Tokyo: Design + Development Studio

研究のスタジオ

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A Joint Studio Between:

C-LAB CURE.

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I. Introduction

Research

This research studio is part of a larger pedagogical experiment which promotes cross-disciplinary approaches to synthesizing theoretical and empirical research into how Tokyo adapts to unprecedented change. This research studio is positioned as an application of substantive work developed within parallel tracks of research undertaken by architecture, urban planning and real estate development faculty. As such, students participating in this studio are selected from each one of these departments. In consultation with the research sponsor—Hulic Co., Ltd.— the studio is asked to position itself within the fictional context of designing and developing a particular site in Tokyo which is bound by the representative physical and market constraints facing Tokyo developers and users. Students will be asked to design and develop normative models and innovative products which are inclusive of component work products in design, finance and management.

Tokyo in Transition

Tokyo's markets, buildings and people are rapidly changing at a pace not experienced by the world's largest metropolis since its post-war rebirth of the late 1940s. Part of this change is driven by Japan's larger unprecedented demographic shift which is defined by an ever aging population. Yet, while Japan's population declines, Tokyo's population is projected to increase and diversify. Tokyo's increased densification of the inner wards is radically undoing decades of suburban and rural dispersal.[1] At the same time, labor and social institutions are changing in response to globalization pressures and western consumers preferences. The direct and indirect impacts of this larger societal and economic transition on the design and management of buildings—and the urban environment— is yet to be fully conceptualized by practitioners and academics.

[1] Tokyo is anticipated to house 30% of the nation's people by 2035, as the rest of the country's population declines (Statistics Bureau of Japan, 2011).

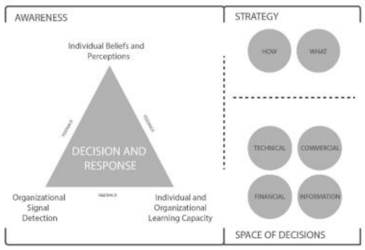
People live, work and consume in cities. As preferences of Tokyo workers and residents are shifting, so too are the requirements for commercial, residential, retail and institutional design and development. Specific to these programs, as CURE's initial research indicates, there will be further corporate relocations to Tokyo in the search for talent and aggregate economies; but, at the same time, a greater percentage of workers will be employed in tertiary industries which are expanding the traditional notion of the workspace and the workplace. Meanwhile, household composition in Tokyo is evolving, with a greater diversity of household size and composition. Most importantly consumer preference research suggests that inner Tokyo is quickly dominating spatial and typological consumer preferences among an already diverse group of households. We also know that that these workers and residents are consuming in different ways in the face of online retail, limited inventory strategies and the decline of the traditionally dominant department retailers. Similar change in healthcare, childcare, education and other programs have also been observed as dependent institutions of residents and workers. The shift in composition and related urban amenities and services will also transform because of Japan's aging society, with roughly a third of Tokyo's residents over the age of 65 by 2035. However, this aging trend, as a percentage of the whole, is anticipated to level off soon thereafter. These totalizing influences have shed a great deal of uncertainty in the planning and design in the inner wards of Tokyo.

The various market economies of Japan and Tokyo represent similar variability in potential or probable outcomes. Some argue that the decline in productivity, absent a more robust increase in real immigration, is setting the country up for a significant economic bust. Others argue that assets, including real estate, are grossly undervalued and that greater inflation is just around the horizon. The historic low levels of inflation even contextualized with relatively low capital costs have in recent decades made Tokyo real estate uncompetitive for global institutional capital. In recent years, innovations in investment products have accelerated investment returns, generally through high levels of leverage. Despite these efforts, the extraordinary cost of developing real estate in the face of comparatively low returns has forced the industry to conceptualize of extended-life buildings. The extended-life of these buildings (i.e., perhaps exceeding a century) are economically desirable because greater or equal returns when contextualized against global standards require extended amortization periods. This economic phenomenon is accelerated by (i) limited transacted available land for development; (ii) disproportionate value assigned to land over the building; and, (iii) comparatively high constructions costs which impose almost equal burdens on development and re-development (i.e., redevelopment is about as expensive as development because land does not necessarily price in lower quality pre-re-development buildings). However, the challenge for the development of extended-life buildings is to design buildings which can accommodate several capital and physical cycles which can respond to transformative change in program and use over the course of a century. Therefore, the research question is how can buildings adapt over the course of a century?

Theoretical Framework: Adaptation

Jesse M. Keenan's *Material and Social Construction: A Framework for Adaptation of Buildings* provides the studio with a theoretical framework from which to contextualize and communicate processes which advance adaptation of buildings. In brief, buildings are both material and social constructions, and the adaptation of buildings is similarly a product of both material and social processes. As a material construction, future buildings will be able to autonomously adapt to changing conditions using automated technologies that integrate measurement sensors and intelligent software to respond to changes in environmental conditions and human behavior. The social construction of buildings comprises not only the intent of the architect as manifested in the design, both in its initial form and throughout the useful life of the building, but also the intents, actions, and interpretations of users and managers of the building. The notion of adaptation unites both aspects of social construction in what is actual realized. Adaptability—which is just one applied mechanism within adaptation—concerns program, form, and the forward-compatibility of materials and technologies, bringing together the design of the building and evolutions in its use over an extended useful life—or, lifespan.

Diagram 1: Framework for Adaptive Capacity of Firms (Owner/ Operator)



Source: Adapted from Berkhourt (2003); Hertin, et al. (2003); Arnell, et al. (2006); Frankheasuser, et al. (1999)

Diagram 2: Framework for Adaptive Capacity of Buildings (Objects)

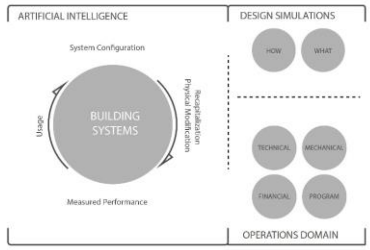
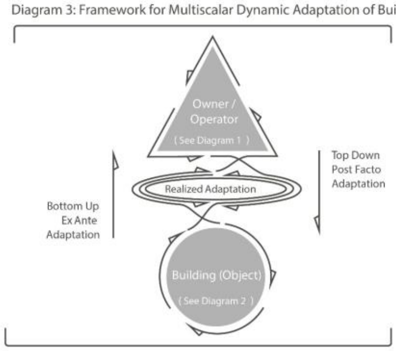


Diagram 3: Framework for Multiscalar Dynamic Adaptation of Buildings



Lifespan is not just a question of long-lasting materials and/or component systems. Rather, it concerns the economic viability of the building as an investment, which means not only a long life, but also adaptation to changing preference, uses and associated management operations. It requires designing spaces that can generously accommodate changes in program, yet have some logic with reduces cyclical capital costs as a matter of efficiency and redundancy of buildings systems. It requires formal decisions that will have great impacts on the operating costs and energy use of the building. Finally, it necessitates an approach to the building as a forward-compatible assembly, comprised of a series of interdependent material and technological layers with different schedules of renovation and replacement. The normative implications of these decisions are parallel and interactive to analytics which evaluate iterations of capital allocation. While much of these exercises are about managing the unknown occurrence and depth of external stimuli, there is an inherent flexibility in the transformability of domains within and of the building which are critical to the exercise of this studio.

Longevity and Risk & Reward

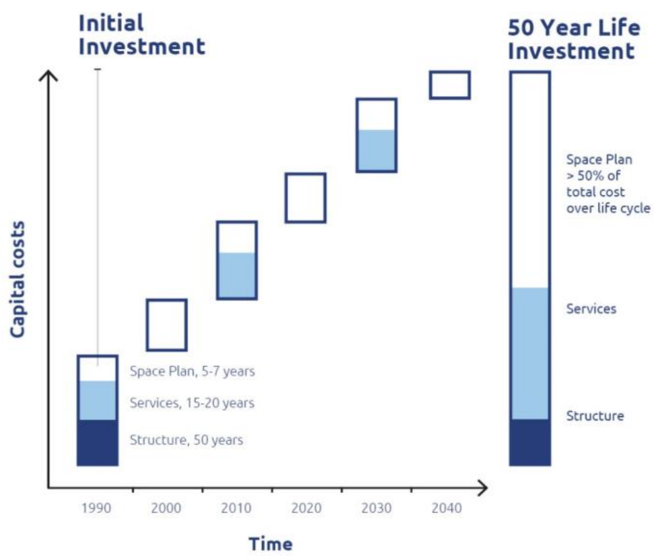
As CURE's qualitative and empirical research suggests, the land economics in an environment of low inflation are favorable to buildings whose useful life extends close to a century. As returns on investments are amortized over longer periods for equivalent yields, it has proven to be a disincentive for the redevelopment of existing buildings whose value is disproportionately—in terms of global property valuations and standards—allocated to land value. Because construction costs and comparatively higher land costs would have to be amortized over the life of the asset based on internationally uncompetitive cap rates, a building with a longer useful life would increase the comparative attractiveness of the assets as investments. While it has been empirically shown that an aging society has been negative influence on land prices, CURE's research suggests that Tokyo will be immune from this downward pricing pressure due to increasing diversification and more varied households. However, the larger proposition for longer useful life buildings assumes that future buildings would be designed to be highly adaptable, in order to accommodate future variability in program as residential and commercial uses evolve with corresponding changes in demography and economy. At the same time, these adaptation measures and strategies must be identified and divided into discrete notions of risk. The management of risk will ultimately be the determinant of the application of this studio's work in professional practice.

Based on CURE's research, C-Lab will develop design strategies that address the life cycle of buildings, producing prototypes with built-in adaptability that will greatly extend their useful life, thereby preventing obsolescence and mitigating risk to stakeholders. We will look at life cycle implications for extended-life buildings, considering both environmental and economic sustainability and/or viability, and the relationship between capital and operational expenditures. Our analysis will extend beyond the technical aspects of design to consider the effects of program, form, and forward-compatibility on the design and management of buildings. Design for adaptability safeguards investment over time, which may promote buildings with higher quality spaces that maintain their value beyond the fluctuating adaptive cycles of various urban systems. Adaptation can enhance the architectural quality, environmental sustainability, and economic security of buildings by reducing risk and consolidating and/or preserving value in a particular location over many generations. From this perspective, buildings are an investment in the city itself.

II. <u>Design for Adaptation</u>

Adaptation is not just about the flexibility of the building's spaces and uses. Design for adaptability, which is just one facet of adaptation, considers the following categories against the aforementioned criteria:

- Program
- Form
- Forward-compatibility



The renovation and modernization of the services and space plan of a building contribute far more to its lifecycle costs than the structure. Changes to the space plan alone comprise more than 50% of the total capital costs over the lifetime of a building. Diagram by C-Lab, based on a diagram by Frank Duffy in *Work and the City* (London: Black Dog, 2008).

Program

Program and occupancy have profound effects on a building's operating expenses and environmental costs, both of which impact the market value of the building. Operating costs make up, on average, 80-90% of the total lifespan cost of a building. Occupancy levels and program affect energy use and the cost of maintaining a building, driving up operating costs. The design of programmatic relationships not only affects the cost of owning a building, but also its value over its lifetime. The ability of a building to accommodate changes in program determines its long-term value as an asset.

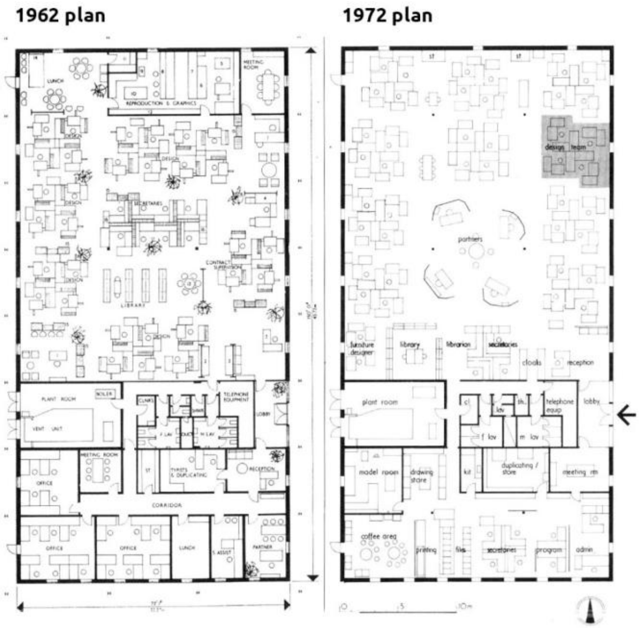
The studio is tasked with researching and contextualizing examples of historic and contemporary buildings that continue to remain highly desirable to tenants after many years of use, in order to understand what allows these buildings maintain their value despite changes in patterns of occupancy. The studio will consider case studies in New York and Tokyo, as well as in other global cities. Program schemes that result from our study may include new prototypes for the office, retail, residential, elder care, and hospitality industries.

Programmatic research will additionally rely on demographic projections produced by Dr. Lance Freeman as interpreted through CURE's estimation of product demand. The studio will conceptualize the logical phasing from one program to another or from one discrete program to a hybrid future program. For instance, preliminary research suggests that senior housing may transition into market rate multi-family housing, which may or may not have a multi-generational component. Likewise, hospitality programs can provide additional value in the future as multi-family housing for singles or couples, as has been the case in many global cities. Finally, certain programs may in the future become hybridized, such as hospitality and healthcare, and commercial and residential. This hybridization may occur at the scale of a building with multiple uses, or may be more closely integrated on a floor-by-floor basis. In either event, the sequencing of program over time in relation to logical future scenarios, based on increasingly more diverse residential population in the subject core areas of Tokyo, is a critical research proposition. Questions relating to duplications of systems, logistical accessibility, and lawful adjacency will ground this exploratory process.

Program, Shell and Interior

While the physical form of a building may remain constant, the patterns of occupancy on the interior are constantly changing. Buildings that can accommodate a wide variety of interior configurations can remain profitable over their lifespan. The studio will analyze examples of office and residential buildings that have experienced radical reconfigurations of their interior space plans over their lifespan, in order to identify strategies for adaptability that allow these buildings to maintain value.

In New York, the Seagram Building (1958) offers an excellent example of a building that has been highly adaptable to different configurations over its lifetime. While its exterior is seemingly timeless, its interior has been dramatically reconfigured almost constantly over its 60 years of life. From 1990-2013, over 467 interior renovation projects were undertaken, suggesting an accelerated rate of change on the interior compared with the relatively static shell. In 2005, following its acquisition by RFR Holdings, costs for interior renovations reached 20% of the original construction costs for the building. A survey of floors offered for rent in the Seagram building over the course of 2013 reveals the variability of interior space plan configurations. While Seagram's exterior remains forever unchanged, its interior is constantly changing, driven by the preferences of tenants and patterns of occupancy. Seagram's adaptability has allowed it to be a remarkably durable and consistent investment for its owners. In 2013, despite being almost 60 years old, it commanded rents of \$135-145/ft^2, one of only 80 office buildings in Manhattan to break the \$100/ft^2 rental price in that year, and more than twice the average rent in Manhattan for Class-A Office space.



Typical plans for Dobson House, London, in 1962 and 1972, showing changes to the interior layout and hierarchy of spaces. Diagram from Frank Duffy et al, *Planning Office Space* (London: Architectural Press, 1976).

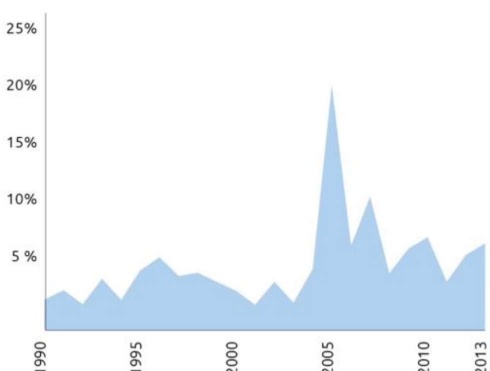
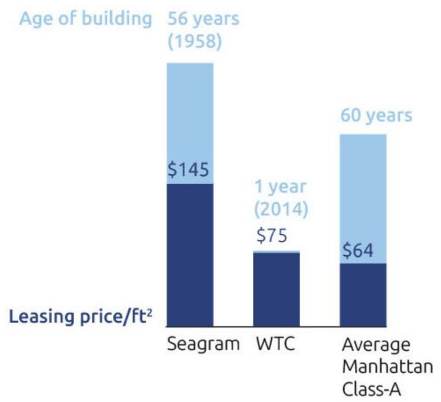
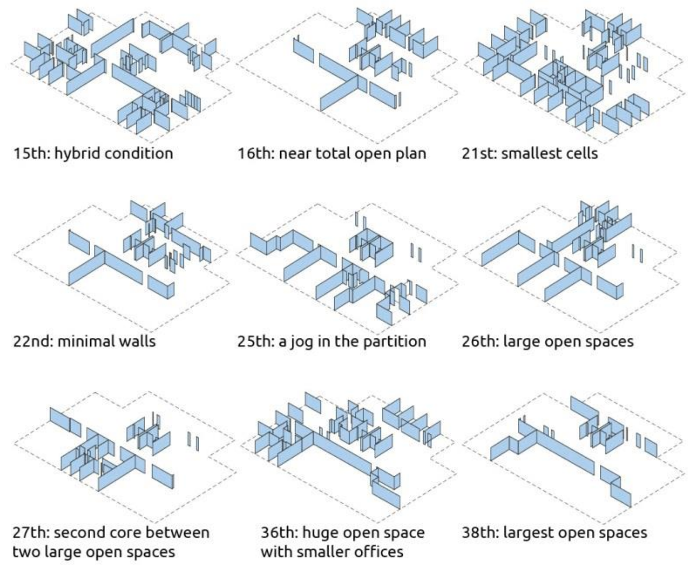


Diagram by C-Lab based on research and drawings by Nicholas Potts, as published in Rem Koolhaas and James Westcott, eds., *Elements of Architecture: Wall*, 2014 Venice Biennale exhibition publication (Venice: Marsilio) 2014. Drawing by Nicholas Potts. Information from NYC Department of Buildings applications.





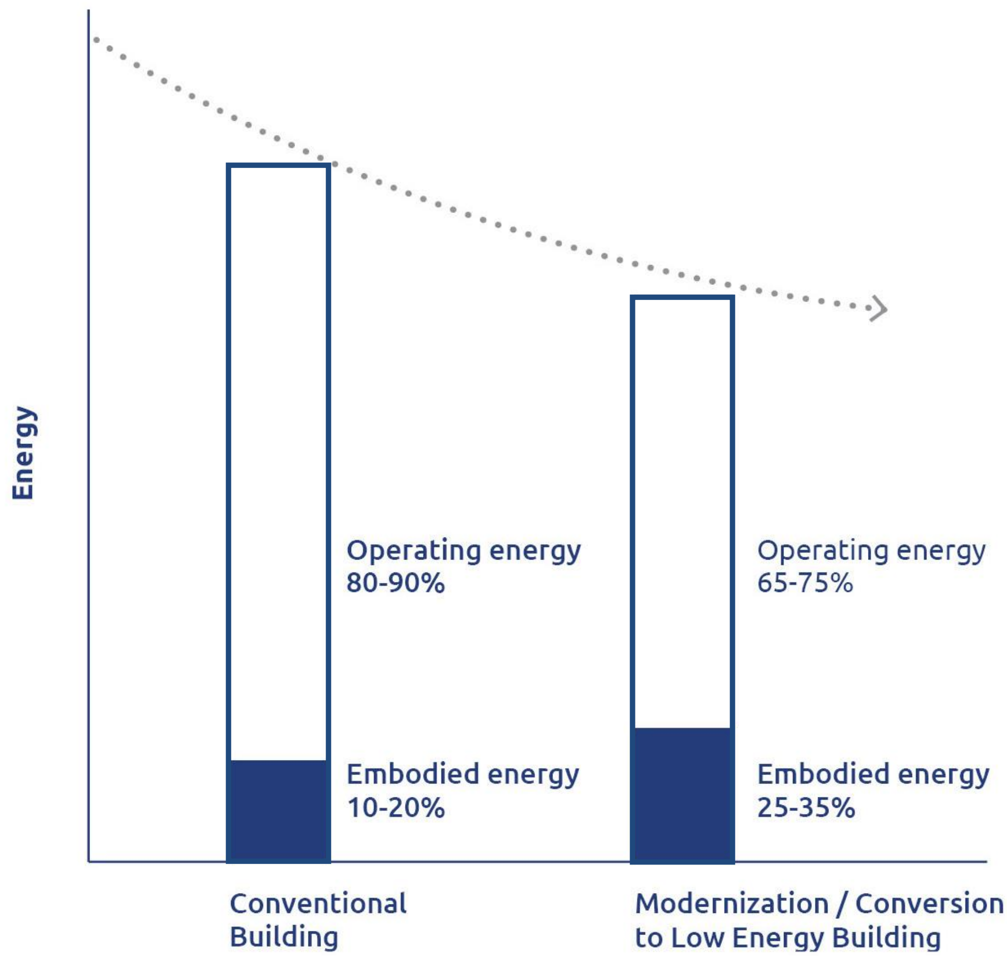
Page 6: Despite its age, the Seagram Building rents for more than twice the average Manhattan Class-A office space, and almost twice the rate of the WTC complex. Diagram by C-Lab based on information from Crain's New York Business.

Page 7: Layouts of floors available for rent in the Seagram Building in 2013. Diagram from Rem Koolhaas and James Westcott, eds., Elements of Architecture: Wall, 2014 Venice Biennale exhibition publication (Venice: Marsilio, 2014). Drawing by Nicholas Potts.

Program and Modernization

As building ages, additional investments in modernizing systems can increase embodied energy, but, more importantly, they decrease operating and life cycle energy costs. Similarly, converting the building to a new use often increases embodied energy costs associated with replacing building components and materials, but reduces operating and life cycle costs. Since operating energy comprises 80-90% of life cycle energy use, this potentially represents considerable value. The studio will assess the tradeoffs between investment in optimizing patterns of occupancy versus maintaining slightly less efficient uses, as well as upgrading versus maintaining systems. The requisite analysis will determine whether the savings incurred by adapting energy-intensive programs to more efficient uses can recoup conversion costs.

In 2011, the Empire State Building's owners began a massive renovation project, estimated to cost $550 million dollars. Of the total cost, $120 million was dedicated to installing new mechanical systems, saving an estimated 40% in energy costs, equivalent to $4.4 million annually. The modernization of the building made it the tallest LEED-certified building in the US. The renovation of the Empire State Building allowed the owners to market the building to larger companies, changing the composition of floors 3-29 from 200 small tenants to only 9 large tenants.



By retrofitting a building with low-energy systems, or converting its program to lower energy uses, the embodied energy increases of the building increases, but its operating energy costs decrease. Diagram by C-Lab, based on data collected by T. Ramesh et al, ‘Life cycle energy analysis of buildings: An overview,’ *Energy and Buildings* 42 (2010) 1592–1600.

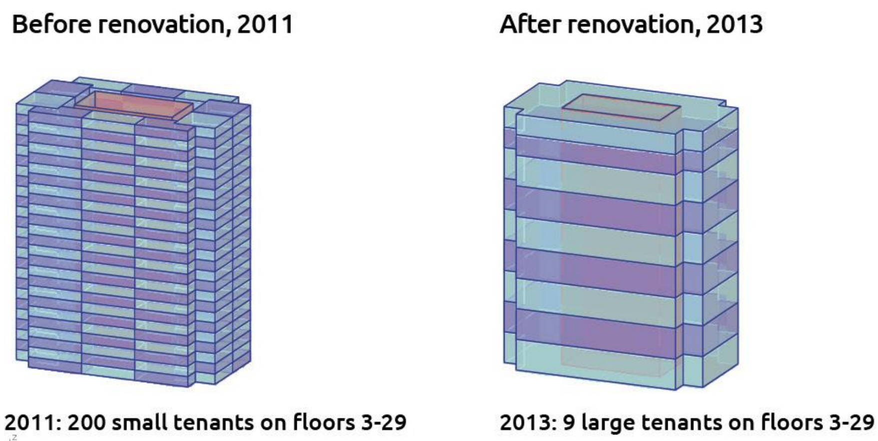


Diagram by C-Lab, based on information from Empire State Realty Trust

The Empire State Building utilized an Energy Service Corporation (ESCO), a company that facilitates and finances physical upgrades in building systems with the proposition that real savings between pre- and post-performance provide cash-flow for financing the improvements. The studio may examine modes of operations within the Japan Association of Energy Service Companies (JAESCO) to evaluate if there is any applicability for future utilization. Or, in the alternative, the research team can evaluate and give greater specificity to where and which systems are or could be subject to future recapitalization with the aims of building design sensitivity to these known limitations.

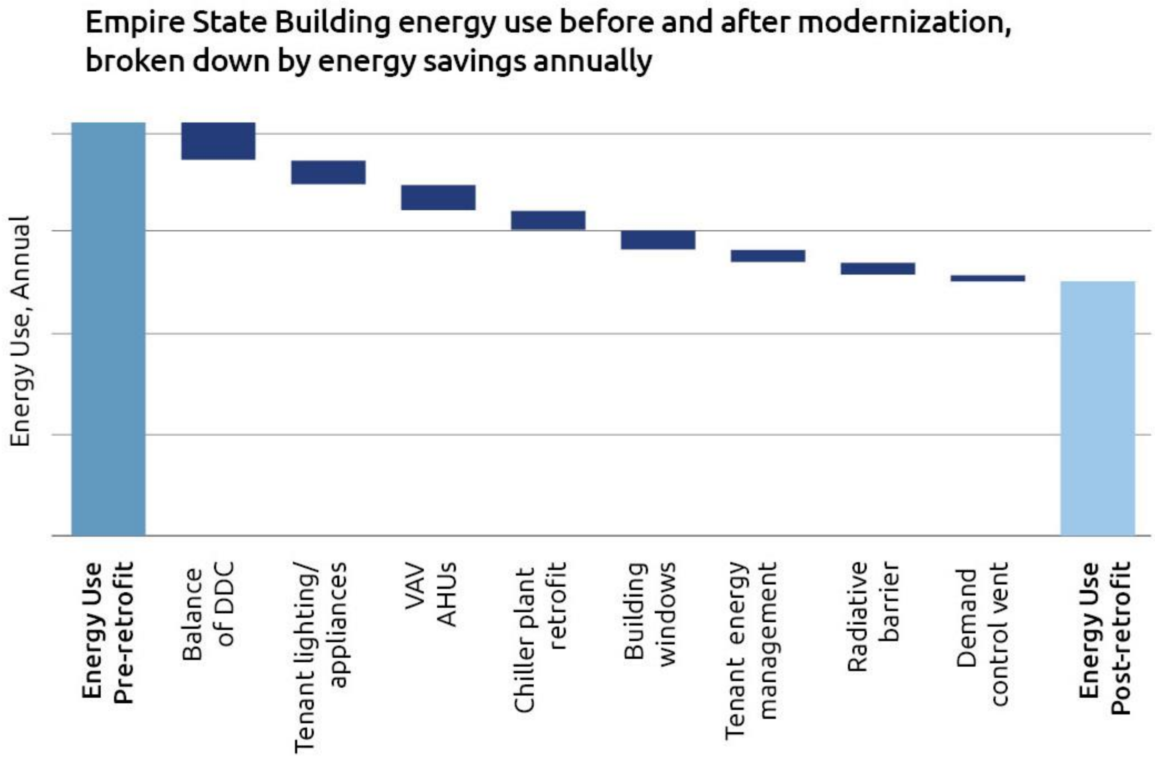
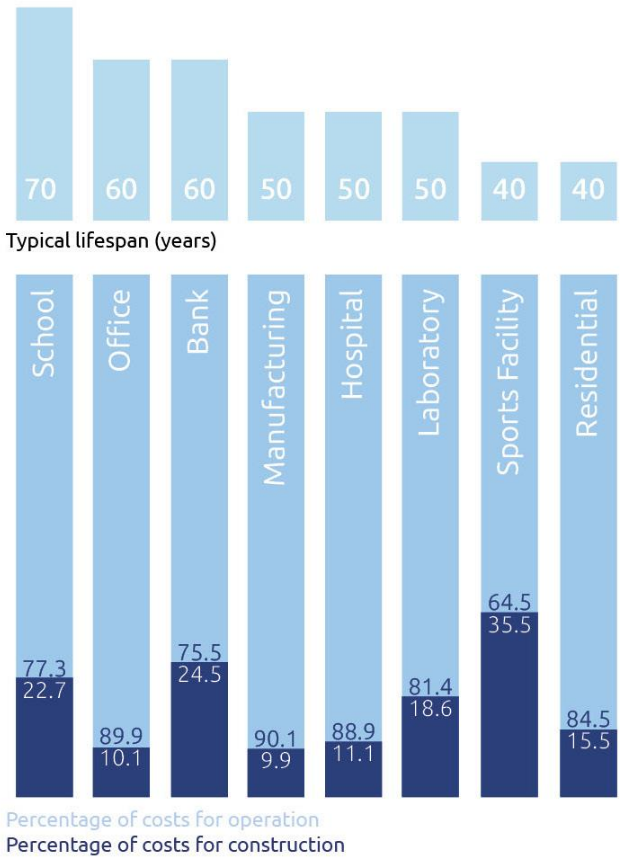


Diagram by C-Lab, based on information from Empire State Realty Trust

Program and Operating Costs

While it is broadly true that buildings with a shorter lifespan carry a greater percentage of their total cost in their initial construction, this is not the only factor. Patterns of occupancy, scale, and form play a strong role in differentiating building types by their energy costs. The studio analyze combinations of programs that yield optimal construction, operational and environmental cost savings.



Life cycle costs: Percentage of cost for construction versus operation for buildings with different projected lifespans. Operating costs make up the vast majority of life cycle costs. Diagram by C-Lab, based on information included in Uwe Refermund, 'Life Cycle Costs of Buildings - Calculation Methods, Status and Outlook.' *Detail*, 2012, no. 4.

Program and Occupancy

Occupancy level affects operating costs, energy use, and lifecycle in tall buildings.

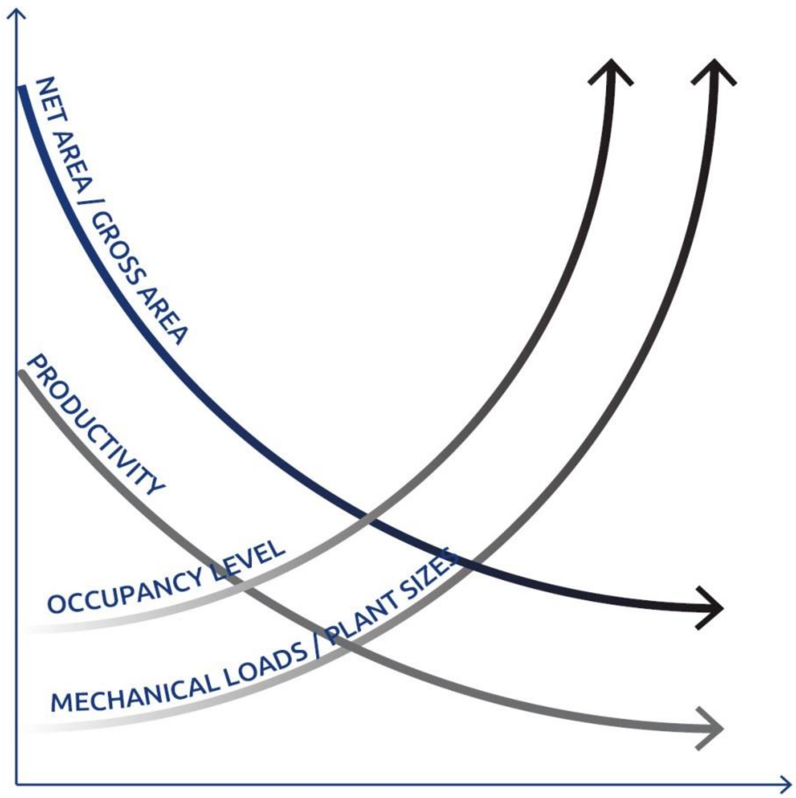
Increasing occupancy increases:

- equipment loads
- internal heating gains
- cooling load
- plant sizes
- circulation/egress space required

And therefore decreases:

- net to gross area (space efficiency)

Increasing occupancy is still typically more efficient than constructing or relocating to additional buildings. However, extremes of occupancy result in lowered productivity, which is itself a cost.

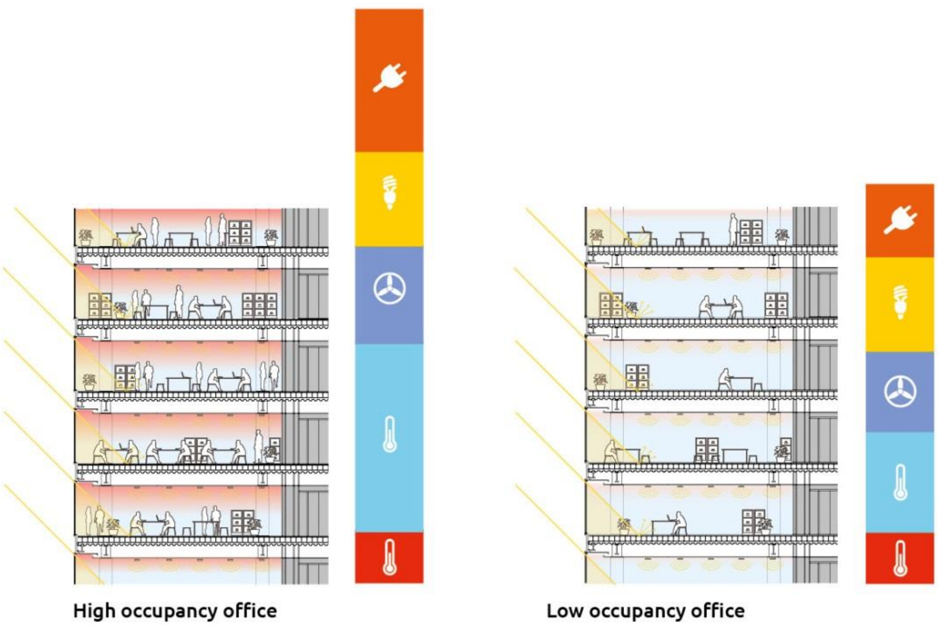


Occupancy affects a building's operating costs and spatial efficiency, as well as user productivity. Diagram by C-Lab, based on relationships described in Judit Kimpian et al. 'Sustainably Tall: Investment, Energy, Life Cycle.' *Detail Green*, 2010, no. 1.

Program and Energy Costs

Patterns of use affect energy costs, with greater occupancy levels requiring more energy spent on cooling, ventilation, and appliances. On the other hand, as a building's occupancy increases, its internal heat gains increase, and therefore its required heating decreases. Life cycle planning includes coordinating internal gains, driven by occupancy patterns, with sources of external gains (glazing area and transmittance, floor to floor height, orientation to sun, air penetration) to optimize savings in energy expenditure.

The percentage of energy used by various systems in a typical office building

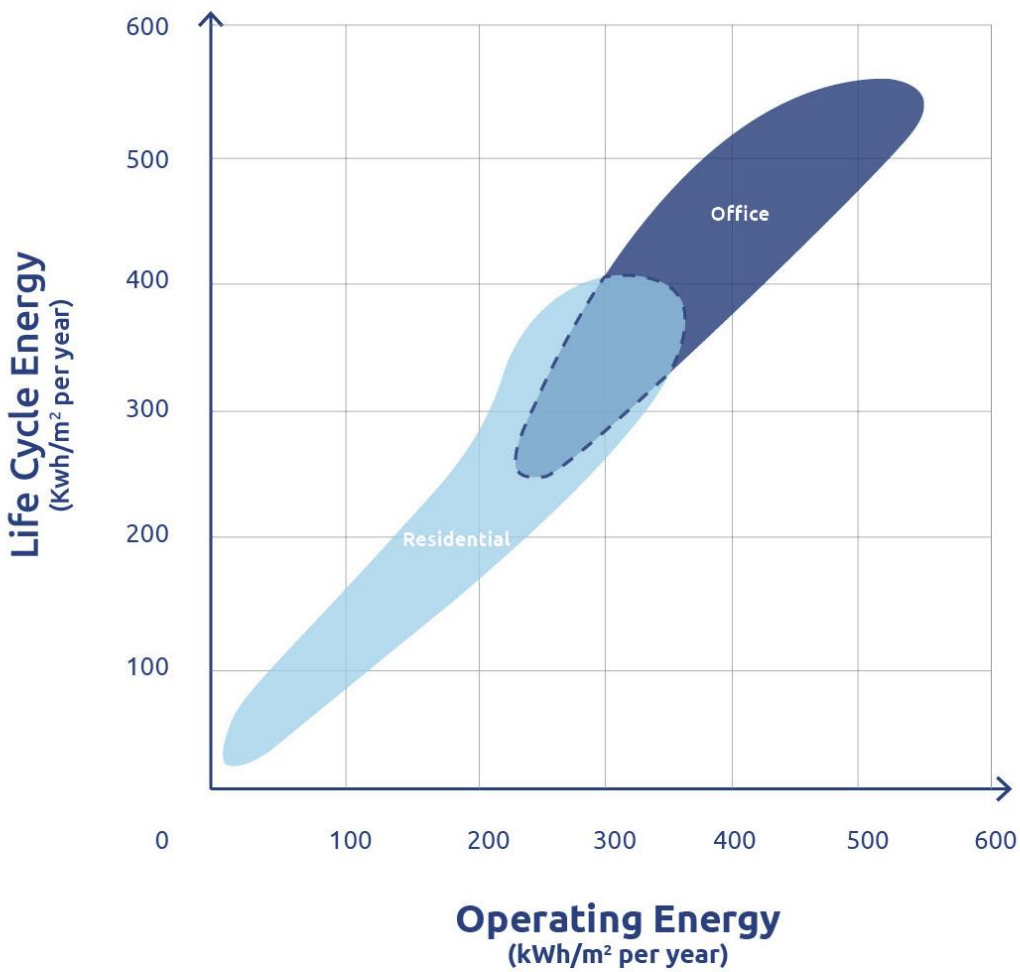


Occupancy levels affect the percentage of energy use consumed by the different systems, and also affect the total energy used. Diagram by C-Lab based on relationships described in Judit Kimpian et al. 'Sustainably Tall: Investment, Energy, Life Cycle.' *Detail Green*, 2010, no. 1.

Program and Life Cycle Energy

Program affects operating energy use and therefore the lifecycle cost of the building. Typically, both the operating energy and lifecycle energy of offices is greater than that of residential buildings.

We will study how intelligent combinations of programs can reduce operating energy and therefore overall costs. For example, by pairing programs that use peak energy during the day (office) with programs that peak in the evening (residential and leisure), it is possible to decrease overall occupancy levels and therefore reduce energy use and plant size, yielding a more efficient floorplate and lower operating costs.



Offices consume more energy per square meter per year than residences. Operating energy is strongly correlated with overall life cycle energy. Diagram by C-Lab, based on data collected by T. Ramesh et al, ‘Life cycle energy analysis of buildings: An overview,’ *Energy and Buildings* 42 (2010) 1592–1600.

Form

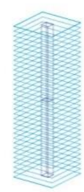
Form affects not only the leasable space of a building, but also the quality of the experience and its operating costs. The overall massing of a building, as well as floor to floor heights and area to perimeter ratios, can increase or decrease operationing energy use depending on the balance between energy saved by daylighting versus energy spent on cooling the interior.

We will consider aspects of form that offer benefits to the building's operational costs and energy use over its lifespan. We will examine emergent forms and technologies, alongside historical examples in New York City and elsewhere that are still successfully occupied today.

Form and Massing

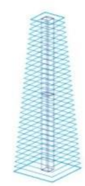
Building mass and orientation provide large-scale opportunities to improve the quality of the space while controlling operating costs and energy use. Using modeling and simulation software, we will study the effects of massing on initial and life cycle costs and energy use, in order to provide an accurate assessment of trade-offs between different formal options. We will also take into account the implications of zoning regulations and urban planning on the range of massing possibilities for buildings in Tokyo.

Option 1: Square Floor Plate



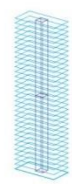
+ High floor area to facade ratio
+ Equal perimeter to core relationship
- Poor fit for many sites
- Shape is indifferent to solar orientation

Option 2: Tapered Square Floor Plate



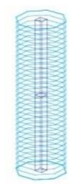
+ High floor area to facade ratio
+ Equal perimeter to core relationship
+ Structurally efficient for wind loads
– Poor fit for many sites
– Indifferent to solar orientation
– Increased solar gain on tilted facade
– Daylight penetration at top offset by dark, deep plan at bottom

Option 3: Rectangular Floor Plate



+ Reduces solar gain by orienting short side toward sun
+ Narrow depth can take advantage of natural ventilation
+ Good daylight penetration
– Lower floor area to facade ratio
– Small floorplate may be less desirable

Option 4: Octagonal Floor Plate



+ Highest floor area to facade ratio
+ Equal perimeter to core relationship
+ Multiple faces allow for control of solar gain through differential cladding
– Poor fit for many sites
– Shape is indifferent to solar orientation

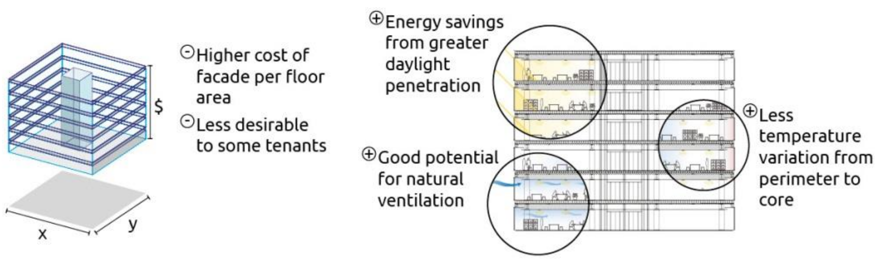
Form and Scale

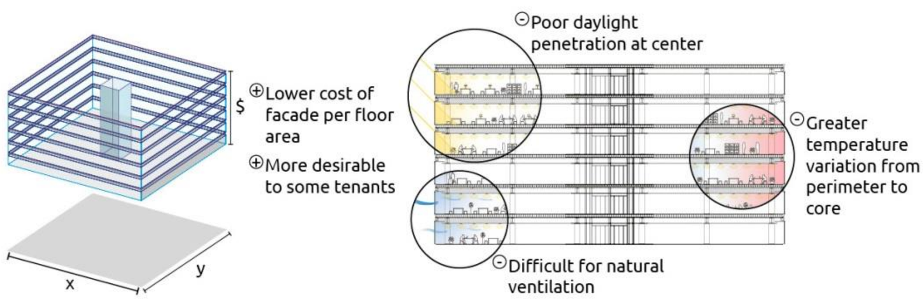
The scale of a building affects operating costs over its life span. Mid-size office buildings afford particular advantages from the standpoint of life cycle costs, in that they are more easily modernized and offer greater potential for conversion between uses, due to the smaller numbers of tenants and the shorter time required for renovation.

The studio will consider other effects of scale on the leasability, operating and life cycle costs of buildings, as well as on the experience of their occupants.

Form and Floorplate Depth

Large floor plates maximize facade/floor ratio efficiency, as a larger floor area per unit of facade amortizes the cost of the building's facade across a greater usable area. They offer users the advantage of efficient spatial arrangement and worker communication within an office.



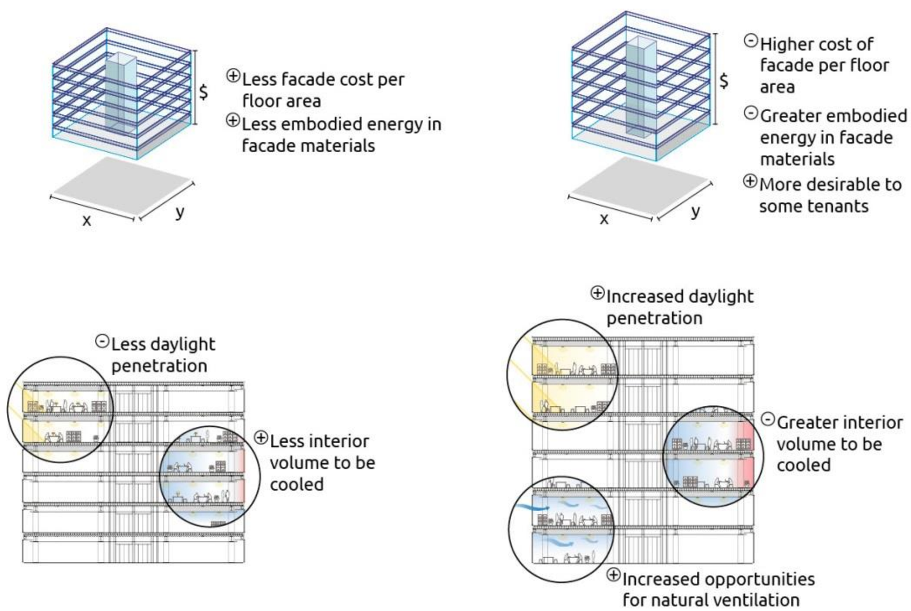


Smaller Floorplate versus Larger Floor Plate. Diagram by C-Lab based on relationships described in Judit Kimpian et al. 'Sustainably Tall: Investment, Energy, Life Cycle.' *Detail Green*, 2010, no. 1.

Form and Floor-to-floor Height

Smaller floor plates offer the advantages of greater daylight and ventilation penetration, resulting in both energy efficiency and more atmospherically desirable space. Large, deep floorplates offer a lower cost of facade per floor area, and may be more desirable to some tenants. Our research will study the relationship between floor plate size and performance, and make design recommendations based on our analysis.

Lower floor-to-floor heights balance the facade/floor ratio, with each unit of facade correlating to a greater floor area. Reducing floor height also reduces the cubic volume of a space, which increases the building's mechanical efficiency by lowering the volume of air per floor. Increases in floor height result in deeper daylight penetration to core, which can make up for the loss of daylight at the center of large floor plates. They provide more opportuntiy for ventilation, offsetting the increased air volume of each floor. Finally, taller floor heights create more luxurious real estate, allowing for higher rental costs per floor area unit. We will investigate optimal floor heights based on different performance criteria in the development of the prototypes.



Standard Floor-to-Floor Height versus Increased Floor-to-Floor Height. Diagram by C-Lab based on relationships described in Judit Kimpian et al. 'Sustainably Tall: Investment, Energy, Life Cycle.' *Detail Green*, 2010, no. 1.

Forward-compatibility

Understanding the lifespans of building materials and systems can help designers and owners plan for future renovation and adaptation. Buildings are comprised of layers of products and components, each with its cycles of maintenance, decay, and replacement. Design decisions can align the timescales of components, optimizing the useable life of a building and minimizing renovation costs.

Forward-compatible Materials

The materials and components that make up a building age at different rates. Coordinating the timing and scope of renovations can minimize costs. By designing with the lifespan of materials, architects can create relationships between layers of systems that anticipate future retrofitting.

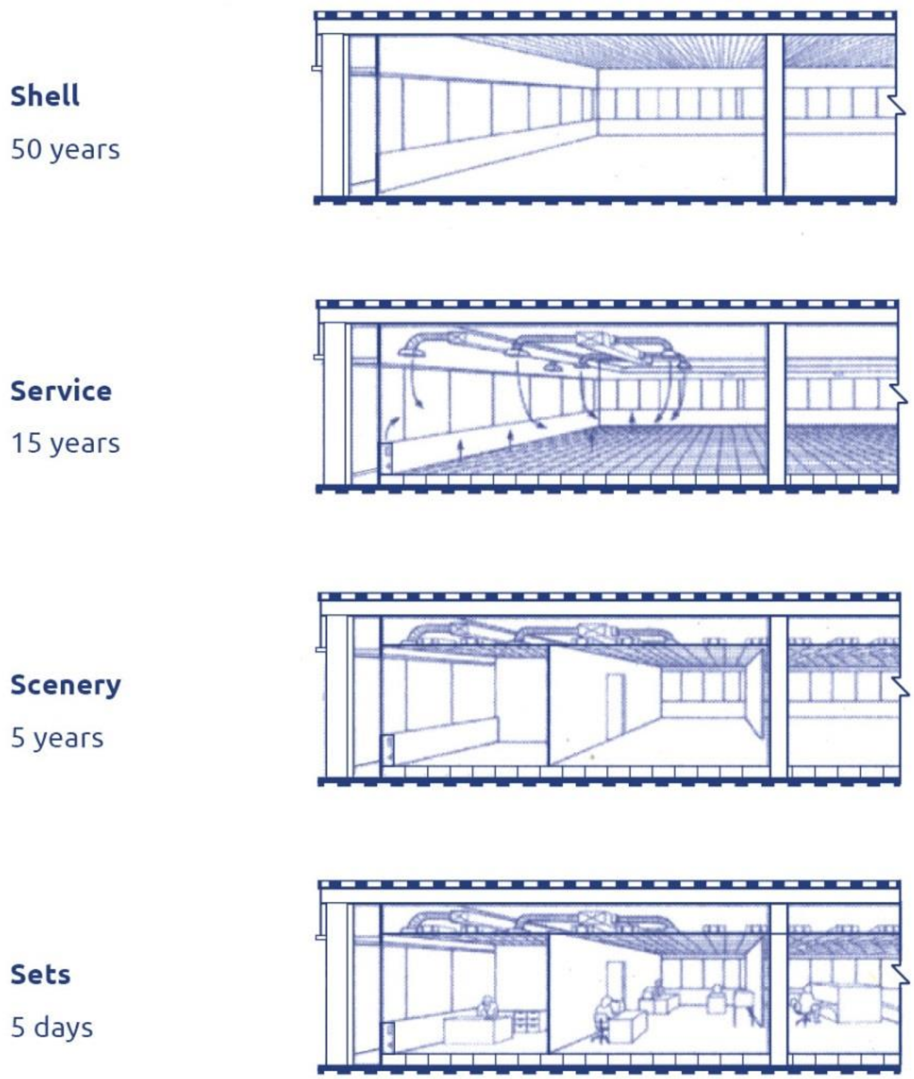
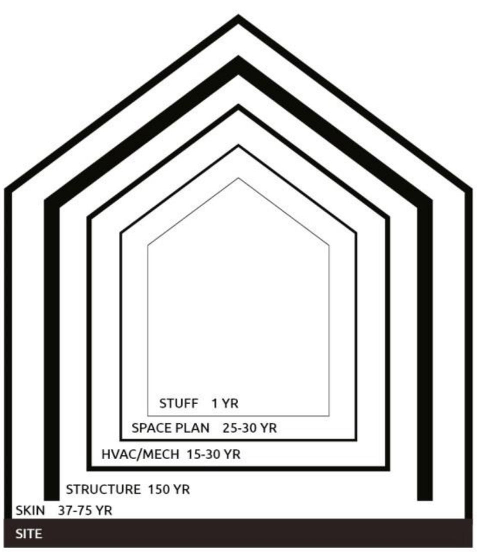


Diagram by Frank Duffy in *Work and the City* (London: Black Dog, 2008).

Cycles of material lifespans. Diagram by C-Lab based on data from *Typical Life Expectancy of Building Components,* by Costmodelling Limited.

Forward-compatible Layering

Adaptable durability considers the spatial relationships of building components and the differences in their cycles of replacement and renovation. The layers of envelope, structure, services, technologies, and finishes that comprise a building have very different periods of replacement. Our design recommendations will attempt to find alignments between the different material cycles, in order to maximize the value of the building over its useable life.



A building is comprised of many layers, each with different timescales for renovation and replacement.

Diagram adapted from “Shearing Layers,” Stewart Brand, in *How Buildings Learn: What Happens After They’re Built?* New York: Penguin Books, 1995.

Forward-compatible Cycles

The labor, material, and ecological costs of building maintenance can be reduced by synchronizing the replacement times of dependent building materials. For example, a building's wiring must be accessed through its walls, so aligning the renovation of wall finishes with electrical upkeep can reduce costs.

Additionally, the usable lifespan of one material may depend on the upkeep of another, creating a cascade effect: wires will corrode if the building's facade and insulation are not properly maintained.

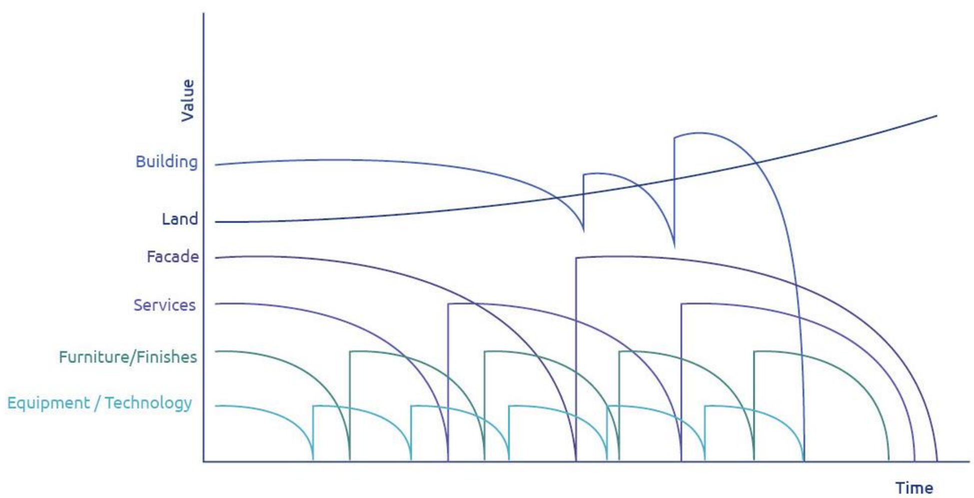
The usable lifespan of one material is contingent upon the maintenance of other materials, and the building's overall duration relies upon shorter term replacements.

One approach to the interdependency between material layers is to align cycles of renovation to get the longest useable life from each material. Better yet is to design the layers from the outset to accommodate a greater degree of independence, allowing upgrades to proceed at any time.

Life Cycle

Program, form, and forward-compatibility come together in the life cycle of the building.

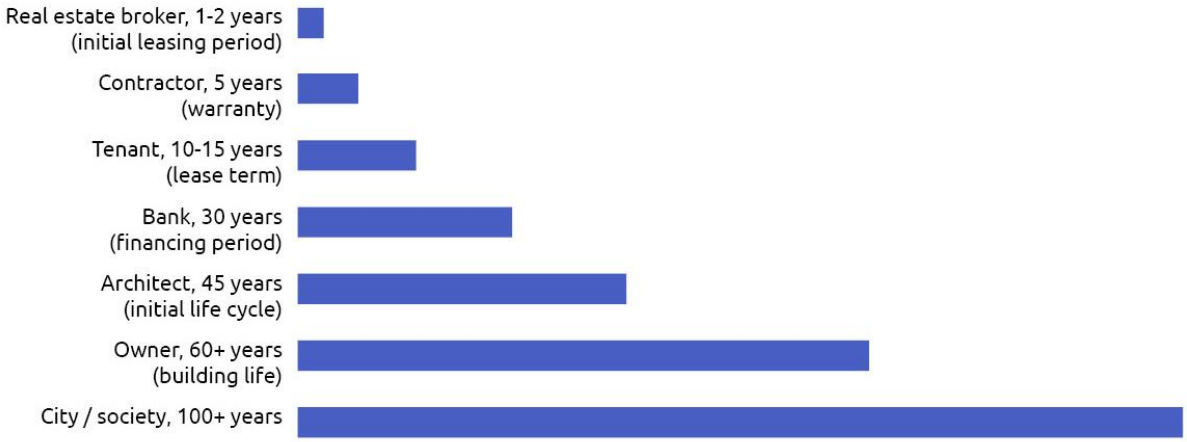
A building's adaptability can be understood through an analysis of its life cycle. If the design of program, form, and forward-compatibility is a means of achieving adaptability, life cycle analysis is the measure of the success of extended lifespan building design.



A building's value at any moment is dependent on how the lifecycles of various components align. Diagram by C-Lab.

Life cycle assessments attempt to align various scales of time:

- product life cycles
- building life cycles
- land use
- interests of developers, manager-owners, tenants, the public



The temporal alignment of interests among stakeholders is as important as the material life cycle of the building. Diagram by C-Lab.

Life cycle assessments can be performed on production processes at a variety of scales, from materials, to products, to buildings, to entire industries. The smaller scales can be thought of as components of the larger scales: the life cycle of a building is determined by the life cycles of the various products that comprise it, which often have drastically different time scales. Design that considers how each of these scales affects the overall energy and cost of a building can improve the value of the building as an investment.

Life cycle assessments take into account three major phases: manufacture, use, and demolition. For each of these phases, both economic and environmental costs can be assessed. The total life cycle costs of a building are the sum of the costs of each phase.

Design can take into account the expenses associated with each phase, in order to reduce the overall costs.

Manufacture

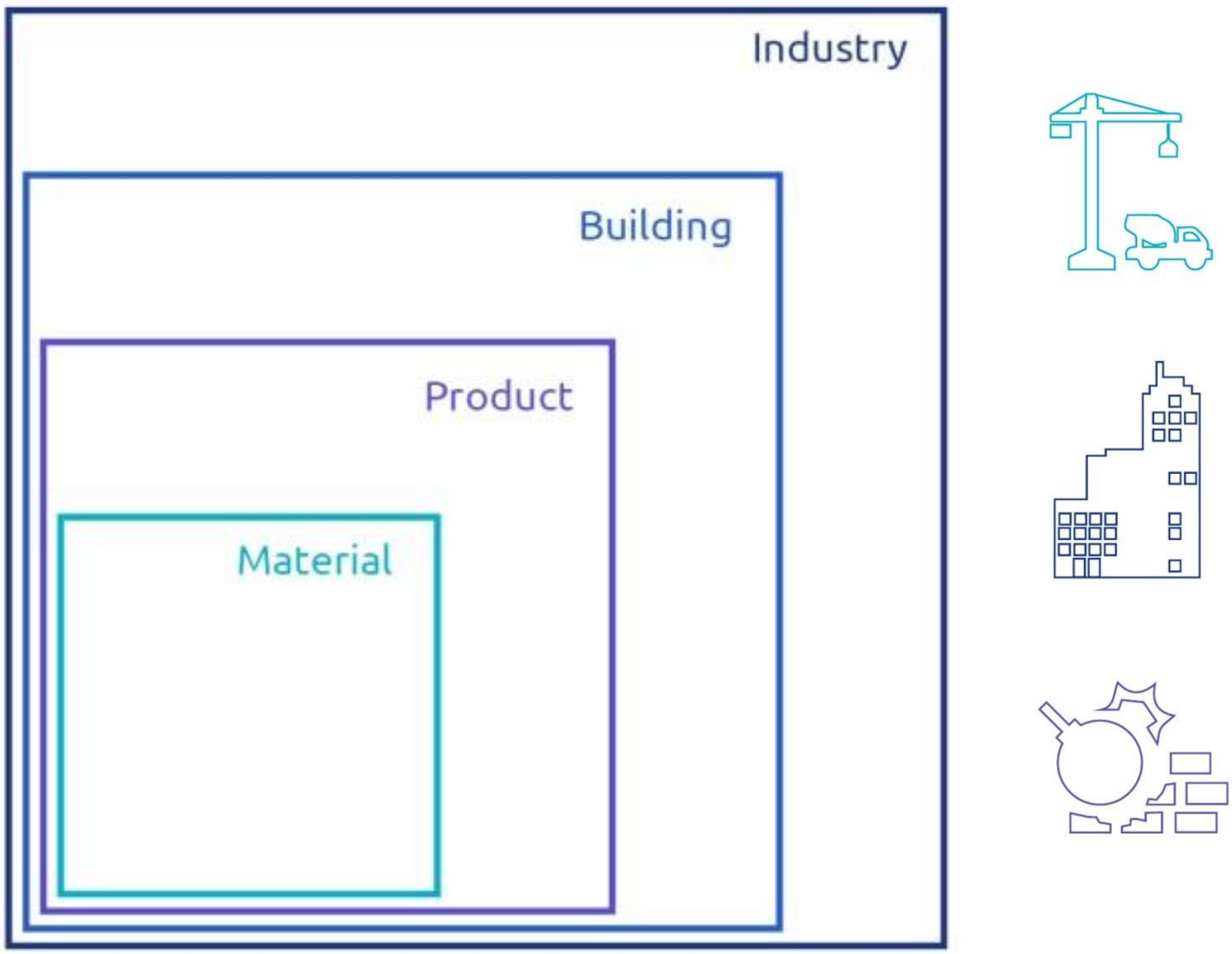
- Raw Material Mining/Quarrying
- Building Material Production
- Prefabrication
- Transport
- Building Shell Construction / Renovation
  Energy & Labor Costs

Use (operation/maintenance)

- HVAC
- Electricity
- Water
  Data
- Renovation or Conversion

Demolition

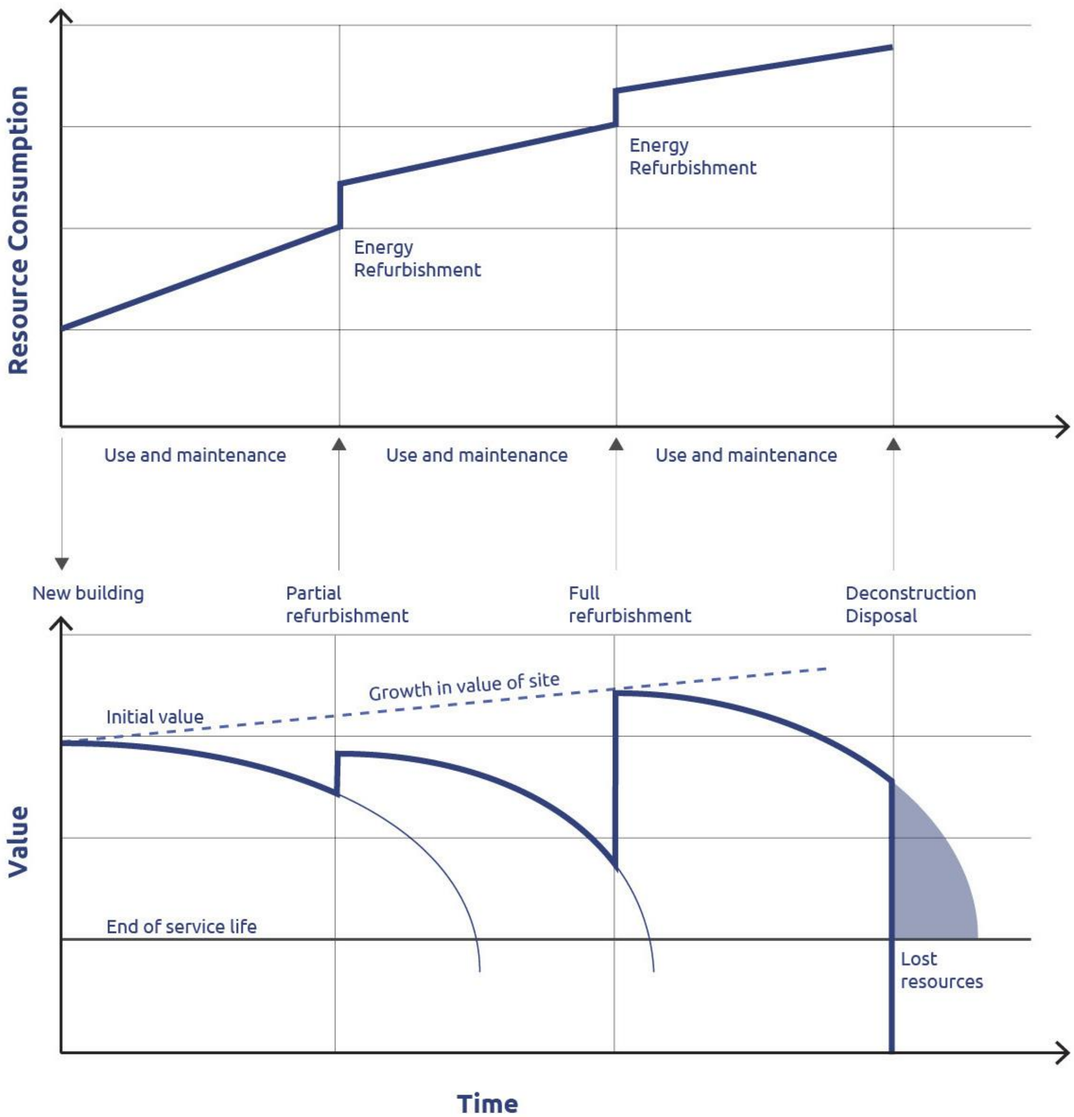
- Building Demolition
- Material Transport
- Landfill Site or Recycling Plant



Life cycle assessments operate over many, nested scales.
Diagram by C-Lab.

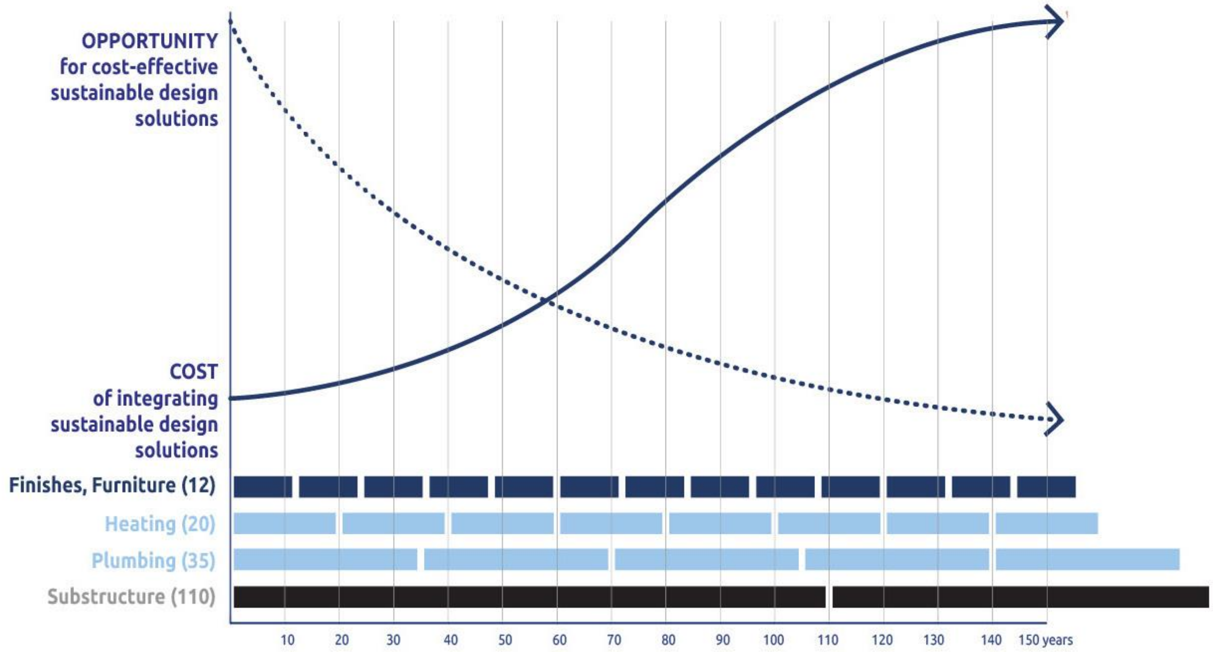
Life cycle assessments can be used to evaluate the total energy expenditure of the building over time, allowing building owners to anticipate costs of operations over the lifespan of the building, and plan for renovations accordingly.

Renovations increase resource consumption in the short term, due to the embodied energy they use. But they can decrease total energy consumption over the lifespan of the building, since with each renovation, building systems are often designed to perform with greater efficiency. Renovations can increase the value of the building to keep pace with the growth in value of the site.



Life cycle assessments take into account the service life and replacement cost of building components, as well as the embodied and operating energy used over each period. Diagram by C-Lab, based on diagram from Holger Konig, et al. *A Life Cycle Approach To Buildings. Principles, Calculations, Tools*. Munich: Edition Detail Books, 2010.

For a building to be forward-compatible, it must be designed to be so from the beginning, because as the building ages, the opportunities for introducing cost-effective sustainable design decrease, and the cost of implementation increases.



As a building ages, the cost of implementing sustainable design decisions increases, and opportunities to do so decrease. Diagram by C-Lab, based on diagram by Renuka Ranaweera and Robert H. Crawford, 'Using Early-stage Assessment to Reduce the Financial Risks and Perceived Barriers of Sustainable Buildings,' *Journal of Green Building*, 2:5, 2007.

Materials and systems age at different rates. If they aren't initially designed together as part of a long-term strategy, they become increasingly dependent on each other, and therefore difficult to update. Therefore, planning for the building's life cycle during the design phase is crucial.

The studio work to establish cost-estimation benchmarks for modeling life cycling scenarios which may be utilized in the design and management of the building.

While these calculations will not be entirely comprehensive, they will allow us begin to speculate on iterative variations in program in relation to optimization of form and operations. Likewise, various calculations relating to life cycle can be contextualized against future scenarios wherein greater or lesser degrees of inflation in rents and prices in various programs may limit or promote specific life cycling decisions in terms of recapitalization.

While these calculations may not be entirely useful to the designer, they will provide external rules sets for understanding programmatic experimentation going forward in other facets of the research.

III. Studio Research Tasks

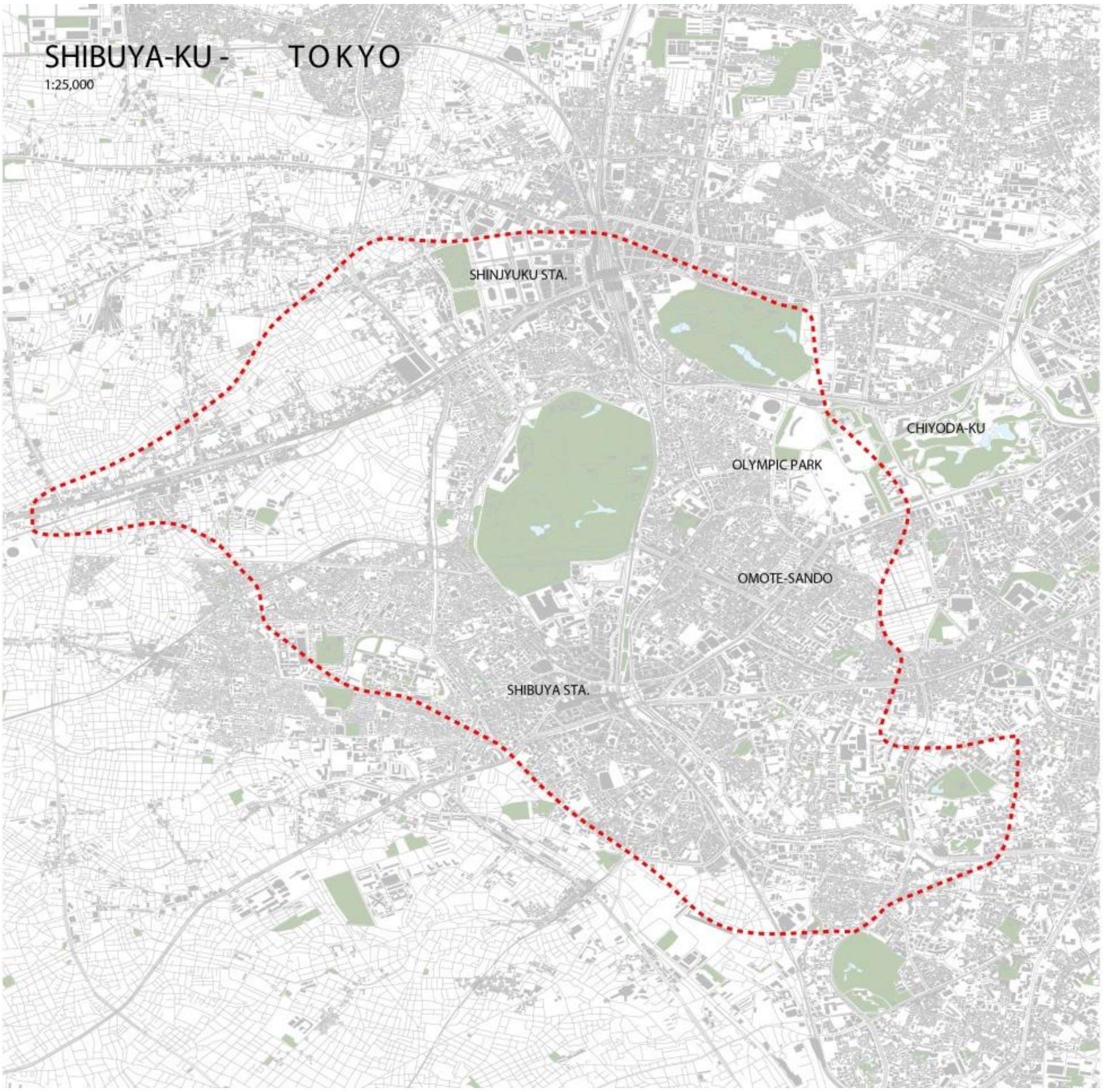
In order to speculate and explore various iterative outcomes within the research framework identified herein, it is desirable to produce a studio that synthesizes research and practice within the context of site-specific rules and limitations. This research studio is more formally a Design + Development Studio as it consists of students in architecture, planning, and real estate development. The students are tasked with developing a site-specific scheme which speculates on programs and uses which reflect shifting demands consistent with parallel research efforts which have hypothesized a greater population densification and diversification within central Tokyo, as well as the emerging economic logics for the production of adaptable, extended-life buildings.

Students will be ask to develop conceptual schemes which include planning, financial, organizational and design work-products. To this end, students will be grouped by core disciplinary functions to form a project team. The organizational work-products will include operational and management implications for a diverse or hybridized program. By exploring various levels of service and associated on-the-ground approaches to engaging users, the ambition is for students to develop a business model which is operationalized as a practical matter and not just physical or financial in its manifestation. The financial component of the work will be to outline development models which take into account the life cycle of the assets. These models will be sensitive to various points of recapitalization necessary to accommodate the phasing of multiple programs over the useful life of the building. These models will serve as analytical tools for iteratively testing various physical and operational scenarios. These financial models will not only consider internal functions but will also be designed to accommodate analysis based on institutional investment criteria for both domestic and international investors. While the long-term implications of extended-life buildings are not aligned with the probabilistic utility of assumptions of real inflation and interest rates, it will provide a basis for further deliberations within a larger corporate strategy envisioned by the studio teams.

IV. Fall Studio Site

To study the implications of adaptation through extended-life buildings in Tokyo, the studio is grounded in a site that Hulic recently acquired in Shibuya, currently housing Tokyu Hands. The site will serve as test-bed to better understand the specific opportunities presented by the property, and we will then apply these findings to a general prototype that can be adopted for a range of possible sites.

The Tokyu Hands property is an ideal site for studying features that can be later incorporated in a replicable prototype. First, its irregular geometry and size is consistent with: (i) Tokyo's land market which is largely driven by infill; and (ii) Hulic's acquisition and development strategy of pursuing sites that have the capacity for mid-scale development in areas that are highly accessible to mass transit. Second, Shibuya represents an ideal urban context for testing design decisions for application to experimental prototypes consistent with the aforementioned working hypotheses. The Shibuya district is highly visible and accessible to foreign observers and research, and offers a comparative advantage for collecting data sets. The district offers many amenities, from recreation to retail, which are attractive to a variety of different sized and aged households. In addition, the district has one of the oldest residential populations in Tokyo which suggests that area will be ripe for transformation and gentrification. This is particularly true in light of the number of educational institutions within the district. Finally, the district is already in a state of transformation with increasing numbers of office developments which are intuitively taking advantage of the logistical conveniences. As such, the Tokyu Hands site can act as representative test case for the prototypes that CURE and C-Lab develop.


SHIBUYA-KU - TOKYO
1:25,000
SHINJYUKU STA.
CHIYODA-KU
OLYMPIC PARK
OMOTE-SANDO
SHIBUYA STA.

V. Course Schedule

1. **Friday, September 5th: Introduction to Studio**[2]

   This first day will cover the larger framework and intent of this studio as defined within this syllabus. Students will take the first steps in formalizing groups based on a “speed dating” exercise.

   Assignment #1: Select One Building which has “adapted” with time to changing use and market conditions. This case will be presented at the first joint session. Each case should identify 10 criteria (i.e., change in market rents, core depth, floor-to-floor, program-to-program phasing, etc…) from which it would be helpful to speculation on adaptive capacities and capabilities.

2. **Monday, September 8th: Desk Crits**

   Students should be prepared to discuss a range of potential case studies and should have selected a specific site by the end of the day.

3. **Wednesday, September 10th: Assignment #1 Working Day**

4. **Friday, September 12th: Adaptation Criteria**

   Students will present individual case studies and criteria. The class with work to classify, distill and organize overlapping criteria. The class will formulate a list which translates these consolidated criteria and are contextualized to Tokyo. The list will be submitted to Hulic in order for baseline conditions to be utilized in model development going forward. The class will conclude with matching and forming studio participants and teams.

   Assignment #2: Teams will prepare Shibuya specific market and urban design evaluations which give context to the studio site. If possible, students should populate the list formulated in Assignment #1. Groups should also begin examining shared work space models, pricing structures and physical layouts.

5. **Monday, September 15th: Assignment #2 Preparation**

   Architecture students should begin drawing physical conditions of the site and the surrounding urban context.

6. **Wednesday, September 17th: Assignment #2 Preparation**

   Architecture students should be working to complete site models and should begin collecting and consolidating shared-work space plans and specifications.

7. **Friday, September 19th: No Joint Session**

   Students will continue to work in teams on finalizing Assignment #2. Real estate students will begin developing project and building life cycle models.

[2] *Unless otherwise noted, Friday joint sessions are from 2 to 6 p.m. in Fayweather 200.

8. **Monday, September 22nd: Desks Crits of Assignment #2**

   Architecture students should begin to sketch site specific floor plans for a shared-office program.

9. **Wednesday, September 24th: Desk Crits of Assignment #2**

10. **Friday, September 26th: Assignment #2 Pinup**

    Teams will present Assignment #2, which consists of site and district level research, as well as shared-office based programmatic research. Early floor plan sketches and analytical models will also be presented.

    Assignment #3: Project and building life cycle financial models should be reaching their final stage of development. Architecture students should prepare a series of phases of program-to-program over the course of 100 years. Assignment #3 will be presented as a team with qualitative arguments for program-to-program phasing and quantitative arguments for evaluating various scenarios as applied within the models.

11. **Monday, September 29th: Desk Crits**

    Architecture students will draw first, middle and top floor plans. Interior sections focusing on site access, ingress and egress contextualized to major building systems.

12. **Wednesday, October 1st: Desk Crits**

    Students will be prepared to discuss three program-to-programs phasing strategies.

13. **Friday, October 3rd: Assignment #3 Pinup**

    Students will present their phase-to-phase programmatic models.

    Assignment #4: Teams should proceed with an integrated building design based on one of the program-to-program phasing scenarios. Architecture students should begin floor plans and building systems plans and sections with an eye for clash detection and redundancy. Architecture and real estate students should work together to cost-estimate production costs and capital cycle costs for each phase. Operations scenarios based on different systems and uses should be evaluated to understand different costs and efficiencies between alternative scenarios. The final output should be first, second and middle floors plans and sections, as well as a project based development model (11 year stabilized) with operations sensitivies. Students are prohibited from façade or urban design considerations at this stage, unless façade material and form articulation is critical to performance based arguments.

14. **Monday, October 6th: Desk Crits**

    Students should be prepared to discuss representative floors and system overlap problems, as well as alternative options for material, form, systems, etc…

15. **Wednesday, October 8th: Assignment #3 Working Day**

16. **Friday, October 10th: Assignment #4 Pinup**

    Students will present their first iteration of their prototype buildings.

    Assignment #5: Based on feedback from Assignment #5, each team will continue to focus on interior design and phasing. At this point, the teams should begin to construct detailed layouts in plan and section of each floor. Detailed specifications from these plans should be extrapolated and aggregated for further analysis and refinements. At this point the project level models should be integrated with life cycle models. Architecture students should developed a tool for visualizing program-to-program phasing and the associated impacts of each phases. Students may begin to develop architecture and urban design designs and strategies which give life to their prototypes.

17. Monday, October 13th: Assignment #5 Working Day

18. Wednesday, October 15th: Desk Crits

Students will be prepared to discuss early story boards of arguments, models and analysis.

19. Friday, October 17th: Pre-Midterm Pinup

Students will present their midterms boards.

20. Week of October 20th: Midterms

21. Monday, October 27th: Desk Crits with Visiting Critics

Students should prepare a game plan and ordered tasks for revising their midterm projects. Real Estate and Urban Planning students should attend studio crits. A schedule will be circulated in advance.

22. Wednesday, October 29th: Desk Crits with Visiting Critics

Students not reviewed on Monday will be reviewed on Wednesday. It will be an ad hoc review for all others.

23. Friday, October 31st: Japan Review

Teams will meet with professors to go over the schedule for the Tokyo trip, as well as last minute revisions to their boards for presentation to Hulic.

24. Week of November 2nd: Tokyo Trip

25. Monday, November 10th: Desk Crits

Students should be prepared to synthesize their experiences from the Hulic presentation and create a game plan for the next phase.

Assignment #6: Students will be asked to discuss lessons learned from Tokyo and will be required to present a detailed work plan for the next phase of project development. Students will also be prepared to present the next iteration of exterior architecture and urban design manifestations and/or logics.

26. Wednesday, November 12th: Assignment #6 Working Day

Critics will be available for ad hoc desk crits.

27. Friday, November 14th: Assignment #6 Pinup

28. Week of November 17th: Desk Crits

29. Monday, November 24th: Pre-Final Pinup

30. Week of December 1st: Final Review

VI. Appendix

Jesse M. Keenan, *Material and Social Construction: A Framework for Adaptation of Buildings*

Andrew Laing, *Work and Workplaces in the Digital City*