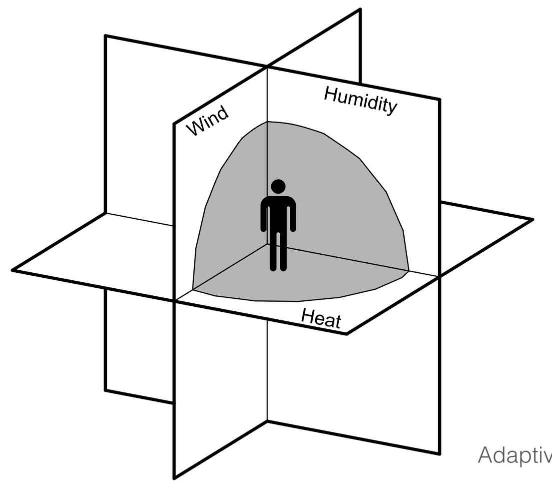
Adaptive Comfort



Adaptive Comfort Element

Adaptive Comfort

The fundamental assumption we should mention of the adaptive approach is the adaptive principle: "If a change occurs such as to produce discomfort, people react in ways which tend to restore their comfort" (Humphreys and Nicol 1998).

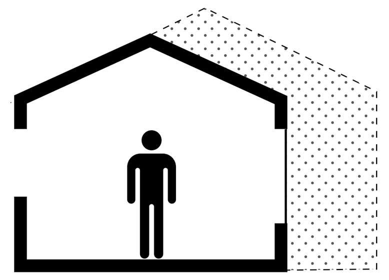
Two basic adaptive actions according to this principle:

·1. Adjustments to the optimal comfort temperature by changes in clothing. activity. posture. etc. so that the occupants are comfortable in prevailing conditions.

2. Adjustment of indoor conditions by the use of controls such as windows, blinds. fans and in certain conditions mechanical heating or cooling. Occupants may also migrate around the room to find improved conditions

The most used standard is ASHRAE Standard, EN 15251,and ISO 7730 standard.

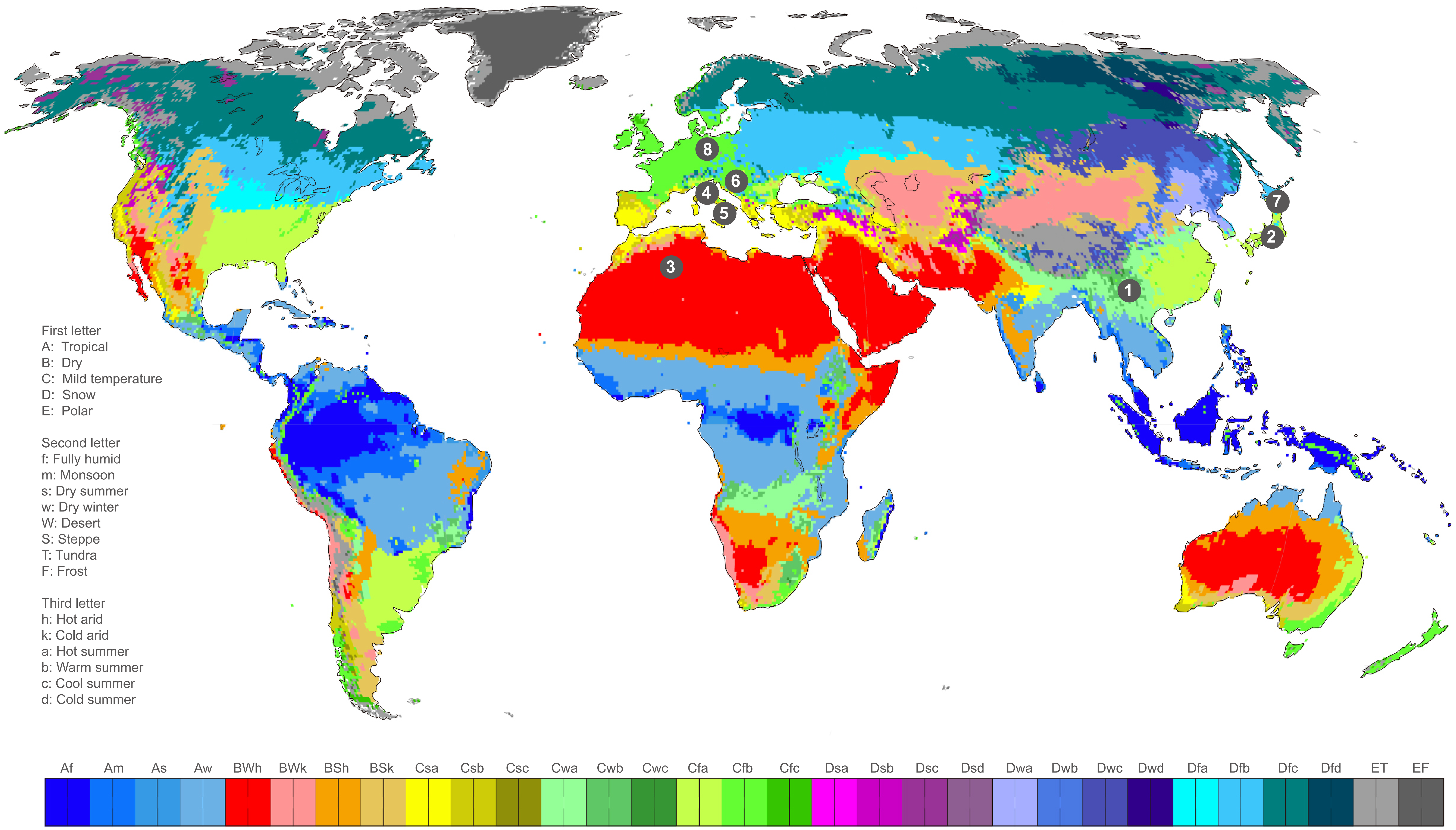
Bufferspace Study


Buffer space

Definition

When we talk about the buffer space, the two words ‘between” or “intermediate” are important for us to define the concept. If we look at the human’s adaption from the first stage biological mechanism like skin, to the second stage the clothes and to the third stage a simple envelope, the buffer space belongs to the building envelope, a more complex part between indoor and outdoor, as a intermediate space.

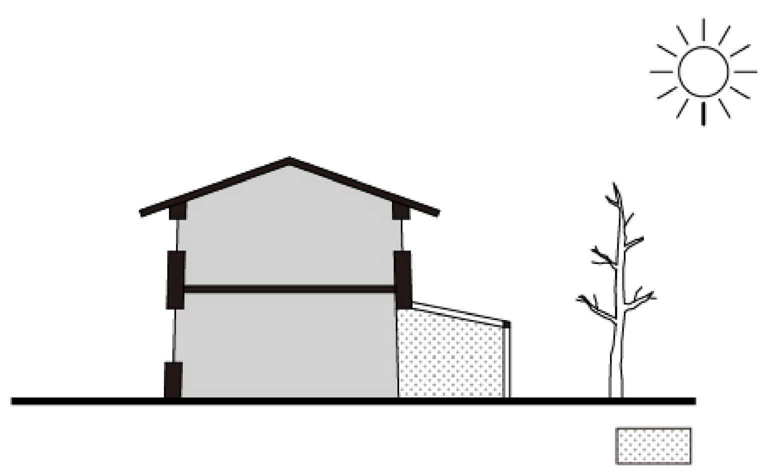
Koppen's Climate Map



Bufferspace in different climate zones

8 Moderately humid-Temperate climate

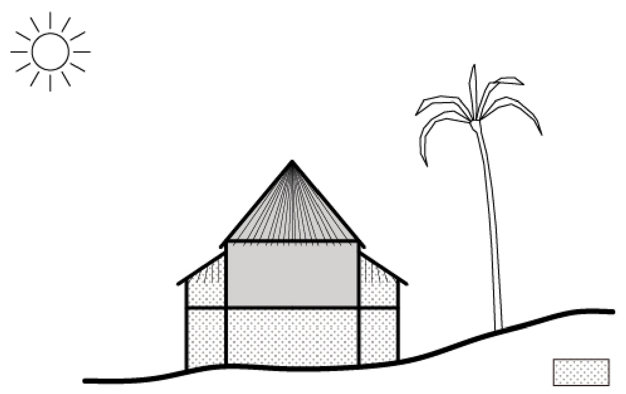
Winter garden is common buffer space in this climate zone. It is a space protected against the wind using a light structure with a lot of glass. The greenhouse effect will make the winter glass room warm. Also, in the cooling season, shading the glass room or with properly opening to remove the greenhouse effect.


Buffer space


Winter garden, Germany

1 Hot humid

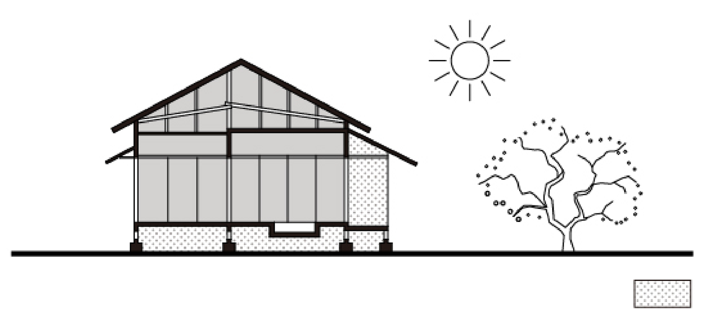
The large roof protects against the frequent rain and creates a semi- outdoor space under the eaves. The space created by the flyover floor worked as the humidity buffer space against the ground.


Buffer space


Silt house, Thailand

2 Subtropical Area

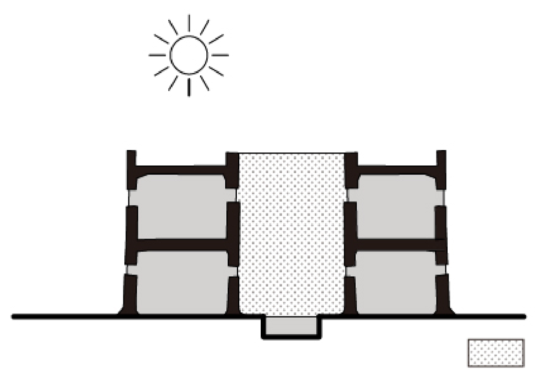
The common buffer space in this area is largely covered terraces, for example, the traditional Japanese house. This kind of buffer space offers a place protected by the roof from the rain and sunshine, provide a semi-outdoor space for daily activities.


Buffer space


Terrace under Roof, Japan

3 Hot dry

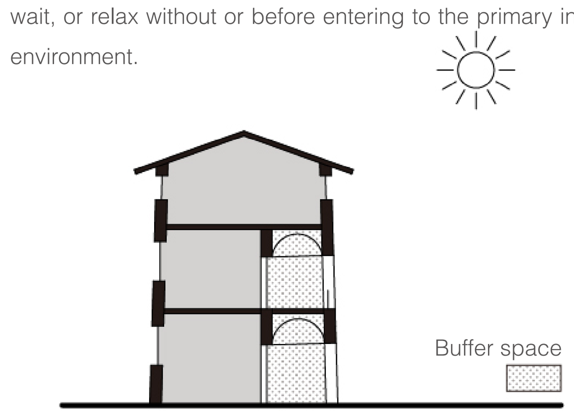
The typical building in Morocco, designed as a protection to the outside, makes the small shaded inner courtyard spaces as the main buffer space. A water pool is shared in the court to supplement the humidity in the dry climate and use evaporation to cool.


Buffer space


Watercourt House,Morroco

4 Mediterranean (Porch)

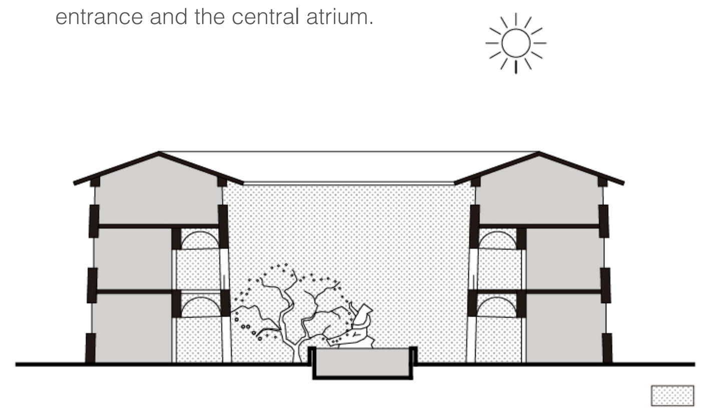
A porch is a term used in architecture to describe a space located in front of the entrance of a building forming a semi-outdoor space. Porch offers a space for people to pause, wait, or relax without or before entering to the primary indoor environment.


Buffer space


Continuous Porch,Bologna

5 Mediterranean (Innercourt)

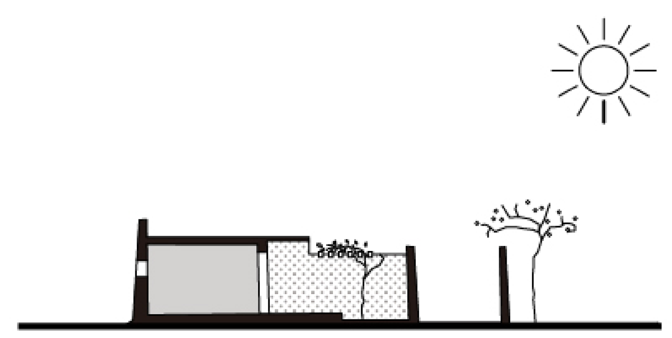
A courtyard or court is a circumscribed area, often surrounded by a building or complex, that is open to the sky. Roman atrium houses were built side by side along the street. They were one-story homes without windows that took in light from the entrance and the central atrium.


Buffer space


The courtyard of Ospedale degli Innocenti, Florence

6 Mediterranean(Greece)

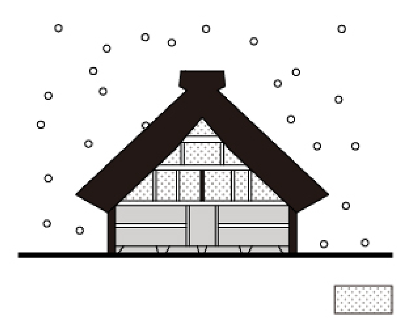
The typical house in Santorini, Greece. the house is painted white and with a courtyard in front of the room. The trees and vine in the south functioned as a shading, which in winter the leaves falls and sunshine pass through




Typical house,Santorini

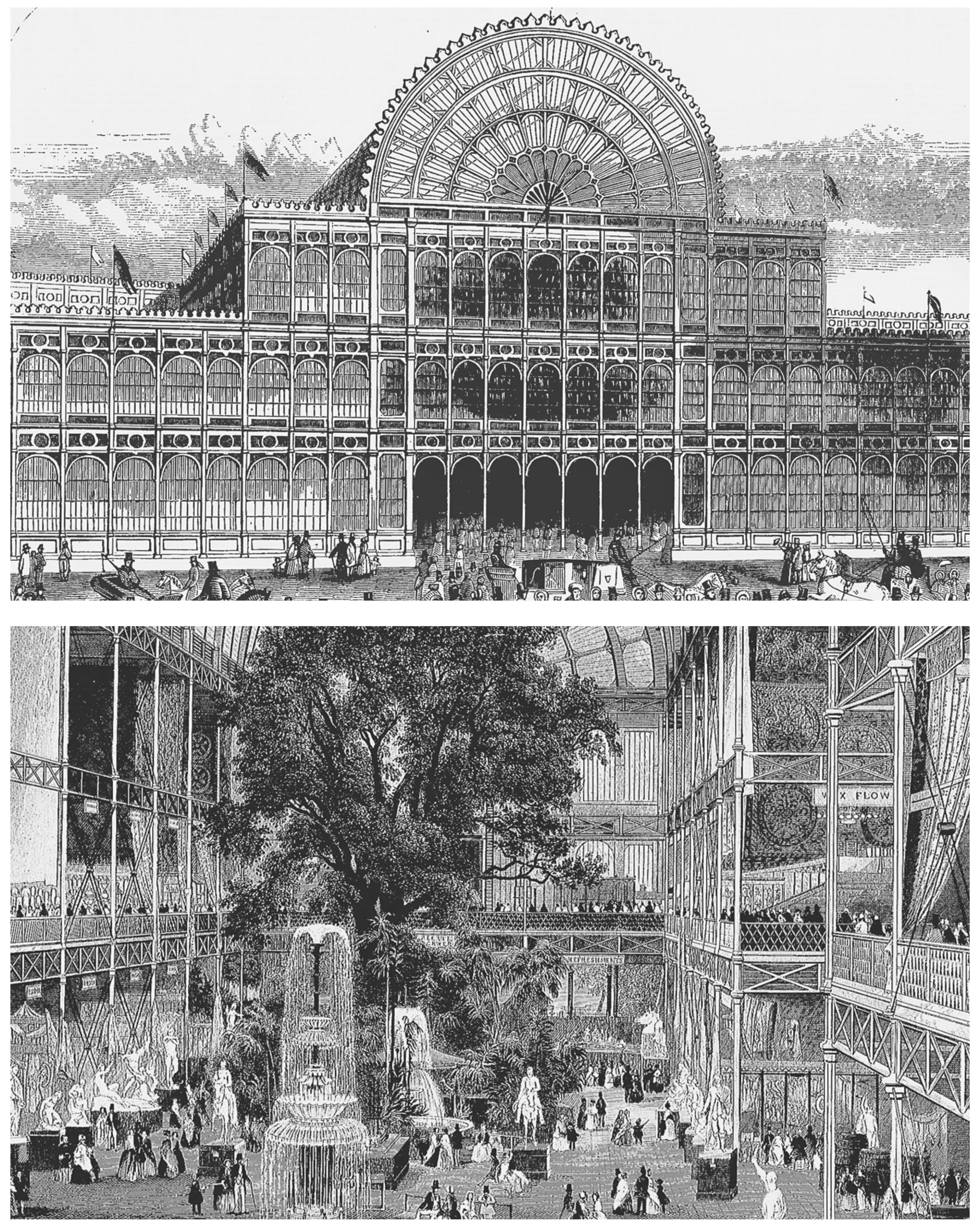
7 Cold humid-Subarctic

The famous rural world heritage in Japan named Shirakawa historical village, where the winter and snow are similar, we can find the attic or space under the sloped roof could be the buffer space in such climate zone.


Buffer space


Shirakawa historical village, Japan

Greenhouse Globally



The Crystal Palace, London, 1851

Burlington Arcade,1819,London

Winter garden in North Europe

Greenhouse in Italy

Tiberius grew cucumis in the prototype greenhouse, a wheeled cart

A 16th-century print of the Botanical Garden of Padua

Galleria Vittorio Emanuele II, Milan

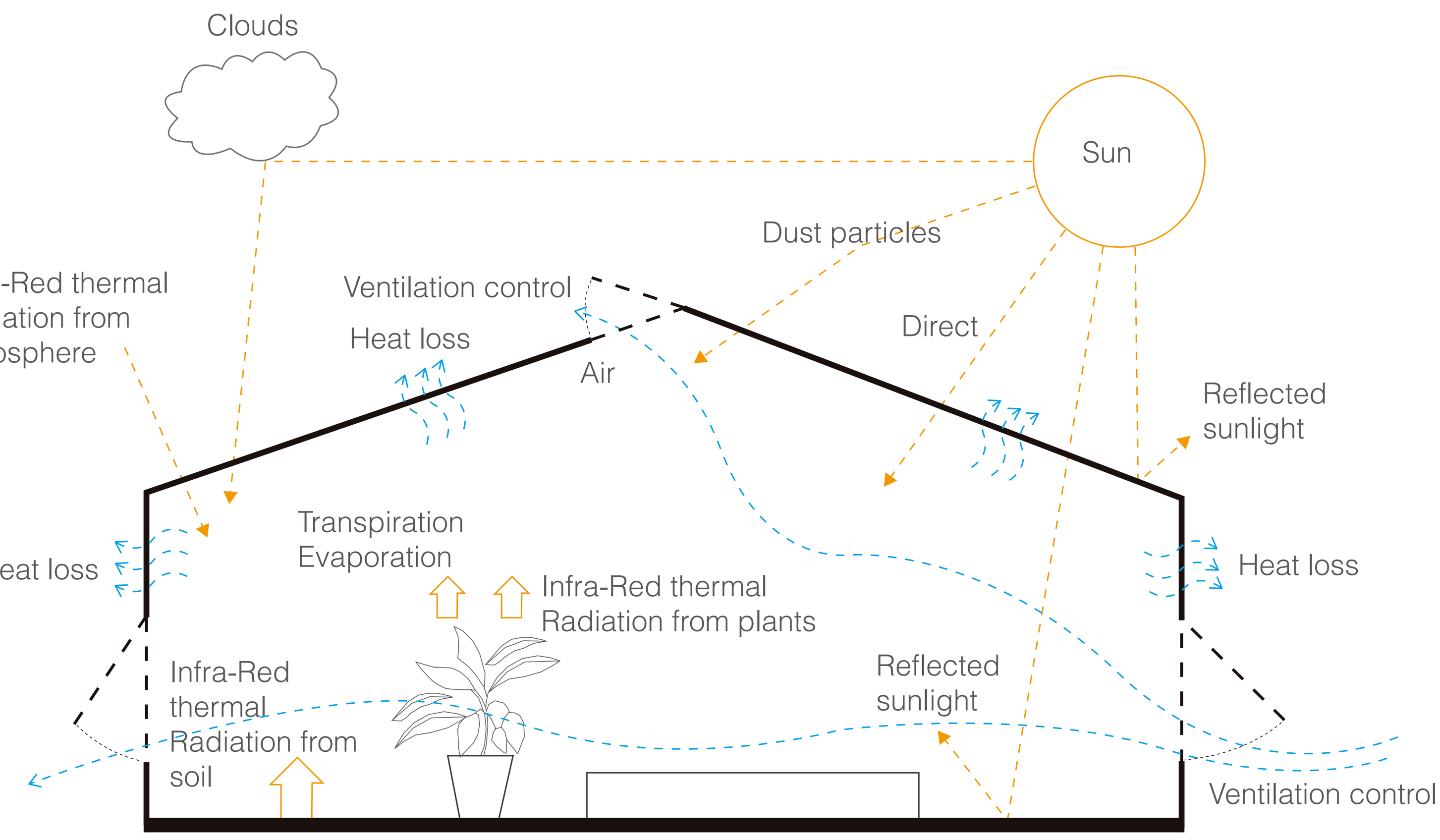
Galleria Umberto I, Napoli

Product offered by Sumroom.it

Greenhouse Energy Perofrmance

Greenhouse Mechanism

The greenhouse effect can function as an organ where the indoor temperature and other properties can be controlled. When sunlight goes through the greenhouse, short wave radiation passes through the glass. Then converted to longwave radiation when absorbed by a solid object, such as the ground. The infra-Red radiation from plants and infra-Red thermal radiation from soil and air, the sunlight reflected by soil as the heating source of the indoor. Glass reflects long wave radiation, so the heat is trapped. Warm air by convection from the heated surfaces is also trapped. Also, the closure protects against the wind cooling effect, too. The process causes the result that indoor temperature is warmer than outside.

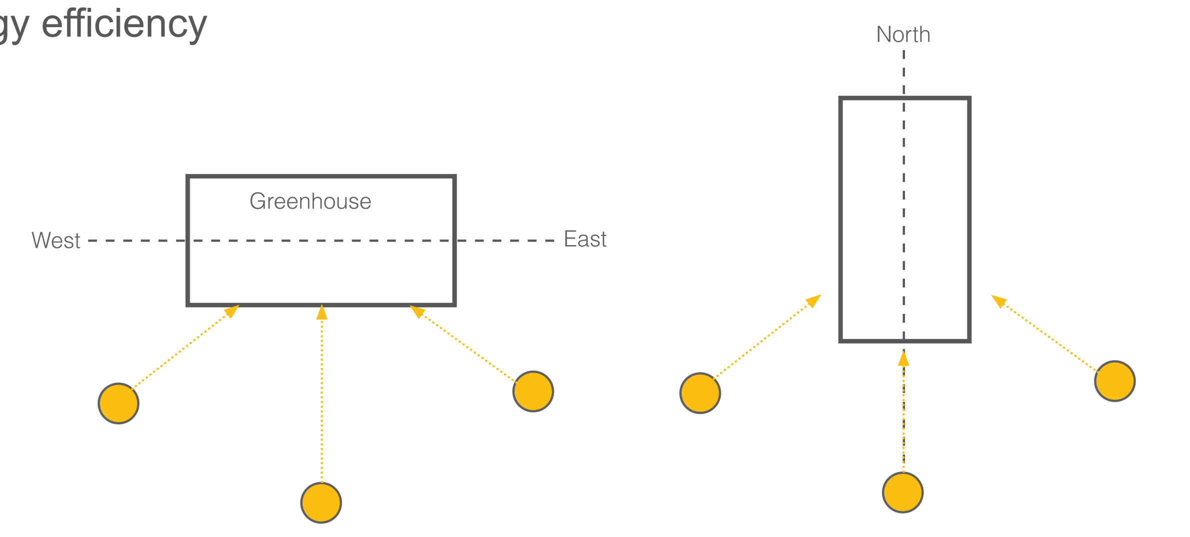


Greenhouse Mechanism

The keys related to energy efficiency

Orientation

The orientation is vital to solar exposure and absorption. Oriented to the leading solar direction may be the best choice, including the surrounding context. Many commercial glasshouses prefer north-south orientation to achieve light exposure throughout the day, but generally east to west orientation ensures higher thermal efficiency. Because in the most important season winter, north to south orientation exposures the least area directly to the sun.

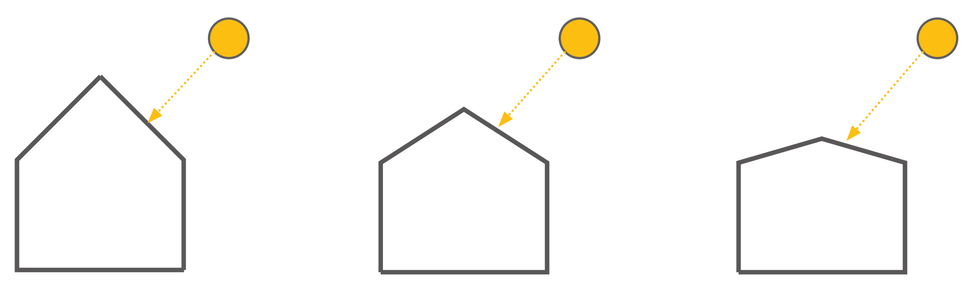


Maximum solar adsorption

Commerical glasshouse

Angle of the surface

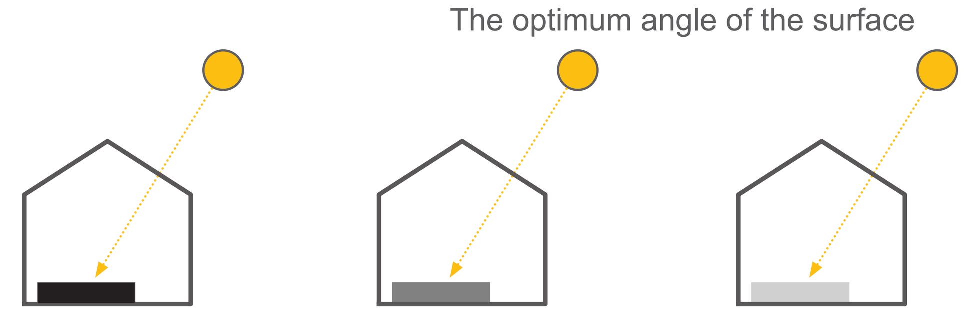
The maximum transmission occurs when the glass is perpendicular to the light source. . A generally finding is to place the glass perpendicular to the sun for the winter by taking the latitude and adding 15°.



The optimum angle of the surface

Convert the light to heat

Light converts to heat through being absorbed by an object. The absorbing factor of the material is related to the color of the material. The black is 100%; white surfaces are 0.25 - 0.40; grey to dark grey is 0.40 - 0.50; It is better to design the interior surface of the greenhouse to be dark for solar absorption.



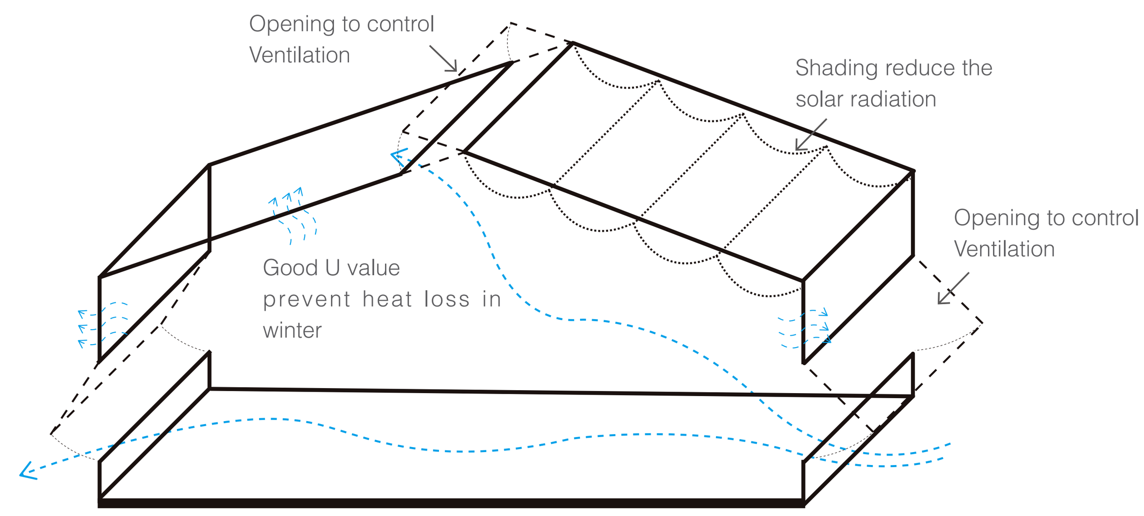
The color of interior

Covering material properties

The envelope of the greenhouse should be well insulated to reduce heat loss. The U value and transimitte is important.

Shading and opening for cooling

In summer, the shading should work and the opening should open to take the heat away.

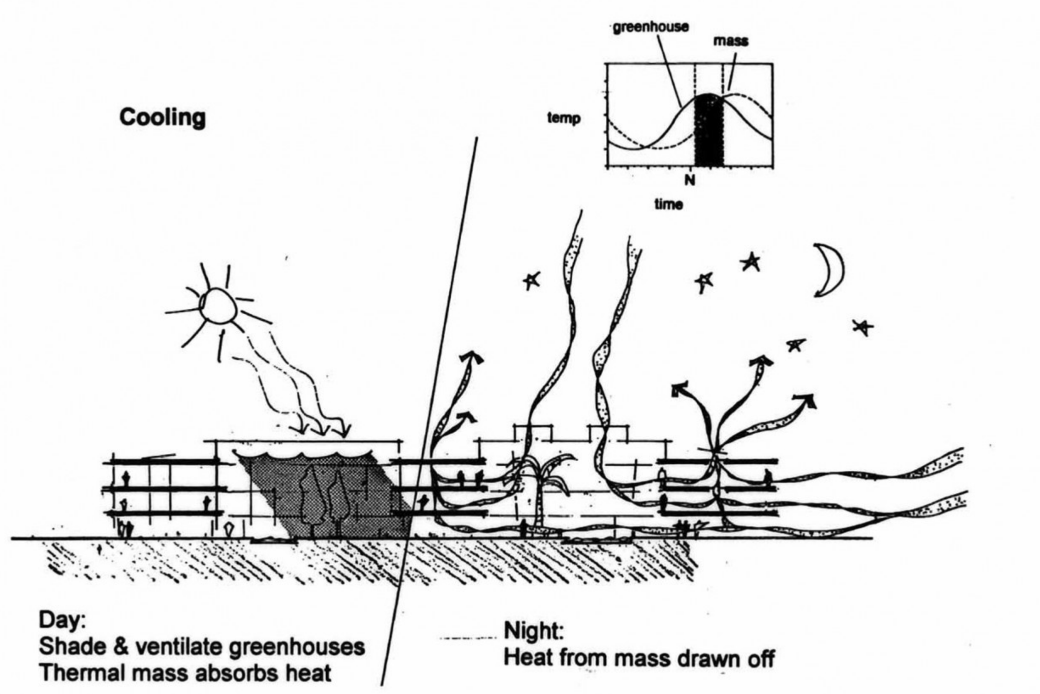


Covering U value, shading and opening

Reference Case

IBN Institute for forestry and nature research Wageningen, The Netherland.

The IBN institute designed by BEHNISCH ARCHITEKTEN in Netherland is a typical case for the buffer space strategy application in modern design. The huge agricultural greenhouse between the buildings functioned both as a main microclimate adjustment organ and a pleasure semi-outdoor space for transportation, informal meeting and daily leisure activities. The big controllable windows on the top give the buffer space a flexibility capability to adapt to the climate. It creates a passive way in modern architectural techniques. All the working place face inner gardens, and outdoor landscape shows the harmony with nature. The buffer space absorbs solar heat in the day; then draw off at night. From the strategic graph from BEHNISCH ARCHITEKTEN shows the different performance of the buffer space.

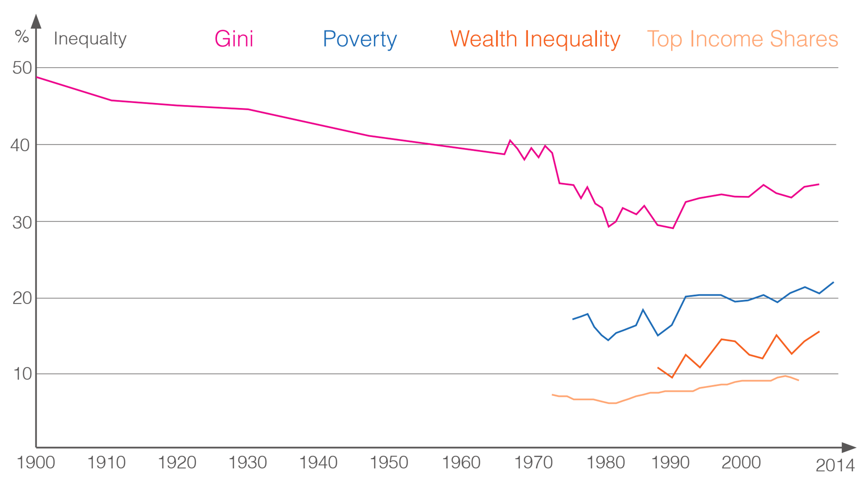


Design strategies sketch from BEHNISCH ARCHITEKTEN

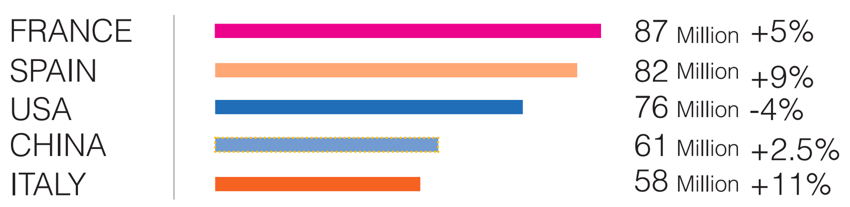
Greenhouse buffer space

Affordable house crisis in Italy

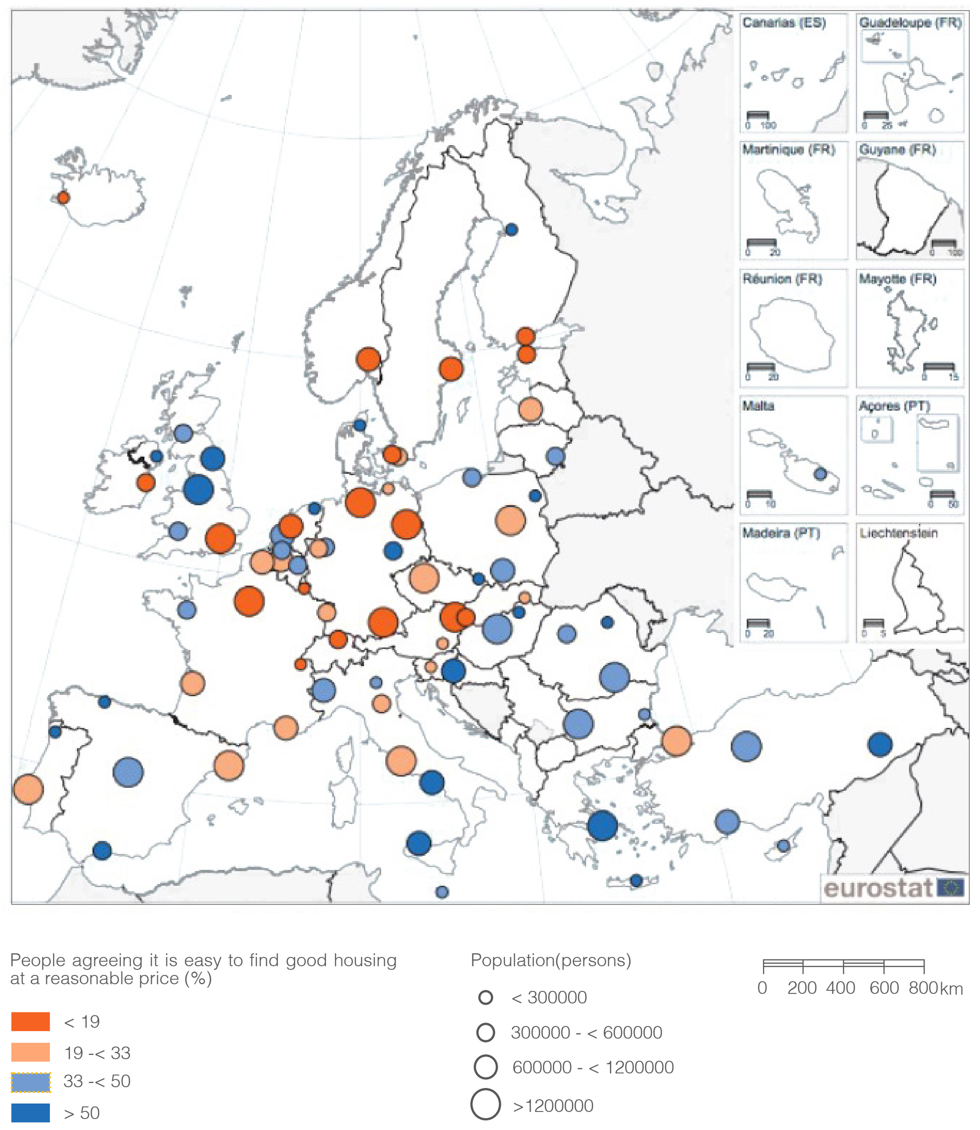
The affordable housing crisis is a new issue that rises in recent years. The causes could be related to the increased of the Gini coefficient, the increase of tourism and short rent business, and the migration of the manufactures caused new poverty and refugee problems. Some of European most in-demand cities have seen sharp increases in housing prices over the past years. It threatens housing affordability as prices are recovering faster than earnings, and the availability of housing is low. Short-term rental platforms cause property prices to spiral and negatively affect local livability.
According to Eurostat's 2015 Urban Europe report, most European big city residents feel that decent housing they can afford is increasingly hard to come by.



Source: A. B. Atkinson, J. Hasell, S. Morelli and M. Roser(2017)- ' The Chartbook of Economic Inequality

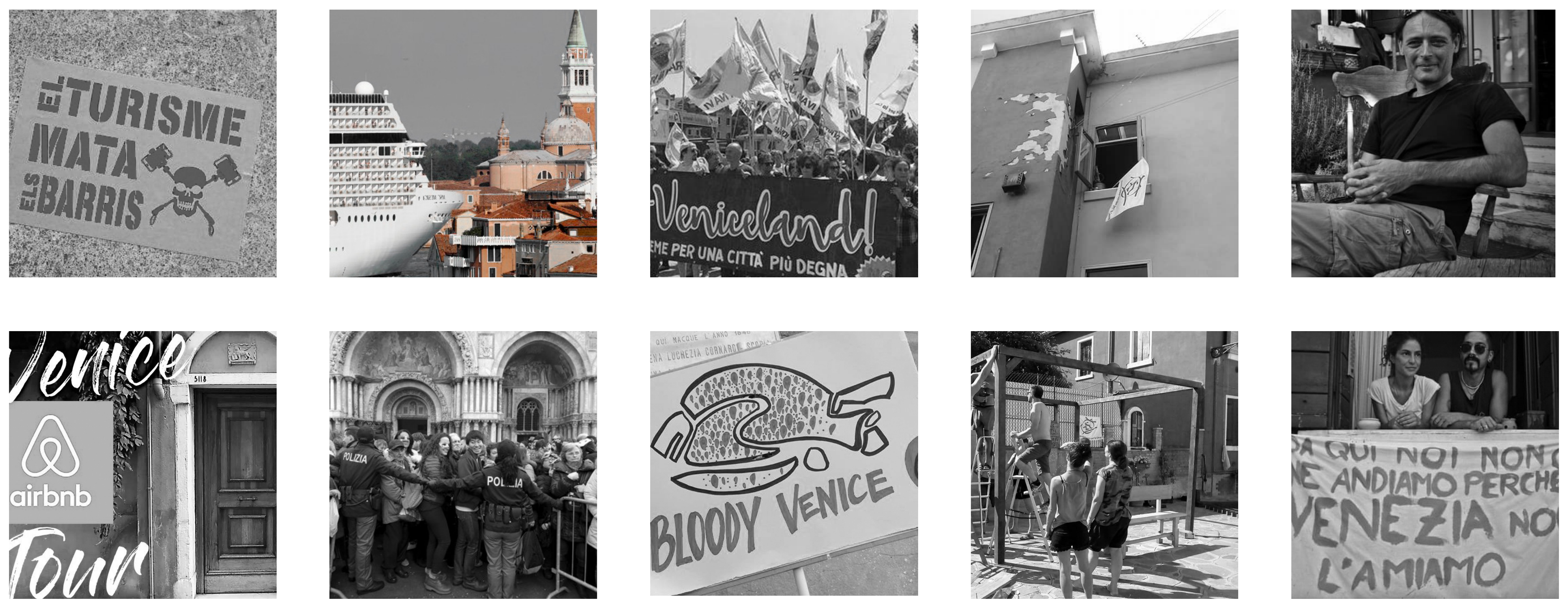


Source: UNWTO Tourism Hightlights 2018, August 2018.

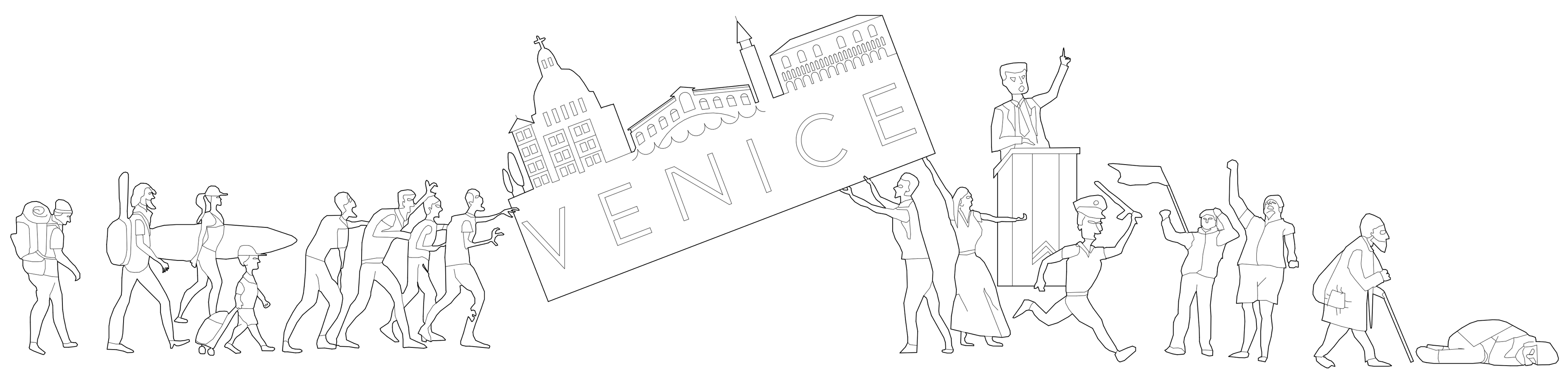


Proportion of people who agreed that it is easy to find good housing at a reasonable price in their cities, 2015. Eurostat.

Problem in Venice



SOCIAL CONTEXT NETWORK

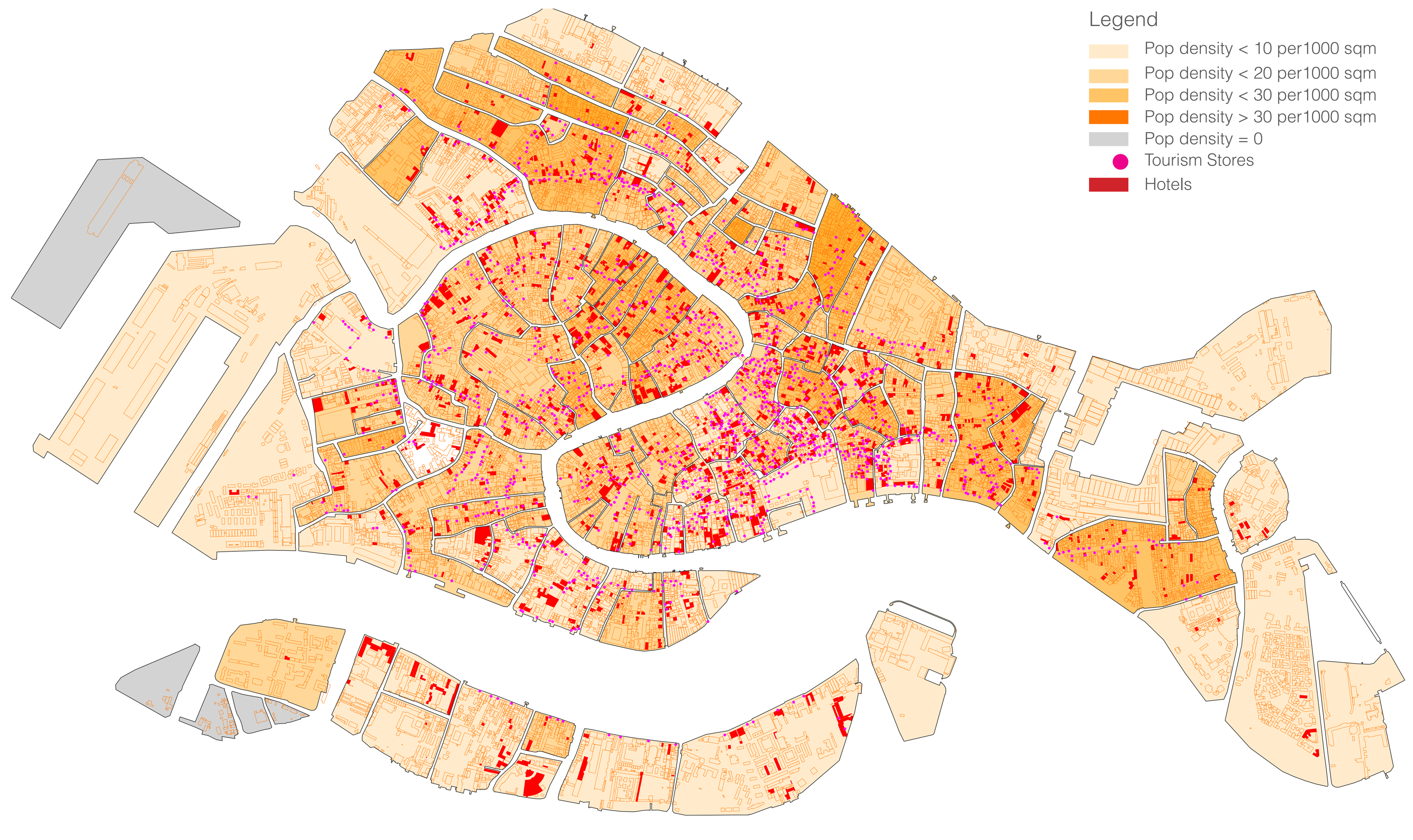


Tourists Increase
135%↑ from 1971-2001

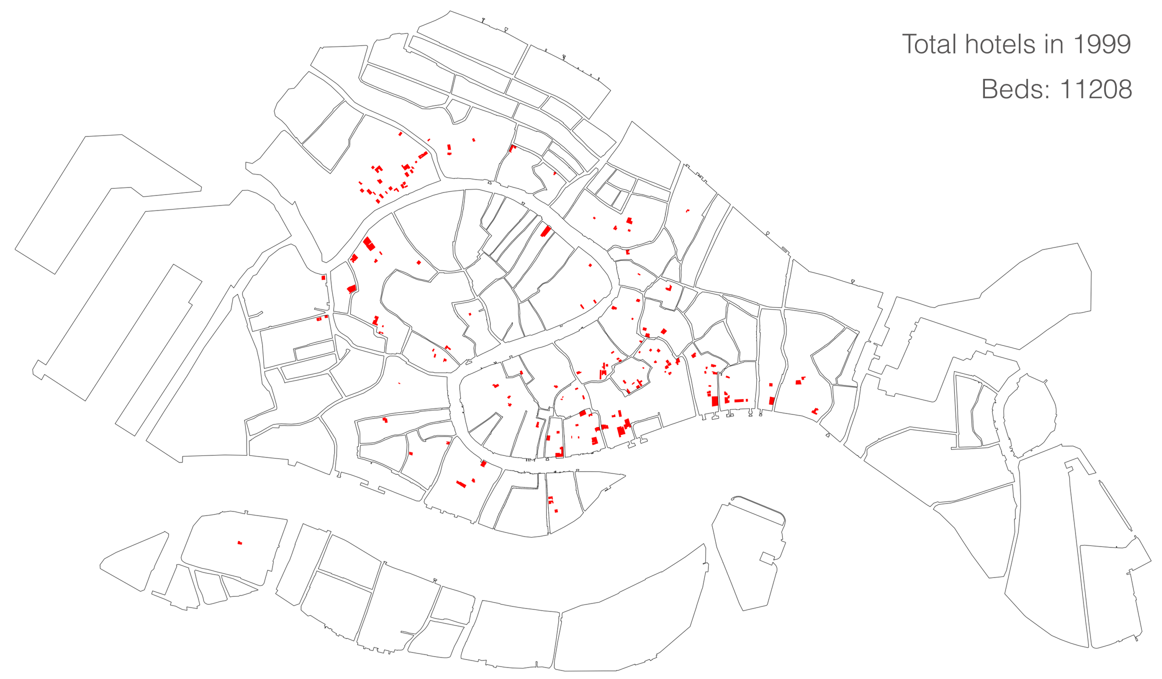
Venetians Decrease
from 1971-2001 45%↓

TOURISM AND POPULATION TRENDS

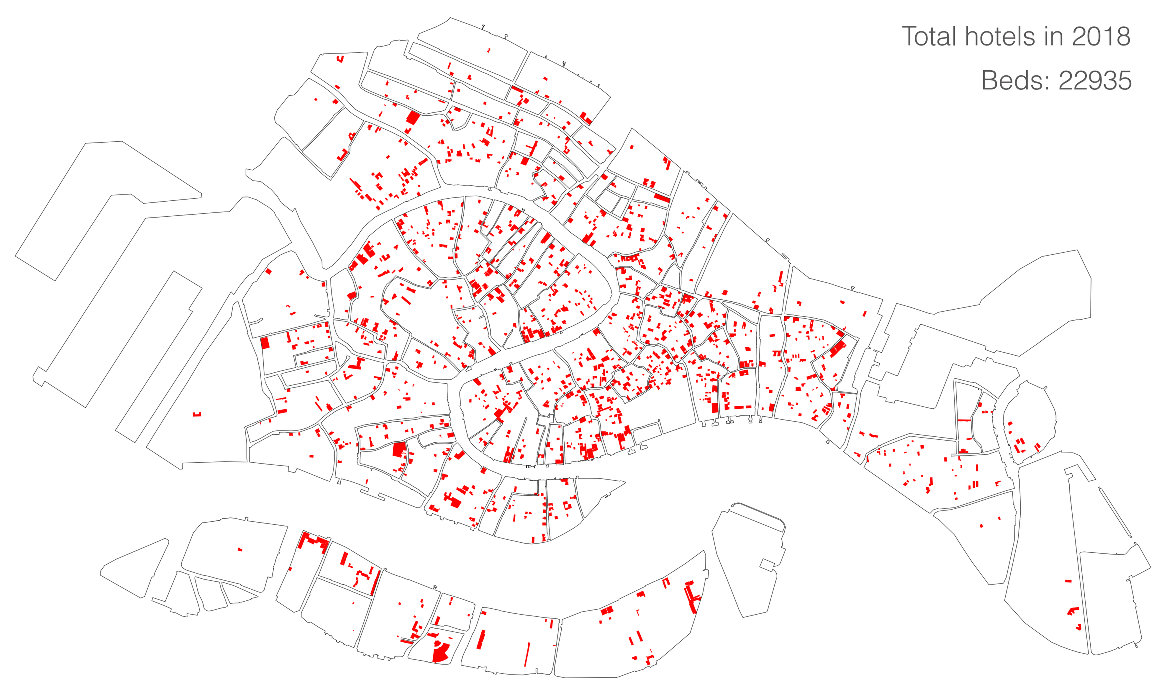
Tourism Influence



TOURISM HEAT MAP



Total hotels in 1999
Beds: 11208



Total hotels in 2018
Beds: 22935

Problem:

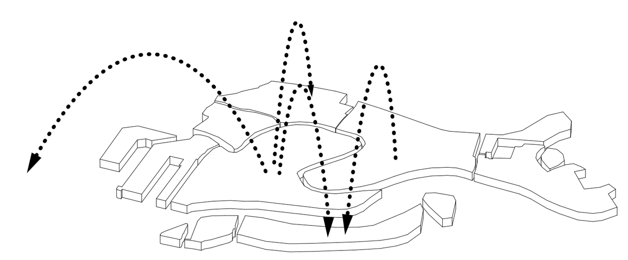
Tourism is causing the lack of affordble house for locals

Members of the grassroots movement Assemblea Sociale per la Casa, including its co-founder, Nicola Ussardi (centre). Photograph: Marta Clinco.

ASC fighting depopulation caused by tourism and high rents, activists are helping Venetians take over abandoned properties.

One of the main problems is landlords renting their apartments to tourists via Airbnb or turning them into hostels and B&Bs. Every year Venice is visited by 20million tourists – and loses about 1,000 residents.

Since 2012, ASC has helped families under threat of losing their homes by either attempting to physically block their eviction orhelping them occupy abandoned houses. Mostly is in in Cannarego and Giudecca.

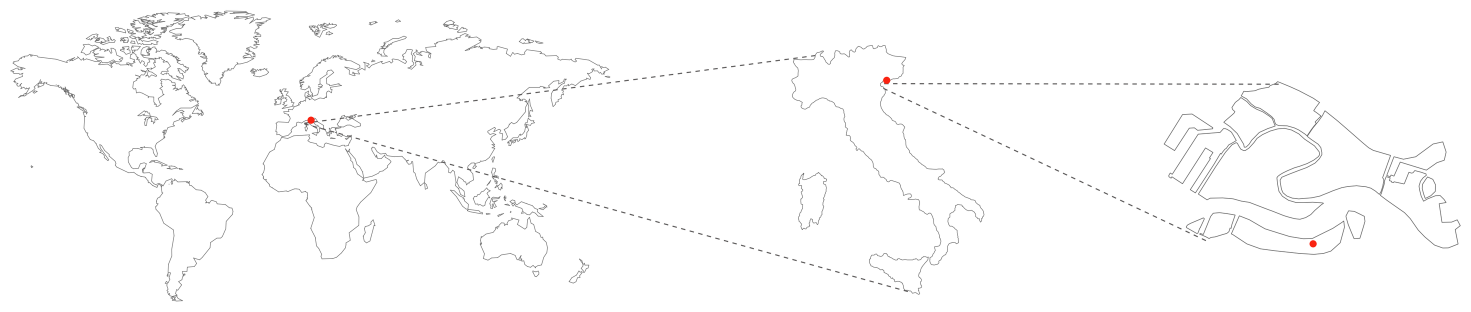


Eviction Direction

STRATEGY:

Convert rooftop to affordable housing and urban farm based in Giudecca Island

LOCATION



We choose Giudecca island as our main location. As the ASC group already active in the island makes it suitable for our aim to help people like ASC. Through modify the existing building roof to provide affordable low cost apartment in venice.
In additon, through design a sustainable living system to nuture local neighborhood to help saving venice.

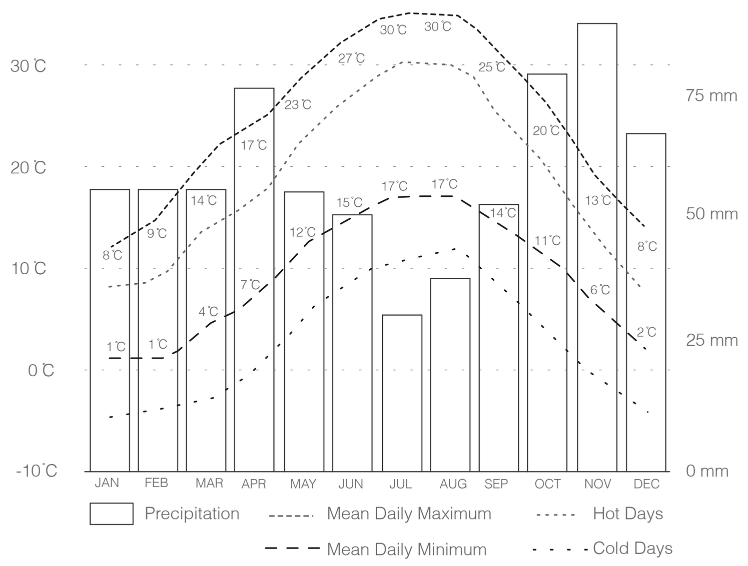
CLIMATE ANALYSIS

SUB-MEDITERRANEAN (Cfa: Humid subtropical)

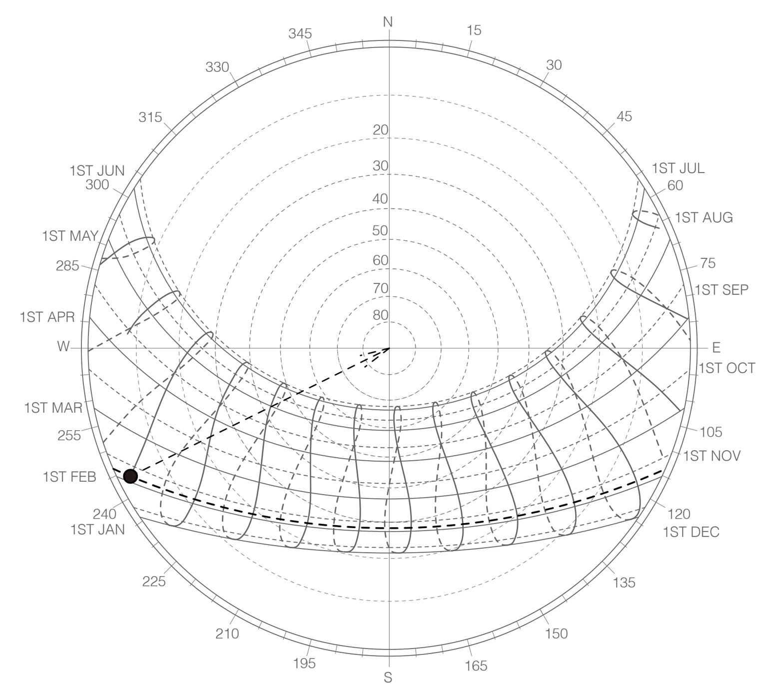
MEDITERRANEAN CLIMATE AREA

CLIMATE DATA

WIND DIRECTION DISTRIBUTION IN %

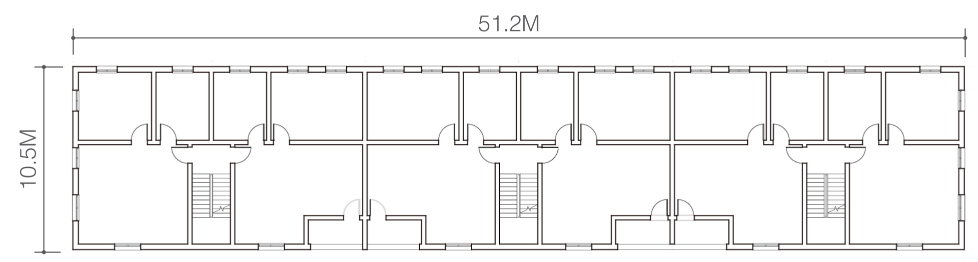


TEMPERATURE AND PRECIPITATION



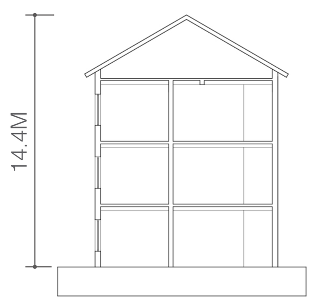
ANNUAL SUN PATH

SELECTED NEIGHBORHOOD



Plan of the selected building

The selected neighborhood is in the eastern part of Giudecca Islan,called Galle Ramo Gran, consisted by 14 buildings with mainly 3 floors, and were built around 80-90s by estimating. residents.



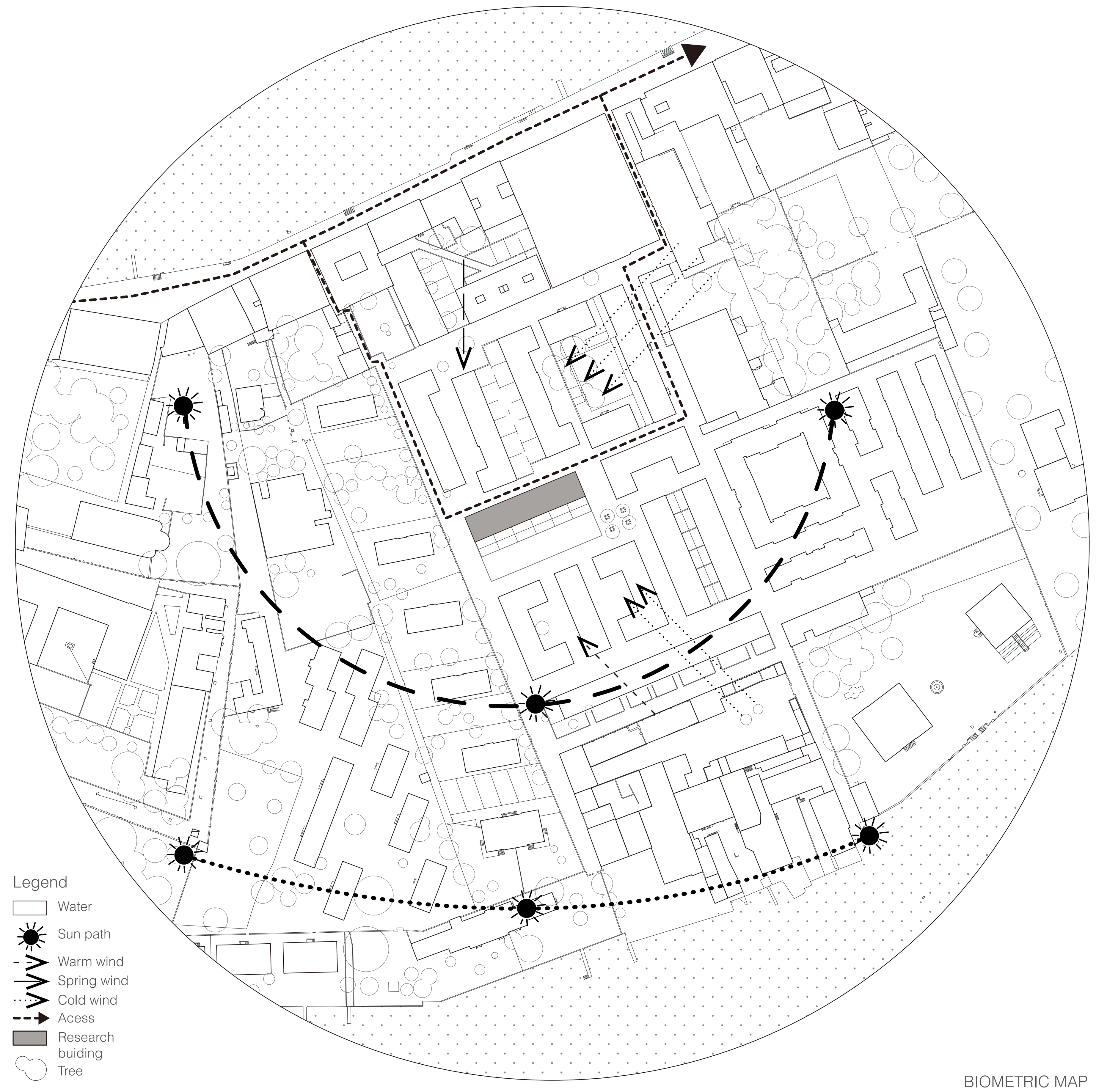
THE SELETED NEUGHBORHOOD

BUILDING FUNCTION ON GIUDECCA

Lengend

- Tourism hotels
- Local Residence
- Public Service
- Sport Service
- Small hotels
- Ship Factory
- Industrial
- Commercial
- Church
- Education

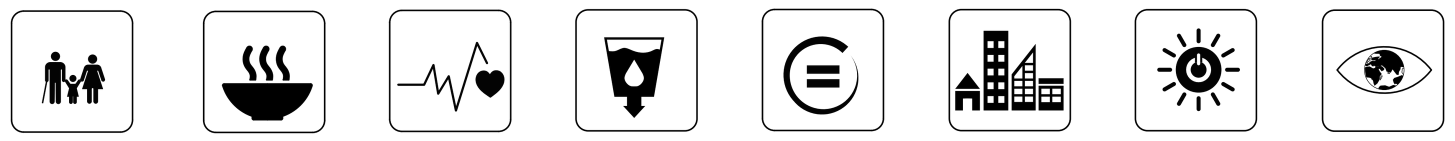
NEIGHBORHOOD SUITABLE FOR PROPASAL



BIOMETRIC MAP

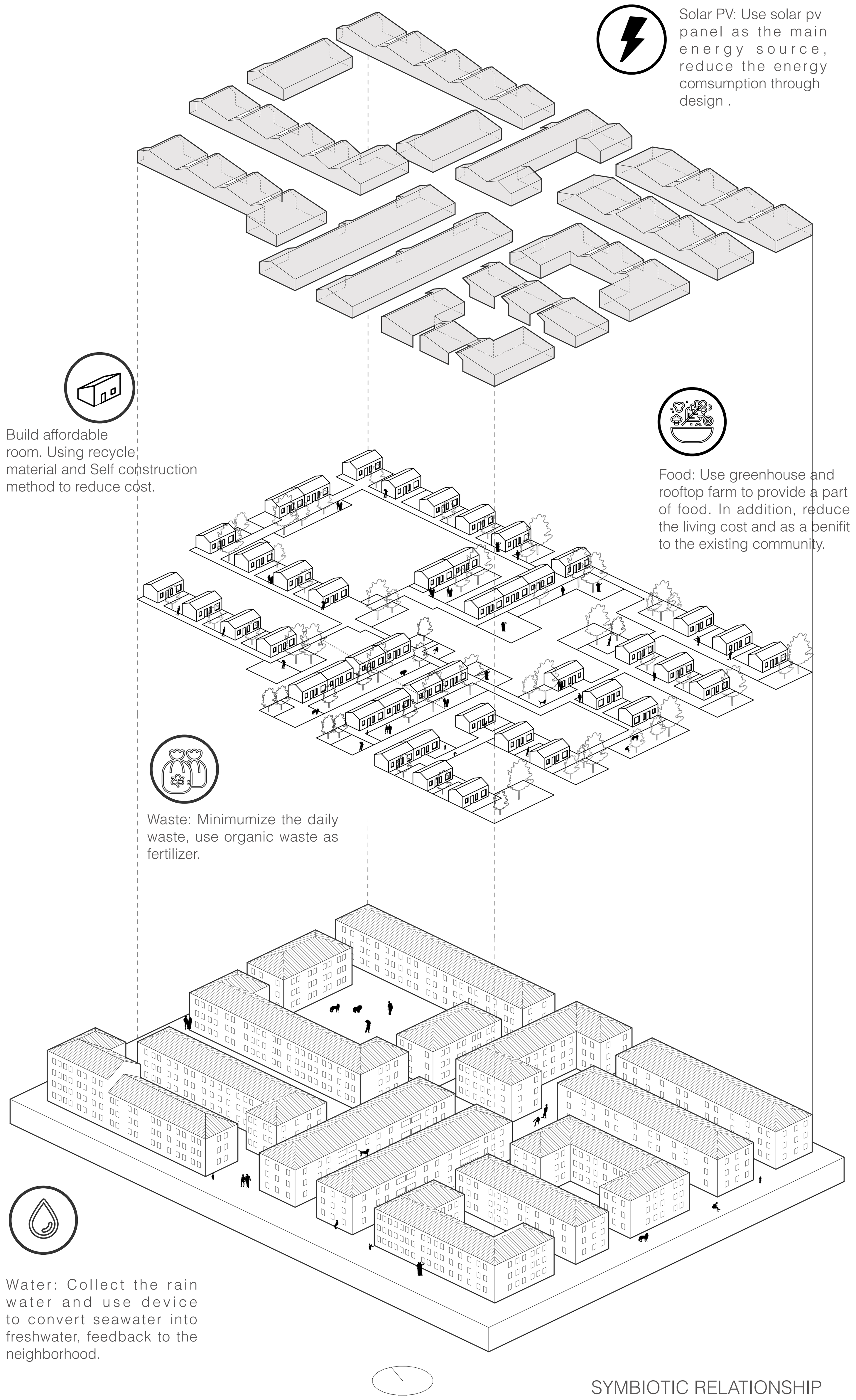
STRATEGY:

Convert rooftop to affordable housing and urban farm based in Giudecca Island

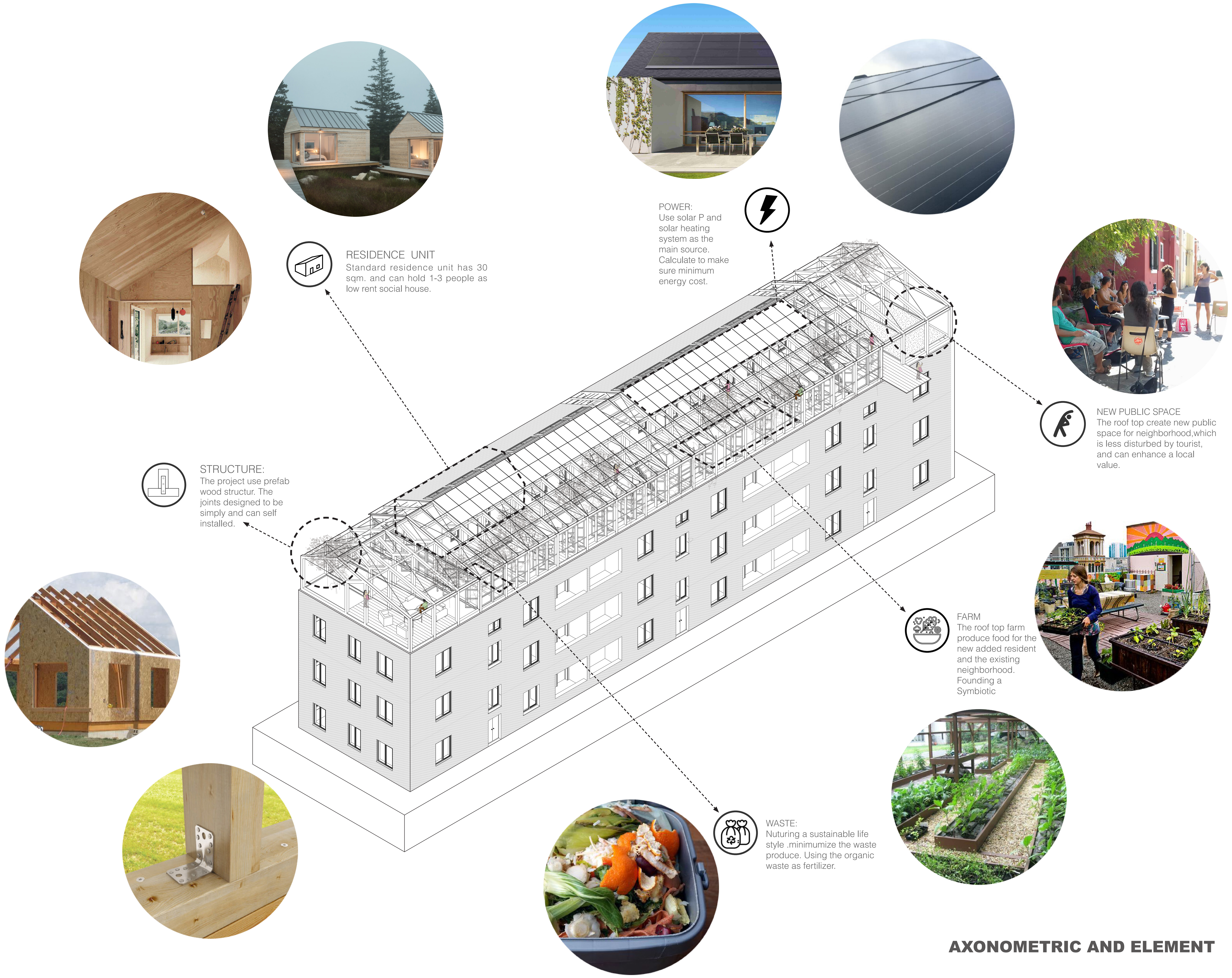


THE PROJECT PROVIDE:

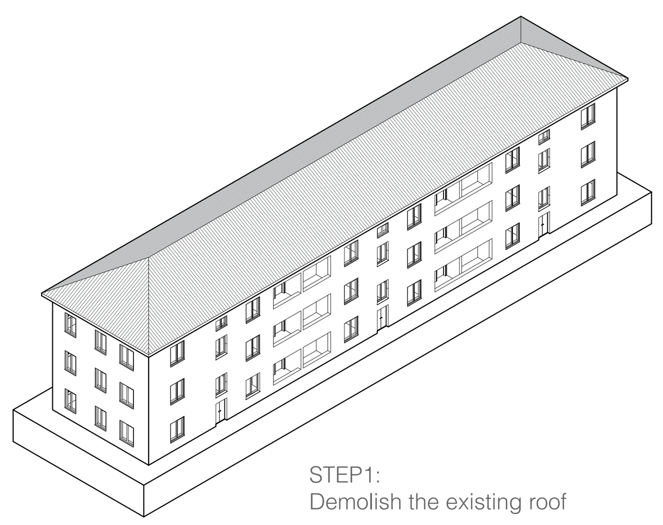
- Farm: 1950 m²
- Social house: 45 uints/ 33 m²
- Public Space: 310 m²
- Landscape: 600 m²



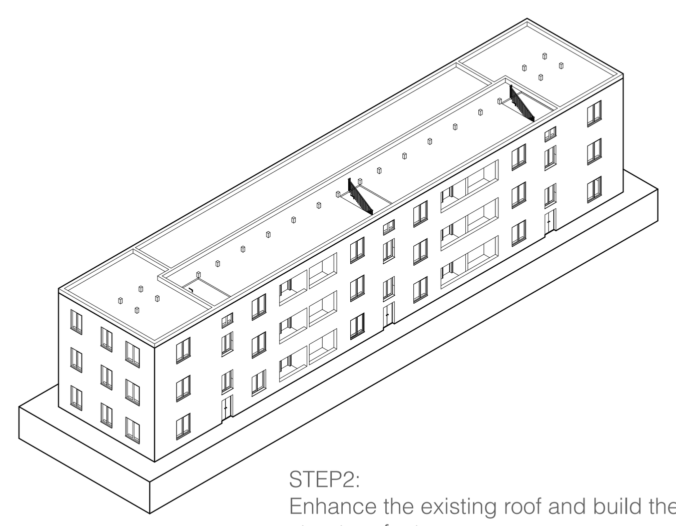
SYMBIOTIC RELATIONSHIP



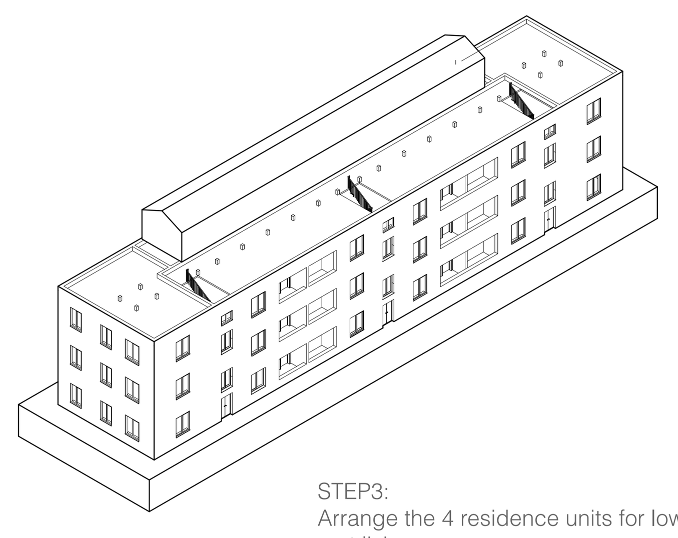
AXONOMETRIC AND ELEMENT



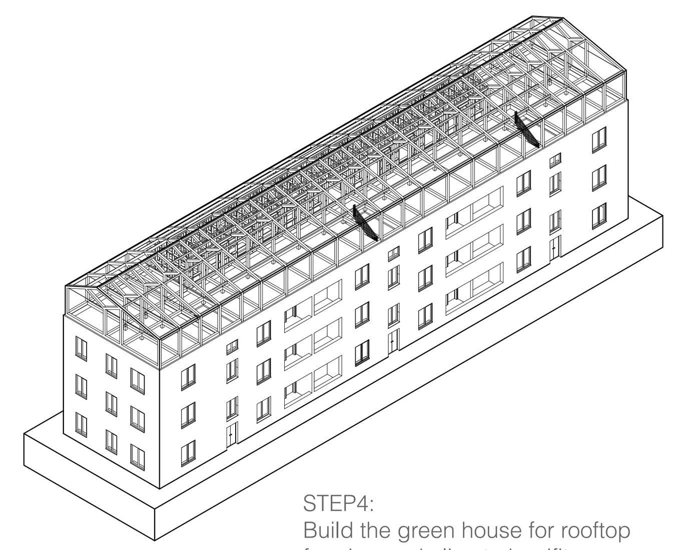
STEP1:
Demolish the existing roof



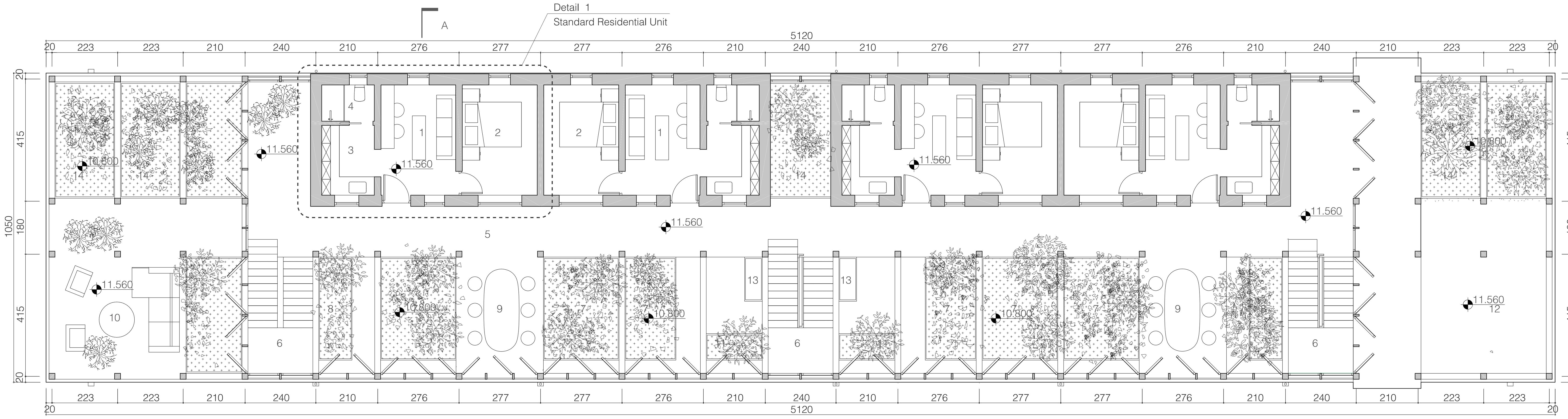
STEP2:
Enhance the existing roof and build the structure foot



STEP3:
Arrange the 4 residence units for low rent living.

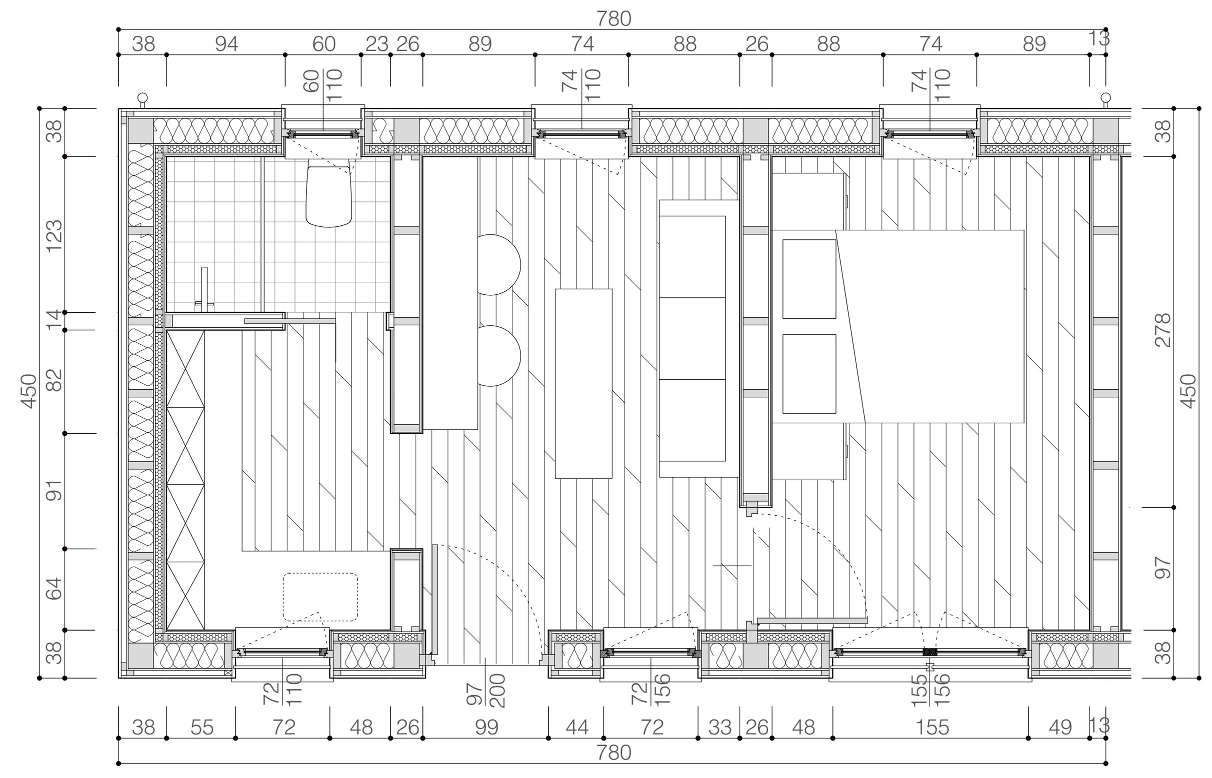


STEP4:
Build the green house for rooftop farming and climate benifit.

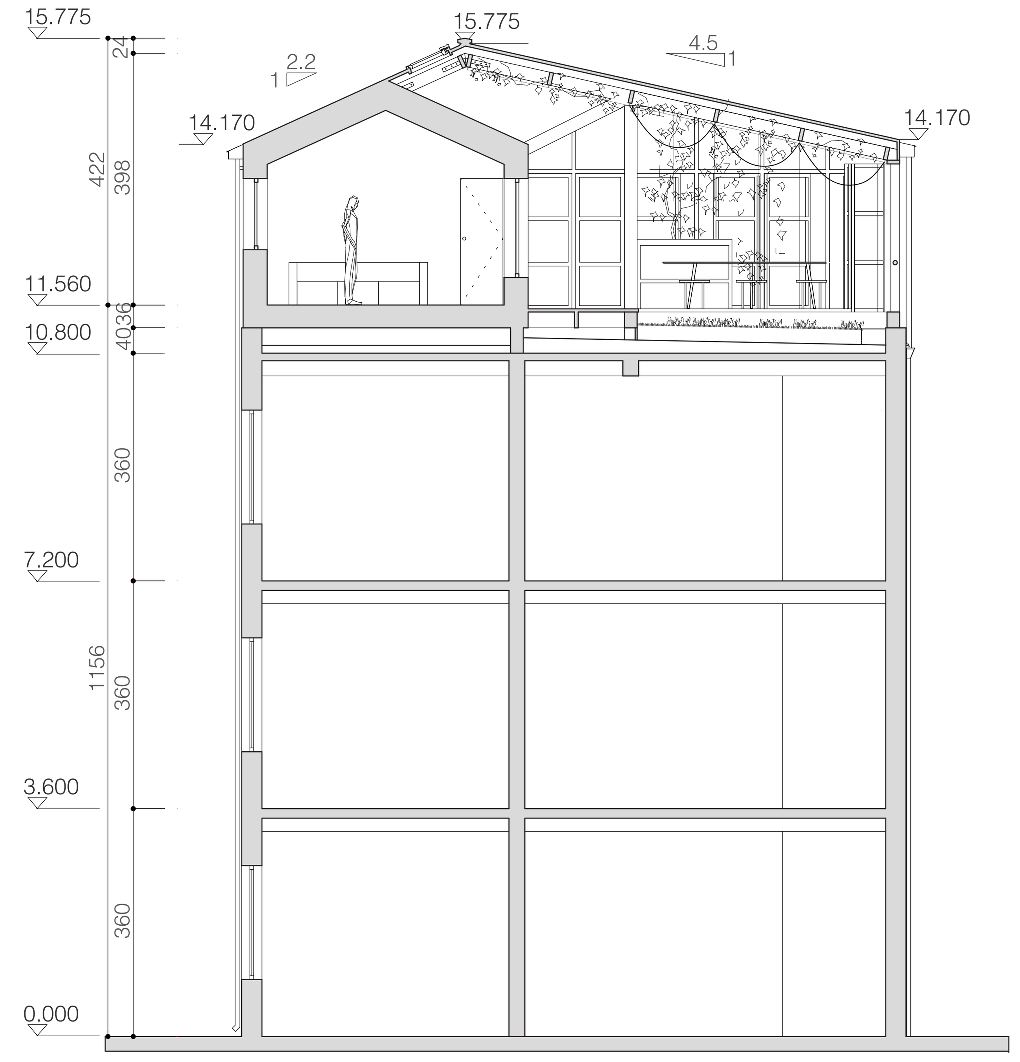


1. Living room
2. Bedroom
3. Kitchen
4. Restroom
5. Porch
6. Existing stair
7. Farming box
8. Waste Treatment
9. Garden dinner table
10. Outdoor public space
11. Rain collector
12. Playground
13. Tool box
14. Landscape

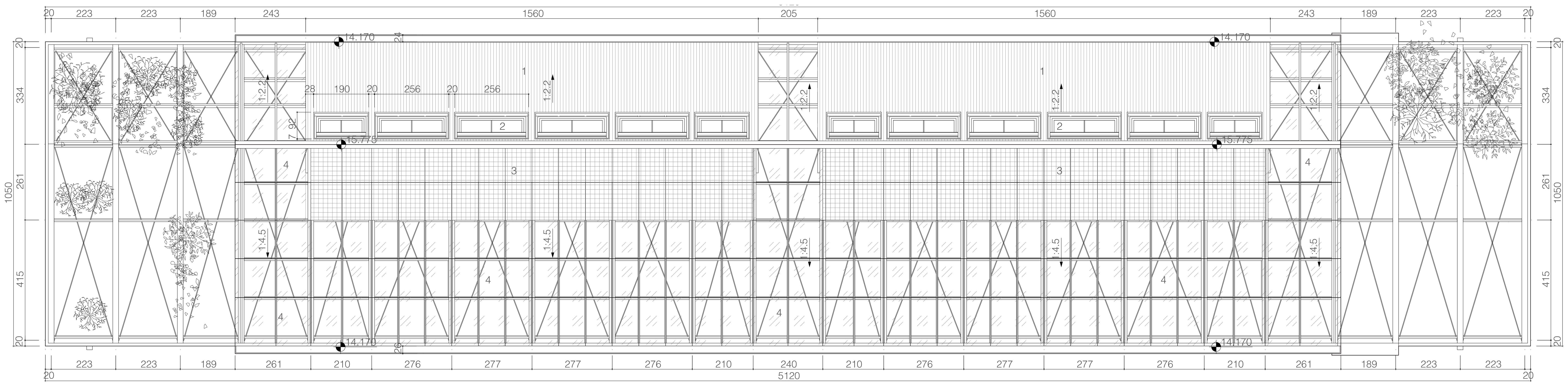
PLAN ROOF+1,2M 1:100



DETAIL 1 RESIDENCE UNIT PLAN 1:50



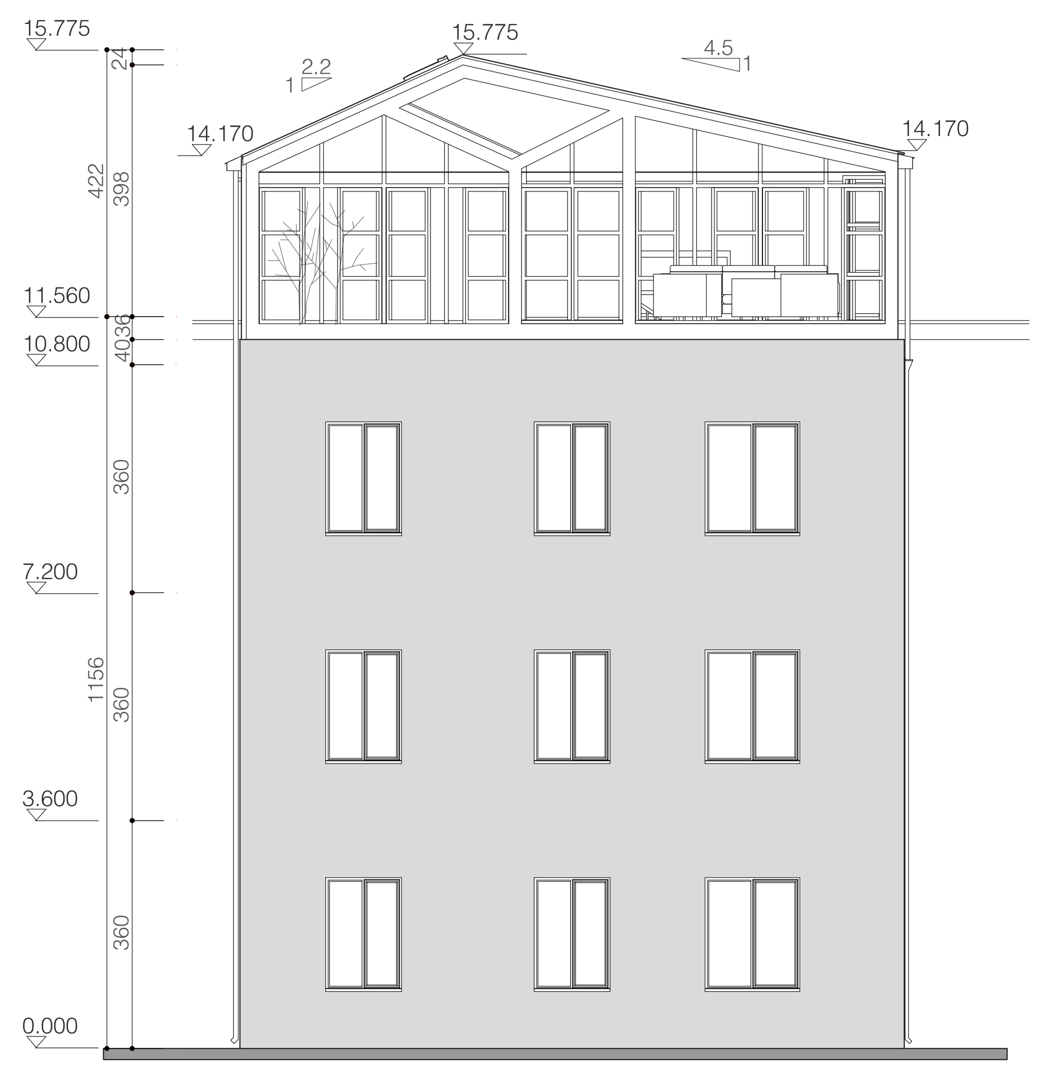
SECTION A-A 1:100



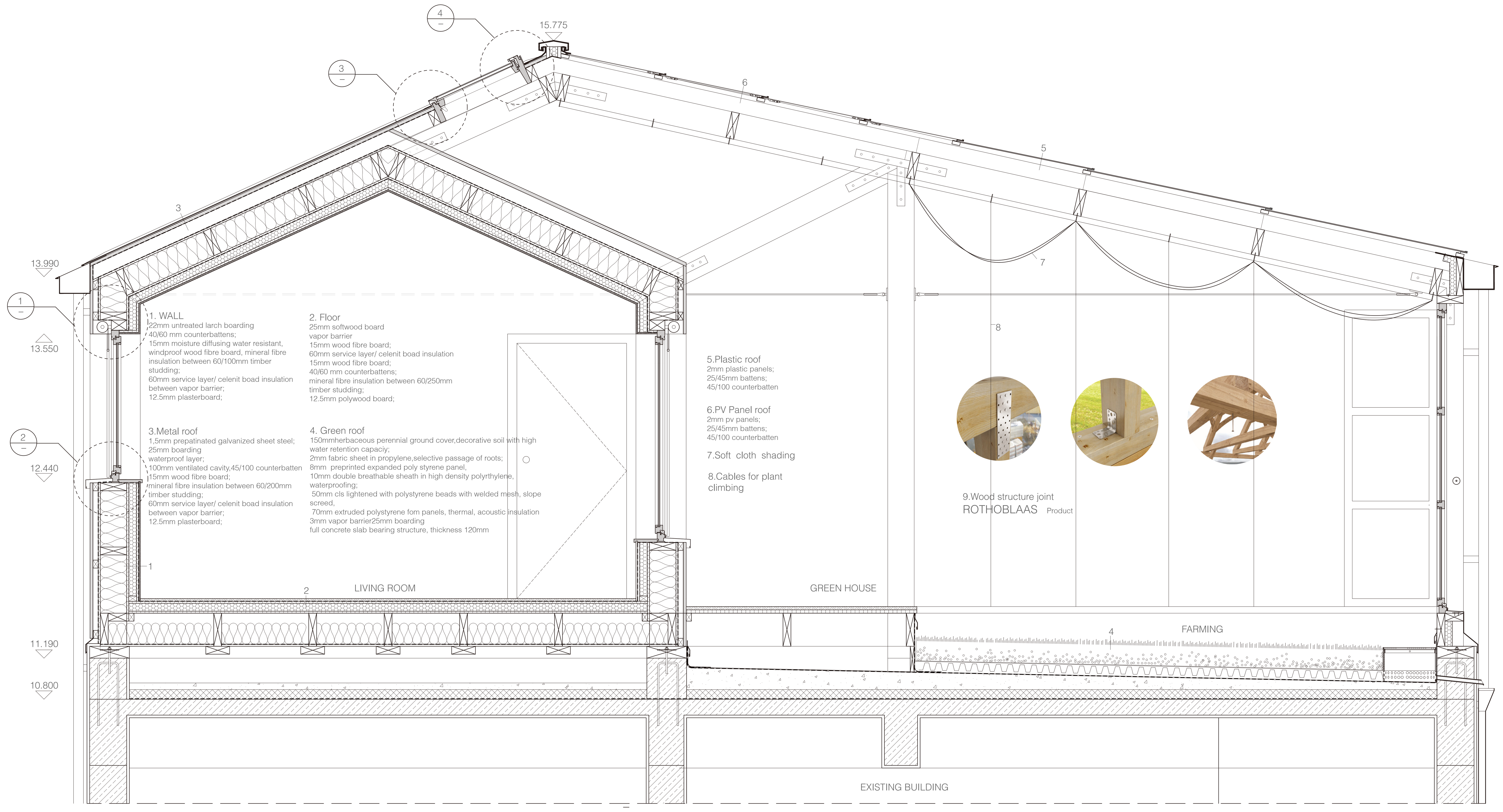
1. Metal roof
2. Skylight
3. PV
4. Plastic roof

PLAN ROOF+2.4M 1:100

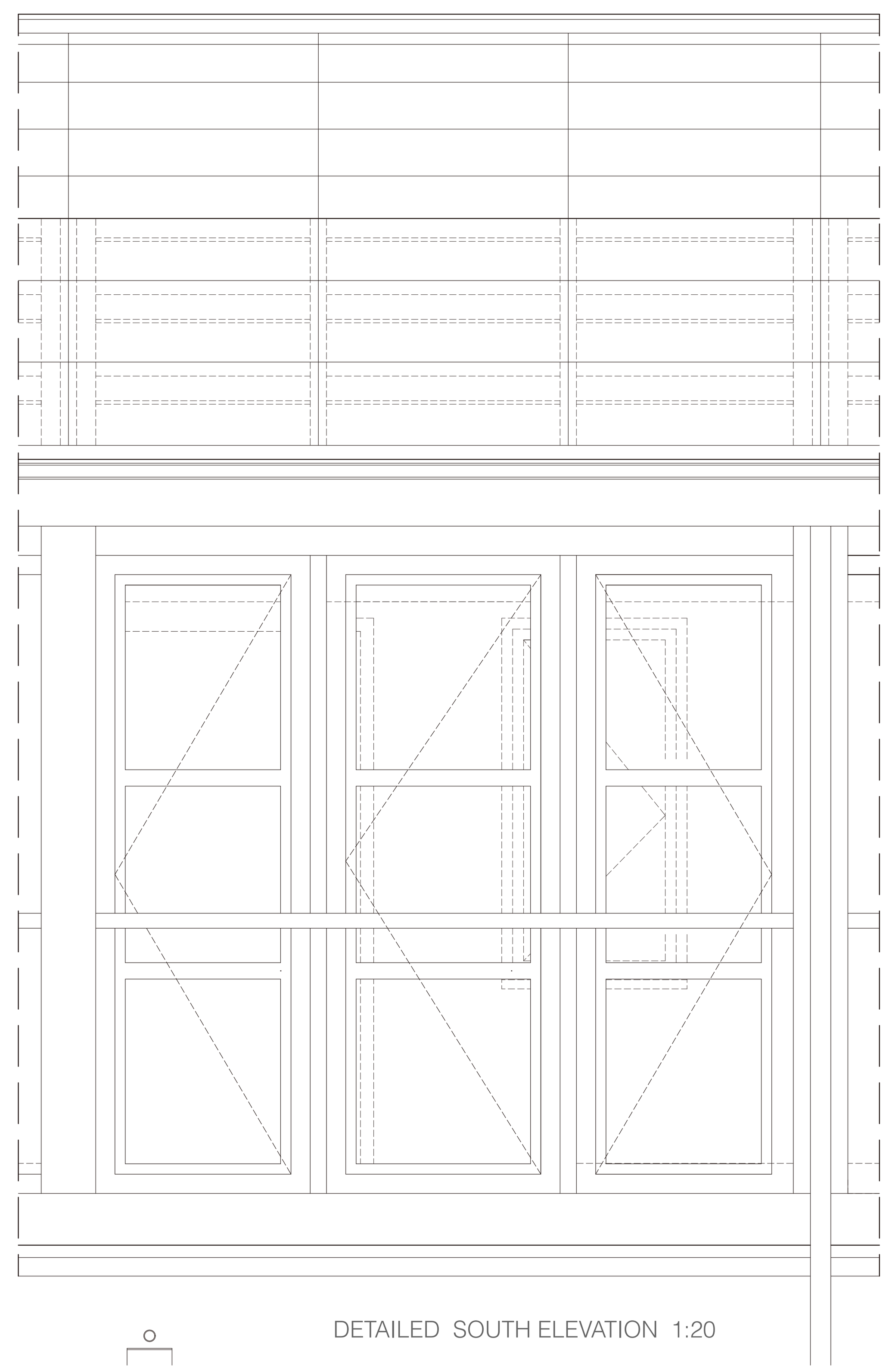
SOUTH ELEVATION 1:100



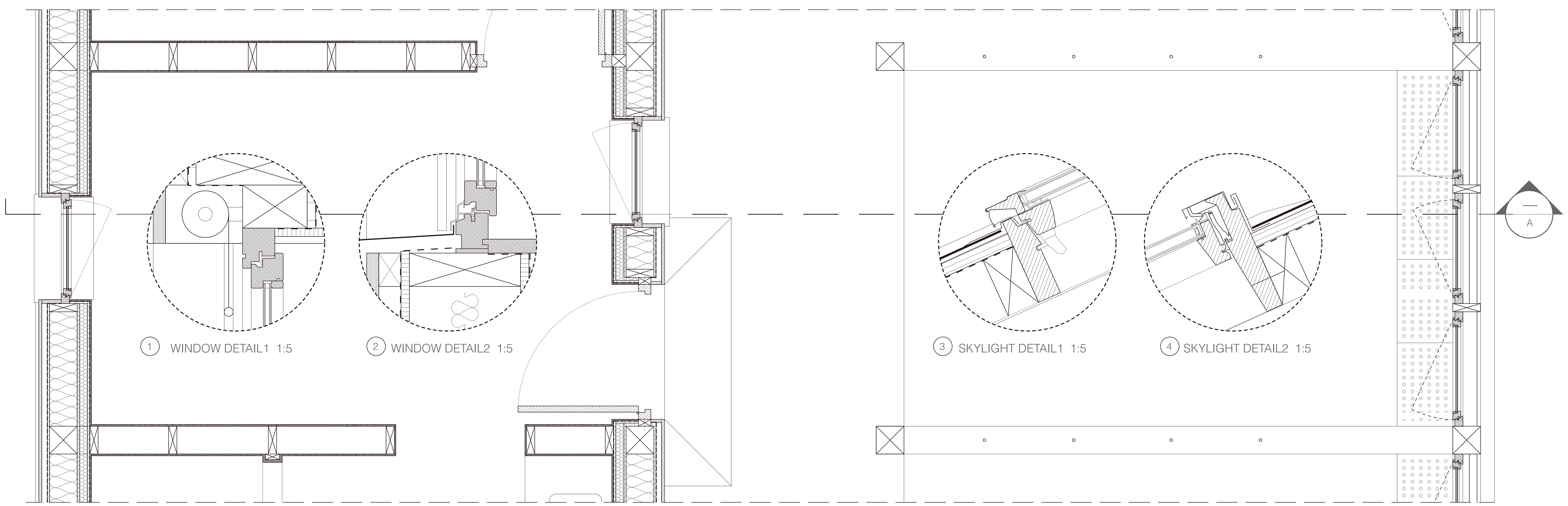
WEST ELEVATION 1:100



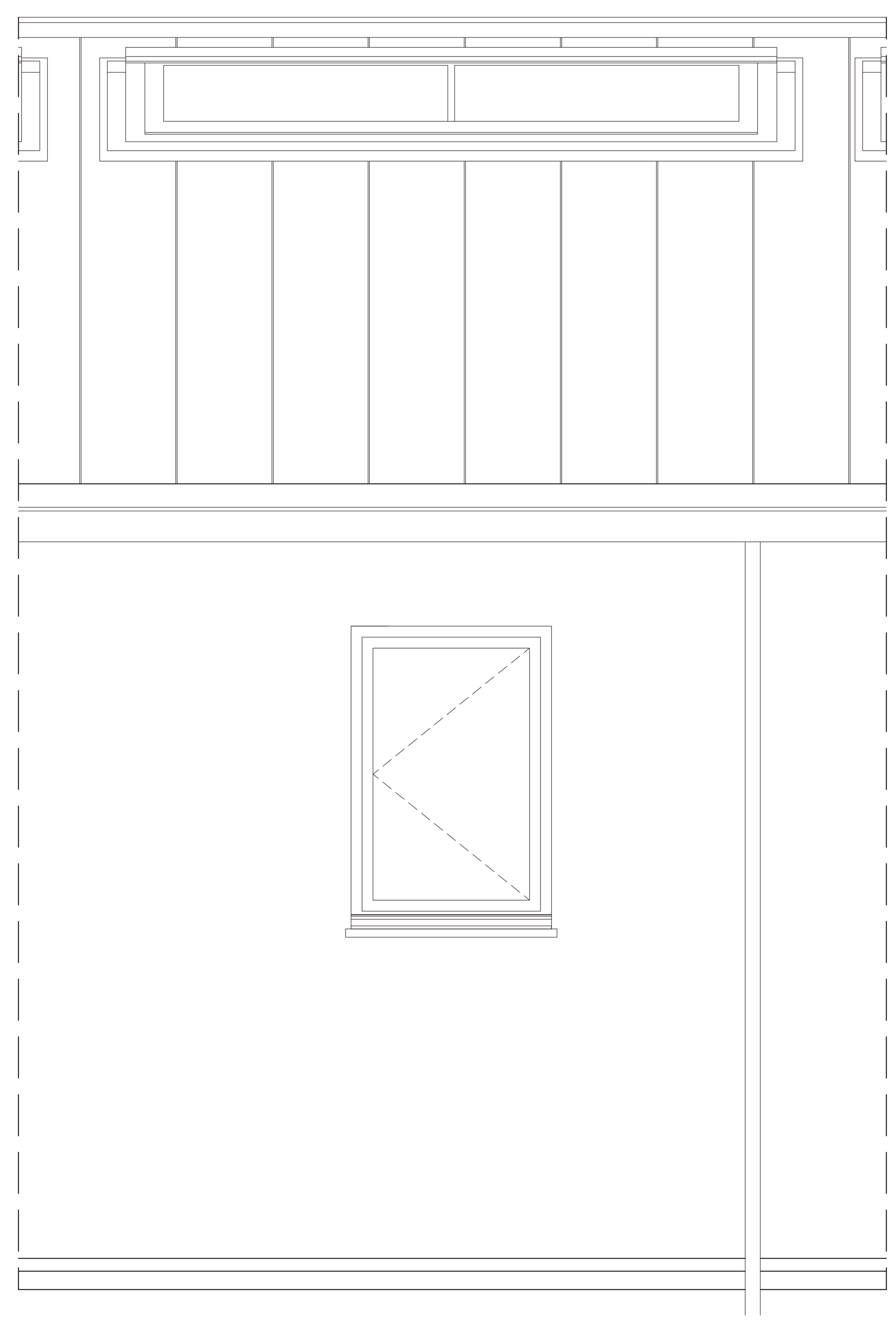
DETAILED A- A SECTION 1:20



DETAILED SOUTH ELEVATION 1:20

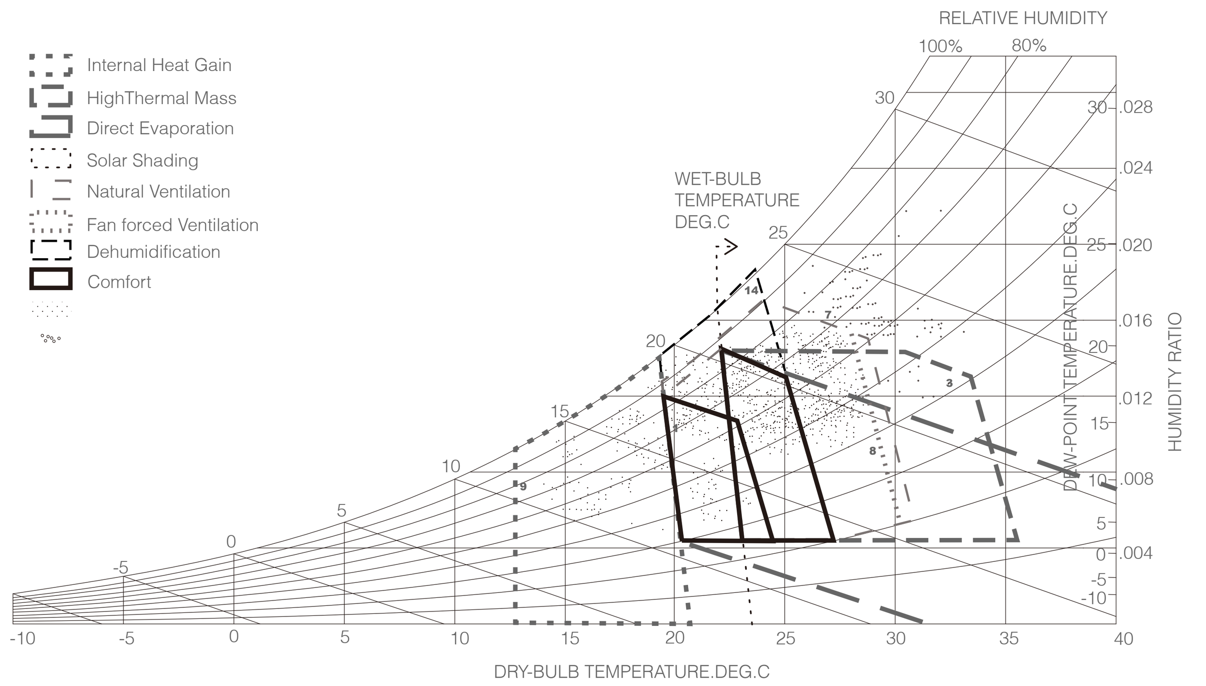


DETAILED PLAN 1:20



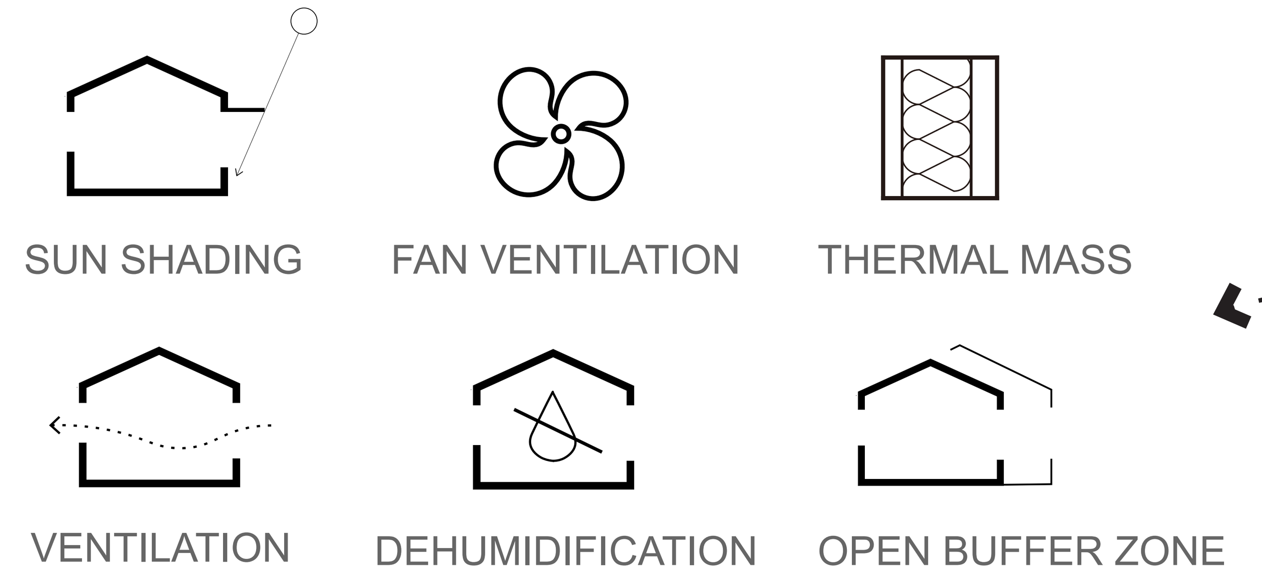
DETAILED NORTH ELEVATION 1:20

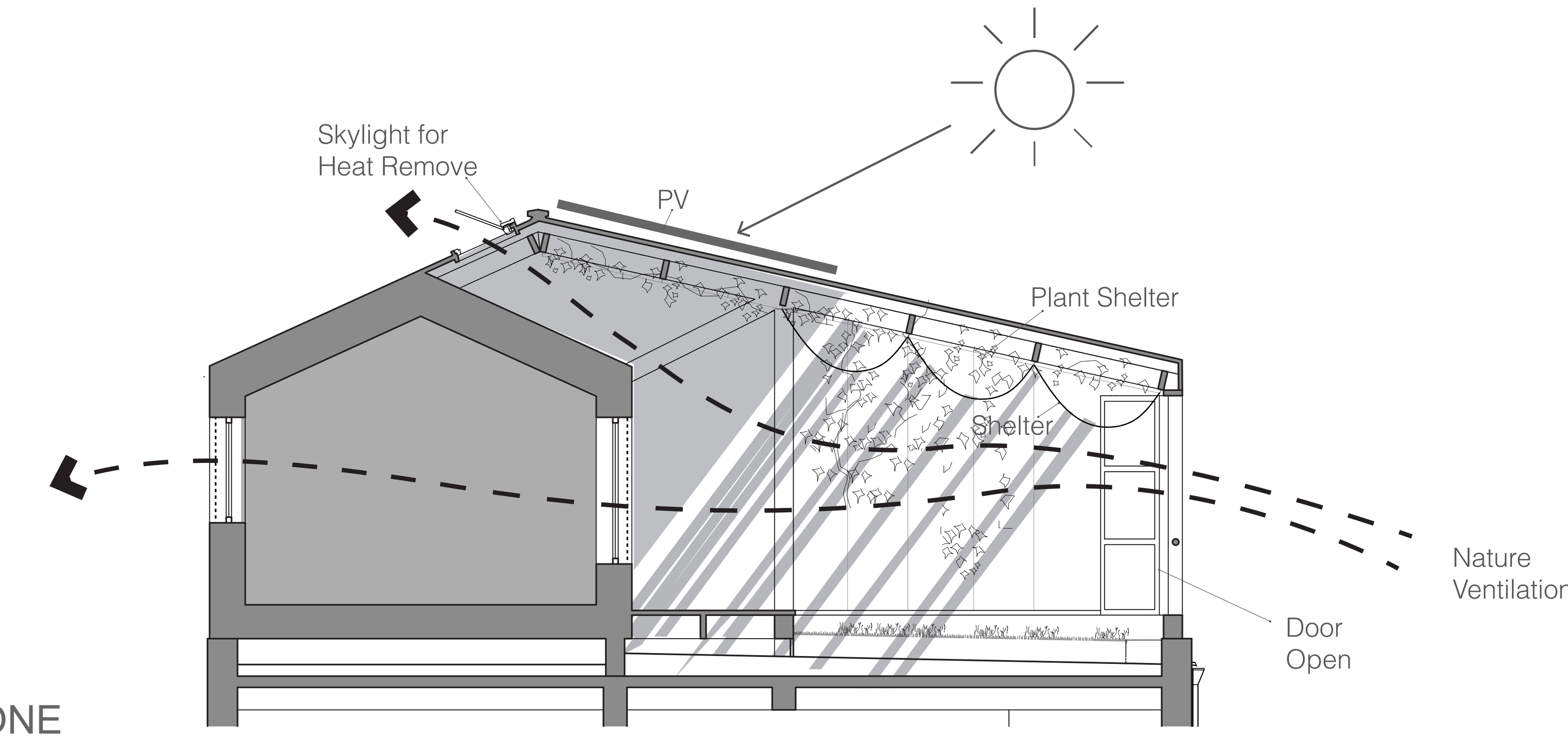
SUMMER DAY: 6AM- 6PM JUN-AUG



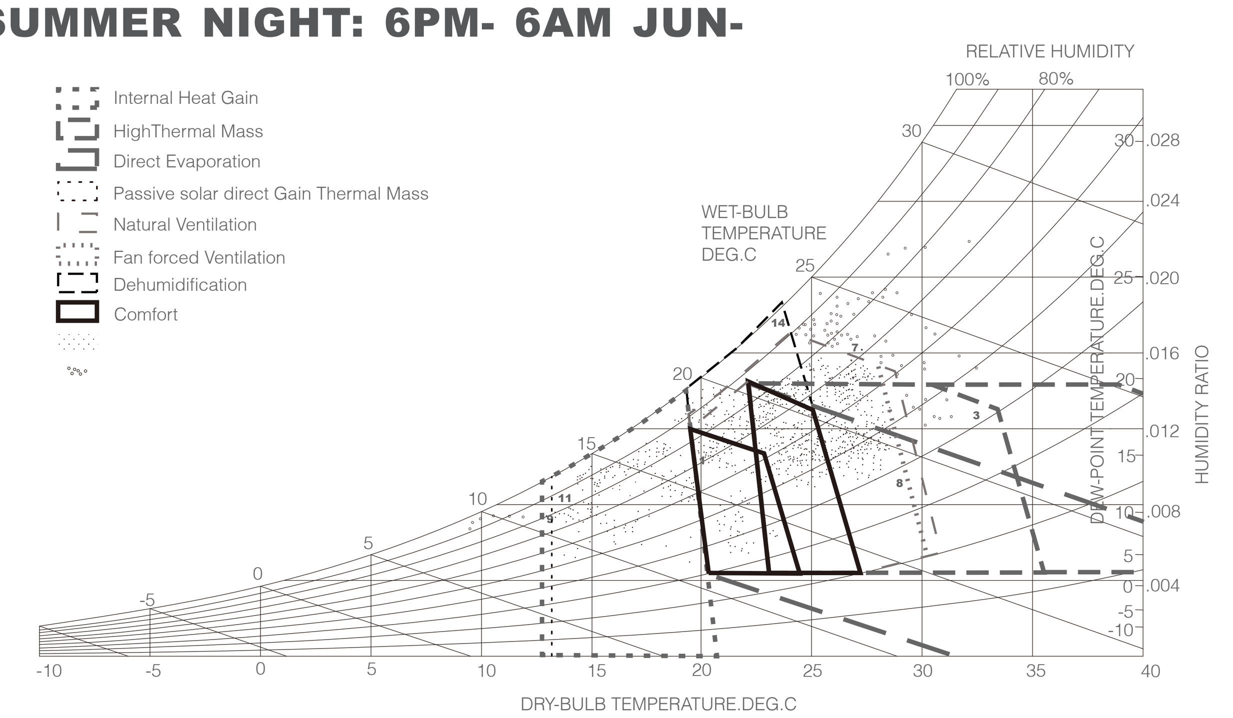
34.6% 1 Comfort (414 hrs)
50.3% 2 Sun Shading of Windows(602 hrs)
14.7% 3 High Thermal Mass (176hrs)
19.3% 4 High Thermal Mass Night Flushed (231 hrs)
13.0% 5 Direct Evaporative Cooling (155 hrs)
17.1% 6 Two- Stage Evaporative Cooling (204 hrs)
20.6% 7 Natural Ventilation Cooling (246 hrs)
38.2% 8 Fan- Forced Ventilation Cooling (457 hrs)
9 Internal Heat Gain (0 hrs)
10 Passive Solar Direct Gain Low Mass(0 hrs)
11 Passive Solar Direct Gain High Mass(0 hrs)
12 Wind Protection of Outdoor Spaces (0 hrs)
13 Humidification Only (0 hrs)
10.5% 14 Dehunidification Only (125 hrs)
15 Cooling,and Dehumidification if needed(0 hrs)
16 Heating,add Humidification if needed (0 hrs)

76.2% Comfortable hrs using selected strategies (911 out of 1196 hrs)



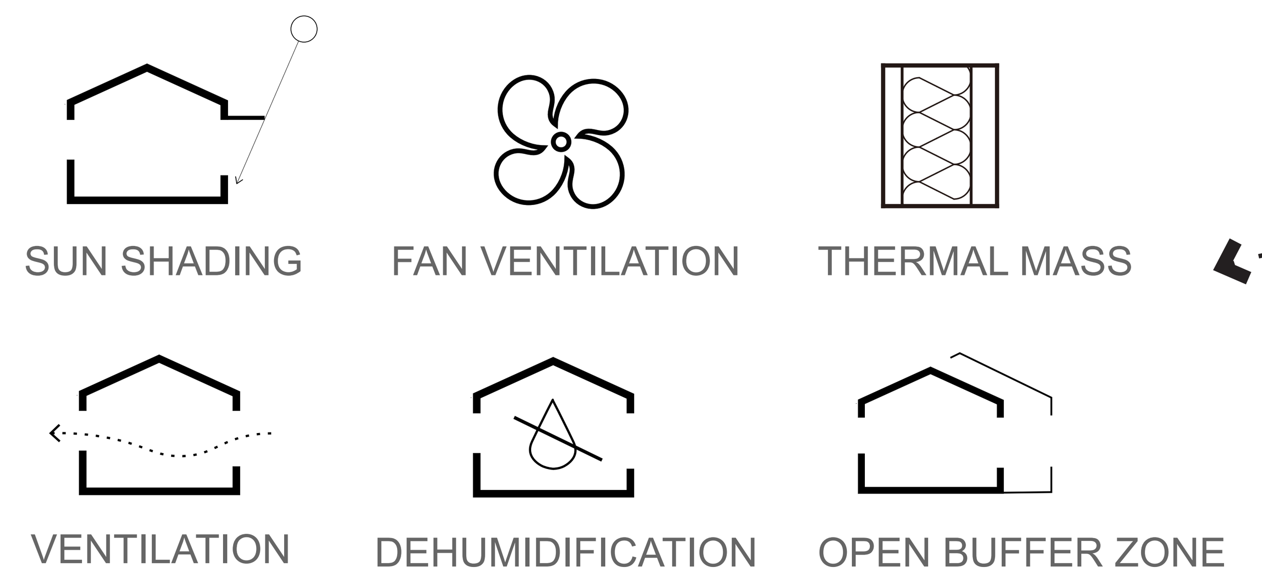


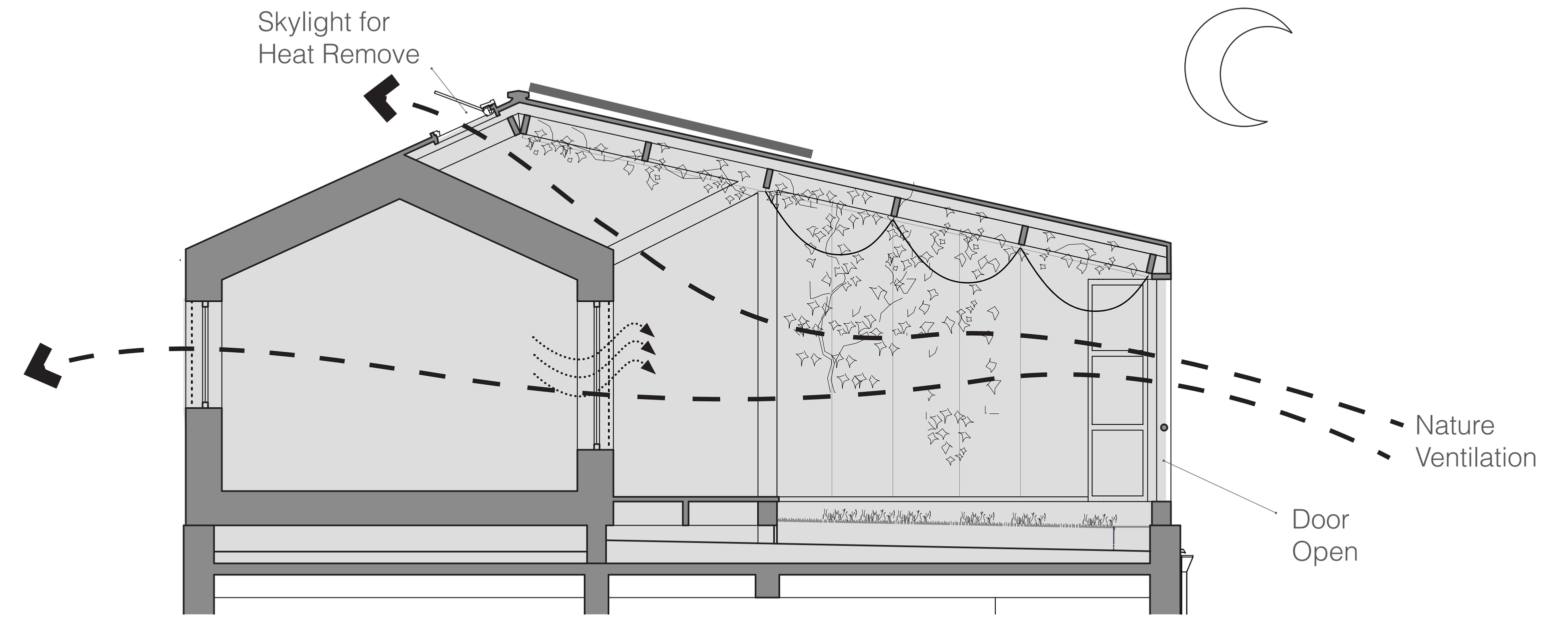
SUMMER NIGHT: 6PM- 6AM JUN-



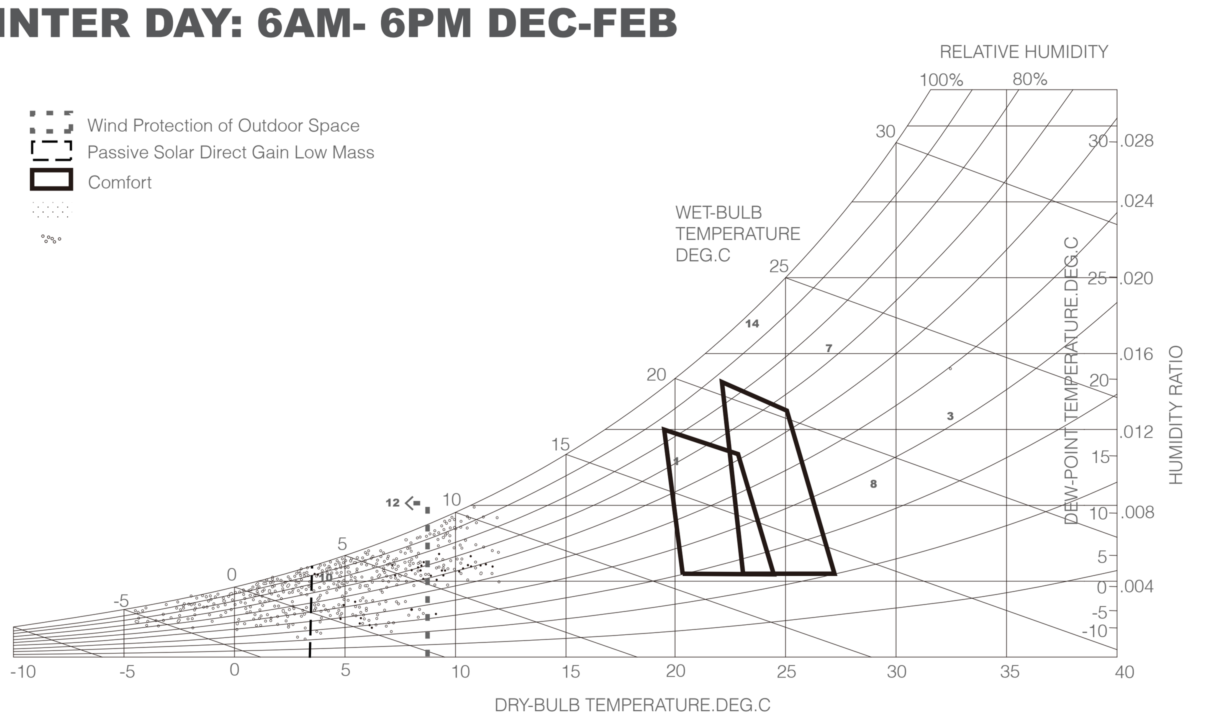
31.9% 1 Comfort (382 hrs)
2 Sun Shading of Windows(0 hrs)
2.3% 3 High Thermal Mass (28hrs)
4.2% 4 High Thermal Mass Night Flushed (50 hrs)
3.7% 5 Direct Evaporative Cooling (44 hrs)
5.1% 6 Two- Stage Evaporative Cooling (61 hrs)
22.2% 7 Natural Ventilation Cooling (265 hrs)
31.4% 8 Fan- Forced Ventilation Cooling (375 hrs)
9 Internal Heat Gain (0 hrs)
10 Passive Solar Direct Gain Low Mass(0 hrs)
11 Passive Solar Direct Gain High Mass(0 hrs)
12 Wind Protection of Outdoor Spaces (0 hrs)
13 Humidification Only (0 hrs)
25.4% 14 Dehunidification Only (304 hrs)
15 Cooling,and Dehumidification if needed(0 hrs)
16 Heating,add Humidification if needed (0 hrs)

69.9% Comfortable hrs using selected strategies (836 out of 1196 hrs)



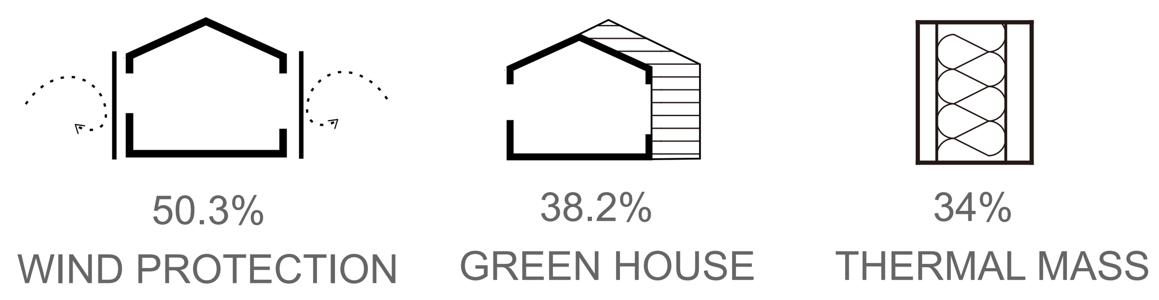


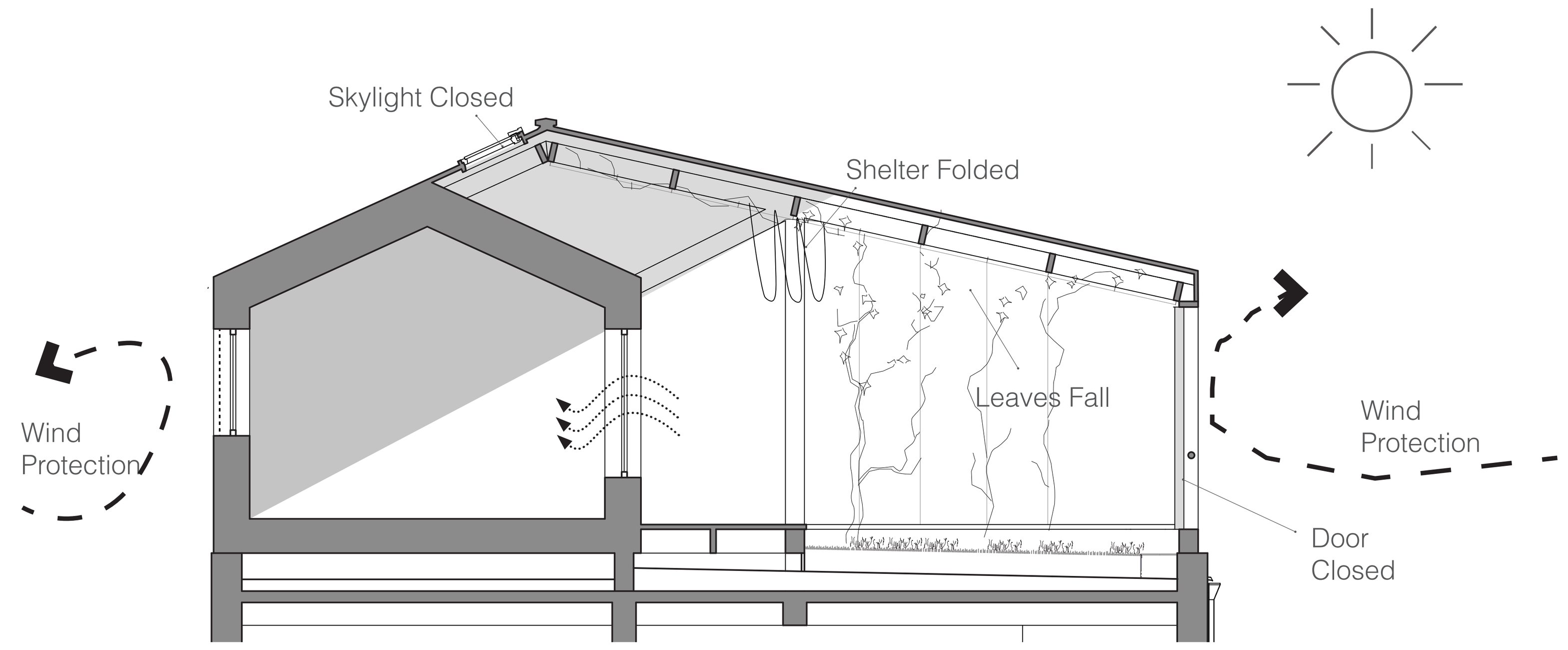
WINTER DAY: 6AM- 6PM DEC-FEB



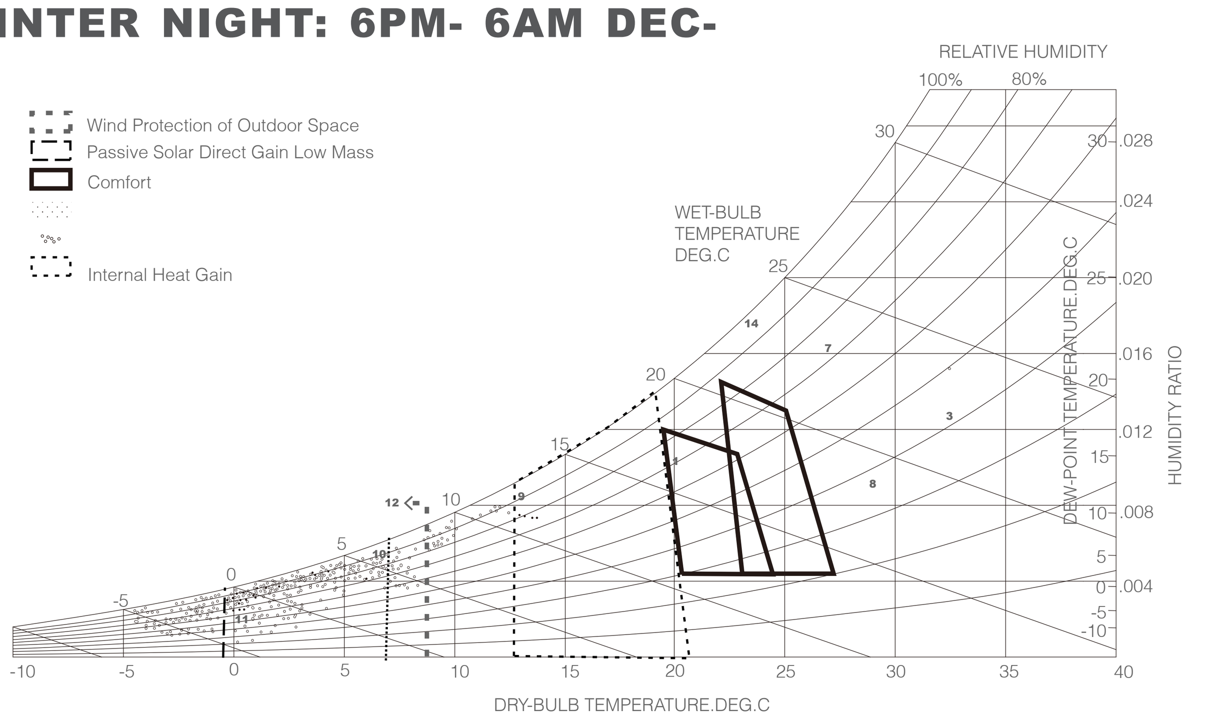
0.0% 1 Comfort (0 hrs)
2 Sun Shading of Windows(0 hrs)
3 High Thermal Mass (0hrs)
4 High Thermal Mass Night Flushed (0 hrs)
5 Direct Evaporative Cooling (0 hrs)
6 Two- Stage Evaporative Cooling (0 hrs)
7 Natural Ventilation Cooling (0 hrs)
8 Fan- Forced Ventilation Cooling (0 hrs)
0.8% 9 Internal Heat Gain (13 hrs)
3.3% 10 Passive Solar Direct Gain Low Mass(39 hrs)
11 Passive Solar Direct Gain High Mass(20 hrs)
2.1% 12 Wind Protection of Outdoor Spaces (24 hrs)
13 Humidification Only (0 hrs)
14 Dehunidification Only (0 hrs)
15 Cooling,and Dehumidification if needed(0 hrs)
16 Heating,add Humidification if needed (0 hrs)

4.1% Comfortable hrs using selected strategies (48 out of 1170 hrs)



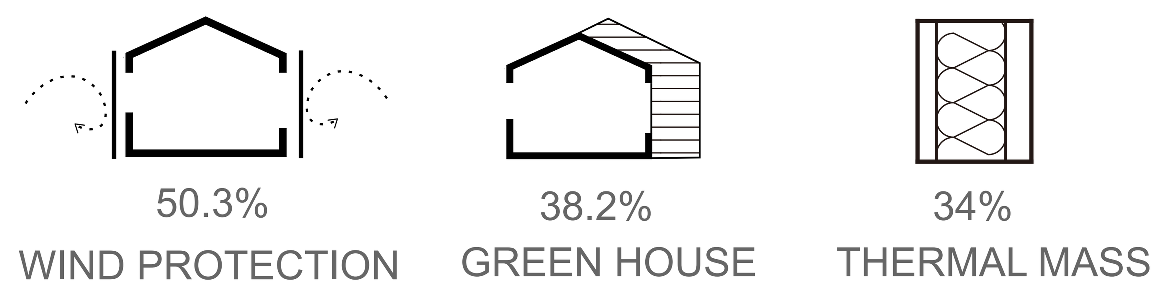


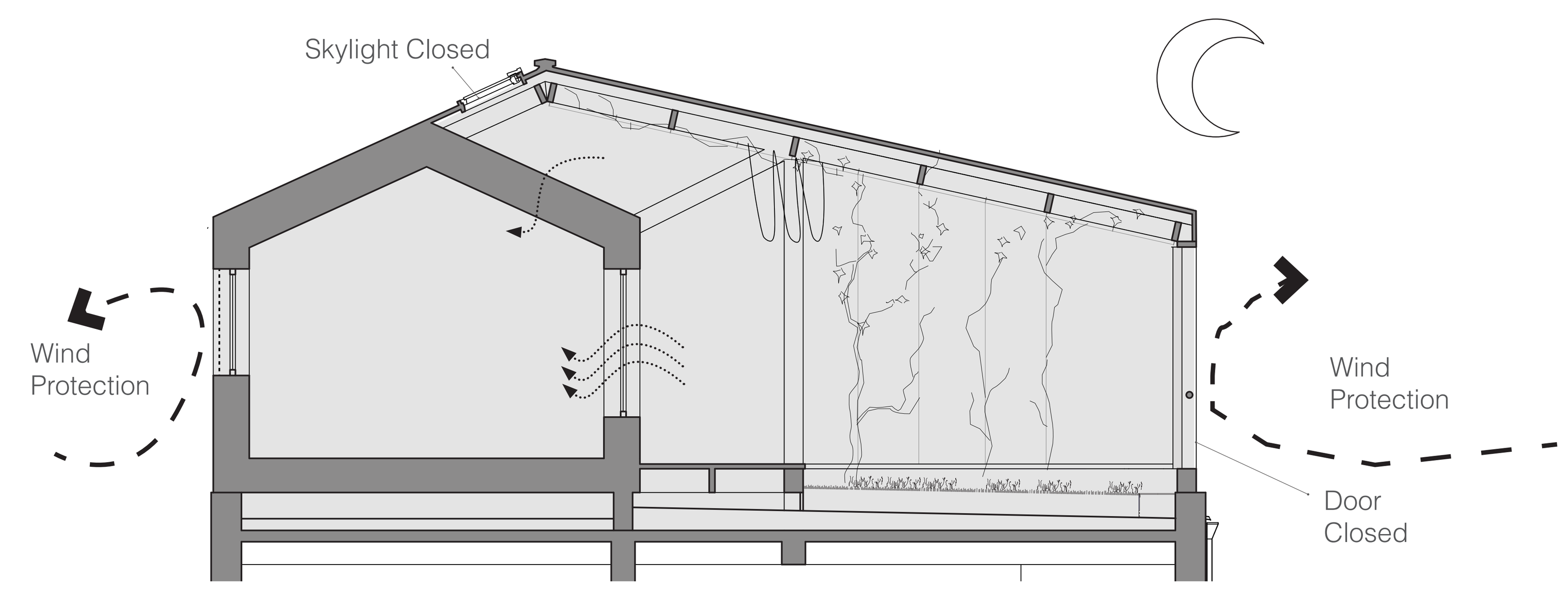
WINTER NIGHT: 6PM- 6AM DEC-



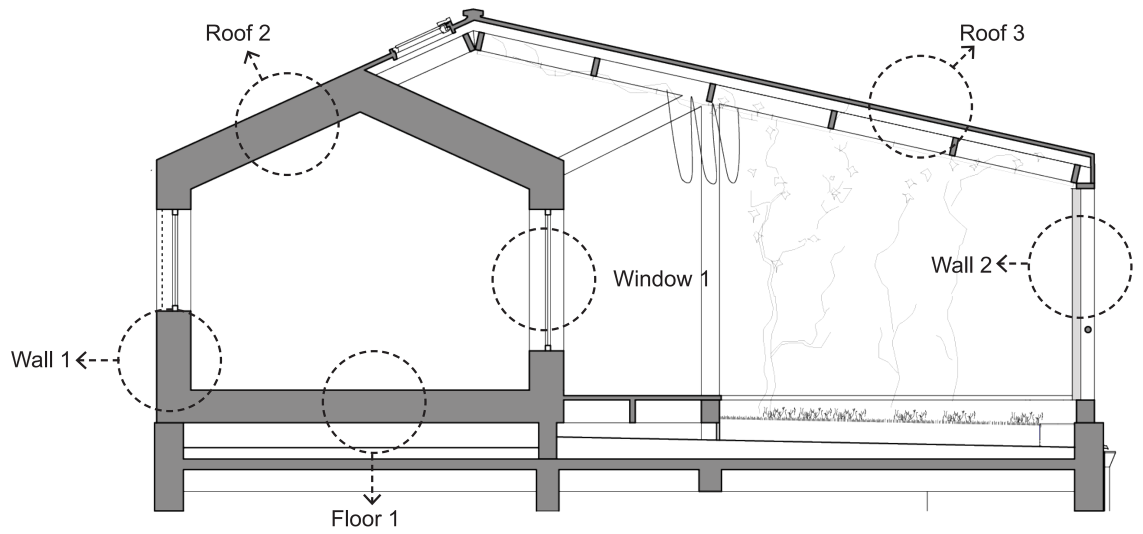
0.0% 1 Comfort (0 hrs)
2 Sun Shading of Windows(602 hrs)
3 High Thermal Mass (190hrs)
4 High Thermal Mass Night Flushed (263 hrs)
5 Direct Evaporative Cooling (180 hrs)
6 Two- Stage Evaporative Cooling (244 hrs)
7 Natural Ventilation Cooling (462 hrs)
8 Fan- Forced Ventilation Cooling (760 hrs)
0.4% 9 Internal Heat Gain (0 hrs)
0.3% 10 Passive Solar Direct Gain Low Mass(0 hrs)
1.7% 11 Passive Solar Direct Gain High Mass(0 hrs)
1.5% 12 Wind Protection of Outdoor Spaces (0 hrs)
13 Humidification Only (0 hrs)
14 Dehunidification Only (388 hrs)

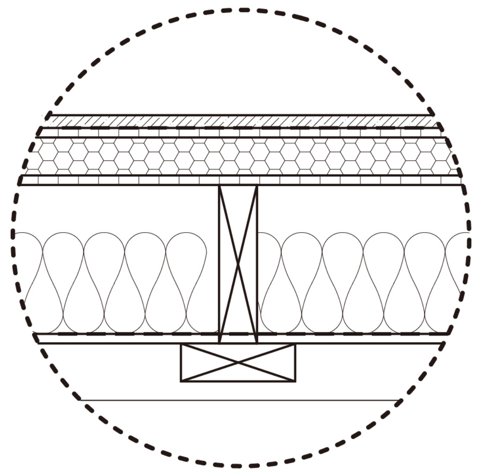
2.4% Comfortable hrs using selected strategies (28 out of 1170 hrs)





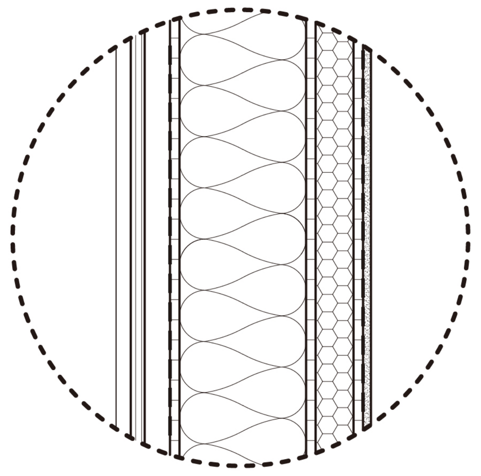
U-value Calculation





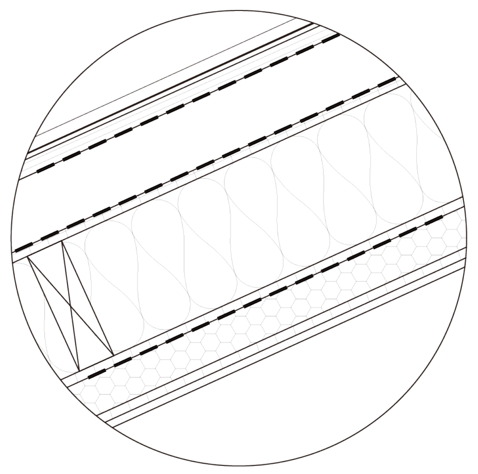
Floor 1 U = 0.149

22mm softwood board
Vapor barrier
15mm wood fiber board
60mm service layer/Celenit board insulation
15mm wood fiber board
40/60mm counter battens
mineral fiber insulation between 60/250mm timber studding
12.5mm plasterboard



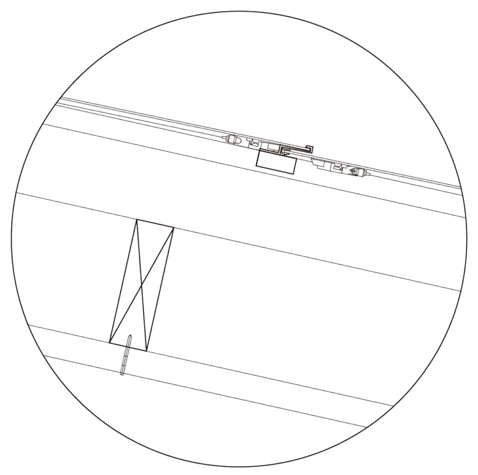
Wall 1 U = 0.150

22mm untreated larch boarding
40/60mm counter battens
15mm moisture diffusing water resistant, windproof wood fiberboard
mineral fiber insulation between 60/200mm timber studding
60mm services layer/mineral fiber insulation between
15mm layers of oriented strand board
Vapor barrier
12.5mm plasterboard



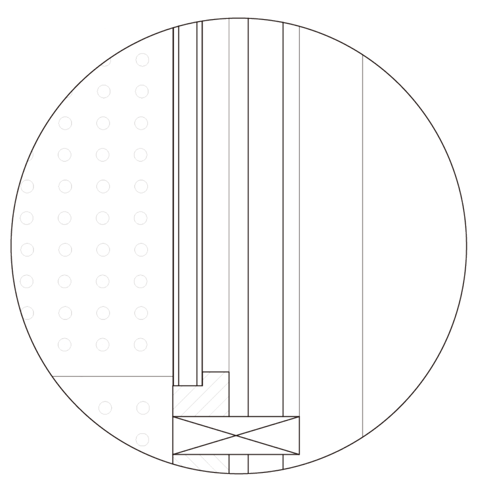
Roof 2 U = 0.150

1.5mm preprinted galvanized sheet steel
25mm boarding
100mm ventilated cavity, 45/100counterbatten;
Waterproof layer
15mm wood fiber board
Mineral fiber insulation between 60/200mm timber studding;
60mm service layer/ celenit board insulation
Between vapor barrier
12.5mm plywoodboard



Roof 3 U = 0.58

Use the PALRAM THERMAGLAS 8mm twin wall polycarbonate sheet
25/45 wood battens
45/100 counterbattens



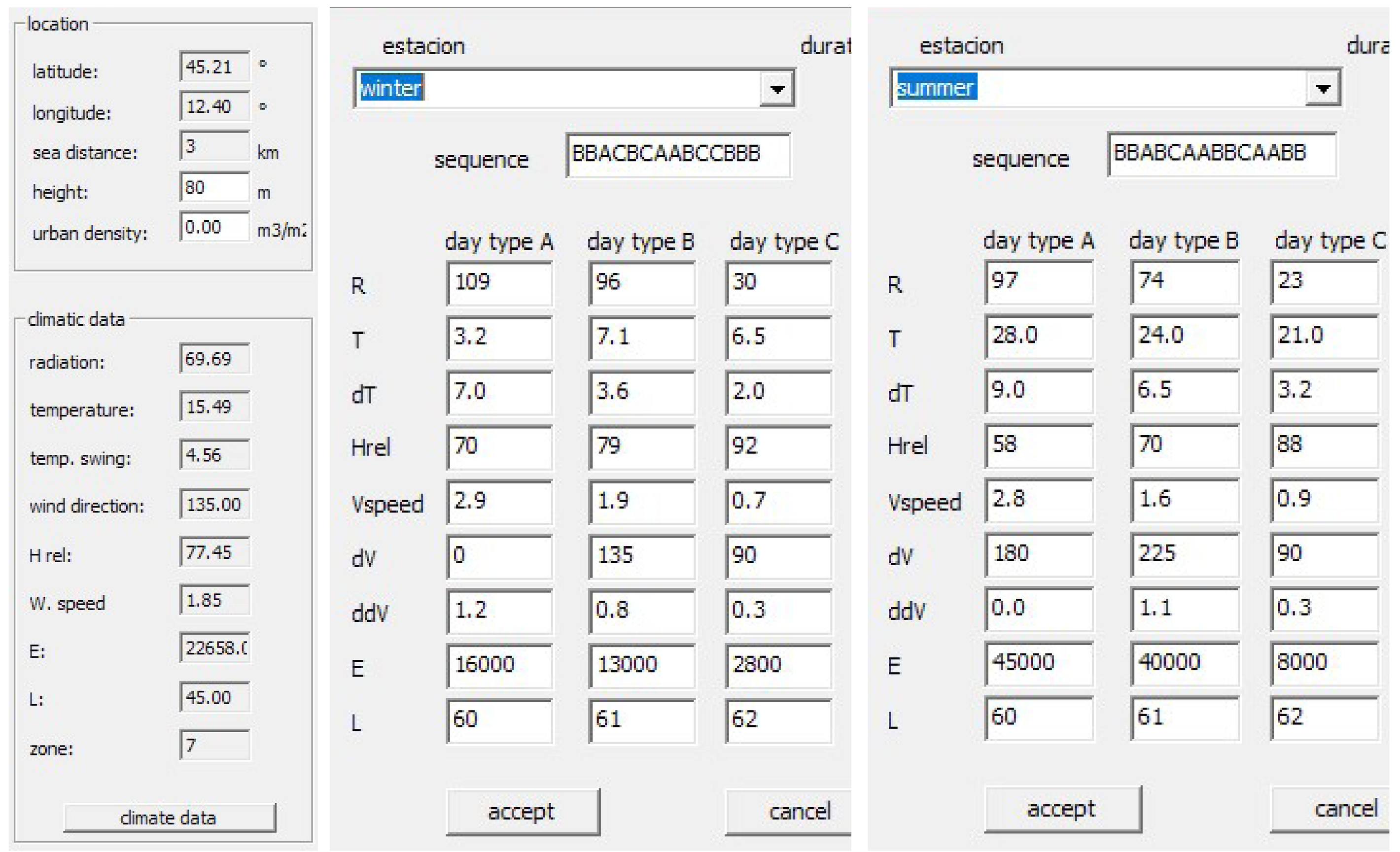
Wall 2 U = 0.58

Use the PALRAM THERMAGLAS 8mm twin wall polycarbonate sheet
25/45 wood battens
45/100 counterbattens

Window 1 U = 0.74

Archisun Simulation

Simulation Setting



Simplify Model In Winter

Model info:

1.Residence Unit:	2.Greenhouse
Volume: 121 m^3	Volume: 381 m^3
Surface: 114m^2	Surface: 249.7 m^2
Roof: 38m^2	Roof: 120m^2
South: 23m^2	PV: 21m^2
Window 4m^2	South: 37.5m2
Door 2m^2	East:39m^2
East: 15m^2	West: 39m^2
West: 15m^2	North: 14.2m^2
North: 23m^2	
Window 3m^2	

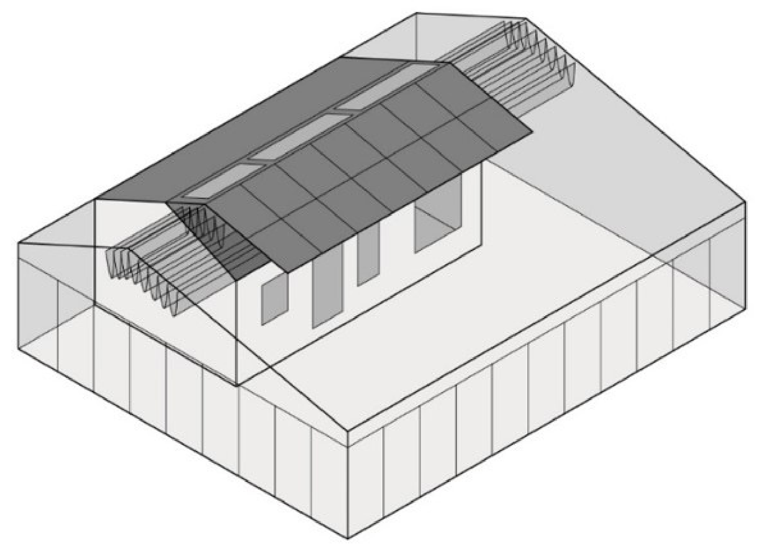


Figure 82, Model in winter.

Simplify Model In Summer

Model info:

1.Residence Unit:	2.Greenhouse
Volume: 121 m^3	Volume: 381 m^3
Surface: 114m^2	Surface: 249.7 m^2
Roof: 38m^2	Roof: 120m^2
South: 23m^2	PV: 21m^2
Window 4m^2	Opening: 7.2m^2
Door 2m^2	South: 37.5m2
East: 15m^2	Opening:29m^2
West: 15m^2	East:39m^2
North: 23m^2	West: 39m^2
Window 3m^2	Opening:25m^2
	North: 14.2m^2

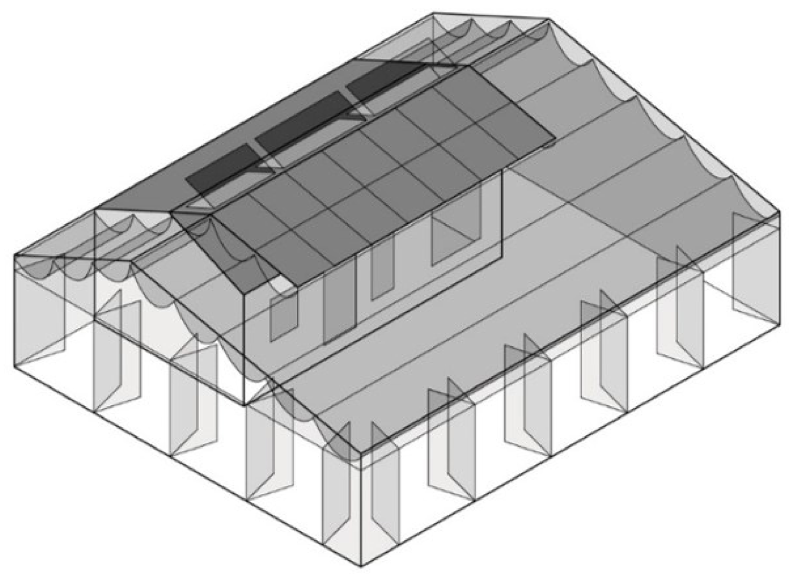
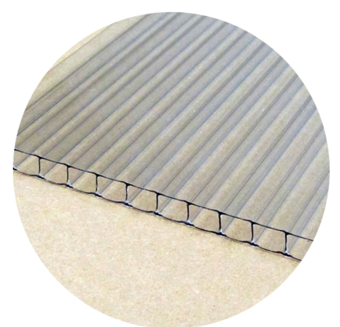


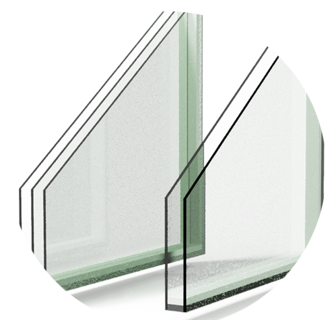
Figure 76, Model in summer.

Covering Material Comparasion

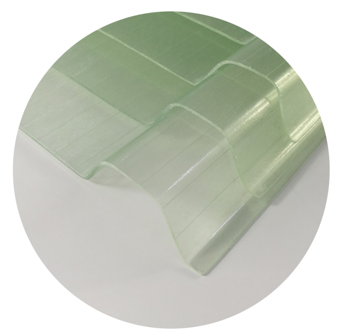
Polyethylene Film
U Value(W/m2·K): 0.7
Price (€/m2): 18
Thickness(mm):0.025
Duration(year): 2
Density(g/cm3): 0.93
Transmitte(%): 80



Polycarbonate Twin Wall
U Value(W/m2·K): 0.58
Price (€/m2): 20
Thickness(mm):8
Duration(year): 15
Density(g/cm3): 1.5
Transmitte(%): 80
Choice

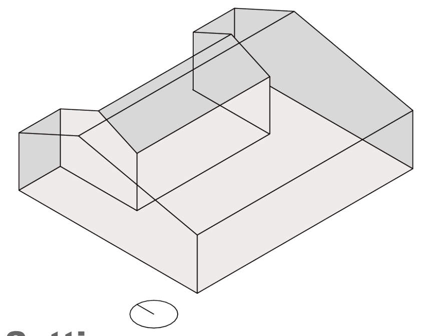


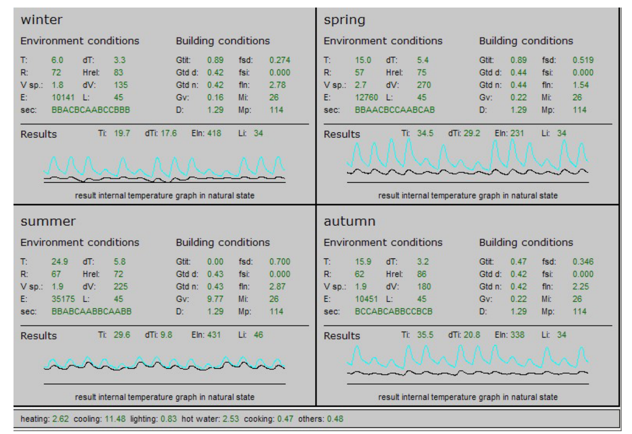
Gouble-pane Glass
U Value(W/m2·K): 0.7
Price (€/m2): 30
Thickness(mm):16
Duration(year): 25
Density(g/cm3): 2.57
Transmitte(%): 85



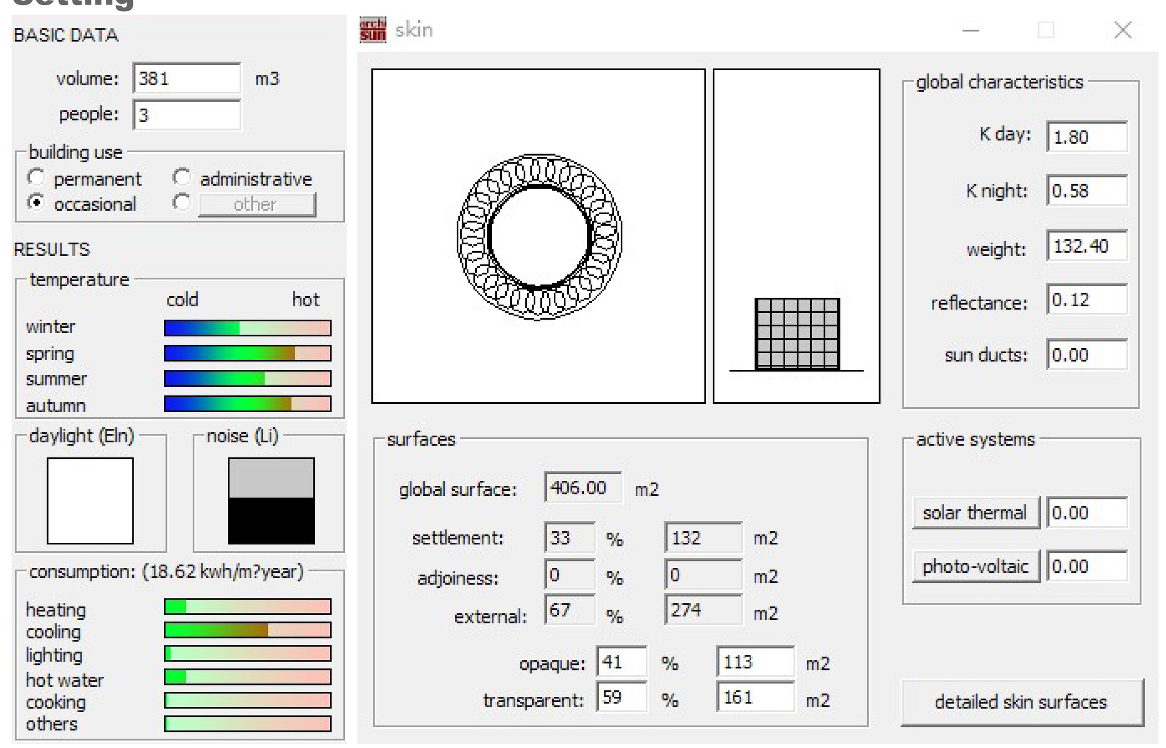
Fiberglass
U Value(W/m2·K): 1.2
Price (€/m2): 10
Thickness(mm):0.6-4
Duration(year): 15
Density(g/cm3): 1.5
Transmitte(%): 80

Seperate Simuation Greenhouse

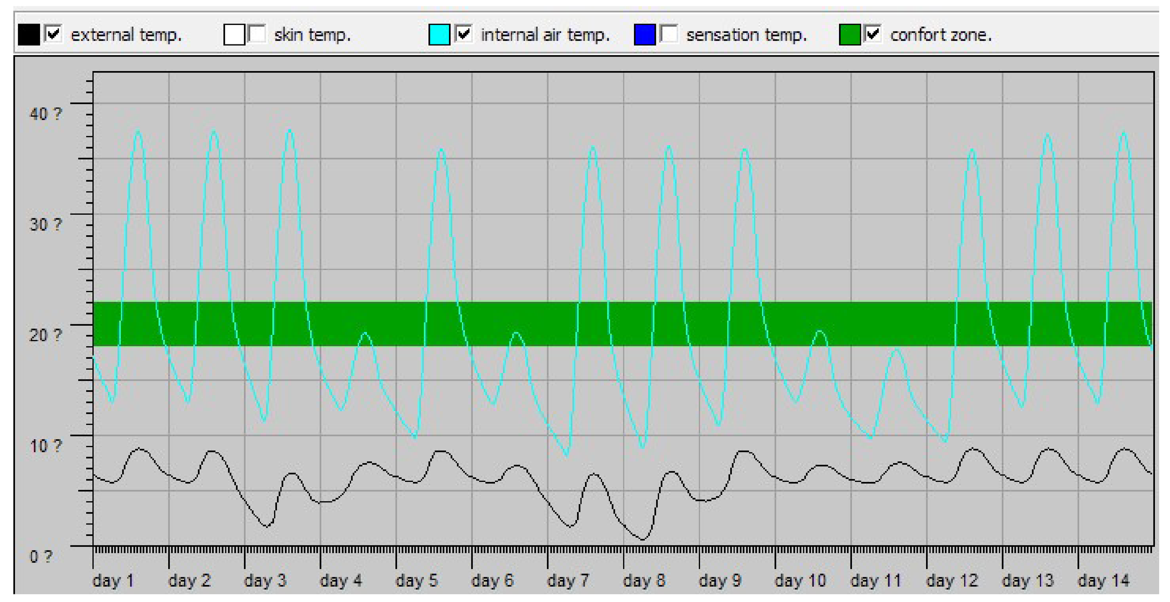




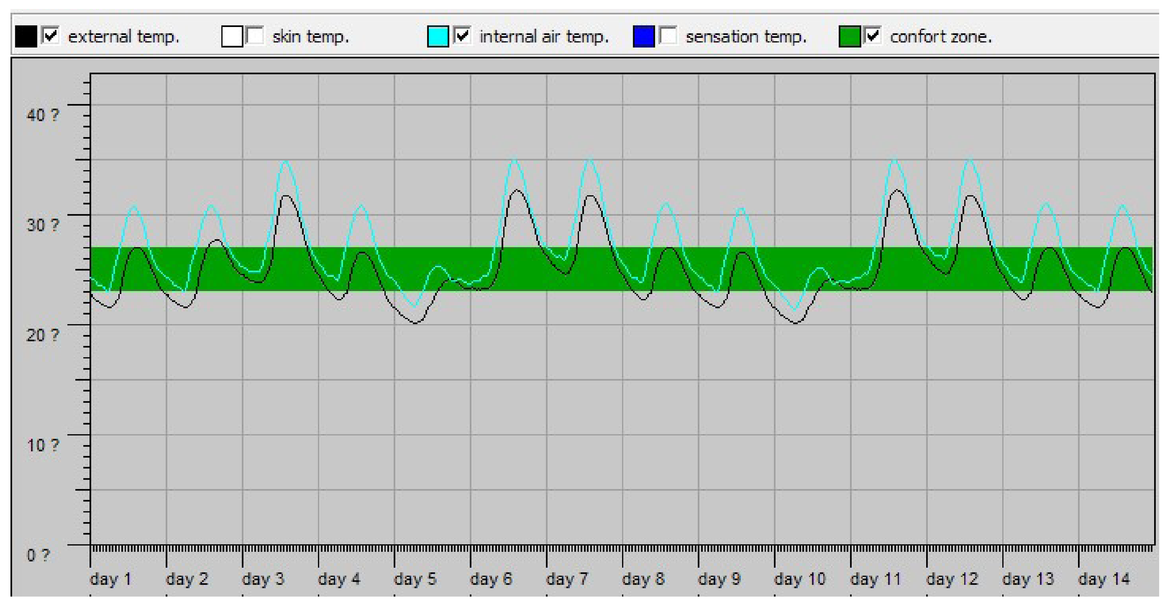
Setting



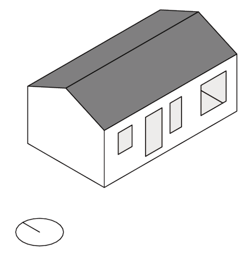
The Result in Winter

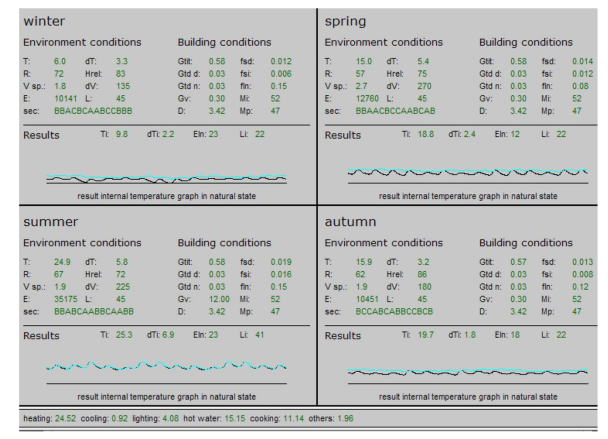


The Result in Summer

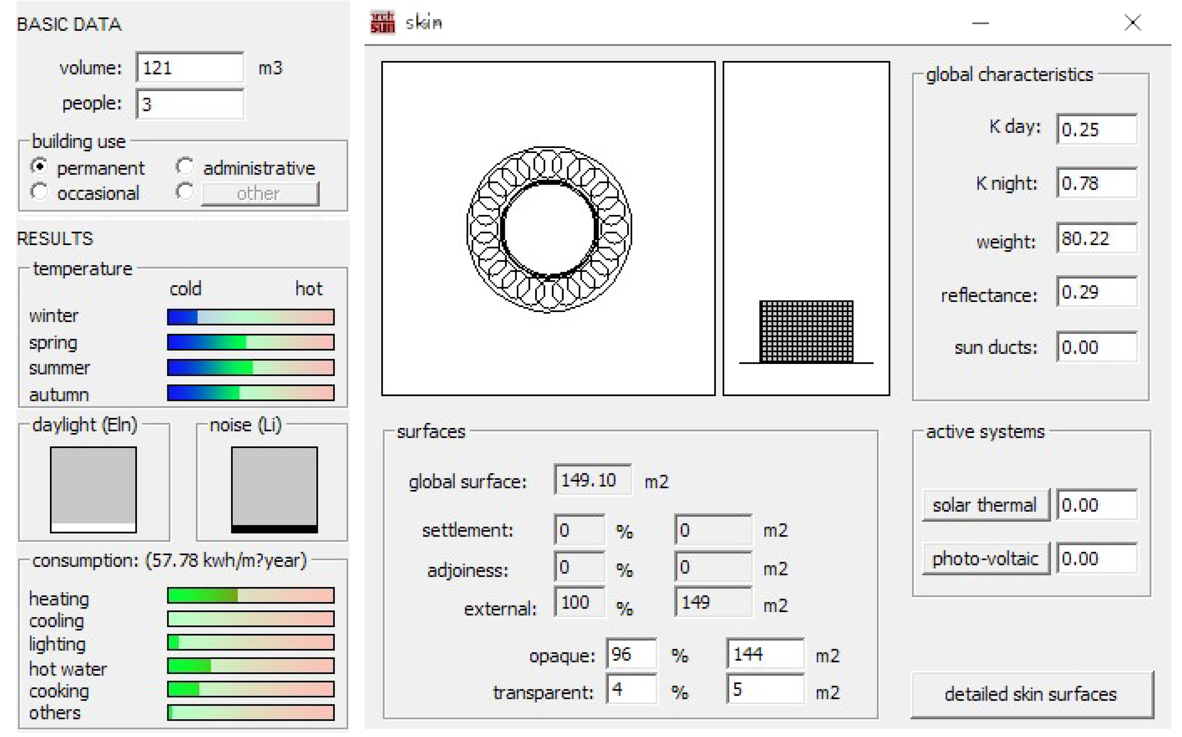


Seperate Simulation Residential Unit

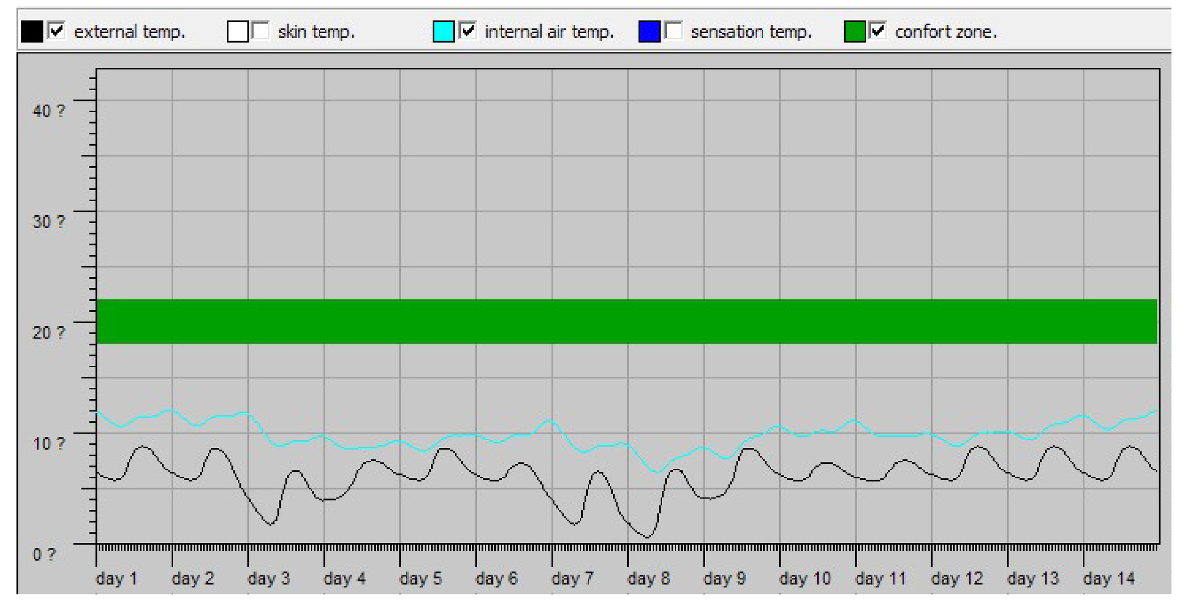




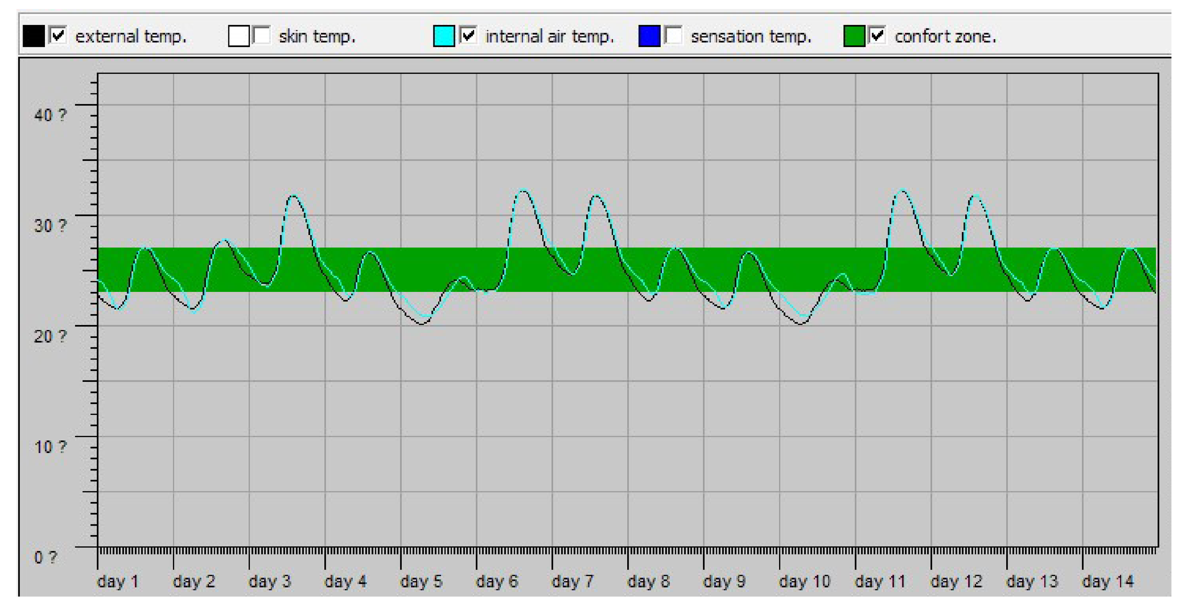
Setting



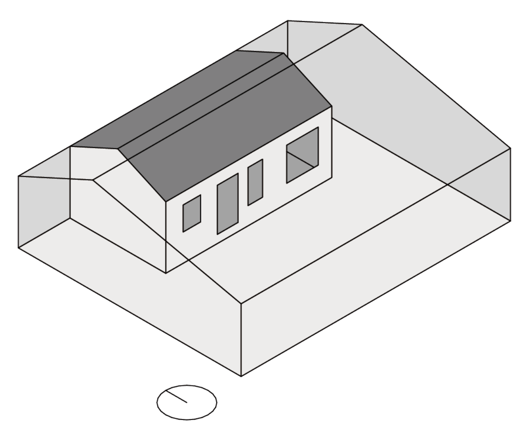
The Result in Winter



The Result in Summer



Combine the greenhouse and the Residential uint



Formula:

TGi, Indoor temperature of greenhouse;

T, outdoor air temperature;

TRi1, indoor temperature under T;

TRi2, indoor temperature under TGi;

TRi2 = (TRi1- T) + TGi