Abstract

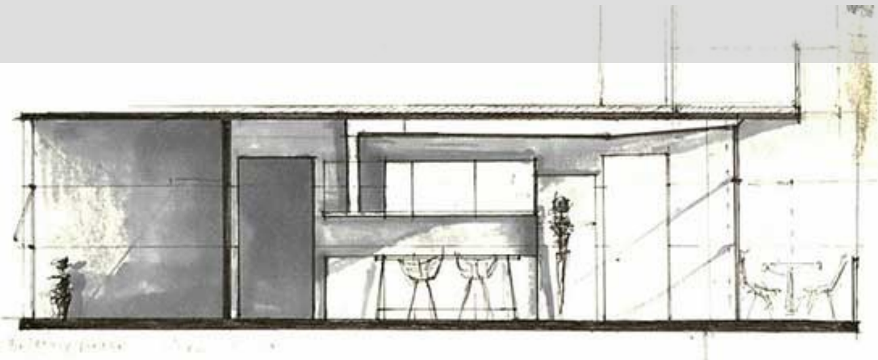
Time • Place • Type, a housing thesis studio, prepares students to become both architects of complex housing projects in today's housing production system, and informed agents to effect change in that system, addressing one of the root causes of climate change.

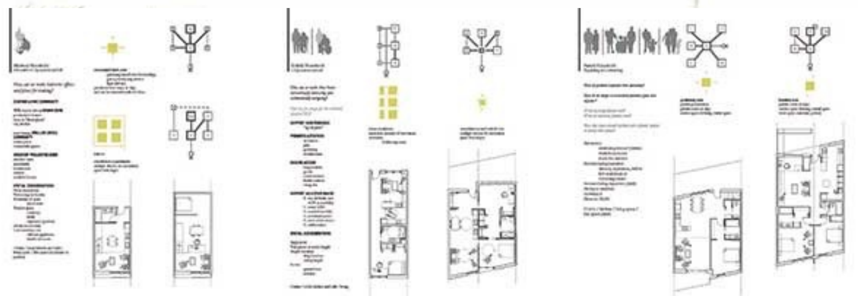
The studio responds to the primary challenge of our **time** by including detailed sustainability strategies from the beginning of the design process. This global problem is addressed through the development of universal **types**, at all scales. These types are then adapted to meet the specific conditions of different **places**.

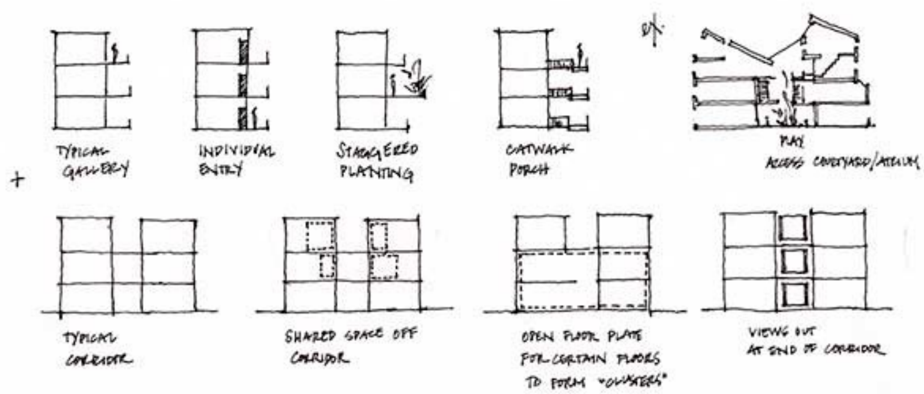
The two-term studio is preceded by a preparatory course, which covers current issues, technologies and processes in housing production. Each student produces a hypothetical but detailed housing project proposal.

In the winter term, each student first develops a kit-of-parts, which embodies spatial, organizational, material and environmental strategies, beginning at the scale of the room, and moving up through unit, cluster, building, and site relationships. A green building consultant participates throughout, reviewing strategies and guiding the students through energy modelling, based upon the Passive House approach, with the goal of each project achieving net-zero status. Near the end of the first term, students finalize their individual thesis agenda and programs, and select sites. Conceptual building design follows, using the kit-of-parts in the first iteration adapted to a specific site.

The second term begins with schematic design of the building, including rough financial pro-formas and energy analyses. A midterm review brings in experienced housing architects, to give students a professionally-oriented critique. The second half of the term is for design development, returning to the building fabric strategies developed in the kit-of-parts phase, and bringing them up to scale. The final presentation and report includes detailed analyses of project finances, energy consumption, and other relevant systems.







The primary challenge of our era is to change the course of our society to reduce the impacts of unavoidable climate change. The carbon footprint of the United States is largely the result of our preference for the detached house and the consequent development pattern of sprawl over the past half-century, a pattern that has now spread to the rest of the world that can afford it. If we are to make any progress in slowing climate change, we must find alternative models for housing our population. Architects have set a demanding agenda for themselves with the 2030 Imperative. But we need more than resolve; we must extend our knowledge and skills so that as society shifts towards a more responsible way of dwelling, we have some clear and ready answers. We should respond to global concerns with a range of universal types that can fulfill our changing needs and address our changing circumstances, and with a firm grasp on emerging technologies that will enable us to reach those goals.

time

But while we architects welcome innovation, everyone else in the housing production process likes the status quo. Most neighborhoods don't want new housing types or higher density. Government agencies take forever to change codes and regulations. Developers want to keep making money doing the same kinds of projects. If our proposals are ever to have an impact in the world outside academia, we must learn how to adapt our universal goals and types to meet local concerns and conditions, to reinforce the existing places. Technological solutions which ignore the reality of current constraints – market preferences and financial feasibility – will see limited implementation and have little effect.

place

Premises and goals

- Sustainable inhabitation of the earth by humans can only be achieved through changing the **typical** patterns of building and dwelling in the modern world, at all scales. Individual signature buildings will not do it.
- Housing and settlement pattern are critical places to focus, perhaps the most critical.
- While housing design must respond to particular parameters (site, market, program), it must also respond to global parameters (building technology, production system, economics, environmental goals).
- Responding intelligently to the global parameters will yield clear housing types (at all scales) and systems, which can then be adapted to address local and particular conditions.
- Projects should push the boundaries towards serious environmental response, integrating issues of sustainability with programmatic demands and spatial design from the beginning.
- However, students must demonstrate where their projects fall in terms of technological, social and economic feasibility, according to current conditions.
- Architecture students should graduate with more than good intentions - we can use this time in school to test new ideas and prototypes, seeing which ones could rebuild and reorient the housing production system.

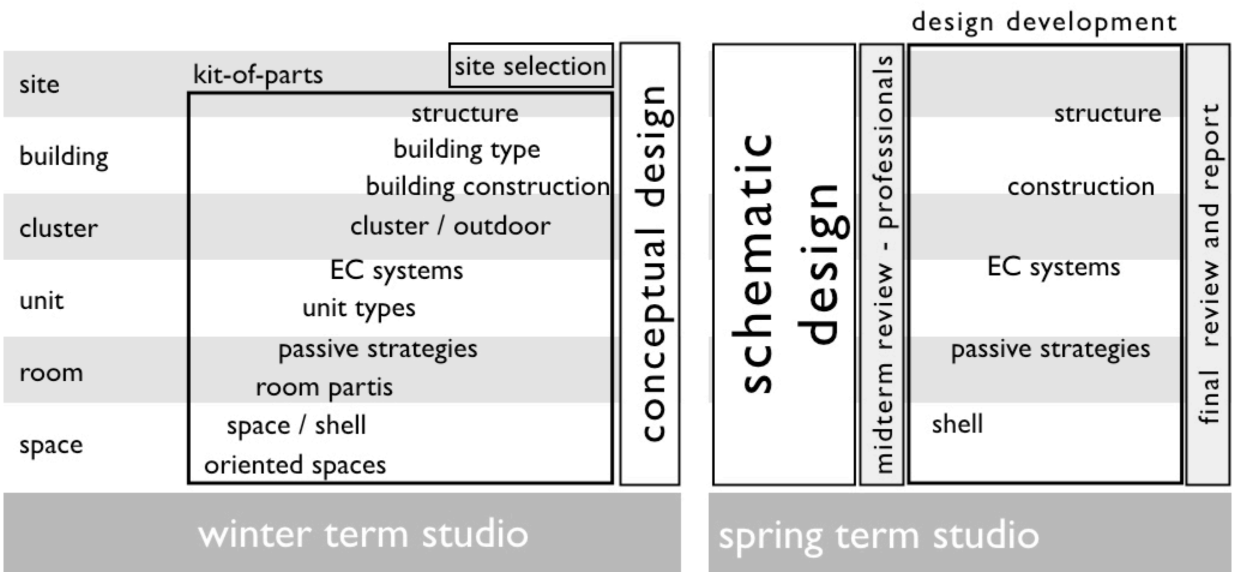
type

Studio methodology

- **Typology:** Development of an integrated set of concepts and types for multi-family housing, and the application of that system to specific sites.
- **Energy and environmental strategies:** These will be developed from the beginning of winter term, in tandem with typological explorations. We will have a strategy and computer-modelling consultant for the studio, who will assist the students in completing quantitative performance analyses throughout the studio.
- **Program:** Students will produce their own programs for their projects, which should reflect their understanding of demographics and market trends in the next 50 to 100 years. Program statements should be overwhelmingly focussed upon housing components; any ancillary uses should be minimal and diagrammatic.
- **Sites:** Site selection will occur later in winter term, after development of types and strategies. The studio will look for collective opportunities or else students may propose their own locations.
- **Density:** Much prior work and analysis has shown that low-rise high density is the way to go, for reasons of practicality and sustainability. Target minimum net densities in this studio will be in the 30 units or 75 residents per acre range.
- **Scale:** Studio projects that are too ambitious in scale often fail to reach the desired degree of development, as students spend their time solving problems they've inadvertently created for themselves. So specific design projects should be limited in size and complexity.

Format and Process

- All students in this studio must enroll in the preparatory course in fall term. This course will cover current issues, technologies and processes in housing production.
- Comprehensive studio students in this course will lead teams comprising other enrolled students to complete a series of focussed projects, which when assembled and integrated at the end of fall term will constitute a detailed project proposal and feasibility analysis. This report does not necessarily define your project for the following two terms – final definition of program, scope, intent and site selection will occur during winter term. However, the prior feasibility study should familiarize students with the analyses and tools required to make those later decisions.
- Winter term will follow the diagram below, first addressing global parameters, to develop a conceptual / typological kit-of-parts. So inverting the usual studio order, **winter term will be for preliminary design development**. This conceptual kit-of-parts will then used to design particular buildings on real sites
- **spring term will continue with schematic design**, including unit, building and site design simultaneously. A second round of design development will follow, as students revisit the technology decisions made during winter term.
- Design decisions will be driven by clear criteria, some of them quantitative. Schematic economic and energy modelling will be used throughout the whole process.



Issues to be explored

The full range of issues as enumerated in the LEED criteria, or the Green Studio Handbook, will be covered. The instructor will also attempt to steer students towards issues he is particularly interested in, such as:

- building envelopes and edges that work technically and socially
- passive heating and cooling strategies (including ventilation)
- open spaces that balance privacy and community
- development patterns which create pedestrian neighborhoods, or enhance existing neighborhoods
- futureproofing and adaptability for changing demands in the next century
- industrialized housing, open building systems, and their appropriate use

Reading list

A short list of references that will enrich your summer:

- Leupen & Mooij, *Housing Design: a Manual*
- Stewart Brand, *How Buildings Learn*
- J Habraken, *The Structure of the Ordinary*
- Corbett and Corbett, *Designing Sustainable Communities*
- Jørn Ørum-Nielsen and Mike Pease, *Dwelling*
- Dan Solomon, *Rebuilding* and *Global City Blues*
- Kwok and Grondzik, *The Green Studio Handbook*
- Dalziel and Cortale, *A House in the City*

week	Focus	Monday	Wednesday	Friday
1	**Introduction space**	**5-Jan** Introduction Schedule ***Energy flow in rooms (DL)*** *assign 1.1*	**7-Jan**	**9-Jan** **1.1 pin-up** Oriented rooms *assign 1.2*
2	**space / shell**	**12-Jan** ***Passivhaus intro*** ***Windows - shading / daylight (DL)***	**14-Jan**	**16-Jan** **1.2 pin-up** Room partis *assign 1.3*
3	**space / shell**	**19-Jan** MLK Birthday	**21-Jan**	**23-Jan** **1.3 pin-up** Passive partis *assign 2.1*
4	**typology / units**	**26-Jan** ***Intro to energy modelling (DL)***	**28-Jan**	**30-Jan** **2.1 pin-up** One person Couple *assign 2.2*
5	**Sketch problem 1: tiny house**	**2-Feb**	**4-Feb**	**6-Feb** **2.2 pin-up** tiny house *assign 2.3*
6	**systems / construction**	**9-Feb** ***Energy modelling (DL)***	**11-Feb**	**13-Feb** **2.3 pin-up** Other households with kids *assign 3.1*
7	**systems / construction**	**16-Feb** ***Enclosures/HVAC (DL)***	**18-Feb**	**20-Feb** **3.1 pin-up** Structure & enclosure Mechanical systems *assign 4.1*
8	**Sketch problem 2: perForm comp.**	**23-Feb** ***Parametric study / graphing (DL)***	**25-Feb**	**27-Feb** **4.1 pin-up** Clusters *assign 5.1*
9	**site / building type**	**2-Mar**	**4-Mar**	**6-Mar** **5.1 pin-up** Site proposal ***Critique (DL)***
10	**Review week**	**9-Mar**	**11-Mar**	**13-Mar** **Final Review 8:00**

week	Focus	Monday	Wednesday	Friday
1	**Schematic design 1: Site**	**30-Mar** desk crits	**1-Apr** desk crits	**3-Apr** desk crits
2	**Schematic design 2: Building**	**6-Apr** desk crits	**8-Apr** desk crits	**10-Apr** desk crits
3	**Schematic design 3: Units**	**13-Apr** desk crits	**15-Apr** desk crits	**17-Apr** desk crits
4	**Schematic design 4: Integration**	**20-Apr** ***(DL Critique)***	**22-Apr** desk crits	**24-Apr** desk crits
5	**Midterm Review**	**27-Apr** desk crits	**29-Apr** **Midterm Review**	**1-May** desk crits
6	**Structure and construction**	**4-May** desk crits ***(DL Critique)***	**6-May** desk crits	**8-May** desk crits
7	**Code compliance**	**11-May** desk crits ***(DL Critique)***	**13-May** desk crits	**15-May** desk crits
8	**Elevations and envelope**	**18-May**	**20-May** desk crits	**22-May** desk crits
9	**Final presentation mock-up**	**25-May** desk crits ***(DL Critique)***	**27-May** desk crits	**29-May** desk crits
10	**Review week**	**1-Jun**	**3-Jun**	**5-Jun** **Final Review** ***(DL Critique)***

Students collect precedents of rooms and spaces that have qualities they wish to emulate. Then they analyze and organize these images, looking for patterns to generate an empirical typology of good spaces.

"Most housing design projects in architecture schools start with the consideration of site and program. Most housing projects that get built start with parking, zoning and the market. In both cases, the quality of the rooms and spaces and their relationship to the environment are mostly afterthoughts. Efficient unit plans are standardized and repeated, carried forward from project to project. They are seldom inflected by orientation, whether to the sun, wind, views, adjacencies or noise. They are neither very good shelters for daydreams, nor very good machines for living in..

“In this studio, we will approach housing design from the opposite direction, putting the quality of rooms and their relationship to the environment up first. This will allow us to focus on two important and intertwined goals: enhancing the experiences and lives of the residents, and lessening the impact of our buildings on the environment. Good spaces which have carefully considered connections to the outdoors are the starting point."

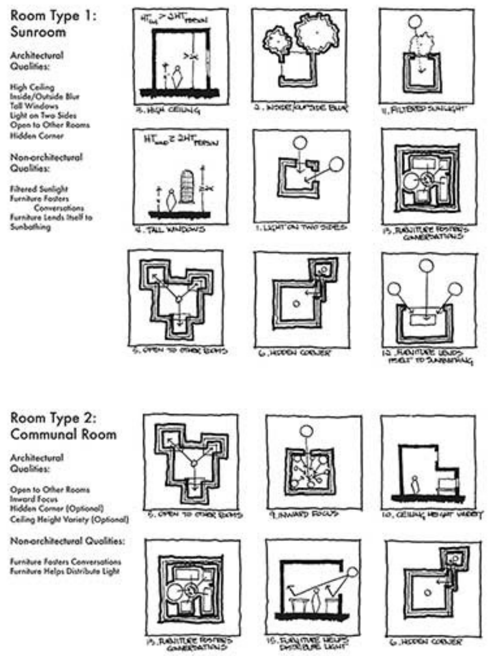
Beginning with the room types they've identified in 1.1, students generate partis at the scale of rooms and building envelope

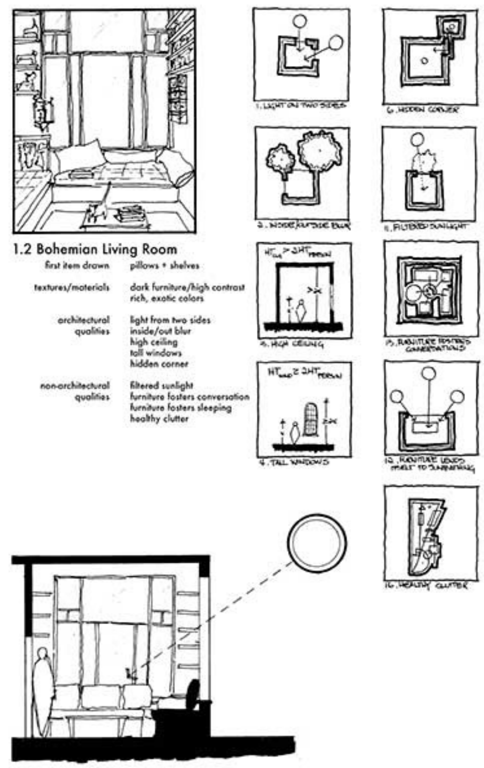
"…generate partis, not for whole schemes, but for rooms that would be worth building. Brainstorm…. Think about experiential, emotional and environmental qualities…do the approaches you take towards making your rooms more environmentally-friendly also make them more pleasing and satisfying to inhabit?

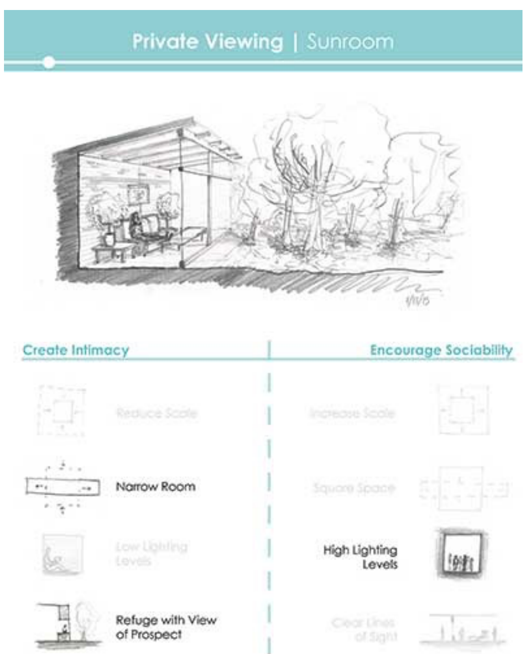
"..sketch out relationships among rooms… sequences of rooms and spaces… Room uses change, but rooms often stay the same…Is there an implicit typology to the sketches you're making?

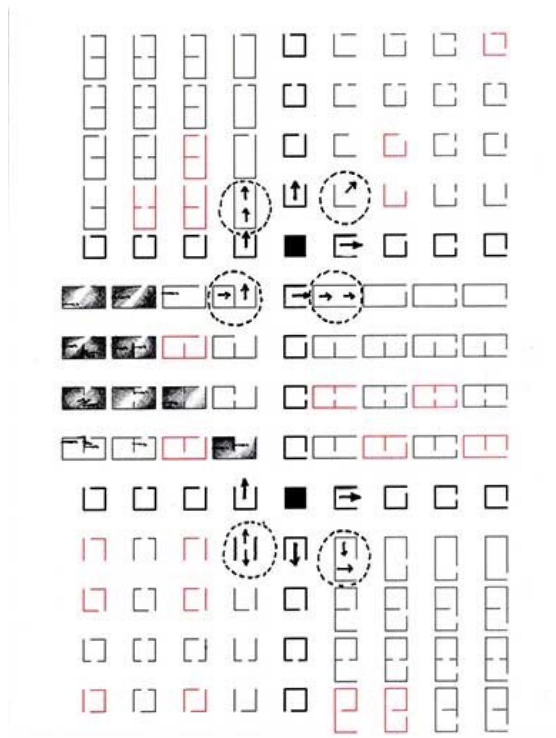
"a list of issues to help you get started:

- Relationship to the outdoors
- Depth
- Changing uses / users
- Changes over time
- Height
- Room separation / openness
- Activities
- Envelope
- Ventilation
- Acoustical
- Privacy
- Threshold
- Transition
- Light









Students revisit their room types and explicitly develop the building envelopes to optimize passive strategies.

" decisions about .. the envelope are at the heart of making your designs work passively...also set the agenda for your determination of active strategies, the development of appropriate unit and building types, and the relationship between buildings and outdoor spaces.

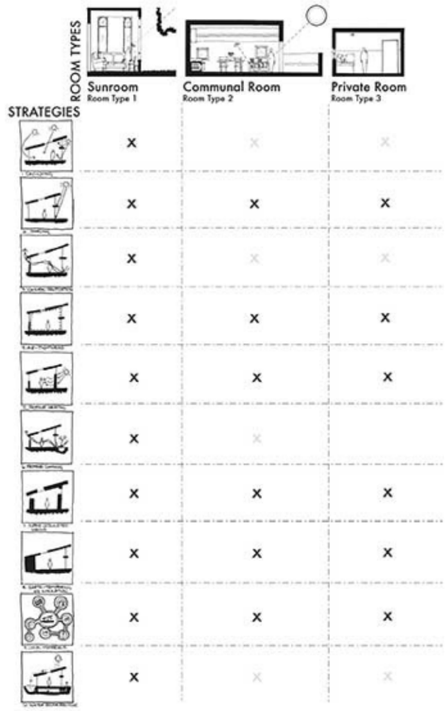
"… explicitly shift to how these spaces work from an environmental and energy performance perspective. ..consider them…somewhat quantitatively.

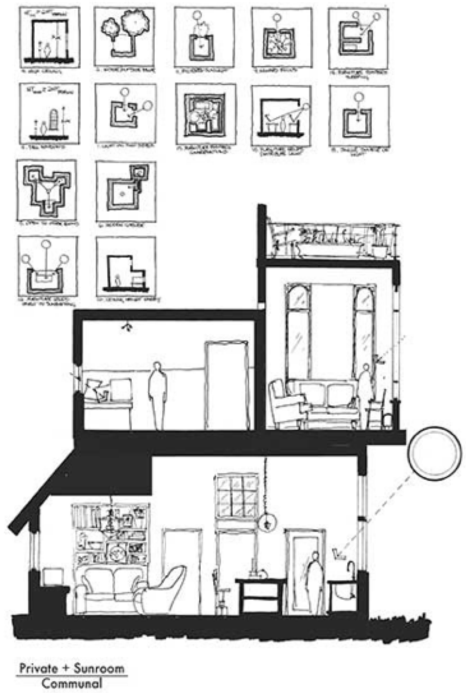
"Revise … to better integrate appropriate strategies. Note parameters that are critical …such as orientation, adjacencies, connection to outdoors, height, etc.

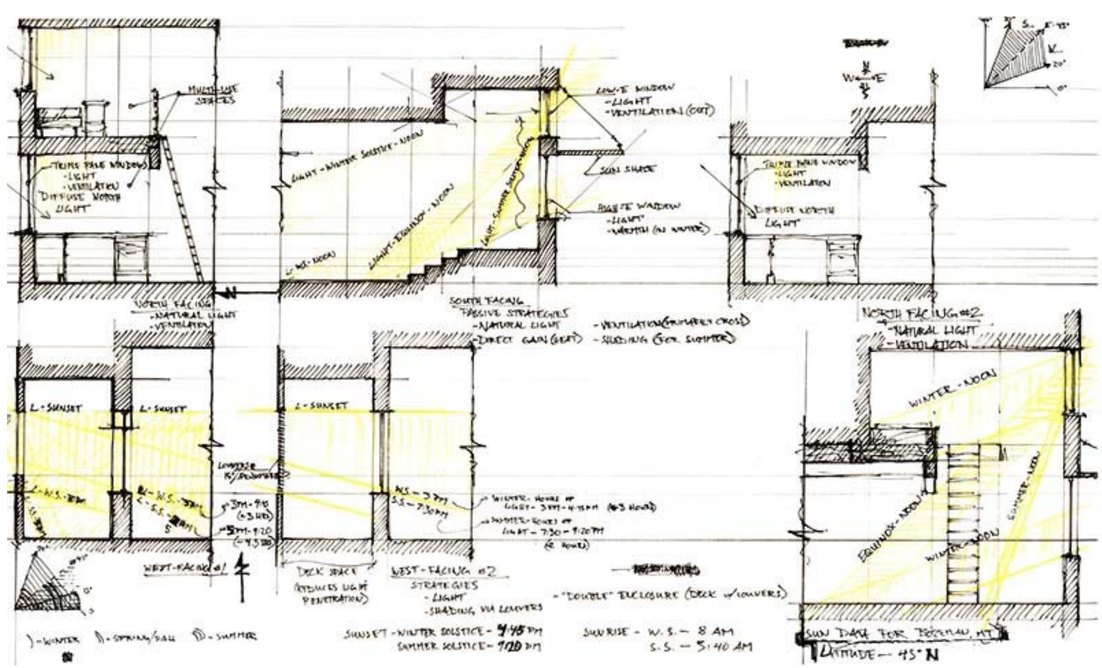
"For each room type show:

- the space in section
- call out all employed strategies
- discussion or calculations
- parameters or constraints
- diagrams forces, concepts, etc.

Work out a matrix which organizes / summarizes your thinking on this, with types across the top, and strategies down the side.



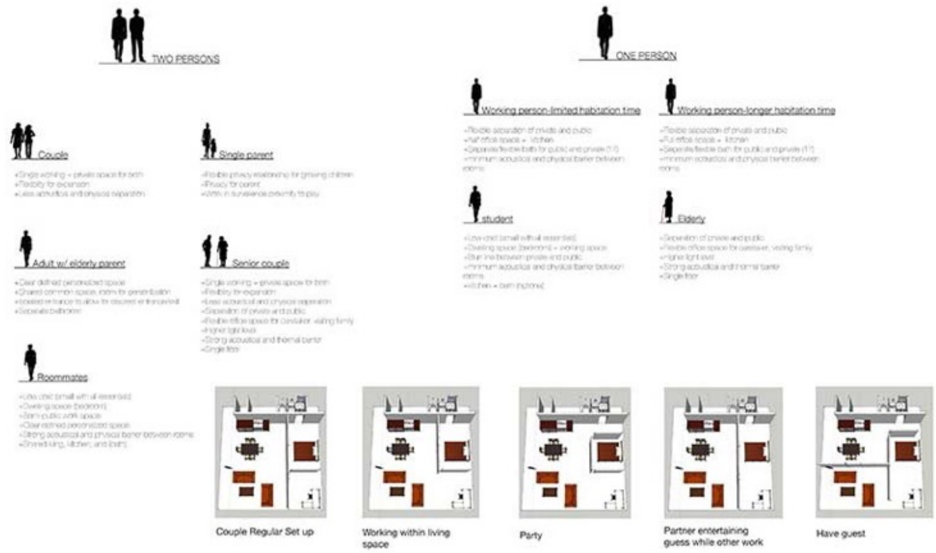




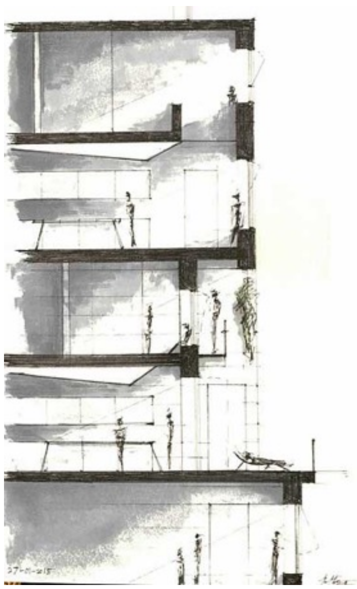
Students design a series of ideal unit types, incorporating ideas from and using the room types that they developed in the prior exercises. Different household sizes and types are considered: single-person, couples, roommates, parent(s) with children, extended families, other. Implicitly, students begin to formalize the programming for their individual theses.

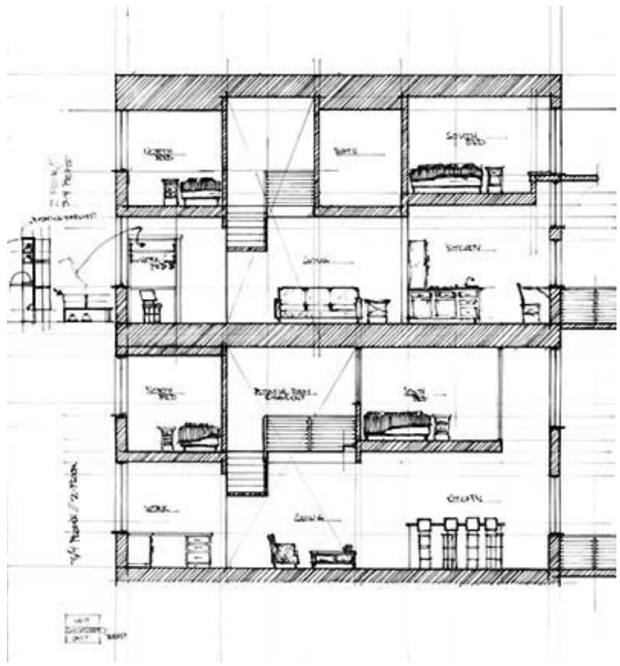
Matrices are used to map the intersections between room types previously developed, and the requirements or needs of different household types. Do certain household types work better with certain room types, or can many different approaches be taken?

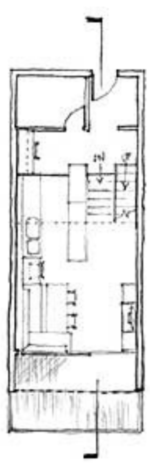
These are unit designs which embody concepts, rather than typical units which fit into a given building type.

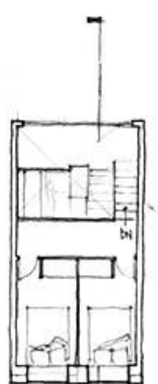


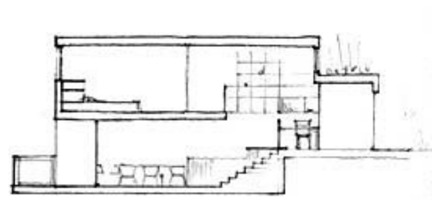
2.1-2.4 occupant study: ONE & TWO PERSONS

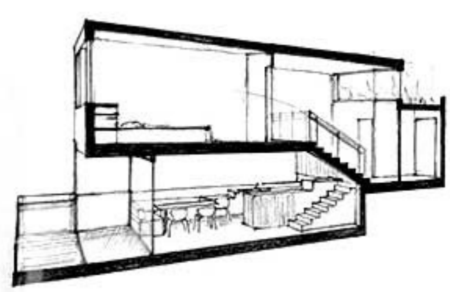












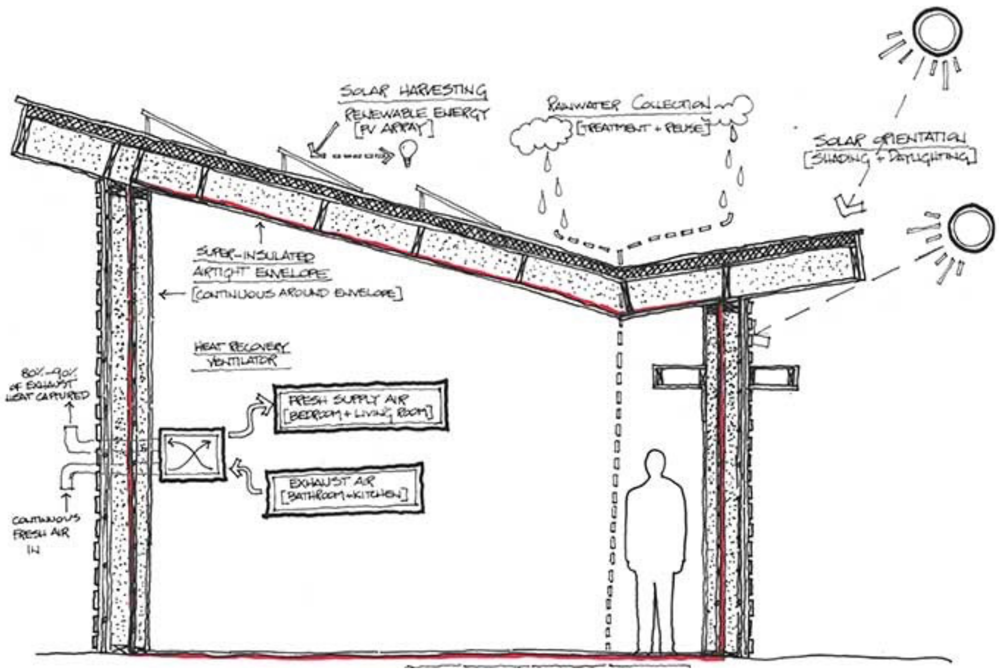
Students conduct preliminary research on building systems that could work with their proposed unit designs.

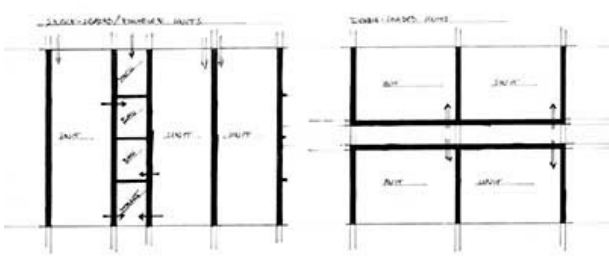
- Plumbing
- Mechanical
- Structural
- Construction

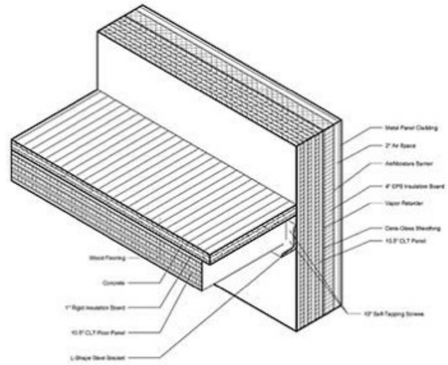
The emphasis is upon finding and utilizing systems that will help achieve the net-zero goal, while still preserving financial viability.

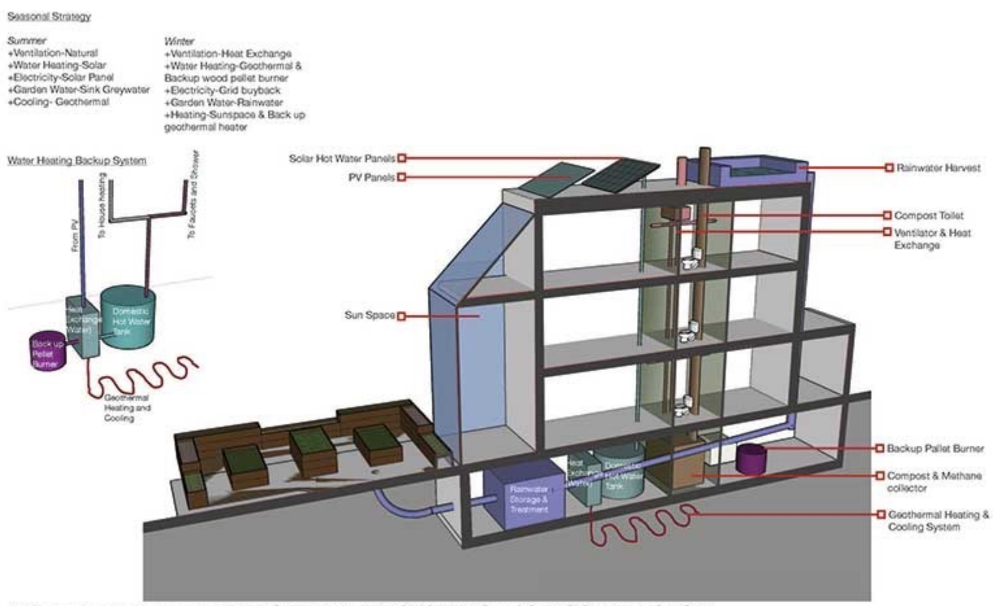
While this degree of design development typically occurs after schematic building design, in this studio it is considered earlier in the kit-of-parts design process. Critical parameters about the desired systems can underlie subsequent building design, and important performance goals will not be precluded by formal design decisions.

These preliminary decisions on building system selection will be revisited in the second term, after schematic building design.









3.2 mechanical system: DENCENTRALIZE SYSTEMS w/ SEASONAL USAGE

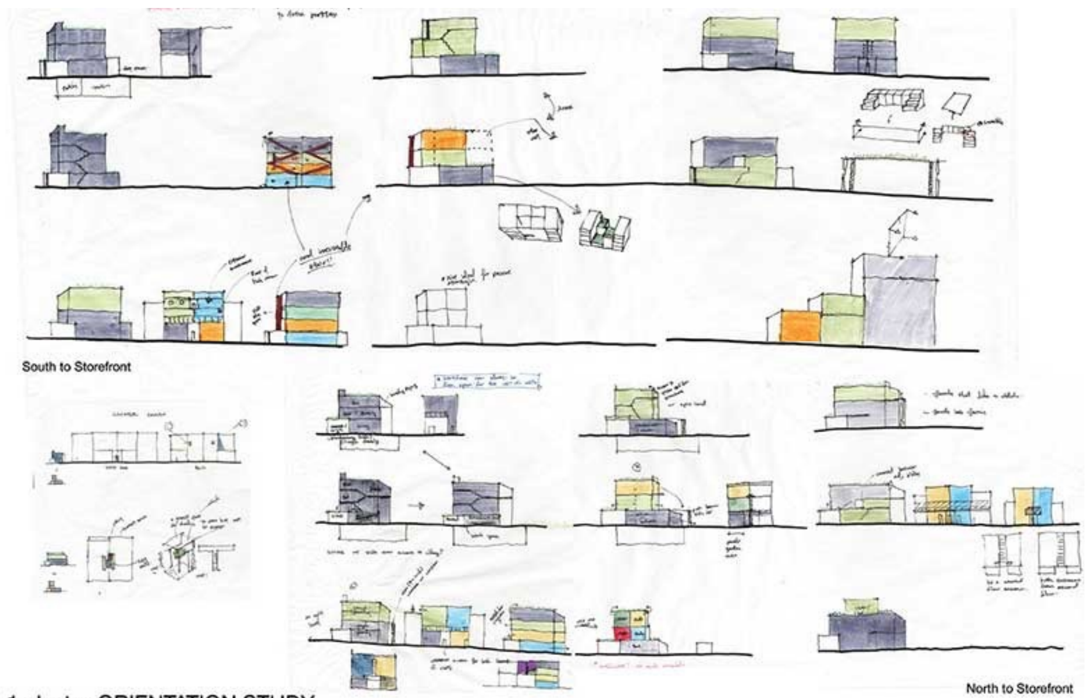
As the design of larger housing projects often involves the repetition of modules at different scales, students now begin to assemble their array of unit designs into clusters. How do different unit types connect to others, both horizontally and vertically? The design of common spaces, both interior and exterior, is considered.

Necessarily, an ideal building type and organizational system develops, before there is any consideration of the demands of a specific site.

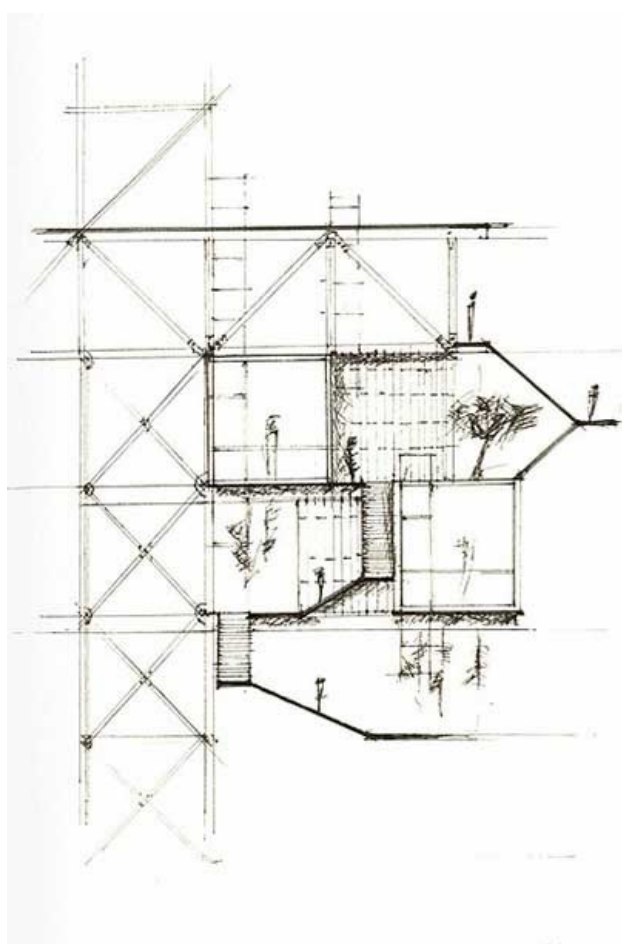
"… think of this as generating building typology. If you are looking at rowhouse types, examine a one-unit-wide slice, and all the permutations that are possible. If you are looking at a vertical entry building, think about the single module around that entry, etc. Final building proposals next term can be built out of the types from this term.

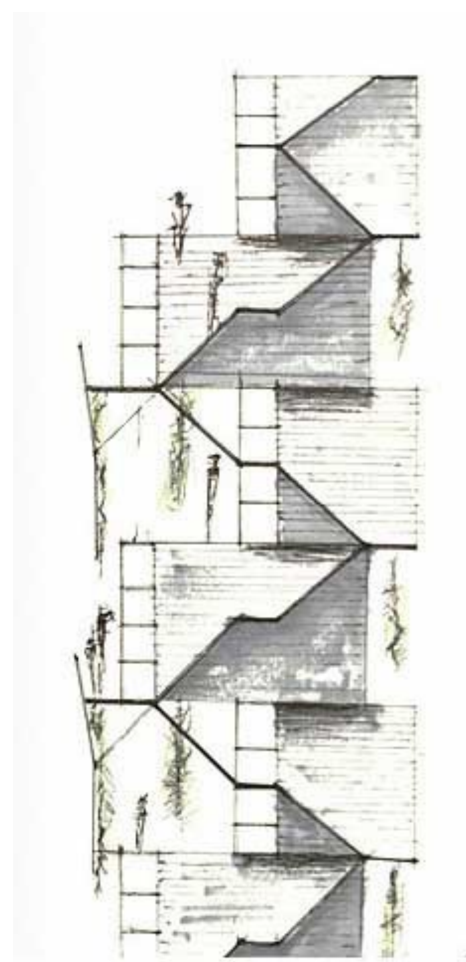
"…how this cluster, which embodies the building type, might adapt to possible site conditions, such as solar orientation, busy streets or shared courtyards, views or poor adjacencies.

"If useful start another matrix - with criteria / issues on one axis, and possible responses on the other.



4.1 cluster: ORIENTATION STUDY





At the end of the first term, students undertake conceptual design of their building for the first time, based upon all the smaller-scale studies completed earlier. Up to this point, their work has been completely in the realm of type; with this project they apply and adapt the typical solutions to a real site, with all of its local opportunities and constraints.

The first-term final review includes both the conceptual building and site design (on which the students have worked for less than two weeks), and the prior studies. It is very much a work-in-progress review, with the emphasis upon the how concepts at smaller scales have been integrated into the building proposal, rather than upon spatial and formal development, or beautiful presentations.

Students must present:

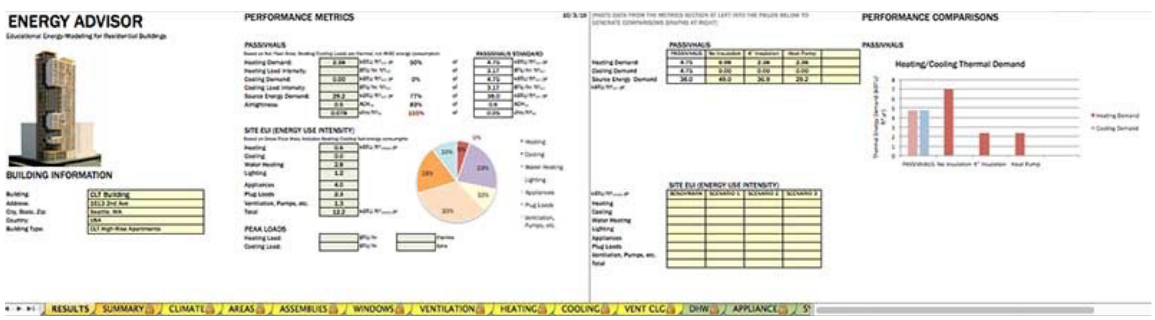
- a comprehensive thesis, which details their individual goals, intentions and program.
- rough quantitative analyses of building areas, costs and energy usage
- summaries of all their preliminary sketch projects
- a complete building design, including site plan, building plans, sections, and three-dimensional representation

The emphasis on environmental and energy performance has both qualitative and quantitative aspects. Studio support funds allowed for the hiring of an adjunct instructor/ consultant, an architect with extensive experience in Passive House modelling, design, and construction.

During the first term there are periodic presentations and discussions on green building strategies, reviewing what students have learned in prior coursework and how these strategies might be employed. The consultant also developed a spreadsheet-based application, Energy Advisor, which takes an approach similar to that of the Passive House modelling tool, PHPP. The students learned how to use this software, and then were able to apply it throughout the schematic design and design development phases.

At the end of second term, students presented summaries of their energy strategies, and their comprehensive energy analyses as part of their final review, with building performance levels ranging from the Passive House standard to beyond net-zero.

		EDGE					CENTER	
		A - WALL REFLECTORS	B - LIGHT SHELF	C - SUN SPACE	D - BALCONY	E - VEG. BRISE-SOLEIL	A - DISCONNECTED	B - CONNECTED
HEATING	DIRECT GAIN	●	●		●	●	●	●
	INDIRECT GAIN	●	●		●			
	ISOLATED GAIN		●	●				
COOLING	VEGETATED SHADING	●	●		●	●	●	●
	EVAPORATIVE COOLING						●	●
	NIGHT VENTILATION	●	●		●	●	●	●
	CROSS-VENTILATION	●	●		●	●		●
	STACK-VENTILATION						●	●
LIGHTING	TOP-LIGHTING						●	●
	SIDE-LIGHTING	●	●	●	●	●		
	LIGHT SHELF	●	●		●			



PERFORMANCE METRICS

PASSIVHAUS

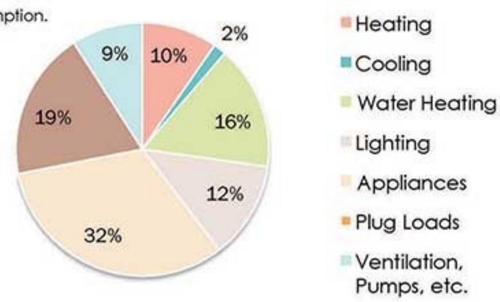
Based on Net Floor Area; Heating/Cooling Loads are thermal, not HVAC energy consumption.

					PASSIVHAUS STANDARD	
Heating Demand:	1.14	kBTU/ft²$_{NET}$·yr	24%	of	4.75	kBTU/ft²$_{NET}$·yr
Heating Load Intensity:		BTU/hr. ft²$_{NET}$		of	3.17	BTU/hr. ft²$_{NET}$
Cooling Demand:	0.78	kBTU/ft²$_{NET}$·yr	16%	of	4.75	kBTU/ft²$_{NET}$·yr
Cooling Load Intensity:		BTU/hr. ft²$_{NET}$		of	3.17	BTU/hr. ft²$_{NET}$
Source Energy Demand:	21.7	kBTU/ft²$_{NET}$·yr	57%	of	38.0	kBTU/ft²$_{NET}$·yr
Airtightness:	0.5	ACH$_{50}$	83%	of	0.6	ACH$_{50}$
	0.001	cfm/ft²$_{50}$	3%	of	0.05	cfm/ft²$_{50}$

SITE EUI (ENERGY USE INTENSITY)

Based on Gross Floor Area; Includes Heating/Cooling fuel-energy consumption.

Heating	0.9	kBTU/ft²$_{GROSS}$·yr
Cooling	0.2	
Water Heating	1.5	
Lighting	1.2	
Appliances	3.0	
Plug Loads	1.8	
Ventilation, Pumps, etc.	0.9	
Total	9.4	kBTU/ft²$_{GROSS}$·yr



As the projects move from ideal types to schematic building designs on real sites, students must demonstrate how their ideas can adapt to financial reality. They research local conditions - market rents and sale prices, land costs, zoning constraints, etc., and integrate these with simple assumptions about per square foot construction costs.

Students are not handed a functioning spreadsheet pro-forma into which they can plug variables, as this would just be a black box, and they would not necessarily understand the relationships among the variables. Rather, students each develop their own pro-formas, applying the simple principles they have learned. They are responsible for adjusting costs (through construction type, square footage of units and amenities, etc.) and income (through market segment, unit mix., etc.) so that their projects pencil out. This happens early in the schematic design phase, so the designs can still be modified.

The students don't have to make huge profits to pass the studio, but they must understand the economic reality of their designs. If they are proposing low-income or affordable housing, they must be clear about the amount of subsidy

FAIR MARKET RATE HOUSING

Sources and Uses

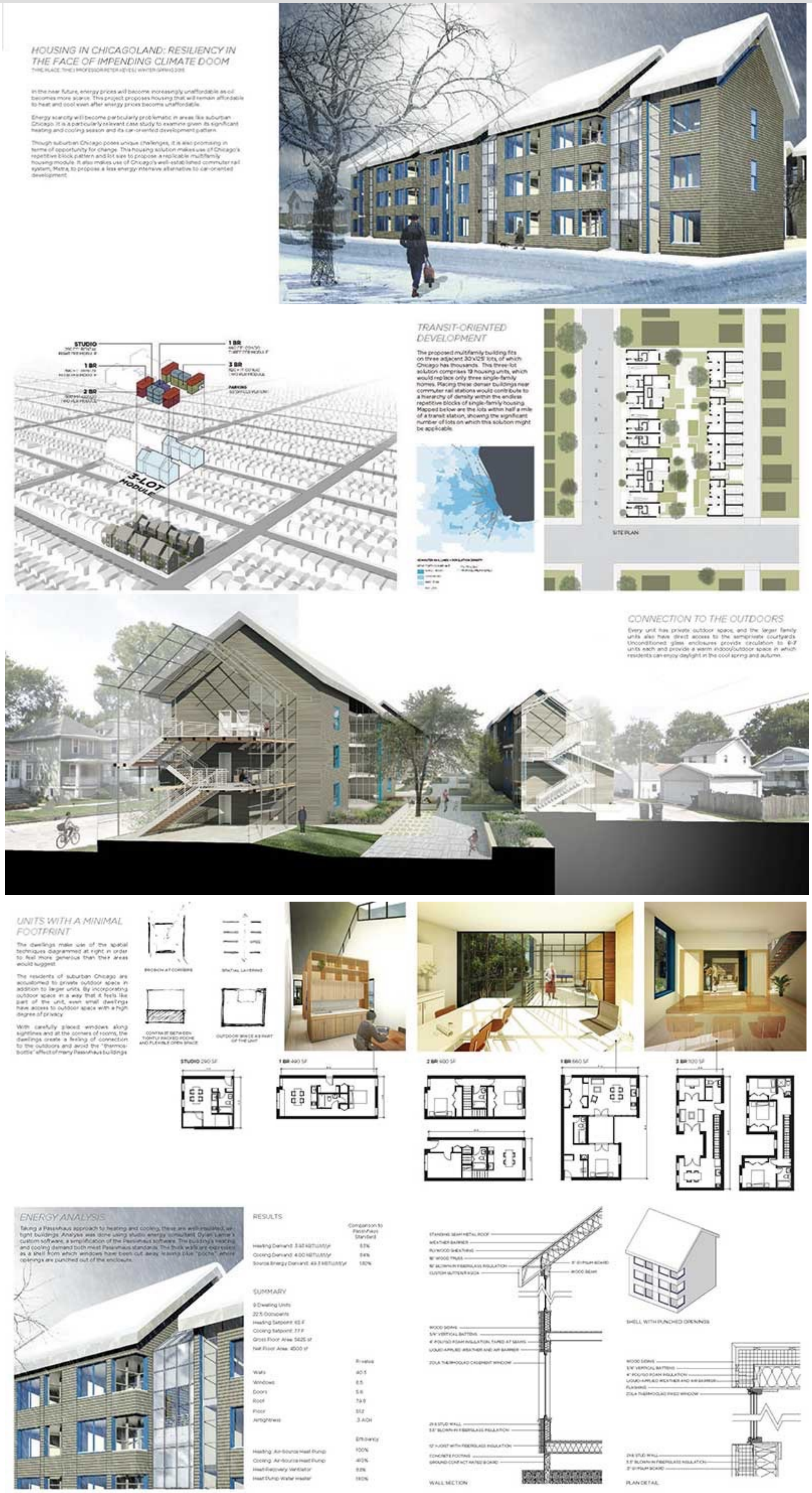
Project Costs			
Hard Costs			
Wood-Framed Upper Floors	$150 per sq. ft.	$	4,502,400.00
Construction Contingency	10% of hard costs	$	450,240.00
	TOTAL HARD COSTS	**$**	**4,952,640.00**
Soft Costs			
Pre-Development Consultants	0.5% of hard costs	$	24,763.20
Architect/Engineer	4%	$	188,200.32
Development Fees	3%	$	148,579.20
Permit Fees	5%	$	247,632.00
Legal & Accounting	0.2%	$	9,905.28
Financing	5.0%	$	247,632.00
Closing	2.5%	$	123,816.00
Soft Cost Contingency	10% of soft costs	$	99,052.80
	TOTAL SOFT COSTS	**$**	**1,089,580.80**
	TOTAL PROJECT COSTS	$	6,042,220.80
Financing Sources			
Total Project Costs		**$**	**6,042,220.80**
Net Annual Income		**$**	**193,011.30**
LIHTC (4% Eligibility)			
Total Development Cost		$	6,042,220.80
Less: Non-eligible costs (land, permanent financing costs)		$	247,632.00
Eligible Basis		**$**	**5,794,588.80**
Applicable Fraction (% of low-income units)	100%	**$**	**5,794,588.80**
Tax Credit Percentage	4%	$	231,783.55
Tax Credit Period	10 years	$	2,317,835.52
LIHTC EQUITY	**0.95 on the dollar**	**$**	**2,201,943.74**
Donations, Sponsorships and Grants			
Anticipated Amount		**$**	**1,510,555.20**
Leverage Loan			
PRINCIPAL		$	2,329,721.86
Interest Rate	7.00% rate		
Years to Pay off Mortgε	30 years		
Annual Mortgage Payment	**per year**	**$**	**187,743.91**
	per month	$	15,645.33
	ANNUAL PROFIT	$	5,267.39
Capitalized Value			
Net Annual Income		$	193,011.30
Cap Rate	9%		
	Capitalized Value	**$**	**2,144,570.00**
	Project Cost	$	6,042,220.80
	THEORETICAL PROFIT	-$	3,897,650.80

Working with typical sites in the gridded neighborhoods of the Chicago area, Andrea D. addressed sustainability and resiliency at every scale.

This transit-oriented development could occur on a wide range of typical infill sites, adapting to site dimensions and constraints.

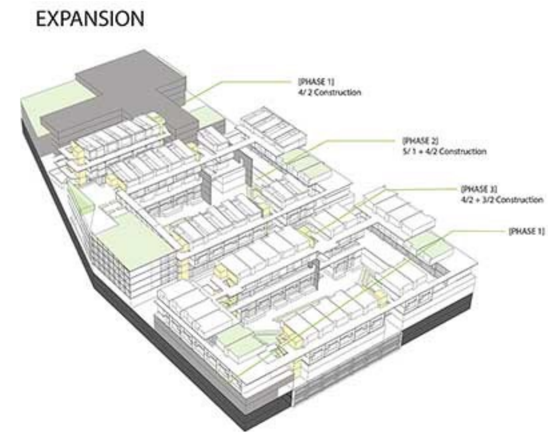
The vertical circulation system supports a range of unit types, which could also adapt over time. Alley buildings could accommodate residences or parking, and again adapt to meet changing needs.

The wood-framed dwelling units are built to Passive House standards, and the common stairway circulation is inside through-floor greenhouse spaces, allowing for solar gain and a connection to the outdoors, while introducing a varied rhythm to the streetscape.



Industrial area redevelopment in downtown Seattle

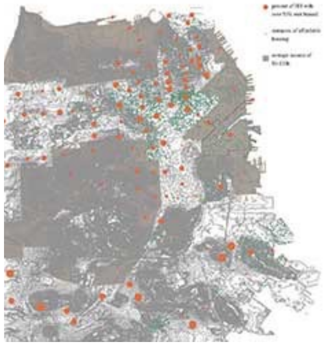
Michael B. selected the rapidly changing district south of downtown Seattle, near the major league stadiums. Rather than proposing one mega-project, he went with a modular design surrounding a courtyard, which would allow for phased construction as the area redevelops. It would also allow for varied building configurations and site plans to work with particular site conditions, and re-introduce pedestrian-scaled blocks into this area of superblocks.



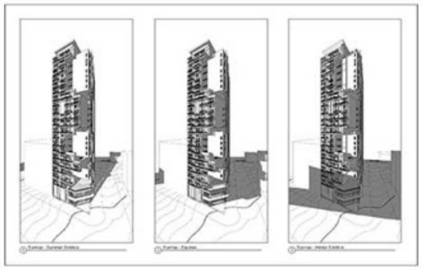
Kiana M. proposed a downtown condominium in San Diego, in a climate zone where passive cooling and water collection and conservation will be increasingly important. Her building collects rainwater, minimizes consumption with composting toilets, and filters and re-uses all domestic water with a "living machine" integrated into the courtyard design. Floor-through units and double-height sections maximize cross ventilation. Besides calculating energy usage and economic viability, she calculated possible total annual rainfall collection amounts, and designed the living machine.

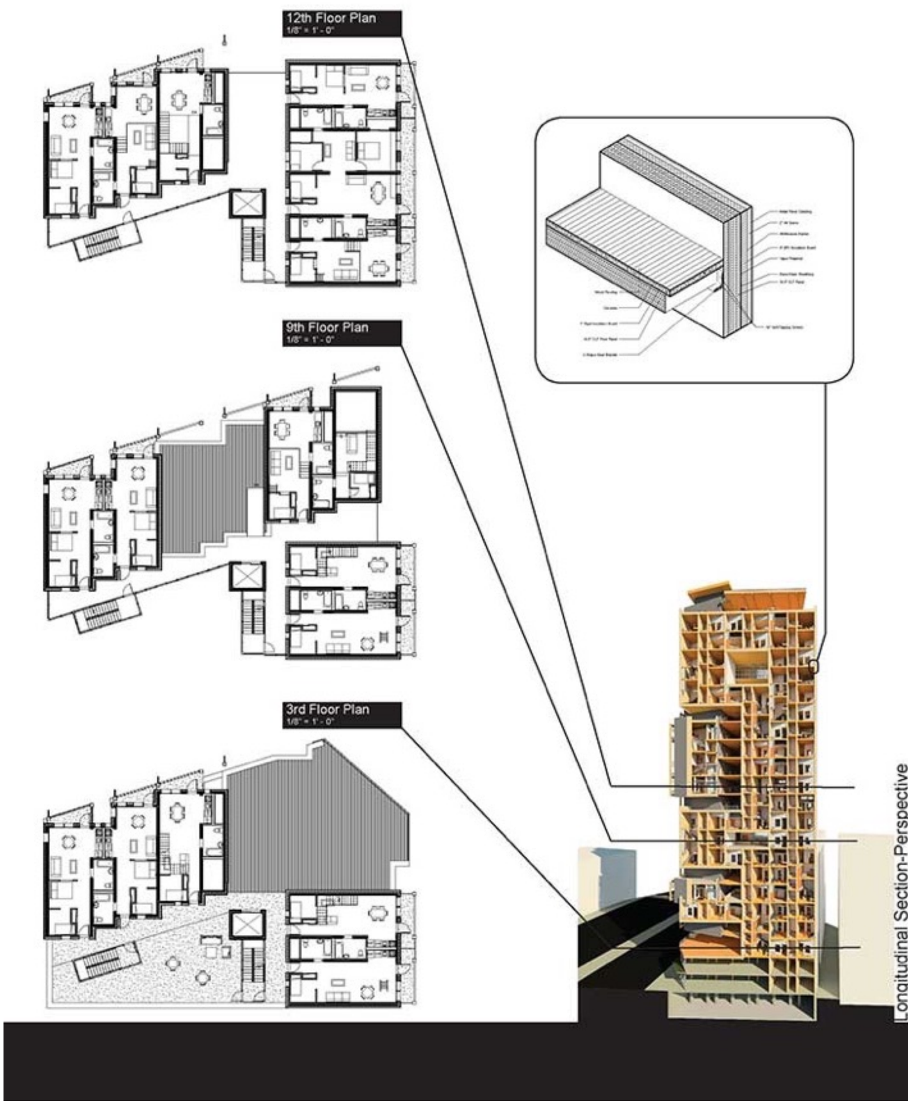
Mixed income family housing in San Francisco

While working on this studio project, Veronika J. was simultaneously completing her honors college thesis on HUD Hope VI housing projects. She applied many of the lessons learned (from observation of built projects) to the design of this mixed-income project on a complex site in the Mission bay area of San Francisco. Different unit and building types accommodated a wide range of household types, and the multi-level public spaces were carefully tuned to facilitate interactions among the residents, and to reinforce the sense of community for the developing neighborhood.

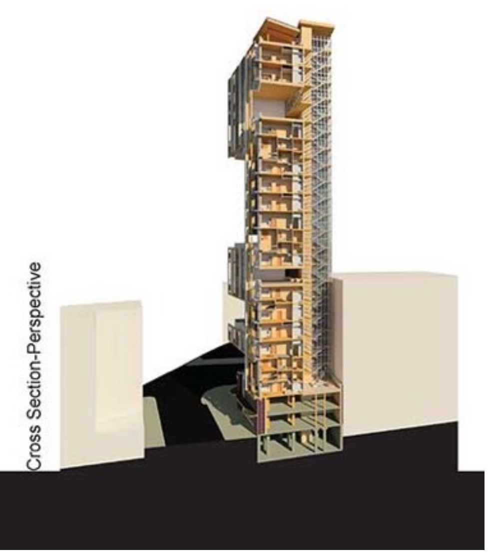


Tyler M. selected a small, irregular infill site in downtown Seattle, and designed a 25-story apartment building using a cross-laminated timber (CLT) structural system. This is taller than any current CLT building in North America, but this renewable resource system will likely become more widespread soon. Shared terraces and gallery circulation facilitate cross-ventilation, and shading studies optimized solar gain.






Site Plan
1/32" = 1'-0"



A food desert in Oakland inspired Olivia A's design for environmental, social and economic sustainability. "A food-centered, microentrepreneurial, affordable co-housing community" addresses issues of food and nutrition, social justice, neighborhood revitalization (rather than gentrification), personal empowerment , economic development, affordability and community.

Rigorous analysis of contextual issues informed site selection, while an equally rigorous understanding of costs and funding opportunities provided a reality check. A building which would engender community for the residents, and for the whole neighborhood.