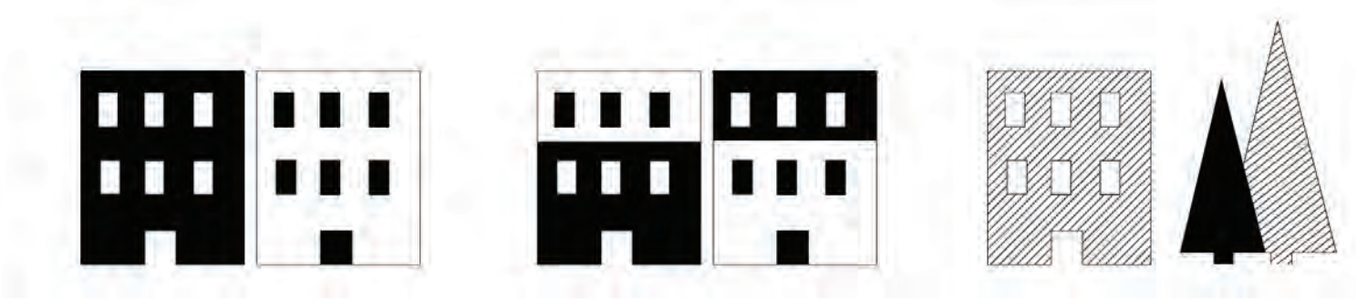

USE-LESS Building

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Thesis submitted to the faculty of Virginia Polytechnic Institute and University in partial fulfillment of the requirements for the degree of:

Master of Architecture

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ABSTRACT

USE-LESS Building

Rayya Newman

A USE-LESS Building aims to use less square feet and resources by adapting over time and by accommodating various uses like apartments, stores, offices, cafes, etc.

Adhering to the USE-LESS concept, this project was developed 4 dimensionally on a site in Mount Pleasant, Washington DC. The relationship between a building and time was explored through three elements, an existing wall that is preserved, a wet wall that houses services, and a moving wall that changes according to the user's will. This site specific approach to design, rather than program specific, enables the structure to adapt to the social and economic needs of the neighborhood at different rates.

Our beds are empty two-thirds of the time.
Our living rooms are empty seven-eighths of the time.
Our office buildings are empty one half of the time.
It's time we have this some thought.

-Buckminster Fuller

Figure 1. Image of Buckminster Fuller

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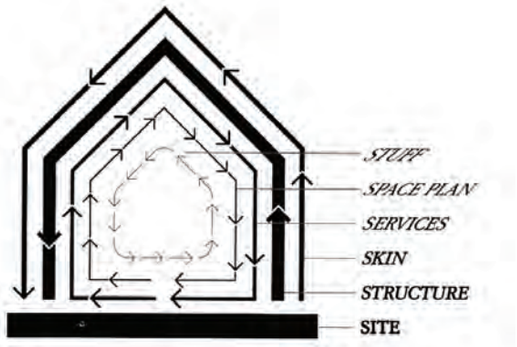
RESEARCH

"Thinking about buildings in this time-laden way is very practical. As a designer you avoid such classic mistakes as solving a five-minute problem with a fifty-year solution, or vice versa. It legitimizes the existence of different design skills–architects, service engineers, space planners, interior designers—all with their different agendas defined by this time scale. It means you invent building forms which are very adaptive."

-Frank Duffy

Figure 2. Image of Frank Duffy



SHEARING LAYERS OF CHANGE.

I've taken the liberty of expanding Duffy's "four S's"–which are oriented toward interior work in commercial buildings–into a slightly revised, general-purpose "six S's":

Site - This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings. "Site is eternal." Duffy agrees.

Structure - The foundation and load-bearing elements are perilous and expensive to change, so people don't. These are the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

Skin - Exterior surfaces now change every 20 years or so, to keep up with fashion or technology, or for wholesale repair. Recent focus on energy costs has led to re-engineered Skins that ale air-tight and better-insulated.

Services - These are tine working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilating, and air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.

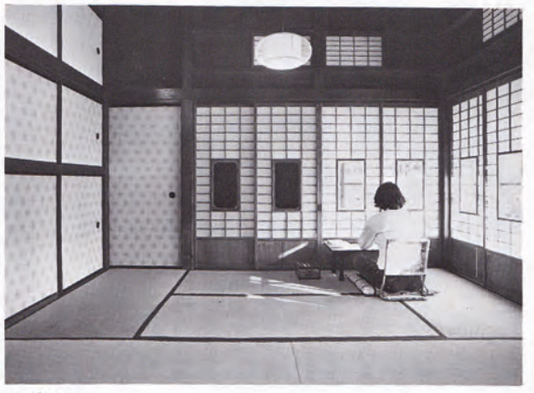
Space Plan - The Interior layout–where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years or. so; exceptionally quiet homes might wait 30 years.

Stuff - Chairs, desks, phones, pictures; kitchen appliances, lamps, hairbrushes; all the things that twitch around daily to monthly. Furniture is called mobilia in Italian for good reason.

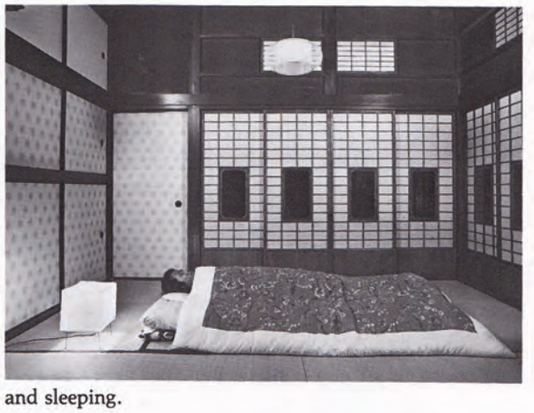
-Stewart Brand (How Buildings Learn)

The same space can be used for eating,

entertaining visitors,



studying,

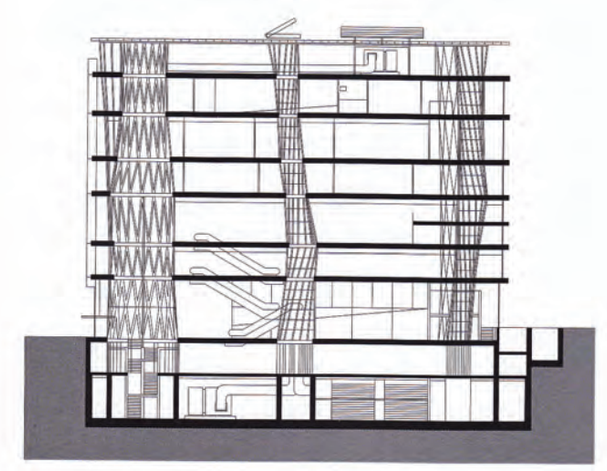


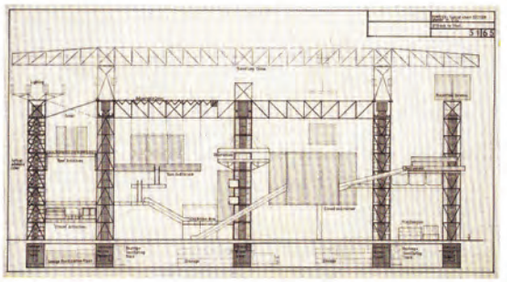
and sleeping.

Figure 3. Diagram of Shearing Layers of Change (above)
Figure 4. Image of multiple uses for a Japanese room (right)

PACE LAYERING

Toyo Ito's Sendai Mediatheque in Japan, 2000 and Cedric Price's Fun Palace are examples of design that allow for programmatic changes. They addressed the layers of change in a structure agreeing that different components move at different speeds.





The science-fiction author Bruce Sterling says "pace layering" - the idea that different layers of a structure or a system move at different speeds - is an interesting notion when considering slowness, as it helps to explain the various rates of change associated with different sectors of society.

It's so much easier to relate to the present than it is to the faraway future. But the value in slowness, according to Sterling, is that people take a lot of comfort in measuring themselves against things that change slowly. "If everything in our lifetime changed at the same pace that we ourselves changed, we would never understand our own maturity."

-Jennifer Leonard
"Hurry Up and Wait", GOOD Winter 2010, p.90

Figure 5. Image of Bruce Sterling
Figure 6. Section through Sendai Mediatheque by Toyo Ito
Figure 7. Concept Drawing of The Fun Palace by Cedric Price

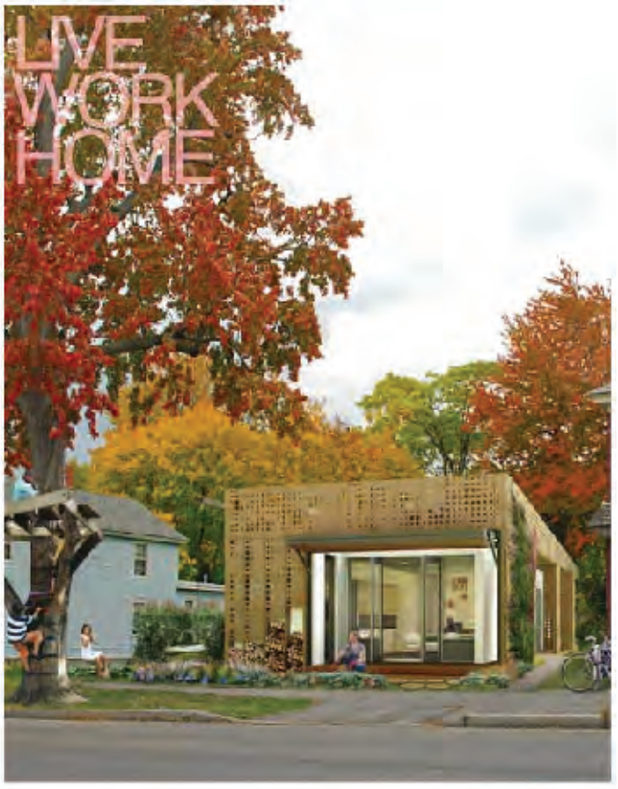
TOM KUNDIG AND BERNARD KHOURY

Tom Kundig designed apartments in Seattle to have sliding walls that divide the bedroom from the living room. Known for his moving pieces a special request was made for a window wall that rotates open so easily that a child could do it. Bernard Khoury designs restaurants and bars that open up to the sky. This example is an old Lebanese house converted into a bar with a roof that rotates open.

Figure 8. Sliding wall at 1111 E. Pike Mixed-Use by Tom Kundig
Figure 9. Rotating window at Chicken Point Cabin by Tom Kundig
Figure 10. Rotating roof at bar Central by Bernard Khoury

LIVE/WORK/HOME

The live/work/home is a project in Syracuse, New York by Terrapin Bright Green and Cook + Fox Architects. Its efficient and highly adaptable space enables it to change use with the needs of the community, making it socially, economically, and environmentally sustainable. Flexible enough to accommodate a number of different uses, it has an open plan modeled after the Native American longhouse with the bathroom and kitchen determined by their connection to plumbing and other services. Other spaces can be reconfigured into bedrooms, offices, or a workshop.



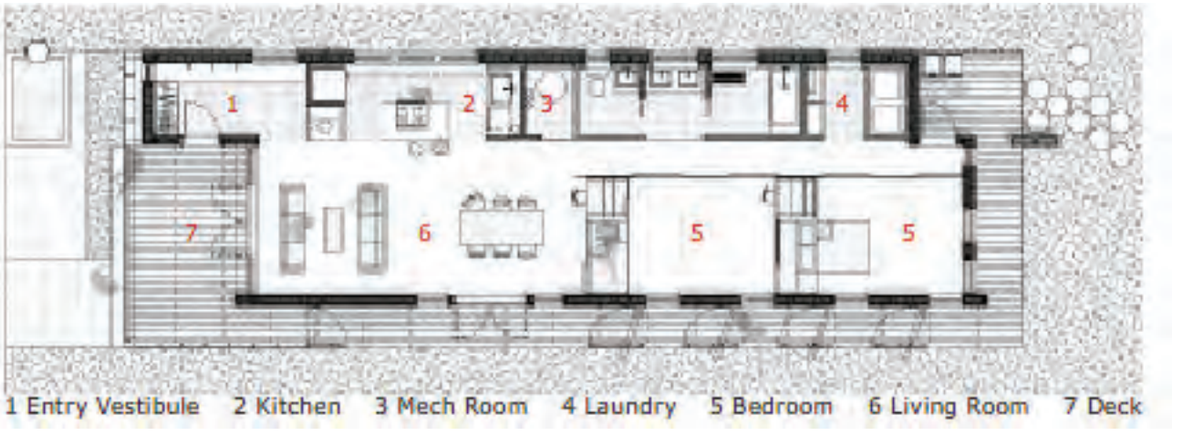
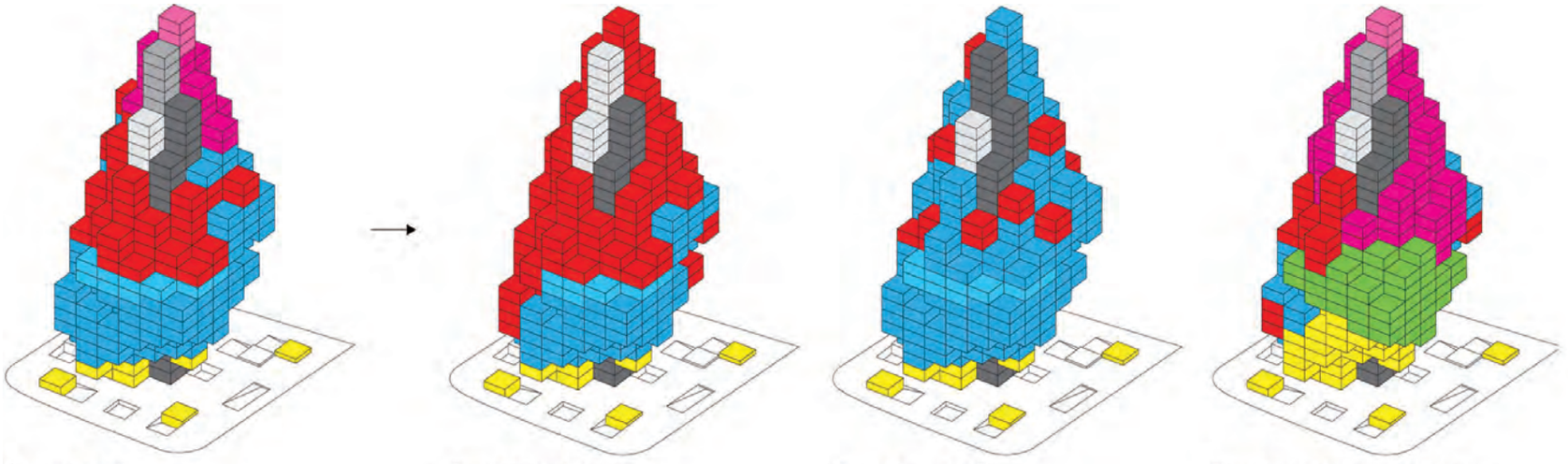


Figure 11. Exterior rendering of the Live/Work/Home
Figure 12. Interior renderings of different interior uses
Figure 13. Floor plan of Live/Work/Home

SKY VILLAGE

This tower in Copenhagen, designed by MVRDV, has a typical unit type that can be used as an office, hotel room, shop, or apartment. Units can be combined to create larger spaces too. Inspiration for this programmatic flexibility came from the unpredictable housing market and investors who were nervous about a building with only one function. This way the program can change with market forces.

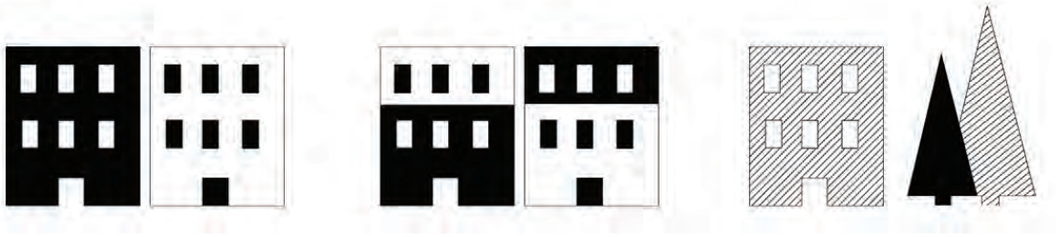


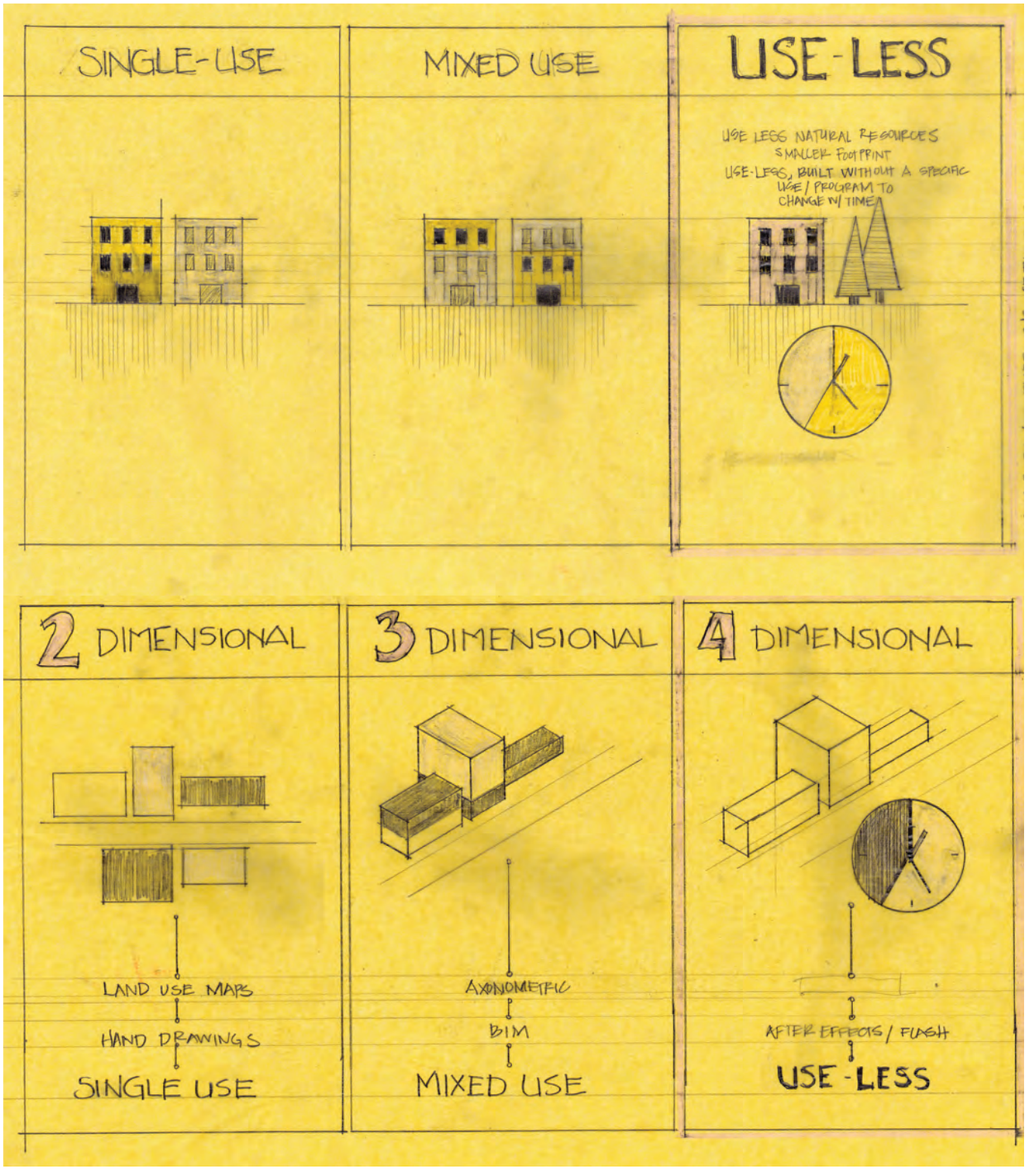
The constellation of pixels allow for flexibility in function. Here is an illustration of how the program in the building could transform according to market forces.

Figure 14. Exterior rendering of Sky Village by MVRDV
Figure 15. Diagram of Sky Village and program flexibility

USE-LESS

Here is analysis of three building types. Single use is a building with one use and can be easily understood in 2 dimensions such as a land-use map. Mixed use is a building divided into different uses and can be described through a 3 dimensional axonometric. USE-LESS is a building with multiple uses that changes with time and can only be understood 4 dimensionally.





LAYERS OF CHANGE

This is a diagram of the frequency of change within a building according to Frank Duffy and Stewart Brand. It is based on a 100 year timeline which reflects the age of the Chesterfield and Winston apartments that burned down 100 years after they were constructed. Site is the most permanent, structure may change twice in 100 years, skin may change four times, services six, space-plan twelve, and stuff eighty times.

ISOTYPE

Otto Neurath translated statistical information into bold graphics. Work, leisure, sleep - he divided the 24 hour day into these three and showed how before work took up more than half the day and now leisure is a significant third. I created another isotype by combining Gerd Arntz graphics to show various independent occupations that are common in Mount Pleasant, such as music, hairdressing, dog-walking, and shoe repair.

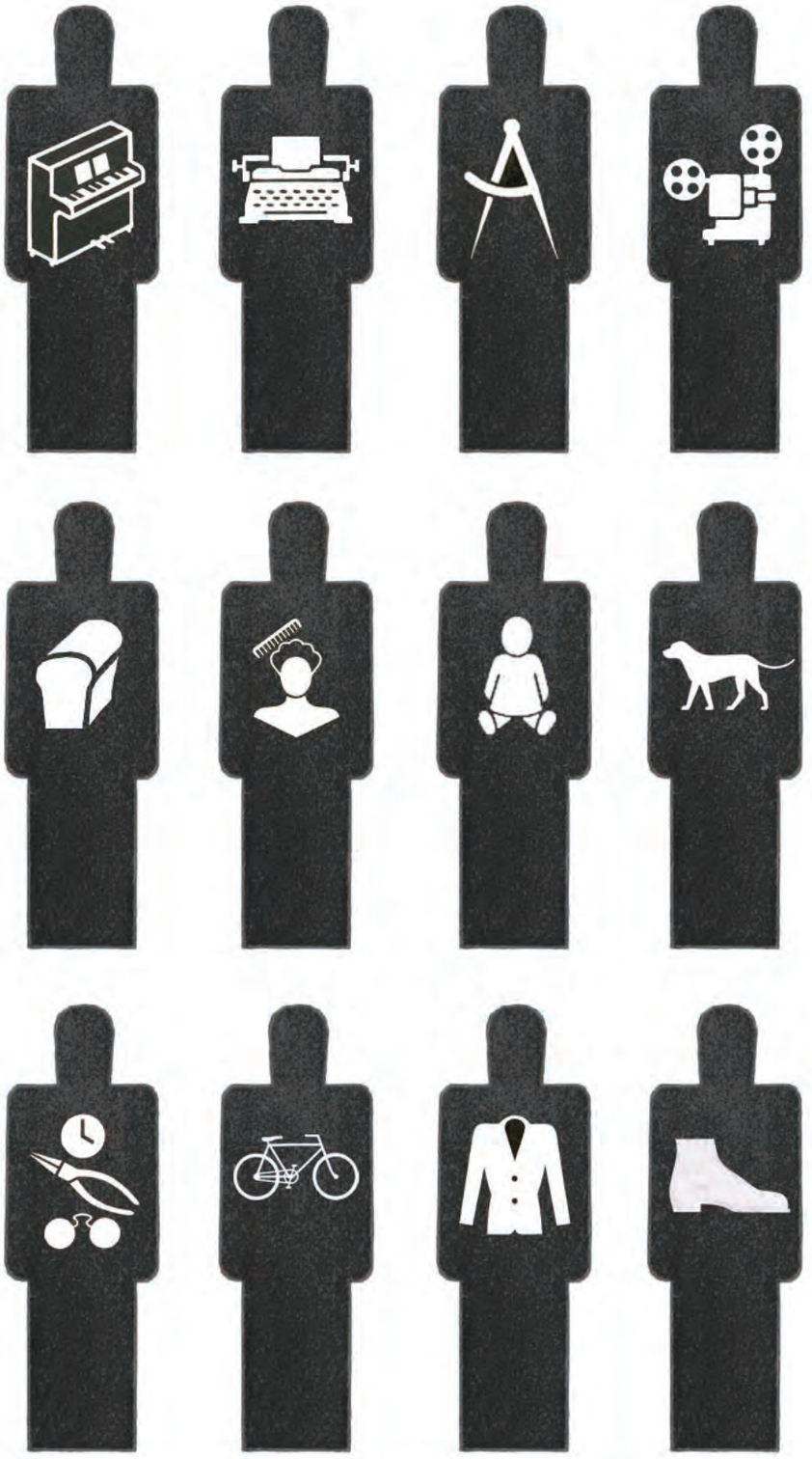
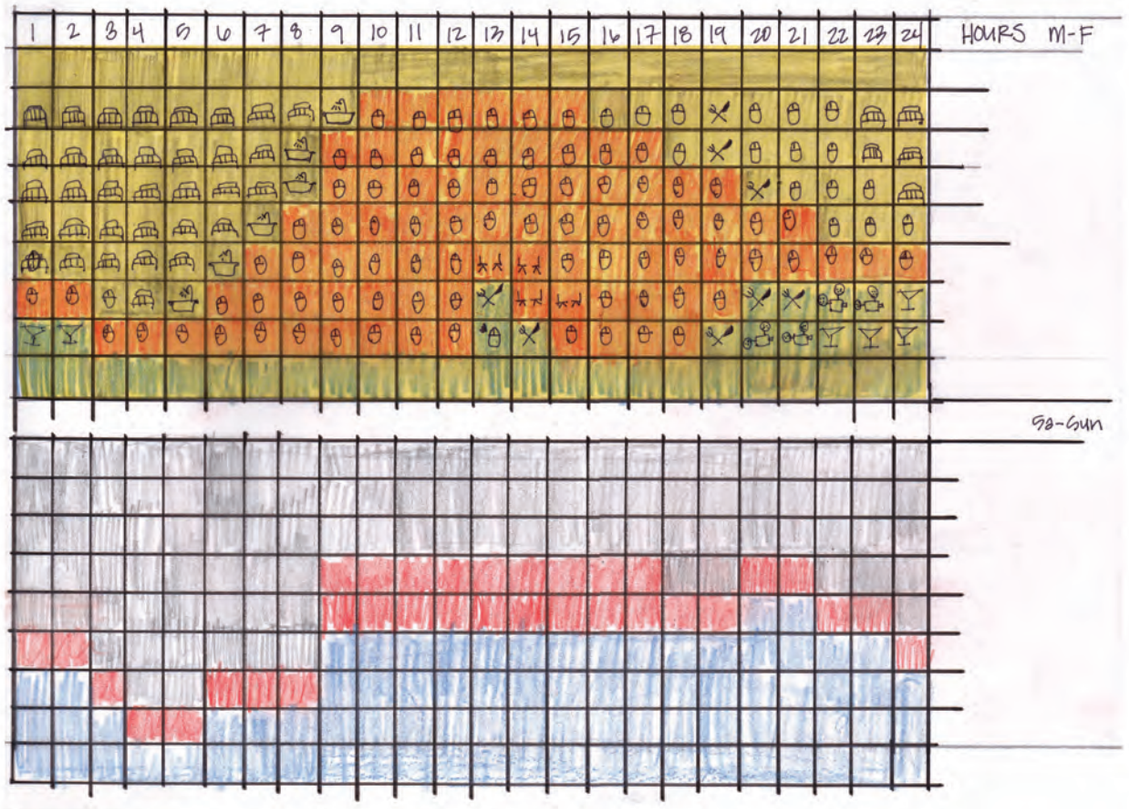
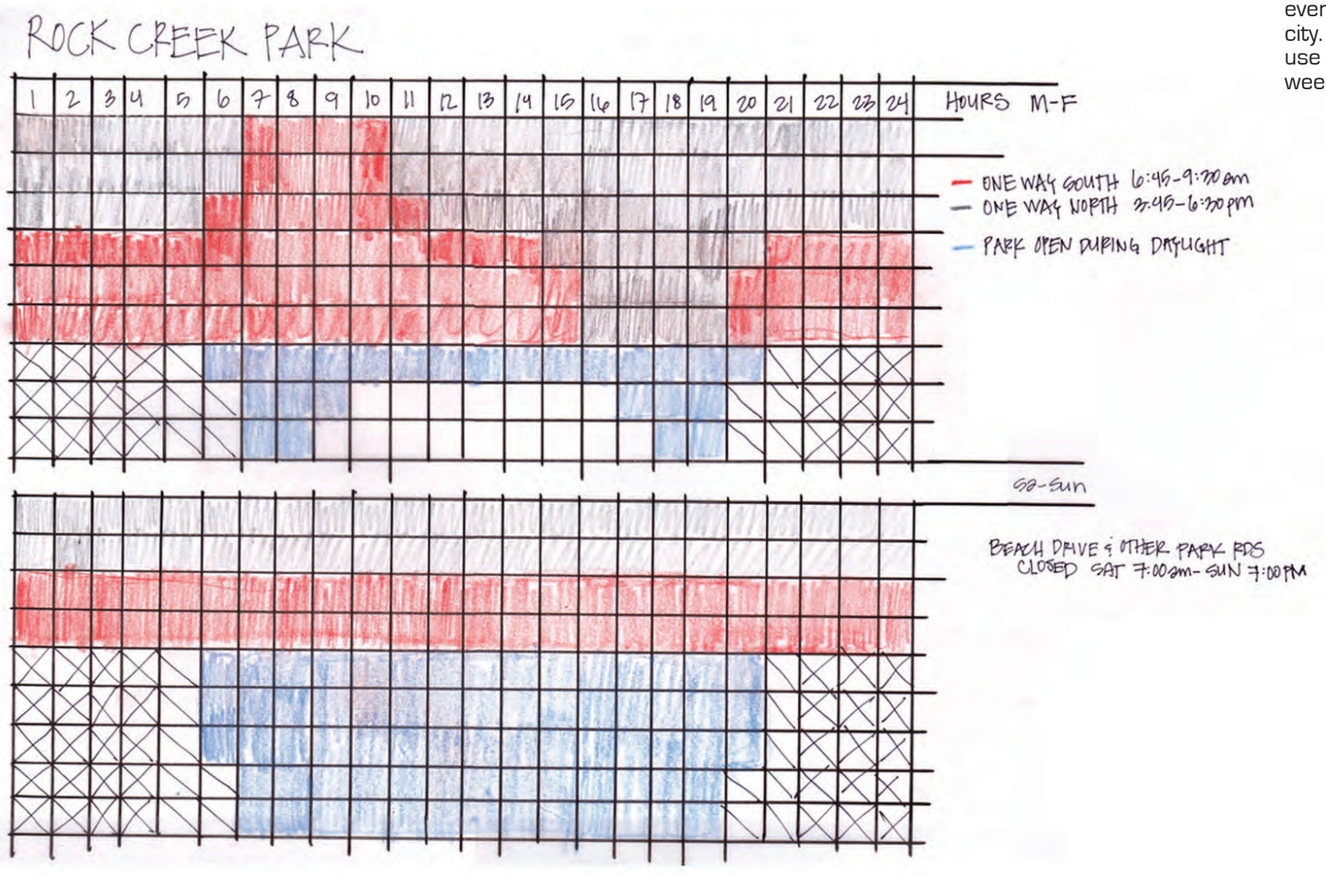


Figure 16. Isotype diagram of the modern day by Otto Neurath (above)

MAN HOURS: WORK, LEISURE, SLEEP





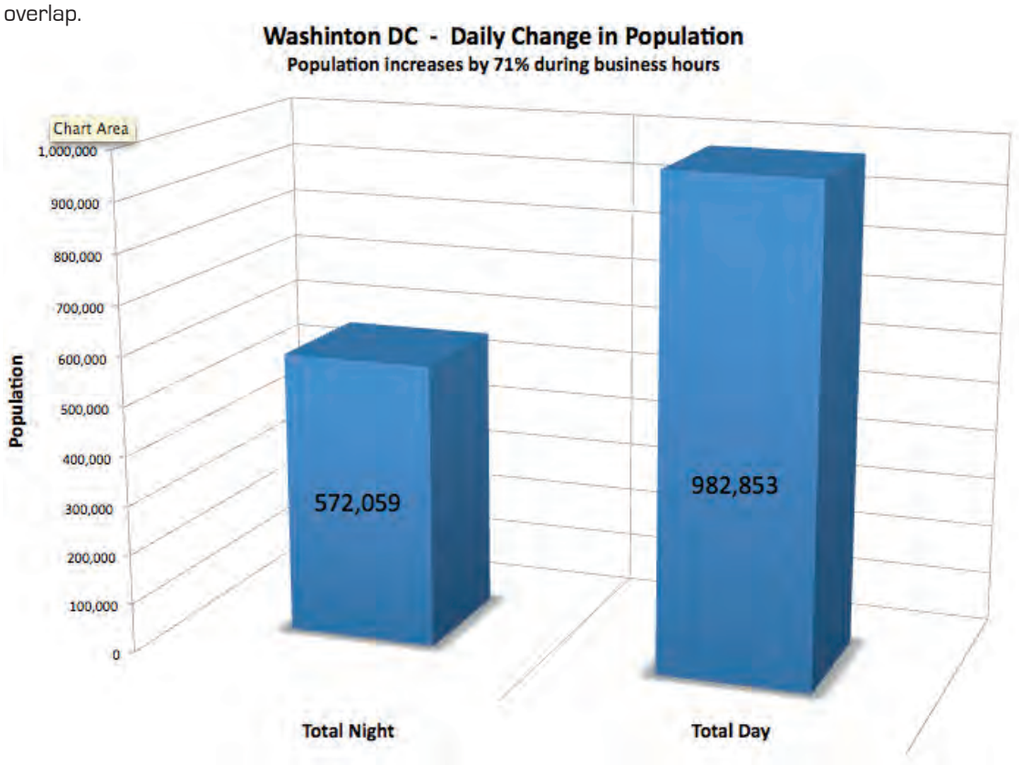
RUSH HOURS

These charts reflect the activities of the general population during the work day and a weekend day. Grey activities are at home, red at work, and blue are leisure activities. There are sleep rush hours, work rush hours, and leisure rush hours on the weekend. This corresponds with the analysis of Rock Creek Park, a street for commuters in Washington DC, that adapts to rush hours by switching a roads' use accordingly. Lanes switch direction for the morning and evening commutes in and out of the city. Streets switch to pedestrian use expanding the park for leisurely weekend activities.

LAND USE IN DC

Pink = Business & Commercial Use
Orange = Medium Density Housing
Yellow = Low Density Housing

Downtown DC is primarily business use which empties out in the evenings and over the weekends. The city's population doubles in size during work hours as people from the suburbs flood in, the most extreme population shift in the USA. This city and its sprawling suburbs and long commutes could be half the size if business and residential areas were to overlap.



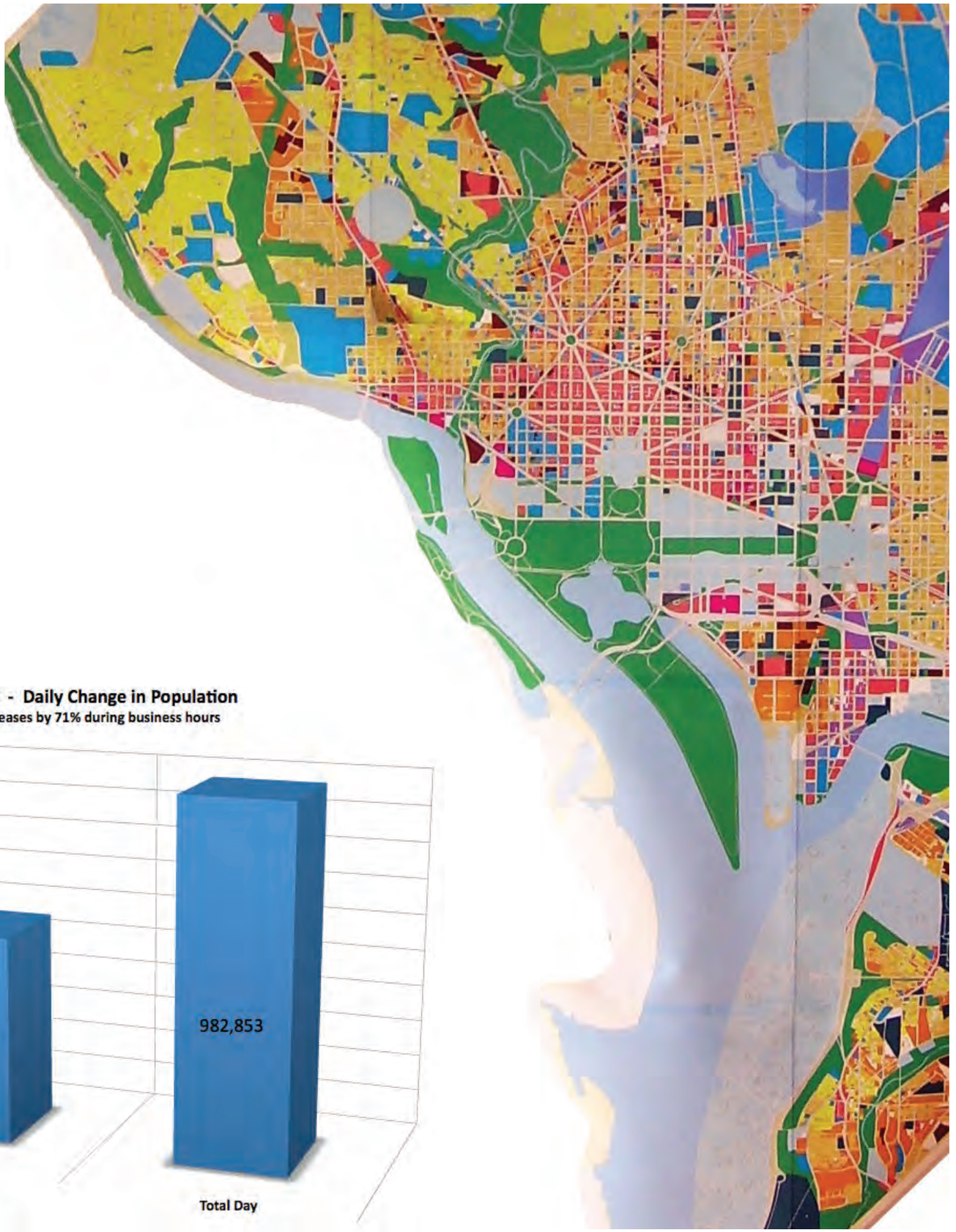
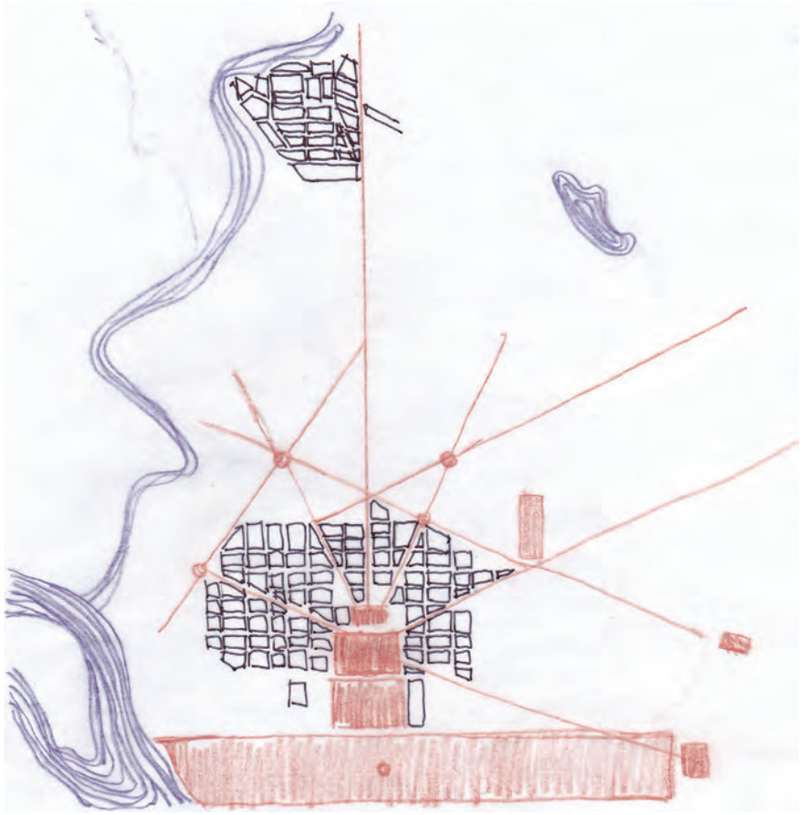
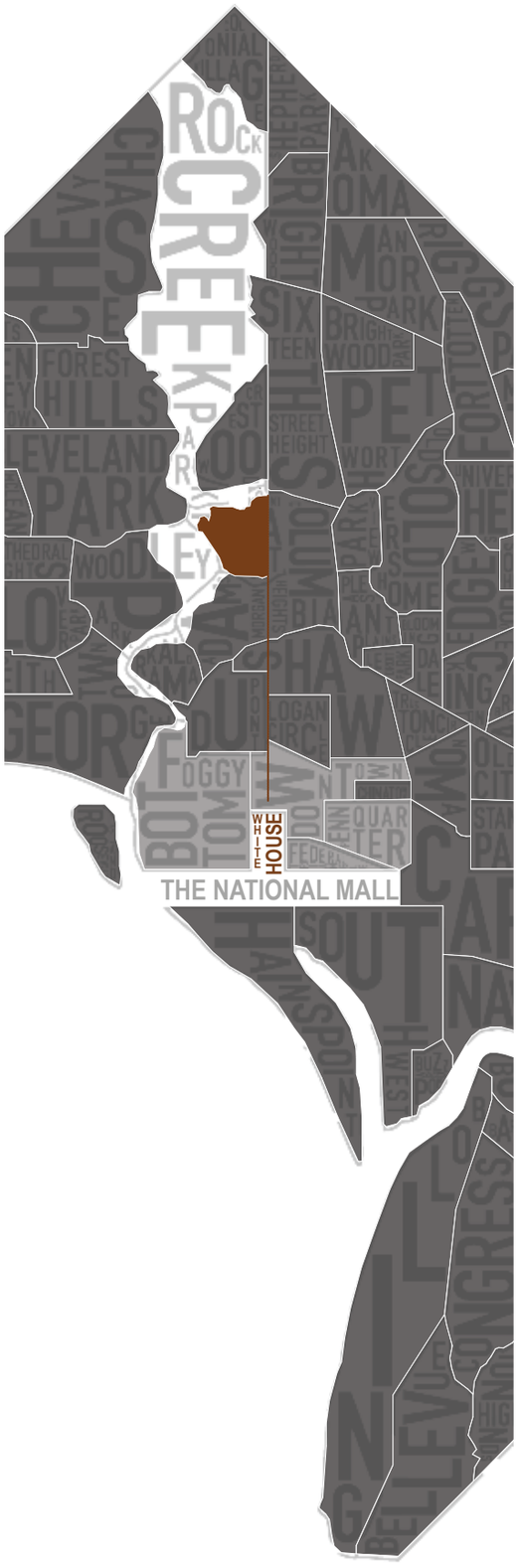


Figure 17. Chart of change in population (left)
Figure 18. Land use map of Washington DC (above)



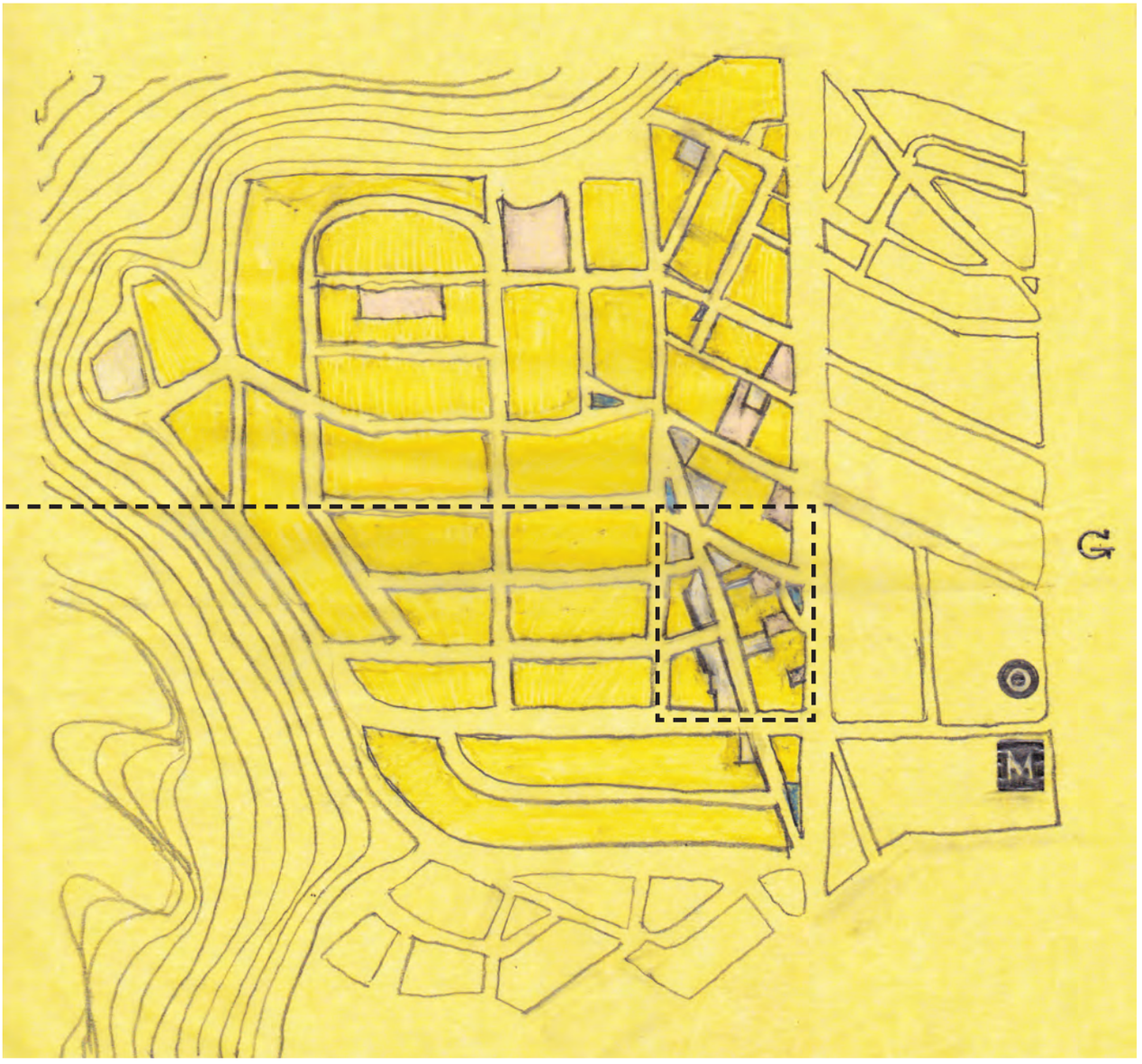


MAPS OF SITE

These maps show the relationship between the urban neighborhood of Mount Pleasant and other parts of Washington. The neighborhood is surrounded by the natural setting of Rock Creek Park on two sides and directly connected to the White House by a major artery, 16th Street. Another map shows the land use in Mount Pleasant with housing in yellow and a defined commercial region in pink around Mount Pleasant Street.

LAND USE/ZONING
MOUNT PLEASANT

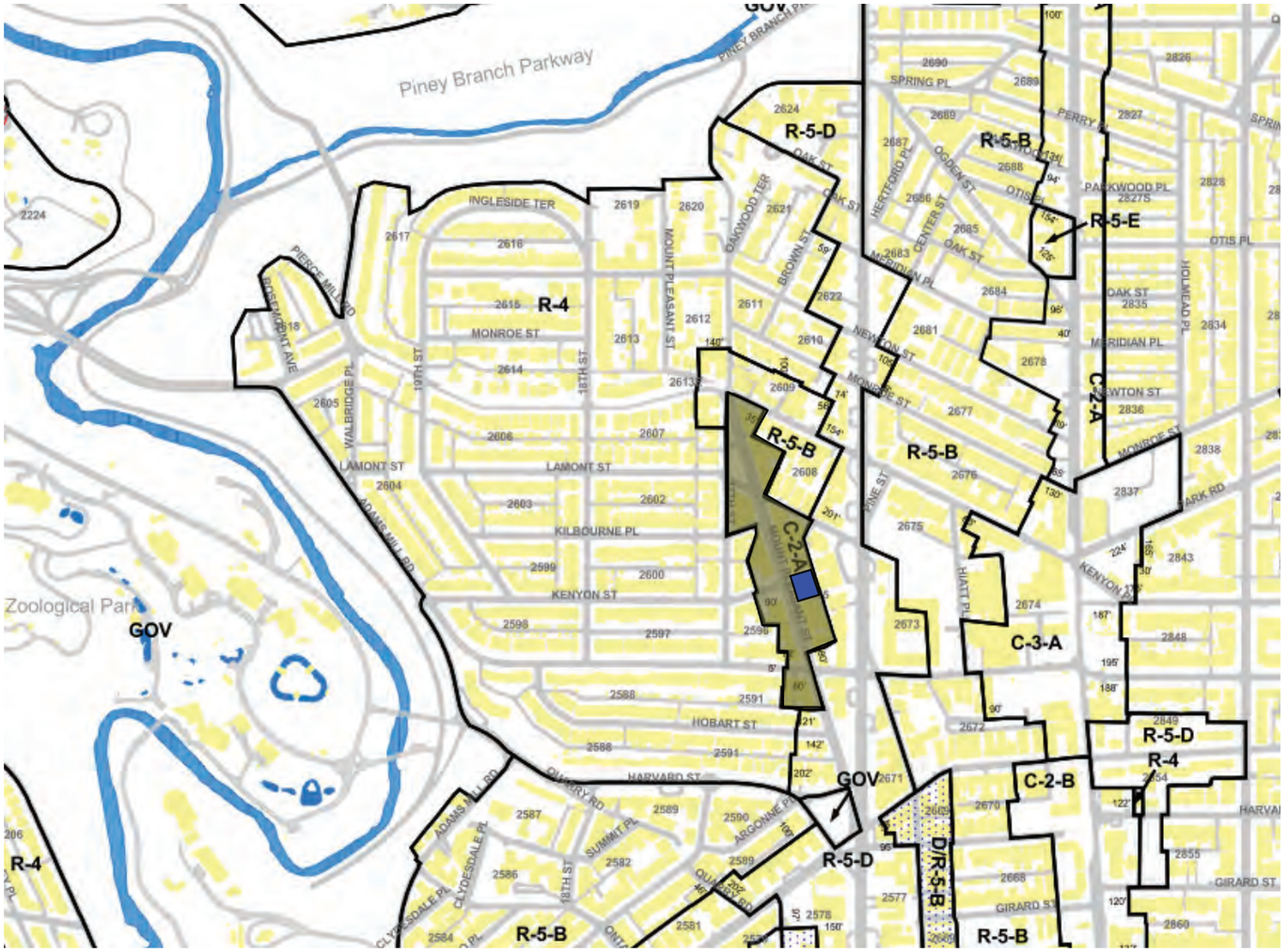
Mount Pleasant is mostly a residential neighborhood in Washington DC. Commercial development is concentrated around Mount Pleasant Street and connects to the Columbia Heights shopping district as shown in red below. The neighborhood is saturated with housing and empties during the day as people head downtown for work while a group of men remain outside the local 7 Eleven to be hired for labor. Across the street is a vacant lot where an apartment building once stood. Is another expensive residential building really what should be rebuilt in its place?



ZONING

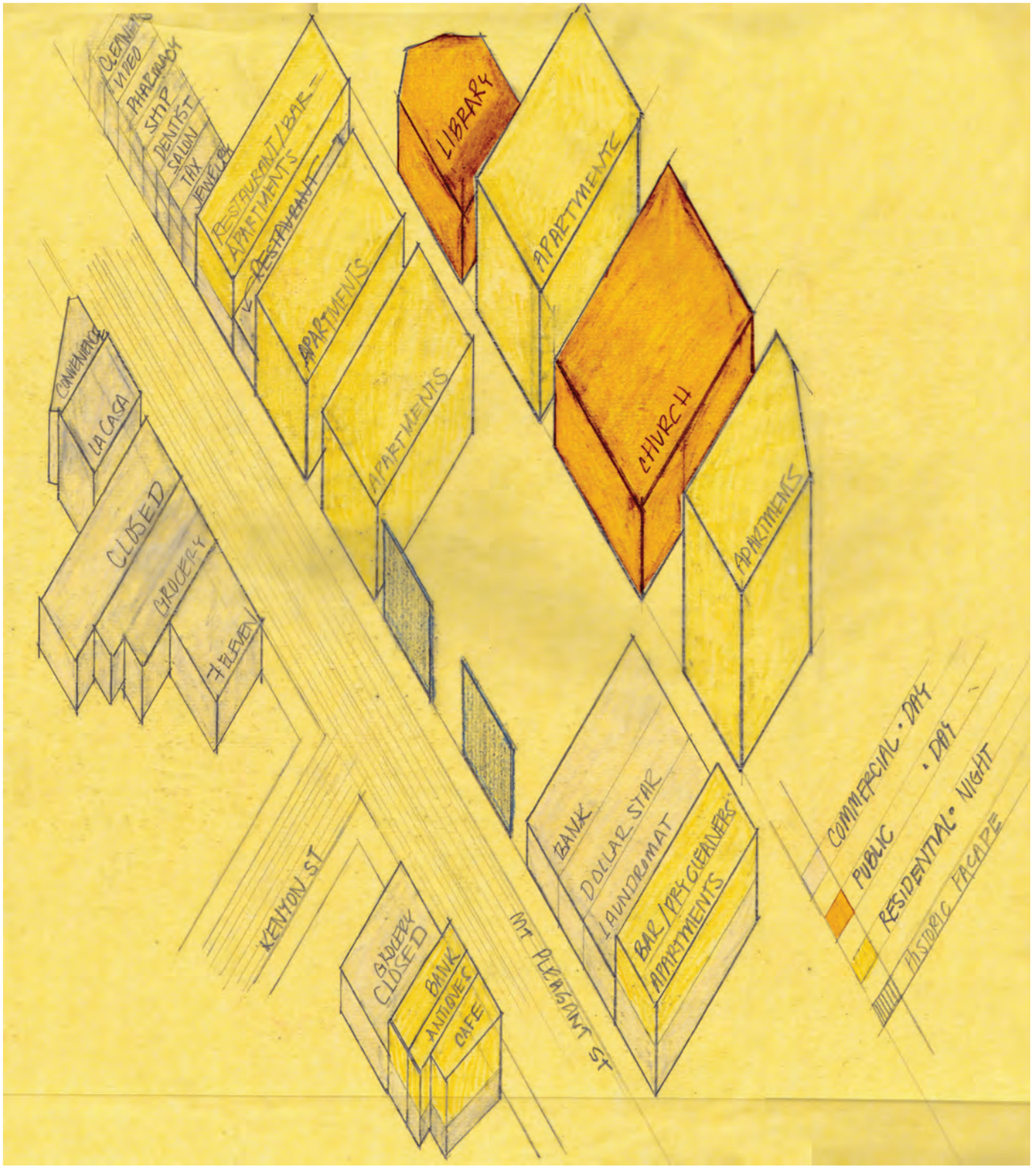
C-2-A

Permits matter-of-right low density development, including **office, retail, and all kinds of residential** uses to a maximun occupancy of 60% for residential use, a maximum FAR of 2.5 for residential use and 1.5 FAR for other permitted uses, and a maximum height of **50 feet**.



BUILDING USES MOUNT PLEASANT ST.

The site at 3145 Mount Pleasant Street is surrounded by various uses. It could shift from residential to commercial and not seem out of place. A public library and church provide many services to the neighborhood including educational programs and occasional housing for the homeless. The main street is also full of small shops which are suffering due to raised rent and competition from the nearby megastore Target.



BUILDING USES

PAST PROGRAM

DEAUVILLE APARTMENTS - 3145 Mount Pleasant Street, NW

- **85 Apartment Units** (200 residents, diverse mix of immigrant families, single professionals, artists, & musicians)
- Laundry facility for residents
- Front desk and office

- **Ethiopian Community Service Center** (Computer and language classes, counseling, youth program)

3145 MOUNT PLEASANT ST.

Originally built as the Chesterfield and Winston apartment buildings in 1908, the Deauville combined the two into one around 1960. The landlord became a slumlord as the conditions of the building deteriorated, but residents were still happy to be provided with affordable housing in the city. However, the fire of 2008 destroyed the building and 200 residents were displaced. After two years without any hope of moving back residents have settled into other homes. The historic facades of the buildings remain and the shell of the Chesterfield is intact.

DOLLAR STAR

HISTORY OF MOUNT PLEASANT

The area of Mount Pleasant is rich with history as it transitioned from a village to a suburb and finally to an urban neighborhood. Mount Pleasant Street was originally the northern portion of 16th Street, but when 16th was extended as a north-south thoroughfare in 1900, it was renamed. The Winston and Chesterfield Apartments, in the Italianate style, were built as two matching buildings in 1908 soon after the streetcar arrived in Mount Pleasant making it a desirable suburb.

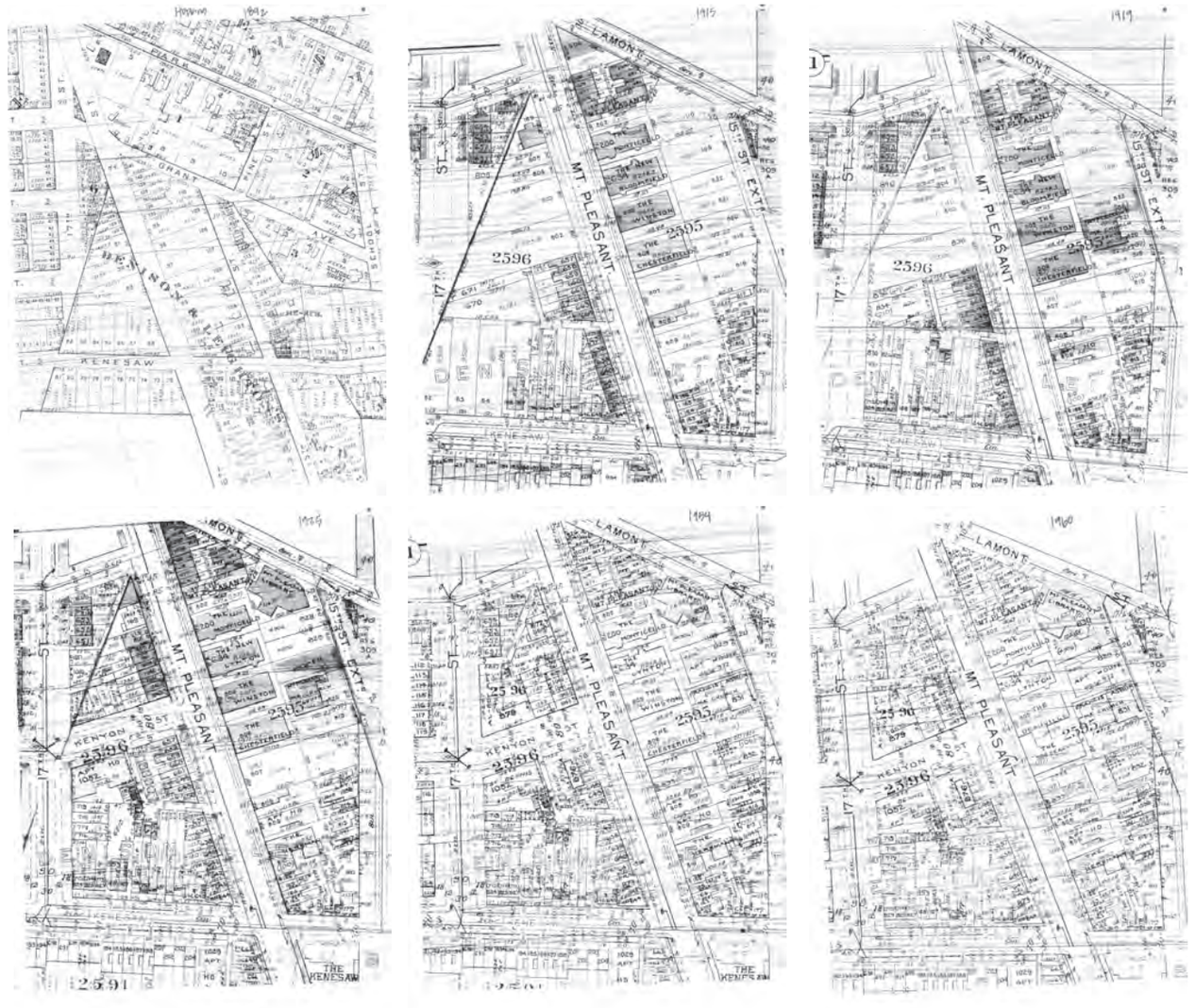
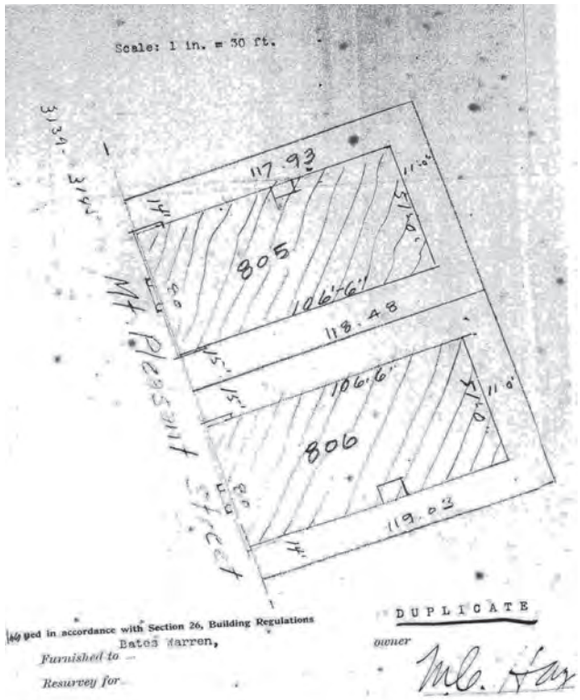
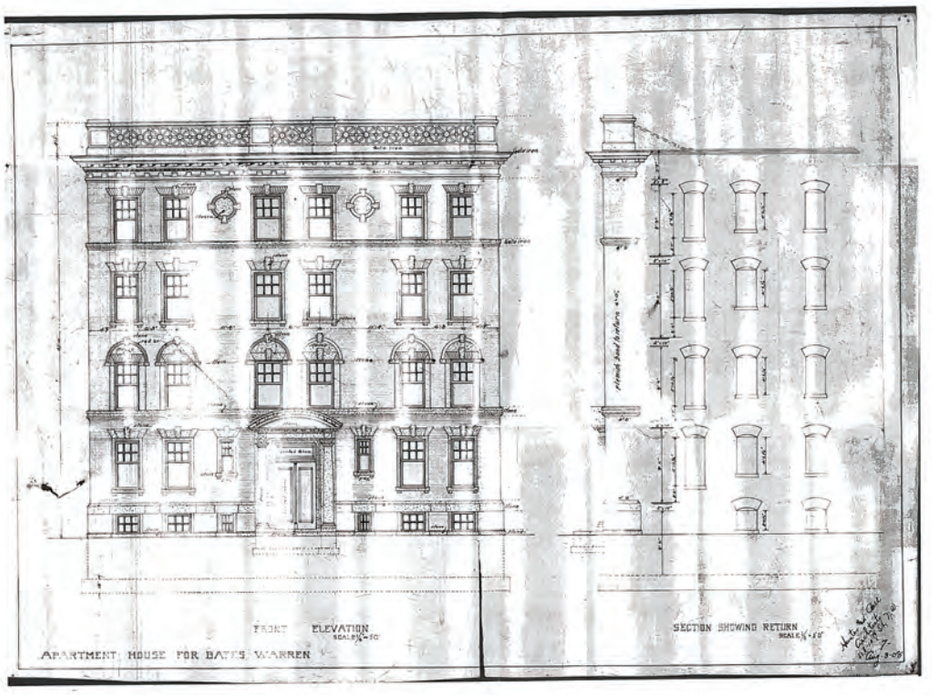
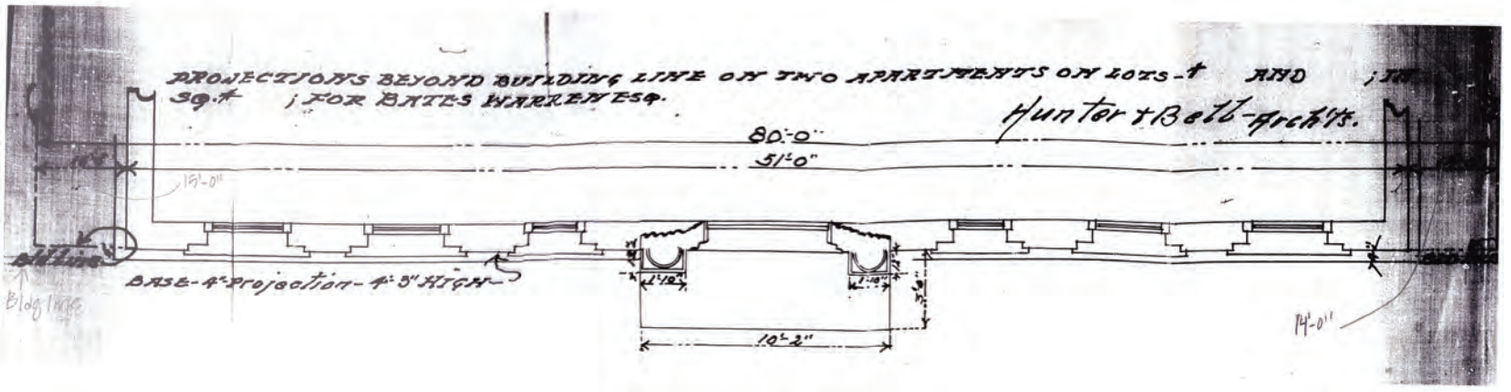


Figure 19. Time line with historic images and maps of Mount Pleasant

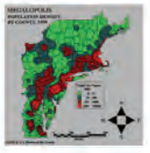

Scale: 1 in. = 30 ft.
117.93
805
106'6"
118.48
106.6'
806
119.03
Mt. Pleasant Street
DUPLICATE
owner
Bates Warren,
Furnished to
Resurvey for

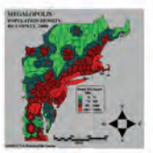

FRONT ELEVATION
SECTION SHOWING RETURN
APARTMENT HOUSE FOR BATES WARREN


PROJECTIONS BEYOND BUILDING LINE ON TWO APARTMENTS ON LOTS 4 AND
39 4 ; FOR BATES WARREN ESQ.
Hunter + Bell - Archts.
80'-0"
51'-0"
15'-0"
BASE - 4" projection - 1' 3" HIGH
10'-2"
14'-0"

STREETCAR SUBURB STREETCAR SUBURB STREETCAR SUBURB
URBAN NEIGHBORHOOD
URBAN NEIGHBORHOOD URBAN NEIGHBORHOOD URBAN NEIGHBORHOOD URBAN
1925 - Mount Pleasant Branch Library is built in Italian Renaissance style by architect Edward L. Tilton. The library acted as a meeting place that the Union Hall once was.
1928 - Heller's Bakery
1930's - Homes are subdivided for WWII housing shortage due to refugees. Greek and Italian families move into the Deauville Apartments.
1948 - Communist coup in Czechoslovakia caused an influx of refugees to Park Road and enclave known as "Czech Row"
1950's - local Jimmy Dean
1960's - local bb Diddley, Rock and roll clubs like Crosstown Lounge, open up in the area. Streetcar is replaced with buses.
1968 - DC riots after the assassination of Dr. Martin Luther King Jr.
1974 - Mount Pleasant Festival, nicknamed the "little UN" for its diversity.
1980s - 1990s - Punk rock flourishes in the basements of Mount Pleasant
1991 - Mount Pleasant riots after police officer shot and wounded Salvadoran man.
1999 - Radio CPR a local radio station. La Casa hosts live music events
2008 - Deauville apartment fire in March

Mt. Pleasant
Historic District Map





LAYERED SITE MAP
MOUNT PLEASANT ST.

This map represents a layering of the Baists maps. White represents the development during the time the Winston and Chesterfield Apartments were built. The original streets are in tan and the continuation of 16th Street and addition of Kenyon are shown in dark brown. The elevator connection which combined the twin buildings making them the Deauville appeared in a 1960 Baist Map.

SITE SECTION
MOUNT PLEASANT ST.

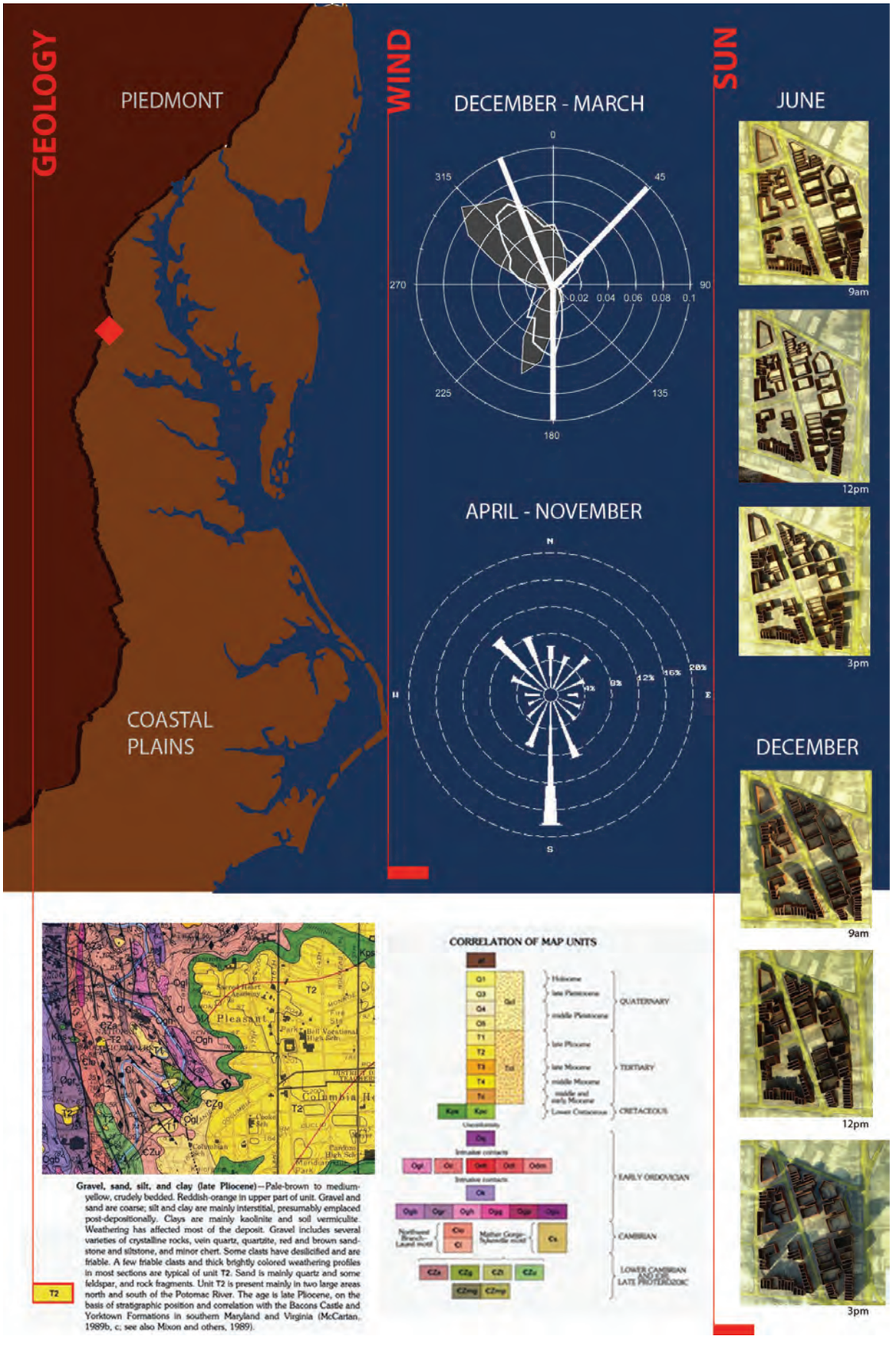
Cut through the land of Mount Pleasant Street and you will find a diverse layer of histories. It is known for its transient residents from Civil War soldiers in a temporary hospital to a mix of immigrants fleeing wars in Europe. Latin American, African, and Southeast Asian ethnicities make up much of the neighborhood today, but who knows what tomorrow will bring.

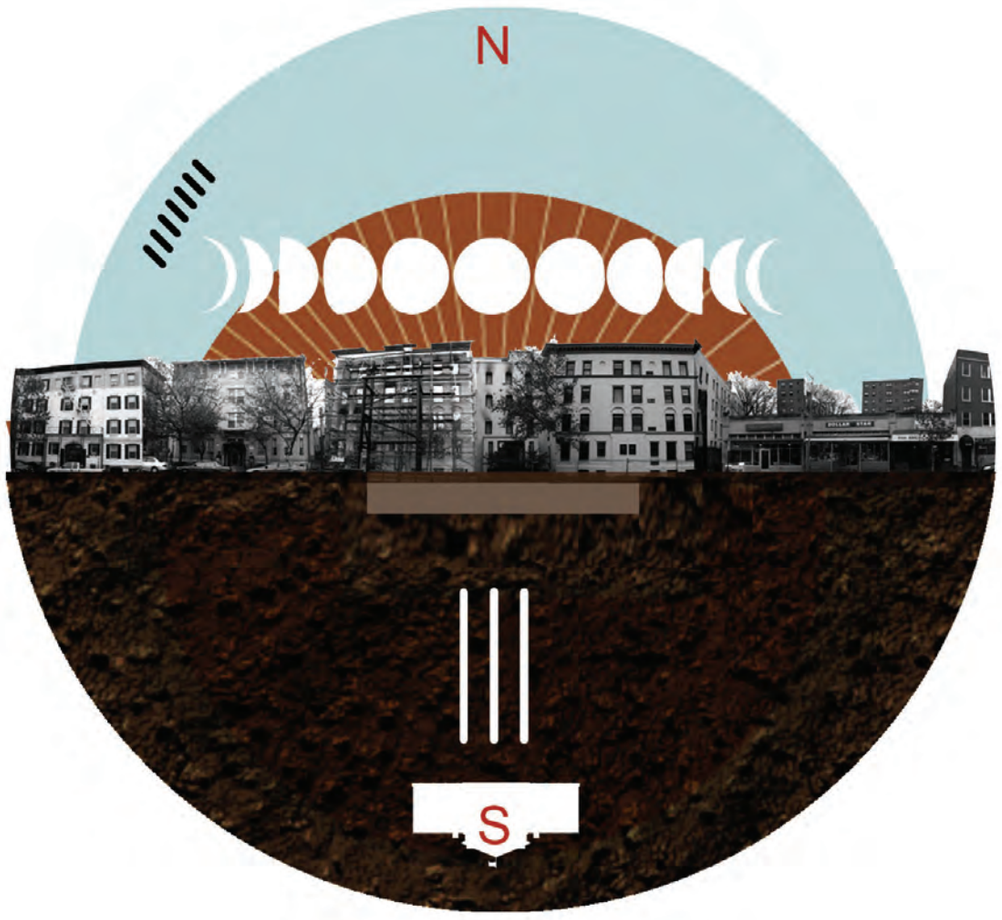
SITE CONDITIONS
MOUNT PLEASANT ST.

Earth - Washington DC is located on the fall line between the Piedmont and Coastal Plains. The new and rocky geological make up of Rock Creek Park is the dividing line. Mount Pleasant is to the east with older earth of gravel, sand, silt, and clay,

Wind - During the winter cold harsh winds come from the northwest. During the summer cooling breezes travel over the Potomac River and into the city from the south.

Fire - The sun and the moon rise in the east and set in the west. The hot southwestern setting sun is a direct hit for angled street.

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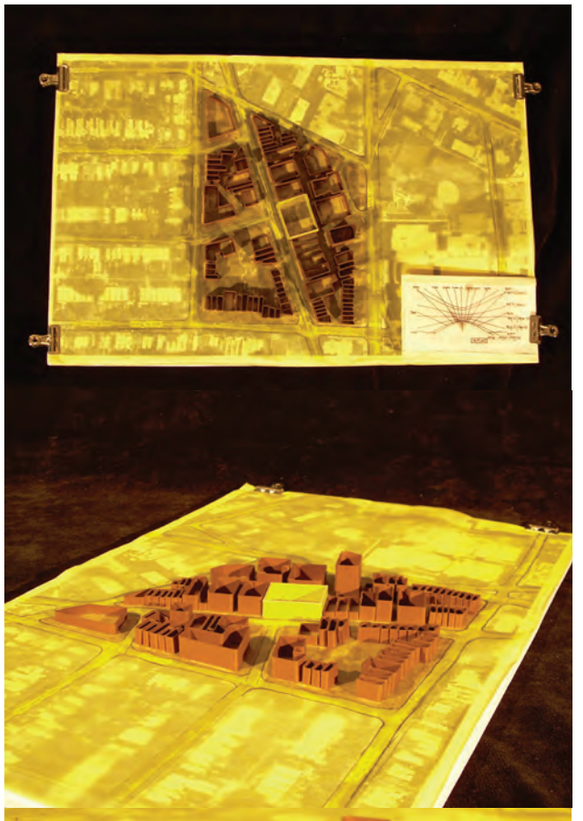
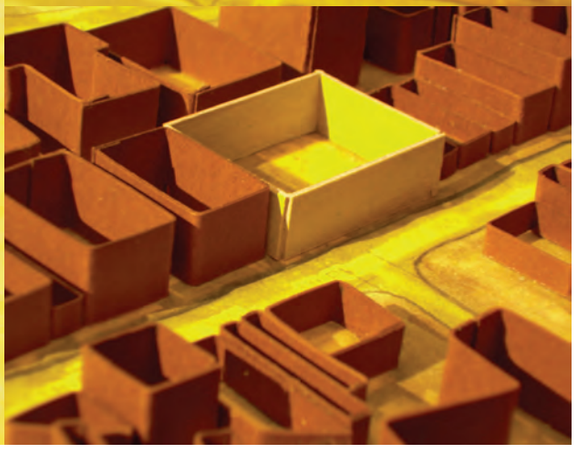
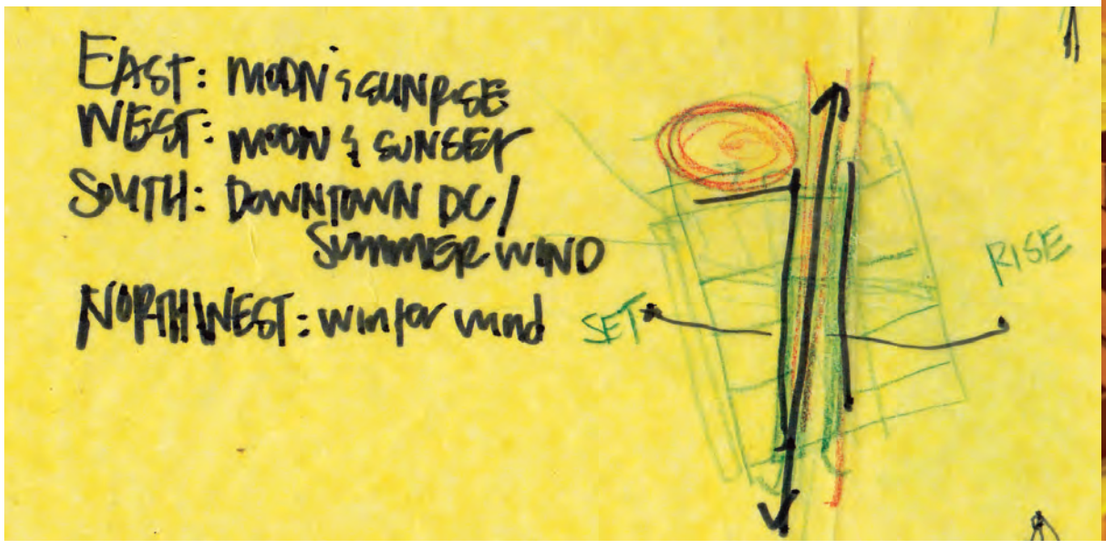


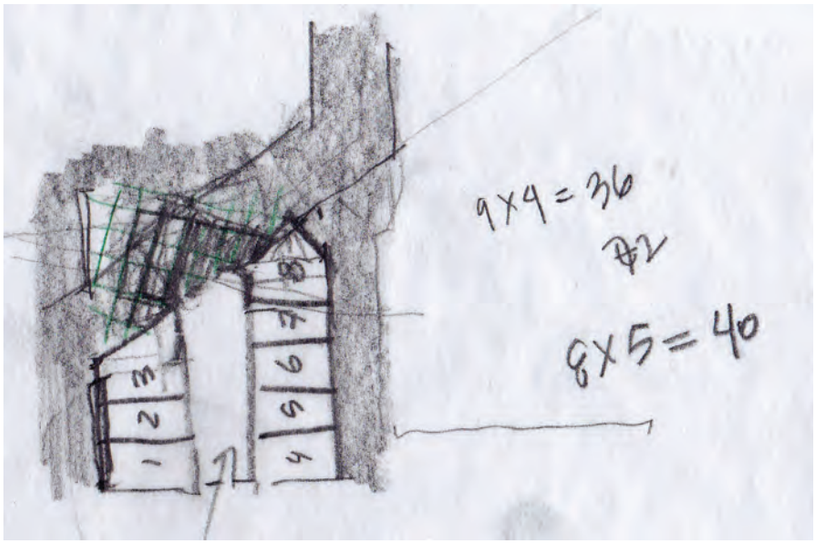


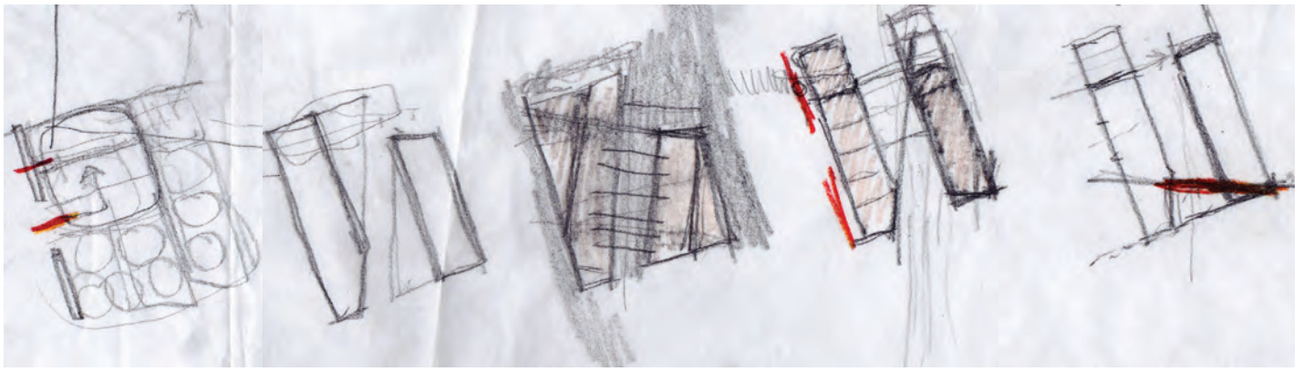

EAST: MOON & SUNRISE
WEST: MOON & SUNSET
SOUTH: DOWNTOWN DC / SUMMER WIND
NORTHWEST: winter wind
SET
RISE

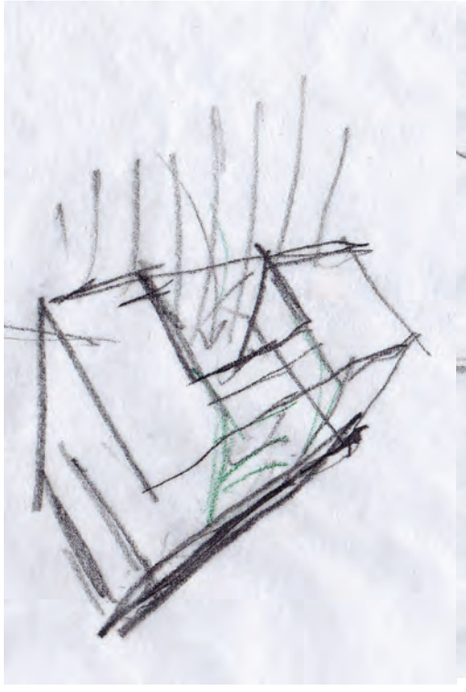
BUILDING SCHEMES

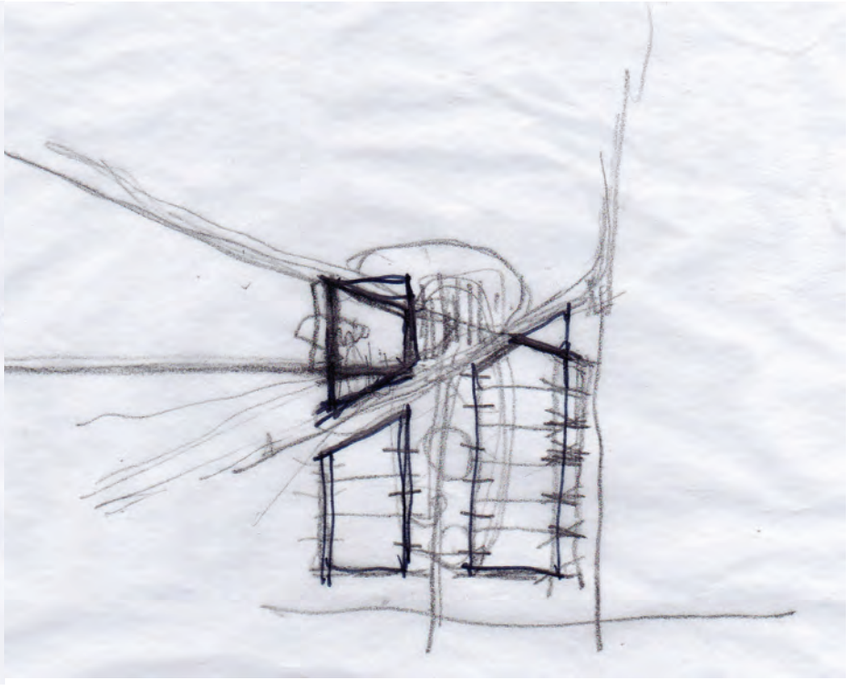
BUILDING DESIGN SITE CONDITIONS

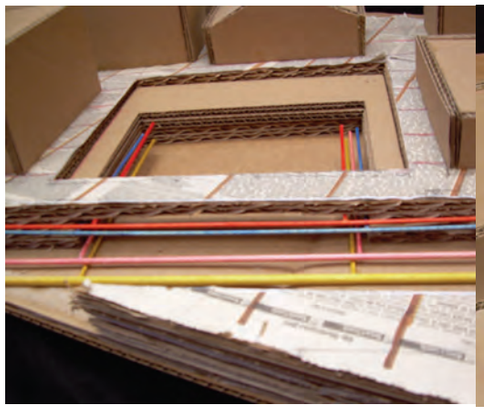
Theses sketches and models show the process of the initial building design. First was to establish the importance of the site. The footprint was reorientated for the direction of wind and sunlight. The existing facades were preserved for screening and historical nature of the neighborhood. A connection to Library was made through reestablishing a fire alley. The two building ideology came from existing city service connections.



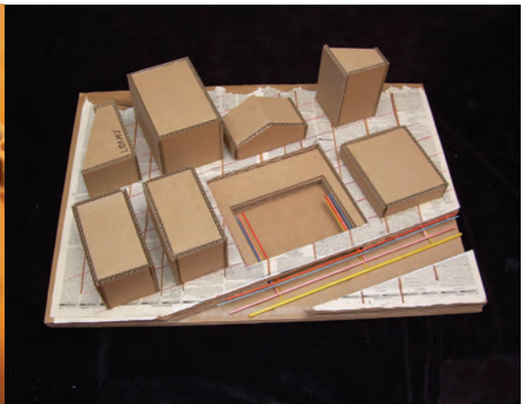
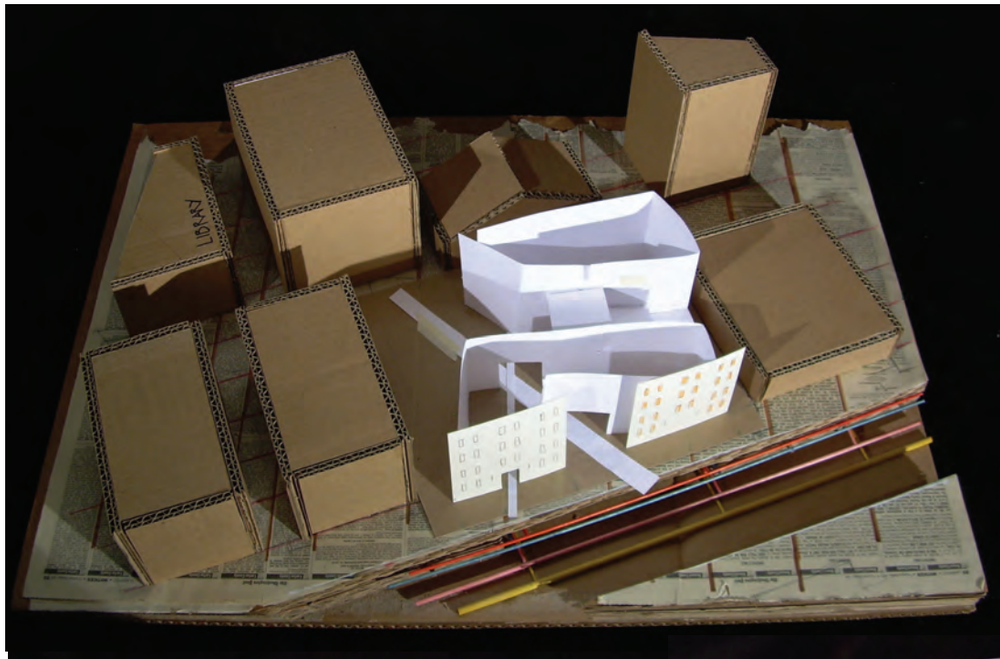








LIBRARY

LIBRARY


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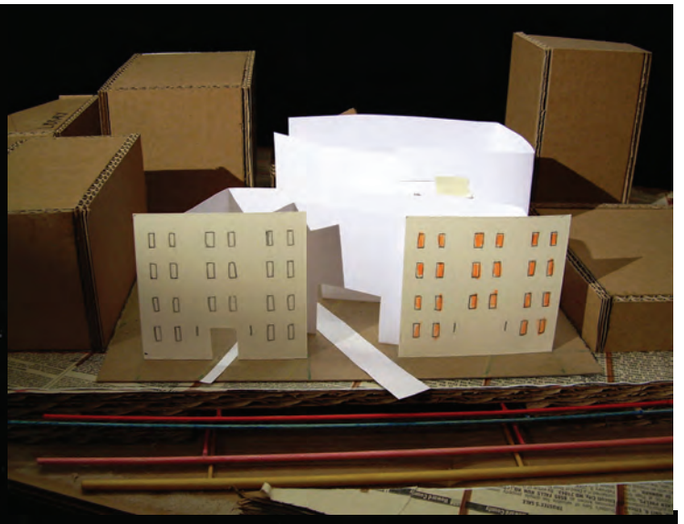
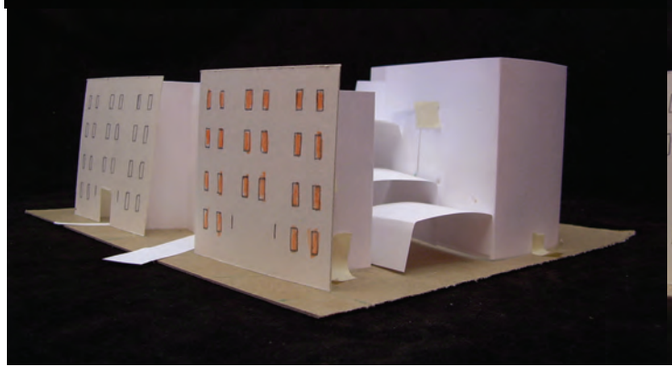
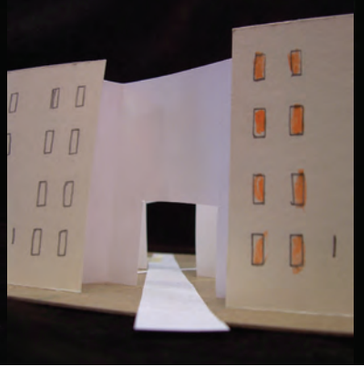
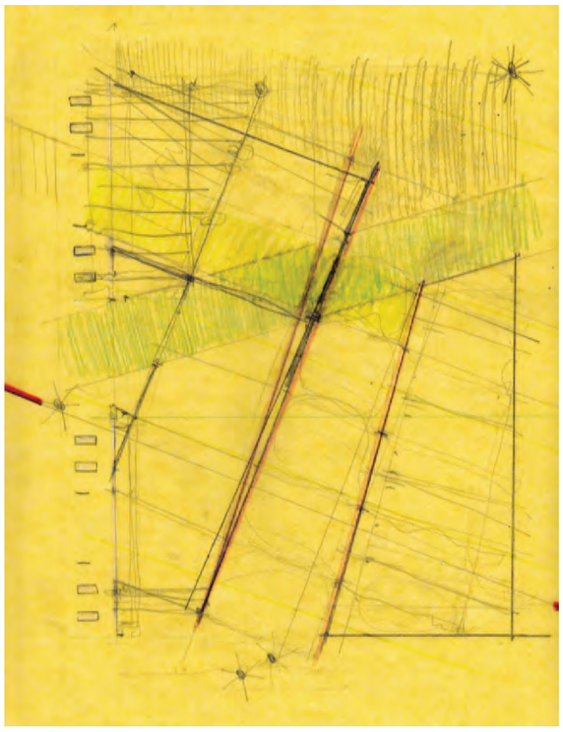
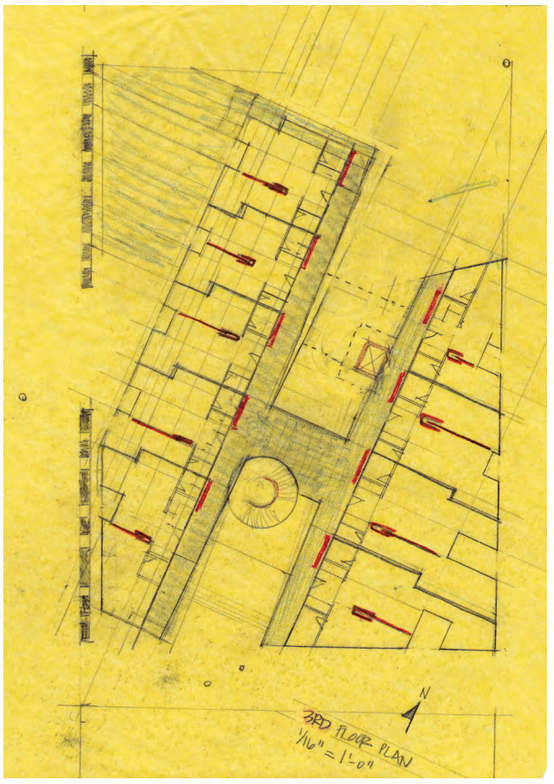
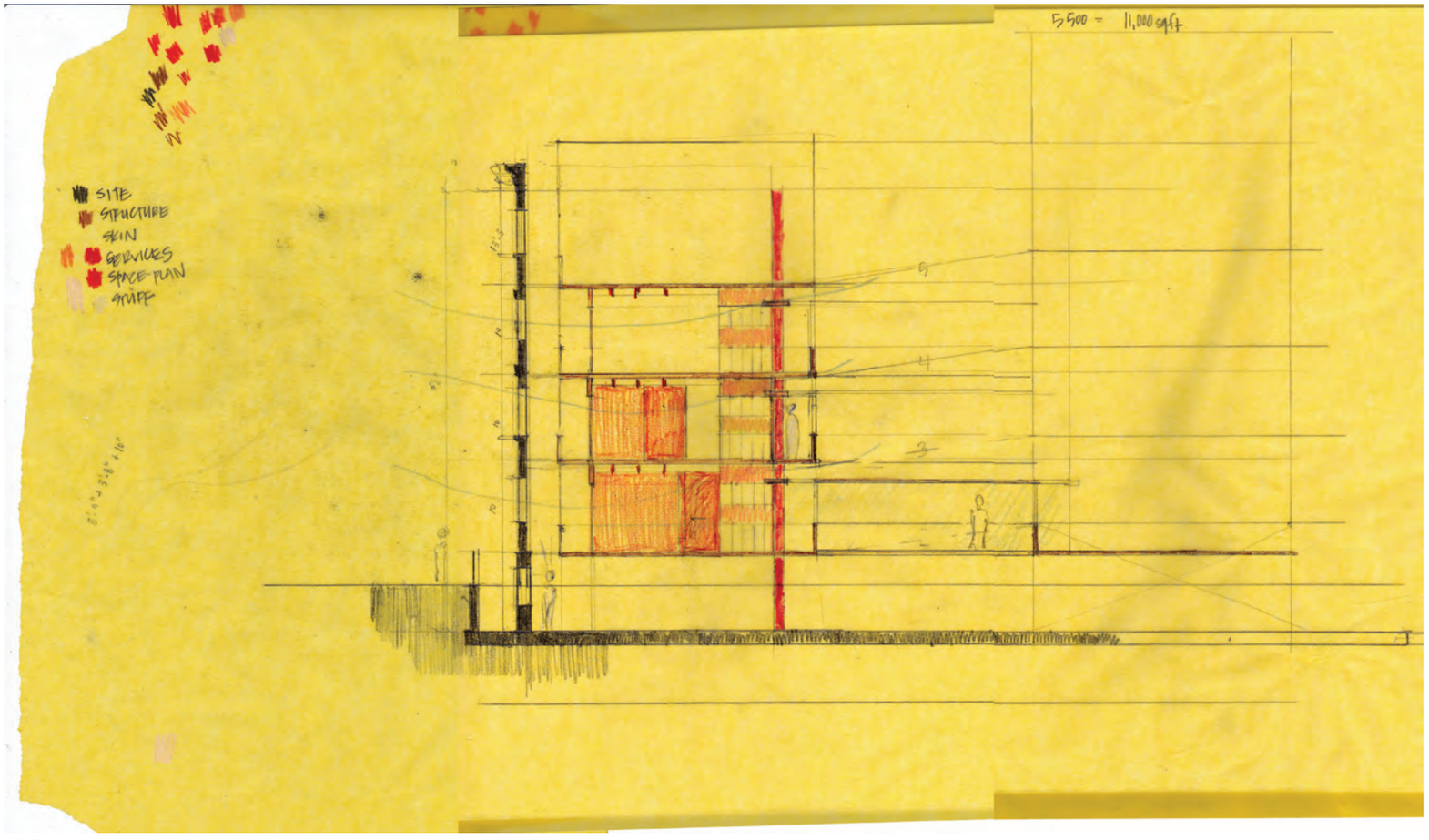




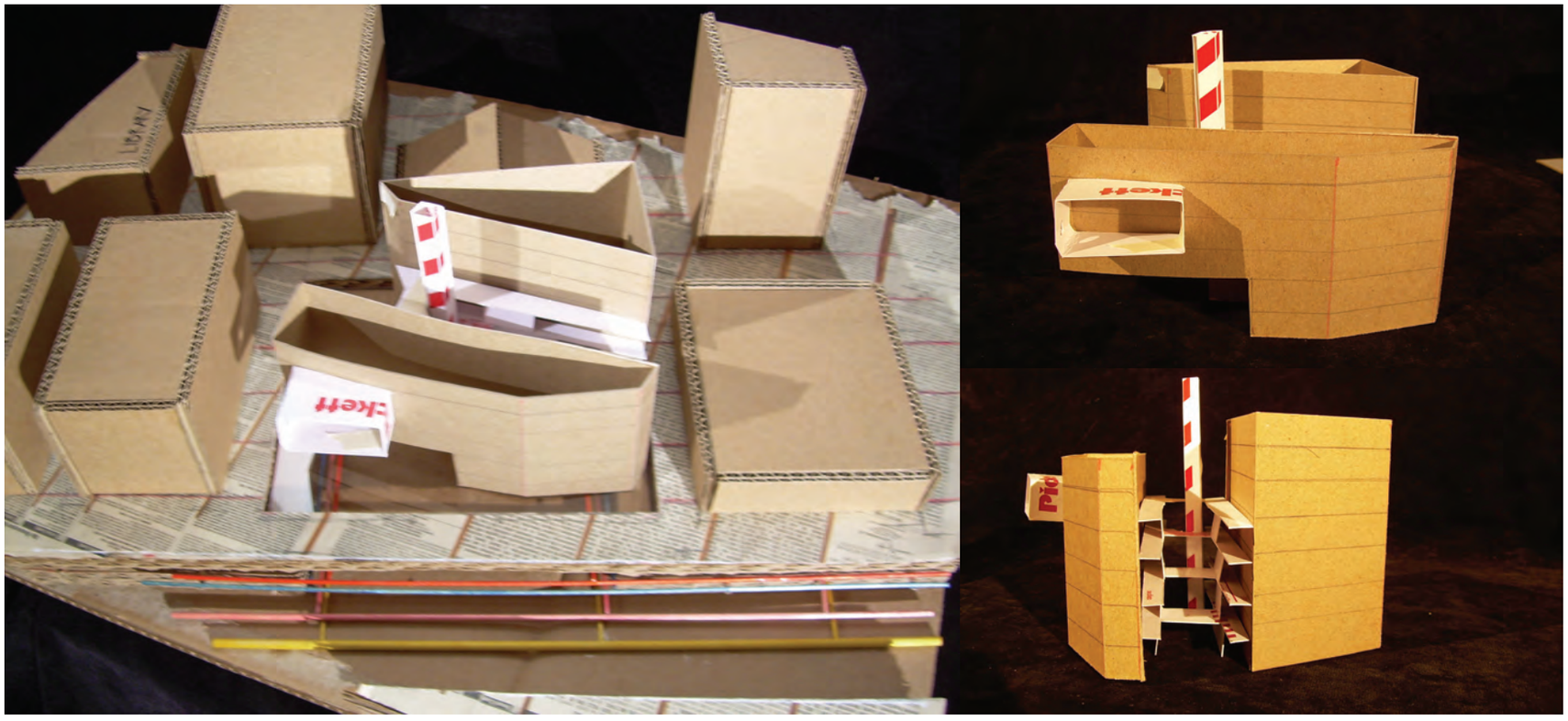
BUILDING DESIGN
PUBLIC AND PRIVATE

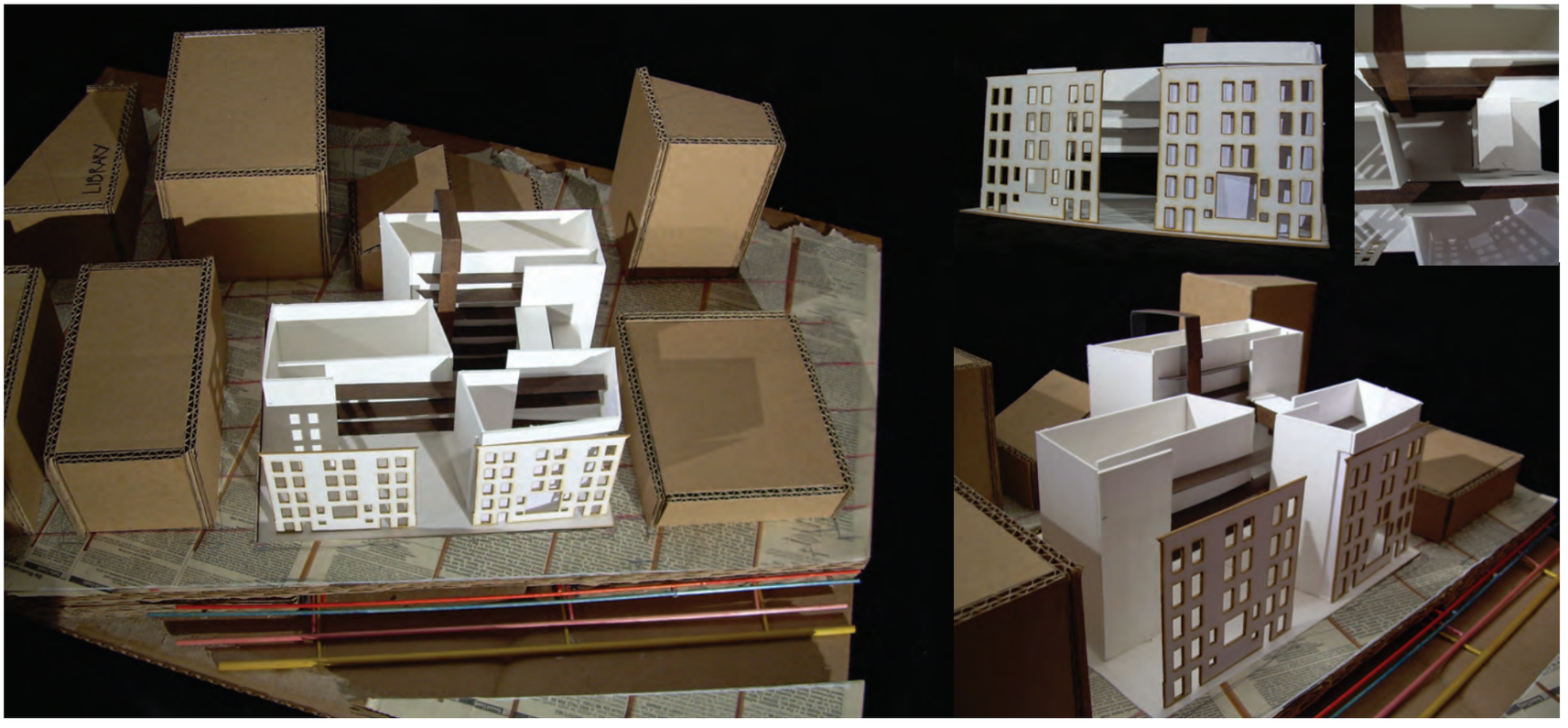
Each facade was treated differently to emphasize a public side with a connection to the crosswalk, Kenyon, and the Library. The two buildings connected with circulation. With further development two buildings became three. A section shows the layers of change in the building through color coding pieces. The wet wall is introduced as a dominant feature to house all services for unit.





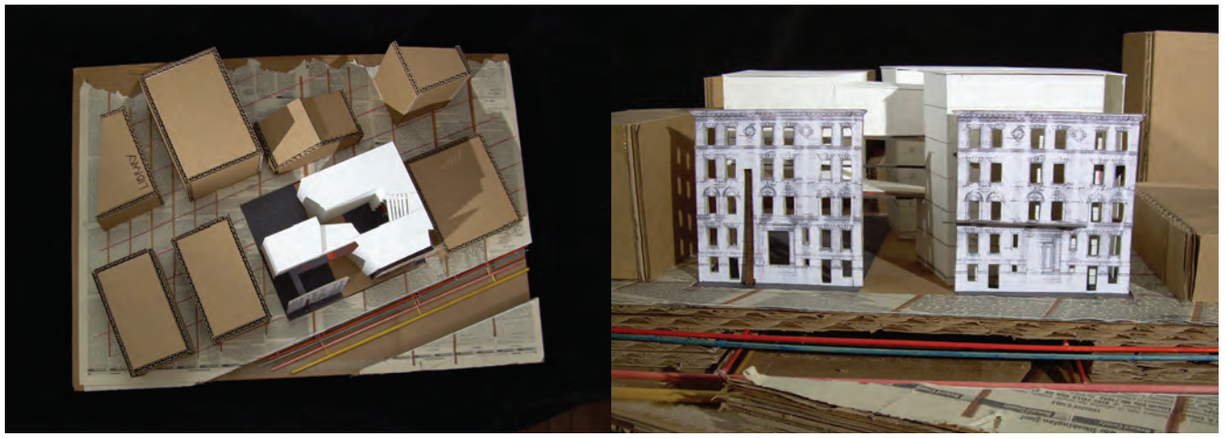


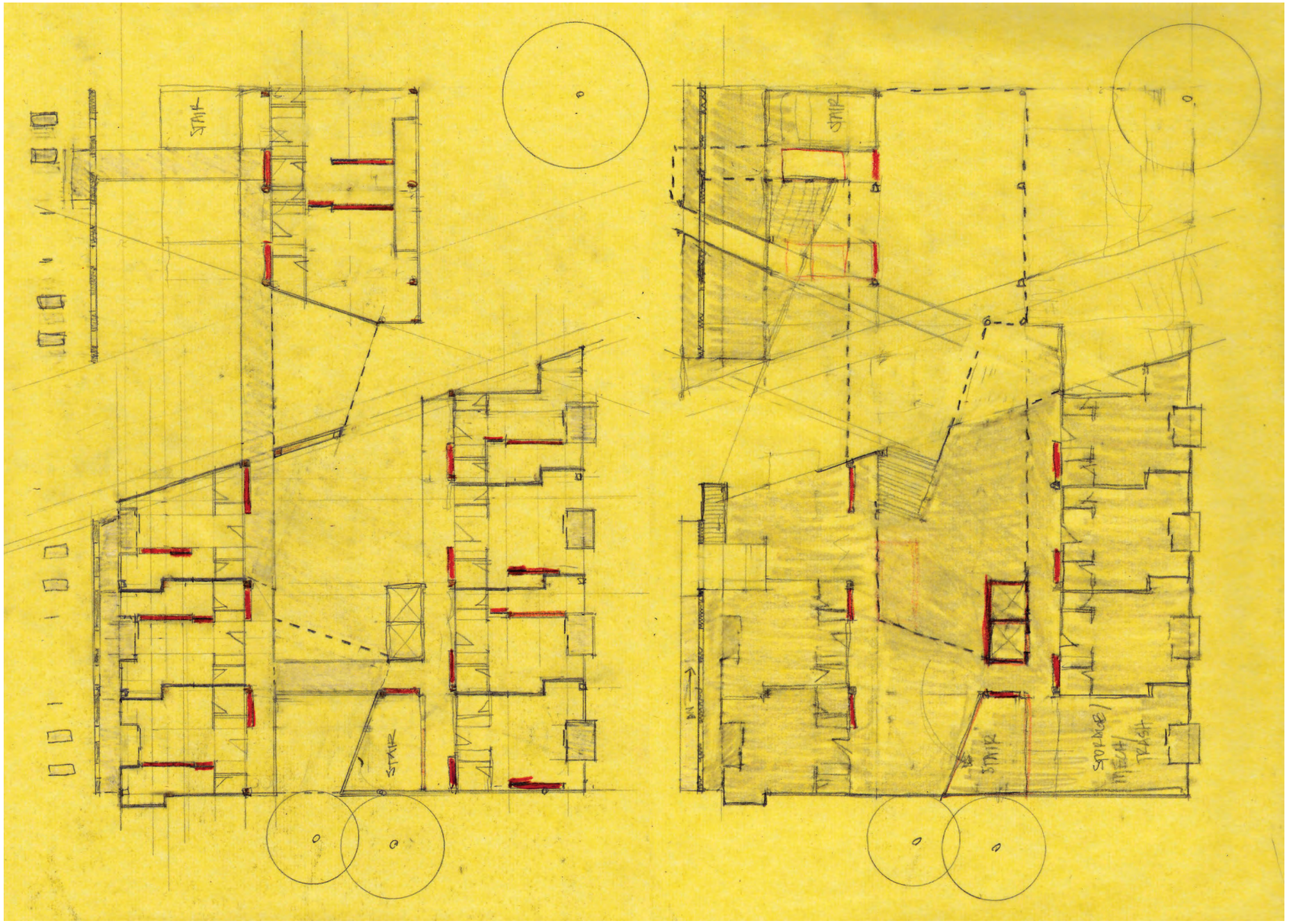

LIBRARY

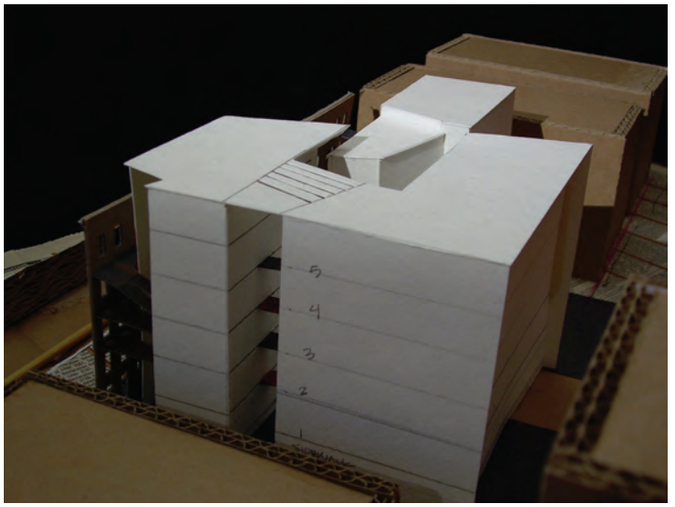
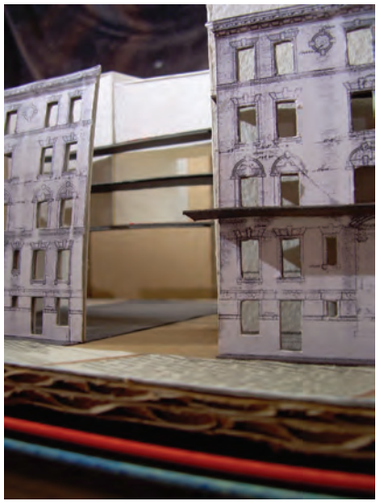
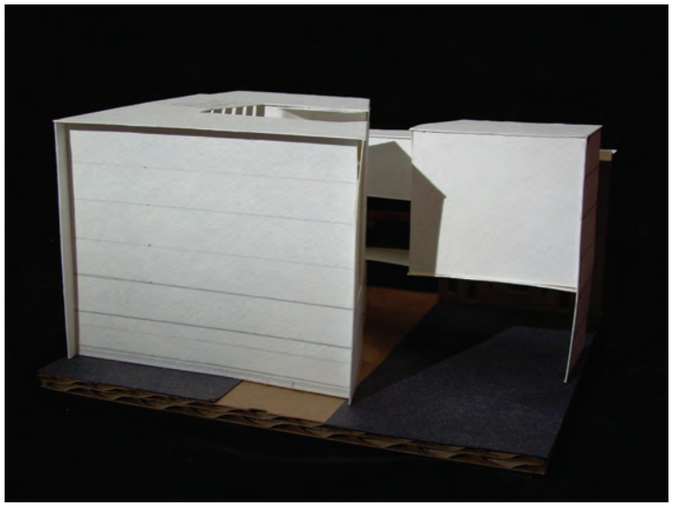
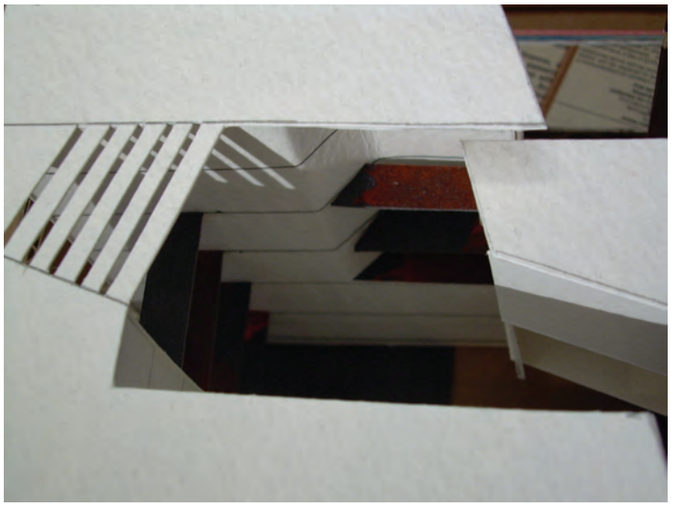

LIBRARY

BUILDING DESIGN GRID AND PIECES

The grid of the building was adjusted to correspond with angled Mount Pleasant Street. North and south grid connections are established through a breezeway from a southern opening. Public and private sides are defined through voids like puzzle pieces with an insular courtyard on the private side. Building on public side looks like it has slid out of private side to invite you in.



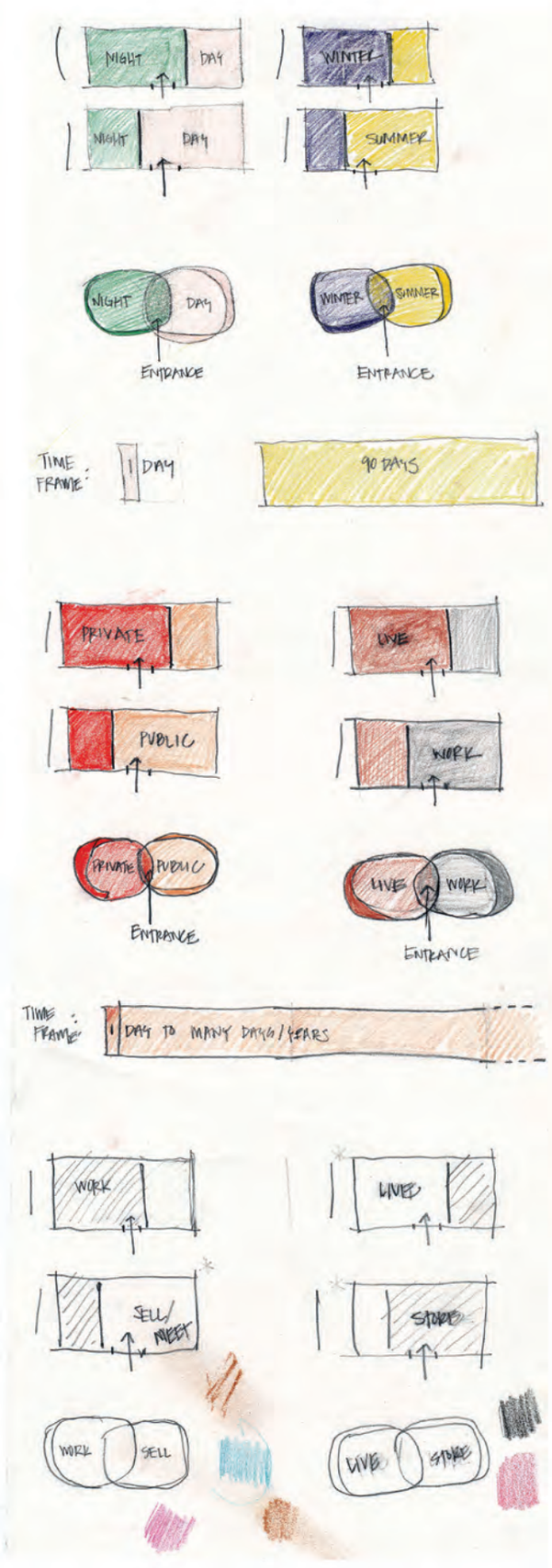


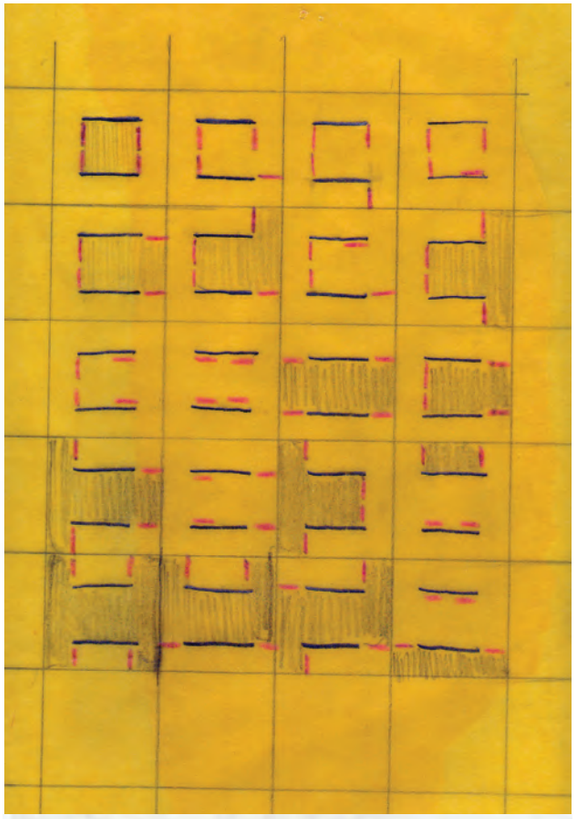





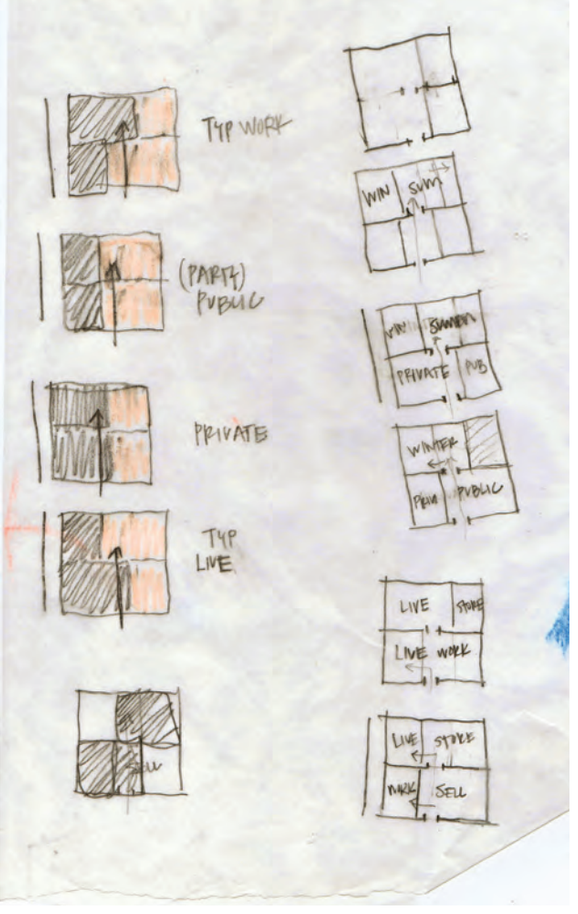
UNIT CONCEPTS

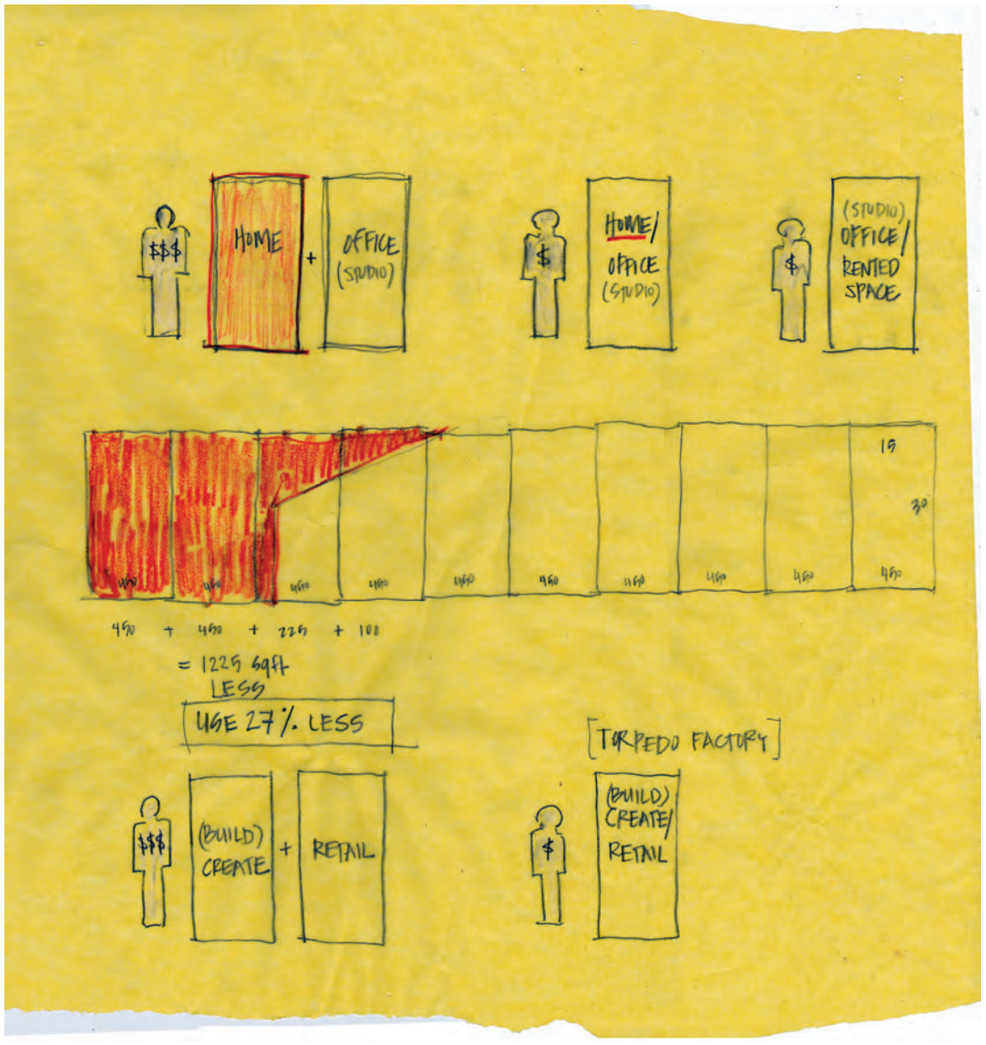
UNIT DESIGN

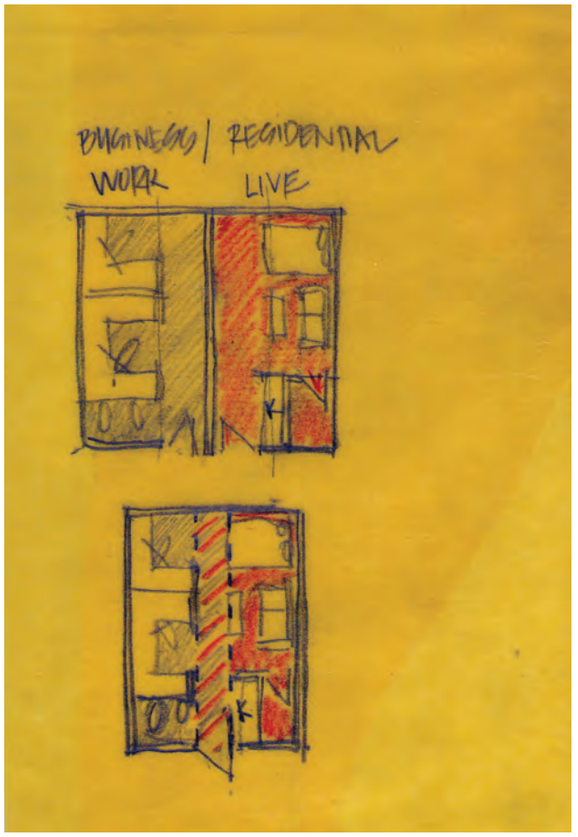
These diagrams show the relationships between different human rush hours, like public and private, work and sleep, sell and build, etc. There is the initial idea in symbolic form of same entrance into one or the other. The inside shifts to make one place act as two. Circulation space is re-used reducing overall footprint and therefore cost for rent.

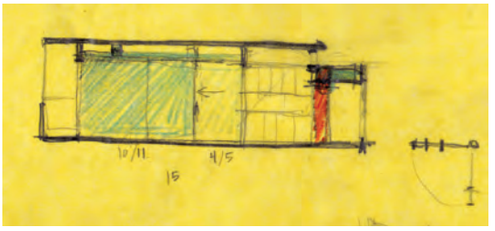


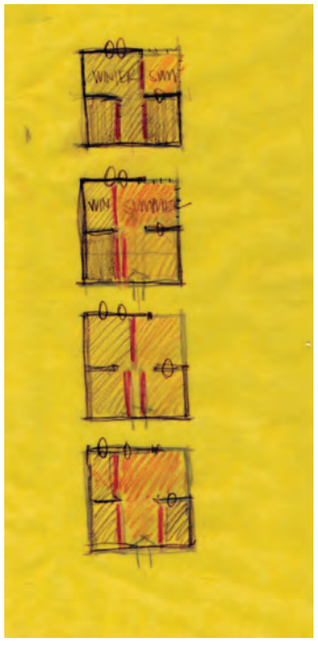


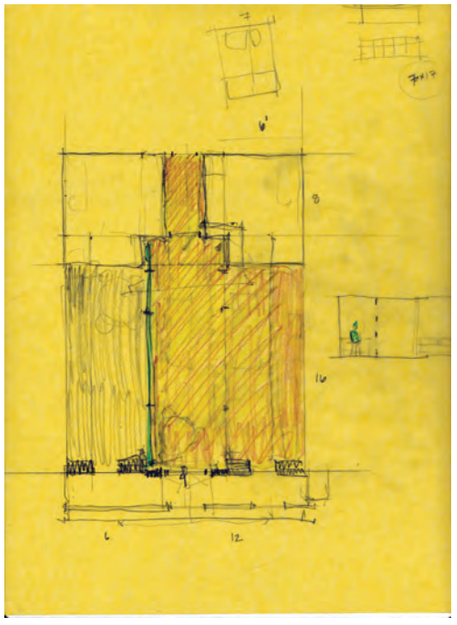



$$$
HOME
+
OFFICE
(STUDIO)
$
HOME/
OFFICE
(STUDIO)
$
(STUDIO)
OFFICE/
RENTED
SPACE
450 + 450 + 225 + 100
= 1225 sqft
LESS
USE 27% LESS
[TORPEDO FACTORY]
$$$
(BUILD)
CREATE
+
RETAIL
$
(BUILD)
CREATE/
RETAIL


BUSINESS/ RESIDENTIAL
WORK
LIVE

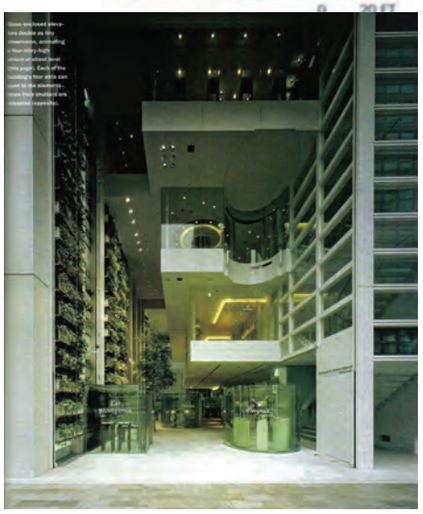






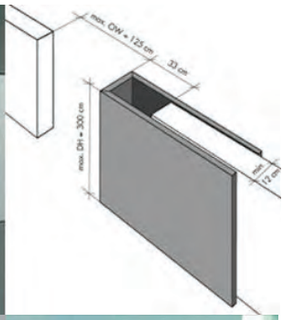
UNIT DESIGN
MOVING COMPONENTS

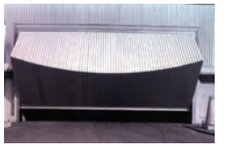
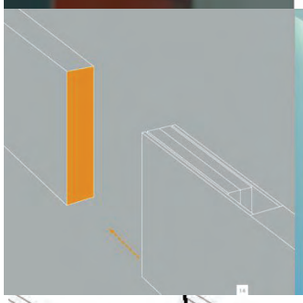
An exploration of what interior shifting can be within the unit.
Floor - Shigeru Ban's opening facade and elevator kiosks and Rem Koolhaus' elevating floor slab.
Wall - MVRDV's bathroom door that creates the bathroom wall, exterior pocket door that forms a wall, Santiago Calatrava's garage door.
Window - double hung window with weights.
Roof - Studio Gang's roof that opens up to the stars
Door - Carlo Scarpa's doors

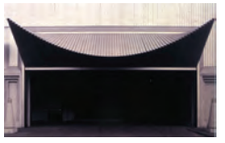
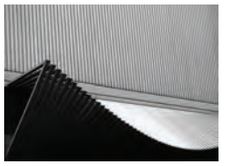
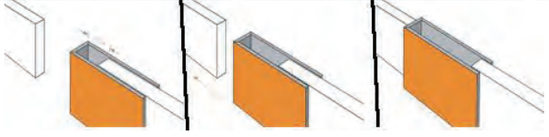


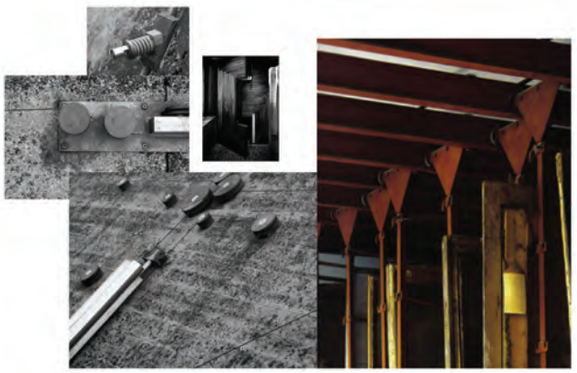
FLOOR

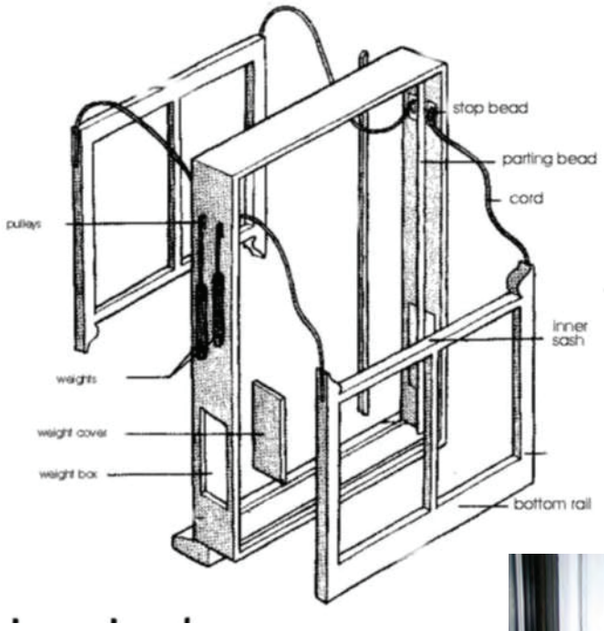
WALL



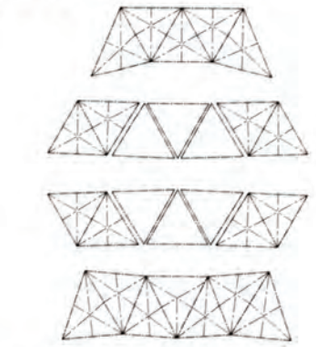






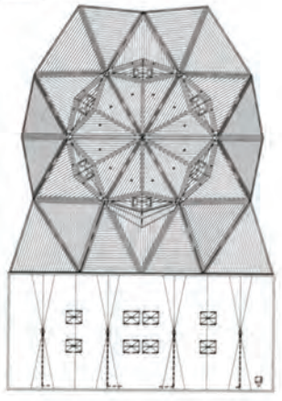


WINDOW

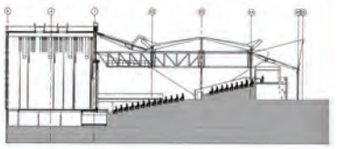
Bengt Sjostrom Starlight Theater, Rockford, Illinois, USA, 2003: Studio Gang O'Donnell (now Studio Gang Architects).

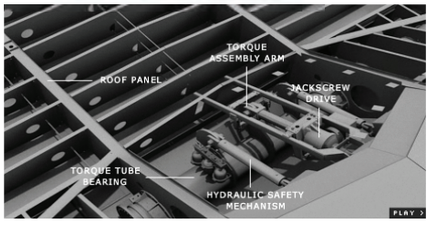


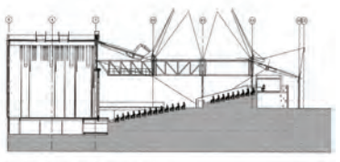
Roof geometry showing fixed and movable elements



ROOF



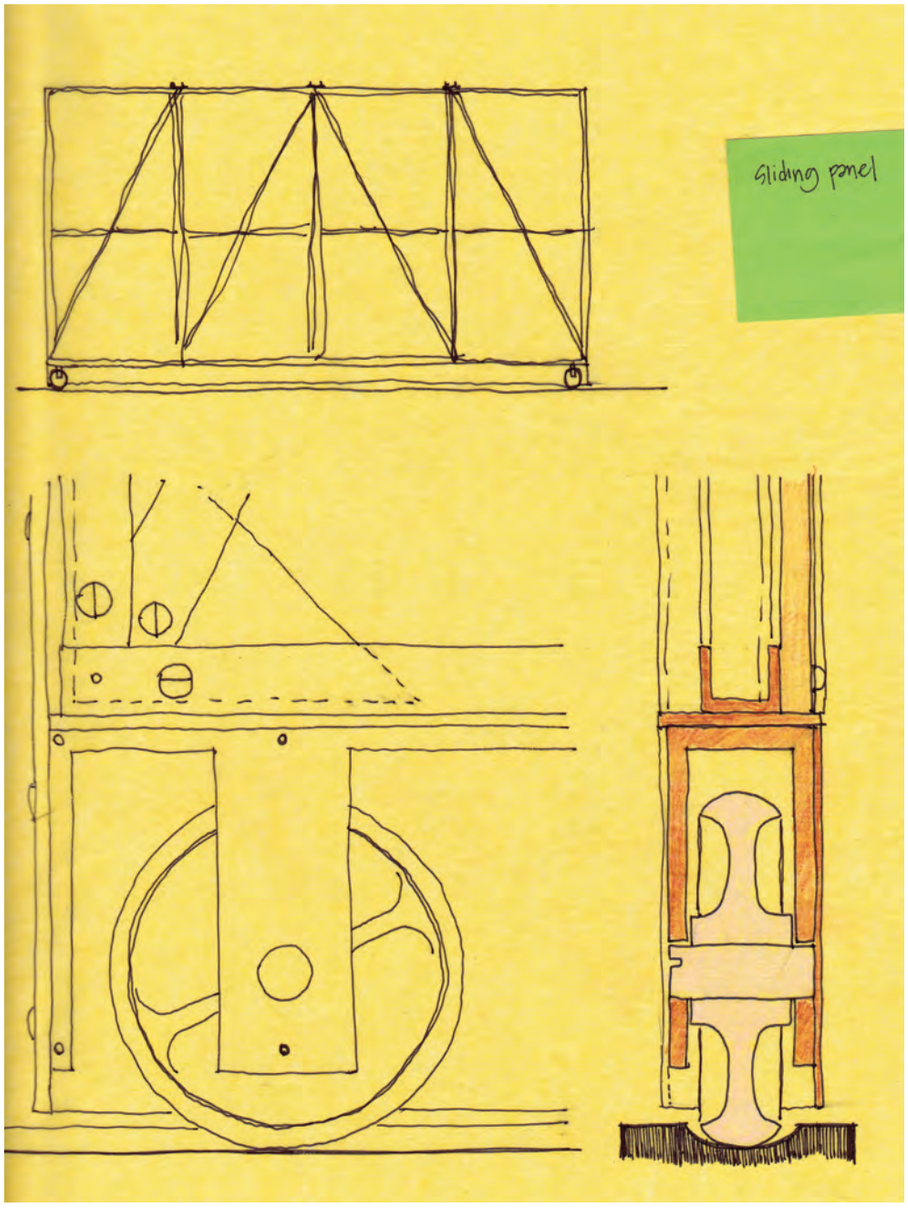




Sections showing roof open and closed

DETAIL STUDY
MAISON DE VERRE

Moving parts are studied through tracing details from Maison de Verre. Sliding wall, rotating window, twisting vent, and hanging stair.



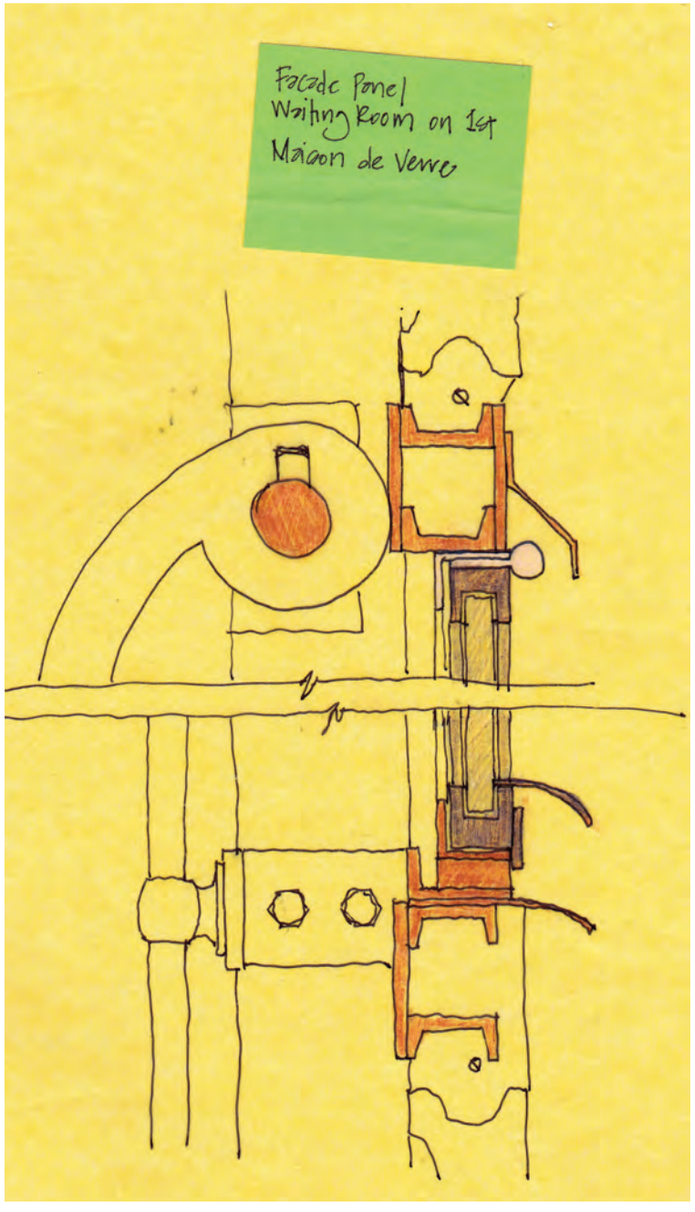
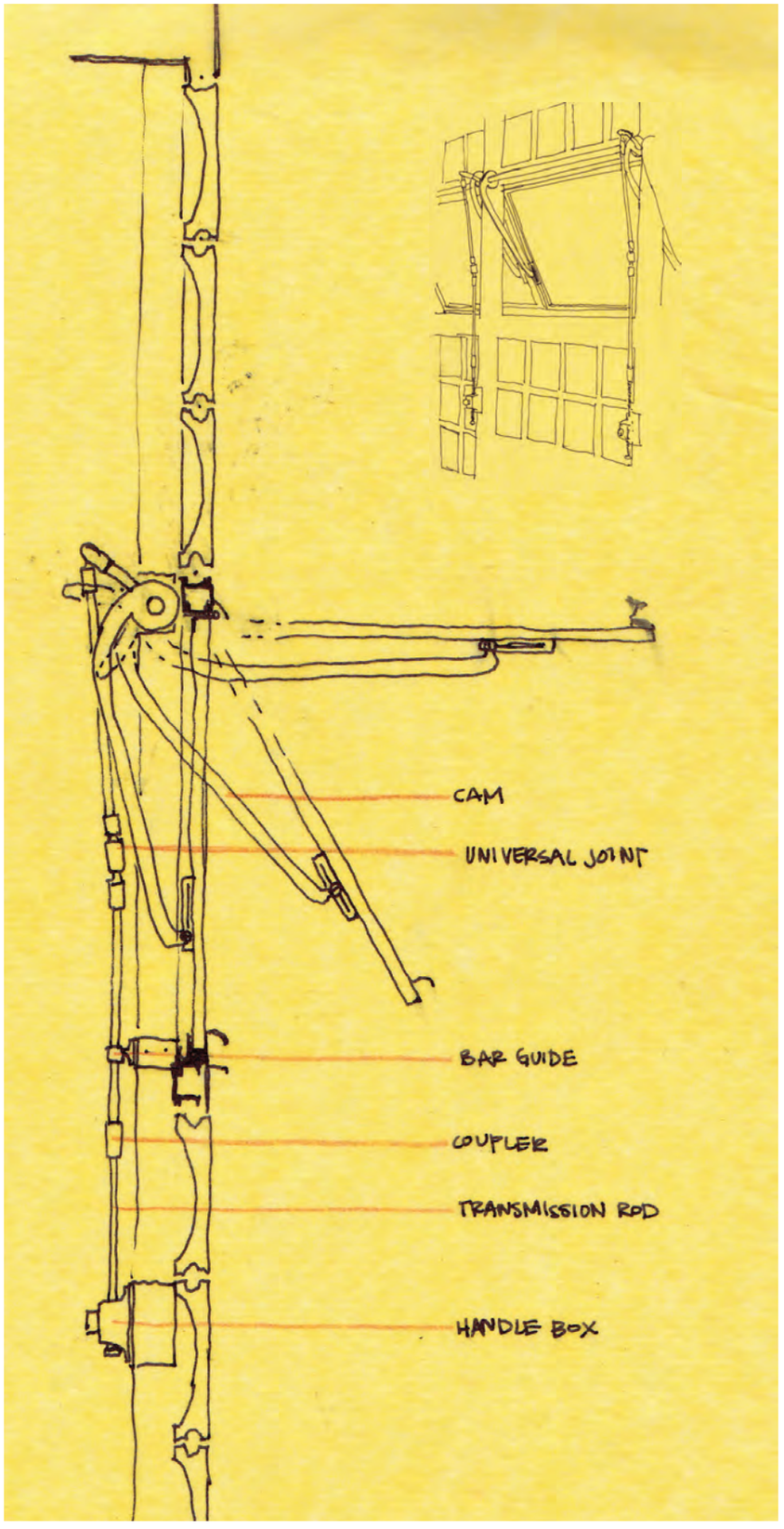
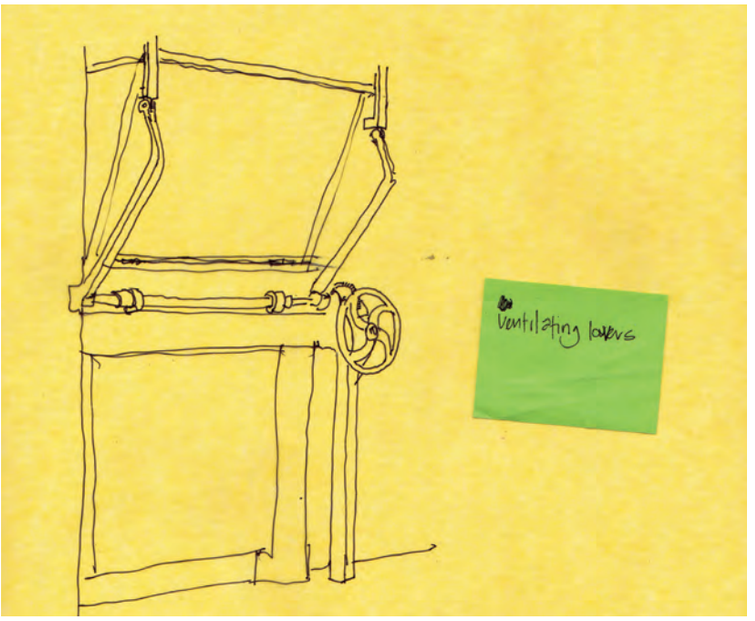
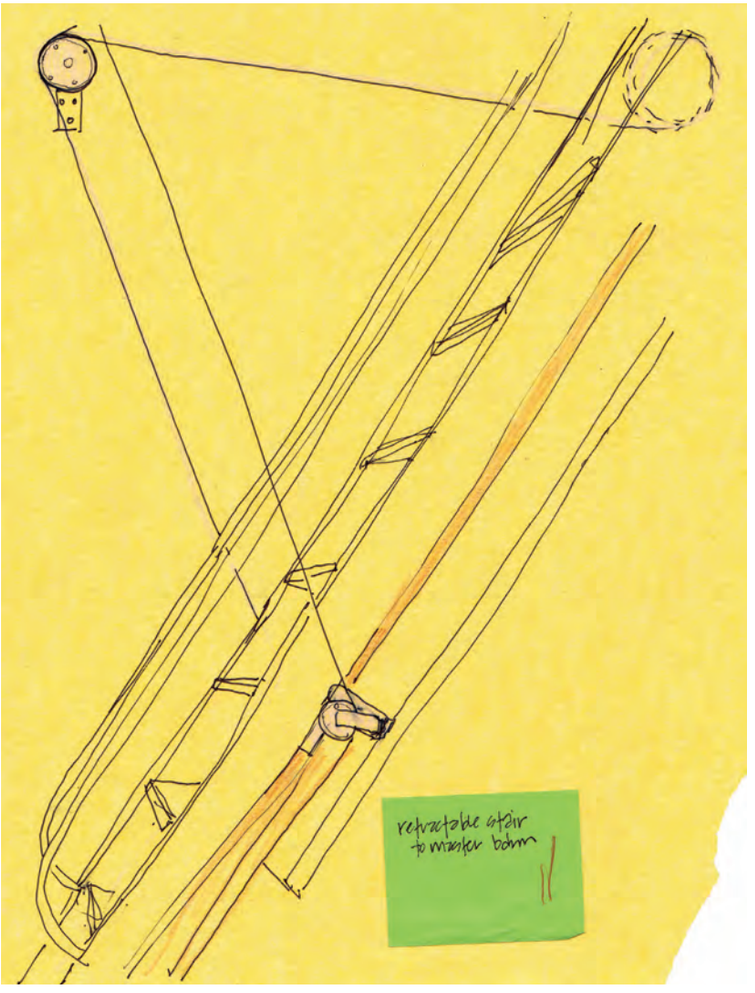


Figure 20. Interior photograph of Maison de Verre (top left)
Figure 21. Exterior photograph of Maison de Verre (top right)

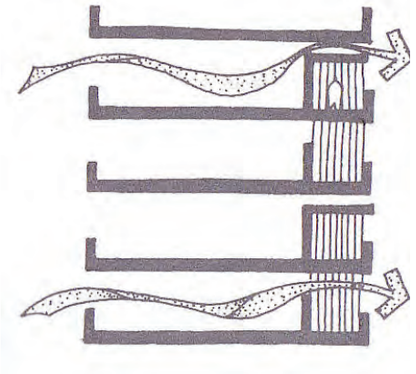

CAM
UNIVERSAL JOINT
BAR GUIDE
COUPLER
TRANSMISSION ROD
HANDLE BOX

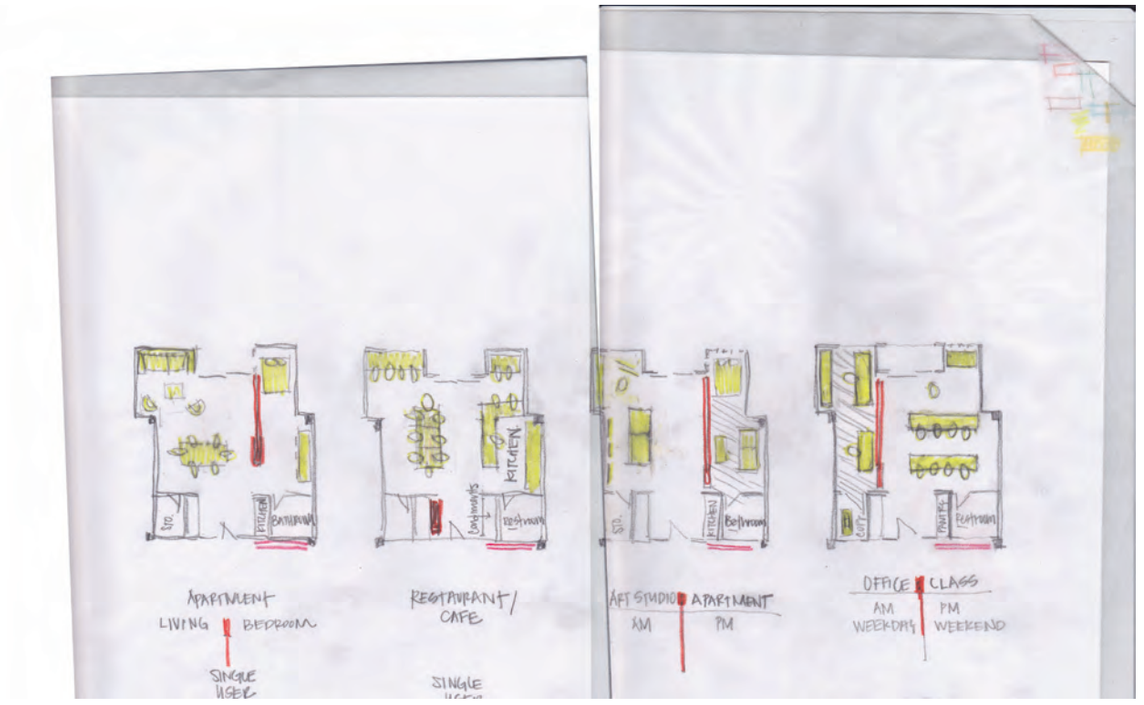

ventilating louvers


retractable stair to master bdrm

UNIT DESIGN

Further development of unit with the study of airflow in apartment types. Also the location of the wet wall and moving wall with 6'-0" grid and room dimensions that maximize furniture layouts and work well with human inhabitation. Different combinations of uses in a the unit are explored.





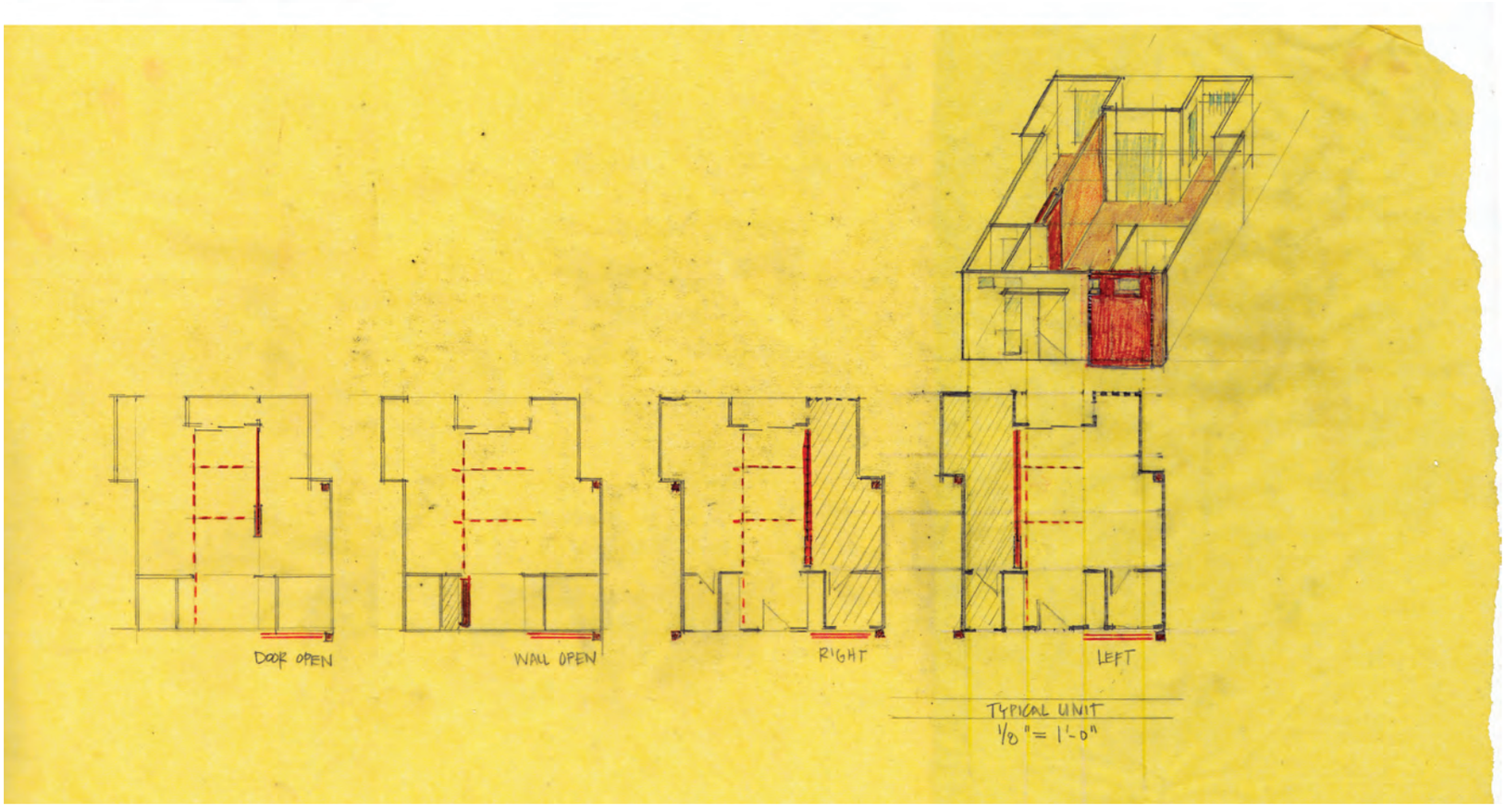
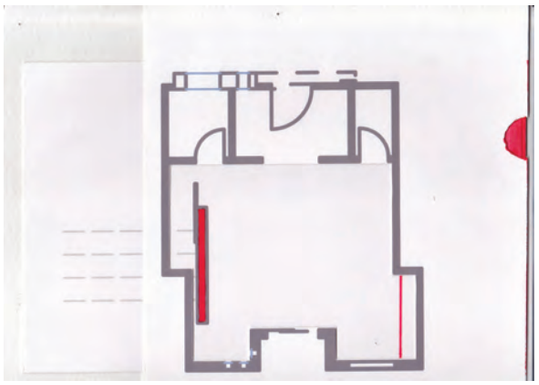
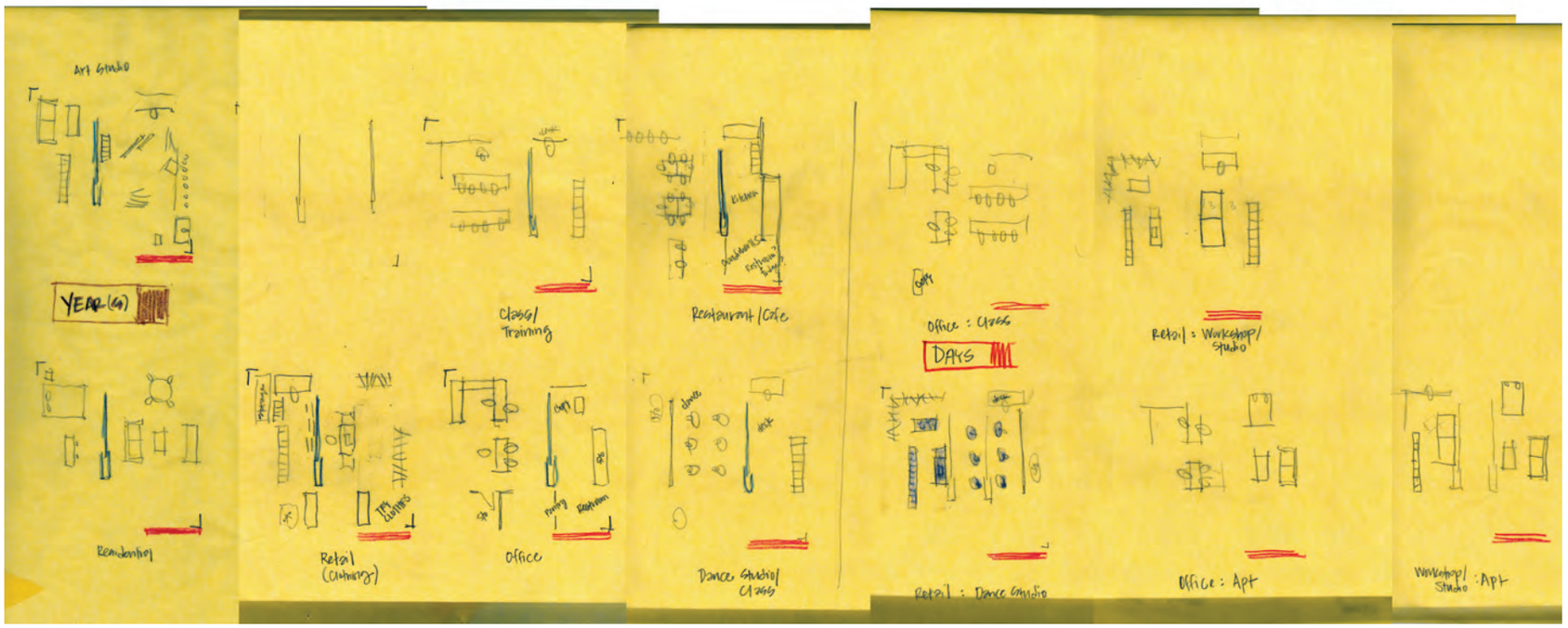


Figure 22. Diagram of airflow through typical apartment layout (top left)

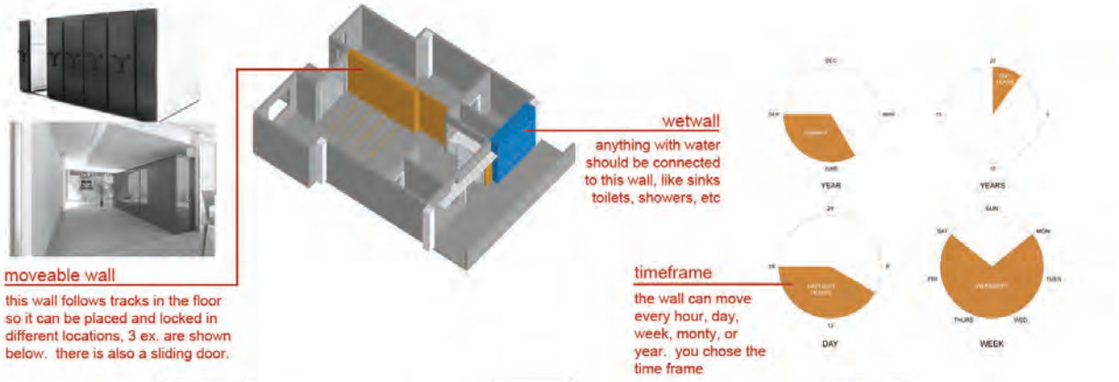


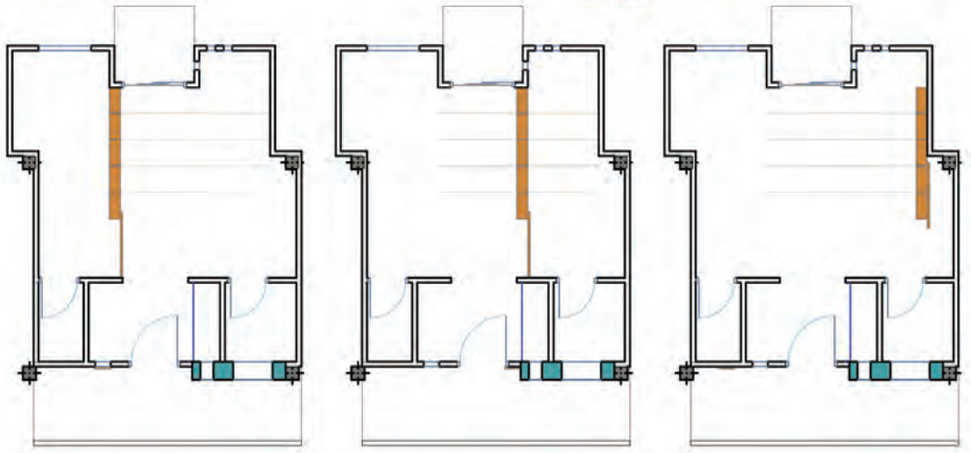

Art Studio
YEAR (G)
Residential
Class/ Training
Retail (Clothing)
Office
Restaurant/Cafe
Dance Studio/ Class
Office : Class
DAYS
Retail : Dance Studio
Retail : Workshop/ Studio
Office : Apt
Workshop/ Studio : Apt

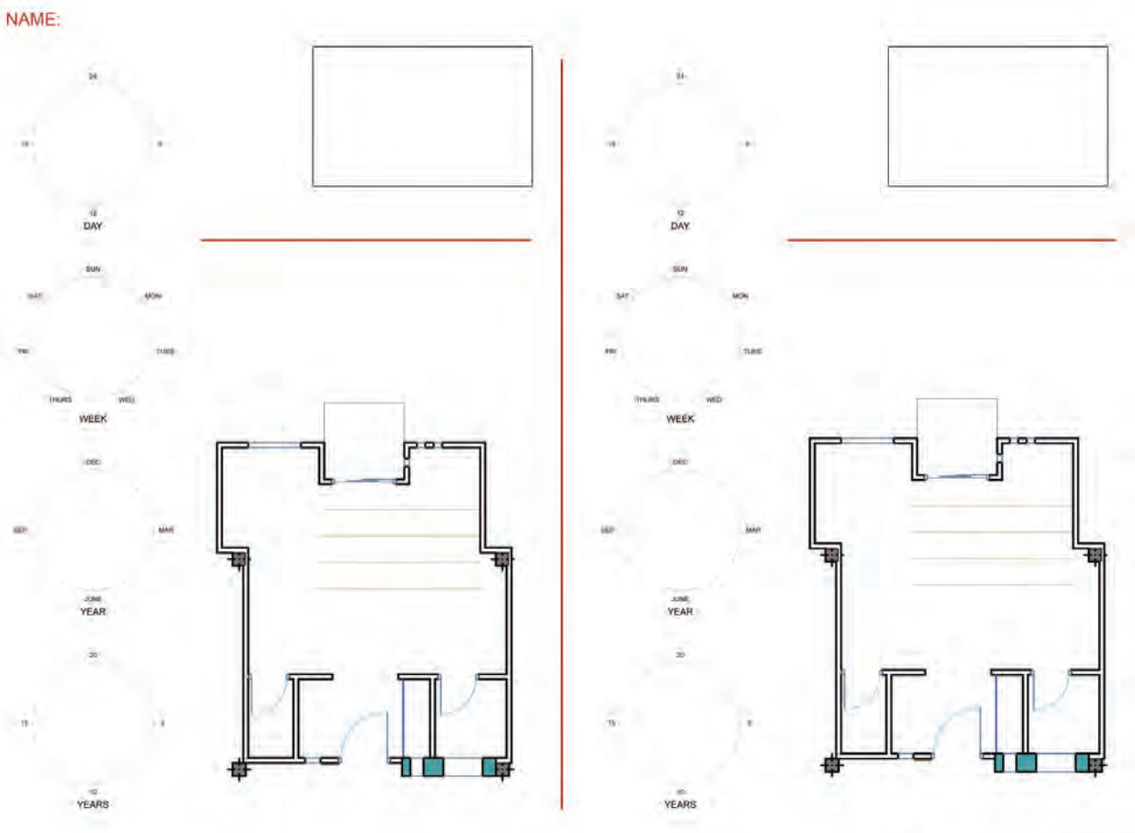
DESIGN A UNIT

MAKE YOUR OWN

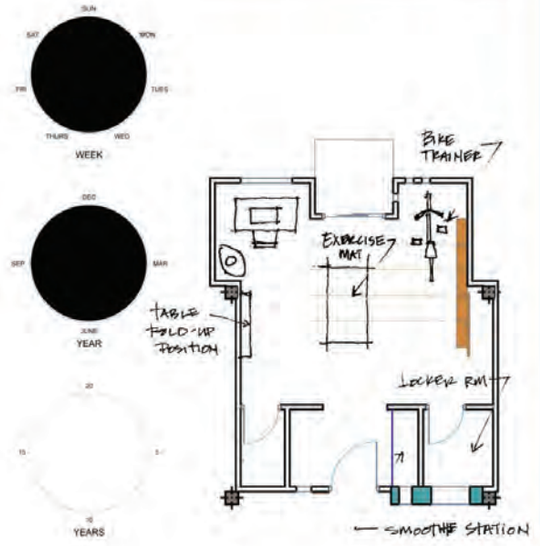
Here is an example of active participation with design. A template and sheet explaining the wet wall and moving wall unit components was sent to 20 friends. Many suggestions were made and responses were drawn out showing how they would use this unit type. Also shown was a time frame to explain when the shift would occur and how often.

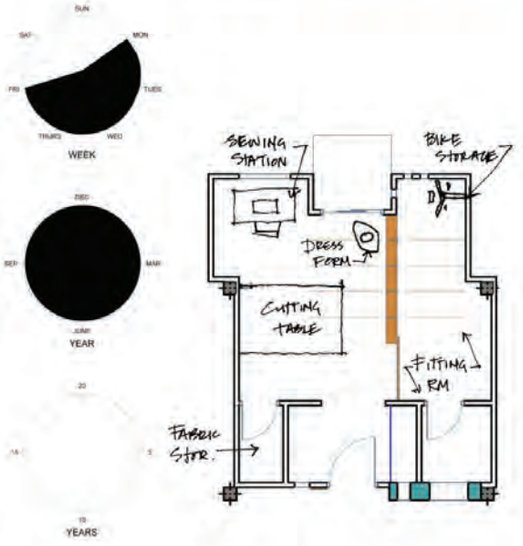






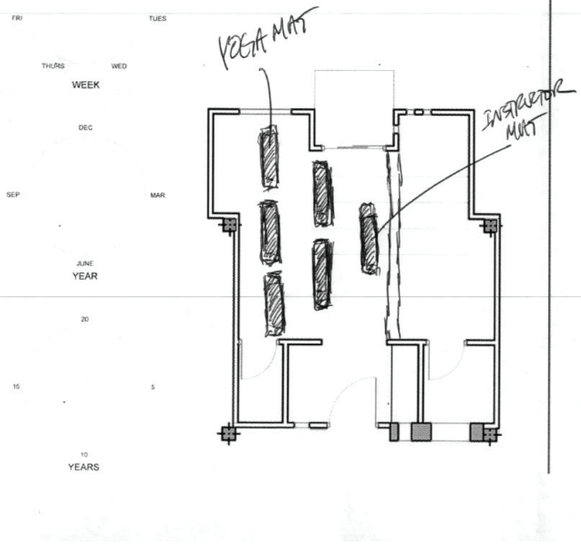
NAME: "Sweatshop" for an exercising seamstress



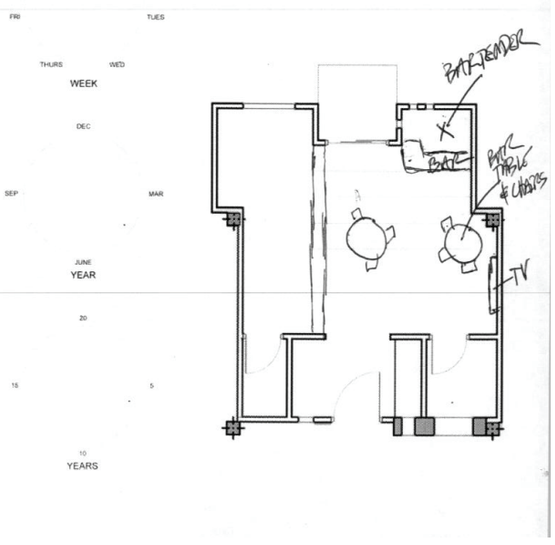


NAME:

YOGA STUDIO



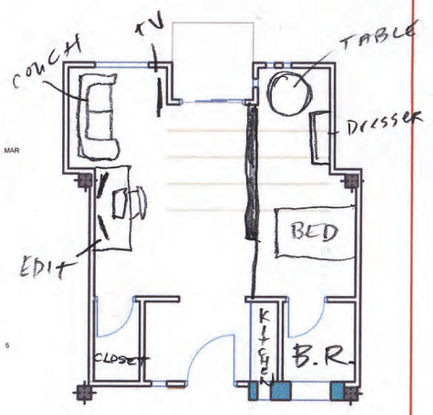
BAR



NAME: ADAM K.

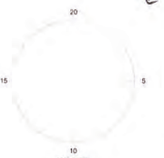
EDITING SUITE

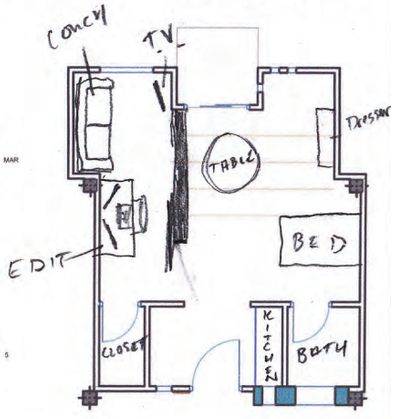
- Editing suite expands when working with clients.



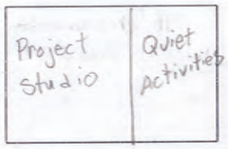
STUDIO APT

- Most of the time I will have it as a studio apt. I can still edit alone in the smaller portion



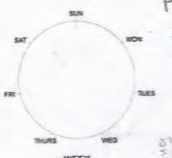


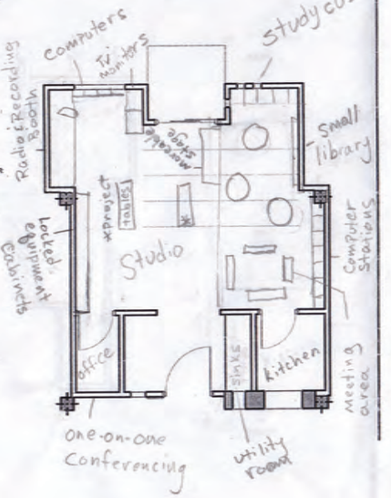
NAME: Emily Gasoi



2 Classrooms

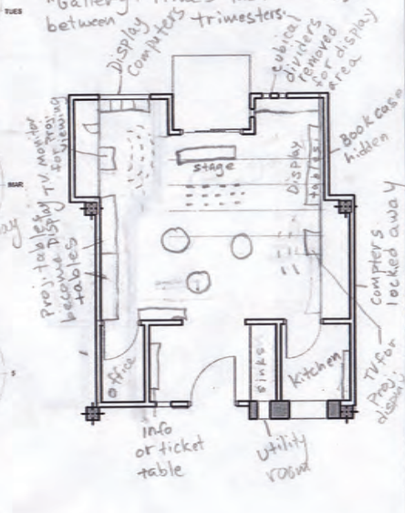
Project-based courses run in 3 mos. trimesters. Students work on projects over the 3 mos blocks indicated.



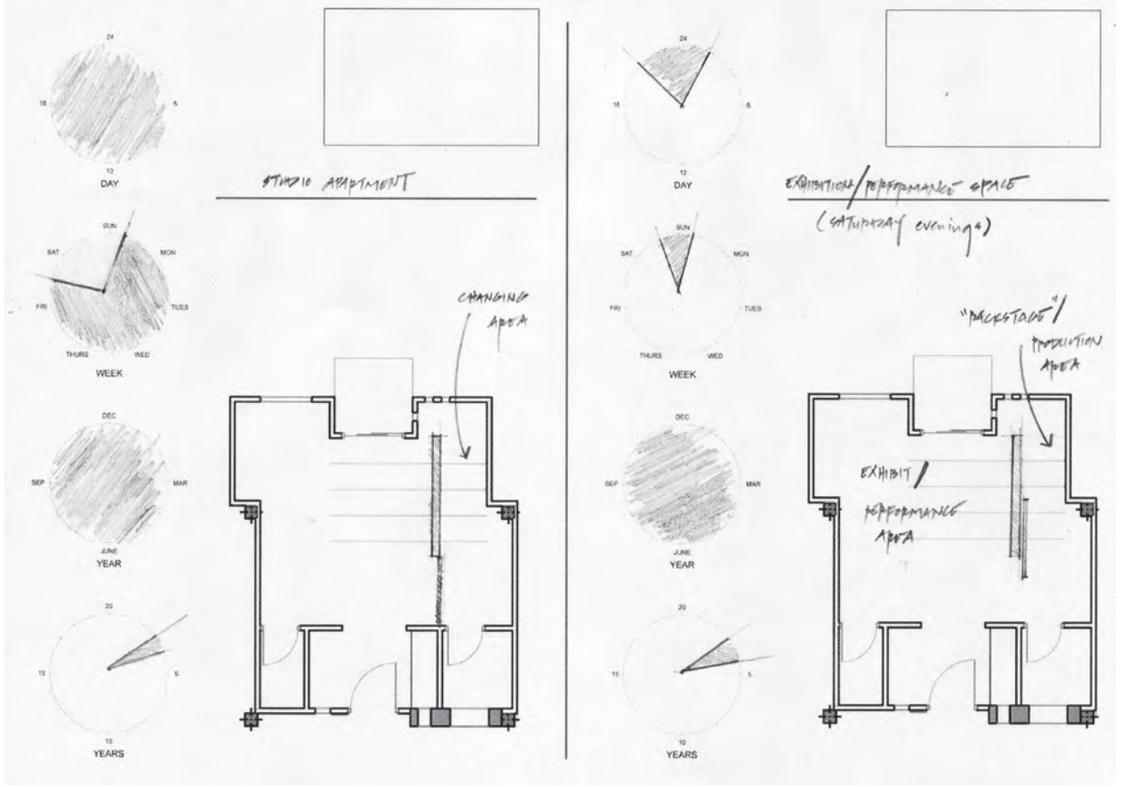


Assessment Gallery

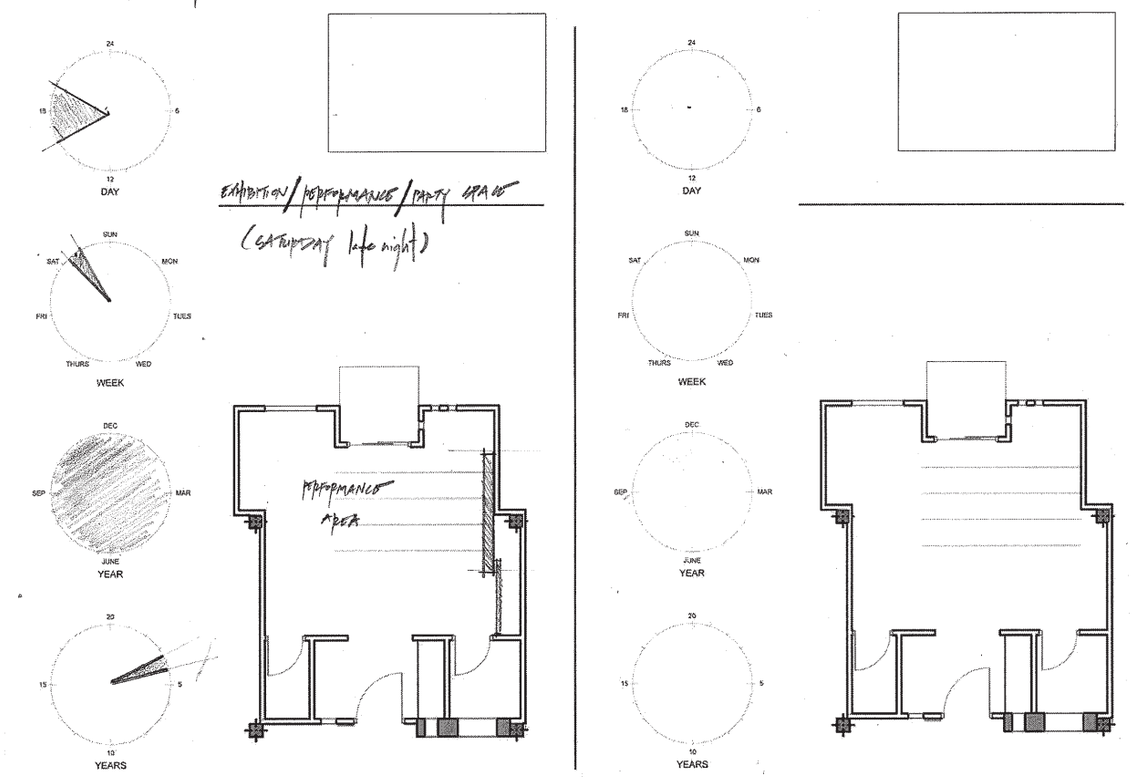
students are graded based on their ability to create a "product" that can be presented to teachers, family, community. "Gallery" times last one mos. between trimesters.



NAME: ANTHONY HARRIS



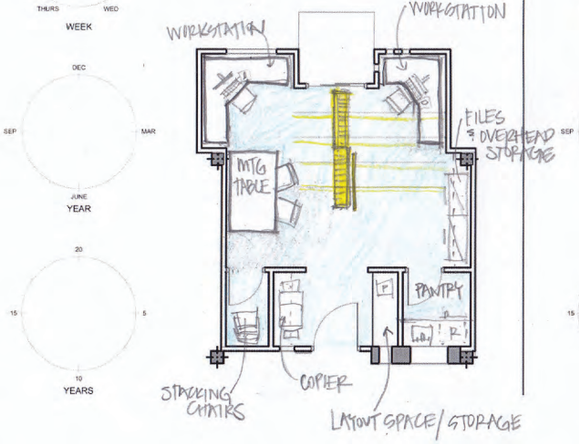
NAME: ANTHONY HARRIS

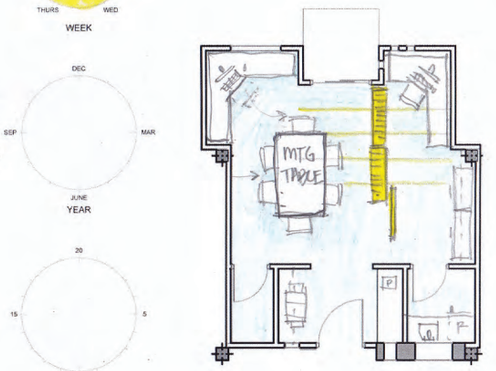


NAME: RAYYA

TWO OFFICES

CONFERENCE ROOM / OFFICE

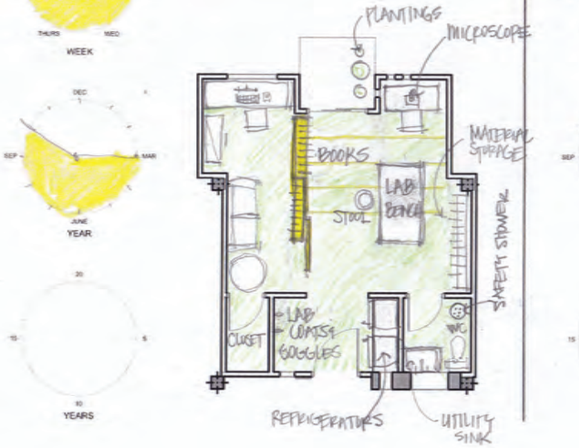


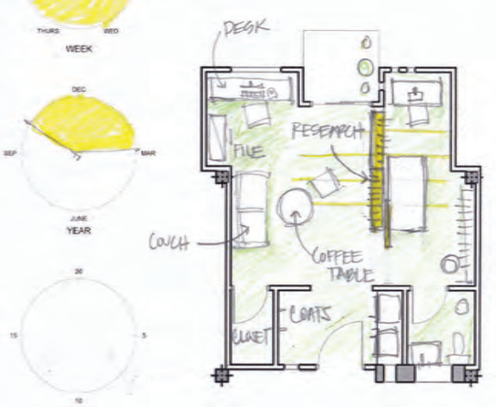


NAME: RAYYA

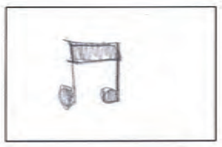
BOTANIST'S LABORATORY
TO PERFORM EXPERIMENT

BOTANIST'S OFFICE
TO RECORD EXPERIMENT

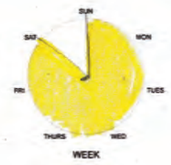


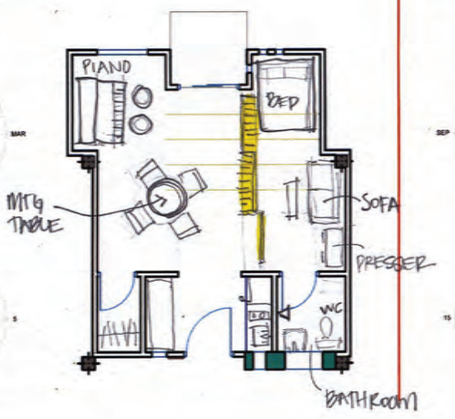


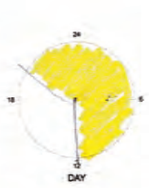
NAME: BAYYA



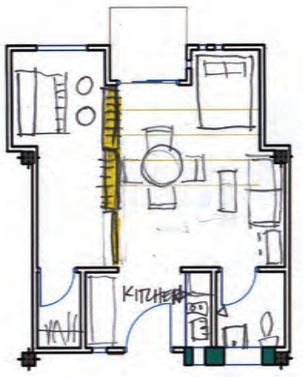
MUSIC LESSONS





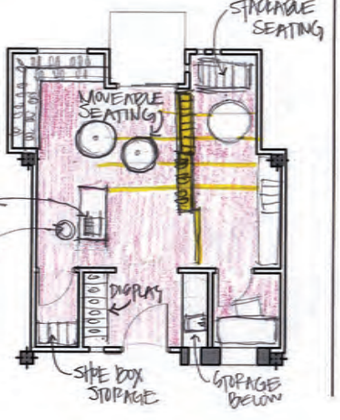


APARTMENT

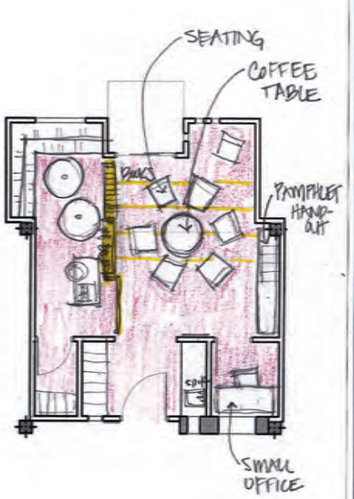


NAME:

SHOE STORE



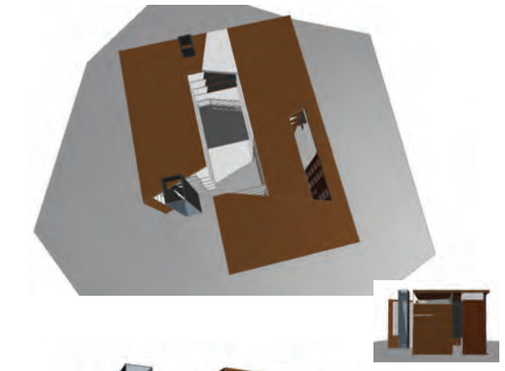
COUNSELING

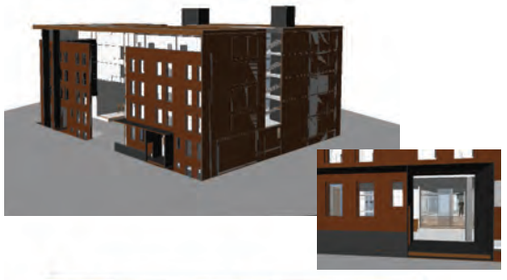


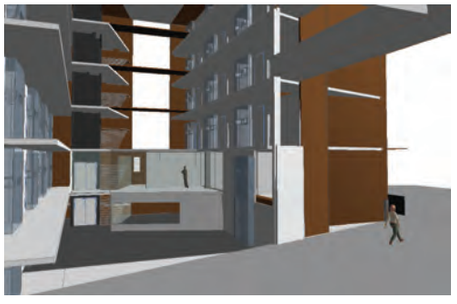
PENULTIMATE

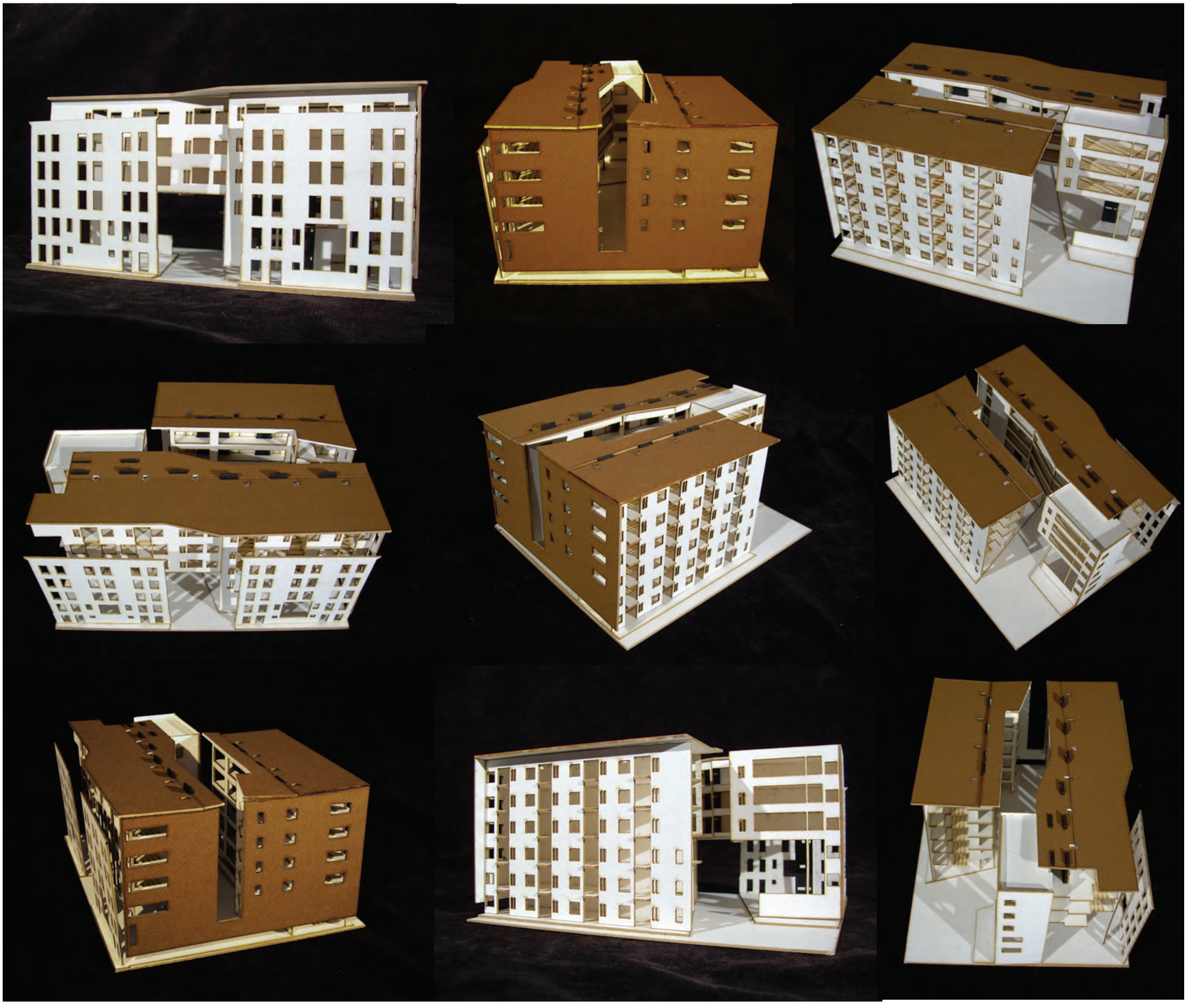
MODEL DEVELOPMENT

Building forms were explored through 3D modeling and physical models. The path to library is a distinct entrance to building's public areas. More units are added to public side to keep the same density as previous Deauville apartments.





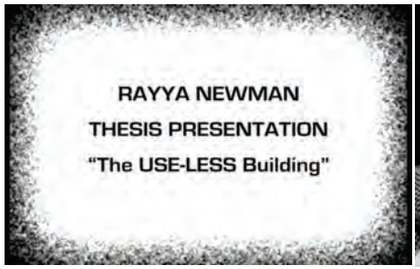


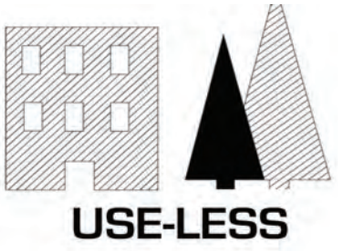


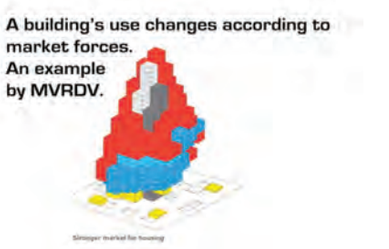
DEFENSE FILM

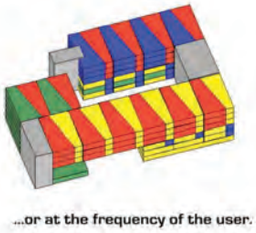
FILM

For the thesis defense a film with graphics, photographs, site video, and 3D model movies to explain project process and concepts, was presented. The three wall types are explored through this 4 Dimensional medium - Moving Wall, Wet Wall, and Existing Wall.
(Read from left to right)

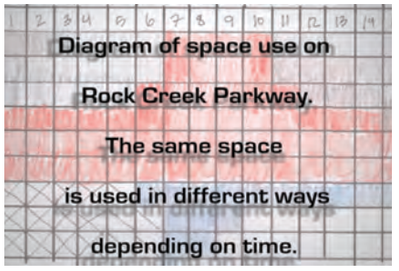


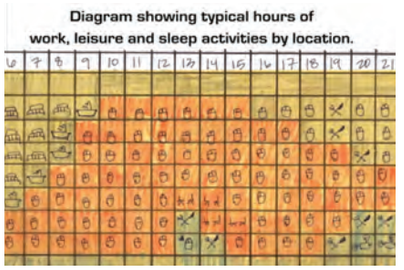


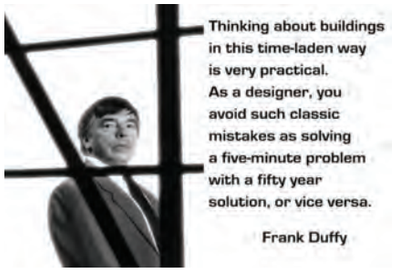


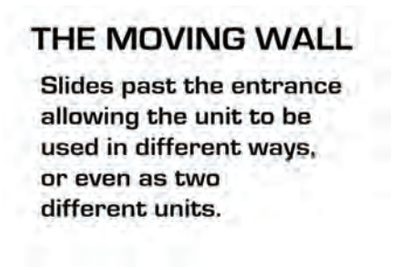


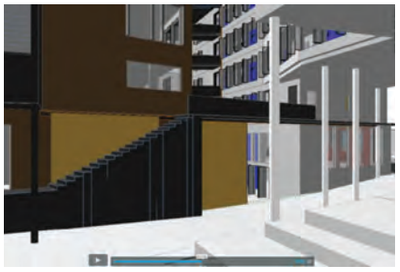
Our office buildings are empty half of the time.

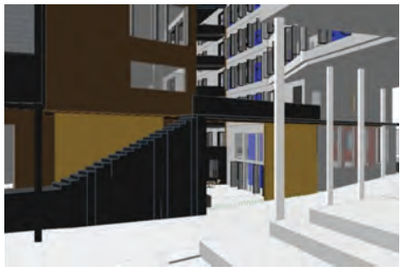


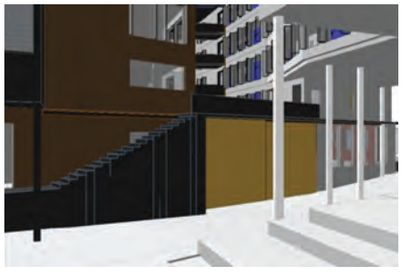


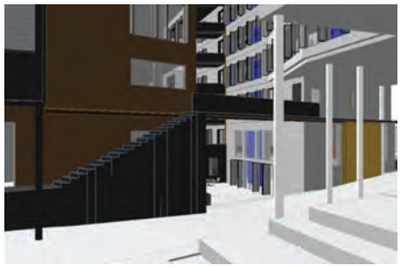


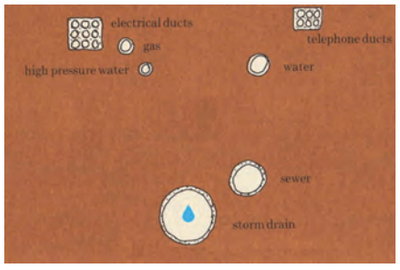


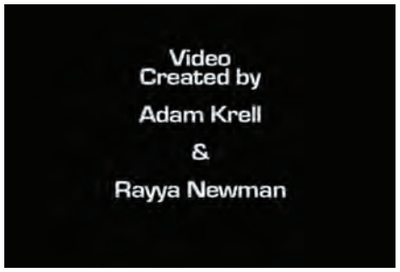




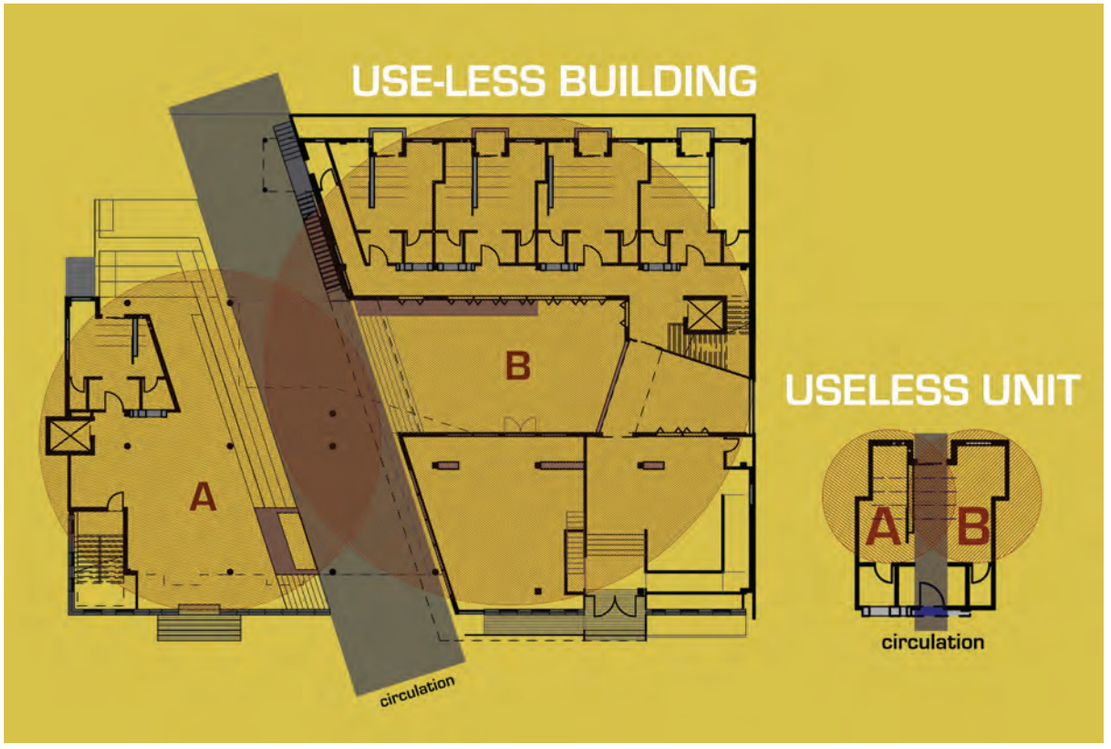








DEFENSE DRAWINGS

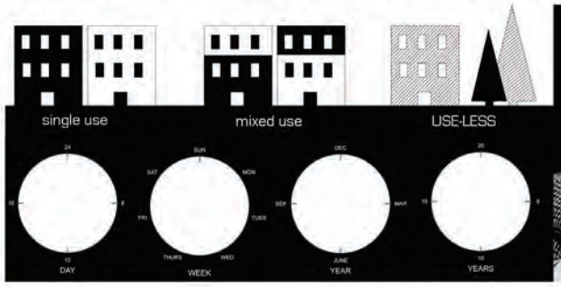


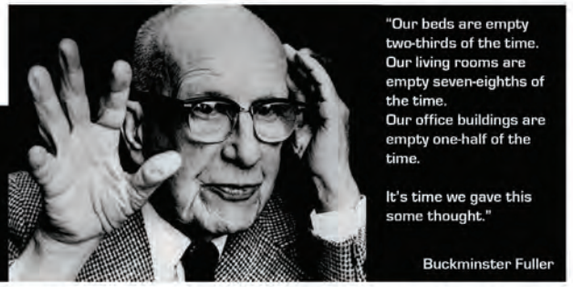
THESIS DEFENSE

A USE-LESS Building and a USE-LESS Unit are shown through interactive plans and sections. Collaged boards full of imagery explain the major concepts of the USE-LESS idea, the Moving Wall, Wet Wall, and Existing Wall.

USE-LESS

A USE-LESS building aims to use less sqft and resources by adapting over time and by accommodating various uses like apartments, stores, offices, cafes, etc.



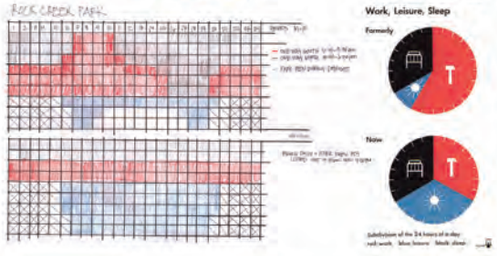


"Our beds are empty two-thirds of the time.
Our living rooms are empty seven-eighths of the time.
Our office buildings are empty one-half of the time.

It's time we gave this some thought."

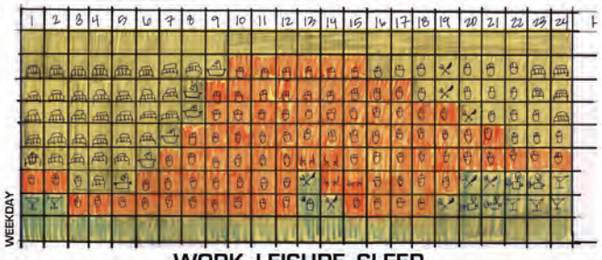
Buckminster Fuller

Work, Leisure, Sleep

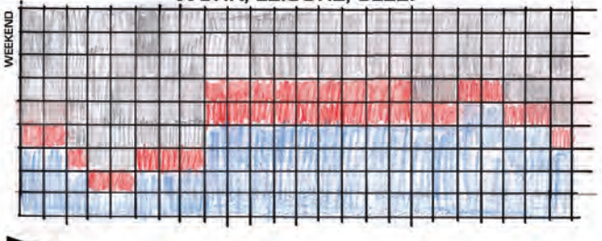


Formerly

Now



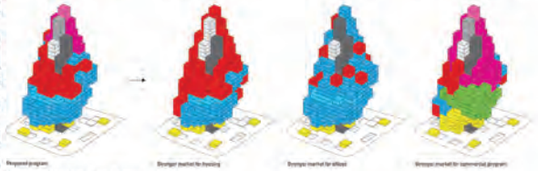
WORK, LEISURE, SLEEP



"Thinking about buildings in this time-laden way is very practical. As a designer you avoid such classic mistakes as solving a five-minute problem with a fifty-year solution, or vice versa. It legitimizes the existence of different design skills–architects, service engineers, space planners, interior designers—all with their different agendas defined by this time scale. It means you invent building forms which are very adaptive."

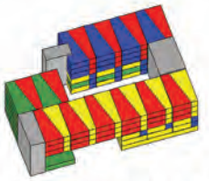
Frank Duffy

MVRDV

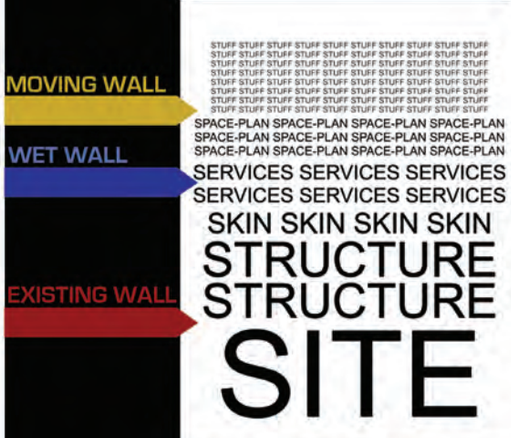


The flexible tower

adapting for market forces

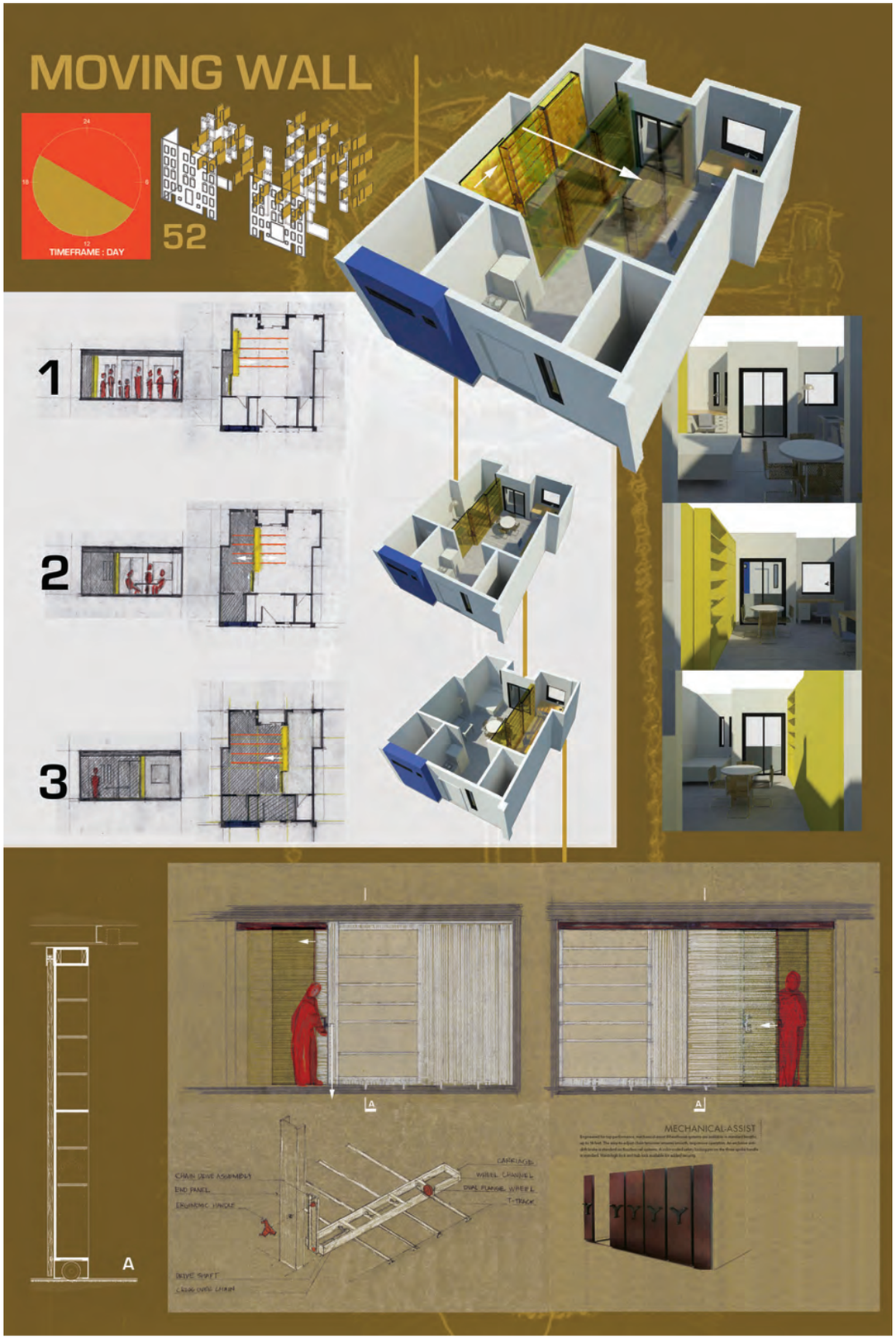


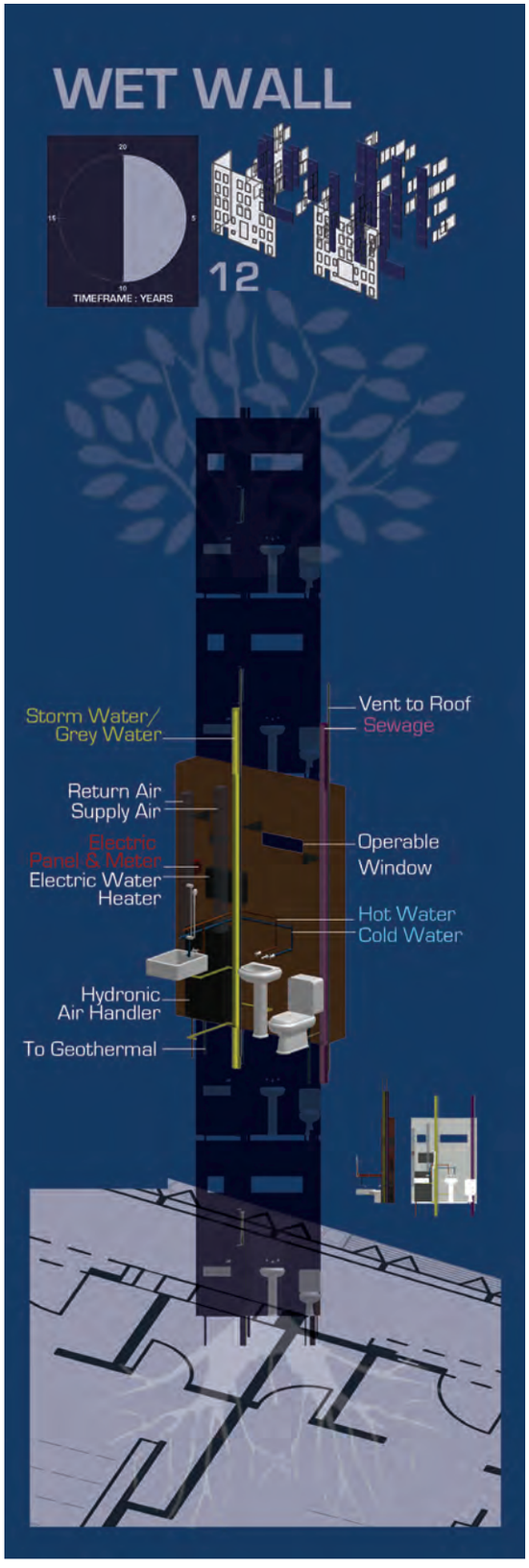
adapting more frequently for user



MOVING WALL
WET WALL
EXISTING WALL

These presentation boards were shown highlighting the 3 major components of this USE-LESS Building and how they relate to the time frame of change within a structure.

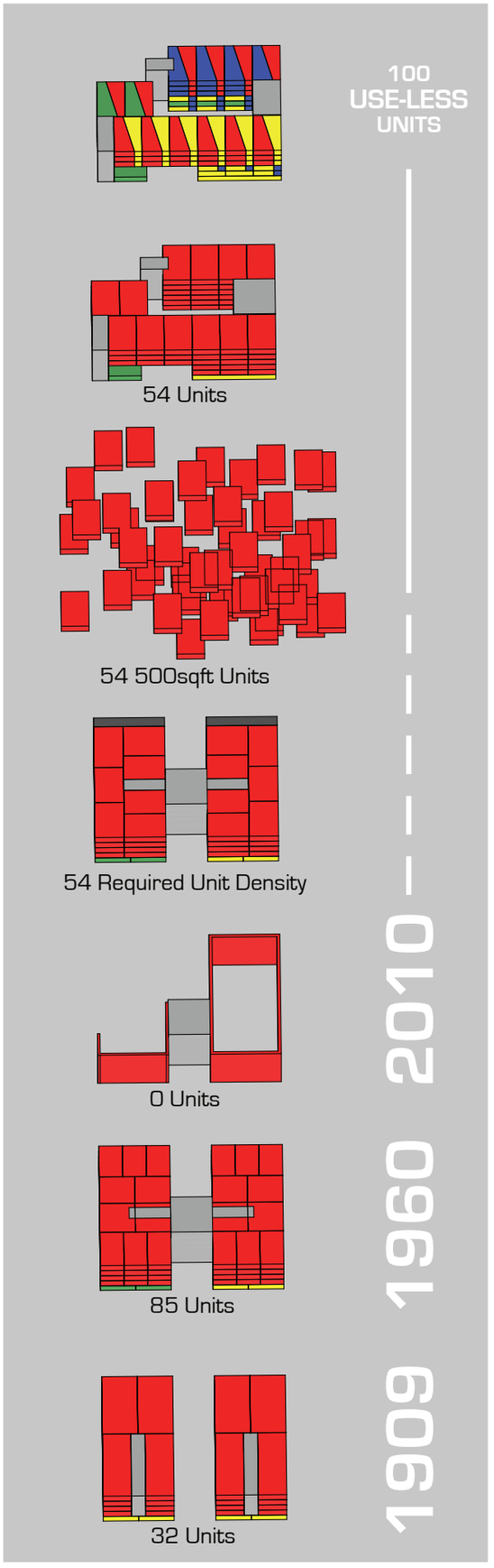



WET WALL
20
15
5
10
TIMEFRAME : YEARS
12
Storm Water/
Grey Water
Vent to Roof
Sewage
Return Air
Supply Air
Electric
Panel & Meter
Electric Water
Heater
Operable
Window
Hot Water
Cold Water
Hydronic
Air Handler
To Geothermal

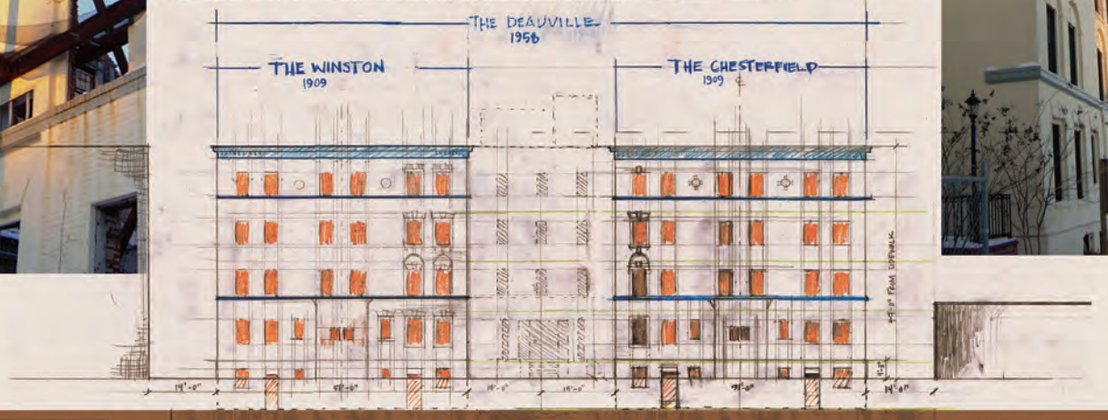
EXISTING WALL
20
15
5
10
TIMEFRAME : YEARS
2
A
B
A
B

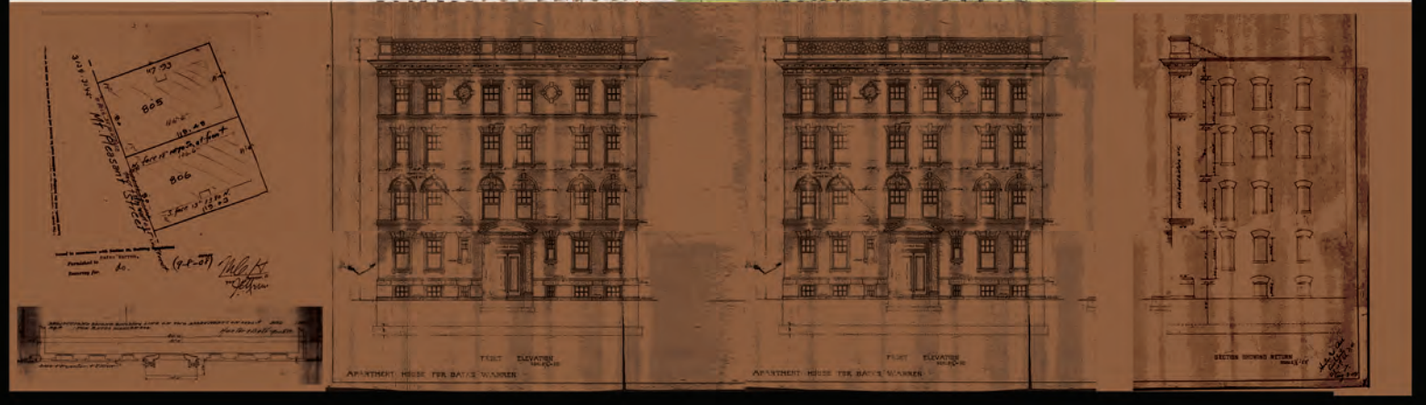
SITE HISTORY AND EXISTING WALL CONDITIONS

Each of these boards represent a vertical time line the starts with origin of the structure in 1909 at the bottom, moves into its present condition, and then the proposed building at the top.



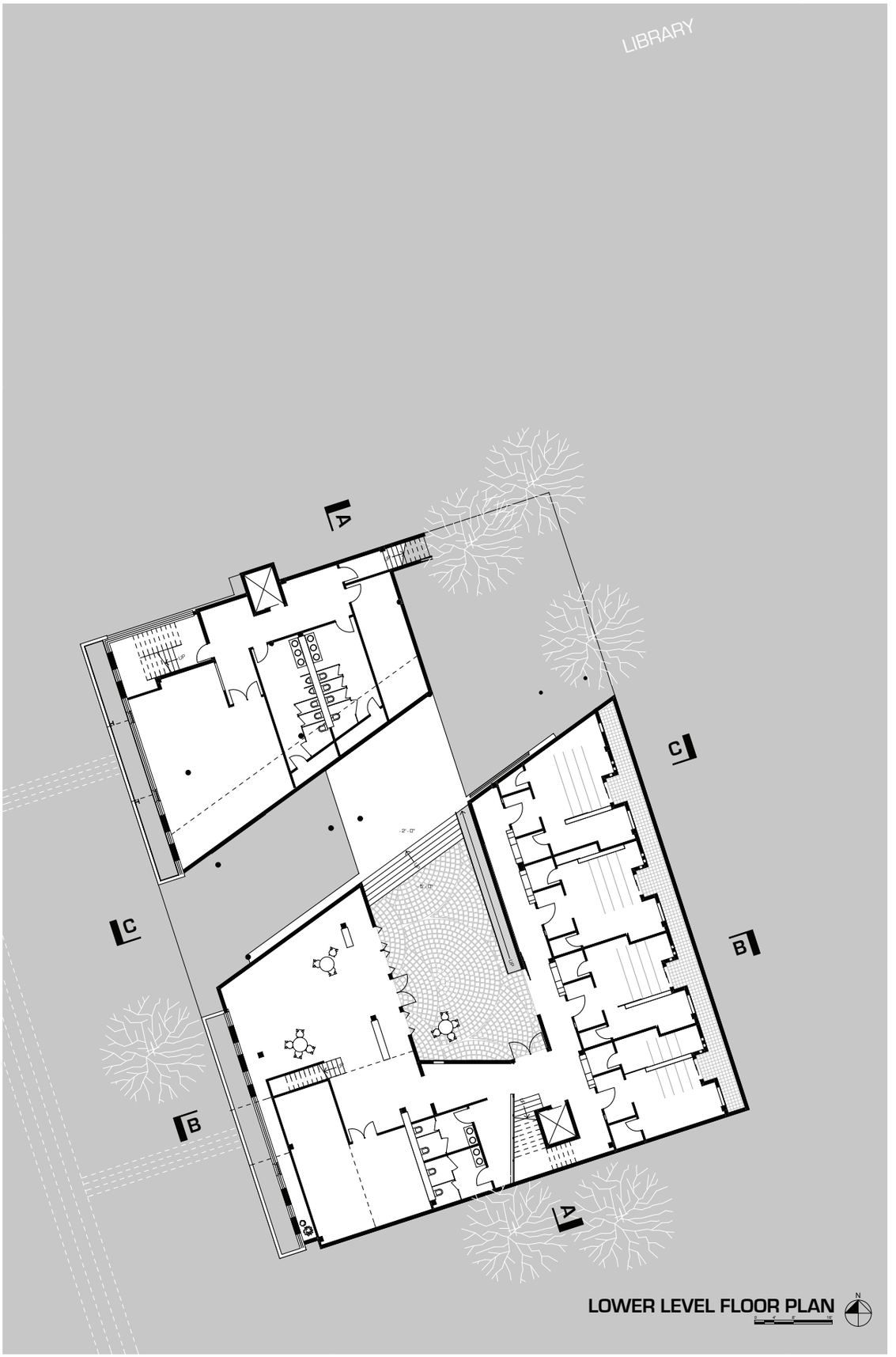
MOUNT PLEASANT STREET ELEVATION



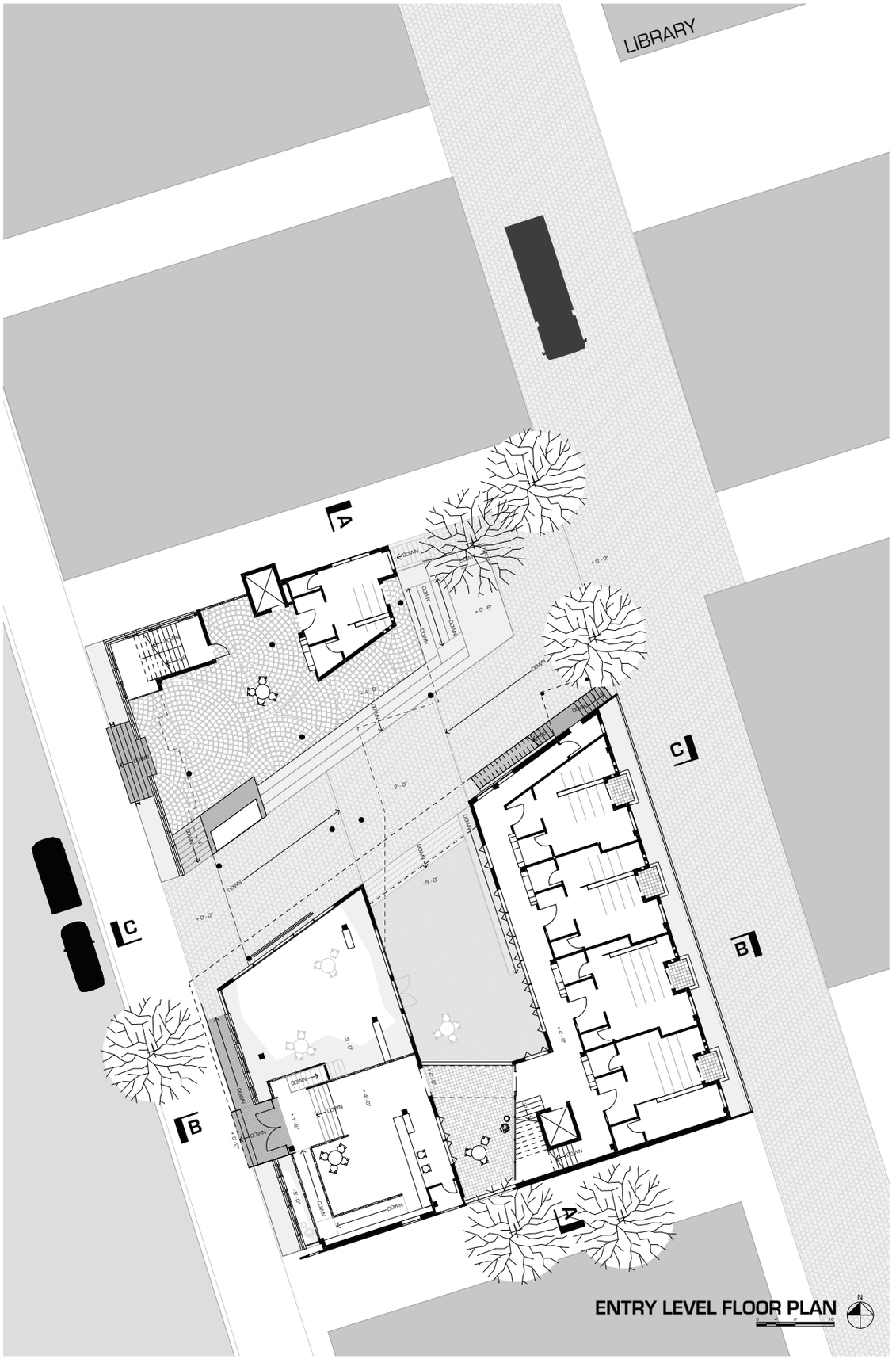


FLOOR PLANS

The Lower Level and Entry Level Floor Plans are shown here. The English basement level of the original building was complex to design with. Playing with many level changes and gradually bringing people up or down as the pass through the site is what creates a very inviting and interesting courtyard area. It also sets up ways in which the site is subtly divided and easily used for different events being public or private. Giant gates can completely close off the private side and make it its own building with a different function depending on market forces and community demands.



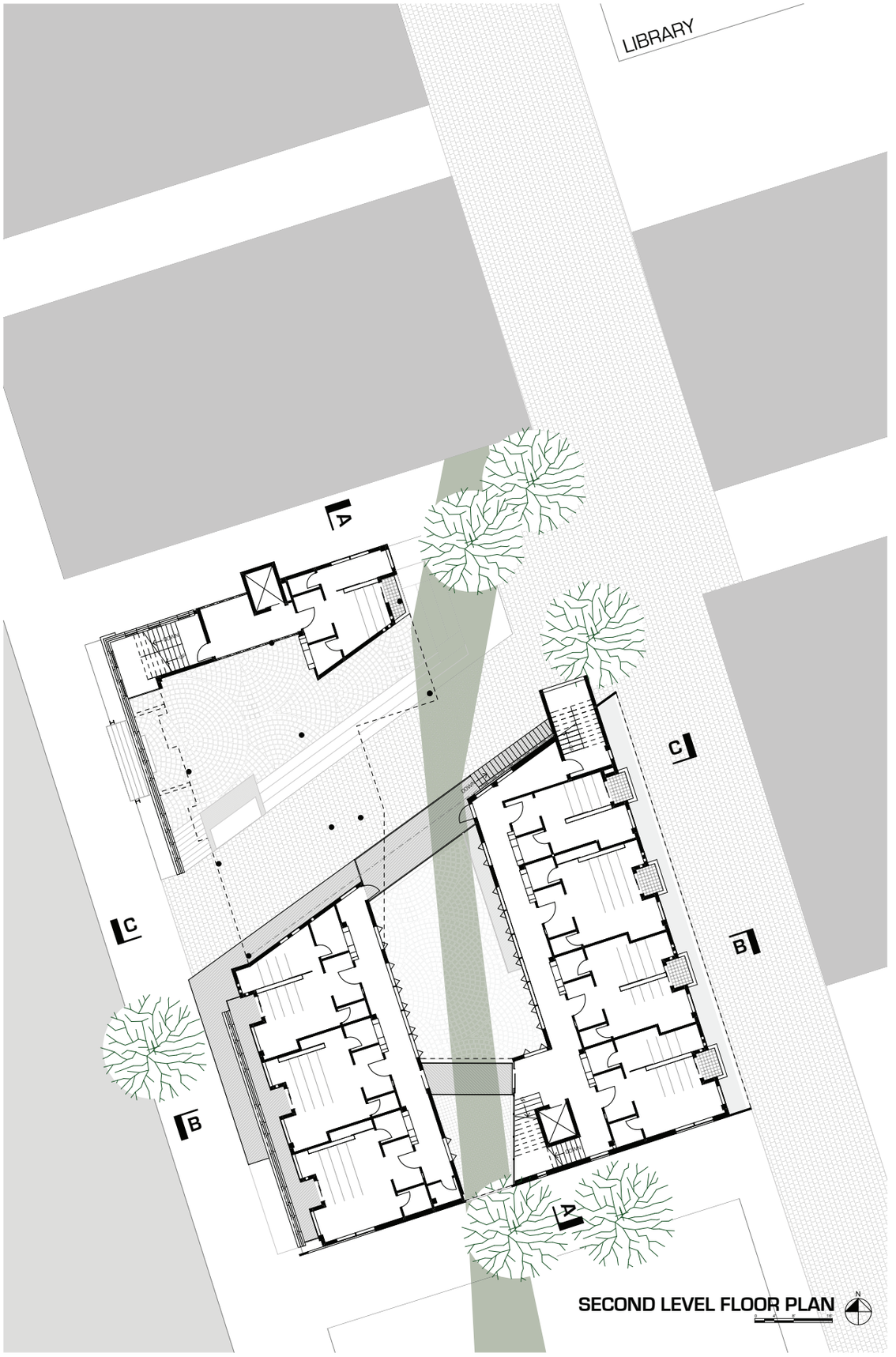
LOWER LEVEL FLOOR PLAN



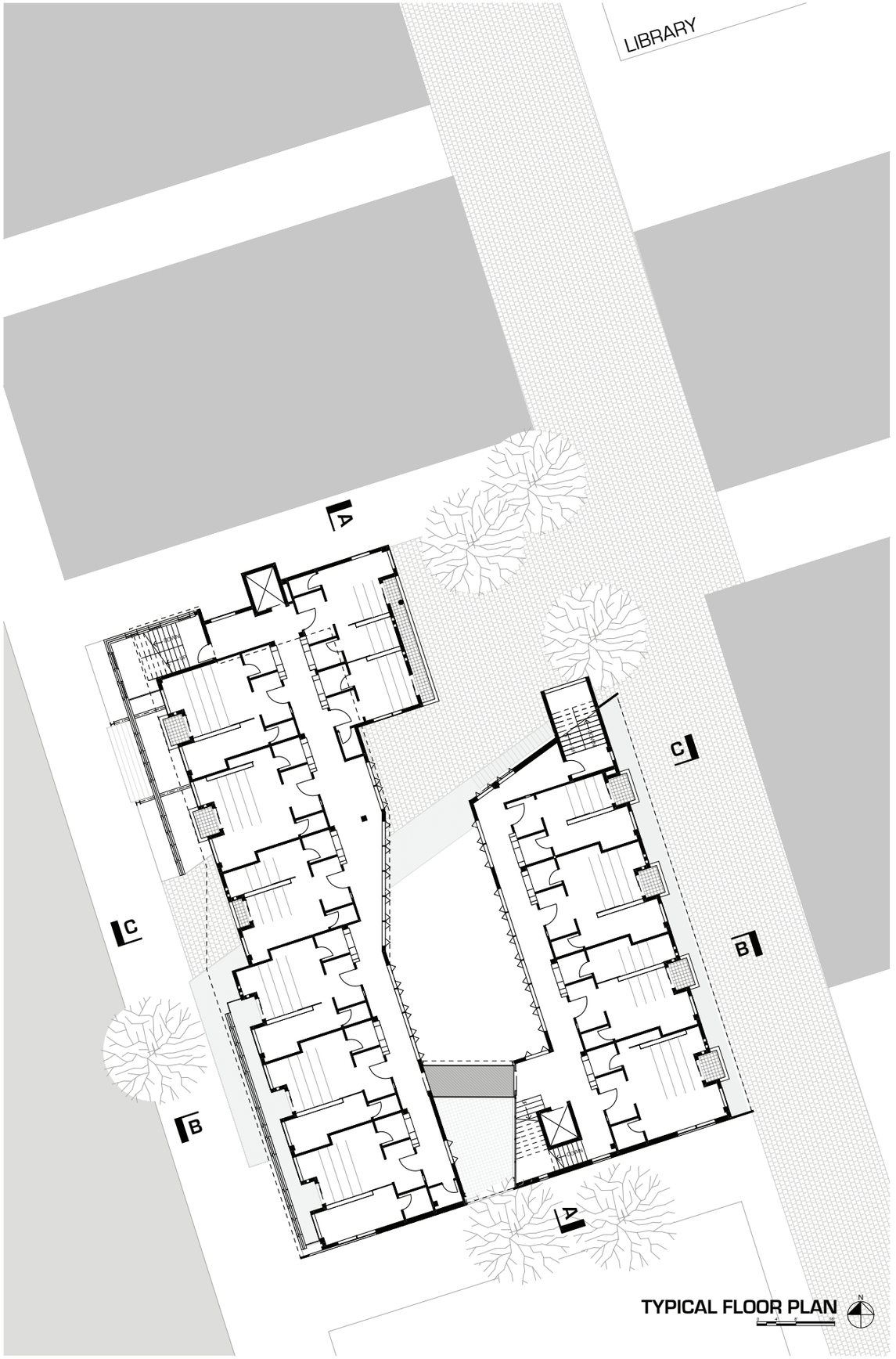
ENTRY LEVEL FLOOR PLAN

FLOOR PLANS

The Second Level and Typical Floor Plans show the units and their relationship with the entire building. On the Second floor a unit is shown alone with much public exposure making it more popular as a commercial space. Bridges connect the unit groups creating interesting views and openings allow cool southern breezes during the summer to flow through the courtyards and units. For the typical floor the moving wall is shown in various locations showing the variety of layouts possible within each unit.



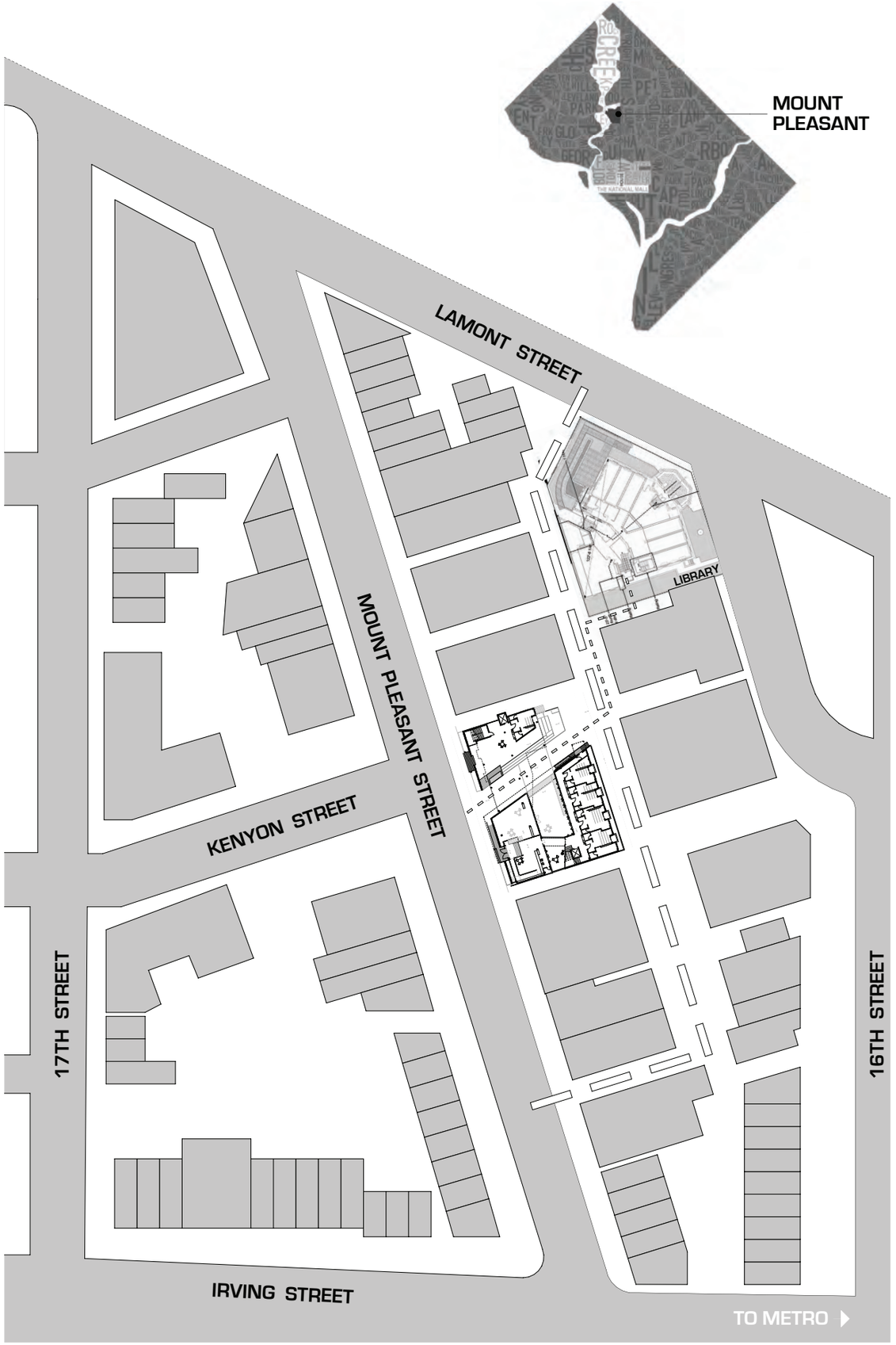
SECOND LEVEL FLOOR PLAN

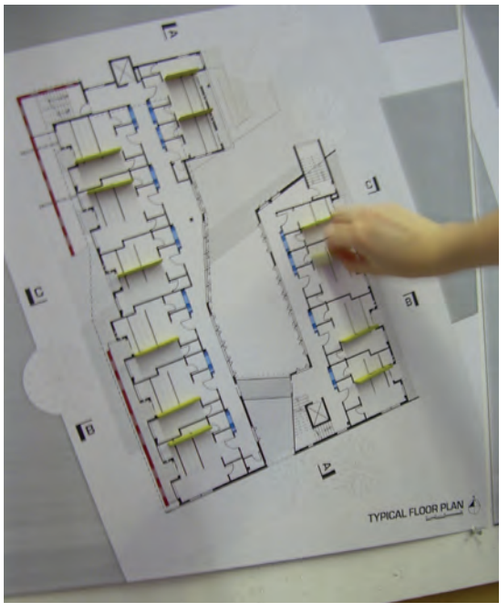


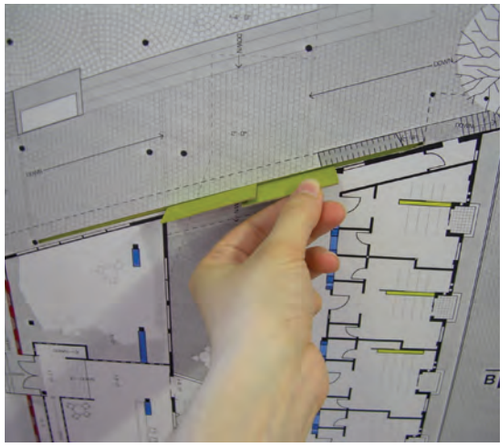
TYPICAL FLOOR PLAN

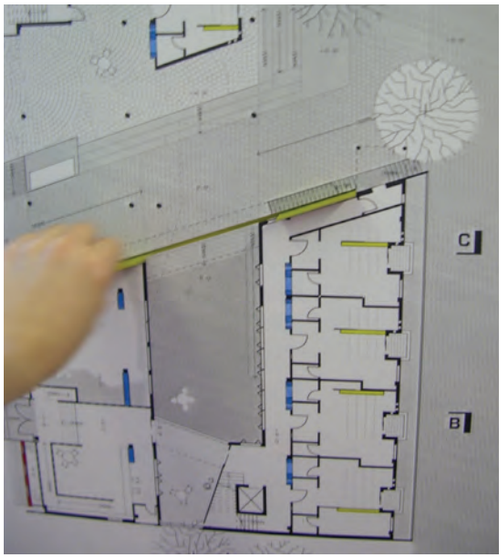
SITE PLAN

The site plan is of the main street, Mount Pleasant Street. It shows that the building is at the center of this area and at an intersection, Also proposed, which drove much of the building's design, was the interior connection to the Library which is not currently on the main street.







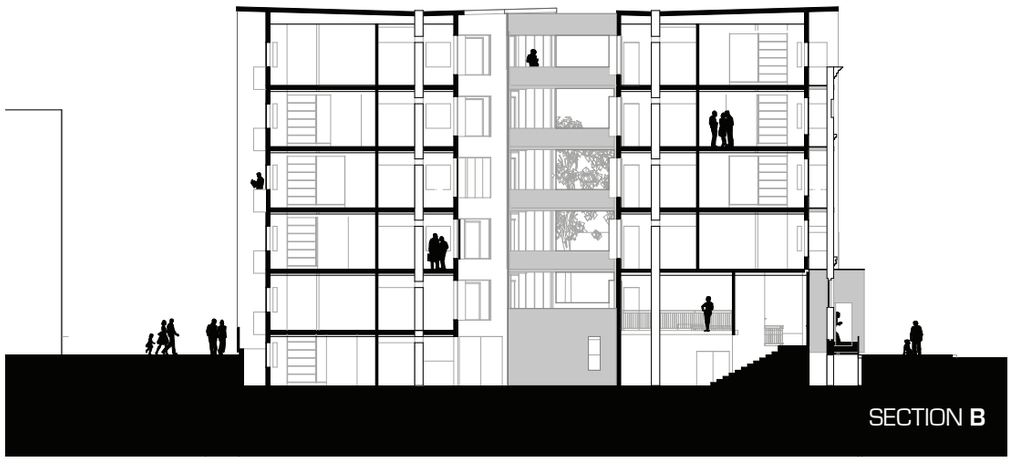


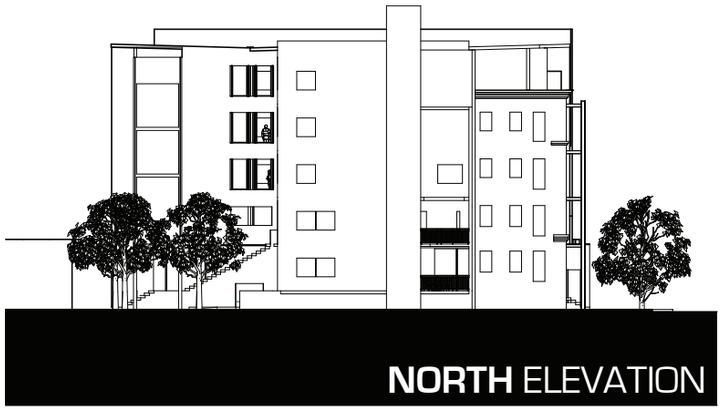
INTERACTIVE DRAWINGS

Thesis defense drawings had interactive pieces to engage the audience. The Typical Floor Plan had the unit Moving Wall slide back and forth to try out different unit options. The Section had a scale model of the unit with a Moving Wall as well. The Entry Level Floor Plan had the giant Moving gates that slid to close off the public and private sides of the building and showed how different locations could create different views into the courtyard.

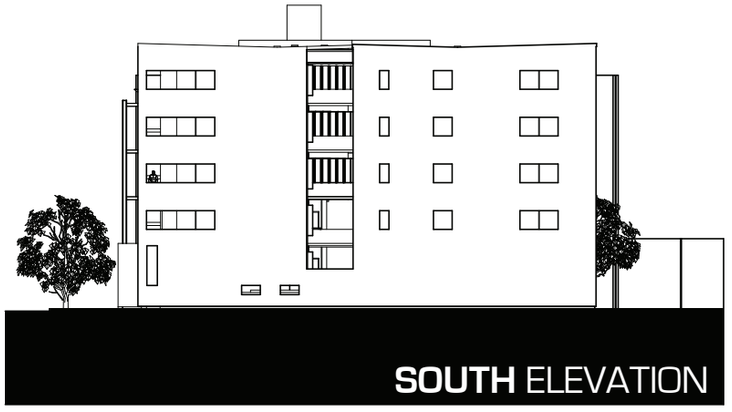
SECTIONS AND ELEVATIONS

These sections show the levels and interactions of the courtyard spaces. The elevations show the breezeway openings. The back elevation is shown with a site plan of the back alley connection to the library and a diagrammatic expression of the uses of the surrounding buildings and spaces.

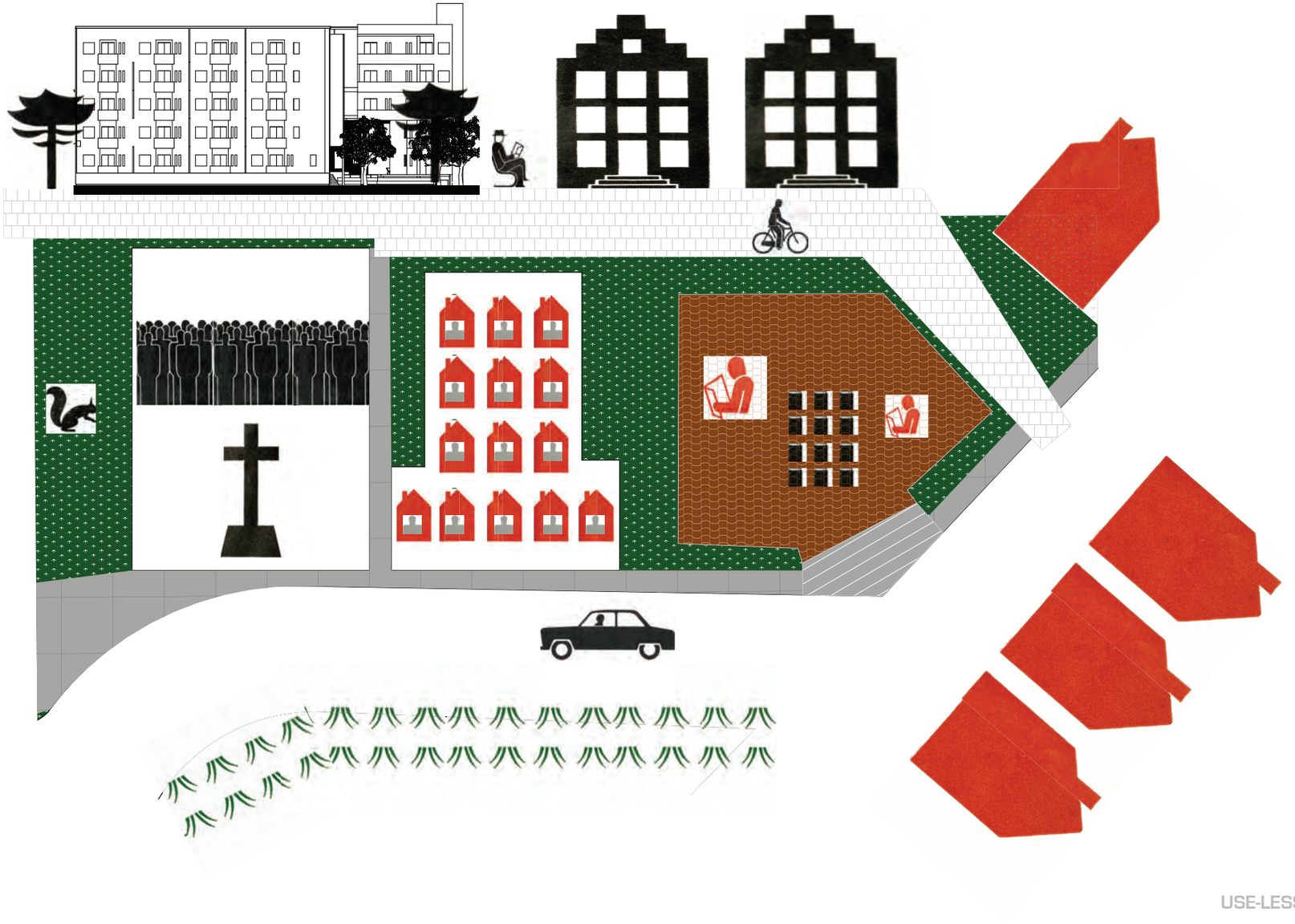




NORTH ELEVATION



SOUTH ELEVATION

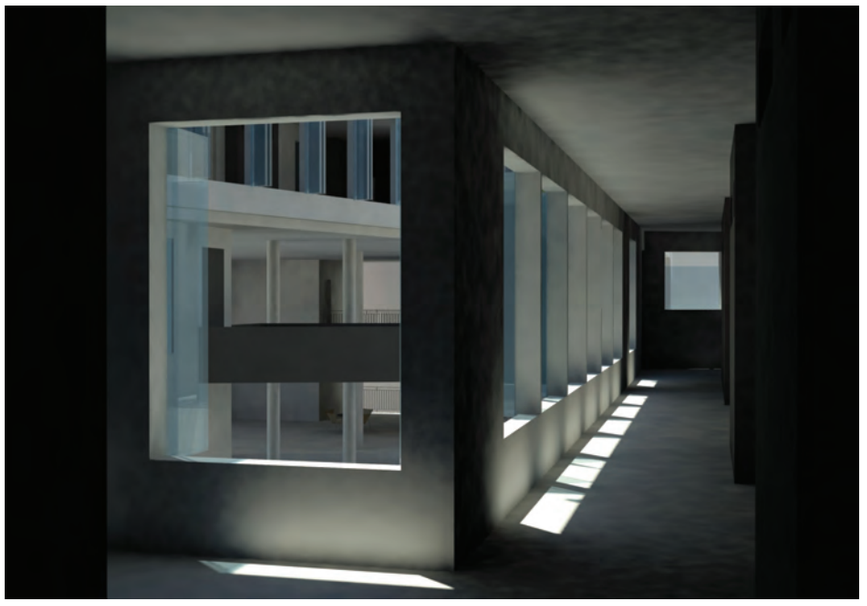


MODEL

These are 3D renderings of the USE-LESS Building. The close-up is a view from the main street entrance toward the Library.

MODEL

These are 3D renderings of the courtyard interiors. To the right is a view from the Library path to the front entrance. Below is from the Library path to the private side of the building. On the opposite page is an interior corridor view and below is a view from the sunken courtyard on the private side towards the public side. Performers are shown on stage as a possible use for events.



IMAGES

Figure 1. Buckminster Fuller Institute <www.bfi.org>
Figure 2. Image of Frank Duffy - google image search
Figure 3. Stewart Brand. How Buildings Learn.
Figure 4. Koji Yagi. Photographs by Ryo Hata. A Japanese Touch for Your Home.
Figure 5. Jennifer Leonard. Illustrations by Mark Weaver. Hurry Up and Wait. GOOD Winter 2010.
Figure 6. Robert Kronenburg. Flexible.
Figure 7. Robert Kronenburg. Flexible.
Figure 8. Olson Kundig Architects. <http://www.olsonkundigarchitects.com/>
Figure 9. Olson Kundig Architects. <http://www.olsonkundigarchitects.com/>
Figure 10. Bernard Khoury. <http://www.bernardkhoury.com/>
Figure 11. Live/Work/Home. Web. <http://www.liveworkhome.com/>
Figure 12. Live/Work/Home. Web. <http://www.liveworkhome.com/>
Figure 13. Live/Work/Home. Web. <http://www.liveworkhome.com/>
Figure 14. MVRDV. Web. <http://www.mvrdv.nl/#/projects>
Figure 15. MVRDV. Web. <http://www.mvrdv.nl/#/projects>
Figure 16. Otto Neurath. Modern Man in the Making.
Figure 17. Chart created from U.S. Census Bureau Daytime Population data 2000.
Figure 18. District of Columbia Office of Planning Existing Land Use Map.
Figure 19. Historic Mount Pleasant. <http://www.historicmountpleasant.org/home.html>
Figure 20. Image of Maison de Verre <http://untappedparis.wordpress.com/2010/07/28/the-maison-de-verre-house-of-glass/>
Figure 21. Image of Maison de Verre <http://untappedparis.wordpress.com/2010/07/28/the-maison-de-verre-house-of-glass/>
Figure 22. G.Z. Brown and Mark DeKay. Sun, Wind, & Light.

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