The Life of Buildings

Design for Adaptation in Tokyo

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Advanced Architecture Studio V
A4105

C-LAB

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I. Introduction

The agenda of this studio is to create buildings that are adaptable. The studio exercise will involve developing the building's form and surfaces so that the building has lasting value well beyond its original use. Its form will not be neutral, but highly specific in its figuration, size, and level of articulation so that it can house future, unanticipated programs. As Aldo Rossi observed—noting the project under Sixtus V to turn the Coliseum into a wool mill and workers' housing—a building can be inhabited well beyond its initial use, with each new use a testament to the formal considerations made by its designers when it was first conceived. When designed in this way, the form accommodates its first intended use and hosts future functions that exceed the imagination of its creators.

It's become a commonplace idea in contemporary architecture that social and technological shifts occur at fast pace, and that in comparison the process of building is slow. Architecture's longstanding value of having permanence, is paradoxically recast as sluggishness, the idea is that the pace of change has outstripped architecture's capacity to adapt, and thus rendered it unresponsive if not irrelevant to an ever accelerating society. This claim inverts the value associated with permanence, but without questioning the assumption that buildings are more or less static.

But buildings aren't (that) static. As any New Yorker knows from walking under this city's ubiquitous construction sheds, cities and their buildings are continuously in flux—shedding layers of material, exfoliating technologies, embedding new pipes and conduits, absorbing energy and radiating waste, all the while making incremental shifts to align with the imperatives that are a part of every building issuing from domains as diverse as finance, décor, technology, habits, demographics. A building is a fiction, its apparent static objecthood an optical illusion resulting from the fact that its structure and façade (lifespan: 50+ years) are slower to change than the arrangement of its furniture (5 days), its interior partitions (5 years), and its services (15 years). Perhaps surprisingly, over the life of a building, the greatest capital expenditure will not be the structure, but rather the internal space plan, which is constantly under construction. Buildings are complex dynamic assemblies of material, economic, and social products, each with specific cycles of production, use, decay, and disposal. From the moment a building is 'completed', the synchronicity of these lifecycles begins to break apart: the economy contracts, tenants shrink and grow, not-so-old gypsum is torn down and new gyp goes up, last year's monitors have dark spots and are replaced, the plastic in the blinds decays from ultraviolet light and…

So buildings aren't slow. But finance is: it can take decades to assemble the combination of capital and parcels of land required to build a tower in an urban center, an investment that needs to be amortized over several subsequent decades. During the life of a building, its component systems, materials, and the organizations that occupy it will need to change at coordinated moments in time to ensure the viability of the whole. Adapting becomes a key operation. The more adaptable a building is, the more likely these moments are to occur, and the more likely it is to remain suitable to its users and valuable to its owners over time.

In the studio, we will produce dynamic models for how a building form can respond over a long lifespan to various material, technological, and use cycles. We will also consider the economic implications of adaptability, and how buildings can accommodate structural changes in supply and demand. These dynamic building prototypes will take into account their adaptations to specific, anticipated trends within the next 20-30 years (which we'll call situated adaptability), as well as possess an additional adaptive capacity in excess of predictable events (which we'll call broad adaptability), in order for the building to maintain its value over a 100-year lifespan, well beyond the limits of our projections.

Life cycle and adaptability

Thinking about life cycle doesn't mean specifying long-lasting materials or component systems. Rather, it concerns the social and economic viability of the building, which means not only a long life, but also adaptability to changing preferences, uses, and associated management operations. It requires formal design decisions that will have great impacts on the operating costs and energy use of the building. It necessitates an approach to the building construction as a forward-compatible assembly, comprised of a series of interdependent material and technological layers with different schedules of replacement. Finally, it means designing a form and its spaces so they accommodate changes in program, yet have some logic about it's massing, figuration, and dimensions that reduces capital costs associated with each conversion. Decisions in each of these areas –form, forward-compatibility, and program – affect cyclical capital costs over the building's lifespan. While many of these decisions attempt to manage necessarily unknowable future external circumstances, we assert that there is an inherent capacity for adaptation in buildings that is critical to the design exercise of this studio.

II. Development Context

Tokyo in Transition

The site will be in central Tokyo, a city whose markets, buildings, and population are changing at a pace not experienced by the world's largest metropolis since its post-war rebirth in the late 1940s.

Tokyo's rapid transformation is driven in part by Japan's unprecedented demographic shift, with an aging population and low birth rates resulting in an overall population decline at the national level. Yet, while Japan's population declines, Tokyo's population is projected to increase and diversify. The increased densification of Tokyo's 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 and consumer preferences. The direct and indirect impacts of this larger societal transition on the design and management of buildings – and the urban environment – have yet to be fully reckoned with.

[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).

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 related research indicates, there will be further corporate relocations to Tokyo in the search for talent and aggregate economies At the same time, a greater percentage of workers will be employed in tertiary industries which are expanding the traditional notion of the workplace. Meanwhile, household composition in Tokyo is evolving, with a greater diversity of household size and structure. Most importantly, real estate consumer preference research suggests that inner Tokyo is quickly dominating spatial and typological preferences among a 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 traditional retailers. Parallel changes in healthcare, childcare, education and other programs have 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. Taken together, these influences have led to a great deal of uncertainty in the planning and design of buildings in Tokyo's inner wards.

The 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 an 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 consider the development of extended-life buildings. The extended lifespan of these buildings (i.e., perhaps exceeding a century) is economically desirable because greater or equal returns, in line with global standards, require extended amortization periods. This economic phenomenon is accelerated by (i) limited available land for development; (ii) disproportionate value assigned to the land over the building; and, (iii) comparatively high construction costs, which impose almost equal burdens on development and re-development (i.e., redevelopment is almost as expensive as development because land accounts for a high percentage of the purchase price of lower quality existing buildings). So the challenge for the development of extended-life buildings is to design buildings that can accommodate several capital and physical cycles which can respond to transformative changes in program and use over the course of a century.

Longevity, Risk, and Reward

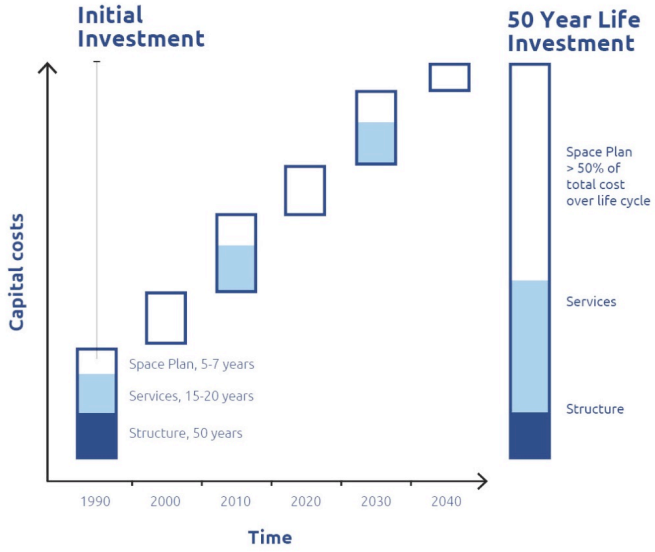
As CURE's background research suggests, the land economics in an environment of low inflation are favorable to buildings whose useful life extends close to a century. As returns on investments are amortized over longer periods for equivalent yields, it has proven to be a disincentive for the redevelopment of existing buildings whose value is disproportionately 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 a 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 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 applicability of this studio's work to professional practice.

Each of the studio's building proposals will include design strategies that address the building's life cycle, producing a prototype with built-in adaptability that will greatly extend its 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 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. Adaptability can enhance the architectural quality, environmental sustainability, and economic security of buildings by reducing risk and consolidating or preserving value in a particular location over many generations. From this perspective, buildings are an investment in the city itself.

III. Design for Adaptation

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:

- Form
- Forward-compatibility
- Program



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).

Form

Form provides value to a building over a long timespan, as structure and façade are the slowest elements to change or be replaced. Form effectively locks in design decisions for the entire useful life of the building, and therefore has the greatest effects on the operating costs of the building. The massing of a building, as well as floor-to-floor heights and area-to-perimeter ratios, can increase or decrease operating energy use depending on the balance between energy saved by daylighting versus energy spent on cooling the interior.

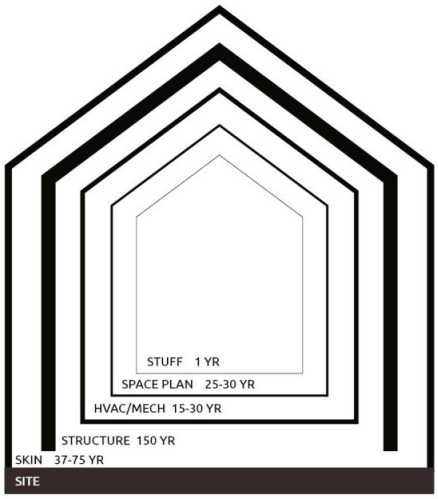
We will develop a form for the building that is novel in its own right, and which offers benefits to the project's operational costs and energy use over its lifespan.

Forward-compatibility

Understanding the lifespans of building materials and systems can help designers and owners plan for future renovation. 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.

Adaptability 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. The design work in the studio 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.

Program

Program and occupancy have profound effects on a building's operating expenses and environmental costs. 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 maintenance, driving up operating expenditures. 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.

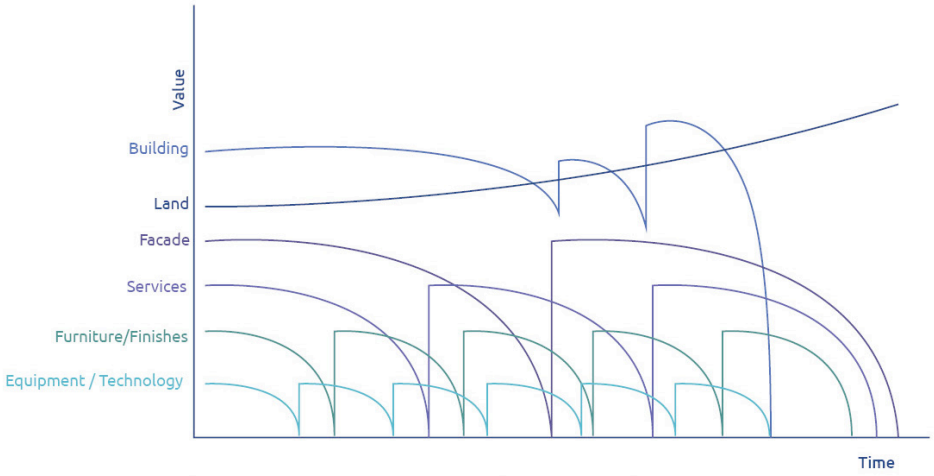
The studio is tasked with researching and contextualizing examples of historic and contemporary buildings that continue to remain highly desirable to tenants after many years of use, in order to understand what allows these buildings to maintain their value despite changes in patterns of occupancy. The 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, and hospitality industries.

Programmatic research will additionally rely on demographic projections produced by Dr. Lance Freeman, Professor of Urban Planning at GSAPP, as interpreted through CURE's estimation of demand. The studio will require students to conceive of a logical phasing from one program to another or from one discrete program to a hybrid future program.

Life Cycle

Form, forward-compatibility, and program come together in the life cycle of the building.

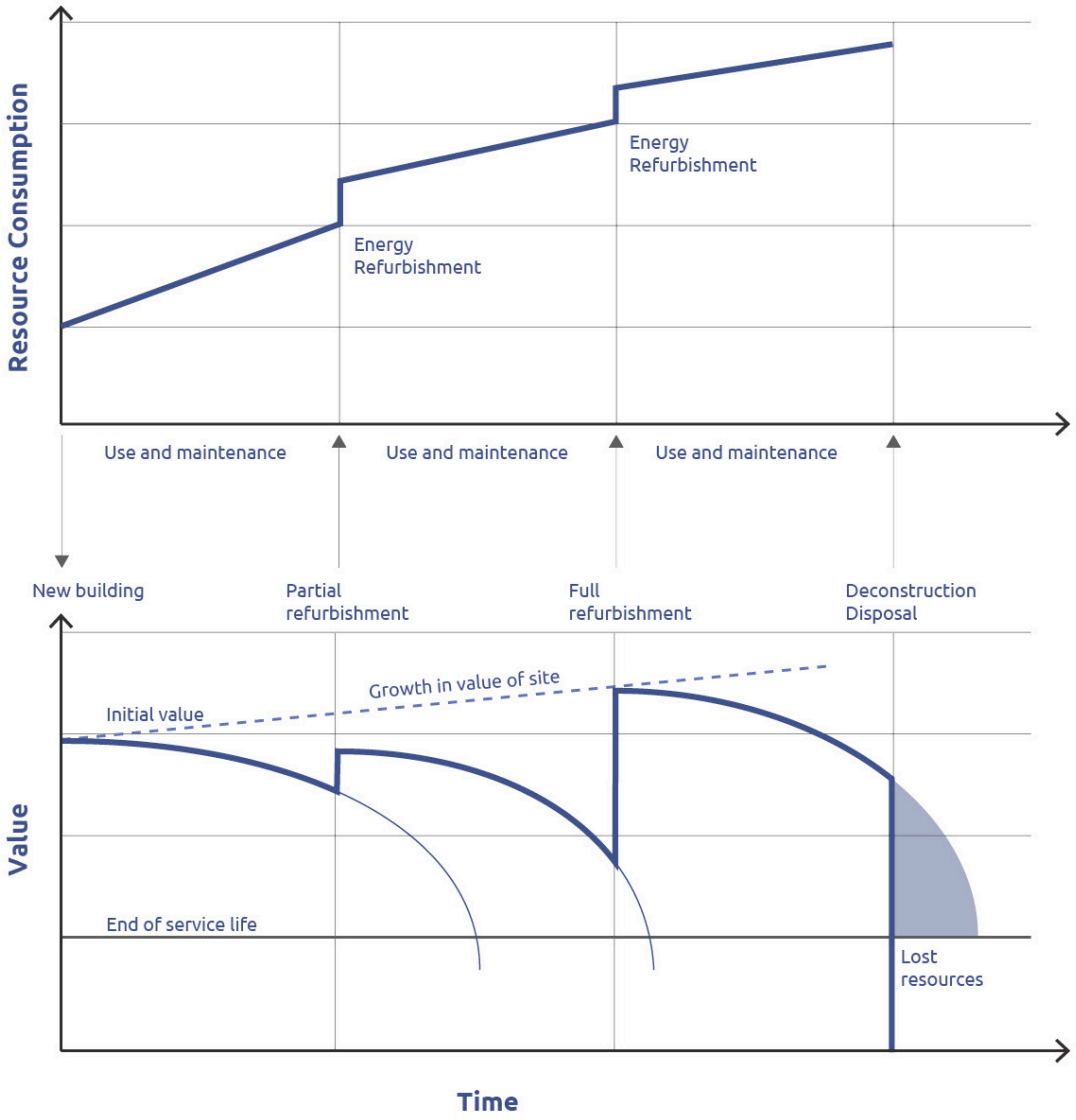
A building's adaptability can be understood through an analysis of its life cycle. If the design of program, form, and forward-compatibility is a means of achieving adaptability, life cycle analysis is the measure of the success of extended lifespan building design.



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

Life cycle assessments can be used to evaluate the total energy expenditure of the building over time so the costs of operations can be anticipated during the lifespan of the building, and renovations can be planned 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.

The studio will establish cost-estimation benchmarks for modeling life cycling scenarios which may be utilized in the design and programming 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.

IV. Studio Research Tasks

In order to speculate and explore various outcomes within this research framework the studio will synthesize research and practice within the context of site-specific rules and limitations. Teams of students—each of which will include students from architecture, real estate and planning—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.

The teams will take advantage of their respective backgrounds to develop conceptual schemes which include design, as well as planning, financial, and organizational models. 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, and 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 strategy envisioned by the studio teams.

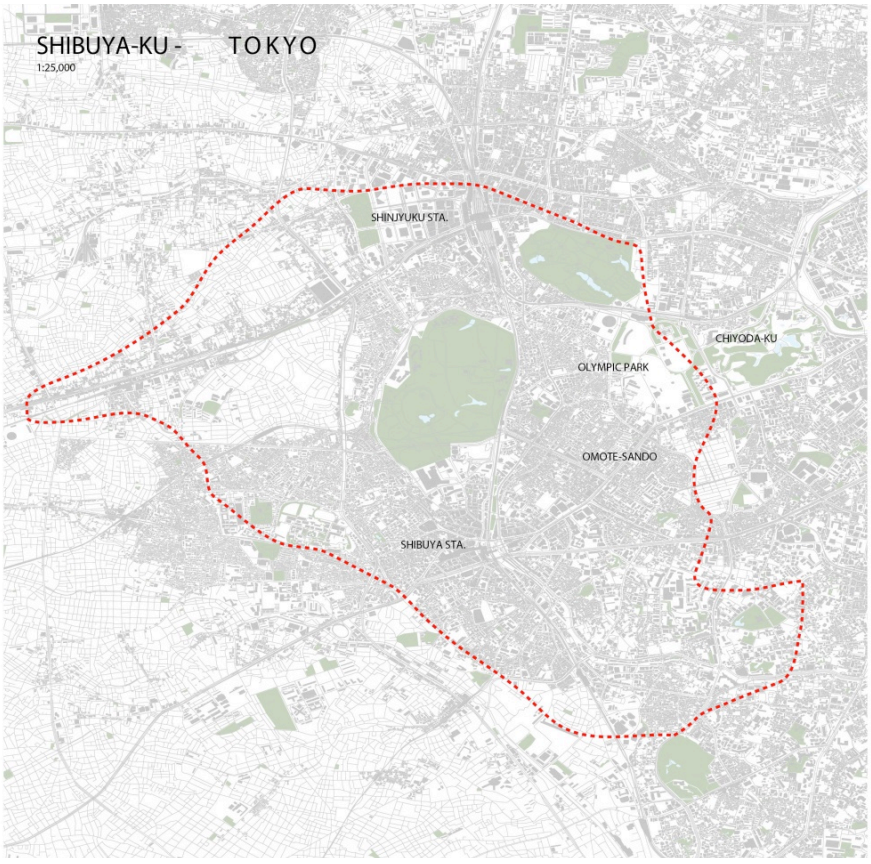
V. Studio Site

To study the implications of adaptation through extended-life buildings in Tokyo, the studio will work on a site in Shibuya, currently housing the department store Tokyu Hands.

The Tokyu Hands site is ideal 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) an 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 the studio will develop.

Through Hulic's sponsorship, the studio will visit Japan in early November. The purpose of the visit will be to re-examine the context of Japanese contemporary architecture and development within which our proposals will be situated.



Joint Studio

The studio is part of a larger pedagogical experiment by C-Lab and CURE to promote cross-disciplinary approaches to research into how Tokyo adapts to unprecedented change. The studio builds upon substantive work developed in parallel tracks of research undertaken by

architecture, urban planning and real estate development faculty. Pairs of architecture students will team up with one RE or UP students from **PLA 6389** and will be asked to design and develop proposals for building prototypes that together include a detailed consideration of design, finance, and management.

VI. Course Schedule

A full schedule will be posted online. Major dates include:

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

Week of October 20th: Midterms

Week of November 2nd: Tokyo Trip

Week of December 1st: Final Review

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