

CODIFIED TERRITORY

Saint Gobain Architecture Student Contest



CODIFIED TERRITORIES is not a predefined solution, but a generative architectural system. One that can be implemented anywhere, evolving in response to local conditions. At its core is the radical idea of 3D printing earth structures like code: a set of spatial instructions that, when applied to different sites, translates local soils and resources into uniquely habitable forms.

The project draws from France's vernacular traditions and the linear development patterns of Chimilin and the Astus crane track in Villefontaine, establishing a continuous yet adaptable band of small-scale dwellings. These reflect the organic growth of rural settlements while enabling modern fabrication and climate resilience.

Rammed earth walls, integrated with locally sourced sheep's wool, replace traditional pisé, delivering both thermal mass and improved insulation. These walls are robotically printed on-site, turning the material of the territory into architecture itself. Above, CLT structures designed for disassembly are placed, allowing for flexible assembly, future modification, and material reuse; ensuring the system can evolve over time.

The project introduces two thermal zones: a dense, insulated core for winter and transitional south-facing wintergardens that act as prosthetic extensions. These buffer zones mediate light, heat, and airflow across the year, offering flexible spaces that shift in use with the seasons; an architecture that responds directly to changing environmental and human needs.

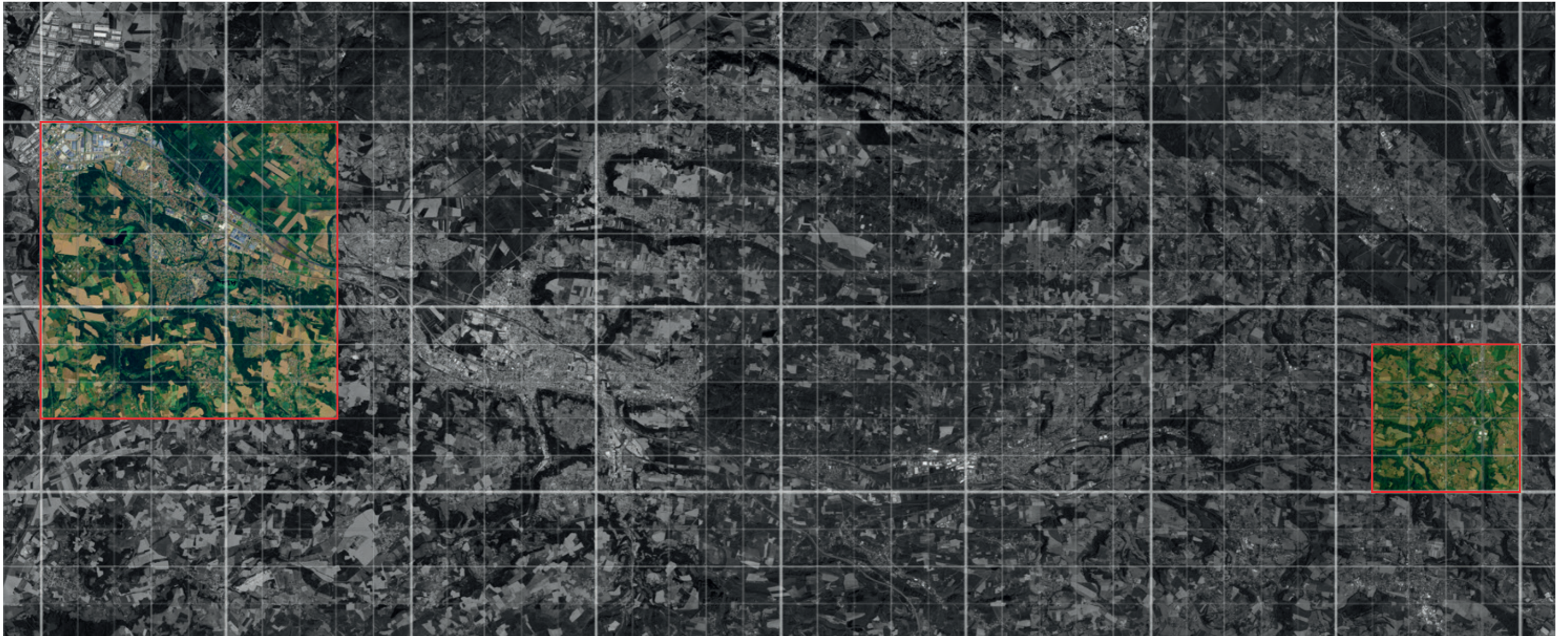
Rather than offering a fixed design, CODIFIED TERRITORIES provides a framework. The architectural "code" remains consistent, but its expression is shaped by local materials, vernacular craft, and cultural adaptation. Each place completes the architecture in its own voice, and inhabitants become co-authors, finishing spaces with their own furniture, finishes, and rhythms of use.

The potential for other locally sourced materials, possibly fabricated using CAD/CAM technologies in the very fabrication facility that inspired the crane infrastructure, opens the system further. It's not only adaptable - it's expandable, scalable, and regionally anchored.

By combining robotic earth printing, territorial resources, and a code-based logic, the project envisions a new village model: sustainable, resilient, and deeply rooted in place. It balances innovation with tradition, permanence with adaptability. It is a living architecture that grows, shifts, and belongs.

Design Statement

Introduction



The project, aligned with the St Gobain Architecture Student Contest 2025, focuses on two sites in Nord Isère, France: Villefontaine (new residential and research facilities) and Chimilin (adaptive reuse of an abandoned school). We must create adaptable, multi-generational housing that balances individual and communal living, using resource-efficient, low-carbon materials.

Brief Summary

Introduction



Site Location Plan 1:1250

Chimilin



Existing Site Plan

Chimilin



Existing Ground Floorplan

Chimilin

6





Existing First Floorplan

Chimilin

7





Site Photos

Chimilin



Site Location Plan 1:1250

Villefontaine



Existing Site Plan

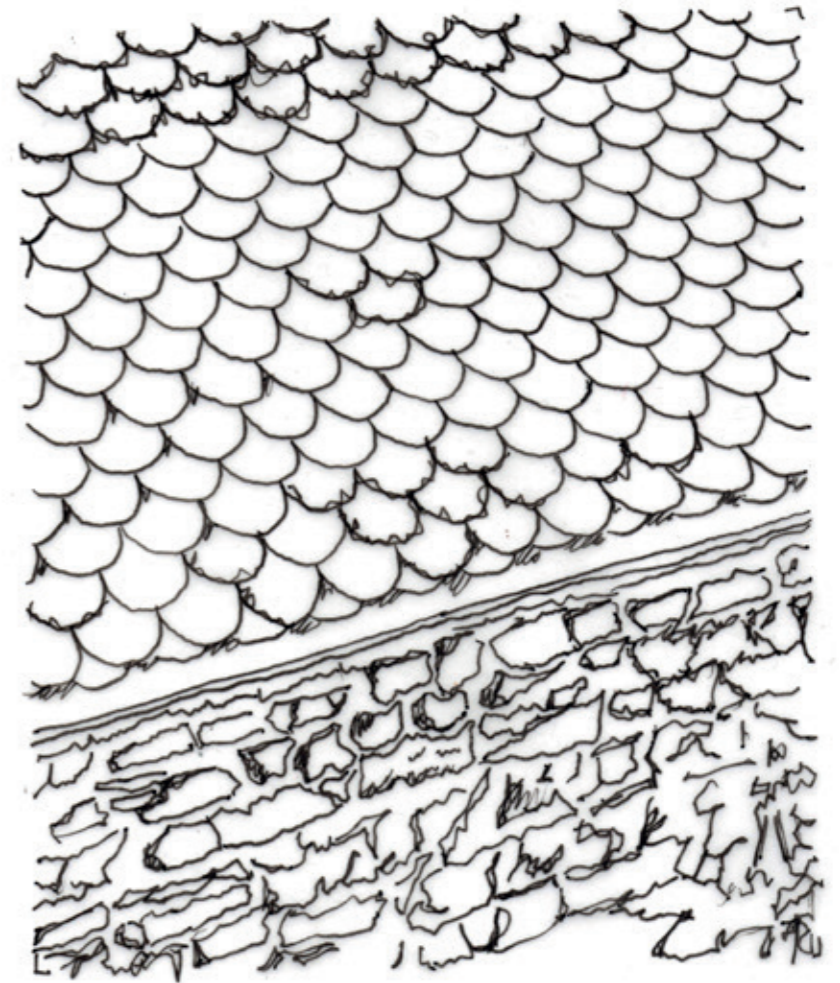
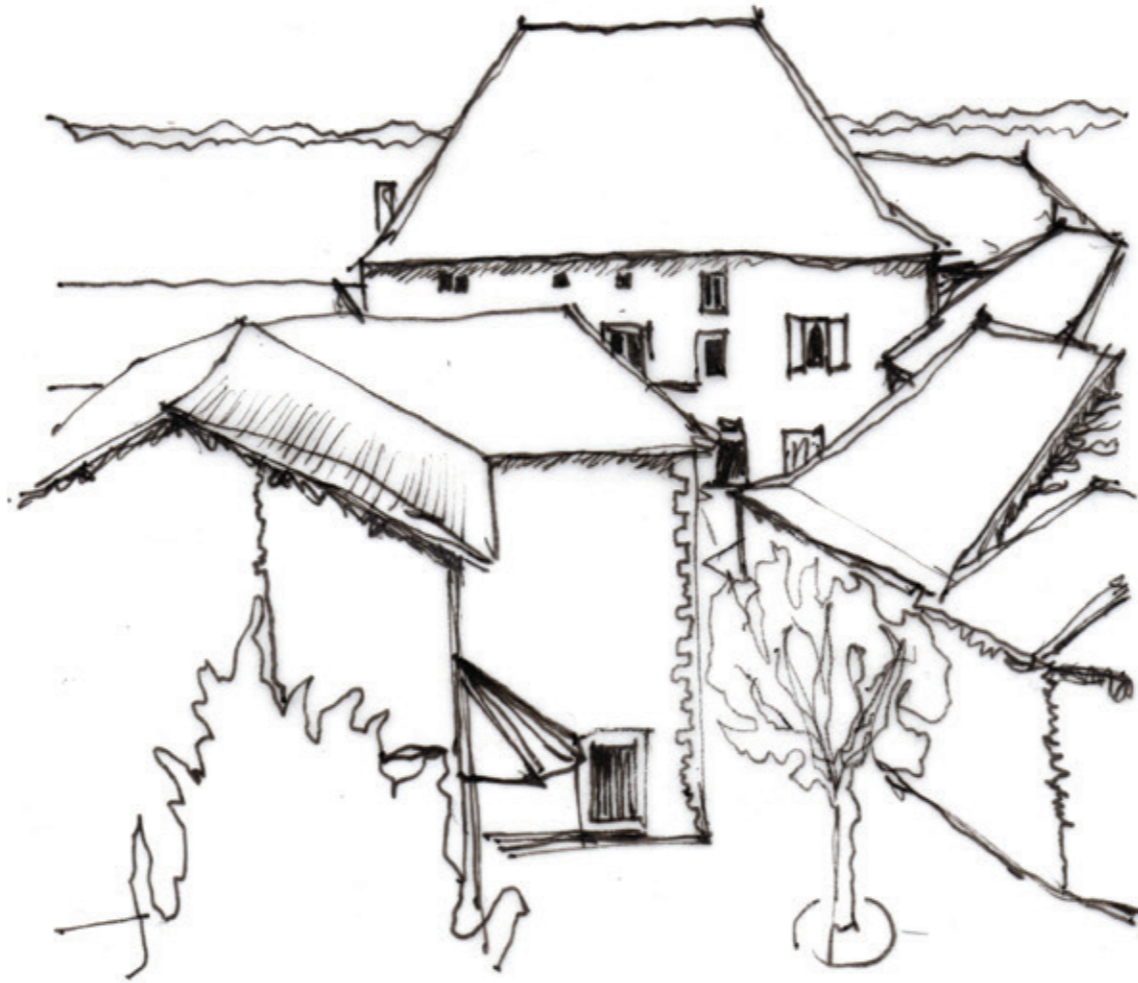
Villefontaine



Site Photos

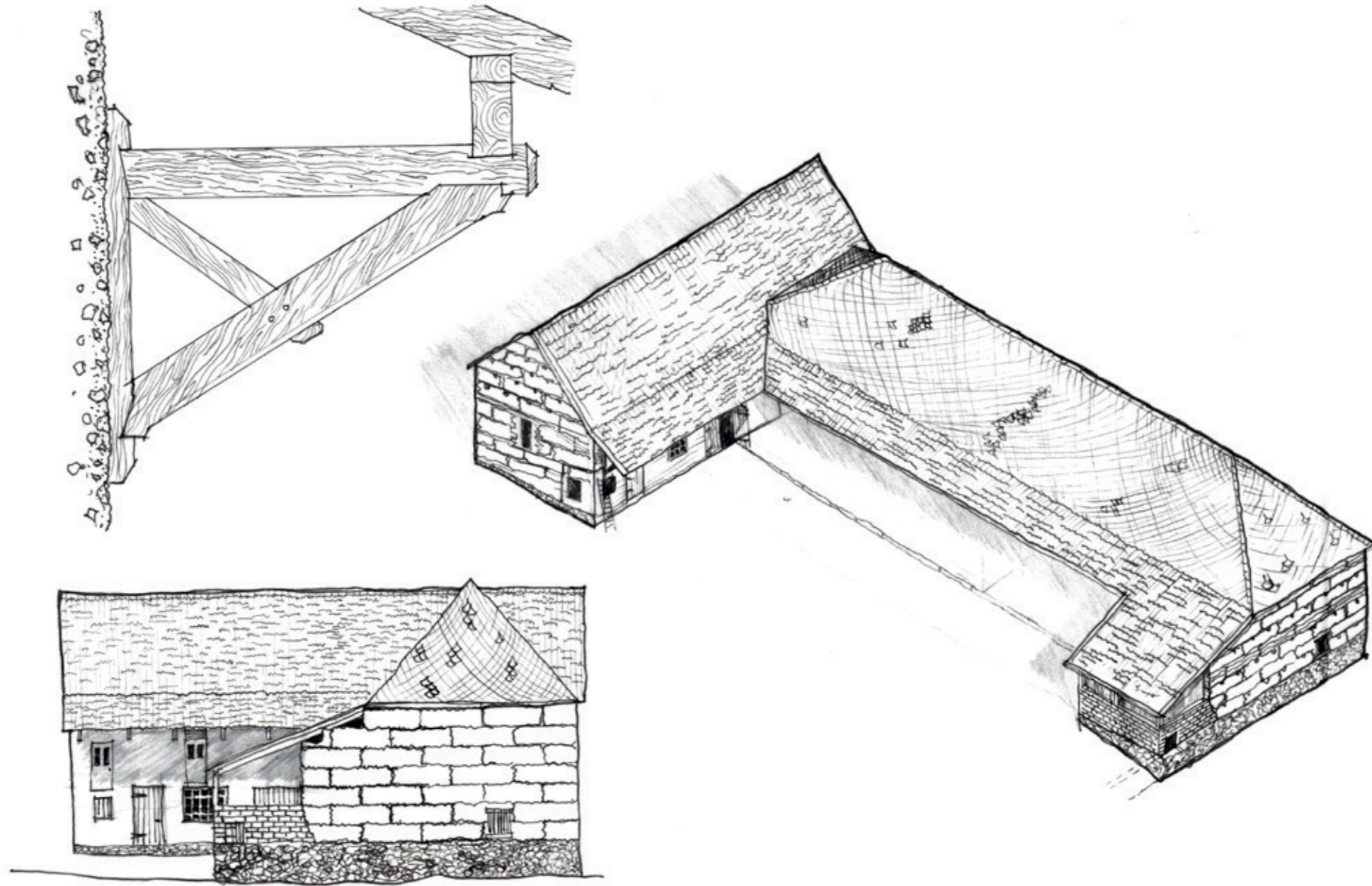
Villefontaine

What if Vernacular Traditions Shaped the Future of Architecture?



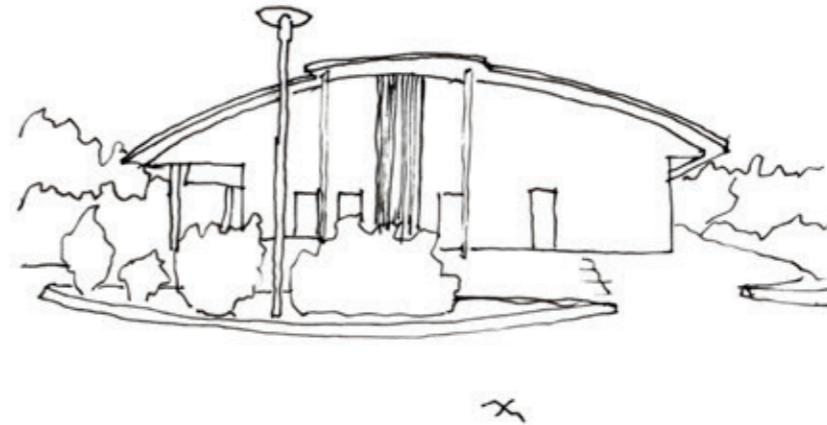
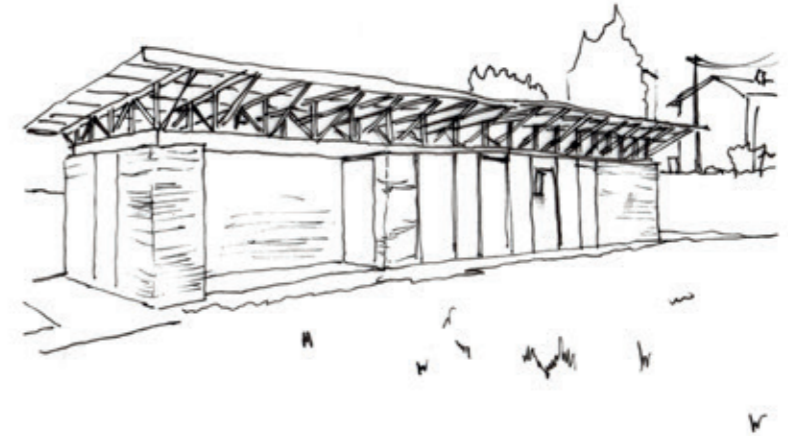
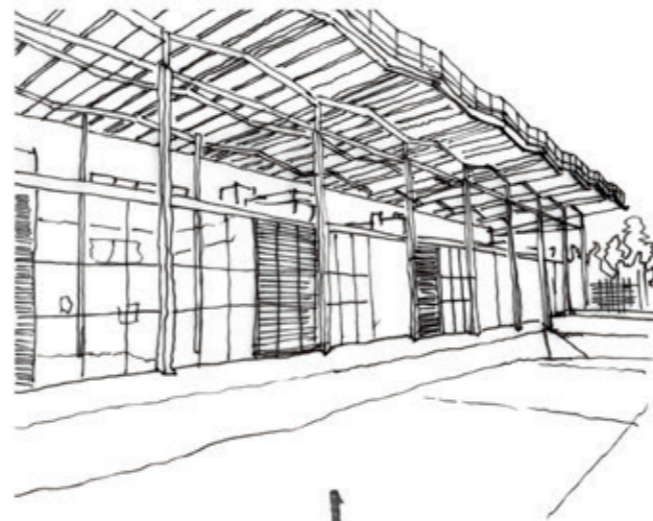
Details

Research



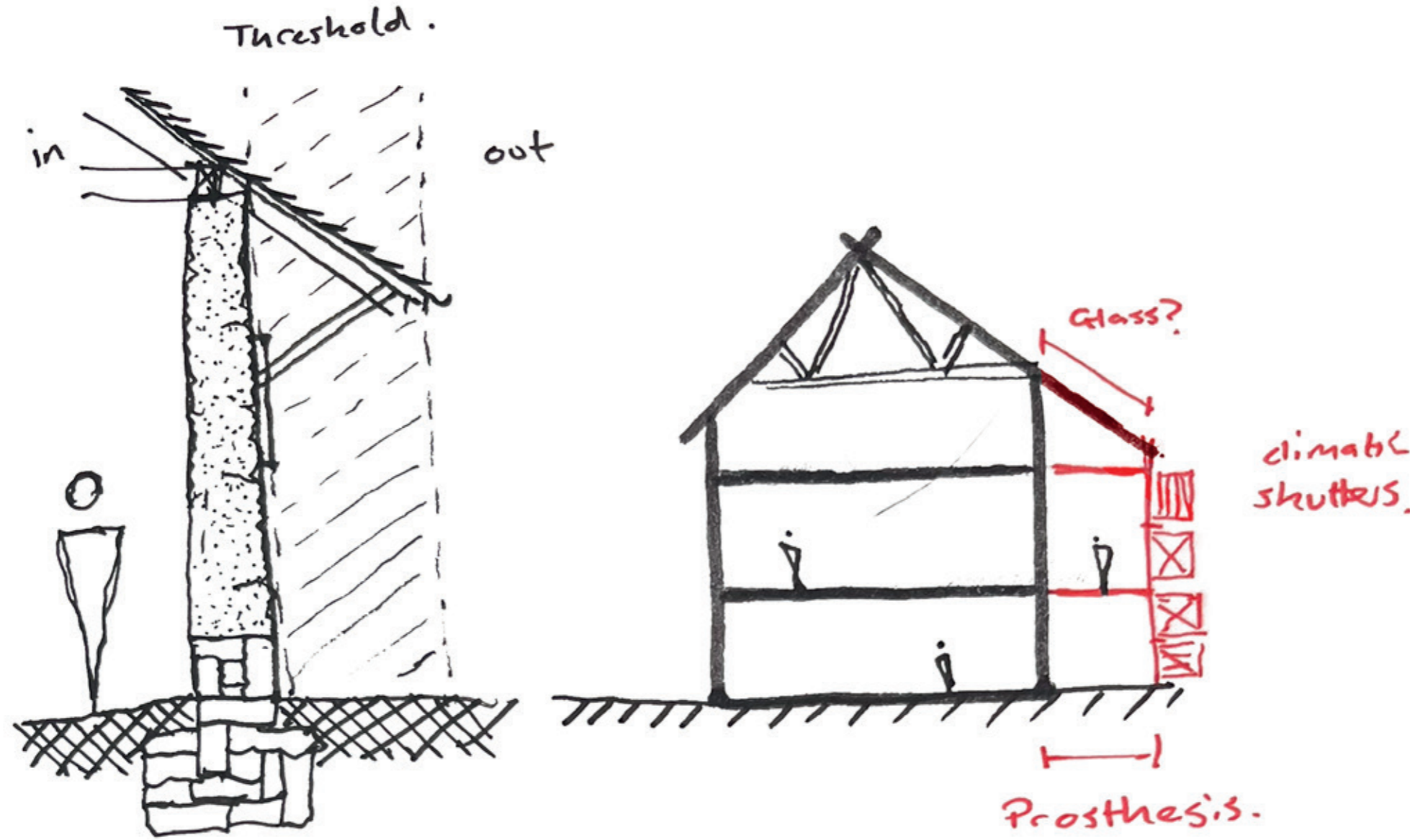
Vernacular Study

Research



Vernacular Development

Research



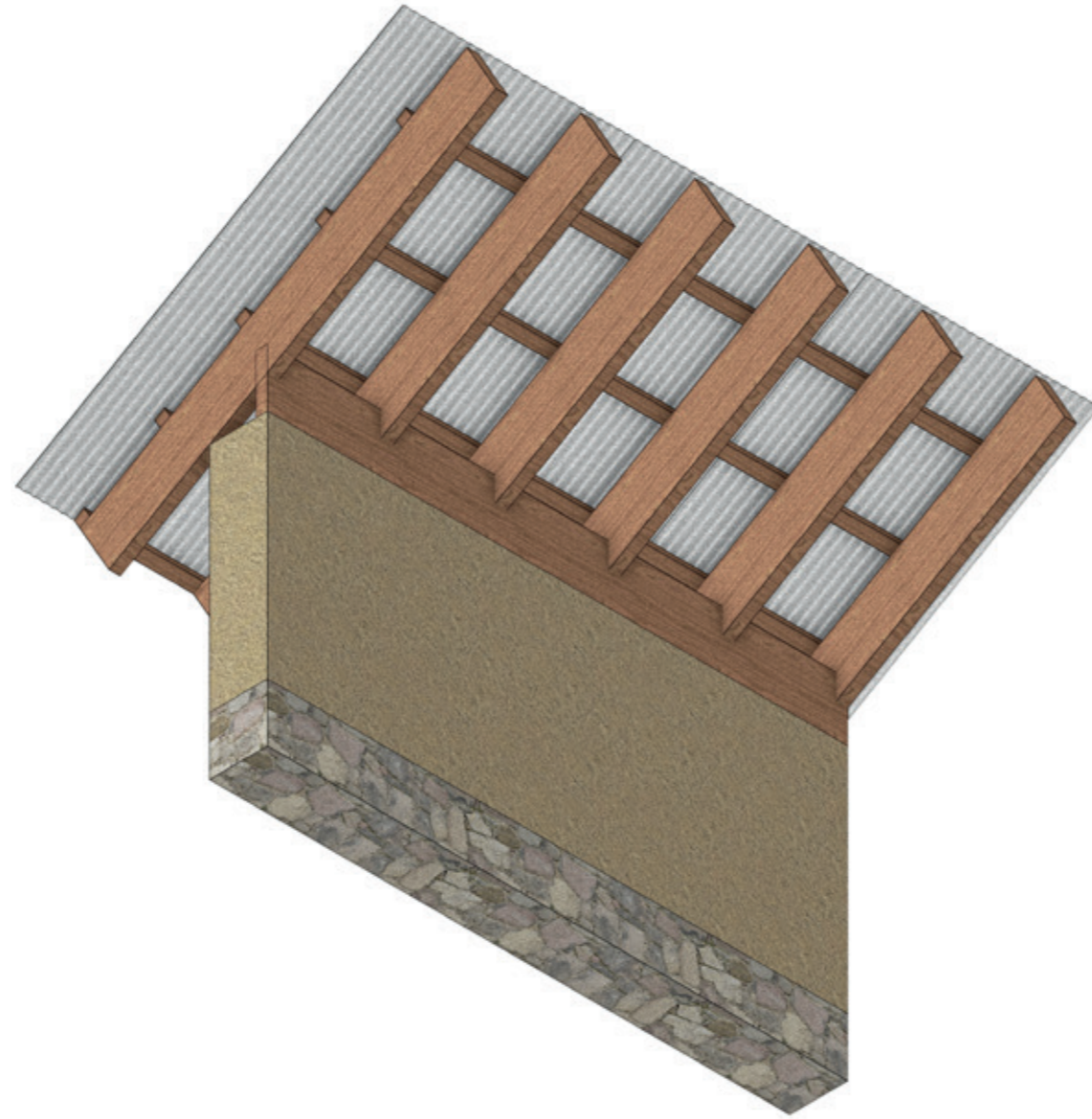
Thresholds

Research



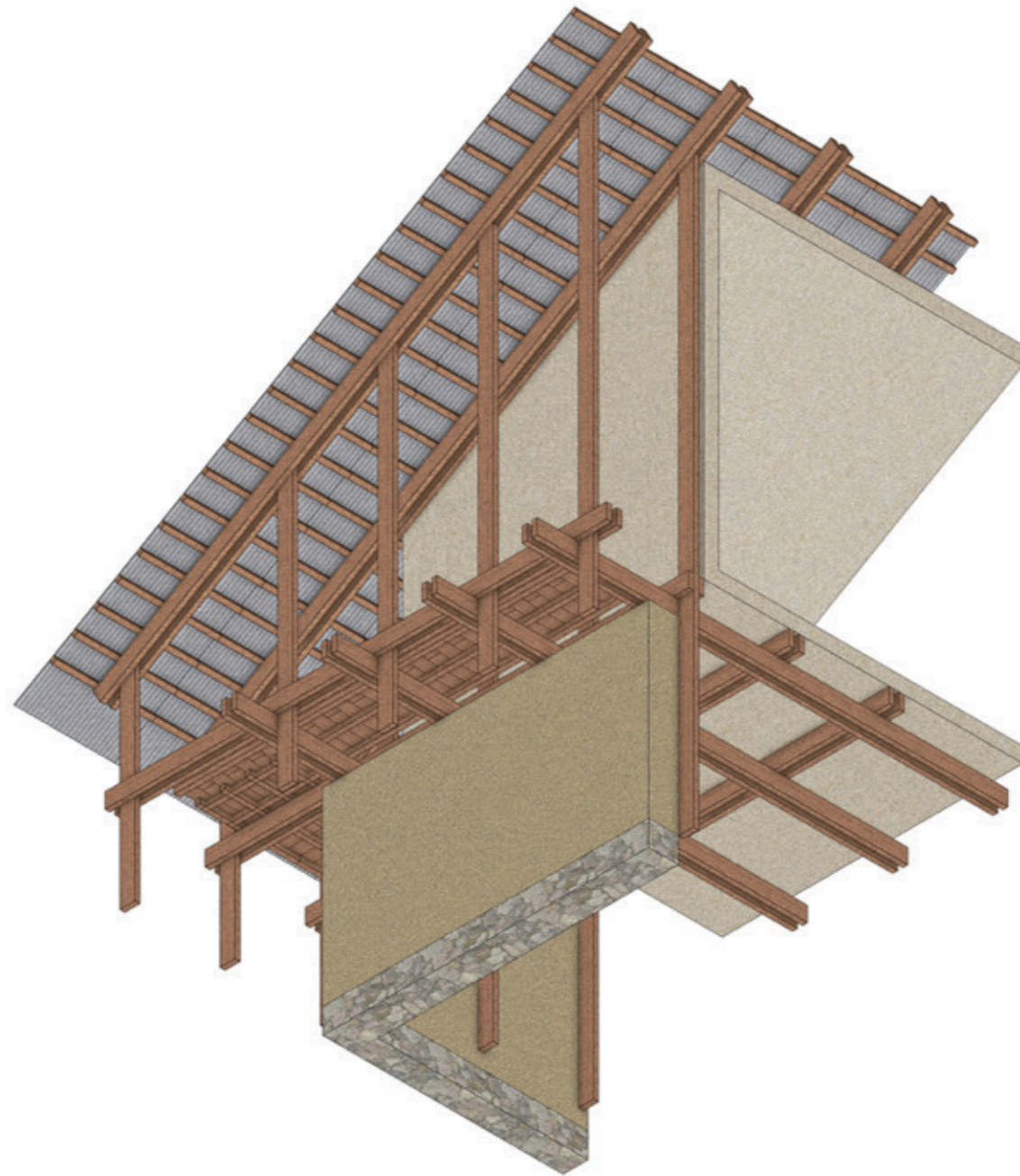
Material Layers

Design Concepts



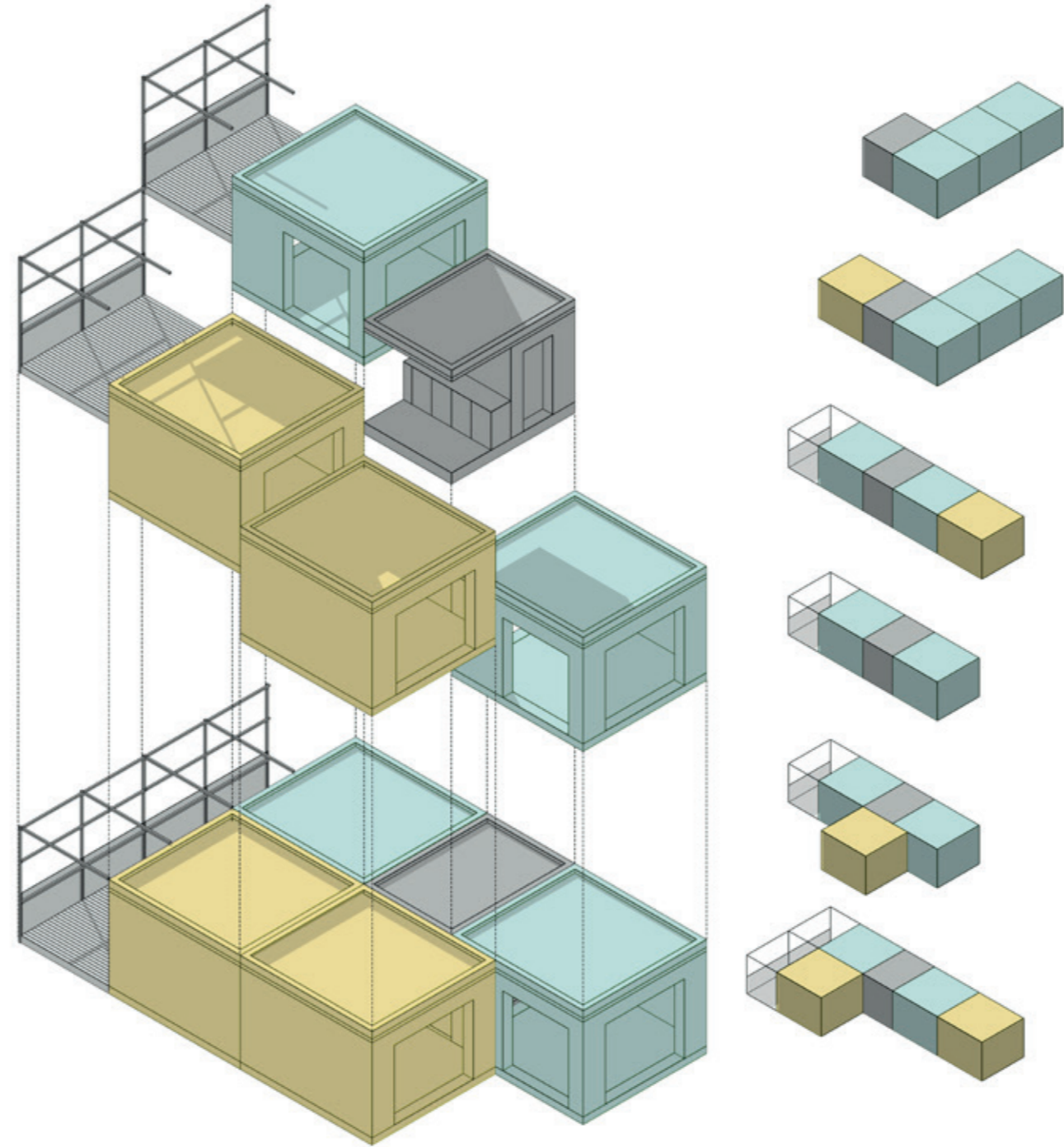
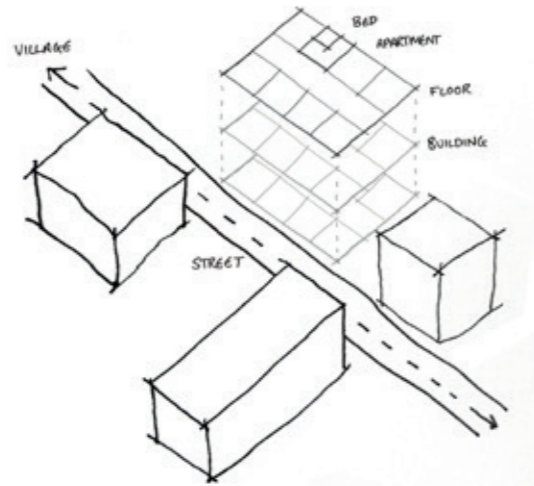
Vernacular Development

Language



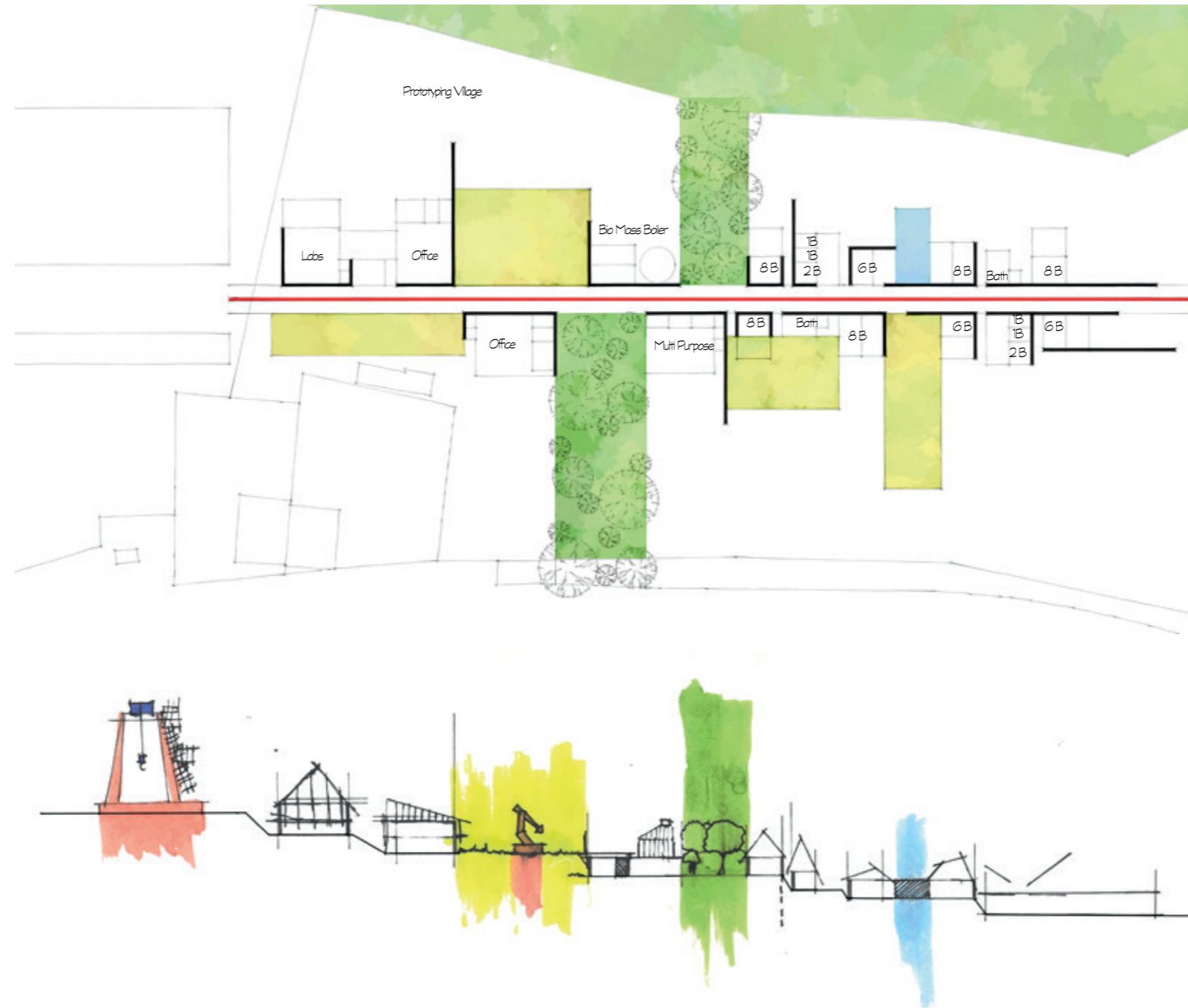
Vernacular Development

Language



La Borda

Precedent Study



Design Concept

Villefontaine

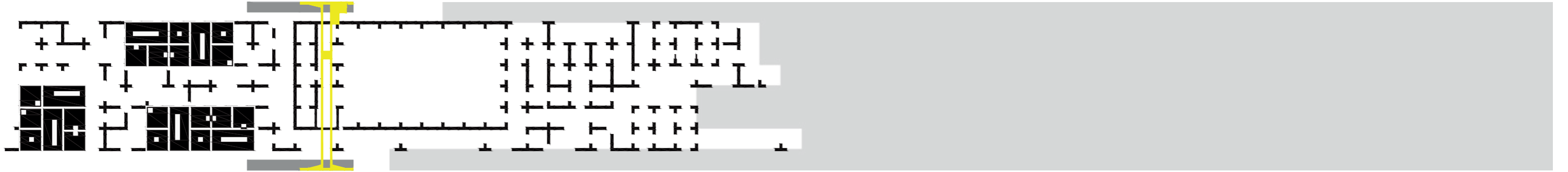
What if our Cities Could be 3D Printed Out of the Materials Around?



2024

Design Strategy

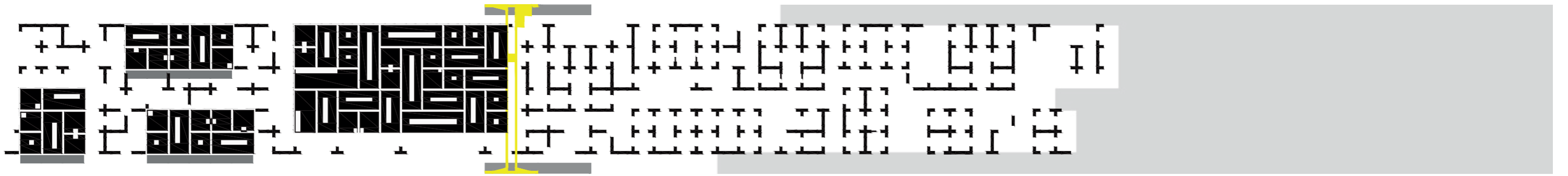
23



2024

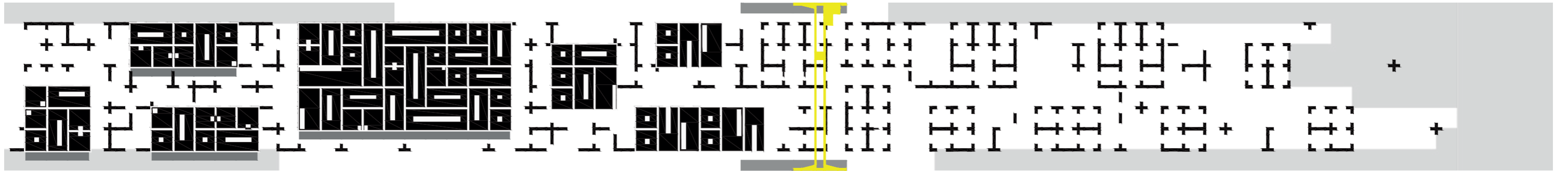
Design Strategy

24



2024

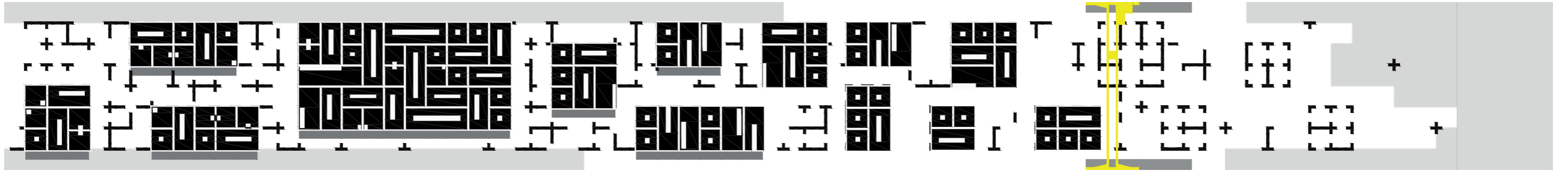
Design Strategy



2024

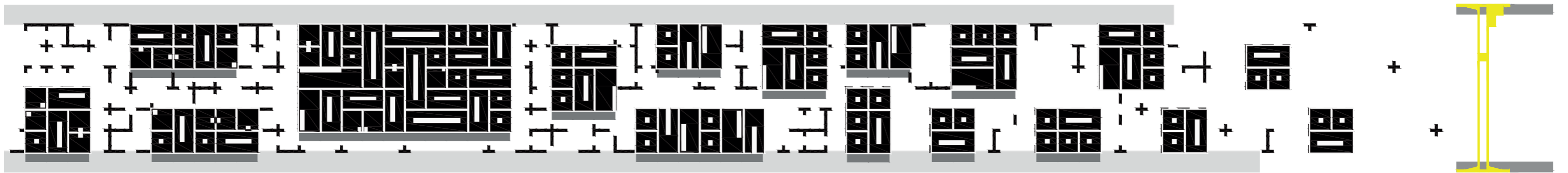
Design Strategy

26



2024

Design Strategy



2024

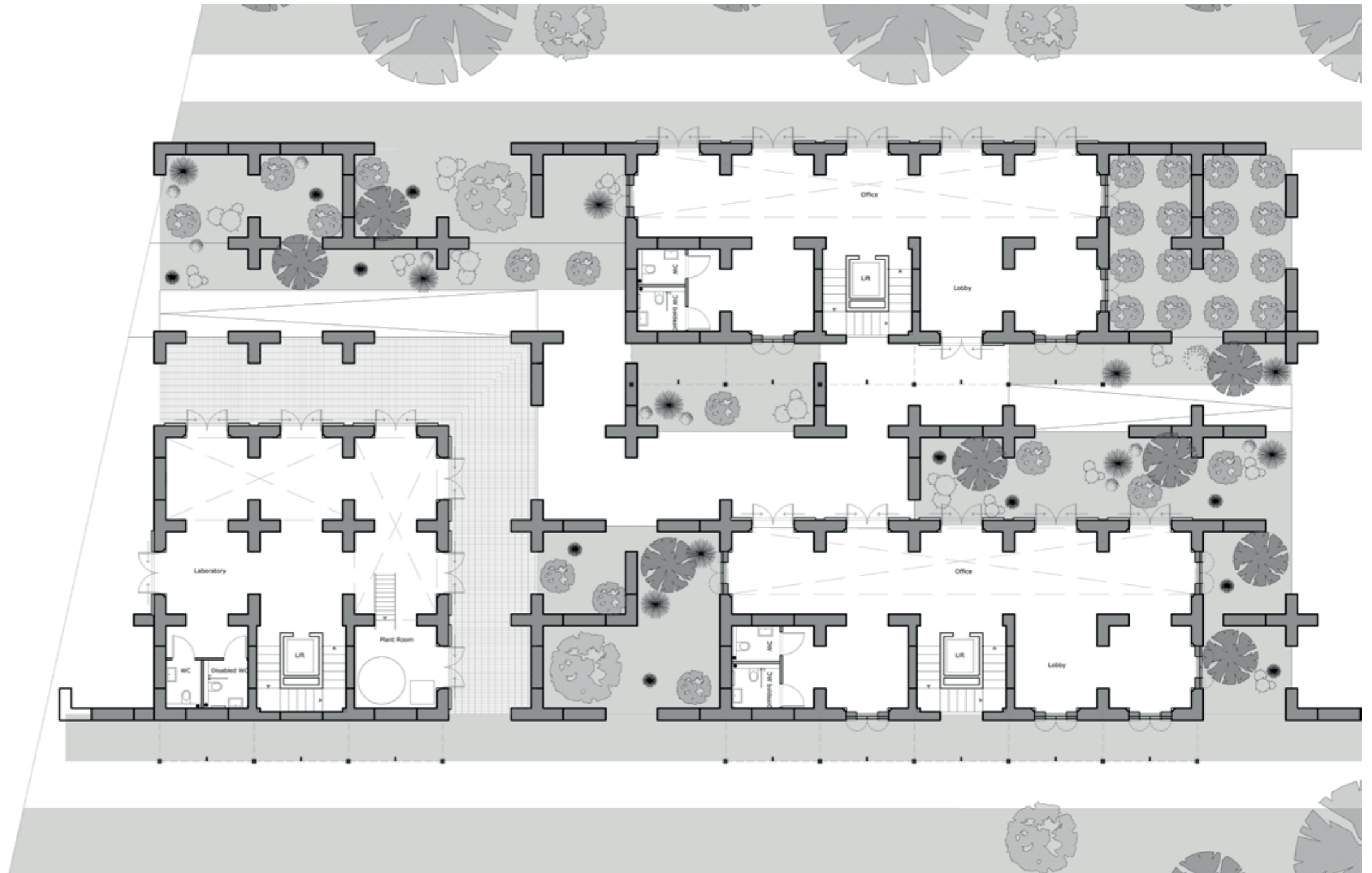
Design Strategy



Proposed Site Plan

Villefontaine

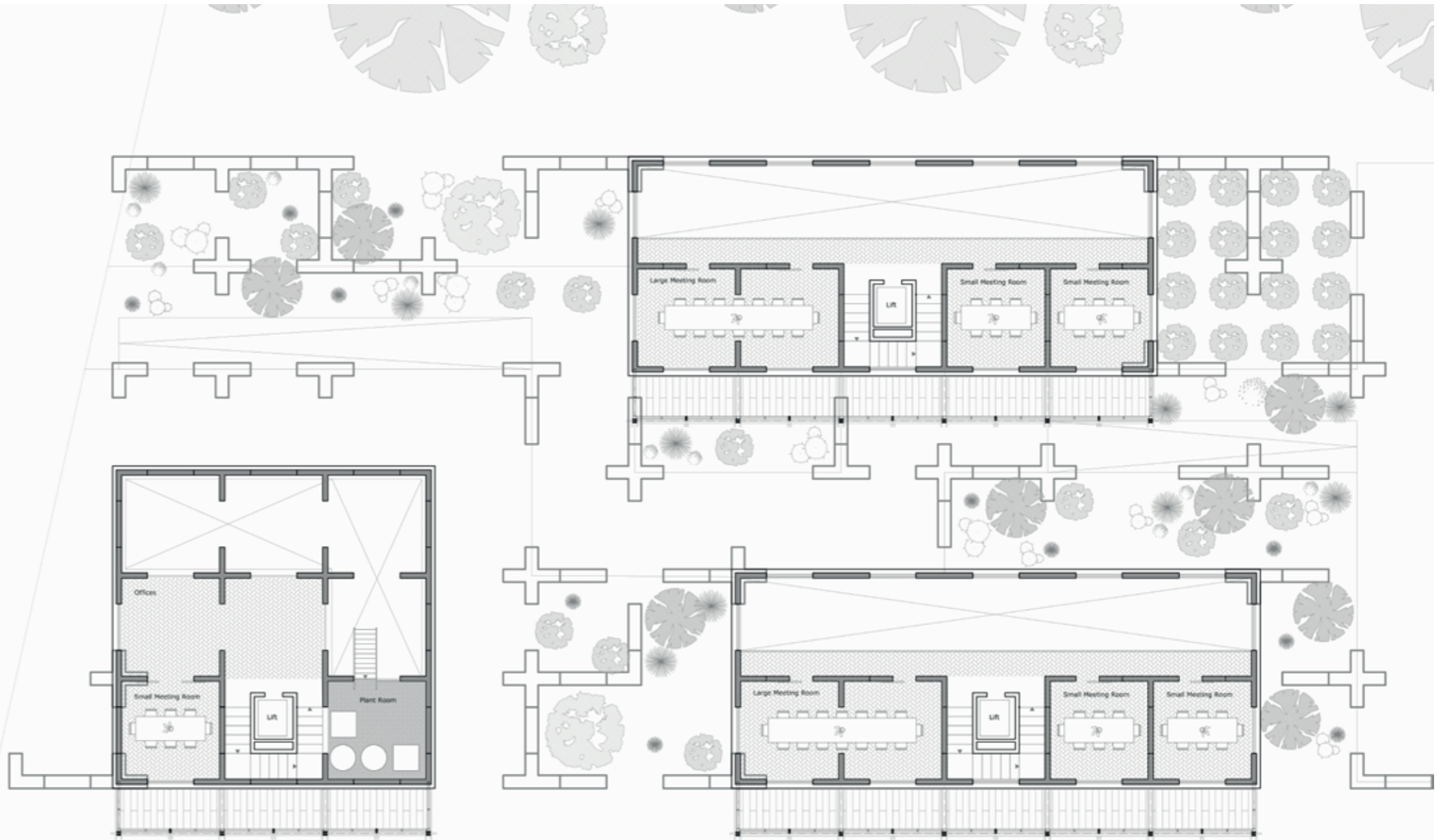




Proposed Ground Floorplan

Villefontaine: Lab and Offices

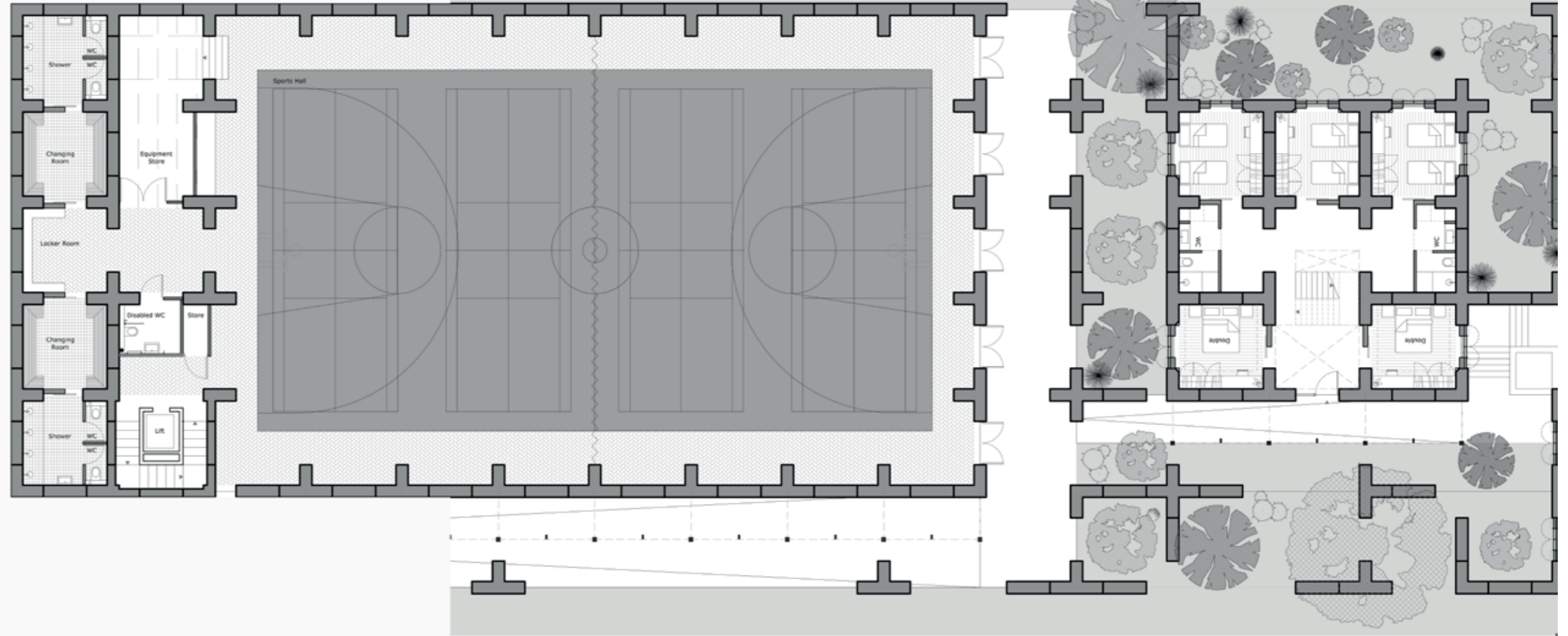




Proposed 1st Floorplans

Villefontaine: Lab and Offices

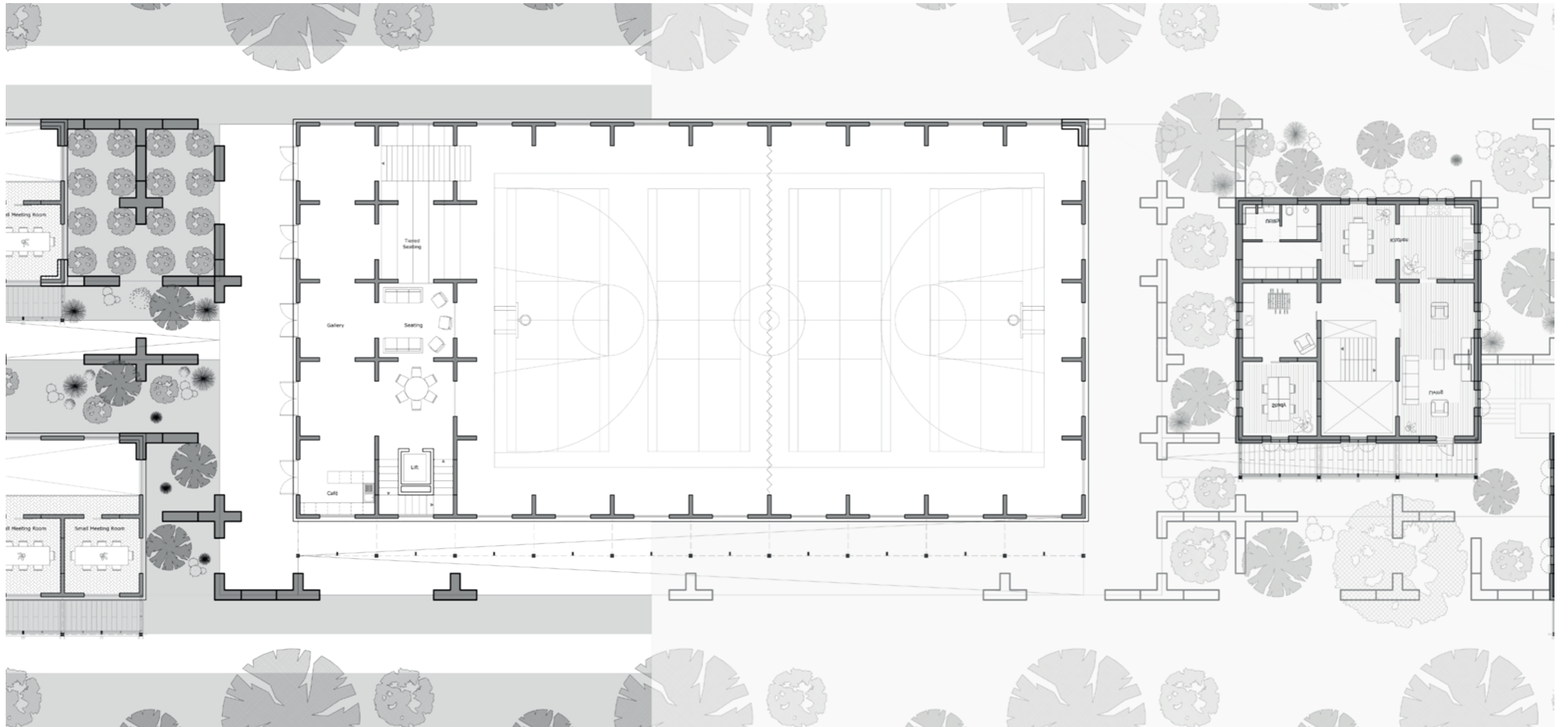




Proposed Ground Floorplan

Villefontaine: Multipurpose Space





Proposed 1st Floorplan

Villefontaine: Multipurpose space



Proposed Ground Floorplan

Villefontaine: Residence

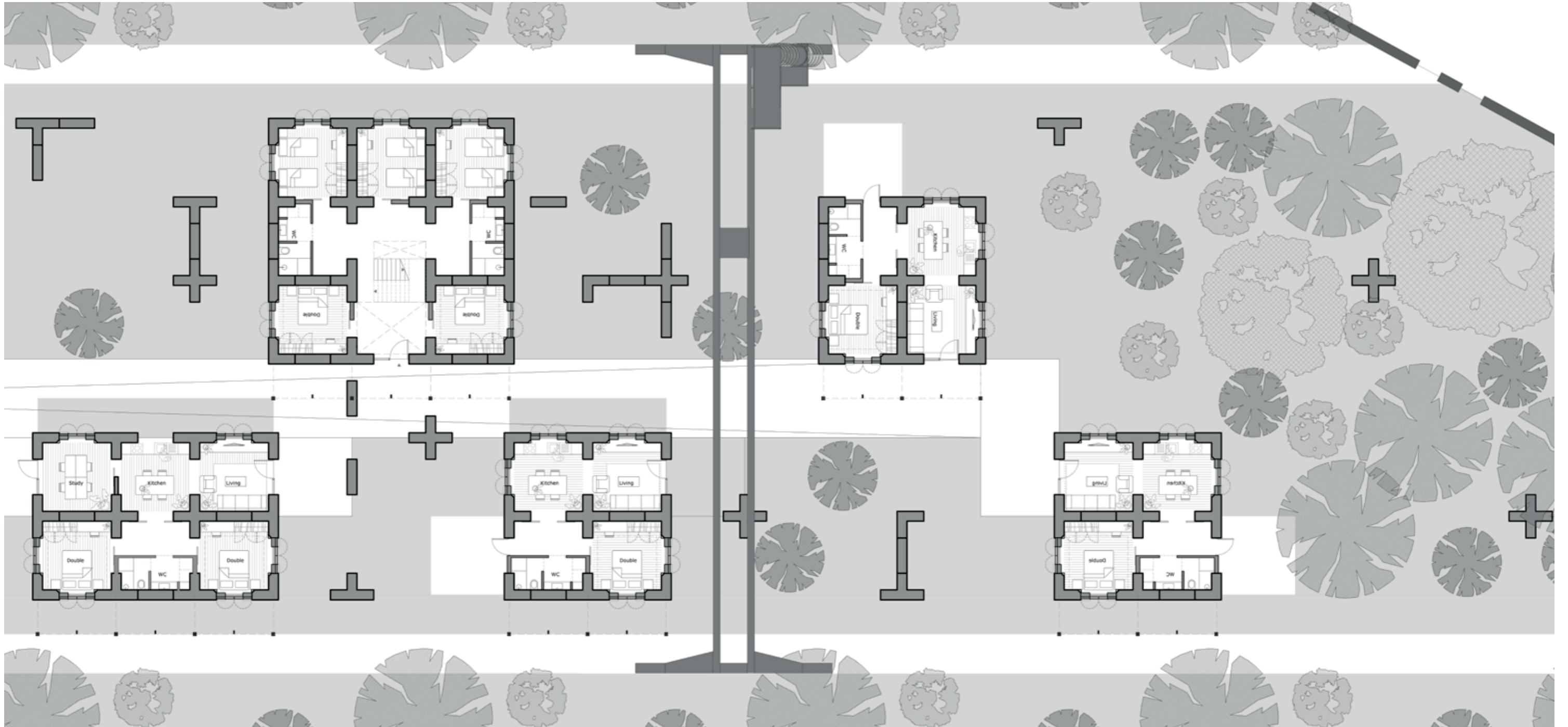




Proposed 1st Floorplan

Villefontaine: Residence

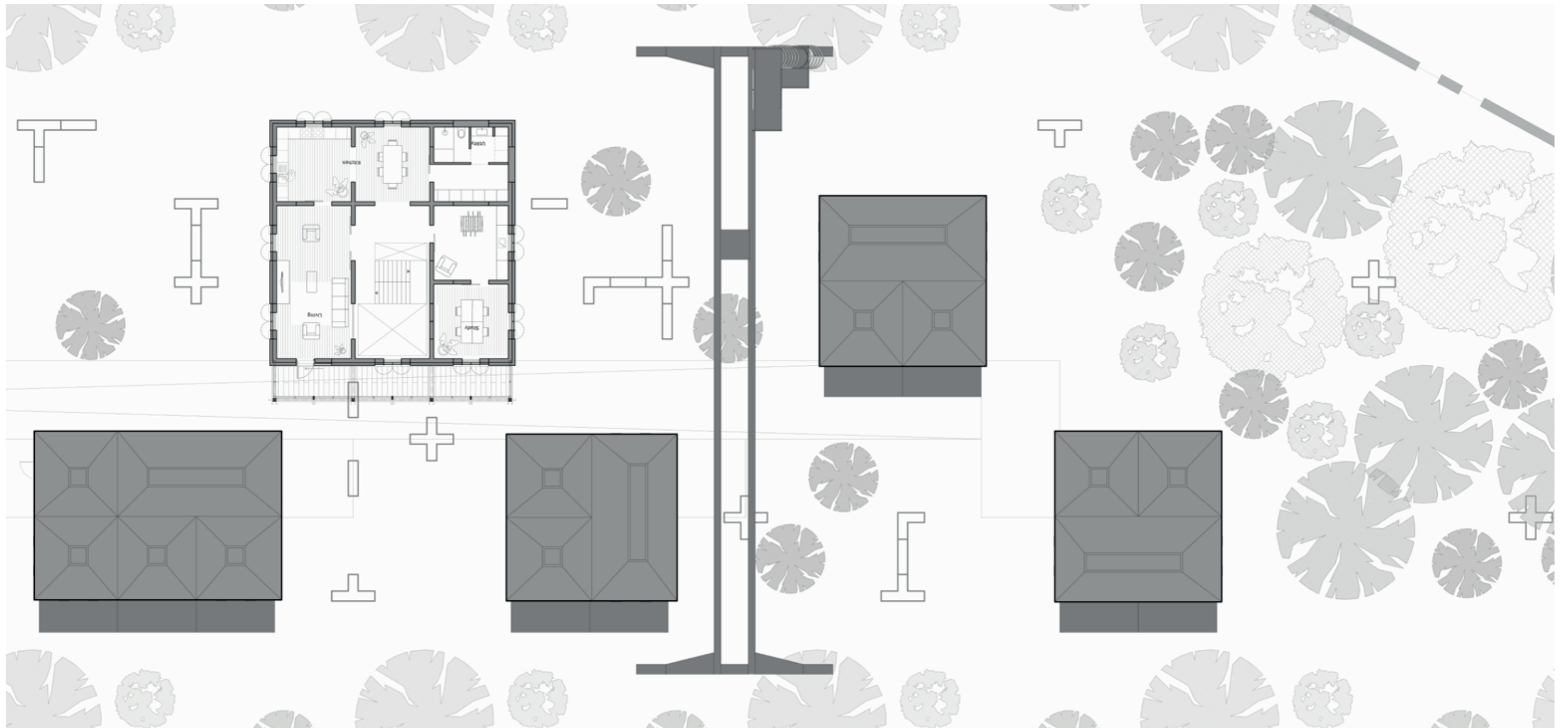




Proposed Ground Floorplan

Villefontaine: Residence

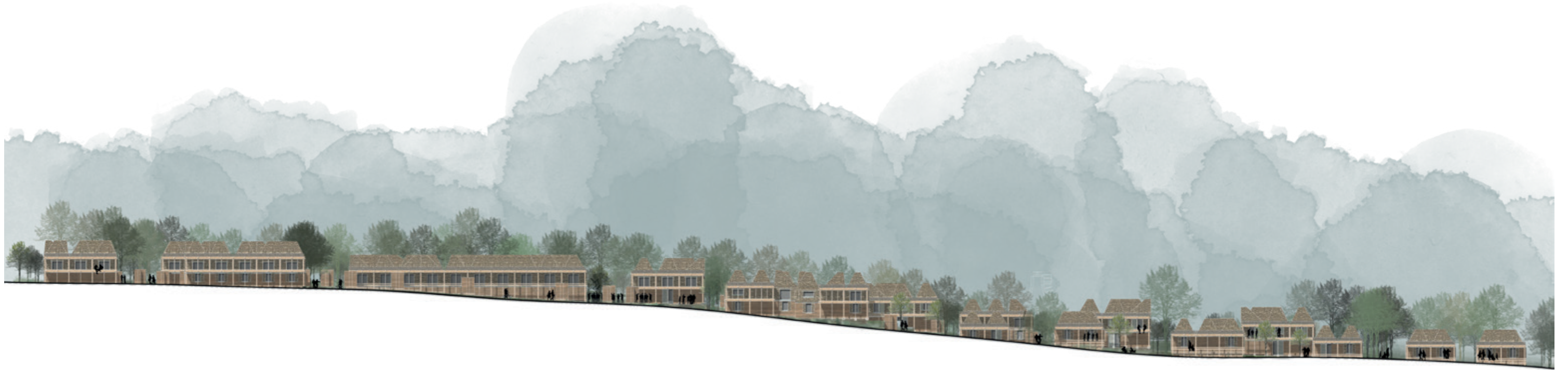




Proposed 1st Floorplan

Villefontaine: Residence





Site Elevation

Villefontaine



Section

Villefontaine

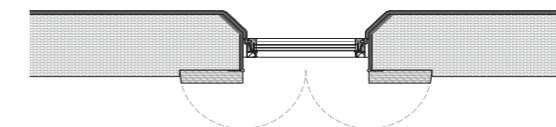
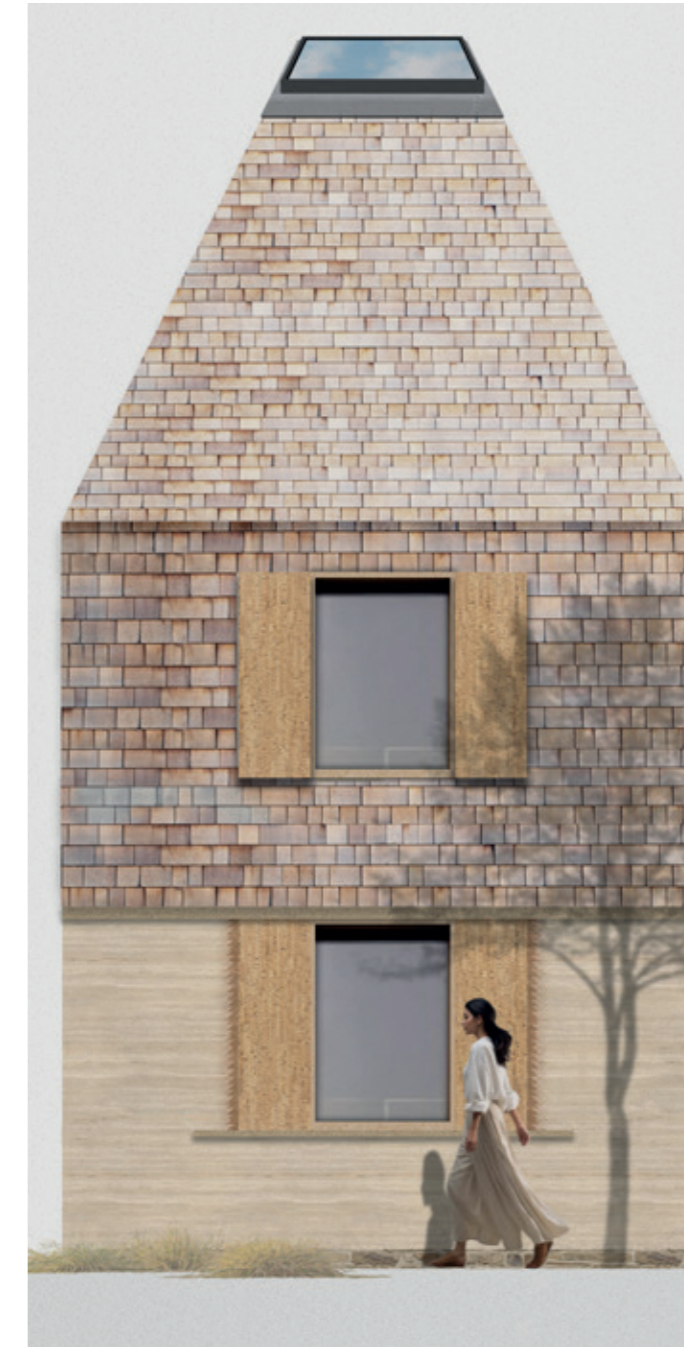
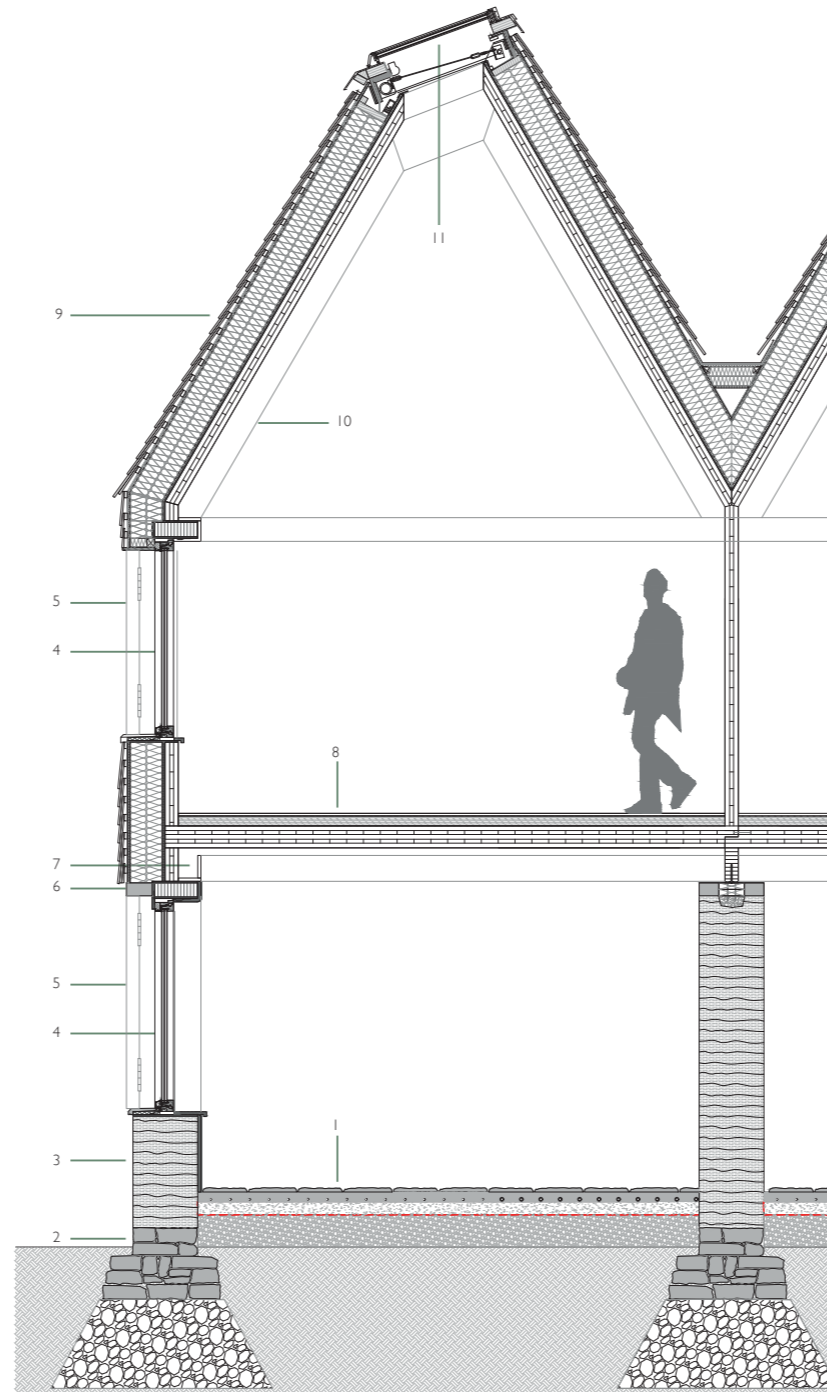


Section

Villefontaine

40

1. Flagstones
75mm Lime/Sand screed
Underfloor Heating pipes 150mm c/c
100mm Limecrete with LECA
Breathable Membrane
250mm Lightweight Expanded Clay Aggregate (LECA)
2. 500mm Cut Stone (local) base and foundation
Compressed stone aggregate
3. 500mm 3d Printed Rammed earth Inspired by the **Weber Beamix** with sheeps wool
25mm Clay Plaster
4. Timber framed **Saint Gobain recycled triple glazing**
5. 100mm **Isover** Cork insulating shutters
6. 200x100mm Limecrete Cill
300mm **Isover** Wood fibre insulation
7. Lighting shelf behind plywood panel
8. 20mm Recycled solid wood flooring
80mm **Isover** Rigid cork insulation
170mm Cross Laminated Timber (CLT) floorslab
9. 10mm Timber shingles
25mm Timber Battens
15mm Oriented Strand board (OSB)
250mm **Saint Gobain Isocoton** 600mm c/c timber studs
100mm CLT wall
10. 170mm Gluelam rafter
11. Openable triple glazed skylight.



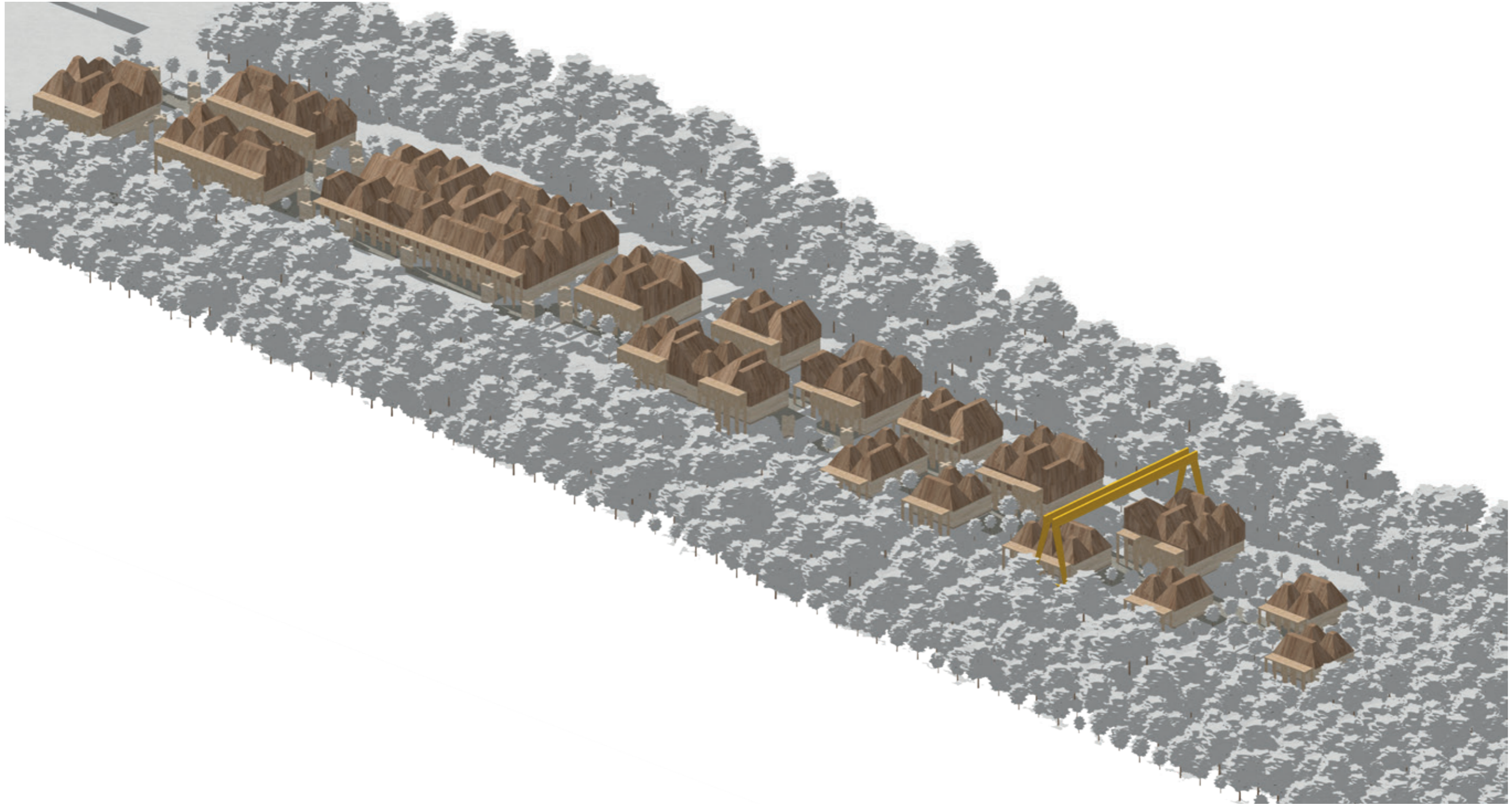
Bay Study

Villefontaine



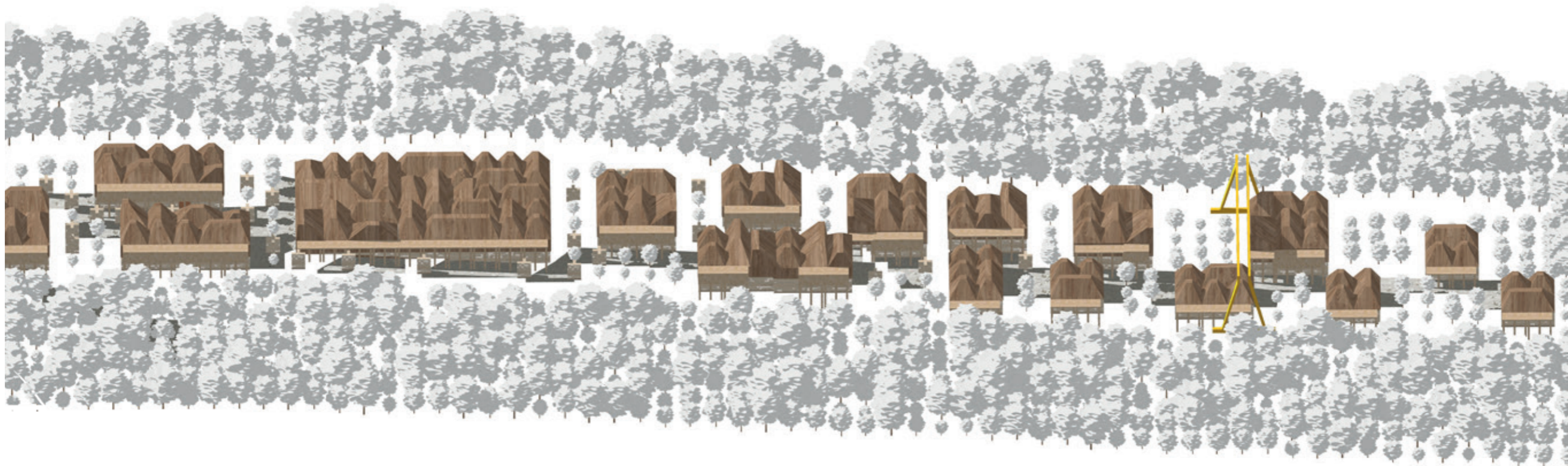
Kitchen View

Villefontaine Residence



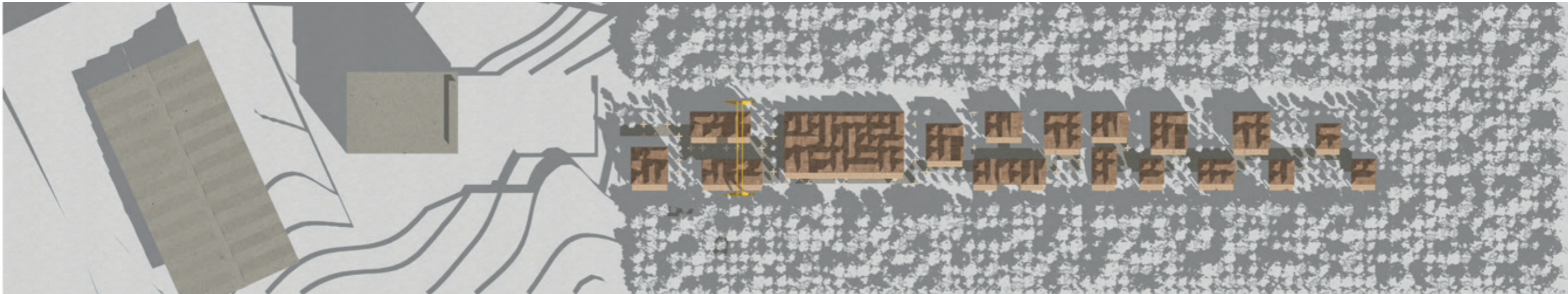
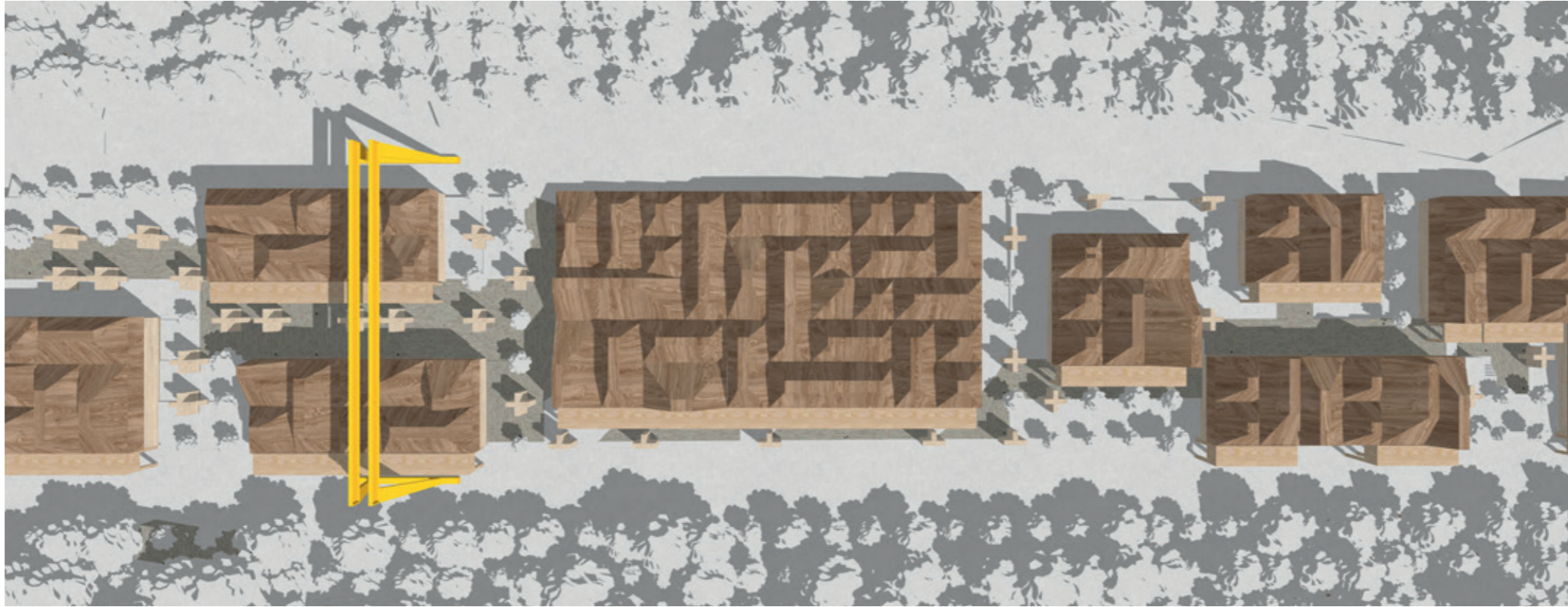
3D Visuals

Villefontaine



3D Visuals

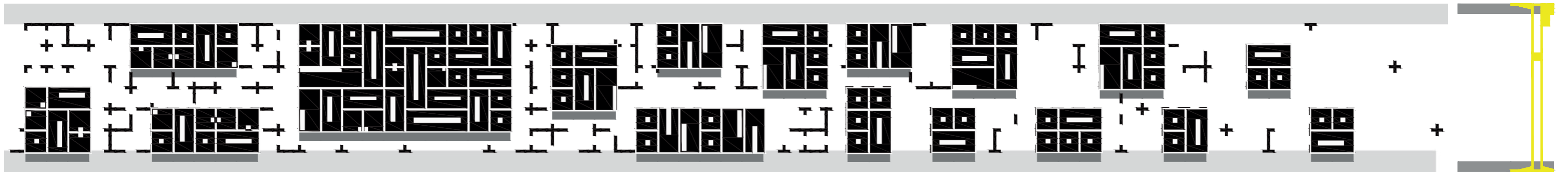
Villefontaine



3D Visuals

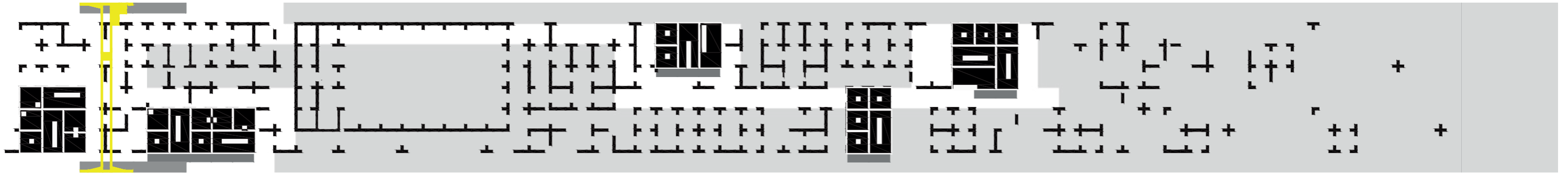
Villefontaine

What if Architecture Could Disappear, Gently?



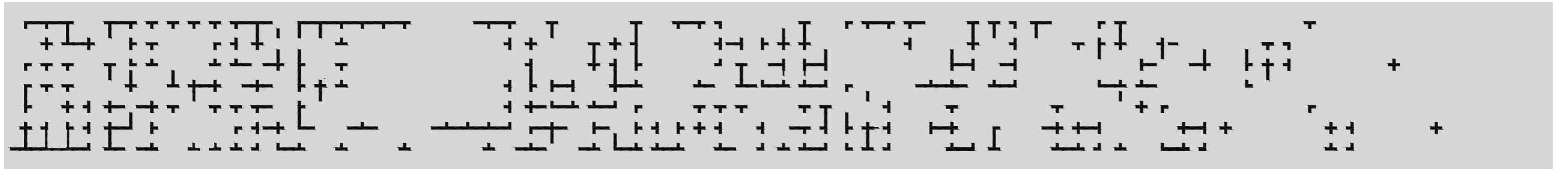
2050

Design Strategy



2100

Design Strategy



2125

Design Strategy

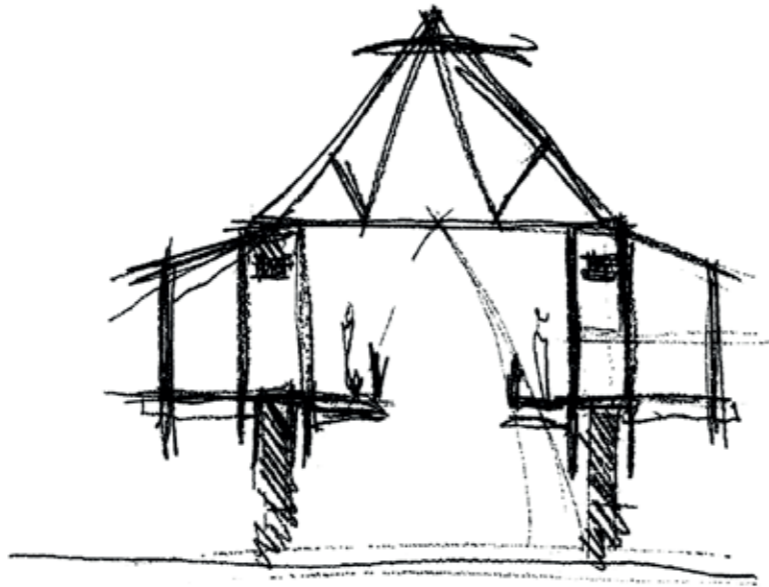
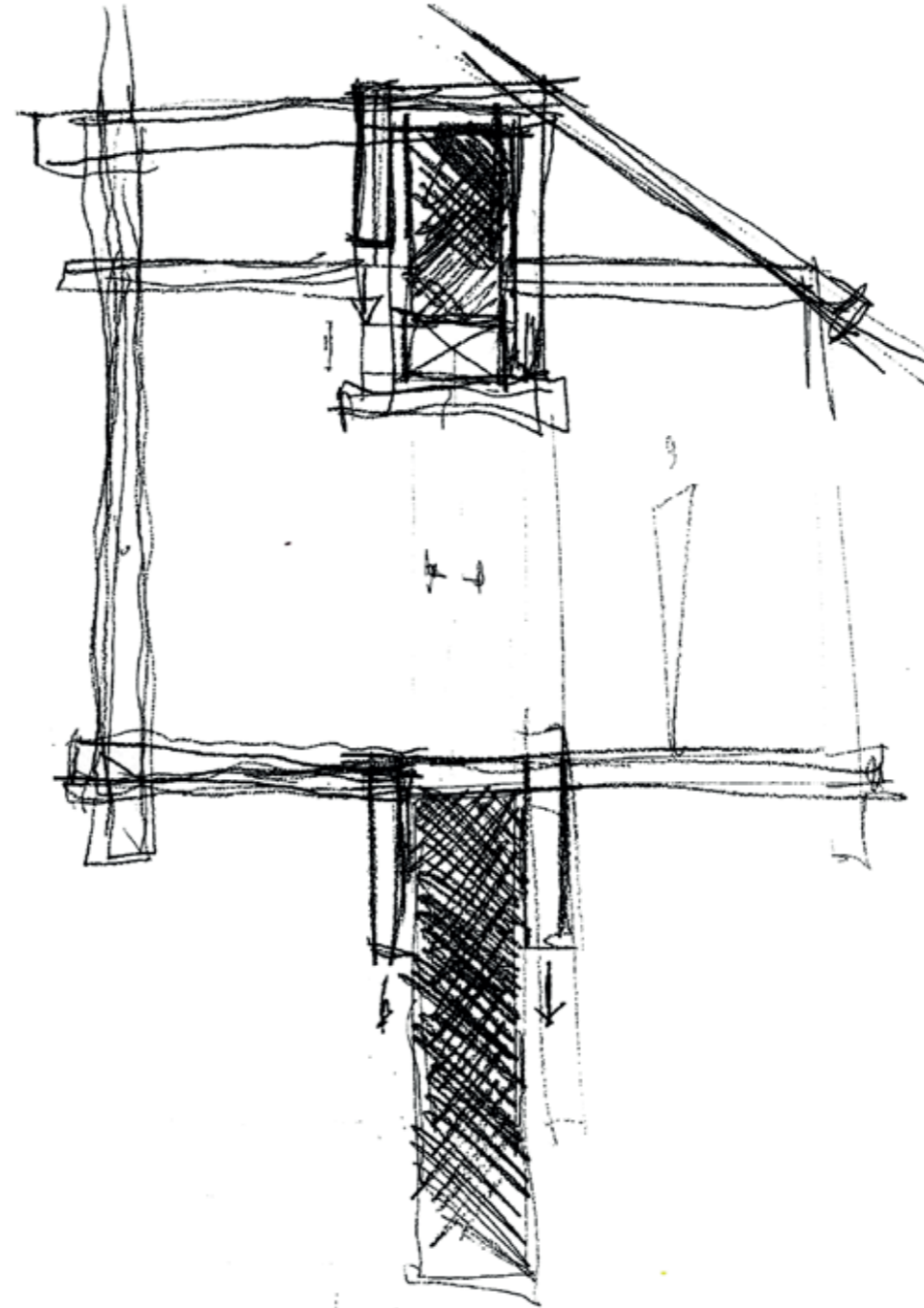
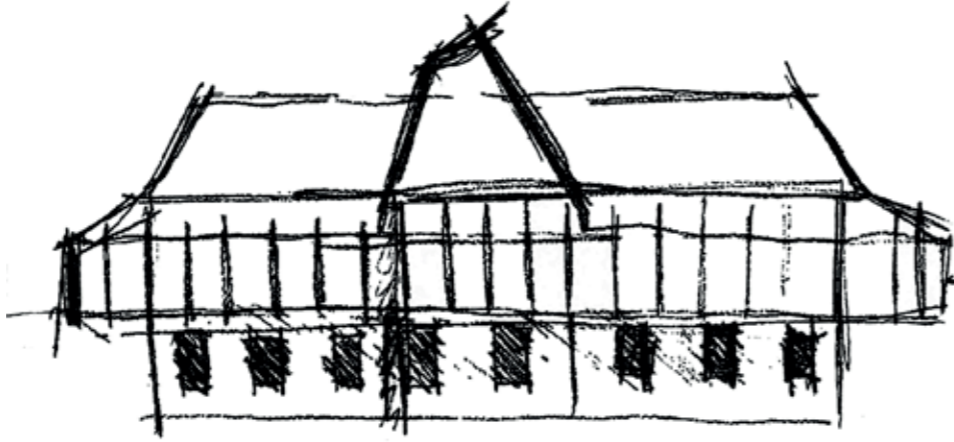
50



Richard Serra

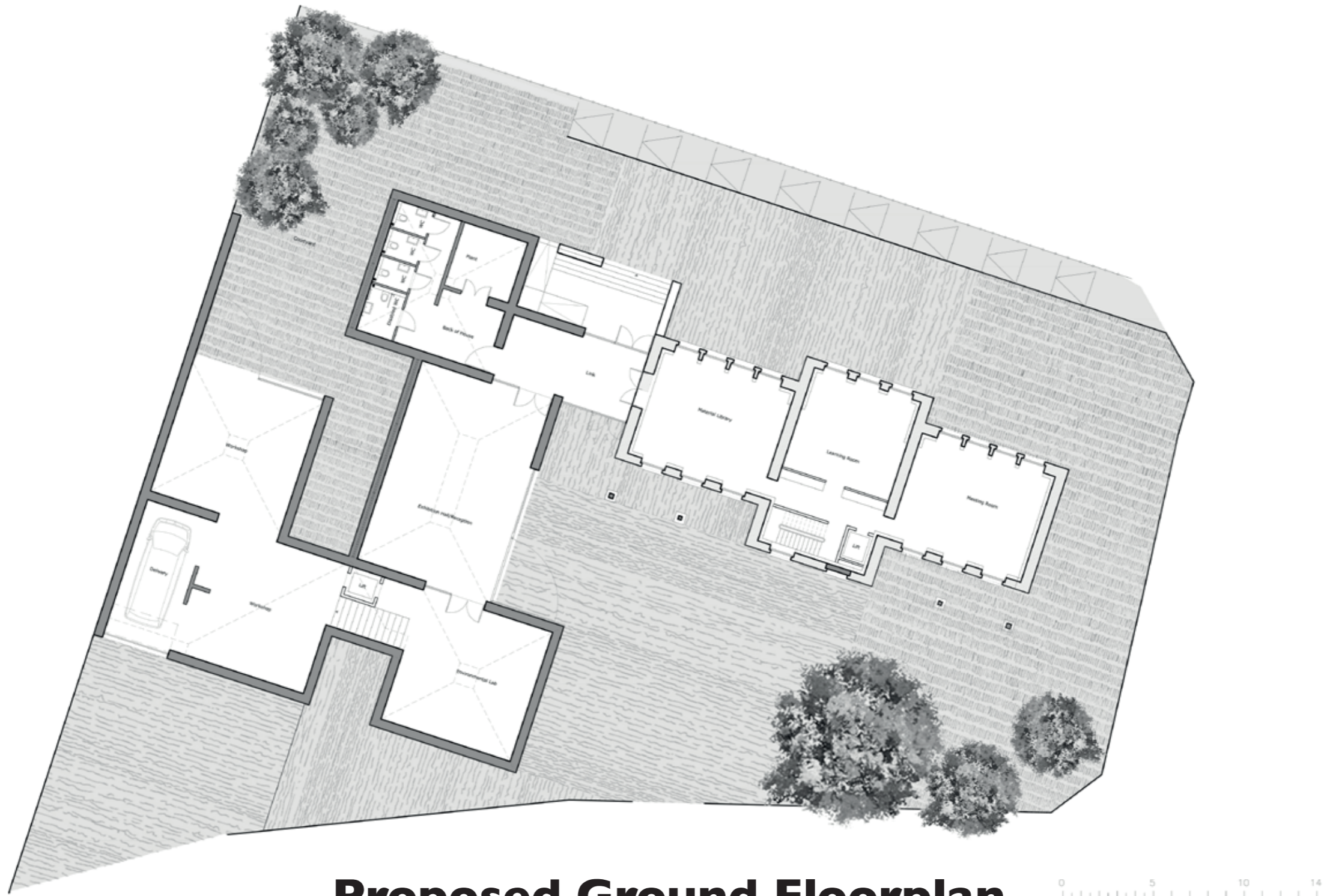
Fine Art Precedent

What if a Village School Became a Laboratory for the Future?



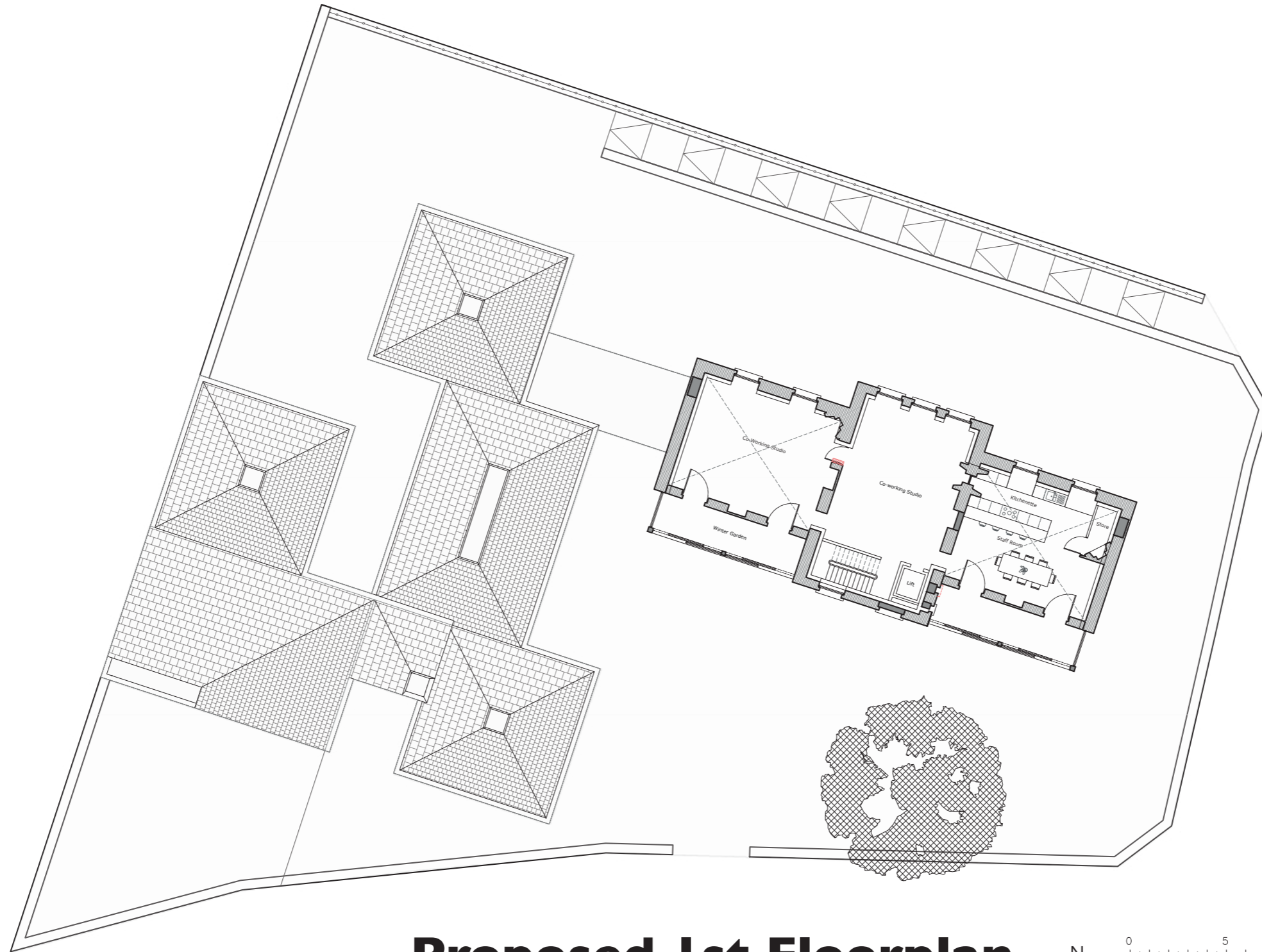
Chimilin Retrofit

Views



Proposed Ground Floorplan

Chimilin

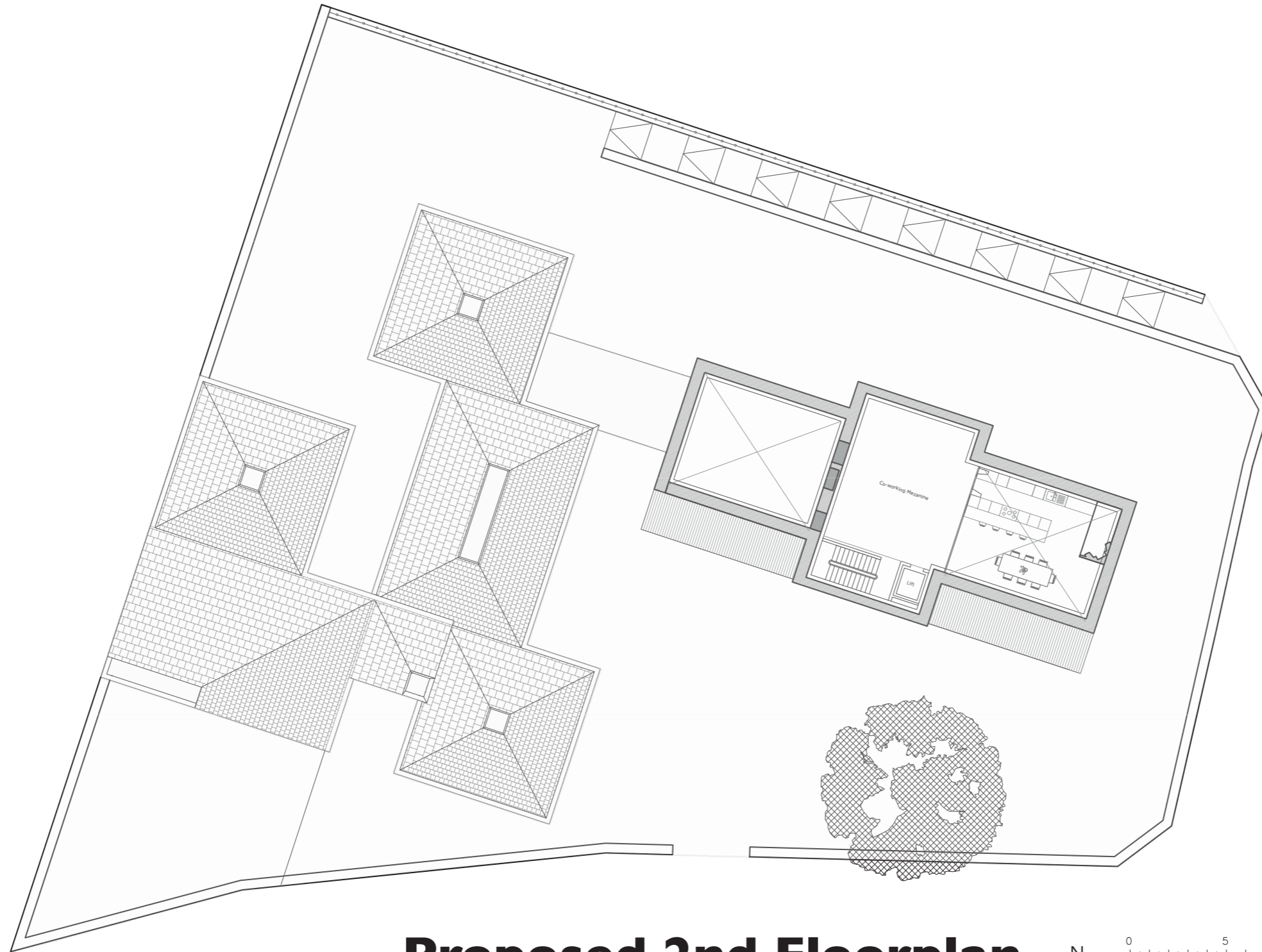


Proposed 1st Floorplan

Chimilin

55



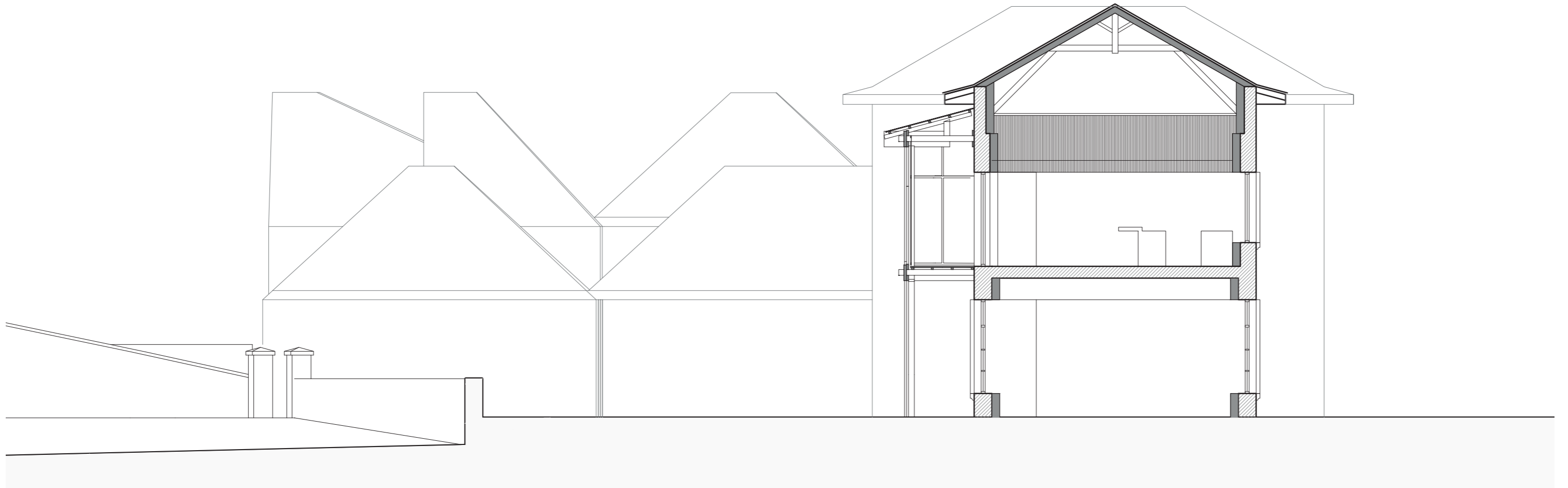


Proposed 2nd Floorplan

Chimilin

56





Section

Chimilin

57



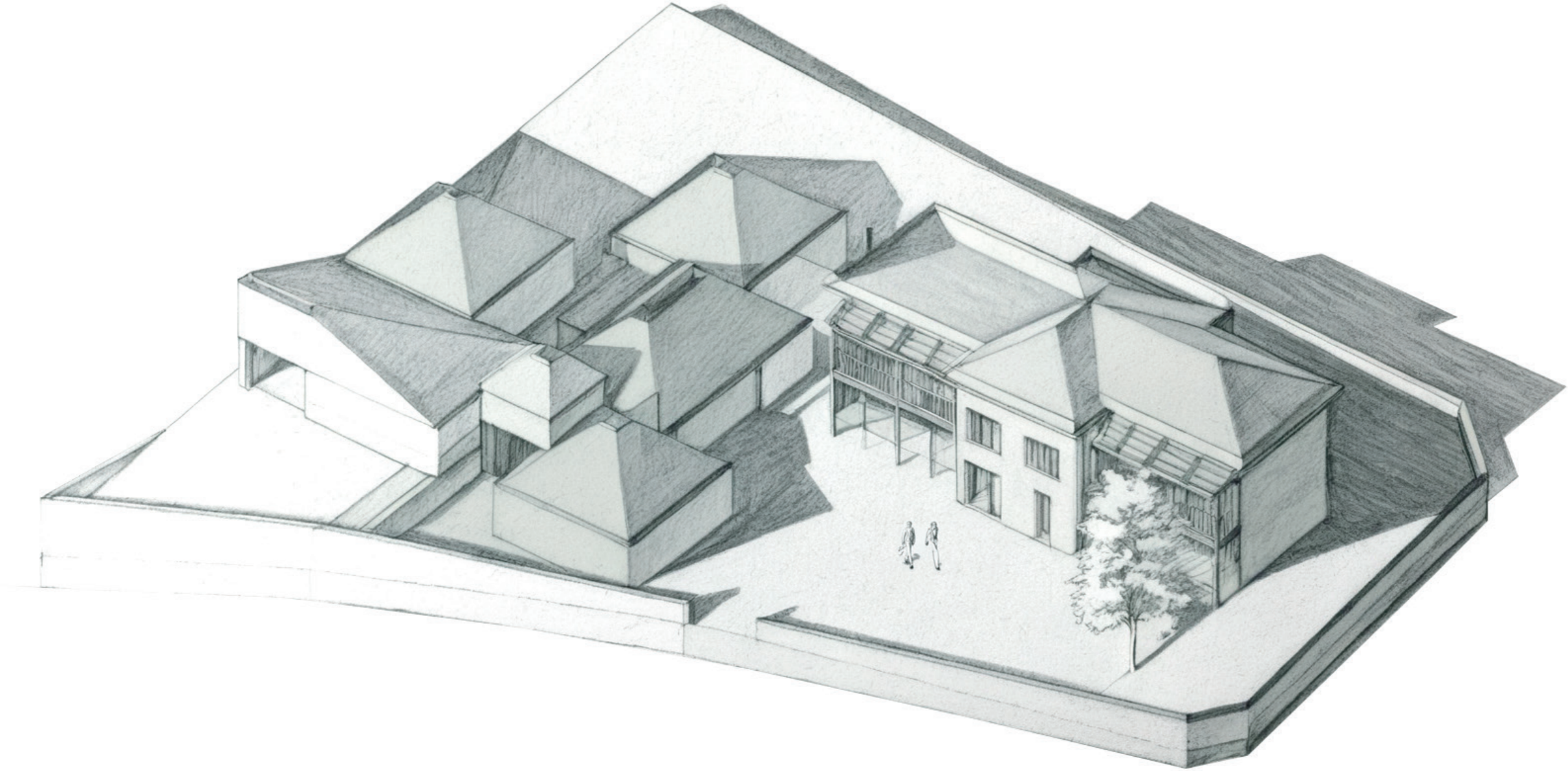
Chimilin: Winter

Proposed Section



Chimilin: Summer

Proposed Section



Axonometric

Chimilin (Sketchup Diffusion)



Elevations

Chimilin

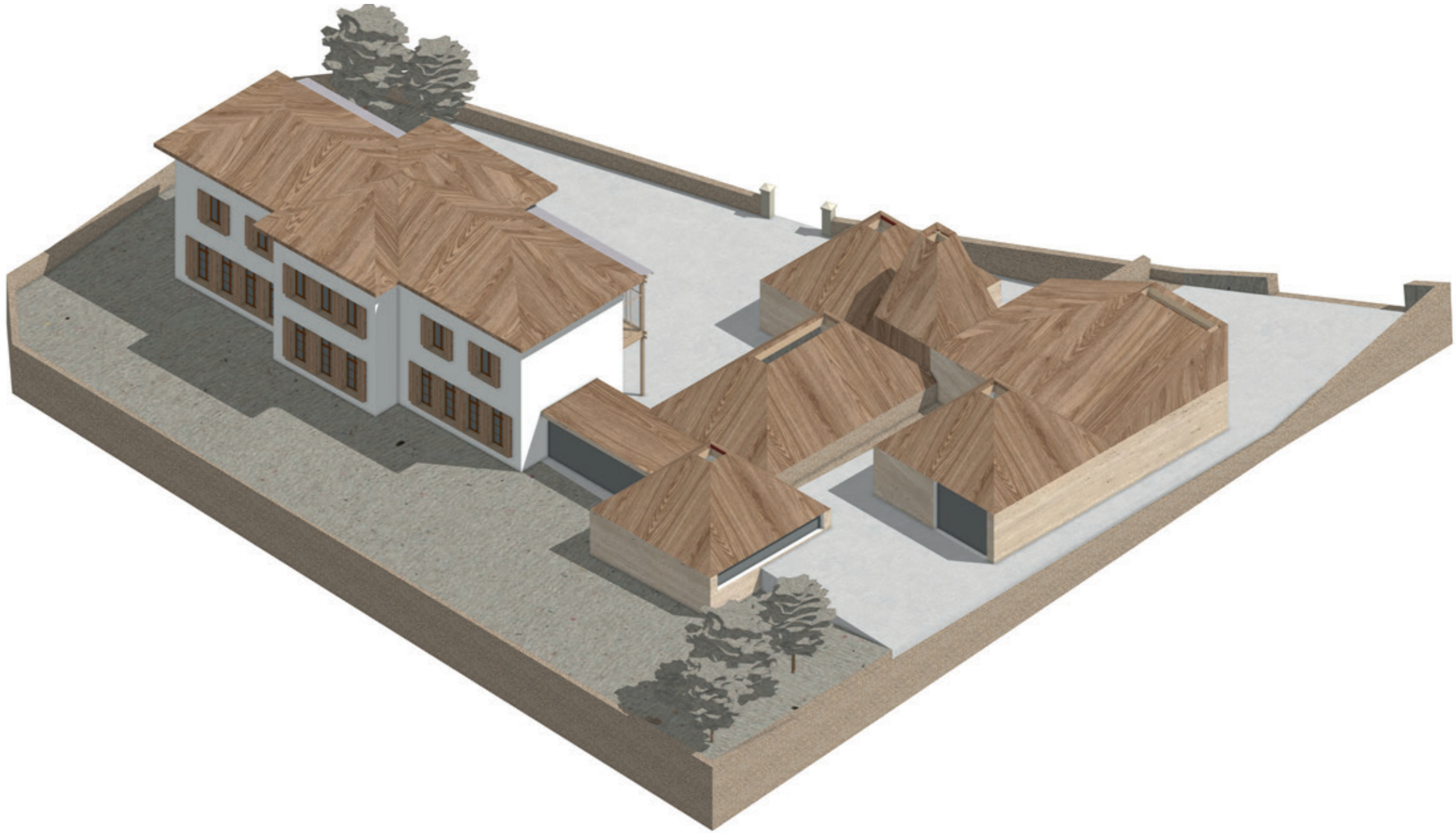
61



Visuals

Chimilin

62



Visuals

Chimilin

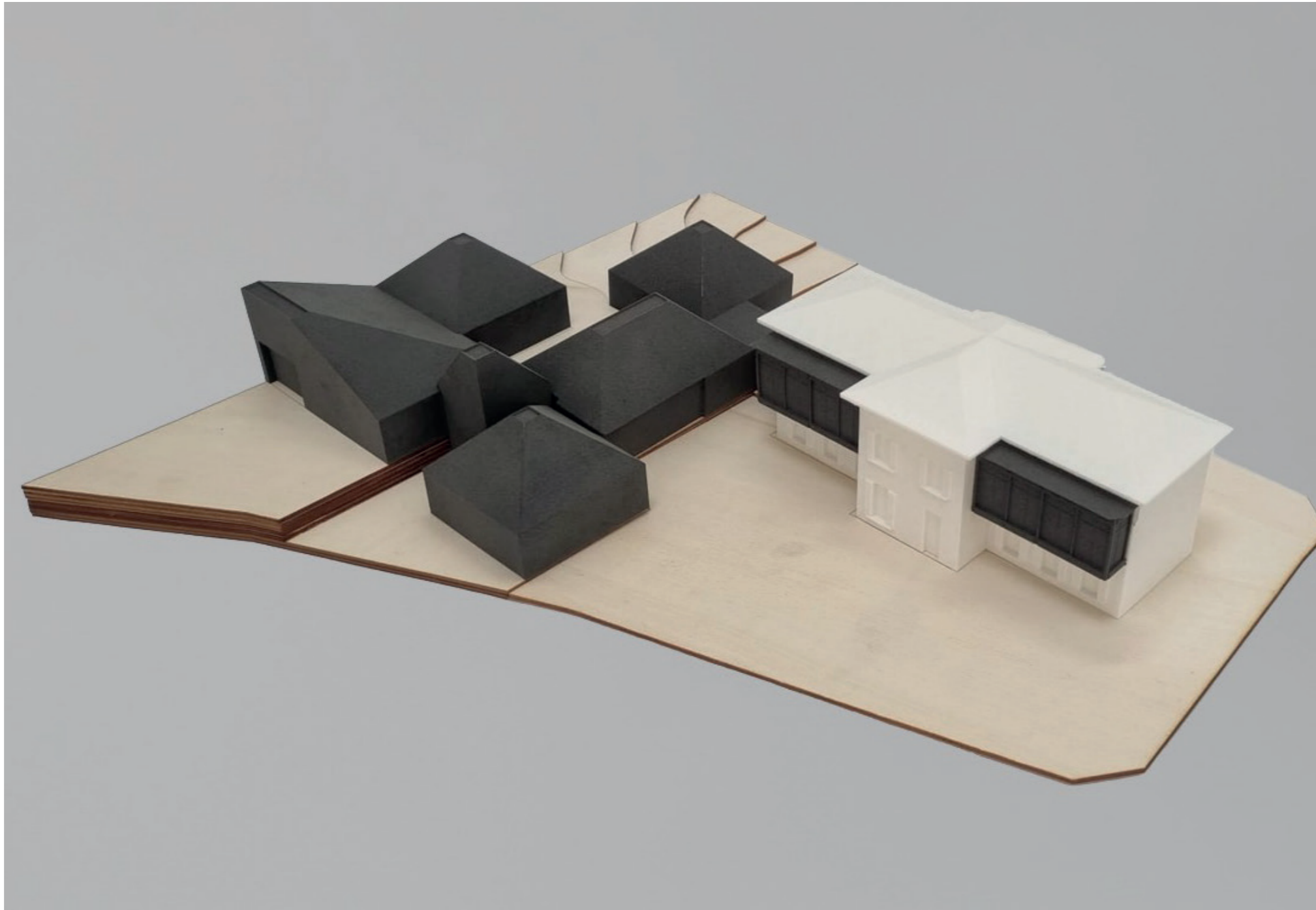
63



Physical Model

Chimilin

64



Physical Model

Chimilin

65

Ground Floor Wall

This project aims to evolve the vernacular technique of pisé (rammed earth) construction by developing a homogeneous wall material that retains the structural integrity of traditional rammed earth while offering improved thermal performance. The approach explores material combinations based on adjusted ratios, creating a mix that integrates earth, sheep's wool for insulation, and lime as a natural binder. The result is a monolithic wall system with both structural and insulating properties. Externally, the wall is left exposed, celebrating the raw aesthetic of rammed earth, while internally a clay plaster finish is applied for breathability and texture. Due to its minimal thickness, the plaster has no significant impact on the thermal performance of the wall.

Material	Conductivity	Percent %	Thickness equivalent mm	Resistance m ² K/W
Internal Surface (R _{si})				0.13
Rammed earth	0.6	50	300	0.5
Sheep's wool	0.035	40	240	6.8571
Lime	0.7	10	60	0.0857
External Surface (R _{se})				0.04

Total Thickness: 600mm
 Total Resistance: 7.613 m²K/W
 U-Value (Uncorrected) : 0.131 W/m²K
 Total U: 0.010
 U-Value (Corrected): 0.141 W/m²K



First floor Wall and roof

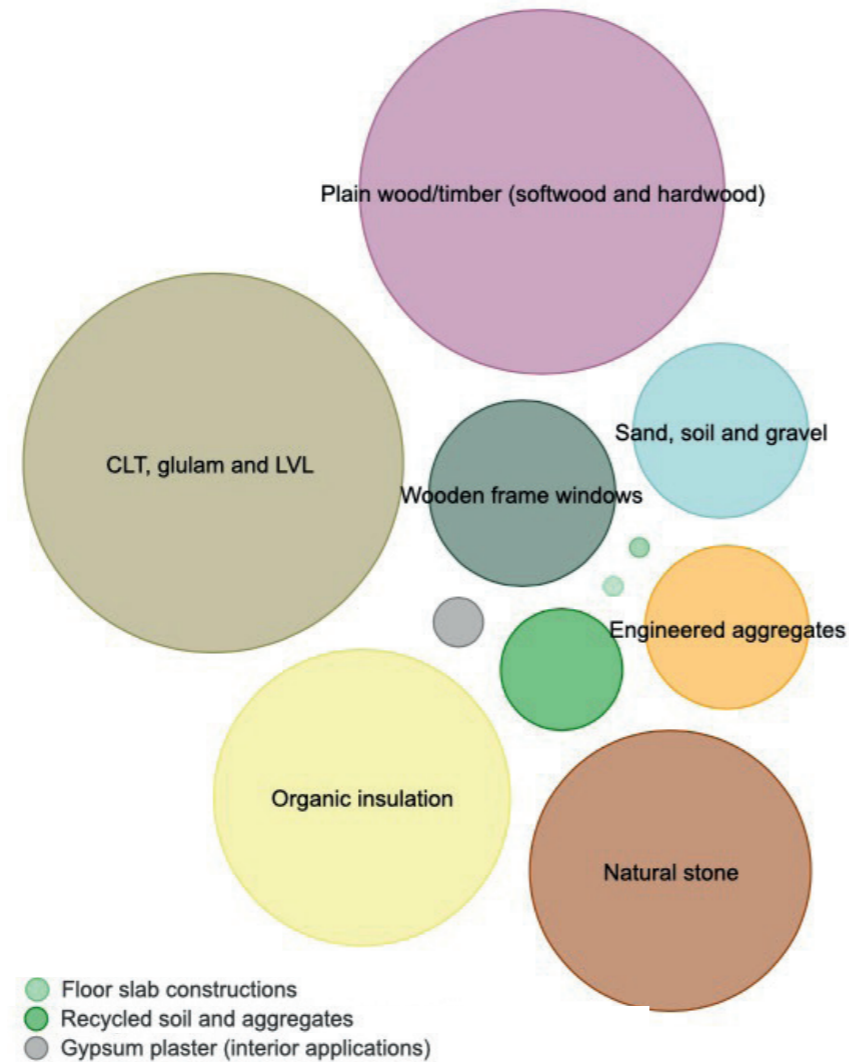
This wall and roof buildup uses CLT (Cross-Laminated Timber) as both the structural core and internal finish, paired with blown cellulose insulation, a sustainable material made from recycled paper. The cellulose is held in place within a stud framework set at 600mm centres, which also provides the fixing structure for the external timber shingles. A vapour control layer is positioned between the CLT and the insulation to manage internal moisture, while a breather membrane is installed between the studwork and the timber shingle battens to allow vapour to escape and protect against external moisture. These membranes do not contribute to the wall's thermal performance.

Material	Conductivity	Percent %	Thickness equivalent mm	Resistance m ² K/W
Internal Surface (R _{si})				0.13
CLT	0.12	100	100	0.8333
Blown Cellulose	0.04	85	260	5.8500
Studwork 600 cc	0.13	15	260	0.2000
Plywood	0.13	100	10	0.0769
Ventilated airspace high emissivity horizontal	0.13	100	25	0.13
Timber shingles	0.14	100	60	0.4286
External Surface (R _{se})				0.04

Total Thickness: 450mm
 Total Resistance: 7.689 m²K/W
 U-Value (Uncorrected) : 0.130 W/m²K
 Total U: 0.010
 U-Value (Corrected): 0.140 W/m²K



Thermal Envelope



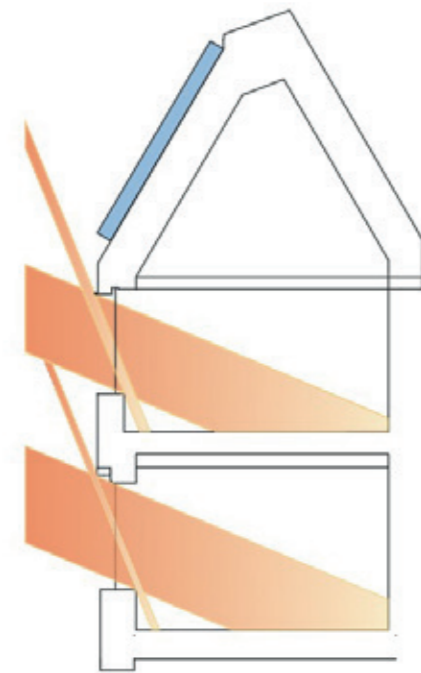
A detailed LCA was conducted for a 12 m² representative area of the building. Using current material-specific embodied carbon data, the total impact was calculated to be 3,210.29 kgCO₂e, resulting in an average of 267.52 kgCO₂e/m². This outcome is well below LETI's 2030 benchmark and demonstrates a successful integration of low-impact and circular construction methods.

Breakdown of major contributors to embodied carbon in the representative area:

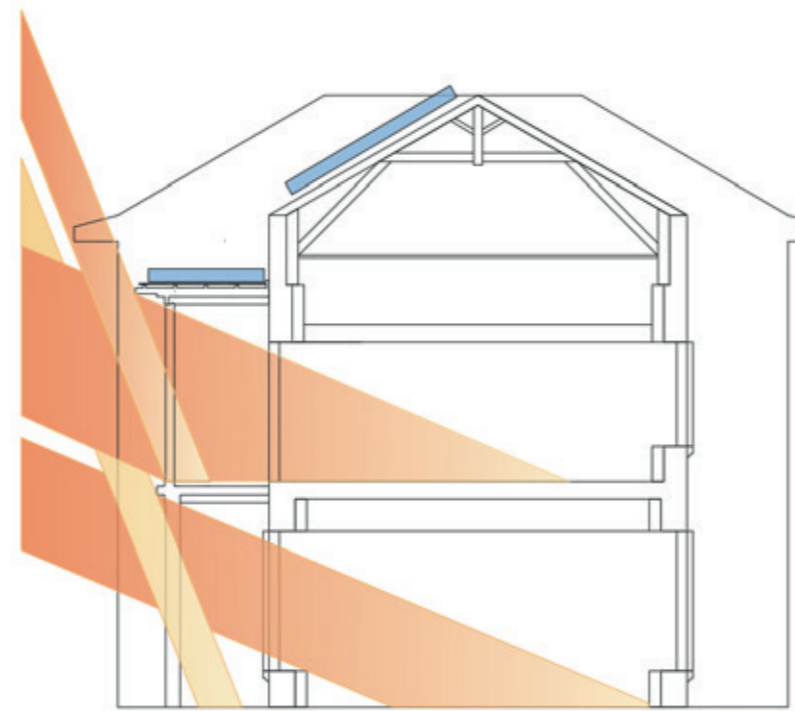
- Engineered timber (CLT, Glulam): ~27%
- Plain softwood timber: ~25%
- Organic insulation (recycled cellulose and sheep's wool): ~16%
- Natural stone and aggregates: ~19%
- Remaining minor contributions from windows, gypsum plaster, and recycled aggregates

These results reflect careful material selection, low-carbon design principles, and a commitment to long-term sustainability.

Life Cycle Assessment



Villefontaine
South -> North



Chimlin
South -> North

Summer Solstice



Winter Solstice



PV Location



South Facing Facade

- **PLANTITHERM ONE T**
- Maximum Insulation & Solar Control
- Internal Panes: Planitherm One T
- Cavity: 90% Argon
- External Pane: Planiclear
- Triple Glazed
- U-value: 0.50 W/m2K
- G-Value: 0.42
- Light Transmittance: 51%
- Light Reflectance Ext: 35%
- Light Reflectance Int: 35%

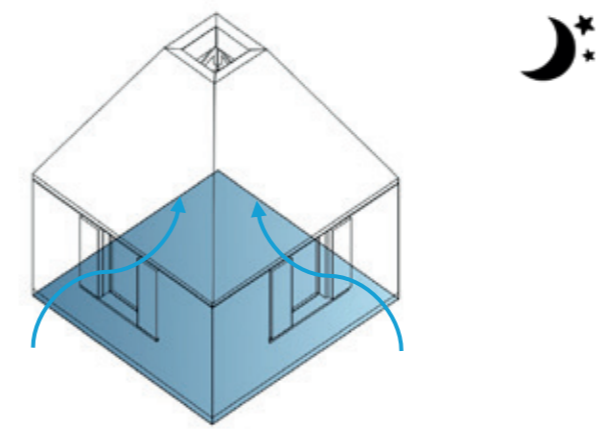
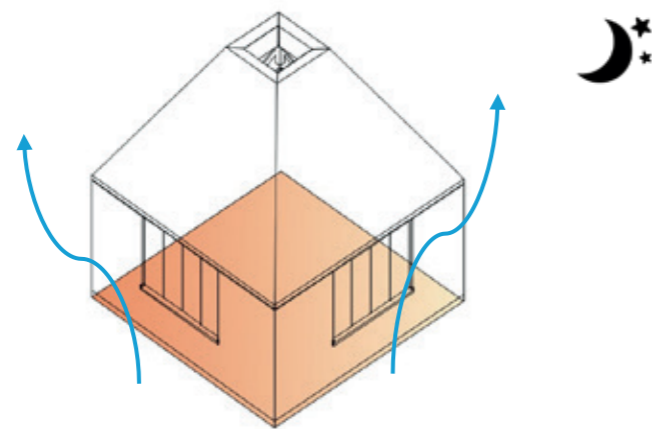
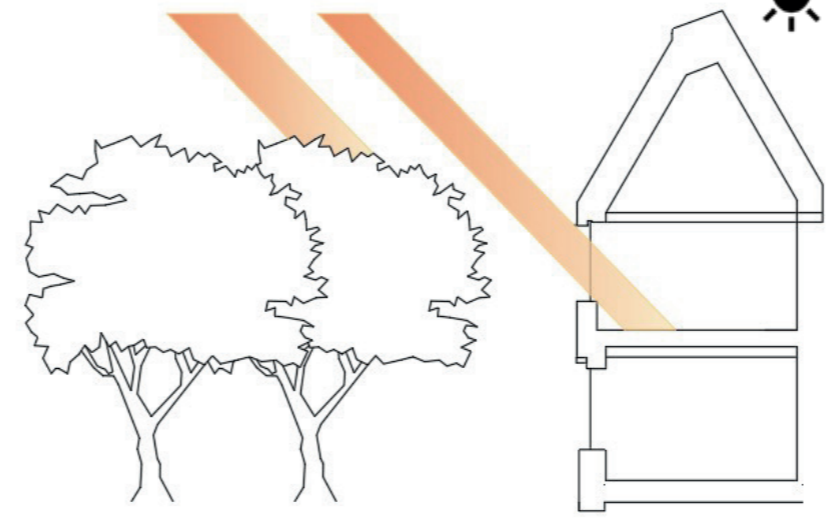
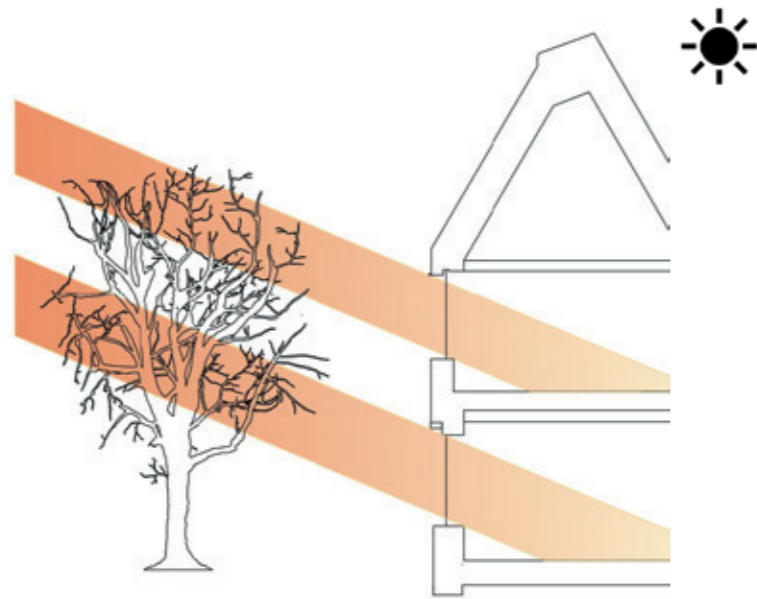
North, East & West Facing Facades

- **PLANTITHERM TOTAL +**
- Balanced Insulation & Solar Control
- Internal Panes: Planitherm Total +
- Cavity: 90% Argon
- External Pane EW: Planiclear
- External Pane N: Diamant
- Triple Glazed
- U-value: 0.60 W/m2K
- G-Value EW: 0.61
- G-Value N: 0.63
- Light Transmittance: 70%
- Light Reflectance Ext: 17%
- Light Reflectance Int: 17%



Daylight Strategies

Featuring glazing on multiple facades, the building integrates advanced glass technology utilising low g-values on the south, moderate on the east and west, and high on the north-to balance abundant natural light while minimizing unwanted solar gain. The winter gardens provide solar shading to the ground floor windows during the summer.



Winter

Summer

Trees **Winter Gains** - Absence of leaves allow increased sunlight into the building supporting passive solar heating in the winter months.

Summer efficiency - Deciduous trees incorporate effective solar shading and reduce heat gain using dense foliage in the hotter months.

Shutters **Reduced Winter Loss** – Thermally insulated shutters are closed in the winter during the night to reduce heat loss, maintaining comfortable indoor temperatures.

Summer Efficiency – When opened at night during the summer, they facilitate night purging via natural ventilation, allowing cooler air into the zone, reducing indoor temperatures and thermal mass.

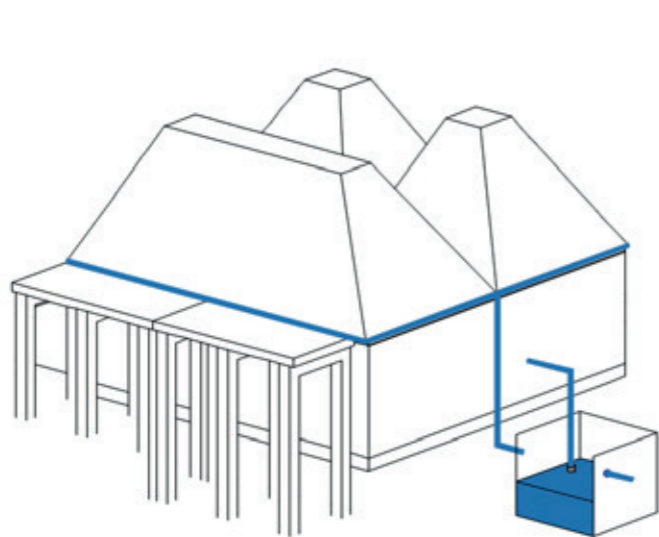
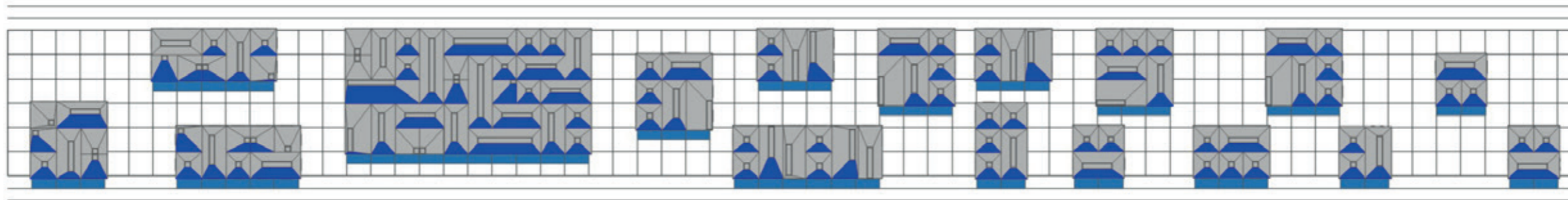
Shading Strategies

By integrating traditional French-style insulated shutters, occupants can flexibly adjust sunlight by opening them to any angle, while closing the shutters provides effective winter & nighttime insulation-resulting in a dynamic and adaptable façade. In addition, strategically placed deciduous trees on the south, east, and west offer natural summer shading and allow winter sunlight to reach the building.

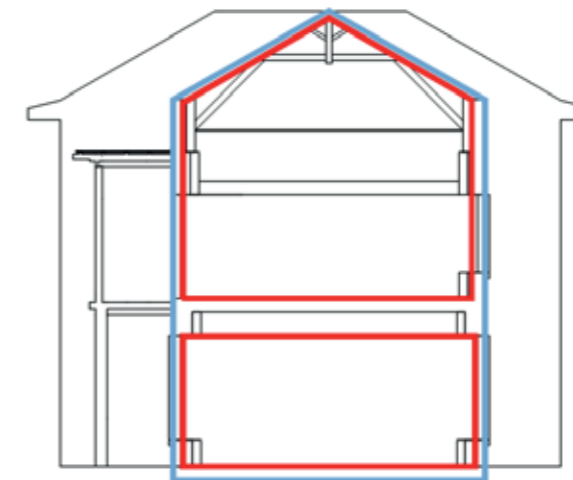
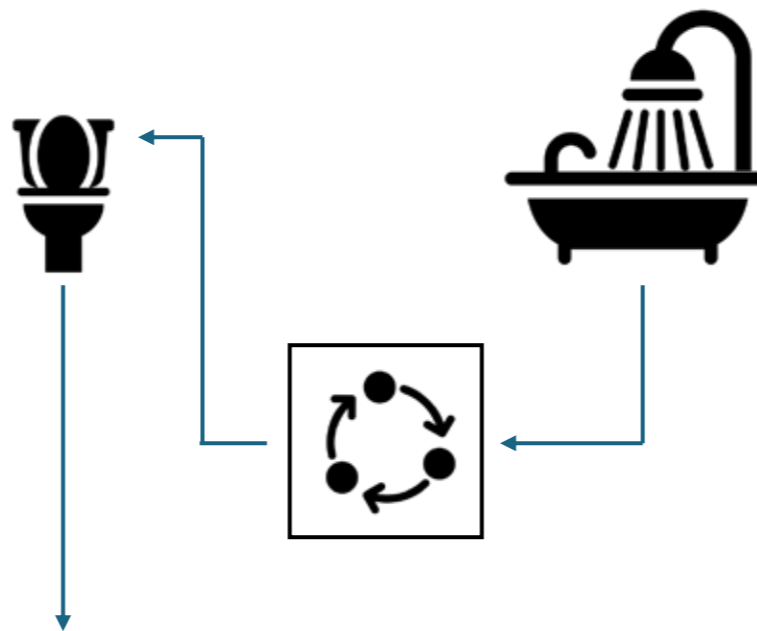
Facade/Orientation	Advantages	Disadvantages	Best Uses	Wind Considerations (N/S Winds)
South-facing	<ul style="list-style-type: none"> - Maximum daylight, especially in winter - Good for passive solar gain 	<ul style="list-style-type: none"> - Risk of overheating in summer - May need shading - Glare possible 	Daylighting, winter heating	Exposed to prevailing south winds; can aid ventilation if operable, but risk of wind-driven rain ingress
North-facing	<ul style="list-style-type: none"> - Even, diffuse daylight - Minimal glare - Reduces overheating risk 	<ul style="list-style-type: none"> - Less direct sunlight, especially in winter - Limited solar gain 	Studios, offices, glare-free daylight	Exposed to prevailing north winds; good for cross-ventilation if paired with south openings, but may increase heat loss in winter
East-facing	<ul style="list-style-type: none"> - Morning sunlight - Warms spaces early in the day 	<ul style="list-style-type: none"> - Little afternoon/evening light - Not optimal for all-day lighting 	Kitchens, bedrooms	Less direct exposure to N/S winds; wind effects minimal
West-facing	<ul style="list-style-type: none"> - Afternoon/evening sunlight - Warms spaces later in the day 	<ul style="list-style-type: none"> - Overheating risk in late afternoon - Potential glare 	Living rooms, evening spaces	Less direct exposure to N/S winds; wind effects minimal
Flat/Rooflight	<ul style="list-style-type: none"> - Maximum daylight - Even light distribution - Can be used for stack ventilation 	<ul style="list-style-type: none"> - Highest risk of overheating if unshaded - Potential heat loss in winter 	Central spaces, deep-plan rooms	Strong uplift and suction effects from N/S winds; must be designed for wind resistance and to prevent leaks
Sloped Roof (pitched)	<ul style="list-style-type: none"> - Balanced daylight and solar gain - Can be oriented for optimal seasonal performance 	<ul style="list-style-type: none"> - Overheating if south/west facing - Needs careful placement 	Attics, flexible daylight/solar gain	Wind pressure varies with slope; N/S winds can increase uplift or suction, so secure installation is critical



Skylight Orientation

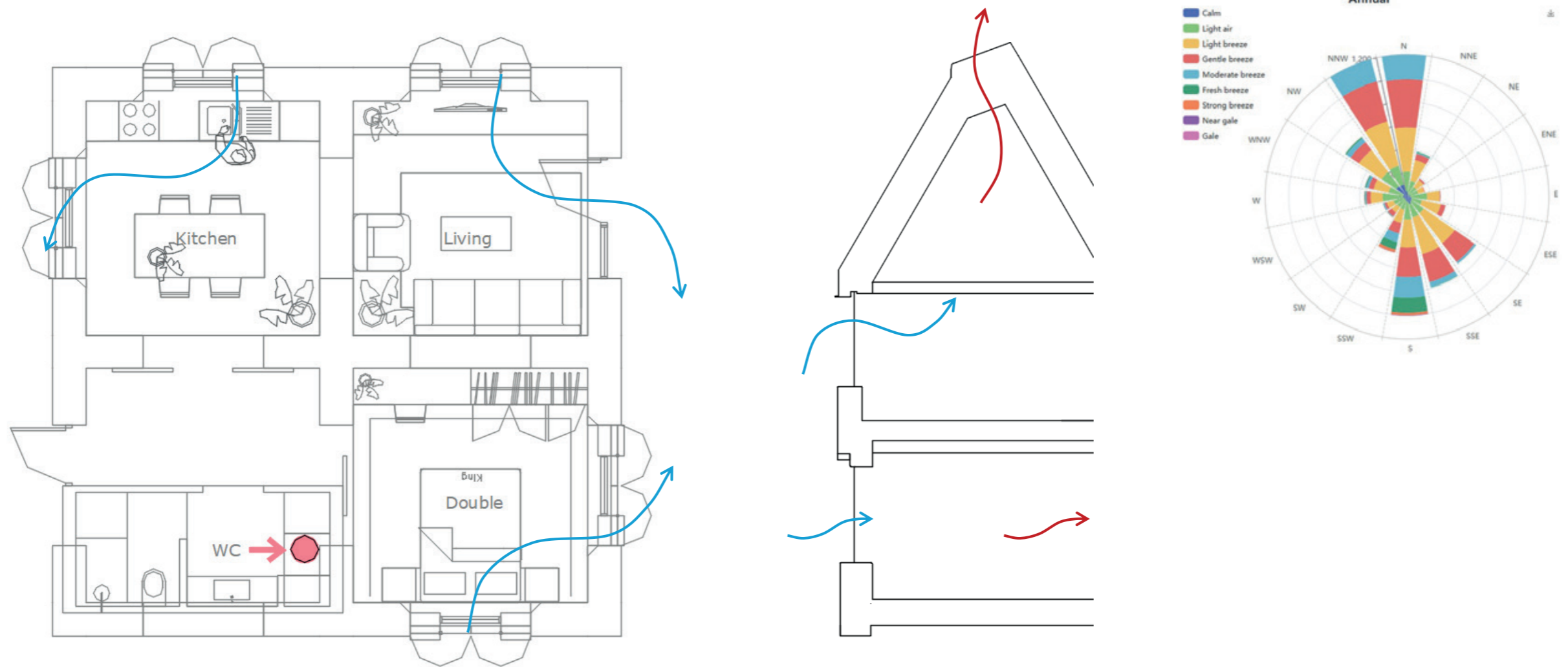


Oli Put Gutter
detail thing
here pls



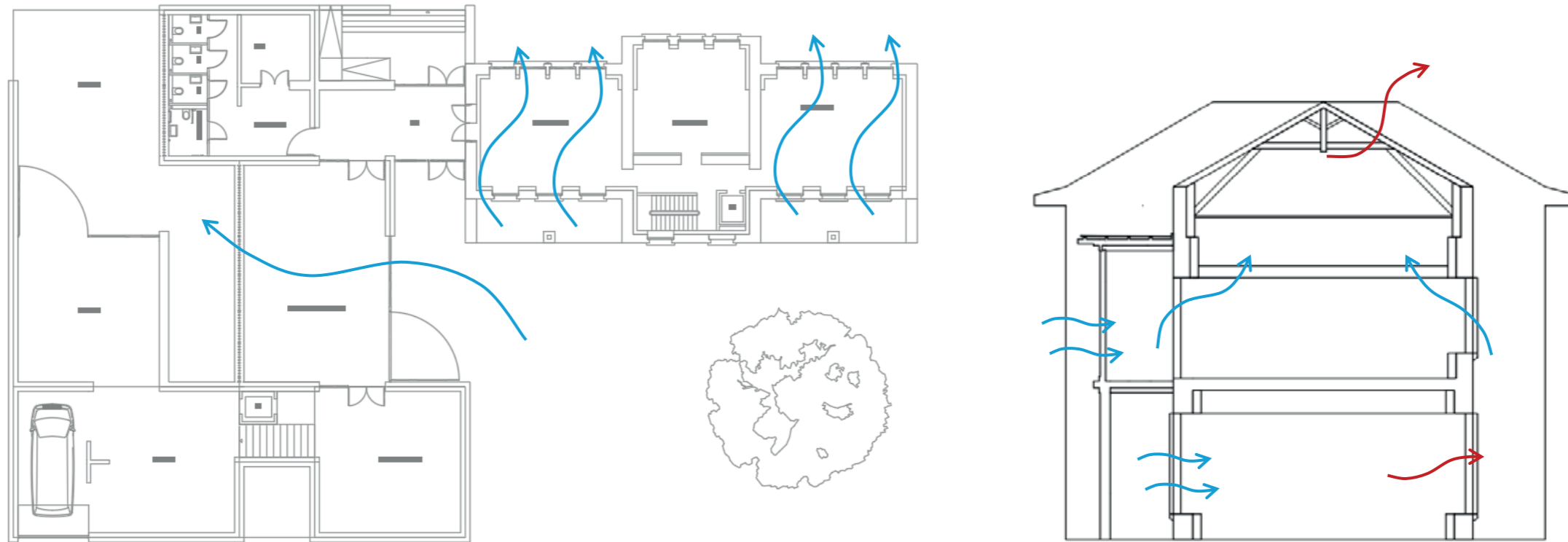
Sustainability Strategy

All south-facing rooftops are equipped with solar panels that harness abundant sunlight to generate surplus electricity. This excess energy is shared across communities, enhancing regional resilience, reducing fossil fuel dependence, and exemplifying a strong commitment to sustainability. All rooftops collect rainwater through efficient harvesting systems that supply shared water resources, enhancing local water resilience. Grey and black water are recycled within the blocks to reduce freshwater demand and support sustainable water management practices. Buildings feature superior airtightness to minimize energy loss, improve comfort, and demonstrate a strong commitment to energy efficiency.



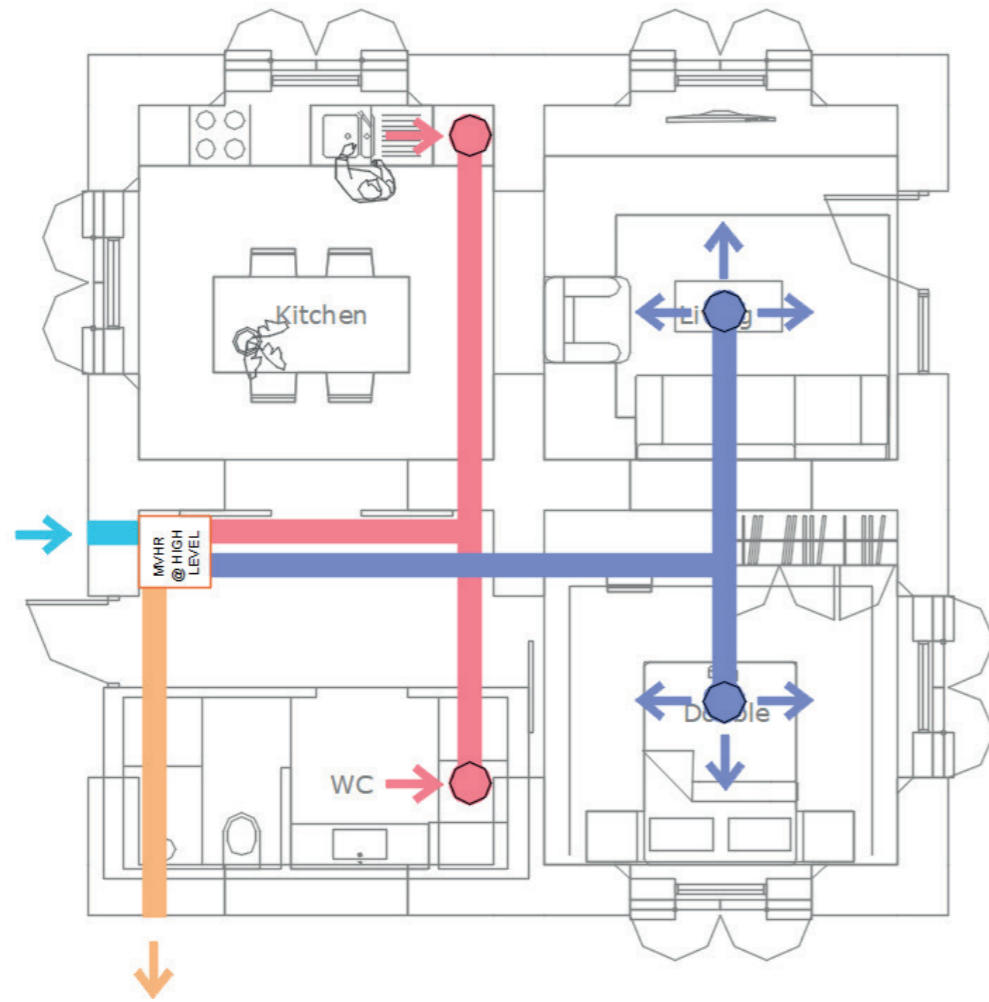
Summer Natural Ventilation

Buildings maximise natural ventilation with well-placed windows opening and vents, using cross flow to move fresh air through spaces and stack vents to draw in cool air as warm air rises. These strategies work best on the north and south facades where the wind is most prominent. These passive strategies keep interiors comfortable and reduce the need for mechanical cooling.



Summer Natural Ventilation

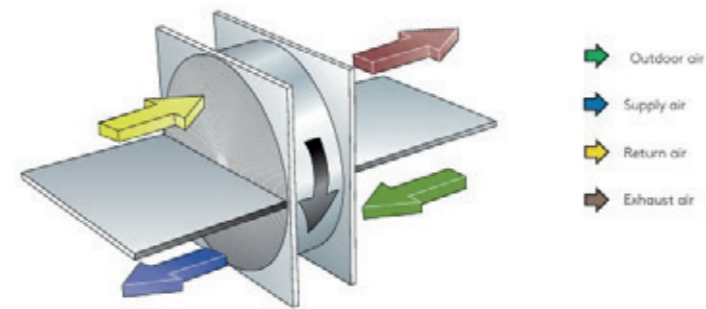
When there's little or no wind in summer for cross ventilation, natural ventilation relies on the stack effect: warm indoor air rises and exits through high vents, drawing cooler air in through lower openings, a process that can be enhanced by the roof lights and inclusion of night cooling.



Automatic Control – Automatic control over relative humidity, CO2 levels and VOC air quality.

Heat Recovery – Rotary Heat Exchanger heat recovery

Boost Ventilation – Future weather scenarios may require boosted ventilation and supply cooling coil.



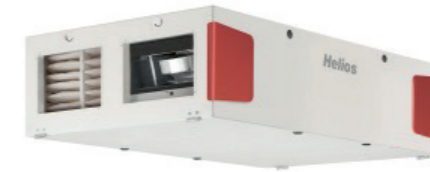
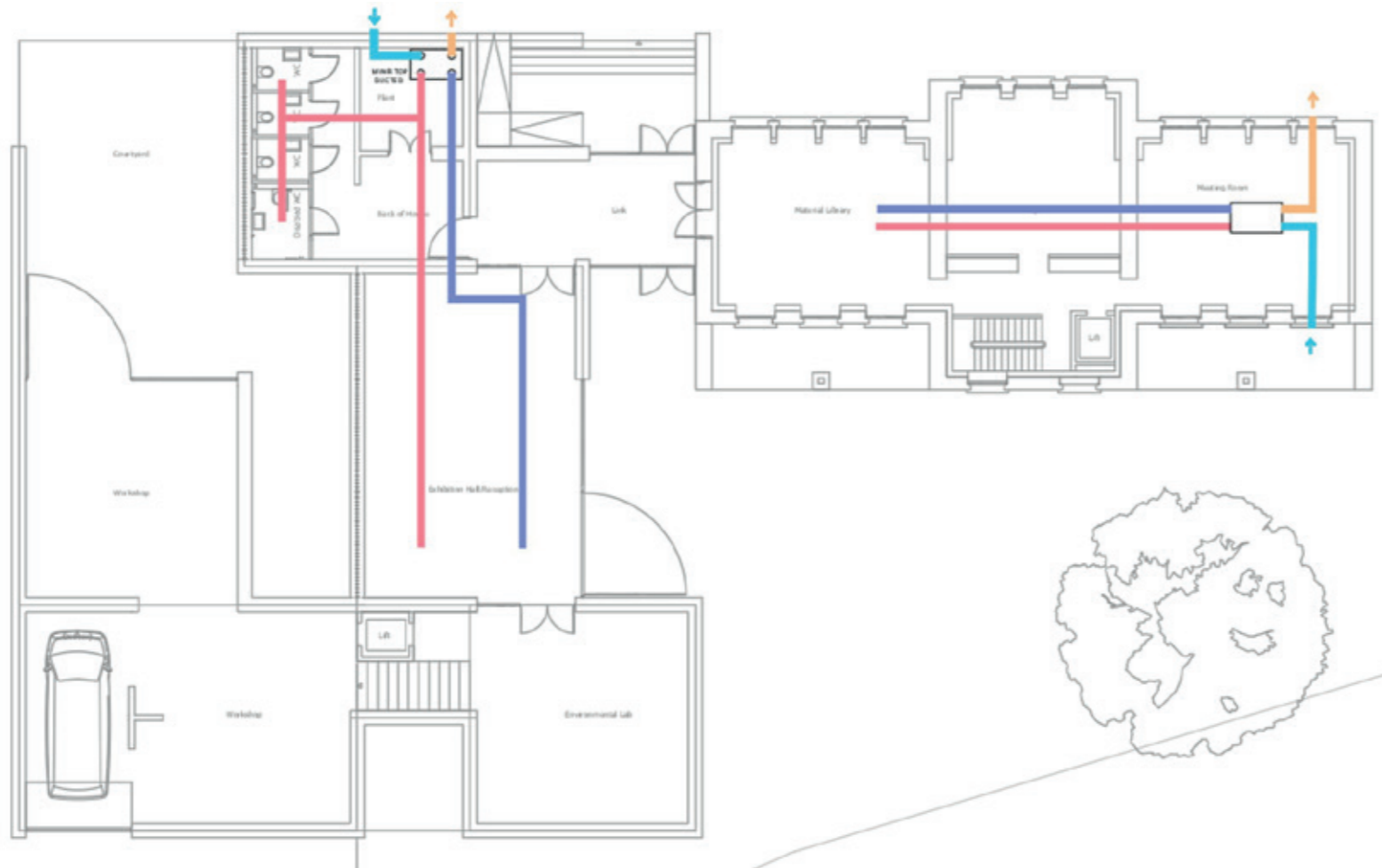
Swegon



Mechanical Ventilation

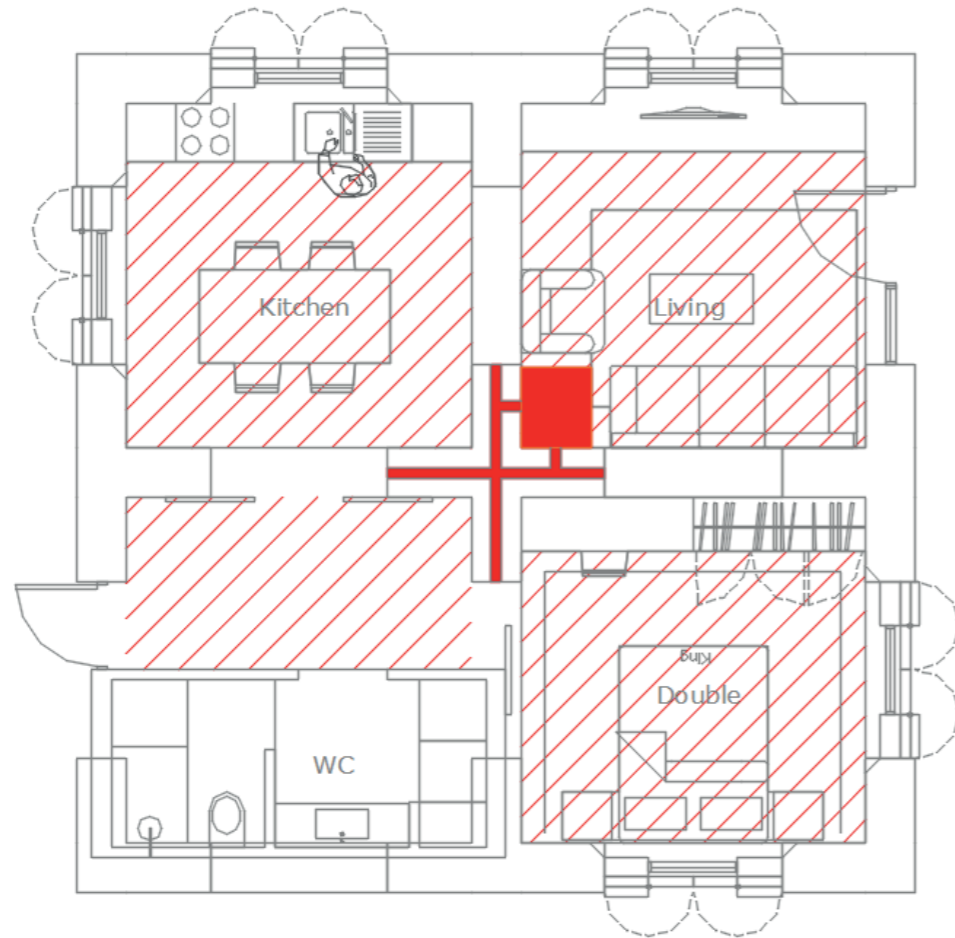
MVHR systems continuously supply fresh, filtered air while recovering heat from outgoing air, with ducts distributed at wall plate level around the buildings to enhance indoor air quality and energy efficiency. The passive house certified Swegon CASA R7 Genius sorption recovers up to 86% of the heat. There is a supply to the living and bedrooms, with extract from the kitchens and toilets.

Engineers Notes



Mechanical Ventilation

Two Helios units serve the ground floor, KWL EC 2000 D ceiling mounted unit, with similar serving the first floor to supply the coworking studios and extract from the kitchenette, enhancing indoor air quality and energy efficiency. The Helios KWL EC 1800S PRO serves the amenity spaces and toilets on the ground floor to maintain <1000ppm CO₂. Specialist Extract and AHU required for lab space and workshop, but similar heat recovery methods would be used, including HEPA filters in the lab space with VAV.



Clothing - Use wool jumpers to complement wool in the building fabric, enhancing natural insulation and sustainability.

Wood Burner - Install a central wood-burning stove as a renewable heat sources

Hollow Walls - Incorporate a hypocaust system in internal walls to channel flue gases, using thermal mass to moderate heat release and extend warmth.

Internal Thermal Mass - Utilise thermal mass from rammed earth for high mean radiant temperatures and improved comfort.

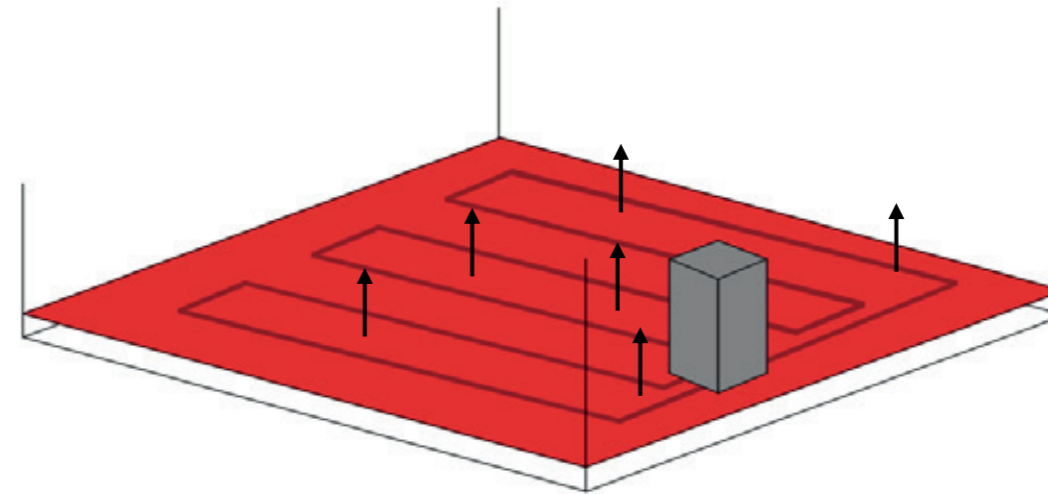
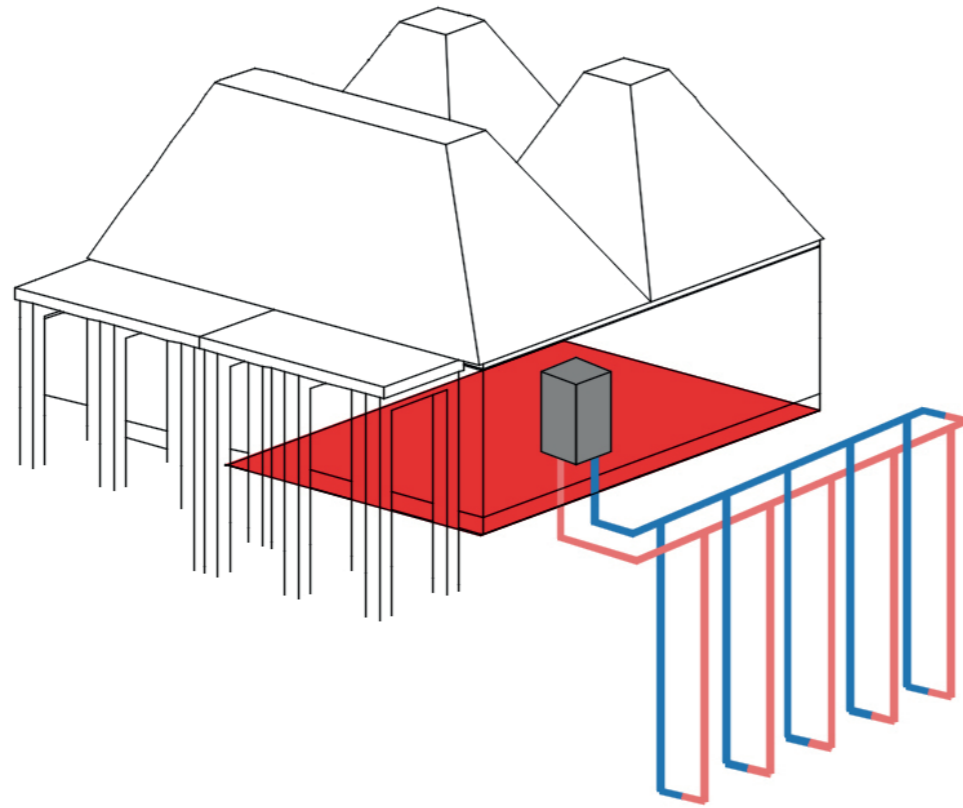
First Floor - First floor will be heated via the first floor incorporating stove fans and natural ventilation principles to transport heat upstairs.

Winter Gardens - First floor winter gardens capture excess solar gain to warm a buffer zone, with this gentle heat then naturally ventilated into the living spaces.



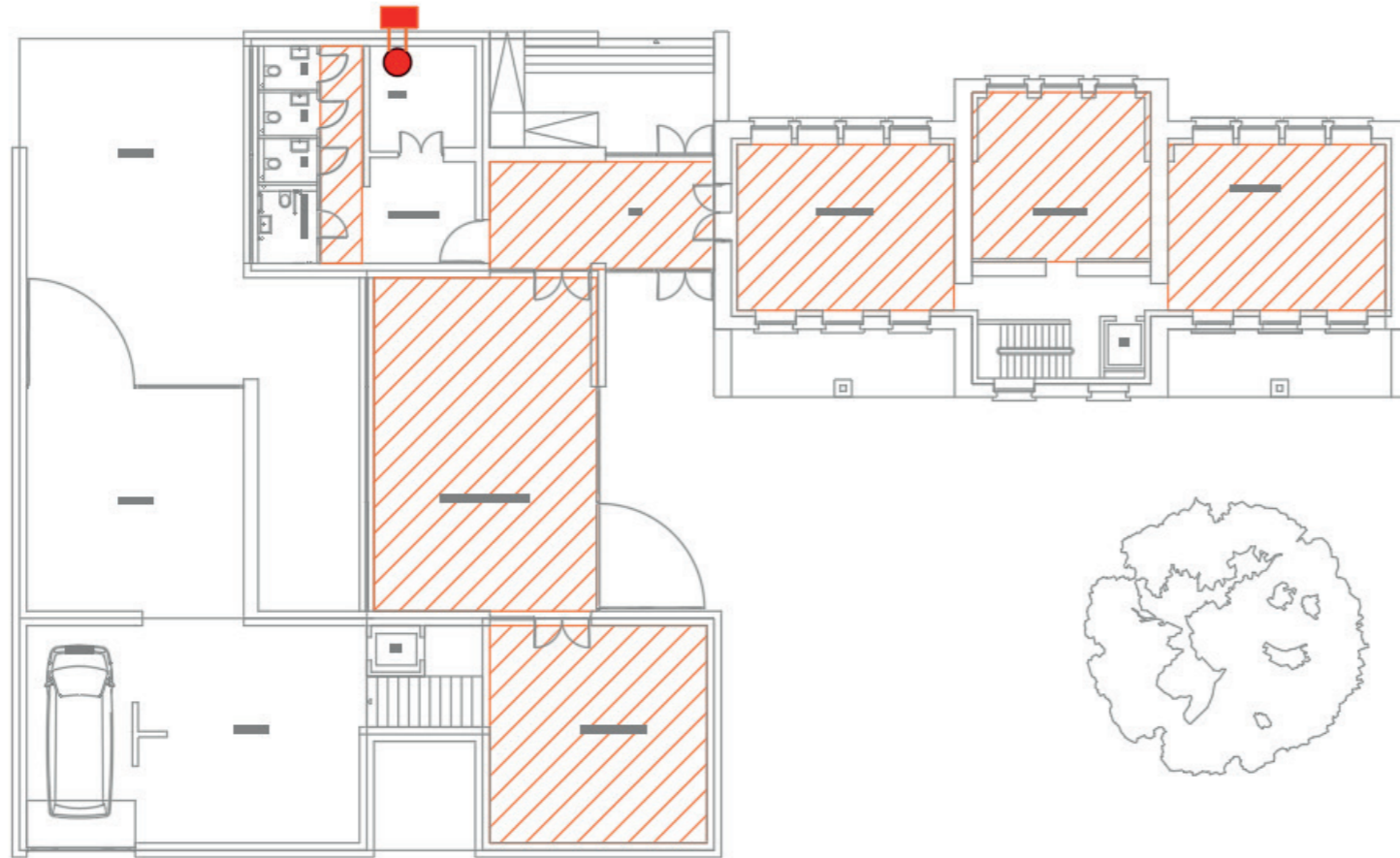
Heating Strategy (Residential)

Earth printing allows thick earth walls to act as a hypocaust, channelling heat from a small wood stove through the building's core for prolonged radiant warmth, while occupants wearing wool in winter actively complement the fabric's natural thermal regulation, with similar strategies applicable for summer. This is adaptation to comfort and willingness not to live under the clout of climatic colonialism.

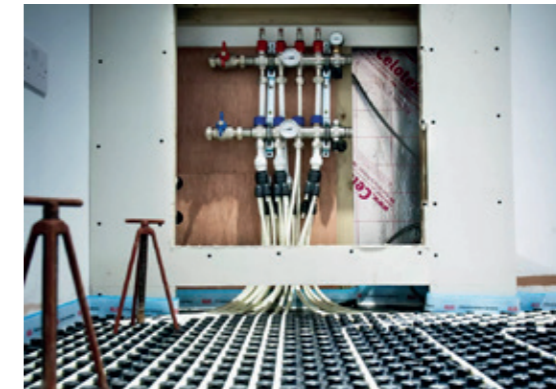


Heating Strategy: Villefontaine

The larger amenity spaces will be heated using a ground source heat pump with vertical boreholes, which sends heat to storage tanks before warming the underfloor heating system for efficient and steady warmth with lower flow temperatures. With adaptation for future scenarios, the GSHP can be reversed and used for cooling if temperatures continue to increase.



Panasonic



Heating Strategy: Chimilin

The larger amenity spaces will be heated using a Panasonic Aquarea K Series air source heat pump, which extracts heat from the outside air and sends it to thermal storage tanks before supplying the underfloor heating system. An ASHP was used for Chimilin due to space restrictions.



Environmental Sensors (Temperature, Humidity, and CO2) – IoT enabled sensors that continuously monitor indoor and outdoor temperature, indoor moisture levels, and air quality by measuring CO2 concentration. This integrated data allows smart HVAC and ventilation systems to adapt heating, cooling, and fresh air supply dynamically in active spaces, or would inform the occupants to use the woodfire and adapt for the correct environment manually.



Motion/Presence Sensors – Occupancy detection in the buildings to optimising heating and lighting.



MVHR Unit Controllers – Interactive MVHR interface and controller connected to IoT for autonomous control.



Motorized Automatic Window Controllers - IoT-enabled systems that use environmental sensors above and actuators to automate window opening/closing for optimal natural ventilation, indoor air quality, and energy efficiency. Features include building scheduling (opening windows only when appropriate), trickle and night purge ventilation control, and integrated smoke ventilation for fire safety.

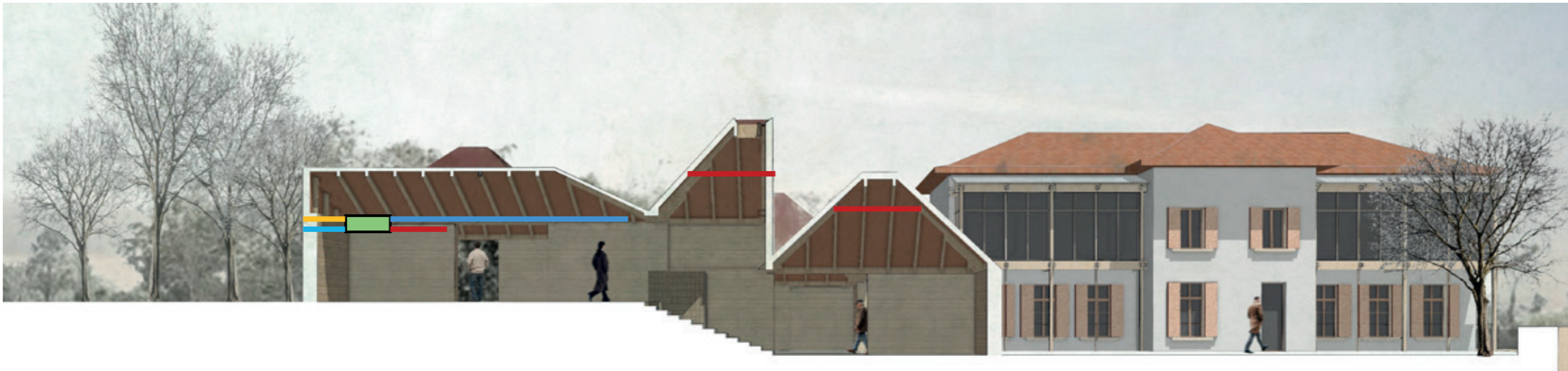
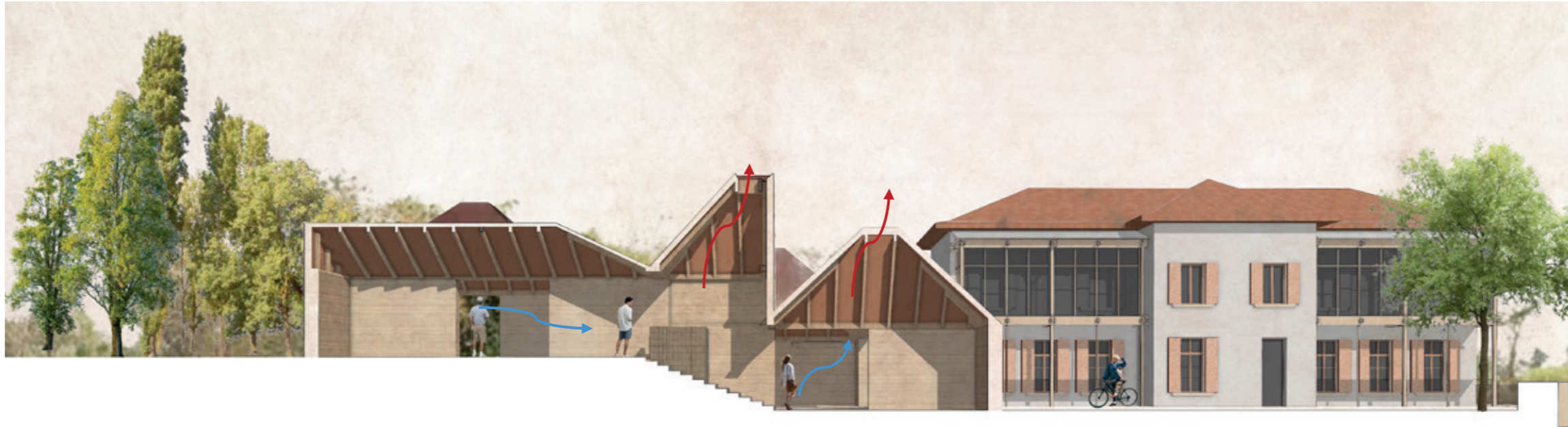
Controls – IoT – NV Windows

Intelligent control systems connected by the Internet of Things in the buildings continuously monitor and optimise heating, ventilation, and shading, ensuring each space operates at peak efficiency.



Section: Villefontaine

All south-facing rooftops are equipped with solar panels that harness abundant sunlight to generate surplus electricity. This excess energy is shared across communities, enhancing regional resilience, reducing fossil fuel dependence, and exemplifying a strong commitment to sustainability.



Section: Chimilin

All south-facing rooftops are equipped with solar panels that harness abundant sunlight to generate surplus electricity. This excess energy is shared across communities, enhancing regional resilience, reducing fossil fuel dependence, and exemplifying a strong commitment to sustainability.

CODIFIED TERRITORY

Saint Gobain

