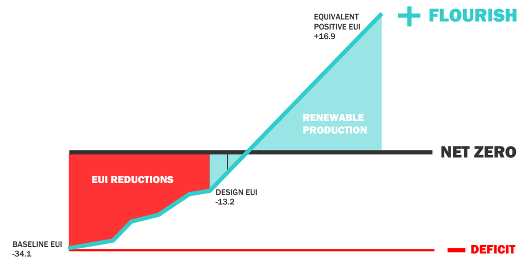
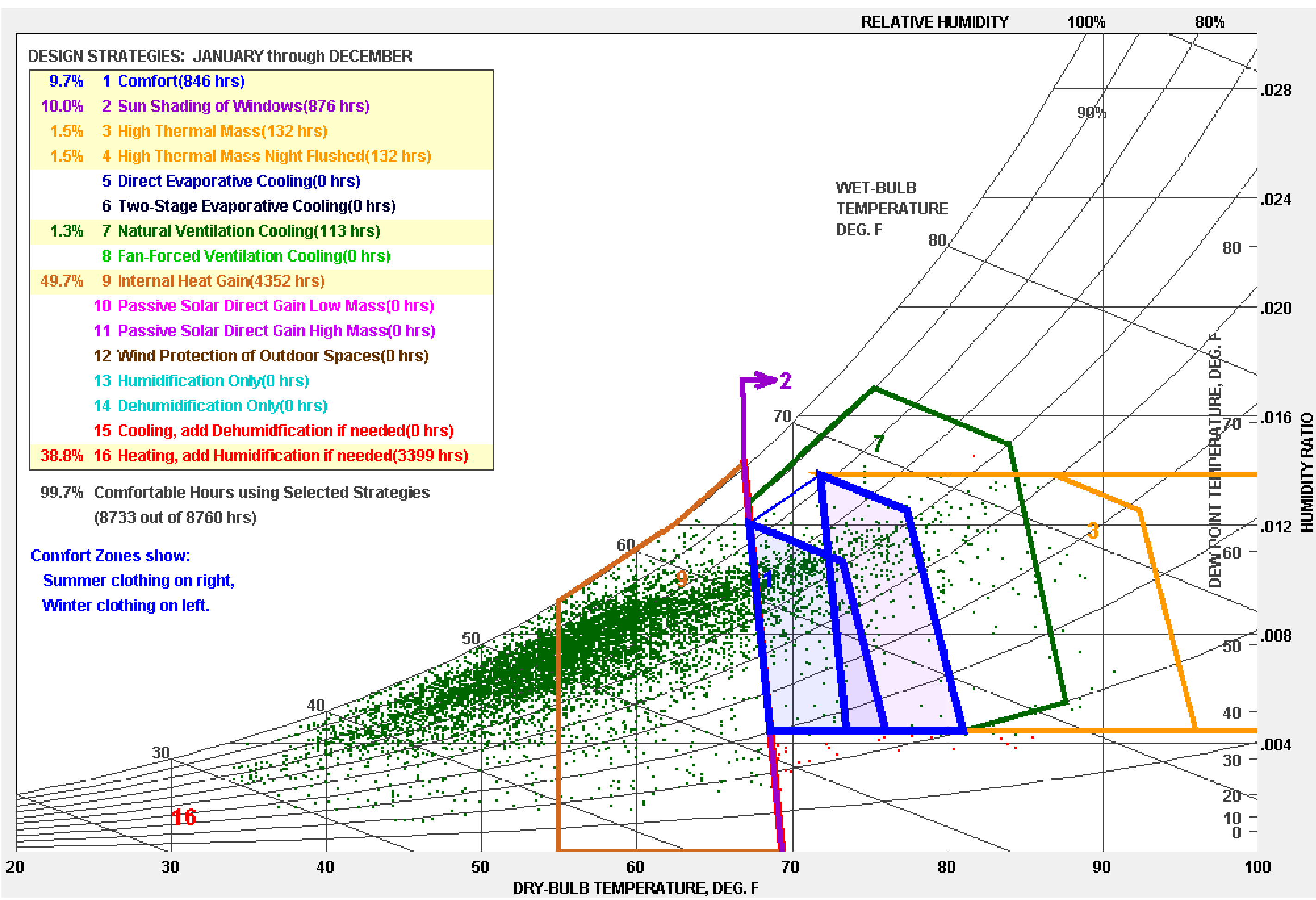
FLOURISH: ENERGY PERFORMANCE DOCUMENTATION

INTRODUCING: FLOURISH | ELEMENTAL ACCESS, EQUITABLE RESOURCE



Affordable housing requires extra care and thoughtfulness as it represents an opportunity to go beyond the provision of shelter toward a means to empowering citizens in the greater community. Residents should be included in an inspiring experience of living and connection to their place; a sense of ownership. To do this, a project must be achievable, simple and robust such that maintenance expenditure and oversight are not constantly required. It must also be engaging; involving residents in the shaping of their lives and the space around them. This leads to empowerment, connection, healthy interdependence, and ultimately contribution back to society.

Flourish strives to make allow occupants to be essential actors in the performance of the project's envelope and systems. Like an eco system, it is more than the sum of its parts, and each component or organism plays an essential role in the overall balance of the system. There is redundancy and resilience built in, but by design, maximum performance requires participation. This approach is central to all of the strategies outlined in the following documentation.



PHSYCOMETRIC CHART FOR OAKLAND MECHANICAL STRATEGIES: Solid understanding of how climate affects occupant comfort drove many of the project strategies. Capitalizing on adaptable passive systems allowed for simplification of active systems.

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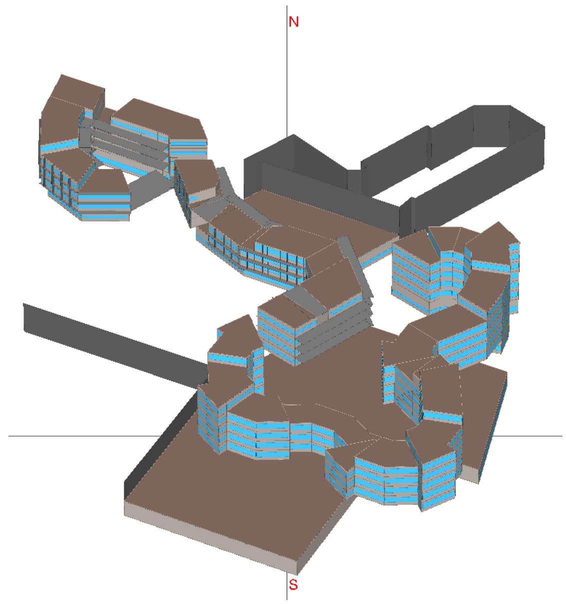
TASK 2A: WINDOW-TO-WALL RATIO

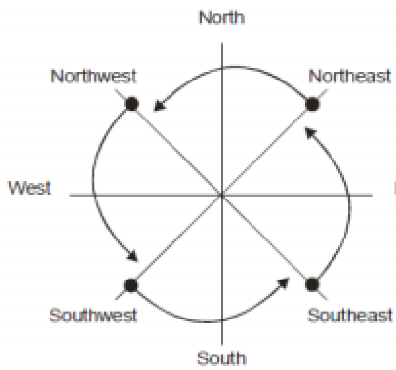


(ABOVE) eQuest software was used to analyze whole building energy performance and to determine optimal glazing, massing, and energy use reduction strategies

2A. Window-to-Wall Ratio

Calculate the window-to-wall ratio for each elevation and the entire building. The window-to-wall ratio of a building is the percentage of its facade taken up by light-transmitting glazing surfaces, including windows and translucent surfaces such as glass bricks. It does not include glass surfaces used ornamentally or as opaque cladding, which do not provide transparency to the interior. Only facade surfaces are counted in the ratio, and not roof surfaces.

Here is the procedure for classifying facades that do not face a cardinal direction. In general, any orientation within 45° of true north, east, south, or west should be assigned to that orientation. If the orientation is exactly at 45° of a cardinal orientation, use the diagram at right to classify the direction of the façade. For example, an east-facing surface cannot face exactly northeast, but it can face exactly southeast. If the surface were facing exactly northeast, it would be considered north-facing.



As the window-to-wall calculation is a ratio, you may enter area in square feet or meters.

North

Step 1: Total area of light transmitting glazing surfaces on north facade: 2,278

Step 2: Total area of north façade: 5,842

Window-to-wall ratio of north façade = $\frac{\text{number from step 1}}{\text{number from step 2}}$ = 39%

East

Step 1: Total area of light transmitting glazing surfaces on east facade: 3,271

Step 2: Total area of east façade: 9,347

Window-to-wall ratio of east façade = $\frac{\text{number from step 1}}{\text{number from step 2}}$ = 35%

South

Step 1: Total area of light transmitting glazing surfaces on south facade: 3,018

Step 2: Total area of south façade: 6,287

Window-to-wall ratio of south façade = $\frac{\text{number from step 1}}{\text{number from step 2}}$ = 48%

West

Step 1: Total area of light transmitting glazing surfaces on west facade: 4,080

Step 2: Total area of west façade: 9,951

Window-to-wall ratio of west façade = $\frac{\text{number from step 1}}{\text{number from step 2}}$ = 41%

Total Building Window-to-Wall Ratio

Step 1: Light transmitting glazing$_{total}$ = step one$_{north}$ + step one$_{east}$ + step one$_{south}$ + step one$_{west}$ = 12,647

Step 2: Façade area$_{total}$ = step two$_{north}$ + step two$_{east}$ + step two$_{south}$ + step two$_{west}$ = 31,427

Total window-to-wall ratio = $\frac{\text{number from step 1}}{\text{number from step 2}}$ = 40%

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TASK 2B: WINDOW OPENINGS AND WINDOW SHADING

2B. Window Openings and Window Shading

In the space below, describe the design approach at window openings to regulating incoming light and heat from the sun. Briefly describe the type of window and glass used on the east, south, west, and north elevations and the performance numbers targeted for U-factor, solar heat gain coefficient (SHGC), and visible transmittance.

Type of window and glass:

Cascadia Turn-Tilt Suspended film triple-glazed windows

East facing
U-factor: 0.19; SHGC: 0.55; Visible Transmittance: 64%

South facing
U-factor: 0.19; SHGC: 0.55; Visible Transmittance: 64%

West facing
U-factor: 0.19; SHGC: 0.55; Visible Transmittance: 64%

North facing
U-factor: 0.19; SHGC: 0.55; Visible Transmittance: 64%

If you included a projecting shading device(s) or a window reveal, include a diagram of a representative residential window on the south and the west elevations showing shadows cast at the dates and times shown below. These studies should be for ”solar time’ rather than “clock time.” (In solar time 12 noon represents the moment when the sun is due south and at the highest point in the sky it will reach that day.) Impose a 1’-0” grid on the window to make it possible for jurors to see the percent shading achieved at each time.

While there are a number of software tools that can be used to accurately cast shadows,it is straightforward to do this analysis in SketchUp, a free software tool.

South Elevation:

December 21:	9 am, 12 noon, 3 pm
March/September 21:	8 am, 10 am, 12 noon, 2 pm, 4 pm
June 21:	9 am, 12 noon, 3 pm

West Elevation:

December 21:	3 pm
March/September 21:	2 pm, 4 pm
June 21:	3 pm, 5 pm

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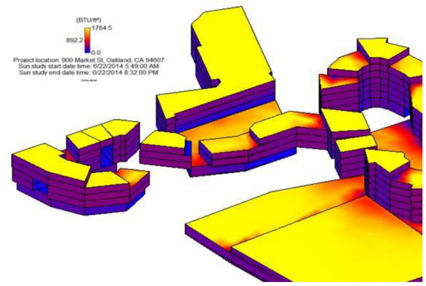
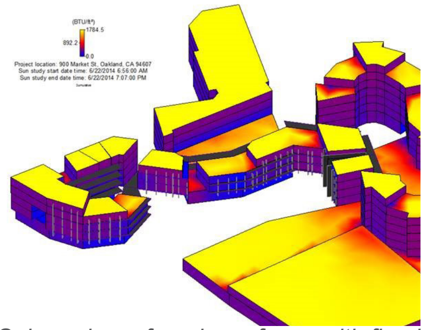
TASK 2B: WINDOW OPENINGS AND WINDOW SHADING

Building orientation attempts to maximize southern exposure and equal access to sun and daylight. Operable shading elements allow occupants to tune their space for optimal comfort and allow units with less than optimal orientation to achieve similar performance to south facing units.

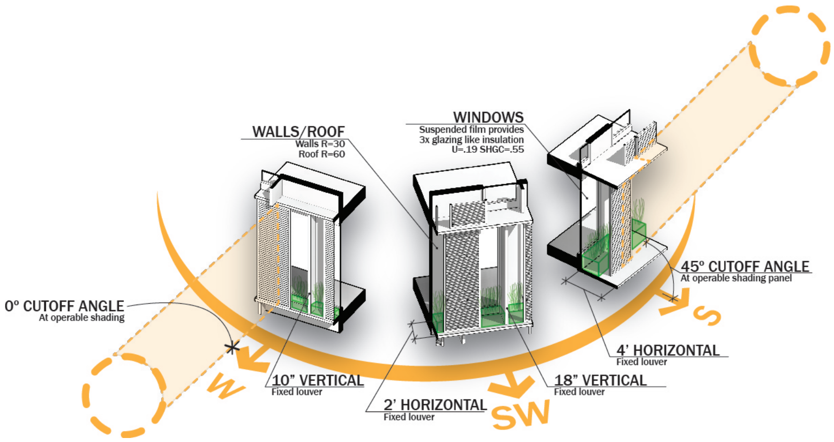
Winter heat gain is maximized since it contributes significantly to energy use reduction. Full shading is possible for occupants who actively participate so that passive cooling can provide optimal comfort.



Solar gain on facade surfaces without shading

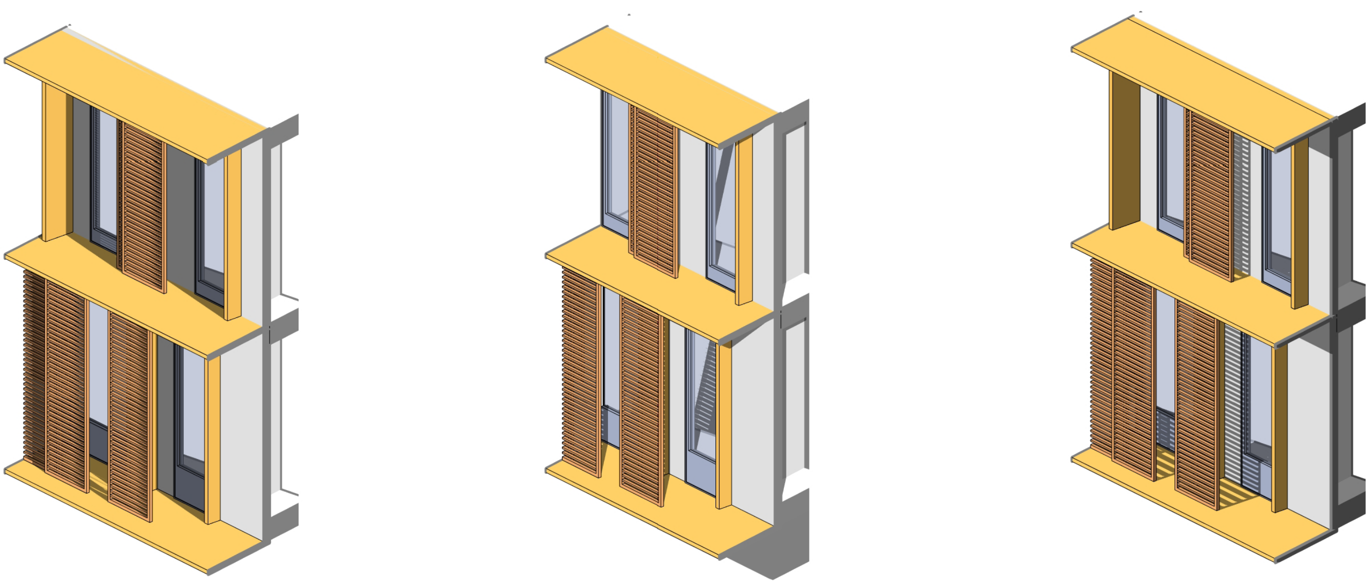


Solar gain on facade surfaces with fixed shading.



South Facade

Primary shading on the south faces of the building come from fixed horizontal structure. However, because the facade with this primary shading is not always directly south, vertical louvers work to block sun that the horizontal shading misses at certain points of the year (see South Face March/September 21st). The operable shades allow for even more personalization of comfort within units.



I. SOUTH FACE ON DECEMBER 21ST. FROM LEFT TO RIGHT: 9 AM, NOON, AND 3 PM
Maximize solar heat gain is desired in winter. Fixed shades have minimal impact and operable shades would generally remain open. The difference the operable shades make are clearly visible when looking at the upper windows, with shades pushed back, and the lower windows partially covered.

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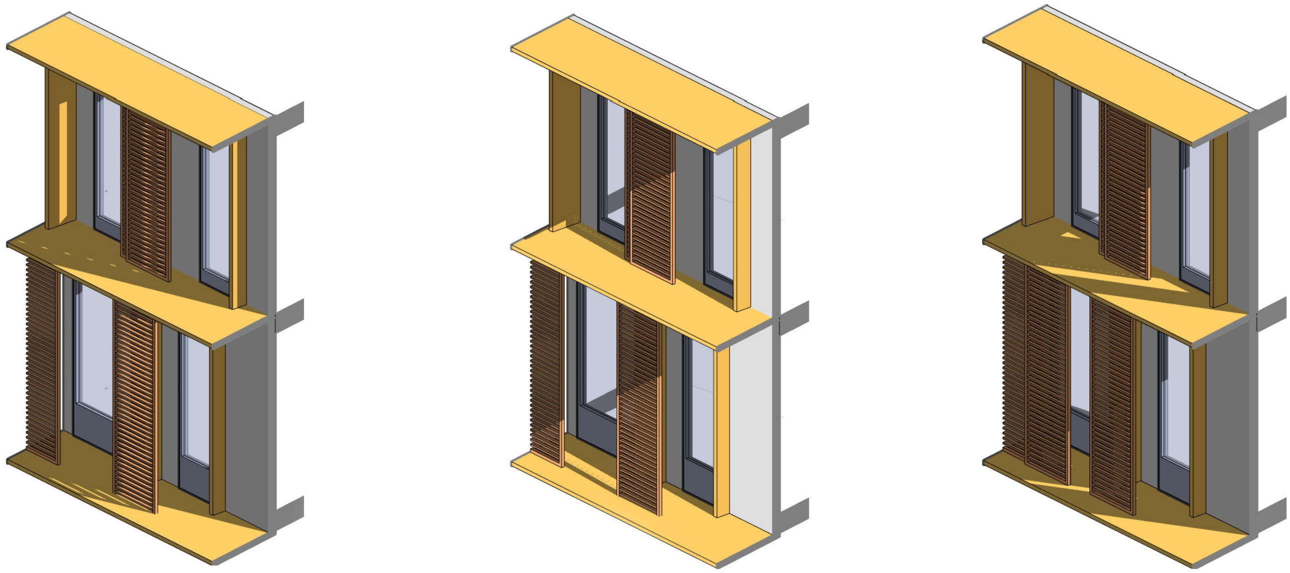
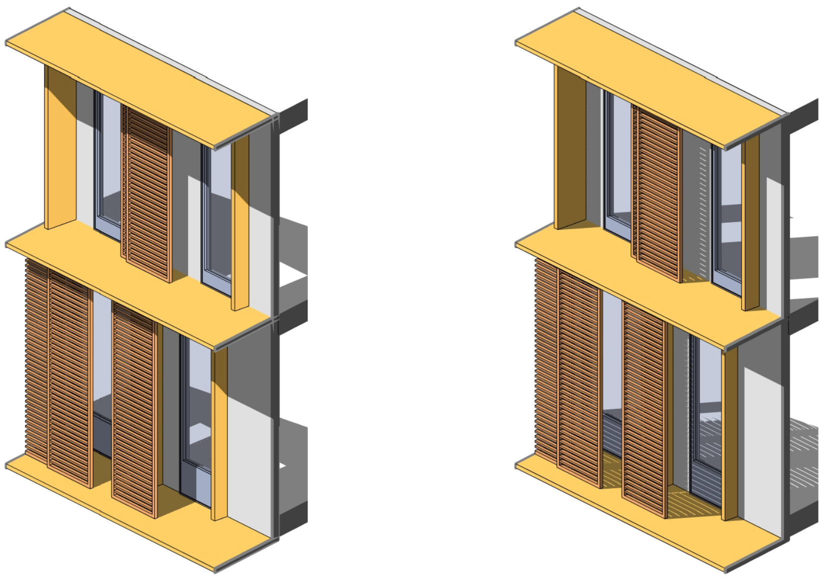
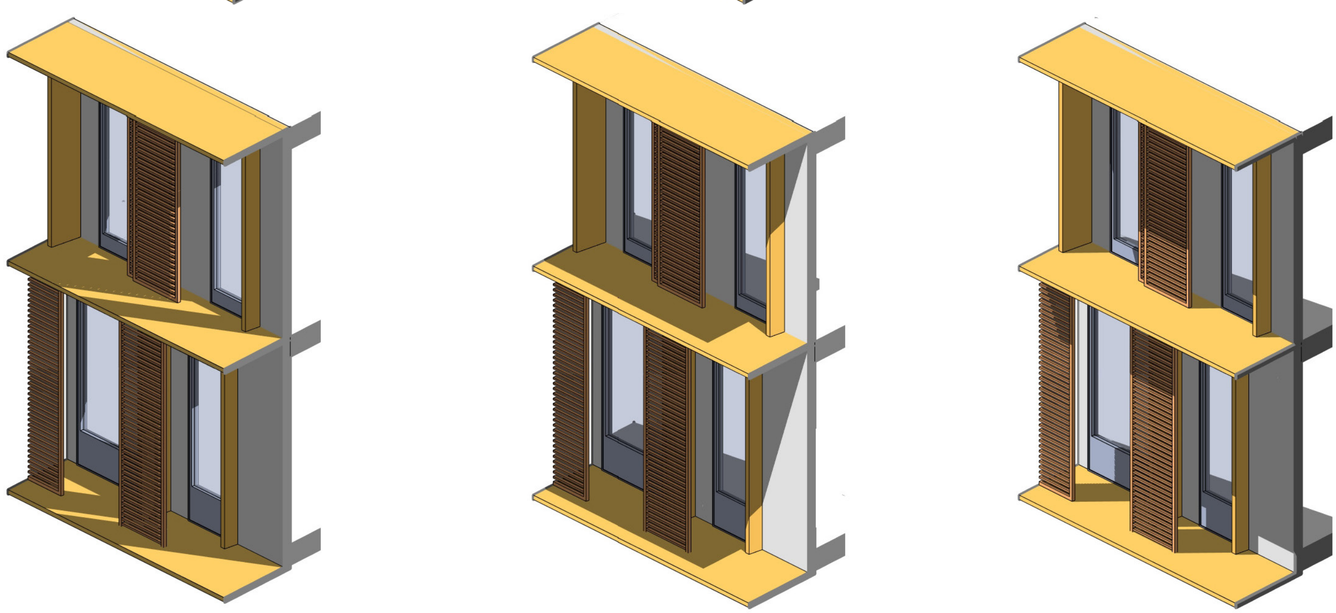


II. SOUTH FACE ON MARCH/SEPTERMBER 21ST. FROM LEFT TO RIGHT: 8 AM, 10AM, AND NOON. SEE 2 PM AND 4 PM BELOW.



III. (BELOW)SOUTH FACE ON JUNE 21ST. FROM LEF TOT RIGHT: 9 AM, NOON, 3PM. In mid-summer, fixed shading is highly effective, though operable shades also contribute and allow occupants to tune privacy, glare and daylight in addition to heat gain.



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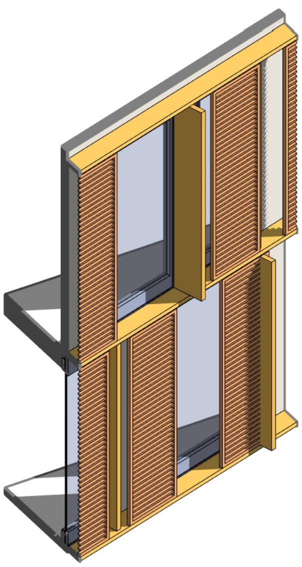
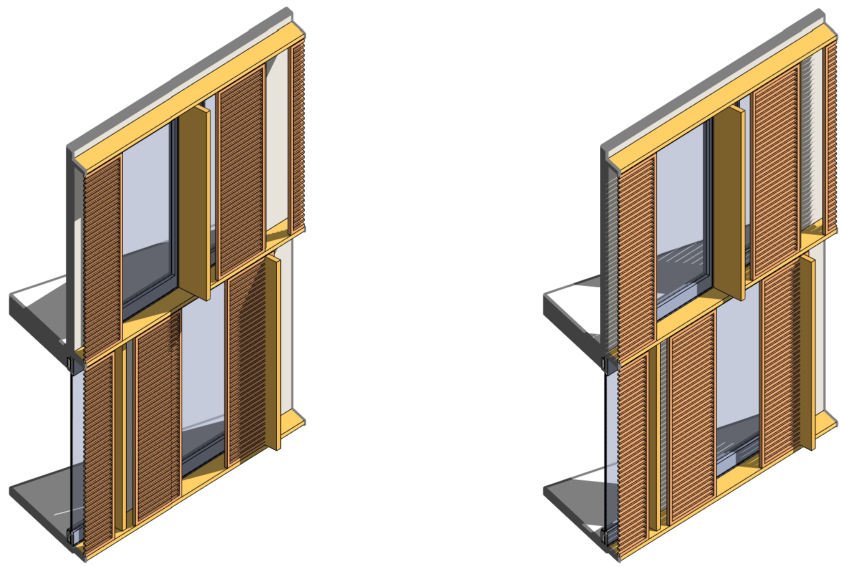
West Facade

Primary shading on the west faces of the building come from a range of fixed vertical louvers. As the building turns from south facing to more dominantly west facing and taller, the vertical louvers grow in depth to accomodate the harsher sun on the west face of the building, this is visible in the examples shown on this page. The west facade follows the same thermal comfort, glare, and occupant engagement strategies as the south facade, with the operable sliding and louvered shade. The pattern of tenants manipulating their shades will not only provide the building with an ever-adapting building skin based on season and times of the day, but it is also a modulated and repeated design element, which makes for easier construction and manufacturing.

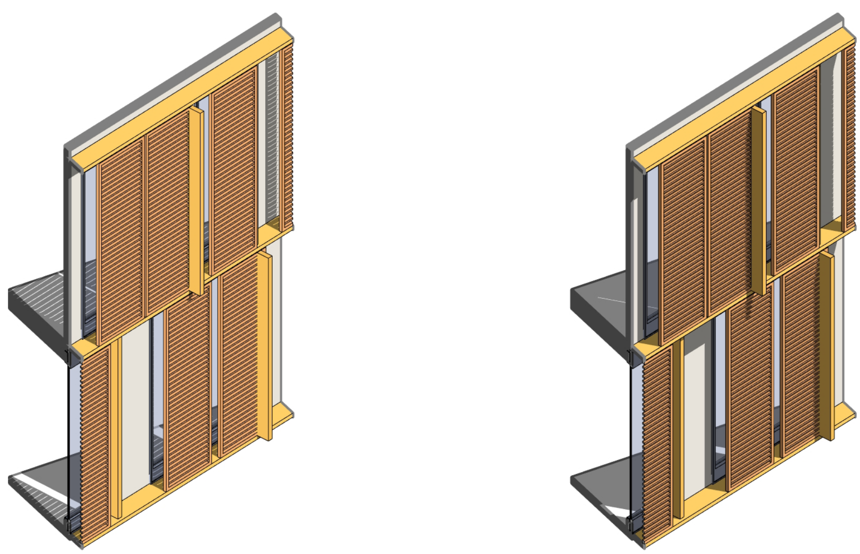


IV. WEST FACE ON DECEMEBER 21ST, 3 PM

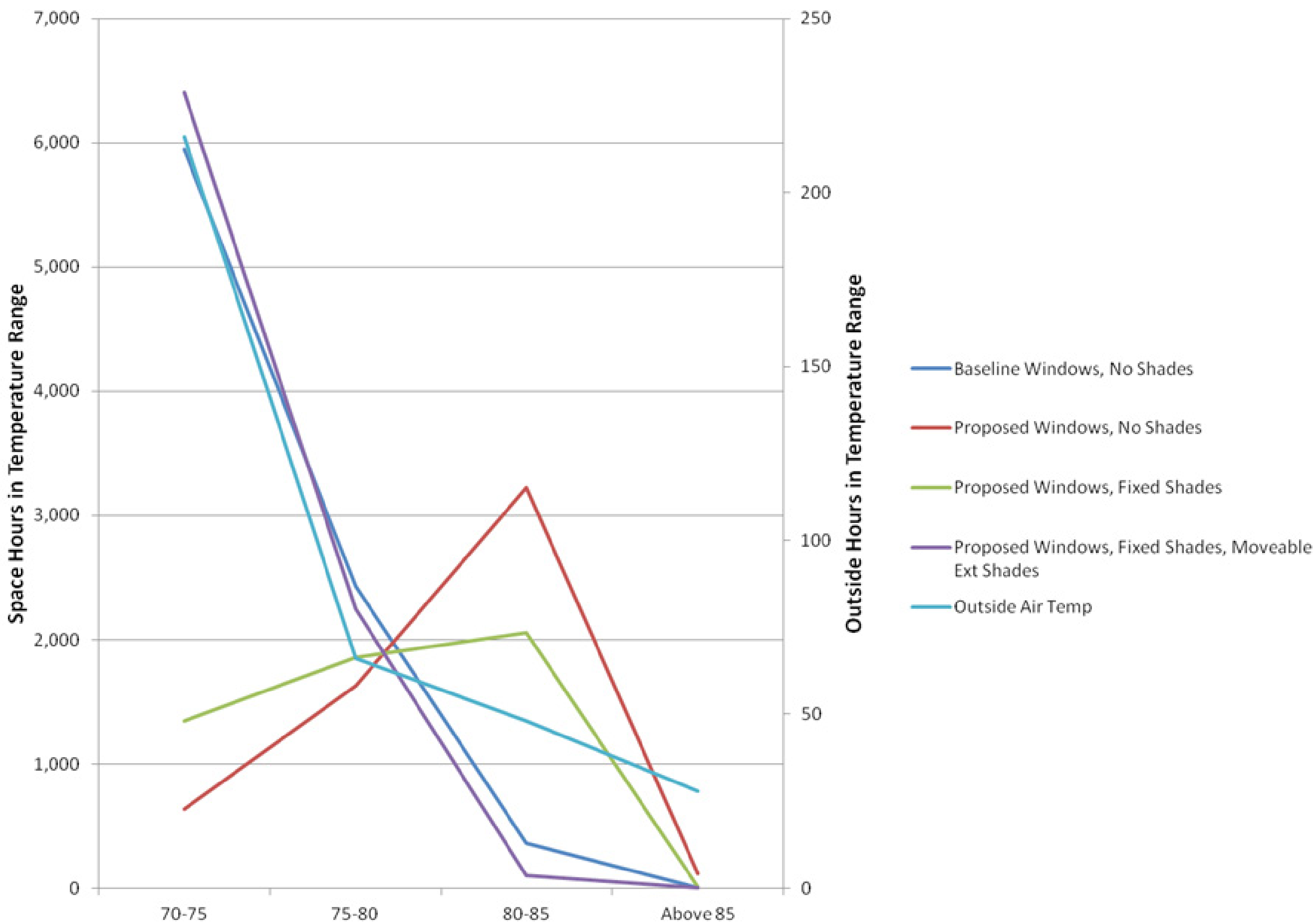


VI. WEST FACE ON MARCH/SEPTEMBER 2ST. FROM LEFT TO RIGHT: 2 PM, 4 PM

Operable shades are essential to maintaining comfort in the shoulder months since needs will swing between heating and cooling, and solar incidence angles are difficult to manage with fixed shades alone, especially on non-south

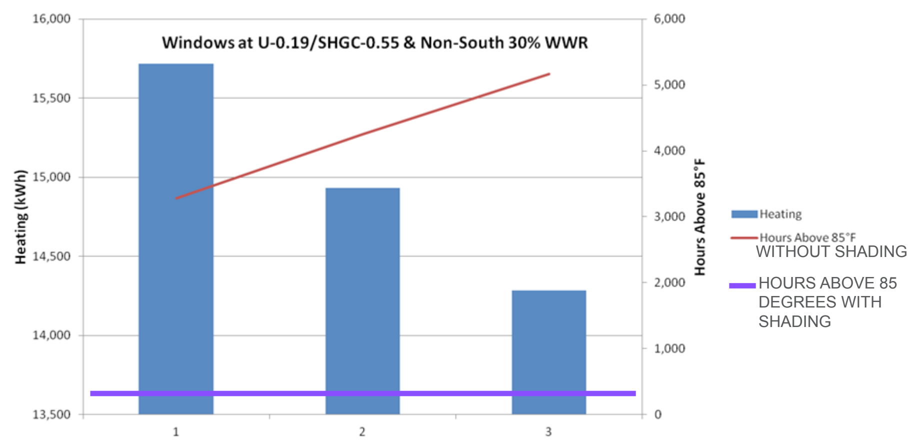


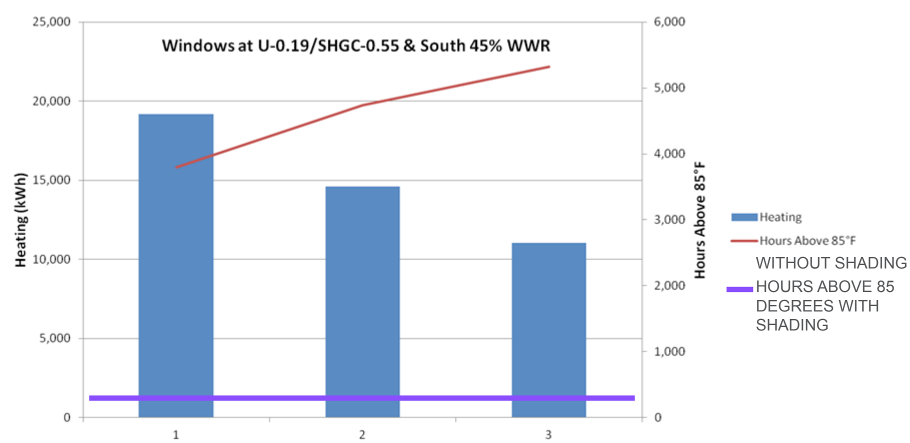
VII. WEST FACE ON JUNE 21ST. FROM LEFT TO RIGHT: 3 PM, 5 PM



VIII.(ABOVE) This graphic shows how shading elements allow for use of glazing tuned for maximum winter heat gain without compromise to summer time comfort. It also demonstrates that passive cooling is highly successful confirming the strategy to eliminate active cooling systems.

VIIII. (RIGHT)These two examples show some of the window to wall ratio tuning and refinement. A relatively high area of glazing maximizes heating benefits, while shading maintains comfort. This also maximizes daylight and views which are critical to creating a rich and uplifting environment for occupants.





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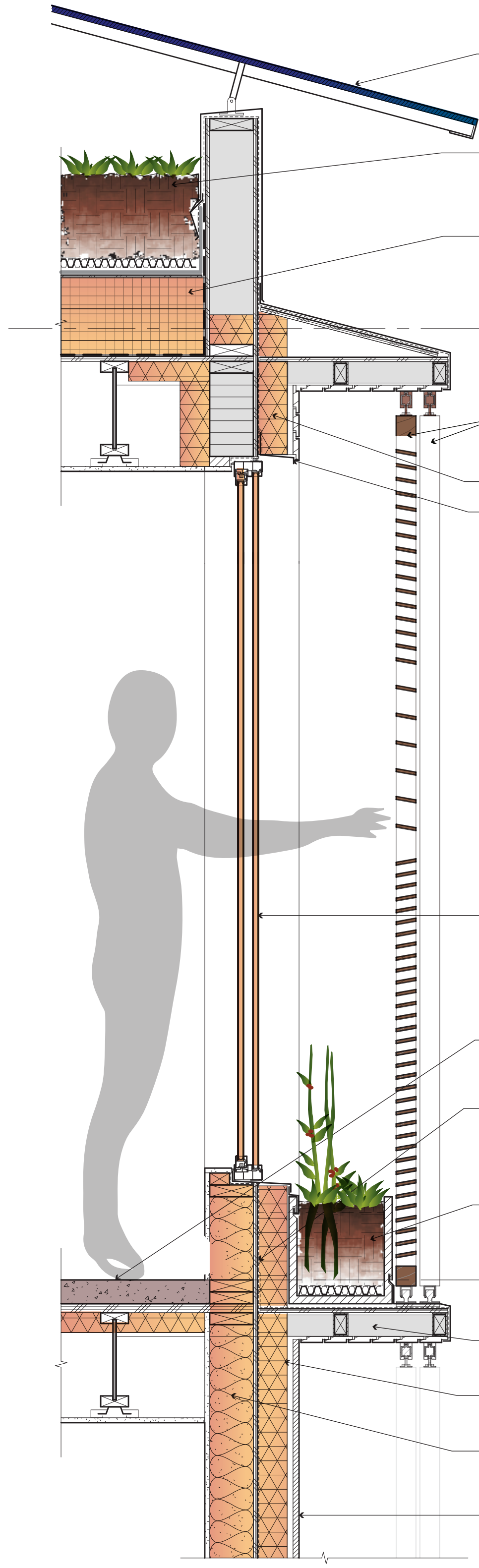
TASK 2C: BUILDING ENCLOSURE DETAILS

Building envelope construction includes continuously taped/sealed air barrier elements to achieve air tightness to passive haus standards (0.6 ACH 50). Continuous weather barrier and flashings as well as robust window wraps provide durable water shedding, and vapor permeability ensures that no condensation will accumulate within assemblies. Projecting elements utilize fiber-wrapped wood members to minimize thermal bridging normally associated with steel or aluminum.

The thermal mass floor assembly not only improves comfort and energy performance, but also acoustic privacy while providing a durable finished floor.



TASK 2D: DESCRIPTION AND DIAGRAM OF WHOLE BUILDING HEATING AND COOLING SYSTEM

Comfort and other living needs of occupants are provided primarily through the climate-responsive design of the building complex. The building enclosure is designed as a “natural habitat” within the temperate bay area climate. Conditioned spaces are honed down to those that really need it, and a set of dynamic filters are engaged to selectively control the exterior environment. The building enclosure is optimized to be very well insulated and have extremely low air leakage (to Passive House standards). This simple approach allows the building to close up and require very minimal heating during cool winter months. In temperate and warm months, the building opens to release heat and allow cool breezes off the bay to keep occupants comfortable. Manually operable shading louvers allow occupants to manage solar heat gain or provide shade as needed.

Ventilation

The living units are arranged along single-sided covered outdoor circulation spaces and supported with shared semi-conditioned laundry spaces. Not only does this configuration reduce the enclosed building area requiring conditioning, it also allows natural ventilation to provide effective ventilation for fresh air and passive cooling.

Passive ventilation via operable windows is supplemented with efficient fan exhaust from kitchens and bathrooms in the apartments. heat recovery units to each apartment provides an efficient method of capturing heat from exhaust air to temper incoming outdoor air.

Heat—space and water

Passive solar gain is admitted to all south, east, and west facing units. As noted, operable shading louvers allow for solar control. Thermal mass is activated by passive solar during the heating season to stretch beneficial heating and even out the daily outdoor temperature cycle. A small amount of heating is needed to supplement passive solar, recovered ventilation heat, and internal sources—this is provided through a combined hydronic heating and domestic hot water system. The heat is supplied to the units through efficient finned convectors.

Water in the combined hydronic and domestic hot water system is pre-heated through a solar-thermal array, heat recovery from shower drain water, and potentially through waste-heat from the grocery store refrigeration system or district scale water loop. Additional heating is provided from a highly efficient air-to-water heat pump system. The need for domestic hot water is kept minimal through the use of low-flow plumbing fixtures.

Cooling

Climate-responsive design provides year-round comfort without mechanical cooling. The passive and exhaust ventilation removes heat from living spaces, and natural ventilation provides air movement to cool residents. Ceiling fans supplement the natural ventilation to provide thermal comfort to residents.

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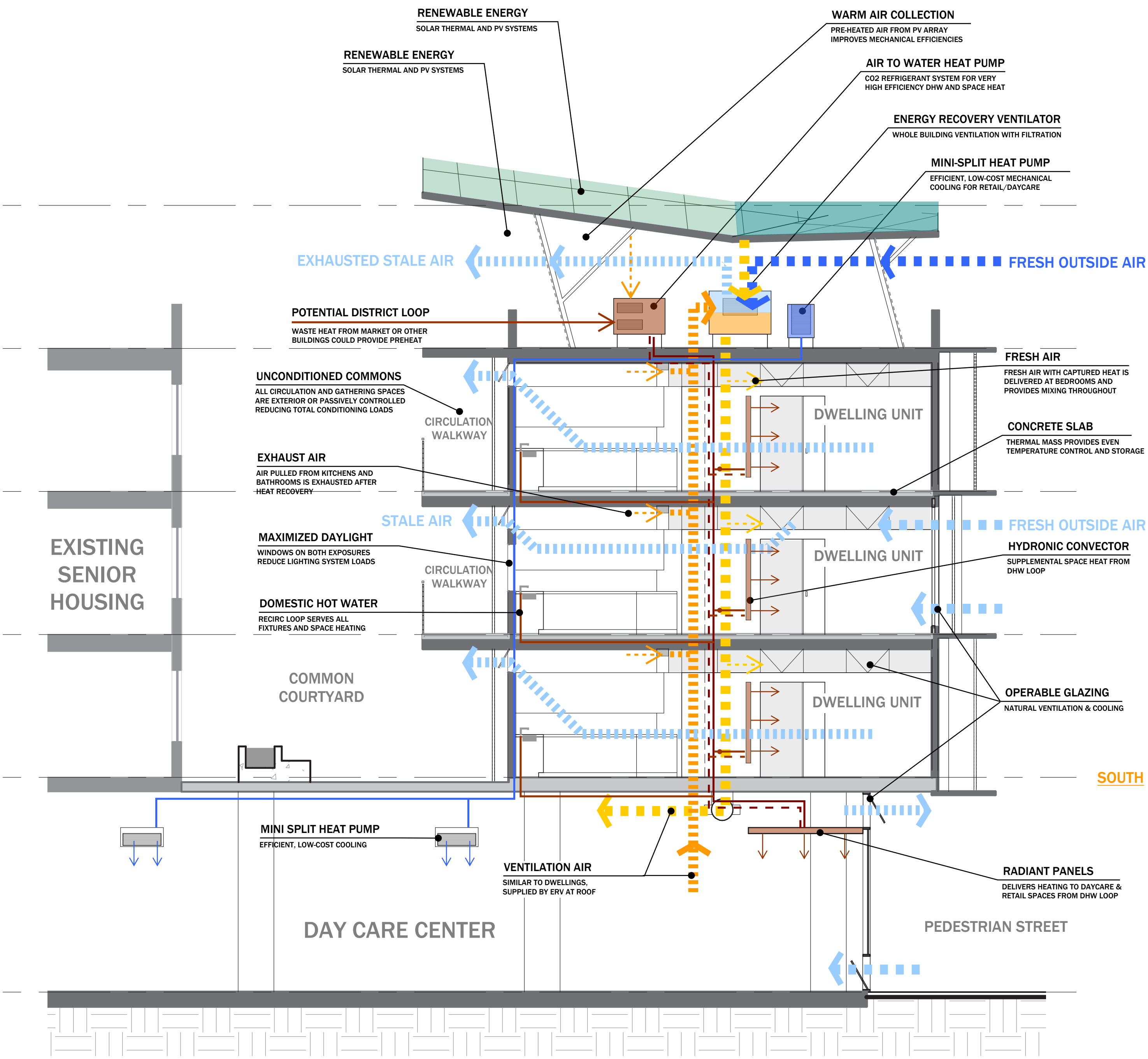
BUILDING SECTION



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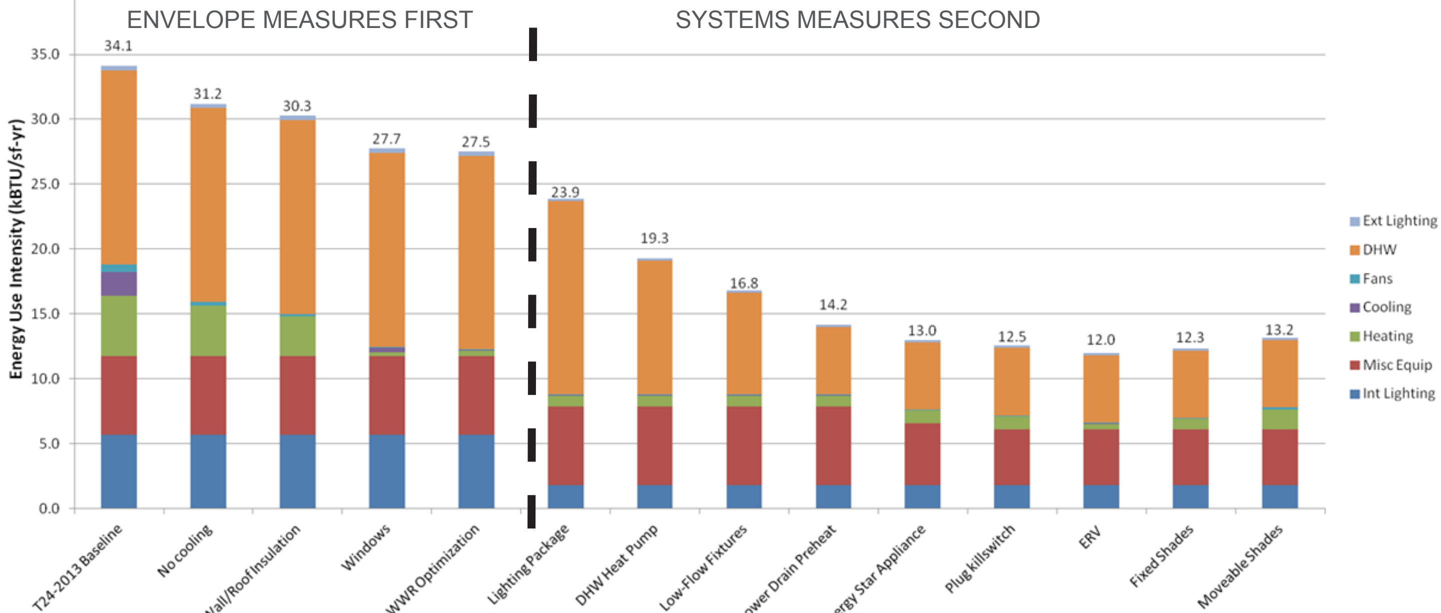
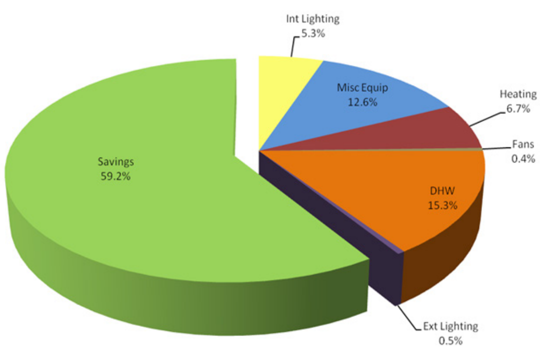
ENERGY USE REDUCTION STRATEGIES

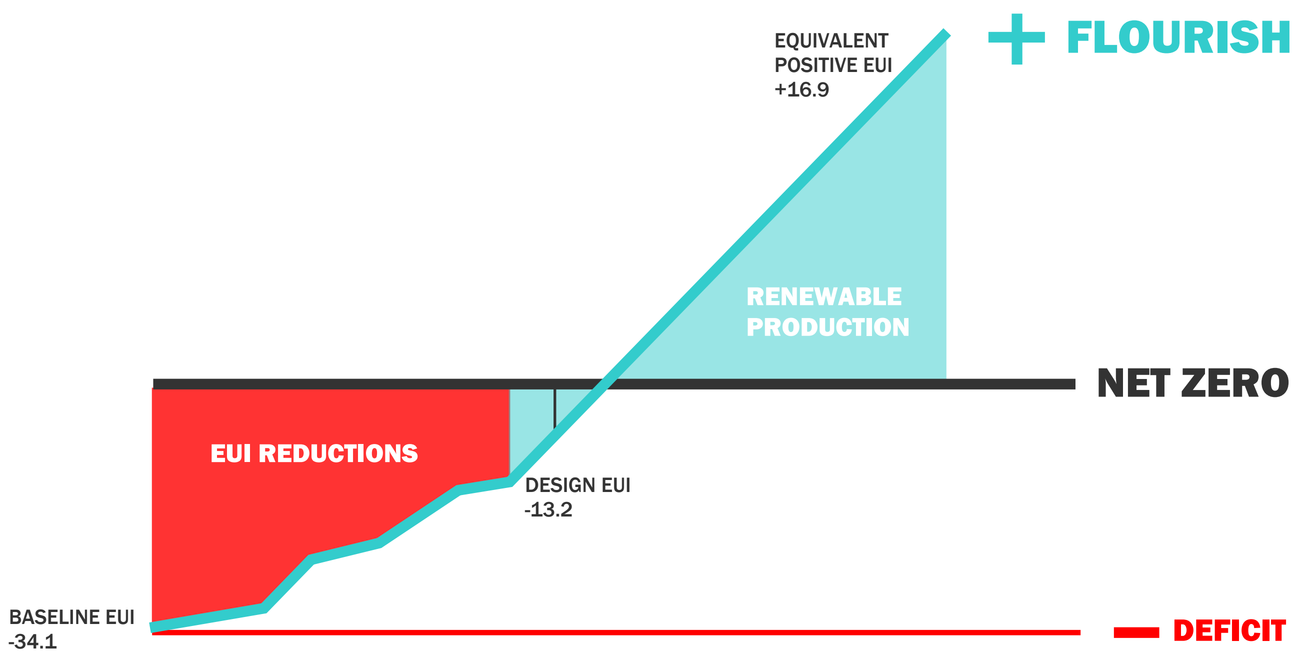


ENERGY USE PIE



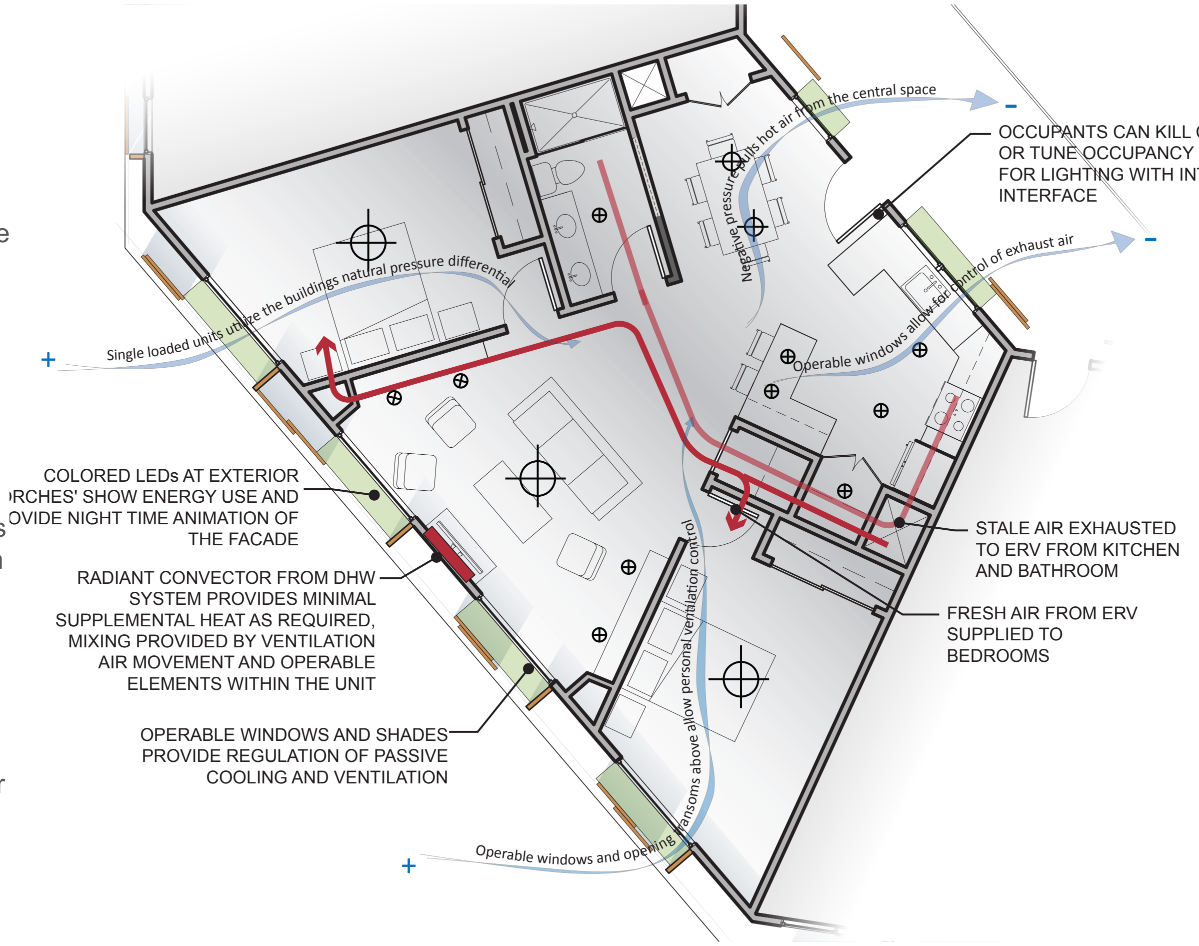
(ABOVE) Energy use reduction strategies prioritizes building envelope strategies, followed by system strategies. The combined strategies result in a significant EUI reduction from Title 24 baseline. A built project could include cost-benefit analysis to determine which measures provide maximum savings at lowest cost in order to balance these against renewable energy system size and cost.

*(LEFT)*Significant energy use reductions coupled with the mild climate allow the project to achieve and exceed net zero significantly



2E: DESCRIPTION AND DIAGRAMMATIC SKETCH OF RESIDENTIAL SYSTEMS

As described in the previous item describing building systems, the primary strategy for conditioning the residential units is the climate-responsive building design.



Ventilation
Operable windows provide natural ventilation for air quality and passive cooling. Efficient fans provide exhaust from the kitchens and bathrooms. During the heating season, individual heat recovery units in each apartment capture heat from exhaust air to temper incoming outdoor air.

Heat—space and water
Passive solar gain can be managed by residents through operable shading louvers. The small amount of additional heating required is provided via combined hydronic heating and domestic hot water system. Finned convectors efficiently supply the heat to the units. Low-flow plumbing fixtures not only reduce water usage, but also minimize the need for domestic hot water.

Cooling
The climate-responsive design provides year-round comfort without mechanical cooling. The passive and exhaust ventilation removes heat from living spaces, and natural ventilation provides air movement to cool residents. Ceiling fans supplement the natural ventilation to provide thermal comfort to residents during warm summer and fall weather.

Daylighting and Lighting
The building configuration and window design of the living units optimize daylighting. A simple integrated control system dims and switches lighting to minimize energy use. Other daylighting strategies include the operable shading system which also deflect daylight toward the ceiling, and interior material selections to help distribute the light. Highly efficient supplemental lighting is provided through the use of LED light fixtures, completely controlled by occupants.

Plug loads
A significant portion of the building energy use is plug loads within the living units. Efficient Energy Star appliances help minimize usage. A simple real-time metering display informs residents of the actual current usage to help them make informed decisions about their energy consumption. And to simplify shutdown of devices with tenants are away—an overall outlet “kill switch” is incorporated.

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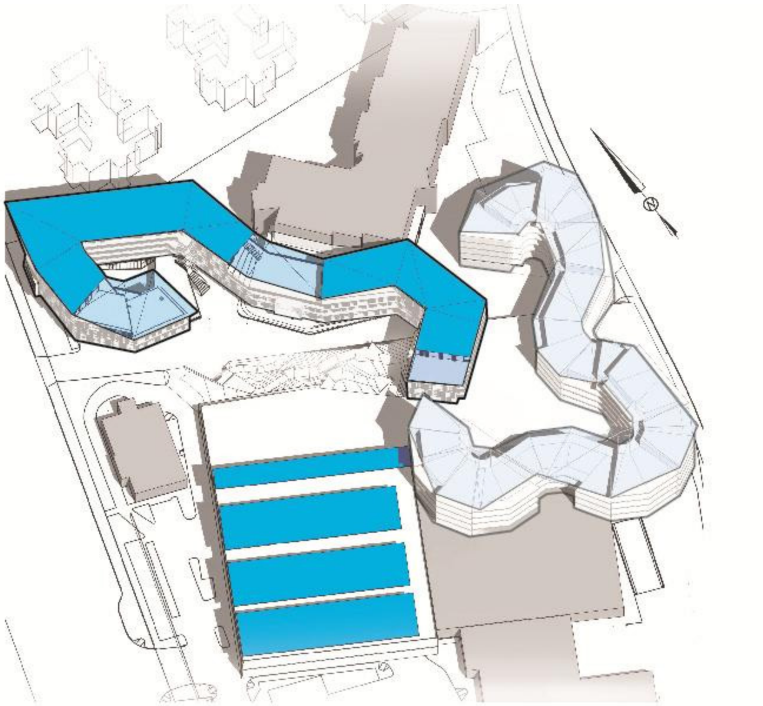
TASK 2F: RENEWABLE ENERGY



SOLAR ENERGY COVERAGE

STANDARD SOLAR PANELS (PV/HOT WATER)

TRANSPARENT PV PANELS

	Parcel 1	Parcel 2	Garage
15 deg Slope (sqft)	14,700	-	21,425
No Slope (sqft)	6,000	18,925	-
Bifacial 15 deg Slope (sqft)	1,500	-	-
Bifacial No Slope (sqft)	1,400	-	-
Total Array kW	336	270	407
Array Type	Fixed		
Efficiency	19 W/sqft		
System Losses	11%		
Inverter Efficiency	99%		
Annual Production (kWh)	**570,130**	**400,768**	**604,121**

Total solar electric production calculated using PV Watts accounting for orientation, tilt and system losses. No shading of panels is assumed due to building massing strategies intended to maximize collection exposure.

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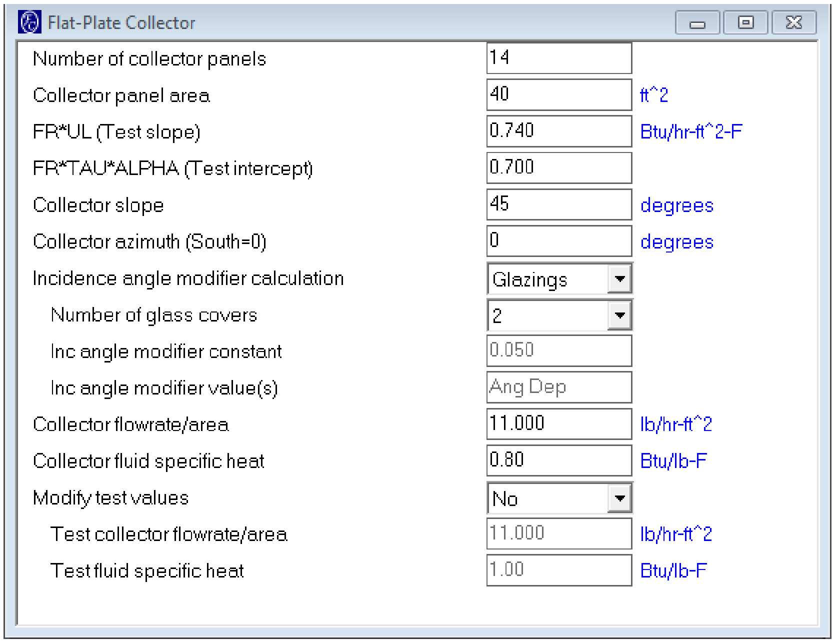
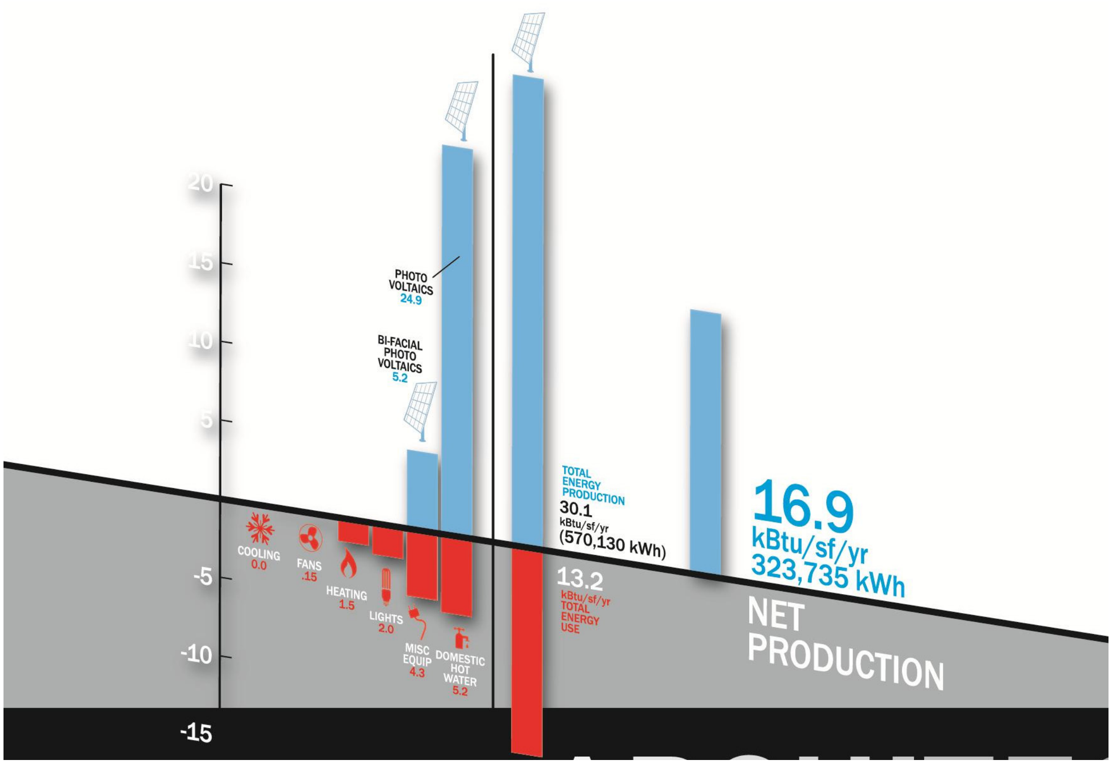


Flat-Plate Collector

Number of collector panels	14	
Collector panel area	40	ft^2
FR*UL (Test slope)	0.740	Btu/hr-ft^2-F
FR*TAU*ALPHA (Test intercept)	0.700	
Collector slope	45	degrees
Collector azimuth (South=0)	0	degrees
Incidence angle modifier calculation	Glazings	
Number of glass covers	2	
Inc angle modifier constant	0.050	
Inc angle modifier value(s)	Ang Dep	
Collector flowrate/area	11.000	lb/hr-ft^2
Collector fluid specific heat	0.80	Btu/lb-F
Modify test values	No	
Test collector flowrate/area	11.000	lb/hr-ft^2
Test fluid specific heat	1.00	Btu/lb-F

Total solar hot water production calculated using fChart assumes 4.5 therms/sf based on local climate.



Significant energy use reductions coupled with the mild climate and maximized use of available roof areas for renewable energy production allow the project to achieve and exceed net zero significantly. It is the goal of Flourish to show what's ultimately possible using the best available strategies coupled with optimized livability through enriched community for residents.

Surplus energy could benefit occupants through rent reductions at certain milestones, or collective donation to other low income housing projects or benefit organizations in the community.

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TASK 2G: OCCPANT BEHAVIOR

There are a number of strategies proposed for engaging the occupants in conserving energy use. These are intertwined across a range of design moves, from site planning, programming down to individual energy use feedback.

Programming

Several programing moves are designed to help occupants use less energy in the project. First, there are ample shared outdoor spaces that encourage residents to take advantage of the climate and go outside – where they will inherently use less resources as nature (not mechanized systems) provide light and air. A range of covered and partially covered spaces let people find the perfect location for the current weather condition.

Shared laundry facilities in naturally ventilated, 2-story community spaces allow higher efficiency washers and condensing driers to be implemented at a reasonable cost (vs. locating in individual apartments) and eliminate the energy required to temper drier exhausts makeup air. These rooms also have play areas, so laundry can provide a backdrop for play.

Architectural

The operable shading devices on the façade are the primary occupant engagement strategy, and allow the residents to tune the amount of light, heat and air that enter the unit from the exterior to achieve a comfortable temperature and light level. Fixed devices allow view to the exterior when the operable shading would otherwise be required. Training is to be provided on move-in at various points in time, and tuning a resident's façade for the temperature can be a regular discussion item during community meetings – connecting individuals and the community to the local climate and weather patterns.

Energy use feedback

Because every unit is sub-metered, energy use feedback can be simply provided at every unit via a dashboard, with aggregated results being displayed in common areas. Energy use targets will be established on move-in depending on the number of residents per unit and their projected energy use. Energy use is then tracked against this target and displayed back to the occupants via the dashboard and back to the community through a color changing LED –wall lighting fixture. This is located on the exterior wall, behind the shading devices and creates a dynamic façade for several hours at night, displaying the entire community's energy use relative to their unique target.

Social Systems

With the granularity of data provided by metering at each unit, friendly competitions can be sponsored and teams can compete against each other to meet their energy savings goals. These can occur by floor, wing, or by shared community/laundry facility, and help everyone realize that resource conservation is a group goal, and we all have to play our part in making it a reality.