Since 2009 over half of the world's population resides in cities, and this number is on the rise. The urban dwelling must be the vanguard of impactful green thinking and practices. The mission of designers must be to build a residential prototype consistent with the demands of a world no longer at our material disposal. The "Green House" of tomorrow must explore every avenue of design innovation from materials, energy, systems, and construction practices, to reclamation, resource efficiency, and lifestyle choices. Living "Green" is more than a applique of technologies applied to design, it is a way to be, think, build, and dwell.

The Mission:House is a domestic experiment in design and building practice. Green experiments range from construction waste reclamation and recycled material integration, to passive energy reliance, renewable resource integration, and urban agriculture.

The house is a two-story mixed use "hybridizing" residence integrating home with office thus eliminating the "commute" and inviting the community in for formal commercial uses, pop-up shop retail, and gallery space. The main residential space sits above. Located in the diverse Mission neighborhood of San Francisco, the house is both the home and living laboratory for the designers, who have made it their personal trial grounds for green materials, light, passive energy, and unorthodox construction techniques. The project represents a ten year experiment through which sustainability was understood not merely as measurable product but also a process. A methodology that integrated material choices, systems, scope, and morphology has resulted in a design to which sustainable thinking was not just applied but woven into the very formal language of the building. Experiments range from floors of expansive steel plates, walls of thermal plastics, and magnetic closet/display walls, to integrated passive energy strategies, ingenious waste-stream material reclamation, home agriculture and high-tech thermal & solar power collection.

Street

The ground floor access to both units is through a façade of shingled glass built entirely of **reclaimed material**, creating an unusual "**GREENskin**" of refracted light filtered through superimposed frames. The lower unit opens up through a sliding recycled thermal plastic façade onto a rear yard containing a translucent garden-shed/play-house and an FSC certified wood tiled deck nestled between a swath of drought tolerant swaying grasses and a tall harvestable bamboo grove. The studio interior is divided by a 50-foot long wall of sliding pin-up/doors which smartly **double the function** of the space by reconfiguring to reveal library shelving, storage and service rooms, a conference space, and kitchenette.

Home

The open interior upstairs breathes light deep into its core where an operable skylight stretches across the house letting in the sky (and rain) allowing for **passive ventilation** of the entire space to balance solar gain from the rear 30-foot tall corrugated thermal plastic façade which looks into the canopy of the timber bamboo grove. The tree bamboo shades the double skin corrugated plastic **trombe-wall** that acts as a seasonal heat collector/dissipater on the south facing wall of the structure. The active air circulation system of the home draws in winter air warmed by the **passive thermal system** and re-distributes it throughout the building. In summer, the horizontal corrugations act as louvers to deflect light energy, while the wall itself opens up to ventilate excess heat through the passive **thermal "chimney"** designed into the home's morphology. In this way the building's morphology considers the natural seasonal cycles and is responsibly manipulated to absorb or shield solar gain.

Landscape & Community Involvement

The **landscape** is designed as a harvestable productive garden, energy regulation system, and aesthetic amenity. Planted of native and non-native adaptive species the landscape is designed to be entirely drought tolerant - from the permeable planted streetscapes in the public right of way at the front of the building to the rear yard grove plantings. **Permeable street plantings** (accomplished by applying for and receiving a neighborhood challenge grant) were also the focus of a **neighborhood involvement** effort. The **importance of community** participation in the landscape's construction was the result of a re-assessment of how sustainability should be more than a laundry list of "green technologies;" rather, it is also a method of **collaboration** so that small scale interventions may eventually serve to achieve larger scale work and longer lasting goals.

Site water management was also a critical point of interest for the project's sustainable design strategy. All of the productive rear and **roof agricultural plantings** are subsurface drip irrigated. The natural soil profile was exploited by design to **reservoir the water** in a natural subsurface clay bowl before draining to a **subsurface collector**. Grey water reuse was employed to siphon bath water into two 30 gallon reservoirs which then drain gradually into the street plantings. The sustainable site extends to the roof to regain the lost footprint of the urban lot as an **energy and food producing surface**. The reconfigured roof integrates an organic vegetable garden, hot tub, and green roof as well as a 4.5 Kwatt photo-voltaic array into a ship-like topography of modular wood tiles.

Recycled + Reclaimed Materials

Recycling on the macro scale, the **original 1890s structure** was recycled and **rehabilitated**, boasting a new central vacuum system, prefabricated cabinetry, recycled materials, and new insulation. On the "street side" of the building, the original turn of the century residential Edwardian façade is restored to float above the re-claimed glass storefront, which extends down from it to the street like a skeletal "hoop skirt". This "**GREENskin**" is an installed prototype for a permanent storefront glazing system made entirely of **re-claimed** insulated glazing units (IGU's) salvaged from the local construction industry and reassembled to create a new glass shingle shop-front. The system seamlessly receives the random shapes, sizes, colors, and thicknesses of this ubiquitous waste stream material, to create a continuous **weather-proof skin** at street level.

Five horizontal steel "shelves" are stretched across the entire facade set at varying offsets, which reduce vertically as they ascend. This allows the **IGU's** to be overlapped like glass shingles, creating a "fish-scale" façade of transparent salvaged units. The vertical modulation allows for larger units at the bottom, and smaller units at the top, all "leaning" into the system like frames on display shelves. Two existing entry door openings are accommodated into the airtight reclaimed skin. The minimal steel assembly is 75% recycled content and the IGU's are **100% reclaimed material**.

The **salvaged units** are arranged and rotated to create the most continuous horizontal skin possible across each shelf. **FSC-certified wood** is used for the doors and infill strips at edge conditions. The geometry, color, transmittance, and reflective quality of the individual found units varies widely producing an unexpected play of light and shadow across the GREENskin's surface, tinting views through a Mondrian-like structure of intersecting frames and reflections.

Mission:House
Sustainable Design Features

The Mission:House boasts many sustainable technologies and design considerations that were a part of its 10 year ongoing evolution as a living sustainable design experiment. The following is a list of technologies, strategies, and principles that the project employed not as a mere attempt to "greenwash" its design, but to truly enfold a sustainable design ethic into the project's aesthetic and functional character.

Overall Green Strategies

- The building's "Thermal-Vent" morphology
- Building smaller
- Building with prefabricated elements in order to minimize waste
- Reclamation of waste stream elements accumulated & gathered over time
- "Slow Building"
- Urban agriculture
- Operable roofs and walls
- Thermal harvesting with integrated active recirculation
- Integrated waste management – systemic utilities
- Solar energy
- Land reclamation / roof harvesting of solar for food production and power
- Inventive water savings from solar heated bath to avoid excessive potable water use.
- Landscape xeroscape/ Native and non-native adapted draught tolerant plantings
- Permeable streets
- Roof water harvesting for streetscape plantings

Recycling + Waste Diversion Strategies

- Re-claimed glass storefront / Green skin Façade system
- Recycled content steel cladding and flooring
- Homasote sliding partitions- 95% recycled content
- Composting area; use in rear yard and roof top plantings
- Urban agriculture and productive plantings
- Onsite Bamboo harvesting for building materials
- Functional tall plantings for thermal control on Trombe wall
- Engineered flooring
- Re-use of framing lumber from demolition to reframing

Wood Conservation Strategies

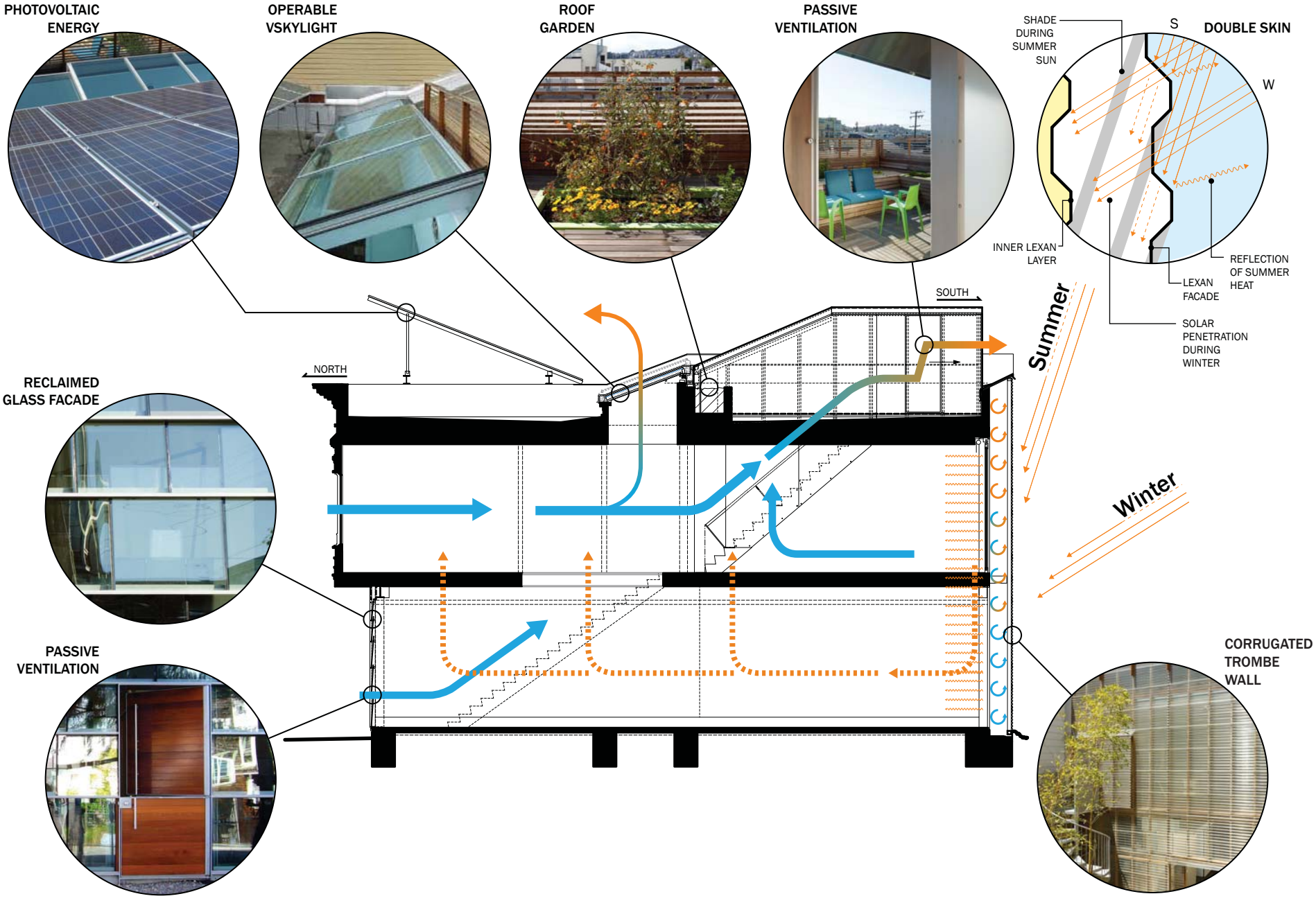
- Tree Bamboo wood-source on site – for PV screens and yard fencing and shade structures
- FSC Certified wood
- Off-cut strips from decking and benches re- used to make fence guardrail with offset spacing
- Reuse of framing lumber and building sheathing where possible

Water Conservation Strategies

- Landscape is designed as a hybrid productive + energy regulating+ aesthetic amenity.
- Drought tolerant plantings used exclusively
- Permeable street plantings (accomplished by applying for and receiving for a neighborhood challenge grant)
- Subsurface drip irrigation.
- Grey water reservoirs
- Roof top solar heated 250 gallon "hot tub" installed on the roof cuts childrens' the baths by 80% and virtually eliminated the grey water supply in combination with a rinse shower often in lieu of bathing saving thousands upon thousands of gallons of potable water per year.

Energy Conservation Strategies

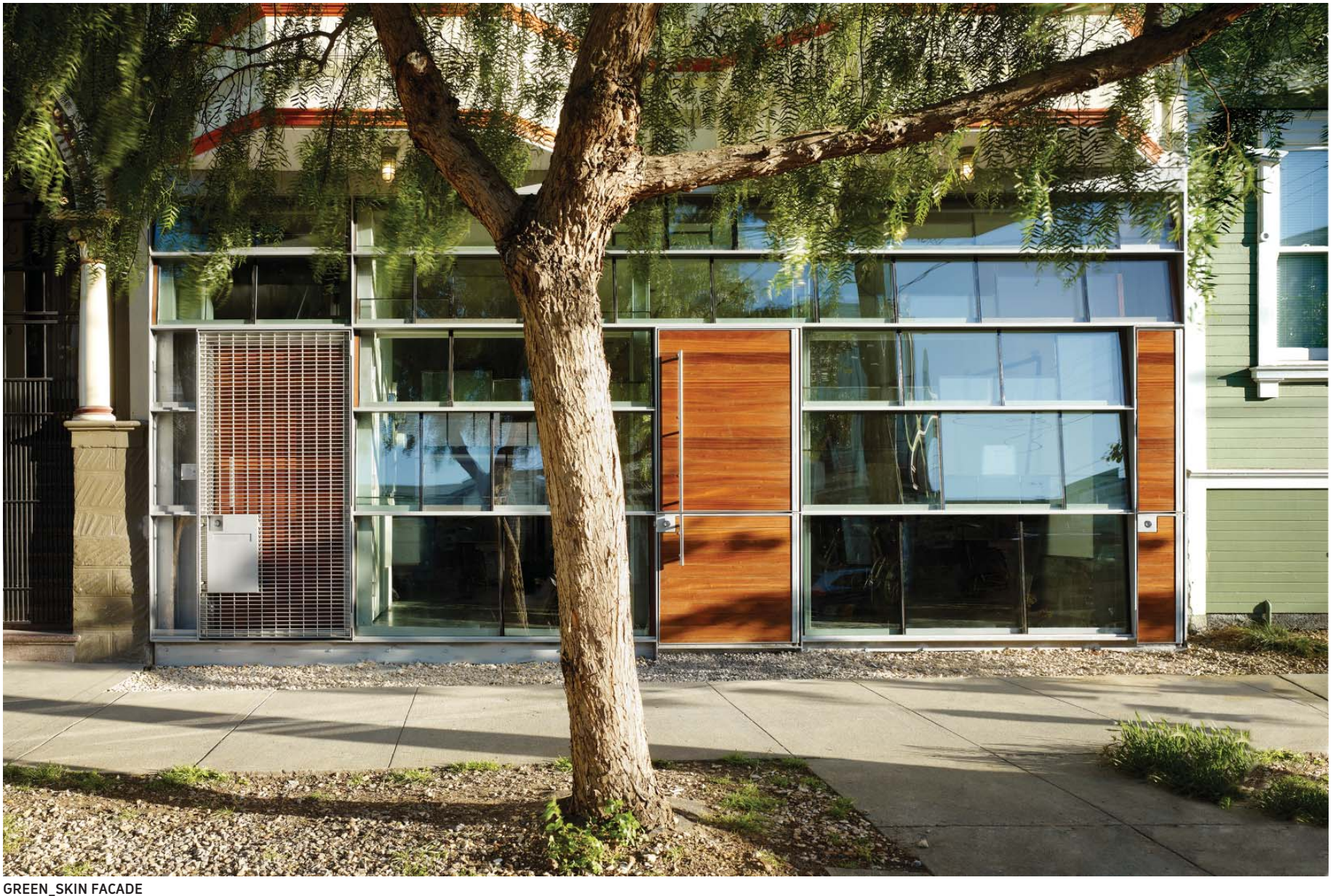
- Passive thermal design - superheated trombe-wall cavities, shading devices, and operable ceilings and wall section allow the entire house to perform like a single thermal chimney.
- Learning to live with the natural seasonal changes by participating and living in dialogue with the external environment has saved more energy than the opposite.
- Solar Photo-voltaic array
- Ventilation Roof – drawing from cooler lower space and seasonally transitioning to draw from warm areas to heat cooler lower areas in complimentary seasonal conditions
- Using solar energy to power hot tub
- Net metered PV 4K array
- Energy Star appliances
- Redundant small scale systems to balance peak demands
- Tree Bamboo shading
- Corrugated double skin wall and upper west facing thermal plastic cavity wall create heat reserves that can be tapped and stored for re-release in off cycle times.



MISSION:HOUSE

Sustainability: Method for Living

A methodology of material choices and integrated thinking regarding systems, scope, and morphology resulted in a design in which sustainable thinking was not applied but woven into the very formal language of the building. The intention was to avoid the cliché pastiche of green components that are products of culture and instead making a home that in turn changes the way one lives. This strategy engenders a culture of sustainability instead of being derivative of an applied sustainable culture.

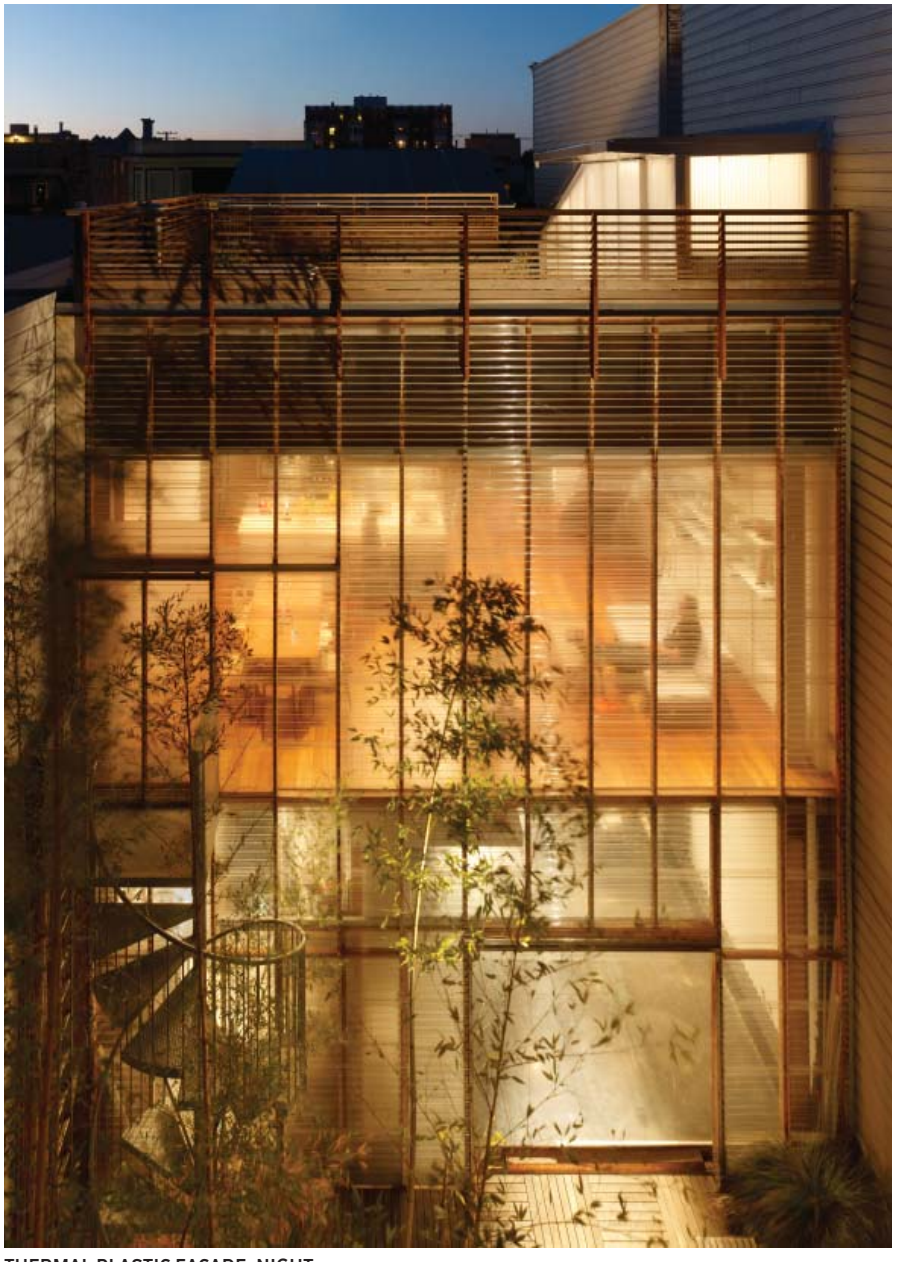


GREEN_SKIN FACADE

MISSION:HOUSE

A Residential Experiment

The house is an extensive renovation of a 1908 Eduardian located in the heart of San Francisco's Mission District. During its 10 year evolution, the client's changing needs have necessitated that design elements be sustainable, thoughtful, and creative in their approach to materiality, energy, aesthetic, and functionality. This resulted in sourcing a variety of unorthodox systems and ideas that have all shaped the form and feel of the house. A 10 year long experiment, the house has over time coalesced into a unified whole.



THERMAL PLASTIC FACADE, NIGHT

DROUGHT TOLERANT LANDSCAPING

SLIDING ACCESS DOOR

RECYCLED PLASTIC FACADE, DAY

MISSION:HOUSE

Solar Facade

The south face of the Mission:House employs creative use of material to maximize the home's solar gain. The two-story transparent wall, composed of Lexan Thermoclear corrugated paneling typically used as a roofing material for greenhouses, creates a Trombe-Wall type air space which warms during the day and heats the interior space at night-time. Alternatively sections of the wall open to cool the interior and provide extra passive ventilation as necessary.

PRODUCTIVE ROOF DECK

THERMAL PLASTIC WALL

PASSIVE VENTILATION

MISSION:HOUSE

Productive Landscape

The design of the Mission:House employs several strategies that provide the clients with energy-saving and green solutions to city living. The roof deck features an edible vegetable garden. A 4.5-kw solar array installed on the roof provides energy, and the roof access creates a natural vent through the house from ground floor to roof, providing the living spaces with passive air circulation. An operable skylight fills the interior with air and light which connects the atmosphere of the roof deck above with the living areas below.

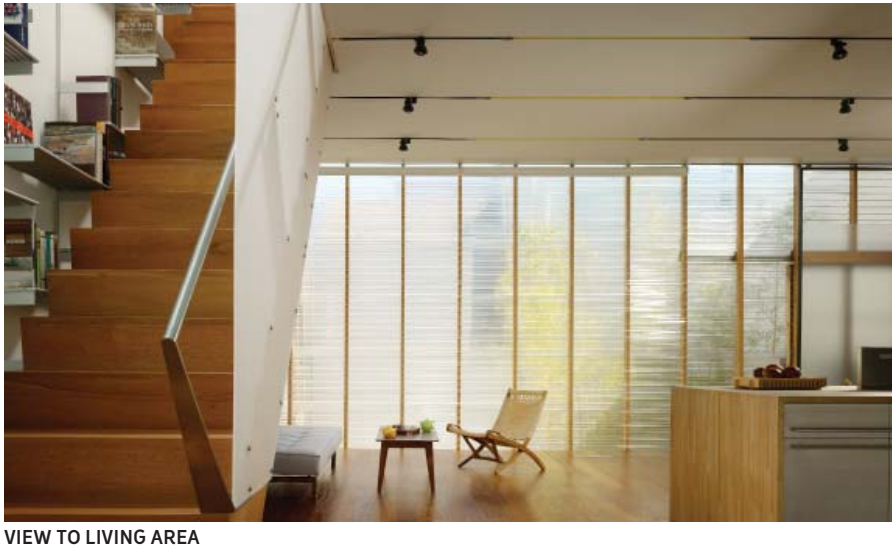
PLASTIC TROMBE WALL

Material Palette

The house's large openings to the outside and generous use of light colors and translucent interior finish materials give what would ordinarily be considered a small space a generous sense of openness and volume. The material palette for the house was kept relatively simple throughout the 10 years of its experimental development: wood floors and work surfaces, large light-filled openings, and interior partitions composed of varying levels of translucency.

“THERMAL CHIMNEY” STAIR FORM

DETAIL



VIEW TO LIVING AREA

Staircase

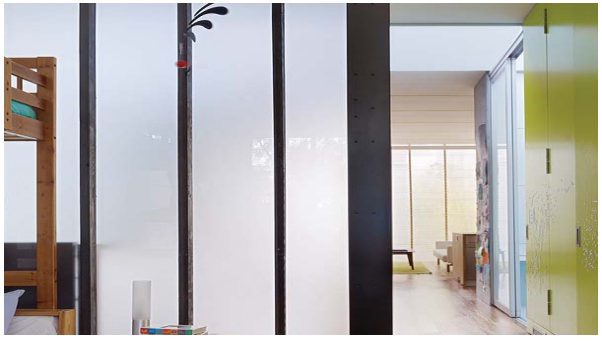
The staircase connecting the second story living space with the roof was seen as an opportunity to create a sculptural element that both framed the space around it while having its own spacial presence. The solid mass of the stair meets a translucent skin of plastic which picks up on the house’s common motif of varying levels of transparency. This skin also allows for the transmission of light from the light-filled roof access above to the living space below.

PREFABRICATED CABINETRY - CONSIDATED PROGRAM FOOTPRINT

MISSION:HOUSE

The house's main living area is a highly efficient space which employs generous use of thick walls and low cabinetry volumes to provide ample storage space for the couple and their two small children. The living/dining/kitchen area features 6 kitchen's worth of IKEA cabinetry retrofitted with custom pulls crafted from L-shaped anodized aluminum extrusions. The kitchen island volume clad in beech wood not only provides a generous food preparation area, but also serves double use as a large, easy-to-clean art space for the couple's children.

Smart Storage

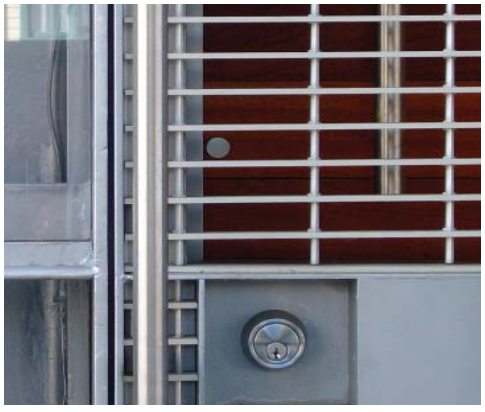


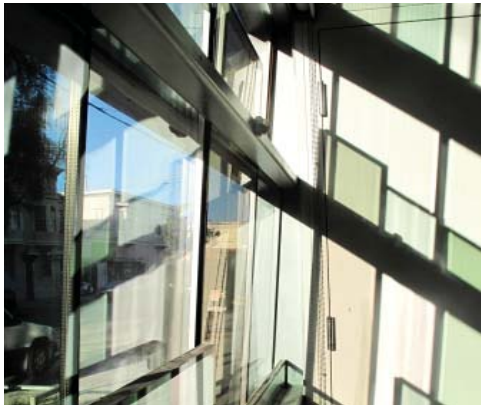
OPERABLE SKYLIGHT - PASSIVE VENTILATION

MISSION:HOUSE

The Outside Inside

The original Eduardian home provided an insufficient amount and quality of light and air to the interior of the structure, so ensuring that the new home enjoyed considerable amounts of became a major programmatic and sustainability design goal. The solution to the client's problem came in the form of a 24 x 7 foot operable skylight that is located above the centrally located bathroom. The skylight opens the house to the sky providing the interior with fresh air, light, and even rain.





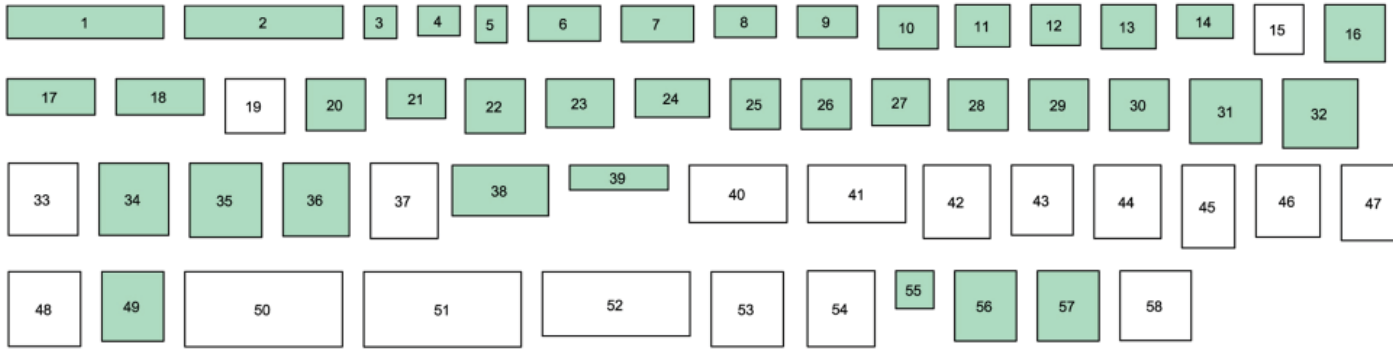
RECLAIMED IGU'S

GREENskin FACADE SYSTEM

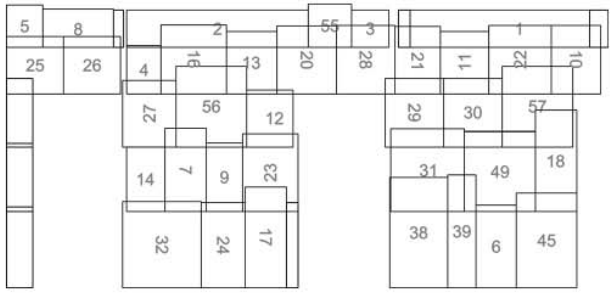
MISSION:HOUSE

GREEN_skin

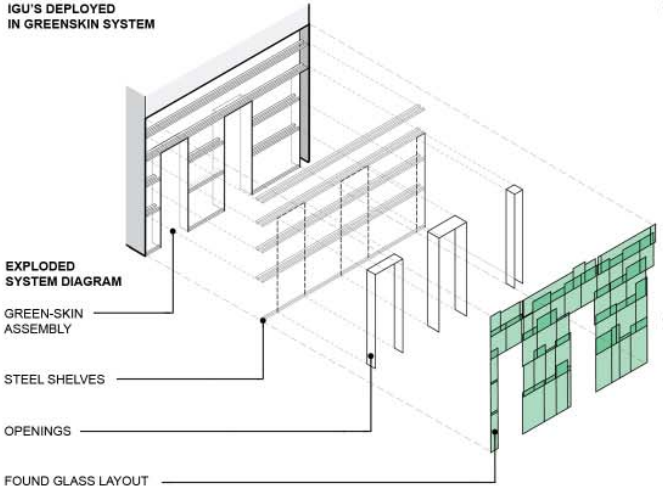
The storefront facade of the house's lower commercial office and studio is constructed from refurbished insulated glass units (IGU's) which were sourced from local salvage yards. The facade system accommodates a wide variety of IGU dimensions, and this purposefully gives the facade a shingled visual character. The angled panes of recycled glass vary in tint and reflectivity, producing a varied and fragmented pattern of reflection towards the street, and cast Mondrian-like compositions of shadow inside the studio space.

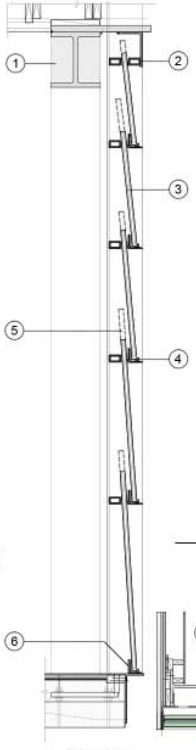


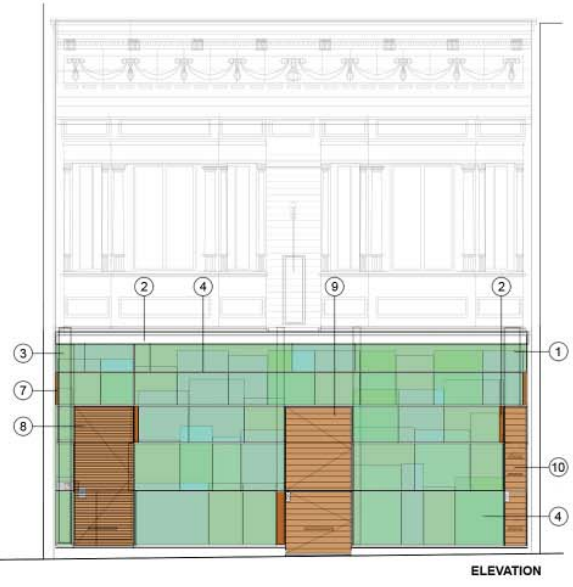
RECLAIMED IGU INVENTORY
(SELECTED UNITS COLORED GREEN)



IGU'S DEPLOYED
IN GREENSKIN SYSTEM

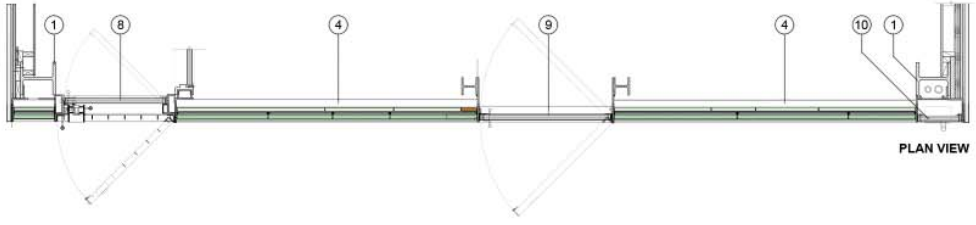






Detail notes - section, elevation, and plan

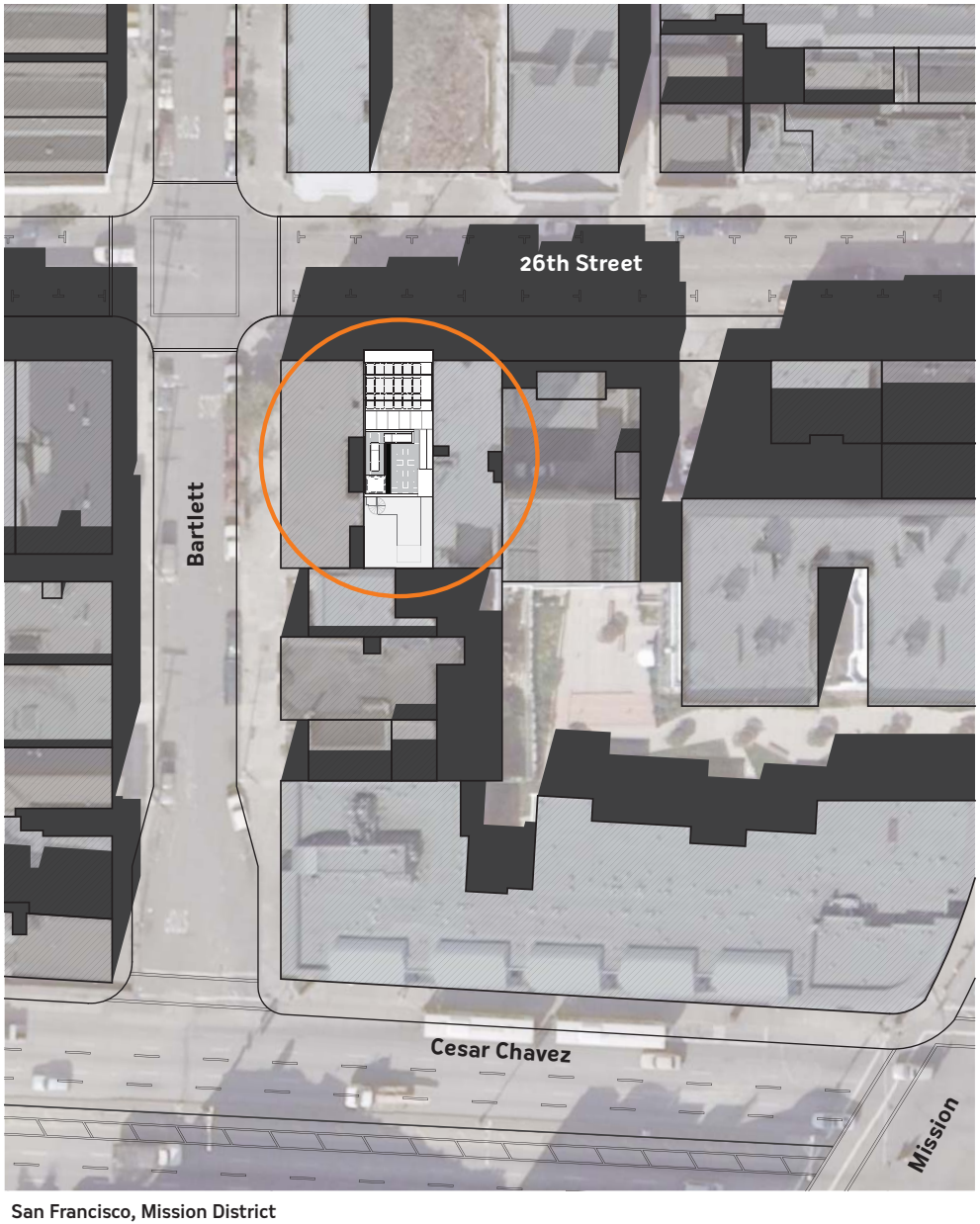
1. moment frame assembly (existing);
   W12X14 steel beam
2. facade head assembly;
   7" x 5" bent steel plate
   double 1.5"x2.5" steel tube sections
   adhered rubber contact cushioning
3. reclaimed sealed insulated glass unit (IGU),
   random sizes, color types
4. typical glass shelf assembly:
   3" steel angle
   1.5" x 2.5" steel tube section
   .75" steel glass stop angle
   rubber glass rail shoe gasket
5. ragged overlapping top edge of random
   reclaimed IGU's
6. 3" steel angle welded to 10" x 4" bent steel
   base angle
7. wood infill panel
8. residential entry door assembly;
   aluminum grate security door
   steel frame FSC certified wood clad door
9. commercial entry door, FSC certified wood clad
   dutch double-swing door
10. public utility panel



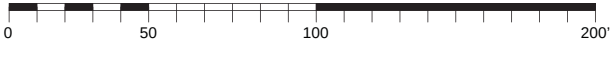
MISSION:HOUSE

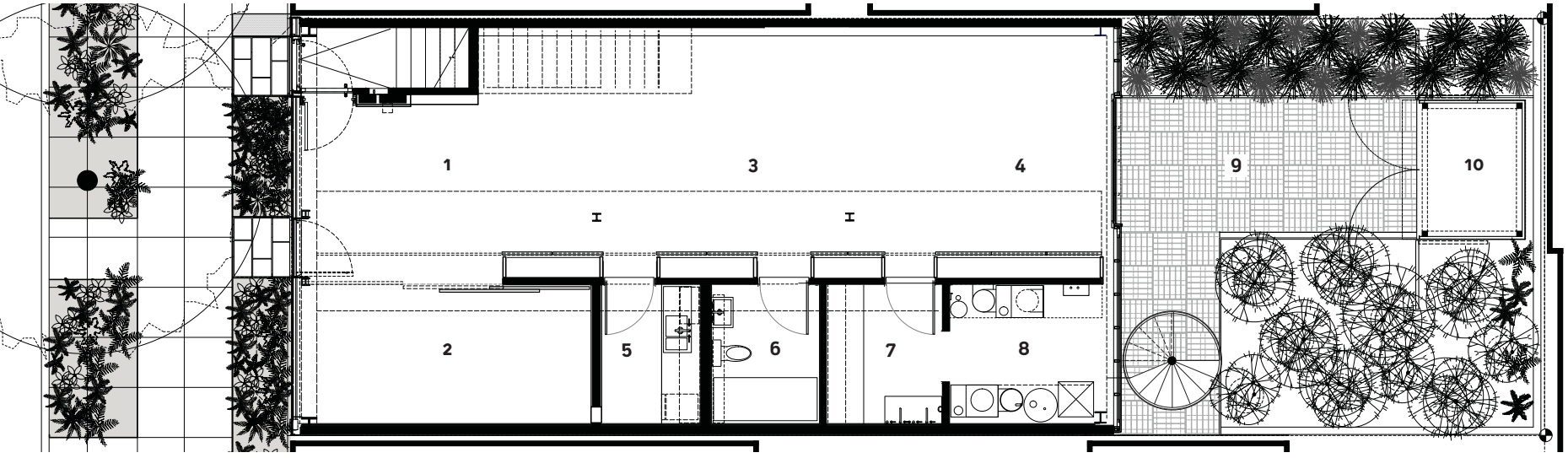
GREEN_skin Detailing

This "GREENskin" is an experimental prototype for a permanent storefront glazing system made entirely of re-claimed insulated glazing units (IGU's) salvaged from the local construction industry and reassembled to create a new glass shingle shop-front. The system seamlessly receives the random shapes, sizes, colors, and thicknesses of this ubiquitous waste stream material, to create a continuous weather-proof skin at street level.

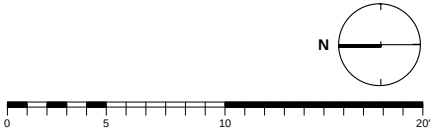


San Francisco, Mission District





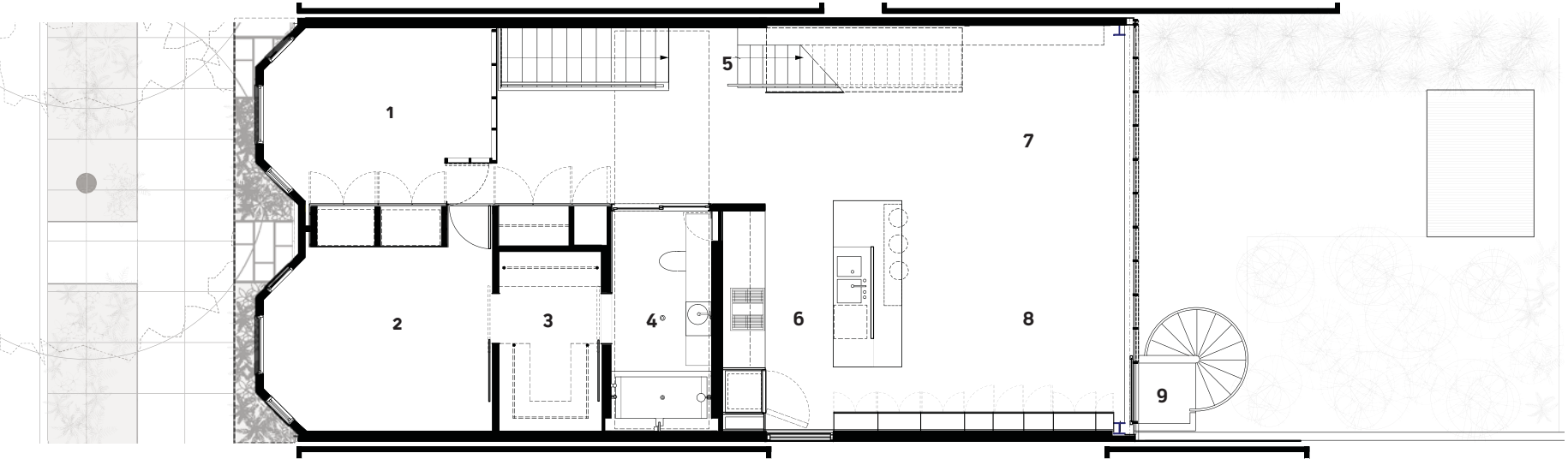
1. GALLERY
2. CONFERENCE
3. OFFICE
4. MODEL
5. STAFF
6. WC
7. MODEL
8. STORAGE
9. BACK DECK
10. STORAGE



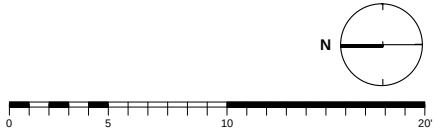
MISSION:HOUSE

Ground Floor Plan

The house employs a multi-functional landscape, combining productive agriculture, energy regulating functions, and an aesthetic amenity. Planted of native and non native adaptive species the landscape is designed to be entirely drought tolerant from the permeable planted streetscapes in the public right of way at the front to the bamboo grove in the house's rear. This also begun a re-assessment of how sustainability can be a way of working to achieve longer lasting goals through neighborhood involvement and smaller scale work.



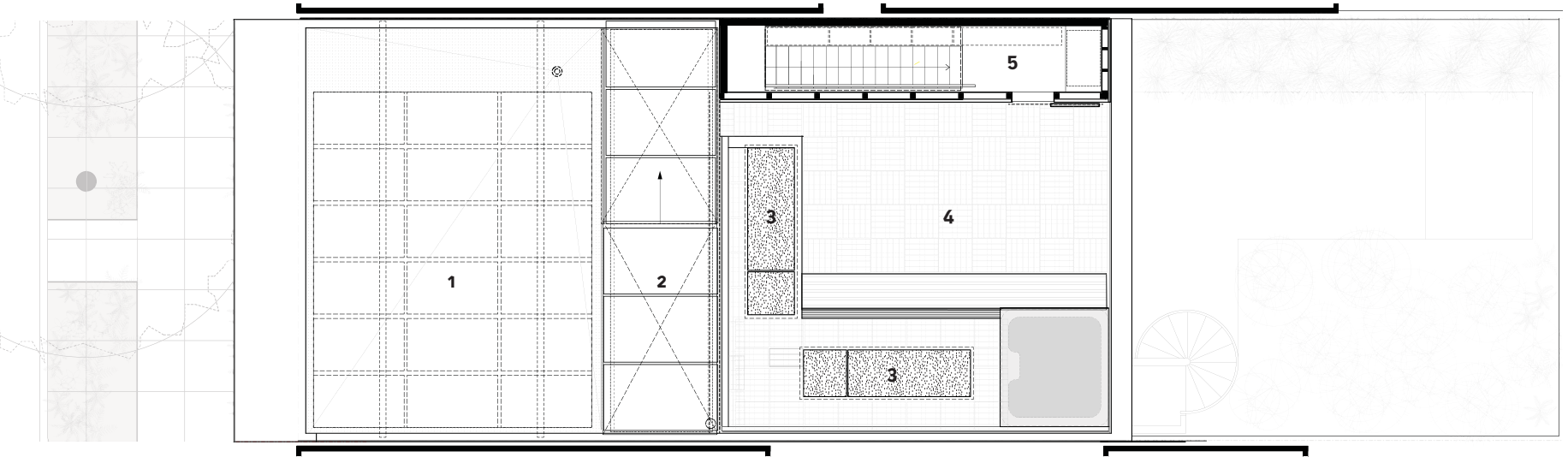
1. BEDROOM
2. MASTER BEDROOM
3. MASTER CLOSET
4. BATHROOM
5. ROOF ACCESS
6. KITCHEN
7. LIVING
8. DINING
9. BACK DECK ACCESS



MISSION:HOUSE

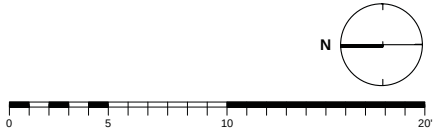
Second Floor Plan

The main residential space, which includes two bedrooms and an open living area, sits above the re-claimed glass storefront, which extends down from the restored turn of the century residential Edwardian façade. The floor plan of the living area was thoughtfully considered in order to maximize usable space and openings to the sky and rear bamboo grove while accommodating necessary space for storage and function. The result is an 1,100 square foot living area that feels much larger than it is.



ROOF DECK

1. PHOTOVOLTAIC PANEL ARRAY
2. OPERABLE SKYLIGHT
3. ROOF GARDEN
4. ROOF DECK
5. ROOF ACCESS



MISSION:HOUSE

Roof Plan

The house's roof deck provides additional space for the family to enjoy the outdoors, while serving double function as a productive "fifth facade." The photovoltaic array powers the roof's hot-tub, and the roof garden provides a means for the family to grow their own fruits and vegetables. The garden is watered by irrigation lines concealed by the decks' modular tiles, which can be removed for easy irrigation maintenance. The tiles turn up to form the edges of parapets and seating walls and unify the sections of the deck into one volume.