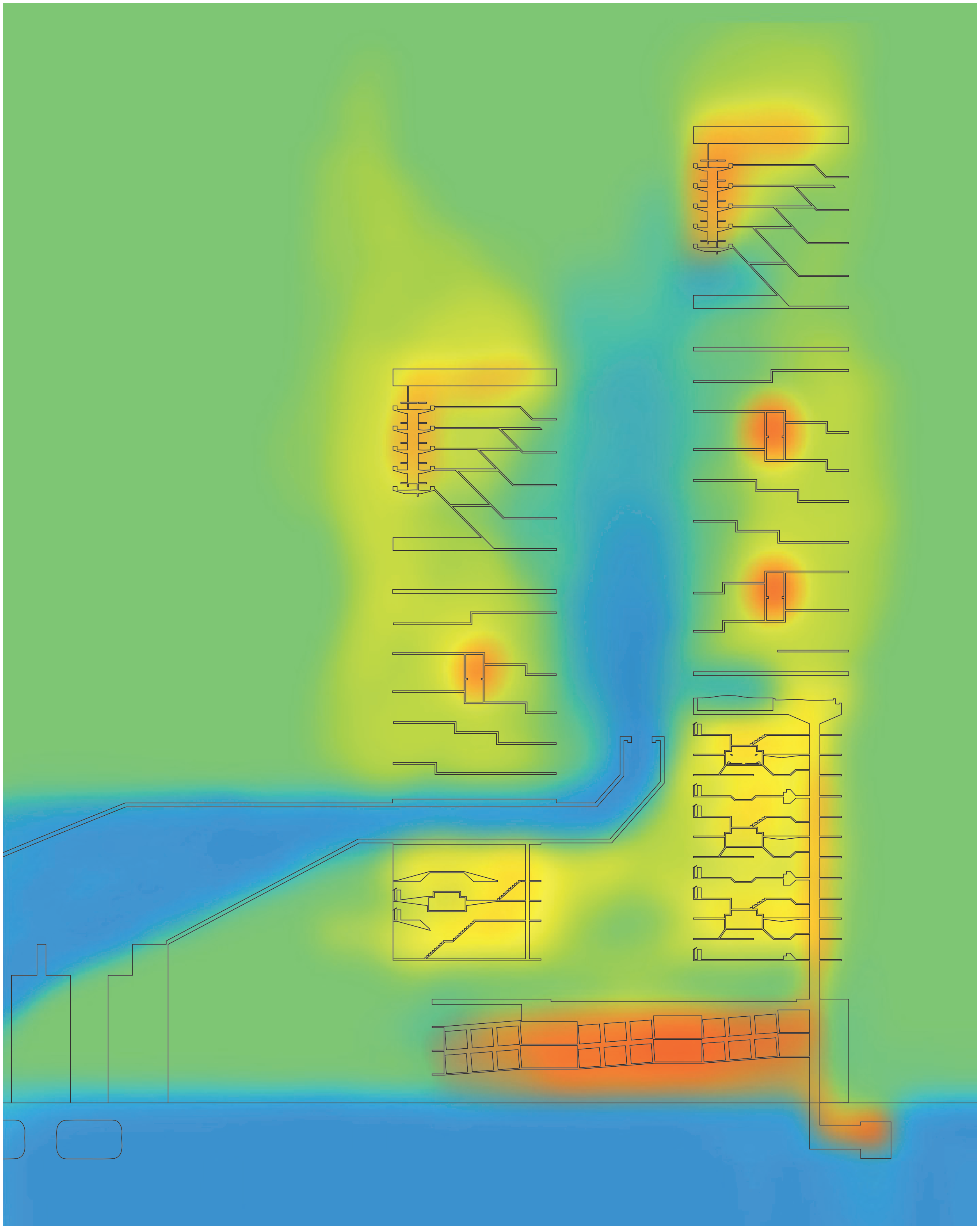
Winter

Overall Thermal Visualization

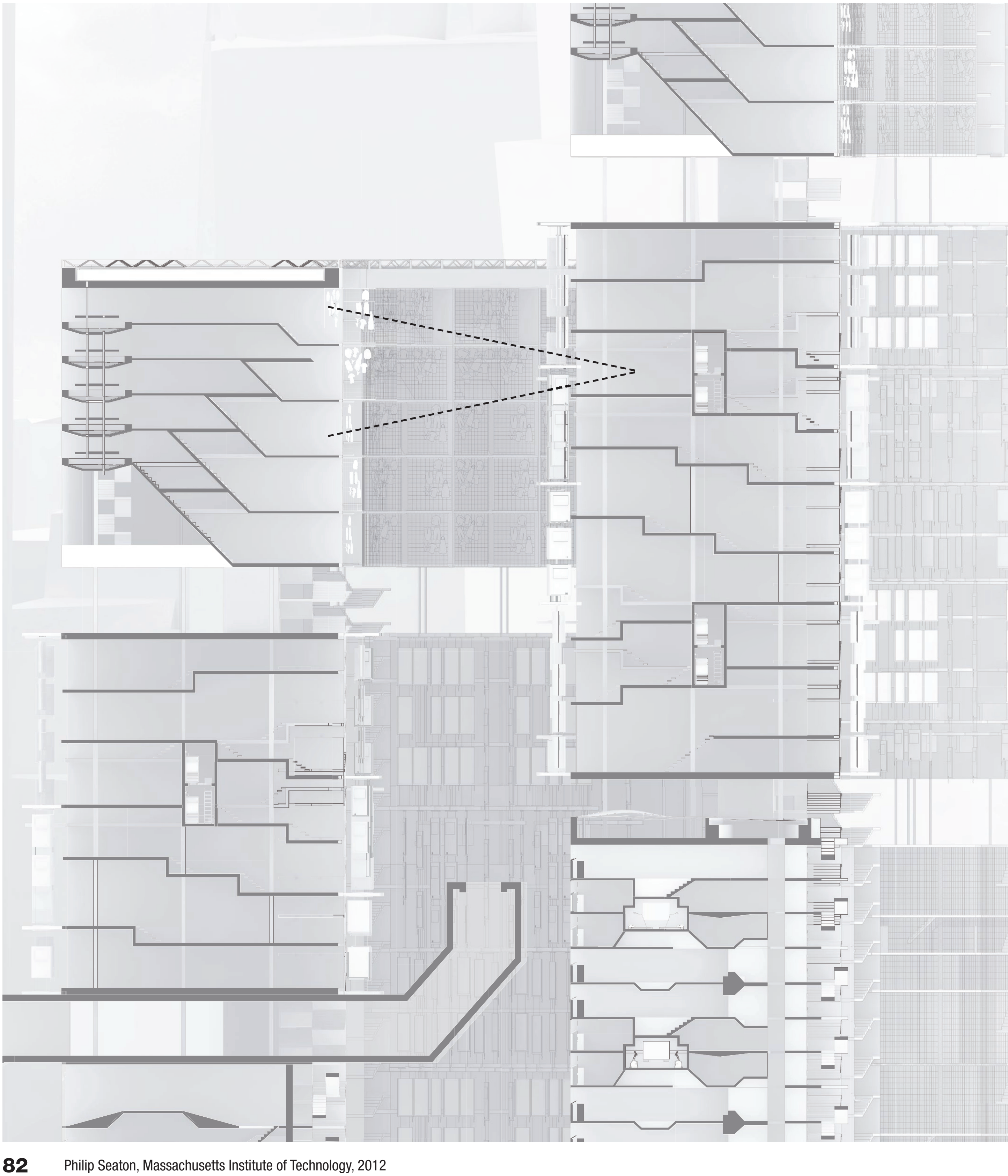


Summer

Overall Thermal Visualization



Post-Vivarium Theatricality



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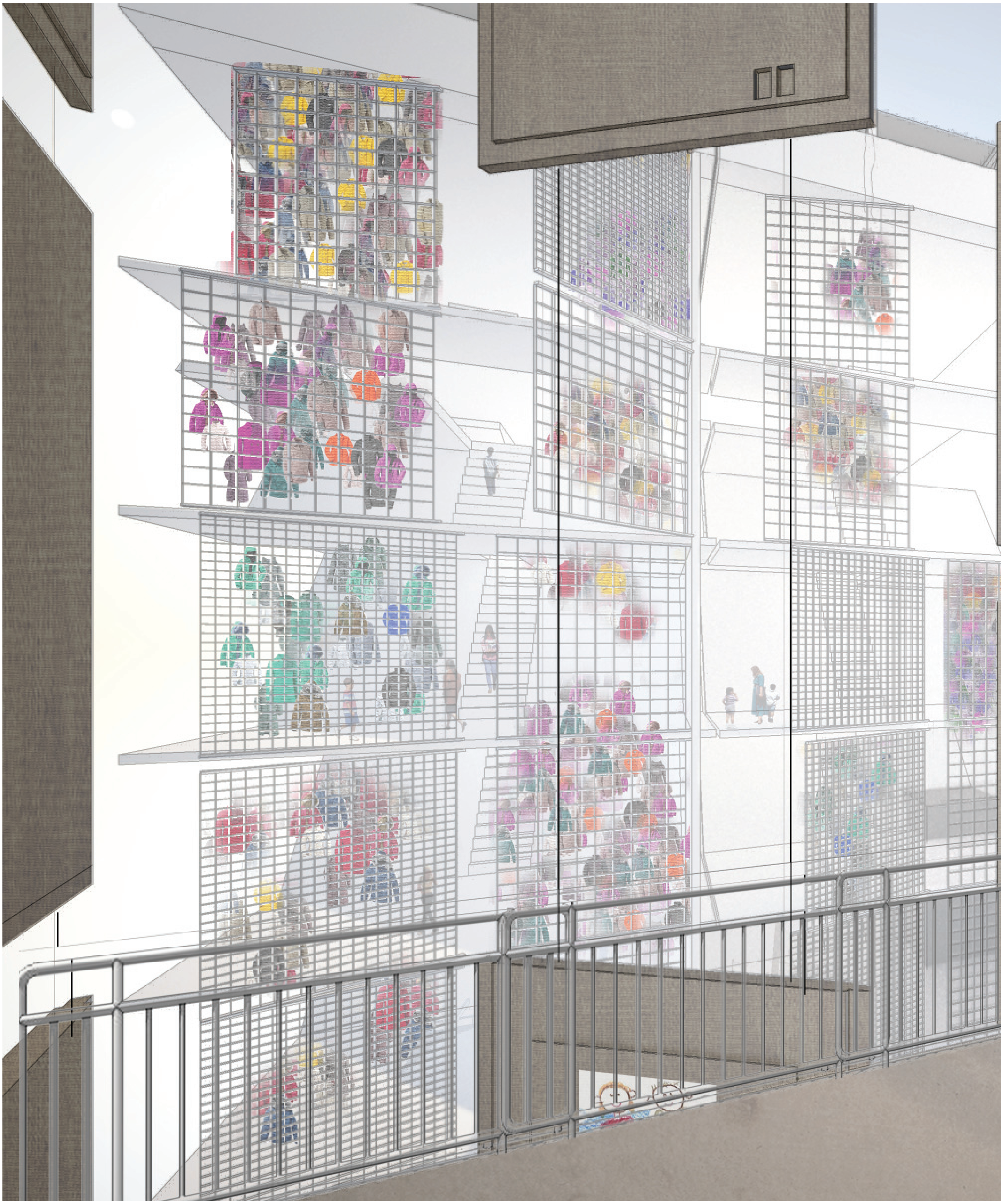
The Vivarium is a stage for an artificially produced performance. The drama: its inhabitants perform, in their daily functions, a unique kind of dislocated, de-climatized existence. They perform their activities, oblivious to the climactic conditions of their larger environment thanks to the mechanical systems that support their interior, also rendered invisible by the vivarium's self-conscious choreography.

The architecture of the post-vivarium age introduces a new kind of theatricality: the theatricality of people adapting to their exterior environment, indoors. Clothes are shared between occupants and the building itself, keeping warm in the winter and directing wind inwards in the summer.

Glass walls, now entirely absent, do not mediate the interior and exterior performances. Views across the gap between the towers are views across a continuous zone of thermal space, a continuous zone of human activity.



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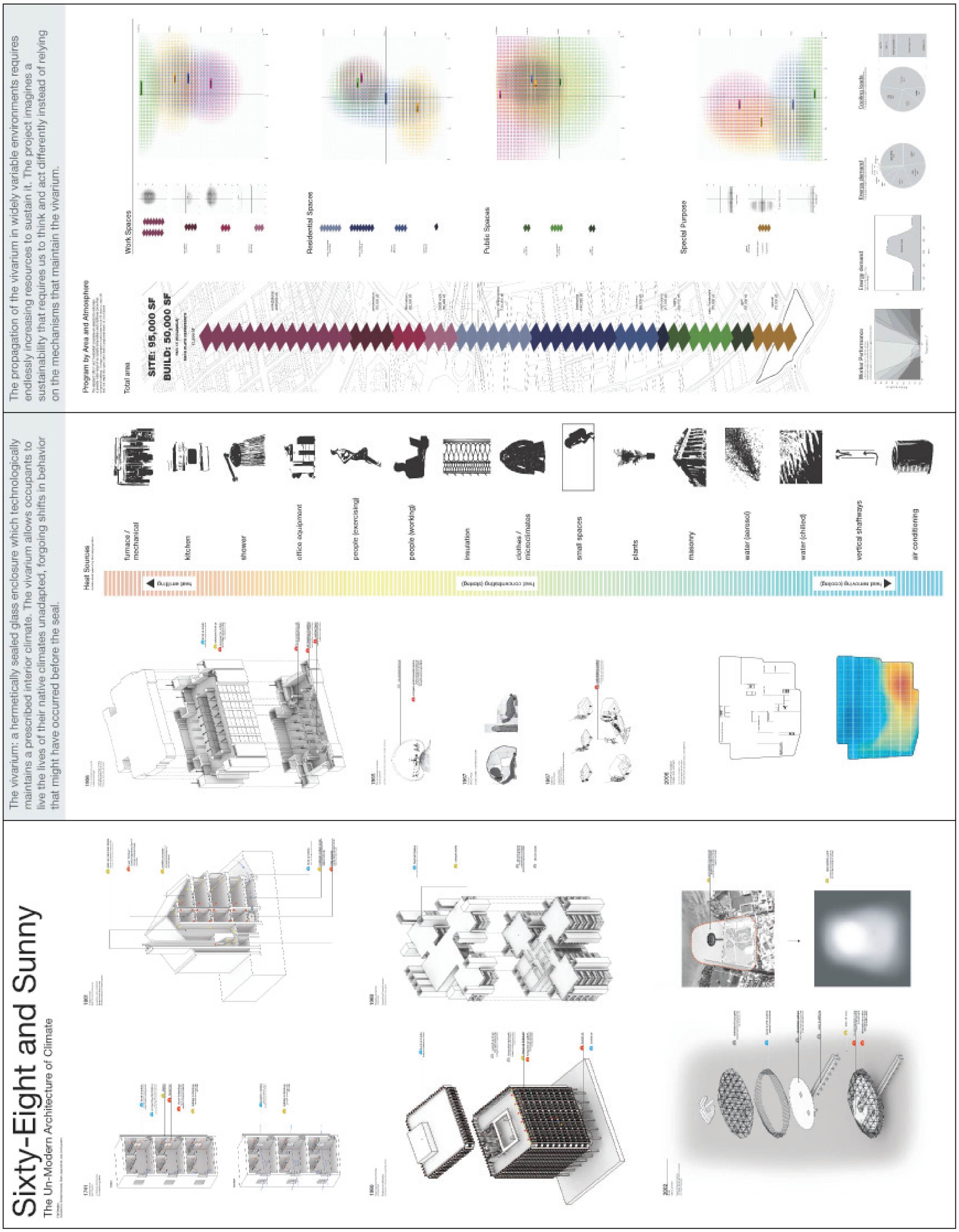
Appendix



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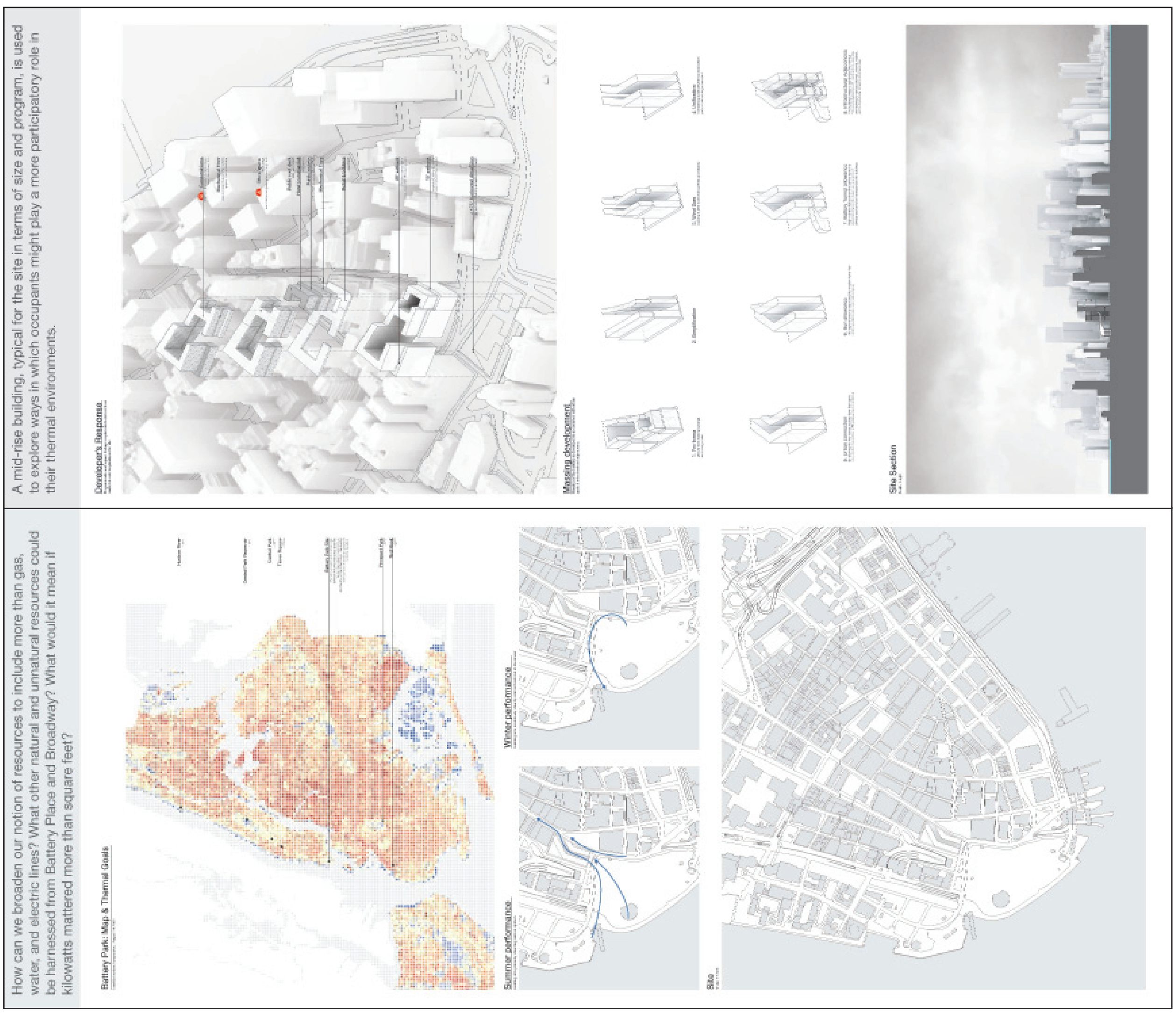
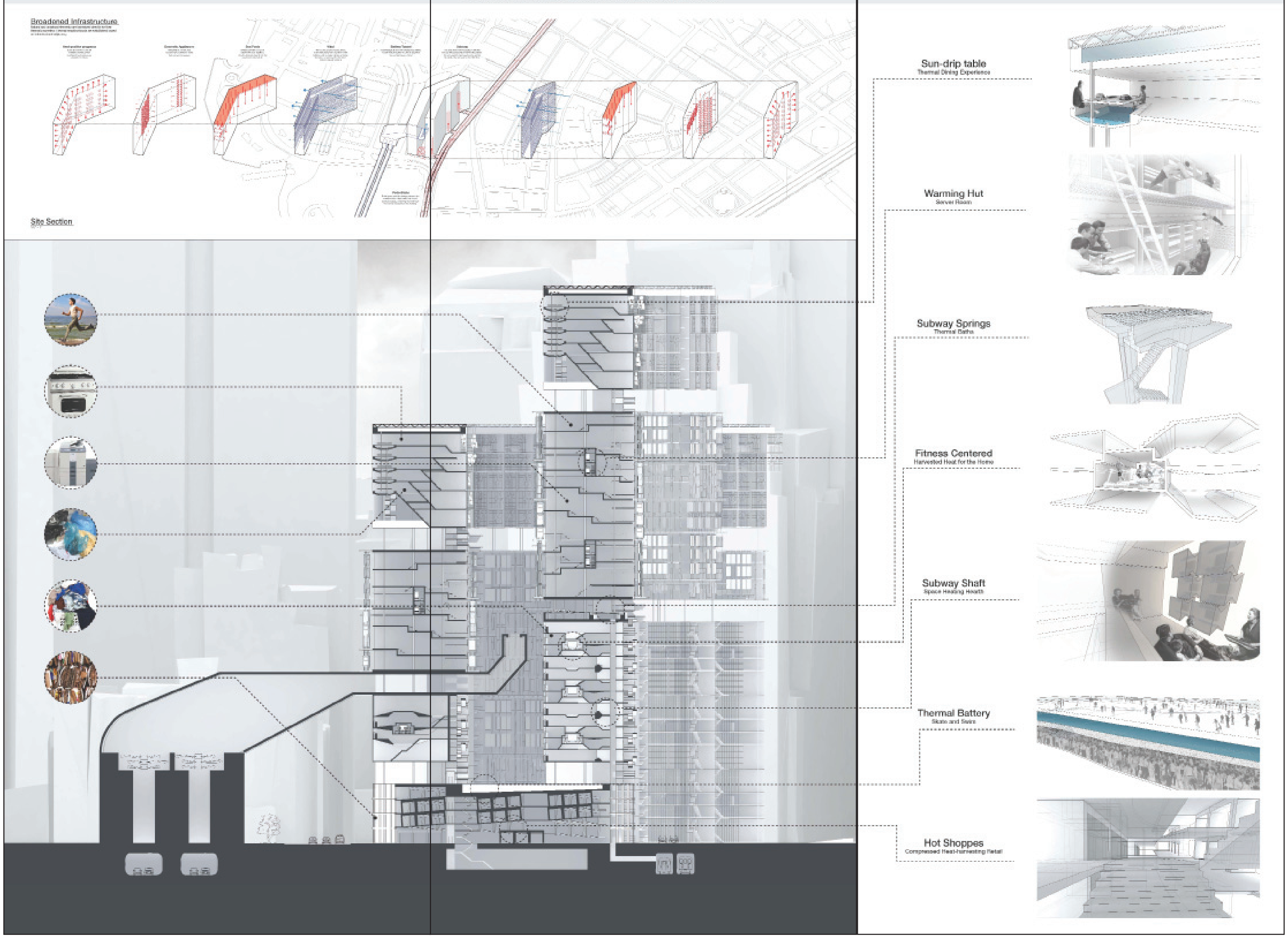

How can we broaden our notion of resources to include more than gas, water, and electric lines? What other natural and unnatural resources could be harnessed from Battery Place and Broadway? What would it mean if kilowatts mattered more than square feet?
A mid-rise building, typical for the site in terms of size and program, is used to explore ways in which occupants might play a more participatory role in their thermal environments.
Battery Park: Map & Thermal Goals
Summer performance
Winter performance
Site
Developer's Response
Massing development
2. Simplification
4. Unification
6. Sun allowance
7. Bottom thermal allowance
8. Infrastructural adjacencies
Site Section

The thesis suggests a need to think differently about sustainability. Sustainability is not a technical problem to be solved by better technologies, but a shared social issue in which we all hold stakes.

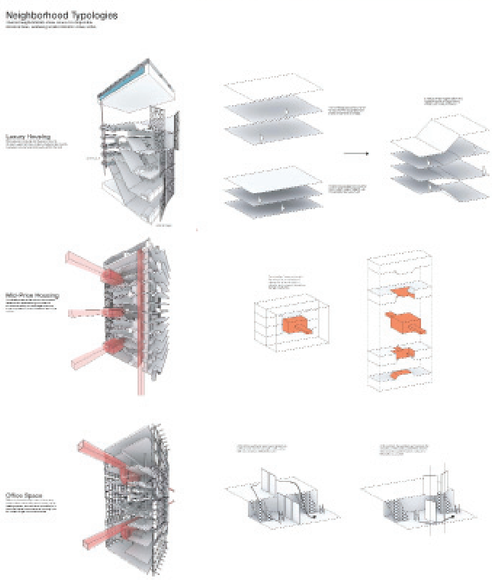
The hermetically sealed building is an automatic part of the built environment, but there are other options. If we are willing to embrace a wider thermal range, temperature becomes again a far more important aspect of our spatial experience.

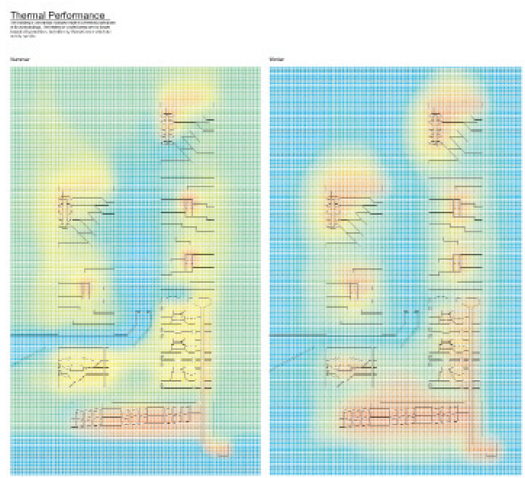
The new hearth: a social hub, created around heat sources and cold sources, produces social involvement with energy and climate.



The development of thermal neighborhoods, within the building, follows from resource proximity rather than from outside goals of the architect. Agency occurs in the spatial and urban arrangement of thermal devices.

Rather than outsiders looking in, the new post-vivarium condition produces zoned boundaries with the outdoors. A new theatricality arises from the climatic behaviors that will evolve.





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The towers serve to funnel cool air from Battery Park deeper into the city, up Broadway.

Broadway then becomes a source of cool deeper into downtown New York; Rather than shutting off the flow of air, the building, which lacks typical glass facades, directs air where it can be most useful rather than blocking it.

In the winter, the building's own residents will do everything they can to slow airflow through their own spaces, making the building urbanistically less transparent to passing wind.

The building's urbanistic thermal properties, then, are influenced directly by the performance of its occupants.

Note: South is to the right. Lighting is to emphasize effects, and does not reflect a real sun position.

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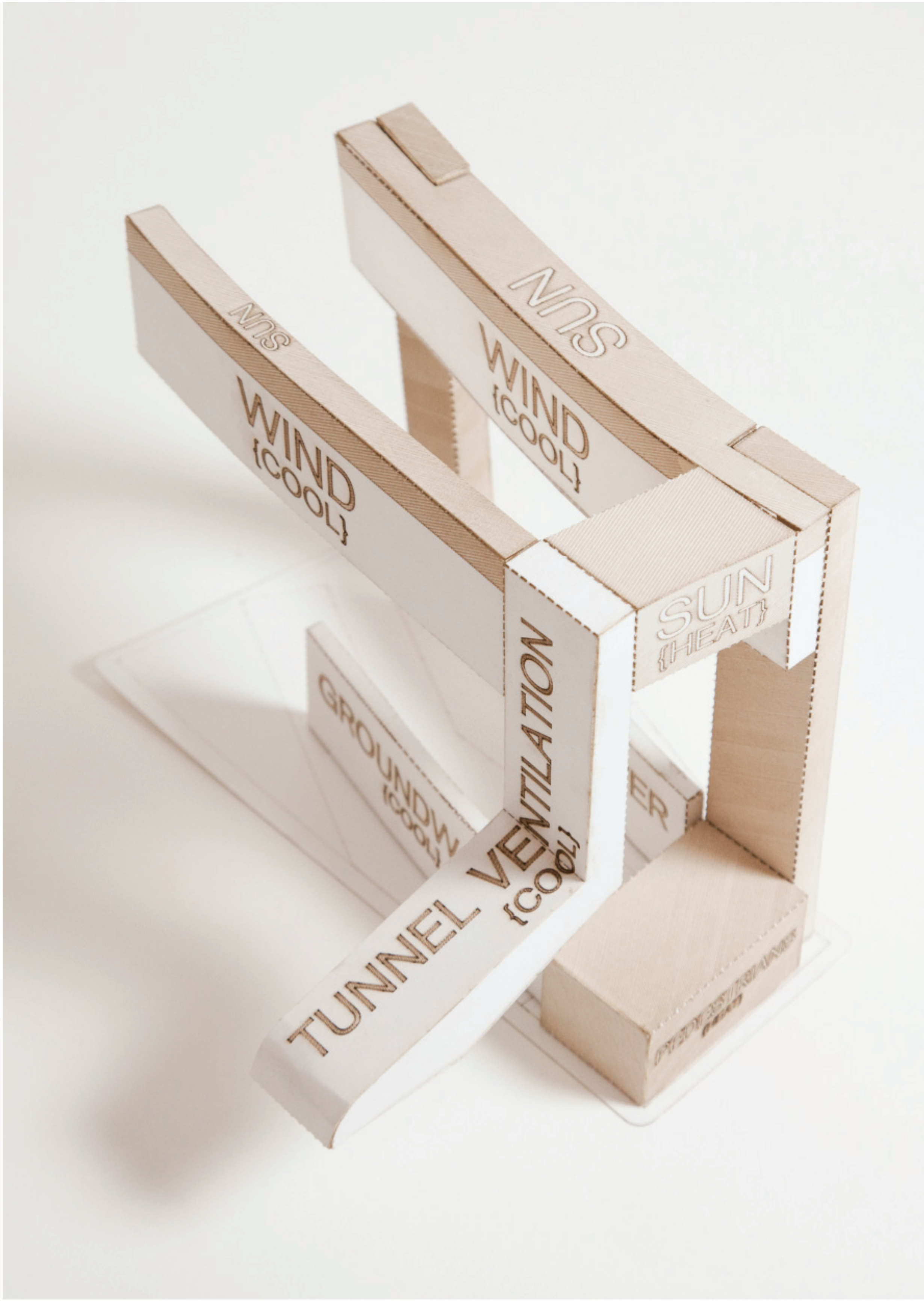
The tall buildings to the site's East cast shadows on it through most of the morning; consequently the Eastern tower is made taller to make sure that the sun pool on its roof is exposed to the sun for longer periods.

The shorter tower, surrounded by much shorter buildings to the West, receives sun throughout midday and the afternoon.

The South face, and approximately 30' back into each tower from the South face, is heated by sun pools similar to those located on the roof.

The building's shared base, facing Battery park and serving as a subway entrance and retail shopping area, is heated by the body heat of the large number of pedestrians passing through.



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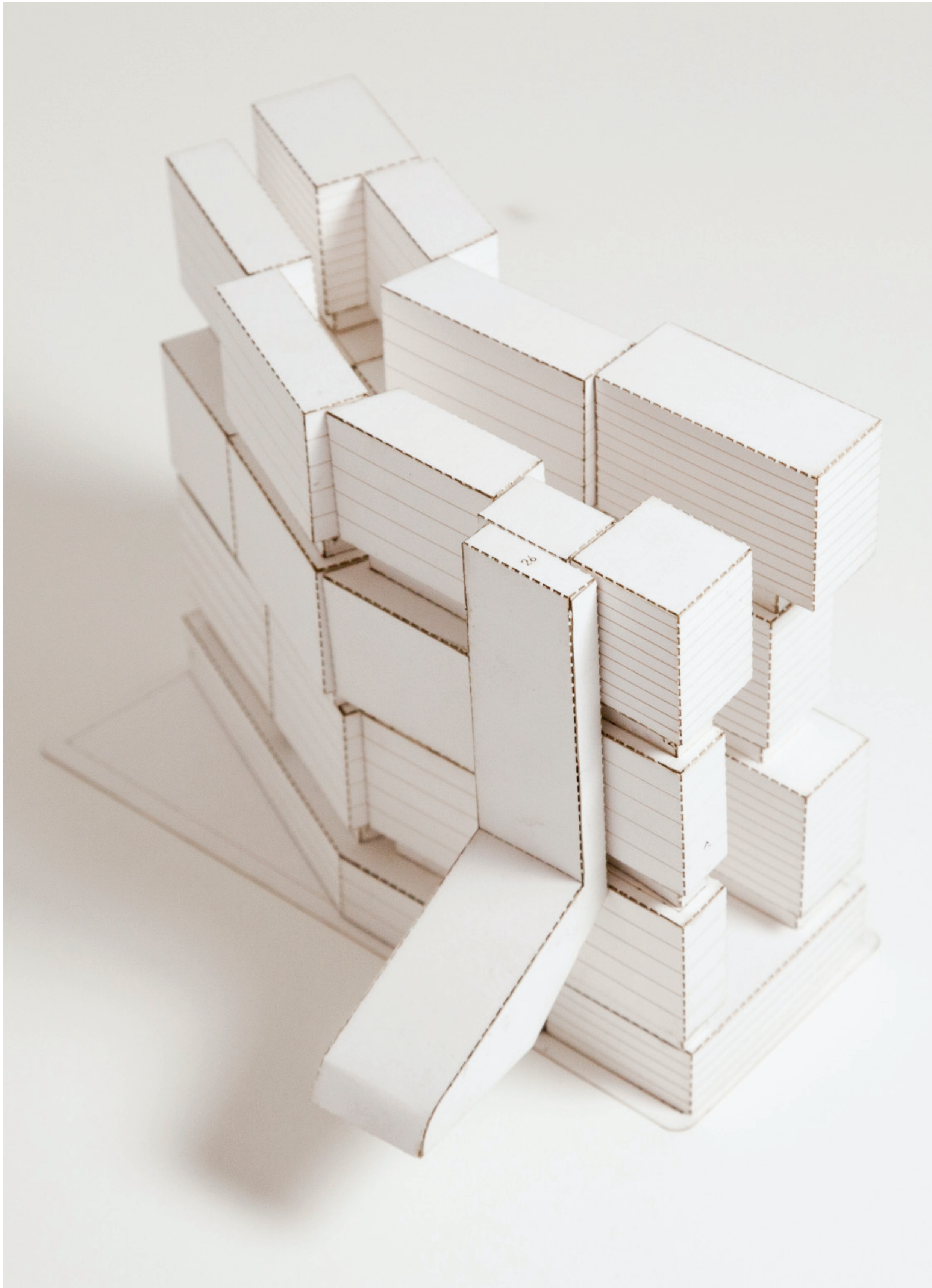

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